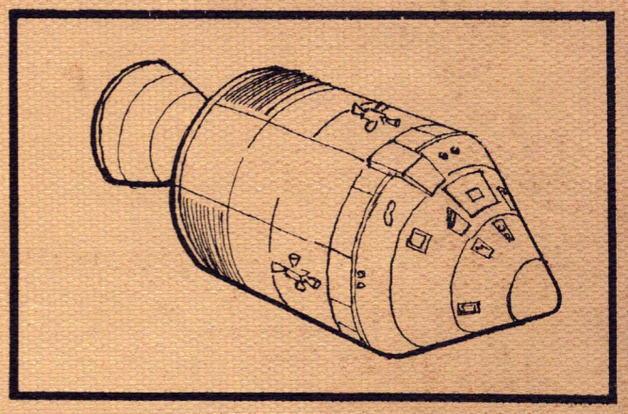
V. SLAMA

SM6T-2-02



SID 65-974-2

APOLLO MISSION SIMULATOR

INSTRUCTOR HANDBOOK

Volume II

INSTRUCTOR WORKBOOK

SPACECRAFT 012



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
TRAINING and SUPPORT DOCUMENTATION D/671

April 1966

APOLLO MISSION SIMULATOR

INSTRUCTOR HANDBOOK

(SPACECRAFT 012 CONFIGURATION)

VOLUME II: INSTRUCTOR WORKBOOK

Contract NAS9-150
Exhibit I; Paragraph 10.6

PREPARED BY NORTH AMERICAN AVIATION, INC.
SPACE AND INFORMATION SYSTEMS DIVISION
TRAINING AND SUPPORT DOCUMENTATION
DEPARTMENT 671

PUBLISHED UNDER AUTHORITY OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LIST OF EFFECTIVE PAGES

NOTE: The portion of the text affected by the current changes is indicated by a vertical line in the outer margins of the page.

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 1704, CONSISTING OF THE FOLLOWING:

Page No.

Title
A
i thru xvi
1-1 thru 1-198
2-1 thru 2-168
3-1 thru 3-200
4-1 thru 4-512
5-1 thru 5-146
6-1 thru 6-462

*The asterisk indicates pages changed, added, or deleted by the current change.

Manuals will be distributed as directed by the NASA Apollo Program Office. All requests for manuals should be directed to the NASA Apollo Spacecraft Program Office at Houston, Texas.

FOREWORD

Paragraph 10.6 of Exhibit I to Contract NAS9-150 specifies that NAA shall provide a trainer instructor handbook that supports NASA conducted training associated with the Apollo Mission Simulator. This book is Volume II of a two-volume instructor handbook in compliance with the exhibit. The contents of this handbook is based on the Spacecraft 012 configuration established for simulator design data purposes at the simulator Preliminary Design Review of August 19, 1965. Mission data used in preparing this handbook was that provided for Apollo Mission 204A in MSC Internal Note 65-FM-58 of April 26, 1965. A previous and preliminary edition of the handbook was addressed to the simulator initial delivered configuration and Apollo Mission 204A as defined in MSC Internal Note 65-FM-16.

VOLUME II

TABLE OF CONTENTS

Section			Page
	INTRODUCTION		xv
1	AMS OPERATION		1-1
	1.1	Purpose and Scope	1-1
	1.2	Equipment Operation	1-1
	1.2.1	Film Cassette Loading	1-1
	1.2.2	Check and Fill Potable Water Tank	1-9
	1.2.3	Check and Empty Waste Storage System	1-11
	1.2.4	Vertical Insertion and Retraction	1-13
	1.2.5	Magnetic Tape Unit Operation	1-16
	1.2.5.1	Tape Spool Installation	1-16
	1.2.5.2	Magnetic Tape Program Loading	1-19
	1.2.5.3	Tape Spool Removal	1-19
	1.2.6	Card Reader Operation	1-19
	1.2.6.1	Loading Punch Card Data	1-20
	1.2.6.2	Punch Card Program Loading	1-20
	1.2.6.3	Preparing Program Changes	1-21
	1.2.7	Paper Tape Program Loading	1-22
	1.2.8	Manual Program Loading	1-22
	1.2.9	Typewriter Operation	1-23
	1.2.9.1	X-T/X-Y Recorder Inputs	1-23
	1.2.9.2	Computer Interrogation	1-26
	1.2.9.3	Initialization of CTE	1-26
	1.2.9.4	Step-Ahead Procedure	1-27
	1.2.9.5	Launch Boost Tape and Ephemeris Entry	1-27
	1.2.9.6	Entry Into Diagnostic Programs	1-27
	1.2.10	Line Printer Operation	1-28
	1.2.11	T/M Console Fault Patching	1-28
	1.2.12	Communications Control System Operation	1-30
	1.2.12.1	Nonintegrated Mode Communication	1-32
	1.2.12.2	Integrated Mode Communication	1-32
	1.2.13	True Trainee Environment Operation	1-34
	1.2.14	Up-Data Link Operation	1-35
	1.2.15	Malfunction Insertion Unit	1-47
	1.2.15.1	Manual Malfunction Insertion	1-47
	1.2.15.2	Preprogrammed Malfunction Insertion	1-65
	1.2.15.3	Time-Dependent Malfunction Insertion	1-66
	1.2.15.4	Computer Initiated Malfunctions	1-67
	1.2.16	Master Control Panel Operation	1-67
	1.3	Simulator Systems Checklists	1-69
	1.3.1	AMS Power On-Off Procedures	1-69
	1.3.1.1	Power On - Manual Mode	1-70
	1.3.1.2	Power On - Sequential Mode	1-72

Section			Page
	1.3.1.3	Power Off - Manual Mode	1-72
	1.3.1.4	Power Off - Sequential Mode	1-72
	1.3.2	Premission Setup Procedure	1-73
	1.3.3	Reset Initialization	1-76
	1.3.4	IOS Preparation	1-77
	1.3.4.1	G&N and Visual Readiness	1-77
	1.3.4.2	True Trainee Environment and Waste Management Status (IOS Panels 2 and 3)	1-78
	1.3.4.3	Up-Data Link Status (IOS Panel 5)	1-79
	1.3.4.4	Computer and Simulator Status (IOS Panels 48 and 81)	1-79
	1.3.4.5	Recorder and Plotter Status (IOS Panel 87)	1-79
	1.3.4.6	Closed Circuit TV Setup	1-80
	1.3.4.7	Communications Control Setup	1-80
	1.3.4.8	Instructor Simulation of MSFN	1-81
	1.3.4.9	Malfunction Insertion and Status	1-82
	1.3.5	Recorder and Plotter Preparation	1-82
	1.3.5.1	Plotter Readiness and Setup (30 x 30)	1-82
	1.3.5.2	Plotter Readiness and Setup (11 x 17)	1-83
	1.3.5.3	Recorder Readiness and Setup (X-T)	1-83
	1.3.5.4	Recorder Calibration Checkout	1-83
	1.3.5.5	Recorder Setup	1-85
	1.3.6	T/M Console Preparation	1-85
	1.3.6.1	T/M Console Readiness Check	1-86
	1.3.6.2	T/M Console Setup	1-86
	1.3.7	Securing IOS	1-101
	1.3.8	Securing Plotters and Recorder	1-102
	1.3.9	Securing T/M Console	1-103
	1.3.10	Securing Computer Complex	1-103
	1.4	Simulator Complex Checklists	1-104
	1.4.1	Mission Simulation Preparation-Operation	1-104
	1.4.2	Launch Simulation Preparation-Operation	1-104
	1.4.2.1	Successful Launch-Boost Preparation-Operation	1-104
	1.4.2.2	Launch-Boost Abort Preparation-Operation	1-105
	1.4.3	Orbital Simulation Preparation-Operation	1-107
	1.4.4	Entry Simulation Preparation-Operation	1-107
	1.4.5	Simulation Complete	1-107
2	SESSION DATA		2-1
	PT1	SYSTEM PROCEDURES	
		PT1.1 SCS Operation	2-3
		PT1.2 RCS and SPS Operation	2-12
		PT1.3 EPS Operation	2-17
		PT1.4 ECS Operation	2-24
		PT1.5 Watch Station Procedures	2-32

Section			Page
PT2	NAVIGATION AND IMU ALIGNMENT		
	PT2.1	IMU Alignment	2-43
	PT2.2	Landmark Tracking Navigation	2-46
	PT2.3	Star-Lunar Landmark Navigation	2-53
	PT2.4	G&N Contingencies	2-56
PT3	DELTA V PROCEDURES		
	PT3.1	Primary and Backup Delta V Modes	2-61
	PT3.2	Retrograde From Earth Orbit	2-66
PT4	ENTRY		
	PT4.1	G&N Mode Entry	2-69
	PT4.2	Entry Contingencies	2-74
PT5	LAUNCH ASCENT AND ABORT		
	PT5.1	Launch-Boost Procedures	2-75
	PT5.2	LES Abort	2-78
	PT5.3	SPS Aborts	2-84
MT1	PRELAUNCH, LAUNCH AND ASCENT, ABORT		
	MT1.1	Prelaunch, Launch-Boost	2-85
	MT1.2	LES Aborts	2-90
	MT1.3	SPS Aborts	2-96
MT2	ORBITAL NAVIGATION AND SYSTEM PROCEDURES		
	MT2.1	Initial Earth Orbit Procedures	2-97
	MT2.2	Orbital Watch Station Routines	2-102
	MT2.3	Transposition and S-IVB Viewing	2-107
MT3	DEORBIT, PLANE CHANGE AND HOHMANN TRANSFER PROCEDURES		
	MT3.1	Plane Change Procedures	2-110
	MT3.2	Hohmann Transfer Procedures	2-116
MT4	DEORBIT, ENTRY AND POSTLANDING		
	MT4.1	SPS Deorbit and Entry Procedures	2-126
	MT4.2	RCS Deorbit and Entry	2-132
	MT4.3	Early Mission Termination	2-133

Section		Page
TM1	BASIC NOMINAL MISSION	
	TM1.1 Orbital Mission Routines	2-137
	TM1.2 Orbital Mission/Transposition and Docking	2-146
	TM1.3 Abortive Early Mission Termination . .	2-149
TM2	NOMINAL MISSION PLANE CHANGES	
	TM2.1 Plane Change Mission	2-150
	TM2.2 Plane Change Contingencies	2-154
TM3	NOMINAL MISSION HOHMANN TRANSFERS	
	TM3.1 Transfer to 105 N MI/130 N MI Elliptical Orbit	2-160
	TM3.2 Hohmann Transfers From 105 N MI to 130 N MI to 105 N MI	2-163
INITIALIZATION DATA		3-1
S1	Station 1 Prelaunch	3-2
S1	Station 2 Prelaunch	3-10
S1	Station 3 Prelaunch	3-20
S2	Station 1 Launch	3-32
S2	Station 2 Launch	3-42
S2	Station 3 Launch	3-54
S3	Station 1 Orbit Insertion	3-66
S3	Station 2 Orbit Insertion	3-74
S3	Station 3 Orbit Insertion	3-88
S4 thru S210 (except S5B, S13A, B, and C)	Station 1 Orbital Routines (S-IVB Separated) . .	3-100
S4 thru S210 (except S5B, S13A, B, and C)	Station 2 Orbital Routines (S-IVB Separated) . .	3-106
S4 thru S210 (except S5B, S13A, B, and C)	Station 3 Orbital Routines (S-IVB Separated) . .	3-116
S5B	Station 1 Orbital Routines (S-IVB Attached) . .	3-128
S5B	Station 2 Orbital Routines (S-IVB Attached) . .	3-134
S5B	Station 3 Orbital Routines (S-IVB Attached) . .	3-144
S6	Station 1 Minimum Power Operations	3-156
S6	Station 2 Minimum Power Operations	3-162
S6	Station 3 Minimum Power Operations	3-170
S13A, B, C, and S211	Station 1 Postseparation Pre-Entry	3-180

Section			Page
	S13A, B, C, and S211	Station 2 Postseparation Pre-Entry	3-186
	S13A, B, C, and S211	Station 3 Postseparation Pre-Entry	3-194
4	IOS DATA		4-1
	P1.1	Initial Prelaunch ECS Check	4-12
	P1.2	Control and Display Check	4-16
	P2.1	Control and Display Check	4-32
	P3.1	Initial Prelaunch ECS Check	4-40
	P3.2	Control and Display Check	4-46
	P1.3	Launch Preparation	4-60
	P2.2	Launch Preparation	4-64
	P3.3	Launch Preparation	4-66
	A1.1	Ascent	4-70
	A2.1	Ascent	4-77
	A3.1	Ascent	4-79
	O1.1	Initial Orbit Procedures	4-80
	O3.1	Initial Orbit Procedures	4-84
	O4.1	Initial Orbit Procedures	4-87
	O1.2	Minimum Power Operations	4-89
	O3.2	Minimum Power Operations	4-92
	O1.3	S-IVB Separation	4-96
	O3.3	S-IVB Separation	4-99
	E1.1	Deorbit Delta V Procedures	4-100
	E3.1	Deorbit Delta V Procedures	4-116
	E4.1	Deorbit Delta V Procedures	4-120
	E1.2	Post-Delta V Operations	4-128
	E2.1	Post-Delta V Operations	4-139
	E3.2	Post-Delta V Operations	4-141
	E1.3	Post-Separation Operations	4-142
	E1.4	ELS Arming	4-146
	E3.4	ELS Arming	4-151
	R1.1	Postlanding Procedures	4-152
	R2.1	Postlanding Procedures	4-157
	R3.1	Postlanding Procedures	4-159
	R4.1	Postlanding Procedures	4-161
	B1.1	Pad and Low-Altitude Abort (Prior to T + 42 Sec) .	4-162
	B1.2	Low Altitude Abort (After T + 42 Sec)	4-168
	B1.3	LES Aborts 30, 000 to 120, 000 Ft	4-172
	B1.4	LES Aborts 120, 000 Ft to Tower Jettison . . .	4-176
	SC1.03	SCS Delta V.	4-180
	RC2.01	C/M RCS Periodic Check	4-190
	RC2.02	S/M RCS Periodic Check	4-192
	EC3.01	Orbital ECS Hourly Check	4-200
	EC4.02	CO_2-Odor Absorbent Filter Replacement . . .	4-202
	EC3.05	Cabin Cold-Soak	4-204
	EC4.06	Waste Water Dump Operations	4-207
	EP3.05	Fuel Cell Hydrogen Purge	4-208

Section		Page
EP3.06	Fuel Cell Oxygen Purge	4-210
EP3.07	Battery Charge	4-212
EP3.08	Fuel Cell Shutdown Procedures	4-214
EP3.10	EPS Periodic Check	4-216
EP3.11	Manual Pressure Control Verification	4-232
EP3.12	Quantity Balance Verification	4-238
SP3.01	SPS Periodic Check	4-240
SP3.02	SPS Periodic Propellant Quantity Gauging System Check	4-244
SP1.03	Gimbal Position Indicators Test	4-251
SP3.04	Delta V Operations	4-252
GN4.01	G&N System Activation	4-258
GN4.02	G&N Periodic Verification	4-270
GN4.03	Program AGC for Major Mode	4-274
GN4.04	IMU Orientation Determination	4-276
GN4.06	IMU Alignment (S-IVB)	4-280
GN4.07	IMU Alignment (SCM)	4-284
GN1.08	GSM Local Vertical	4-290
GN4.09	Landmark Tracking	4-294
GN4.10	Star-Landmark Navigation Measurement	4-298
GN4.11	AGC Update	4-306
GN4.12	Orbit Change Delta V Station 4	4-310
GN1.13	Orbit Change Delta V Station 1	4-316
GN1.40	Attitude Control Mode Check	4-332
GN1.44	Attitude Maneuver	4-334
GN4.49	Sighting Mark	4-336
GN4.50	Automatic Optics Positioning	4-340
GN4.55	Orbit Parameter Display	4-342
GN4.56	Prethrust Orbit Change Data Load	4-344
TC1.01	Audio Center Activation Station 1, 2, and 3	4-348
TC3.02	VHF-AM Voice Communications (MSFN Contacts)	4-350
TC3.03	Up-Data Link Activation	4-353
TC3.04	VHF-FM Activation	4-354
TC3.05	Transmit High-Bit Rate PCM, VHF-FM	4-356
TC3.06	Transmit Low-Bit Rate PCM, VHF-FM	4-358
TC3.07	Transmit Recorded High-Bit Rate PCM, VHF-FM	4-360
TC3.08	Transmit Recorded Low-Bit Rate PCM, VHF-FM	4-362
TC3.09	Record High-Bit Rate PCM	4-364
TC3.10	Record Low-Bit Rate PCM	4-366
TC3.11	Record Real-Time Analog Data	4-368
TC3.12	Activate USBE Power Amplifier in Bypass Mode	4-371
TC3.13	Activate USBE Power Amplifier in High- or Low-Power Mode	4-373
TC3.14	USBE Voice Operations	4-375
TC3.15	USBE, Transmit Recorded Low- or High-Bit Rate PCM	4-376
TC3.16	USBE, Transmit Recorded High-Rate PCM and Analog	4-378
TC3.17	USBE, Transmit Low- or High-Bit Rate PCM	4-380

Section		Page
TC3.18	USBE, Transmit Low- or High-Bit Rate PCM in Ranging Mode	4-383
TC3.19	USBE, Transmit in Ranging Only	4-385
TC3.20	USBE, Transmit High- or Low-Bit Rate PCM and TV	4-387
TC3.21	C-Band Tracking and Ranging	4-389
TC3.22	Revised Tape Recorder	4-391
MRC.01	S/M RCS C&W Light Illuminates	4-392
MEC.01	O_2 FLOW HI Light Illuminates	4-402
MEC.02	O_2 FLOW HI Light Illuminates, O_2 Flow High, Cabin Pressure High	4-406
MEC.03	Glycol Discharge Pressure Abnormal	4-416
MEC.04	Suit Compressor Delta P Indicates Below Normal	4-420
MEC.05	Suit Temperature Indicates Low	4-424
MEC.06	Suit Temperature Indicates High	4-429
MEC.07	Cabin Temperature Indicates High	4-432
MEC.08	Suit Pressure Indicates Low	4-436
MEC.09	Suit Pressure Indicates High	4-441
MEC.10	Cabin Pressure High	4-443
MEC.11	Tank Pressure 1 O_2 Low	4-444
MEP.01	O_2 Failure	4-450
MEP.02	H_2 Failure	4-452
MEP.03	N_2 Failure	4-455
MEP.04	O_2 PRESS Light Illuminates	4-456
MEP.05	H_2 PRESS Light Illuminates	4-460
MEP.06	Fuel Cell Fail Light Illuminates, H_2 Flow High	4-464
MEP.07	Fuel Cell Fail Light Illuminates, O_2 Flow High	4-466
MEP.08	DC BUS A UNDERVOLT Light Illuminates	4-468
MEP.10	A-C Inverter and Bus Check	4-472
MEP.11	Critical Loads Transfer	4-476
MEP.12	Duel-Inverter Changeover	4-478
MEP.13	Single-Inverter Changeover	4-484
MEP.14	Bus Reset	4-492
MEP.15	Connect A-C Bus Loads to Bus 1	4-496
MEP.16	Overload Isolation Check	4-499
MEP.20	Bus 1 Failure, Dual-Inverter Operation	4-501
MEP.21	Both 1 and 2 A-C Bus Fail, Single-Inverter Operation	4-503
MEP.22	Bus 1 Overload and A-C Bus 1 Fail Lights Illuminate	4-505
MEP.23	Single-Inverter Operation	4-507
MEP.24	Inverter Temperature High, Dual-Inverter Operation, SCS Operating	4-509
MSP.01	SPS PU SENSOR FAIL Light Illuminates	4-510

Section			Page
5	MALFUNCTION DATA		5-1
	5-1	S-IVB Control System	5-2
	5-2	Stabilization and Control System	5-5
	5-3	Guidance and Navigation System	5-25
	5-4	Sequence Control Group	5-36
	5-5	Reaction Control System	5-45
	5-6	Service Propulsion System	5-68
	5-7	Cryogenic Storage System	5-81
	5-8	Fuel Cell Systems	5-87
	5-9	Electrical Power System	5-94
	5-10	Environmental Control System	5-106
	5-11	Caution and Warning System	5-120
	5-12	Telecommunication Systems	5-126
	5-13	Telemetry System	5-131
	5-14	Smoke Simulation System	5-132
	5-15	Malfunction Selection Set 1 - RCS Jets Operative	5-133
	5-16	Malfunction Selection Set 2 - EPS Malfunctions	5-138
	5-17	Malfunction Selection Set 3 - ECS Malfunctions	5-142
6	SIMULATION OUTPUT DATA		6-1
	6-1	Simulated Spacecraft Dynamics - Equations of Motion	6-2
	6-2	Simulated Spacecraft Dynamics - Ephemeris	6-9
	6-3	Simulated Spacecraft Dynamics - Aerodynamic Forces and Moments	6-17
	6-4	Simulated Spacecraft Dynamics - Weights and Balances	6-20
	6-5	Simulated Spacecraft Dynamics - S-IVB Attitude Control	6-22
	6-6	Stabilization and Control System - Power & Mode Control Logic	6-28
	6-7	Stabilization and Control System - Attitude Control	6-34
	6-8	Stabilization and Control System - Thrust Vector Control	6-40
	6-9	Stabilization and Control System - Inertial Sensors	6-44
	6-10	Visual Displays - Scanning Telescope	6-52
	6-11	Visual Displays - Sextant Starfield	6-53
	6-12	Visual Displays - Celestial Sphere Drive	6-60
	6-13	Visual Displays - Mission Effects Projector Drive Signals	6-65
	6-14	Visual Displays - Sun Image Projector	6-93
	6-15	Visual Displays - Occultation Mask	6-96
	6-16	Guidance and Navigation System - Inertial Measurement	6-104

Section		Page
6-17	Guidance and Navigation System - IMU Temperature Control	6-112
6-18	Guidance and Navigation System - Error Warning	6-115
6-19	Guidance and Navigation System - IMU CDU Drive	6-118
6-20	Guidance and Navigation System - IMU CDU Difference Signals	6-121
6-21	Guidance and Navigation System - IMU Mode Switching	6-123
6-22	Guidance and Navigation System - Executive	6-127
6-23	Guidance and Navigation System - Computer Input/Output	6-132
6-24	Guidance and Navigation System - AGC Prelaunch	6-138
6-25	Guidance and Navigation System - Boost Monitor	6-139
6-26	Guidance and Navigation System - Coast	6-141
6-27	Guidance and Navigation System - Prethrusting	6-150
6-28	Guidance and Navigation System - Thrusting	6-152
6-29	Guidance and Navigation System - In-Flight Align	6-154
6-30	Guidance and Navigation System - Re-Entry	6-156
6-31	Guidance and Navigation System - CSM Boost Abort Control	6-157
6-32	Guidance and Navigation System - AGC Subroutines	6-158
6-33	Guidance and Navigation System - Optics CDU Drive	6-246
6-34	Guidance and Navigation System - AGC Up-Data Link	6-249
6-35	Sequential Events Control System - Emergency Detection	6-251
6-36	Communication and Instrumentation Systems - Power and Switching Logic	6-268
6-37	Communication and Instrumentation Systems - Antenna Effects	6-275
6-38	Communication and Instrumentation Systems - Antenna Effects Station Location	6-276
6-39	Communication and Instrumentation System - Central Timing and Simulator Master Timing	6-281
6-40	CM and SM Reaction Control System	6-283
6-41	Service Propulsion System - Thermodynamics	6-316
6-42	Service Propulsion System - Propellant Utilization	6-327
6-43	Electrical Power System - Cryogenic Storage, Oxygen	6-333
6-44	Electrical Power System - Cryogenic Storage, Hydrogen	6-338
6-45	Electrical Power System - Fuel Cell Thermodynamics	6-342
6-46	Electrical Power System - EPS Control Logic	6-350

Section		Page
6-47	Electrical Power System - EPS DC Buses	6-370
6-48	Electrical Power System - EPS Displays	6-381
6-49	Electrical Power System - Space Radiators	6-390
6-50	Environmental Control System - Oxygen	6-394
6-51	Environmental Control System - Water Supply	6-397
6-52	Environmental Control System - Water-Glycol	6-402
6-53	Environmental Control System - Cabin and Suit	6-415
6-54	Environmental Control System - Smoke Simulation	6-430
6-55	Environmental Control System - Aural Cue	6-431
6-56	Master Caution and Warning System	6-436
6-57	MSCC Interface - Up-Data Link System	6-444
6-58	MSCC Interface - PCM Telemetry	6-448
6-59	Instructor's Operating Station - Data Output	6-449
6-60	Instructor's Operating Station - Visual System Supplementary Display	6-450
6-61	Instructor's Operating Station - True Position and Attitude	6-455
6-62	Instructor's Operating Station - Master Control	6-456
6-63	X/T and X/Y Recorders	6-458
6-64	Measurement Data Group 1 - G&N and SCS Attitude Control	6-459
6-65	Measurement Data Group 2 - IMU Alignment, AGCU Alignment	6-459
6-66	Measurement Data Group 3 - Entry and Earth Landing	6-460
6-67	Measurement Data Group 4 - Abort Procedures	6-460
6-68	Measurement Data Group 5 - Mission Parameters	6-461

LIST OF ILLUSTRATIONS

Figure		Page
1-1	MEP Film Cassette Location	1-7
1-2	Potable Water System Component Location	1-10
1-3	Waste Management Storage	1-12
1-4	Vertical and Horizontal Insertion Mechanism	1-14
1-5	Vertical Insertion Controls and Displays	1-15
1-6	MTU Tape Loading Deck	1-17
1-7	T/M Fault Patching Functional Flow	1-29
1-8	Power Control Panel	1-71

LIST OF TABLES

Table		Page
1-1	AMS Operating Procedure and Checklist Summary	1-2
1-2	AMS Film Cassettes	1-5
1-3	Recorder/Plotter Code Identification	1-25
1-4	AMS Console Communications Loops	1-30
1-5	AMS Circuits	1-33
1-6	SE-012 AMS Real Time Commands	1-36
1-7	AMS Noun Data Listing (SE-012)	1-37
1-8	AMS Verb Listing (SE-012)	1-45
1-9	AGC Major Modes (SE-012)	1-48
1-10	AMS Navigation Stars	1-49
1-11	Earth Landmarks	1-50
1-12	Lunar Landmarks	1-64
1-13	Preprogrammed Malfunction Card Format	1-66
1-14	Time-Dependent Malfunction Card Format	1-66
1-15	AMS SE-012 Initialization Points	1-77
1-16	SE-012 PCM Telemetry Analog Channel Assignments	1-88
1-17	SE-012 PCM Telemetry Bilevel Channel Assignments	1-95
1-18	Simulator Complex Checklist	1-109
4-1	IOS Data Sheets	4-1

INTRODUCTION

The purpose of this instructor handbook is to provide detailed instructions for using the Apollo Mission Simulator (AMS) to train flight crew personnel for Apollo Mission 204A. The handbook is comprised of two volumes. Volume I (Description & Utilization) describes the AMS and provides a recommended plan for using the AMS to train Apollo flight crews. This volume (Volume II, Instructor Workbook) provides instructions for operating the simulator and contains the material for making up a complete instructor-operator data package for each training session in the syllabus. This volume is looseleaf bound to permit removal of contents for copying, and is divided into six sections.

Section 1 (AMS Operation) provides the instructor-operator with the simulator operating procedures required to use the simulator for training purposes.

Section 2 (Session Data) provides a separate set of data sheets for each session of the syllabus described in section 3 (AMS Utilization) of Volume I. The session data sheets describe the purpose and scope of the session, identify each simulation run, define crew procedures to be used during the session, identify a suggested set of parameters to be transcribed, outline instructor activities with specific reference to AMS operating procedures in section 1 of this volume, and give instructions for building a session script from materials provided in the other sections of this volume.

Section 3 (Initialization Data) contains initialization checklists for each of the spacecraft stations at all of the initialization points defined in section 3 (AMS Utilization) of Volume I. Initialization checklists take the form of a pictorial and a tabular presentation of the desired SCM systems configuration for each initialization point as manufactured at the IOS.

Section 4 (IOS Data) contains an IOS Data Sheet for each crew procedure identified in the Apollo Operations Handbook (AOH). IOS data sheets are comprised of two or more pages containing both pictorial and tabular information on crew procedures as their performance is manifested at the IOS.

Section 5 (Malfunction Data) contains a complete list of spacecraft malfunctions simulated in the initial delivered configuration of the AMS. Malfunctions are identified by number and descriptive title, and are individually supported with descriptions of the manner of manifestation (to crew and instructor) and appropriate crew response.

Section 6 (Simulation Output Data) contains a complete list of spacecraft and mission simulation outputs available to X-T and X-Y recorders, tape recorders, the electronic typewriter, and TM console.

1 AMS OPERATION

SECTION 1

AMS OPERATION

1.1 PURPOSE AND SCOPE.

It is the purpose of this section of the Apollo Mission Simulator Instructor Handbook to provide the instructor-operator with those simulator operating procedures required to accomplish the training sessions in the syllabus in section 3 of Volume I. Instructions will include descriptive text, step-by-step procedures, illustrations, and tables, as needed, to explain required instructor-operator activity. When simulator peculiar variables exist, appropriate tabular and/or graphic data covering the range of such variables is included. When simulator variables are identified in spacecraft quantities, the manner of transposing such spacecraft data into the simulator is described.

Three types of procedural information are provided. The first of these is text and figures as required to explain how specific tasks are performed on individual equipment units. The second type of procedure is systems checklists. These checklists are step-by-step outlines for the preparation, use, and shutdown of each simulator system. The third type of procedure is simulator complex checklists. These checklists are integrated composites of the unit procedures and system checklists, and are used to prepare, use, and shut down the trainer complex.

Table 1-1 identifies all of the procedures and checklists included in this section of this manual. The table illustrates the relationship between the unit procedures and the system checklists, and identifies the procedures-checklists of which each complex checklist is comprised.

1.2 EQUIPMENT OPERATION.

This portion of the operations section provides text, figures, and tables to explain the operation of individual equipment units of the AMS. However, many of these units do not require explanation above and beyond the description provided in section 1 of Volume I, the computer program section of Volume I, and/or tabular data provided in Volume II. These items will not be supported with written operating instructions at the unit level. Their step-by-step operation will be identified in outline form, however, as it occurs in the system and complex checklists.

1.2.1 FILM CASSETTE LOADING.

Insertion of the proper film cassettes, as determined by the desired mission training session, is required prior to each exercise. Table 1-2 contains the list of each cassette available with the SE-012 configuration of the AMS and its normally assigned turret location. The desired film cassettes are obtained from the maintenance storage area and identified by the part numbers listed in table 1-2.

Table 1-1. AMS Operating Procedure and Checklist Summary

Unit Procedure	System Checklist	Simulator Complex Checklists					
		1.4.1 Mission Simulation Prep Oper	1.4.2 Launch Simulation Prep Oper	1.4.2.2 Abort Simulation Prep Oper	1.4.3 Orbital Simulation Prep Oper	1.4.4 Entry Simulation Prep Oper	1.4.5 Simulation Complete
Visual Display System							
1.2.1 Film Cassette Loading		X	X	X	X	X	
Simulated Command Module							
1.2.2 Check and Fill Potable Water Tank		X			X		
1.2.3 Check and Empty Waste Storage System		X			X		
1.2.4 Vertical Insertion and Retraction		⊗	⊗	⊗	⊗	⊗	⊗
Computer Complex							
	1.3.2 Pre-Mission Setup Procedure	X	X	X	X	X	
1.2.5.1 MTU Tape Spool Installation		X	X	X	X	X	
1.2.5.3 MTU Tape Spool Removal							X
1.2.6.1 Loading Punch Card Data		X	X	X	X	X	
1.2.9.5 Ephemeris Input		X			X		
1.2.9.1 X-T/X-Y Recorder Inputs		⊗	⊗	⊗	⊗	⊗	
1.2.9.5 Launch Boost Tape Label		X	X	X			
1.2.15 Malfunction Insertion Unit		⊗	⊗	⊗	⊗	⊗	
1.2.10 Line Printer Operation		⊗	⊗	⊗	⊗	⊗	
1.2.9.3 Initialization of CTE		X	X	X	X	X	
	1.3.10 Securing Computer Complex						X

X Simulator System Required
⊗ Unit Procedure Optional

Table 1-1. AMS Operating Procedure and Checklist Summary (Cont)

Unit Procedure	System Checklist	Simulator Complex Checklists					
		1.4.1 Mission Simulation Prep Oper	1.4.2 Launch Simulation Prep Oper	1.4.2.2 Abort Simulation Prep Oper	1.4.3 Orbital Simulation Prep Oper	1.4.4 Entry Simulation Prep Oper	1.4.5 Simulation Complete
X-Y Plotter (30 x 30)							
	1.3.5.1 Plotter Readiness and Setup	⊗	⊗	⊗	⊗	⊗	
	1.3.8 Securing Recorder and Plotters						X
X-Y Plotter (11 x 17)							
	1.3.5.2 Plotter Readiness and Setup	⊗	⊗	⊗	⊗	⊗	
	1.3.8 Securing Recorder and Plotters						X
X-T Recorders							
	1.3.5.3 Recorder Readiness and Setup	⊗	⊗	⊗	⊗	⊗	
	1.3.8 Securing Recorder and Plotters						X
Telemetry Console							
1.2.11 TM Console Fault Patching		⊗	⊗	⊗	⊗	⊗	
	1.3.6.1 TM Console Readiness	⊗	⊗	⊗	⊗	⊗	
	1.3.6.2 TM Console Setup	⊗	⊗	⊗	⊗	⊗	
	1.3.9 TM Console Secure						X
Instructor-Operator Station							
	1.3.4.1 G&N and Visual Readiness	X	X	X	X	X	
1.2.13 True Trainee Environment Operation	1.3.4.2 True Trainee Environment and Waste Management Status	X	X	X	X	X	

X Simulator System Required
⊗ Unit Procedure Optional

Table 1-1. AMS Operating Procedure and Checklist Summary (Cont)

Unit Procedure	System Checklist	Simulator Complex Checklists					
		1.4.1 Mission Simulation Prep Oper	1.4.2 Launch Simulation Prep Oper	1.4.2.2 Abort Simulation Prep Oper	1.4.3 Orbital Simulation Prep Oper	1.4.4 Entry Simulation Prep Oper	1.4.5 Simulation Complete
1.2.14 Up-Data Link Operation	1.3.4.3 Up-Data Link Status	X	X	X	X	X	
	1.3.4.4 Computer and Simulator Status	X	X	X	X	X	
	1.3.4.5 Recorder and Plotter Status	⊗	⊗	⊗	⊗	⊗	
	1.3.4.6 Closed Circuit Television Setup	X	⊗	⊗	X	⊗	
1.2.12 Communication Console System Operation	1.3.4.7 Communications Control Setup	X	X	X	X	X	
	1.3.4.8 Malfunction Insertion and Status	⊗	⊗	⊗	⊗	⊗	
	1.3.3 Reset Initialization			X	X	X	
1.2.9.4 Step-Ahead Procedure					⊗		
	1.3.7 IOS Secure						X

X Simulator System Required
⊗ Unit Procedure Optional

Table 1-2. AMS Film Cassettes

Turret No. 1	Turret No. 2	Altitude (Nautical Miles)	Film Presentation
AMS SE-012 Capabilities			
	Cassette 2a	100-215 (Earth)	Earth orbits 1 through 9 - part No. 573937
	Cassette 2c	100-215 (Earth)	Earth orbits 9 through 16 (plus orbit 1) - part No. 573938
Cassette 1c			30 lunar scenes and 3 parachute descent scenes - part No. 573939
Cassette 1a			None
Additional Capabilities Beyond SE-012			
	Cassette (TBD)	Earth 215 to 464	Constant scale rectilinear grid. Coverage: 2150 n mi; Scale: 18.9 n mi/mm.
Cassette (TBD)		Earth 464 to 1000	Constant scale rectilinear grid. Coverage: 4640 n mi; Scale: 40.7 n mi/mm.
	Cassette (TBD)	Trajectory from 1400 n mi above earth to 383 n mi above moon	Variscale spherical view of earth and moon.
Cassette (TBD)		Trajectory from 1000 to 1400 n mi above earth	Constant scale frame view of earth with 5 mm area of solid cloud surrounding the earth scene.
Cassette (TBD)		Trajectory from 1400 n mi above earth to 383 n mi above moon	Variscale spherical view of moon and earth.
	Cassette (TBD)	Moon 273 to 126	Constant scale rectilinear grid. Coverage: 1270 n mi; Scale: 1.2 n mi/mm.
Cassette (TBD)		Moon 126 to 58	Constant scale rectilinear grid. Coverage: 590 n mi; Scale: 5.23 n mi/mm.
	Cassette (TBD)	Moon 58 to 27	Constant scale rectilinear grid. Coverage: 283 n mi; Scale: 2.4 n mi/mm.

Power should be removed from the related MEP and optical assembly before removing or installing cassettes. Power to each window and to the telescope optics is controlled by alternate-action switch-lights located in the visual power cabinet, unit 61. These switch-lights are labeled MEP AND CELESTIAL SPHERE - WINDOW NO. 1, -WINDOW NO. 2, -HATCH WINDOW, -WINDOW NO. 4, -WINDOW NO. 5 and -TELESCOPE. (There are no visual effects for the hatch window for SE-012 AMS.) The switch-light operation is indicated by the back-lighting at each switch-light and by the associated indicator light on IOS panel 1, the VISUAL SYSTEM STATUS panel. The VISUAL SYSTEM light on IOS panel 48, SIMULATOR STATUS panel, will also be illuminated as a result of removing power from any of the windows or the telescope MEPs. The MAINTENANCE IN PROGRESS switch-light, located in unit 61, should also be manually activated to caution crew members of the impending action. This warning is also reflected on IOS panel 48. During the removal or installation of the film cassettes, should the instructor desire to turn off the cooling air to the MEPs, the operation of the AIR COMPRESSOR switch-light in unit 61 will provide the control. However, due to an interlock between the air compressor and the visual system, power cannot be re-applied to the visuals unless the air compressor is supplying the proper amount of cooling air to each visual unit.

NOTE

To protect the film and to prolong its life, it is recommended the air compressor remain on while the cassettes are being installed or removed. During normal shutdown of the visual system, it is also recommended the air compressor remain on for a sufficient period of time after power has been removed from the visual system to allow the MEPs to cool to the ambient temperature.

A typical turret assembly is illustrated in figure 1-1. Each assembly contains two turrets and each turret can contain up to four cassettes which will accommodate the visual requirements for a full lunar mission. As indicated by table 1-2, only three loaded cassettes will be used for the SE-012 AMS configuration. A fourth cassette will be installed opposite the translunar cassette to serve only as a counterbalance to ensure proper indexing. In addition, each MEP contains a transboundary effect cassette not housed within the turret assembly. This film cassette provides the moving cloud-cover effect that is simulated during all phases of mission training. For this reason, the removal and replacement of these cassettes are considered maintenance functions.

As illustrated in figure 1-1, removable covers are located at the top and bottom of each MEP unit to provide access to the two turrets. Attached to the covers are handles which are to be removed and attached to the cassette to facilitate handling. The film cassette can only be removed or installed when it is positioned beneath the loading and adjustment opening. If the cassette to be removed is not located in this position, the turret must be indexed manually (i.e., the turret must be rotated until the desired film

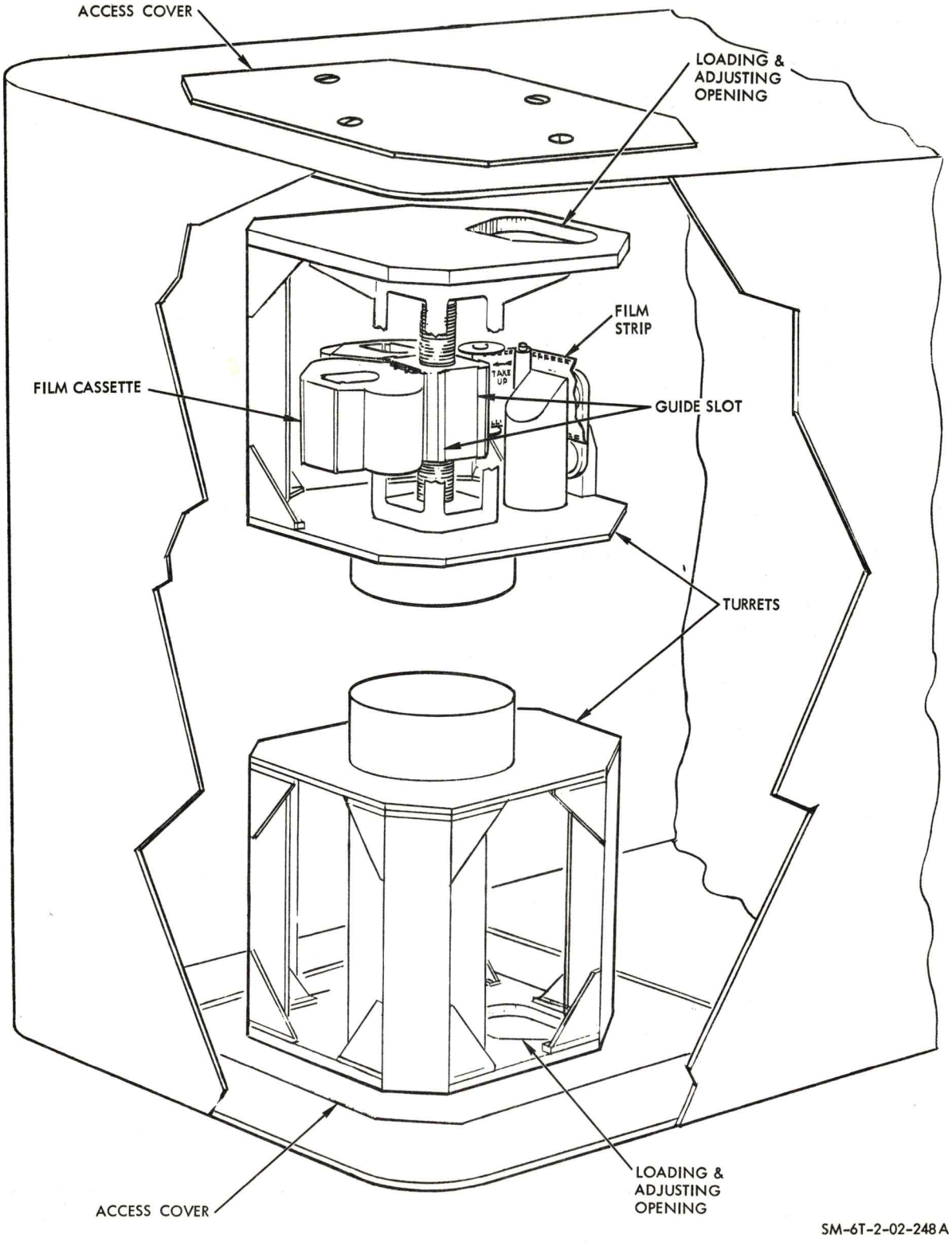


Figure 1-1. MEP Film Cassette Location

cassette is beneath the opening). In addition, the cassette must be driven along the worm gear to the nearest point at the opening. To accomplish this the instructor returns to unit 61 and re-establishes power to the particular MEP. The turret and cassette is manually controlled through the CASSETTE SELECTION controls located on test panel A19 of each window equipment cabinet. (Refer to table 1-1, section 1 of Volume I, for unit number and location.) To drive the cassette to the end of the worm gear (off course) position, place the controls labeled OFF COURSE I-OFF COURSE II to the MAN 1 position and turn the rotary control to either the - or + extreme, depending on the direction to be traveled to the opening. Allow 30 seconds to elapse before attempting to index the cassette. This allows sufficient time for the distortion lens of the MEP to drive to the proper position. By operating the TURRET I/TURRET II - AUTO A, B, C, and D switches and the TURRET INDEX pushbutton, the desired cassette may be positioned beneath the loading and adjustment opening under manual control. The cassette may now be removed by loosening the clamping block screw approximately two turns which releases a cam lock on the slide. The locking screw is backed off until completely disengaged. The cassette may now be removed using the handle which was disassembled from the MEP cover and attached to the cassette.

When installing a cassette, the cassette should be guided gently into the carriage. The locking screw and the clamping block screw should be tightened firmly, but not overtightened. The loading handle should be removed from the cassette and replaced on the MEP cover. After installation, the cassette should be driven to the center position by rotating the OFF COURSE rotary control to its center position. Upon completion of cassette loadings, all access doors should be replaced and all controls returned to the AUTO (computer-driven) position. This action is verified by inspection of the IOS panel 1, which indicates all optical assemblies are under computer control and all indicators on panel 48 are extinguished.

Other precautions to be observed during cassette operation are as follows:

- Do not load turrets with only one cassette. This causes unbalance and may affect proper indexing as explained previously.
- Do not load cassettes in turrets for extended periods without film in the cassettes.
- Do not reverse the direction of the film drive without providing reverse signals to the tensioning motors. (During manual operation, the FLIGHT DIRECTION switch, on panel A20, may be left in the reverse position.)
- Do not operate the illumination varifocal lens at the small spot size for more than a few minutes when the film is stationary in the film gate.
- Make certain the cassettes are placed in their proper positions in the turrets. The cassettes are not interchangeable.

In the event the instructor should be required to change the film in the cassettes, the following requirements should be observed:

- Load the film in the cassettes in strict accordance with instructions on the cassette cover.
- Disengage the gear on the spline shaft with a special tool when threading film through the cassette, and make certain that the gear is re-engaged after loading film.
- Ensure that the zero reset microswitch roller is riding on the edge of the film.
- Check that the spring-loaded flange on the guide rollers is on the outside edge of the film.
- Check that the film is properly threaded through the sprocket-guide springs.
- Check that the pressure chamber cover plate screws are all in place and tightened.
- Do not use film with splices that can reach the film gate.
- Do not use silver emulsion film.

1.2.2 CHECK AND FILL POTABLE WATER TANK.

Prior to each exercise that is expected to embrace mission proportions, the instructor is required to ascertain that there is sufficient potable water within the simulated spacecraft. In the AMS, potable water is supplied for the crew members at three locations in the simulated command module. These are at the food reconstitution device, the water service shutoff valve, and at the waste water outlet on the water control panel.

A 42-gallon tank, located beneath the SCM, contains the reservoir for the potable water system. This quantity is sufficient for missions of the longest expected duration with proper water system management. Attached to the tank (figure 1-2) is a level gage that provides an indication of the quantity of water within the tank. The water tank is filled and pressurized in the following manner. Turn the air supply regulator valve to the OFF position and position the FILL/PRESSURE valve to the VENT & FILL position; this reduces the pressure within the tank to facilitate filling. Ensure that all water valves in the SCM are closed. Attach a standard flexible hose to the fill and drain quick-disconnect valve and, with the other end connected to a water connection supplied by the facility, fill the tank observing the level gage. After disconnecting the hose, position the FILL/PRESSURE valve to the CLOSE & PRESSURIZE position. Adjust the regulator valve until the tank is pressurized to 20 psig. The instructor must then operate the SCM potable and waste valves mentioned above, to bleed any air that may have accumulated in the lines and insure a smooth even flow of water.

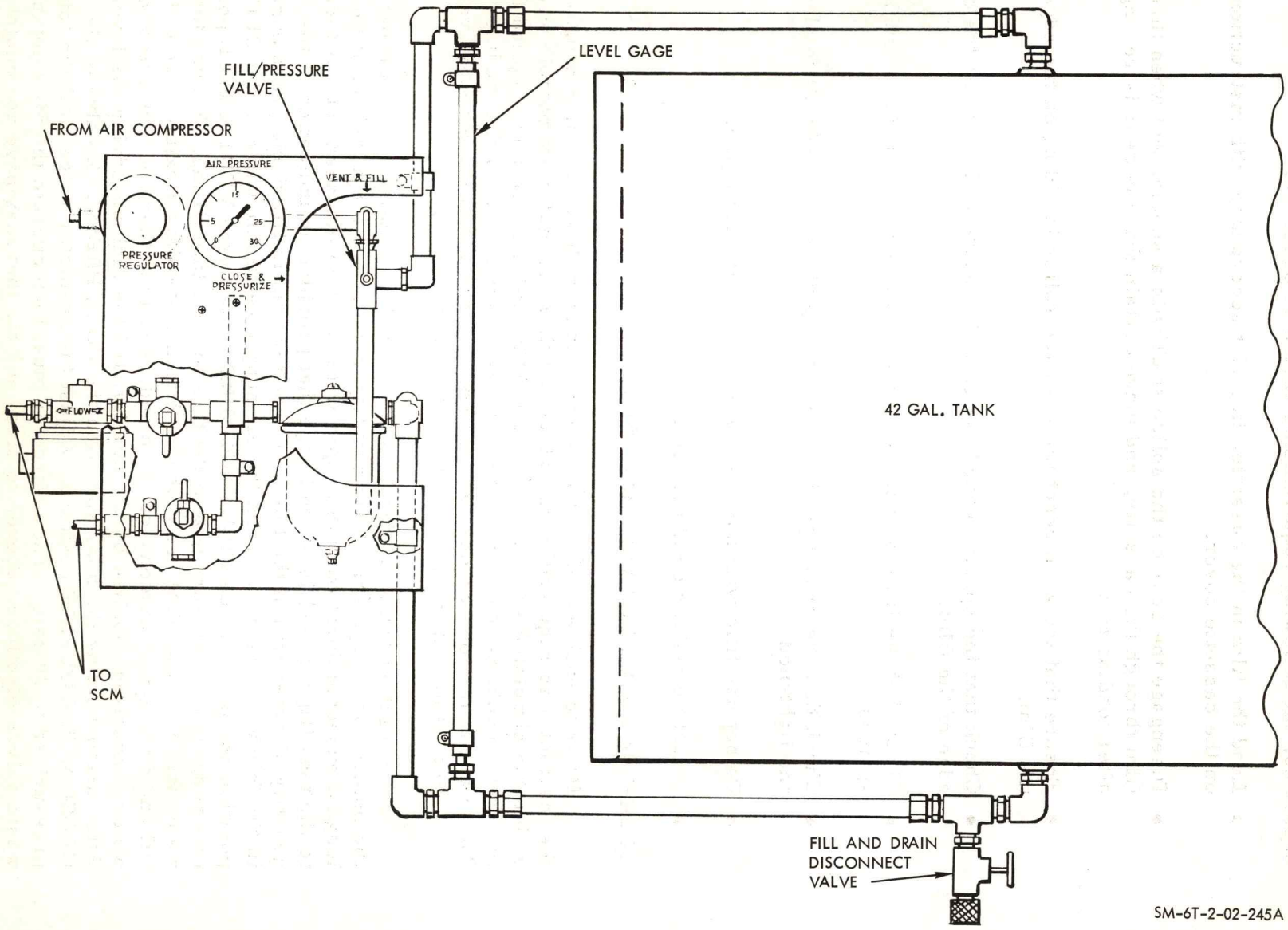


Figure 1-2. Potable Water System Component Location

At the completion of training, the tank is drained by a hose connection from the fill and drain quick-disconnect valve to the building plumbing facilities. Draining is required to prevent stagnation and assures trainees with a fresh water supply for each mission.

1.2.3 CHECK AND EMPTY WASTE STORAGE SYSTEM.

During the extended training exercise, the instructor may be required to eliminate waste material accumulated by the AMS waste management system. Liquid waste material accumulates in the main storage tank located in the support base beneath the access hatch. Bulk material is stored in the portion of the waste storage compartment in the SCM which extends below to the support base. This compartment is located beneath the lower right-hand equipment bay. After removal, proper disposal is to be ensured by the instructor. Figure 1-3 illustrates component location.

Urine samples can be taken from the 2-quart intermediate translucent polyethylene tank through a drain line controlled by a sample valve and/or the urine may be drained into the main storage tank. The main storage tank is also translucent polyethylene with a 15-gallon capacity. Levels of both containers can be viewed through windows on the door of the waste management support assembly.

The main storage tank contains a plug valve and drain line for drainage purposes. A flexible hose and hose adapter is inserted into the drain outlet connection so that urine will drain into a portable container used for disposal. Rotation of the drain valve 90 degrees counterclockwise will open and drain the tank.

A disinfectant (2-quart) storage tank of translucent polyethylene is used to hold disinfectant that is combined with the urine in the main storage tank. The tank is filled by either removing the top panel of the assembly by rotating four quick-release fasteners and removing the plug from the top of the tank, or by inserting a soft flexible tube around the tank, up the rear side, and into the filling port at the top of the tank.

The following procedures enable proper waste management shutdown after usage. The control panel for the system is also illustrated in figure 1-3.

a. Place VACUUM CLEANER MOTOR and MAIN BLOWER switch-breakers to OFF.

b. Place both switches on the waste management panel in the SCM to URINE DUMP position.

c. Attach a flexible hose to the drain outlet quick-disconnect valve and drain into a portable container.

d. Place switches referred to in step b to the OFF position.

e. Set MAIN BLOWER switch-breaker to ON.

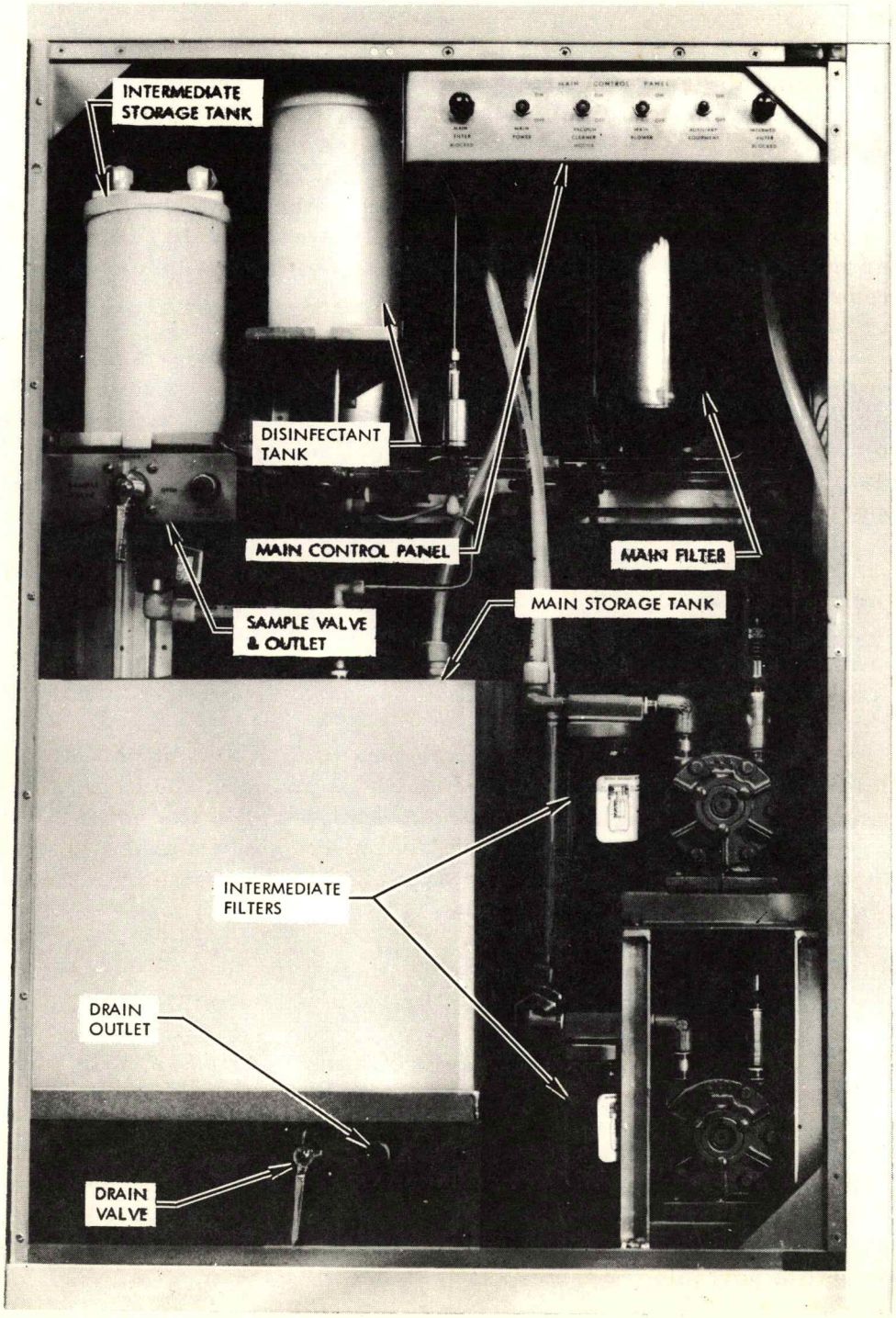


Figure 1-3. Waste Management Storage

f. Fill the urinal in the SCM with one quart of disinfectant.

g. Place SCM switches referred to in step b to URINE DUMP position.

h. Place MAIN BLOWER switch-breaker to OFF.

i. Drain disinfectant tank by alternately opening and closing the SCM URINE DUMP switches every 20 seconds until the tank is empty.

j. Repeat step c.

The above procedures are applicable only to AMS No. 1 (Clear Lake). The waste management support assembly, illustrated in figure 1-3, has been deleted for AMS No. 2 and in its place has been substituted a 6-hour-capacity urine tank, a drain cock, and plumbing to a connection outside the AMS. In addition, the fecal system for AMS No. 2 is not functional.

1.2.4 VERTICAL INSERTION AND RETRACTION.

The SCM is capable of motion in the horizontal and vertical direction. Horizontal movement is on one of two sets of wheels; four, 10-inch double-caster wheels or four, 6-inch-diameter V-grooved wheels. The caster wheels provide unlimited motion of the SCM. The grooved wheels provide powered motion on raised inverted angle tracks. The tracks allow accurate positioning of the SCM within the visual equipment.

The end of the track most distant from the visual equipment is inclined to allow the castered wheels to be lifted clear of the floor when the grooved-drive wheels climb the incline. Forward motion on the rails is now provided by the motor-driven grooved wheels at a pre-set speed until a limit switch, located at a predetermined position, is actuated. This limit switch energizes a motor decelerator, slowing the SCM to zero speed within a prescribed distance. Fixed stops, with limit switch affixed to each stop, are located on the end of the tracks for additional safety features.

Figure 1-4 illustrates the location of the rails, limit switches, stops, and controls used to position the SCM.

Upon completion of horizontal motion, the locking lever is operated to prevent undesirable horizontal movement. Actuation of this lever drops two locating pins into striker plates. The pins actuate limit switches which de-energize the horizontal drive circuits and energize the vertical drive circuits. Vertical travel is normally 27 inches under electrical or manual power. Limit switches and stops are provided to stop vertical motion. A circular safety strip is located on the lower horizontal surface of the tunnel assembly which prevents objects being caught between the SCM and the tunnel structure. Safety strips are also located on the SCM skirt frame preventing objects from being caught between the SCM and the floor.

Figure 1-5 illustrates the controls used by the instructor to position the SCM. For forward motion (toward the optical equipment) the MOTOR FORWARD switch is depressed. This starts the motor; however, SCM

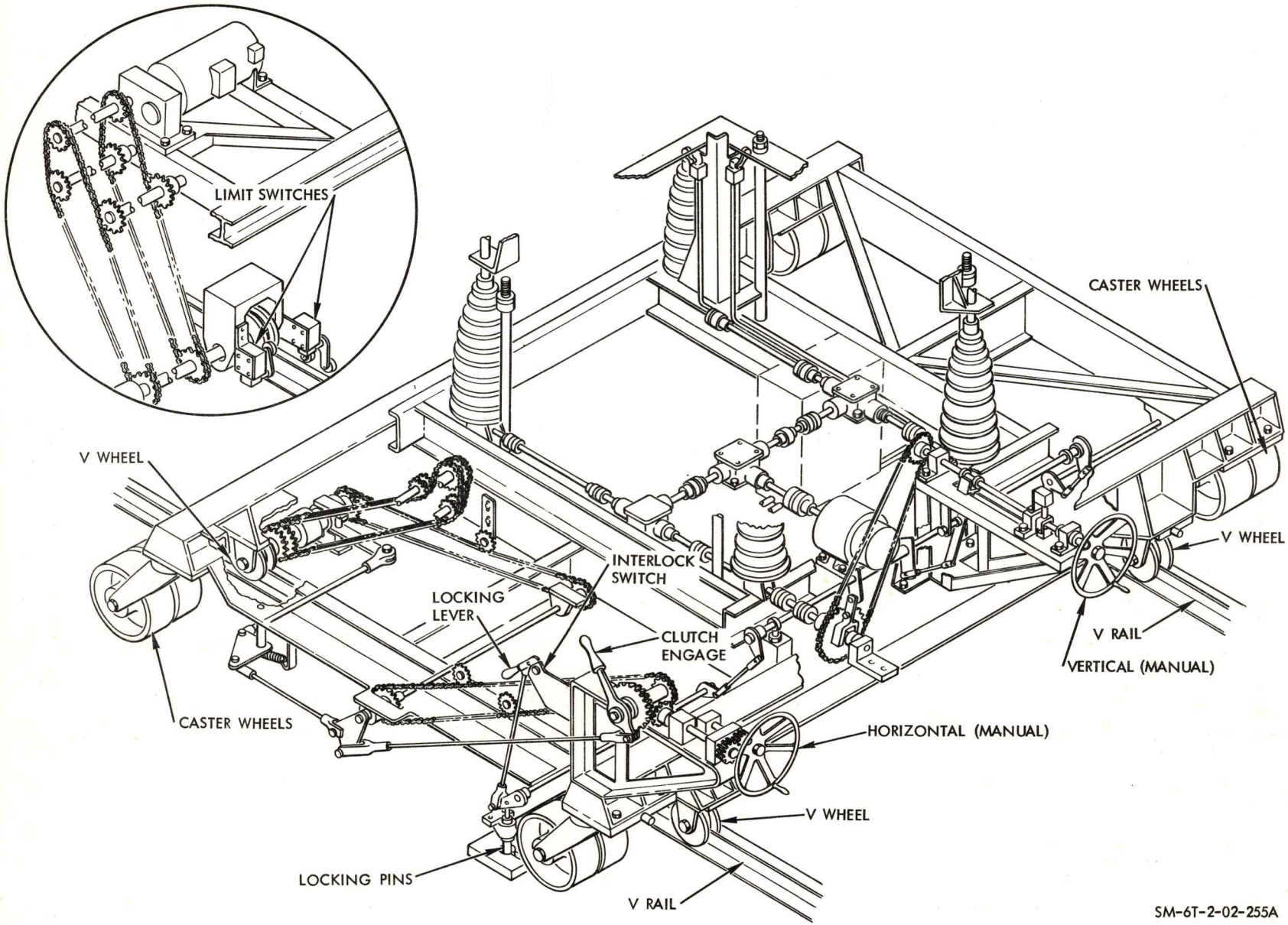


Figure 1-4. Vertical and Horizontal Insertion Mechanism

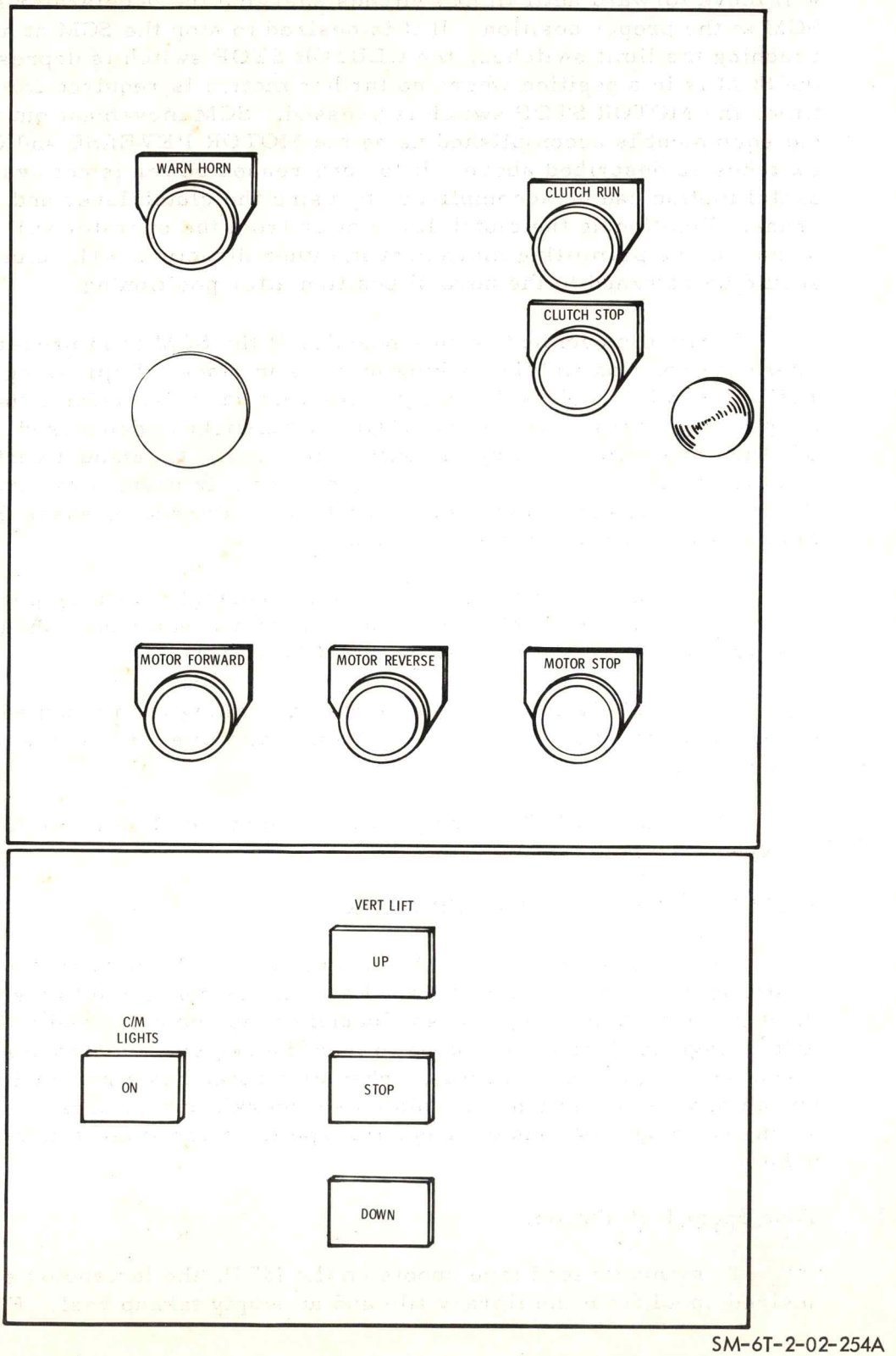


Figure 1-5. Vertical Insertion Controls and Displays

movement is not started until the CLUTCH RUN switch is depressed. The SCM will move forward until limit switches energize the decelerator stopping the SCM at the proper position. If it is desired to stop the SCM at any time before reaching the limit switches, the CLUTCH STOP switch is depressed. After the SCM is in a position where no further motion is required for a length of time, the MOTOR STOP switch is pressed. SCM movement out from the optical equipment is accomplished using the MOTOR REVERSE and CLUTCH RUN switches as described above. If for any reason power is not available, horizontal motion can be accomplished by using the clutch lever and the manual crank. Positioning the clutch lever away from the operator will engage the manual drive permitting movement in either direction. The clutch lever should be returned to the normal position after positioning.

Vertical movement is only possible if the SCM is in proper horizontal operating position and the locking lever is in place. Depressing the VERT LIFT-UP switch-light will energize the vertical drive raising the SCM to its fully raised position unless the STOP switch-light is depressed. Lowering the SCM is accomplished using the DOWN switch-light. Manual vertical motion is possible by rotating the vertical hand crank while pushing the crank in toward the SCM. This action engages the vertical clutch and releases the vertical motor mechanical brake when engaged.

After the SCM has been raised to the normal operating position, the shrouds between the SCM windows and the visual equipment should be adjusted to ensure no external light enters the SCM windows.

The WARN HORN switch activates a warning horn mounted in the SCM base which should be used before any SCM movement to alert any personnel in the area.

The C/M LIGHTS switch provides emergency lighting to the SCM in the event of a power failure.

1.2.5 MAGNETIC TAPE UNIT OPERATION.

The magnetic tape units (MTU) are used in the AMS system as input-output devices for the computers. Each unit is connected to the computers through a direct memory access channel of the computer and a time multiplex unit. Magnetic tape data is used to load the computer memories with operational and diagnostic programs, ephemeric data, reset parameters, and launch boost information. Simulated spacecraft parameters are recorded during training missions on magnetic tape for later evaluation and initialization points.

1.2.5.1 Tape Spool Installation.

To manually load tape spools on the MTU, the instructor selects the desired spool from the library file and an empty takeup reel. Figure 1-6

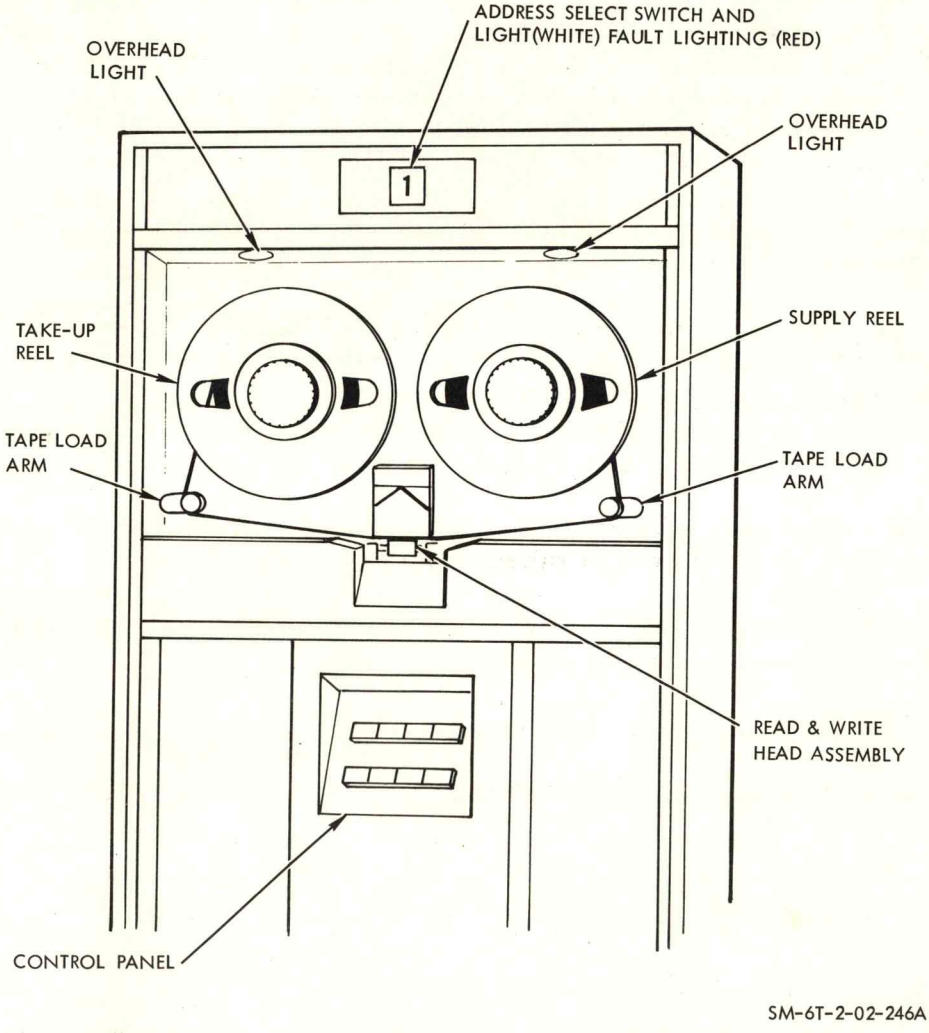


Figure 1-6. MTU Tape Loading Deck

illustrates the MTU tape deck and components referenced for the proper installation of the tape spools on the MTU. The following procedures are to be used for reel mounting:

a. Press POWER switch-light on the MTU control panel, and hold for approximately 2 seconds. Observe illumination of POWER switch-light.

b. Slide the front door down to its lowest position.

c. Turn the knurled knob on the left reel (takeup) counterclockwise two or three turns. Slide empty tape reel onto hub and turn knob clockwise while pressing reel firmly onto hub.

d. Check back of full reel of tape for the presence of a file ring. (A file ring should be present on the reel if a write operation is to be allowed, and the FILE PROTECT LIGHT should be illuminated when the tape is installed.)

e. Check that a load point marker is located approximately 10 feet from beginning of tape.

f. Turn knob on right reel (supply) hub counterclockwise. Slide full tape reel on hub with file ring slot toward transport, and tighten knob clockwise while pressing reel firmly onto hub.

g. Push load arms to the up position.

h. Thread tape from supply reel around supply load arm, under takeup load arm, and onto top of takeup reel.

i. Press tape onto takeup reel through one of openings in side of reel, and turn reel three turns to hold tape onto reel.

j. Slide tape under the head assembly.

k. Push both load arms down.

l. Raise front door.

m. Press LOAD switch-light on the MTU control panel. Tape should now be drawn into loop boxes and then advanced to the load point. LOAD switch-light will illuminate when the tape reaches the load point and remain on until tape is moved away from the load point.

n. Set ADDRESS SELECT switch (drum switch above the front door) to the desired position.

o. Select DENSITY HI or DENSITY LO mode at the MTU control panel as specified on the spool canister.

p. Press READY switch-light and observe illumination of switch-light. Unit is now under remote control of the computers.

1.2.5.2 Magnetic Tape Program Loading.

To input program data into the computer memory from the MTU, a specially prepared program, usually referred to as a "bootstrap" or "fill" program must be loaded previously into the computer via the card recorder or paper tape. The "bootstrap" or "fill" program enables the MTU to input programs or data into memory under computer control. The procedure used to load from the MTU is as follows:

a. Load tape onto the MTU tape deck as per paragraph 1.2.5.1.

b. Verify "bootstrap" or "fill" program has been entered into the computer.

c. Select either DENSITY HI or DENSITY LO mode at the MTU control panel as specified on the spool canister.

d. Depress MASTER CLEAR pushbutton at each of the three computer control panels.

e. At the controlling computer control panel, place SENSE, MAIN INTERRUPT, and REAL TIME INTERRUPT switches to their specified positions as defined in the program operational instructions. Verify I/O function selection switch is positioned at ON-LINE.

f. Normally punch in the starting address of "bootstrap" program into the computer program register.

g. Depress START pushbutton at the computer control panel.

1.2.5.3 Tape Spool Removal.

To manually remove the tape spools from the MTU after data transfer is complete, the following procedure is used:

a. Press CLEAR switch-light on the MTU control panel.

b. Press REWIND switch-light, and observe tape being rewound to the nearest load-point marker. Press REWIND switch-light each time tape motion stops until tape is drawn out of loop boxes.

c. Slide down front door.

d. Loosen supply reel hub knob and remove supply reel.

e. Add or remove file ring from reel as necessary, and label reel for storage.

1.2.6 CARD READER OPERATION.

The card reader, which is physically and functionally described in section 1 of Volume I, will be used by the instructor during pre-mission setup

operation for "bootstrap" program loading and malfunction insertion as described in paragraph 1.3.2. The following procedure provides the loading and data transfer instructions in addition to an operational readiness check of the card reader.

1.2.6.1 Loading Punch Card Data.

To load the punch card data, proceed with the following steps:

a. Depress POWER ON switch and observe that NOT READY light illuminates.

b. Depress VALIDITY ON switch and observe that switch-light illuminates.

c. Place card deck in read hopper, face down, column one first.

d. At card reader manual control panel, lift cover on lower panel to gain access to LOCAL-RUN switch.

e. Place LOCAL-RUN switch to LOCAL.

f. Observe card feeds from hopper through read heads to stacker, until hopper is emptied.

g. Note that FEED CHECK light illuminates.

h. Remove cards from stacker.

i. Place LOCAL-RUN switch to RUN.

j. Close cover over LOCAL-RUN switch.

k. Depress RESET switch and observe that FEED CHECK light extinguishes.

l. Place desired deck of cards into card reader hopper, face down, column one first.

m. Depress START switch and observe that NOT READY light extinguishes and READY light illuminates. The card reader is now ready to feed under computer control.

1.2.6.2 Punch Card Program Loading.

The following procedure is used to transfer the data from the card deck to the computer memory:

a. Verify that READY light is illuminated and NOT READY light is extinguished on the card reader control panel.

b. At the computer control panel, perform the following:

1. Place FILL selection rotary switch to CARD RDR HOL.

2. Place I/O function selection switch to ON-LINE.

3. Insert proper operation code in OP CODE register (053) and proper address in Z register (26150).

4. Depress EXECUTE pushbutton.

5. Depress RESET pushbutton for OP CODE register.

6. Depress FILL pushbutton and monitor card feed at reader.

c. Observe that NOT READY light on card reader illuminates when card hopper is exhausted or card stacker becomes full.

d. If hopper is emptied, depress END OF FILE switch, on card reader, to run out remaining cards.

e. Depress STOP switch at card reader.

f. If stacker is full and cards are still in the read hopper, depress STOP switch and remove cards from stacker.

g. Depress RESET switch at card reader.

h. Depress START switch at card reader and observe NOT READY light extinguishes and READY light illuminates.

i. Continue operation until all program cards have been processed through the card reader.

j. At computer control panel, depress MASTER CLEAR pushbutton.

1.2.6.3 Preparing Program Changes.

For the method of program variation using the card reader, the instructor should obtain a computer printout of the affected program or otherwise be familiar with the program card deck. The procedure involved in this method is as follows:

a. Prepare card(s) with new information in same format as old card(s).

b. Remove old card(s) from card deck and file or dispose.

c. Set new card(s) in place of old card(s).

d. Re-insert program into computer.

1.2.7 PAPER TAPE PROGRAM LOADING.

The paper tape reader functionally described in section 1, Volume I, is used to load programs into the computer memory. Paper tape loading is usually used for "bootstrap" or "fill" programing or for short off-line diagnostic or utility programs. ("Bootstrap" or "fill" programs are used for start-up operation. The "bootstrap" program used for SE-012 AMS is entered using card decks processed through the card reader.)

The following procedure is used when loading by paper tape:

a. At the controlling computer control panel (computer C, unit 49, for SE-012) perform the following:

1. Place fill selection rotary switch to PAPER TAPE.

2. Place I/O function selection switch to ON-LINE.

3. Depress MASTER CLEAR pushbutton.

b. At paper tape reader, place POWER switch to ON and insert tape into reader with three-channel side next to reader front panel.

c. If paper tape is a "fill" or "bootstrap", a starting location is manually inserted into program register and FILL pushbutton is depressed which initiates the transfer of information on tape into the computer. If tape is not a "fill" or "bootstrap" it is not necessary to insert a starting location, but only to depress FILL pushbutton at which time a portion of paper tape information is transferred into the computer. After the tape reader stops, MASTER CLEAR is depressed followed by START pushbutton. At this time the remainder of tape data is entered in the computer.

d. Upon completion of tape loading, depress MASTER CLEAR pushbutton.

1.2.8 MANUAL PROGRAM LOADING.

Programs can be manually loaded into computer memory from the computer control panel; however, due to the extensive time involved and the various other means of computer loading, it is highly unlikely that manual loading will be used. In the event manual loading is required, the procedure is as follows:

a. Depress MASTER CLEAR pushbutton at the computer control panel.

b. Set OP CODE register to desired operation code by depressing desired indicator pushbuttons to form the numerical binary code.

c. Set Z register to address of first word to be entered in the same manner.

d. Set program data word into A register in the same manner.

e. Depress EXECUTE pushbutton at the computer control panel.

f. Reset all registers by depressing the associated RESET pushbutton.

The procedure outlined must be repeated for each program word until the program is loaded. At this time, the program may be executed per the defined program instructions.

1.2.9 TYPEWRITER OPERATION.

The IBM selectric typewriter, described in section 1 of Volume I and located at the desk between the IOS and T/M consoles, is used as an on-line input-output device. As such, it provides the instructor with the ability to communicate with the AMS computers while the simulator is being used operationally. Inputs to the computers via the typewriter can only be accomplished prior to exercise initialization or during freeze condition of the AMS. During the pre-mission loading of the computers, the typewriter acts as an auxiliary printer notifying the instructor of tasks to be performed. The typewriter will be used to perform the following on-line functions:

a. Insert and/or change the variables being recorded on the X-T or X-Y recorders.

b. Interrogate and print out contents of any memory location.

c. Enter time parameters to initialize central timing equipment.

d. Enter time parameters for step-ahead function.

e. Identify and call up proper launch boost and ephemeris data.

f. Transfer control of AMS to the diagnostic monitor program.

1.2.9.1 X-T/X-Y Recorder Inputs.

The IOS typewriter is used to assign parameters to be recorded in the X-T and X-Y recorders during the premission loading or in the FREEZE mode. The format to be used at the typewriter is as follows:

- XXXXX/±YY/ZZ where X is 5 octal integers representing the absolute address in memory of the desired parameter; Y represents the scale factor in terms of either + or - and a two-digit number ranging from 00 to 22; and Z represents the recorder channel where the parameter will be recorded.

- The absolute address in memory of a parameter can be obtained from a listing known as the "memory map". Reference to the Simulation Output tables, section 6 of this volume, may be required to identify the terms as they appear on the "memory map" as they are listed only by program symbols. The Simulation Output tables associate the program symbol with its proper name and also provide the maximum and minimum operating limits.

- The scale factor is used to increase or decrease the magnitude of variation that a word will present at a recorder. The scale factor in effect, shifts the contents of the word to the usable portion of the computer register that results in a voltage from the digital-to-analog converter that is suitable for proper recorder presentation. The digital-to-analog converter uses only the first 13 significant bits of the 24-bit word and will output a +10 volts if bits 2 through 13 are all 1's which is equivalent to a binary count of 4095. (The 1st bit is the sign bit.) For example, if a Boolean, such as the liftoff signal, is desired to be recorded, a +22 will be inserted as the scale factor. This shifts the Boolean from the 24th or least significant bit to the 2nd or most significant bit. The resultant voltage from the digital-to-analog converter to the recorder will be a +5 volts, equivalent to a binary count of 2048. With 0.5 volt per line attenuation set on the recorder, a deflection of 10 lines will be recorded when the Boolean is received.

- For variable signals, such as rates, accelerations, etc., the determination of the scale factor is more involved. Several factors must be taken into consideration. These are the operating limits of the term, the anticipated operating range, and the programer placement of the binary point in the computer register for that term. The binary point is used by the programer when arithmetic operations on integers are being performed to retain as many significant digits as possible without computer register overflow. The binary point for each parameter is located in the AMS symbol dictionary in terms of B7, B9, etc., and is referenced to the right of the sign bit of the computer word.

- As an example for determining a scale factor, assume a parameter selected has the operating range of from 0 to 100 units and this number is scaled at B7. When the maximum value of the word is reached, an output of 7.8 volts will be outputted from the digital-to-analog converter to the recorder. The output voltage is based on 100 scaled at B12 being equivalent to 3200 in relation to a maximum count of 4095 which results in a ratio of 0.78 output. However, if only 25 units were the expected output, only one-fourth of the maximum voltage, or approximately 1.9 volts, would be applied to the recorder. This can be increased by inserting a scale factor of +02 which results in a multiplicative factor of 2^2 or 4 or 7.6 volts output. Although in many cases, the scale factor will be +00, each term must be examined to determine the proper scale factor.

- The selection of the recorder or plotter on which the parameter will be displayed rests with the instructor. Table 1-3 contains the numbers assigned each channel which must be typed in following the scale factor.

- After the information for each parameter is obtained, the IOS typewriter is used to enter each term using the format outlined in the opening paragraph. If the AMS is in the pre-mission loading mode, the parameters are entered after the following message is typed out: BEGIN TO ENTER X/Y-X/T INPUTS. After each complete parameter entry, a carriage return is depressed and after all entries (maximum of 32) are inserted, the Backspace is depressed.

- If the AMS is in on-line operation, the FREEZE switch-light on IOS panel 46, must be depressed and an X must be typed in before each entry. The X will initiate an automatic carriage return. If an incorrect input has been inserted, the following message will be typed out: ERROR ON LAST INPUT. TYPE IN CORRECT INPUT.

Table 1-3. Recorder/Plotter Code Identification

Recorder	Nomenclature	Channel Code Location
X/T No. 1 (unit 23)	Channel 1	01
	Channel 2	02
	Channel 3	03
	Channel 4	04
	Channel 5	05
	Channel 6	06
	Channel 7	07
	Channel 8	08
X/Y (11 x 17 in.)	Pen No. 1	09
	Arm No. 1	10
	Pen No. 1	11
	Arm No. 1	12
X/T No. 2 (unit 24)	Channel 1	13
	Channel 2	14
	Channel 3	15
	Channel 4	16
	Channel 5	17
	Channel 6	18
	Channel 7	19
	Channel 8	20
X/Y (30 x 30 in.)	Pen No. 1	21
	Arm No. 1	22
	Pen No. 2	23
	Arm No. 2	24
X/T No. 3 (unit 25)	Channel 1	25
	Channel 2	26
	Channel 3	27
	Channel 4	28
	Channel 5	29
	Channel 6	30
	Channel 7	31
	Channel 8	32

1.2.9.2 Computer Interrogation.

The following procedure is used to interrogate and record the contents of any memory location with the typewriter.

a. At IOS panel 46, MASTER CONTROL panel, depress FREEZE switch-light.

b. At IOS typewriter, type in the letter L.

c. Observe an automatic carriage return.

d. Type in location of desired memory core. (Leading zeros may be necessary to complete the 5-digit insertion.)

e. Observe an automatic carriage return.

f. Type in a U if desired memory location is in the upper core, or an L, if in the lower core.

g. Observe contents of the memory location being typed out on the typewriter.

NOTE

Parameters identified by program symbols and their memory location are obtained from a listing known as a "memory map."

1.2.9.3 Initialization of CTE.

The following procedure is used to initialize the central timing equipment used during initialization of the AMS:

a. At IOS panel 46, MASTER CONTROL, depress FREEZE switch-light and observe illumination of switch-light.

b. At IOS typewriter, type in the letter C and observe an automatic carriage return.

c. Type in desired time using the following format:

AAA/BBBBBB/CC/DD

where A is the day of the year, B is the hours, minutes, and seconds in that order, C is the day of the month, and D is the last day of the month.

d. After the insertion of the 16th entry, observe for an automatic carriage return.

e. Verify that the timers at the IOS and the T/M consoles change to reflect the time inserted.

1.2.9.4 Step-Ahead Procedure.

The following procedure is used to advance the mission to a point along the trajectory factor than in real time:

a. At IOS panel 46, MASTER CONTROL, depress FREEZE switch-light and observe illumination of switch-light.

b. At IOS typewriter, type in the letter S and observe an automatic carriage return.

c. Type in desired time using the following format:

AAA/BB CC DD

where A is the day of the year, B is the hour, C is the minutes, and D is the seconds. The time inserted is related to the end of the step-ahead period.

d. After the new time has been displayed on IOS timers, depress STEP-AHEAD switch-light at the IOS panel 46.

e. Observe illumination of STEP-AHEAD switch-light with FREEZE switch-light remaining illuminated.

f. Completion of the step-ahead program is indicated by extinguishing STEP AHEAD switch-light; however, FREEZE switch-light will remain on until READY/RUN switch-light is depressed to begin the training session.

1.2.9.5 Launch Boost Tape and Ephemeris Entry.

The procedure for identifying and calling up of the proper launch boost parameters from the launch boost tape is an ephemeris defined in paragraph 1.3.2.

1.2.9.6 Entry into Diagnostic Programs.

The following procedure will transfer the AMS control to the diagnostic program. This procedure is to be used when the instructor has reason to believe the AMS is not functioning properly.

a. Depress FREEZE switch-light at IOS panel 46, and observe illumination of switch-light.

b. At IOS typewriter, type in the letter D.

c. Inform maintenance personnel of conditions precipitating the entry into the diagnostic mode of operation.

1.2.10 LINE PRINTER OPERATION.

The line printer, described in section 1 of Volume I, provides the instructor with a printed copy of the computer systems outputs. Among these outputs will be the list of malfunctions both pre-programed and time-dependent, inserted into the computer system. The operation of the line printer is accomplished as follows:

a. Depress POWER ON switch-light and observe illumination of light and the momentary illumination of STANDBY switch-light. When STANDBY light extinguishes, the line printer is ready to receive information from the computer system.

b. Depress SKIP-FEED to advance the paper; if it is desired to start print-out at the top of a new page, depress TOP OF FORM switch-light.

c. If printer is to remain inactive for long periods of time, but it is desirous not to remove power completely, STANDBY switch-light can be depressed. The second depression of the switch-light will extinguish switch-light and return printer to normal operation.

1.2.11 T/M CONSOLE FAULT PATCHING.

The faulting of down telemetry signals is accomplished at the telemetry console by either computer or manual control. The fault controls of the T/M console are described in section 1, Volume I. Fault controls are provided to enable the T/M console operator to vary the presentation of telemetry parameters at the flight controller consoles. Operation of the fault controls does not affect system simulation data manifested to either the flight crew in the SCM or the instructor-operators at the IOS.

The T/M console operator can fault any 20 of the 320 analog channels or any 16 of the 312 bilevel channels of the AMS. The analog and bilevel channels are identified in the simulation output tables in section 6, Volume II, of this handbook.

Faulting of selected T/M channels is accomplished by means of a patch panel located in the upper left portion of unit 30 (figure 1-7). This panel is removed by loosening a thumbscrew in the left center of the patch panel front face to unlatch it, and then pulling the handle down and out. The handle pivots in a downward quarter-circle which lifts the panel patch contacts clear of the connecting pins prior to the panel being pulled out. The panel slides outward on guide slots which prevent misalignment during removal and installation of the panel.

Normally, the T/M channels, identified on the patch panel, are bottle-plugged to allow the signal through to the T/M console monitors and the flight controller monitors. To fault a particular parameter, the T/M instructor must refer to the telemetry channel list located in the Simulation Output Table. The table includes the type of parameter (analog, digital bit, digital

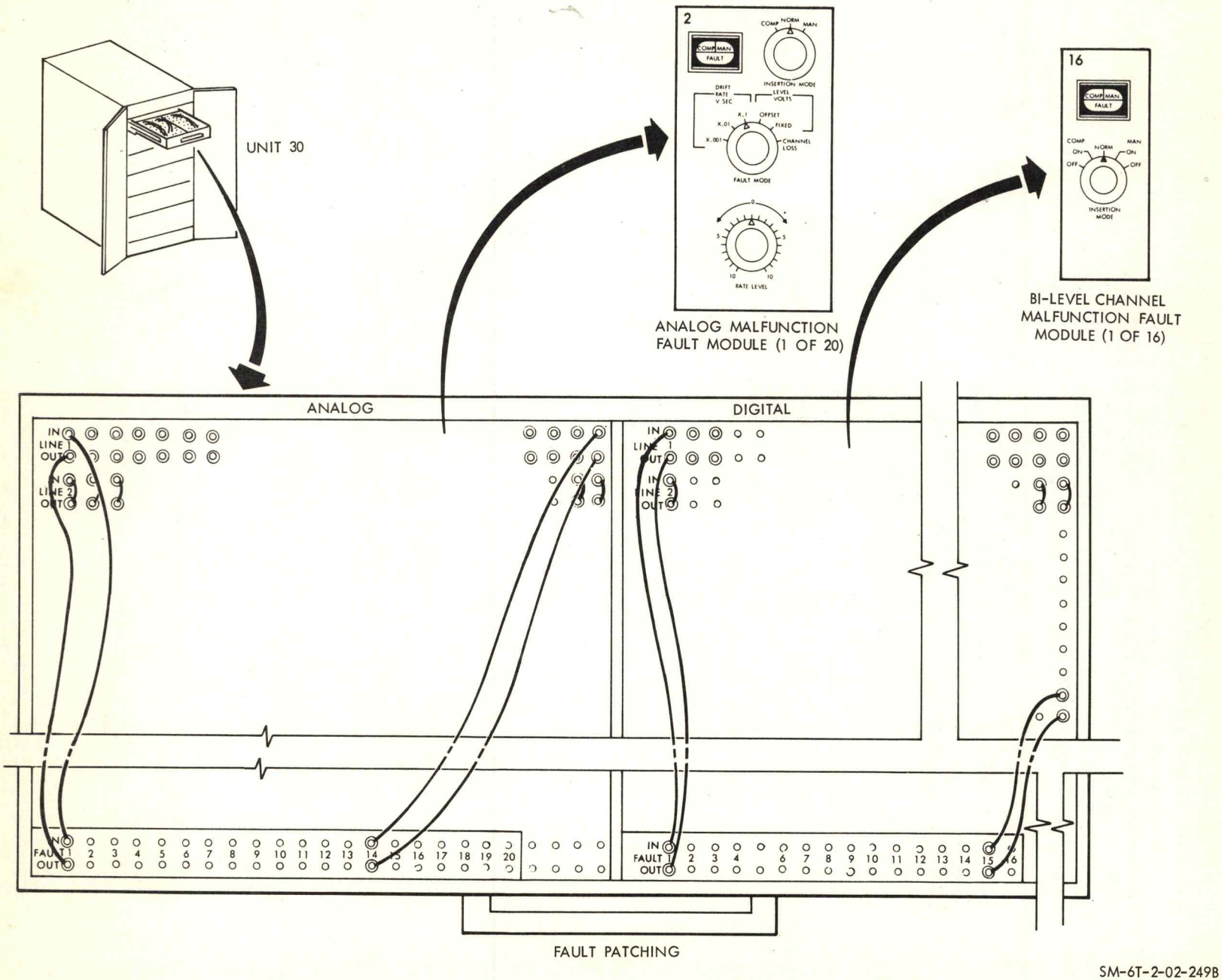


Figure 1-7. TM Fault Patching Functional Flow

word), its channel assignment, and the related pin connection. With this information, the T/M console operator can locate the desired channel at the patch panel and remove the bottle plug located there. With patchcords, the T/M console operator connects the channel number to one of the 20 analog or 16 bilevel (depending on the type of parameters) fault channels located at the bottom of the patch panel bay. This procedure is repeated for all T/M parameters that are to be faulted until the limit of 20 and 16 channels are exhausted. The patch panel is then replaced and secured in unit 30.

The T/M console operator can then use the fault modules to accomplish the particular type of fault required for the parameter assigned to each module, or he can allow the parameter to be transmitted unaffected by the fault controls. Faulting can be done manually or by computer control.

NOTE

The T/M instructor should be cognizant of all malfunctions affecting system T/M parameters that have been inserted at the IOS. This can be accomplished by monitoring the MIU display when operating fault control modules to assure that previously malfunctioned system T/M parameters are not being inadvertently faulted.

1.2.12 COMMUNICATIONS CONTROL SYSTEM OPERATION.

The console communications system (CCS) interfaces with flight crew simulator communications systems and other systems, as required. The CCS consists of eleven independent loops and shares nine other loops with MSCC for integrated operations. These loops are two local conference loops (command module instructor loop, and computer loop), five intersite conference loops (simulator conference loop, simulation tracking and trajectory loop, flight crew simulator-conference loop, and telemetry loops 1 and 2), three astronaut loops (AL 1, AL 2, and AL 3), and four monitor loops (flight director, prime MSFN, launch vehicle-test conductor, and spacecraft operations). Each CCS loop is defined in table 1-4.

Table 1-4. AMS Console Communications Loops

Local Conference Loops
Local conference loops provide signaling, as required, two-way (talk-listen) communications; and monitoring capabilities at all stations in the loop. • Command Module Instructor Loop (CMIL). The CMIL provides conference communications between the console instructor-operators. • Computer Loop (CL). The CL provides two-way communications between the instructor console and support position for the purpose of maintaining AMS equipment.

Table 1-4. AMS Console Communications Loops (Cont)

Intersite Conference Loops
Intersite conference loops are identical to local conference loops with additional facilities to provide connection with MSCC internal loops. • Simulator Conference Loop (SCL). The SCL provides conference communications between AMS instructor-operator and the simulation control area (SCA) during integrated training. • Simulator Tracking and Trajectory Loop (ST and TL). The ST and TL provides conference communications between AMS instructor-operator and SCA personnel. • Flight Crew Simulator Computer Loop (FCS-CL). The FCS-CL provides conference capability for coordinating AMS and MSCC computer operations. • Telemetry Loops 1 (TM 1) and 2 (TM 2). The T/M loops provide conference communications between MSCC and AMS telemetry fault operators.
Command Module Simulated Voice Communications Loops
The C/M simulated voice communications loops are identical to local conference loops except that signaling circuits will not be provided and voice signals are appropriately muted for simulation of half-duplex communications between flight crew and ground. C/M voice loops can be patched to include the MSCC. • Very High Frequency - 1 (VHF-1). The VHF-1 loop simulates the RF voice transmission between the C/M flight crews and the MSFN stations. • Very High Frequency - 2 (VHF-2). The VHF-2 loop will simulate the RF voice transmission between the C/M flight crew and the LEM flight crew. • High Frequency (HF). Same function as VHF-1. • S-Band. The S-band loop will simulate the duplex voice transmission between the C/M flight crews and MSFN stations. • Command Module Intercom. The C/M intercom loop will simulate the command module intercommunications and the ground to spacecraft hardwire communications for prelaunch. The astronaut loops are identical to the local conference loops with no signaling capability. The three astronaut loops (AL 1, AL 2, AL 3) provide communications with each individual astronaut and the instructor-operator at the IOS. These loops do not simulate a portion of the Apollo spacecraft communications systems.

Table 1-4. AMS Console Communications Loops (Cont)

Monitor Loops
The monitor loops provides monitoring capability of MSCC and MSFN stations by AMS instructor-operators. • Flight Director (FD). The FD loop provides AMS personnel with a capability to monitor the flight director. • Prime MSFN. The prime MSFN loop provides the AMS instructor-operator with a capability to monitor the entire MSFN range. • Launch Vehicle Test Conductor Monitor (LV-TC). The LV-TC loop provides the AMS instructor-operator with a capability to monitor the launch vehicle test conductor. • Spacecraft Operations (SC-OP). The SC-OP loop provides the AMS instructor-operator with a capability to monitor the simulated activities of the blockhouse spacecraft test conductor personnel.

Control over and access to these loops is accomplished through the use of two panels: the keyset panel and the trainer communications control panel. The function of each control is described and illustrated in section 1 of Volume I. Table 1-5 illustrates, in matrix form, the connections available at each position through the use of the keyset. This section delineates requirements for operating the CCS in both the integrated and nonintegrated modes.

1.2.12.1 Nonintegrated Mode Communication.

During nonintegrated operations, the instructor-operator simulates the function of the MSFN and supporting organizations. Therefore, the integrated conference loops previously mentioned will not be required. Only the local loops, astronaut loops, and the simulated S/C voice systems will be used. Operation is initiated by connecting individual headsets to the jack plugs at each position. The AUDIO SELECT switch at the trainer communications control panel is placed to the CCS position and the VOLUME control is set as desired. For training purposes, S/C voice communications are simulated by the instructor-operator acting as ground support personnel. This is accomplished by appropriate manipulation of the keyset panel in simulating ground messages on the correct spacecraft communication subsystems. For utility purposes, the astronaut loops or any of the local conference loops may be selected at the discretion of the operator for coordinating conversation with either the flight crew or support personnel.

1.2.12.2 Integrated Mode Communication.

During integrated operations, the AMS operator interfaces with other simulator-training devices and support personnel. In this mode, control of the training operations is the responsibility of the simulation supervisor

Table 1-5. AMS Circuits

Loops	Position								
	Command Instructor Astronaut	Navigation Instructor	Systems Management Instructor	Trainer Setup and Control Instructor	No. 1 Telemetry Instructor	No. 2 Telemetry Instructor	Viewing Station	Digital Computer	Equipment Area
VHF-1	X	X	X						
VHF-1 (mon)	X	X	X		X	X	X		
VHF-2	X	X	X						
VHF-2 (mon)	X	X	X		X	X	X		
HF	X	X	X						
HF (mon)	X	X	X		X	X	X		
S-band	X	X	X						
S-band (mon)	X	X	X		X	X	X		
Intercom	X	X	X						
Intercom (mon)	X	X	X		X	X	X		
AL 1	X	X	X	X					
AL 1 (mon)	X	X	X	X	X	X	X		
AL 2	X	X	X	X					
AL 2 (mon)	X	X	X	X	X	X			
AL 3	X	X	X	X					
AL 3 (mon)	X	X	X	X	X	X			
(ML) Maintenance loop	X	X	X	X	X	X		X	X
(ML) (mon)	X	X	X	X	X	X		X	
(CL) Computer loop	X	X	X	X	X	X		X	X
(CL) (mon)	X	X	X	X				X	
(CMIL) Command module instructor loop	X	X	X	X	X	X		X	X
(CMIL) (mon)	X	X	X	X	X	X	X	X	
(SC) Simulator conf loop	X	X	X	X	X	X		X	
(SC) (mon)	X	X	X	X	X	X	X	X	
(ST&T) Simulation tracking and trajectory loop				X	X	X			
(ST&T) (mon)				X	X	X			
(FCS-CL) Flight crew simulator computer loop				X				X	
(FCS-CL) (mon)				X				X	
(TM 1) Telemetry loop					X	X			
(TM 1) (mon)				X	X	X			
(TM 2) Telemetry loop					X	X			
(TM 2) (mon)				X	X	X			
(FD) Flight director (mon)				X			X		
(PRIME MSFN) (mon)				X	X	X	X		
(LV-TC) L/V test conductor (mon)				X	X	X			
(SCOP) Spacecraft operations (mon)				X	X	X	X		
(BC/O) Buzzer cutoff	X	X	X	X	X	X			
MULTI-ACCESS	X	X	X	X	X	X			
(RLS) Release	X	X	X	X	X	X			
HOLD				X	X	X			
RING	X	X	X	X	X	X			
Total Keys	28	28	28	29	29	29	10	10	3

(flight director), and the instructor-operator no longer simulates ground voice inputs. Since the instructor must still remain cognizant of all operations, utilization of the intersite and monitor loops becomes mandatory. Access to these loops (intersite and monitor) is acquired through the keyset located at the trainer setup and control station (IOS panel 89). Incoming signals on intersite conference loops are signified by the station buzzer sounding and the appropriate talk-listen key flashing. Depressing the key causes the buzzer to stop and changes the illumination from flashing to steady. Initially depressing a talk-listen key causes all keys associated with the loop to flash until another key on the loop is depressed. In this manner the instructor-operator can signal others on his loop and is aware when they have responded to his outgoing signal. If his outgoing signal is not acknowledged, the instructor-operator may use the RING key. This key activates the buzzer at the called station. The talk keys are normally interlocked so that only one key can be operated at one time. An alternative is provided by the MULTI ACCESS key, which allows up to three talk keys to be used simultaneously. Any number of monitor keys may be engaged at any one time. To discontinue conversation on any one line, the instructor may select another talk-listen key or he may depress the RLS (release) key, which unlatches all keys on that particular keyset panel.

Push-to-talk capability is provided at all stations. This is controlled from switches provided in the headset cords, switches on the hand set, or in certain cases, foot switches wired in parallel with the headset switch. A HOLD key is provided at IOS panel 89 to enable hold of any talk-listen key circuit. The buzzer, which signifies an incoming signal in conjunction with the flashing key illumination, may be terminated by the use of the BC/O (buzzer cutoff) key. This also changes the flashing key to a steady illumination.

1.2.13 TRUE TRAINEE ENVIRONMENT OPERATION.

The indicators on IOS panel 2 reflect the actual environmental conditions existing in the flight crew spacesuits and the simulated command module cabin. These indicators display temperature, pressure, humidity, suit air flow, and cabin noise level. The simulator environmental system (to be distinguished from the simulated ECS) controls these various inputs with instructor inputs for suit pressure, and temperature and noise control. Control of the system for maintenance purposes can be accomplished at the environmental control panel mounted on the SCM base, and is indicated by illumination of either or both of the MAN TEMP lights on IOS panel 2.

During training exercises, these environmental conditions are exercised within safe limits under computer control. However, the trainee (or instructor) may desire to dispense with the authenticity of pressure and temperature conditions for the sake of comfort and convenience. In these cases, the instructor may utilize the override controls on the true trainee environment panel. Other situations warranting the use of the suit pressure manual control may result from simulated malfunctions. In the AMS, the condition of cabin depressurization (for example, meteorite strike) is simulated by means of a rapid change from the shirtsleeve environment of a few inches of water

pressure to full pressure. This condition may cause crew discomfort after repeated or prolonged occurrence. The instructor may use the manual control positions to control the pressure of the suits.

The HI position of the SUIT PRESSURE switch will provide 5 psig, while the LO regulates the pressure at 0.5 psig. Any pressure between these limits can be obtained through the use of these controls and maintained using the HOLD position. The INSTR-SERVICE split-level switch-light is used to transfer control between the IOS and the environmental control panel on the SCM base.

The temperature of the SCM will rise to 90°F during a simulated entry. The instructor may reduce this temperature through the use of the RE-ENTRY HEAT OVERRIDE control.

1.2.14 UP-DATA LINK OPERATION.

The up-data link panel, IOS panel 5, enables the instructor to simulate the transmission of data originating at various ground stations. The panel allows the instructor (operating independently of the SCATS-IMCC) to select appropriate systems and transmit the required types of messages to the simulated onboard up-data link. In addition, during navigational sightings the proper information must be relayed to the AMS computer complex via the panel for the supplementary displays reference.

During integrated mission training the instructor is provided the capability of failing or inserting erroneous information being transmitted by SCATS/MSCC.

The non-integrated mode of operation is initiated by activating the alternate-action split-level switch-indicator to the NON INT indication. The following modes are then enabled: the RTC (real time command), G&N (guidance and navigation), CTE (central timing equipment). These switch-lights are interlocked to prevent the selection of more than one system. The KEYBOARD CLEAR switch-light unlatches the selected system, and resets the panel allowing selection of another system.

The first step of UDL operation is to select the desired system and format the proper message. System address is accomplished by depressing the approrpiate key (RTC, G&N, CTE). The message format is signified by the use of the NOUN, VERB, PLUS, MINUS, and the 0-9 keys on the decimal keyboard. The message is transmitted to the computer through the use of the ENTER key after proper formating. Inadvertent errors, occurring through the keyboard, can be rectified through the use of the NON-INTEGRATED-CLEAR switch-light. The KEYBOARD RELEASE switch-light is used to notify the trainee, via the AGC DSKY, that up-data information is imminent. The ERROR RESET switch-light duplicates the function of the ERROR RESET switch on the AGC DSKY via UDL.

The real time commands effective for SE-012 AMS are listed in table 1-6. These commands are inserted by depressing the RTC switch-light, the appropriate numerals on the KEYBOARD panel, and the the ENTER switch-light.

Table 1-6. SE-012 AMS Real Time Commands

Code No.	Command
02	TURNS on C-BAND transponder to 1 pulse mode.
03	TURNS off C-BAND transponder if C-BAND switch on panel 20 is in center position.
04	Turns on VHF/FM transmitter and selects PCM high-bit rate.
05	Turns off VHF/FM transmitter if VHF/FM switch on panel 20 is in OFF position, and selects PCM low-bit rate if the TLM INPUTS - PCM switch on panel 20 is set at LOW position.
21	Turns on A abort request light.
27	Turns on B abort request light.
	NOTE There are no commands for turning off the A or B abort request lights.

The method for updating the central timing is by depressing the CTE followed by the ENTER switch-lights. This action results in the changing of the time displayed on the COMMAND MODULE TIME-GMT display on the left side of the T/M console, to correspond with the time displayed on the MISSION TIME-GMT display on the right side of the T/M console. This action will be necessary after failure of the simulated CTE due to a simulated power failure or malfunctions inserted involving the CTE.

The insertion of G&N commands are accomplished by the actuation of the G&N switch-light followed by successive insertion of the NOUN, VERB, PLUS, MINUS, and the 0-9 keys on the keyboard. Depression of the ENTER switch-light transmits the signal to the computer. The effective G&N VERB-NOUN listing for SE-012 is listed in tables 1-7 and 1-8. The G&N major modes simulated in SE-012 are listed on table 1-9.

During an integrated mission, the instructor has the capability of simulating a complete or temporary failure of the ground to spacecraft transmission link. The depression of the DCS FAIL switch-light results in the complete failure. The FAIL NEXT MESSAGE switch-light will fail only the next message regardless of whether it is an RTC, G&N, or CTE. The number of times the same message is failed depends on the number depressed on the keyboard prior to depressing the FAIL NEXT MESSAGE; only 0 to 7 is effective for this mode. A maximum of 8 successive messages can be transmitted in the AMS. When the message has been transmitted more times then failed, the MESSAGE RECEIVED light illuminates indicating the receipt of the message. The KEYBOARD CLEAR is used to clear the failure mode switch-lights.

Table 1-7. AMS Noun Data Listing (SE-012)

Noun No.	Register	Units	Description
01	R1	XXX.XX degrees	Vehicle flight data angle
	R2	XXXX.X fps	Vehicle velocity
	R3	XXXX.X n mi	Vehicle altitude
02	R1	XXXX.X g's	Max. predicted g's for free fall
	R2	XXXX.X fps	Velocity required for safe orbit insertion
	R3	XX-XX min-sec	Time of free fall to 300K feet
03	R1	XXXX.X fps	Velocity required for safe orbit insertion
	R2	XXXX.X n mi	Free fall miss distance from Indian Ocean recovery area
	R3	XX-XX min-sec	Time of free fall to 300K feet
04	R1	XXX.XX degrees	Angle measured from local vertical to S/C X axis
	R2	Blank	
	R3	Blank	
05	R1	Spare	
	R2	Spare	
	R3	Spare	
06	R1	Spare	
	R2	Spare	
	R3	Spare	
07	R1	XXXX.X g's	Max. predicted g's for free fall
	R2	XXXX.X n mi	Free fall miss distance
	R3	XX-XX min-sec	Time of free fall to 300K feet
10	R1	XXXX.X n mi	Alt. of apogee or perigee
	R2	XXX.XX degrees	Astro. specified latitude of apogee or perigee

Table 1-7. AMS Noun Data Listing (SE-012) (Cont)

Noun No.	Register	Units	Description
	R3	XXX.XX degrees	Astro. specified desired longitude of apogee or perigee
11	R1	XXXXX hr	Time to go to SPS ignition
	R2	XX min	
	R3	XX sec	
12	R1	XXXXX hr	Time of SPS ignition measured from time of epoch.
	R2	XX min	
	R3	XX sec	
13	R1	XXXX.X n mi	Longitude component of predicted splash-down point miss distance
	R2	XXX.XX degrees	Entry path angle
	R3	Blank	
14	R1	XX-XX hr-min	Time since IMU last aligned
	R2	Blank	
	R3	Blank	
15	R1	XX-XX min-sec	Time from now to T-ignition
	R2	XXXX.X fps	Magnitude of V_G required for maneuver
	R3	Blank	
16	R1	XX-XX min-sec	Time remaining for thrusting
	R2	XXXX.X fps	Magnitude of V_G remaining
	R3	Blank	
17	R1	XX-XX min-sec	Time of free fall to 300K feet
	R2	Blank	
	R3	Blank	

Table 1-7. AMS Noun Data Listing (SE-012) (Cont)

Noun No.	Register	Units	Description
20	R1	XXX.XX degrees	Outer ICDU gimbal angle
	R2	XXX.XX degrees	Inner ICDU gimbal angle
	R3	XXX.XX degrees	Middle ICDU gimbal angle
21	R1	XXXXX counts	X PIPA counts
	R2	XXXXX counts	Y PIPA counts
	R3	XXXXX counts	Z PIPA counts
22	R1	XXX.XX degrees	Desired ICDU gimbal angle
	R2	XXX.XX degrees	Desired ICDU gimbal angle
	R3	XXX.XX degrees	Desired ICDU gimbal angle
23	R1	Spare	
	R2	Spare	
	R3	Spare	
24	R1	Spare	
	R2	Spare	
	R3	Spare	
25	R1	XXXXX code (octal)	Checklist code
	R2	Blank	
	R3	Blank	
26	R1	XXXX min-sec	Time to go to SPS cutoff
	R2	XXXX.X fps	Velocity to be gained
	R3	XXXX min-sec	Time of free fall to 300K feet
27	R1	XXXX min-sec	Time for now to SPS ignition
	R2	XXXX.X fps	Velocity to be gained

Table 1-7. AMS Noun Data Listing (SE-012) (Cont)

Noun No.	Register	Units	Description
	R3	XXXX min-sec	Time of free fall to 300K feet
30	R1	XXXXX code (decimal)	Star code
	R2	Blank	
	R3	Blank	
31	R1	XXXXX code (octal)	Failure
	R2	Blank	
	R3	Blank	
32	R1	XXXX. X fps	Velocity required for safe orbit insert
	R2	XX-XX min-sec	Time from now to ΔT-ignition
	R3	XX-XX min-sec	Time of free fall to 300K feet
33	R1	XXXX. X fps	Velocity required for safe orbit insert
	R2	XX-XX min-sec	Time remaining for thrusting
	R3	XX-XX min-sec	Time of free fall to 300K feet
34	R1	XXXX min-sec	Time remaining for thrusting
	R2	XXXX. X fps	Velocity required to be gained
	R3	Blank	Please perform enter
35	R1	XXXX. X n mi	ΔR miss distance along ground track
	R2	XXXX. X fps	ΔV reqd for safe orbit insertion
	R3	XXXX min-sec	Time of free fall to 300K feet
36	R1	XXX. XX degrees	Landmark data - latitude, known landmass data
	R2	XXX. XX degrees	Landmark data - longitude, known landmass data
	R3	Blank	

Table 1-7. AMS Noun Data Listing (SE-012) (Cont)

Noun No.	Register	Units	Description
37	R1	Blank	Unknown landmass data
	R2	Blank	
	R3	Blank	
40	R1	XX-XX min-sec	Time from now to T-ignition
	R2	XXXX.X n mi	Free fall miss distance from recovery area
	R3	XX-XX min-sec	Time of free fall to 300K feet
41	R1	XX-XX min-sec	Time remaining for thrusting maneuver
	R2	XXXX.X n mi	Free fall miss distance from recovery area
	R3	XX-XX min-sec	Time of free fall to 300K feet
42	R1	XXXX.X fps	ΔV counter (from back-up ΔV counter routine)
	R2	Blank	
	R3	Blank	
43	R1	X.XXXX degrees	Fine alignment data bad
	R2	X.XXXX degrees	
	R3	X.XXXX degrees	
44	R1	X.XXXX degrees	Fine alignment data good
	R2	X.XXXX degrees	
	R3	X.XXXX degrees	
45	R1	Spare	
	R2	Spare	
	R3	Spare	
46	R1	XXXXX hr	Astro. desires to know lat. and long. at this time.

Table 1-7. AMS Noun Data Listing (SE-012) (Cont)

Noun No.	Register	Units	Description
	R2	XX min	
	R3	XX sec	
47	R1	XXX.XX degrees	Inclination of orbit
	R2	XX-XX min-sec	Time to arrival of inclination
	R3	Blank	
50	R1	Blank	Two nav. stars not available due to vehicle attitude
	R2	Blank	
	R3	Blank	
51	R1	XXX.XX degrees	Star test routine; difference between actual and indicated angles > test tolerance
	R2	XXX.XX degrees	
	R3	XXX.XX degrees	
52	R1	Blank	Minimum number of required marks not made
	R2	Blank	
	R3	Blank	
53	R1	Blank	More than required number of marks not made
	R2	Blank	
	R3	Blank	
54	R1	Blank	
	R2	Blank	
	R3	Blank	
55	R1	XXX.XX degrees	

Table 1-7. AMS Noun Data Listing (SE-012) (Cont)

Noun No.	Register	Units	Description
	R2	XXX.XX degrees	
	R3	Blank	
56	R1	XXX.XX degrees	Sextant shaft angle
	R2	XXX.XX degrees	Sextant trunnion angle
	R3	XX-XX min-sec	Time at receipt of mark
57	R1	XXX.XX degrees	Commanded bank angle
	R2	XXXX.X n mi	Free fall miss distance from recovery area
	R3	XXXX.X g's	Max. predicted g's in free fall
60	R1	XXXX.X n mi	Predicted lateral range error
	R2	XXXX.X n mi	Predicted free fall miss distance
	R3	XXXX.X g's	Predicted max. g's in free fall
61	R1	XXXX.X fps	ΔVelocity for contingency orbit insertion in 125 sec
	R2	XXXX.X n mi	Free fall miss distance from discrete recovery area
	R3	XX-XX min-sec	Time of free fall to 300K feet
62	R1	XXX.XX degrees	Desired geocentric latitude
	R2	XXX.XX degrees	Desired geocentric longitude
	R3	XXXX.X n mi	Desired altitude
63	R1	Blank	
	R2	Blank	
	R3	Blank	
64	R1	Blank	
	R2	Blank	
	R3	Blank	

Table 1-7. AMS Noun Data Listing (SE-012) (Cont)

Noun No.	Register	Units	Description
65	R1	XXX.XX degrees	Desired geocentric latitude
	R2	XXX.XX degrees	Desired geocentric longitude
	R3	Blank	
66	R1	XXXX.X fps	ΔV allowable
	R2	XXXX.X fps	ΔV tail-off
67	R1	Spare	
	R2	Spare	
	R3	Spare	
70	R1	Blank	Time to ignition has been passed
	R2	Blank	
	R3	Blank	
71	R1	XX-XX hr-min	Time
	R2	XXX.XX degrees	Lat. at specified time
	R3	XXX.XX degrees	Long. at specified time
72	R1	Blank	Major mode incompatibility
	R2	Blank	
	R3	Blank	
73	R1	XXX.XX degrees	Δ Pitch trim
	R2	XXX.XX degrees	Δ Yaw trim
	R3	Blank	
74	R1	Spare	
	R2	Spare	
	R3	Spare	

Table 1-7. AMS Noun Data Listing (SE-012) (Cont)

Noun No.	Register	Units	Description
75	R1	XXX.XX degrees	Lat. of splash-down point
	R2	XXX.XX degrees	Long. of splash-down point
	R3	Blank	
76	R1	Blank	
	R2	Blank	
	R3	Blank	
77	R1	Blank	
	R2	Blank	
	R3	Blank	

Table 1-8. AMS Verb Listing (SE-012)

Verb No.	Description
01	Display octal component No. 1 only
02	Display octal component No. 2 only
03	Display octal component No. 3 only
04	Display octal components No. 1 and No. 2
05	Display octal components No. 1, No. 2, and No. 3
06	Decimal display all components
07	
10	
11	
12	
13	
14	
15	
16	Monitor to decimal all components
17	
20	
21	Load first component from R1
22	Load second component from R2
23	Load third component from R3
24	Load first and second components from R1 and R2
25	Load first, second, and third components from R1, R2, and R3
26	
27	
30	

Table 1-8. AMS Verb Listing (SE-012) (Cont)

Verb No.	Description
31	Bank displays
32	Bump displays
33	Proceed without data
34	Terminate
35	
36	
37	Change major mode
40	
42	
43	
44	
45	
46	
47	Ground track determination routine
50	Please perform
51	Please mark
52	Mark reject
53	
54	
55	AGC clock increment
56	
57	
60	
61	
62	
63	
64	
65	
66	
67	
70	
71	
72	
73	Return to earth aim point update
74	Orbit change aim point update
75	Set lift-off discrete
76	State vector update
77	

The DATA DISPLAY switch-light is used to insert the identification of the star(s) and/or landmarks that the trainee has orally reported, to the instructor, he is observing with the sextant or telescope. The format to be used is as follows:

When sighting on a single star, the VERB switch-light is depressed followed by 01, and then entered using the ENTER switch-light. Following this, the three-digit number representing the selected star is entered.

When sighting between two stars, the VERB and 02 is entered. The number for the first star is entered, followed by the number for the second star. The stars with their code numbers are listed in table 1-10.

The VERB and 03 is entered when a sighting on an earth landmark is being made. The three-digit landmark number is then entered. The earth landmarks and their associated numbers are listed in table 1-11.

When sighting on a lunar landmark, the VERB and 05 is entered, followed by the three-digit number for the corresponding landmark. Table 1-12 lists the lunar landmarks and their numbers.

When a sighting between a star and lunar landmark is being performed, the VERB and 06 is entered, followed by the entering of the selected star number. The selected landmark number is then entered.

1.2.15 MALFUNCTION INSERTION UNIT.

Procedures for malfunction insertion are grouped under three topic subjects: manual malfunction insertion, preprogramed malfunction insertion, and time-dependent malfunction insertion. The operation of the malfunction insertion unit (MIU), in relation to each of these categories, is also described in general terms. For a functional description of the MIU, refer to section 1 of Volume I.

1.2.15.1 Manual Malfunction Insertion.

The following discussion of operating procedures entails use of controls and displays described in section 1 of Volume I. Operation of the MIU involves two basic manipulations: malfunction insertion and malfunction clear. Status indications exist only to the extent of notifying the instructor-operator that a specific malfunction has or has not been entered into the computer program. This indication may be printed out on the line printer prior to the start of a mission exercise, or displayed on the MIU display panel during a mission exercise. In the case of a time-dependent malfunction, an impending indication of the malfunction occurs at the display panel at a preset time prior to activation.

In many cases a given simulated malfunction requires the programing of more than one malfunction code. Where such is the case, each malfunction code is inserted and entered in the same manner as separate malfunctions.

Malfunction Insertion.

The instructor-operator must follow the outlined procedure for use of the MIU control panel. The system is designed to prevent errors and notify the instructor-operator when an error in procedure has occurred. To insert a malfunction into the computer program, the instructor selects an indicator display on the display panel. This is done by depressing any one of the nine DISPLAY switches. The tenth display (No. 10) is reserved for display of preprogramed time-dependent malfunctions. This action causes the selected

Table 1-9. AGC Major Modes (SE-012)

Mission Phase	Major Mode Display	Major Mode
	00	AGC idling
Prelaunch	02	Gyrocompassing
	04	Inertial reference
Booster Monitor	11	Pre LET jettison
	12	Post LET jettison
Coast	21	CSM local vertical
	22	Landmark tracking
	23	Star/landmark or horizon sighting
	27	AGC update (ground)
Prethrusting	31	Orbit change
	32	Return to earth
Thrusting	41	Orbit change
	42	Return to earth
	46	G&N standby SPS monitor
	47	G&N standby RCS monitor
Inflight Alignment	51	IMU orientation determination (S-IVB or CSM)
	52	S-IVB/IMU align
	53	CSM/IMU align
Entry	61	CM/SM separation maneuver
	62	CM/SM separation and pre-entry maneuver
	63	Post 0.05 g phase
	65	Pre-final phase
	66	Final phase
CSM Abort	71	First abort phase
	72	Abort mode selection
	73	Thrust to discrete recovery area
	74	Contingency orbit insertion

Table 1-10. AMS Navigation Stars

UDL Code No.	Generic Name	Star Name	Magnitude	Right Ascension	Declination
001	αAndromedae	Alpheratz	2.1	0:06:28.2	+28°53'10"
002	βCeti	Deneb Kaitos	2.2	0:41:43.9	-18°11'22"
003	αEridani	Achernar	0.6	1:36:20.3	-57°25'28"
004	αUrsae Minoris	Polaris	2.1	1:57:53.8	+89°5'33"
005	αArietis	Hamal	2.2	2:05:04.9	+23°17'18"
006	αFornax	Alpha Fornax	3.9	3:10:29.9	-29°7'55"
007	αPersei	Marfak	1.9	3:21:40.2	+49°43'52"
008	αTauri	Aldebaran	1.1	4:33:47.7	+16°26'11"
009	αCanis Majoris	Sirius	-1.6	6:43:31.1	-16°39'50"
010	βGeminorum	Pollux	1.2	7:43:03.3	+28°7'2"
011	γVelorum	Gamma Velorum	1.9	8:08:23.5	-47°13'37"
012	αCarinae	Mioplacidus	1.8	9:12:48.2	-69°33'53"
013	αHydrae	Alphard	2.2	9:25:46.1	-8°29'51"
014	αLeonis	Regulus	1.3	10:06:24.2	+12°8'55"
015	αUrsae Majoris	Dubhe	1.9	11:01:27.6	+61°57'4"
016	γCentauri	Gamma Centauri	2.4	12:39:28.0	-48°45'25"
017	αVirginis	Spica	1.2	13:23:14.4	-10°58'8"
018	ηUrsae Majoris	Alkaid	1.9	13:46:05.0	+49°29'50"
019	αBootis	Arcturus	0.2	14:13:58.4	+19°22'27"
020	αCentauri	Rigil Kentaurus	0.1	14:37:04.3	-60°41'2"
021	αScorpii	Antares	1.2	16:27:08.1	-26°21'6"
022	αOphiuchi	Rasalhague	2.1	17:33:12.9	+12°35'8"
023	αLyrae	Vega	0.1	18:35:41.1	+38°44'53"
024	βCapricornus	Beta Capricornus	3.2	20:18:56.0	-14°53'59"
025	αPavonis	Peacock	2.1	20:22:43.9	-56°51'20"
026	αCygni	Deneb	1.3	20:40:10.1	+45°8'50"
027	εPegasi	Enif	2.5	21:42:22.0	+9°42'16"
028	αPiscis Aistrini	Fomalhaut	1.3	22:55:36.6	-29°49'8"

Table 1-11. Earth Landmarks

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
1	Cape Receife south of Port Elizabeth in Algoa Bay	S 34° 02'	E 25° 42'	1421	South Africa	001
2	Cape St. Francis southwest of Port Elizabeth in St. Francis Bay	S 34° 12'	E 24° 50'	1421	South Africa	002
3	Cape Agulhos southmost tip of South Africa	S 34° 50'	E 20° 01'	1422	South Africa	003
4	Cape of Good Hope	S 34° 21'	E 18° 29'	1422	South Africa	004
5	Northernmost tip of coast in St. Helena Bay at a town called "Stompneusbaai"	S 32° 42'	E 17° 58'	1422	South Africa	005
6	Tip of southern bank at mouth of the Orange River	S 28° 38'	E 16° 27'	1396	South Africa	006
7	Northern tip of the peninsula at the City of Durban	S 29° 52'	E 31° 03'	1398	South Africa	007
8	Southern tip of peninsula at the town of Richards Bay	S 28° 48'	E 32° 05'	1398	South Africa	008
9	Westernmost peninsula located in Luderitz Bay	S 26° 38'	E 15° 05'	1302	Southwest Africa	009
10	"Pelican Point" in Walvin Bay	S 22° 53'	E 14° 26'	1273	Southwest Africa	010
11	Western tip of Kilwa Island located in Lake Mweru	S 09° 15'	E 28° 29'	1055	Southwest Africa	012
12	Southern tip of island called "Nosey Mangabe" in northern part of bay called "Baie Antongil"	S 15° 31'	E 49° 46'	1156	Southwest Africa	013
13	Southern tip of the island called "Ile Saint-Marie" at the town of Talavia	S 17° 07'	E 49° 49'	1173	Southwest Africa	014
14	"Pointe Fenambosy" location on the spit of land enclosing the bay called "Baie De Fenembasy"	S 25° 15'	E 44" 21'	1297	Southwest Africa	015
15	Northern tip of the peninsula called "Cape Lopez" location in bay called "Baie Du Cap Lopez"	S 00° 37'	S 08° 43'	936	French Colonial Territory	016
16	Extreme tip of sand bar beyond city of Mayoumba	S 03° 23'	E 10° 40'	936	French Colonial Territory	017
17	Northern tip of the shoreline in estuary called "Estuaire Du Gabon"	N 00° 21'	E 09° 21'	905	French Colonial Territory	018
18	Tip of peninsula in the harbor of Pointe Noire	S 04° 46'	E 11° 49'	1027	French Congo	019

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
19	Westernmost tip of the peninsula about 3 statute miles northwest of Dakar	N 14° 44'	W 17° 32'	697	French West Africa	020
20	Southeastern tip of the island of Anjouan	S 12° 22'	E 44° 30'	1155	French West Africa	021
21	Northern tip of the peninsula in Lake Tanganyika about 2 statute miles north of the town Manga	N 04° 03'	E 29° 14'	1030	French West Africa	026
22	Southern tip of the peninsula called "Cap Blanc"	N 20° 46'	W 17° 03'	575	Mauritania	028
23	Fuawi Point on the west coast of Lake Nyasa	S 12° 56'	E 34° 19'	1154	Rhodesia and Myasaland	029
24	Western tip of Boadzula Island in the southern port of Lake Nyasa	S 14° 16'	E 35° 08'	1154	Rhodesia and Myasaland	030
25	Western tip of Sherbro Island at the town of Kambia	N 07° 34'	W 12° 57'	818	Sierra Leone	032
26	Northwesternmost tip of the coastline about 3 statute miles west of Freetown	N 08° 30'	W 13° 17'	780	Sierra Leone	033
27	Northernmost shoreline of the largest island in the middle of Lake Zuai	N 07° 57'	E 38° 52'	810	British Cameroons	035
28	Any point on the shoreline of the island called Daga in the lake called "T'Ana"	N 11° 53'	E 37° 18'	789	British Cameroons	037
29	Some point at the city of Bathurst	N 13° 27'	W 16° 35'	697	Gambia	038
30	Southern tip of the westernmost island in the group of islands called "Iles De Los" 6 statute miles west of Conakry	N 09° 27'	W 13° 50'	780	Guinea	039
31	Southern tip of a sand bar called "Ponta Da Macaneta	S 25° 52'	E 32° 45'	1299	Guinea	040
32	Southern tip of the peninsula jutting into bay called "Baia De Inhambane"	S 23° 44'	E 35° 25'	1276	Guinea	041
33	Northern tip of the island called "Ilha De Bazaruta"	S 21° 31'	E 35° 29'	1276	Guinea	042
34	Shoreline at mouth of river "Rio Pungue" near the town of Beira	S 19° 51'	E 34° 50'	1176	Guinea	043
35	Highest point (9760 ft) on the island of Fogo	N 14° 57'	W 24° 21'	699	Cape Verde Island	044

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
36	Northern tip of a large spit of land called "Punta Da Marca"	S 16° 31'	E 11° 42'	1179	Cape Verde Island	045
37	Tip of the sand bar in the Harbor of Luanda	S 08° 45'	E 13° 16'	1057	Cape Verde Island	046
38	Northern tip of a peninsula jutting into the mouth of the Congo River, town of Santa Antonia Da Zaire	S 06° 04'	E 12° 20'	1027	Cape Verde Island	047
39	Either southern tip of peninsula across Rusinga Channel at mounth of Kavirondo Gulf or northern tip of Rusinga Island	S 00° 24'	E 34° 17'	932	Kenya	049
40	Northern tip of South Island which is located in Lake Rudolf	N 02° 38'	E 36° 37'	910	Kenya	050
41	Northernmost shoreline of North Island in Lake Rudolf	N 04° 05'	E 36° 02'	810	Kenya	051
42	Cape Rhir on the coast of Morocca	N 30° 37'	W 09° 54'	454	Morocco	052
43	Western tip of Goba Island in Lake Tanganyika	S 06° 28'	E 29° 50'	1030	Zanzibar and Tanganyika	053
44	Eastern tip of Akerewe Island opposite the town of Rugenzi Ukerewe Island located in Lake Victoria	S 02° 06'	E 33° 12'	932	Zanzibar and Tanganyika	054
45	Northern tip of Mafia Island about 7.5 statute miles north of the town Kanga	S 07° 38'	E 39° 55'	1031	Zanzibar and Tanganyika	055
46	Northern tip of Zanzibar Island at the town of Mwanda	S 05° 44'	E 39° 18'	1031	Zanzibar and Tanganyika	056
47	Northern tip of Pemba Island about 3.5 statute miles north of the town of Miperan	S 04° 53'	E 39° 41'	1031	Zanzibar and Tanganyika	057
48	Southernmost tip of the island of La Palma at the point called "Punta De La Fuencaliente"	N 28° 27'	W 17° 50'	455	Canary Islands (Spain)	058
49	Westernmost tip of the island of Tenerife about 2.5 statute miles west of the town called "Buenavista"	N 28° 20'	W 16° 55'	455	Canary Islands	059
50	Easternmost tip of the island of Tenerife about 2 statute miles north of the town "Igueste"	N 28° 35'	W 16° 07'	455	Canary Islands	060

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
51	Northernmost tip of the island of Gran Canaria at the port of the city of "Las Palmas"	N 28° 11'	W 15° 24'	455	Canary Islands	061
52	Southernmost tip of the island called "Isle De Fuerteventura" at the point called "Punta De Jandla"	N 28° 04'	W 14° 30'	455	Canary Islands	062
53	Southern tip of peninsula called "Peninsula De Yala" at point called "Punta Durnford"	N 23° 40'	W 16° 02'	575	Spanish Sahara	063
54	Northwestern tip of a compound spit at a point called "Punta Carducci" The spit is called "Penisoha Di Hafun"	N 10° 33'	E 51° 10'	791	Somali Republic	064
55	Cabo De Vela on a peninsula called "De Guajura" in northern Columbia	N 12° 13'	W 72° 10'	707	Columbia	065
56	Southwestern tip of an island called "Isle De Baru". It is one of the group of islands called "Islas De El Rosario"	N 10° 08'	W 75° 42'	770	Columbia	066
57	Cape called "Cabo Corrientes" located in the Gulf of Panama	N 05° 29'	W 77° 33'	829	Columbia	067
58	Southern tip of a cape called "Cabo Marzo" located in the Gulf of Panama	N 06° 51'	W 77° 42'	829	Columbia	068
59	Cape called "Cabo Cadera" east of the city of Caracas	N 10° 35'	W66" 03'	771	Venezuela	075
60	Eastern tip of an island called "Enterprise" (Leguan) at the mouth of the Essequibo River	N 06° 57'	W 58° 20'	826	Venezuela	077
61	Town opposite the airport called "Los Perales" at the entrance to the bay called "Bahia De Caraquez"	S 00° 36'	W 80° 25'	951	Ecuador	080
62	Tip of coast called "Ponta Da Baleia" northeast of the town Armacao	S 17° 42'	W 39° 08'	1189	Brazil	081
63	Southeastern tip of "Ilha De Sao Sebastiaa"	S 25° 58'	W 45° 15'	1262	Brazil	082
64	Small island called "Cabo Frio" east of a large sand bar about 80 statute miles due east of Rio De Janeiro	S 23° 00'	W 41° 59'	1263	Brazil	083

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
65	Point of land on the southern bank of the mouth of the Paraiba River at the town of Atafona	S 21° 37'	W 41° 01'	1263	Brazil	084
66	Point of land at the mouth of a river near the town of Espirito Santo De Vitoria	S 20° 19'	W 40° 16'	1263	Brazil	085
67	Mouth of the canal "De Sao Goncato east of the city of Pelotas	S 31° 47'	W 52° 14'	1384	Brazil	086
68	Either Santa Rita Airport (runway 6500 ft) or tip of the peninsula at town of Gabedelo	S 06° 58'	W 34° 50'	1018	Brazil	088
69	Ponta Manguinho located at the mouth of the San Francisco River	S 10° 31'	W 36° 24'	1066	Brazil	090
70	Southern tip of Salvador City located in the bay called "Bahia De Todos Os Santos"	S 13° 01'	W 38° 33'	1141	Brazil	091
71	Pinto Martins Airport (runway 6900 ft) or tip of Ponta Da Muciripe near Fortaleza on northeastern coast of Brazil	S 03° 42'	W 38° 28'	944	Brazil	095
72	Punta Das Desertes located in the northern section of the lake "Dos Patos"	S 30° 26'	W 50° 54'	1384	Brazil	096
73	Western edge of sand bar where railroad bridge crosses the lagoon called "Lagoa Imarui"	S 28° 26'	W 48° 50'	1384	Brazil	097
74	Southern tip of a sand bar eastern side of the lagoon called "Lagoa Dos Patos" located south of the town "Pontal Da Barra" at a breakwater	S 32° 09'	W 52° 04'	1433	Brazil	098
75	Tip of coastline jutting into bay Bahia De Sechuro called "Punta Aguja"	S 05° 47'	W 81° 04'	1011	Peru	099
76	Tip of coast called "Punta Parinas" near the town of Negritos located south of a large oil field	S 04° 40'	W 81° 20'	1011	Peru	100
77	Punta Lachay near the town of Las Salinas	S 11° 18'	W 77° 39'	1073	Peru	101
78	Southern tip of peninsula in the bay Bahia De Samanco	S 09° 14'	W 78° 34'	1073	Peru	103

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
79	Tip of the peninsula jutting out from the city of Lima off the island of San Lorengo	S 12° 04'	W 77° 10'	1135	Peru	104
80	Island called "Isla San Gallan" west of the peninsula Paracas	S 13° 50'	W 76° 27'	1135	Peru	105
81	Punta Parada located on the south shore of San Juan Bay	S 15° 22'	W 75° 12'	1135	Peru	106
82	Punta Tinaja located on the coast near Pan American Highway	S 16° 15'	W 76° 43'	1194	Peru	107
83	Punta Coles near Ilo Airport and south of the town Ilo	S 17° 43'	W 71° 23'	1194	Peru	108
84	Isla De Panza in the lake called "Lago De Poopo" northwestern tip of the island	S 18° 43'	W 67° 12'	1195	Bolivia	109
85	Northern tip of peninsula in Lake Titicaca opposite the island called "Isla De Titicaca"	S 16° 03'	W 69° 08'	1194	Bolivia	110
86	Southern tip of Punta Del Este south of San Carlos about 85 statute miles due east of Montevideo	S 34° 58'	W 54° 57'	1433	Uruguay	111
87	Southern tip of peninsula jutting out from San Diego Harbor	N 32° 39'	W 117° 14'	404	Unites States	113
88	Northern tip of Santa Catalina Island	N 33° 28'	W 118° 36'	404	United States	114
89	Where runways meet with tip of peninsula south of Port Royal off Coast of South Carolina	N 32° 18'	W 80° 40'	409	United States	116
90	Tip of off shore sand bar called "Cape Lookout" off coast of North Carolina	N 34° 35'	W 76° 32'	410	United States	117
91	Southern tip of Cape Fear a cuspate delta in the mouth of Cape Fear river near Wilmington, North Carolina	N 33° 51'	W 77° 58'	410	United States	118
92	Airport (Schales Field) on Galveston Island in Gulf of Mexico off the coast of Texas	N 29° 16'	W 94° 51'	468	United States	119
93	Tip of point jutting into bay near Corpus Christi, Texas	N 27° 41'	W 97° 14:5'	522	United States	125

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
94	Westernmost tip of Key West Island	N 24° 32.5'	W 81° 48'	525	United States	127
95	Southern tip of break in off-shore bar at Biscayne Bay off east coast of Florida	N 25° 40'	W 80° 09'	525	United States	128
96	Tip of Cabo Haro (southern tip) near Guaymas in Gulf of California	N 27° 50'	W 110° 53'	520	Mexico	130
97	Tip of Punta Falsa off Lower California in North Pacific Ocean	N 27° 51'	W 115° 05'	519	Mexico	131
98	Tip of Punta Abreojos off Lower California in North Pacific Ocean	N 26° 43'	W 113° 37'	520	Mexico	132
99	Punta Tosca, southern tip of Isle Magdalena off Lower California in North Pacific Ocean	N 24° 19'	W 111° 42'	520	Mexico	133
100	Tip of peninsula in Bahia De La Paz near La Paz	N 24° 11'	W 110° 19:5'	520	Mexico	134
101	Tip of Cabo San Lucas at head of Lower California	N 22° 52'	W 109° 54'	591	Mexico	136
102	Southern tip of Mazatlan on West Coast of Mexico	N 23° 11'	W 106° 25'	590	Mexico	137
103	Lighthouse at Cabo Corrientes on western coast of Mexico	N 20° 25'	W 105° 42.5'	590	Mexico	138
104	Mouth of Rio Panuoo near Tampico on eastern coast of Mexico	N 22° 16'	W 97° 48'	589	Mexico	139
105	Point of land jutting into the Pacific Ocean called "Cabo Santa Elena"	N 10° 54'	W 85° 58'	768	Costa Rica	144
106	Peninsula off western coast of Costa Rica at point called "Cabo Blanco," flashing light 2 miles off shore	N 09° 34'	W 85° 07'	768	Costa Rica	145
107	Tip of peninsula in bay called "Bahia Charco Azul" point at peninsula called "Punta Burica"	N 08° 02'	W 82° 52'	768	Costa Rica	146
108	Spit of land in Balboa Harbor in Panama City	N 08° 53'	W 79° 32'	769	Costa Rica	147
109	Eastern tip of the island Isla Coiba called "Punta Anegade" western coast of peninsula De Azuero	N 07° 20'	W 81° 36'	830	Costa Rica	148
110	Tip of Cabo De Tres Puntas in Gulf-of Honduras	N 15° 57'	W 88° 37'	710	Guatemala	149

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
111	Western tip of Grand Bahama Island at the west end of settlement	N 26° 41'	W 79° 00'	526	Bahama Island	153
112	Simms Point of New Providence Island	N 25° 02'	W 77° 35'	526	Bahama Islands	154
113	Powell Point on Eleuthera Island about 6 statute miles northwest of Free Town	N 24° 52'	W 76° 20'	526	Bahama Islands	155
114	Northern tip of Eleuthera Island about 5 statute miles northwest of Gregory Town opposite northern Eleuthera Island	N 25° 26'	W 76° 36'	526	Bahama Islands	156
115	Southern tip of Long Island at a point called "Cape Verde"	W 22° 51'	W 76° 51'	585	Bahama Islands	157
116	Columbus Point at the southern tip of Cat Island	N 24° 08'	W 75° 16'	526	Bahama Islands	158
117	Southern tip of Castle Island about 4 statute miles south of Acklins Island	N 22° 07'	W 74° 20'	585	Bahama Islands	159
118	Southwest point of Mayaguana Island	N 22° 22'	W 73° 11'	585	Bahama Islands	160
119	Northwest Point on Great Inagua Island	N 21° 07'	W 75° 40'	585	Bahama Islands	161
120	Any point on the southern tip of Grand Turk Island	N 21° 26'	W 71° 9'	585	West Indies (UK)	162
121	Western tip of the sand bar outside the city of Kingston in Jamaica	N 17° 56'	W 76° 51'	647	West Indies	163
122	South Negril Point on the western tip of Jamaica Island	N 18° 16'	N 78° 22'	647	West Indies	164
123	Westernmost tip of Anguilla Island	N 18° 10'	W 63° 11'	649	West Indies	165
124	Highest point (3596 ft) on Nevis Island	N 17° 09'	W 62° 34'	649	West Indies	166
125	Northeastern tip of Trinidad at Galera Point	N 10° 50'	W 60° 54'	772	West Indies	167
126	Galeota Point southeastern extremity of Trinidad Island 3.5 statute miles southeast of the town Guayaguayere	N 10° 08'	W 60° 59'	772	West Indies	168
127	Any feature on Grand Cayman Island such as Conch Point	N 19° 23'	W 81° 22'	646	West Indies	169
128	Any point in the mouth of Guantanamo Bay	N 19° 54'	W 75° 10'	585	Cuba	170
129	Western tip of Ile de la Tortue called "Pointe Quest"	N 20° 04'	W 72° 59'	585	Haiti	171

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
130	Cabo Falso in the bay called "Bahia de las Aguilas" on the island of Hispaniola	N 17° 46'	W 71° 42'	648	Hispaniola	172
131	Any point on the tip of land called "Cabro Cabron" in the Dominican Republic	N 19° 21'	W 69° 12'	648	Dominican Republic	173
132	Southwestern tip of Puerto Rico at a point called 'Cabo Rojo"	N 17° 56'	W 67° 12'	648	Puerto Rico	174
133	Westernmost tip of Puerto Rico at the point called "Punta Higuera"	N 18° 22'	N 67° 16'	648	Puerto Rico	175
134	Some feature in the harbor of San Juan	N 18° 28'	W 66° 07'	648	Puerto Rico	176
135	Eastern tip of Grande-Terre Island at a point called "Pointe des Chateaux"	N 16° 15'	W 61° 11'	649	Guadaloupe (France)	177
136	Tip of the peninsula on the eastern coast of Martinique about 6.5 statute miles east of the town of La Trinite	N 14° 46'	W 60° 53'	705	Windward Islands	178
137	Hawaii Island at a point called "Ka Heiauo Kalalea" (South Cape)	N 18° 55'	W155° 41'	634	Hawaii	179
138	Eastern tip of Hawaii Is at a point called "Cape Kumukahi"	N 19° 31'	W 154° 49'	634	Hawaii	180
139	"Kaena Point" on the western tip of Oahu Island	N 21° 34'	W 158° 17'	599	Hawaii	181
140	"Cape Halawa" on the eastern tip of Molahai Island	N 21° 09'	W 156° 43'	599	Hawaii	182
141	Northernmost tip of Kangaroo Island at Point Marsden 60 miles southwest of the City Adelaide	S 35° 34'	E 137° 38'	1458	Australia	183
142	Southwest tip of Yorke Peninsula at Corny Point	S 34° 54'	E 137° 00'	1458	Australia	184
143	Southwest tip of Coffin Bay Penninsula at Point Widbey	S 34° 35'	E 136° 06'	1458	Australia	185
144	Southwest tip of Kangaroo Island at Cape Du Conedie	S 36° 04'	E 136° 41'	1468	Australia	186
145	Northern tip of Wardang Island at Island Point	S 34° 27'	E 137° 22'	1458	Australia	187
146	Any port at either Port Augusta or Port Augusta West	S 32° 29'	E 137° 46'	1458	Australia	188
147	Sugarload Point approximately 110 n mi northeast of Sidney	S 32° 26'	E 152° 31'	1456	Australia	189
148	Point at the city of Sidney such as Port Jackson or Cape Banks	S 33° 51'	E 151° 17'	1456	Australia	190

Table 1-11. Earth Landmarks (Cont)

T/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
149	Southernmost tip of Cape Arid southeast of Tagon Harbour and southwest of Sandy Bight	S 34° 02'	E 123° 09'	1460	Australia	191
150	Cape Le Grand southeast of Esperance Bay southeast of Mississippi Bay	S 34° 00'	E 122° 05'	1460	Australia	192
151	Any point at the city of Albany in King George Sound	S 35° 02'	E 117° 55'	1461	Australia	193
152	Cape Naturaliste located in Geographe Bay	S 33° 32'	E 115° 00'	1461	Australia	194
153	Cape Leeuin at Flinders Bay	S 34° 23'	E 115° 08'	1461	Australia	195
154	Mouth of Swan River at the City of Perth	S 32° 03'	E 115° 44'	1461	Australia	196
155	Northern tip of a lagoon at a town called "Ballina"	S 28° 52'	E 153° 35'	1357	Australia	197
156	Cape Peron at the northern tip of Peron Peninsula between Dirk Hartog Island on the mainland	S 25° 32'	E 113° 29'	1346	Australia	198
157	Southern tip of Dorre Island at a point called "Cape St Cricq"	S 25° 18'	E 113° 05'	1346	Australia	199
158	Pointe Lookout which is the northeastern tip of North Stradbroke Island	S 27° 25'	E 153° 33'	1340	Australia	200
159	Cape Moreton which is the northeastern tip of Moreton Island	S 27° 02'	E 153° 28'	1340	Australia	201
160	Double Island Point located at Wilde Bay	S 25° 56'	E 153° 11'	1340	Australia	202
161	Sandy Cape located at the northern tip of Fraser Island	S 24° 42'	E 153° 16'	1340	Australia	203
162	Easternmost point at the tip of "North West Cape"	S 21° 49'	E 114° 111	1229	Australia	204
163	Northwestern tip of Legendre Island	S 20° 21'	E 116° 50'	1229	Australia	205
164	Pasco Island located off southern tip of Barrow Island	S 20° 58'	E 115° 21'	1229	Australia	206
165	Northern tip of South Island which is one of the Percy Islands	S 21° 43'	E 150° 21'	1235	Australia	207
166	Gantheaume Point just north of Roebuck Bay	S 17° 59'	E 122° 10'	1223	Australia	208
167	Cape Bowling Green in the northern tip of a sandbar	S 19° 19'	E 147° 25'	1219	Australia	209

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
168	Eastern tip of Great Palm Island one of the Palm Islands off the eastern coast of Australia	S 18° 46'	E 146° 42'	1219	Australia	210
169	Cape Ford located southwest of Anson Bay	S 13° 26'	E 129° 53'	1109	Australia	211
170	Cape Hay located southwest of Hyland Bay	S 14° 03'	E 129° 28'	1109	Australia	212
171	Any point at the city of Darwin	S 28° 12'	E 130° 51'	1109	Australia	213
172	Southwest tip of Maria Island located in Limmen Bight	S 14° 55'	E 135° 41'	1110	Australia	214
173	Southern tip of Duifhen Point on the western coast of Cape Yorke Peninsula	S 12° 33'	E 141° 39'	1111	Australia	215
174	Cape Direction located east of Lloyd Bay	S 12° 51'	E 143° 32'	1111	Australia	216
175	Cullen Point at a bay called Port Musgrave on west coast of Cape Yorke Peninsula	S 11° 58'	E 141° 55'	1097	Australia	217
176	Cape Croker on the northern tip of Croker Island	S 10° 57'	E 132° 36'	1099	Australia	218
177	Northeast Point on Christmas Island	S 10° 24'	E 105° 45'	1103	Australia	219
178	Tandjoeng Poerwa at western tip of island called "Shiereiland Poerwa"	S 08° 45'	E 114° 21'	1102	Indonesia	220
179	Northern tip of peninsula called "Tandjoeng Samboeloengan" north of Schiereiland Poerwa	S 08° 27'	E 114° 24'	1102	Indonesia	221
180	Tandjoeng Sasar a peninsula on the northernmost point of Soemba (Sumba) Island	S 09° 15'	E 119° 56'	1101	Indonesia	222
181	Lambok Island southeast tip of Lake Anak Meer west of active volcano called "Goenoeng Rindjani"	S 08° 25'	E 116° 25'	1101	Indonesia	223
182	Tandjoeng Gede (Java Head) at the western tip of Java	S 06° 45'	E 105° 12'	981	Indonesia	224
183	Balimbing at southern tip of Sumatra and western tip of peninsula forming Semangko Bay with mainland	S 05° 55'	E 104° 33'	981	Indonesia	225
184	Taboetoele Island of southwest Celebes in the strait called "Salajak"	S 05° 39'	E 120° 26'	984	Indonesia	227
185	Southern tip of Salajak Island south of southwest Celebes	S 06° 30'	E 120° 29'	984	Indonesia	228

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
186	Tandjoeng (Cape) Berikat on the eastern tip of Bangha Island in the South China Sea	S 02° 34'	E 106° 50'	980	Indonesia	229
187	Tandjoeng (Cape) Djang on the eastern tip of Poelan (Island) Lingga	S 00° 18'	E 105° 00'	980	Indonesia	230
188	Tandjoeng Karang in northern Celebes	S 00° 38'	E 119° 45'	978	Indonesia	231
189	Kaap (Cape) Williams on west coast of Celebes at a bay called "Mamoedjuebaai"	S 02° 37'	E 118° 48'	978	Indonesia	232
190	Hoek (Cape) Van Mandar in western Celebes	S 03° 34'	E 118° 56'	978	Indonesia	233
191	Town of Popedi on a peninsula off north Celebes Island	S 00° 01'	E 119° 40'	978	Indonesia	234
192	Tanjung Sial on the southwestern tip of Saram Island	S 03° 33'	E 127° 55'	976	Indonesia	235
193	Udjung (Point) Batu Mamak south of the Teluk (inlet) Tapanuli	N 01° 33'	E 98° 43'	920	Indonesia	236
194	Isthmus where Pulau Island in Lake Danan Toba joins mainland of central Sumatra	N 02° 36'	E 98° 41'	920	Indonesia	237
195	Some feature in the vicinity of the city of Singapore	N 01° 15'	E 103° 49'	860	Indonesia	238
196	Tanjong (Cape) Datu at northwest tip of Borneo at border between Indonesia and northwest Sarawak	N 02° 05'	E 109° 38'	861	Indonesia	239
197	Northern tip of "Pulau Lembeh" Island off northeast coast of Celebes	N 01° 33'	E 125° 17'	863	Indonesia	240
198	Tanjong Bisoa at the northern tip of Halmakera Island one of the Molucca Islands	N 02° 13'	E 127° 57'	864	Indonesia	241
199	Eastern tip of Halmakera Island at a point called "Tanjong Ngolopopo"	N 00° 12'	E 128° 54'	864	Indonesia	242
200	Tanjong Sempand Mangayau north of the town of Keretang in North Borneo	N 07° 03'	E 116° 45'	857	Norther Borneo & Sarawak	243
201	"Tanjong Baram" south of the mouth of the Batang Baram River in Sarawak	N 04° 35'	E 113° 58'	857	North Borneo & Sarawak	244
202	Northeast tip of Ko Joi Island in the lagoon called "Lake Lnang" at the point where island is nearest sandbar	N 07° 35'	E 100° 18'	857	North Borneo & Sarawak	245

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
203	Poelau Jaco a small island at eastern tip of Timor Island (Highest point 266 ft)	S 08° 26'	E 127° 19'	1100	Portuguese Timor	246
204	Town of Oisina at the tip of Timor Island	S 10° 21'	E 123° 26'	1100	Portuguese Timor	247
205	Southeast tip of Poelau (Island) Adi off New Guinea	S 19° 4'	E 133° 36'	986	New Guinea	248
206	Singer Island in Lake Wisdom located on Long Island	S 05° 19'	E 147° 05'	988	New Guinea	249
207	Tandjoeng Fatagar on the western tip of Schiereiland (Peninsula) Onin	S 02° 46'	E 131° 57'	976	New Guinea	250
208	Tandjoeng Woka on the western tip of Japan Island north of Geelvink Bay	S 01° 36'	E 135° 25'	975	New Guinea	251
209	Tandjoeng Menori northwest of Geelvink Bay	S 00° 51'	E 134° 08'	975	New Guinea	252
210	Southern tip of Cape San Agustin on southeastern Mindanao Island	N 06° 15'	E 126° 11'	855	Philippines	253
211	Pucia Point southwest tip of a peninsula on Panay Island western end of Ranlan Bay	N 11° 46'	E 121° 50'	742	Philippines	255
212	Sangley Point in Manila Bay on Luzon Island	N 14° 30'	E 120° 54'	735	Philippines	256
213	Cape San Ildefonsa on the southern tip of San Ildefonso Peninsula east coast of Luzon Island	N 16° 02'	E 121° 59'	620	Philippines	257
214	Taguntun Point at the southern tip of Cantanduanes	N 13° 31'	E 124° 12'	735	Philippines	258
215	Cape Zelee at the southern tip of Maramasika Island	S 09° 48'	E 161° 33'	1094	Southwest Pacific	259
216	Cape St George at the southern tip of New Ireland Island	S 04° 54'	E 152° 53'	989	Southwest Pacific	260
217	Northern tip of a peninsula in Lake Dakataua near northern coast of New Britian Island	S 05° 00'	E 150° 06'	989	Southwest Pacific	261
218	Motupena Point off the western coast of Bouganville Island	S 06° 31'	E 155° 10'	990	Southwest Pacific	262
219	Cape Cumberland at the northern tip of Espiritu Island	S 14° 37'	E 166° 37'	1115	Southwest Pacific	263
220	North Point on Aurora Island	S 14° 55'	E 168° 06'	1115	Southwest Pacific	264
221	Cap Lefevre on the western tip of Ile Lifou	S 20° 55'	E 167" 02'	1238	Southwest Pacific	265
222	Cap Ouabao at the south-western tip of Ile Mare	S 21° 36'	E 167° 50'	1238	Southwest Pacific	266

Table 1-11. Earth Landmarks (Cont)

L/M No.	Landmark	Latitude	Longitude	WAC Map	Area Country/	UDL Code No.
223	Northwest tip of Ile (Island) de Phu Quoc in the Gulf of Siam	N 10° 22'	E 103° 51'	739	Vietnam	267
224	Cap (Cape) Saint Jacques off southeast coast of Vietnam 40 m.m. southeast of Saigon	N 10° 19'	E 107° 05'	739	Vietnam	268
225	Southern tip of a peninsula south of the town of Ba Gia east of Honlon Island	N 12° 34'	E 109° 26'	739	Vietnam	269
226	Town of Konlie at northern tip of Babelthuap Island one of the Palau Islands	N 07° 43'	E 134° 37'	854	Northwest Pacific	270
227	Southwestern tip of Yap Island one of the Carolina Islands	N 09° 26'	E 138° 04'	744	Northwest Pacific	271
228	Some point in Apra Harbor on Guam Island	N 13° 27'	E 144° 37'	731	Northwest Pacific	272
229	Northern tip of Aruba Island at the town of Kudarebe	N 12° 37'	W 70° 04'	707	Netherland Antilles	273
230	Northern tip of peninsula called "Puenta San Francisco Solano" located in the Gulf called "Gulfo De Cupica" in Gulf of Panama	N 06° 17'	W 77° 28'	829	Columbia	069

Table 1-12. Lunar Landmarks

UDL Code No.	Landmark	Longitude	Latitude
001	Magelhaens	44° 57' 24"	-12° 40' 52"
002	Vitrovius	33° 47' 47"	17° 46' 28"
003	Dawes	26° 19' 37"	17° 13' 03"
004	Arago	21° 22' 57"	6° 10' 31"
005	Dionysius	17° 16' 31"	2° 48' 04"
006	Sulticius	11° 39' 06"	19° 35' 26"
007	Pickering	7° 00' 09"	-2° 50' 10"
008	Conon	1° 57' 48"	21° 37' 56"
009	Bode	357° 34' 57"	6° 44' 36"
010	Lassell	325° 08' 45"	-15° 26' 24"
011	Gambart C	348° 13' 37"	3° 20' 46"
012	Gambart	344° 48' 12"	0° 27' 00"
013	Gay-Lassac A	339° 41' 31"	13° 10' 39"
014	Hortensius	332° 05' 08"	6° 28' 13"
015	Gassendi A	320° 18' 08"	-15° 31' 19"
016	Famsteed	315° 41' 39"	-4° 29' 38"

DISPLAY switch to illuminate on the control panel, as well as the CONTROL PANEL-IN-USE light on all panels. The malfunctions are coded alpha-numerically. The system to be malfunctioned is identified by the letter portion and is selected by depressing the desired SYSTEM switch, which is also backlighted. Three successive depressions of the octal digits on the KEYBOARD identifies - selects the particular system malfunction. The selected digits are displayed in the VERIFY register as they are keyed. The selection of the third digit initiates a logic communication between the MIU and the computer, which results in one of three possibilities.

- If the instructor procedures were improper and/or the selected malfunction code invalid, the INSTRUCTION INVALID light illuminates. In this instance, all controls are inhibited with the exception of the CONTROL PANEL RESET switch. This switch must be utilized to clear the control panel, turn off all indications, and allow renewed utiliziation of the control panel.

- If the instruction is valid, but the malfunction has been previously entered into the program, the appropriate DISPLAY STATUS and ENT (entered) lights illuminate on the display panel and the magnaline indicator is driven to the selected mode.

- If the instruction is valid and the malfunction is not already in the program, the appropriate DISPLAY STATUS number and the IMP (impending) lights on the display panel illuminates. The magnaline display indicates the selected code and all control panel lights extinguish.

In the second possibility, the only alternative available to the instructor is the clear function (to be described later). In the third possibility, the instructor may elect several actions. He has selected a malfunction but this malfunction is not yet active, that is, entered into the computer programs. He may choose to select further malfunctions (up to nine) in the manner described or he may activate a selected malfunction.

To activate a selected malfunction (or group of malfunctions), the instructor depressed the appropriate DISPLAY switch. This causes the same switch to illuminate on all control panels, as well as the CONTROL PANEL-IN-USE light. By depressing the MALFUNCTION ENTER switch, the malfunction is activated, the ENT (entered) light illuminates, the IMP light and all control panel lights extinguish. Successively depressing appropriate DISPLAY switches, followed by depressing MALFUNCTION ENTER switch, activates all selected displayed malfunctions.

Malfunction Clear.

All active malfunctions within the computer program may be cleared by depressing the MASTER CLEAR ALL SYSTEMS switch. This switch has a lock cover to prevent inadvertent use. This inhibits all control panels until the malfunctions have been cleared. This is indicated when the MASTER CLEAR ALL SYSTEMS indicator is extinguished. All display panel lights extinguish and all alphanumeric readouts become blank. At this point all malfunctions except those time-dependent have been cleared.

Individual malfunctions may be cleared from a system by selecting the malfunction through the procedure outlined for malfunction insertion. However, instead of activating the malfunction, the appropriate DISPLAY switch followed by the MALFUNCTION CLEAR switch is depressed. When the malfunction has been cleared, the display lights and control panel lights extinguish and the alphanumeric readout becomes blank.

The instructor-operator also has the option of clearing the MIU display only. He can do this by depressing the appropriate DISPLAY switch and then the DISPLAY CLEAR switch. This causes all lights associated with the selected MIU display panel to extinguish and the alphanumeric readout to become blank. However, this only clears the selected MIU display and in no way effects the malfunction which has been displayed.

1.2.15.2 Preprogramed Malfunction Insertion.

The use of this procedure is prescribed, prior to the initialization of a training exercise, if the number of malfunctions to be used is considerable. Small numbers of malfunctions should be manually inserted through the MIU as described.

A card deck of malfunctions is stored in the library of cards. These cards have been prepunched to include the information tabulated in table 1-13 in that format. Now malfunctions, which require cards, must also be punched

Table 1-13. Preprogramed Malfunction Card Format

Columns 1 and 2	- Blank
Columns 3 and 4	- System code (two alphabetic characters)
Columns 5 through 7	- 3-digit malfunction number
Column 8	- Blank
Columns 9 through 80	- Malfunction description or blank

in this format. The individual cards for each malfunction are selected from the deck by the instructor. These selected cards form a subdeck to be used with a particular exercise or run. It is not necessary to sort or arrange the cards in any special order. The cards are placed in the card reader stacker and inserted into the computer using the procedure outlined in paragraph 1.3.2 of this section. The MIU program in the computer outputs a list of the malfunctions on the line printer. This list can be used by the instructor as ready reference during the performance of the exercise.

1.2.15.3 Time-Dependent Malfunction Insertion.

This type of malfunction carries a time tag in its format as indicated in table 1-14. Time-dependent malfunctions can only be inserted via the card reader, using the procedure defined in paragraph 1.3.2. They may be included in the preprogramed card deck described, or they may be inserted separately to facilitate organization of card decks and filing. Time-dependent malfunctions must be in order by time sequence (earliest to latest). The program outputs a list of time-dependent malfunctions on the line printer, if entered separately. Otherwise, they are included in the printout of preprogramed malfunctions along with their respective time of occurrence.

Table 1-14. Time-Dependent Malfunction Card Format

Column 1	- T
Column 2	- Blank
Columns 3 and 4	- System code (two alphabetic characters)
Columns 5 through 7	- 3-digit malfunction number
Column 8	- Blank from launch
*Columns 9 through 11	- Day
Column 12	- Blank
*Columns 13 and 14	- Hour
Column 15	- Blank
*Columns 16 and 17	- Minute
Column 18	- Blank
*Columns 19 and 20	- Second
Column 21	- Blank
Columns 22 through 80	- Blank or malfunction description

*The information in columns 9 through 20 will indicate the time (day, hour, minute, second) for the malfunction to be entered into the system. This time will be referenced to "time from launch."

1.2.15.4 Computer Initiated Malfunctions.

In addition to the described instructor-operator initiated functions, the following computer functions are performed by the MIU. The computer sends an impending signal to the MIU logic, along with the displayed malfunction, 90 seconds prior to the time a time-dependent malfunction is to become active. This function is performed for predictable malfunctions only. The TIME DEP light flashes and the operator may perform such instructions upon the malfunction as previously described. When the malfunction becomes active, the TIME DEP light extinguishes, providing the operator did not initiate any instruction. The display is then cleared by the MIU logic.

The time-dependent malfunctions may only be cleared during the 90-second period before activation. The same procedure is used as described previously, that is, depress the No.10 DISPLAY and the MALFUNCTION CLEAR switch-lights when the TIME DEP light begins flashing.

1.2.16 MASTER CONTROL PANEL OPERATION.

The master control panel, IOS panel 46, provides the instructor with the means of controlling the various modes of AMS operation. During a non-integrated training session, the instructor has complete control of AMS operation. The operation of an integrated mission is the responsibility of the Simulation Supervisor located in the Mission Operations Control Room. His commands are transmitted to the AMS instructor, via the console communication system, who coordinates the AMS operations from these commands.

The initiation and operation of an integrated mission shall be conducted in the following manner:

For a prelaunch condition, the simulator is initialized by dialing in the appropriate number on the INITIAL CONDITION CALL UP display and depressing the RESET switch-light. If the GMT, day of month, and last day of month does not correspond with that desired by the Simulation Supervisor, type in the correct time parameters via the IOS typewriter as described in paragraph 1.2.9.3. After inserting the new time, depress the RECYCLE switch-light to ensure the TO-FROM clocks remain at T - 60 seconds. At the direction of the Simulation Supervisor, to being the GMT clocks running, the instructor shall depress the READY-RUN switch-light. The READY portion of the split-level light shall illuminate, and upon receipt by the computer of the next one-minute pulse, the READY portion shall extinguish and the RUN portion shall illuminate at which time the GMT timers on the IOS and T/M console shall begin to run. When the Simulation Supervisor desires to start the training session, he will issue the command to the instructor who, in turn, depresses the READY-GO switch-light. This action illuminates the READY portion of the split light-indicator and, upon receipt by the computer of the next one-minute pulse, the READY light extinguishes, the GO light illuminates, and the TO-FROM timers will begin counting down, indicating the simulator is a "go" condition.

If the Simulation Supervisor desires to hold the launch, a signal will be received from the GSSC illuminating the HOLD switch-light and extinguishing the GO light. The TO-FROM timers are stopped at this point but the GMT clocks continue to run. If the Simulation Supervisor desires to re-start back to the first starting GMT point, the instructor will re-initialize as first described. If the mission is to continue at the point of hold, the instructor depresses the RECYCLE switch-light which return the TO-FROM clocks to T-60 seconds. He then depresses the READY-GO at the Simulation Supervisor's direction and the mission continues as described previously.

During the postlaunch integrated operation, the READY-GO, HOLD, and RECYCLE switch functions are not used. The RESET function during the integrated mission is initiated by the order from the Simulation Supervisor who will designate the reset point. The instructor then dials in the proper number on the INITIAL CONDITION CALL UP display and depresses the RESET switch-light. The AMS enters the RESET and FREEZE modes as indicated by the illumination of both lights. After the reset program is completed, the RESET light automatically extinguishes; however, the FREEZE light remains on. After all initial conditions are set (SCM switch positioning, etc.), the instructor advises the Simulation Supervisor the AMS is ready to proceed. When the Simulation Supervisor advises the instructor the mission will begin in 60 seconds or less, the instructor then depresses the READY-RUN switch-light. This action extinguishes the FREEZE light and illuminates the READY portion of the READY-RUN light. Upon receipt of the next one-minute pulse from GSSC, the READY light extinguishes and the RUN light illuminates indicating the AMS is in real-time operation.

The STEP-AHEAD function, during an integrated mission, is also initiated by the Simulation Supervisor. The time to which the AMS is to be advanced is given to the instructor by the Simulation Supervisor. The procedure for entering the time and the sequence of events following is described in paragraph 1.2.9.4. The instructor again coordinates with the Simulation Supervisor when to begin the mission and uses the READY-RUN switch-light to begin the mission.

The STORE function operates in the same manner for both the integrated and non-integrated modes. Two types of storing are available in the AMS; the instructor-store and the safe-store.

The instructor-store provides the capability of storing certain parameters at any time during the training mission. This is accomplished by depressing the STORE switch-light. The switch-light will remain illuminated for approximately 0.8 seconds, at which time the light will extinguish indication the completion of the store function. If the instructor wishes to reset the AMS to these stored conditions, the INITIAL CONDITION CALL UP dial is set to 001 and the RESET switch-light is depressed. This will recall all the parameters and return the AMS to the FREEZE condition. If the instructor desires to record these parameters on magnetic tape to be used for future reset or initialization points, the INITIAL CONDITION CALL UP dial is set to 7XX where XX is assigned the next available reset or initialization point

number in octal. The RESET switch-light is then depressed which initiates the magnetic tape recording. The instructor must record the number used so that the total number of reset points are known.

The safe-store records the same parameters as the instructor-store except it is only initiated once per hour automatically. These may also be recorded on tape using the same procedure as above.

The use of the FREEZE switch-light rests entirely with the instructor; however, an integrated mission can be completely disoriented by use of the FREEZE switch-light at the IOS without the coordination of the Simulation Supervisor.

The operation of a non-integrated mission is completely at the direction of the AMS instructor. The operation of the master control panel is the same as in the integrated mission.

1.3 SIMULATOR SYSTEMS CHECKLISTS.

Simulator systems checklists are provided in the following paragraphs for each specific AMS system-instructor procedure. The procedure outlined are for three specific purposes: (1) preparation of each system for use, (2) operation of each system during AMS operation, and (3) restoring each system to a safe and known baseline configuration in readiness for the next utilization.

In many instances, these procedures encompass the unit procedure previously presented, and will reference these paragraph numbers and/or particular step numbers where applicable. The paragraphs are not presented in any chronological order and may be interchanged at the instructor's convenience, provided that any referenced procedure in a specific paragraph is performed.

1.3.1 AMS POWER ON-OFF PROCEDURES.

The AMS operates from a 300-kva, 120/208-volt 60-cps 3-phase, 4-wire facility source. This power is divided into two groups; utility and simulator power. The distribution of the utility power is controlled manually by CB4-UTILITY PWR, circuit breaker in unit 32, and the utility circuit breaker panels in unit 37.

The distribution of simulator power is controlled by a main circuit breaker to six main branches, listed as follows:

- Life support
- 400-cycle motor-generator
- Computer complex
- Data conversion equipment
- Peripheral
- Visual

Two methods of distributing simulator power are available; manually or sequentially. In the manual mode, all power application is manually controlled by circuit breakers. In the sequential mode, first power is manually controlled and the remaining actions are automatic. The following procedures are to be used for power distribution to the AMS.

1.3.1.1 Power On - Manual Mode.

a. At unit 32, place CB4 - UTILITY PWR to ON position.

b. At unit 37, place all utility circuit breakers to ON position.

c. At unit 32, place CB9 - MAIN PWR circuit breaker to ON position.

d. At unit 33, on POWER control panel, verify POWER AVAILABLE light is illuminated and CORRECTLY PHASED WHEN BRIGHT - PHASE LIGHT light is illuminated brightly. (See figure 1-8.)

e. At MAIN POWER control panel, monitor ac line voltage using METER SELECTOR switch in conjunction with MAIN POWER ac voltmeter. On positions A, B, and C of the NEUTRAL TO LINE position, the readings should be 115±9 vac. On A TO B, A TO C, and B TO C positions of the LINE TO LINE position, the readings should be 208±15 vac.

f. At MAIN POWER control panel, position STARTING MODE switch to MANUAL and observe illumination of MANUAL portion of the split-level indicator.

g. At unit 32, place remaining circuit breakers to ON position.

h. At MAIN POWER control panel on unit 33, apply power to each subsystem by depressing the associated power ON switch-light, allowing 10 seconds between actuation.

CAUTION

The following precautions must be observed before applying power to each subsystem to prevent equipment damage.

- The 400-cycle power must be turned on before applying power to the COMPUTER system.
- All data conversion circuit breakers in unit 37 must be on before applying power via the DATA CONVERSION power ON switch-light at unit 33.

i. After depressing 400 CPS MG power ON switch-light, monitor voltage and frequency of motor-generator at MAIN POWER control panel. Frequency should read 400±8 cps. Output voltage of motor-generator should be 115 vac, if not, rotate VOLTAGE REGULATOR panel control until desired voltage is reached.

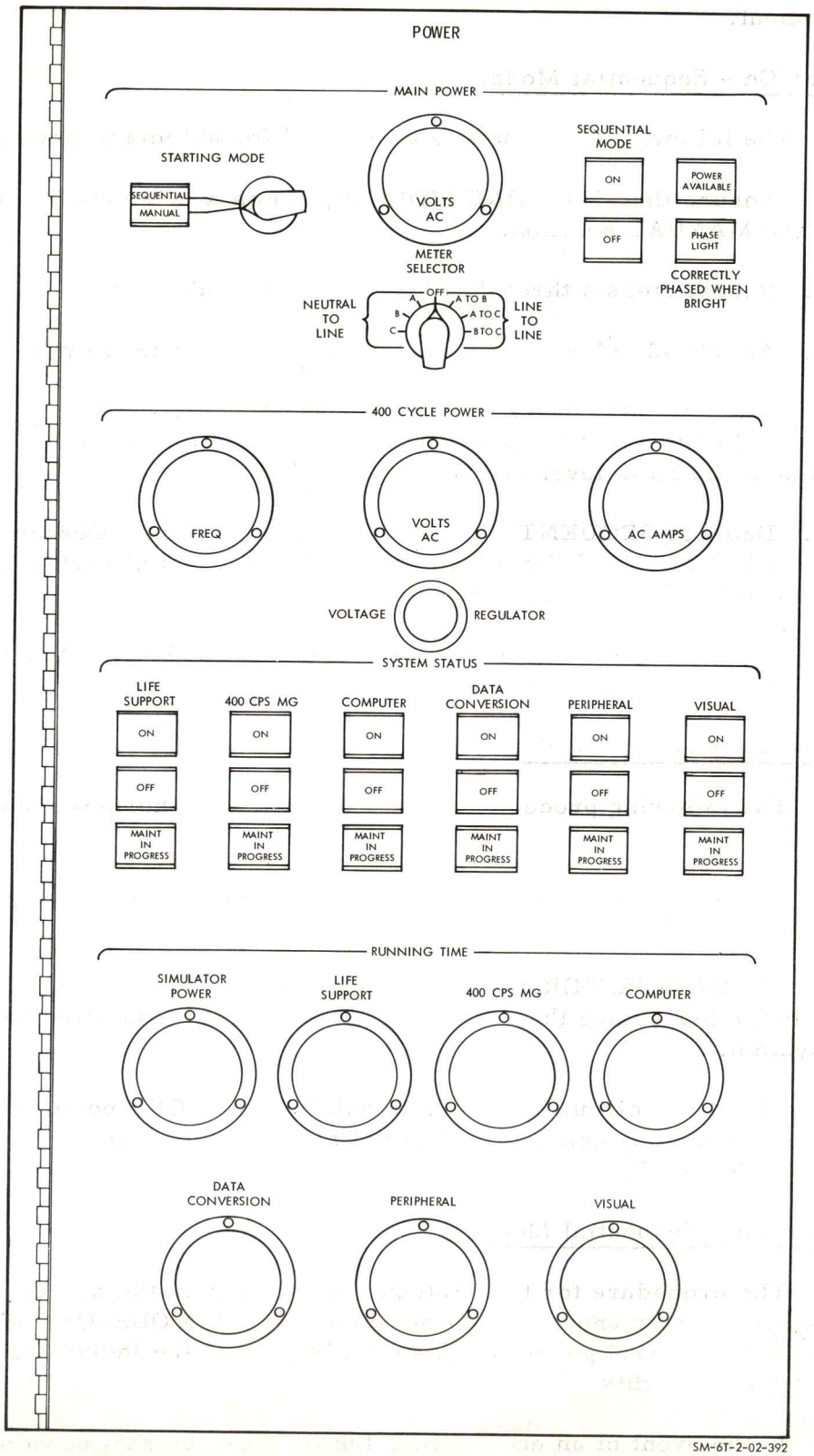


Figure 1-8. Power Control Panel

j. At unit 61, visual power cabinet, apply power to the visual system by depressing alternate-action switch-lights which power the optical assembly equipment.

1.3.1.2 Power On - Sequential Mode.

The following procedure is to be used for automatic power distribution:

a. Ensure that STARTING MODE switch on MAIN POWER control panel is in the MANUAL position.

b. Repeat steps a through e for MANUAL mode.

c. At unit 32, place remaining circuit breakers to ON position.

d. At MAIN POWER control panel (unit 33) position STARTING MODE switch to SEQUENTIAL and observe the illumination of the SEQUENTIAL portion of the split-level indicator.

e. Depress SEQUENTIAL MODE-ON switch-light. Observe illumination of LIFE SUPPORT-ON light followed by illumination of each of the other subsystem lights at 10-second intervals.

f. Repeat steps i and j listed under manual mode after completion of power application to all subsystems.

1.3.1.3 Power Off - Manual Mode.

The following procedure is to be used for the normal shutdown of the AMS:

a. Secure all equipment as per detailed description for each unit in paragraphs 1.3.7 through 1.3.10.

b. At MAIN POWER control panel in unit 33, remove power from each system by depressing the power OFF switch-light associated with that subsystem.

c. Place all circuit breakers in unit 32 to the OFF position. During normal day-to-day operation, it is not necessary to turn off circuit breakers in units 33 and 37.

1.3.1.4 Power Off - Sequential Mode.

The procedure for the shutdown of the AMS in the SEQUENTIAL mode is the same as the manual except the SEQUENTIAL MODE-OFF switch-light on the POWER control panel is depressed instead of the individual subsystem power switch-lights.

In the event of an emergency, the AMS can be shut down by depressing any of the EMERGENCY-OFF switches located at each end of the cabinets and at the IOS. This action drops out the sequence control relays and removes power from all systems.

1.3.2 PREMISSION SETUP PROCEDURE.

This procedure is to be used by the instructor to load and initialize the AMS computers in preparation for a training session. The procedure consists of loading the computer memories with the AMS operational programs, library subroutines, and data pool parameters from a mission tape using card deck bootstrap programs. In addition, the procedure also includes the entering of the ephemeris information, the inserting of the X-T and X-Y recorder inputs, malfunction insertion, and the preparation of the magnetic tape units for use prior to the training session.

This procedure is based upon the assumption that the power has been applied to the computer complex, diagnostic checks have been completed, and otherwise ascertained the operational readiness of the AMS.

Based on this assumption, the following steps are to be accomplished:

a. Mount AMS mission tape on MTU No. 4 as per paragraph 1.2.5.1. (Refer to section 1, Volume I for MTU identification.)

b. Prepare card reader for operation as per paragraph 1.2.6.1 and load ephemeris bootstrap card deck into card reader.

c. Depress MASTER CLEAR pushbutton on each computer control panel.

d. At computer control panel for system D (Unit 50), perform the following:

1. Position fill selection rotary switch to CARD RDR HOL and I/O function selection rotary switch to ON LINE.

2. Place SENSE switch No. 6 to up position.

3. Manually enter 053 in OP code register and 26150 in Z register.

4. Depress EXECUTE pushbutton.

5. Depress RESET pushbuttons for OP code and Z registers.

6. Enter 00100 in program register.

7. Depress START pushbutton and observe following message typed out on typewriter: MOUNT EPHEMERIS TAPE ON MTU.

e. Mount tape as per paragraph 1.2.5.1.

f. Upon completion of mounting of ephemeris tape, depress START pushbutton on system D computer control panel and observe following message typed out: TYPE IN YEAR AND DAY OF LAUNCH.

g. Using following format, type in year and day of launch: XXXXØYYY where X is year of launch in decimal e.g., 1966 and Y is day of year, e.g., 274.

NOTE

If the instructor should enter incorrect information, the computer will type out ERROR and the instructor can repeat the process. If the instructor recognizes he has entered an error before he has completed his input, he will type in a $ sign. The computer will respond by typing out READY indicating the incorrect entry has been disregarded and is ready for a new instruction.

h. The following message will be typed out after completion of ephemeris program: PREMISSION EPHEMERIS INITIALIZATION COMPLETE.

i. At computer control panel D, place SENSE switch No. 6 to down position and SENSE switch No. 2 to up position. Place SENSE switch No. 1 on computer C (Unit 49) and SENSE switch No. 3 on computer E (Unit 51) to up position. At each computer control panel, depress the MASTER CLEAR pushbutton.

j. At computer control panel C, manually punch in 053 in OP CODE register and 26150 in Z register. Verify fill selection rotary switch is positioned to CARD RDR HOL and I/O function selection rotary switch is positioned to ON-LINE. Depress EXECUTE pushbutton followed by depressing RESET pushbuttons for OP CODE and Z registers.

k. Set up card reader as per paragraph 1.2.6.1, inserting bootstrap card deck prepared for system C computer.

NOTE

Each computer will have a specially prepared card deck to be used as a bootstrap program for loading the operational programs from the AMS mission tape.

l. Depress FILL pushbutton on system C computer control panel, initiating transfer of information from card deck to computer.

m. Depress MASTER CLEAR on computer control panel after last card has been processed.

n. Repeat steps j, k, l, and m on system D computer.

o. Repeat steps j, k, l, and m on system E computer.

p. After each bootstrap program has been loaded, depress START button on each computer control panel. (This initiates data transfer from AMS mission tape into memory.)

q. When loading each computer is finished, following message will be typed out on each computer typewriter: LOADING COMPLETED.

r. Remove tape from magnetic tape unit No. 4 as per paragraph 1.2.5.3 and store.

s. At each of three computers, place MAIN INTERRUPT and REAL TIME INTERRUPT switches to up position and all SENSE switches to down position. Depress each MASTER CLEAR pushbutton.

t. Enter starting location of each computer load into their respective program registers.

u. Depress START pushbutton on each computer and observe following messages typed out:

- MOUNT THE INITIAL CONDITIONS (RESET) TAPE ON MAGNETIC TAPE UNIT (MTU) #1.
- MOUNT THE DATA RECORDING TAPE ON MTU #2.
- MOUNT THE LAUNCH BOOST TAPE ON MTU #3.
- CHECK THAT MTU #2 IS AVAILABLE TO WRITE.
- CHECK THAT ALL MTU'S ARE ON REMOTE.
- WHEN THE ABOVE STEPS HAVE BEEN COMPLETED, TYPE IN ONE BACKSPACE.

v. Perform above steps, 1 through 5 in accordance with paragraph 1.2.5.1; and upon completion, depress BACKSPACE.

w. After depressing BACKSPACE, next message typed out will request character label for data recording tape. After four-character label has been typed in, computer will perform a parity check on label. If no parity error is detected, message specifying label of tape will be typed out. If parity check detects an error, the following message will be typed out: EXCESSIVE PARITY FOUND IN WRITING DATA RECORD LABEL. MOUNT NEW TAPE IF DESIRED AND DEPRESS BACKSPACE WHEN READY. If it becomes necessary to replace tape, depress BACKSPACE and repeat this step.

x. Following data recording tape label print out, next instruction will be: BEGIN TO ENTER X/Y-X/T INPUTS. Enter desired parameters to be recorded as per paragraph 1.2.9.1, depressing BACKSPACE after final entry.

y. Next instruction typed out will be: IF MISSION IS INTEGRATED, DEPRESS BACKSPACE. IF NOT, DEPRESS CARRIAGE RETURN. If training session is to be nonintegrated, depress carriage return and type in

four-character launch number label. Upon receipt of label, computer will search launch boost tape and return one of the following messages:

- PARITY FOUND IN READING LAUNCH TAPE. MOUNT NEW LAUNCH TAPE ON UNIT #3. DEPRESS BACKSPACE WHEN READY.
- LAUNCH DESIRED NOT ON LAUNCH TAPE. MOUNT LAUNCH TAPE ON UNIT #3 AND DEPRESS BACKSPACE WHEN READY.
- LAUNCH TAPE NOW POSITIONED. LAUNCH NUMBER IS XXXX.

If either message 1 or 2 is received, mount new tape, depress BACKSPACE and type in launch number label again. If mission is to be integrated, depress BACKSPACE and observe a message being typed out indicating integrated mode of operation.

z. Next instruction typed out will be: PLACE MIU CARDS IN THE CARD READER AND MAKE CARD READER READY. DEPRESS BACKSPACE WHEN READY. The session data sheets recommend preprogramed and time-dependent malfunctions for each training session. Instructor will insert cards for these malfunction into card reader and prepare card reader and line printer for operation on per paragraphs 1.2.10 and 1.2.6.1. Depressing of BACKSPACE will initiate entry of malfunctions into computer. Upon completion of malfunction insertion, the following message will be type out: THE MIU INITIALIZATION IS COMPLETE. Malfunctions that have been entered will be printed out on line printer. Printout will also indicate any malfunctions that are invalid due to incorrect system code, improper number, or if time-dependent malfunctions are spaced less than 90 seconds apart. Printout is removed from line printer and used as reference material during training session.

aa. Upon completion of malfunction insertion, reset routines will be called up at which time film in MEP cassettes will be properly positioned and all initial conditions set.

ab. Completion of reset routines will be indicated by illumination of FREEZE switch-light on IOS panel No. 46. At this time, initialization of central timing equipment is performed at computer D using procedure outlined in paragraph 1.2.9.3.

ac. AMS is now under control from master control panel, IOS panel No. 46. Beginning of training session is now responsibility of AMS instructor if in a nonintegrated training session or simulation supervisor if in an integrated training session. Paragraph 1.2.1.6, Master Control Panel Operation, describes series of events initiating training session for both cases.

1.3.3 RESET INITIALIZATION.

The procedures outlined in this paragraph are to be used for initializing the AMS to the desired reset point during on-line operation. These procedures are not to be confused with the Premission Operational procedures which prepares the trainer with all the data and requirements necessary for a training session.

The parameters to be recalled, when reset initializing, are contained on the initial condition or reset tape which is mounted on MTU 1 during normal operations.

The initialization procedure is performed as follows:

a. Depress FREEZE switch-light on IOS panel 46 and observe illumination of switch-light.

b. On initial condition callup indicators, dial in the three-digit number corresponding to the desired reset point. (Refer to table 1-15 and paragraph 1.2.16.)

Table 1-15. AMS SE-012 Initialization Points

Initialization Point	Init Cond Callup No.
T - 60 seconds	002
Insertion into earth orbit	003
Begin re-entry	004
Instructor-store/safe-store (See Master Control Panel Operation, Paragraph 1.2.16.)	001

c. Depress RESET switch-light and observe illumination of switch-light. Verify that FREEZE switch-light remains illuminated.

d. Observe the automatic extinguishing of RESET switch-light indicating completion of reset program in the computer system. FREEZE switch-light will remain illuminated.

e. Verify the changing of time displays to reflect simulated GMT for that particular reset point. If the instructor desires to change the time displayed, repeat procedure described in paragraph 1.2.9.3.

1.3.4 IOS PREPARATION.

The following paragraphs specify the conditions that are to exist or be inserted at each of the listed IOS panels, prior to a training session.

1.3.4.1 G&N and Visual Readiness.

The visual system status panel, IOS panel 1, provides gross status indications of conditions existing within each of the visual systems.

a. Verify that all SERVO SYSTEM-COMPUTER portions of the split-screen indicators are illuminated and the MANUAL portions are extinguished with the exception of No. 3 MEP and STARFIELD. (No. 3 is reserved for the hatch window visual simulation not included in SE-012AMS).

b. Verify that all lamp supply and power supply fail indicators are extinguished.

NOTE

The air compressor is interlocked with all MEP arc lamps to turn off all lamps if the compressor fails or does not deliver the proper air pressure.

c. Verify that the AIR COMPRESSOR-SAFE portion of the split-screen indicator is illuminated and the FAIL portion is extinguished.

The G&N supplementary and navigation evaluation panels, IOS 17 through 22 and panel 25, require the following steps to be accomplished:

a. Adjust INTENSITY, FOCUS, and SCALE illumination on CRT display, panel 21, as desired.

b. Depress ZERO buttons on panel 25, and observe that related digital displays indicate zero.

c. Place CRT MODE SELECTOR switch to the 60° position.

d. Depress MARK HOLD RELEASE/MAN-AUTO alternate-action split-screen switch-light, selecting AUTO condition as indicated by illumination of that portion of the switch-light.

1.3.4.2 True Trainee Environment and Waste Management Status (IOS Panels 2 and 3).

The true trainee environment, IOS panel 2, contains the instructor controls and displays used to monitor and assist the simulation effects. The instructor is referred to paragraph 1.2.13 for further information related to panel control operation. Setup and readiness checks involved require the instructor to accomplish the following:

a. Verify that AIR FLOW LOW light is extinguished.

b. Observe both MAN TEMP lights are extinguished, indicating suit and cabin temperature is under computer control.

c. Place SUIT PRESSURE rotary switch to AUTO and verify that INSTR portion of the INSTR-SERVICE switch-light is illuminated. If SERVICE is illuminated, depress the switch-light and observe transfer to INSTR.

d. Rotate RE-ENTRY HEAT OVERRIDE control to NORM position.

e. Lift the guard on AURAL SIMULATION ON-OFF switch and place switch to ON.

f. Place AURAL SIMULATION OVERRIDE db control to NORM.

g. Verify SMOKE GENERATOR FLUID LOW light is extinguished.

The waste management panel (IOS 3) is a repeater panel of simulated spacecraft controls with no action necessary other than monitoring the position of the SCM controls. At the waste management component compartment, located at the SCM base directly beneath the hatch door, the instructor should verify that the four switch-breakers on the waste management control panel are ON and the FILTER BLOCKED indicators are extinguished.

1.3.4.3 Up-Data Link Status (IOS Panel 5).

The preparation of this panel for simulation use requires only that the instructor select the mode of operation, integrated or non-integrated, as required. For operation of this panel during simulation, the instructor is referred to paragraph 1.2.14 of this section.

1.3.4.4 Computer and Simulator Status (IOS Panels 48 and 81).

Prior to training operation of the AMS, a gross status check is performed by the instructor at the IOS. The overall status of the three computers and the peripheral equipment is indicated at the computer status panel, IOS 81. The indicators on this panel are intended to notify the instructor of the computer complex status during the training problem performance. However, for the SE-012 AMS configuration, only the following indicators are active:

- DITIGAL COMP POWER ON lights
- DIGITAL COMP HALT lights
- DIGITAL COMP C PAPER TAPE READER-PUNCH lights
- TYPE WRITER ON LINE lights

The overall status of the entire AMS complex is provided at IOS panel 48, simulator status. This panel indicates to the instructor whether there is any trouble within the major subsystem. Only a gross indication is provided and if any indicator is illuminated, the instructor must check the associated panel on the IOS or peripheral cabinet to determine the nature of the problem. Therefore, the readiness checks required of the instructor are limited to the following:

a. Verify that all indicators at the simulator status panel are extinguished.

b. Verify that none of the computers are in a halt condition at the computer status panel (that is, the HALT light should be extinguished).

1.3.4.5 Recorder and Plotter Status (IOS Panel 87).

The following procedure defines the steps required by the instructor to operate the recorder and plotter panel during preparation, initialization, and simulation.

a. At IOS panel 87, depress VOICE RECORDER-RECORDING OFF switch-light and observe that switch-light extinguishes.

b. AT IOS panel 87, depress VOICE RECORDER-RECORDING-CONT switch-light and observe that switch-light illuminates.

c. Verify that VOICE RECORDER-LAST CARTRIDGE indicator is extinguished.

d. Depress each X-T RECORDERS switch-light.

e. Observe that ON portion of split-screen switch-light illuminates.

f. Depress each of four X-Y PLOTTERS PEN DOWN switch-lights and observe that switch-lights illuminate.

g. At IOS panel 46, depress X-T RECORDER-RECORD switch-light to begin recorder operation at the start of training session.

1.3.4.6 Closed Circuit TV Setup.

The instructor's control and operation of the CCTV is confined to the covered controls located on each monitor. These are illustrated and described in section I, Volume I.

Each camera image is prealigned and adjusted by the maintenance personnel using controls located for each monitor in unit 64. Therefore, the instructor is only required to turn on and adjust the picture controls available at each monitor. Actions performed at one station have no affect on the presentation or operation at either of the other two stations.

1.3.4.7 Communications Control Setup.

The procedure outlined in this paragraph pertains to setup and checkout of the communications configuration to be used during simulation. The operation of the CCS has been presented in paragraph 1.2.12. The CCS setup procedure is as follows:

a. Place all trainer communication control panel switches to CCS.

b. Insert headset cords into TALK-LISTEN plugs at trainer communication control panel.

c. Adjust VOLUME control to nominal position.

d. Depress CMIL talk-listen key at each IOS keyset station.

e. Verify continuity of communication over instructor loop.

f. Depress CL talk-listen key at each IOS keyset station.

g. Depress RING key at trainer control and setup positions (IOS panel 88).

h. Observe that CL key flashing illumination changes to steady.

i. Verify continuity of communications over computer loop.

j. Depress ML talk-listen key at each instructor keyset station.

k. Depress RING key at IOS panel 89.

l. Observe that ML key illumination changes from flashing to steady.

m. Verify continuity of communications over maintenance loop.

n. At IOS panel 89, depress CMIL talk-listen key and the following monitor keys: AL 1, AL 2, AL 3, TM 1 and TM 2.

o. At command, navigation, and system management instructor positions (IOS panels 27, 47, and 71), depress CMIL and CM INTERCOM monitor keys.

p. At these same panels, select appropriate talk-listen key that is required to simulate spacecraft voice communications as described in the crew procedures, section 2 of Volume II.

1.3.4.8 Instructor Simulation of MSFN.

Further operation of the CCS is dictated by compliance with the crew procedures of Volume II. The instructor may vary his individual communications loops during the performance of the training problem to monitor individual crew member conversations or complete individual crew member communication loops in the instructor-trainee faculty (that is, astronaut loops, backup loops, or other monitor loops).

In conjunction with the simulation of spacecraft voice communications, the instructor may operate the noise and garble controls on the communications interference panel (IOS panel 86), to simulate the effects of spacecraft misorientation or improper communications configuration management. This requires the instructor to be aware of simulated spacecraft position and orientation, and the location of the ground stations in order to perform the following steps:

a. Vary VHF-AM NOISE and GARBLE controls at IOS panel 86 if voice communications configuration indicates trainee use of VHF modes.

b. Vary S-BAND NOISE and GARBLE controls at IOS panel 86 if voice communications configuration indicates trainee use of S-BAND modes.

c. Vary HF NOISE and GARBLE controls at IOS panel 86 if voice communications configuration indicates trainee use of HF modes.

d. Monitor effect of previous steps on astronaut management of spacecraft orientation controls and communication configuration.

1.3.4.9 Malfunction Insertion and Status.

The status of the malfunction insertion unit is determined by the line printer readout of the malfunctions entered during premission setup operations. This readout should contain the malfunctions selected from the Session Data Sheets for the proposed training session.

Entry of malfunctions through the MIU control panels, or prescribed by the Session Data Sheets is accomplished as described in paragraph 1.2.15.1.

1.3.5 RECORDER AND PLOTTER PREPARATION.

The following procedures are to be performed for preparation of the recorders and plotters prior to a training session.

1.3.5.1 Plotter Readiness and Setup (30 x 30).

The EAI variplotter used as an X-Y plotter is operated under remote control of the computer system. The instructor is referred to section 1 of Volume I for a description of the X-Y plotter and the function of the local controls. Detailed here is the procedure required to set up this plotter prior to a training exercise.

a. Place PEN UP-DOWN-REMOTE switches to REMOTE.

b. Place PEN OPERATE-STANDBY-REMOTE switches to REMOTE.

c. Place POWER switch on.

d. Place LIGHTS switch to ON.

e. Place plotting paper over plotting surface.

f. Place VACUUM switch to ON.

g. Place PEN INTERCHANGE switch to AUTOMATIC.

h. Adjust PEN & ARM PARALLAX controls to set initial positions of pens and arms.

i. Place PAPER ADJUST controls for reference voltages in each servo.

j. Adjust rotary selector pen and arm SCALE FACTOR switches to desired setting.

k. Using VERNIER control, adjust scale factor.

1.3.5.2 Plotter Readiness and Setup (11 x 17).

The EAI variplotter, model 1110E, is used as the second X-Y plotter for the AMS. It also is described in section 1 of Volume I including its local controls. This plotter is remote-controlled by the computer system during training operations. Those operations, required of the instructor prior to an exercise, are outlined. The following procedure enables the plotting of various simulated spacecraft and mission parameters.

a. Place VAC PWR switch to OFF-ON to apply power.

b. Place VARIABLE-FIXED switches on all four modules to FIXED.

c. Place RANGE controls on all four modules to desired setting.

d. Place SCALE-FACTOR controls for plotted parameters.

NOTE

The plug-in modules must be removed to gain access to the switch which allows a changeover from volts/inch to volts/cm.

e. Place PEN-ARM switches to UP-STANDBY.

f. Adjust X and Y ZERO controls to set desired center of plot.

g. Place plotting paper over plotting surface.

h. Place VAC PWR switch to ON-ON to apply vacuum to plotting surface.

i. Place PEN INTCHG switch to AUTO.

j. Place PEN-ARM switches to UP-OPERATE.

1.3.5.3 Recorder Readiness and Setup (X-T).

The AMS is equipped with three Brush, Mark 200, X-T recorders with remote controls for operating the pen lift and marking systems. The instructor has the capability of selecting parameters and routing them to any of the recording equipment channels. This selection is made through the use of the typewriter and the procedures defined in paragraph 1.2.9 of this section. The recording equipment is physically and functionally described in section 1 of Volume I. It operates under the remote control of the computer system during a training exercise.

1.3.5.4 Recorder Calibration Checkout.

The recorders are to be checked out prior to setup for operation in a training condition. This checkout procedure is outlined as follows:

a. Verify that main power switch at amplifier level indicator panel is at OFF.

b. Press CONTROL MODE-LOCAL pushbutton on oscillograph control panel.

c. Depress STOP pushbutton on same panel.

d. Loosen locking knobs on SENSITIVITY controls at attenuation and control panel.

e. Rotate SENSITIVITY controls fully clockwise.

f. Depress ZERO pushbutton at attenuation and control panel.

g. Depress red pushbuttons, located beneath light level panel behind pens, for polarity reversal.

h. Verify black polarity reversal pushbuttons are released on all channels.

i. Place MAIN POWER switch to ON and observe that power switch indicator illuminates at light level panel.

NOTE

Allow 15 minutes for proper warmup before operation.

j. Place SPEED - 100 switch to up position on oscillograph control panel.

k. Depress CHART SPEED MM/SEC 100 or 200 pushbutton.

l. Observe that paper motion is at 1 or 2 millimeters per second.

m. Loosen locking knobs on PEN POSITION controls at attenuation and control panel and center pens using bias control.

n. Depress 25 LINE CAL. CHECK pushbutton and observe that pen deflects 25 lines.

NOTE

If proper calibration is not observed, refer to maintenance and calibration documents.

o. Depress ZERO pushbutton to return pens to baseline.

p. Depress .05 VOLTS/LINE pushbutton for all channels.

q. Depress and hold ATTEN. STEP IDENT. pushbutton and note that pen deflects 16 lines.

NOTE

If proper calibration is not observed, refer to maintenance and calibration documents.

r. Release ATTEN. STEP IDENT. pushbutton and observe that pens return to baseline.

1.3.5.5 Recorder Setup.

After completing the recorder calibration procedure and verifying that calibration is satisfactory, the X-T recorders are ready for setup. The following steps are performed to complete the recorder preparation:

a. Select desired attenuation for each channel by depressing appropriate VOLTS/LINE pushbuttons at the attenuation and control panel. This selection will be determined by the output expected from each digital-to-analog converter as determined by the description of parameter selections of paragraph 1.2.9.1.

b. Establish the zero baseline for each pen using PEN POSITION controls on the attenuator control panel.

c. Depress INPUT SELECTOR-OPERATE pushbutton.

d. Select desired chart speed by depressing appropriate CHART SPEED MM/SEC pushbuttons in conjunction with SPEED ÷100 switch located on the oscillograph control panel.

e. Depress CONTROL MODE-PARTIAL REMOTE pushbutton.

f. Take up slack in paper roll by using TAKE-UP SPEED control and PAPER TAKE-UP pushbutton on the oscillograph control panel.

g. Repeat the procedure for each X-T recorder.

h. Recorders are now ready to be controlled remotely from the IOS.

1.3.6 T/M CONSOLE PREPARATION.

Operations involved in preparing the T/M console, require the T/M instructor-operator to coordinate with both the IOS instructor-operator and MSFN personnel. Interface between the T/M console, the IOS, and various stations in MSCC is provided via the console communications system (CCS). Procedures and loops available in the CCS are the subject of paragraphs 1.2.12 and 1.3.4.7. The CCS interface between the T/M console, the IOS, and MSCC should be set up and manned prior to initiation of T/M console readiness and setup procedures.

Other preparations required before T/M console readiness and setup include T/M channel faulting as specified for the simulation being prepared.

The procedure for T/M console fault patching is provided in paragraph 1.2.11. In addition, the T/M console operator should have a list of both the T/M faults to be initiated at the T/M console and the simulated malfunctions to be initiated at the IOS.

1.3.6.1 T/M Console Readiness Check.

The procedure establishing a readiness for use condition at the T/M console areas is as follows:

a. Prepare CCS as defined in paragraph 1.3.4.7.

b. Verify, with IOS instructor, correlation of TO-FROM LAUNCH TIME and MISSION TIME displays with those at IOS.

c. Depress all LAMP TEST pushbuttons on T/M console and verify that all lamps illuminate.

d. Depress LAMP TEST pushbutton on two SPRIL repeater indicators, on communications subpanels, and verify that lamps illuminate.

e. Adjust CONSOLE and INDICATOR LIGHT INTENSITY controls as required for adequate illumination.

f. Depress TELEMETRY PCM ON switch-light at status panel and observe that switch-light illuminates.

g. Verify GO status of PCM units by observing OCM STATUS split-screen switch-light. If either UNIT 1 and/or UNIT 2 lights are illuminated, depress the switch-light in an attempt to reset the PCM unit. (Illumination of the lights indicates a failure in the PCM units.) If the light(s) extinguish(es), failure of the PCM unit was of a temporary nature. If light(s) remain on, notify maintenance personnel.

h. Confer via the CCS with MSFN as to which TV monitor presentation is desired, and place CCTV TO IMCC SELECTOR CAMERA switch to the corresponding position.

i. Verify with the IOS instructor checklist that proper indications exist for the communication subpanels.

1.3.6.2 T/M Console Setup.

Following the readiness check procedure, the T/M console instructor-operator prepares the console for the training situation. This involves selecting and inserting faults into the preselected channels through the analog, digital word, and bilevel fault modules at the T/M console; and selecting those channels that the T/M instructor initially chooses to monitor on his displays. This setup is accomplished by performing following the steps:

a. With grease pencil or other soft-lead pencil, note channel number, parameter and characteristics of faulted channels on writing surface above each fault module.

b. At ANALOG MALFUNCTION CONTROL panel, place INSERTION MODE switch to NORM on each of 20 fault modules.

c. Select type of fault to be inserted into each channel controlled by 20 fault modules by operating FAULT MODE selector switch on each fault module.

d. Adjust RATE LEVEL control on each fault module to required setting. If CHANNEL LOSS position had been selected in previous step, this control has no affect.

e. At DIGITAL WORD MALFUNCTION panel, repeat step a.

f. Place INSERTION MODE switch to NORM.

g. At BI-LEVEL CHANNEL MALFUNCTION panel, repeat step a.

h. Place INSERTION MODE switch to NORM.

i. Operate the digi-switches at the ANALOG MONITOR and BI-LEVEL CHANNEL MONITOR panels to the selected desired parameters to be displayed on each meter. After digi-switches have been positioned, ANALOG MONITOR and DIGITAL MONITOR switch-lights must be depressed to call up the selected parameter.

Tables 1-16 and 1-17 list the analog and bilevel parameters available for monitoring and/or faulting for SE-012 AMS. The selection of the bilevel parameters for monitoring is made by groups, each group consisting of eight parameters. For example, the bilevel signal representing the + PITCH SOLENOID driver (listed as GP01-1) can be monitored by dialing in 01 on a GROUP digi-switch and depressing the DIGITAL MONITOR switch-light. The signal in discussion will be displayed on the first neon light of the set of 8 for that group.

This completes the setup procedure for the T/M console. Note that the faults are set up but are not as yet inserted (that is, the INSERTION MODE switch is in NORM). During the training exercise, the T/M instructor operates the insertion rotary switches and the insertion switch-lights to activate the selected faults. If these faults are to be manually inserted, the rotary INSERTION MODE switches are positioned to MAN and the switch-light depressed. If the instructor desires the fault to be inserted via the computer, the COMP position is selected. However, the T/M instructor must verify that all fault control malfunctions have been either preprogrammed into the AMS computer or inserted manually through the MIU by the AMS instructor at the IOS.

The T/M malfunction tables are listed in section 5, Volume II of the handbook.

Table 1-16. SE-012 PCM Telemetry Analog Channel Assignments

Channel Number	Analog Measurement Description	Type Dynamic (D) Static (S)
1	None assigned	
2	None assigned	
3	None assigned	
4	None assigned	
5	None assigned	
6	None assigned	
7	None assigned	
8	IGA servo error in phase	D
9	MGA servo error in phase	D
10	OGA servo error in phase	D
11	None assigned	
12	None assigned	
13	None assigned	
14	None assigned	
15	Press engine chamber	D
16	VHF/AM XTMR detected RF output	D
17	None assigned	
18	None assigned	
19	None assigned	
20	None assigned	
21	Pitch rate	D
22	Pitch manual rotation control	D
23	Pitch positive feedback in	D
24	PTV DIFF clutch volts comb	D
25	Yaw rate	D
26	Yaw manual rotation control	D
27	Yaw positive feedback in	D
28	Yaw thrust vector diff clutch volts comb	D
29	Roll rate	D
30	Roll manual rotation control	D
31	None assigned	
32	None assigned	
33	None assigned	
34	None assigned	
35	None assigned	
36	None assigned	
37	None assigned	
38	None assigned	
39	None assigned	
40	None assigned	
41	None assigned	
42	None assigned	
43	None assigned	
44	None assigned	
45	None assigned	

Table 1-16. SE-012 PCM Telemetry Analog Channel Assignments (Cont)

Channel Number	Analog Measurement Description	Type Dynamic (D) Static (S)
46	AC voltage main bus 1, phase A	D
47	AC voltage main bus 2, phase A	D
48	Press. batt compartment (MANF)	D
49	DC voltage main bus A	D
50	AC voltage main bus 1 phase B	D
51	DC voltage main bus B	D
52	DC current batt charger out	D
53	AC voltage main bus 1, phase C	D
54	AC voltage main bus 2, phase B	D
55	AC voltage main bus 2, phase C	D
56	DC voltage battery bus A	D
57	DC voltage battery bus B	D
58	MGA IX RES output cosine phase	D
59	DC voltage battery relay bus	D
60	DC voltage postlanding battery	D
61	DC current F/C 1 output	D
62	DC voltage batt charger out	D
63	DC current fuel cell 2 output	D
64	DC voltage PYRO batt A	D
65	DC current fuel cell 3 output	D
66	DC current battery A	D
67	DC current battery B	D
68	DC current battery C	D
69	O_2 pressure F/C 1 regulated	D
70	O_2 pressure F/C 2 regulated	D
71	IGA torque motor input	S
72	MGA torque motor input	S
73	O_2 pressure F/C 3 regulated	D
74	OGA torque motor input	S
75	H_2 pressure F/C 1 regulated	D
76	P integrator/att error summing	D
77	Pitch SCS att error	D
78	H_2 pressure F/C 2 regulated	D
79	H_2 pressure F/C 3 regulated	D
80	Flow rate H_2 F/C 1	D
81	Flow rate H_2 F/C 2	D
82	Flow rate H_2 F/C 3	D
83	Y integrator/att error summing	D
84	Yaw SCS att error	D
85	Flow rate O_2 F/C 1	D
86	Roll SCS att error	D
87	Flow rate O_2 F/C 2	D
88	Resolver sine output pitch att	D
89	Flow rate O_2 F/C 3	D
90	Resolver cosine out pitch att	D

Table 1-16. SE-012 PCM Telemetry Analog Channel Assignments (Cont)

Channel Number	Analog Measurement Description	Type Dynamic (D) Static (S)
91	DC voltage pyro bus A	D
92	DC voltage pyro bus B	D
93	None assigned	
94	None assigned	
95	DC voltage logic bus A	D
96	Resolver sine out yaw att	D
97	Resolver cosine out yaw att	D
98	DC voltage logic bus B	D
99	Resolver sine out roll att	D
100	None assigned	
101	Resolver cosine out roll att	D
102	-28 VDC supply	D
103	None assigned	
104	Combined attitude gyro SMRD	D
105	None assigned	
106	None assigned	
107	Combined rate gyro SMRD	D
108	None assigned	
109	None assigned	
110	Q-ball vector sum output	D
111	He press tank	D
112	None assigned	
113	Press oxidizer tanks	D
114	None assigned	
115	Press fuel tanks	D
116	Tower phys separation mon A	D
117	Tower phys separation mon B	D
118	ISA IX resolver output sine in phase	D
119	IGA IX resolver output cosine in phase	D
120	MGA IX resolver output sine in phase	D
121	Press main valve eng oxidizer in	D
122	Press main valve eng fuel in	D
123	None assigned	
124	Press oxidizer tank A	D
125	OGA IX resolver output sine in phase	D
126	Press. oxidizer tank B	D
127	A He manifold press.	D
128	OGA IX resolver output cosine in phase	D
129	IGA CDU IX resolver error in phase	D
130	SXT trun motor drive in phase	S
131	SXT shaft motor drive in phase	S
132	Trun CDU motor drive in phase	S
133	B He manifold press.	D
134	C He manifold press.	D
135	SCT shaft motor drive	S
136	D He manifold press.	D

Table 1-16. SE-012 PCM Telemetry Analog Channel Assignments (Cont)

Channel Number	Analog Measurement Description	Type Dynamic (D) Static (S)
137	SCT trun motor drive	S
138	Sig cond positive supply volts	D
139	None assigned	
140	Sig cond negative supply volts	D
141	Trun CDU 16 X resolver error in phase	S
142	He temp tank	D
143	Roll attitude error amp out	D
144	DV remaining pot. out	D
145	None assigned	
146	Sensor excitation 5 volts	D
147	Sensor excitation 10 volts	D
148	Position fuel/oxidizer VLV 1	D
149	PCM hi-level 85 percent ref	D
150	Position fuel/oxidizer VLV 2	D
151	PCM hi-level 15 percent ref	D
152	Press. fuel tank A	D
153	DC voltage pyro batt B	D
154	None assigned	
155	Position fuel/oxidizer VLV 3	D
156	Position fuel/oxidizer VLV 4	D
157	None assigned	
158	UDL receiver signal strength	D
159	Press. fuel tank B	D
160	VHF/FM XMTR Pa detected RF out	D
161	Gas analysis - suit and cabin	S
162	C-band decoder out	D
163	S-band rec AGC voltage	D
164	None assigned	
165	S-band RCVR static phase error	D
166	VHF/AM rec AGC voltage	S
167	C-band XMTR output monitor	D
168	MGA CDU IX res error in phase	D
169	OGA CDU IX res error in phase	D
170	Eng VLV act sys tank press. sec	D
171	Temp F/C 1 cond exhaust	D
172	None assigned	
173	Temp F/C 2 cond exhaust	D
174	Temp side HS bond loc A	S
175	None assigned	
176	Temp F/C 3 cond exhaust	D
177	Quantity waste water tank	D
178	Temp side HS bond loc C	S
179	Temp static inverter 1	D
180	Temp sect 6 in surf	S
181	Temp static inverter 2	D

Table 1-16. SE-012 PCM Telemetry Analog Channel Assignments (Cont)

Channel Number	Analog Measurement Description	Type Dynamic (D) Static (S)
182	Temp sect 6 fuel tank surf	S
183	Temp static inverter 3	D
184	Temp sect 4 in surf	S
185	Temp sect 4 in surf	S
186	Temp battery A case	D
187	Temp battery B case	D
188	Frequency AC bus 1 phase A	D
189	Temp F/C 1 skin	D
190	Frequency AC bus 2 phase A	D
191	Temp F/C 2 skin	D
192	N_2 pressure F/C 1 regulated	D
193	Temp F/C 3 skin	D
194	N_2 pressure F/C 2 regulated	D
195	N_2 pressure F/C 3 regulated	D
196	Temp F/C 1 radiator outlet	D
197	Temp F/C 2 radiator outlet	D
198	None assigned	
199	Temp F/C 3 radiator outlet	D
	Temp side HS bond loc B	S
200	Temp side HS bond loc B	S
201	Pressure cabin	D
202	Temp sect 3 in surf	S
203	Temp cabin	D
204	None assigned	
205	None assigned	
206	Press CO_2 partial	S
207	Press. suit compressor diff	S
208	None assigned	
209	Temp space radiator outlet	D
210	Barometric press. static ref	D
211	Quantity H_2 tank 1	D
212	Press. surge tank	D
213	Quantity H_2 tank 2	D
214	Temp suit supply manif	S
215	Temp sect 3 fuel tank surf	S
216	Quantity O_2 tank 1	D
217	Quantity O_2 tank 2	D
218	None assigned	
219	Flow rate ECS O_2	D
220	IMU pressure	D
221	Press. O_2 tank 1	D
222	He temp tank A	D
223	Press. O_2 tank 2	D
224	Temp glycol evap outlet steam	D
225	He temp tank B	D
226	Press. H_2 tank 1	D

Table 1-16. SE-012 PCM Telemetry Analog Channel Assignments (Cont)

Channel Number	Analog Measurement Description	Type Dynamic (D) Static (S)
227	Press. H_2 tank 2	D
228	None assigned	
229	Temp O_2 tank 1	D
230	Press. outlet O_2 reg supply	D
231	Temp O_2 tank 2	D
232	Temp engine package B1	D
233	Temp H_2 tank 1	D
234	Combined attitude gyro temp	D
235	None assigned	
236	Temp H_2 tank 2	D
237	PIPA temp	D
238	None assigned	
239	Quantity glycol accum	D
240	PSA temp 1 tray 3	S
241	IMU heater current	S
242	PSA temp 2 tray 2	S
243	IMU blower current	S
244	PSA temp 3 tray 4	S
245	None assigned	
246	Quan potable H_2O tank	D
247	Press. suit demand reg sense	D
248	Eng VLV act sys tank Press. PR1	D
249	IRIG temp	D
250	AGC temp monitor	S
251	He press. tank A	D
252	None assigned	
253	H_2 press. tank B	D
254	Temp chamber outer skin 1	D
255	Temp nozzle outer skin 1	D
256	Press. glycol pump outlet	D
257	Temp glycol evap outlet liquid	D
258	Quantity SPS oxidizer tank 1	D
259	He press. tank A	D
260	Quantity SPS oxidizer tank 2	D
261	He press. tank B	D
262	Quantity SPS fuel tank 1	D
263	He press. tank C	D
264	Quantity SPS fuel tank 2	D
265	Temp engine package A1	D
266	He press. tank D	D
267	2.5 VDC T/M bias	D
268	Temp engine package C1	D
269	S-band XMTR detected RF output	S
270	Temp engine package D1	D
271	None assigned	
272	None assigned	

Table 1-16. SE-012 PCM Telemetry Analog Channel Assignments (Cont)

Channel Number	Analog Measurement Description	Type Dynamic (D) Static (S)
273	None assigned	
274	None assigned	
275	None assigned	
276	None assigned	
277	None assigned	
278	None assigned	
279	None assigned	
280	None assigned	
281	None assigned	
282	None assigned	
283	None assigned	
284	None assigned	
285	None assigned	
286	None assigned	
287	None assigned	
288	None assigned	
289	None assigned	
290	None assigned	
291	None assigned	
292	None assigned	
293	None assigned	
294	None assigned	
295	None assigned	
296	None assigned	
297	None assigned	
298	None assigned	
299	None assigned	
300	None assigned	
301	None assigned	
302	None assigned	
303	None assigned	
304	None assigned	
305	None assigned	
306	None assigned	
307	None assigned	
308	None assigned	
309	None assigned	
310	None assigned	
311	None assigned	
312	None assigned	
313	None assigned	
314	PCM low-level 85 percent ref	D
315	None assigned	
316	None assigned	

Table 1-16. SE-012 PCM Telemetry Analog Channel Assignments (Cont)

Channel Number	Analog Measurement Description	Type Dynamic (D) Static (S)
317	None assigned	
318	None assigned	
319	PCM low-level 15 percent ref	D
320	None assigned	

Table 1-17. SE-012 PCM Telemetry Bilevel Channel Assignments

Group No.	Bit No.	Bilevel Measurement Description
01	1	+ Pitch/+X solenoid driver out
01	2	- Pitch/+X solenoid driver out
01	3	+ Pitch/-X solenoid driver out
01	4	- Pitch/-X solenoid driver out
01	5	+ Yaw/+X solenoid driver out
01	6	- Yaw/+X solenoid driver out
01	7	+ Yaw/-X solenoid driver out
01	8	- Yaw/-X solenoid driver out
02	1	+ Roll/+Z solenoid driver out
02	2	- Roll/+Z solenoid driver out
02	3	+ Roll/-Z solenoid driver out
02	4	- Roll/-Z solenoid driver out
02	5	+ Roll/+Y solenoid driver out
02	6	- Roll/+Y solenoid driver out
02	7	+ Roll/-Y solenoid driver out
02	8	- Roll/-Y solenoid driver out
03	1	UDL sys validity signal (8 bits)
03	2	UDL sys validity signal
03	3	UDL sys validity signal
03	4	UDL sys validity signal
03	5	UDL sys validity signal
03	6	UDL sys validity signal
03	7	UDL sys validity signal
03	8	UDL sys validity signal
04	1	SPS solenoid driver out 1
04	2	SPS solenoid driver out 2
04	3	None assigned
04	4	None assigned
04	5	None assigned
04	6	None assigned
04	7	None assigned
04	8	None assigned

Table 1-17. SE-012 PCM Telemetry Bilevel Channel Assignments (Cont)

Group No.	Bit No.	Bilevel Measurement Description
05	1	Central timing GMT (seconds)
05	2	Central timing GMT (seconds)
05	3	Central timing GMT (seconds)
05	4	Central timing GMT (seconds)
05	5	Central timing GMT (seconds)
05	6	Central timing GMT (seconds)
05	7	Central timing GMT (seconds)
05	8	Central timing GMT (seconds)
06	1	Central timing GMT (minutes)
06	2	Central timing GMT (minutes)
06	3	Central timing GMT (minutes)
06	4	Central timing GMT (minutes)
06	5	Central timing GMT (minutes)
06	6	Central timing GMT (minutes)
06	7	Central timing GMT (minutes)
06	8	Central timing GMT (minutes)
07	1	Central timing GMT (hours)
07	2	Central timing GMT (hours)
07	3	Central timing GMT (hours)
07	4	Central timing GMT (hours)
07	5	Central timing GMT (hours)
07	6	Central timing GMT (hours)
07	7	Central timing GMT (hours)
07	8	Central timing GMT (hours)
08	1	Central timing GMT (days)
08	2	Central timing GMT (days)
08	3	Central timing GMT (days)
08	4	Central timing GMT (days)
08	5	Central timing GMT (days)
08	6	Central timing GMT (days)
08	7	Central timing GMT (days)
08	8	Central timing GMT (days)
09	1 thru 8	None assigned
10	1 thru 8	None assigned
11	1 thru 8	None assigned
12	1	Quantity fuel/oxidizer tanks A, B, C, D
12	2	Quantity fuel/oxidizer tanks A, B, C, D
12	3	Quantity fuel/oxidizer tanks A, B, C, D
12	4	Quantity fuel/oxidizer tanks A, B, C, D
12	5	Quantity fuel/oxidizer tanks A, B, C, D

Table 1-17. SE-012 PCM Telemetry Bilevel Channel Assignments (Cont)

Group No.	Bit No.	Bilevel Measurement Description
12	6	Quantity fuel/oxidizer tanks A, B, C, D
12	7	Quantity fuel/oxidizer tanks A, B, C, D
12	8	Quantity fuel/oxidizer tanks A, B, C, D
13	1	Quantity fuel/oxidizer tanks A, B, C, D
13	2	Quantity fuel/oxidizer tanks A, B, C, D
13	3	Quantity fuel/oxidizer tanks A, B, C, D
13	4	Quantity fuel/oxidizer tanks A, B, C, D
13	5	Quantity fuel/oxidizer tanks A, B, C, D
13	6	Quantity fuel/oxidizer tanks A, B, C, D
13	7	None assigned
13	8	None assigned
14	1 thru 8	None assigned
15	1 thru 8	None assigned
16	1	.05 g manual switch
16	2	MTVC mode control
16	3	None assigned
16	4	None assigned
16	5	None assigned
16	6	Sel switch position mon astro No. 1
16	7	Sel switch position mon astro No. 2
16	8	Sel switch position mon astro No. 3
17	1 thru 8	None assigned
18	1 thru 8	None assigned
19	1	Fuel cell 1 bus A disconnect
19	2	Fuel cell 2 bus A disconnect
19	3	Fuel cell 3 bus A disconnect
19	4	Fuel cell 1 bus B disconnect
19	5	Fuel cell 2 bus B disconnect
19	6	Fuel cell 3 bus B disconnect
19	7	Fuel cell 1 shutoff mon
19	8	Fuel cell 2 shutoff mon
20	1	Fuel cell 3 shutoff mon
20	2	Adapt separation B
20	3	FWD HS jettison A
20	4	ELS seq start relay close A
20	5	None assigned
20	6	EDS enable B
20	7	LE/PC MTR fire initiate A
20	8	None assigned

Table 1-17. SE-012 PCM Telemetry Bilevel Channel Assignments (Cont)

Group No.	Bit No.	Bilevel Measurement Description
21	1	LES abort initiate signal A
21	2	Adapt separation A
21	3	CM-SM sep relay close A
21	4	CM-SM sep relay close B
21	5	None assigned
21	6	Direct ullage on A
21	7	LES abort initiate signal B
21	8	Direct ullage on B
22	1	Adapt/SM sep initiate A
22	2	Adapt/SM sep initiate B
22	3	None assigned
22	4	None assigned
22	5	None assigned
22	6	RCS activate sig A
22	7	RCS activate sig B
22	8	CM RCS press. sig A
23	1	CM RCS press. sig B
23	2	None assigned
23	3	None assigned
23	4	Drogue deploy relay close A
23	5	Drogue deploy relay close B
23	6	Main chute depl-drg rel rly A
23	7	Main chute depl-drg rel rly B
23	8	Baro sw lock-in rly close A
24	1	Baro sw lock-in rly close B
24	2	Main chute disconnect relay A
24	3	Main chute disconnect relay B
24	4	None assigned
24	5	Canard deploy A
24	6	Hand controller input B
24	7	None assigned
24	8	SCS DV mode control
25	1	EDS abort logic in No. 1
25	2	EDS abort logic in No. 2
25	3	EDS abort logic in No. 3
25	4	None assigned
25	5	None assigned
25	6	None assigned
25	7	Canard deploy B
25	8	Booster cutoff sig A

Table 1-17. SE-012 PCM Telemetry Bilevel Channel Assignments (Cont)

Group No.	Bit No.	Bilevel Measurement Description
26	1	IMU +28 VDC operate
26	2	IMU +28 VDC standby
26	3	AGC +28 VDC
26	4	OPTX +28 VDC
26	5	PIPA fail
26	6	IMU fail
26	7	CDU fail
26	8	Gimbal lock warning
27	1	None assigned
27	2	Error detect
27	3	IMU temp light
27	4	Zero encoder light
27	5	IMU relay light
27	6	AGC alarm 1 (program)
27	7	AGC alarm 2 (AGC activity)
27	8	AGC alarm 3 (T/M)
28	1	AGC alarm 4 (prog ck fail)
28	2	AGC alarm 5 (scalar fail)
28	3	AGC alarm 6 (parity fail)
28	4	AGC alarm 7 (counter fail)
28	5	AGC alarm 8 (key release)
28	6	AGC alarm 9 (rupt lock)
28	7	AGC alarm 10 (TC trap)
28	8	Computer power fail light
29	1	ELS seq start rly close B
29	2	LE/PC MTR fire initiate B
29	3	Hand controller input A
29	4	None assigned
29	5	None assigned
29	6	None assigned
29	7	None assigned
29	8	None assigned
30	1	None assigned
30	2	None assigned
30	3	G&N att mode control
30	4	G&N entry mode control
30	5	Monitor mode control
30	6	None assigned
30	7	None assigned
30	8	SCS att mode control

Table 1-17. SE-012 PCM Telemetry Bilevel Channel Assignments (Cont)

Group No.	Bit No.	Bilevel Measurement Description
31	1	SCS entry mode control
31	2	None assigned
31	3	None assigned
31	4	None assigned
31	5	None assigned
31	6	None assigned
31	7	None assigned
31	8	None assigned
32	1	None assigned
32	2	EDS enable A
32	3	None assigned
32	4	Booster cutoff sig B
32	5	G&N DV mode control
32	6	Launch veh guidance fail A
32	7	None assigned
32	8	None assigned
33	1	Launch veh rate excessive A
33	2	None assigned
33	3	Eng No. 1 out A
33	4	Eng No. 2 out A
33	5	Eng No. 3 out A
33	6	Eng No. 4 out A
33	7	Eng No. 5 out A
33	8	Eng No. 6 out A
34	1	Eng No. 7 out A
34	2	Eng No. 8 out A
34	3	Lift-off signal A
34	4	Liit-off signal B
34	5	None assigned
34	6	None assigned
34	7	EDS abort request A
34	8	None assigned
35	1	CM-SM phys separation mon A
35	2	CM-SM phys separation mon B
35	3	None assigned
35	4	None assigned
35	5	SM/adapter phys separation mon A
35	6	SM/adapter phys separation mon B
35	7	EDS abort logic out A
35	8	SCS local vertical mode control

Table 1-17. SE-012 PCM Telemetry Bilevel Channel Assignments (Cont)

Group No.	Bit No.	Bilevel Measurement Description
36	1	CTE timing mode monitor
36	2	None assigned
36	3	PCM timing source EXT or INT
36	4	Reset Coincidence
36	5	EDS abort logic out B
36	6	Master caution-warning on
36	7	None assigned
36	8	FWD HS jettison B
37	1	None assigned
37	2	TWR jettison A
37	3	TWR jettison B
37	4	None assigned
37	5	pH factor water condition F/C 1
37	6	pH factor water condition F/C 2
37	7	pH factor water condition F/C 3
37	8	None assigned
38	1 thru 8	None assigned
39	1 thru 8	None assigned

1.3.7 SECURING IOS.

The following steps are to be taken to secure the IOS panels to a known baseline configuration following the completion of a training mission:

a. At IOS panel 2, ensure SUIT PRESSURE selector switch is in AUTO position and the INSTR portion of INSTR/SERVICE switch-light is illuminated.

b. Position RE-ENTRY HEAT OVERRIDE control to NORM position.

c. Return AURAL SIMULATION control to NORM position and ensure ON-OFF switch is ON.

d. At IOS panel 5, UP-DATA LINK, depress KEYBOARD CLEAR switch-light.

e. At IOS panel 25, depress both ZERO buttons and observe that RCS (lb) and TIME (sec) displays return to zero.

f. At IOS panel 28, MALFUNCTION STATUS, clear all displays by using procedure outlined in paragraph 1.2.15.2.

g. At panel 30, MALFUNCTION INSERTION, clear all malfunctions in computer by depressing MASTER CLEAR ALL SYSTEMS switch-light. (Refer to paragraph 1.2.15.4 for clearing time-dependent malfunctions.)

h. At panel 32, reset any circuit breaker switch-light which indicates FAILED BY INSTR by depressing the switch-light and observing that C/M RESETABLE light illuminates. (This enables the associated circuit breaker in the SCM to be reset.)

i. At panel 46, MASTER CONTROL panel, depress X-T RECORDER switch-light extinguishing the RECORD light.

j. Position INITIAL CONDITION CALL-UP dial to 002 at IOS panel 46, and depress RESET switch-light.

k. At IOS panel 72, repeat step h.

l. At IOS panel 83, KRS recorder, remove the used tape from unit using EJECT controls. Position CUE SELECT switch to OFF; turn off power to recorder by depressing PWR switch.

m. At IOS panel 86, return all GARBLE and NOISE controls to OFF position.

n. At IOS panel 87, depress X-Y PLOTTERS switch-light extinguishing the DOWN lights. Depress X-T RECORDERS switch-light extinguishing the ON light and illuminating the READY portion of the switch-light. Depress VOICE RECORDER-OFF switch-light observing OFF light illuminates.

o. At each of the CCS control panels, depress the RCS switch. Remove the headsets from each of the communication control panels and store in compartment under desk area.

p. Turn off each of CCTV monitors using the ON switch located on control panels under the monitor.

1.3.8 SECURING PLOTTERS AND RECORDER.

The following procedure is used to secure the plotters and recorders at the completion of a training session:

a. At X-Y variplotter (30 x 30), position OPERATE-STANDBY-REMOTE switches to STANDBY. The arms shall position to extreme ends of the board. Position VACUUM switch to OFF and remove plotting paper. Position LIGHTS switch to OFF and turn off plotter by placing switch OFF.

b. At X-Y variplotter (11 x 17), position PEN-ARM switch to UP-STBY position. This positions the arms to extreme ends of the board. Place the VAC-PWR switch to the OFF-OFF position. Remove plotting paper from board.

c. At each of the X-T recorders, remove used portion of chart paper. In order to run out enough paper for removal, it may be necessary to use LOCAL and OPERATE switches, on the oscillograph central panel, and a CHART SPEED MM/SEC position. Turn off each recorder using MAIN POWER switch located on LIGHT LEVEL panel.

1.3.9 SECURING T/M CONSOLE.

The following procedure is to be used for securing the T/M console:

a. Return all malfunction controls to NORM position.

b. Return CCTV to IMCC, SELECTOR CAMERA switch to OFF position.

c. Depress TELEMETRY-PCM ON switch-light.

d. Depress RLS switch on both CCS panels.

1.3.10 SECURING COMPUTER COMPLEX.

The following procedure is to be used to secure the computer complex following the completion of a training session.

a. Depress FREEZE switch-light at IOS panel 46.

b. At each of the MTUs, rewind and unload the tapes on each transport as described in paragraph 1.2.6.3, and store.

c. Turn off each MTU by depressing the POWER switch-light on each MTU control panel.

d. Position power switches on paper tape reader and punch to OFF.

e. Remove any cards from card punch and store. Turn off card punch by depressing POWER OFF switch-light at card punch control panel.

f. Remove any cards from card reader and store. Remove power from card reader by depressing POWER OFF switch-light on card reader control panel.

g. At line printer, tear off any portion of printed data from paper spool and store if desired. Turn off line printer by depressing POWER ON switch-light on line printer control panel.

h. At the typewriter for each computer, type in the letter "D" and observe HALT light illuminates on each computer control panel. Lock each typewriter keyboard by use of the ON-OFF switch on the typewriter.

i. At each computer control panel, depress MASTER CLEAR pushbutton. Return all INTERRUPT and SENSE switches to OFF position.

j. Turn off each computer by depressing POWER switch-light at each control panel.

k. Refer to paragraph 1.2.1 for removal of main power to the computer system.

1.4 SIMULATOR COMPLEX CHECKLISTS.

Table 1-18 comprises a checklist for instructor-operator setup and operation of the AMS complex for complete mission simulations, that is, from prelaunch through orbital phase and retrofire, and backdown to touchdown. All procedures included are with specific reference to unit procedures and/or systems checklists provided elsewhere in this section of the handbook.

The checklist procedures, provided in table 1-18, are the procedures for setup and operation for a complete 16-orbital mission and inherently contain procedures for setting up the simulator for simulation of all partial missions. Table 1-1 this section, illustrates how and which portions of the complete (mission) AMS complex checklist are used to prepare checklists for launch-boost, orbit, and entry part-mission simulations. Which AMS complex checklist each procedure applies to is noted in the procedure heading in the complete (mission) checklist. The special procedure for abort simulation is given in paragraph 1.4.2.2.

1.4.1 MISSION SIMULATION PREPARATION-OPERATION.

Preparation and operation of the AMS for purposes of simulating complete Apollo missions involves the accomplishment of all procedures in table 1-18 as described in paragraph 1.4.

1.4.2 LAUNCH SIMULATION PREPARATION-OPERATION.

The checklists outlined in table 1-1 for launch simulation preparation-operation are for simulation of launch boosts that are not continued into the orbital phase. Such simulations fall into two groups: simulation of successful launch boost that is terminated at orbit injection, and simulation of abortive launch boosts that are concluded with LES or SPS abort simulation. Because such simulations are relatively short, many procedures in the complete (mission) checklists are omitted, for example, potable water system waste management system, and visual system procedures.

1.4.2.1 Successful Launch-Boost Preparation-Operation.

The procedure for preparation and operation of the AMS for simulation of successful launch-boost is in accordance with those portions of table 1-18 outlined for this purpose in table 1-1.

1.4.2.2 Launch-Boost Abort Preparation-Operation.

The complex checklist for successful launch-boost simulation must be augmented with cause for abort and abort initiation instructions in order to be used for abort simulation.

The boost tape provided for the SE-012 configuration of the AMS does not include any simulation of booster malfunction. This is not, however, prohibitive to effective simulation of crew and auto abort simulation for training purposes.

All instructor access to abort simulation is by means of the malfunction insertion unit. The malfunctions available for this purpose are listed as follows:

Malfunction Title	MIU Code
ABORT REQUEST LIGHT ON	CS 201
BOOSTER ENGINE #1 FAIL	CS 203
BOOSTER ENGINE #2 FAIL	CS 205
BOOSTER ENGINE #3 FAIL	CS 207
BOOSTER ENGINE #4 FAIL	CS 211
BOOSTER ENGINE #5 FAIL	CS 213
BOOSTER ENGINE #6 FAIL	CS 215
BOOSTER ENGINE #7 FAIL	CS 217
BOOSTER ENGINE #8 FAIL	CS 221
LV RATES EXCESSIVE	CS 223
LV GUIDANCE FAIL	CS 225
INSTRUCTOR INITIATED ABORT	CS 250

These malfunctions, with the exception of INSTRUCTOR INITIATED ABORT, only illuminate the respective lights within the SCM and do not cause an automatic abort to occur, as would happen in the actual spacecraft. Therefore, the instructor must augment the simulation. To do this, he may choose one of two alternatives after he has activated abort initiation malfunction indications: (1) initiate an automatic abort (malfunction No. 250) to cause the simulation to appear realistic, or (2) allow events that occur to be dependent upon crew actions (that is, apparent failure of EDS automatic abort system). The following procedures are recommended for the operation of the MIU during the launch phase for purposes of effective abort simulation. In the procedures, specific malfunction codes are used as examples; however, others tabulated in the preceding list may be substituted for those used.

Alternative 1, Auto Abort.

a. Depress MIU CONTROL PANEL RESET switch-light. Switch-light illuminates and extinguishes when MIU control panel clears.

b. Depress DISPLAY 1 switch-light. Switch-light illuminates on MIU control and display panel; CONTROL PANEL IN USE light illuminates on all MIU control panels.

c. Depress CS SYSTEM SELECT switch-light. Switch-light illuminates.

d. Depress KEYBOARD digits 2, 0, and 3, in that order. Code 203 displayed in VERIFY register; IMP light illuminates; CS 203 code is displayed in DISPLAY 1 of MIU display panels, and control panel is reset.

e. Repeat steps a through d for malfunction codes CS 205 and CS 250 using DISPLAY 2 and DISPLAY 3.

f. At desired time after lift-off, depress DISPLAY 1 switch-light on MIU control panel. Switch-light illuminates; CONTROL PANEL IN USE light illuminates on all MIU control panels.

g. Depress MALF ENTER switch-light at MIU control panel. Switch-light illuminates, IMP light extinguishes, and ENT light illuminates.

h. Observe crew reaction to booster engine failure indication.

i. Reset MIU control panel.

j. Repeat steps 6 and 7 for DISPLAY 2 and DISPLAY 3.

k. Observe trainee response to abort initiation.

l. Continue with abort crew procedures data.

Alternative 2, Crew Initiated Abort.

a. Key malfunction codes CS 201, CS 203, and CS 205 in DISPLAY 1, 2, and 3, respectively. Malfunction codes are displayed on MIU display in respective display locations with each IMP light illuminated.

b. At desired time after lift-off, depress DISPLAY 2 switch-light on MIU control panel. Switch-light illuminates; CONTROL PANEL IN USE light illuminates on all control panels.

c. Depress MALF ENTER switch-light. Switch-light illuminates, display panel ENT light for DISPLAY 2 illuminates, and IMP light extinguishes.

d. Observe crew reaction to booster engine failure indication.

e. Reset MIU control panel.

f. Depress DISPLAY 3 switch-light. Switch-light illuminates.

g. Depress MALF ENTER switch-light. Switch-light illuminates, display panel ENT light for DISPLAY 3 illuminates, and IMP light extinguishes.

h. Monitor crew response to abort situation.

i. If crew does not initiate abort within prescribed time, depress DISPLAY 1 switch-light at MIU control panel. Switch-light illuminates; CONTROL PANEL IN USE light illuminates on all control panels.

j. Depress MALF ENTER and verbally request crew to initiate abort. Switch-light illuminates, display panel ENT light illuminates, and IMP light extinguishes.

k. Monitor crew reaction to ABORT indication and request.

l. If crew does not initiate abort, terminate simulation.

1.4.3 ORBITAL SIMULATION PREPARATION-OPERATION.

The procedure for preparation and operation of the AMS for simulation of orbital situations is in accordance with those portions of table 1-18 outlined for this purpose in table 1-1. Preparation of the potable water and waste management system is optional on the basis of planned time duration for the simulation.

1.4.4 ENTRY SIMULATION PREPARATION-OPERATION.

The procedure for preparation and operation of the AMS for simulation of entry subsequent to retrograde deboost is in accordance with those portions of table 1-18 outlined for this purpose in table 1-1. Such simulation is relatively short; therefore many procedures in the complete (mission) complex checklists are omitted, for example, potable water system, waste management system, and visual system procedures.

1.4.5 SIMULATION COMPLETE.

These checklists will enable the instructor-operator to return the AMS to a known baseline configuration at the completion of training.

Table 1-18. Simulator Complex Checklist

VISUAL SYSTEM CHECKLIST
SIMULATOR PREPARATION

FILM CASSETTE LOADING

This checklist is used to prepare the optical system with film required for the selected training exercise. Unit procedure is described in paragraph 1.2.1.

This procedure is used for all complex checklists.

a.	Access doors	Remove
b.	Loading handles	Remove
c.	Index and position	Perform
d.	MAINT IN PROGRESS switch-lights	Depress
e.	MEP power	Off
f.	Loading handles	Attach
g.	Film cassette	Install
h.	Loading handles	Remove and attach
i.	MEP power	On
j.	Position controls	AUTO
k.	Access doors	Attach
l.	MAINT IN PROGRESS switch-lights	Depress
m.	VISUAL SYSTEM STATUS - servo systems lights	Computer
n.	Simulator status lights	Off

Table 1-18. Simulator Complex Checklist (Cont)

SIMULATED COMMAND MODULE CHECKLIST

SIMULATOR PREPARATION

POTABLE WATER SYSTEM

This checklist is used for replenishing the water supply within the simulated spacecraft. Unit procedure is described in paragraph 1.2.2.

This procedure is used for all complex checklists except launch, abort, and entry.

a.	Pressure regulator valve	Closed
b.	FILL-PRESSURE valve	FILL VENT
c.	Fill hose disconnect valve	Attach
d.	Fill tank-level gage	42 gal.
e.	Fill hose	Remove
f.	FILL-PRESSURE valve	PRESSURE CLOSE
g.	Pressure regulator 20 PSI	OPEN
h.	Water supply valves	CYCLE

Table 1-18. Simulator Complex Checklist (Cont)

SIMULATED COMMAND MODULE CHECKLIST

SIMULATOR PREPARATION

CHECK AND EMPTY WASTE MANAGEMENT

This checklist is used to prepare the WMS for operation by removing waste matter and replenishing the disinfectant. Unit procedure is described in paragraph 1.2.3.

This procedure is used for all complex checklists except launch, abort, and entry.

a.	MAIN POWER & AUXILIARY EQUIP breakers	ON
b.	FILTER BLOCKED indicators (2)	Out
c.	SCM URINE DUMP switches (2)	DUMP
d.	Flexible hose to urine outlet	Attach
e.	Urine valve 90° CW	Rotate
f.	SCM URINE DUMP switches (2)	OFF
g.	Fill urinal with disinfectant	1 quart
h.	Steps c and e	
i.	Fill Disinfectant tank	2 quarts
j.	VACUUM CLEANER MOTOR switch	ON
k.	WMS storage compartment	Empty

Table 1-18. Simulator Complex Checklist (Cont)

SIMULATED COMMAND MODULE CHECKLIST
SIMULATOR PREPARATION

VERTICAL INSERTION AND RETRACTION

This checklist is used in positioning the SCM in the horizontal and vertical direction for operation. The unit procedure is described in paragraph 1.2.4.

The use of this checklist is dependent upon the location and position of the SCM prior to a training session.

a.	SCM clear obstructions	Verify
b.	C/M lights ON switch	Depress
c.	Warn horn switch	Depress
d.	Horizontal movement:	
	1. CLUTCH lever position	NORMAL
	2. MOTOR FORWARD switch	Depress
	3. CLUTCH RUN switch	Depress
	4. MOTOR STOP switch	Depress
e.	Locking lever	Down and lock
f.	Vertical movement: VERT LIFT-UP switch	Depress
g.	Shrouds	Adjust

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKLIST
SIMULATOR PREPARATION

MAGNETIC TAPE SPOOL INSTALLATION

This checklist is used to install the tape spools on the MTU prior to a training session. Unit procedure is described in paragraph 1.2.5.1.

This procedure is used for all complex checklists.

a.	Spool read or write (file ring)	Select
b.	MTU POWER switch	Depress
c.	Front door	Lower
d.	Takeup reel knob	CCW 3 turns
e.	Empty tape spool	Install
f.	Supply reel	Install
g.	Takeup load arms	Raise
h.	Thread tape on takeup spool	Perform
i.	Takeup load arms	Lower
j.	Front door	Raise
k.	LOAD switch light	Depress
l.	Tape positions - LOAD light on	Verify
m.	ADDRESS SELECT switch	Set
n.	DENSITY MODE	Select
o.	READY switch-light	Depress

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKOUT

SIMULATOR PREPARATION

MAGNETIC TAPE PROGRAM LOADING

This checklist is used to load the computer memory from magnetic tape. Unit procedure is described in paragraph 1.2.5.2.

This procedure is used for premission setup procedure effective for all checklists.

a.	Verify READY switch-light on	Observe
b.	Verify bootstrap program entered	Verify
c.	Density mode	Select
d.	MASTER CLEAR pushbutton	Depress
e.	SENSE switches position (Refer to premission checklist.)	
f.	I/O function selection switch	ON-LINE
g.	PROGRAM register starting location	
h.	START pushbutton	Depress

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKLIST

SIMULATOR SECURE

TAPE SPOOL REMOVAL

This checklist is used to remove the tape spools from the MTU tape deck during premission setup or for securing the computer complex. Unit procedure is described in paragraph 1.2.5.3.

a.	CLEAR switch-light	Depress
b.	REWIND switch-light	Depress
c.	FRONT DOOR	Slide down
d.	Supply reel hub knob	Loosen
e.	Supply reel	Remove
f.	File ring	Remove/add
g.	Store reel	Perform

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKLIST

SIMULATOR PREPARATION

LOADING CARD READER

This procedure is used to load and check the operational readiness of the card reader. Unit procedure is described in paragraph 1.2.6.1.

This procedure is used for all complex checklists.

a.	POWER ON switch-light	Depress
b.	NOT READY light on	Verify
c.	VALIDITY ON switch-light	Depress
d.	Card deck	Install
e.	LOCAL-RUN switch	LOCAL
f.	Card feed	Observe
g.	FEED CHECK light on	Verify
h.	Card deck	Remove
i.	LOCAL-RUN switch	RUN
j.	RESET switch-light	Depress
k.	FEED CHECK light off	Verify
l.	Card deck	Install
m.	START switch	Depress
n.	READY light on	Verify

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKLIST

SIMULATOR PREPARATION

PUNCHED CARD PROGRAM LOADING

This procedure is used to transfer the data from the card deck to the computer memory. Unit procedure is described in paragraph 1.2.6.2.

This procedure is used for all complex checklists.

a.	READY light on	Verify
b.	FILL selection rotary switch	CARD RDR HOL
c.	I/O function selection switch	ON-LINE
d.	OP code register	053
e.	Z register	26150
f.	EXECUTE pushbutton	Depress
g.	FILL pushbutton	Depress
h.	Card deck feed	Verify
i.	MASTER CLEAR pushbutton	Depress

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKLIST

SIMULATOR PREPARATION

PAPER TAPE PROGRAM LOADING

This procedure is used when loading the computer memory from paper tape. Unit procedure is described in paragraph 1.2.7.

a.	FILL selection rotary switch	PAPER TAPE
b.	I/O function selection	ON-LINE
c.	MASTER CLEAR pushbutton	Depress
d.	Paper tape reader switch	On
e.	Paper tape	Install
f.	Program register starting location	
g.	FILL pushbutton	Depress
h.	Paper tape feed	Monitor
i.	MASTER CLEAR pushbutton	Depress

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKLIST

SIMULATOR PREPARATION

MANUAL PROGRAM LOADING

This checklist is used for manual memory loading of the computer program words, one at a time. Unit procedure is described in paragraph 1.2.8.

This procedure can be used for any complex checklist.

a.	MASTER CLEAR pushbutton	Depress
b.	OP REGISTER *	Set
c.	Z REGISTER *	Set
d.	A REGISTER *	Set
e.	EXECUTE pushbutton	Depress
f.	HALT light	On
g.	MASTER CLEAR pushbutton	Depress
h.	Subsequent words repeat from step b	

*Refer to operational program procedure.

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR OPERATOR STATION CHECKLIST

SIMILATOR PREPARATION

RECORDER AND PLOTTER INPUTS

This checklist is used to assign selected parameters to the X/T and X/Y recorders during on-line operation. This assigning of selected parameters to the recorders during premission preparation is described in the premission set-up checklist. Unit procedure described in paragraph 1.2.9.1 is applicable to both modes of operation.

This procedure may be used for all checklists:

a.	FREEZE switch-light	Depress
b.	X typewriter key	Depress
c.	Carriage return	Observe
d.	Five octal characters on typewriter	Type
e.	(slash) typewriter key	Type
f.	+ or - typewriter key	Type
g.	Two decimal integers	Type
h.	/ (Slash) typewriter key	Type
i.	Two decimal integers	Type
j.	Carriage return	Observe

NOTE: To enter additional parameters, repeat steps b through j.

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR - OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

COMPUTER INTERROGATION

This procedure is used to interrogate any computer memory location and to type out its contents. Unit procedure is described in paragraph 1.2.9.2.

a.	FREEZE switch-light	Depress
b.	L typewriter key	Type
c.	Carriage return	Verify
d.	Five octal digits	Type
e.	Carriage return	Verify
f.	U or L typewriter key	Type
g.	Contents typed out	Observe

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR - OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

INITIALIZATION OF CTE

This checklist is used to initialize or change the simulated GMT as displayed on the TM and IOS consoles prior to or during a training session. The unit procedure is described in paragraph 1.2.9.3.

This procedure may be used for all checklists.

a.	FREEZE switch light	Depress
b.	C typewriter key	Depress
c.	Three decimal integers	Type
d.	/ (slash) typewriter key	Depress
e.	Six decimal integers	Type
f.	/ (slash) typewriter key	Depress
g.	Two decimal integers	Type
h.	/ (slash) typewriter key	Depress
i.	Two decimal integers	Type
j.	Carriage return	Observe
k.	Verify timers change	Observe

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR - OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

STEP-AHEAD PROCEDURE

This checklist is used when the instructor desires to advance the training session to an advanced point on the trajectory. The unit pressure is described in paragraph 1.2.9.4.

This procedure may be used for the orbital simulation checklists.

a.	FREEZE switch-light	Depress
b.	S typewriter key	Depress
c.	Three decimal integers	Type
d.	"/" (slash) typewriter key	Type
e.	Six decimal integers	Type
f.	STEP-AHEAD switch-light	Depress
g.	STEP-AHEAD switch-light	ON
h.	STEP-AHEAD switch-light	OFF
i.	FREEZE switch-light	ON
j.	Timers change	Verify

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

LAUNCH-BOOST TAPE ENTRY

The entry of the launch-boost parameters are performed as an integral part of the premission set-up procedure. Refer to the premission set-up checklist and the unit procedure as described in paragraph 1.3.2.

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

EMPHEMERIS ENTRY

The entry of the ephemeris data is performed as an integral part of the premission set-up procedure. Refer to the premission set-up checklist and the unit procedure as described in paragraph 1.3.2.

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKLIST
SIMULATOR PREPARATION

DIAGNOSTIC ENTRY

This procedure is used to enter the simulator into the diagnostic mode of operation. Unit procedure is described in paragraph 1.2.9.6.

a.	FREEZE switch-light	Depress
b.	D typewriter key	Type
c.	Maintenance checks	Perform

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER SYSTEM CHECKLIST

SIMULATOR PREPARATION

LINE PRINTER OPERATION

This procedure is used to prepare the line printer for operation. Unit procedure is described in paragraph 1.2.10.

This procedure may be used for all checklists.

a.	POWER ON switch-light	Depress
b.	STANDBY switch-light	On momentarily
c.	TOP OF FORM switch-light	Depress

Table 1-18. Simulator Complex Checklist (Cont)

TELEMETRY SYSTEM CHECKLIST

SIMULATOR PREPARATION

T/M CONSOLE FAULT PATCHING

This checklist is used for inserting parameter faults into simulated spacecraft down telemetry channels. Unit procedure is described in paragraph 1.2.11.

This procedure can be used on all complex checklists.

a.	Patch panel	Remove
b.	T/M fault patch per paragraph 1.2.11	
c.	Patch panel	Replace

Table 1-18. Simulator Complex Checklist (Cont)

SIMULATOR PREPARATION

POWER ON (MANUAL)

This checklist is used to apply power to the AMS under manual control. Unit procedure is described in paragraph 1.3.1.

a.	UTILITY PWR circuit breaker	ON
b.	All utility circuit breakers	ON
c.	MAIN PWR circuit breaker	ON
d.	POWER AVAILABLE light	ON
e.	CORRECTLY PHASED WHEN BRIGHT light	Illuminated brightly
f.	AC LINE VOLTAGE METER readings	Verify
g.	STARTING MODE switch	MANUAL
h.	MANUAL light	ON
i.	All circuit breakers (unit 32)	ON
j.	All data conversion circuit breakers (unit 37)	ON
h.	LIFE SUPPORT-ON switch-light	Depress
l.	400 CPS MG-ON switch-light	Depress
m.	COMPUTER-ON switch-light	Depress
n.	DATA CONVERSION-ON switch-light	Depress
o.	PERIPHERAL-ON switch light	Depress
p.	VISUAL-ON switch light	Depress
q.	400 CYCLE POWER-VOLTAGE REGULATOR control	Adjust, if necessary
r.	VISUAL POWER switch-light on (unit 61)	Verify

Table 1-18. Simulator Complex Checklist (Cont)

SIMULATOR PREPARATION

POWER ON (SEQUENTIAL)

This checklist is used to apply power to the AMS under manual and automatic control. Unit procedure is described in paragraph 1.3.1.

a.	UTILITY PWR circuit breaker	ON
b.	All utility power circuit breakers	ON
c.	All data conversion circuit breakers	ON
d.	MAIN PWR circuit breaker	ON
e.	POWER AVAILABLE light	ON
f.	CORRECTLY PHASED WHEN BRIGHT light	Illuminated brightly
g.	AC LINE VOLTAGE meter readings	Verify
h.	STARTING MODE switch	SEQUENTIAL
i.	SEQUENTIAL light	ON
j.	SEQUENTIAL MODE-ON switch-light	Depress
h.	LIFE SUPPORT-ON light	ON
l.	400 CPS MG-ON switch-light	ON
m.	COMPUTER-ON switch-light	ON
n.	DATA CONVERSION-ON switch-light	ON
o.	PERIPHERAL-ON switch-light	ON
p.	VISUAL-ON switch-light	ON
q.	400 CYCLE POWER-VOLTAGE REGULATOR control	Adjust, if necessary
r.	VISUAL POWER switch-light on (unit 61)	Verify

Table 1-18. Simulator Complex Checklist (Cont)

SIMULATOR PREPARATION

POWER OFF - MANUAL

This checklist is used to shut down the AMS under manual control. Unit procedure is listed under paragraph 1.3.1.

a.	Secure equipment	Verify
b.	VISUAL-OFF switch-light	Depress
c.	PERIPHERAL-OFF switch-light	Depress
d.	DATA CONVERSION-OFF switch-light	Depress
e.	COMPUTER-OFF switch-light	Depress
f.	400 CPS MG-OFF switch-light	Depress
g.	LIFE SUPPORT-OFF switch-light	Depress
h.	All circuit breakers (unit 32)	OFF

Table 1-18. Simulator Complex Checklist (Cont)

SIMULATOR PREPARATION

POWER OFF - SEQUENTIAL

This checklist is used to shut down the AMS under sequential control. Unit procedure is described in paragraph 1.3.1.

a.	Secure equipment	
b.	SEQUENTIAL MODE-OFF switch-light	Depress
c.	All circuit breakers (unit 32)	OFF

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER COMPLEX CHECKLIST

SIMULATOR PREPARATION

PREMISSION SETUP

This checklist is used to prepare the computer complex and the peripheral equipment for a training session. Unit procedure is described in paragraph 1.3.2.

This procedure is used for all complex checklists.

a.	Mount mission tape on MTU No. 4 (See MTU loading checklist.)	Perform
b.	Set up card reader (See card reader checklist.)	Perform
c.	Ephemeris bootstrap card deck	Load
d.	MASTER CLEAR pushbutton (all computers)	Depress
e.	Fill selection rotary switch (computer D)	CARD RDR HOL
f.	I/O function selection rotary switch (computer D)	ON-LINE
g.	SENSE switch 6 (computer D)	Up
h.	OP CODE register (computer D)	053
i.	Z register (computer D)	26150
j.	EXECUTE pushbutton (computer D)	Depress
k.	OP CODE register RESET pushbutton (computer D)	Depress
l.	Z register RESET pushbutton (computer D)	Depress
m.	Program Register (computer D)	00100
n.	START pushbutton (computer D)	Depress
o.	MESSAGE typed out	Monitor
p.	Mount ephemeris tape (See MTU loading checklist.)	Program

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER COMPLEX CHECKLIST SIMULATOR PREPARATION		
PREMISSION SETUP (CONT)		
q.	START pushbutton (computer D)	Depress
r.	Message typed out	Monitor
s.	Four decimal digits (typewriter keyboard)	Type
t.	Ø typewriter key	Type
u.	Three decimal digits (typewriter keyboard)	
v.	Message typed out	Monitor
w.	SENSE switch 6 (computer D)	Down
x.	SENSE switch 2 (computer D)	Up
y.	SENSE switch 1 (computer C)	Up
z.	SENSE switch 3 (computer E)	Up
aa.	MASTER CLEAR pushbutton (all computers)	Depress
ab.	OP CODE register (computer C)	053
ac.	Z register (computer C)	26150
ad.	Fill selection rotary switch (computer C)	CARD RDR HOL
ae.	I/O function selection rotary switch (computer C)	ON-LINE
af.	EXECUTE pushbutton (computer C)	Depress
ag.	OP CODE register RESET pushbutton (computer C)	Depress
ah.	Z register RESET pushbutton (computer C)	Depress
ai.	Mission tape bootstrap card deck	LOAD
aj.	FILL pushbutton (computer C)	Depress

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER COMPLEX CHECKLIST SIMULATOR PREPARATION		
PREMISSION SETUP (CONT)		
ak.	MASTER CLEAR pushbutton (computer C)	Depress
al.	Repeat steps bb through kk on computer D	Perform
am.	Repeat steps bb through kk on computer E	Perform
an.	START pushbutton (all computers)	Depress
ao.	Message typed out	Observe
ap.	Remove mission tape (See MTU tape unload checklist.)	Perform
aq.	MAIN INTERRUPT switches (all computers)	Up
ar.	REAL TIME INTERRUPT switches (all computers)	Up
as.	All SENSE switches (all computers)	Down
at.	MASTER CLEAR pushbuttons (all computers)	Depress
au.	Program registers (all computers)	Starting Location
av.	Start pushbuttons (all computers)	Depress
aw.	Message typed out	Monitor
ax.	Message instructions	Perform
ay.	BACKSPACE typewriter key	Depress
az.	Message typed out	Monitor
ba.	Four characters (typewriter keyboard)	Type
bb.	Data recording tape label message	Monitor
bc.	BACKSPACE typewriter key	Depress
bd.	X/Y-X/T recorder message	Monitor

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER COMPLEX CHECKLIST SIMULATOR PREPARATION	
PREMISSION SETUP (CONT)	
be. Enter X/Y-X/T recorder inputs (See recorder input/checklist.)	Type
bf. BACKSPACE typewriter key	Depress
bg. Integrated/nonintegrated message	Monitor
bh. Carriage return (nonintegrated mode)	Depress
bi. Four-character launch number label (nonintegrated)	Type
bj. Launch boost tape message	Monitor
bk. BACKSPACE (integrated mode)	Depress
bl. Integrated mode message	Monitor
bm. MIU message	Monitor
bn. Set up card reader (see card reader checklist.)	Perform
bo. Set up line printer (see line printer checklist.)	Perform
bp. BACKSPACE typewriter key	Depress
bq. MIU initialization message	Monitor
br. FREEZE switch-light	ON
bs. Enter CTE (See initialization of CTE checklist.)	Perform

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

RESET INITIALIZATION

This checklist is used to reset to any of the reset points available for SE012 AMS. Unit procedure is described in paragraph 1.3.3.

This procedure is used for all complex checklists when resetting is desired.

a.	FREEZE switch-light	Depress
b.	INITIAL CONDITION CALL-UP indicators	Dial
c.	RESET switch-light	Depress
d.	Verify timer change	Monitor times
e.	Change time, if desired (Refer to initialization of CTE checklist.)	Perform
f.	Perform SCM configuration changer	Perform

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST
SIMULATOR PREPARATION

G&N AND VISUAL READINESS

This checklist is used to verify the readiness of the system and indicator operation. Unit procedure is described in paragraph 1.3.4.1.

This procedure is used for all complex checklists.

a.	SERVO SYSTEM COMPUTER light	On
b.	Lamp and power fail light	Off
c.	AIR COMPRESSOR SAFE light	On
d.	INTENSITY, SCALE, and FOCUS controls	Adjust
e.	ZERO pushbuttons	Depress
f.	CRT MODE SELECTOR rotary switch	Set
g.	MARK HOLD RELEASE MAN-AUTO switch-light	AUTO

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST
SIMULATOR PREPARATION

TRUE TRAINEE ENVIRONMENT

This checklist is used for setup and readiness checks of the instructor controls used to monitor and assist the simulation of system effects. Unit procedure is described in paragraph 1.3.4.2.

This procedure is used for all complex checklists.

a.	AIR FLOW LOW light	Off
b.	Operation of SUIT and CABIN ECS	Verify
c.	SUIT PRESSURE OVERRIDE control	AUTO
d.	REENTRY HEAT OVERRIDE control	NORM
e.	AURAL SIMULATION ON-OFF switch	ON
f.	AURAL SIMULATION OVERRIDE control	NORM
g.	SMOKE GENERATOR FLUID LOW light	Off

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST SIMULATOR PREPARATION	
UP-DATA LINK STATUS	
This checklist is used as a readiness check for nonintegrated operation of the up-data link panel. Unit procedure is described in paragraph 1.3.4.3.	
This procedure is used for all complex checklists.	
a. UDL MODE switch-light	Depress
b. NON INT/INT light	ON

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

COMPUTER AND SIMULATOR STATUS

This checklist is used for establishing readiness of the AMS through status indicator checks. Unit procedure is described in paragraph 1.3.4.4.

This procedure is used for all complex checklists.

a.	STATUS lights (IOS panel 48)	Off
b.	HALF lights (IOS panel 81)	Off

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

RECORDER AND PLOTTER STATUS

This checklist is used for defining steps needed in preparation, initialization, and simulation. Unit procedure is described in paragraph 1.3.4.5.

This procedure may be used for all complex checklists.

a.	VOICE RECORDER RECORDING ON-OFF switch-light	Out
b.	VOICE RECORDER RECORDING CONT. switch-light	Depress
c.	VOICE RECORDER LAST CART light	Off
d.	X-T RECORDER switch-lights	Depress
e.	X-Y PLOTTERS PEN DOWN switch-lights	Depress

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

CLOSED CIRCUIT TV SETUP

This checklist is used for setting the controls of the CCTV system at each instructor station prior to simulation run. Unit procedure is described in paragraph 1.3.4.6.

This procedure may be used for all complex checklists.

a.	Power switch	ON
b.	H-HOLD, V-HOLD controls	Adjust, if necessary
c.	BRIGHTNESS AND CONTRAST controls	Adjust
d.	V-LIN control	Adjust, if necessary

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

COMMUNICATIONS CONTROL SETUP

This checklist is used for setting up the communications configuration to be used during a simulation training exercise. Unit procedure is described in paragraph 1.2.12.

This procedure is used for all complex checklists.

a.	AUDIO SELECT switches to CCS	Set
b.	Headset cords	Connect
c.	VOLUME control	Adjust
d.	CMIL talk-listen keys	Depress
e.	Continuity instructor loop	Verify
f.	CL talk-listen keys	Depress
g.	RING key (IOS panel 89)	Depress
h.	CL key light	ON
i.	Continuity computer loop	Verify
j.	ML talk-listen key	Depress
k.	RING key (IOS panel 89)	Depress
l.	ML key light	On
m.	Continuity maintenance loop	Verify
n.	CMIL talk-listen key (IOS panel 89)	Depress
o.	Monitor keys AL-1 (IOS panel 80) AL-2 AL-3 TM-1 TM-2	Depress

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST SIMULATOR PREPARATION	
COMMUNICATIONS CONTROL SETUP (CONT)	
p. CMIL and CM INTERCOM monitor keys	Depress
1. Command (IOS panel 27) 2. Navigation (IOS panel 47) 3. System management instructor (IOS panel 71)	
q. Talk-listen keys per crew procedures	Depress
1. Command (IOS panel 27) 2. Navigation (IOS panel 47) 3. System management instructor (IOS panel 71)	

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

VOICE INTERFERENCE OPERATION

This checklist is used to allow the instructor to simulate effects of spacecraft misorientation or improper communications configuration management. Unit procedure is described in paragraph 1.3.4.7.

This procedure is used for orbital and entry complex checklists.

a.	VHF-AM NOISE & GARBLE control	Adjust
b.	HF NOISE & GARBLE control	Adjust
c.	S-BAND NOISE & GARBLE control	Adjust

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST
SIMULATOR PREPARATION

MALFUNCTION INSERTION AND STATUS

This checklist is used to verify the status of the malfunction insertion unit and for inserting malfunctions manually during the training session. Unit procedure is described in paragraph 1.3.4.8.

This checklist is used for all complex checklists.

a.	LINE PRINTER readout	Verify
b.	Session data sheets	Monitor
c.	Malfunctions as per paragraph 1.2.15	Insert

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

PLOTTER READINESS AND SETUP (30 X 30)

This checklist is used for setup of the plotter prior to a training exercise. Unit procedure is described in paragraph 1.3.5.1.

This procedure may be used for all complex checklists.

a.	PEN UP-DOWN-REMOTE switch	REMOTE
b.	PEN OPERATE-STANDBY-REMOTE switch	REMOTE
c.	POWER switch	ON
d.	LIGHTS switch	On
e.	Load paper	
f.	VACUUM switch	ON
g.	PEN INTERCHANGE	AUTO
h.	PEN & ARM PARALLAX control	Adjust
i.	PEN & ARM SCALE FACTOR control	Adjust
j.	VERNIER control	Adjust
k.	PAPER ADJUST controls	Adjust

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

PLOTTER READINESS AND SETUP (11 X 17)

This checklist is used for setup of the plotter for various simulated spacecraft and mission parameters. Unit procedure is described in paragraph 1.3.5.2.

This procedure may be used for all complex checklists.

a.	VAC PWR switch	OFF-ON
b.	VARIABLE-FIXED switches	FIXED
c.	RANGE controls	Set
d.	PEN-ARM switches	UP-STANDBY
e.	ZERO controls	Adjust
f.	Load paper	
g.	VAC PWR switch	ON-ON
h.	PEN INTCHG switch	AUTO
i.	PEN-ARM switch	UP-OPERATE
j.	SCALE FACTOR controls	Adjust

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST
SIMULATOR PREPARATION

RECORDER SETUP (X-T)

This checklist is used for setting up the recorders prior to operation for a training exercise. Unit procedure is described in paragraph 1.3.5.3.

This procedure may be used in all complex checklists.

a.	POWER switch	ON
b.	Calibration test	Perform
c.	VOLT/LINE pushbuttons	Depress
d.	PEN POSITION controls	Adjust
e.	OPERATE pushbutton	Depress
f.	CHART SPEED	Select
g.	CONTROL MODE-PARTIAL REMOTE switch	Depress
h.	TAKE-UP SPEED control	Select
i.	PAPER TAKE-UP pushbutton	Depress

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR PREPARATION

T/M CONSOLE READINESS CHECK

This checklist is used for establishing a readiness for use condition at the console. Unit procedure is described in paragraph 1.3.6.1.

This procedure is used for all complex checklists.

a.	CCS as defined in paragraph 1.2.12	
b.	Correlation TO-FROM LAUNCH TIME AND MISSION TIME	Verify
c.	LAMP TEST pushbutton	Depress
d.	SPRIL LAMP TEST pushbutton	Depress
e.	Light intensity controls	Adjust
f.	TELEMETRY PCM ON switch	Depress
g.	PCM STATUS switch-light	Observe
h.	CCTV TO IMCC SELECTOR CAMERA switch	Set
i.	Communications subpanel lights	Verify

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST
SIMULATOR PREPARATION

T/M CONSOLE SETUP

This checklist is used for insertion of faults into preselected channels and selection of channels instructor chooses to monitor. Unit procedure is described in paragraph 1.3.6.2.

This procedure is used for all complex checklists.

a.	Analog fault INSERTION MODE switch	NORM
b.	FAULT MODE rotary switch	OFFSET
c.	RATE LEVEL control	Adjust
d.	Digital word INSERTION MODE switch	NORM
e.	Bilevel fault INSERTION MODE switch	NORM
f.	CCTV to IMCC SELECT CAMERA switch	Set

NOTE

Write faults above modules for reference.

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST
SIMULATOR SECURE

IOS SECURE

This checklist is used to secure the IOS upon completion of a training session prior to AMS shutdown.

SUIT PRESSURE selector switch	AUTO
INSTR/SERVICE switch-light	INSTR
RE-ENTRY HEAT OVERRIDE control	NORM
AURAL SIMULATION OFF-ON switch	ON
AURAL SIMULATION control	NORM
UP-DATA LINK-KEYBOARD CLEAR switch-light	Depress
ZERO button - RCS (lb)	Depress
ZERO button - TIME (sec)	Depress
MALFUNCTION STATUS displays	Blank
MALFUNCTION INSERTION - MASTER CLEAR ALL SYSTEMS	Depress
All circuit breakers indicating FAILED BY INSTR	Depress
X-T RECORDER-RECORD light	Out
INITIAL CONDITION CALL-UP dial	002
RESET switch-light	Depress
CUE SELECT switches	OFF
PWR switch	Depress
GARBLE controls	OFF
NOISE controls	OFF

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST SIMULATOR SECURE	
IOS SECURE (CONT)	
X-Y PLOTTERS-DOWN LIGHT	OFF
X-T RECORDERS-READY LIGHT	ON
VOICE RECORDER-OFF light	ON
CCTV MONITORS-ON switches	OFF

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST
SIMULATOR SECURE

RECORDERS AND PLOTTERS SECURE

This checklist is used to secure the recorders and plotters following a completed training session prior to AMS shutdown.

(X-Y, 30 x 30 in.)	
OPERATE-STANDBY-REMOTE sw	STANDBY
VACUUM switch	OFF
LIGHTS switch	OFF
Plotters paper	Remove
(X-Y, 11 x 17 in.)	
PEN-ARM switch	UP-STBY
VAC-PWR	OFF-OFF
Plotting paper	Remove
X-T	
Plotting paper	Remove
MAIN POWER switch	OFF

Table 1-18. Simulator Complex Checklist (Cont)

INSTRUCTOR-OPERATOR STATION CHECKLIST

SIMULATOR SECURE

T/M CONSOLE SECURE

This checklist is used to secure the T/M console at the completion of a training session prior to shutdown of the AMS.

All malfunction controls	NORM
CCTV to IMCC SELECTOR CAMERA switch	Off
TELEMETRY-PCM ON switch-light	OFF
RLS switches	Depress

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER COMPLEX CHECKLIST

SIMULATOR SECURE

COMPUTER COMPLEX SECURE

This checklist is used to secure the computer complex after completion of a training session prior to AMS shutdown. Unit procedure is described in paragraph 1.3.10.

a.	FREEZE switch-light	Depress
b.	MTU tape transports	Rewind and unload
c.	MTU POWER switch-light	OFF
d.	Paper tape reader and punch ON switch	OFF
e.	Card punch cards	STORE
f.	Card punch POWER OFF switch-light	Depress
g.	Card reader cards	STORE
h.	Card reader POWER OFF switch-light	Depress
i.	LINE printer readout	Store
j.	Line printer POWER ON switch-light	OFF
k.	System C typewriter D key	Type
l.	System C MASTER CLEAR pushbutton	Depress
m.	System C typewriter keyboard	Lock
n.	System C POWER switch	Depress
o.	System D typewriter D key	Type
p.	System D MASTER CLEAR pushbutton	Depress
q.	System D typewriter keyboard	Lock
r.	System D POWER switch	Depress

Table 1-18. Simulator Complex Checklist (Cont)

COMPUTER COMPLEX CHECKLIST
SIMULATOR SECURE

COMPUTER COMPLEX SECURE (CONT)

s.	System E typewriter D key	Type
g.	System E MASTER CLEAR pushbutton	Depress
u.	System E typewriter keyboard	Lock
v.	System E POWER switch	Depress

2 SESSION DATA

SECTION 2

SESSION DATA

This section of the instructor handbook contains a separate session data sheet (comprised of several pages) for each AMS training session in the syllabus outlined in section 3 of Volume I. Each session data sheet is comprised of seven parts.

- Purpose. A statement of the training purpose for the specified training session.
- Scope. A brief definition of the overall scope of crew activity to be accomplished in the session (including definition of each simulation run).
- Crew Procedures Reference. Specific identification of those procedures in the Apollo Operations Handbook (SM2A-03) that are to be practiced by the crew during the session.
- Measurement Data. A suggested set of parameters to be transcribed during the session with specific reference to the simulation output tables provided in section 6 of this volume. In some cases, reference is made to a "measurement data group." Measurement data groups are sets of measurement parameters that have been prepared for selected crew procedures and mission events and used in a number of training sessions throughout the syllabus. Measurement data groups and the parameters of which each is comprised are contained in section 6 of this volume of the handbook.
- Instructor Activity Outline. An outline of instructor-operator procedures used in preparing the AMS for and accomplishing the specified runs (including initialization and malfunction selection). Procedures referenced in the outline are those provided in section 1 (AMS Operation) of this volume. Initialization points are those defined in section 3 (AMS Utilization) of Volume I. A list of simulated malfunctions suggested for use in each run is also included. Individual simulated malfunctions are described in section 5 (Malfunction Data) of this volume. In some cases reference is made to "malfunction selection sets." Malfunction selection sets are pre-selected groups of simulated malfunctions which may be used interchangeably for purposes of inducing a variety of training situations with respect to specific crew procedures. Malfunction selection sets and the simulated malfunctions of which each is comprised are contained in section 5 of this volume of the handbook.
- Scripting Notes. Any special instructions, explanation, or supplementary data required to prepare, understand, and effectively utilize the session script. Such explanation includes identification of those portions of the nominal training mission to be practiced. Nominal training mission references are with respect to both the mission profile and the crew procedure outlines provided in section 3 (AMS Utilization) of Volume I.
- Scripting Worksheets. Specific notes to be used by the instructor in annotating IOS data sheets (from section 4 of this volume) as required to prepare the session scripts. Notes are normally transposed from the scripting worksheet to the IOS data sheet to

which they apply. As the complexity of the sessions develops (from part task to typical mission), the level of detail of the scripting worksheet is reduced. This progressive reduction in detail occurs for two reasons. The first is that the scope of the earlier sessions is limited enough to permit detailed explanation; while the scope of later sessions is such that detailed explanation would result in session data sheets of unwieldly bulk. The second reason is that the AMS instructor-operator will accumulate experience in script preparation as he progresses through the syllabus and, as a function of experience gained, will require less and less detailed instructions in script preparation.

SESSION DATA SHEET SCS OPERATION	PT1.1	1

PURPOSE.

To provide flight crewmembers with an introduction to and practice in operating the SCS and G&N systems for purposes of attitude control. Emphasis is placed on SCS and manual direct modes.

SCOPE.

Training in attitude manipulation with both S/M RCS and C/M RCS is included in the five runs of this session. Malfunctions are used in runs 3, 4, and 5 to establish a requirement for alternate procedures. The runs required for this session are as follows:

1. Walk-through of SCS setup, power-on verification, and SCS and G&N attitude and translation control mode (S/M RCS)
2. Practice of SCS setup, power-on verification, and SCS and G&N attitude and translation control modes
3. Practice S/M RCS attitude control in G&N, SCS, and manual direct modes with selected S/M RCS jets inoperative
4. Practice C/M RCS attitude control (nonaerodynamic free fall) in G&N, SCS, and manual direct mode
5. Practice C/M RCS attitude control (nonaerodynamic free fall) in G&N, SCS, and manual direct mode with selected C/M RCS jets inoperative.

CREW PROCEDURES.

Procedure to be practiced during this session is as follows:

Procedure	Run	Source
1. S/C attitude references and control	1, 2, 3, 4, 5	Crew procedures not determined at time of publication.

MEASUREMENT DATA.

X-T RECORDERS

Title	Program Symbol
1. Rotation H/C signal, roll	HPLRHS
2. Rotation H/C signal, pitch	HPLPHS
3. Rotation H/C signal, yaw	HPLYHS
4. True attitude - pitch	STAP
5. True attitude - roll	STAR
6. True attitude - yaw	STAY
7. S/M RCS system A oxidizer quantity	ROAS

SESSION DATA SHEET SCS OPERATION	PT1.1	2

Title	Program Symbol
8. S/M RCS system B oxidizer quantity	ROBS
9. S/M RCS system C oxidizer quantity	ROCS
10. S/M RCS system D oxidizer quantity	RODS

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	2	3	4	5
VISUAL SYSTEMS					
Film Cassette Loading	X	X	X	X	X
SIMULATED C/M					
Vertical Insertion and Retraction	*	*	*	*	*
COMPUTER COMPLEX					
Premission Setup	X	X	X	X	X
X-Y PLOTTERS					
Plotter Readiness and Setup (X-Y 30 X 30)	⊠	X	X	X	X
Plotter Readiness and Setup (X-Y 11 X 17)	⊠	X	X	X	X
X-T RECORDERS					
Records Readiness and Setup (X-T)	⊠	X	X	X	X
INSTRUCTOR-OPERATOR STATION					
Computer and Simulator Status	X	X	X	X	X
Communications Control Setup	X	X	X	X	X
Closed Circuit TV Setup	X	X	X	X	X
Recorder and Plotter Status	X	X	X	X	X
True Trainee Environment and Waste Management Status	X	X	X	X	X
G&N and Visuals Readiness	X	X	X	X	X
Reset Initialization	X	X	X	X	X

X = Required ⊠ = Optional * = If not previously accomplished

SESSION DATA SHEET SCS OPERATION	PT1.1	3

2. Select the following malfunctions for runs 3, 4, and 5:
   a. SC-042 reaction jet 1 fails off, + pitch
   b. SC-055 reaction jet 6 fails off, - yaw
   c. SC-111 reaction jet 10 fails off, - roll
   d. SC-115 reaction jet 12 fails off, - roll
3. Additional malfunctions may be selected for these runs from Malfunction Selection Set 1 provided in section 5, this volume of this handbook.

SCRIPTING NOTES.

Three scripts are required for this session as shown below:

Script	Scripting Worksheet	Run
1	1	1 and 2
2	2	3
3	3	4 and 5

No typical mission references are required for this session as the procedures to be practiced could occur at any time during any orbit.

Malfunctions are utilized in runs 3, 4, and 5 to demonstrate and provide practice in S/C response to commands for attitude changes and translations under SCS RCS failure conditions.

Changes in spacecraft attitude may be requested, in addition to those stated in the scripting worksheets. The number and type of attitude changes used in each run will be determined by the IOS instructor-operator in accordance with crewmember needs.

No reference to crew procedures is made when selection of manual direct mode is requested due to the procedural simplicity of that mode.

SESSION DATA SHEET
Scripting Worksheet 1 (Runs 1 and 2) PT1.1 4

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start runs 1 and 2	Initialize at . . . . (S4)	Crew procedures not determined at time of publication.
			SCS attitude hold procedures	Request establishment of spacecraft attitude at: _____°pitch _____°yaw _____°roll	Crewmember will position S/C using rotation control.
			SCS rotation maneuver	Request spacecraft attitude change to: _____°pitch _____°yaw _____°roll	
			SCS translation maneuver procedures	Request spacecraft translation in X-, Y-, and Z-axes. No direct IOS or C/M visibility of translation is available. Slight changes will be observed in S/M RCS propellant quantities.	
			G&N attitude hold procedures		Crew procedures not determined at time of publication.

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Accomplish changes through SCS control	Request establishment of S/C attitude at: _____°pitch _____°yaw _____°roll Request attitude change to: _____°pitch _____°yaw _____°roll	
			G&N attitude control with SCS rotational controller	Request establishment of S/C attitude at: _____°pitch _____°yaw _____°roll Request attitude change to: _____°pitch _____°yaw _____°roll Request selection of manual direct mode.	

SESSION DATA SHEET
Scripting Worksheet 1 (Runs 1 and 2) (Cont)

PT1.1 6

Step	Malf	Time	Function	IOS Visibility/Action	Notes
				Request attitude change to: _____°pitch _____°yaw _____°roll	
			End of runs 1 and 2		
Scripting Worksheet 2 (Run 3) Practice Use of S/M RCS in Attitude Control and Translation With/Without Jet Failures					
			Start run 3	Initialize at . . . . . (S4)	Crew procedures not available at time of publication.
			SCS attitude hold procedures		
			G&N attitude hold procedures	Request establishment of spacecraft attitude at: _____°pitch _____°yaw _____°roll	
	SC-042		Reaction jet 1 fails off (+ pitch)	Request spacecraft attitude change to: _____°pitch _____°yaw _____°roll	

Scripting Worksheet 2 (Run 3) Practice Use of S/M RCS in Attitude Control and Translation With/Without Jet Failures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	SC-055		Reaction jet 6 fails off (- yaw)	Request spacecraft attitude change to: _____ °pitch _____ °yaw _____ °roll	
	SC-111		Reaction jet 10 fails off (+ roll)	Request spacecraft attitude change to: _____ °pitch _____ °yaw _____ °roll	
	SC-115		Reaction jet 12 fails off (- roll)	Request spacecraft attitude change to: _____ °pitch _____ °yaw _____ °roll Request selection of manual direct mode Request spacecraft attitude change to: _____ °pitch _____ °yaw _____ °roll	
			End of run 3		

SESSION DATA SHEET PT1.1 8

Scripting Worksheet 3 (Runs 4 and 5) Practice Use of C/M RCS in Attitude Control With/Without Jet Failures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start runs 4 and 5	Initialization TBD	
			SCS attitude hold procedures		Crew procedures not available at time of publication.
			G&N attitude hold procedures	Request establishment of spacecraft attitude at: _____ °pitch _____ °yaw _____ °roll	
	SC-042		Reaction jet 1 fails off (+ pitch)	Request spacecraft attitude change to: _____ °pitch _____ °yaw _____ °roll	
	SC-055		Reaction jet 6 fails off (- yaw)	Request spacecraft attitude change to: _____ °pitch _____ °yaw _____ °roll	
	SC-111		Reaction jet 10 fails off (+ roll)	Request spacecraft attitude change to: _____ °pitch _____ °yaw _____ °roll	

SESSION DATA SHEET

Scripting Worksheet 3 (Runs 4 and 5) Practice Use of C/M RCS in Attitude Control With/Without Jet Failures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	SC-115		Reaction jet 12 fails off (- roll)	Request spacecraft attitude change to: _____°pitch _____°yaw _____°roll	
			End of runs 4 and 5		

SESSION DATA SHEET RCS AND SPS OPERATION	PT1.2	1

PURPOSE.

To provide demonstration and practice of management and operating procedures for spacecraft thrusting systems. Systems involve S/M RCS, C/M RCS, and SPS.

SCOPE.

The runs in this session will give the crewmember experience in preparation for and accomplishment of G&N delta V, SCS mode delta V, and SPS and RCS periodic checks. Five runs are required to accomplish this session. The runs are as follows:

1. Walk-through of SPS propellant gaging, gimbal position indicator testing, SPS and RCS periodic verification
2. Walk-through of procedures for preparing for and accomplishing G&N mode delta V (stations 1 and 3)
3. Practice preparation for and accomplishing G&N mode delta V (stations 1 and 3)
4. Walk-through of procedures for SCS mode delta V (station 1)
5. Practice preparing for and accomplishing SCS mode delta V (stations 1 and 3).

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedure	Run	Source
1. Gimbal position indicators test	1	SM2A-03, para. 8.1
2. SPS periodic verification	1	SM2A-03, para. 8.3.1.3
3. RCS periodic verification	1	SM2A-03, para. 8.3.1.4
4. G&N delta V mode	2, 3	Task Analysis Function SP003, SP004 R507 - P31, P37, P41
5. SCS delta V mode	4, 5	NAA IL-697-503-110-65-118

MEASUREMENT DATA.

Measurement data group 1, section 6, this document.

SESSION DATA SHEET RCS AND SPS OPERATION	PT1.2	2

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	2	3	4	5
VISUAL SYSTEMS					
Film Cassette Loading	⊠	X	X	X	X
SIMULATED C/M					
Vertical Insertion and Retraction	*	*	*	*	*
COMPUTER COMPLEX					
Premission Setup	X	X	X	X	X
X-Y PLOTTERS					
Plotter Readiness and Setup (X-Y 30 X 30)	⊠	X	X	X	X
X-T RECORDERS					
Records Readiness and Setup (X-T)	⊠	X	X	X	X
INSTRUCTOR-OPERATOR STATION					
Computer and Simulator Status	X	X	X	X	X
Communications Control Setup	X	X	X	X	X
Closed Circuit TV Setup	X	X	X	X	X
Recorder and Plotter Status	⊠	X	X	X	X
True Trainee Environment and Waste Management Status	X	X	X	X	X
G&N and Visuals Readiness	X	X	X	X	X
Reset Initialization	X	X	X	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this section.

SCRIPTING NOTES.

No typical mission references are required for this session as the procedures to be practiced may occur at any time during any orbit.

SESSION DATA SHEET RCS AND SPS OPERATION	PT1.2	3

This session is intended for accomplishment by one crewmember. This will require him to move from one station to another during a run.

Three scripts are required for this session as shown.

Script	Scripting Worksheet	Run
1	1	1
2	2	2 and 3
3	3	4 and 5

Scripting Worksheet 1 (Run 1) Walk-Through of SPS Propellant Gaging, Gimbal Position Indicator Testing, SPS and RCS Periodic Verification

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at . . . (S4)	
			SPS periodic check	IOS Data Sheet SP3.01	Crew procedures, SM2A-03, para. 8.3.1.3
			SPS periodic propellant quantity gaging system check	SP3.02	SM2A-03, para. 8.3.1.3
			Gimbal position indicator test	SP1.03	SM2A-03, para. 8.1
			S/M RCS periodic check C/M RCS periodic check	RC2.02 RC2.01	SM2A-03, para. 8.3.1.4
			End of run 1		
Scripting Worksheet 2 (Runs 2 and 3) Preparation for and Accomplishment of G&N Delta V					
			Start run 2 or 3	Initialize at . . . (S4)	
				Instructor program AGC for G&N delta V	
				Place trainer in FREEZE mode	
				Crewmember ingress SCM	
				Depress RUN pushbutton	Crew procedures, task analysis SP003

SESSION DATA SHEET PT1.2 5

Scripting Worksheet 2 (Runs 2 and 3) Preparation for and Accomplishment of G&N Delta V (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-19			Preparation for delta V	IOS Data Sheet SP3.04	
1-66			Ingress into station 1 couch Orbit change for delta V	GN1.13	R507 - P31, P41, R37
20-34			Delta V operations	SP3.04	Task analysis SP004
			End of run 2 or 3		
Scripting Worksheet 3 (Runs 4 and 5) Walk-Through Preparation and Accomplishment of SCS Delta V					
			Start run 4 or 5	Initialize at . . . . . (S4)	
1-19			Delta V operations	IOS Data Sheet SP3.04	Task analysis SP003
1-31			Prepare for SCS mode delta V	SC1.03	(NAA) IL-697-503-110-65-118
			Delta V		
			Thrust off		
20-34			Delta V operations	SP3.04	Task analysis SP004
			End of run 4 or 5		

SESSION DATA SHEET EPS OPERATION	PT1.3	1

PURPOSE.

To provide the flight crewmembers with a demonstration and practice in EPS operating procedures. Emphasis is placed on normal operation, servicing procedures, recognition of malfunctions, and alternate procedures.

SCOPE.

This session gives experience in the EPS periodic checks and exercise in malfunction isolation and selection of alternate procedures. Three training runs are required to accomplish this session. Training runs are as follows:

1. Walk-through EPS periodic checks and cryogenic pressure control and quantity balance
2. Walk-through fuel cell purge and battery charge
3. Practice EPS checks with simulated malfunctions
4. Walk-through fuel cell shutdown procedures.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedures	Run	Source SM2A-03, Paragraph
1. Electrical power system procedures	1, 2, 3, 4	8.3.1.5
2. F/C 1 (2 or 3) light illuminated	3	9.1.5.3
3. DC BUS B UNDERVOLTAGE light illuminated	3	9.1.5.5
4. AC BUS 1 (or 2) OVERLOAD and AC BUS 1 (or 2) FAIL lights illuminated	3	9.1.5.9
5. INV No. 1 (or 2) TEMP HI light illuminated	3	9.1.5.10
6. INV No. 3 TEMP HI light illuminated	3	9.1.5.11
7. AC VOLTS meter indicates minimum	3	9.1.5.12
8. FREQUENCY meter indicates minimum	3	9.1.5.13

SESSION DATA SHEET EPS OPERATION	PT1.3	2

MEASUREMENT DATA.

Select the following signals to record performance during session:

X-T RECORDERS

Title	Program Symbol
1. F/C BUS DISCONNECT light on	C001
2. INVERTER 1 ON	C215
3. INVERTER 3 ON	C217
4. AC BUS 2 OVERLOAD light on	E345
5. MASTER ALARM	E349

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	2	3	4
COMPUTER COMPLEX				
Premission Setup	X	X	X	X
X-T RECORDERS				
Records Readiness and Setup (X-T)			X	
INSTRUCTOR-OPERATOR STATION				
Computer and Simulator Status	X	X	X	X
Communications Control Setup	X	X	X	X
Closed Circuit TV Setup	X	X	X	X
True Trainee Environment and Waste Management Status	X	X	X	X
Reset Initialization	X	X	X	X

X = Required

2. Select from the following malfunctions for run 3:

a. EP-014 A-C bus 2 overload
b. EP-016 Inverter 2 temperature high
c. EP-032 Main d-c bus B shorted
d. EP-040 Frequency meter failure
e. EP-053 Main d-c bus B undervoltage sensor fails in off condition
f. EP-057 Inverter 1 failure (no output)
g. EP-111 F/C 2 pH factor high
h. EP-116 F/C 1 coolant pump failure

SESSION DATA SHEET EPS OPERATION	PT1.3	3

3. Additional malfunctions may be selected for this run from Malfunction Selection Set 2, section 5, Volume II.

SCRIPTING NOTES.

Scripts required for this session are as follows:

Run 1 uses scripting worksheet 1 in preparing script 1.
Run 2 uses scripting worksheet 2 in preparing script 2.
Run 3 uses scripting worksheet 3 in preparing script 3.

Script	Scripting Worksheet	Run
1	1	1
2	2	2
3	3	3
4	4	4

No typical mission references are required for this session as spacecraft location has no effect on ECS operation.

SESSION DATA SHEET PT1.3 4

Scripting Worksheet 1 (Run 1) EPS Periodic Checks and Cryogenic Pressure Control and Quantity Balance

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at . . . (S5)	Crew procedures, SM2A-03, para. 8.3.1.5
			EPS periodic check - cryogenics	IOS Data Sheet EP3.10	
			EPS periodic check - fuel cells	EP3.10	
			EPS periodic check - d-c power	EP3.10	
			EPS periodic check - a-c power	EP3.10	
			Manual pressure control verification	EP3.11	
			Quantity balance verification	EP3.12	
			End of run 1		
Scripting Worksheet 2 (Run 2) Walk-Through Fuel Cell Purging and Battery Charging					
			Start run 2	Initialize at . . . (S5)	Crew procedures, SM2A-03, para. 8.3.1.5
1-12			Fuel cell purging	IOS Data Sheet EP3.05	
				EP3.06	
1-9			Battery charge	EP3.07	
			End of run 2		

Scripting Worksheet 3 (Run 3) Practice EPS Periodic Check With Malfunctions

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 3	Initialize at . . . (S5)	
			EPS periodic check - cryogenics	IOS Data Sheet EP3.10	Crew procedures, SM2A-03, para. 8.3.1.5
			EPS periodic check - fuel cells	EP3.10	
			EPS periodic check - d-c power	EP3.10	
46	EP-031		Main d-c bus A shorted	MEP.08	SM2A-03, para. 9.1.5.4
				DC BUS A UNDERVOLT light illuminates	
				DC VOLTS - MAIN BUS A reads low	
				MASTER ALARM light illuminates	
			Continue EPS periodic check d-c power	As above	
48	EP-053		Main d-c bus B undervoltage sensor fails - ON	Crew will request verification of failure and remove power from sensor.	SM2A-03, para. 9.1.5.5
			EPS periodic check - a-c power	IOS Data Sheet EP3.10	
66	EP-057		INVERTER 1 fails, no output	IOS Data Sheet MEP.12 or MEP.13	SM2A-03, para. 9.1.5.6 and 9.1.5.12

SESSION DATA SHEET PT1.3 6

Scripting Worksheet 3 (Run 3) Practice EPS Periodic Check With Malfunctions (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
				AC BUS 1 FAIL light illuminates	
				AC VOLTS - BUS 1 - ØA, B, and C reads minimum	
				FREQUENCY - BUS 1 - ØA, B, and C reads minimum	
				MASTER ALARM light illuminates	
68	EP-040		Frequency meter fails	Crew will request frequency information from instructor.	Crew procedures, SM2A-03, para. 9.1.5.14
74	EP-014		A-C bus 2 overload	IOS Data Sheet MEP.20	SM2A-03, para. 9.1.5.10
				AC BUS 2 FAIL light illuminates	
				AC BUS 2 OVERLOAD light illuminates	
				AC VOLTS - BUS 2 - ØA, B, and C reads minimum	
				FREQUENCY - BUS 2 - ØA, B and C reads minimum	
			End of run 3		

SESSION DATA SHEET
Scripting Worksheet 4 (Run 4) Walk-Through of Fuel Cell Shutdown Procedures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 4	Initialize at . . . (S5)	
1-5			Fuel cell shutdown procedures	IOS Data Sheet EP3.08	Crew procedures not available at time of publication.
			End of run 4		

SESSION DATA SHEET ECS OPERATION	PT1.4	1

PURPOSE.

To provide the flight crewmembers with practice in operating and managing the ECS. Emphasis is placed on normal operation, recognition of malfunctions, and selection of and operation in alternate modes.

SCOPE.

Seven training runs are required to accomplish this session. Malfunctions are used to require selection of alternate modes of operation. Training runs are as follows:

1. Walk-through initial orbital ECS procedures, stations 1, 3, and 4
2. Practice of initial orbital ECS procedures
3. Walk-through routine orbital ECS procedures
4. Walk-through ECS preparation for deorbit and entry
5. Practice ECS preparation for deorbit and entry
6. Walk-through waste management system procedures
7. Walk-through demonstration of ECS malfunctions and alternate modes and procedures.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedure	Run	Source SM2A-03, Paragraph
1. Ascent and initial orbit	1, 2	8.2
2. Environmental control system procedures (ECS)	3 through 6	8.3.1.6
3. CO_2 PP HI light illuminates	7	9.1.6.3
4. O_2 FLOW HI light illuminates	7	9.1.6.4
5. PRESS GLY DISCH gage indicating outside of nominal 38 (+8, -12) psia operating range	7	9.1.6.6
6. ΔP COMPR gage indicates outside nominal 0.35±0.1 psi operating range	2, 7	9.1.6.7
7. TEMP-CABIN gage indicating outside nominal 70° to 80°F operating range	5, 7	9.1.6.9

MEASUREMENT DATA.

Measurement data group 5, section 6, this volume.

SESSION DATA SHEET ECS OPERATION	PT1.4	2

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	2	3	4	5	6	7
COMPUTER COMPLEX							
Premission Setup	X	X	X	X	X	X	X
INSTRUCTOR-OPERATOR STATION							
Computer and Simulator Status	X	X	X	X	X	X	X
Communications Control Setup	X	X	X	X	X	X	X
Closed Circuit TV Setup	X	X	X	X	X	X	X
True Trainee Environment and Waste Management Status	X	X	X	X	X	X	X
Reset Initialization	X	X	X	X	X	X	X

X = Required

2. Select the following malfunctions for run 7:
   a. EC-003 Suit compressor 1 motor failure
   b. EC-012 CO_2 partial pressure sensor failure
   c. EC-023 O_2 pressure regulator 2 fails open
   d. EC-026 Cabin recirculating blower 1 fails
   e. EC-033 Cabin temperature sensor fails (maximum output)
   f. EC-054 Water quantity indicator fails
   g. EC-126 Glycol pump 1 fails
3. Additional malfunctions may be selected for this run from Malfunction Selection Set 3, section 5, this volume.

SCRIPTING NOTES.

Five scripts are required for this session. They are prepared as follows:

Script	Scripting Worksheet	Run
1	1	1 and 2
2	2	3
3	3	4 and 5
4	4	6
5	5	7

SESSION DATA SHEET ECS OPERATION	PT1.4	3

No typical mission references are required for this session as spacecraft location has no effect on ECS operation.

This session is intended for accomplishment by one crewmember. This will require him to move from one station to another during a run.

Scripting Worksheet 1 (Runs 1 and 2) Initial Orbital ECS Procedures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1 or 2	Initialize at . . . (S3)	
1-8			Initial orbital procedures	IOS Data Sheet O1.1 O4.1	Crew procedures, SM2A-03, para. 8.3.1.6
1			Initial orbital procedures		
1-3			Initial orbital procedures	O3.1	
2-3			Initial orbital procedures	O4.1	
9-14			Initial orbital procedures	O1.1	
4-10			Initial orbital procedures (station 3)	IOS Data Sheet O3.1	
			End of run 1 or 2		
Scripting Worksheet 2 (Run 3) Walk-Through of Routine Orbital ECS Procedures					
			Start run 3	Initialize at . . . (S4)	
1-16			ECS hourly flight verification	IOS Data Sheet EC3.01	Crew procedures, SM2A-03, para. 8.3.1.6
1-7			CO_2-odor absorber filter replacement	EC4.02	SM2A-03, para. 8.3.1.6
			End of run 3		

SESSION DATA SHEET PT1.4 5

Scripting Worksheet 3 (Runs 4 and 5) ECS Preparation for Deorbit and Entry

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start runs 4 and 5	Initialize at . . . (S8)	
1-3			ECS preparation for deorbit and entry (cabin cold-soak)	IOS Data Sheet EC3.05	Crew procedures, SM2A-03, para. 8.3.1.6, cabin cold-soak operation (both normal and backup procedures).
1			Attenuator panel installation	IOS Data Sheet E4.1	Crew procedures, SM2A-03, para. 8.3.1.6
			End of runs 4 and 5		
Scripting Worksheet 4 (Run 6) Walk-Through of Waste Management System Procedures					
			Start run 6	Initialize at . . . (S4)	
			Urination while unsuited	Waste management panel switch - URINE-FECES position indicator illuminates.	Crew procedures, SM2A-03, para. 8.3.1.6
			Urination while suited	Waste management panel switch - URINE-FECES position indicator illuminates, later extinguishes.	
			Urine overboard dump	Waste management panel switch - URINE DUMP position indicator illuminates, 30 seconds later extinguishes.	

Step	Malf	Time	Function	IOS Visibility/Action	Notes
				Waste management backup valve URINE DUMP light illuminates. Waste management panel switch - URINE DUMP position indicator extinguishes, OFF position indicator illuminates.	
			Defecation	Waste management panel switch - URINE-FECES position indicator illuminates, later extinguishes.	
			End of run 6		
Scripting Worksheet 5 (Run 7) ECS Malfunction Procedures and Alternate Mode Procedures					
			Start run 7	Initialize at . . . (S7)	
	EC-003		Suit compressor 1 motor fails	IOS Data Sheet MEC. 04 DELTA V COMP indicator reads low	Crew procedures, SM2A-03, para. 9.1.6.7
	EC-012		CO_2 partial pressure sensor fails	Crew will change CO_2 filter CO_2 PP HI light illuminates PART PRESS CO_2 indicator reads high Instructor should verify sensor failure upon request.	Crew will attempt to isolate malfunction using SM2A-03, para. 9.1.6.3; then report suspected sensor failure to MSFN.

SESSION DATA SHEET PT1.4 7

Scripting Worksheet 5 (Run 7) ECS Malfunction Procedures and Alternate Mode Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EC-023		O_2 pressure regulator 2 fails open	IOS Data Sheet MEC. 02 O_2 FLOW HI light illuminates CABIN PRESS indicator reads high	Crew procedures, SM2A-03, para. 9.1.6.4c
	EC-026		Cabin air fan 1 fails	IOS Data Sheet MEC. 07 CABIN TEMP indicator increases	Crew procedures, SM2A-03, para. 9.1.6.9
	EC-033		Cabin temp sensor fails - maximum output	IOS Data Sheet MEC. 07 CABIN TEMP indicator reads maximum	SM2A-03, para. 9.1.6.9
	EC-054		Water quantity indicator fails - zero output	Instructor should provide water quantities upon request WATER QUANTITY reads minimum	Crew should check waste and potable water indications and water availability from drinking tube; then request verification of indicator failure from MSFN.
	EC-126		Glycol pump 1 fails	IOS Data Sheet MEC. 03	Crew procedures, SM2A-03, para. 9.1.6.6

Scripting Worksheet 5 (Run 7) ECS Malfunction Procedures and Alternate Mode Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
				GLY DISCH PRESS indicator reads low EVAP STEAM TEMP indicator reads low	
			End of run 7		

SESSION DATA SHEET WATCH STATION PROCEDURES	PT1.5	1

PURPOSE.

To provide practice in procedures for periodically checking and servicing spacecraft systems.

SCOPE.

In this session, the flight crew will practice procedures for routine periodic checking and servicing of spacecraft systems and reporting of system status via the telecommunication system. Runs are as follows:

1. Walk-through telecommunications procedures
2. Practice periodic checks - SPS, RCS, EPS, and ECS (without malfunctions)
3. Practice periodic checks - SPS, RCS, EPS, and ECS with noncritical simulated malfunctions requiring alternate modes or redundant systems
4. Practice cryogenic pressure control and quantity balance verification, fuel cell purge, and waste water dump
5. Practice removing and inserting attenuator panels.

CREW PROCEDURES.

Procedures to be practices during this session are as follows:

Procedure	Run	Source SM2A-03, Paragraph
1. Initial orbital procedures	5	8.2
2. SPS periodic verification	2, 3	8.3.1.3
3. RCS periodic verification	2, 3	8.3.1.4
4. EPS periodic verification	2, 3	8.3.1.5
5. Fuel cell power plant purging	4	8.3.1.5
6. Cryogenic pressure control and quantity balance	4	8.3.1.5
7. ECS periodic verification	2, 3	8.3.1.6
8. ECS redundant components periodic operational checkout	4	8.3.1.6
9. ECS waste water dumping operation	4	8.3.1.6
10. Voice communications	1	8.3.1.7.1
11. C-band tracking and ranging	1	8.3.1.7.2
12. Data storage, transmission and reception	1	8.3.1.7.3
13. S-band operations	1	8.3.1.7.4
14. S/M RCS A (B, C, D) helium 1 switch to off	2, 3	9.1.4.2
15. F/C 1 (2 or 3) light illuminates		9.1.5.3

SESSION DATA SHEET WATCH STATION PROCEDURES	PT1.5	2

Procedure	Run	Source SM2A-03, Paragraph
16. INV No. 1 (or 2) TEMP HI light illuminates	4	9.1.5.10
17. CO_2 PP HI light illuminates		9.1.6.3
18. PRESS GLY DISCH reading outside nominal	2, 3	9.1.6.6
19. ΔP SUIT COMP indicator reading outside nominal		9.1.6.7

MEASUREMENT DATA.

X-T RECORDERS

Title	Program Symbol
1. Helium tank pressure readout	PPHE1
2. Oxidizer ullage pressure readout	PPO
3. S/M RCS quad A helium pressure	RPHEAC
4. Inverter 1 temp high readout	CTINV1
5. Inverter 3 on	C217
6. F/C 2 H_2 pressure	CH2PFC2
7. F/C 2 reactants on	C624
8. Glycol discharge pressure	FPGCM
9. Glycol pump 2 on	F703
10. ΔP compressor	FP13CI
11. Suit compressor 1 on	F920
12. Suit compressor 2 on	F921

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in table 1-18, section 1 of this volume.

System Checklist	Run No. 1	2	3	4	5
COMPUTER COMPLEX					
Premission Setup	X	X	X	X	X
X-T RECORDERS					
Records Readiness and Setup (X-T)			X		

X = Required

SESSION DATA SHEET WATCH STATION PROCEDURES	PT1.5	3

System Checklist	Run No. 1	2	3	4	5
INSTRUCTOR-OPERATOR STATION					
Computer and Simulator Status	X	X	X	X	X
Communications Control Setup	X	X	X	X	X
Closed Circuit TV Setup	X	X	X	X	X
Recorder and Plotter Status	X	X	X	X	X
True Trainee Environment and Waste Management Status	X	X	X	X	X
Reset Initialization	X	X	X	X	X

X = Required

2. Select from the following malfunctions for run 3.
   a. SP-014 Helium tank pressure readout indicates zero.
   b. SP-020 Oxidizer ullage pressure indicator fails.
   c. RC-015/244/246 S/M RCS quad A helium pressure regulator 1 fails - high
   d. RC-324/224 S/M RCS quad B oxidizer quantity sensor fails - zero output
   e. EP-015 Inverter 1 temp high
   f. EP-103 F/C 2 H_2 supply valve fails closed
   g. EC-126 Glycol pump 1 fails
   h. EC-004 Suit compressor 2 motor fails
   i. EC-012 CO_2 partial pressure sensor fails.

SCRIPTING NOTES.

A separate script is required for each run in this session. Scripts are prepared as shown.

Script	Scripting Worksheet	Run
1	1	1
2	2	2
3	2	3
4	3	4
5	4	5

No typical mission references are required for this session as spacecraft location has no effect on these systems.

SESSION DATA SHEET WATCH STATION PROCEDURES	PT1.5	4

Malfunctions listed for the runs of this session have no necessary order of insertion. They should be inserted after the normal procedures for run 3 have been completed.

This session is intended for accomplishment by one crewmember and will require him to move from one station to another during a run.

SESSION DATA SHEET PT1.5 5

Scripting Worksheet 1 (Run 1) Walk-Through Telecommunication Procedures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at S4 through S8	Accomplished from SCM station 3
			Voice communications - ICS and VHF	IOS Data Sheets TC1.01 and TC3.02	Crew procedures, SM2A-03, para. 8.3.1.7.1
			Up-data link operation	Request crew activation of UDL in S-band, then UHF modes. IOS Data Sheet TC3.03	SM2A-03; para. 8.3.1.7.3, step 11; and 8.3.1.7.4, step 10
			Data storage, transmission and reception	Request crew performance of the following operations: Activate VHF-FM, IOS Data Sheet TC3.04	SM2A-03, para. 8.1.3.7.3 Step 1
				Transmit high-bit rate PCM, IOS Data Sheet IC3.05	Step 3
				Transmit low-bit rate PCM, IOS Data Sheet TC3.06	Step 4
				Record high-bit rate PCM, IOS Data Sheet TC3.10	Step 7
				Transmit recorded high-bit rate PCM, IOS Data Sheet TC3.07	Step 5

Step	Malf	Time	Function	IOS Visibility/Action	Notes
				Record low-bit rate PCM, IOS Data Sheet TC3.08	Step 8
				Transmit recorded low-bit rate PCM, IOS Data Sheet TC3.08	Step 6
				Record real-time analog data, IOS Data Sheet TC3.11	Step 9
			S-band operations	Request crew performance of the following operations:	SM2A-03, para. 8.1.3.7.4, steps 1 and 2
				Activate USBE in bypass, low and high modes	
				IOS Data Sheets TC3.12 and TC3.13	
				Communicate with MSFN via S-band, IOS Data Sheet TC3.14	Step 3
				Transmit low- (or high-) bit rate PCM via USBE, IOS Data Sheet TC3.17	Step 6
				Transmit recorded low- (or high-) bit rate PCM via USBE, IOS Data Sheet TC3.15	Step 4

SESSION DATA SHEET PT1.5 7

Scripting Worksheet 1 (Run 1) Walk-Through Telecommunication Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
				Transmit high-bit rate PCM and analog via USBE, IOS Data Sheet TC3.16	Step 5
				Transmit PCM in ranging mode via USBE, IOS Data Sheet TC3.18	Step 7
				Transmit in ranging mode only via Data Sheet TC3.19	Step 8
				Transmit PCM and TV via USBE, IOS Data Sheet TC3.20	Step 9
				Transmit emergency voice via USBE; no IOS data sheet	Step 11
				Transmit CW code in emergency key mode via USBE; no IOS data sheet	Step 12
			C-band tracking and ranging	IOS Data Sheet TC3.21	SM2A-03, para. 8.3.1.7.2, accomplished from seat 3
			End of run 1		

Scripting Worksheet 2 (Runs 2 and 3) Practice Periodic Checks

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 2 or 3	Initialize at S5	Malfunctions identified are for run 3 only. These runs are accomplished from seats 2 and 3.
			SPS periodic verification	IOS Data Sheet SP3.01	Crew procedures, SM2A-03, para. 8.3.1.3
3	SP-014		Helium tank pressure readout indicates zero	Respond to crew request for helium tank pressure reading.	Crew should request helium tank press from MSFN.
8	SP-020		Oxidizer ullage pressure indicator fails	Respond to crew request for oxidizer tank pressure reading.	Crew should request oxidizer tank press from MSFN.
			RCS periodic verification	IOS Data Sheet RC2.02	Crew procedures, SM2A-03, para. 8.3.1.4
2	RC-015/244/246		S/M RCS quad A helium press regulator 1 fails - high	MCR.01	SM2A-03, para. 9.1.4.2
7	RC-324/224		S/M RCS system B oxidizer quantity sensor fails - zero output	MCR.01	SM2A-03, para. 9.1.4.2

SESSION DATA SHEET PT1.5 9

Scripting Worksheet 2 (Runs 2 and 3) Practice Periodic Checks (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			EPS periodic verification	IOS Data Sheet EP3.10	Crew procedures, SM2A-03, para. 8.3.1.5
40-65			D-C voltage - amperage A-C voltage - frequency		
	EP-015		Inverter 1 temp high	MEP24 (includes MEP10, MEP11, MEP12, and MEP15)	SM2A-03, para. 9.1.5.10
			EPS periodic verification	MEP3.10	SM2A-03, para. 8.3.1.5
1-8			Cryogenic press - quantity		
9-39			Fuel cell power plant		
16	EP-103		F/C 2 H_2 supply valve fails closed	MEP.02 and EP3.08	SM2A-03, para. 9.1.5.3
1			ECS periodic verification	EC3.01	
	EC-126		Glycol pump 1 fails	MEC.03	SM2A-03, para. 9.1.6.6
	EC-004		Suit compressor 2 motor fails	MEC.04	SM2A-03, para. 9.1.6.7

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EC-012		CO_2 partial pressure sensor fails	CO_2 PP HI light on PART PRESS CO_2 reads high. Instructor should respond to crew request for sensor failure verification.	Crew procedures, SM2A-03, para. 9.1.6.3
			End of run 2 or 3		
Scripting Worksheet 3 (Run 4) Practice Cryogenic Pressure Control and Quantity Balance Verification, Fuel Cell Purge, ECS Redundant Component Periodic Check and Waste Water Dump					
			Start run 4	Initialize at S4 through S8	Start run in seat 3.
			Cryogenic pressure control and quantity balance	IOS Data Sheet EP3.11	Crew procedures, SM2A-03, para. 8.3.1.5 This procedure may not be completed since the pressure drop time is approx 8 hours.
			Fuel cell purging		
			Oxygen	EP3.06	Crew procedures, SM2A-03, para. 8.3.1.5
			Hydrogen	EP3.05	
					Trainee should move to station 4.

Scripting Worksheet 3 (Run 4) Practice Cryogenic Pressure Control and Quantity Balance Verification, Fuel Cell Purge, ECS Redundant Component Periodic Check and Waste Water Dump (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Waste water dump	IOS Data Sheet EC4.06	Crew procedures, SM2A-03, para. 8.3.1.6
			End of run 4		
Scripting Worksheet 4 (Run 5) Practice Removing and Inserting Attenuator Panels					
			Start run 5	Initialize at S4 through S	Accomplished from the SCM-LHEB
			Remove attenuator panels	IOS Data Sheet O4.1	Crew procedures, SM2A-03, para. 8.2, step 5.2
			Install attenuator panels	No IOS data sheet required.	SM2A-03, para. 8.4, step 6
			End of run 5		

SESSION DATA SHEET IMU ALIGNMENT	PT2.1	1

PURPOSE.

To provide practice in G&N system activation, coarse and fine IMU alignment, and AGCU (FDAI) alignment.

SCOPE.

This session includes G&N system operation with both DSKY and CDU input methods. Runs are as follows:

1. Walk-through of G&N activation, IMU alignment, and AGCU (FDAI) alignment
2. Practice of G&N activation, IMU alignment, and AGCU (FDAI) alignment
3. Practice coarse IMU alignment (manual).

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedures	Run	Source
1. G&N system activation	1, 2, 3	R507 - P22
2. IMU determination (G&N)	1, 2, 3	R507 - P51
3. IMU fine alignment (G&N)	1, 2, 3	R507 - P53

MEASUREMENT DATA.

Measurement data group 2.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18 of this document.

System Checklist	Run No. 1	2	3
VISUAL SYSTEMS			
Film Cassette Loading		X	X
SIMULATED C/M			
Vertical Insertion and Retraction	⊠	*	*

X = Required ⊠ = Optional * = If not previously accomplished

SESSION DATA SHEET IMU ALIGNMENT	PT2.1	2

System Checklist	Run No. 1	2	3
COMPUTER COMPLEX			
Premission Setup	X	X	X
X-Y PLOTTERS			
Plotter Readiness and Setup (X-Y 30 X 30)		X	X
X-T RECORDERS			
Records Readiness and Setup (X-T)		X	X
INSTRUCTOR-OPERATOR STATION			
Computer and Simulator Status	X	X	X
Communications Control Setup	X	X	X
Closed Circuit TV Setup	X	X	X
Recorder and Plotter Status	⊠	X	X
True Trainee Environment and Waste Management Status	X	X	X
G&N and Visuals Readiness	⊠	X	X
Reset Initialization	X	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this session.

SCRIPTING NOTES.

Two scripts are required for this session. Scripting worksheets are provided for their preparation as follows:

Script	Scripting Worksheet	Run
1	1	1 and 3
2	2	2

The star sighting portions of the IMU alignment procedures are directly related to figure 3-4 of Volume I.

Scripting Worksheet 1 (Runs 1 and 2) IMU Alignment

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Begin run 1 or 2	Initiate at S5	Simulated GMT 15:33:00
			G&N activation	IOS Data Sheet GN4.01 (includes GN4.03)	Crew procedures, R507 - P22
			IMU orientation determination (IMU alignment preparations) (star availability between longitudes 02°E and 178°W as shown in figure 3-4, Volume I)	GN4.04 (includes GN4.03 and GN4.49)	R507 - P51
			IMU alignment (SCM) (star availability between longitudes 02°E and 178°W as shown in figure 3-4 of Volume I)	GN4.07 (includes GN4.03, GN4.49, and GN4.50	R507 - P53
			End of run 1 or 2		
Scripting Worksheet 2 (Run 3) Manual IMU Alignment					
			Data not available at time of publication.		

SESSION DATA SHEET LANDMARK TRACKING NAVIGATION	PT2.2	1

PURPOSE.

To provide the training in earth orbital navigation with the spacecraft SCT.

SCOPE.

This session includes the procedures for spacecraft navigation by the landmark tracking technqiue using the spacecraft G&N system. Landmark selection and recognition is emphasized along with equipment operating procedures. Runs are as follows:

1. Walk-through landmark tracking navigation procedures
2. Practice landmark tracking navigation procedures
3. Practice G&N activation and IMU alignment, followed by orbit measurement using landmark tracking method.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedures	Run	Source
1. Landmark sighting	1, 2, 3	R507 - P22
2. G&N system activation	3	R507 - P22
3. IMU orientation determination	3	R507 - P51
4. IMU fine alignment	3	R507 - P53
5. Orbital parameters display	3	R507 - P33

MEASUREMENT DATA.

Measurement data group 2.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	2	3
VISUAL SYSTEMS			
Film Cassette Loading	X	X	X
SIMULATED C/M			
Vertical Insertion and Retraction	*	*	*

X = Required

* = If not previously accomplished

SESSION DATA SHEET LANDMARK TRACKING NAVIGATION	PT2.2	2

System Checklist	Run No. 1	2	3
COMPUTER COMPLEX			
Premission Setup	X	X	X
X-Y PLOTTERS			
Plotter Readiness and Setup (X-Y 30 X 30)		⊠	⊠
X-T RECORDERS			
Records Readiness and Setup (X-T)		X	X
INSTRUCTOR-OPERATOR STATION			
Computer and Simulator Status	X	X	X
Communications Control Setup	X	X	X
Closed Circuit TV Setup	X	X	X
Recorder and Plotter Status		⊠	⊠
True Trainee Environment and Waste Management Status	X	X	X
G&N and Visuals Readiness	X	X	X
Up-Data Link Status	X	X	X
Reset Initialization	X	X	X

X = Required ⊠ = Optional

2. Inhibit day termination for run 2. Use step-ahead for runs 2 and 3.
3. No malfunctions are required during this session.

SCRIPTING NOTES.

Two scripts are required for this session and two scripting worksheets are provided:

Script	Scripting Worksheet	Run
1	1	1
2	1	2
3	2	3

Navigation during the three runs is directly related to figures 3-4, 3-5, and 3-6, Volume I of this handbook. It is suggested these figure references be made available at the IOS during session accomplishment. In run 2 the day-night

SESSION DATA SHEET LANDMARK TRACKING NAVIGATION	PT2.2	3

terminator is inhibited in order to provide continuous daylight for landmark sighting purposes. Runs 2 and 3 also use step-ahead for purposes of skipping over those areas where no landmarks are available.

As many sightings as possible should be taken on each landmark in order to establish orbital parameters in the AGC. A minimum of three sightings on three different landmarks are required to complete the orbital measurement.

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initiate at S3	Simulated GMT 14:10:02
			Landmark sightings (Africa and Madagascar)	IOS Data Sheet GN4.09 (includes GN4.03, GN4.49, and GN4.50)	Crew procedures, R507 - P22
			Additional sightings	IOS Data Sheets GN4.03, GN4.49, and GN4.50 for each additional set of landmarks	R507 - P22
			Complete series of sightings (Africa and Madagascar)		Simulated GMT 14:40:00
			End of run 1		
				Inhibit day-night termination	
				Step ahead to simulated GMT 14:54:00 (run 2)	
			Landmark sightings (Australia and SW Pacific)	IOS Data Sheets GN4.03, GN4.49, and GN4.50 for each set of landmarks	Crew procedures, R507 - P22
			Complete series of sightings (Australia and SW Pacific)		Simulated GMT 15:10:00
				Step ahead to simulated GMT 15:30:00	

SESSION DATA SHEET PT2.2 5

Scripting Worksheet 1 (Runs 1 and 2) Landmark Tracking Navigation Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Landmark sightings (Mexico and U.S.)	IOS Data Sheets GN4.03, GN4.49, and GN4.50 for each set of landmarks	Crew procedures, R507 - P22
			Complete series of sightings (Mexico and U.S.)		Simulated GMT 15:40:00
				Step ahead to simulated GMT 15:50:00	
				Inhibit day-night termination	
			Landmark sightings (Africa and Madagascar)	IOS Data Sheets GN4.03, GN4.49, and GN4.50 for each set of landmarks	Crew procedures, R507 - P22
			Complete series of sightings (Africa and Madagascar)		Simulated GMT 16:15:00
				Step ahead to simulated GMT 16:28:00	
			Landmark sightings (Australia and SW Pacific)	IOS Data Sheets GN4.03, GN4.49, and GN4.50 for each set of landmarks	Crew procedures, R507 - P22
			Complete series of sightings (Australia and SW Pacific)		Simulated GMT 16:44:00
				Step ahead to simulated GMT 17:03:00	

Scripting Worksheet 1 (Runs 1 and 2) Landmark Tracking Navigation Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Landmark sightings (Mexico and U.S.)	IOS Data Sheets GN4.03, GN4.49, and GN4.50 for each set of landmarks	Crew procedures, R507 - P22
			Complete series of sightings (Mexico and U.S.)		Simulated GMT 17:14:00
				Step ahead to simulated GMT 17:35:00	
				Inhibit day-night termination	
			Landmark sightings (South Africa)	IOS Data Sheets GN4.03, GN4.49, and GN4.50 for each set of landmarks	Crew procedures, R507 - P22
			Complete series of sightings (South Africa)		Simulated GMT 17:47:00
				Step ahead to simulated GMT 18:00:00	
			Landmark sightings (Australia, New Guinea, and Central Pacific)	IOS Data Sheets GN4.03, GN4.49, and GN4.50 for each set of landmarks	Crew procedures, R507 - P22
			Complete series of sightings (Australia, New Guinea, and Central Pacific)		Simulated GMT 18:15:00
			End of run 2		

SESSION DATA SHEET

Scripting Worksheet 2 (Run 3) G&N Activation, IMU Alignment, and Orbital Measurement

PT2.2 7

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 3	Initiate at S5	Simulated GMT 15:30:00
			G&N activation	IOS Data Sheet GN4.01 (includes GN4.03)	Crew procedures, R507 - P22
			IMU orientation determination (star availability between longitudes 02°E and 178°W as shown in figure 3-5, Volume I)	GN4.04 (includes GN4.03 and GN4.49)	R507 - P51
			IMU alignment (star availability between longitudes 00° and 180° as shown in figure 3-5, Volume I)	GN4.07 (includes GN4.03, GN4.49, and GN4.50)	R507 - P53
			Landmark tracking (Mexico and U.S.)	GN4.09 (includes GN4.03, GN4.49, and GN4.50)	R507 - P22 Landmarks available: 88, 87, 98, 96, 93, 92, 94, 89, 90, 112, and 117.
			Complete series of sightings (Mexico and U.S.)		(Three sightings required for each of three landmarks to determine orbital parameters.)
			Orbital parameter display	GN4.55 (includes GN4.03)	Crew procedures, R507 - R33
			End of run 3		

SESSION DATA SHEET STAR-LUNAR LANDMARK NAVIGATION	PT2.3	1

PURPOSE.

To provide training in spacecraft navigation using the G&N system and star-lunar landmark technique.

SCOPE.

As star-lunar landmark navigation is a mission objective of mission 204A, this session provides experience in this technique.

CREW PROCEDURES.

Procedure	Run	Source
1. G&N activation	1, 2	R507 - P22
2. IMU orientation determination	1, 2	R507 - P51
3. IMU alignment	1, 2	R507 - P51
4. Star-lunar landmark navigation	1, 2	R507 - P23

MEASUREMENT DATA.

Measurement data group 2, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run 1
VISUAL SYSTEMS	
Film Cassette Loading	X
SIMULATED C/M	
Vertical Insertion and Retraction	*
COMPUTER COMPLEX	
Premission Setup	X
X-Y PLOTTERS	
Plotter Readiness and Setup (X-Y 30 x 30)	⊠

X = Required ⊠ = Optional * = If not previously accomplished

SESSION DATA SHEET STAR-LUNAR LANDMARK NAVIGATION	PT2.3	2

System Checklist	Run 1
X-T RECORDERS	
Records Readiness and Setup (X-T)	⊠
INSTRUCTOR-OPERATOR STATION	
Computer and Simulator Status	X
Communications Control Setup	X
Closed Circuit TV Setup	X
Recorder and Plotter Status	X
True Trainee Environment and Waste Management Status	X
G&N and Visuals Readiness	X
Up-Data Link Status	X
Reset Initialization	X

X = Required ⊠ = Optional

2. No malfunctions required for this session.

SCRIPTING NOTES.

One script is required for the two runs of this session. This script is constructed using scripting worksheet 1 as a guide. Star availability during these runs is available in figure 3-6.

Scripting Worksheet 1 (Runs 1 and 2) Star-Lunar Landmark Navigation

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1 or 2	Initialize at S8	
			G&N activation	IOS Data Sheet GN4.01 (includes GN4.03)	Crew procedures, R507 - P22
			IMU orientation determination (star availability between longitudes 135°E and 25°W as shown in figure 3-5, Volume I)	GN4.04 (includes GN4.03 and GN4.49)	R507 - P51
			IMU alignment (SCM) (star availability between longitudes 135°E and 25°W as shown in figure 3-5, Volume I)	GN4.07 (includes GN4.03, GN4.49, and GN4.50)	R507 - P51
			Star-lunar landmark navigation measurement	GN4.10 (includes GN4.03)	R507 - P23
			End of run 1 or 2		

SESSION DATA SHEET G&N CONTINGENCIES	PT2.4	1

PURPOSE.

To provide the flight crew training in the procedures for G&N system operation.

SCOPE.

This session comprises the demonstration and practice of G&N malfunctions, special procedures, and alternate modes. Runs involved are as follows:

1. Practice G&N operation with various optical subsystem failures
2. Practice G&N operation with various IMU subsystem failures
3. Practice G&N operation with various AGC subsystem failures.

CREW PROCEDURES.

Procedure	Run	Source
1. Activate G&N system	1, 2, 3	R507 - P22
2. IMU orientation determination	1, 2	R507 - P51
3. Loss of 28-volt 800-cps wheel excitation	3	SM2A-03, para. 9.1.1.2
4. IMU temperature control indicator relay fail	3	SM2A-03, para. 9.1.1.3
5. Loss of 2-volt 3200-cps microsyn excitation	2	SM2A-03, para. 9.1.1.4

MEASUREMENT DATA.

Measurement data group 2, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in table 1-18, section 1, Volume I of this document.

System Checklist	Run No. 1	2	3
VISUAL SYSTEMS			
Film Cassette Loading	X	X	X
SIMULATED C/M			
Vertical Insertion and Retraction	*	*	*

X = Required

* = If not previously accomplished

SESSION DATA SHEET G&N CONTINGENCIES	PT2.4	2

System Checklist	Run No. 1	2	2
COMPUTER COMPLEX			
Premission Setup	X	X	X
INSTRUCTOR-OPERATOR STATION			
Computer and Simulator Status	X	X	X
Communications Control Setup	X	X	X
Closed Circuit TV Setup	X	X	X
True Trainee Environment and Waste Management Status	X	X	X
G&N and Visuals Readiness	X	X	X
Up-Data Link Status	X	X	X
Reset Initialization	X	X	X

X = Required

2. Select the following malfunctions for the applicable run:

Run 1

GN-047 Sextant shaft motor drive amplifier fails

GN-050 Telescope shaft and trunnion motor drive amplifier fails

Run 2

GN-027 IMU temperature control indicator relay fails

GN-113 IMU CONTROL-TRANSFER switch MANUAL position fails open

GN-040 Loss of 2-volt 3200-cps excitation

Run 3

GN-021 ZERO ENCODER backlight inoperative

GN-034 Fine align mode relay fails open

GN-033 Coarse align mode relay fails open

GN-037 Loss of 28-volt 800-cps wheel excitation.

SCRIPTING NOTES.

Three scripts are required for this session. A separate scripting worksheet is provided for each script.

Sightings made during this session are directly related to figure 3-4, Volume I. It would be convenient to have this figure available at the IOS.

SESSION DATA SHEET PT2.4 3

Scripting Worksheet 1 (Run 1) G&N Operation With Optical Failures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at S5	These runs are accomplished from station 4.
			Activate G&N system	IOS Data Sheet GN4.01	Crew procedures, R507 - P22
1	GN-047		Sextant shaft motor drive amplifier fails	None	These two malfunctions will not be noticeable until sextant operation is attempted (loss of sextant use in nav sightings).
1	GN-050		Telescope shaft and trunnion motor drive amplifier fails	None	
			IMU orientation determination	GN4.04 (includes GN4.03 and GN4.49)	Malfunctions will require trainee to manually position telescope during IMU alignment. Crew procedures, R507 - P51
			End of run 1		
Scripting Worksheet 2 (Run 2) G&N Operation With IMU Failures					
			Start run 2	Initialize at S6	These runs are accomplished from station 4.

Scripting Worksheet 2 (Run 2) G&N Operation With IMU Failures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Activate G&N system	IOS Data Sheet GN4.01	Crew procedures, R507 - P22
2	GN-027		IMU temperature control indicator relay fails	IMU TEMP light illuminates. Verify sensor circuit failure upon crew request	SM2A-03, para. 9.1.1.3
5	GN-113		IMU CONTROL-TRANSFER sw MANUAL position fails open	None	Crewmember should select COMPUTER position.
			IMU orientation determination (stars available between longitudes 75°E and 105°W as shown in figure 3-5, Volume I)	IOS Data Sheet GN4.04 (includes GN4.03 and GN4.49)	Crew procedures, R507 - P51
20	GN-040		Loss of 2-volt 3200-cps microsyn excitation	G&N ERROR light G&N ACCEL FAIL light MASTER ALARM light Instructor should verify failure upon crew request	Crew procedures, SM2A-03, para. 9.1.1.4
			End of run 2		
Scripting Worksheet 3 (Run 3) G&N Operation With AGC Failures					
			Start run 3	Initialize at S7	These runs are accomplished from station 4.
			Activate G&N system	IOS Data Sheet GN4.01	Crew procedures, R507 - P22

SESSION DATA SHEET PT2.4 5

Scripting Worksheet 3 (Run 3) G&N Operation With AGC Failures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
10	GN-021		ZERO ENCODER backlight inoperative	ZERO ENCODER light fails to illuminate	Crewmember should perform lamp test.
			IMU orientation determination (stars available between longitudes 30°E and 30°W, as shown in figure 3-5, Volume I)	IOS Data Sheet GN4.04 (includes GN4.03 and GN4.49)	
3	GN-034		Fine align mode relay fails open	Fine align light fails to light automatically	Crewmember should manually select fine align mode.
5	GN-033		Coarse align mode relay fails open	Coarse align light fails to light automatically	Crewmember should manually select coarse align mode.
17	GN-037		Loss of 28-volt 800-cps wheel excitation	IMU FAIL light G&N ERROR light MASTER ALARM light	Crew procedures, SM2A-03, para. 9.1.1.2
			End of run 3		

SESSION DATA SHEET PRIMARY AND BACKUP DELTA V MODES	PT3.1	1

PURPOSE.

To provide an introduction to the basic orbit change modes and training in the procedures involved.

SCOPE.

The five runs of this session provide demonstrations and practice in the four G&N and SCS delta V modes. The orbital change objective of each run is the same, minus one-degree plane change. Runs are as follows:

1. Walk-through procedures for delta V in the G&N, SCS, G&N/manual TVC, and SCS/manual TVC modes
2. Practice procedures for G&N mode delta V
3. Practice procedures for SCS mode delta V
4. Practice procedures for delta V in the G&N/manual TVC mode
5. Practice procedures for delta V in the SCS/manual TVC mode.

CREW PROCEDURE.

Procedures to be used during this session are as follows:

Procedure	Run	Source
1. G&N delta V	1, 2 and 4	R507 - P31, P32, P41, R14, R37 Task analysis SP003, SP004
2. SCS delta V	1, 3 and 5	Not available at time of publication

MEASUREMENT DATA.

Measurement data group 1, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	2	3	4	5
VISUAL SYSTEMS					
Film Cassette Loading	X	X	X	X	X

X = Required

SESSION DATA SHEET PRIMARY AND BACKUP DELTA V MODES	PT3.1	2

System Checklist	Run No. 1	2	3	4	5
SIMULATED C/M					
Vertical Insertion and Retraction	*	*	*	*	*
COMPUTER COMPLEX					
Premission Setup	X	X	X	X	X
X-Y PLOTTERS					
X-Y Plotter Readiness and Setup (X-Y 30 X 30)		X	X	X	X
X-T RECORDERS					
X-T Recorder Readiness and Setup		X	X	X	X
INSTRUCTOR-OPERATOR STATION					
Computer and Simulator Status	X	X	X	X	X
Communications Control Setup	X	X	X	X	X
Closed-Circuit TV Setup	X	X	X	X	X
True Trainee Environment and Waste Management Status	X	X	X	X	X
G&N Visuals Readiness	X	X	X	X	X
Reset Initialization	X	X	X	X	X

X = Required

* = If not previously accomplished

2. No malfunctions are required during this session.

SCRIPTING NOTES.

Three scripts are required for the five runs in this session.

Script	Scripting Worksheet	Run
1	1	1
2	2	2, 4
3	3	3, 5

Sighting portions are directly related to figure 3-4 in Volume I. It would be convenient to have this figure available at the IOS. Inhibiting of the day terminator is required to permit navigation sightings with South Africa and Madagascar landmarks. The sighting mark routine will be repeated as often as possible during each landmark sighting routine.

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at S4	Simulated GMT 14:40:02
1-32			Preparation for G&N delta V	IOS Data Sheet GN4.12 (includes GN4.03, GN4.04, GN4.07, GN4.49, and GN4.50)	Crew procedures, R507 - P31
1-19			Delta V operations	SP3.04	Crew procedures task analysis SP003
1-65			Orbit change delta V	GN1.13	Crew procedures, R507 - P32
20-34			Delta V operations	SP3.04	Crew procedures task analysis SP004
66-98			Orbit change delta V	GN1.13 (includes GN1.40 and GN1.44)	Crew procedures R507 - P31, P32, R37
1-12			SCS delta V	SC1.03 (includes GN4.03)	Crew procedures not available at time of publication.
1-25			Sighting mark routine	GN4.49	Crew procedures, R507 - R14
1-34			Delta V operations	SP3.04	Crew procedures task analysis SP003, SP004

Scripting Worksheet 1 (Run 1) Primary and Backup Delta V Modes (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13-46			SCS delta V	IOS Data Sheet SC1.03 (includes GN4.03)	Crew procedures not available.
			End of run 1		
Scripting Worksheet 2 (Runs 2 and 4) G&N Mode Delta V					
			Start run 2 or 4	Initialize at S4	Simulated GMT 14:40:02
1-32			Station preparation for G&N delta V	IOS Data Sheet GN4.12 (includes GN4.03, GN4.04, GN4.07, GN4.49, and GN4.50)	Crew procedures, R507 - P31
1-19			Delta V operation	SP3.04	Task analysis, SP003, SP004
1-50			Orbit change delta V	GN1.13	R507 - P31, P41
			Initiate manual TVC control	Check FDAI and TV monitor	Run 4 only
51-98			Orbit change delta V	GN1.13	Crew procedures, R507 - P41
			End run 2 or 4		
Scripting Worksheet 3 (Runs 3 and 5) SCS Mode Delta V					
			Start run 3 or 5	Initialize at S4	Simulated GMT 14:40:02

SESSION DATA SHEET
Scripting Worksheet 3 (Runs 3 and 5) SCS Mode Delta V (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-12			SCS delta V	IOS Data Sheet SC1.03 (includes GN4.03)	Crew procedures not available at time of publication.
1-25			Sighting mark routine	GN4.49	Crew procedures, R507 - R14
1-34			Station 3 delta V operation	SP3.04	Crew procedures task analysis SP003, SP004
13-35			SCS delta V	SC1.03	Crew procedures not available at time of publication.
			Initiate manual TVC control	Check FDAI and TV monitor	Run 5 only
36-46			SCS delta V	IOS Data Sheet SC1.03	Crew procedures not available at time of publication.
			End of run 3 or 5		

SESSION DATA SHEET RETROGRADE FROM EARTH ORBIT	PT3.2	1

PURPOSE.

To provide training in preparation for and accomplishing retrograde from earth orbit.

SCOPE.

The four runs of this session provide demonstration and practice in the G&N SPS and G&N RCS deorbit delta V modes. Runs are as follows:

1. Walk-through spacecraft system retrograde preparation procedures
2. Practice final orbit navigation and system procedures used in preparing for and accomplishing SPS/G&N mode retrograde
3. Walk-through procedures used in preparing for and accomplishing RCS retrograde
4. Practice final orbit navigation and system procedures used in preparing for and accomplishing RCS retrograde.

CREW PROCEDURES.

Procedure	Run	Source
1. Cabin cold soak	1, 2	SM2A-03, para. 8.1.3.6
2. Deorbit and entry	1, 2	SM2A-03, para. 8.4 and R507 - P32, P42

MEASUREMENT DATA.

Measurement data group 1, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	2	3	4
VISUAL SYSTEMS				
Film Cassette Loading	X	X	X	X
SIMULATED C/M				
Vertical Insertion and Retraction	*	*	*	*

X = Required

* = If not previously accomplished

SESSION DATA SHEET RETROGRADE FROM EARTH ORBIT	PT3.2	2

System Checklist	Run No. 1	2	3	4
COMPUTER COMPLEX				
Premission Setup	X	X	X	X
X-Y PLOTTERS				
Plotter Readiness and Setup (X-Y 30 X 30)		⊠		⊠
X-T RECORDERS				
Recorder Readiness and Setup (X-T)		⊠		⊠
INSTRUCTOR-OPERATOR STATION				
Computer and Simulator Status	X	X	X	X
Communication Control Setup	X	X	X	X
Closed Circuit TV Setup	X	X	X	X
True Trainee Environment and Waste Management Status	X	X	X	X
G&N Visual Readiness	X	X	X	X
Reset initialization	X	X	X	X

X = Required ⊠ = Optional

2. No malfunctions are required for this session.

SCRIPTING NOTES.

Two scripts are required for the runs of this session.

Script	Scripting Worksheet	Run
1	1	1, 2
2	2	3, 4 (data not available)

Start these runs at step 9 of table 3-10, Basic Nominal Training Mission, Volume I, and table 3-2, Volume II, this document. The sighting mark routine will be repeated as often as possible during each landmark sighting routine.

SESSION DATA SHEET PT3.2 3

Scripting Worksheet 1 (Runs 1 and 2) Walk-Through and Practice G&N SPS Deorbit Procedures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1 or 2	Initialize at S8	Simulated GMT time 17:00:00
1-3			Cabin cold-air soak	IOS Data Sheet EC3.05	Crew procedures, SM2A-03, para. 8.3.1.6
1-48			Deorbit delta V, station 4	E4.1 (includes GN4.03)	R507 - P32
1-53			Deorbit delta V procedures	E1.1	R507 - P32, P42
1-14			Deorbit delta V procedures	E3.1 (includes SP3.04)	SM2A-03, para. 8.4
54-94			Deorbit delta V procedures	E1.1	R507 - P32, P42
			End of run 1 or 2		
Scripting Worksheet 2 (Runs 3 and 4) Walk-Through and Practice RCS Retrograde Data not available at time of publication.					

SESSION DATA SHEET G&N MODE ENTRY	PT4.1	1

PURPOSE.

To provide experience in the procedures for preparing for and accomplishing C/M-S/M separation, G&N mode entry, and monitor-control of the earth landing sequence.

SCOPE.

The session is comprised of three runs. The first two are to demonstrate and practice crew procedures for descent from orbit beginning immediately after retrograde and continuing through touchdown. The third run is for practicing the previously learned procedures for retrograde in conjunction with the descent to touchdown. The walk-through should include demonstration of both station 1 and station 3 procedures used before and after C/M-S/M separation. Only the station 1 procedures require practice during this session. Runs are as follows:

1. Walk-through procedures used in preparing for and accomplishing C/M-S/M separation, G&N mode entry, and monitor-control of the earth landing sequence
2. Practice procedures used in preparing for and accomplishing C/M-S/M separation and G&N mode entry
3. Practice procedures used in preparing for and accomplishing retrograde, C/M-S/M separation, G&N mode entry, and monitor-control of earth landing system sequence.

CREW PROCEDURES.

Crew procedures to be practiced during this session are as follows:

Procedure	Run	Source
1. Deorbit and entry	1, 2, 3	SM2A-03, para. 8.4 R507 - P61, P62, P63, P66
2. G&N delta V	3	R507 - P32, P42, P61, P62, P63, P66

MEASUREMENT DATA.

X-T RECORDERS

Title	Program Symbol
1. G loading	$A\ddot{X}DDB$
2. Velocity relative to atmosphere	V_R
3. True attitude-pitch	STAP
4. True attitude-roll	STAR
5. True attitude-yaw	STAY

SESSION DATA SHEET G&N MODE ENTRY	PT4.1	2

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18 of this document.

System Checklist	Run No. 1	2	3
VISUAL SYSTEMS			
Film Cassette Loading	X	X	X
SIMULATED C/M			
Vertical Insertion and Retraction	*	*	*
COMPUTER COMPLEX			
Premission Setup	X	X	X
X-Y PLOTTERS			
Plotter Readiness and Setup (X-Y 30 X 30)		⊠	⊠
Plotter Readiness and Setup (X-Y 11 X 17)		⊠	⊠
INSTRUCTOR-OPERATOR STATION			
Computer and Simulator Status	X	X	X
Communications Control Setup	X	X	X
Closed Circuit TV Setup	X	X	X
Recorder and Plotter Status		⊠	⊠
True Trainee Environment and Waste Management Status	X	X	X
Reset Initialization	X	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this session.

SCRIPTING NOTES.

Two scripts are required for the three runs of this session as follows:

Script	Scripting Worksheet	Run
1	1	1, 2
2	2	3

Scripting Worksheet 1 (Runs 1 and 2) G&N Mode Entry From SPS Retrofire

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1 or 2	Initialize at S12	Simulated GMT 18:15:00
			Remove lockpins from inlet and outlet cabin postlanding vent valves (station 4)	None	Crew procedures, SM2A-03, para. 8.4, step 18
1			Post-deorbit delta V	IOS Data Sheet E3.2	SM2A-03, para. 8.4, step 19
1-30			Post-deorbit delta V	E1.2 (includes GN4.03, GN1.40, and GN1.44)	R507 - P61
2-4			Post-deorbit delta V	E3.2 (includes EP3.08)	SM2A-03, para. 8.4, steps 22, 23, 26
1-2			Post-delta V operations	E2.1	SM2A-03, para. 8.4, steps 24-25
33-55			Post-deorbit delta V	E1.2	R507 - P62
3-4			Post-delta V operations	E2.1 (includes RC2.01)	SM2A-03, para. 8.4, step 32 (may be performed from seat)
5			Post-deorbit delta V	E3.2	SM2A-03, para. 8.4, step 55
1-19			Post-separation and entry	E1.3	R507 - P62, P63, P66

SESSION DATA SHEET PT4.1 4

Scripting Worksheet 1 (Runs 1 and 2) G&N Mode Entry From SPS Retrofire (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-19			ELS arming	IOS Data Sheet E1.4	Crew procedures, SM2A-03, para. 8.4, steps 61-82
			Touchdown		
			End of run 1 or 2		
Scripting Worksheet 2 (Run 3) G&N Mode Entry Including SPS Retrograde					
			Start run 3	Initialize at S11	Simulated GMT 18:10:00
1-13			Deorbit delta V	IOS Data Sheet E3.1	Crew procedures, SM2A-03, para. 8.4, steps 1-4, 7, 16
1-37			Deorbit delta V	E4.1 (includes GN4.03)	R507 - P32
1-6			Deorbit delta V	E1.1	R507 - P32
38-48			Deorbit delta V	E4.1 (includes GN4.04 and GN4.07)	R507 - P32
7-94			Deorbit delta V	E1.1 (includes GN4.03)	R507 - P42
1			Post-deorbit delta V	E3.2	SM2A-03, para. 8.4, step 19
1-30			Post-deorbit delta V	E1.2 (includes GN4.03, GN1.40, and GN1.44)	R507 - P61

Scripting Worksheet 2 (Run 3) G&N Mode Entry Including SPS Retrograde (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
2-4			Post-deorbit delta V	IOS Data Sheet E3.2 (includes EP3.08)	Crew procedures, SM2A-03, para. 8.4, steps 22, 23, and 26
1-2			Post-delta V operations	E2.1	SM2A-03, para. 8.4, steps 24-25
33-55			Post-deorbit delta V	E1.2	R507 - P62
3-4			Post-delta V operations	E2.1 (includes RC2.01)	SM2A-03, para. 8.4, step 32 (may be performed from station 1)
5			Post-deorbit delta V	E3.2	SM2A-03, para. 8.4, step 55
1-19			Post-separation and entry	E1.3 (includes GN1.44)	R507 - P62, P63, P66
1-19			ELS arming	E1.4	SM2A-03, para. 8.4, step 61-82
			Touchdown		
			End of run 3		

SESSION DATA SHEET ENTRY CONTINGENCIES	PT4.2	1

PURPOSE.

To provide the flight crewmembers training in the use of alternate modes, redundant systems, and manual overrides in accomplishing entry and recovery under system malfunction circumstances.

SCOPE.

Eight runs are required to accomplish this session. Entry procedures in the SCS mode retro will be practiced with and without selected malfunctions and RCS retrograde separation. Runs are as follows:

1. Walk-through of procedures for entry in the SCS mode (SPS retrotrajectory)
2. Practice SCS mode entry (SPS retrotrajectory)
3. Practice entry (SPS retrotrajectory) in G&N mode with selected CM-RCS jets inoperative
4. Practice entry (SPS retrotrajectory) in SCS mode with selected CM-RCS jets inoperative
5. Practice entry (SPS retrotrajectory) in manual direct mode
6. Practice entry (SPS retrotrajectory) in manual direct mode with selected CM-RCS jets inoperative
7. Practice preparation for separation preparation for entry, SCS mode entry (SPS retrotrajectory) and monitor-control of the earth landing sequence with sequencing malfunctions
8. Practice preparation for and accomplishment of RCS retrograde, separation, and SCS mode entry.

CREW PROCEDURES.

SM2A-03 does not presently include crew procedures for SCS on manual direct modes of entry; therefore, these runs cannot be provided.

MEASUREMENT DATA.

TBD

INSTRUCTOR ACTIVITY OUTLINE.

TBD

SCRIPTING NOTES.

TBD

SCRIPTING WORKSHEET.

TBD

SESSION DATA SHEET LAUNCH-BOOST PROCEDURES	PT5.1	1

PURPOSE.

To provide Apollo station 1 flight crewmembers with training in normal launch and ascent procedures as they relate to EDS, AGC and FDAI displays.

SCOPE.

This session is comprised of two launch and ascent runs for monitoring the launch-boost. Runs are as follows:

1. Walk-through station 1 launch and ascent procedures
2. Practice station 1 launch and ascent procedures.

CREW PROCEDURES.

Procedure to be practiced during this session is as follows:

Procedures	Run	Source
1. Ascent and initial orbit	1, 2	SM2A-03, para. 8.2

MEASUREMENT DATA.

None

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	Run No. 2
VISUAL SYSTEMS		
Film Cassette Loading	X	X
SIMULATED C/M		
Vertical Insertion and Retraction	*	*
COMPUTER COMPLEX		
Premission Setup	X	X

X = Required

* = If not previously accomplished

SESSION DATA SHEET LAUNCH-BOOST PROCEDURES	PT5.1	2

System Checklist	Run No. 1	Run No. 2
INSTRUCTOR-OPERATOR STATION		
Computer and Simulator Status	X	X
Communications Control Setup	X	X
Closed Circuit TV Setup	X	X
True Trainee Environment and Waste Management Status	X	X
Reset Initialization	X	X

X = Required

2. No malfunctions are required for this session.

SCRIPTING NOTES.

Only one script is required for the two runs of this session. Scripting worksheet 1 should be used in its preparation.

This script starts at step 1, table 3-8, Volume I, and table 3-10, Volume I, this document.

As an aid to the instructor, figures 3-2 and 3-3 of Volume I should be used.

Scripting Worksheet 1 (Runs 1 and 2) Practice Launch and Ascent

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1 or 2	Initialize at . . . S2	
			Ascent	IOS Data Sheet A1.1	Crew procedures, SM2A-03, para. 8.2
			End of run 1 or 2		

SESSION DATA SHEET LES ABORT	PT5.2	1

PURPOSE.

This session is to provide flight crewmembers with experience in all aspects of LES abort procedures for station 1.

SCOPE.

This training session includes both crew- and instructor-initiated abort sequences. Multiple runs are used with malfunctions to provide various LES abort sequences. Runs are as follows:

1. Walk-through of pad and low-altitude before +42 seconds abort sequence
2. Practice procedures for LES abort (42 seconds to 30,000 ft)
3. Practice procedures for LES abort (30,000 ft to 120,000 ft)
4. Practice procedures for LES abort (120,000 ft to LET jettison)
5. Practice LES abort (30,000 to 120,000 ft) with sequencing malfunctions
6. Practice low-altitude LES abort (less than 10,000 ft) with sequencing malfunctions.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedure	Run	Source
1. Low-altitude abort	1, 2, 6	SM2A-03, para. 9.2.1.1.1
2. Medium-altitude abort	3, 5	9.2.1.1.2
3. High-altitude abort	4	9.2.1.1.3
4. Ascent and initial orbit	1, 2, 3, 4, 5, 6	8.2

MEASUREMENT DATA.

Measurement data group 4, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18 of this handbook.

SESSION DATA SHEET LES ABORT	PT5.2	2

System Checklist	Run No. 1	2	3	4	5	6
VISUAL SYSTEMS						
Film Cassette Loading	*	*	*	*	*	*
SIMULATED C/M						
Vertical Insertion and Retraction	*	*	*	*	*	*
COMPUTER COMPLEX						
Premission Setup	X	X	X	X	X	X
X-Y PLOTTERS						
Plotter Readiness and Setup (X-Y 30 X 30)					⊠	
X-T RECORDERS						
Records Readiness and Setup (X-T)						X
INSTRUCTOR-OPERATOR STATION						
Computer and Simulator Status	X	X	X	X	X	X
Communications Control Setup	X	X	X	X	X	X
Closed Circuit TV Setup	X	X	X	X	X	X
Recorder and Plotter Status					⊠	X
True Trainee Environment and Waste Management Status	X	X	X	X	X	X
Reset Initialization	X	X	X	X	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. Use the following malfunctions for the runs indicated.

Run 5

CS201 Abort request light fails ON
GS001 24,000 ft barometric switch fails to close
GS003 10,000 ft barometric switch fails to close

Run 6

CS250 Instructor initiated abort
GS005 ELS transistor switches fail
GS055 LES and pitch motor fails to fire
GS002 Drogue parachutes fail to deploy

SESSION DATA SHEET LES ABORT	PT5.2	3

SCRIPTING NOTES.

Three scripts are required for this session as follows:

Script	Scripting Worksheet	Run
1	1	1, 2, 6
2	2	3, 5
3	3	4

This session should start at step 1, table 3-8 Volume I, and table 1-18, Volume II, this document. Instructor should familiarize himself with paragraph 3.2.1.2 of Volume I for abort simulation sessions.

Scripting Worksheet 1 (Runs 1, 2 and 6) Walk-Through/Practice LES Aborts, Pad to 30,000 ft with/without Malfunctions

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1, 2, or 6	Initialize at . . . S2	
1-11			Ascent and initial orbit	IOS Data Sheet A1.1	Crew procedures, SM2A-03, para. 8.2
	CS-201	T + 20 sec	Abort initiation (run 1 or 2)	ABORT light illuminates	Crewman will initiate abort.
	CS-250	T + 20 sec	Abort initiation (run 6)	Instructor initiated abort	Simulated automatic abort.
11			Pad and low attitude aborts	IOS Data Sheet B1.2	Crew procedures, SM2A-03, para. 9.2.1.1.1
8	GS-055		LES and pitch motor fire switch fails	All "GS" malfunctions may be inserted prior to liftoff. These will not become apparent until time for the function to occur in the abort sequence. Override procedures for these malfunctions are listed in SM2A-03 abort procedures and on IOS data sheet B1.3 in the sequence of normal occurrence.	
9	GS-005		ELS transistor switches fails		

SESSION DATA SHEET

PT5.2 5

Scripting Worksheet 1 (Runs 1, 2 and 6) Walk-Through/Practice LES Aborts, Pad to 30,000 ft with/without Malfunctions (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
11	GS-002		Drogue parachute fails to deploy Touchdown End of run 1, 2, or 6		
Scripting Worksheet 2 (Runs 3 and 5) Practice LES Abort (30,000 to 120,000 ft) with/without Malfunction					
			Start run 3 or 5	Initialize at . . . S2	
1-16			Ascent and initial orbit	IOS Data Sheet A1.1	Crew procedures, SM2A-03, para. 8.2
	CS-201		ABORT request light on	ABORT light illuminates	Crewman will initiate abort.
16			LES medium-altitude abort	IOS Data Sheet B1.3	Crew procedures, SM2A-03, para. 9.2.1.1.2
8	GS-001		24,000 ft barometric switch fails to close	Override indications for these malfunctions are listed on the B1.3 IOS data sheet in the sequence of normal occurrence.	Training in override procedures and failure recognition. These malfunctions should be inserted in run 5 only.

Scripting Worksheet 2 (Runs 3 and 5) Practice LES Abort (30,000 to 120,000 Ft) with/without Malfunction (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12	GS-003		10,000 ft baroswitch fails to close Touchdown End of run 3 or 5		
Scripting Worksheet 3 (Run 4) Practice LES Abort (120,000 Ft to LET Jettison)					
			Start run 4	Initialize at . . . S2	
1-20			Ascent and initial orbit	IOS Data Sheet A1.1	Crew procedures, SM2A-03, para. 8.2
20	CS-201	0:02:15	Abort initiation	ABORT light illuminates	Crewman will initiate abort.
			High altitude abort	IOS Data Sheet B1.4	Crew procedures, SM2A-03, para. 9.2.1.1.3
			Entry operations	E1.3	SM2A-03, para. 8.4
			Touchdown		
			End of run 4		

SESSION DATA SHEET SPS ABORTS	PT5.3	1

PURPOSE.

To provide training in station 1 SPS abort procedures. This includes aborts to suborbital trajectory and aborts to orbit.

SCOPE.

Data required to accurately determine the scope of this session is not available as of publication date. Runs which should be accomplished are as follows:

1. Walk-through of station 1 procedures for SPS retrograde abort to suborbital trajectory (G&N mode)
2. Practice station 1 procedures for SPS posigrade abort to suborbital trajectory (G&N mode)
3. Practice station 1 procedures for SPS retrograde abort to suborbital trajectory (G&N mode)
4. Practice station 1 procedures for SPS posigrade abort to orbit.

CREW PROCEDURES.

TBD

MEASUREMENT DATA.

TBD

INSTRUCTOR ACTIVITY OUTLINE.

TBD

SCRIPTING NOTES.

TBD

SCRIPTING WORKSHEETS.

TBD

SESSION DATA SHEET PRELAUNCH, LAUNCH—BOOST	MT1.1	1

PURPOSE.

To provide training in the final prelaunch preparations and launch. Prelaunch procedures were not included in part task training, and this session comprises their introduction into the syllabus.

SCOPE.

This session is comprised of stations 1, 2, and 3 procedures for prelaunch (excluding ingress and hatch installation) and launch and ascent. Two training runs are required for the session.

1. Walk-through of crew procedures for prelaunch
2. Practice crew procedures for normal prelaunch, launch and boost to orbit

CREW PROCEDURES.

Crew procedures to be practiced during the session are as follows:

Procedures	Run	Source
1. Prelaunch*	1, 2	SM2A-03, para. 8.1
2. Ascent and initial orbit	2	8.2

*Procedures from paragraph 8.1 of SM2A-03 have been abridged for the purpose of this training session. Steps omitted are 1 through 8, 12, 14 through 18 and 20 (except for 20.9). Composition of the prelaunch procedures sequence is discussed at length under "Prelaunch IOS Data Sheet" in paragraph 3.6.5.1 of Volume I of the handbook.

MEASUREMENT DATA.

No measurement data is required for this session.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	Run No. 2
VISUAL SYSTEMS		
Film Cassette Loading	X	X

X = Required

SESSION DATA SHEET PRELAUNCH, LAUNCH—BOOST	MT1.1	2

System Checklist	Run No. 1	Run No. 2
SIMULATED C/M		
Vertical Insertion and Retraction	*	*
COMPUTER COMPLEX		
Premission Setup	X	X
INSTRUCTOR-OPERATOR STATION		
Computer and Simulator Status	X	X
Communications Control Setup	X	X
Closed Circuit TV Setup	X	X
True Trainee Environment and Waste Management Status	X	X
Reset Initialization	X	X

X = Required

* = If not previously accomplished

2. No malfunctions are required for this session.

SCRIPTING NOTES.

Since there is no simulated real time prior to program initiation point S2, it is necessary to provide some definition of simultaneous and sequential activities in the crew stations during the prelaunch phase of the session. Such is the purpose of the following table of SM2A-03, paragraph 8.1 (prelaunch) steps.

Station 1	Station 2	Station 3
Step 9 (ECS status check) - P1.1		
Step 11 (controls and displays checklist plus step 20.9) P1.2		Step 10 (ECS status check) - P3.1
	Step 22 (controls and displays checklists) ↓ Step 23 (RCS checks)	Step 13 (controls and displays checklist) ↓ Step 24 (EPS check) ↓

SESSION DATA SHEET PRELAUNCH, LAUNCH—BOOST		MT1.1	3
Station 1	Station 2	Station 3	
	Steps 22, 23 - P2.1	Step 25 (SPS check) P3.1 Steps 13, 24, 25 - P3.2	
Final Preparations for Launch			
Station 1	Station 2	Station 3	
Steps 28, 31, 33, and 35 - P1.3	Steps 32, 34 - P2.2	Steps 29, 30, 32, 37 - P3.3	

One scripting worksheet is required in the preparation of one script for this session. The launch and ascent to be simulated is that described in paragraph 3.6.5.2 of Volume I of this handbook.

SESSION DATA SHEET

MT1.1 4

Scripting Worksheet 1 (Runs 1 and 2) Prelaunch, Launch and Ascent

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start runs 1 and 2	Initialize at . . . . . S2 Place AMS in HOLD for S1 initialization	Crew procedures, SM2A-03, para. 8.1 as follows:
			Initial prelaunch ECS check	IOS Data Sheet P1.1	Step 9
			Initial prelaunch ECS check	P3.1	Step 10 (after step 9)
			Controls and displays check	P1.2	Step 11 (after step 9 and concurrent with stations 2 and 3 activities to step 28)
			Controls and displays check, EPS checks, and SPS checks	P3.2	Steps 13, 24, 25 (after step 10 and concurrent with station 1 and 2 activities to step 28)
			Controls and displays check, RCS checks	P2.1	Steps 22, 23 (after step 10 and concurrent with station 1 and 3 activities to step 28)
			Prepare sequencing systems, SPS, and SCS (in that order).	P1.3	Steps 28, 31, 33

Scripting Worksheet 1 (Runs 1 and 2) Prelaunch, Launch and Ascent

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Prepare telecommunications, final ECS and EPS preparations.	IOS Data Sheet P3.3	Steps 29 (concurrent with step 28), 30, 36, 37 (after station 1 and station 2 activities are complete)
			Verify AGC programming.	P2.2	Step 34 (concurrent with step 33)
			End of run 1		
				Place simulator in RUN mode	
		00:00	Launch		Crew procedures, SM2A-03 para. 8.2 as follows:
			Ascent	IOS Data Sheet A1.1	Steps 1-8, 12, 13, 18, 19, 21-30, 32, 34, 35, 37, 39 and 40
			Ascent	A2.1	Steps 9, 10, 14, 16, 20, 31 and 39
			Ascent	A3.1	Steps 11, 17, 20, 36 and 38
		10:02	Orbit insertion		
			End of run 2		

SESSION DATA SHEET LES ABORTS	MT1.2	1

PURPOSE.

To provide LES abort procedures training.

SCOPE.

Except for manual override of sequencing malfunctions and communication of abort events, crew activities are limited to monitoring functions during LES aborts. This session includes practice of these override activities as initiated from both prelaunch and ascent situations. Each run in this session is continuous from launch through abort sequences to touchdown. Runs are as follows:

1. Walk-through of crew procedures for pad abort
2. Practice crew procedures for LES abort (+42 seconds to 30,000 ft)
3. Practice crew procedures for LES abort (30,000 to 120,000 feet)
4. Practice crew procedures for LES abort (120,000 ft to LET jettison).

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

	Procedure	Run	Source
1.	Ascent and initial orbit	2, 3, 4	SM2A-03 para. 8.2
2.	Entry operations	4	8.4
3.	Low-altitude abort	1, 2	9.2.1.1.1
4.	Medium-altitude abort (30,000 to 120,000 ft)	3	9.2.1.1.2
5.	High-altitude abort (120,000 ft to LET tower jettison)	4	9.2.1.1.3

MEASUREMENT DATA.

Measurement data group 4, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the described run. These checklists are found in Volume II, section 1, table 1-18.

System Checklist	Run No. 1	2	3	4
VISUAL SYSTEMS				
Film Cassette Loading	X	X	X	X

X = Required

SESSION DATA SHEET LES ABORTS	MT1.2	2

System Checklist	Run No. 1	2	3	4
SIMULATED C/M				
Vertical Insertion and Retraction	*	*	*	*
COMPUTER COMPLEX				
Premission Setup	X	X	X	X
X-Y PLOTTERS				
Plotter Readiness and Setup (X-Y 30 X 30)		⊠	⊠	⊠
X-T RECORDERS				
Records Readiness and Setup (X-T)		⊠	⊠	⊠
INSTRUCTOR-OPERATOR STATION				
Computer and Simulator Status	X	X	X	X
Communications Control Setup	X	X	X	X
Closed Circuit TV Setup	X	X	X	X
Recorder and Plotter Status		⊠	⊠	⊠
True Trainee Environment and Waste Management Status	X	X	X	X
Reset Initialization	X	X	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. Select the following malfunctions.

Run 1: CS-250 instructor-initiated abort

Run 2: CS-250 instructor-initiated abort - time dependent T + 65 sec

Run 3: CS-203 BOOSTER ENGINE 1 FAIL
CS-205 BOOSTER ENGINE 2 FAIL
CS-250 Instructor initiated abort

Run 4: CS-201 ABORT request light on
CS-203 BOOSTER ENGINE 1 FAIL
CS-205 BOOSTER ENGINE 2 FAIL

SESSION DATA SHEET LES ABORTS	MT1.2	3

SCRIPTING NOTES.

The malfunctions listed for these runs are used to initiate or to require initiation of aborts. No malfunctions are required after abort initiation.

The instructor-operator should have a thorough understanding of paragraph 3.2.1.2, Volume I. The MIU will be used to insert the malfunctions for this session.

No typical mission reference is used for this session.

The following four scripts are required.

Script	Scripting Worksheet	Run
1	1	1
2	2	2
3	3	3
4	4	4

The crewmember at station one is the only active participant in this session. Crewmembers 2 and 3 are required only to observe the reaction of the displays in their areas during abortive situations.

SESSION DATA SHEET

Scripting Worksheet 1 (Run 1) Pad Abort (Pad to 42 Sec After Lift-Off)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at . . . S2	
	CS-250	T-15 sec	Instructor initiated abort	ABORT light on	
			Low-altitude abort (prior to T + 42 sec)	IOS Data Sheet B1.1	Crew procedures, SM2A-03, para. 9.2.1.1.1
			Touchdown		
			End of run 1		
Scripting Worksheet 2 (Run 2) LES Abort (T + 42 Sec to 30,000 Ft)					
			Start run 2	Initialize at . . . S2	
		0:00:00	Ascent and initial orbit	IOS Data Sheets A1.1, A2.1, and A3.1	Crew procedures, SM2A-03, para. 8.2
	CS-250	0:01:05	Instructor initiated abort	ABORT light on	Time-dependent malfunction
			Low-altitude abort (after T + 42 sec)	IOS Data Sheet B1.2	Crew procedures, SM2A-03, para. 9.2.1.1.2
			Touchdown		
			End of run 2		

Scripting Worksheet 3 (Run 3) LES Abort (30,000 to 120,000 Ft)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 3	Initialize at . . . S2	
		0:00:00	Ascent and initial orbit	IOS Data Sheets A1.1, A2.1, and A3.1	Crew procedures, SM2A-03, para. 8.2
	CS-203	0:01:20	BOOSTER ENGINE 1 FAIL	BOOSTER ENGINE 1 FAIL lt on	
	CS-205	0:01:20	BOOSTER ENGINE 2 FAIL	BOOSTER ENGINE 2 FAIL lt on	
	CS-250	0:01:20	Instructor initiated abort medium	ABORT light on	
			LES altitude abort (30,000 to 120,000 ft)	IOS Data Sheet B1.3	Crew procedures, SM2A-03, para. 9.2.1.1.2
			Touchdown		
			End of run 3		

Scripting Worksheet 4 (Run 4) LES Abort (120,000 Ft to LET Tower Jettison)

			Start run 4	Initialize at . . . S2	
		0:00:00	Ascent and initial orbit	IOS Data Sheets A1.1, A2.1, and A3.1	Crew procedures, SM2A-03, para. 8.2

Scripting Worksheet 4 (Run 4) LES Abort (120,000 Ft to LET Tower Jettison) (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	CS-201	0:02:15	ABORT request light on	ABORT lt on	Crew may request verification of failure prior to initiating abort.
	CS-203	0:02:15	BOOSTER ENGINE 1 FAIL	BOOSTER ENGINE 1 FAIL lt on	
	CS-205	0:02:15	BOOSTER ENGINE 2 FAIL	BOOSTER ENGINE 2 FAIL lt on	
			Crew initiated abort		
			High-altitude abort (120,000 ft to tower jettison)	IOS Data Sheet B1.4	Crew procedures, SM2A-03, para. 9.2.1.1.3
			Entry operations	E1.3	SM2A-03, para. 8.4
			ELS arming	E1.4	SM2A-03, para. 8.4
			ELS arming	E3.4	SM2A-03, para. 8.4
			Touchdown		
			End of run 4		

SESSION DATA SHEET SPS ABORTS	MT1.3	1

PURPOSE.

To provide training in integrated crew procedures for SPS aborts, including aborts to suborbital trajectory and abort to orbit.

SCOPE.

Data required to accurately determine the scope of this session is not available as of publication date. Runs to be accomplished are as follows:

1. Walk-through of integrated crew procedures for SPS abort to suborbital trajectory
2. Practice integrated crew procedures for SPS abort to suborbital trajectory due to booster failure
3. Practice integrated crew procedures for SPS abort to orbit due to booster failure
4. Practice recognizing spacecraft system failures requiring suborbital abort and accomplish SPS abort.

CREW PROCEDURES.

TBD

MEASUREMENT DATA.

TBD

INSTRUCTOR ACTIVITY OUTLINE.

TBD

SCRIPTING NOTES.

TBD

SCRIPTING WORKSHEETS.

TBD

SESSION DATA SHEET INITIAL EARTH ORBIT PROCEDURES	MT2.1	1

PURPOSE.

To provide crew procedures training for the initial earth orbital phases.

SCOPE.

The two runs of this session provide familiarization and training in procedures required for navigation and system management as an integrated crew. System procedures include transfer of systems configuration from launch-boost and period checkout, initial IMU alignment and navigation sightings. Runs are as follows:

1. Walk-through of integrated crew procedures for initial phases of orbital operation
2. Practice crew procedures for initial phases of orbital operation.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

	Run	Source
1. Initial orbit procedures	1, 2	SM2A-03, para. 8.2 (steps 40-55)
2. G&N system activation	1, 2	SM2A-03, para. 8.3.1.1
3. Landmark tracking	1, 2	R507 - P22
4. IMU orientation determination	1, 2	R507 - P51
5. IMU alignment (S-IVB)	1, 2	R507 - P52
6. ECS hourly verification	1, 2	SM2A-03, para. 8.3.1.6
7. EPS periodic verification	1, 2	SM2A-03, para. 8.3.1.5
8. RCS periodic verification	1, 2	SM2A-03, para. 8.3.1.4
9. SPS periodic verification	1, 2	SM2A-03, para. 8.3.1.3

MEASUREMENT DATA.

Measurement data group 2, section 6, this volume (optional).

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

SESSION DATA SHEET INITIAL EARTH ORBIT PROCEDURES	MT2.1	2

System Checklist	Run No. 1	Run No. 2
VISUAL SYSTEMS		
Film Cassette Loading	X	X
SIMULATED C/M		
Vertical Insertion and Retraction	*	*
COMPUTER COMPLEX		
Premission Setup	X	X
X-Y PLOTTERS		
Plotter Readiness and Setup (X-Y 30 X 30)	X	X
X-T RECORDERS		
Recorder Readiness and Setup (X-T)		⊠
INSTRUCTOR-OPERATOR STATION		
Computer and Simulator Status	X	X
Communication Control Setup	X	X
Closed Circuit TV Setup	X	X
Recorder and Plotter Status	X	X
Voice and Interference Operations		X
True Trainee Environment and Waste Management Status	X	X
G&N Visual Readiness	X	X
Up-Data Link Status		X
Reset Initialization	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. There are no malfunctions required for this session.

SCRIPTING NOTES.

One script is to be prepared in accordance with the following scripting worksheet. Station 1 activity is very low throughout the session, and stations 1 and 3 are both inactive during IMU alignment. Table 3-8, Volume I, should be used to provide the sequence of operations. The sighting mark routine will be repeated as often as possible during each landmark sighting procedure.

Scripting Worksheet (Runs 1 and 2) Initial Earth Orbital Procedures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start runs 1 and 2	Initialize at . . . S3	T + 10:02 minutes - mission time Simulated GMT 14:10:02 Crew procedures, SM2A-03, para. 8.2
1-8		0:15:00	Initial orbit procedures	IOS Data Sheet O1.1	Steps 40-44 (excluding step 43)
1-3		0:15:00	Initial orbit procedures	O3.1	Step 45
1		0:15:00	Initial orbit procedures	O4.1	Step 46
3			Initial orbit procedures	O3.1	Step 47
9, 10		0:18:00	Initial orbit procedures	O1.1	Step 50
2, 3		0:18:00	Initial orbit procedures	O4.1	Steps 51, 52
11-14		0:20:00	Initial orbit procedures	O1.1	
		0:20:00	Initial orbit procedures	O3.1	Steps 54, 55
		0:22:00	End of run 1		
1-60		00:20:00	G&N system activation	IOS Data Sheet GN4.01	Step not included in AOH

SESSION DATA SHEET

MT2.1 4

Scripting Worksheet (Runs 1 and 2) Initial Earth Orbital Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Landmark tracking	GN4.09	Crew procedures R507 - P22
1-9			Program AGC	GN4.03	
3-8			Landmark tracking	GN4.09	R507 - P22
1-15			Automatic optics positioning	GN4.50	R507 - R15
1-25			Sighting mark routine	GN4.49	R507 - R14
11-16			Landmark tracking	GN4.09	R507 - P22
1		00:48:00	IMU orientation determination	GN4.04	R507 - P51
1-9			Program AGC	GN4.03	
3-19			IMU orientation determination	GN4.04	R507 - P51
1-25			Sighting mark routine first star	GN4.49	R507 - P14
1-25			Sighting mark routine second star	GN4.49	R507 - P14
17-21			IMU orientation determination	GN4.04	R507 - P51
1			IMU alignment (S-IVB)	GN4.09	R507 - P52
1-9			Program AGC	GN4.03	

Scripting Worksheet (Runs 1 and 2) Initial Earth Orbital Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-15			Auto optics positioning first star	IOS Data Sheet GN4.50	Crew procedures R507 - R15
1-25			Sighting mark routine first star	GN4.49	R507 - R14
1-15			Auto optics positioning second star	GN4.50	R507 - R15
1-25			Sighting mark routine second star	GN4.49	R507 - R14
8-23			IMU alignment (S-IVB)	GN4.09	R507 - P52
1-16		01:00:00	ECS hourly verifications	EC3.01	SM2A-03, para. 8.3.1.6
1-80			EPS periodic verification	EP3.10	SM2A-03, para. 8.3.1.5
1-22			RCS periodic verification	RC2.02	SM2A-03, para. 8.3.1.4
1-17			SPS periodic verification	SP3.01/SP3.02	SM2A-03, para. 8.3.1.3

SESSION DATA SHEET ORBITAL WATCH STATION ROUTINES	MT2.2	1

PURPOSE.

To provide training in system management under reduced power, IMU alignment, and system management and servicing.

SCOPE.

This training session provides two-man performance of orbital watch station routines with the third member, not involved (assumed in a rest cycle). A single run is required to accomplish this session.

CREW PROCEDURES

Crew procedures to be practiced during this session are as follows:

Procedure	Source
1. G&N system activation	Task analysis, GN008, GN041, GN044, GN126, SM2A-03
2. Voice communications (VHF-AM)	SM2A-03, para. 8.3.1.7.1
3. Data storage, transmission, and reception	SM2A-03, para. 8.3.1.7.3
4. IMU orientation determination	R507 - P51
5. IMU alignment SCM	R507 - P53
6. Landmark tracking	R507 - P22
7. Hourly verification	SM2A-03, para. 8.3.1.3 8.3.14, 8.3.1.5, 8.3.1.6

MEASUREMENT DATA.

Measurement data group 2, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists prior to initiating the session. These checklists are found in Volume II, section 1, table 1-18.

System Checklist	Run 1
VISUAL SYSTEM	
Film Cassette Loading	X

X = Required

SESSION DATA SHEET ORBITAL WATCH STATION ROUTINES	MT2.2	2

System Checklist	Run 1
SIMULATED C/M	
Vertical Insertion and Retraction	*
COMPUTER COMPLEX	
Premission Setup	X
X-Y PLOTTERS	
X-Y Plotter Readiness and Setup (X-Y 30 X 30)	⊠
X-T RECORDERS	
X-T Recorder Readiness and Setup (X-T)	⊠
INSTRUCTOR-OPERATOR STATION	
Computer and Simulator Status	X
Communication Control Setup	X
Closed Circuit TV Setup	X
True Trainee Environment and Waste Management Status	X
G&N Visual Readiness	X
Up-Data Link Status	X
Reset Initialization	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this session.

3. The day terminator should be inhibited to allow landmark sightings at anytime.

SCRIPTING NOTES.

The script required for the single run of this session is constructed using scripting worksheet 1. The run is to be initialized at S5 (1:30:00), step 5.5 of table 3-8, Volume I. Sequence of operations is generally in accordance with table 3-10 of Volume I, although some changes are incorporated to decrease overall time required. The sighting mark routine will be repeated as often as possible during each landmark sighting routine.

SESSION DATA SHEET MT2.2 3

Scripting Worksheet 1 (Run 1) Extended Mission Earth Orbital Procedures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at . . . S5	Simulated GMT 15:30:00
		1:30:00	Initiate two-man extended mission operations		Mission time 1:30:00
			Navigation sightings		
			Landmark tracking	IOS Data Sheet GN4.09, (includes GN4.03, GN4.49, and GN4.50)	Crew procedures:
			Deactivate VHF/AM	S3,701, TC3.02	SM2A-03, para. 1.3.1.7.1
			Deactivate VHF/FM	S3.704, TC3.04	SM2A-03, para. 1.3.1.7.3
			Crewmember at station 4 should ingress to seat 1		
		2:15:00	Minimum activity operations	O1.2	Crew procedures not provided in AOH.
			Minimum activity operations	O3.2	Crew procedures not provided in AOH.
		2:25:00	Terminate minimum activity	O1.2 and O3.2	
			Crewmember in seat 1 should move to station 4		

Scripting Worksheet 1 (Run 1) Extended Mission Earth Orbital Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Navigation sightings		Crew procedures, task analysis functions, GN008, GN041, GN044, GN126, and SC010
		2:25:00	G&N system activation	GN4.01	
			IMU orientation determination	GN4.04 (includes GN4.03, and GN4.49)	R507 - P53
		2:46:00	IMU alignment (SCM)	IOS Data Sheet GN4.07 (includes GN4.03, GN4.49, and GN4.50)	R507 - P53
1-16		3:00:00	ECS hourly verification	EC3.01	SM2A-03, para. 8.3.1.6
1-80			EPS periodic verification	EP3.10	SM2A-03, para. 8.3.1.5
1-22			RCS periodic verification	RC2.02	SM2A-03, para. 8.3.1.4
1-17			SPS periodic verification	SP3.01, SP3.02	SM2A-03, para. 8.3.1.3
		3:01:00	Landmark tracking	GN4.09 (includes GN4.03, GN4.49, and GN4.50)	R507 - P53

SESSION DATA SHEET MT2.2 5

Scripting Worksheet 1 (Run 1) Extended Mission Earth Orbital Procedures (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Activate VHF/AM	TC3.02	SM2A-03, para. 8.3.1.7.1
			Activate VHF/FM	TC3.04	SM2A-03, para. 8.3.1.7.3
		3:50:00	IMU alignment	(Includes GN4.03, GN4.49, and GN4.50)	R507 - P53
			End of run 1		

SESSION DATA SHEET TRANSPOSITION AND S-IVB VIEWING	MT2.3	1

PURPOSE.

This session is to provide integrated flight crew training in spacecraft transposition and simulated docking.

SCOPE.

One run with three crewmembers is prescribed. Crewmembers will take turns in stations 1, 2, and 3 for purposes of practicing spacecraft rotation and translation in station 1 and for experience in observing the S-IVB from stations 2 and 3.

CREW PROCEDURES.

Crew procedures to be practiced during this session are as follows:

Procedure	Run	Source
1. Initial orbit procedures	1	SM2A-03, para. 8.3

MEASUREMENT DATA.

None

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists prior to initiating the run. These checklists are found in section 1, Volume II, table 1-18.

System Checklist	Run 1
VISUAL SYSTEMS	
Film Cassette Loading	X
SIMULATED C/M	
Vertical Insertion and Retraction	*
COMPUTER COMPLEX	
Premission Setup	X
X-Y PLOTTERS	
Plotter Readiness and Setup (X-Y 30 X 30)	⊠
Plotter Readiness and Setup (X-Y 11 X 17)	⊠

X = Required ⊠ = Optional * = If not previously accomplished

SESSION DATA SHEET TRANSPOSITION AND S-IVB VIEWING	MT2.3	2

System Checklist	Run 1
X-T RECORDERS	
Records Readiness and Setup (X-T)	⊠
INSTRUCTOR-OPERATOR STATION	
Computer and Simulator Status	X
Communications Control Setup	X
Closed Circuit TV Setup	X
Recorder and Plotter Status	⊠
True Trainee Environment and Waste Management Status	X
Reset Initialization	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this run. For additional manual attitude maneuvering experience malfunctions from Malfunction Selection Set 1, section 5, this volume, may be used.

SCRIPTING NOTES.

Use scripting worksheet 1 in preparing the single script required for this session. The run is to be initialized at S5 (mission time 1:30:00), step 4.9, table 3-13, Volume I.

Maneuvers may be repeated during the run if more experience in transposition is desired.

Scripting Worksheet 1 (Run 1) Transposition and S-IVB Viewing

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at S5	
			Initial orbital procedures	IOS Data Sheet O1.1	Crew procedures, SM2A-03, para. 8.3
			+X translation	None	
			Pitchup 180°	FDAI repeater	
			+X translation	None	
			Observe S-IVB	None	
			Pitchdown 180°	FDAI repeater	
			Crewmen should change seats and repeat transposition and observation of S-IVB twice so each crewmember has observed/performed the procedure from all three stations (1, 2, and 3).	TV monitor	
			End of run 1		

SESSION DATA SHEET PLANE CHANGE PROCEDURES	MT3.1	1

PURPOSE.

To demonstrate integrated crew procedures used in preparing for and accomplishing G&N mode delta V and to provide practice in the plane change application of such procedures.

SCOPE.

This session contains exercises in the initial delta V maneuvers as used in plane changes, IMU alignment and measurement of transient orbit, and orbital changes. Two training runs are required to accomplish this session; runs are as follows:

1. Walk-through of integrated crew procedures for preparing spacecraft systems for and accomplishing plane change (-1°) delta V
2. Practice integrated crew procedures for -1° plane change including measuring initial orbit, aligning IMU, preparing spacecraft systems for delta V, performing delta V, and measuring altered orbit.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

	Procedure	Run	Source
1.	G&N delta V	1, 2	R507, task analysis SP003, SP004
2.	IMU orientation determination	1, 2	R507 - P51
3.	IMU alignment (SCM)	2	R507 - P53
4.	Landmark tracking	2	R507 - P22
5.	C-band tracking and ranging	2	SM2A-03, para. 8.3.17.2
6.	Activate VHF-AM	2	SM2A-03, para. 8.3.1.7.1
7.	Activate VHF-FM	2	SM2A-03, para. 8.3.1.7.3
8.	Battery charging	2	SM2A-03, para. 8.3.1.5

MEASUREMENT DATA.

Measurement data group 2, section 6, this volume.

SESSION DATA SHEET PLANE CHANGE PROCEDURES	MT3.1	2

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18 of this document.

System Checklist	Run No. 1	Run No. 2
VISUAL SYSTEMS		
Film Cassette Loading	X	X
SIMULATED C/M		
Vertical Insertion and Retraction	*	*
COMPUTER COMPLEX		
Premission Setup	X	X
X-Y PLOTTERS		
Plotter Readiness and Setup (X-Y 30 X 30)		⊠
X-T RECORDERS		
Records Readiness and Setup (X-T)		⊠
INSTRUCTOR-OPERATOR STATION		
Computer and Simulator Status	X	X
Communications Control Setup	X	X
Closed Circuit TV Setup	⊠	⊠
Recorder and Plotter Status		⊠
Voice Interference Operation	⊠	⊠
True Trainee Environment and Waste Management Status	X	X
G&N and Visuals Readiness	X	X
Up-Data Link Status	X	X
Reset Initialization	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this session.

SESSION DATA SHEET PLANE CHANGE PROCEDURES	MT3.1	3

SCRIPTING NOTES.

The two scripts required for this session are prepared as follows:

Script	Scripting Worksheet	Run
1	1	1
2	2	2

Runs 1 and 2 are initialized at step 4.8 and 6.2, respectively, of table 3-8, Volume I. Table 3-11, Volume I, provides scripting outlines and time coordination.

The sighting mark routine should be repeated as often as possible during each landmark sighting procedure.

Scripting Worksheet 1 (Run 1) Walk-Through Integrated Procedures for Preparing for and Accomplishing Plane Change (-1°) Delta V

Step	Malf	Time	Function	IOS Visibility/Action	Notes
		00:40:00	Start run 1	Initialize at S4 test time to 1:11:00	Simulated GMT 14:40:02
1-32			Orbit change delta V, station 4	IOS Data Sheet GN4.12 (includes GN4.03, GN4.04, GN4.07, GN4.49, and GN4.50)	Crew procedures, R507 - P31
1-19			Delta V operations, station 3	SP3.04	Crew procedure, task analysis, SP003
1-65			Orbit change delta V, station 1	GN1.13 (includes GN4.03, GN1.40, GN1.44)	Crew procedures, R507 - P31, P32
20-34			Delta V operations, station 3	SP.04	Crew procedures, task analysis, SP004
66-98			Orbit change delta V End of run 1	GN1.13 (includes GN4.03, GN1.40 and GN1.44)	Crew procedures, R507 - P32
Scripting Worksheet 2 (Run 2) Practice Integrated Procedure for Preparing for and Accomplishing Plane Change (-1°) Delta V					
		1:52:00	Start run 2	Initialize at S6	Simulated GMT 15:50:00
1-16			Landmark tracking	IOS Data Sheet GN4.09 (includes GN4.03, GN4.50)	Crew procedures, R507 - P22

Scripting Worksheet 2 (Run 2) Practice Integrated Procedures for Preparing for and Accomplishing Plane Change (-1°) Delta V (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-21			IMU orientation determination	GN4.04 (includes GN4.03, GN4.49)	R507 - P51
1-4		2:30:00	IMU alignment (SCM)	GN4.07 (includes GN4.03)	R507 - P53
1-9			Attitude control mode check	GN1.40	R507 - R1
5-7			IMU alignment (SCM)	GN4.07	R507 - P53
1-15			Attitude maneuver	GN1.44	R507 - R2
1			Activate VHF-FM	TC3.04	SM2A-03, para. 8.3.1.7.3
1			Activate VHF-AM	TC3.02	SM2A-03, para. 8.3.1.7.1
8-27			IMU alignment (SCM)	GN4.07 (includes GN4.49, GN4.50)	R507 - P53
1-15			Attitude maneuver	GN1.44	R507 - R2
28			IMU alignment (SCM)	GN4.07	R507 - P53
1-31			Orbit change delta V	GN4.12 (includes GN4.03, GN4.56)	R507 - P31
1-5			Orbit change delta V	GN1.13 (includes GN1.40, GN1.44)	R507 - P31

Scripting Worksheet 2 (Run 2) Practice Integrated Procedures for Preparing for and Accomplishing Plane Change (-1°) Delta V (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
32			Orbit change delta V	GN4.12	R507 - P31
6-39			Orbit change delta V	GN1.13	R507 - P31, P32
1-19			Delta V operations	SP3.04	Task analysis, SP003
1			Activate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
40-64			Orbit change delta V	IOS Data Sheet GN1.13	Crew procedures, R507 - P31
20-34		2:45:33	Delta V operations	SP3.04	Task analysis, SP004
65-98			Orbit change delta V	GN1.13 (includes GN4.55)	Crew procedures R507 - P32
1-9			Battery charging	EP3.07	SM2A-03, para. 8.3.1.5
2			Deactivate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
1-28		02:46:00	Fine align IMU	GN4.07 (includes GN4.03, GN4.49, and GN4.50)	R507 - P53
1-16		03:01:00	Landmark tracking	GN4.09 (includes GN4.03)	R507 - P22
			End of run 2		

SESSION DATA SHEET HOHMANN TRANSFER PROCEDURES	MT3.2	1

PURPOSE.

This session provides additional practice of integrated crew procedures for G&N mode delta V in the Hohmann transfer application. Practice of integrated crew procedures for SCS mode delta V in the same application is also included.

SCOPE.

This session includes practices of Hohmann transfer, measuring orbits and making new orbit measurements in both G&N and SCS modes.

There are two training sessions required to accomplish this session. Training runs are as follows:

1. Practice integrated crew procedures for Hohmann transfer from 105-n mi to 130-n mi circular orbit including measuring initial orbit. IMU alignment, preparing for and accomplishing G&N delta V to transfer trajectory, measuring transient orbit preparing for and accomplishing G&N delta V for purposes of circularization, and measuring the 130-n mi orbit.
2. Practice integrated crew procedures for Hohmann transfer from 130-n mi circular orbit to 105-n mi circular orbit using SCS mode for delta V. Run to include measuring 130-n mi orbit, IMU alignment, preparing for and accomplishing SCS delta V to transfer trajectory, measuring transient orbit, preparing for and accomplishing SCS delta V for purposes of circularization, and measuring the 105-n mi orbit.

CREW PROCEDURES.

Procedures to be practiced during the session are as follows:

	Procedure	Run	Source
1.	G&N delta V	1	R507 - P51, P53, P31, P41, P47, R1, R2, R14, R15
2.	SCS delta V	2	Not available at publication
3.	IMU orientation determination	1, 2	R507 - P52
4.	IMU alignment (SCM)	1, 2	R507 - P53
5.	Landmark tracking	1, 2	R507 - P22
6.	C-band tracking and ranging	1, 2	SM2A-03, para. 8.3.1.7.2
7.	Activate VHF-AM	1, 2	SM2A-03, para. 8.3.1.7.1

SESSION DATA SHEET HOHMANN TRANSFER PROCEDURES	MT3.2	2

Procedure	Run	Source
8. Activate VHF-FM	1, 2	SM2A-03, para. 8.3.1.7.3
9. Battery charging	1, 2	SM2A-03, para. 8.3.1.7.5
10. Cabin cold-soak operation	2	SM2A-03, para. 8.3.1.5

MEASUREMENT DATA.

Measurement data groups 1 and 2 combined.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	Run No. 2
VISUAL SYSTEMS		
Film Cassette Loading	X	X
SIMULATED C/M		
Vertical Insertion and Retraction	*	*
COMPUTER COMPLEX		
Premission Setup	X	X
X-Y PLOTTERS		
Plotter Readiness and Setup (X-Y 30 X 30)	⊠	⊠
X-T RECORDERS		
Records Readiness and Setup (X-T)	⊠	⊠
INSTRUCTOR-OPERATOR STATION		
Computer and Simulator Status	X	X
Communications Control Setup	X	X
Closed Circuit TV Setup	⊠	⊠
Recorder and Plotter Status	⊠	⊠
Voice Interference Operation	⊠	⊠

X = Required ⊠ = Optional * = If not previously accomplished

SESSION DATA SHEET HOHMANN TRANSFER PROCEDURES	MT3.2	3

System Checklist	Run No. 1	Run No. 2
True Trainee Environment and Waste Management Status	X	X
G&N and Visuals Readiness	X	X
Up-Data Link Status	X	X

X = Required

2. No malfunctions are used during this session.

SCRIPTING NOTES.

Run 1. Use scripting worksheet 1 to prepare script 1.
Run 2. Use scripting worksheet 2 to prepare script 2.

Runs 1 and 2 are initialized at steps 4.8 and 7.5, respectively, of table 3-8, Volume I. Table 3-12, Volume I, provides scripting outlines and time coordination. IOS data sheets to be used during these runs are listed on the scripting worksheet.

The sighting mark routine should be repeated as often as possible during each landmark sighting procedure.

SESSION DATA SHEET MT3.2 4

Scripting Worksheet 1 (Run 1) Practice Integrated Procedures for Preparing for and Accomplishing Hohmann Transfer from 105- to 130-N Mi Orbit (G&N Mode)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
		0:40:00	Start run 1 Nominal mission, Hohmann transfer (table 3-12, Volume I)	Initialize at . . . S4	Simulated GMT 14:40:00, Mission time (0:40:00)
All		0:40:00	Fine align IMU and SCS	IOS Data Sheets GN4.07 (includes GN4.04, GN4.03, GN4.49, and GN4.50)	R507 - P52
All		0:55:00	Landmark tracking	GN4.09 (includes GN4.02, GN4.03, GN4.49, and GN4.50)	R507 - P22
1-16		1:00:00	Orbital ECS hourly check	EC3.01	Crew Procedures SM2A-03, para. 8.3.1.6
1-8			EPS periodic check (cryogenics)	EP3.10	SM2A-03, para. 8.3.1.5
1-35			SM-RCS periodic check	RC2.02	SM2A-03, para. 8.3.1.4
All			SPS periodic check	SP3.01/SP3.02	SM2A-03, para. 8.3.1.3
All		1:05:00	Fuel cell purge	EP3.05/EP3.06	SM2A-03, para. 8.3.1.5

SESSION DATA SHEET MT3.2 5

Scripting Worksheet 1 (Run 1) Practice Integrated Procedures for Preparing for and Accomplishing Hohmann Transfer from 105- to 130-N Mi Orbit (G&N Mode) (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
All			G&N delta V mode	IOS Data Sheets GN4.02, GN4.03, GN4.04, GN4.07, GN4.49, GN4.50, GN4.12, GN1.13, GN1.40, GN1.44, and SP3.04	Crew procedures SM2A-03, para. 8.3.1.1, 8.3.1.3 R507 - P51, P53, P31, P41, P37, R1, R2, R14, R15, task analysis SP0034, SP004
1			Activate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
			Battery charging	EP3.07	SM2A-03, para. 8.3.1.5
2			Deactivate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
All			IMU alignment	GN4.07 (includes GN4.03, GN4.49, and GN4.50)	R507 - P53
All		1:30:00	Landmark tracking	GN4.09 (includes GN4.02, GN4.03, GN4.49, and GN4.50)	R507 - P22
		1:40:00	IMU alignment	GN4.07 (includes GN4.03, GN4.49, and GN4.50)	R507 - P53
1-16			Orbital ECS hourly check	EC3.01	SM2A-03, para. 8.3.1.6

Scripting Worksheet 1 (Run 1) Practice Integrated Procedures for Preparing for and Accomplishing Hohmann Transfer from 105- to 130-N Mi Orbit (G&N Mode) (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-8			EPS periodic check (cryogenics)	IOS Data Sheet EP3.10	Crew procedures SM2A-03, para. 8.3.1.5
1-35			SM-RCS periodic check	RC2.02	SM2A-03, para. 8.3.1.4
All			SPS periodic check	SP3.01/SP3.02	SM2A-03, para. 8.3.1.3
All			Fuel cell purge	EP3.05/EP3.06	SM2A-03, para. 8.3.1.5
1-6			Activate VHF-FM	TC3.04	SM2A-03, para. 8.3.1.7.3
1-5			Activate VHF-AM	TC3.02	SM2A-03, para. 8.3.1.7.1
1			Activate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
All		2:02:26	G&N delta V	GN4.02, GN4.03, GN4.04, GN4.07, GN4.49, GN4.50, GN4.12, GN1.13, GN1.40, GN1.44, and SP3.04	Task analysis, SP003 and SP004, R507 - P51, P53, P31, P41, P37, R1, R2, R14, R15
2			Deactivate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2

SESSION DATA SHEET

MT3.2 7

Scripting Worksheet 1 (Run 1) Practice Integrated Procedures for Preparing for and Accomplishing Hohmann Transfer from 105- to 130-N Mi Orbit (G&N Mode) (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Fine align IMU and SCS	IOS Data Sheet GN4.02, GN4.03, GN4.04, GN4.07, GN4.49, and GN4.50	R507 - P52
All		2:25:00	Landmark tracking	GN4.09 (includes GN4.02, GN4.03, GN4.49, and GN4.50)	R507 - P22
			End of run 1		
Scripting Worksheet 2 (Run 2) Practice Integrated Procedures for Preparing for and Accomplishing Hohmann Transfer from 130- to 105-N Mi Orbit (SCS Mode)					
		01:40:00	Start run 2	Initialize at . . . S6	Simulated GMT 16:03:00, mission time (02:03:00)
			Nominal Mission Hohmann Transfers (table 3-12, Volume I)		
All		02:03:00	Fine align IMU and SCS	IOS Data Sheets GN4.03, GN4.04, GN4.07, GN4.49, and GN4.50	R507 - P52
All		02:25:00	Landmark tracking	GN4.09 (includes GN4.02, GN4.03, GN4.49, and GN4.50)	R507 - P22
1-6			Activate VHF-FM	TC3.04	Crew procedures, SM2A-03, para. 8.3.1.7.3

Scripting Worksheet 2 (Run 2) Practice Integrated Procedures for Preparing for and Accomplishing Hohmann Transfer from 130- to 105-N Mi Orbit (SCS Mode) (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-5			Activate VHF-AM	IOS Data Sheet TC3.02	Crew procedures SM2A-03, para. 8.3.1.7.1
1			Activate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
1-46		02:40:00	SCS delta V	SC1.03 (includes GN4.03)	Not available at time of publication.
			Battery charging	EP3.07	Crew procedures, SM2A-03, para. 8.3.1.5
2			Deactivate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
All			IMU alignment	GN4.03, GN4.04, GN4.07, GN4.49, and GN4.50	R507 - P52
All		03:01:00	Landmark tracking	GN4.09 (includes GN4.03, GN4.49, and GN4.50)	R507 - P22
1-16		03:08:00	Orbital ECS hourly check	EC3.01	Crew procedures, SM2A-03, para. 8.3.1.6
1-8			EPS periodic check (cryogenics)	EP3.10	SM2A-03, para. 8.3.1.5

SESSION DATA SHEET MT3.2 9

Scripting Worksheet 2 (Run 2) Practice Integrated Procedures for Preparing for and Accomplishing Hohmann Transfer from 130- to 105-N Mi Orbit (SCS Mode) (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-35			SM/RCS periodic check	IOS Data Sheet RC2.02	Crew procedures, SM2A-03, para. 8.3.1.4
All			SPS periodic check	SP3.05/SP3.02	SM2A-03, para. 8.3.1.3
			G&N periodic check	GN4.02	SM2A-03, para. 8.3.1.1
1			Activate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
1-46		03:30:02	SCS delta V	SC1.03 (includes GN4.03)	Not available at time of publication.
			Battery charging	EP3.07	Crew procedures, SM2A-03, para. 8.3.1.5
2			Deactivate C-band tracking and ranging	TC3.21	SM2A-03, para. 8.3.1.7.2
All		03:36:00	Landmark tracking	GN4.03, GN4.09, GN4.49, and GN4.50	R507 - P22
7			Deactivate VHF-FM	TC3.04	Crew procedures, SM2A-03, para. 8.3.1.7.3

SESSION DATA SHEET

Scripting Worksheet 2 (Run 2) Practice Integrated Procedures for Preparing for and Accomplishing Hohmann Transfer from 130- to 105-N Mi Orbit (SCS Mode) (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
6			Deactivate VHF-AM	IOS Data Sheet TC3.02	Crew procedures, SM2A-03, para. 8.3.1.7.1
1-3			Cabin cold-soak operation	EC3.05	SM2A-03, para. 8.3.1.5
			End of run 2		

SESSION DATA SHEET SPS DEORBIT AND ENTRY PROCEDURES	MT4.1	1

PURPOSE.

This session is to introduce the integrated crew procedures for preparing for and accomplishing the deorbit maneuver, C/M-S/M, separation, entry, monitor control of the earth landing sequence and postlanding operation of spacecraft systems.

SCOPE.

This session provides training in accomplishment of both G&N and SCS deorbit modes. Runs are as follows:

1. Walk-through of integrated crew procedures for preparing spacecraft systems for and accomplishing the G&N mode deorbit maneuver, C/M-S/M separation and entry; the earth landing sequence and postlanding system operations
2. Practice crew procedures for preparing spacecraft systems for G&N deorbit maneuver from 105-n mi circular orbit and accomplishing G&N mode retrofire, separation, entry, and the earth landing sequence and postlanding system operations
3. Practice crew procedures for preparing spacecraft systems for SCS deorbit maneuver from 105-n mi circular orbit and accomplishing SCS mode retrofire, separation, entry and the earth landing sequence.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedure	Run	Source
1. Deorbit and entry	1, 2	SM2A-03, para. 8.4
2. Postlanding	1, 2	8.5
3. G&N delta V	2	R507-P31, P32, R41, R14, R37 task analysis, SP003 and SP004
4. SCS delta V	3	Procedures not available at time of publication.

MEASUREMENT DATA.

Measurement data group 3, section 6, this volume.

SESSION DATA SHEET SPS DEORBIT AND ENTRY PROCEDURES	MT4.1	2

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-8, this document.

System Checklist	Run No. 1	2	3
VISUAL SYSTEMS			
Film Cassette Loading	X	X	X
SIMULATED C/M			
Check - Fill Potable Water Tank			
Check - Empty Waste Storage System			
Vertical Insertion and Retraction	*	*	*
COMPUTER COMPLEX			
Premission Setup	X	X	X
X-Y PLOTTERS			
Plotter Readiness and Setup (X-Y 30 X 30)		⊠	⊠
X-T RECORDERS			
Records Readiness and Setup (X-T)		⊠	⊠
INSTRUCTOR-OPERATOR STATION			
Computer and Simulator Status	X	X	X
Communications Control Setup	X	X	X
Closed Circuit TV Setup	⊠	⊠	⊠
Recorder and Plotter Status		⊠	⊠
Voice Interference Operation		⊠	⊠
True Trainee Environment and Waste Management Status	X	X	X
G&N and Visuals Readiness	X	X	X
Up-Data Link Status	X	X	X
Reset Initialization	X	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this session.

SESSION DATA SHEET SPS DEORBIT FWD ENTRY PROCEDURES	MT4.1	3

SCRIPTING NOTES.

Two scripts are required for this session. They are prepared from the scripting worksheets listed below.

Script	Scripting Worksheet	Run
1	1	1, 2
2	2	3

Initiate runs 1 and 2 of this session at step 10.4, table 3-11, Volume I.

Scripting Worksheet 1 (Runs 1 and 2) C/M-S/M Separation, Entry, Descent and Postlanding Operations

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at . . . S11	
1-13			Deorbit delta V	IOS Data Sheet E3.1	Crew procedures, SM2A-03, para 8.4, steps 1-4
1-48			Deorbit delta V	E4.1 (includes GN4.03, GN4.04, and GN4.07)	R507 - P32
1-94			Deorbit delta V	E1.1 (includes GN4.03)	R507 - P32, P42
1-4			Post-deorbit delta V	E3.2 (includes EP3.08)	Crew procedures, SM2A-03, para. 8.4, steps 19, 22, 23, 26, and 55
1-2			Post-delta V operations	E2.1	SM2A-03, para. 8.4, steps 24-25
1-55			Post-delta V operations	E1.2 (includes GN4.03, GN1.40, and GN1.44)	R507 - P61, P62
3-5			Post-delta V operations	E2.1 (includes RC2.01)	Crew procedures, SM2A-03, para. 8.4, steps 24-25
5			Post-delta V operation	E3.2	SM2A-03, para. 8.4, step 55

SESSION DATA SHEET MT4.1 5

Scripting Worksheet 1 (Runs 1 and 2) C/M-S/M Separation, Entry, Descent and Postlanding Operations (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-19			Post separation and entry	IOS Data Sheet E1.3 (includes GN1.44)	R507 - P62, P63, P66
1-19			ELS arming	E1.4	Crew procedures, SM2A-03, para. 8.4, steps 61-82
1-5			ELS arming	E3.4	SM2A-03, para. 8.4, steps 68-70, 74 and 81
1-3			Postlanding procedures	R1.1	SM2A-03, para. 8.5, steps 1 and 2
1-3			Postlanding procedures	R4.1	SM2A-03, para. 8.5, step 3
1-2			Postlanding procedures	R3.1	SM2A-03, para. 8.5, step 5
4-14			Postlanding procedures	R1.1	SM2A-03, para. 8.5, steps 4, 6-10
1			Postlanding procedures	R2.1	SM2A-03, para. 8.5, step 10
3-5			Postlanding procedures	R3.1	SM2A-03, para. 8.5, steps 10 and 11
			End of run 1		

Scripting Worksheet 2 (Run 3) C/M-S/M Separation, SCS Entry, Descent and Postlanding Operation

Step	Malf	Time	Function	IOS Visibility/Action	Notes

Procedures not available at time of publication.

SESSION DATA SHEET RCS DEORBIT AND ENTRY	MT4.2	1

PURPOSE.

To provide practice in integrated crew procedures for accomplishing retrofire and entry without the SPS by using the RCS for retrograde.

SCOPE.

Data required to accurately determine the scope of this session is not available as of publication date. Runs are as follows:

1. Practice crew procedures for preparing spacecraft systems for and accomplishment of RCS retrograde from 105-n mi circular orbit, separation, and G&N mode entry.
2. Practice crew procedures for preparing spacecraft systems for and accomplishment of RCS retrograde from 105-n mi circular orbit, separation, and SCS mode entry.

CREW PROCEDURES.

TBD

MEASUREMENT DATA.

TBD

INSTRUCTOR ACTIVITY OUTLINE.

TBD

SCRIPTING NOTES.

TBD

SCRIPTING WORKSHEETS.

TBD

SESSION DATA SHEET EARLY MISSION TERMINATION	MT4.3	1

PURPOSE.

To provide training in the integrated crew procedures for recovering from the extended mission configuration (one man assumed in rest cycle - systems on minimum power) and accomplishing an emergency deorbit and entry.

SCOPE.

This session gives more demonstration to the crewmember of the alternate procedures for terminating a mission. Two training runs are required to accomplish this session. Training runs are as follows:

1. Walk-through of procedures for early mission termination from orbital operation configuration
2. Practice crew procedures for early mission termination from orbital operation configuration.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedure	Run	Source
1. Deorbit and entry	1, 2	SM2A-03, para. 8.4 R507 - P22, P32, P42, P53, P61, P62, P66, task analysis SP003 and SP004

MEASUREMENT DATA.

Measurement data group 3, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklist corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	Run No. 2
VISUAL SYSTEMS		
Film Cassette Loading	X	X
SIMULATED C/M		
Vertical Insertion and Retraction	*	*

X = Required

* = If not previously accomplished

SESSION DATA SHEET EARLY MISSION TERMINATION	MT4.3	2

System Checklist	Run No. 1	Run No. 2
COMPUTER COMPLEX		
Premission Setup		
X-Y PLOTTERS		
Plotter Readiness and Setup (X-Y 30 X 30)		⊠
X-T RECORDERS		
Records Readiness and Setup (X-T)		⊠
INSTRUCTOR-OPERATOR STATION		
Computer and Simulator Status	X	X
Communications Control Setup	X	X
Closed Circuit TV Setup	⊠	⊠
Recorder and Plotter Status		⊠
Voice Interference Operation		⊠
True Trainee Environment and Waste Management Status	X	X
G&N and Visuals Readiness	X	X
Up-Data Link Status	X	X
Reset Initialization	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No requirement for malfunctions during this session.

SCRIPTING NOTES.

Use scripting worksheet 1 to prepare the single script required for runs 1 and 2 of this session.

Crew procedures and IOS data sheets required for this session are the same as those in table 3-10, Volume I, from Preparation for Retrofire to Touchdown. The mission times listed in table 3-10 will not be accurate due to the early termination of the mission.

Scripting Worksheet 1 (Runs 1 and 2) Early Mission Termination

Step	Malf	Time	Function	IOS Visibility/Action	Notes
		01:52:00	Start run 1 or 2	Initialize at . . . S6	Simulated GMT 15:52:00. Time from launch 01:52:00
			Request early mission termination		Crew procedures, SM2A-03, para. 8.3.1.6
1-3			Cabin cold-soak	IOS Data Sheet EC3.05	
		01:52:00	Landmark tracking	GN4.09 (includes GN4.02, GN4.03, GN4.49, and GN4.50)	R507 - P22
		02:03:00	IMU fine align	GN4.07 (includes GN4.03, GN4.49, and GN4.50)	R507 - P53
1-48			Deorbit delta V	E4.1 (includes GN4.03)	R507 - P32
1-53			Deorbit delta V procedures	E1.1	R507 - P32, P42
1-14			Deorbit delta V procedures	E3.1 (includes SP3.04)	R507 - P32, Task analysis SP003 and SP004
54-94		02:42:00	Deorbit delta V procedures	E1.1	R507 - P32
1-55			Post-delta V operations	E1.2	R507 - P61, P62
1-5			Post-delta V operations	E2.1	SM2A-03, para. 8.4
1-5			Post-delta V operations	E3.2	para. 8.4

SESSION DATA SHEET MT4.3 4

Scripting Worksheet 1 (Runs 1 and 2) Early Mission Termination (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-19			Postseparation and entry	IOS Data Sheet E1.3	Crew procedures, R507 - P62, P63, P66
1-19			ELS arming	E1.4	SM2A-03, para. 8.4
1-5			ELS arming	E3.4	para. 8.4
			Touchdown		
			End of run 1 or 2		

SESSION DATA SHEET ORBITAL MISSION ROUTINES	TM1.1	1

PURPOSE.

This session is a complete three-orbit mission involving launch and ascent to orbit, initial orbital procedures, navigation and IMU alignment, systems checks and servicing, systems management during power conservation, two-man routines (third man in rest cycle), preparation for and accomplishment of deorbit maneuver, C/M-S/M separation, entry and descent, and postlanding procedures.

SCOPE.

A basic nominal three-orbit mission with simulated malfunctions will give the crewmembers experience in the use of special procedures, alternate modes and crew override decision making. The training runs required for this session are as follows:

1. Practice crew procedures for three-orbit basic nominal mission with simulated malfunctions to induce use of special procedures, alternate modes and redundant systems in orbit, and crew override of sequencing events during C/M-S/M separation, G&N mode entry, and descent.
2. Practice crew procedures for three-orbit basic nominal mission with simulated malfunctions to induce use of special procedures, alternate modes and redundant systems in orbit, with retrograde and entry in SCS mode.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

	Procedures	Run	Source
1.	Ascent and initial orbit	1, 2	SM2A-03, para. 8.2
2.	Earth orbit	1, 2	8.3
3.	Deorbit and entry	1, 2	8.4
4.	Postlanding	1, 2	8.5
5.	Yaw rate gyro fails	1	9.1.2.3
6.	S/M-C/M PACKAGE TEMP meter fails	1	9.1.4.7
7.	Battery bus A shorts	1	9.1.5.4
8.	Inverter 1 synchronization equipment drifts	1	9.1.5.14
9.	GLYCOL TEMP LO lamp drive fails	1	9.1.6.2
10.	Suit relief and demand regulator valve 2 fails	1	9.1.6.4
11.	Glycol pump 1 fails	1	9.1.6.6
12.	Cabin temperature sensor fails open	1	9.1.6.9
13.	Booster engine 3 light fails on	1	9.1.8.2
14.	LES tower jettison motor ignition fails	1	9.1.8.6

SESSION DATA SHEET ORBITAL MISSION ROUTINES	TM1.1	2

Procedures	Run	Source
15. Delta V	1, 2	R507 - P32, P42, P61, P62, P63, P66, task analysis SP003 SP004
16. Guidance and navigation	1, 2	R507 - P21, P22, P23, P27, P31, P41, P51, P52, P53, R1, R2, R14, R15, R33, R37

MEASUREMENT DATA.

Measurement data group 5, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in table 1-18, Volume II of this handbook.

System Checklist	Run No. 1	Run No. 2
VISUAL SYSTEMS		
Film Cassette Loading	X	X
SIMULATED C/M		
Check - Fill Potable Water Tank	X	X
Check - Empty Waste Storage System	X	X
Vertical Insertion and Retraction	⊠	⊠
COMPUTER COMPLEX		
Premission Setup	X	X
X-Y PLOTTERS		
Plotter Readiness and Setup (X-Y 30 X 30)	⊠	⊠
Plotter Readiness and Setup (X-Y 11 X 17)	⊠	⊠
X-T RECORDERS		
Records Readiness and Setup (X-T)	⊠	⊠

X = Required ⊠ = Optional

SESSION DATA SHEET ORBITAL MISSION ROUTINES	TM1.1	3

System Checklist	Run No. 1	Run No. 2
INSTRUCTOR-OPERATOR STATION		
Computer and Simulator Status	X	X
Communications Control Setup	X	X
Closed Circuit TV Setup	X	X
Recorder and Plotter Status	⊠	⊠
Voice Interference Operation	⊠	⊠
True Trainee Environment and Waste Management Status	X	X
G&N and Visuals Readiness	X	X
Up-Data Link Status	X	X
Reset Initialization	X	X

X = Required ⊠ = Optional

2. Select the following malfunctions:

Run 1

EP-007 Inverter 1 synchronization equipment drifts
EP-033 Battery bus A shorted
CM-021 Astronaut 3 audio center fails
CM-011 VHF-AM transceiver transmitter fails
CM-044 VHF-FM transmitter fails
SP-014 Helium tank pressure indicator fails
EC-002 Suit relief and demand regulator valve 2 fails
EC-126 Glycol pump 1 fails
SC-001 Yaw rate gyro fails - no output
CS-207 Booster engine 3 light fails on
CS-304 GLYCOL TEMP LO lamp driver shorted
RC-320 S/M-C/M package temp meter fails open
GS-051 LES tower jettison motor ignition fails
EC-032 Cabin temperature sensor fails open

3. Additional malfunctions may be selected from Malfunction Selection Set 2 and/or 3.

SCRIPTING NOTES.

One script is required for each of the two runs in this session. IOS data sheets for the script should be compiled in accordance with the outline provided in table 3-10, Volume I, of this handbook. Time-line data from table 3-10 should be copied into the script for crew activity synchronization during the simulation runs. In using the IOS data sheet information provided in table 3-10, it should be noted that several IOS data sheets identified therein are really composites of other data sheets.

SESSION DATA SHEET ORBITAL MISSION ROUTINES	TM1.1	4

Two scripting worksheets are provided, one for each run. Each identifies the suggested malfunctions for the run, the recommended time of malfunction insertion, IOS data sheet on which malfunction should be noted, the step number in the normal procedures IOS data sheet to which the malfunction relates, and crew procedures to be applied in response to each malfunction.

Run 2 involves an SCS mode retrograde and entry. Crew procedures for such SCS mode operations are not available at the date of publication.

Space suits are required in run 1 since smoke simulation is used in conjunction with EP-006.

Scripting Worksheet 1 (Run 1) Practice 3-Orbit Basic Nominal Mission With Simulated Malfunctions Crew Override (G&N Mode)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
		-01:00	Start run 1	Initialize at. . . S2	
			Basic nominal training mission (table 3-10, Volume I)		Crew procedures, SM2A-03, para. 8.2, 8.3, 8.4, and 8.5
			Launch boost	IOS Data Sheet A1.1	
19	CS-207	01:24	Booster engine 3 light fails on	Booster engine 3 light illuminates. Instructor should verify sensor failure.	SM2A-03, para. 9.1.8.2
			S-IVB boost	IOS Data Sheet A1.1	
23	GS-051	02:47	LES tower jettison motors ignition fails	ADAP SEP ARMED does not illuminate until manual override is activated.	SM2A-03, para. 9.1.8.6
			Report LES tower jettison	IOS Data Sheet A3.1	
2	CM-021	02:47	Astronaut 3 audio center fails	Loss of transmission or reception from audio center 3.	Crewmember 3 should select alternate audio center.
			EPS periodic verification	IOS Data Sheet EP3.10	Crew procedures, SM2A-03, para. 8.3.1.5
3	EP-007	1:00:00	Inverter 1 synchronization equipment drifts	MEP.10 or MEP.11. FREQUENCY AC BUS 1 - (and/or BUS 2) ØA, B & C out of tolerance indications.	SM2A-03, para. 9.1.5.14

SESSION DATA SHEET TM1.1 6

Scripting Worksheet 1 (Run 1) Practice 3-Orbit Basic Nominal Mission With Simulated Malfunctions Crew Override (G&N Mode)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			RCS periodic verification	IOS Data Sheet RC2.02	Crew procedures, SM2A-03, para. 8.3.1.5
1	CM-011	1:02:00	VHF-AM transceiver fails (transmitter failure)	Loss of redundant voice communications with MSFN from C/M. IOS loss of VHF-AM voice reception.	Crew should activate S-band equipment and select alternate down-link function using S-band.
			Fuel cell oxygen purge	IOS Data Sheet EP3.06	
13	EC-002	1:35:00	Suit relief and demand regulator valve fails (leaking)	MEC.01 DELTA P COMP reads low O_2 FLOW HI light illuminates CABIN-PRESS indication increases. MASTER ALARM light illuminates	Crew procedures, SM2A-03, para. 9.1.6.4
			Landmark sightings	IOS Data Sheet GN4.09	
1	CM-044		VHF-FM transmitter fails	Loss of downlink telemetry; instructor should notify crew of this loss.	Crew should select S-band downlink equipment.

Scripting Worksheet 1 (Run 1) Practice 3-Orbit Basic Nominal Mission With Simulated Malfunctions Crew Override (G&N Mode)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Orbital ECS hourly check	IOS Data Sheet EC3.01	Crew procedures, SM2A-03, para. 8.3.1.6
10-11	CS-304	2:20:00	GLYCOL TEMP LO lamp drive fails (shorted)	GLYCOL TEMP LO light illuminates Instructor should verify sensor failure upon crew request.	SM2A-03, para. 9.1.6.2
			RCS periodic verification	IOS Data Sheet RC2.02	SM2A-03, para. 8.3.1.4
31	RC-320	3:12:00	S/M-C/M PACKAGE TEMP meter fails open	S/M TEMP PKG indicator reads minimum. All other indicators normal.	SM2A-03, para. 9.1.4.7
			EPS periodic verification	IOS Data Sheet EP3.10	SM2A-03, para. 8.3.1.5
50	EP-033	3:15:00	Battery bus A shorts	DC VOLTS - BAT BUS A reads minimum MASTER ALARM light illuminates DC AMPS - BAT BUS A reads minimum	SM2A-03, para. 9.1.5.4

SESSION DATA SHEET TM1.1 8

Scripting Worksheet 1 (Run 1) Practice 3-Orbit Basic Nominal Mission With Simulated Malfunctions Crew Override (G&N Mode)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			SPS periodic verification	IOS Data Sheet SP3.01	Crew procedures, SM2A-03, para. 8.3.1.3
1	SP-014	3:17:00	Helium tank pressure indicator	He TANK PRESS indicator reads minimum. All other indicators read normal. Instructor should verify indicator failure upon request.	SM2A-03, para. 9.1.3.8
			SPS periodic verification	IOS Data Sheet SP3.02	SM2A-03, para. 8.3.1.3
18	EC-126	3:35:00	Glycol pump 1 fails	MEC.03 GLY DISCH PRESS indicator reads low. MASTER ALARM light illuminates.	SM2A-03, para. 9.1.6.6 Crewmember may also attempt to isolate malfunction using para. 9.1.6.8 and/or 9.1.6.9.
			Battery charging	IOS Data Sheet EP3.07	Crew procedures, SM2A-03, para. 9.1.6.9
	EC-032	3:37:00	Cabin temperature sensor fails open	MEC.07 CABIN TEMP indicator reads minimum. Instructor should verify indicator failure upon request.	

Scripting Worksheet 1 (Run 1) Practice 3-Orbit Basic Nominal Mission With Simulated Malfunctions Crew Override (G&N Mode)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Deorbit and entry	IOS Data Sheet E1.1	
3	SC-001	4:10:00	Yaw rate gyro fails (no output)	Yaw rate indicator on FDAI remains at zero. No rate damping of S/C-RCS rotation. Student should select YAW RATE BACK-UP.	Crew procedures, SM2A-03, para. 9.1.2.3
			Postlanding procedures	IOS Data Sheet R1.3	
5			End of run 1		
Scripting Worksheet 2 (Run 2) Practice 3-Orbit Basic Nominal Mission With Simulated Malfunctions (SCS Mode)					
			Procedures not available at date of publication.		

SESSION DATA SHEET ORBITAL MISSION/TRANSPOSITION AND DOCKING	TM1.2	1

PURPOSE.

To provide training in nominal mission transposition and docking described in paragraph 3.2.5.

SCOPE.

Only one run is required for this session: a complete iteration of the mission defined in paragraph 3.2.5. The mission includes prelaunch, launch-boost to orbit, navigation and IMU alignment, spacecraft transposition and simulated docking with S-IVB spacecraft maneuver for purposes of S-IVB viewing, system checks and sensing, preparation for and accomplishment of deorbit maneuver C/M-S/M separation, entry, descent to touchdown, and postlanding procedures.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedures	Run	Source
1. Prelaunch	1	SM2A-03, para. 8.1
2. Ascent and initial orbit	1	8.2
3. Earth orbit	1	8.3
4. Deorbit and entry	1	8.4
5. Postlanding	1	8.5
6. Delta V	1	R507 - P32, P42, P61, P62, P63, P66, task analysis SP003 and SP004
7. Guidance and navigation	1	R507 - P21, P22, P23, P27, P31, P41, P51, P52, P53, R1, R2, R14, R15, R33, R37

MEASUREMENT DATA.

Measurement data group 5, section 6, this volume.

SESSION DATA SHEET ORBITAL MISSION/TRANSPOSITION AND DOCKING	TM1.2	2

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1
VISUAL SYSTEMS	
Film Cassette Loading	X
SIMULATED C/M	
Check - Fill Potable Water Tank	X
Check - Empty Waste Storage System	X
Vertical Insertion and Retraction	⊠
COMPUTER COMPLEX	
Premission Setup	X
X-Y PLOTTERS	
Plotter Readiness and Setup (X-Y 30 X 30)	⊠
Plotter Readiness and Setup (X-Y 11 X 17)	⊠
X-T RECORDERS	
Records Readiness and Setup (X-T)	⊠
TELEMETRY CONSOLE	
TM Console Fault Patching	⊠
TM Console Readiness and Setup	⊠
INSTRUCTOR-OPERATOR STATION	
Computer and Simulator Status	X
Communications Control Setup	X
Closed Circuit TV Setup	X
Recorder and Plotter Status	⊠
Voice Interference Operation	⊠
True Trainee Environment and Waste Management Status	X
G&N and Visuals Readiness	X
Up-Data Link Status	X
Reset Initialization	X

X = Required ⊠ = Optional

SCRIPTING NOTES.

One script is required for this session.

SESSION DATA SHEET TM1.2 3

Scripting Worksheet 1 (Run 1) Orbital Mission/Transposition and Docking

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1. Transposition and docking nominal mission (table 3-13, Volume I) End of run 1.	Initialize at S1	Crew procedures, SM2A-03, para. 8.1, 8.2, 8.3, 8.4, and 8.5 A hold must be initiated in order to perform prelaunch procedures.

SESSION DATA SHEET ABORTIVE EARLY MISSION TERMINATION	TM1.3	1

PURPOSE.

It is the purpose of this session to provide crew training in procedures for recognizing requirements for and accomplishing early mission termination from 105-n mi earth orbit.

SCOPE.

There is only one run required for this session. The run entails a complete simulated mission from prelaunch through entry. It includes practice of crew procedures for a simulated mission that requires early mission termination by SCS mode retrograde and entry in the second orbit because of spacecraft malfunction.

CREW PROCEDURES.

Crew procedures for this session are not available at the date of publication. Therefore, the remainder of this session data sheet cannot be provided.

MEASUREMENT DATA.

TBD

INSTRUCTOR ACTIVITY OUTLINE.

TBD

SCRIPTING NOTES.

TBD

SCRIPTING WORKSHEETS.

TBD

SESSION DATA SHEET PLANE CHANGE MISSION	TM2.1	1

PURPOSE.

Training in this session includes further practice of navigation, IMU alignment, and system management procedures along with delta V procedures for changing orbital inclination.

SCOPE.

This training run provides the crewmembers with procedures for making delta V changes in orbital inclination by varying from orbital flight path. A complete simulated mission from launch to touchdown is required. Training run is as follows:

1. Practice procedures for a simulated mission involving a -1-degree change in orbital inclination followed one orbit later by a corresponding +1-degree change (all delta V maneuvers in G&N mode).

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedures	Run	Source
1. Ascent and initial orbit	1	SM2A-03, para. 8.2
2. Earth orbit	1	8.3
3. Deorbit and entry	1	8.4
4. Postlanding	1	8.5
5. Delta V	1	R507 - P32, P42, P61, P62, P63, P66 and task analysis SP003, SP004
6. Guidance and navigation	1	R507 - P21, P22, P23, P27, P31, P41, P51, P53, R1, R2, R14, R15, R33, R37

MEASUREMENT DATA.

Measurement data group 5, section 6, this volume.

SESSION DATA SHEET PLANE CHANGE MISSION	TM2.1	2

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18 this document.

System Checklist	Run No. 1
VISUAL SYSTEMS	
Film Cassette Loading	X
SIMULATED C/M	
Check - Fill Potable Water Tank	X
Check - Empty Waste Storage System	X
Vertical Insertion and Retraction	*
COMPUTER COMPLEX	
Premission Setup	X
X-Y PLOTTERS	
Plotter Readiness and Setup (X-Y 30 X 30)	⊠
Plotter Readiness and Setup (X-Y 11 X 17)	⊠
X-T RECORDERS	
Records Readiness and Setup (X-T)	⊠
INSTRUCTOR-OPERATOR STATION	
Computer and Simulator Status	X
Communications Control Setup	X
Closed Circuit TV Setup	⊠
Recorder and Plotter Status	⊠
Voice Interference Operation	⊠
True Trainee Environment and Waste Management Status	X
G&N and Visuals Readiness	X
Up-Data Link Status	X
Reset Initialization	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this session.

SESSION DATA SHEET PLANE CHANGE MISSION	TM2.1	3

SCRIPTING NOTES.

One script is required for this session. This script (run 1) is prepared from scripting worksheet 1.

This run should be initialized at step 1, table 3-8, Volume I. Table 3-11, Volume I provides scripting outlines and IOS data sheets to be used during this session.

Scripting Worksheet 1 (Run 1) Plane Change Procedures

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at. . . S1	
			Nominal mission plane change (table 3-11, Volume I)		Crew procedures, SM2A-03, para. 8.2, 8.3, 8.4, and 8.5
			End of run 1		

SESSION DATA SHEET PLANE CHANGE CONTINGENCIES	TM2.2	1

PURPOSE.

To provide training in crew procedures for dealing with various mission and system contingencies during nominal mission plane changes.

SCOPE.

Two runs are required to accomplish this session. Each run comprises a complete simulated mission from launch through touchdown. Training runs are as follows:

1. Practice procedures for a simulated mission including a -1-degree plane change and a +1-degree change one orbit later with simulated malfunctions to require second plane change, retrograde, and entry in the SCS mode.
2. Practice procedures for a simulated mission including a plane change planned for -1 degree, but resulting in a larger change because of SPS overrun (manual thrusting cutoff), computation and accomplishment of plane change to intercept planned landing site, and malfunctions requiring SCS mode retrograde and manual direct mode entry.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedures	Run	Source
1. Ascent and initial orbit	1, 2	SM2A-03, para 8.2
2. Earth orbit	1, 2	8.3
3. Deorbit and entry	1, 2	8.4
4. Postlanding	1, 2	8.5
5. FDAI attitude ball does not follow S/C rotation	2	9.1.2.7
6. Delta V	1, 2	R507 - P32, P42, P61, P62, P63, P66, and task analysis SP003, SP004
7. Guidance and navigation	1, 2	R507 - P21, P22, P23, P27, P31, P41, P51, P53, R1, R2, R14, R15, R33, R37

MEASUREMENT DATA.

Measurement data group 5, section 6, this volume.

SESSION DATA SHEET PLANE CHANGE CONTINGENCIES	TM2.2	2

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1	Run No. 2
VISUAL SYSTEMS		
Film Cassette Loading	X	X
SIMULATED C/M		
Check - Fill Potable Water Tank	X	X
Check - Empty Waste Storage System	X	X
Vertical Insertion and Retraction	*	*
COMPUTER COMPLEX		
Premission Setup	X	X
X-Y PLOTTERS		
Plotter Readiness and Setup (X-Y 30 X 30)	⊠	⊠
Plotter Readiness and Setup (X-Y 11 X 17)	⊠	⊠
X-T RECORDERS		
Records Readiness and Setup (X-T)	⊠	⊠
INSTRUCTOR-OPERATOR STATION		
Computer and Simulator Status	X	X
Communications Control Setup	X	X
Closed Circuit TV Setup	X	X
Recorder and Plotter Status	⊠	⊠
Voice Interference Operation	⊠	⊠
True Trainee Environment and Waste Management Status	X	X
G&N and Visuals Readiness	X	X
Up-Data Link Status	X	X
Reset Initialization	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. Malfunctions required for these runs are as follows:

Run 1

GN-003 AGC 13-vdc power failure

Run 2

SC-014 SCS accelerometer fails (no output)
GN-006 AGC 2.048-mc oscillator fails
SC-002 Yaw BMAG fails (no output, SCS mode)

SESSION DATA SHEET PLANE CHANGE CONTINGENCIES	TM2.2	3

SCRIPTING NOTES.

Two scripts are required for the two runs of this session. These scripts are prepared using scripting worksheets called out as follows:

Script	Scripting Worksheet	Run
1	1	1
2	2	2

These two runs should be initialized at initialization point S1, step 1.1, table 3-8, Volume I. A hold mode should then be selected to allow time for prelaunch procedures. Depressing the run pushbutton restarts real time simulation. Table 3-11, Volume I, provides scripting outlines and IOS data sheets to be used during this session.

This session requires retrograde and entry in the SCS mode. SCS procedures are not available at this date; therefore, these portions of the scripting worksheets are marked "TBD."

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at. . . S1	
			Nominal mission, plane changes (table 3-11, Volume I)		Crew procedures, SM2A-03, para. 8.2, 8.3, 8.4, and 8.5
			Landmark sightings	IOS Data Sheet GN4.09	R507 - P22
2	GN-003	1:52:00	AGC 13-vdc power failure	MASTER ALARM light illuminates COMP FAIL light illuminates AGC PWR FAIL light illuminates Instructor should request SCS retrofire and entry.	Contact MSFN for calculations; activate SCS mode of operation.
1-46		2:45:33	SCS delta V mode	IOS Data Sheet SC1.03	Crew procedures not available at time of publication.
		4:16:00	SCS entry	IOS Data Sheet - TBD	Crew procedures not available at time of publication.
			Postlanding End of run 1	IOS Data Sheet R1.1	

SESSION DATA SHEET TM2.2 5

Scripting Worksheet 2 (Run 2) Plane Change Contingencies

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 2	Initialize at. . . S1	
			Nominal mission, plane changes (table 3-11, Volume I)		Crew procedures, SM2A-03, para. 8.2, 8.3, 8.4, and 8.5
			G&N delta V mode	IOS Data Sheet GN1.13	R507 - P51, R37
28	SC-014	1:17:44	SCS accelerometer fails, no output	THRUST ON light remains illuminated and SPS engine continues to fire after delta V remaining indicator goes through zero during G&N delta V maneuver.	Crewmember 1 should manually terminate SPS engine firing.
			G&N periodic verification	IOS Data Sheet GN4.02	
1	GN-006	3:10:00	AGC 2.048-mc oscillator failure	MASTER ALARM light illuminates COMP FAIL light illuminates G&N ERROR light illuminates. Instructor should request use of SCS retrofire and entry.	Crewmember 1 should select SCS mode of operation.
		4:16:00	SCS entry	IOS Data Sheet - TBD	Crew procedures not available at time of publication.

Scripting Worksheet 2 (Run 2) Plane Change Contingencies (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Post-delta V operations	IOS Data Sheet E1.2	
1	SC-002	4:18:00	Yaw BMAG fails (no output SCS mode)	FDAI attitude ball does not follow S/C yaw maneuvers. FDAI error indicator remains at zero during yaw maneuvers. S/C does not hold preset attitude yaw deadband.	Crew procedures, SM2A-03, para. 9.1.2.7 Use manual direct control for entry.
		4:23:00	Manual direct mode entry	IOS Data Sheet - TBD	Crew procedures not available at time of publication.
			Post-touchdown	IOS Data Sheet R1.1	
			End of run 2		

SESSION DATA SHEET TRANSFER TO 105 N MI/130 N MI ELLIPTICAL ORBIT	TM3.1	1

PURPOSE.

This session is to provide further practice of crew procedures for navigation, IMU alignment, delta V, and system management along with crew experience operating in elliptical orbit.

SCOPE.

This run is a complete simulated mission from launch to touchdown, involving transfer from 105-n mi circular orbit to 105/130-n mi elliptical orbit. Training run is as follows:

1. Practice procedures for a simulated mission involving transfer from 105-n mi circular orbit to 105/130-n mi elliptical orbit with entry from orbital perigee.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedures	Run	Source
1. Ascent and initial orbit	1	SM2A-03, para. 8.2
2. Earth orbit	1	8.3
3. Deorbit and entry	1	8.4
4. Postlanding	1	8.5
5. Delta V	1	R507 - P32, P42, P61, P62, P63, P66, and task analysis SP003, SP004
6. Guidance and navigation	1	R507 - P21, P22, P23, P27, P31, P41, P51, P53, R1, R2, R14, R15, R33, R37

MEASUREMENT DATA.

Measurement data group 6, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18, this document.

System Checklist	Run No. 1
VISUAL SYSTEMS	
Film Cassette Loading	X

X = Required

SESSION DATA SHEET TRANSFER TO 105 N MI/130 N MI ELLIPTICAL ORBIT	TM3.1	2

System Checklist	Run No. 1
SIMULATED C/M	
Check - Fill Potable Water Tank	X
Check - Empty Waste Storage System	X
Vertical Insertion and Retraction	*
COMPUTER COMPLEX	
Premission Setup	X
X-Y PLOTTERS	
Plotter Readiness and Setup (X-T 30 X 30)	⊠
Plotter Readiness and Setup (X-Y 11 X 17)	⊠
X-T RECORDERS	
Records Readiness and Setup (X-T)	⊠
INSTRUCTOR-OPERATOR STATION	
Computer and Simulator Status	X
Communications Control Setup	X
Closed Circuit TV Setup	X
Recorder and Plotter Status	⊠
Voice Interference Operation	⊠
True Trainee Environment and Waste Management Status	X
G&N and Visuals Readiness	X
Up-Data Link Status	X
Reset Initialization	X

X = Required ⊠ = Optional * = If not previously accomplished

2. No malfunctions are required for this session.

SCRIPTING NOTES.

One script is required for this session. It is prepared from scripting worksheet 1.

This run should be initialized at step 1, table 3-8, Volume I. Table 3-12, Volume I, provides scripting outlines and IOS data sheets to be used during this session.

SESSION DATA SHEET TM3.1 3

Scripting Worksheet 1 (Run 1) Transfer to 105-n mi/140-n mi Elliptical Orbit

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at. . . S2	
			Nominal mission, Hohmann transfers (table 3-12, Volume I)		Crew procedures, SM2A-03, para. 8.2, 8.3, 8.4, and 8.5
			End of run 1		

SESSION DATA SHEET HOHMANN TRANSFERS 105 N MI TO 130 N MI TO 105 N MI	TM3.2	1

PURPOSE.

This session provides practice in integrated crew procedures for navigation, IMU alignment, delta V, and system management with emphasis on accomplishing orbital change maneuvers.

SCOPE.

Three runs are required to accomplish this session. Each run is a complete three-orbit mission. Runs 1 and 2 are continuous from launch to touchdown. Run 3 is the training summary and should be conducted from prelaunch through postlanding procedures. Training runs are as follows:

1. Practice procedures for a simulated mission involving Hohmann transfer from 105-n mi orbit to 130-n mi orbit and back to 105-n mi orbit (all delta V maneuvers in G&N mode)
2. Practice procedures for a simulated mission involving Hohmann transfer from 105-n mi to 130-n mi orbit and back to 105-n mi orbit (using simulated malfunctions to require final circularization delta V, retrograde, and entry in the SCS mode)
3. Practice procedures for a simulated mission involving Hohmann transfer to 130 n mi with malfunctions to induce azimuth error in 130-n mi orbit, computing and accomplishing a plane change to intercept planned landing site, malfunctions to induce SCS mode during the plane change retrograde, and entry.

CREW PROCEDURES.

Procedures to be practiced during this session are as follows:

Procedures	Run	Source
1. Prelaunch	3	SM2A-03, para. 8.1
2. Ascent and initial orbit	1, 2, 3	8.2
3. Earth orbit	1, 2, 3	8.3
4. Deorbit and entry	1, 2, 2	8.4
5. Postlanding	3	8.5
6. Delta V	1, 2, 3	R507 - P32, P42, P61, P62, P63, P66, and task analysis SP003, SP004
7. Guidance and navigation	1, 2, 3	R507 - P21, P22, P23, P27, P31, P41, P51, P53, R1, R2, R14, R15, R33, R37

SESSION DATA SHEET HOHMANN TRANSFERS 105 N MI TO 130 N MI TO 105 N MI	TM3.2	2

MEASUREMENT DATA.

Measurement data group 5, section 6, this volume.

INSTRUCTOR ACTIVITY OUTLINE.

1. Perform the following checklists corresponding to the desired run. These checklists are found in Volume II, section 1, table 1-18 this document.

System Checklist	Run No. 1	2	3
VISUAL SYSTEMS			
Film Cassette Loading	X	X	X
SIMULATED C/M			
Check - Fill Potable Water Tank	X	X	X
Check - Empty Waste Storage System	X	X	X
Vertical Insertion and Retraction	*	*	*
COMPUTER COMPLEX			
Premission Setup	X	X	X
X-Y PLOTTERS			
Plotter Readiness and Setup (X-Y 30 X 30)	⊠	⊠	⊠
Plotter Readiness and Setup (X-Y 11 X 17)	⊠	⊠	⊠
X-T RECORDERS			
Records Readiness and Setup (X-T)	⊠	⊠	⊠
INSTRUCTOR-OPERATOR STATION			
Computer and Simulator Status	X	X	X
Communications Control Setup	X	X	X
Closed Circuit TV Setup	⊠	⊠	⊠
Recorder and Plotter Status	⊠	⊠	⊠
Voice Interference Operation	⊠	⊠	⊠
True Trainee Environment and Waste Management Status	X	X	X
G&N and Visuals Readiness	X	X	X
Up-Data Link Status	X	X	X
Reset Initialization	X	X	X

X = Required ⊠ = Optional * = If not previously accomplished

2. Use the following malfunctions for the respective runs of this session:
Run 2
GN-003 AGC 13-vdc power failure

SESSION DATA SHEET HOHMANN TRANSFERS 105 N MI TO 130 N MI TO 105 N MI	TM3.2	3

Run 3

GN-040 Loss of 2-volt, 3200-cps microsyn excitation.

SCRIPTING NOTES.

The three scripts required for this session are compiled using the following scripting worksheets.

Script	Scripting Worksheet	Run
1	1	1
2	2	2
3	3	3

Runs 1 and 2 should be initialized at S2 launch-boost, table 3-8, Volume I.

Run 3 should be initialized at S1 and the hold pushbutton depressed. After completion of prelaunch preparations the run pushbutton should be depressed. When the Hohmann transfer to 130-n mi orbit is made, an azimuth error should be introduced and the crewmembers informed of the error. Crewmember should measure orbit and make calculations required to return to planned landing site when 105-n mi orbit change is made.

Table 3-12, Volume I, provides scripting outlines and IOS data sheets to be used during this session.

SESSION DATA SHEET TM3.2 4

Scripting Worksheet 1 (Run 1) Hohmann Transfers 105 n mi to 130 n mi to 105 n mi

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Start run 1	Initialize at. . . S2	
			Nominal mission Hohmann transfers (table 3-12, Volume I)		Crew procedures, SM2A-03, para. 8.2, 8.3, 8.4, and 8.5
			Touchdown		
			End of run 1		
Scripting Worksheet 2 (Run 2) Hohmann Transfer 105 n mi to 130 n mi to 105 n mi					
			Start run 2	Initialize at. . . S2	
			Nominal mission Hohmann transfers (table 3-12, Volume I)		Crew procedures, SM2A-03, para. 8.2, 8.3, 8.4, and 8.5
			G&N delta V	IOS Data Sheet GN4.12 and GN1.13	R507 - P31, P41, and R37
1	GN-003	2:40:00	AGC 13-vdc power failure	MASTER ALARM light illuminates COMP FAIL light illuminates AGC PWR FAIL light illuminates. Instructor should request SCS retrofire and entry.	Crewmember should contact MSFN for calculations; activate SCS mode of operation.

Scripting Worksheet 2 (Run 2) Hohmann Transfer 105 n mi to 130 n mi to 105 n mi (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-46		2:45:33	SCS delta V mode	IOS Data Sheet SC1.03	Crew procedures not available at time of publication.
		4:16:00	SCS entry	IOS Data Sheet - TBD	Crew procedures not available at time of publication.
			Touchdown		
			End of run 2		
Scripting Worksheet 3 (Run 3) Hohmann Transfer 105 n mi to 130 n mi to 105 n mi					
			Start run 3	Initialize at. . . S1 Place AMS in hold mode until completion of prelaunch.	
			Nominal Mission Hohmann transfer (table 3-12, Volume I)		Crew procedures, SM2A-03, para. 8.2, 8.3, 8.4, and 8.5

SESSION DATA SHEET TM3.2 6

Scripting Worksheet 3 (Run 3) Hohmann Transfer 105 n mi to 130 n mi to 105 n mi (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
		1:17:44	Preparation for delta V to 130-n mi orbit with azimuth error	Instructor should feed erroneous azimuth information via up-data and voice link to the C/M prior to first delta V. Crew should perform computations required to intercept planned landing site after azimuth error is discovered.	
			G&N delta V mode	IOS Data Sheet GN4.12 and GN1.13	R507 - P31, P41, and R37 Crewmember should contact MSFN for calculations; activate SCS mode of operation.
1	GN-040	2:40:00	Loss of 2-volt 3200-cps microsyn excitation	MASTER ALARM light illuminates G&N ACCEL FAIL light illuminates G&N ERROR light illuminates.	
1-44		2:45:33	SCS delta V mode	IOS Data Sheet SC1.03	Crew procedures not available at time of publication.
		4:16:00	SCS and manual direct mode entry	IOS Data Sheet - TBD	Crew procedures not available at time of publication.
			Post-touchdown	IOS Data Sheet R1.1	
			End of run 3		

3 INITIALIZATION DATA

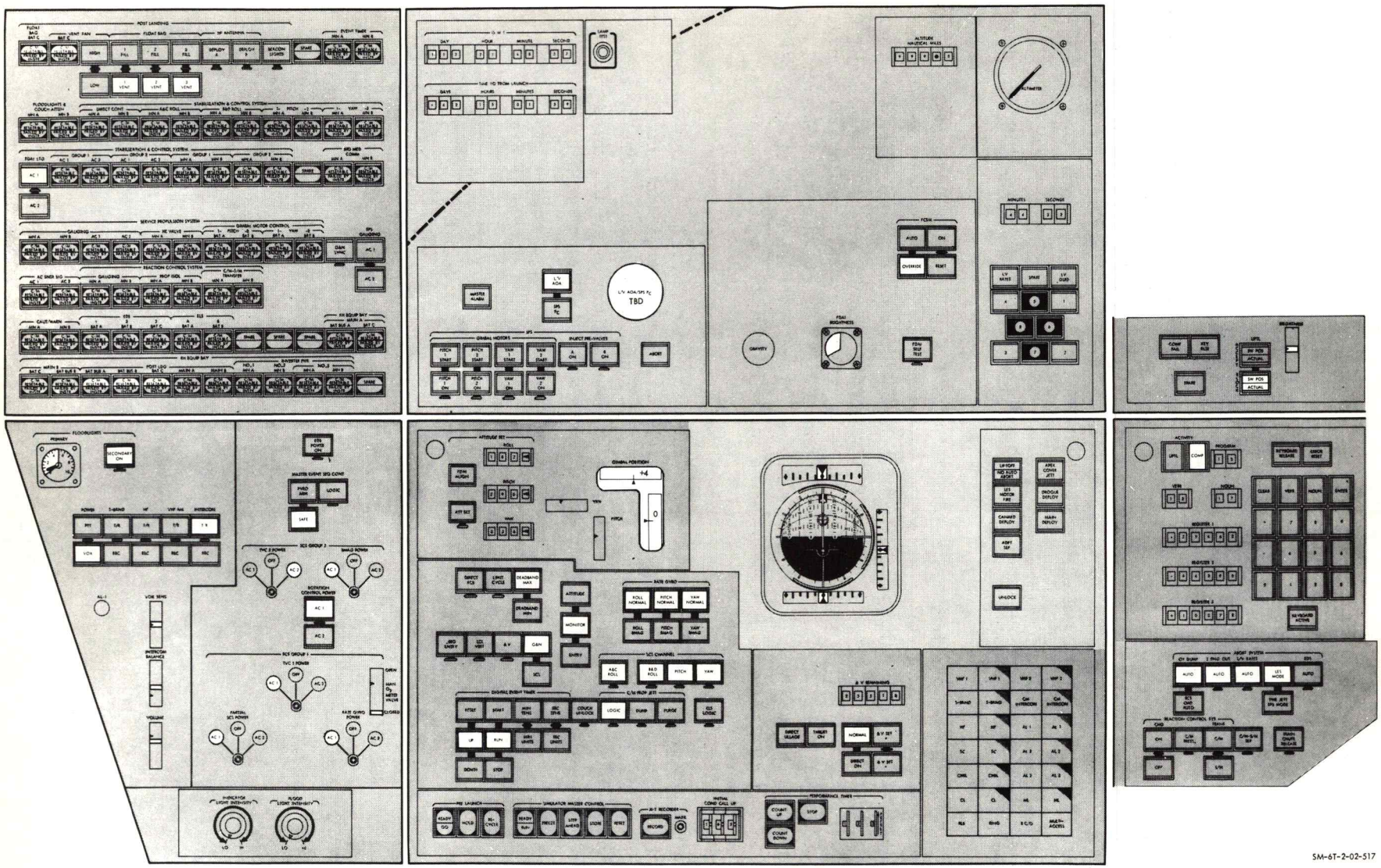
SECTION 3

INITIALIZATION DATA

This section of the instructor handbook contains those initialization checklists required to establish appropriate spacecraft systems configuration (in the SCM) for each of the program initialization points described in section 3 (AMS Utilization) of Volume I. System configuration data in each of these initialization checklists takes the form of pictorial and tabular presentation of the desired SCM controls configuration as manifested at the IOS. Initialization checklists relate only to the simulated spacecraft control settings in the SCM and should not be confused with the procedures for AMS initialization for the IOS as described in section 1 (AMS Operation) of this volume.

Separate initialization checklists are provided for spacecraft crew stations 1, 2, and 3. However, a separate set of crew station-oriented checklists are not required for each initialization point. Prelaunch (S1), launch (S2), orbit injection (S3), and post-separation/pre-entry (S13 and S211) all require separate and peculiar initialization checklists for each of the three crew stations. All of the orbital routine initialization points can be supported with only three sets of initialization checklists. Normal orbital operations require separate initialization configurations for S-IVB attached (S5B) and S-IVB separated (S4). A third orbital routine initialization checklist (S6) is required for minimum operations.

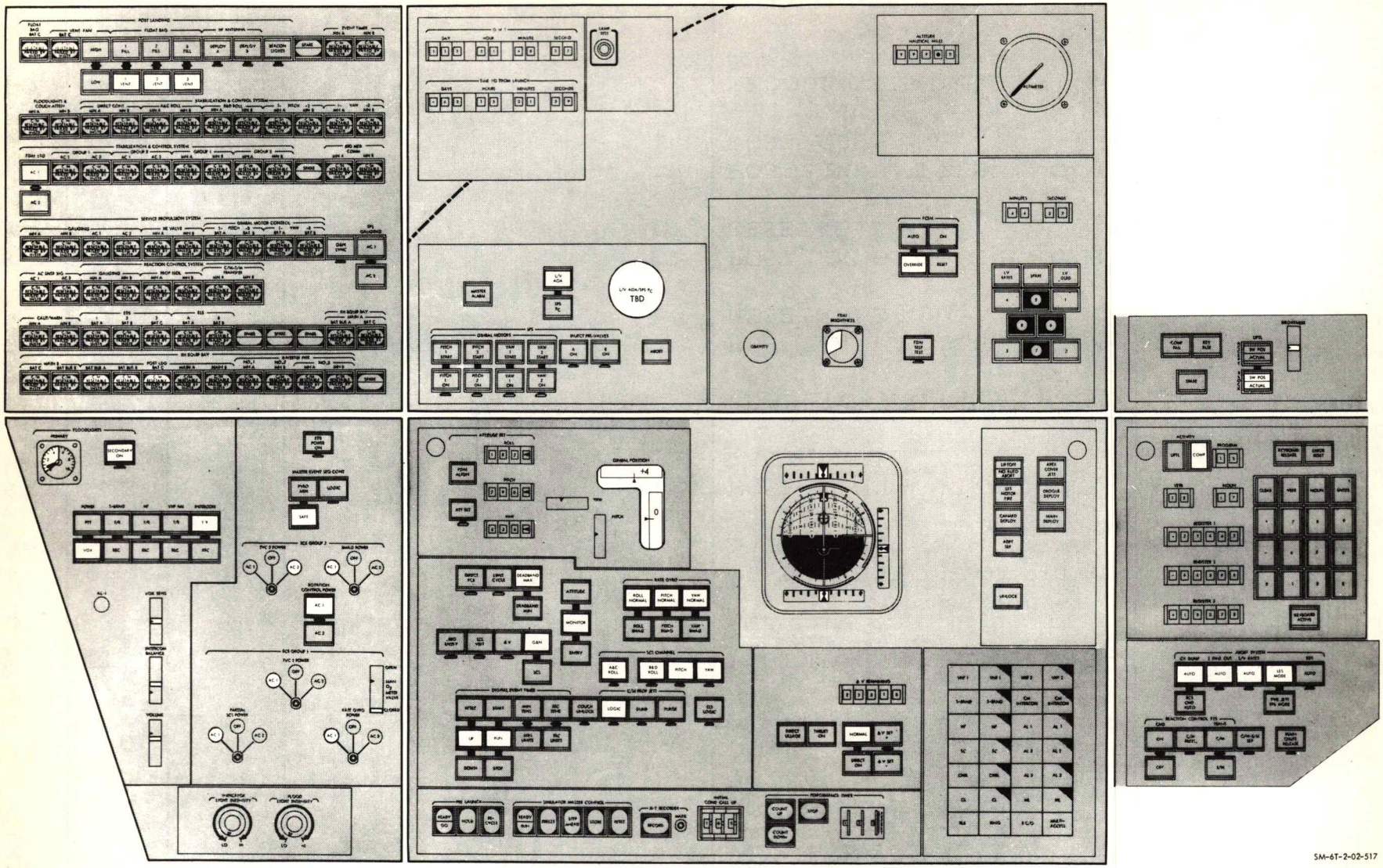
No initialization checklists are required for spacecraft crew station 4. Setup of G&N system configuration in the lower equipment bay is the subject of the G&N system activation procedures in IOS data sheet GN4.01 provided in section 4 of this volume of the instructor handbook. Where initialization of the G&N station is an activated condition is required, IOS data sheet GN4.01 can be used as an initialization checklist for spacecraft station 4.



Station 1 Prelaunch

Initialization Data Sheet

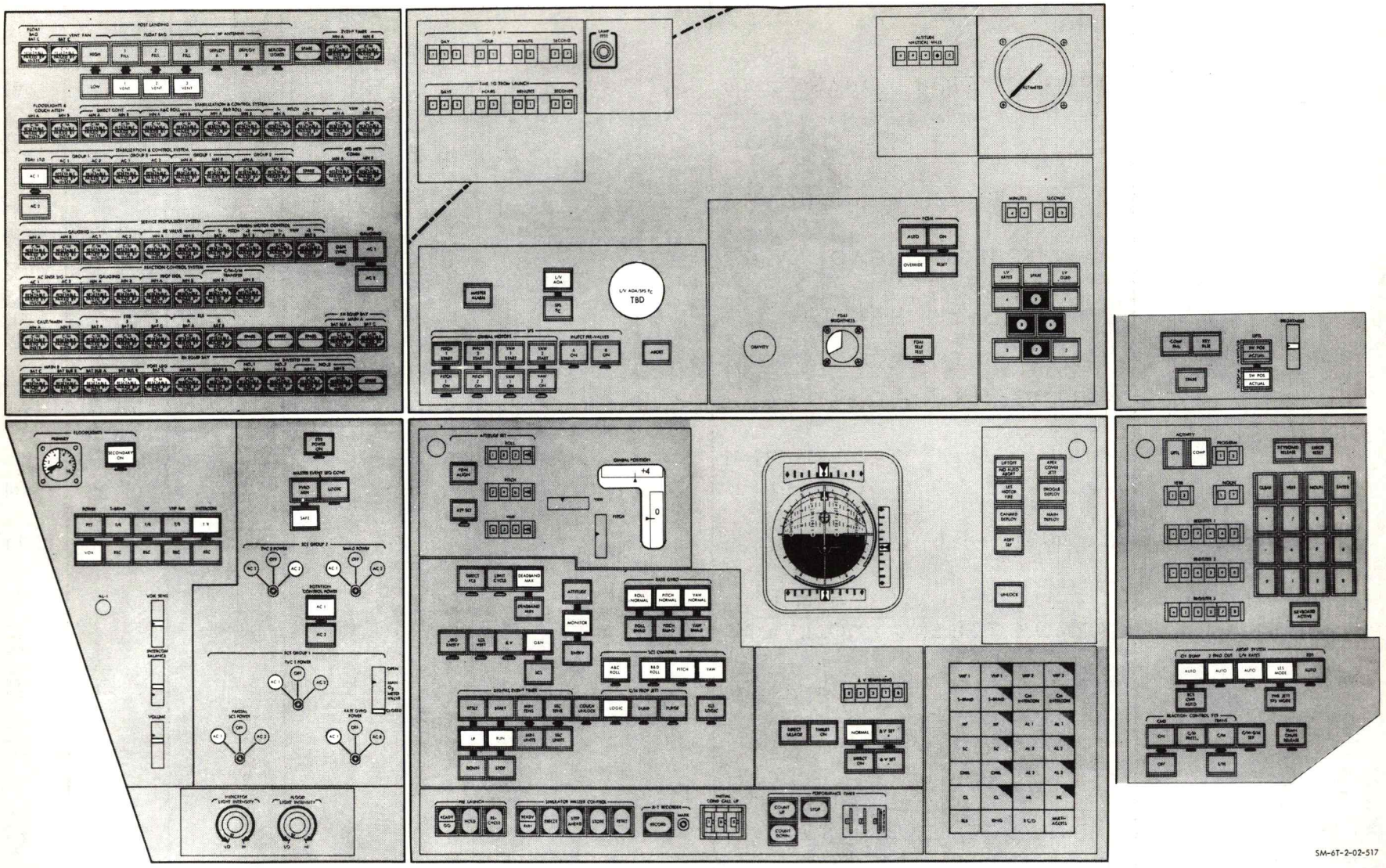
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				POST LANDING FLOAT BAG C - C/M RESETABLE lt on	
2				POST LANDING VENT FAN - C/M RESETABLE lt on	
3				POST LANDING FLOAT BAG - 1 VENT lt on	
4				POST LANDING FLOAT BAG - 2 VENT lt on	
5				POST LANDING FLOAT BAG - 3 VENT lt on	
6				FDAI LTG - AC 1 lt on	
7				POST LDG BAT BUS A - C/M RESETABLE lt on	
8				POST LDG BAT BUS B - C/M RESETABLE lt on	
9				POST LDG BAT BUS C - C/M RESETABLE lt on	
10				FLOODLIGHTS PRIMARY - as required	
11				POWER - VOX lt on	



Station 1 Prelaunch

Initialization Data Sheet

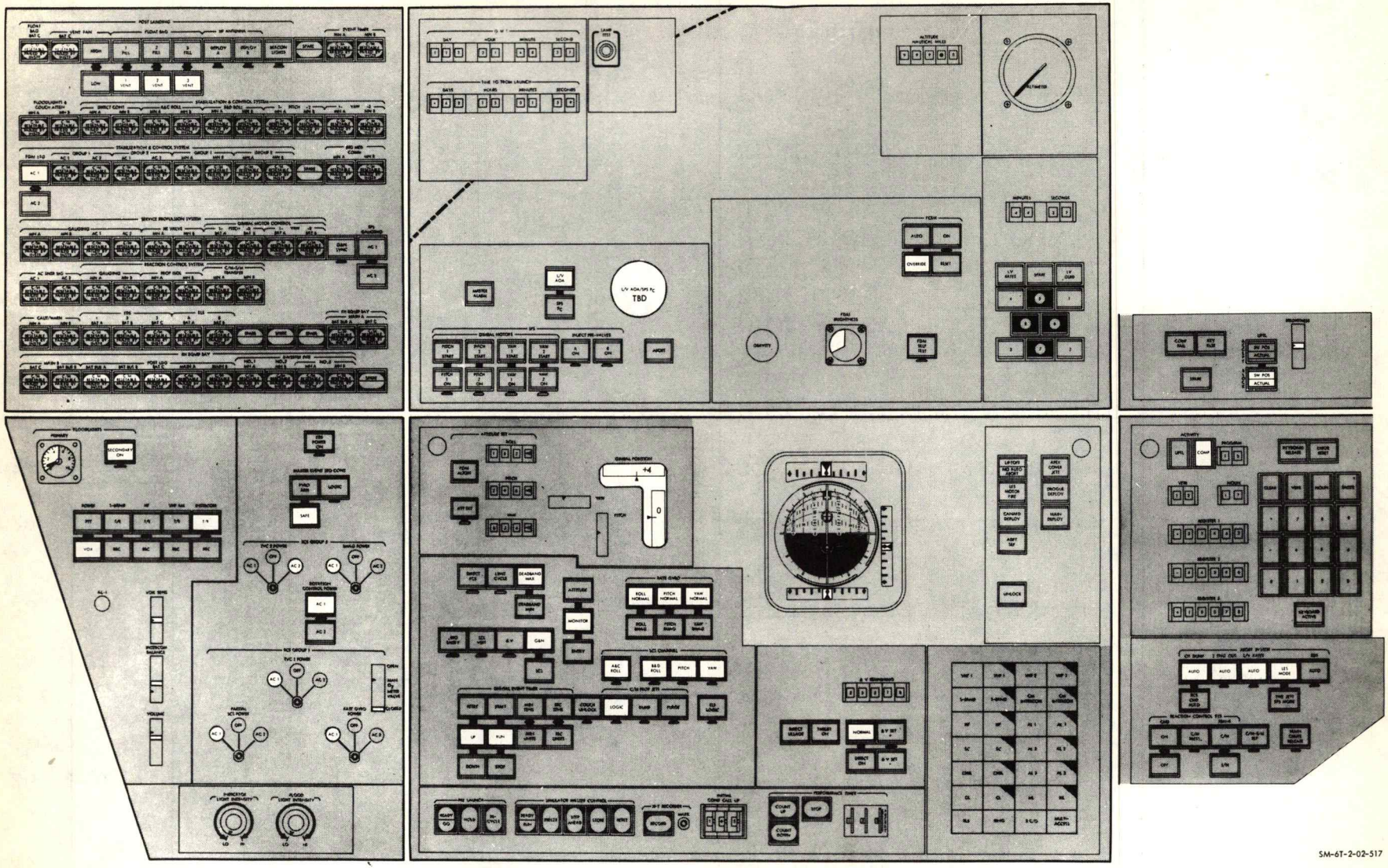
Step	Malf	Time	Function	IOS Visibility/Action	Notes
12				INTERCOM - T/R lt on	
13				MASTER EVENT SEQ CONT - SAFE lt on	
14				TVC 2 POWER - AC 2 lt on	
15				BMAG POWER - AC 1 lt on	
16				ROTATION CONTROL POWER - AC 1 lt on	
17				TVC 1 POWER - AC 1 lt on	
18				PARTIAL SCS POWER - AC 1 lt on	
19				RATE GYRO POWER - AC 1 lt on	
20				L/V AOA lt on	
21				FCSM - OVERRIDE lt on	
22				DEADBAND MAX lt on	
23				MONITOR lt on	
24				RATE GYRO - ROLL NORMAL lt on	



Station 1 Prelaunch

Initialization Data Sheet

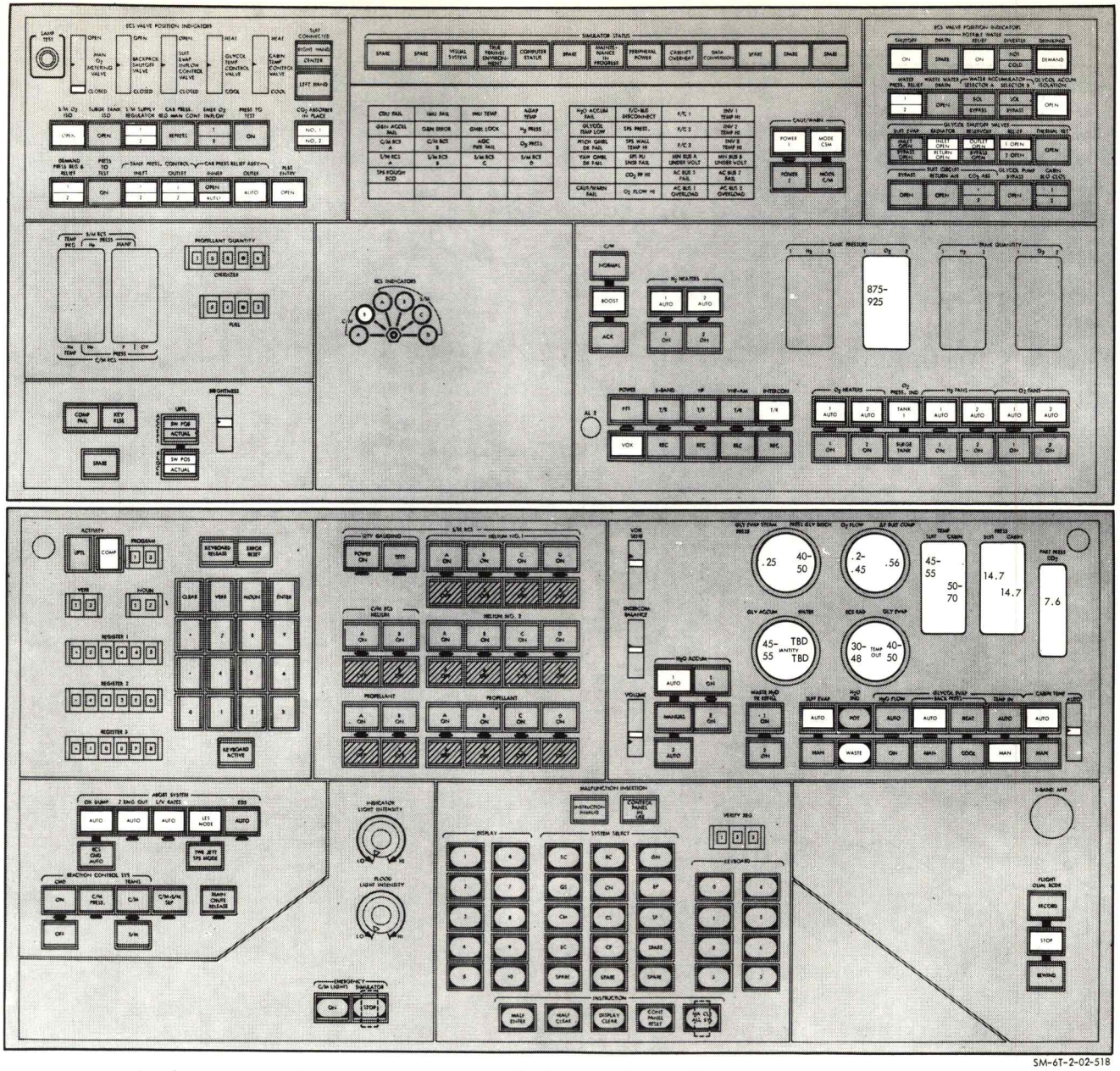
Step	Malf	Time	Function	IOS Visibility/Action	Notes
25				RATE GYRO - PITCH NORMAL lt on	
26				RATE GYRO - YAW NORMAL lt on	
27				SCS CHANNEL - A&C ROLL lt on	
28				SCS CHANNEL - B&D ROLL lt on	
29				SCS CHANNEL - PITCH lt on	
30				SCS CHANNEL - YAW lt on	
31				DIGITAL EVENT TIMER - UP lt on	
32				DIGITAL EVENT TIMER - RUN lt on	
33				C/M PROP JETT - LOGIC lt on	
34				FDAI attitude ball 59.5° pitch	
35				FDAI attitude ball 8.7° yaw	
36				FDAI roll bug 163.5°	



Station 1 Prelaunch

Initialization Data Sheet

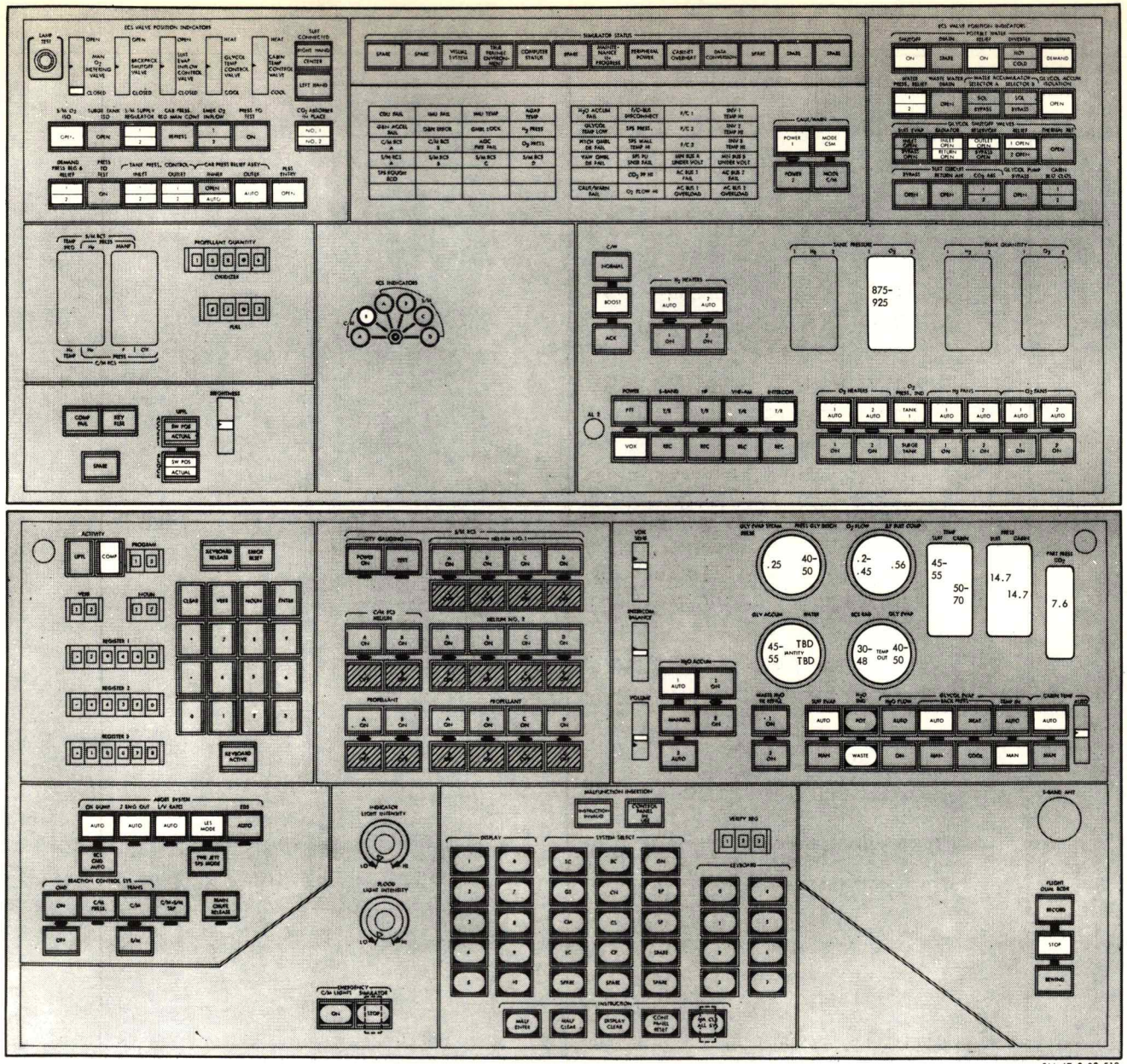
Step	Malf	Time	Function	IOS Visibility/Action	Notes
37				All rate and error ind - zero	
38				ΔV REMAINING ind - 10000	
39				NORMAL lt on	
40				Event timer - zeroed	



Station 2 Prelaunch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				MAN O_2 METERING VALVE - CLOSED	
2				S/M O_2 150 - OPEN lt on	
3				S/M SUPPLY REGULATOR 1 and 2 lt on	
4				CO_2 ABSORBER IN PLACE - No. 1 and No. 2 lt on	
5				DEMAND PRESS REG 7 RELIEF - 1 and 2 lt on	
6				TANK PRESS CONTROL INLET - 1 and 2 lt	
7				TANK PRESS CONTROL OUTLET - 1 and 2 lt on	
8				CABIN PRESSURE RELIEF ASSY INNER - AUTO lt on	
9				CABIN PRESSURE RELIEF ASSY OUTER - AUTO lt on	
10				PLSS ENTRY - OPEN lt on	
11				RCS INDICATORS C/M - B lt on	

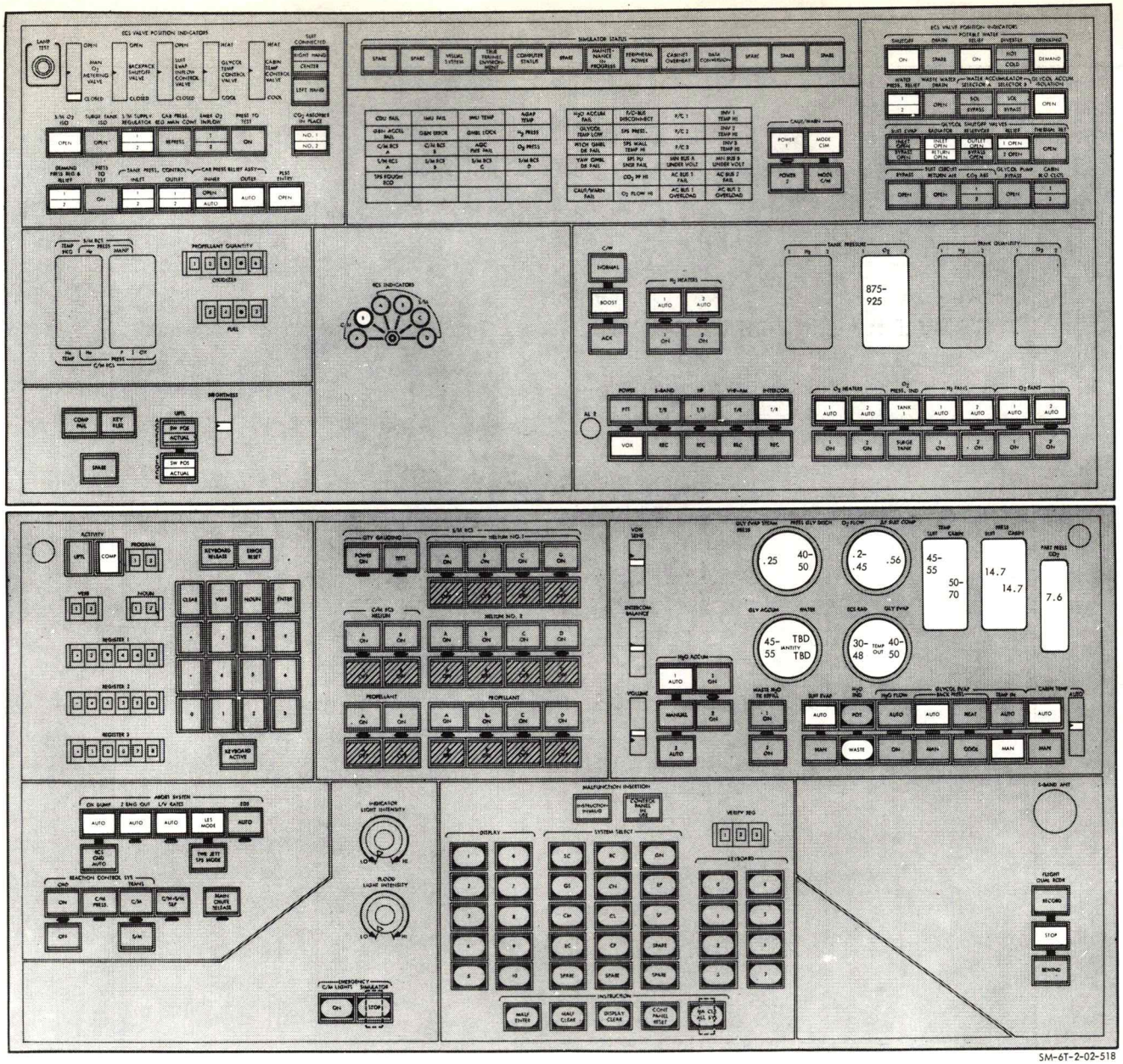


Station 2 Prelaunch

S1

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12				UPTL BLOCK - SW POS and ACTUAL lt on	
13				ACTIVITY - COMP lt on	
14				PROGRAM - 02	
15				VERB - 37	
16				NOUN - 01	
17				REGISTER 1 - TBD	
18				REGISTER 2 - TBD	
19				REGISTER 3 - TBD	
20				ABORT SYSTEM OX DUMP - AUTO lt on	
21				ABORT SYSTEM 2 END OUT - AUTO lt on	
22				ABORT SYSTEM L/V RATES - AUTO lt on	
23				CAUT/WARN - POWER 1 lt on	
24				CAUT/WARN - MODE C/M lt on	

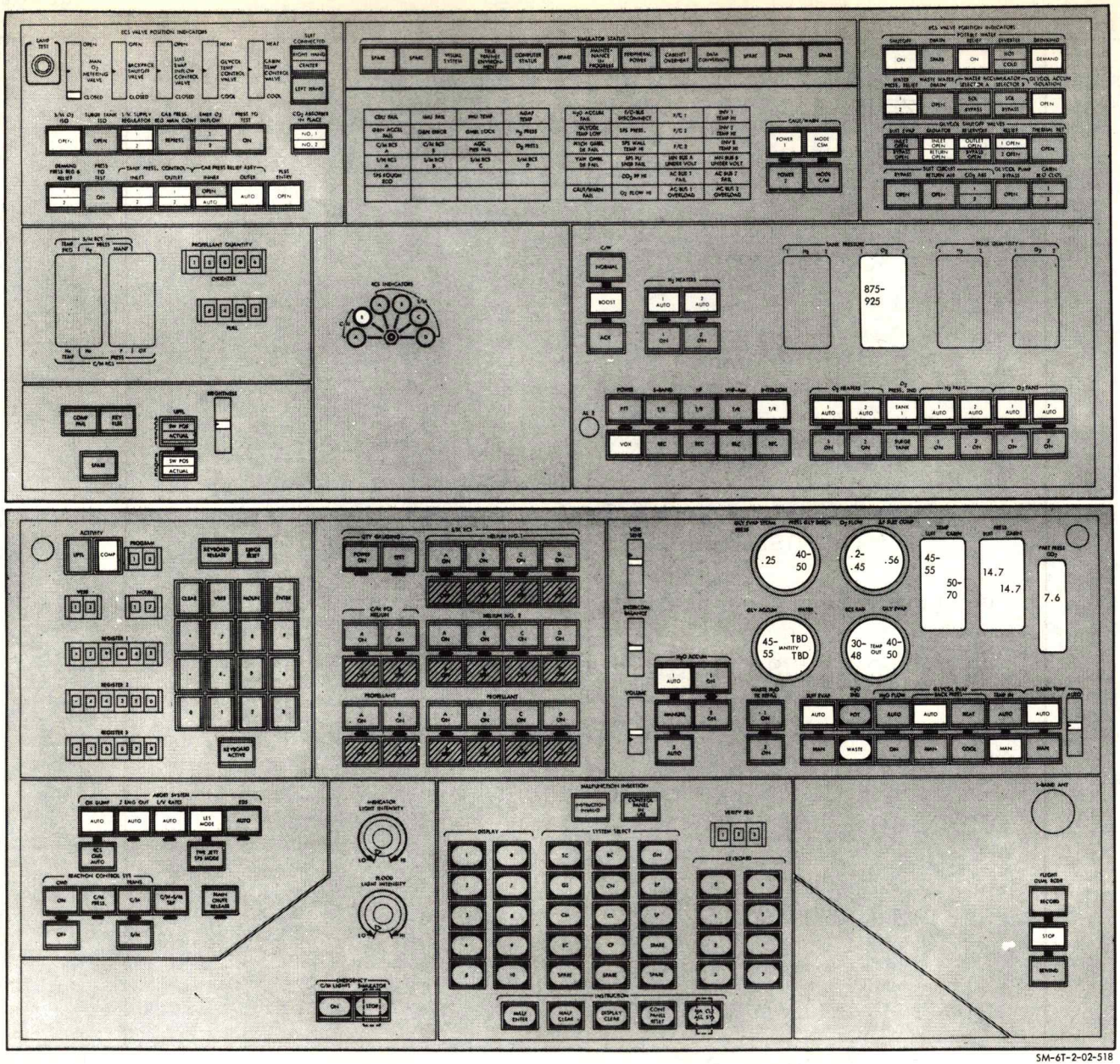


SM-6T-2-02-518

Station 2 Prelaunch

Initialization Data Sheet

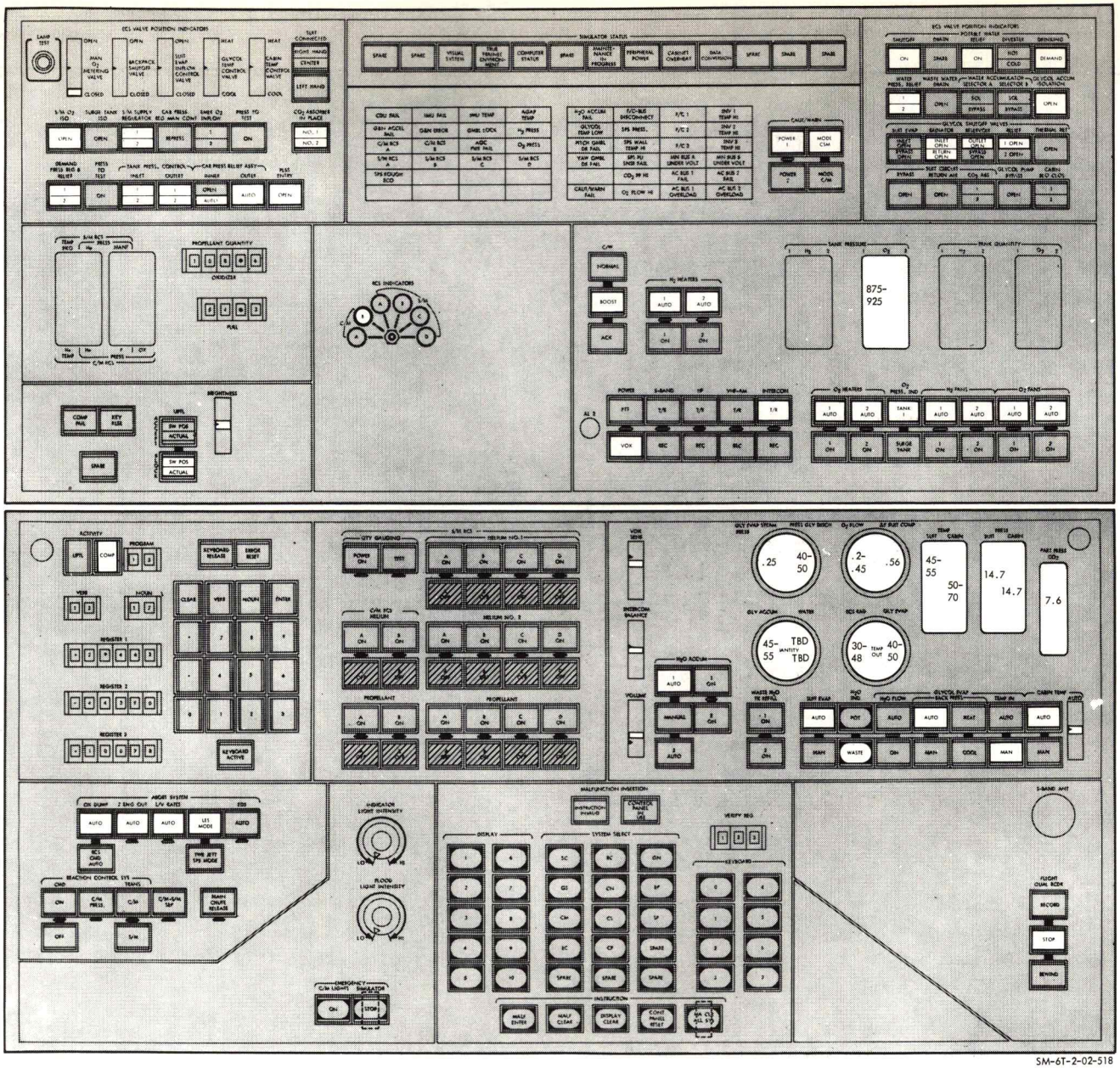
Step	Malf	Time	Function	IOS Visibility/Action	Notes
25				POTABLE WATER SHUTOFF - ON lt on	
26				POTABLE WATER RELIEF - ON lt on	
27				POTABLE WATER DRINKING - DEMAND lt on	
28				C/W - BOOST lt on	
29				H_2 HEATERS - 1 AUTO lt on	
30				H_2 HEATERS - 2 AUTO lt on	
31				TANK PRESSURE H_2 1 - 230-260	
32				TANK PRESSURE H_2 2 - 230-260	
33				TANK PRESSURE O_2 1 - 875-925	
34				TANK PRESSURE O_2 2 - 875-925	
35				TANK QUANTITY H_2 1 - 28	
36				TANK QUANTITY H_2 2 - 28	


875-925
.25
40-50
.2-.45
.56
45-55
50-70
14.7
14.7
7.6
45-55
TBD
TBD
30-48
40-50

SM-6T-2-02-518

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
37				TANK QUANTITY O_2 1 - 320	
38				TANK QUANTITY O_2 2 - 320	
39				POWER - VOX lt on	
40				INTERCOM - T/R lt on	
41				O_2 HEATERS - 1 AUTO lt on	
42				O_2 HEATERS - 2 AUTO lt on	
43				PRESS IND - TANK 1 lt on	
44				H_2 FAN - 1 AUTO lt on	
45				H_2 FAN - 2 AUTO lt on	
46				O_2 FAN - 1 AUTO lt on	
47				O_2 FAN - 2 AUTO lt on	
48				GLY EVAP STEAM PRESS - .25	
49				PRESS GLY DISCH - 40-50	
50				O_2 FLOW - .2-.45	
51				ΔP SUIT COMP - .56	



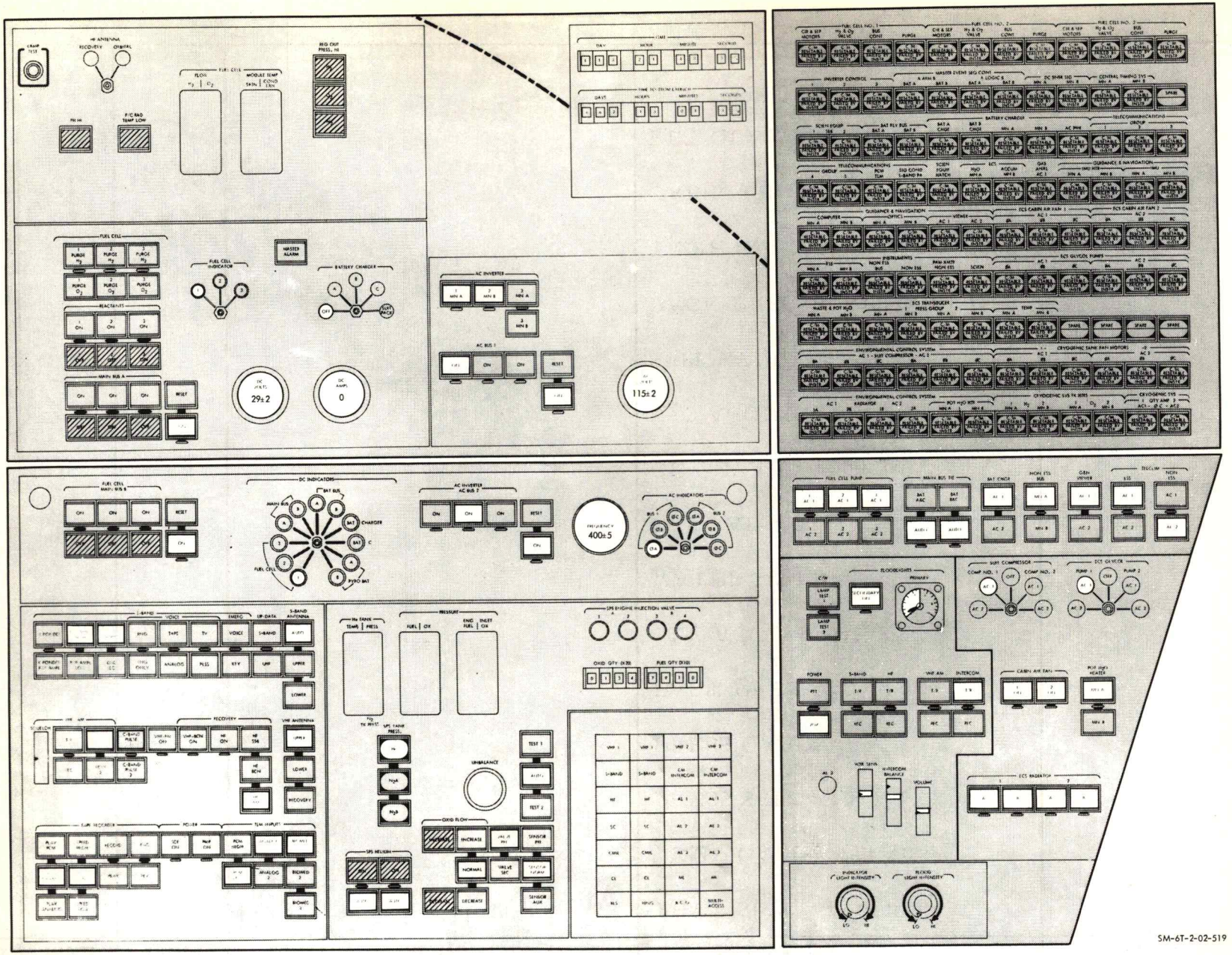
SM-6T-2-02-518

Station 2 Prelaunch

S1

Initialization Data Sheet

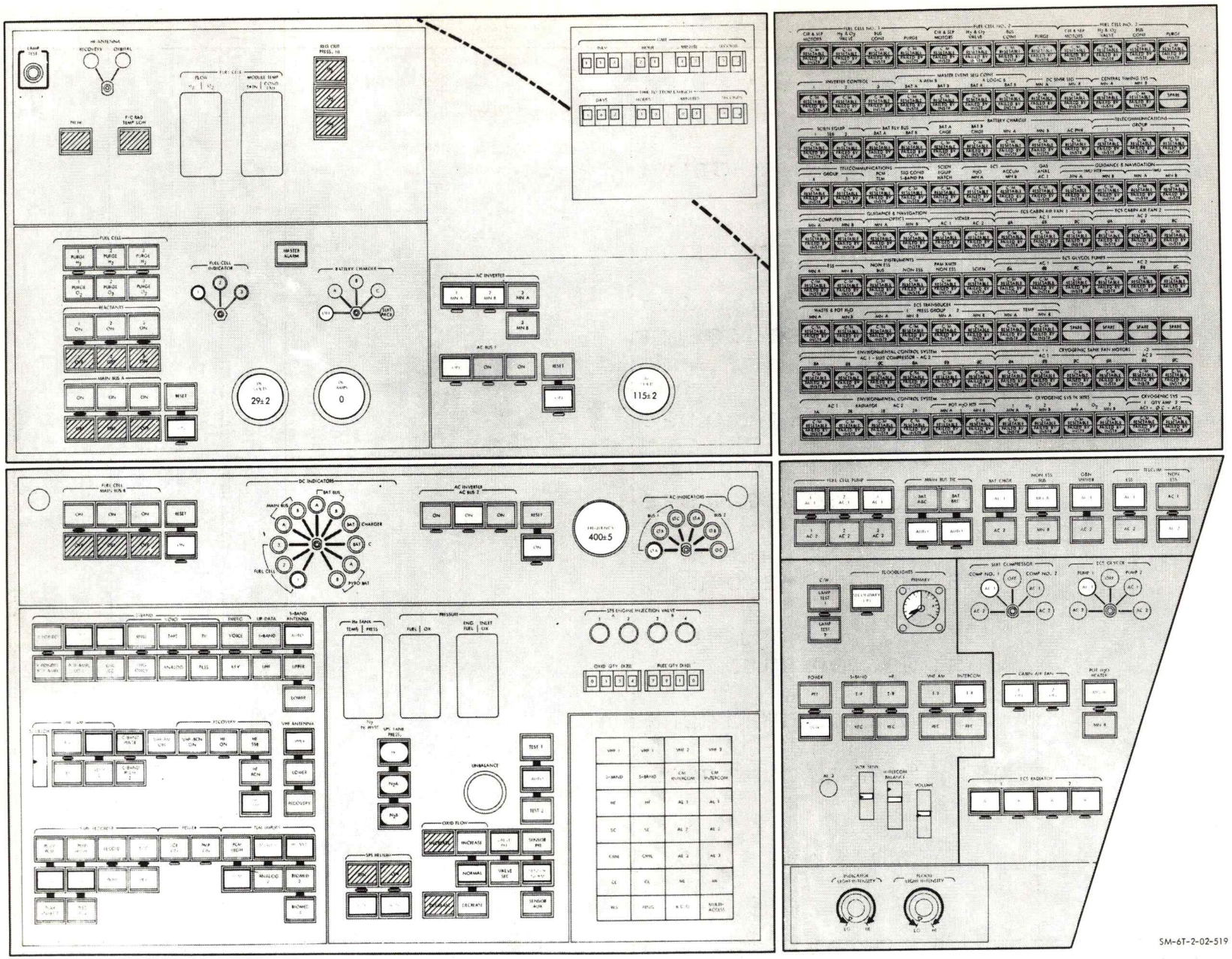
Step	Malf	Time	Function	IOS Visibility/Action	Notes
52				TEMP SUIT - 45-55	
53				TEMP CABIN - 50-70	
54				PRESS SUIT - 14.7	
55				PRESS CABIN - 14.7	
56				PART PRESS CO_2 - 7.6	
57				GLY ACCUM - 45-35	
58				WATER - TBD	
59				ECS RAD - 30-48	
60				GLY EVAP - 40-50	
61				H_2O ACCUM - 1 AUTO lt on	
62				SUIT EVAP - AUTO lt on	
63				BACK PRESS - AUTO lt on	
64				TEMP IN - MAN lt on	
65				CABIN TEMP - AUTO lt on	
66				FLT QUAL RCDR - STOP lt on	



Station 3 Prelaunch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				PH HI ind - gray	
2				F/C RAD TEMP LOW ind - gray	
3				FUEL CELL FLOW H_2 - TBD	
4				FUEL CELL FLOW O_2 - TBD	
5				FUEL CELL MODULE TEMP SKIN - TBD	
6				FUEL CELL MODULE TEMP COND EXH - TBD	
7				REG OUT PRESS HI-O_2 ind - gray	
8				REG OUT PRESS HI-H_2 ind - gray	
9				REG OUT PRESS HI-N_2 ind - gray	
10				FUEL CELL INDICATOR - 1 lt on	
11				BATTERY CHARGER - OFF lt on	
12				MAIN BUS A - RESET - ON lt on	

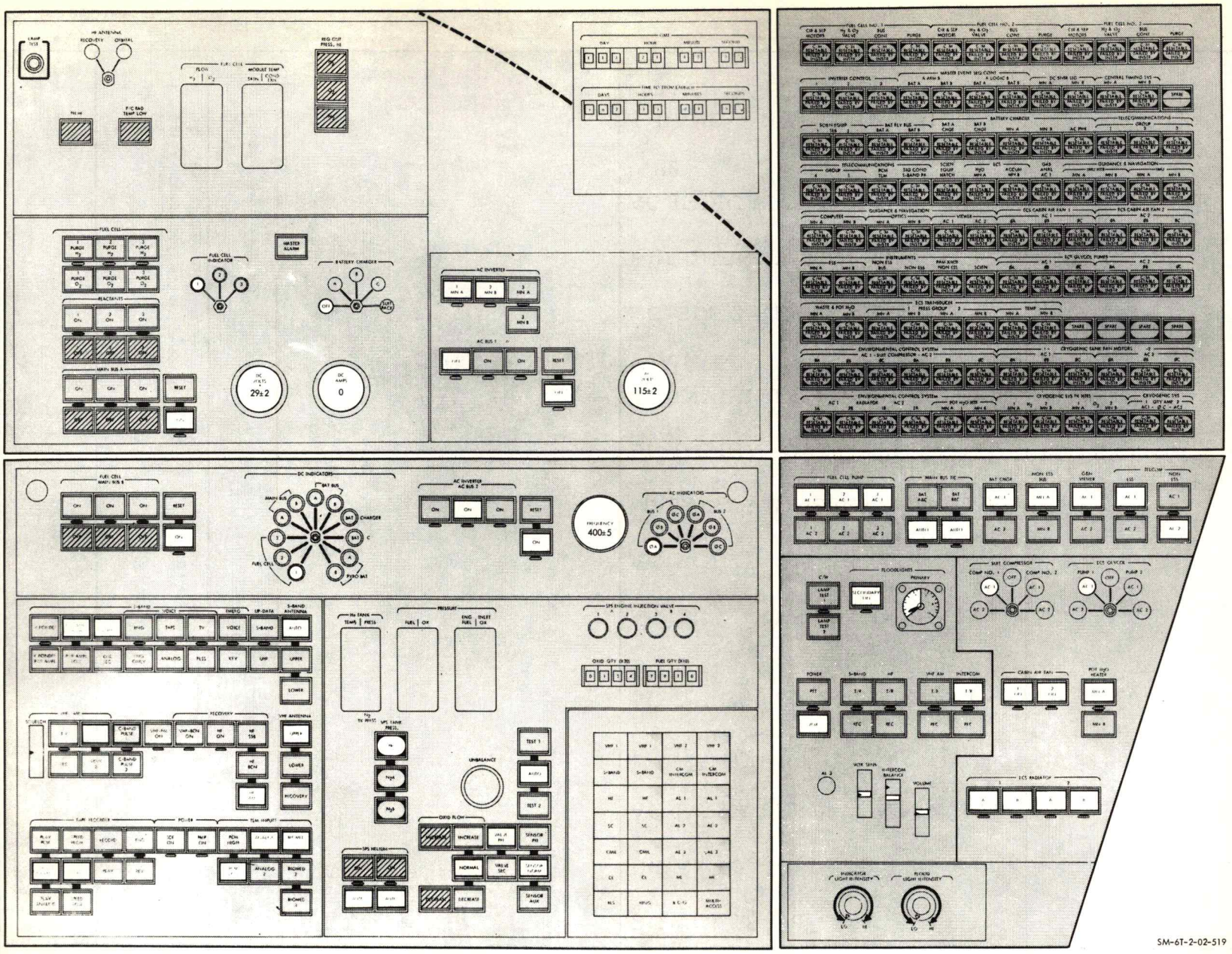


Station 3 Prelaunch

S1

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				DC VOLTS ind - 29±2	
14				DC AMPS - 0	
15				AC INVERTERS - 1 MN A lt on	
16				AC INVERTERS - 2 MN A lt on	
17				AC INVERTER 1 - AC BUS 1 - ON lt on	
18				AC BUS 1 RESET - ON lt on	
19				AC VOLTS - 115±2	
20				MAIN BUS B RESET - ON lt on	
21				DC INDICATORS - 1 lt on	
22				AC INVERTER 2 - AC BUS 2 - ON lt on	
23				AC BUS 2 RESET - ON lt on	
24				FREQUENCY ind - 400±5	
25				AC INDICATORS BUS 1 - ØA lt on	
26				S-BAND - PWR AMPL HIGH lt on	

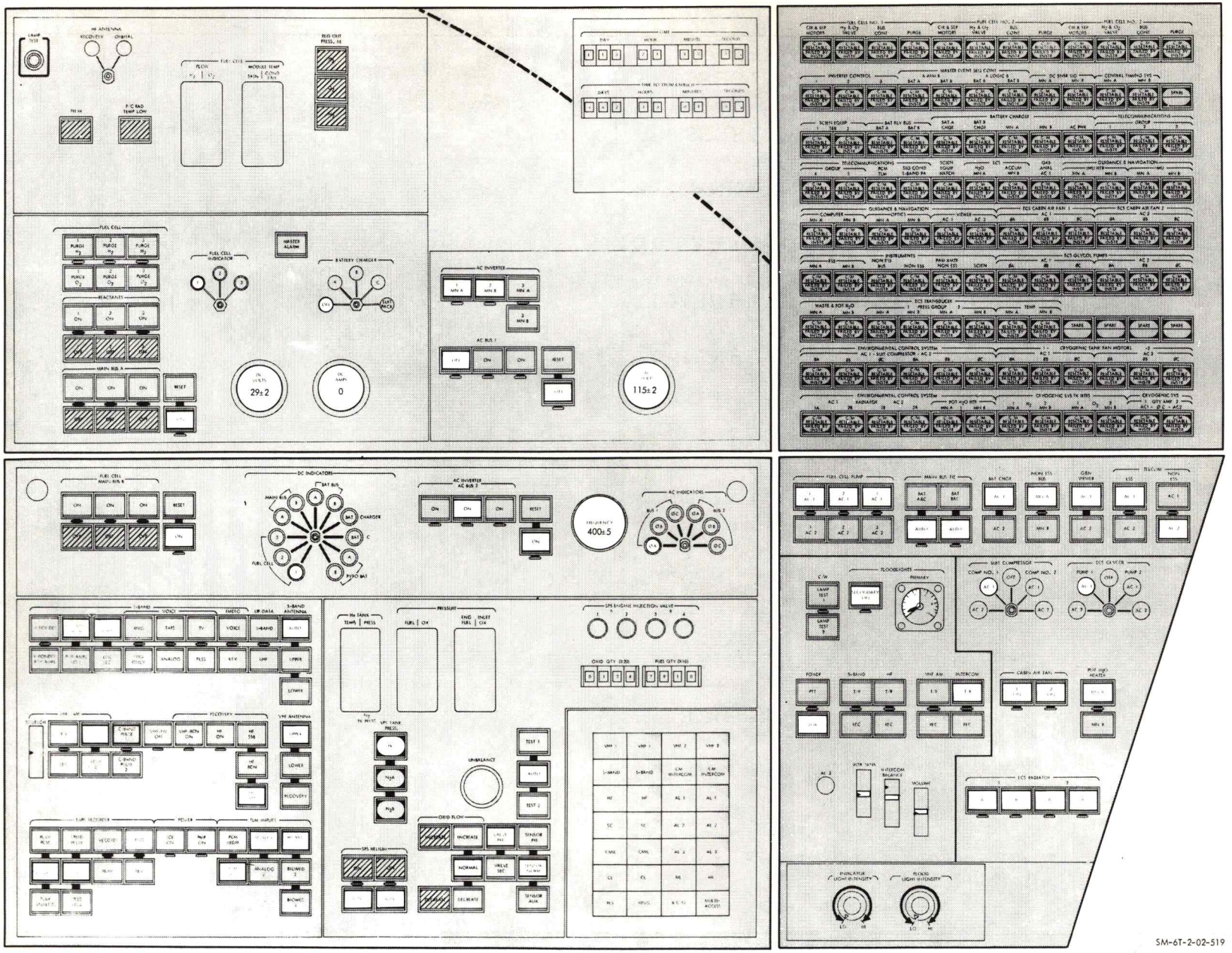


Station 3 Prelaunch

S1

Initialization Data Sheet

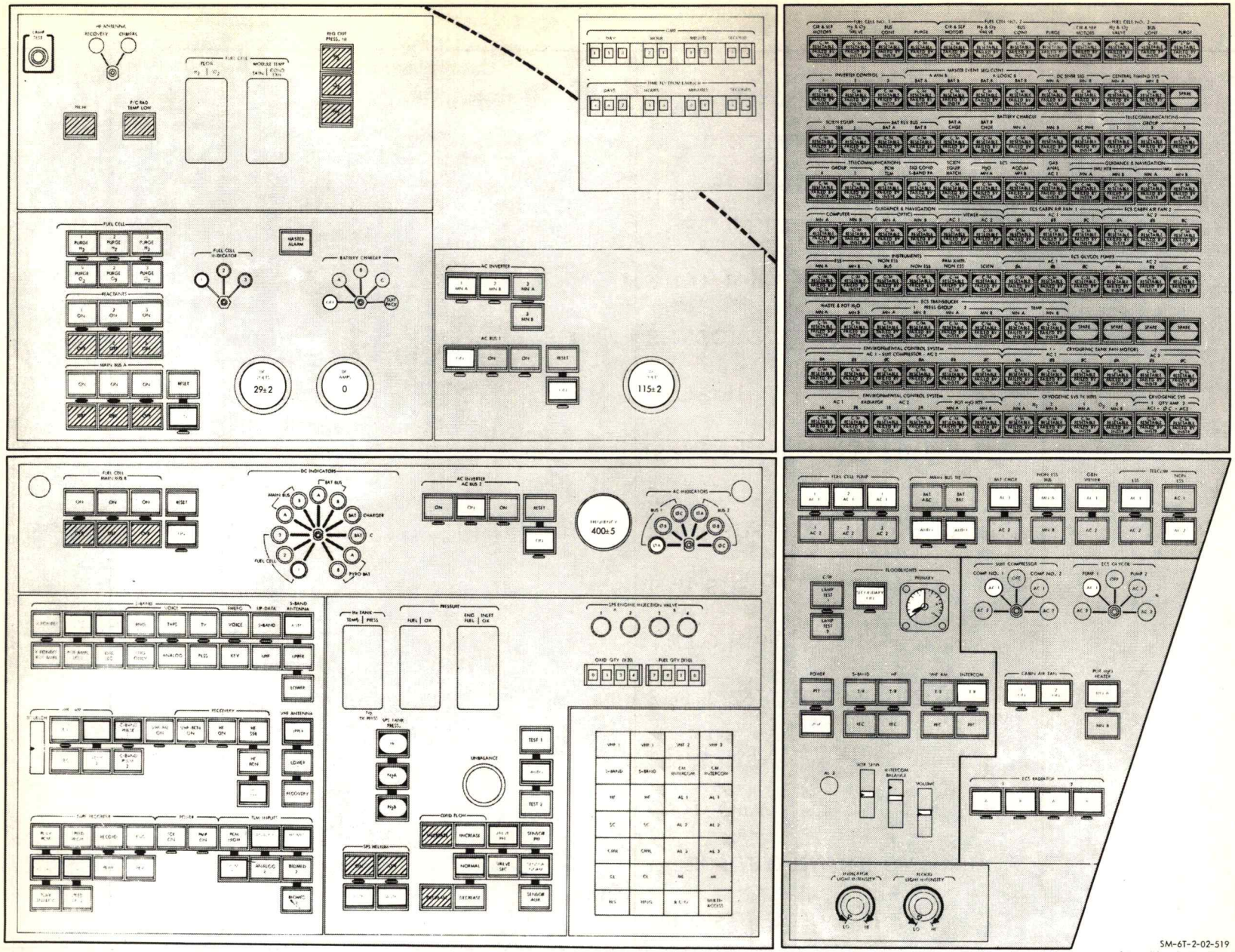
Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				S-BAND - OSC PRIM lt on	
28				S-BAND ANTENNA - AUTO lt on	
29				VHF AM - RCVR 1 lt on	
30				RECOVERY - HF AM lt on	
31				VHF ANTENNA - UPPER lt on	
32				TAPE RECORDER - PLAY NORMAL lt on	
33				TAPE RECORDER - SPEED NORMAL lt on	
34				TLM INPUTS - PCM LOW lt on	
35				TLM INPUTS - ANALOG 1 lt on	
36				TLM INPUTS - BIOMED 1 lt on	
37				He TANK PRESS - TBD	
38				He TANK TEMP - TBD	
39				PRESSURE FUEL - TBD	
40				PRESSURE OX - TBD	



Station 3 Prelaunch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
41				PRESSURE ENG FUEL - TBD	
42				PRESSURE INLET OX - TBD	
43				OXID QTY - TBD	
44				FUEL QTY - TBD	
45				SPS TANK PRESS - He lt on	
46				AUTO lt on	
47				Left SPS HELIUM - AUTO lt on	
48				Right SPS HELIUM - AUTO lt on	
49				OXID FLOW - NORM lt on	
50				AUTO lt on	
51				SENSOR NORM lt on	
52				All C/B lt out	
53				FUEL CELL PUMP - 1 AC 1 lt on	
54				FUEL CELL PUMP - 2 AC 1 lt on	

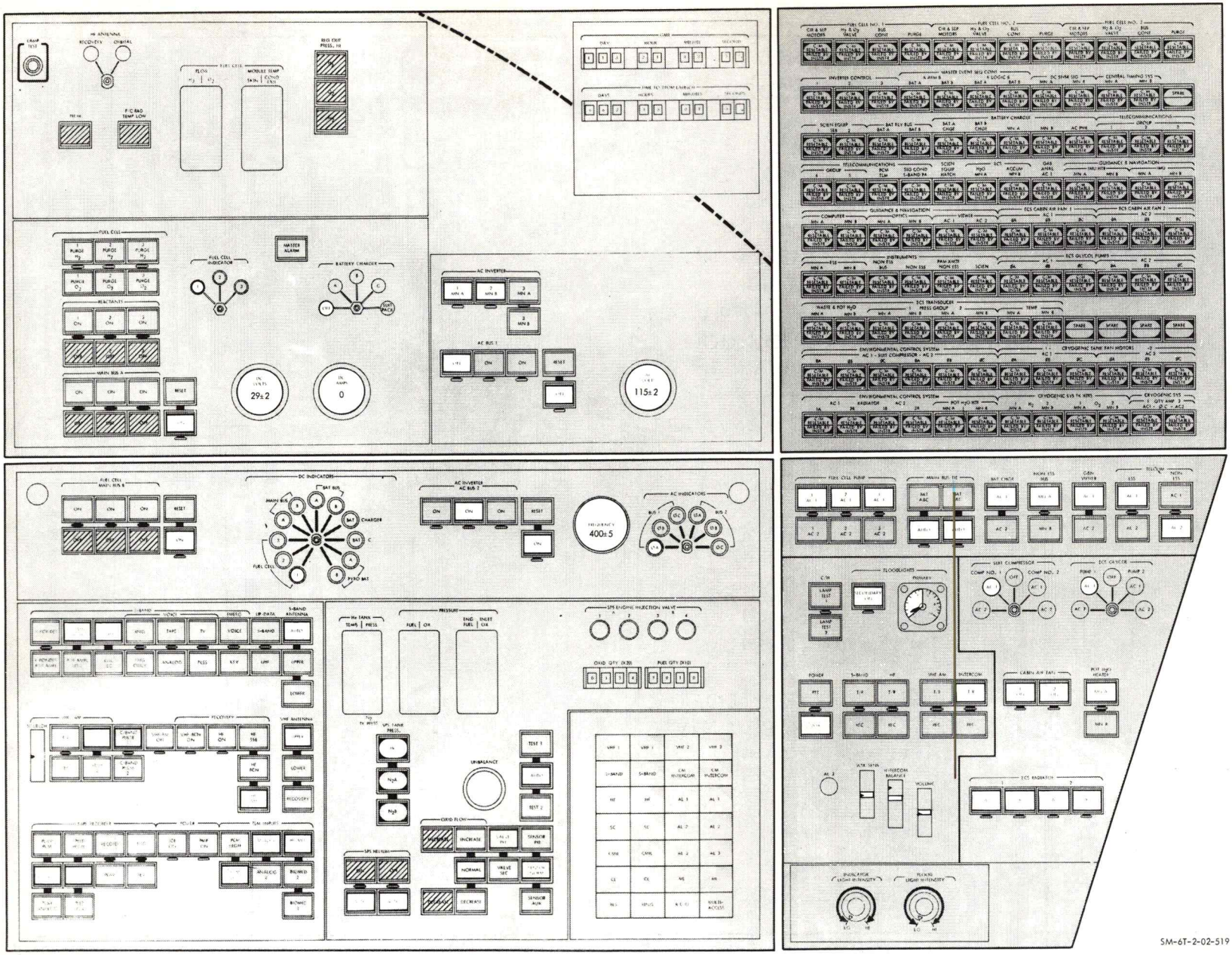


Station 3 Prelaunch

S1

Initialization Data Sheet

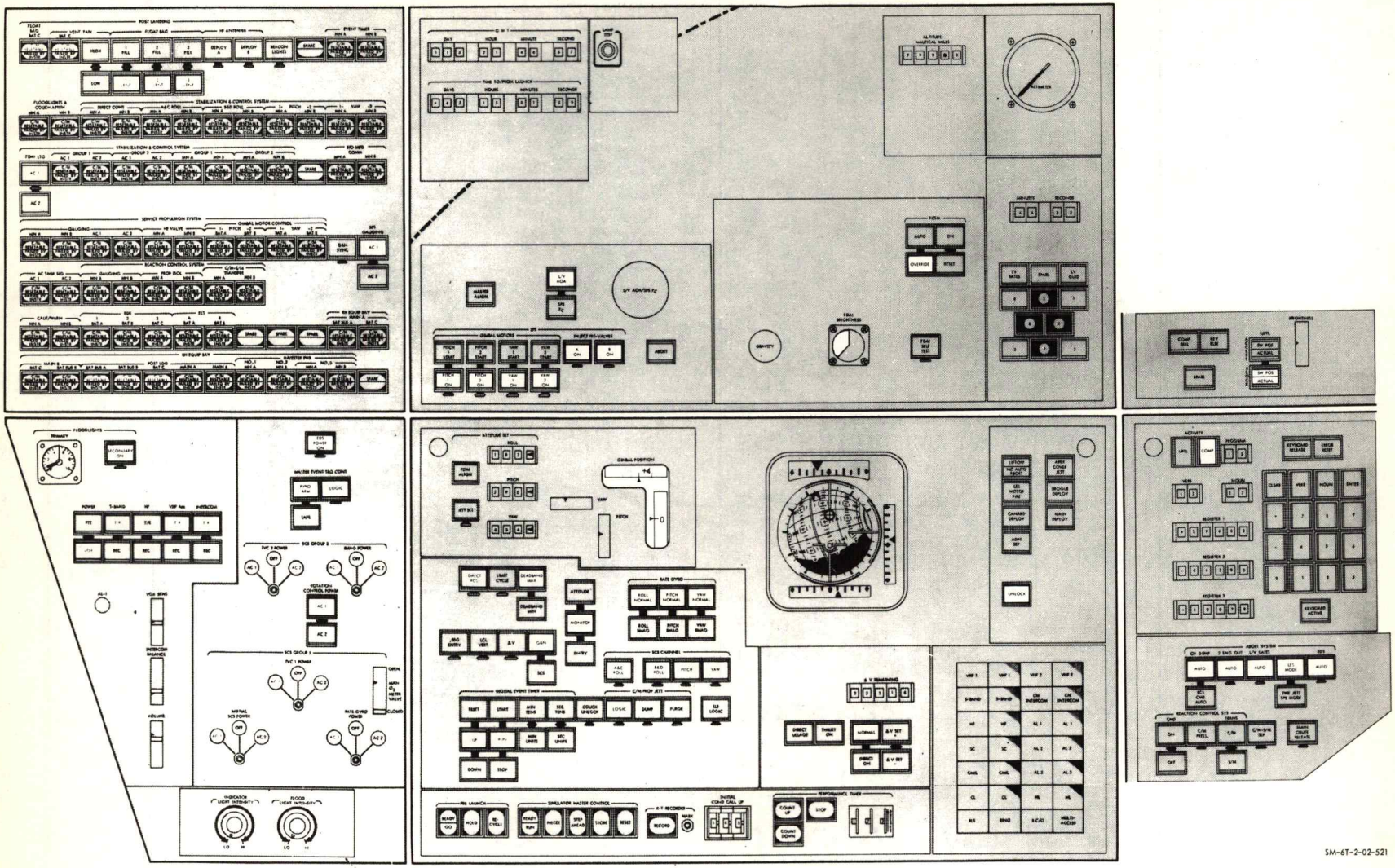
Step	Malf	Time	Function	IOS Visibility/Action	Notes
55				FUEL CELL PUMP - 3 AC 1 lt on	
56				MAIN BUS TIE BAT A&C - AUTO lt on	
57				MAIN BUS TIE BAT B&C - AUTO lt on	
58				BAT CHGR - AC 1 lt on	
59				NON ESS BUS - MN A lt on	
60				G&N VIEWER - AC 1 lt on	
61				TELCOM ESS - AC 1 lt on	
62				TELCOM NON ESS - AC 2 lt on	
63				FLOODLIGHTS - SECONDARY ON lt on	
64				FLOODLIGHTS PRIMARY - as required	
65				SUIT COMPRESSOR COMP No. 1 - AC 1 lt on	
66				ECS GLYCOL PUMP 1 - AC 1 lt on	



Station 3 Prelaunch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
67				POWER - VOX lt on	
68				INTERCOM - T/R lt on	
69				CABIN AIR FAN - 1 ON lt on	
70				CABIN AIR FAN - 2 ON lt on	
71				POT H_2O HEATER - MN A lt on	
72				ECS RADIATOR 1 - A lt on	
73				ECS RADIATOR 1 - B lt on	
74				ECS RADIATOR 2 - A lt on	
75				ECS RADIATOR 2 - B lt on	



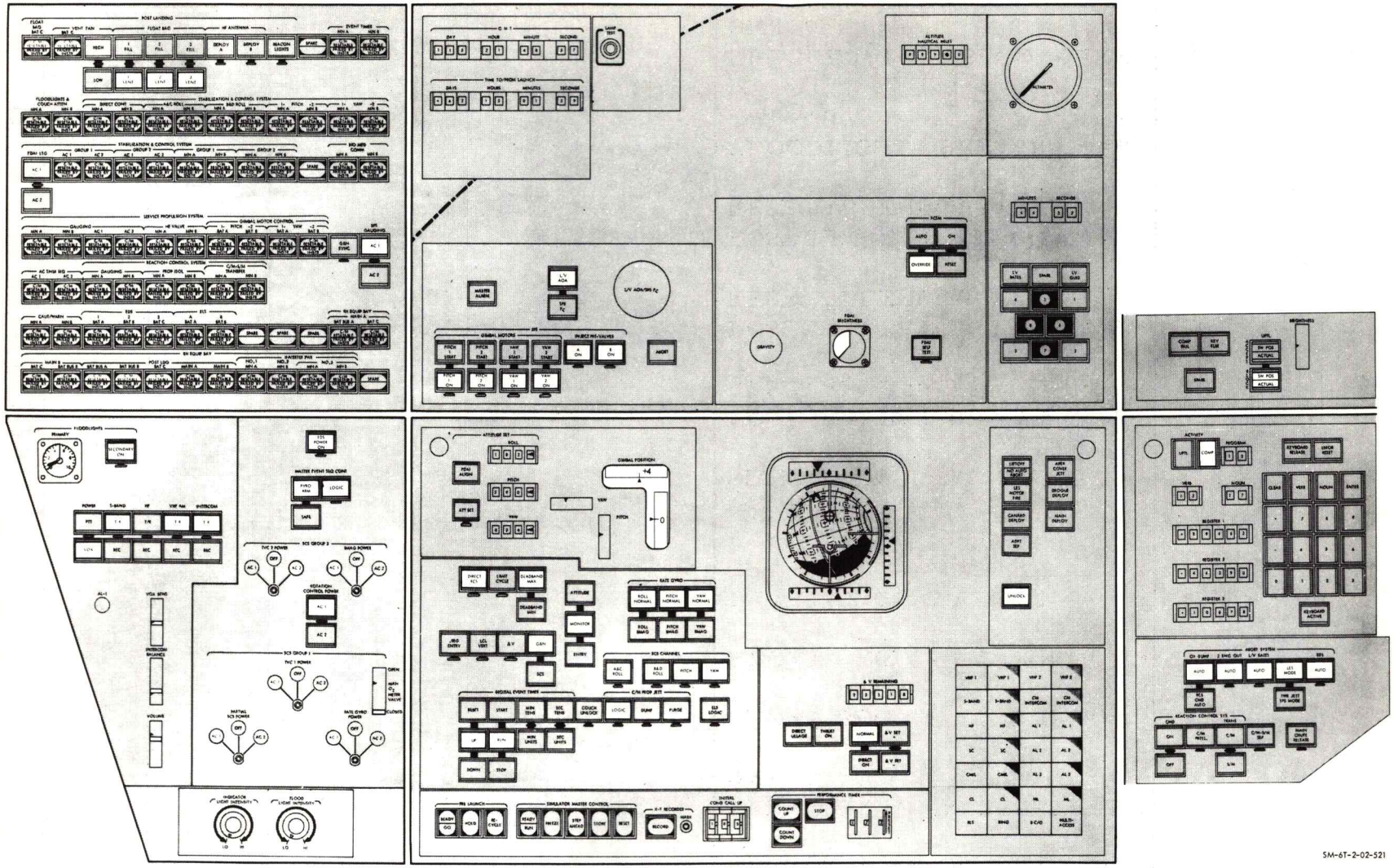
SM-6T-2-02-521

Station 1 Launch

S2

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				FLOAT BAG BAC C - C/M RESETABLE lt on	
2				VENT FAN - C/M RESETABLE lt on	
3				FLOAT BAG - 1 VENT lt on	
4				FLOAT BAG - 2 VENT lt on	
5				FLOAT BAG - 3 VENT lt on	
6				FDAI LTG - AC 1 lt on	
7				SPS GAUGING - AC 1 lt on	
8				POST LDG BAT BUS A - C/M RESETABLE lt on	
9				POST LDG BAT BUS B - C/M RESETABLE lt on	
10				POST LDG BAT BUS C - C/M RESETABLE lt on	
11				FLOODLIGHTS PRIMARY - as required	
12				FLOODLIGHTS - SECONDARY ON lt on	

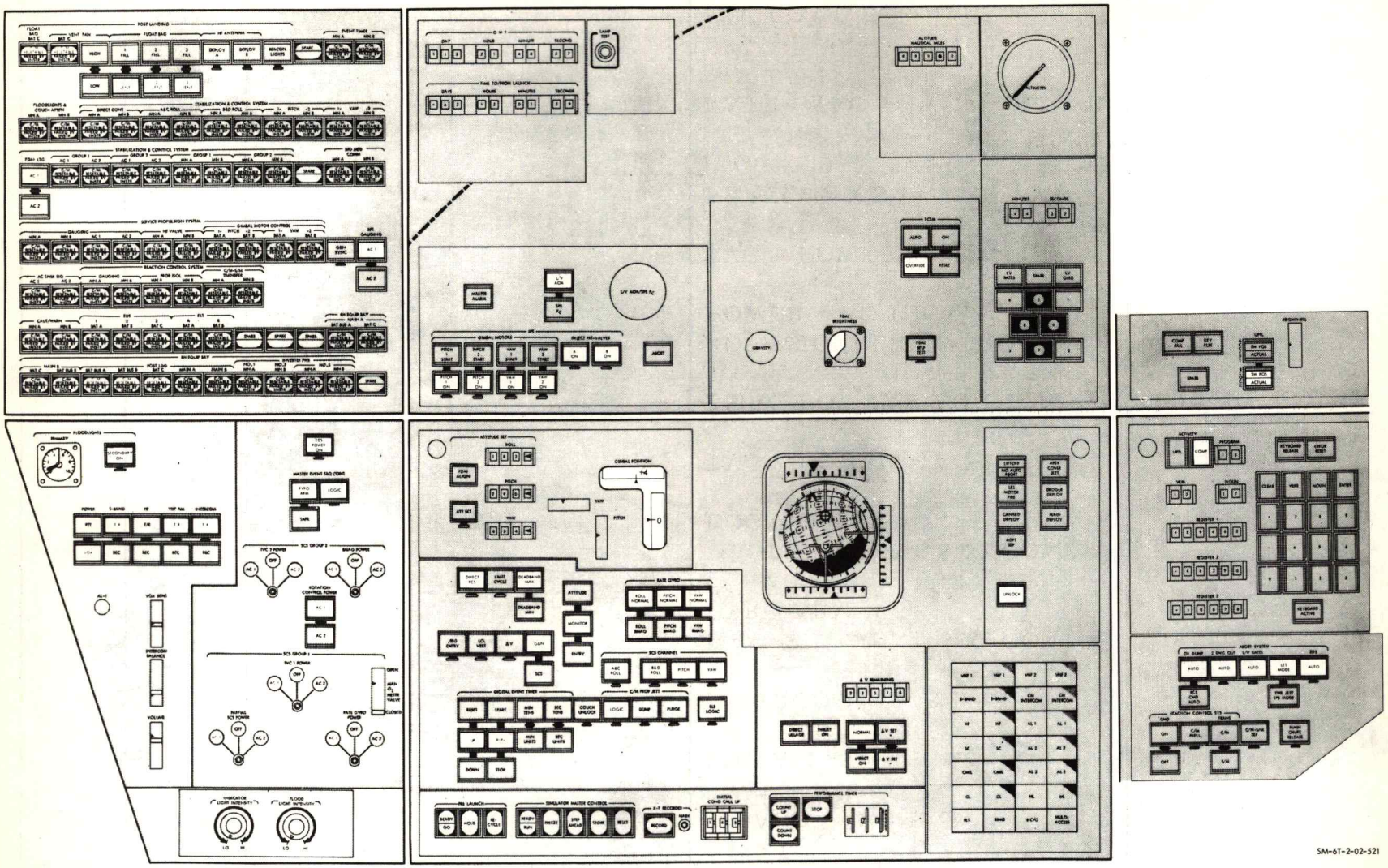


SM-6T-2-02-521

Station 1 Launch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				POWER - VOX lt on	
14				S-BAND - T/R lt on	
15				VHF AM - T/R lt on	
16				INTERCOM - T/R lt on	
17				MASTER EVENT SEQ CONT - PYRO ARM lt on	
18				MASTER EVENT SEQ CONT - LOGIC lt on	
19				TVC 2 POWER - AC 2 lt on	
20				BMAG POWER - AC 1 lt on	
21				ROTATIONAL CONTROL POWER - AC 1 lt on	
22				TVC 1 POWER - AC 1 lt on	
23				PARTIAL SCS POWER - AC 1 lt on	
24				RATE GYRO POWER - AC 1 lt on	
25				L/V AOA lt on	



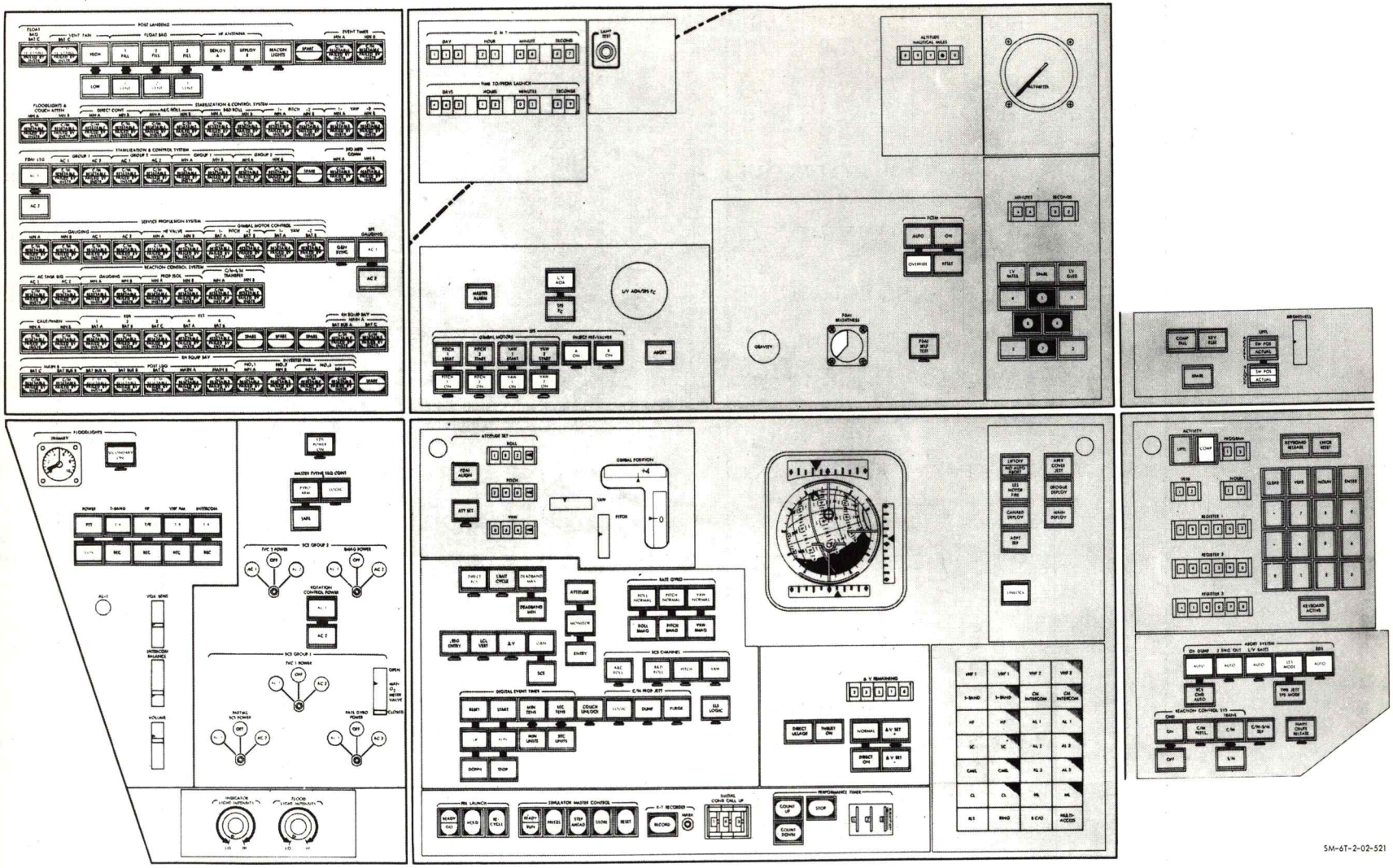
SM-6T-2-02-521

Station 1 Launch

S2

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
26				FCSM - OVERRIDE lt on	
27				GIMBAL MOTORS - PITCH 1 ON lt on	
28				GIMBAL MOTORS - PITCH 2 ON lt on	
29				GIMBAL MOTORS - YAW 1 ON lt on	
30				GIMBAL MOTORS - YAW 2 ON lt on	
31				INJECT PRE-VALVES - A ON lt on	
32				INJECT PRE-VALVES - B ON lt on	
33				DIRECT RCS lt on	
34				DEADBAND MAX lt on	
35				MONITOR lt on	
36				RATE GYRO - ROLL NORMAL lt on	
37				RATE GYRO - PITCH NORMAL lt on	



SM-6T-2-02-521

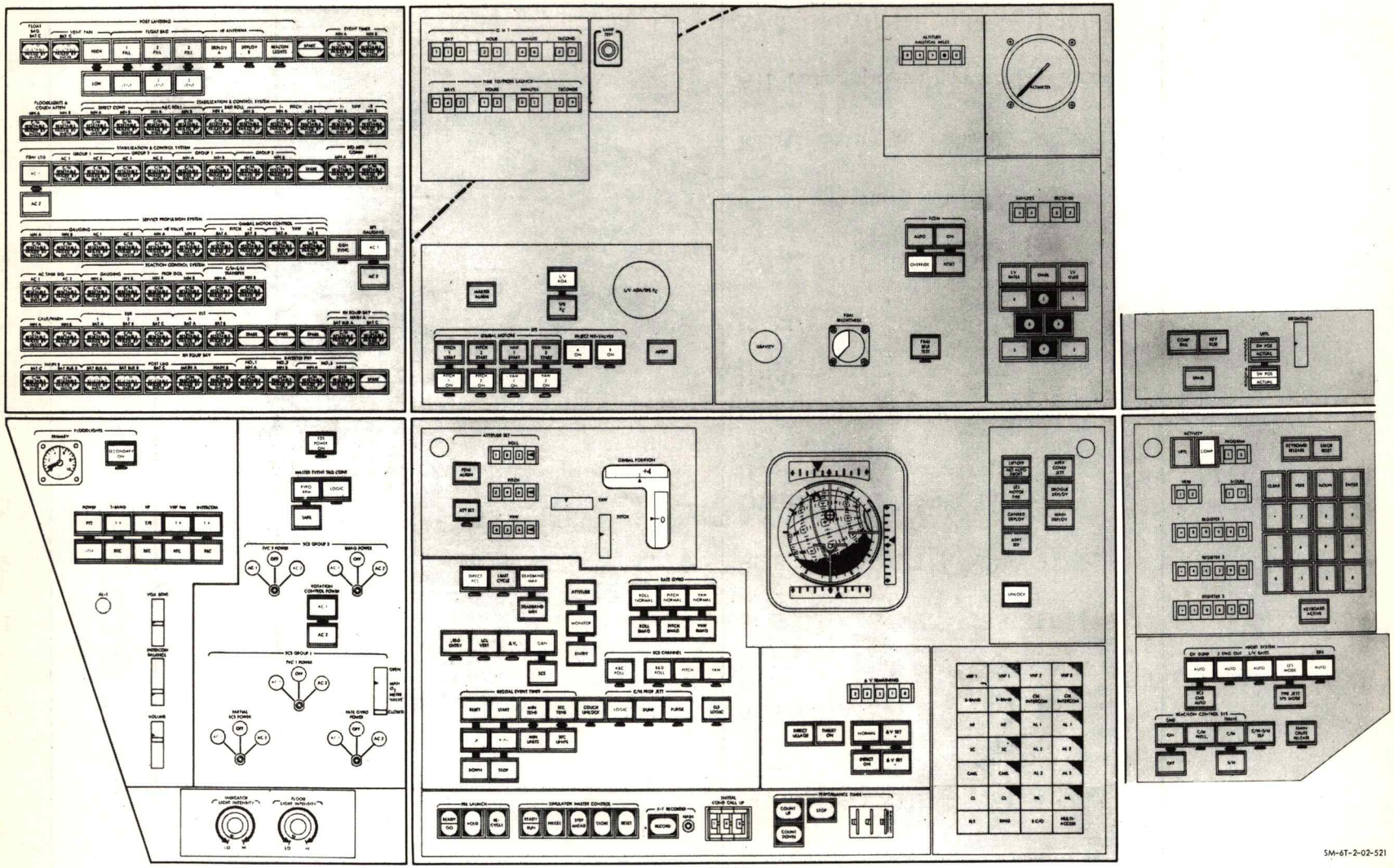
Station 1 Launch

S2

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
38				RATE GYRO - YAW NORMAL lt on	
39				SCS CHANNEL - A&C ROLL lt on	
40				SCS CHANNEL - B&D ROLL lt on	
41				SCS CHANNEL - PITCH lt on	
42				SCS CHANNEL - YAW lt on	
43				DIGITAL EVENT TIMER - UP lt on	
44				DIGITAL EVENT TIMER - RUN lt on	
45				C/M PROP JETT - LOCK lt on	
46				FDAI attitude ball 59.5° pitch	
47				FDAI attitude ball 8.7° yaw	
48				FDAI roll bug 163.5°	
49				All rate and error ind - zero	
50				ΔV REMAINING ind - 10000	

Station 1 Launch



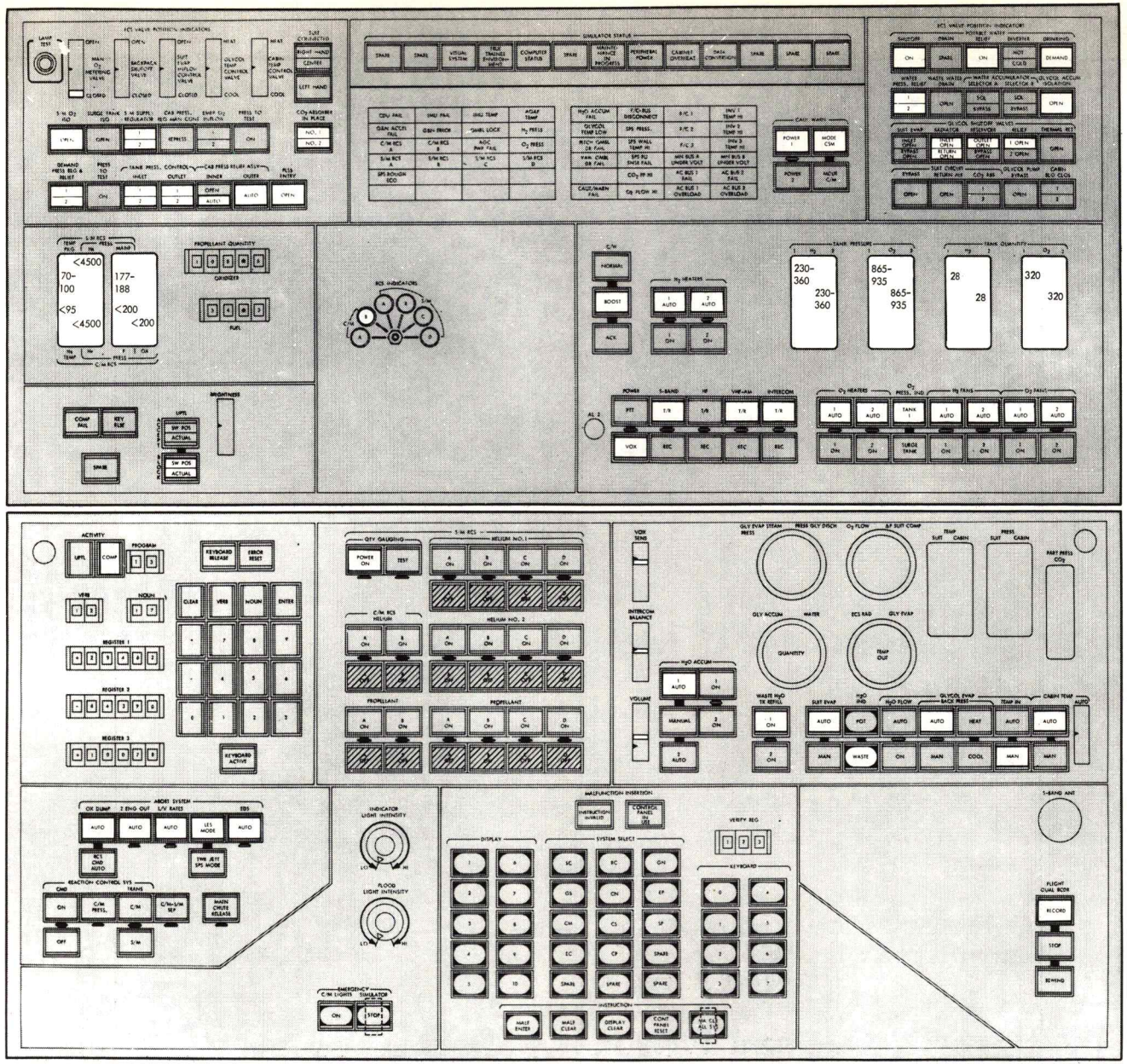
5M-6T-2-02-521

Station 1 Launch

S2

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
51				NORMAL lt on	
52				UNLOCK lt on	

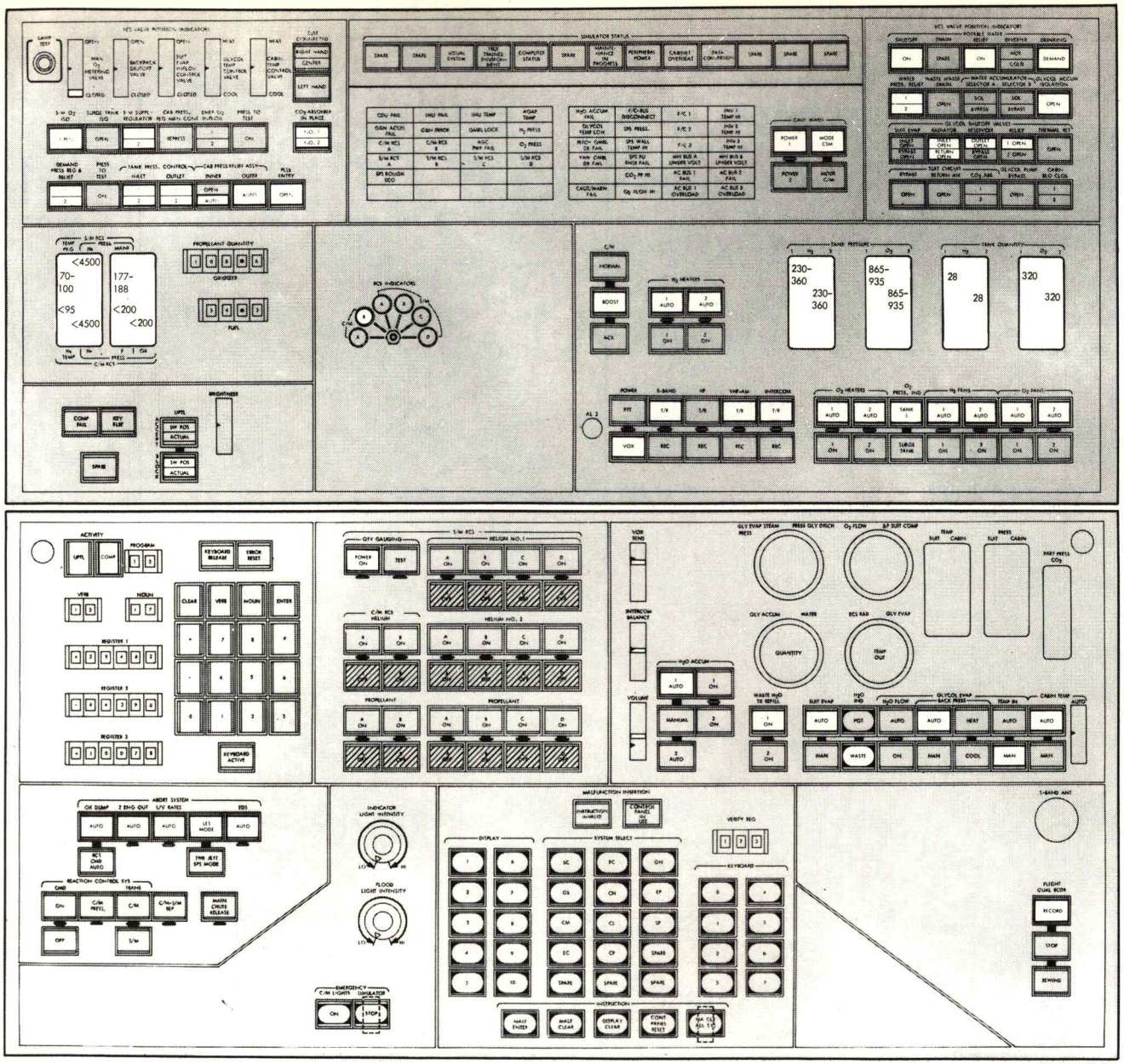


SM-6T-2-02-522

Station 2 Launch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				MAN O_2 METERING VALVE - CLOSED	
2				S/M O_2 ISO - OPEN lt on	
3				S/M SUPPLY REGULATOR - 1 and 2 lt on	
4				CO_2 ABSORBER IN PLACE - No. 1 and No. 2 lt on	
5				C/M RCS He TEMP - 95	
6				C/M RCS PRESS He - 4500	
7				C/M RCS PRESS F - 200	
8				C/M RCS PRESS OX - 200	
9				PROPELLANT QUANTITY OXIDE - 131	
10				PROPELLANT QUANTITY FUEL - 65	
11				RCS INDICATORS C/M - B lt on	
12				UPTL BLOCK lt on	
13				S/M RCS QTY GAUGING - POWER ON lt on	

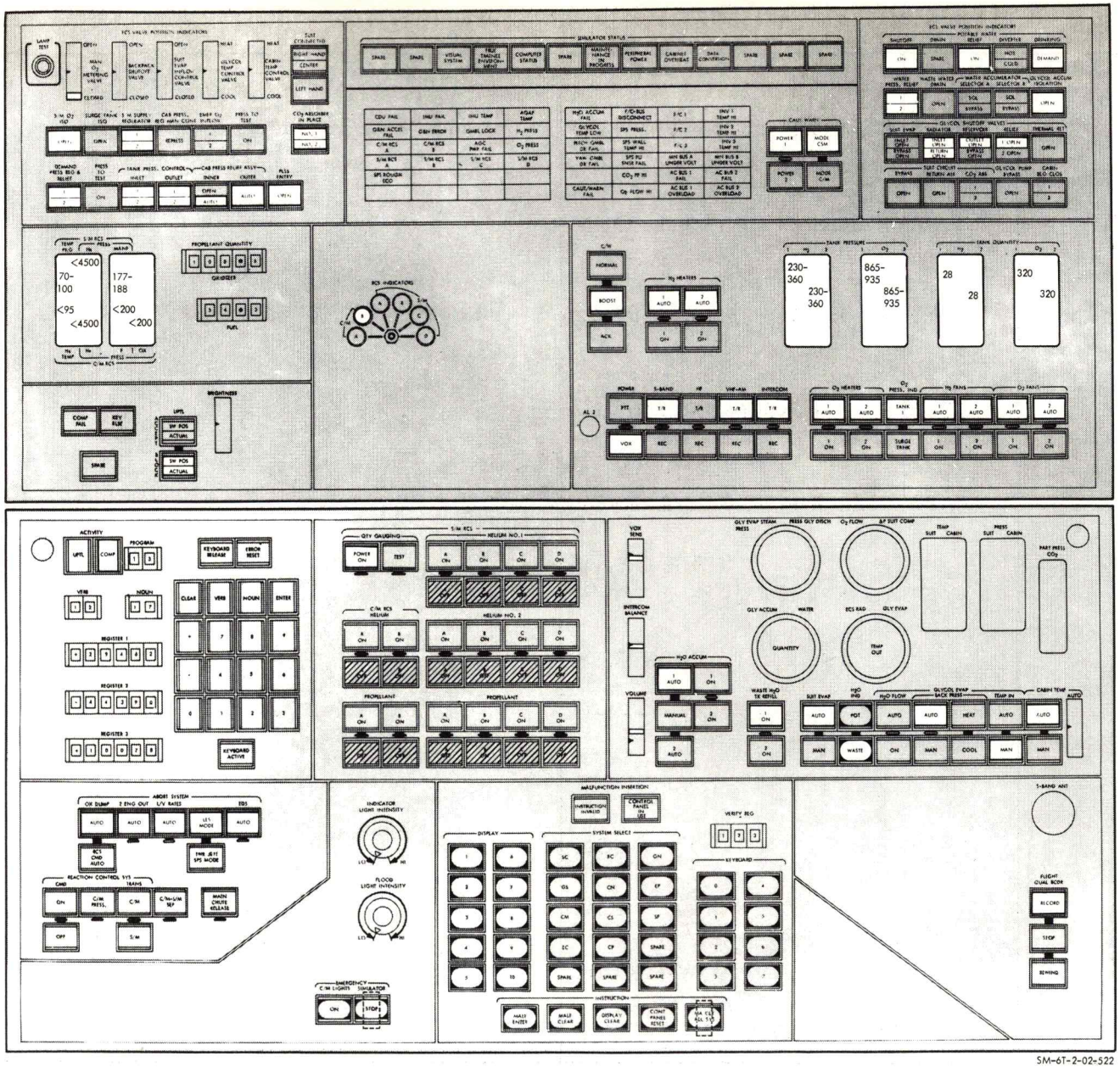


SM-6T-2-02-522

Station 2 Launch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14				ACTIVITY - COMP lt on	
15				PROGRAM - 02	
16				VERB - 37	
17				NOUN - 01	
18				REGISTER 1 - TBSL	
19				REGISTER 2 - TBSL	
20				REGISTER 3 - TBSL	
21				ABORT SYSTEM OX DUMP - AUTO lt on	
22				ABORT SYSTEM 2 ENG OUT - AUTO lt on	
23				ABORT SYSTEM L/V RATES - AUTO lt on	
24				ABORT SYSTEM - LES MODE lt on	
25				ABORT SYSTEM EDS - AUTO lt on	
26				CAUT/WARN - POWER 1 lt on	

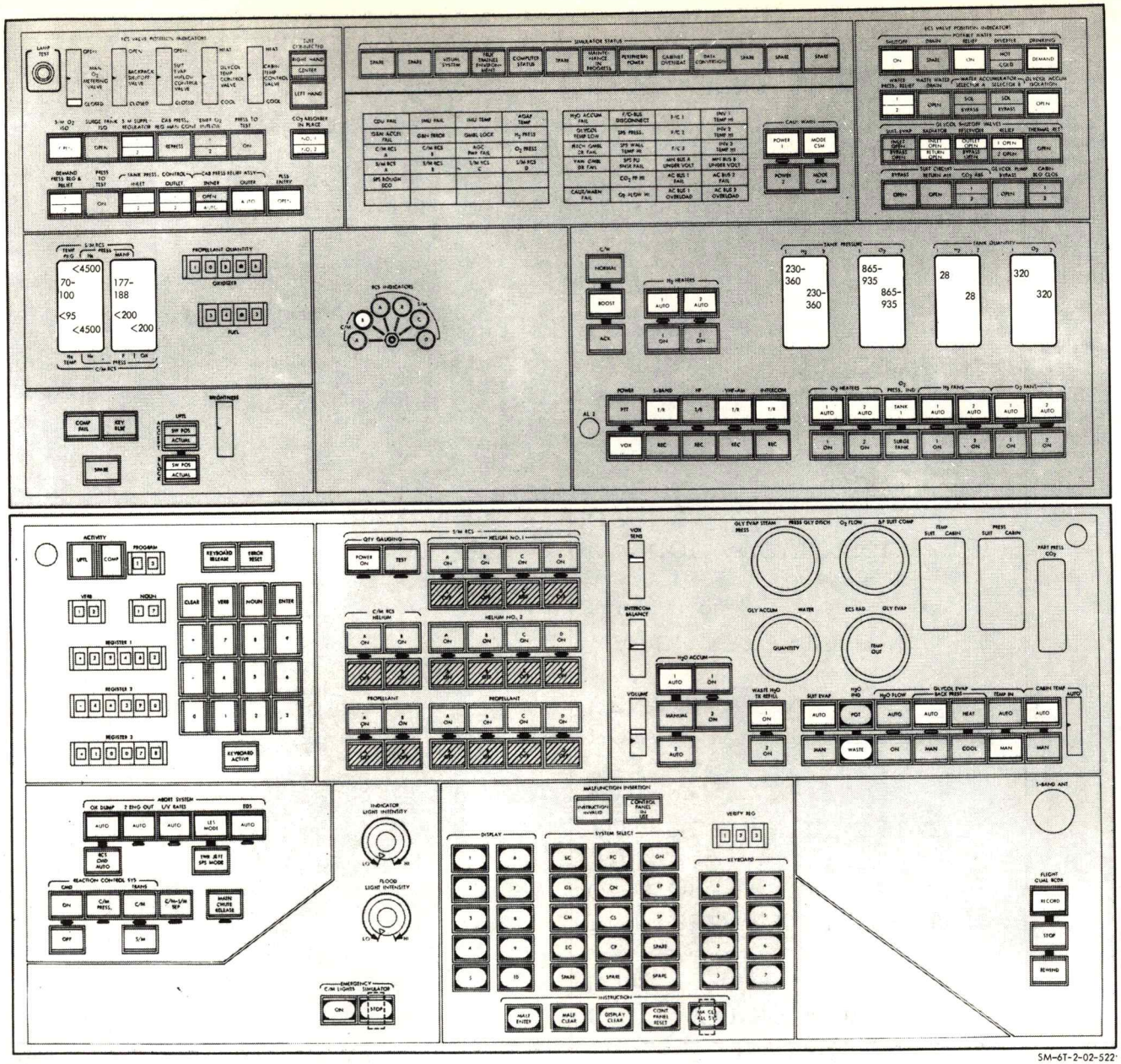


SM-6T-2-02-522

Station 2 Launch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				CAUT-WARN - MODE CSM lt on	
28				POTABLE WATER SHUTOFF - ON lt on	
29				POTABLE WATER RELIEF - ON lt on	
30				POTABLE WATER DRINKING - DEMAND lt on	
31				WATER PRESS RELIEF - 1 and 2 lt on	
32				GLYCOL ACCUM ISOLATION - OPEN lt on	
33				RADIATOR - INLET OPEN and RETURN OPEN lt on	
34				RESERVOIR - OUTLET OPEN lt on	
35				RELIEF - 1 OPEN lt on	
36				C/W - BOOST lt on	
37				H_2 HEATERS - 1 AUTO lt on	
38				H_2 HEATERS - 2 AUTO lt on	

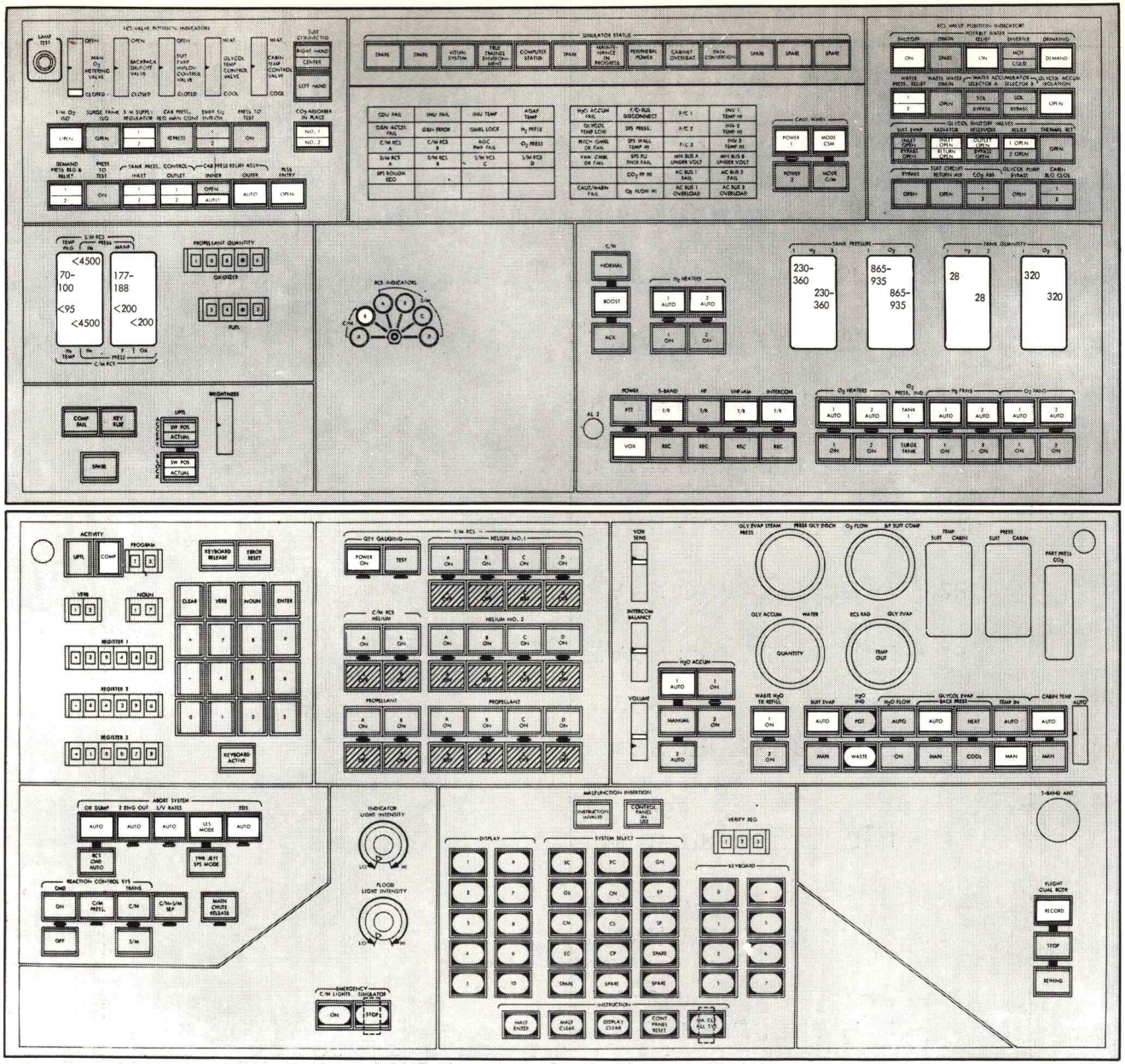


Station 2 Launch

S2

Initialiation Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
39				TANK PRESSURE H_2 1 - 230-260	
40				TANK PRESSURE H_2 2 - 230-260	
41				TANK PRESSURE O_2 1 - 865-935	
42				TANK PRESSURE O_2 2 - 865-935	
43				TANK QUANTITY H_2 1 - 28	
44				TANK QUANTITY H_2 2 - 28	
45				TANK QUANTITY O_2 1 - 320	
46				TANK QUANTITY O_2 2 - 320	
47				POWER - VOX lt on	
48				S-BAND - T/R lt on	
49				VHF AM - T/R lt on	
50				INTERCOM - T/R lt on	
51				O_2 HEATERS - 1 AUTO lt on	
52				O_2 HEATERS - 2 AUTO lt on	



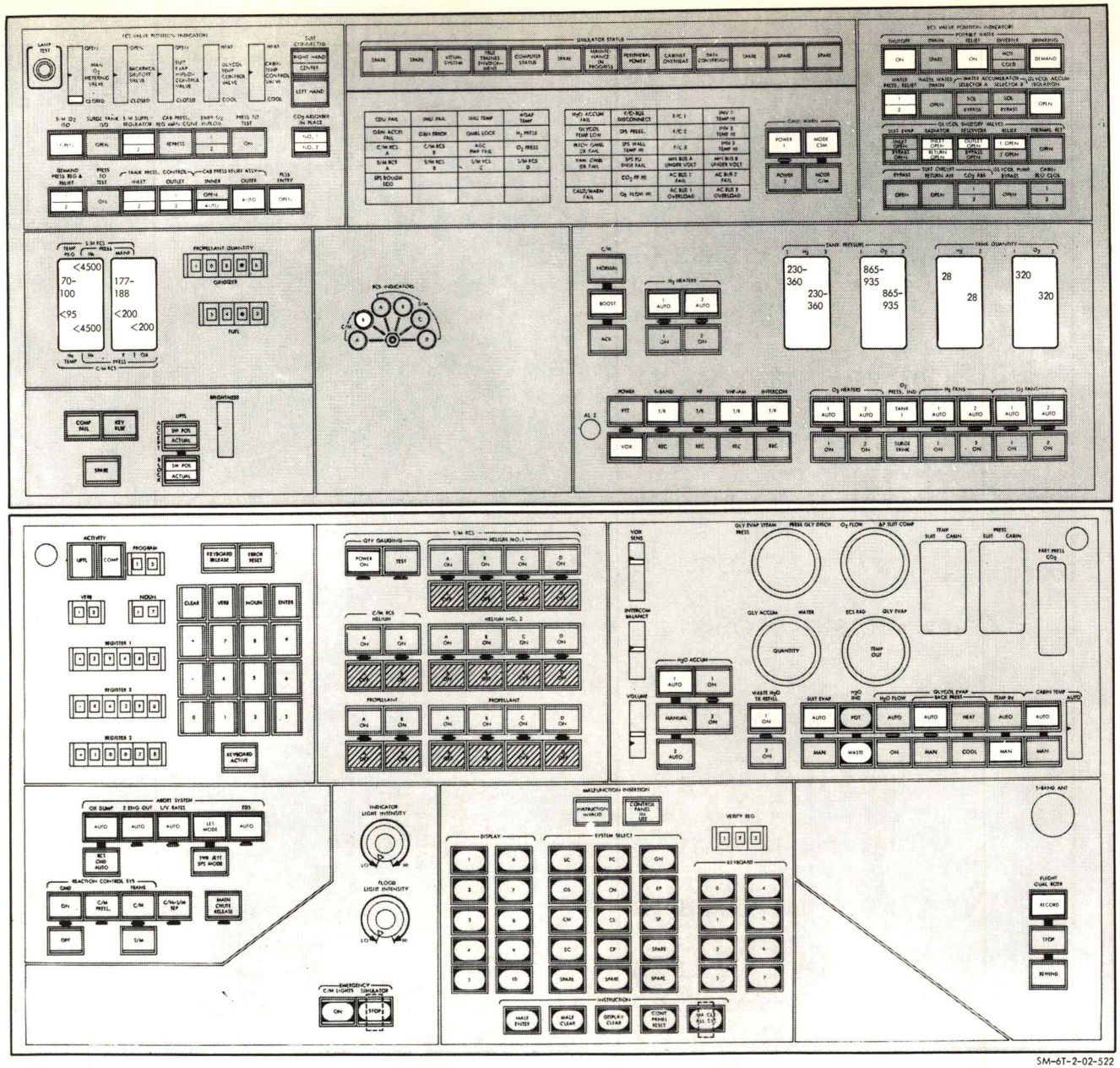
SM-6T-2-02-522

Station 2 Launch

S2

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
53				O_2 PRESS IND - TANK 1 lt on	
54				H_2 FAN - 1 AUTO lt on	
55				H_2 FAN - 2 AUTO lt on	
56				O_2 FAN - 1 AUTO lt on	
57				O_2 FAN - 2 AUTO lt on	
58				GLY EVAP STEAM PRESS - .25	
59				PRESS GLY DISCH - 40-50	
60				O_2 FLOW - .2-.45	
61				ΔP SUIT COMP - .56	
62				TEMP SUIT - 55-55	
63				TEMP CABIN - 50-70	
64				PRESS SUIT - 14.7	
65				PRESS CABIN - 14.7	
66				PART PRESS CO_2 - 7.6	
67				GLY ACCUM - 45-35	



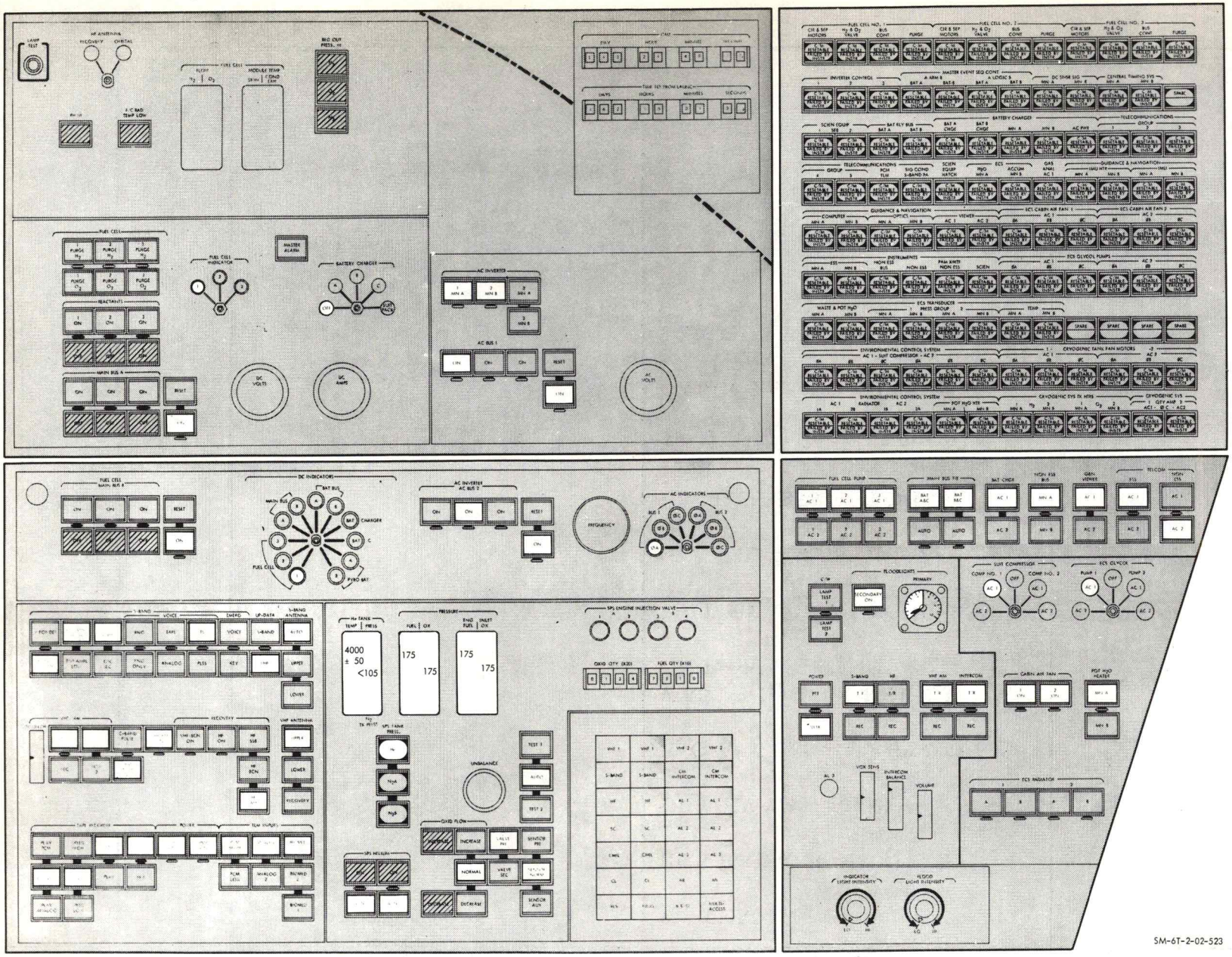
SM-6T-2-02-522

Station 2 Launch

S2

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
68				WATER - TBD	
69				RCS RAD - 30-48	
70				GLY EVAP - 40-50	
71				H_2O ACCUM - 1 AUTO lt on	
72				WASTE H_2O TK REFILL - 1 ON lt on	
73				SUIT EVAP - AUTO lt on	
74				H_2O IND - WASTE lt on	
75				BACK PRESS AUTO lt on	
76				TEMP IN - MAN lt on	
77				CABIN TEMP - AUTO lt on	
78				FLT QUAL RCDR - RECORD lt on	



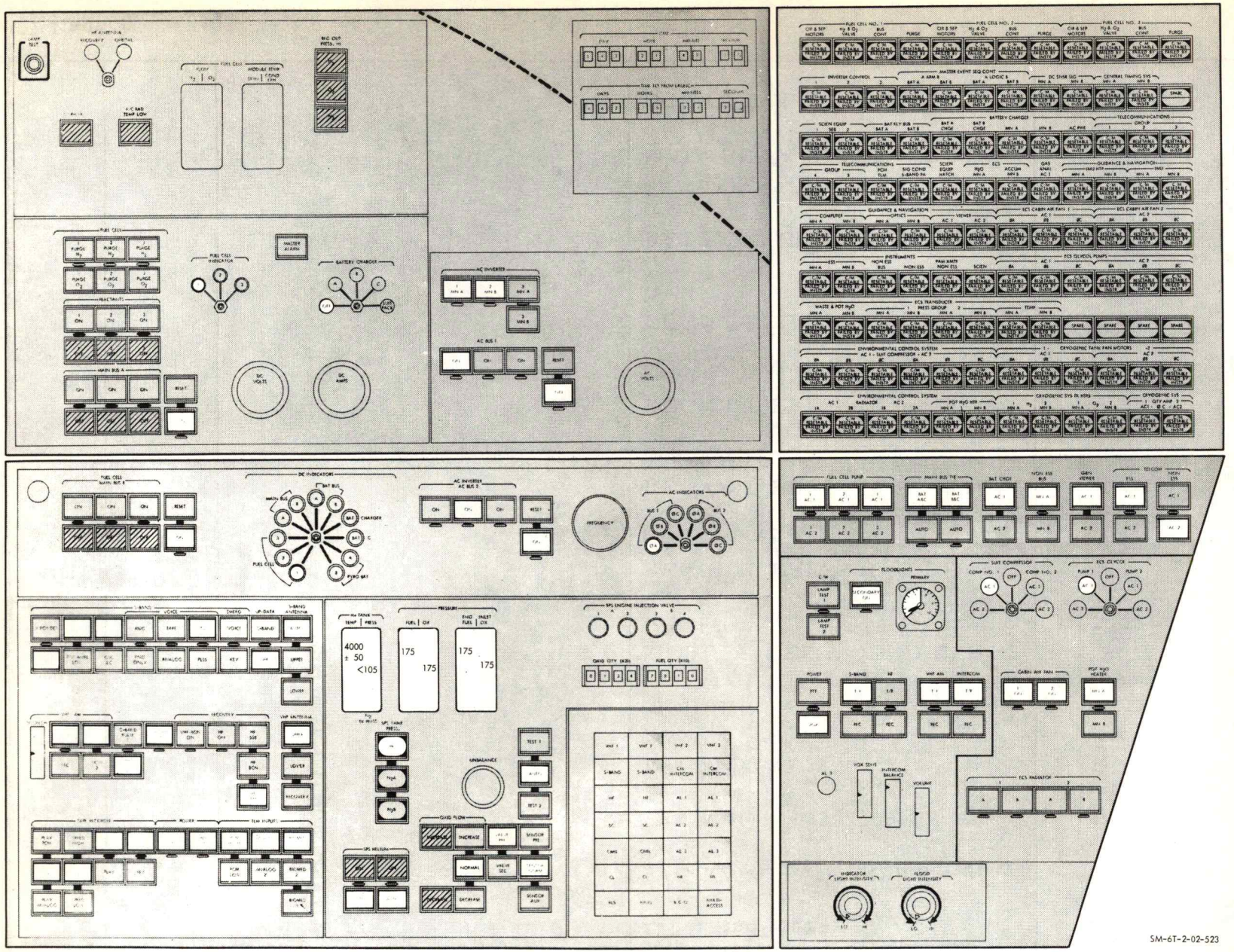
Station 3 Launch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				PH HI ind - gray	
2				F/C RAD TEMP LO ind - gray	
3				FLOW H_2 - .036-.09	
4				FLOW O_2 - .288-.72	
5				MODULE TEMP SKIN - 385-425	
6				MODULE TEMP COND EXH - 155-170	
7				REG OUT PRESS HI O_2 ind - gray	
8				REG OUT PRESS HI H_2 ind - gray	
9				REG OUT PRESS HI N_2 ind - gray	
10				FUEL CELL INDICATOR - 1 lt on	
11				BATTERY CHARGER - OFF lt on	
12				MAIN BUS A RESET - ON lt on	
13				DC VOLTS ind - 29±2	

Station 3 Launch

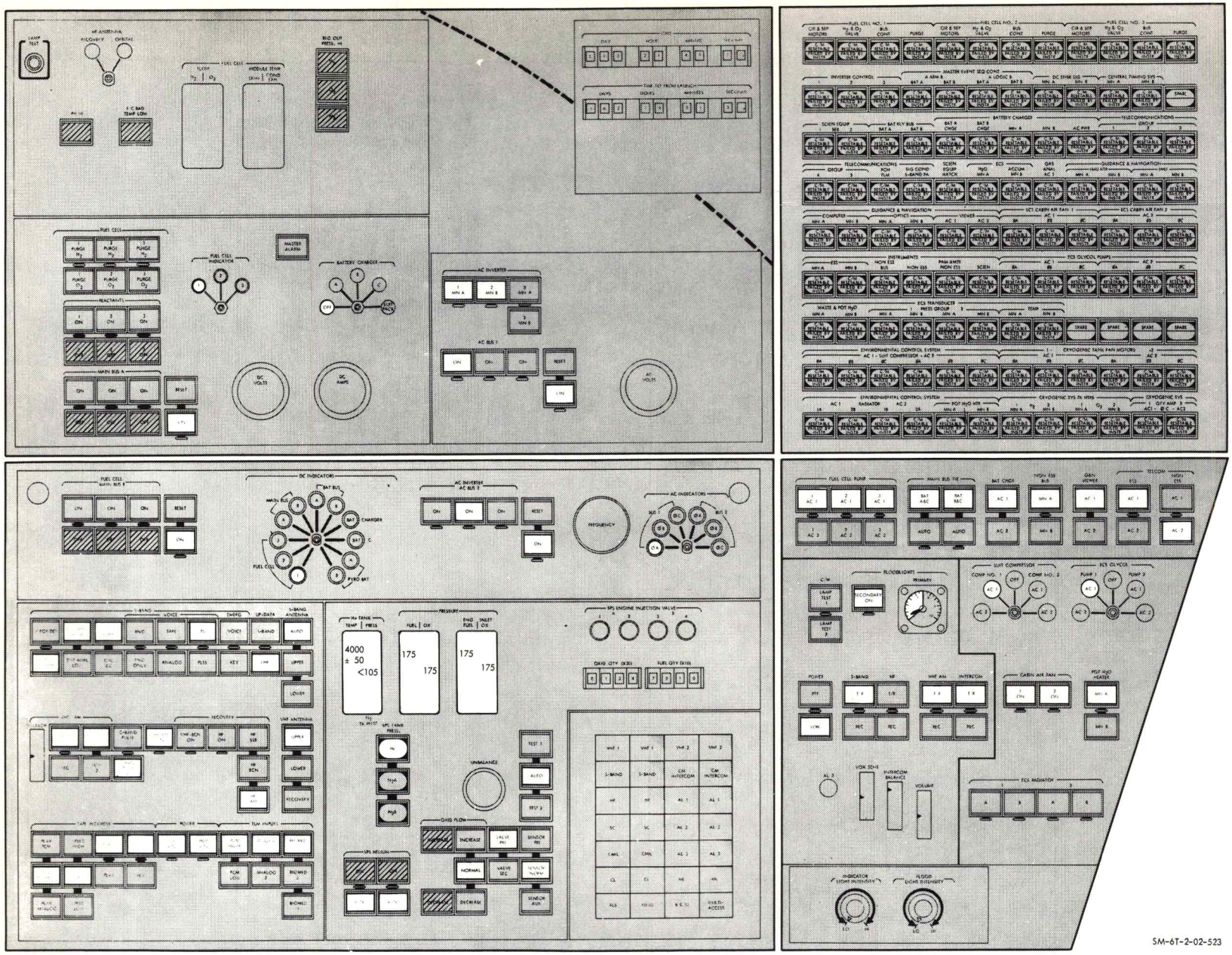
S2



Station 3 Launch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14				DC AMPS ind - 0	
15				AC INVERTER - 1 MN A lt on	
16				AC INVERTER - 2 MN A lt on	
17				AC INVERTER 1 - AC BUS 1 - ON lt on	
18				AC VOLTS ind 115±2	
19				MAIN BUS B RESET - ON lt on	
20				DC INDICATORS FUEL CELL - 1 lt on	
21				AC INVERTER 2 - AC BUS 2 - ON lt on	
22				FREQUENCY ind - 400±5	
23				AC INDICATORS BUS 1 - ØA lt on	
24				S-BAND - XPONDER PWR AMPL lt on	
25				S-BAND - PWR AMPL HIGH lt on	
26				S-BAND - OSC PRIM lt on	

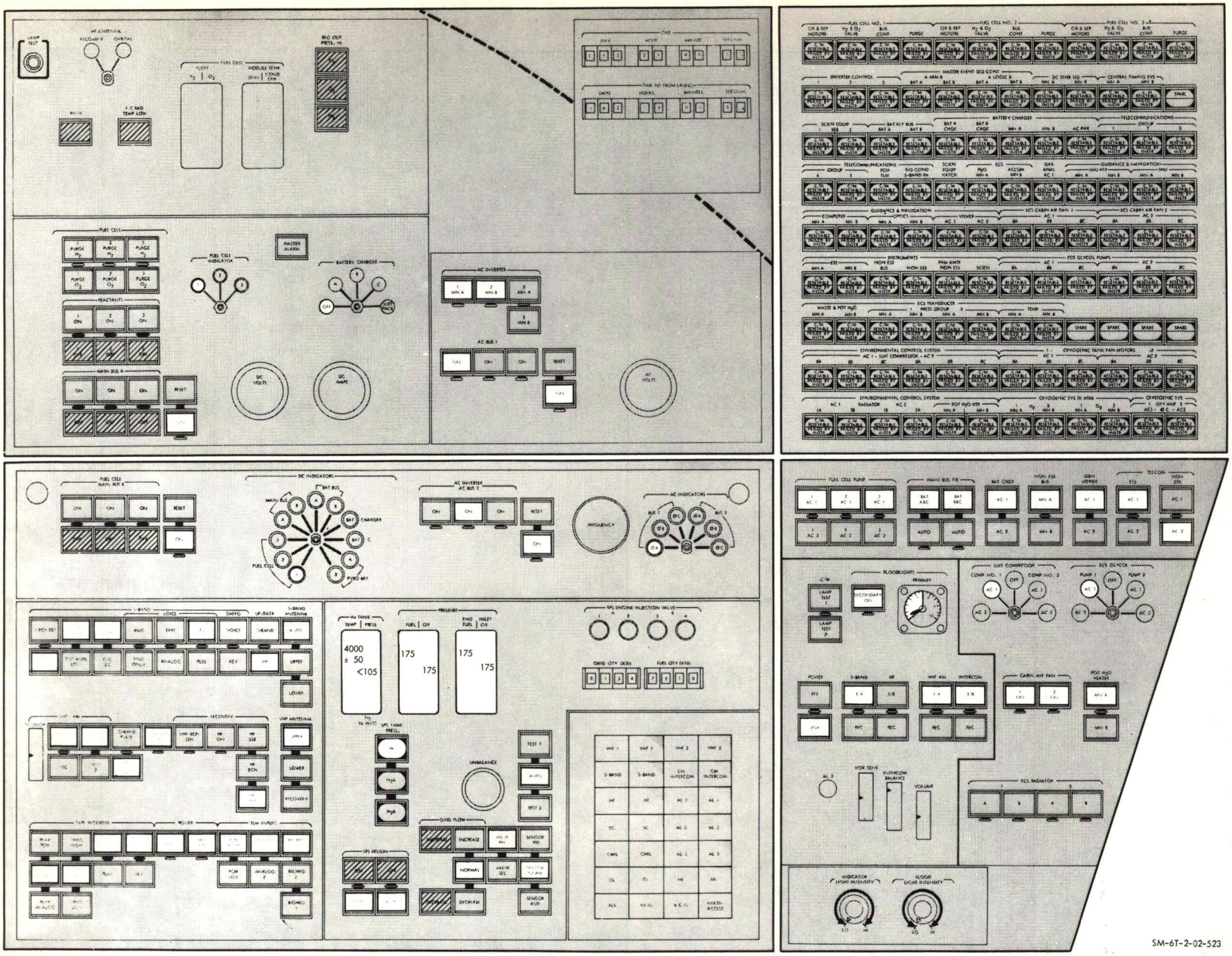


Station 3 Launch

S2

Initialization Data Sheet

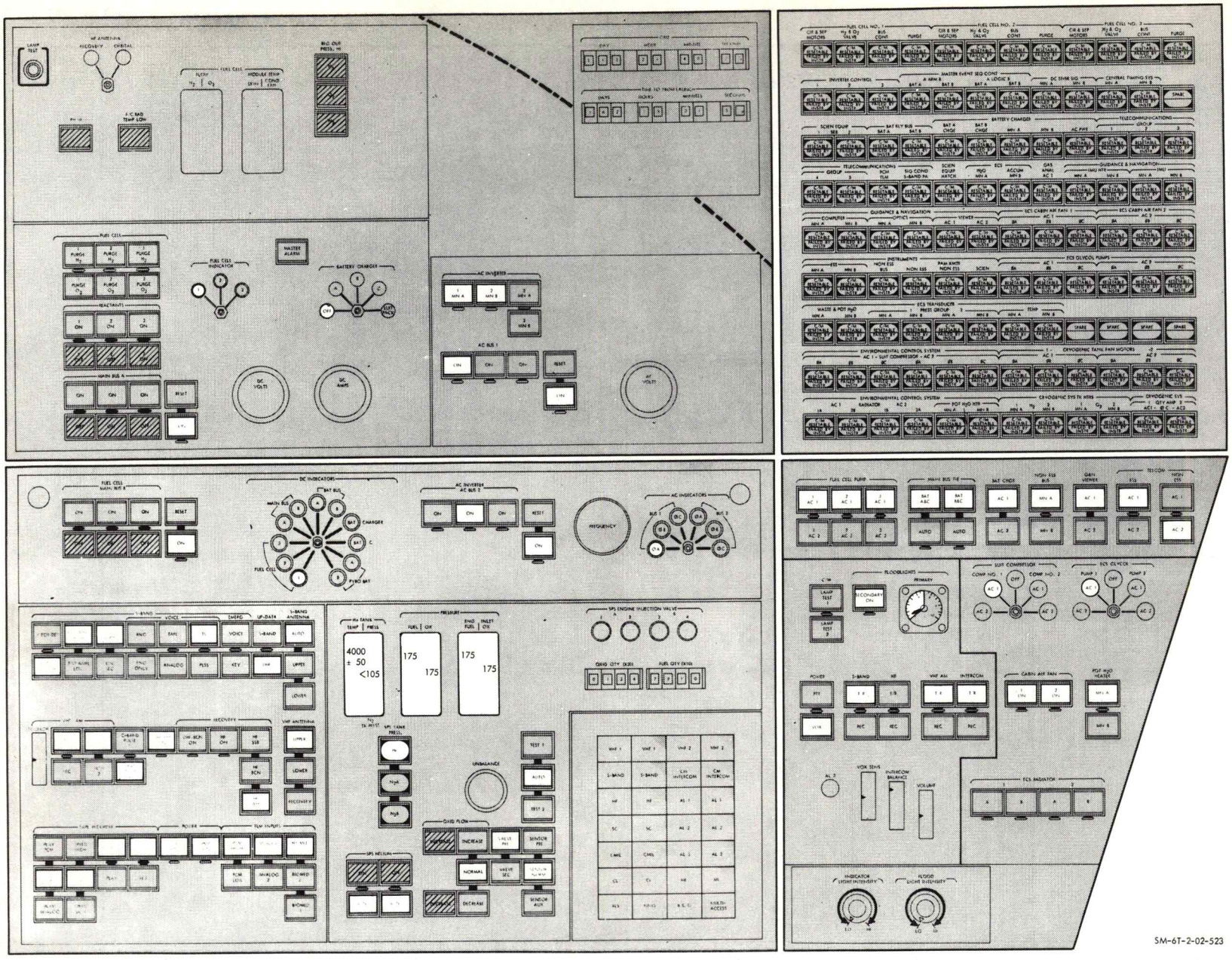
Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				S-BAND - TV lt on	
28				UP-DATA - UHF lt on	
29				S-BAND ANTENNA - AUTO lt on	
30				VHF AM - T/R lt on	
31				VHF AM - RCVR 1 lt on	
32				C-BAND PULSE 2 lt on	
33				VHF FM ON lt on	
34				RECOVERY - HF AM lt on	
35				VHF ANTENNA - UPPER lt on	
36				TAPE RECORDER - PLAY NORMAL lt on	
37				TAPE RECORDER - SPEED NORMAL lt on	
38				TAPE RECORDER - RECORD lt on	
39				TAPE RECORDER - FWD lt on	
40				POWER - SCS ON lt on	



Station 3 Launch

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
41				POWER - PMP ON lt on	
42				TLM INPUTS - PCM HIGH lt on	
43				TLM INPUTS - ANALOG 1 lt on	
44				TLM INPUTS - BIOMED 1 lt on	
45				He TANK PRESS - 4000±50	
46				He TANK TEMP - 105	
47				PRESSURE FUEL - 175	
48				PRESSURE OX - 175	
49				PRESSURE ENG FUEL - 175	
50				PRESSURE INLET OX - 175	
51				OXIDE QTY (X20) - 2604	
52				FUEL QTY (X10) - 2604	
53				SPS TANK PRESS - He lt on	
54				AUTO lt on	
55				Left SPS HELIUM - AUTO lt on	

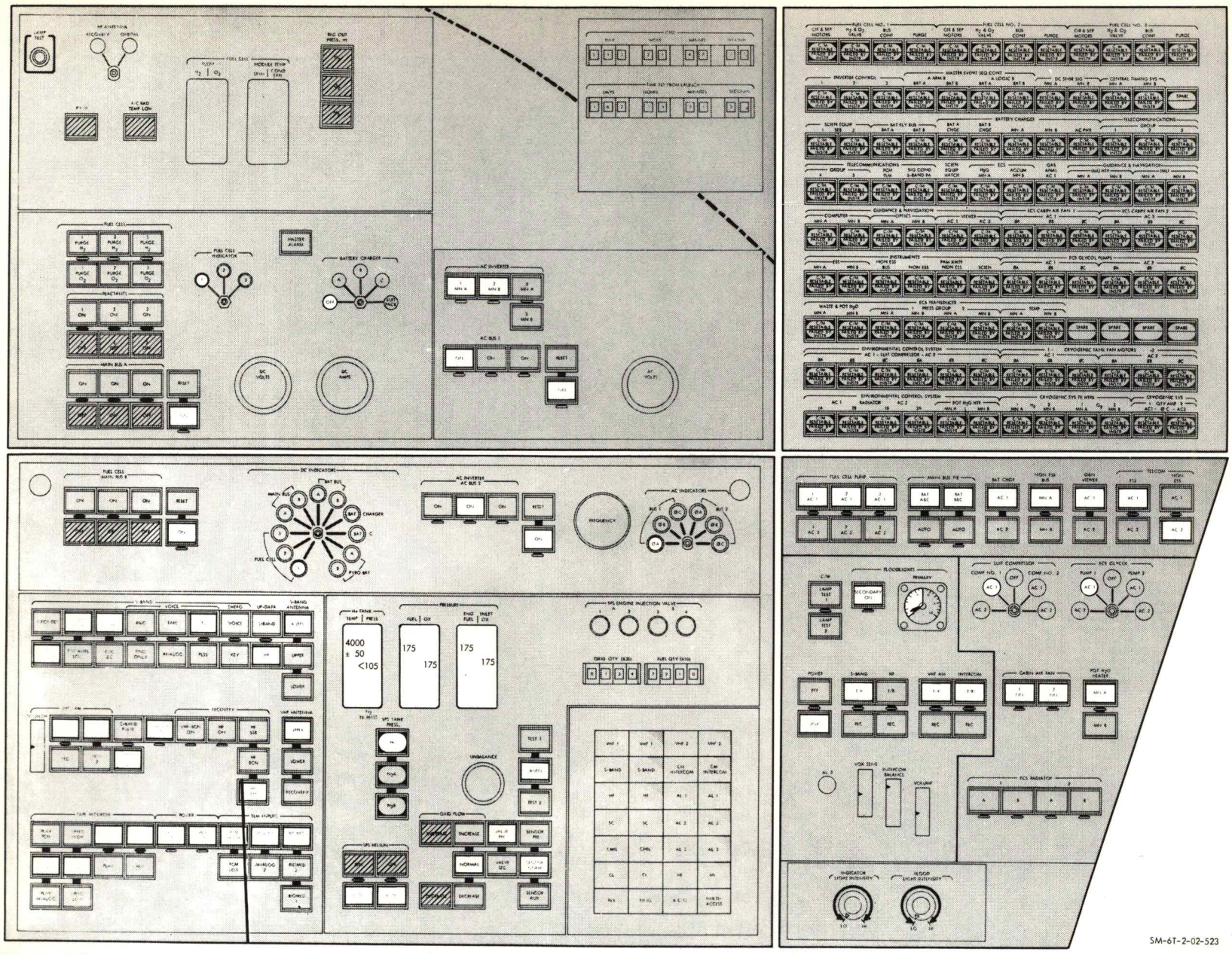


Station 3 Launch

S2

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
56				Right SPS HELIUM - AUTO lt on	
57				OXID FLOW - NORM lt on	
58				VALVE PRI - lt on	
59				SENSOR NORM - lt on	
60				All C/B lt out	
61				FUEL CELL - 1 AC 1 lt on	
62				FUEL CELL - 2 AC 1 lt on	
63				FUEL CELL - 3 AC 1 lt on	
64				MAIN BUS TIE - BAT A&C lt on	
65				MAIN BUS TIE - BAT B&C lt on	
66				BAT CHGR - AC 1 lt on	
67				NON ESS BUS - MN A lt on	
68				G&N VIEWER - AC 1 lt on	
69				TELCOM ESS - AC 1 lt on	

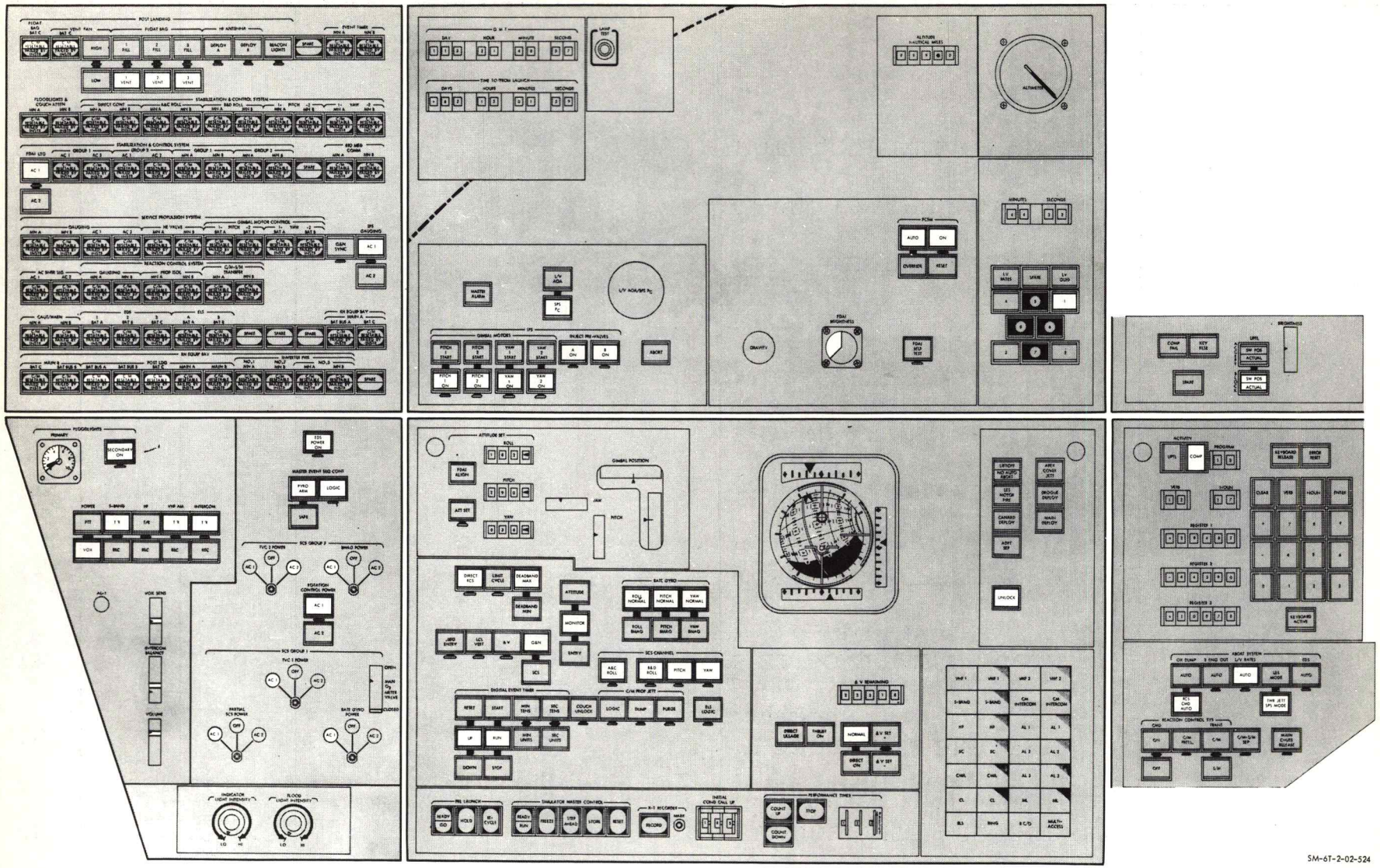


Station 3 Launch

S2

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
70				TELCOM NON ESS - AC 2 lt on	
71				FLOODLIGHTS - SECONDARY ON lt on	
72				FLOODLIGHTS PRIMARY - as required	
73				SUIT COMPRESSOR COMP No. 1 - AC 1 lt on	
74				ECS GLYCOL PUMP 1 - AC 1 lt on	
75				POWER - VOX lt on	
76				S-BAND - T/R lt on	
77				VHF AM - T/R lt on	
78				INTERCOM - T/R lt on	
79				CABIN AIR FAN - 1 ON lt on	
80				CABIN AIR FAN - 2 ON lt on	
81				POT H_2O HEATER - MN A lt on	



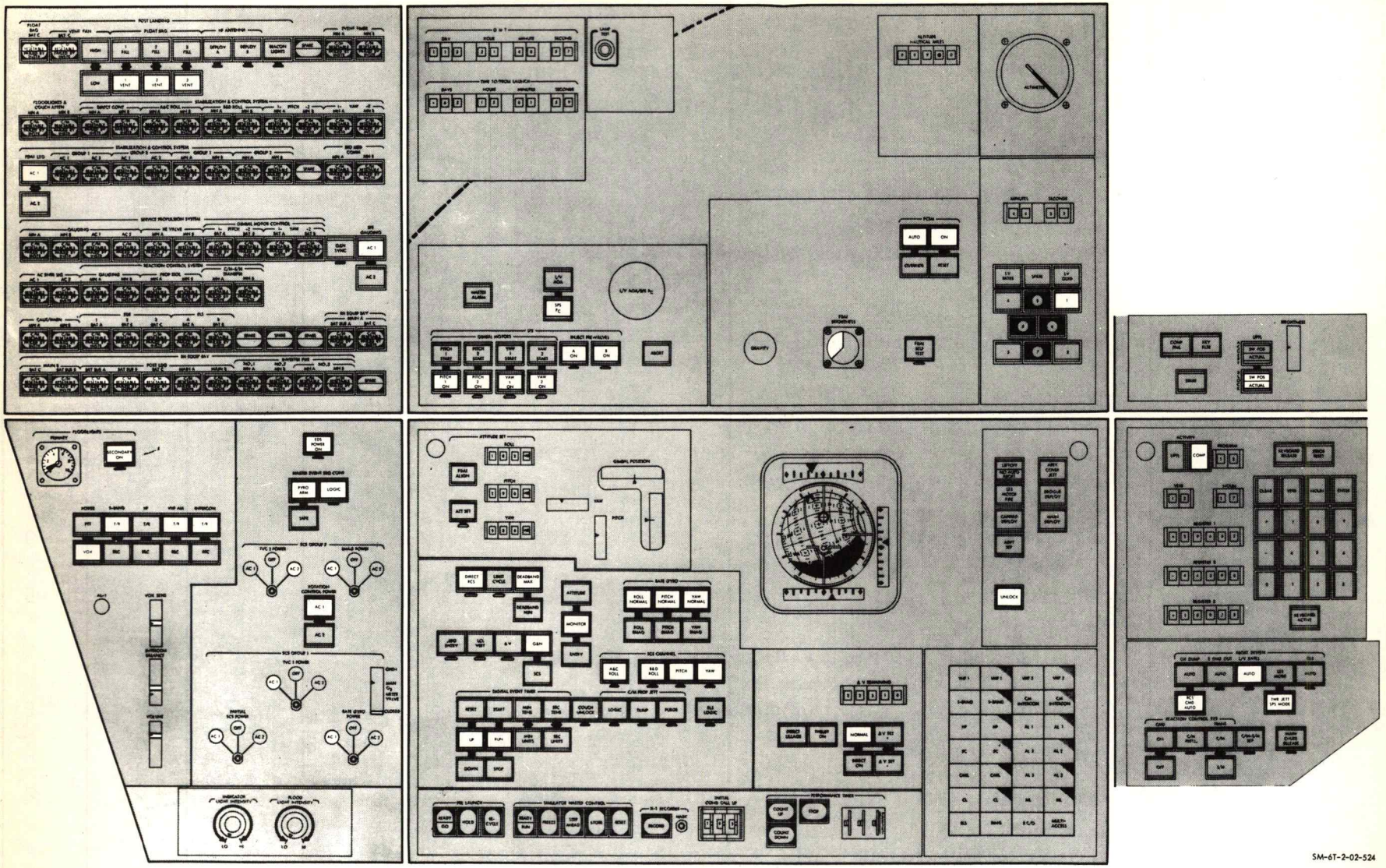
SM-6T-2-02-524

Station 1 Orbit Insertion

S3

Initialization Data Sheet

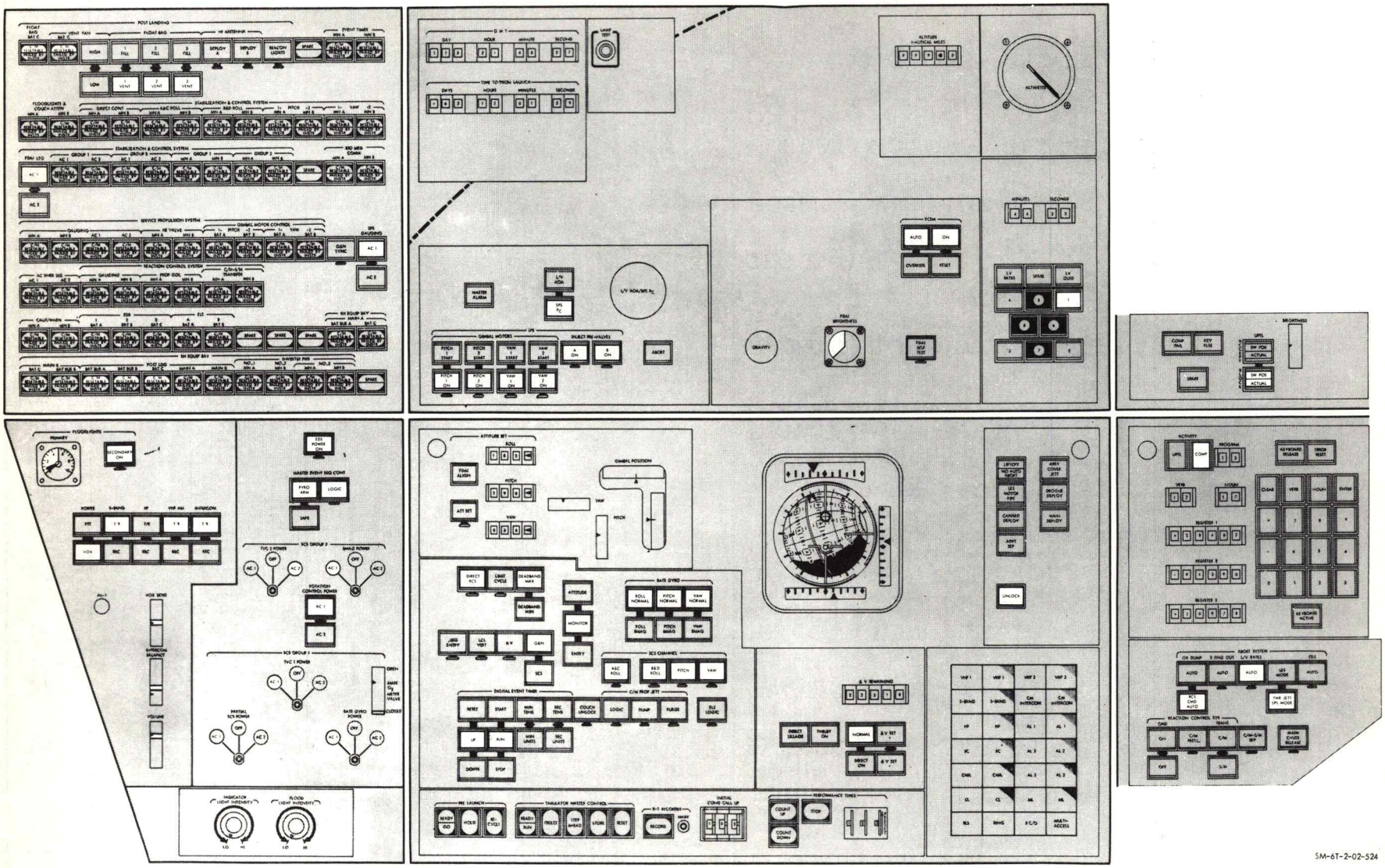
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				FLOT BAG BAT C - C/M RESETABLE lt on	
2				VENT FAN - C/M RESETABLE lt on	
3				FLOAT BAG - 1 VENT lt on	
4				FLOAT BAG - 2 VENT lt on	
5				FLOAT BAG - 3 VENT lt on	
6				FDAI LTG - AC 1 lt on	
7				SPS GAUGING - AC 1 lt on	
8				FLOODLIGHTS PRIMARY - as required	
9				FLOODLIGHTS - SECONDARY ON lt on	
10				EDS POWER ON lt on	
11				MASTER EVENT SEQ CONT - PYRO ARM lt on	
12				MASTER EVENT SEQ CONT - LOGIC lt on	
13				POWER - VOX lt on	



Station 1 Orbit Insertion

Initialization Data Sheet

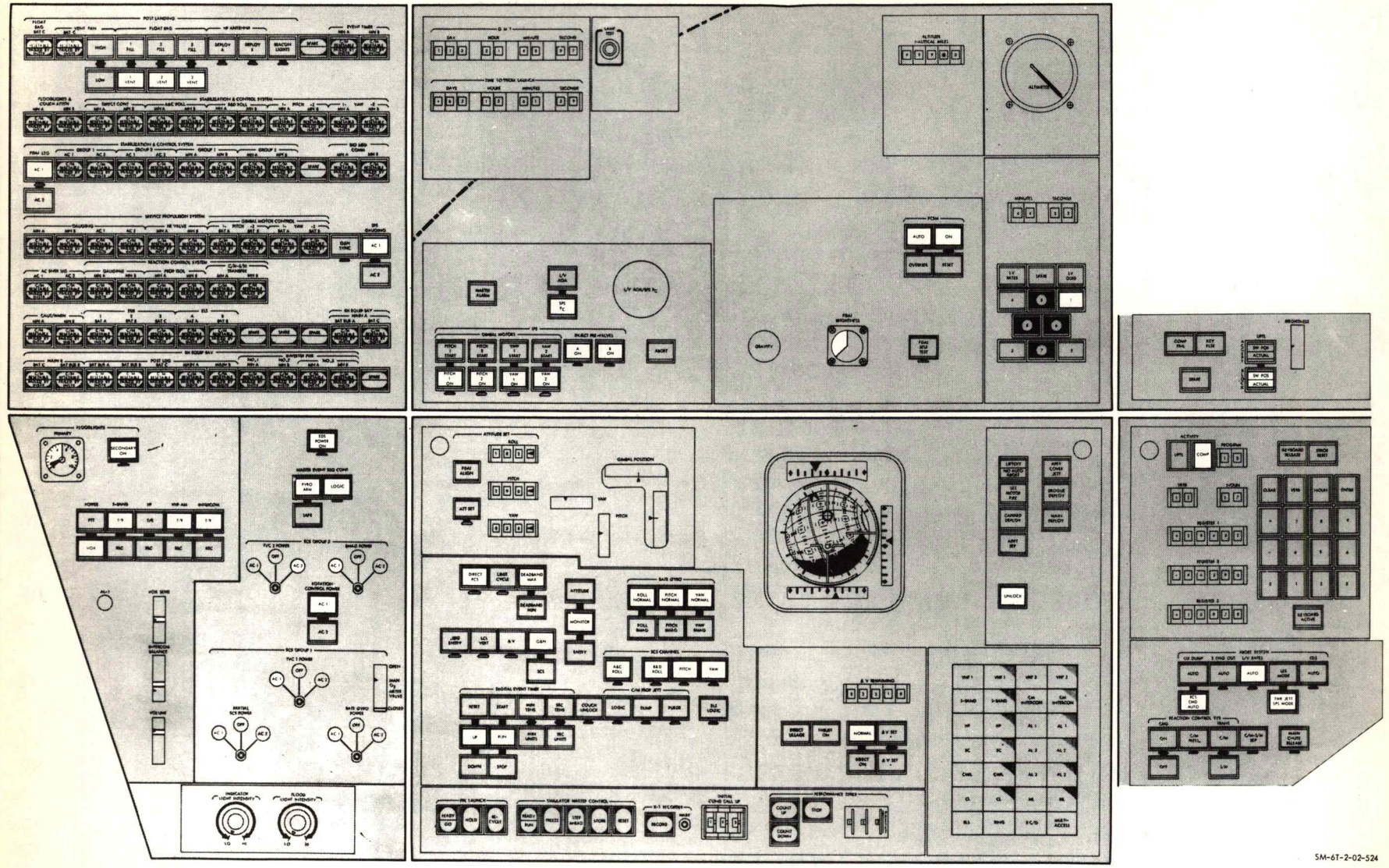
Step	Malf	Time	Function	IOS Visibility/Action	Notes
14				S-Band - T/R lt on	
15				VHF AM - T/R lt on	
16				INTERCOM - T/R lt on	
17				TVC 2 POWER - AC 2 lt on	
18				BMAG POWER - AC 1 lt on	
19				ROTATIONAL CONTROL POWER - AC 1 lt on	
20				TVC 1 POWER - AC 1 lt on	
21				PARTIAL SCS POWER - AC 1 lt on	
22				RATE GYRO POWER - AC 1 lt on	
23				SPS P_C lt on	
24				FCSM - OVERRIDE lt on	
25				GIMBAL MOTORS - PITCH 1 ON lt on	
26				GIMBAL MOTORS - PITCH 2 ON lt on	



SM-6T-2-02-524

Station 1 Orbit Insertion

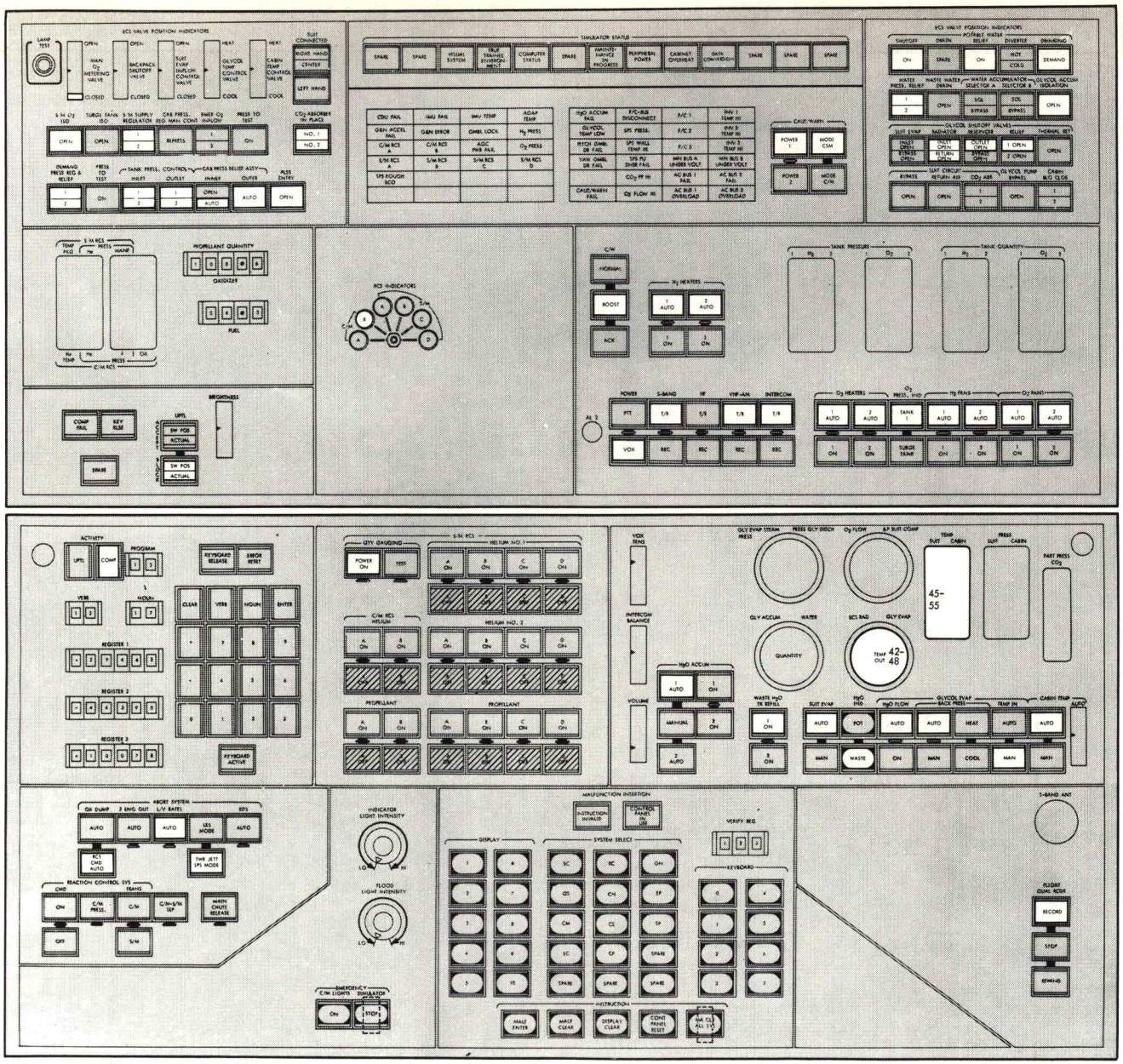
Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				GIMBAL MOTORS - YAW 1 ON lt on	
28				GIMBAL MOTORS - YAW 2 ON lt on	
29				INJECT PRE-VALVES - A ON lt on	
30				INJECT PRE-VALVES - B ON lt on	
31				LAUNCH VEHICLE ENGINES - 1 lt on	
32				UNLOCK lt on	
33				DIRECT RCS lt on	
34				DEADBAND MAX lt on	
35				MONITOR lt on	
36				RATE GYRO - ROLL NORMAL lt on	
37				RATE GYRO - PITCH NORMAL lt on	
38				RATE GYRO - YAW NORMAL lt on	



Station 1 Orbit Insertion

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
39				SCS CHANNEL - A&C ROLL lt on	
40				SCS CHANNEL - B&D ROLL lt on	
41				SCS CHANNEL - PITCH lt on	
42				SCS CHANNEL - YAW lt on	
43				DIGITAL EVENT TIMER - UP lt on	
44				DIGITAL EVENT TIMER - RUN lt on	
45				ΔV REMAINING - NORMAL lt on	

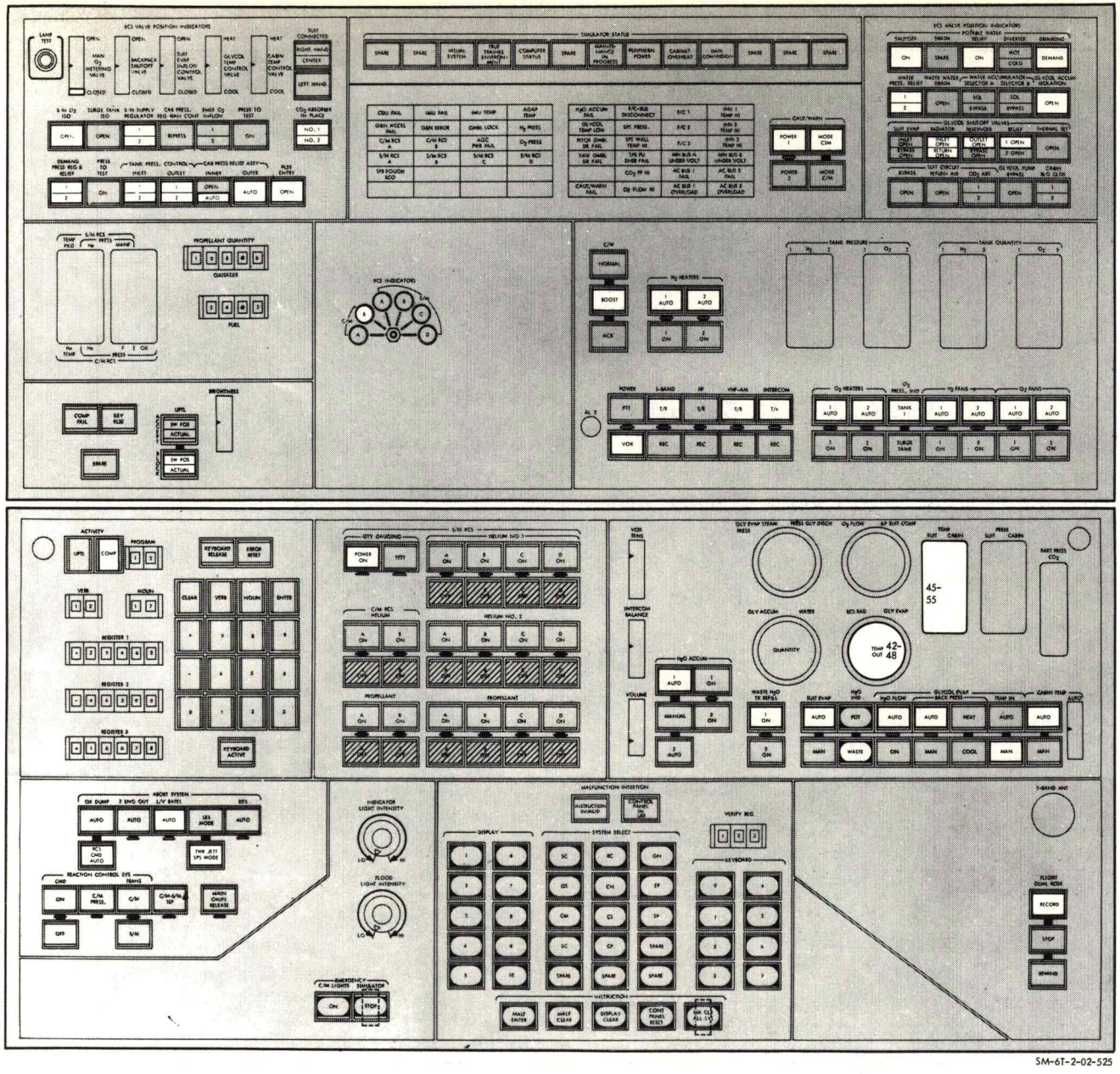


SM-6T-2-02-525

Station 2 Orbit Insertion

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				MAN O_2 METERING VALVE - CLOSED	
2				S/M O2 ISO - OPEN lt on	
3				S/M SUPPLY REGULATOR - 1 and 2 lt on	
4				CO_2 ABSORBER IN PLACE - No. 1 and No. 2 lt on	
5				DEMAND PRESS REG & RELIEF - 1 and 2 lt on	
6				TANK PRESS CONTROL INLET - 1 and 2 lt on	
7				TANK PRESS CONTROL OUTLET - 1 and 2 lt on	
8				CAB PRESS RELIEF ASSY INNER - AUTO lt on	
9				CAB PRESS RELIEF ASSY OUTER - AUTO lt on	
10				PLSS ENTRY - OPEN lt on	
11				C/M RCS TEMP He	
12				C/M RCS PRESS He	

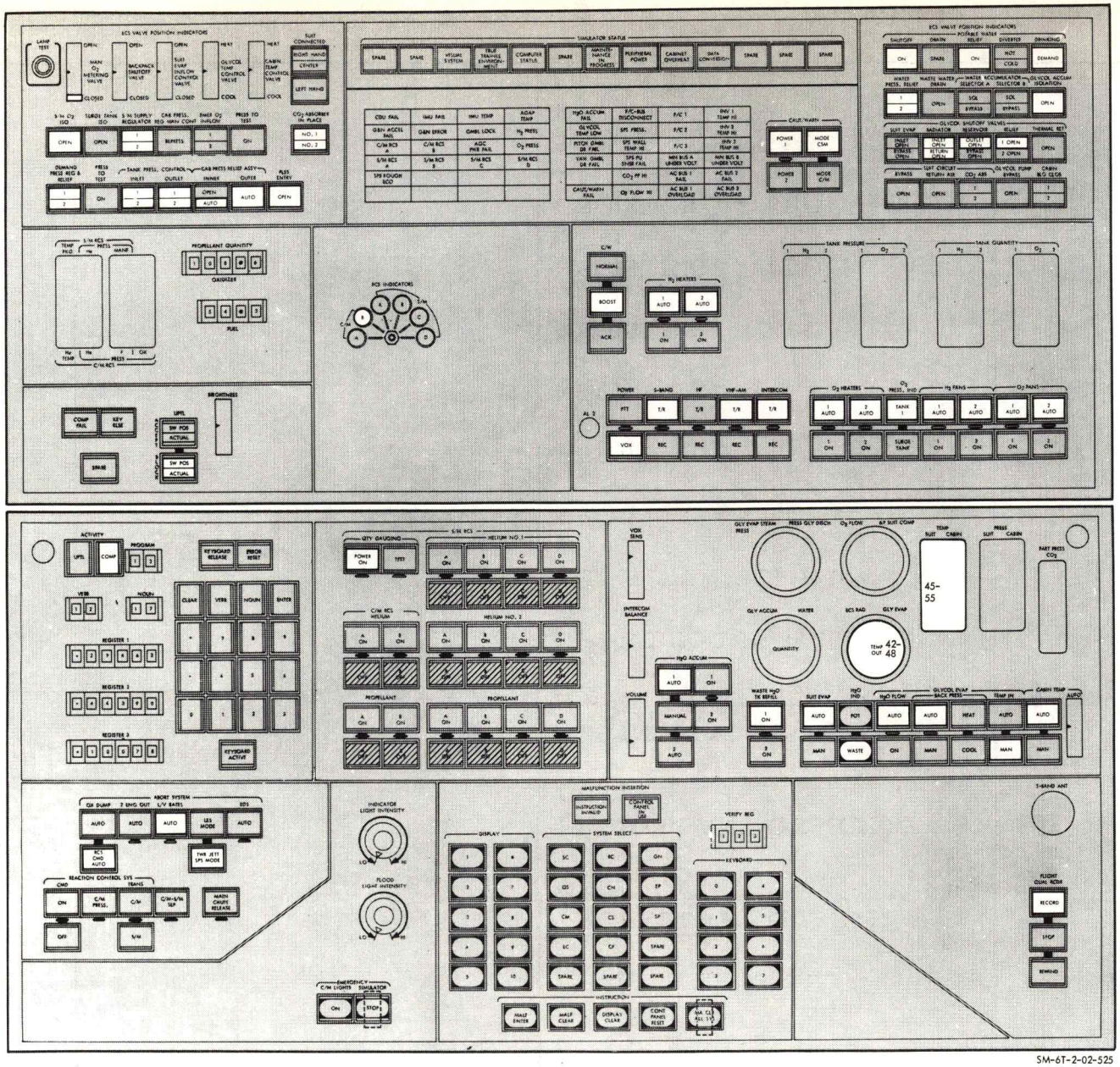


SM-6T-2-02-525

Station 2 Orbit Insertion

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				C/M RCS PRESS F	
14				C/M RCS PRESS OX	
15				PROPELLANT QUANTITY OXID	
16				PROPELLANT QUANTITY FUEL	
17				RCS INDICATORS C/M - B lt on	
18				UPTL BLOCK - lt on	
19				ACTIVITY - COMP lt on	
20				PROGRAM - TBD	
21				VERB - TBD	
22				NOUN - TBD	
23				REGISTER 1 - TBO	
24				REGISTER 2 - TBO	
25				REGISTER 3 - TBO	
26				S/M RCS QTY GAUGING - POWER ON lt on	

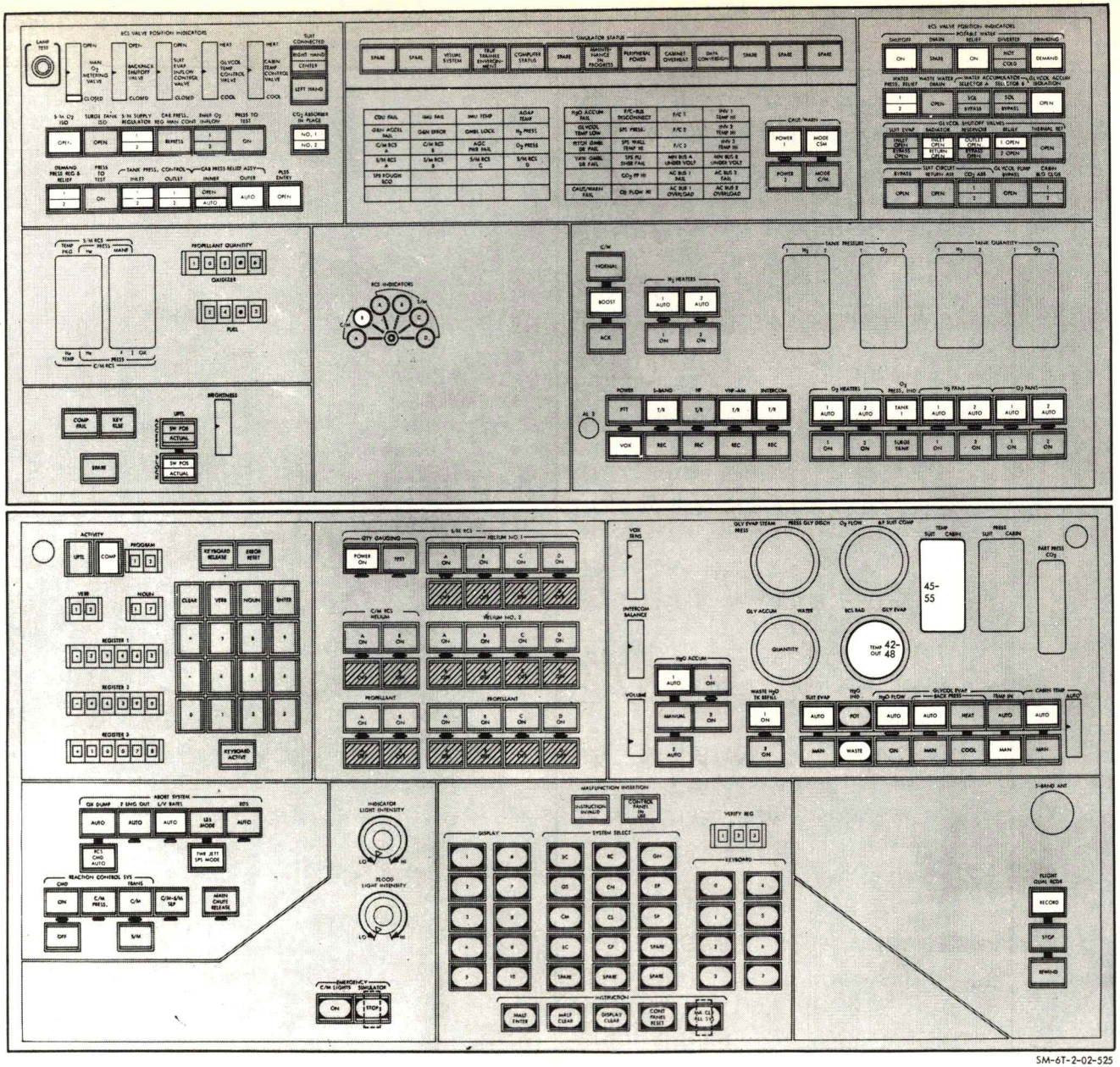


SM-6T-2-02-525

Station 2 Orbit Insertion

Initialization Data Sheet

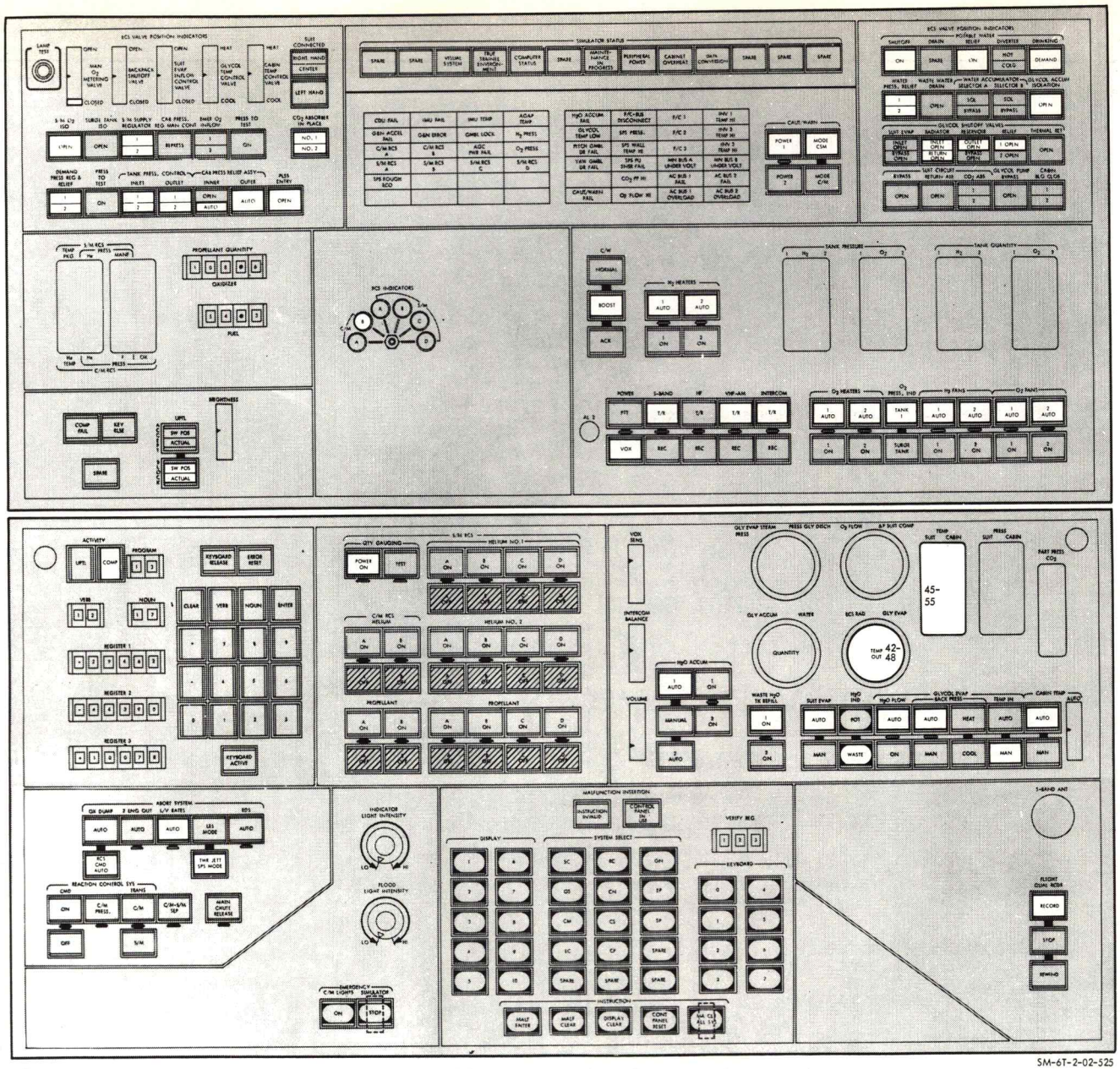
Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				ABORT SYSTEM OX DUMP - RCS CMD AUTO lt on	
28				ABORT SYSTEM L/V RATES - AUTO lt on	
29				ABORT SYSTEM - TWR JETT SPS MODE lt on	
30				CAUT/WARN - POWER 1 lt on	
31				CAUT/WARN - MODE CSM lt on	
32				POTABLE WATER SHUTOFF - ON lt on	
33				POTABLE WATER RELIEF - ON lt on	
34				POTABLE WATER DRINKING - DEMAND lt on	
35				WATER PRESS RELIEF - 1 and 2 lt on	
36				GLYCOL ACCUM ISOLATION - OPEN lt on	
37				RADIATOR - INLET OPEN and RETURN OPEN lt on	



Station 2 Orbit Insertion

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
38				RESERVOIR - OUTLET OPEN lt on	
39				RELIEF - 1 OPEN lt on	
40				C/W - BOOST lt on	
41				H_2 HEATERS - 1 AUTO lt on	
42				H_2 HEATERS - 2 AUTO lt on	
43				TANK PRESSURE H_2 1 - 230-260	
44				TANK PRESSURE H_2 2 - 230-260	
45				TANK PRESSURE O_2 1 - 875-925	
46				TANK PRESSURE O_2 2 - 875-925	
47				TANK QUANTITY H_2 1 - 28	
48				TANK QUANTITY H_2 2 - 28	
49				TANK QUANTITY O_2 1 - 320	
50				TANK QUANTITY O_2 2 - 320	

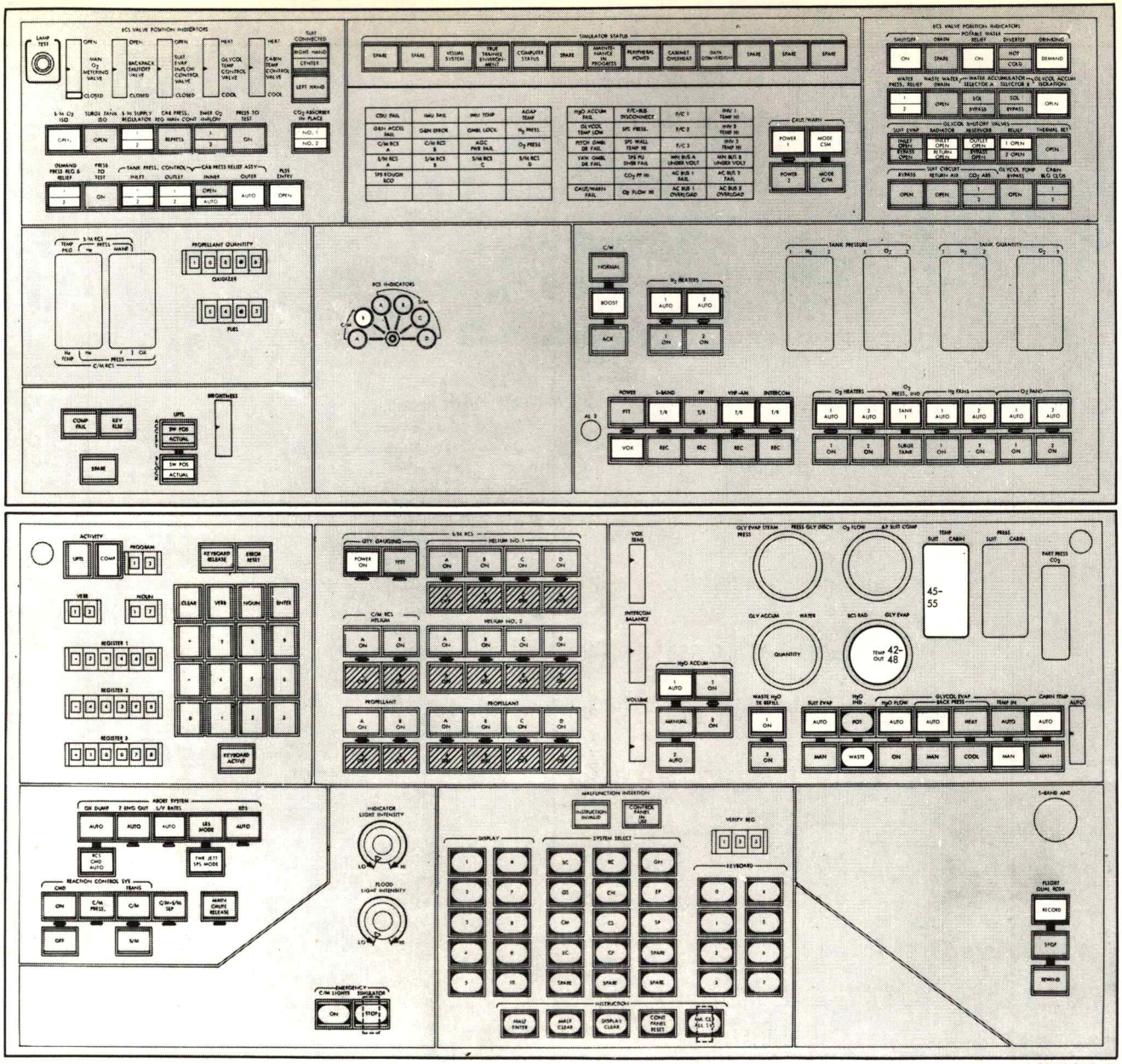


SM-6T-2-02-525

Station 2 Orbit Insertion

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
51				POWER - VOX lt on	
52				S-BAND - T/R lt on	
53				VHF AM - T/R lt on	
54				INTERCOM - T/R lt on	
55				O_2 HEATERS - 1 AUTO lt on	
56				O_2 HEATERS - 2 AUTO lt on	
57				O_2 PRESS IND - TANK 1 lt on	
58				H_2 FAN - 1 AUTO lt on	
59				H_2 FAN - 2 AUTO lt on	
60				O_2 FAN - 1 AUTO lt on	
61				O_2 FAN - 2 AUTO lt on	
62				GLY EVAP STEAM PRESS - TBD	
63				PRESS GLY DISCH - 40-50	
64				O_2 FLOW	
65				ΔP SUIT COMP	

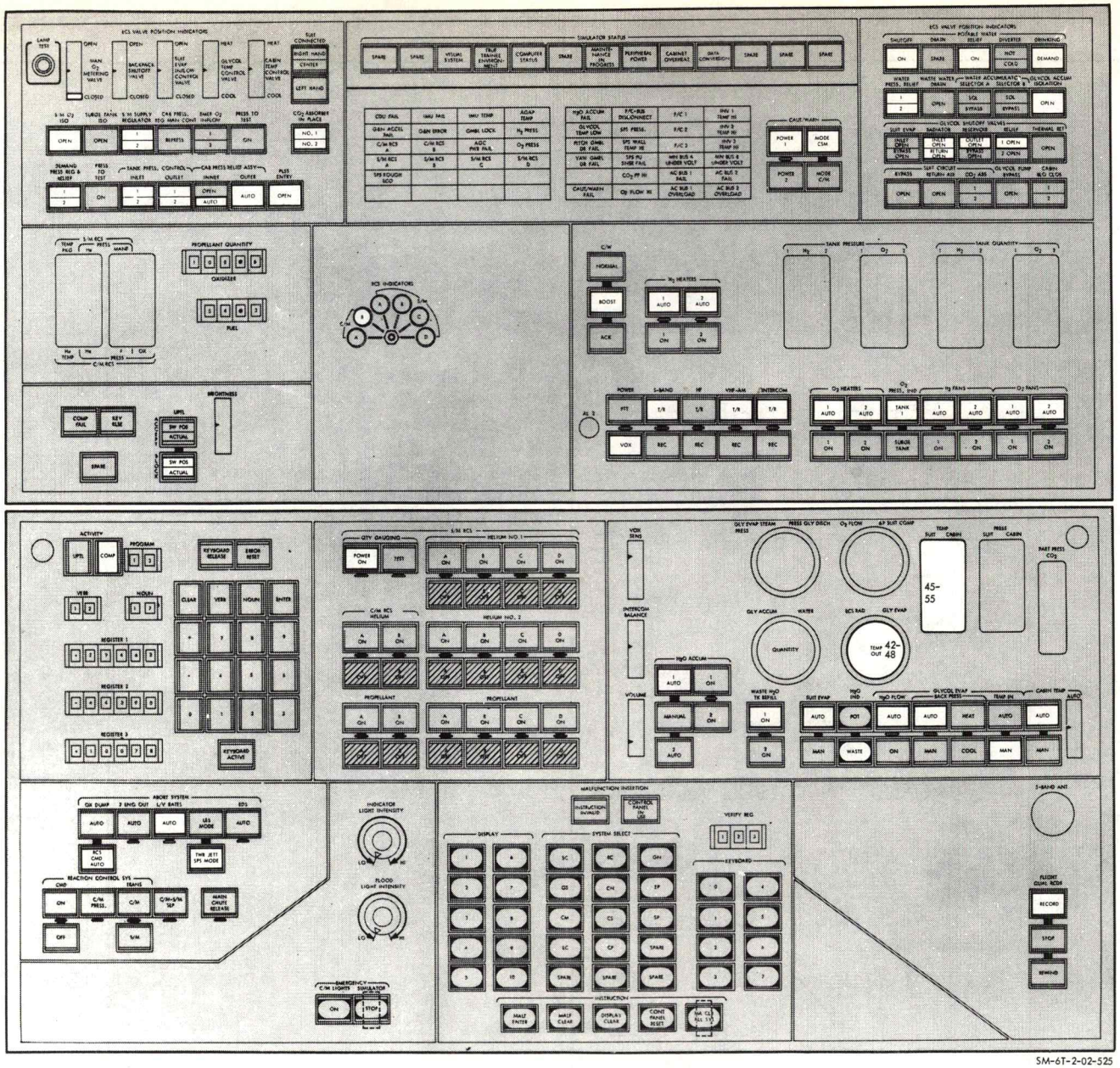


SM-6T-2-02-525

Station 2 Orbit Insertion

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
66				TEMP SUIT	
67				TEMP CABIN - TBD	
68				PRESS SUIT - TBD	
69				PRESS - CABIN - TBD	
70				PART PRESS CO_2 - TBD	
71				GLY ACCUM - TBD	
72				WATER - TBD	
73				ECS RAD - TBD	
74				GLY EVAP - 42-48	
75				H_2O ACCUM - 1 AUTO lt on	
76				WASTE H_2O TK REFILL - 1 ON lt on	
77				SUIT EVAP - AUTO lt on	
78				H_2O IND - WASTE lt on	
79				H_2O FLOW - AUTO lt on	
80				BACK PRESS - AUTO lt on	

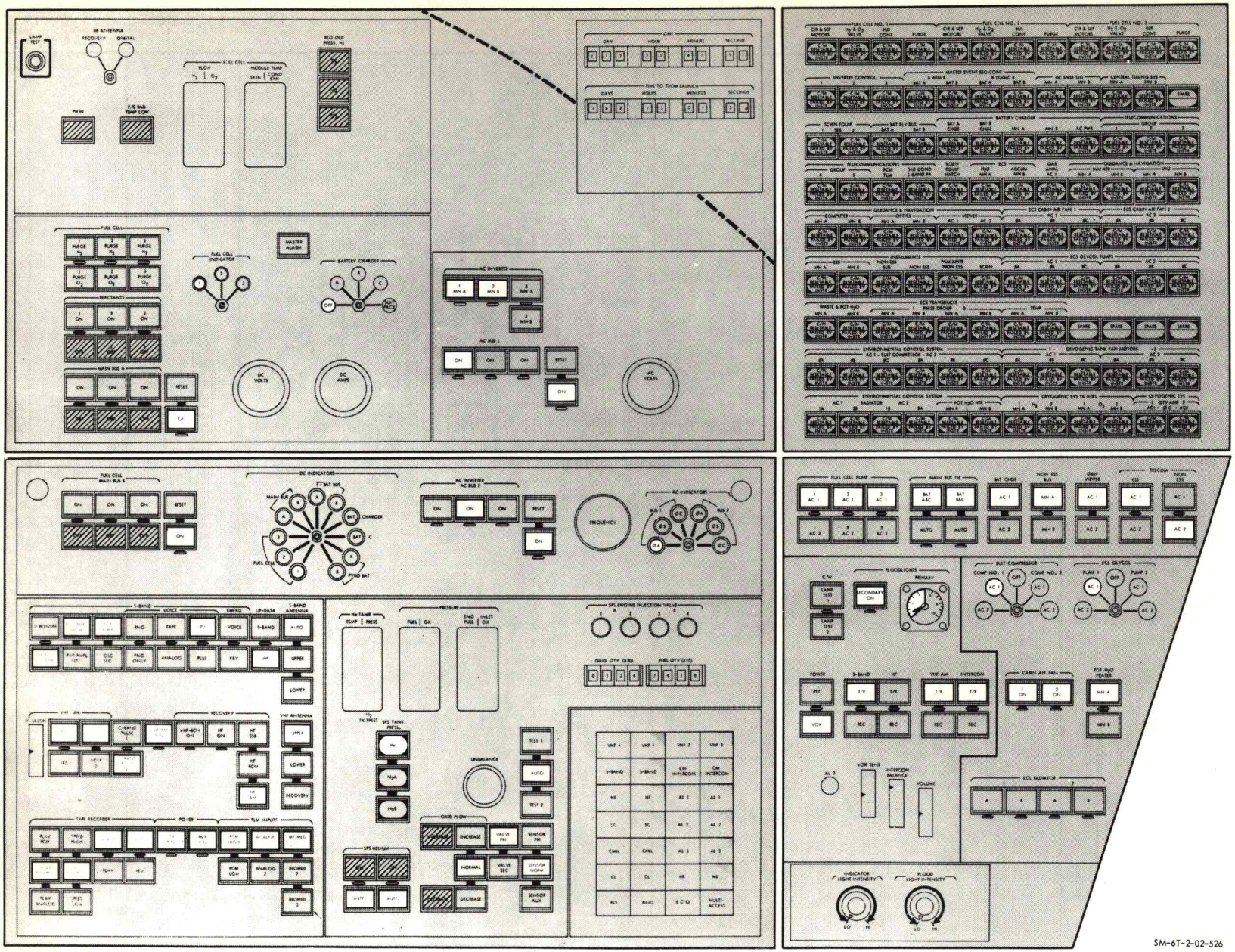


SM-6T-2-02-525

Station 2 Orbit Insertion

Initialization Data Sheet

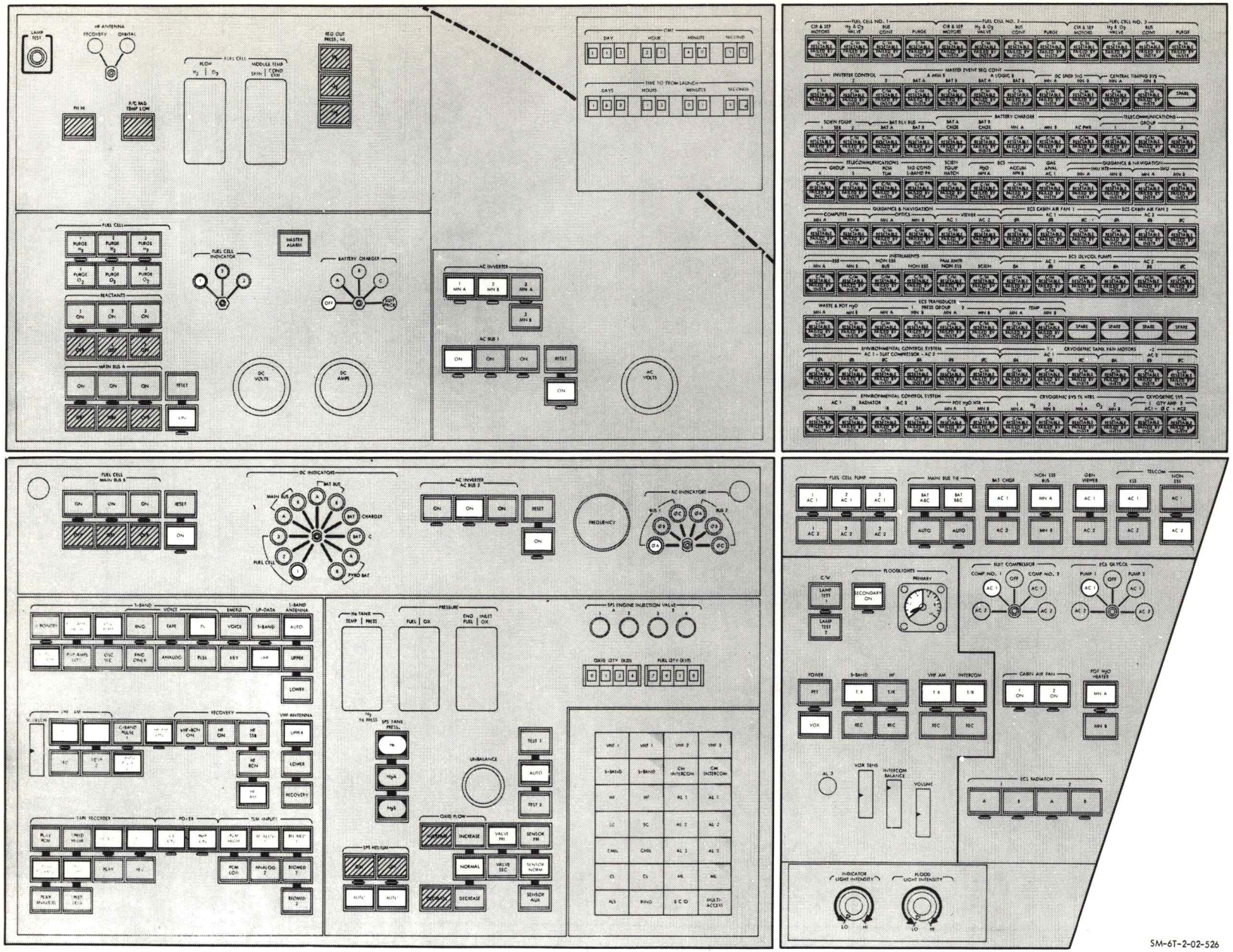
Step	Malf	Time	Function	IOS Visibility/Action	Notes
81				TEMP IN - MAN lt on	
82				CABIN TEMP - AUTO lt on	
83				FLT QUAL RCDR - RECORD lt on	



Station 3 Orbit Insertion

Initialization Data Sheet

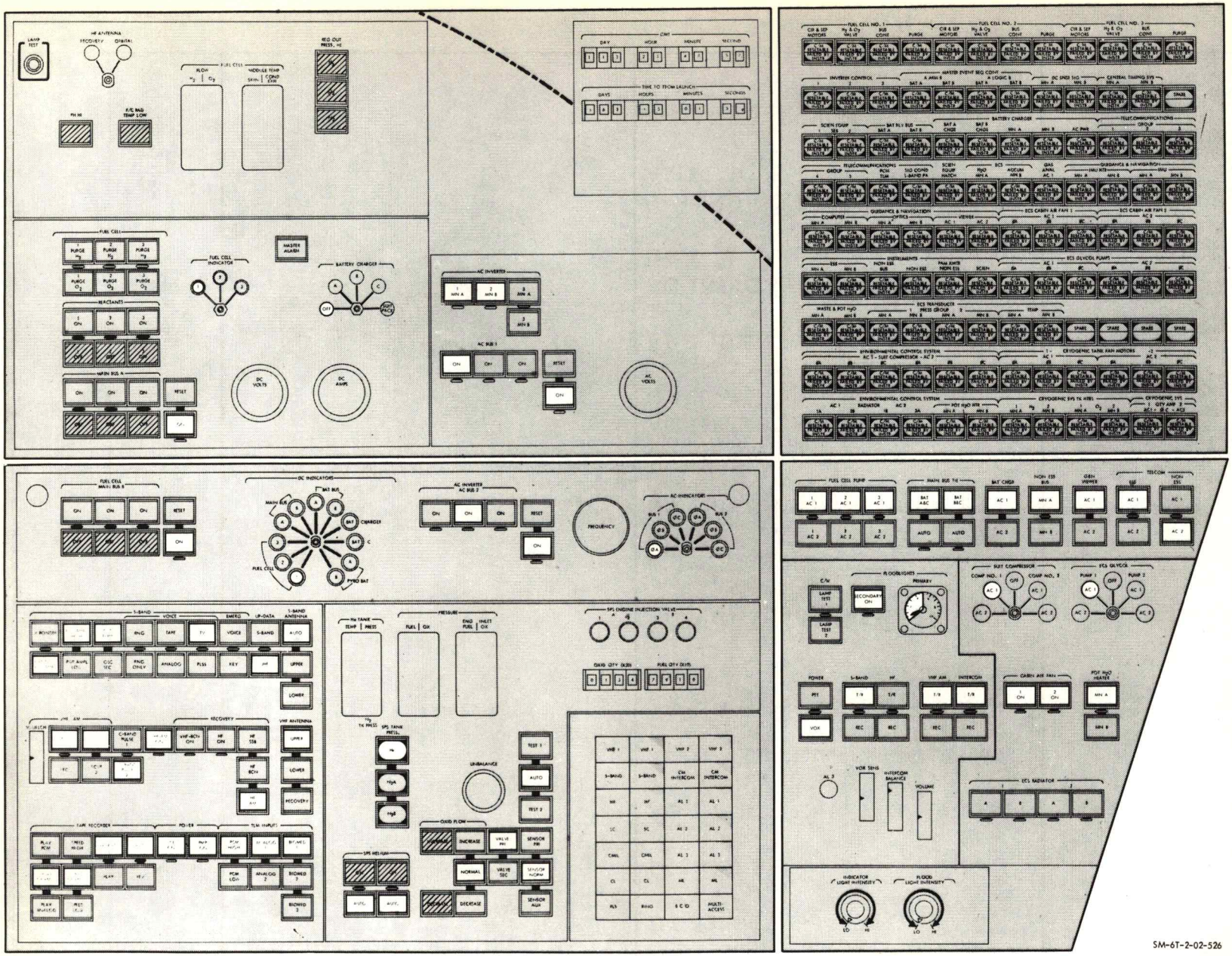
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			PH 11	PH HI ind - gray	
2				F/C RAD TEMP LO ind - gray	
3				FLOW H_2 - .036-.09	
4				FLOW O_2 - .288-.72	
5				MODULE TEMP SKIN - 385-455	
6				MODULE TEMP COND EXH - 155-170	
7				REG OUT PRESS HI O_2 ind - gray	
8				REG OUT PRESS HI H_2 ind - gray	
9				REG OUT PRESS HI N_2 ind- gray	
10				FUEL CELL INDICATOR - 1 lt on	
11				BATTERY CHARGER - OFF lt on	
12				MAIN BUS A RESET - ON lt on	



Station 3 Orbit Insertion

Initialization Data Sheet

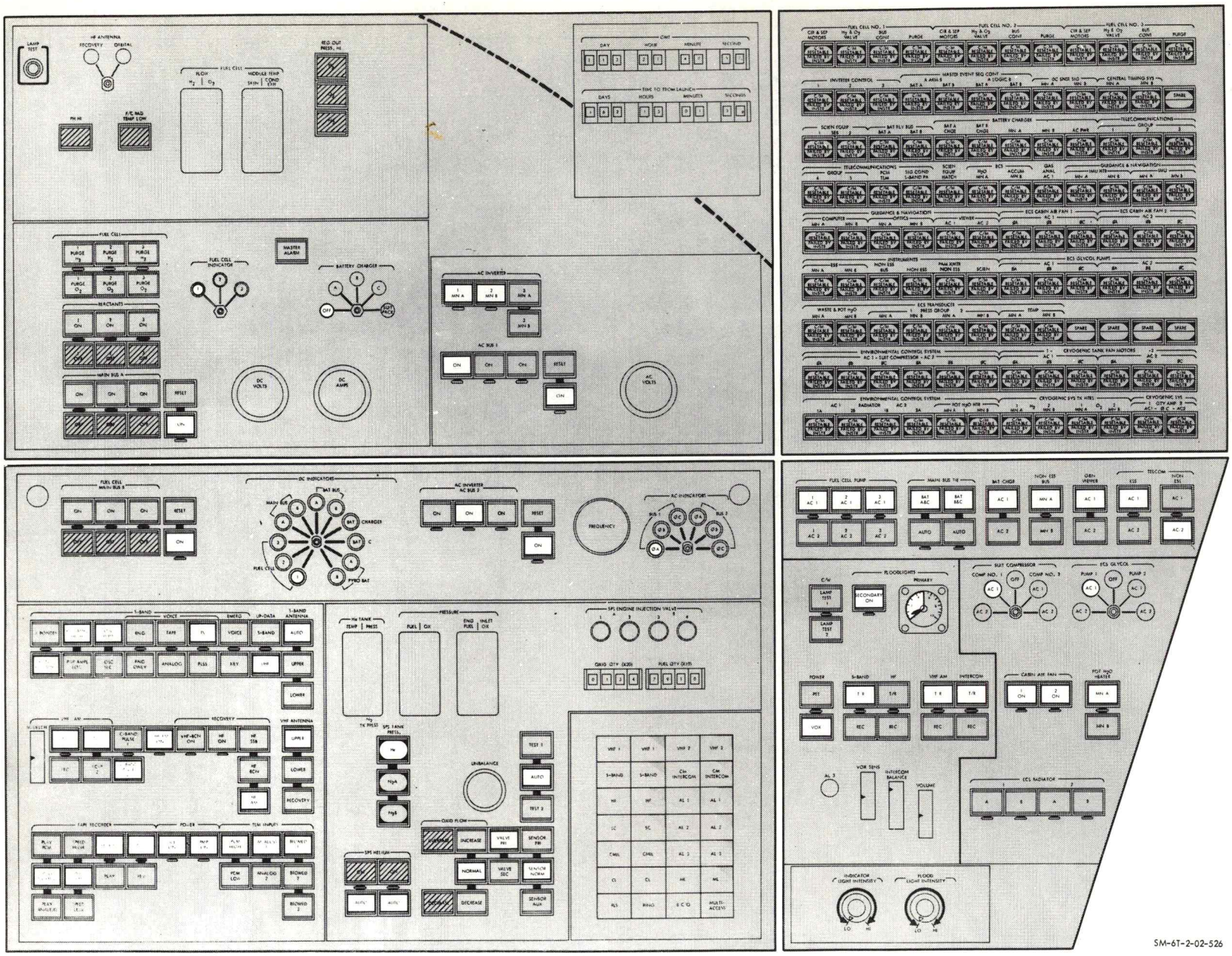
Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				DC VOLTS ind - 29±2	
14				DC AMPS ind - 0	
15				AC INVERTER - 1 MN A lt on	
16				AC INVERTER - 2 MN A lt on	
17				AC INVERTER 1 - AC BUS 1 - ON lt on	
18				AC VOLTS ind 115±2	
19				MAIN BUS B RESET - ON lt on	
20				DC INDICATORS FUEL CELL - 1 lt on	
21				AC INVERTER 2 - AC BUS 2 - ON lt on	
22				FREQUENCY ind - 400±5	
23				AC INDICATORS BUS 1 - ØA lt on	
24				S-BAND - XPONDER PWR AMPL lt on	
25				S-BAND - PWR AMPL HIGH lt on	



Station 3 Orbit Insertion

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
26				S-BAND - OSC PRIM lt on	
27				S-BAND - TV lt on	
28				UP-DATA - UHF lt on	
29				S-BAND ANTENNA - AUTO lt on	
30				VHF AM - T/R lt on	
31				VHF AM - RCVR 1 lt on	
32				C-BAND PULSE 2 lt on	
33				VHF FM ON lt on	
34				RECOVERY - HF AM lt on	
35				VHF ANTENNA - UPPER lt on	
36				TAPE RECORDER - PLAY NORMAL lt on	
37				TAPE RECORDER - SPEED NORMAL lt on	
38				TAPE RECORDER - RECORD lt on	
39				TAPE RECORDER - FWD lt on	

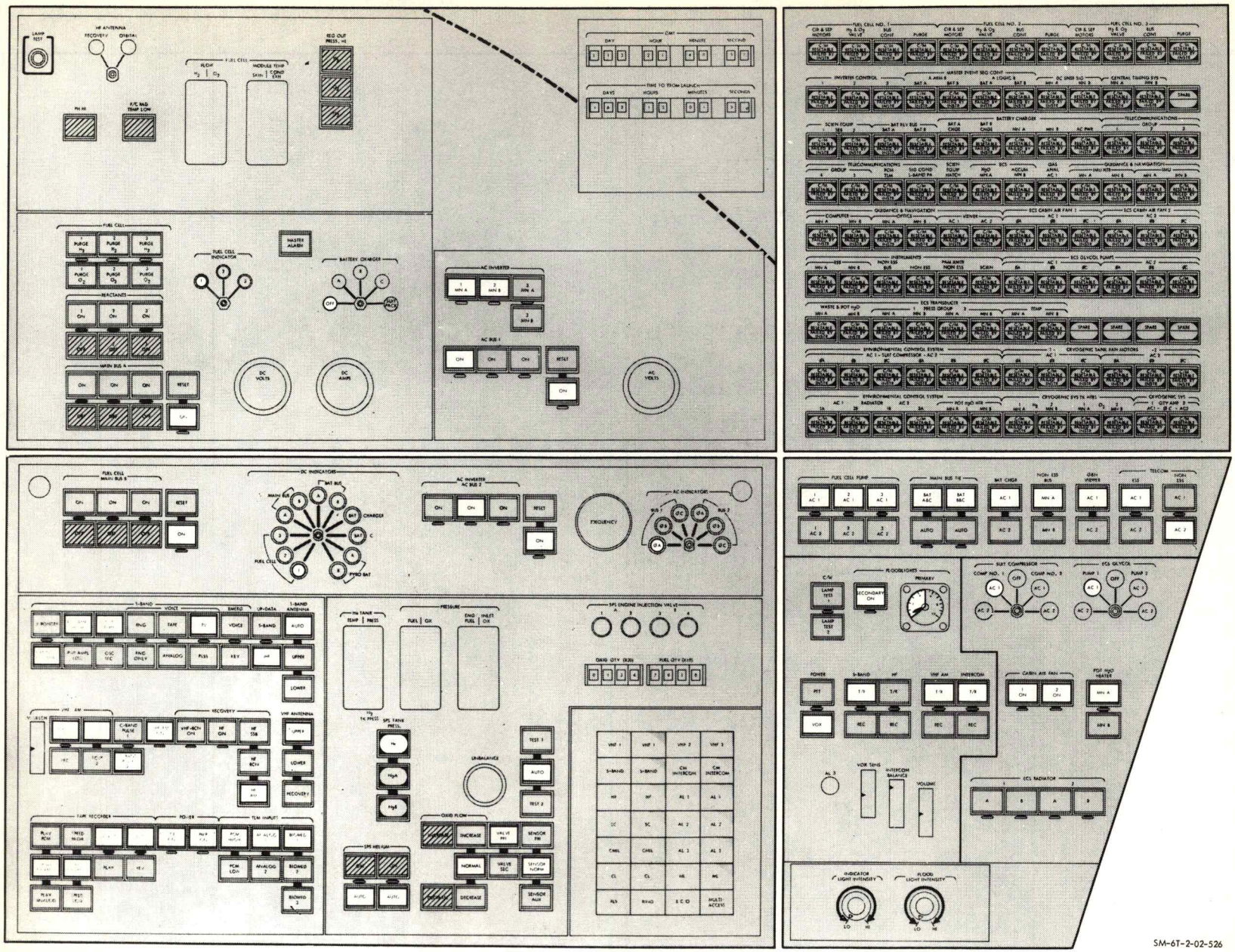


SM-6T-2-02-526

Station 3 Orbit Insertion

Initialization Data Sheet

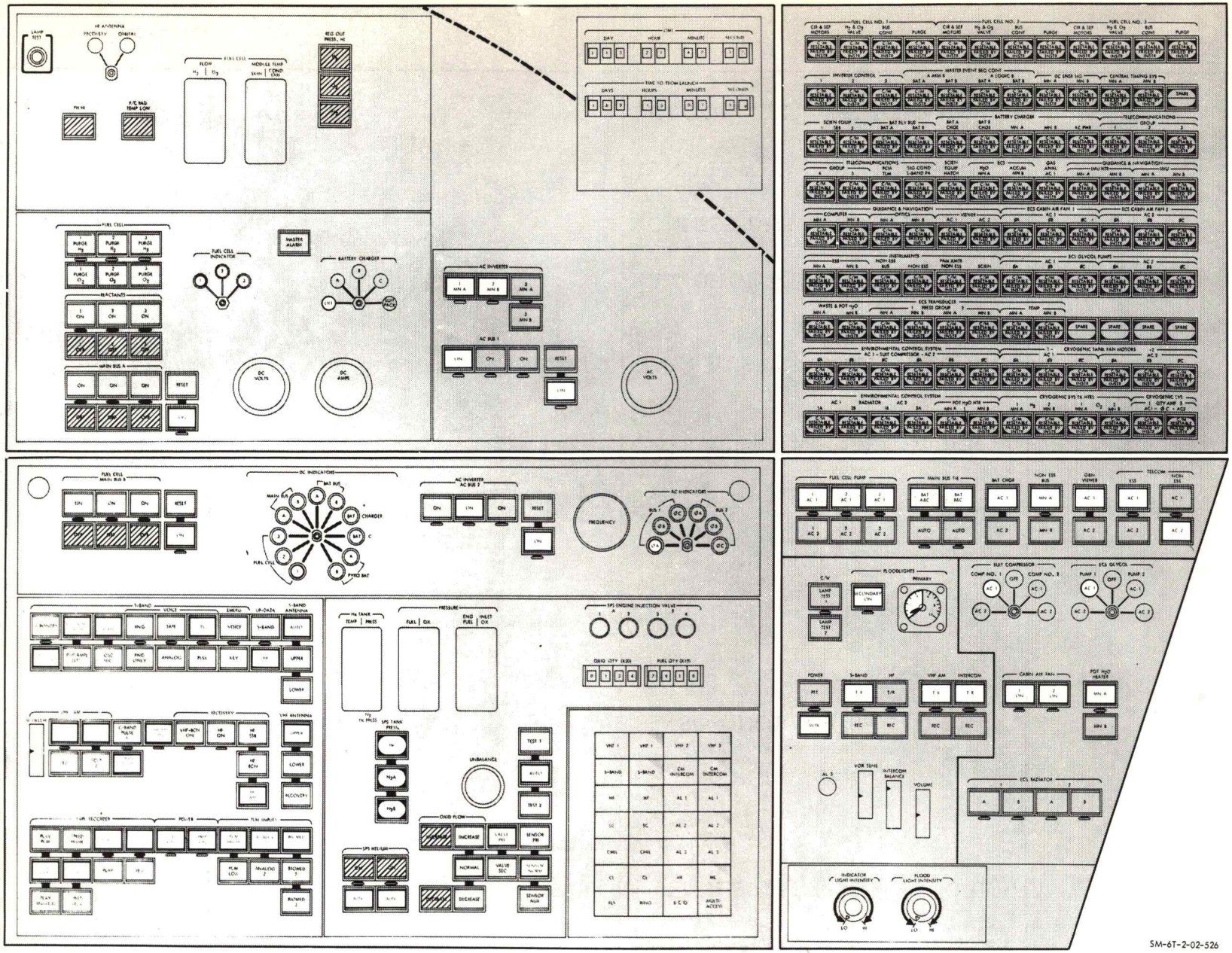
Step	Malf	Time	Function	IOS Visibility/Action	Notes
40				POWER - SCE ON lt on	
41				POWER - PMP ON lt on	
42				TLM INPUTS - PCM HIGH lt on	
43				TLM INPUTS - ANALOG 1 lt on	
44				TLM INPUTS - BIOMED 1 lt on	
45				He TANK PRESS - 4000±50	
46				He TANK TEMP - 105	
47				PRESSURE FUEL - 175	
48				PRESSURE OX - 175	
49				PRESSURE ENG FUEL - 175	
50				PRESSURE INLET OX - 175	
51				OXIDE QTY (X20) - 2604	
52				FUEL QTY (X10) - 2604	
53				SPS TANK PRESS - He lt on	
54				AUTO lt on	



Station 3 Orbit Insertion

Initialization Data Sheet

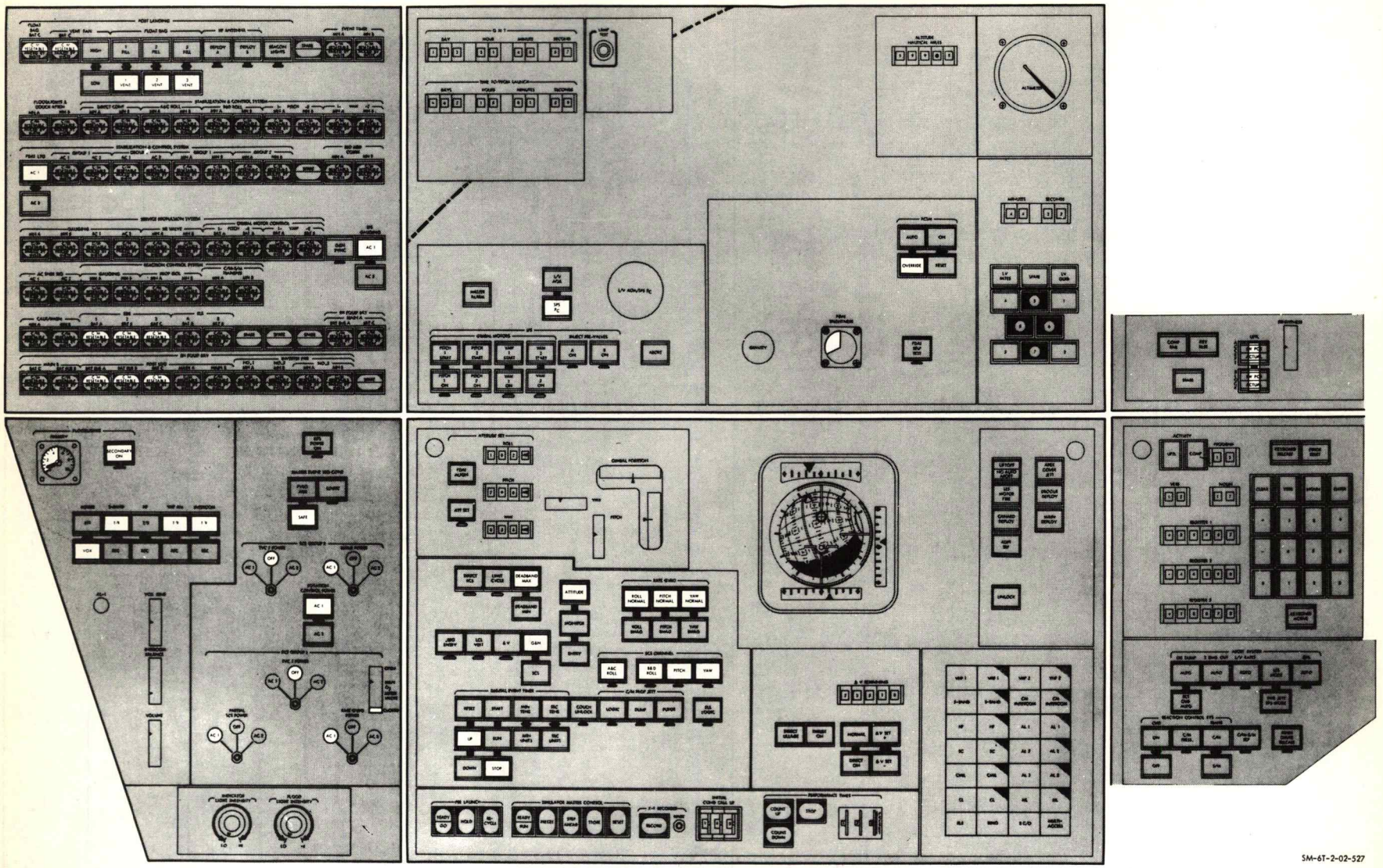
Step	Malf	Time	Function	IOS Visibility/Action	Notes
55				Left SPS HELIUM - AUTO lt on	
56				Right SPS HELIUM - AUTO lt on	
57				OXID FLOW - NORM lt on	
58				VALVE PRI - lt on	
59				SENSOR NORM lt on	
60				All C/B lt out	
61				FUEL CELL - 1 AC 1 lt on	
62				FUEL CELL - 2 AC 1 lt on	
63				FUEL CELL - 3 AC 1 lt on	
64				MAIN BUS TIE - BAT A&C lt on	
65				MAIN BUS TIE - BAT B&C lt on	
66				BAT CHGR - AC 1 lt on	
67				NON ESS BUS - MN A lt on	
68				G&N VIEWER - AC 1 lt on	
69				TELCOM ESS - AC 1 lt on	



Station 3 Orbit Insertion

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
70				TELCOM NON ESS - AC 2 lt on	
71				FLOODLIGHTS - SECONDARY ON lt on	
72				FLOODLIGHTS PRIMARY - as required	
73				SUIT COMPRESSOR COMP No. 1 - AC 1 lt on	
74				ECS GLYCOL PUMP 1 - AC 1 lt on	
75				POWER - VOX lt on	
76				S-BAND - T/R lt on	
77				VHF AM - T/R lt on	
78				INTERCOM - T/R lt on	
79				CABIN AIR FAN - 1 ON lt on	
80				CABIN AIR FAN - 2 ON lt on	
81				POT H_2O HEATER - MN A lt on	

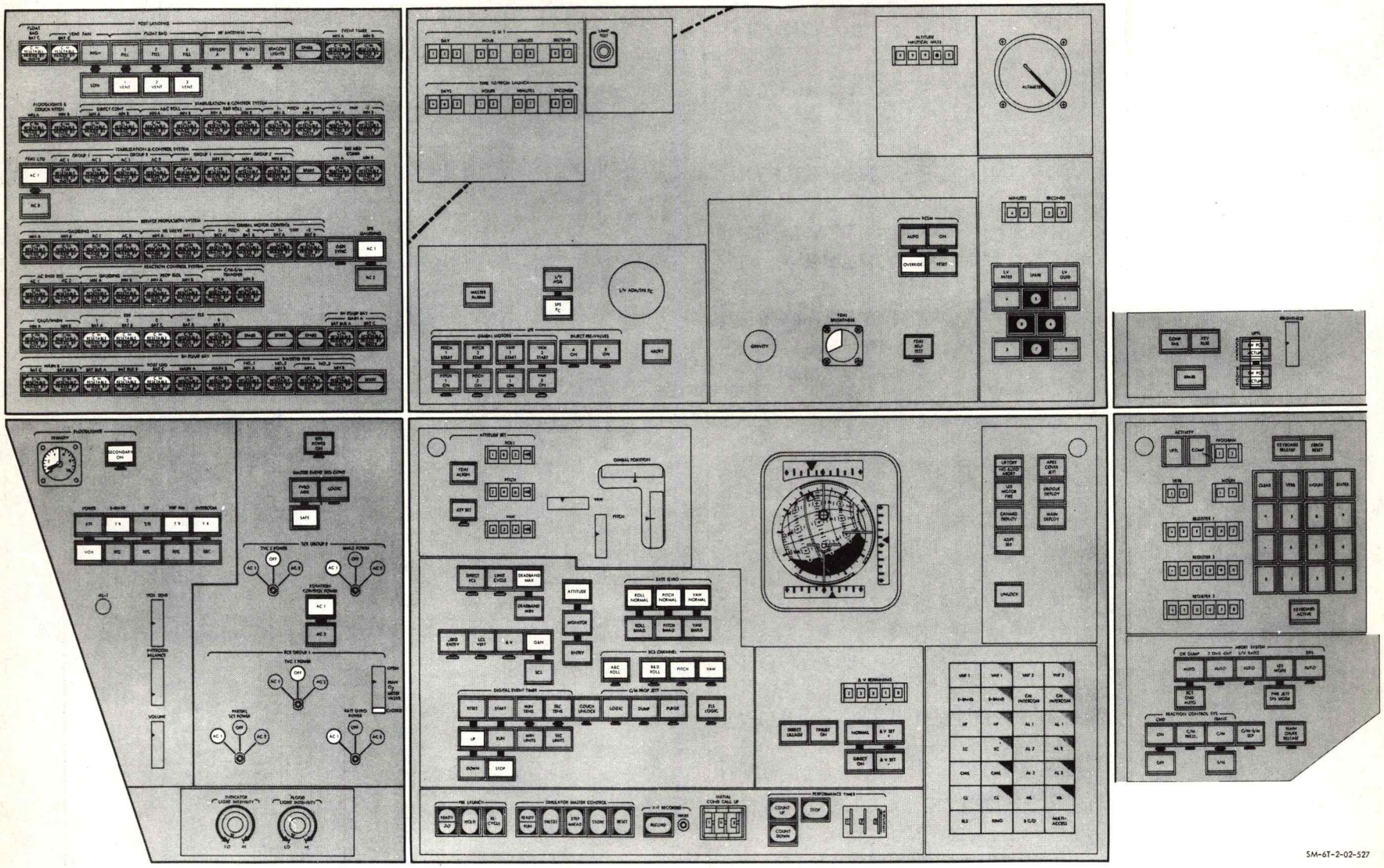


Station 1 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				FLOAT BAG BAT C C/M RESETABLE lt on	
2				VENT FAN - C/M RESETABLE lt on	
3				FLOAT BAG - 1 VENT lt on	
4				FLOAT BAG - 2 VENT lt on	
5				FLOAG BAG - 3 VENT lt on	
6				FDAI LTG - AC 1 lt on	
7				SPS GAUGING - AC 1 lt on	
8				EDS 1 BAT A - C/M RESETABLE lt on	
9				EDS 2 BAT B - C/M RESETABLE lt on	
10				EDS 3 BAT C - C/M RESETABLE lt on	
11				FLOODLIGHTS SECONDARY lt on	
12				POWER - VOX lt on	
13				S-BAND - T/R lt on	

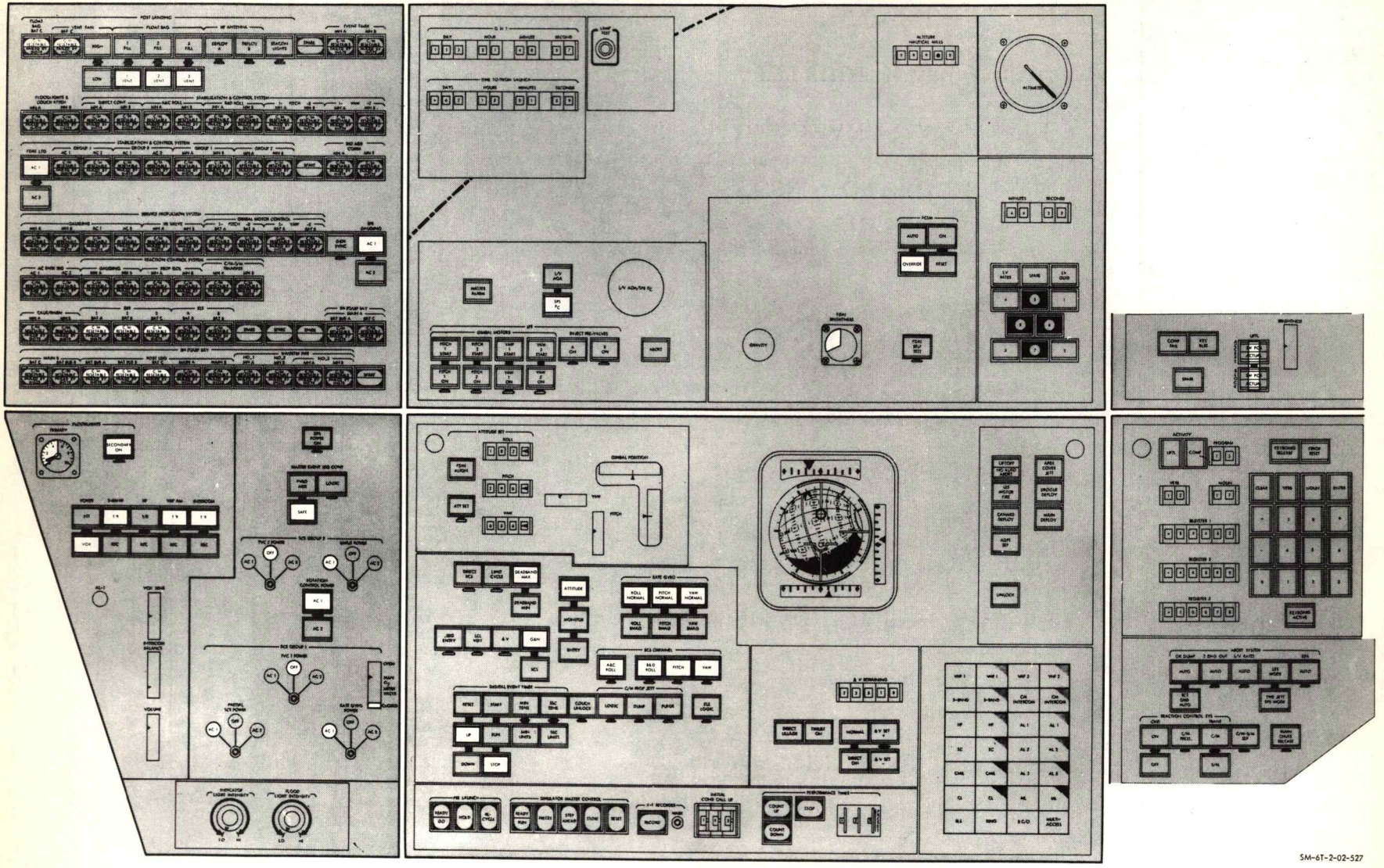


Station 1 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14				VHF AM - T/R lt on	
15				INTERCOM - T/R lt on	
16				MASTER EVENT SEQ CONT - SAFE lt on	
17				TVC 2 POWER - OFF lt on	
18				BMAG POWER - AC 1 lt on	
19				ROTATIONAL CONTROL POWER - AC 1 lt on	
20				TVC 1 POWER - OFF lt on	
21				PARTIAL SCS POWER - AC 1 lt on	
22				RATE GYRO POWER - AC 1 lt on	
23				SPS P_C lt on	
24				FCSM - OVERRIDE lt on	
25				DEADBAND MAX lt on	
26				ATTITUDE lt on	



Station 1 Orbital Routines (S-IVB Separated)

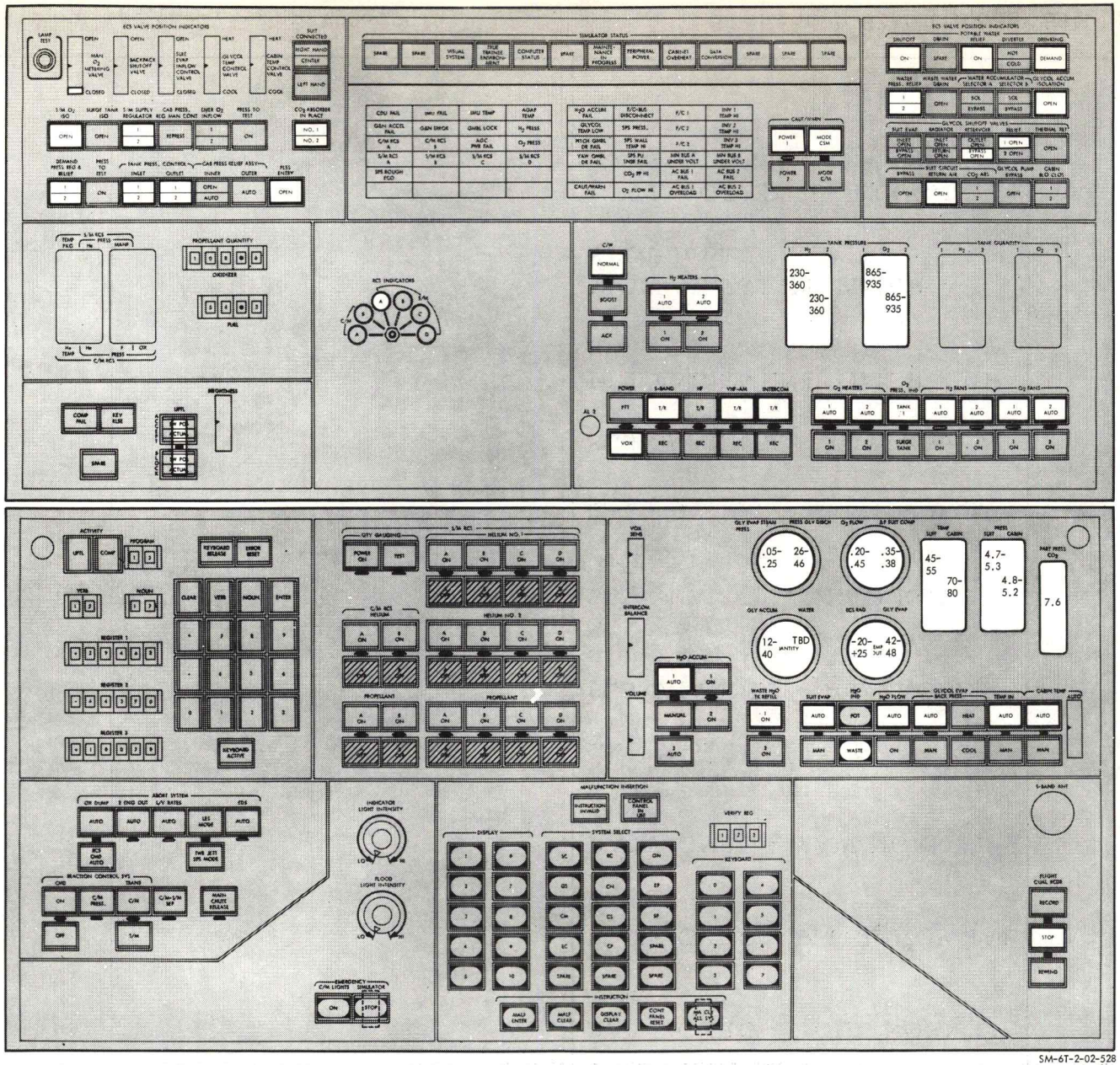
S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				RATE GYRO - ROLL NORMAL lt on	
28				RATE GYRO - PITCH NORMAL lt on	
29				RATE GYRO - YAW NORMAL lt on	
30				G&N lt on	
31				SCS CHANNEL - A&C ROLL lt on	
32				SCS CHANNEL - B&D ROLL lt on	
33				SCS CHANNEL - PITCH lt on	
34				SCS CHANNEL - YAW lt on	
35				DIGITAL EVENT TIMER - UP lt on	
36				DIGITAL EVENT TIMER - STOP lt on	
37				UPTL ACCEPT or BLOCK lts as selected	

Station 1 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)



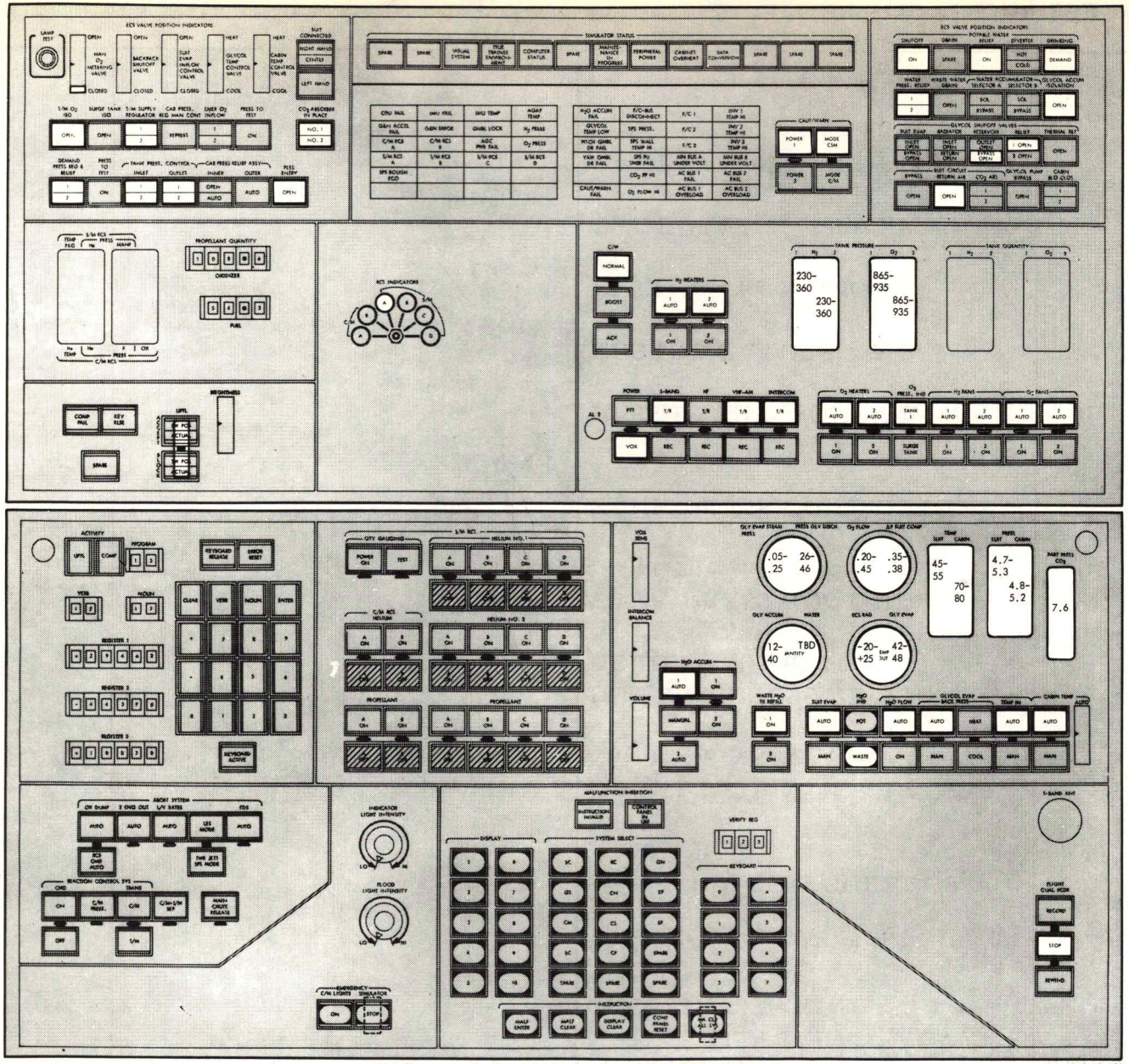
SM-6T-2-02-528

Station 2 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				MAN O_2 METERING VALVE - CLOSED	
2				S/M O_2 ISO - OPEN lt on	
3				S/M SUPPLY REGULATOR - 1 and 2 lt on	
4				CO_2 ABSORBER IN PLACE - No. 1 and No. 2 lt on	
5				DEMAND PRESS REG & RELIEF - 1 and 2 lt on	
6				TANK PRESS CONT INLET - 1 and 2 lt on	
7				TANK PRESS CONT OUTLET - 1 and 2 lt on	
8				PLSS ENTRY - OPEN lt on	
9				ECS INDICATORS - A lt on	
10				UPTL lt - as selected	
11				CAUT/WARN - POWER 1 lt on	
12				CAUT/WARN - MODE CSM lt on	

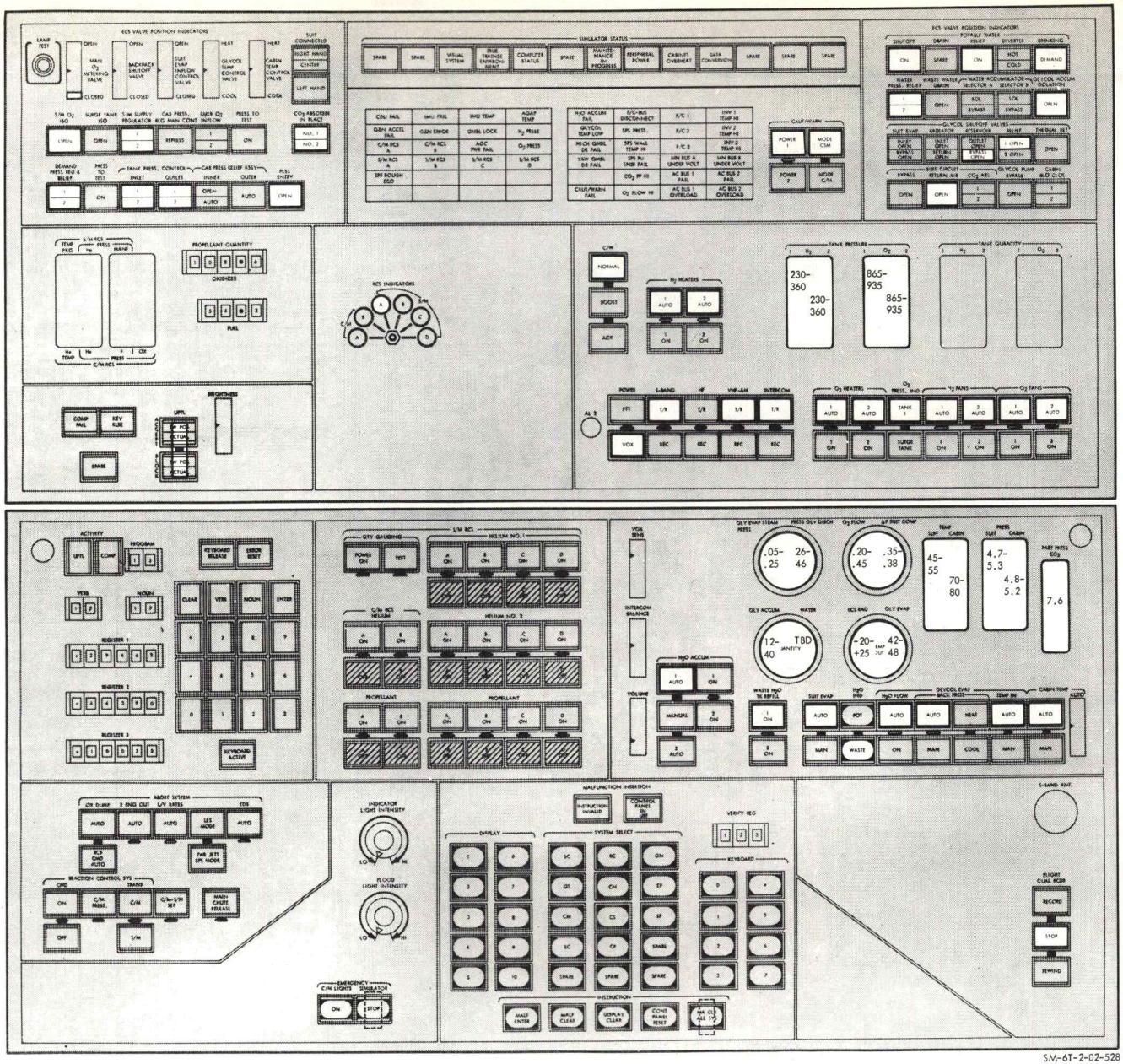


Station 2 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				POTABLE WATER SHUTOFF - OPEN lt on	
14				POTABLE WATER RELIEF - ON lt on	
15				POTABLE WATER DRINKING - DEMAND lt on	
16				WATER PRESS RELIEF - 1 and 2 lt on	
17				GLYCOL ACCUM ISOLATION - OPEN lt on	
18				RESERVOIR - BYPASS OPEN lt on	
19				RELIEF - 1 OPEN lt on	
20				SUIT CIRCUIT RETURN AIR - OPEN lt on	
21				C/W - NORMAL lt on	
22				H_2 HEATERS - 1 AUTO lt on	
23				H_2 HEATERS - 2 AUTO lt on	
24				TANK PRESSURE H_2 1 ind - 230-360	



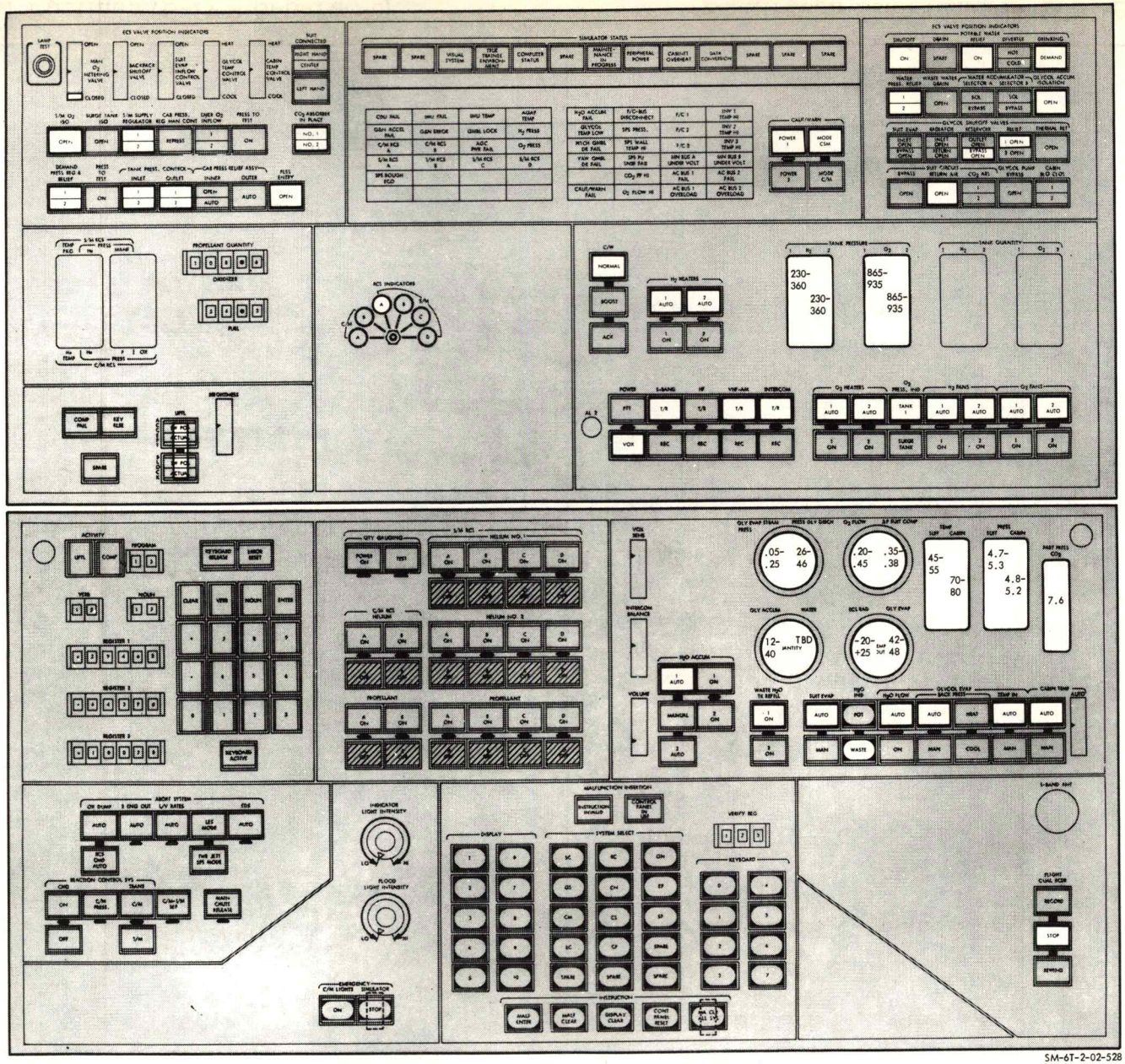
SM-6T-2-02-528

Station 2 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
25				TANK PRESSURE H_2 2 ind - 230-360	
26				TANK PRESSURE O_2 1 ind - 865-935	
27				TANK PRESSURE O_2 2 ind - 865-935	
28				POWER - VOX lt on	
29				S-BAND - T/R lt on	
30				VHF AM - T/R lt on	
31				INTERCOM - T/R lt on	
32				O_2 HEATERS - 1 AUTO lt on	
33				O_2 HEATERS - 2 AUTO lt on	
34				O_2 PRESS IND - TANK 1 lt on	
35				H_2 FAN - 1 AUTO lt on	
36				H_2 FAN - 2 AUTO lt on	
37				O_2 FAN - 1 AUTO lt on	
38				O_2 FAN - 2 AUTO lt on	

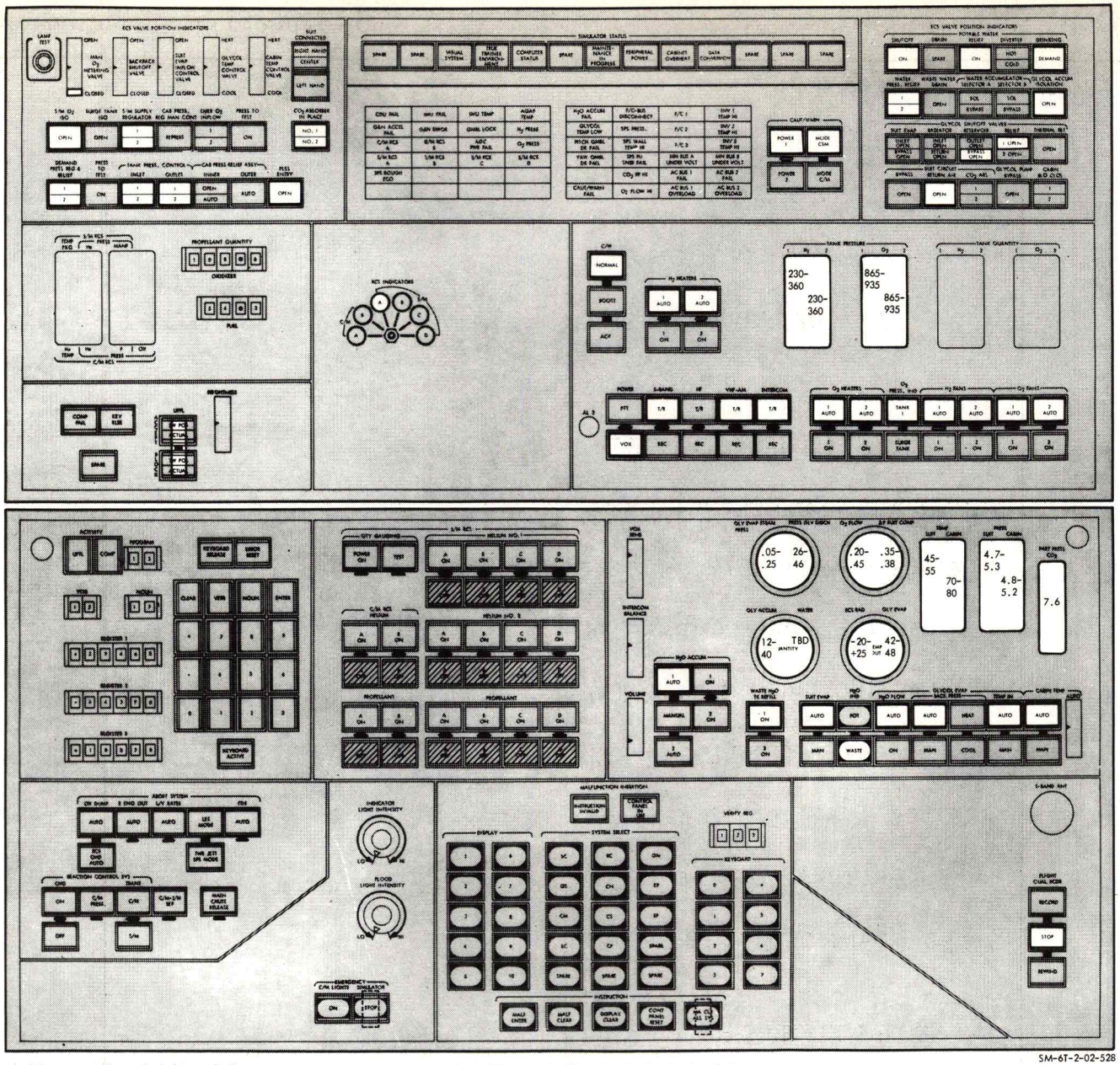


Station 2 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
39				GLY EVAP STEAM PRESS ind - .05-.25	
40				PRESS GLY DISCH ind - 26-46	
41				O_2 FLOW ind - .20-.45	
42				ΔP SUIT COMP ind - .35-.38	
43				TEMP SUIT ind - 45-55	
44				TEMP CABIN ind - 70-80	
45				PRESS SUIT ind - 4.7-5.3	
46				PRESS CABIN ind - 4.8-5.2	
47				PART PRESS CO_2 ind - 7.6	
48				GLY ACCUM ind - 12-40	
49				WATER ind - TBD	
50				ECS RAD ind - 20 - +75	
51				H_2O ACCUM - 1 AUTO lt on	
52				WASTE H_2O TK REFILL - 1 ON lt on	

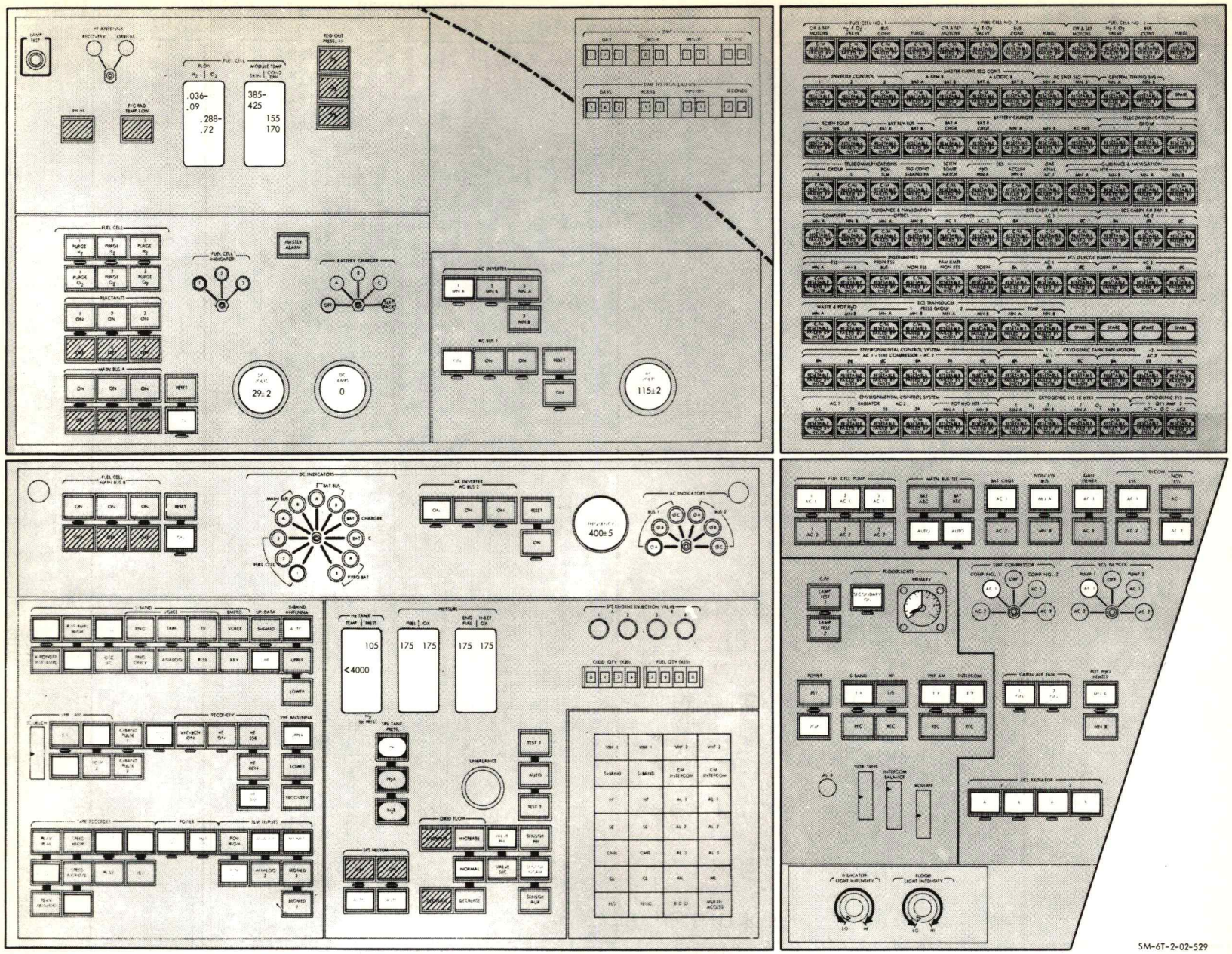


Station 2 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
53				H_2O IND - WASTE lt on	
54				H_2O FLOW - AUTO lt on	
55				BACK PRESS - AUTO lt on	
56				TEMP IN - AUTO lt on	
57				CABIN TEMP - AUTO lt on	
58				FLT QUAL RCDR - STOP lt on	

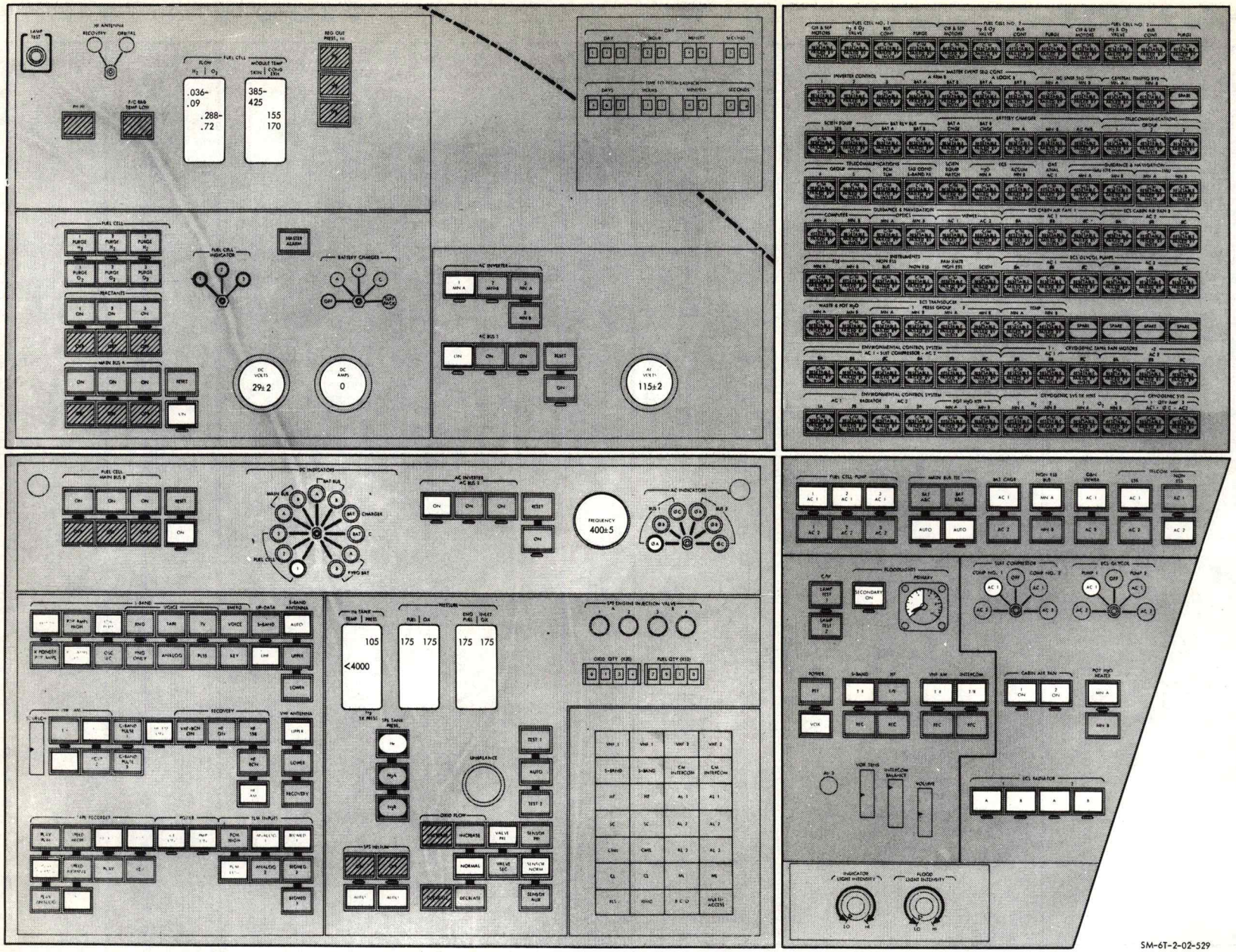


Station 3 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				PH HI ind - gray	
2				F/C RAD TEMP LO ind - gray	
3				FUEL CELL FLOW H_2 ind - .036-.09	
4				FUEL CELL FLOW O_2 ind - .288-.72	
5				MODULE TEMP SKIN ind - 385-425	
6				MODULE TEMP COND EXH ind - 155-170	
7				REG OUT PRESS HI O_2 ind - gray	
8				REG OUT PRESS HI H_2 ind - gray	
9				REG OUT PRESS HI N_2 ind - gray	
10				FUEL CELL INDICATOR - 1 lt on	
11				BATTERY CHARGER - OFF lt on	

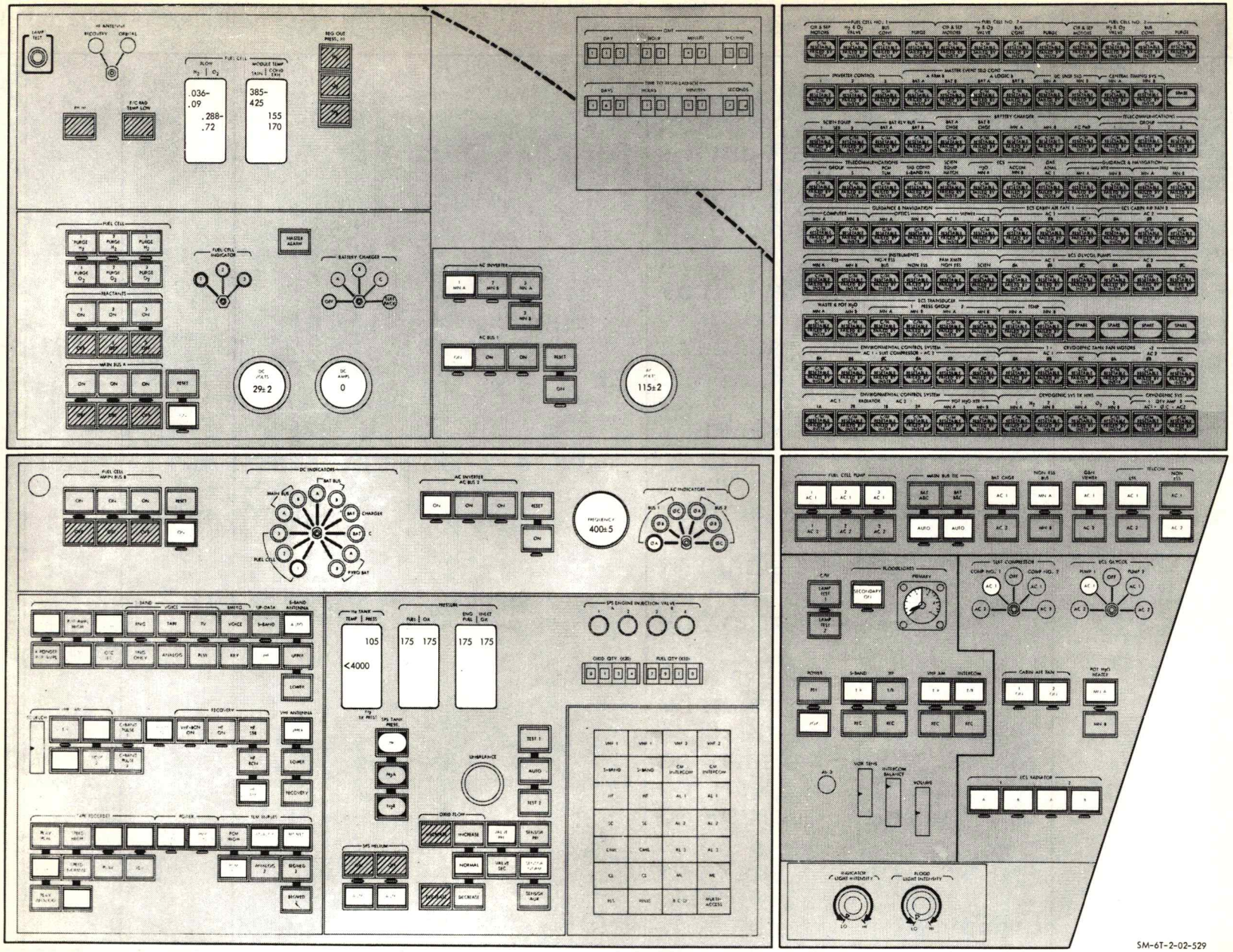


Station 3 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12				AC INVERTER - 1 MN A lt on	
13				MAIN BUS A RESET - ON lt on	
14				DC VOLTS ind - 29±2	
15				DC AMPS ind - 0	
16				AC INVERTER 1 - AC BUS 1 - ON lt on	
17				AC VOLTS ind - 115±2	
18				MAIN BUS B RESET - ON lt on	
19				DC INDICATORS FUEL CELL - 1 lt on	
20				AC INVERTER 1 - AC BUS 2 - ON lt on	
21				FREQUENCY ind - 400±5	
22				AC INDICATORS BUS 1 - ØA lt on	
23				S-BAND - XPONDER lt on	
24				S-BAND - POWER AMPL LOW lt on	

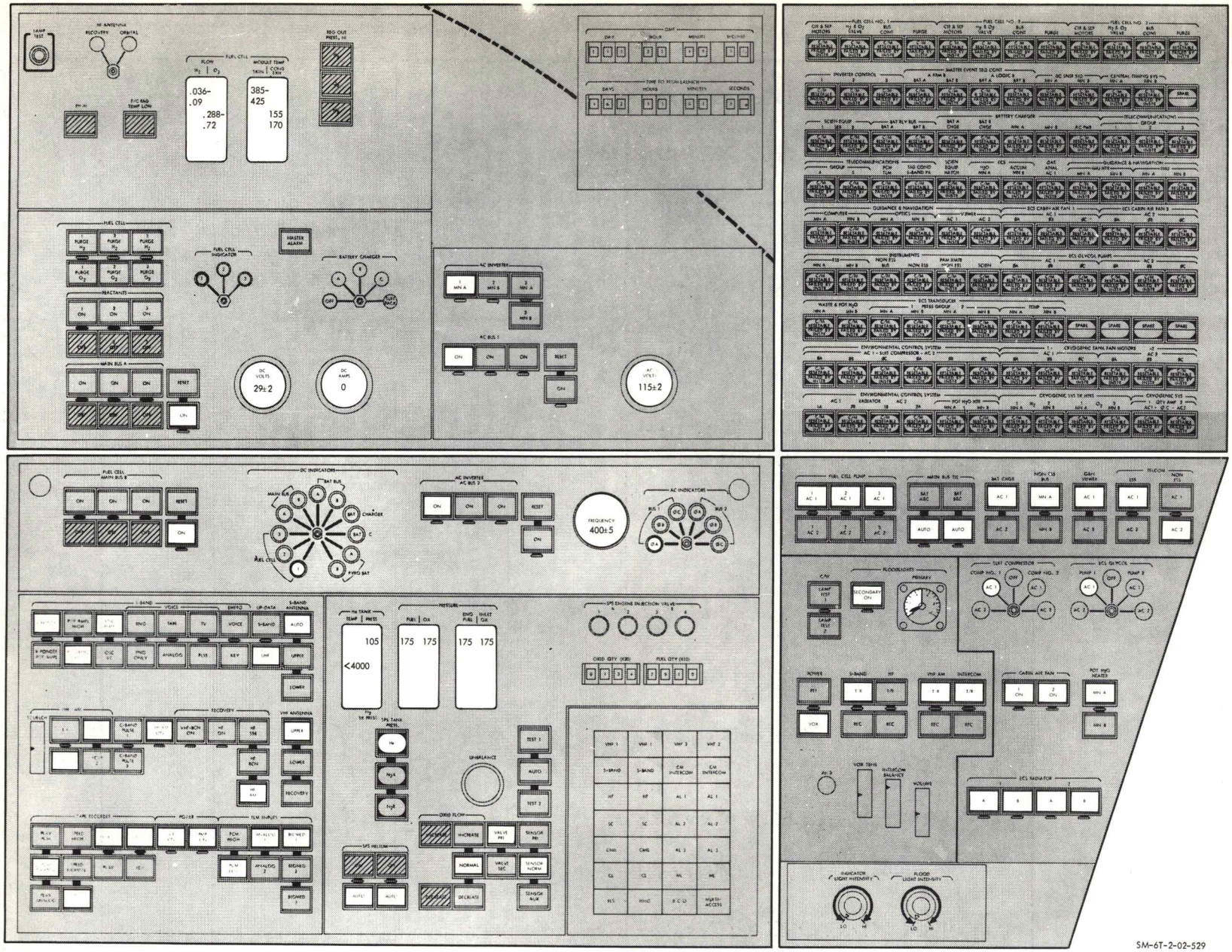


Station 3 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
25				S-BAND - OSC PRIM lt on	
26				UP-DATA - UHF lt on	
27				S-BAND ANTENNA - AUTO lt on	
28				VHF AM - REC lt on	
29				VHF AM - RCVR 1 lt on	
30				VHF FM ON lt on	
31				RECOVERY HF AM lt on	
32				VHF ANTENNA - UPPER lt on	
33				TAPE RECORDER - PLAY NORMAL lt on	
34				TAPE RECORDER - SPEED LOW lt on	
35				TAPE RECORDER - RECORD lt on	
36				TAPE RECORDER - FWD lt on	
37				POWER SCE lt on	
38				POWER PMP lt on	

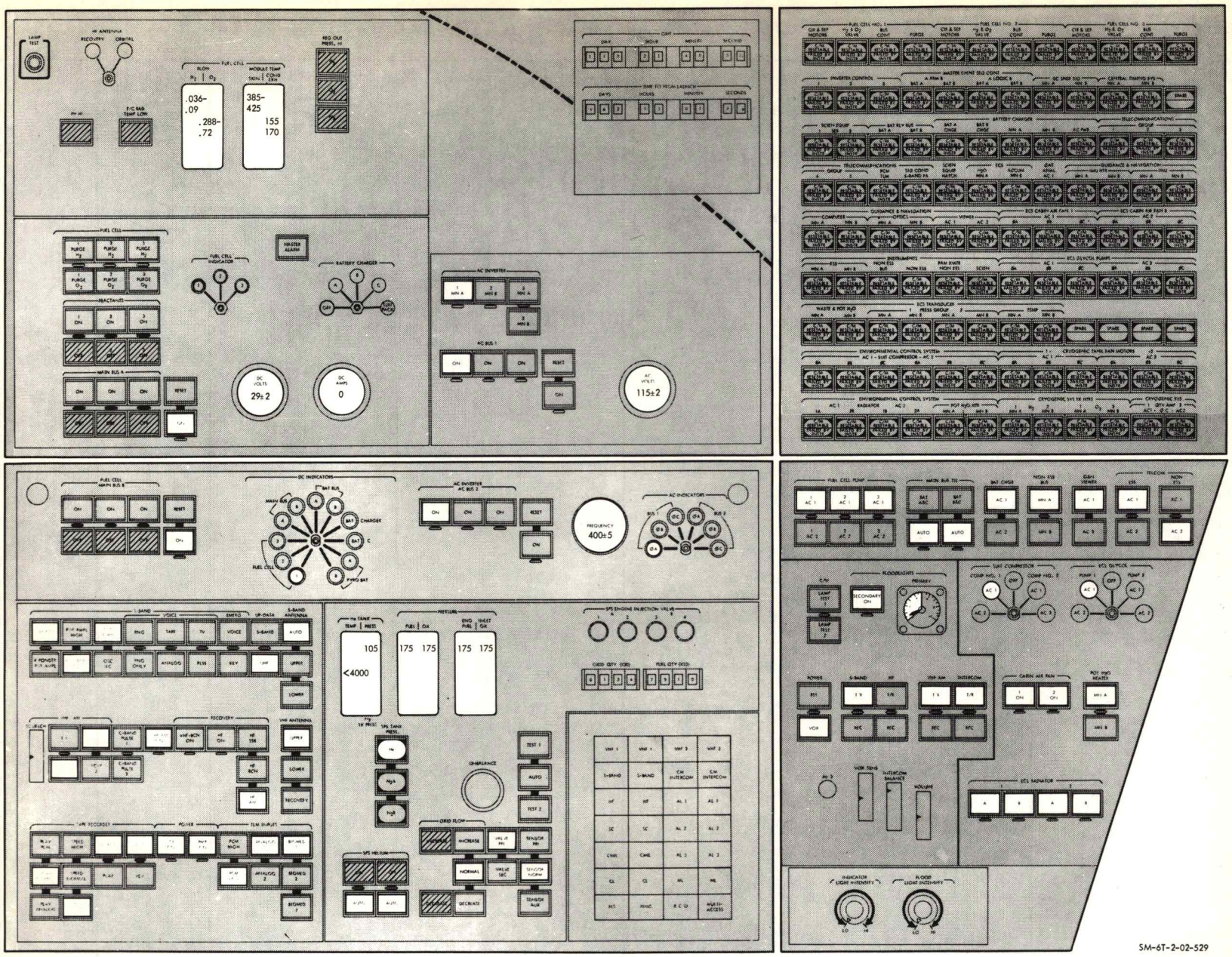


Station 3 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
39				TLM INPUTS - PCM LOW lt on	
40				TLM INPUTS - ANALOG 1 lt on	
41				TLM INPUTS - BIOMED 1 lt on	
42				He TANK PRESS ind - 4000	
43				He TANK TEMP ind - 105	
44				PRESSURE FUEL ind - 175	
45				PRESSURE OX ind - 175	
46				PRESSURE ENG INLET ind - 175	
47				PRESSURE INLET OX ind - 175	
48				SPS TANK PRESS - He lt on	
49				Left SPS HELIUM - AUTO lt on	
50				Right SPS HELIUM - AUTO lt on	
51				OXID FLOW - NORMAL lt on	
52				VALVE PRI lt on	
53				SENSOR NORM lt on	

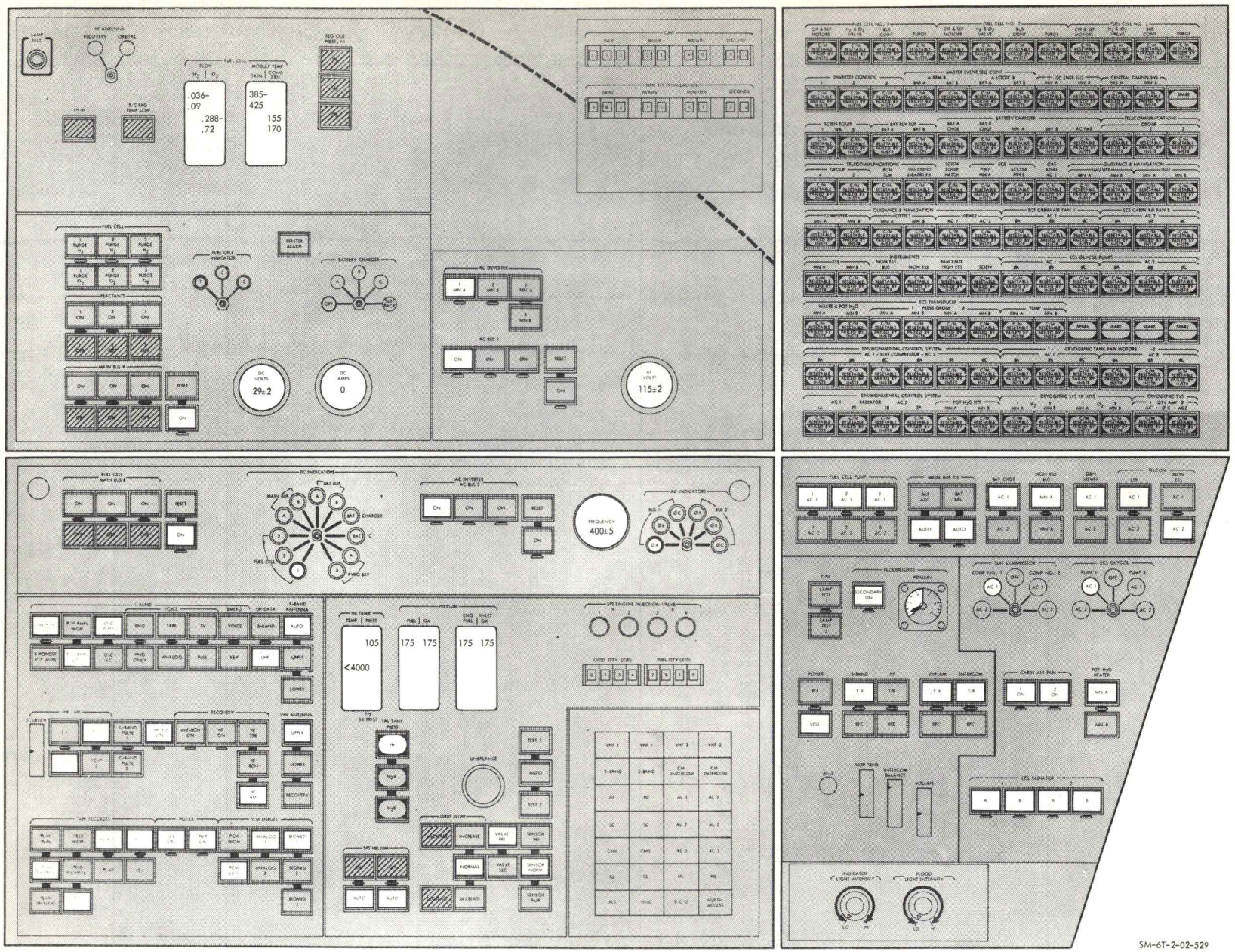


Station 3 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
54				FUEL CELL PUMP - 1 AC 1 lt on	
55				FUEL CELL PUMP - 2 AC 1 lt on	
56				FUEL CELL PUMP - 3 AC 1 lt on	
57				MAIN BUS TIE BAT A&C - AUTO lt on	
58				MAIN BUS TIE BAT B&C - AUTO lt on	
59				BAT CHGR - AC 1 lt on	
60				NON ESS BUS - MN A lt on	
61				G&N VIEWER - AC 1 lt on	
62				TELCOM ESS - AC 1 lt on	
63				TELCOM NON ESS - AC 2 lt on	
64				FLOODLIGHTS - SECONDARY ON lt on	
65				FLOODLIGHTS PRIMARY - as required	

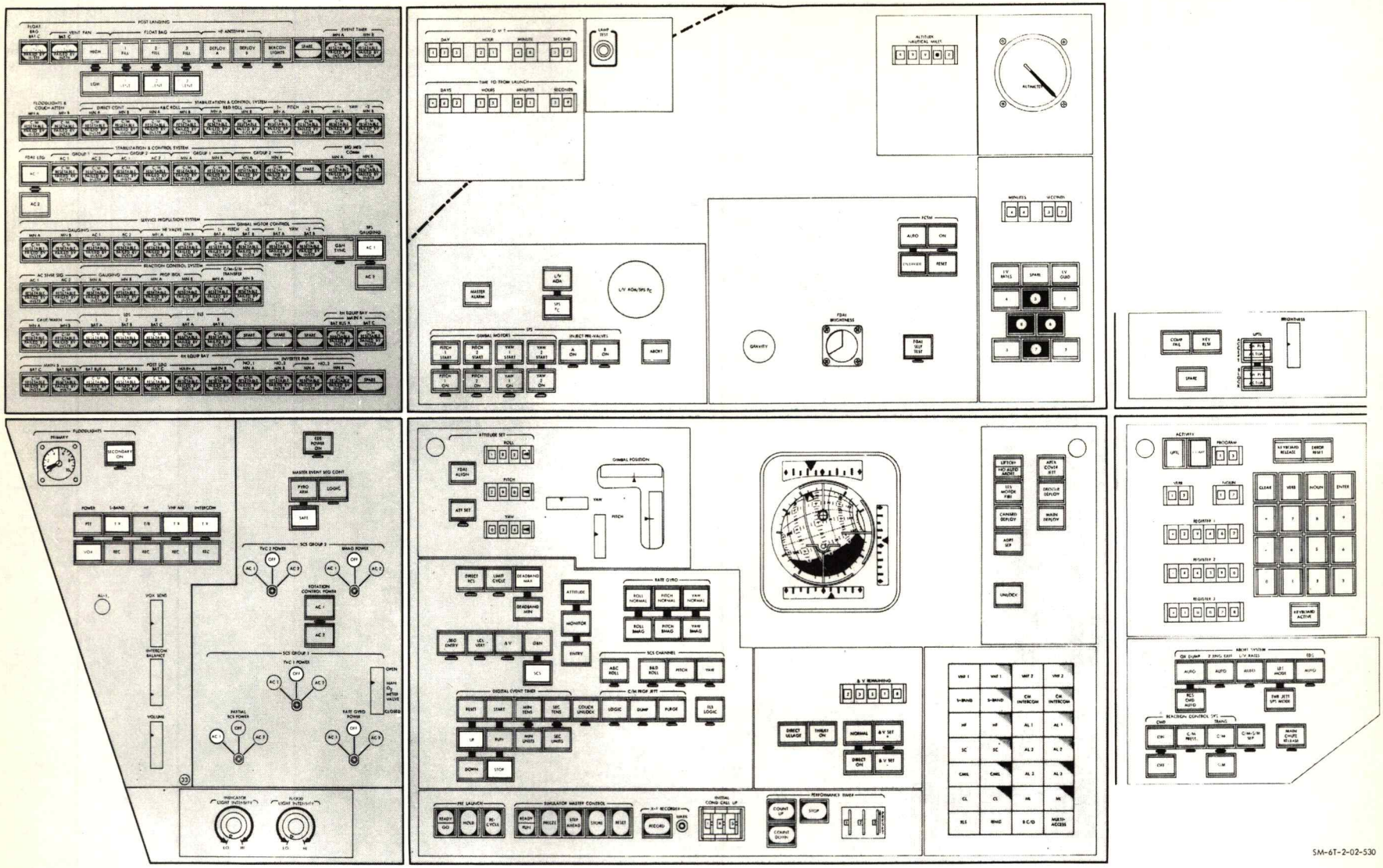


Station 3 Orbital Routines (S-IVB Separated)

S4 through S210 (Except S5B, S13A, B and C)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
66				SUIT COMPRESSOR COMP No. 1 - AC lt on	
67				ECS GLYCOL PUMP 1 - AC 1 lt on	
68				POWER - VOX lt on	
69				S-BAND - T/R lt on	
70				VHF AM - T/R lt on	
71				INTERCOM - T/R lt on	
72				CABIN AIR FAN - 1 ON lt on	
73				CABIN AIR FAN - 2 ON lt on	
74				POT H_2O HEATER - MN A lt on	
75				ECS RADIATOR 1 - A lt on	
76				ECS RADIATOR 1 - B lt on	
77				ECS RADIATOR 2 - A lt on	
78				ECS RADIATOR 2 - B lt on	



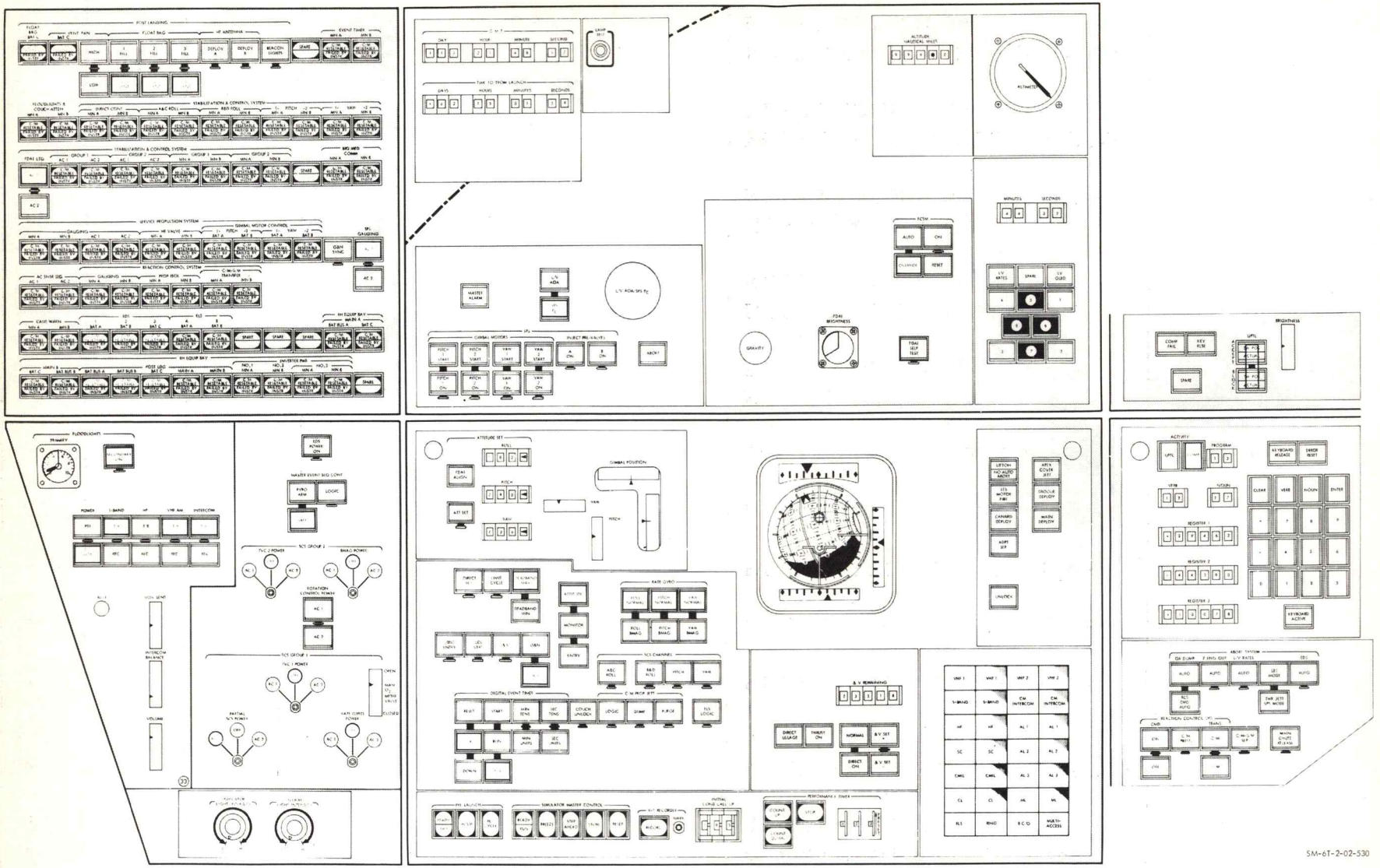
SM-6T-2-02-530

Station 1 Orbital Routines (S-IVB Attached)

S5B

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				FLOAT BAG BAT C - C/M RESETABLE lt on	
2				VENT FAN - C/M RESETABLE lt on	
3				FLOAT BAG - 1 VENT lt on	
4				FLOAT BAG - 2 VENT lt on	
5				FLOAT BAG - 3 VENT lt on	
6				FDAI LTG - AC 1 lt on	
7				SPS GAUGING - AC 1 lt on	
8				EDS 1 BAT A - C/M RESETABLE lt on	
9				EDS 2 BAT B - C/M RESETABLE lt on	
10				EDS 3 BAT C - C/M RESETABLE lt on	
11				POST LDG BAT BUS A - C/M RESETABLE lt on	
12				POST LDG BAT BUS B - C/M RESETABLE lt on	

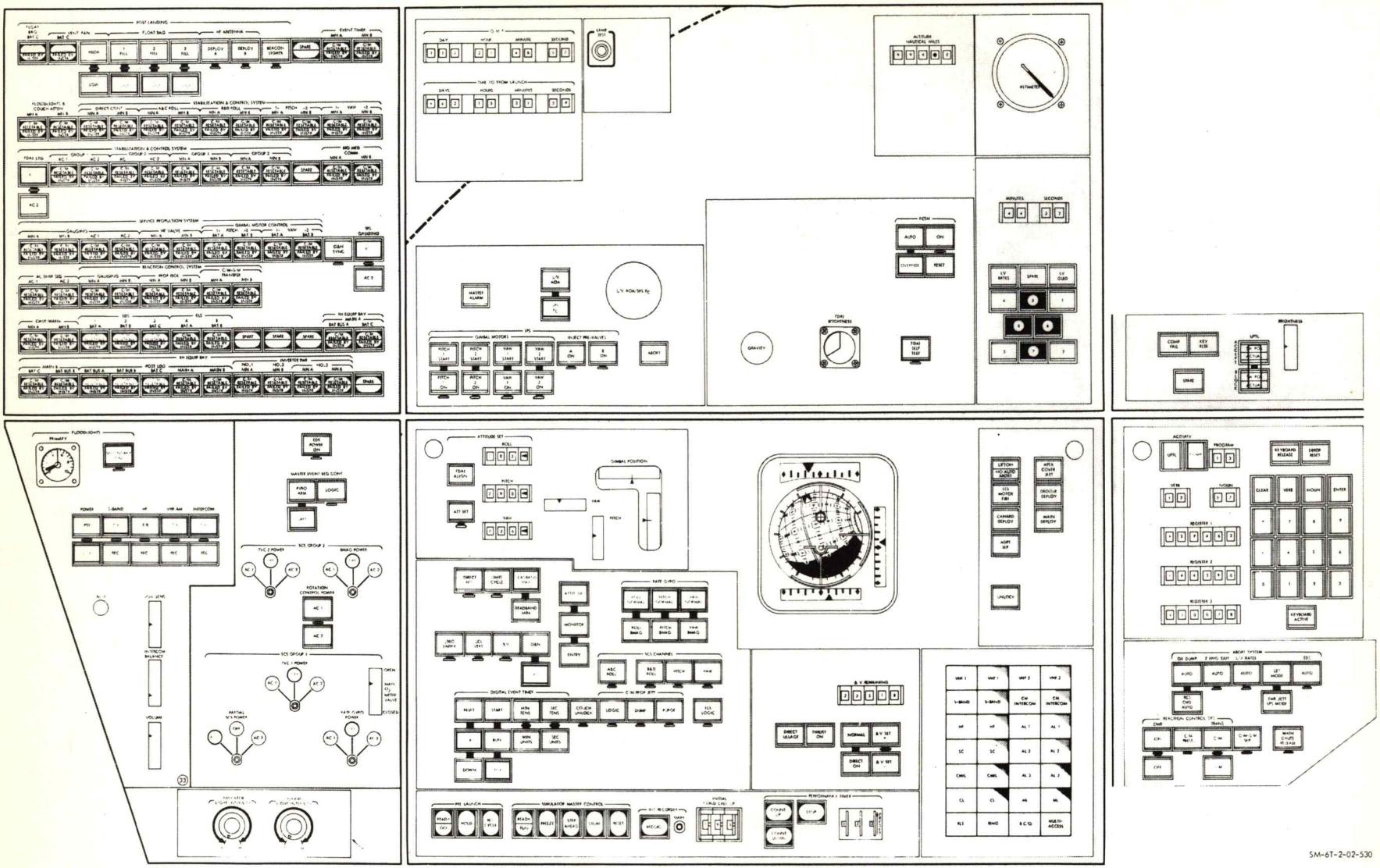


Station 1 Orbital Routines (S-IVB Attached)

S5B

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				POST LDG BAT C - C/M RESETABLE lt on	
14				FLOODLIGHTS PRIMARY - as required	
15				FLOODLIGHTS - SECONDARY ON lt on	
16				POWER - VOX lt on	
17				S-BAND - T/R lt on	
18				VHF AM - T/R lt on	
19				INTERCOM - T/R lt on	
20				MASTER EVENT SEQ CONT - SAFE lt on	
21				TVC 2 POWER - AC 1 lt on	
22				BMAG POWER - OFF lt on	
23				TVC 1 POWER - TVC 1 POWER - OFF lt on	
24				PARTIAL SCS POWER - AC 1 lt on	

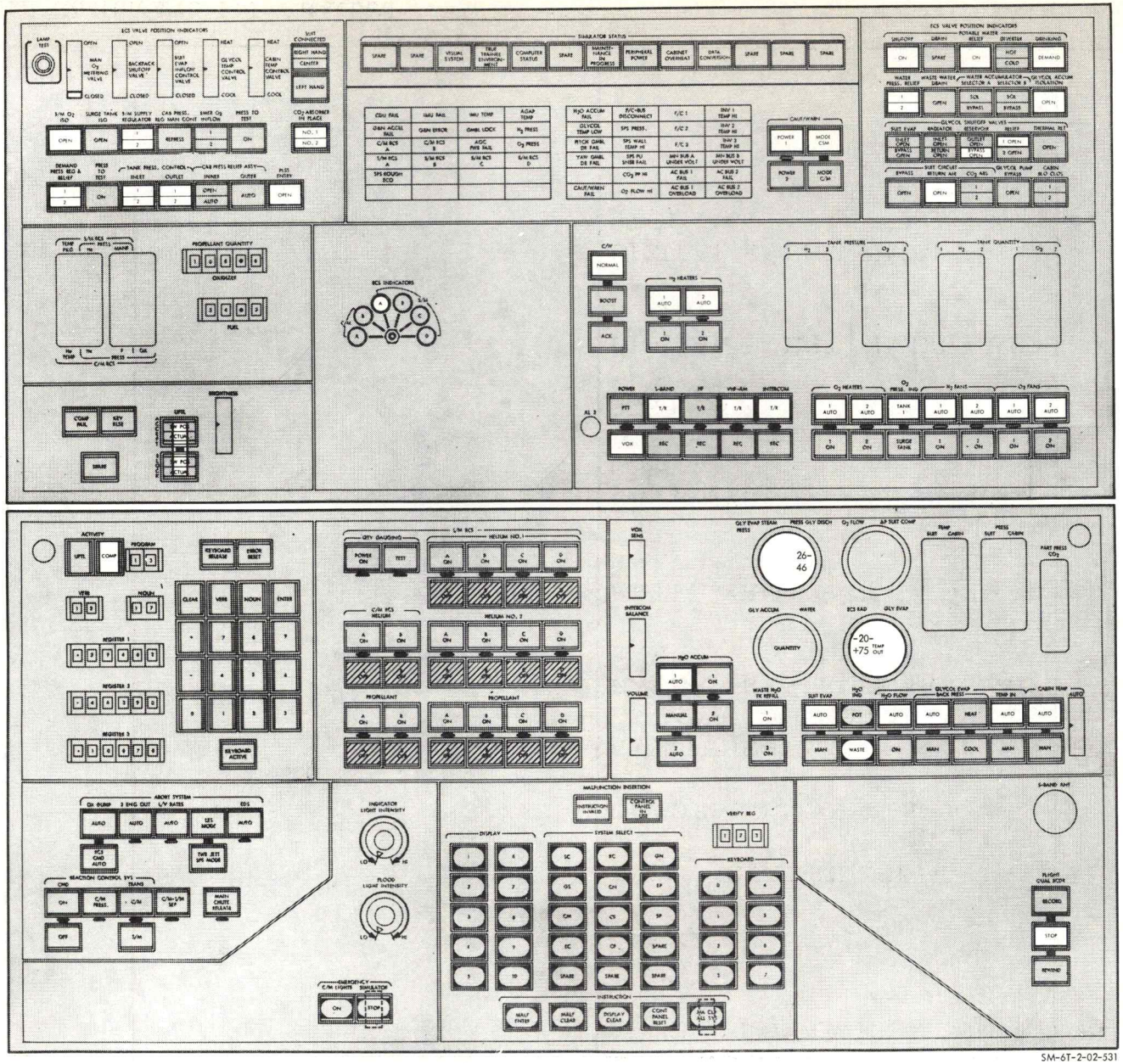


Station 1 Orbital Routines (S-IVB Attached)

S5B

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
25				RATE GYRO POWER - OFF lt on	
26				SPS P_C lt on	
27				FCSM - OVERRIDE lt on	
28				DEADBAND MAX lt on	
29				ATTITUDE lt on	
30				RATE GYRO - ROLL NORMAL lt on	
31				RATE GYRO - PITCH NORMAL lt on	
32				RATE GYRO - YAW NORMAL lt on	
33				SCS lt on	
34				DIGITAL EVENT TIMER - UP lt on	
35				DIGITAL EVENT TIMER - STOP lt on	

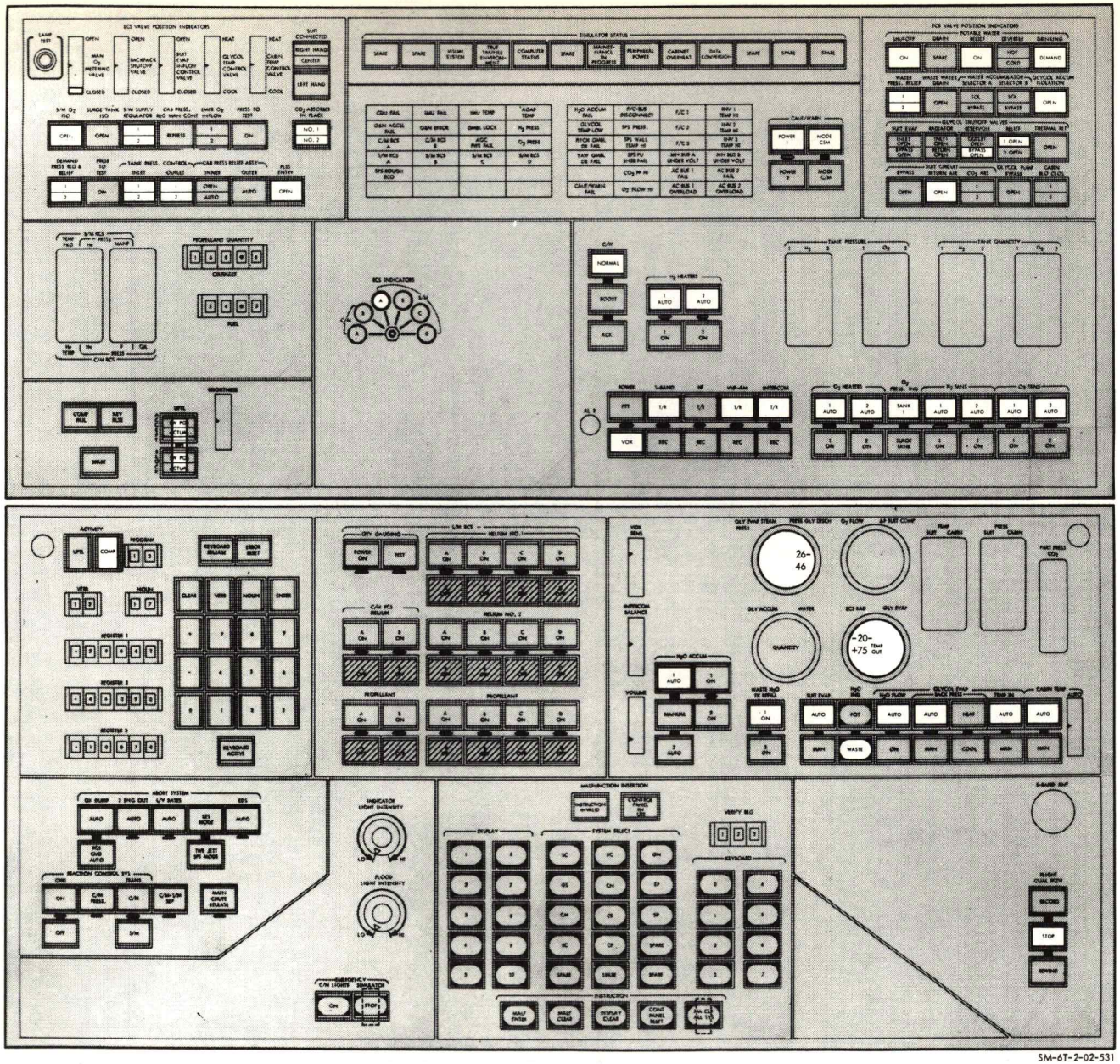


SM-6T-2-02-531

Station 2 Orbital Routines (S-IVB Attached)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				MAN O_2 METERING VALVE ind - CLOSED	
2				S/M O_2 ISO - OPEN lt on	
3				S/M SUPPLY REGULATOR - 1 and 2 lt on	
4				CO_2 ABSORBER IN PLACE - No. 1 and No. 2 lt on	
5				DEMAND PRESS REG & RELIEF - 1 and 2 lt on	
6				TANK PRESS CONTROL INLET - 1 and 2 lt on	
7				TANK PRESS CONTROL OUTLET - 1 and 2 lt on	
8				PLSS ENTRY - OPEN lt on	
9				RCE INDICATORS S/M - A lt on	
10				UPTL ACCEPT OR BLOCK lt on	
11				ACTIVITY - COMP lt on	
12				CAUT/WARN - POWER 1 lt on	



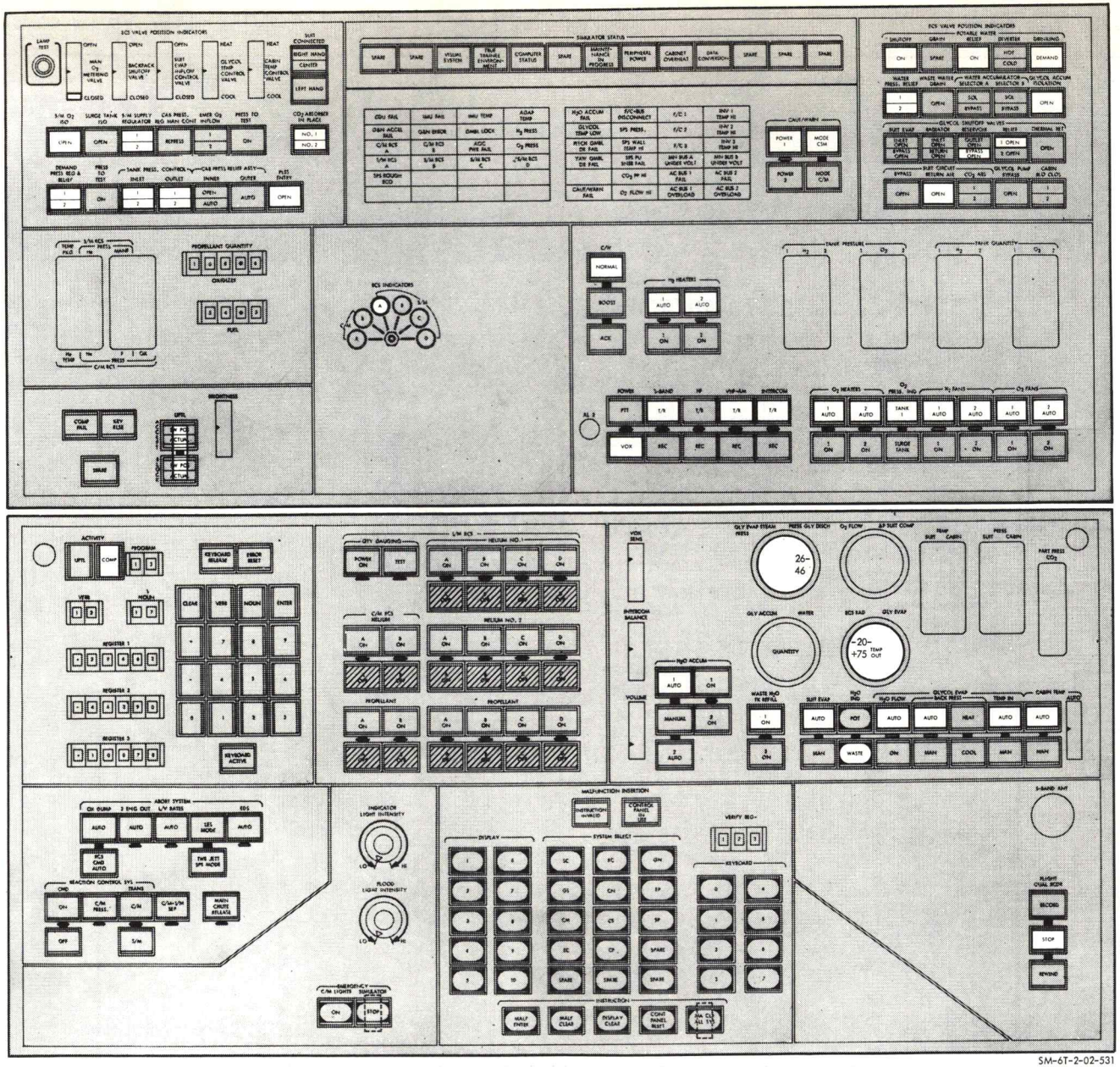
SM-6T-2-02-531

Station 2 Orbital Routines (S-IVB Attached)

S5B

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				CAUT/WARN - MODE CSM lt on	
14				POTABLE WATER SHUTOFF - ON lt on	
15				POTABLE WATER RELIEF - ON lt on	
16				POTABLE WATER DRINKING - DEMAND lt on	
17				WATER PRESS RELIEF - 1 and 2 lt on	
18				GLYCOL ACCUM ISOLATION - OPEN lt on	
19				RESERVOIR - BYPASS OPEN lt on	
20				RELIEF - 1 OPEN lt on	
21				SUIT CIRCUIT RETURN AIR - OPEN lt on	
22				C/W - NORMAL lt on	
23				H_2 HEATERS - 1 AUTO lt on	
24				H_2 HEATERS - 2 AUTO lt on	

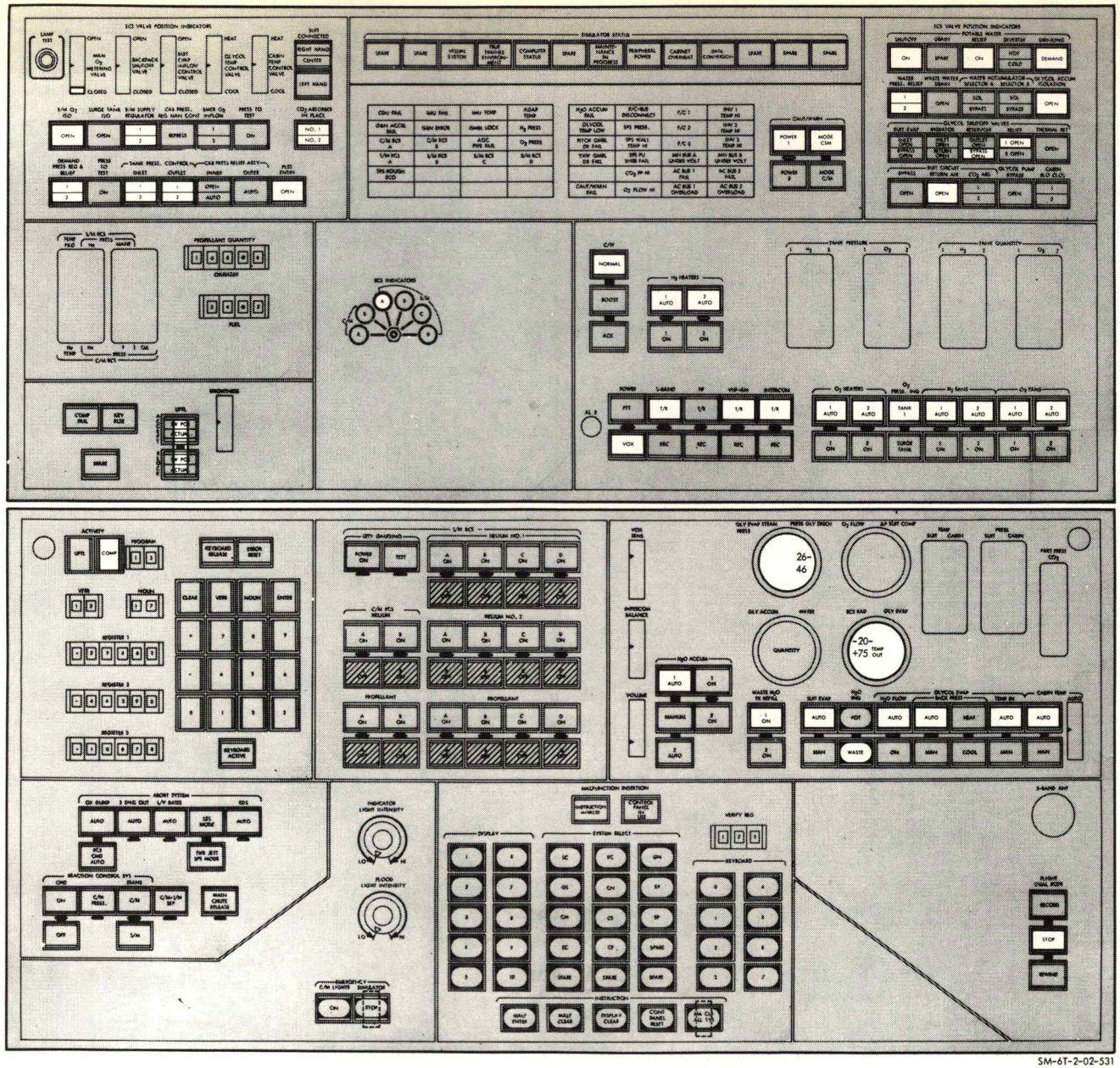


SM-6T-2-02-531

Station 2 Orbital Routines (S-IVB Attached)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
25				TANK PRESSURE H_2 1 ind - 230-360	
26				TANK PRESSURE H_2 2 ind - 230-360	
27				TANK PRESSURE O_2 1 ind - 865-935	
28				TANK PRESSURE O_2 2 ind - 865-935	
29				POWER - VOX lt on	
30				S-BAND - T/R lt on	
31				VHF AM - T/R lt on	
32				INTERCOM - T/R lt on	
33				O_2 HEATERS - 1 AUTO lt on	
34				O_2 HEATERS - 2 AUTO lt on	
35				O_2 PRESS IND - TANK 1	
36				H_2 FAN - 1 AUTO lt on	
37				H_2 FAN - 2 AUTO lt on	
38				O_2 FAN - 1 AUTO lt on	



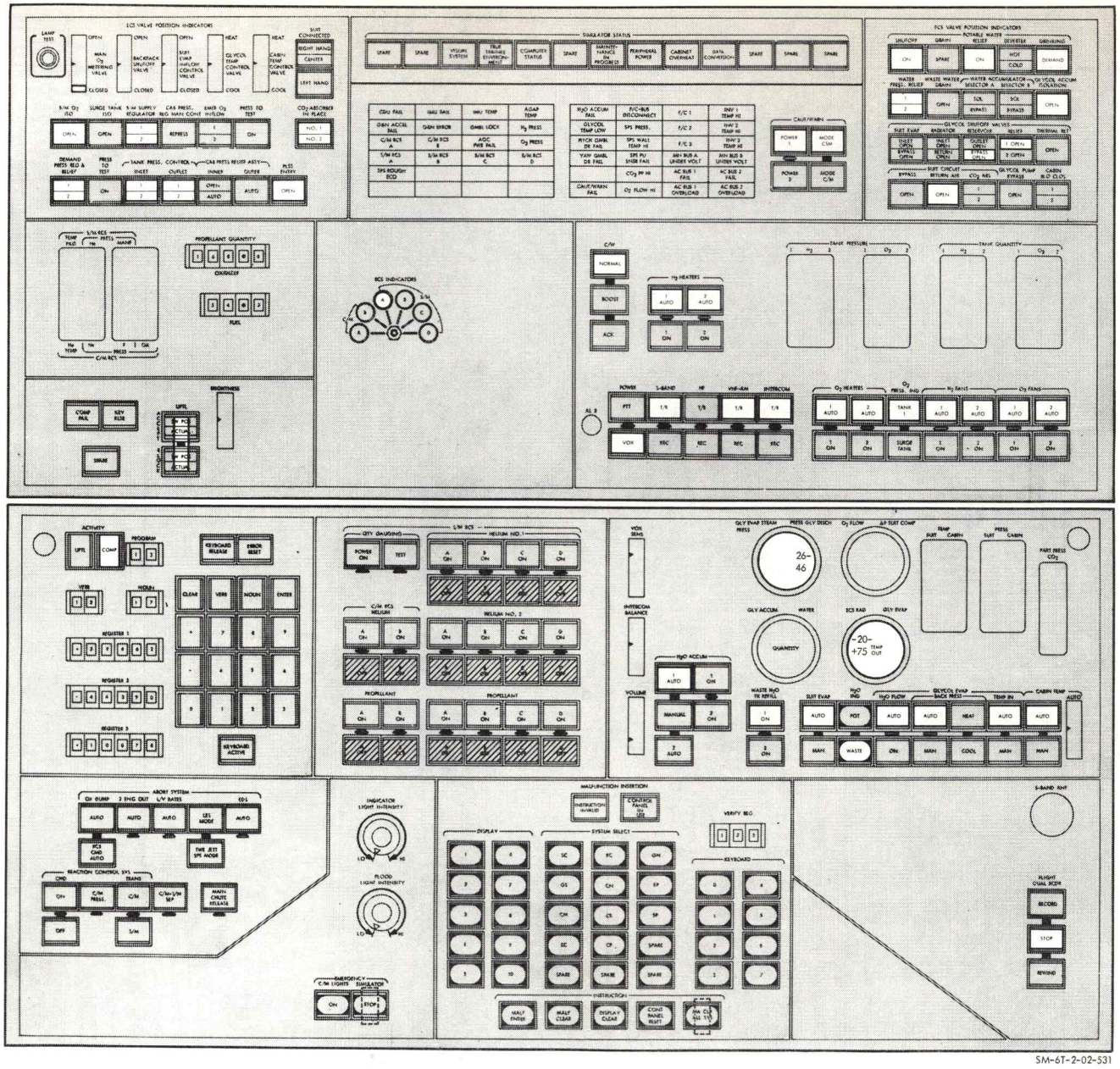
SM-6T-2-02-531

Station 2 Orbital Routines (S-IVB Attached)

S5B

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
39				O_2 FAN - 2 AUTO lt on	
40				GLY EVAP STEAM PRESS ind - .05-.25	
41				PRESS GLY DISCH ind - 26-46	
42				O_2 FLOW ind - .20-.45	
43				ΔP SUIT COMP ind - .35-.38	
44				TEMP SUIT ind - 45-55	
45				TEMP CABIN ind - 70-80	
46				PRESS SUIT ind - 4.7-5.3	
47				PRESS CABIN ind - 4.8-5.2	
48				PART PRESS CO_2 ind - 7.6	
49				GLY ACCUM ind - 12-40	
50				WATER ind - TBD	
51				ECS RAD ind - -20 - +75	
52				GLY EVAP ind - 42-48	
53				H_2O ACCUM - 1 AUTO lt on	



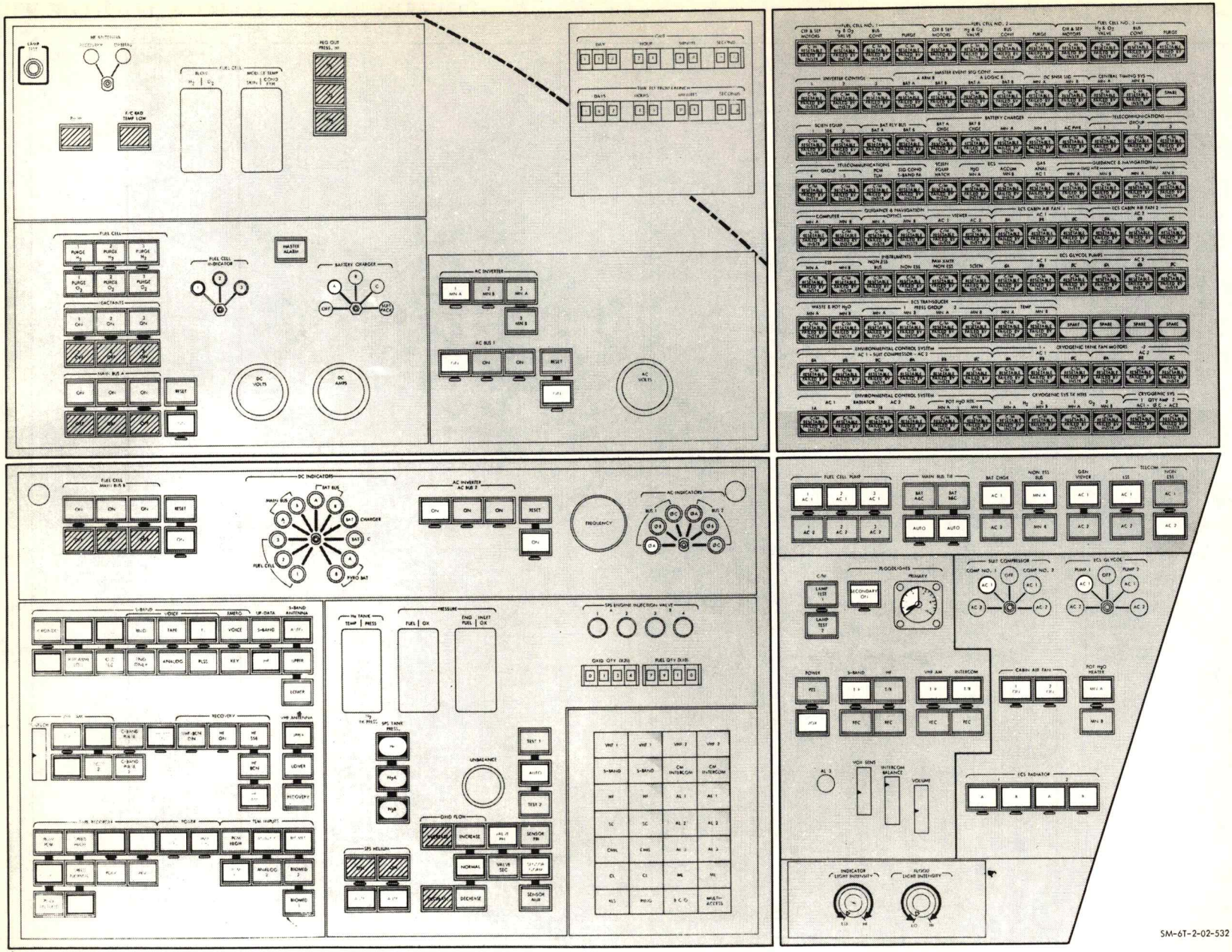
SM-6T-2-02-531

Station 2 Orbital Routines (S-IVB Attached)

S5 B

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
54				WASTE H_2O TK REFILL - 1 ON lt on	
55				SUIT EVAP - AUTO lt on	
56				H_2O FLOW - AUTO lt on	
57				BACK PRESS - AUTO lt on	
58				TEMP IN - AUTO lt on	
59				CABIN TEMP - AUTO lt on	
60				FLT QUAL RCDR - STOP lt on	

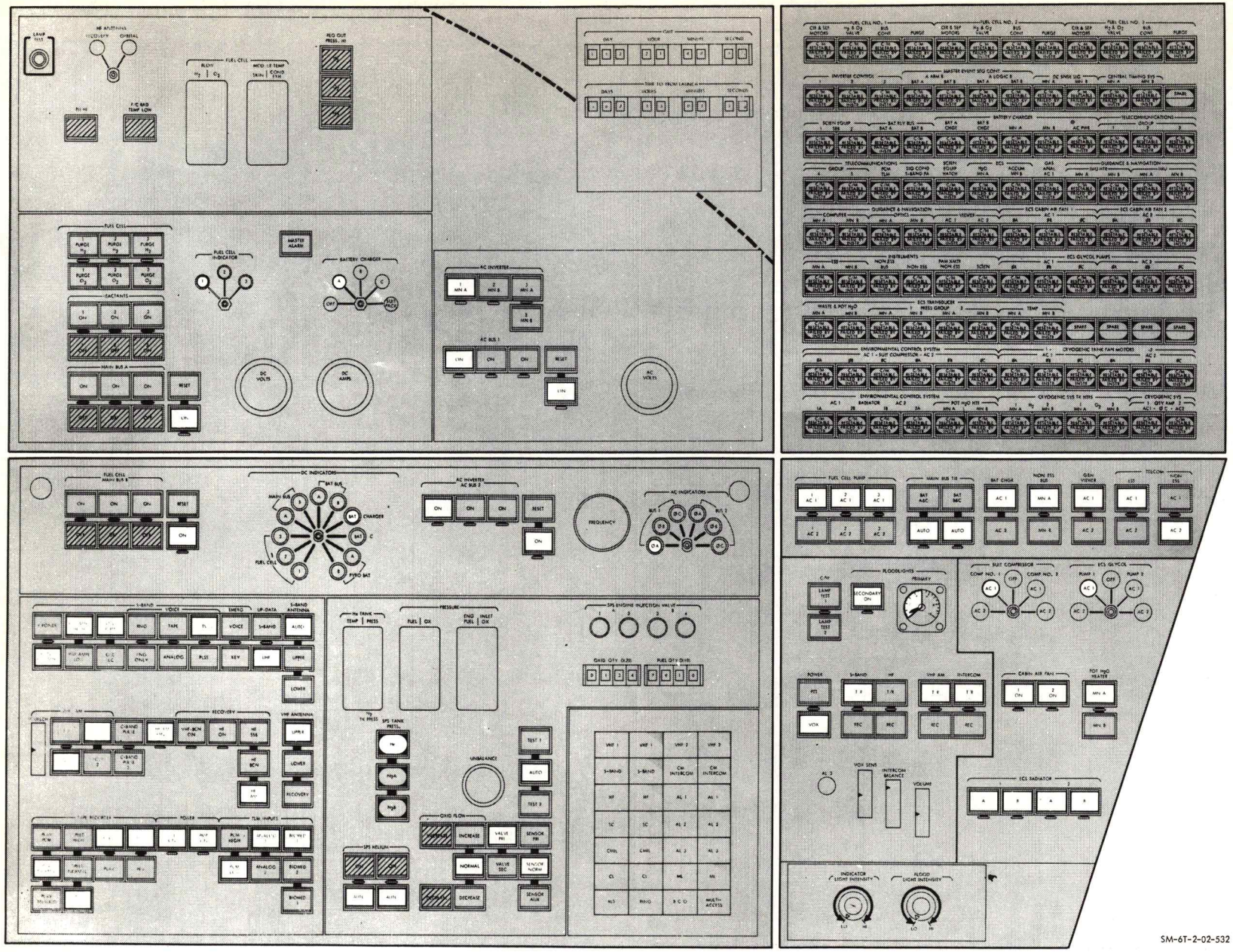


Station 3 Orbital Routines (S-IVB Attached)

S5B

Initialization Data Sheet

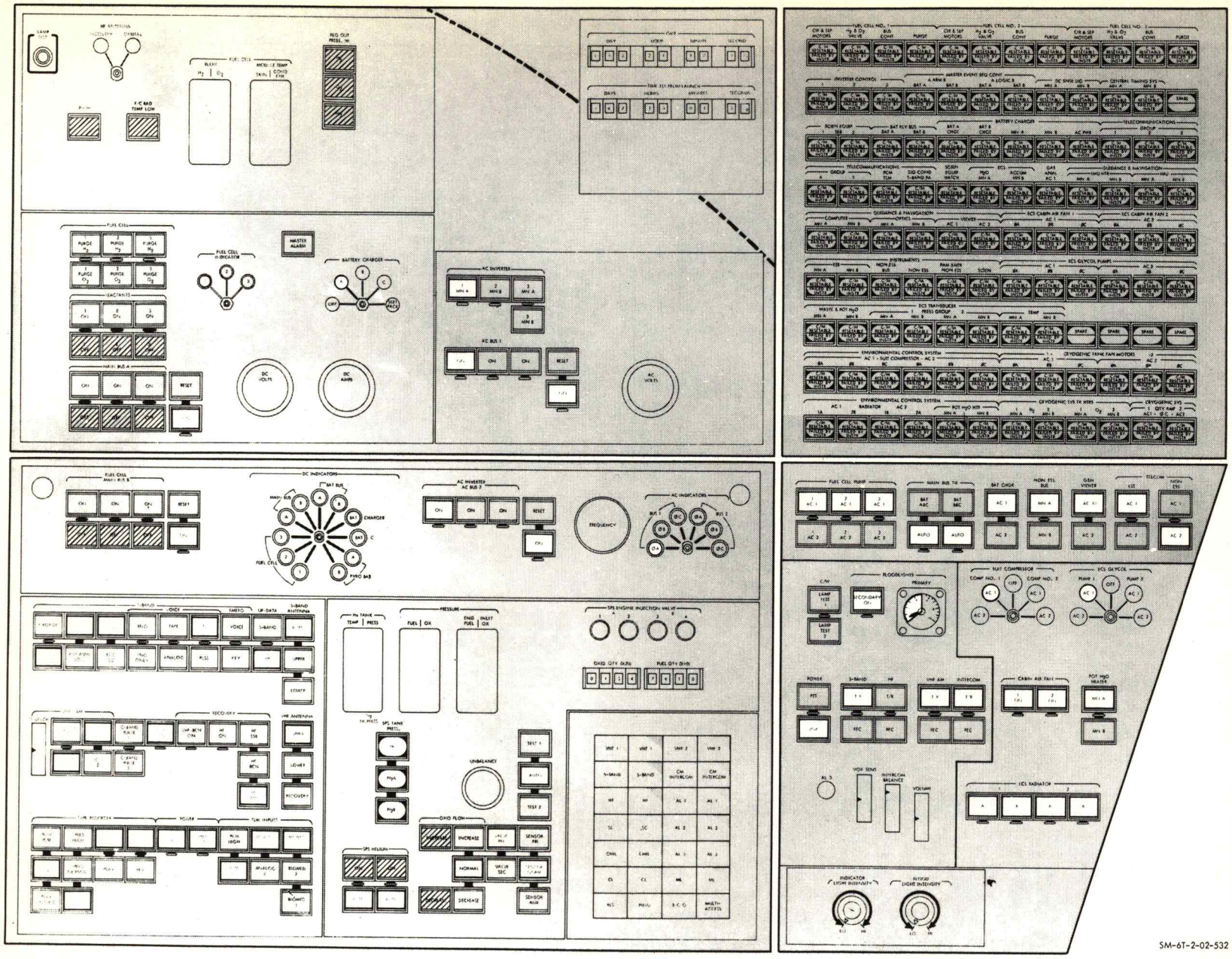
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				PH HI ind - gray	
2				F/C MOD TEMP LO ind - gray	
3				FLOW H_2 ind - .036-.09	
4				FLOW O_2 ind - .288-.72	
5				MODULE TEMP SKIN ind -	
6				MODULE TEMP COND EXH ind - TBD	
7				REG OUT PRESS HI O_2 ind - gray	
8				REG OUT PRESS HI H_2 ind - gray	
9				REG OUT PRESS HI N_2 ind - gray	
10				FUEL CELL INDICATOR - 1 lt on	
11				BATTERY CHARGER - A lt on	
12				MAIN BUS A RESET - ON lt on	
13				DC VOLTS ind - as programed	



Station 3 Orbital Routines (S-IVB Attached)

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14				DC AMPS ind - as programed	
15				AC INVERTER 1 - MN A lt on	
16				AC INVERTER 1 - AC BUS 1 - ON lt on	
17				AC BUS 1 RESET - ON lt on	
18				AC VOLTS ind - 115±2	
19				MAIN BUS B RESET - ON lt on	
20				DC INDICATORS CHARGER - BAT lt on	
21				AC INVERTER 1 - AC BUS 2 - ON lt on	
22				AC BUS 2 RESET - ON lt on	
23				FREQUENCY ind - 400±5	
24				AC INDICATORS BUS 1 - ØA lt on	
25				S-BAND - XPONDER PWR AMPL lt on	
26				S-BAND - PWR AMPL HIGH lt on	

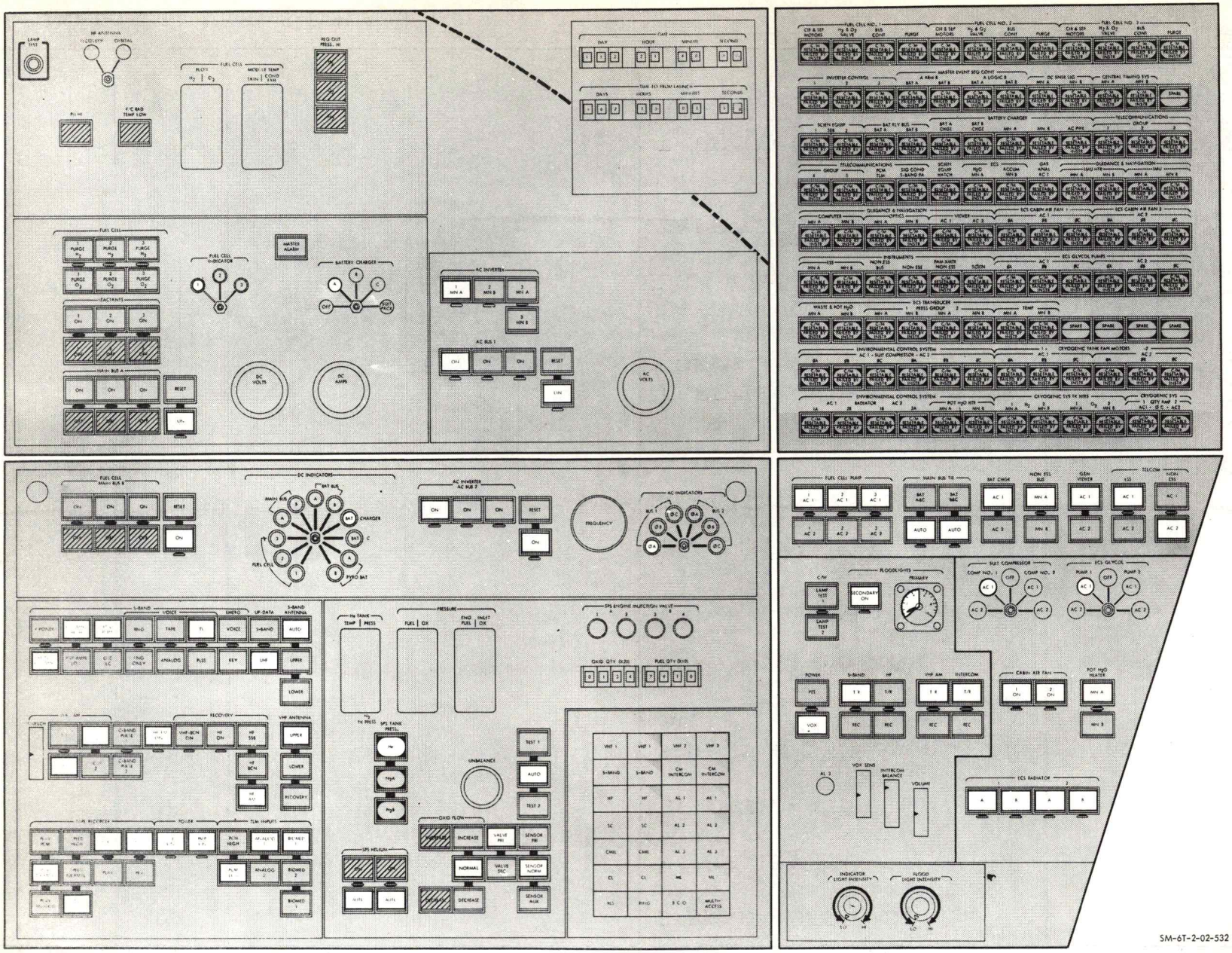


Station 3 Orbital Routines (S-IVB Attached)

S5B

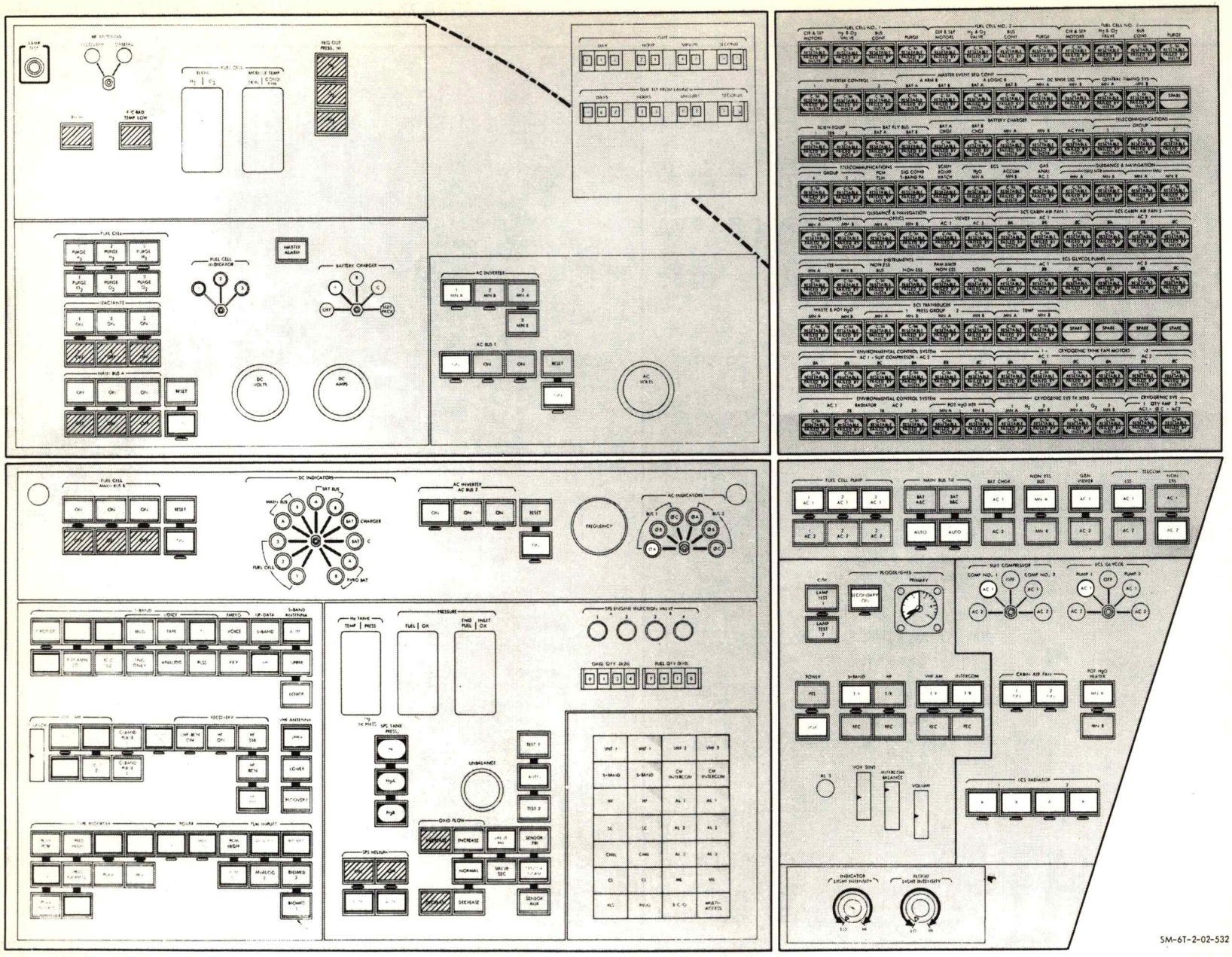
Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				S-BAND - OSC PRIM lt on	
28				VOICE - TV lt on	
29				UP-DATA - UHF lt on	
30				S-BAND ANTENNA - AUTO lt on	
31				VHF AM - REC lt on	
32				VHF AM - RCVR 1 lt on	
33				VHF FM ON lt on	
34				RECOVERY - HF AM lt on	
35				VHF ANTENNA - UPPER lt on	
36				TAPE RECORDER - PLAY NORMAL lt on	
37				TAPE RECORDER - SPEED LOW lt on	
38				TAPE RECORDER - RECORD lt on	
39				TAPE RECORDER - FWD lt on	


SM-6T-2-02-532

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
40				POWER - SCE ON lt on	
41				POWER - PMP ON lt on	
42				TLM INPUTS - PCM LOW lt on	
43				TLM INPUTS - ANALOG 1 lt on	
44				TLM INPUTS - BIOMED 1 lt on	
45				He TANK PRESS ind - 4000±5	
46				He TANK TEMP ind - 105	
47				SPS TANK PRESS - He lt on	
48				AUTO lt on	
49				Left SPS HELIUM - AUTO lt on	
50				Right SPS HELIUM - AUTO lt on	
51				OXID FLOW - NORM lt on	
52				VALVE PRI lt on	
53				SENSOR NORM lt on	
54				FUEL CELL PUMP - 1 AC 1 lt on	

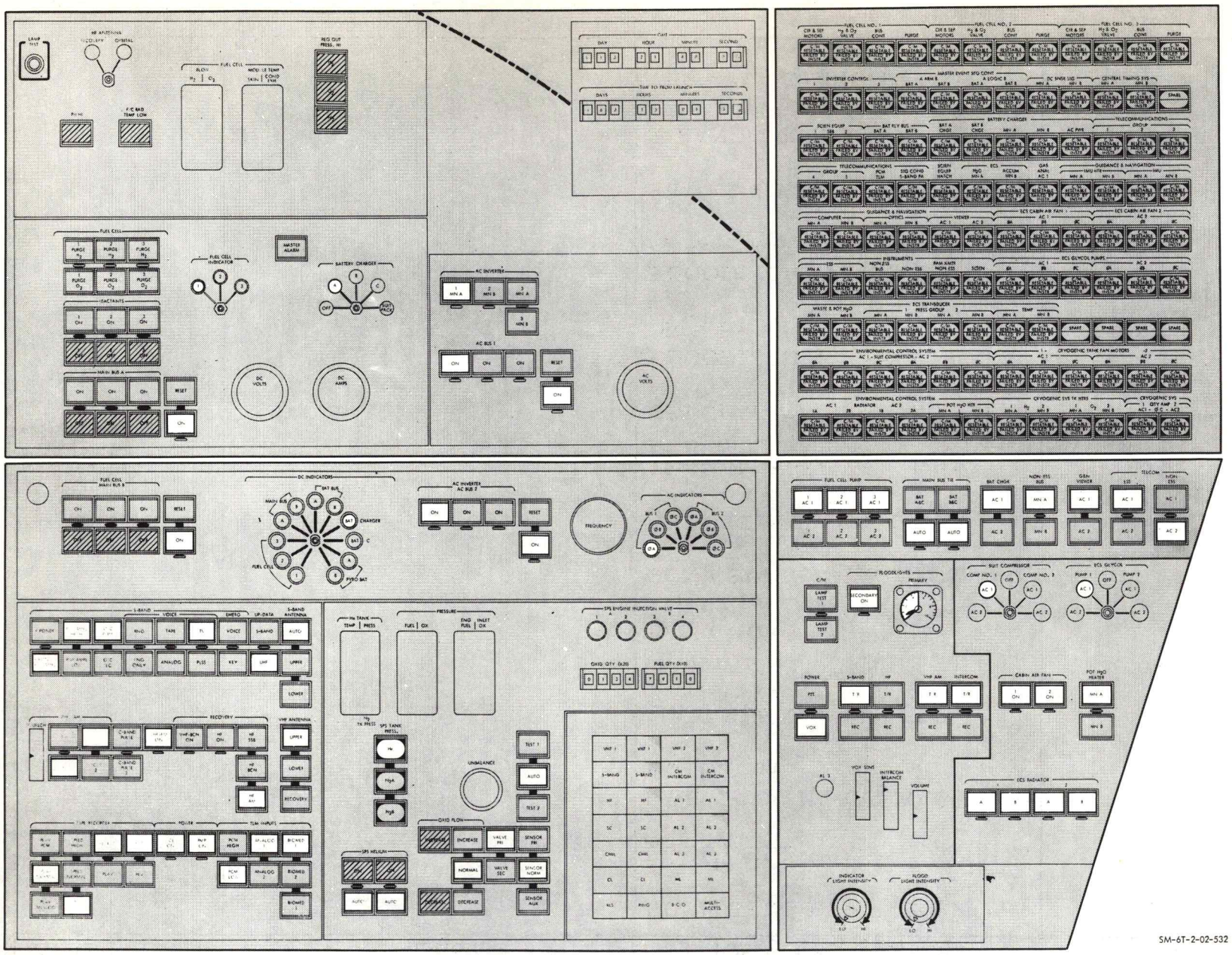


Station 3 Orbital Routines (S-IVB Attached)

S5B

Initialization Data Sheet

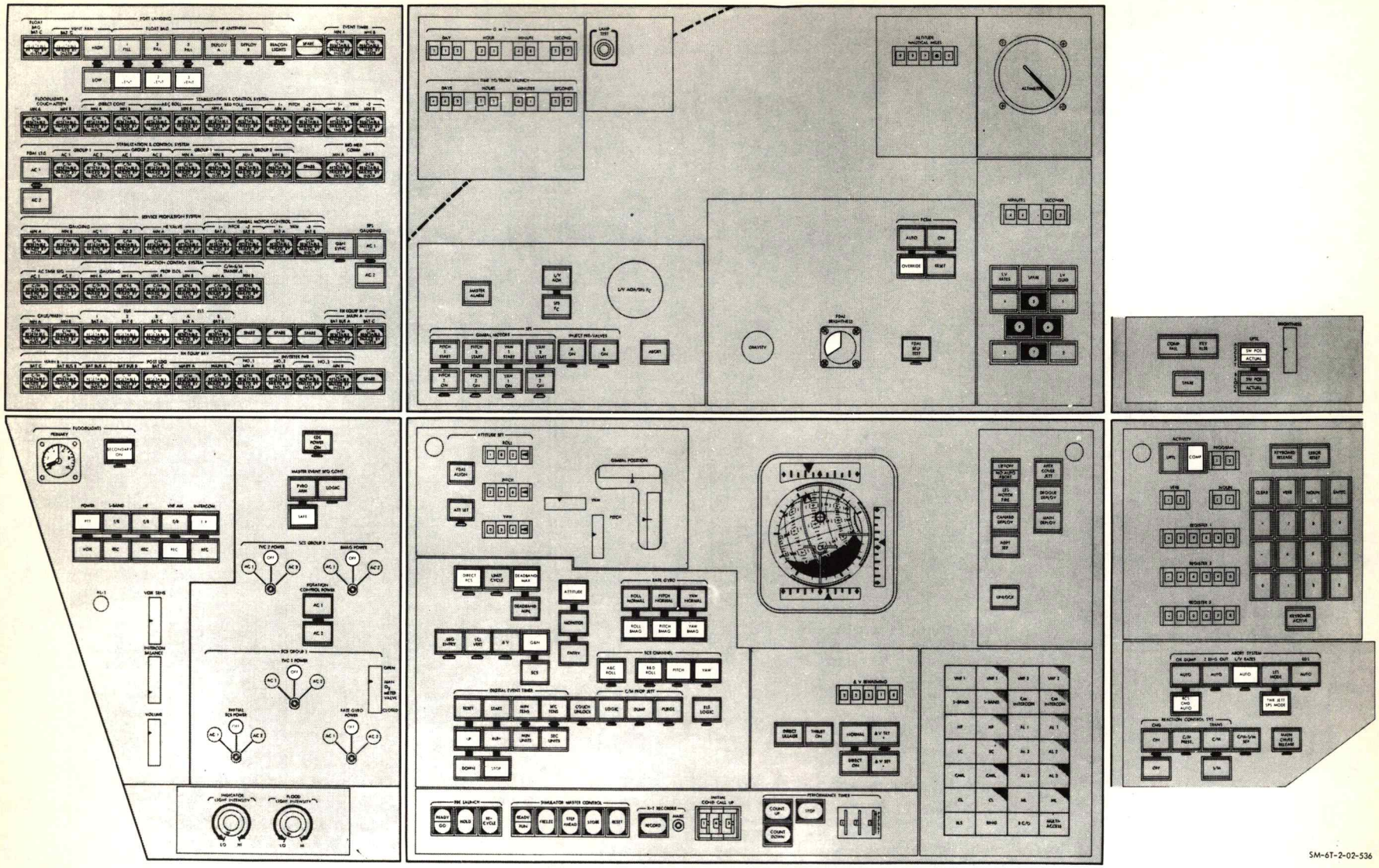
Step	Malf	Time	Function	IOS Visibility/Action	Notes
55				FUEL CELL PUMP - 2 AC 1 lt on	
56				FUEL CELL PUMP - 3 AC 1 lt on	
57				MAIN BUS TIE BAT A&C - AUTO lt on	
58				MAIN BUS TIE BAT B&C - AUTO lt on	
59				BAT CHGR - AC 1 lt on	
60				NON ESS BUS - MN A lt on	
61				G&N VIEWER - AC 1 lt on	
62				TELCOM ESS - AC 1 lt on	
63				TELCOM NON ESS - AC 1 lt on	
64				FLOODLIGHTS - SECONDARY ON lt on	
65				FLOODLIGHTS PRIMARY - as required	
66				POWER - VOX lt on	
67				S-BAND - T/R lt on	
68				VHF AM - T/R lt on	



Station 3 Orbital Routines (S-IVB Attached)

Initialization Data Sheet

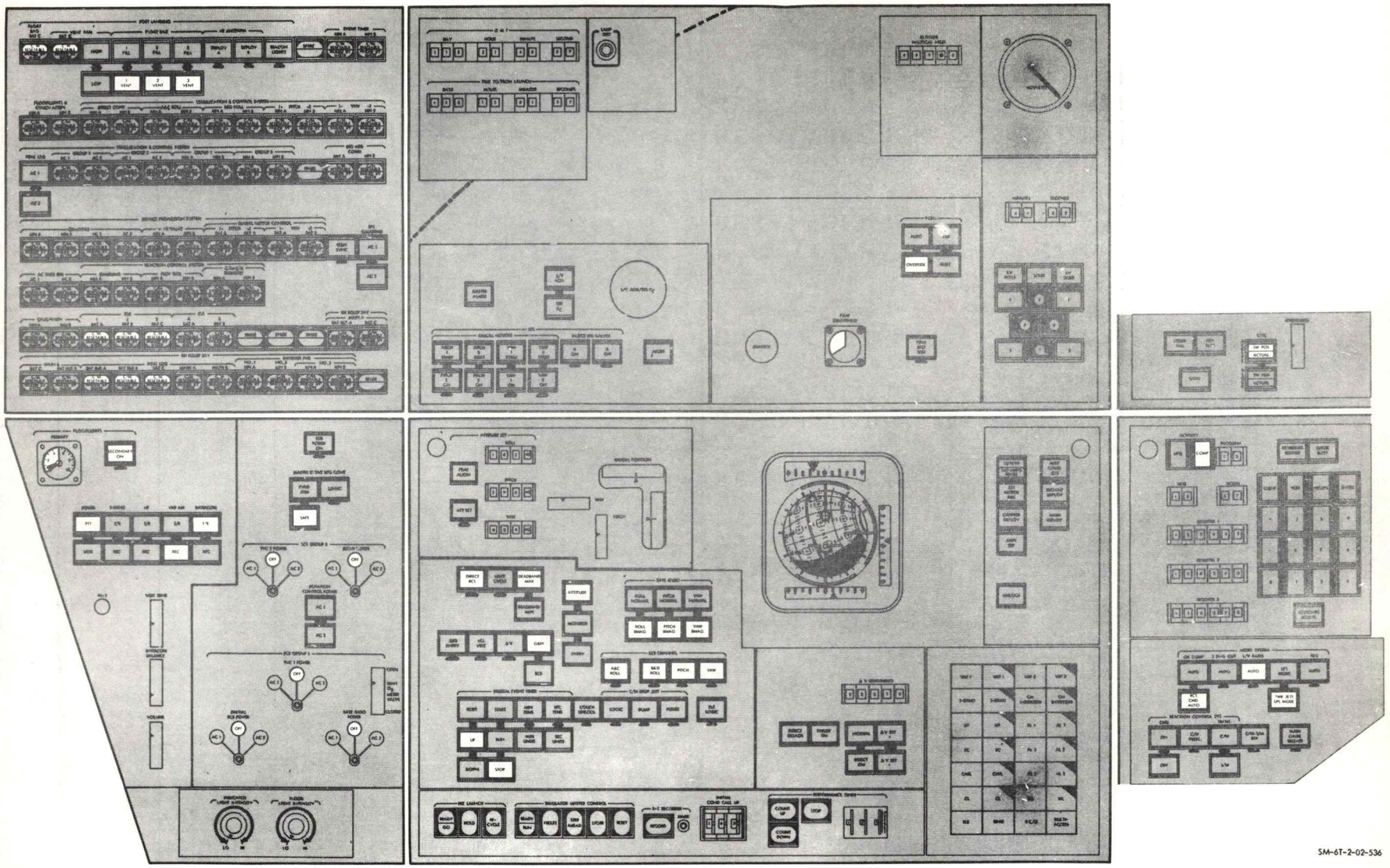
Step	Malf	Time	Function	IOS Visibility/Action	Notes
69				INTERCOM - T/R lt on	
70				SUIT COMPRESSOR COMP No. 1 - AC 1 lt on	
71				ECS GLYCOL PUMP 1 - AC 1 lt on	
72				CABIN AIR FAN - 1 ON lt on	
73				CABIN AIR FAN - 2 ON lt on	
74				POT H_2O HEATERS - MN A lt on	
75				ECS RADIATOR 1 - A lt on	
76				ECS RADIATOR 1 - B lt on	
77				ECS RADIATOR 2 - A lt on	
78				ECS RADIATOR 2 - B lt on	



Station 1 Minimum Power Operations

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				FLOAT BAG BAT C - C/M RESETABLE lt on	
2				VENT FAN - C/M RESETABLE lt on	
3				FLOAT BAG - 1 VENT lt on	
4				FLOAT BAG - 2 VENT lt on	
5				FLOAT BAG - 3 VENT lt on	
6				EDS 1 BAT A - C/M RESETABLE lt on	
7				EDS 2 BAT B - C/M RESETABLE lt on	
8				EDS 3 BAT C - C/M RESETABLE lt on	
9				POST LDG BAT BUS A - C/M RESETABLE lt on	
10				POST LDG BAT BUS B - C/M RESETABLE lt on	
11				POST LDG BAT C - C/M RESETABLE lt on	

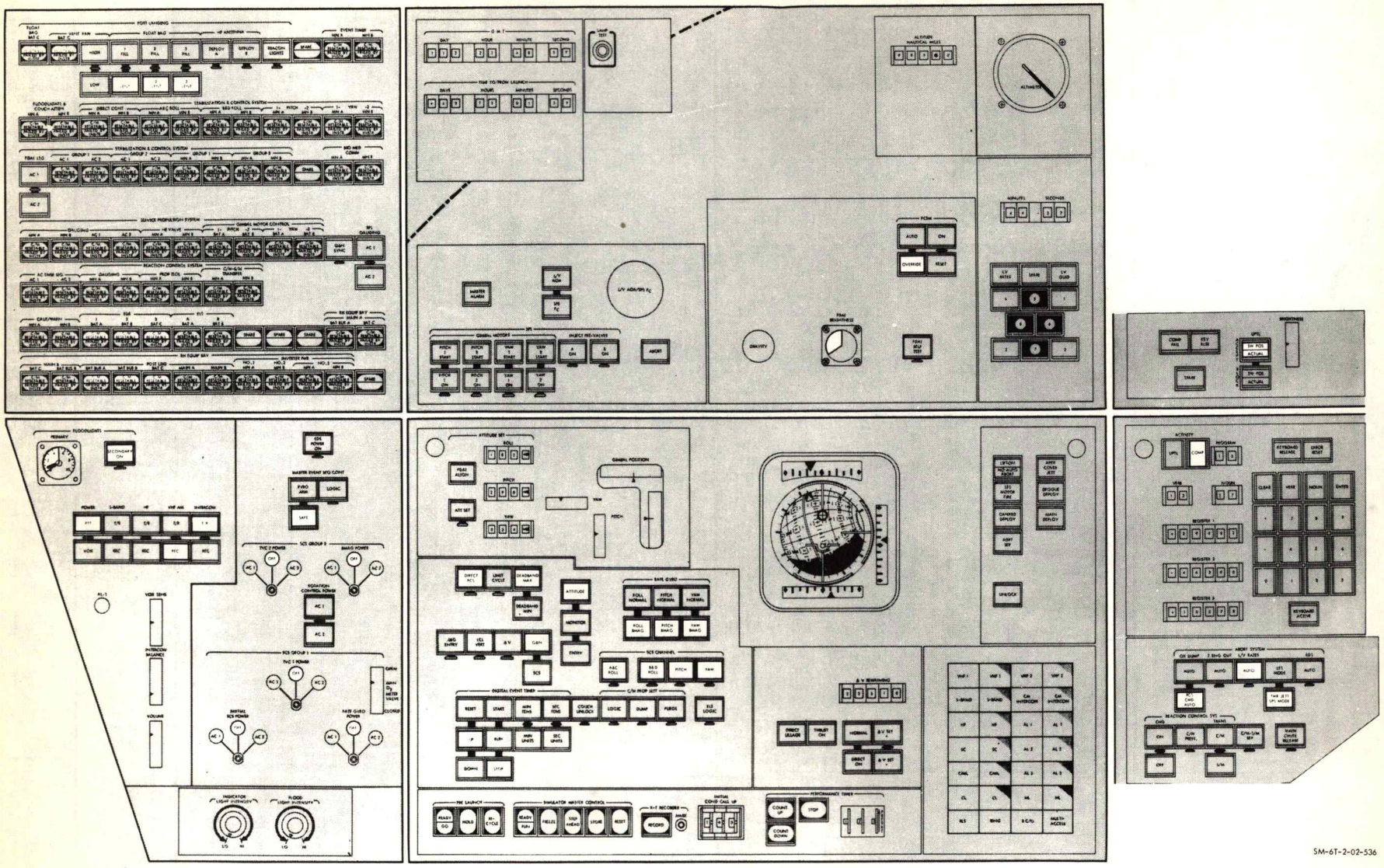


SM-6T-2-02-536

Station 1 Minimum Power Operations

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12				FLOODLIGHTS PRIMARY - as required	
13				FLOODLIGHTS - SECONDARY ON lt on	
14				POWER - PTT lt on	
15				VHF AM - REC lt on	
16				INTERCOM - T/R lt on	
17				MASTER EVENT SEQ CONT - SAFE lt on	
18				TVC 2 POWER - OFF lt on	
19				BMAG POWER - OFF lt on	
20				TVC 1 POWER - OFF lt on	
21				PARTIAL SCS POWER - OFF lt on	
22				RATE GYRO POWER - OFF lt on	
23				L/V AOA lt on	
24				FCSM - OVERRIDE lt on	



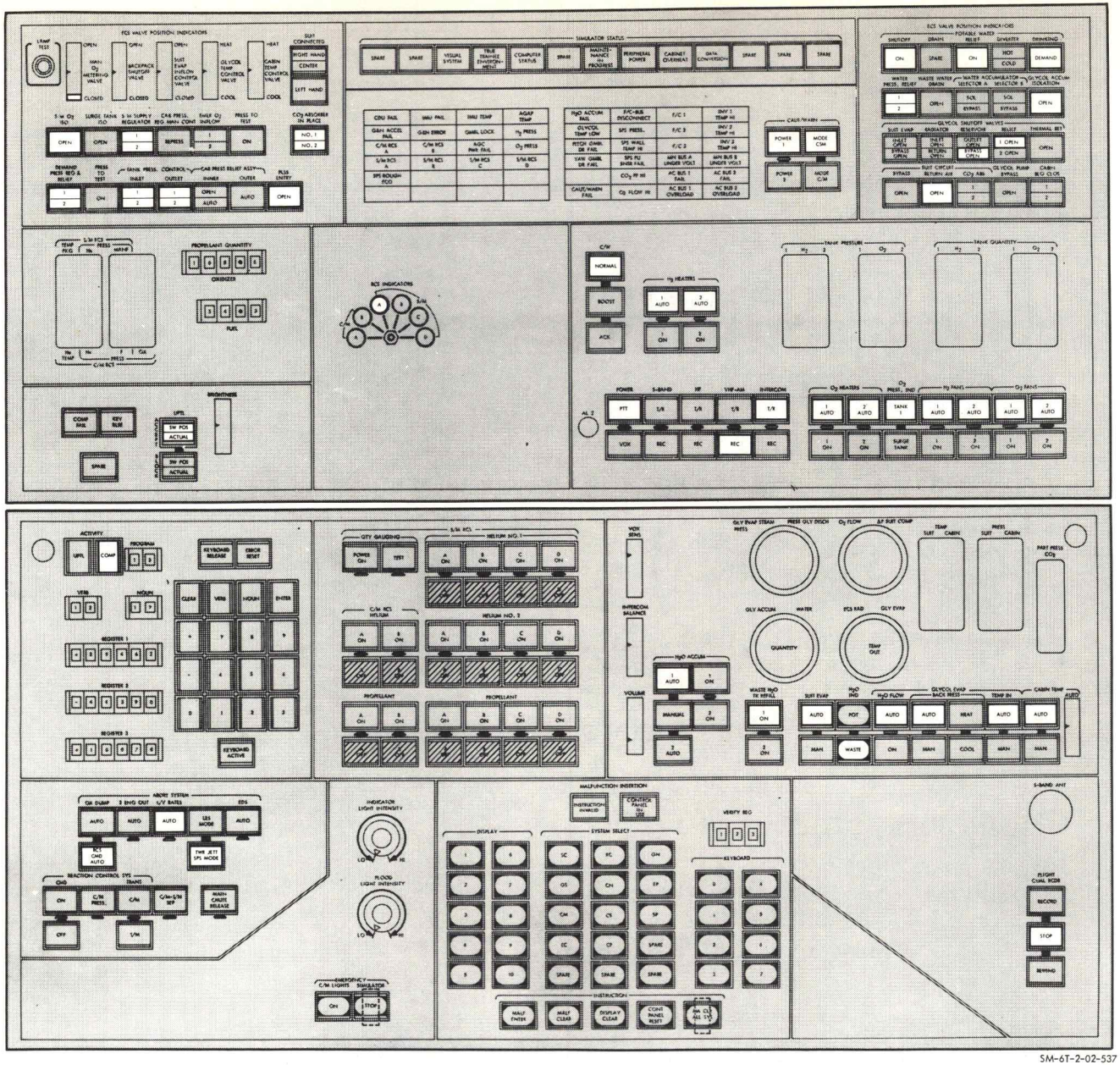
SM-6T-2-02-536

Station 1 Minimum Power Operations

S6

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
25				DIRECT RCS lt on	
26				DEADBAND MAX lt on	
27				ATTITUDE lt on	
28				RATE GYRO - ROLL BMAG lt on	
29				RATE GYRO - PITCH BMAG lt on	
30				RATE GYRO - YAW BMAG lt on	
31				G&N lt on	
32				SCS CHANNEL - A&C ROLL lt on	
33				SCS CHANNEL - B&D ROLL lt on	
34				SCS CHANNEL - PITCH lt on	
35				SCS CHANNEL - YAW lt on	
36				DIGITAL EVENT TIMER - UP lt on	
37				DIGITAL EVENT TIMER - STOP lt on	

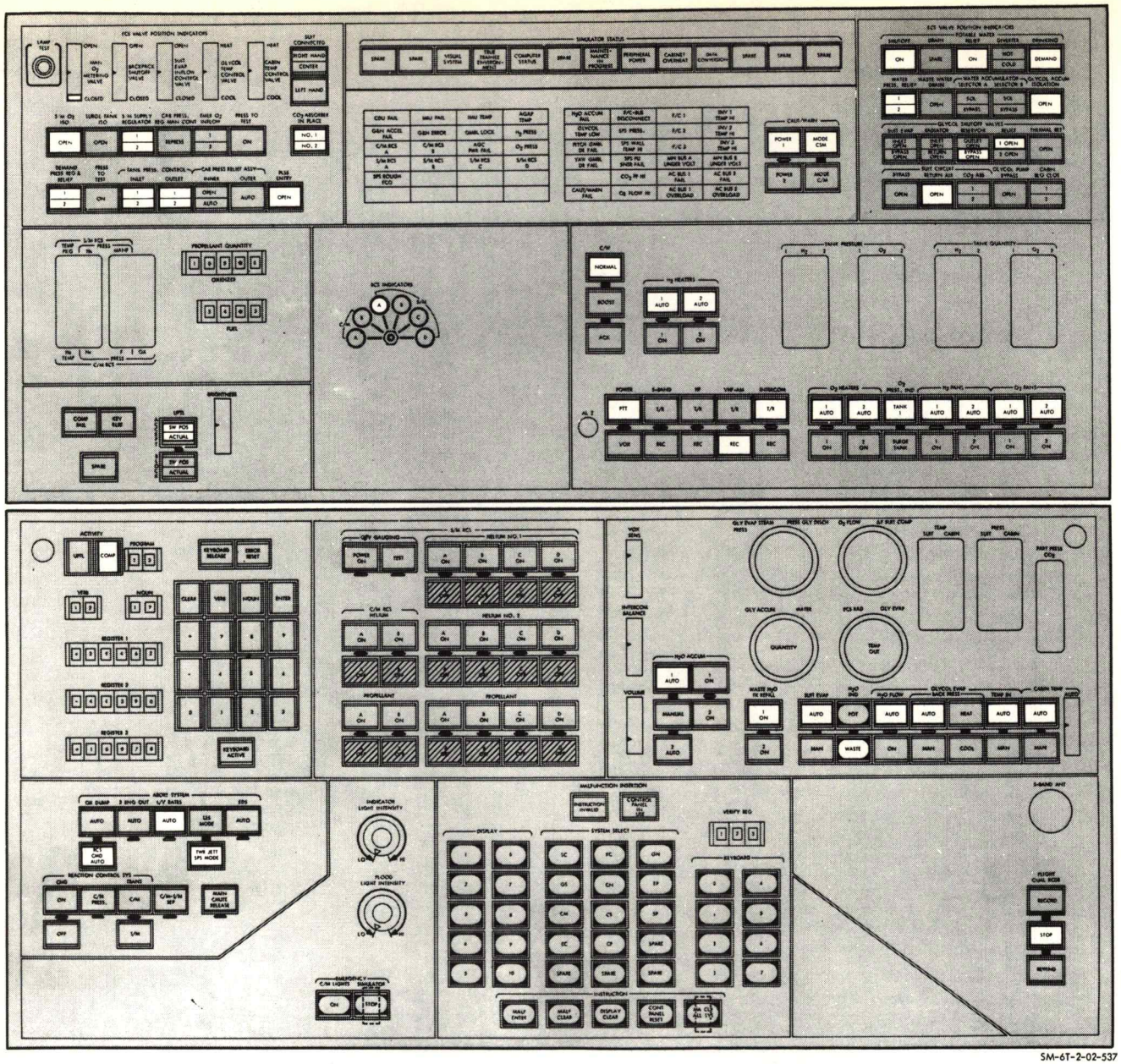


SM-6T-2-02-537

Station 2 Minimum Power Operations

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				MAN O_2 METERING VALVE - CLOSED	
2				S/M O_2 ISO - OPEN lt on	
3				S/M SUPPLY REGULATOR - 1 and 2 lt on	
4				CO_2 ABSORBER IN PLACE - No. 1 and No. 2 lt on	
5				DEMAND PRESS REG & RELIEF - 1 and 2 lt on	
6				TANK PRESS CONT INLET - 1 and 2 lt on	
7				TANK PRESS CONT OUTLET - 1 and 2 lt on	
8				PLSS ENTRY - OPEN lt on	
9				UPTL ACCEPT lt on	
10				RCS INDICATORS S/M - A lt on	
11				ACTIVITY - COMP lt on	
12				ABORT SYSTEM OX DUMP RCS OXID AUTO lt on	

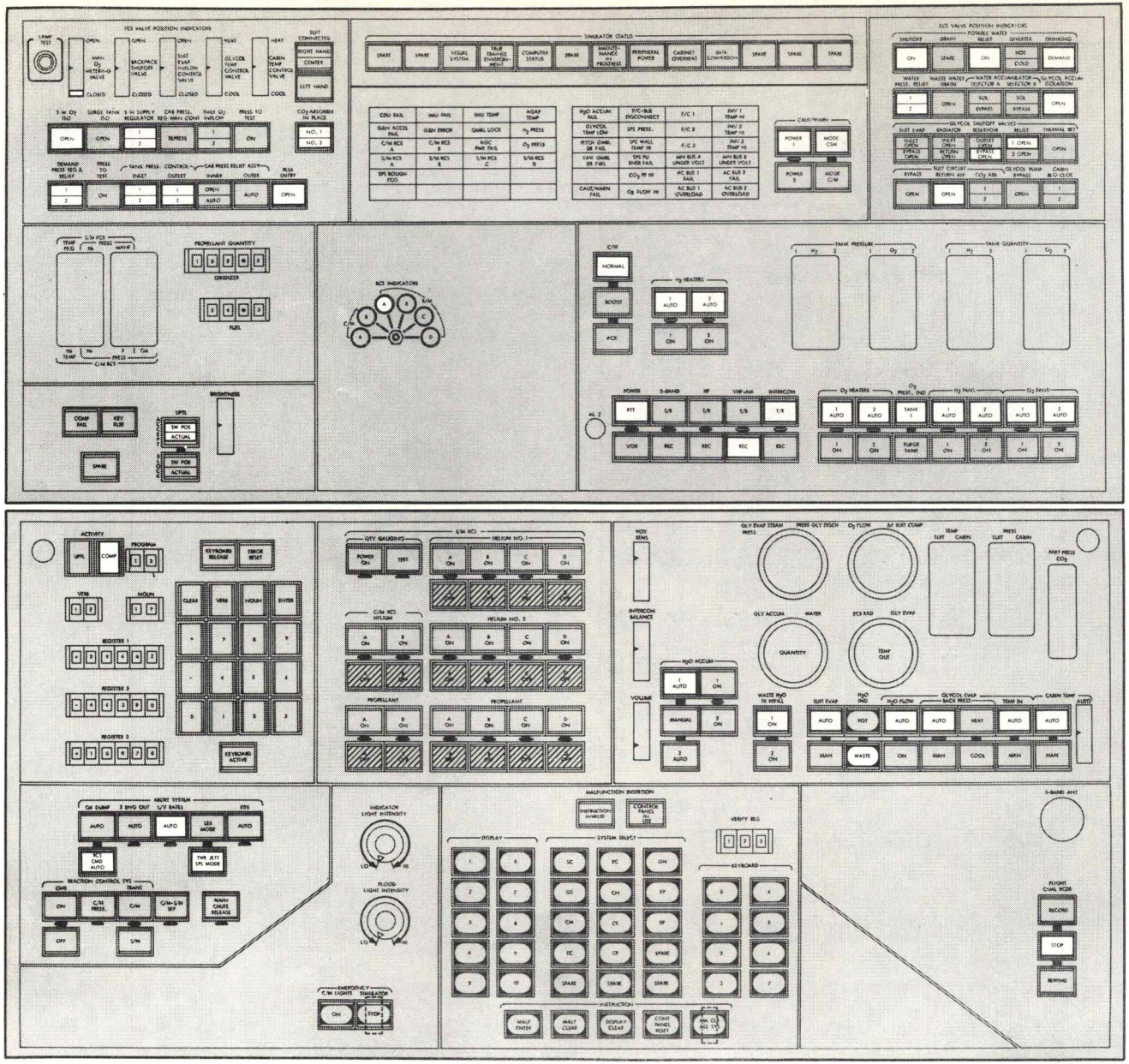


SM-6T-2-02-537

Station 2 Minimum Power Operations

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				ABORT SYSTEM L/V RATES - AUTO lt on	
14				ABORT SYSTEM - TWR JETT SPS MODE lt on	
15				POTABLE WATER SHUTOFF - ON lt on	
16				POTABLE WATER RELIEF - ON lt on	
17				POTABLE WATER DRINKING - DEMAND lt on	
18				WATER PRESS RELIEF 1 and 2 lt on	
19				GLYCOL ACCUM ISOLATION - OPEN lt on	
20				RESERVOIR - BYPASS OPEN lt on	
21				RELIEF - 1 OPEN lt on	
22				RETURN AIR - OPEN lt on	
23				CAUT/WARN - POWER 1 lt on	

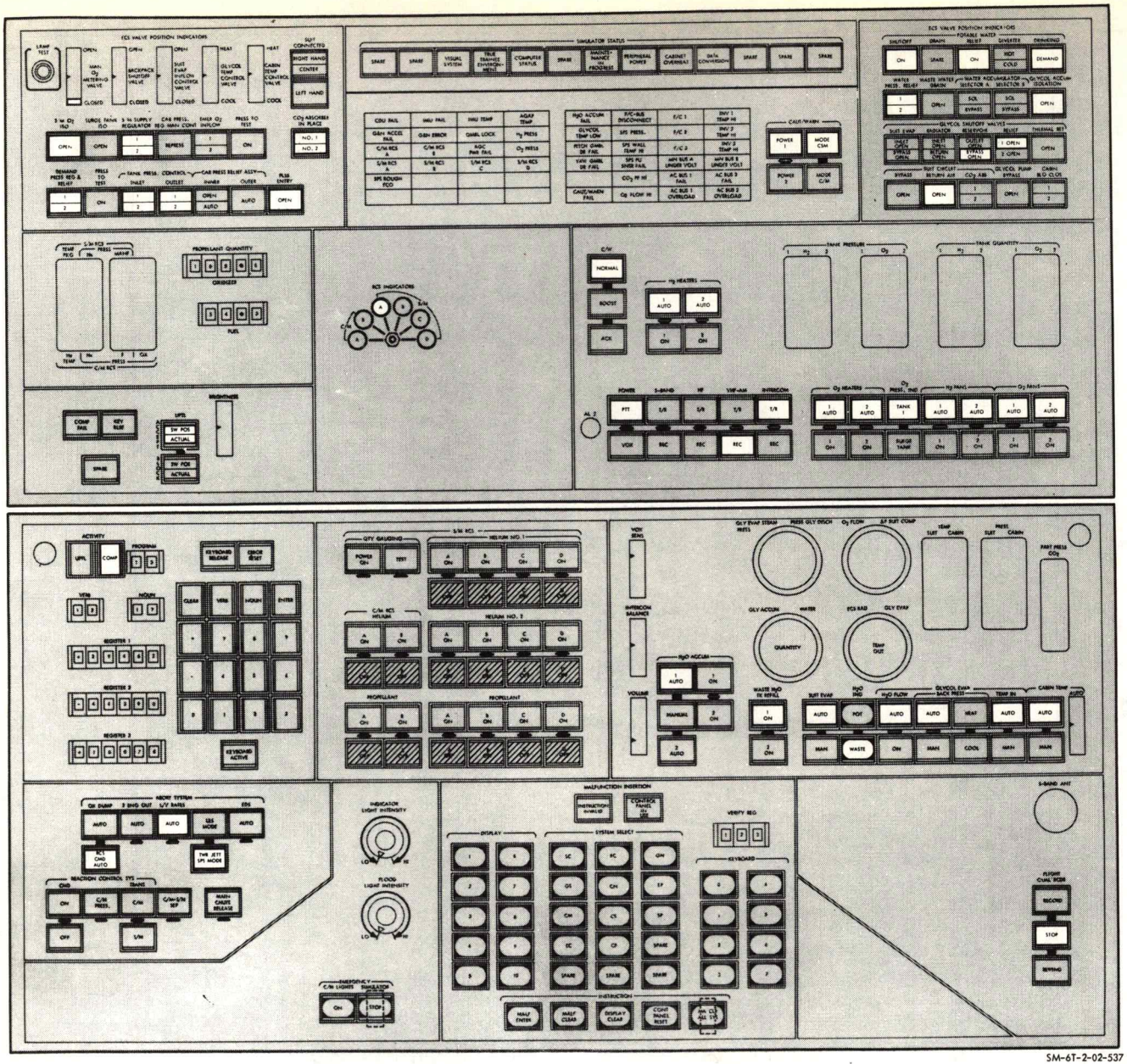


SM-6T-2-02-537

Station 2 Minimum Power Operations

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
24				CAUT/WARN - MODE CSM lt on	
25				C/W - NORMAL lt on	
26				H_2 HEATERS - 1 AUTO lt on	
27				H_2 HEATERS - 2 AUTO lt on	
28				POWER - PTT lt on	
29				VHF AM - REG lt on	
30				INTERCOM - T/R lt on	
31				O_2 HEATERS - 1 AUTO lt on	
32				O_2 HEATERS - 2 AUTO lt on	
33				O_2 PRESS IND - TANK 1 lt on	
34				H_2 FAN - 1 AUTO lt on	
35				H_2 FAN - 2 AUTO lt on	
36				O_2 FAN - 1 AUTO lt on	
37				O_2 FAN - 2 AUTO lt on	
38				H_2O ACCUM - 1 AUTO lt on	

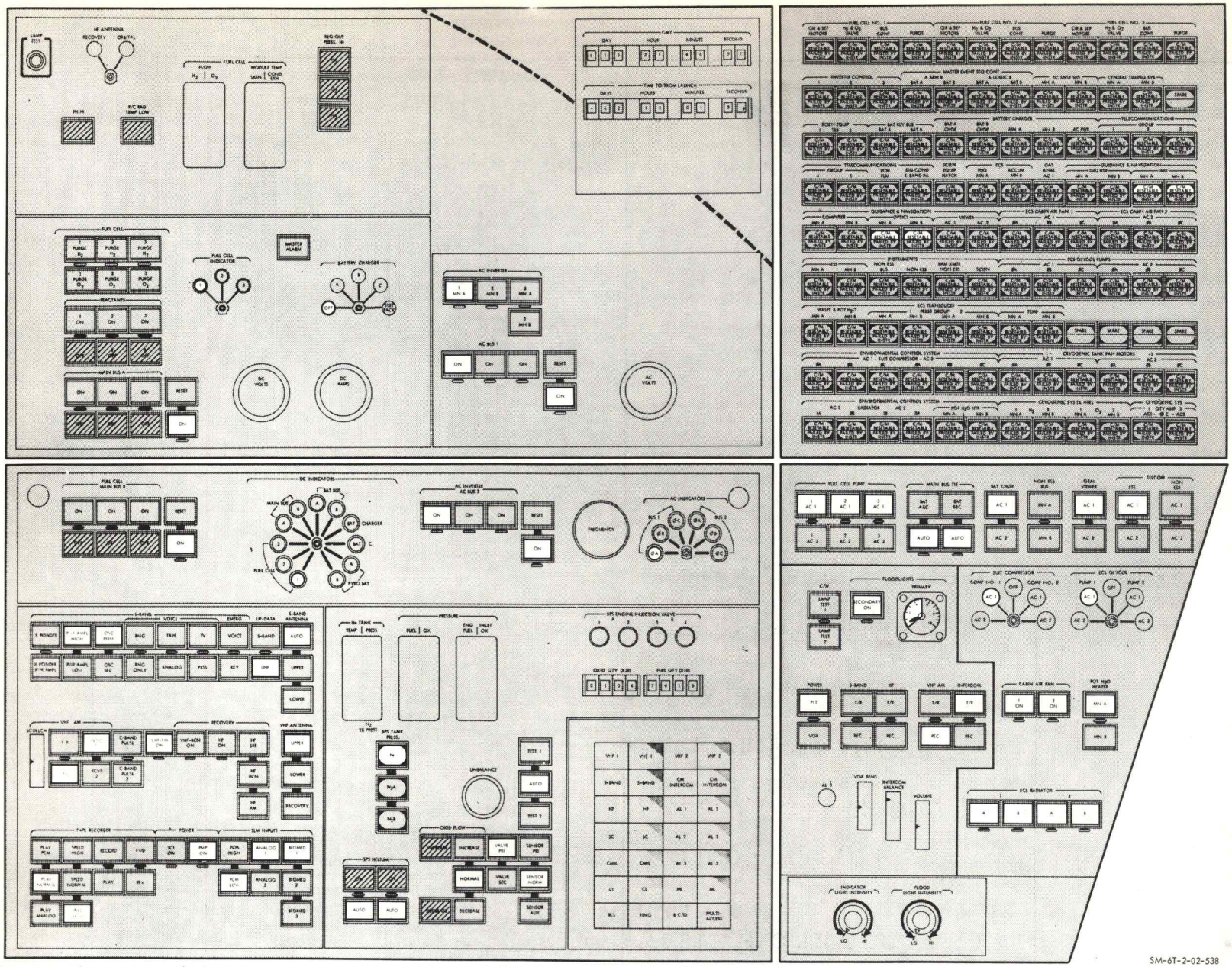


SM-6T-2-02-537

Station 2 Minimum Power Operations

Initialization Data Sheet

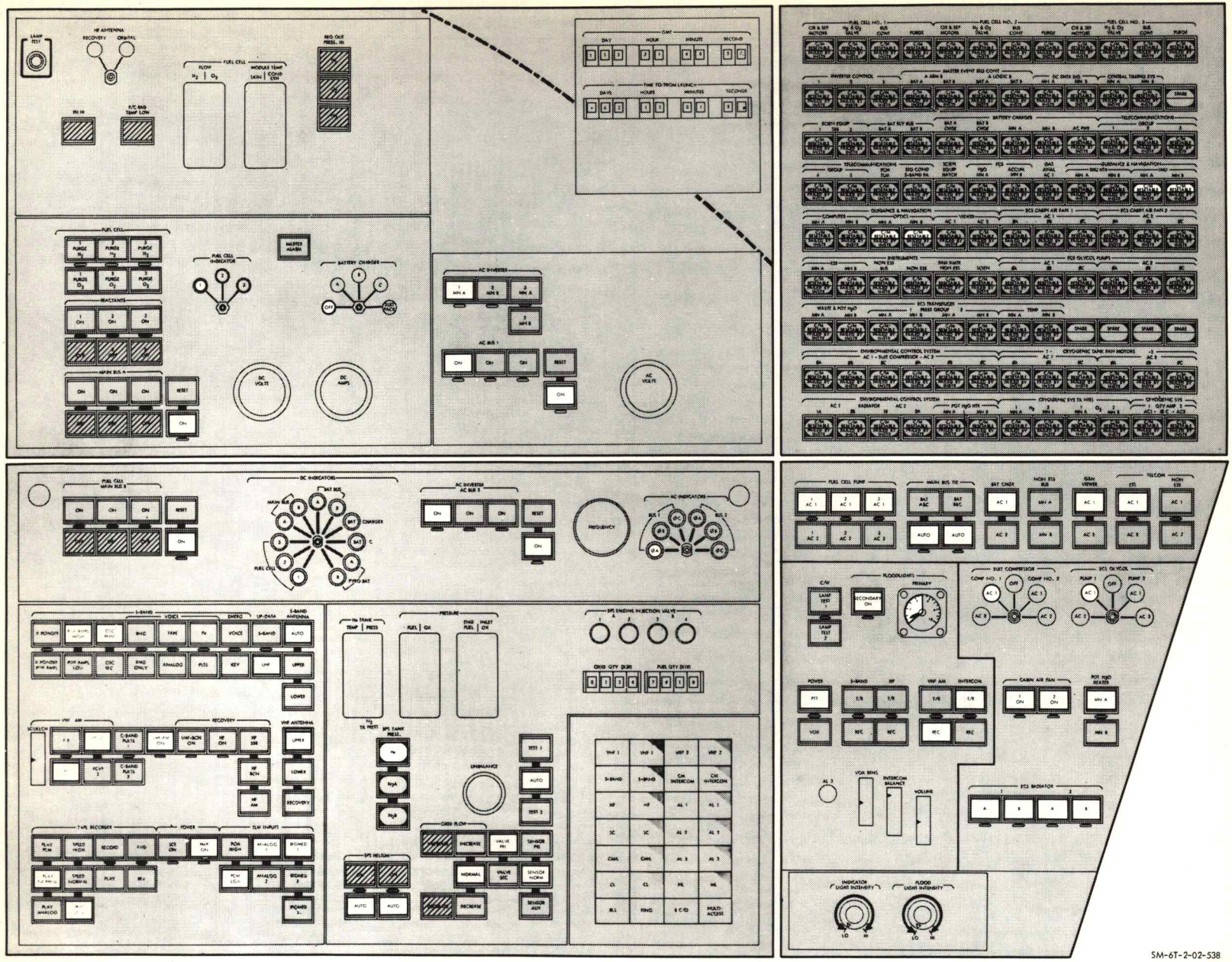
Step	Malf	Time	Function	IOS Visibility/Action	Notes
39				WASTE H_2O TK REFILL - 1 ON lt on	
40				H_2O IND - WASTE lt on	
41				H_2O FLOW - AUTO lt on	
42				BACK PRESS - AUTO lt on	
43				TEMP IN - AUTO lt on	
44				CABIN TEMP - AUTO lt on	
45				FLT QUAL RCDR - STOP lt on	



Station 3 Minimum Power Operations

Initialization Data Sheet

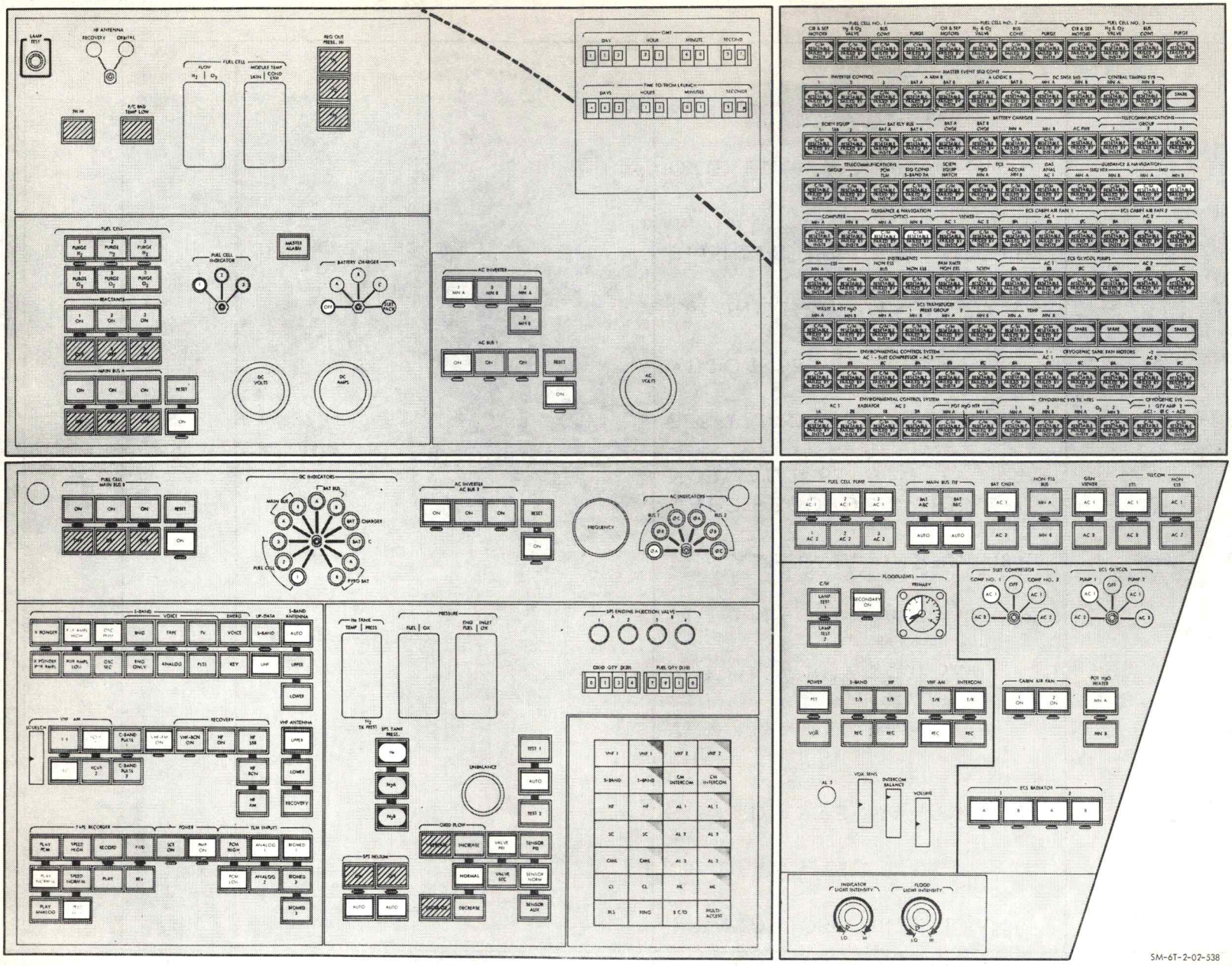
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				FUEL CELL INDICATOR - 1 lt on	
2				BATTERY CHARGER - OFF lt on	
3				MAIN BUS A RESET - ON lt on	
4				AC INVERTER - 1 MN A lt on	
5				AC INVERTER 1 - AC BUS 1 - ON lt on	
6				AC BUS 1 RESET - ON lt on	
7				MAIN BUS B RESET - ON lt on	
8				DC INDICATORS FUEL CELL - 1 lt on	
9				AC INVERTER 1 - AC BUS 2 - ON lt on	
10				AC BUS 1 RESET - ON lt on	
11				AC INDICATORS BUS 1 - ØA lt on	
12				S-BAND - PWR AMPL HIGH lt on	



Station 3 Minimum Power Operations

Initialization Data Sheet

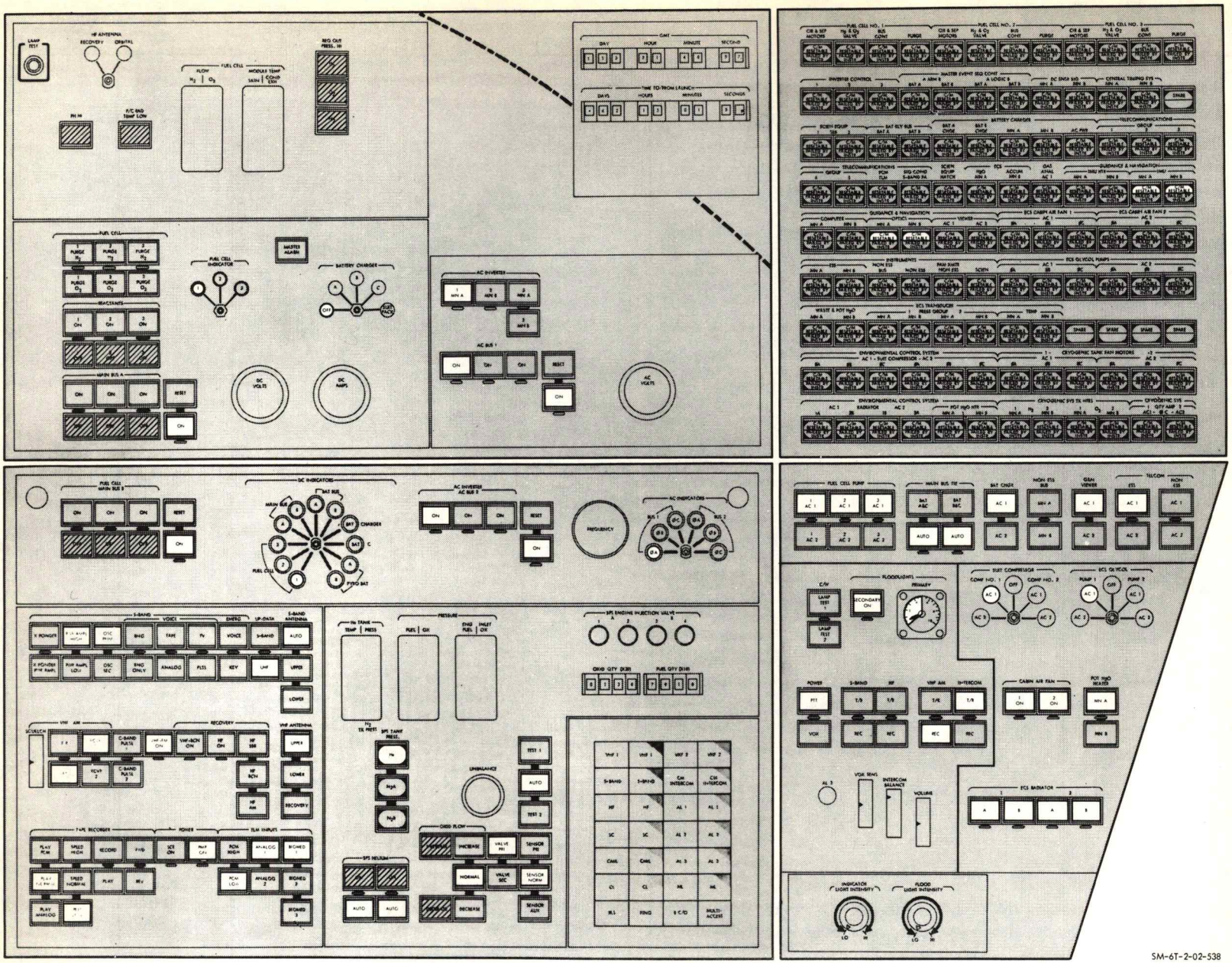
Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				S-BAND - OSC PRIM lt on	
14				UP-DATA - UHF lt on	
15				S-BAND ANTENNA - AUTO lt on	
16				VHF AM - REC lt on	
17				VHF AM - RCVR 1 lt on	
18				VHF FM - ON lt on	
19				VHF ANTENNA - UPPER lt on	
20				TAPE RECORDER - PLAY NORMAL lt on	
21				SPS TANK PRESS - He lt on	
22				AUTO lt on	
23				Left SPS HELIUM - AUTO lt on	
24				Right SPS HELIUM - AUTO lt on	
25				OXID FLOW - NORM lt on	
26				SENSOR NORM lt on	



Station 3 Minimum Power Operations

Initialization Data Sheet

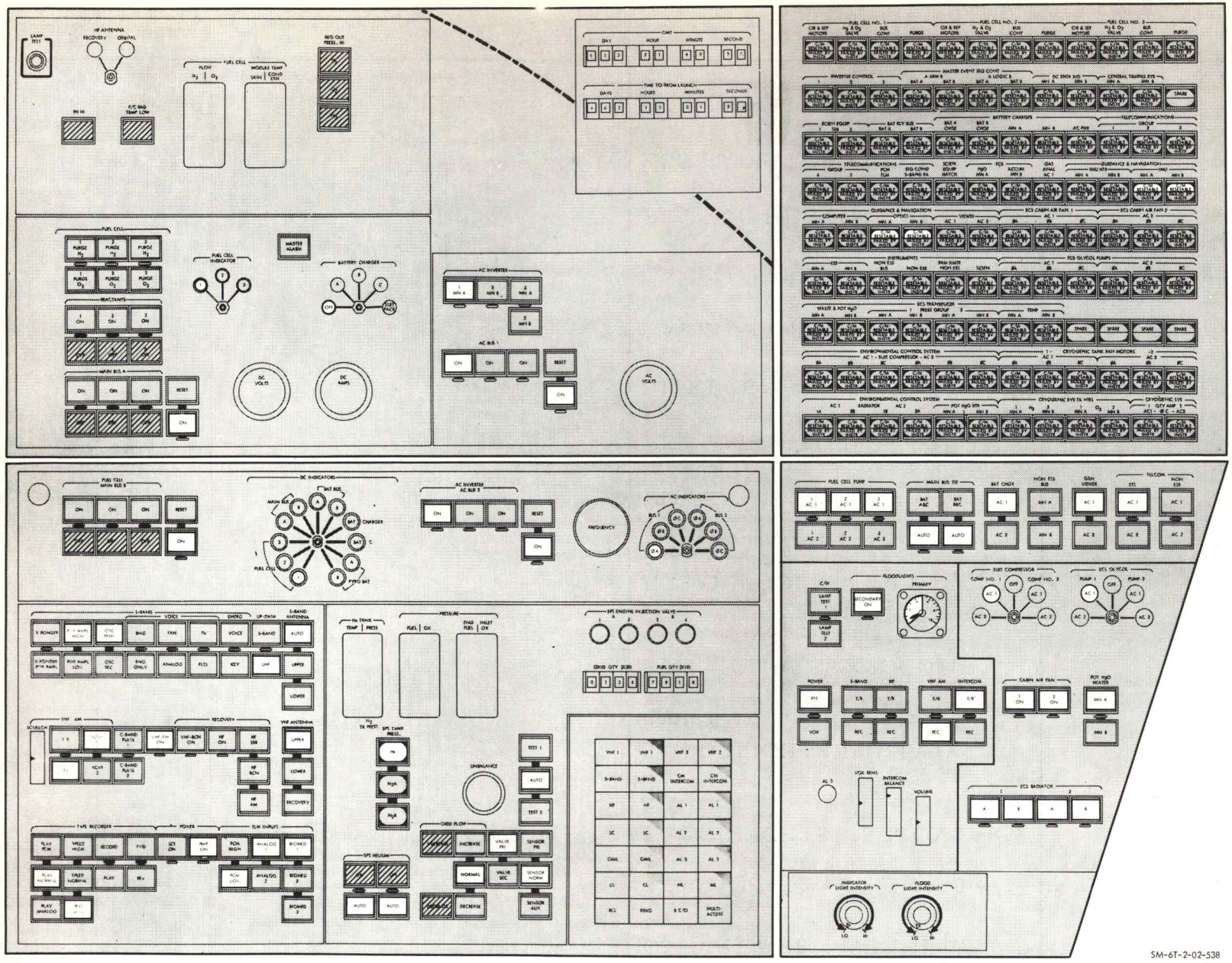
Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				GUIDANCE & NAVIGATION IMU MN A - C/M RESETABLE lt on	
28				GUIDANCE & NAVIGATION IMU MN B - C/M RESETABLE lt on	
29				GUIDANCE & NAVIGATION OPTICS MN A - C/M RESETABLE lt on	
30				GUIDANCE & NAVIGATION OPTICS MN B - C/M RESETABLE lt on	
31				FUEL CELL PUMP - 1 AC 1 lt on	
32				FUEL CELL PUMP - 2 AC 1 lt on	
33				FUEL CELL PUMP - 3 AC 1 lt on	
34				MAIN BUS TIE - AUTO lt on	
35				MAIN BUS TIE - AUTO lt on	
36				BAT CHGR - AC 1 lt on	



Station 3 Minimum Power Operations

Initialization Data Sheet

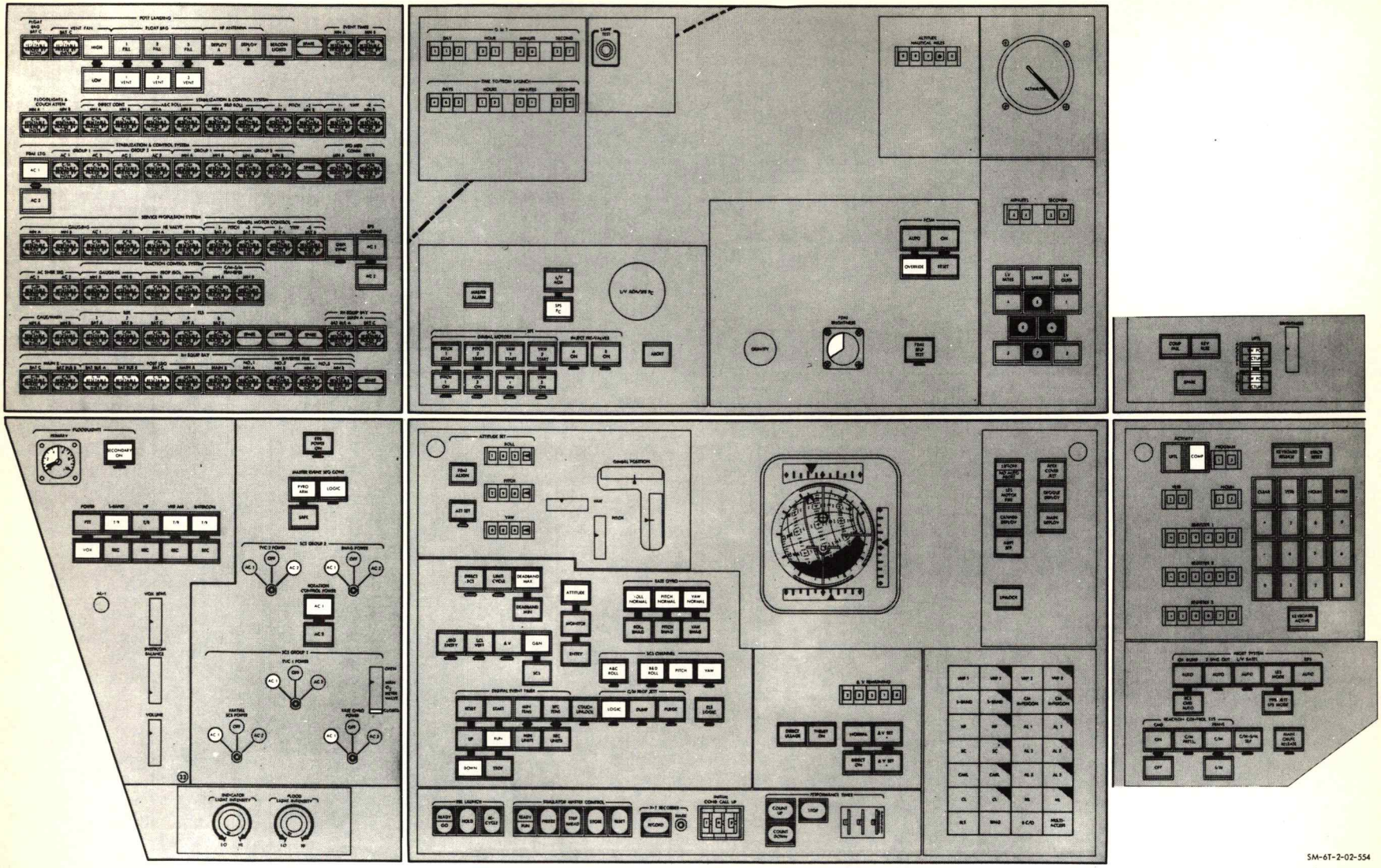
Step	Malf	Time	Function	IOS Visibility/Action	Notes
37				G&N VIEWER - AC 1 lt on	
38				TELCOM ESS - AC 1 lt on	
39				FLOODLIGHTS - SECONDARY ON lt on	
40				FLOODLIGHTS PRIMARY - as required	
41				SUIT COMPRESSOR COMP No. 1 - AC 1 lt on	
42				ECS GLYCOL PUMP 1 - AC 1 lt on	
43				POWER - PTT lt on	
44				VHF AM - REC lt on	
45				INTERCOM - T/R lt on	
46				CABIN AIR FAN - 1 ON lt on	
47				CABIN AIR FAN - 2 ON lt on	
48				POT H_2O HEATER - MN A lt on	
49				ECS RADIATOR 1 - A lt on	
50				ECS RADIATOR 1 - B lt on	



Station 3 Minimum Power Operations

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
51				ECS RADIATOR 2 - A lt on	
52				ECS RADIATOR 2 - B lt on	

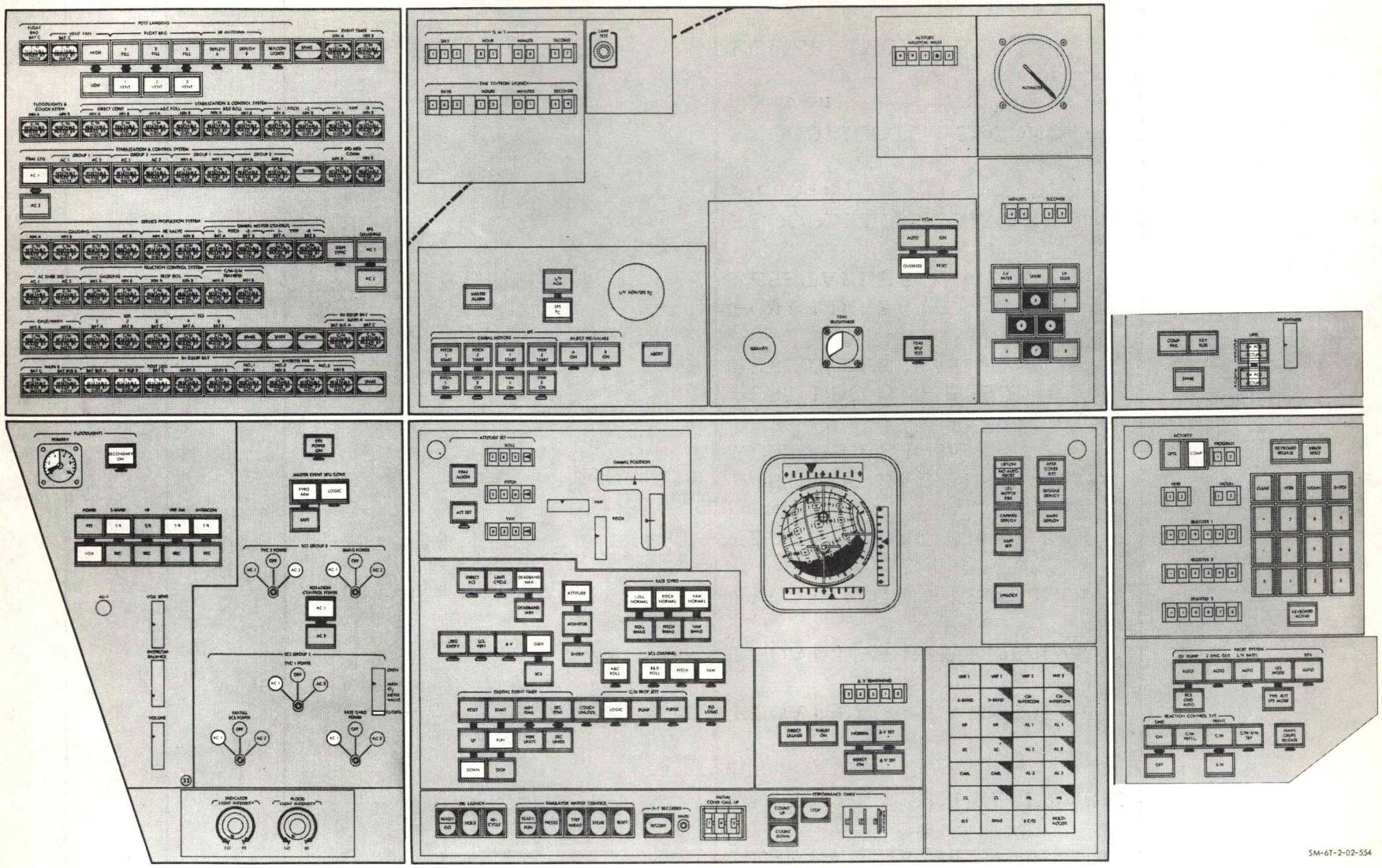


Station 1 Postseparation Pre-entry

S13A, B, C and S211

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				FLOAT BAG BAT C - C/M RESETABLE lt on	
2				VENT FAN - C/M RESETABLE lt on	
3				FLOAT BAG - 1 VENT lt on	
4				FLOAT BAG - 2 VENT lt on	
5				FLOAT BAG - 3 VENT lt on	
6				FDAI LTG - AC 1 lt on	
7				POST LDG BAT BUS A - C/M RESETABLE lt on	
8				POST LDG BAT BUS B - C/M RESETABLE lt on	
9				POST LDG BAT C - C/M RESETABLE lt on	
10				FLOODLIGHTS PRIMARY - as required	
11				FLOODLIGHTS - SECONDARY ON lt on	
12				POWER - VOX lt on	

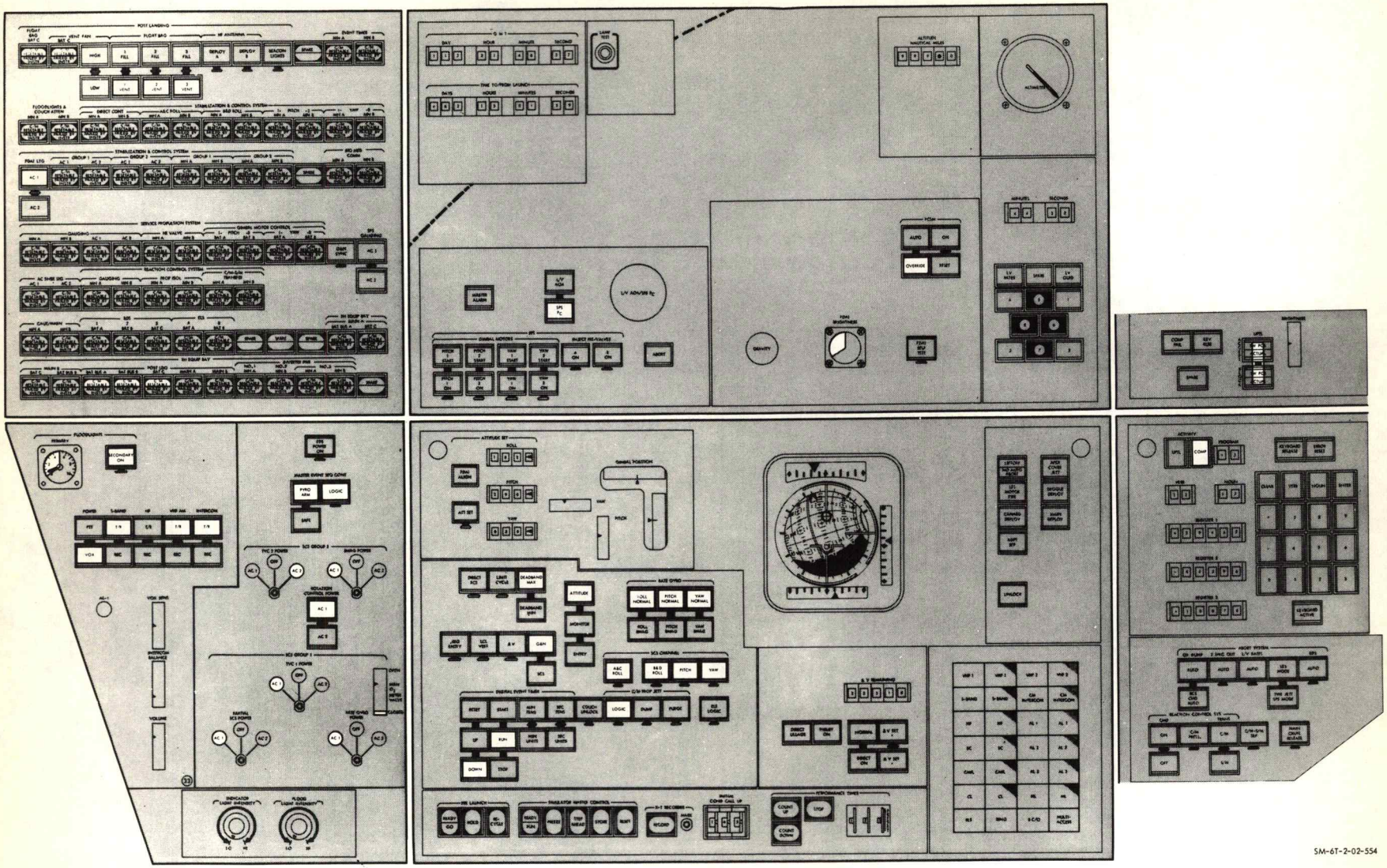


Station 1 Postseparation Pre-entry

S13A, B, C and S211

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13				S-BAND - T/R lt on	
14				VHF AM - T/R lt on	
15				INTERCOM - T/R lt on	
16				MASTER EVENT SEQ CONT - PYRO ARM lt on	
17				MASTER EVENT SEQ CONT - LOGIC lt on	
18				TVC 2 POWER - AC 2 lt on	
19				BMAG POWER - AC 1 lt on	
20				ROTATIONAL CONTROL POWER - AC 1 lt on	
21				TVC 1 POWER - AC 1 lt on	
22				PARTIAL SCS POWER - AC 1 lt on	
23				RATE GYRO POWER - AC 1 lt on	
24				SPS P_C lt on	
25				FCSM - OVERRIDE lt on	

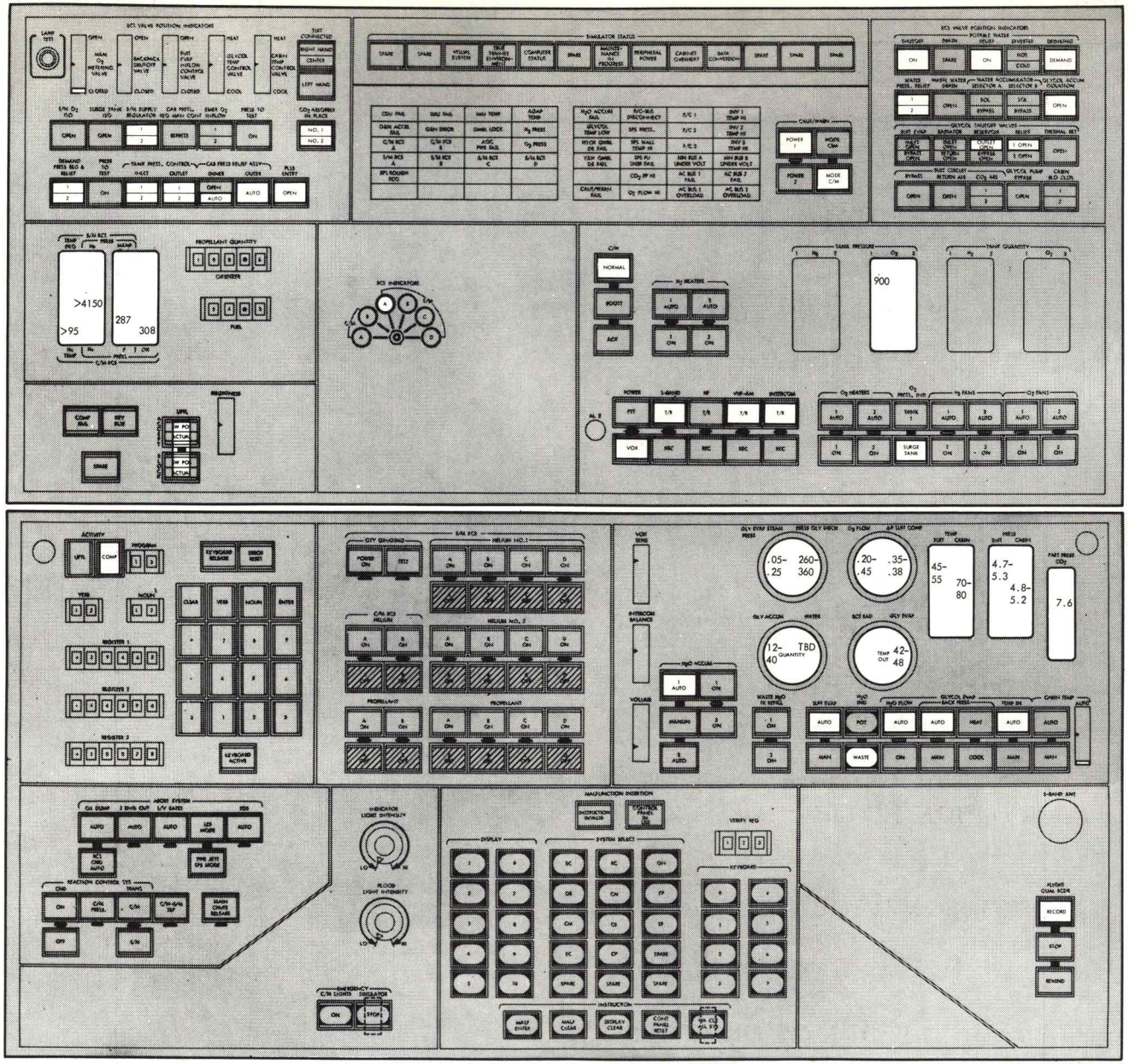


Station 1 Postseparation Pre-entry

S13A, B, C and S211

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
26				DEADBAND MAX lt on	
27				ATTITUDE lt on	
28				RATE GYRO - ROLL NORMAL lt on	
29				RATE GYRO - PITCH NORMAL lt on	
30				RATE GYRO - YAW NORMAL lt on	
31				SCS CHANNEL - A&C ROLL lt on	
32				SCS CHANNEL - B&D ROLL lt on	
33				SCS CHANNEL - PITCH lt on	
34				SCS CHANNEL - YAW lt on	
35				DIGITAL EVENT TIMER - DOWN lt on	
36				DIGITAL EVENT TIMER - RUN lt on	
37				C/M PROP JETT - LOGIC lt on	

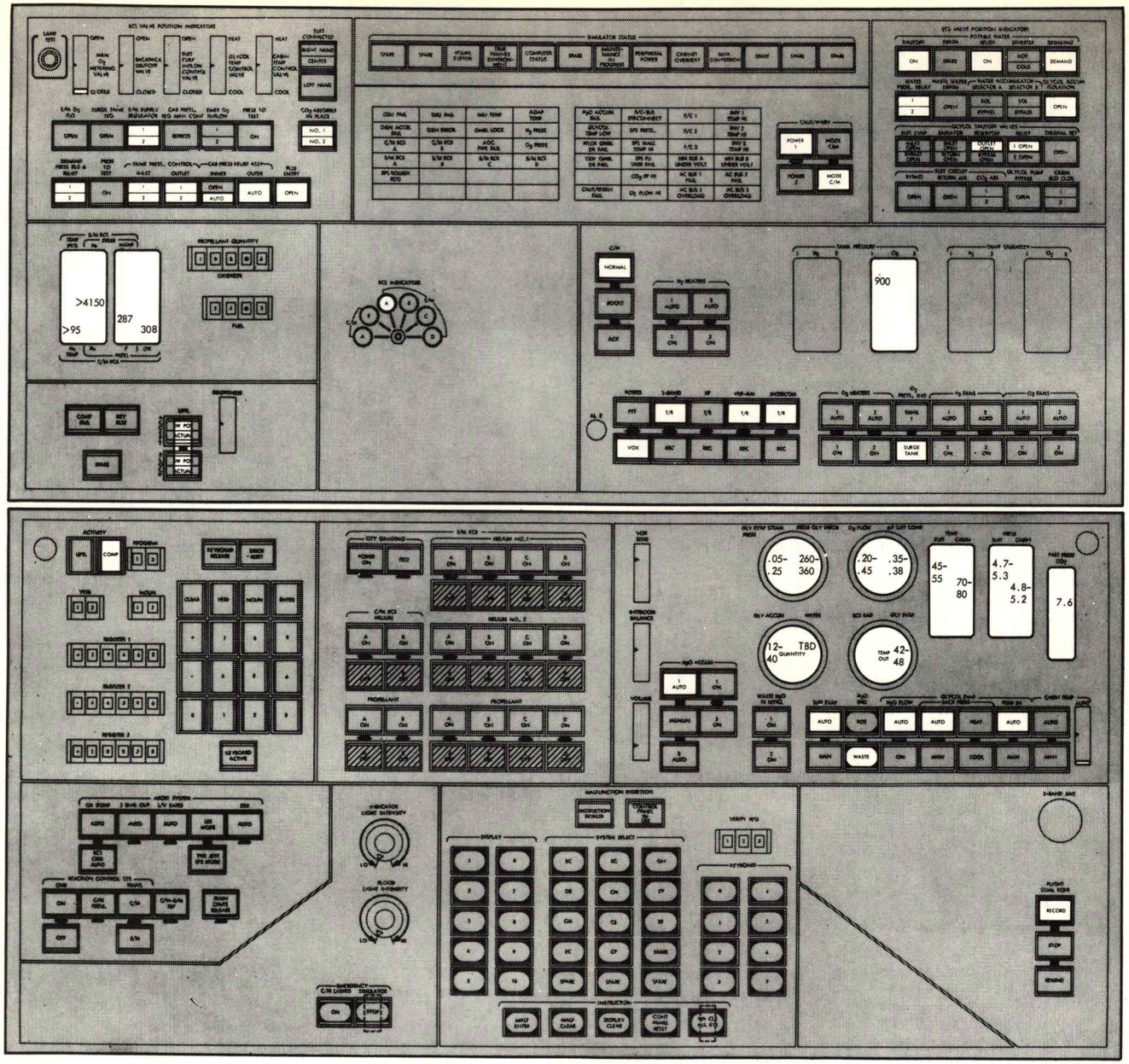


Station 2 Postseparation Pre-entry

S13A, B, C and S211

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				MAN O_2 METERING VALVE - CLOSED	
2				S/M SUPPLY REGULATOR - 1 and 2 lt on	
3				CO_2 ABSORBER IN PLACE - No. 1 and No. 2 lt on	
4				DEMAND PRESS REG & RELIEF - 1 and 2 lt on	
5				TANK PRESS CONTROL INLET - 1 and 2 lt on	
6				TANK PRESS CONTROL OUTLET - 1 and 2 lt on	
7				CABIN PRESS RELIEF ASSY INNER - AUTO lt on	
8				CABIN PRESS RELIEF ASSY OUTER - AUTO lt on	
9				PLSS ENTRY - OPEN lt on	
10				RCS INDICATORS - A lt on	
11				UPTL ACCEPT or BLOCK lt as selected	



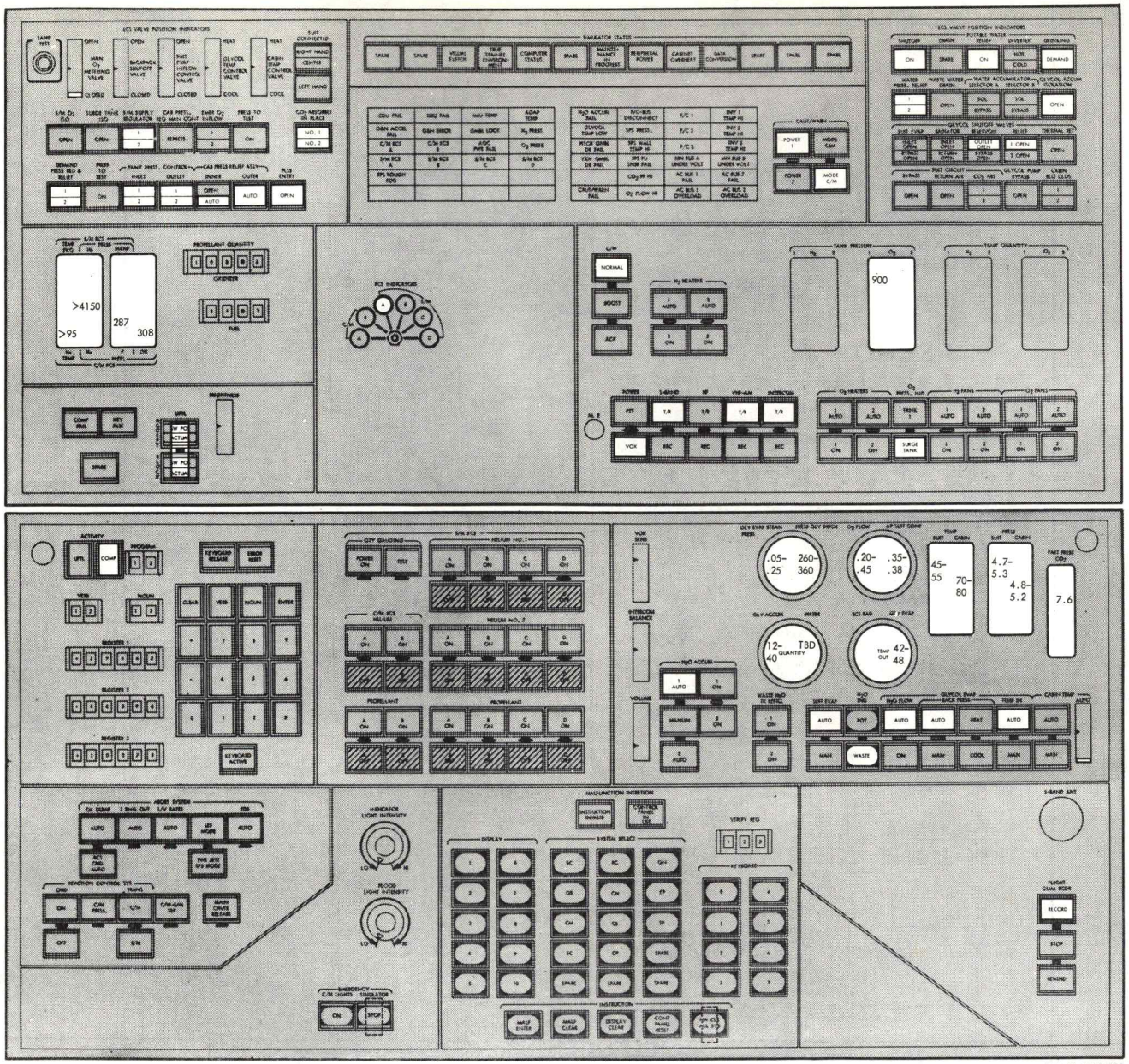
SM-6T-2-02-555

Station 2 Postseparation Pre-entry

S13A, B, C and S211

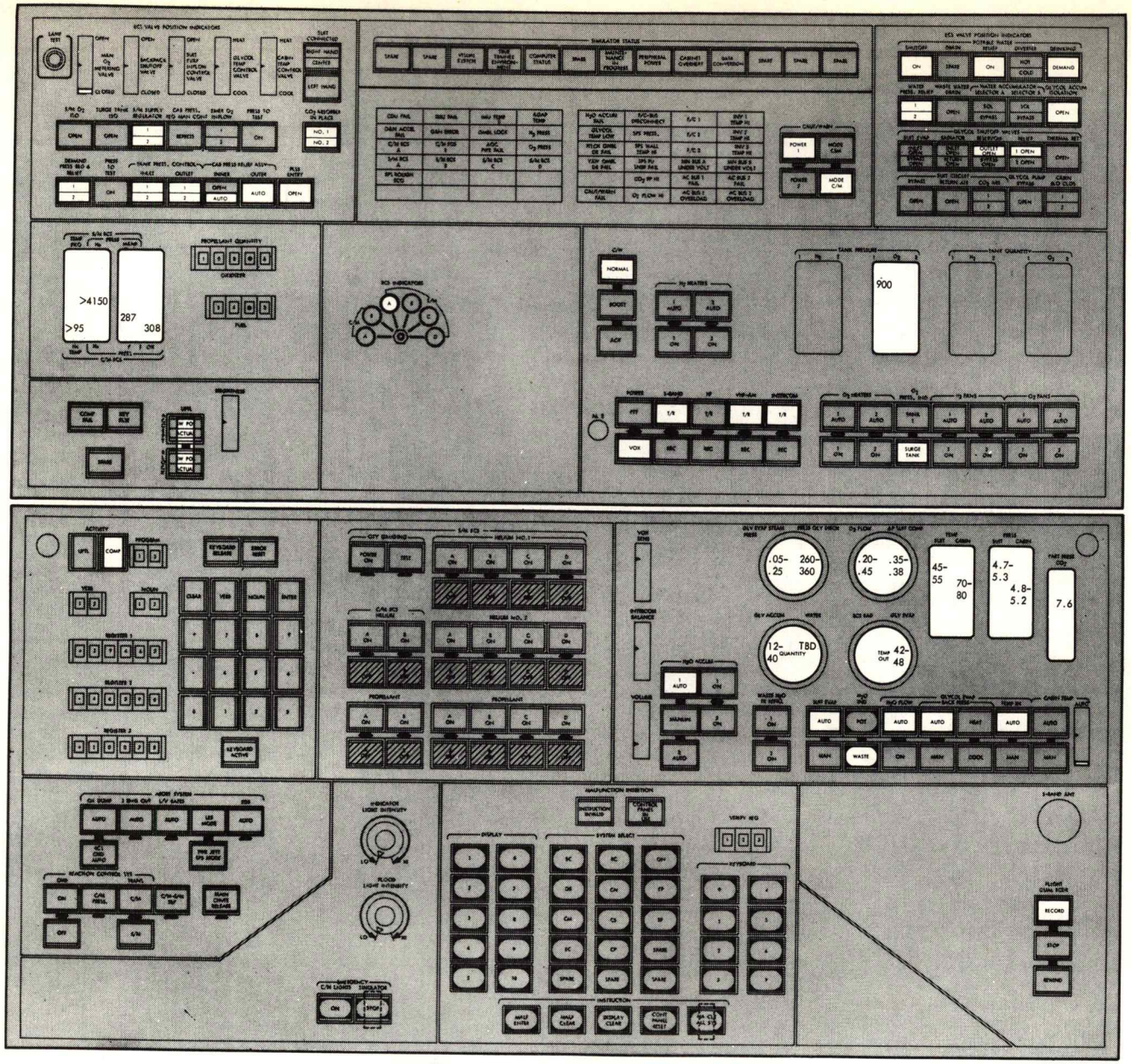
Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12				CAUT/WARN - POWER 1 lt on	
13				CAUT/WARN - MODE C/M lt on	
14				POTABLE WATER SHUTOFF - OPEN lt on	
15				POTABLE WATER RELIEF - ON lt on	
16				POTABLE WATER DRINKING - DEMAND lt on	
17				WATER PRESS RELIEF - 1 and 2 lt on	
18				GLYCOL ACCUM ISOLATION - OPEN lt on	
19				RESERVOIR - OUTLET OPEN lt on RELIEF 1 - OPEN lt on	
20				C/W - NORMAL lt on	
21				TANK PRESSURE O_2 1 ind - 900	
22				POWER - VOX lt on	
23				S-BAND - T/R lt on	


SIMULATOR STATUS
SPARE
SPARE
SPARE

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
24				VHF AM - T/R lt on	
25				INTERCOM - T/R lt on	
26				O_2 PRESS IND - SURGE TANK	
27				GLY EVAP STEAM PRESS ind - .15-.25	
28				PRESS GLY DISC ind - 260-360	
29				O_2 FLOW ind - .20-.45	
30				ΔP SUIT COMP ind - .35-.38	
31				TEMP SUIT ind - 45-55	
32				TEMP CABIN ind - 70-80	
33				PRESS SUIT ind - 4.7-5.3	
34				PRESS CABIN ind - 4.8-5.2	
35				PART PRESS CO_2 ind - 7.6	
36				GLY ACCUM ind - 12-40	
37				WATER ind - TBD	
38				GLY EVAP ind - 42-48	



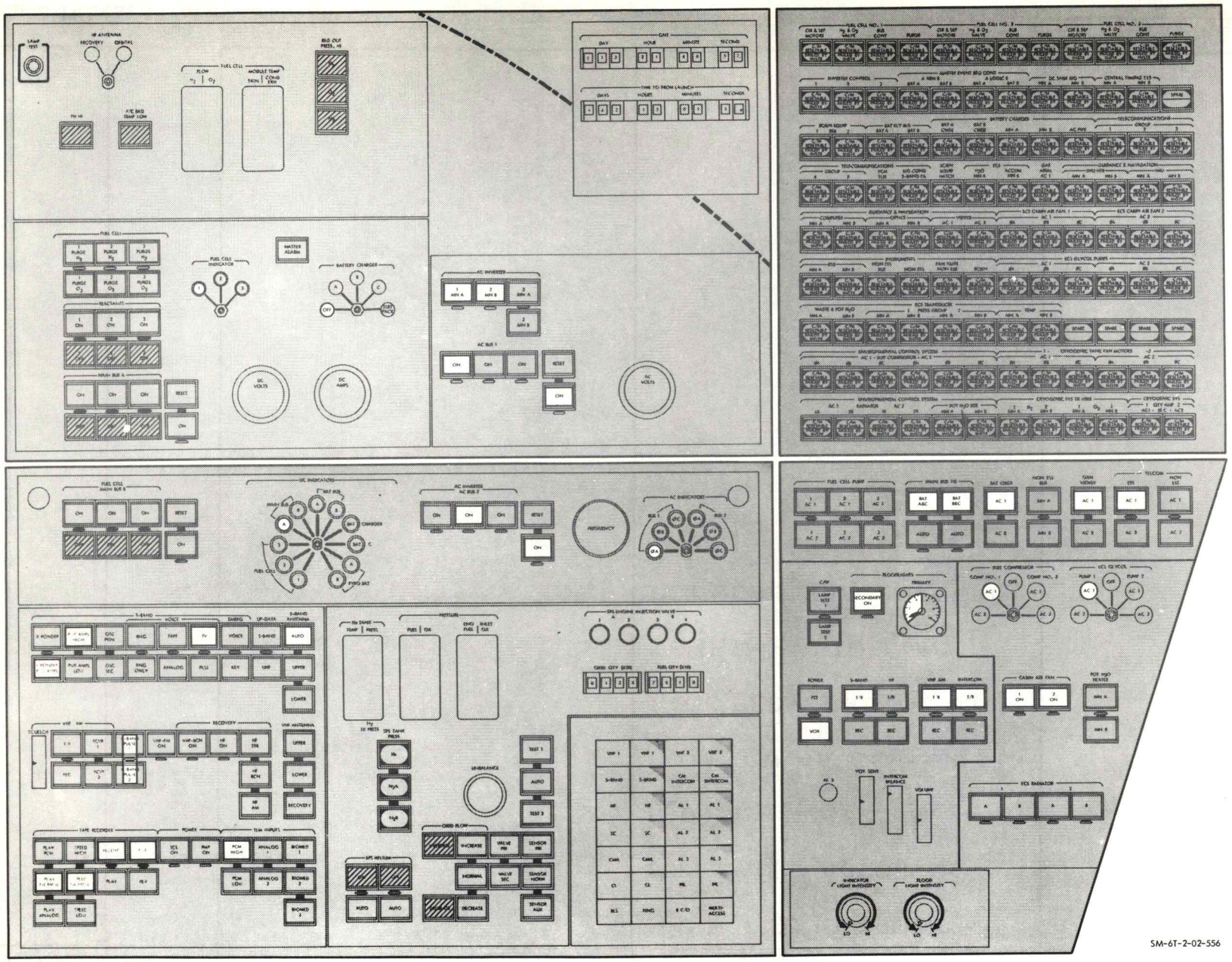
SM-6T-2-02-555

Station 2 Postseparation Pre-entry

S13A, B, C and S211

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
39				H_2O ACCUM - 1 AUTO lt on	
40				SUIT EVAP - AUTO lt on	
41				H_2O IND - WASTE lt on	
42				H_2O FLOW - AUTO lt on	
43				BACK PRESS - AUTO lt on	
44				TEMP IN - AUTO lt on	
45				FLT QUAL RCDR - RECORD lt on	

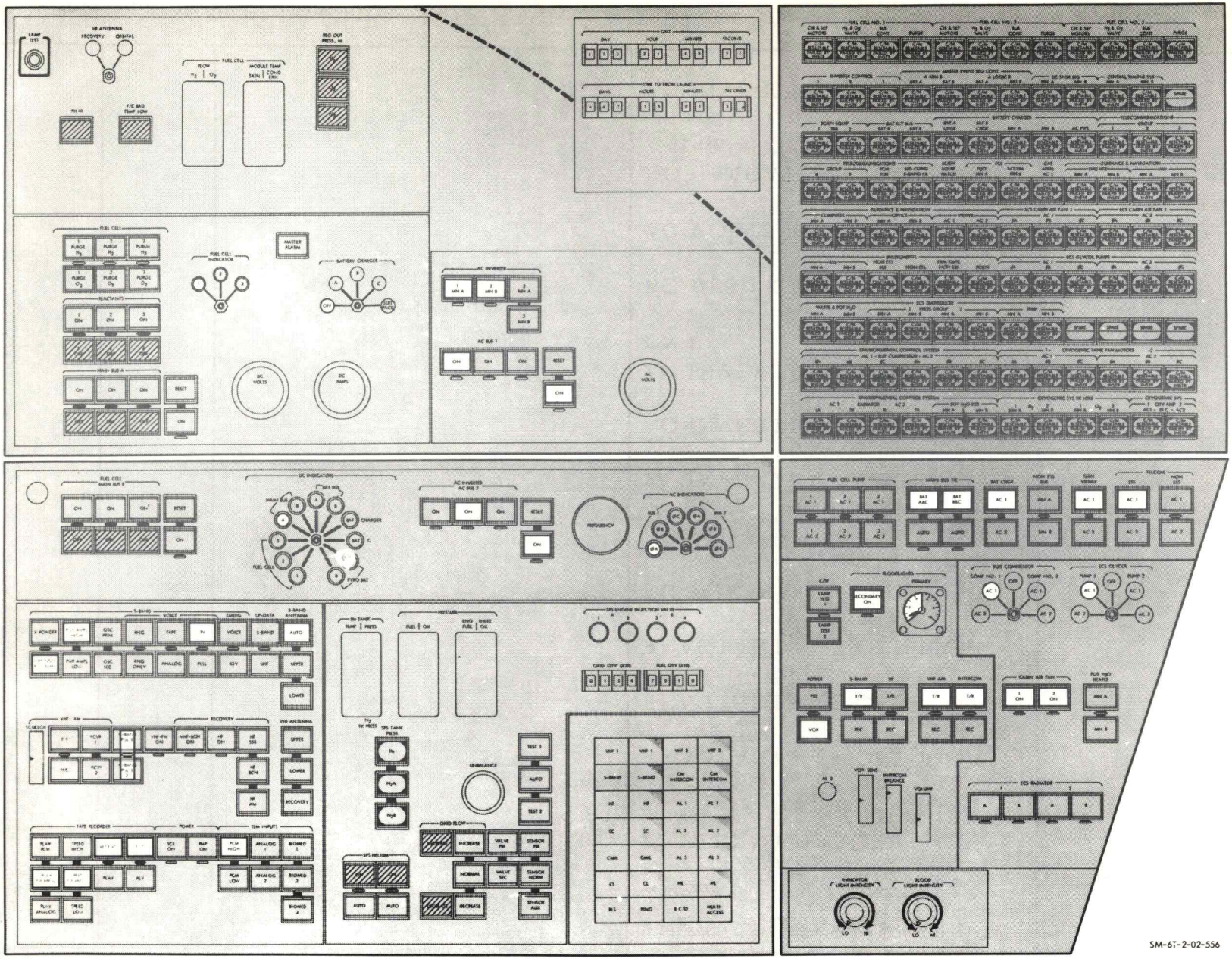


Station 3 Postseparation Pre-entry

S13A, B, C and S211

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1				FUEL CELL INDICATOR - 1 lt on	
2				BATTERY CHARGER - OFF lt on	
3				REACTANTS - 1 OFF lt on	
4				REACTANTS - 2 OFF lt on	
5				REACTANTS - 3 OFF lt on	
6				DC VOLTS ind - 29±2	
7				DC AMPS ind - as programed	
8				AC INVERTER - 1 MN A lt on	
9				AC INVERTER - 2 MN A lt on	
10				AC INVERTER 1 - AC BUS 1 - ON lt on	
11				AC BUS 1 RESET - ON lt on	
12				AC VOLTS ind - 115±2	
13				DC INDICATORS - MAIN BUS - A lt on	
14				AC INVERTER 2 - AC BUS 2 - ON lt on	

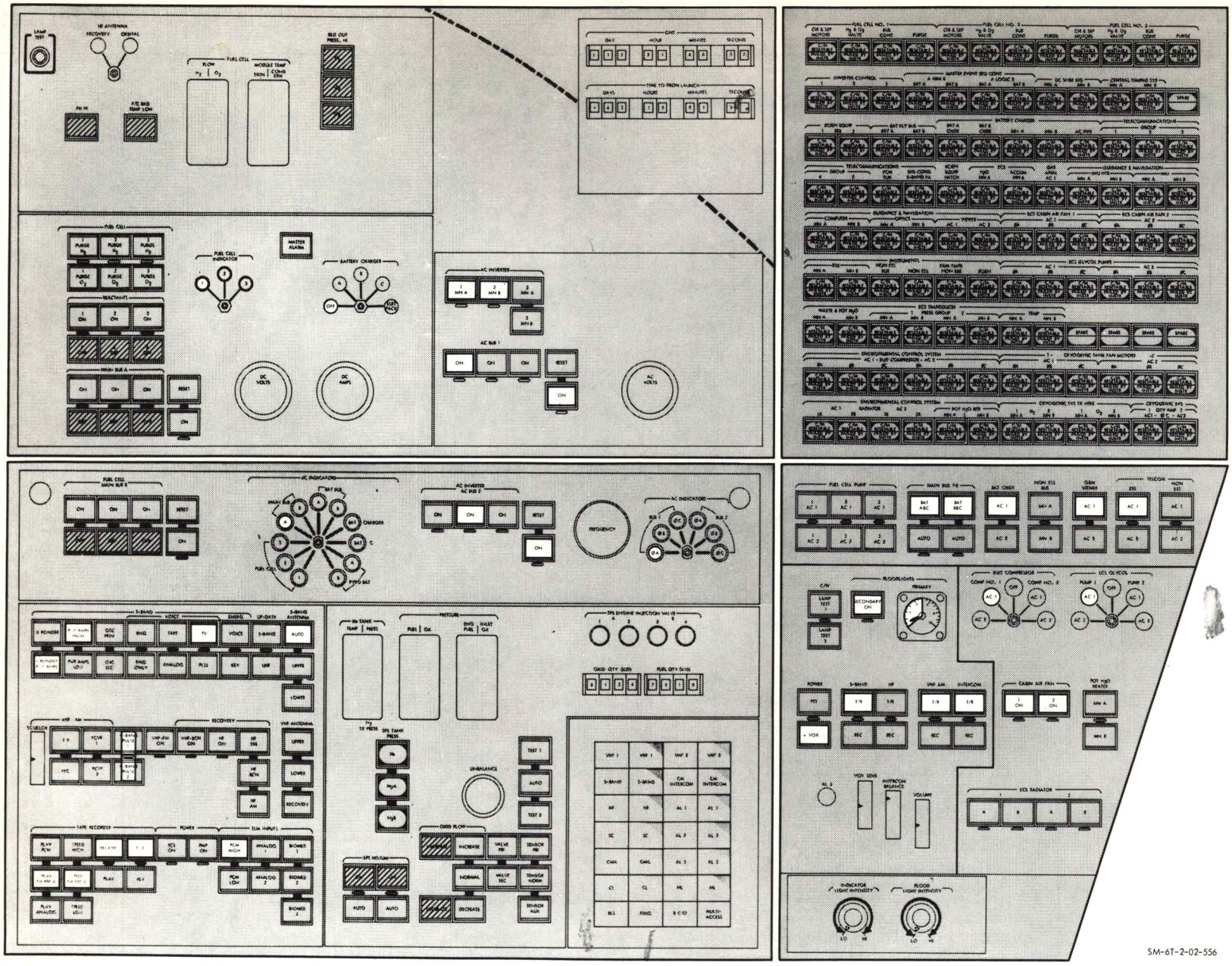


Station 3 Postseparation Pre-entry

S13A, B, C and S211

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
15				AC INDICATORS BUS 1 - ØA lt on	
16				S-BAND - XPONDER PWR AMPL lt on	
17				S-BAND - PWR AMPL HIGH lt on	
18				VOICE - TV lt on	
19				S-BAND ANTENNA - AUTO lt on	
20				C-BAND PULSE 1 or C-BAND PULSE 2 lt on	
21				TAPE RECORDER - PLAY NORMAL lt on	
22				TAPE RECORDER - SPEED NORMAL lt on	
23				TAPE RECORDER - RECORD lt on	
24				TAPE RECORDER - FWD lt on	
25				TLM INPUTS - PCM HIGH lt on	
26				MAIN BUS TIE - BAT A&C lt on	



Station 3 Postseparation Pre-entry

S13A, B, C and S211

Initialization Data Sheet

Step	Malf	Time	Function	IOS Visibility/Action	Notes
27				MAIN BUS TIE - BAT B&C lt on	
28				G&N VIEWER - AC 1 lt on	
29				TELCOM ESS - AC 1 lt on	
30				FLOODLIGHTS - SECONDARY ON lt on	
31				FLOODLIGHTS - PRIMARY - as required	
32				SUIT COMPRESSOR COMP No. 1 - AC 1 lt on	
33				ECS GLYCOL PUMP 1 - AC 1 lt on	
34				POWER - VOX lt on	
35				S-BAND - T/R lt on	
36				VHF AM - T/R lt on	
37				INTERCOM - T/R lt on	
38				CABIN AIR FAN - ON lt on	
39				CABIN AIR FAN - 2 ON lt on	

4 IOS DATA

SECTION 4

IOS DATA

This section of the AMS Instructor Handbook contains an IOS Data Sheet for each crew procedure identified in the Apollo Operations Handbook of October 15, 1965. Since that revision of the AOH specifically identified SCS and G&N procedures as "To be Supplied Later," alternate source information has been used to prepare IOS data for such procedures in this instructor handbook. The G&N procedures used are from MIT Report R507 and the SCS procedures used are from miscellaneous NAA Engineering internal correspondence.

IOS data sheets are comprised of two or more pages containing both pictorial and tabular information on crew procedures as their performance is manifested at the IOS. Table 4-1 of this section of the instructor handbook provides a complete list of the IOS data sheets included. Where crew procedures source is the October 15 AOH, the specific paragraph is referenced by number. Where alternate crew procedures data is used, the crew procedures reference is identified. Tabular steps preceded by an asterisk are not represented on graphic sheets.

IOS data sheets, their purpose, format, contents, etc., are discussed at length in paragraph 3.6.5 of Volume I of this handbook.

Table 4-1. IOS Data Sheets

AOH Para	IOS Data	Crew Activity	Remarks
8.1	P1.1	Initial Prelaunch ECS Check	Also refer to para. 3.6.5.1 (Prelaunch IOS Data Sheets).
8.1	P1.2	Control and Display Check	Also refer to para. 3.6.5.1 (Prelaunch IOS Data Sheets).
8.1	P2.1	Control and Display Check	Also refer to para. 3.6.5.1 (Prelaunch IOS Data Sheets).
8.1	P3.1	Initial Prelaunch ECS Check	Also refer to para. 3.6.5.1 (Prelaunch IOS Data Sheets).
8.1	P3.2	Control and Display Check	Also refer to para. 3.6.5.1 (Prelaunch IOS Data Sheets).
8.1	P1.3	Launch Preparation	Also refer to para. 3.6.5.1 (Prelaunch IOS Data Sheets).
8.1	P2.2	Launch Preparation	Also refer to para. 3.6.5.1 (Prelaunch IOS Data Sheets).

Table 4-1. IOS Data Sheets (Cont)

AOH Para	IOS Data	Crew Activity	Remarks
8.1	P3.3	Launch Preparation	Also refer to para. 3.6.5.1 (Prelaunch IOS Data Sheets).
		ASCENT AND INITIAL ORBIT	
8.2	A1.1	Ascent	Also refer to para. 3.6.5.2 (Launch & Ascent IOS Data Sheets).
8.2	A2.1	Ascent	Also refer to para. 3.6.5.2 (Launch & Ascent IOS Data Sheets).
8.2	A3.1	Ascent	Also refer to para. 3.6.5.2 (Launch & Ascent IOS Data Sheets).
8.2	01.1	Initial Orbit Procedures	Also refer to para. 3.6.5.3 (Special Orbital Procedures).
8.2	03.1	Initial Orbit Procedures	Also refer to para. 3.6.5.3 (Special Orbital Procedures).
8.2	04.1	Initial Orbit Procedures	Also refer to para. 3.6.5.3 (Special Orbital Procedures).
None	01.2	Minimum Power Operations	Refer to para. 3.6.5.3 (Special Orbital Procedures).
None	03.2	Minimum Power Operations	Refer to para. 3.6.5.3 (Special Orbital Procedures).
None	01.3	S-IVB Separation	Derived from Task Analysis for Mission 204A.
None	03.3	S-IVB Separation	Derived from Task Analysis for Mission 204A.
		DEORBIT AND ENTRY	
8.4	E1.1	Deorbit Delta V Procedures	Also refer to para. 3.6.5.4 (Deorbit and Entry IOS Data Sheets), includes GN1.40 (Attitude Control Mode Check) and GN1.44 (Attitude Maneuver).

Table 4-1. IOS Data Sheets (Cont)

AOH Para	IOS Data	Crew Activity	Remarks
		DEORBIT AND ENTRY (Cont)	
8.4	E3.1	Deorbit Delta V	Also refer to para. 3.6.5.4 (Deorbit & Entry IOS Data Sheets), includes SP3.04 (Delta V Operations).
8.4	E4.1	Deorbit Delta V	Also refer to para. 3.6.5.4 (Deorbit & Entry IOS Data Sheets), includes GN4.01 (IMU Orientation Determination) and GN4.03 (Program AGC), and GN4.07 (IMU Alignment) (SCM).
8.4	E1.2	Post-Delta V Operations	Also refer to para. 3.6.5.4 (Deorbit & Entry IOS Data Sheets), includes GN1.03 (Program AGC) and GN1.44 (Attitude Maneuver).
8.4	E2.1	Post-Delta V Operations	Also refer to para. 3.6.5.4 (Deorbit & Entry IOS Data Sheets), includes RC2.01 (C/M-RCS Check).
8.4	E3.2	Post-Delta V Operations	Also refer to para. 3.6.5.4 (Deorbit & Entry IOS Data Sheets), includes EP3.08 (Disconnect Fuel Cells).
8.4	E1.3	Post-Separation Operations	Also refer to para. 3.6.5.4 (Deorbit & Entry IOS Data Sheets).
8.4	E1.4	ELS Arming	Also refer to para. 3.6.5.4 (Deorbit & Entry IOS Data Sheets).
8.4	E3.4	ELS Arming	Also refer to para. 3.6.5.4 (Deorbit & Entry IOS Data Sheets).
		RECOVERY PROCEDURES	
8.5	R1.1	Postlanding Procedures	
8.5	R2.1	Postlanding Procedures	

Table 4-1. IOS Data Sheets (Cont)

AOH Para	IOS Data	Crew Activity	Remarks
RECOVERY PROCEDURES (Cont)			
8.5	R3.1	Postlanding Procedures	
8.5	R4.1	Postlanding Procedures	
ABORT PROCEDURES			
9.2.1.1.1	B1.1	Pad & Low-Altitude Abort (Prior to T + 42 Sec)	
9.2.1.1.1	B1.2	Low Altitude Abort (After T + 42 Sec)	
9.2.1.2	B1.3	LES Aborts 30,000 to 120,000 Ft	
9.2.1.3	B1.4	LES Aborts 120,000 Ft to Tower Jettison	
9.2.2	B1.5	SPS Abort	SPS Abort Procedures remain as TBSL items in AOH.
SYSTEMS			
SCS			
8.3.2	SC1.03	SCS Delta V	This procedure is based on Engineering procedures released through IL 697-503-110-65-118, also includes IOS Data Sheet GN4.03 (Program AGC).
RCS			
8.3.1.4	RC2.01	C/M-RCS Periodic Check	
8.3.1.4	RC2.02	S/M-RCS Periodic Check	
ECS			
8.3.1.6	EC3.01	Orbital ECS Hourly Check	
8.3.1.6	EC3.02	CO_2-Odor Absorbent Filter Replacement	

Table 4-1. IOS Data Sheets (Cont)

AOH Para	IOS Data	Crew Activity	Remarks
SYSTEMS (Cont)			
ECS			
8.3.1.6	EC3.05	Cabin Cold-Soak	
8.3.1.6	EC4.06	Waste Water Dump Operations	
EPS			
8.3.1.5	EP3.05	Fuel Cell Hydrogen Purge	
8.3.1.5	EP3.06	Fuel Cell Oxygen Purge	
8.3.1.5	EP3.07	Battery Charge	
8.3.1.5	EP3.08	Fuel Cell Shutdown Procedures	
8.3.1.5	EP3.10	EPS Periodic Check	
8.3.1.5	EP3.11	Manual Pressure Control Verification	
8.3.1.5	EP3.12	Quantity Balance Verification	
SPS			
8.3.1.3	SP3.01	SPS Periodic Check	
8.3.1.3	SP3.02	SPS Periodic Propellant Quantity Gauging System Check	
8.3.1.3	SP1.03	Gimbal Position Indicators Test	
	SP3.04	Delta V Operations, Station 3	Task Analysis Function SP003, SP004
G&N			
	GN4.01	G&N System Activation	Task Analysis Function GN008, GN041, GN044, GN075, GN126, SC010
8.3.1.1	GN4.02	G&N Periodic Verification	
	GN4.03	Program AGC for major mode	R507

Table 4-1. IOS Data Sheets (Cont)

AOH Para	IOS Data	Crew Activity	Remarks
SYSTEMS (Cont)			
G&N			
	GN4.04	IMU Orientation Determination	R507 - P51 Also includes IOS Data Sheets GN4.03 (Program AGC), GN4.49 (Sighting Mark Routine).
	GN4.06	IMU Alignment (S-IVB)	R507 - P52 Also includes IOS Data Sheets GN4.03 (Program AGC), GN4.49 (Sighting Mark Routine), GN4.50 (Automatic Optics Positioning).
	GN4.07	IMU Alignment (SCM)	R507 - P53 Also includes IOS Data Sheets GN4.03 (Program AGC), GN4.49 (Sighting Mark Routine), GN4.50 (Optics Positioning).
	GN1.08	CSM Local Vertical	R507 - P21 Also includes IOS Data Sheets GN4.03 (Program AGC), GN1.40 (Attitude Control Mode Check), GN1.44 (Attitude Maneuver).
	GN4.09	Landmark Tracking	R507 - P22 Also includes IOS Data Sheets GN4.03 (Program AGC), GN4.49 (Sighting Mark Routine), GN4.50 (Automatic Optics Positioning).
	GN4.10	Star-Landmark Navigation Measurement	R507 - P23 Also includes IOS Data Sheet GN4.03 (Program AGC)
	GN4.11	AGC Update	R507 - P27
	GN4.12	Orbit Change Delta V Station 4	R507 - P31 Also includes IOS Data Sheets GN4.03 (Program AGC), GN4.04 (IMU Orientation Determination), GN4.07 (IMU Alignment) (SCM).

Table 4-1. IOS Data Sheets (Cont)

AOH Para	IOS Data	Crew Activity	Remarks
		SYSTEMS (Cont)	
		G&N	
	GN1.13	Orbit Change Delta V Station 1	R507 - P31, P41 Also includes IOS Data Sheets GN4.03 (Program AGC), GN1.40 (Attitude Control Mode Check), GN1.44 (Attitude Maneuver).
	GN1.40	Attitude Control Mode Check	R507 - R1
	GN1.44	Attitude Maneuver	R507 - R2
	GN4.49	Sighting Mark	R507 - R14
	GN4.50	Automatic Optics Positioning	R507 - R15
	GN4.55	Orbit Parameter Display	R507 - R33 Also includes IOS Data Sheet GN4.03 (Program AGC)
	GN4.56	Prethrust Orbit Change Data Load	R507 - R22
		T/C	
8.3.1.7.1	TC1.01	Audio Center Activation Station 1, 2, and 3	
8.3.1.7.1	TC3.02	VHF AM Voice Communications (MSFN contacts)	
8.3.1.7.3	TC3.03	Up-Data Link Activation	
8.3.1.7.3	TC3.04	VHF-FM Activation	
8.3.1.7.3	TC3.05	Transmit High Bit Rate PCM, VHF-FM	
8.3.1.7.3	TC3.06	Transmit Low Bit Rate PCM, VHF-FM	
8.3.1.7.3	TC3.07	Transmit Recorded High Bit Rate PCM, VHF-FM	

Table 4-1. IOS Data Sheets (Cont)

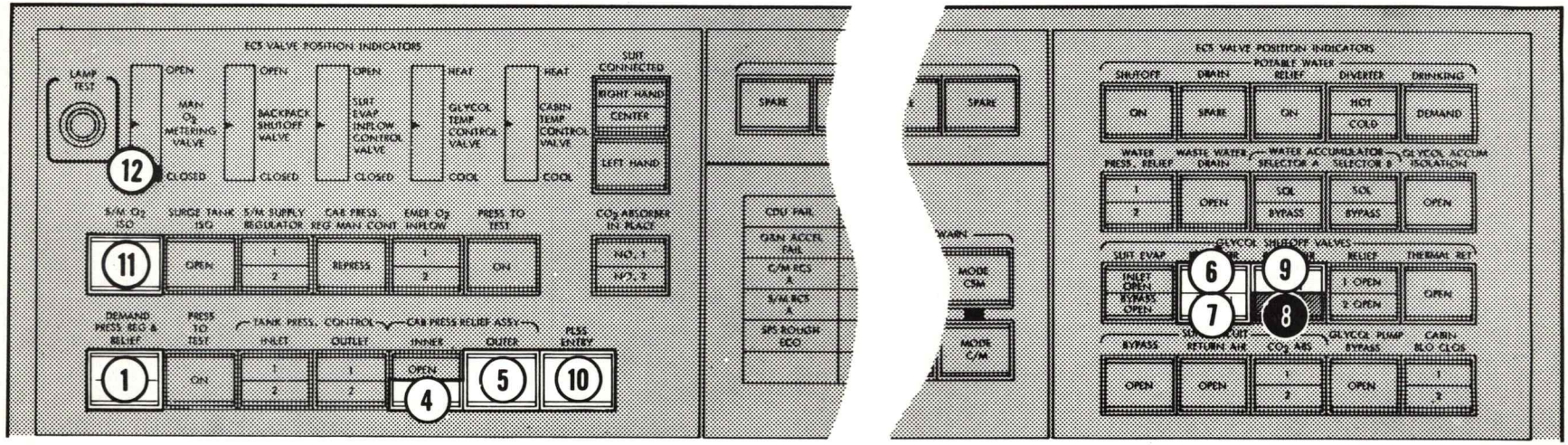
AOH Para	IOS Data	Crew Activity	Remarks
		SYSTEMS (Cont)	
		T/C	
8.3.1.7.3	TC3.08	Transmit Recorded Low Bit Rate PCM, VHF-FM	
8.3.1.7.3	TC3.09	Record High Bit Rate PCM	
8.3.1.7.3	TC3.10	Record Low Bit Rate PCM	
8.3.1.7.3	TC3.11	Record Real Time Analog Data	
8.3.1.7.4	TC3.12	Activate USBE Power Amplifier in Bypass Mode	
8.3.1.7.4	TC3.13	Activate USBE Power Amplifier in High or Low Power Mode	
8.3.1.7.4	TC3.14	USBE Voice Operations	
8.3.1.7.4	TC3.15	USBE, Transmit Recorded Low (or High) Bit Rate PCM	
8.3.1.7.4	TC3.16	USBE, Transmit Recorded High Rate PCM and Analog	
8.3.1.7.4	TC3.17	USBE, Transmit Low or High Bit Rate PCM	
8.3.1.7.4	TC3.18	USBE, Transmit Low or High Bit Rate PCM	
8.3.1.7.4	TC3.19	USBE, Transmit in Ranging Only	
8.3.1.7.4	TC3.20	USBE, Transmit High or Low Bit Rate PCM and TV	
1.3.1.7.2	TC3.21	C-Band Tracking and Ranging	
8.3.1.7.4	TC3.22	Reviewed Tape Recorder	
		MALFUNCTIONS	
9.1.4.2	MRC.01	S/M RCS C/W light illuminates	
9.1.6.4	MEC.01	O_2 FLOW HI light illuminates	

Table 4-1. IOS Data Sheets (Cont)

AOH Para	IOS Data	Crew Activity	Remarks
SYSTEMS (Cont)			
MALFUNCTIONS			
9.1.6.3	MEC.02	O_2 FLOW HI light illuminates, O_2 flow high, cabin pressure high	
9.1.6.6	MEC.03	Glycol discharge pressure abnormal	
9.1.6.7	MEC.04	Suit compressor delta P indicates below normal	
9.1.6.8	MEC.05	Suit temperature indicates low	
9.1.6.8	MEC.06	Suit temperature indicates high	
9.1.6.9	MEC.07	Cabin temperature indicates high	
9.1.6.10	MEC.08	Suit pressure indicates low	
9.1.6.10	MEC.09	Suit pressure indicates high	
9.1.6.11	MEC.10	Cabin pressure high	
9.1.6.5	MFC.11	Tank pressure 1 O_2 low	
9.1.5.3	MEP.01	O_2 failure	
9.1.5.2	MEP.02	H_2 failure	
9.1.5.3	MEP.03	N_2 failure	
9.1.5.1	MEP.04	O_2 PRESS light illuminates	
9.1.5.1	MEP.05	H_2 PRESS light illuminates	
9.1.5.3	MEP.06	Fuel cell fail light illuminates H_2 flow high	
9.1.5.3	MEP.07	Fuel cell fail light illuminates, O_2 flow high	
9.1.5.4	MEP.08	D-C BUS A UNDERVOLT light illuminates	

Table 4-1. IOS Data Sheets (Cont)

AOH Para	IOS Data	Crew Activity	Remarks
SYSTEMS (Cont)			
MALFUNCTIONS			
9.1.5.6-14	MEP.10	A-C inverter and bus check	Part of AOH para. 9.1.5.6 thru 9.1.5.14
9.1.5.6-14	MEP.11	Critical loads transfer	Part of AOH para. 9.1.5.6 thru 9.1.5.14
9.1.5.6.7	MEP.12	Dual-inverter changeover	
9.1.5.8	MEP.13	Single-inverter changeover	
9.1.5.8.9	MEP.14	Bus reset	
9.1.5.6-8	MEP.15	Connect A-C bus loads to bus 1	
9.1.5.9	MEP.16	Overload isolation check	
9.1.5.6	MEP.20	Bus 1 failure, dual-inverter operation	
9.1.5.8	MEP.21	Both 1 and 2 A-C bus fail, single-inverter operation	
9.1.5.9	MEP.22	Bus 1 overload and A-C bus 1 fail lights illuminate	
9.1.5.9	MEP.23	Single-inverter operation	
9.1.5.10	MEP.24	Inverter temperature high, dual-inverter operation SCS operating	
9.1.3.5	MSP.01	SPS PU SENSOR FAIL light illuminates	



LISTED STEPS

2, 3

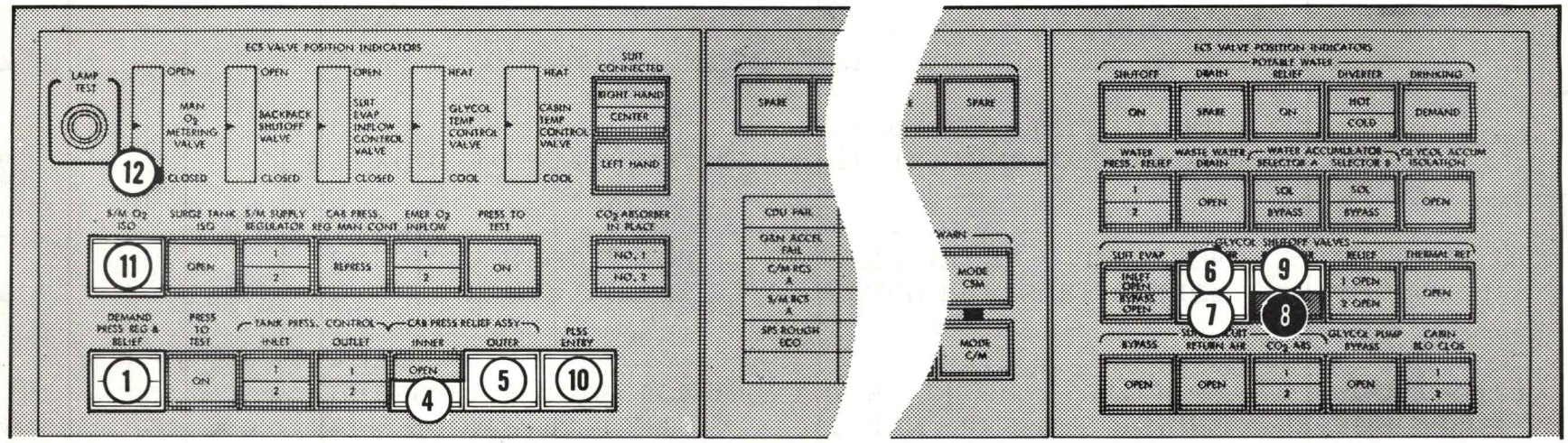
SM-6T-2-02-546

Initial Prelaunch ECS Check

Pl. 1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Suit demand pressure regulator valve - BOTH	DEMAND PRESS REG & RELIEF - 1 and 2 lt on	AOH callout - 1 & 2
*2			SUIT EVAP sw - WATER/GLY EVAP	None	Control not provided on AMS
*3			SURGE TANK PRESSURE RELIEF VALVE - NORMAL	None	Control not provided on AMS
4			Upper COMPARTMENT PRESSURE REGULATOR - AUTO	CABIN PRESSURE RELIEF ASSY INNER - AUTO lt on	AOH callout - BOOST ENTRY
5			Lower COMPARTMENT PRESSURE REGULATOR - AUTO	CABIN PRESSURE RELIEF ASSY OUTER - AUTO lt on	AOH callout - BOOST ENTRY
6			GLYCOL TO RAD valve - OPEN	GLYCOL SHUTOFF VALVES-RADIATOR - INLET OPEN lt on	
7			GLYCOL RESERVOIR INLET valve - ON	GLYCOL SHUTOFF VALVES-RADIATOR - RETURN OPEN lt on	
8			GLYCOL RESERVOIR BYPASS valve - OFF	GLYCOL SHUTOFF VALVES-RESERVOIR - BYPASS OPEN lt out	
9			GLYCOL RESERVOIR OUTLET valve - ON	GLYCOL SHUTOFF VALVES-RESERVOIR - OUTLET OPEN lt on	



LISTED STEPS

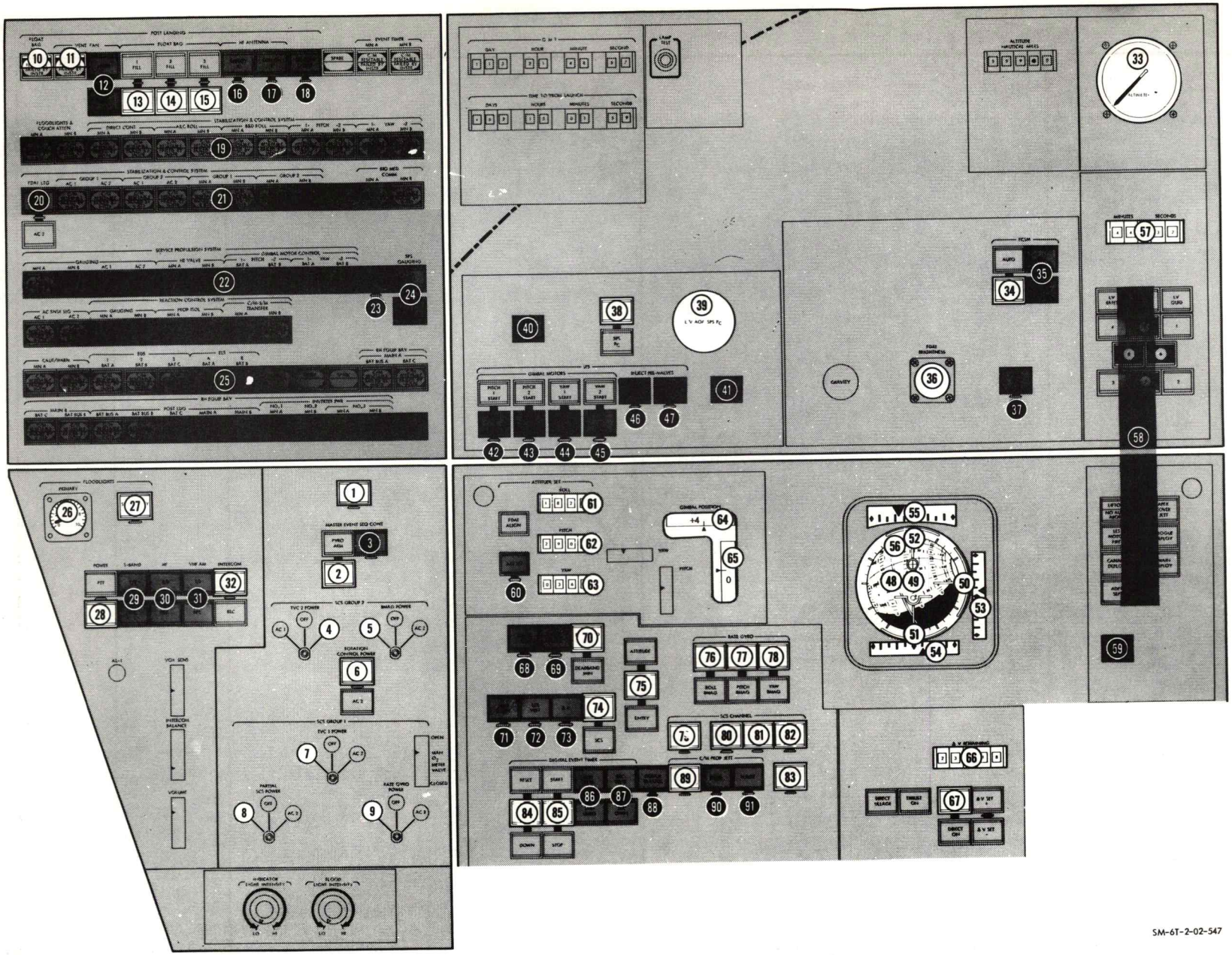
2, 3

SM-6T-2-02-546

Initial Prelaunch ECS Check

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
10			OXYGEN ENTRY valve - ON	PLSS ENTRY - OPEN lt on	
11			OXYGEN S/M SUPPLY valve - ON	S/M O_2 ISO - OPEN lt on	
12			DIRECT O_2 valve - closed	MAN O_2 METERING VALVE - CLOSED	

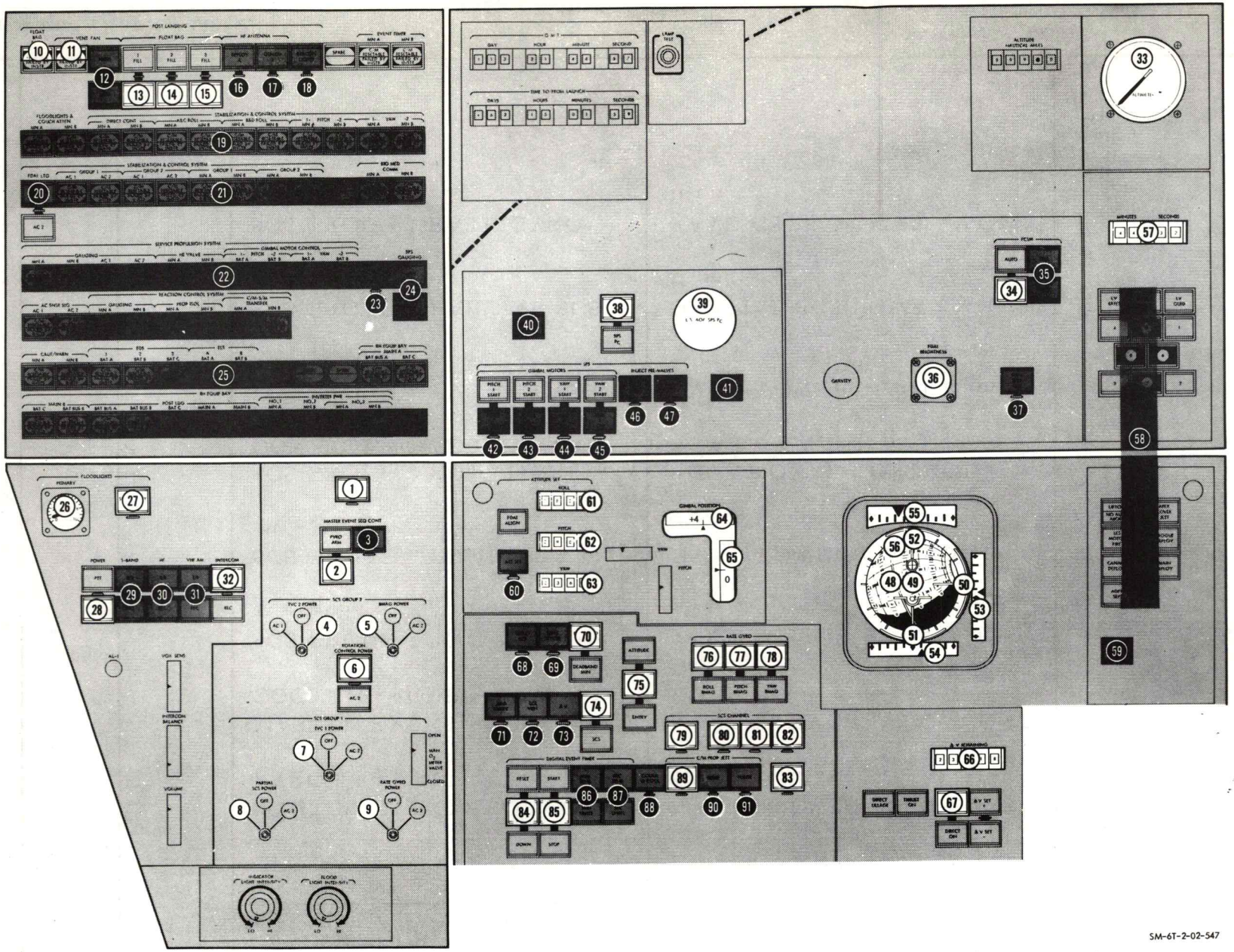


Control and Display Check

P1.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-9			Master Sequence Control Panel		
1			EDS power sw - OFF	EDS POWER ON - lt on	
2			MASTER EVENT SEQ. CONT PYRO sw - SAFE	MASTER EVENT SEQ.CONT - SAFE lt on	
3			MASTER EVENT SEQ. CONT LOGIC sw - OFF	MASTER EVENT SEQ. CONT - LOGIC lt out	
4			SCS GROUP 2 TVC 2 POWER sw - AC2	TVC 2 POWER - AC2 lt on	
5			SCS GROUP 2 BMAG POWER sw - AC1	BMAG POWER - AC1 lt on	
6			SCS GROUP 2 ROTATION CONTROL POWER sw - AC1	ROTATIONAL CONTROL POWER - AC1 lt on	
7			SCS GROUP 1 TVC 1 POWER sw - AC1	TVC 1 POWER - AC1 lt on	
8			SCS GROUP 1 PARTIAL SCS POWER sw - AC1	PARTIAL SCS POWER - AC1 lt on	
9			SCS GROUP 1 RATE GYRO POWER sw - AC1	RATE GYRO POWER - AC1 lt on	



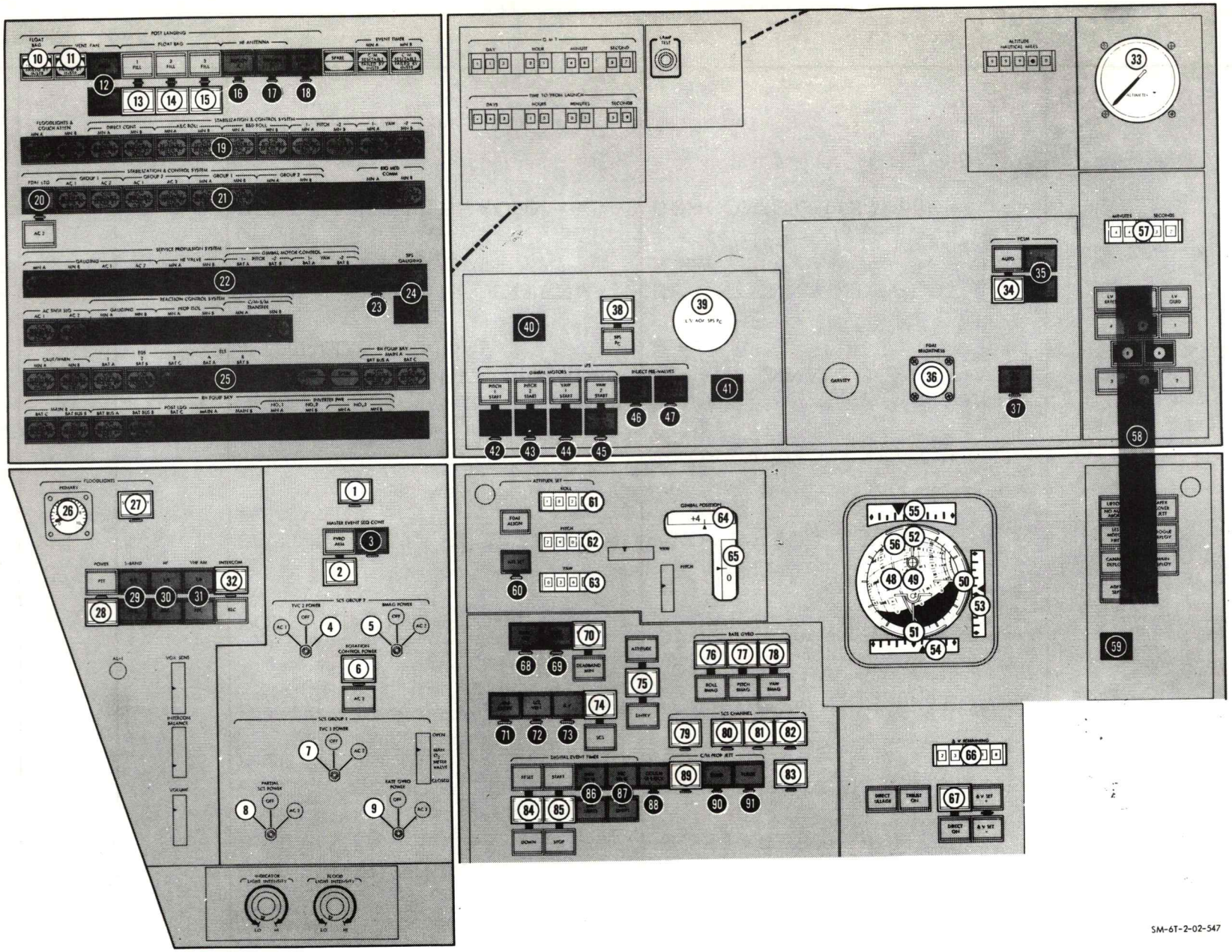
SM-6T-2-02-547

Control and Display Check

P1.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
10-25			Left-Hand Circuit Breaker Panel		
10			POST LANDING FLOAT BAG BAT C C/B - out	FLOAT BAG BAT C - C/M RESETABLE lt on	
11			POST LANDING VENT FAN BAT C C/B - out	VENT FAN - C/M RESETABLE lt on	
12			POST LANDING VENT FAN sw - off	VENT FAN - HIGH and LOW lt out	
13			POST LANDING FLOAT BAG 1 sw - VENT	FLOAT BAG - 1 VENT lt on	
14			POST LANDING FLOAT BAG 2 sw - VENT	FLOAT BAG - 2 VENT lt on	
15			POST LANDING FLOAT BAG 3 sw - VENT	FLOAT BAG - 3 VENT lt on	
16			POST LANDING HF ANTENNA A DEPLOY sw - OFF	HF ANTENNA - DEPLOY A lt out	
17			POST LANDING HF ANTENNA B DEPLOY sw - OFF	HF ANTENNA - DEPLOY B lt out	
18			POST LANDING BEACON sw - OFF	BEACON LIGHTS lt out	
19			All C/Bs, 2nd row - in	All lt out	

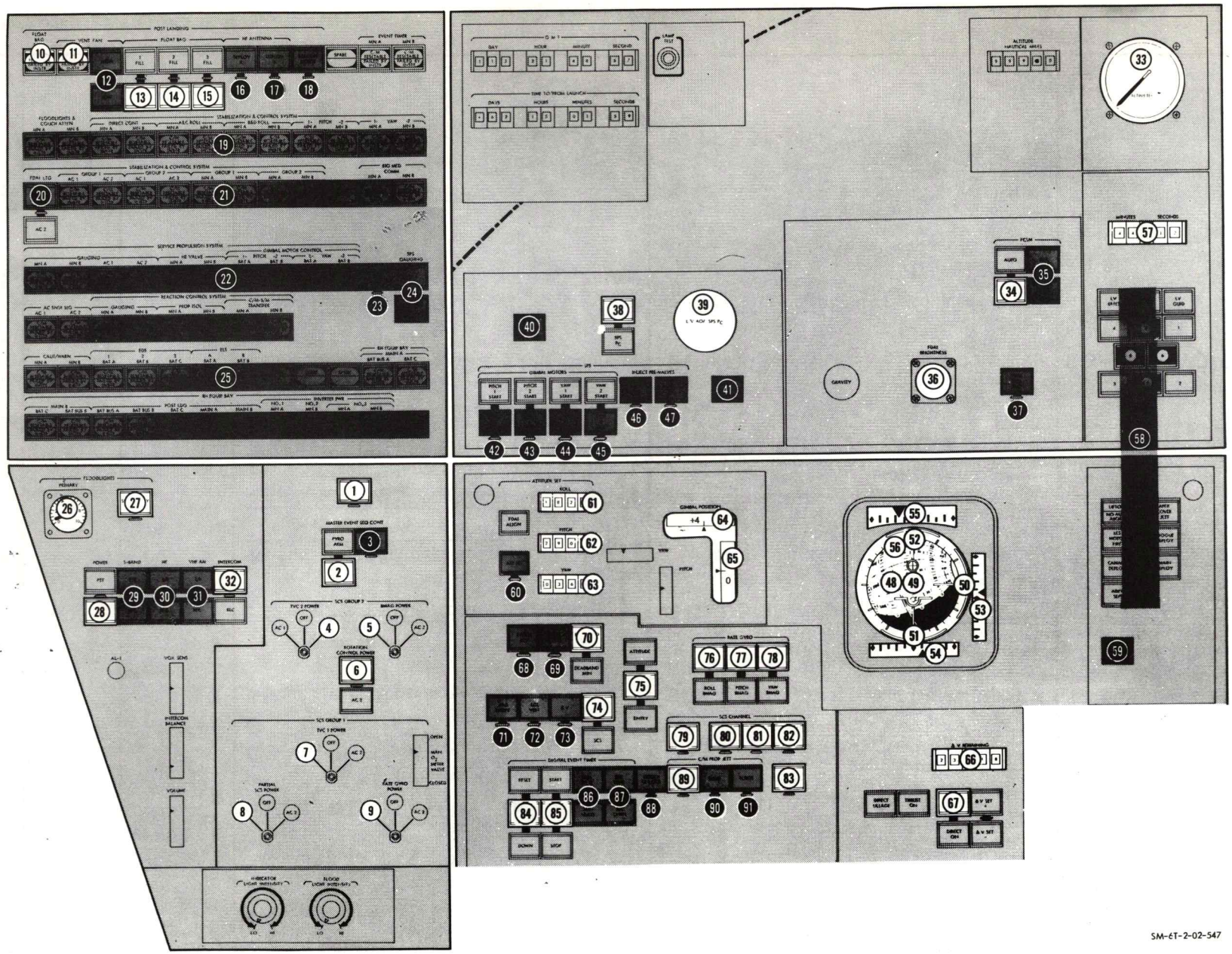


Control and Display Check

P1.2

IOS DATA SHEET

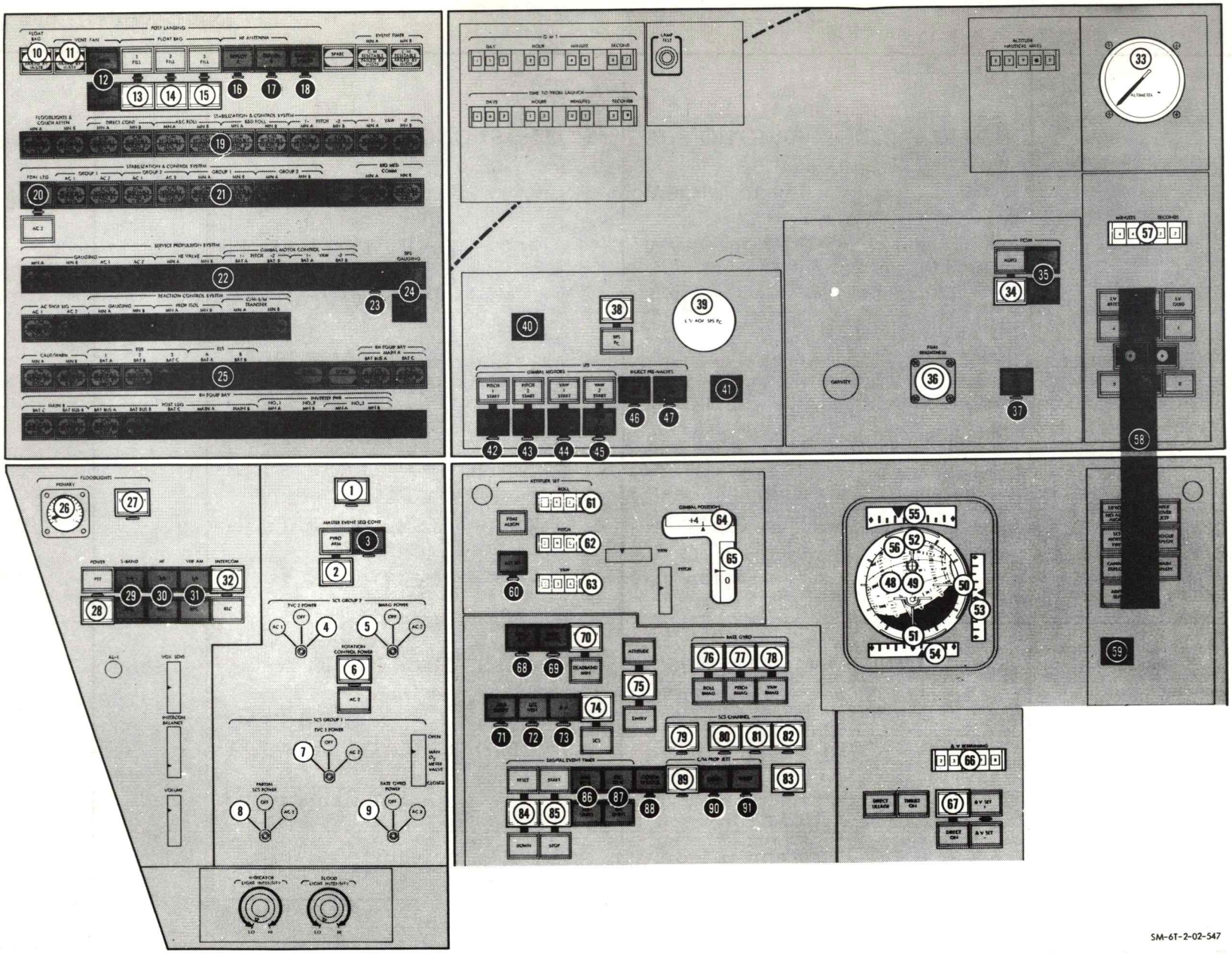
Step	Malf	Time	Function	IOS Visibility/Action	Notes
20			FDAI LTG sw - AC1	FDAI LTG - AC1 lt on	
21			All C/Bs, 3rd row - in	All lt out	
22			All C/Bs, 4th row - in	All lt out	
23			G&N SYNC sw - OFF	G&N SYNC lt out	
24			SPS GAUGING sw - OFF	SPS GAUGING - AC1 and AC2 lt out	
25			All C/Bs, 5th row - in	All lt out	
26-37			Left-Hand Audio Panel		
26			FLOODLIGHTS PRIMARY cont	As required	
27			FLOODLIGHTS SECONDARY sw - ON	FLOODLIGHTS - SECONDARY ON lt on	
28			POWER sw - VOX	POWER - VOX lt on	Refer to AOH step 2.
29			S-BAND sw - OFF	S-BAND - T/R and REC lt out	
30			HF sw - OFF	HF - T/R and REC lt out	
31			VHF AM sw - OFF	VHF AM - T/R and REC lt out	
32			INTERCOM sw - T/R	INTERCOM - T/R lt on	



Control and Display Check

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Altimeter Panel		
33			Altimeter indicator	Pad altitude	
34-37			FDAI Control Panel		
34			FCSM AUTO-OVERRIDE sw - OVERRIDE	FCSM - OVERRIDE lt on	
35			FCSM ON/OFF/RESET sw - OFF	FCSM - ON and RESET lt out	
36			FDAI BRIGHTNESS - cont	As desired	
37			FDAI SELF TEST sw - OFF	FDAI SELF TEST lt out	
38-47			ENDS/SPS Gimbal Drive Control Panel		
38			L/V AOA/SPS P_C sw - L/V AOA	L/V AOA lt on	
39			L/V AOA/SPS P_C ind	TBD	
40			MASTER ALARM lt - out	MASTER ALARM lt out	
41			ABORT lt out	ABORT lt out	
42			SPS GIMBAL MOTORS PITCH 1 sw - OFF	SPS GIMBAL MOTORS PITCH 1 START lt out	



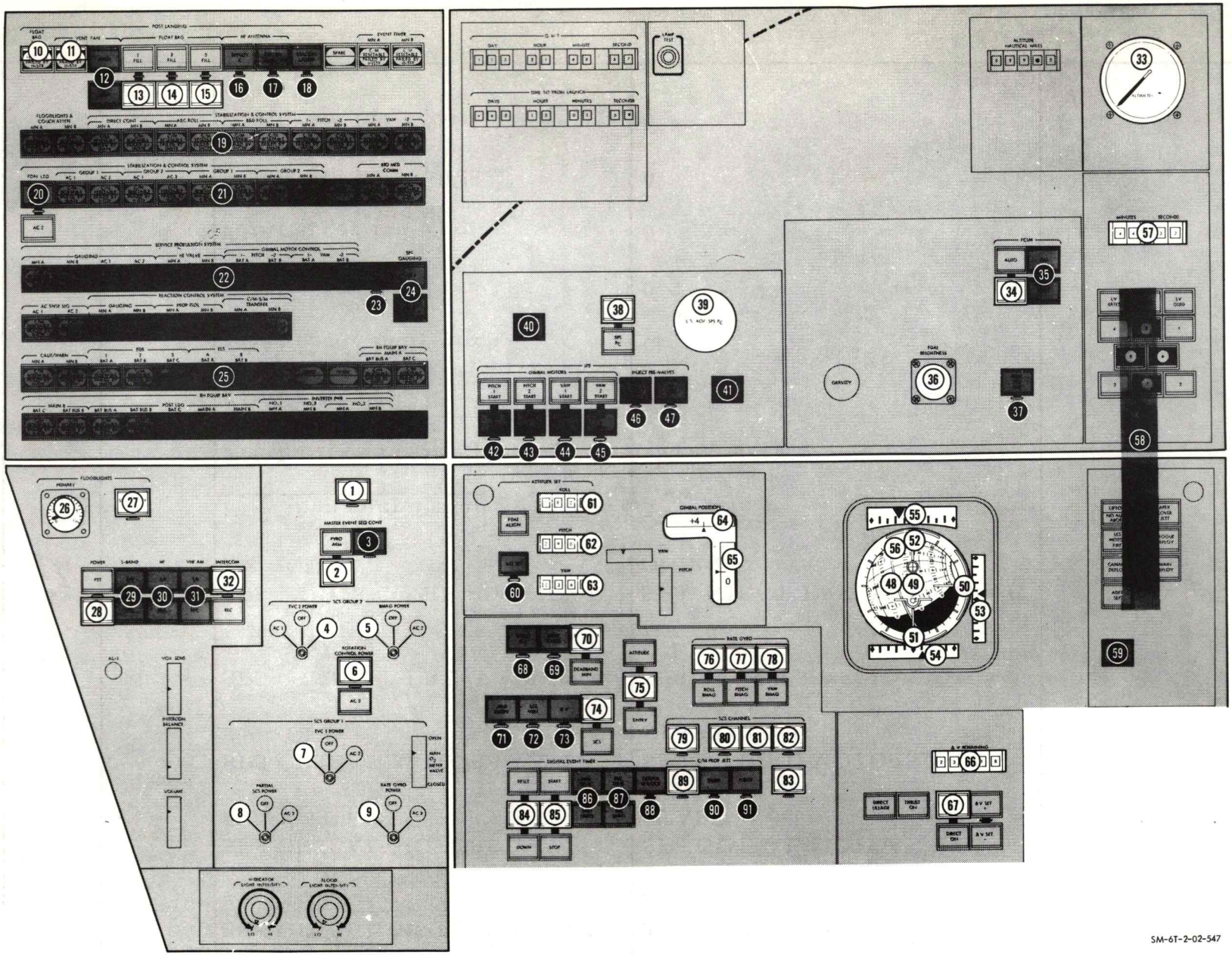
SM-6T-2-02-547

Control and Display Check

P1.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
43			SPS GIMBAL MOTORS PITCH 2 sw - OFF	SPS GIMBAL MOTORS PITCH 2 START lt out	
44			SPS GIMBAL MOTORS YAW 1 sw - OFF	SPS GIMBAL MOTORS YAW 1 START lt out	
45			SPS GIMBAL MOTORS YAW 2 sw - OFF	SPS GIMBAL MOTORS YAW 2 START lt out	
46			SPS - INJECT PRE-VALVES A sw - OFF	SPS INJECT PRE-VALVES - A ON lt on	
47			SPS - INJECT PRE-VALVES B sw - OFF	SPS INJECT PRE-VALVES - B ON lt on	
47-56			FDAI Indicator Panel		
48			FDAI attitude ball - pitch	59.5	
49			FDAI attitude ball - yaw	8.7	
50			FDAI error ind - pitch	0	
51			FDAI error ind - yaw	0	
52			FDAI error ind - roll	0	
53			FDAI rate ind - pitch	0	
54			FDAI rate ind - yaw	0	



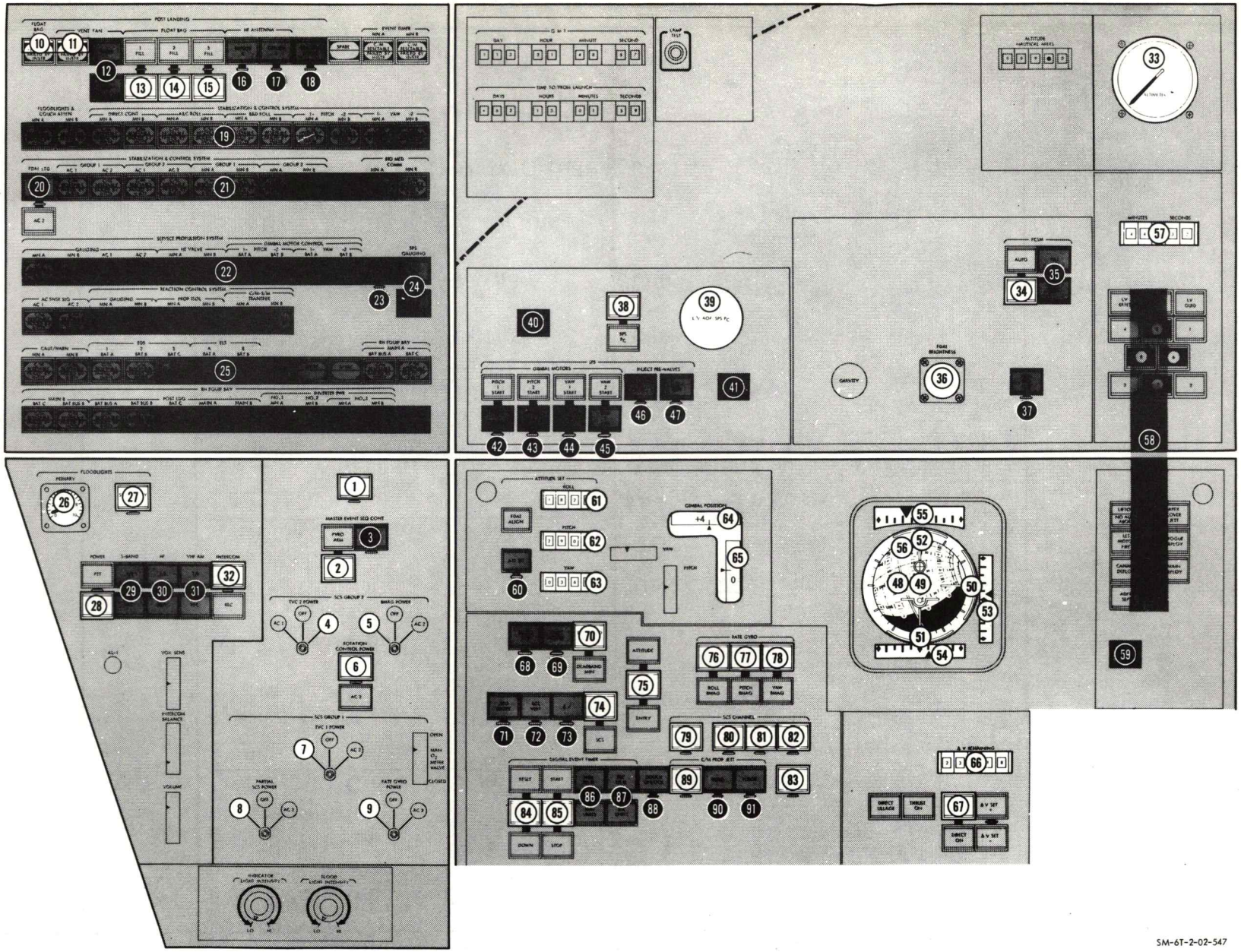
SM-6T-2-02-547

Control and Display Check

P1.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
55			FDAI rate ind - roll	0	
56			FDAI roll pointer	163.5	
57-59			Sequential Control/Display Panel		
57			Event timer	0000	
58			All FDS lt - out		
59			LOCK/UNLOCK sw - LOCK	UNLOCK lt out	
60-65			Attitude Set/Gimbal Position Panel		
60			ATT SET sw - OFF	ATT SET lt out	
61			ATTITUDE SET ROLL ind	180	
62			ATTITUDE SET PITCH ind	090	
63			ATTITUDE SET YAW ind	000	
64			GIMBAL POSITION YAW ind	+4	
65			GIMBAL POSITION PITCH ind	0	
66-67			Delta V Display Panel		
66			ΔV REMAINING ind	10000	



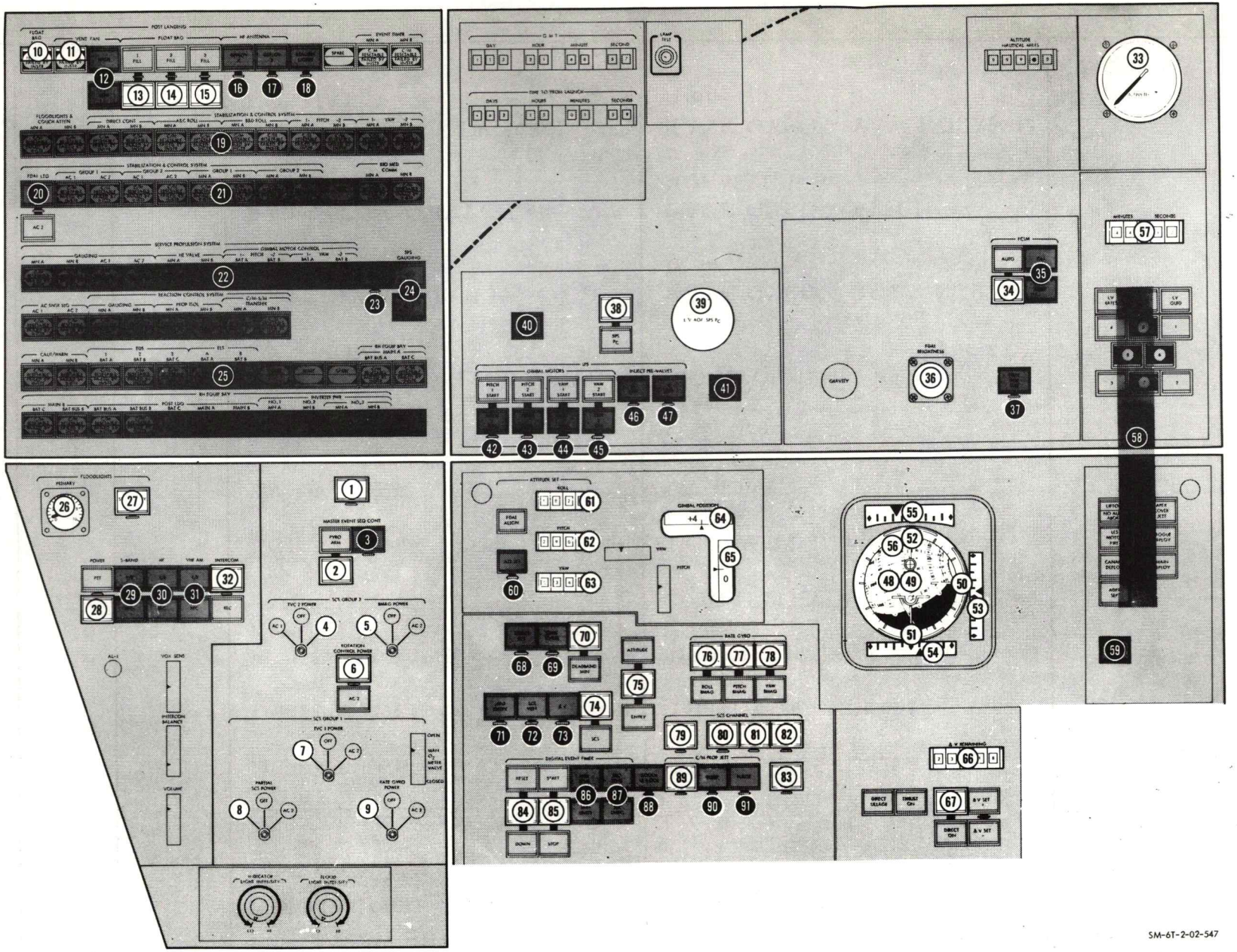
SM-6T-2-02-547

Control and Display Check

P1. 2

IOS DATA SHEET

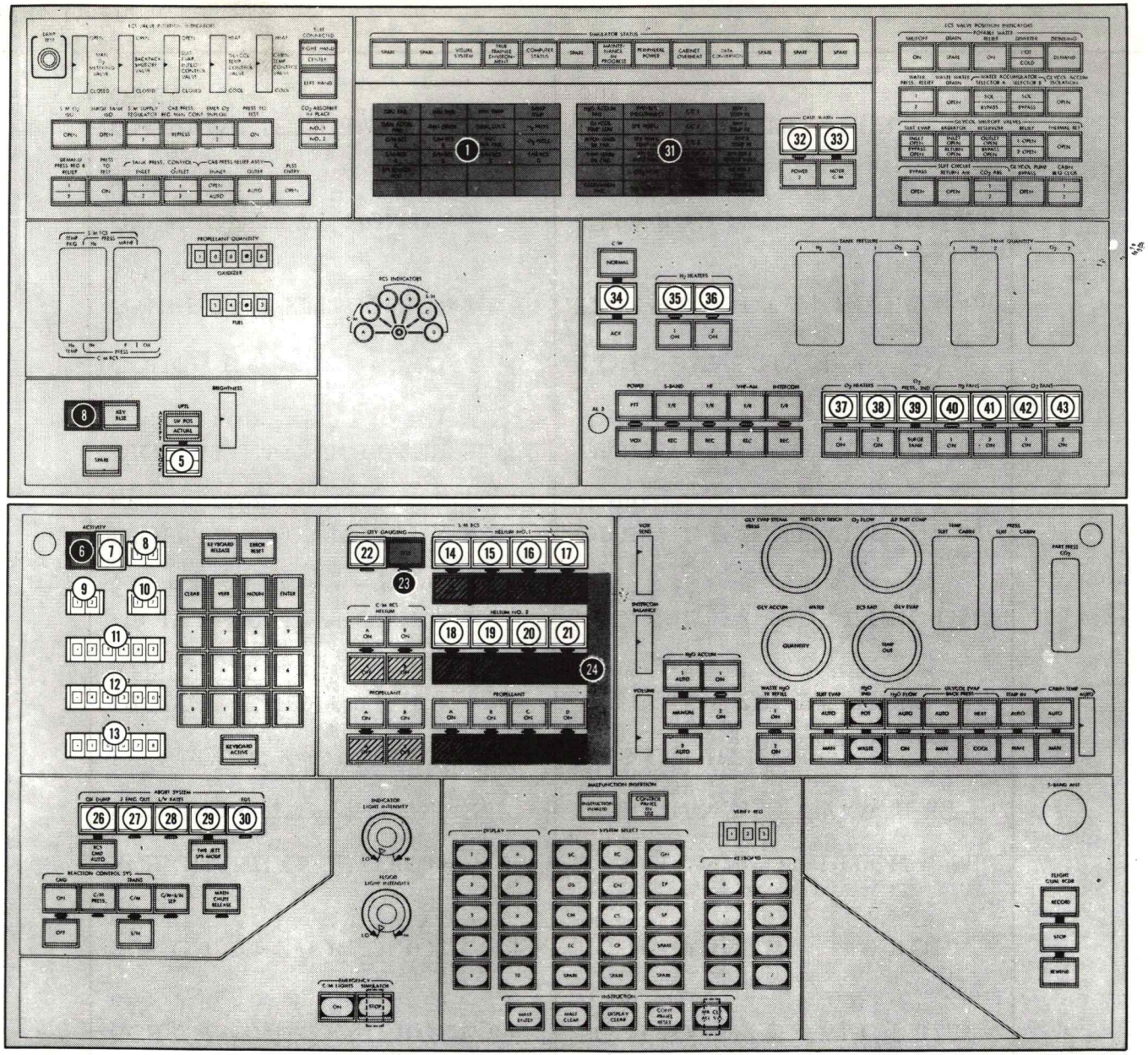
Step	Malf	Time	Function	IOS Visibility/Action	Notes
67			NORMAL/OFF DIRECT ON sw - NORMAL	NORMAL and DIRECTION lt out	
68-91			SCS Control Panel		
68			DIRECT RCS sw - OFF	DIRECT RCS lt out	
69			LIMIT CYCLE sw - OFF	LIMIT CYCLE lt out	
70			ATT DEADBAND sw - MAX	DEADBAND MAX lt out	
71			.05G ENTRY sw - OFF	.05G ENTRY lt out	
72			LCL VERT sw - OFF	LCL VERT lt out	
73			ΔV sw - OFF	ΔV lt out	
74			G&N/SCS sw - G&N	G&N lt on	
75			ATTITUDE/MONITOR/ENTRY sw - MONITOR	MONITOR lt on	
76			RATE GYRO - ROLL sw - NORMAL	RATE GYRO - ROLL NORMAL lt on	
77			RATE GYRO - PITCH sw - NORMAL	RATE GYRO - PITCH NORMAL lt on	
78			RATE GYRO - YAW sw - NORMAL	RATE GYRO - YAW NORMAL lt on	



Control and Display Check

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
79			SCS CHANNEL A&C ROLL sw - on	SCS CHANNEL - A&C ROLL lt on	
80			SCS CHANNEL B&D ROLL sw - on	SCS CHANNEL - B&D ROLL lt on	
81			SCS CHANNEL PITCH sw - on	SCS CHANNEL - PITCH lt on	
82			SCS CHANNEL YAW sw - on	SCS CHANNEL - YAW lt on	
83			ELS LOGIC sw - OFF	ELS LOGIC lt on	
84			DIGITAL EVENT TIMER RESET/UP/DOWN sw - UP	DIGITAL EVENT TIMER - UP lt on	
85			DIGITAL EVENT TIMER START/STOP sw - center	DIGITAL EVENT TIMER - RUN lt on	
86			DIGITAL EVENT TIMER MIN sw - center	DIGITAL EVENT TIMER - MIN lt out	
87			DIGITAL EVENT TIMER SEC sw - center	DIGITAL EVENT TIMER - SEC lt out	
88			COUCH UNLOCK sw - OFF	COUCH UNLOCK lt out	
89			CM PROP JETT LOGIC sw - LOGIC	CM PROP JETT - LOGIC lt on	
90			CM PROP JETT DUMP sw - OFF	CM PROP JETT - DUMP lt out	
91			CM PROP JETT PURGE sw - OFF	CM PROP JETT - PURGE lt out	

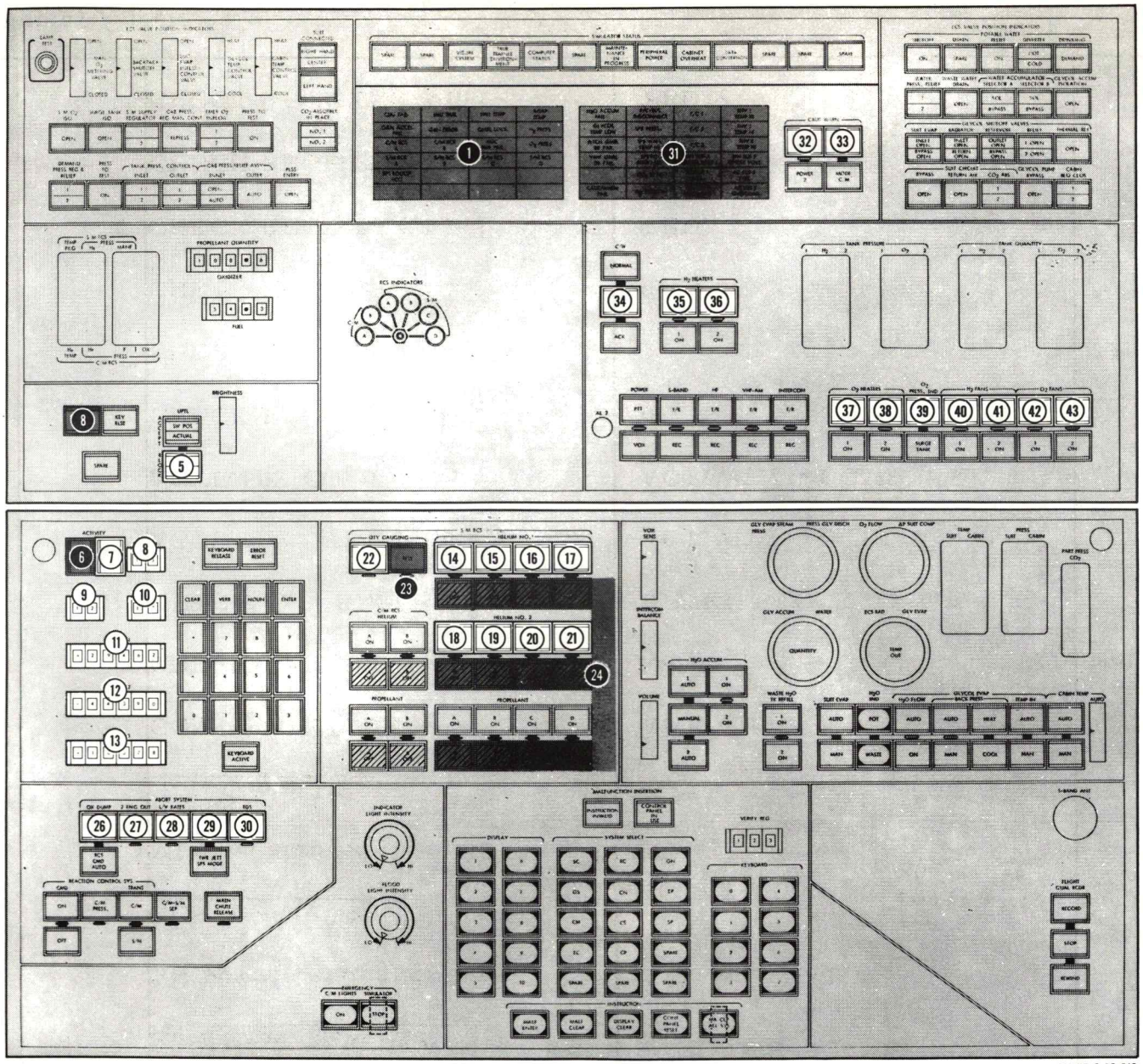


LISTED STEPS
2, 4, 25, 44

Control and Display Check

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Left-Hand C&W Panel		
1			All system status lts out	As programed	
2-			RCS Display Panel		
*2			Mission elapsed time ind	None	
3-13			G&N Control Panel		
3			COMP FAIL lt out	As programed	
*4			CHECK FAIL lt out	None	Not provided in AMS
5			UPTEL sw - BLOCK	UPTEL BLOCK lts on	
6			ACTIVITY UTEL lt out	ACTIVITY - UTEL lts out	
7			ACTIVITY COMP lt on	ACTIVITY - COMP lt on	
8			CHECK PROGRAM ind	02	
9			CHECK VERB ind	37	
10			CHECK NOUN ind	01	
11			CHECK REGISTER 1 ind	TBD	
12			CHECK REGISTER 2 ind	TBD	
13			CHECK REGISTER 3 ind	TBD	



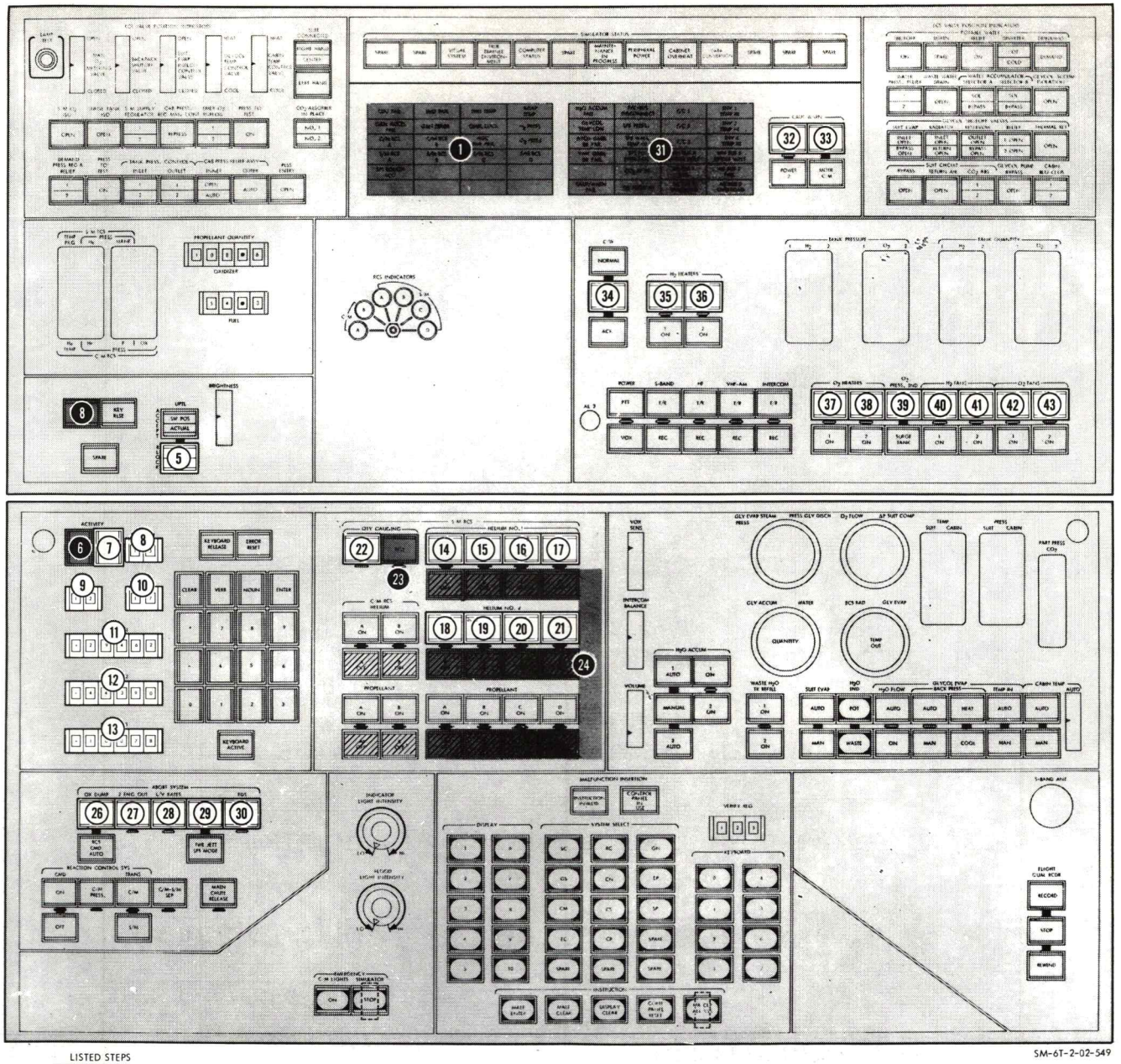
SM-6T-2-02-549

LISTED STEPS
2, 4, 25, 44

Control and Display Check

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14-24			RCS Control Panel		
14			S/M RCS A HELIUM 1 sw - ON and release	S/M RCS HELIUM NO. 1 - A ON lt on	
15			S/M RCS B HELIUM 1 sw - ON and release	S/M RCS HELIUM NO. 1 - B ON lt on	
16			S/M RCS C HELIUM 1 sw - ON and release	S/M RCS HELIUM NO. 1 - B ON lt on	
17			S/M RCS D HELIUM 1 sw - ON and release	S/M RCS HELIUM NO. 1 - D ON lt on	
18			S/M RCS A HELIUM 2 sw - ON and release	S/M RCS HELIUM NO. 2 - A ON lt on	
19			S/M RCS B HELIUM 2 sw - ON and release	S/M RCS HELIUM NO. 2 - B ON lt on	
20			S/M RCS C HELIUM 2 sw - ON and release	S/M RCS HELIUM NO. 2 - C ON lt on	
21			S/M RCS D HELIUM 2 sw - ON and release	S/M RCS HELIUM NO. 2 - D ON lt on	
22			S/M RCS QTY GAUGING POWER sw - on	S/M RCS QTY GAUGING - POWER ON lt on	
23			S/M RCS - QTY GAUGING TEST sw - OFF	S/M RCS QTY GAUGING - TEST lt on	Refer to step 23.1 in AOH.



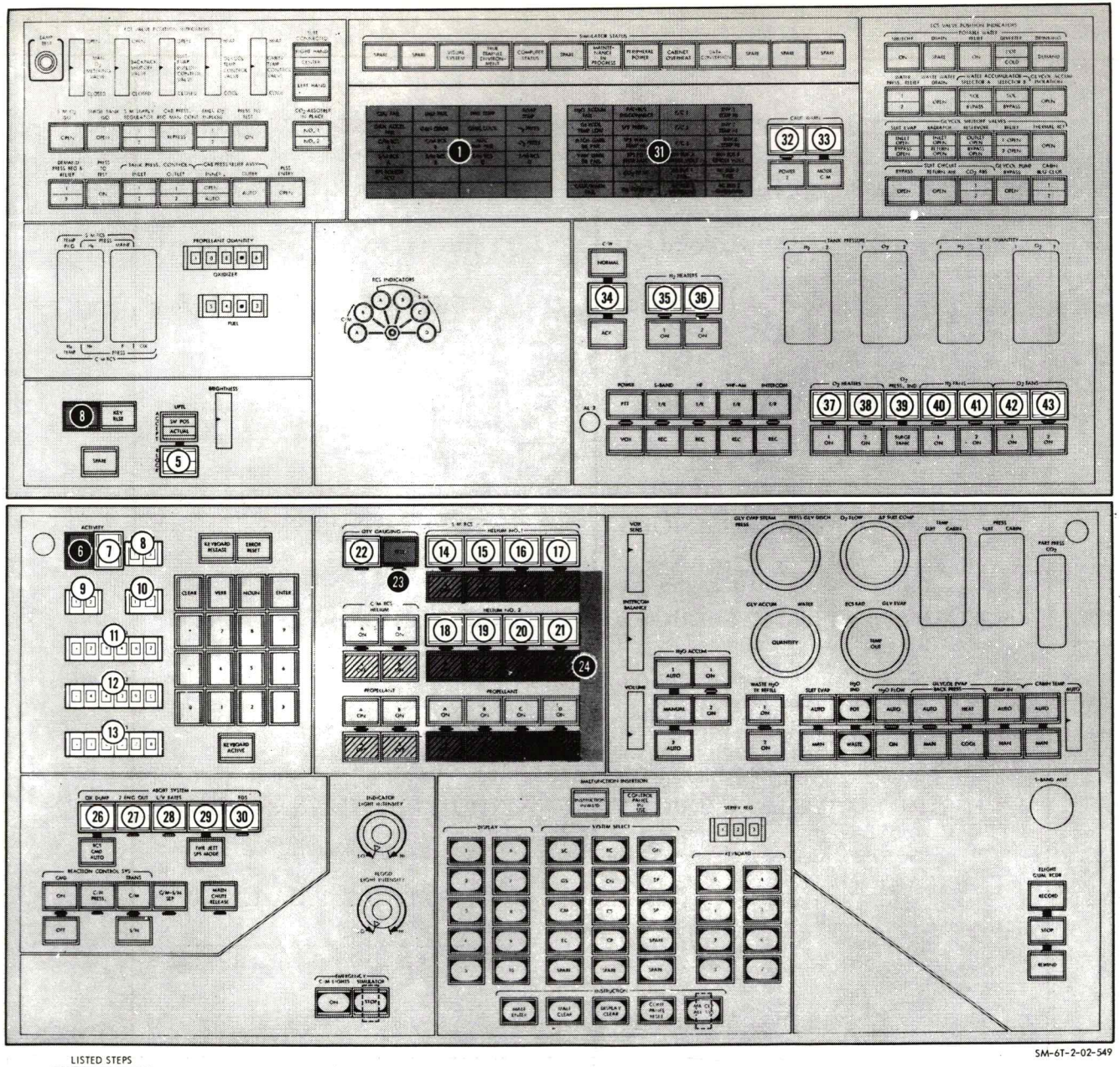
SM-6T-2-02-549

LISTED STEPS
2, 4, 25, 44

Control and Display Check

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
24			All event inds gray	All striped off lts out	
25-30			EDS/SEO Control Panel		
*25			MAIN CHUTE DEPLOY sw - MAN	None	Not provided in AMS
26			ABORT SYSTEMS OX DUMP sw - AUTO	ABORT SYSTEM OX DUMP - AUTO lt on	
27			ABORT SYSTEMS 2 ENG OUT sw - AUTO	ABORT SYSTEM 2 ENG OUT - AUTO lt on	
28			ABORT SYSTEMS L/V RATES sw - AUTO	ABORT SYSTEM L/V RATES - AUTO lt on	
29			ABORT SYSTEMS MODE LES/ TWR JETT SPS MODE sw - MODE LES	ABORT SYSTEM - LES MODE lt on	
30			ABORT SYSTEMS EDS sw - OFF	ABORT SYSTEM EDS - AUTO lt out	
31-33			Right-Hand C&W Panel		
31			All system status lts out	As programed	
32			CAUT/WARN POWER sw - 1	CAUT/WARN - POWER 1 lt on	
33			CAUT/WARN MODE sw - CSM	CAUT/WARN - MODE CSM lt on	

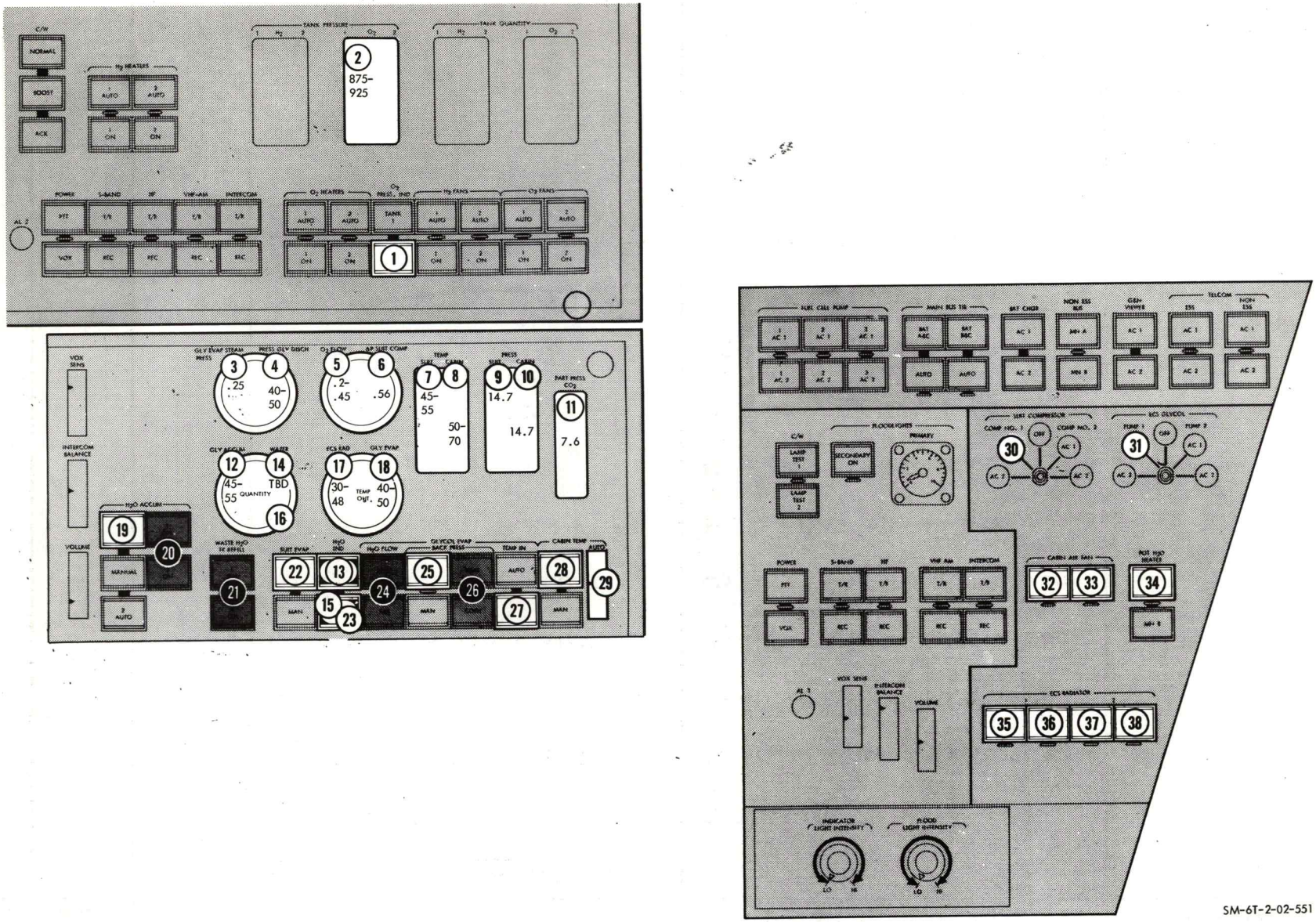


LISTED STEPS
2, 4, 25, 44

Control and Display Check

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
34-44			ECS EPS Audio Control Panel		
34			CW sw - BOOST	C/W - BOOST lt on	
35			H_2 HEATERS 1 sw - AUTO	H_2 HEATERS - 1 AUTO lt on	
36			H_2 HEATERS 2 sw - AUTO	H_2 HEATERS - 2 AUTO lt on	
37			O_2 HEATERS 1 sw - AUTO	O_2 HEATERS - 1 AUTO lt on	
38			O_2 HEATERS 2 sw - AUTO	O_2 HEATERS - 2 AUTO lt on	
39			PRESS IND sw - TANK 1	PRESS IND - TANK 1 lt on	
40			H_2 FANS 1 sw - AUTO	H_2 FAN - 1 AUTO lt on	
41			H_2 FANS 2 sw - AUTO	H_2 FAN - 2 AUTO lt on	
42			O_2 FANS 1 sw - AUTO	O_2 FAN - 1 AUTO lt on	
43			O_2 FANS 2 sw - AUTO	O_2 FAN - 2 AUTO lt on	
*44			Continue with S/M and C/M RCS status checks	RC2.02, RC2.01	

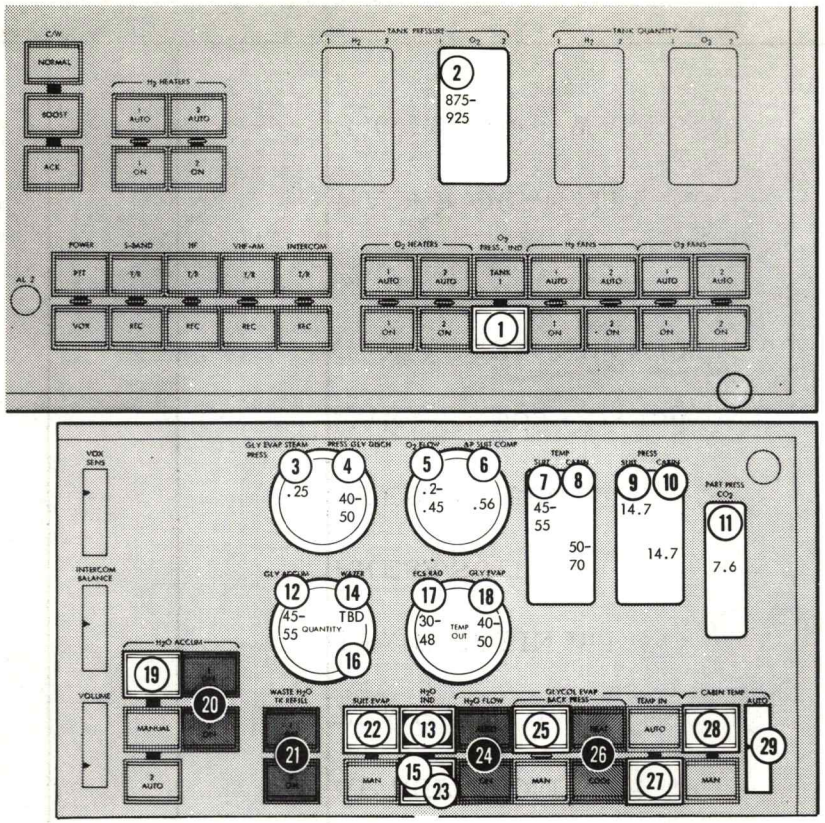


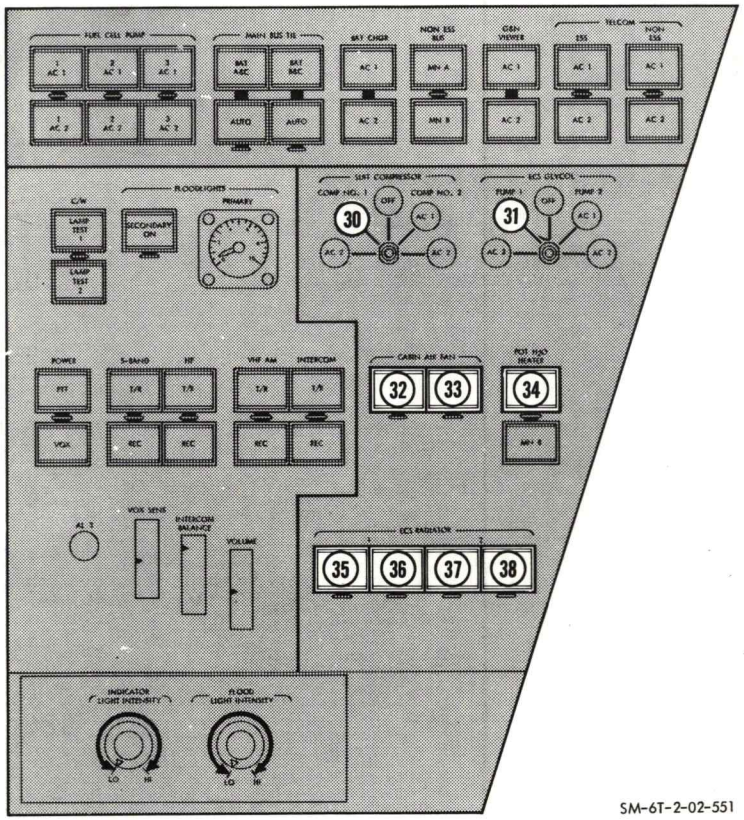
Initial Prelaunch ECS Check

P3.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			O_2 PRESS IND sw - SURGE TANK	O_2 PRESS IND - SURGE TANK	
2			TANK PRESSURE 1 O_2 ind	875-925	
3			GLY EVAP STEAM PRESS ind	0.25	
4			PRESS GLY DISCH ind	40-45	
5			O_2 FLOW ind	.2-.45	
6			ΔP SUIT COMP ind	.56	
7			TEMP SUIT ind	45-55	
8			TEMP CABIN ind	50-70	
9			PRESS SUIT ind	14.7	
10			PRESS CABIN ind	14.7	
11			PART PRESS CO_2 ind	7.6	
12			GLY ACCUM QUANTITY ind	45-55	
13			H_2O IND sw - POT	H_2O IND - POT lt on	
14			WATER QUANTITY ind	TBD	
15			H_2O IND sw - WASTE	H_2O IND - WASTE lt on	



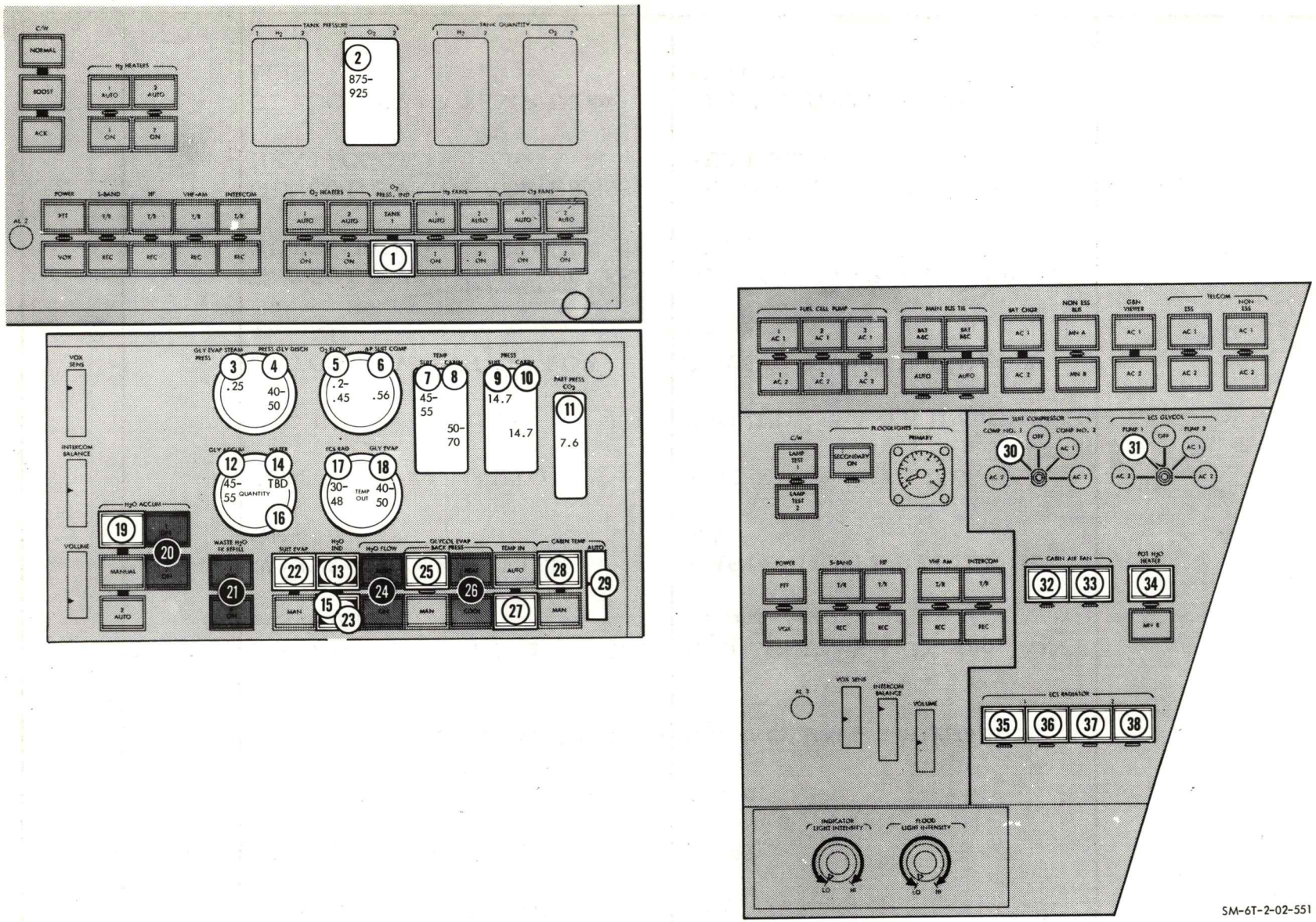


Initial Prelaunch ECS Check

P3.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
16			WATER QUANTITY ind	TBD	
17			ECS RAD ind	30-48	
18			GLY EVAP TEMP OUT ind	40-50	
19			H_2O ACCUM-AUTO/MAN/AUTO 2 sw - AUTO 1	H_2O ACCUM - 1 AUTO lt on	
20			H_2O ACCUM - ON 1/OFF/ON 2 sw - OFF	H_2O ACCUM - 1 ON and 2 ON lts out	
21			WASTE H_2O TK REFILL sw - OFF	WASTE H_2O TK REFILL lts out	
22			SUIT EVAP sw - AUTO	SUIT EVAP AUTO lt on	
23			H_2O IND sw - WASTE	H_2O IND - WASTE lt on	
24			GLYCOL EVAP-H_2O FLOW sw - off	GLYCOL EVAP-H_2O FLOW lts out	
25			GLYCOL EVAP-BACK PRESS-AUTO/MAN sw - AUTO	GLYCOL EVAP-BACK PRESS AUTO lt on	
26			GLYCOL EVAP-BACK PRESS-HEAT/COOL sw - off	GLYCOL EVAP-BACK PRESS - HEAT and COOL lts out	
27			GLYCOL EVAP TEMP IN sw - MAN	GLYCOL EVAP-TEMP IN - AUTO lt on	

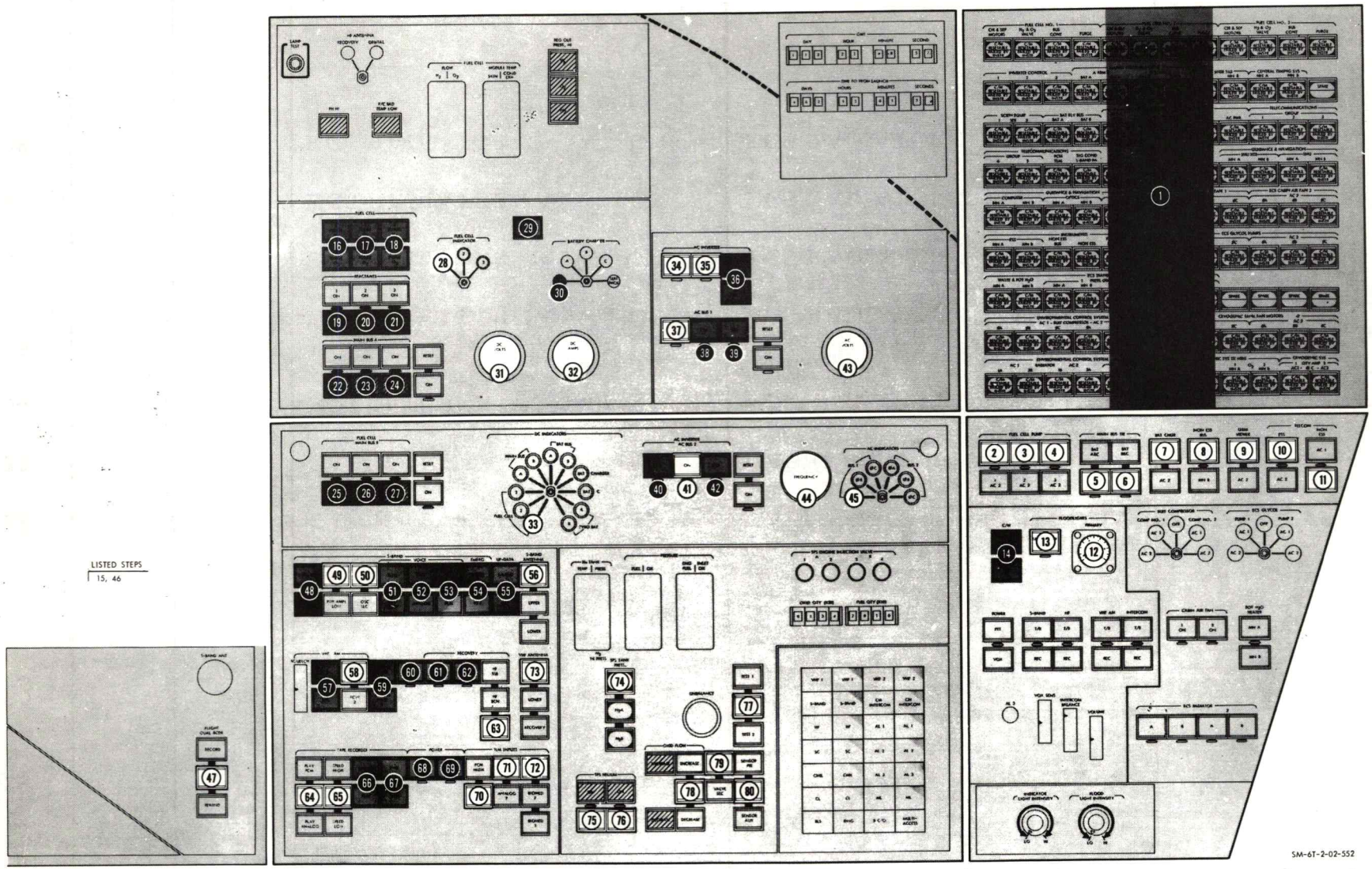


Initial Prelaunch ECS Check

P3.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
28			CABIN TEMP sw - AUTO	CABIN TEMP - AUTO lt on	
29			CABIN TEMP AUTO SEL - as required	CABIN TEMP - AUTO ind as selected	
30			SUIT COMPRESSOR sw - COMPR 1 - AC 1	SUIT COMPRESSOR - COMP NO. 1 - AC1	
31			ECS GLYCOL sw - PUMP 1 AC 1	ECS GLYCOL-PUMP 1 - AC1 lt on	
32			CABIN AIR FAN 1 sw - ON	CABIN AIR FAN 1 - ON lt on	
33			CABIN AIR FAN 2 sw - ON	CABIN AIR FAN 2 - ON lt on	
34			POT H_2O HEATER sw MN A	POT H_2O HEATER sw - MN A lt on	
35			ECS RADIATOR 1A sw - ON	ECS RADIATOR 1 - A lt on	
36			ECS RADIATOR 1B sw - ON	ECS RADIATOR 1 - B lt on	
37			ECS RADIATOR 2A sw - ON	ECS RADIATOR 2 - A lt on	
38			ECS RADIATOR 2B sw - ON	ECS RADIATOR 2 - B lt on	

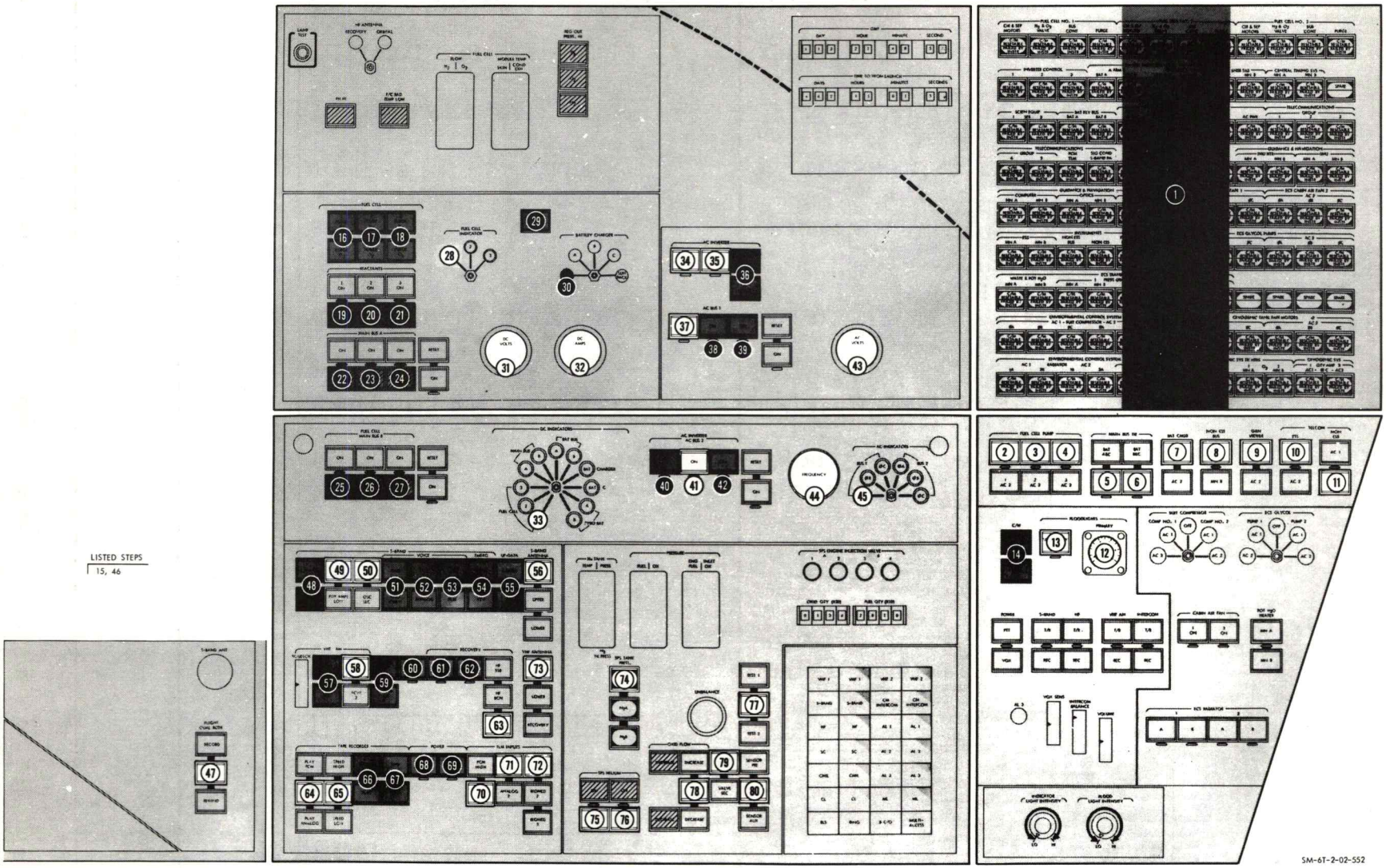


Control and Display Check

P3.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			RH Bus and Radiator Panel		
1			All C/Bs in	All C/B lts out	
2-11			RH Circuit Breaker Panel		
2			FUEL CELL PUMP 1 sw - AC 1	FUEL CELL PUMP - 1 AC 1 lt on	
3			FUEL CELL PUMP 2 sw - AC 1	FUEL CELL PUMP - 2 AC 1 lt on	
4			FUEL CELL PUMP 3 sw - AC 1	FUEL CELL PUMP - 3 AC 1 lt on	
5			MAIN BUS TIE BAT A&C sw - AUTO	MAIN BUS TIE - AUTO lt on	
6			MAIN BUS TIE BAT B&C sw - AUTO	MAIN BUS TIE - AUTO lt on	
7			BAT CHGR sw AC 1	BAT CHGR - AC 1 lt on	
8			NONESS BUS sw - MN A	NON ESS BUS - MN A lt on	
9			G&N VIEWER sw - AC 1	G&N VIEWER - AC 1 lt on	
10			TELCOM ESS sw - AC 1	TELCOM ESS - AC 1 lt on	
11			TELCOM NONESS sw - AC 2	TELCOM NON ESS - AC 2 lt on	

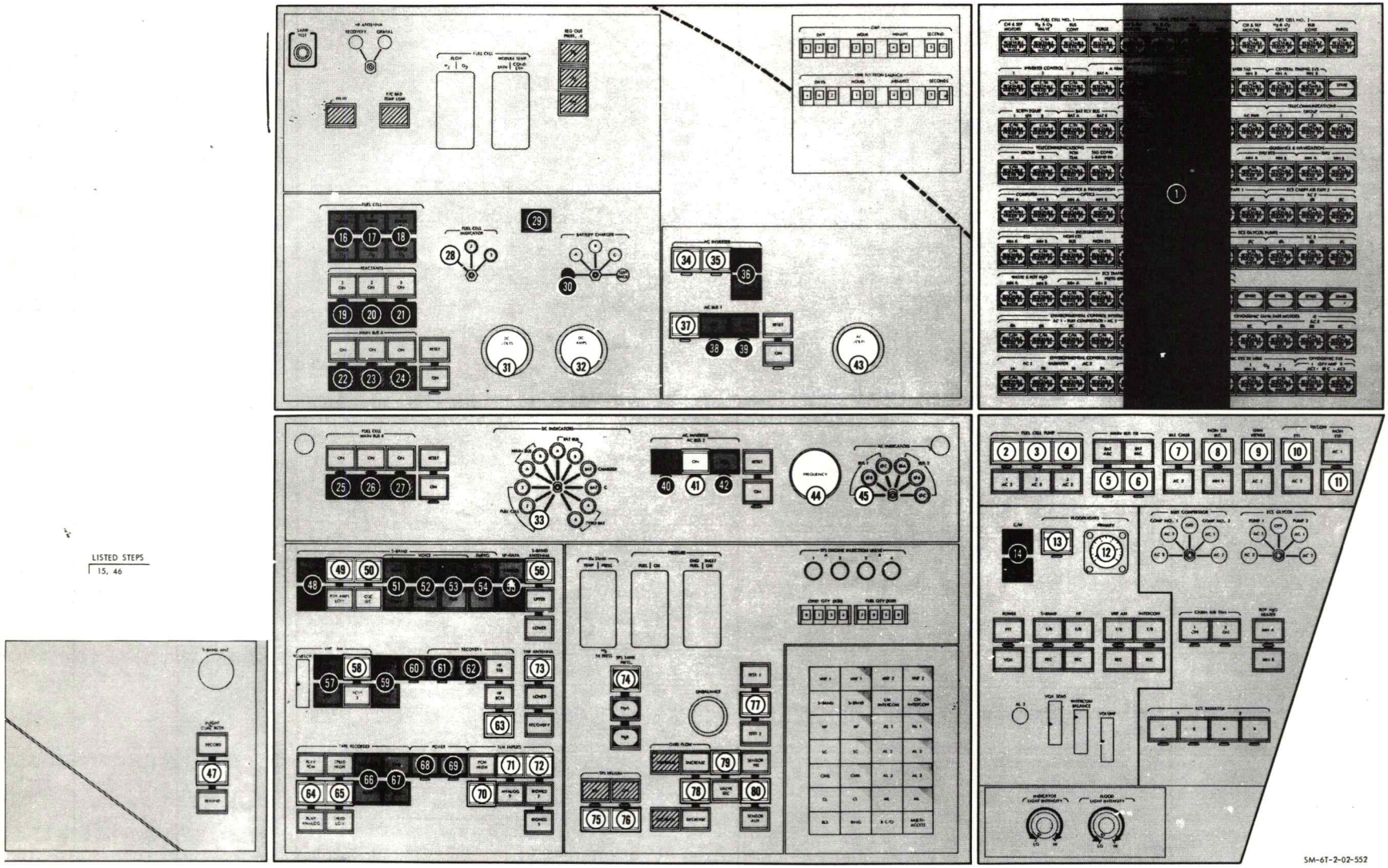


Control and Display Check

P3.2

IOS DATA SHEET

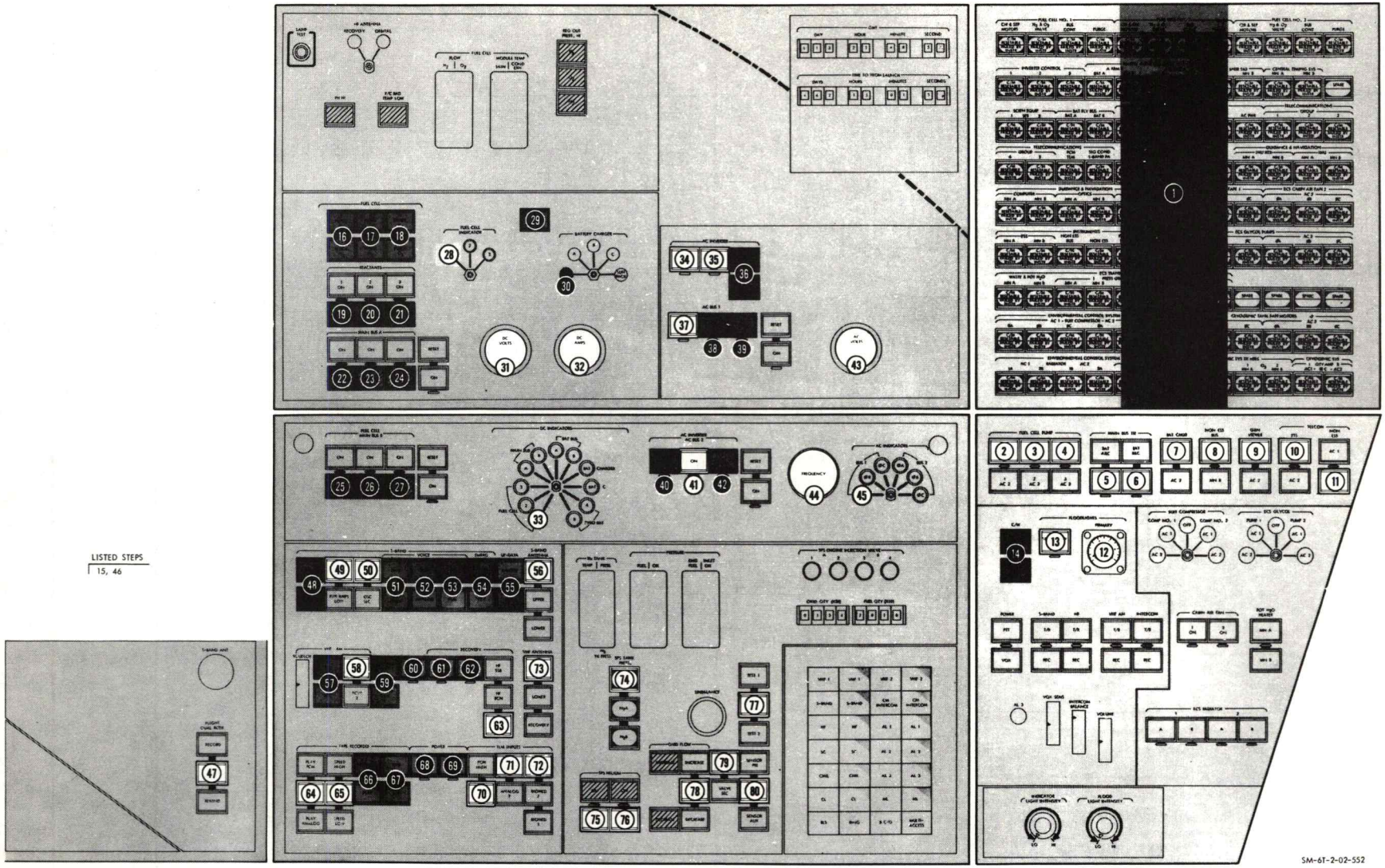
Step	Malf	Time	Function	IOS Visibility/Action	Notes
12-14			RH Audio Panel		
12			FLOODLIGHTS PRIMARY cont	As required	
13			FLOODLIGHTS SECONDARY sw - on	FLOODLIGHTS - SECONDARY ON lt on	
14			C/W LAMP TEST sw - off	C/W lts out	
15			HF Antenna Control Panel		
*15			HF ANTENNA sw	Not functional	
16-47			EPS Control Panel		
16			FUEL CELL 1 H_2 PURGE/O_2 PURGE sw - off	FUEL CELL PURGE lights out	
17			FUEL CELL 2 H_2 PURGE/O_2 PURGE sw - off	FUEL CELL PURGE lights out	
18			FUEL CELL 3 H_2 PURGE/O_2 PURGE sw - off	FUEL CELL PURGE lights out	
19			FUEL CELL 1 REACTANTS event ind gray	FUEL CELL REACTANTS - 1 OFF - striped lights out	
20			FUEL CELL 2 REACTANTS event ind gray	FUEL CELL REACTANTS - 2 OFF - striped light out	



Control and Display Check

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
21			FUEL CELL 3 REACTANTS event ind gray	FUEL CELL REACTANTS - 3 OFF - striped light out	
22			FUEL CELL 1 MAIN BUS A event ind gray	FUEL CELL MAIN BUS A light out	
23			FUEL CELL 2 MAIN BUS A event ind gray	FUEL CELL MAIN BUS A light out	
24			FUEL CELL 3 MAIN BUS A event ind gray	FUEL CELL MAIN BUS A light out	
25			FUEL CELL 1 MAIN BUS B event ind gray	FUEL CELL MAIN BUS B light out	
26			FUEL CELL 2 MAIN BUS B event ind gray	FUEL CELL MAIN BUS B light out	
27			FUEL CELL 3 MAIN BUS B event ind gray	FUEL CELL MAIN BUS B light out	
28			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	
29			MASTER ALARM lt out	As programed	
30			BATTERY CHARGER sw - OFF	BATTERY CHARGER - OFF lt on	
31			DC VOLTS ind	Zero	AOH to be changed.

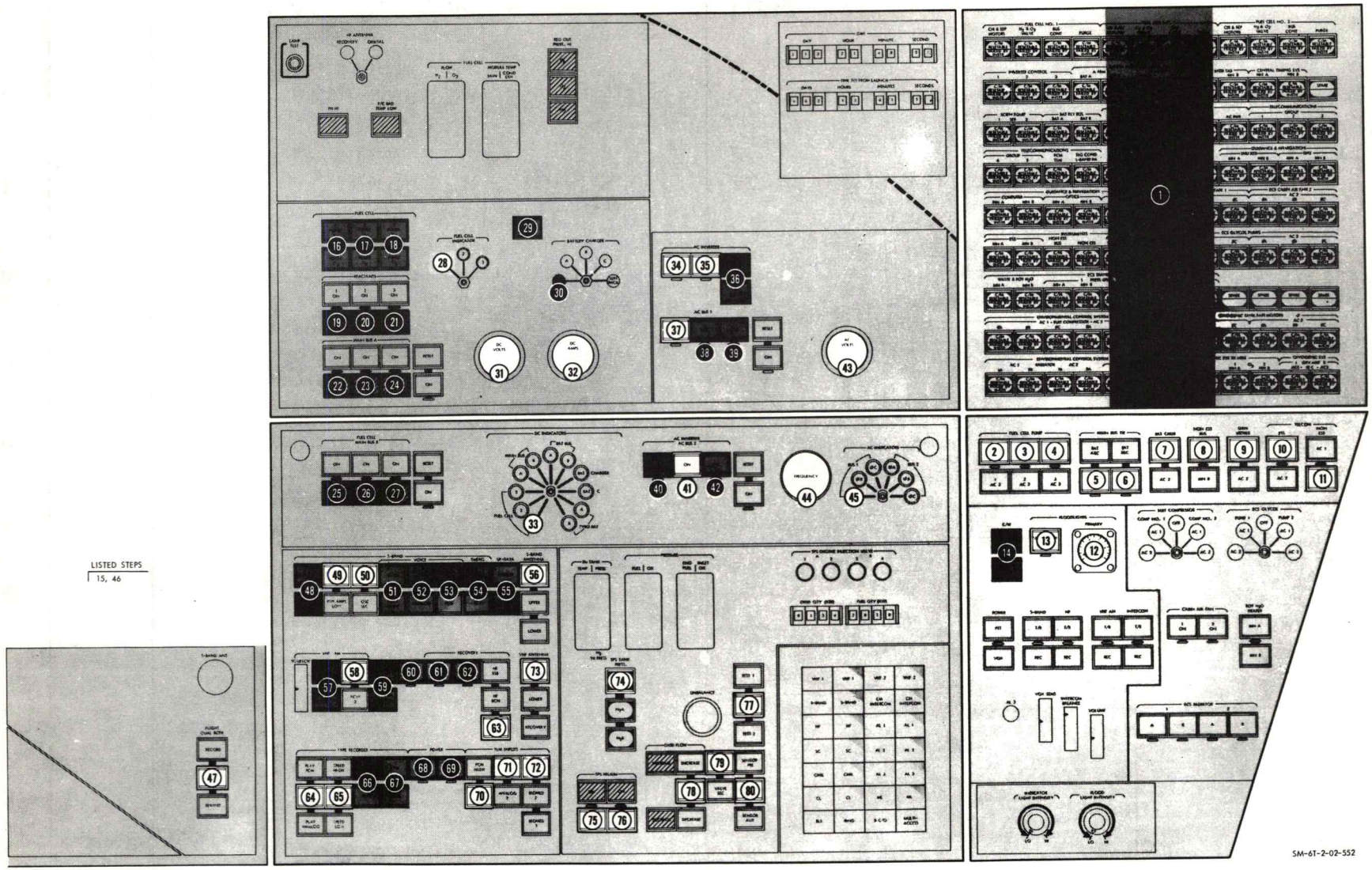


Control and Display Check

P3.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
32			DC AMPS ind	TBD	AOH to be changed.
33			DC INDICATORS sw - FUEL CELL 1	DC INDICATORS - FUEL CELL 1 lt on	
34			AC INVERTER 1 sw - MN A	AC INVERTER - 1 MN A lt on	
35			AC INVERTER 2 sw - MN B	AC INVERTER - 2 MN A lt on	
36			AC INVERTER 3 sw - off	AC INVERTER - 3 lights out	
37			AC INVERTER 1 AC BUS 1 sw ON	AC INVERTER AC BUS 1 - ON lt on	
38			AC INVERTER 2 AC BUS 1 sw - OFF	AC INVERTER AC BUS 1 - ON lt out	
39			AC INVERTER 3 AC BUS 1 sw - OFF	AC INVERTER AC BUS 1 - ON lt out	
40			AC INVERTER 1 AC BUS 2 sw - OFF	AC INVERTER AC BUS 2 - ON lt out	
41			AC INVERTER 2 AC BUS 2 sw - ON	AC INVERTER AC BUS 2 - ON lt on	
42			AC INVERTER 3 AC BUS 2 sw - OFF	AC INVERTER AC BUS 2 - ON lt out	
43			AC VOLTS ind	115±2	

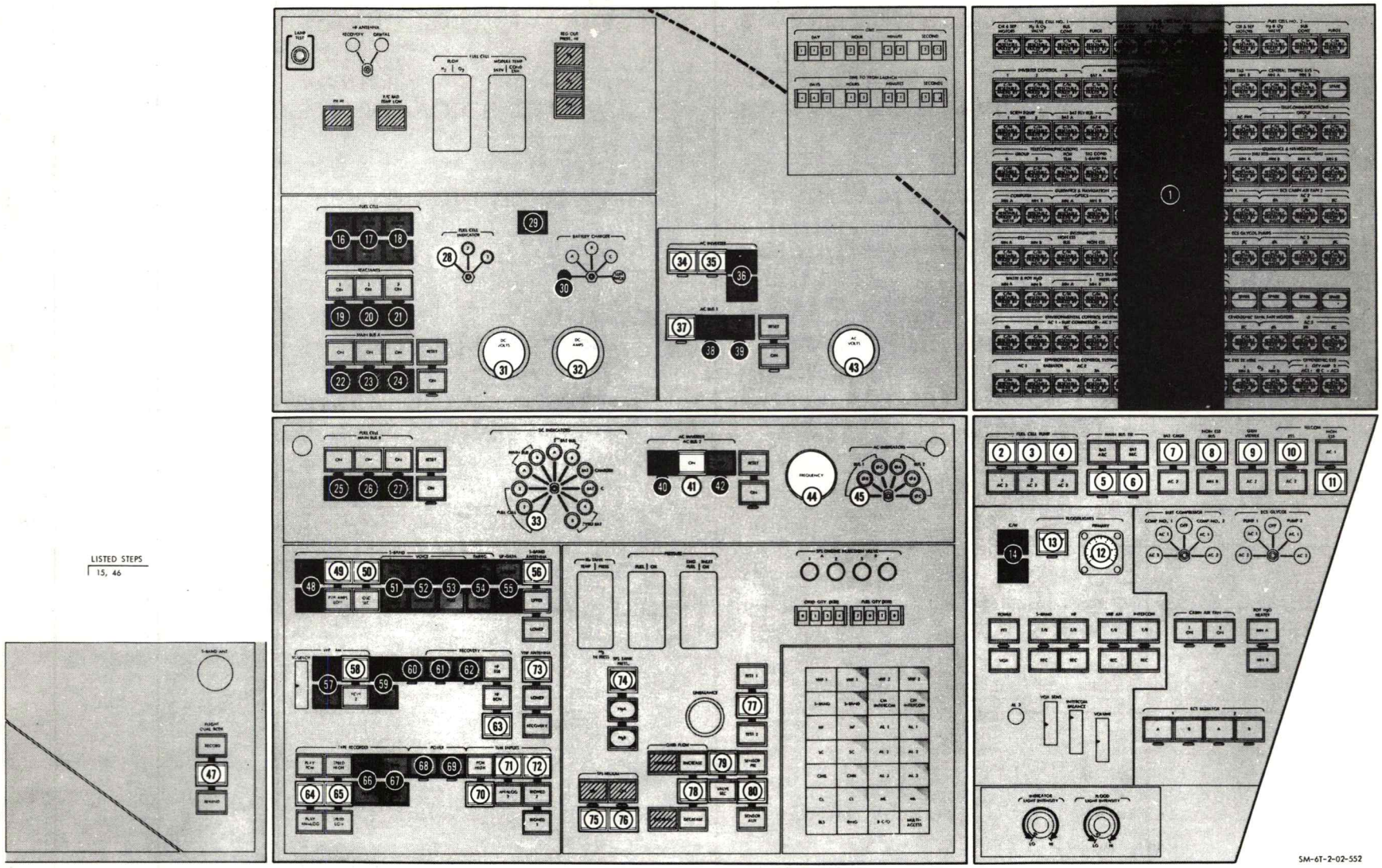


Control and Display Check

P3.2

IOS DATA SHEET

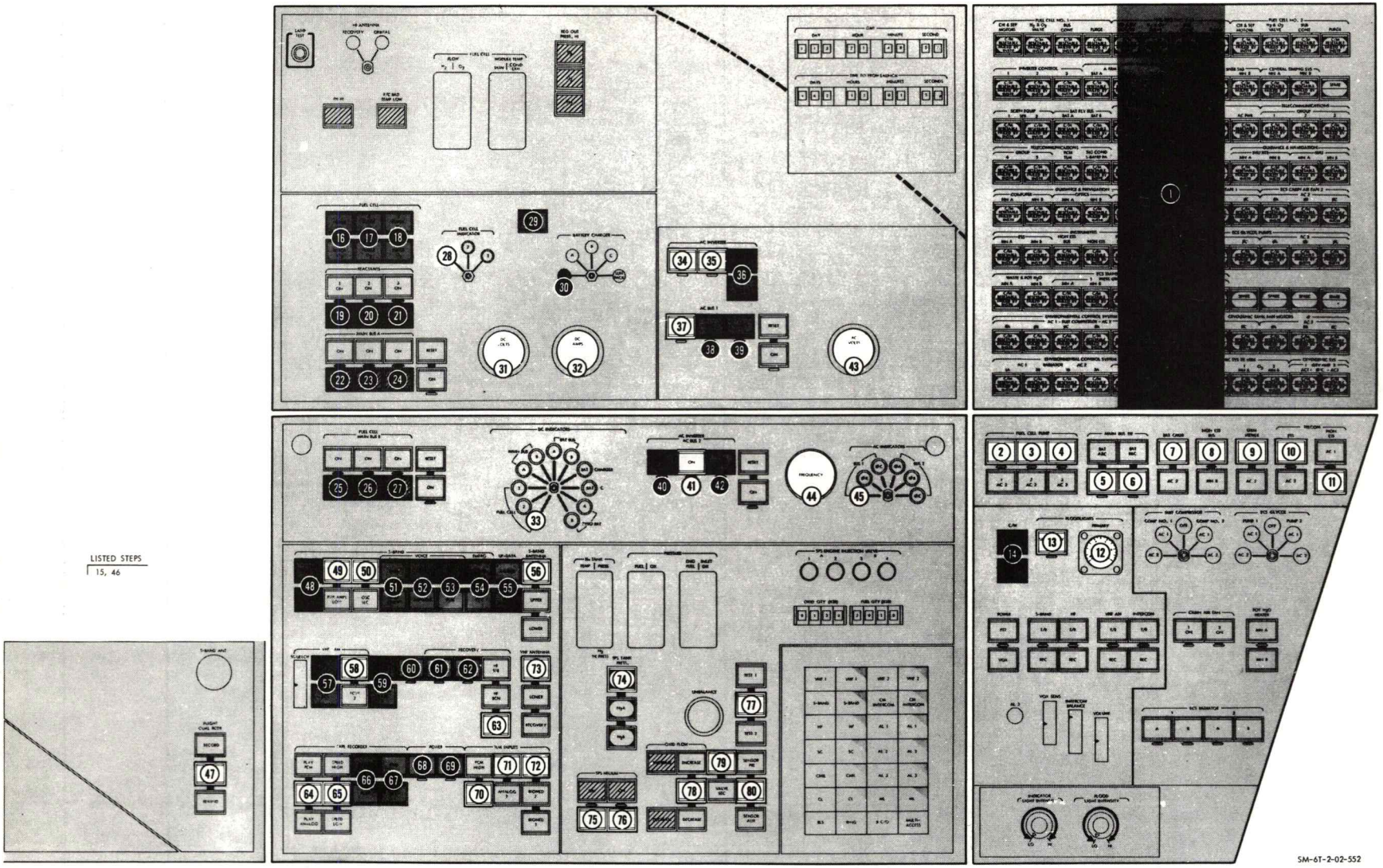
Step	Malf	Time	Function	IOS Visibility/Action	Notes
44			FREQUENCY ind	400±0.5	
45			AC INDICATORS - BUS 1 ØA	AC INDICATORS BUS 1 - ØA lt on	
46-47			S-Band and FQR Panel		
*46			S-BAND ANT ind	TBD	
47			FLT QUAL RCDR sw - STOP	FLIGHT QUAL RCDR - STOP lt on	
48-80			Telecommunications/SPS Control Panel		
48			S-BAND XPONDER/OFF/ XPONDER PWR AMPL sw - off	S-BAND - XPONDER lights out	
49			S-BAND PWR AMPL sw - HIGH	S-BAND - PWR AMPL HIGH lt on	
50			S-BAND OSC sw - PRIM	S-BAND - OSC PRI lt on	
51			S-BAND VOICE RNG/RNG ONLY sw off	S-BAND VOICE-RNG lts out	
52			S-BAND VOICE TAPE/ ANALOG sw - off	S-BAND VOICE-TAPE and ANALOG lts out	
53			S-BAND VOICE TV/PLSS sw - off	S-BAND VOICE-TV and PLSS lts out	



Control and Display Check

IOS DATA SHEET

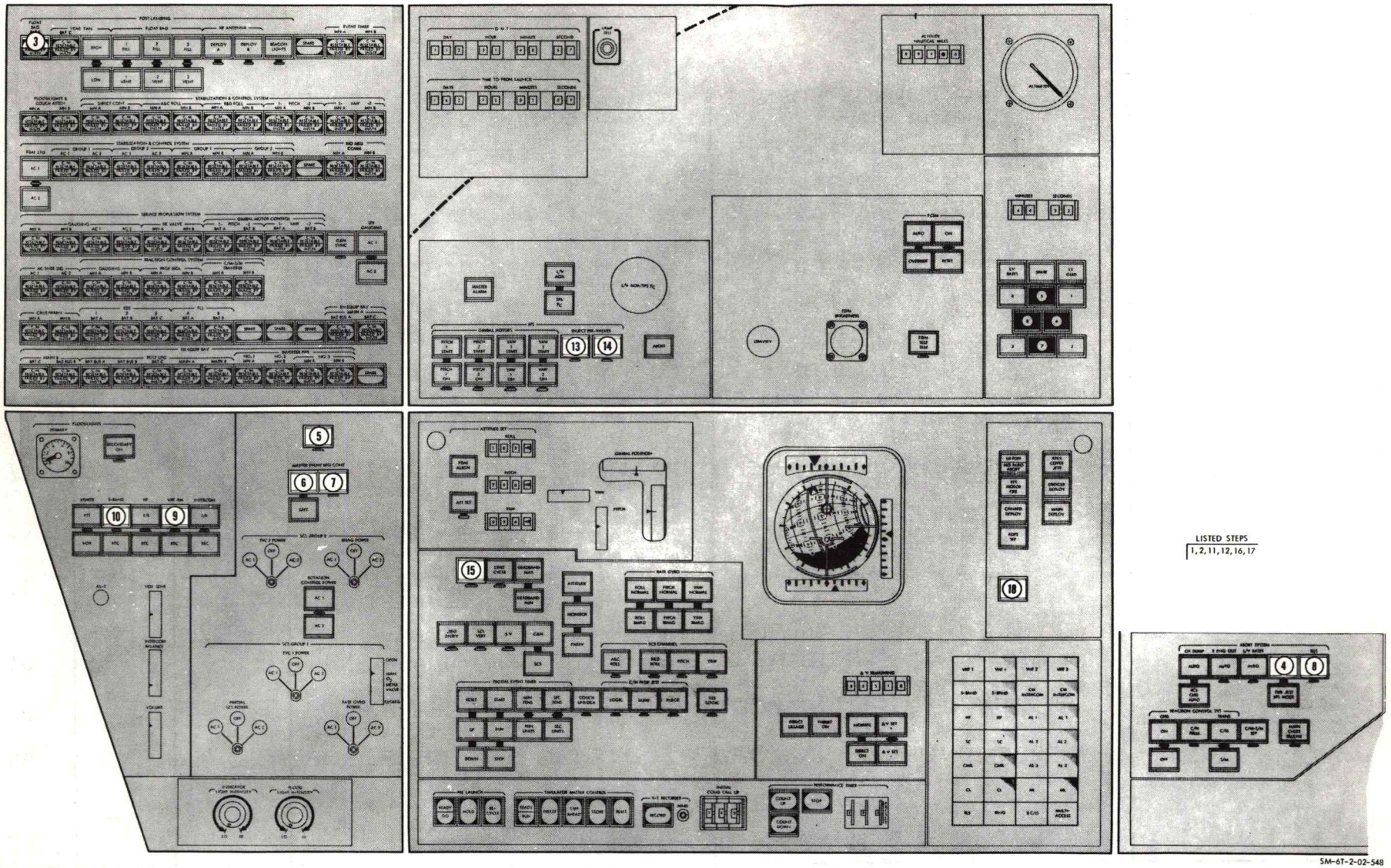
Step	Malf	Time	Function	IOS Visibility/Action	Notes
54			S-BAND EMERG sw - off	S-BAND EMRG lights out	
55			UP DATA sw - off	UP DATA lights out	
56			S-BAND ANTENNA sw - AUTO	S-BAND ANTENNA - AUTO lt on	
57			VHF AM T/R REC sw - off	VHF AM - TR light on	
58			VHF AM RCVR sw - 1	VHF AM - RCVR 1 lt on	
59			C-BAND sw - off	C-BAND lights out	
60			VHF FM sw - off	VHF FM - ON light out	
61			RECOVERY VHF BCN sw - OFF	RECOVERY VHF - BCN light out	
62			RECOVERY HF ON/OFF sw - OFF	RECOVERY - HF ON lt out	
63			RECOVERY HF SSB/BCN/AM sw - AM	RECOVERY - HF AM light on	
64			TAPE RECORDER PLAY sw - NORM	TAPE RECORDER - PLAY NORMAL lt on	
65			TAPE RECORDER SPEED sw - NORM	TAPE RECORDER - SPEED NORMAL lt on	
66			TAPE RECORDER RECORD/ PLAY sw - OFF	TAPE RECORDER - RECORD and PLAY lights out	



Control and Display Check

IOS DATA SHEET

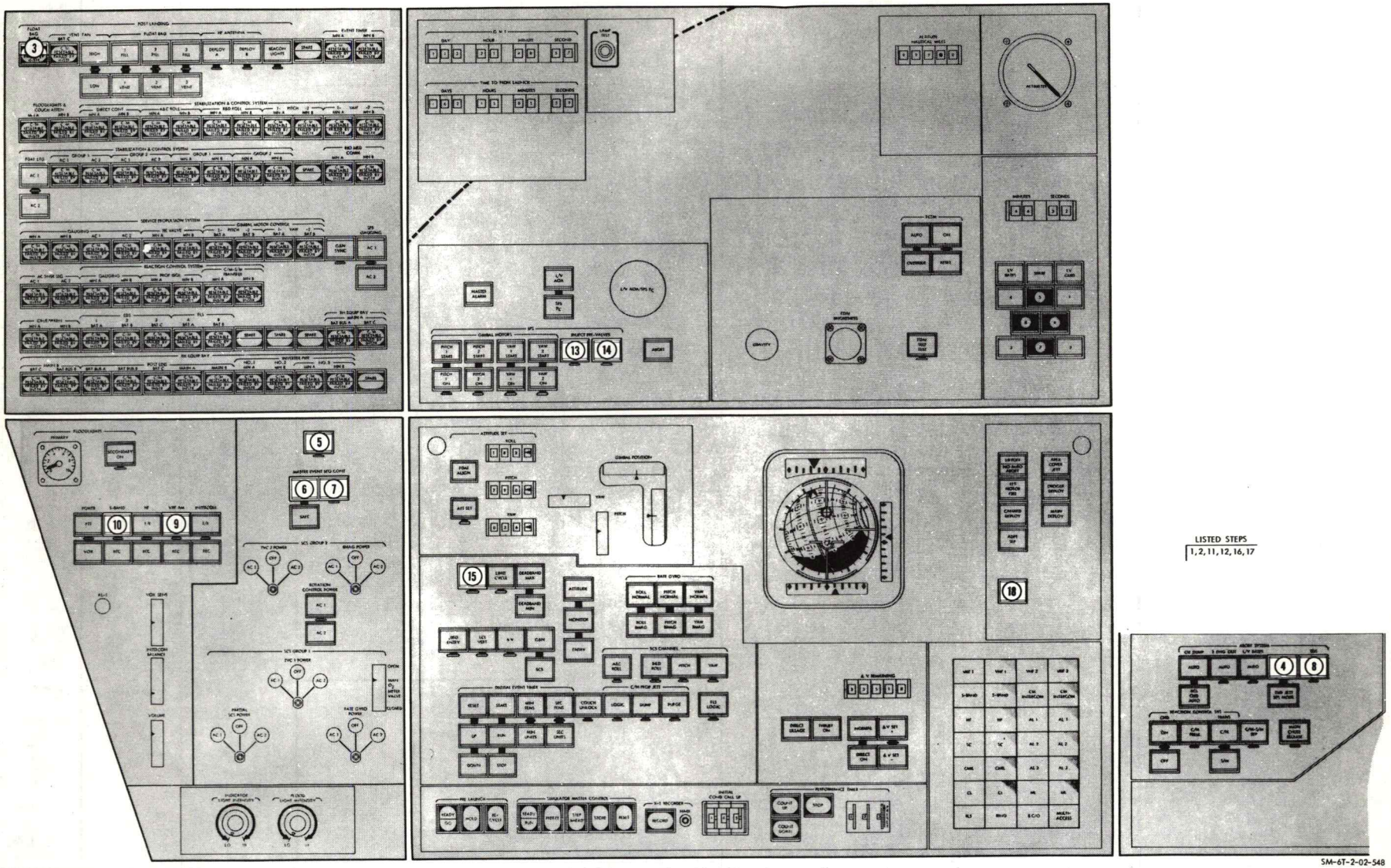
Step	Malf	Time	Function	IOS Visibility/Action	Notes
67			TAPE RECORDER FWD/REV sw - OFF	TAPE RECORDER - FWD and REV lts out	
68			POWER SCE sw - OFF	POWER - SCE ON light out	
69			POWER PMP sw - OFF	POWER - PMP ON light out	
70			TLM INPUTS PCM sw - LOW	TLM INPUTS - PCM LOW light on	
71			TLM INPUTS ANALOG sw - 1	TLM INPUTS - ANALOG 1 lt on	
72			TLM INPUTS BIOMED sw - 1	TLM INPUTS - BIOMED 1 lt on	
73			VHF ANTENNA sw - UPPER	VHF ANTENNA - UPPER lt on	
74			SPS TANK PRESS sw - He	SPS TANK PRESS - He lt on	
75			SPS HELIUM sw (left) - AUTO	SPS HELIUM - AUTO lt on	
76			SPS HELIUM sw (right) - AUTO	SPS HELIUM - AUTO lt on	
77			TEST/AUTO/TEST sw - AUTO	AUTO lt on	
78			OX FLOW sw - NORM	OXID FLOW - NORM lt on	
79			VALVE sw - PR1	VALVE PR1 lt on	
80			SENSOR sw - NORM	SENSOR NORM lt on	



Launch Preparation

IOS DATA SHEET

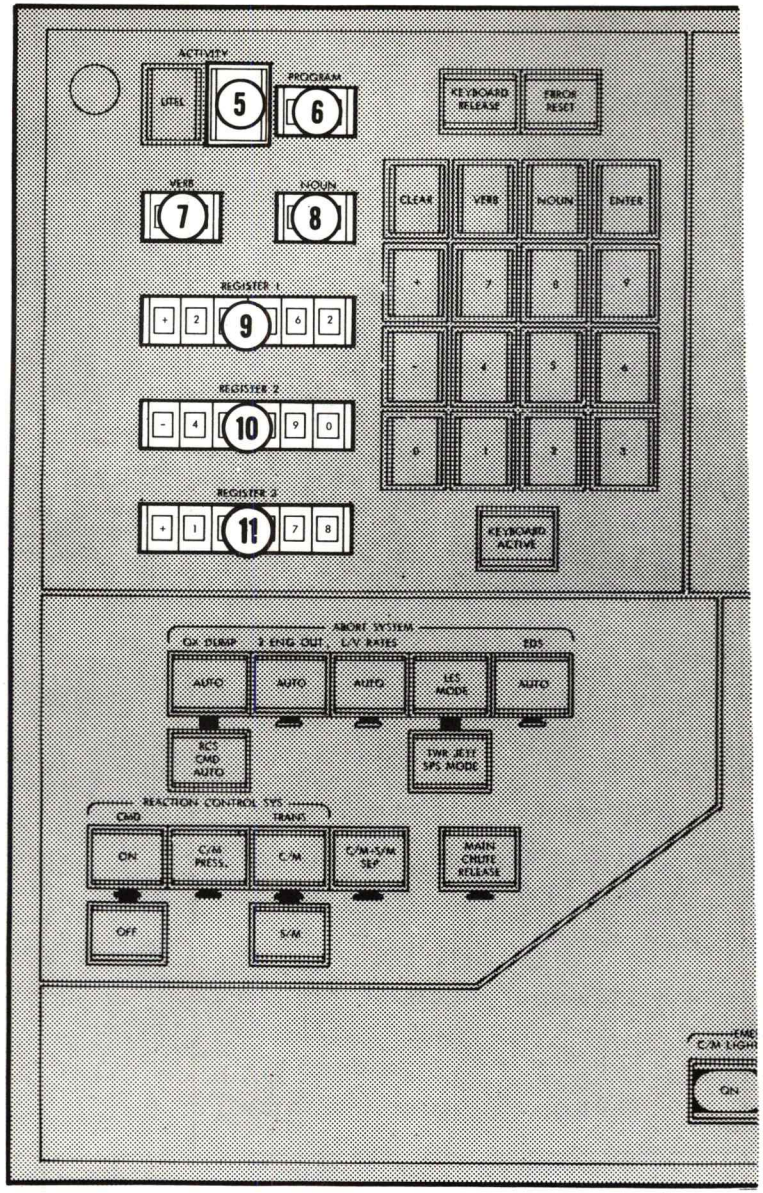
Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Receive launch ready signal	Provide appropriate communication	
*2			Adjust seat restraints for launch	Observe TV monitor	
3-8			Sequencing Controls		
3			Check POST LANDING FLOAT BAG BAT C C/B out	POST LANDING FLOAT BAG BAT C - C/M RESETABLE lt on	
4			Check ABORT SYSTEM LES MODE/TWR JETT SPS MODE sw - LES MODE	ABORT SYSTEM - LES MODE lt on	
5			EDS POWER sw - ON	EDS POWER ON lt on	
6			MASTER EVENT SEQ CONT PYRO sw - ARM	MASTER EVENT SEQ CONT - PYRO ARM lt on	
7			MASTER EVENT SEQ CONT LOGIC/OFF sw - LOGIC	MASTER EVENT SEQ CONT - LOGIC lt on	
8			ABORT SYSTEM EDS sw - AUTO	ABORT SYSTEM EDS - AUTO lt on	
9-18			Communications Control		
9			VHF-AM sw - T/R	VHF-AM - T/R lt on	
10			S-BAND sw - T/R	S-BAND - T/R lt on	

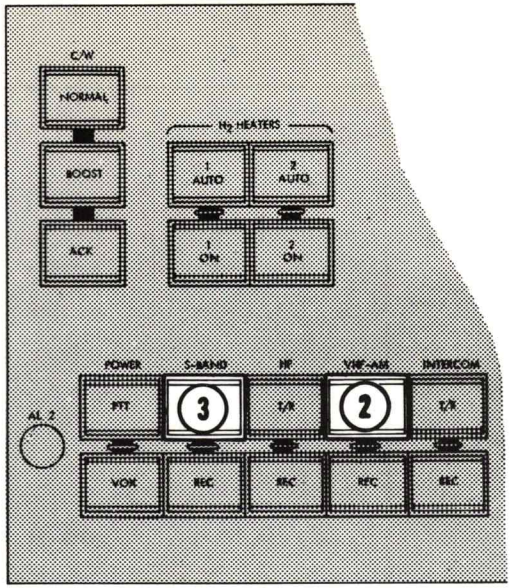


Launch Preparation

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*11			Perform position inds test for TVC channel 2	Continue with SP1.03	
*12			Perform position inds test for TVC channel 1	Repeat SP1.03	
13			SPS INJECT PRE-VALVES A sw - ON SPS INJECT PRE-VALVES B sw - ON	SPS INJECT PRE-VALVES - A ON lt on SPS INJECT PRE-VALVES - B ON lt on	
14			Perform SCS AGCU alignment	Continue with GN1.12	
15			DIRECT RCS sw - ON	DIRECT RCS lt on	
*16			Unlock rotation control	Observe TV monitor	
*17			Lock translation controls	Observe TV monitor	
18			LOCK/UNLOCK sw - UNLOCK	UNLOCK lt on	





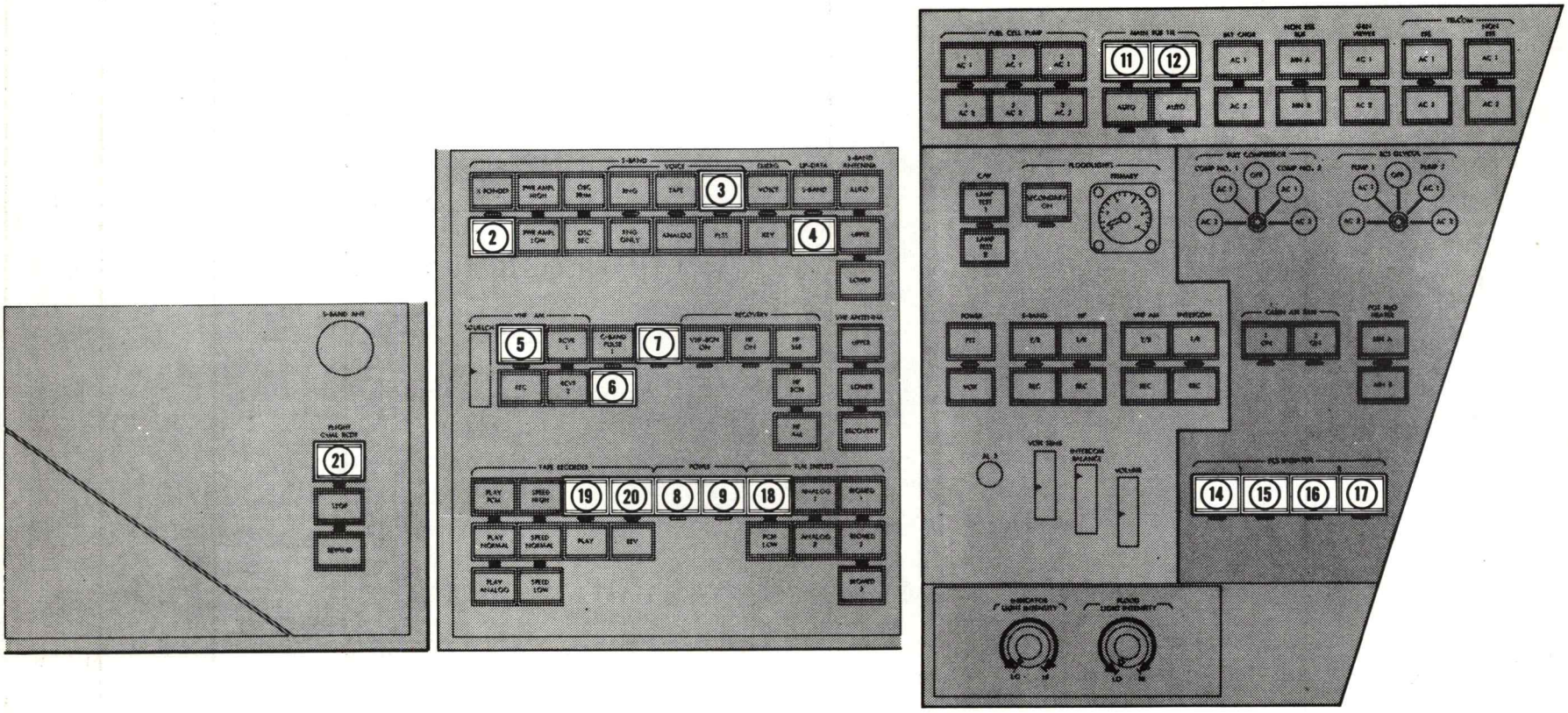
LISTED STEPS

1, 4

SM-6T-2-02-550

IOS DATA SHEET

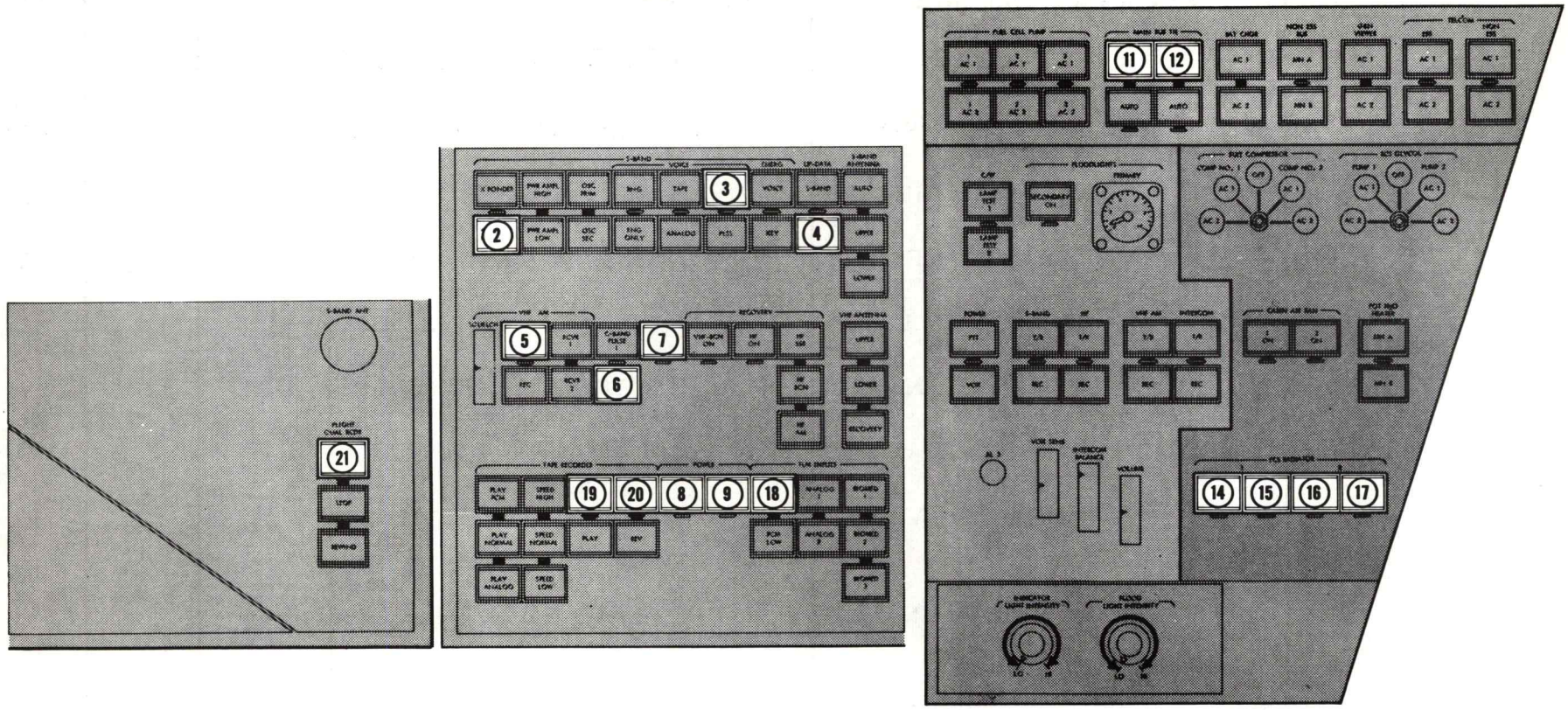
Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Adjust seat restraints for launch	Observe TV monitor	
2			VHF-AM sw - T/R	VHF-AM - T/R lt on	
3			S-BAND sw - T/R	S-BAND - T/R lt on	
*4			Monitor critical parameters	Parameters as programed	
5-11			Check AGC Program		
5			ACTIVITY - COMP lt on	ACTIVITY - COMP lt on	
6			Check PROGRAM correct	04	
7			Check VERB correct	37	
8			Check NOUN correct	01	
9			Check REGISTER 1	TBD	
10			Check REGISTER 2	TBD	
11			Check REGISTER 3	TBD	



SM-6T-2-02-553

IOS DATA SHEET

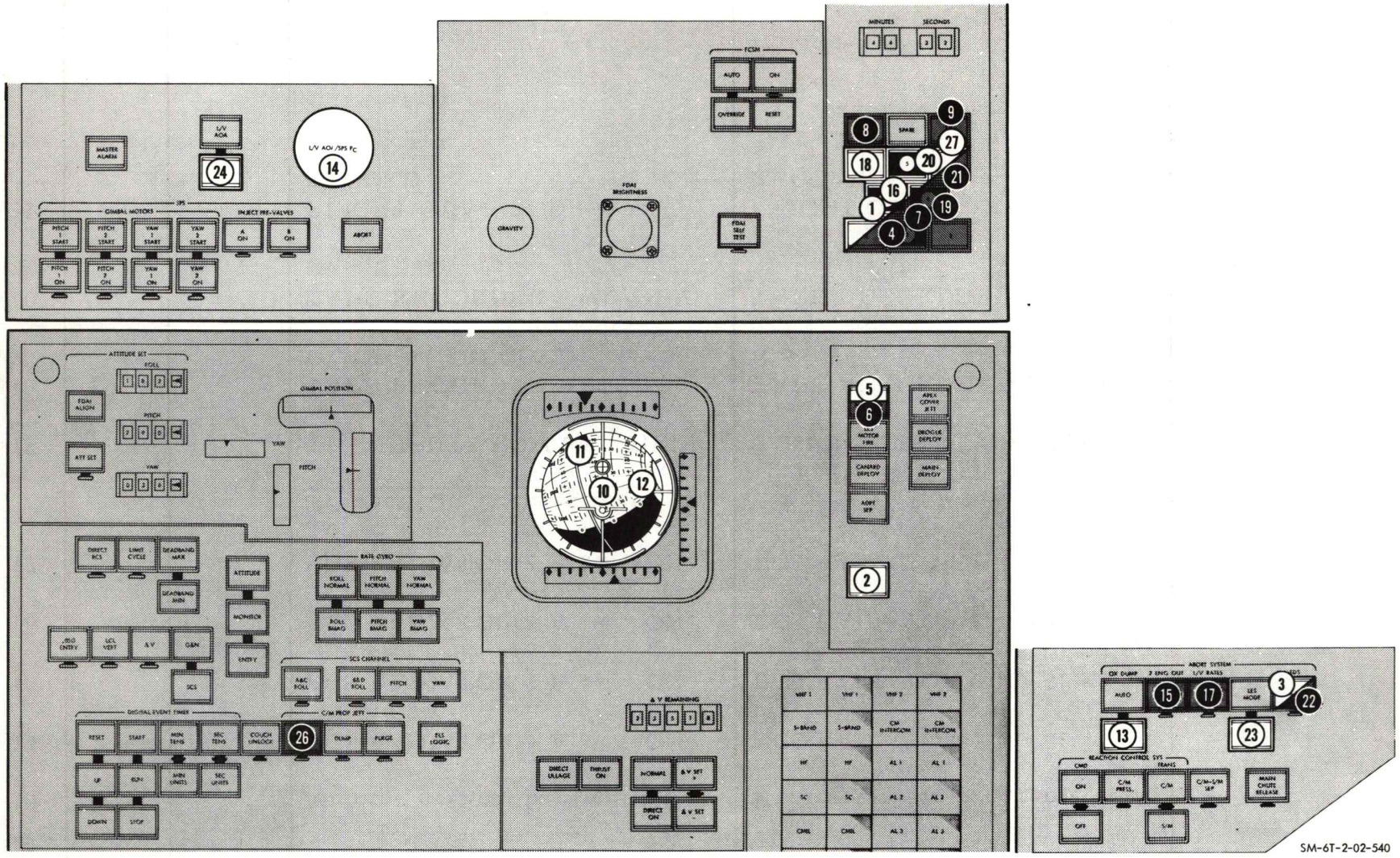
Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Adjust seat restraints for launch	Observe TV monitor	
			Prepare TC for Launch		
2			S-BAND XPONDER/OFF/ XPONDER PWR AMPL sw - XPONDER PWR AMPL	S-BAND - XPONDER PWR AMPL lt on	
3			S-BAND VOICE TV/PLSS sw - TV	S-BAND VOICE - TV lt on	
4			UP-DATA sw - UHF	UP-DATA - UHF lt on	
5			VHF-AM mode sw - T/R	VHF AM T/R lt on	
6			C-BAND sw - 2 PULSE	C-BAND PULSE 2 lt on	
7			VHF-FM sw - ON	VHF-FM ON lt on	
8			POWER SCE sw - ON	POWER - SCE ON lt on	
9			POWER PMP sw - ON	POWER - PMP ON lt on	
*10			Check VHF-AM SQUELCH	As programed	
			Connect Entry Batteries		
11			MAIN BUS TIE (left) sw - BAT A&C	MAIN BUS TIE - BAT A&C lt on	



SM-6T-2-02-553

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12			MAIN BUS TIE (right) sw - BAT B&C	MAIN BUS TIE - BAT B&C lt on	
*13			Monitor critical parameters	Parameters as programed	
14			ECS RADIATOR 1 A sw - ON	ECS RADIATOR 1 - A lt on	
15			ECS RADIATOR 1 B sw - ON	ECS RADIATOR 2 - A lt on	
16			ECS RADIATOR 2 A sw - ON	ECS RADIATOR 1 - B lt on	
17			ECS RADIATOR 2 B sw - ON	ECS RADIATOR 2 - B lt on	
			TC and FQR Preparations		
18			TLM INPUTS PCM sw - HIGH	TLM INPUTS - PCM HIGH lt on	
19			TAPE RECORDER RECORD/ PLAY sw - RECORD	TAPE RECORDER - RECORD lt on	
20			TAPE RECORDER FWD/REV sw - FWD	TAPE RECORDER - FWD lt on	
21			FLIGHT QUAL RCDR sw - RECORD	FLIGHT QUAL RCDR - RECORD lt on	



SM-6T-2-02-540

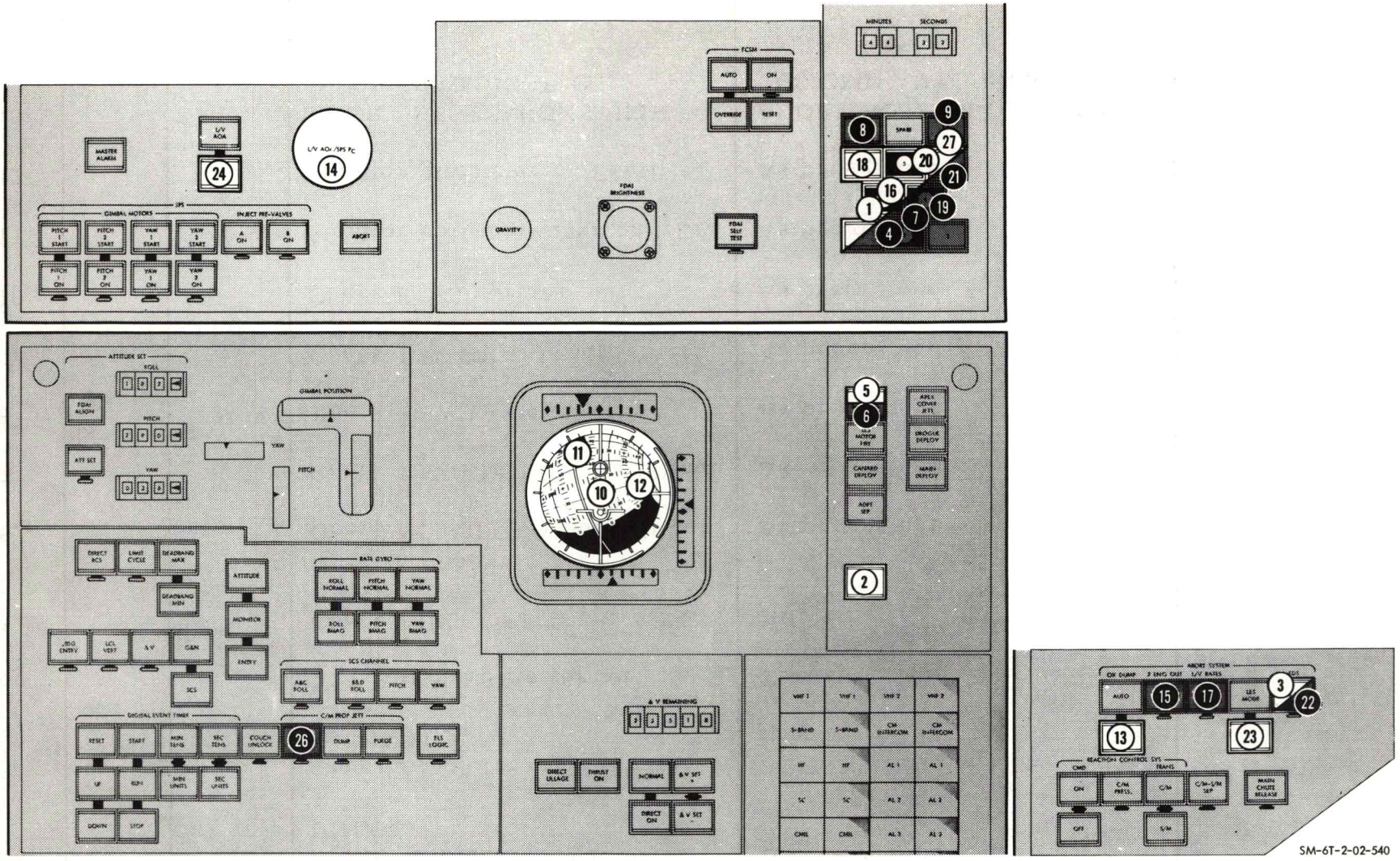
LISTED STEPS
25

Ascent

A1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1		T - 4 sec	Check L/V ENGINES lts (8) on	S-IB ignition	
2			Check LOCK/UNLOCK sw - UNLOCK	UNLOCK lt on	
3			Check ABORT SYSTEM EDS sw - AUTO	ABORT SYSTEM EDS - AUTO lt on	
4			L/V ENGINES lts (8) out	Thrust buildup	
5			Check LIFT OFF lt on, out in 5 sec	Lift-off	
6			Check NO AUTO ABORT lt out	As programed	
7			Check L/V ENGINES lts (8) out	As programed	
8			Check L/V RATE lt out	As programed	
9			Check L/V GUID lt out	As programed	
10			Check FDAI normal	As programed	
11		T +10 sec	Monitor roll maneuver on FDAI	As programed	
12			Monitor pitchover on FDAI	As programed	
13		T +42 sec	ABORT SYSTEM OX DUMP sw - RCS CMD AUTO	ABORT SYSTEM OX DUMP - RCS CMD AUTO lt on	

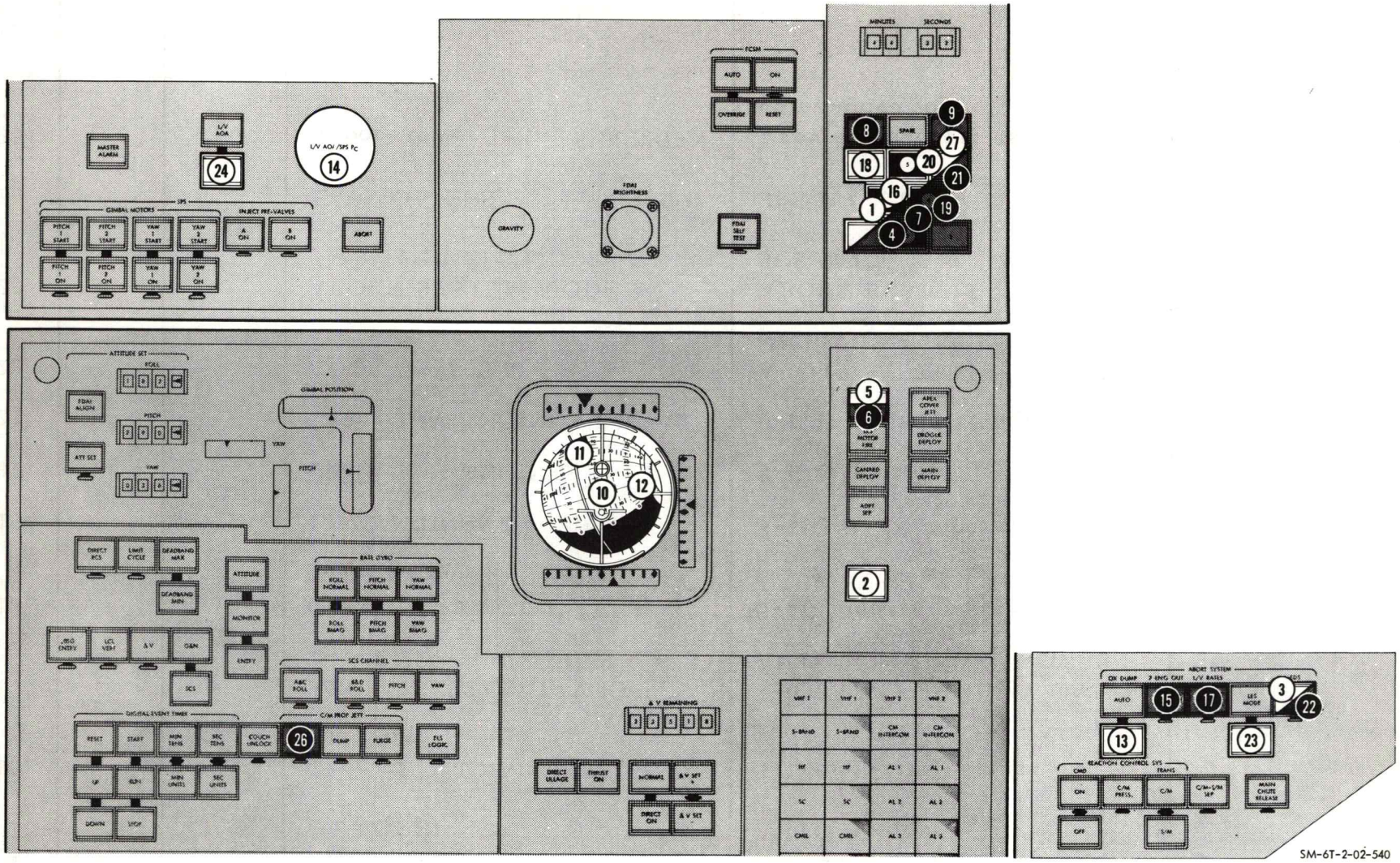


SM-6T-2-02-540

LISTED STEPS
25

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14		T+50sec	Monitor L/V AOA ind	As programed	
15			ABORT SYSTEM 2 ENG OUT sw - OFF	ABORT SYSTEM 2 ENG OUT - AUTO lt out	
16		T+140 sec	Check L/V ENGINES 5, 6, 7, and 8 on	S-IB outboard engines off	
17			ABORT SYSTEM L/V RATES sw - OFF	ABORT SYSTEM L/V RATES - AUTO lt out	
18			Check L/V ENGINES 1, 2, 3, and 4 lts on	S-IB inboard engines off	
19			L/V ENGINES lts (8) out	S-IB/S-IVB separation	
20			Check L/V ENGINES 1 lt on	S-IVB ignition	
21			Check L/V ENGINES 1 lt out	S-IVB engine buildup	
22			ABORT SYSTEM EDS sw - OFF	ABORT SYSTEM - AUTO lt out	
23			ABORT SYSTEM MODE sw - TWR JETT SPS MODE	ABORT SYSTEM - TWR JETT SPS MODE lt on	
24			L/V AOA/SPS P_C sw - SPS P_C	SPS P_C lt on	
*25			Report tower jettison is MSFN	Provide appropriate communication	



SM-6T-2-02-540

LISTED STEPS
25

Ascent

A1.1

IOS DATA SHEET

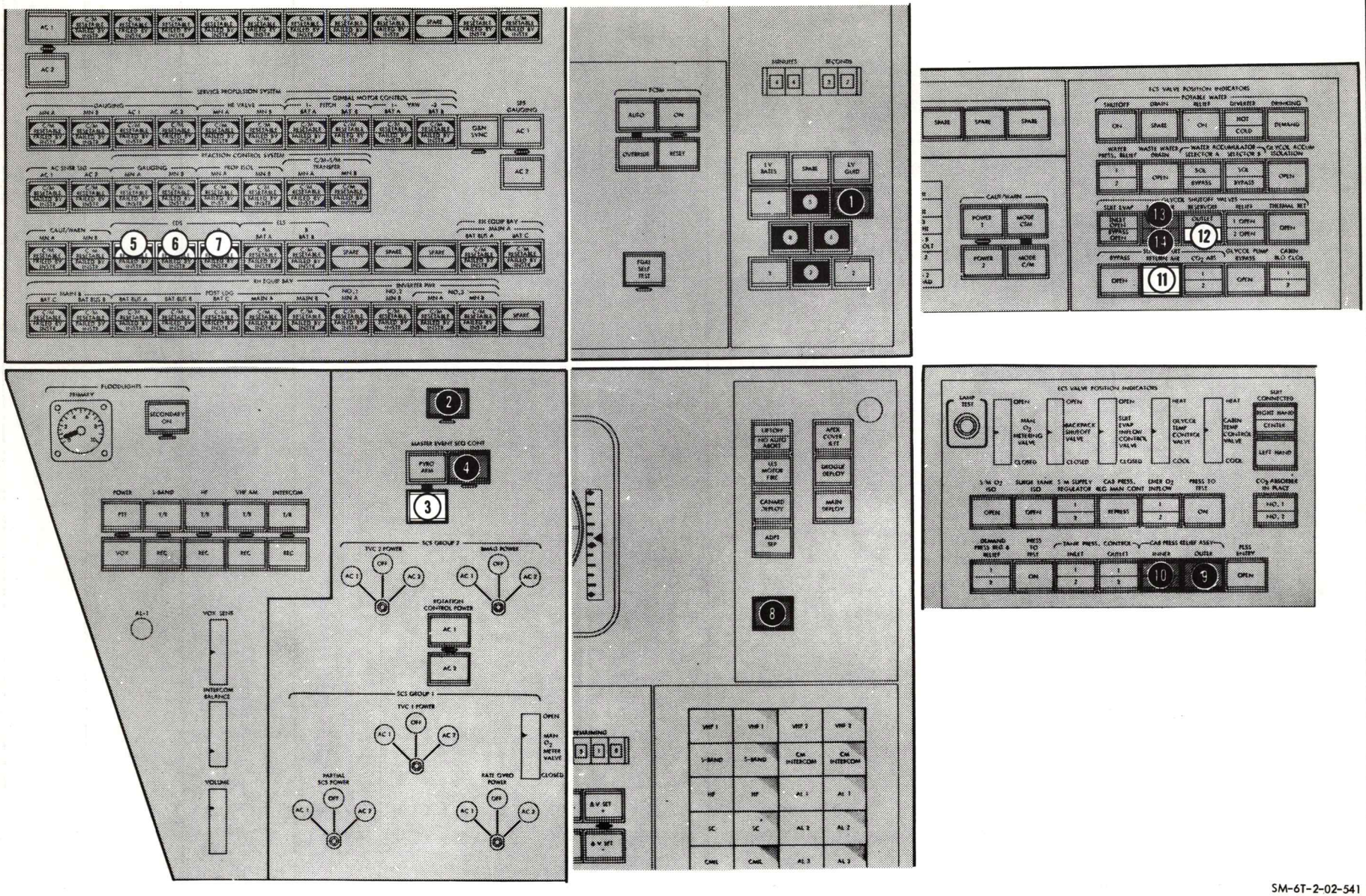
Step	Malf	Time	Function	IOS Visibility/Action	Notes
26			C/M PROP JETT - LOGIC/OFF sw - OFF	C/M PROP JETT - LOGIC lt out	
27			Check L/V ENGINES - 1 lt on	S-IVB cut off	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-4			Monitor DSKY Display - S-IB Boost		
1			REGISTER 1	Altitude (n mi)	
2			REGISTER 2	Flight path angle	
3			REGISTER 3	Velocity (fps)	
4			Check C&W lts out	As programed	
5-7			Monitor DSKY Displays - S-IVB Boost		
5			REGISTER 1	Time of free fall to 30,000 ft	
6			REGISTER 2	Max entry g's	
7			REGISTER 3	Delta V required to orbit	

IOS DATA SHEET

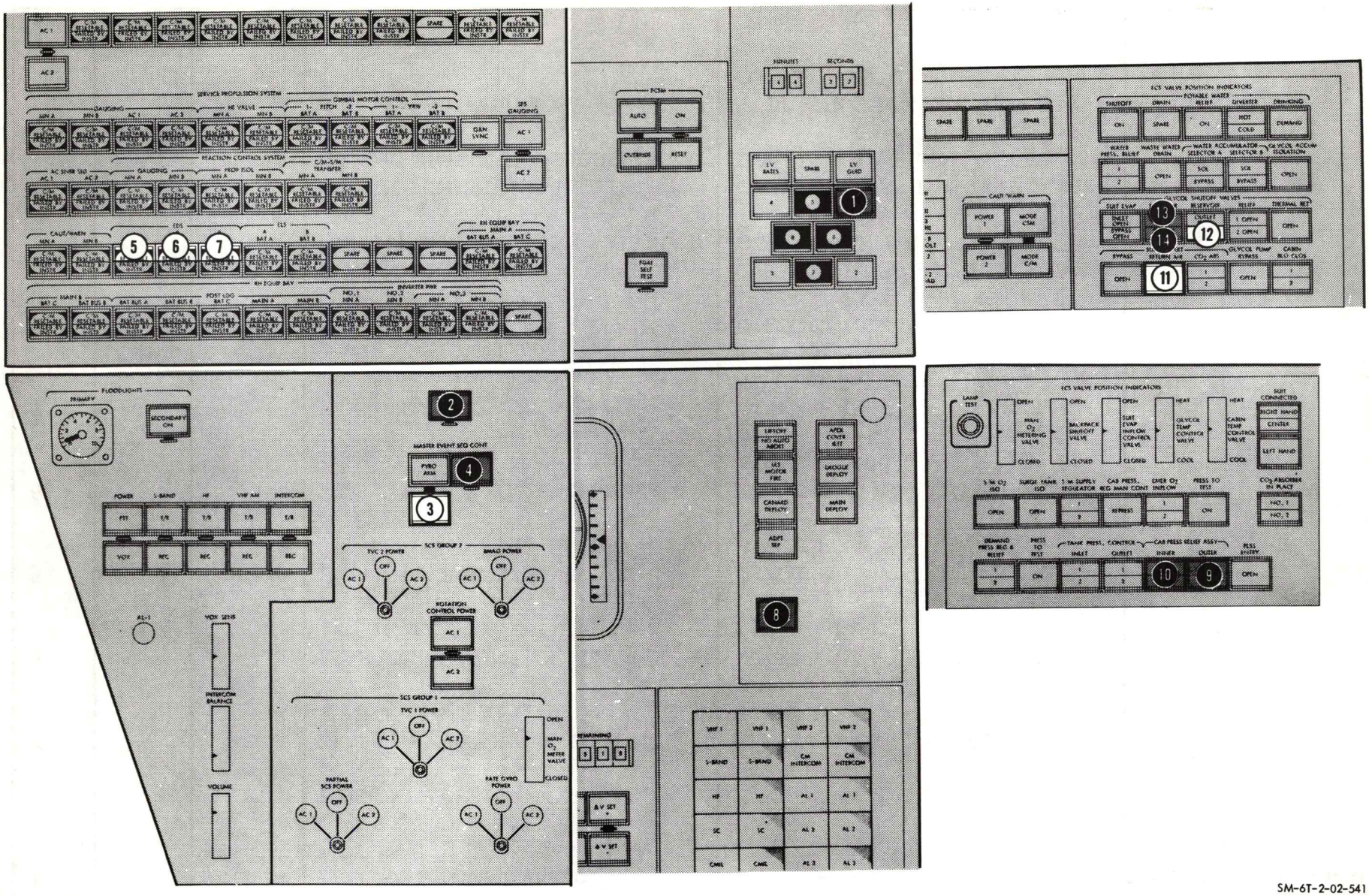
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Monitor system parameters throughout	Observe TV monitor	
2			Report LES tower jettison	Provide appropriate communication	



SM-6T-2-02-541

IOS DATA SHEET

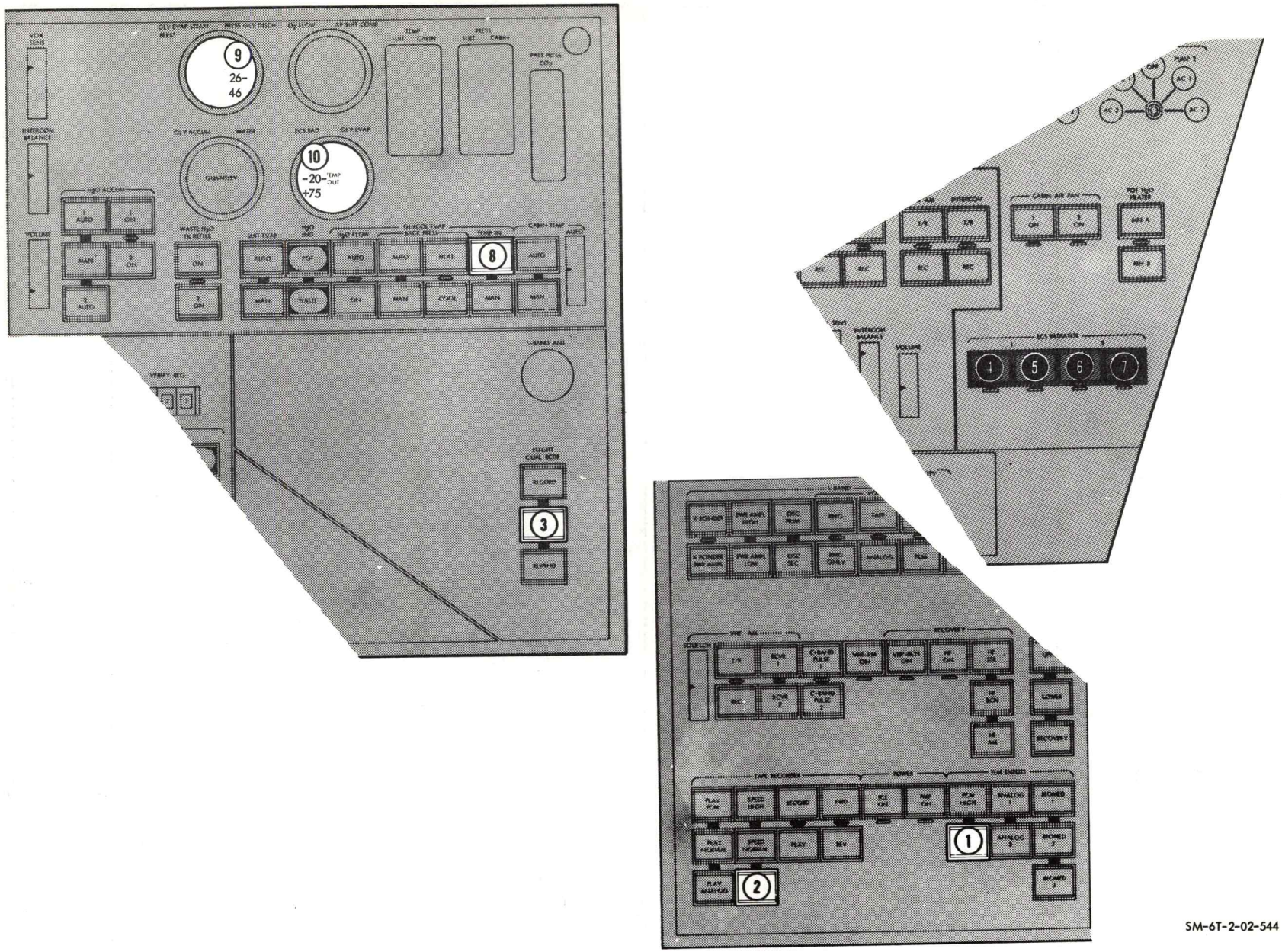
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			L/V ENGINES 1 lt out	S-IVB separation	Training Mission B and C only.
2			EDS POWER sw - OFF	EDS POWER ON lt out	
3			MASTER EVENT SEQ CONT PYRO sw - SAFE	MASTER EVENT SEQ CONT - SAFE lt on	
4			MASTER EVENT SEQ CONT LOGIC/OFF sw - OFF	MASTER EVENT SEQ CONT - LOGIC lt out	
5			EDS 1 BAT A C/B - out	EDS 1 BAT A - C/M RESET-ABLE lt on	
6			EDS 2 BAT B C/B - out	EDS 2 BAT B - C/M RESET-ABLE lt on	
7			EDS 3 BAT C C/B - out	EDS 3 BAT C - C/M RESET-ABLE lt on	
8			LOCK/UNLOCK sw - LOCK	UNLOCK lt out	
9			CABIN PRESSURE RELIEF (lower) cont - CLOSE NORMAL	CABIN PRESS RELIEF ASSY OUTER - lt out	
10			CABIN PRESSURE RELIEF (upper) cont - CLOSE NORMAL	CABIN PRESS RELIEF ASSY INNER - lts out	
11			Suit circuit return air valve - 0	SUIT CIRCUIT RETURN AIR - OPEN lt on	



SM-6T-2-02-541

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12			GLYCOL RESERVOIR BYPASS valve - OPEN	GLYCOL SHUTOFF VALVES RESERVOIR - BYPASS OPEN lt on	
13			GLYCOL RESERVOIR INLET valve - CLOSE	GLYCOL SHUTOFF VALVES RADIATOR - INLET OPEN lt out	
14			GLYCOL RESERVOIR OUTLET valve - CLOSE	GLYCOL SHUTOFF VALVES RESERVOIR - OUTLET OPEN lt out	



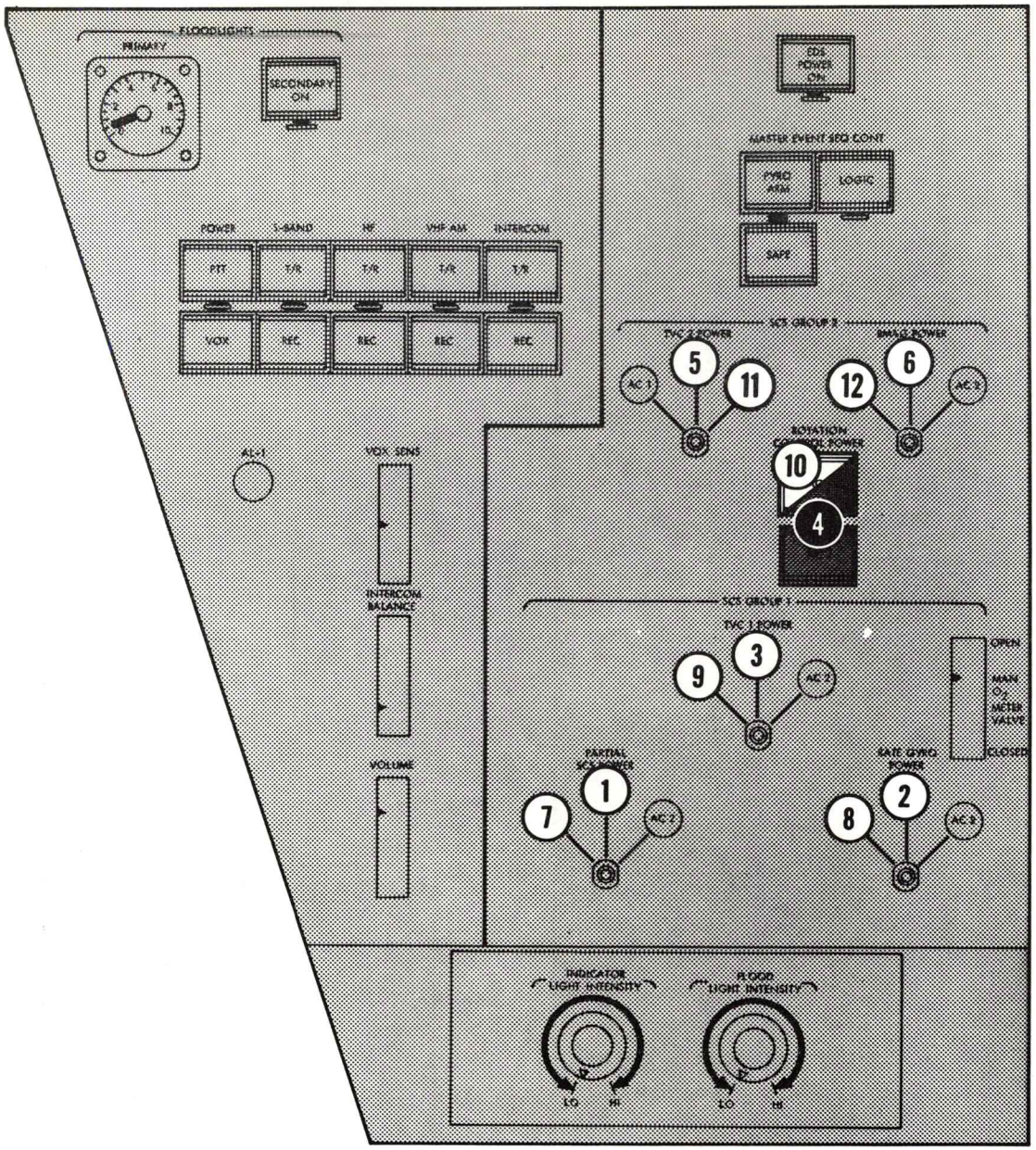
SM-6T-2-02-544

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			TLM INPUTS PCM sw - LOW	TLM INPUTS - PCM LOW lt on	
2			TAPE RECORDER SPEED sw - LOW	TAPE RECORDER - SPEED LOW lt on	
3			FLIGHT QUAL RCDR sw - STOP	FLIGHT QUAL RCDR - STOP lt on	
4			ECS RADIATOR 1 A sw - OFF	ECS RADIATOR 1 - A lt out	
5			ECS RADIATOR 1 B sw - OFF	ECS RADIATOR 1 - B lt out	
6			ECS RADIATOR 2 A sw - OFF	ECS RADIATOR 2 - A lt out	
7			ECS RADIATOR 2 B sw - OFF	ECS RADIATOR 2 - B lt out	
8			GLYCOL EVAP TEMP IN sw - AUTO	GLYCOL EVAP TEMP IN - AUTO lt on	
9			Check PRESS GLY DISCH ind	26-46	
10			ECS RAD TEMP OUT IND	-20-+75	

IOS DATA SHEET

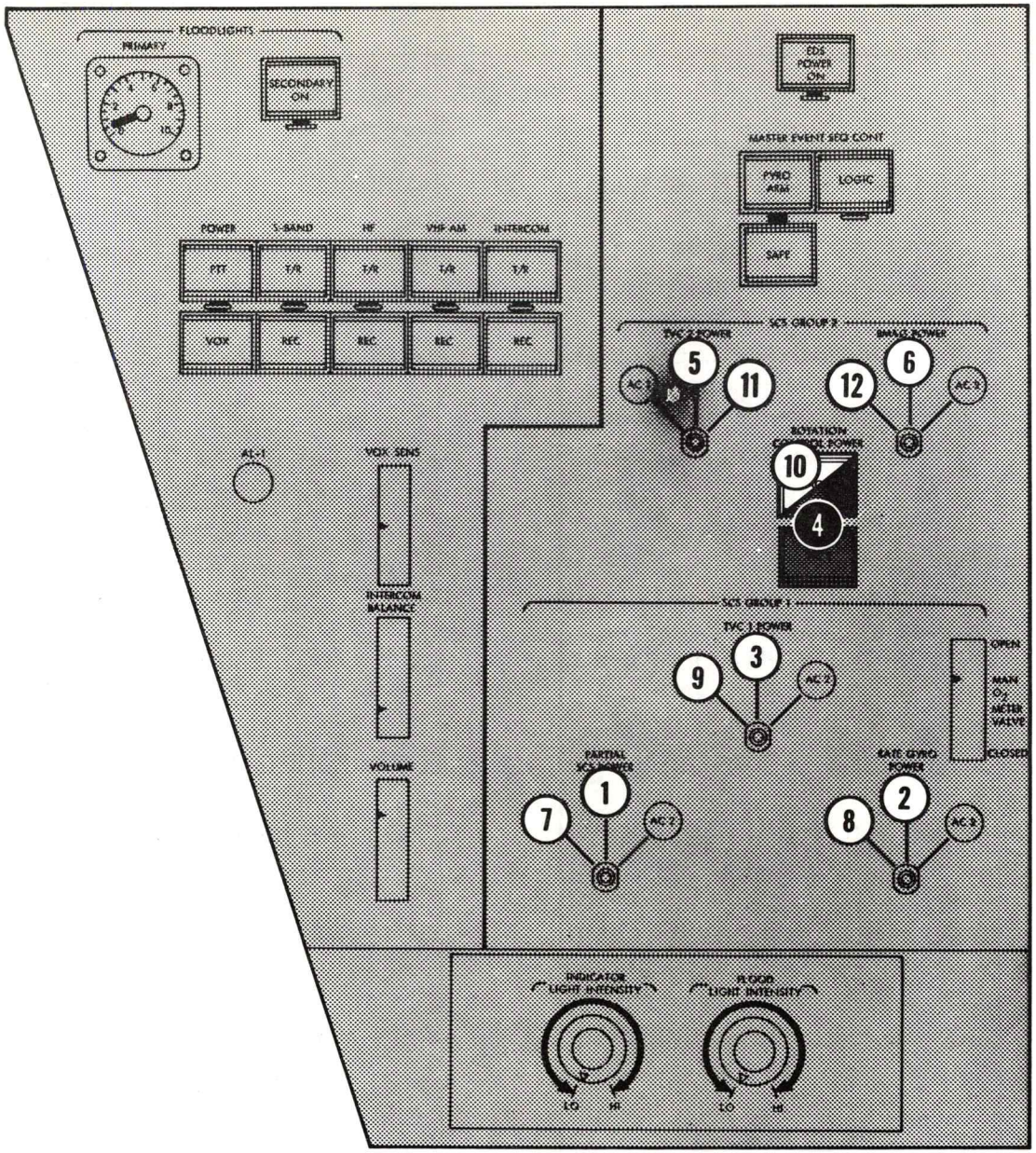
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			SM RCS QTY GAUGING POWER sw - OFF	S/M RCS QTY GAUGING - POWER ON lt out	Training Missions A and D only.
2			Install postlanding vent valves lockpins	Observe TV monitor	
3			Remove Y-axis attenuator panels	Observe TV monitor	


FLOODLIGHTS
PRIMARY
SECONDARY ON
CDS POWER ON
MASTER EVENT SEQ CONT
PYRO ARM
LOGIC
SAFE
POWER
S-BAND
HF
VHF AM
INTERCOM
PTT
T/R
VOX
REC
SCS GROUP 2
TVC 2 POWER
SM/RCS POWER
AC 1
AC 2
5
11
12
6
ROTATION CONTROL POWER
10
4
AC-1
VOX SENS
INTERCOM BALANCE
VOLUME
SCS GROUP 1
TVC 1 POWER
9
3
OPEN
MAN O2 METER VALVE
CLOSED
PARTIAL SCS POWER
1
7
RATE GYRO POWER
2
8
INDICATOR LIGHT INTENSITY
FLOOD LIGHT INTENSITY
LO
HI

SM-6T-2-02-542

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-6			Initiation		
1			PARTIAL SCS POWER sw - OFF	PARTIAL SCS POWER - OFF lt on	
2			RATE GYRO POWER sw - OFF	RATE GYRO POWER - OFF lt on	
3			TVC 1 POWER sw - OFF	TVC 1 POWER - OFF lt on	
4			ROTATION CONTROL POWER sw - OFF	ROTATIONAL CONTROL POWER lts out	
5			TVC 2 POWER sw - OFF	TVC 2 POWER - OFF lt on	
6			BMAG POWER sw - OFF	BMAG POWER - OFF lt on	
7-12			Recovery		
7			PARTIAL SCS POWER sw - AC 1	PARTIAL SCS POWER - AC 1 lt on	
8			RATE GYRO POWER sw - AC 1	RATE GYRO POWER - AC 1 lt on	
9			TVC 1 POWER sw - AC 1	TVC 1 POWER - AC 1 lt on	
10			ROTATIONAL CONTROL POWER sw - AC 1	ROTATIONAL CONTROL POWER - AC 1 lt on	

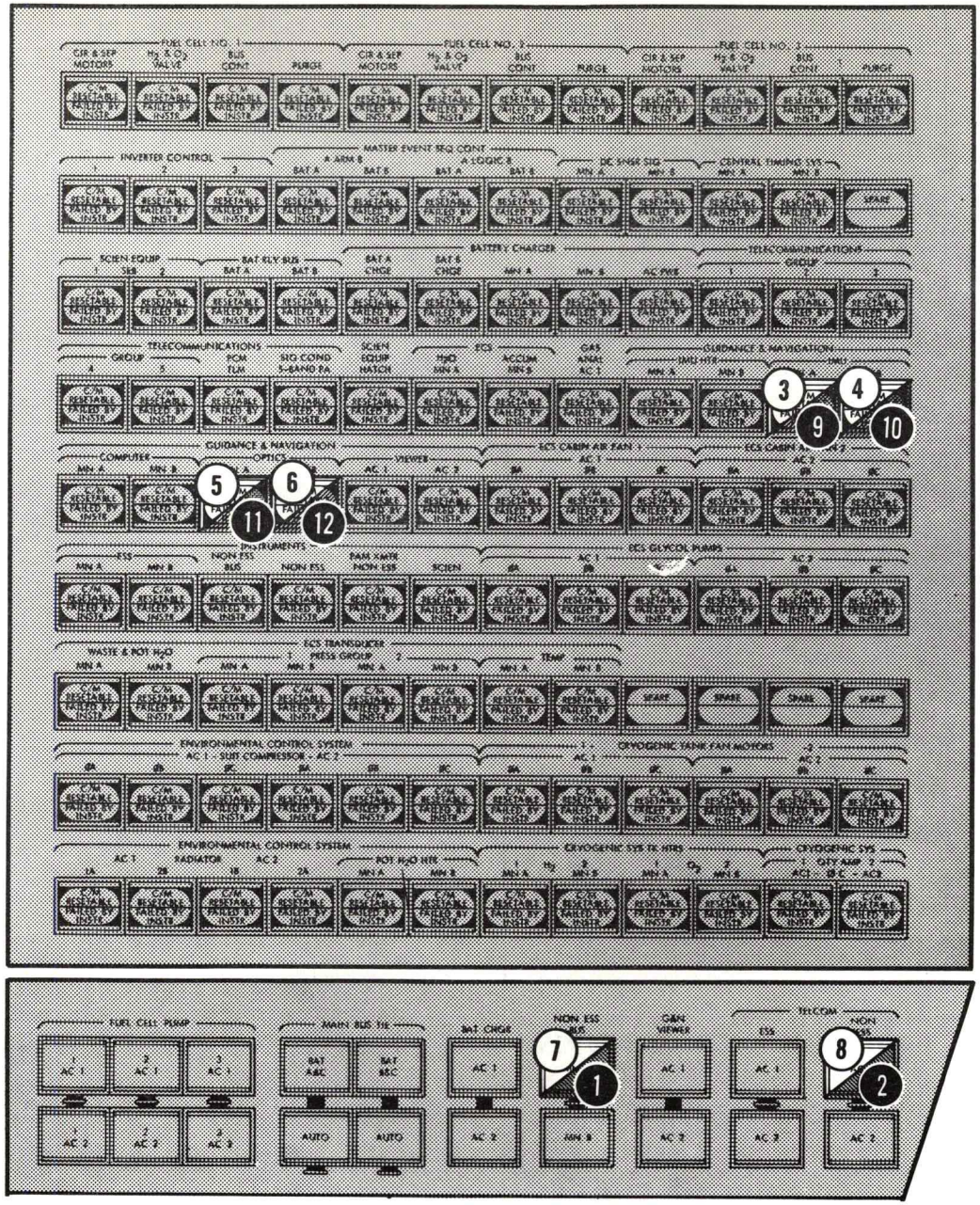


SM-6T-2-02-542

Minimum Power Operations

01.2

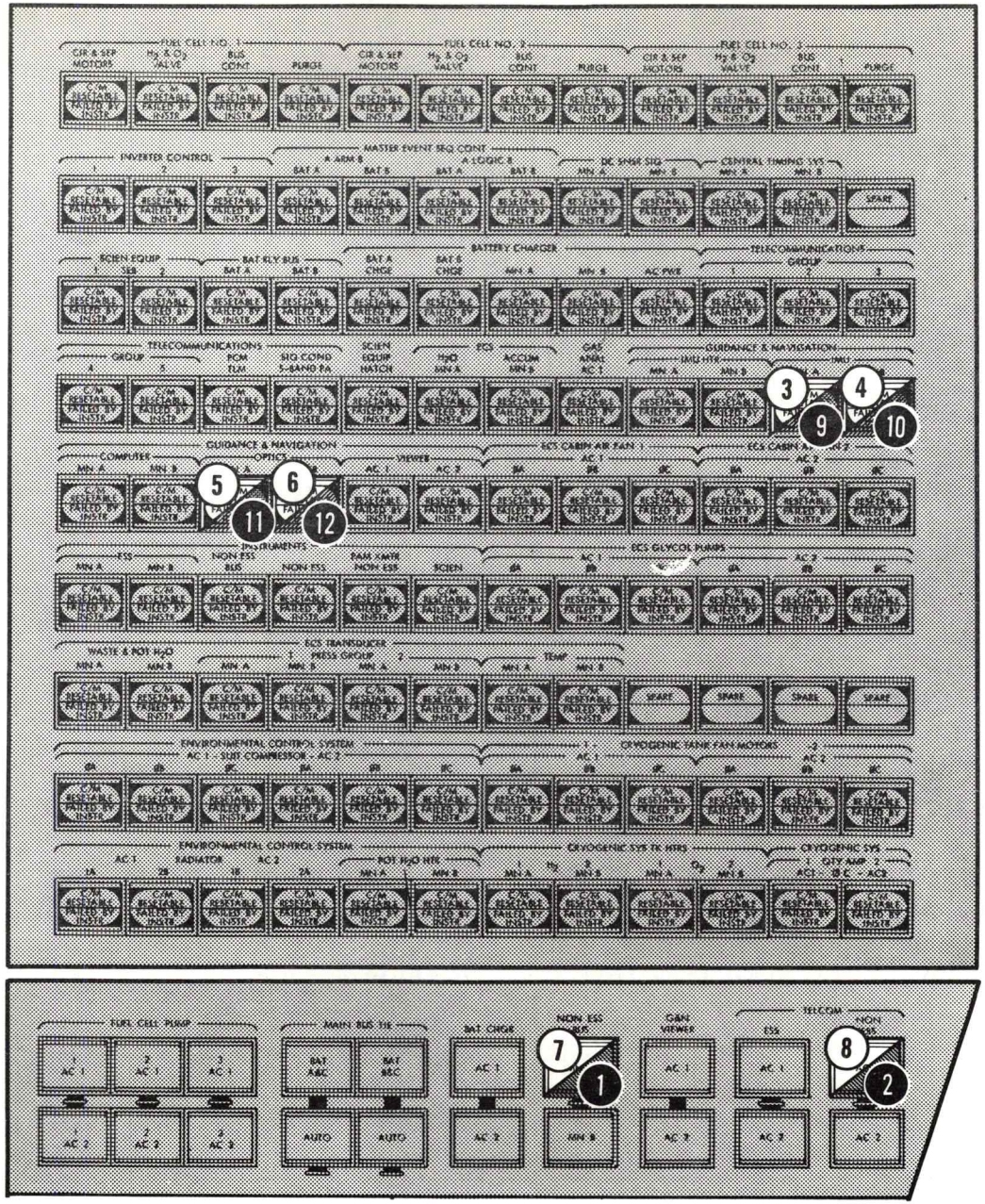
Step	Malf	Time	Function	IOS Visibility/Action	Notes
11			TVC 2 POWER sw - AC 2	TVC 2 POWER - AC 2 lt on	
12			BMAG POWER sw - AC 1	BMAG POWER - AC 1 lt on	


FUEL CELL NO. 1
FUEL CELL NO. 2
FUEL CELL NO. 3
CIR & SEP MOTORS
H_2 & O_2 VALVE
BUS CONT
PURGE
INVERTER CONTROL
MASTER EVENT SEQ CONT
A ARM B
A LOGIC B
BAT A
BAT B
DC SNSR SIG
CENTRAL TIMING SYS
SPARE
SCIEN EQUIP
BAT RLY BUS
BATTERY CHARGER
BAT A CHGR
BAT B CHGR
MN A
MN B
AC PWR
TELECOMMUNICATIONS
GROUP
SCIEN EQUIP HATCH
ECS
H_2O ACCUM
GAS ANAL
GUIDANCE & NAVIGATION
IMU HTR
IMU
COMPUTER
OPTICS
VIEWER
ECS CABIN AIR FAN
INSTRUMENTS
ESS
NON ESS BUS
NON ESS
PAM XMTR
SCIEN
ECS GLYCOL PUMPS
WASTE & POT H_2O
ECS TRANSDUCER
PRESS GROUP
TEMP
ENVIRONMENTAL CONTROL SYSTEM
AC 1 - SUIT COMPRESSOR - AC 2
CRYOGENIC FANS FAN MOTORS
RADIATOR
POT H_2O HTR
CRYOGENIC SYS TK HTRS
CRYOGENIC SYS
QTY ASM
SPARE
FUEL CELL PUMP
MAIN BUS TIE
BAT CHGR
NON ESS BUS
C&W VIEWER
TELCOM
NON ESS
BAT A&C
BAT B&C
AUTO
3
4
5
6
7
8
9
10
11
12
1
2

SM-6T-2-02-572

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-6			Initiation		
1			NONESS BUS sw - OFF	NONESS BUS lts out	
2			TELECOM NON ESS sw - OFF	TELECOM NON ESS lts out	
3			GUIDANCE & NAVIGATION IMU MN A C/B out	GUIDANCE & NAVIGATION IMU MN A - C/M RESETABLE lt on	
4			GUIDANCE & NAVIGATION IMU MN B C/B out	GUIDANCE & NAVIGATION IMU MN B - C/M RESETABLE lt on	
5			GUIDANCE & NAVIGATION OPTICS MN A - C/B out	GUIDANCE & NAVIGATION OPTICS MN A - C/M RESETABLE lt on	
6			GUIDANCE & NAVIGATION OPTICS MN B - C/B out	GUIDANCE & NAVIGATION OPTICS MN B - C/M RESETABLE lt on	
7-12			Recovery		
7			NONESS BUS sw - MN A	NONESS BUS - MN A lt on	
8			TELECOM NON ESS sw - AC 2	TELECOM NONESS - AC 2 lt on	
9			Reset GUIDANCE & NAVIGATION IMU MN A C/B	GUIDANCE & NAVIGATION IMU MN A - C/M RESETABLE lt out	



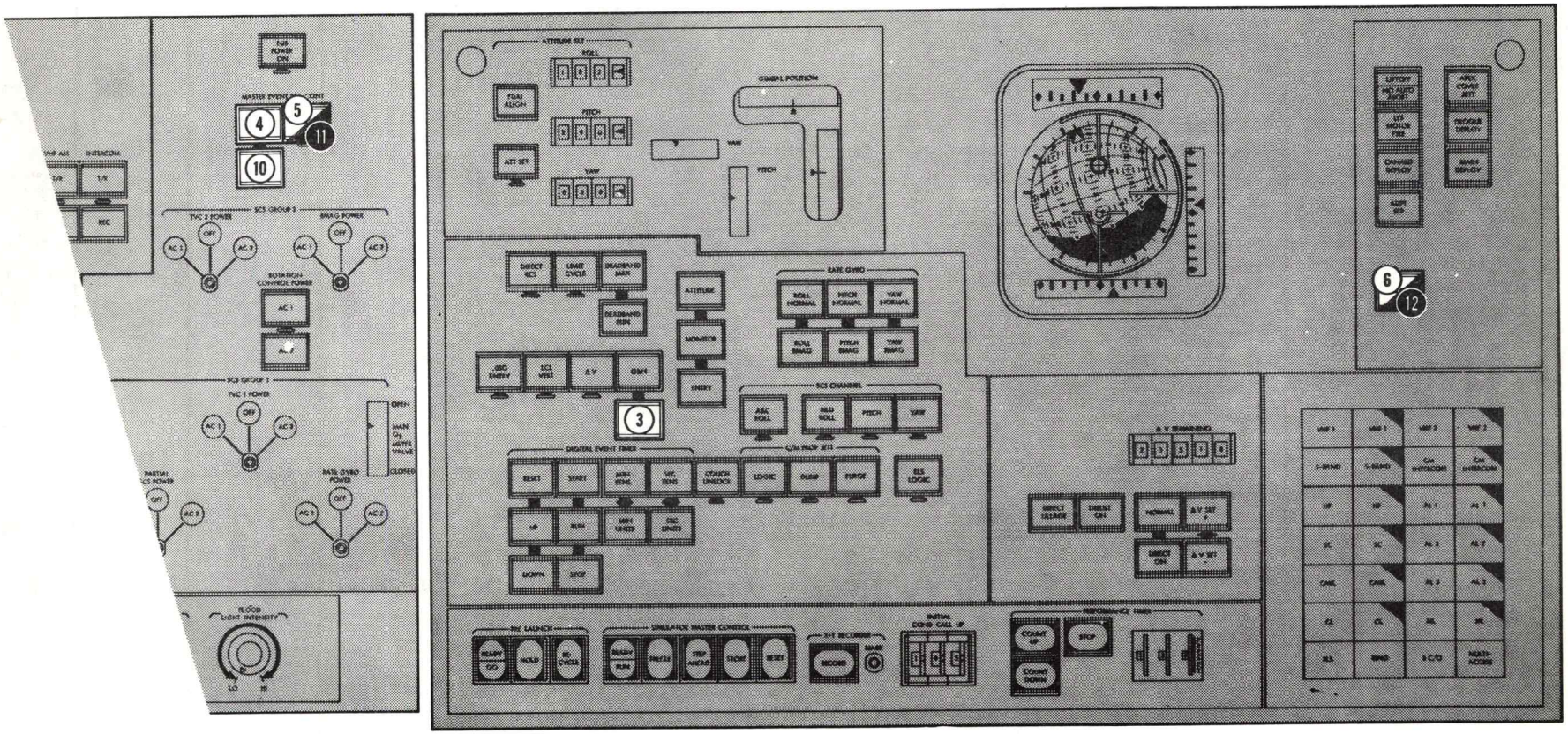
SM-6T-2-02-572

Minimum Power Operations

O3.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
10			Reset GUIDANCE & NAVIGATION IMU MN B C/B	GUIDANCE & NAVIGATION IMU MN B - C/M RESETABLE lt on	
11			Reset GUIDANCE & NAVIGATION OPTICS MN A C/B	GUIDANCE & NAVIGATION OPTICS MN A - C/M RESETABLE lt out	
12			Reset GUIDANCE & NAVIGATION OPTICS MN B C/B	GUIDANCE & NAVIGATION OPTICS MN B - C/M RESETABLE lt out	



LISTED STEPS

1,2,7,8

SM-6T-2-02-543

S-IVB Separation

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Unlock translation control	Observe TV monitor	
*2			Unlock rotation control	Observe TV monitor	
3			G&N/SCS sw - SCS	SCS lt on	
4			MASTER EVENT SEQ CONT PYRO sw - ARM	MASTER EVENT SEQ CONT - PYRO ARM lt on	
5			MASTER EVENT SEQ CONT LOGIC sw - on	MASTER EVENT SEQ CONT - LOGIC lt on	
6			LOCK/UNLOCK cont - UNLOCK	UNLOCK lt on	
*7		1:30:00	S-IVB separation	Aural	
*8			Translate away from S-IVB	Observe TV monitor	
*9			Pitch SCM to view SLA deploy	Observe FDAI, TV monitor	
10			MASTER EVENT SEQ CONT PYRO sw - SAFE	MASTER EVENT SEQ CONT - SAFE lt on	
11			MASTER EVENT SEQ CONT LOGIC sw - OFF	MASTER EVENT SEQ CONT - LOGIC lt out	
12			LOCK/UNLOCK control - LOCK	UNLOCK lt out	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Perform S/M RCS periodic	RC2.02	
*2			Perform EPS periodic	EP3.10	
*3			Perform ECS periodic	EC3.01	
4			VHF-AM mode sw - T/R	VHF-AM - T/R lt on	
5			VHF-FM sw - ON	VHF-FM ON lt on	
6			S-BAND PWR AMPL sw - LOW	S-BAND PWR AMPL LOW lt on	
*7			Photograph SLA deployment	Observe TV monitor	

DELTA V REQUIRED	P	32
V	06 *	N	14 *
R1 ΔV REQUIRED R2 R3			

2-4

SEL PROG	P	32
V	05 *	N	07 *
R1 0 0 0 4 2 R2 R3			

14-16

SEL MODE	P	42
V	50 *	N	25 *
R1 0 0 0 0 2 R2 R3			

18-20

ICDU DISPLAY	P	42
V	06 *	N	20 *
R1 OUTER GIMBAL ANGLE R2 INNER GIMBAL ANGLE R3 MIDDLE GIMBAL ANGLE			

23-27

ΔV REQUIRED	P	42
V	16	N	15
R1 TIME TO IGN R2 ΔV REQ R3			

39-42

ΔV PARAMETERS	P	42
V	16	N	15
R1 TIME TO IGN R2 ΔV REQ R3 ULLAGE ΔV			

54-58

REQ ENGINE IGN	P	42
V	50 *	N	11 *
R1 TIME TO IGN R2 ΔV REQ R3 ULLAGE ΔV			

62-66

ENGINE FIRING	P	42
V	50 *	N	11 *
R1 R2 R3			

68-69

ΔV PARAMETERS	P	42
V	16	N	52
R1 TIME TO CUTOFF R2 ΔV MEASURED R3 TIME TO FREEFALL			

72-76

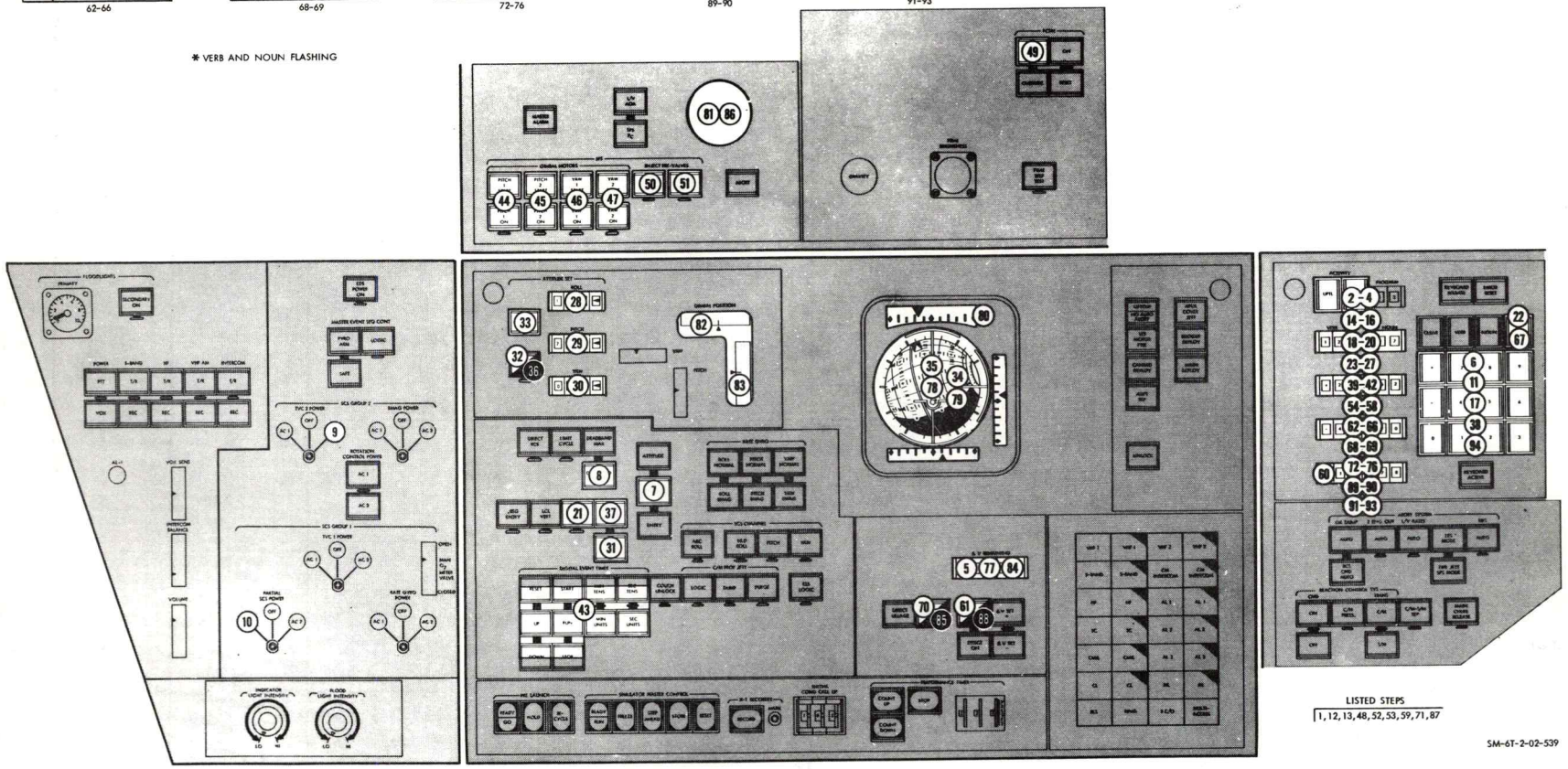
SPS CUTOFF	P	42
V	16	N	52
R1 ZERO R2 ZERO R3			

89-90

KEY IN PROCEED	P	42
V	06 *	N	52 *
R1 ZERO R2 ZERO R3 TIME TO FREE FALL			

91-93

* VERB AND NOUN FLASHING



LISTED STEPS

1, 12, 13, 48, 52, 53, 59, 71, 87

SM-6T-2-02-539

Deorbit Delta V Procedures

E1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Receive request from seat 4 set backup ΔV counter	Monitor intercom	Concurrent with step 37 of E4.1
2			Check VERB window	Flashing 06	
3			Check NOUN window	Flashing 14	
4			Check REGISTER 1	Delta V value	
5			Set ΔV REMAINING ind	As indicated in step 4	
6			Key in proceed	VERB, 33, and ENTER lts as pressed	
7			ATTITUDE/MONITOR/ENTRY sw - MONITOR	MONITOR lt on	
8			DEADBAND sw - MIN	DEADBAND MIN lt on	
9			TVC 2 POWER sw - AC 2	TVC 2 POWER - AC 2 lt on	
10			TVC 1 POWER sw - AC 1	TVC 1 POWER - AC 1 lt on	
11			Key in ENTER	ENTER lt as pressed	
*12			Perform Attitude Control Mode Check	GN1.40	
*13			Perform Attitude Maneuver	GN1.44	

DELTA V REQUIRED	P	32
V	06 *	N	14 *
R1 R2 R3	ΔV REQUIRED		

2-4

SEL PROG	P	32
V	05 *	N	07 *
R1 R2 R3	0 0 0 4 2		

14-16

SEL MODE	P	42
V	50 *	N	25 *
R1 R2 R3	0 0 0 0 2		

18-20

ICDU DISPLAY	P	42
V	06 *	N	20 *
R1	OUTER GIMBAL ANGLE
R2	INNER GIMBAL ANGLE
R3	MIDDLE GIMBAL ANGLE

23-27

ΔV REQUIRED	P	42
V	16	N	15
R1 R2 R3	TIME TO IGN ΔV REQ		

39-42

ΔV PARAMETERS	P	42
V	16	N	15
R1 R2 R3	TIME TO IGN ΔV REQ ULLAGE ΔV		

54-58

REQ ENGINE IGN	P	42
V	50 *	N	11 *
R1 R2 R3	TIME TO IGN ΔV REQ ULLAGE ΔV		

62-66

ENGINE FIRING	P	42
V	50 *	N	11 *
R1 R2 R3			

68-69

ΔV PARAMETERS	P	42
V	16	N	52
R1 R2 R3	TIME TO CUTOFF ΔV MEASURED TIME TO FREEFALL		

72-76

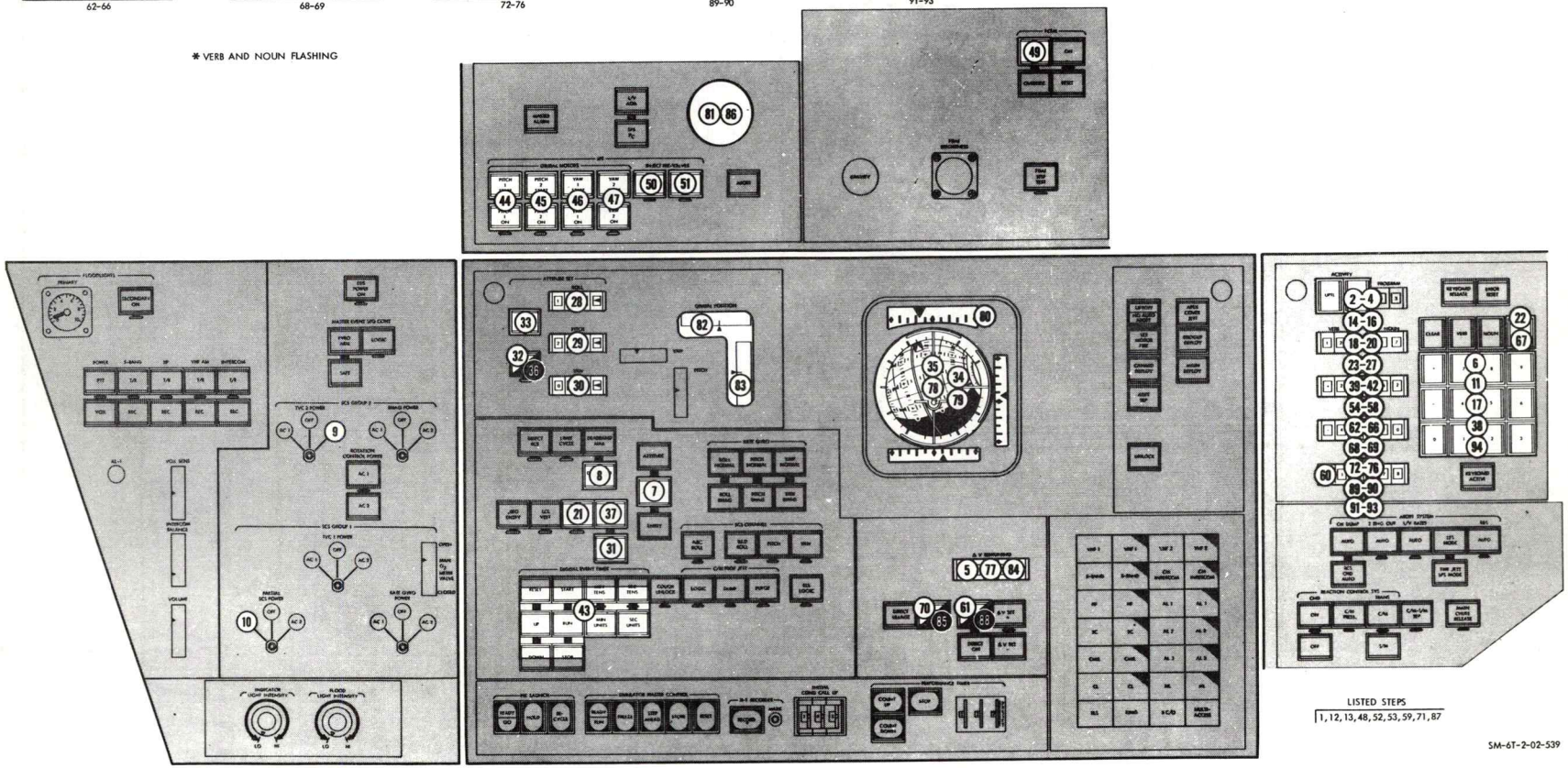
SPS CUTOFF	P	42
V	16	N	52
R1 R2 R3	ZERO ZERO		

89-90

KEY IN PROCEED	P	42
V	06 *	N	52 *
R1 R2 R3	ZERO ZERO TIME TO FREE FALL		

91-93

* VERB AND NOUN FLASHING



LISTED STEPS

1, 12, 13, 48, 52, 53, 59, 71, 87

SM-6T-2-02-539

Deorbit Delta V Procedures

E1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14			Check VERB window	Flashing 05	Request program selection.
15			Check NOUN window	Flashing 07	
16			Check REGISTER 1	00042	
17			Key in Return to Earth Program	GN4.03 V37, P42	
18-22			Perform Thrust Control Mode Check		
18			Check VERB window	Flashing 50	Request mode selection
19			Check NOUN window	Flashing 25	
20			Check REGISTER 1	00002	
21			DELTA V sw - on	ΔV lt on	
22			Key in ENTER	ENTER lt on, out as released	
23-37			Align AGC and FDAI		
23			Check VERB window	Flashing 06	ICDU display
24			Check NOUN window	Flashing 20	
25			Check REGISTER 1	Outer gimbal angle	

DELTA V REQUIRED	P	32
V 06 *	N	14 *
R1 ΔV REQUIRED R2 R3		

2-4

SEL PROG	P	32
V 05 *	N	07 *
R1 0 0 0 4 2 R2 R3		

14-16

SEL MODE	P	42
V 50 *	N	25 *
R1 0 0 0 0 2 R2 R3		

18-20

ICDU DISPLAY	P	42
V 06 *	N	20 *
R1 OUTER GIMBAL ANGLE R2 INNER GIMBAL ANGLE R3 MIDDLE GIMBAL ANGLE		

23-27

ΔV REQUIRED	P	42
V 16	N	15
R1 TIME TO IGN R2 ΔV REQ R3		

39-42

ΔV PARAMETERS	P	42
V 16	N	15
R1 TIME TO IGN R2 ΔV REQ R3 ULLAGE ΔV		

54-58

REQ ENGINE IGN	P	42
V 50 *	N	11 *
R1 TIME TO IGN R2 ΔV REQ R3 ULLAGE ΔV		

62-66

ENGINE FIRING	P	42
V 50 *	N	11 *
R1 R2 R3		

68-69

ΔV PARAMETERS	P	42
V 16	N	52
R1 TIME TO CUTOFF R2 ΔV MEASURED R3 TIME TO FREEFALL		

72-76

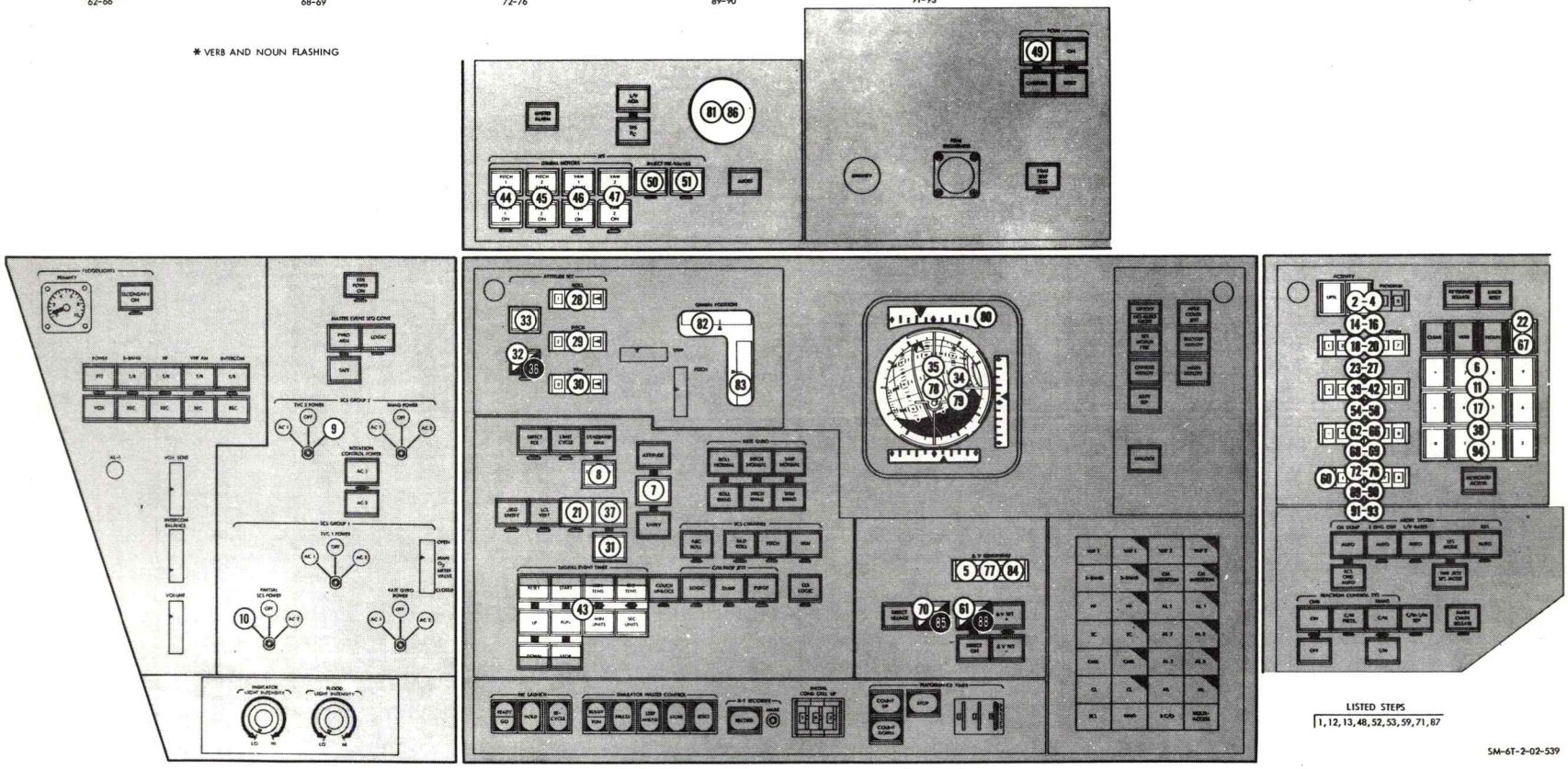
SPS CUTOFF	P	42
V 16	N	52
R1 ZERO R2 ZERO R3		

89-90

KEY IN PROCEED	P	42
V 06 *	N	52 *
R1 ZERO R2 ZERO R3 TIME TO FREE FALL		

91-93

* VERB AND NOUN FLASHING



LISTED STEPS
1, 12, 13, 48, 52, 53, 59, 71, 87

SM-6T-2-02-539

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
26			Check REGISTER 2	Inner gimbal angle	
27			Check REGISTER 3	Middle gimbal angle	
28			Set ATTITUDE SET ROLL ind	Check REGISTER 1	
29			Set ATTITUDE SET PITCH ind	Check REGISTER 2	
30			Set ATTITUDE SET YAW ind	Check REGISTER 3	
31			G&N/SCS sw - SCS	SCS lt on	
32			ATT SET sw - on	ATT SET lt on	
33			Press FDAI ALIGN sw -	FDAI ALIGN lt as pressed	
34			Check FDAI error needles	Erros nulled as FDAI aligns	
35			Check FDAI nav axis	Aligned to AGC registers	
36			ATT SET sw - OFF	ATT SET lt out	
37			G&N/SCS sw - G&N	G&N lt on	
38			Key in ENTER	ENTER lt as pressed	
39			Check VERB window	16	ΔV required
40			Check NOUN window	15	
41			Check REGISTER 1	Time to ignition	

DELTA V REQUIRED	P	32
V	06 *	N	14 *
R1 ΔV REQUIRED R2 R3			

2-4

SEL PROG	P	32
V	05 *	N	07 *
R1 0 0 0 4 2 R2 R3			

14-16

SEL MODE	P	42
V	50 *	N	25 *
R1 0 0 0 0 2 R2 R3			

18-20

ICDU DISPLAY	P	42
V	06 *	N	20 *
R1 OUTER GIMBAL ANGLE R2 INNER GIMBAL ANGLE R3 MIDDLE GIMBAL ANGLE			

23-27

ΔV REQUIRED	P	42
V	16	N	15
R1 TIME TO IGN R2 ΔV REQ R3			

39-42

ΔV PARAMETERS	P	42
V	16	N	15
R1 TIME TO IGN R2 ΔV REQ R3 ULLAGE ΔV			

54-58

REQ ENGINE IGN	P	42
V	50 *	N	11 *
R1 TIME TO IGN R2 ΔV REQ R3 ULLAGE ΔV			

62-66

ENGINE FIRING	P	42
V	50 *	N	11 *
R1 R2 R3			

68-69

ΔV PARAMETERS	P	42
V	16	N	52
R1 TIME TO CUTOFF R2 ΔV MEASURED R3 TIME TO FREEFALL			

72-76

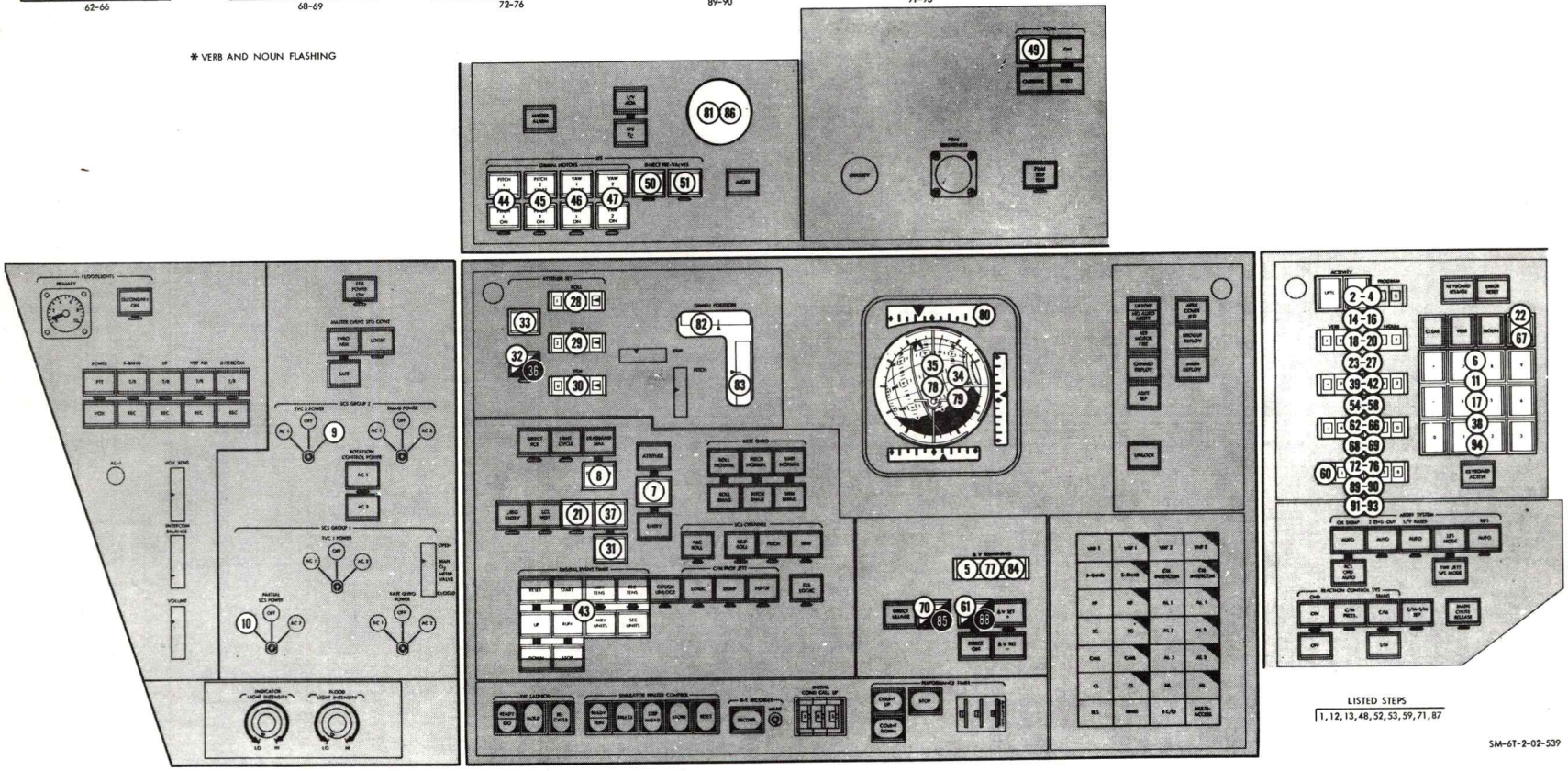
SPS CUTOFF	P	42
V	16	N	52
R1 ZERO R2 ZERO R3			

89-90

KEY IN PROCEED	P	42
V	06 *	N	52 *
R1 ZERO R2 ZERO R3 TIME TO FREE FALL			

91-93

* VERB AND NOUN FLASHING



LISTED STEPS

1, 12, 13, 48, 52, 53, 59, 71, 87

SM-6T-2-02-539

Step	Malf	Time	Function	IOS Visibility/Action	Notes
42			Check REGISTER 2	ΔV required	
43			Set DET to sychronization time	DET lts as selected	
44			SPS GIMBAL MOTORS PITCH 1 sw - START and release to ON	SPS GIMBAL MOTORS - PITCH 1 START lt on, out as released, PITCH 1 ON lt on	
45			SPS GIMBAL MOTORS PITCH 2 sw - START and release to ON	SPS GIMBAL MOTORS - PITCH 2 START lt on, out as released, PITCH 2 ON lt on	
46			SPS GIMBAL MOTORS YAW 1 sw - START and release to ON	SPS GIMBAL MOTORS - YAW 1 ON lt on, out as released, SPS GIMBAL MOTORS - YAW 1 ON lt on	
47			SPS GIMBAL MOTORS YAW 2 sw - START and release to ON	SPS GIMBAL MOTORS - YAW 2 START lt on, out as released, YAW 2 ON lt on	
*48			Perform SPS Gimbal Test Procedure	SC 1.03	
49			FCSM AUTO/OVERRIDE sw - AUTO	FCSM - AUTO lt on	
50		Ign - 2 min	SCS INJECT PRE-VALVES A sw - ON	SPS INJECT PRE-VALVES - A ON lt on	

DELTA V REQUIRED	P	32
V	06 *	N	14 *
R1 R2 R3	ΔV REQUIRED		

2-4

SEL PROG	P	32
V	05 *	N	07 *
R1 R2 R3	0 0 0 4 2		

14-16

SEL MODE	P	42
V	50 *	N	25 *
R1 R2 R3	0 0 0 0 2		

18-20

ICDU DISPLAY	P	42
V	06 *	N	20 *
R1 R2 R3	OUTER GIMBAL ANGLE INNER GIMBAL ANGLE MIDDLE GIMBAL ANGLE		

23-27

ΔV REQUIRED	P	42
V	16	N	15
R1 R2 R3	TIME TO IGN ΔV REQ		

39-42

ΔV PARAMETERS	P	42
V	16	N	15
R1 R2 R3	TIME TO IGN ΔV REQ ULLAGE ΔV		

54-58

REQ ENGINE IGN	P	42
V	50 *	N	11 *
R1 R2 R3	TIME TO IGN ΔV REQ ULLAGE ΔV		

62-66

ENGINE FIRING	P	42
V	50 *	N	11 *
R1 R2 R3			

68-69

ΔV PARAMETERS	P	42
V	16	N	52
R1 R2 R3	TIME TO CUTOFF ΔV MEASURED TIME TO FREEFALL		

72-76

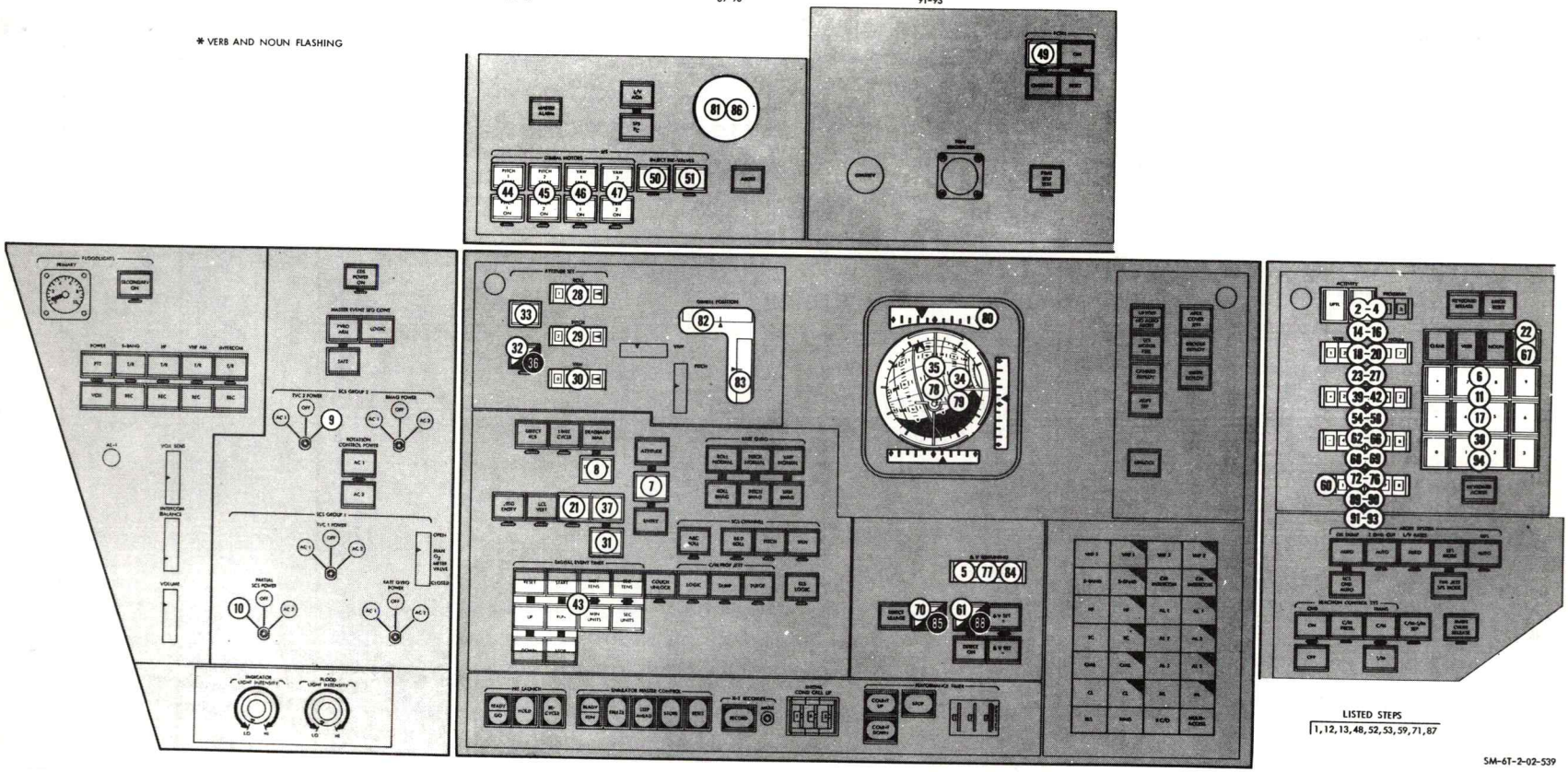
SPS CUTOFF	P	42
V	16	N	52
R1 R2 R3	ZERO ZERO		

89-90

KEY IN PROCEED	P	42
V	06 *	N	52 *
R1 R2 R3	ZERO ZERO TIME TO FREE FALL		

91-93

* VERB AND NOUN FLASHING



LISTED STEPS

1, 12, 13, 48, 52, 53, 59, 71, 87

SM-6T-2-02-539

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
51			SCS INJECT PRE-VALVES B sw - ON	SPS INJECT PRE-VALVES - B ON lt on	
*52			Unlock translation control	Observe TV monitor	
*53			Unlock rotation control	Observe TV monitor	
54-90			SPS Engine Ignition		
54			Check VERB window	16	ΔV Parameters
55			Check NOUN window	15	
56			Check REGISTER 1	Time to ignition	
57			Check REGISTER 2	ΔV required	
58			Check REGISTER 3	ΔV due to ullage	
*59		Ign - 15 sec	Initiate ullage	Observe TV monitor	
60			Check REGISTER 3	ΔV due to ullage	
61			NORMAL/OFF/DIRECT sw - NORMAL	NORMAL lt on	
62		Ign - 5 sec	Check VERB window	Flashing 50	Request SPS ignition
63			Check NOUN window	Flashing 11	

DELTA V REQUIRED			P 32
V	06 *	N	14 *
R1	ΔV REQUIRED		
R2			
R3			

2-4

SEL PROG			P 32
V	05 *	N	07 *
R1	0 0 0 4 2		
R2			
R3			

14-16

SEL MODE			P 42
V	50 *	N	25 *
R1	0 0 0 0 2		
R2			
R3			

18-20

ICDU DISPLAY			P 42
V	06 *	N	20 *
R1	OUTER GIMBAL ANGLE		
R2	INNER GIMBAL ANGLE		
R3	MIDDLE GIMBAL ANGLE		

23-27

ΔV REQUIRED			P 42
V	16	N	15
R1	TIME TO IGN		
R2	ΔV REQ		
R3			

39-42

ΔV PARAMETERS			P 42
V	16	N	15
R1	TIME TO IGN		
R2	ΔV REQ		
R3	ULLAGE ΔV		

54-58

REQ ENGINE IGN			P 42
V	50 *	N	11 *
R1	TIME TO IGN		
R2	ΔV REQ		
R3	ULLAGE ΔV		

62-66

ENGINE FIRING			P 42
V	50 *	N	11 *
R1			
R2			
R3			

68-69

ΔV PARAMETERS			P 42
V	16	N	52
R1	TIME TO CUTOFF		
R2	ΔV MEASURED		
R3	TIME TO FREEFALL		

72-76

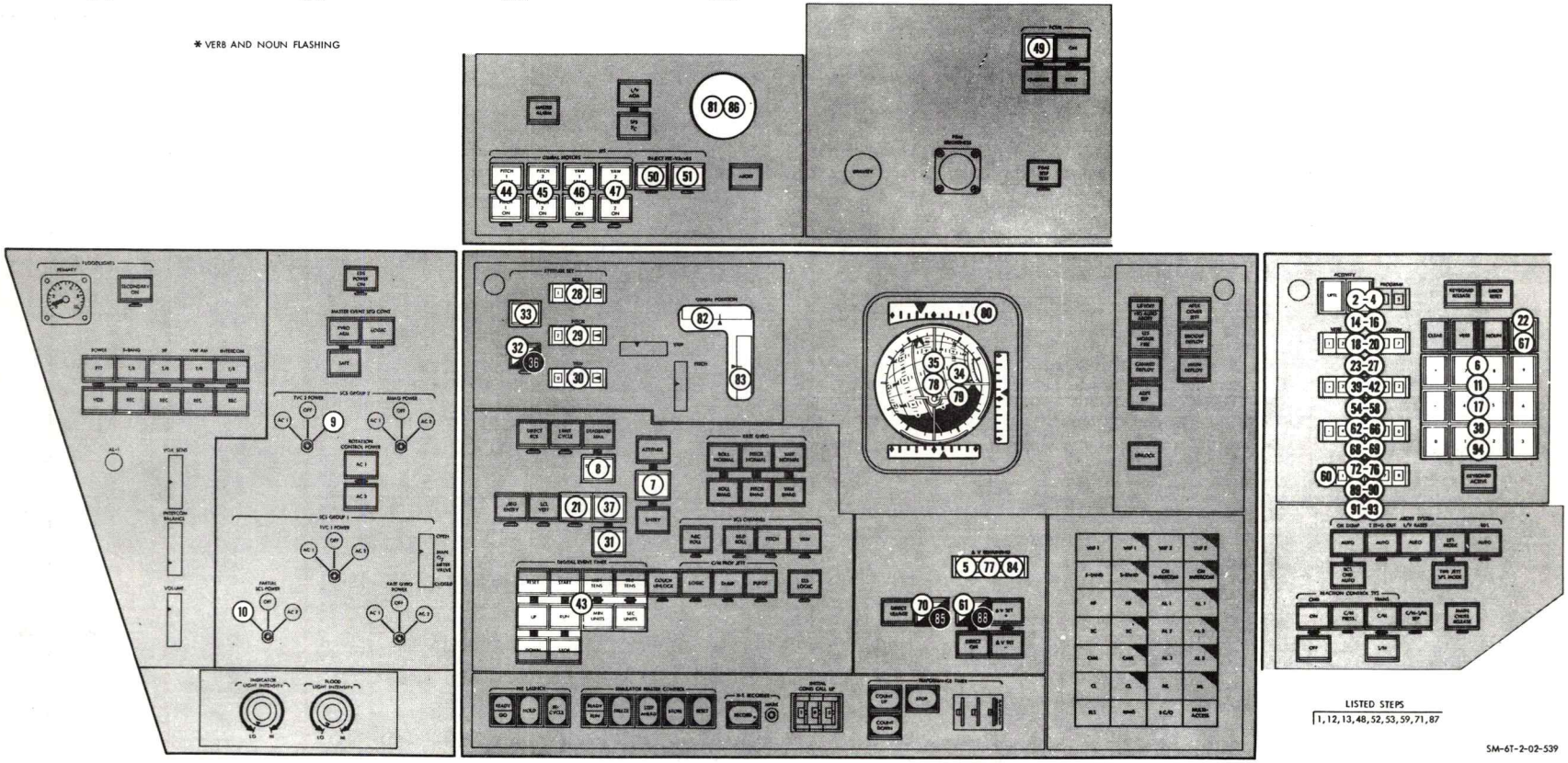
SPS CUTOFF			P 42
V	16	N	52
R1	ZERO		
R2	ZERO		
R3			

89-90

KEY IN PROCEED			P 42
V	06 *	N	52 *
R1	ZERO		
R2	ZERO		
R3	TIME TO FREE FALL		

91-93

* VERB AND NOUN FLASHING



LISTED STEPS
1, 12, 13, 48, 52, 53, 59, 71, 87

SM-6T-2-02-539

Deorbit Delta V Procedures

E1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
64			Check REGISTER 1	Time to ignition	
65			Check REGISTER 2	ΔV required	
66			Check REGISTER 3	ΔV due to ullage	
67			Press ENTER sw	ENTER lt on, out as released	
68			Check VERB window	50 not flashing	SPS firing
69			Check NOUN window	11 not flashing	
70		Ign -0	Check THRUST ON lt on	THRUST ON lt on	
*71			Terminate ullage	Observe TV monitor	
72			Check VERB window	16	ΔV parameters
73			Check NOUN window	52	
74			Check REGISTER 1	Time to cutoff, decreasing	
75			Check REGISTER 2	ΔV measured, increasing	
76			Check REGISTER 3	Time to free fall	
77			Check ΔV REMAINING ind	Decreasing	
78			Check FDAI ball	As programed	
79			Check error inds	Change as cg shifts	

DELTA V REQUIRED			P	32
V	06 *	N	14 *	
R1	ΔV REQUIRED			
R2				
R3				

2-4

SEL PROG			P	32
V	05 *	N	07 *	
R1	0 0 0 4 2			
R2				
R3				

14-16

SEL MODE			P	42
V	50 *	N	25 *	
R1	0 0 0 0 2			
R2				
R3				

18-20

ICDU DISPLAY			P	42
V	06 *	N	20 *	
R1	OUTER GIMBAL ANGLE			
R2	INNER GIMBAL ANGLE			
R3	MIDDLE GIMBAL ANGLE			

23-27

ΔV REQUIRED			P	42
V	16	N	15	
R1	TIME TO IGN			
R2	ΔV REQ			
R3				

39-42

ΔV PARAMETERS			P	42
V	16	N	15	
R1	TIME TO IGN			
R2	ΔV REQ			
R3	ULLAGE ΔV			

54-58

REQ ENGINE IGN			P	42
V	50 *	N	11 *	
R1	TIME TO IGN			
R2	ΔV REQ			
R3	ULLAGE ΔV			

62-66

ENGINE FIRING			P	42
V	50 *	N	11 *	
R1				
R2				
R3				

68-69

ΔV PARAMETERS			P	42
V	16	N	52	
R1	TIME TO CUTOFF			
R2	ΔV MEASURED			
R3	TIME TO FREEFALL			

72-76

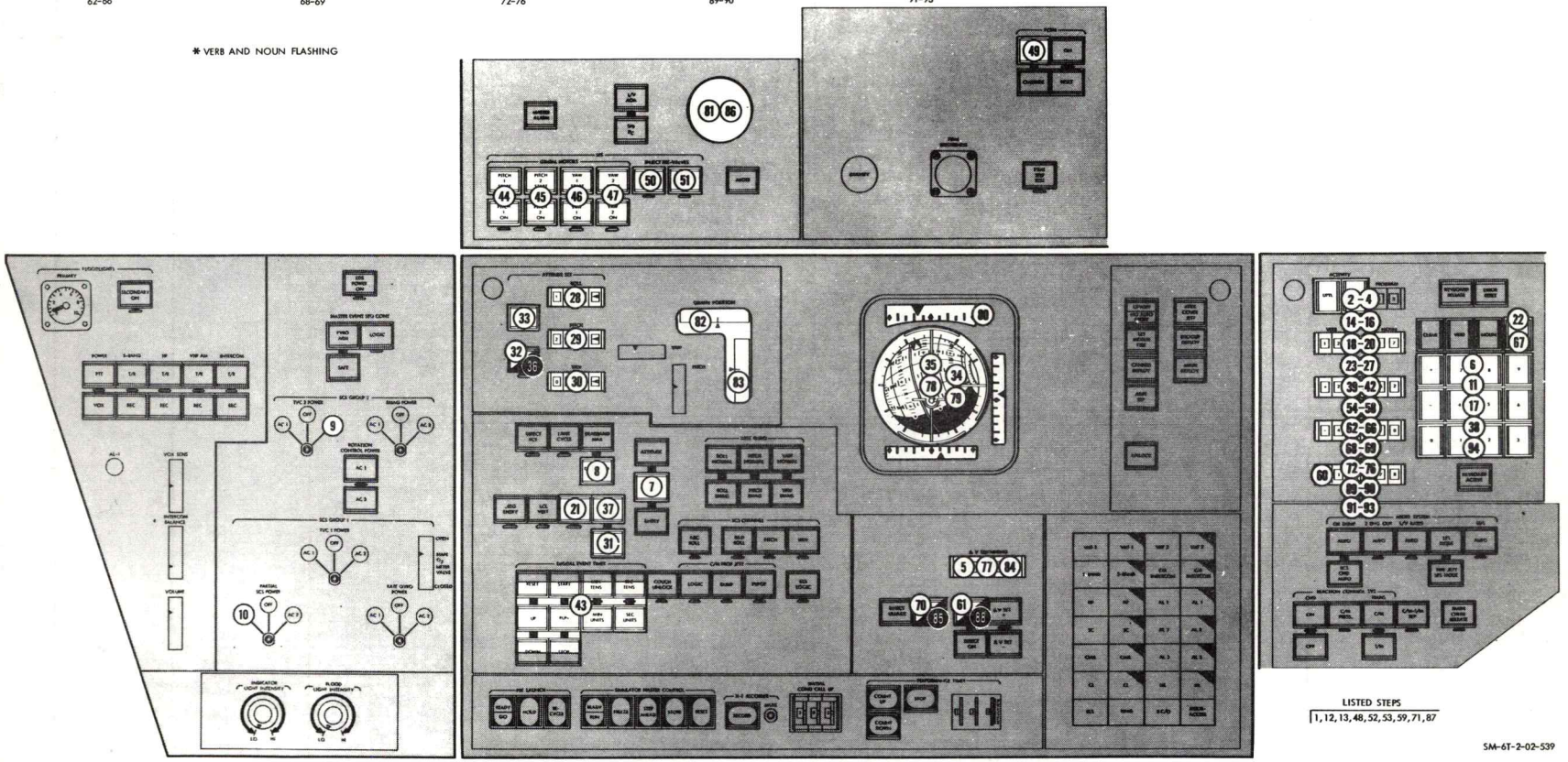
SPS CUTOFF			P	42
V	16	N	52	
R1	ZERO			
R2	ZERO			
R3				

89-90

KEY IN PROCEED			P	42
V	06 *	N	52 *	
R1	ZERO			
R2	ZERO			
R3	TIME TO FREE FALL			

91-93

* VERB AND NOUN FLASHING



LISTED STEPS

1, 12, 13, 48, 52, 53, 59, 71, 87

SM-6T-2-02-539

Deorbit Delta V Procedures

E1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
80			Check rate inds	As programed	
81			Check SPS P_C ind	Normal	
82			Check GIMBAL POSITION YAW ind	Normal	
83			Check GIMBAL POSITION PITCH ind	Normal	
84			Check ΔV REMAINING ind - zero	As programed	
85			Check THRUST ON lt out	Lt out as SPS shutdown	
86			Check SPS P_C ind	Decreasing	
*87			Report SPS engine off	Monitor communication	
88			NORMAL/OFF/DIRECT sw - OFF	NORMAL lt out	
89			Check REGISTER 1	Xero	SPS cutoff
90			Check REGISTER 2	Zero	Request proceed
91			Check VERB window	Flashing 06	
92			Check NOUN window	Flashing 52	

DELTA V REQUIRED	P	32
V	06 *	N	14 *
R1	ΔV REQUIRED
R2	
R3	

2-4

SEL PROG	P	32
V	05 *	N	07 *
R1	0 0 0 4 2
R2	
R3	

14-16

SEL MODE	P	42
V	50 *	N	25 *
R1	0 0 0 0 2
R2	
R3	

18-20

ICDU DISPLAY	P	42
V	06 *	N	20 *
R1	OUTER GIMBAL ANGLE
R2	INNER GIMBAL ANGLE
R3	MIDDLE GIMBAL ANGLE

23-27

ΔV REQUIRED	P	42
V	16	N	15
R1	TIME TO IGN
R2	ΔV REQ
R3	

39-42

ΔV PARAMETERS	P	42
V	16	N	15
R1	TIME TO IGN
R2	ΔV REQ
R3	ULLAGE ΔV

54-58

REQ ENGINE IGN	P	42
V	50 *	N	11 *
R1	TIME TO IGN
R2	ΔV REQ
R3	ULLAGE ΔV

62-66

ENGINE FIRING	P	42
V	50 *	N	11 *
R1	
R2	
R3	

68-69

ΔV PARAMETERS	P	42
V	16	N	52
R1	TIME TO CUTOFF
R2	ΔV MEASURED
R3	TIME TO FREEFALL

72-76

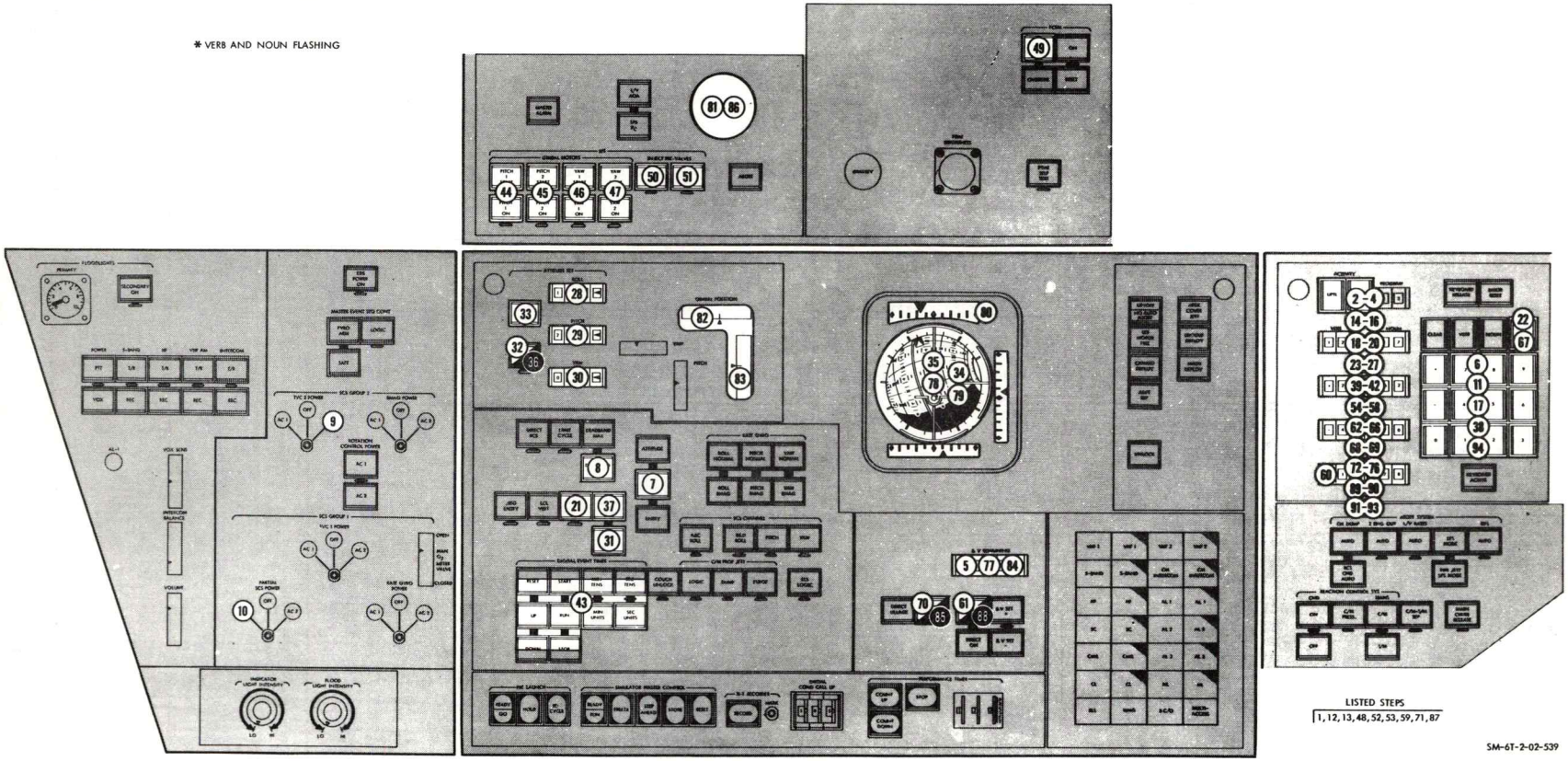
SPS CUTOFF	P	42
V	16	N	52
R1	ZERO
R2	ZERO
R3	

89-90

KEY IN PROCEED	P	42
V	06 *	N	52 *
R1	ZERO
R2	ZERO
R3	TIME TO FREE FALL

91-93

* VERB AND NOUN FLASHING



LISTED STEPS

1, 12, 13, 48, 52, 53, 59, 71, 87

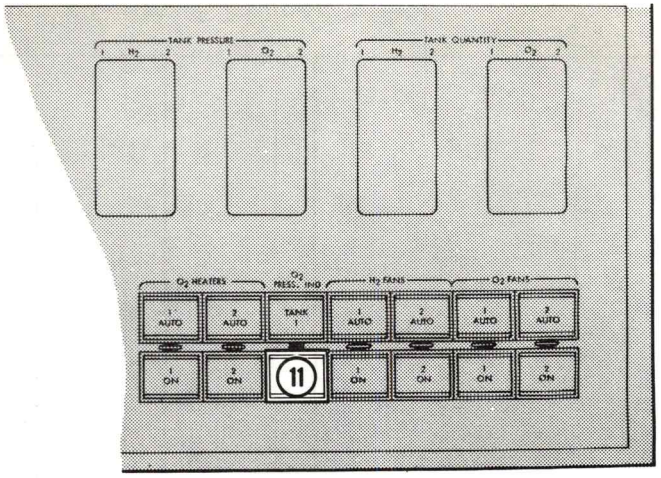
SM-6T-2-02-539

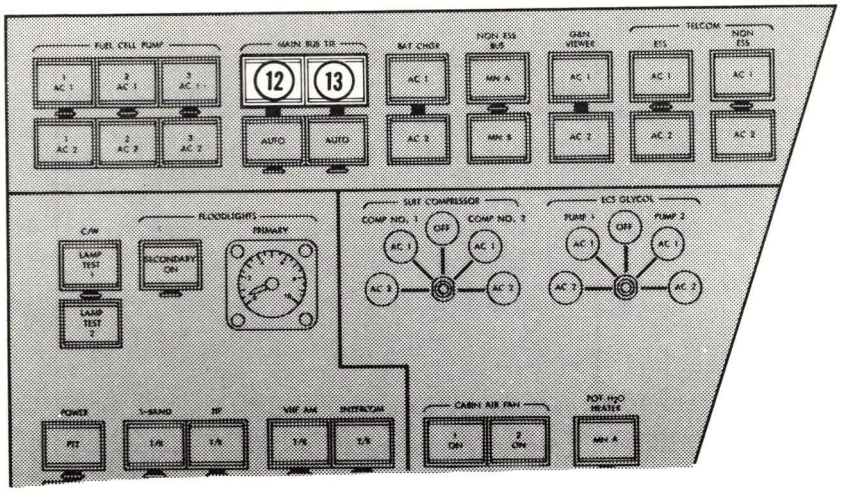
Deorbit Delta V Procedures

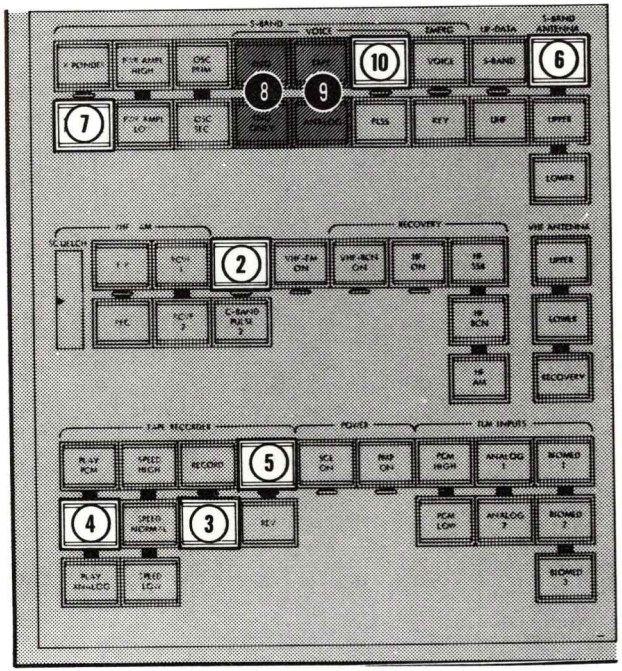
E1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
93			Check REGISTER 3	Time to free fall	
94			Key in proceed	VERB, 33 and ENTER lts as pressed	





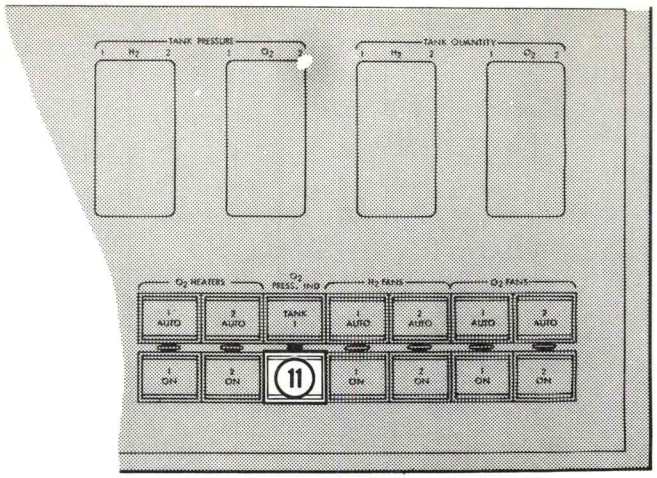


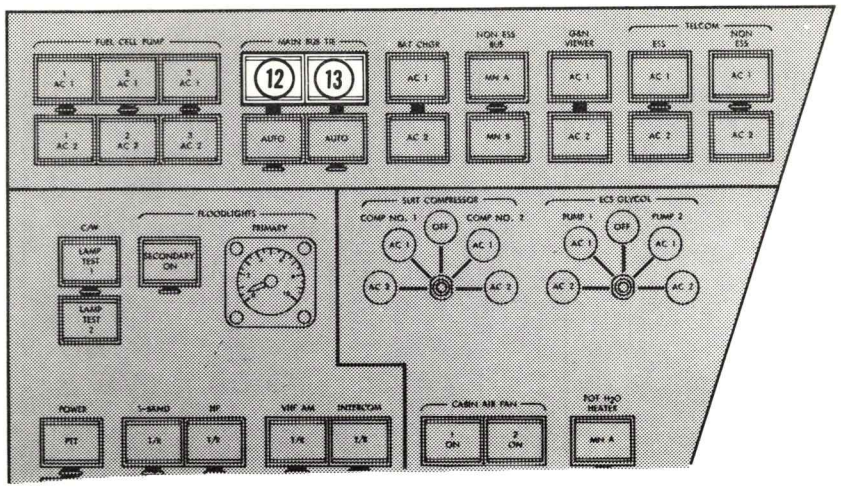
LISTED STEPS
1, 14

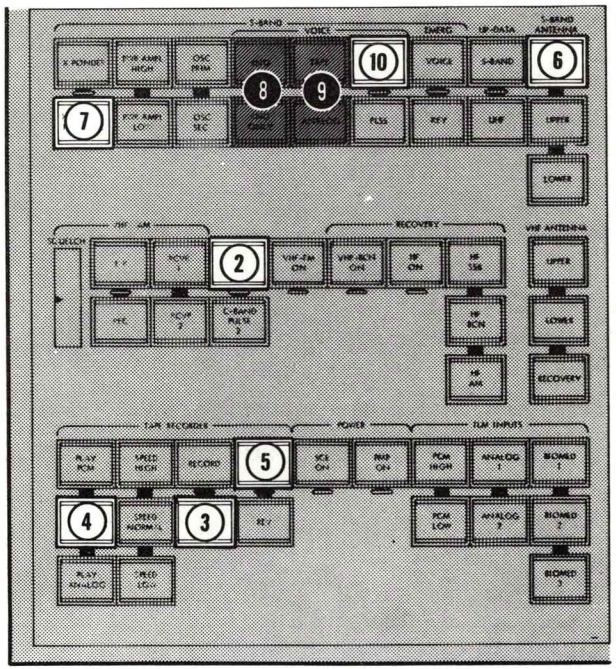
SM-6T-2-02-545

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Perform ECS periodic	EC3.01	
2			C-BAND sw - 1 PULSE	C-BAND 1 PULSE lt on	
3			TAPE RECORDER RECORD/ PLAY sw - RECORD	TAPE RECORDER - PLAY RECORD lt on	
4			TAPE RECORDER SPEED sw - NORM	TAPE RECORDER - SPEED NORMAL lt on	
5			TAPE RECORDER FWD/REF sw - FWD	TAPE RECORDER - FWD lt on	
6			S-BAND ANTENNA sw - AUTO	S-BAND ANTENNA - AUTO lt on	
7			S-BAND XPONDER/OFF/ XPONDER PWR AMPL sw - XPONDER PWR AMPL	S-BAND - XPONDER PWR AMPL lt on	
8			S-BAND VOICE RNG/RNG ONLY sw - off	S-BAND VOICE - RNG & RNG ONLY lts out	
9			S-BAND VOICE TAPE/ ANALOG sw - off	S-BAND VOICE - TAPE ANALOG lts out	
10			S-BAND VOICE TV/PLSS sw - TV	S-BAND VOICE - TV lt on	
11			O_2 PRESS IND sw - SURGE TANK	PRESS IND - SURGE TANK lt on	







LISTED STEPS
1, 14

SM-6T-2-02-545

IOS DATA SHEET

Step	Mal	Time	Function	IOS Visibility/Action	Notes
12			MAIN BUS TIE BAT A&C sw - on	MAIN BUS TIE - BAT A&C lt on	
13			MAIN BUS TIE BAT B&C sw - on	MAIN BUS TIE - BAT B&C lt on	
*14			Perform G&N Delta V	Continue with SP3.04	

SPLASH DISPLAY	P	32
V	06 *	N 65 *
R1	LAT OF SPLASH	
R2	LONG. OF SPLASH	
R3		

3-6

SPS PARAMETERS	P	32
V	06 *	N 66 *
R1	MAX DELTA	
R2	TAIL OFF	
R3		

8-11

SPS PARAMETERS	P	32
V	06 *	N 66 *
R1	SPS PITCH GIMBAL	
R2	SPS YAW GIMBAL	
R3		

13-16

SPS PARAMETERS	P	32
V	06 *	N 34 *
R1	EARLIEST IGN HRS	
R2	EARLIEST IGN MIN	
R3	EARLIEST IGN SEC	

18-22

ENTRY PARAMETERS	P	32
V	06 *	N 31 *
R1	FLT PATH ANGLE	
R2	MISS DISTANCE	
R3		

24-27

ENTRY PARAMETERS	P	32
V	16 *	N 11 *
R1	TIME TO IGN HRS	
R2	TIME TO IGN MIN	
R3	TIME TO IGN SEC	

30-34

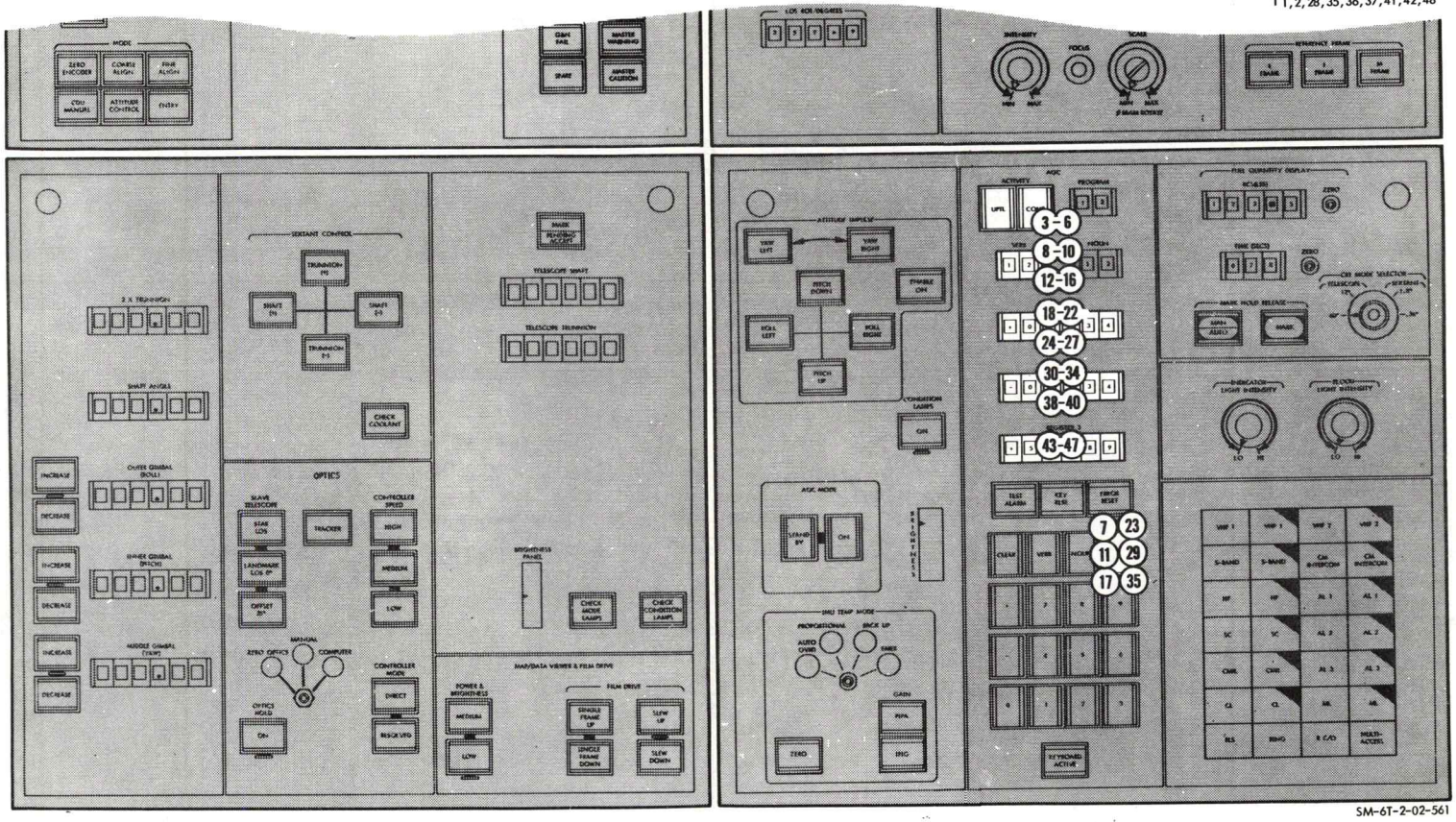
REQUEST PROGRAM	P	32
V	05 *	N 07 *
R1	0 0 0 5 1	
R2		
R3		

38-40

THRUST ANGLES	P	32
V	06 *	N 22 *
R1	OUTER GIMBAL	
R2	INNER GIMBAL	
R3	MIDDLE GIMBAL	

43-47

LISTED STEPS
1, 2, 28, 35, 36, 37, 41, 42, 48



SM-6T-2-02-561

Deorbit Delta V Procedures

E4.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Replace Y-axis attenuator panels	Observe TV monitor	
*2			Enter prethrusting procedures in AGC	GN4.03 V37 P32	
3-23			Perform Data Load		
3			Check VERB window	Flashing 06	
4			Check NOUN window	Flashing 65	
5			Check REGISTER 1	Latitude of splash	
6			Check REGISTER 2	Longitude of splash	
7			Key in proceed	VERB, 33 and ENTER lts as pressed	
8			Check VERB window	Flashing 06	
9			Check NOUN window	Flashing 66	
10			Check REGISTER 1	Max Delta V allowable	
11			Check REGISTER 2	Tail off	
12			Key in proceed	VERB, 33 and ENTER lts as pressed	
13			Check VERB window	Flashing 06	

SPLASH DISPLAY	P	32
V	06 *	N	65 *
R1	LAT OF SPLASH
R2	LONG. OF SPLASH
R3	

3-6

SPS PARAMETERS	P	32
V	06 *	N	66 *
R1	MAX DELTA
R2	TAIL OFF
R3	

8-11

SPS PARAMETERS	P	32
V	06 *	N	66 *
R1	SPS PITCH GIMBAL
R2	SPS YAW GIMBAL
R3	

13-16

SPS PARAMETERS	P	32
V	06 *	N	34 *
R1	EARLIEST IGN HRS
R2	EARLIEST IGN MIN
R3	EARLIEST IGN SEC

18-22

ENTRY PARAMETERS	P	32
V	06 *	N	31 *
R1	FLT PATH ANGLE
R2	MISS DISTANCE
R3	

24-27

ENTRY PARAMETERS	P	32
V	16 *	N	11 *
R1	TIME TO IGN HRS
R2	TIME TO IGN MIN
R3	TIME TO IGN SEC

30-34

REQUEST PROGRAM	P	32
V	05 *	N	07 *
R1	0 0 0 5 1
R2	
R3	

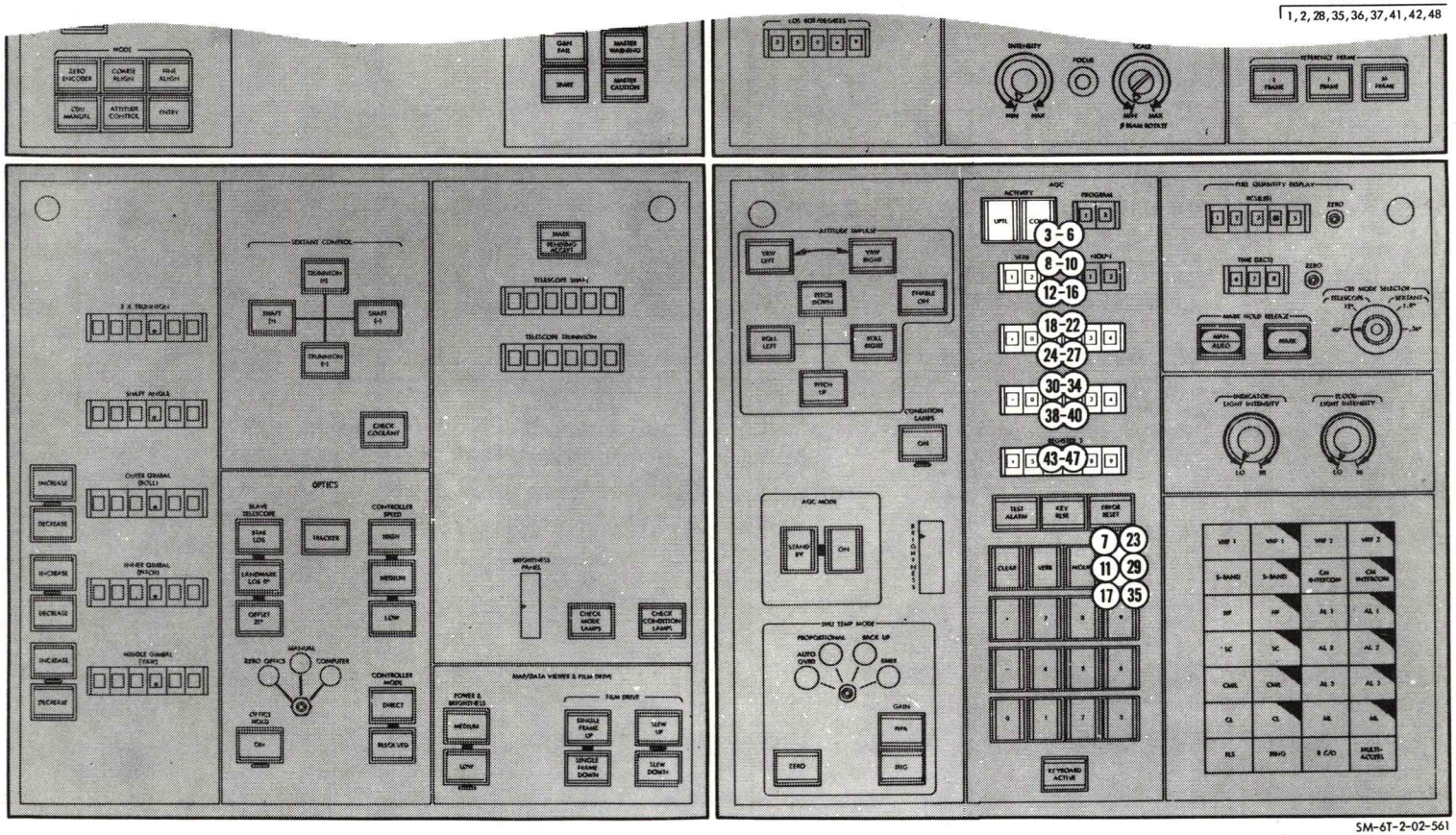
38-40

THRUST ANGLES	P	32
V	06 *	N	22 *
R1	OUTER GIMBAL
R2	INNER GIMBAL
R3	MIDDLE GIMBAL

43-47

LISTED STEPS

1, 2, 28, 35, 36, 37, 41, 42, 48



SM-6T-2-02-561

Deorbit Delta V Procedures

E4.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14			Check NOUN window	Flashing 66	
15			Check REGISTER 1	SPS gimbal pitch angle	
16			Check REGISTER 2	Tail off	
17			Key in ENTER	ENTER lt as pressed	
18			Check VERB window	Flashing 06	
19			Check NOUN window	Flashing 12	
20			Check REGISTER 1	Earliest time to ignition - hr	
21			Check REGISTER 2	Earliest time to ignition - min	
22			Check REGISTER 3	Earliest time to ignition - sec	
23			Key in ENTER	ENTER lt as pressed	
24			Check VERB window	Flashing 06	
25			Check NOUN window	Flashing 31	
26			Check REGISTER 1	Flight path angle	
27			Check REGISTER 2	Miss distance along ground track	
*28			Evaluate parameters with MSFN	Provide confirming communication	

SPLASH DISPLAY	P	32
V	06 *	N	65 *
R1	LAT OF SPLASH
R2	LONG. OF SPLASH
R3	

3-6

SPS PARAMETERS	P	32
V	06 *	N	66 *
R1	MAX DELTA
R2	TAIL OFF
R3	

8-11

SPS PARAMETERS	P	32
V	06 *	N	66 *
R1	SPS PITCH GIMBAL
R2	SPS YAW GIMBAL
R3	

13-16

SPS PARAMETERS	P	32
V	06 *	N	34 *
R1	EARLIEST IGN HRS
R2	EARLIEST IGN MIN
R3	EARLIEST IGN SEC

18-22

ENTRY PARAMETERS	P	32
V	06 *	N	31 *
R1	FLT PATH ANGLE
R2	MISS DISTANCE
R3	

24-27

ENTRY PARAMETERS	P	32
V	16 *	N	11 *
R1	TIME TO IGN HRS
R2	TIME TO IGN MIN
R3	TIME TO IGN SEC

30-34

REQUEST PROGRAM	P	32
V	05 *	N	07 *
R1	0 0 0 5 1
R2	
R3	

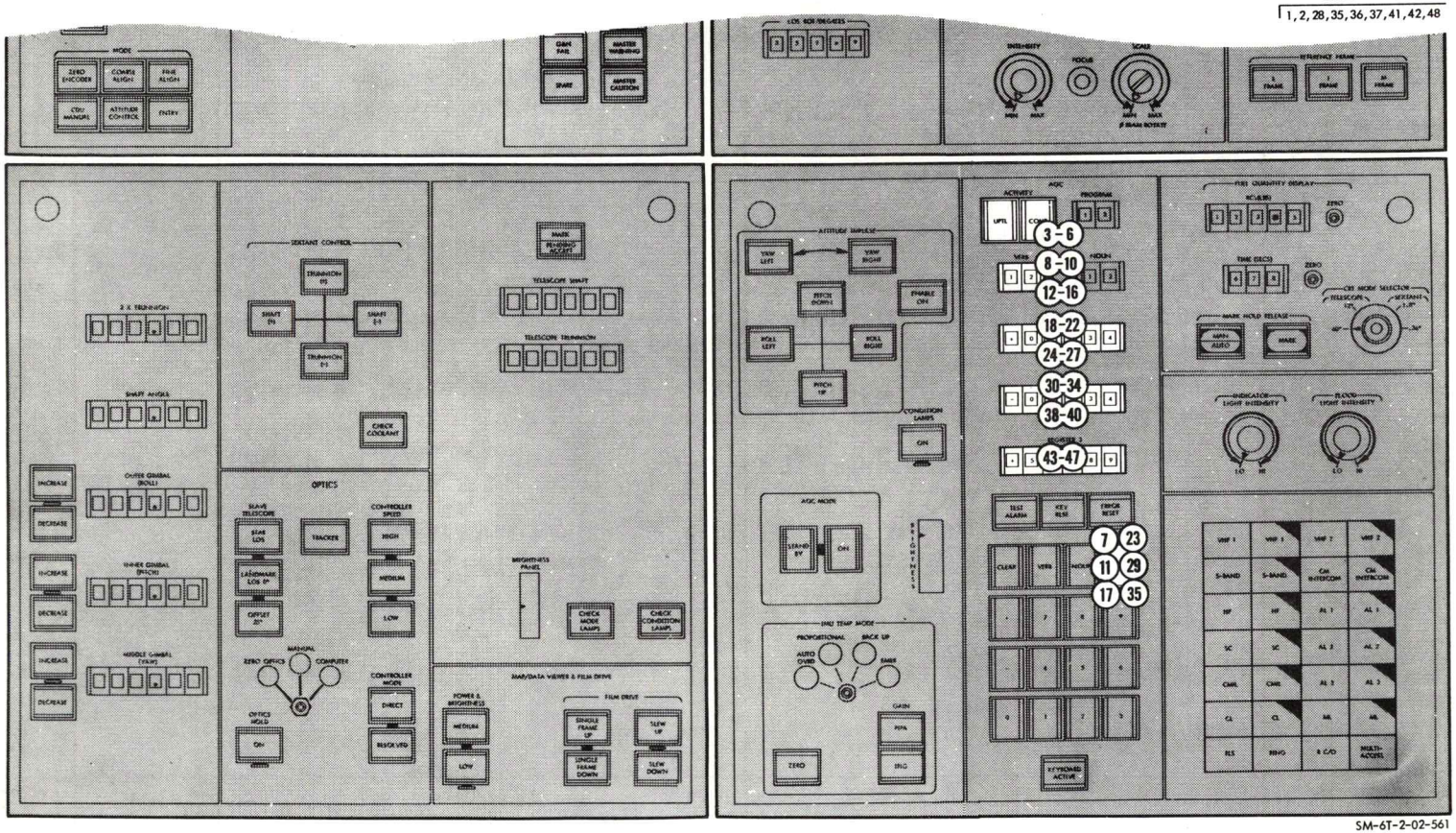
38-40

THRUST ANGLES	P	32
V	06 *	N	22 *
R1	OUTER GIMBAL
R2	INNER GIMBAL
R3	MIDDLE GIMBAL

43-47

LISTED STEPS

1, 2, 28, 35, 36, 37, 41, 42, 48



SM-6T-2-02-561

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
29			Key in ENTER	VERB, 33, and ENTER lts as pressed	
30			Check VERB window	Flashing 16	
31			Check NOUN window	Flashing 11	
32			Check REGISTER 1	Time to ignition - hr	
33			Check REGISTER 2	Time to ignition - min	
34			Check REGISTER 3	Time to ignition - sec	
*35			Request seat 1 set DET	Monitor intercom	
*36			Set TO EVENT clock	Observe TV monitor	
*37			Request seat 1, perform backup delta V counter routine	Monitor intercom	Concurrent with step 1 of E1.1
38			Check VERB window	Flashing 05	
39			Check NOUN window	Flashing 07	
40			Check REGISTER 1	00051	
*41			Perform IMU orientation determination	GN4.04 V37 P51	
*42			Perform IMU alignment	GN4.07 V37 P53	

SPLASH DISPLAY	P	32
V	06 * N	65 *
R1 LAT OF SPLASH R2 LONG. OF SPLASH R3		

3-6

SPS PARAMETERS	P	32
V	06 * N	66 *
R1 MAX DELTA R2 TAIL OFF R3		

8-11

SPS PARAMETERS	P	32
V	06 * N	66 *
R1 SPS PITCH GIMBAL R2 SPS YAW GIMBAL R3		

13-16

SPS PARAMETERS	P	32
V	06 * N	34 *
R1 EARLIEST IGN HRS R2 EARLIEST IGN MIN R3 EARLIEST IGN SEC		

18-22

ENTRY PARAMETERS	P	32
V	06 * N	31 *
R1 FLT PATH ANGLE R2 MISS DISTANCE R3		

24-27

ENTRY PARAMETERS	P	32
V	16 * N	11 *
R1 TIME TO IGN HRS R2 TIME TO IGN MIN R3 TIME TO IGN SEC		

30-34

REQUEST PROGRAM	P	32
V	05 * N	07 *
R1 00051 R2 R3		

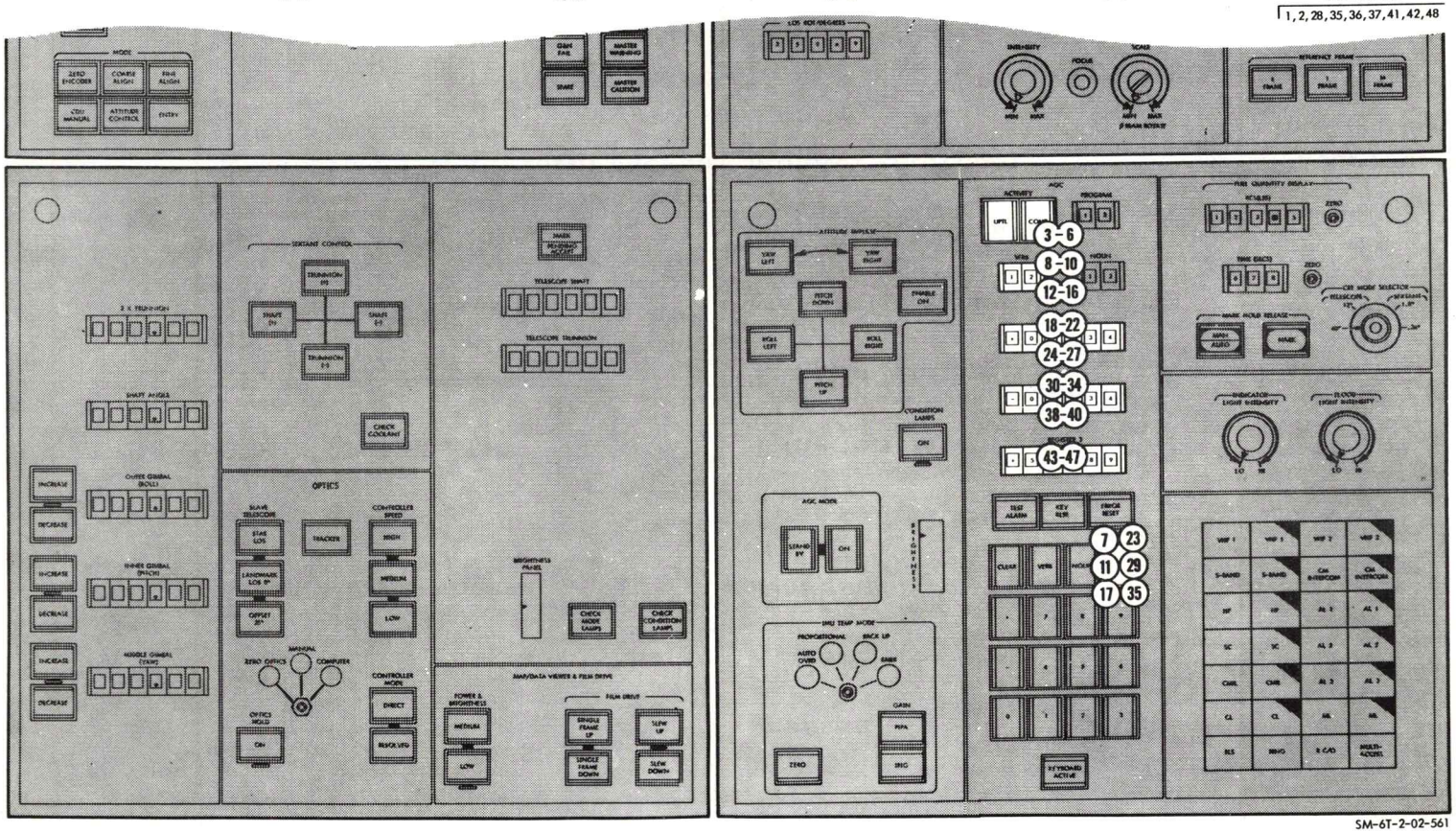
38-40

THRUST ANGLES	P	32
V	06 * N	22 *
R1 OUTER GIMBAL R2 INNER GIMBAL R3 MIDDLE GIMBAL		

43-47

LISTED STEPS

1, 2, 28, 35, 36, 37, 41, 42, 48



SM-6T-2-02-561

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
43			Check VERB window	Flashing 06	
44			Check NOUN window	Flashing 22	
45			Check REGISTER 1	Outer gimbal angle	
46			Check REGISTER 2	Inner gimbal angle	
47			Check REGISTER 3	Middle gimbal angle	
*48			Remove lockpins from post-landing vent valves	Observe TV monitor	

ORBIT PARAMETERS	P	42
V	16 *	N 64 *
R1 SPLASH LATITUDE R2 SPLASH LONGITUDE R3 TIME TO FREE FALL		

3-7

REQUEST PROGRAM	P	42
V	50 *	N 07 *
R1 00061 R2 R3		

9-11

GIMBAL ANGLES	P	61
V	06 *	N 17 *
R1 OUTER GIMBAL R2 INNER GIMBAL R3 MIDDLE GIMBAL		

23-27

REQUEST ROUTINE	P	62
V	50 *	N 25 *
R1 00004 R2 R3		

35-37

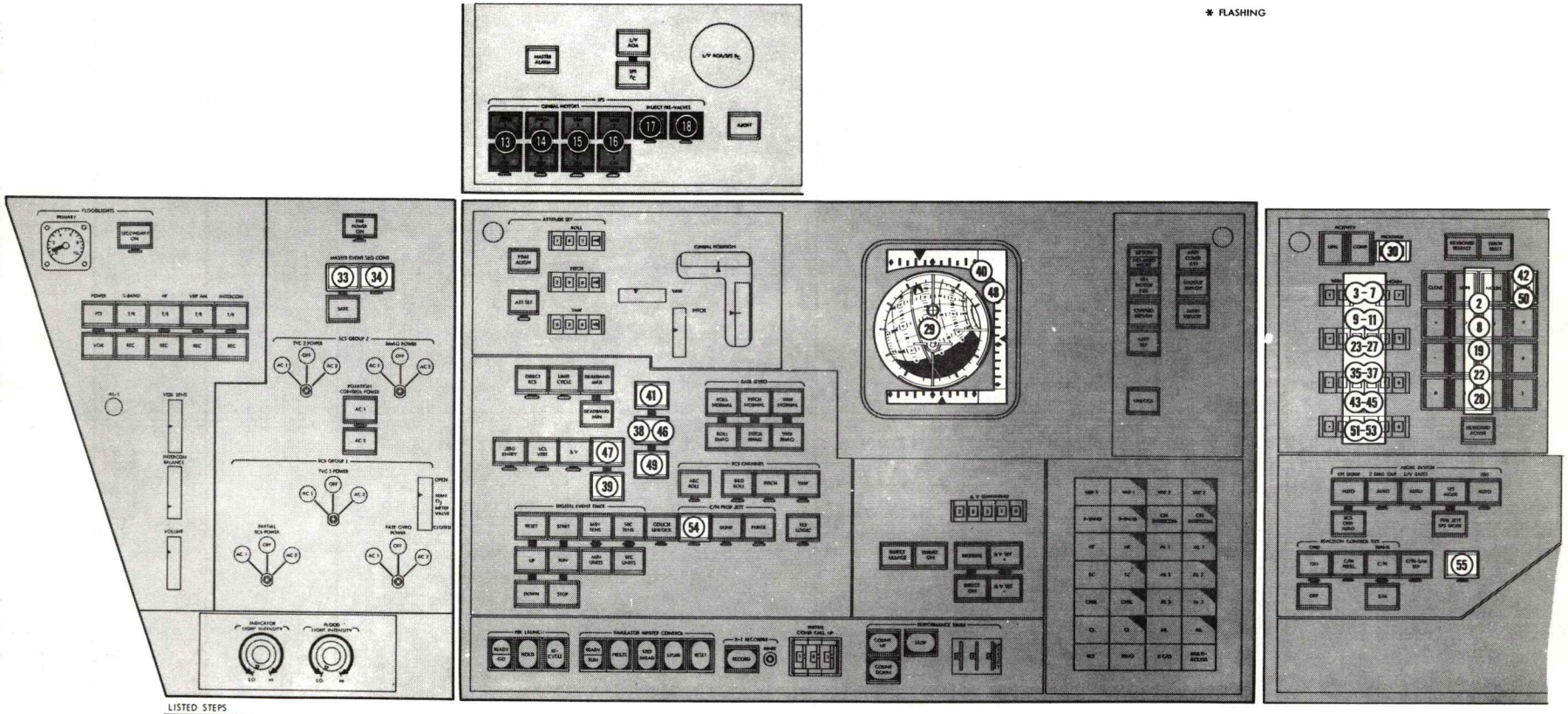
SELECT MODE	P	62
V	50 *	N 25 *
R1 00003 R2 R3		

43-45

REQUEST SEP	P	62
V	50 *	N 25 *
R1 00041 R2 R3		

51-53

* FLASHING



LISTED STEPS

1, 12, 20, 21, 31, 32

SM-6T-2-02-558

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Receive orbit parameters from MSFN	Provide communication	
2-8			Perform Orbit Parameter Display Routine		
2			Key in orbit display routine	VERB, 64, and ENTER lts as pressed	
3			Check VERB window	Flashing 06	
4			Check NOUN window	Flashing 54	
5			Check REGISTER 1	Latitude of desired splash	
6			Check REGISTER 2	Longitude of desired splash	
7			Check REGISTER 3	Time of free fall	
8			Key in proceed	VERB, 33, and ENTER lts as pressed	
9			Check VERB window	Flashing 50	
10			Check NOUN window	Flashing 07	
11			Check REGISTER 1	00061	
*12			Lock translation control	Observe TV monitor	

ORBIT PARAMETERS		P	42
V	16 *	N	64 *
3-7 R1	SPLASH LATITUDE		
R2	SPLASH LONGITUDE		
R3	TIME TO FREE FALL		

REQUEST PROGRAM		P	42
V	50 *	N	07 *
9-11 R1	0 0 0 6 1		
R2			
R3			

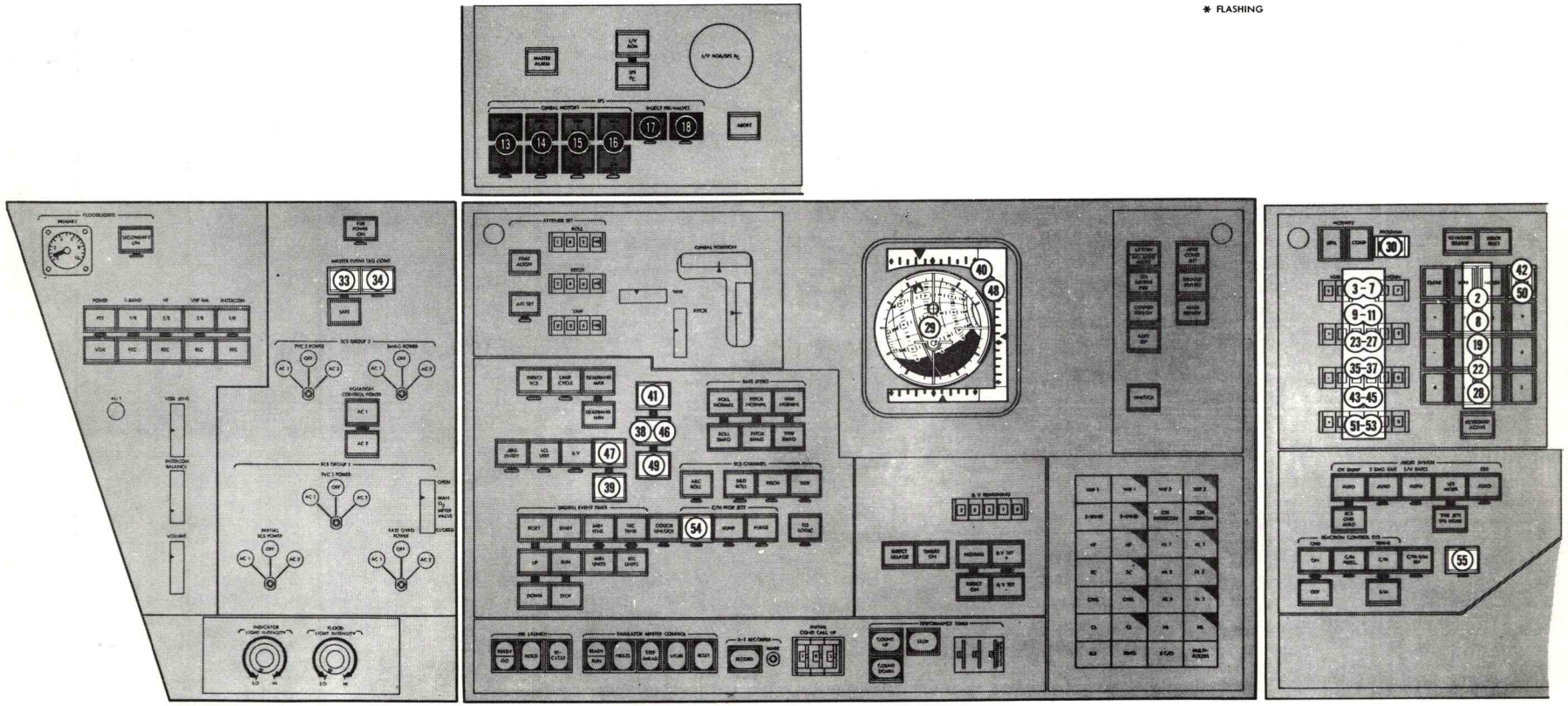
GIMBAL ANGLES		P	61
V	06 *	N	17 *
23-27 R1	OUTER GIMBAL		
R2	INNER GIMBAL		
R3	MIDDLE GIMBAL		

REQUEST ROUTINE		P	62
V	50 *	N	25 *
35-37 R1	0 0 0 0 4		
R2			
R3			

SELECT MODE		P	62
V	50 *	N	25 *
43-45 R1	0 0 0 0 3		
R2			
R3			

REQUEST SEP		P	62
V	50 *	N	25 *
51-53 R1	0 0 0 4 1		
R2			
R3			

* FLASHING



LISTED STEPS
1, 12, 20, 21, 31, 32

SM-6T-2-02-558

Post-Delta V Operations

E1.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13			SPS GIMBAL MOTORS PITCH 1 sw - OFF	SPS GIMBAL MOTORS pitch 1 lts out	
14			SPS GIMBAL MOTORS PITCH 2 sw - OFF	SPS GIMBAL MOTORS pitch 2 lts out	
15			SPS GIMBAL MOTORS YAW 1 sw - OFF	SPS GIMBAL MOTORS yaw 1 lts out	
16			SPS GIMBAL MOTORS YAW 2 sw - OFF	SPS GIMBAL MOTORS yaw 2 lts out	
17			SPS INJECT PRE-VALVES A sw - OFF	SPS INJECT PRE-VALVES - A ON lt out	
18			SPS INJECT PRE-VALVES B sw - OFF	SPS INJECT PRE-VALVES - B ON lt out	
19			Key in maneuver to separation	GN4.03 V37 P61	
*20			Perform Attitude Control Mode Check	GN1.40	
*21			Perform Attitude Maneuver	GN1.44	
22			Key in proceed	VERB, 37, and ENTER lts as pressed	
23			Check VERB window	Flashing 06	
24			Check NOUN window	Flashing 17	

ORBIT PARAMETERS	P	42
V	16 *	N 64 *
R1 SPLASH LATITUDE R2 SPLASH LONGITUDE R3 TIME TO FREE FALL		

3-7

REQUEST PROGRAM	P	42
V	50 *	N 07 *
R1 00061 R2 R3		

9-11

GIMBAL ANGLES	P	61
V	06 *	N 17 *
R1 OUTER GIMBAL R2 INNER GIMBAL R3 MIDDLE GIMBAL		

23-27

REQUEST ROUTINE	P	62
V	50 *	N 25 *
R1 00004 R2 R3		

35-37

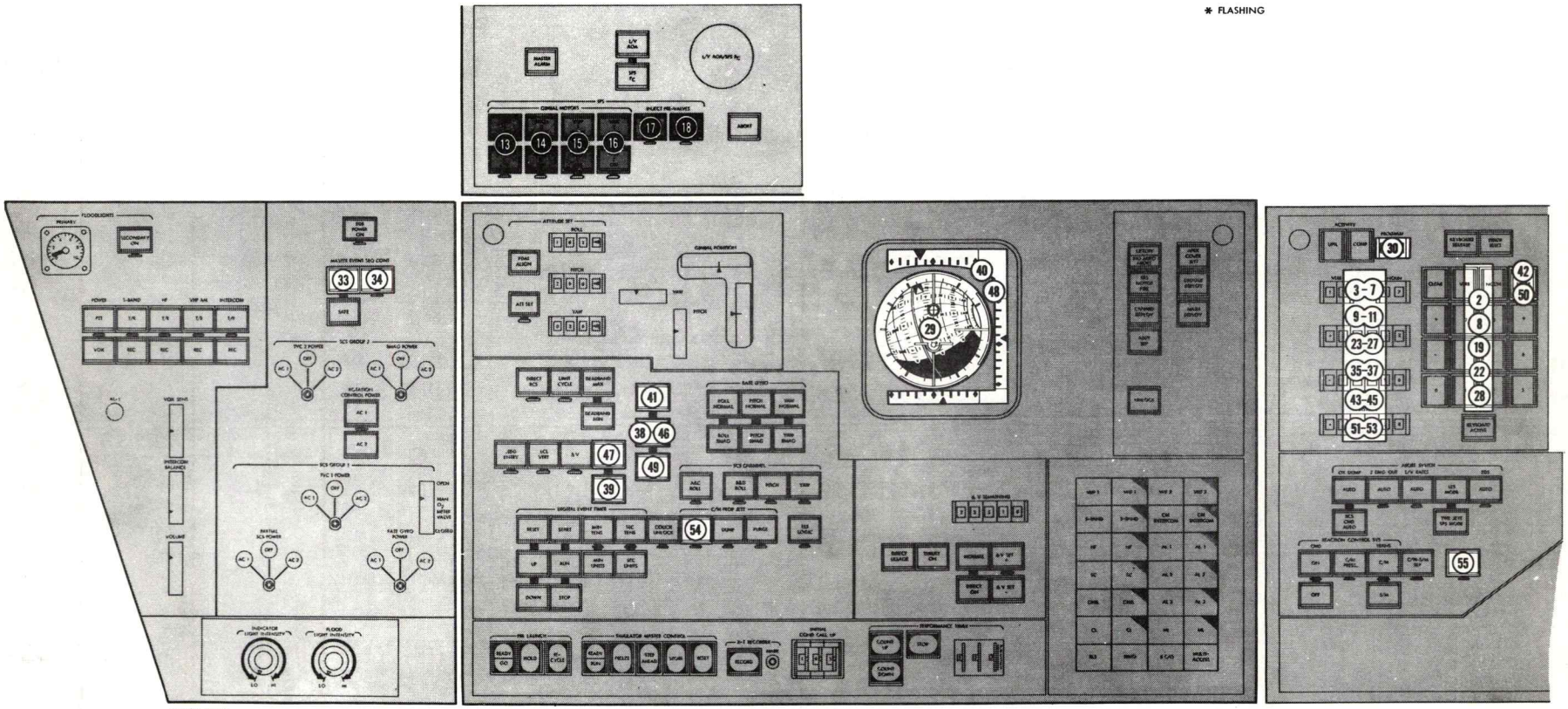
SELECT MODE	P	62
V	50 *	N 25 *
R1 00003 R2 R3		

43-45

REQUEST SEP	P	62
V	50 *	N 25 *
R1 00041 R2 R3		

51-53

* FLASHING



LISTED STEPS
1, 12, 20, 21, 31, 32

SM-6T-2-02-558

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
25			Check REGISTER 1	Outer gimbal	
26			Check REGISTER 2	Inner gimbal	
27			Check REGISTER 3	Middle gimbal	
28			Key in proceed	VERB, 33, and ENTER lts as pressed	
29			Check FDAI assumes attitude displayed on DSKY	FDAI aligns to separation attitude	
30			Check PROGRAM window	62	
*31			Request seat 3 check MASTER EVENT SEQ CONT C/Bs (4)	Monitor intercom	
*32			Request seat 2 set CAUT/WARN MODE sw - C/M	Monitor intercom	
33			MASTER EVENT SEQ CONT PYRO sw - ARM	MASTER EVENT SEQ CONT - PYRO ARM lt on	
34			MASTER EVENT SEQ CONT LOGIC sw - on	MASTER EVENT SEQ CONT - LOGIC lt on	
35			Check VERB window	Flashing 50	
36			Check NOUN window	Flashing 25	
37			Check REGISTER 1	00004	

ORBIT PARAMETERS		P	42
V	16 *	N	64 *
3-7 R1	SPLASH LATITUDE		
R2	SPLASH LONGITUDE		
R3	TIME TO FREE FALL		

REQUEST PROGRAM		P	42
V	50 *	N	07 *
9-11 R1	00061		
R2			
R3			

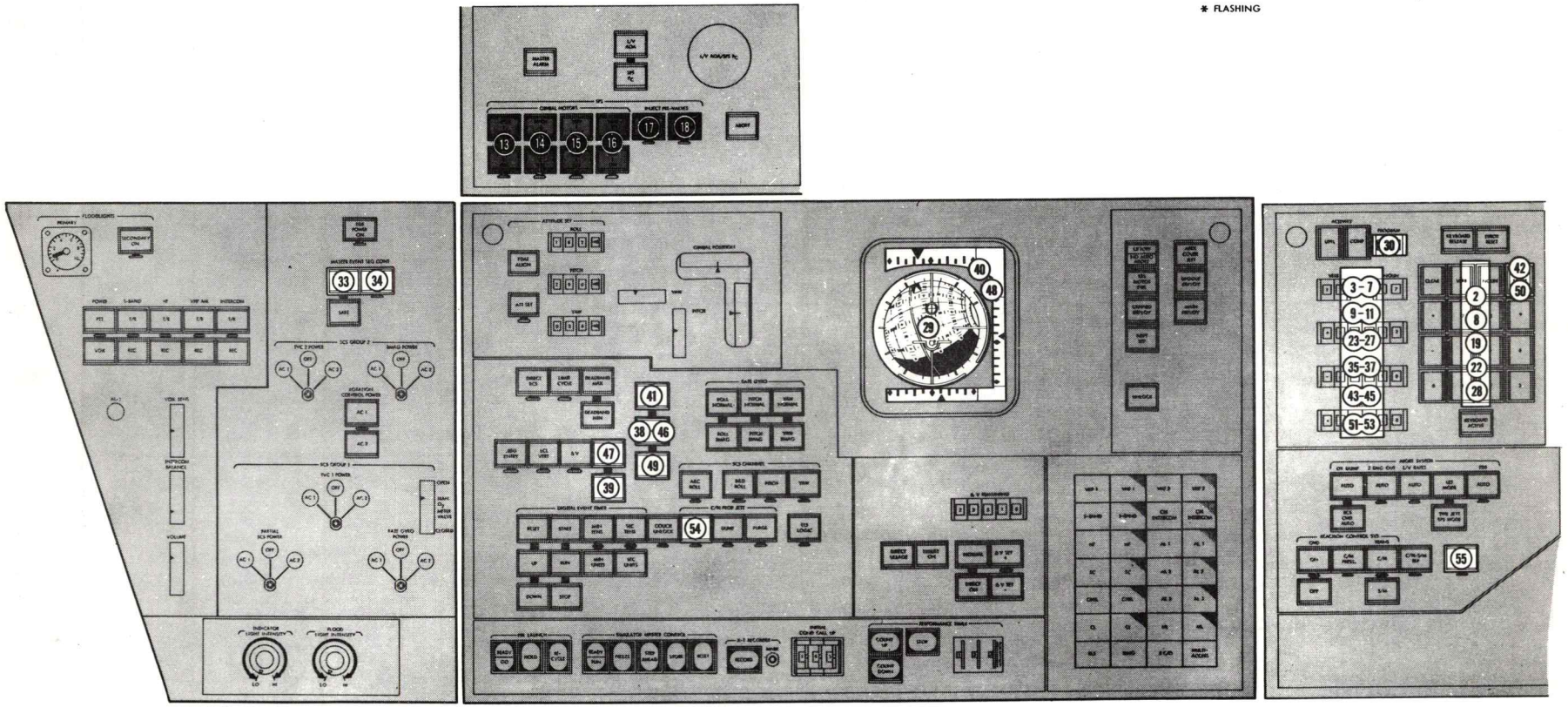
GIMBAL ANGLES		P	61
V	06 *	N	17 *
23-27 R1	OUTER GIMBAL		
R2	INNER GIMBAL		
R3	MIDDLE GIMBAL		

REQUEST ROUTINE		P	62
V	50 *	N	25 *
35-37 R1	00004		
R2			
R3			

SELECT MODE		P	62
V	50 *	N	25 *
43-45 R1	00003		
R2			
R3			

REQUEST SEP		P	62
V	50 *	N	25 *
51-53 R1	00041		
R2			
R3			

* FLASHING



LISTED STEPS
1, 12, 20, 21, 31, 32

SM-6T-2-02-558

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
38			ATTITUDE/MONITOR/ENTRY sw - MONITOR	MONITOR lt on	
39			G&N/SCS sw - SCS	SCS lt on	
40			Check FDAI error needles	Nulled	
41			ATTITUDE/MONITOR/ENTRY sw - ATTITUDE	ATTITUDE lt on	
42			Press ENTER sw	ENTER lt on, out as released	
43			Check VERB window	Flashing 50	
44			Check NOUN window	Flashing 25	
45			Check REGISTER 1	00003	
46			ATTITUDE/MONITOR/ENTRY sw - MONITOR	MONITOR lt on	
47			G&N/SCS sw - G&N	G&N lt on	
48			Check FDAI error needles	Nulled	
49			ATTITUDE/MONITOR/ENTRY sw - ENTRY	ENTRY lt on	
50			Press ENTER sw	ENTER lt on, out as released	
51			Check VERB window	Flashing 50	

ORBIT PARAMETERS		P	42
V	16 *	N	64 *
R1	SPLASH LATITUDE		
R2	SPLASH LONGITUDE		
R3	TIME TO FREE FALL		

3-7

REQUEST PROGRAM		P	42
V	50 *	N	07 *
R1	0 0 0 6 1		
R2			
R3			

9-11

GIMBAL ANGLES		P	61
V	06 *	N	17 *
R1	OUTER GIMBAL		
R2	INNER GIMBAL		
R3	MIDDLE GIMBAL		

23-27

REQUEST ROUTINE		P	62
V	50 *	N	25 *
R1	0 0 0 0 4		
R2			
R3			

35-37

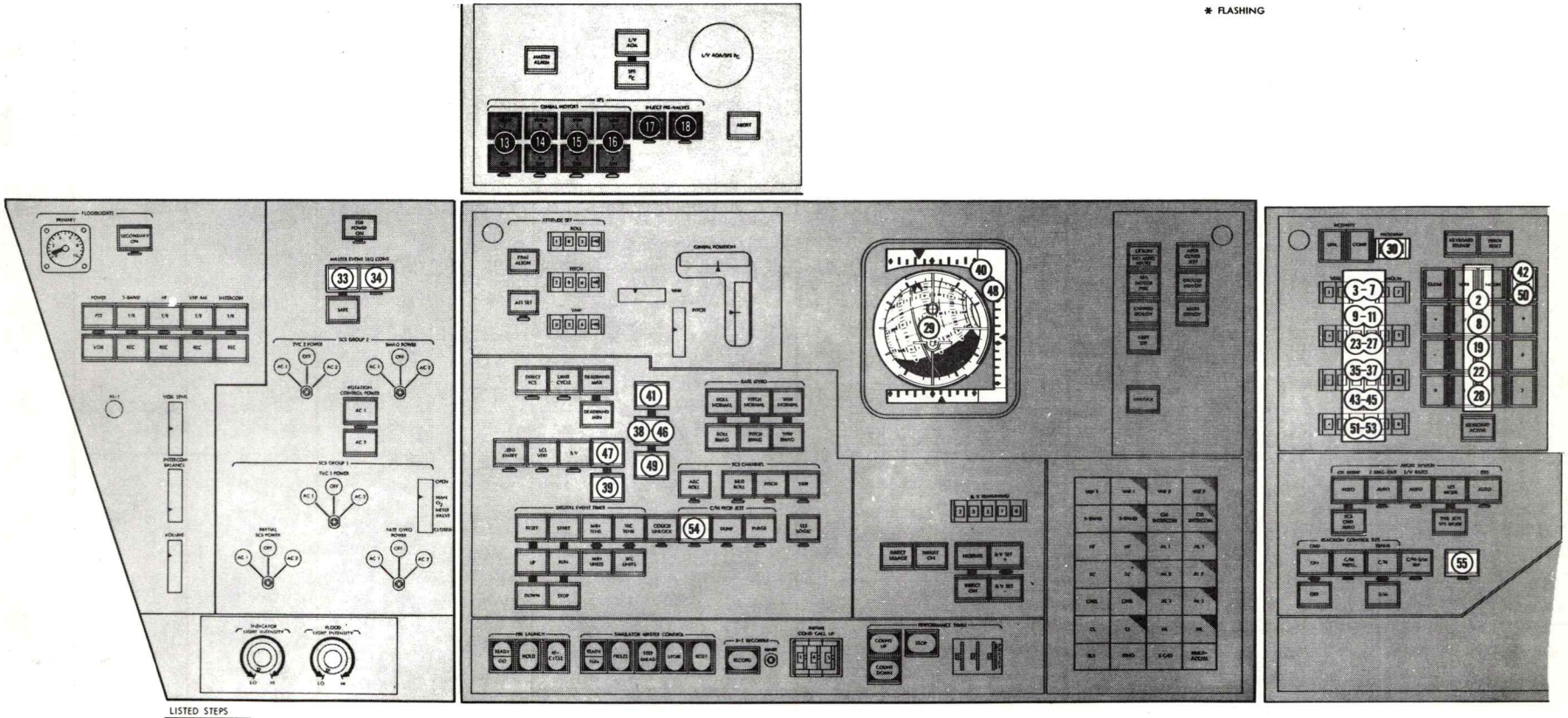
SELECT MODE		P	62
V	50 *	N	25 *
R1	0 0 0 0 3		
R2			
R3			

43-45

REQUEST SEP		P	62
V	50 *	N	25 *
R1	0 0 0 4 1		
R2			
R3			

51-53

* FLASHING



LISTED STEPS
1, 12, 20, 21, 31, 32

SM-6T-2-02-558

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
52			Check NOUN window	Flashing 25	
53			Check REGISTER 1	00041	
54			C/M PROP JETT LOGIC sw - on	C/M PROP JETT - LOGIC lt on	
55			CM-SM SEP sw - ON	C/M-S/M SEP lt on	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Observe MISSION ELAPSED TIME clock and communicate countdown to MSFN	Monitor countdown	
2			CAUT/WARN MODE sw - C/M	CAUT/WARN - MODE C/M lt on	
3			Check all C/M RCS HELIUM and PROPELLANT EVENT inds gray	As programed. All C/M RCS HELIUM and PROPELLANT lts out	After separation
4			Perform C/M RCS periodic	RC2.01	
5			Monitor AGC DSKY displays	As programed	

IOS DATA SHEET

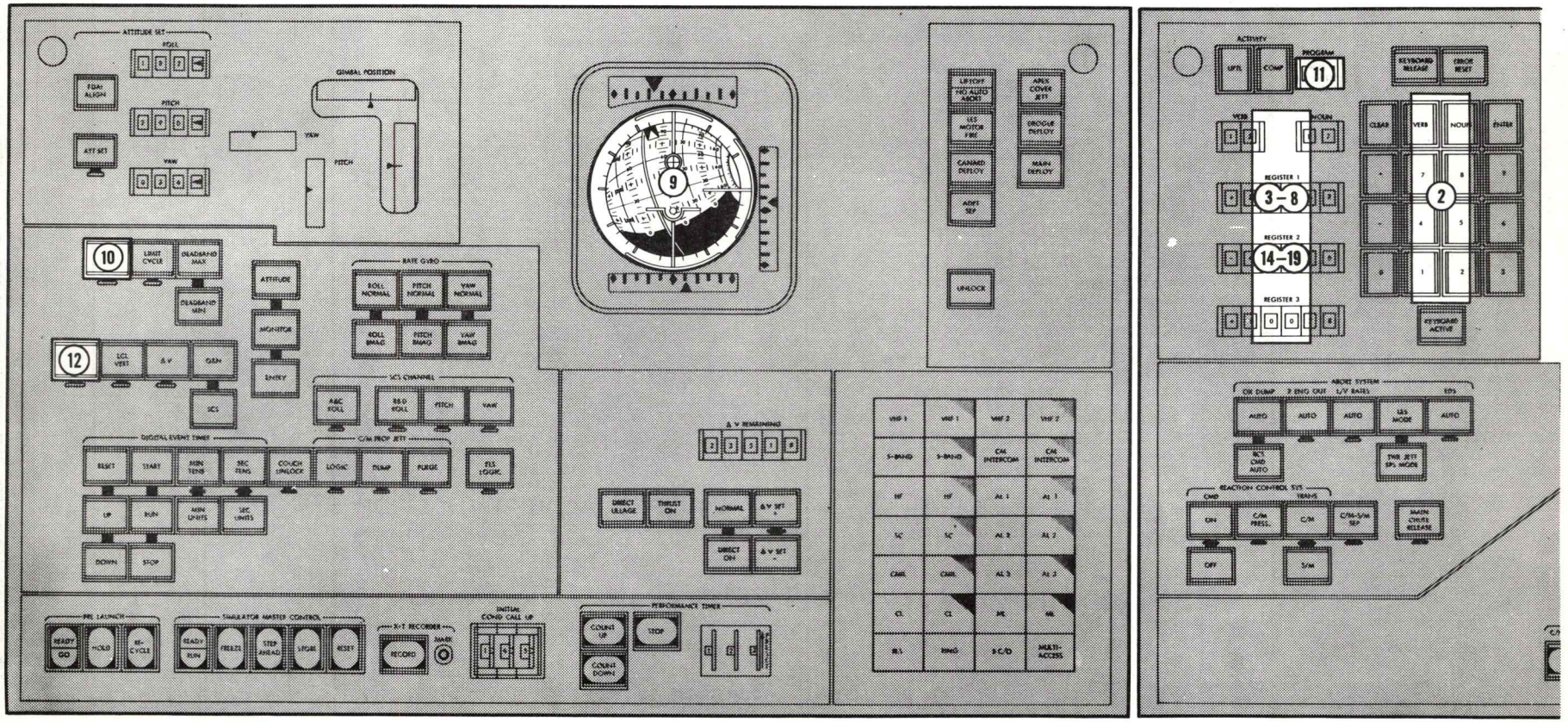
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FLT QUAL RECORDER sw - RECORD	FLT QUAL RCDR - RECORD lt on	
2			Remove non-essential electrical loads	TBSL	
3			Disconnect fuel cells	Continue with EP3.08	
4			Check MASTER EVENT SEQ CONT C/Bs in	MASTER EVENT SEQ CONT C/M lts out	
5			UP-DATA sw - off	UP-DATA lts out	After separation

ENTRY PARAMETERS		P	63
V	16	N	54
R1	REQ BANK ANGLE		
R2	LATERAL MISS		
R3	MAX PREDICTED G'S		

3-8

ENTRY PARAMETERS		P	66
V	16	N	60
R1	RANGE ERROR		
R2	FREE FALL MISS		
R3	MAX G'S		

14-19



LISTED STEPS
1, 13

SM-6T-2-02-559

IOS DATA SHEET

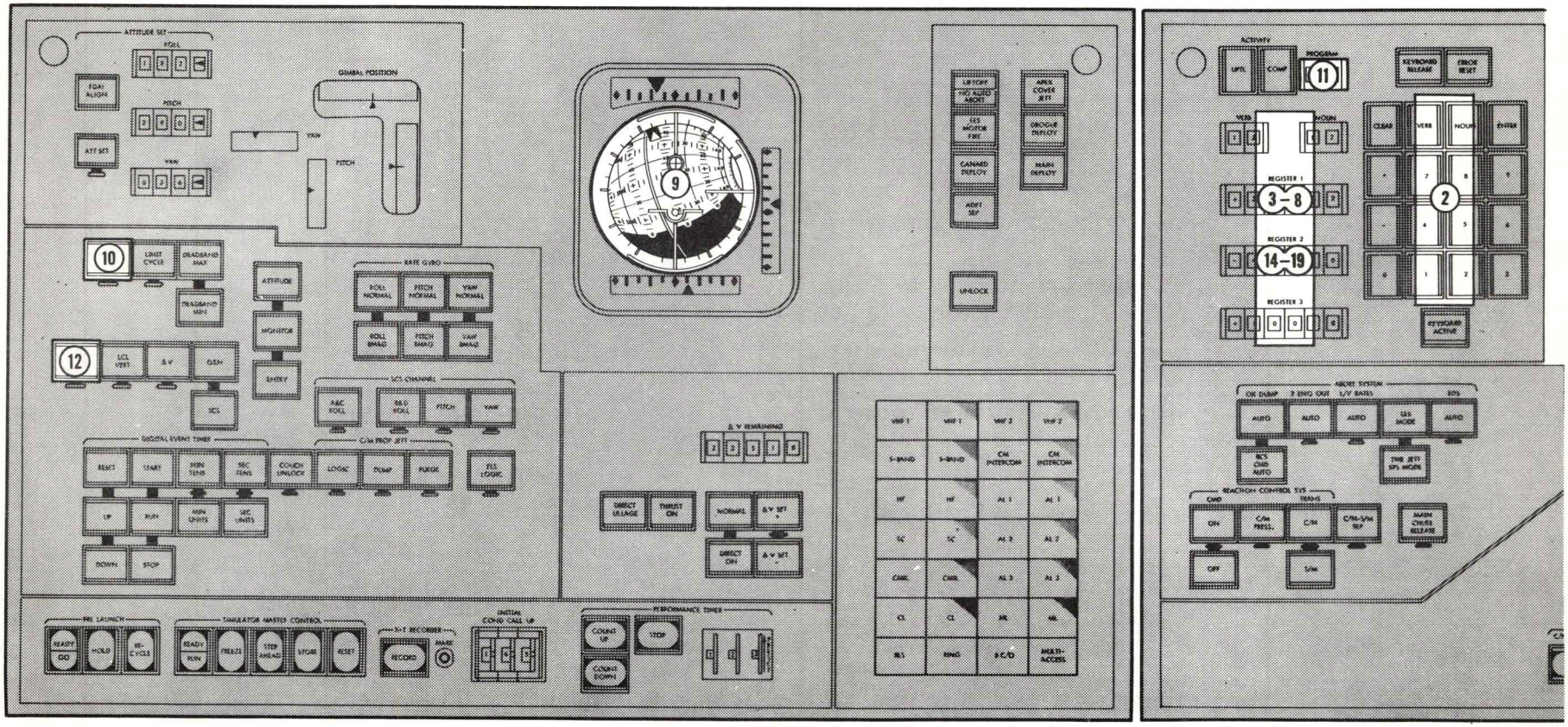
Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Perform attitude maneuver	GN1.44	
2			Key in proceed	VERB, 33, and ENTER lts as pressed	
3			Check PROGRAM window	63	
4			Check VERB window	16	
5			Check NOUN window	57	
6			Check REGISTER 1	Commanded bank angle	
7			Check REGISTER 2	Lateral miss	
8			Check REGISTER 3	Max predicted g's	
9			Monitor FDAI	Roll-zero, pitch-272, yaw-zero	
10			DIRECT RCS sw - on	DIRECT - RCS lt on	
11			Check PROGRAM window	65	
12			.05 G ENTRY sw - on	.05 G ENTRY lt on	
*13			Monitor G&N entry	As programed	
14			Check PROGRAM window	66	

ENTRY PARAMETERS		P	63
V	16	N	54
R1	REQ BANK ANGLE		
R2	LATERAL MISS		
R3	MAX PREDICTED G'S		

3-8

ENTRY PARAMETERS		P	66
V	16	N	60
R1	RANGE ERROR		
R2	FREE FALL MISS		
R3	MAX G'S		

14-19



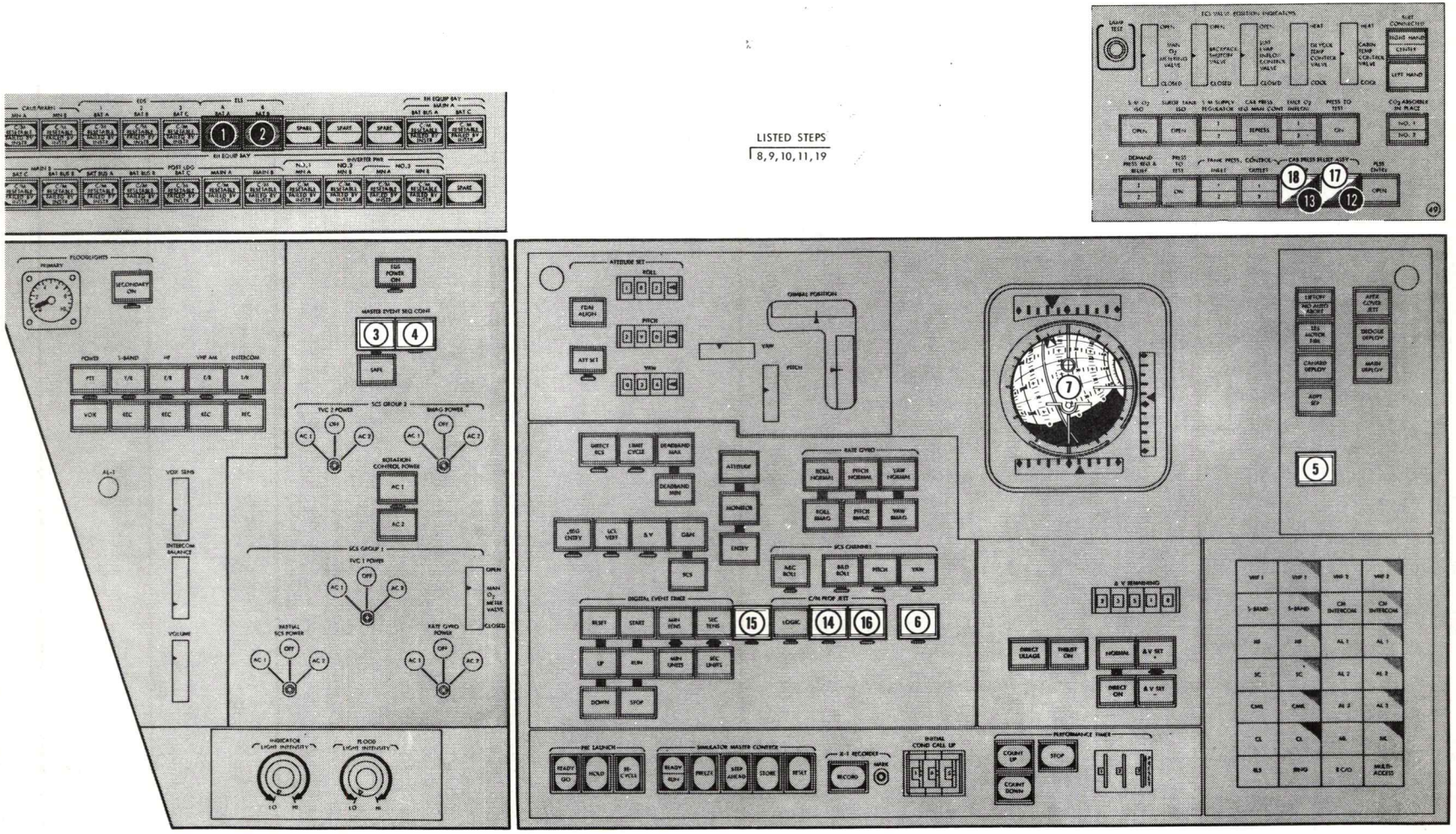
LISTED STEPS
1,13

SM-6T-2-02-559

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
15			Check VERB window	16	
16			Check NOUN window	60	
17			Check REGISTER 1	Range error	
18			Check REGISTER 2	Free fall miss distance	
19			Check REGISTER 3	Max g's	

LISTED STEPS
8, 9, 10, 11, 19



ELS Arming

E1.4

IOS DATA SHEET

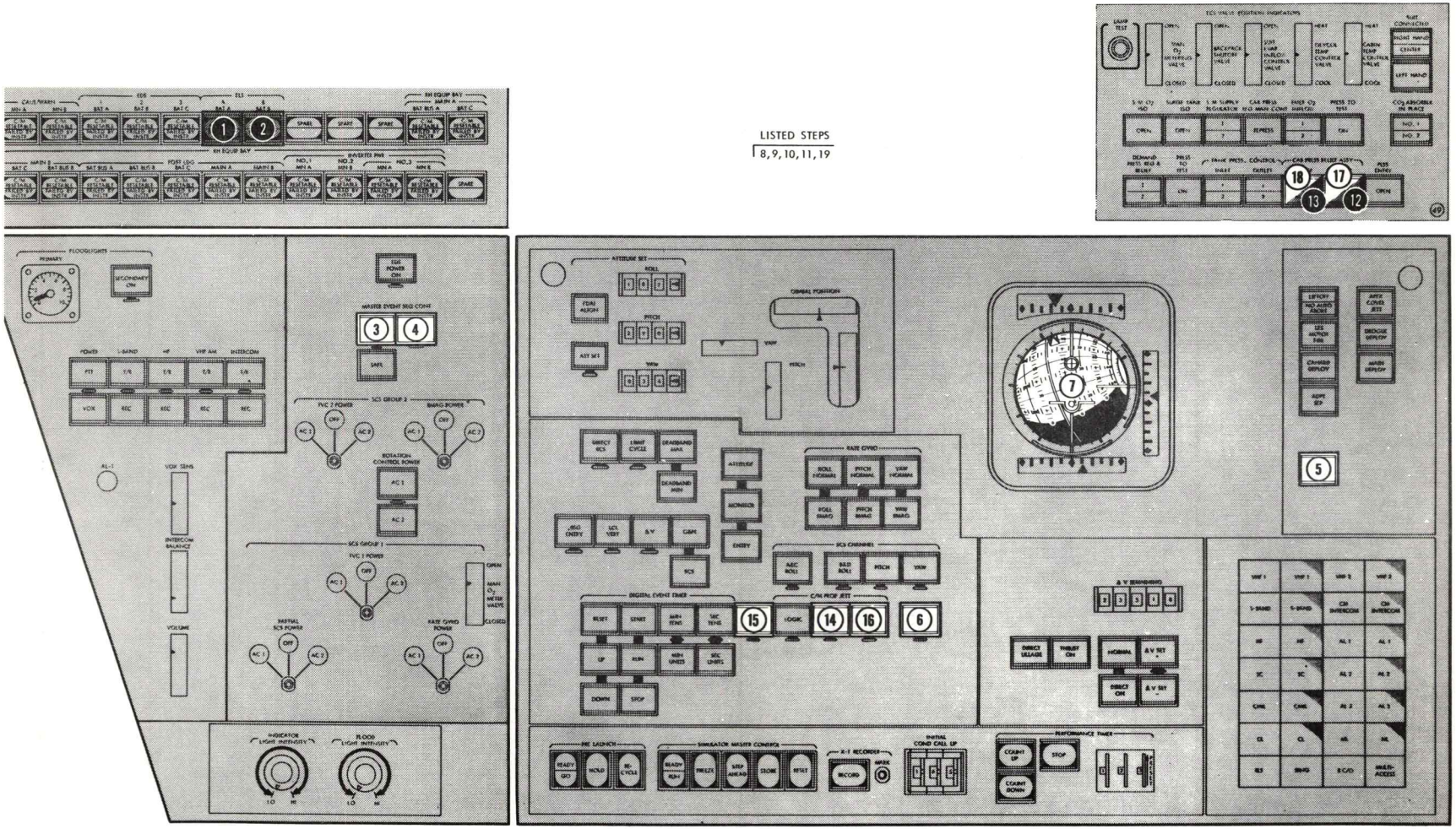
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Check ELS A BAT A C/B in	ELS A BAT A C/B lts out	
2			Check ELS B BAT B C/B in	ELS B BAT B C/B lts out	
3			MASTER EVENT SEQ CONT PYRO sw - ARM	MASTER EVENT SEQ CONT - PYRO ARM lt on	
4			MASTER EVENT SEQ CONT LOGIC sw - on	MASTER EVENT SEQ CONT - LOGIC lt on	
5			LOCK/UNLOCK cont - UNLOCK	UNLOCK lt on	
6			ELS LOGIC sw - on	ELS LOGIC lt on	
7			Monitor descent on FDAI	As programed	
*8			Confirm descent status with MSFN	Provide appropriate communication	
*9			Verify apex cover jettison	25,000 - 21,900 ft, backup - APEX COVER JETT lt on	Backup - press APEX COVER JETT sw.
*10			Verify drogue chute deploy	1.6 sec after step 9, backup - DROGUE DEPLOY lt on	Backup - press DROGUE DEPLOY sw.
*11			Verify main chute deploy (reefed)	10,000 - 9,500 ft backup - MAIN DEPLOY lt on	Backup - press MAIN DEPLOY sw.

ELS Arming

E1.4

LISTED STEPS

8, 9, 10, 11, 19



SM-6T-2-02-560

ELS Arming

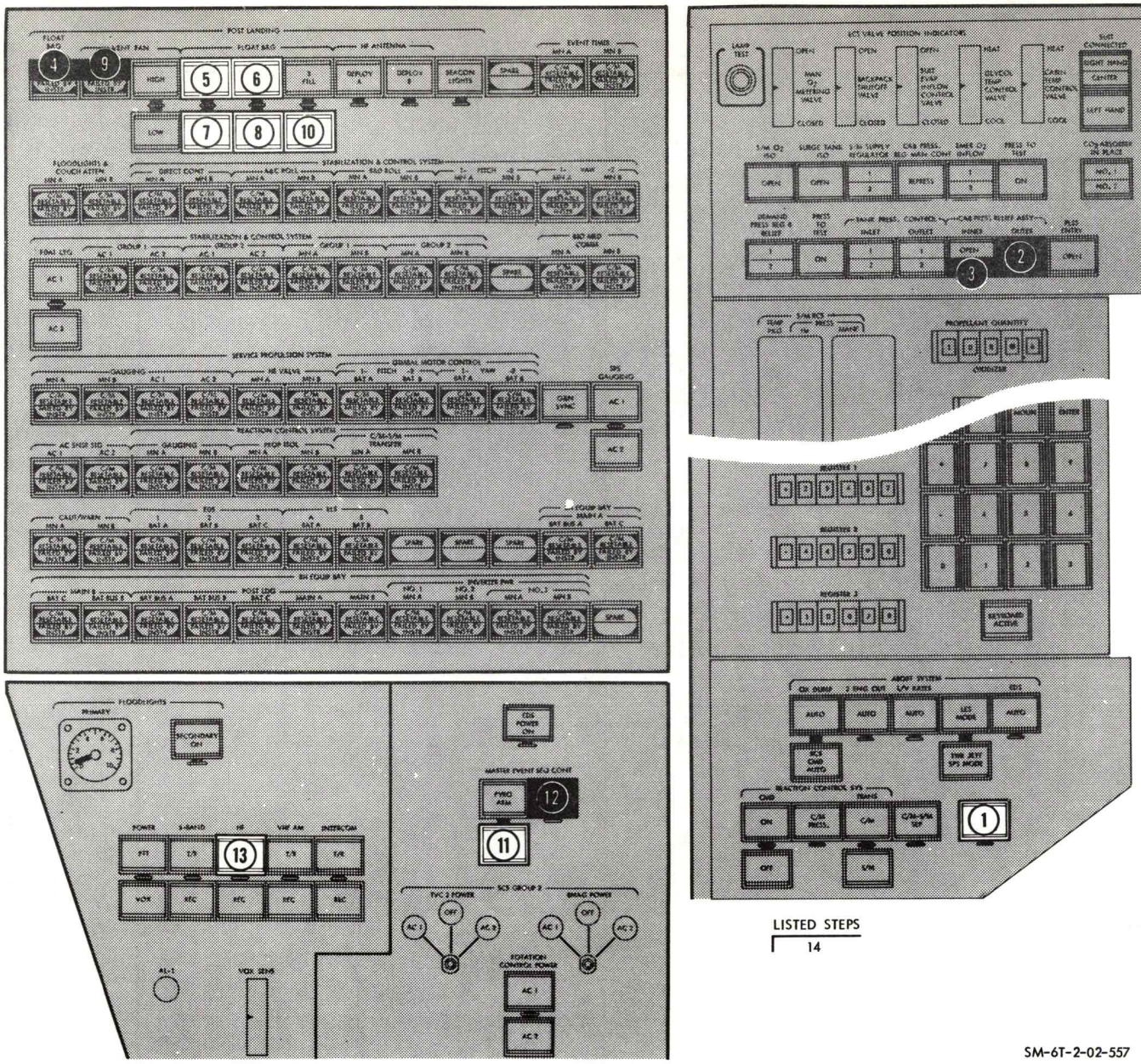
E1.4

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12			CABIN PRESS RELIEF (upper) valve - CLOSE	CAB PRESS RELIEF ASSY OUTER - AUTO lt out	
13			CABIN PRESSURE RELIEF (lower) valve - CLOSE	CAB PRESS RELIEF ASSY OUTER - AUTO lt out	
14			C/M PROPELLANT JETT DUMP sw - on	C/M PROP JETT - DUMP lt on	
15			COUCH sw - UNLOCK	COUCH UNLOCK lt on	
16			C/M PROPELLANT JETT PURGE sw - on	C/M PROP JETT - PURGE lt on	
17			CABIN PRESSURE RELIEF (lower) valve - BOOST ENTRY	CAB PRESS RELIEF ASSY - OUTER - AUTO lt on	
18			CABIN PRESS RELIEF (upper) valve - BOOST ENTRY	CAB PRESS RELIEF ASSY INNER - AUTO lt on	
*19			Set restraints for impact	Observe TV monitor	

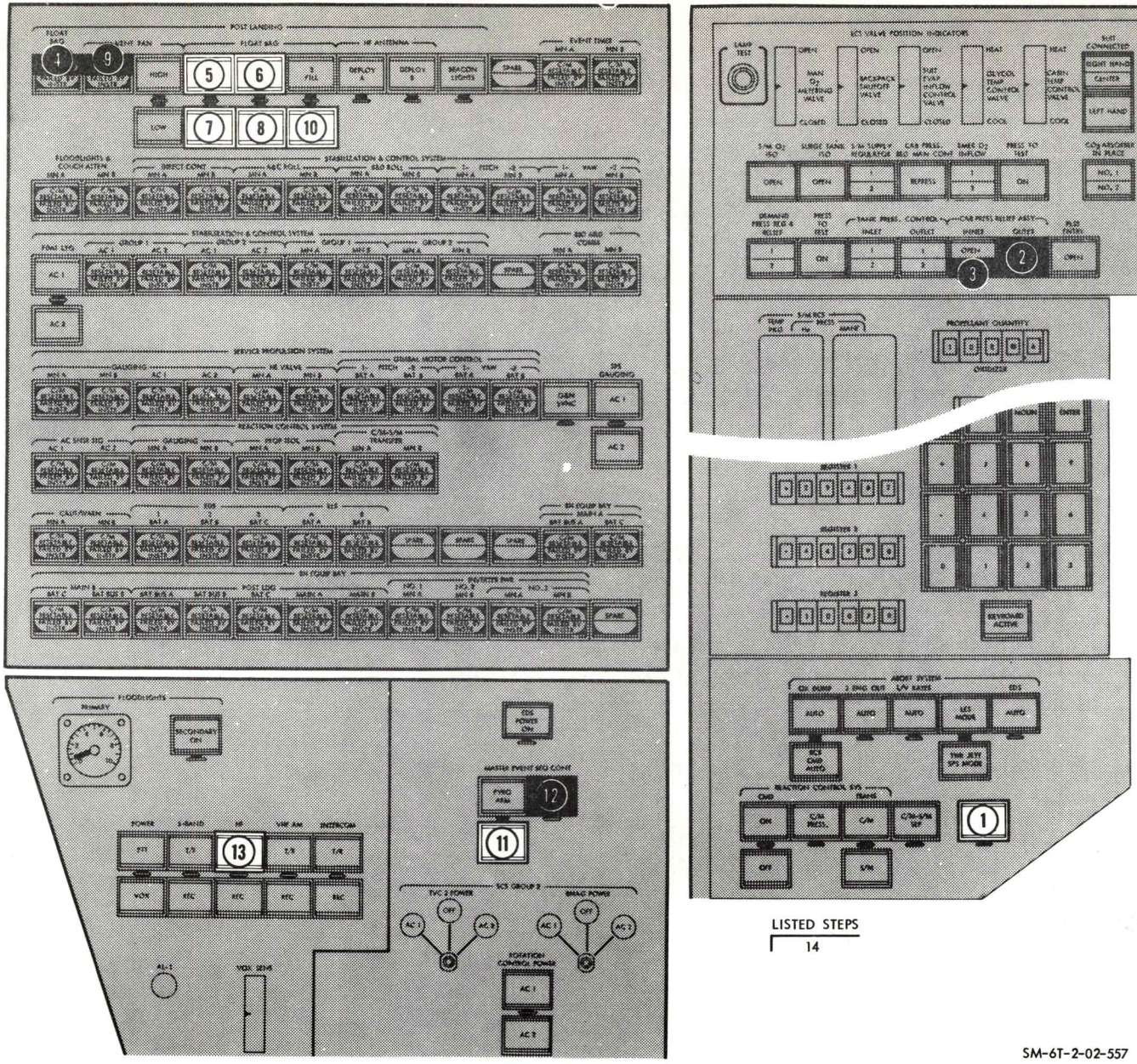
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Verify apex cover jettison	Aural	
2			Verify drogue chute deploy	Aural	
3			Verify main chute deploy	Aural	
4			RECOVERY VHF BCN sw - ON	RECOVERY - VHF BCN ON lt on	
5			Adjust restraints for impact	Observe TV monitor	


4
9
5
6
7
8
10
2
3
1
12
11
13
LISTED STEPS
14
SM-6T-2-02-557

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			MAIN CHUTE RELEASE sw - on	MAIN CHUTE RELEASE lt on	
2			CABIN PRESSURE RELIEF (lower) valve - CLOSE	CAB PRESS RELIEF ASSY OUTER - AUTO lts out	
3			CABIN PRESSURE RELIEF (upper) valve - CLOSE	CAB PRESS RELIEF ASSY INNER - lts out	
4			POST LANDING FLOAT BAG BAT C C/B in	POST LANDING FLOAT BAG BAT C C/B lt out	
5			POST LANDING FLOAT BAG 1 sw - FILL	POST LANDING FLOAT BAG - 1 FILL lt on	
6			POST LANDING FLOAT BAG 3 sw - FILL	POST LANDING FLOAT BAG - 3 FILL lt on	
7			POST LANDING FLOAT BAG 1 sw - VENT	POST LANDING FLOAT BAG - 1 VENT lt on	
8			POST LANDING FLOAT BAG 3 sw - VENT	POST LANDING FLOAT BAG - 3 VENT lt on	
9			Check POST LANDING VENT FAN BAT C C/B in	POST LANDING FLOAT BAG C/B lt out	
10			POST LANDING VENT FAN sw - HIGH	POST LANDING VENT FAN - HIGH lt on	



Postlanding Procedures

R1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
11			MASTER EVENT SEQ CONT PYRO sw - SAFE	MASTER EVENT SEQ CONT - SAFE lt on	
12			MASTER EVENT SEQ CONT LOGIC sw - OFF	MASTER EVENT SEQ CONT - LOGIC lt out	
13			H/F sw - T/R	HF - T/R lt on	
*14			Prepare for recovery	Observe TV monitor	

IOS DATA SHEET

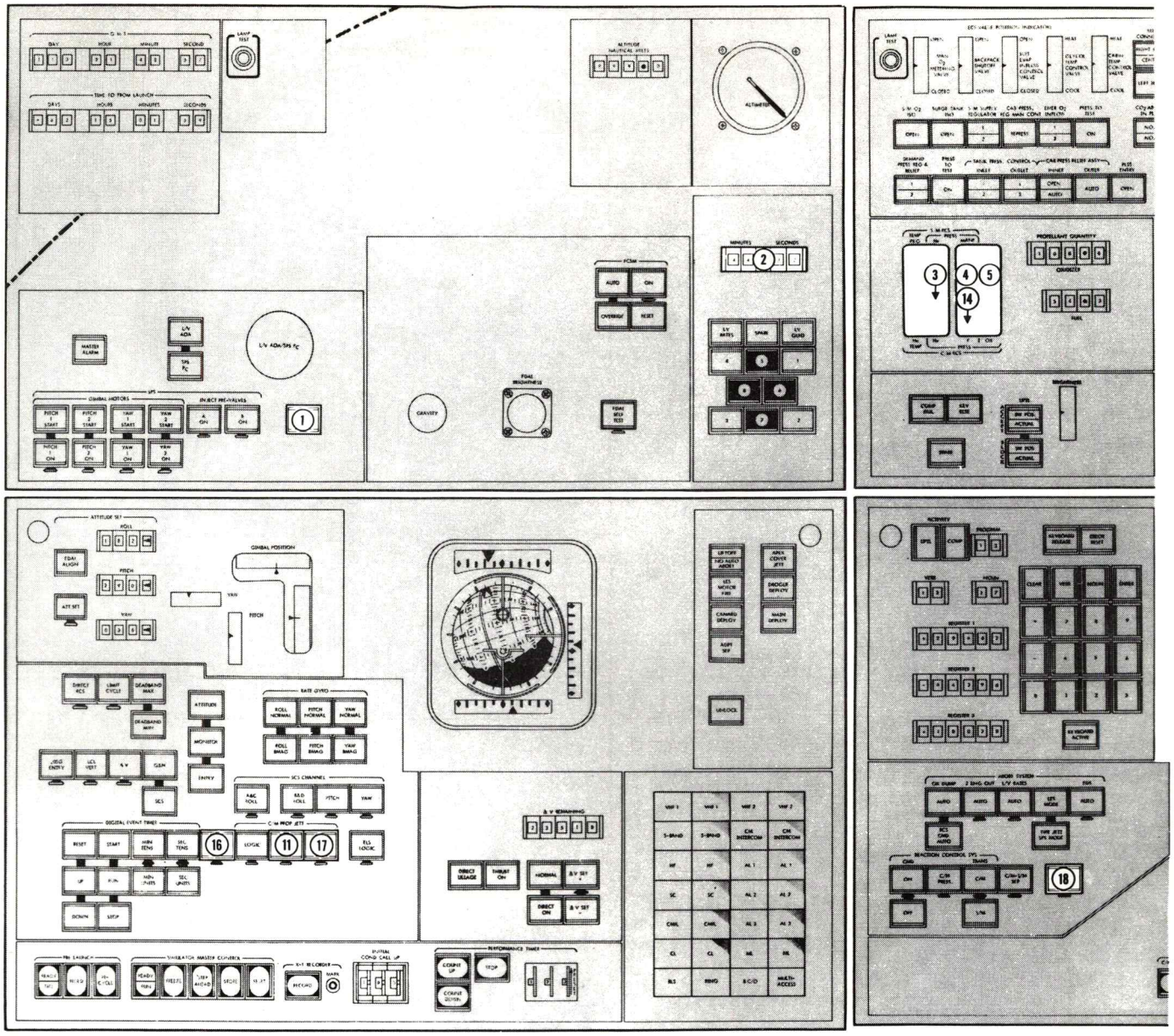
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			HF sw - T/R	HF - T/R lt on	
2			Prepare for recovery	Observe TV monitor	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			MAIN BUS TIE BAT A&C sw - OFF	MAIN BUS TIE BAT A&C lt out	
2			MAIN BUS TIE BAT B&C sw - OFF	MAIN BUS TIE - BAT B&C lt out	
3			RECOVERY HF ON/OFF sw - on	RECOVERY - HF ON lt on	
4			RECOVERY HF SSB/BCN/AM sw - AM	RECOVERY - HF AM lt on	
5			Communicate with recovery forces via HF	Provide appropriate communication	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Engage BUS TIE POST LDG BAT A C/B	LWR EQUIP BAY BAT A PWR C/B lts out	
2			Engage BUS TIE POST LDG BAT B C/B	LWR EQUIP BAY BAT B PWR C/B lts out	
3			Engage BUS TIE POST LDG BAT C C/B	LWR EQUIP BAY BAT C POST LANDING & ENTRY C/B lts out	



LISTED STEPS

6,7,8,9,10,12,13,15

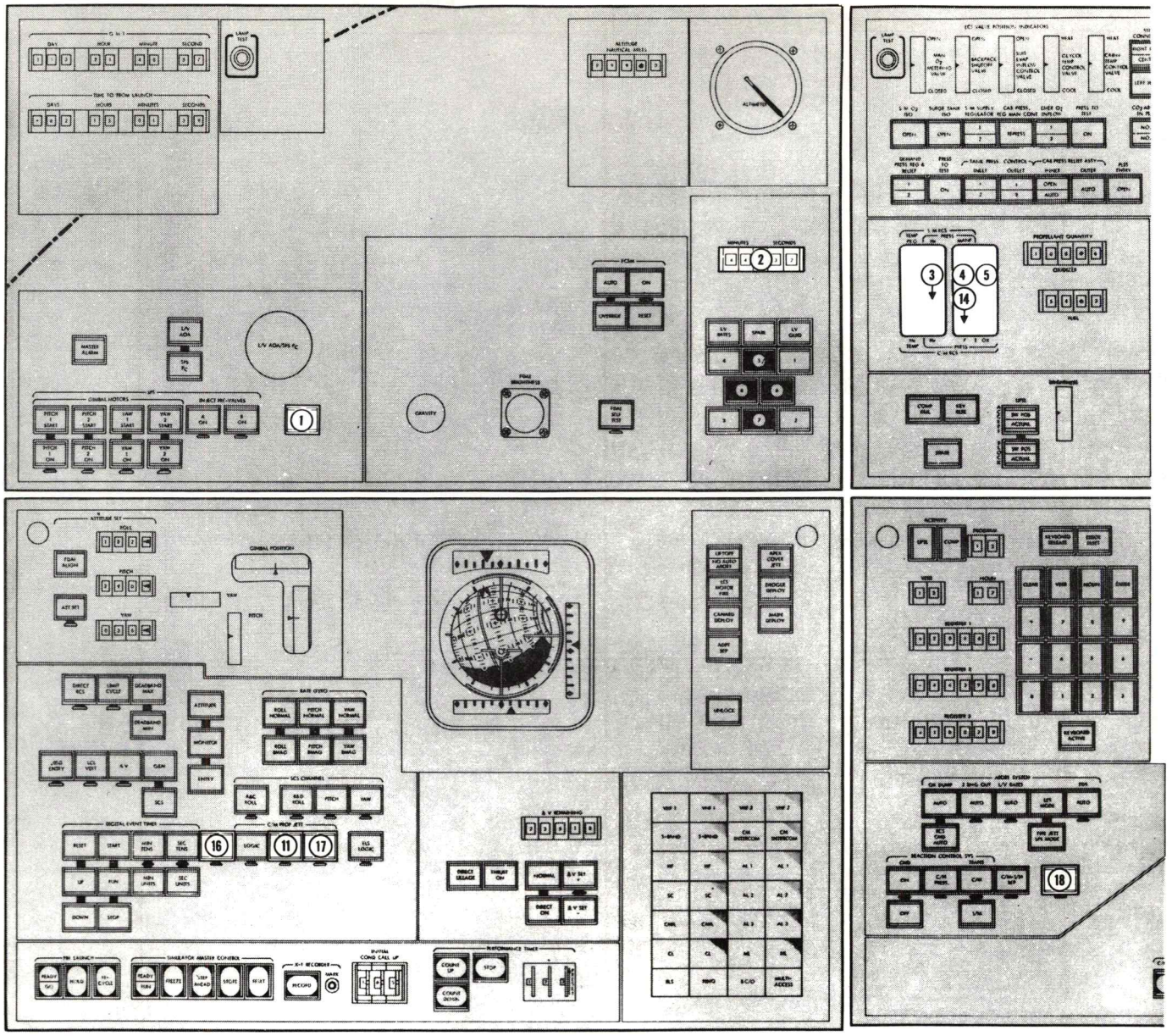
SM-6T-2-02-633

Pad and Low-Altitude Abort (Prior to T + 42 Sec)

B1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1		T - 0	Abort initiation	ABORT lt on	Automatic or crew initiated
2			Event timer reset and counting up	Timer counting up from zero. Backup - DIGITAL EVENT TIMER - RESET lt on, then out, UP lt on	Backup - DIGITAL EVENT TIMER RESET/UP/DOWN sw - RESET then UP
3			Check C/M RCS PRESS He decreasing	As programed. Backup - REACTION CONTROL SYS - C/M PRESS lt on	Backup - REACTION CONTROL SYS C/M PRESS sw - on
4			Check C/M RCS PRESS F ind	291±4	
5			Check C/M RCS PRESS OX ind	291±4, decreasing	
*6		T + 0.1	C/M-S/M separation	Aural. Backup - C/M-S/M SEP lt on	Backup - C/M-S/M SEP sw - on
*7		T + 11	Canard deployed	As programed. Backup - CANARD DEPLOY lt on	Backup - Depress CANARD DEPLOY sw
*8		T + 14	LES tower jettisoned	Aural. Backup - ABORT SYSTEM - TWR JETT SPS MODE lt on	Backup - ABORT SYSTEM LES MODE/TWR JETT SPS MODE sw - TWR JETT SPS MODE



LISTED STEPS
6,7,8,9,10,12,13,15

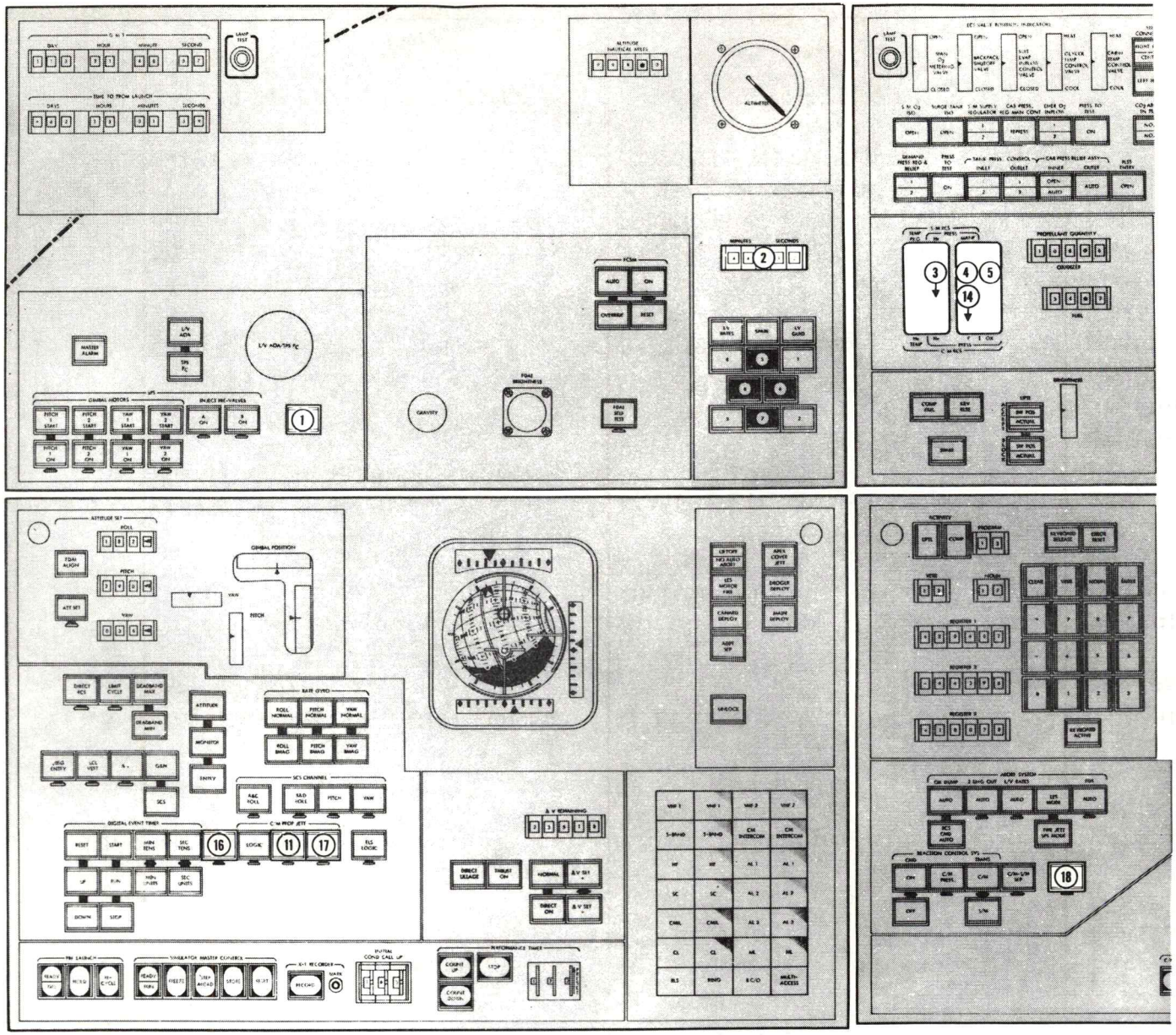
SM-6T-2-02-633

Pad and Low-Altitude Abort (Prior to T + 42 Sec)

B1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*9			ELS logic circuit armed	As programed. Backup - ELS LOGIC lt on	Backup - ELS LOGIC/OFF sw LOGIC
*10		T + 14.4	Apex cover jettisoned	Aural. Backup - APEX COVER JETT lt on	Backup - Depress APEX COVER JETT sw
11		T + 15	CM PROP JETT DUMP/OFF sw - DUMP	C/M PROP JETT - DUMP lt on	Only if altitude is in excess of 5,000 ft.
*12		T + 16	Drogue parachutes deployed	Aural. Backup - DROGUE DEPLOY lt on	Backup - Depress DROGUE DEPLOY sw
*13		T + 17	MAIN CHUTES DEPLOY sw - MAN, press MAIN DEPLOY sw	MAIN DEPLOY lt on	Only if altitude is same or below alt marker. Not provided on AMS
14		T + 18	Check C/M RCS F ind decreases	RCS fuel dumping	If not initiated at T+15
*15		T + 28	Drogue release, main parachutes deployed	Aural. Backup - MAIN DEPLOY lt on	Backup - Depress MAIN DEPLOY sw
16			COUCH sw - UNLOCK	COUCH UNLOCK lt on	
17		T + 90	CM PROP JETT PURGE/OFF sw - PURGE	C/M PROP JETT - PURGE lt on	



LISTED STEPS
6,7,8,9,10,12,13,15

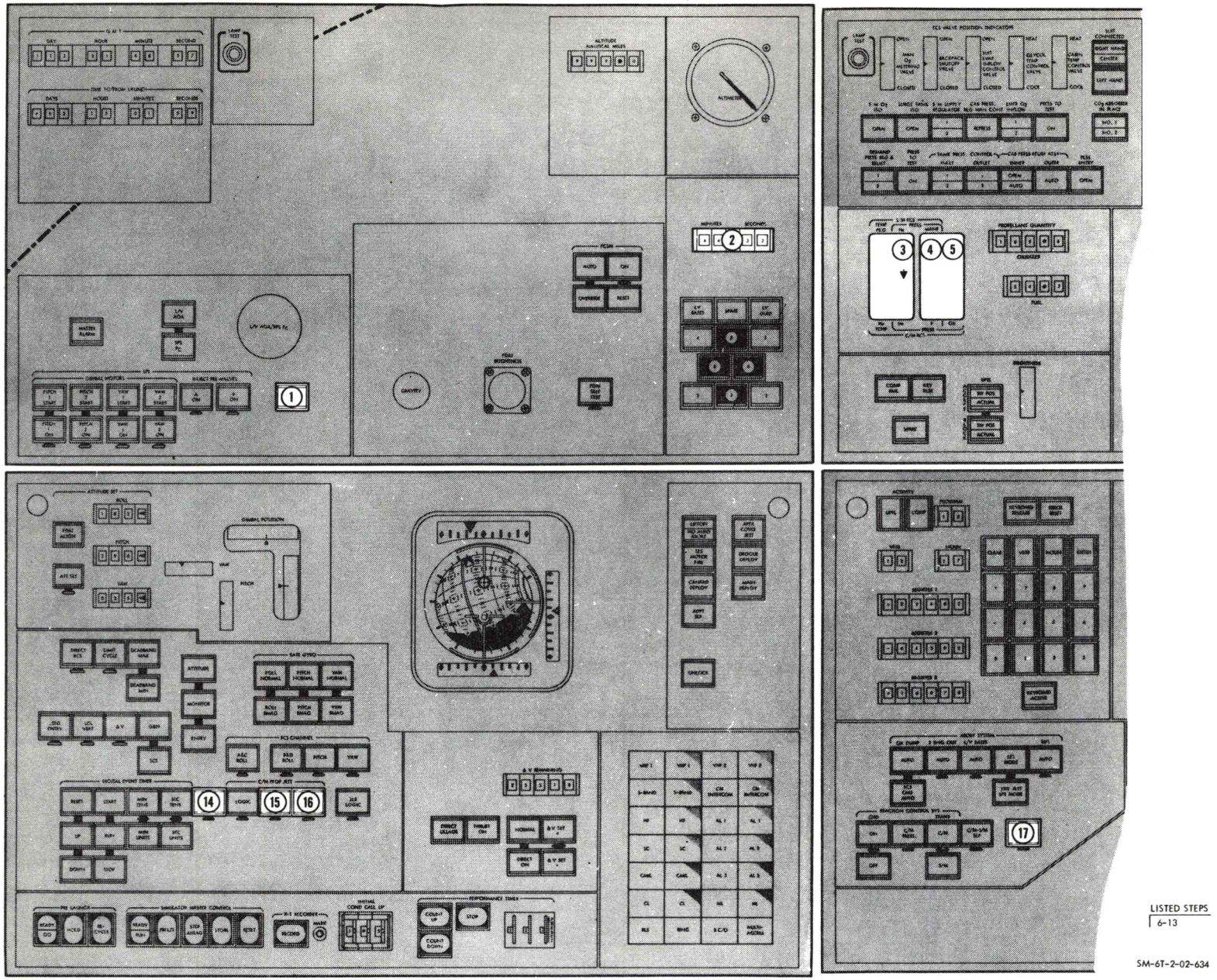
SM-6T-2-02-633

Pad and Low-Altitude Abort (Prior to T + 42 Sec)

B1.1

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
18			MAIN CHUTE RELEASE sw - on at impact	MAIN CHUTE RELEASE lt on	



Low-Altitude Abort (After T + 42 Sec)

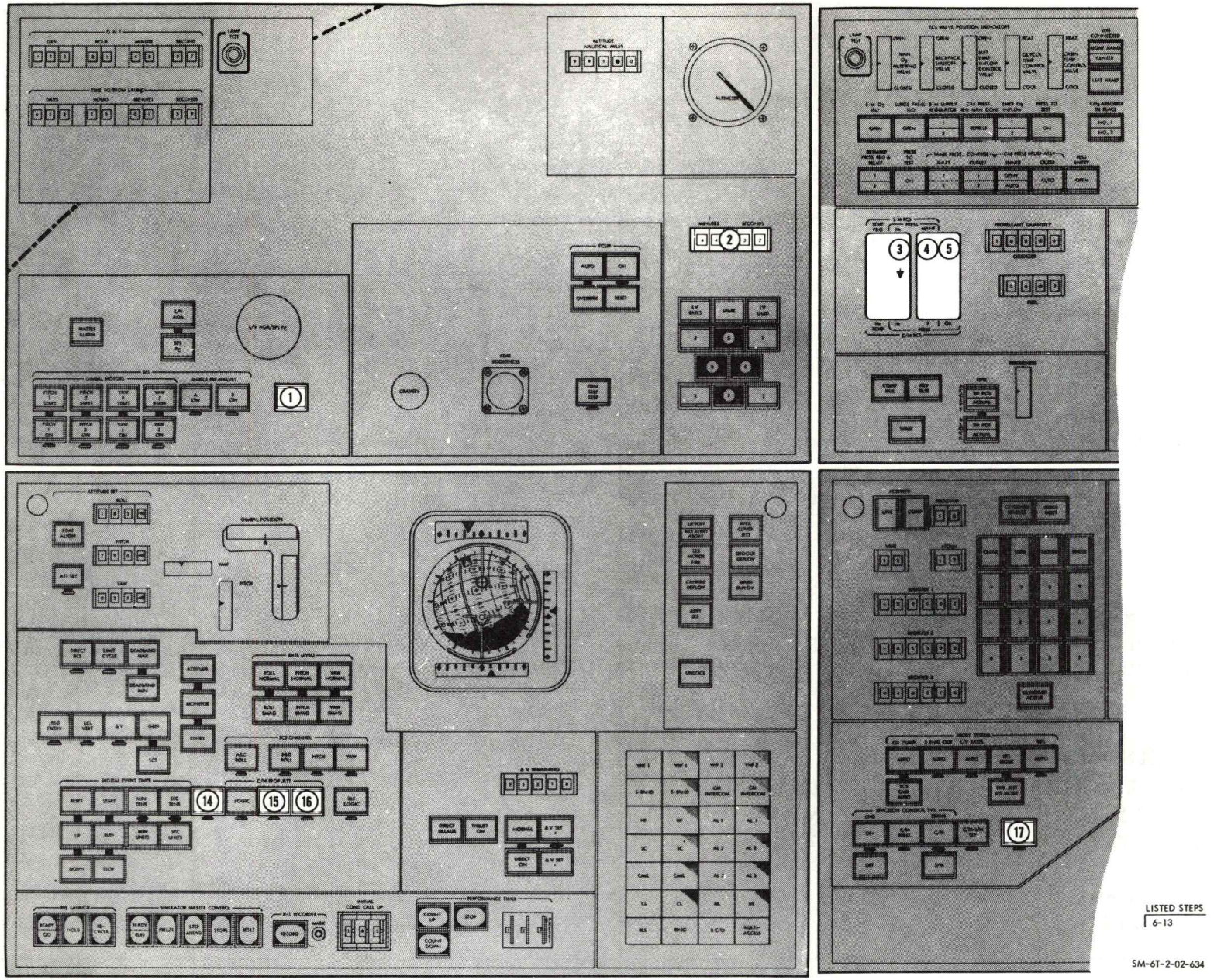
B1.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1		T - 0	Abort initiation	ABORT lt on	Automatic or crew initiated
2			Event timer reset and counting up	Timer counting up. Backup - DIGITAL EVENT TIMER - RESET lt on, then out, UP lt on	Backup - DIGITAL EVENT TIMER RESET/UP/DOWN sw - RESET, then UP
3			Check C/M RCS PRESS He decreasing	As programed. Backup - REACTION CONTROL SYS - C/M PRESS lt on	Backup - REACTION CONTROL SYS C/M PRESS sw - on
4			Check C/M RCS F ind	291±4	
5			Check C/M RCS OX ind	291±4 decreasing	
*6		T + 0.1	C/M-S/M separation	Aural. Backup - C/M-S/M lt on	Backup - C/M-S/M SEP sw - on
*7		T + 11	Canard deploy	As programed. Backup - CANARD DEPLOY lt on	Backup - Depress CANARD DEPLOY sw
*8		T + 14	LES tower jettison	Aural. Backup - ABORT SYSTEM - TWR JETT SPS MODE lt on	Backup - ABORT SYSTEM LES MODE/TWR JETT SPS MODE sw - TWR JETT SPS MODE

Low-Altitude Abort (After T + 42 Sec)

B1.2



Low-Altitude Abort (After T + 42 Sec)

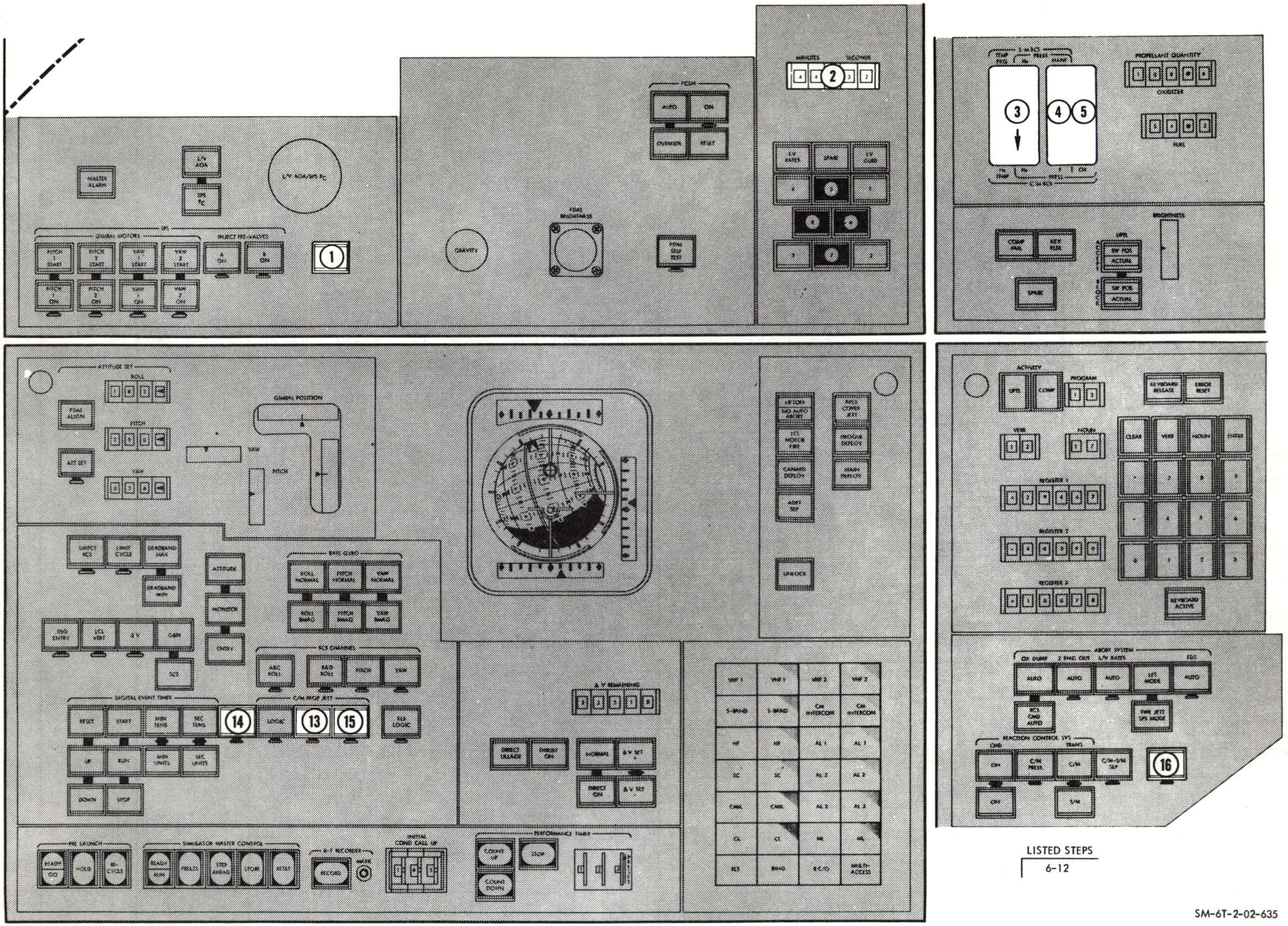
B1.2

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*9			ELS logic circuit armed	As programed. Backup - ELS LOGIC lt on	Backup - ELS LOGIC/OFF sw - LOGIC
*10		T + 14.4	Apex cover jettison	Aural. Backup - APEX COVER JETT lt on	Backup - Depress APEX COVER JETT sw
*11		T + 16	Drogue parachutes deployed (reefed)	Aural. Backup - DROGUE DEPLOY lt on	Backup - Depress DROGUE DEPLOY sw
*12		T + 24	Drogue parachutes disreefed	None	
*13		T + 28	Drogue parachutes release, main parachutes deployed	Aural. Backup - MAIN DEPLOY lt on	Backup - Depress MAIN DEPLOY sw
14			Couch sw - UNLOCK	COUCH UNLOCK lt on	
15		X	C/M PROP JETT DUMP/OFF sw - DUMP	C/M PROP JETT - DUMP lt on	
16		X + 90	C/M PROP JETT PURGE/OFF sw - PURGE	C/M PROP JETT - PURGE lt on	90 sec after step 15
17			MAIN CHUTE RELEASE sw - on at impact	MAIN CHUTE RELEASE lt on	

Low-Altitude Abort (After T + 42 Sec)

B1.2



LES Abort (30,000 to 120,000 Ft)

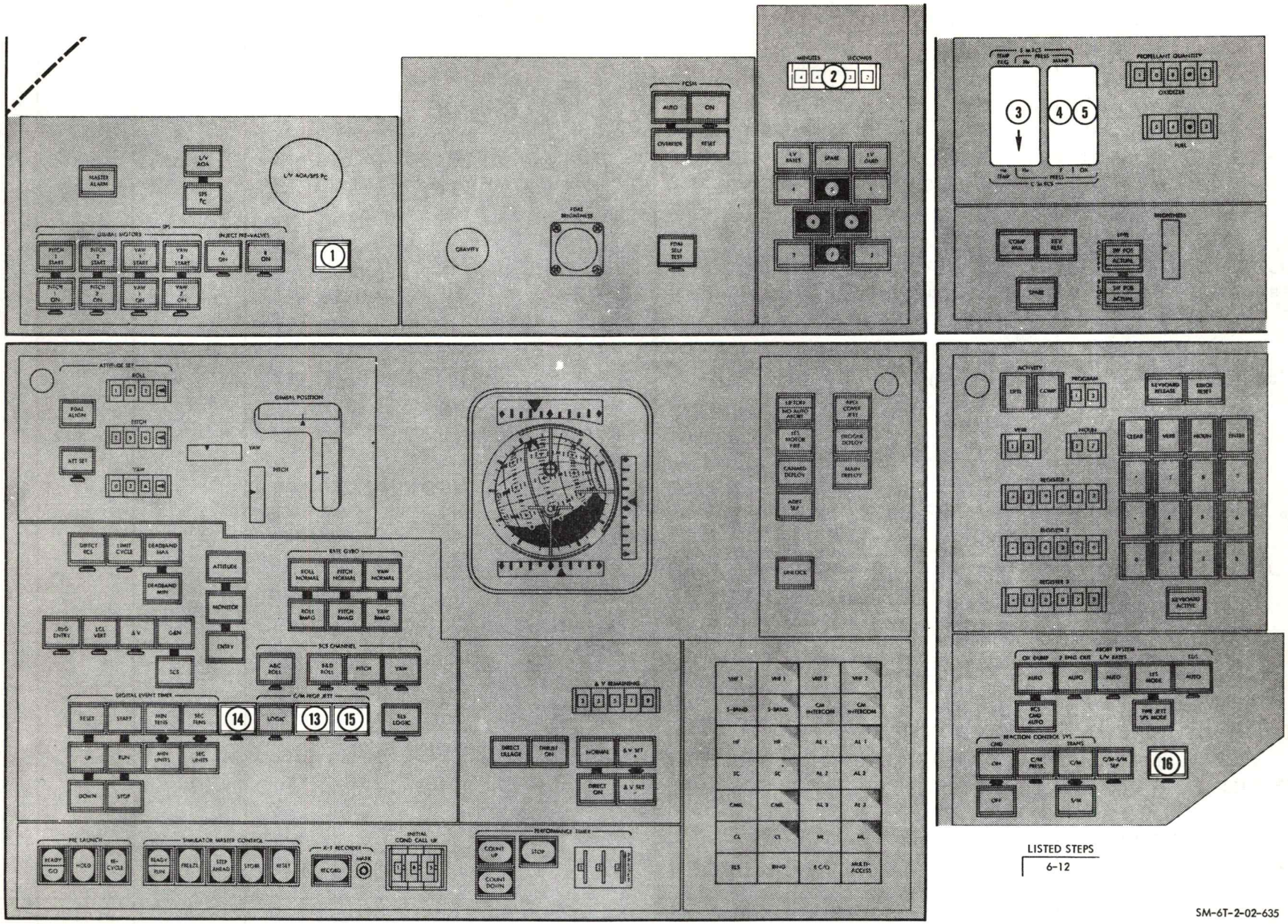
B1.3

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1		T - 0	Abort initiation	ABORT lt on	Automatic or crew initiated
2			Check event timer reset and counting up	Timer counting up. Backup - DIGITAL EVENT TIMER - RESET lt on, then out, UP lt on	Backup - DIGITAL EVENT TIMER RESET/UP/DOWN sw - RESET then UP
3			Check C/M RCS PRESS He decrease	As programed. Backup - REACTION CONTROL SYS - C/M PRESS lt on	Backup - REACTION CONTROL SYS C/M PRESS sw - on
4			Check C/M RCS PRESS F ind	291±4	
5			Check C/M RCS Press OX ind	291±4	
*6		T + 0.1	C/M-S/M separation	Aural. Backup - C/M-S/M lt on	Backup - C/M-S/M SEP sw - on
*7		T + 11	Canard deploy	As programed. Backup - CANARD DEPLOY lt on	Backup - Depress CANARD DEPLOY sw
*8		T ± 14	LES tower jettison between 24, 900 and 21, 700 ft	Aural. Backup - ABORT SYSTEM - TWR JETT SPS MODE lt on	LES MODE/TWR JETT SPS MODE sw - TWR JETT SPS MODE

LES Abort (30, 000 to 120, 000 Ft)

B1.3



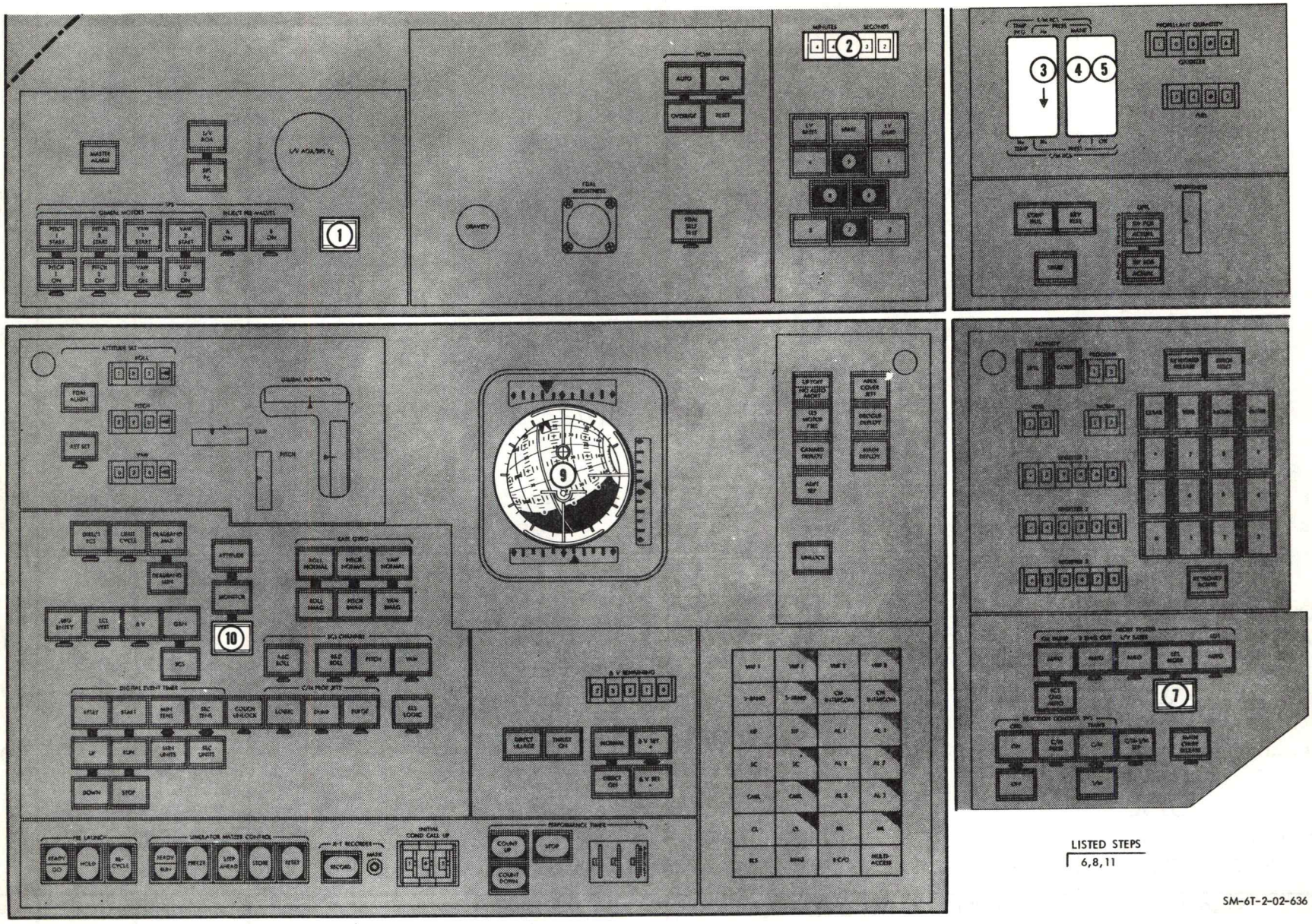
LES Abort (30,000 to 120,000 Ft)

B1.3

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*9		X	ELS logic circuit armed	As programed. Backup - ELS LOGIC lt on	Backup - ELS LOGIC/OFF sw - LOGIC
*10		X + .04	Apex cover jettison	Aural. Backup - APEX COVER JETT lt on	Backup - Depress APEX COVER JETT sw
*11		X + 2	Drogue parachutes deploy	Aural. Backup - DROGUE DEPLOY lt on	Backup - Depress DROGUE DEPLOY sw
*12			Drogue parachutes release, main parachutes deploy from 10, 950 to 9, 450 ft	Aural. Backup - MAIN DEPLOY lt on	Backup - Depress MAIN DEPLOY sw
13		Y	CM PROP JETT - DUMP/OFF sw - DUMP	C/M PROP JETT - DUMP lt on	
14			COUCH UNLOCK sw - on	COUCH UNLOCK lt on	
15		Y + 90	CM PROP JETT PURGE/OFF sw - PURGE		
16			MAIN CHUTE RELEASE sw - on at impact	MAIN CHUTE RELEASE lt on	

LES Abort (30, 000 to 120, 000 Ft) B1.3



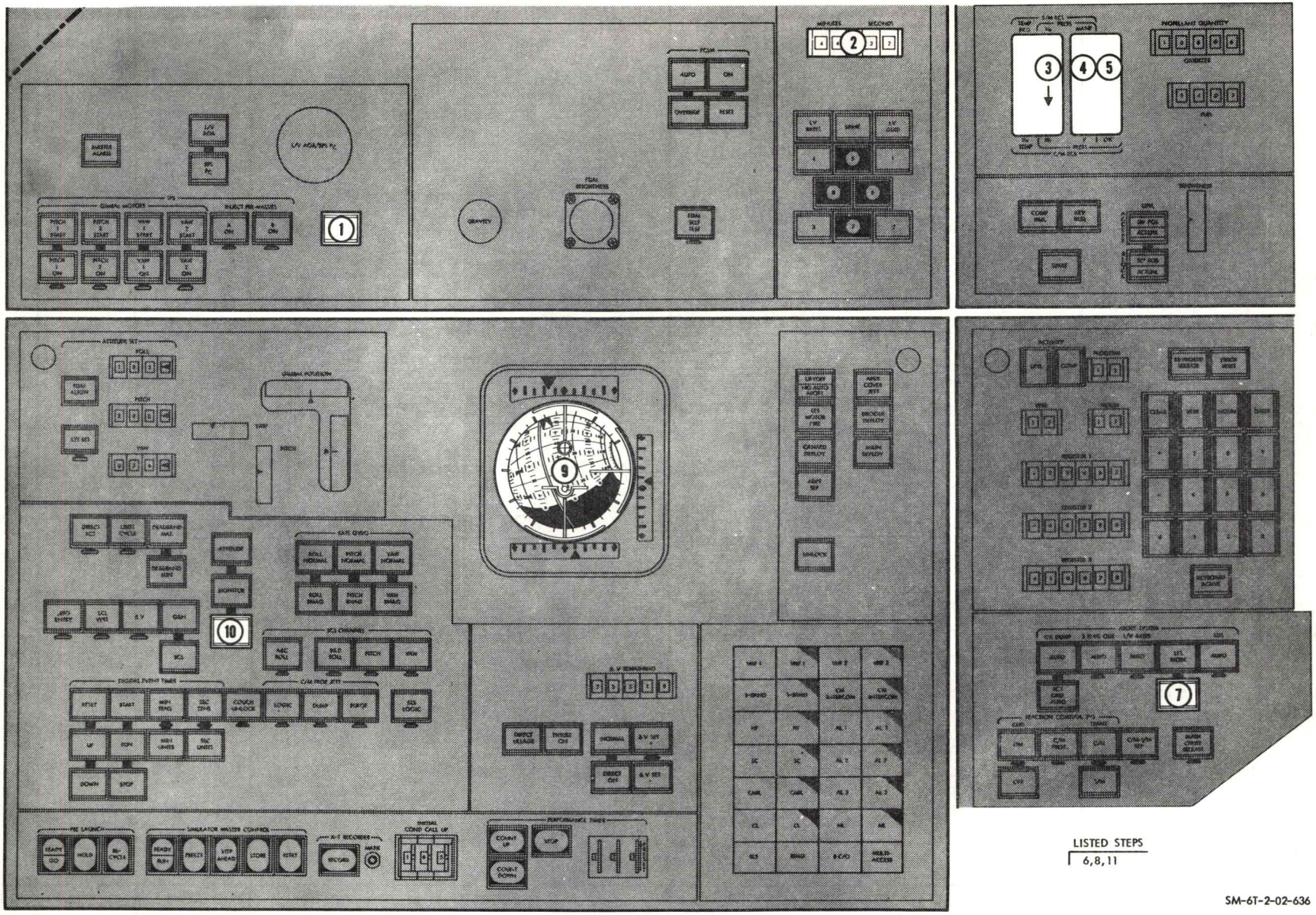
LES Aborts 120, 000 Ft to Tower Jettison

B1.4

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1		T - 0	Abort initiation	ABORT lt on	Automatic or crew initiated
2			Check event timer reset and counting up	Timer counting up from zero. Backup - DIGITAL EVENT TIMER RESET lt on, then out, UP lt on	Backup DIGITAL EVENT TIMER RESET/UP/DOWN sw - RESET then UP
3			Check C/M RCS PRESS He decrease	As programed. Backup - REACTION CONTROL SYS - C/M PRESS lt on	Backup - REACTION CONTROL SYS - C/M PRESS sw - ON
4			Check CM RCS PRESS F ind	291±4	
5			Check CM RCS PRESS OX ind	291±4	
*6		T + 0.1	C/M-S/M separation	Aural. Backup C/M-S/M SEP lt on	Backup - C/M-S/M SEP sw - on
7		T + 6 - T + 10	ABORT SYSTEM LES MODE/ TWR JETT SPS MODE sw - TWR JETT SPS MODE	ABORT SYSTEM - TWR JETT SPS MODE lt on	Backup - C/M-S/M SEP sw - on
*8		T + 14	ELS logic circuit armed	As programed. Backup - ELS LOGIC lt on	Backup - ELS LOGIC/OFF sw - LOGIC
9			Orient S/C to entry attitude	Observe FDAI	

LES Aborts 120, 000 Ft to Tower Jettison

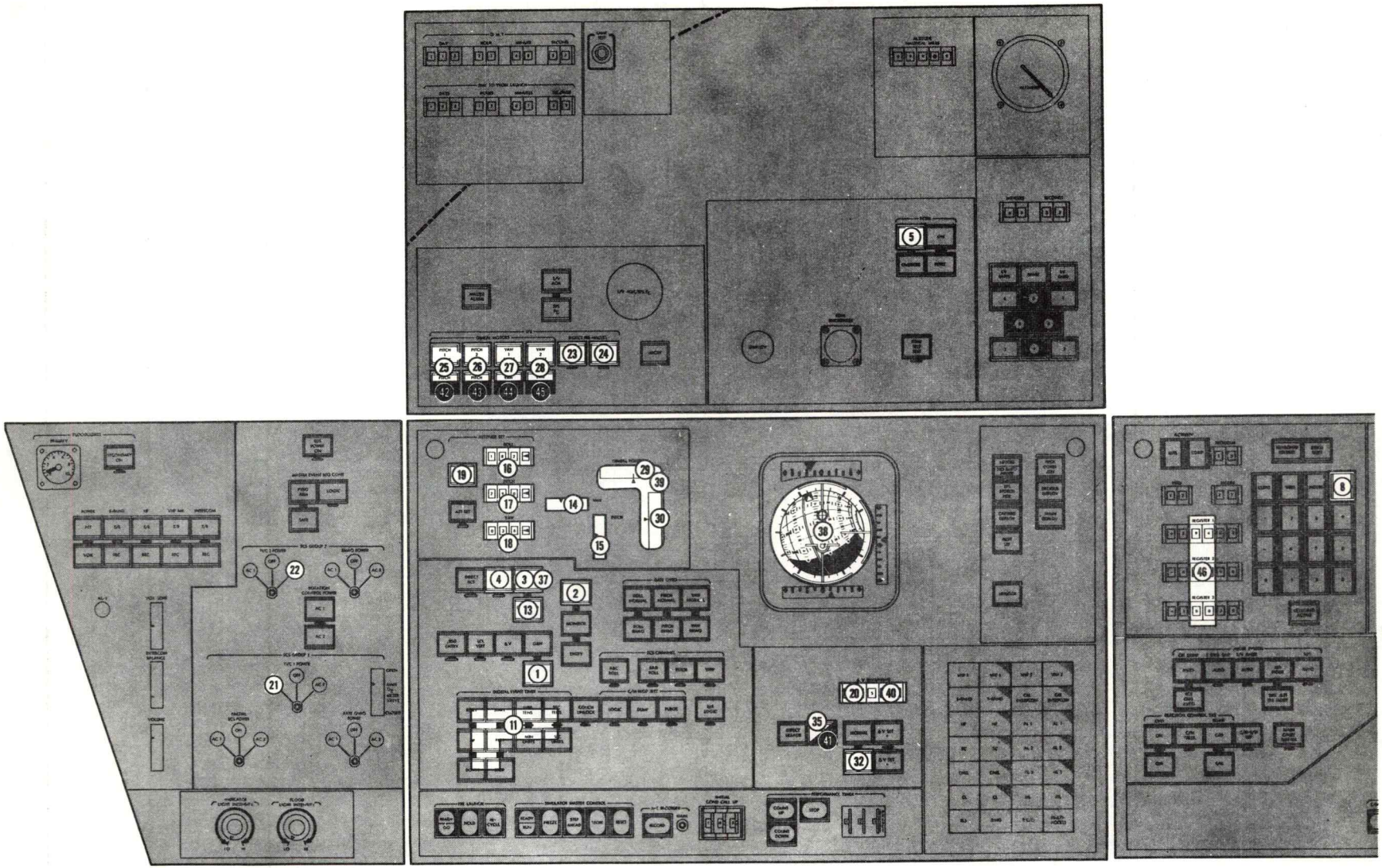


LES Aborts 120,000 Ft to Tower Jettison

B1.4

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
10			ATTITUDE/MONITOR/ENTRY sw - ENTRY		
*11			Perform normal entry	Continue with E1.4	



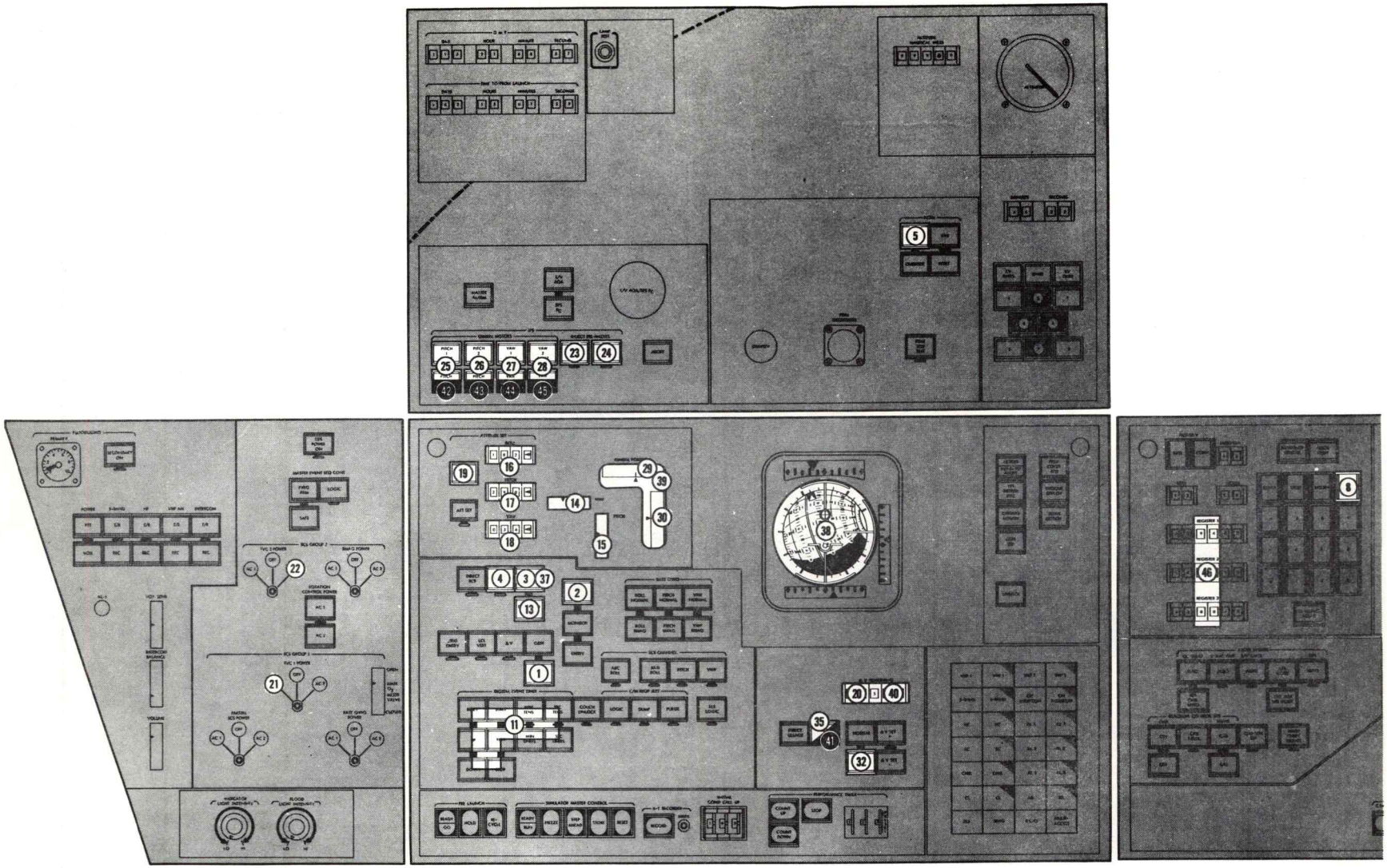
LISTED STEPS

6, 7, 10, 12, 31, 33, 34, 36

SM-6T-2-02-615

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			G&N/SCS sw - SCS	SCS lt on	
2			ATTITUDE/MONITOR/ENTRY sw - ATTITUDE	ATTITUDE lt on	
3			ATT DEADBAND sw - MAX	DEADBAND MAX lt on	
4			LIMIT CYCLE sw - ON	LIMIT CYCLE lt on	
5			FCSM AUTO/OVERRIDE sw - AUTO	FCSM - AUTO lt on	
*6			Determine delta V parameters with MSFN	Provide communications concerning: Time of firing Delta V required Firing duration SCT angles Target stars Visual references SPS gimbal angles	
*7			Program AGC to obtain stored delta V data	GN4.03	
8			Check parameters displayed	As programed	
9			Depress ENTER sw	ENTER lt on, out as released	



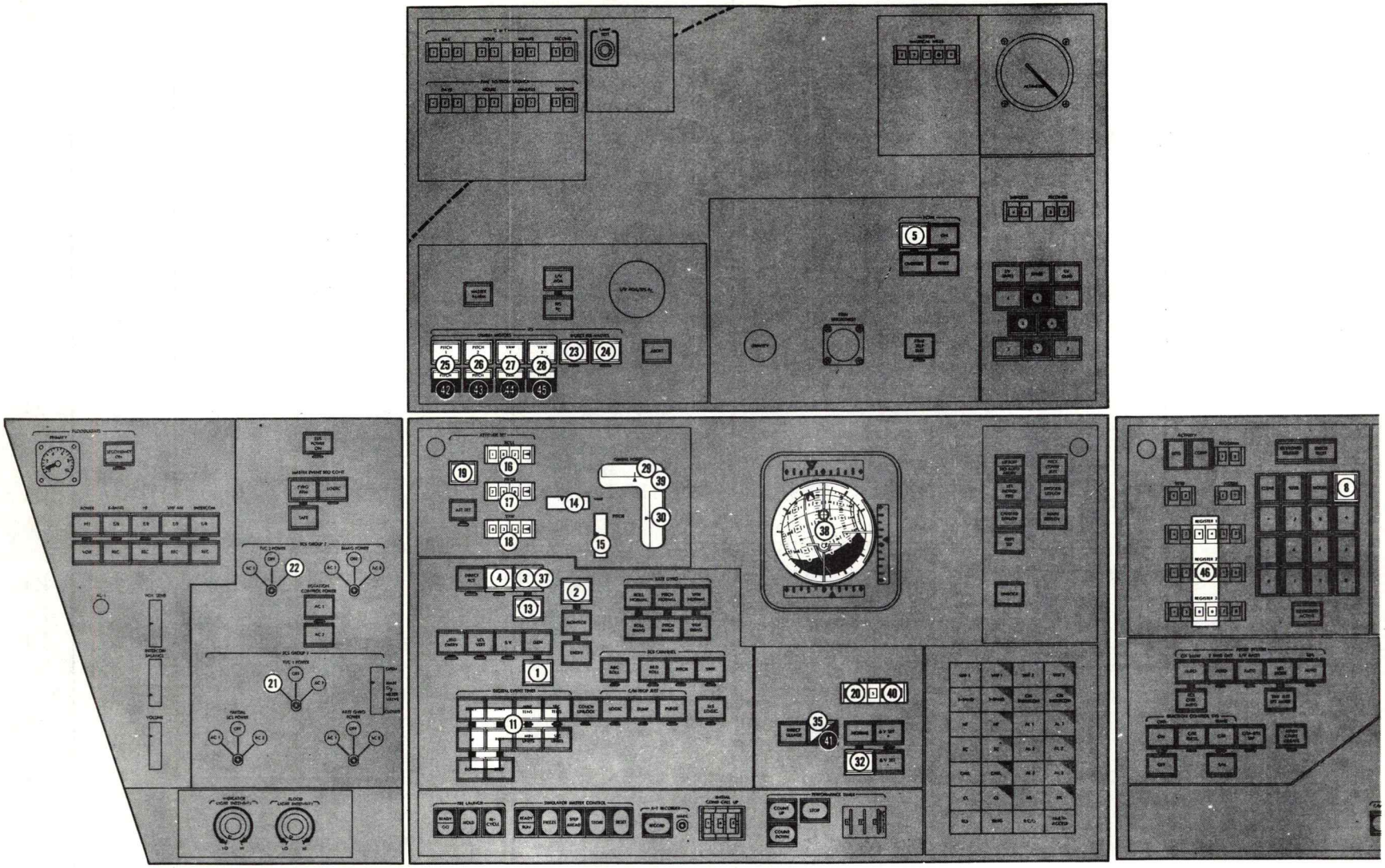
LISTED STEPS

6, 7, 10, 12, 31, 33, 34, 36

SM-6T-2-02-615

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*10			Program AGC for G&N standby SPS Monitor	GN4.03 V37 P46	
11			Adjust DET for firing	DET lts as selected	
*12			Request station 4 orient S/C to thrusting attitude	Monitor intercom	
13			ATT DEADBAND sw - MIN	DEADBAND MIN lt on	
14			GIMBAL POSITION YAW cont to desired setting	Check GIMBAL POSITION YAW control ind	
15			GIMBAL POSITION PITCH cont to desired setting	Check GIMBAL POSITION PITCH control ind	
16			Set ATTITUDE SET ROLL cont - 0	Check angle set in	
17			Set ATTITUDE SET PITCH cont - 32	Check angle set in	
18			Set ATTITUDE SET YAW cont - 0	Check angle set in	
19			Depress FDAI ALIGN sw, hold until error needles null	Check FDAI drives to attitude set in	
20			Set DELTA V REMAINING ind	Check setting per step 6	
21			TVC 1 POWER sw - AC 1	TVC 1 POWER - AC 1 lt on	



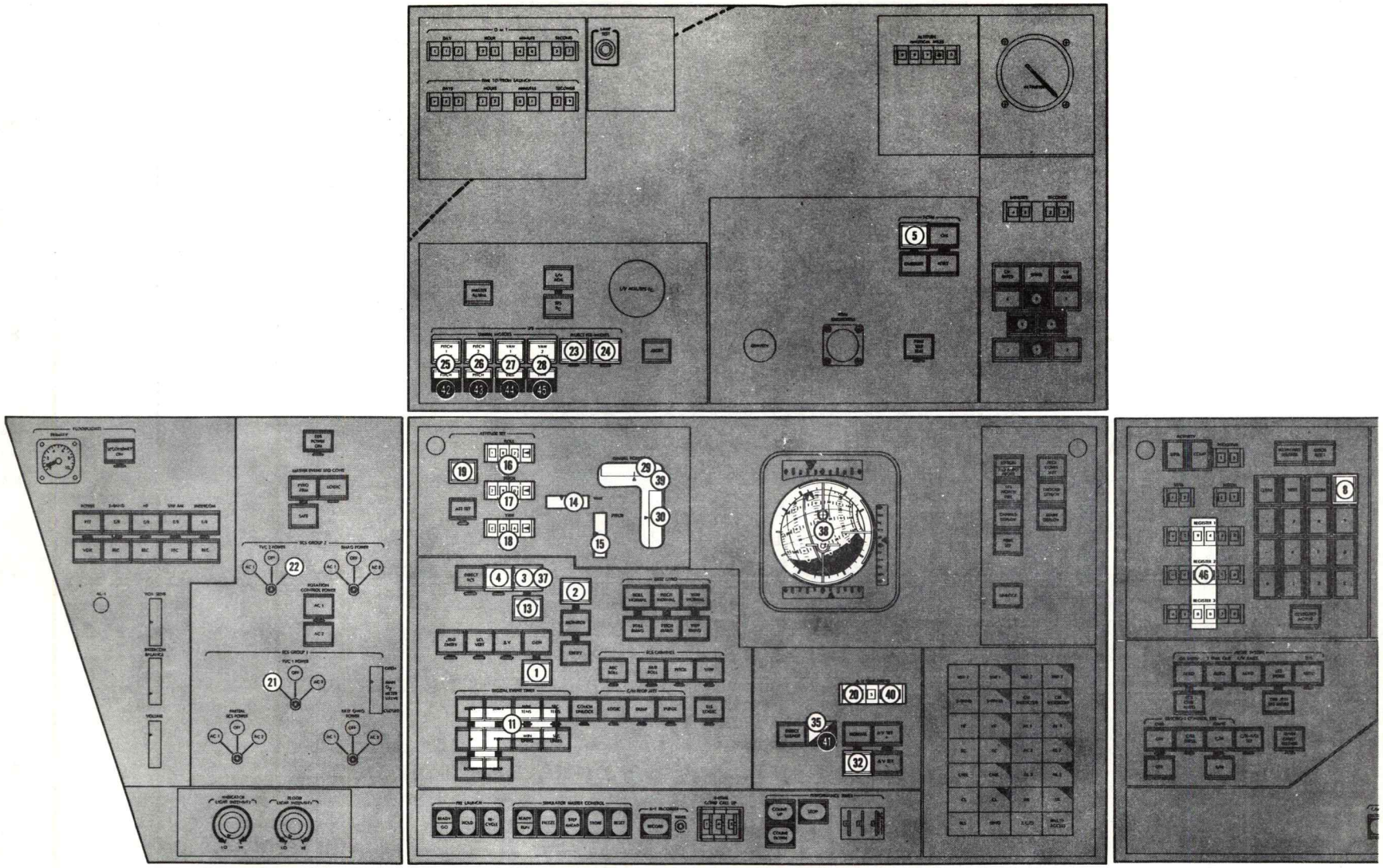
LISTED STEPS

6, 7, 10, 12, 31, 33, 34, 36

SM-6T-2-02-615

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
22			TVC 2 POWER sw - AC 2	TVC 2 POWER - AC 2 lt on	
23			SPS INJECT PREVALVES A sw - ON	SPS INJECT PREVALVES - A ON lt on	
24			SPS INJECT PREVALVES B sw - ON	SPS INJECT PREVALVES - B ON lt on	
25			SPS GIMBAL MOTORS PITCH 1 sw - START and release to ON	SPS GIMBAL MOTORS - PITCH 1 START lt on, out as released, PITCH 1 ON lt on	
26			SPS GIMBAL MOTORS PITCH 2 sw - START and release to ON	SPS GIMBAL MOTORS - PITCH 2 START lt on, out as released, PITCH 2 lt on	
27			SPS GIMBAL MOTORS YAW 1 sw - START and release to ON	SPS GIMBAL MOTORS - YAW 1 START lt on, out as released, - YAW 1 lt on	
28			SPS GIMBAL MOTORS YAW 2 sw - START and release to ON	SPS GIMBAL MOTORS - YAW 2 START lt on, out as released, - YAW 2 lt on	
29			Check GIMBAL POSITION YAW ind	To preset angles	
30			Check GIMBAL POSITION PITCH ind	To preset angles	



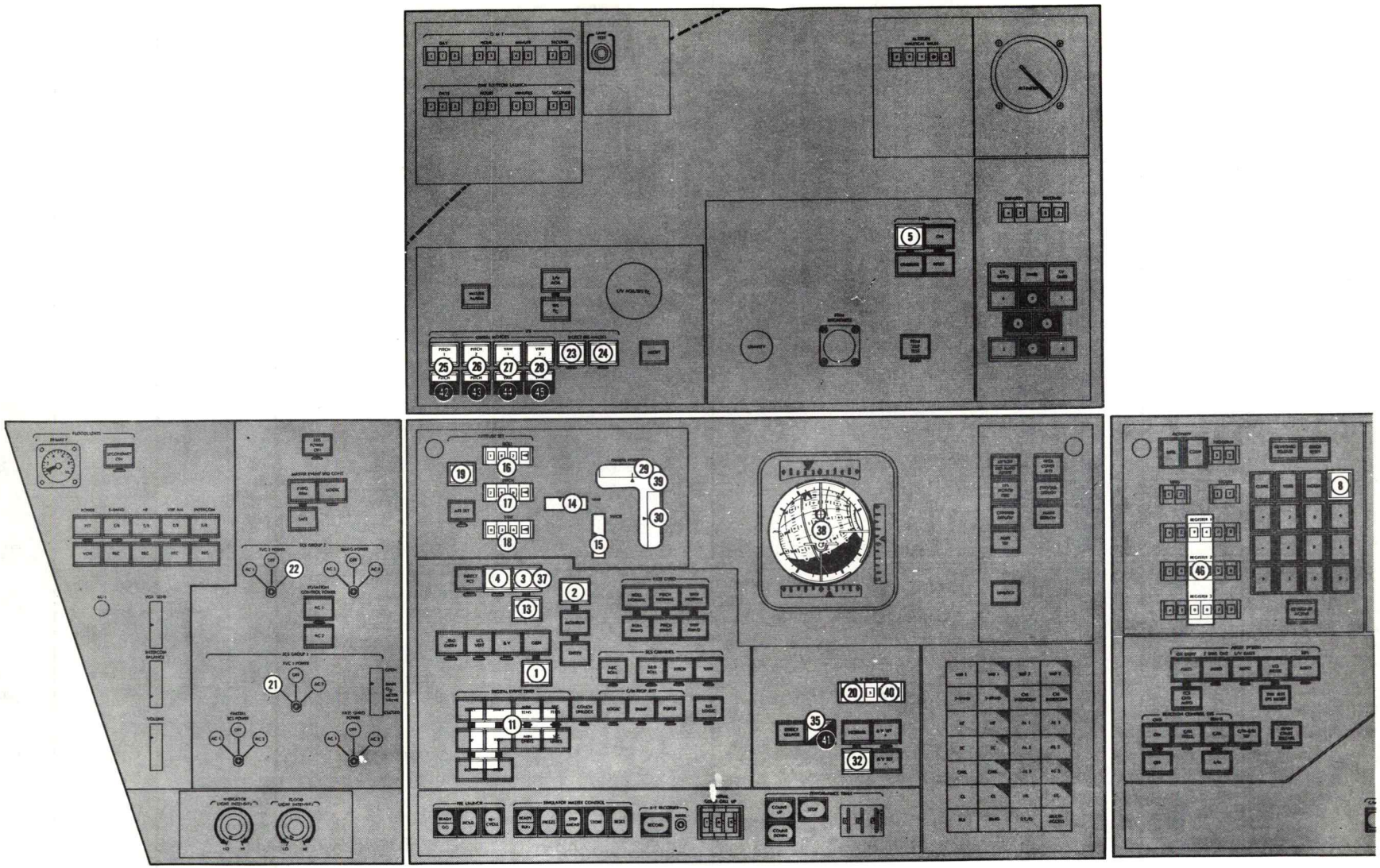
LISTED STEPS

6, 7, 10, 12, 31, 33, 34, 36

SM-6T-2-02-615

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*31			Unlock translation control	Observe TV monitor	
32			NORMAL/OFF/DIRECT ON sw - DIRECT ON	DIRECT ON lt on	
*33			Unpin rotation control	Observe TV monitor	
*34		Ign - 15 sec	Initiate ullage	Observe TV monitor	
35		Ign - 0	Depress THRUST ON sw	THRUST ON lt on	
*36		Ign + 1 sec	Terminate ullage	Observe TV monitor	
37			ATT DEADBAND sw - MAX	DEADBAND MAX lt on	
38			Monitor FDAI	As programed	
39			Monitor GIMBAL POSITION inds	As programed	
40			Check DELTA V REMAINING ind	Zero	
41			Check THRUST ON lt out	THRUST ON lt out	
42			SPS GIMBAL MOTORS-PITCH 1 sw - OFF	SPS GIMBAL MOTORS - PITCH 1 ON lt out	
43			SPS GIMBAL MOTORS-PITCH 2 sw - OFF	SPS GIMBAL MOTORS - PITCH 2 ON lt out	



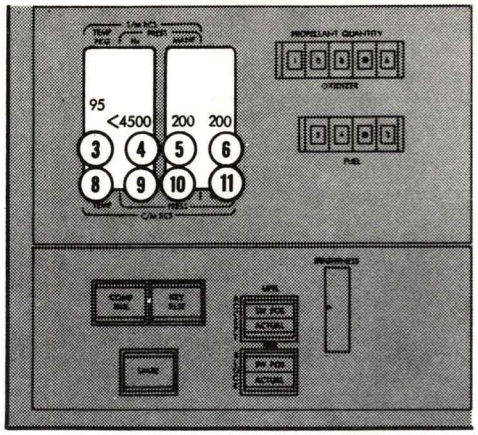
LISTED STEPS

6, 7, 10, 12, 31, 33, 34, 36

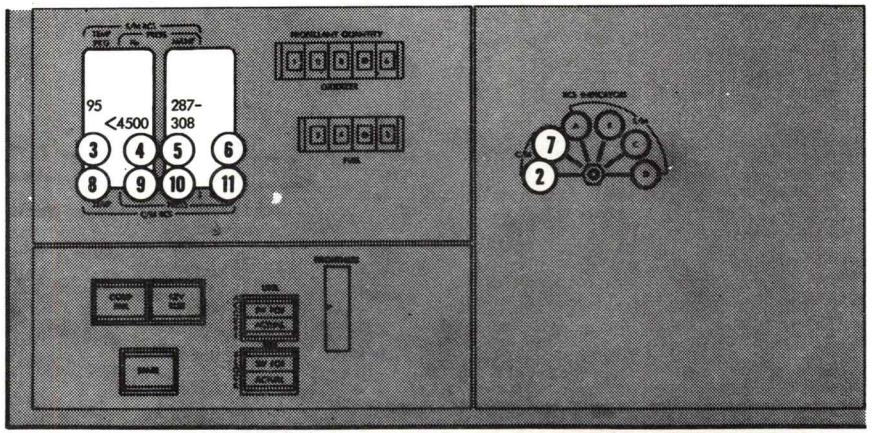
SM-6T-2-02-615

IOS DATA SHEET

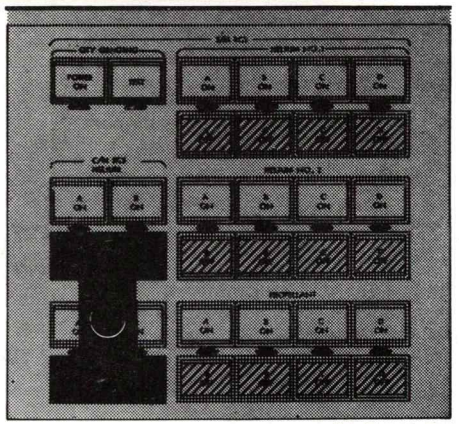
Step	Malf	Time	Function	IOS Visibility/Action	Notes
44			SPS GIMBAL MOTORS - YAW 1 sw - OFF	SPS GIMBAL MOTORS - YAW 1 ON lt out	
45			SPS GIMBAL MOTORS - YAW 2 sw - OFF	SPS GIMBAL MOTORS - YAW 2 ON lt out	
46			Check AGC for delta V parameters communicate	As programed	



PRIOR TO SM-CM SEPARATION



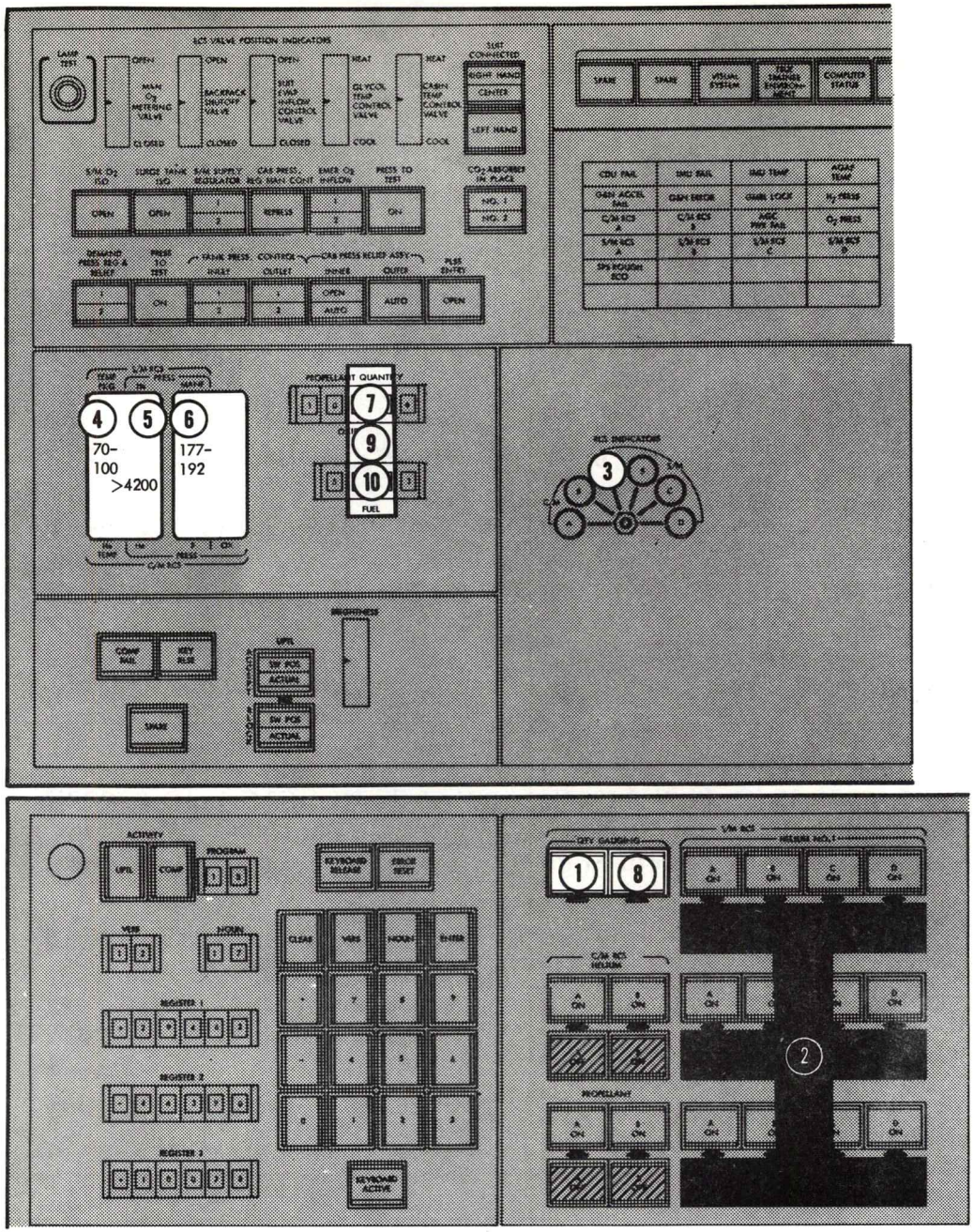
POST SM-CM SEPARATION



SM-6T-2-02-292A

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Verify all C/M RCS HELIUM and PROPELLANT event inds gray	All C/M RCS OFF striped lts out	
2			RCS INDICATORS sw - C/M A	RCS INDICATORS C/M - A lt on	
3			Record C/M TEMP He ind	95 max.	
4			Record C/M SYS PRESS He ind	4500 max.	
5			Record C/M SYS PRESS F ind	Before S/M-C/M separation 200 max, after 287-308	
6			Record C/M SYS PRESS OX ind	Before S/M-C/M separation 200 max., after 287-308	
7			RCS INDICATORS sw - C/M B	RCS INDICATOR C/M - B lt on	
8			Record C/M TEMP He ind	95 max.	
9			Record C/M SYS PRESS He ind	4500 max.	
10			Record C/M SYS PRESS F ind	Before S/M-C/M separation 200 max., after 287-308	
11			Record C/M SYS PRESS OX ind	Before S/M-C/M separation 200 max., after 287-308	

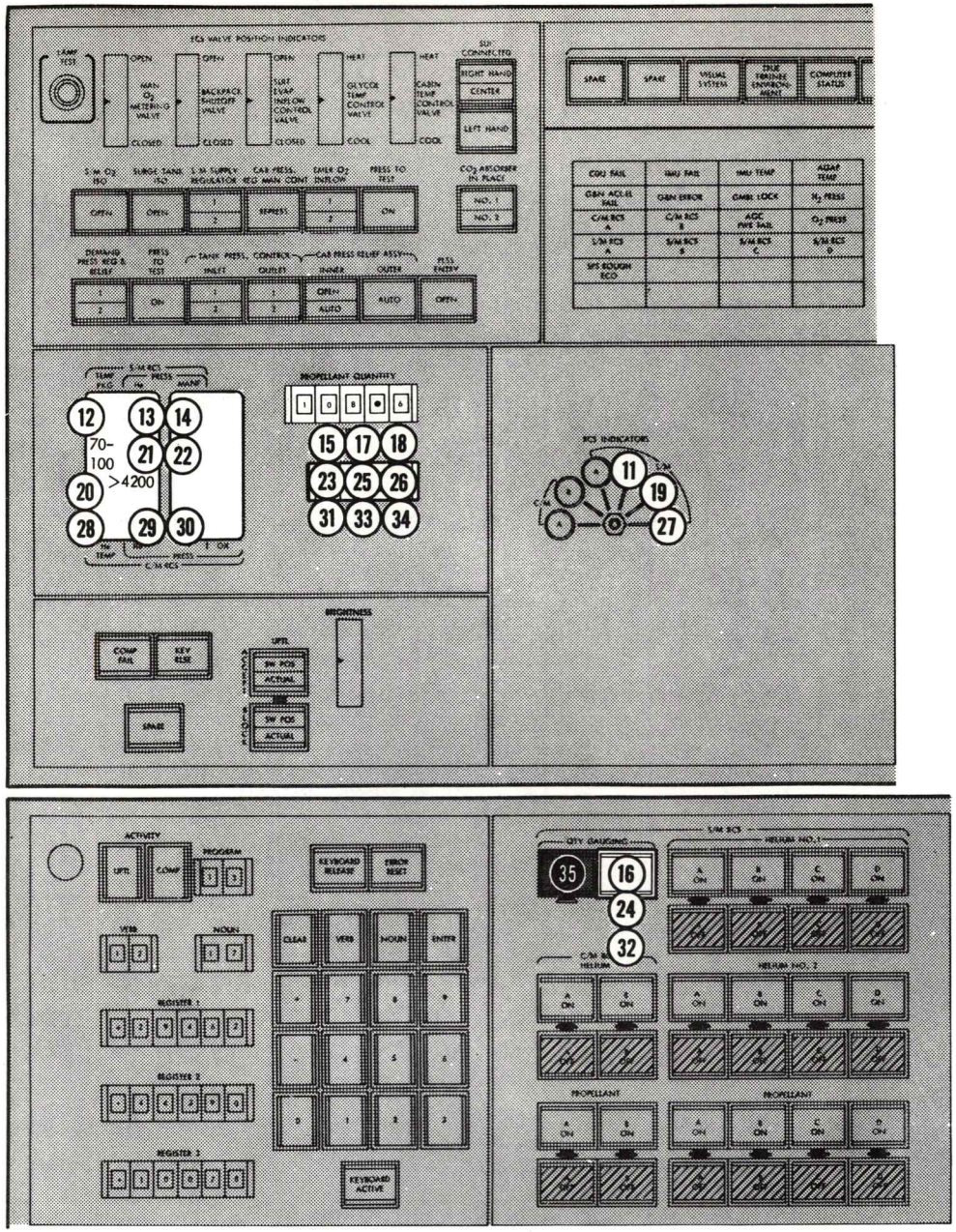


S/M RCS Periodic Check

RC2.02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Verify S/M QTY GAUGING POWER sw - on	S/M QTY GAUGING - POWER ON lt on	
2			Verify all S/M RCS HELIUM NO. 1, HELIUM NO. 2, and PROPELLANT event inds gray	All S/M RCS - striped OFF lts out	
3-10			S/M RCS A Check		
3			RCS INDICATORS sw - S/M A	RCS INDICATORS S/M - A lt on	
4			Record S/M TEMP PKG ind	70 - 100	
5			Record S/M SYS PRESS He ind	Less than 4200	
6			Record S/M SYS PRESS MANF ind	177 - 192	
7			Record FUEL and OX quantity readout	Fuel 69.3; oxid 137.4 full	
8-10			Quantity Gaging Test Check		
8			S/M QTY GAUGING TEST sw - TEST and release	S/M QTY GAUGING - TEST lt on, out as released	
9			Check fuel and oxid digital readouts increase	In approx 10 sec readouts increased to: fuel 90.2, oxidizer 180.2	
10			Fuel and oxid readouts return to actual	Return to actual in 20 sec	



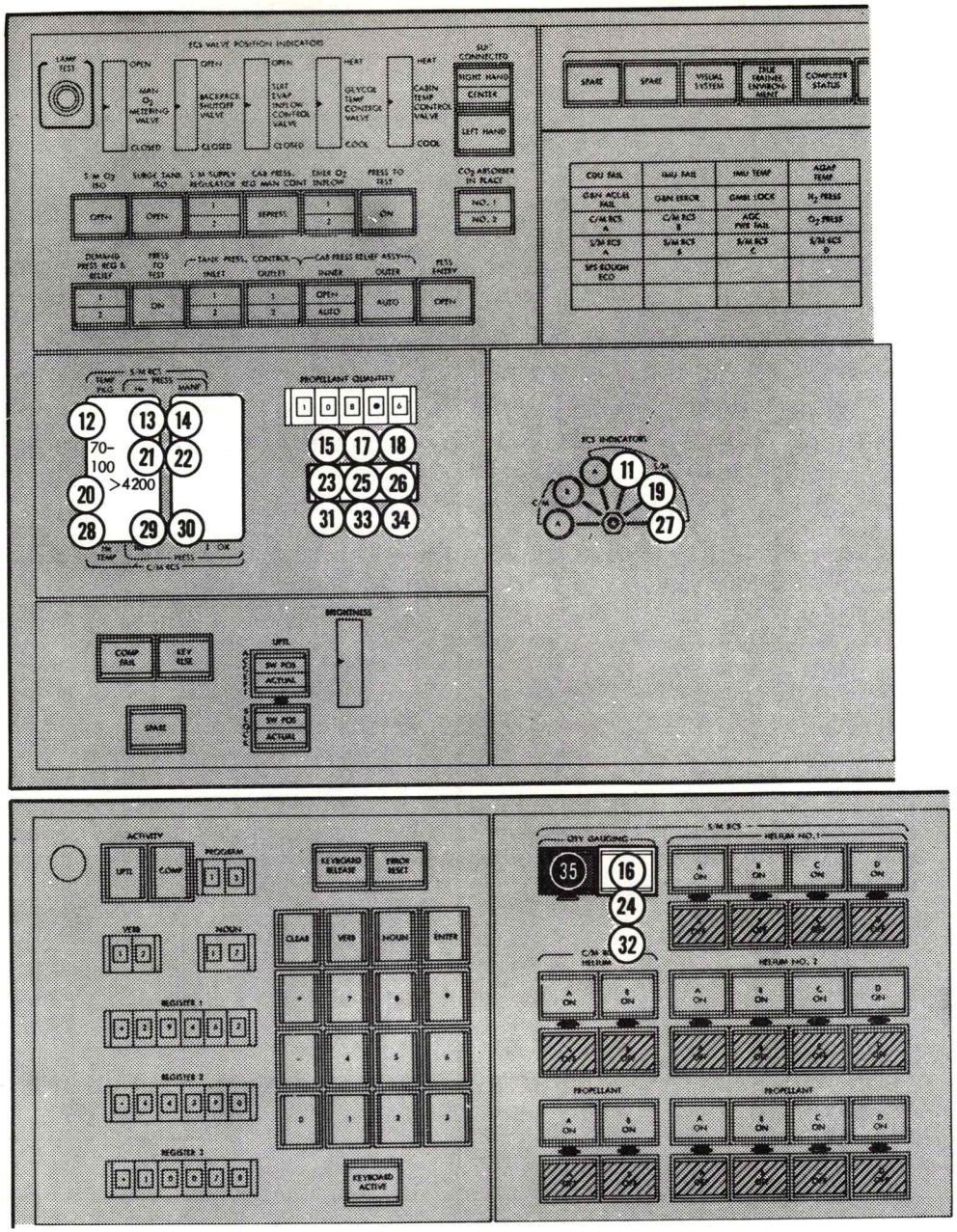
SM-6T-2-02-608

S/M RCS Periodic Check

RC2.02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
11-18			S/M RCS B Check		
11			RCS INDICATORS sw - S/M B	RCS INDICATORS S/M - B lt on	
12			Record S/M TEMP PKG ind	70 - 100	
13			Record S/M SYS PRESS He ind	Less than 4200	
14			Record S/M SYS PRESS MANF ind	177 - 192	
15			Record FUEL and OX quantity readout	Fuel 69.3, Oxid 137.4 full	
16-19			Quantity Gaging Test Check		
16			S/M QTY GAUGING TEST sw - TEST and release	S/M QTY GAUGING - TEST lt on, then out when released	
17			Check fuel and oxid digital readouts increase	In approx 10 sec readout increased to: fuel 90.2, oxidizer 180.2	
18			Fuel and oxid readouts return to actual	Return to actual in 20 sec	



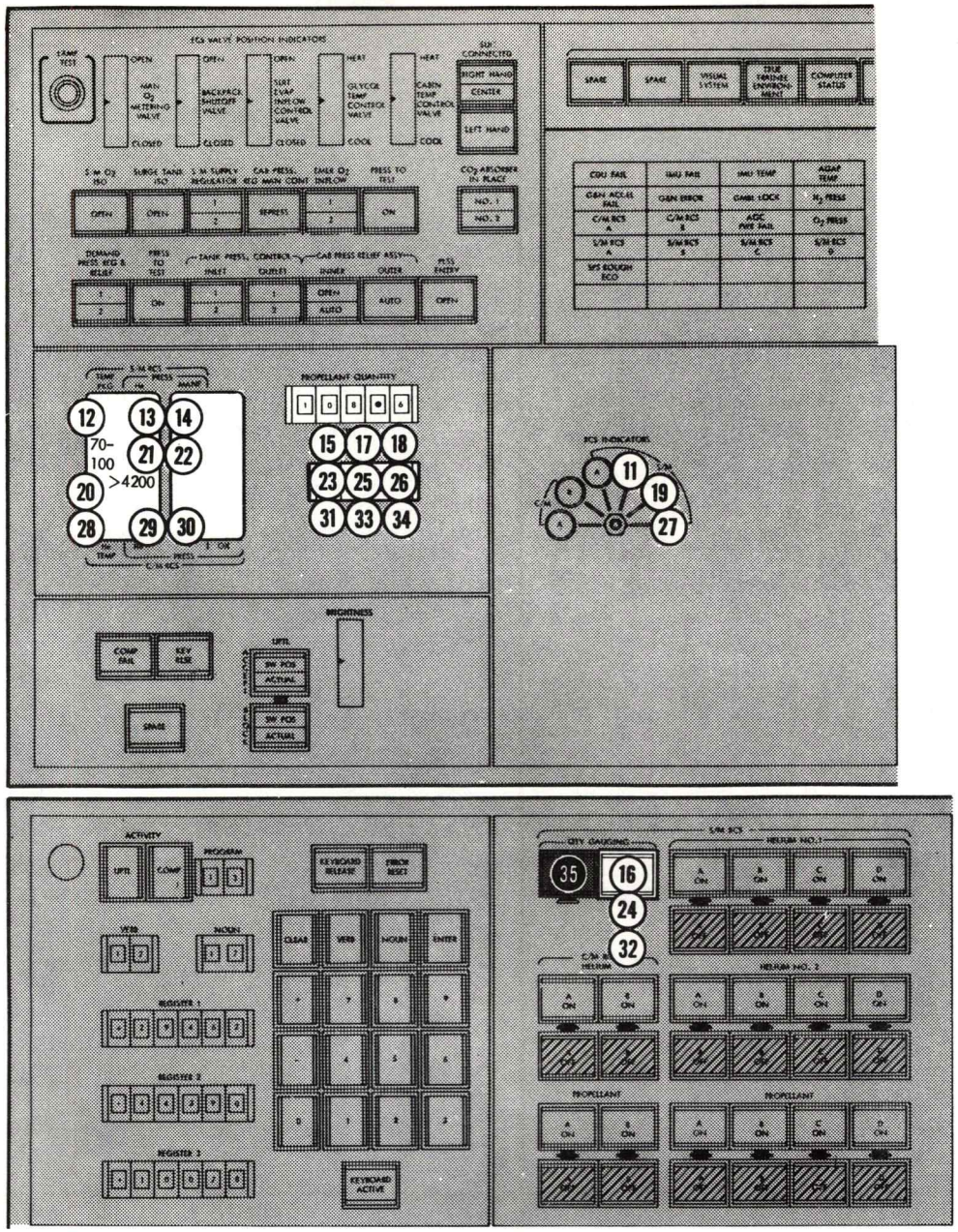
SM-6T-2-02-608

S/M RCS Periodic Check

RC2.02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
19-26			S/M RCS C Check		
19			RCS INDICATORS sw - S/M C	RCS INDICATORS S/M - C lt on	
20			Record S/M TEMP PKG ind	70 - 100	
21			Record S/M SYS PRESS He ind	Less than 4200	
22			Record S/M SYS PRESS MANF ind	177 - 192	
23			Record FUEL and OX quantity readout	Fuel 69.3, oxid 137.4 full	
24-26			Quantity Gaging Test Check		
24			S/M QTY GAUGING TEST sw - TEST and release	S/M QTY GAUGING - TEST lt on	
25			Check fuel and oxid digital readouts increase	In approx 10 sec readout increased to: fuel 90.2, oxidizer 180.2	
26			Fuel and oxid readouts return to actual	Return to actual in 20 sec	



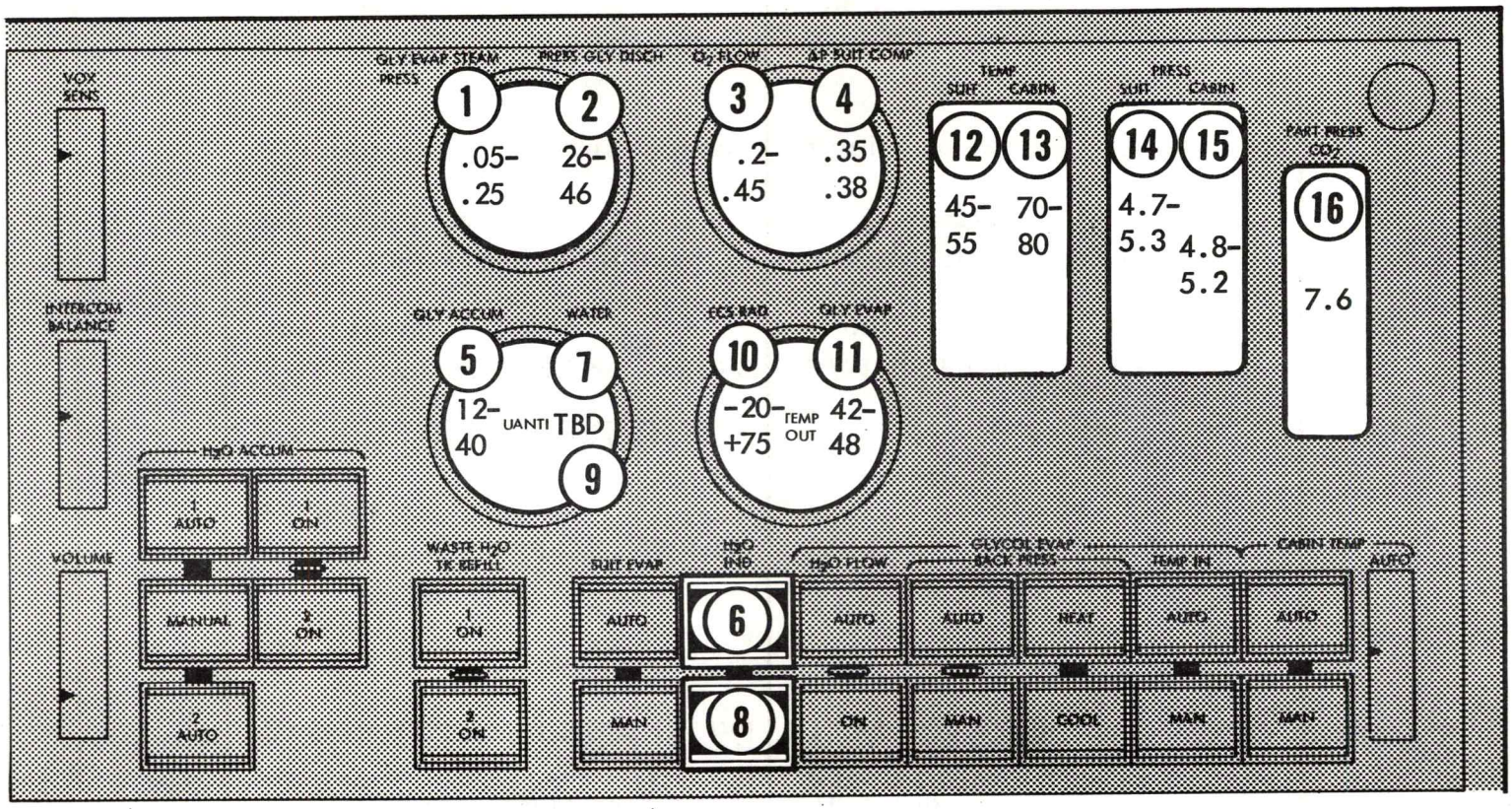
SM-6T-2-02-608

S/M RCS Periodic Check

RC2.02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
27-34			S/M RCS D Check		
27			RCS INDICATORS sw - S/M D	RCS INDICATORS S/M - D lt on	
28			Record S/M TEMP PKG ind	70 - 100	
29			Record S/M SYS PRESS He ind	Less than 4200	
30			Record S/M SYS PRESS MANF ind	177 - 192	
31			Record FUEL and OX quantity readout	Fuel 69.3, oxid 137.4	
32-38			Quantity Gaging Test Check		
32			S/M QTY GAUGING sw - TEST and release	S/M QTY GAUGING - TEST lt on	
33			Check fuel and oxid digital readouts increase	Readout increased to: fuel 90.2, oxidizer 180.2	
34			Fuel and oxid readouts return to actual	Return to actual in 40 sec	
35			S/M QTY GAUGING POWER sw - OFF	S/M QTY GAUGING PWR lt out	



SM-6T-2-02-574

Orbital ECS Hourly Check

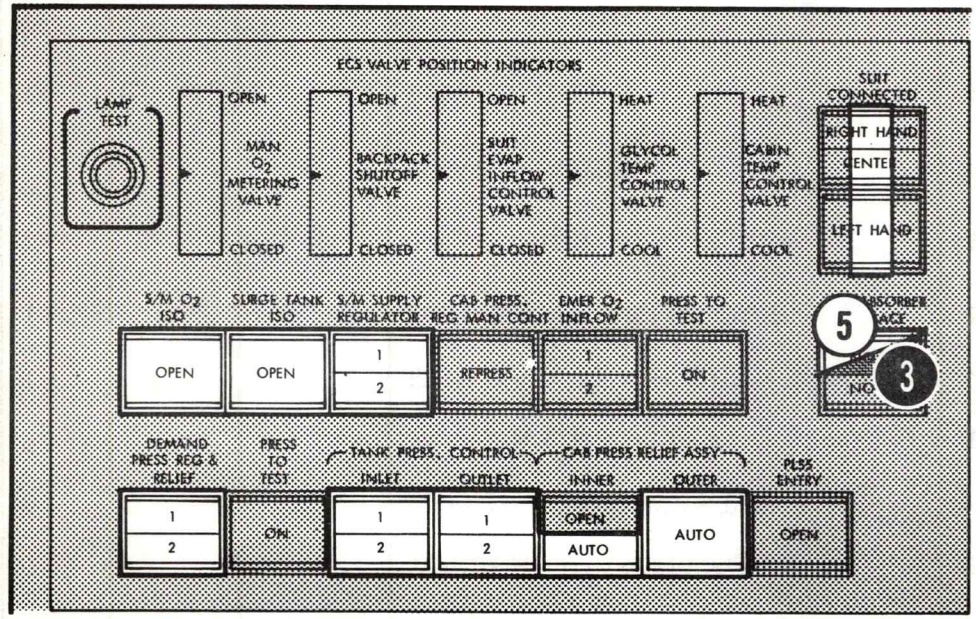
EC3.01

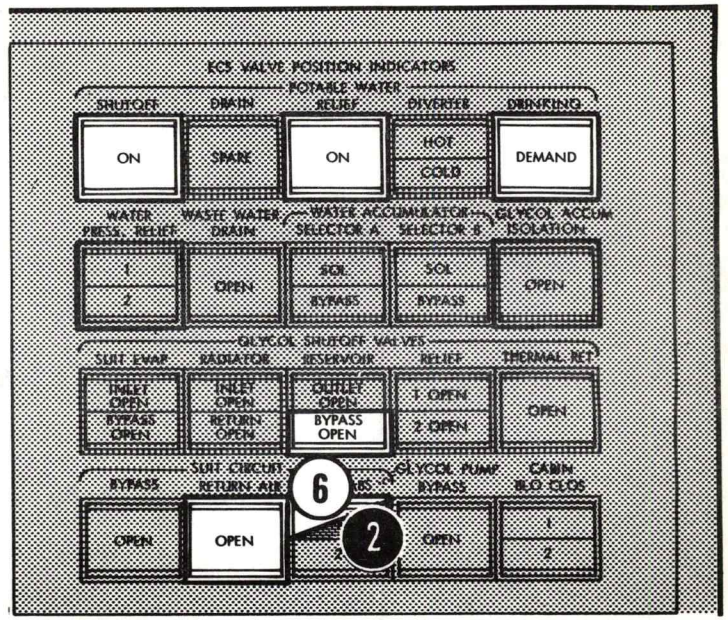
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			GLY EVAP STEAM PRESS	.05 - .25	
2			PRESS GLYC DISCH	26 - 46	
3			FLOW O_2	.2 - .45	
4			ΔP SUIT	.35 - .38	
5			GLY ACCUM QUANTITY	12 - 40	
6			H_2O IND sw - POT	H_2O IND - POT lt on	
7			WATER QUANTITY	TBD	
8			H_2O IND sw - WASTE	H_2O IND - WASTE lt on	
9			WATER QUANTITY	TBD	
10			ECS RAD TEMP OUT	-20 - +75	
11			GLY EVAP TEMP OUT	42 - 48	
12			TEMP SUIT	45 - 55	
13			TEMP CABIN	70 - 80	
14			PRESS SUIT	4.7 - 5.3	
15			PRESS CABIN	4.8 - 5.2	
16			PART PRESS CO_2	7.6	

Orbital ECS Hourly Check

EC3.01





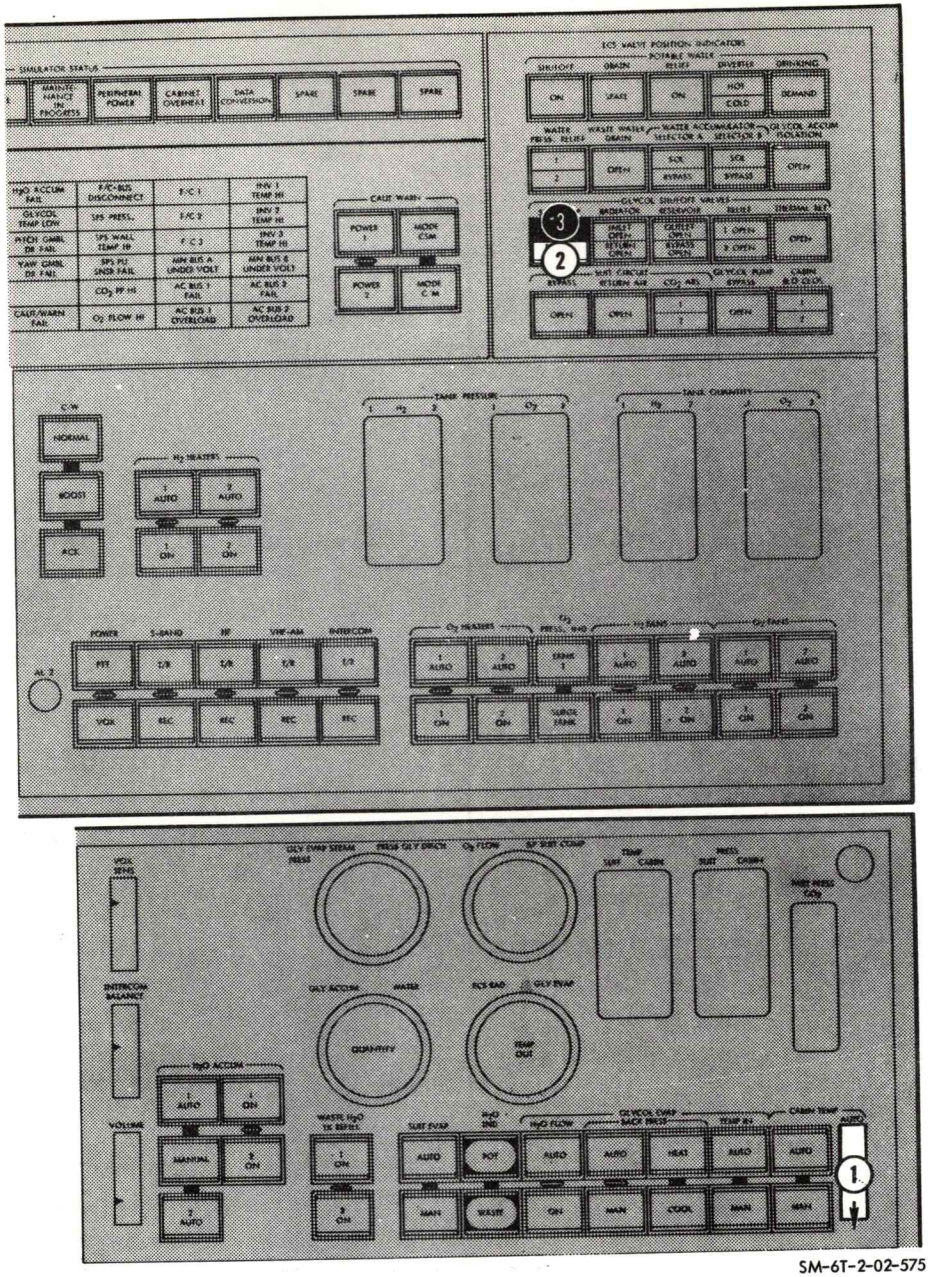
LISTED STEPS

1,4,7

SM-6T-2-02-290A

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Obtain unused filter from storage container	Observe TV monitor	
2			Set diverter valve to release interlock of appropriate canister	SUIT CIRCUIT CO_2 ABS 1 or 2 lt out, 2 or 1 lt on	
3			Open canister	CO_2 ABSORBER IN PLACE - 1 or 2 lt out	
*4			Replace with fresh filter	Observe TV monitor	
5			Close canister	CO_2 ABSORBER IN PLACE 1 or 2 lt on	
6			Set diverter valve to center	SUIT CIRCUIT CO_2 ABS 1 and 2 lts on	
*7			Place used filter in storage container	Observe TV monitor	



SM-6T-2-02-575

Cabin Cold-Soak

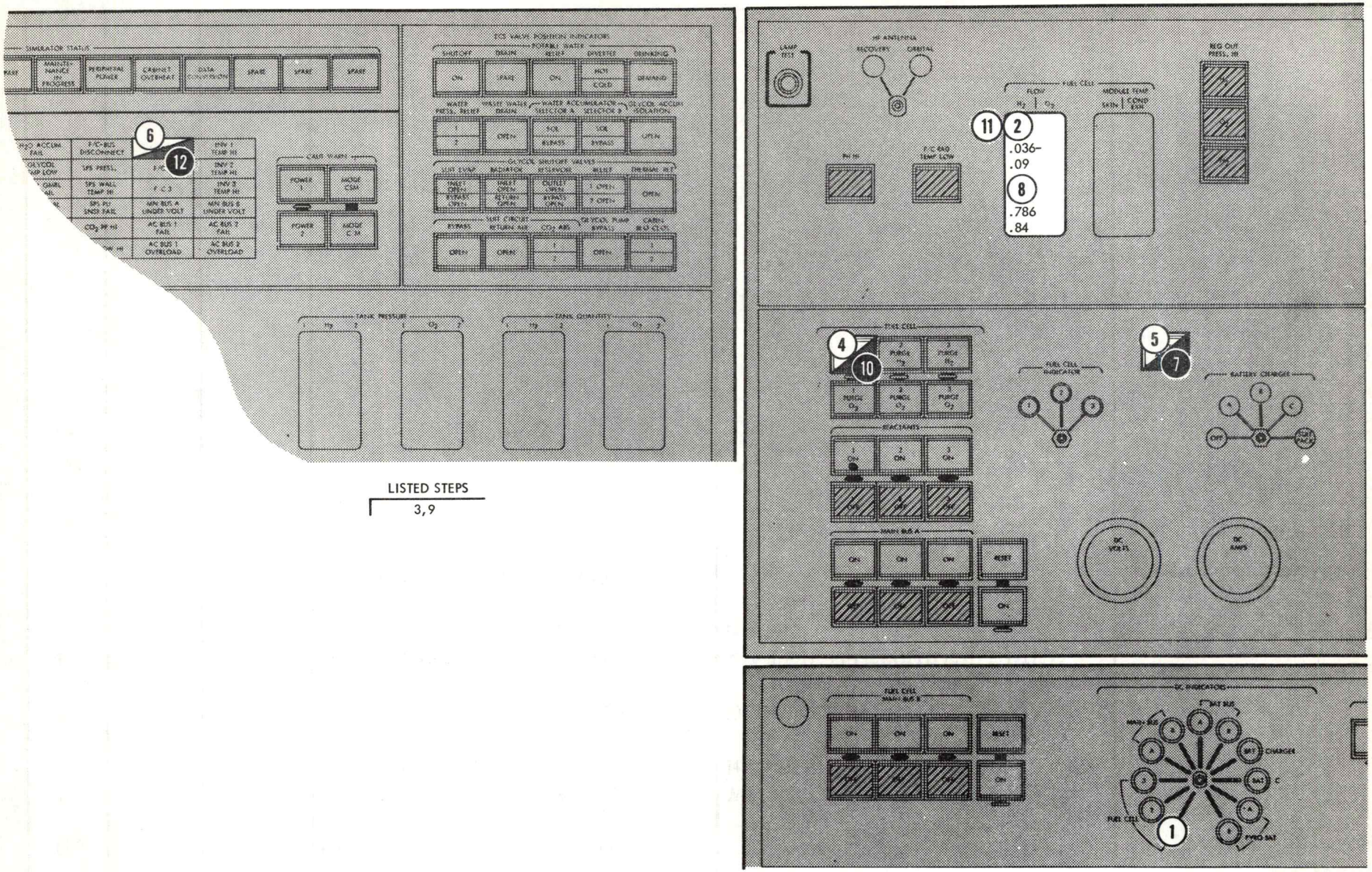
EC3.05

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			CABIN TEMP AUTO control - full decrease	CABIN TEMP AUTO ind to decrease	
2			SUIT EVAP GLYCOL BYPASS control - ON	GLYCOL SHUTOFF VALVES SUIT EVAP - BYPASS OPEN lt on	
3			SUIT EVAP GLYCOL INLET control - OFF	GLYCOL SHUTOFF VALVES SUIT EVAP - INLET OPEN lt out	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			DUMP HEATER sw - ON		Not provided on AMS.
2			OVERBOARD PRESSURE RELIEF valve - ON	WATER PRESSURE RELIEF lts on	
3			Check WATER QUANTITY ind	Decrease to correct level	
4			OVERBOARD PRESSURE RELIEF valve - AUTO	WATER PRESSURE RELIEF lts out	
5			DUMP HEATER sw - OFF		Not provided on AMS.



LISTED STEPS

3,9

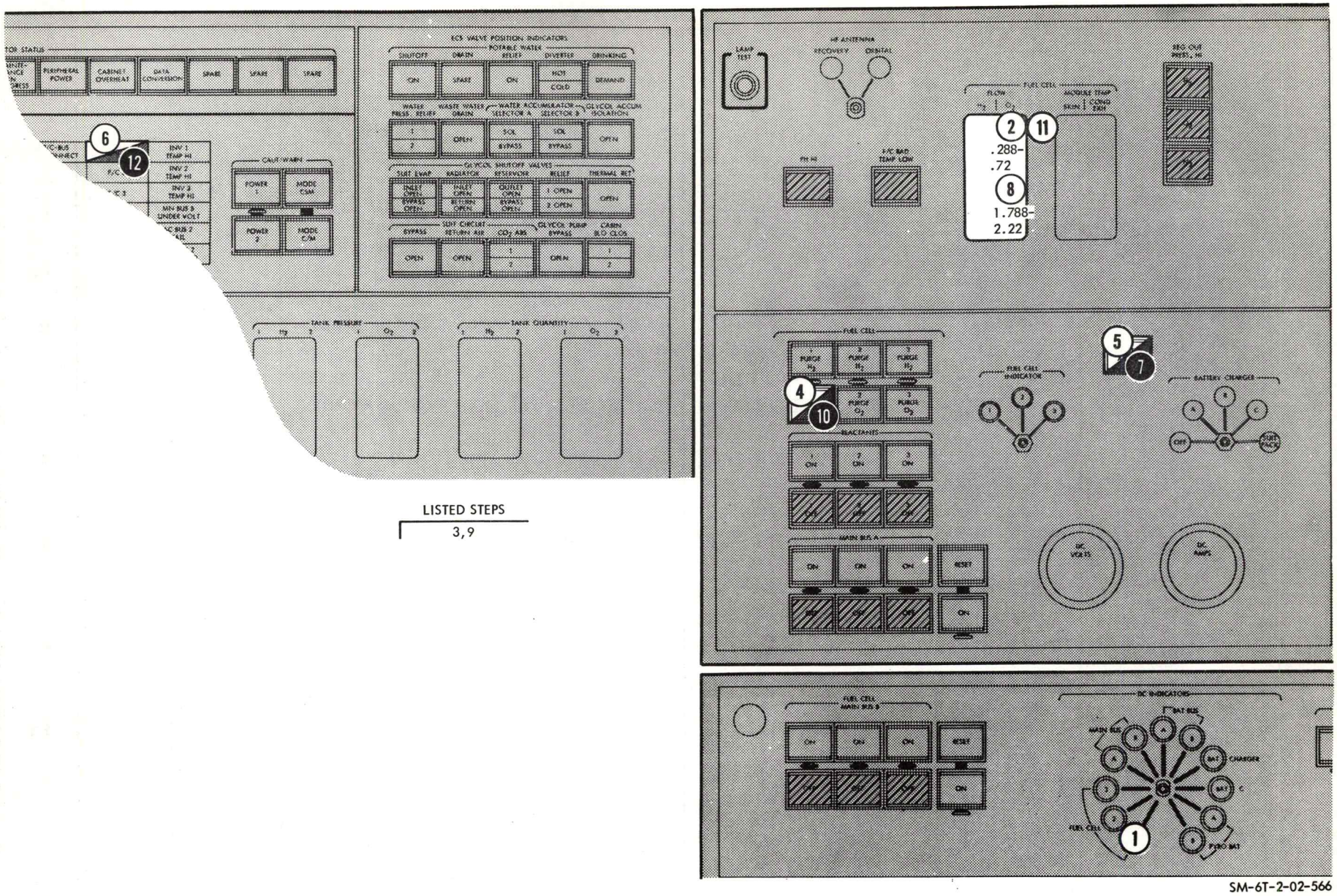
SM-6T-2-02-565

Fuel Cell Hydrogen Purge

EP3.05

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	
2			FLOW H_2 ind	.036 - .09	
*3			Request seat 1, set event timer for 80 sec	RESET lt on, out when released, DOWN lt on	
4		X	Request seat 1, start event timer, and place FUEL CELL 1 sw - H_2 PURGE	START lt on, out when released, timer counting down, FUEL CELL - 1 PURGE H_2 lt on	
5			MASTER CAUTION lt on, audio tone in headsets	MASTER CAUTION lt on	
6			F/C 1 C&W lt on	F/C 1 C&W lt on	
7			Depress MASTER CAUTION sw lt	MASTER CAUTION lt out, audio tone stops	
8			FLOW H_2 ind increase by 0.75	.786 - .84	
*9			Monitor SECONDS timer		
10		X + 80 sec	FUEL CELL 1 H_2 PURGE sw off	FUEL CELL - 1 PURGE H_2 lt out	
11			FLOW H_2 ind decrease to normal	.036 - .09	
12			F/C 1 C&W lt out	F/C 1 C&W lt out	



SM-6T-2-02-566

LISTED STEPS

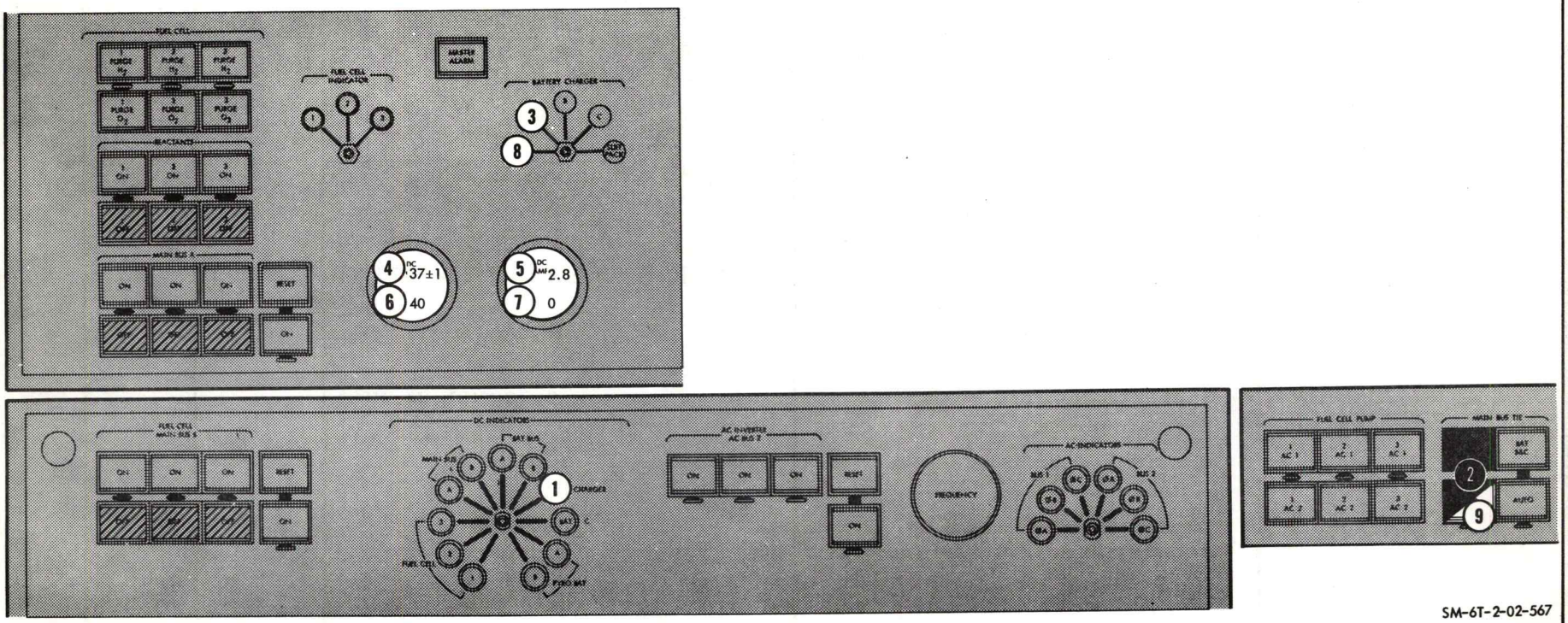
3,9

Fuel Cell Oxygen Purge

EP3.06

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	
2			Check FLOW O_2 ind	.288 - .72	
*3			Request seat 1, set event timer for 120 seconds	RESET lt on, out when released, DOWN lt on	
4		X	Request seat 1, start event timer, and place FUEL CELL 1 sw - O_2 PURGE	START lt on, out when released, timer counting down, FUEL CELL - 1 PURGE O_2 lt on	
5			MASTER CAUTION lt on, audio tone in headsets	MASTER CAUTION lt on	
6			F/C 1 C&W lt on	F/C 1 C&W lt on	
7			Depress MASTER CAUTION sw-lt	MASTER CAUTION lt out, audio tone stops	
8			FLOW O_2 ind increase by 1.5	1.788 - 2.22	
*9			Monitor event timer	Timer to zero	
10		X + 120 sec	FUEL CELL 1 O_2 PURGE sw off	FUEL CELL - 1 PURGE O_2 lt out	
11			FLOW O_2 decrease	.288 - .72	
12			F/C 1 C&W lt out	F/C 1 C&W lt out	



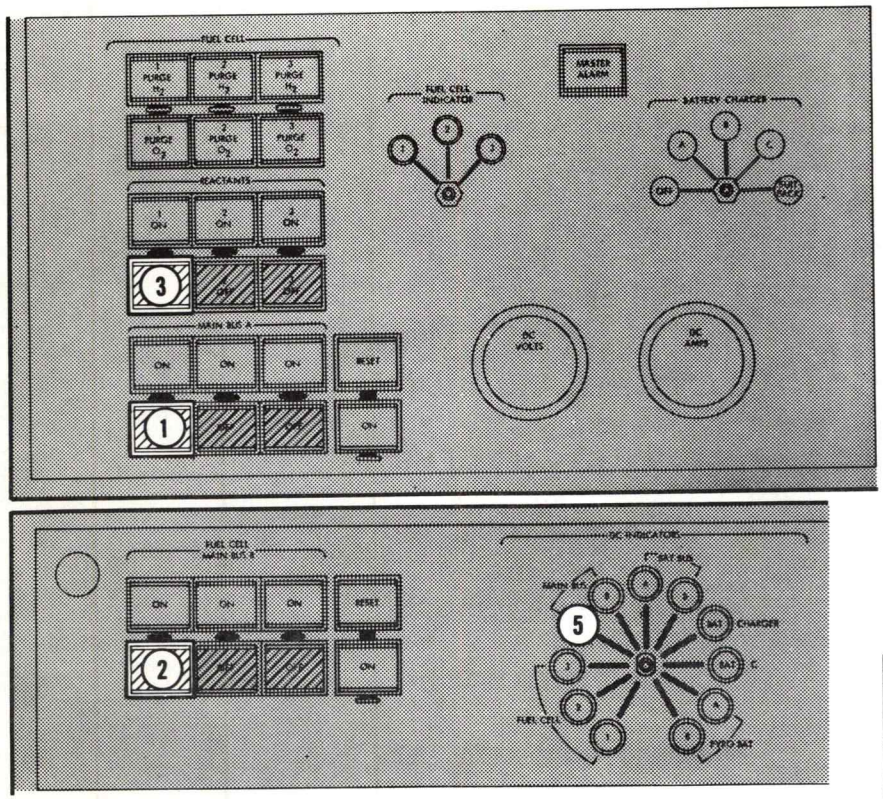
SM-6T-2-02-567

Battery Charge

EP3.07

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			DC INDICATORS sw - BAT CHARGER	DC INDICATORS - BAT CHARGER lt on	
2			MAIN BUS TIE BAT A&C sw OFF	MAIN BUS TIE - BAT A&C and AUTO lts out	
3			BATTERY CHARGER sw - A	BAT CHARGER - A lt on	
4			DC VOLTS ind 37±1	Charging volts	
5			DC AMPS ind 2.8	Charging current	
6			DC VOLTS ind 40	Full charge	
7			DC AMPS ind 0	Full charge	
8			BATTERY CHARGER sw - OFF	BAT CHARGER - OFF lt on	
9			MAIN BUS TIE BAT A&C sw - AUTO	MAIN BUS TIE - AUTO lt on	



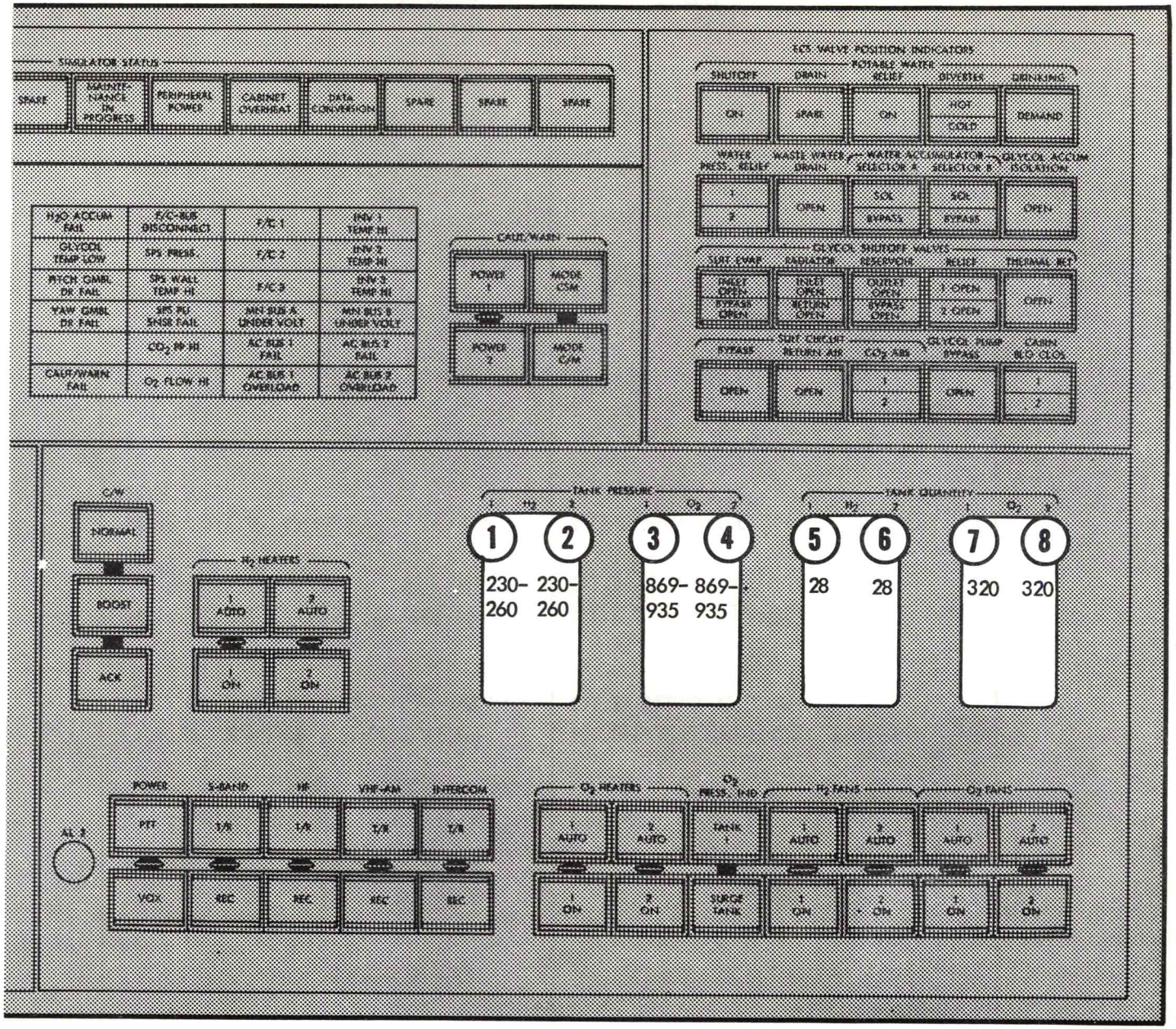
SM-6T-2-02-573

Fuel Cell Shutdown Procedures

EP3.08

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL 1 MAIN BUS A sw - OFF and check event ind striped	FUEL CELL 1 MAIN BUS A - striped OFF lt on	These procedures are not based on SM2A-03.
2			FUEL CELL 1 MAIN BUS B sw - OFF and check event ind striped	FUEL CELL 1 MAIN BUS B - striped OFF lt on	
3			FUEL CELL 1 REACTANTS sw - OFF and check event ind striped	FUEL CELL REACTANTS - 1 OFF striped lt on	
4			FUEL CELL PUMPS NO. 1 sw - OFF	FUEL CELL PUMPS NO. 1 - OFF lt on	
5			DC INDICATORS sw - MAIN BUS A	DC INDICATORS MAIN BUS A - lt on	



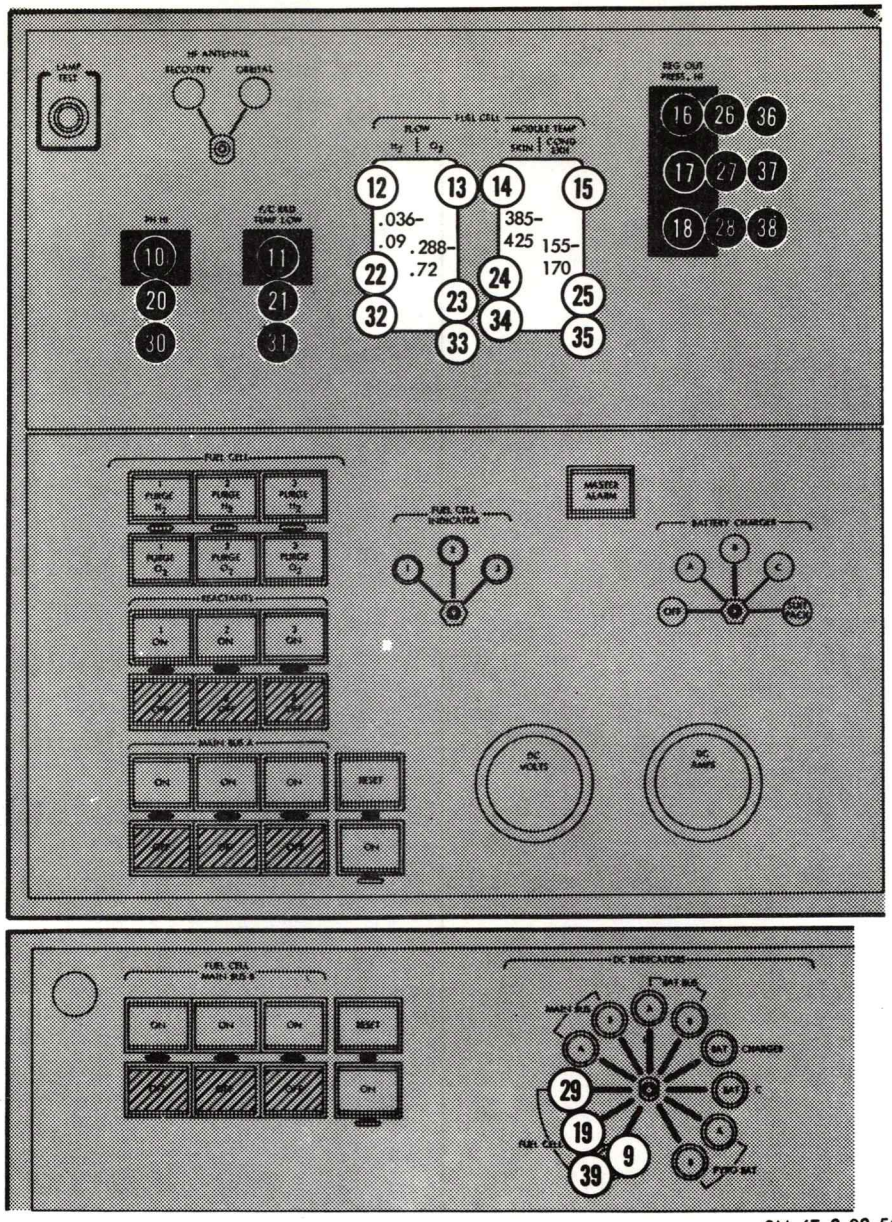
SM-6T-2-02-570

EPS Periodic Check (Cryogenics)

EP3.10

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			TANK PRESSURE H_2 1 ind	230 - 260	
2			TANK PRESSURE H_2 2 ind	230 - 260	
3			TANK PRESSURE O_2 1 ind	869 - 935	
4			TANK PRESSURE O_2 2 ind	869 - 935	
5			TANK QUANTITY H_2 1 ind	28 max.	
6			TANK QUANTITY H_2 2 ind	28 max.	
7			TANK QUANTITY O_2 1 ind	320 max.	
8			TANK QUANTITY O_2 2 ind	320 max.	



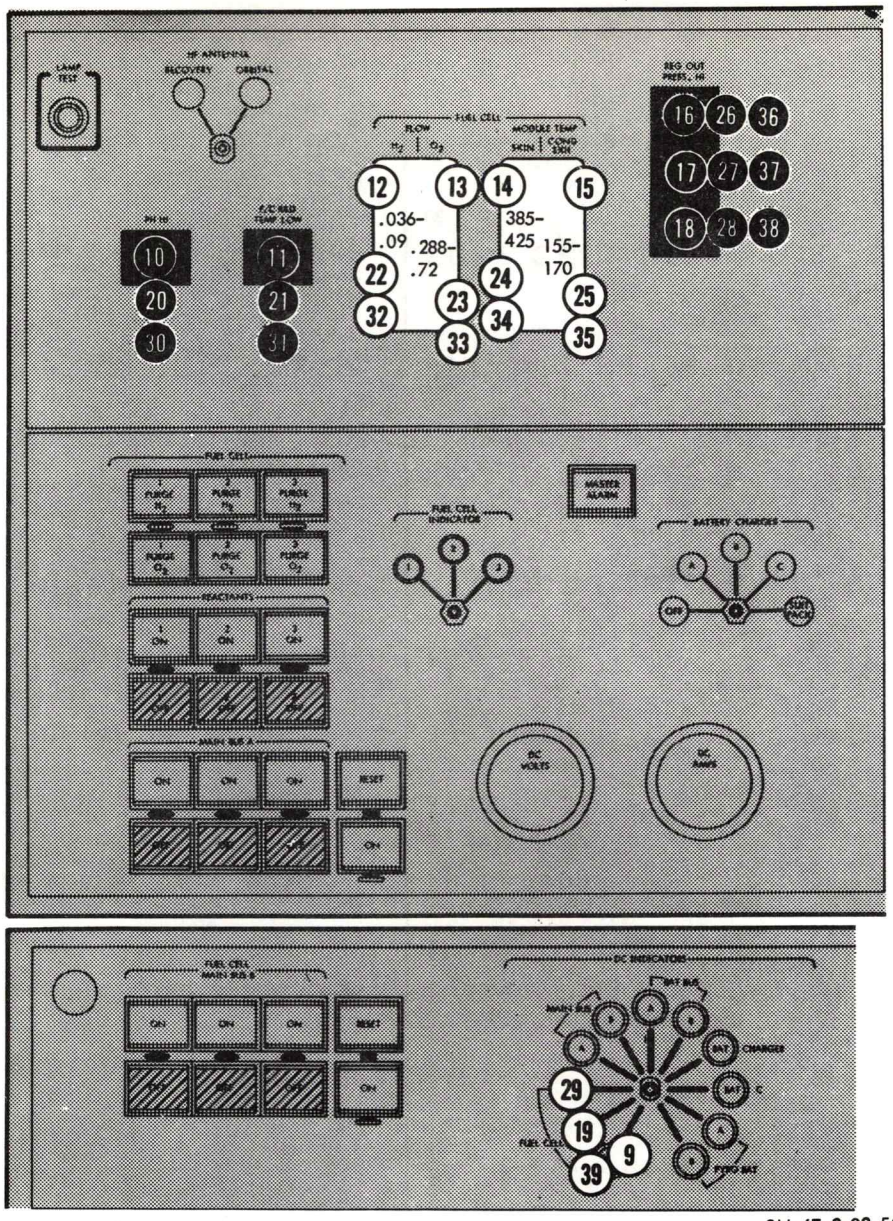
SM-6T-2-02-569

EPS Periodic Check (Fuel Cells)

EP3.10

IOS DATA SHEET

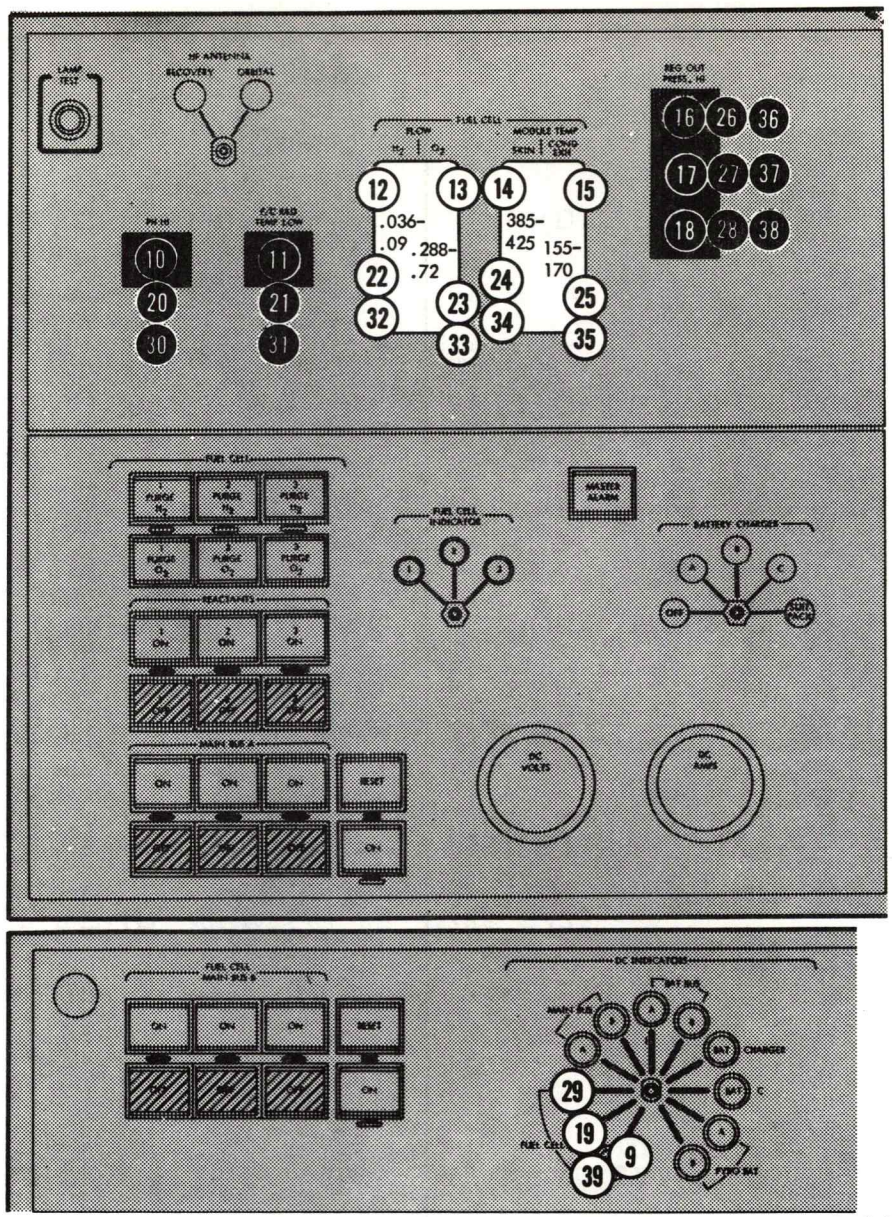
Step	Malf	Time	Function	IOS Visibility/Action	Notes
9			Verify FUEL CELL INDICATORS - 1	FUEL CELL INDICATOR - 1 lt on	
10			pH HI event ind gray	PH HI lt out	
11			F/C RAD TEMP LO event ind gray	F/C RAD TEMP LO lt out	
12			FLOW H_2 ind	.036 - .09	
13			FLOW O_2 ind	.288 - .72	
14			MODULE TEMP SKIN ind	385 - 425	
15			MODULE TEMP COND EXH ind	155 - 170	
16			REG OUT PRESS HI - H_2 event ind gray	REG OUT PRESS HI - H_2 lt out	
17			REG OUT PRESS HI - O_2 event ind gray	REG OUT PRESS HI - O_2 lt out	
18			REG OUT PRESS HI - N_2 event ind gray	REG OUT PRESS HI - N_2 lt out	
19			FUEL CELL INDICATORS sw - 2	FUEL CELL INDICATOR - 1 lt on	
20			pH HI event ind gray	PH HI lt out	


LAMP TEST
12
13
14
15
.036-
.09
.288-
.72
385-
425
155-
170
22
32
23
33
24
34
25
35
16
26
36
17
27
37
18
28
38
10
20
30
11
21
31
FUEL CELL
MASTER ALARM
BATTERY CHARGER
RESET
DC VOLTS
DC AMPS
DC INDICATORS
29
19
39
9

SM-6T-2-02-569

IOS DATA SHEET

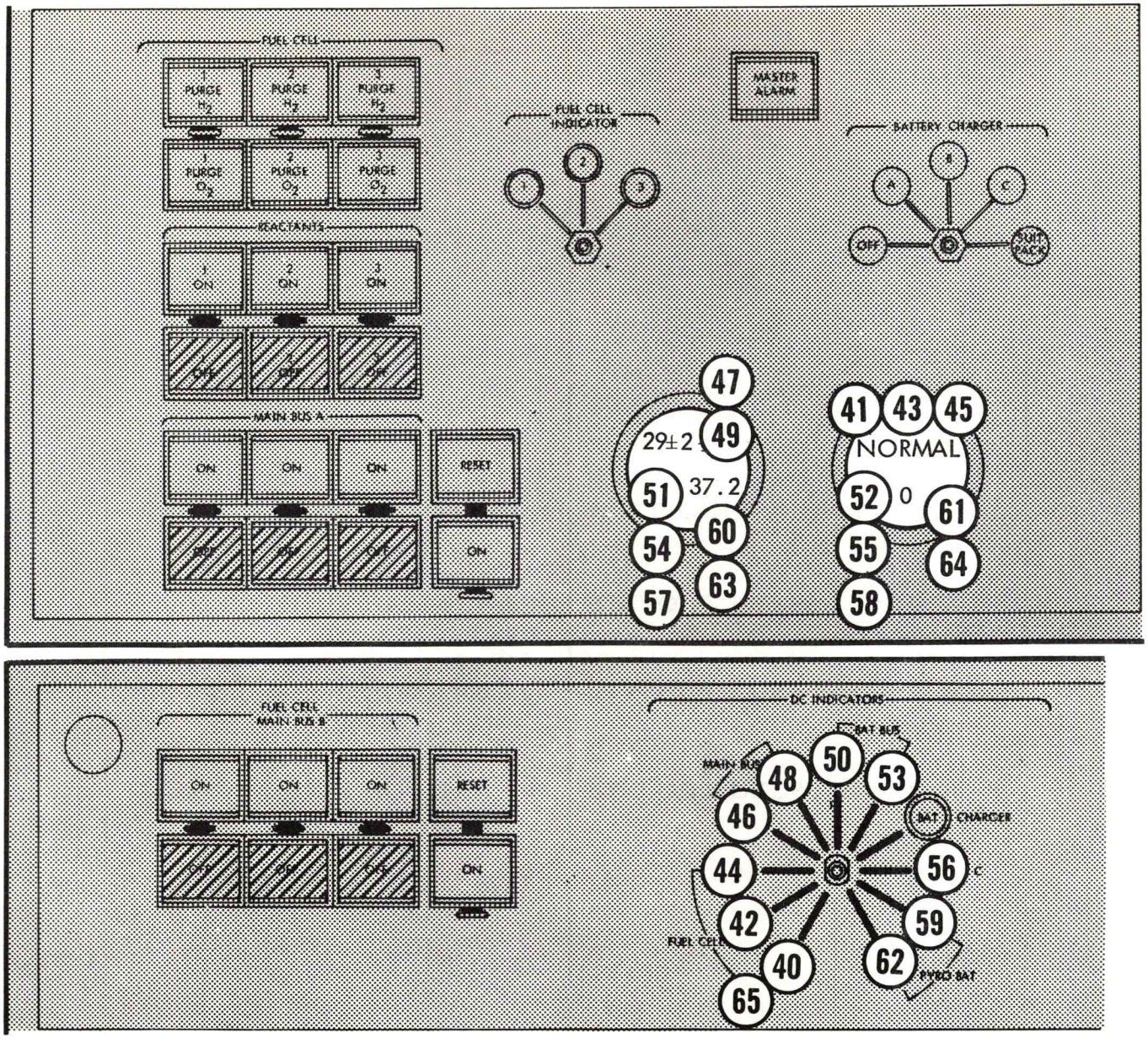
Step	Malf	Time	Function	IOS Visibility/Action	Notes
21			F/C RAD TEMP LO event ind gray	F/C RAD TEMP LO lt out	
22			FLOW - H_2	.036 - .09	
23			FLOW - O_2	.288 - .72	
24			MODULE TEMP - SKIN ind	385 - 425	
25			MODULE TEMP - COND EXH ind	155 - 170	
26			REG OUT PRESS HI - H_2 event ind gray	REG OUT PRESS HI - H_2 lt out	
27			REG OUT PRESS HI - O_2 event ind gray	REG OUT PRESS HI - O_2 lt out	
28			REG OUT PRESS HI - N_2 event ind gray	REG OUT PRESS HI - N_2 lt out	
29			FUEL CELL INDICATOR sw - 3	FUEL CELL INDICATOR - 3 lt on	
30			pH HI event ind gray	PH HI	
31			F/C RAD TEMP LO event ind gray	FC RAD TEMP LO lt out	
32			FLOW - H_2 ind	.036 - .09	


LAMP TEST
HF ANTENNA
RECOVERY
ORBITAL
FUEL CELL
FLOW
MODULE TEMP
SKIN
COND EXH
12
13
14
15
.036-
.09
.288-
.72
385-
425
155-
170
16
26
36
17
27
37
18
28
38
10
20
30
11
21
31
22
32
23
33
24
34
25
35
FUEL CELL
PURGE
REACTANTS
ON
RESET
MASTER ALARM
FUEL CELL INDICATOR
BATTERY CHARGER
AC VOLTS
AC AMPS
DC INDICATOR
BAT BUS
MAIN BUS
CHARGER
29
19
9
39

SM-6T-2-02-569

IOS DATA SHEET

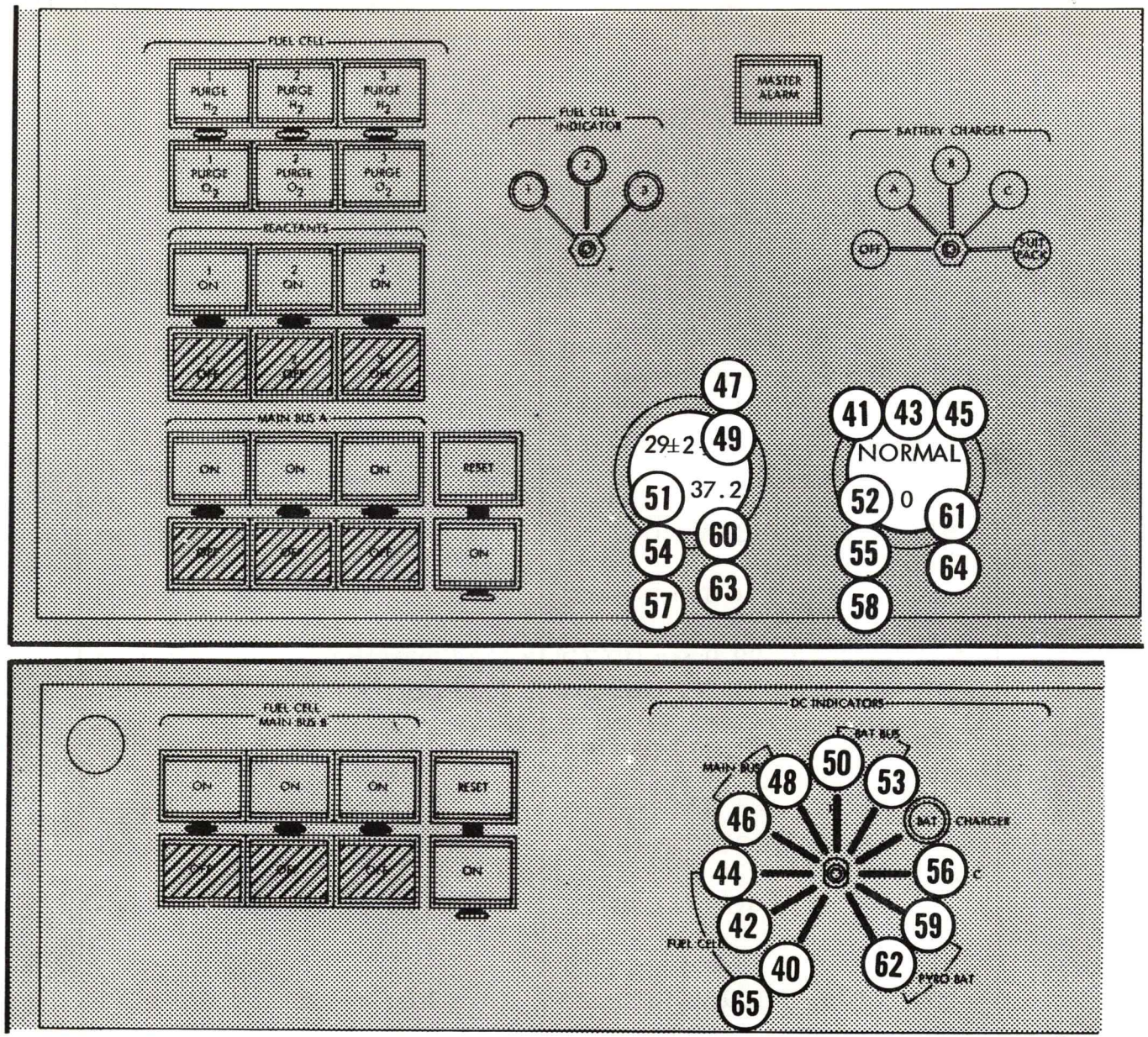
Step	Malf	Time	Function	IOS Visibility/Action	Notes
33			FLOW - O_2 ind	.288 - .72	
34			MODULE TEMP - SKIN ind	385 - 425	
35			MODULE TEMP - COND EXH ind	155 - 170	
36			REG OUT PRESS HI - H_2 event ind gray	REG OUT PRESS HI - H_2 lt out	
37			REG OUT PRESS HI - O_2 event ind gray	REG OUT PRESS HI - O_2 lt out	
38			REG OUT PRESS HI - N_2 event ind gray	REG OUT PRESS HI - N_2 lt out	
39			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	


FUEL CELL
PURGE H2
PURGE O2
REACTANTS
ON
OFF
MAIN BUS A
RESET
FUEL CELL INDICATOR
MASTER ALARM
BATTERY CHARGER
A
B
C
OFF
SUIT PACK
47
49
29±2
51
37.2
60
54
63
57
41
43
45
NORMAL
52
0
61
55
64
58
FUEL CELL MAIN BUS B
DC INDICATORS
BAT BUS
MAIN BUS
48
50
53
46
BAT CHARGER
44
56
C
42
59
FUEL CELL
40
62
PYRO BAT
65

SM-6T-2-02-568

IOS DATA SHEET

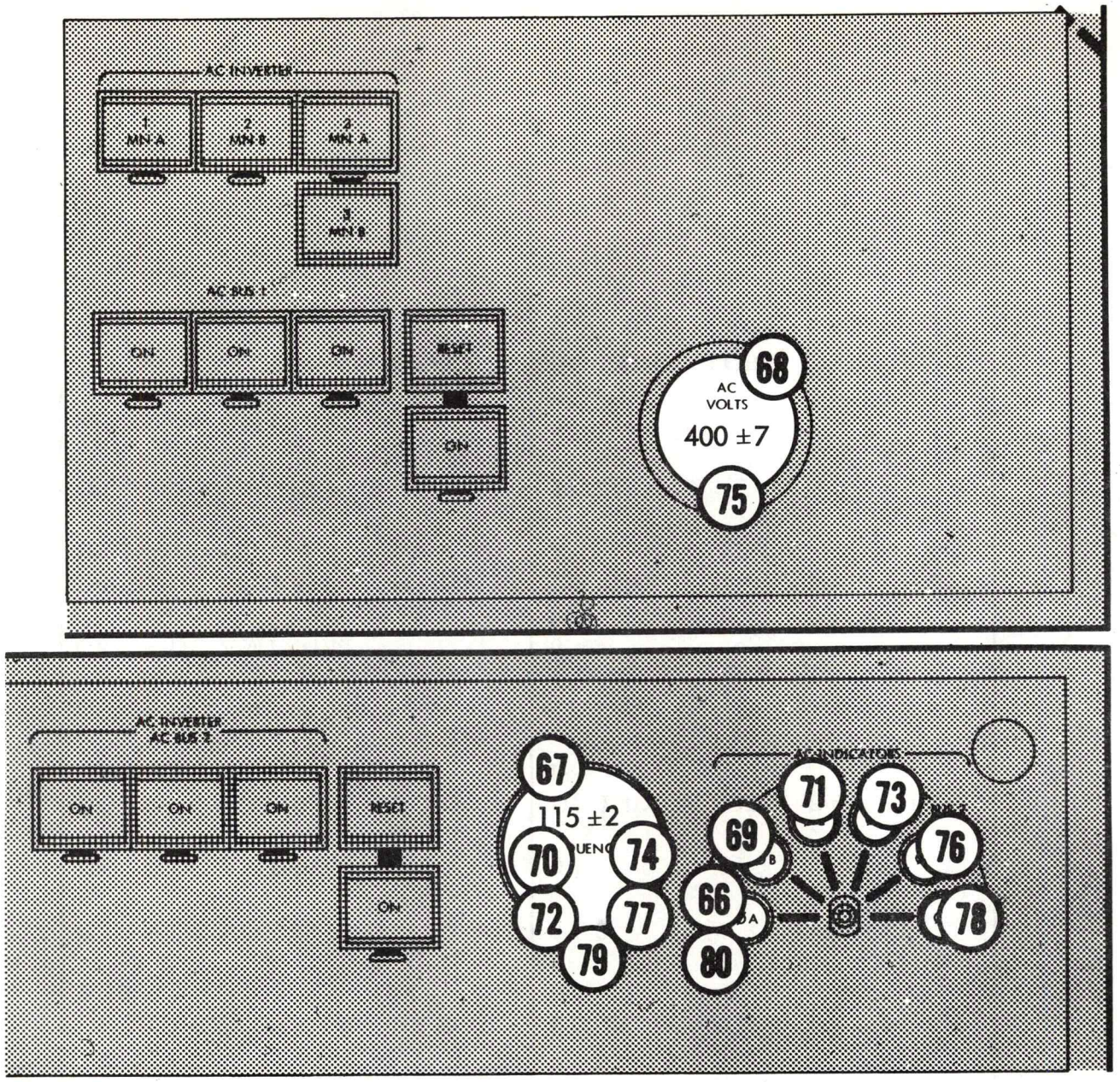
Step	Malf	Time	Function	IOS Visibility/Action	Notes
40			DC INDICATORS sw - FUEL CELL 1	DC INDICATORS, FUEL CELL - 1 lt on	
41			Check DC AMPS ind	Normal (TBD)	
42			DC INDICATORS sw - FUEL CELL 2	DC INDICATORS, FUEL CELL - 2 lt on	
43			Check DC AMPS ind	Normal (TBD)	
44			DC INDICATORS sw - FUEL CELL 3	DC INDICATORS, FUEL CELL - 3 lt on	
45			Check DC AMPS ind	Normal (TBD)	
46			DC INDICATORS sw - MAIN BUS A	DC INDICATORS, MAIN BUS A lt on	
47			Check DC VOLTS ind	29±2	
48			DC INDICATORS sw - MAIN BUS B	DC INDICATORS, MAIN BUS B lt on	
49			Check DC VOLTS ind	29±2	
50			DC INDICATORS sw - BAT BUS A	DC INDICATORS, BAT BUS A lt on	
51			Check DC VOLTS ind	37.2	
52			Check DC AMPS ind	0	


FUEL CELL
1 PURGE H_2
2 PURGE H_2
3 PURGE H_2
1 PURGE O_2
2 PURGE O_2
3 PURGE O_2
REACTANTS
1 ON
2 ON
3 ON
MAIN BUS A
ON
ON
ON
RESET
ON
FUEL CELL INDICATOR
MASTER ALARM
BATTERY CHARGER
A
B
C
OFF
SUIT PACK
47
49
29±2
51
37.2
60
54
57
63
41
43
45
NORMAL
52
0
61
55
64
58
FUEL CELL MAIN BUS B
ON
ON
ON
RESET
ON
DC INDICATORS
BAT BUS
MAIN BUS
48
50
53
46
BAT CHARGER
44
56
C
42
59
FUEL CELL
40
62
PYRO BAT
65

SM-6T-2-02-568

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
53			DC INDICATORS sw - BAT BUS B	DC INDICATORS, BAT BUS B lt on	
54			Check DC VOLTS ind	37.2	
55			Check DC AMPS ind	0	
56			DC INDICATORS sw - POST LDG BAT	DC INDICATORS, BAT BUS C lt on	
57			Check DC VOLTS ind	37.2	
58			Check DC AMPS ind	0	
59			DC INDICATORS sw - PYRO BAT - A	DC INDICATORS, PYRO BAT - A lt on	
60			Check DC VOLTS ind	37.2	
61			Check DC AMPS ind	0	
62			DC INDICATORS sw - PYRO BAT - B	DC INDICATORS, PYRO BAT - B lt on	
63			Check DC VOLTS ind	37.2	
64			Check DC AMPS ind	0	
65			DC INDICATORS sw - FUEL CELL 1	DC INDICATORS FUEL CELL 1 lt on	



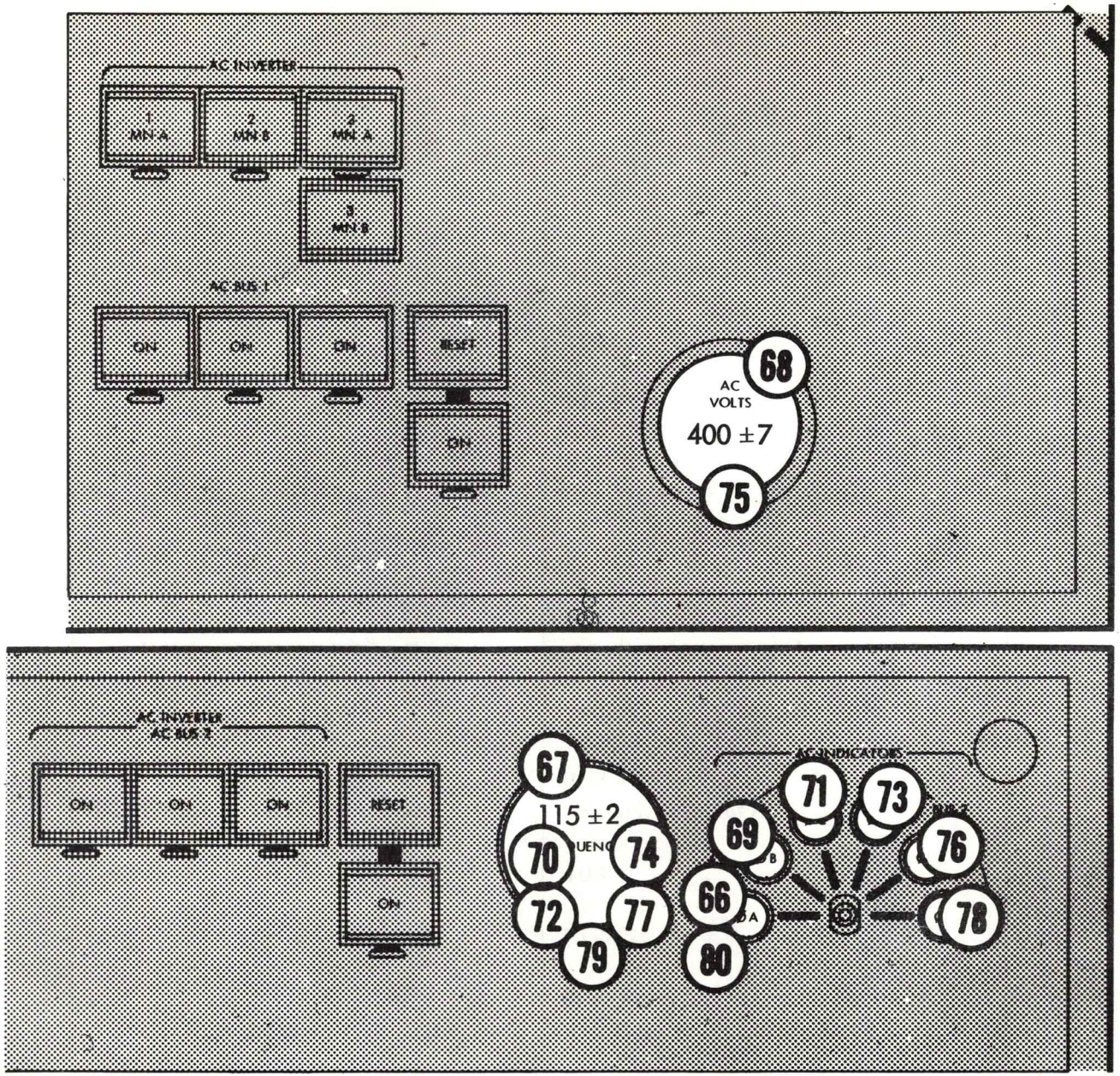
SM-6T-2-02-571

EPS Periodic Check (A-C Power)

EP3.10

IOS DATA SHEET

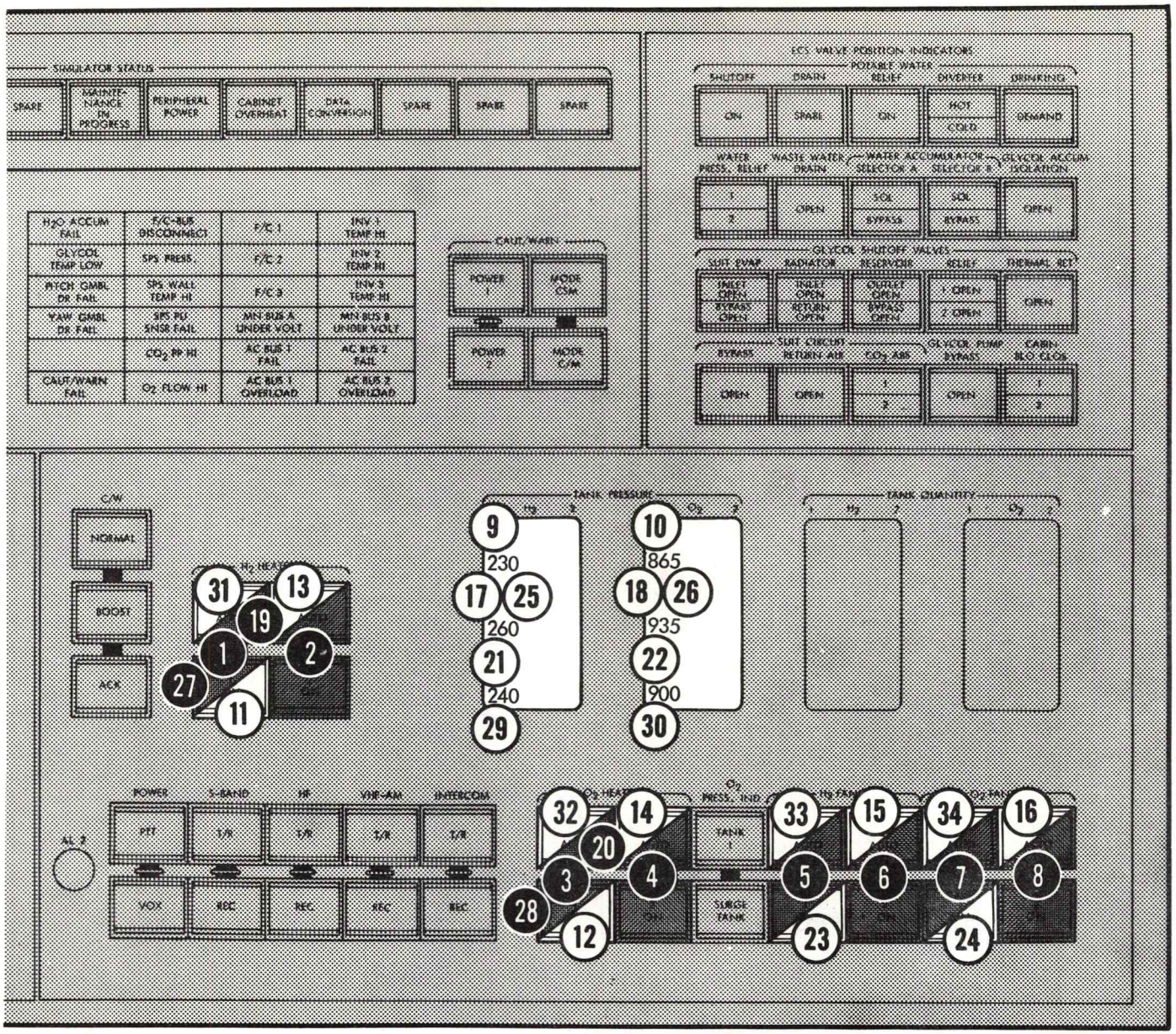
Step	Malf	Time	Function	IOS Visibility/Action	Notes
66			AC INDICATORS sw - BUS 1 Ø A	AC INDICATORS, BUS 1 - Ø A lt on	
67			Check AC VOLTS ind	115±2	
68			Check FREQUENCY ind	400±7	
69			AC INDICATORS sw - BUS 1 Ø B	AC INDICATORS, BUS 1 - Ø B lt on	
70			Check AC VOLTS ind	115±2	
71			AC INDICATORS sw - BUS 1 Ø C	AC INDICATORS, BUS 1 - Ø C lt on	
72			Check AC VOLTS ind	115±2	
73			AC INDICATORS sw - BUS 2 Ø A	AC INDICATORS, BUS 2 - Ø A lt on	
74			Check AC VOLTS ind	115±2	
75			Check FREQUENCY ind	400±7	
76			AC INDICATORS sw - BUS 2 Ø B	AC INDICATORS, BUS 2 - Ø B lt on	
77			Check AC VOLTS ind	115±2	
78			AC INDICATORS sw - BUS 2 Ø C	AC INDICATORS, BUS 2 - Ø C lt on	


AC INVERTER
1 MN A
2 MN B
4 MN A
3 MN B
AC BUS 1
ON
ON
ON
RESET
ON
68
AC VOLTS
400 ±7
75
AC INVERTER
AC BUS 2
ON
ON
ON
RESET
ON
67
115 ±2
70
74
72
77
79
AC INDICATORS
71
73
69
76
66
78
80

SM-6T-2-02-571

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
79			Check AC VOLTS ind	115±2	
80			AC INDICATORS sw - BUS 1 Ø A	AC INDICATORS, BUS 1 - Ø A lt on	



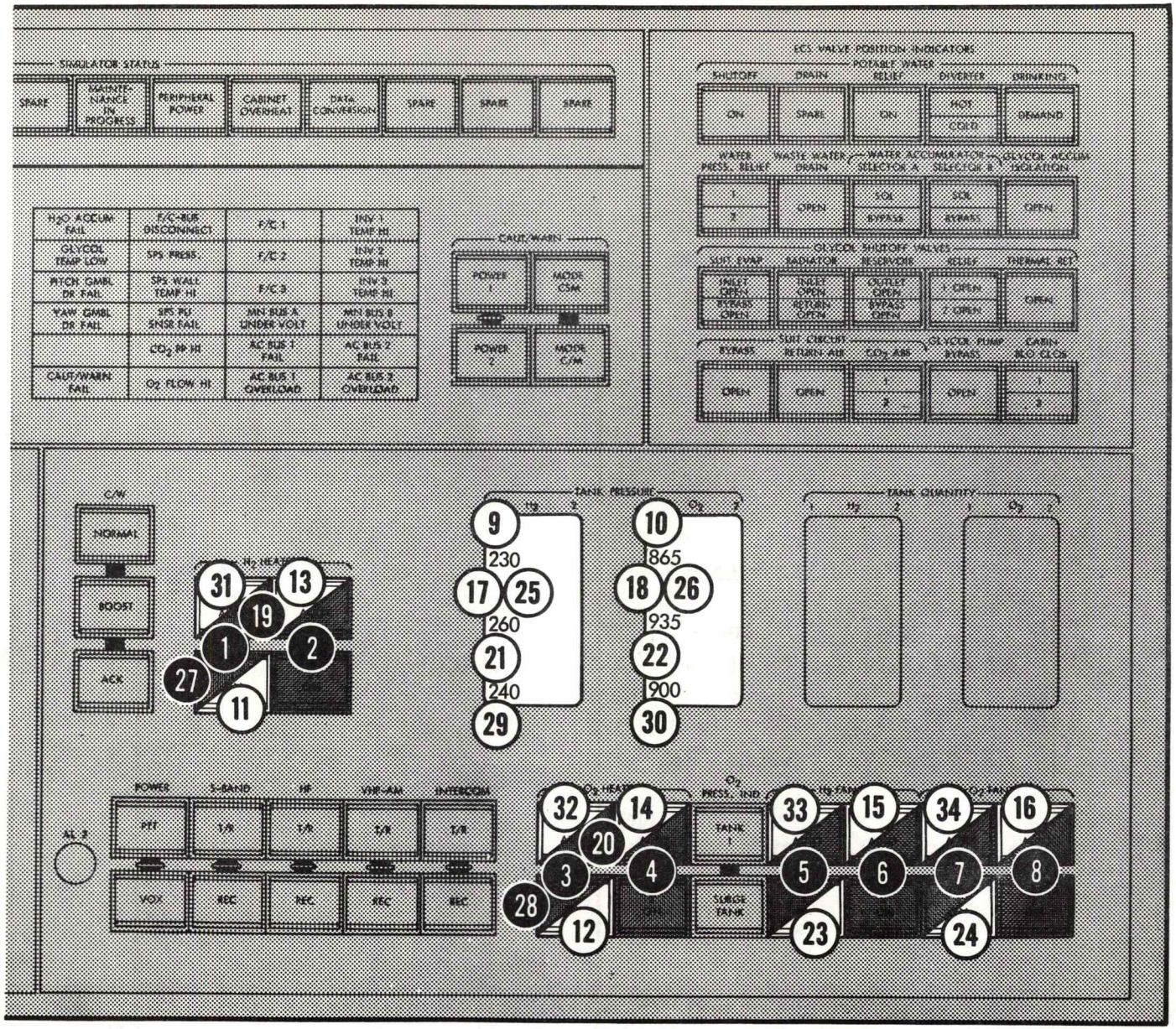
SM-6T-2-02-609

Manual Pressure Control Verification

EP3.11

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			H_2 HEATERS 1 sw - OFF	H_2 HEATERS - 1 AUTO and 1 ON lt on	
2			H_2 HEATERS 2 sw - OFF	H_2 HEATERS - 2 AUTO and 1 ON lt on	
3			O_2 HEATERS 1 sw - OFF	O_2 HEATERS - 1 AUTO and 1 ON lt on	
4			O_2 HEATERS 2 sw - OFF	O_2 HEATERS - 2 AUTO and 2 ON lts out	
5			H_2 FANS 1 sw - OFF	H_2 FANS - 1 AUTO and 1 ON lts out	
6			H_2 FANS 2 sw - OFF	H_2 FANS - 2 AUTO and 2 ON lts out	
7			O_2 FANS 1 sw - OFF	O_2 FANS - 1 AUTO and 1 ON lts out	
8			O_2 FANS 2 sw - OFF	O_2 FANS - 2 AUTO and 2 ON lts out	
9			Check TANK PRESSURE H_2 1	230	
10			Check TANK PRESSURE O_2 1	865	
11			H_2 HEATERS 1 sw - ON	H_2 HEATERS - ON lt on	
12			O_2 HEATERS 1 sw - ON	O_2 HEATERS - 1 ON lt on	



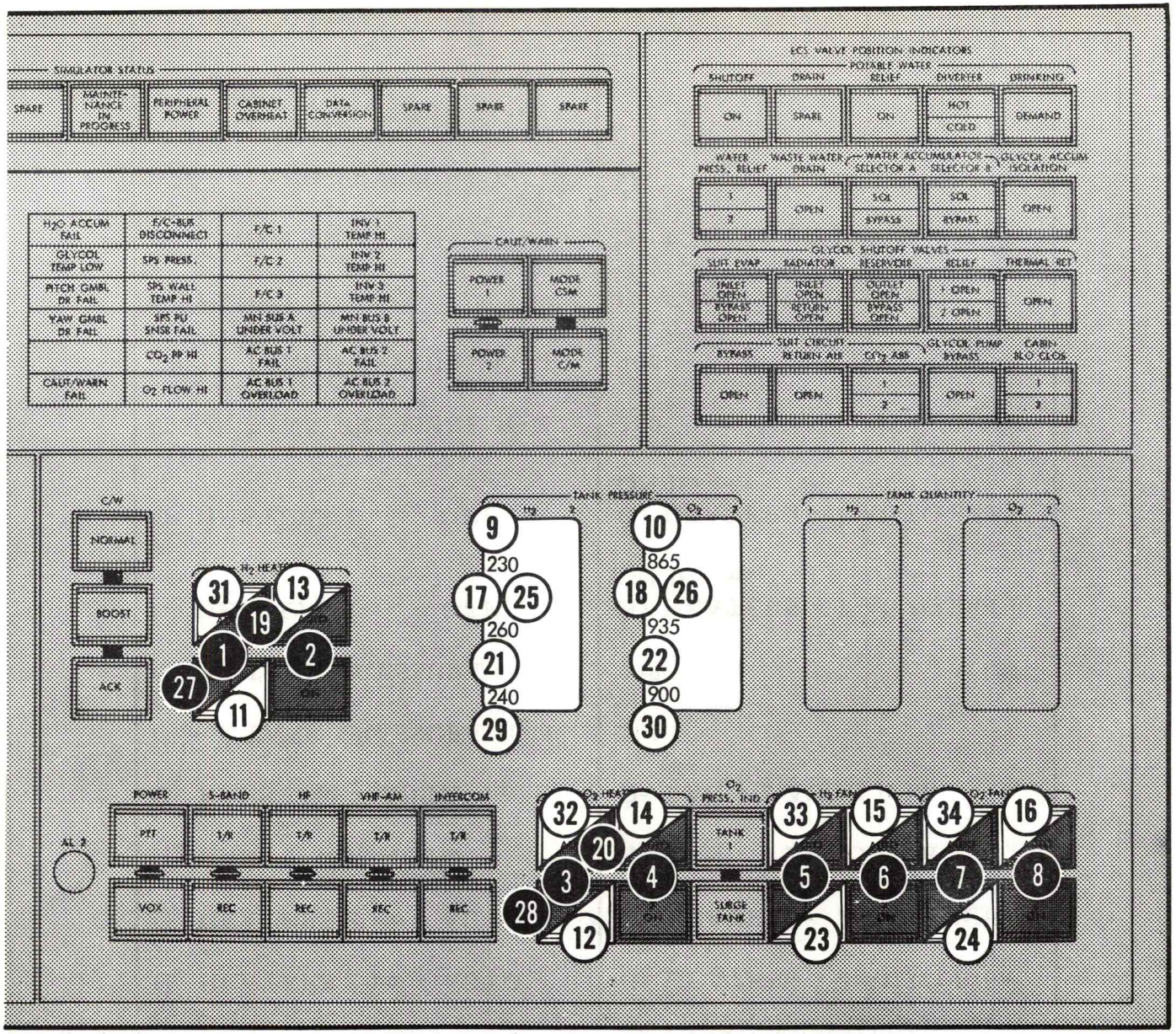
SM-6T-2-02-609

Manual Pressure Control Verification

EP3.11

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13			H_2 HEATERS 2 sw - AUTO	H_2 HEATERS - 2 AUTO lt on	
14			O_2 HEATERS 2 sw - AUTO	O_2 HEATERS - 2 AUTO lt on	
15			H_2 FANS 2 sw - AUTO	H_2 FAN - 2 AUTO lt on	
16			O_2 FANS 2 sw - AUTO	O_2 FAN - 2 AUTO lt on	
17			Check TANK PRESSURE H_2 1	260	
18			Check TANK PRESSURE O_2 1	935	
19			H_2 HEATERS 1 sw - OFF	H_2 HEATERS - 1 AUTO and 1 ON lts out	
20			O_2 HEATERS 1 sw - OFF	O_2 HEATERS - 1 AUTO and 1 ON lts out	
21			Check TANK PRESSURE H_2 1	240	
22			Check TANK PRESSURE O_2 1	900	
23			H_2 FANS 1 sw - ON	H_2 FAN - 1 ON lt on	
24			O_2 FANS 1 sw - ON	O_2 FAN - 1 ON lt on	
25			Check TANK PRESSURE H_2 1	260	
26			Check TANK PRESSURE O_2 1	935	



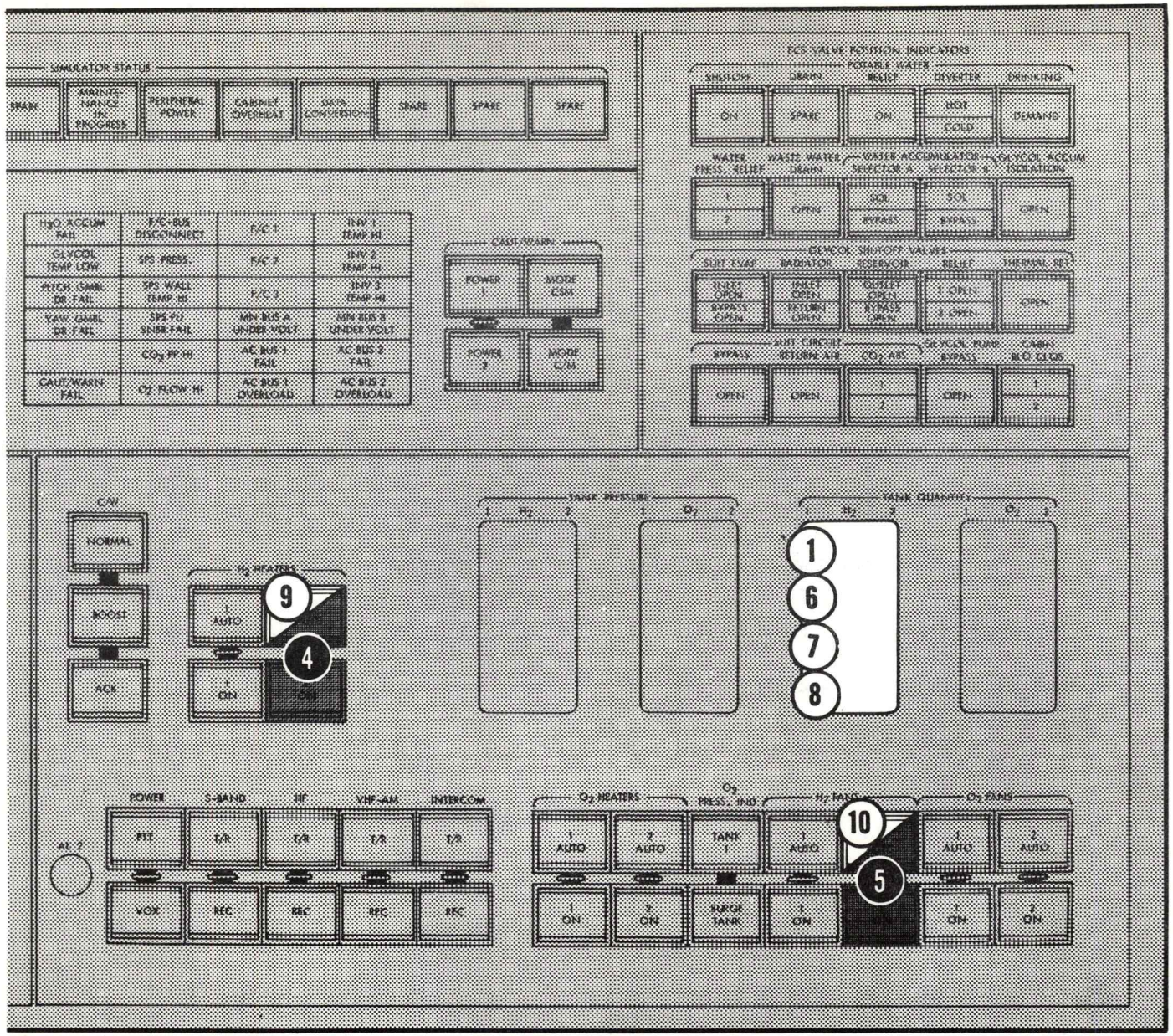
SM-6T-2-02-609

Manual Pressure Control Verification

EP3.11

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
27			H_2 FANS 1 sw - OFF	H_2 FANS - 1 AUTO and 1 ON lts out	
28			O_2 FANS 1 sw - OFF	O_2 FANS - 1 AUTO and 1 ON lts out	
29			Monitor TANK PRESSURE H_2 1	As programed	
30			Monitor TANK PRESSURE O_2 1	As programed	
31			H_2 HEATERS 1 sw - AUTO	H_2 HEATERS - 1 AUTO lt on	
32			O_2 HEATERS 1 sw - AUTO	O_2 HEATERS - 1 AUTO lt on	
33			H_2 FANS 1 sw - AUTO	H_2 FAN - 1 AUTO lt on	
34			O_2 FANS 1 sw - AUTO	O_2 FAN - 1 AUTO lt on	



LISTED STEPS

2,3

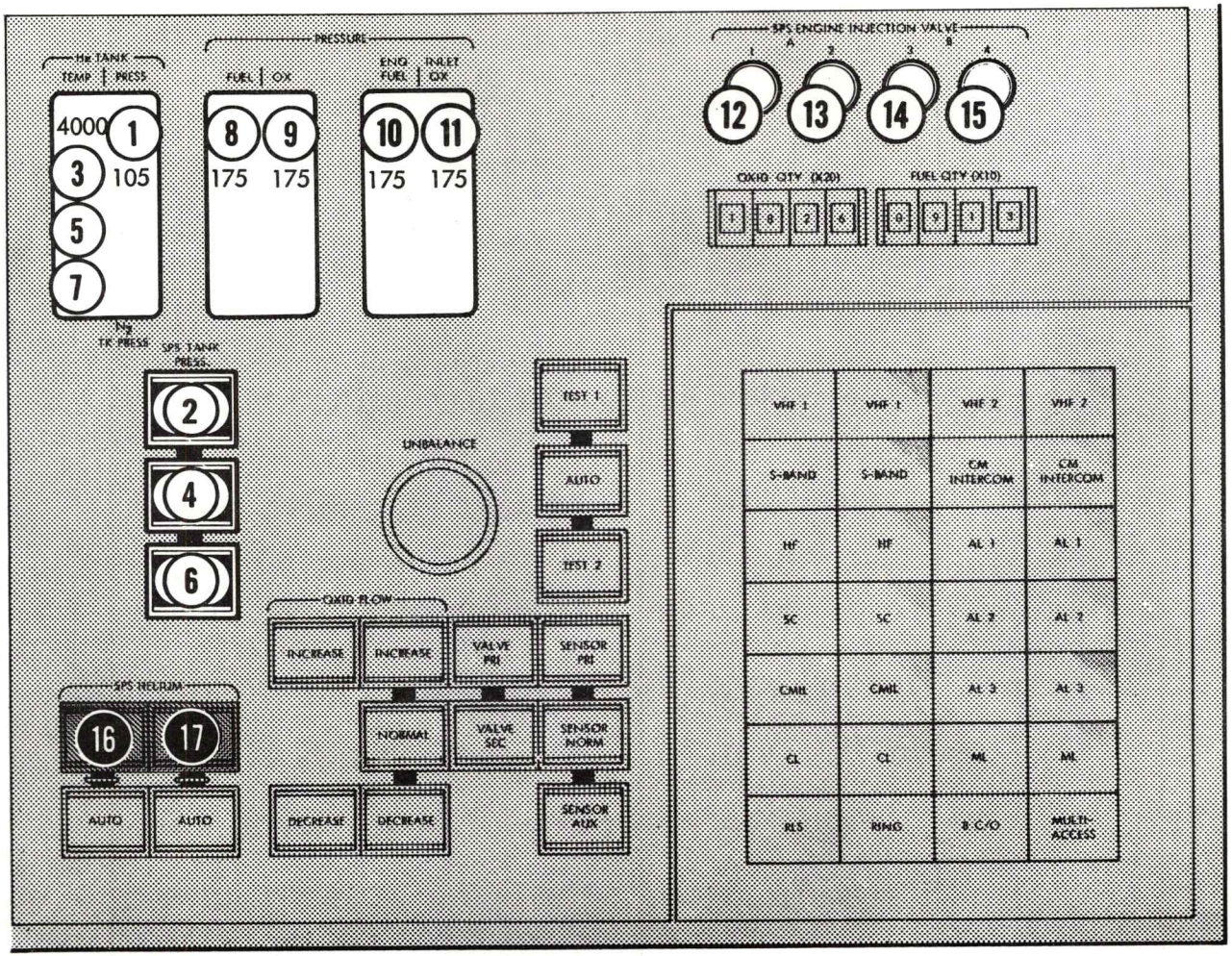
SM-6T-2-02-610

Quantity Balance Verification

EP3.12

IOS DATA SHEET

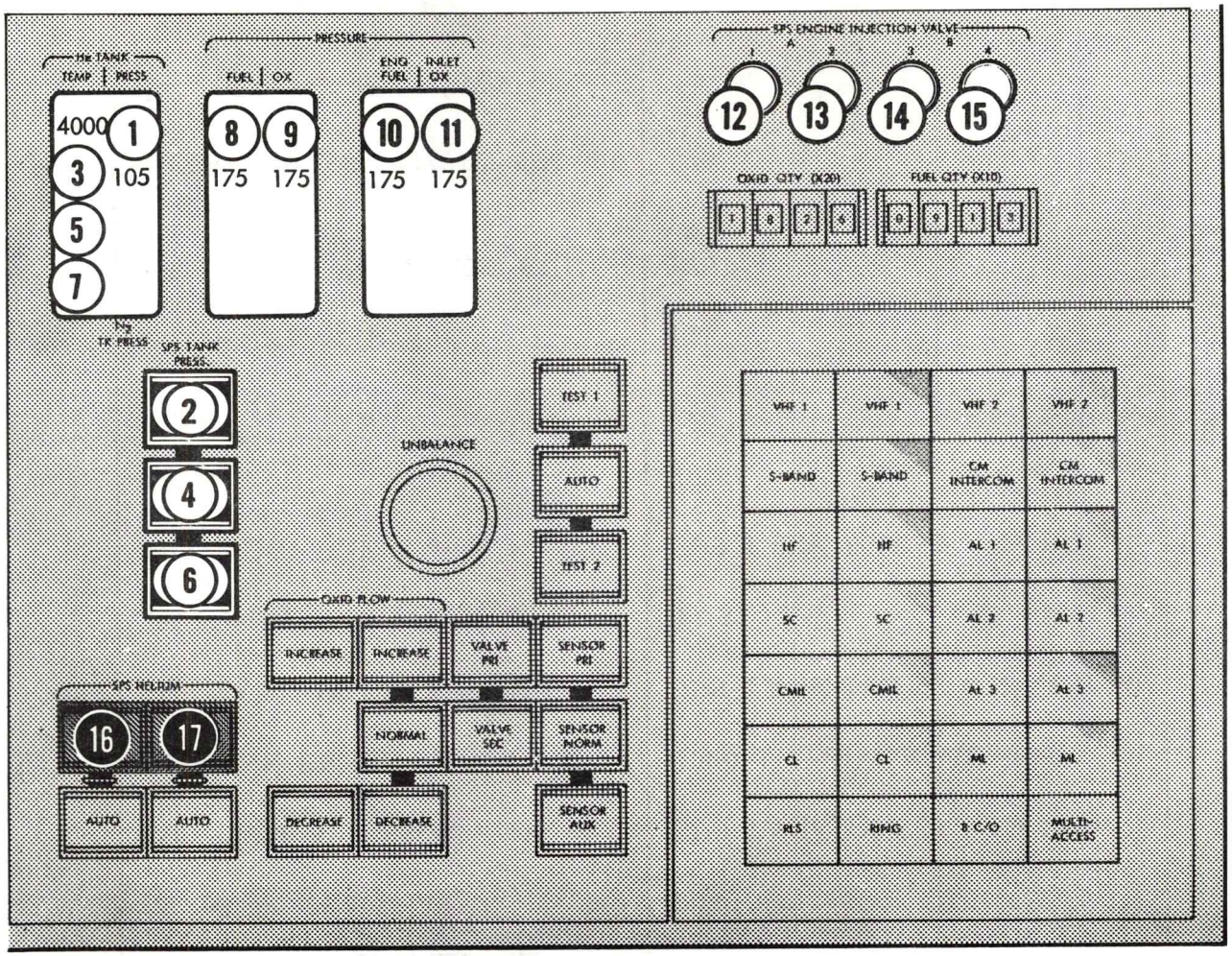
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Check TANK QUANTITY H_2 1 ind		
*2			Quantity equal	End of H_2 check	
*3			TANK QUANTITY H_2 1 > than 2	As programed	
4			H_2 HEATERS 2 sw - OFF	H_2 HEATER - lts out	
5			H_2 FANS 2 sw - OFF	H_2 FAN - lts out	
6			Monitor TANK PRESSURE H_2 inds	As programed	
7			Monitor TANK QUANTITY H_2 inds	As programed	
8			Check TANK QUANTITY H_2 ind equal or < 1 lb difference	As programed	
9			H_2 HEATERS 2 sw - AUTO	H_2 HEATERS - 2 AUTO lt on	
10			H_2 FANS 2 sw - AUTO	H_2 FAN - 2 AUTO lt on	


He TANK
TEMP
PRESS
PRESSURE
FUEL
OX
ENG FUEL
INLET OX
SPS ENGINE INJECTION VALVE
A
B
4000
105
175
175
175
175
OX/FU QTY (K20)
FUEL QTY (K10)
SPS TANK PRESS
UNBALANCE
TEST 1
AUTO
TEST 2
OX/FU FLOW
INCREASE
INCREASE
VALVE PRI
SENSOR PRI
NORMAL
VALVE SEC
SENSOR NORM
DECREASE
DECREASE
SENSOR AUX
SPS HELIUM
AUTO
AUTO
VHF 1
VHF 1
VHF 2
VHF 2
S-BAND
S-BAND
CM INTERCOM
CM INTERCOM
HF
HF
AL 1
AL 1
SC
SC
AL 2
AL 2
CMIL
CMIL
AL 3
AL 3
CL
CL
ML
ML
RLS
RING
S-C/O
MULTI-ACCESS

SM-6T-2-02-562

IOS DATA SHEET

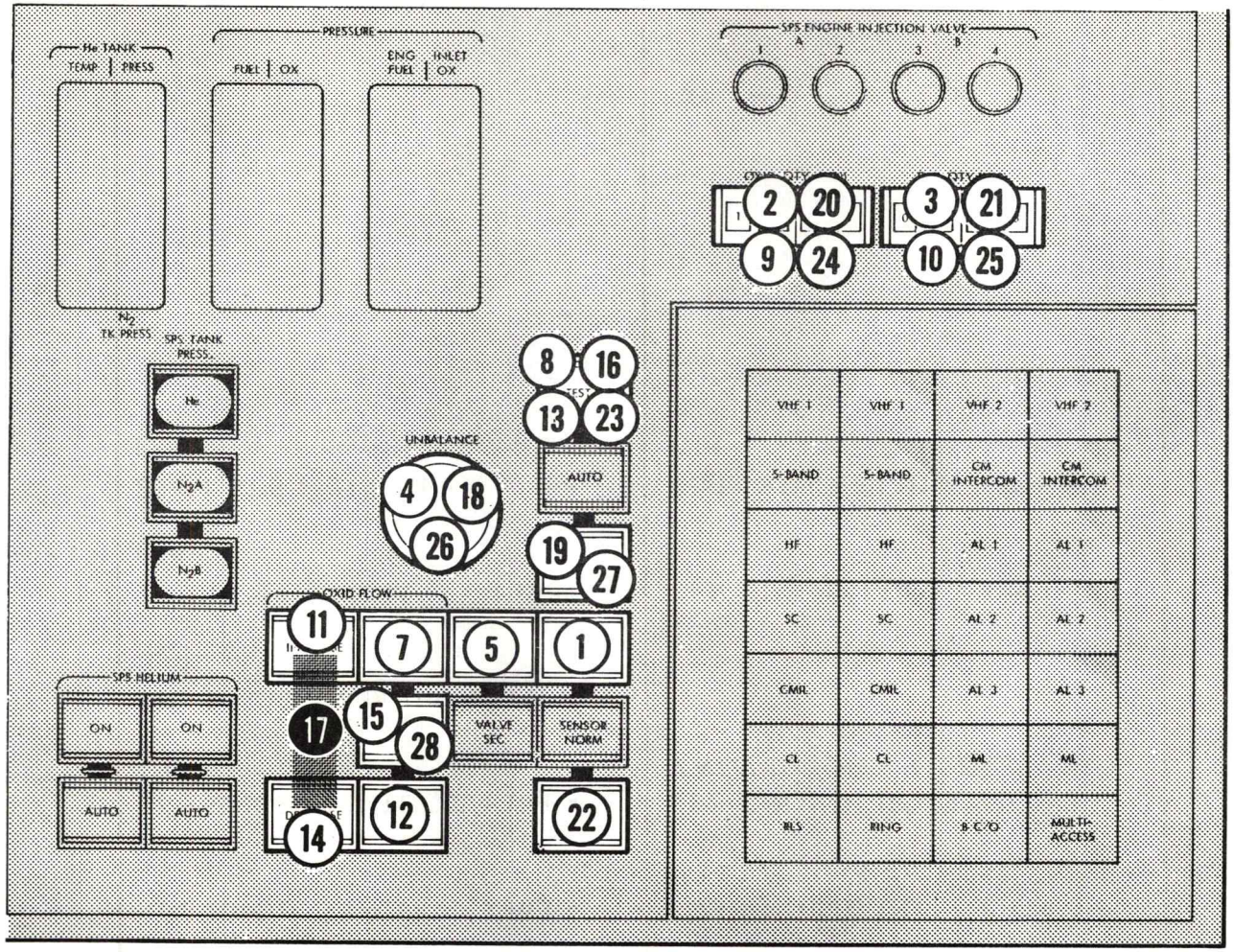
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-11			Record Pressure and Temperature Parameters		
1			He TANK TEMP ind	105	
2			SPS TANK PRESS sw - He	SPS TANK PRESS - He lt on	
3			He TANK PRESS ind	4000 decreasing with use	
4			SPS TANK PRESS sw - N_2 A	SPS TANK PRESS - N_2 A lt on	
*5			TK N_2 ind	TBSL	
6			SPS TANK PRESS sw - N_2 B	SPS TANK PRESS - N_2 B lt on	
*7			TK N_2 ind	TBSL	
8			PRESSURE FUEL ind	175	
9			PRESSURE OXID ind	175	
10			PRESSURE ENG INLET FUEL ind	175	
11			PRESSURE ENG INLET OX ind	175	
12-15			Record SPS Engine Injection Valve Positions		
12			SPS ENGINE INJECT 1 ind - CLOSE	SPS ENGINE INJECTION VALVE 1 ind - CLOSE	


He TANK
TEMP
PRESS
4000
105
PRESSURE
FUEL
OX
ENG FUEL
INLET OX
175
175
175
175
SPS ENGINE INJECTION VALVE
OXID QTY (X20)
FUEL QTY (X10)
SPS TANK PRESS.
UNBALANCE
TEST 1
AUTO
TEST 2
OXID FLOW
INCREASE
INCREASE
VALVE POS
SENSOR POS
NORMAL
VALVE SEC
SENSOR NORM
DECREASE
DECREASE
SENSOR AUX
SPS HELIUM
AUTO
AUTO
VHF 1
VHF 1
VHF 2
VHF 2
S-BAND
S-BAND
CM INTERCOM
CM INTERCOM
HF
HF
AL 1
AL 1
SC
SC
AL 2
AL 2
CMIL
CMIL
AL 3
AL 3
CL
CL
ML
ML
RLS
RING
B C/O
MULTI-ACCESS

SM-6T-2-02-562

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13			SPS ENGINE INJECT 2 ind - CLOSE	SPS ENGINE INJECTION VALVE 2 ind - CLOSE	
14			SPS ENGINE INJECT 3 ind - CLOSE	SPS ENGINE INJECTION VALVE 3 ind - CLOSE	
15			SPS ENGINE INJECT 4 ind - CLOSE	SPS ENGINE INJECTION VALVE 4 ind - CLOSE	
16-17			SPS Helium Inds Upon SPS Eng Ignition		
16			Left SPS HELIUM event ind gray	Left SPS HELIUM - ON lt out	
17			Right SPS HELIUM event ind gray	Right SPS HELIUM - ON lt out	



LISTED STEPS
6

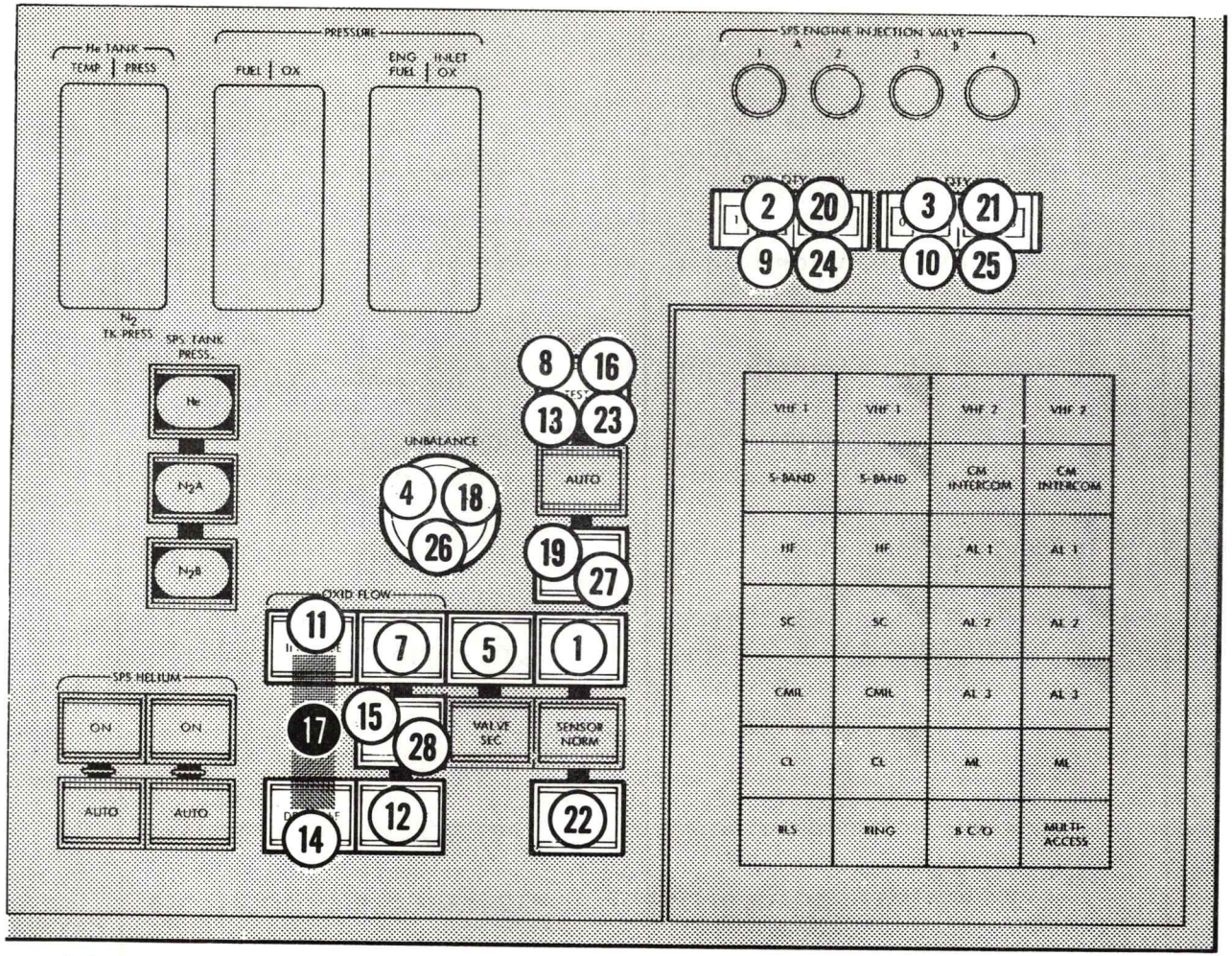
SM-6T-2-02-563

SPS Periodic Propellant Quantity Gaging System Check

SP3.02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			SENSOR sw - PRI	SENSOR PRI lt on	
2			Record QUANTITY OX	Note displayed quantities	
3			Record QUANTITY FUEL	Note displayed quantities	
4			Record UNBALANCE ind position	Note ind position	
5			Check VALVE sw - PRI	VALVE PRI lt on	
6			Request seat 1, place SPS GAUGING sw - AC-1	Monitor intercom, SPS GAUGING - AC 1 lt on	
7			OX FLOW sw INCR	OXID FLOW - INCREASE lt on	
8			TEST/AUTO/TEST sw - TEST (up), release in 5 seconds	Upper TEST lt on, out as programed	
9			Check QUANTITY OX ind increase	Note displayed quantities	
10			Check QUANTITY FUEL ind increase	Note displayed quantities	
11			Check OX FLOW INCREASE event ind striped	OXID FLOW - INCREASE striped lt on	
12			OX FLOW sw - DECR	OXID FLOW - DECREASE lt on	



LISTED STEPS
6

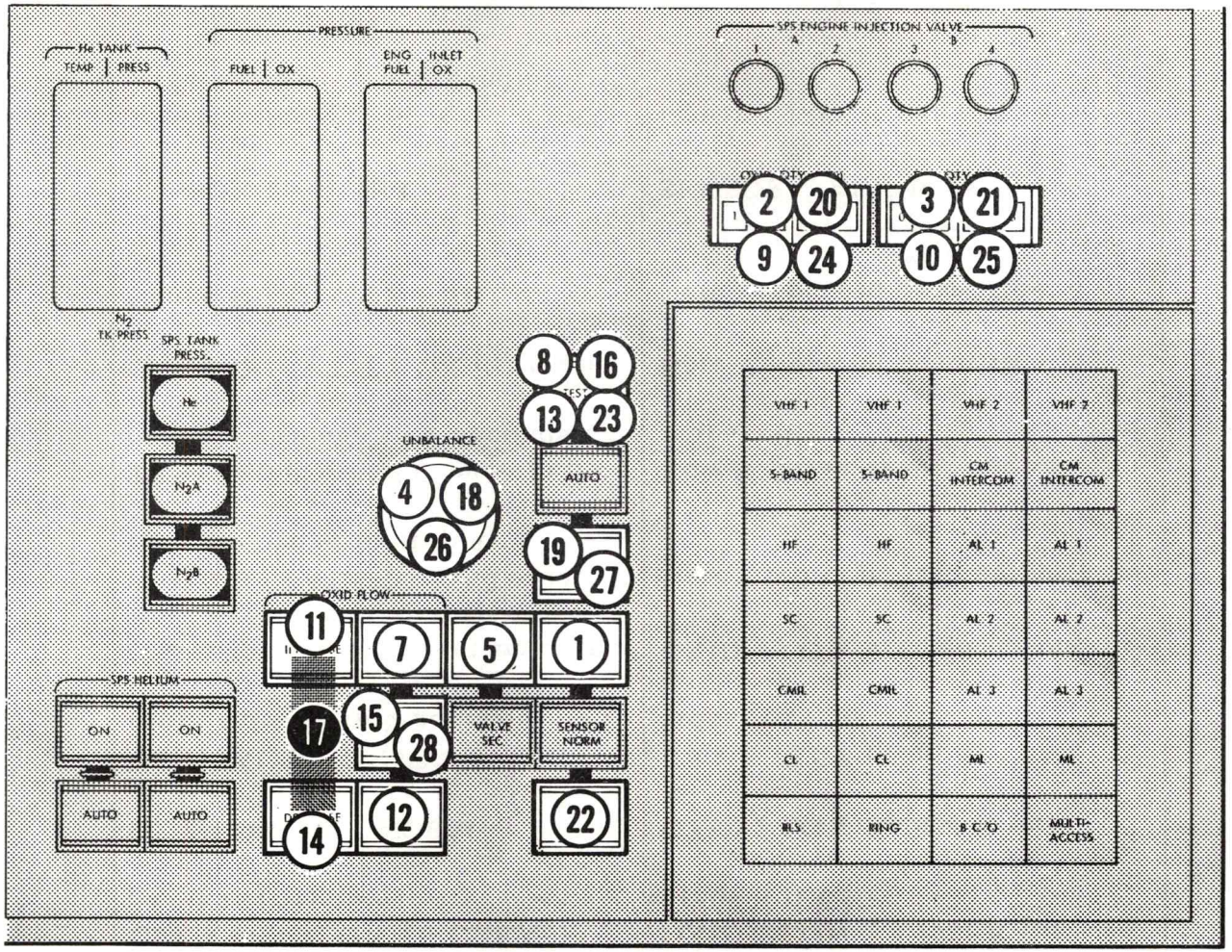
SM-6T-2-02-563

SPS Periodic Propellant Quantity Gaging System Check

SP3.02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13			TEST/AUTO/TEST sw - TEST (up), release in 5 seconds	Upper TEST lt on, out as released	
14			Check OX FLOW DECREASE event ind striped	OXID FLOW - DECREASE striped lt on	
15			OX FLOW sw - NORM	OXID FLOW NORM lt on	
16			TEST/AUTO/TEST sw - TEST (up), release in 5 seconds	Upper TEST lt on, out as released	
17			Check OX FLOW event inds gray	OXID FLOW striped lts out	
18			Check UNBALANCE ind other than recorded in step 4	Note UNBALANCE ind position	
19			TEST/AUTO/TEST sw - TEST (down), release in 5 seconds	Lower TEST lt on, out as released	
20			Check QUANTITY OX decrease	Note displayed quantities	
21			Check QUANTITY FUEL decrease	Note displayed quantities	
22			SENSOR sw - AUX	SENSOR - AUX lt on	
23			TEST/AUTO/TEST sw - TEST (up), release in 5 seconds	Upper TEST lt on, out as released	
24			Check QUANTITY OX increase	Note displayed quantities	



LISTED STEPS
6

SM-6T-2-02-563

SPS Periodic Propellant Quantity Gaging System Check

SP3.02

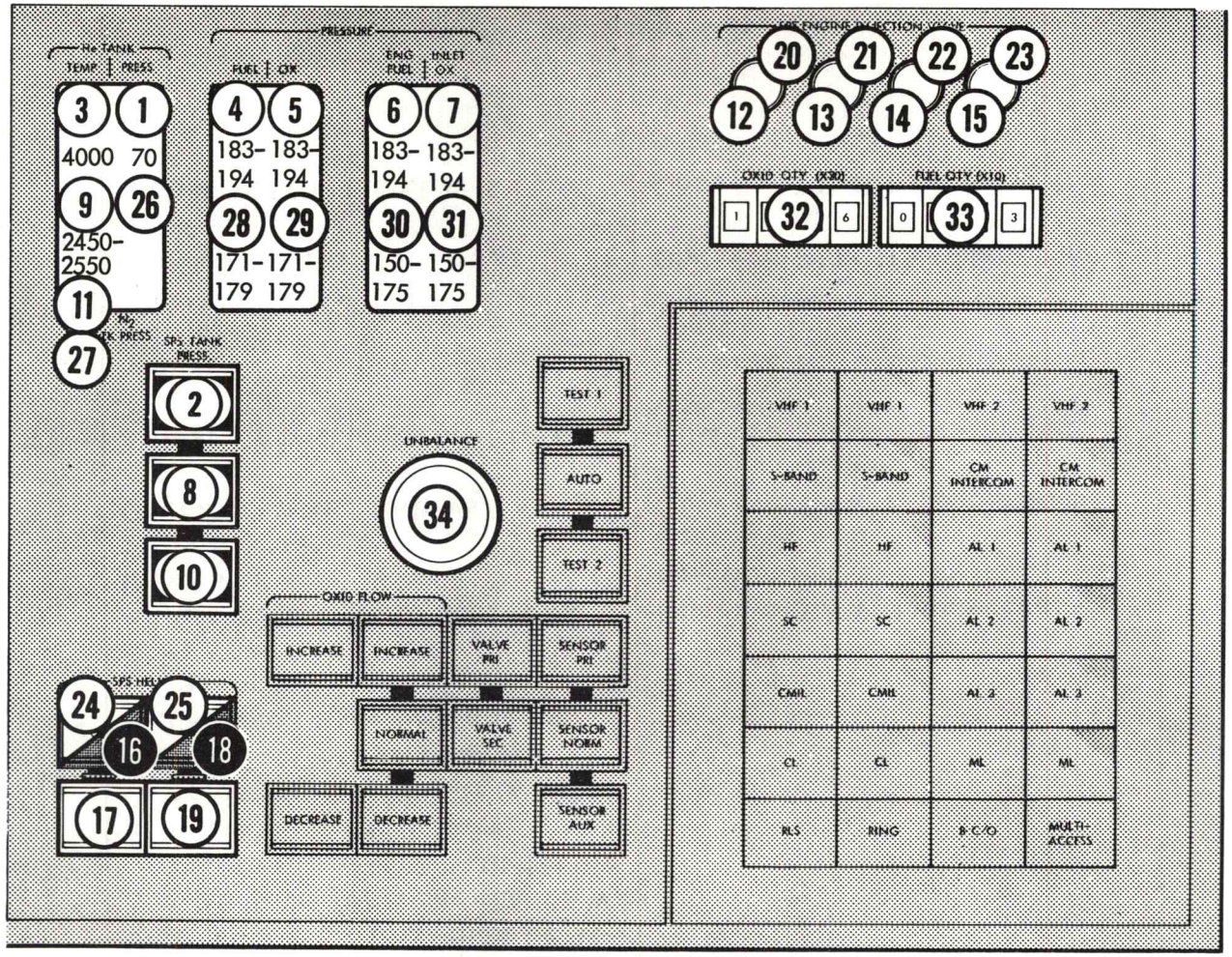
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
25			Check QUANTITY FUEL increase	Note displayed quantities	
26			Check UNBALANCE ind other than recorded in step 4	Note UNBALANCE ind position	
27			TEST/AUTO/TEST sw - TEST (down) release in 5 seconds	Lower TEST lt on, out as released	
28			SENSOR sw - NORMAL	SENSOR NORMAL lt on	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			CAUTION PITCH indicator must be at 0° before adjusting the YAW thumbwheel. YAW indicator must be at +4° before adjusting the PITCH thumbwheel. This is to avoid damage to the SPS engine extention.		
1			Adjust YAW thumbwheel to +6° then to +2°	Observe YAW thumbwheel position ind	
2			Check YAW ind follows	Observe YAW repeater ind	
3			Adjust YAW thumbwheel to +4°	Observe YAW repeater ind	
4			Adjust PITCH thumbwheel to +2° then to -2°	Observe PITCH thumbwheel position ind	
5			Check PITCH ind follows	Observe PITCH repeater ind	
6			Adjust PITCH thumbwheel to 0°	Observe PITCH repeater ind	

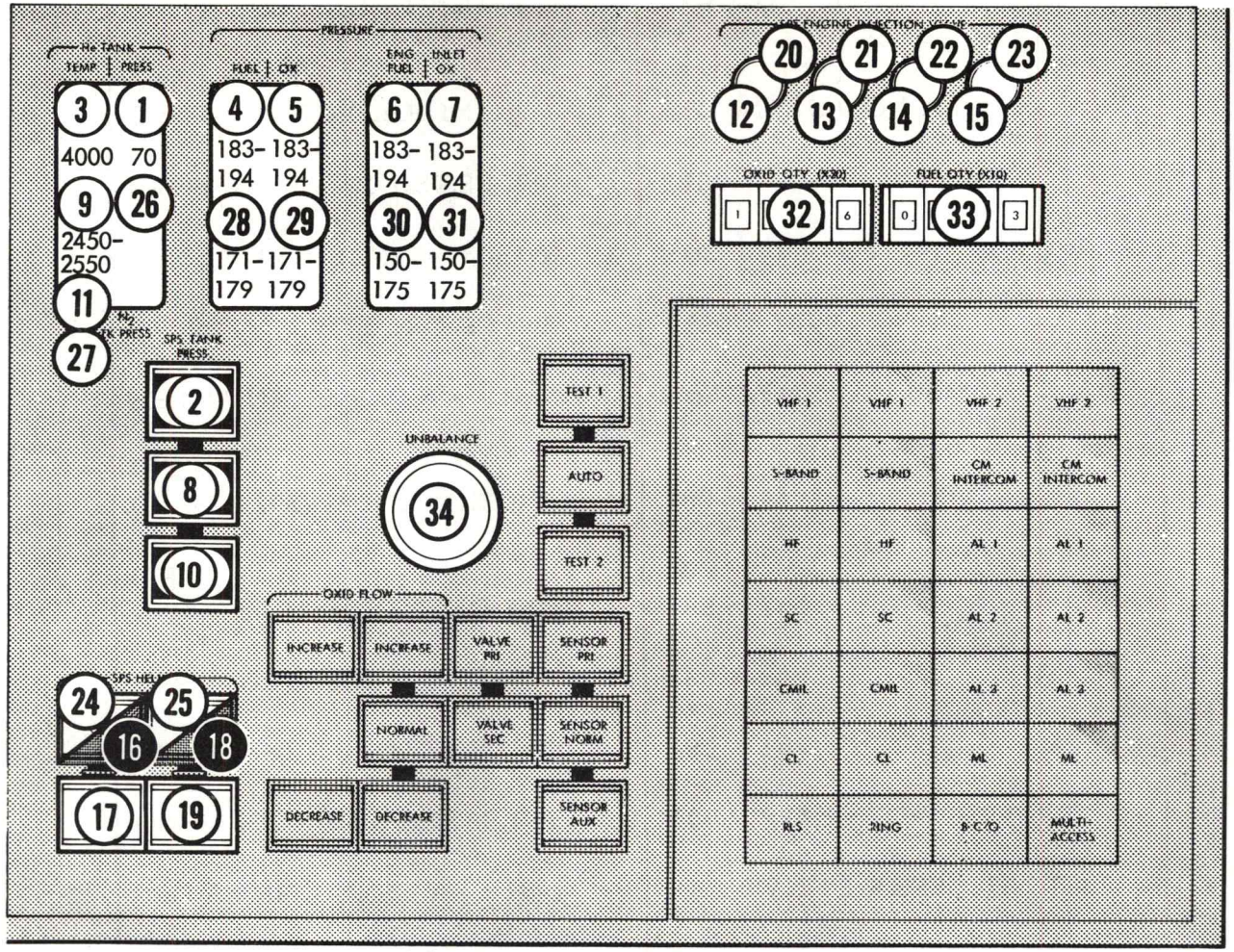
Gimbal Position Indicators Test


He TANK
TEMP
PRESS
PRESSURE
FUEL
OX
ENG FUEL
INLET OX
4000
70
2450-2550
183-194
171-179
150-175
OXID QTY (X30)
FUEL QTY (X10)
SPS TANK PRESS
UNBALANCE
TEST 1
AUTO
TEST 2
OXID FLOW
INCREASE
VALVE PRI
SENSOR PRI
NORMAL
VALVE SEC
SENSOR NORM
DECREASE
SENSOR AUX
VHF 1
VHF 2
S-BAND
CM INTERCOM
HF
AL 1
SC
AL 2
CMIL
AL 3
CL
ML
RLS
RING
B C/O
MULTI-ACCESS

SM-6T-2-02-564

IOS DATA SHEET

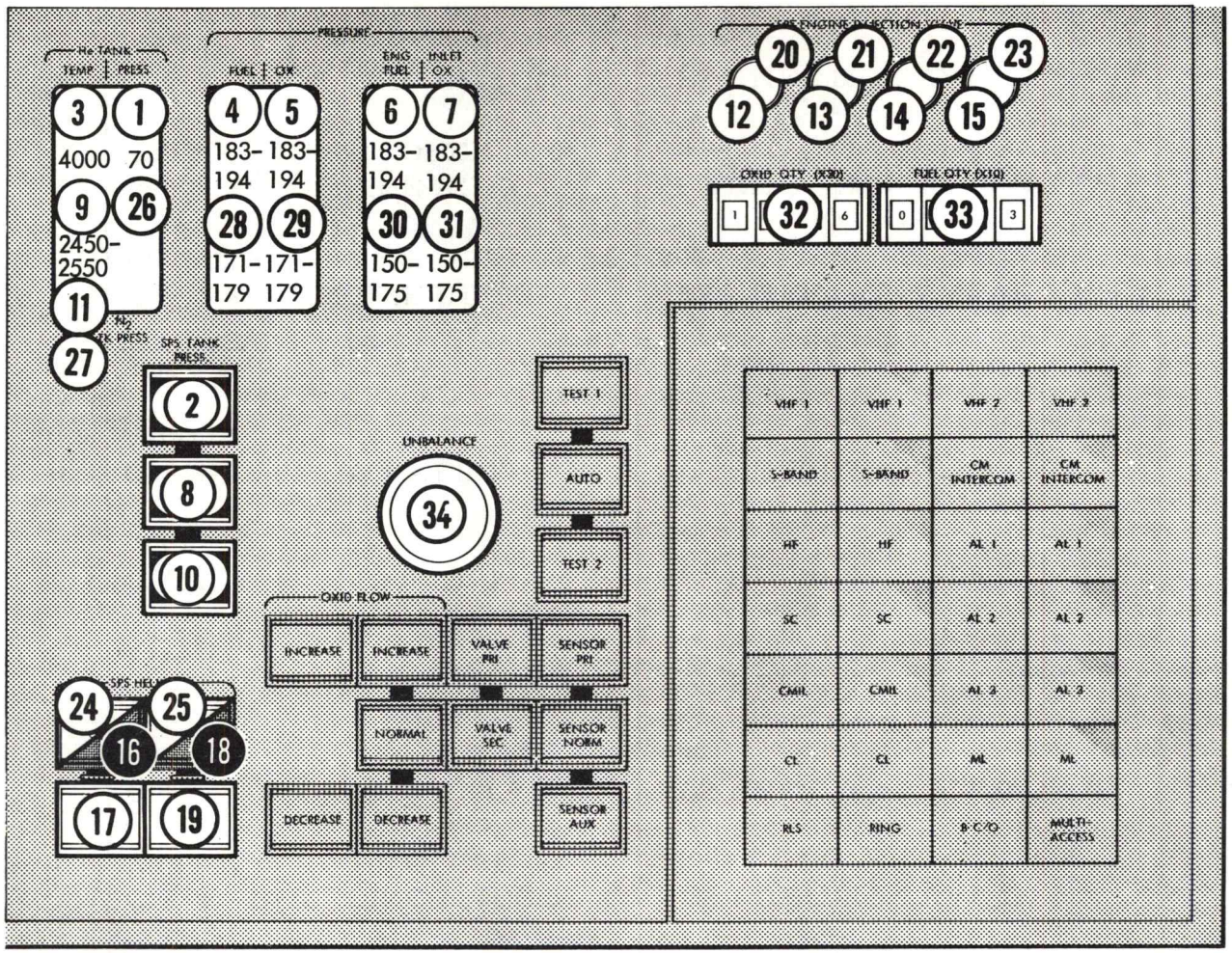
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-19			Preparation for Delta V		
1			Check He TANK TEMP ind	70	
2			SPS TANK PRESS sw - He	SPS TANK PRESS - He lt on	
3			Check He TANK PRESS ind	4000 less consumption	
4			Check PRESSURE FUEL ind	183 - 194	
5			Check PRESSURE OX ind	183 - 194	
6			Check PRESSURE ENG FUEL ind	183 - 194	
7			Check PRESSURE INLET OX ind	183 - 194	
8			SPS TANK PRESS sw - N_2 A	SPS TANK PRESS - N_2 A lt on	
9			Check N_2 TANK PRESS ind	2450 - 2550	
10			SPS TANK PRESS sw- N_2 B	SPS TANK PRESS - N_2 B lt on	
11			Check N_2 TANK PRESS ind	2450 - 2550	
12			Check SPS ENGINE INJECT VALVE A 1 ind - CLOSE	SPS INJECTION VALVE 1 - closed (left)	
13			Check SPS ENGINE INJECT VALVE A 2 ind - CLOSE	SPS INJECTION VALVE 2 - closed (left)	


He TANK
TEMP
PRESS
PRESSURE
FUEL
OX
ENG FUEL
INLET OX
4000
70
2450-2550
183-194
171-179
150-175
OXID QTY (X10)
FUEL QTY (X10)
SPS TANK PRESS
UNBALANCE
TEST 1
AUTO
TEST 2
OXID FLOW
INCREASE
VALVE PRI
SENSOR PRI
NORMAL
VALVE SEC
SENSOR NORM
DECREASE
SENSOR AUX
VHF 1
VHF 2
S-BAND
CM INTERCOM
HF
AL 1
SC
AL 2
CMIL
ML
CL
RLS
RING
B-C/O
MULTI-ACCESS

SM-6T-2-02-564

IOS DATA SHEET

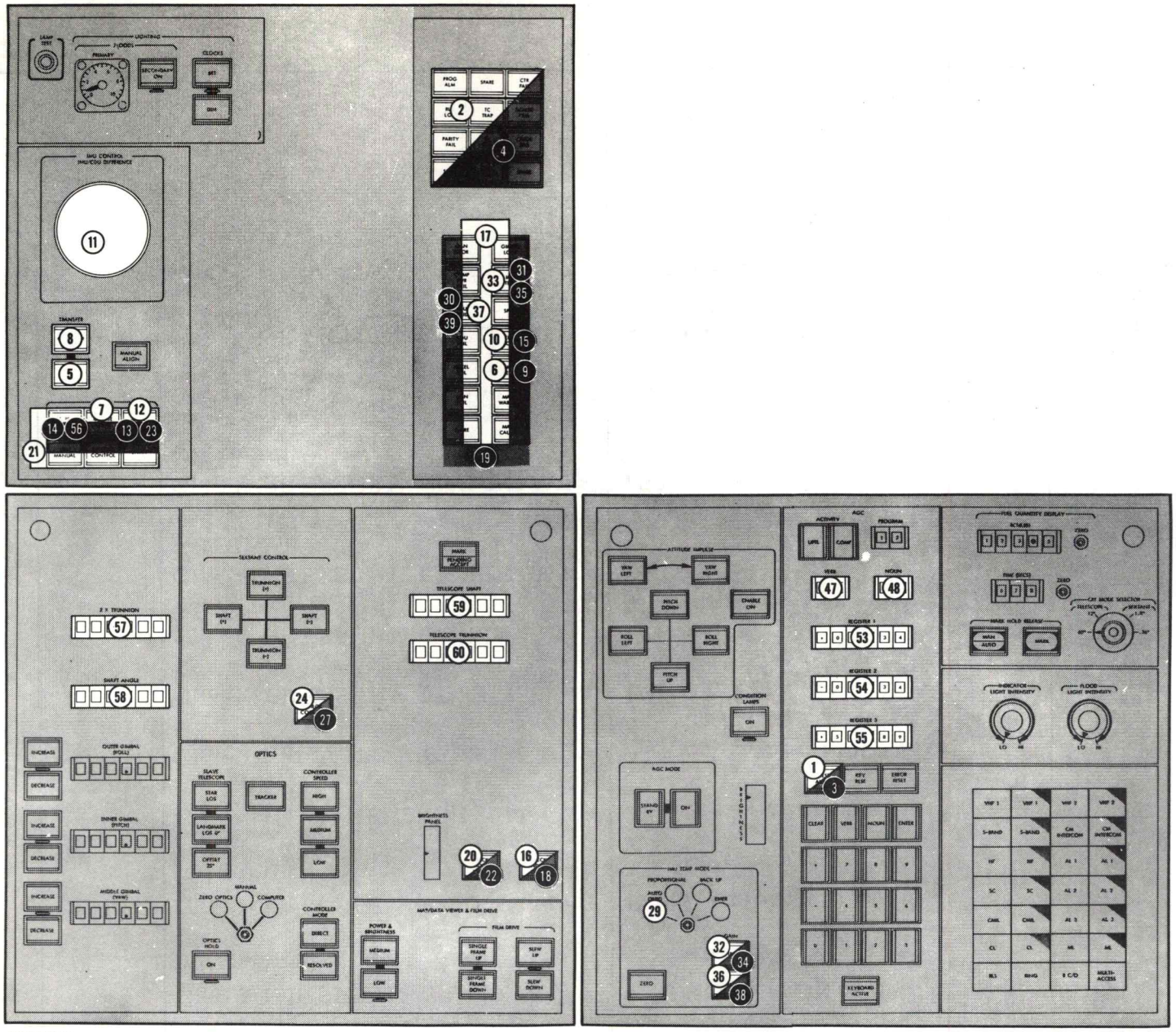
Step	Malf	Time	Function	IOS Visibility/Action	Notes
14			Check SPS ENGINE INJECT VALVE B 3 ind - CLOSE	SPS INJECTION VALVE 3 - closed (left)	
15			Check SPS ENGINE INJECT VALVE B 4 ind - CLOSE	SPS INJECTION VALVE 4 - closed (left)	
16			Check left SPS HELIUM event ind gray	SPS HELIUM - striped ON lt out	
17			Check left SPS HELIUM sw - AUTO	SPS HELIUM - AUTO lt on	
18			Check right SPS HELIUM event ind gray	SPS HELIUM - striped ON lt out	
19			Check right SPS HELIUM sw- AUTO	SPS HELIUM - AUTO lt on	
20-34			SPS Firing		
20			Check SPS ENGINE INJECT VALVE A 1 ind - OPEN	SPS INJECTION VALVE 1 ind - open	
21			Check SPS ENGINE INJECT VALVE A 2 ind - OPEN	SPS INJECTION VALVE 2 ind - open	
22			Check SPS ENGINE INJECT VALVE B 3 ind - OPEN	SPS INJECTION VALVE 3 ind - open	
23			Check SPS ENGINE INJECT VALVE B 4 ind - OPEN	SPS INJECTION VALVE 4 ind - open	


He TANK
TEMP
PRESS
PRESSURE
FUEL
OX
ENG FUEL
ENG INLET OX
ENGINE SELECTION VALVE
3
1
4000
70
9
26
2450-2550
11
27
N_2 TK PRESS
SPS TANK PRESS
4
5
183-194
183-194
28
29
171-179
171-179
6
7
183-194
183-194
30
31
150-175
150-175
20
21
22
23
12
13
14
15
OXID QTY (X30)
FUEL QTY (X30)
1
32
6
0
33
3
2
8
10
UNBALANCE
34
TEST 1
AUTO
TEST 2
OXID FLOW
INCREASE
INCREASE
VALVE PRI
SENSOR PRI
NORMAL
VALVE SEC
SENSOR NORM
DECREASE
DECREASE
SENSOR AUX
SPS HELIUM
24
25
16
18
17
19
VHF 1
VHF 1
VHF 2
VHF 2
S-BAND
S-BAND
CM INTERCOM
CM INTERCOM
HF
HF
AL 1
AL 1
SC
SC
AL 2
AL 2
CMIL
CMIL
AL 3
AL 3
CL
CL
ML
ML
RLS
RING
S-C/O
MULTI-ACCESS

SM-6T-2-02-564

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
24			Check left SPS HELIUM event ind striped	Left striped ON lt on	
25			Check right SPS HELIUM event ind striped	Right striped ON lt on	
26			Check He TANK TEMP ind	As programed	
27			Check He TANK PRESS ind	As programed (4000 max.)	
28			Check PRESSURE FUEL ind	171 - 179	
29			Check PRESSURE OX ind	171 - 179	
30			Check PRESSURE ENG INLET FUEL ind	150 - 175	
31			Check PRESSURE ENG INLET OX ind	150 - 175	
32			Check QUANTITY OX ind	As programed	These three inds will determine necessity to manually control fuel-oxidizer ratio during SPS burn.
33			Check QUANTITY FUEL ind	As programed	
34			Check UNBALANCE ind	As programed	



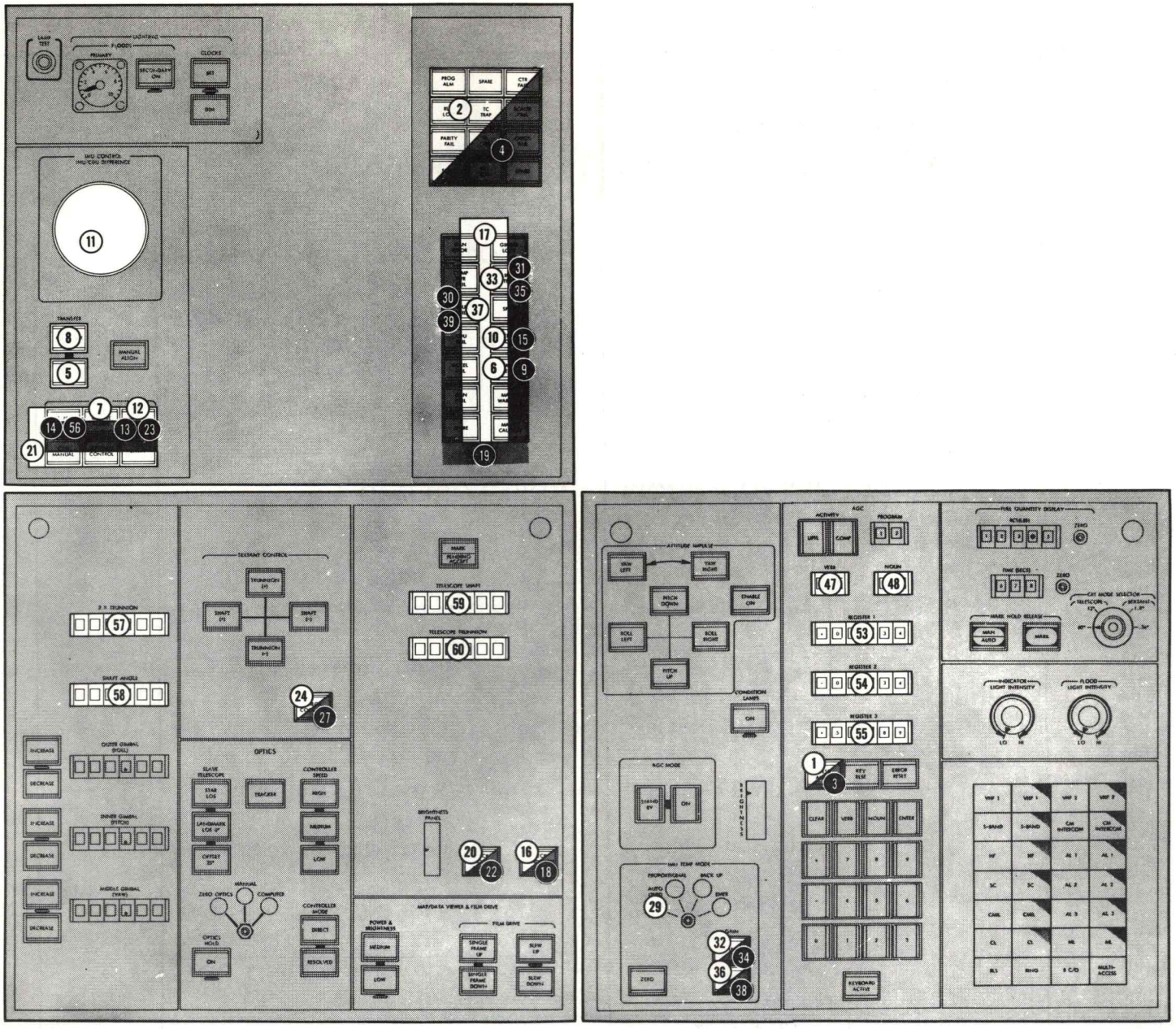
LISTED STEPS

25, 26, 28, 40, 41, 42, 43, 44, 45, 46, 49, 50, 51, 52,

SM-6T-2-02-621

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-4			AGC Condition Lamp Test		
1			Depress TEST ALARM sw	TEST ALARM lt on	
2			Check AGC condition lts on	AGC condition lts on	
3			Release TEST ALARM sw	TEST ALARM lt out	
4			Check AGC condition lts out	As programed	
5-15			IMU Activation		
5			TRANSFER sw - MANUAL	TRANSFER - MANUAL lt on	
6			Check IMU DELAY C&W lt on	IMU DELAY C&W lt on	
7			Check MODE-COARSE ALIGN lt on	MODE-COARSE ALIGN lt on	
8			TRANSFER sw - COMPUTER	TRANSFER - COMPUTER lt on	
9			Check IMU DELAY lt out in 30 sec	IMU DELAY C&W lt out	
10			Check C&W ZERO ENCODER lt on	ZERO ENCODER C&W lt on	
11			Check IMU DIFFERENCE inds to zero	IMU CONTROL IMU/CDU DIFFERENCE inds zero	



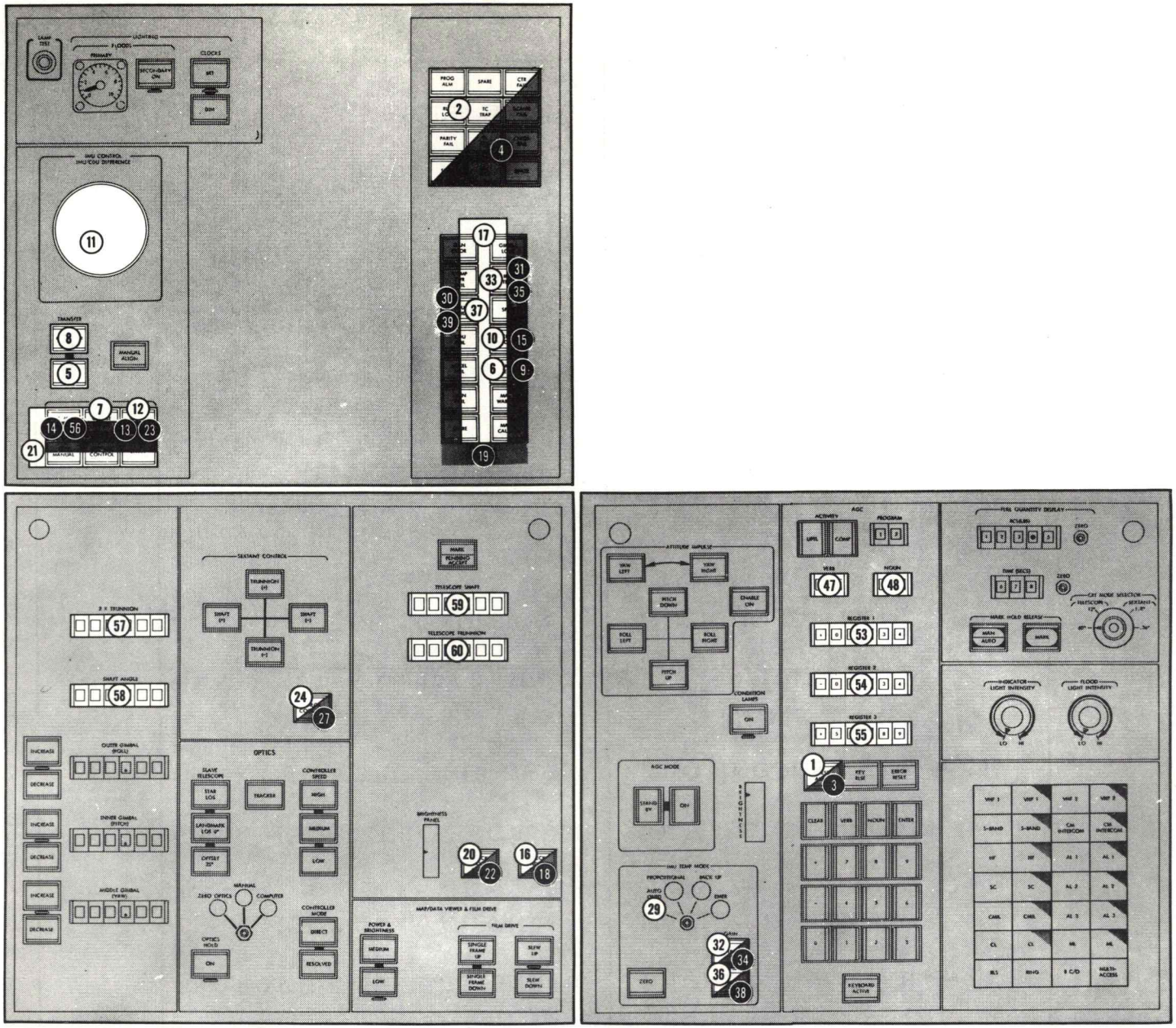
LISTED STEPS

25, 26, 28, 40, 41, 42, 43, 44, 45, 46, 49, 50, 51, 52,

SM-6T-2-02-621

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12			Check MODE-FINE ALIGN lt on	MODE-FINE ALIGN lt on	
13			Check MODE-FINE ALIGN lt out in 5 sec	MODE-FINE ALIGN lt out	
14			Check MODE-ZERO ENC lt out	MODE-ZERO ENCODER lt out	
15			Check C&W ZERO ENCODER lt out	ZERO ENCODER C&W lt out	
16-19			G&N Condition Lamps Test		
16			Depress CHECK CONDITION LAMPS sw	CHECK CONDITION LAMPS lt on	
17			Check condition lts on	G&N condition lts on	
18			Release CHECK CONDITION LAMPS sw	CHECK CONDITION LAMPS lt out	
19			Check condition lts out	G&N condition lts out	
20-23			Mode Lamps Test		
20			Depress CHECK MODE LAMPS sw	CHECK MODE LAMPS lt on	
21			Check MODE lts on	MODE lts on	
22			Release CHECK MODE LAMPS sw	CHECK MODE LAMPS lt out	



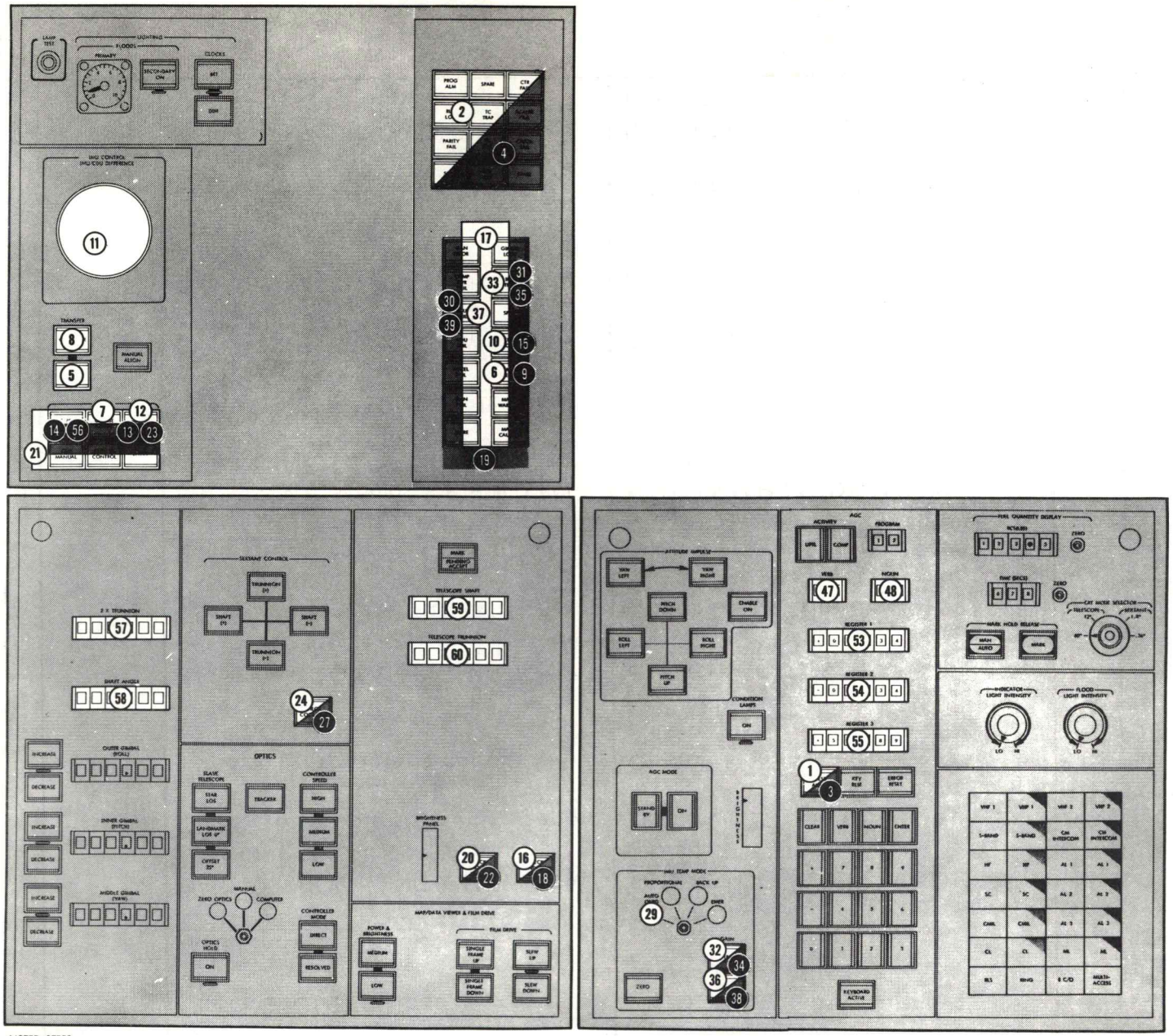
LISTED STEPS

25, 26, 28, 40, 41, 42, 43, 44, 45, 46, 49, 50, 51, 52,

SM-6T-2-02-621

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
23			Check MODE lts out	MODE lts out	
24-28			IMU Coolant Check		
24			Depress COOLANT CHECK sw	CHECK COOLANT lt on	
*25			Check left coolant check window	Observe TV monitor	
*26			Check right coolant check window	Observe TV monitor	
27			Release COOLANT CHECK sw	CHECK COOLANT lt out	
*28			Check window lts out	Observe TV monitor	
29-39			IMU Temperature Control Check		
29			IMU TEMP MODE sw - AUTO OVERRIDE	IMU TEMP MODE AUTO OVERRIDE lt on	
30			Check IMU FAIL C&W lt out	As programed	
31			Check IMU TEMP C&W lt out	As programed	
32			Depress MODE GAIN PIPA sw	IMU TEMP MODE GAIN - PIPA lt on	
33			Check IMU TEMP C&W lt on	IMU TEMP C&W lt on	
34			Release MODE GAIN PIPA sw	IMU TEMP MODE GAIN - PIPA lt out	



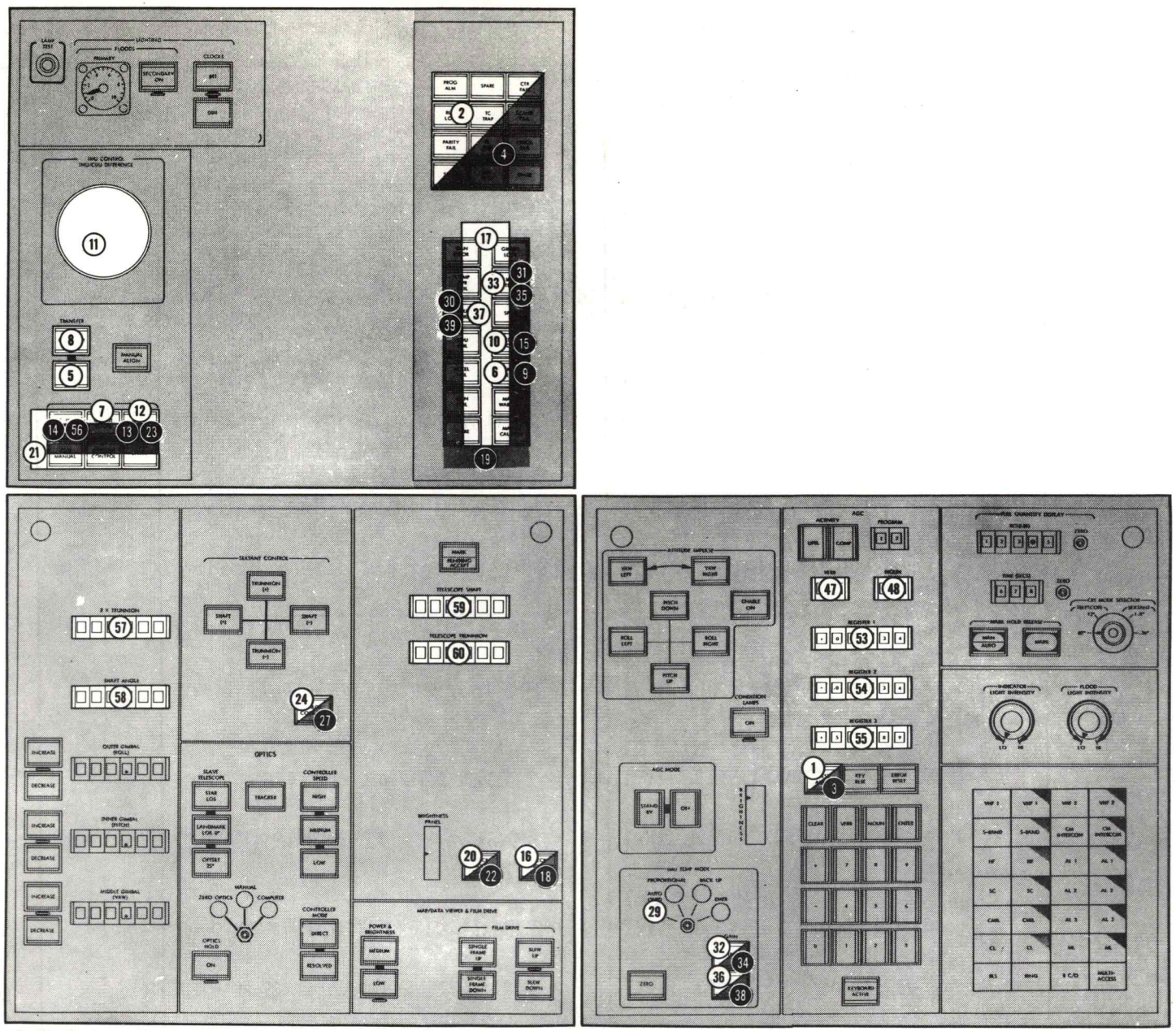
LISTED STEPS

25, 26, 28, 40, 41, 42, 43, 44, 45, 46, 49, 50, 51, 52,

SM-6T-2-02-621

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
35			Check IMU TEMP C&W lt out	IMU TEMP C&W lt out	
36			Depress MODE GAIN IRIG sw	IMU TEMP MODE GAIN - IRIG lt on	
37			Check IMU FAIL C&W lt on	IMU FAIL C&W lt on	
38			Release MODE GAIN IRIG sw	IMU TEMP MODE GAIN - IRIG lt out	
39			Check IMU FAIL C&W lt out	IMU FAIL C&W lt out	
40-45			Perform C&W System Test		
*40			Report test to stations 1 and 2	Monitor intercom	
*41			Receive reply from stations 1 and 2	Monitor intercom	
*42			Program AGC for C&W test	GN4.03	
*43			Monitor test	As programed	
*44			Report test complete to stations 1 and 2	Monitor intercom	
45			Receive reply from stations 1 and 2	Monitor intercom	



LISTED STEPS

25, 26, 28, 40, 41, 42, 43, 44, 45, 46, 49, 50, 51, 52,

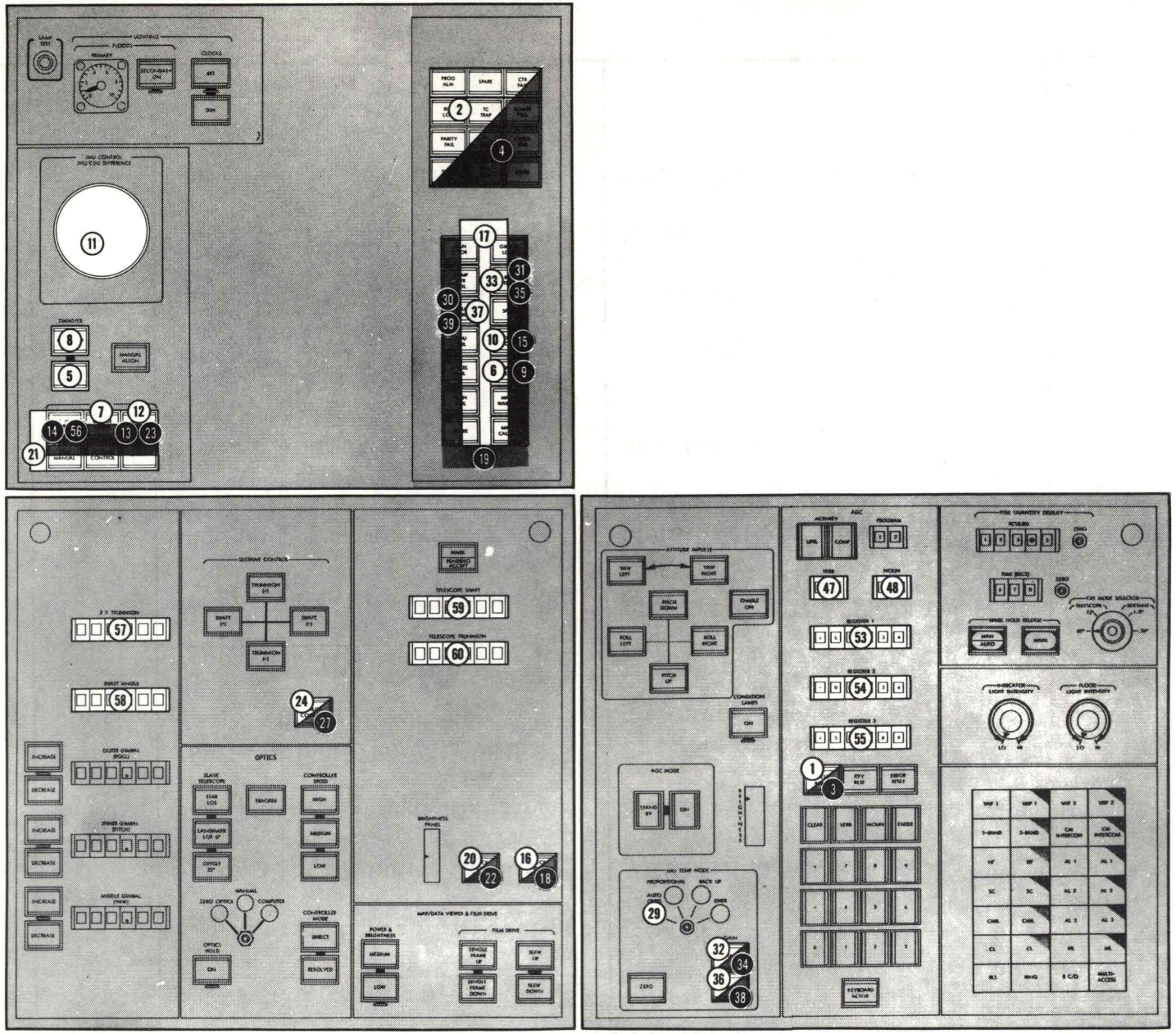
SM-6T-2-02-621

G&N System Activation

GN4.01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
46-49			Program AGC for Prethrusting		
46			Program AGC for prethrusting	GN4.03	
47			Check VERB window flashing	VERB window flashing	
48			Check NOUN window flashing	NOUN window flashing	
*49			Compare onboard data with MSFN	Provide appropriate communication	
50-60			Prepare Optics		
*50			Program AGC for CDU display	GN4.03	
*51			Request power activation, station 3	Monitor intercom	
*52			Receive activation complete report	Monitor intercom	
53			Check REGISTER 1 display	As programed	
54			Check REGISTER 2 display	As programed	
55			Check REGISTER 3 display	As programed	
56			Check ZERO ENCODER C&W lt out	ZERO ENCODER C&W lt out	



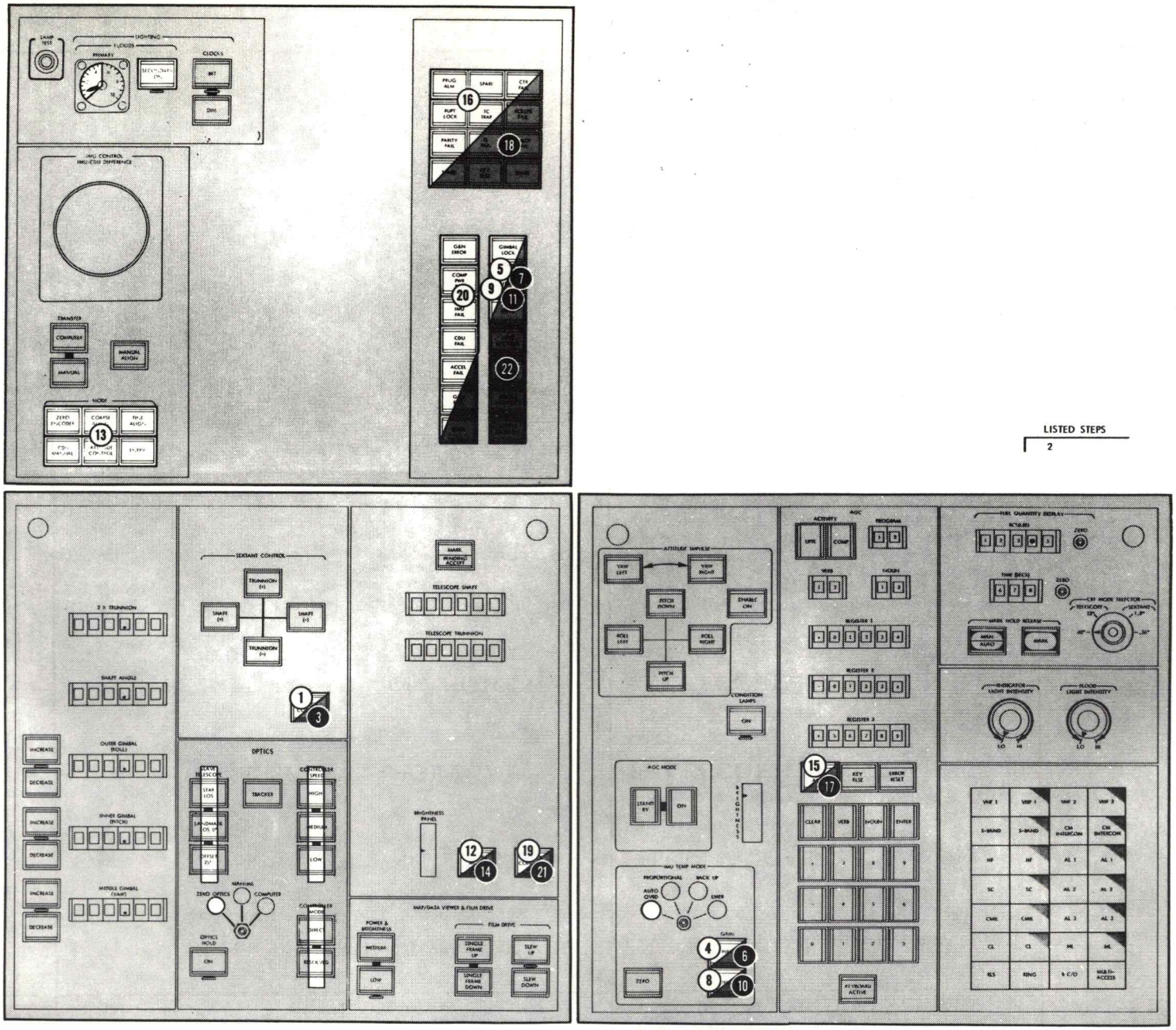
LISTED STEPS

25, 26, 28, 40, 41, 42, 43, 44, 45, 46, 49, 50, 51, 52,

SM-6T-2-02-621

IOS DATA SHEET

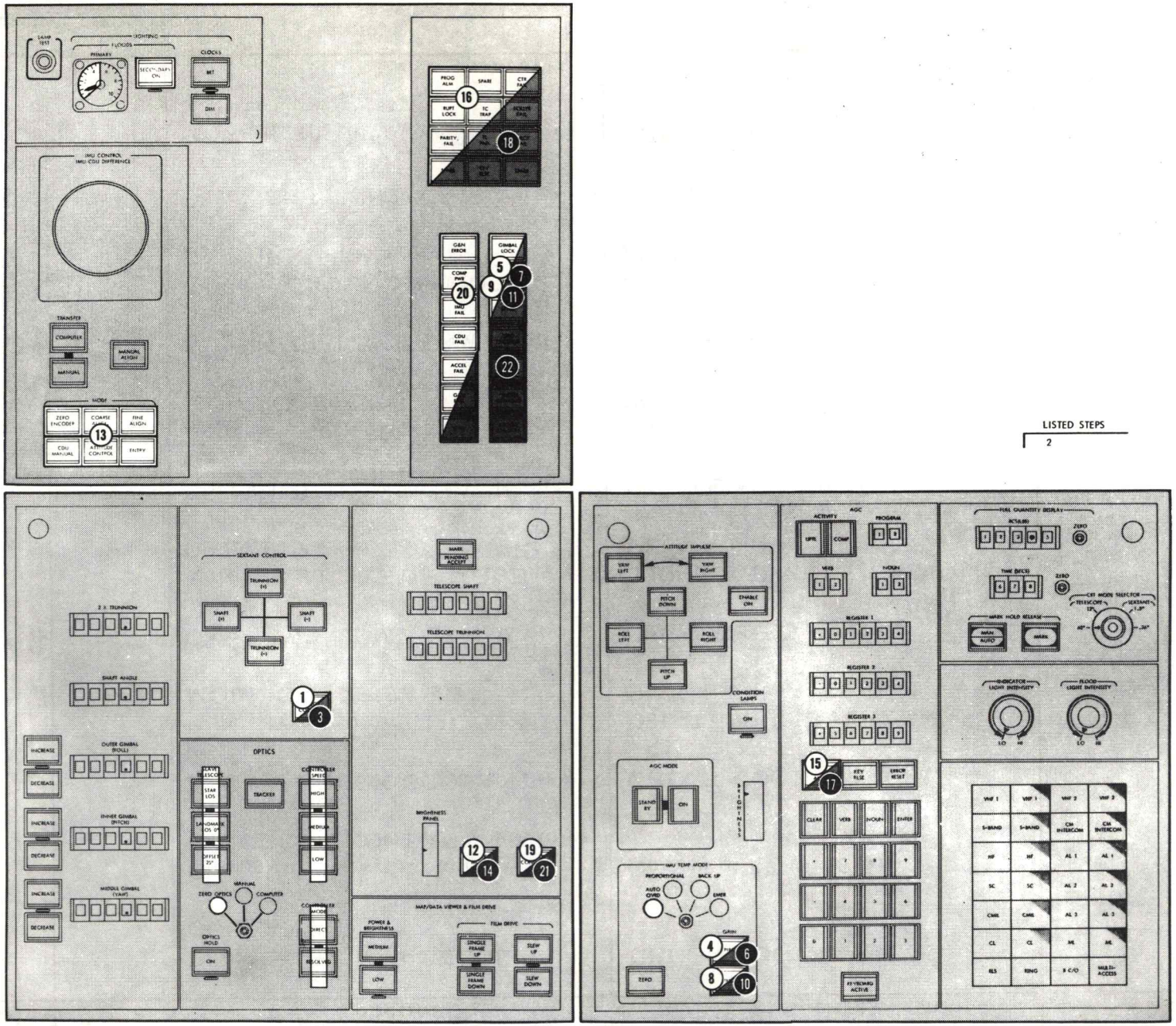
Step	Malf	Time	Function	IOS Visibility/Action	Notes
57			Check 2X TRUNNION CDU zeroed	2X TRUNNION ind zeroed	
58			Check SHAFT ANGLE CDU zeroed	SHAFT ANGLE ind zeroed	
59			Check SHAFT ANGLE ind zeroed	TELESCOPE SHAFT ind zeroed	
60			Check TRUNNION ANGLE ind zeroed	TELESCOPE TRUNNION ind zeroed	



G&N Periodic Verification

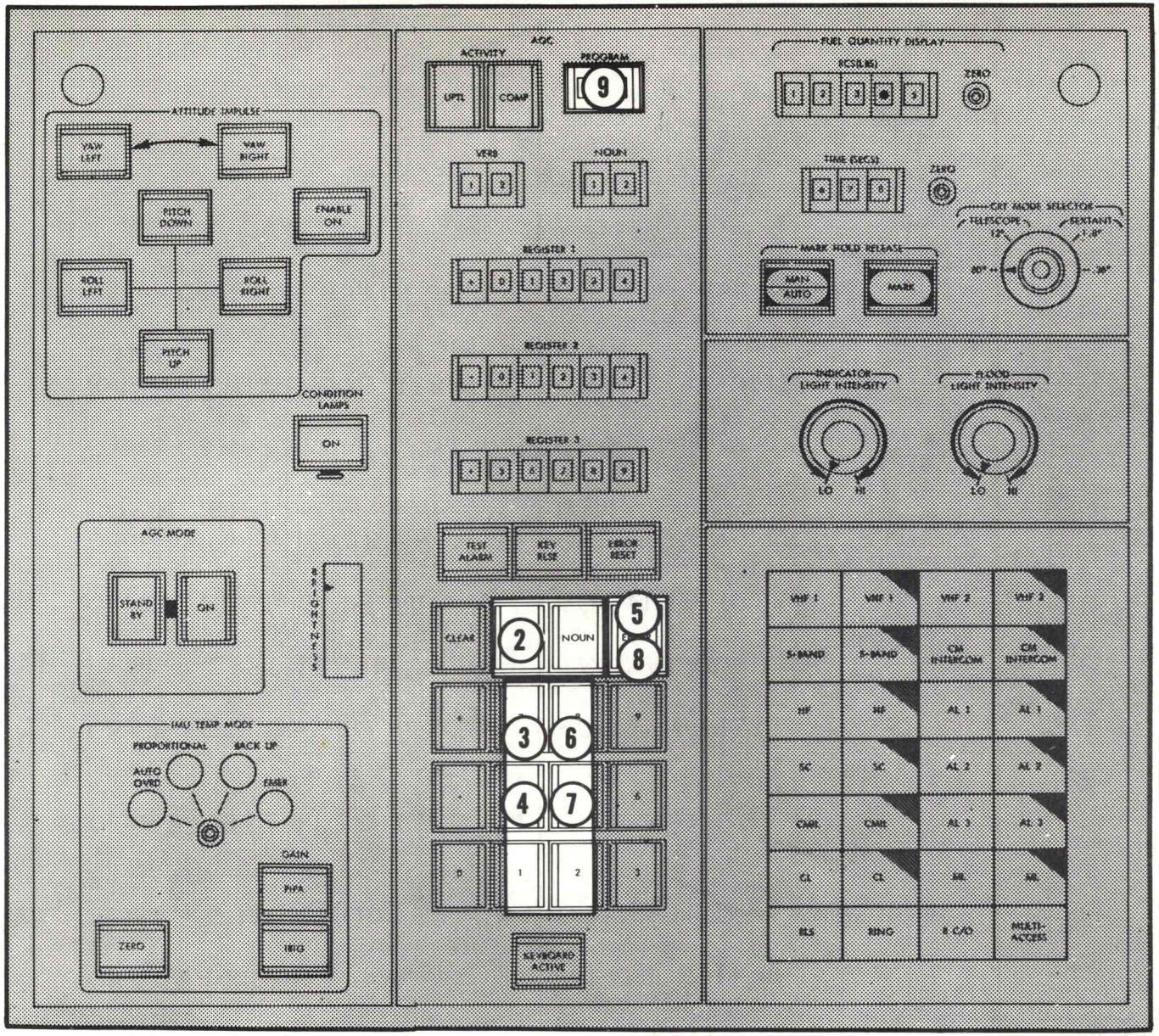
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Depress and hold CHECK COOLANT sw	CHECK COOLANT lt on	
*2			Check for leak through right and left CHECK COOLANT windows	Observe TV monitor	
3			Release CHECK COOLANT sw	CHECK COOLANT lt out	
4			Depress and hold IMU TEMP MODE GAIN PIPA sw	IMU TEMP MODE GAIN - PIPA lt on	
5			Check IMU TEMP C&W lt on	IMU TEMP C&W lt on	
6			Release IMU TEMP MODE GAIN PIPA sw	IMU TEMP MODE GAIN - PIPA lt out	
7			Check IMU TEMP C&W lt out	IMU TEMP C&W lt out	
8			Depress and hold IMU TEMP MODE GAIN IRIG sw	IMU TEMP MODE GAIN - IRIG lt on	
9			Check IMU TEMP C&W lt on	IMU TEMP C&W lt on	
10			Release IMU TEMP MODE GAIN IRIG sw	IMU TEMP MODE GAIN - IRIG lt out	
11			Check IMU TEMP C&W lt out	IMU TEMP C&W lt out	
12			Depress and hold CHECK MODE LAMPS sw	CHECK MODE LAMPS lt on	


LISTED STEPS
2
SM-6T-2-02-614

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13			Check all MODE sw-lts on	All MODE lts on	
14			Release CHECK MODE LAMPS sw	CHECK MODE LAMPS lt out	
15			Depress and hold TEST ALARM sw	TEST ALARM lt on	
16			Check AGC alarm lts on	AGC alarm lts on	
17			Release TEST ALARM sw	TEST ALARM lt out	
18			Check AGC alarm lts out	AGC alarm lts out	
19			Depress and hold CHECK CONDITION LAMPS sw	CHECK CONDITION LAMPS lt on	
20			Check G&N condition lts on	G&N condition lts on	
21			Release CHECK CONDITION LAMPS sw	CHECK CONDITION LAMPS lt out	
22			Check G&N condition lts out	G&N condition lts out	



LISTED STEPS
1

SM-6T-2-02-622

Program AGC for Major Mode

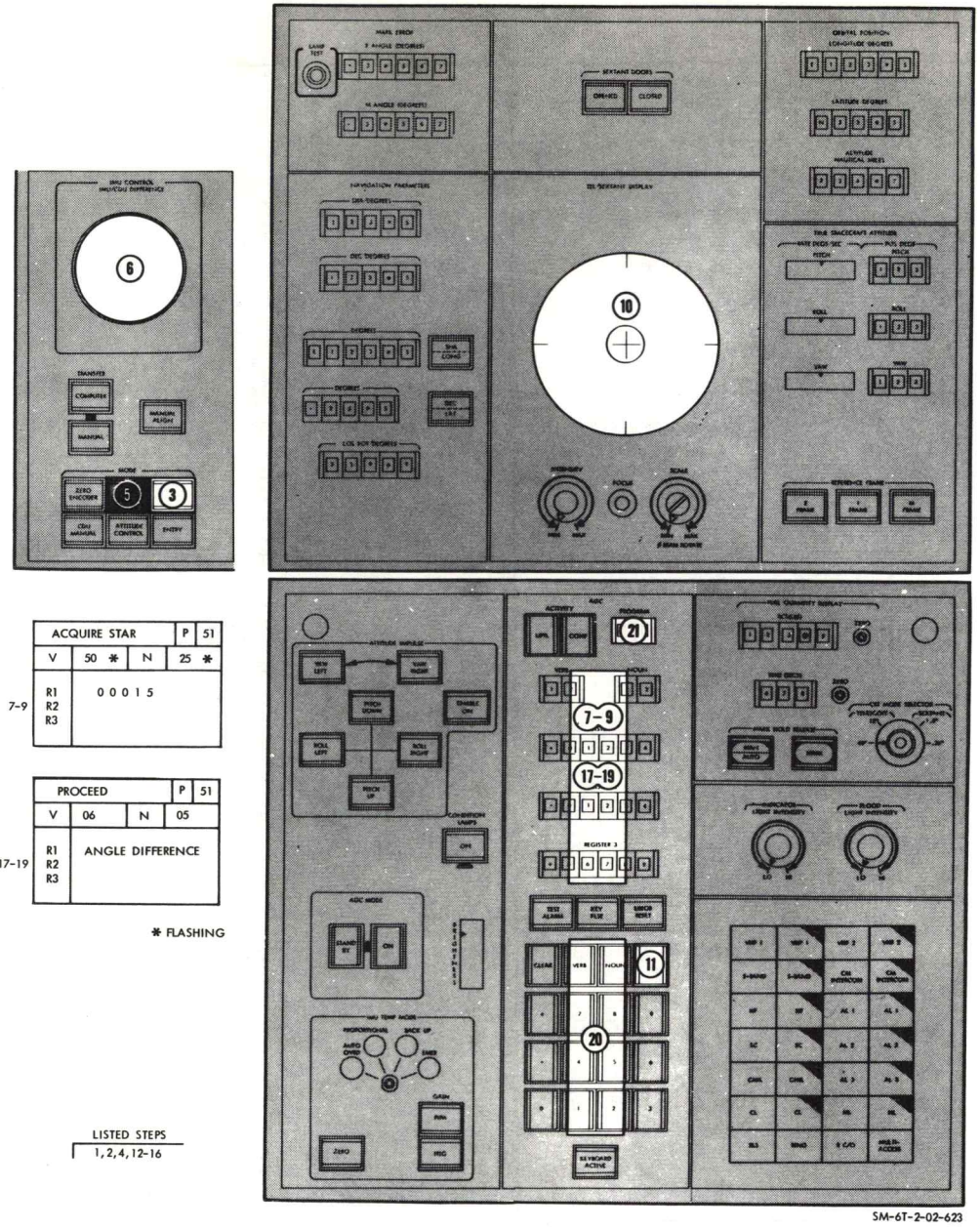
GN4.03

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Obtain procedures	Observe TV monitor	
2			Depress VERB P/B	VERB lt as depressed	
3			Depress verb first digit P/B	Digit lt as depressed	
4			Depress verb second digit P/B	Digit lt as depressed	
5			Depress ENTER P/B	ENTER lt as depressed	
6			Depress program first digit P/B	Digit lt as depressed	
7			Depress program second digit P/B	Digit lt as depressed	
8			Depress ENTER P/B	ENTER lt as depressed	
9			Check PROGRAM window	Check program correct	

Program AGC for Major Mode

GN4.03



ACQUIRE STAR		P	51
V	50 *	N	25 *
7-9 R1 R2 R3	00015		

PROCEED		P	51
V	06	N	05
17-19 R1 R2 R3	ANGLE DIFFERENCE		

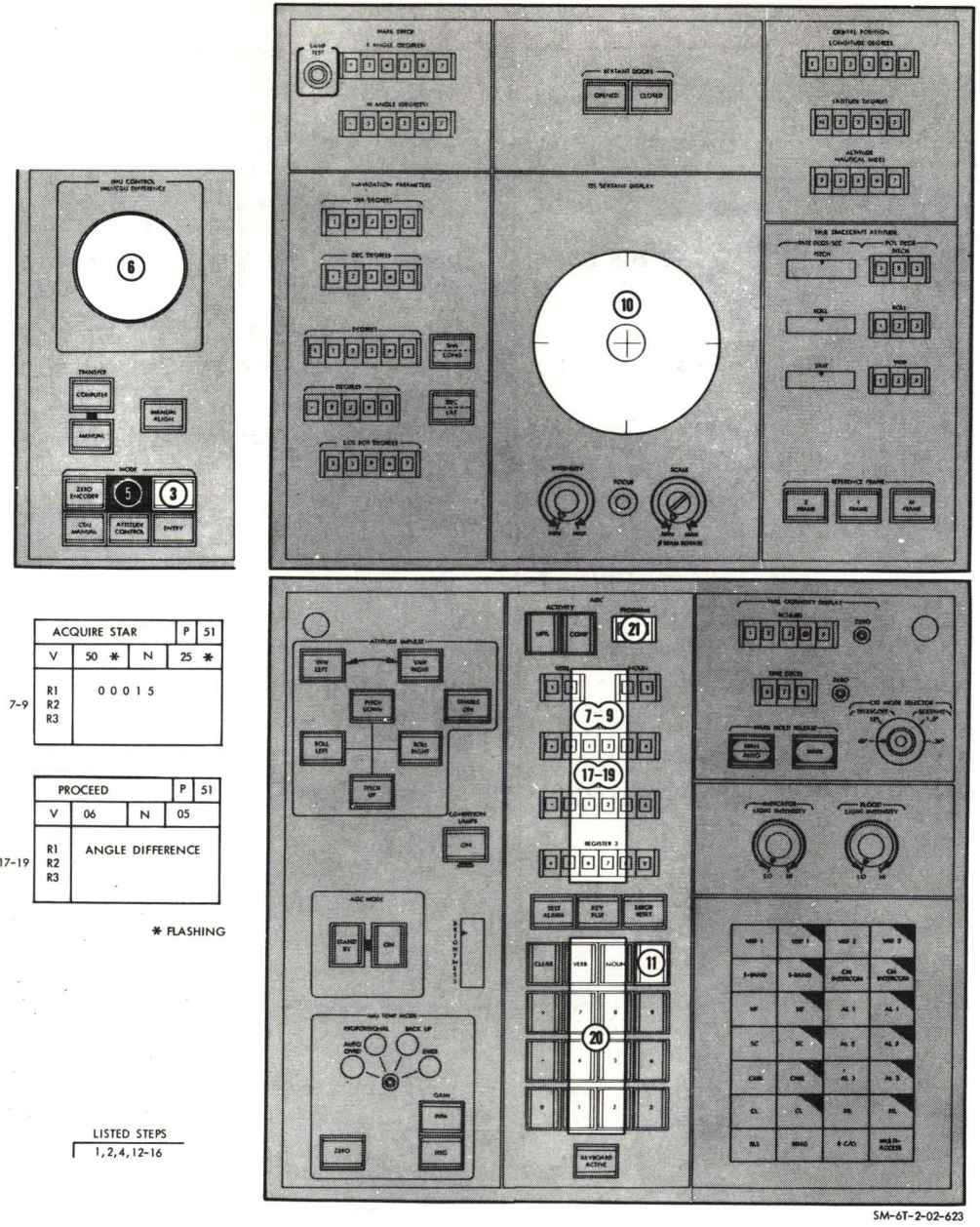
* FLASHING

LISTED STEPS
1, 2, 4, 12-16

SM-6T-2-02-623

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Obtain procedures	Observe TV monitor	
*2			Program AGC	GN4.03 V34 P51	
3			Check MODE FINE ALIGN lt on	MODE-FINE ALIGN lt on in 20 sec	
*4			Request seat 1, perform attitude control mode check	Monitor intercom	
5			Check MODE COARSE ALIGN lt on	MODE-COARSE ALIGN lt on in 45 sec	
6			Check IMU-CDU DIFFERENCE ind	All axes zero ±1.5 degrees	
7			Check VERB window	Flashing 50	
8			Check NOUN window	Flashing 25	
9			Check REGISTER 1	00015	
10			Acquire target stars in telescope field of view	Observe telescope display	
11			Depress ENTER sw when SCT view is correct	ENTER lt on, out as released	



ACQUIRE STAR		P	51
V	50 *	N	25 *
7–9 R1 R2 R3	0 0 0 1 5		

PROCEED		P	51
V	06	N	05
17–19 R1 R2 R3	ANGLE DIFFERENCE		

* FLASHING

LISTED STEPS
1, 2, 4, 12-16

5M-6T-2-02-623

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12-14			Instructor Steps		
*12				Request star identification from student	
*13				Obtain star reference code	
*14				Enter star code on UP DATA LINK keyboard	
*15			Perform sighting mark routine for first star	GN4.49	
*16			Perform sighting mark routine for second star	GN4.49	
17-19			Monitor Star Test Data		
17			Check VERB window	06	
18			Check NOUN window	05	
19			Check REGISTER 1	Star angle difference	
20			Key in proceed	VERB, 33, and ENTER lts as depressed	
21			Check PROGRAM window	00	

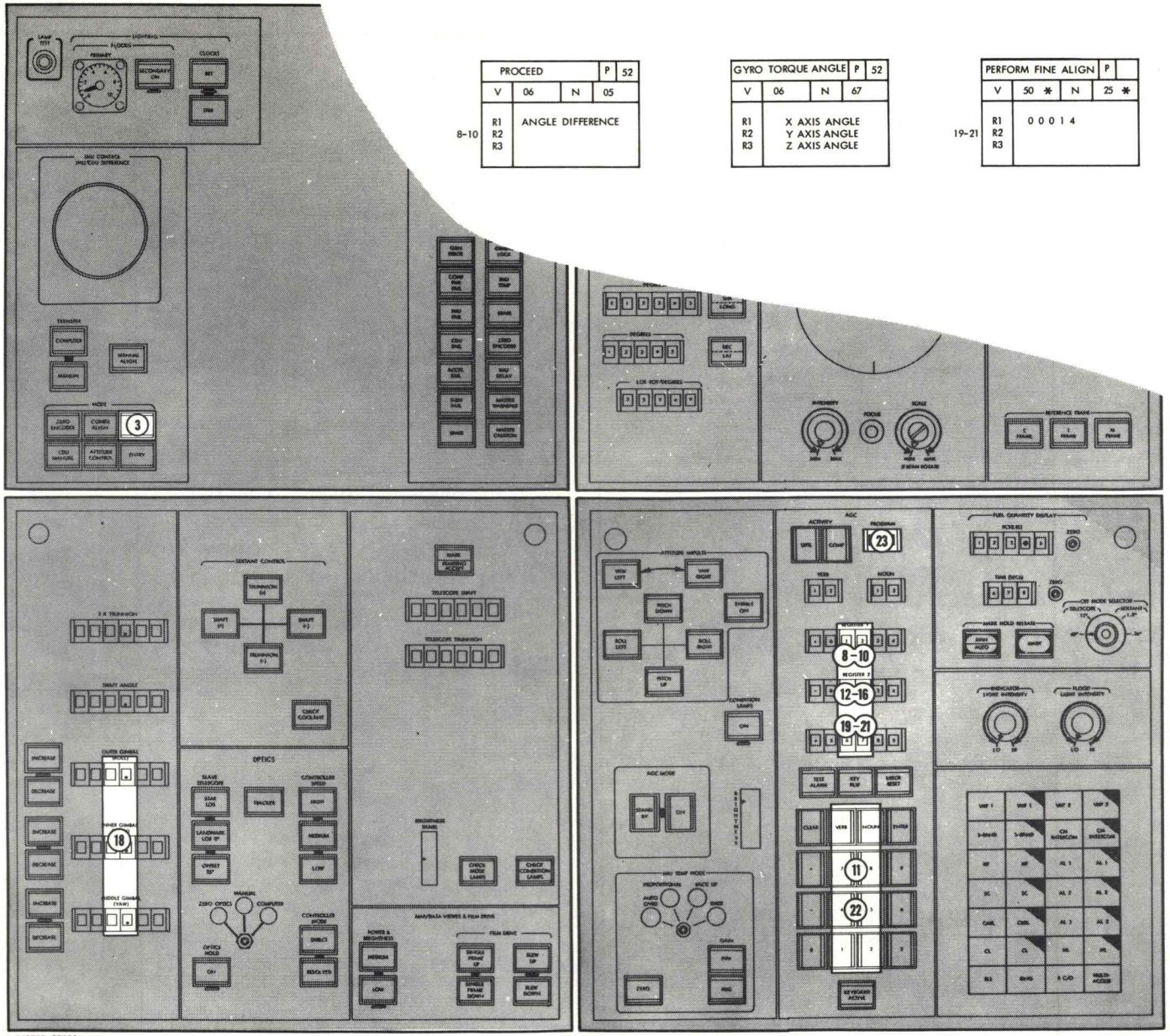
PROCEED		P	52
V	06	N	05
R1 R2 R3	ANGLE DIFFERENCE		

8-10

GYRO TORQUE ANGLE		P	52
V	06	N	67
R1 R2 R3	X AXIS ANGLE Y AXIS ANGLE Z AXIS ANGLE		

PERFORM FINE ALIGN		P	
V	50 *	N	25 *
R1 R2 R3	0 0 0 1 4		

19-21

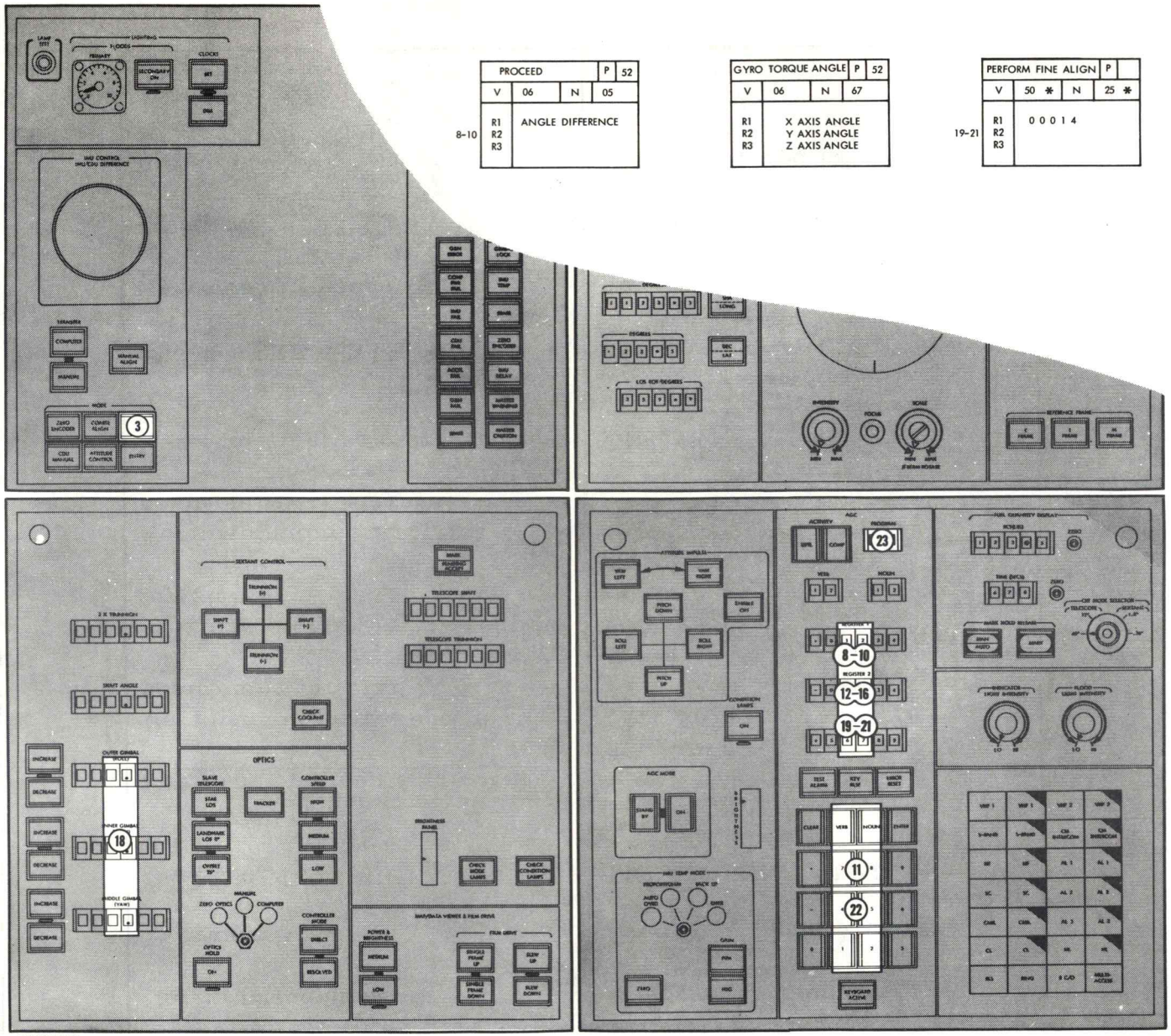


LISTED STEPS
1, 2, 4-7

SM-6T-2-02-624

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Obtain procedures	Observe TV monitor	
*2			Program AGC	GN4.03 V37 P52	
3			Check MODE - FINE ALGIN lt on	MODE - FINE ALIGN lt on	
4-23			Perform Common Alignment		R4
*4			Perform automatic optics positioning for star 1	GN4.50	
*5			Perform sighting mark routine for star 1	GN4.49	
*6			Perform automatic optics positioning for star 2	GN4.50	
*7			Perform sighting mark routine for star 2	GN4.49	
8			Check VERB window	06	
9			Check NOUN window	05	
10			Check REGISTER 1	Star angle difference	
11			Key in proceed	VERB, 33, and ENTER lts as depressed	



PROCEED			P	52
V	06	N	05	
R1	ANGLE DIFFERENCE			
R2				
R3				

8-10

GYRO TORQUE ANGLE			P	52
V	06	N	67	
R1	X AXIS ANGLE			
R2	Y AXIS ANGLE			
R3	Z AXIS ANGLE			

PERFORM FINE ALIGN			P	
V	50 *	N	25 *	
R1	0 0 0 1 4			
R2				
R3				

19-21

LISTED STEPS
1,2,4-7

SM-6T-2-02-624

IMU Alignment (S-IVB)

GN4.06

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12-23			Fine Align IMU		
12			Check VERB window	06	
13			Check NOUN window	67	
14			Check REGISTER 1	X-axis gyro torquing angle	
15			Check REGISTER 2	Y-axis gyro torquing angle	
16			Check REGISTER 3	Z-axis gyro torquing angle	
17			Key in proceed	VERB, 33, and ENTER lts as depressed	
18			Check ICDUs	AGC torques platform	
19			Check VERB window	Flashing 50	
20			Check NOUN window	Flashing 25	
21			Check REGISTER 1	00014	
22			Key in proceed	VERB, 33, and ENTER lts as depressed	
23			Check PROGRAM window	00	

12-14

PROCEED		P	53
V	06	N	05
R1 R2 R3	ANGLE DIFFERENCE		

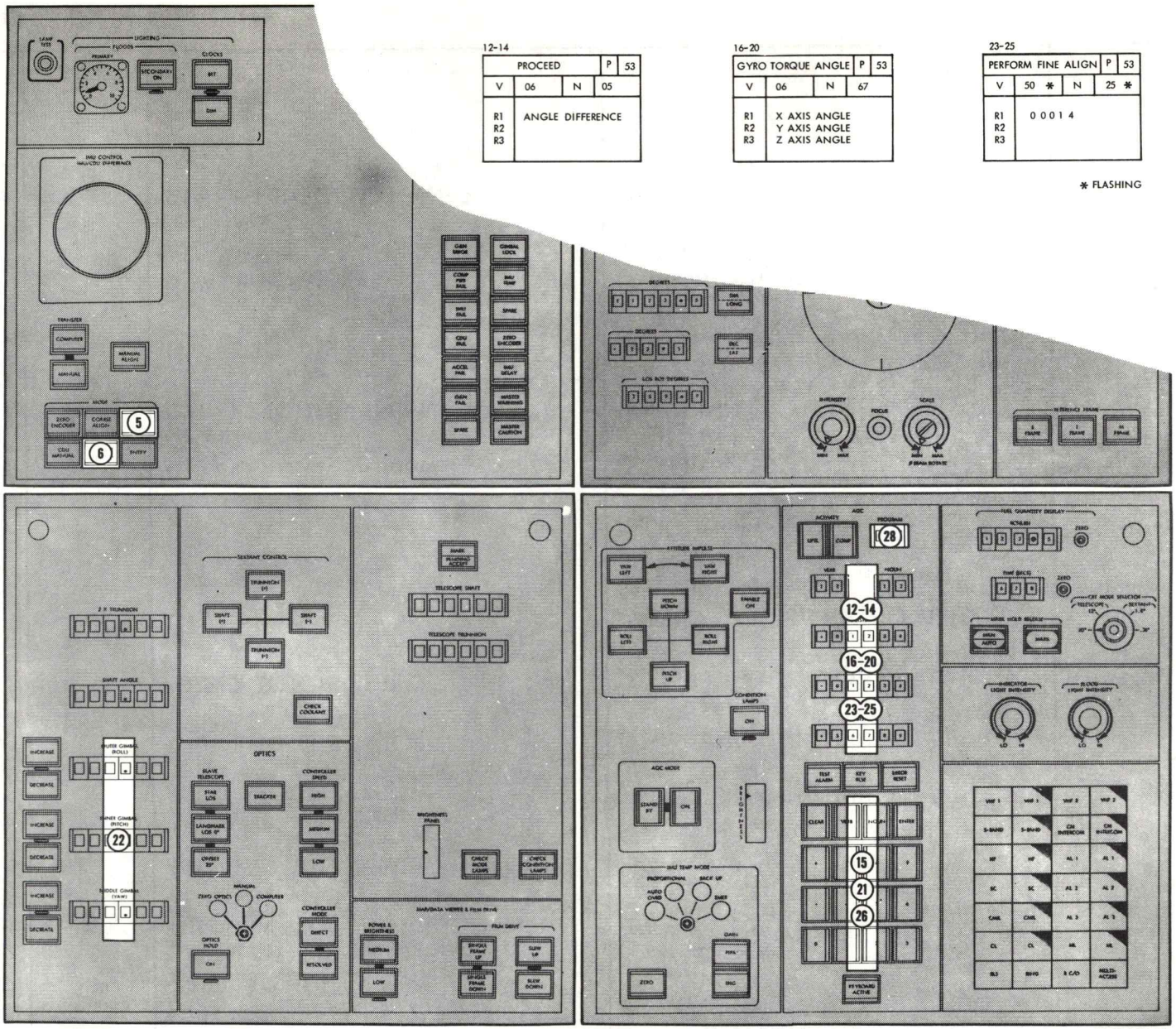
16-20

GYRO TORQUE ANGLE		P	53
V	06	N	67
R1 R2 R3	X AXIS ANGLE Y AXIS ANGLE Z AXIS ANGLE		

23-25

PERFORM FINE ALIGN		P	53
V	50 *	N	25 *
R1 R2 R3	0 0 0 1 4		

* FLASHING



LISTED STEPS
1-4,7-11,27

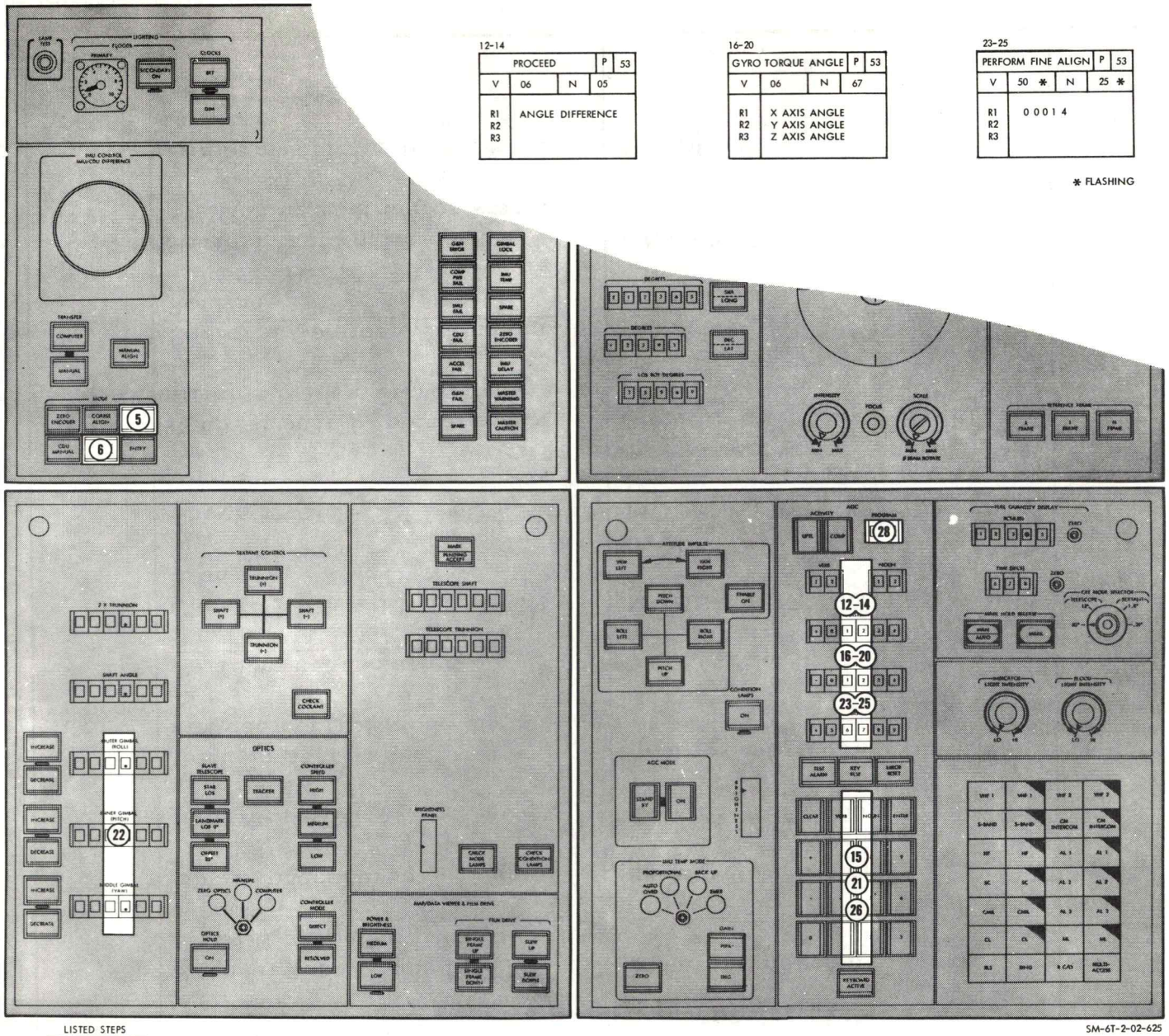
SM-6T-2-02-625

IMU Alignment (SCM)

GN4.07

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Request seat 1, set LIMIT CYCLE sw on	Monitor intercom	
*2			Obtain procedures	Observe TV monitors	
*3			Program AGC	GN4.03 V37 P53	
*4			Request seat 1, perform attitude control mode check	Monitor intercom GN1.40	
5-6			Perform coarse align		
5			Check MODE - FINE ALIGN lt on	MODE - FINE ALIGN lt on	
6			Check MODE - ATT CONT lt on	MODE - ATTITUDE CONTROL lt on	
*7			Request seat 1, perform attitude maneuver routine	Monitor intercom GN1.44	
8-11			Perform Common Alignment Routine		
*8			Perform automatic optics positioning routine for star 1	GN4.50	
*9			Perform sighting mark routine for star 1	GN4.49	



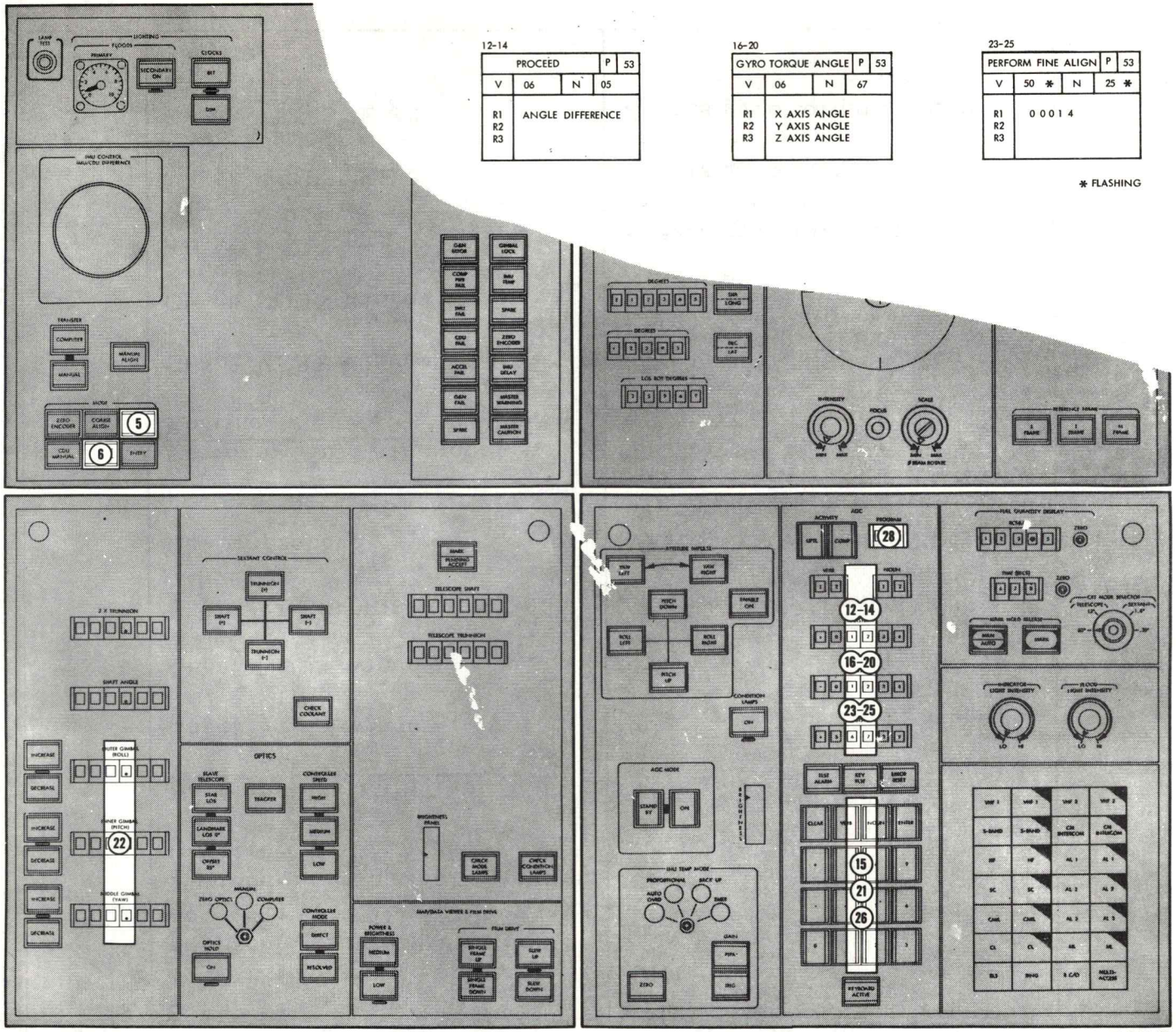
LISTED STEPS
1-4, 7-11, 27

IMU Alignment (SCM)

GN4.07

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*10			Perform automatic optics positioning routine for star 2	GN4.50	
*11			Perform sighting mark routine for star 2	GN4.49	
12-15			Perform Star Data Test		
12			Check VERB window	06	
13			Check NOUN window	05	
14			Check REGISTER 1	Star angle difference	
15			Key in proceed	VERB, 33, and ENTER lts as depressed	
16-27			Perform Final Alignment Routine		
16			Check VERB window	06	
17			Check NOUN window	67	
18			Check REGISTER 1	X-axis gyro torquing angle	
19			Check REGISTER 2	Y-axis gyro torquing angle	
20			Check REGISTER 3	Z-axis gyro torquing angle	



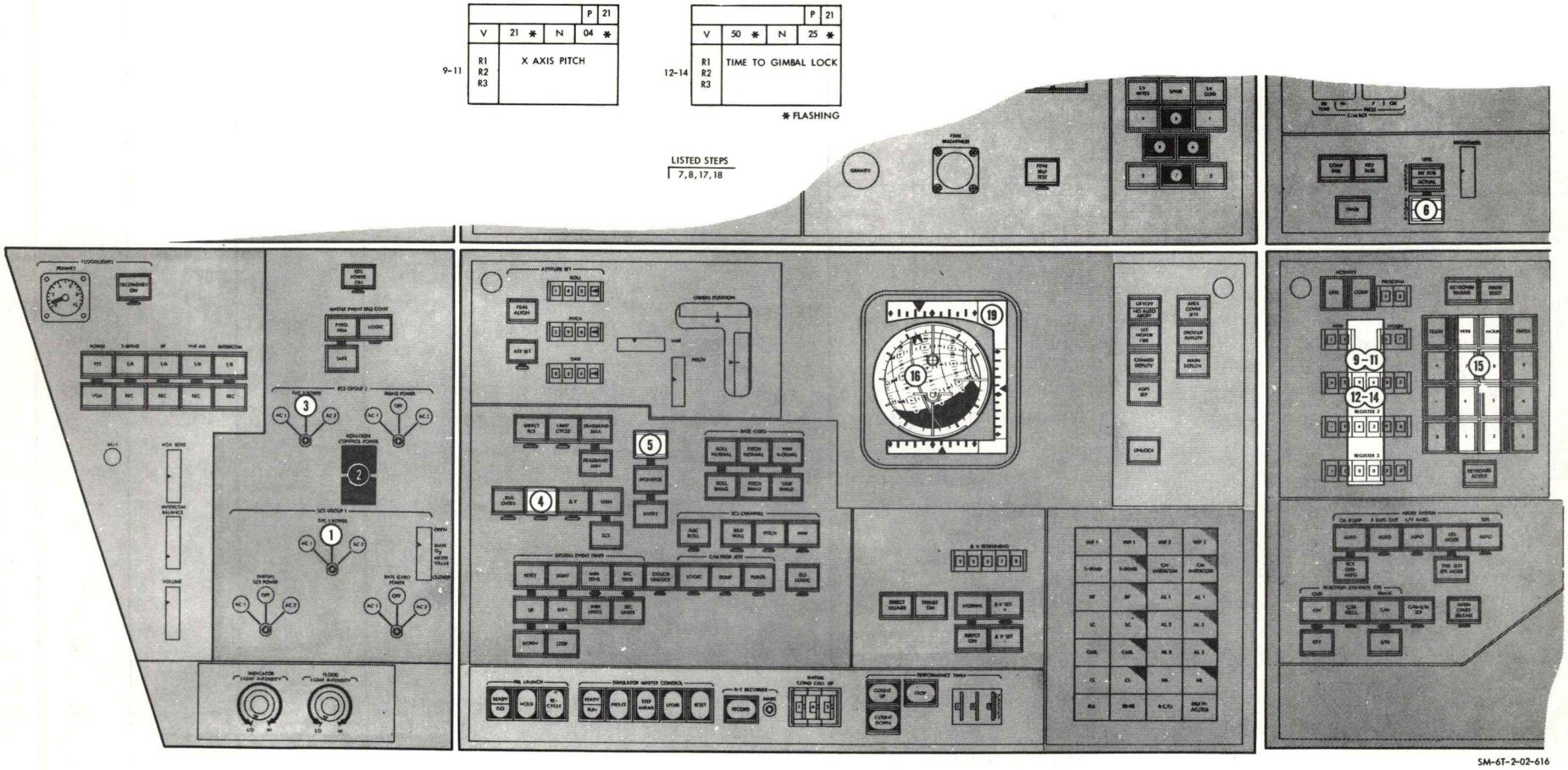
LISTED STEPS
1-4,7-11,27

IMU Alignment (SCM)

GN4.07

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
21			Key in proceed	VERB, 33, and ENTER lts as depressed	
22			Check ICDUs	AGC torques platform	
23			Check VERB window	Flashing 50	
24			Check NOUN window	Flashing 25	
25			Check REGISTER 1	00014	
26			Key in proceed	VERB, 33, and ENTER lts as depressed	
*27			Request seat 1, perform attitude maneuver	Monitor intercom GN1.44	
28			Check PROGRAM window	00, 21, 31, or 33, as programed	



CSM Local Vertical

GN1.08

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			TVC 1 POWER sw - OFF	TVC 1 POWER - OFF lt on	
2			ROTATIONAL CONTROL POWER sw - OFF	ROTATIONAL CONTROL POWER lts out	
3			TVC 2 POWER sw - OFF	TVC 2 POWER - OFF lt on	
4			LCL VERT sw - ON	LCL VERT lt on	
5			ATTITUDE/MONITOR/ENTRY sw - MONITOR	MONITOR lt on	
6			UPTEL sw - BLOCK	UPTEL BLOCK lts on	
*7			Request seat 3, open OPTICS MN A and MN B C/Bs	Monitor intercom	
*8			Enter local vertical program in AGC	GN4.03 V37, P21	
9			Check VERB window flashing	Flashing 21	
10			Check NOUN window flashing	Flashing 04	
11			Enter X-axis pitch angle	Check REGISTER 1	
12			Check VERB 50 flashing	Flashing 50	
13			Check NOUN 25 flashing	Flashing 25	
14			Check REGISTER 1	Time to gimbal lock	

CSM Local Vertical

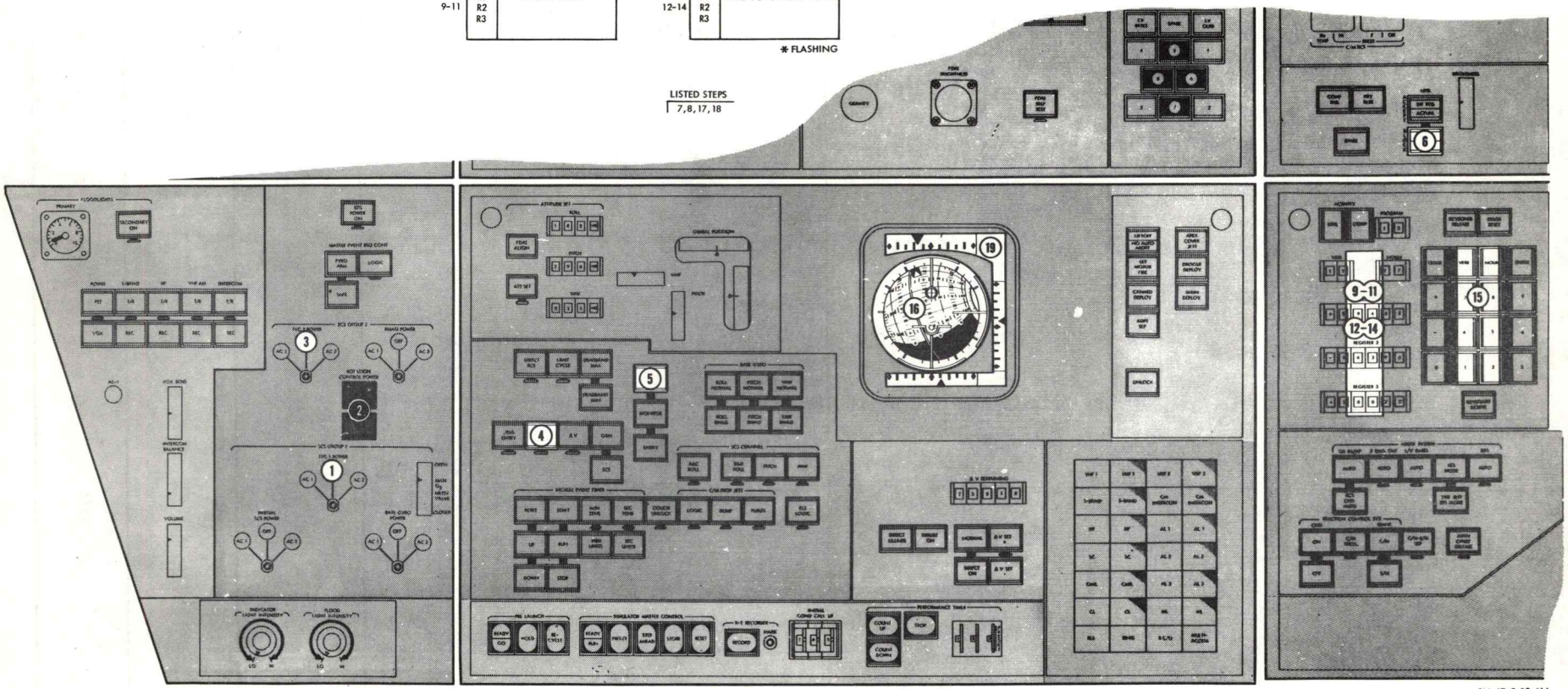
GN1.08

		P	21
V	21 *	N	04 *
9-11 R1 R2 R3	X AXIS PITCH		

		P	21
V	50 *	N	25 *
12-14 R1 R2 R3	TIME TO GIMBAL LOCK		

* FLASHING

LISTED STEPS
7, 8, 17, 18



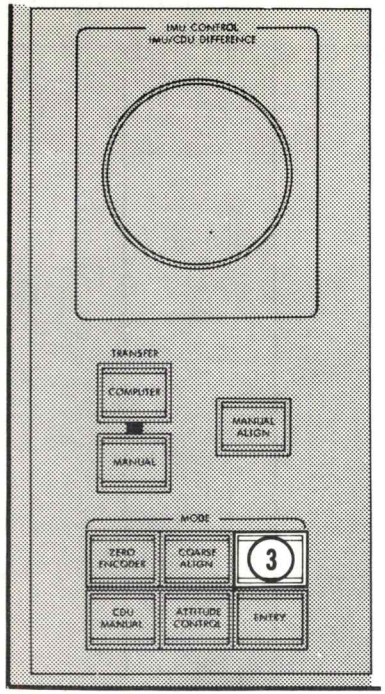
SM-6T-2-02-616

CSM Local Vertical

GN1.08

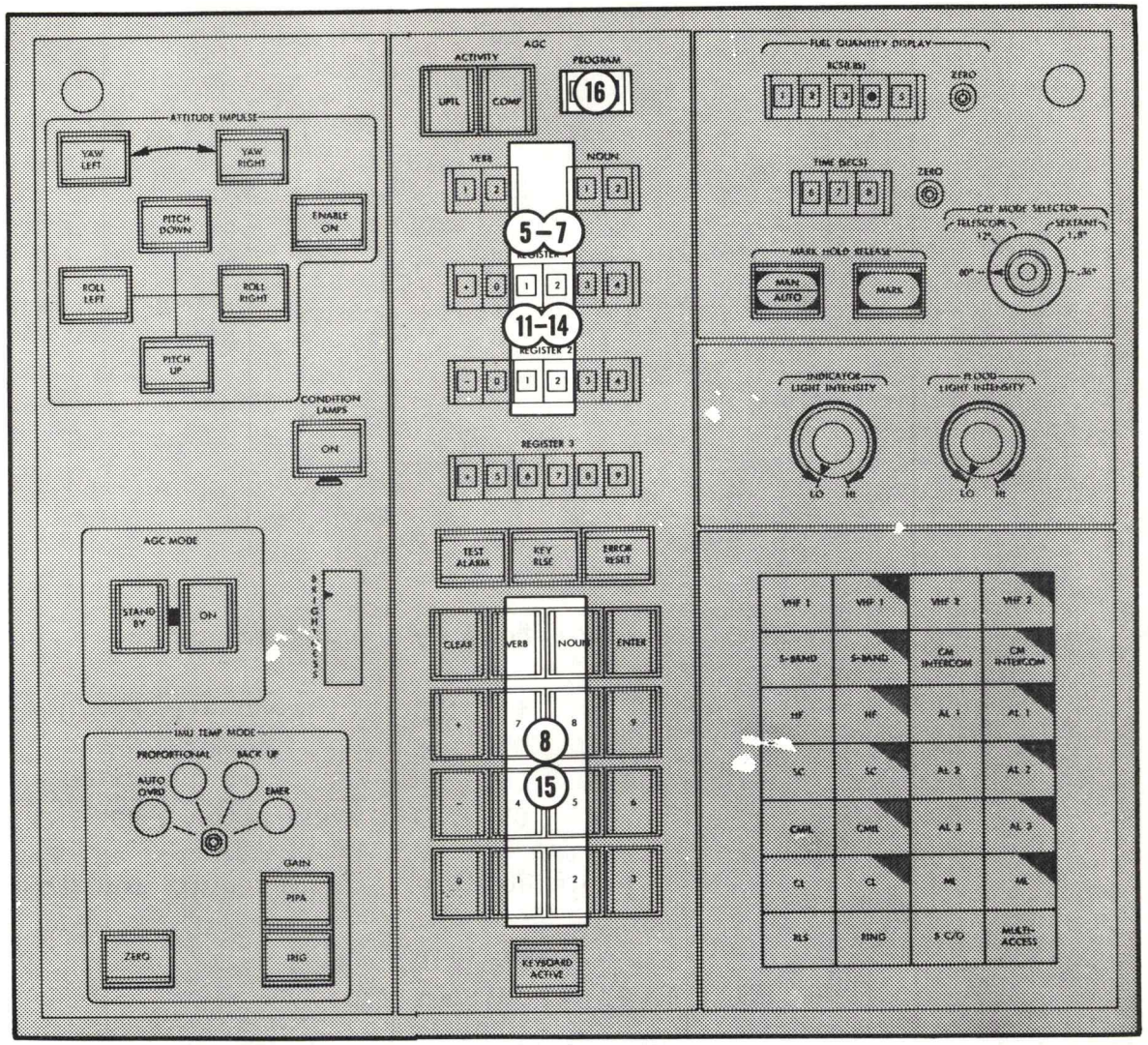
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
15			Key in proceed	VERB, 33, and ENTER lts as depressed	
16			Monitor FDAI for gimbal lock	As programed	
*17			Perform Attitude Control Mode Check	GN1.40	
*18			Perform Attitude Maneuver	GN1.44	
19			Check FDAI error and rate inds normal	As programed	



LISTED STEPS

1, 2, 4, 9, 10



SM-6T-2-02-626

AUTO OPTICS			P	22
V	50 *	N	25 *	
5-7 R1 R2 R3	0 0 0 1 6			

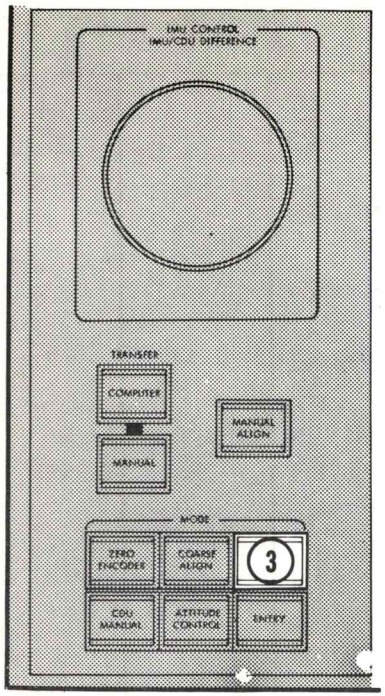
ORBIT CHANGE			P	22
V	06 *	N	06 *	
11-14 R1 R2 R3	POSITION DIFFERENCE VECTOR DIFFERENCE			

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Obtain procedures	Observe TV monitor	
*2			Program AGC for landmark tracking	GN4.03 V37 P22	
3			Check MODE - FINE ALIGN lt on		
*4			Request seat 1, place G&N/SCS sw - SCS		
5			Check VERB window	Flashing 50	
6			Check NOUN window	Flashing 25	
7			Check REGISTER 1	00016	
8			Key in proceed	VERB, 33, and ENTER lts as depressed	
*9			Perform automatic optics positioning routine	GN4.50	
*10			Perform sighting mark routine	GN4.49	
11			Check VERB window	Flashing 06	
12			Check NOUN window	Flashing 06	
13			Check REGISTER 1	Position state vector difference	

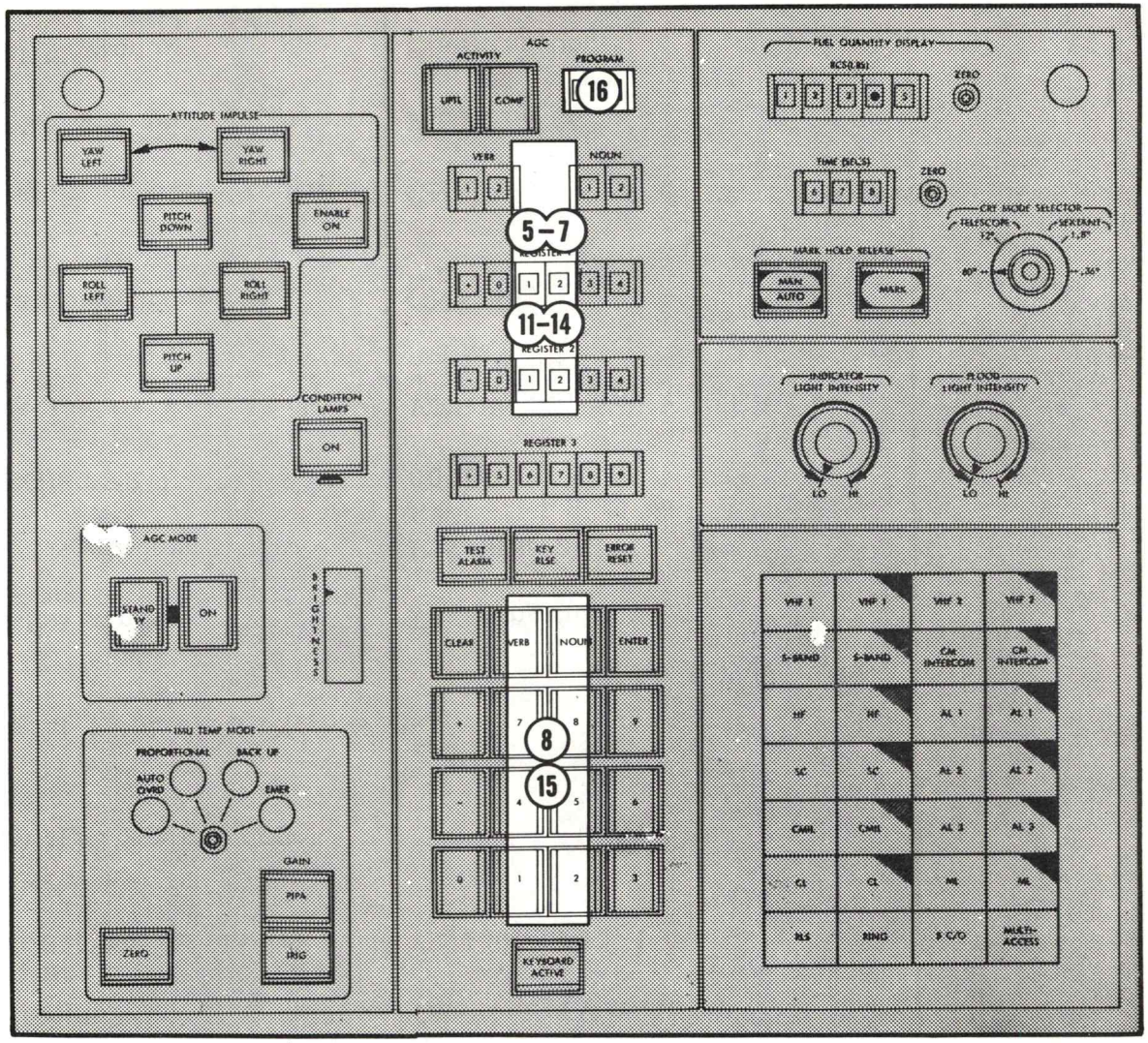
Landmark Tracking

GN4.09



LISTED STEPS

1, 2, 4, 9, 10



SM-6T-2-02-626

AUTO OPTICS		P	22
V	50 *	N	25 *
5-7 R1 R2 R3	00016		

ORBIT CHANGE		P	22
V	06 *	N	06 *
11-14 R1 R2 R3	POSITION DIFFERENCE VECTOR DIFFERENCE		

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14			Check REGISTER 2	Velocity state vector difference	
15			Key in proceed	VERB, 33, and ENTER lts as depressed	
16			Check PROGRAM window	00	

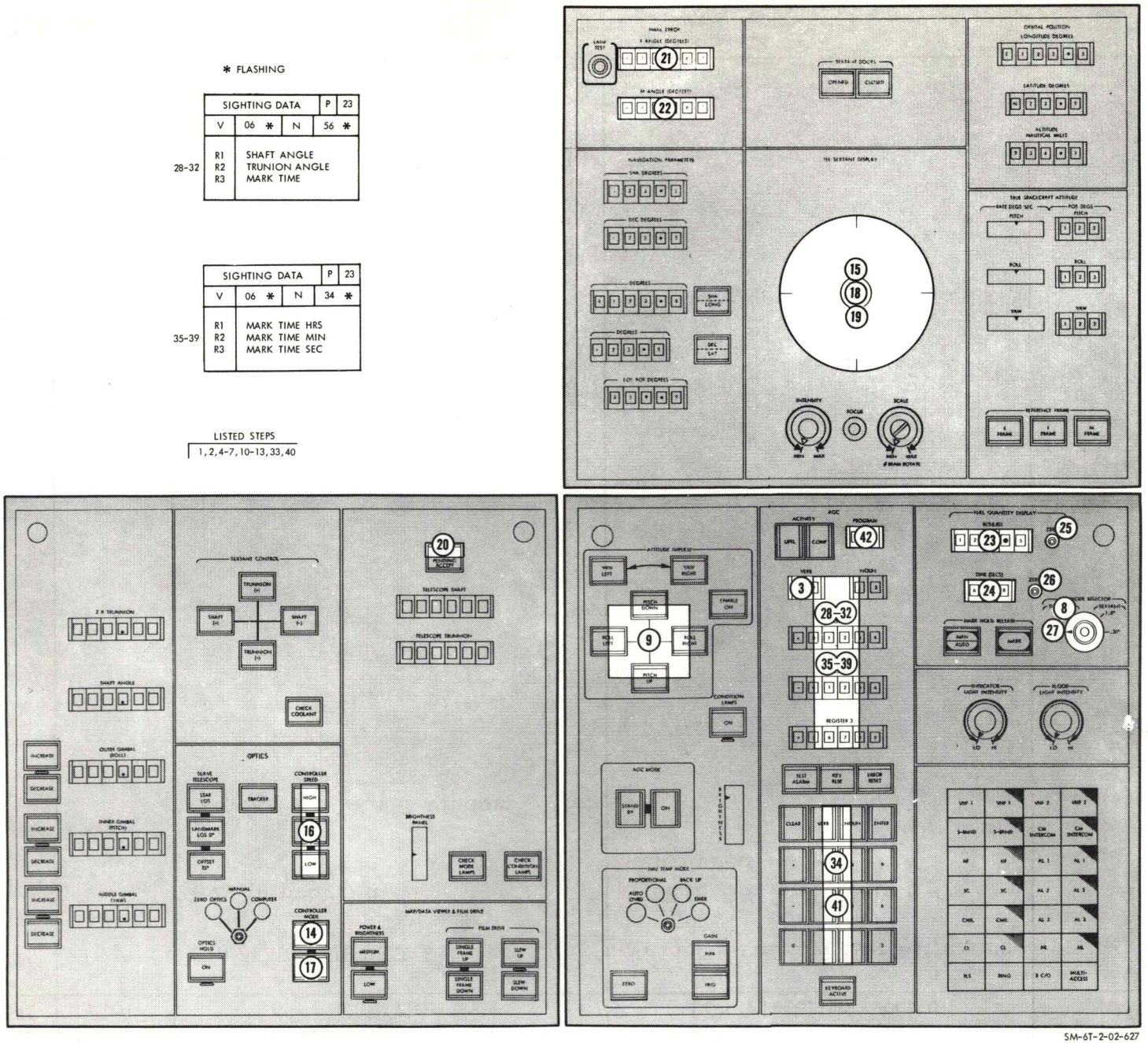
* FLASHING

SIGHTING DATA		P	23
V	06 *	N	56 *
28-32	R1 SHAFT ANGLE R2 TRUNION ANGLE R3 MARK TIME		

SIGHTING DATA		P	23
V	06 *	N	34 *
35-39	R1 MARK TIME HRS R2 MARK TIME MIN R3 MARK TIME SEC		

LISTED STEPS

1, 2, 4-7, 10-13, 33, 40



SM-6T-2-02-627

Star-Landmark Navigation Measurement

GN4.10

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Unlock rotation control	Observe TV monitor	
*2			Enter star-landmark or horizon nav program in AGC	GN4.03 V37 P23	
3			Check VERB window	Flashing 51	
*4			Select landmark from reference data	Observe TV monitor	
5-7			Instructor Steps		
*5				Request landmark identification from student	
*6				Obtain reference code for landmark in catalog	
*7				Enter reference code in UP DATA LINK keyboard	
8				Position CRT MODE SELECTOR sw as required	
9			Maneuver SCM to center landmark in SCT	ATTITUDE IMPULSE lt activity	
*10			Select target star from reference data	Observe TV monitor	

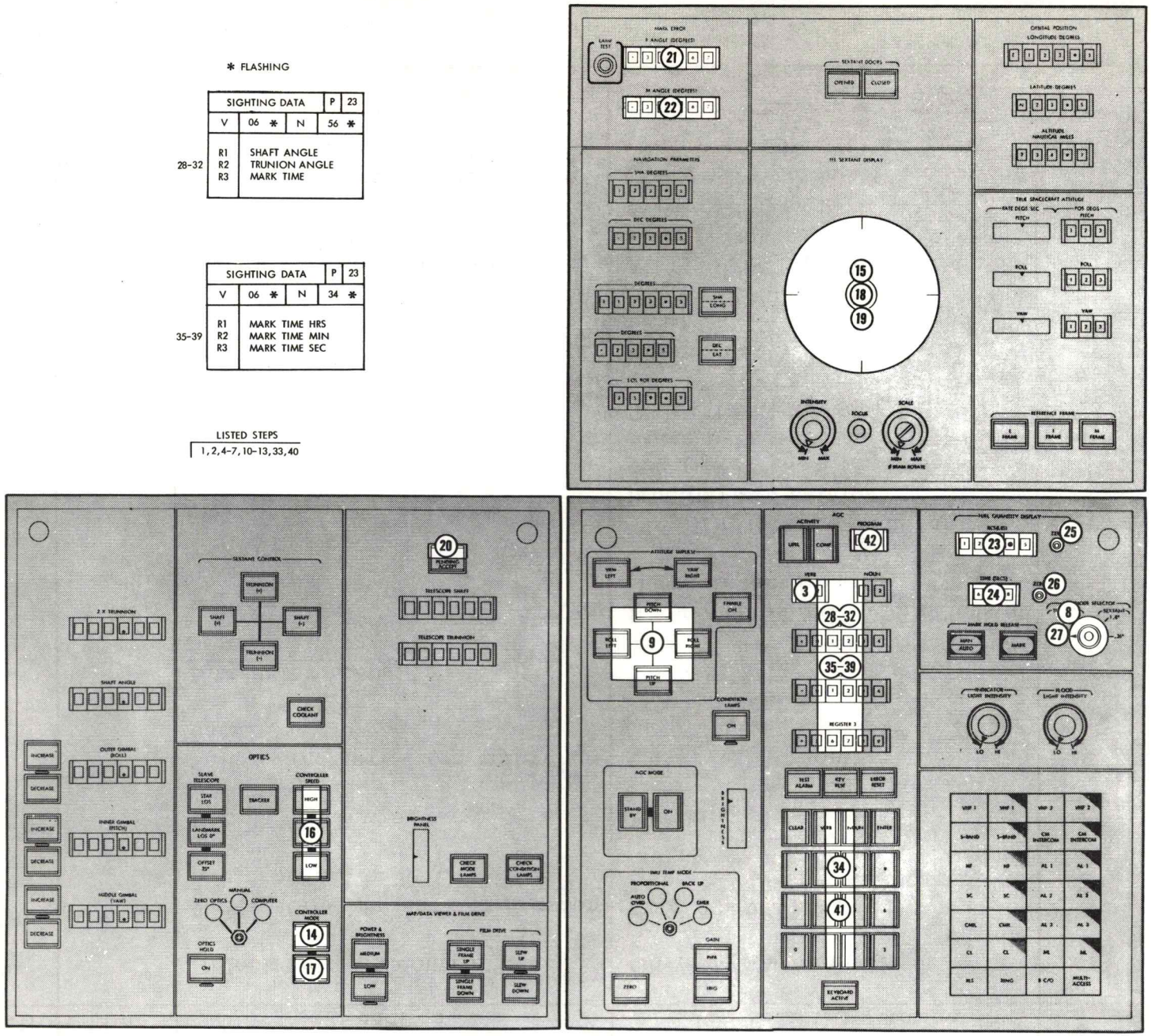
* FLASHING

SIGHTING DATA		P	23
V	06 *	N	56 *
28-32	R1 SHAFT ANGLE R2 TRUNION ANGLE R3 MARK TIME		

SIGHTING DATA		P	23
V	06 *	N	34 *
35-39	R1 MARK TIME HRS R2 MARK TIME MIN R3 MARK TIME SEC		

LISTED STEPS

1, 2, 4-7, 10-13, 33, 40



SM-6T-2-02-627

Star-Landmark Navigation Measurement

GN4.10

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
11-13			Instructor Steps		
*11				Request star identification from student	
*12				Obtain star reference code in catalog	
*13				Enter reference code in UP DATA LINK keyboard	
14			OPTICS MODE sw - DIRECT	CONTROLLER MODE - DIRECT lt on	
15			Align target star on R line in SXT	SEXTANT CONTROL lt activity	
16			Place CONTROLLER SPEED sw - as required	CONTROLLER SPEED lts, as selected	
17			CONTROLLER MODE sw - RESOLVED	CONTROLLER MODE - RESOLVED lt on	
18			Center star in SXT	SEXTANT CONTROL lt activity	
19			Superimpose star on landmark	Observe CRT	
20			Depress MARK sw	MARK lt on, out as released; PENDING ACCEPT lt on, out in 20 sec	

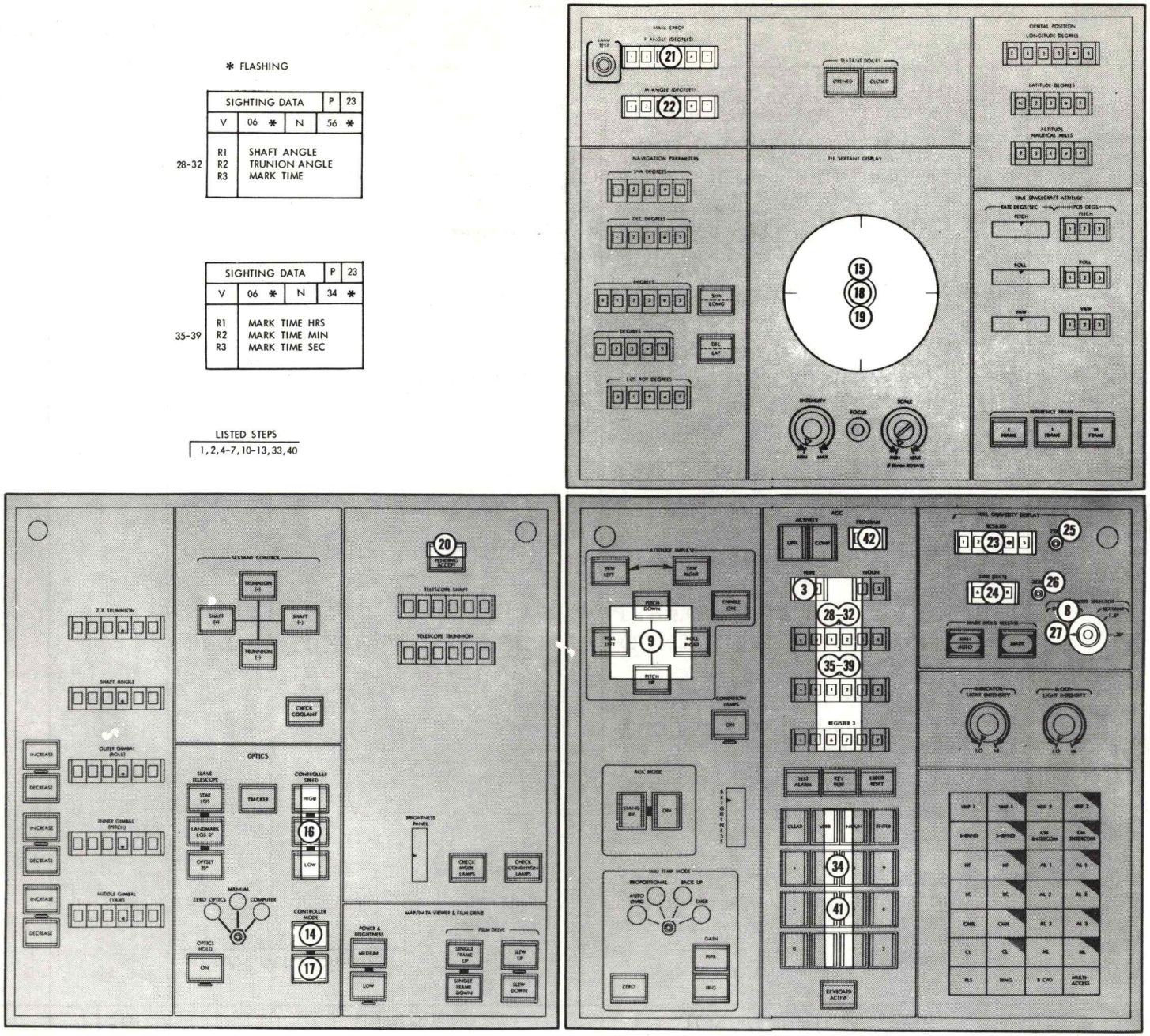
* FLASHING

	SIGHTING DATA		P	23
	V	06 *	N	56 *
28-32	R1 R2 R3	SHAFT ANGLE TRUNION ANGLE MARK TIME		

	SIGHTING DATA		P	23
	V	06 *	N	34 *
35-39	R1 R2 R3	MARK TIME HRS MARK TIME MIN MARK TIME SEC		

LISTED STEPS

1, 2, 4-7, 10-13, 33, 40



SM-6T-2-02-627

Star-Landmark Navigation Measurement

GN4.10

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
21-27			Instructor Steps		
21				Check MARK ERROR R ANGLE (DEGREES)	
22				Check MARK ERROR M ANGLE (DEGREES)	
23				Check RCS (LBS) digital readout	
24				Check TIME (SEC) digital readout	
25				Depress RCS (LBS) ZERO sw	
26				Depress TIME (SEC) ZERO sw	
27				CRT MODE SELECTOR - 60°	
28			Check VERB window	Flashing 06	
29			Check NOUN window	Flashing 56	
30			Check REGISTER 1	Shaft angle	
31			Check REGISTER 2	Trunnion angle	
32			Check REGISTER 3	Time of mark	

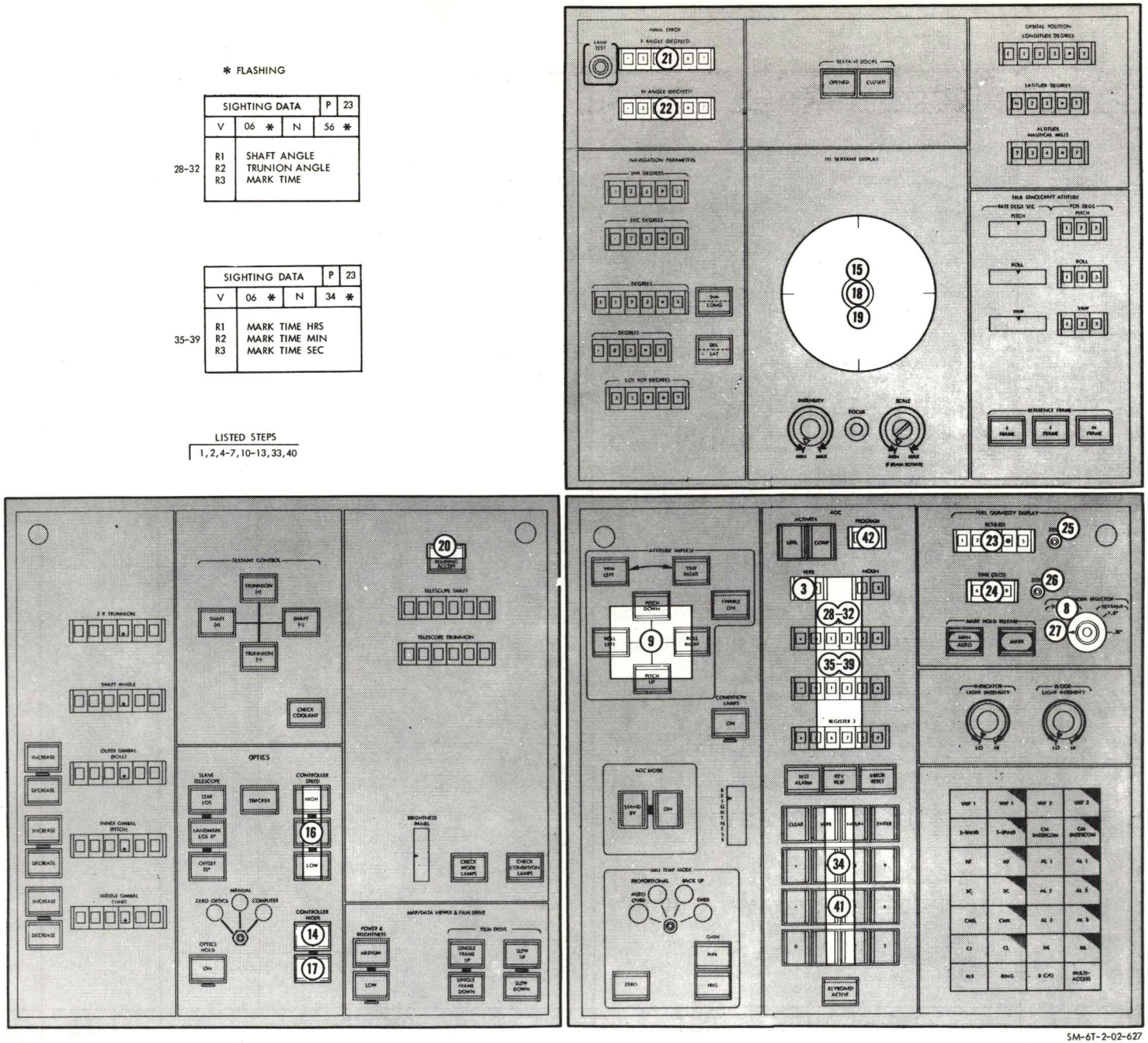
* FLASHING

SIGHTING DATA		P	23
V	06 *	N	56 *
28-32	R1 SHAFT ANGLE R2 TRUNION ANGLE R3 MARK TIME		

SIGHTING DATA		P	23
V	06 *	N	34 *
35-39	R1 MARK TIME HRS R2 MARK TIME MIN R3 MARK TIME SEC		

LISTED STEPS

1, 2, 4-7, 10-13, 33, 40



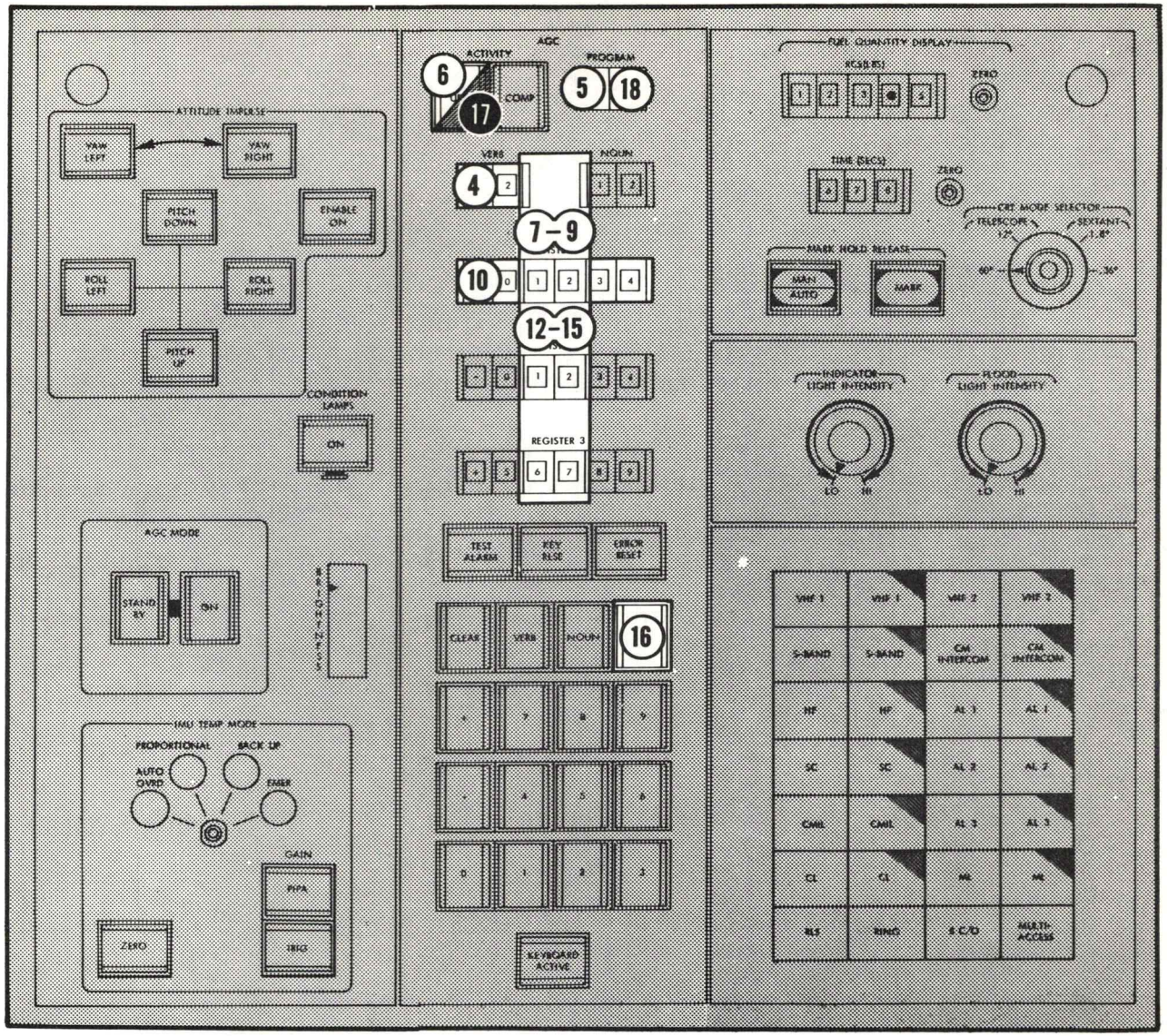
SM-6T-2-02-627

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*33			Verify data with MSFN	Provide appropriate communication	
34			Key in proceed	VERB, 33, and ENTER lts as depressed	
35			Check VERB window	Flashing 06	
36			Check NOUN window	Flashing 34	
37			Check REGISTER 1	Mark time - hrs	
38			Check REGISTER 2	Mark time - min	
39			Check REGISTER 3	Mark time - sec	
*40			Confirm data with MSFN	Provide appropriate communication	
41			Key in ENTER	ENTER lt as depressed	
42			Check PROGRAM window	00	

INSERT DATA		P	27
V	21 *	N	05 *
7-9 R1 R2 R3	STORAGE ADDRESS		

REQUEST LOAD		P	27
V	50 *	N	25 *
12-15 R1 R2 R3	0 0 0 1 2		



SM-6T-2-02-628

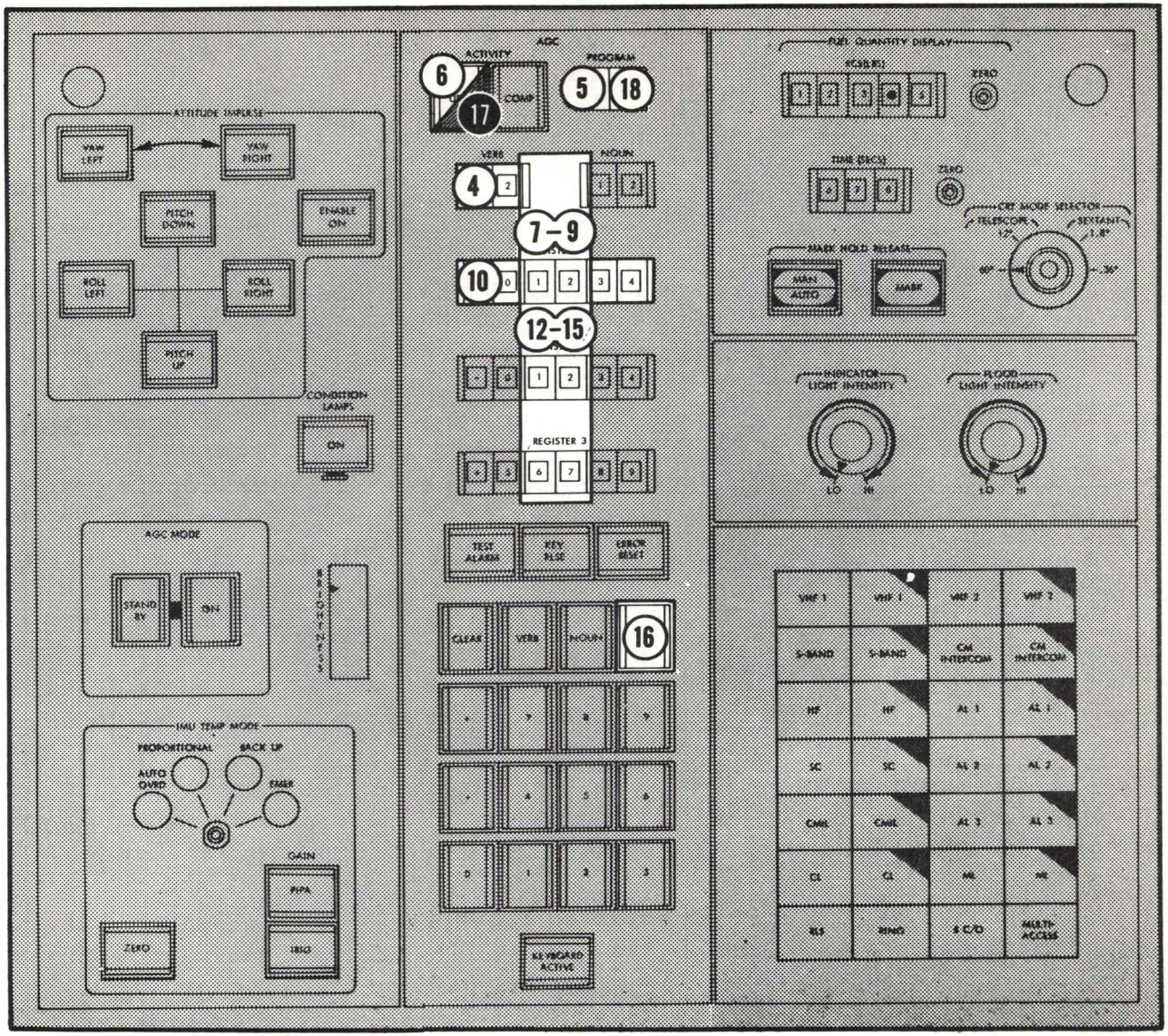
1,2,3,11,19

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Receive request or request AGC update	Request or receive request for AGC update	
*2			Identify parameters	Identify parameters	
*3			Request seat 1; place UPTEL sw - ACCEPT	Monitor intercom	Continue with step 17 if update is to be automatic.
4			Key in appropriate verb to identify parameters	VERB, digit, and ENTER lt, as selected	
5			Check PROGRAM window	27	
6			Check ACTIVITY - UPTEL lt on	ACTIVITY - UPTEL lt on	
7			Check VERB window	Flashing 21	
8			Check NOUN window	Flashing 05	
9			Check REGISTER 3	Temporary storage address	
10			Key in update data	Check REGISTER 1	
*11			Repeat step 9 until loading complete		
12			Check VERB window	Flashing 50	
13			Check NOUN window	Flashing 25	

INSERT DATA		P	27
V	21 *	N	05 *
7-9 R1 R2 R3	STORAGE ADDRESS		

REQUEST LOAD		P	27
V	50 *	N	25 *
12-15 R1 R2 R3	0 0 0 1 2		



SM-6T-2-02-628

1,2,3,11,19

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14			Check REGISTER 1	00012	
15			Check PROGRAM window	27	
16			Key in ENTER	ENTER lt as depressed	
17			Check UPTEL-ACTIVITY lt out		
18			Check PROGRAM window	Other than 27	
*19			Request seat 1, place UPTEL sw - BLOCK	Monitor intercom	Only if update was automatic.

*FLASHING

4-8

DELTA V PARAMETERS		P	31
V	06 *	N	10 *
R1	PERIGEE ALT		
R2	DELTA V REG		
R3	MIN DISTANCE		

11-15

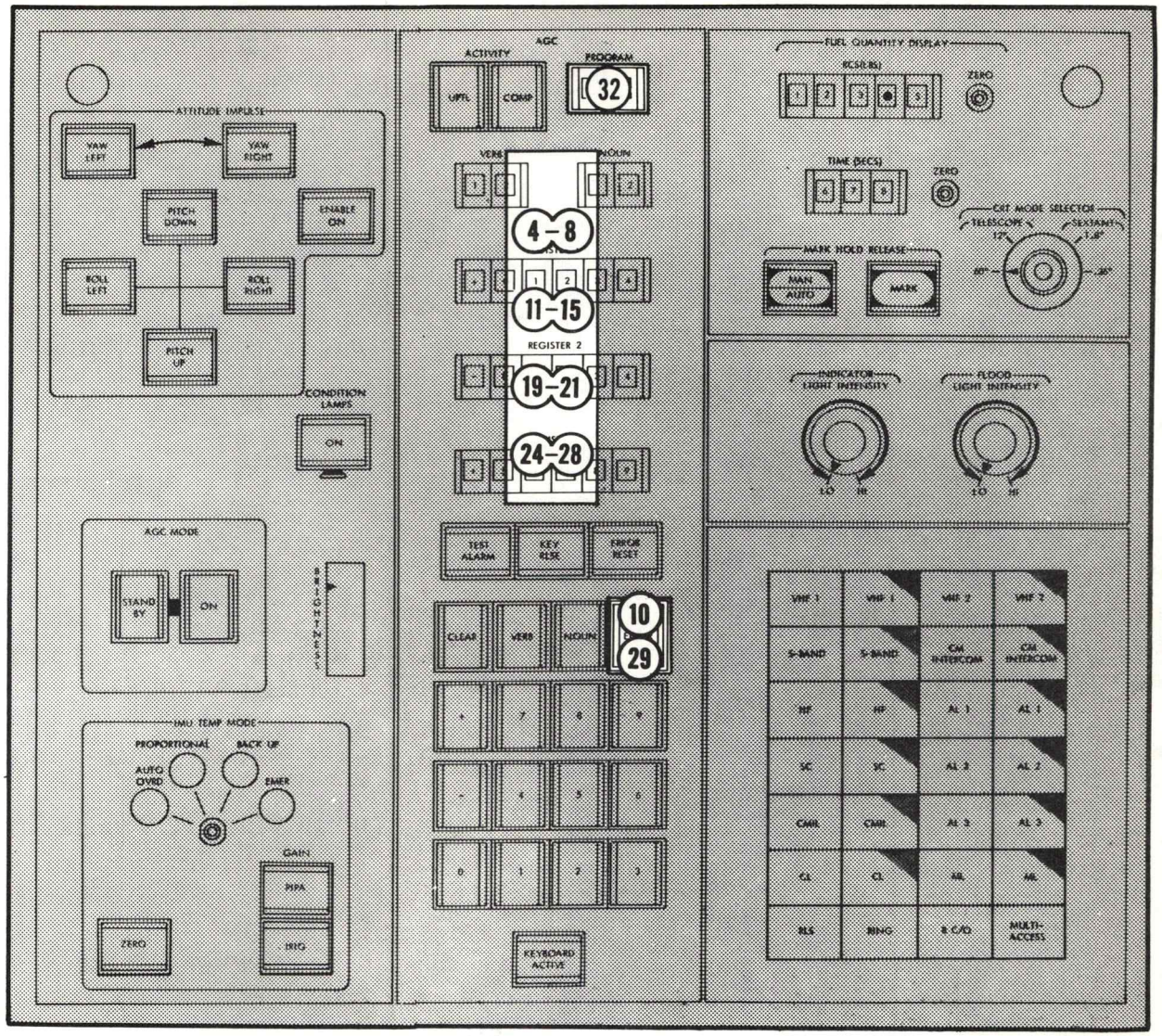
DELTA V PARAMETERS		P	31
V	06 *	N	11 *
R1	TIME TO IGN HRS		
R2	TIME TO IGN MIN		
R3	TIME TO IGN SEC		

19-21

Dg IMU ORIENTATION		P	41
V	37 *	N	51 *
R1	0 0 0 5 1		
R2			
R3			

24-28

GIMBAL ANGLES		P	31
V	06 *	N	22 *
R1	OUTER GIMBAL		
R2	INNER GIMBAL		
R3	MIDDLE GIMBAL		



LISTED STEPS

1, 2, 3, 9, 16, 17, 18, 22, 23, 30, 31

SM-6T-2-02-629

Orbit Change Delta V Station 4

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Obtain procedures	Observe TV monitor	
*2			Program AGC	GN4.03 V37 P31	
*3			Perform orbit change data load	GN4.56	
4			Check VERB window	Flashing 06	
5			Check NOUN window	Flashing 10	
6			Check REGISTER 1	Perigee altitude	
7			Check REGISTER 2	Delta V required	
8			Check REGISTER 3	Minimum distance	
*9			Evaluate parameters with MSFN	Provide appropriate communication	
10			Key in ENTER	ENTER lt as depressed	
11			Check VERB window	16	
12			Check NOUN window	11	
13			Check REGISTER 1	Time to ignition - hrs	
14			Check REGISTER 2	Time to ignition - min	
15			Check REGISTER 3	Time to ignition - sec	

Orbit Change Delta V Station 4

GN4.12

*FLASHING

4-8

DELTA V PARAMETERS		P	31
V	06 *	N	10 *
R1	PERIGEE ALT		
R2	DELTA V REG		
R3	MIN DISTANCE		

11-15

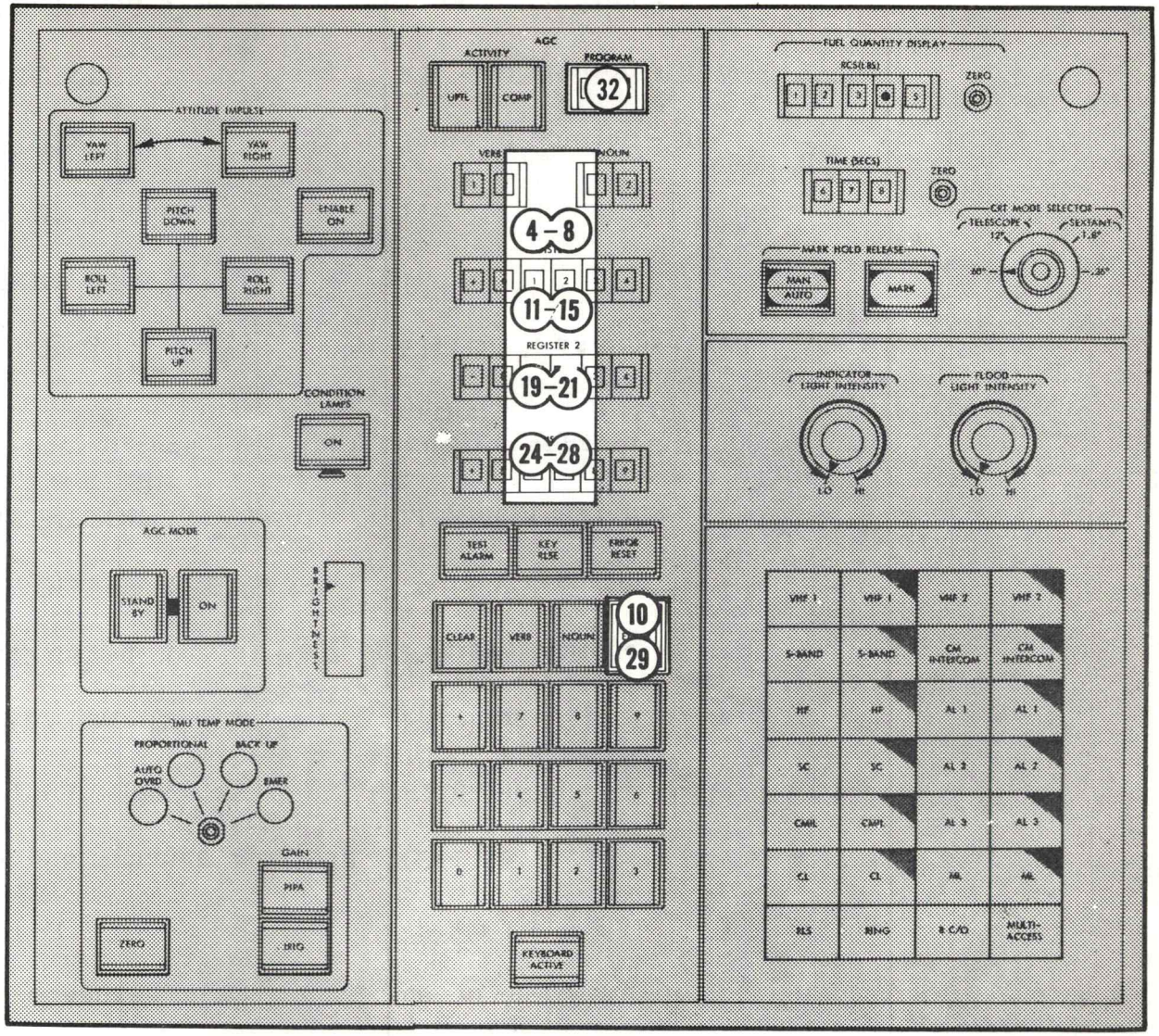
DELTA V PARAMETERS		P	31
V	06 *	N	11 *
R1	TIME TO IGN HRS		
R2	TIME TO IGN MIN		
R3	TIME TO IGN SEC		

19-21

Dg IMU ORIENTATION		P	41
V	37 *	N	51 *
R1	0 0 0 5 1		
R2			
R3			

24-28

GIMBAL ANGLES		P	31
V	06 *	N	22 *
R1	OUTER GIMBAL		
R2	INNER GIMBAL		
R3	MIDDLE GIMBAL		



SM-6T-2-02-629

LISTED STEPS

1, 2, 3, 9, 16, 17, 18, 22, 23, 30, 31

Orbit Change Delta V Station 4

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*16			Request seat 1, set DET	Monitor intercom	
*17			Set TIME TO EVENT clock	Observe TV monitor	
*18			Request seat 1, perform backup delta V counter routine		
19			Check VERB window	Flashing 37	
20			Check NOUN window	Flashing 51	
21			Check REGISTER 1	00051	
*22			Perform IMU orientation determination	GN4.04 V37 P51	
*23			Perform CSM IMU alignment	GN4.07 V37 P53	
24			Check VERB window	Flashing 06	
25			Check NOUN window	Flashing 22	
26			Check REGISTER 1	Outer gimbal angle	
27			Check REGISTER 2	Inner gimbal angle	
28			Check REGISTER 3	Middle gimbal angle	
29			Key in ENTER	ENTER lt as depressed	

*FLASHING

4-8

DELTA V PARAMETERS		P	31
V	06 *	N	10 *
R1	PERIGEE ALT		
R2	DELTA V REG		
R3	MIN DISTANCE		

11-15

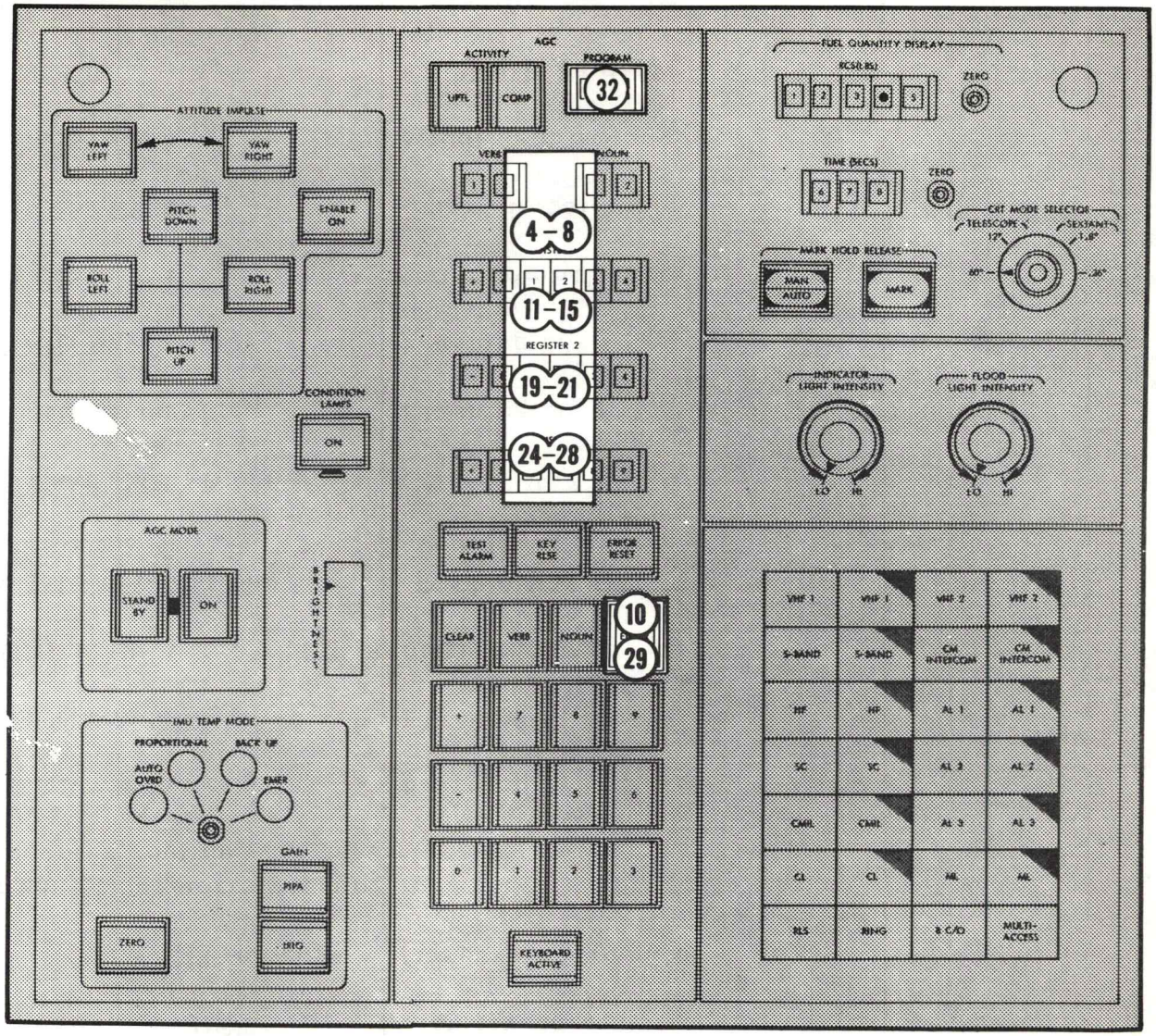
DELTA V PARAMETERS		P	31
V	06 *	N	11 *
R1	TIME TO IGN HRS		
R2	TIME TO IGN MIN		
R3	TIME TO IGN SEC		

19-21

Dg IMU ORIENTATION		P	41
V	37 *	N	51 *
R1	0 0 0 5 1		
R2			
R3			

24-28

GIMBAL ANGLES		P	31
V	06 *	N	22 *
R1	OUTER GIMBAL		
R2	INNER GIMBAL		
R3	MIDDLE GIMBAL		



SM-6T-2-02-629

LISTED STEPS

1, 2, 3, 9, 16, 17, 18, 22, 23, 30, 31

Orbit Change Delta V Station 4

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*30			Request Seat 1, Perform Attitude Control Mode Check	GN1.40	
*31			Request Seat 1, Perform Attitude Maneuver Routine	GN1.44	
32			Check PROGRAM window	00	

*FLASHING

6-8

DO ORBIT CHANGE	P	31
V	50 * N	07 *
R3 R2 R1	0 0 0 4 1	

34-37

	P	41
V	16 N	15
R1 R2 R3	TIME TO IGN DELTA V	

67-68

DELTA V DATA	P	41
V	06 N	11
R1 R2 R3	TIME TO CUTOFF DELTA V ULLAGE DELTA V	

83-84

REQUEST PROCEED	P	41
V	06 * N	51 *
R3 R2 R1	TIME TO CUTOFF DELTA V ULLAGE DELTA V	

10-12

THRUST MODE CHECK	P	41
V	50 * N	25 *
R1 R2 R3	0 0 0 0 7	

50-54

DELTA V PARAMETERS	P	41
V	16 N	51
R1 R2 R3	TIME TO CUTOFF DELTA V REQUIRED ULLAGE DELTA V	

16-20

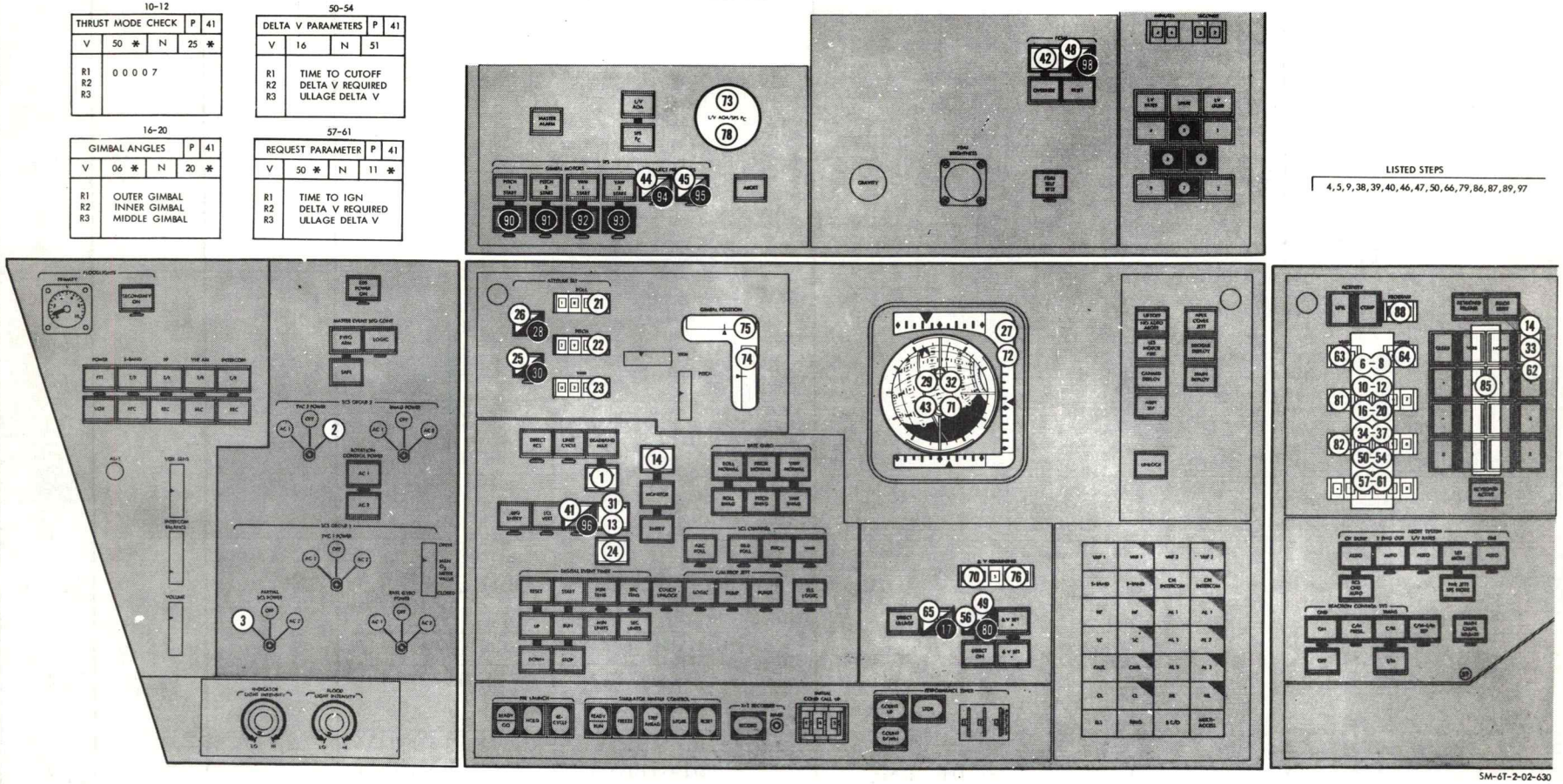
GIMBAL ANGLES	P	41
V	06 * N	20 *
R1 R2 R3	OUTER GIMBAL INNER GIMBAL MIDDLE GIMBAL	

57-61

REQUEST PARAMETER	P	41
V	50 * N	11 *
R1 R2 R3	TIME TO IGN DELTA V REQUIRED ULLAGE DELTA V	

LISTED STEPS

4, 5, 9, 38, 39, 40, 46, 47, 50, 66, 79, 86, 87, 89, 97



SM-6T-2-02-630

Orbit Change Delta V, Station 1

GN1.13

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			DEADBAND sw - MIN	DEADBAND MIN lt on	
2			TVC 2 POWER sw - AC 2	TVC 2 POWER - AC 2 lt on	
3			TVC 1 POWER sw - AC 1	TVC 1 POWER - AC 1 lt on	
*4			Perform attitude control mode check	GN1.40	
*5			Perform attitude maneuver routine	GN1.44	
6			Check NOUN window	Flashing 50	
7			Check VERB window	Flashing 07	
8			Check REGISTER 1	00041	
*9			Enter thrusting orbit change program	GN4.03 V37 P41	
10-15			Perform Thrust Control Mode Check		
10			Check VERB window	Flashing 50	
11			Check NOUN window	Flashing 25	
12			Check REGISTER 1	00007	
13			G&N/SCS sw - G&N	G&N lt on	

*FLASHING

6-8

DO ORBIT CHANGE	P	31
V 50 *	N	07 *
R3 00041 R2 R1		

34-37

	P	41
V 16	N	15
R1 TIME TO IGN R2 DELTA V R3		

67-68

DELTA V DATA	P	41
V 06	N	11
R1 TIME TO CUTOFF R2 DELTA V R3 ULLAGE DELTA V		

83-84

REQUEST PROCEED	P	41
V 06 *	N	51 *
R3 TIME TO CUTOFF R2 DELTA V R1 ULLAGE DELTA V		

10-12

THRUST MODE CHECK	P	41
V 50 *	N	25 *
R1 00007 R2 R3		

50-54

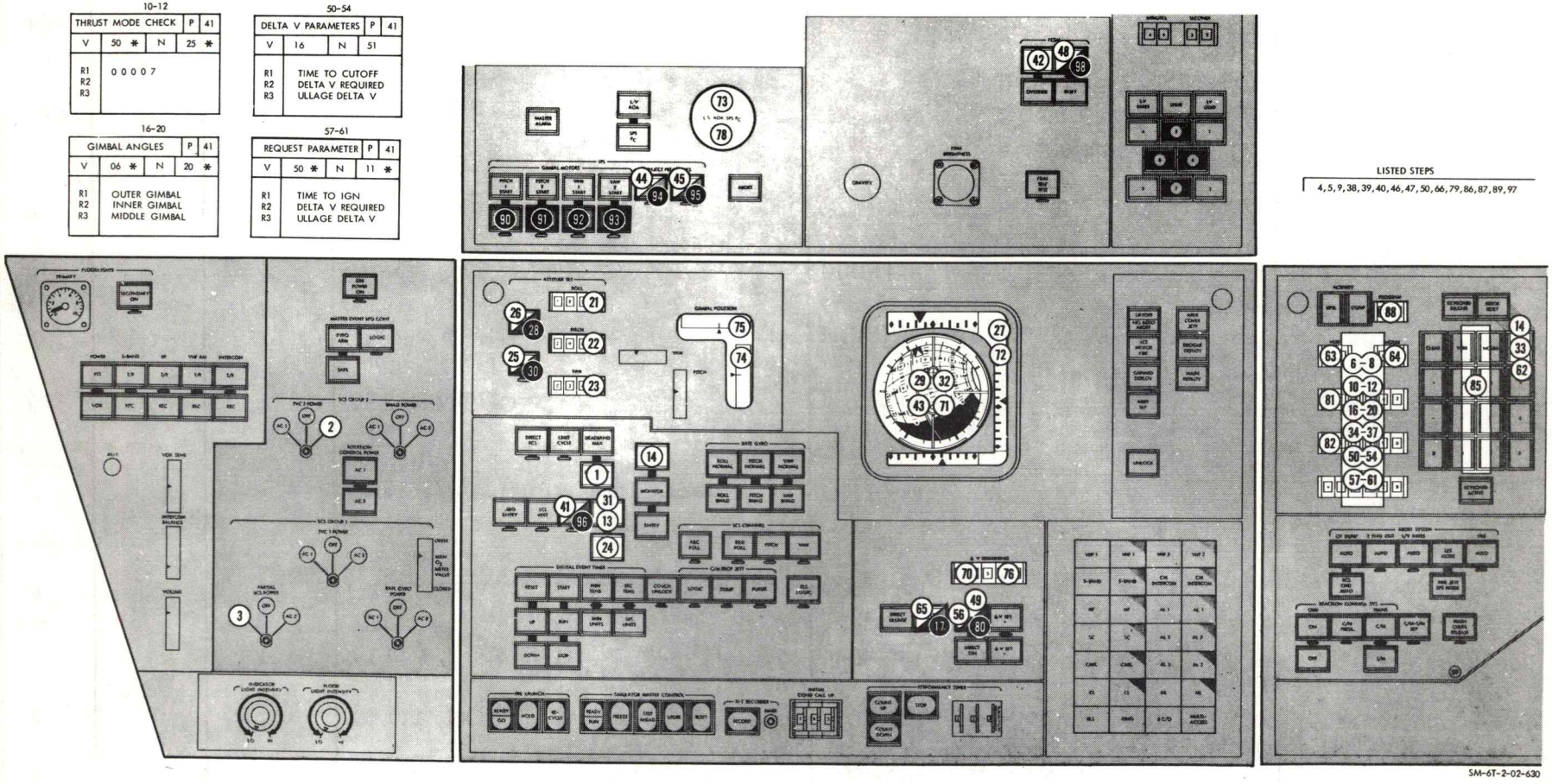
DELTA V PARAMETERS	P	41
V 16	N	51
R1 TIME TO CUTOFF R2 DELTA V REQUIRED R3 ULLAGE DELTA V		

16-20

GIMBAL ANGLES	P	41
V 06 *	N	20 *
R1 OUTER GIMBAL R2 INNER GIMBAL R3 MIDDLE GIMBAL		

57-61

REQUEST PARAMETER	P	41
V 50 *	N	11 *
R1 TIME TO IGN R2 DELTA V REQUIRED R3 ULLAGE DELTA V		



LISTED STEPS

4, 5, 9, 38, 39, 40, 46, 47, 50, 66, 79, 86, 87, 89, 97

SM-6T-2-02-630

Orbit Change Delta V, Station 1

GN1.13

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
14			ATTITUDE/MONITOR/ENTRY sw - ATTITUDE	ATTITUDE lt on	
15			Depress ENTER sw	ENTER lt on, out as released	
16			Check VERB window	Flashing 06	
17			Check NOUN window	Flashing 20	
18			Check REGISTER 1	Outer gimbal angle	
19			Check REGISTER 2	Inner gimbal angle	
20			Check REGISTER 3	Middle gimbal angle	
21			Set ATTITUDE SET ROLL ind	As in REGISTER 1	
22			Set ATTITUDE SET PITCH ind	As in REGISTER 2	
23			Set ATTITUDE SET YAW ind	As in REGISTER 3	
24			G&N/SCS sw SCS	SCS lt on	
25			ATT SET sw - On	ATT SET lt on	
26			Depress FDAI ALIGN and hold sw	FDAI ALIGN lt on	
27			Check FDAI ball and error ind nulled	FDAI will align to angles set on attitude set inds	

Orbit Change Delta V, Station 1

*FLASHING

6-8

DO ORBIT CHANGE			P	31
V	50 *	N	07 *	
R3	0 0 0 4 1			
R2				
R1				

34-37

			P	41
V	16	N	15	
R1	TIME TO IGN			
R2	DELTA V			
R3				

67-68

DELTA V DATA			P	41
V	06	N	11	
R1	TIME TO CUTOFF			
R2	DELTA V			
R3	ULLAGE DELTA V			

83-84

REQUEST PROCEED			P	41
V	06 *	N	51 *	
R3	TIME TO CUTOFF			
R2	DELTA V			
R1	ULLAGE DELTA V			

10-12

THRUST MODE CHECK			P	41
V	50 *	N	25 *	
R1	0 0 0 0 7			
R2				
R3				

50-54

DELTA V PARAMETERS			P	41
V	16	N	51	
R1	TIME TO CUTOFF			
R2	DELTA V REQUIRED			
R3	ULLAGE DELTA V			

16-20

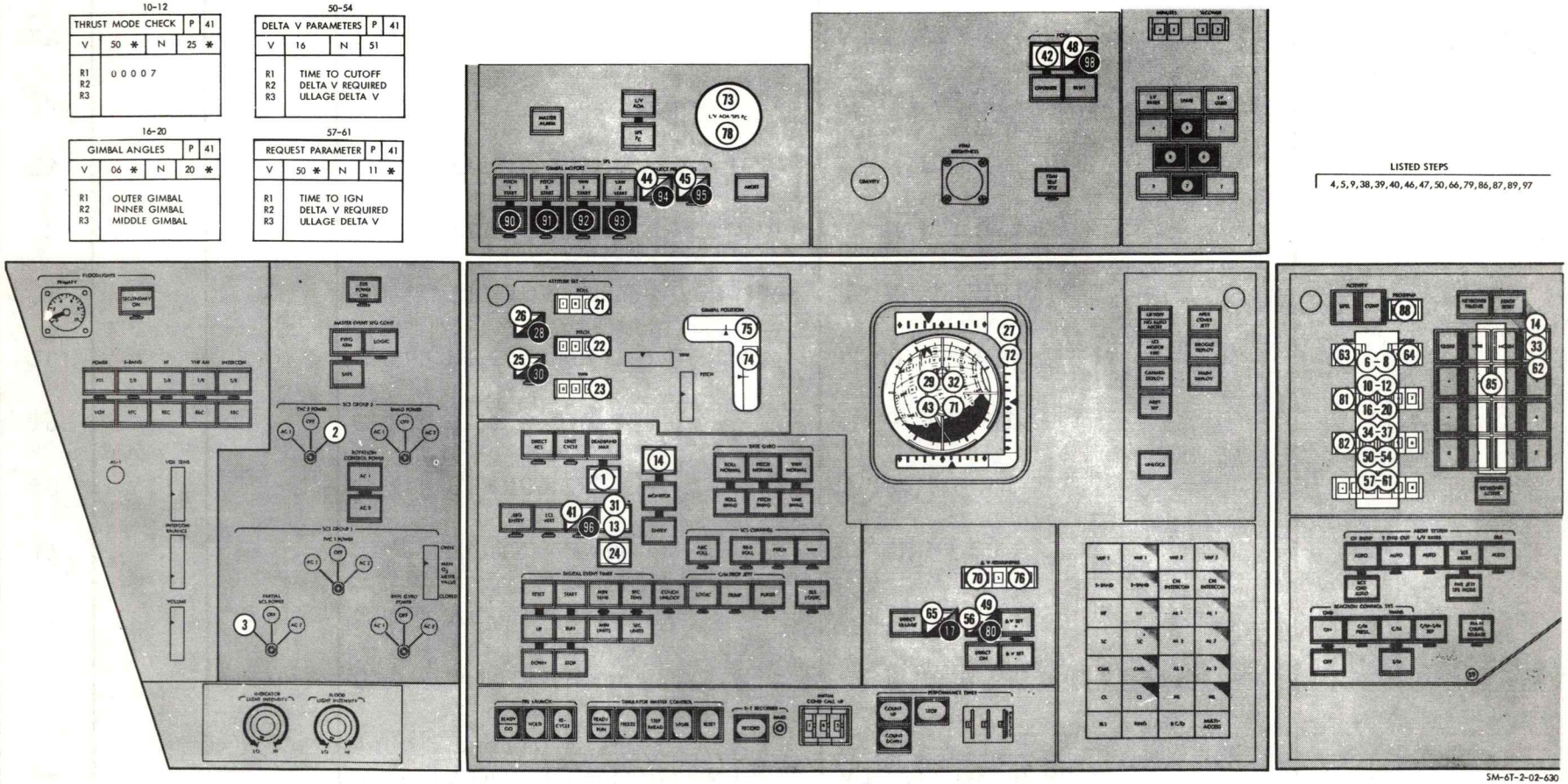
GIMBAL ANGLES			P	41
V	06 *	N	20 *	
R1	OUTER GIMBAL			
R2	INNER GIMBAL			
R3	MIDDLE GIMBAL			

57-61

REQUEST PARAMETER			P	41
V	50 *	N	11 *	
R1	TIME TO IGN			
R2	DELTA V REQUIRED			
R3	ULLAGE DELTA V			

LISTED STEPS

4, 5, 9, 38, 39, 40, 46, 47, 50, 66, 79, 86, 87, 89, 97



SM-6T-2-02-630

Orbit Change Delta V, Station 1

GN1.13

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
28			Release FDAI ALIGN sw	FDAI ALIGN lt out	
29			Check alignment to AGC angles	Observe FDAI ball	
30			ATT SET sw - OFF	ATT SET lt out	
31			G&N/SCS sw - G&N	G&N lt on	
32			Check FDAI for attitude change	Attitude should not change	
33			Key in ENTER	ENTER lt as depressed	
34			Check VERB window	16	
35			Check NOUN window	15	
36			Check REGISTER 1	Time to ignition	
37			Check REGISTER 2	Velocity to be gained	
*38			Set DET	Observe DET setting	
*39			Request seat 3, actuate SPS	Monitor intercom	
*40			Perform gimbal position indicator test	SP1.03	
41			ΔV sw - On	ΔV lt on	
42			FCSM AUTO/OVERRIDE sw - AUTO	FCSM-AUTO lt on	

Orbit Change Delta V, Station 1

*FLASHING

6-8

DO ORBIT CHANGE		P	31
V	50 *	N	07 *
R3 R2 R1	0 0 0 4 1		

34-37

		P	41
V	16	N	15
R1 R2 R3	TIME TO IGN DELTA V		

67-68

DELTA V DATA		P	41
V	06	N	11
R1 R2 R3	TIME TO CUTOFF DELTA V ULLAGE DELTA V		

83-84

REQUEST PROCEED		P	41
V	06 *	N	51 *
R3 R2 R1	TIME TO CUTOFF DELTA V ULLAGE DELTA V		

10-12

THRUST MODE CHECK		P	41
V	50 *	N	25 *
R1 R2 R3	0 0 0 0 7		

50-54

DELTA V PARAMETERS		P	41
V	16	N	51
R1 R2 R3	TIME TO CUTOFF DELTA V REQUIRED ULLAGE DELTA V		

16-20

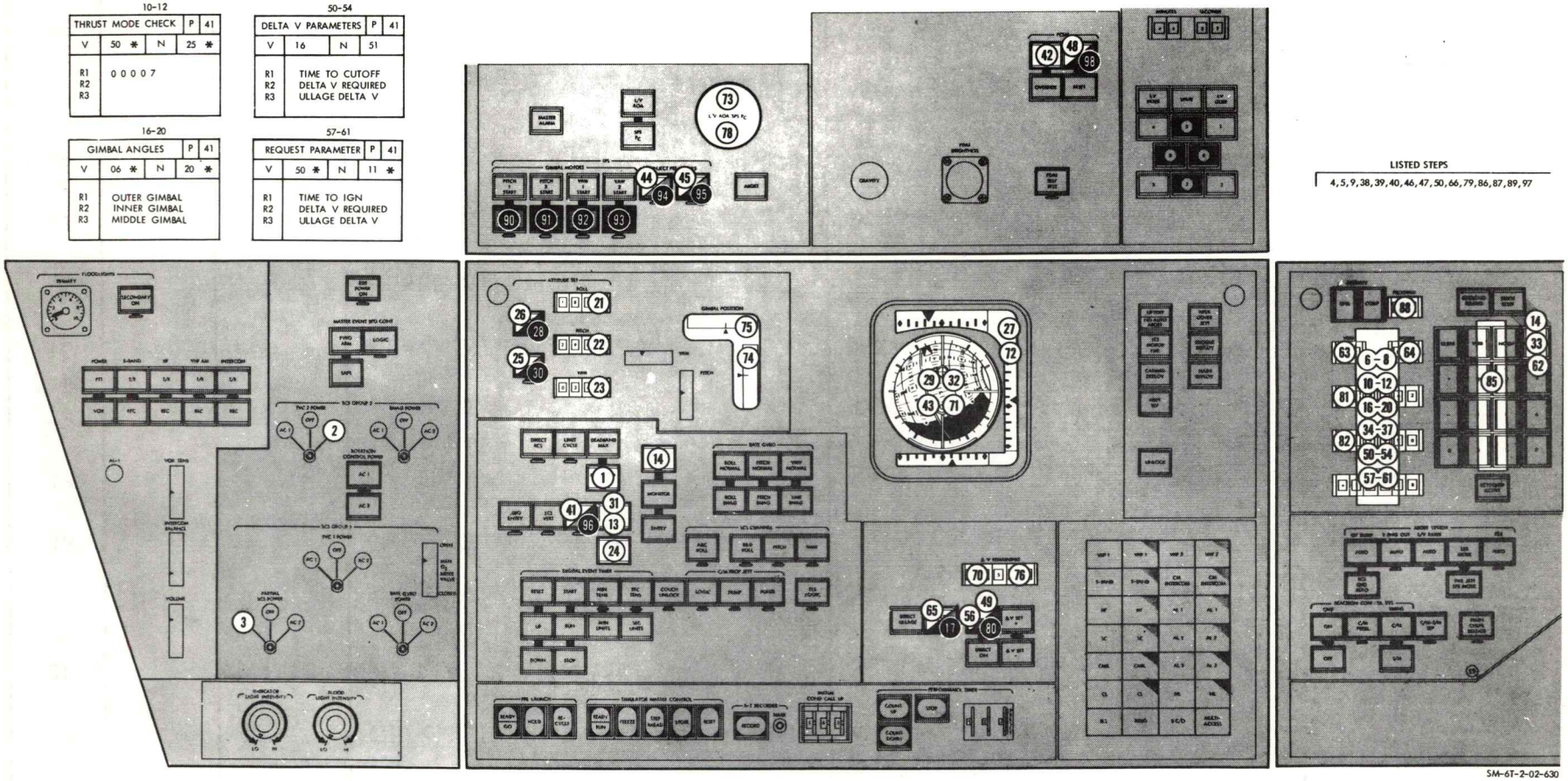
GIMBAL ANGLES		P	41
V	06 *	N	20 *
R1 R2 R3	OUTER GIMBAL INNER GIMBAL MIDDLE GIMBAL		

57-61

REQUEST PARAMETER		P	41
V	50 *	N	11 *
R1 R2 R3	TIME TO IGN DELTA V REQUIRED ULLAGE DELTA V		

LISTED STEPS

4, 5, 9, 38, 39, 40, 46, 47, 50, 66, 79, 86, 87, 89, 97



SM-6T-2-02-630

Orbit Change Delta V, Station 1

GN1.13

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
43			Check FDAI	Error and rates normal	
44		Ign-02:00	SPS INJECT PREVALVES A sw - ON	SPS INJECT PREVALVES - A on lt on	
45			SPS INJECT PREVALVES B sw - ON	SPS INJECT PREVALVES - B on lt on	
*46			Unlock translation control	Observe TV monitor	
*47			Unpin rotation control	Observe TV monitor	
48			FCSM ON/OFF/RESET sw - ON	FCSM - ON lt on	
49			NORMAL/OFF/DIRECT sw - NORMAL	NORMAL lt on	
*50-66			Perform SPS Engine Ignition Routine		
50			Check VERB window	16	
51			Check NOUN window	51	
52			Check REGISTER 1	Time to ignition	
53			Check REGISTER 2	Velocity to be gained	
54			Check REGISTER 3	Ullage delta V measured	

Orbit Change Delta V, Station 1

GN1.13

*FLASHING

6-8

DO ORBIT CHANGE	P	31
V	50 * N	07 *
R3 R2 R1	0 0 0 4 1	

34-37

	P	41
V	16 N	15
R1 R2 R3	TIME TO IGN DELTA V	

67-68

DELTA V DATA	P	41
V	06 N	11
R1 R2 R3	TIME TO CUTOFF DELTA V ULLAGE DELTA V	

83-84

REQUEST PROCEED	P	41
V	06 * N	51 *
R3 R2 R1	TIME TO CUTOFF DELTA V ULLAGE DELTA V	

10-12

THRUST MODE CHECK	P	41
V	50 * N	25 *
R1 R2 R3	0 0 0 0 7	

50-54

DELTA V PARAMETERS	P	41
V	16 N	51
R1 R2 R3	TIME TO CUTOFF DELTA V REQUIRED ULLAGE DELTA V	

16-20

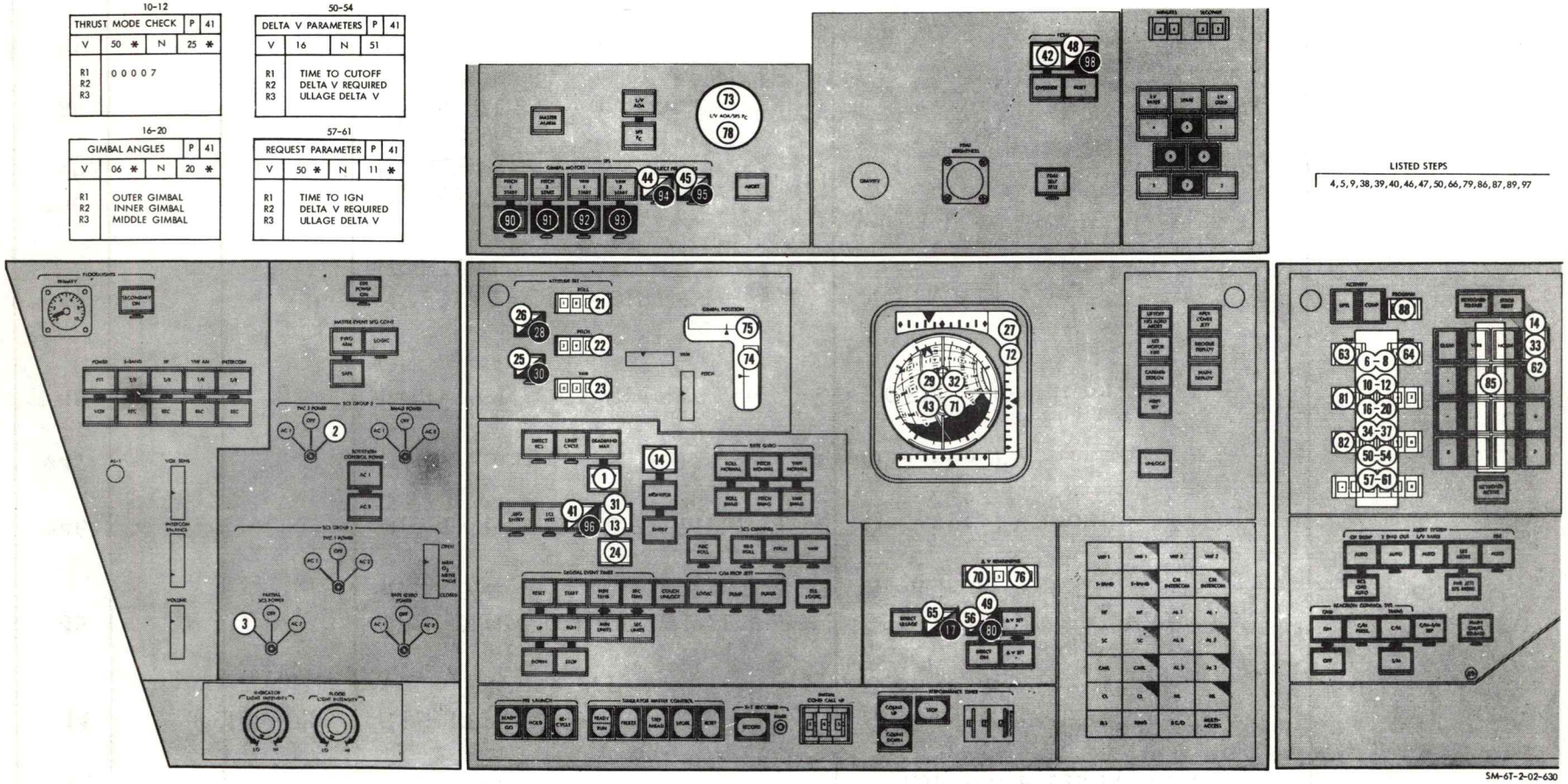
GIMBAL ANGLES	P	41
V	06 * N	20 *
R1 R2 R3	OUTER GIMBAL INNER GIMBAL MIDDLE GIMBAL	

57-61

REQUEST PARAMETER	P	41
V	50 * N	11 *
R1 R2 R3	TIME TO IGN DELTA V REQUIRED ULLAGE DELTA V	

LISTED STEPS

4, 5, 9, 38, 39, 40, 46, 47, 50, 66, 79, 86, 87, 89, 97



SM-6T-2-02-630

Orbit Change Delta V, Station 1

GN1. 13

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
55		Ign-15 sec	Initiate ullage	Observe TV monitor	
56			Check NORMAL/OFF/DIRECT ON sw - NORMAL	NORMAL lt on	
57		Ign-5 sec	Check VERB window	Flashing 50	
58			Check NOUN window	Flashing 11	
59			Check REGISTER 1	Time to ignition	
60			Check REGISTER 2	Velocity to be gained	
61			Check REGISTER 3	Ullage delta V	
62			Depress ENTER sw	ENTER lt as depressed	
63			Check VERB window	50 not flashing	
64			Check NOUN window	11 not flashing	
65			Check THRUST ON lt on	THRUST ON lt on	
66			Terminate ullage	Observe TV monitor	
67			Check REGISTER 1	Decreasing	
68			Check REGISTER 2	Decreasing	
69			Check REGISTER 3	Ullage delta V measured	

Orbit Change Delta V, Station 1

GN1.13

*FLASHING

6-8

DO ORBIT CHANGE	P	31
V	50 *	N	07 *
R3 R2 R1	0 0 0 4 1		

34-37

	P	41
V	16	N	15
R1 R2 R3	TIME TO IGN DELTA V		

67-68

DELTA V DATA	P	41
V	06	N	11
R1 R2 R3	TIME TO CUTOFF DELTA V ULLAGE DELTA V		

83-84

REQUEST PROCEED	P	41
V	06 *	N	51 *
R3 R2 R1	TIME TO CUTOFF DELTA V ULLAGE DELTA V		

10-12

THRUST MODE CHECK	P	41
V	50 *	N	25 *
R1 R2 R3	0 0 0 0 7		

50-54

DELTA V PARAMETERS	P	41
V	16	N	51
R1 R2 R3	TIME TO CUTOFF DELTA V REQUIRED ULLAGE DELTA V		

16-20

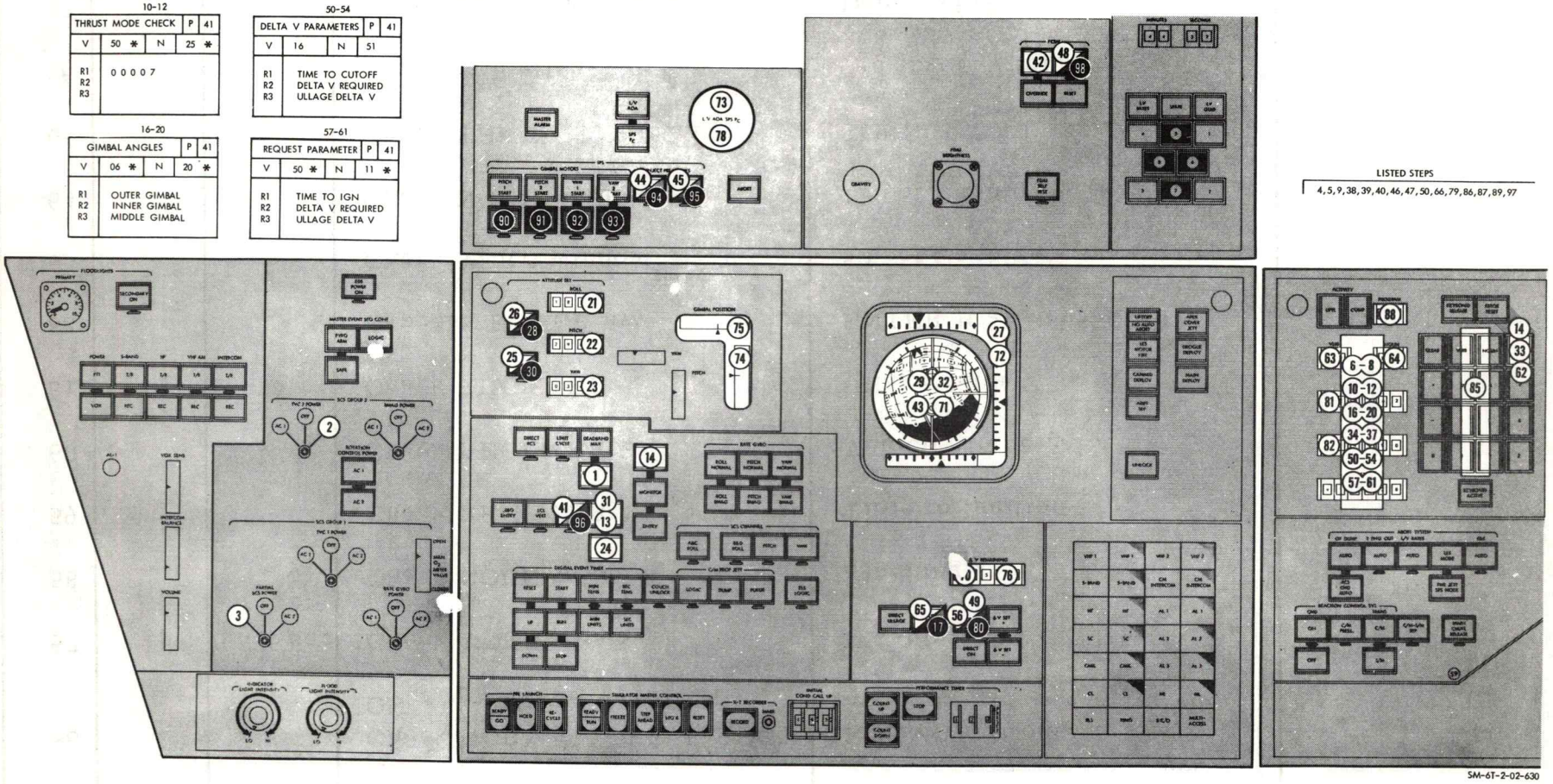
GIMBAL ANGLES	P	41
V	06 *	N	20 *
R1 R2 R3	OUTER GIMBAL INNER GIMBAL MIDDLE GIMBAL		

57-61

REQUEST PARAMETER	P	41
V	50 *	N	11 *
R1 R2 R3	TIME TO IGN DELTA V REQUIRED ULLAGE DELTA V		

LISTED STEPS

4, 5, 9, 38, 39, 40, 46, 47, 50, 66, 79, 86, 87, 89, 97



SM-6T-2-02-630

Orbit Change Delta V, Station 1

GN1.13

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
70			Check DELTA V REMAINING ind	Decreasing	
71			Check FDAI attitude	As programed	
72			Check FDAI rates	As programed	
73			Check SPS P_C ind	As programed	
74			Check GIMBAL POSITION PITCH ind	As programed	
75			Check GIMBAL POSITION YAW ind	As programed	
76			Check ΔV REMAINING ind zero	As programed	
77			Check THRUST ON lt out	THRUST ON lt out	
78			Check SPS P_C ind decrease	SPS engine cutoff	
79			Report SPS engine cutoff to MSFN	Provide appropriate communication	
80			NORMAL/OFF/DIRECT sw - OFF	NORMAL lt out	
81			Check REGISTER 1	Zero	
82			Check REGISTER 2	Zero	

*FLASHING

6-8

DO ORBIT CHANGE	P	31
V 50 *	N	07 *
R3 R2 R1	0 0 0 4 1	

34-37

	P	41
V 16	N	15
R1 R2 R3	TIME TO IGN DELTA V	

67-68

DELTA V DATA	P	41
V 06	N	11
R1 R2 R3	TIME TO CUTOFF DELTA V ULLAGE DELTA V	

83-84

REQUEST PROCEED	P	41
V 06 *	N	51 *
R3 R2 R1	TIME TO CUTOFF DELTA V ULLAGE DELTA V	

10-12

THRUST MODE CHECK	P	41
V 50 *	N	25 *
R1 R2 R3	0 0 0 0 7	

50-54

DELTA V PARAMETERS	P	41
V 16	N	51
R1 R2 R3	TIME TO CUTOFF DELTA V REQUIRED ULLAGE DELTA V	

16-20

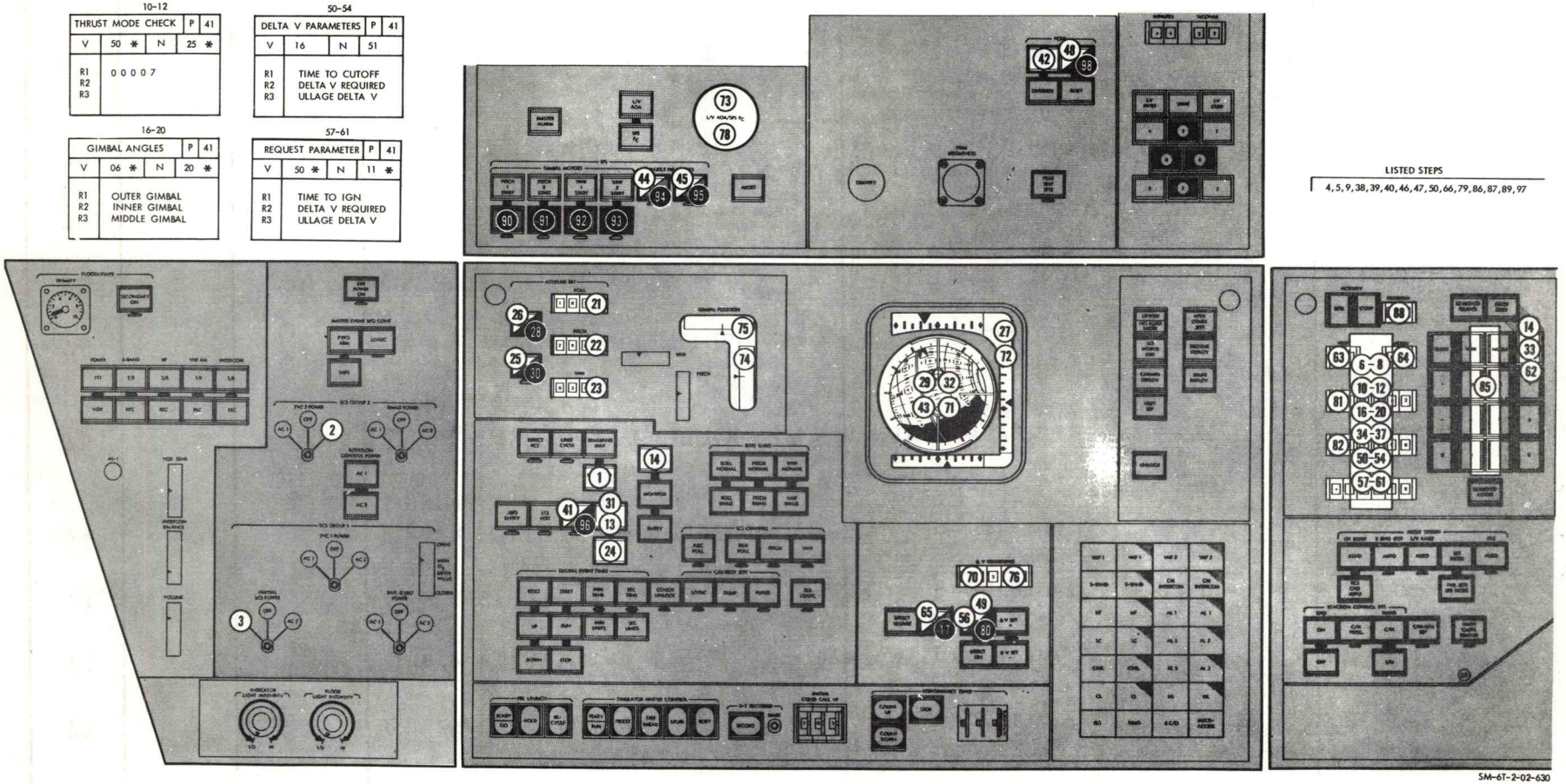
GIMBAL ANGLES	P	41
V 06 *	N	20 *
R1 R2 R3	OUTER GIMBAL INNER GIMBAL MIDDLE GIMBAL	

57-61

REQUEST PARAMETER	P	41
V 50 *	N	11 *
R1 R2 R3	TIME TO IGN DELTA V REQUIRED ULLAGE DELTA V	

LISTED STEPS

4, 5, 9, 38, 39, 40, 46, 47, 50, 66, 79, 86, 87, 89, 97



SM-6T-2-02-630

Orbit Change Delta V, Station 1

GN1.13

Step	Malf	Time	Function	IOS Visibility/Action	Notes
83			Check VERB window	Flashing 06	
84			Check NOUN window	Flashing 51	
85			Key in proceed	VERB, 33, and ENTER lt as depressed	
*86			Receive orbit parameters from MSFN	Provide data	
*87			Perform orbit parameter display routine	GN4.55	
88			Check PROGRAM window	00	
*89			Lock translation control	Observe TV monitor	
90			SPS GIMBAL MOTORS PITCH 1 sw - OFF	SPS GIMBAL MOTORS pitch 1 lt out	
91			SPS GIMBAL MOTORS PITCH 2 sw - OFF	SPS GIMBAL MOTORS pitch 2 lt out	
92			SPS GIMBAL MOTORS YAW 1 sw - OFF	SPS GIMBAL MOTORS yaw 1 lt out	
93			SPS GIMBAL MOTORS YAW 2 sw - OFF	SPS GIMBAL MOTORS yaw 2 lt out	
94			SPS INJECT PREVALVES A sw - OFF	SPS INJECT PREVALVES - A ON lt out	

*FLASHING

6-8

DO ORBIT CHANGE		P	31
V	50 *	N	07 *
R3 R2 R1	0 0 0 4 1		

34-37

		P	41
V	16	N	15
R1 R2 R3	TIME TO IGN DELTA V		

67-68

DELTA V DATA		P	41
V	06	N	11
R1 R2 R3	TIME TO CUTOFF DELTA V ULLAGE DELTA V		

83-84

REQUEST PROCEED		P	41
V	06 *	N	51 *
R3 R2 R1	TIME TO CUTOFF DELTA V ULLAGE DELTA V		

10-12

THRUST MODE CHECK		P	41
V	50 *	N	25 *
R1 R2 R3	0 0 0 0 7		

50-54

DELTA V PARAMETERS		P	41
V	16	N	51
R1 R2 R3	TIME TO CUTOFF DELTA V REQUIRED ULLAGE DELTA V		

16-20

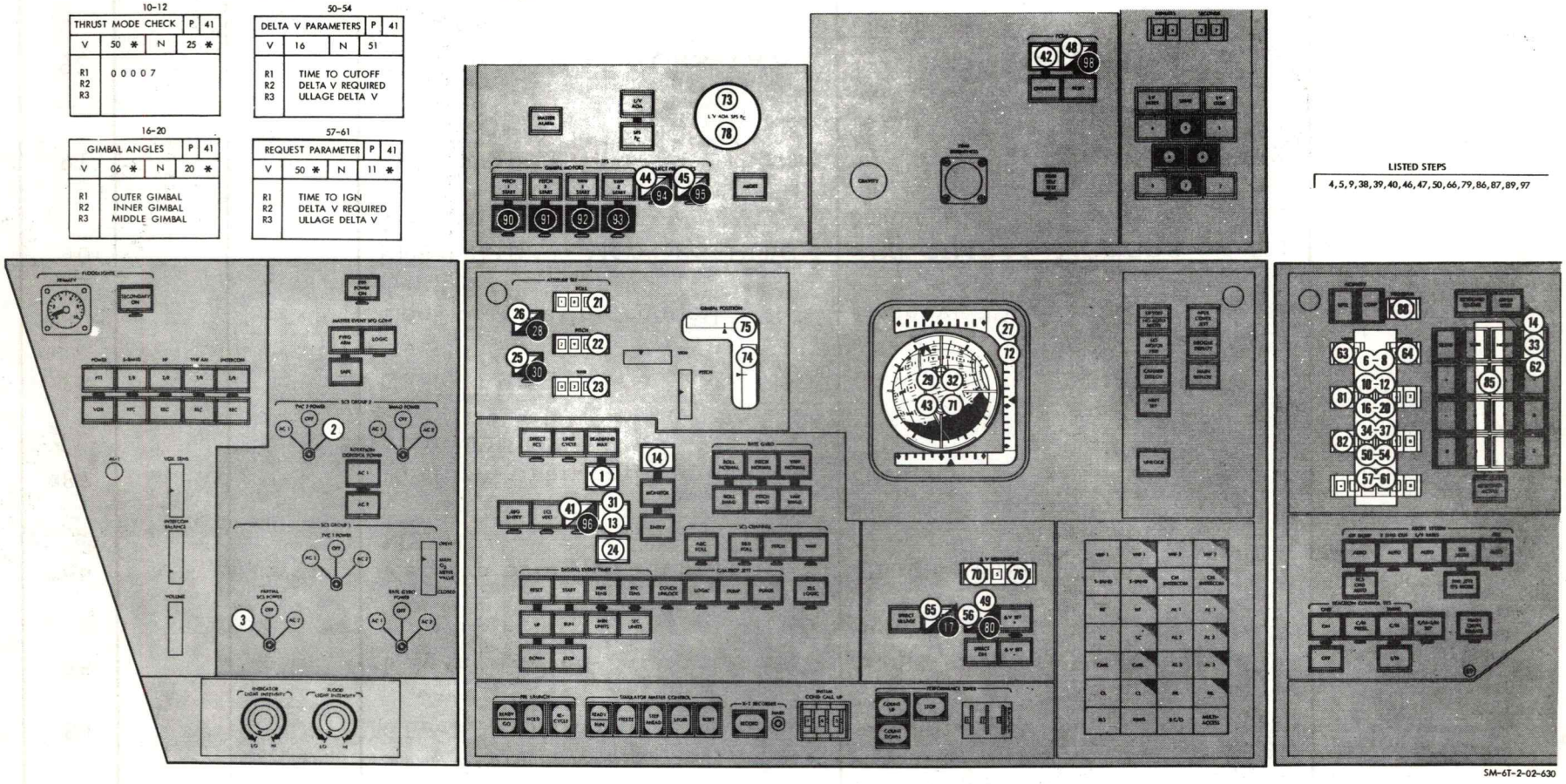
GIMBAL ANGLES		P	41
V	06 *	N	20 *
R1 R2 R3	OUTER GIMBAL INNER GIMBAL MIDDLE GIMBAL		

57-61

REQUEST PARAMETER		P	41
V	50 *	N	11 *
R1 R2 R3	TIME TO IGN DELTA V REQUIRED ULLAGE DELTA V		

LISTED STEPS

4, 5, 9, 38, 39, 40, 46, 47, 50, 66, 79, 86, 87, 89, 97



SM-6T-2-02-630

Orbit Change Delta V, Station 1

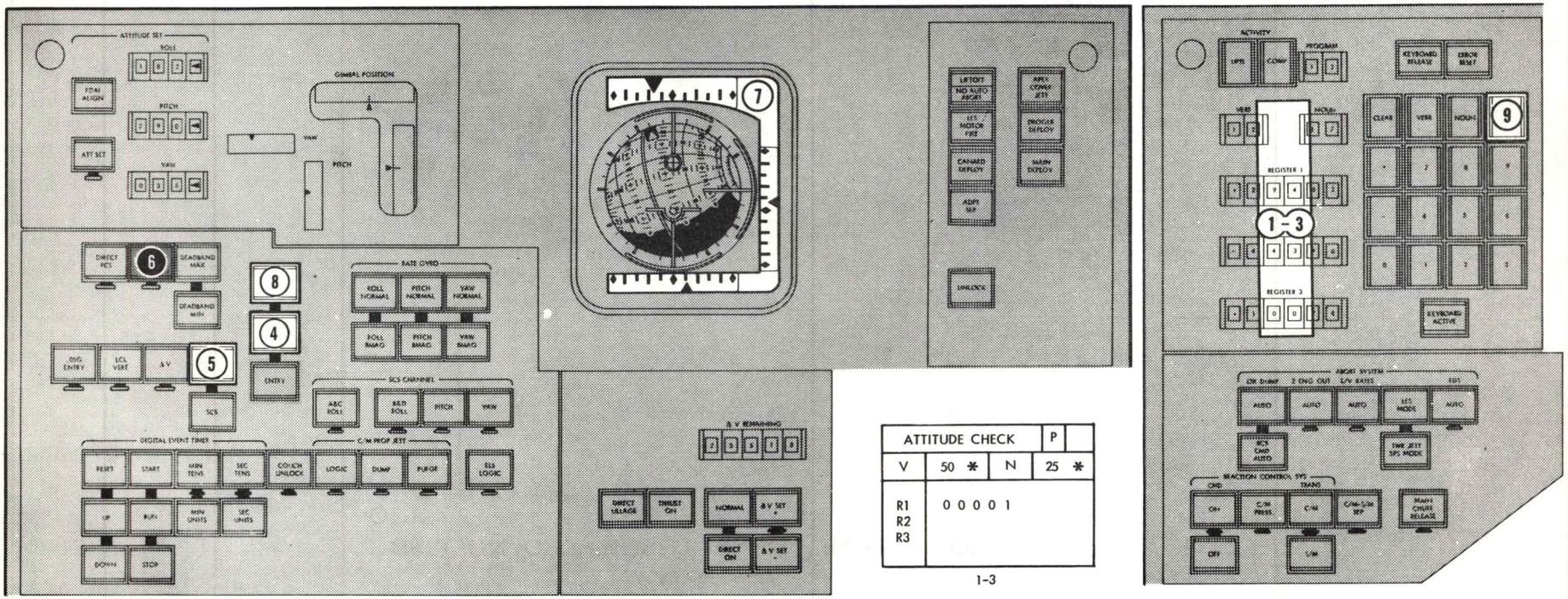
GN1.13

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
95			SPS INJECT PREVALVES B sw - OFF	SPS INJECT PREVALVES - B ON lt out	
96			DELTA V sw - OFF	DELTA V lt out	
97			Secure rotation control	Observe TV monitor	
98			FCSM ON/OFF/RESET sw - OFF	RCSM - ON lt out	

Orbit Change Delta V, Station 1

GN1.13



ATTITUDE CHECK			P	
V	50 *	N	25 *	
R1	0 0 0 0 1			
R2				
R3				

1-3

* FLASHING

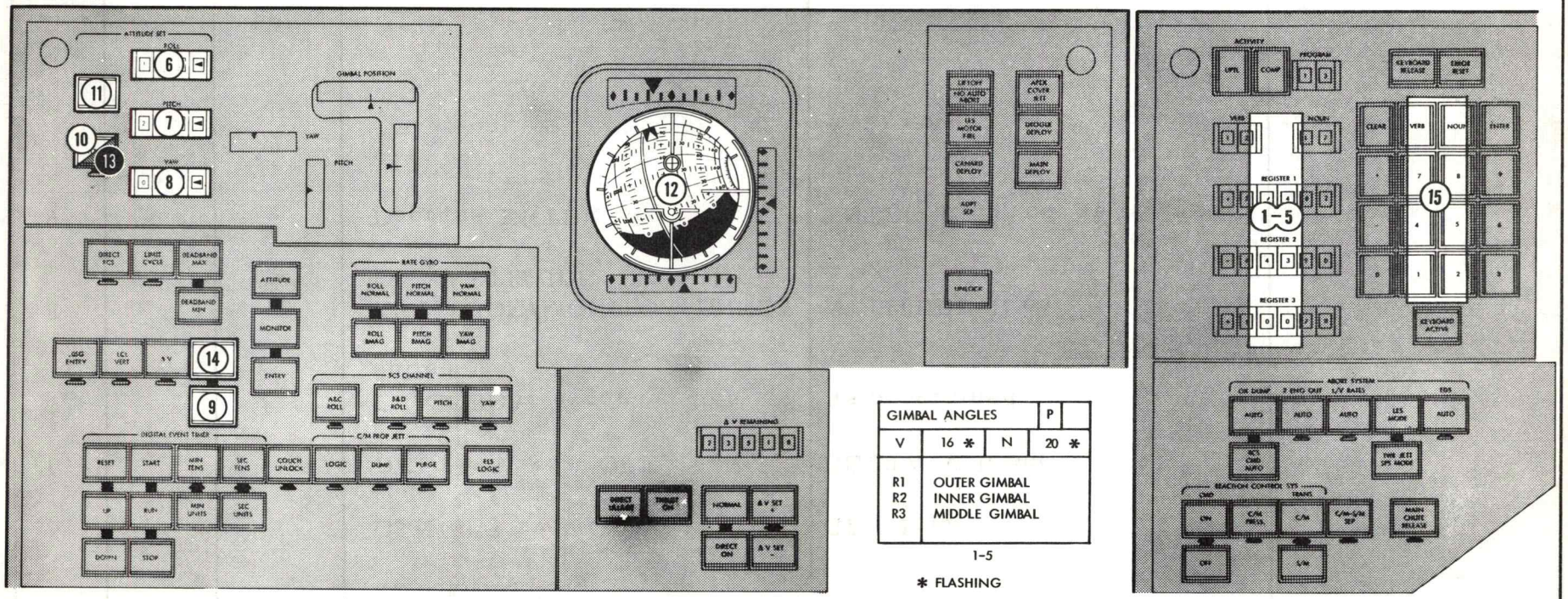
SM-6T-2-02-617

Attitude Control Mode Check

GN1.40

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Check VERB window	Flashing 50	
2			Check NOUN window	Flashing 25	
3			Check REGISTER 1	00001	
4			ATTITUDE/MONITOR/ENTRY sw - MONITOR	MONITOR lt on	
5			G&N/SCS sw - G&N	G&N lt on	
6			DELTA V sw - OFF	DELTA V lt out	
7			Check FDAI error needles nulled	As programed	
8			ATTITUDE/MONITOR/ENTRY sw - ATTITUDE	ATTITUDE lt on	
9			Depress ENTER sw	ENTER lt on, out as released	



GIMBAL ANGLES		P	
V	16 *	N	20 *

R1	OUTER GIMBAL
R2	INNER GIMBAL
R3	MIDDLE GIMBAL

1-5

* FLASHING

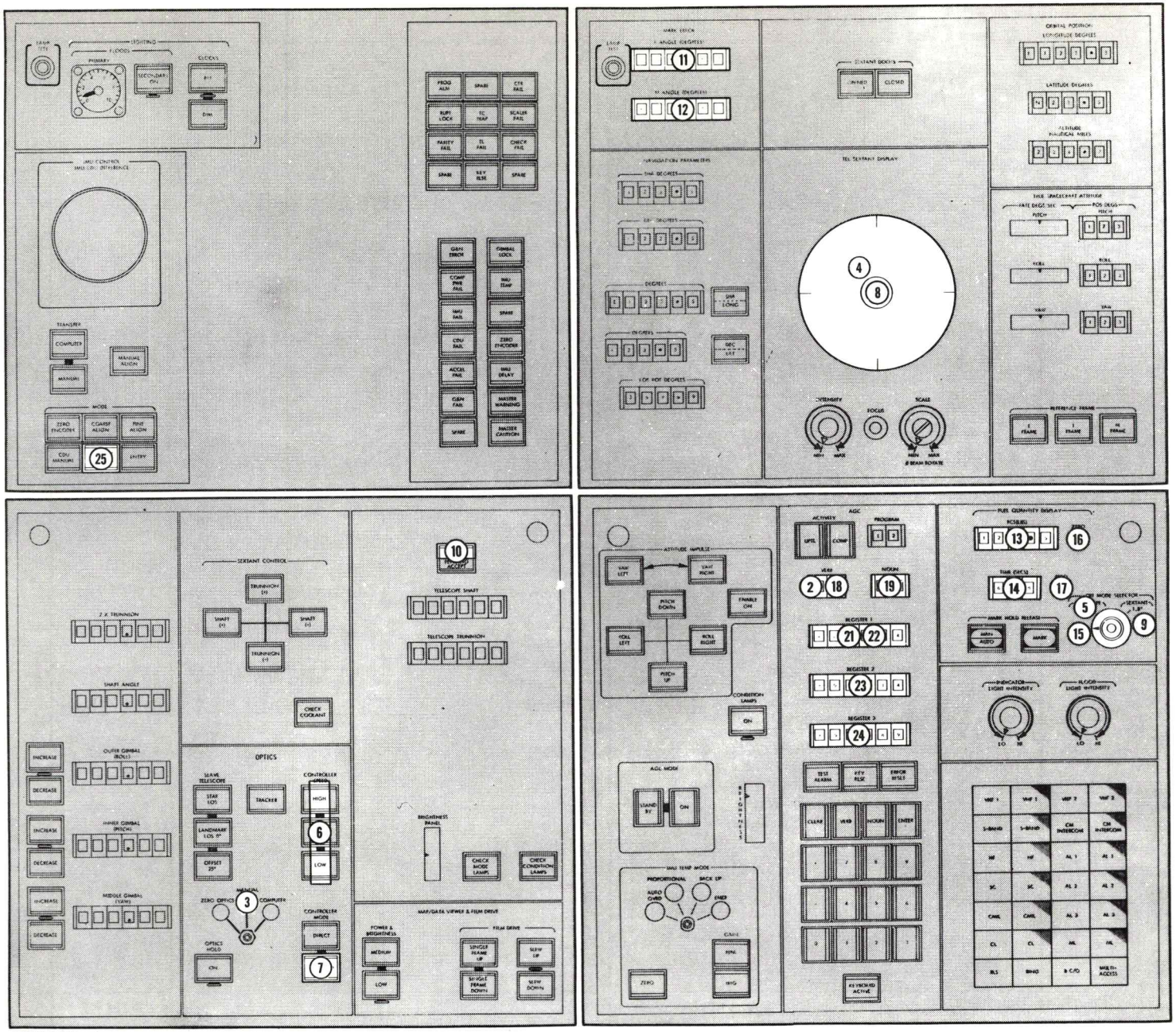
SM-6T-2-02-618

Attitude Maneuver

GN1.44

IOS DATA SHEET

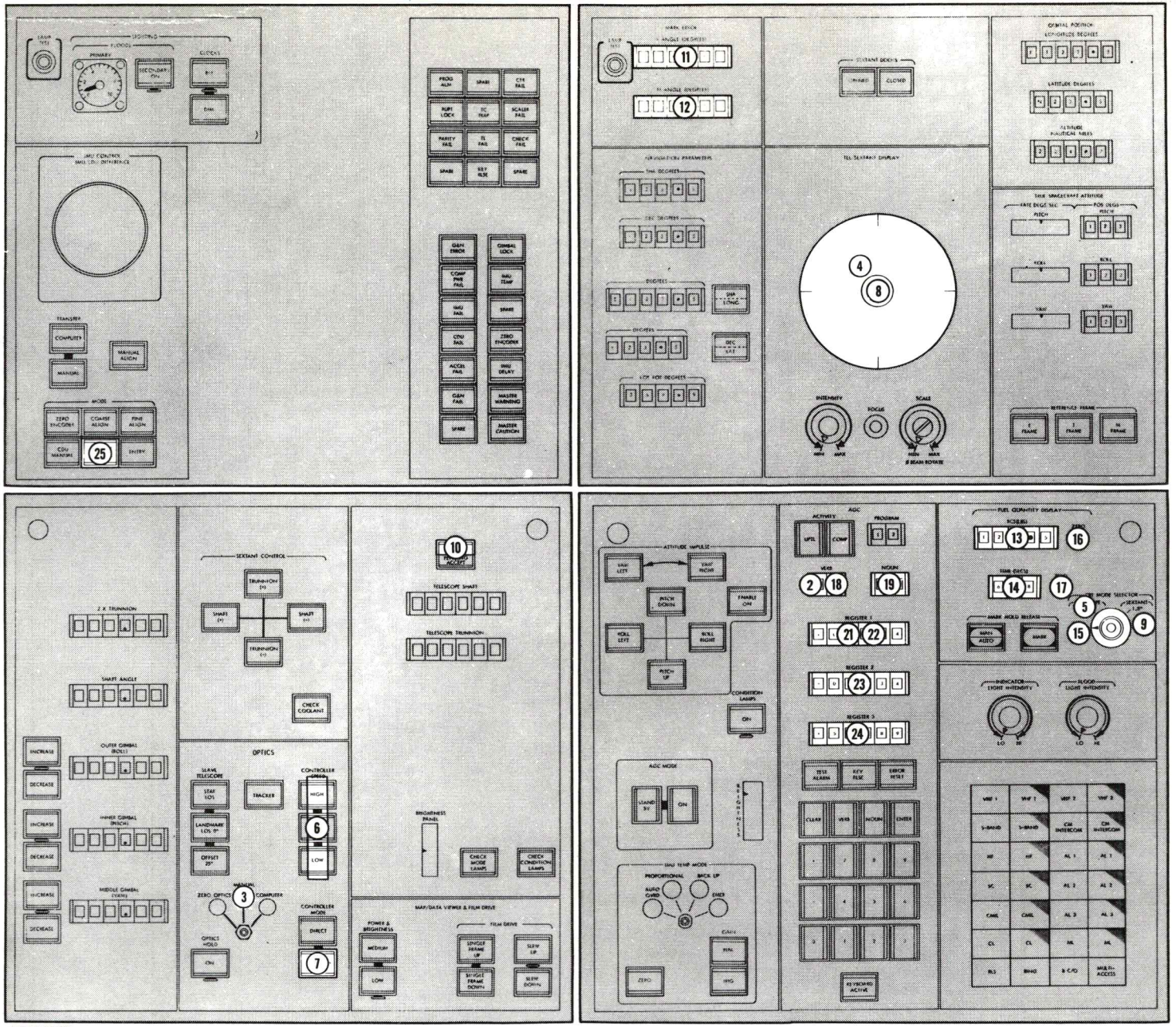
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Check VERB window	Flashing 16	
2			Check NOUN window	Flashing 20	
3			Check REGISTER 1	Outer gimbal angle	
4			Check REGISTER 2	Inner gimbal angle	
5			Check REGISTER 3	Middle gimbal angle	
6			ATTITUDE SET ROLL ind per REGISTER 1	Check angle set in	
7			ATTITUDE SET PITCH ind per REGISTER 2	Check angle set in	
8			ATTITUDE SET YAW ind per REGISTER 3	Check angle set in	
9			G&N/SCS sw - SCS	SCS lt on	
10			ATT SET sw - on	ATT SET lt on	
11			Depress FDAI ALIGN sw, hold until error ind nulled	FDAI ALIGN lt on, out as released	
12			Check FDAI against AGC registers	Check nav axis angles	
13			ATT SET sw - OFF	ATT SET lt out	
14			G&N/SCS sw - G&N	G&N lt on	
15			Key in proceed	VERB, 33, and ENTER lt as depressed	



Sighting Mark

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Acquire and identify target star		
2			Check VERB window	Flashing 51	
3			OPTICS mode sw - MANUAL	OPTICS - MANUAL lt on	
4			Center star in SCT	Observe CRT	
5			Instructor Step	CRT MODE SELECTOR sw - 12° as star centers	
6			Select OPTICS CONTROLLER SPEED sw as desired	OPTICS CONTROLLER SPEED lt as selected	
7			OPTICS CONTROLLER MODE sw - RESOLVED, as required	OPTICS CONTROLLER MODE - RESOLVED lt on	
8			Center star in SXT	Observe CRT	
9			Instructor step	CRT MODE SELECTOR sw - 1.8° and .36° as star centers	This step not performed on GN4.04.
10			Depress MARK sw where centered	MARK lt on, out as released PENDING ACCEPT lt on, out in 20 sec	
11-15			Instructor Steps		
11				Check MARK ERROR R ANGLE (DEGREES)	



Sighting Mark

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12				Check MARK ERROR M ANGLE (DEGREES)	
13				Check RCS (LBS) digital readout	
14				Check TIME (SEC) digital readout	
15				CRT MODE SELECTOR sw - 60°	
16				Depress RCS (LBS) ZERO sw	
17				Depress TIME (SEC) ZERO sw	
18			Check VERB window	Flashing 21 star, 25 landmark	
19			Check NOUN window	Flashing 25 star, 44 landmark	
20			Obtain target identification	Observe TV monitor	
21			Load star code in REGISTER 1	Star sighting only	
22			Load landmark latitude in REGISTER 1	Landmark sighting only	
23			Load landmark longitude in REGISTER 2	Landmark sighting only	
24			Load altitude in REGISTER 3	Landmark sighting only	
25			Check MODE ATT CONT lt on	MODE-ATTITUDE CONTROL lt on	Post S-IVB separation only.

Sighting Mark

GN4.49

* FLASHING

STAR		P	
V	21 *	N	30 *
R1 R2 R3	STAR CODE		

1-5

STAR

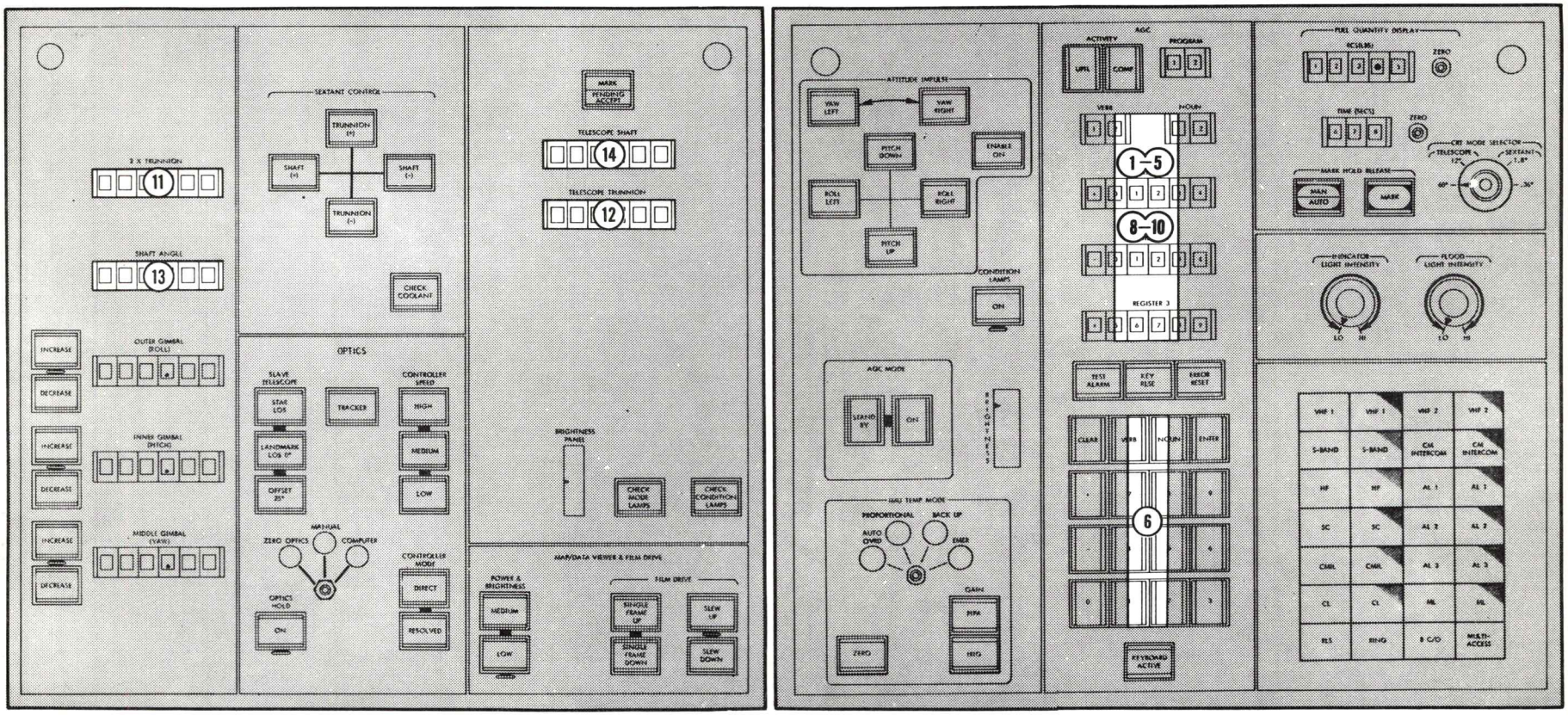
LANDMARK		P	
V	24 *	N	36 *
R1 R2 R3	LATITUDE LONGITUDE ALTITUDE		

1-5

LANDMARK

TARGET ANGLES		P	
V	16 *	N	57 *
R1 R2 R3	SHAFT ANGLE TRUNNION ANGLE		

8-10



SM-6T-2-02-620

LISTED STEPS
15

Automatic Optics Positioning

GN4.50

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Check VERB window	Flashing star -21 landmark -24	
2			Check NOUN window	Flashing star -30 landmark -36	
3			Check REGISTER 1	Star - Star code, landmark - latitude	
4			Check REGISTER 2	Star - NA, landmark - longitude	
5			Check REGISTER 3	Star - NA, landmark - altitude	
6			Key in proceed	VERB, 33, and ENTER lt as depressed	
7			Check VERB window	16	
8			Check NOUN window	57	
9			Check REGISTER 1	Shaft angle	
10			Check REGISTER 2	Trunnion angle	
11			Check 2X TRUNNION CDU	Per REGISTER 2	
12			Check TRUNNION ANGLE ind	Per REGISTER 2	
13			CHECK SHAFT ANGLE CDU ind	Per REGISTER 1	
14			Check SHAFT ANGLE ind	Per REGISTER 1	
*15			Identify target in SCT	None	

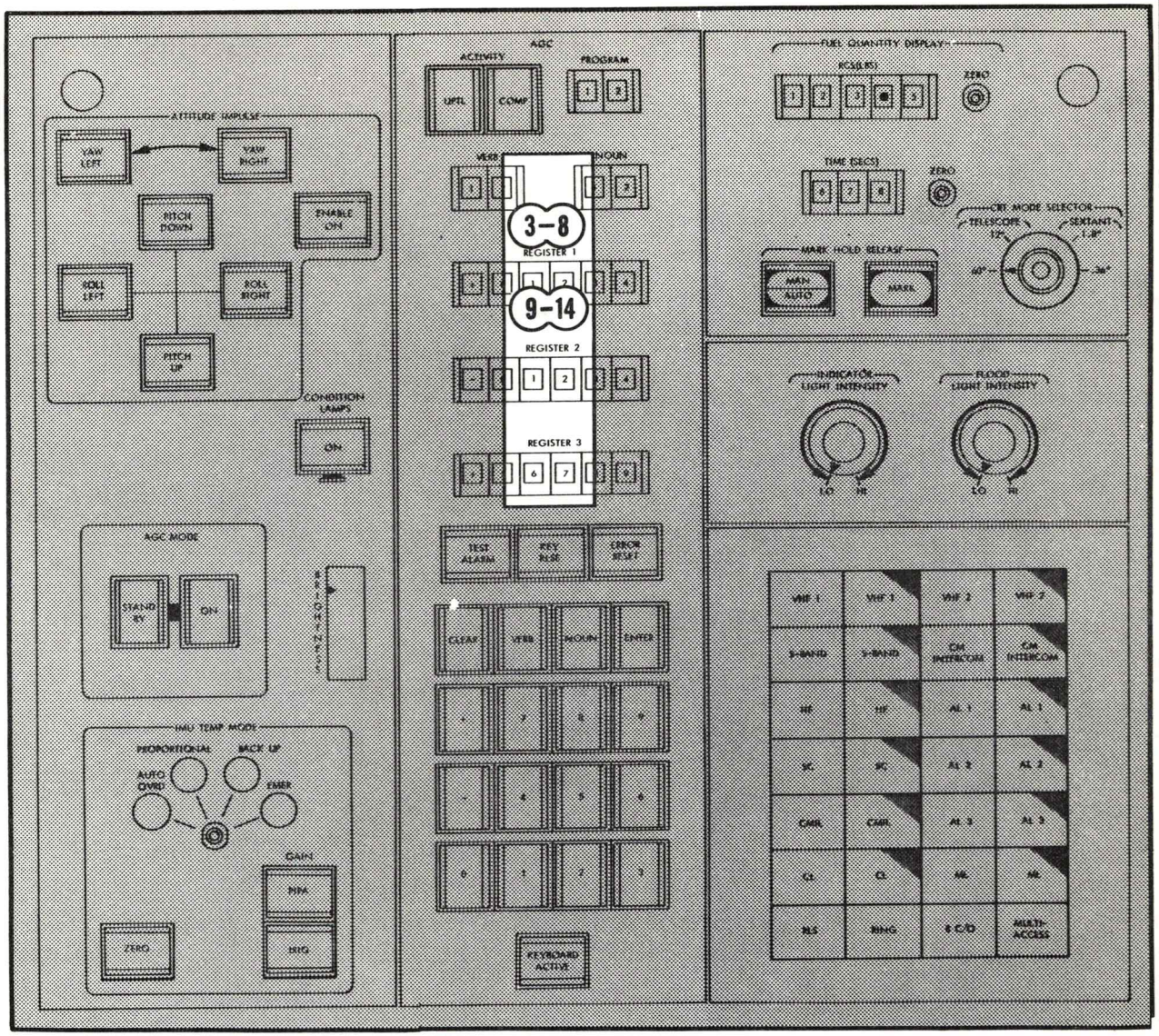
ORBIT PARAMETER		P	41
V	16 *	N	43 *
R1	PERIGEE		
R2	APOGEE		
R3	TIME TO FREE FALL		

DEORBIT PARAMETER		P	42
V	16 *	N	64 *
R1	LATITUDE SPLASH		
R2	LONGITUDE SPLASH		
R3	TIME TO FREE FALL		

* FLASHING

LISTED STEPS

1, 2,



SM-6T-2-02-631

Orbit Parameter Display

GN4.55

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Obtain procedures	Observe TV monitor	
*2			Program AGC for orbit parameters display	GN4.03 V54 ENTER	
3-8			Orbit Display		
3			Check VERB window	Flashing 16	
4			Check NOUN window	Flashing 43	
5			Check REGISTER 1	Perigee altitude	
6			Check REGISTER 2	Apogee altitude	
7			Check REGISTER 3	Time to Free Fall	
8			Key in ENTER	ENTER lt as depressed	
9-14			Deorbit Display		
9			Check VERB window	Flashing 16	
10			Check NOUN window	Flashing 64	
11			Check REGISTER 1	Latitude of splashdown	
12			Check REGISTER 2	Longitude of splashdown	
13			Check REGISTER 3	Time to free fall	
14			Key in ENTER	ENTER lt as depressed	

Orbit Parameter Display

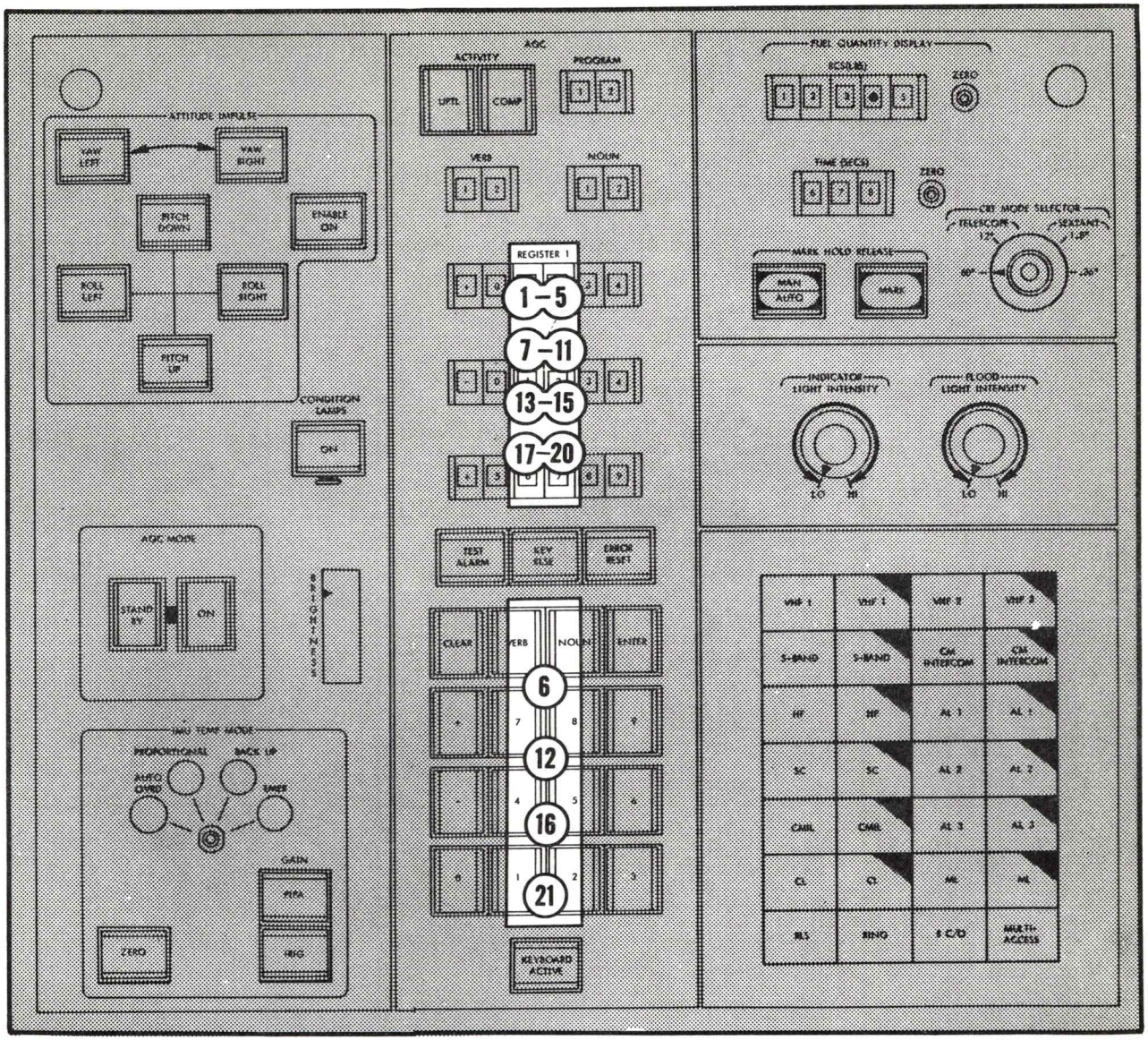
GN4.55

	DELTA V DATA		P	
	V	06 *	N	12 *
1-5	R1	IGN TIME HRS		
	R2	IGN TIME MIN		
	R3	IGN TIME SEC		

	DELTA V DATA		P	
	V	06 *	N	62 *
7-11	R1	LATITUDE		
	R2	LONGITUDE		
	R3	ALTITUDE		

	DELTA V DATA		P	
	V	06 *	N	68 *
13-15	R1	MAX DELTA V		
	R2			
	R3			

			P	
	V	06 *	N	70 *
17-20	R1	PITCH GIMBAL		
	R2	YAW GIMBAL		
	R3			



SM-6T-2-02-632

Prethrust Orbit Change Data Load

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Check VERB window	Flashing 06	
2			Check NOUN window	Flashing 12	
3			Check REGISTER 1	Time of ignition hrs	
4			Check REGISTER 2	Time of ignition min	
5			Check REGISTER 3	Time of ignition sec	
6			Key in proceed	VERB, 33, and ENTER lt as depressed	
7			Check VERB window	Flashing 06	
8			Check NOUN window	Flashing 62	
9			Check REGISTER 1	Latitude	
10			Check REGISTER 2	Longitude	
11			Check REGISTER 3	Altitude	
12			Key in proceed	VERB, 33, and ENTER lt as depressed	
13			Check VERB window	Flashing 06	
14			Check NOUN window	Flashing 68	
15			Check REGISTER 1	Max delta V	

Prethrust Orbit Change Data Load

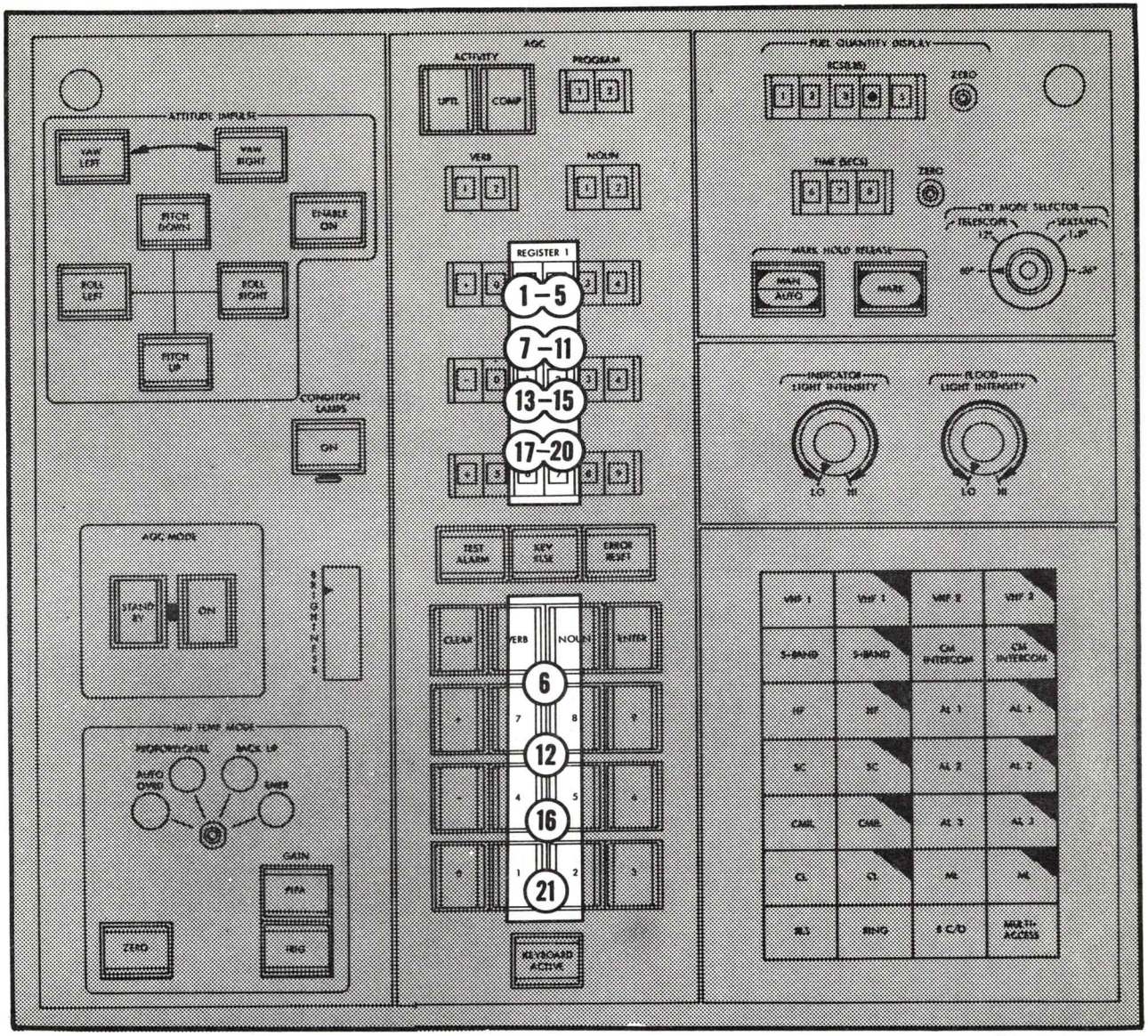
GN4. 56

	DELTA V DATA		P	
	V	06 *	N	12 *
1-5	R1 R2 R3	IGN TIME HRS IGN TIME MIN IGN TIME SEC		

	DELTA V DATA		P	
	V	06 *	N	62 *
7-11	R1 R2 R3	LATITUDE LONGITUDE ALTITUDE		

	DELTA V DATA		P	
	V	06 *	N	68 *
13-15	R1 R2 R3	MAX DELTA V		

			P	
	V	06 *	N	70 *
17-20	R1 R2 R3	PITCH GIMBAL YAW GIMBAL		

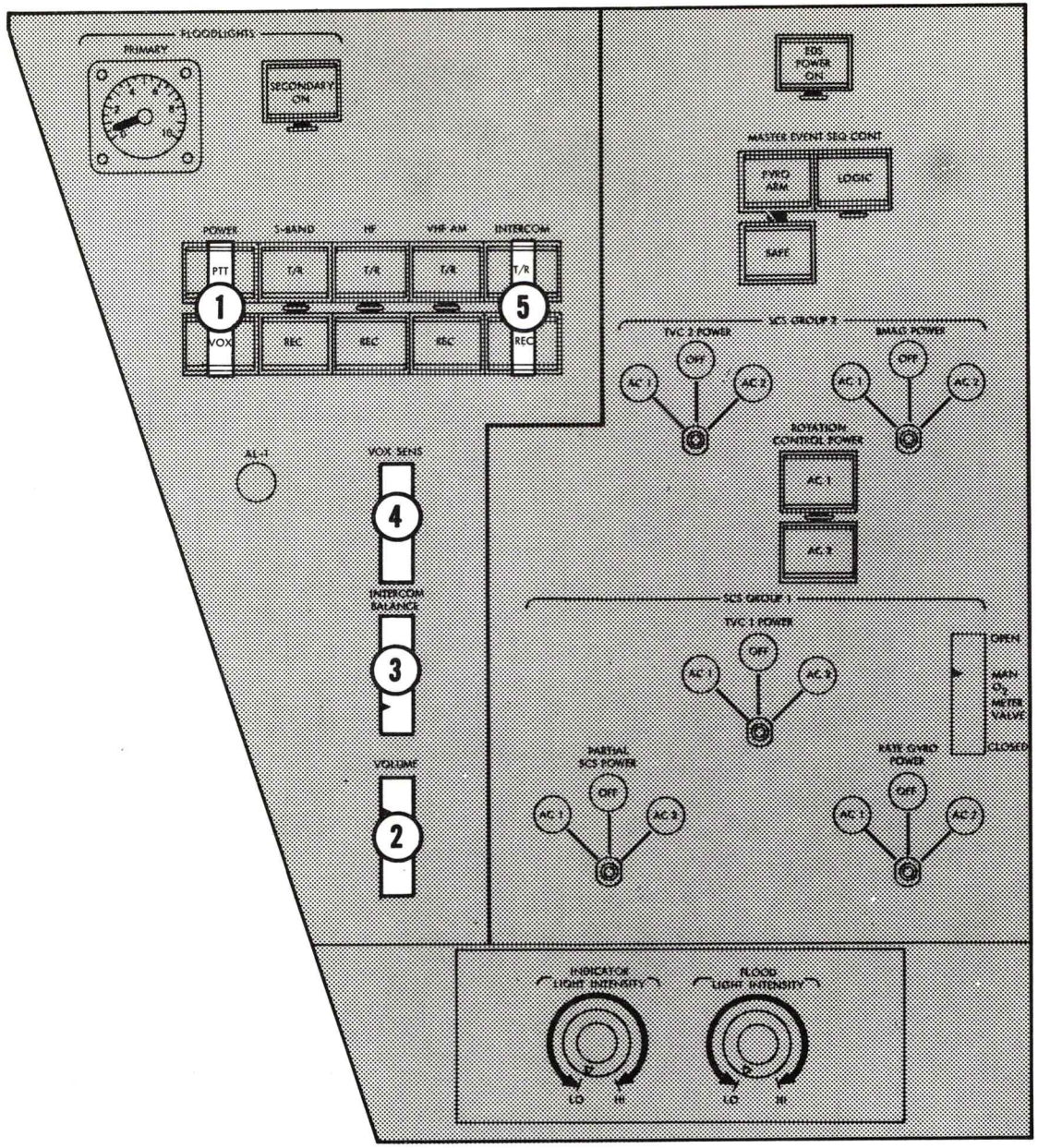


SM-6T-2-02-632

Prethrust Orbit Change Data Load

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
16			Key in proceed	VERB, 33, and ENTER lt as depressed	
17			Check VERB window	Flashing 06	
18			Check NOUN window	Flashing 70	
19			Check REGISTER 1	SPS pitch gimbal	
20			Check REGISTER 2	SPS yaw gimbal	
21			Key in proceed	VERB, 33, and ENTER lt as depressed	



SM-6T-2-02-576

Audio Center Activation Stations 1, 2 and 3

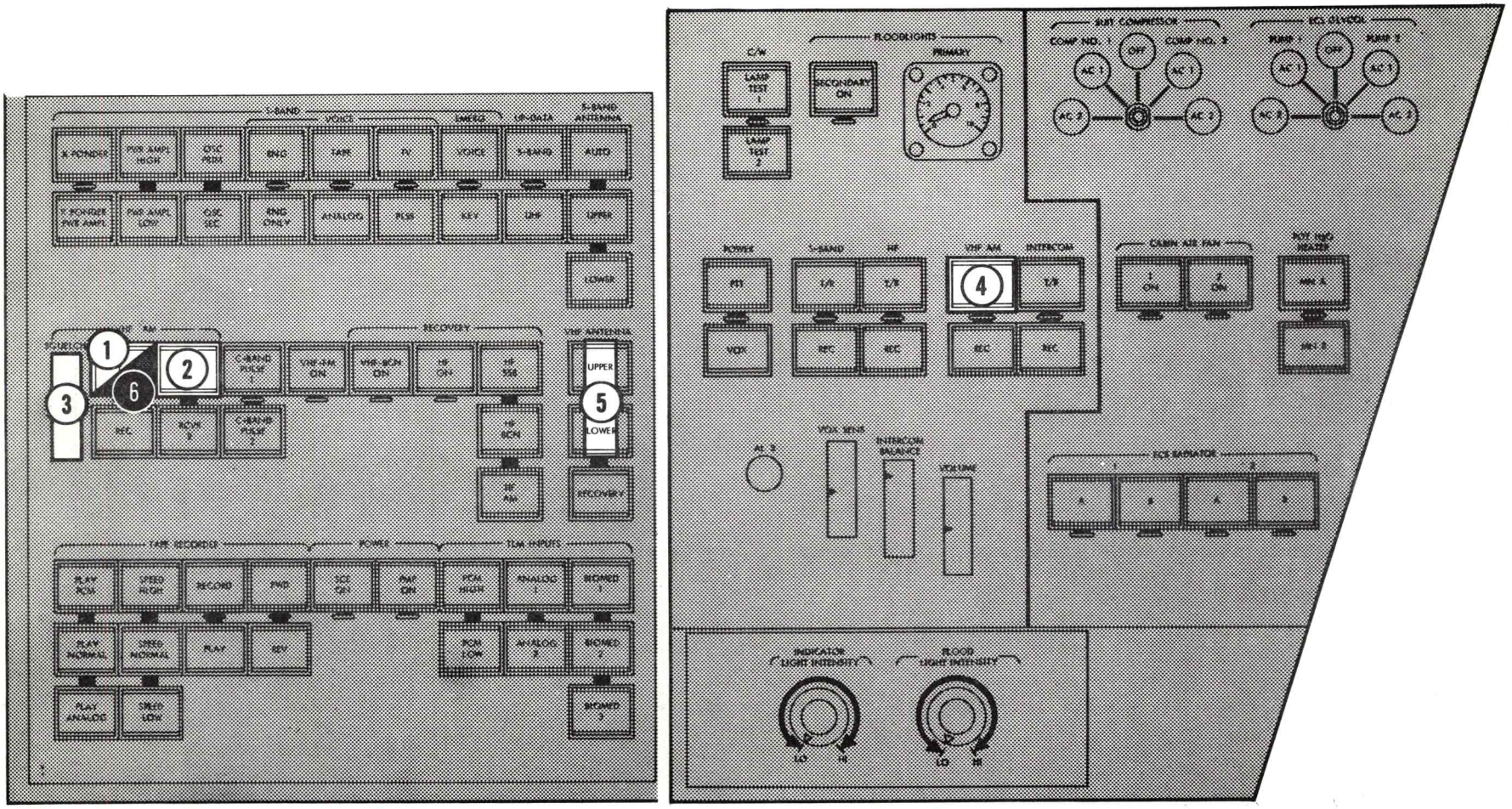
TC1.01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER sw - VOX or PTT	POWER - PTT or VOX lt on	
2			Adjust VOLUME cont	Check VOLUME ind	
3			Adjust INTERCOM BALANCE cont	Check INTERCOM BALANCE ind	
4			Adjust VOX SENS cont	Check VOX SENS ind	
5			INTERCOM sw T/R or REC	INTERCOM - T/R or REC lt on	

Audio Center Activation Stations 1, 2 and 3

TC1.01



SM-6T-2-02-577

VHF-AM Voice Communications (MSFN Contacts)

TC3.02

IOS DATA SHEET

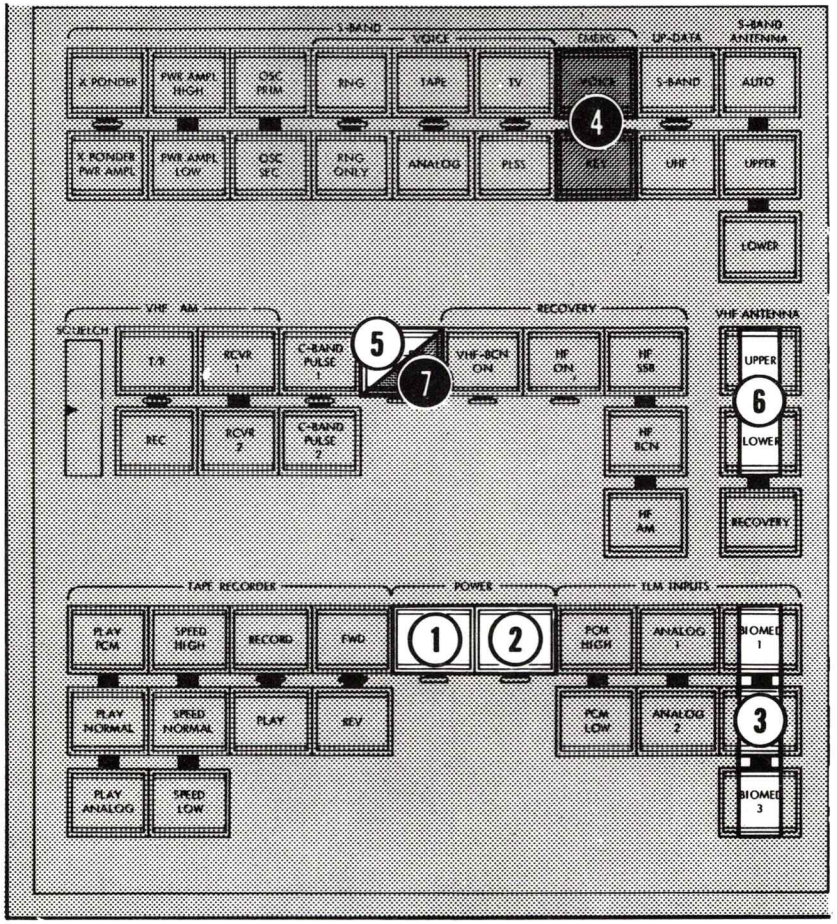
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			VHF-AM sw - T/R	VHF-AM- T/R lt on	
2			VHF-AM RCVR sw - 1	VHF-AM - RCVR 1 lt on	
3			VHF-AM SQUELCH - as required	Check VHF-AM SQUELCH ind	
4			VHF-AM sw - T/R	VHF-AM - T/R lt on	
5			VHF ANTENNA sw - UPPER or LOWER	VHF ANTENNA - UPPER or LOWER lt on	
			Deactive VHF AM		
6			VHF-AM sw - OFF	VHF-AM - T/R and REC lt out	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			S-Band Activation		
1			UP-DATA sw - S-BAND	UP-DATA - S-BAND lt on	
			S-Band Deactivation		
2			UP-DATA sw - off	UP-DATA lts out	
			UHF Activation		
1			UP-DATA sw - UHF	UP-DATA - UHF lt on	
			UHF Deactivation		
2			UP-DATA sw - off	UP-DATA lt out	

Up-Data Link Activation

TC3.03


S-BAND
VOICE
EMERG
UP-DATA
S-BAND ANTENNA
X PONDER
PWR AMPL HIGH
OSC PRIM
RNG
TAPE
TV
VOICE
S-BAND
AUTO
X PONDER PWR AMPL
PWR AMPL LOW
OSC SEC
RNG ONLY
ANALOG
PCM
KEY
UHF
UPPER
LOWER
VHF AM
RECOVERY
VHF ANTENNA
SQUELCH
T/R
RCVR 1
C-BAND PULSE 1
VHF-BCN ON
HF ON
HF SSB
UPPER
REC
RCVR 2
C-BAND PULSE 2
HF BCN
LOWER
HF AM
RECOVERY
TAPE RECORDER
POWER
TLM INPUTS
PLAY PCM
SPEED HIGH
RECORD
FWD
PCM HIGH
ANALOG 1
BIOMED 1
PLAY NORMAL
SPEED NORMAL
PLAY
REV
PCM LOW
ANALOG 2
PLAY ANALOG
SPEED LOW
BIOMED 3
1
2
3
4
5
6
7

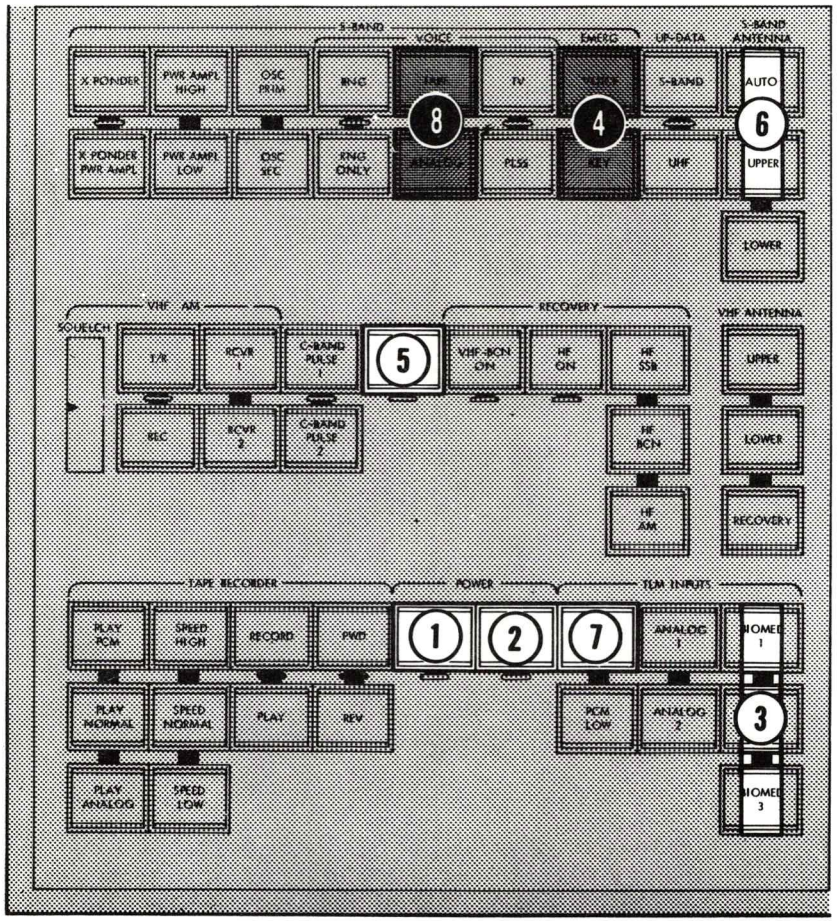
SM-6T-2-02-578

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER SCE sw - ON	POWER - SCE ON lt on	
2			POWER PMP sw - ON	POWER - PMP ON lt on	
3			TLM INPUTS BIOMED sw - as required	TLM INPUTS BIOMED 1, 2, or 3 lt on, as selected	
4			S-BAND EMERG sw - off	S-BAND - EMERG VOICE, and KEY lt out	
5			VHF-FM sw - ON	VHF-FM ON lt on	
6			VHF ANTENNA sw - UPPER or LOWER, as required	VHF ANTENNA - UPPER or LOWER lt on	
			Deactivate FHF-FM		
7			VHF-FM sw - OFF	VHF-FM ON lt out	

VHF-FM Activation

TC3.04



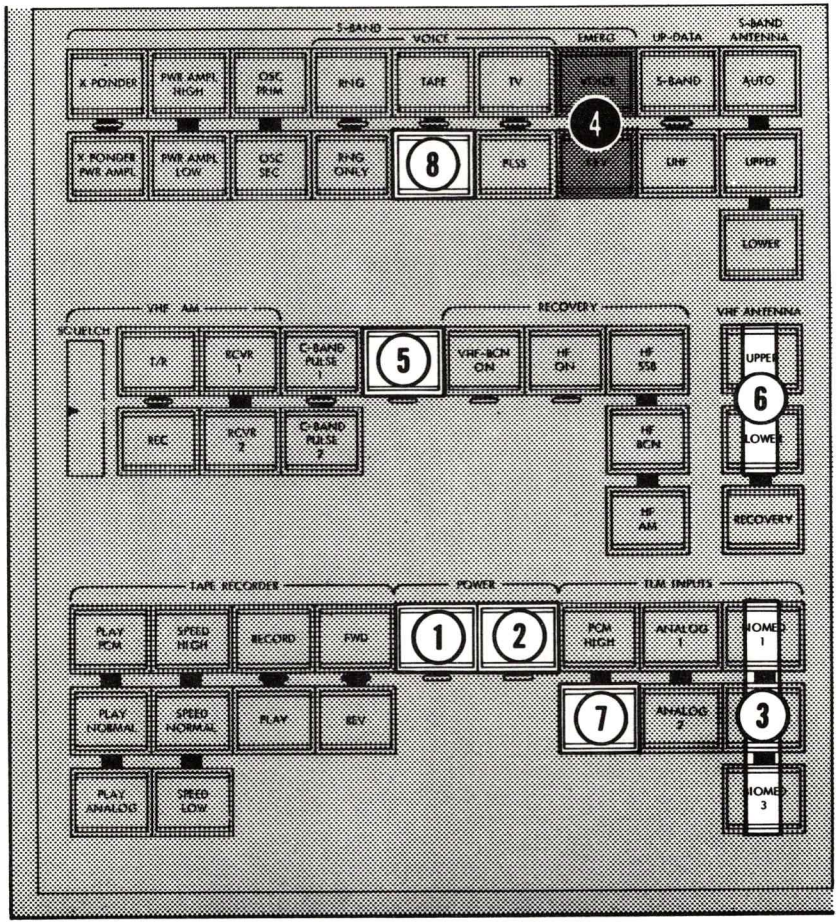
SM-6T-2-02-579

Transmit High-Bit Rate PCM, VHF-FM

TC3.05

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER SCE sw - ON	POWER - SCE ON lt on	
2			POWER PMP sw - ON	TLM DATA POWER - PMP ON lt on	
3			TLM INPUTS BIOMED sw - as required	TLM INPUTS BIOMED 1, 2, or 3 lt on, as selected	
4			S-BAND EMERG sw - off	S-BAND - EMERG MODE VOICE and KEY lt out	
5			VHF-FM sw - ON	VHF-FM ON lt on	
6			VHF ANTENNA sw - UPPER or LOWER, as required	VHF ANTENNA - UPPER or LOWER lt on	
7			TLM INPUTS PCM sw - HIGH	TLM INPUTS - PCM HIGH lt on	
8			S-BAND VOICE TAPE/ ANALOG sw - off	S-BAND VOICE - TAPE and ANALOG lt out	



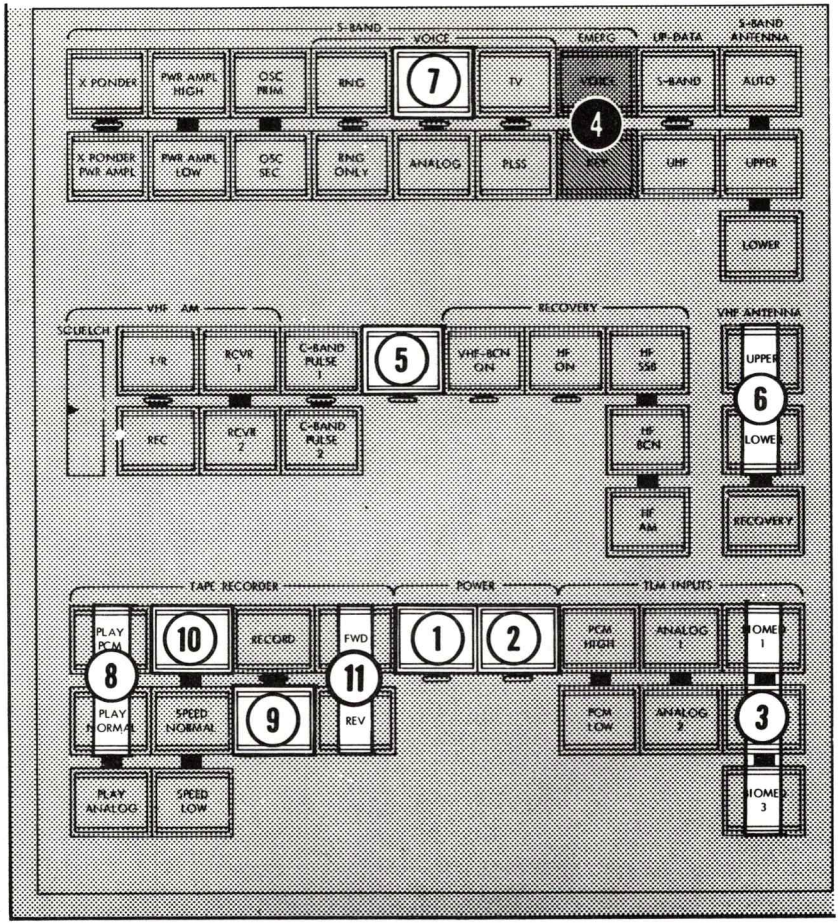
SM-6T-2-02-580

Transmit Low-Bit Rate PCM, VHF-FM

TC3.06

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER SCE sw - ON	TLM DATA PWR - SCE ON lt on	
2			POWER PMP sw - ON	TLM DATA PWR - PMP ON lt on	
3			TLM INPUTS BIOMED sw - as required	TLM INPUTS BIOMED 1, 2, or 3 lt on, as selected	
4			S-BAND EMERG sw - off	S-BAND - EMERG VOICE and KEY lt out	
5			VHF-FM sw - ON	VHF-FM ON lt on	
6			VHF ANTENNA sw - UPPER or LOWER	VHF ANTENNA - LOWER or UPPER lt on	
7			TLM INPUTS PCM sw - LOW	TLM INPUTS - PCM LOW lt on	
8			S-BAND VOICE TAPE/ ANALOG sw - OFF or ANALOG	S-BAND - VOICE ANALOG lt on or NORM MODES ANALOG and TAPE lt out	



SM-6T-2-02-581

Transmit Recorded High-Bit Rate PCM, VHF-FM

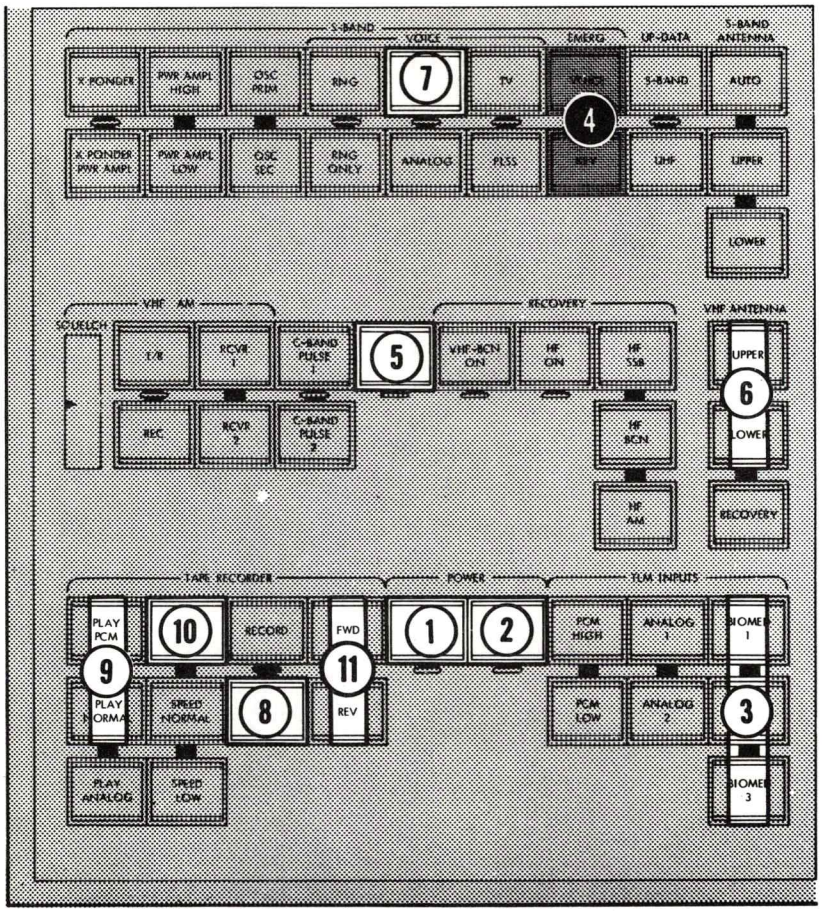
TC3.07

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER SCE sw - ON	PWR - SCE ON lt on	
2			POWER PMP sw - ON	PWR - PMP ON lt on	
3			BIOMED sw - as required	BIOMED 1, 2, or 3 lt on, as selected	
4			S-BAND EMERG sw - off	S-BAND EMERG lt out	
5			VHF-FM sw - ON	VHF-FM ON lt on	
6			VHF ANTENNA sw - UPPER or LOWER	VHF ANTENNA - LOWER or UPPER lt on	
7			S-BAND VOICE TAPE/ ANALOG sw - TAPE	S-BAND - VOICE TAPE lt on	
8			TAPE RECORDER PCM/ ANALOG sw - PCM or NORMAL	TAPE RECORDER - PCM or PLAY NORMAL lt on	
9			TAPE RECORDER sw - PLAY	TAPE RECORDER - PLAY lt on	
10			TAPE RECORDER SPEED sw - HIGH	TAPE RECORDER - SPEED HIGH lt on	
11			TAPE RECORDER FWD/REV sw - as required	TAPE RECORDER - FWD or REV lt on	

Transmit Recorded High-Bit Rate PCM, VHF-FM

TC3.07



SM-6T-2-02-582

Transmit Recorded Low-Bit Rate PCM, VHF-FM

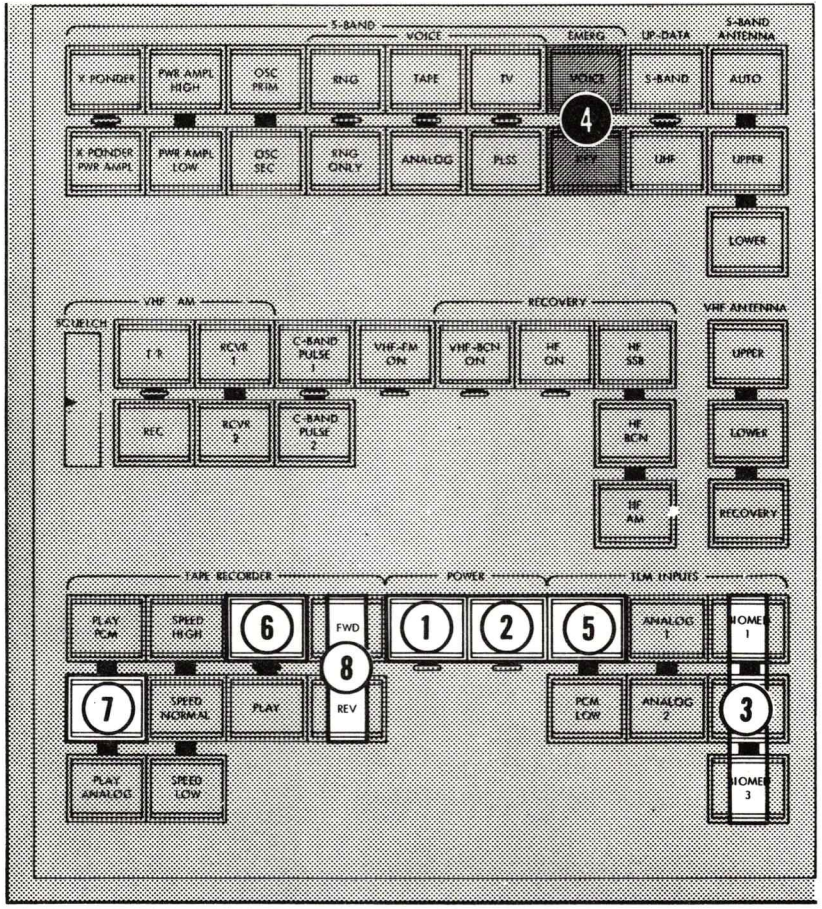
TC3.08

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER SCE sw - ON	PWR - SCE ON lt on	
2			POWER PMP sw - ON	PWR - ON lt on	
3			BIOMED sw - as required	BIOMED 1, 2, or 3 lt on	
4			S-BAND EMERG sw - off	S-BAND EMERG lt out	
5			VHF-FM sw - ON	VHF-FM ON lt on	
6			VHF ANTENNA sw - UPPER or LOWER	VHF ANTENNA - UPPER or LOWER lt on	
7			S-BAND VOICE TAPE/ ANALOG sw - TAPE	S-BAND VOICE TAPE lt on	
8			TAPE RECORDER RECORD/ PLAY - sw - PLAY	TAPE RECORDER - PLAY lt on	
9			TAPE RECORDER PCM/ ANALOG sw - PCM or NORMAL	TAPE RECORDER - PCM or NORMAL lt on	
10			TAPE RECORDER SPEED sw - HIGH	TAPE RECORDER - SPEED HIGH lt on	
11			TAPE RECORDER FWD/REV sw - as required	TAPE RECORDER - FWD or REV lt on	

Transmit Recorded Low-Bit Rate PCM, VHF-FM

TC3.08



SM-6T-2-02-583

Record High-Bit Rate PCM

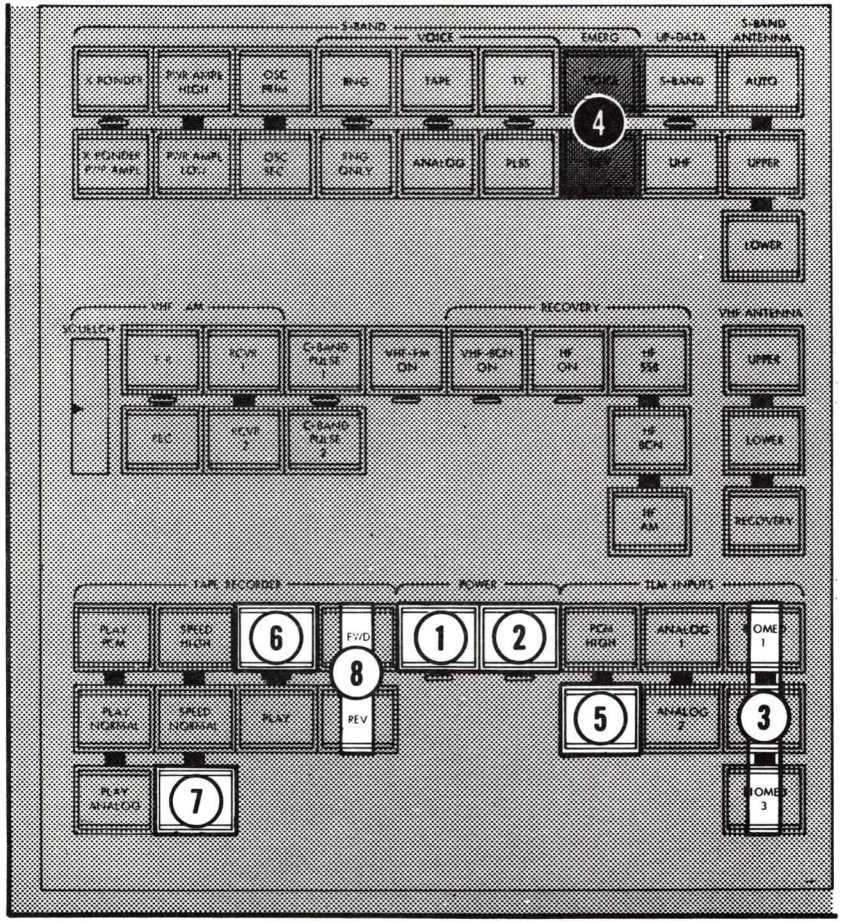
TC3.09

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER SCE sw - ON	PWR - SCE ON lt on	
2			POWER PMP sw - ON	PWR - PMP ON lt on	
3			BIOMED sw - as required	BIOMED 1, 2, or 3 lt on	
4			S-BAND EMERG sw - off	S-BAND - EMERG lt out	
5			TLM INPUTS PCM sw - HI	TLM INPUTS - PCM HI lt on	
6			TAPE RECORDER RECORD/ PLAY sw - RECORD	TAPE RECORDER - RECORD lt on	
7			TAPE RECORDER SPEED sw - NORM	TAPE RECORDER - SPEED NORMAL lt on	
8			TAPE RECORDER FWD/REV sw - as required	TAPE RECORDER - FWD or REV lt on	

Record High-Bit Rate PCM

TC3.09



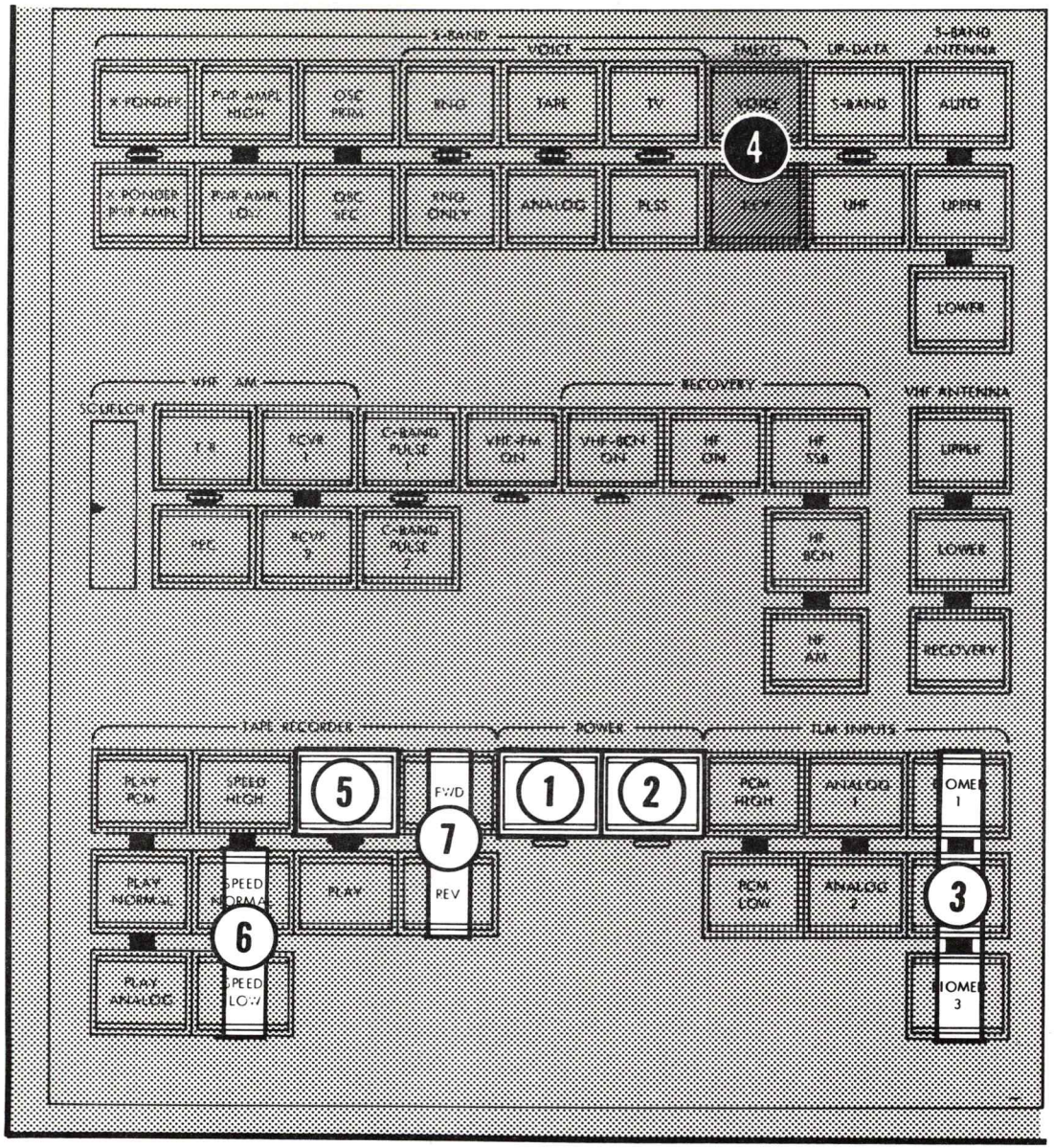
SM-6T-2-02-584

Record Low-Bit Rate PCM

TC3.10

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER SCE sw - ON	PWR - SCE ON lt on	
2			POWER PMP sw - ON	PWR - PMP ON lt on	
3			BIOMED sw - as required	BIOMED 1, 2, or 3 lt on	
4			S-BAND EMERG sw - off	S-BAND - EMERG lt out	
5			TLM INPUTS PCM sw - LOW	TLM INPUTS - PCM LOW lt on	
6			TAPE RECORDER sw - RECORD	TAPE RECORDER - RECORD lt on	
7			TAPE RECORDER SPEED HIGH/LOW sw - LOW	TAPE RECORDER - SPEED LOW lt on	
8			TAPE RECORDER FWD/REV sw - as required	TAPE RECORDER - FWD or REV lt on	



SM-6T-2-02-585

Record Real-Time Analog Data

TC3.11

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			POWER SCE sw - ON	PWR - SCE ON lt on	
2			POWER PMP sw - ON	PWR - PMP ON lt on	
3			BIOMED sw - as required	BIOMED 1, 2, or 3 lt on	
4			S-BAND EMERG sw - off	S-BAND - EMERG VOICE and KEY lt out	
5			TAPE RECORDER POWER sw - RECORD	TAPE RECORDER - POWER RECORD lt on	
6			TAPE RECORDER SPEED sw - LOW or NORM	TAPE RECORDER - SPEED LOW or MED lt on	
7			TAPE RECORDER FWD/REV sw - as required	TAPE RECORDER - FWD or REV lt on	

Record Real-Time Analog Data

TC3.11

IOS DATA SHEET

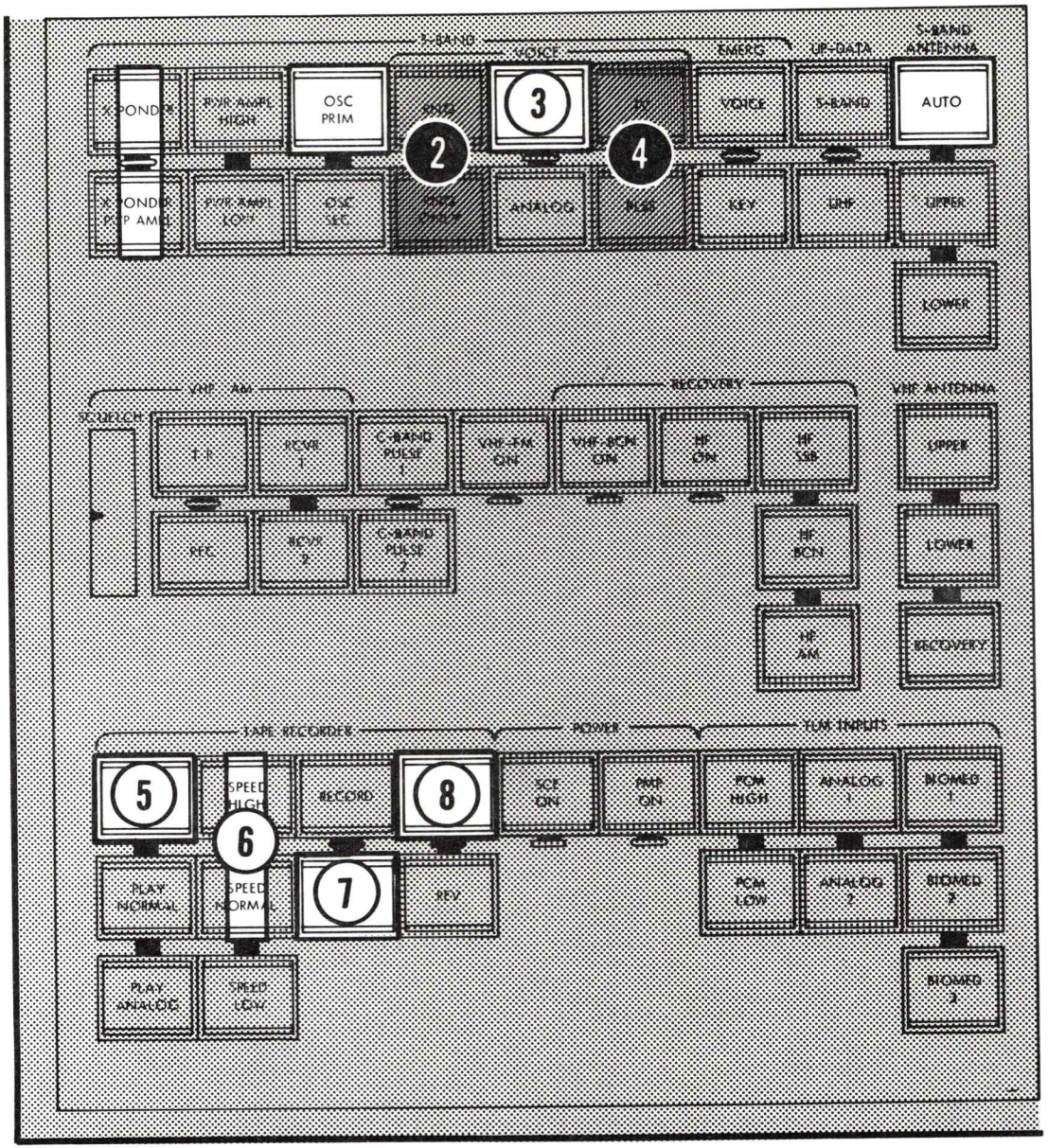
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			S-BAND XPONDER/OFF/ XPONDER PWR AMPL sw - XPONDER	S-BAND - XPONDER lt on	
2			S-BAND OSC sw - PRIM	S-BAND - OSC PRIM lt on	
3			S-BAND EMERG sw - OFF	S-BAND - EMERG lt out	
4			S-BAND ANTENNA sw - AUTO	S-BAND ANTENNA - AUTO lt on	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			S-BAND XPONDER/OFF/ XPONDER PWR AMPL sw - XPONDER PWR AMPL	S-BAND - XPONDER PWR AMPL lt on	
2			S-BAND PWR AMPL sw - HIGH or LOW	S-BAND - PWR AMPL HIGH lt on	
3			S-BAND OSC sw PRIM	S-BAND - OSC PRIM lt on	
4			S-BAND EMERG sw - off	S-BAND - EMERG lt out	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Complete USBE activation	TC3.12 or TC3.13	
2			S-BAND sw - T/R or REC	S-BAND - T/R or REC lt on	
3			POWER PMP sw - ON	POWER - PMP ON lt on	



SM-6T-2-02-586

LISTED STEPS

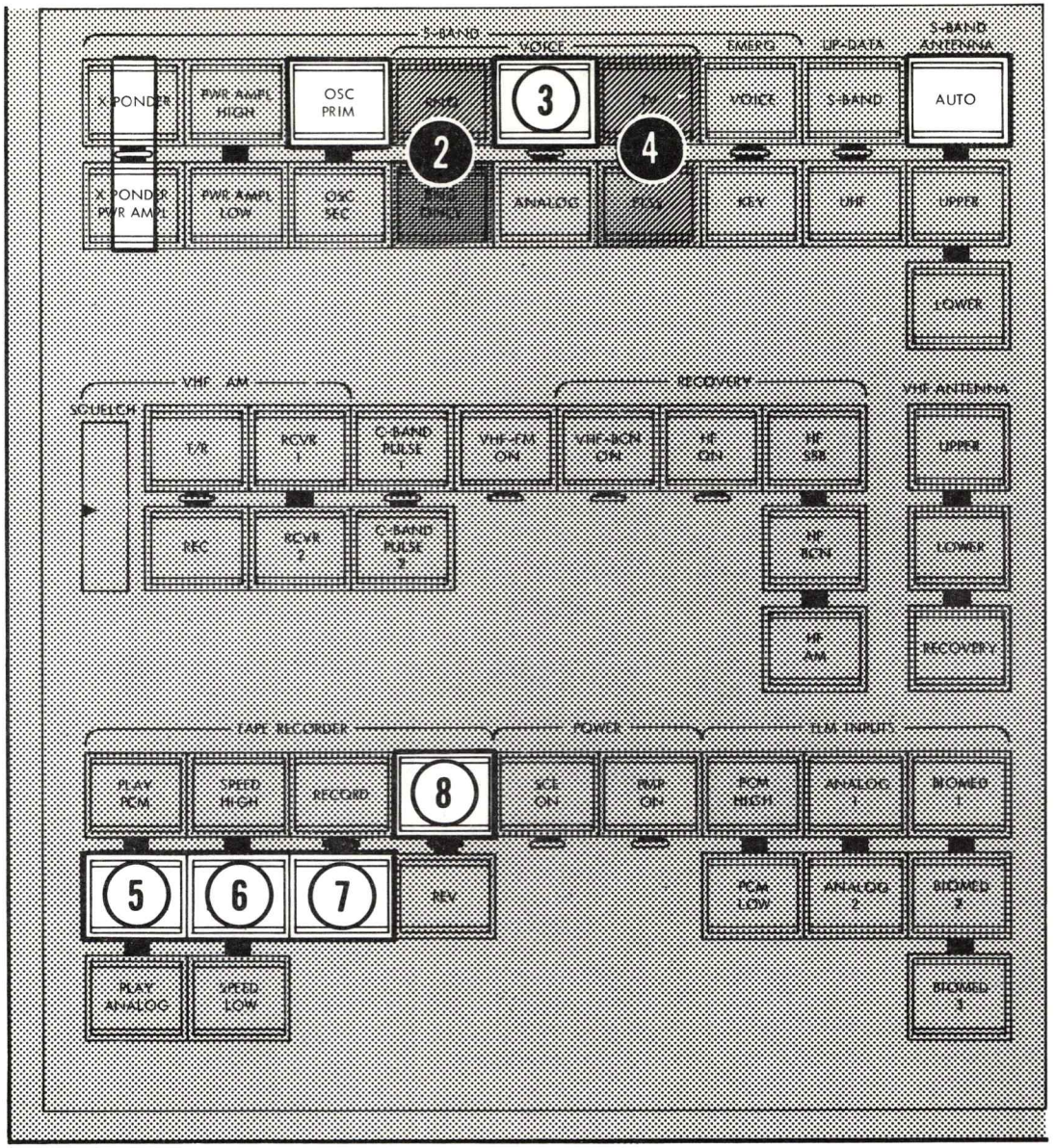
1

USBE, Transmit Recorded Low- or High-Bit Rate PCM

TC3.15

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Complete USBE activation	TC3.12 or TC3.13	
2			S-BAND VOICE RNG/RNG ONLY sw - OFF	S-BAND VOICE - RNG lt out	
3			S-BAND VOICE TAPE/ ANALOG sw - TAPE	S-BAND VOICE TAPE lt on	
4			S-BAND VOICE TV/PLSS sw - OFF	S-BAND VOICE TV and PLSS lt out	
5			TAPE RECORDER PLAY sw - PCM	TAPE RECORDER - PLAY PCM lt on	
6			TAPE RECORDER SPEED sw - HIGH or NORMAL	TAPE RECORDER - SPEED HIGH or SPEED NORMAL lt on	
7			TAPE RECORDER RECORD/ PLAY sw - PLAY	TAPE RECORDER - PLAY lt on	
8			TAPE RECORDER FWD/REV sw - FWD	TAPE RECORDER - FWD lt on	



SM-6T-2-02-587

LISTED STEPS

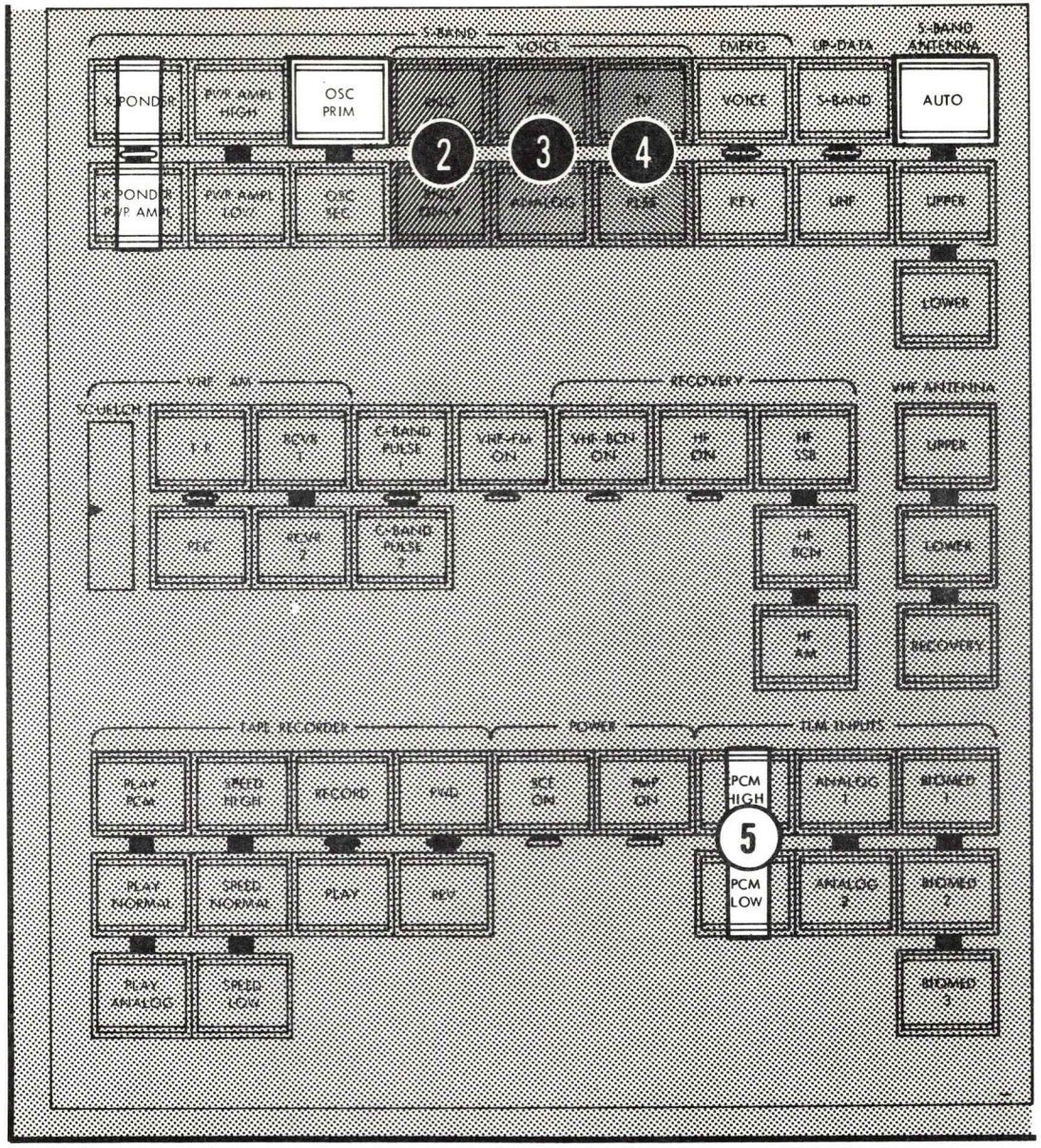
1

USBE, Transmit Recorded High-Rate PCM and Analog

TC3.16

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Complete USBE activation	TC3.12 or TC3.13	
2			S-BAND VOICE RNG/RNG ONLY sw - OFF	S-BAND VOICE - RNG lt out	
3			S-BAND VOICE TAPE/ ANALOG sw - TAPE	S-BAND VOICE - TAPE lt out	
4			S-BAND VOICE TV/PLSS sw - OFF	S-BAND VOICE TV and PLSS lt out	
5			TAPE RECORDER PLAY sw - NORM	TAPE RECORDER - PLAY NORMAL lt on	
6			TAPE RECORDER SPEED sw - NORM	TAPE RECORDER - SPEED NORMAL lt on	
7			TAPE RECORDER RECORD/ PLAY sw - PLAY	TAPE RECORDER - PLAY lt on	
8			TAPE RECORDER FWD/REV sw - FWD	TAPE RECORDER - FWD lt on	



SM-6T-2-02-588

LISTED STEPS

1

USBE, Transmit Low- or High-Bit Rate, PCM

TC3.17

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Complete USBE activation	TC3.12 or TC3.13	
2			S-BAND VOICE RNG/RNG ONLY sw - OFF	S-BAND VOICE RNG lt out	
3			S-BAND VOICE TAPE/ ANALOG sw - OFF	S-BAND VOICE - TAPE and ANALOG lt out	
4			S-BAND VOICE TV/PLSS sw - OFF	S-BAND VOICE - TV and PLSS lt out	
5			TLM INPUTS PCM sw - LOW or HIGH	TLM INPUTS - PCM HIGH or PCM LOW lt on	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Complete USBE activation	TC3.12 or TC3.13	
2			S-BAND VOICE RNG/RNG ONLY sw - RNG	S-BAND VOICE - RNG lt on	
3			S-BAND VOICE TAPE/ ANALOG sw - OFF	S-BAND VOICE - TAPE and ANALOG lt out	
4			S-BAND VOICE TV/PLSS sw - OFF	S-BAND VOICE - TV and PLSS lt out	
5			TLM INPUTS - PCM sw - LOW or HIGH	TLM INPUTS - PCM LOW or PCM HIGH lt on	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Complete USBE activation	TC3.12 or TC3.13	
2			S-BAND VOICE RNG/RNG ONLY sw - RNG ONLY	S-BAND VOICE - RNG ONLY lt on	
3			S-BAND VOICE TAPE/ ANALOG sw - OFF	S-BAND VOICE - TAPE and ANALOG lt out	
4			S-BAND VOICE TV/PLSS sw - OFF	S-BAND VOICE TV and PLSS lt out	

USBE, Transmit in Ranging Only

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Complete USBE activation	TC3.12 or TC3.13	
2			S-BAND VOICE RNG/RNG ONLY sw - OFF	S-BAND VOICE - RNG and RNG ONLY lt out	
3			S-BAND VOICE TAPE/ ANALOG sw - OFF	S-BAND VOICE - TAPE and ANALOG lt out	
4			S-BAND VOICE TV/PLSS sw - TV	S-BAND VOICE - TV lt on	
5			TLM INPUTS PCM sw - LOW or HIGH	TLM INPUTS - PCM LOW or PCM HIGH lt on	

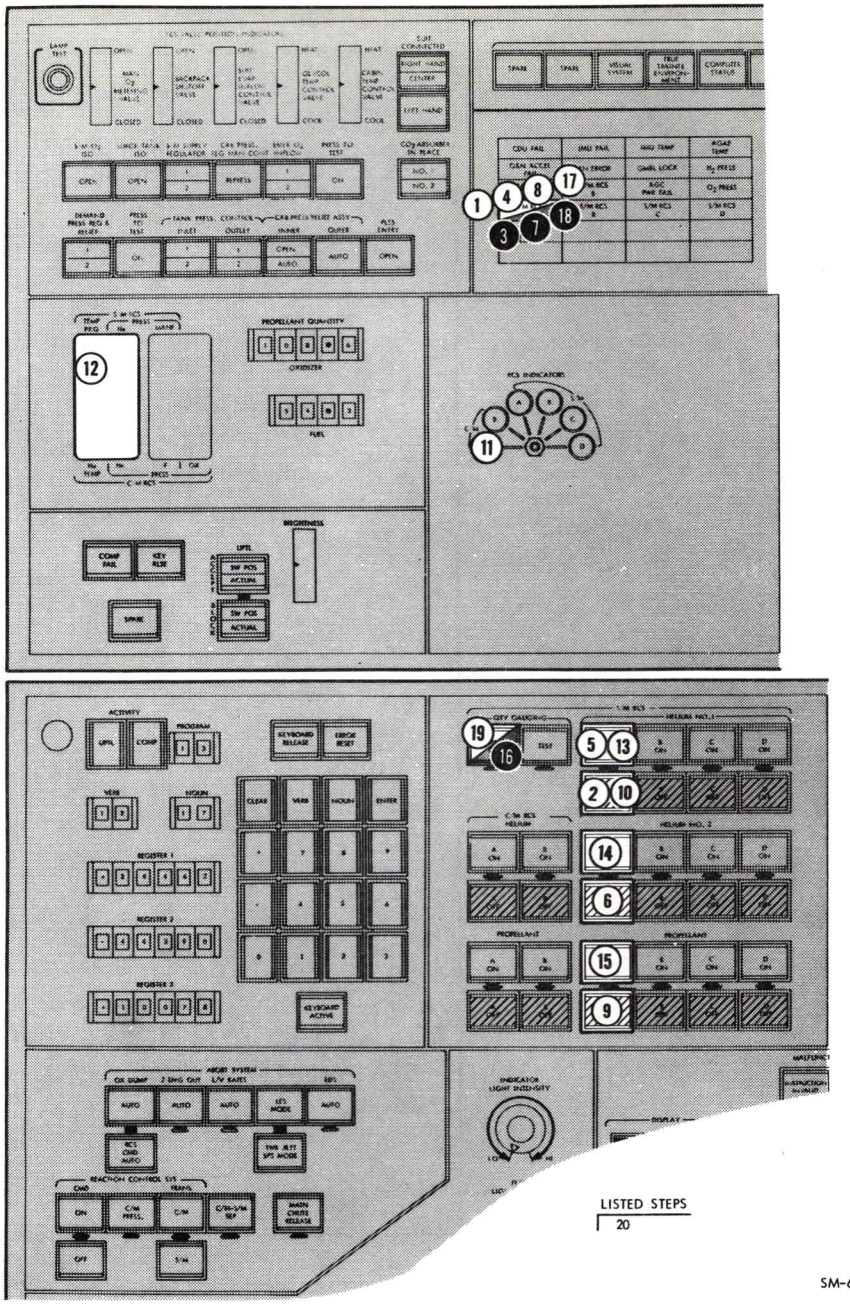
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Activate C-Band Transponder		
1			C-BAND sw - 1 PULSE or 2 PULSE, as required		
			Deactivate C-Band Transponder		
2			C-BAND sw - OFF		

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			TAPE RECORDER RECORD/ PLAY sw - PLAY	TAPE RECORDER - PLAY lt on	
2			TAPE RECORDER SPEED sw - HIGH	TAPE RECORDER - SPEED HIGH lt on	
3			TAPE RECORDER FWD/REV sw - REV	TAPE RECORDER - REV lt on	

Rewind Tape Recorder



S/M RCS C&W Light Illuminates

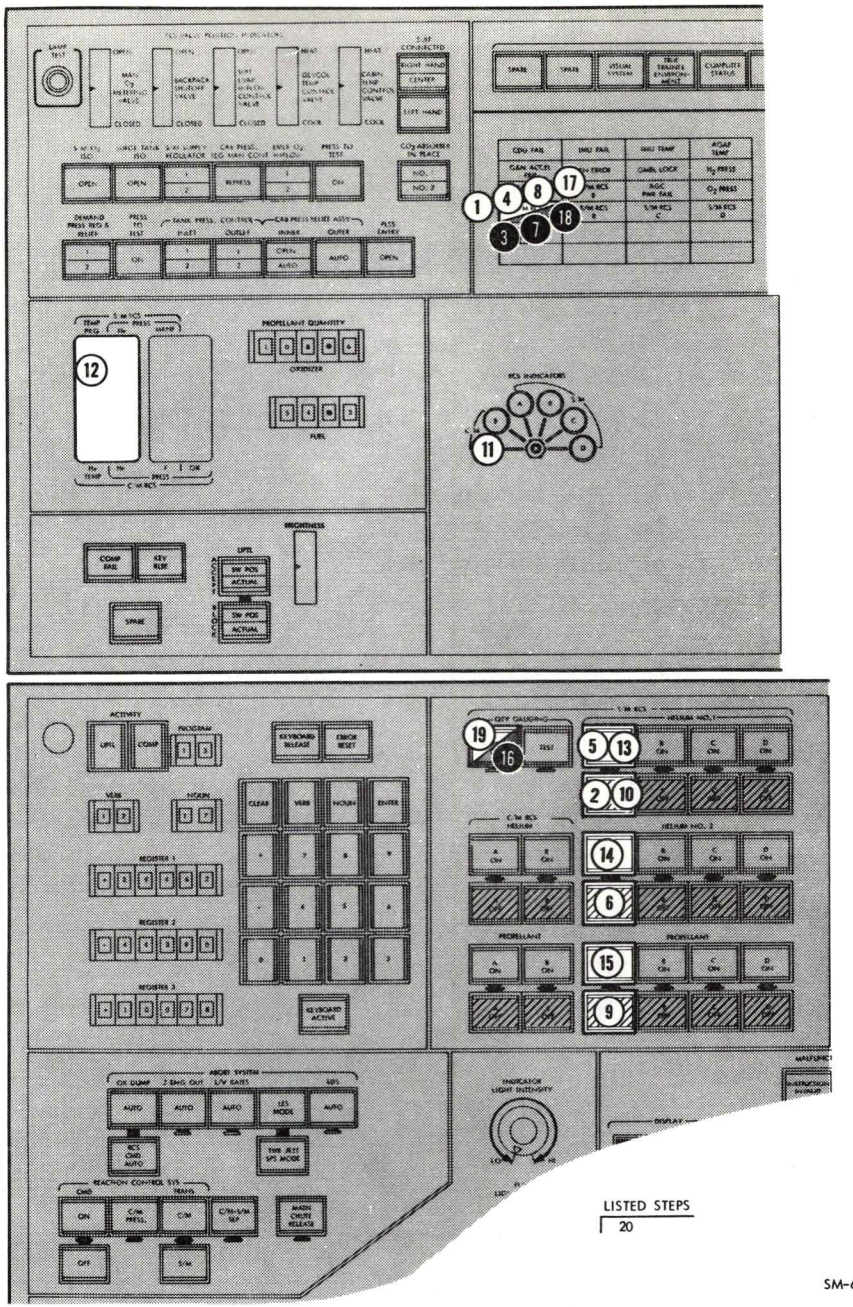
MRC. 01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			S/M RCS A C&W lt on	S/M RCS A C&W lt on	
2			S/M RCS A HELIUM NO. 1 sw - OFF, event ind striped	S/M RCS HELIUM NO. 1 - A OFF striped lt on	
3			C&W lt out	S/M RCS quad functional loss of redundant He press	
4			C&W lt on	Continue check	
5			S/M RCS A HELIUM NO. 1 sw - ON, event ind gray	S/M RCS HELIUM NO. 1 - A ON lt on	
6			S/M RCS A HELIUM NO. 2 sw - OFF, event ind striped	S/M RCS HELIUM NO. 2 - A OFF striped lt on	
7			C&W lt out	S/M RCS quad functional, loss of redundant He press	
8			C&W lt on	Continue check	
9			S/M RCS A PROPELLANT sw - OFF, event ind striped	S/M RCS PROPELLANT - A OFF striped lt on	
10			S/M RCS A HELIUM NO. 1 sw - OFF, event ind striped	S/M RCS HELIUM NO. 1 - A OFF striped lt on	
11			RCS INDICATORS sw - S/M A	RCS INDICATORS S/M - A lt on	

S/M RCS C&W Light Illuminates

MRC.01



S/M RCS C&W Light Illuminates

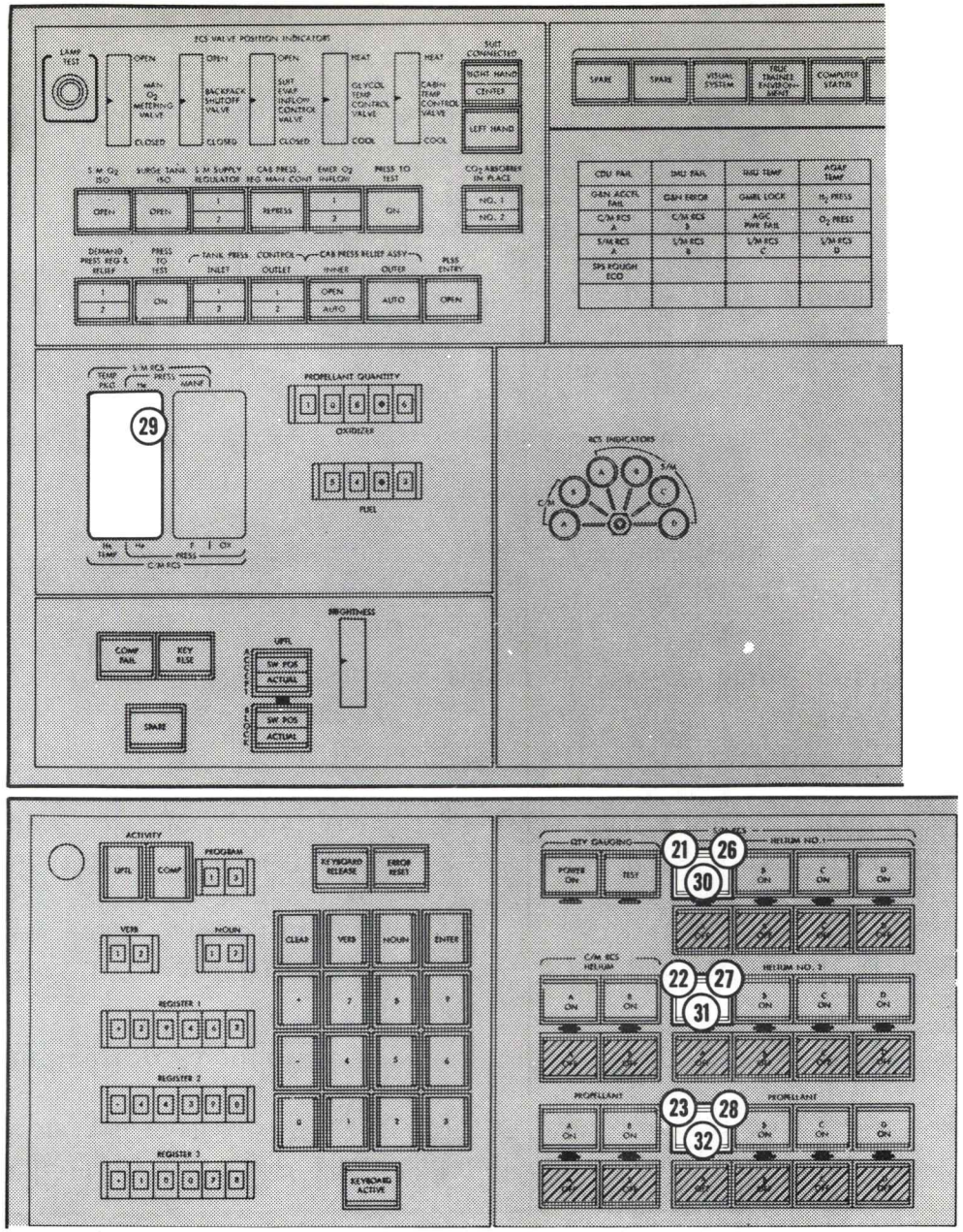
MRC. 01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12			Check S/M TEMP PKG ind and confirm with MSFN	Provide appropriate communication	
13-15			Indication Abnormal		
13			S/M RCS A HELIUM NO. 1 sw - ON, event ind gray	S/M RCS A HELIUM NO. 1 - A ON lt on	
14			S/M RCS A HELIUM NO. 2 sw - ON, event ind gray	S/M RCS A HELIUM NO. 2 - A ON lt on	
15			S/M RCS A PROPELLANT sw - ON, event ind gray	S/M RCS PROPELLANT - A ON lt on S/M RCS quad, functional may be degraded	
16-17			Indication Normal		
16			S/M QUANTITY GAGING POWER sw - OFF	S/M QTY GAGING - POWER ON lt out	
17			C&W lt on	Continue check at step 26	
18			C&W lt out	Continue with following check	
19			S/M RCS QTY GAGING POWER sw - ON	S/M QTY GAGING - POWER ON lt on	
*20			Perform quantity gaging system test check	RC2.02	

S/M RCS C&W Light Illuminates

MRC.01



LISTED STEPS
24, 25

SM-6T-2-02-612

S/M RCS C&W Light Illuminates

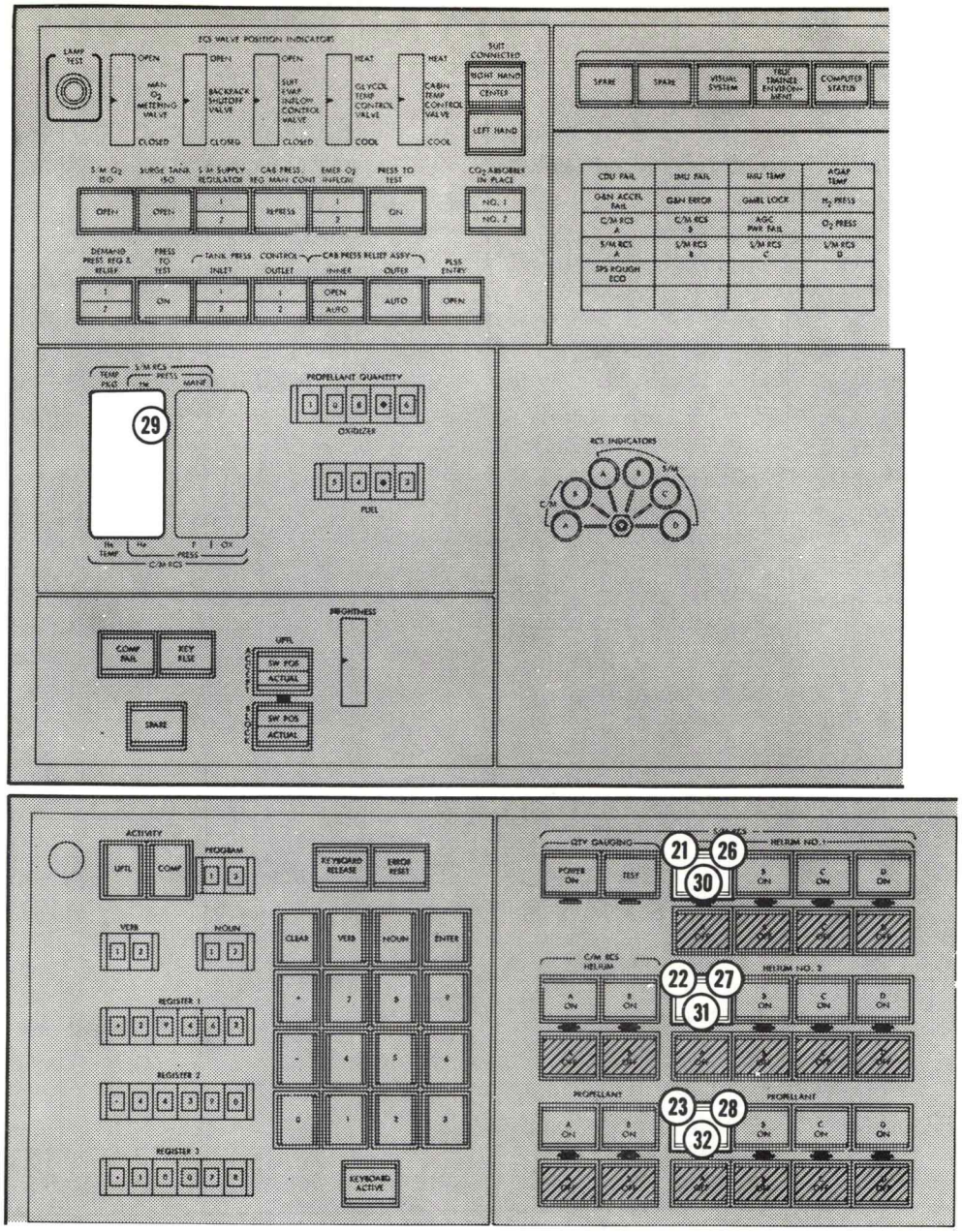
MRC. 01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
21-23			Test Check Abnormal	S/M RCS quad functional, propellant quantities unreliable Provide actual quantities	
21			S/M RCS A HELIUM NO. 1 sw - ON, event ind gray	S/M RCS HELIUM NO. 1 - A ON lt on	
22			S/M RCS A HELIUM NO. 2 sw - ON, event ind gray	S/M RCS HELIUM NO. 2 - A ON lt on	
23			S/M RCS PROPELLANT A sw - ON, event ind gray	S/M RCS PROPELLANT - A ON lt on	
24-28			Test Check Normal	Continue with check	
*24			Determine propellant ratio and confirm with MSFN	Provide appropriate communication	
*25			Propellant ratio abnormal	S/M RCS quad functional, reduced efficiency and operating time	
26			S/M RCS A HELIUM NO. 1 sw - ON, event ind gray	S/M RCS HELIUM NO. 1 - A ON lt on	
27			S/M RCS A HELIUM NO. 2 sw - ON, event ind gray	S/M RCS HELIUM NO. 2 - A ON lt on	
28			S/M RCS A PROPELLANT sw - ON, event ind gray	S/M RCS PROPELLANT - A ON lt on	

S/M RCS C&W Light Illuminates

MRC. 01



SM-6T-2-02-612

LISTED STEPS
24, 25

S/M RCS C&W Light Illuminates

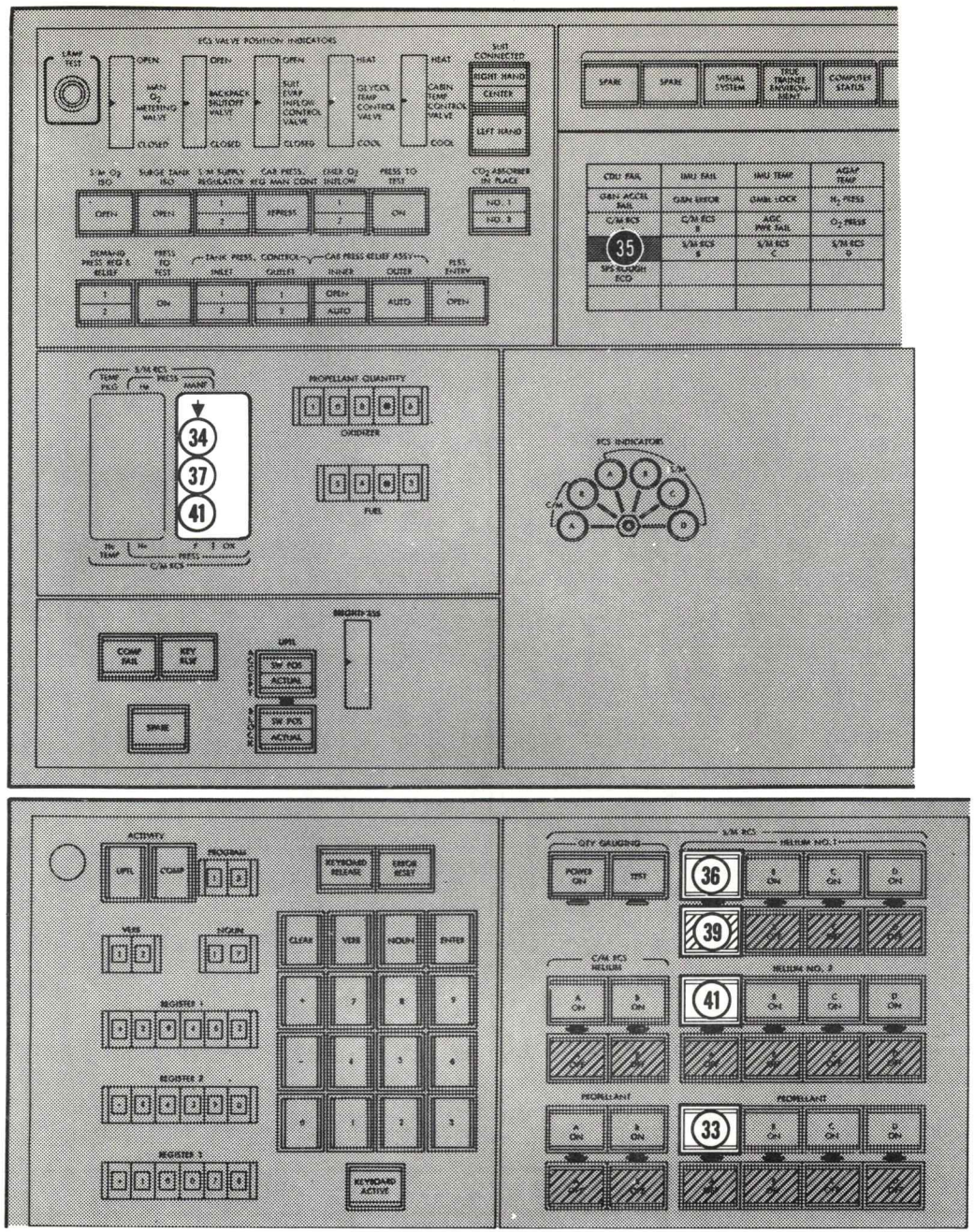
MRC. 01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
29-42			Propellant Ratio Normal	Continue with check	
29			Check S/M RCS PRESS He ind	As programed	
30			S/M RCS A HELIUM NO. 1 sw - ON, event ind gray	S/M RCS HELIUM NO. 1 - A ON lt on	
31			S/M RCS A HELIUM NO. 2 sw - ON, event ind gray	S/M RCS HELIUM NO. 2 - A ON lt on	
32			S/M RCS A PROPELLANT sw - ON, event ind gray	S/M RCS PROPELLANT - A ON lt on	

S/M RCS C&W Light Illuminates

MRC. 01



LISTED STEPS
38

SM-6T-2-02-613

S/M RCS C&W Light Illuminates

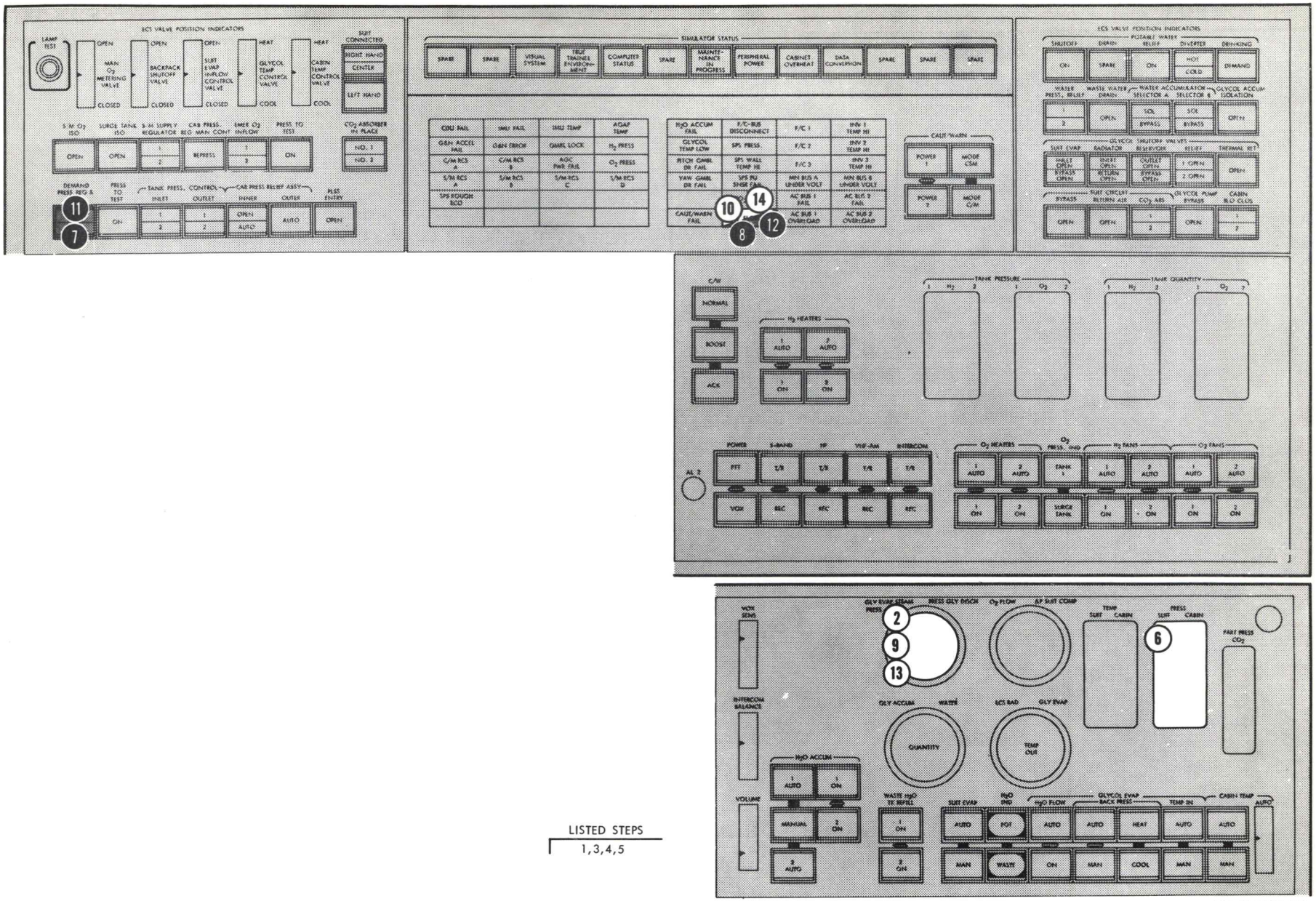
MRC.01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
33-38			Indication High		
33			S/M RCS A PROPELLANT sw - ON, event ind gray	S/M RCS PROPELLANT - A ON striped lt on	
34			Check S/M SYS PRESS MANF ind for decrease to normal	S/M SYS PRESS MANF ind decreasing	
35			Check C&W lt out as press drops slightly below normal	C&W lt out	
36			S/M RCS A HELIUM NO. 1 sw - ON, event ind gray	S/M RCS HELIUM NO. 1 - A ON lt on	
37			Check S/M SYS PRESS MANF ind	As programed	
*38			Depress normal	S/M RCS quad functional, loss of redundant He regulation	
39-41			Press High	He No. 1 system regulator out	
39			S/M RCS A HELIUM NO. 1 sw - OFF, event ind striped	S/M RCS HELIUM NO. 1 - A OFF striped lt on	
40			S/M RCS A HELIUM NO. 2 sw - ON, event ind gray	S/M RCS HELIUM NO. 2 - A ON lt on	
41			Check S/M SYS PRESS MANF ind drop to normal	As programed	

S/M RCS C&W Light Illuminates

MRC. 01



O_2 FLOW HI Light Illuminates

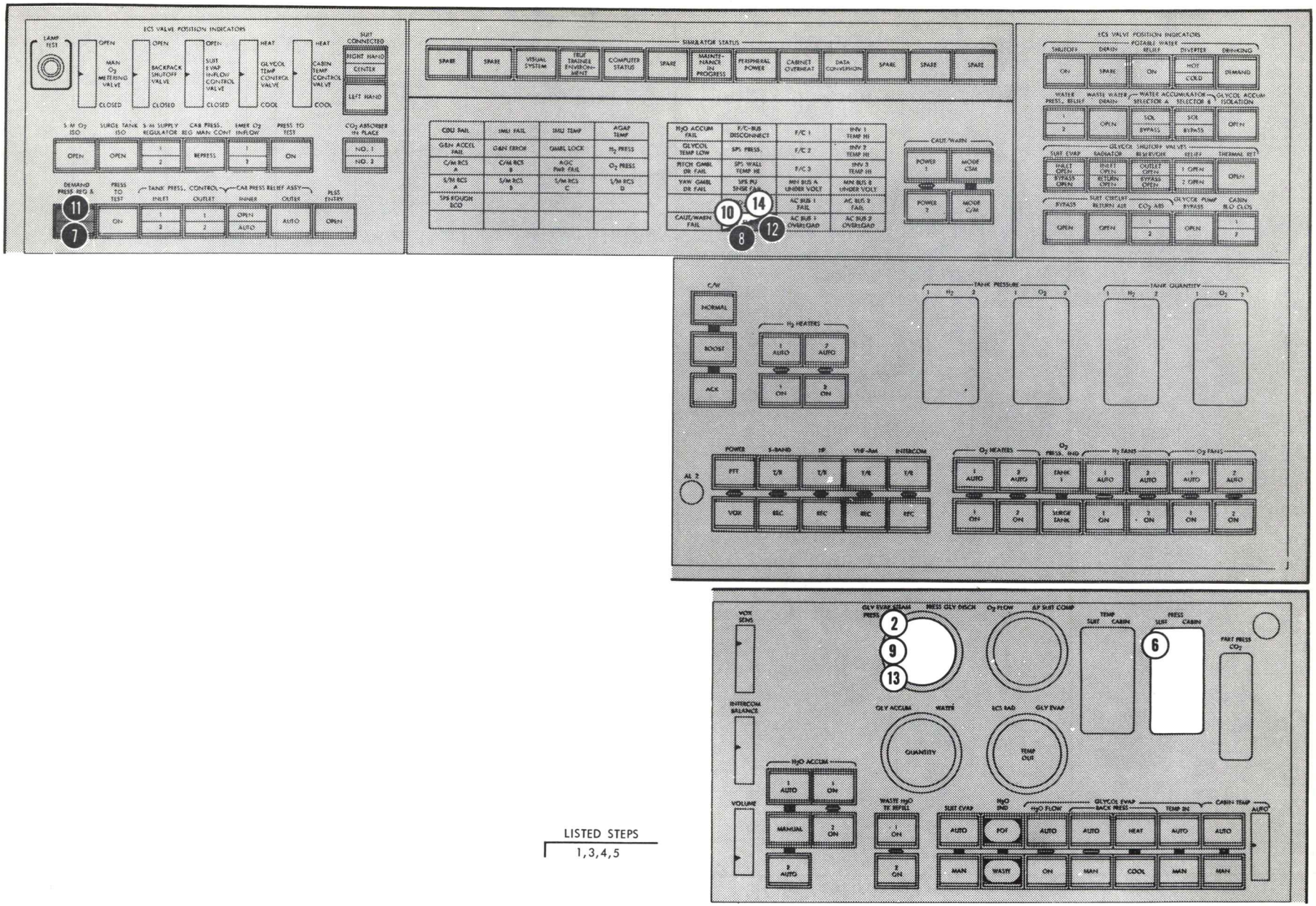
MEC. 01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*1			Determine C/M cabin not punctured		
2-4			O_2 FLOW HI Light On, O_2 FLOW Meter Normal		
2			Check FLOW O_2 ind	As programed	
*3			FLOW O_2 less than 1	Sensing circuit out	
*4			Confirm with MSFN	Provide confirming communication	
5-14			O_2 FLOW HI Light On, O_2 FLOW Meter High		
*5			FLOW O_2 ind 1 or greater	FLOW O_2 ind max	
6			Check PRESS. SUIT ind higher than PRESS. CABIN ind and note suit ballooned	As programed	
7			Suit demand pressure regulator valve - 1 REG	DEMAND PRESS. REG & RELIEF 2 lt out	
8			O_2 FLOW HI lt out	Number 2 regulator out	
9			Check FLOW O_2 ind normal	As programed	
10			O_2 FLOW HI lt remains on	Continue check	

O_2 FLOW HI Light Illuminates

MEC. 01



LISTED STEPS
1,3,4,5

SM-6T-2-02-596

O_2 FLOW HI Light Illuminates

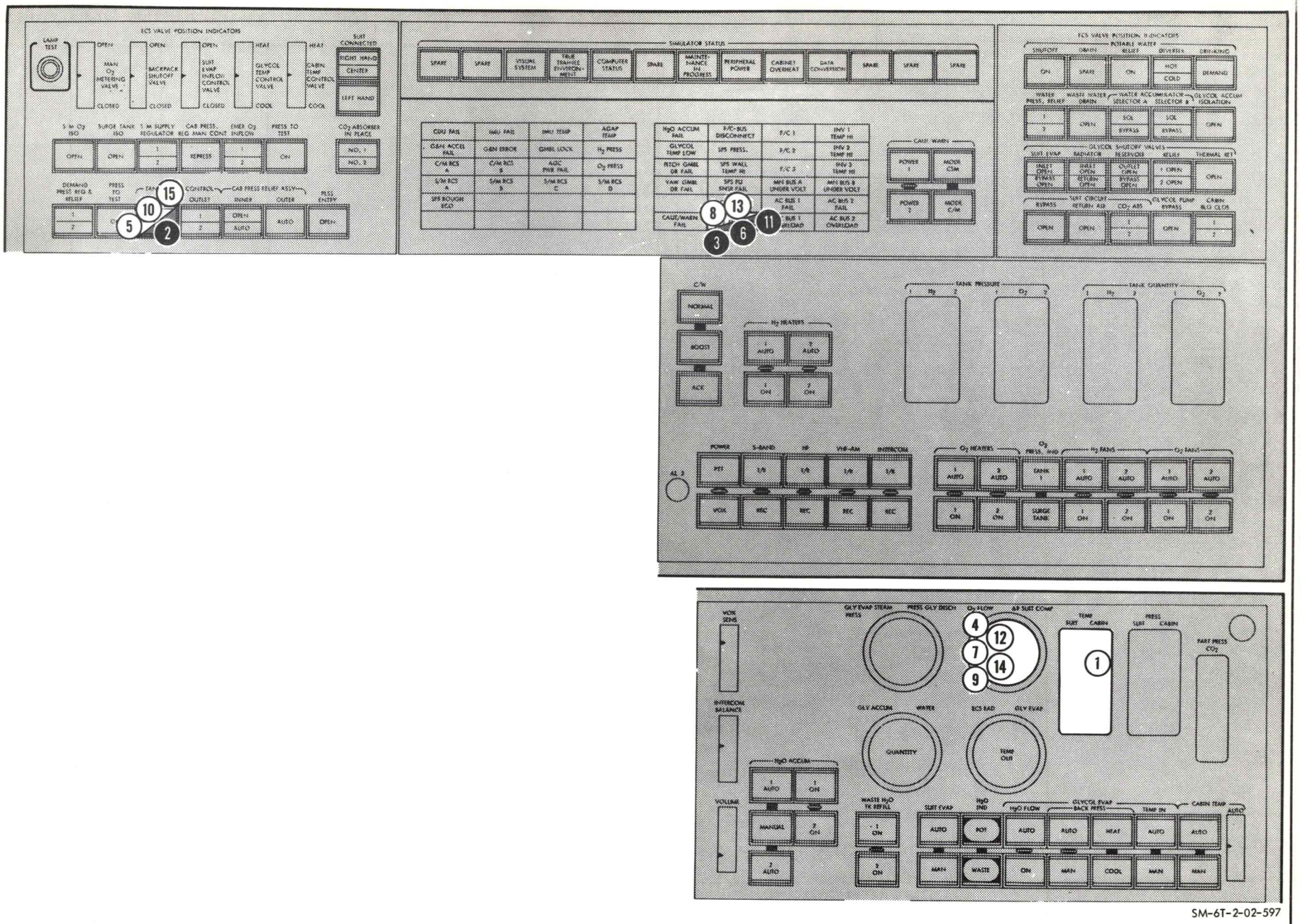
MEC. 01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
11			Suit demand pressure regulator valve - 2 REG	DEMAND PRESS. REG & RELIEF 1 lt out	
12			O_2 FLOW HI lt - out	Number 1 regulator out	
13			Check FLOW O_2 ind - normal	As programed	
14			O_2 FLOW HI lt - remains on	Continue check	

O_2 FLOW HI Light Illuminates

MEC. 01

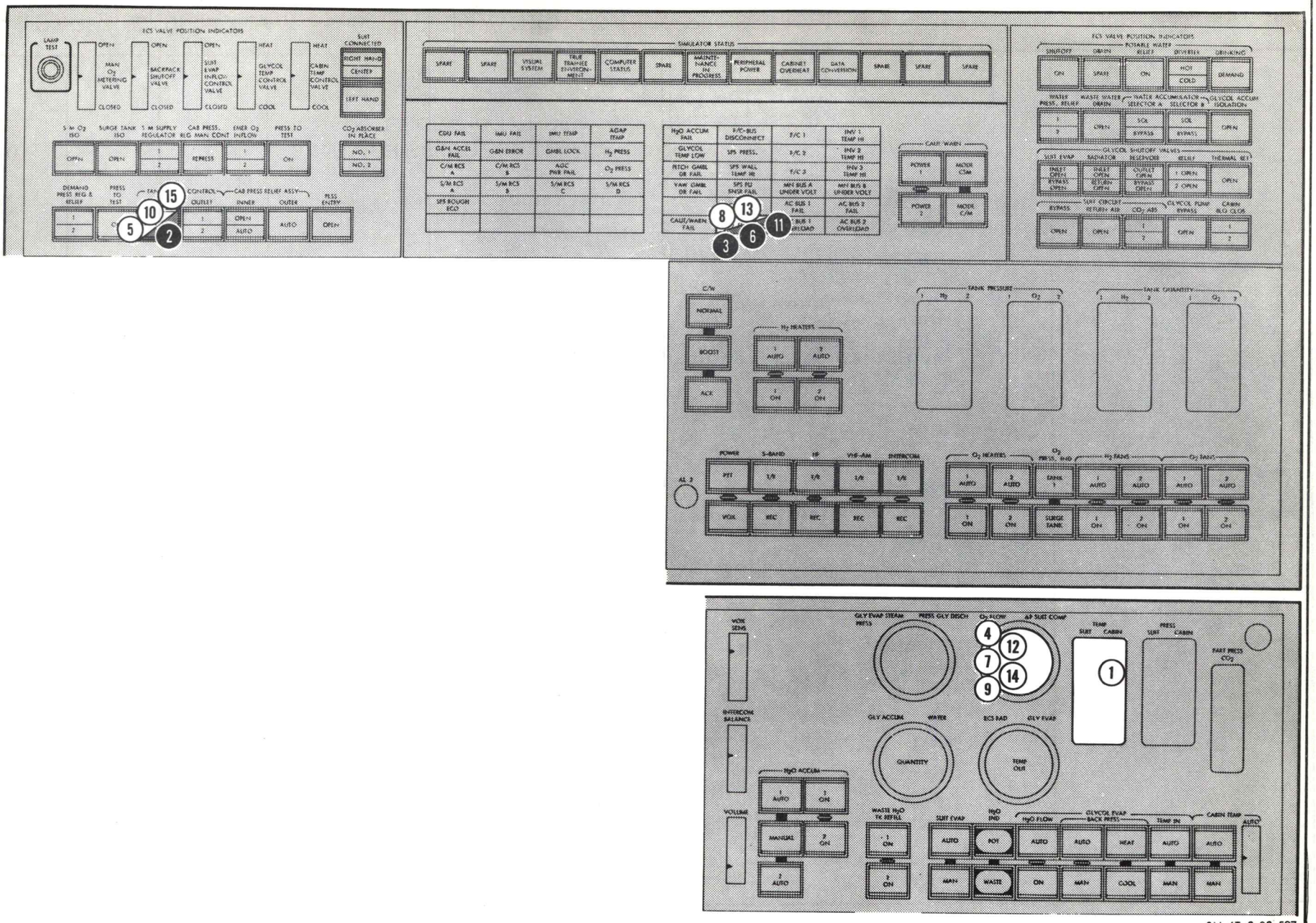


O_2 FLOW HI Light Illuminates, O_2 FLOW HIGH, CABIN PRESSURE HIGH

MEC. 02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-32			O_2 FLOW HI Light ON, FLOW O_2 IND Meter High, PRESS. CABIN Greater Than 5.2		
1			Check PRESS. CABIN ind - greater than 5.2	As programed	
2			TANK PRESSURE REGULATOR SELECTOR INLET valve - OFF	TANK PRESS. CONTROL INLET 1 and 2 lt out	
3			O_2 FLOW HI lt - out	As programed	
4			FLOW O_2 ind - normal	As programed	
5			TANK PRESSURE REGULATOR SELECTOR INLET valve - 1	TANK PRESS. CONTROL INLET - 1 lt on	
6			O_2 FLOW HI lt - out	Number 2 regulator out	
7			FLOW O_2 ind - normal	As programed	
8			O_2 FLOW HI lt - on	Continue check	
9			FLOW O_2 ind - normal		
10			TANK PRESSURE REGULATOR SELECTOR INLET valve - 2	TANK PRESS. CONTROL INLET - 2 lt on	



SM-6T-2-02-597

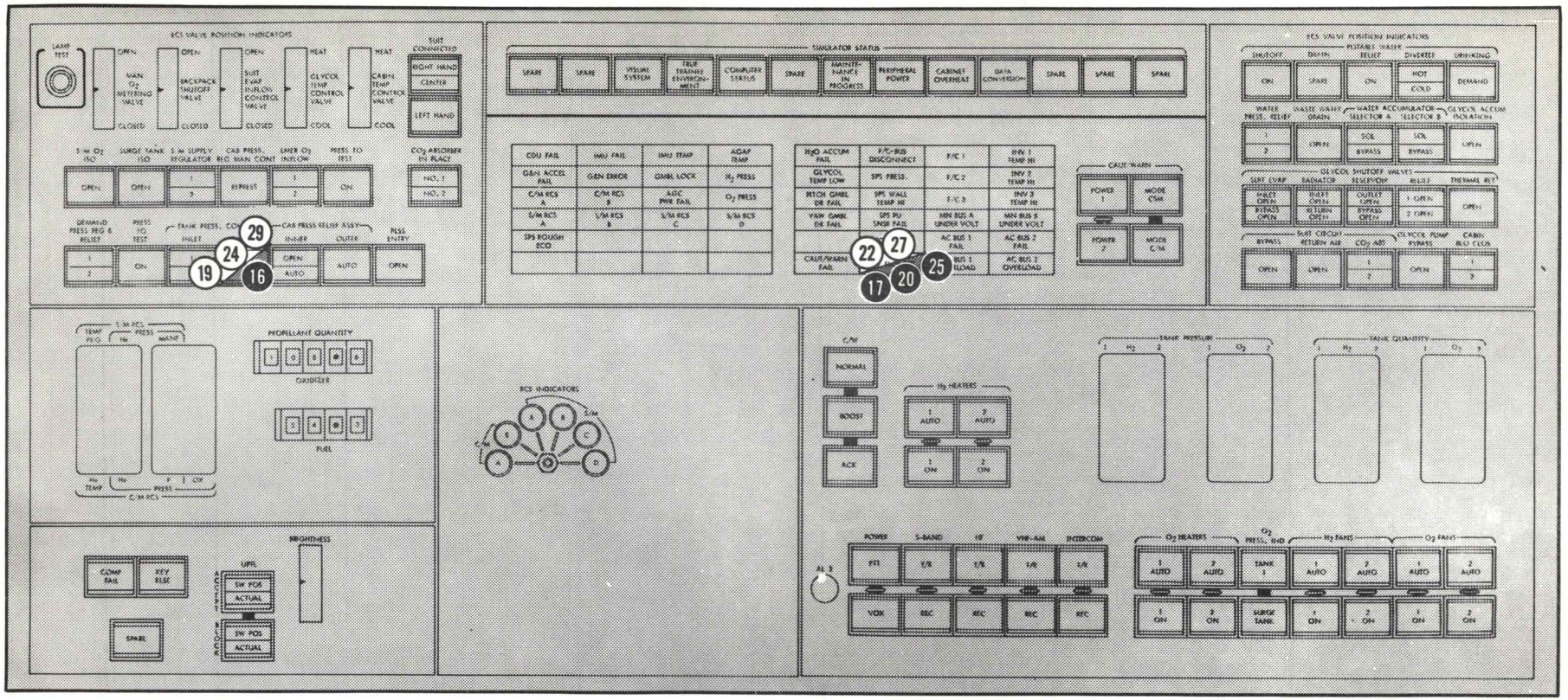
O_2 FLOW HI Light Illuminates, O_2 FLOW HIGH, CABIN PRESSURE HIGH

MEC. 02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
11			O_2 FLOW HI lt out	Number 1 regulator out	
12			FLOW O_2 ind - normal	As programed	
13			O_2 FLOW HI lt - remains on		
14			FLOW O_2 ind - remains high		
15			TANK PRESSURE REGULATOR SELECTOR INLET valve - 1 and 2	TANK PRESS. CONTROL INLET - 1 and 2 lt on	

O_2 FLOW HI Light Illuminates, O_2 FLOW HIGH, CABIN PRESSURE HIGH



SM-6T-2-02-598

O_2 FLOW HI Light Illuminates, O_2 FLOW HIGH, CABIN PRESSURE HIGH

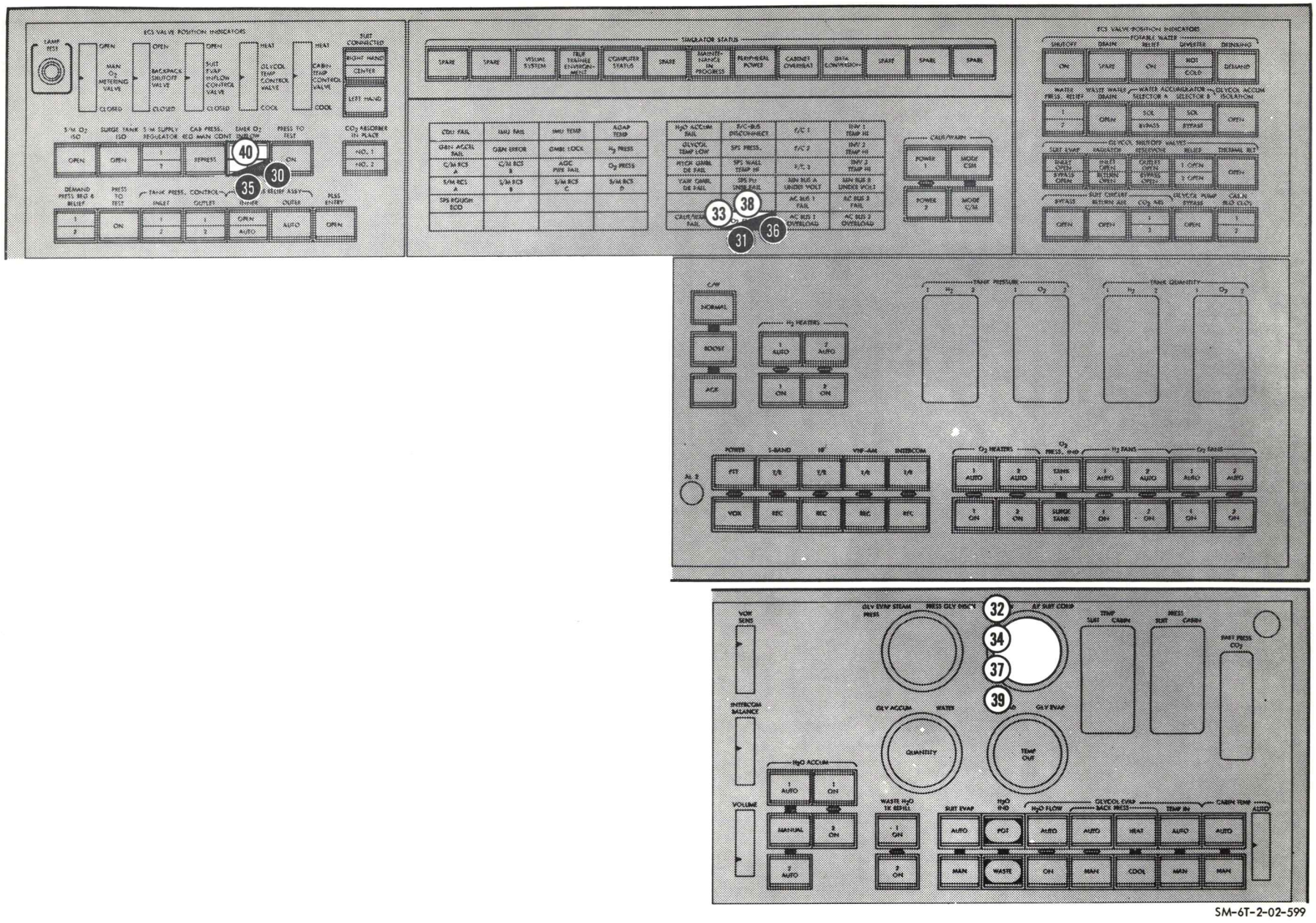
MEC. 02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
16			TANK PRESSURE REGULATOR SELECTOR OUTLET valve - OFF	TANK PRESS. CONTROL OUTLET - 1 and 2 lt out	
17			O_2 FLOW HI lt - out	As programed	
18			FLOW O_2 ind - normal	As programed	
19			TANK PRESSURE REGULATOR SELECTOR OUTLET valve - 1	TANK PRESS. CONTROL OUTLET - 1 lt on	
20			O_2 FLOW HI lt - out	Number 2 regulator out	
21			FLOW O_2 ind - normal	As programed	
22			O_2 FLOW HI lt - on	Continue check	
23			FLOW O_2 ind - high		
24			TANK PRESSURE REGULATOR SELECTOR OUTLET valve - 2	TANK PRESS. CONTROL OUTLET - 2 lt on	
25			O_2 FLOW HI lt - out	Number 1 regulator out	
26			FLOW O_2 ind - normal	As programed	
27			O_2 FLOW HI lt - remains on	Continue check	
28			FLOW O_2 ind - remains high		
29			TANK PRESSURE REGULATOR SELECTOR OUTLET valve - 1 and 2	TANK PRESS. CONTROL OUTLET - 1 and 2 lt on	

O_2 FLOW HI Light Illuminates, O2 FLOW HIGH, CABIN PRESSURE HIGH

MEC. 02



SM-6T-2-02-599

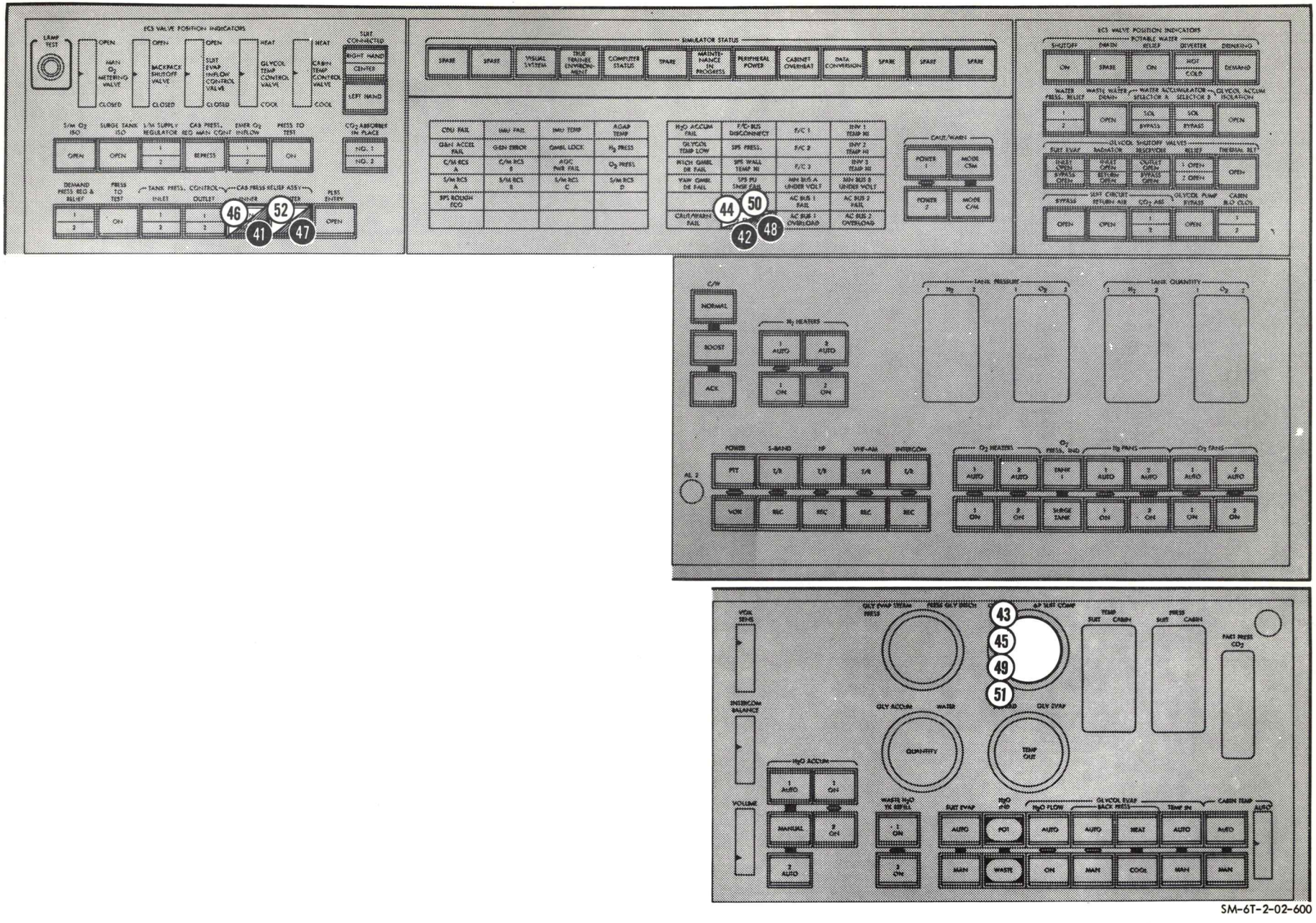
O_2 FLOW HI Light Illuminates, O_2 FLOW HIGH, CABIN PRESSURE HIGH MEC. 02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
30-40			Shirt sleeve Environment Only		
30			EMERGENCY INFLOW REGULATOR valve - 1	EMER O_2 INFLOW - 2 lt out	
31			O_2 FLOW HI lt - out	Number 2 regulator out	
32			FLOW O_2 ind - normal	As programed	
33			O_2 FLOW HI lt - remains on	Continue check	
34			FLOW O_2 ind - remains high	As programed	
35			EMERGENCY INFLOW REGULATOR valve - 2	EMER O_2 INFLOW - 1 lt out	
36			O_2 FLOW HI lt - out	Number 1 regulator out	
37			FLOW O_2 ind - normal	As programed	
38			O_2 FLOW HI lt - remains on	Continue check	
39			FLOW O_2 ind - remains high		
40			EMERGENCY INFLOW REGULATOR valve - 1 and 2	EMER O_2 INFLOW - 1 and 2 lt on	

O_2 FLOW HI Light Illuminates, O_2 FLOW HIGH, CABIN PRESSURE HIGH

MEC. 02



SM-6T-2-02-600

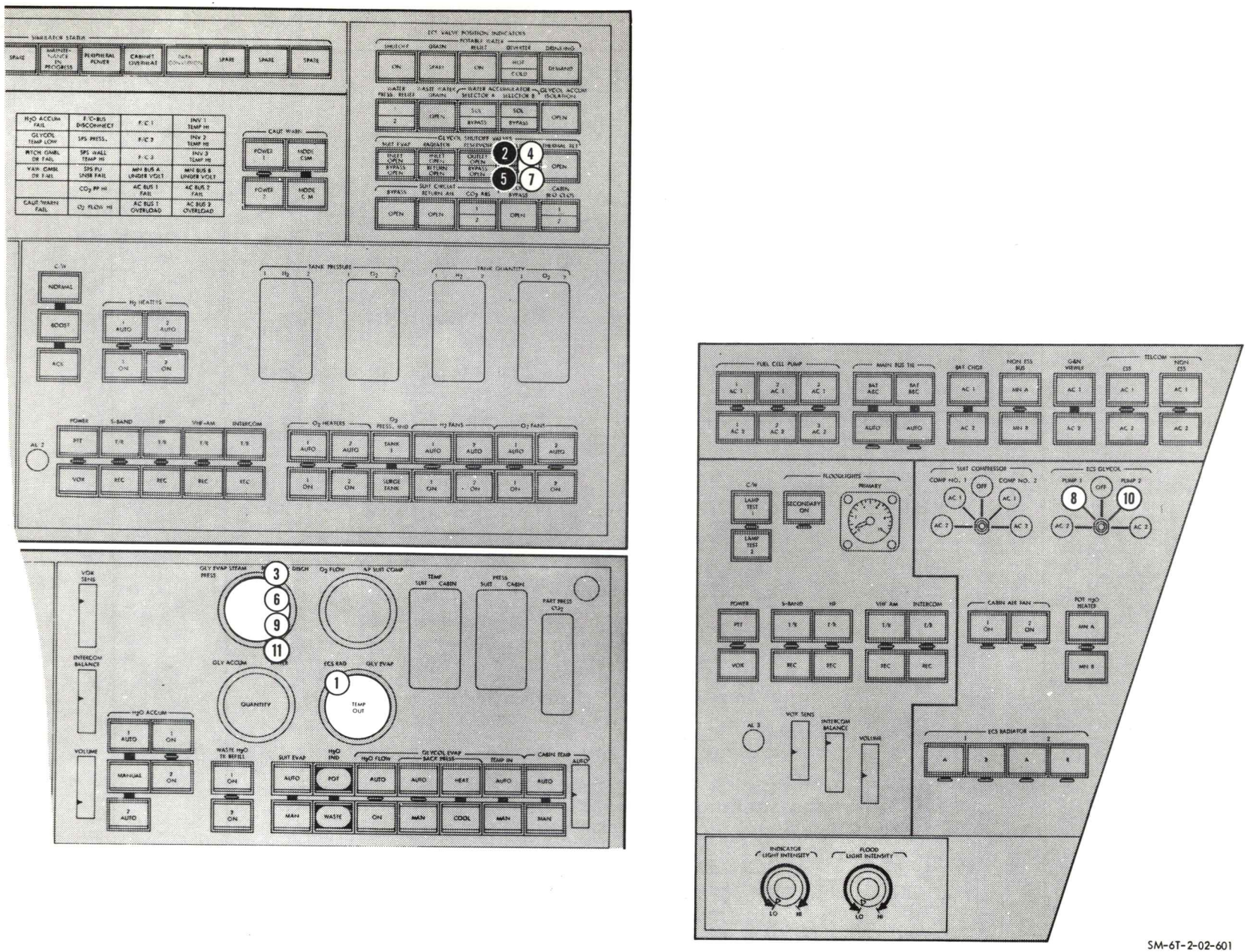
O_2 FLOW HI Light Illuminates, O_2 FLOW HIGH, CABIN PRESSURE HIGH

MEC. 02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
41			Upper CABIN PRESSURE RELIEF valve - CLOSE	CABIN PRESS. RELIEF ASSY INNER - AUTO lt out	
42			O_2 FLOW HI lt - out	Redundant regulator out	
43			FLOW O_2 ind - normal	As programed	
44			O_2 FLOW HI lt remains on	Continue check	
45			FLOW O_2 ind - remains high		
46			Upper CABIN PRESSURE RELIEF valve - AUTO	CABIN PRESS. RELIEF ASSY INNER - AUTO lt on	
47			Lower CABIN PRESSURE RELIEF valve - CLOSE	CABIN PRESS. RELIEF ASSY OUTER - AUTO lt out	
48			O_2 FLOW HI lt - out	Redundant regulator out	
49			FLOW O_2 ind - normal	As programed	
50			O_2 FLOW HI lt - remains on	Continue check	
51			FLOW O_2 ind - remains high	As programed	
52			Lower CABIN PRESSURE RELIEF valve - AUTO	CABIN PRESS. RELIEF ASSY OUTER - AUTO lt on	

O_2 FLOW HI Light Illuminates, O_2 FLOW HIGH, CABIN PRESSURE HIGH



SM-6T-2-02-601

Glycol Discharge Pressure Abnormal

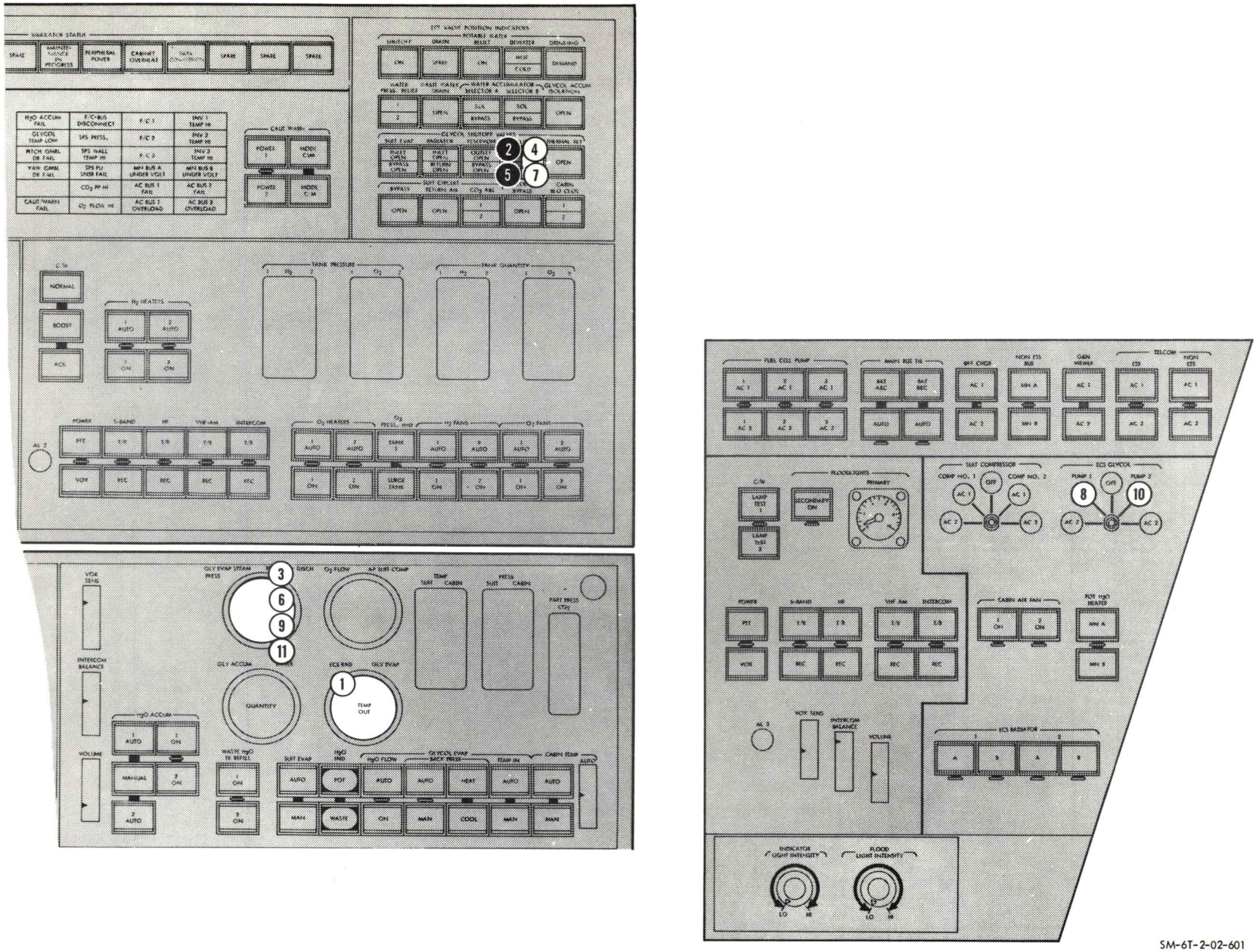
MEC. 03

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Glycol Discharge Pressure Indicates Abnormal		
1			Check PRESS GLY DISCH ind	Normal 12-40%	
			Quantity normal	Verifies no water-glycol leak	
			Quantity low, below 30	Indicates leak or relief valve failure	
2			GLYCOL PRESSURE RELIEF BYPASS 1 valve - OFF	GLYCOL SHUTOFF VALVES RELIEF - 1 OPEN lt out	
3			Check PRESS GLY DISCH ind	As programed	
			Pressure normal	No. 1 pressure relief valve out	
			Pressure low	Continue check	
4			GLYCOL PRESSURE RELIEF BYPASS 1 valve - ON	GLYCOL SHUTOFF VALVES RELIEF - 1 OPEN lt on	
5			GLYCOL PRESSURE RELIEF BYPASS 2 valve - OFF	GLYCOL SHUTOFF VALVES RELIEF - 2 OPEN lt out	
6			Check PRESS GLY DISCH ind	As programed	
			Pressure normal	No. 2 pressure relief valve out	
			Pressure low	Continue check	

Glycol Discharge Pressure Abnormal

MEC. 03



SM-6T-2-02-601

Glycol Discharge Pressure Abnormal

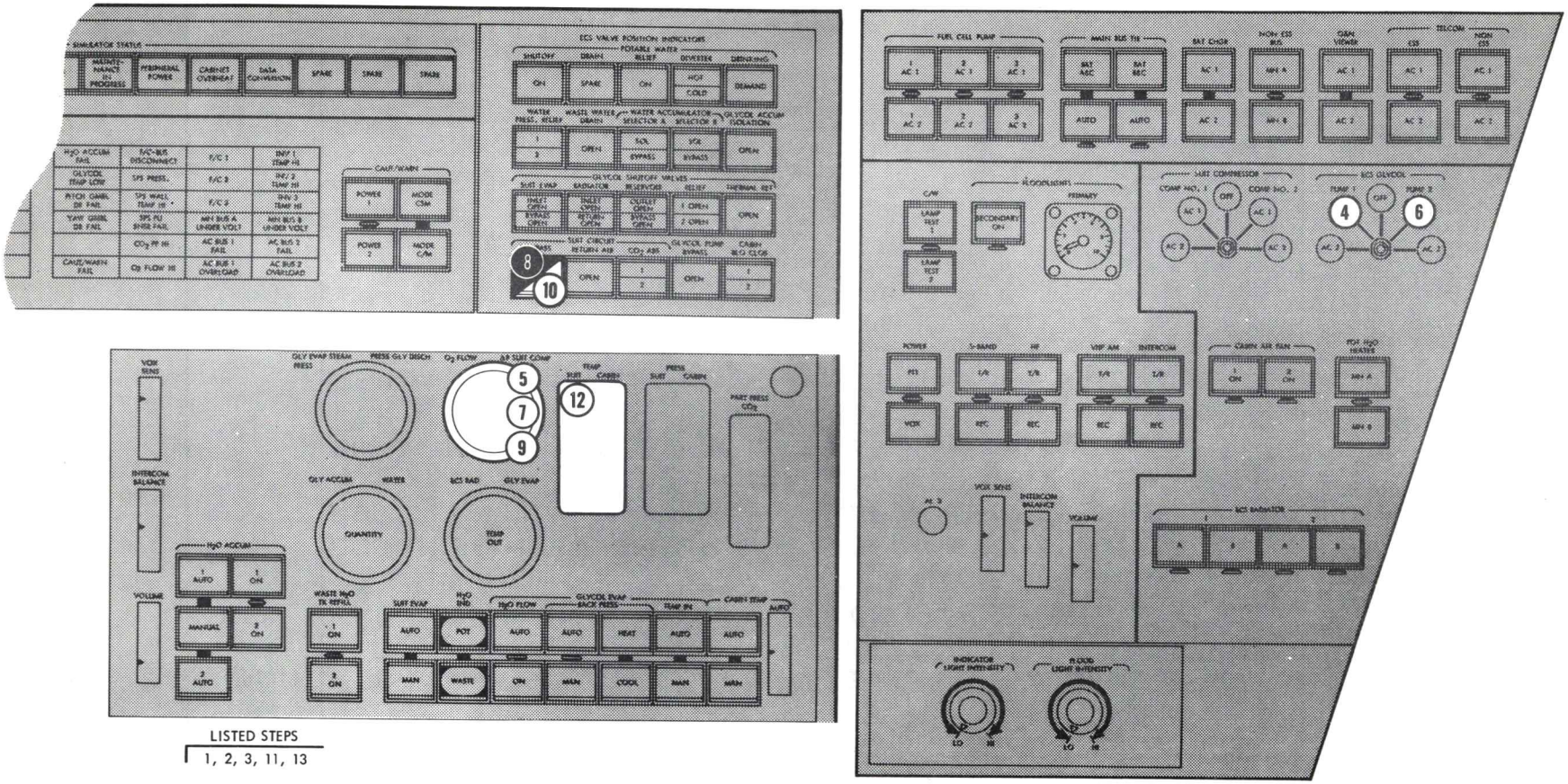
MEC. 03

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
7			GLYCOL PRESSURE RELIEF BYPASS 2 valve - ON	GLYCOL SHUTOFF VALVES RELIEF - 2 OPEN lt on	
8			ECS GLYCOL sw - PUMP 1 alternate bus	ECS GLYCOL - PUMP 1 - AC 1 (or 2) lt on	
9			Check PRESS GLY DISCH ind	As programed	
			Pressure normal	Indicates power malfunction	
			Pressure low	Continue check	
10			ECS GLYCOL sw - PUMP 2 BUS 1	ECS GLYCOL PUMP 2 - AC 1 lt on	
11			Check PRESS GLY DISCH ind	As programed	
			Pressure normal	Coolant pump No. 1 out	

Glycol Discharge Pressure Abnormal

MEC. 03



LISTED STEPS
1, 2, 3, 11, 13

SM-6T-2-02-606

Suit Compressor Delta P Indicates Below Normal

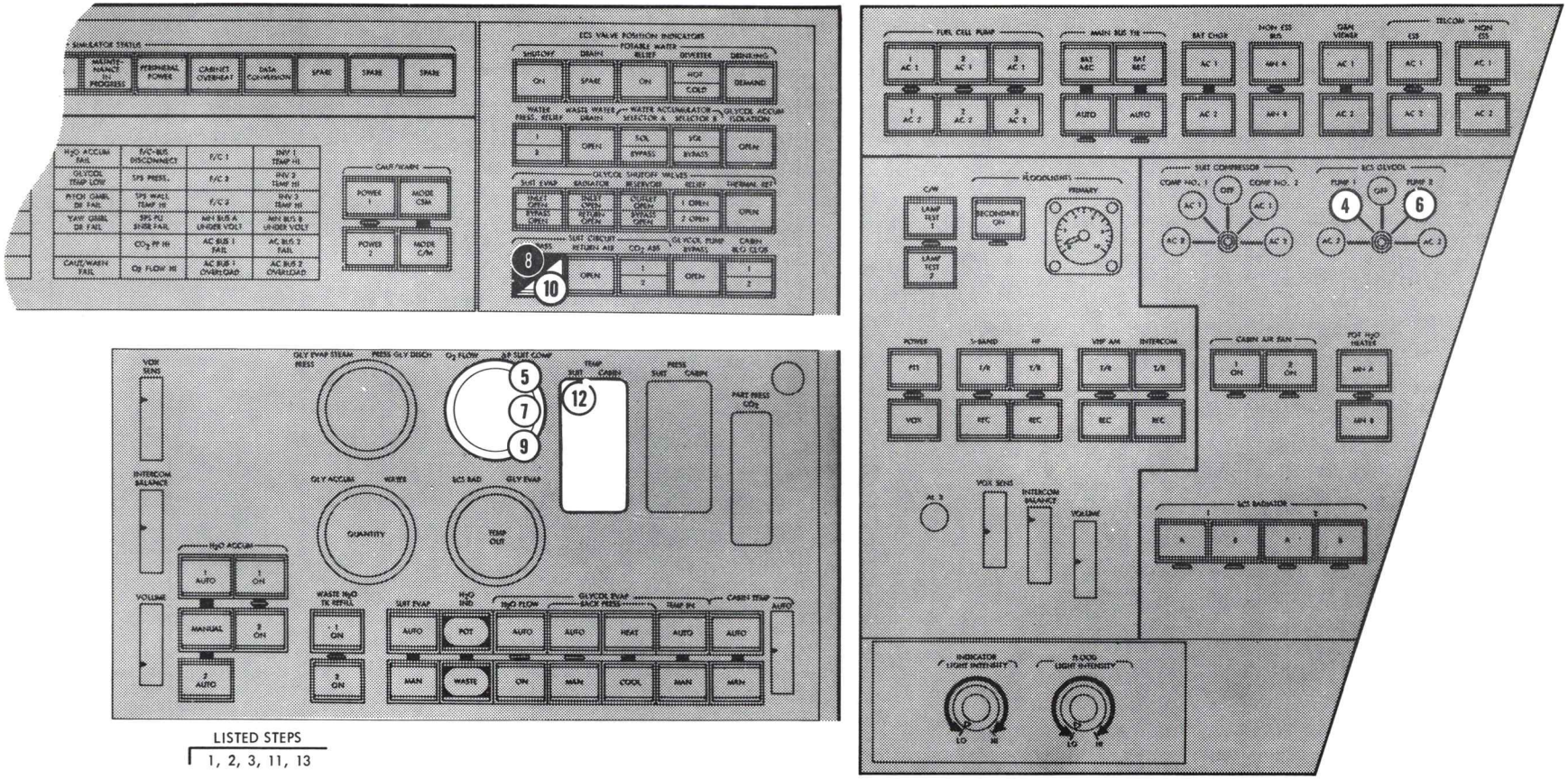
MEC. 04

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			ΔP COMPR Indicates Less Than .35		
*1			Verify abnormal condition with suited crewman	Monitor intercom	
*2			Abnormal condition denied, verify with MSFN	Provide appropriate communication	
*3			Abnormal condition affirmed	Continue check	
4			SUIT COMPRESSOR sw - COMP 1 Alternate bus	SUIT COMPRESSOR COMP NO. 1 - AC 1 (or 2) lt on	
5			Check ΔP SUIT COMPR ind	As programed	
			Pressure normal	Indicates power failure	
			Pressure abnormal	Continue check	
6			SUIT COMPRESSOR sw - COMP 2 BUS 1	SUIT COMPRESSOR COMP NO. 2 - AC 1 lt on	
7			Check ΔP SUIT COMPR ind	As programed	
			Pressure normal	COMP NO. 1 out	
			Pressure abnormal	Continue check	
8			SUIT FLOW RELIEF valve - OFF	SUIT CIRCUIT BYPASS - OPEN lt out	

Suit Compressor Delta P Indicates Below Normal

MEC. 04



LISTED STEPS
1, 2, 3, 11, 13

SM-6T-2-02-606

Suit Compressor Delta P Indicates Below Normal

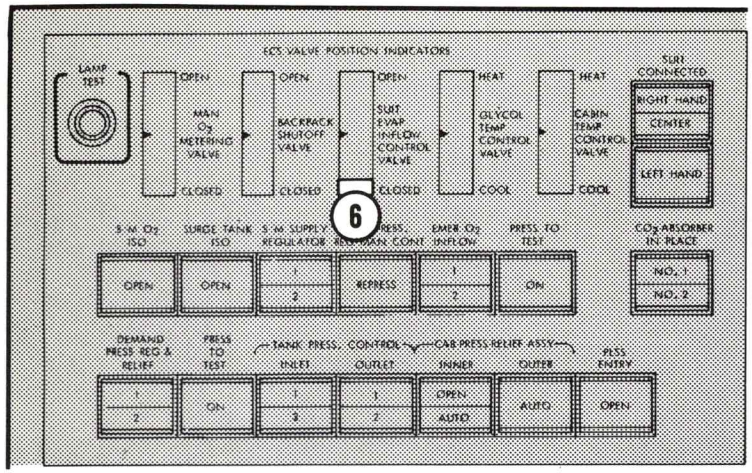
MEC. 04

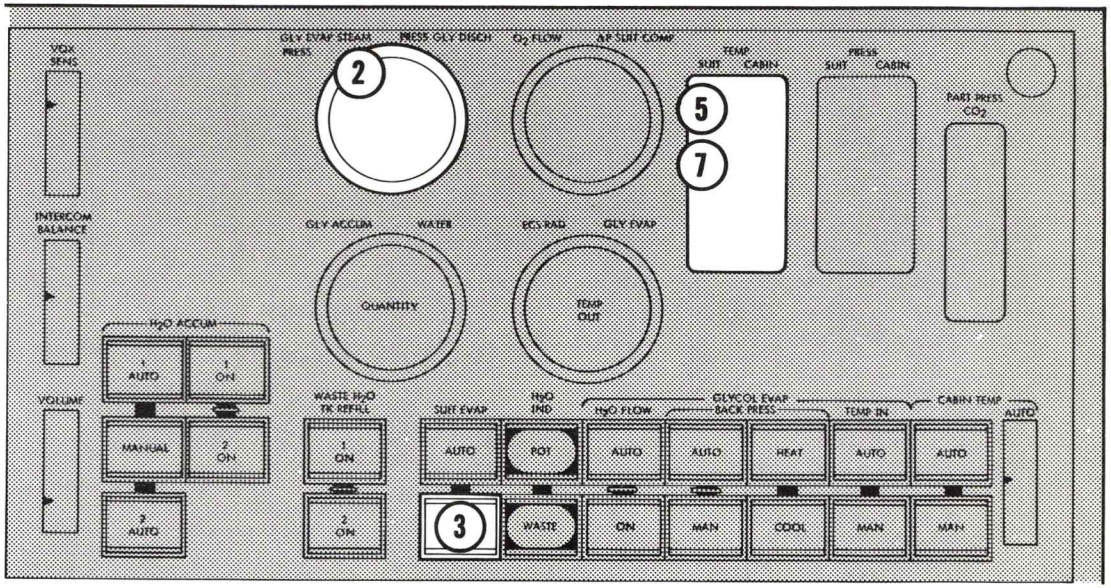
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
9			Check ΔP SUIT COMPR ind	As programed	
			Pressure normal	Suit flow relief valve out	
			Pressure abnormal	Continue check	
10			SUIT FLOW RELIEF valve - AUTO	SUIT CIRCUIT BYPASS - OPEN lt on	
*11			Demand pressure regulator SUIT TEST control - PRESS		Not provided on AMS.
12			Check PRESS SUIT ind	As programed	
			Slight or no increase	Verifies suit circuit-to-cabin leak	
			4.25 increase above normal	Verifies no suit or suit circuit leakage	
*13			Demand pressure regulator SUIT TEST control - DEPRESS, OFF in 75 sec		Not provided on AMS.

Suit Compressor Delta P Indicates Below Normal

MEC. 04





SM-6T-2-02-602

LISTED STEPS

1,4,8

Suit Temperature Indicates Low

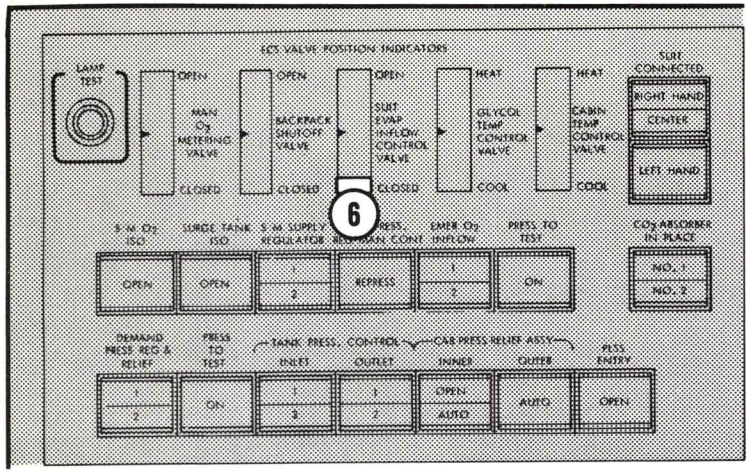
MEC.05

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Suit Temp Indicates Below 45		
*1			Verify temperature in suits is low	Monitor intercom	
			Temperature in suits is normal, verify with MSFN	Provide appropriate communication	
			Temperature in suits is low	Continue check	
2			Check GLY EVAP TEMP OUT ind	As programed	
			Temperature below 42	Water glycol temp control component out	
			Temperature normal	Continue check	
3			SUIT EVAP sw (MDC) - MAN	SUIT EVAP - MAN lt on	
*4			SUIT EVAP sw (LHEB) - EVAP ONLY	Not provided on AMS	
5			Check TEMP SUIT ind	As programed	
			Temperature increase	Verifies failure of suit temp cont circuit	
			Temperature remains low	Continue check	

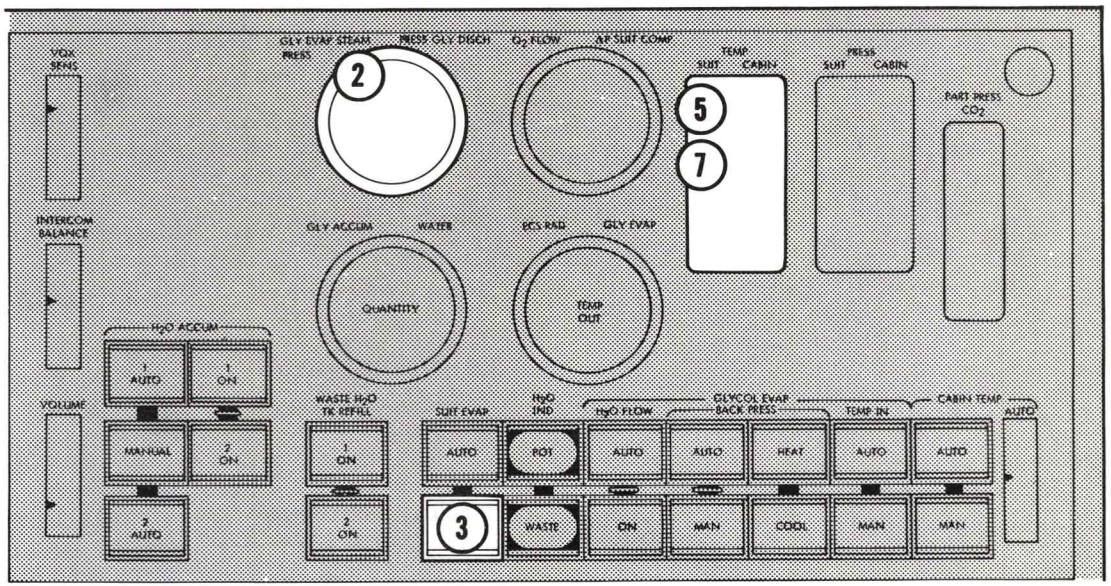
Suit Temperature Indicates Low

MEC. 05



LISTED STEPS

1,4,8



SM-6T-2-02-602

Suit Temperature Indicates Low

MEC.05

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
6			SUIT EVAP GLYCOL valve - ON	ECS VALVE POSITION INDICATOR, SUIT EVAP INFLOW CONTROL VALVE - CLOSED	
7			Check TEMP SUIT ind	As programed	
			Temperature increase	Verifies circuit manual control capability	
			Temperature remains low	Verifies water inlet control valve failure	
8			Set suit flow control valve for minimum	Observe TV monitor	

Suit Temperature Indicates Low

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Suit Temperature Indicates Above 45		
1			Verify temperature in suits is high		
			Temperature in suits normal, verify with MSFN	Provide appropriate communication	
			Temperature in suits high	Continue check	
2			Check ΔP COMPR ind	As programed	
			Indication abnormal	Continue with MEC. 04	
			Indication normal	Continue check	
3			SUIT EVAP sw (MDC) - AUTO	SUIT EVAP - AUTO lt on	
4			SUIT EVAP sw (LHEB) - EVAP ONLY		Not provided on AMS.
5			Check SUIT TEMP ind	As programed	
			Temperature increase	Indicates suit temp control failure	
			Indicates no change	Indicates inflow control valve failure	

Suit Temperature Indicates High

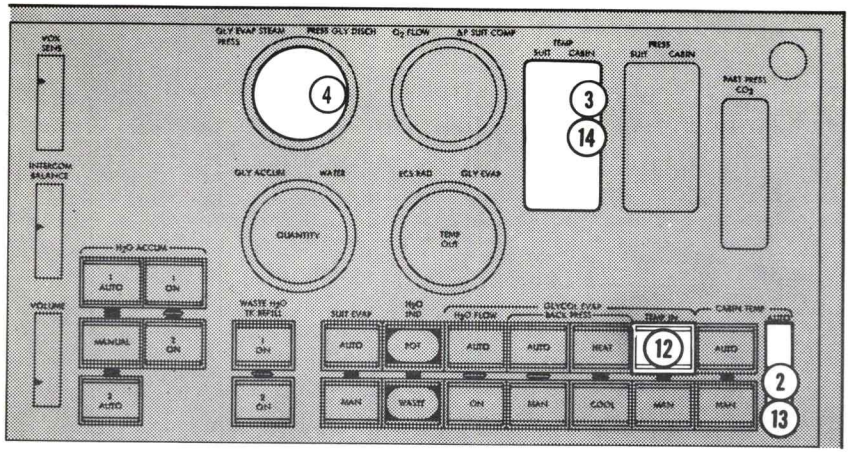
MEC. 06

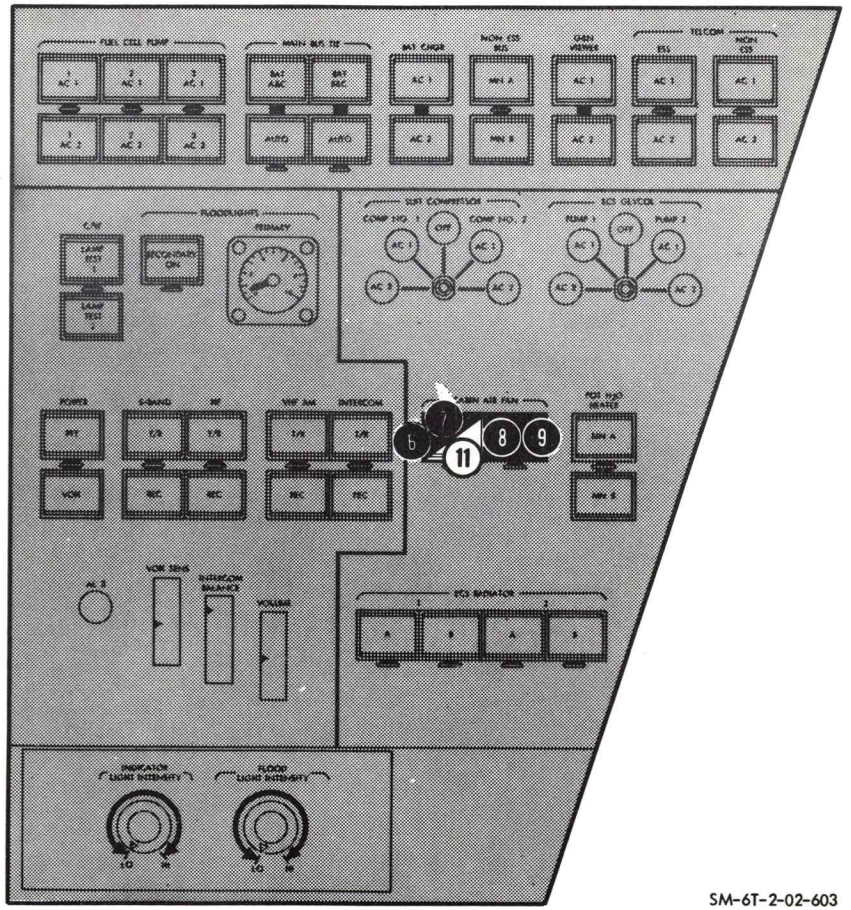
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
6			SUIT EVAP sw (LHEB) - WATER/GLY EVAP		Not provided on AMS.
7			SUIT EVAP GLYCOL valve - OFF		Not provided on AMS.
8			Check SUIT TEMP ind	As programed	
			Temperature decrease	Water-glycol diverter valve motor failure	
			Indicates no change	Continue check	
9			SUIT EVAP manual valve - MAN		Not provided on AMS.
10			Check SUIT TEMP ind		
			Temperature decreases	Verifies manual control capability.	
			Indicates no change	SUIT EVAP manual selector failure	
11			SUIT EVAP GLYCOL valve - ON		Not provided on AMS.
12			Set suit flow control valves(s) for max. flow, as required, to maintain comfort		

Suit Temperature Indicates High

MEC. 06





SM-6T-2-02-603

LISTED STEPS

1, 5, 10, 14

Cabin Temperature Indicates High

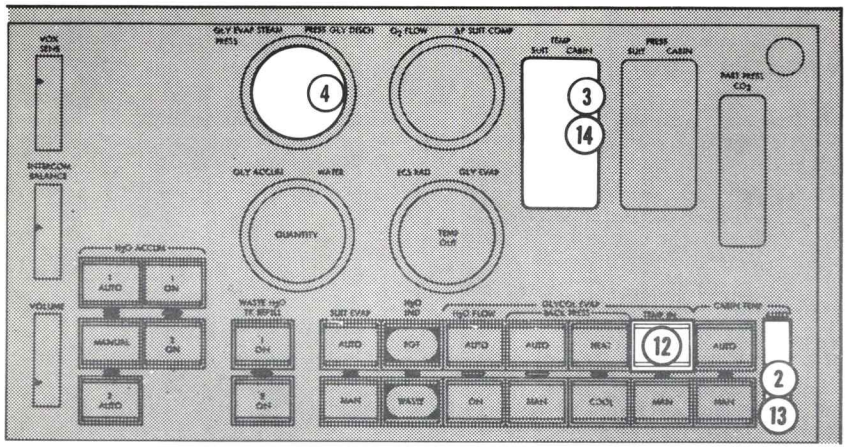
MEC.07

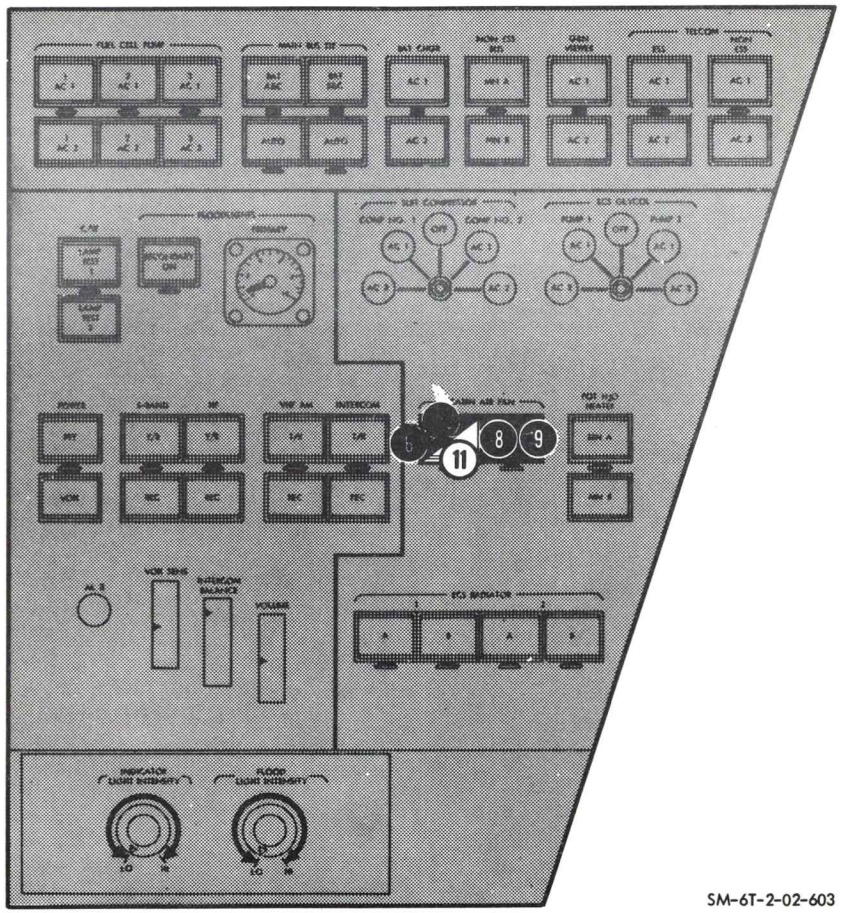
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Cabin Temp Indicates Above 80		
1			Verify temperature with unsuited crewman	Monitor intercom	
			Temperature normal, verify with MSFN	Provide appropriate communication	
			Temperature high	Continue check	
2			CABIN TEMP AUTO sel - decrease	CABIN TEMP AUTO ind - decrease	
3			Check TEMP CABIN ind	As programed	
			Temperature decrease	Adjustment corrected	
			Temperature remains high	Continue check	
4			Check PRESS GLY DISCH ind	As programed	
			Pressure less than 26	Continue with MEC. 03	
			Pressure normal	Continue check	
*5			Check cabin air fan operation	Observe TV monitor	
6-11			Cabin Air Fans Inoperative		
6-17			Both Fans Inoperative or Degraded	Cabin temp control out	

Cabin Temperature Indicates High

MEC. 07





SM-6T-2-02-603

LISTED STEPS

1, 5, 10, 14

Cabin Temperature Indicates High

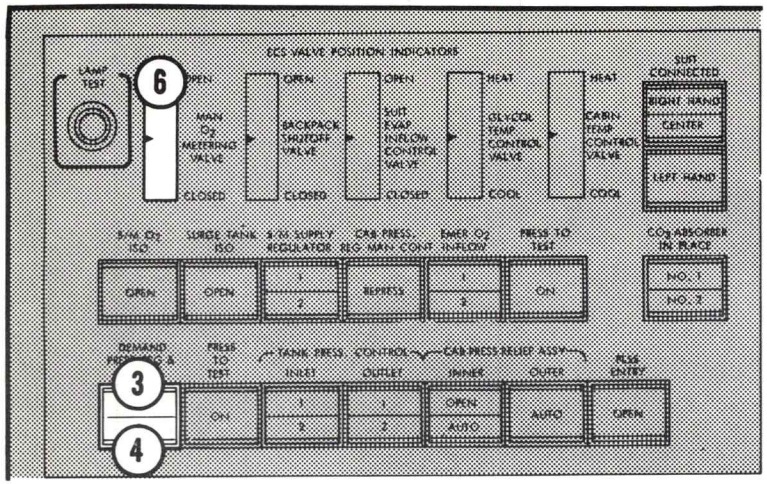
MEC. 07

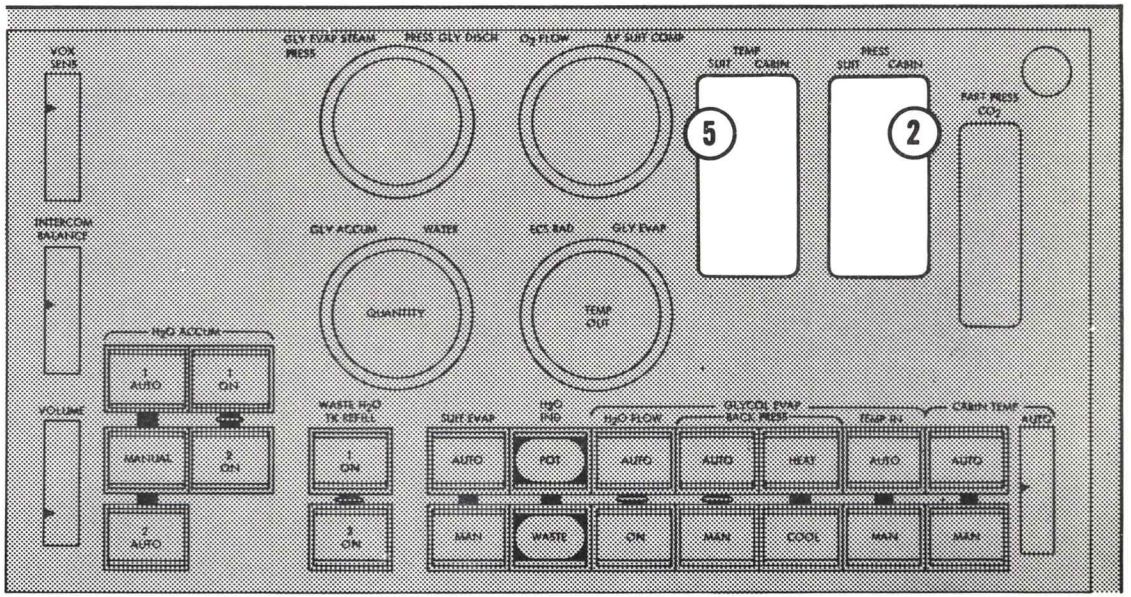
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
6			CABIN AIR FAN NO. 1 - OFF	CABIN AIR FAN 1 ON - lt out	
7			CABIN AIR FAN NO. 2 - OFF	CABIN AIR FAN 2 ON - lt out	
8-11			One Fan Inoperative or Degraded		
8			CABIN AIR FAN NO. 1 - OFF	CABIN AIR FAN 1 ON - lt out	
9			CABIN AIR FAN NO. 2 - OFF	CABIN AIR FAN 2 ON - lt out	
*10			Install closure cover over inlet of inoperative fan	Observe TV monitor	
11			Operative CABIN AIR FAN NO. 1 (or 2) sw - ON	CABIN AIR FAN 1 ON or 2 ON lt on	
12-14			Cabin Air Fans Operative		
12			CABIN TEMP sw - MAN	CABIN TEMP - MAN lt on	
13			CABIN TEMP manual control valve - C	CABIN TEMP CONTROL VALVE ind - COOL	
*14			Check TEMP CABIN ind	As programed	

Cabin Temperature Indicates High

MEC. 07





SM-6T-2-02-604

LISTED STEPS

1

Suit Pressure Indicates Low

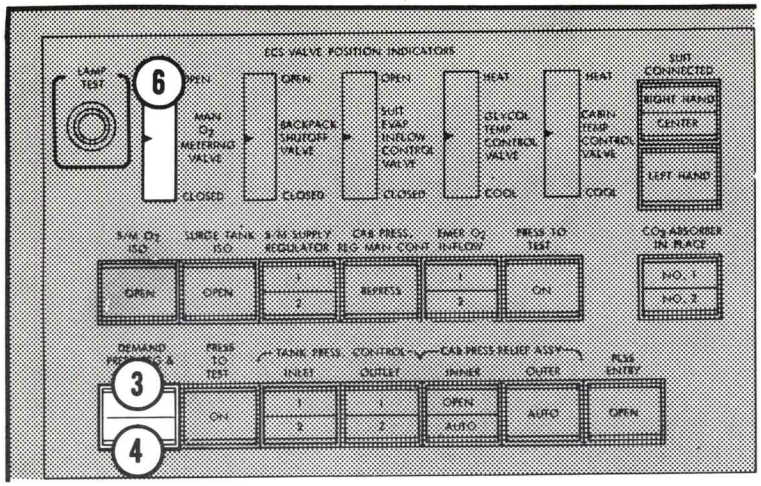
MEC. 08

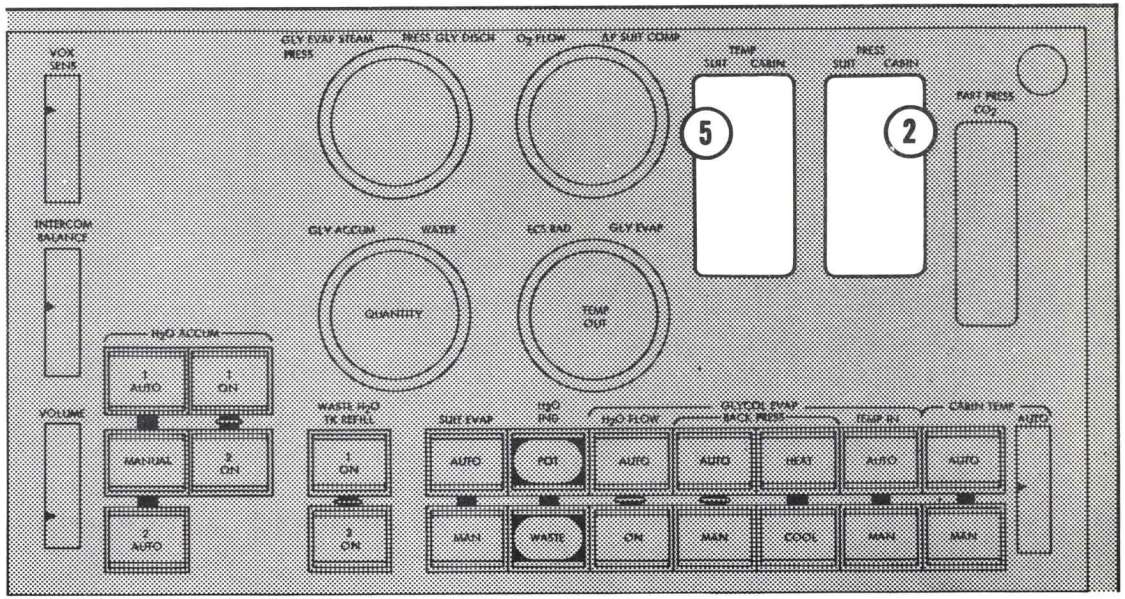
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Suit Pressure Indicates Less Than 4.7		
*1			Verify indication with suited crewman	Monitor intercom	
			Pressure normal, confirm with MSFN	Provide appropriate communication	
			Pressure low	Continue check	
2			Check PRESS. CABIN ind	As programed	
			Pressure low	Continue with MEC. 10	
			Pressure normal	Continue check	
3			Check position of suit demand pressure regulator control	DEMAND PRESS. REG & RELIEF - 1 and/or 2 lt on	
4			Select alternate position of regulator	DEMAND PRESS. REG & RELIEF - 2 (or 1) lt on	
5			Check PRESS. SUIT ind		
			Pressure normal	No. 1 (or 2) demand pressure regulator out	
			Pressure low	Both demand pressure regulators out	

Suit Pressure Indicates Low

MEC. 08





SM-6T-2-02-604

LISTED STEPS

1

Suit Pressure Indicates Low

MEC. 08

IOS DATA SHEET

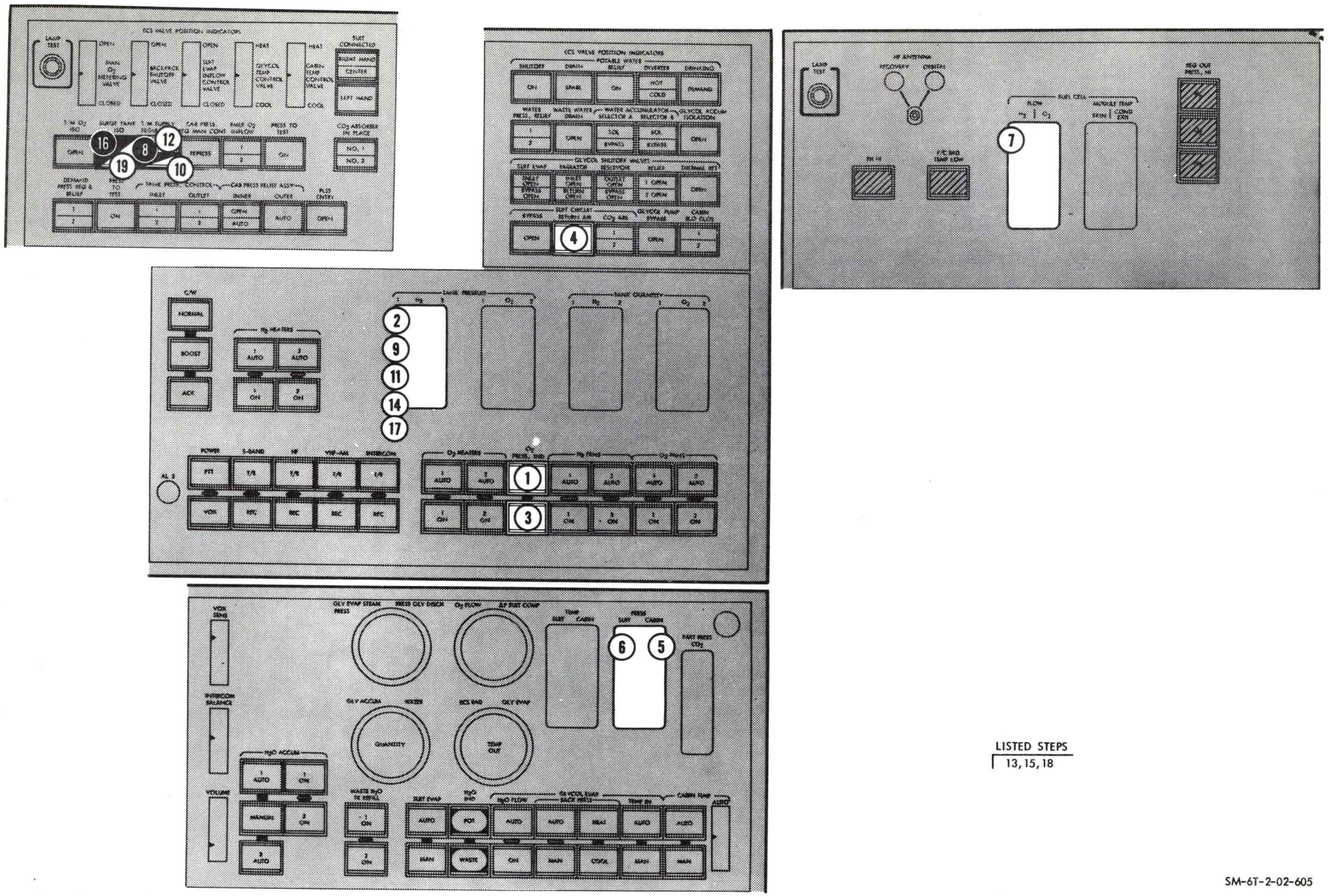
Step	Malf	Time	Function	IOS Visibility/Action	Notes
6			Meter suit pressure with DIRECT O_2 valve	Observe MAN O_2 METERING VALVE ind	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Suit Pressure Indicates Greater Than 5.3°		
1			Verify indication with suited crewman	Monitor intercom	
			Pressure normal, confirm with MSFN	Provide appropriate communication	
			Pressure high	Continue check	
2			Check PRESS CABIN ind	As programed	
			Pressure high	Continue with MEC.10	
			Pressure normal	Continue check	
3			Suit demand pressure regulator - 1 REG	DEMAND PRESS. REG & RELIEF - 1 lt on	
4			Check PRESS CABIN ind	As programed	
			Pressure normal	No. 2 regulator out	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Cabin Pressure Above 5.2, Suit Circuit Return Air Manual Valve Open		
1			Verify indication with suited crewman	Monitor intercom	
			Pressure normal, verify with MSFN	Provide appropriate communication	
			Pressure high	Continue check	
2			Check FLOW O_2 ind	As programed	
			Flow greater than 5.2	Continue with MEC.02	
			Flow normal	Continue with MEC.02 and MEC.04	



LISTED STEPS
13, 15, 18

SM-6T-2-02-605

Tank Pressure 1 O_2 Low

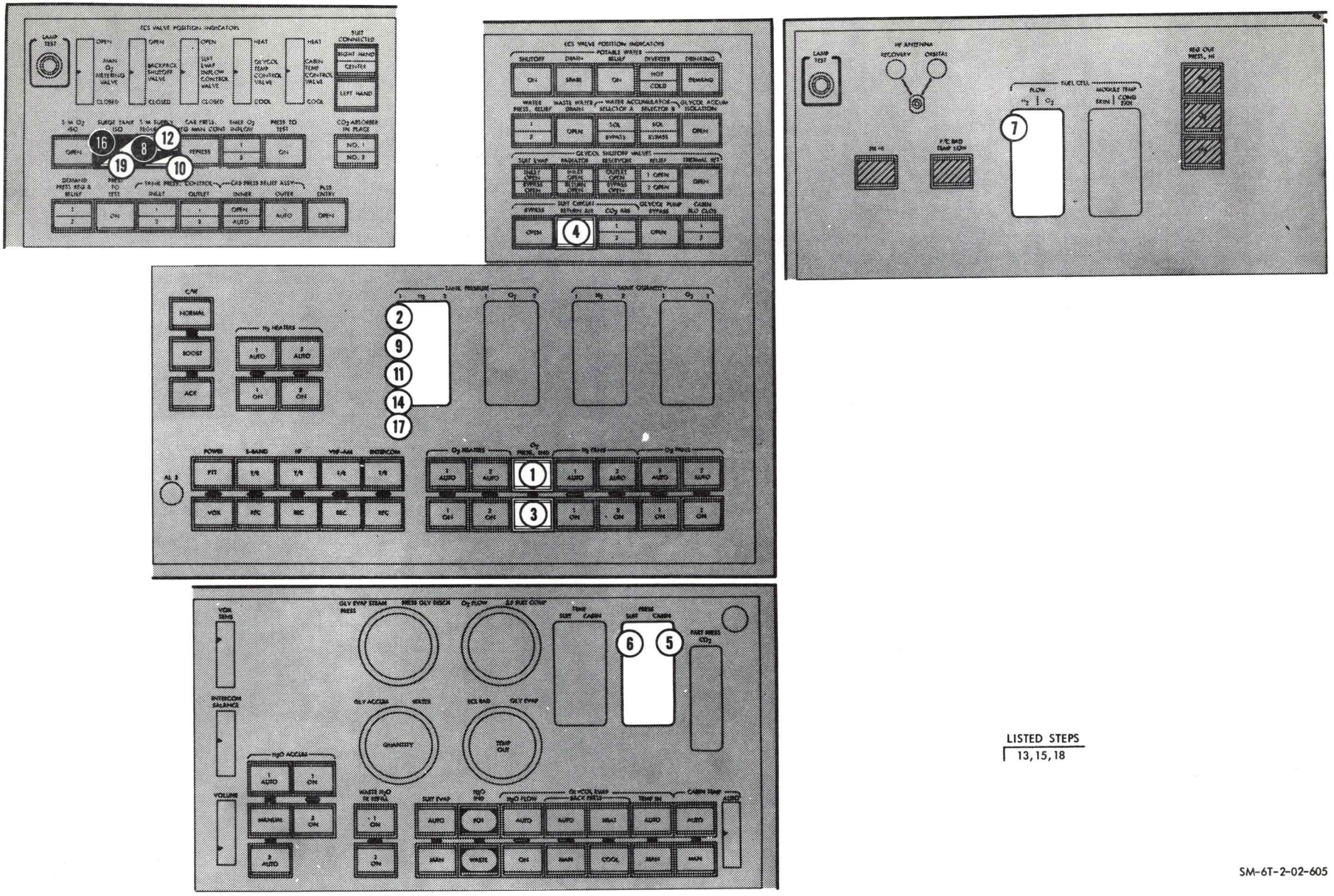
MEC. 11

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			TANK PRESSURE 1 O_2 indicates below 875, O_2 PRESS ind sw - SURGE TANK		
1			O_2 PRESS IND sw - TANK 1	PRESS IND - TANK 1 lt on	
2			Check TANK PRESS 1 O_2 ind	Normal 875 - 925	
			Pressure low	Continue with MEP.04	
			Pressure normal	Continue check	
3			O_2 PRESS IND sw - SURGE TANK	PRESS IND - SURGE TANK lt on	
4			Check suit circuit return air valve - OPEN	SUIT CIRCUIT RETURN AIR - OPEN lt on	
5			Check PRESS CABIN ind	Normal 4.8 - 5.2	
6			Check PRESS SUIT ind	Normal 4.7 - 5.3	
			Indicates no change, confirm with MSFN	Provide appropriate communication	
			Indicates increase	Continue check	
7			Check FLOW O_2 ind	Normal .2 - .45	
			Flow high	Continue with MEC.02	
			Flow normal	Continue check	

Tank Pressure 1 O_2 Low

MEC.11



LISTED STEPS
13, 15, 18

SM-6T-2-02-605

Tank Pressure 1 O_2 Low

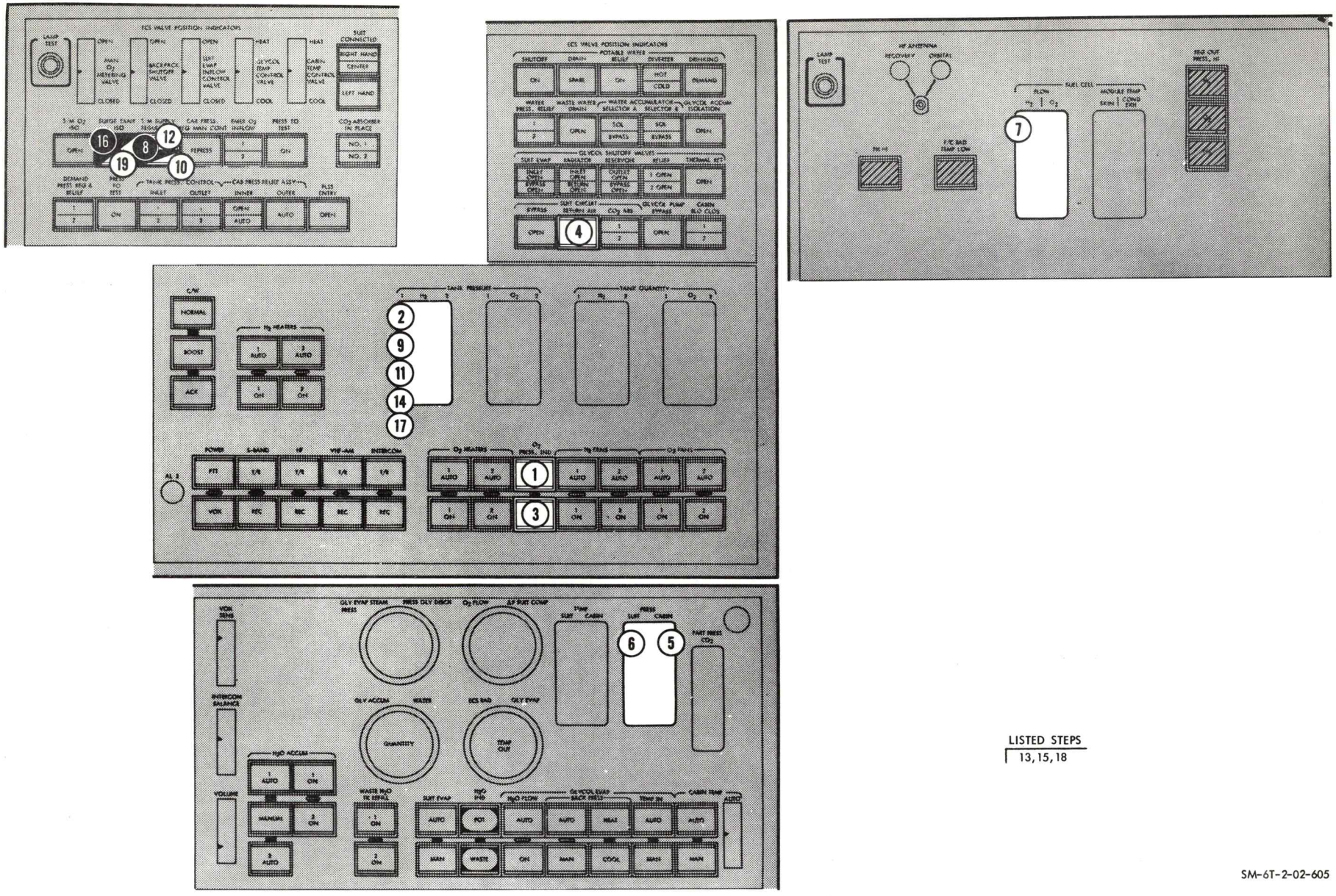
MEC. 11

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
8			S/M SUPPLY REGULATOR valve - 1	S/M SUPPLY REGULATOR - 2 lt out	
9			Check TANK PRESSURE 1 O_2 ind	As programed	
			Pressure increase	No. 2 S/M supply regulator failed	
			Indicates no change	Continue check	
10			S/M SUPPLY REGULATOR valve - 2	S/M SUPPLY REGULATOR - 2 lt on	
11			Check TANK PRESSURE 1 O_2 ind	As programed	
			Pressure increase	No. 1 S/M supply regulator failed	
			Indicates no change	Continue check	
12			S/M SUPPLY REGULATOR valve - 1 and 2	S/M SUPPLY REGULATOR - 1 and 2 lt on	
*13			SURGE TANK PRESSURE RELIEF valve - OFF		Not provided on AMS.
14			Check TANK PRESSURE 1 O_2 ind	As programed	

Tank Pressure 1 O_2 Low

MEC. 11



LISTED STEPS
13, 15, 18

SM-6T-2-02-605

Tank Pressure 1 O_2 Low

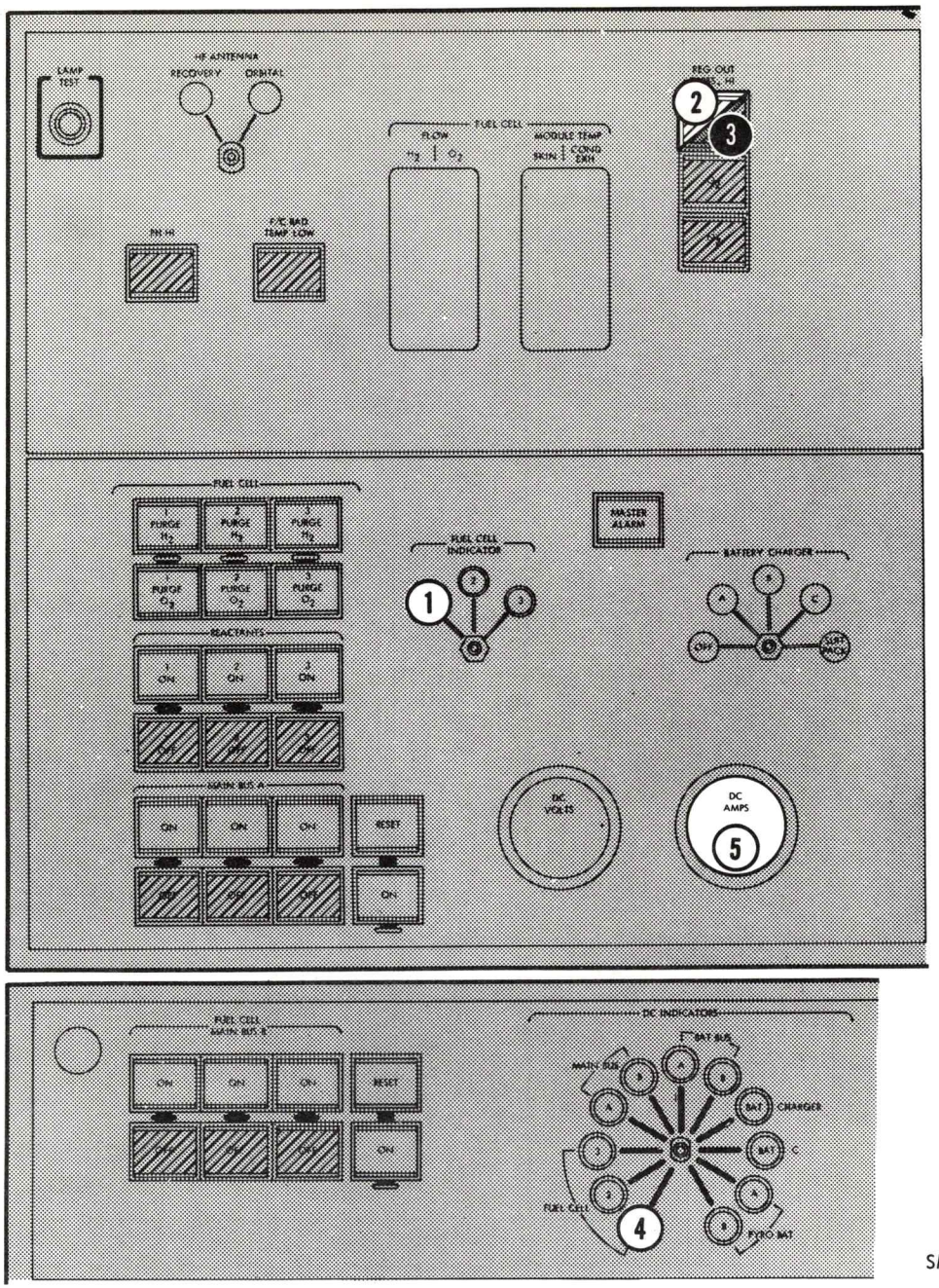
MEC. 11

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Pressure increase	Surge tank pressure relief valve failure	
			Indicates no change	Continue check	
*15			SURGE TANK PRESSURE RELIEF valve - ON		Not provided on AMS.
16			OXYGEN SURGE TANK valve - OFF	SURGE TANK ISO - lt out	
17			Check TANK PRESSURE 1 O_2 ind	As programed	
			Pressure decreasing	Surge tank leak	
*18			Pressure steady	Leak upstream of flow sensor	
19			OXYGEN SURGE TANK valve - ON	SURGE TANK ISO - OPEN lt on	

Tank Pressure 1 O_2 Low

MEC. 11



SM-6T-2-02-432A

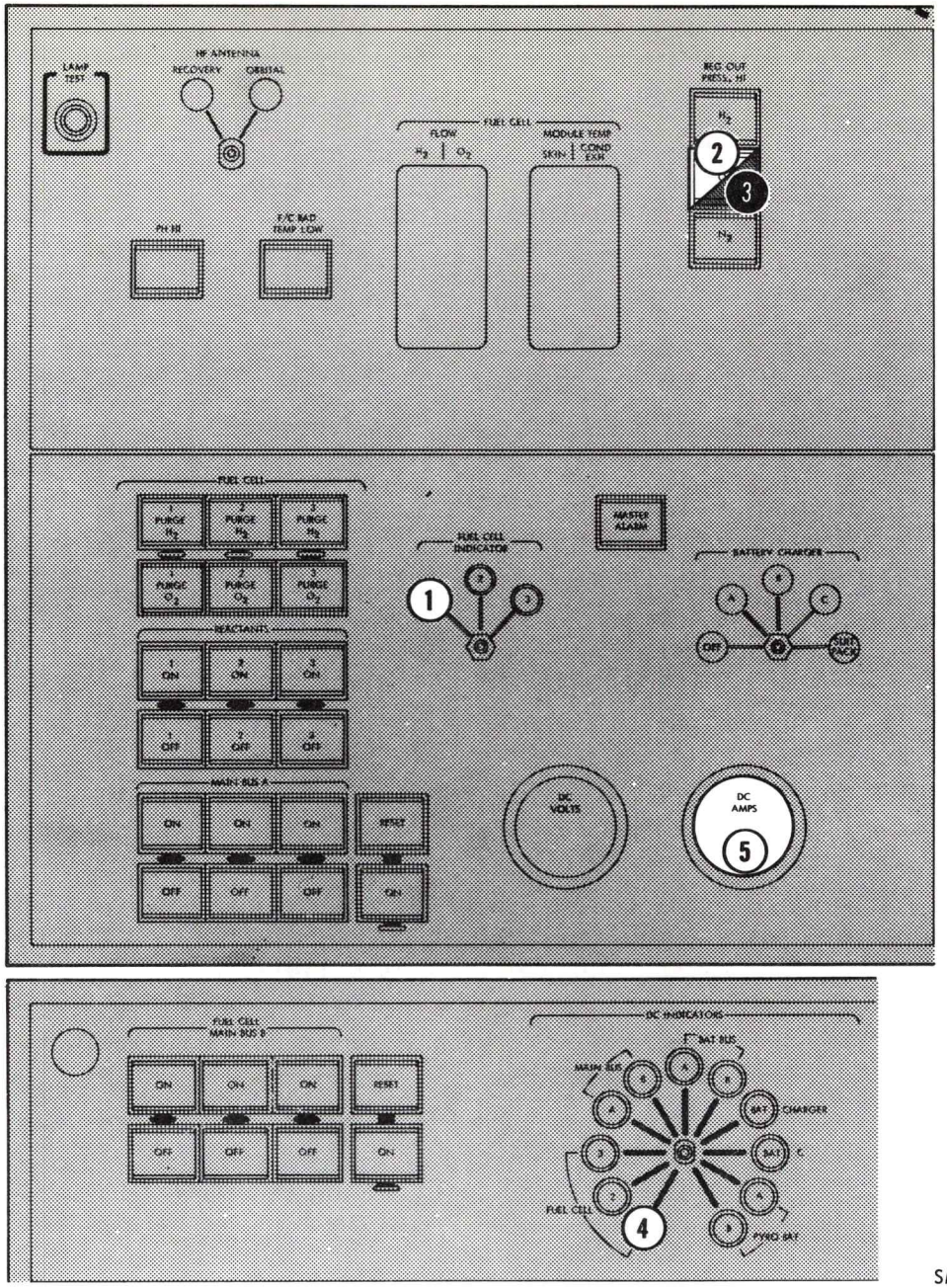
LISTED STEPS
6, 7, 8

O_2 Failure

MEP.01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	
2			Check REG OUT PRESS. HI - O_2 event ind	As programed	
3			Event ind grey, request MSFN verification	Sensing circuit out, provide appropriate communication	
4-8			Event Indicator Striped		
4			DC INDICATORS sw - FUEL CELL 1	DC INDICATORS - 1 lt on	
5			Check DC AMPS for low output	As programed	
6-7			Output Normal		
*6			D-C current level normal	REG OUT PRESS. HI O_2 circuit out	
*7			Request MSFN verification	Provide confirming communication	
			Output Low		
*8			D-C current level below tolerance	Requires fuel cell shutdown, continue with EP3.08	



LISTED STEPS
6, 7, 8

SM-6T-2-02-431A

H_2 Failure

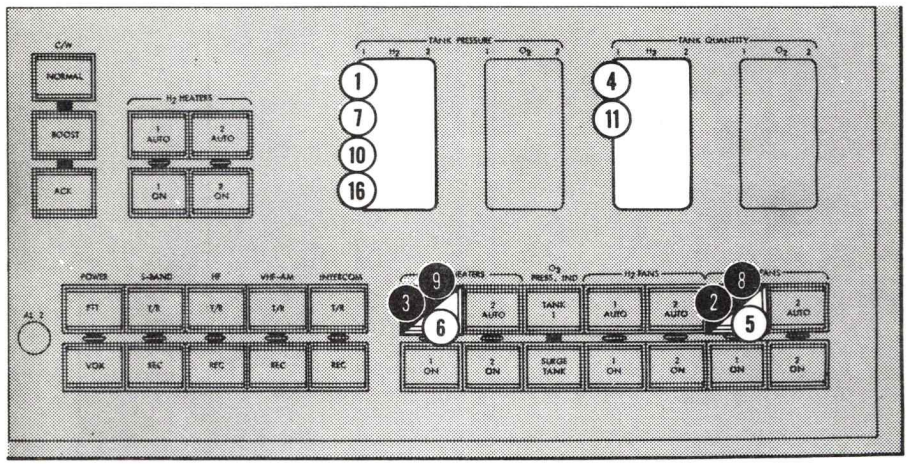
MEP.02

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	
2			Check REG OUT PRESS. HI - H_2 event ind	As programed	
3			Event ind grey, request MSFN verification	Sensing circuit out, provide appropriate communication	
4-8			Event Indicator Striped		
4			DC INDICATORS sw - FUEL CELL 1	DC INDICATORS - 1 (2 or 3) lt on	
5			Check DC AMPS for low output		
6-7			Output Normal		
*6			D-C current level normal	REG OUT PRESS. HI H_2 circuit out	
*7			Request MSFN verification	Provide confirming communication	
			Output Low		
*8			D-C current below tolerance	Require fuel cell shutdown, continue with EP3.08	

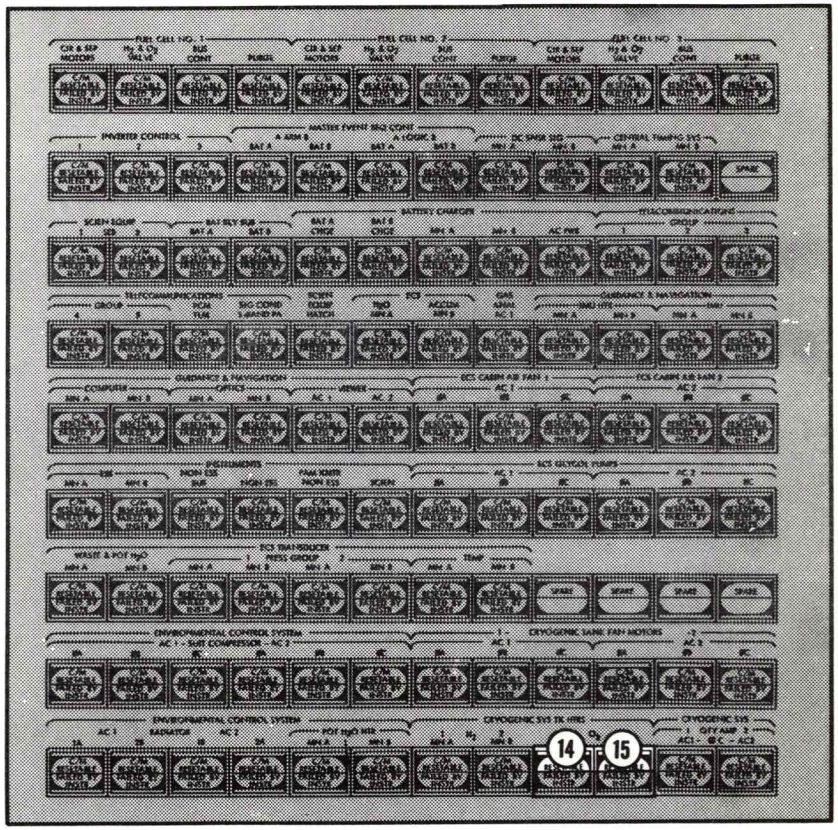
IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	
2			Check REG OUT PRESS HI - N_2 event ind	As programed	
3			Check REG OUT PRESS HI - H_2 and O_2 event inds	As programed	
4			Event inds grey, request MSFN verification	Sensing circuit out, provide appropriate communication	
5			Event inds striped	Requires fuel cell shutdown, continue with EP3.08	



LISTED STEPS

12, 13, 17



SM-6T-2-02-589

O_2 PRESS Light Illuminates

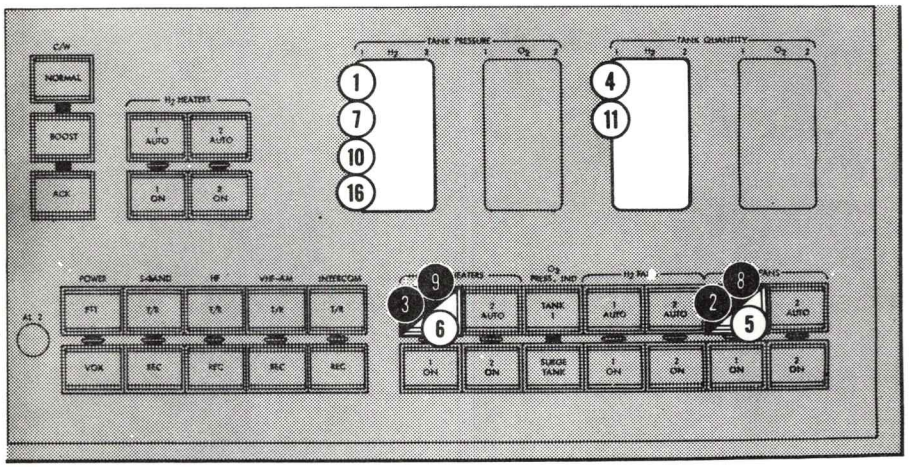
MEP. 04

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Check TANK PRESSURE O_2 1 ind and verify with MSFN	Provide confirming communications	
			Pressure high	Greater than 950	
2			O_2 FANS 1 sw - OFF	O_2 FAN - 1 AUTO lt out	
3			O_2 HEATERS 1 sw - OFF	O_2 HEATERS - 1 AUTO lt out	
4			Check TANK QUANTITY O_2 1 ind	Pressure decrease without quantity loss	
5			O_2 FANS 1 sw - AUTO	O_2 FAN - 1 AUTO lt on	
6			O_2 HEATERS 1 sw - AUTO	O_2 HEATERS - 1 AUTO lt on	
7			Check TANK PRESSURE O_2 1 ind	As programed	
			Pressure normal	Continue normal operation	
			Pressure high	Continue check	
8			O_2 FANS 1 sw - OFF	O_2 FAN - 1 AUTO lt out	
9			O_2 HEATERS 1 sw - OFF	O_2 HEATERS - 1 AUTO lt out	
10			Check PRESSURE O_2 1 ind	Pressure decreasing rapidly	
11			Check QUANTITY O_2 1 ind	Quantity decreasing rapidly	

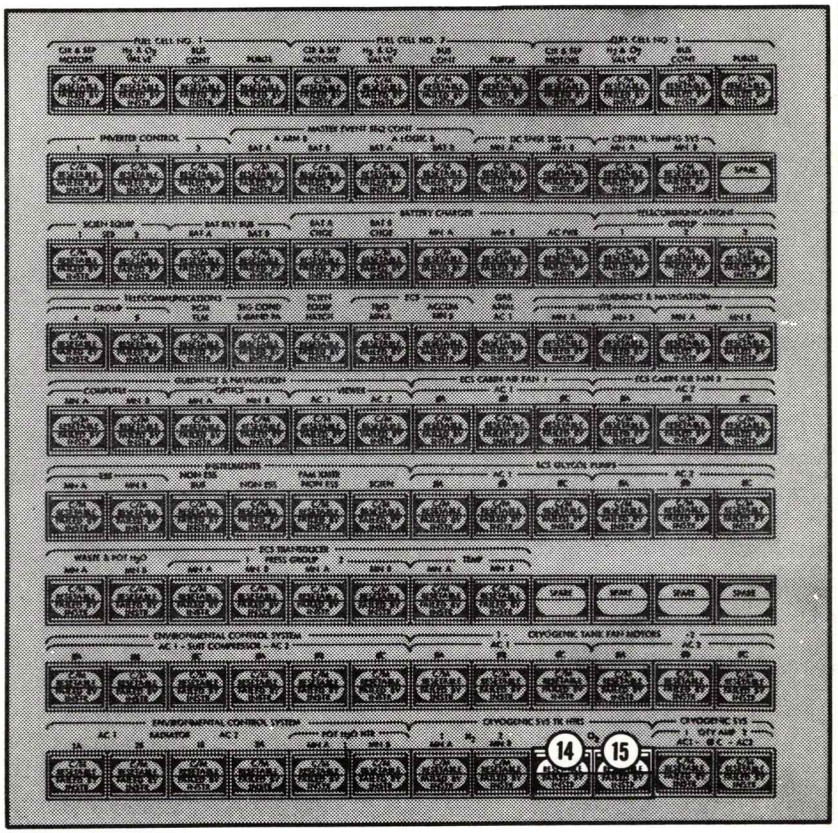
O_2 PRESS Light Illuminates

MEP. 04



LISTED STEPS

12, 13, 17



SM-6T-2-02-589

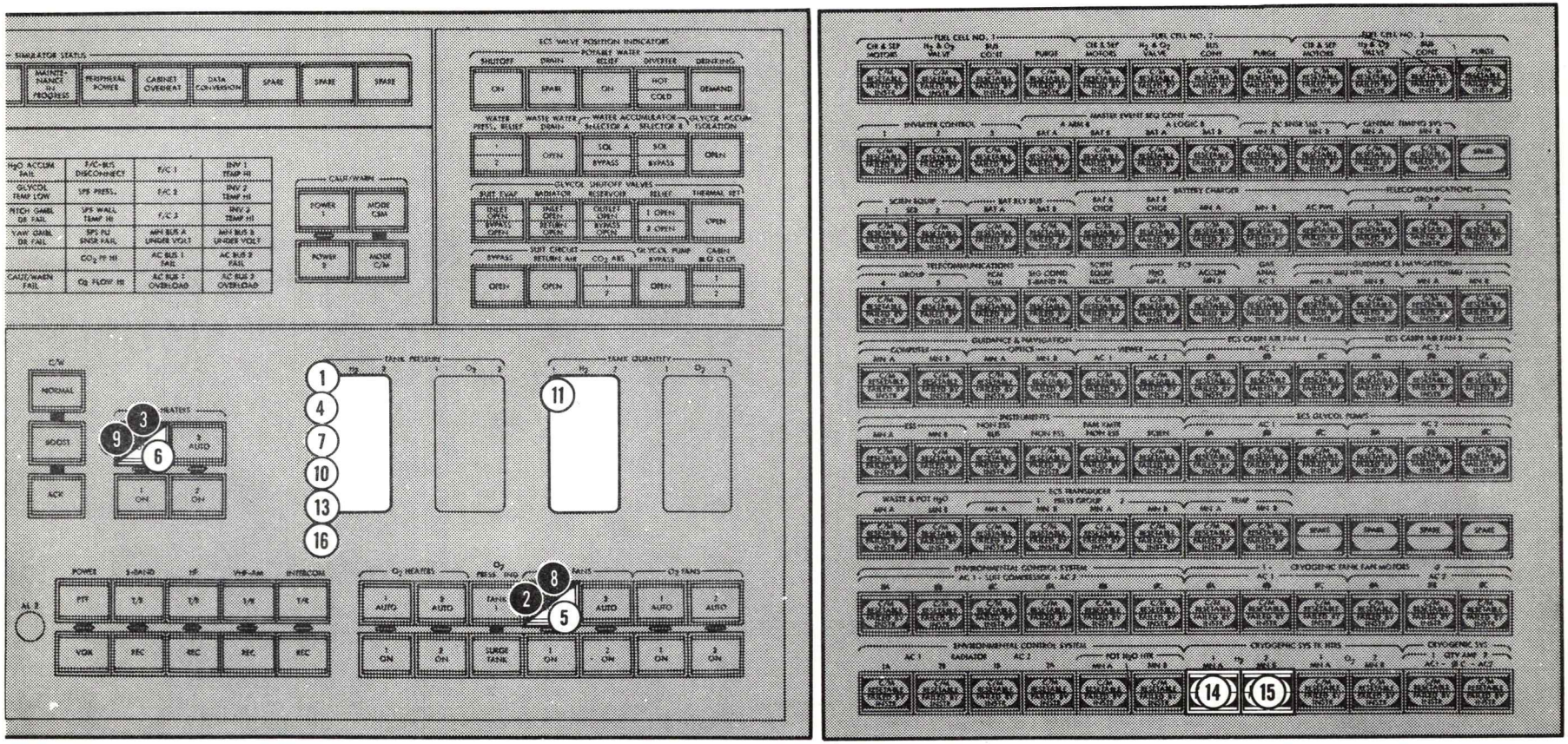
O_2 PRESS Light Illuminates

MEP. 04

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*12			Use O_2 FANS and O_2 HEATERS sw to maintain pressure	Loss of automatic control	
*13			Pressure remains high	Continue check	
14			Disengage CRYOGENIC SYSTEM TANK HEATERS O_2 1 MN A C/B	CRYOGENIC SYS TK HTRS O_2 1 MN A - C/M RESETABLE lt on	
15			Disengage CRYOGENIC SYSTEM TANK HEATERS O_2 1 MN B C/B	CRYOGENIC SYS TK HTRS O_2 1 MN B - C/M RESETABLE lt on	
16			Check TANK PRESSURE O_2 1 ind	As programed	
			Pressure decrease	Limited use of O_2 tank 1	
			Pressure remains high	Continue check	
*17			Increase O_2 use by purging fuel cell	Continue with EP3.06	

O_2 PRESS Light Illuminates



LISTED STEPS
12, 17

SM-6T-2-02-590

H_2 PRESS Light Illuminates

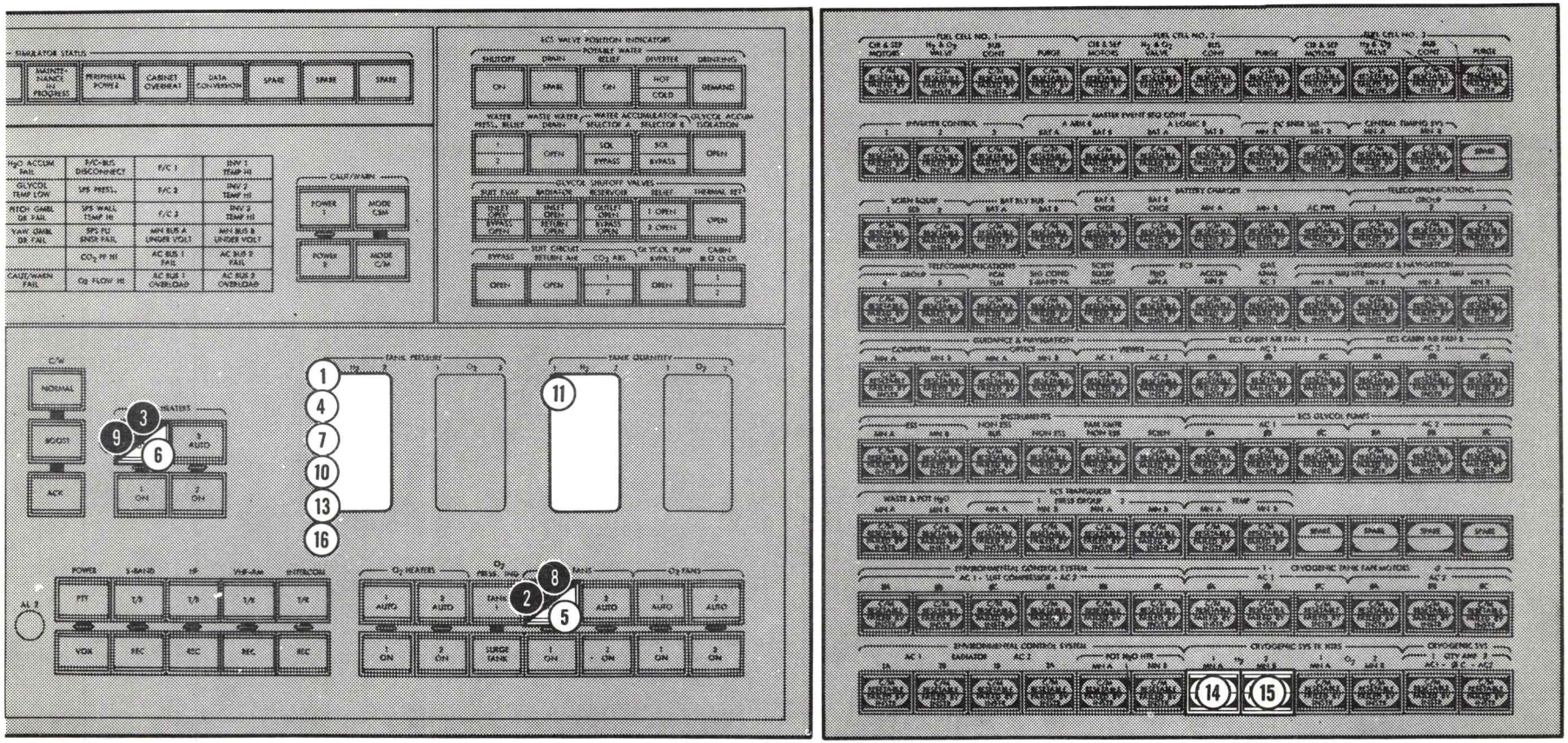
MEP. 05

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			Check TANK PRESSURE H_2 1 ind	Provide confirming communication	
			Pressure high	Greater than 270	
2			H_2 FANS 1 sw - OFF	H_2 FAN - 1 AUTO lt out	
3			H_2 HEATERS 1 sw - OFF	H_2 HEATERS - 1 AUTO lt out	
4			Check TANK QUANTITY H_2 1 ind	Pressure decrease without quantity loss	
5			H_2 FANS 1 sw - AUTO	H_2 FAN - 1 AUTO lt on	
6			H_2 HEATERS 1 sw - AUTO	H_2 HEATERS - 1 AUTO lt on	
7			Check TANK PRESSURE H_2 1 ind	As programed	
			Pressure normal	Continue normal operation	
			Pressure high	Continue with check	
8			H_2 FANS 1 sw - OFF	H_2 FAN - 1 AUTO lt out	
9			H_2 HEATERS 1 sw - OFF	H_2 HEATERS - 1 AUTO lt out	
10			Check TANK PRESSURE H_2 1 ind	Pressure decrease	
11			Check TANK QUANTITY H_2 1 ind	Quantity rapid decrease	

H_2 PRESS Light Illuminates

MEP. 05



LISTED STEPS
12, 17

SM-6T-2-02-590

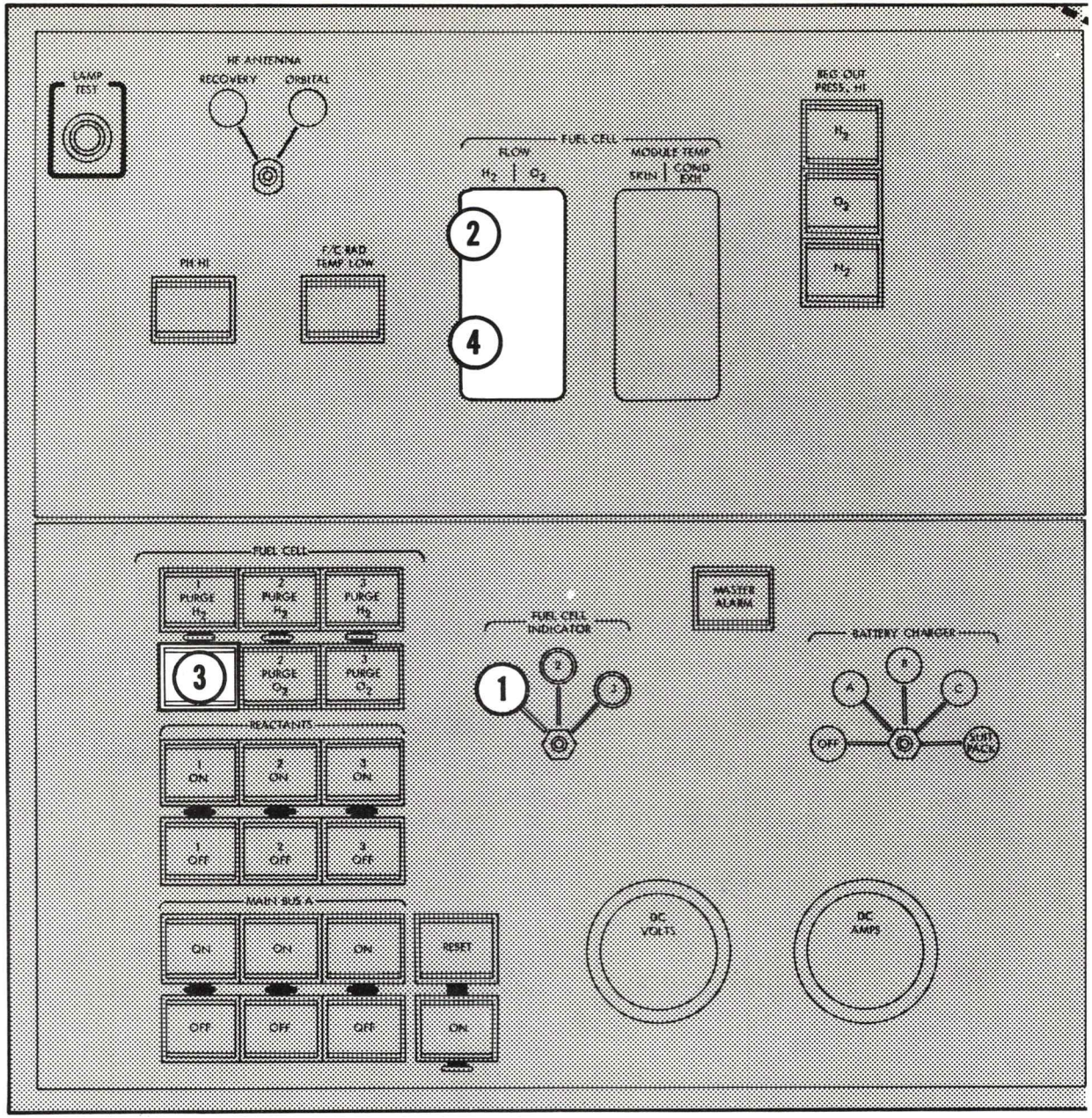
H_2 PRESS Light Illuminates

MEP.05

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*12			Use fan and heater sw to maintain pressure	Lt on and out, as selected	
13			Check TANK PRESSURE H_2 1 ind	As programed	
			Pressure high	Automatic control out	
			Pressure increase	Continue check	
14			Disengage CRYOGENIC SYSTEM TANK HEATERS H_2 MN A C/B	CRYOGENIC SYS TK HTRS H_2 1 MN A - C/M RESETABLE lt on	
15			Disengage CRYOGENIC SYSTEM TANK HEATERS H_2 MN B C/B	CRYOGENIC SYS TK HTRS H_2 1 MN A - C/M RESETABLE lt on	
16			Check TANK PRESSURE H_2 1 ind	As programed	
			Pressure decrease	Automatic and manual pressure control	
			Pressure high	Continue check	
*17			Increase H2 use by purging fuel cell	Continue with EP3.07	

H_2 PRESS Light Illuminates



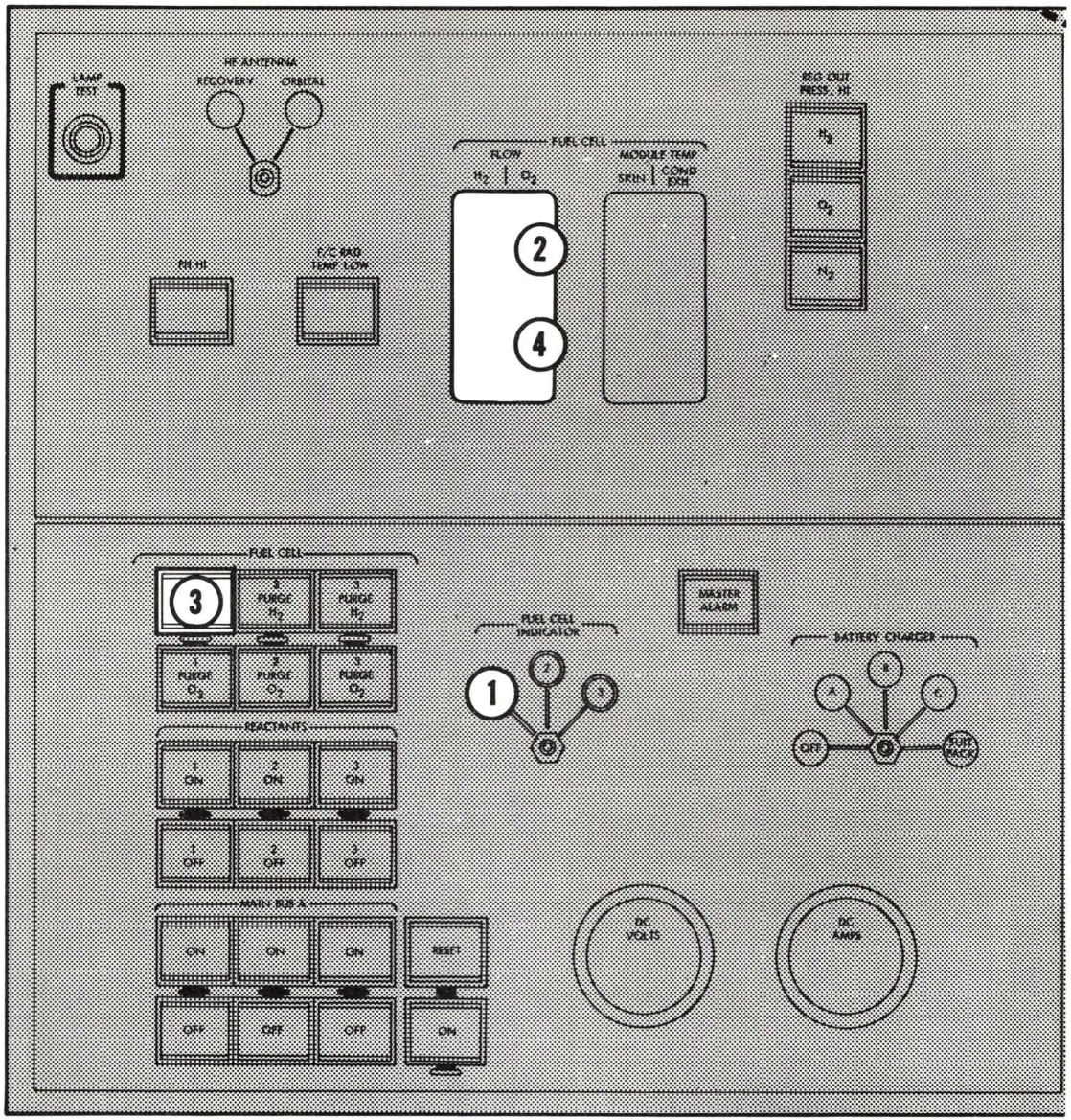
SM-6T-2-02-641

Fuel Cell Fail Light Illuminates, H_2 Flow High

MEP.06

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	
2			Check FLOW H_2 ind	As programed	
3-4			Flow High		
3			FUEL CELL 1 purge sw - PURGE H_2 and OFF several times	FUEL CELL - 1 PURGE H_2 and OFF lt, as selected	
4			Check FLOW H_2 ind	As programed	
			Flow normal	Purge valve seated	
			Flow high	Requires fuel cell shutdown, continue with EP3.08	



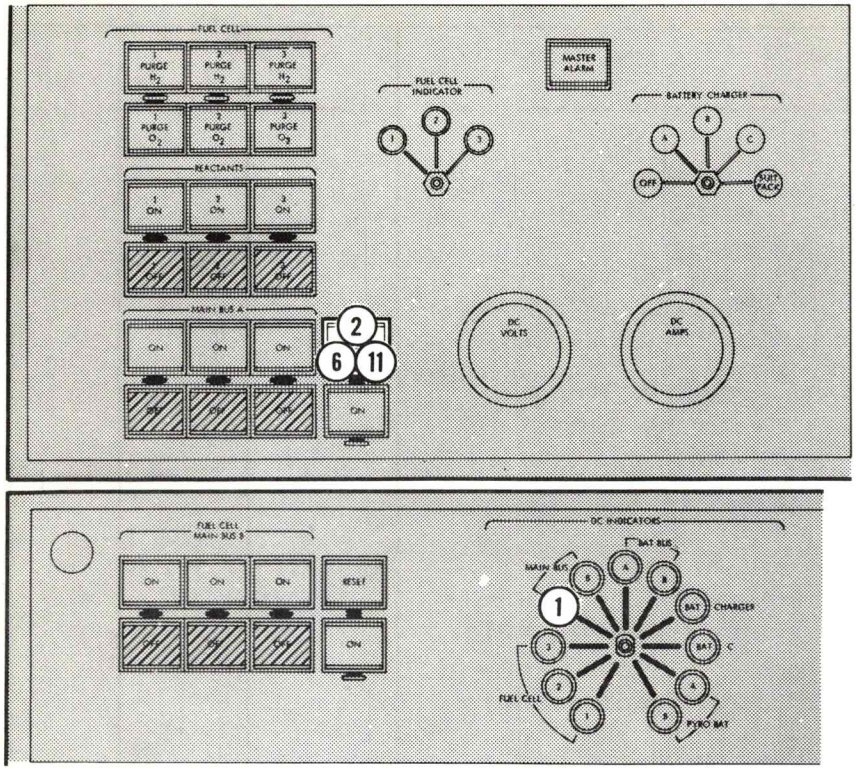
SM-6T-2-02-640

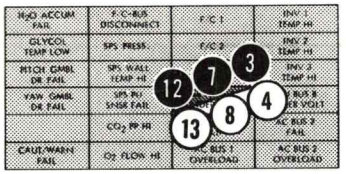
Fuel Cell Fail Light Illuminates O_2 Flow High

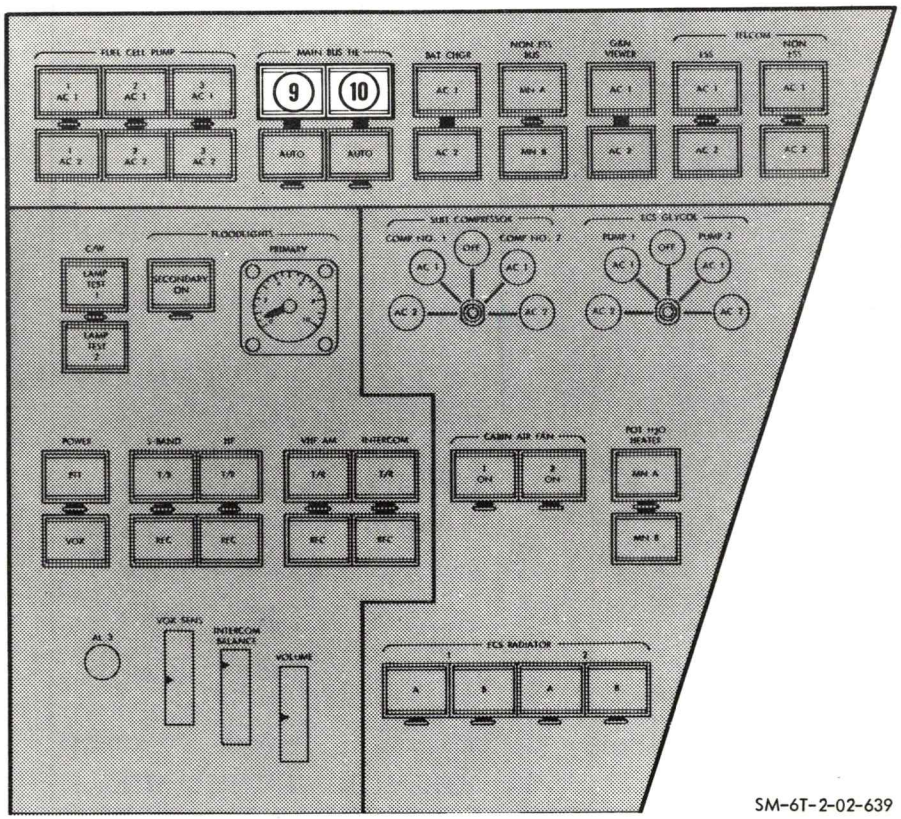
MEP. 07

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL INDICATORS sw - 1	FUEL CELL INDICATOR - 1 lt on	
2			Check FLOW O_2 ind	As programed	
3-4			Flow High		
3			FUEL CELL 1 purge sw - PURGE O_2 and OFF several times	FUEL CELL - 1 PURGE O_2 lt on and out, as selected	
4			Check FLOW O_2 ind	As programed	
			Flow normal	Purge valve seated	
			Flow high	Requires fuel cell shutdown, continue with EP3.08	







SM-6T-2-02-639

LISTED STEPS

5, 14

DC BUS A UNDERVOLT Light Illuminates

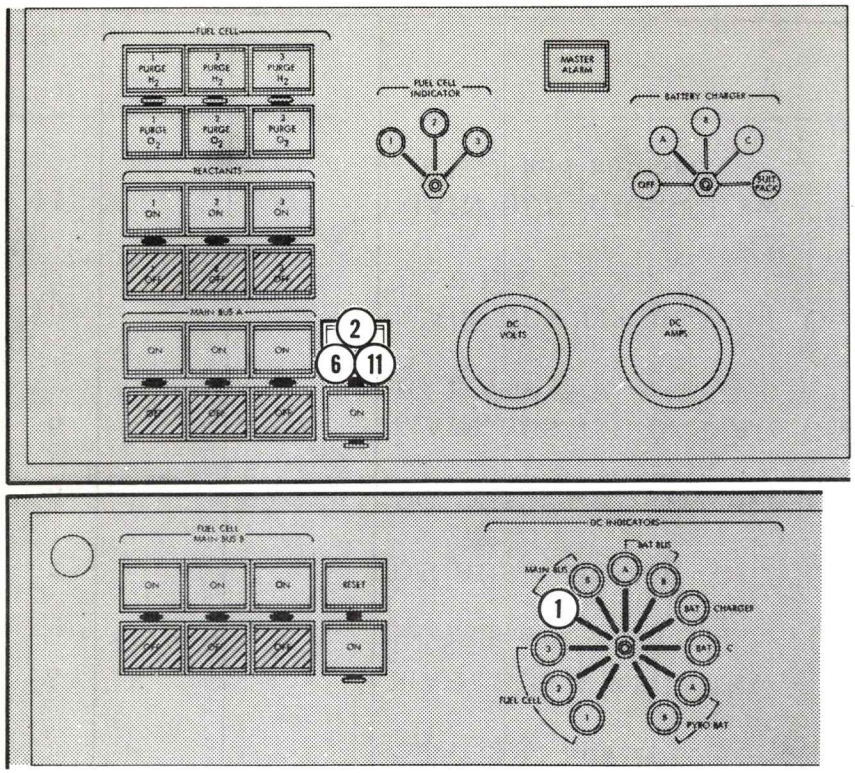
MEP. 08

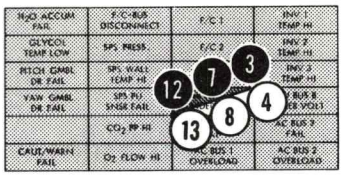
IOS DATA SHEET

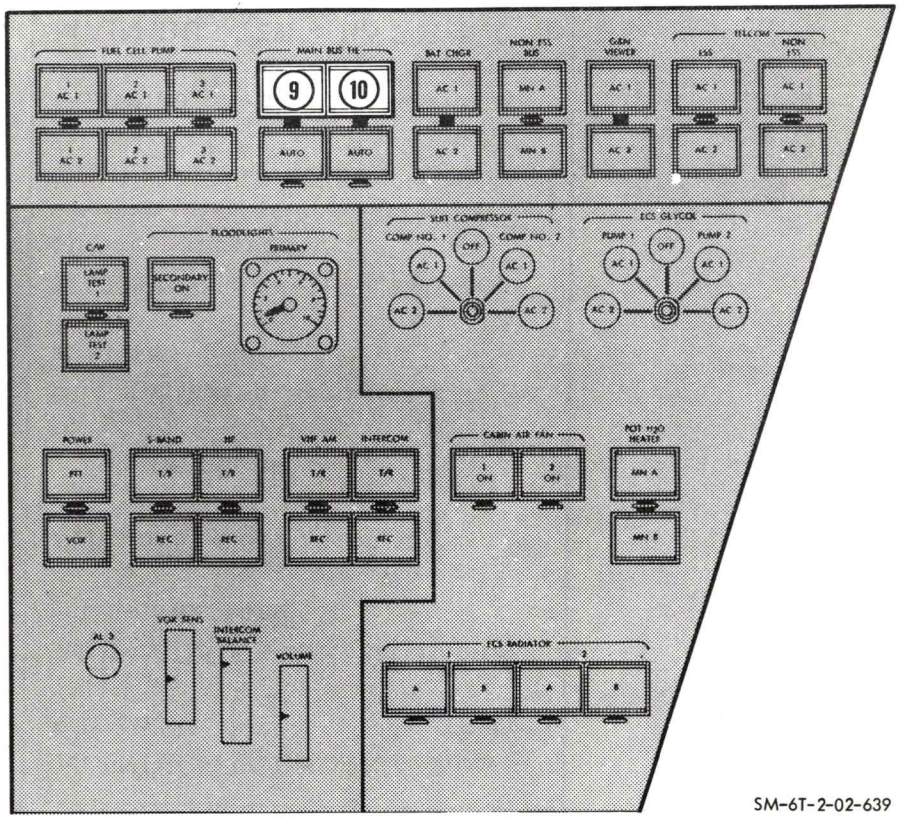
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			DC INDICATORS sw - MAIN BUS A	DC INDICATORS MAIN BUS - A lt on	
2			MAIN BUS A RESET sw - RESET and release	MAIN BUS A - RESET lt on, out as released	
3			DC BUS A UNDERVOLT lt out	Temporary condition corrected	
4			DC BUS A UNDERVOLT lt on	Continue check	
*5			Remove load from bus A and connect to bus B	Bus switching lt on and off, as selected	
6			MAIN BUS A RESET sw - RESET and release	MAIN BUS A - RESET lt on, out as released	
7			DC BUS A UNDERVOLT lt out	Condition corrected	
8			DC BUS A UNDERVOLT lt on	Continue check	
9			MAIN BUS TIE BAT A & C sw - BAT A & C	MAIN BUS TIE - BAT A & C lt on	
10			MAIN BUS TIE BAT B & C sw - BAT B & C	MAIN BUS TIE - BAT B & C lt on	
11			MAIN BUS A RESET sw - RESET and release	MAIN BUS A - RESET lt on, out as released	

DC BUS A UNDERVOLT Light Illuminates

MEP. 08







SM-6T-2-02-639

LISTED STEPS

5, 14

DC BUS A UNDERVOLT Light Illuminates

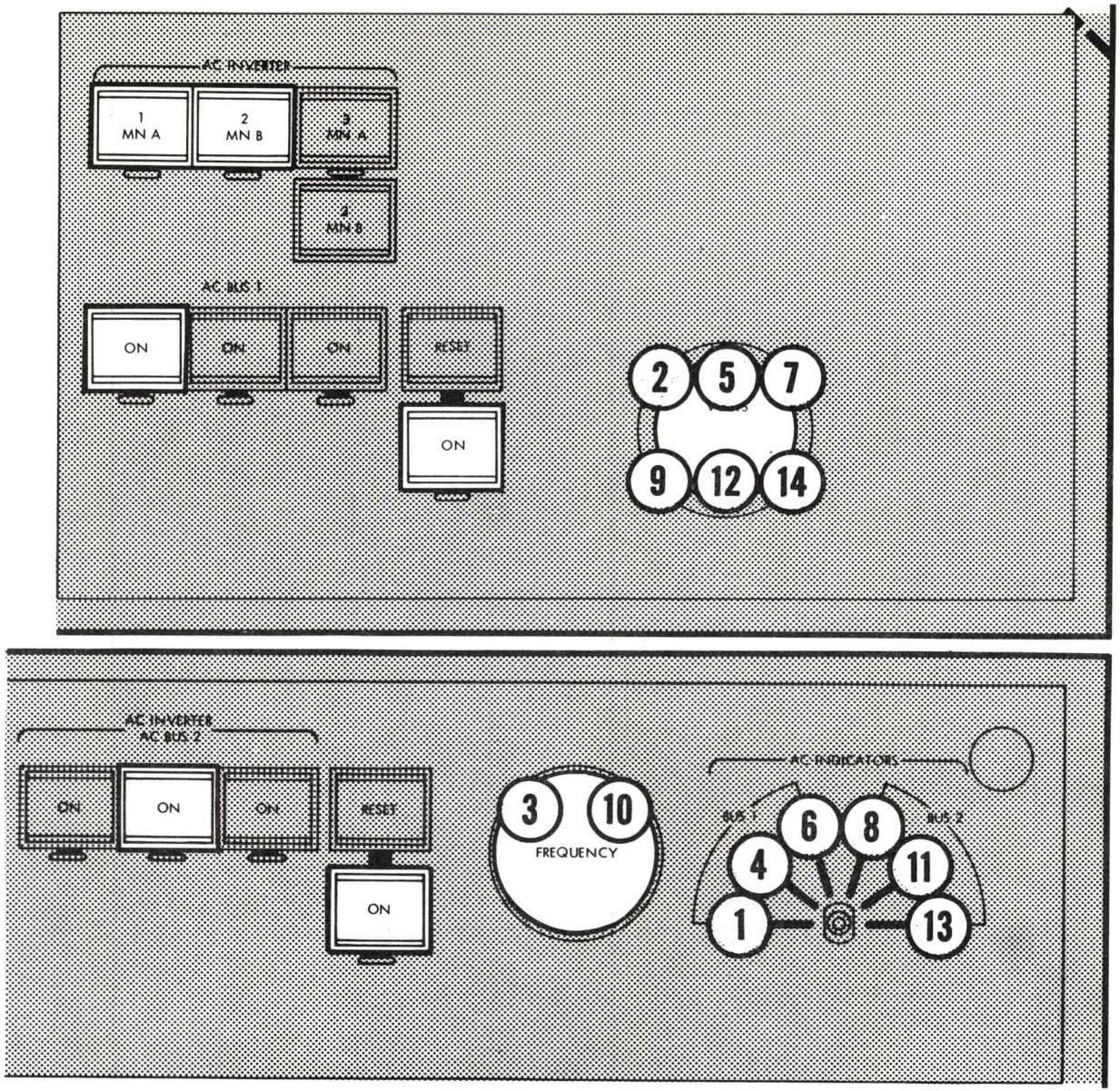
MEP. 08

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12			DC BUS A UNDERVOLT lt out	Load redistribution required	
13			DC BUS A UNDERVOLT lt on	Load redistribution required	
*14			Remove additional loads from bus A and connect to bus B.	Bus selector light switching, as selected	

DC BUS A UNDERVOLT Light Illuminates

MEP. 08



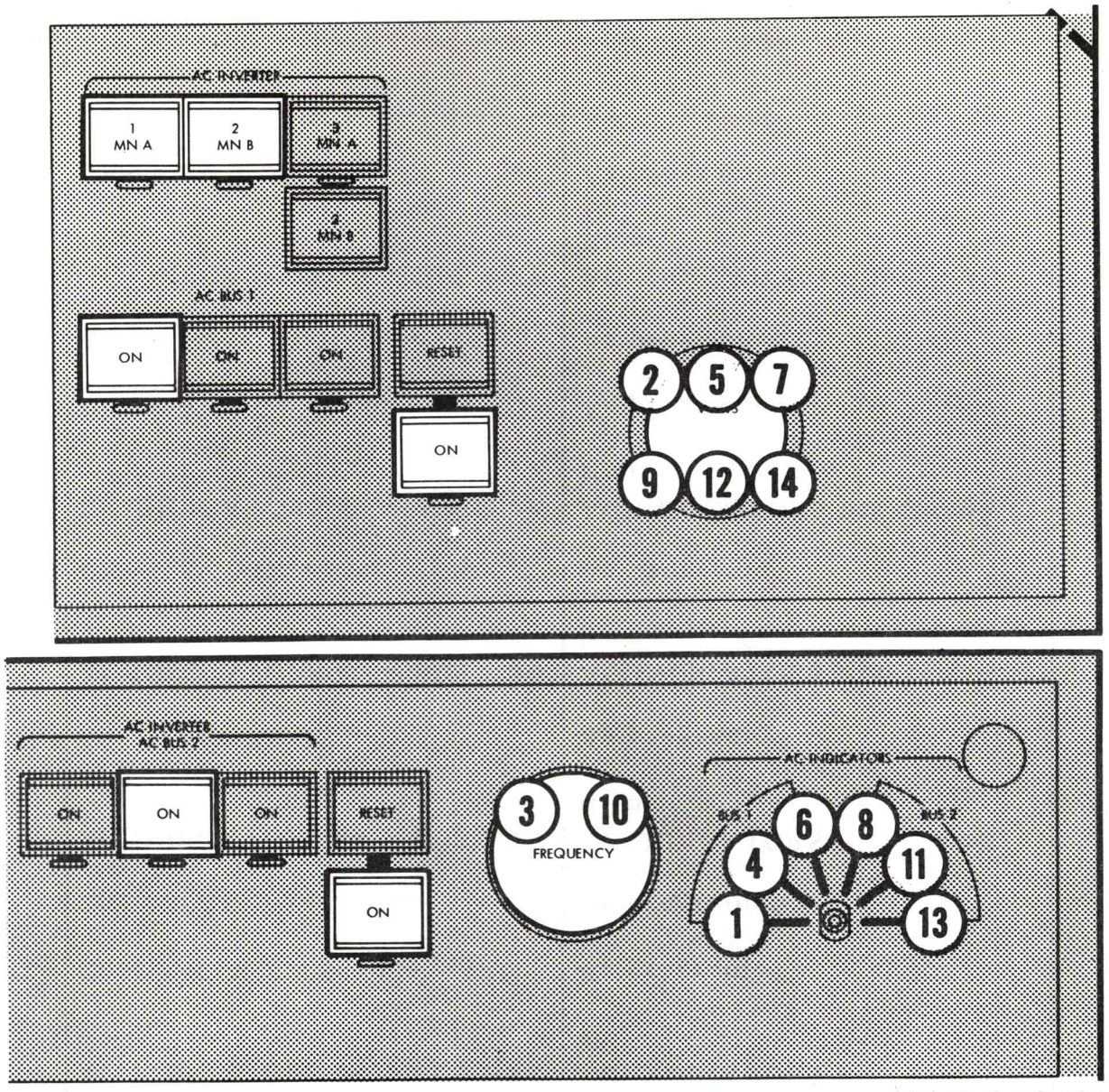
SM-6T-2-02-638

A-C Inverter and Bus Check

MEP. 10

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			AC INDICATORS sw - BUS 1 ØA	AC INDICATORS BUS 1 - ØA lt on	
2			Check AC VOLTS ind	As programed	
3			Check FREQUENCY ind	As programed	
4			AC INDICATORS sw - BUS 1 ØB	AC INDICATORS BUS 1 - ØB lt on	
5			Check AC VOLTS ind	As programed	
6			AC INDICATORS sw - BUS 1 ØC	AC INDICATORS BUS 1 - ØC lt on	
7			Check AC VOLTS ind	As programed	
8			AC INDICATORS sw - BUS 2 ØA	AC INDICATORS BUS 2 - ØA lt on	
9			Check AC VOLTS ind	As programed	
10			Check FREQUENCY ind	As programed	
11			AC INDICATOFS sw - BUS 2 ØB	AC INDICATORS BUS 2 - ØB lt on	
12			Check AC VOLTS ind	As programed	



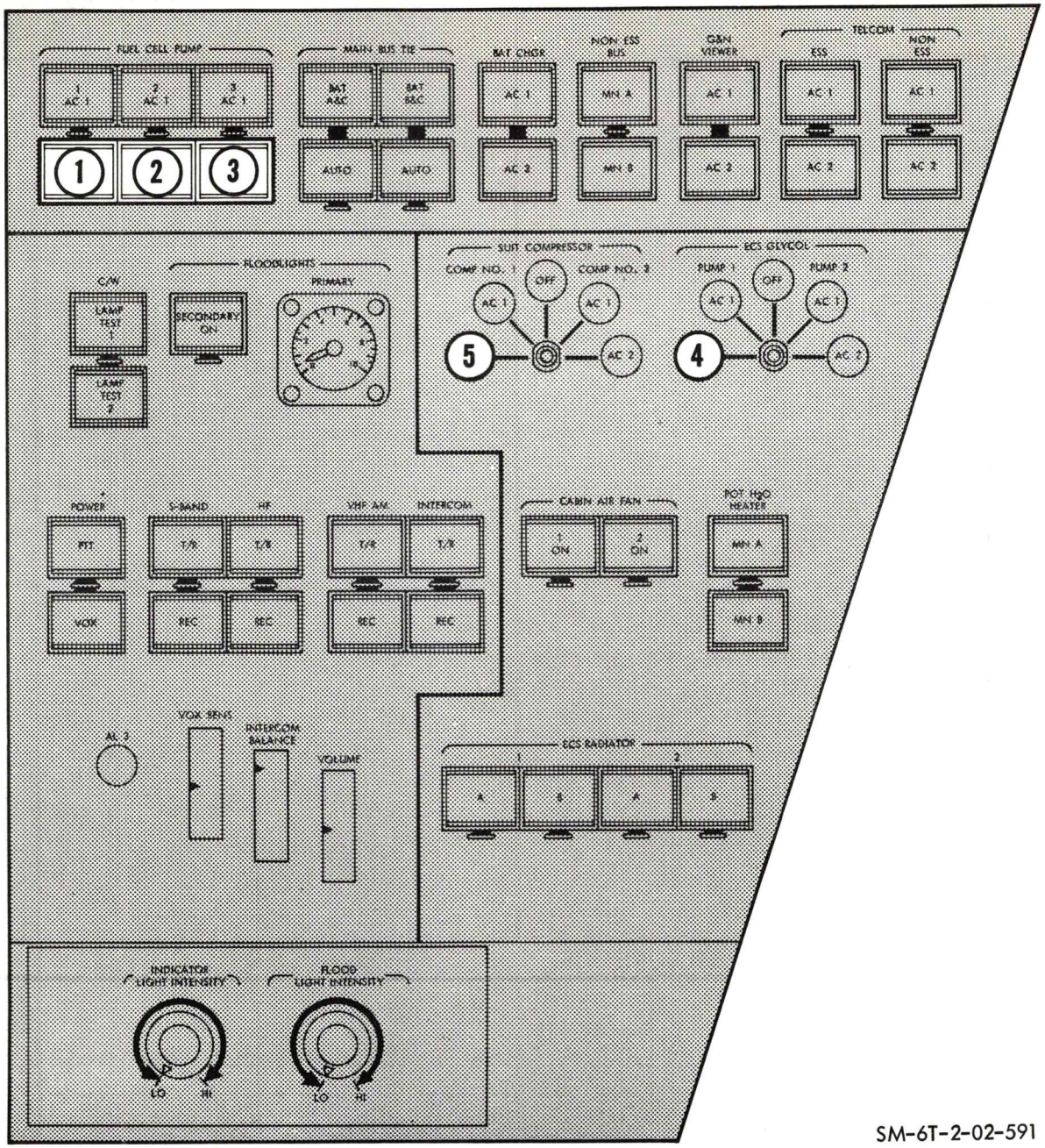
SM-6T-2-02-638

A-C Inverter and Bus Check

MEP. 10

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
13			AC INDICATORS sw - BUS 2 ØC	AC INDICATORS BUS 2 - ØC lt on	
14			Check AC VOLTS ind	As programed	



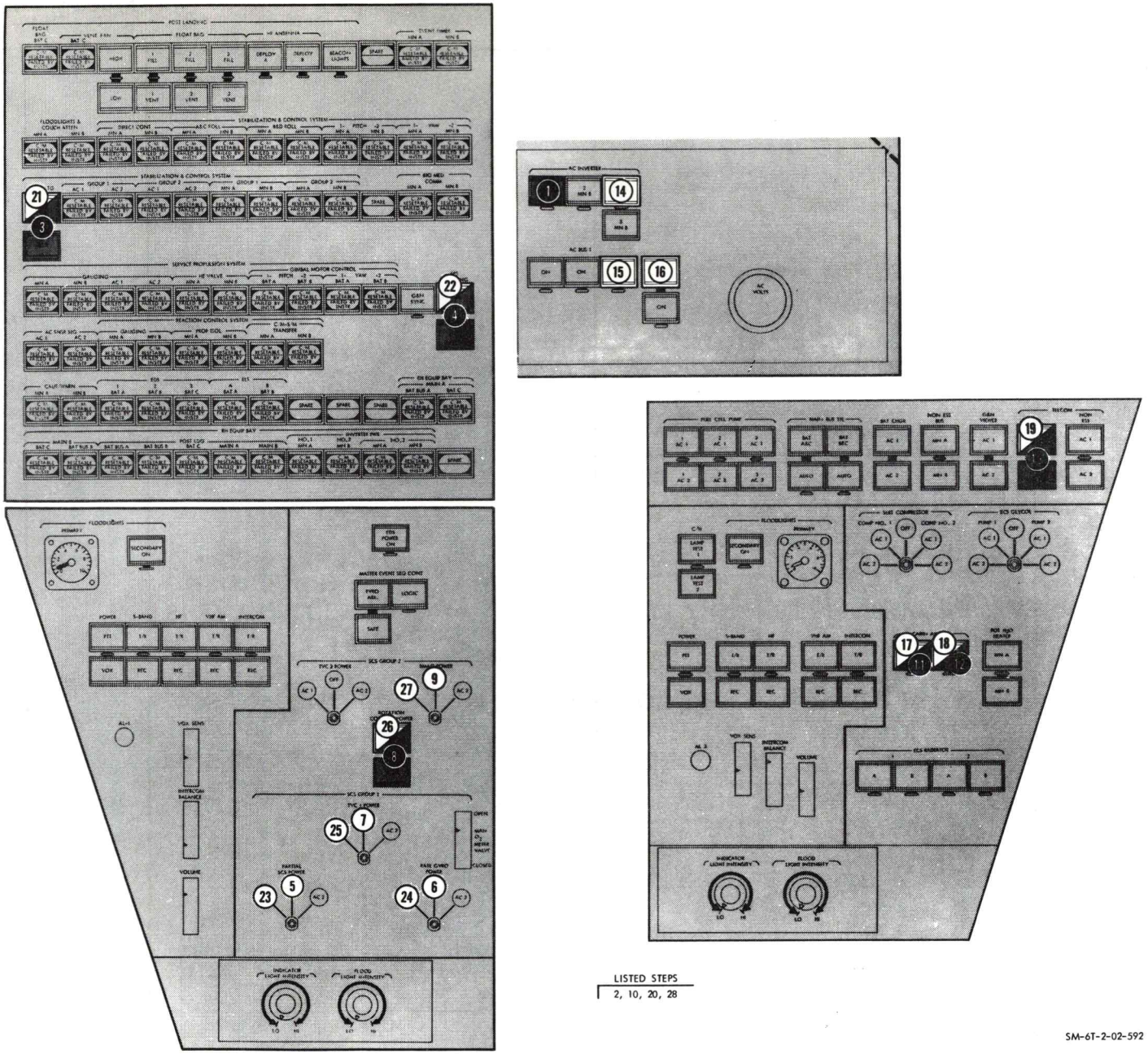
SM-6T-2-02-591

Critical Loads Transfer

MEP. 11

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			FUEL CELL PUMP 1 sw - BUS 2	FUEL CELL PUMP - 1 AC 2 lt on	
2			FUEL CELL PUMP 2 sw - BUS 2	FUEL CELL PUMP - 2 AC 2 lt on	
3			FUEL CELL PUMP 3 sw - BUS 2	FUEL CELL PUMP - 3 AC 2 lt on	
4			ECS GLYCOL sw - PUMP 1 BUS 2	ECS GLYCOL PUMP 1 - AC 2 lt on	
5			SUIT COMPRESSOR sw - COMP 1 BUS 2	SUIT COMPRESSOR COMP NO. 1 - AC 2 lt on	



LISTED STEPS
2, 10, 20, 28

SM-6T-2-02-592

Dual-Inverter Changeover

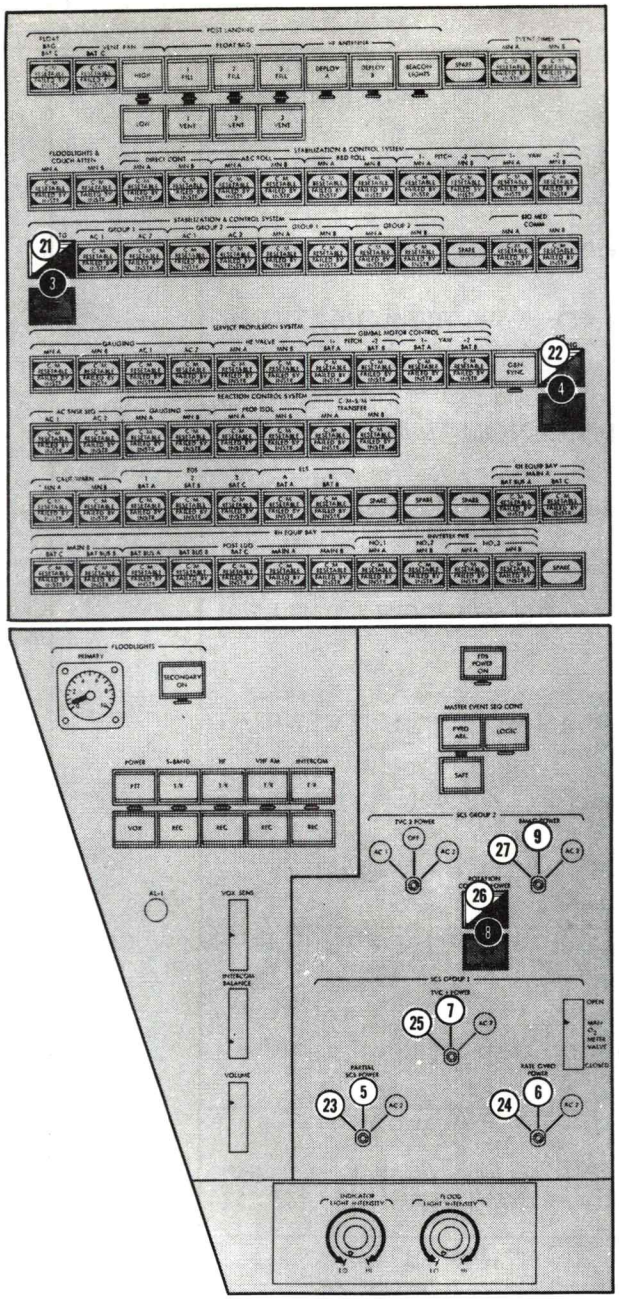
MEP.12

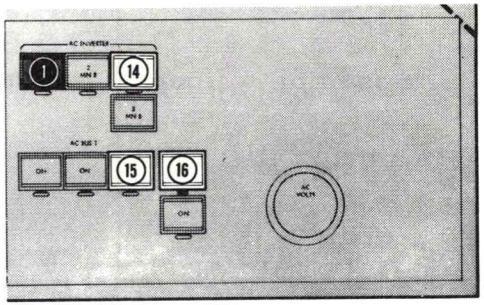
IOS DATA SHEET

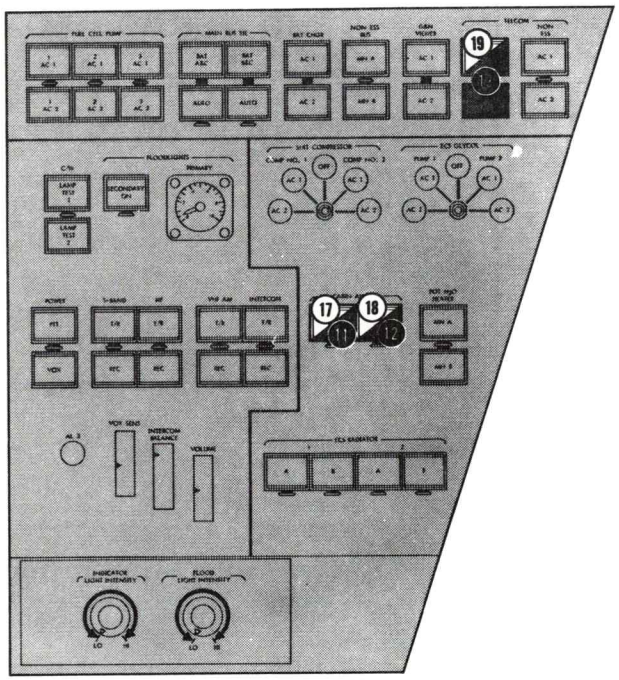
Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			AC INVERTER 1 sw - OFF	AC INVERTER - 1 MN A lt out	
2-11			Bus 1 Disconnect		
*2			Request seat 1, disconnect loads from bus 1	Monitor intercom	
3-9			Seat 1 Bus 1 Disconnect		
3			FDAI LTG sw - OFF	FDAI LTG lt out	
4			SPS GAUGING sw - OFF	SPS GAUGING lt out	
5			PARTIAL SCS POWER sw - OFF	PARTIAL SCS POWER - OFF lt on	
6			RATE GYRO POWER sw - OFF	RATE GYRO POWER - OFF lt on	
7			TVC 1 POWER sw - OFF	TVC 1 POWER - OFF lt on	
8			ROTATIONAL CONTROL POWER sw - OFF	ROTATIONAL CONTROL POWER lts out	
9			BMAG POWER sw - OFF	BMAG POWER - OFF lt on	
*10			Confirm seat 1, bus switching complete	Monitor intercom	

Dual-Inverter Changeover

MEP. 12







LISTED STEPS

2, 10, 20, 28

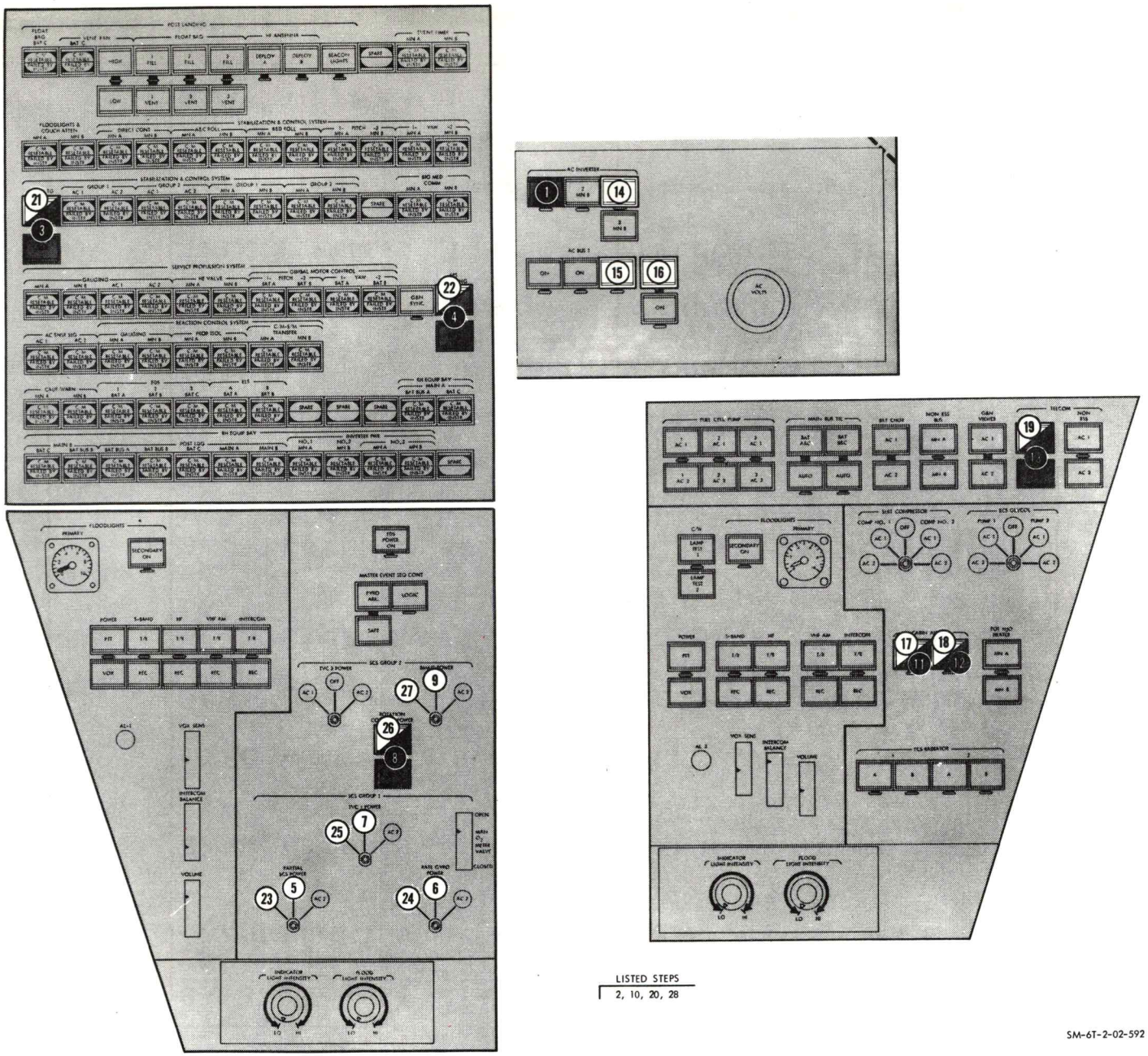
SM-6T-2-02-592

Dual-Inverter Changeover

MEP.12

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
11-16			Seat 3, Bus 1 Disconnect		
11			CABIN AIR FANS 1 sw - OFF	CABIN AIR FAN NO. 1 - OFF lt on	
12			CABIN AIR FANS 2 sw - OFF	CABIN AIR FAN NO. 2 - OFF lt on	
13			TELCOM ESS sw - OFF	TELCOM ESS - lt out	
14			AC INVERTER 3 sw - BUS A	AC INVERTER - 3 MN A lt on	
15			AC INVERTER 3 AC BUS 1 sw - ON	AC INVERTER 3 AC BUS 1 - ON lt on	
16			AC INVERTER AC BUS 1 RESET sw - RESET and release	AC INVERTER AC BUS 1 - RESET lt on, out as released. ON lt on	
17-28			Bus 1 Connect		
17			CABIN AIR FANS 1 sw - ON	CABIN AIR FAN - 1 ON lt on	
18			CABIN AIR FANS 2 sw - ON	CABIN AIR FAN - 2 ON lt on	
19			TELCOM ESS sw - AC 1	TELCOM ESS - AC 1 lt on	
*20			Request seat 1, connect as bus loads	Monitor intercom	
21			FDAI LTG sw - AC 1	FDAI LTG - AC 1 lt on	



LISTED STEPS
2, 10, 20, 28

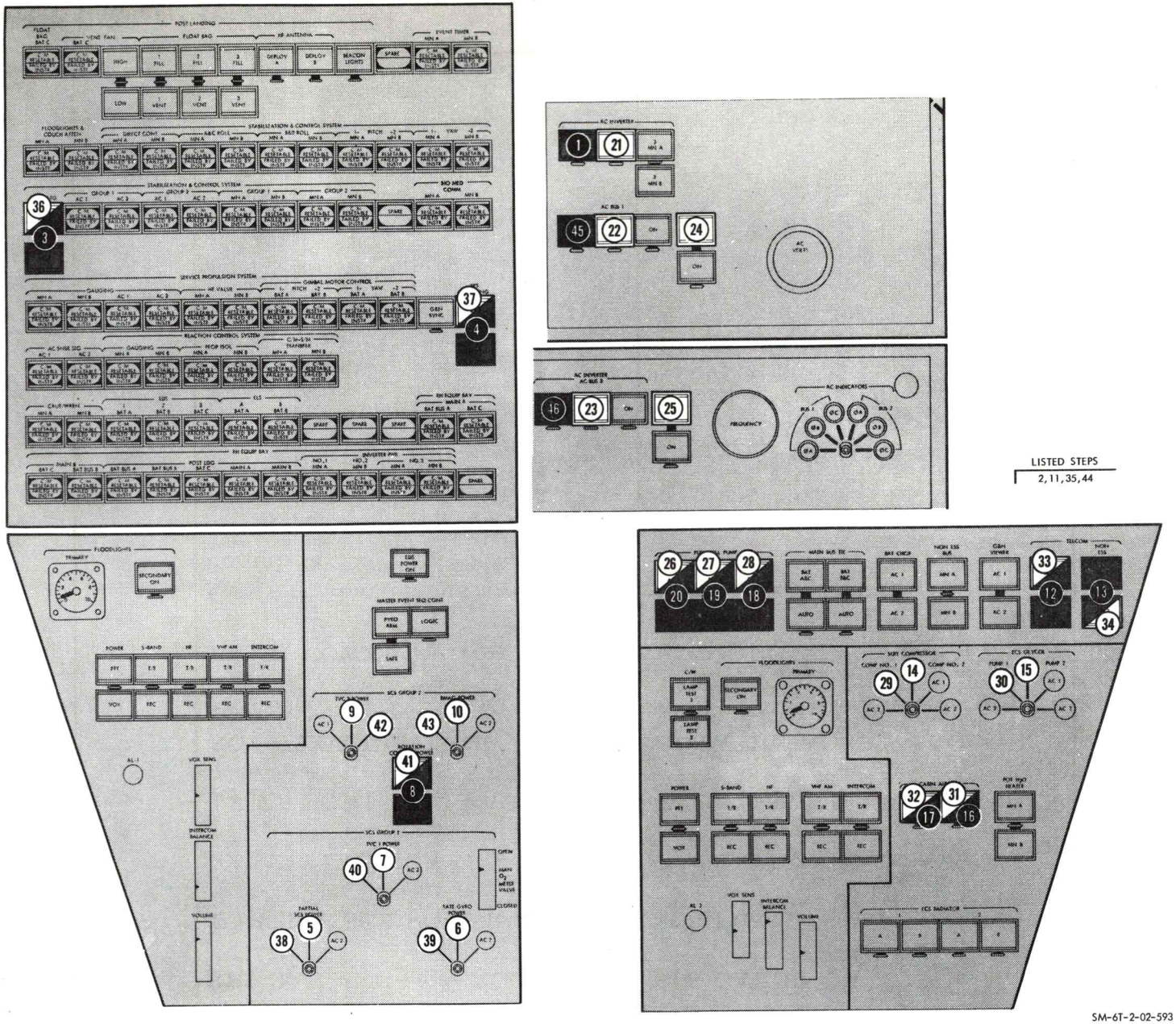
SM-6T-2-02-592

Dual-Inverter Changeover

MEP. 12

IOS DATA SHEET

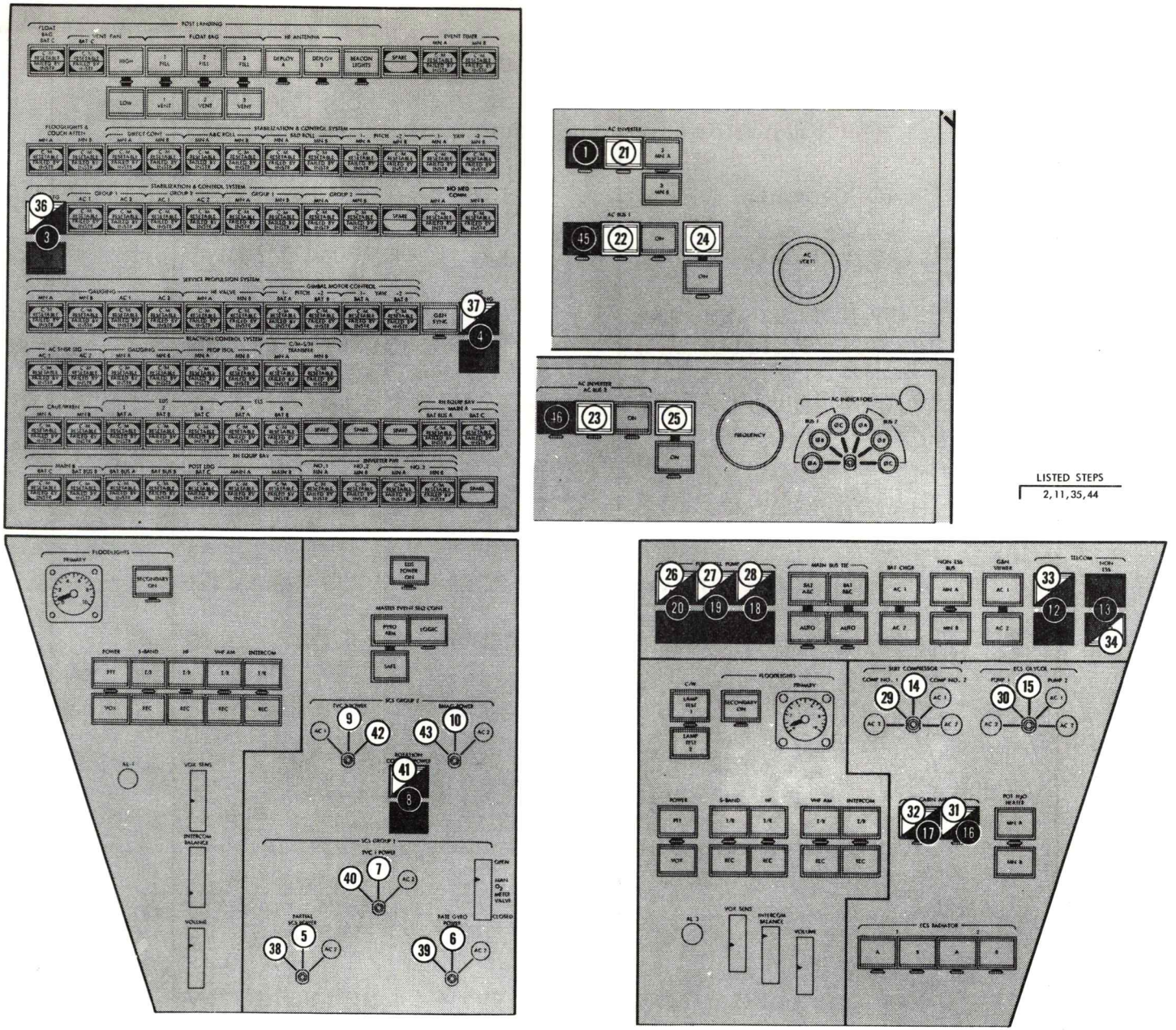
Step	Malf	Time	Function	IOS Visibility/Action	Notes
22			SPS GAUGING sw - AC 1	SPS GAUGING - AC 1 lt on	
23			PARTIAL SCS POWER sw - AC 1	SCS POWER - AC 1 lt on	
24			RATE GYRO POWER sw - AC 1	RATE GYRO - AC 1 on	
25			TVC 1 POWER sw - AC 1	TVC 1 POWER - AC 1 lt on	
26			ROTATION CONTROL POWER sw - AC 1	ROTATIONAL CONTROL POWER - AC 1 lt on	
27			BMAG POWER sw - AC 1	BMAG POWER - AC 1 lt on	
*28			Confirm seat 1, bus switching complete	Monitor intercom	



Single-Inverter Changeover

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			AC INVERTER 1 sw - OFF	AC INVERTER - 1 ON lt out	
2-22			A-C Bus 1 and A-C Bus 2 Disconnect		
*2			Request seat 1, disconnect A-C loads	Monitor intercom	
3-8			Seat 1, Bus Disconnect		
3			FDAI LTG sw - OFF	FDAI LTG lt out	
4			SPS GAUGING sw - OFF	SPS GAUGING - lt out	
5			PARTIAL SCS POWER sw - OFF	PARTIAL SCS POWER - OFF lt on	
6			RATE GYRO POWER sw - OFF	RATE GYRO POWER - OFF lt on	
7			TVC 1 POWER sw - OFF	TVC 1 POWER - OFF lt on	
8			ROTATIONAL CONTROL POWER sw - OFF	ROTATIONAL CONTROL POWER - OFF lt on	
9			TVC 2 POWER sw - OFF	TVC 2 POWER - OFF lt on	
10			BMAG POWER sw - OFF	BMAG POWER - OFF lt on	
*11			Confirm seat 1, switching complete	Monitor intercom	

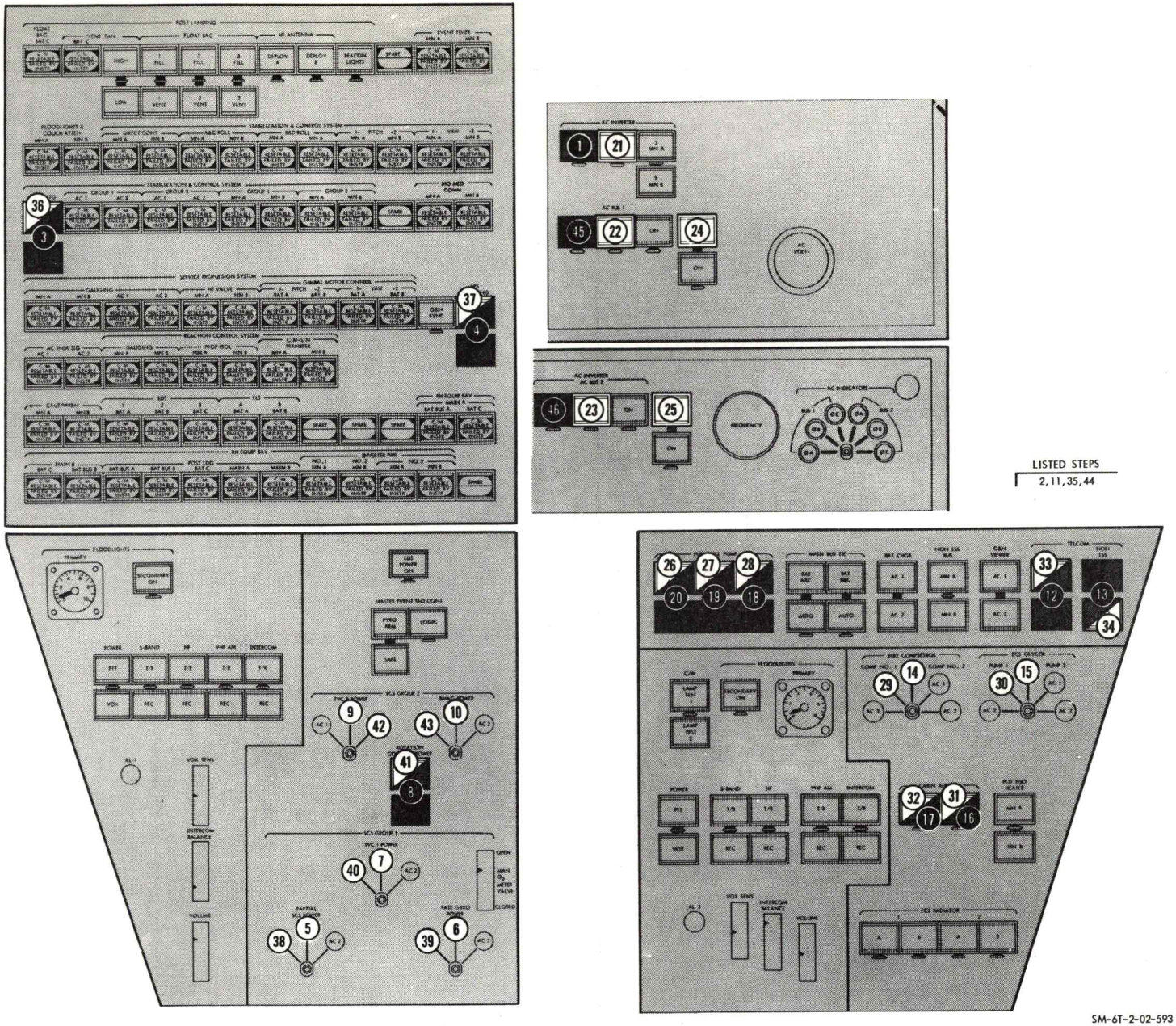


Single-Inverter Changeover

MEP. 13

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
12-20			Seat 3, Bus Disconnect		
12			TELCOM ESS sw - OFF	TELCOM ESS - lt out	
13			TELCOM NON ESS sw - OFF	TELCOM NON ESS - lt out	
14			SUIT COMPRESSOR sw - OFF	SUIT COMPRESSOR - OFF lt on	
15			ECS GLYCOL sw - OFF	ECS GLYCOL - OFF lt on	
16			CABIN AIR FAN 2 sw - OFF	CABIN AIR FAN - 2 ON lt out	
17			CABIN AIR FAN 1 sw - OFF	CABIN AIR FAN - 1 ON lt out	
18			FUEL CELL PUMP 3 sw - OFF	FUEL CELL PUMP 3 lt out	
19			FUEL CELL PUMP 2 sw - OFF	FUEL CELL PUMP 2 lt out	
20			FUEL CELL PUMP 1 sw - OFF	FUEL CELL PUMP 1 lt out	
21			AC INVERTER 2 sw - ON	AC INVERTER 2 - ON lt on	
22			AC INVERTER 2 AC BUS 1 sw - ON	AC INVERTER 2 AC BUS 1 - ON lt on	
23			AC INVERTER 2 AC BUS 2 sw - ON	AC INVERTER 2 AC BUS 2 - ON lt on	
24			AC INVERTER AC BUS 1 RESET sw - RESET and release	AC INVERTER AC BUS 1 - RESET lt on, out as released, ON lt on	

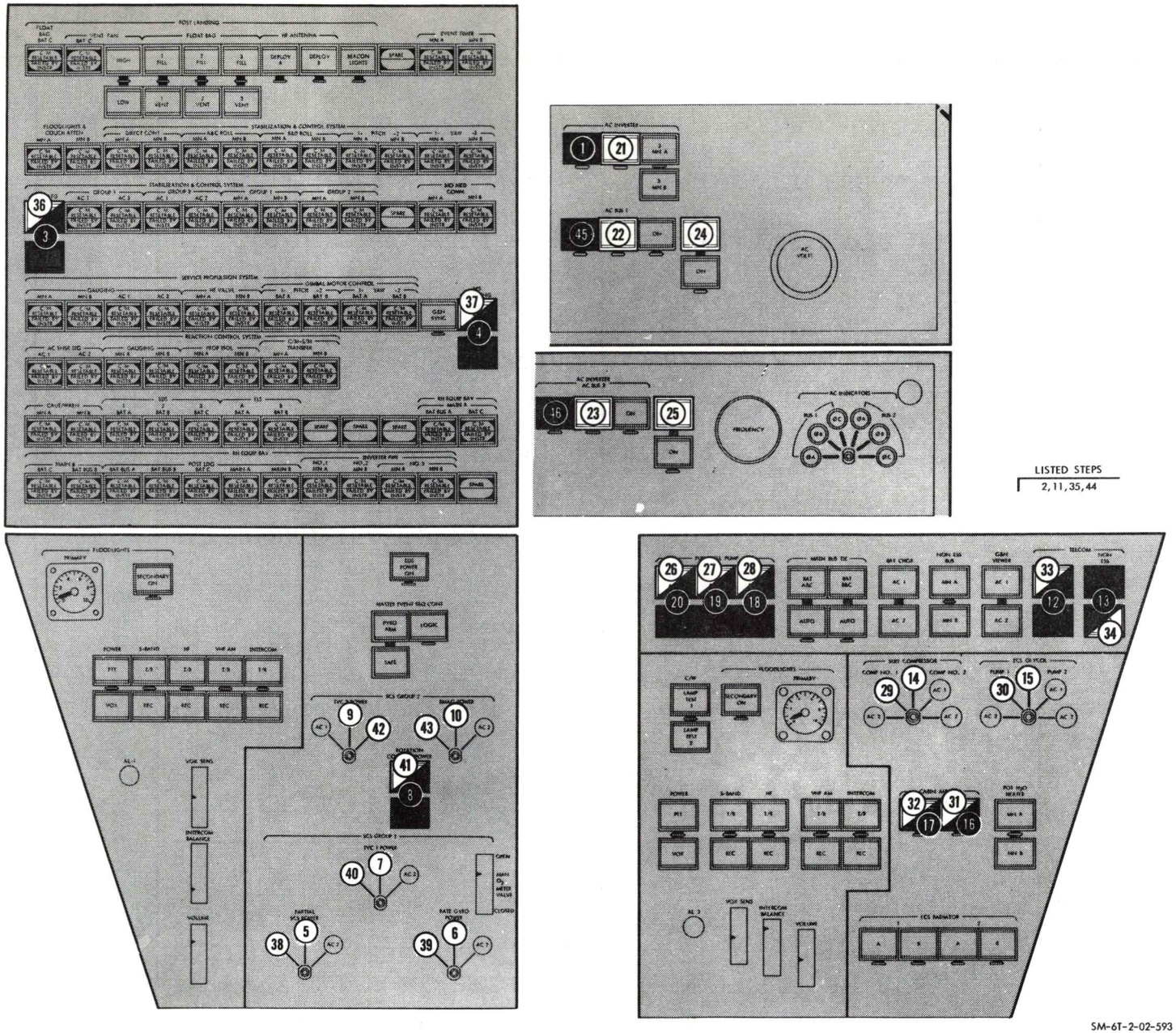


Single-Inverter Changeover

MEP. 13

IOS DATA SHEET

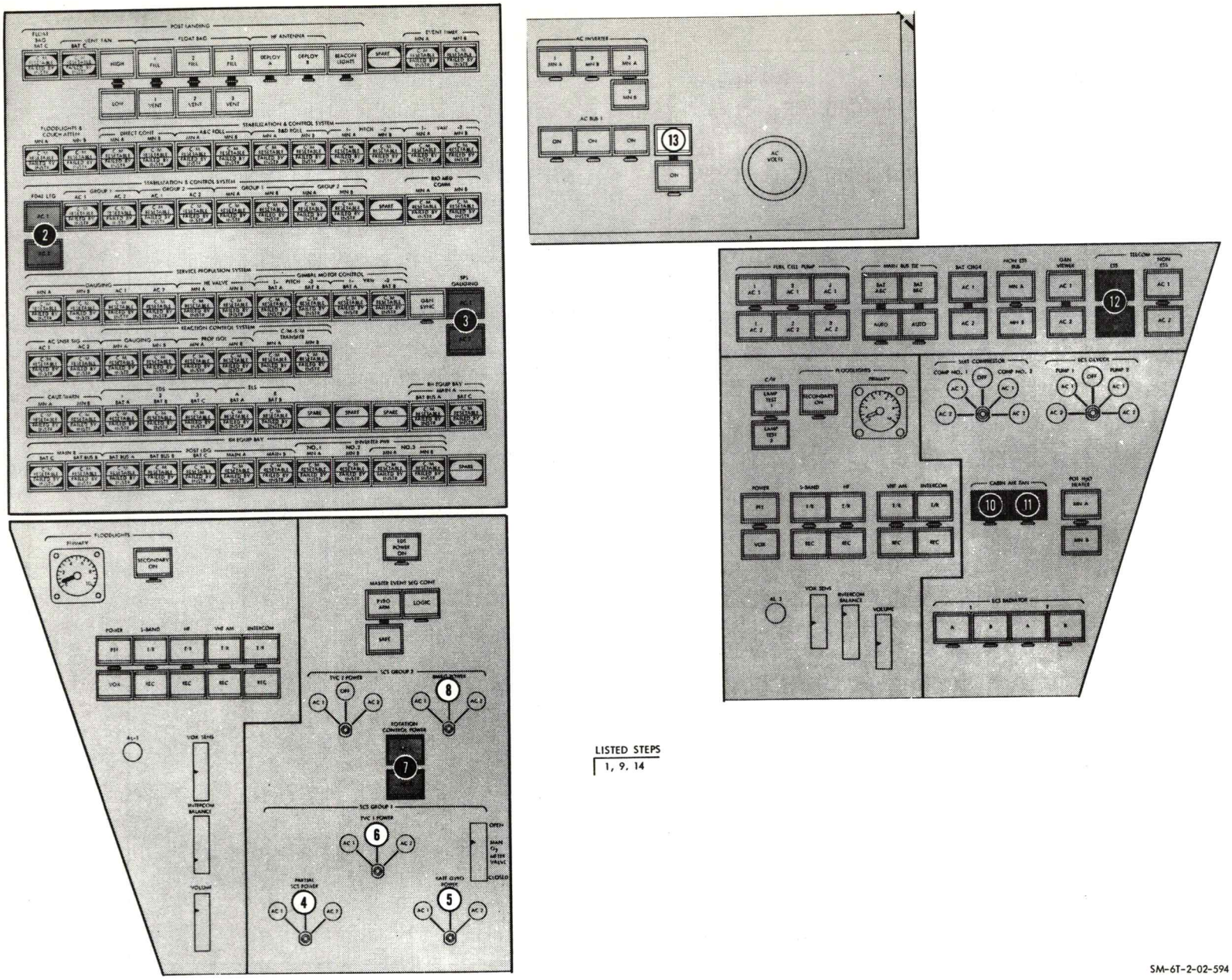
Step	Malf	Time	Function	IOS Visibility/Action	Notes
25			AC 1 INVERTER AC BUS 2 RESET sw - RESET and release	AC INVERTER AC BUS 2 - RESET lt on, out as released, ON lt on	
26-34			Seat 3, Bus Connect		
26			FUEL CELL PUMP 1 sw - AC 1	FUEL CELL PUMP 1 AC 1 lt on	
27			FUEL CELL PUMP 2 sw - AC 1	FUEL CELL PUMP 2 AC 1 lt on	
28			FUEL CELL PUMP 3 sw - AC 1	FUEL CELL PUMP 3 AC 1 lt on	
29			SUIT COMPRESSOR sw - COMP 1 AC 1	SUIT COMPRESSOR - COMP NO. 1 AC 1 lt on	
30			ECS GLYCOL sw - PUMP 1 AC 1	ECS GLYCOL PUMP 1 - AC 1 lt on	
31			CABIN AIR FAN 2 sw - ON	CABIN AIR FAN 2 - ON 1 lt on	
32			CABIN AIR FAN 1 sw - ON	CABIN AIR FAN - 1 ON lt on	
33			TELCOM ESS sw - AC 1	TELCOM ESS - AC 1 lt on	
34			TELCOM NON ESS AC sw - AC 2	TELCOM NON ESS sw - AC 2 lt on	



Single-Inverter Changeover

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
*35			Request seat 1, connect a-c loads	Monitor intercom	
36-44			Seat 1, Bus Connect		
36			FDAI 1 LTG sw - AC 1	FDAI LTG - AC 1 lt on	
37			SPS GAUGING sw - AC 1	SPA GAUGING - AC 1 lt on	
38			PARTIAL SCS POWER sw - ON	PARTIAL SCS POWER - AC 1 lt on	
39			RATE GYRO POWER sw - ON	RATE GYRO POWER - AC 1 lt on	
40			TVC 1 POWER sw - AC 1	TVC POWER sw - AC 1 lt on	
41			ROTATIONAL CONTROL POWER sw - AC 1	ROTATIONAL CONTROL POWER - AC 1 lt on	
42			TVC 2 POWER sw - AC 2	TVC 2 POWER - AC 2 lt on	
43			BMAG POWER sw - AC 1	BMAG POWER - AC 1 lt on	
44			Confirm seat 1, switching complete	Monitor intercom	
45			AC INVERTER 1 AC BUS 1 sw - OFF	AC INVERTER 1 AC BUS 1 - ON lt out	
46			AC INVERTER 1 AC BUS 2 sw - OFF	AC INVERTER 1 AC BUS 2 - ON lt out	



LISTED STEPS
1, 9, 14

SM-6T-2-02-594

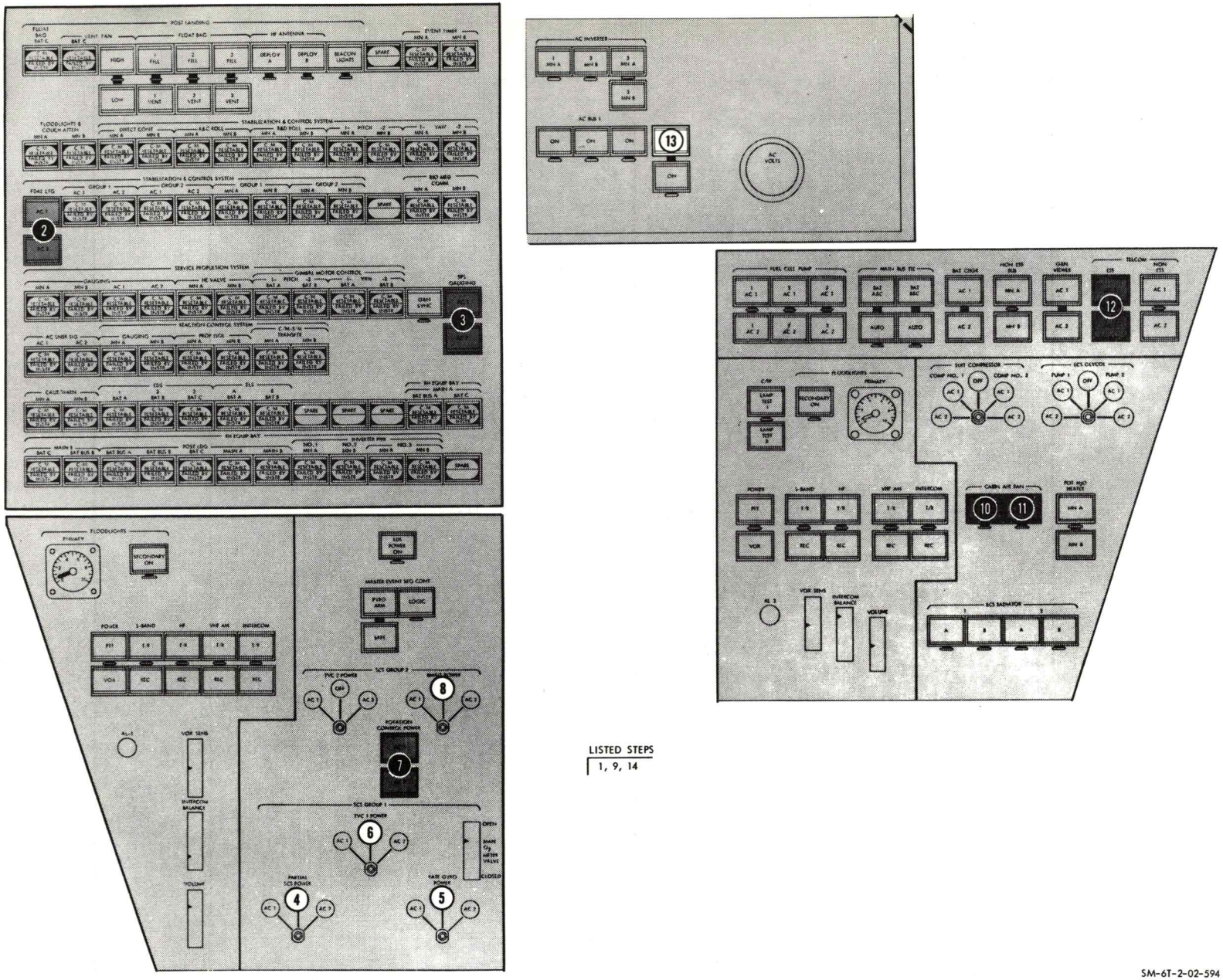
Bus Reset

MEP. 14

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Disconnect Loads		
*1			Request seat 1, remove loads from bus 1	Monitor intercom	
2-7			Seat 1, Remove Loads		
2			FDAI LTG sw - OFF	FDAI LTG lt out	
3			SPS GAUGING sw - OFF	SPS GAUGING lt out	
4			PARTIAL SCS POWER sw - OFF	PARTIAL SCS POWER - OFF lt on	
5			RATE GYRO POWER sw - OFF	RATE GYRO POWER - OFF lt on	
6			TVC 1 POWER sw - OFF	TVC 1 POWER - OFF	
7			ROTATIONAL CONTROL POWER sw - OFF	ROTATIONAL CONTROL POWER - OFF lt on	
8			BMAG POWER sw - OFF		
*9			Confirm seat switching complete	Monitor intercom	
			Seat 3, Remove Loads		
10			CABIN AIR FAN 1 sw - OFF	CABIN AIR FAN - 1 ON lt out	

Bus Reset



LISTED STEPS

1, 9, 14

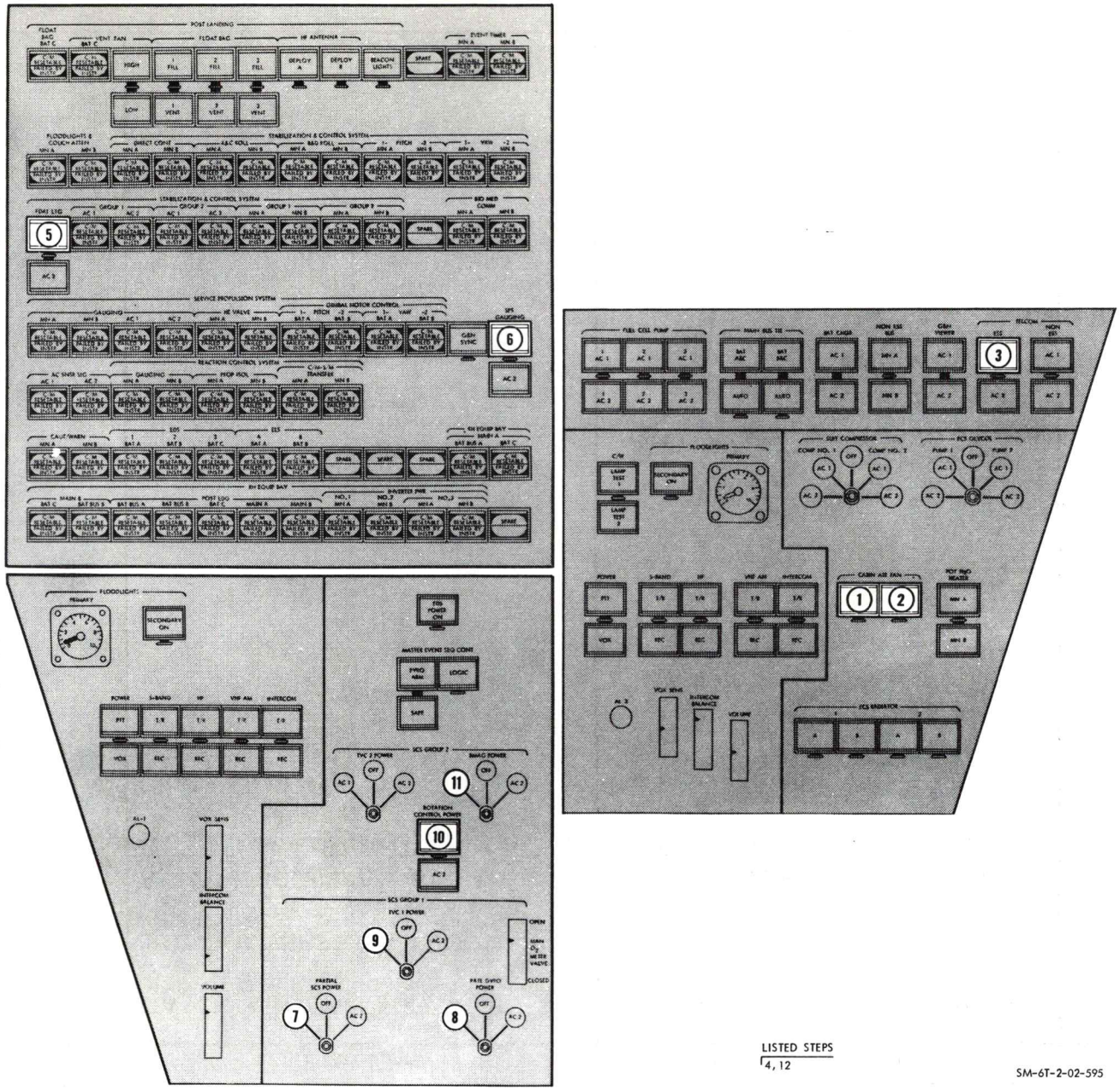
SM-6T-2-02-594

Bus Reset

MEP. 14

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
11			CABIN AIR FAN 2 sw - OFF	CABIN AIR FAN - 2 ON lt out	
12			TELCOM ESS sw - OFF	TELCOM ESS lt out	
13			AC INVERTER AC BUS 1 RESET sw - RESET	AC INVERTER AC BUS 1 - RESET lt on, out as released	
*14			Check C&W lt	As programed	



Connect A-C Bus Loads to Bus 1

MEP. 15

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1-4			Seat 3 Connect Loads		
1			CABIN AIR FAN 1 sw - ON	CABIN AIR FAN - 1 ON lt on	
2			CABIN AIR FAN 2 sw - ON	CABIN AIR FAN - 2 ON lt on	
3			TELCOM ESS T/C sw - AC 1	TELCOM ESS T/C - AC 1 lt on	
*4			Request seat 1, connect loads to bus 1	Monitor intercom	
5-10			Seat 1 Connect Loads		
5			FDAI LTG sw - AC 1	FDAI LTG - AC 1 lt on	
6			SPS GAUGING sw - AC 1	SPS GAUGING - AC 1 lt on	
7			PARTIAL SCS POWER sw - ON	PARTIAL SCS POWER - AC 1 lt on	
8			RATE GYRO POWER sw - ON	RATE GYRO POWER - AC 1 lt on	
9			TVC 1 POWER sw - AC 1	TVC 1 POWER - AC 1 lt on	
10			ROTATIONAL CONTROL POWER sw - AC 1	ROTATIONAL CONTROL POWER - AC 1 lt on	
11			BMAG POWER sw - AC 1	BMAG POWER - AC 1 lt on	
12			Confirm switching complete	Monitor intercom	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Connect Loads		
1			Connect loads one at a time to a-c bus 1	Bus selection lt activity per MEP. 15	
2			Check C&W lt	As programed	
			No Overload Indication		
3			Continue connecting load	Bus selection lt activity	
			Overload Indication		
4			Disconnect offending load	Affected circuit disconnect lt on	
5			AC INVERTERS AC BUS 1 RESET sw - RESET	AC INVERTER AC BUS 1 - RESET lt on, out as released, ON lt on	
6			Connect remaining loads	STA 3 bus selection lt activity per MEP. 15	
7			Request seat 1 connect loads to bus 1	STA 1 bus selection lt activity per MEP. 15	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			A-C Bus 1 Fail Light On		
1			Complete a-c bus check	MEP. 10	
			Bus Readings Normal		
2			Request MSFN verification of normal bus readings	Defective bus sensing circuits	
			Bus Readings Abnormal		
3			Complete critical loads bus transfer	MEP. 11	
4			Complete inverter changeover	MEP. 12	
5			Complete bus 1 connect	MEP. 15	
6			AC INVERTER 1 AC BUS 1 sw - OFF	AC INVERTER 1 AC BUS 1 - ON lt out	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			A-C Bus 1 Fail and A-C Bus 2 Fail Lights On		
1			Complete A-C bus check	MEP. 10	
			Bus Readings Normal		
2			Confirm normal readings with MSFN	Defective bus sensing circuits provide appropriate communication	
			Bus Readings Abnormal		
3			Complete inverter changeover procedures	Continue with single-inverter changeover procedures MEP. 13	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			A-C Bus 1 Overload and A-C Bus 1 Fail Lights On		
1			Complete a-c bus check	MEP. 10	
			Bus Readings Normal		
2			Confirm normal readings with MSFN	Defective sensing circuits, provide appropriate communication	
			Bus Readings Abnormal		
3			Complete critical loads	MEP. 11	
			Transfer procedures		
			Dual inverter changeover	MEP. 12 or MEP. 13	
4			Complete bus reset procedures	MEP. 14	
5			Complete overload isolation procedures	MEP. 16	

Bus 1 Overload and A-C Bus 1 Fail Lights Illuminate

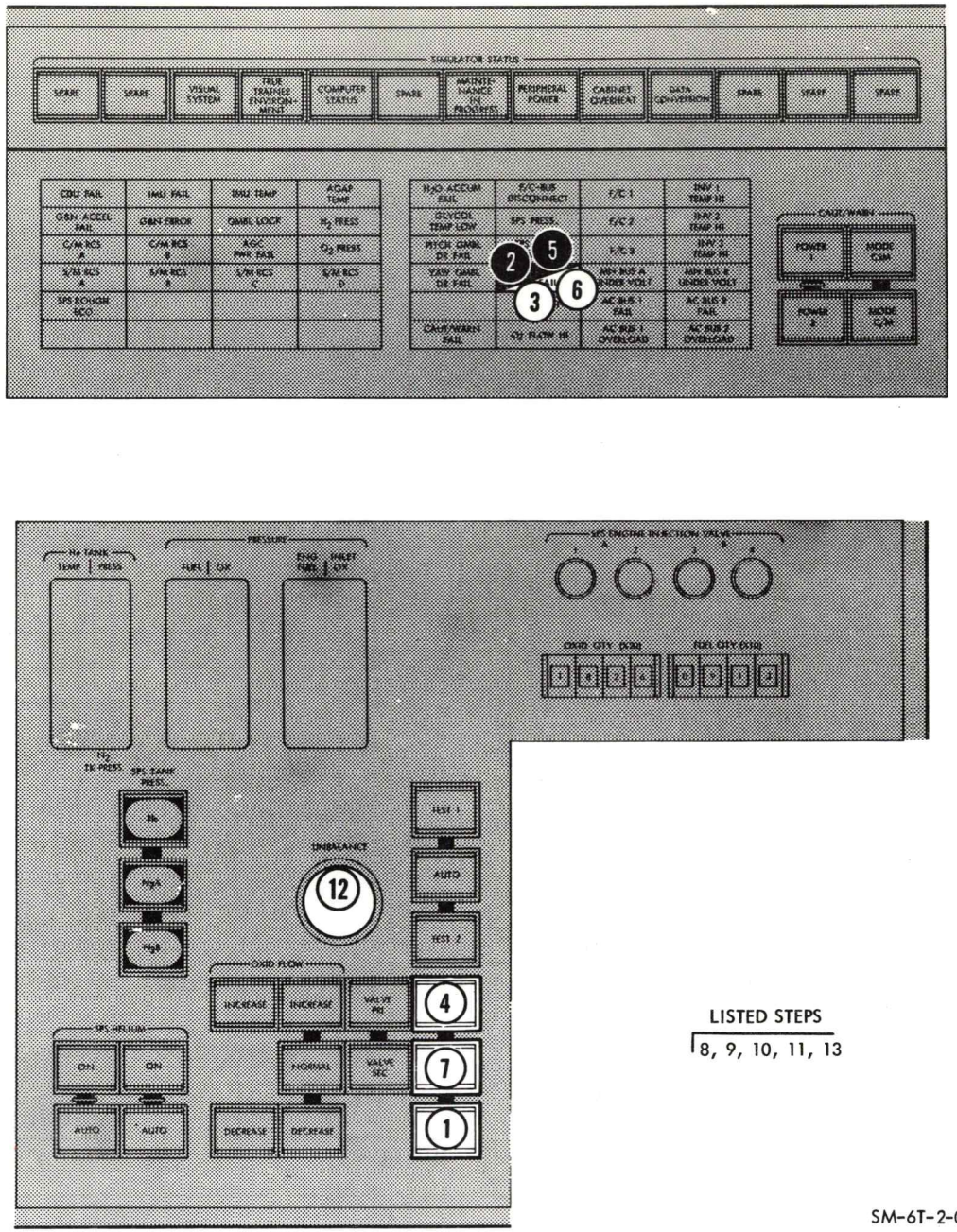
MEP. 22

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			A-C Bus 1 Overload and A-C Bus 1 Fail Lights On		
1			Complete a-c bus check	MEP. 10	
			Bus Readings Normal		
2			Confirm normal reading with MSFN	Defective sensing circuits, provide appropriate communication	
			Bus Readings Abnormal		
3			Complete bus reset procedures	MEP. 14	
4			Overload light re-illuminates	Bus out	
5			Overload light remains out	Continue with overload isolation check MEP. 16	

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
			Inverter 1 Temperature High Light On		
1			Complete a-c bus check	MEP. 10	
2			Verify temperature conditions with MSFN	Provide appropriate communication	
3			Temperature normal	Sensing unit out	
4			Temperature abnormal	Continue check	
5			Complete critical loads transfer procedures	MEP. 11	
6			Complete dual inverter changeover procedures	MEP. 12	
7			Complete bus connect procedures	MEP. 15	
8			AC INVERTER 1 AC BUS 1 sw - OFF	AC INVERTER 1 AC BUS 1 - ON lt out	



LISTED STEPS

8, 9, 10, 11, 13

SM-6T-2-02-637

SPS PU SENSOR FAIL Light Illuminates

MSP. 01

IOS DATA SHEET

Step	Malf	Time	Function	IOS Visibility/Action	Notes
1			SENSOR sw - AUX	SENSOR AUX lt on	
2			SPS PU SENSOR FAIL lt out	Propellant quantity operable on aux sensors only	
3			SPS PU SENSOR FAIL lt on	Continue check	
4			SENSOR sw - PRI	SENSOR PRI lt on	
5			SPS PU SENSOR FAIL lt out	Propellant quantity operable on aux sensors only	
6			SPS PU SENSOR FAIL lt on	Continue check	
7			SENSOR sw - NORM	SENSOR NORM lt on	
*8			Check quantity digital inds for operation	SP3.01	
*9			Operation abnormal	Propellant quantity display out	
*10			Request quantity data from MSFN	Provide appropriate data	
*11			Operation normal	Continue check	
*12			Check unbalance ind	As programed	
*13			Maintain balance with OX FLOW sw as required	OXID FLOW - INCREASE, DECREASE, and NORM lt, as selected	

SPS PU SENSOR FAIL Light Illuminates

MSP.01

5 MALFUNCTION DATA

SECTION 5

MALFUNCTION DATA

This section of Volume II of the AMS Instructor Handbook contains a complete list of the spacecraft malfunctions simulated in the initial delivered configuration of the AMS. The malfunctions are identified by MIU number and descriptive title, and are individually supported with descriptions of the manner of manifestation to the crew (and instructor) and appropriate crew response information. The malfunction lists are broken into systems, and malfunctions listed in the tables are also illustrated in the respective system flow diagrams provided in section 2 (Simulator Systems) of Volume I. Procedures for programing simulated malfunctions into the AMS are included in section 1 (AMS Operation) of this volume.

This section of the handbook also includes several lists of malfunctions identified as "malfunction selection sets." Malfunction selection sets are preselected groups of simulated malfunctions which may be used interchangeably for purposes of inducing a variety of training situations with respect to specific crew procedures. Malfunction selection sets also identify the AOH procedure and related IOS data sheet to be used in conjunction with each listed malfunction.

Table 5-1. S-IVB Control System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Pitch attitude error gain fails. (CP-144)	No pitch attitude control reflected on FDAI.	Confirm with MSFN and initiate abort or manually control attitude.
Yaw attitude error gain fails. (CP-145)	No yaw attitude control reflected on FDAI.	Same as CP-144.
Pitch rate gyro gain fails. (CP-146)	Pitch attitude instability reflected on FDAI.	Same as CP-144.
Yaw rate gyro gain fails. (CP-147)	Yaw attitude instability reflected on FDAI.	Same as CP-144.
Roll attitude error gain fails. (CP-162)	No roll attitude control reflected on FDAI.	Same as CP-144.
Roll rate gyro gain fails. (CP-163)	Roll attitude instability reflected on FDAI.	Same as CP-144.
Pitch channel pseudo rate modulation system (PRMS) filter feedback fails. (CP-167)	Loss of pitch channel limit cycle deadband reflected on FDAI.	Same as CP-144.
Pitch channel PRMS summing network fails. (CP-170)	FDAI reflects loss of pitch stability.	Same as CP-144.
Roll-yaw channel PRMS filter feedback fails. (CP-171)	Loss of roll and yaw limit cycle deadband reflected on FDAI.	Same as CP-144.

Table 5-1. S-IVB Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Roll-yaw channel PRMS summing network fails. (CP-172)	Loss of yaw and roll stabilization reflected on FDAI.	Same as CP-144
Roll-yaw channel PRMS filter feedback fails (identical to CP-171). (CP-173)	Loss of roll and yaw limit cycle deadbands displayed on FDAI.	No data available.
Roll-yaw channel PRMS summing network fails (identical to CP-172). (CP-174)	FDAI reflects loss of roll and yaw stability.	Same as CP-144.
Pitch channel PRMS filter fails. (CP-175)	FDAI displays loss of pitch channel deadband.	No data available.
Roll-yaw channel PRMS filter fails. (CP-176)	Loss of pitch channel deadband reflected on FDAI.	No data available.
Roll-yaw channel PRMS filter fails. (CP-177)	Loss of roll and yaw deadbands reflected on deadband.	No data available.
Engine 1 ignition fails. (CP-211)	FDAI displays loss of pitch control.	Same as CP-144.
Engine 2 ignition fails. (CP-212)	FDAI displays loss of pitch control.	Same as CP-144.

Table 5-1. S-IVB Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Engine 3 ignition fails. (CP-213)	FDAI displays reduced (-) yaw control and increased yaw-roll cross-coupling.	Same as CP-144.
Engine 4 ignition fails. (CP-214)	FDAI displays reduced (+) yaw control and increased yaw-roll cross-coupling.	Same as CP-144.
Engine 5 ignition fails. (CP-215)	FDAI displays increased yaw-roll cross-coupling and reduced (-) yaw control.	Same as CP-144.
Engine 6 ignition fails. (CP-216)	FDAI displays increased yaw-roll cross-coupling and reduced (+) yaw control.	Same as CP-144.
Auxiliary propulsion system (APS) quad No. 1 fuel leak. (CP-221)	FDAI indicates loss of attitude control due to premature S-IVB propellant runout.	No data available.
APS quad No. 2 fuel leak. (CP-222)	FDAI indicates loss of attitude control due to premature S-IVB propellant runout.	No data available.

Table 5-2. Stabilization and Control System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Yaw rate gyro - fails to zero. (SC-001)	FDAI yaw rate needle remains at zero during yaw attitude maneuvers. FDAI ball indicates excessive yaw during yaw attitude maneuvers.	Place RATE GYRO switch in upper position. Prepare G&N system for operation. Place G&N/SCS switch in G&N position.
Yaw BMAG - fails to zero. (SC-002)	FDAI ball indicates yaw axis rotation. FDAI yaw rate needle indicates yaw rate. FDAI yaw error needle remains at zero with ATT SET/OFF switch in ATT SET or OFF positions. YAW GIMBAL position indicator assumes maximum displacement reading.	Employ G&N mode or MTVC for SPS thrusting.
Pitch BMAG - fails to zero. (SC-003)	FDAI ball fails to indicate pitch attitude command changes. FDAI pitch error needle fails to respond to rotation control pitch changes with ATT SET/OFF switch in ATT SET position. FDAI pitch error needle fails to indicate pitch deadband error with ATT SET/OFF switch in OFF position.	Prepare G&N system for operation. Place G&N/SCS switch in G&N position.
Pitch rate gyro - fails to zero. (SC-004)	FDAI pitch rate needle remains at zero during pitch attitude maneuvers. FDAI ball indicates excessive pitch rates during pitch attitude maneuvers.	Place RATE GYRO PITCH switch in BMAG position. Prepare G&N system for operation. Place G&N/SCS switch in G&N position or select pitch backup rate configuration.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Roll rate gyro - fails to zero. (SC-010)	FDAI roll rate needle remains at zero during roll attitude maneuvers. FDAI ball indicates excessive roll rates during roll attitude maneuvers.	Place RATE GYRO ROLL switch in BMAG position. Prepare G&N system for operation. Place G&N/SCS switch in G&N position, or select roll backup rate configuration.
Roll BMAG gyro - fails to zero. (SC-011)	FDAI ball fails to indicate roll attitude command changes. FDAI roll error needle fails to respond to rotation control changes with ATT SET/OFF switch in ATT SET position. FDAI roll error needle fails to indicate roll deadband error with ATT SET/OFF switch in OFF position.	Prepare G&N system for operation. Place G&N/SCS switch in G&N position or control S/C manually.
Pitch gimbal position indicator demodulator - fails to zero. (SC-012)	PITCH GIMBAL position indicator reads null (0°). FDAI ball indicates normal pitch readiness. FDAI pitch rate needle indicates normal pitch rate. FDAI pitch error needle indicates normal pitch error.	Continue to monitor FDAI if malfunction occurs during SPS thrusting. Discontinue SPS thrust preparation if malfunction occurs during SPS thrust preparation.
Yaw gimbal position indicator demodulator - fails to zero. (SC-013)	YAW GIMBAL position indicator reads null (4°). FDAI ball indicates normal yaw readings. FDAI yaw rate needle indicates normal yaw rate. FDAI yaw error needle indicates normal yaw error.	Same as SC-012.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
SCS accelerometer - fails to zero. (SC-014)	Delta V counter does not count down.	Manually terminate SPS engine ignition.
Open G&N min. impulse enable. (SC-016)	Selected RCS engines do not fire when hand controller is moved (indicated by no response on FDAI ball).	Use rotation hand controller to position spacecraft during navigational sightings.
Attitude gyro coupler unit fails. (SC-017)	FDAI ball does not drive in any axis during SCS attitude maneuvers.	Select G&N mode of operation.
Pitch switch amplifier - fails to zero. (SC-020)	FDAI ball fails to indicate pitch attitude changes during pitch rotation commands. FDAI ball indicates pitch attitude drift exceeding deadband limits.	Place DIRECT RCS switch to DIRECT RCS position.
Open monitor mode select. (SC-021)	None	None
Open SCS attitude mode select. (SC-022)	None	Select G&N attitude control mode.
Open G&N attitude mode select. (SC-024)	None	Select SCS attitude control mode.
Open SCS delta V mode select. (SC-025)	None	Select G&N delta V control mode.
Open G&N delta V mode select. (SC-026)	None	Select SCS delta V control mode.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Open SCS entry mode select. (SC-027)	None	Select G&N entry mode.
Open G&N entry mode select. (SC-030)	None	Select SCS entry mode.
Yaw switch amplifier - fails to zero. (SC-031)	FDAI ball fails to indicate yaw attitude changes during yaw rotation commands. FDAI ball indicates yaw attitude drift exceeding deadband limits.	Place DIRECT RCS switch to DIRECT RCS position. Maintain vehicle attitude hold with rotation control.
Open pitch axis engage. (SC-032)	FDAI ball fails to respond to pitch commands. FDAI ball indicates pitch attitude drift exceeding deadband limits. FDAI pitch error needle indicates increasing pitch error with ATT SET/OFF switch in OFF position.	Control and maintain pitch axis attitude using proportion control.
Open yaw axis engage. (SC-033)	FDAI ball fails to respond to yaw commands. FDAI ball indicates yaw attitude drift exceeding deadband limits.	Same as SC-032.
Open roll axis engage - A&C. (SC-034)	FDAI ball fails to respond to rotation control roll axis command with DIRECT RCS switch in OFF position. FDAI roll rate needle fails to respond to rotation control roll axis commands with DIRECT RCS switch in OFF position.	Place SCS CHANNEL B&D ROLL switch to B&D ROLL position. Place SCS CHANNEL A&C ROLL switch to OFF position.
Open roll axis engage - B&D. (SC-035)	Same as SC-034.	Place SCS CHANNEL A&C ROLL switch to OFF position.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
		Place SCS CHANNEL B&D ROLL switch to B&D ROLL position.
Open 0.05 g entry control mode. (SC-036)	No effect unless automatic switching function fails. If failed, no gain or scale change on FDAI using BACK-UP switch.	None
Open minimum deadband select. (SC-037)	FDAI pitch, yaw, and roll error needles exceed minimum deadband limits with ATT DEADBAND switch in MIN position and ATT SET/OFF switch in OFF position.	Employ rotation control with DIRECT RCS switch in OFF position to maintain desired attitude deadband.
Roll switching amplifier - fails to zero. (SC-040)	FDAI ball fails to indicate roll attitude changes during roll rotation commands. FDAI ball indicates roll attitude drift exceeding deadband limits.	Place DIRECT RCS switch to DIRECT RCS position. Maintain vehicle attitude hold with rotation control.
Reaction jet 1 fails on (C/M or S/M). (SC-041)	FDAI ball indicates uncommanded pitch axis rotation. FDAI pitch rate needle indicates same pitch rate. FDAI pitch error needle indicates pitch error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL PITCH switch to OFF position. Place DIRECT RCS switch to DIRECT RCS position. Control vehicle attitude with rotation control.
Reaction jet 1 fails off (C/M or S/M). (SC-042)	Slow FDAI response to + pitch rotation commands. Translation in the +X direction also causes a slow ± pitch movement.	Make allowances for slow pitch reaction time in manual maneuvers.
Reaction jet 2 fails on (C/M or S/M). (SC-043)	Same as SC-041.	Same as SC-041.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Reaction jet 2 fails off (C/M or S/M). (SC-044)	Slow FDAI response to - pitch rotation commands. Translation in the +X direction also causes a slow - pitch movement.	Same as SC-042.
Reaction jet 3 fails on (C/M or S/M). (SC-045)	Same as SC-041.	Same as SC-041.
Reaction jet 3 fails off (C/M or S/M). (SC-046)	Same as SC-042.	Same as SC-042.
Reaction jet 4 fails on (C/M or S/M). (SC-047)	Same as SC-041.	Same as SC-041.
Pitch rate gyro - fails to maximum output. (SC-050)	FDAI pitch rate needle reads max. FDAI pitch attitude error needle indicates pitch deadband exceeded.	Set RATE GYRO - PITCH switch to BMAG. Select G&N mode.
Reaction jet 4 fails off (C/M or S/M). (SC-051)	Same as SC-044.	Same as SC-042.
Reaction jet 5 fails on (C/M or S/M). (SC-052)	FDAI indicates uncommanded yaw rotation. FDAI yaw rate needle indicates same pitch rate. FDAI yaw error needle indicates yaw error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL - PITCH switch to OFF. Place DIRECT RCS switch to DIRECT RCS. Control vehicle attitude manually.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Reaction jet 5 fails off (C/M or S/M). (SC-053)	Slow FDAI response to + yaw rotation commands. Translation in the +X direction also causes a slow - yaw movement.	Make allowances for slow yaw reaction time in manual maneuvers.
Reaction jet 6 fails on (C/M or S/M). (SC-054)	Same as SC-052.	Same as SC-052.
Reaction jet 6 fails off (C/M or S/M). (SC-055)	Slow FDAI response to - yaw rotation commands. Translation in the +X direction also causes a slow + yaw movement.	Same as SC-053.
Reaction jet 7 fails on (C/M or S/M). (SC-056)	Same as SC-052.	Same as SC-052.
Reaction jet 7 fails off (C/M or S/M). (SC-057)	Slow FDAI response to + yaw rotation commands. Translation in the -X direction also causes a slow - yaw movement.	Same as SC-053.
Yaw rate gyro - fails to maximum. (SC-060)	FDAI yaw rate needle reads max. FDAI pitch attitude error needle indicates yaw deadband exceeded.	Set RATE GYRO - YAW switch to BMAG. Select G&N mode.
Reaction jet 8 fails on (C/M or S/M). (SC-061)	Same as SC-052.	Same as SC-052.
Reaction jet 8 fails off (C/M or S/M). (SC-062)	Slow response to - yaw rotation commands. Translation in the -X direction also causes a slow + yaw.	Same as SC-053.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Reaction jet 9 fails on (C/M or S/M). (SC-063)	FDAI indicates uncommanded roll rotation. FDAI roll rate needle indicates some roll rate. FDAI roll error needle indicates roll error with ATT SET/OFF switch in the OFF position.	Place SCS CHANNEL - ROLL switch to OFF. Place DIRECT RCS switch to DIRECT RCS. Control vehicle attitude manually.
FDAI attitude ball malfunctions. (SC-067)	FDAI attitude ball does not drive in any axis.	Monitor FDAI and rate indicator to maintain spacecraft attitude.
Roll rate gyro - fails to max. (SC-070)	FDAI roll rate needle indicates maximum rate. FDAI ball indicates uncommanded roll axis rotation. FDAI roll error needle indicates roll error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL A&C ROLL switch to OFF position. Place RATE GYRO ROLL switch to BMAG position. Place SCS A&C ROLL switch to A&C position. Prepare G&N system for operation. Place G&N/SCS switch to G&N position.
FDAI roll error meter fails. (SC-071)	FDAI roll error needle reads zero during attitude maneuvers with RATE GYRO switch in NORMAL and BMAG positions.	Monitor FDAI ball roll axis for roll error during roll axis maneuvers.
FDAI yaw error meter fails. (SC-072)	FDAI yaw error needle reads zero during and after yaw attitude maneuvers with ATT SET/OFF switch in ATT SET and OFF positions.	Monitor FDAI ball yaw axis and FDAI yaw rate needle to determine attitude error.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
FDAI pitch rate meter fails. (SC-073)	FDAI pitch rate needle reads zero during attitude maneuvers.	Monitor FDAI ball pitch axis for pitch rate during attitude maneuvers.
FDAI roll rate meter fails. (SC-074)	FDAI roll rate needle reads zero during roll attitude maneuvers.	Monitor FDAI ball roll axis for roll rate during attitude maneuvers.
FDAI yaw rate meter fails. (SC-075)	FDAI yaw rate needle reads zero during attitude maneuvers.	Monitor FDAI ball yaw axis for yaw rate during attitude maneuvers.
Rotational control + roll microswitch fails. (SC-076)	FDAI does not indicate + roll vehicle rotation when commanded using controller 1.	Use alternate rotation controller.
Rotational control - pitch microswitch. (SC-077)	FDAI does not indicate - pitch vehicle rotation using controller.	Use alternate rotation controller.
Rotational control + yaw microswitch. (SC-100)	FDAI does not indicate + yaw vehicle rotation using controller.	Use alternate rotation controller.
Minimum impulse control - roll microswitch. (SC-101)	FDAI indicates no vehicle rotation in commanded direction.	Use rotation controller to position vehicle.
Minimum impulse control - yaw microswitch. (SC-102)	FDAI indicates no vehicle rotation in commanded direction.	Use rotation controller to position vehicle.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
Pitch gimbal drive fails. (SC-103)	PITCH GIMBAL DR FAIL MASTER ALARM Audio tone in C/M headsets.	On On	Monitor FDAI ball, rate needles, error needles, and PITCH GIMBAL position indicator.
Yaw gimbal drive fails. (SC-104)	YAW GIMBAL DR FAIL MASTER ALARM Audio tone in C/M headsets.	On On	Monitor FDAI ball, rate needles, error needles, and PITCH GIMBAL position indicator.
AGAP HEATER FAILURE (SC-105)	AGAP TEMP Smoke emitted from upper left main instrument panel. MASTER ALARM Audio tone in C/M headsets.	On On	Turn off AGAP.
Reaction jet 9 fails off (C/M or S/M). (SC-106)	Slow FDAI response to + roll commands. +Z translations will also cause a roll movement.		Make allowances for slow roll response time and for roll during Z-axis translation.
Reaction jet 10 fails on (C/M or S/M). (SC-107)	FDAI ball indicates uncommanded roll rotation. FDAI roll rate needle indicates some roll rate. FDAI roll error needle indicates roll error with ATT SET/OFF switch in OFF position.		Place SCS CHANNEL - ROLL B&D switch to OFF. Place DIRECT RCS switch to DIRECT RCS. Control vehicle attitude manually using rotation control.
Reaction jet 10 fails off (C/M or S/M). (SC-111)	Slow FDAI response to - roll commands. +Z translation also causes a roll movement.		Same as SC-106.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Reaction jet 11 fails on (C/M or S/M). (SC-112)	Same as SC-107.	Same as SC-107.
Reaction jet 11 fails off (C/M or S/M). (SC-113)	Same as SC-106.	Same as SC-106.
Reaction jet 12 fails on (C/M or S/M). (SC-114)	Same as SC-107.	Same as SC-107.
Reaction jet 12 fails off (C/M or S/M). (SC-115)	Same as SC-111.	Same as SC-106.
S/M reaction jet 13 fails on. (SC-116)	Same as SC-107.	Place SCS CHANNEL - ROLL A&C switch to OFF. Place DIRECT RCS switch to DIRECT RCS. Control vehicle attitude manually using rotation control.
S/M reaction jet 13 fails off. (SC-117)	Slow FDAI response to + roll commands. +Y translations also cause a - roll movement.	Make allowances for slow roll response time and for roll during Y-axis translations.
S/M reaction jet 14 fails on. (SC-121)	Same as SC-107.	Same as SC-116.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
S/M reaction jet 14 fails off. (SC-122)	Slow FDAI response to - roll commands. +Y translations also cause a + roll movement.	Same as SC-117.
S/M reaction jet 15 fails on. (SC-123)	Same as SC-107.	Same as SC-116.
S/M reaction jet 15 fails off. (SC-124)	Slow FDAI response to + roll commands. -Y translations also cause a - roll movement.	Same as SC-117.
S/M reaction jet 16 fails on. (SC-125)	Same as SC-107.	Same as SC-116.
S/M reaction jet 16 fails off. (SC-126)	Slow FDAI response to - roll commands. -Y translations also cause a + roll movement.	Same as SC-117.
Pitch rotation hand control demodulator fails - zero output. (SC-133)	FDAI ball fails to indicate pitch attitude changes during pitch proportional rotation commands. FDAI pitch rate needle fails to respond to pitch proportional commands. FDAI pitch error needle assumes zero reading when rotation is commanded with ATT SET/ OFF switch in OFF position.	Place DIRECT RCS switch to DIRECT RCS position. Control vehicle attitude with rotation control.
Yaw rotation hand control demodulator fails - zero output. (SC-134)	FDAI ball fails to indicate yaw attitude changes. FDAI yaw rate and error needles remain at zero.	Same as SC-133.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item / MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Roll rotation hand control demodulator fails - zero output. (SC-135)	FDAI ball fails to indicate roll attitude changes. FDAI roll rate needle and roll error needle remain zeroed.	Same as SC-133.
Pitch G&N demodulator fails - zero output. (SC-136)	FDAI ball indicates uncorrected pitch attitude error with G&N ATT CONT, G&N DELTA V, or G&N ENTRY modes selected. FDAI error needle indicates pitch attitude drift exceeding deadband limits.	Place G&N/SCS switch to SCS position.
Yaw G&N demodulator fails - zero output. (SC-137)	FDAI ball indicates uncorrected yaw attitude error with G&N ATT CONT, G&N DELTA V, or G&N ENTRY modes selected. FDAI error needle indicates yaw attitude drift exceeding deadband limits.	Same as SC-136.
Roll G&N demodulator fails - zero output. (SC-140)	FDAI ball indicates uncorrected roll attitude error with G&N ATT CONT, G&N DELTA V, or G&N ENTRY modes selected. FDAI error needle indicates roll attitude drift exceeding deadband limits.	Same as SC-136.
Pitch BMAG demodulator fails - zero output. (SC-141)	FDAI ball indicates pitch attitude drift exceeding deadband limits. FDAI pitch error needle indicates excessive attitude error with ATT SET/OFF switch in OFF position.	Select G&N mode.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Yaw BMAG demodulator fails - zero output. (SC-142)	FDAI ball indicates yaw attitude drift exceeding deadband limits. FDAI yaw error needle indicates excessive attitude error with ATT SET/OFF switch in OFF position.	Select G&N mode.
Roll BMAG demodulator fails - zero output. (SC-143)	FDAI ball indicates roll attitude drift exceeding deadband limits. FDAI roll error needle indicates excessive attitude error with ATT SET/OFF switch in OFF position.	Select G&N mode.
Pitch rate error amplifier fails - zero output. (SC-144)	FDAI indicators fail to respond to pitch axis proportional commands by either rotation control. FDAI pitch rate needle indicates excessive pitch rotational rate during G&N commanded maneuvers.	Place DIRECT RCS switch to DIRECT RCS position. Control vehicle attitude with rotation control.
Yaw rate error amplifier fails - zero output. (SC-145)	FDAI indicators fail to respond to yaw axis proportional commands by either hand control. FDAI yaw rate needle indicates excessive yaw rotational rate during G&N commanded maneuvers.	Place DIRECT RCS switch to DIRECT RCS position. Control vehicle attitude with rotation control.
Roll rate error amplifier fails - zero output. (SC-146)	FDAI fails to respond to roll axis proportional commands by both rotation controls. FDAI roll rate needle indicates excessive roll rotational rate during G&N commanded maneuvers.	Place DIRECT RCS switch to DIRECT RCS position. Control vehicle attitude with rotation control.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Pitch switching amplifier fails - maximum output. (SC-152)	FDAI ball indicates uncommanded pitch rotation. FDAI pitch rate needle indicates maximum rate. FDAI pitch error needle indicates excessive attitude error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL PITCH switch to OFF position. Place DIRECT RCS switch to DIRECT RCS position. Control vehicle attitude with rotation control.
Yaw switching amplifier fails - maximum output. (SC-153)	FDAI ball indicates uncommanded yaw rotation. FDAI yaw rate needle indicates maximum rate. FDAI yaw error needle indicates excessive attitude error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL YAW switch to OFF position. Place DIRECT RCS switch to DIRECT RCS position. Control vehicle attitude with rotation control.
Roll switching amplifier fails - maximum output. (SC-154)	FDAI ball indicates uncontrolled roll rotation. FDAI roll needle indicates maximum rate. FDAI roll error needle indicates excessive attitude error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL A&C ROLL and B&D ROLL switches to OFF position. Place DIRECT RCS switch to DIRECT RCS position. Control vehicle attitude with rotation control.
Pitch BMAG fails - maximum output. (SC-161)	FDAI ball indicates uncommanded pitch rotation. FDAI pitch rate needle indicates pitch rotation. FDAI pitch error needle indicates excessive attitude error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL PITCH switch to OFF position. Place DIRECT RCS switch to DIRECT RCS position for manual direct control of vehicle attitude in SCS mode or place G&N SCS switch to G&N position.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Yaw BMAG fails - maximum output. (SC-162)	FDAI ball indicates uncommanded yaw rotation. FDAI yaw rate needle indicates yaw rotation. FDAI yaw error needle indicates excessive deadband attitude error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL YAW switch to OFF position. Place DIRECT RCS switch to DIRECT RCS position for manual direct control of vehicle attitude in SCS mode or place G&N/SCS switch to G&N position.
Roll BMAG fails - maximum output. (SC-163)	FDAI ball indicates uncommanded roll rotation. FDAI roll rate needle indicates roll rotation. FDAI roll error needle indicates excessive attitude error with ATT SET/OFF switch in OFF position.	Place SCS CHANNEL ROLL switch to OFF position. Place DIRECT RCS switch to DIRECT RCS position for manual control of vehicle attitude in SCS mode or place G&N/SCS switch to G&N position.
Pitch rate gyro demodulator fails - zero output. (SC-164)	FDAI pitch rate needle indicates excessive rates during pitch attitude maneuvers. FDAI ball indicates excessive pitch attitude maneuvers.	Stabilize vehicle rates with rotation control during pitch attitude maneuvers. Monitor FDAI pitch rate needle.
Yaw rate gyro demodulator fails - zero output. (SC-165)	FDAI yaw rate needle indicates excessive rates during yaw attitude maneuvers. FDAI ball indicates excessive yaw attitude maneuvers.	Stabilize vehicle rates with rotation control during yaw attitude maneuvers. Monitor FDAI yaw rate needle.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Roll rate gyro demodulator fails - zero output. (SC-166)	FDAI roll needle indicates excessive rates during roll attitude maneuvers. FDAI ball indicates excessive roll attitude maneuvers.	Stabilize vehicle rates with rotation control during roll attitude maneuvers. Monitor FDAI roll rate needle.
TVC logic G&N AND gate fails. (SC-167)	THRUST ON light illuminates during G&N initiated SPS thrusting maneuver but SPS fails to fire.	Place G&N/SCS switch in SCS position and depress THRUST ON pushbutton.
Pitch rate limiter fails - zero output. (SC-170)	FDAI ball fails to respond to G&N pitch rotational commands. FDAI ball indicates pitch attitude drift exceeding deadband limits. FDAI pitch error needle indicates pitch error with ATT SET/OFF switch in OFF position.	Control and maintain pitch axis attitude using rotation control or select SCS mode.
Yaw rate limiter fails - zero output. (SC-171)	FDAI ball fails to respond to G&N yaw rotational commands. FDAI ball indicates yaw attitude drift exceeding deadband limits with DEADBAND switch in MAX and MIN position. FDAI yaw error needle indicates pitch error with ATT SET/OFF switch in OFF position.	Control and maintain yaw axis attitude using rotation control.
TVC integrator fails - zero output, pitch. (SC-172)	PITCH GIMBAL POSITION indicators reads maximum. FDAI pitch rate needle indicates excessive rate. FDAI pitch error needle indicates excessive error.	Employ MTVC for SPS thrusting control.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
TVC integrator fails - zero output, yaw. (SC-173)	YAW GIMBAL POSITION indicator reads maximum deflection from zero. FDAI pitch rate needle indicates excessive rate. FDAI yaw error needle indicates excessive error.	Employ MTVC for SPS thrusting control.
Yaw gimbal position feedback fails. (SC-174)	FDAI ball indicates yaw axis rotation with G&N/SCS switch in G&N position. FDAI yaw rate needle indicates yaw rate. FDAI yaw error needle indicates yaw error with ATT SET/OFF switch in OFF position. YAW GIMBAL POSITION indicator reads maximum.	Employ MTVC for SPS.
Pitch gimbal drive velocity generator 1 fails - zero output. (SC-175)	FDAI ball indicates pitch axis oscillation with G&N/SCS switch in G&N position. FDAI pitch rate needle indicates oscillation. FDAI pitch error needle indicates oscillation with ATT SET/OFF switch in OFF position. PITCH GIMBAL POSITION indicator indicates oscillation.	Turn off pitch gimbal motor 1 or place the THRUST switch to OFF.
Yaw gimbal drive velocity generator 1 fails - zero output. (SC-176)	FDAI ball indicates yaw axis oscillation with G&N/SCS switch in G&N position. FDAI yaw rate needle oscillates. FDAI yaw error needle indicates oscillation with ATT SET/OFF switch in OFF position. PITCH GIMBAL POSITION indicator indicates oscillation.	Turn off yaw gimbal motor 1 or place the THRUST switch to OFF.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Pitch TVC error amplifier fails - zero output. (SC-177)	PITCH GIMBAL POSITION indicator assumes trim indication. FDAI ball indicates uncommanded pitch rotation with G&N/SCS switch in G&N position. FDAI pitch rate needle indicates pitch rate. FDAI pitch error needle indicates pitch error with ATT SET/OFF switch in OFF position.	Employ MTVC for SPS thrusting.
Yaw TVC error amplifier fails - zero output. (SC-200)	YAW GIMBAL POSITION indicator assumes trim indication. FDAI ball indicates uncommanded yaw rotation with G&N/SCS switch in G&N position. FDAI yaw rate needle indicates yaw rate. FDAI yaw error needle indicates yaw error with ATT SET/OFF switch in OFF position.	Employ MTVC for SPS thrusting.
FDAI pitch error meter amplifier fails - zero output. (SC-202)	FDAI pitch error needle reads zero during and after pitch attitude maneuvers with ATT SET/OFF switch in ATT SET and OFF positions.	Monitor FDAI ball pitch axis and FDAI pitch rate needle to determine attitude error.
TVC logic SPS AND gate fails. (SC-212)	THRUST ON light illuminates when THRUST ON pushbutton switch is depressed during normal SPS thrusting preparation. ΔV REMAINING counter fails to initiate counting after THRUST ON light illuminates. OXID QTY indicator fails to count down after THRUST ON light illuminates. FUEL QTY indicator fails to count down after THRUST ON light illuminates.	Place NORMAL/OFF/DIRECT ON switch to OFF position. Select G&N mode for delta V.

Table 5-2. Stabilization and Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
THRUST ON switch fails closed. (SC-217)	THRUST ON light illuminates when ΔV-OFF switch is placed to ΔV position with NORMAL/OFF/DIRECT ON switch in OFF position.	Depress SCS ΔV mode select pushbutton. Place NORMAL/OFF/DIRECT ON switch to ON position to initiate SPS ignition. Place NORMAL/OFF/DIRECT ON switch to OFF to terminate SPS thrusting.

Table 5-3. Guidance and Navigation System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Uplink logic blocked - UPTEL switch fails. (GN-001)	ACTIVITY UPTL light does not illuminate.	Contact MSFN by voice link; manually insert data into AGC.
Uplink logic not blocked. (GN-002)	UPTL ACTIVITY lights with UPTEL switch in BLOCKED position.	Coordinate with MSFN as to availability of AGC for reception of uplink data.
AGC 13-vdc power fails. (GN-003)	COMP FAIL On G&N ERROR On AGC PWR FAIL On MASTER ALARM On Audio tone in C/M headsets	Contact MSFN for calculations; activate SCS mode of operation.
AGC 3-vdc power fails. (GN-004)	Same as GN-003.	Same as GN-003.
AGC 28-vdc power fails. (GN-005)	Same as GN-003.	Same as GN-003.
AGC 2.048-mc oscillator fails. (GN-006)	Same as GN-003.	Same as GN-003.
Main AGC keyboard 800-cps supply fails. (GN-007)	Main AGC keyboard inoperative and unlighted.	Use LEB-AGC keyboard.
LEB-AGC keyboard 800-cps supply fails. (GN-010)	LEB-AGC keyboard inoperative and unlighted.	Use main AGC keyboard.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Main AGC keyboard 13-vdc supply fails. (GN-011)	Main keyboard inoperative.	Use LEB-AGC keyboard.
AGC-LEB keyboard 13-vdc supply fails. (GN-012)	LEB keyboard inoperative.	Use main AGC keyboard.
AGC 1.5-cps supply fails. (GN-013)	Noun-verb flasher inoperative.	Contact MSFN for verification of computer operation.
Main AGC keyboard row 1 digit fails. (GN-014)	Third digit is always 4 on main keyboard.	Use LEB-AGC keyboard.
LEB-AGC keyboard row 1 digit fails. (GN-015)	Third digit is always 8 on LEB keyboard.	Use main AGC keyboard.
LEB-AGC keyboard row 3 digit fails. (GN-016)	Fifth digit on LEB keyboard is always 0.	Use main AGC keyboard.
LEB-AGC keyboard 5 switch open. (GN-017)	No display response when 5 key is depressed.	Use main AGC keyboard.
ZERO ENCODER backlight inoperative. (GN-021)	ZERO ENCODER backlight remains extinguished when engaging mode.	Perform light test to verify failure.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
COARSE ALIGN backlight inoperative. (GN-022)	COARSE ALIGN backlight remains extinguished when engaging mode.	Perform light test to verify failure.
CDU MAN backlight inoperative. (GN-023)	CDU MAN backlight remains extinguished when engaging mode.	Perform light test to verify failure.
ENTRY backlight inoperative. (GN-024)	ENTRY backlight remains extinguished when engaging mode.	Perform light test to verify failure.
Loss of 28-vdc to mode select latching relays. (GN-025)	Mode backlights remain out when engaging mode.	Select mode through AGC.
IMU TEMP light inoperative. (GN-026)	Light does not illuminate during IMU overtemperature.	Perform light test to detect failure. Request IMU temperature information from MSFN.
IMU temperature control indicator relay fails. (GN-027)	IMU TEMP light continually illuminated.	Check temperature in auto proportional mode.
COMP PWR FAIL light inoperative. (GN-030)	COMP PWR FAIL light remains extinguished when CHECK MODE pushbutton is depressed.	Perform light test to verify failure.
CDU FAIL light inoperative. (GN-031)	CDU FAIL light remains extinguished when CHECK MODE pushbutton is depressed.	Perform light test to verify failure; monitor MASTER ALARM lights.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
Zero encoder mode relay open. (GN-032)	ZERO ENC light fails to illuminate when that mode is selected by AGC.		Manually activate zero encoder mode.
Coarse align mode relay open. (GN-033)	COARSE ALIGN light fails to illuminate when that mode is selected by AGC.		Manually activate coarse align mode.
Fine align mode relay open. (GN-034)	FINE ALIGN light fails to illuminate when mode is selected by AGC.		Manually activate fine align mode.
Attitude control mode relay open. (GN-035)	ATT CONT light fails to illuminate when mode is selected by AGC.		Manually activate attitude control mode.
Entry mode relay open. (GN-036)	ENTRY light fails to illuminate when mode is selected by AGC.		Manually activate entry mode.
Loss of 28-volt 800-cps wheel excitation. (GN-037)	IMU FAIL G&N ERROR MASTER ALARM Audio tone in C/M headsets.	On On On	Position G&N IMU to standby; select SCS mode.
Loss of 2-volt 3200-cps excitation. (GN-040)	G&N ERROR G&N ACCEL FAIL MASTER ALARM Audio tone in C/M headsets.	On On On	Position G&N IMU to standby; select SCS mode.
Encoder excitation fails (25.6 kc). (GN-041)	G&N ERROR CDU FAIL ZERO ENCODER MASTER ALARM Audio tone in C/M headsets.	On On On On	Manually position CDUs; select SCS mode for entry.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
Computer locked in interrupt mode. (GN-042)	COMP FAIL RUPT LOCK G&N ERROR MASTER ALARM Audio tone in C/M headsets.	On On On On	Perform keyboard checks after resetting. Switch to SCS mode of operation.
AGC in endless control loop. (GN-043)	COMP FAIL G&N ERROR TC TRAP MASTER ALARM Audio tone in C/M headsets.	On On On On	Same as GN-042.
Parity failure. (GN-044)	COMP FAIL G&N ERROR PARITY FAIL MASTER ALARM Audio tone in C/M headsets.	On On On On	Same as GN-042.
Computer increment in progress 30 milliseconds. (GN-045)	COMP FAIL G&N ERROR MASTER ALARM Audio tone in C/M headsets.	On On On	Same as GN-042.
Sextant trunnion motor drive amplifier fails. (GN-046)	Unable to position sextant trunnion using hand controller or CDUs.		Use telescope for sighting.
Sextant shaft motor drive amplifier fails. (GN-047)	Unable to position sextant shaft using hand controller or CDUs.		Use telescope for sighting.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Telescope shaft and trunnion motor drive amplifier fails. (GN-050)	Unable to position telescope with hand controller or CDU.	Manually position telescope using universal tool.
IMU blower 1 inoperative. (GN-051)	IMU TEMP On MASTER ALARM On Audio tone in C/M headsets.	Change temperature control mode.
IMU blower 2 inoperative. (GN-052)	Same as GN-051.	Change temperature control mode.
PIPA fixed heater regulator fails. (GN-053)	No data available.	No data available.
IRIG temperature sensor transistor Q1 fails open. (GN-054)	IMU TEMP On MASTER ALARM On Audio tone in C/M headsets.	Select alternate position of IMU temperature mode.
IRIG temperature sensor transistor Q1 fails shorted. (GN-055)	IMU TEMP light illuminates in auto override and proportional mode.	Select emergency temperature control mode or use SCS mode.
IRIG temperature sensor transistor Q2 fails open. (GN-056)	IMU TEMP light illuminates in backup mode. MASTER ALARM On Audio tone in C/M headsets.	Same as GN-055.
IRIG temperature sensor transistor Q2 fails shorted. (GN-057)	Same as GN-056.	Same as GN-055.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Magnetic amplifier excitation fails. (GN-060)	Same as GN-055.	Same as GN-055
IMU relay K1 fails in energized position. (GN-061)	None (No alarm indication if overtemperature condition occurs.)	Determine failure by performing mode tests.
IMU relay K2 fails in de-energized position. (GN-062)	None	Change IMU temperature control mode.
IMU relay K2 fails in energized position. (GN-063)	Automatic switchover to emergency mode inoperative when overtemperature condition occurs.	Switch to backup mode manually.
Optics 28-volt 800-cps 5-percent power fails. (GN-064)	CDUs do not respond to hand control activation. Sextant and telescope inoperative.	Position telescope manually.
Optics 28-volt 800-cps 1-percent power fails. (GN-065)	Optical subsystem inoperative.	Position telescope manually. Insert optic angles via keyboard.
Optic 25.6-kc power supply fails. (GN-066)	None	No data available.
Optics trunnion CDU motor excitation fails. (GN-067)	Trunnion CDU not positioned using hand controller.	Manually reposition CDU using thumbwheel.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Optics shaft CDU motor excitation fails. (GN-070)	Shaft CDU not positioned using hand controller.	Manually reposition CDU using thumbwheel.
IMU 28-volt 800-cps 5-percent power fails. (GN-071)	No data available.	No data available.
IMU 28-volt 800-cps gyro wheel power fails. (GN-072)	No data available.	No data available.
Optics hand controller - trunnion axis fails to increase. (GN-074)	Trunnion CDU fails to increase angle on command.	Position trunnion via thumbwheel or switch to computer control.
Optics hand controller - shaft axis fails to increase. (GN-075)	Shaft CDU fails to increase angle on command.	Position shaft via thumbwheel or switch to computer control.
Optics hand controller - shaft axis fails to decrease. (GN-076)	Shaft CDU fails to decrease angle on command.	Same as GN-075.
Optics slave telescope switch - landmark LOS 0° fails open. (GN-077)	Telescope fails to drive to zero when commanded from the SLAVE TELESCOPE switch.	Position optics using universal tool or ZERO OPTICS - MANUAL - COMPUTER switch.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Optics slave telescope switch - offset 25° fails open. (GN-100)	Telescope fails to offset 25° from sextant when commanded by the SLAVE TELESCOPE switch.	Same as GN-077.
Optics controller MODE switch - DIRECT position fails open. (GN-101)	Optics CDUs will not drive.	Switch to RESOLVED mode.
Optics controller MODE switch - RESOLVED position fails open. (GN-102)	Optics CDUs will not drive.	Switch to DIRECT mode.
Optics mode switch - ZERO OPTICS position fails open. (GN-103)	Optics CDUs will not drive to zero when ZERO OPTICS position is selected.	Position optics using universal tool.
Optics mode switch - MANUAL position fails open. (GN-104)	Hand controller will not drive optics CDUs.	Position optics using thumbwheel.
Optics mode switch - COMPUTER position fails open. (GN-105)	Optics CDUs will not drive under computer control.	Position optics using hand controller.
CDU fail signal. (GN-106)	G&N ERROR On CDU FAIL On MASTER ALARM On Audio tone in C/M headsets.	Send all inputs through the computer and make no attempt to fine align.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
IMU CONTROL - TRANSFER switch COMPUTER position fails open. (GN-112)	Computer will not assume control of IMU.	Position IMU CONTROL - TRANSFER switch to MANUAL.
IMU CONTROL - TRANSFER switch MANUAL position fails open. (GN-113)	IMU cannot be manually controlled.	Position IMU CONTROL - TRANSFER switch to COMPUTER.
OUTER GIMBAL (ROLL) slew switch increase direction fails open. (GN-114)	No increase visible in roll angle when slew switch is moved in the increase direction.	Use computer to increase roll angle.
OUTER GIMBAL (ROLL) slew switch decrease direction fails open. (GN-115)	No decrease visible in roll angle when slew switch is moved in the decrease direction.	Use computer to decrease roll angle.
INNER GIMBAL (YAW) slew switch increase direction fails open. (GN-116)	No increase visible in yaw angle when slew switch is moved in the increase direction.	Use computer to increase yaw angle.
INNER GIMBAL (YAW) slew switch decrease direction fails open. (GN-117)	No decrease visible in yaw angle when slew switch is moved in the decrease direction.	Use computer to decrease yaw angle.

Table 5-3. Guidance and Navigation System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
MIDDLE GIMBAL (PITCH) slew switch increase direction fails open. (GN-120)	No increase visible in pitch angle when slew switch is moved in the decrease direction.	Use computer to increase pitch angle.
MIDDLE GIMBAL (PITCH) slew switch decrease direction fails open. (GN-121)	No decrease visible in pitch angle when slew switch is moved in the increase direction.	Use computer to decrease pitch angle.
Turn on timer delay relay fails open. (GN-127)	IMU DELAY light remains on.	Use coarse alignment only.
IMU-CDU DIFFERENCE meter fails open for outer gimbal section. (GN-130)	No IMU-CDU difference displayed for outer gimbal.	Insert gimbal angles and wait until angles are achieved before continuing with other operations.
IMU-CDU DIFFERENCE meter fails open for inner gimbal section. (GN-131)	No IMU-CDU difference displayed for inner gimbal.	Same as GN-130.
IMU-CDU DIFFERENCE meter fails open for middle gimbal section. (GN-132)	No IMU-CDU difference displayed for middle gimbal.	Same as GN-130.

Table 5-4. Sequence Control Group

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
24, 000 ft baro switches fail open. (GS-001)	FDAI does not show rate and attitude effects of LES tower and/or apex cover jettison and drogue parachute deployment. SCS-RCS auto rate stabilization fails to turn off. Altimeter is monitored to determine when SCM descends to closing altitude of 24, 000 ft baro switches.	Place MODE LES/TWR JETT SPS MODE switch to TWR JETT SPS MODE position. (Medium altitude abort only.) Place RCS CMD switch to OFF position, depress APEX COVER JETT switch and DROGUE DEPLOY switches during entry.
Time delay switches before drogue deploy relays fail. (GS-002)	FDAI will not show rate dumping due to drogue parachute deployment.	Depress DROGUE DEPLOY switch.
10, 000 ft baro switches fail open. (GS-003)	FDAI does not show rate and attitude effects of main parachute deployment when altimeter indicates SCM has descended to closing altitude of 10, 000 ft baro switches.	Press MAIN CHUTE DEPLOY switch when altitude decreases to less than 10, 000 feet.
S-IVB/CSM staging failure. (GS-004)	Booster engine 1 light fails to extinguish upon ADPP SEP command.	First depress ADPT SEP switch; then place RCS CMD switch to ON position.
ELS transistor switches fail. (GS-005)	FDAI does not show rate and attitude effects of LES tower and/or apex cover jettison and drogue parachute deployment. SCS-RCS auto rate stabilization fails to turn off when SCM descends to closing altitude of 24, 000 ft baro switches.	Place MODE LES/TWR JETT SPS MODE switch to TWR JETT SPS MODE position. (High altitude abort only.) Place RCS CMD switch to OFF position; depress APEX COVER JETT DROGUE

Table 5-4. Sequence Control Group (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
		DEPLOY and MAIN DEPLOY switches at corresponding altitudes.
Barometric altimeter static pressure port plugged. (GS-006)	Altimeter fails to respond to altitude changes.	Request altitude information from MSFN.
Barometric altimeter diaphragm punctured. (GS-007)	Altimeter reads zero.	Request altitude information from MSFN.
Apex cover fails to jettison. (GS-010)	FDAI does not show rate and attitude effects of apex cover jettison when SCM descends to closing altitude of 24,000 ft baro switches.	Depress APEX COVER JETT switch.
RCS control latching relay fails to close during SPS abort. (GS-011)	FDAI does not show effects of SCS-RCS auto rate stabilization following an SPS abort.	Place RCS CMD switch to ON position.
S-band antenna relays fail. (GS-012)	FDAI does not show effects of rate stabilization due to enabling of S/M RCS 2.5 seconds following an SPS abort.	Place RCS CMD switch to ON position.
RCS CMD switch fails in ON position. (GS-013)	FDAI does not show effects of S/M RCS rate stabilization during S-IVB firing.	None, crew must await CSM S-IVB separation or C/M-S/M separation for the RCS to be enabled.

Table 5-4. Sequence Control Group (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Automatic RCS transfer fails following C/M-S/M separation. (GS-014)	FDAI does not show effects of rate stabilization following C/M-S/M separation.	Place RCS TRANS switch to C/M position.
ABORT SYSTEM-OXID DUMP AUTO/RCS CMD AUTO switch fails open in the RMS CMD AUTO position. (GS-015)	FDAI does not show effects of rate stabilization following C/M-S/M separation.	Place RCS CMD switch to ON position.
Main parachutes fail to deploy and drogue parachutes fail to release automatically. (GS-016)	FDAI does not show rate damping due to main parachute deployment when altimeter indicates SCM has descended to altitude of 10,000 ft.	Depress MAIN CHUTE DEPLOY switch.
Canards fail to deploy automatically. (GS-017)	FDAI and visual system will not show effects of vehicle stabilization 11 seconds after a LES abort has been initiated by the EDS.	Depress CANARD DEPLOY switch.
Angle-of-attack indicator fails to zero. (GS-020)	Angle of attack - SPS chamber pressure indicator reads zero.	Request MSFN to provide angle of attack and SPS chamber pressure information.
LET fails to jettison during LES abort. (GS-045)	FDAI fails to show effects on attitude due to tower jettison.	Place MODE LES/TWR JETT SPS MODE switch to TWR JETT SPS MODE position.
Translational controller abort inhibit. (GS-046)	When pilot's translational hand controller is rotated CCW, it does not initiate manual abort sequencing as evidenced by the	Place C/M-S/M SEP switch to ON position. Depress CANARD DEPLOY switch

Table 5-4. Sequence Control Group (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
	following: Booster engine sound does not cut off, no change in FDAI indications, and event timer does not reset to zero and begin counting up.	11 seconds after LES motor fires (medium abort only).
Missing sequencer fails to arm ELS logic during an LES abort. (GS-047)	FDAI does not show effects of apex cover jettison and drogue parachute deployment.	Place ELS LOGIC switch to ON position.
C/M-S/M separation bolts fail (upon LES abort). (GS-050)	Changes in FDAI attitude rates are not noticed. The LES motors aural cue will not be heard.	Place C/M-S/M SEP switch to ON position.
LES tower jettison motors ignition failure. (GS-051)	When ABORT SYSTEM - MODE switch is placed to TWR JETT SPS MODE position during normal launch boost, the FDAI fails to show effects on attitude due to tower jettison.	Depress LES MOTOR FIRE switch.
SPS abort programer 1.7-second time delay switches fail open. (GS-054)	FDAI shows that SCS has not damped out roll oscillations due to enabling of S/M RCS 2.5 seconds after hand controller is put in abort position.	Depress ADPT SEP switch; then place RCS CMD switch to ON position.
LES and pitch motors fail to fire (LES abort). (GS-055)	The crew will not hear the LES motors aural cue nor see drastic change in FDAI attitude, rates and error representations.	Depress LES MOTOR FIRE switch.
RCS command relays fail to close. (GS-070)	FDAI does not show effects of rate stabilization after C/M-S/M separation.	Place RCS CMD switch to ON position.

Table 5-4. Sequence Control Group (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
RCS command relays fail to open. (GS-071)	FDAI indicates SCS-RCS auto rate stabilization fails to turn off when SCM descends to closing altitude of 24, 000 ft baro switches.	Place RCS CMD switch to OFF position.
C/M RCS fails to pressurize - system A. (GS-072)	System A C/M RCS PRESS He meter indicates no change in pressure.	Place RCS C/M PRESS switch to up position.
C/M RCS fails to pressurize - system B. (GS-073)	System B C/M RCS PRESS He meter indicates no change in pressure.	Place RCS C/M PRESS switch to up position.
E/T jettison fire and tower separation relays fail. (GS-074)	FDAI does not show rate and attitude effects of tower jettison.	Depress LES MOTOR FIRE switch.
Event timer count fails. (CS-200)	Event timer is inoperative.	Request MSFN to provide time checks on sequencing operation.
Abort request light fails on. (CS-201)	ABORT light illuminates.	Crew decision to abort. NOTE This malfunction allows the instructor to initiate an abort request situation.
Abort request light off or open wire. (CS-202)	ABORT light remains off, except during C/M lamp test.	Crew decision to abort after receiving verbal instruction.

Table 5-4. Sequence Control Group (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Booster engine 1 light on or shorted. (CS-203)	L/V ENGINES 1 light illuminates.	Verify booster thrust with MSFN.
Booster engine 1 light off or open wire. (CS-204)	L/V ENGINES 1 light extinguishes or remains off, except during C/M light test.	Same as CS-203.
Booster engine 2 light on or shorted. (CS-205)	L/V ENGINES 2 light illuminates.	Same as CS-203.
Booster engine 2 light off or open wire. (CS-206)	L/V ENGINES 2 light extinguishes or remains off, except during C/M light test.	Same as CS-203.
Booster engine 3 light on or shorted. (CS-207)	L/V ENGINES 3 light illuminates.	Same as CS-203.
Booster engine 3 light off or open wire. (CS-210)	L/V ENGINES 3 light extinguishes or remains off, except during C/M light test.	Same as CS-203.
Booster engine 4 light on or shorted. (CS-211)	L/V ENGINES 4 light illuminates.	Same as CS-203.
Booster engine 4 light off or open wire. (CS-212)	L/V ENGINES 4 light extinguishes or remains off, except during C/M light test.	Same as CS-203.

Table 5-4. Sequence Control Group (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Booster engine 5 light on or shorted. (CS-213)	L/V ENGINES 5 light illuminates.	Same as CS-203.
Booster engine 5 light off or open wire. (CS-214)	L/V ENGINES 5 light extinguishes or remains off, except during C/M light test.	Same as CS-203.
Booster engine 6 light on or shorted. (CS-215)	L/V ENGINES 6 light illuminates.	Same as CS-203.
Booster engine 6 light off or open wire. (CS-216)	L/V ENGINES 6 light extinguishes or remains off, except during C/M light test.	Same as CS-203.
Booster engine 7 light on or shorted. (CS-217)	L/V ENGINES 7 light illuminates.	Same as CS-203.
Booster engine 7 light off or open wire. (CS-220)	L/V ENGINES 7 light extinguishes or remains off, except during C/M light test.	Same as CS-203.
Booster engine 8 light on or shorted. (CS-221)	L/V ENGINES 8 light illuminates.	Same as CS-203.
Booster engine 8 light off or open wire. (CS-222)	L/V ENGINES 8 light extinguishes or remains off, except during C/M light test.	Same as CS-203.

Table 5-4. Sequence Control Group (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
L/V RATES light on or shorted. (CS-223)	L/V RATES light illuminates.	Verify indication by monitoring FDAI or request information from MSFN.
L/V RATES light off or open wire. (CS-224)	L/V RATES light extinguishes or remains off, except during C/M light test.	Monitor launch vehicle rates on FDAI or request information from MSFN if failure of L/V RATES light is suspected.
L/V GUIDANCE light on or shorted. (CS-225)	L/V GUIDANCE light illuminates.	Crew decision to abort is based on verbal confirmation from MSFN.
L/V GUIDANCE light off or open wire. (CS-226)	L/V GUIDANCE light extinguishes or remains off.	Crew decision to abort is based on verbal confirmation from MSFN.
LIFT OFF light on or shorted. (CS-227)	LIFT OFF light illuminates.	Verify improper operation of LIFT OFF light by observing event timer, altimeter, and/or by MSFN verification.
LIFT OFF light off or open wire. (CS-230)	LIFT OFF light does not illuminate.	Verify improper operation of light by observing event timer, altimeter, and/or by MSFN verification.
EDS fails to initiate a two-engine-out abort. (CS-231)	L/V ENGINES lights indicate a two-engine-out condition exists but the EDS fails to initiate an automatic abort.	Initiate abort with translation control.

Table 5-4. Sequence Control Group (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Auto abort enable relay failure. (CS-232)	The NO AUTO ABORT switch-light illuminates at lift-off.	Depress NO AUTO ABORT switch-light.
Digital event timer fails to start at lift-off. (CS-233)	The event timer fails to reset to zero and begin to count up upon lift-off.	Reset timer with DIGITAL EVENT TIMER MIN AND SECS switch. Momentarily place START/STOP switch to START when correct time following lift-off is indicated (as received from MSFN).
Instructor initiated abort. (CS-250)	LES abort initiated as determined from the following effects: LES motor fire aural cue, C/M RCS fuel and oxidizer tanks pressurized, altimeter and FDAI indications, digital event timer resets and counts up.	Monitor various instruments and digital event timer to determine if proper sequence of events after abort is being performed by sequencer. Be prepared to back up failures.
Instructor auto abort inhibit. (CS-251)	Auto abort is not initiated although excess L/V rates or two-engine-out condition is indicated.	Initiate abort with translation controller.

Table 5-5. Reaction Control System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Helium isolation valves		
a. Both fail open. (RC-233) (S/M-A) (RC-234) (S/M-B) (RC-235) (S/M-C) (RC-236) (S/M-D) (RC-120) (C/M-A) (RC-121) (C/M-B)	No indication until another malfunction requires that valves be closed. Then helium valve position indicator will show valve is open when HELIUM switch is placed to OFF position.	Discontinue use of malfunctioned system.
b. Both fail closed. (RC-237) (S/M-A) (RC-240) (S/M-B) (RC-241) (S/M-C) (RC-242) (S/M-D) (RC-116) (C/M-A) (RC-117) (C/M-B)	Gradual loss of the affected RCS system. Helium valve position indicator will indicate valves are closed on system that is failed.	Discontinue use of malfunctioned system.
Fuel isolation valves		
a. Fails closed. (RC-253) (S/M-A) (RC-254) (S/M-B) (RC-255) (S/M-C) (RC-256) (S/M-D) (RC-140) (C/M-A) (RC-141) (C/M-B)	Loss of affected system rocket engines.	Control spacecraft using available engines.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
b. Fails open. (RC-202) (S/M-A) (RC-203) (S/M-B) (RC-204) (S/M-C) (RC-205) (S/M-D) (RC-142) (C/M-A) (RC-143) (C/M-B)	None, unless a corresponding system fuel injector valve fails open simultaneously causing fuel depletion.	Place RCS HELIUM switch for affected system to OFF position.
Oxidizer isolation valve		
a. Fails closed. (RC-257) (S/M-A) (RC-260) (S/M-B) (RC-261) (S/M-C) (RC-262) (S/M-D) (RC-144) (C/M-A) (RC-145) (C/M-B)	Loss of affected system rocket engines.	Control spacecraft using available engines.
b. Fails open. (RC-263) (S/M-A) (RC-264) (S/M-B) (RC-265) (S/M-C) (RC-266) (S/M-D) (RC-146) (C/M-A) (RC-147) (C/M-B)	None, unless a corresponding system oxidizer injector valve fails open simultaneously causing oxidizer depletion.	Place RCS HELIUM switch for affected system to OFF position.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Helium isolation valve 1 position indicators		
a. Fails closed (striped). (RC-001/011) (S/M-A) (RC-001/012) (S/M-B) (RC-001/013) (S/M-C) (RC-001/014) (S/M-D) (RC-152) (C/M-A) (RC-154) (C/M-B)	Valve position indicator flag remains in view when applicable helium switch is positioned to ON.	Monitor helium tank and manifold pressures to evaluate indicator operation.
b. Fails open (blank). (RC-002/011) (S/M-A) (RC-002/012) (S/M-B) (RC-002/013) (S/M-C) (RC-002/014) (S/M-D) (RC-052/153) (C/M-A) (RC-154/155) (C/M-B)	Valve position indicator flag fails to appear when applicable helium switch is positioned to OFF.	Monitor helium tank and manifold pressures to evaluate indicator operation.
Helium isolation valve 2 position indicators		
a. Fails closed (striped). (RC-003/011) (S/M-A) (RC-003/012) (S/M-B) (RC-003/013) (S/M-C) (RC-003/014) (S/M-D)	Valve position indicator flag remains in view when applicable helium switch is positioned to ON.	Monitor helium tank and manifold pressures to evaluate indicator operation.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
b. Fails open (blank). (RC-004/011) (S/M-A) (RC-004/012) (S/M-B) (RC-004/013) (S/M-C) (RC-004/014) (S/M-D)	Valve position indicator flag fails to appear when applicable helium switch is positioned to OFF.	Monitor helium tank and manifold pressure to evaluate indicator operation.
Propellant isolation valve position indicator		
a. Fails closed (striped). (RC-005/011) (S/M-A) (RC-005/012) (S/M-B) (RC-005/013) (S/M-C) (RC-005/014) (S/M-D) (RC-156) (C/M-A) (RC-160) (C/M-B)	Valve position indicator flag remains in view when applicable propellant switch is positioned to ON.	Monitor propellant quantity indicator to evaluate position indicator operation.
b. Fails open (blank). (RC-006/011) (S/M-A) (RC-006/012) (S/M-B) (RC-006/013) (S/M-C) (RC-006/014) (S/M-D) (RC-156/157) (C/M-A) (RC-160/161) (C/M-B)	Valve position indicator flag fails to appear when applicable helium switch is positioned to OFF.	Monitor propellant quantity indicator to evaluate position indicator operation.
S/M He branch 1 primary series regulator fails full open. (RC-244/245/246) (S/M-A) (RC-244/245/247) (S/M-B)	Propellant tank pressure increases 5 psia.	Close helium isolation valve 1.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
(RC-244/245/250) (S/M-C) (RC-244/245/251) (S/M-D)		
C/M primary series He regulator fails full open. (RC-125) (System A) (RC-126) (System B)	Propellant tank pressure increases 7 psia.	Close helium isolation valve in malfunctioning system.
S/M He branch 2 primary series regulator fails full open. (RC-245/246) (S/M-A) (RC-245/247) (S/M-B) (RC-245/250) (S/M-C) (RC-245/251) (S/M-D)	Propellant tank pressure increases 5 psia.	Close helium isolation valve 2.
S/M He branch 1 primary series regulator fails full open and secondary fails high. (RC-015/244/246) (S/M-A) (RC-016/244/247) (S/M-B) (RC-017/244/250) (S/M-C) (RC-020/244/251) (S/M-D)	Propellant tank pressure increases 44 psia.	Close helium isolation valve 1.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
S/M He branch 2 primary series regulator fails full open and secondary fails high. (RC-021/246) (S/M-A) (RC-022/247) (S/M-B) (RC-023/250) (S/M-C) (RC-024/251) (S/M-D)	Propellant tank pressure increases 44 psia.	Close helium isolation valve 2.
Helium storage tank leak. (RC-333/207) (S/M-A) (RC-333/211) (S/M-B) (RC-333/212) (S/M-C) (RC-333/214) (S/M-D) (RC-333/127) (C/M-A) (RC-333/130) (C/M-B) NOTE Rate of leakage may be varied from 0 to 0.02 lb/sec in increments of 1/7 by inserting any one or combinations of the following in addition to the previous: (RC-330) (1/7 max. rate) (RC-331) (2/7 max. rate) (RC-332) (4/7 max. rate)	Helium storage tank pressure of failed system decreases constantly if monitored on He pressure indicator.	No data available.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel tank ullage helium leak. (RC-334/207) (S/M-A) (RC-334/211) (S/M-B) (RC-334/212) (S/M-C) (RC-334/214) (S/M-D) (RC-334/127) (C/M-A) (RC-334/130) (C/M-B) NOTE Rate of leakage may be varied from 0 to 0.0028 lb/sec in increments of 1/7 by inserting any one or combination of the following: (RC-330) (1/7 max. rate) (RC-331) (2/7 max. rate) (RC-332) (4/7 max. rate)	Gradual loss of ullage helium supply with possible loss of defective system.	Close helium isolation valve in defective system.
Oxidizer tank ullage helium leak. (RC-335/207) (S/M-A) (RC-335/211) (S/M-B) (RC-335/212) (S/M-C) (RC-335/214) (S/M-D) (RC-335/127) (C/M-A) (RC-335/130) (C/M-B) NOTE Rate of leakage may be varied from 0 to 0.0028 lb/sec in increments of	Gradual loss of helium supply with possible loss of use of defective system.	Close helium isolation valve in defective system.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
1/7 by inserting any one or combination of the following in addition to the previous: (RC-330) (1/7 max. rate) (RC-331) (2/7 max. rate) (RC-332) (4/7 max. rate)		
C/M RCS systems A&B temperature control a. Incremental increase of 10°R (RC-110/111) b. Incremental increase of 15°R (RC-110/112) c. Incremental increase of 15°R (RC-110/113) d. Incremental decrease of 10°R (RC-111) e. Incremental decrease of 15°R (RC-113)	No data available.	No data available.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
NOTE Any combination of RC-111, RC-112, and RC-113 may be inserted. Failure effective to both systems. Oxidizer quantity sensors - S/M RCS systems A and B		
a. Sensor output zero. (RC-324/223) (A) (RC-324/224) (B)	S/M RCS A (B) On Fuel/oxidizer ratio not 2:1 MASTER ALARM On Audio tone in C/M headsets	Monitor pressure and package temperature of failed system for degradation.
b. 1/7 incremental error greater than true value. (RC-314/313/223) (A) (RC-314/313/224) (B)	If sensor failure is great enough, effects for b through g are same as previously mentioned.	Same as previously mentioned.
c. 2/7 incremental error greater than true value. (RC-315/313/223) (A) (RC-315/313/224) (B)		
d. 4/7 incremental error greater than true value. (RC-316/313/223) (A) (RC-316/313/224) (B)		
e. 1/7 incremental error less than true value. (RC-314/223) (A) (RC-314/224) (B)		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
f. 2/7 incremental error less than true value. (RC-315/223) (A) (RC-315/224) (B) g. 4/7 incremental error less than true value. (RC-316/223) (A) (RC-316/224) (B) NOTE Total offset error is 35 lb above or below true value. Any 1/7 increment may be obtained by inserting RC-314, RC-315, RC-316 or any combination thereof.		
S/M RCS systems A, B, C, D control temperature a. Incremental increase of 10°R. (RC-230/231) b. Incremental increase of 20°R. (RC-230/232) c. Incremental decrease of 10° R. (RC-231) d. Incremental decrease of 20°R. (RC-232)	No data available.	No data available.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
NOTE Total incremental increase/ decrease of 30°R may be inserted using RC-231 and RC-232. Failure effective to all systems.		
Helium reservoir pressure sensors - S/M RCS systems A and C	No data available.	No data available.
a. Sensor output zero. (RC-324/206) (A) (RC-324/210) (C)		
b. 1/7 incremental error greater than true value. (RC-314/313/206) (A) (RC-314/313/210) (C)		
c. 2/7 incremental error greater than true value. (RC-315/313/206) (A) (RC-315/313/210) (C)		
d. 4/7 incremental error greater than true value. (RC-316/313/206) (A) (RC-316/313/210) (C)		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
e. 1/7 incremental error less than true value. (RC-314/206) (A) (RC-314/210) (C) f. 2/7 incremental error less than true value. (RC-315/206) (A) (RC-315/210) (C) g. 4/7 incremental error less than true value. (RC-316/206) (A) (RC-316/210) (B) NOTE Total offset sensor error range from 1250 psia above or below true value. Any 1/7 increment may be obtained by inserting RC-314, RC-315, RC-316 or any combination thereof.		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Helium manifold pressure sensors - S/M RCS systems B and D		
a. Sensor output zero. (RC-324/213) (B) (RC-324/215) (D)	S/M RCS B (D) On MASTER ALARM On Audio tone in C/M headsets.	Monitor helium pressure readings for all systems for probable sensor failure or regulator malfunction.
b. 1/7 incremental error greater than true value. (RC-314/313/213) (B) (RC-314/313/215) (D)	If sensor error is great enough to cause an out-of-tolerance condition, the same effects as previously mentioned will occur in items b through g.	Same as previously mentioned.
c. 2/7 incremental error greater than true value. (RC-315/313/213) (B) (RC-315/313/215) (D)		
d. 4/7 incremental error greater than true value. (RC-316/313/213) (B) (RC-316/313/215) (D)		
e. 1/7 incremental error less than true value. (RC-314/213) (B) (RC-314/215) (D)		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
f. 2/7 incremental error less than true value. (RC-315/213) (B) (RC-315/215) (D) g. 4/7 incremental error less than true value. (RC-316/213) (B) (RC-316/215) (D) NOTE Total offset sensor error range from 100 psia above or below true value. Any 1/7 increment may be obtained by inserting RC-314, RC-315, RC-316 or any combination thereof. Fuel quantity sensors - S/M RCS systems C and D a. Sensor output zero. (RC-324/220) (C) (RC-324/221) (D)	S/M RCS C (D) On Fuel oxidizer ratio not 2:1 MASTER ALARM On Audio tone in C/M headsets	Monitor pressure and package temperature of failed system for degradation.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
b. 1/7 incremental error greater than true value. (RC-314/313/220) (C) (RC-314/313/221) (D)	If sensor failure is great enough, effects for b through g are same as previously mentioned.	Monitor pressure and package temperature of failed system for degradation.
c. 2/7 incremental error greater than true value. (RC-315/313/220) (C) (RC-315/313/221) (D)		
d. 4/7 incremental error greater than true value. (RC-316/313/220) (C) (RC-316/313/221) (D)		
e. 1/7 incremental error less than true value. (RC-314/220) (C) (RC-314/221) (D)		
f. 2/7 incremental error less than true value. (RC-315/220) (C) (RC-315/221) (D)		
g. 4/7 incremental error less than true value. (RC-316/220) (C) (RC-316/221) (D)		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
NOTE Total offset sensor error ranges from 17.5 lb above or below true value. Any 1/7 increment may be obtained by inserting RC-314, RC-315, RC-316 or any combination thereof. Helium storage tank temperature sensors - S/M RCS		
a. Sensor output zero. (RC-324/101)	C/M He TEMP reads low. C/M RCS B On MASTER ALARM On Audio tone in C/M headsets.	Monitor helium pressures for normal readings. Where sufficient time is available to monitor helium pressure, isolate system B helium tank.
b. 1/7 incremental error greater than true value. (RC-314/313/101)	If failure is great enough to cause an out-of-tolerance condition, same effects as previously mentioned will occur for items b through g.	Same as previously mentioned.
c. 2/7 incremental error greater than true value. (RC-315/313/101)		
d. 4/7 incremental error greater than true value. (RC-316/313/101)		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
e. 1/7 incremental error less than true value. (RC-314/101) f. 2/7 incremental error less than true value. (RC-315/101) g. 4/7 incremental error less than true value. (RC-316/101) NOTE Any combination of RC-314, RC-315, or RC-316 may be inserted simultaneously.		
Helium storage tank pressure sensor - C/M RCS system A a. Sensor output zero. (RC-324/102) b. 1/7 incremental error greater than true value. (RC-314/313/102) c. 2/7 incremental error greater than true value. (RC-315/313/102)	No data available.	No data available.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
d. 4/7 incremental error greater than true value. (RC-316/313/102) e. 1/7 incremental error less than true value. (RC-314/102) f. 2/7 incremental error less than true value. (RC-315/102) g. 4/7 incremental error less than true value. (RC-316/102) NOTE Total offset sensor error range from 1250 psia above or below total value. Any 1/7 increment may be obtained by inserting RC-314, RC-315, RC-316 or any combination thereof.		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel tank helium pressure sensor - C/M RCS system B		
a. Sensor output zero. (RC-324/105)	C/M RCS B On MASTER ALARM On Audio tone in C/M headsets.	Monitor system B helium temperature for degradation. Where insufficient time is available to monitor helium temperature, isolate system B helium tank.
b. 1/7 incremental error greater than true value. (RC-314/313/105)	If error is great enough to cause an out-of-tolerance condition, same effect as previously mentioned will occur in steps b through g.	Same as previously mentioned.
c. 2/7 incremental error greater than true value. (RC-315/313/105)		
d. 4/7 incremental error greater than true value. (RC-316/313/105)		
e. 1/7 incremental error less than true value. (RC-314/105)		
f. 2/7 incremental error less than true value. (RC-315/105)		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
g. 4/7 incremental error less than true value. (RC-316/105) NOTE Any combination of RC-314, RC-315, RC-316 may be inserted simultaneously.		
Oxidizer tank pressure sensor C/M RCS system A		
a. Sensor output zero. (RC-324/106)	C/M RCS A ON MASTER ALARM ON Audio tone in C/M headsets	Monitor systems A and B parameter and fuel oxidizer quantity ratio in attempt to isolate failure.
b. 1/7 incremental error greater than true value. (RC-314/313/106)	If error is great enough to cause out-of-tolerance condition, the same effect as previously mentioned will occur for items b through g.	Same as previously mentioned.
c. 2/7 incremental error greater than true value. (RC-315/313/106)		
d. 4/7 incremental error greater than true value. (RC-316/313/106)		

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
e. 1/7 incremental error less than true value. (RC-314/106) f. 2/7 incremental error less than true value. (RC 315/106) g. 4/7 incremental error less than true value. (RC-316/106) NOTE Total offset sensor range from 1000 psia above or below true value. Any 1/7 increment may be obtained by inserting RC-314, RC-315, RC-316 or any combination thereof.		
C/M fuel tank pressure meter fails open. (RC-151)	C/M RCS PRESS - FUEL reads minimum with RCS INDICATORS switch positioned to C/M-A and C/M-B.	Monitor and observe normal readings on all other indicators. Contact MSFN to verify meter failure.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
S/M fuel quantity meter		
a. Fails to count down during S/M RCS utilization. (RC-200)	PROPELLANT QUANTITY - FUEL indicator fails to count down during S/M RCS utilization.	Monitor oxidizer indicator for normal operation; monitor FDAI for normal operation during attitude maneuvers.
b. Appears blank. (RC-225)	PROPELLANT QUANTITY - FUEL indicator goes blank.	Contact MSFN for fuel quantity information.
S/M oxidizer quantity meter		
a. Fails to count down during S/M RCS utilization (RC-201)	PROPELLANT QUANTITY - OXIDIZER indicator fails to count down during S/M RCS utilization.	Monitor fuel indicator for normal operation; monitor FDAI for normal operation.
b. Appears blank. (RC-226)	PROPELLANT QUANTITY - OXIDIZER indicator goes blank.	Monitor MSFN for oxidizer quantity information.
Shared S/M-C/M RCS temperature meter fails open. (RC-320)	S/M RCS - C/M RCS TEMP indicator reads minimum. All other indicators normal.	Monitor temperature on all systems to isolate failure; contact MSFN for verification.
Shared S/M-C/M RCS helium storage tank pressure meter fails open. (RC-321)	S/M RCS - C/M RCS PRESS - He indicator reads minimum. All other displays normal.	Monitor pressure on all systems to isolate failure; contact MSFN for verification.

Table 5-5. Reaction Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Oxidizer and manifold pressure meter fails open. (RC-323)	No data available.	No data available.
S/M RCS quantity sensing computer fuel leg failure. (RC-025) (Quad A) (RC-026) (Quad B) (RC-027) (Quad C) (RC-028) (Quad D)	PROPELLANT QUANTITY - FUEL indicator reads low (approximately 50% of true value) for failed quad (A, B, C, or D). S/M RCS status light for failed system is illuminated.	Contact MSFN for verification of failure.
S/M RCS fuel quantity sensor fails (open circuit). (RC-035) (System A) (RC-036) (System B) (RC-037) (System C) (RC-039) (System D)	PROPELLANT QUANTITY - FUEL indicator reads minimum for failed system. S/M RCS status light for failed system is illuminated.	Contact MSFN for verification of failure.
S/M RCS fuel quantity sensor fails at maximum value. (RC-041) (System A) (RC-042) (System B) (RC-043) (System C)	PROPELLANT QUANTITY - FUEL indicator maintains maximum indication for failed system during RCS utilization. S/M RCS status light for failed system is illuminated.	Contact MSFN for verification of failure.
S/M RCS injector fuel valve fails in open position. (RC-031) (Quad A) (RC-032) (Quad B) (RC-033) (Quad C) (RC-034) (Quad D)	PROPELLANT QUANTITY - FUEL indicator for failed system shows declining fuel quantity during no utilization condition.	Place S/M RCS PROPELLANT switch for failed system to OFF position.

Table 5-6. Service Propulsion System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Helium tank leakage a. 1/7 max. rate (SP-001) b. 2/7 max. rate (SP-002) c. 4/7 max. rate (SP-003) NOTE Any combination of the above may be inserted.	He TANK PRESS indicator shows constantly decreasing pressure reading when SPS TANK PRESS switch is in He position.	After mission.
Helium isolation valves a. Valve A fails in present position. (SP-004)	SPS HELIUM evant indicator shows that valve position does not change when SPS HELIUM switch position is changed between OFF and ON.	If valve fails open, contact MSFN to determine if mission abort is required. If valve fails closed, contact MSFN to determine if mission can be continued using path B (A) only or if abort is required.
b. Valve B fails in present position. (SP-005)	Same as SP-004.	Same as SP-004.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Helium regulator fails closed.		
a. Regulator A fails closed. (SP-006)	None, unless the isolation valve for the other branch is closed. Then downstream pressures decrease during SPS thrusting.	Switch isolation valve in other branch to open.
b. Regulator B fails closed. (SP-010)	Same as SP-006.	Same as SP-006.
Helium regulator primary fails open.		
a. Regulator A primary section fails open. (SP-007)	PRESSURE - FUEL and PRESSURE - OX indicators display slightly higher than normal valves.	Switch isolation valve in faulty branch to off.
b. Regulator B primary section fails open. (SP-011)	Same as SP-007.	Same as SP-007.
Helium isolation valve event indicator coil fails open. (SP-012) (Branch A)	Helium isolation event indicator display indicates helium isolation valve is closed at all times.	Switch isolation valve in the other branch to off and monitor regulated fuel and oxidizer pressure for normal indications.
Helium isolation valve event indicator coil fails open. (SP-013) (Branch B)	Same as SP-012.	Same as SP-012.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Helium tank pressure indicator fails. (SP-014)	He TANK PRESS indicator reads zero. All other indicators read normal.	Contact MSFN for helium tank pressure reading.
Helium tank temperature indicator fails. (SP-015)	He TANK PRESS indicator reads zero. All other indicator readings normal.	Contact MSFN for helium tank temperature reading.
Oxidizer ullage pressure indicator fails. (SP-020)	PRESSURE - OX indicator reads zero. All other indicator readings normal. SPS PRESS status light remains off.	Contact MSFN for oxidizer tank pressure reading.
Fuel ullage pressure indicator fails. (SP-021)	PRESSURE - FUEL indicator reads zero. All other indicator readings normal. SPS PRESS status light remains off.	Contact MSFN for fuel tank pressure reading.
Oxidizer system helium leakage. a. 1/7 max. rate (SP-022) b. 2/7 max. rate (SP-023) c. 4/7 max. rate (SP-024) NOTE Any combination may be inserted.	PRESSURE - OX indicator displays a gradual loss of oxidizer ullage pressure. SPS PRESS On MASTER ALARM On Audio tone in C/M headsets.	Check with MSFN for possible abort.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item / MIU Code Ident No.	Indication Crew / Instructor		Anticipated Crew Response
Oxidizer system oxidizer leakage.			
a. 1/7 max. rate (SP-025)	SPS PU SENSOR FAIL	On	Place OX FLOW switch to Decrease. Crew decision to alter mission.
	UNBALANCE indicator	Decrease	
	OX QUANTITY and FUEL QUANTITY indicators display different readings.		
b. 2/7 max. rate (SP-026)	MASTER ALARM	On	
	Audio tone in C/M headsets.		
c. 4/7 max. rate (SP-027)			
NOTE Any combination may be inserted.			
Fuel system helium leakage.			
a. 1/7 max. rate (SP-030)	SPS PU SENSOR FAIL	On	Check with MSFN for possible abort.
	PRESSURE FUEL indicator displays a gradual loss of fuel ullage pressure.		
b. 2/7 max. rate (SP-031)	MASTER ALARM	On	
	Audio tone in C/M headsets.		
c. 4/7 max. rate (SP-032)			
NOTE Any combination may be inserted.			

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel system fuel leakage. a. 1/7 max. rate (SP-033) b. 2/7 max. rate (SP-034) c. 4/7 max. rate (SP-035) NOTE Any combination may be inserted.	SPS PU SENSOR FAIL On UNBALANCE indicator Increase OX QUANTITY and FUEL QUANTITY indicators display different readings. MASTER ALARM On Audio tone in C/M headsets.	Place OX FLOW switch to INCREASE. Crew decision to alter mission.
Engine injector valve actuators failed in present position. a. SP-036 (Actuator A1) b. SP-037 (Actuator A2) c. SP-040 (Actuator B3) d. SP-041 (Actuator B4)	Fails open. SPS ENGINE INJECT VALVE indicator for failed actuator indicates open during SPS quiescent periods. Fails closed. SPS ENGINE INJECT VALVE indicator for failed actuator indicates closed during SPS firing.	Place INJECT PRE-VALVE switch A to OFF if actuator A1 or A2 fails, and B to OFF if actuator B3 or B4 fails. Place INJECT PRE-VALVE switch A to OFF if actuator A1 or A2 fails, and B to OFF if actuator B3 or B4 fails.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Engine injector valve position indicator		
a. Valve 1 fails closed. (SP-042)	Valve 1 indicates closed during SPS firing.	Contact MSFN for verification of injector valve position.
b. Valve 3 fails open. (SP-043)	Valve 3 indicates open during SPS quiescent periods.	Contact MSFN for verification of injector valve position.
c. Valve 3 fails 1/3 open. (SP-044)	Valve 3 indicates 1/3 open during SPS quiescent periods.	Contact MSFN for verification of injector valve position.
d. Valve 4 fails 2/3 open. (SP-045)	Valve 4 indicates 2/3 open during SPS quiescent periods.	Contact MSFN for verification of injector valve position.
PU primary valve fails. (SP-046)	Corrective action with OXID FLOW switch does not rectify unbalance reading of UNBALANCE indicator.	Switch to secondary valve position.
PU secondary valve fails. (SP-047)	Corrective action with OXID FLOW switch does not rectify unbalance reading of BALANCE indicator.	Switch to primary valve position.
PU valve position indicator		
a. Fails present position. (SP-050)	Loss of monitor capability for PU valve.	None
b. Slews to max. orifice. (SP-051)	Upper OX FLOW event indicator displays increase with OXID FLOW switch in NORMAL position.	Switch to secondary valve position; monitor indicator to verify indicator failure.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item / MIU Code Ident No.	Indication Crew / Instructor	Anticipated Crew Response
c. Slows to min orifice. (SP-052)	Lower OX FLOW event indicator displays decrease with OXID FLOW switch in NORMAL position.	Switch to secondary valve position; monitor indicator to verify indicator failure.
Helium tank pressure sensor fails. (SP-053)	HE TANK PRESS indicator reads zero.	Contact MSFN for helium tank pressure reading.
Oxidizer ullage pressure sensor fails. (SP-054)	OX PRESSURE indicator reads zero. All other indications normal.	Contact MSFN for oxidizer pressure reading.
Engine inlet fuel pressure indicator fails. (SP-055)	ENG INLET FUEL PRESSURE indicator reads zero. All other indications normal.	Contact MSFN for engine inlet fuel pressure reading.
Engine inlet oxidizer pressure indicator fails. (SP-056)	ENG INLET OX PRESSURE indicator reads zero. All other indications read normal.	Contact MSFN for engine inlet fuel pressure reading.
PU primary sensing system fuel storage tank sensor fails. (SP-057)	SPS PU SENSOR FAIL On MASTER ALARM On Audio tone in C/M headsets.	Place SENSOR switch to AUX.
PU primary sensing system oxidizer sump tank sensor fails. (SP-060)	SPS PU SENSOR FAIL On MASTER ALARM On Audio tone in C/M headsets.	Place SENSOR switch to AUX.
PU auxiliary sensing system fuel flow rate integrator fails. (SP-061)	SPS PU SENSOR FAIL On MASTER ALARM On Audio tone in C/M headsets.	Place SENSOR switch to PRI if the primary sensing system is operative.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
PU auxiliary sensing system point sensor update failure. (SP-062)	SPS PU SENSOR FAIL On MASTER ALARM On Audio tone in C/M headsets.	Place SENSOR switch to PR1.
PU fuel quantity indicator fails.		
a. Slews to maximum. (SP-063)	FUEL QUANTITY indicator slews to maximum.	Perform PU test to determine failure. Contact MSFN for verification.
b. Slews to minimum. (SP-064)	FUEL QUANTITY indicator slews to minimum.	Perform PU test to determine failure. Contact MSFN for verification.
PU oxidizer quantity indicator fails.		
a. Slews to maximum. (SP-065)	OX QUANTITY slews to maximum.	Perform PU test to determine failure. Contact MSFN for verification.
b. Slews to zero. (SP-066)	OX QUANTITY slews to minimum.	Perform PU test to determine failure. Contact MSFN for verification.
PU unbalance indicator failure.		
a. Slews to maximum increase position. (SP-067)	UNBALANCE indicator drives to maximum increase position (fuel and oxidizer quantity equal).	Perform propellant utilization test procedure.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
b. Slews to maximum decrease position. (SP-070)	UNBALANCE indicator drives to maximum decrease position (fuel and oxidizer quantity equal).	Perform propellant utilization test procedure.
c. Slews to zero. (SP-075)	UNBALANCE indicator remains at zero with fuel and oxidizer quantities unbalanced.	Perform propellant utilization test procedure.
SPS engine skin breakup. (SP-071)	SPS WALL TEMP HI On MASTER ALARM On Audio tone in C/M headsets.	Terminate SPS engine firing.
Oxidizer storage tank sensor fails (PU primary). (SP-072)	OX QUANTITY indicates maximum reading.	Perform PU test and verify results with MSFN. Switch to auxiliary sensing system.
Fuel point sensor fails (PU aux). (SP-073)	SPS PU SNSR FAIL On CAUTION ALARM On Audio tone in C/M headsets.	Switch to primary system.
Oxidizer normal flow fails (PU aux sensing). (SP-074)	SPS PU SNSR FAIL On CAUTION ALARM On Audio tone in C/M headsets.	Switch to primary system.
PU fails (SP-076)	SPS PU SNSR FAIL On CAUTION ALARM On Audio tone in C/M headsets.	Perform PU test procedure to determine failure.
PU fault detection system No. 2 fails. (SP-077)	No fault indication when fault occurs.	No data available.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel sump tank sensor fails (PU primary) (SP-100)	FUEL QUANTITY indicator provides faulty indication.	Switch to auxiliary system.
OX FLOW INCR valve position indicator fails. (SP-101)	Upper OX FLOW flag not visible when OX FLOW switch is in INCR position.	Monitor unbalance indicator with OX FLOW switch in INCR position during SPS thrusting.
SPS fuel display servo amplifier failure. (SP-102)	FUEL QUANTITY display does not change during SPS thrusting or propellant sensor testing.	Contact MSFN for fuel quantity information.
SPS unbalance servo amplifier failure. (SP-103)	Unbalance indication does not change during unbalanced propellant flow or propellant sensor testing.	Compare OX QUANTITY and FUEL QUANTITY displays.
SPS oxidizer display servo amplifier failure. (SP-104)	OX QUANTITY display does not change during SPS thrusting or propellant sensor testing.	Contact MSFN for oxidizer quantity information.
Fuel sump servo amplifier failure. (SP-105)	FUEL QUANTITY display reads high when primary sensing system is used.	Switch to auxiliary sensing system.
Fuel storage servo amplifier failure. (SP-106)	FUEL QUANTITY display reads high when primary sensing system is used.	Switch to auxiliary sensing system.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Oxidizer sump servo amplifier failure. (SP-107)	OX QUANTITY display reads high when primary sensing system is used.	Switch to auxiliary sensing system.
Oxidizer storage servo amplifier failure. (SP-110)	OX QUANTITY display reads high when primary sensing system is used.	Switch to auxiliary sensing system.
Auxiliary fuel servo amplifier fails with zero output. (SP-111)	FUEL QUANTITY display reads high when auxiliary sensing system is used.	Switch to primary sensing system.
Auxiliary oxidizer servo amplifier fails with zero output. (SP-112)	OX QUANTITY display reads high when auxiliary sensing system is used.	Switch to primary sensing system.
SPS injector pre-valve A fails in closed position. (SP-113)	SPS ENGINE INJECT VALVE indicators remain in CLOSE position when engine is commanded on with INJECT PRE-VALVE A switch ON and INJECT PRE-VALVE B switch OFF.	Place INJECT PRE-VALVE B switch to ON position.
SPS injector pre-valve B fails in closed position. (SP-114)	SPS ENGINE INJECT VALVE indicators remain in CLOSE position when engine is commanded on with INJECT PRE-VALVE B switch ON and INJECT PRE-VALVE A switch OFF.	Place INJECT PRE-VALVE A switch to ON position.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
SPS helium regulator valve A (both primary and secondary) fails open. (SP-115)	FUEL and OX PRESS indicators read between 220 and 240 psia.	Place SPS HELIUM switch (left) to OFF position to isolate failed regulator.
SPS combustion unstable. (SP-116) NOTE Engine is shut down by FCSM command at time of malfunction insertion.	SPS ENGINE INJECT VALVE indicators change from OPEN to CLOSE position.	Place FCSM ON/OFF/RESET switch to RESET and restart engine.
SPS combustion unstable at 1/7 max. time. (SP-117) NOTE Engine is shutdown by FCSM command at 85 seconds following malfunction insertion.	SPS ENGINE INJECT VALVE indicators change from OPEN to CLOSE position.	Place FCSM ON/OFF/RESET switch to RESET and restart engine.
SPS combustion unstable at 2/7 max. time. (SP-120)	SPS ENGINE INJECT VALVE indicators change from OPEN to CLOSE position.	Place FCSM ON/OFF/RESET switch to RESET and restart engine.

Table 5-6. Service Propulsion System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
NOTE Engine is shut down by FCSM command at 170 seconds following malfunction insertion. SPS combustion unstable at 4/7 max. time. (SP-121) NOTE Engine is shut down by FCSM command at 340 seconds following malfunction insertion.	SPS ENGINE INJECT VALVE indicators change from OPEN to CLOSE position.	Place FCSM ON/OFF/RESET switch to RESET and restart engine.

Table 5-7. Cryogenics Storage System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
O_2 tank 2 quantity sensor fails - maximum output. (CN-001)	TANK QUANTITY - O_2 TANK 2 indication is maximum. All other indications normal.	Verify sensor failure with MSFN.
H_2 tank 2 pressure transducer fails - maximum output. (CN-002)	TANK QUANTITY - H_2 TANK 2 indication is maximum. MASTER ALARM On All other indications normal.	Verify sensor failure with MSFN.
H_2 HEATERS 1 switch AUTO position fails open. (CN-003)	TANK PRESSURE - H_2 TANK 1 reads low. H_2 PRESS On MASTER ALARM On Audio tone in C/M headsets.	Crew should manually control H_2 pressure via H_2 HEATERS 1 switch ON position.
O_2 tank 2 pressure switch fails open. (CN-004)	TANK PRESSURE - O_2 TANK 1 and O_2 TANK 2 read low. O_2 PRESS On MASTER ALARM On Audio tone in C/M headsets.	Crew should manually control O_2 pressure via O_2 HEATERS 2 switch ON position.
O_2 tank 1 pressure switch fails open. (CN-005)	Same as CN-004.	Crew should manually control O2 pressure via O_2 HEATERS 1 switch ON position.
O_2 tank 1 heater current sensor output fails - maximum output. (CN-006)	None	None

Table 5-7. Cryogenics Storage System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
H_2 tank 1 heater current sensor output fails - zero output. (CN-007)	None	None
O_2 tank 1 quantity signal conditioner fails - maximum output. (CN-010)	TANK QUANTITY - O_2 TANK 1 reads maximum. All other indicators normal.	Crew should verify sensor failure with MSFN after comparing present reading with past readings.
H_2 tank 1 quantity signal conditioner fails - zero output. (CN-011)	TANK QUANTITY - H_2 TANK 1 reads zero. All other indicators normal.	Crew should verify sensor failure with MSFN, also noting no drop in H_2 tank 1 pressure.
O_2 tank 1 pressure signal conditioner fails - maximum output. (CN-012)	TANK PRESSURE - O_2 TANK 1 reads max. O_2 PRESS On MASTER ALARM On Audio tone in C/M headsets. All other indications normal.	Crew should monitor system operation to verify sensor failure.
H_2 tank 1 pressure signal conditioner fails open. (CN-013)	TANK PRESSURE - H_2 TANK 1 reads zero. H_2 PRESS light illuminates. MASTER ALARM On Audio tone in C/M headsets. All other indications normal.	Crew should monitor H_2 tank 1 quantity indications to verify sensor failure.
O_2 tank 2 temperature signal conditioner fails - maximum output. (CN-014)	None	None

Table 5-7. Cryogenics Storage System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
H_2 tank 1 temperature signal conditioner fails - output zero (CN-015)	None	None
O_2 tank 1 quantity meter fails open. (CN-020)	TANK QUANTITY - O_2 TANK 1 reads zero. All other indications normal.	Crew should verify meter failure with MSFN and by monitoring O_2 tank 1 pressure.
H_2 tank 1 quantity meter fails stuck in present position. (CN-021)	No change in H_2 tank 1 quantity.	Crew should contact MSFN for reading of H_2 tank 1 quantity.
O_2 tank 1 pressure meter fails open. (CN-022)	TANK PRESSURE - O_2 TANK 1 reads zero. All other indications normal.	Crew should verify meter failure with MSFN and by monitoring O_2 tank 1 quantity.
H_2 tank 1 pressure meter fails stuck in present position. (CN-023)	None	None
O_2 tank 1 pressure switch fails to open at high-pressure limit. (CN-026)	TANK PRESSURE - O_2 TANK 1 reads high. O_2 PRESS On MASTER ALARM On Audio tone in C/M headsets.	Manually control O_2 tank 1 pressure via O_2 TANK 1 HEATERS switch ON and OFF position.
H_2 tank 1 pressure switch fails to close at low-pressure limit. (CN-027)	TANK PRESSURE - H_2 TANK 1 reads low. H_2 PRESS On MASTER ALARM On Audio tone in C/M headsets.	Manually control H_2 tank 1 pressure via H_2 TANK 1 HEATERS switch ON and OFF positions.

Table 5-7. Cryogenics Storage System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
O_2 tank 1 heater - temperature limit switch fails closed. (CN-030)	Same as CN-026.	Same as CN-026.
H_2 tank 1 heater - temperature limit switch fails open. (CN-031)	Same as CN-027.	Attempts to manually control H_2 temperature and pressure via H_2 TANK 1 HEATERS switch will be unsuccessful. Crew may then make decision on aborting mission.
O_2 tank 1 heater element fails open (one of two elements) (CN-037)	TANK PRESSURE - O_2 TANK 1 consistantly reads below O_2 TANK 2. Eventually O_2 tank 1 pressure may cause O_2 PRESS and MASTER ALARM lights to illuminate, and audio tone in C/M headsets, if allowed to go unchecked.	Place O_2 TANK HEATERS 1 switch to ON until O_2 TANK 1 and O_2 TANK 2 pressures are equal.
O_2 TANK HEATERS 2 switch ON position fails open. (CN-040)	TANK PRESSURE - O_2 TANK 2 decreases when O_2 TANK HEATERS switch is in ON position.	Place O_2 TANK HEATERS 2 switch to AUTO position.
O_2 tank 1 rupture. (CN-041)	TANK QUANTITY - O_2 TANK 1 reads minimum. TANK PRESSURE - O_2 TANK 1 reads minimum. O_2 PRESS On MASTER ALARM On Audio tone in C/M headsets.	Isolate O_2 tank 1; remove power from tank 1 heater. Possible crew decision to abort.

Table 5-7. Cryogenics Storage System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
O_2 tank 2 rupture. (CN-042)	TANK QUANTITY - O_2 TANK 2 reads minimum. TANK PRESSURE - O_2 TANK 2 reads minimum. O_2 PRESS light illuminates. MASTER ALARM lights illuminate. Audio tone in C/M headsets.	Isolate O_2 tank 1; remove power from tank 1 heater. Possible crew decision to abort.
O_2 tank 1 relief valve fails to open when tank pressure exceeds relief pressure. (CN-043)	TANK PRESSURE O_2 TANK 1 continues to increase above normal relief valve opening pressure. (Will not be effective unless used with a malfunction to cause O_2 tank 1 pressure to exceed limits.)	Prepare for loss of O_2 tank 1. Possible crew decisions to abort. (Pressure may be reduced by continuous F/C O_2 purging for all three F/Cs.)
O_2 TANK HEATERS 1 switch AUTO position fails off. (CN-046)	TANK PRESSURE - O_2 TANK 1 decreases below lower limit when O_2 TANK HEATER 1 switch is in AUTO position. O_2 PRESS On MASTER ALARM On Audio tone in C/M headsets.	Place O_2 TANK HEATERS 1 switch to ON position.
H_2 tank 1 heater element fails (one of two elements) (CN-050)	TANK PRESSURE - H_2 TANK 1 consistantly reads below H_2 TANK 2. Eventually H_2 tank 1 pressure may cause H_2 PRESS and MASTER ALARM lights to illuminate, and audio tone in C/M headsets, if not corrected.	Place O_2 TANK HEATERS 1 switch to ON until O_2 TANK 2 pressures are equal.
H_2 tank 2 heater element fails (one of two elements). (CN-051)	Same as CN-050.	Same as CN-050.

Table 5-7. Cryogenics Storage System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
H_2 tank 1 pressure switch fails to open at upper pressure limit. (CN-052)	TANK PRESSURE - H_2 TANK 1 reads high. H_2 PRESS On MASTER ALARM On Audio tone in C/M headsets.	Manually control H_2 tank 1 pressure via H_2 TANK 1 HEATERS switch ON and OFF positions.
H_2 tank 2 pressure switch fails to open at upper pressure limit. (CN-053)	Same as CN-052.	Same as CN-052.
H_2 tank 1 rupture. (CN-054)	TANK QUANTITY - H_2 TANK 1 reads minimum. TANK PRESSURE - H_2 TANK 1 reads minimum. H_2 PRESS On MASTER ALARM On Audio tone in C/M headsets.	Isolate H_2 tank 1; remove power from tank 1 heaters. Possible crew decision to abort.
H_2 tank 2 rupture. (CN-055)	Same as CN-054.	Same as CN-054.
O_2 tank 2 heater element fails open (one of two elements). (CN-060)	Same as CN-037.	Same as CN-037.
O_2 tank 2 pressure switch fails to open at upper pressure limit. (CN-063)	Same as CN-026.	Same as CN-026.

Table 5-8. Fuel Cell Systems

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
Fuel cell 1 N_2 pressure regulator fails - pressure rises to 80 psia. (EP-100)	REG OUT PRESS HI - O_2 flag in view. REG OUT PRESS HI - H_2 flag in view. REG OUT PRESS HI - N_2 flag in view. F/C light illuminates. MASTER ALARM Audio tone in C/M headsets.	 On 	Perform procedures for shutdown of fuel cell.
Fuel cell 1 H_2 pressure regulator fails - pressure rises to 80.5 psia. (EP-101)	F/C 1 REG OUT PRESS HI - H_2 flag is visible. MASTER ALARM Audio tone in C/M headsets.	On On 	Perform procedures for shutdown of fuel cell.
Fuel cell 1 O_2 pressure regulator fails - pressure rises to 82.5 psia. (EP-102)	F/C 1 REG OUT PRESS HI - O_2 flag is visible. MASTER ALARM Audio tone in C/M headsets.	On On 	Perform procedures for shutdown of fuel cell.
Fuel cell 1 H_2 leak - mass flow increases to 0.164 lb/hr. (EP-105)	F/C 1 FLOW - H_2 reads high. FUEL CELL INDICATORS switch at FUEL CELL 1. MASTER ALARM Audio tone in C/M headsets.	On On 	Perform procedure for shutdown of fuel cell.
Fuel cell 1 O_2 leak - mass flow increases to 1.304 lb/hr. (EP-106)	F/C 1 FLOW - O_2 reads high. FUEL CELL INDICATORS switch at FUEL CELL 1. MASTER ALARM Audio tone in C/M headsets.	On On 	Perform procedure for shutdown of fuel cell.

Table 5-8. Fuel Cell Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
Fuel cell 2 pH factor high. (EP-111)	F/C 2 pH HI flag in view. FUEL CELL INDICATORS switch at FUEL CELL 2. MASTER ALARM Audio tone in C/M headsets.	On On	Shut down fuel cell; purge contaminated water from line.
Fuel cell 2 primary bypass valve fails full open. (EP-112)	F/C 2 MODULE TEMP - SKIN reads low. FUEL CELL INDICATORS switch at FUEL CELL 2. MASTER ALARM Audio tone in C/M headsets.	On On	Attempt to increase skin temperature by closing radiator valves and increasing electrical load on fuel cell. Shut down fuel cell if proper temperature cannot be obtained.
Fuel cell 2 primary bypass valve fails closed. (EP-113)	F/C 2 MODULE TEMP - SKIN above 500°F. FUEL CELL INDICATORS switch at FUEL CELL 2. MASTER ALARM Audio tone in C/M headsets.	On On	Attempt to decrease skin temperature by opening radiator valves and decreasing electrical load on fuel cell; if not successful, shut down fuel cell.
Fuel cell 3 secondary bypass valve fails open. (EP-114)	MODULE TEMP - COND EXH reading for fuel cell 3 decreases. F/C 3 MASTER ALARM Audio tone in C/M headsets.	 On On	Increase load on fuel cell and/or reorient spacecraft to increase area of space radiator in sunlight to increase fuel cell temperature. If not successful, perform procedure for shutdown of fuel cell.

Table 5-8. Fuel Cell Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel cell 3 secondary bypass valve fails closed. (EP-115)	MODULE TEMP - COND EXH reading for fuel cell 3 increases F/C 3 On MASTER ALARM On Audio tone in C/M headsets.	Reduce load on fuel cell and/or reorient spacecraft to reduce area of space radiators to direct sunlight to reduce temperature of fuel cell. If not successful, shut down fuel cell.
Fuel cell 1 coolant pump fails. (EP-116)	MODULE TEMP - SKIN reading increases for fuel cell 1. MODULE TEMP - COND EXH reading increases for fuel cell 1. F/C 1 On MASTER ALARM On Audio tone in C/M headsets.	Perform procedure for shutdown of fuel cell.
Fuel cell 1 primary bybass valve fails closed. (EP-131)	Same as EP-113.	Same as EP-113.
Fuel cell 3 primary bypass valve fails closed. (EP-132)	Same as EP-113.	Same as EP-113.
Fuel cell 2 H_2 pressure regulator fails high; pressure rises to 80.5 psia. (EP-133)	Same as EP-101.	Same as EP-101.

Table 5-8. Fuel Cell Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel cell 3 H_2 pressure regulator fails high; pressure rises to 80.5 psia. (EP-134)	Same as EP-101.	Same as EP-101.
Fuel cell 2 H_2 leak - mass flow increases to 0.164 lb/hr. (EP-135)	Same as EP-105.	Same as EP-105.
Fuel cell 3 H_2 leak - mass flow increase to 0.164 lb/hr. (EP-136)	Same as EP-105.	Same as EP-105.
Fuel cell 1 pH factor high. (EP-137)	Same as EP-111.	Same as EP-111.
Fuel cell 3 pH factor high. (EP-140)	Same as EP-111.	Same as EP-111.
Fuel cell 1 primary bypass valve fails full open. (EP-141)	Same as EP-112.	Same as EP-112.
Fuel cell 3 primary bypass valve fails full open. (EP-142)	Same as EP-112.	Same as EP-112.

Table 5-8. Fuel Cell Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel cell 1 H_2 pressure regulator fails low; pressure decreases to 40.5 psia. (EP-143)	F/C 1 On pH high - F/C 1 flag is visible. DC AMPS - F/C 1 will decrease. F/C 1 bus disconnect flags may become visible. MASTER ALARM On Audio tone in C/M headset.	Perform procedures for shutdown of fuel cell.
Fuel cell 2 H_2 pressure regulator fails low; pressure decreases to 40.5 psia. (EP-144)	Same as EP-143.	Same as EP-143.
Fuel cell 3 H_2 pressure regulator fails low; pressure decreases to 40.5 psia. (EP-145)	Same as EP-143.	Same as EP-143.
Fuel cell 2 O_2 pressure regulator fails high; pressure increases to 82.5 psia. (EP-146)	Same as EP-102.	Same as EP-102.
Fuel cell 3 O_2 pressure regulator fails high; pressure increases to 82.5 psia. (EP-147)	Same as EP-102.	Same as EP-102.

Table 5-8. Fuel Cell Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel cell 1 O_2 pressure regulator fails low; pressure falls to 42.5 psia. (EP-150)	F/C 1 On DC AMPS - F/C 1 reads minimum. F/C bus disconnect flags may become visible. MASTER ALARM On Audio tone in C/M headsets.	Perform procedures for shutdown of fuel cell.
Fuel cell 2 O_2 pressure regulator fails low; pressure falls to 42.5 psia. (EP-151)	Same as EP-150.	Same as EP-150.
Fuel cell 3 O_2 pressure regulator fails low; pressure falls to 42.5 psia. (EP-152)	Same as EP-150.	Same as EP-150.
Fuel cell 2 N_2 pressure regulator fails high; pressure rises to 80 psia. (EP-153)	Same as EP-100.	Same as EP-100.
Fuel cell 3 N_2 pressure regulator fails high; pressure rises to 80 psia. (EP-154)	Same as EP-100.	Same as EP-100.
Fuel cell 1 N_2 pressure regulator fails low; pressure drops to 24 psia. (EP-155)	None (in actual SC012 system F/C output voltage and current would decrease).	None

Table 5-8. Fuel Cell Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel cell 2 N_2 pressure regulator fails low; pressure drops to 24 psia. (EP-156)	Same as EP-155.	None
Fuel cell 3 N_2 pressure regulator fails low; pressure drops to 24 psia. (EP-157)	Same as EP-155.	None
Fuel cell 2 O_2 leak - mass flow increases to 1.304 lb/hr. (EP-160)	Same as EP-106.	Same as EP-106.
Fuel cell 3 O_2 leak - mass flow increases to 1.304 lb/hr. (EP-161)	Same as EP-106.	Same as EP-106.

Table 5-9. Electrical Power System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
Inverter 1 motor control switch fails off. (EP-001)	AC BUS 1 (and/or BUS 2) FAIL AC VOLTS - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. FREQUENCY - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. All equipment powered by a-c bus 1 and/or bus 2 inoperative. MASTER ALARM Audio tone in C/M headsets.	On On	Perform procedure for connecting alternate inverter(s).
D-C bus A to inverter 3 motor control switch fails off. (EP-003)	AC BUS 1 (and/or BUS 2) FAIL AC VOLTS - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. FREQUENCY - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. All equipment powered by a-c bus 1 and/or bus 2 inoperative. MASTER ALARM Audio tone in C/M headsets.	On On	Perform procedure for switching power for inverter 3 from d-c bus A to d-c bus B.
Inverter 1 to a-c bus 1 motor control switch fails off. (EP-004) (Inverter 1 powering a-c bus 1)	AC BUS 1 FAIL MASTER ALARM Audio tone in C/M headsets. AC VOLTS - BUS 1 - ØA, B, C reads minimum. FREQUENCY - BUS 1 - ØA, B, C reads minimum. All equipment powered by a-c bus 1 inoperative.	On On	Perform procedure for connecting alternate inverter to power a-c bus 1.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
Inverter 3 to a-c bus 2 motor control switch fails off. (EP-005) (Inverter 3 powering a-c bus 2)	AC BUS 2 FAIL AC VOLTS - BUS 2 - ØA, B, C reads minimum. FREQUENCY - BUS 2 - ØA, B, C reads minimum All equipment powered by a-c bus 2 inoperative. MASTER ALARM Audio tone in C/M headsets.	On On	Perform procedure for connecting alternate inverter to a-c bus 2.
Inverter 1 burned out. (EP-006)	AC BUS 1 (and/or BUS 2) FAIL AC VOLTS - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. FREQUENCY - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. INV 1 TEMP HI All equipment powered by a-c bus 1 and/or bus 2 inoperative. Smoke emerging from lower left-hand equipment bay. MASTER ALARM Audio tone in C/M headsets.	On On On	Perform procedure for connecting alternate inverter(s).
Inverter 1 synchronization equipment drifts. (EP-007)	FREQUENCY BUS 1 (and/or BUS 2) - ØA, B, C out of tolerance		Perform procedure for connecting alternate inverter(s).

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
Inverter 2 overvoltage. (EP-010)	AC BUS 1 (and/or BUS 2) FAIL AC VOLTS - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. FREQUENCY - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. Equipment powered by a-c bus 1 and/or bus 2 inoperative. MASTER ALARM Audio tone in C/M headsets.	On On	Perform procedure for connecting alternate inverter.
Inverter 3 low voltage fails. (EP-011)	AC BUS 1 (and/or BUS 2) FAIL AC VOLTS - BUS 1 (and/or BUS 2) - ØA, B, C reads 90 vac. MASTER ALARM Audio tone in C/M headsets.	On On	Perform procedure for connecting alternate inverter.
Fuel cell 2 pump draws excessive current. (EP-013)	No data available.		No data available.
A-C bus 2 overload. (EP-014)	AC BUS 2 FAIL AC BUS 2 OVERLOAD AC VOLTS - BUS 2 ØA, B, C reads minimum. FREQUENCY - BUS 2 - ØA, B, C reads minimum. Equipment powered by a-c bus 2 inoperative. MASTER ALARM Audio tone in C/M headsets.	On On On	Transfer fuel cell pumps and suit compressor to a-c bus 1; disconnect loads from a-c bus 2; reset bus and reconnect each load until failure is isolated.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Inverter 1 temperature high. (EP-015)	INV 1 TEMP HI On MASTER ALARM On Audio tone in C/M headsets.	Turn off and disconnect loads from faulty inverter; select and connect loads to alternate inverter.
Inverter 2 temperature high. (EP-016)	INV 2 TEMP HI On MASTER ALARM On Audio tone in C/M headsets.	Turn off and disconnect loads from faulty inverter; select and connect loads to alternate inverter.
Inverter 3 temperature high. (EP-017)	INV 3 TEMP HI On MASTER ALARM On Audio tone in C/M headsets.	Turn off and disconnect loads from faulty inverter; select and connect loads to alternate inverter.
Battery charger fails (no output). (EP-020)	DC VOLTS reads minimum on BAT CHARGER position of DC INDICATORS switch.	Batteries may not be recharged. Crew decision to abort.
Inverter 2 frequency low. (EP-023)	FREQUENCY reads low (380 cps) for phases A, B, and C when monitoring a-c bus powered by inverter 2.	Perform procedures for connecting alternate inverter.
Inverter 3 frequency high. (EP-024)	FREQUENCY reads high (420 cps) for phases A, B, and C when monitoring a-c bus powered by inverter 3.	Perform procedures for connecting alternate inverter.
Pyro battery A fails (no output). (EP-027)	DC VOLTS reads minimum on PYRO BAT A position of DC INDICATORS switch.	No data available.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Pyro battery B fails (one-half output). (EP-030)	DC VOLTS reads minimum on PYRO BAT B position of DC INDICATORS switch.	No data available.
Main d-c bus A shorted. (EP-031)	DC BUS A UNDERVOLT On DC VOLTS - MAIN BUS A reads less than 26.25 vdc. Equipment powered by d-c bus A inoperative. MASTER ALARM On Audio tone in C/M headsets.	Disconnect loads from bus A; reset bus and reconnect loads to isolate shorted equipment.
Main d-c bus B shorted. (EP-032)	DC BUS B UNDERVOLT On DC VOLTS - MAIN BUS B reads less than 26.25 vdc. Equipment powered by d-c bus B inoperative. MASTER ALARM On Audio tone in C/M headsets.	Disconnect loads from bus B; reset bus and reconnect loads to isolate shorted equipment.
Battery bus A shorted. (EP-033)	DC VOLTS - BAT BUS A reads minimum. DC AMPS - BAT BUS A reads minimum. BAT A PWR - ENTRY circuit breaker tripped.	Transfer load to battery bus B.
Battery bus B shorted. (EP-034)	DC VOLTS - BAT BUS B reads minimum. DC AMPS - BAT BUS B reads minimum. BAT B PWR - ENTRY circuit breaker tripped.	Transfer load to battery bus A.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Flight and postlanding bus shorted. (EP-035)	POST LDG - MAIN A circuit breaker tripped. POST LDG - MAIN B circuit breaker tripped. Communications equipment inoperative.	Crew decision to alter mission unless shorted condition can be isolated.
Battery relay bus shorted. (EP-036)	BAT RLY BUS - BAT A circuit breaker tripped. BAT RLY BUS - BAT B circuit breaker tripped.	Crew decision to alter mission, unless shorted condition can be isolated.
A-C voltmeter fails. (EP-037)	AC VOLTS reads minimum for all positions of AC INDICATORS switch. (True value available at IOS by depressing SPRIL switch.) All other indications normal.	Monitor frequency readings to verify voltmeter failure; contact MSFN. Monitor C&W and EPS indicators.
Frequency meter fails (EP-040)	FREQUENCY indicator reads minimum for all positions of AC INDICATOR switch. (True value available at IOS by depressing SPRIL switch.) All other indications normal.	Monitor a-c voltage to verify meter failure; contact MSFN. Monitor C&W and EPS indicators.
D-C voltmeter fails. (EP-042)	DC VOLTS reads minimum for all positions of DC INDICATORS switch. (True value available at IOS by depressing SPRIL switch.)	Monitor DC AMPS in all positions of DC INDICATORS switch to verify meter failure; contact MSFN. Monitor C&W and EPS indicators.
D-C voltmeter fails. (EP-043)	All DC VOLTS meter readings 25 percent below normal value. (True values available on IOS by depressing SPRIL switch.)	Contact MSFN to verify meter failure.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
D-C ammeter fails. (EP-044)	DC AMPS reads minimum on all positions of DC INDICATORS switch. (True reading available at IOS by depressing SPRIL switch.)	Monitor DC VOLTS and systems operation. To verify meter failure, contact MSFN.
Nonessential bus fails. (EP-045)	None	Crew advised by MSFN of failure and desired action.
D-C bus A undervoltage sensor fails. (EP-046)	None, unless undervoltage condition occurs on d-c bus A. If undervoltage occurs, no indication of failure would be reflected on annunciators.	Constant monitoring of d-c parameters and system operation is necessary if sensor failure is suspected.
A-C bus 1 under/overvoltage sensor fails indicating undervoltage. (EP-047)	AC BUS 1 FAIL On AC VOLTS - BUS 1 - ØA, B, C reading normal. MASTER ALARM On Audio tone in C/M headsets.	Disable sensor unit; reset AC BUS 1 FAIL lights.
Main d-c bus B RESET switch fails off. (EP-050)	None, unless an undervoltage condition occurs on d-c bus B. If this occurs and failure is of a transient nature, attempts to reset bus will not extinguish DC BUS B UNDERVOLT light although DC VOLTS - MAIN BUS B reads normal.	Disable sensor unit; monitor d-c voltage reading continually if switch failure is suspected.
Main d-c bus B undervoltage sensor fails on. (EP-053)	DC BUS B UNDERVOLT On DC VOLTS - MAIN BUS B reads normal. MASTER ALARM On Audio tone in C/M headsets.	Disable sensor unit; continually monitor d-c bus A and B voltage readings.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
A-C bus 1 under/overvoltage sensor fails indicating overvoltage. (EP-054)	AC BUS 1 FAIL On AC VOLTS - BUS 1 - ØA, B, C reads minimum. FREQUENCY - BUS 1 - ØA, B, C reads minimum. Equipment powered by a-c bus 1 inoperative. MASTER ALARM On Audio tone in C/M headsets.	Transfer all loads to a-c bus 2. If attempts to reset bus are not successful, assume sensor failure and disable. (Assume one inverter powering both buses.) If separate inverter powering different buses, switch inverters powering failed bus and attempt reset. If not successful, assume sensor failure and disable.
A-C bus 2 under/overvoltage sensor fails off. (EP-055)	None, unless under or overvoltage condition occurs on a-c bus 2. If failure does occur, no indication would be reflected on annunciator.	Constant monitoring of a-c voltages and system operation is necessary if sensor failure is suspected.
Inverter 1 fails (no output) (EP-057)	AC BUS 1 (and/or BUS 2) FAIL On AC VOLTS - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. FREQUENCY - BUS 1 (and/or BUS 2) - ØA, B, C reads minimum. Equipment powered by a-c buses inoperative. MASTER ALARM On Audio tone in C/M headsets.	Turn off and disconnect loads from failed inverter; select and connect loads to alternate inverter.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel cell 2 H_2 supply valve fails closed. (EP-103)	FLOW - H_2 decreases. DC AMPS - FUEL CELL 2 decreases. DC VOLTS - FUEL CELL 2 decreases. F/C 2 On F/C DISCONNECT flags may be visible. MASTER ALARM On Audio tone in C/M headsets.	Attempt to free valve by cycling reactant switch. If not successful, perform procedures for shutdown of fuel cell.
Fuel cell 2 O_2 supply valve fails closed. (EP-104)	FLOW - O_2 decreases. DC AMPS - FUEL CELL 2 decreases. DC VOLTS - FUEL CELL 2 decreases. F/C 2 On F/C DISCONNECT On MASTER ALARM On Audio tone in C/M headsets.	Attempt to free valve by cycling reactant switch. If not successful, perform procedure for shutdown of fuel cell.
Fuel cell 1 H_2 purge valve fails closed. (EP-107)	FLOW - H_2 does not indicate purge flow when H_2 - PURGE switch is on. F/C 1 does not light when purge is attempted.	Attempt to free valve by cycling H_2 purge switch. If not successful, use fuel cell until cell efficiency degradation becomes excessive; then shut down fuel cell.
Fuel cell 1 O_2 purge valve fails closed. (EP-110)	FLOW - O_2 does not indicate purge flow when O_2 - PURGE switch is on. F/C 1 does not light when purge is attempted.	Attempt to free valve by cycling O_2 purge switch. If not successful, use fuel cell until cell efficiency degradation becomes excessive; then shut down fuel cell.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel cell 1 motor control switch (bus A) fails in last position. (EP-117)	Fails on FUEL CELL 1 - MAIN BUS A event indicator grey in window with FUEL CELL 1 - MAIN BUS A switch in OFF position. DC AMPS reads above minimum with DC INDICATORS switch in FUEL CELL 1 position.	Perform procedure for shutdown of fuel cell if fuel cell failure also exists.
	Fails off FUEL CELL 1 MAIN BUS A event indicator striped in window with FUEL CELL 1 - MAIN BUS A switch in ON position. DC AMPS indicates no change when attempt is made to connect fuel cell to main bus A.	Perform procedure for shutdown of fuel cell or connect fuel cell to bus B.
Fuel cell 1 motor control switch (bus B) fails in last position. (EP-120)	Fails on FUEL CELL 1 - MAIN BUS B event indicator remains grey in window with FUEL CELL 1 - MAIN BUS B switch in OFF position. DC AMPS - FUEL CELL 1 reads high (above minimum with DC INDICATORS switch in FUEL CELL 1 position).	Same as EP-117.
	Fails off FUEL CELL 1 - MAIN BUS B event indicator striped in window with FUEL CELL 1 - MAIN BUS B switch in ON position. DC AMPS - FUEL CELL 1 indicates no change when attempt is made to connect F/C main bus B.	Same as EP-117.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
H_2 flow indicator fails. (EP-121)	H_2 FLOW indicator reads minimum; all other EPS indicators normal.	Contact MSFN for verification of indicator failure.
Module skin temperature indicator fails. (EP-122)	MODULE TEMP - SKIN reads minimum for all fuel cells. All other EPS indicators normal.	Contact MSFN for verification of indicator failure.
Fuel cell 2 bus A overload/ reverse current sensor fails on. (EP-124)	FC BUS DISCONNECT On F/C 2 - BUS A event indicator striped. DC AMPS - FUEL CELL 2 reads less than normal operating value. MASTER ALARM On Audio tone in C/M headsets.	Attempt to reset fuel cells; if not successful, perform procedure for shutdown of fuel cell.
Fuel cell 2 bus B overload/ reverse current sensor fails on. (EP-125)	FUEL CELL DISCONNECT On F/C 2 - BUS B event indicator striped. DC AMPS - FUEL CELL 2 reads less than normal operating value. MASTER ALARM On Audio tone in C/M headsets.	Same as EP-124
H_2 flowmeter fails. (EP-126)	FLOW - H_2 reads 150 percent higher than normal on all fuel cells. (True reading available on IOS by depressing SPRIL switch.) All other indications normal.	Monitor all fuel cell parameters; contact MSFN to verify failure.
O_2 flow rate meter fails. (EP-127)	FLOW - O_2 reads minimum for all fuel cells. (True reading available at IOS by depressing SPRIL switch.) All other indications normal.	Monitor all fuel cell parameters; contact MSFN to verify failure.

Table 5-9. Electrical Power System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Condenser exhaust temperature meter fails. (EP-130)	MODULE TEMP - COND EXH meter reads minimum for all fuel cells. (True reading available at IOS by depressing SPRIL switch.) All other indications normal.	Monitor all fuel cell parameters; contact MSFN to verify failure.
Fuel cell 1 electrode contaminated. (EP-162)	DC AMPS - F/C 1 reads low. DC VOLTS - F/C 1 reads low. H_2 FLOW - F/C 1 reads low. SKIN MODULE TEMP - F/C 1 reads low.	Perform procedures for purging fuel cell H_2 and O_2.
Fuel cell 2 electrode contamination. (EP-163)	Same as EP-162, but for F/C 2.	Same as EP-162.
Fuel cell 3 electrode contamination. (EP-164)	Same as EP-162, but for F/C 3.	Same as EP-162.

Table 5-10. Environmental Control System

Malfunction Item / MIU Code Ident No.	Indication Crew / Instructor	Anticipated Crew Response
Suit relief and demand regulator valve fails (leaking disphragm).	O_2 FLOW HI On PRESS-CABIN reading increases.	Select alternate regulator.
a. Valve 1 (EC-001)	ΔP SUIT COMPR indicator reads low.	
b. Valve 2 (EC-002)	MASTER ALARM On Audio tone in C/M headsets.	
Suit compressor motor fails.	ΔP SUIT COMPR indicator reads low.	Switch to alternate compressor.
a. Compressor 1 (EC-003)		
b. Compressor 2 (EC-004)		
Suit compressor outlet check valve leak.	ΔP SUIT COMPR indicator reads low.	Select alternate compressor.
a. Valve 1 (EC-005)	Pressure suit deflate.	
b. Valve 2 (EC-006)		
ΔP SUIT COMPR indicator fails min. (EC-007)	ΔP SUIT COMPR indicator reads minimum, all other indicators normal.	Monitor suit temperature and pressure to evaluate compressor operation.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
SUIT PRESS indicator fails max. (EC-010)	SUIT PRESS indicator reads maximum. Suits inflated normally; all other indicators normal.	Monitor cabin pressure and suit inflation to evaluate suit pressure condition.
PART PRESS CO_2 indicator fails max. (EC-011)	PART PRESS CO_2 indicator reads maximum.	Monitor CO_2 PP HI status light to evaluate CO_2 partial pressure.
CO_2 partial pressure sensor fails. (EC-012)	CO_2 PP HI On PART PRESS CO_2 indicator reads max. MASTER ALARM On Audio tone in C/M headsets.	Replace CO_2 filters. Assume sensor failure when failure indications persist.
Suit circuit leak. (EC-013)	O_2 FLOW HI On O_2 FLOW indicator reads high. ΔP SUIT COMPR indicator reads low. MASTER ALARM On Audio tone in C/M headsets.	Terminate mission if repair not possible.
Cabin temperature control valve motor fails. (EC-014)	TEMP-CABIN indicator reads outside of nominal range.	Place CABIN TEMP-AUTO/MAN switch to MAN and control cabin temperature control valve manually.
Suit evaporator water inflow control valve fails (leaks). (EC-015)	TEMP-SUIT indicator reads low GLY EVAP STEAM PRESS indicator reading changes.	Manually cycle SUIT EVAP valve to obtain normal TEMP-SUIT indication; then place valve to OFF position.
O_2 FLOW indicator fails. (EC-016)	O_2 FLOW indicator reads minimum. All other indicators normal.	Monitor cabin and suit pressures to evaluate O_2 flow.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
O_2 pressure regulator 1 fails open. (EC-020)	None, except that MSFN will notify crew that high O_2 manifold pressure condition exists.	Select alternate regulator with S/M SUPPLY REGULATOR selector valve control knob.
O_2 pressure regulator fails closed. a. Regulator 1 (EC-021) b. Regulator 2 (EC-022)	PRESS-SUIT indicator reads low. PRESS-CABIN indicator reads low.	Select alternate regulator with S/M SUPPLY REGULATOR selector valve control knob.
O_2 pressure regulator 2 fails open. (EC-023)	None, except that MSFN will notify crew that high O_2 manifold pressure condition exists.	Select alternate regulator with S/M SUPPLY REGULATOR selector valve control knob.
Glycol temperature control valve motor fails. (EC-024)	GLY EVAP outlet temperature indicator fluctuates.	Manually control the GLYCOL EVAP TEMP in valve.
Cabin pressure sensor fails. (EC-025)	PRESS-CABIN indicator reads zero.	Monitor suit and related systems indicators.
Cabin fan fails. a. Fan 1 (EC-026)	TEMP-CABIN indicator reading increases.	Close vent on unoperative fan. Open vent on operative fan and place CABIN AIR FAN switch for operative fan to ON.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
b. Fan 2 (EC-027)		
C/M inner structure punctured. (EC-030)	O_2 FLOW HI On O_2 FLOW indicator reads high. CABIN PRESS indicator reads low. MASTER ALARM On Audio tone in C/M headsets.	Ensure surge tank valve open. Don pressure suit. Crew decision to abort mission. Place EMERGENCY INFLOW REGULATOR selector valve to OFF position.
Cabin pressure indicator fails. (EC-031)	PRESS-CABIN indicator reads minimum. All other indicators normal.	Monitor suit pressure and related systems to evaluate cabin pressure.
Cabin temperature sensor fails open. (EC-032)	TEMP-CABIN indicator reads minimum.	Vary temperature control to verify failure.
Cabin temperature sensor fails maximum output. (EC-033)	CABIN TEMP indicator reads maximum.	Vary temperature control to verify failure.
Cabin pressure regulator valve 1 fails open. (EC-034)	PRESS-CABIN indicator reads high.	Terminate mission.
Cabin pressure regulator valve 1 fails closed. (EC-035)	None	None

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Cabin pressure regulator valve 2 fails closed. (EC-036)	None	None
Cabin pressure regulator valve 2 fails open. (EC-037)	PRESS-CABIN indicator reads high.	Terminate mission.
Cabin temperature indicator fails. (EC-040)	TEMP-CABIN indicator reads minimum.	Vary cabin temperature control; sense temperature change indicating normal operation.
Space radiator leaking. (EC-041) (1B leaking) (EC-042) (2A leaking)	GLY ACCUM quantity indicator reads low.	Isolate leaking radiator and refill system.
Emergency O_2 inflow control valve 2 fails closed. (EC-043)	None	No data available.
Emergency O_2 inflow control valve 1 fails open. (EC-044)	O_2 FLOW HI On O_2 FLOW indicator reads high. MASTER ALARM On Audio tone in C/M headsets.	Isolate malfunction by placing EMERGENCY INFLOW REGULATOR selector valve to alternate position.
Cabin inner pressure relief valve fails open. (EC-045)	CABIN PRESS indicator reads low. O_2 FLOW indicator reads high. O_2 FLOW HI On MASTER ALARM On Audio tone in C/M headsets.	Operate manual shutoff.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Cabin inner pressure-relief valve fails closed. (EC-046)	None	None
Cabin outer pressure-relief valve fails open. (EC-047)	PRESS-CABIN indicator reads low. O_2 FLOW HI On O_2 FLOW indicator reads high. MASTER ALARM On Audio tone in C/M headsets.	Operate manual shutoff.
Cabin outer pressure-relief valve fails closed. (EC-050)	None	None
Accumulator 1 auto valve fails closed. (EC-051)	Accumulator fills with water; no capability of automatic purging. No visual C/M indications.	Place H_2O ACCUMULATOR valve 1 to OFF and 2 to RMTE. Place H_2O ACCUM switch to AUTO 2 position.
Accumulator 2 auto valve fails open. (EC-052)	None	Place H_2O ACCUMULATOR valve 2 to OFF and 1 to RMTE. Place H_2O ACCUM switch to AUTO 1 position.
Accumulator 2 diaphragm leak. (EC-053)	H_2O SEP PUMP FAIL On CO_2 PART PRESS possible increase. MASTER ALARM On Audio tone in C/M headsets.	Select accumulator 1.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Water quantity indicator fails. (EC-054)	WATER QUANTITY reads minimum.	Check water quantity reading in WASTE and POTABLE position. Check availability of water at drinking hose.
Cabin pressure-relief valve leaks at slow rate. (EC-055)	Cabin pressure indicator reads normal. Flow O_2 indicators read high.	None
Wetness control amplifier fails (valve closed). (EC-056)	ECS RAD TEMP OUT and GLY EVAP TEMP OUT indicators increase.	Operate water control valve by placing GLYCOL EVAP H_2O FLOW switch to MAN and closely monitor GLY EVAP TEMP OUT indicator.
Surge tank leak 1/7 max. (EC-057)	PRESS-CABIN indicator reads high and FLOW O_2 indicator reads low.	Don pressure suits.
Water pressure-relief valve 1 fails open. (EC-060)	Potable water tank and waste water tank quantity indicators show depleting or empty tank conditions.	Select alternate relief valve.
Suit evaporator temperature control unit fails. (EC-061)	Limited suit cooling.	Place SUIT EVAP selector valve to MAN position.
Glycol pump outlet check valve fails closed. (EC-064)	PRESS GLY DISCH indicator reads low. GLY EVAP STEAM PRESS indicator reading changes, probably low. ECS RAD temp out indicator reads low. CABIN TEMP indicator reads high.	Activate alternate pump and monitor PRESS GLY DISCH indicator for rise in pressure.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Waste water tank 1 leaks slowly. (EC-065)	Low or declining reading on water quantity indicator.	Terminate mission.
Surge tank leak 2/7 max. (EC-067)	PRESS-CABIN indicator reads high and FLOW O_2 indicator reads low.	Don pressure suits.
Surge tank leak 4/7 max. (EC-070)	PRESS-CABIN indicator reads high FLOW O_2 indicator reads low.	Don pressure suits.
Suit evaporator water control valve fails closed. (EC-071)	GLY EVAP STEAM PRESS indicator reading increases.	None
Space radiator 2B fails (leaking). (EC-072)	GLY ACCUM quantity indicator reads low.	Isolate radiator and refill system.
Suit compressor outlet check valve 1 fails open and leaking. (EC-073)	ΔP SUIT COMPR indicator reads low; FLOW O_2 indicator reads low.	Remain in pressure suit.
S/M supply regulator valve 2 fails (leaking). (EC-076)	PRESS-CABIN indicator reads high; FLOW O_2 indicator shows transient increase. O_2 FLOW HI On	Don pressure suits.
Cabin fan 2 fails. (EC-077)	TEMP-CABIN indicator reads high.	Close vent 2.
Radiator relief valve branch A fails closed. (EC-100)	No data available.	No data available.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Glycol accumulator leak. a. 1/7 max. rate (EC-101) b. 3/7 max. rate (EC-102) d. 4/7 max. rate (EC-103) NOTE Any combination of above may be inserted; i.e., 3/7, 5/7 etc.	GLY ACCUM quantity indicator reading decreases. GLYCOL DISCH PRESS indicator reading decreases.	Close water-glycol accumulator shutoff valve.
Space radiator fails. (EC-104)	GLYCOL DISCH PRESS indicates lower than normal.	Isolate radiator and replenish glycol.
Glycol leak in suit heat exchang.. (EC-105)	GLYCOL DISCH PRESS indicates lower than normal. GLYCOL ACCUM QUANTITY indicator reads low if reservoir is isolated.	Isolate glycol portion of suit heat exchanger.
Glycol temperature control amplifier fails. (EC-106)	GLY EVAP indicator reading decreases.	Manually control glycol temperature control valve to control evaporator liquid temperature.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Heat bypass valve motor fails. (EC-107)	GLY EVAP indicator read high. SUIT TEMP indicator reads high.	Control evaporator temperature manually with GLYCOL EVAP TEMP IN valve.
Suit heat exchanger temperature control amplifier fails. (EC-110)	TEMP-SUIT indicator shows uncontrolled evaporator temperature change.	Manually operate SUIT EVAP valve between OFF and MAN position.
Suit evaporator water inflow control valve motor fails. (EC-111)	SUIT TEMP indicator shows uncontrolled evaporator temperature change.	Manually regulate suit temperature by operating SUIT EVAP valve.
Cabin heat exchanger check valve fails. (EC-112)	TEMP-CABIN indicator reading increases.	Close glycol shutoff valve. Possible abort.
Cabin heat exchanger temperature control amplifier fails. (EC-113)	Cabin temperature uncontrolled.	Manually control cabin temperature.
Cabin heat exchanger temperature control valve fails. (EC-114)	Cabin temperature uncontrolled.	Manually operate valve.
Cabin automatic temperature control fails. (EC-115)	CABIN TEMP fails to respond to control changes.	Use manual control of cabin temperature.
Glycol discharge pressure sensor fails. (EC-116)	GLY DISCH PRESS indicator reads zero.	Monitor suit temperature to determine normal system operation.

Table 5-10. Environmental Control System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Glycol discharge pressure indicator fails. (EC-117)	GLY DISCH PRESS indicator reads minimum.	Monitor suit temperature to determine normal system operation.
Radiator temperature sensor fails. (EC-120)	RAD TEMP indicator reads minimum.	No data available.
Glycol radiator temperature indicator fails. (EC-121)	RAD TEMP indicator reads minimum.	No data available.
Glycol evaporator outlet temperature sensor fails. (EC-122)	GLY EVAP temp out indicator reads minimum.	Monitor suit and cabin temperatures to evaluate system operation.
Glycol evaporator outlet temperature indicator fails. (EC-123)	GLY EVAP temp out indicator reads minimum.	Monitor suit and cabin temperatures to evaluate system operation.
Steam outlet temperature fails. (EC-124)	No data available.	No data available.
Evaporator steam pressure indicator fails. (EC-125)	GLY EVAP STEAM PRESS indicator reads minimum.	Check ECS RAD temperature and indicator and GLY EVAP temperature out indicator to evaluate failure.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Glycol pump fails. a. Pump 1 (EC-126) b. Pump 2 (EC-127)	GLY DISCH PRESS indicator reads low. SUIT TEMP indicator reading increases. CABIN TEMP indicator reading increases. GLY EVAP temp out indicator reading increases.	Select alternate pump.
Steam outlet pressure sensor fails. (EC-130)	None Loss of TM monitoring.	None
Glycol accumulator quantity sensor fails. (EC-131)	GLY ACCUM quantity indicator reads minimum.	Monitor other system indications to determine water-glycol loop status.
Glycol accumulator quantity indicator fails. (EC-132)	GLY ACCUM quantity indicator reads minimum	Monitor other system indications to determine water-glycol loop status.
Radiator 1 valve fails. (EC-133)	No data available.	No data available.
Radiator 2 valve fails. (EC-134)	No data available.	No data available.
Radiator 3 valve fails. (EC-135)	No data available.	No data available.
Radiator 4 valve fails. (EC-136)	No data available.	No data available.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Glycol pump outlet check valve 1 fails. (EC-137)	None	Switch to pump 1.
Manual O_2 metering valve fails open. (EC-140)	FLOW O_2 indicator reads high. PRESS-CABIN indicator reads normal.	Don pressure suits and recharge back packs.
Glycol check valve fails (vents glycol out of GSE connection). (EC-145)	GLY ACCUM quantity indicator shows decreasing quantity.	Close GLYCOL TO RAD valve.
Tank pressure control relief valve fails open venting tank pressure. (EC-146) (Valve 1) (EC-147) (Valve 2)	FLOW O_2 indicator reads high. PRESS-CABIN indicator reads high.	Place TANK PRESSURE REGULATOR-SELECTOR OUTLET valve to alternate valve position.
Tank pressure control relief valve fails - fails leaking to cabin. (EC-150) (Valve 1) (EC-151) (Valve 2)	FLOW O_2 indicator reads high. PRESS-CABIN indicator reads normal.	Place TANK PRESSURE REGULATOR-SELECTOR OUTLET valve to alternate valve position.
Tank pressure control inlet selector fails - leaking to cabin. (EC-152)	FLOW O_2 indicator reads high. PRESS-CABIN indicator reads normal.	Select alternate valve.
Tank pressure control outlet selector fails - leaking to cabin. (EC-153)	FLOW O_2 indicator reads high. PRESS-CABIN indicator reads normal.	Select alternate valve.

Table 5-10. Environmental Control System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Glycol relief valve 2 fails in open position. (EC-154)	TEMP-CABIN indicator reads above normal. PRESS GLY DISCH indicator reads high.	Close shutoff valve for relief valve 2.
Water pressure-relief valve 2 fails in open position. (EC-155)	FLOW O_2 indicator reads high. PRESS-CABIN indicator reads low.	Select valve 1.

Table 5-11. Caution and Warning System

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Caution/warning power supply 1 fails (output zero). (CS-300)	CAUT/WARN FAIL lamp illuminates. All comparator-driven caution/warning lamps are extinguished. MASTER ALARM lamp is extinguished and audio tone is off.	Place CAUT/WARN-POWER switch to position 2.
CO_2 PP HI comparator reference voltage drifts low. (CS-301)	CO_2 PP HI On MASTER ALARM On Audio tone in C/M headsets.	Monitor PART PRESS CO_2 meter to verify comparator failure.
CO_2 PP HI lamp driver shorted. (CS-302)	CO_2 PP HI On	Monitor PART PRESS CO_2 meter to verify lamp driver failure.
GLYCOL TEMP LO comparator reference voltage low. (CS-303)	None	Crew receives information from MSFN if glycol temperature exceeds limits as indication would not be reflected on annunciator.
GLYCOL TEMP LO lamp driver shorted. (CS-304)	GLYCOL TEMP LO On	Monitor glycol temperature meter to verify driver failure.
O_2 tank pressure comparator high reference voltage goes high and low reference voltage goes low. (CS-305)	None	Crew receives information from MSFN if O_2 pressure exceeds limits as no indication would be reflected on annunciator.
O_2 PRESS lamp driver shorted. (CS-306)	O_2 PRESS On	Monitor O_2 PRESS meter to verify lamp driver failure.

Table 5-11. Caution and Warning System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
SPS WALL TEMP HI comparator reference voltage high. (CS-307)	None	Crew receives information from MSFN if SPS wall temperature does exceed limits as no indication would be reflected on annunciator.
S/M RCS B lamp driver shorted. (CS-310)	S/M RCS B On	Monitor S/M RCS B pressure, temperature, and fuel/ oxidizer quantity meters to verify lamp driver failure.
S/M RCS C annunciator wire open. (CS-311)	No indication unless out-of-tolerance condition occurs in S/M RCS C quadrant. If this happens, MASTER ALARM and audio tone go on.	Monitor gages to determine where out-of-tolerance condition exists or request MSFN to determine which parameter has exceeded limits.
S/M RCS D comparators high reference voltage goes low or low reference voltage goes high. (CS-312)	S/M RCS D On MASTER ALARM On Audio tone in C/M headsets.	Monitor S/M RCS D pressure, temperature, and fuel/ oxidizer readouts to verify reference voltage failure.
C/M RCS A annunciators wire open. (CS-313)	No indication unless out-of-tolerance condition occurs in C/M RCS A quadrant. If this happens, MASTER ALARM and audio tone go on.	Monitor gages to determine where out-of-tolerance condition exists or request MSFN to determine which parameter has exceeded limits.
C/M RCS A lamp driver shorted. (CS-314)	C/M RCS A On	Monitor C/M RCS system A readouts to verify lamp driver shorted.

Table 5-11. Caution and Warning System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Fuel cell 2 annunciator wire open. (CS-315)	No indications unless out-of-tolerance condition occurs in fuel cell 2. If this happens, MASTER ALARM and audio tone go on and F/C talk-back indicator is energized.	Monitor gages and talk-back indicators to determine where out-of-tolerance condition exists or request MSFN to determine which parameter has exceeded limits.
Fuel cell 3 annunciator lamp driver shorted. (CS-316)	F/C 3 On	Monitor fuel cell 3 readouts to verify lamp driver failure.
High reference voltage goes high or low reference voltage goes low for H_2 flow rate for fuel cell 1. (CS-320)	None	Crew receives information from MSFN if H_2 flow rate exceeds limits as no indication would be reflected on annunciator.
High reference voltage goes low or low reference voltage goes high for skin temperature for fuel cell 2. (CS-321)	F/C 2 On MASTER ALARM On Audio tone in C/M headsets.	Monitor fuel cell 2 readouts to verify reference voltage failure.
Reference voltage for pH factor fuel cell 1 comparator low. (CS-322)	F/C 1 On pH factor talk-back indicator energized. MASTER ALARM On Audio tone in C/M headsets.	Monitor fuel cell 1 parameter readouts; check with MSFN for verification of reference voltage failure.
Reference voltage for H_2 pressure of fuel cell 1 comparator high. (CS-323)	None	Crew receives information from MSFN if H_2 pressure exceeds limits as no

Table 5-11. Caution and Warning System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor		Anticipated Crew Response
			indication would be reflected on annunciators.
Reference voltage for radiator temperature of fuel cell 2 comparator high. (CS-324)	F/C 2 F/C 2 RAD temp low talk-back indicator energized. MASTER ALARM Audio tone in C/M headsets.	On On	Monitor all fuel cell 2 parameter readouts and/or check with MSFN to verify reference voltage failure.
Reference voltage for fuel cell 2 N_2 pressure comparator high. (CS-325)	None		Crew receives information from MSFN if N_2 pressure exceeds limits as no indication would be reflected on annunciators.
Reference voltage for fuel cell 3 O_2 pressure comparator low. (CS-326)	F/C 3 F/C 3 O_2 pressure talk-back indicator energized. MASTER ALARM Audio tone in C/M headsets.	On On On	Monitor all fuel cell 3 parameter readouts and/or check with MSFN to verify reference voltage failures.
O_2 flow fuel cell 2 comparators high reference voltage goes high or low reference voltage goes low. (CS-327)	None		Crew receives information from MSFN if O_2 flow rate exceeds limits as no indication would be reflected on annunciators.
SPS WALL TEMP HI annunciator lamp driver shorted. (CS-340)	SPS WALL TEMP HI	On	Check with MSFN as to status of SPS chamber wall temperature.

Table 5-11. Caution and Warning System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
S/M regulator pressure system A comparator high reference voltage goes high or low reference voltage goes low. (CS-341)	None	Crew receives information from MSFN if S/M RCS system A parameters exceed limits as no indication would be reflected on annunciators.
Spare annunciator (DS11) on panel 10 comparator high reference voltage goes low or low reference voltage goes high. (CS-342)	DS11 annunciator On MASTER ALARM On Audio tone in C/M headsets.	(This malfunction is not to be used in the IDC, but is reserved for future use.)
Spare annunciator (DS5) on panel 11 comparator high reference voltage goes low or low reference voltage goes high. (CS-343)	DS5 annunciator On MASTER ALARM On Audio tone in C/M headsets.	(This malfunction is not to be used in the IDC, but is reserved for future use.)
Condenser exhaust temperature fuel cell 3 comparator high reference voltage goes low or low reference voltage goes high. (CS-344)	F/C 3 On MASTER ALARM On Audio tone in C/M headsets.	Monitor fuel cell 3 parameter readouts and/or check with MSFN to verify reference voltage failure.
Open wire to MASTER ALARM lights and audio tone. (CS-345)	Three MASTER ALARM lights and audio tone are not energized when an out-of-tolerance condition is sensed by C&W system.	Monitor panels 10 and 11 for failures.
Open wire to IMU temperature annunciator. (CS-360)	IMU TEMP light fails to illuminate, except during lamp test. If IMU temperature exceeds limits, MASTER ALARM and audio tone are energized.	Monitor all indicators and gages to determine failure when MASTER ALARM and audio tone are energized or

Table 5-11. Caution and Warning System (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
		contact MSFN for information.
Open wire to G&N accelerometer fail annunciator. (CS-361)	G&N ACCEL FAIL light does not illuminate, except during lamp test. If G&N accelerometer does fail, MASTER ALARM and audio tone are generated.	Monitor all indicators and gages to determine failure when MASTER ALARM and audio tone are energized or contact MSFN for information.
Open wire to MN BUS B UNDERVOLT annunciator. (CS-362)	MN BUS B UNDERVOLT light does not illuminate, except during lamp test. If d-c bus B failure does occur, MASTER ALARM and audio tone are generated.	Monitor all indicators and gages to determine failure when MASTER ALARM and audio tone are energized or contact MSFN for information.
Open wire to H_2O ACCUM FAIL annunciator. (CS-363)	H_2O ACCUM FAIL light does not illuminate, except during lamp test. If H_2O accumulator failure does occur, MASTER ALARM and audio tone are generated.	Crew receives information from MSFN if suit inlet humidity level increases indicating an H_2O accumulator failure.
Open wire to SPS PU SNSR FAIL annunciator. (CS-364)	SPS PU SNSR FAIL light does not illuminate, except during lamp test. If SPS sensor does fail, no indications are directed to C/M.	Crew receives information from MSFN.

Table 5-12. Telecommunication Systems

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
S-band power amplifier fails. a. 20 watts (CM-001) b. 5 watts (CM-002)	Indication from MSFN of S-band communication failure.	Select alternate position of S-BAND-PWR AMPL switch or place S-BAND-XPONDER/XPONDER PWR switch to XPONDER position.
S-band normal down voice fails. (CM-003)	Indication from MSFN of S-band communication failure.	Select S-band emergency voice mode of operation.
S-band emergency voice down fails. (CM-004)	Indication from MSFN of S-band communication failure.	Select S-band emergency key mode of operation.
S-band up-voice fails. (CM-005)	Loss of MSFN S-band up-voice reception.	Select VHF-AM mode of reception if within VHF-AM range.
Astro audio center 1 fails. (CM-006)	Loss of all transmission and reception from audio center 1. Loss of sidetone.	Select alternate audio center by connecting suit umbilical plug or cobra cable emergency receptacle.
Astro audio center 2 fails. (CM-007)	Loss of all transmission and reception from audio center 2. Loss of sidetone.	Select alternate audio center by connecting suit umbilical plug to cobra cable emergency receptacle.

Table 5-12. Telecommunications Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Upper VHF scimitar antenna fails. (CM-010)	Loss of VHF-AM voice communication and UFH up-data link (C/M).	Select alternate antenna; rotate spacecraft to re-establish communications.
VHF-AM down-voice fails (transmitter fails). (CM-011)	Loss of VHF-AM down-voice communications with MSFN (C/M).	Activate S-band equipment; select alternate downlink function using S-band.
VHF-AM transceiver fails (receiver fails). (CM-012)	Loss of all VHF-AM voice reception from MSFN.	Activate S-band equipment; select alternate voice communications function using S-band.
VHF-AM transceiver-receiver frequency 2 fails. (CM-013)	Loss of reception from LEM.	None
VHF-AM transceiver-receiver frequency 1 fails. (CM-014)	Loss of reception from MSFN.	Select alternate voice communications facility with S-band switches.
Up-data S-band fails. (CM-015)	Loss of up-data link information to G&N computer.	Select alternate up-data link function (UHF).
UHF-FM receiver fails. (CM-016)	Loss of up-data link information to G&N computer.	Activate S-band equipment; select alternate up-data link function (S-band).
Up-data link validation fails. (CM-017)	Indication from MSFN of failure to receive up-data link verification.	Voice transmission to MSFN of reception of up-data link on computer keyboard.

Table 5-12. Telecommunication Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Central timing equipment oscillator fails. (CM-020)	Indication from MSFN of loss of voice communication on S-band (C/M). Loss of S-band voice communication (IOS).	Select S-band emergency mode. Activate VHF-AM transceiver.
Astro audio center 3 fails. (CM-021)	No transmission or reception from audio center 3.	Select alternate audio center.
Lower VHF scimitar antenna fails. (CM-022)	Loss of voice communication and up-data link (C/M).	Select alternate antenna; rotate spacecraft to re-establish communications.
Signal conditioner +5v fails. (CM-023)	All indicators driven by +5-volt excitation read minimum. IOS repeater indicators read minimum.	None
Signal conditioner internal power fails. (CM-024)	All indicators processed by signal conditioner read minimum. IOS repeater indicators read minimum.	None
PCM fails. (CM-025)	PCM transmission to SCATS interrupted.	None
Signal conditioner +10v fails. (CM-026)	All indicators utilizing +10-volt excitation read minimum. IOS repeaters indicate minimum.	None
Automatic selection of S-band omni antennas fail. (CM-027)	Communications with MSFN degrades with spacecraft attitude change; signal strength meter indicates loss of signal reception.	Use manual control of S-band omni antennas.

Table 5-12. Telecommunication Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
Upper S-band omni antenna fails. (CM-030)	Degraded S-band communications; signal strength meter reflects loss of reception.	Select alternate omni antenna; rotate spacecraft to re-establish communications.
Lower S-band omni antenna fails. (CM-031)	Degraded S-band communications; signal strength meter reflects loss of reception.	Select alternate omni antenna; rotate spacecraft to re-establish communications.
TUNE TO MAX meter fails. (CM-036)	S-BAND ANT meter does not respond to changes in signal strength.	Acquire S-band high-gain antenna using audio signals; select automatic function of antenna tracking.
Complete C-band fails. (CM-043)	Indication from MSFN of C-band tracking-ranging failure.	Activate S-band ranging circuitry.
VHF-FM transmitter fails. (CM-044)	Indication from MSFN of failure to receive PCM telemetry.	Activate S-band downlink equipment.
Complete central timing equipment fails. (CM-045)	Loss of S-band and emergency key transmissions. Malfunction of CTE-GMT word in data bit stream.	Select emergency voice function or alternate voice communication facility.
C-band transponder overheat condition. (CM-046)	Smoke from LEB area.	Disable nonessential circuit breaker.
VHF recovery beacon short or overload. (CM-047)	TELECOMMUNICATIONS GROUP 3 circuit breaker opens. Loss of VHF recovery beacon. Loss of audio control center 3.	Isolate malfunction. Reset circuit breaker; activate HF beacon when necessary in place of VHF beacon.

Table 5-12. Telecommunication Systems (Cont)

Malfunction Item/MIU Code Ident No.	Indication Crew/Instructor	Anticipated Crew Response
S-band TV circuit short or overload. (CM-054)	TELECOMMUNICATIONS GROUP 5 circuit breaker opens causing loss of audio control center 2, up-data link, and S-band antenna tracking. VHF-FM, TV camera, DSE and C-band, and PMP inoperative.	Isolate malfunction. Reset circuit breaker; select alternate function, if necessary.
HF transceiver equipment short or overload. (CM-055)	TELECOMMUNICATIONS GROUP 4 circuit breaker opens causing loss of VHF-AM communications, audio control center 2 key, complete audio control center 1, and HF recovery communications.	Isolate malfunction. Reset circuit breaker; select alternate function, if necessary.
PMP equipment short or overload. (CM-057)	TELECOMMUNICATIONS GROUP 2 circuit breaker opens causing loss of S-band communication.	Isolate malfunction and reset circuit breaker. Select alternate function, if necessary.
Audio center VOX fails off. (CM-060) (Station 1) (CM-061) (Station 2) (CM-062) (Station 3)	Loss of sidetone at failed station. Indication from MSFN of down-voice failure (HF, VHF, S-band). Indication from other stations of intercom voice failure.	Switch from VOX to PTT mode of operation.
Audio center VOX fails on. (CM-063) (Station 1) (CM-064) (Station 2) (CM-065) (Station 3)	Loss of inserted noise at failed station headset when not transmitting (HF, VHF-AM RCVR 1, S-band). Loss of reception (HF, VHF-AM RCVR 1 and S-band).	Switch from VOX to PTT mode of operation.
Audio center PTT fails off. (CM-066) (Station 1) (CM-067) (Station 2) (CM-070) (Station 3)	Loss of sidetone at failed station. Indication from MSFN of down-voice failure (HF, VHF and S-band). Indications from other stations of intercom voice failure.	Switch from PTT to VOX mode of operation.

Table 5-13. Telemetry System

Malfunction Item / MIU Code Ident No.	Indication Crew / Instructor	Anticipated Crew Response
PCM unit fault 1 (CM-753)	Indication from MSFN of faulty TM data.	None
PCM unit fault 2 (CM-754)	Indication from MSFN of faulty TM data.	None
PCM unit fault 3 (CM-755)	Indication from MSFN of faulty TM data.	None
PCM unit fault 4 (CM-756)	Indication from MSFN of faulty TM data.	None
PCM unit fault 5 (CM-757)	Indication from MSFN of faulty TM data.	None
PCM unit fault 6 (CM-760)	Indication from MSFN of faulty TM data.	None
PCM unit fault 7 (CM-761)	Indication from MSFN of faulty TM data.	None
PCM unit fault 8 (CM-762)	Indication from MSFN of faulty TM data.	None
PCM unit fault 9 (CM-763)	Indication from MSFN of faulty TM data.	None

Table 5-14. Smoke Simulation System

Malfunction Item / MIU Code Ident No.	Indication Crew / Instructor	Anticipated Crew Response
Smoke generation.		
a. CS-774	Smoke from left side of main display panel.	Shut down equipment; isolate malfunction.
b. CS-775	Smoke from left side of lower equipment bay.	
c. CS-776	Smoke from right side of main display panel.	
d. CS-777	Smoke from right side of equipment bay.	
The following failures will also initiate smoke generation.		
a. AGAP heater fails. (SC-105)	Smoke from left side of main display panel.	(Refer to SCS malfunction, SC-105.)
b. Inverter 1 fails. (EP-006)	Smoke from left side of lower equipment bay.	(Refer to EPS malfunction, EP-006.)
c. Inverter 1 temperature high. (EP-015)	Smoke from left side of lower equipment bay.	(Refer to EPS malfunction, EP-015.)
d. C-band transponder. (CM-046)	Smoke from right side of lower equipment bay.	(Refer to communication malfunction, CM-046.)

Table 5-15. Malfunction Selection Set 1 - RCS Jets Inoperative

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	SC-042		Reaction jet 1 fails off	Insert SC-042 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow reaction to + pitch commands.)	Crewmember should compensate for lost jet when maneuvering to new attitude. SC-042 and SC-046 together simulate total loss of + pitch control.
	SC-044		Reaction jet 2 fails off	Insert SC-044 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow reaction to - pitch commands.)	Same response as SC-042. SC-044 and SC-051 together simulate total loss of - pitch control.
	SC-046		Reaction jet 3 fails off	Insert SC-046 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow reaction to + pitch commands.)	Same response as SC-042.
	SC-051		Reaction jet 4 fails off	Insert SC-051 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow reaction to - pitch commands.)	Same response as SC-042.

Table 5-15. Malfunction Selection Set 1 - RCS Jets Inoperative (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	SC-053		Reaction jet 5 fails off	Insert SC-053 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll	Same response as SC-042. SC-053 and SC-057 together simulate total loss of + yaw control.
	SC-055		Reaction jet 6 fails off	Insert SC-055 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow reaction to - yaw commands.)	Same response as SC-042. SC-055 and SC-062 together simulate total loss of - yaw control.
	SC-057		Reaction jet 7 fails off	Insert SC-057 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow reaction to + yaw commands.)	Same response as SC-042.
	SC-062		Reaction jet 8 fails off	Insert SC-062 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow reaction to - yaw commands.)	Same response as SC-042.

Table 5-15. Malfunction Selection Set 1 - RCS Jets Inoperative (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	SC-106		Reaction jet 9 fails off	Insert SC-106 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow response to + roll commands.)	Same response as SC-042. SC-106, SC-113, SC-117 and SC-124 together simulate total loss of + roll control.
	SC-111		Reaction jet 10 fails off	Insert SC-111 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow response to - roll commands.)	Same response as SC-042. SC-111, SC-115, SC-122 and SC-126 together simulate total loss of - roll control.
	SC-113		Reaction jet 11 fails off	Insert SC-113 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow response to + roll commands.)	Same response as SC-042.
	SC-115		Reaction jet 12 fails off	Insert SC-115 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow response to - roll commands.)	Same response as SC-042.

Table 5-15. Malfunction Selection Set 1 - RCS Jets Inoperative (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	SC-117		Reaction jet 13 fails off	Insert SC-117 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow response to + roll commands.)	Same response as SC-042.
	SC-122		Reaction jet 14 fails off	Insert SC-122 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow response to - roll commands.)	Same response as SC-042.
	SC-124		Reaction jet 15 fails off	Insert SC-124 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow response to + roll commands.)	Same response as SC-042.

Table 5-15. Malfunction Selection Set 1 - RCS Jets Inoperative (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	SC-126		Reaction jet 16 fails off	Insert SC-126 via MIU. Request attitude change to _____°pitch _____°yaw _____°roll (Slow response to - roll commands.)	Same response as SC-042. Instructur should reiterate various situations as requested by crew-member prior to run completion.

Table 5-16. Malfunction Selection Set 2 - EPS Malfunctions

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EP-006		Inverter 1 burned out	AC BUS 1 (2) FAIL light on MASTER ALARM light on AC VOLTS - bus 1 (2) minimum FREQUENCY bus 1 (2) All equipment powered by bus(s) inoperative IOS Data Sheets, MEP.10 and MEP.13 single-inverter operation; MEP.11 and MEP.12 for dual-inverter operation	Crew Procedures SM2A-03 para. 9.1.5.6 -7 single-inverter operation, 9.1.5.8 for dual-inverter operation.
	EP-010		Inverter 2 overvoltage	AC BUS 1 (2) FAIL light(s) on MASTER ALARM lights on AC VOLTS bus 1 (2) minimum FREQUENCY bus 1 (2) minimum Equipment powered by bus(s) inoperative IOS Data Sheets MEP. 10 and MEP. 13 single-inverter operation; MEP. 11, MEP. 12 for dual inverter operation.	Crew Procedures same as EP.006.
	EP-011		Inverter 3 low-voltage failure	AC BUS 1 (2) FAIL light(s) on MASTER ALARM lights on AC VOLTS reads 90 volts IOS Data Sheets MEP.10, MEP.11 and MEP.12	Crew Procedures SM2A-03, para. 9.1.5.6 -7.

Table 5-16. Malfunction Selection Set 2 - EPS Malfunctions (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EP-014		A-C bus 2 overload	AC BUS 2 FAIL light on AC BUS 2 OVERLOAD light on AC VOLTS bus 2 minimum FREQUENCY bus 2 minimum IOS Data Sheets MEP. 10, MEP. 22, and MEP. 16	Crew Procedures SM2A-03 para. 9.1.5.9.
	EP-015 EP-016		Inverter 1, (2) temperature high	MASTER ALARM light on INV 1, (2) TEMP HI light on IOS Data Sheet MEP. 24	Crew Procedures SM2A-03 para. 9.1.5.10 Crewman will transfer to alternate inverter.
	EP-031 EP-032		Main d-c bus A (B) shorted	MASTER ALARM light on DC BUS A (B) UNDERVOLT light on IOS Data Sheet MEP. 08	Crew Procedures SM2A-03 para. 9.1.5.4. Crewman will perform failure isolation procedures.
	EP-037		A-C voltmeter fails	Voltmeter reads minimum on all buses Frequency meter normal IOS Data Sheet MEP. 10	Instructor to provide voltage at request of crewman.
	EP-040		Frequency meter fails	Frequencing meter reads minimum on all buses. A-C volts meter normal IOS Data Sheet MEP. 10	Instructor to provide frequency at request of crewman.

Table 5-16. Malfunction Selection Set 2 - EPS Malfunctions (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EP-047		A-C bus 1 under-overvolt sensor fails indicating under-voltage	AC BUS 1 FAIL C&W light on MASTER ALARM light on AC VOLTS bus 1 normal IOS Data Sheet MEP. 10	Crewman will disable sensor circuit, reset a-c bus 1 and change SCS power sw to bus 1.
	EP-053		Main d-c bus B undervolt sensor fails indicating under-voltage	DC BUS B UNDERVOLT light on MASTER ALARM light on D-C volts main bus B reads normal. Bat. relay bus - power B - C/M Resetable light on to affect override IOS Data Sheet MEP. 08	Crew Procedures SM2A-03 para. 9.1.5.4. Crew-member will disable failed system by pulling circuit breaker.
	EP-057		Inverter 1 fails (no output)	AC BUS 1 (2) FAIL light on MASTER ALARM light on A-C volts reads minimum Frequency reads minimum Equipment powered by a-c buses inoperative IOS Data Sheets MEP. 20 (dual-inverter operation), MEP. 21 (single-inverter operation) and MEP. 10	Crew Procedures SM2A-03 para. 9.1.5.6 or 8. Crew-man will transfer to alternate inverter.

Table 5-16. Malfunction Selection Set 2 - EPS Malfunctions (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EP-103		Fuel cell 2 H_2 supply valve fails closed	FLOW H_2 decreases DC AMPS, F/C 2 decrease DC VOLTS, F/C 2 decrease F/C 2 light on MASTER ALARM light on F/C DISCONNECT light on IOS Data Sheets MEP.02 and EP3.08	Crew Procedures SM2A-03 para. 9.1.5.3. Crewman may try to isolate malfunction using 9.1.5.2.
	EP-104		Fuel cell 2 O_2 supply valve fails closed	FLOW O_2 decreases DC AMPS, F/C 2 decrease DC VOLTS, F/C 2 decrease F/C 2 C&W light on MASTER ALARM light on F/C DISCONNECT C&W light on IOS Data Sheets MEP.01 and EP3.08	Crew Procedures SM2A-03 para. 9.1.5.1.

Table 5-17. Malfunction Selection Set 3 - ECS Malfunctions

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EC-003 or EC-004		Suit compressor 1 or 2 motor fails	Insert malfunction via MIU. IOS repeater indicator reads DELTA P COMP low. IOS Data Sheet MEC.04	Crew Procedures SM2A-03 para. 9.1.6.7 DELTA P COMP gage reads abnormal. Use of EC-003 and EC-004 together becomes a catastrophic condition.
	EC-012		CO_2 partial pressure sensor fails	Insert malfunction via MIU. IOS repeater indicators read CO_2 PP HI on MASTER ALARM on PART PRESS CO_2 reads high. No IOS Data Sheet.	Crew Procedures SM2A-03 para. 9.1.6.3. CO_2 PP HI light illuminates. Crewmember should change CO_2 filter. When this does not correct problem, communication with GOSS (IOS) will verify sensor failure.
	EC-026		Cabin recirculation blower 1 fails	Insert malfunction via MIU. IOS repeater indicator shows CABIN TEMP increasing. IOS Data Sheet MEC.07	Crew Procedures SM2A-03 para. 9.1.6.9. TEMP-CABIN gage above 80°F.

Table 5-17. Malfunction Selection Set 3 - ECS Malfunctions (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EC-033		Cabin temperature sensor fails (maximum output)	Insert malfunction via MIU. IOS repeater indicators read CABIN TEMP gage maximum IOS Data Sheet MEC.07	Crew Procedures SM2A-03 para. 9.1.6.9. TEMP-CABIN gage above 80°F.
	EC-045		Cabin inner pressure relief valve fails open	Insert malfunction via MIU. IOS repeater indicators read MASTER ALARM on CABIN PRESS gage low O_2 FLOW HI on O_2 FLOW indicator high SUIT PRESS gage low IOS Data Sheet MEC.10 Attempted malfunction isolations may be followed using IOS Data Sheets MEC.08 and/or MEC.01	Crew Procedures SM2A-03 para. 9.1.6.11. PRESS-CABIN gage reads low. Crewmembers may also attempt to isolate malfunction using para. 9.1.6.10 and/or 9.1.6.4. Cabin inner pressure relief valve is the three-position cabin press relief valve. It is also referred to as the upper cabin pressure relief valve.
	EC-047		Cabin outer pressure relief valve fails open	Same procedure as EC-045.	Same procedures as EC-045 directly above. Cabin outer pressure relief valve is the two-position cabin press relief valve. It is also

Table 5-17. Malfunction Selection Set 3 - ECS Malfunctions (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
					referred to as the blower cabin pressure relief valve.
	EC-054		Water quantity indicator fails	Insert malfunction via MIU. IOS repeater indicator reads WATER QUANTITY gage minimum.	Crewmember should check WATER QUANTITY reading in both WASTE and POTABLE positions. Check availability of water in drinking hose. Verify with MSFN that only indicator has malfunctioned.
	EC-104		Space radiator leak	Insert malfunction via MIU. IOS repeater indicator GLY ACCUM QUANTITY reads low. This malfunction may take one hour or more to accumulate a visible error.	Crewmember should isolate failed radiator and replenish glycol.
	EC-107		Heat bypass valve motor fails (coolant temp control valve)	Insert malfunction via MIU. IOS repeater indicators read EVAP EVAP TEMP high SUIT TEMP high IOS Data Sheet MEC.06	Crew Procedures SM2A-03 para. 9.1.6.8. TEMP-SUIT gage reads above 55°F. Crewmember should manually control coolant temp control valve.

Table 5-17. Malfunction Selection Set 3 ECS Malfunctions (Cont)

Step	Malf	Time	Function	IOS Visibility/Action	Notes
	EC-116		Glycol discharge pressure sensor fails	Insert malfunction via MIU. IOS repeater indicators read GLY DISCH PRESS gage min. SUIT TEMP gage - no change IOS Data Sheet MEC.03	Crew procedures SM2A-03 para. 9.1.6.6 may be attempted by crewmember before malfunction is isolated to sensor. Crewmember should verify sensor failure with MSFN.
	EC-126		Glycol pump 1 fails	Insert malfunction via MIU. IOS repeater indicators read MASTER ALARM on RADIATOR TEMP gage low CABIN TEMP gage increases IMU TEMP on PRESS GLY DISCH gage low SUIT TEMP gage high IOS Data Sheet MEC.03 for other attempts at malfunction isolation, see MEC.16 and/or MEC.07	Crew Procedures SM2A-03 para. 9.1.6.6. PRESS GLY DISCH gage below 26 psia. Crewmember may also attempt to isolate malfunction using para 9.1.6.8 and/or 9.1.6.9.

6 SIMULATION OUTPUT DATA

SECTION 6

SIMULATION OUTPUT DATA

This section of Volume II of the AMS Instructor Handbook contains a list of spacecraft system and dynamic simulation outputs available to X-T and X-Y recorders, digital tape recorders, the electronic typewriter, and the TM console.

The list provides all data available at date of publication, except the classified information pertaining to table 6-4. This omitted information is provided in the SE 012 Math Model, Weight and Balance, Program No. 3, Report No. ER642, Confidential Supplement. The report is prepared by General Precision, Inc., Link Group, Systems Division, Binghamton, New York.

The tables are grouped by computer program. Instructions for imposing the signals identified in the simulation output tables on the various transcription devices are included in section 1 (AMS Operation) of this volume. Contents of the simulation output tables include:

- Program symbol for each simulation parameter.
- Descriptive title of each simulation parameter.
- Unit of measure and operating range (upper and lower limit) of each parameter.
- TM console channel and TM fault panel numbers for those parameters available at TM console.
- Identification of parameters normally transcribed on digital tape.

This section of the handbook also includes several parameter listings identified as "measurement data groups". Measurement data groups are sets of measurement parameters that have been pre-prepared for selected crew procedures and mission events and used in a number of sessions throughout the syllabus.

Table 6-1. Simulated Spacecraft Dynamics — Equations of Motion

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
$*p_b$	Projection of the absolute rotational velocity vector of the B-frame on the X B-frame axis	±1.5 rad/sec		X
$*q_b$	Projection of the absolute rotational velocity vector of the B-frame on the Y B-frame axis	±1.5 rad/sec		X
$*r_b$	Projection of the absolute rotational velocity vector of the B-frame on the Z B-frame axis	±1.5 rad/sec		X
e_1	Quaternion parameter notation	±1		X
e_2	Quaternion parameter notation			X
e_3	Quaternion parameter notation			X
e_4	Quaternion parameter notation	±1		X
$(\dot{X}_{I_E})_V$	Time rate of change of I_E-frame coordinate of vehicle position	±32768 ft/sc		X
$(\dot{Y}_{I_E})_V$	Time rate of change of I_E-frame coordinate of vehicle position	±32768 ft/sc		X
$(\dot{Z}_{I_E})_V$	Time rate of change of I_E-frame coordinate of vehicle position	±32768 ft/sc		X
$(X_{I_E})_V$	I_E-frame coordinate of vehicle position	$\pm 2^{26}$ ft		X
$(Y_{I_E})_V$	I_E-frame coordinate of vehicle position	$\pm 2^{26}$ ft		X
$(Z_{I_E})_V$	I_E-frame coordinate of vehicle position	-20.8×10^6, $+2^{26}$ ft		X
r_{VE}	Position vector of the distance from the center of mass of the earth to the center of gravity of the Apollo spacecraft	20.8×10^6, 2^{26} ft		
$\ddot{X}_{G_{I_E}}$	I_E-frame gravitational acceleration component	±32.2 ft/sec		
$\ddot{Y}_{G_{I_E}}$	I_E-frame gravitational acceleration component	±32.2 ft/sec		
$\ddot{Z}_{G_{I_E}}$	I_E-frame gravitational acceleration component	±32.2 ft/sec		
C_{11}	Projection of a unit vector along the X B-frame axis on the X, I-frame axis	±1		
C_{12}	Projection of a unit vector along the X B-frame axis on the Y, I-frame axis	±1		
C_{13}	Projection of a unit vector along the X B-frame axis on the Z, I-frame axis	±1		
C_{21}	Projection of a unit vector along the Y B-frame axis on the X, I-frame axis	±1		
C_{22}	Projection of a unit vector along the Y B-frame axis on the Y, I-frame axis	±1		
C_{23}	Projection of a unit vector along the Y B-frame axis on the Z, I-frame axis	±1		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-1. Simulated Spacecraft Dynamics — Equations of Motion (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*C_{31}	Projection of a unit vector along the Z B-frame axis on the X, I-frame axis	±1		
*C_{32}	Projection of a unit vector along the Z B-frame axis on the Y, I-frame axis	±1		
*C_{33}	Projection of a unit vector along the Z B-frame axis on the Z, I-frame axis	±1		
*SIN λ_E	Sin of the angle of longitude with respect to the I_E-frame	±1		
*COS λ_E	Cos of the angle of longitude with respect to the I_E-frame	±1		
*SIN $<_E$	Sin of the angle of latitude with respect to the I_E-frame	±1		
*COS $<_E$	Cos of the angle of latitude with respect to the I_E-frame	±1		
*u_R	Projection of V_R on the X B-frame axis	0, 30,000 ft/sec		
*v_R	Projection of V_R on the Y B-frame axis	0, 30,000 ft/sec		
*w_R	Projection of V_R on the Z B-frame axis	0, 30,000 ft/sec		
*V_R	Vehicle velocity relative to the rotating atmosphere	0, 30,000 ft/sec		
*h	Vehicle altitude above the earth's surface measured along the radius vector	0, 33554432 ft		
*a_{11}	E-frame to B-frame direction cosine	±1		X
*a_{12}	E-frame to B-frame direction cosine	±1		X
*a_{13}	E-frame to B-frame direction cosine	±1		X
*a_{21}	E-frame to B-frame direction cosine	±1		X
*a_{22}	E-frame to B-frame direction cosine	±1		X
*a_{23}	E-frame to B-frame direction cosine	±1		X
*a_{31}	E-frame to B-frame direction cosine	±1		X
*a_{32}	E-frame to B-frame direction cosine	±1		X
*a_{33}	E-frame to B-frame direction cosine	±1		X
*$\theta_{VB \rightarrow VE}$	B-frame to E-frame Euler angle	$\pm 2\pi$		X
*$\phi_{VB \rightarrow VE}$	B-frame to E-frame Euler angle	$\pm 2\pi$		X
*$\psi_{VB \rightarrow VE}$	B-frame to E-frame Euler angle	$\pm 2\pi$		X
*$\theta_{VB \rightarrow I}$	B-frame to I-frame Euler angle	$\pm 2\pi$		
*$\phi_{VB \rightarrow I}$	B-frame to I-frame Euler angle	$\pm 2\pi$		
*$\psi_{VB \rightarrow I}$	B-frame to I-frame Euler angle	$\pm 2\pi$		
*T_{X_b}	Projection of the total thrust vector on the X B-frame axis	0, 20,000 lb		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-1. Simulated Spacecraft Dynamics — Equations of Motion (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*T_{Y_b}	Projection of the total thrust vector on the Y B-frame axis	0, 3600 lb		
*T_{Z_b}	Projection of the total thrust vector on the Z B-frame axis	0, 3600 lb		
*$F_{X_b'}$	Projection of the Apollo total applied force vector minus the gravitational force vector on the X Apollo B-frame axis	-40000, 60000 lb		
*$F_{Y_b'}$	Projection of the Apollo total applied force vector minus the gravitational force vector on the Y Apollo B-frame axis	-40000, 43600 lb		
*$F_{Z_b'}$	Projection of the Apollo total applied force vector minus the gravitational force vector on the Z Apollo B-frame axis	-444, 666 lb		
*$\ddot{X}_{I_E'}$	I-frame acceleration component minus the gravitational projections	-444, 486 ft/sec^2		
*$\ddot{Y}_{I_E'}$	I-frame acceleration component minus the gravitational projections	-444, 486 ft/sec^2		
*$\ddot{Z}_{I_E'}$	I-frame acceleration component minus the gravitational projections	-444, 486 ft/sec^2		
*$M_{T_{X_b}}$	Projection of the resultant thrust moment on the X B-frame axis	0, 496 ft/lb		
*$M_{T_{Y_b}}$	Projection of the resultant thrust moment on the Y B-frame axis	0, 496 ft/lb		
*$M_{T_{Z_b}}$	Projection of the resultant thrust moment on the Z B-frame axis	0, 496 ft/lb		
*M_{X_b}	Projection of the total applied moment vector on the X B-frame axis	-40000, 44096 ft/lb		
*M_{Y_b}	Projection of the total applied moment vector on the Y B-frame axis	-40000, 44096 ft/lb		
*M_{Z_b}	Projection of the total applied moment vector on the Z B-frame axis	-40000, 44096 ft/lb		
*$\dot{p}_b$	Projection of the absolute rotational acceleration vector of the B-frame on the X B-frame axis	±5.0 rad/sec^2		
*$\dot{q}_b$	Projection of the absolute rotational acceleration vector of the B-frame on the Y B-frame axis	±5.0 rad/sec^2		
*$\dot{r}_b$	Projection of the absolute rotational acceleration vector of the B-frame on the Z B-frame axis	±5.0 rad/sec^2		
*$(\ddot{X}_{I_E})_V$	I_E-frame acceleration component	±1024 ft/sec^2		X
*$(\ddot{Y}_{I_E})_V$	I_E-frame acceleration component	±1024 ft/sec^2		X
*$(\ddot{Z}_{I_E})_V$	I_E-frame acceleration component	±1024 ft/sec^2		X

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-1. Simulated Spacecraft Dynamics — Equations of Motion (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*$\dot{e}_1$	Quaternion rate	±1		
*$\dot{e}_2$	Quaternion rate	±1		
*$\dot{e}_3$	Quaternion rate	±1		
*$\dot{e}_4$	Quaternion rate	±1		
*T_{X_b}	B-frame thrust TPM relative to S/C	±22000 lb		
*T_{Y_b}	B-frame thrust TPM relative to S/C	±22000 lb		
*T_{Z_b}	B-frame thrust TPM relative to S/C	±22000 lb		
AFXITMSC	I_E-frame total force components TPM relative to S/C	±22000 lb		
AFYITMSC	I_E-frame total force components TPM relative to S/C	±22000 lb		
AFZITMSC	I_E-frame total force components TPM relative to S/C	±22000 lb		
*$\ddot{X}_{I_E}$ TPM→S/C	I_E-frame total acceleration TPM relative to S/C	±644 ft/sec^2		
*$\ddot{Y}_{I_E}$ TPM→S/C	I_E-frame total acceleration TPM relative to S/C	±644 ft/sec^2		
*$\ddot{Z}_{I_E}$ TPM→S/C	I_E-frame total acceleration TPM relative to S/C	±644 ft/sec^2		
*$\dot{X}_{I_E}$ TPM→S/C	I_E-frame velocity TPM relative to S/C	±1024 ft/sec		
*$\dot{Y}_{I_E}$ TPM→S/C	I_E-frame velocity TPM relative to S/C	±1024 ft/sec		
*$\dot{Z}_{I_E}$ TPM→S/C	I_E-frame velocity TPM relative to S/C	±1024 ft/sec		
*X_{I_E} TPM→S/C	I_E-frame position TPM relative to S/C	±8000 ft		
*Y_{I_E} TPM→S/C	I_E-frame position TPM relative to S/C	±8000 ft		
*Z_{I_E} TPM→S/C	I_E-frame position TPM relative to S/C	±8000 ft		
*X_b TPM→S/C	B-frame position TPM relative to S/C	±8000 ft		
*Y_b TPM→S/C	B-frame position TPM relative to S/C	±8000 ft		
*Z_b TPM→S/C	B-frame position TPM relative to S/C	±8000 ft		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-1. Simulated Spacecraft Dynamics — Equations of Motion (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
$*p_{b_{t=t_o}}$	Initial condition quantity			
$*q_{b_{t=t_o}}$	Initial condition quantity			
$*r_{b_{t=t_o}}$	Initial condition quantity			
$*e1_{t=t_o}$	Initial condition quantity			
$*e_{2_{t=t_o}}$	Initial condition quantity			
$*e_{3_{t=t_o}}$	Initial condition quantity			
$*e_{4_{t=t_o}}$	Initial condition quantity			
$*(\dot{X}_{I_E})_{V\,t=t_o}$	Initial condition quantity			
$*(\dot{Y}_{I_E})_{V\,t=t_o}$	Initial condition quantity			
$*(\dot{Z}_{I_E})_{V\,t=t_o}$	Initial condition quantity			
$*(X_{I_E})_{V\,t=t_o}$	Initial condition quantity			
$*(Y_{I_E})_{V\,t=t_o}$	Initial condition quantity			
$*(Z_{I_E})_{V\,t=t_o}$	Initial condition quantity			
$*K^2$	Gravitational potential constant	3.43818×10^{-8} lb-ft^2/slug^2		
$*m_E$	Mass of the earth	$4094.17551850 \times 10^{20}$ slugs		
$*\ddot{X}_b$	Body axes acceleration component	-148, +222 ft/sec^2		
$*\ddot{Y}_b$	Body axes acceleration component	-148, +222 ft/sec^2		
$*\ddot{Z}_b$	Body aces acceleration component	-148, +222 ft/sec^2		
$*\omega_E$	Rotational rate of the earth	$.729211508 \times 10^{-4}$ rad/sec		
$*\mathrm{SIN}\,\sigma_{\theta n}$	Gimbal angle	±0.13917		
$*\mathrm{SIN}\,\sigma_{\psi n}$	Gimbal angle	-0.06975, +20791		
$*M_{T_{X_b\,\mathrm{SPS}}}$	SPS thrust moment about X-body axis	0 ft/lb		
$*M_{T_{Y_b\,\mathrm{SPS}}}$	SPS thrust moment about Y-body axis	-87188, +259888 ft/lb		
$*M_{T_{Z_b\,\mathrm{SPS}}}$	SPS thrust moment about Z-body axis	±173963 ft/lb		
$*K_1$	Quaternion redundancy check gain factor	Const. 1.0 (sec)$^{-1}$		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-1. Simulated Spacecraft Dynamics — Equations of Motion (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*$M_{T_{X_b}}$ S/M RCS	Rolling moment about the X-body axis due to S/M RCS thrust	±4096 ft/lb		
*$M_{T_{Y_b}}$ S/M RCS	Pitching moment about the Y-body axis due to S/M RCS thrust	±4096 ft/lb		
*$M_{T_{Z_b}}$ S/M RCS	Yawing moment about the Z-body axis due to S/M RCS thrust	±4096 ft/lb		
*$M_{T_{X_b}}$ C/M RCS	Rolling moment about the X-body axis due to C/M RCS thrust	±2048 ft/lb		
*$M_{T_{Y_b}}$ C/M RCS	Pitching moment about the Y-body axis due to C/M RCS thrust	±2048 ft/lb		
*$M_{T_{Z_b}}$ C/M RCS	Yawing moment about the Z-body axis due to C/M RCS thrust	±2048 ft/lb		
*C_{I1}	I - B-frame TPM direction cosine	±1		
*C_{I2}	I - B-frame TPM direction cosine	±1		
*C_{I3}	I - B-frame TPM direction cosine	±1		
*C_{21}	I - B-frame TPM direction cosine	±1		
*C_{22}	I - B-frame TPM direction cosine	±1		
*C_{23}	I - B-frame TPM direction cosine	±1		
*C_{31}	I - B-frame TPM direction cosine	±1		
*C_{32}	I - B-frame TPM direction cosine	±1		
*C_{33}	I - B-frame TPM direction cosine	±1		
ACK1	Initial condition quantity Ratio of reference area of TPM to that of SCM			
ACK2	Ratio of mass of SCM to mass of TPM at time of C/M-S/M sep.	0 or 1.7		
ACK3	Ratio (1.7 after C/M-S/M sep.)	0 or 1.7		
GIND	Output to drive accelerometer	-9.632, +2.618 volts		
*O_{LC}	Limit cycle Euler angle - roll	±0.01745 rad		
*θ_{LC}	Limit cycle Euler angle - pitch	±0.00873 rad		
*ψ_{LC}	Limit cycle Euler angle - yaw	±0.00873 rad		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-1. Simulated Spacecraft Dynamics — Equations of Motion (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
AXDDBGRV	Acceleration due to gravity along X-body axis	±32.2 ft/sec^2		
AXDDBTOT	Total acceleration along X-body axis	-180.2, +254.2 ft/sec^2		
ADBTPMSC	Distance between TPM and S/C	0, 10000 ft		
b_{11}	I-frame to E-frame direction cosine	±1		
b_{12}	I-frame to E-frame direction cosine	±1		
b_{13}	I-frame to E-frame direction cosine	±1		
b_{21}	I-frame to E-frame direction cosine	±1		
b_{22}	I-frame to E-frame direction cosine	±1		
b_{23}	I-frame to E-frame direction cosine	±1		
b_{31}	I-frame to E-frame direction cosine	±1		
b_{32}	I-frame to E-frame direction cosine	±1		
b_{33}	I-frame to E-frame direction cosine	±1		

Table 6-2. Simulated Spacecraft Dynamics - Ephemeris

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TLYEAR	Launch year, a typewriter input	1966, 1986 years		
TLDAY	Day of year, a typewriter input	0, 365 days		
ULYDAY	No. of leap yr days from Jan. 1950 to launch	4, 9 days		
UDAYL	No. of days from Jan. 1, 1950 to launch	5844, 13514 days		
UDAYLET	No. of days from Jan. 1, 1950 to launch in E. T.	5844, 13514 days		
UJDL	Julian date of launch	2439126.5, 2446796.5 days		
UTL	Centuries from Jan. 1, 1950 to launch date in E. T.	0.160000, 0.360000 cent		
UJDMAX	End date of mission	2439142.5, 2446812.5 days		
UDELTAT	ΔT, where E. T. = U. T. + ΔT from 1950 launch year	$8.42592(10^{-5})$, $18.95332(10^{-5})$ days		
UJEPOCH	Julian date for Jan. 1, 1950	Const 2433282.5003332 days		
UDPCENT	Number of days/century	Const 36525.0 days/cent		
UC006021	Constants used in computing elements of UP	Const $-223.4988(10^{-4})$ units/cent		
UC006031	Constants used in computing elements of UP	Const $-97.1711(10^{-4})$ units/cent		
UC006012	Constants used in computing elements of UP	Const $-29697(10^{-4})$ units/cent^2		
UC006022	Constants used in computing elements of UP	Const $0.0676(10^{-4})$ units/cent^2		
UC006032	Constants used in computing elements of UP	Const $0.0207(10^{-4})$ units/cent^2		
UC006042	Constants used in computing elements of UP	Const $-2.4976(10^{-4})$ units/cent^2		
UC006052	Constants used in computing elements of UP	Const $-1.0859(10^{-4})$ units/cent^2		
UC006062	Constants used in computing elements of UP	Const $-0.4721(10^{-4})$ units/cent^2		
UC006013	Constants used in computing elements of UP	Const $-0.0013(10^{-4})$ units/cent^3		
UC006023	Constants used in computing elements of UP	Const $0.0221(10^{-4})$ units/cent^3		
UC006033	Constants used in computing elements of UP	Const $0.0096(10^{-4})$ units/cent^3		
UC006043	Constants used in computing elements of UP	Const $0.0015(10^{-4})$ units/cent^3		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-2. Simulated Spacecraft Dynamics - Ephemeris (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
UC006053	Constants used in computing elements of UP	Const $0.0003(10^{-4})$ units/cent^3		
UC006063	Constant used in computing the elements of UP.	Const $0.0002(10^{-4})$ units/cent^3		
UP11, UP12, UP13, UP21, UP22, UP23, UP31, UP32, UP33	Precessional matrix P_{ij} , UP, transforming coordinates in the 1950.0 equatorial reference frame to that in the inertial reference frame. The inertial reference frame is defined as the O^h launch date equatorial and equinox frame. It is referred to the I_E-frame if earth-centered, J_E-frame if moon-centered. The J_E frame is also referred to as the inertial M-frame. $[P_{ij}]$ is needed only for prelaunch.	-1.0, 1.0		
UXMIE	The X-component of moon pos vector with respect to I_E of Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UYMIE	The Y-component of moon pos vector with respect to I_E of Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UZMIE	The Z-component of moon pos vector with respect to I_E of Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UXMIEP	The X-component of moon pos vector with respect to I_E of O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UYMIEP	The Y-component of moon pos vector with respect to I_E of O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UZMIEP	The Z-component of moon pos vector with respect to I_E of O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UXSIE	The X-component of sun pos vector with respect to I_E of Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UYSIE	The Y-component of sun pos vector with respect to I_E of Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UZSIE	The Z-component of sun pos vector with respect to I_E of Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UXSIEP	The X-component of sun pos vector with respect to I_E of O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UYSIEP	The Y-component of sun pos vector with respect to I_E of O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UZSIEP	The Z-component of sun pos vector with respect to I_E of O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD2XS	The X-component of 2nd order dif of solar pos w.r.t. Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD2YS	The Y-component of 2nd order dif of solar pos w.r.t. Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD2ZS	The Z-component of 2nd order dif of solar pos w.r.t. Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD4XS	The X-component of 4th order dif of solar pos w.r.t. Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD4YS	The Y-component of 4th order dif of solar pos w.r.t. Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-2. Simulated Spacecraft Dynamics - Ephemeris (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
UD4ZS	The Z-component of 4th order dif of solar pos w.r.t. Jan 1, 1950	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD2XSP	The X-component of 2nd order dif of solar pos w.r.t. O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD2YSP	The Y-component of 2nd order dif of solar pos w.r.t. O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD2ZSP	The Z-component of 2nd order dif of solar pos w.r.t. O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD4XSP	The X-component of 4th order dif of solar pos w.r.t. O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD4YSP	The Y-component of 4th order dif of solar pos w.r.t. O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD4ZSP	The Z-component of 4th order dif of solar pos w.r.t. O^h launch	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UD2XM	The X-component of 2nd order dif of lunar pos w.r.t. I_E Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD2YM	The Y-component of 2nd order dif of lunar pos w.r.t. I_E Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD2ZM	The Z-component of 2nd order dif of lunar pos w.r.t. I_E Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD2XMP	The X-component of 2nd order dif of lunar pos w.r.t. I_E O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD2YMP	The Y-component of 2nd order dif of lunar pos w.r.t. I_E O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD2ZMP	The Z-component of 2nd order dif of lunar pos w.r.t. I_E O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD4XM	The X-component of 2nd order dif of lunar pos w.r.t. I_E Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD4YM	The Y-component of 2nd order dif of lunar pos w.r.t. I_E Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD4ZM	The Z-component of 2nd order dif of lunar pos w.r.t. I_E Jan 1, 1950	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD4XMP	The X-component of 2nd order dif of lunar pos w.r.t. I_E O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD4YMP	The Y-component of 2nd order dif of lunar pos w.r.t. I_E O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UD4ZMP	The Z-component of 2nd order dif of lunar pos w.r.t. I_E O^h launch	$-0.167(10^{10})$, $0.167(10^{10})$ ft		
UJDSZ	Julian day number corresponding to 1st solar data pt.	2439126.5, 2446796.5 days		
UJDMZ	Julian day number corresponding to 1st solar data pt.	2439126.5, 2446796.5 days		
UZ11MAX	Max. number of solar data pts	5, 6		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-2. Simulated Spacecraft Dynamics - Ephemeris (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
UZ12MAX	Max. number of lunar data pts	33, 34		
USINI	Sine of Hayne's value (1.535°); elem of $[\bar{a}_{em}]$	Const sin (1.535°)		
UCOSI	Cosine of Hayne's value (1.535°); elem of $[\bar{a}_{em}]$	Const cos (1.535°)		
UC00301 UC00302	Constants used in computing the mean obliquity, UEPB, $\bar{\epsilon}$ (obtained from TR 32-223 P-69)	Const -0.1309404 deg/cent		
UEPB	Mean obliquity, $\bar{\epsilon}$	23.4, 23.5 deg		
UASINE	Sine of mean obliquity, elem of $[\tilde{a}_{nj}]$	-1.0, 1.0		
UACOSE	Cosine of mean obliquity, elem of $[\tilde{a}_{nj}]$	-1.0, 1.0		
U2AA, U2AB U2AC, U2AD	Values used in phase 2 for the computation of the I_E to selenographic transformation matrix $[a_{ij}]$, UA.	-1.0, 1.0		
UC00401 UC00402 UC00403	Constants used in computing the rotational rate of the earth, UOMGF, ω_E	Const 360.0 deg Const 86164.09974 sec Const 0.00164 sec/ julian cent		
UOMGE	Rotational rate of the earth ω_E	$0.415(10^{-2})$, $0.417(10^{-2})$ deg/sec		
UC00411 UC00412	Constants used to compute the Greenwich hour angle at O^h of launch	Const 100.07554260 deg Const 0.985673460 deg/ day		
UGHAL	Greenwich hour angle at O^h date of launch, δ_{oo}	0, 360 deg		
UDPR	Degrees to radians conversion factor	Const 57.29579951 deg/ rad		
UC801 UC802 UC803 UC804	Constants used to compute the mean longitude of the lunar node at O^h of launch date, Ω_{oo}, and the rate of change, $\dot{\Omega}_{oo}$, at O^h of launch date.	Const 12.1127902 deg Const 0.0529539222 deg/ day Const $20.795(10^{-4})$ deg/cent Const $20.81(10^{-4})$ deg/cent^2		
UOMEGAL	Mean long. of lunar node at O^h of launch, Ω_{oo}	0, 2π radians		
UOMEGALD	Rate of change of mean long. of lunar node at O^h of launch	Const -0.00092421996 rad/day		
UC811 UC812 UC813 UC814	Constants used to compute the mean longitude of the moon at O^h launch date, $\mathbb{C}_{oo}$, and the rate of change, $\dot{\mathbb{C}}_{oo}$, at O^h of launch date.	Const 64.37545167 deg Const 13.1763965628 deg/day Const $-11.31575(10^{-4})$ deg/cent Const $-11.3015(10^{-4})$ deg/cent^2		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-2. Simulated Spacecraft Dynamics - Ephemeris (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
UMOONL	Mean long. of moon at O^h of launch date, $\mathbb{C}_{oo}$	0, 2π radians		
UMOONLD	Rate of change of mean long. of moon at O^h launch date	Const 0.22997142 rad/day		
UC821	Constants used in computing the mean longitude of the lunar perigee at O^h date of launch, Γ'_{oo} and the rate of change at O^h date of launch, $\dot{\Gamma}'_{oo}$	Const 208.8439877 deg		
UC822		Const 0.111404083 deg/day		
UC823		Const -0.010334 deg/cent		
UC824		Const -0.010343 deg/cent^2		
UGAMMAL	Mean long. of lunar perigee at O^h launch date, Γ'_{oo}	0, 2π radians		
UGAMMALD	Rate of change of mean long. of lunar perigee at O^h launch	Const $1.9443673(10^{-13})$ rad/day		
UDELTATD	Rate of change of ΔT	Const $0.52662(10^{-5})$ days/year		
UPROBDAY	Days from O^h launch date	0, 16.0 days		
UDAY	Days from Jan 1, 1950 to prob time in ephem time	5860, 13530 days		
UJD	Julian date of problem time	2439126.5, 2446812.5 days		
UGHA	Greenwich hour angle at problem time, γ_T	0, 360 deg		
UOMEGA	Mean longitude of the lunar node at prob time, Ω_T	0, 2π radians		
UMOON	Mean longitude of the moon node at prob time, $\mathbb{C}_T$	0, 2π radians		
UGAMMA	Mean longitude of the lunar perigee at prob time, Γ'_T	0, 2π radians		
UC831	Constants used to compute the mean anomaly of the sun, g.	Const 358.009067, 2π radians		
UC832		Const 0.9856005, 2π rad/day		
UGSUN	Mean anomaly of the sun, g.	0, 2π radians		
UTMPP1	$\Gamma'_T - \Omega_T$	0, 2π radians		
UTMPP2	$\mathbb{C}_T - \Omega_T$	0, 2π radians		
UTMPP3	$\mathbb{C}_T - \Gamma'_T$	0, 2π radians		
USINA1	Sine-Cosine comp for UA; sin $(\Gamma'_T - \Omega_T)$	-1.0, 1.0		
USINA2	Sine-Cosine comp for UA; sin $(\mathbb{C}_T - \Omega_T)$	-1.0, 1.0		
USINA3	Sine-Cosine comp for UA; sin $(\mathbb{C}_T - \Gamma'_T)$	-1.0, 1.0		
USINA4	Sine-Cosine comp for UA; sin Ω	-1.0, 1.0		
USINA5	Sine-Cosine comp for UA; sin g.	-1.0, 1.0		
UCOSA1	Sine-Cosine comp for UA; cos $(\Gamma'_T - \Omega_T)$	-1.0, 1.0		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-2. Simulated Spacecraft Dynamics - Ephemeris (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
UCOSA2	Sine-Cosine comp for UA; cos ($\mathbb{C}_T - \Omega_T$)	-1.0, 1.0		
UCOSA3	Sine-Cosine comp for UA; cos ($\mathbb{C}_T - \Gamma'_T$)	-1.0, 1.0		
UC861	Constants used in the computation of the physical libration vectors; LX, LY, and LZ	Const $-34.42(10^{-5})$		
UC862		Const $-5.33(10^{-5})$		
UC863		Const $70.30(10^{-5})$		
UC864		Const $8.73(10^{-5})$		
UC865		Const $-5.82(10^{-5})$		
UC866		Const $28.6(10^{-5})$		
ULY	Y-component of physical libration	$-79.03(10^{-5})$, $79.03(10^{-5})$		
ULZ	Z-component of physical libration	$-43.15(10^{-5})$, $43.15(10^{-5})$		
U1A11	Elements of matrix U_{1A}	-1.0, 1.0		
U1A12	$U_{1A} = [L_{iK}]\ [a'_{KL}]$	-1.0, 1.0		
U1A13 U1A21 U1A22 U1A23 U1A31 U1A32 U1A33	This matrix equals the product of the physical libration matrix $[L_{iK}]$ and the $\mathbb{C} - \Omega$ matrix $[a'_{KL}]$. Note that U1A23 equals the X-component of the physical libration vector.	-1.0, 1.0		
U2A11	Elements of the matrix U_{2A}	-1.0, 1.0		
U2A12	$U_{2A} = [\bar{a}_{em}] \cdot [a''_{mn}] \cdot [\tilde{a}_{nj}]$	-1.0, 1.0		
U2A13	Note that U2A11 is equal to the cosine of the angle Ω_T.	-1.0, 1.0		
U2A21	Note that U2A11 is equal to the cosine of the angle Ω_T.	-1.0, 1.0		
U2A22	Note that U2A11 is equal to the cosine of the angle Ω_T.	-1.0, 1.0		
U2A23	Note that U2A11 is equal to the cosine of the angle Ω_T.	-1.0, 1.0		
U2A31	Note that U2A11 is equal to the cosine of the angle Ω_T.	-1.0, 1.0		
U2A32	Note that U2A11 is equal to the cosine of the angle Ω_T.	-1.0, 1.0		
U2A33	Note that U2A11 is equal to the cosine of the angle Ω_T.	-1.0, 1.0		
UA11, UA12	Elements of the I_E - selenographic transformation matrix $[a_{ij}]$, UA.	-1.0, 1.0		
UA13	$UA = [U_{1A}] \cdot [U_{2A}]$	-1.0, 1.0		
UA21	$UA = [U_{1A}] \cdot [U_{2A}]$	-1.0, 1.0		
UA22	Elements of the I_E - selenographic	-1.0, 1.0		
UA23	Transformation, matrix UA, $[a_{ij}]$	-1.0, 1.0		
UA31	Transformation, matrix UA, $[a_{ij}]$	-1.0, 1.0		
UA32	Transformation, matrix UA, $[a_{ij}]$	-1.0, 1.0		
UA33	Transformation, matrix UA, $[a_{ij}]$	-1.0, 1.0		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-2. Simulated Spacecraft Dynamics - Ephemeris (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
UI	Integer value denoting the number of solar data pts from 1st solar data pt to prob time data pt	1, 5		
UJDBZ	Julian day number for solar data pt	2439126.5, 2446812.5 days		
UEVRT	Everett's interp variable, t, for solar data	0, 1.0		
UEVRTSQ	Everett's interp variable, t^2 for solar data	0, 1.0		
UEVRU	Everett's interp variable, u = t - 1, for solar data	-1.0, 0		
USTEP1	Everett's interp variable, u^2 - 1, for solar data	-1.0, 0		
UTPP1	Everett's interp variable, $u(u^2 - 1)$ for solar data	-1.0, 0		
USTEP2	Everett's interp variable, $t^2 - 1$, for solar data	-1.0, 0		
UTPP2	Everett's interp variable, $t(t^2 - 1)$, for solar data	-1.0, 0		
UTPP3	Everett's interp variable, $u(u^2 - 1)(u^2 - 4)$, for solar data	-1.0, 2		
UTPP4	Everett's interp variable, $t(t^2 - 1)(t^2 - 4)$, for solar data	-1.0, 2		
UJ	One data pt past UI, UJ = UI + 1	2, 6		
UXSUNI	Problem time X-component of sun pos w.r.t. I_E-frame	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UYSUNI	Problem time Y-component of sun pos w.r.t. I_E-frame	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UZSUNI	Problem time Z-component of sun pos w.r.t. I_E-frame	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
URSUNI	Magnitude of the earth-sun pos vector	$-0.6(10^{12})$, $0.6(10^{12})$ ft		
UXVSUN	Direction cosines of the sun	-1.0, 1.0		
UYVSUN	Direction cosines of the sun	-1.0, 1.0		
UZVSUN	Direction cosines of the sun	-1.0, 1.0		
UII	Integer value denoting the number of lunar data pts from the 1st lunar data pt. to prob time data pt	1, 33		
UJDBBZ	Julian day number for lunar data pt	2439126.5, 2446812.5 days		
UEVRTP	Everett's interp variable, t, for lunar data	0, 1.0		
UEVRTPSQ	Everett's interp variable, t^2, for lunar data	0, 1.0		
UEVRUP	Everett's interp variable, u = t - 1, for lunar data	-1.0, 0		
USTEP3	Everett's interp variable, u^2 - 1, for lunar data	-1.0, 0		
UTPP5	Everett's interp variable, $u(u^2 - 1)$, for lunar data	-1.0, 0		
USTEP4	Everett's interp variable, $t^2 - 1$, for lunar data	-1.0, 0		
UTPP6	Everett's interp variable, $t(t^2 - 1)$, for lunar data	-1.0, 0		
UTPP7	Everett's interp variable, $u(u^2 - 1)(u^2 - 4)$, for lunar data	-1.0, 2.0		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-2. Simulated Spacecraft Dynamics - Ephemeris (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
UTPP8	Everett's interp variable, $t(t^2 - 1)(t^2 - 4)$, for lunar data	-1.0, 2.0		
UJJ	One data pt, past UII; UJJ = UII + 1	$-0.167(10^{10})$, $0.167(10^{10})$		
UXMOON	Prob time X-component of moon pos w.r.t. I_E-frame	$-0.167(10^{10})$, $0.167(10^{10})$		
UYMOON	Prob time Y-component of moon pos w.r.t. I_E-frame	$-0.167(10^{10})$, $0.167(10^{10})$		
UZMOON	Prob time Z-component of moon pos w.r.t. I_E-frame	$-0.167(10^{10})$, $0.167(10^{10})$		
URMOON	Magnitude of earth-moon pos vector			

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-3. Simulated Spacecraft Dynamics-Aerodynamic Forces and Moments

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
f_1 (h)	Atmospheric density	0.001042, 0.52582 slugs/feet^3		
q	Dynamic pressure	0, 1000 lbs/feet^2		
a	Speed of sound	884, 1116.26 ft/sec		
M	Mach number	0, 40		
A	Total angle of attack	0, 180 deg		
α	Aerodynamic angle of attack	-180, 180 deg		
C_A	Aerodynamic axial force coefficient	-2, 2		
C_{NY}	Vector sum of the aerodynamic normal force and side force coefficients	-0.028, 2.38		
C_{mn}	Vector sum of the aerodynamic pitching and yawing moment coefficients	-0.72, 3.30		
$C_{OW}S'$	Wind axis drag coefficient multiplied by reference area	0, 14500 feet^2		
S	Representative area	129.4 feet^2		
D_{x_b}	Magnitude of the projection of the total aerodynamic force on the S, B-frame axis	-207040 lbs		
D_{Y_b}	Magnitude of the projection of the total aerodynamic force on the Y, B-frame axis	-207040, 207040 lbs		
D_{Z_b}	Magnitude of the projection of the total aerodynamic force on the Z, B-frame axis	-207040, 207040 lbs		
B_Y	Distance from origin of fixed body axis to point of application of drogue parachute, main parachute force	0 feet		
B_Z	Distance from origin of fixed body axis to point of application of drogue parachute, main parachute force	-2, 0 feet		
$M_{D_{X_b}}$	Magnitude of the projection of the resultant aerodynamic moment on the X, B-frame axis	±2097152 ft/lbs		
$M_{D_{Y_b}}$	Magnitude of the projection of the resultant aerodynamic moment on the Y, B-frame axis	±2097152 ft/lbs		
dS	Reference length multiplied by reference area	1660.633 ft^3		
f_{17} (M, A)	Damping derivative for the C/M	-15.000, +7.25		
f_{16} (| α |)	ΔC_m due to canted heat shield	0, +0.015		
B_X	Distance from origin of the fixed body axis to point of application of drogue parachute, main parachute force	-5.13, 0 ft		
$M_{D_{Z_b}}$	Magnitude of the projection of the resultant aerodynamic moment in the Z, B-frame axis	±2097152 ft/lbs		
t_1	Drogue parachute operation time	0, 35 sec		
t_2	Main parachute operation time	0, 500 sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-3. Simulated Spacecraft Dynamics-Aerodynamic Forces and Moments (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
f_2 (A)	Incremental axial force coefficient due to the forward heat shield	-0.155, 0.155		
f_3 (M, A)	Axial force coefficient for the LEV	-1.580, 0.920		
f_4 (M, A)	Incremental axial force coefficient due to the launch escape vehicle	-0.170, 0.360		
f_5 (A)	Axial force coefficient for the C/M + S/M	-1.80, 0.70		
f_6 (M, A)	Vector sum of normal force and side force coefficients for the C/M	-0.20, 0.765		
f_7 (A)	Vector sum of incremental side force and normal force coeff due to forward heat shield	-0.090, 0.132		
f_8 (M, A)	Vector sum of side force and normal force coefficients for the LEV	0, 1.480		
f_9 (M, A)	Vector sum of incremental side force and normal force coefficients due to LES power on	-560, 0.180		
f_{10} (A)	Vector sum of side force and normal force coefficients for the C/M plus S/M	0, 2.33		
f_{11} (M, A)	Vector sum of the pitching and yawing moment coefficients for the C/M	-545, 0.210		
f_{12} (A)	Vector sum of the incremental pitching and yawing moment coeff due to the fwd heat shield	-140, 0.143		
f_{13} (M, A)	Vector sum of the pitching and yawing moment coefficients for the LEV	-0.300, 0.310		
f_{14} (M, A)	Vector sum of the incremental pitching and yawing moment coefficients due to power on	-0.054, 0.350		
f_{15} (A)	Vector sum of the pitching and yawing moment coefficients for the C/M plus S/M	0, 3.20		
f_{18} (M, A)	Axial force coefficient for the LEV, canards deployed	-1.510, 1.000		
f_{19} (M, A)	Side force coefficient for the LEV, canards deployed, $\phi = 90°$	-1.483, 0.020		
$f'_{19}(\phi)$	Variation of side force coefficient due to roll angle, LEV, canards deployed	0, 1.000		
f_{20} (M, A)	Normal force coefficient for the LEV, canards deployed, $\phi = 0°$	-0.085, 1.608		
$f'_{20}(\phi)$	Variation of normal force coefficient due to roll angle, LEV, canards deployed	0, 1.000		
$f_{21}(A, \phi)$	Pitching moment coefficient for the LEV, canards deployed	-0.045, 0.420		
$f_{22}(A, \phi)$	Yawing moment coefficient for the LEV, canards deployed	-0.255, 0.200		
f_{23} (M, A)	Damping derivative for the LEV, power off	-45,000, 30.000		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-3. Simulated Spacecraft Dynamics-Aerodynamic Forces and Moments (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
f_{24} (M, A)	Damping derivative for the LEV, canards deployed	-60.625, 28.750		
f_1 (M, A)	Axial force coefficient for the C/M	-1.500, 1.120		
C	Damping constant for drogue parachute	-15.000		
KϕAP	Outside air pressure	0, 14.7000		
f_2 (h)	Pressure variation with altitude	0, 14.7000		
K014	1.0 When fwd heat shield is jettisoned	Boolean		
K020	1.0 When in C/M configuration	Boolean		
K021	1.0 When in LEV configuration	Boolean		
K022	1.0 When LES thrust applied	Boolean		
K023	1.0 When in C/M and S/M configuration	Boolean		
K035	1.0 IF 450,000 ft < h ≤ 1,100,000 ft	Boolean		
K036	1.0 for C/M, S/M, and S-IVB configuration only	Boolean		
K040	1.0 IF h ≤ 450,000 ft	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-4. Simulated Spacecraft Dynamics-Weights and Balances

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
M	Mass	270.50, 11,026.73 slugs		
A_{X_b}	Body axis component of the distance vector	±50 feet		
A_{Y_b}	Body axis component of the distance vector	±50 feet		
A_{Z_b}	Body axis component of the distance vector	±50 feet		
$I_{XX_{FB}}$	Moment of inertia of the complete vehicle	2^{12}, 2^{17} slug/ft^2		
$I_{YY_{FB}}$	Moment of inertia of the complete vehicle	22873.13, 24459860 slug/ft^2		
$I_{ZZ_{FB}}$	Moment of inertia of the complete vehicle	22667.77, 23194950 slug/ft^2		
I_{XX}	Moment of inertia of the complete vehicle	2^{12}, 2^{17} slug/ft^2		
I_{YY}	Moment of inertia of the complete vehicle	4004.13, 8000000 slug/ft^2		
I_{ZZ}	Moment of inertia of the complete vehicle	3795.77, 8000000 slug/ft^2		
I_{XZ}	Product of inertia	0, 190 slug/ft^2		
B002	1.0 when S/M abort initiated	Boolean		
B006	1.0 at recoupling during transportation	Boolean		
B008	1.0 when S-IVB is jettisoned	Boolean		
B009	1.0 when S/M is separated	Boolean		
B010	1.0 when LES is separated	Boolean		
B013	1.0 when C/M RCS propellant is jettisoned	Boolean		
B018	O when main parachutes are deployed	Boolean		
B032 (1)	1.0 in mission mode when LEM is not used	Boolean		
B033 (1)	1.0 in mission mode when LEM descent stage is not used	Boolean		
B034 (1)	1.0 when LEM descent stage is jettisoned	Boolean		
B030	O when H > 25,000 ft	Boolean		
B031	O before drogue deploy switch activated	Boolean		
$M_{S/M_{RCSA}}$	Mass of propellant in RCS tank A	0, 6.422 slugs		
$M_{S/M_{RCSB}}$	Mass of propellant in RCS tank B	0, 6.422 slugs		
$M_{S/M_{RCSC}}$	Mass of propellant in RCS tank C	0, 6.422 slugs		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-4. Simulated Spacecraft Dynamics-Weights and Balances (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
$M_{S/M_{RCSD}}$	Mass of propellant in RCS tank D	0, 6.422 slugs		
$X_{S/M_{Fuel\ C.G.1}}$	SPS C.G. location along X-axis for tank 1 (fuel)	-25.938, -18.584 ft		
$X_{S/M_{Fuel\ C.G.2}}$	SPS C.G. location along X-axis for tank 2 (fuel)	-28.246, -20.892 ft		
$X_{S/M_{Ox.\ C.G.3}}$	SPS C.G. location along X-axis for tank 3 (Ox.)	-25.596, -18.288 ft		
$X_{S/M_{Ox.\ C.G.4}}$	SPS C.G. location along X-axis for tank 4 (Ox.)	-27.830, -20.522 ft		
m_{TPM}	Mass of the transposition module	951.62, 8566.38 slugs		
IXXR	Reciprical of I_{XX}	0.762×10^{-5}, 0.24414×10^{-3} $1/slug/ft^2$		
IYYR	Reciprical of I_{YY}	0.125×10^{-6}, 0.24974×10^{-3} $1/slug/ft^2$		
IZZR	Reciprical of I_{ZZ}	0.125×10^{-6}, 0.26345×10^{-3} $1/slug/ft^2$		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-5. Simulated Spacecraft Dynamics-S-IVB Attitude Control

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
IPHEP	Roll attitude error I-frame	$\pm 2\pi$ rad		X
ITHEP	Pitch attitude error I-frame	$\pm 2\pi$ rad		X
IPSEP	Yaw attitude error I-frame	$\pm 2\pi$ rad		X
APHVBTI	B-frame to I-frame Euler angle	$\pm \pi$ rad		
ATHVBTI	B-frame to I-frame Euler angle	$\pm \pi/2$ rad		
APSVBTI	B-frame to I-frame Euler angle	$0, +2\pi$ rad		
IPHC	Roll att cmd int hold	$\pm 2\pi$ rad		
ITHC	Pitch att cmd int hold	$\pm 2\pi$ rad		
IPSC	Yaw att cmd int hold	$\pm 2\pi$ rad		
IPHEPP1	Adj roll attitude error to limits	$\pm 2\pi$ rad		
ITHEPP1	Adj pitch attitude error to limits	$\pm 2\pi$ rad		
IPSEPP1	Adj yaw attitude error to limits	$\pm 2\pi$ rad		
IAOPH	Roll attitude error gain	Const 1.0 rad/rad		
IAOTH	Pitch attitude error gain	Const 1.0 rad/rad		
IAOPS	Yaw attitude error gain	Const 1.0 rad/rad		
IPPHEPPM	Roll att err max pos lim	Const + 0.105 rad		
INPHEPPM	Roll att err max neg lim	Const - 0.105 rad		
IPTHEPPM	Pitch att err max pos lim	Const + 0.035 rad		
INTHEPPM	Pitch att err max neg lim	Const - 0.035 rad		
IPPSEPPM	Yaw att err max pos lim	Const + 0.035 rad		
INPSEPPM	Yaw att err max neg lim	Const - 0.035 rad		
APB	Projection mag rotation vel vec	±1.5 rad/rad		
AQB	Projection mag rotation vel vec	±1.5 rad/rad		
ARB	Projection mag rotation vel vec	±1.5 rad/rad		
IPHD	Roll rate	±0.1745 rad/sec		
IPPHDM	Roll rate max pos lim	Const + 0.1745 rad/sec		
INPHDM	Roll rate max neg lim	Const - 0.1745 rad/sec		
ITHD	Pitch rate	±0.1745 rad/sec		
IPTHDM	Pitch rate max pos lim	Const + 0.1745 rad/sec		
INTHDM	Pitch rate max neg lim	Const - 0.1745 rad/sec		

Table 6-5. Simulated Spacecraft Dynamics-S-IVB Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
IPSD	Yaw rate	±0.1745 rad/sec		
IPPSDM	Yaw rate max pos lim	Const + 0.1745 rad/sec		
INPSDM	Yaw rate max neg lim	Const - 0.1745 rad/sec		
IPHDP	Adj roll rate	±0.1745 rad/sec		
ITHDP	Adj pitch rate	±0.1745 rad/sec		
IPSDP	Adj yaw rate	±0.1745 rad/sec		
IAIPH	Roll rate gain	Const 5 rad/ rad/sec		
IAITH	Pitch rate gain	Const 5 rad/ rad/sec		
IAIPS	Yaw rate gain	Const 5 rad/ rad/sec		
IHPH	Eng command sig roll	±0.27923 rad		
IHTH	Eng command sig pitch	±0.20942 rad		
IHPS	Eng command sig yaw	±0.20942 rad		
ISITHC	Pitch nozzle command angle	±0.20942 rad		
ISIPSC	Yaw nozzle command angle	±0.20942 rad		
IHT1	Yaw-Roll command diff	±0.48865 rad		
IHT2	Yaw-Roll command sum	±0.48865 rad		
ICTHT	Prm sum amp-pitch	±0.19895 rad		
ICT1T	Prm sum amp-yaw-roll diff	±0.47818 rad		
ICT2T	Prm sum amp-yaw-roll sum	±0.47818 rad		
IK1TH	Prms fdbk gain-pitch	Const 0.0011633 rad/volt		
IK1T	Prms fdbk gain-yaw/roll	Const 0.0011633 rad/volt		
IETHT	Prms ntwk output-pitch	0		
IET1T	Prms ntwk output-yaw-roll diff	±1.0 volts		
IET2T	Prms ntwk output-yaw-roll sum	±1.0 volts		
IVTHT	Prms filt output-pitch	±1.0 volts		
IVT1T	Prms filt output-yaw-roll diff	±1.0 volts		
IVT2T	Prms filt output-yaw-roll sum	±1.0 volts		
IPFTH	Prms sys dead band max pitch	Const + 0.01745 rad		

Table 6-5. Simulated Spacecraft Dynamics-S-IVB Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
INFTH	Prms sys dead band min pitch	Const - 0.01475 rad		
IPFT1	Prms sys dead band max yaw/roll	Const + 0.01475 rad		
INFT1	Prms sys dead band min yaw/roll	Const - 0.01475 rad		
IP	Prms filt increment change	Const 0.09516		
IVTHPT	Adj prms filt output-pitch	±0.011633 rad		
IVT1PT	Adj prms filt output-yaw-roll diff	±0.011633 rad		
IVT2PT	Adj prms filt output-yaw-roll sum	±0.011633 rad		
IKTHTH	Prms filt gain-pitch	Const 0.011633 rad/volt		
IKPSPH	Prms filt gain-yaw/roll	Const 0.011633 rad/volt		
ILP	Veh moment arm to c.g.-pitch	45.386, 145.386 ft		
ILY	Veh moment arm to c.g.-yaw	44.425, 144.425 ft		
ILPR	Ref length-pitch eng to S/C fwd sth	Const 95.386 ft		
ILYR	Ref length-yaw eng to S/C fwd sth	Const 94.425 ft		
BAXB	Body axis comp of the dist vec for the c.g.	±50 ft		
ILR	Veh moment arm to c.g.-roll	Const 11.51 ft		
BIXXR	Veh moment of inertia roll reciprocal	B-12, B-12 slug/ft^2		
BIYYR	Veh moment of inertia pitch reciprocal	B-12, B-12 slug/ft^2		
BIZZR	Veh moment of inertia yaw reciprocal	B-11, B-11 slug/ft^2		
IDET	Comp time increment	Const 0.05 sec		
ITH	Prms filt time constant	Const 0.05 sec		
IMUR3	Roll eff param eng 3	0.02138743, 0.02140126 1/sec/sec		
IMUR4	Roll eff param eng 4	0.02138743, 0.02140126 1/sec/sec		
IMUR5	Roll eff param eng 5	0.02138743, 0.02140126 1/sec/sec		
IMUR6	Roll eff param eng 6	0.02138743, 0.02140126 1/sec/sec		

Table 6-5. Simulated Spacecraft Dynamics-S-IVB Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
IMUP1	Pitch eff param eng 1	0.00319057, 0.00373057 1/sec/sec		
IMUP2	Pitch eff param eng 2	0.00319057, 0.00373057 1/sec/sec		
IMUY3	Yaw eff param eng 3	0.00323908, 0.00378295 1/sec/sec		
IMUY4	Yaw eff param eng 4	0.00323908, 0.00378295 1/sec/sec		
IMUY5	Yaw eff param eng 5	0.00323908, 0.00378295 1/sec/sec		
IMUY6	Yaw eff param eng 6	0.00323908, 0.00378295 1/sec/sec		
IF11	Eng 1 thrust	Const 150 lb		
IF13	Eng 2 thrust	Const 150 lb		
IF14	Eng 3 thrust	Const 150 lb		
IF22	Eng 4 thrust	Const 150 lb		
IF25	Eng 5 thrust	Const 150 lb		
IF26	Eng 6 thrust	Const 150 lb		
IW1R	Aps 1 prop remain	0, 62.5 lb		
IW2R	Aps 2 prop remain	0, 62.5 lb		
IWD11	Prop flow eng 1	Const 0.5275 lb/sec		
IWD13	Prop flow eng 2	Const 0.5275 lb/sec		
IWD14	Prop flow eng 3	Const 0.5275 lb/sec		
IWD22	Prop flow eng 4	Const 0.5275 lb/sec		
IWD25	Prop flow eng 5	Const 0.5275 lb/sec		
IWD26	Prop flow eng 6	Const 0.5275 lb/sec		
IWDU1	Aps 1 prop flow ullage	Const 0.246 lb/sec		
IWD1L	Aps 1 prop leak	Const 0.200 lb/sec		
IWDU2	Aps 2 prop flow ullage	Const 0.246 lb/sec		

Table 6-5. Simulated Spacecraft Dynamics-S-IVB Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
IWD2L	Aps 2 prop leak	Const 0.200 lb/sec		
IDET1	Min imp mode pulse width	Const 0.05 sec		
IDET14	Roll aps pulse duration	0.02746, 0.05 sec		
IDET15	Pitch aps pulse duration	0.0338, 0.05 sec		
IDET16	Yaw aps pulse duration	0.0384, 0.05 sec		
IW1I	Aps 1 init prop	Const 62.5 lb		
IW2I	Aps 2 init prop	Const 62.5 lb		
IFZ	Aps thrust-Z axis	±150 lb		
IFY	Aps thrust-Y axis	±300 lb		
IDEPT	Veh roll rate	±0.00214, rad/sec		
IDEQT	Veh pitch rate	±0.0002 rad/sec		
IDERT	Veh yaw rate	±0.0004 rad/sec		
IPDTH	Pitch aps max switching constant	Const + 0.0227 rad		
INDTH	Pitch aps min switching constant	Const - 0.0227 rad		
IPDPS	Yaw aps max switching constant	Const + 0.0227 rad		
INDPS	Yaw aps min switching constant	Const - 0.0227 rad		
IPDPH	Roll aps max switching constant	Const + 0.0227 rad		
INDPH	Roll aps min switching constant	Const - 0.0227 rad		
ITR	Roll aps limit cycle pulse time	Const 0.02476 sec		
ITY	Yaw aps limit cycle pulse time	Const 0.0338 sec		
ITP	Pitch aps limit cycle pulse time	Const 0.0384 sec		
T511	Integrated mode select	Boolean		
I107	Aps mode select	Boolean		
I108	Aps 1 prop runout	Boolean		
I109	Aps 2 prop runout	Boolean		
I111	Eng 1 on command	Boolean		
I112	Eng 2 on command	Boolean		
I113	Eng 3 on command	Boolean		
I114	Eng 4 on command	Boolean		
I115	Eng 5 on command	Boolean		
I116	Eng 6 on command	Boolean		
I117	Guidance mode select	Boolean		
I131	Aps 2 ullage thrust ind	Boolean		

Table 6-5. Simulated Spacecraft Dynamics-S-IVB Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
I134	Aps 1 ullage thrust ind	Boolean		
MI144	Pitch att err gain malf	Boolean		
MI145	Yaw att err gain malf	Boolean		
MI146	Pitch att rate gyro or gain malf	Boolean		
MI147	Yaw att rate gyro or gain malf	Boolean		
MI162	Roll att err gain malf	Boolean		
MI163	Roll rate gyro or gain malf	Boolean		
MI167	Pitch prms hyst fdbk gain malf	Boolean		
MI170	Pitch prms sum or relay malf	Boolean		
MI171	Yaw-roll prms hyst fdbk gain malf	Boolean		
MI172	Yaw-roll prms sum or relay malf	Boolean		
MI173	Yaw-roll prms hyst fdbk gain malf	Boolean		
MI174	Yaw-roll prms sum or relay malf	Boolean		
MI175	Pitch prms filt gain malf	Boolean		
MI176	Yaw-roll prms filt gain malf	Boolean		
MI177	Yaw-roll prms filt gain malf	Boolean		
MI211	Eng 1 malf	Boolean		
MI212	Eng 2 malf	Boolean		
MI213	Eng 3 malf	Boolean		
MI214	Eng 4 malf	Boolean		
MI215	Eng 5 malf	Boolean		
MI216	Eng 6 malf	Boolean		
MI221	Aps 1 leak	Boolean		
MI222	Aps 2 leak	Boolean		
D516	S/M adap phys sep squibs fired	Boolean		

Table 6-6. Stabilization and Control System - Power and Mode Control Logic

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H503	TVC1 switch (S14) - 1A24 AC1 psn	Boolean		
H185	TVC1 switch (S14) - 1A24 AC2 psn	Boolean		
H076	Partial power switch (S13) - 1A24 - AC1 psn	Boolean		
H075	Partial power switch (S13) - 1A24 - AC2 psn	Boolean		
H501	Rate gyro switch (S12) - 1A24 - AC1 psn	Boolean		
H502	Rate gyro switch (S12) - 1A24 - AC2 psn	Boolean		
H183	BMAG switch (S9) - 1A24 - AC1 psn	Boolean		
H184	BMAG switch (S9) - 1A24 - AC2 psn	Boolean		
H186	Rot. control switch (S16) - 1A24 - AC2 posn	Boolean		
H187	Rot. control switch (S16) - 1A24 - AC1 posn	Boolean		
H181	TVC 2 switch (S15) - 1A24 - AC1 posn	Boolean		
H182	TVC 2 switch (S15) - 1A24 - AC2 posn	Boolean		
H188	Limit cycle select ON	Boolean		
H189	Direct RCS mode sel ON	Boolean		
H190	G&N-SCS transfer sel SCS posn	Boolean		
H200	Pitch channel enable ON	Boolean		
H201	Yaw channel enable ON	Boolean		
H202	Roll b/c channel enable ON	Boolean		
H203	Roll a/c channel enable ON	Boolean		
H204	0.05 G entry sel ON	Boolean		
H205	Deadband sel MAX posn	Boolean		
H206	Roll b/u rate ON	Boolean		
H207	Pitch b/u rate ON	Boolean		
H208	Yaw b/u rate ON	Boolean		
H213	Local vertical control mode sel ON	Boolean		
H214	Attitude control mode sel ON	Boolean		
H215	ΔV control mode sel ΔV	Boolean		
H216	Entry control mode sel ON	Boolean		
H110	Attitude impulse enable ON	Boolean		
H400	FDAI align ON	Boolean		
H401	Attitude set ON	Boolean		
H017	TVC1 switch - group 1 - a-c power available	Boolean		
H018	TVC1 switch - group 1 - d-c power available	Boolean		

Table 6-6. Stabilization and Control System - Power and Mode Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H019	Partial power - group 1 - a-c power available	Boolean		
H020	Partial power - group 1 - d-c power available	Boolean		
H086	Rate gyro power - group 1 - a-c power available	Boolean		
H088	BMAG power - group 2 - a-c power available	Boolean		
H089	BMAG power - group 2 - d-c power available	Boolean		
H090	Rot. power control - group 2 - a-c power available	Boolean		
H092	TVC2 switch - group 2 - a-c power available	Boolean		
H117	Unswitched power available (ullage A)	Boolean		
H118	Unswitched power available (ullate B)	Boolean		
H119	Unswitched power available No. 1	Boolean		
H120	Unswitched power available No. 2	Boolean		
H322	Thrust vector power available	Boolean		
H169	Power available to BMAG	Boolean		
H132	FDAI a-c power available	Boolean		
H140	D-c power available at SCS and G/N transfer	Boolean		
H136	D-c power common to enable switches	Boolean		
H151	Pitch auto coil d-c power available - bus A	Boolean		
H152	Pitch auto coil d-c power available - bus B	Boolean		
H111	Yaw auto coil d-c power available - bus A	Boolean		
H112	Yaw auto coil d-c power available - bus B	Boolean		
H113	Roll a/c auto coil d-c power available - bus A	Boolean		
H114	Roll a/c auto coil d-c power available - bus B	Boolean		
H115	Roll b/d auto coil d-c power available - bus A	Boolean		
H116	Roll b/d auto coil d-c power available - bus B	Boolean		
H235	AGAP power available	Boolean		
H232	SCS power available	Boolean		
H234	Rate gyro - power available	Boolean		
H233	ΔV acceleration - power available	Boolean		
H150	Translation power available - pilot	Boolean		
H106	Translation power available - copilot	Boolean		
MH022	Open SCS attitude mode select	Malfunction		
H222	SCS attitude mode select		GP30-8(D), 240	
MH023	Open SCS local vert mode select	Malfunction		
H221	SCS local vertical mode select		GP35-8(D), 280	

Table 6-6. Stabilization and Control System - Power and Mode Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MH025	Open SCS ΔV mode select	Malfunction		
H223	SCS ΔV mode select		GP24-8(D), 192	
MH027	Open SCS entry mode select	Malfunction		
H224	SCS entry mode select		GP31-1(D), 241	
MH024	Open G&N attitude mode select	Malfunction		
H218	G&N attitude mode select		GP30-3(D), 235	
MH026	Open G&N ΔV mode select	Malfunction		
H219	G&N ΔV mode select		GP32-5(D), 253	
MH030	Open G&N entry mode select	Malfunction		
H220	G&N entry mode select		GP30-4(D), 236	
MH021	Open monitor mode select	Malfunction		
H217	Monitor mode select		GP30-5(D), 237	
MH037	Open minimum db select	Malfunction		
H158	Minimum deadband select	Boolean		
MH036	Open 0.05 G entry control mode	Malfunction		
H157	0.05 G entry select	Boolean	GP16-1(D), 121	
H163	Copilot's tran cont T-hdl cw sw	Boolean		
H164	Copilot's tran cont cw sw output	Boolean		
H905	Pilot's tran cont T-hdl cw sw	Boolean		
H165	Pilot's tran cont cw sw output	Boolean		
H167	MTVC sig to ΔV sw	Boolean		
H148	MTVC engage	Boolean		
MH035	Open roll axis engage - B&D	Malfunction		
H159	Roll backup rate select BMAG	Boolean		
H143	Roll a/c SCS channel select	Boolean		
H160	Pitch backup rate select BMAG	Boolean		
H161	Yaw backup rate select BMAG	Boolean		
MH034	Open roll axis engage - A&C	Malfunction		
H144	Roll b/d SCS channel select	Boolean		
MH032	Open pitch axis engage	Malfunction		
H141	Pitch SCS channel select	Boolean		
MH033	Open yaw axis engage	Malfunction		
H142	Yaw SCS channel select	Boolean		

Table 6-6. Stabilization and Control System - Power and Mode Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H145	Direct RCS mode select	Boolean		
H166	Direct RCS mode select	Boolean		
H146	FDAI align mode select	Boolean		
H147	Attitude set mode select	Boolean		
H153	Pilot rot. cont b/o sw	Boolean		
H154	Pilot rot. cont b/o sw output CSS	Boolean		
H155	Copilot rot. cont b/o sw	Boolean		
H156	Copilot rot. cont b/o sw output CSS	Boolean		
H168	Control stick steering mode	Boolean		
H125	Min impulse sw solenoid hold	Boolean		
MH016	Open G&N min impulse enable	Malfunction		
H066	G&N minimum impulse enable	Boolean		
H067	G&N att in	Boolean		
H063	AGAA att in	Boolean		
H069	Entry gain	Boolean		
H084	RJC att sw	Boolean		
H082	Pseudo rate co	Boolean		
H039	RJC att sw-roll	Boolean		
H083	G&N sync relay	Boolean		
H080	B/u rt ref trans and rt in trans	Boolean		
H056	AB simplification	Boolean		
H057	AB + C + D simplification	Boolean		
H058	Simplification 1	Boolean		
H059	Simplification 2	Boolean		
H060	Simplification 3	Boolean		
H078	Pitch b/u rt relay	Boolean		
H087	Yaw b/u relay	Boolean		
H091	Roll b/u relay	Boolean		
H061	AGCU caged	Boolean		
H122	AGCU align	Boolean		
H123	Temporary hold	Boolean		
H180	FDAI self-test sw pnl 1A2	Boolean		
H170	Self test - FDAI	Boolean		

Table 6-6. Stabilization and Control System - Power and Mode Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H172	G&N p/y err sf	Boolean		
H173	P/y/r rt sf	Boolean		
H174	G&N FDAI sigs	Boolean		
H175	Att mot exc att vg/ad ref, att pwr	Boolean		
H176	Roll err/rt sf	Boolean		
H177	Gp ad pwr	Boolean		
H178	Gpx exc	Boolean		
H179	SCS FDAI sigs	Boolean		
H149	Err G&N body/r G&N err/AGCU inh	Boolean		
H481	AGAA err simplification	Boolean		
H482	Yaw err AGAA	Boolean		
H483	Pitch err AGAA	Boolean		
H484	Roll err AGAA	Boolean		
H485	R G&N err/AGCU inh	Boolean		
H486	G&N err inh	Boolean		
H487	Pitch err G&N	Boolean		
H191	P/y err G&N offset	Boolean		
H192	AGCU p/y/r err	Boolean		
H194	Roll rt	Boolean		
H195	Roll b/u rt	Boolean		
H196	Pitch rate and AGAA pwr	Boolean		
H197	Pitch b/u rt	Boolean		
H198	Yaw rt and AGAA/rt gyro pwr	Boolean		
H128	Yaw b/u rt	Boolean		
HKL1	Current drawn when 1 main is operating	Const 1.6 amps		
HKL3	Current drawn when 1 main is operating	Const 1.6 amps		
HKL5	Current drawn when 1 main is operating	Const 1.6 amps		
HKL7	Current drawn when 1 main is operating	Const 1.6 amps		
HKL9	Current drawn when 1 main is operating	Const 1.5 amps		
HKL11	1/3 power to rate gyro and 1 phase of FDAI	Const 0.40 amps		
HKL12	1/3 power to AGAP and 1 phase of FDAI	Const 0.40 amps		
HKL13	1/3 power to av display and accelerometer	Const 0.40 amps		
HKL14	1/3 power to roll, pitch, yaw, aux, eca and FDAI 3ϕ5	Const 0.40 amps		

Table 6-6. Stabilization and Control System - Power and Mode Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
HKL15	Bus A SPS gimbal cont, yaw	Const 0.40 amps		
HKL16	Bus B SPS gimbal cont, pitch	Const 0.40 amps		
HKL19	Current drawn when 1 main is operating	Const 3 amps		
HKL20	Current drawn when 1 main is operating	Const 3 amps		
HKL21	Current drawn when 1 main is operating	Const 3 amps		
HKL22	Current drawn when 1 main is operating	Const 3 amps		
H4C32	A-C load drawn through C432 grp. 1 bus No. 2	0, 2 amps		
H4C33	A-C load drawn through C433 grp. 1 bus No. 1	0, 2 amps		
H4C37	A-C load drawn through C437 grp. 1 bus No. 2	0, 2 amps		
H4C38	A-C load drawn through C538 grp. 1 bus No. 1	0, 2 amps		
H5C37	D-C load drawn through C537 roll channel a/c bus A	0, 3 amps		
H5C21	D-C load drawn through C521 roll channel a/c bus B	0, 3 amps		
H5C38	D-C load drawn through C538 roll channel b/d bus A	0, 3 amps		
H5C22	D-C load drawn through C522 roll channel b/d bus B	0, 3 amps		
H5C36	D-C load drawn through C536 pitch channel bus A	0, 3 amps		
H5C20	D-C load drawn through C520 pitch channel bus B	0, 3 amps		
H5C39	D-C load drawn through C539 yaw channel bus A	0, 3 amps		
H5C23	D-C load drawn through C523 yaw channel bus B	0, 3 amps		
H5C35	D-C load drawn through C535 direct control bus A	0, 3 amps		
H5C19	D-C load drawn through C519 direct control bus B	0, 3 amps		
H5C40	D-C load drawn through C540 system load bus A	0, 3 amps		
H5C24	D-C load drawn through C524 system load bus B	0, 3 amps		
H5C71	D-C load drawn through C571 system load bus A	0, 3 amps		
H5C72	D-C load drawn through C572 system load bus B	0, 3 amps		

Table 6-7. Stabilization and Control System — Attitude Control

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*HPSWAMP	Pitch sw amp time on, desired	-50.0, 50.0 milli/ sec		
*HYSWAMP	Yaw sw amp time on, desired	-50.0, 50.0 milli/ sec		
*HRSWAMP	Roll sw amp time on, desired	-50.0, 50.0 milli/ sec		
*HPSWAMPA	Pitch sw amp A time on, milliseconds/iter	0, 1.0		
*HPSWAMPB	Pitch sw amp B time on, milliseconds/iter	0, 1.0		
*HYSWAMPA	Yaw sw amp A time on, milliseconds/iter	0, 1.0		
*HYSWAMPB	Yaw sw amp B time on, milliseconds/iter	0, 1.0		
*HRSWAMPA	Roll sw amp A time on, milliseconds/iter	0, 1.0		
*HRSWAMPB	Roll sw amp B time on, milliseconds/iter	0, 1.0		
*HPAD	Pitch att error deadband	-5.0, 5.0 deg		
*HYAD	Yaw att error deadband	-5.0, 5.0 deg		
*HRAD	Roll att error deadband	-5.0, 5.0 deg		
*HPAESD	Pitch att error, after deadband	-180, 180 deg		
*HYAESD	Yaw att error, after deadband	-180, 180 deg		
*HRAESD	Roll att error, after deadband	-180, 180 deg		
*HLPAESD	Pitch attitude error after deadband, limiting	±3.65 deg		
*HLYAESD	Yaw attitude error after deadband, limiting	±3.65 deg		
*HLRAESD	Roll attitude error after deadband, limiting	±9.92 deg		
BAXB	X distance from C.G. to fixed origin	±50 feet		
BAYB	Y distance from C.G. to fixed origin	±50 feet		
BAZB	Z distance from C.G. to fixed origin	±50 feet		
*HAXB1	Proportional value of BAXB	±50 feet		
*HAYB1	Proporational value of BAYB	±50 feet		
*HAYB2	Proportional value of BAYB	±50 feet		
*HAYB3	Proportional value of BAYB	±50 feet		
*HAYB4	Proportional value of BAYB	±50 feet		
*HAYB5	Proportional value of HAYB	±50 feet		
*HAYB6	Proportional value of BAYB	±50 feet		
*HAYB7	Proportional value of BAYB	±50 feet		
*HAZB1	Proportional value of BAZB	±50 feet		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-7. Stabilization and Control System — Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*HAZB2	Proportional value of BAZB	±50 feet		
*HAZB3	Proportional value of BAZB	±50 feet		
*HAZB4	Proportional value of BAZB	±50 feet		
*HAZB5	Proportional value of BAZB	±50 feet		
*HAZB6	Proportional value of BAZB	±50 feet		
*HAZB7	Proportional value of BAZB	±50 feet		
*HPPACCA	Positive pitch acceleration available	0, +32 deg/sec^2		
*HNPACCA	Negative pitch acceleration available	0, +32 deg/sec^2		
*HPYACCA	Positive yaw acceleration available	0, +32 deg/sec^2		
*HNYACCA	Negative yaw acceleration available	0, +32 deg/sec^2		
*HPRACCA	Positive roll acceleration available	0, +32 deg/sec^2		
*HNRACCA	Negative roll acceleration available	0, +32 deg/sec^2		
*HPACCR	Pitch acceleration required present iteration	-200, 200 deg/sec^2		
*HYACCR	Yaw acceleration required present iteration	-200, 200 deg/sec^2		
*HRACCR	Roll acceleration required present iteration	-600, 600 deg/sec^2		
*HPSAT	Pitch switching amplifier threshold	-2, 2 deg+deg/sec		
*HYSAT	Yaw switching amplifier threshold	-2, 2 deg+deg/sec		
*HRSAT	Roll switching amplifier threshold	-2, 2 deg+deg/sec		
*HCPP	Positive roll clock enable logic time	0, 50 mili/sec		
*HCPN	Negative roll clock enable logic time	0, 50 milli/sec		
*HCQP	Positive pitch clock enable logic time	0, 50 milli/sec		
*HCQN	Negative pitch clock enable logic time	0, 50 milli/sec		
*HCRP	Positive yaw clock enable logic time	0, 50 milli/sec		
*HCRN	Negative yaw clock enable logic time	0, 50 milli/sec		
*HR1	Jet 1, pitch pos on/off ratio per iteration	0, 1		
*HR2	Jet 2, pitch neg on/off ratio per iteration	0, 1		
*HR3	Jet 3, pitch pos on/off ratio per iteration	0, 1		
*HR4	Jet 4, pitch neg on/off ratio per iteration	0, 1		
*HR5	Jet 5, yaw pos on/off ratio per iteration	0, 1		
*HR6	Jet 6, yaw neg on/off ratio per iteration	0, 1		
*HR7	Jet 7, yaw pos on/off ratio per iteration	0, 1		
*HR8	Jet 8, yaw neg on/off ratio per iteration	0, 1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-7. Stabilization and Control System — Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*HR9	Jet 9, roll pos on/off ratio per iteration	0, 1		
*HR10	Jet 10, roll neg on/off ratio per iteration	0, 1		
*HR11	Jet 11, roll pos on/off ratio per iteration	0, 1		
*HR12	Jet 12, roll neg on/off ratio per iteration	0, 1		
*HR13	Jet 13, roll pos on/off ratio per iteration	0, 1		
*HR14	Jet 14, roll neg on/off ratio per iteration	0, 1		
*HR15	Jet 15, roll pos on/off ratio per iteration	0, 1		
*HR16	Jet 16, roll neg on/off ratio per iteration	0, 1		
*HPFPD	Pitch sw amp factor, pos direct controller used	0, 1		
*HPFND	Pitch sw amp factor, neg direct controller used	0, 1		
*HYFPD	Yaw sw amp factor, pos direct controller used	0, 1		
*HYFND	Yaw sw amp factor, neg direct controller used	0, 1		
*HRFPD	Roll sw amp factor, pos direct controller used	0, 1		
*HRFND	Roll sw amp factor, neg direct controller used	0, 1		
*HOPT82	Constant equal to 0.823	Const 0.823		
*HOPT92	Constant equal to 0.922	Const 0.922		
*H1PT93	Constant equal to 1.93	Const 1.93		
*H2PT00	Constant equal to 2.00	Const 2.00		
*H3PT65	Constant equal to 3.65	Const 3.65		
*H9PT92	Constant equal to 9.92	Const 9.92		
*HDETR	Constant equal to 20.0, recep of iter period	Const 20.0		
*H227	Ullage system A operated	Boolean		
*H229	Jet No. 1 auto solenoid operable	Boolean		
*H230	Jet No. 2 auto solenoid operable	Boolean		
*H231	Ullage system B operated	Boolean		
*H236	Jet No. 3 auto solenoid operable	Boolean		
*H237	Jet No. 4 auto solenoid operable	Boolean		
*H238	Jet No. 5 auto solenoid operable	Boolean		
*H239	Jet No. 6 auto solenoid operable	Boolean		
*H240	Jet No. 7 auto solenoid operable	Boolean		
*H241	Jet No. 8 auto solenoid operable	Boolean		
*H242	Jet No. 9 auto solenoid operable	Boolean		
*H243	Jet No. 10 auto solenoid operable	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-7. Stabilization and Control System — Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*H244	Jet No. 11 auto solenoid operable	Boolean		
*H245	Jet No. 12 auto solenoid operable	Boolean		
*H246	Jet No. 13 auto solenoid operable	Boolean		
*H247	Jet No. 14 auto solenoid operable	Boolean		
*H248	Jet No. 15 auto solenoid operable	Boolean		
*H249	Jet No. 16 auto solenoid operable	Boolean		
*H271	Pitch swamp A output greater than zero	Boolean		
*H272	Pitch sw amp B output greater than zero	Boolean		
*H273	Roll sw amp A output greater than zero	Boolean		
*H274	Roll sw amp B output greater than zero	Boolean		
*H276	Auto amplifier enabled, roll A and C	Boolean		
*H277	Auto amplifier enabled, roll B and D	Boolean		
*H278	Auto amplifier enabled, pitch	Boolean		
*H279	Auto amplifier enabled, yaw	Boolean		
*H280	Yaw sw amp A output greater than zero	Boolean		
*H281	Yaw sw amp B output greater than zero	Boolean		
*H282	Auto control inhibit common	Boolean		
*H289	Pos roll direct control commanded	Boolean		
*H290	Pos pitch direct control commanded	Boolean		
*H291	Pos yaw direct control commanded	Boolean		
*H292	Pos X-axis translation command	Boolean		
*H293	Pos Y-axis translation command	Boolean		
*H294	Pos Z-axis translation command	Boolean		
*H296	Neg roll direct control commanded	Boolean		
*H297	Neg pitch direct control commanded	Boolean		
*H298	Neg yaw direct control commanded	Boolean		
*H299	Neg X-axis translation command	Boolean		
*H300	Neg Y-axis translation command	Boolean		
*H306	Direct ullage switch	Boolean		
*H325	Neg Z-axis translation command	Boolean		
*H326	Pos roll minimum impulse switch	Boolean		
*H327	Pos pitch minimum impulse switch	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-7. Stabilization and Control System — Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*H328	Pos yaw minimum impulse switch	Boolean		
*H339	Neg roll minimum impulse switch	Boolean		
*H340	Neg pitch minimum impulse switch	Boolean		
*H341	Neg yaw minimum impulse switch	Boolean		
*H526	Pos roll minimum impulse switch reset	Boolean		
*H527	Pos pitch minimum impulse switch reset	Boolean		
*H528	Pos yaw minimum impulse switch reset	Boolean		
*H539	Neg roll minimum impulse switch reset	Boolean		
*H540	Neg pitch minimum impulse switch reset	Boolean		
*H541	Neg yaw minimum impulse switch reset	Boolean		
*H550	Min deadband, nonentry mode condition	Boolean		
*H551	Max deadband, nonentry mode condition	Boolean		
*H929	Jet amplifier outputs - telemetry inputs - Jet 1	Boolean	GP1-1 (D), 1	
*H930	Jet amplifier outputs - telemetry inputs - Jet 2	Boolean	GP1-2 (D), 2	
*H936	Jet amplifier outputs - telemetry inputs - Jet 3	Boolean	GP1-3 (D), 3	
*H937	Jet amplifier outputs - telemetry inputs - Jet 4	Boolean	GP1-4 (D), 4	
*H938	Jet amplifier outputs - telemetry inputs - Jet 5	Boolean	GP1-5 (D), 5	
*H939	Jet amplifier outputs - telemetry inputs - Jet 6	Boolean	GP1-6 (D), 6	
*H940	Jet amplifier outputs - telemetry inputs - Jet 7	Boolean	GP1-7 (D), 7	
*H941	Jet amplifier outputs - telemetry inputs - Jet 8	Boolean	GP1-8 (D), 8	
*H942	Jet amplifier outputs - telemetry inputs - Jet 9	Boolean	GP2-1 (D), 9	
*H943	Jet amplifier outputs - telemetry inputs - Jet 10	Boolean	GP2-2 (D), 10	
*H944	Jet amplifier outputs - telemetry inputs - Jet 11	Boolean	GP2-3 (D), 11	
*H945	Jet amplifier outputs - telemetry inputs - Jet 12	Boolean	GP2-4 (D), 12	
*H946	Jet amplifier outputs - telemetry inputs - Jet 13	Boolean	GP2-5 (D), 13	
*H947	Jet amplifier outputs - telemetry inputs - Jet 14	Boolean	GP2-6 (D), 14	
*H948	Jet amplifier outputs - telemetry inputs - Jet 15	Boolean	GP2-7 (D), 15	
*H949	Jet amplifier outputs - telemetry inputs - Jet 16	Boolean	GP2-8 (D), 16	
*MH020	Pitch sw amp fail, zero output	Boolean		
*MH031	Yaw sw amp fail, zero output	Boolean		
*MH040	Roll sw amp fail, zero output	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-7. Stabilization and Control System — Attitude Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*MH041	Jet No. 1, pitch pos, fail open	Malfunction		
*MH043	Jet No. 2, pitch neg, fail open	Malfunction		
*MH045	Jet No. 3, pitch pos, fail open	Malfunction		
*MH047	Jet No. 4, pitch neg, fail open	Malfunction		
*MH052	Jet No. 5, yaw pos, fail open	Malfunction		
*MH054	Jet No. 6, yaw neg, fail open	Malfunction		
*MH056	Jet No. 7, yaw pos, fail open	Malfunction		
*MH061	Jet No. 8, yaw neg, fail open	Malfunction		
*MH063	Jet No. 9, roll pos, fail open	Malfunction		
*MH076	Rotational control - roll microswitch	Malfunction		
*MH077	Rotational control - pitch microswitch	Malfunction		
*MH100	Rotational control - yaw microswitch	Malfunction		
*MH101	Minimum impulse ctl - P microswitch (-roll)	Malfunction		
*MH102	Minimum impulse ctl - R microswitch (-yaw)	Malfunction		
*MH107	Jet No. 10, roll neg, fail open	Malfunction		
*MH112	Jet No. 11, roll pos, fail open	Malfunction		
*MH114	Jet No. 12, roll neg, fail open	Malfunction		
*MH116	Jet No. 13, roll pos, fail open	Malfunction		
*MH121	Jet No. 14, roll neg, fail open	Malfunction		
*MH123	Jet No. 15, roll pos, fail open	Malfunction		
*MH125	Jet No. 16, roll neg, fail open	Malfunction		
*MH152	Pitch sw amp fail, full output	Malfunction		
*MH153	Yaw sw amp fail, full output	Malfunction		
*MH154	Roll sw amp fail, full output	Malfunction		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-8. Stabilization and Control System - Thrust Vector Control

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H301	TVC logic No. 1	Boolean		
H302	TVC logic No. 2	Boolean		
H303	TVC logic No. 3	Boolean		
H304	Thrust sw NORMAL	Boolean		
H306	Direct ullage switch	Boolean		
H199	Thrust switch DIRECT	Boolean		
H308	TVC logic No. 4	Boolean		
H309	THRUST light on	Boolean		
H310	Integrator inhibit	Boolean		
H311	THRUST ON sw	Boolean		
H312	Delta V counter coincidence sw	Boolean		
H314	Eng ignition logic SPS	Boolean		
MH012	Pitch gimbal position	Malfunction		
MH013	Yaw gimbal position	Malfunction		
MH104	Yaw gimbal drive	Malfunction		
H318	SPS eng ignition signal			
H320	Thrust on switch failed closed	Boolean		
H321	Yaw gimbal motor operating No. 1	Boolean		
H323	Criteria for delta V motor run	Boolean		
H426	Delta V motor control	Boolean		
H209	No. 1 pitch gimbal motor sw START	Boolean		
H101	No. 1 pitch gimbal motor sw OFF	Boolean		
H210	No. 2 pitch gimbal motor sw START	Boolean		
H102	No. 2 pitch gimbal motor sw OFF	Boolean		
H212	No. 1 yaw gimbal motor sw START	Boolean		
H103	No. 1 yaw gimbal motor sw OFF	Boolean		
H211	No. 2 yaw gimbal motor sw START	Boolean		
H104	No. 2 yaw gimbal motor sw OFF	Boolean		
H335	Pitch gimbal motors power available	Boolean		
H336	Ignition time delay	Boolean		
H337	Yaw gimbal motor operating No. 2	Boolean		
H338	Pitch gimbal motor operating No. 1	Boolean		
H439	Pitch gimbal motor operating No. 2	Boolean		

Table 6-8. Stabilization and Control System - Thrust Vector Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H440	No. 1 yaw gimbal motor start period	Boolean		
H441	No. 1 yaw gimbal motor on bus	Boolean		
H342	No. 2 yaw gimbal motor on bus	Boolean		
H343	No. 1 pitch gimbal motor on bus	Boolean		
H344	No. 2 pitch gimbal motor on bus	Boolean		
H345	No. 2 yaw gimbal motor start period	Boolean		
H346	Yaw gimbal motors pwr available	Boolean		
H998	SPS eng solenoid No. 1	Boolean		
H999	SPS eng solenoid No. 2	Boolean		
H2C12	No. 1 gimbal motor power load	0, 85 amps		
H2C11	No. 2 gimbal motor power load	0, 85 amps		
H2C09	No. 3 gimbal motor power load	0, 85 amps		
H2C10	No. 4 gimbal motor power load	0, 85 amps		
H350	No. 1 pitch motor start period	Boolean		
H351	No. 2 pitch motor start period	Boolean		
MH167	TVC logic G&N and gate failure	Malfunction		
MH212	TVC logic SPS and gate failure	Malfunction		
MH217	Thrust on switch fails closed	Malfunction		
MH014	SCS accelerometer failure	Malfunction		
H313	MTVC inter	Boolean		
HKYEI	Yaw integrator constant 0.613	Const 0.613		
HKPEI	Pitch integrator constant 0.613	Const 0.613		
HKYGK	Yaw gimbal constant 0.5	Const 0.5		
HKPGH	Pitch gimbal constant 0.5	Const 0.5		
HYGCDI	Yaw gimbal clutch differential current	±0.833 amps		
HA$\ddot{X}$DDB	TVC accelerometer	-148, 222 ft/sec^2		
HDV2	Delta velocity integration	0, 13000 ft/sec		
MH170	Pitch rate limiter fails to zero	Malfunction		
MH174	Yaw gimbal position feedback failure	Malfunction		
HDET	Delta time = 0.05	Const 0.05		
HDVI	Delta velocity computation	0.0, 13000 ft/sec	144(A), 144	
HACCIN	Input from encoder	0.0, 13000 ft/sec		
H382	Delta velocity > 0	Boolean		

Table 6-8. Stabilization and Control System - Thrust Vector Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
HYPEI	Yaw position integrator	-200, 200 deg/sec		
HYAGMST	Yaw gimbal set	-4.0, 12.0 deg/sec		
HPIGMST	Pitch position set	-6, 6 deg/sec		
MH200	Yaw TVC error amplifier fail zero-output	Malfunction		
MH173	TVC integrator fails to zero yaw	Malfunction		
HYAEA	Yaw attitude error	-180, 180 deg		
HYGPC	Yaw gimbal pos command	-8.0, 8.0 deg		
HY1BP	Yaw inverter breakpoint	-6.0, 6.0 deg		
HYAAHCC	Yaw attitude hand control command	-180, 180 deg/sec		
HYAASC	Yaw actuator SCS or G&N command	-8.0, 8.0 deg/sec		
HYAA	Yaw actuator acceleration	-4.78, 4.78 deg/ sec^2		
HYAPF	Yaw actuator position feedback	-100, 100 deg	27(A), 27	
HYARF	Yaw actuator rate feedback	-100, 100 deg/sec		
HYAP	Yaw actuator position	-180, 180 deg		
MH171	Yaw rate limiter failure	Malfunction		
HYAR	Yaw actuator rate	-300, 300 deg/sec		
MH176	Yaw gimbal dr vel gen No. 1 fails to zero	Malfunction		
HYGP1	Yaw gimbal position indicator	-4.0, 12 deg		
HDEL02	Gimbal position (rad)	-0.6098, 0.209 rad		
HYGCD1	Clutch differential current yaw	-0.833, 0.833 amps	28(A), 28	
HPPE1	Pitch position integrator	-13.0, 13.0 deg		
HPAES	Pitch attitude error sum	-180, 180 deg		
MH172	TVC integrator fails zero output pitch	Malfunction		
HPAEA	Pitch attitude error	-180, 180 deg		
MH177	Pitch TVC error amplifier fail zero - output	Malfunction		
HPGPC	Pitch gimbal position command	-200, 200 deg		
HP1BP	Pitch inverter breakpoint	-200, 200 deg		
HPAAHCC	Pitch actuator manual command	-180, 180 deg/sec		
HMTVCPR	MTVC pitch rate	-180, 180 deg/sec		
HPAASC	Pitch actuator SCS or G&N command	-180, 180 deg/sec		
HPAA	Pitch actuator acceleration	-200, 200 deg/ sec^2		
HPAPF	Pitch actuator position feedback	-100, 100 deg	23(A), 23	

Table 6-8. Stabilization and Control System - Thrust Vector Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
HPARF	Pitch actuator rate feedback	-100, 100 deg/sec		
HPAP	Pitch actuator position	-180, 180 deg		
HPAR	Pitch actuator rate	-300, 300 deg/sec		
MH175	Pitch gimbal velocity generator No. 1 fails to zero	Malfunction		
MH103	Pitch gimbal drive fails	Malfunction		
HPGP1	Pitch gimbal position indication	-13.0, 13.0 deg		
HDEL01	Pitch gimbal position conversion	-0.139, 0.139 rad		
HPGCD1	Pitch gimbal clutch differential current	-0.833, 0.833 amps	24(A)/24	
H108	SCS pitch gimbal drive fail	Boolean		
H109	SCS yaw gimbal drive fail	Boolean		
THPAPF	TM pitch position feedback	-6, 6	23(A)/23	
THPGCDI	TM pitch clutch differential current	-833, 833	24(A)/24	
THPAEC	TM pitch integrator/attitude error	-2.8, 2.8	76(A)/76	
THYAPF	TM yaw position feedback	-8.5, 8.5	27(A)/27	
THYGCDI	TM yaw differential clutch current	-833, 833	28(A)/28	
THYAEC	TM yaw integrator/attitude error	-2.8, 2.8	83(A)/83	
THDV1	TM delta V remaining	0, 13000	144(A)/144	
TH318	TM SPS solenoid driver out, No. 1 and 2	Boolean	GP4-1(D)/25, GP4-1(D)/26	

Table 6-9. Stabilization and Control System-Inertial Sensors

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MH001	Yaw rate gyro - fail to zero	Malfunction		
MH002	Yaw BMAG - fail to zero	Malfunction		
MH003	Pitch BMAG - fail to zero	Malfunction		
MH004	Pitch rate gyro - fail to zero	Malfunction		
MH010	Roll rate gyro - fail to zero	Malfunction		
MH011	Roll BMAG - fail to zero	Malfunction		
MH017	Attitude gyro coupler unit malf	Malfunction		
MH050	Pitch rate gyro - fail to max.	Malfunction		
MH060	Yaw rate gyro - fail to max.	Malfunction		
MH067	FDAI attitude ball malf	Malfunction		
MH070	Roll rate gyro - fail to max.	Malfunction		
MH071	FDAI roll error meter malf	Malfunction		
MH072	FDAI yaw error meter malf	Malfunction		
MH073	FDAI pitch rate meter malf	Malfunction		
MH074	FDAI roll rate meter malf	Malfunction		
MH075	FDAI yaw rate meter malf	Malfunction		
MH133	Pitch rotational h/c demod. - fail to zero	Malfunction		
MH134	Yaw rotational h/c demod. - fail to zero	Malfunction		
MH135	Roll rotational h/c demod. - fail to zero	Malfunction		
MH136	Pitch G&N demod - fail to zero	Malfunction		
MH137	Yaw G&N demod - fail to zero	Malfunction		
MH140	Roll G&N demod - fail to zero	Malfunction		
MH141	Pitch BMAG demod - fail to zero	Malfunction		
MH142	Yaw BMAG demod - fail to zero	Malfunction		
MH143	Roll BMAG demod - fail to zero	Malfunction		
MH144	Pitch rate error amp - fail to zero	Malfunction		
MH145	Yaw rate error amp - fail to zero	Malfunction		
MH146	Roll rate error amp - fail to zero	Malfunction		
MH161	Pitch BMAG - fail to max.	Malfunction		
MH162	Yaw BMAG - fail to max.	Malfunction		
MH163	Roll BMAG - fail to max.	Malfunction		
MH164	Pitch rate gyro demod - fail to zero	Malfunction		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-9. Stabilization and Control System-Inertial Sensors (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MH165	Yaw rate gyro demod - fail to zero	Malfunction		
MH166	Roll rate gyro demod - fail to zero	Malfunction		
MH202	FDAI pitch error meter amp - fail to zero	Malfunction		
HPLPH	No. 1 rotational h/c position - pitch	±10.0 volts		
HPLYH	No. 1 rotational h/c position - yaw	±10.0 volts		
HPLRH	No. 1 rotational h/c position - roll	±10.0 volts		
HPLPHD	No. 2 rotational h/c position - pitch	±10.0 volts		
HPLYHD	No. 2 rotational h/c position - yaw	±10.0 volts		
HPLRHD	No. 2 rotational h/c position - roll	±10.0 volts		
HPLPHST	Pitch rotational h/c sig to telemetry	±20.0 volts		
HPLYHST	Yaw rotational h/c sig to telemetry	±20.0 volts		
HPLRHST	Roll rotational h/c sig to telemetry	±20.0 volts		
HPLPHS	Pitch rotational h/c sig to TVC	±20.0 volts		
HPLYHS	Yaw rotational h/c sig	±20.0 volts		
HPLRHS	Roll rotational h/c sig	±20.0 volts		
HPLPHSD	Pitch rotational h/c rate	±45.0 volts		
HPLYHSD	Yaw rotational h/c	±45.0 volts		
HPLRHSD	Roll rotational h/c	±45.0 volts		
HQRG	Pitch rate gyro	±45.0 volts		
HRRG	Yaw rate gyro	±45.0 volts		
HPRG	Roll rate gyro	±45.0 volts		
HQBI	Pitch b/u rate gyro	±45.0 volts		
HRBI	Yaw b/u rate gyro	±45.0 volts		
HPBI	Roll b/u rate gyro	±45.0 volts		
HQRGT	Pitch gyro rate to telemetry	±30 deg/sec		
HPRGT	Roll gyro rate to telemetry	±30 deg/sec		
HRRGT	Yaw gyro rate to telemetry	±30 deg/sec		
HMQ	Pitch rate sum to TVC & att ctl	±180 deg/sec		
HMP	Roll rate sum to TVC & att ctl	±180 deg/sec		
HMR	Yaw rate sum to TVC & att ctl	±180 deg/sec		
HPASTEE	Pitch attitude set error - Euler	±360 deg		
HYASTEE	Yaw attitude set error - Euler	±360 deg		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-9. Stabilization and Control System-Inertial Sensors (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
HRASTEE	Roll attitude set error - Euler	±360 deg		
HPASTEN	Pitch attitude set error - nav	±180 deg		
HYASTEN	Yaw attitude set error - nav	±180 deg		
HRASTEN	Roll attitude set error - nav	±180 deg		
HPASTEB	Pitch attitude set error - body	±180 deg		
HYASTEB	Yaw attitude set error - body	±180 deg		
HRASTEB	Roll attitude set error - body	±180 deg		
HPBAER	BMAG attitude error rate - pitch	±5 deg		
HYBAER	BMAG attitude error rate - yaw	±5 deg		
HRBAER	BMAG attitude error rate - roll	±5 deg		
HPBAEB	Pitch BMAG attitude error - body	±180 deg		
HYBAEB	Yaw BMAG attitude error - body	±180 deg		
HRBAEB	Roll BMAG attitude error - body	±180 deg		
HPBAEN	Pitch BMAG attitude error - nav	±180 deg		
HYBAEN	Yaw BMAG attitude error - nav	±180 deg		
HRBAEN	Roll BMAG attitude error - nav	±180 deg		
HPBAEE	Pitch BMAG attitude error - Euler	±180 deg		
HYBAEE	Yaw BMAG attitude error - Euler	±180 deg		
HRBAEE	Roll BMAG attitude error - Euler	±180 deg		
APAGCUE	Pitch AGCU attitude error	±180 deg		
HYAGCUE	Yaw AGCU attitude error	±180 deg		
HRAGCUE	Roll AGCU attitude error	±180 deg		
HTHETAT	Pitch AGCU shaft angle	0, 360 deg		
HSIT	Yaw AGCU shaft angle	0, 360 deg		
HPHIT	Roll AGCU shaft angle	0, 360 deg		
HPORT	Pitch orbital rate	±180 deg		
HPTN	Pitch torquer signal - nav	±180 deg		
HYTN	Yaw torquer signal - nav	±180 deg		
HRTN	Roll torquer signal - nav	±180 deg		
HPTB	Pitch torquer signal - body	±180 deg		
HYTB	Yaw torquer signal - body	±180 deg		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-9. Stabilization and Control System-Inertial Sensors (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
HRTB	Roll torquer signal - body	±180 deg		
HPTR	Pitch BMAG torquer rate signal	±5 deg		
HYTR	Yaw BMAG torquer rate signal	±5 deg		
HRTR	Roll BMAG torquer rate signal	±5 deg		
HPAET	Pitch att error to telemetry	±180 deg		
HYAET	Yaw att error to telemetry	±180 deg		
HRAET	Roll att error to telemetry	±180 deg		
HPAEC	SCS pitch att error to TVC & att ctl	±180 deg		
HYAEC	SCS yaw att error to TVC & att ctl	±180 deg		
HRAEC	SCS roll att error to TVC & att ctl	±180 deg		
HPAES	Pitch att error to TVC & att ctl	±180 deg		
HYAES	Yaw att error to TVC & att ctl	±180 deg		
HRAES	Roll att error to TVC & att ctl	±180 deg		
HMTVCPR	Pitch MTVC rate to TVC	±180 deg/sec		
HMTVCYR	Yaw MTVC rate to TVC	±180 deg/sec		
HPBR	FDAI pitch angular velocity meter	±5 volts		
HRBR	FDAI roll angular velocity meter	±25 volts		
HYBR	FDAI yaw angular velocity meter	±5 volts		
HPAE	FDAI pitch command meter (att err)	±15 volts		
HYAE	FDAI yaw command meter (att err)	±15 volts		
HRAE	FDAI roll command meter (att err)	±25 volts		
HPASDA	FDAI ball - pitch sine	±10 volts		
HPASDB	FDAI ball - pitch cosine	±10 volts		
HYASDA	FDAI ball - yaw sine	±10 volts		
HYASDB	FDAI ball - yaw cosine	±10 volts		
HRASDA	FDAI ball - roll sine	±10 volts		
HRASDB	FDAI ball - roll cosine	±10 volts		
HPASIN	IOS attitude set display - pitch	0, +360 nondim		
HYASIN	IOS attitude set display - yaw	±90 nondim		
HRASIN	IOS attitude set display - roll	0, +360 nondim		
THPLPHST	Pitch man rot. ctl T/M output CH0025V	±20 volts	22(A)/22	
THPLYHST	Yaw man rot. ctl T/M output CH1025V	±20 volts	26(A)/26	

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-9. Stabilization and Control System-Inertial Sensors (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
THPLRHST	Roll man rot. ctl T/M output CH2025V	±20 volts	30(A)/30	
THQRGT	Pitch rate gyro T/M output CH0024V	±25 deg/sec	21(A)/21	
THRRGT	Yaw rate gyro T/M output CH1024V	±25 deg/sec	25(A)/25	
THPRGT	Roll rate gyro T/M output CH2024V	±25 deg/sec	29(A)/29	
THPAET	SCS pitch att error - T/M output CH0075V	±20 deg	77(A)/77	
THYAET	SCS yaw att error - T/M output CH1075V	±20 deg	84(A)/84	
THRAET	SCS roll att error - T/M output CH2075V	±20 deg	86(A)/86	
TSINTHA	Resolver sin out pitch - T/M output CH4100H	±10 volts	88(A)/88	
TCOSTHA	Resolver cos out pitch - T/M output CH4101H	±10 volts	90(A)/90	
TSINPSA	Resolver sin out yaw - T/M output CH4102H	±10 volts	96(A)/96	
TCOSPSA	Resolver cos out yaw - T/M output CH4103H	±10 volts	97(A)/97	
TSINPHA	Resolver sin out roll - T/M output CH4104H	±10 volts	99(A)/99	
TCOSPHA	Resolver cos out roll - T/M output CH4105H	±10 volts	101(A)/101	
HWTEMP1	Pitch body rate limited	±180 deg/sec		
HWTEMP2	Yaw body rate limited	±180 deg/sec		
HWTEMP3	Roll body rate limited	±180 deg/sec		
HWTEMP4	Scaled G&N pitch att error	±180 deg/sec		
HWTEMP5	Scaled G&N yaw att error	±180 deg/sec		
HWTEMP6	Roll att err meter s.f.	1.0, 5.0 nondim		
HWTEMP7	Sine of roll shaft angle	±1.0 nondim		
HWTEMP8	Cosine of roll shaft angle	±1.0 nondim		
HWTEMP9	Sine of yaw shaft angle	±1.0 nondim		
HWTEMP10	Cosine of yaw shaft angle	±1.0		
HWTEMP11	Total pitch AGCU error (includes orbit rt)	±180 deg		
HWTEMP12	Pitch/yaw rot. h/c scale factor	±45 deg/volt		
HWTEMP13	Roll rot. h/c scale factor	±45 deg/volt		
HWTEMP14	Pitch rate gyro with threshold error	±180 deg/sec		
HWTEMP15	Yaw rate gyro with threshold error	±180 deg/sec		
HWTEMP16	Roll rate gyro with threshold error	±180 deg/sec		
HYAATSTM	Yaw attitude set - modified DWI input conversion	±360 deg		
HPIATSTM	Pitch attitude set - DWI input conversion	±360 deg		
HROATSTM	Roll attitude set - DWI input conversion	±360 deg		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-9. Stabilization and Control System-Inertial Sensors (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
HWTEMP20	Pitch/yaw angular velocity meter s.f.	1, 5		
HWTEMP21	Pitch/yaw velocity meter self test delta	-5, 5 volts		
HWTEMP22	Roll velocity meter self test delta	-25, 25 volts		
HWTEMP23	G&N yaw att err nav or body	±180 deg		
HWTEMP24	G&N roll att err nav or body	±180 deg		
HWTEMP25	Pitch/yaw att err meter self test delta	±15 volts		
HWTEMP27	Pitch rate gyro or b/u rate gyro	±180 deg/sec		
HWTEMP28	Roll rate gyro or b/u rate gyro	±180 deg/sec		
HWTEMP29	Yaw rate gyro or b/u rate gyro	±180 deg/sec		
HWTEMP30	Roll angular velocity meter s.f.	1, 25		
HWTEMP31	G&N gimbal or AGCU shaft angle - pitch	±180 deg		
HWTEMP32	G&N gimbal or AGCU shaft angle - yaw	±180 deg		
HWTEMP33	G&N gimbal or AGCU shaft angle - roll	±180 deg		
HWTEMP34	Pitch rate gyro threshold error	±45 deg/sec		
HWTEMP35	Yaw rate gyro threshold error	±45 deg/sec		
HWTEMP36	Roll rate gyro threshold error	±45 deg/sec		
H499	Self test	Boolean		
HK001	Rotational h/c scale factor	Const 0.065 deg/ volts		
HK002	Rotational h/c scale factor	Const 0.500 deg/ volts		
HK003	Rotational h/c scale factor	Const 1.700 deg/ volts		
HK004	Conversion from degrees to radians	Const 57.296 deg/radian		
HK005	Maximum gyro rate	Const 30.0 deg/sec		
HK006	Tangent 22° for y-r rate meter cplg	0.40403		
HK007	Sine 33° for nav transformations	0.54464		
HK008	Cosine 33° for nav transformations	0.83867		
HK009	Pitch orbit rate	Const 0.83867 Deg/0.05 sec		
HK012	P-Y rate meter self test delta	Const +2.5 deg/sec		
HK013	Roll rate meter self test delta	Const +12.5 deg/ sec		
HK014	P-Y error meter self test delta	Const +7.5 deg		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-9. Stabilization and Control System-Inertial Sensors (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
HK017,	Maximum backup gyro rate	Const 25.0 deg/sec		
HPAGCUEL	Pitch shaft angle rate	±180 deg/0.05 sec		
HYAGCUEL	Yaw shaft angle rate	±180 deg/0.05 sec		
HRAGCUEL	Roll shaft angle rate	±180 deg/0.05 sec		
HSLEW	FDAI ball slew rate per 50 ms	-360, 0 deg		
HDET	Deltat = 50 milliseconds	Const 0.05 sec		
HPIATST	Pitch attitude set 1A6	0, 360 deg		
HYAATST	Yaw attitude set 1A6	0, 360 deg		
HROATST	Roll attitude set 1A6	0, 360 deg		
THPAES	Pitch err sum amp out T/M	±20 deg		
THYAES	Yaw err sum amp out T/M	±20 deg		
THRAES	Roll sum amp out T/M	±20 deg	143(A)/143	
H105	AGAP temperature out of limits to CWS			
HGTEMP	Combined attitude gyro temperature for T/M	0, 4.84 volts		
HASMRD	Attitude gyro SMRD for T/M	0, 4.84 volts		
HRSMRD	Rate gyro SMRD for T/M	0, 4.84 volts		
THGTEMP	Combined gyro attitude temperature to T/M	0, 4.84 volts	234(A)/234	
THASMRD	Combined attitude gyro SMRD to T/M CH2015V	0, 4.84 volts	104(A)/104	
THRSMRD	Combined rate gyro SMRD to T/M CH2026V	0, 4.84 volts	107(A)/107	
H383	AGAP package overtemp - direction upper left	Boolean		
H475	Pitch rate gyro on	Boolean		
H476	Yaw rate gyro on	Boolean		
H477	Roll rate gyro on	Boolean		
H478	Pitch BMAG on	Boolean		
H479	Yaw BMAG on	Boolean		
H480	Roll BMAG on	Boolean		
MH105	AGAP heater failure	Boolean		
GEPCHNBA	G&N pitch error	±180 deg		
GEYAWBA	G&N yaw error - body axis	±180 deg		
GEROLBA	G&N roll error - body axis	±180 deg		
GEYAWNB	G&N yaw error - nav base	±180 deg		
GEROLNB	G&N roll error - nav base	±180 deg		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-9. Stabilization and Control System-Inertial Sensors, (Cont)

*Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GOGA	Outer gimbal angle, 1X resolver output	0, 360		
GMGA	Middle gimbal angle, 1X resolver output	0, 360		
GIGA	Inner gimbal angle, 1X resolver output	0, 360		
HPASDA1	Pitch ball angle	0, 360		
HYASDA1	Yaw ball angle	0, 360		
HRASDA1	Roll ball angle	0, 360		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-10. Visual Displays-Scanning Telescope

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V300	Boolean equals 1 if cos A_T >.00001	Boolean		
VBTBEFAB	$B_{F(A)B}$ is the projected telescope line-of-sight angle on X_{NB}- Z_{NB} plane	-100, 100		
VBTBERLB	$B_{R(L)B}$ is the projected telescope line-of-sight angle on Y_{NB}- Z_{NB} plane	-100, 100		
V301	Boolean equals 1 if tan $B_{F(A)B}$ >.5317	Boolean		
V302	Boolean equals 1 if tan $B_{F(A)B}$ <-.6619	Boolean		
VBPHFAB	Forward (aft) occulting blade resolver angle	-1.3963, 1.963 rad		
VBSPHFAB	Forward (aft) occulting blade drive signal	0, 1		
VBCPHFAB	Forward (aft) occulting blade drive signal	-0.482, 1		
V313	Boolean equals 1 if the astro-sextant doors are fully opened	Boolean		
VBETRB	Variable defined by equation V613	-0.577, 0.577		
V303	Boolean equals 1 if $\|\eta_{RB}\|$< .5774	Boolean		
VBPHRB	Right occulting blade resolver angle	0, 2.0734 rad		
VBSPHRB	Right occulting blade drive signal	0, 1		
VBCPHRB	Right occulting blade drive signal	-0.482, 1		
VBETLB	Required left occulting blade displacement angle	-0.577, 0.577		
V305	Boolean equals 1 if $\|\eta_{LB}\|$ <.5774	Boolean		
VBPHLB	Left occulting blade resolver angle	0, 2.0734 rad		
VBSPHLB	Left occulting blade drive signal	0, 1		
VBCPHLB	Left occulting blade drive signal	-0.482, 1		
VBBW5	X^5_W (telescope window) frame component of a unit vector from earth to sun	-1, 1		
V311	Boolean equals 1 when B^5_W >.83867	Boolean		
V310	Boolean denoting that the telescope lamp should be turned on	Boolean		

Table 6-11. Visual Displays-Sextant Starfield

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V337	Boolean defined by Equation V1100	Boolean		
VAN11	(X), I_E-frame to (X), OR-frame direction cosine	-1, 1		
VAN12	(Y), I_E-frame to (X), OR-frame direction cosine	-1, 1		
VAN13	(Z), I_E-frame to (X), OR-frame direction cosine	-1, 1		
VAN21	(X), I_E-frame to (Y), OR-frame direction cosine	-1, 1		
VAN22	(Y), I_E-frame to (Y), OR-frame direction cosine	-1, 1		
VAN23	(Z), I_E-frame to (Y), OR-frame direction cosine	-1, 1		
VAN31	(X), I_E-frame to (Z), OR-frame direction cosine	-1, 1		
VAN32	(Y), I_E-frame to (Z), OR-frame direction cosine	-1, 1		
VAN33	(Z), I_E-frame to (Z), OR-frame direction cosine	-1, 1		
VAXIMOON	(X), I_E-frame component of a unit vector from center of earth to center of moon	-1, 1		
VAYIMOON	(Y), I_E-frame component of a unit vector from center of earth to center of moon	-1, 1		
VAZIMOON	(Z), I_E-frame component of a unit vector from center of earth to center of moon	-1, 1		
VAXORM	(X), OR-frame component of center of moon relative to center of earth	-1, 1		
VAYORM	(Y), OR-frame component of center of moon relative to center of earth	-1, 1		
VAZORM	(Z), OR-frame component of center of moon relative to center of earth	-1, 1		
V350	1 if $(X_{OR})_M \geq .98481$	Boolean		
VAXSSUN	(X), Selenographic-frame component of a unit vector from the earth to the sun	-1, +1		
VAYSSUN	(Y), Selenographic-frame component of a unit vector from the earth to the sun	-1, +1		
VANSUN	(Trig function of) lunar slide selection parameter	0, +1		
VASNLASP	(Trig function of) lunar slide selection parameter	-1, +1		
VACSLASP	(Trig function of) lunar slide selection parameter	-1, +1		
V351	1 if SIN λSP $\geq$ 0	Boolean		
V352	1 if COS λSP $\geq$ 0	Boolean		
V370	Boolean defined by eq (V1118.5)	Boolean		
V371	Boolean defined by eq (V1118.6)	Boolean		
V372	Boolean defined by eq (V1118.7)	Boolean		
V373	Boolean defined by eq (V1118.8)	Boolean		

Table 6-11. Visual Displays-Sextant Starfield (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VASNM	Landmark LOS lunar slide number	+1, +30		
VASLORLM	(Trig function of) inertial latitude of landmark LOS	-1, 1		
VACLORLM	(Trig function of) inertial latitude of landmark LOS	0, 1		
V353	1 if COS $(L_{OR})_{LM}$ .0000004768	Boolean		
VASLAORL	(Trig function of) inertial longitude of landmark LOS	-1, 1		
VACLAORL	(Trig function of) inertial longitude of landmark LOS	-1, 1		
V354	1 if SIN $(L_{OR})_{LM}$ >0	Boolean		
V355	1 if COS $(\lambda_{OR})_{LM}$ >0	Boolean		
V356	1 if SIN $(\lambda_{OR})_{LM}$ >0	Boolean		
V357	Boolean defined by eq V1127	Boolean		
V358	Boolean defined by eq V1128	Boolean		
V359	Boolean defined by eq V1129	Boolean		
V360	Boolean defined by eq V1130	Boolean		
V361	Boolean defined by eq V1131	Boolean		
VASNS	Landmark LOS star slide number	31, 35		
VASN	Carousel slide No. (1-35)	1, 35		
VASDLM	Sextent slide BCD output coding	BCD		
VAPHLMO	Slide initial rotational offset	-90, 90 deg		
VAYLMO	Center of slide offset	-10, 10 in.		
VAZLMO	Center of slide offset	-10, 10 in.		
VALALMS	Right ascension of selected landmark LOS star	-180, 180 deg		
VADELMS	Declination of selected landmark LOS star	-90, 90 deg		
VASLALMS	Sine of right ascension of selected LM star	-1, 1		
VACLALMS	Cosine of right ascension of selected LM star	-1, 1		
VASDELMS	Sine of declination of selected LM star	-1, 1		
VACDELMS	Cosine of declination of selected LM star	0, 1		
VASR11	(X), Slide-frame to X_{I_E}-frame direction cosine	-1, 1		
VASR13	(Z), Slide-frame to X_{I_E}-frame direction cosine	-1, 1		
VASR21	(X), Slide-frame to Y_{I_E}-frame direction cosine	-1, 1		
VASR23	(Z), Slide-frame to Y_{I_E}-frame direction cosine	-1, 1		
VASR31	(X), Slide-frame to Z_{I_E}-frame direction cosine	-1, 1		
VASR33	(Z), Slide-frame to Z_{I_E}-frame direction cosine	-1, 1		
VAT23	(Z), Slide-frame to (Y), OR-frame direction cosine	-1, 1		

Table 6-11. Visual Displays-Sextant Starfield (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VAT33	(Z), Slide-frame to (Z), OR-frame direction cosine	-1, 1		
VASPHLMC	(Trig function of) SXT LM LOS slide rotational angle	-1, 1		
VACPHLMC	(Trig function of) SXT LM LOS slide rotational angle	-1, 1		
VASNPHDP	SXT derotation prism signal	-1, 1		
VACSPHDP	SXT derotation prism signal	-1, 1		
VASINXAS	Sine of SXT shaft angle	-1, 1		
VACOSXAS	Cosine of SXT shaft angle	-1, 1		
VASNPHSS	Sine of parameter for SXT reticle and polaroid rotation	-1, 1		
VACSPHSS	Cosine of parameter for SXT reticle and polaroid rotation	-1, 1		
VAPHSS	Sxt reticle and polaroid rotation parameter angle	0, 360 deg		
VAPHSR	Sxt reticle rotation signal	0, 360 deg		
VASNPHPL	Polaroid rotation signal	-1, 1		
VACSPHPL	Polaroid rotation signal	-1, 1		
VAXORS	(X), OR-frame coordinate of a unit vector directed toward a LM LOS star	-1, 1		
VAYORS	(Y), OR-frame coordinate of a unit vector directed toward a LM LOS star	-1, 1		
VAZORS	(Z), OR-frame coordinate of a unit vector directed toward a LM LOS star	-1, 1		
VAXORLM	Parameter defined by eq V1159	-1, 1		
VAYORLM	Parameter defined by eq V1160	-1, 1		
VAZORLM	Parameter defined by eq V1161	-1, 1		
VAYORSL	Parameter defined by eq V1162	-15.56, 15.56 in.		
VAZORSL	Parameter defined by eq V1163	-15.56, 15.56 in.		
VAYORSLC	(Y), OR-frame slide coordinate of a landmark image	-14.56, 14.45 in.		
VAZORSLC	(Z), OR-frame slide coordinate of a landmark image	-14.56, 14.56 in.		
VAYORCSC	Corrected (Y), OR-frame slide coordinate of LM image	-12.62, 1.88 in.		
VAZORCSC	Corrected (Z), OR-frame slide coordinate of LM image	-7.25, 7.25 in.		
VADL	Parameter defined by eq V1173	2.25, 7.25 in.		
VAEL	Parameter defined by eq V1174	-1, 3.22		
VAFL	Parameter defined by eq V1175	-1, 3.22		
VACOSGAL	(Trig function of) LM rhomb scan interior angle	0, 1		
VACOSDEL	(Trig function of) LM rhomb scan interior angle	0, 1		
VASINGAL	(Trig function of) LM rhomb scan interior angle	0, 1		
VASINDEL	(Trig function of) LM rhomb scan interior angle	0, 1		

Table 6-11. Visual Displays-Sextant Starfield (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VAK6	LM rhomb scan angle parameter	0.42, 4.32		
VAK7	LM rhomb scan angle parameter	-2.35, 2.39		
VASINALL	LM rhomb scan angle (trig function of)	-1, 1		
VACOSALL	LM ohomb scan angle (trig function of)	0, 1		
VASINBEL	LM rhomb scan angle (trig function of)	-1, 1		
VACOSBEL	LM rhomb scan angle (trig function of)	0, 1		
VAALL	LM rhomb scan angle	-15, 15 deg		
VABEL	LM rhomb scan angle	-30, 30 deg		
VAALLC	Parameter defined by eq V1184	-90, 90 deg		
VABELC	Parameter defined by eq V1185	-180, 180 deg		
VASNALLC	LM rhomb coarse resolver signal	-1, 1		
VACSALLC	LM rhomb coarse resolver signal	0, 1		
VASNBELC	LM rhomb coarse resolver signal	-1, 1		
VACSBELC	LM rhomb coarse resolver signal	-1, 1		
VAALLF	LM rhomb fine resolver signal	-360, 360 deg		
VABELF	LM rhomb fine resolver signal	-360, 360 deg		
V322	LM intensity control Boolean (high)			
V323	LM intensity control Boolean (med)			
V324	LM intensity control Boolean (low)			
VAPSVM	Variable magnification servo signal	0, 360 deg		
VASINXAT	Sine of SXT trunnion angle	-1, 1		
VACOSXAT	Cosine of SXT trunnion angle	-1, 1		
VAA1	Parameter defined by eq V1202	-1, 1		
VAA2	Parameter defined by eq V1203	-1, 1		
VAA3	Parameter defined by eq V1204	-1, 1		
VASNALSX	Parameter defined by eq V1205	-1, 1		
VACSALSX	Parameter defined by eq V1206	-1, 1		
VASNBESX	Parameter defined by eq V1207	-1, 1		
VACSBESX	Parameter defined by eq V1208	-1, 1		
VASX11	(X), OR-frame to (X), SX-frame direction cosine	-1, 1		
VASX12	(Y), OR-frame to (X), SX-frame direction cosine	-1, 1		
VASX13	(Z), OR-frame to (X), SX-frame direction cosine	-1, 1		
VASX21	(X), OR-frame to (Y), SX-frame direction cosine	-1, 1		

Table 6-11. Visual Displays-Sextant Starfield (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VASX22	(Y), OR-frame to (Y), SX-frame direction cosine	-1, 1		
VASX23	(Z), OR-frame to (Y), SX-frame direction cosine	-1, 1		
VASX31	(X), OR-frame to (Z), SX-frame direction cosine	-1, 1		
VASX32	(Y), OR-frame to (Z), SX-frame direction cosine	-1, 1		
VASX33	(Z), OR-frame to (Z), SX-frame direction cosine	-1, 1		
VAP11	(X), I_E-frame to (X), SX-frame direction cosine	-1, 1		
VAP12	(Y), I_E-frame to (X), SX-frame direction cosine	-1, 1		
VAP13	(Z), I_E-frame to (X), SX-frame direction cosine	-1, 1		
VAP21	(X), I_E-frame to (Y), SX-frame direction cosine	-1, 1		
VAP22	(Y), I_E-frame to (Y), SX-frame direction cosine	-1, 1		
VAP23	(Z), I_E-frame to (Y), SX-frame direction cosine	-1, 1		
VAP31	(X), I_E-frame to (Z), SX-frame direction cosine	-1, 1		
VAP32	(Y), I_E-frame to (Z), SX-frame direction cosine	-1, 1		
VAP33	(Z), I_E-frame to (Z), SX-frame direction cosine	-1, 1		
VASINLSX	(Trig function of) latitude of SXT star LOS	-1, 1		
VACOSLSX	(Trig function of) latitude of SXT star LOS	0, 1		
V331	1 if COS $L_{SX} >$ .0000004768	Boolean		
VASNLASX	(Trig function of) longitude of SXT star LOS	-1, 1		
VACSLASX	(Trig function of) longitude of SXT star LOS	-1, 1		
VALSX	Latitude of SXT star LOS	-90, 90 degrees		
VALASX	Longitude of SXT star LOS	-180, 180 degrees		
VADEST	Declination of selected SXT star	-90, 90 degrees		
VALAST	Longitude of selected SXT star	-180, 180 degrees		
VAXSSD	BCD output coding for selected star group No.	Boolean		
VASPHSPO	(Trig function of) rotational position of starfield servo (initial)	-0.210, .450		
VACPHSPO	(Trig function of) rotational position of starfield servo (initial)	0.880, 1		
VASNLAST	Sine of the right ascension of the selected star	-1, 1		
VACSLAST	Cosine of the right ascension of the selected star	-1, 1		
VASNDEST	Sine of the declination of the selected star	-1, 1		
VACSDEST	Cosine of the declination of the selected star	0, 1		
VAS11	(X), S-frame to (X), I_E-frame direction cosine (selected star)	-1, 1		

Table 6-11. Visual Displays-Sextant Starfield (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VAS12	(Y), S-frame to (X), I_E-frame direction cosine (selected star)	-1, 1		
VAS13	(Z), S-frame to (X), I_E-frame direction cosine (selected star)	-1, 1		
VAS21	(X), S-frame to (Y), I_E-frame direction cosine (selected star)	-1, 1		
VAS22	(Y), S-frame to (Y), I_E-frame direction cosine (selected star)	-1, 1		
VAS23	(Z), S-frame to (Z), I_E-frame direction cosine (selected star)	-1, 1		
VAS31	(X), S-frame to (Z), I_E-frame direction cosine (selected star)	-1, 1		
VAS32	(Y), S-frame to (Z), I_E-frame direction cosine (selected star)	-1, 1		
VAS33	(Z), S-frame to (Z), I_E-frame direction cosine (selected star)	-1, 1		
VAXSXS	(X), SX-frame component of a selected star	-1, 1		
VAYSXS	(Y), SX-frame component of a selected star	-1, 1		
VAZSXS	(Z), SX-frame component of a selected star	-1, 1		
VAYORP	(Y), OR-frame coordinate of a selected star	-10.28, 10.28 in.		
VAZORP	(Z), OR-frame coordinate of a selected star	-10.28, 10.28 in.		
VAYORCPC	Corrected (Y), OR-frame coordinate of plate image	-8.92, 1.32 in.		
VAZORCPC	Corrected (Z), OR-frame coordinate of plate image	-5.12, 5.12 in.		
VADS	Parameter defined by eq V1258	1.625, 5.125 in.		
VAES	Parameter defined by eq V1259	-1, 3.2		
VAFS	Parameter defined by eq V1260	-1, 3.2		
VACOSGAS	(Trig function of) starplate rhomb interior angle	0, 1		
VACOSDES	(Trig function of) starplate rhomb interior angle	0, 1		
VASINGAS	(Trig function of) starplate rhomb interior angle	0, 1		
VASINDES	(Trig function of) starplate rhomb interior angle	0, 1		
VAK14	Starplate rhomb scan angle parameter	-1.35, 4.32		
VAK15	Starplate rhomb scan angle parameter	-2.39, 2.36		
VASINALS	(Trig function of) starplate rhomb scan angle	-1, 1		
VACOSALS	(Trig function of) starplate rhomb scan angle	0, 1		
VASINBES	(Trig function of) starplate rhomb scan angle	-1, 1		
VACOSBES	(Trig function of) starplate rhomb scan angle	0, 1		
VAALS	Starplate rhomb scan angle	-15, 15 deg		

Table 6-11. Visual Displays-Sextant Starfield (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VABES	Starplate rhomb scan angle	-30, 30 deg		
VAALSC	Starplate α rhomb coarse resolver angle	-90, 90 deg		
VABESC	Starplate β rhomb coarse resolver angle	-180, 180 deg		
VASNALSC	Starplate rhomb coarse resolver signal	-1, 1		
VACSALSC	Starplate rhomb coarse resolver signal	0, 1		
VASNBESC	Starplate rhomb coarse resolver signal	-1, 1		
VACSBESC	Starplate rhomb coarse resolver signal	-1, 1		
VAALSF	Rhomb fine resolver signal (starplate)	0, 360 deg		
VABESF	Rhomb fine resolver signal (starplate)	0, 360 deg		
VAR22	Parameter defined by eq V1281	-1, 1		
VAR23	Parameter defined by eq V1282	-1, 1		
VAK20	Variable defined by eq V1281	-1, 1		
VAK21	Variable defined by eq V1282	-1, 1		
VASNPHSP	(Trig function of) reqd displacement of starfield rotation servo	-1, 1		
VACSPHSP	(Trig function of) reqd displacement of starfield rotation servo	-1, 1		
V335	1 if $(X_{SX})_S > .999263$	Boolean		
V336	1 if $\lvert XA_T \rvert < 57°$	Boolean		
V364	Starfield illumination signal	Boolean		
V365	Boolean defined by eq V1290	Boolean		
V330	Boolean defined by eq V1291	Boolean		
V320	Boolean defined by eq V1292	Boolean		

Table 6-12. Visual Displays-Celestial Sphere Drive

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VDSINGA1	Y_1 is the obliquity of the ecliptic	Const 0.39875		
VDCOSGA1	Y_1 is the obliquity of the ecliptic	Const 0.91706		
VDGA11	X_B to X ecliptic direction cosine	±1		
VDGA12	Y_B to X ecliptic direction cosine	±1		
VDGA13	Z_B to X ecliptic direction cosine	±1		
VDGA21	X_B to Y ecliptic direction cosine	±1		
VDGA22	Y_B to Y ecliptic direction cosine	±1		
VDGA23	Z_B to Y ecliptic direction cosine	±1		
VDGA31	X_B to Z ecliptic direction cosine	±1		
VDGA32	Y_B to Z ecliptic direction cosine	±1		
VDGA33	Z_B to Z ecliptic direction cosine	±1		
VDOM111	X_W^1 (window one) to X_B direction cosine	Const 0.45226		
VDOM112	Y_W^1 (window one) to X_B direction cosine	Const 0.88295		
VDOM113	Z_W^1 (window one) to X_B direction cosine	Const -0.12594		
VDOM121	X_W^1 (window one) to Y_B direction cosine	Const -0.85059		
VDOM122	Y_W^1 (window one) to Y_B direction cosine	Const 0.46947		
VDOM123	Z_W^1 (window one) to Y_B direction cosine	Const 0.23685		
VDOM131	X_W^1 (window one) to Z_B direction cosine	Const 0.26825		
VDOM132	Y_W^1 (window one) to Z_B direction cosine	Const 0		
VDOM133	Z_W^1 (window one) to Z_B direction cosine	Const 0.96335		
VDOM211	X_W^2 (window two) to X_B direction cosine	Const 0.98481		
VDOM212	Y_W^2 (window two) to X_B direction cosine	Const 0.08682		
VDOM213	Z_W^2 (window two) to X_B direction cosine	Const -0.15038		
VDOM221	X_W^2 (window two) to Y_B direction cosine	Const -0.17365		
VDOM222	Y_W^2 (window two) to Y_B direction cosine	Const 0.49240		
VDOM223	Z_W^2 (window two) to Y_B direction cosine	Const -0.85287		
VDOM231	X_W^2 (window two) to Z_B direction cosine	Const 0		
VDOM232	Y_W^2 (window two) to Z_B direction cosine	Const 0.86603		
VDOM233	Z_W^2 (window two) to Z_B direction cosine	Const 0.50000		
VDOM311	X_W^3 (window four) to X_B direction cosine	Const 0.98481		
VDOM312	Y_W^3 (window four) to X_B direction cosine	Const -0.08682		
VDOM313	Z_W^3 (window four) to X_B direction cosine	Const -0.15038		
VDOM321	X_W^3 (window four) to Y_B direction cosine	Const 0.17365		

Table 6-12. Visual Displays-Celestial Sphere Drive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VDOM322	Y_W^3 (window four) to Y_B direction cosine	Const 0.49240		
VDOM323	Z_W^3 (window four) to Y_B direction cosine	Const 0.85287		
VDOM331	X_W^3 (window four) to Z_B direction cosine	Const 0		
VDOM332	Y_W^3 (window four) to Z_B direction cosine	Const -0.86603		
VDOM333	Z_W^3 (window four) to Z_B direction cosine	Const 0.50000		
VDOM411	X_W^4 (window five) to X_B direction cosine	Const 0.45226		
VDOM412	Y_W^4 (window five) to X_B direction cosine	Const -0.88295		
VDOM413	Z_W^4 (window five) to X_B direction cosine	Const 0.12594		
VDOM421	X_W^4 (window five) to Y_B direction cosine	Const 0.85059		
VDOM422	Y_W^4 (window five) to Y_B direction cosine	Const 0.46947		
VDOM423	Z_W^4 (window five) to Y_B direction cosine	Const -0.23685		
VDOM431	X_W^4 (window five) to Z_B direction cosine	Const 0.26825		
VDOM432	Y_W^4 (window five) to Z_B direction cosine	Const 0		
VDOM433	Z_W^4 (window five) to Z_B direction cosine	Const 0.96335		
VD5ALW5	Telescope window to or-frame parameter	-1, 1		
VDCALW5	Telescope window to or-frame parameter	-1, 1		
VDSBEW5	Telescope window to or-frame parameter	-1, 1		
VDCBEW5	Telescope window to or-frame parameter	-1, 1		
VDA1SCT	Variable defined by equation 52	-1, 1		
VDA2SCT	Variable defined by equation 52	-1, 1		
VDOR11	X telescope window to X OR-frame direction cosine	-1, 1		
VDOR12	Y telescope window to X OR-frame direction cosine	-1, 1		
VDOR13	Z telescope window to X OR-frame direction cosine	-1, 1		
VDOR21	X telescope window to Y OR-frame direction cosine	-1, 1		
VDOR22	Y telescope window to Y OR-frame direction cosine	-1, 1		
VDOR23	Z telescope window to Y OR-frame direction cosine	-1, 1		
VDOR31	X telescope window to Z OR-frame direction cosine	-1, 1		
VDOR32	Y telescope window to Z OR-frame direction cosine	0		
VDOR33	Z telescope window to Z OR-frame direction cosine	-1, 1		
VDOM511	X_W^5 telescope window to X_B direction cosine	-1, 1		
VDOM512	Y_W^5 telescope window to X_B direction cosine	-1, 1		
VDOM513	Z_W^5 telescope window to X_B direction cosine	-1, 1		
VDOM521	X_W^5 telescope window to Y_B direction cosine	-1, 1		

Table 6-12. Visual Displays-Celestial Sphere Drive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VDOM522	Y_W^5 telescope window to Y_B direction cosine	-1, 1		
VDOM523	Z_W^5 telescope window to Y_B direction cosine	-1, 1		
VDOM531	X_W^5 telescope window to Z_B direction cosine	-1, 1		
VDOM532	Y_W^5 telescope window to Z_B direction cosine	-1, 1		
VDOM533	Z_W^5 telescope window to Z_B direction cosine	-1, 1		
VDDE111	X ecliptic to X_W^1 (window one) direction cosine	-1, 1		
VDDE121	X ecliptic to Y_W^1 (window one) direction cosine	-1, 1		
VDDE131	X ecliptic to Z_W^1 (window one) direction cosine	-1, 1		
VDDE132	Y ecliptic to Z_W^1 (window one) direction cosine	-1, 1		
VDDE133	Z ecliptic to Z_W^1 (window one) direction cosine	-1, 1		
VDDE211	X ecliptic to X_W^2 (window two) direction cosine	-1, 1		
VDDE221	X ecliptic to Y_W^2 (window two) direction cosine	-1, 1		
VDDE231	X ecliptic to Z_W^2 (window two) direction cosine	-1, 1		
VDDE232	Y ecliptic to Z_W^2 (window two) direction cosine	-1, 1		
VDDE233	Z ecliptic to Z_W^2 (window two) direction cosine	-1, 1		
VDDE311	X ecliptic to X_W^3 (window four) direction cosine	-1, 1		
VDDE321	X ecliptic to Y_W^3 (window four) direction cosine	-1, 1		
VDDE331	X ecliptic to Z_W^3 (window four) direction cosine	-1, 1		
VDDE332	Y ecliptic to Z_W^3 (window four) direction cosine	-1, 1		
VDDE333	Z ecliptic to Z_W^3 (window four) direction cosine	-1, 1		
VDDE411	X ecliptic to X_W^4 (window five) direction cosine	-1, 1		
VDDE421	X ecliptic to Y_W^4 (window five) direction cosine	-1, 1		
VDDE431	X ecliptic to Z_W^4 (window five) direction cosine	-1, 1		
VDDE432	Y ecliptic to Z_W^4 (window five) direction cosine	-1, 1		
VDDE433	Z ecliptic to Z_W^4 (window five) direction cosine	-1, 1		
VDDE511	X ecliptic to X_W^5 (telescope window) direction cosine	-1, 1		
VDDE521	X ecliptic to Y_W^5 (telescope window) direction cosine	-1, 1		
VDDE531	X ecliptic to Z_W^5 (telescope window) direction cosine	-1, 1		
VDDE532	Y ecliptic to Z_W^5 (telescope window) direction cosine	-1, 1		
VDDE533	Z ecliptic to Z_W^5 (telescope window) direction cosine	-1, 1		
VDSTHSF1	θ_{SF}^1 intermediate gimbal angle of star field globe window 1	-1, 1		
VDCTHSF1	θ_{SF}^1 intermediate gimbal angle of star field globe window 1	-1, 1		
VDSTHSF2	θ_{SF}^2 intermediate gimbal angle of star field globe window 2	-1, 1		

Table 6-12. Visual Displays-Celestial Sphere Drive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VDCTHSF2	θ_{SF}^{2} intermediate gimbal angle of star field globe window 2	-1, 1		
VDSTHSF3	θ_{SF}^{3} intermediate gimbal angle of star field globe window 3	-1, 1		
VDCTHSF3	θ_{SF}^{3} intermediate gimbal angle of star field globe window 3	-1, 1		
VDSTHSF4	θ_{SF}^{4} intermediate gimbal angle of star field globe window 4	-1, 1		
VDCTHSF4	θ_{SF}^{4} intermediate gimbal angle of star field globe window 4	-1, 1		
VDSTHSF5	θ_{SF}^{5} intermediate gimbal angle of star field globe window 5	-1, 1		
VDCTHSF5	θ_{SF}^{5} intermediate gimbal angle of star field globe window 5	-1, 1		
VDSPSSF1	ψ_{SF}^{1} outer gimbal angle of star field globe window 1	-1, 1		
VDCPSSF1	ψ_{SF}^{1} outer gimbal angle of star field globe window 1	-1, 1		
VDSPSSF2	ψ_{SF}^{2} outer gimbal angle of star field globe window 2	-1, 1		
VDCPSSF2	ψ_{SF}^{2} outer gimbal angle of star field globe window 2	-1, 1		
VDSPSSF3	ψ_{SF}^{3} outer gimbal angle of star field globe window 3	-1, 1		
VDCPSSF3	ψ_{SF}^{3} outer gimbal angle of star field globe window 3	-1, 1		
VDSPSSF4	ψ_{SF}^{4} outer gimbal angle of star field globe window 4	-1, 1		
VDCPSSF4	ψ_{SF}^{4} outer gimbal angle of star field globe window 4	-1, 1		
VDSPSSF5	ψ_{SF}^{5} outer gimbal angle of star field globe window 5	-1, 1		
VDCPSSF5	ψ_{SF}^{5} outer gimbal angle of star field globe window 5	-1, 1		
VDSINPH1	Variable defined by equation 117	-1, 1		
VDCOSPH1	Variable defined by equation 118	-1, 1		
VDSINPH2	Variable defined by equation 119	-1, 1		
VDCOSPH2	Variable defined by equation 120	-1, 1		
VDSINPH3	Variable defined by equation 121	-1, 1		
VDCOSPH3	Variable defined by equation 122	-1, 1		
VDSINPH4	Variable defined by equation 123	-1, 1		
VDCOSPH4	Variable defined by equation 124	-1, 1		
VDSINPH5	Variable defined by equation 125	-1, 1		
VDCOSPH5	Variable defined by equation 126	-1, 1		
VDSPHSF1	ϕ_{SF}^{1} inner gimbal angle of star field globe window 1	-1, 1		
VDCPHSF1	ϕ_{SF}^{1} inner gimbal angle of star field globe window 1	-1, 1		
VDSPHSF2	ϕ_{SF}^{2} inner gimbal angle of star field globe window 2	-1, 1		
VDCPHSF2	ϕ_{SF}^{2} inner gimbal angle of star field globe window 2	-1, 1		
VDSPHSF3	ϕ_{SF}^{3} inner gimbal angle of star field globe window 3	-1, 1		
VDCPHSF3	ϕ_{SF}^{3} inner gimbal angle of star field globe window 3	-1, 1		

Table 6-12. Visual Displays-Celestial Sphere Drive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VDSPHSF4	$\emptyset_{SF}^{4}$ inner gimbal angle of star field globe window 4	-1, 1		
VDCPHSF4	$\emptyset_{SF}^{4}$ inner gimbal angle of star field globe window 4	-1, 1		
VDSPHSF5	$\emptyset_{SF}^{5}$ inner gimbal angle of star field globe window 5	-1, 1		
VDCPHSF5	$\emptyset_{SF}^{5}$ inner gimbal angle of star field globe window 5	-1, 1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VERENM	Radius of earth in N MI	3432.890, 3443.934		
VEHNM	Altitude in N MI	0, 215.50 0.3001.200		
VERH	Altitude parameter	0.300, 1.200		
VETP	Parameter defined by equation V1304	0, 360		
VELAR	Parameter defined by equation V1305	0, 360		
VETHG	Parameter defined by equation V1306	0, 360		
VETHXY	Parameter defined by equation V1306	0, 360		
VEXITH	Parameter defined by equation V1307	0, 360		
VEST	Parameter defined by equation V1308	±1		
VECT	Parameter defined by equation V1309	±1		
VEMU	Parameter defined by equation V1310	±100		
VETHXO	Longitude of that point on film centerline whose transversal passes through NADIR	0, 360		
VEXOF	Parameter defined by equation V1312	±22275		
VENTN	Parameter defined by equation V1313	±18		
VENFC	Earth orbital film drive parameter	±18		
VENDEC	Earth orbital film drive parameter	0, 360		
VEYO	Parameter defined by equation V1316	±35		
VEYFP	Off-course earth orbital film drive	±35		
VETANM	Projection of angle between meridians of longitude and great circles. Perp. to ground track onto MEP film.	±100		
VESINM	I_E-frame to N-frame direction cosine	±1		
VECOSM	I_E-frame to N-frame direction cosine	±1		
VEH11	I_E-frame to N-frame direction cosine	±1		
VEH12	I_E-frame to N-frame direction cosine	±1		
VEH13	I_E-frame to N-frame direction cosine	±1		
VEH21	I_E-frame to N-frame direction cosine	±1		
VEH22	I_E-frame to N-frame direction cosine	±1		
VEH23	I_E-frame to N-frame direction cosine	±1		
VEH31	I_E-frame to N-frame direction cosine	±1		
VEH32	I_E-frame to N-frame direction cosine	±1		
VEH33	I_E-frame to N-frame direction cosine	±1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEI111	X_W^1 (window 1) to X_{IE} direction cosine	±1		
VEI121	Y_W^1 (window 1) to X_{IE} direction cosine	±1		
VEI131	Z_W^1 (window 1) to X_{IE} direction cosine	±1		
VEI211	X_W^1 (window 1) to Y_{IE} direction cosine	±1		
VEI221	Y_W^1 (window 1) to Y_{IE} direction cosine	±1		
VEI231	Z_W^1 (window 1) to Y_{IE} direction cosine	±1		
VEI311	X_W^1 (window 1) to Z_{IE} direction cosine	±1		
VEI321	Y_W^1 (window 1) to Z_{IE} direction cosine	±1		
VEI331	Z_W^1 (window 1) to Z_{IE} direction cosine	±1		
VEI112	X_W^2 (window 2) to X_{IE} direction cosine	±1		
VEI122	Y_W^2 (window 2) to X_{IE} direction cosine	±1		
VEI132	Z_W^2 (window 2) to X_{IE} direction cosine	±1		
VEI212	X_W^2 (window 2) to Y_{IE} direction cosine	-1, 1		
VEI222	Y_W^2 (window 2) to Y_{IE} direction cosine	-1, 1		
VEI232	Z_W^2 (window 2) to Y_{IE} direction cosine	-1, 1		
VEI312	X_W^2 (window 2) to Z_{IE} direction cosine	-1, 1		
VEI322	Y_W^2 (window 2) to Z_{IE} direction cosine	-1, 1		
VEI332	Z_W^2 (window 2) to Z_{IE} direction cosine	-1, 1		
VEI113	X_W^3 (window 4) to X_{IE} direction cosine	-1, 1		
VEI123	Y_W^3 (window 4) to X_{IE} direction cosine	-1, 1		
VEI133	Z_W^3 (window 4) to X_{IE} direction cosine	-1, 1		
VEI213	X_W^3 (window 4) to Y_{IE} direction cosine	-1, 1		
VEI223	Y_W^3 (window 4) to Y_{IE} direction cosine	-1, 1		
VEI233	Z_W^3 (window 4) to Y_{IE} direction cosine	-1, 1		
VEI313	X_W^3 (window 4) to Z_{IE} direction cosine	-1, 1		
VEI323	Y_W^3 (window 4) to Z_{IE} direction cosine	-1, 1		
VEI333	Z_W^3 (window 4) to Z_{IE} direction cosine	-1, 1		
VEI114	X_W^4 (window 5) to X_{IE} direction cosine	-1, 1		
VEI124	Y_W^4 (window 5) to X_{IE} direction cosine	-1, 1		
VEI134	Z_W^4 (window 5) to X_{IE} direction cosine	-1, 1		
VEI214	X_W^4 (window 5) to Y_{IE} direction cosine	-1, 1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEI224	Y_W^4 (window 5) to Y_{I_E} direction cosine	-1, 1		
VEI234	Z_W^4 (window 5) to Y_{I_E} direction cosine	-1, 1		
VEI314	X_W^4 (window 5) to Z_{I_E} direction cosine	-1, 1		
VEI324	Y_W^4 (window 5) to Z_{I_E} direction cosine	-1, 1		
VEI334	Z_W^4 (window 5) to Z_{I_E} direction cosine	-1, 1		
VEI115	X_W^5 (window 6) to X_{I_E} direction cosine	±1		
VEI125	Y_W^5 (window 6) to X_{I_E} direction cosine	±1		
VEI135	Z_W^5 (window 6) to X_{I_E} direction cosine	±1		
VEI215	X_W^5 (window 6) to Y_{I_E} direction cosine	±1		
VEI225	Y_W^5 (window 6) to Y_{I_E} direction cosine	±1		
VEI235	Z_W^5 (window 6) to Y_{I_E} direction cosine	±1		
VEI315	X_W^5 (window 6) to Z_{I_E} direction cosine	±1		
VEI325	Y_W^5 (window 6) to Z_{I_E} direction cosine	±1		
VEI335	Z_W^5 (window 6) to Z_{I_E} direction cosine	±1		
V478	Parameter defined by equation V1373			
VEJ111M	X_W^1 (window 1) to moon X_N direction cosine	±1		
VEJ121M	Y_W^1 (window 1) to moon X_N direction cosine	±1		
VEJ131M	Z_W^1 (window 1) to moon X_N direction cosine	±1		
VEJ112M	X_W^2 (window 2) to moon X_N direction cosine	±1		
VEJ122M	Y_W^2 (window 2) to moon X_N direction cosine	±1		
VEJ132M	Z_W^2 (window 2) to moon X_N direction cosine	±1		
VEJ113M	X_W^3 (window 4) to moon X_N direction cosine	±1		
VEJ123M	Y_W^3 (window 4) to moon X_N direction cosine	±1		
VEJ133M	Z_W^3 (window 4) to moon X_N direction cosine	±1		
VEJ114M	X_W^4 (window 5) to moon X_N direction cosine	±1		
VEJ124M	Y_W^4 (window 5) to moon X_N direction cosine	±1		
VEJ134M	Z_W^4 (window 5) to moon X_N direction cosine	±1		
VEJ115M	Parameter defined by equation V1386	±1		
VEJ125M	Parameter defined by equation V1387	±1		
VEJ135M	Parameter defined by equation V1388	±1		
VEJ211M	Parameter defined by equation V1389	±1		
VEJ311M	Parameter defined by equation V1390	±1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEJ212M	Parameter defined by equation V1391	±1		
VEJ312M	Parameter defined by equation V1392	±1		
VEJ213M	Parameter defined by equation V1393	±1		
VEJ313M	Parameter defined by equation V1394	±1		
VEJ214M	Parameter defined by equation V1395	±1		
VEJ314M	Parameter defined by equation V1396	±1		
VEJ215M	Parameter defined by equation V1397	±1		
VEJ315M	Parameter defined by equation V1398	±1		
VEWX	Parameter defined by equation V1399	±1		
VEWY	Parameter defined by equation V1400	±1		
VEWZ	Parameter defined by equation V1401	±1		
VEXWP2	Rendezvous window frame parachute component	±2500		
VEYWP2	Rendezvous window frame parachute component	±2500		
VEZWP2	Rendezvous window frame parachute component	±2500		
VEXWP3	Rendezvous window frame parachute component	±2500		
VEYWP3	Rendezvous window frame parachute component	±2500		
VWZWP3	Rendezvous window frame parachute component	±2500		
VERWP2	Rendezvous window frame parachute component	±2500		
VERWP3	Rendezvous window frame parachute component	±2500		
VEJWP	Parameter defined by equation V1410	±1		
V477	Parameter defined by equation V1411	±1		
VEJ112P	X_W^2 (window 2) to X_P direction cosine	±1		
VEJ122P	Y_W^2 (window 2) to X_P direction cosine	±1		
VEJ132P	Z_W^2 (window 2) to X_P direction cosine	±1		
VEJ212P	X_W^2 (window 2) to Y_P direction cosine	±1		
VEJ312P	X_W^2 (window 2) to Z_P direction cosine	±1		
VEJ113P	X_W^3 (window 4) to X_P direction cosine	±1		
VEJ123P	Y_W^3 (window 4) to X_P direction cosine	±1		
VEJ133P	Z_W^3 (window 4) to X_P direction cosine	±1		
VEJ213P	X_W^3 (window 4) to Y_P direction cosine	±1		
VEJ313P	X_W^3 (window 4) to Z_P direction cosine	±1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEJ111E	X_W^1 (window 1) to X_E N-frame direction cosine	±1		
VEJ121E	Y_W^1 (window 1) to X_E N-frame direction cosine	±1		
VEJ131E	Z_W^1 (window 1) to X_E N-frame direction cosine	±1		
VEJ211E	X_W^1 (window 1) to Y_E N-frame direction cosine	±1		
VEJ311E	X_W^1 (window 1) to Z_E N-frame direction cosine	±1		
VEJ112E	X_W^2 (window 2) to X_E N-frame direction cosine	±1		
VEJ122E	Y_W^2 (window 2) to X_E N-frame direction cosine	±1		
VEJ132E	Z_W^2 (window 2) to X_E N-frame direction cosine	±1		
VEJ212E	X_W^2 (window 2) to Y_E N-frame direction cosine	±1		
VEJ312E	X_W^2 (window 2) to Z_E N-frame direction cosine	±1		
VEJ113E	X_W^3 (window 4) to X_E N-frame direction cosine	±1		
VEJ123E	Y_W^3 (window 4) to X_E N-frame direction cosine	±1		
VEJ133E	Z_W^3 (window 4) to X_E N-frame direction cosine	±1		
VEJ213E	X_W^3 (window 4) to Y_E N-frame direction cosine	±1		
VEJ313E	X_W^3 (window 4) to Z_E N-frame direction cosine	±1		
VEJ114E	X_W^4 (window 5) to X_E N-frame direction cosine	±1		
VEJ124E	Y_W^4 (window 5) to X_E N-frame direction cosine	±1		
VEJ134E	Z_W^4 (window 5) to X_E N-frame direction cosine	±1		
VEJ214E	X_W^4 (window 5) to Y_E N-frame direction cosine	±1		
VEJ314E	X_W^4 (window 5) to Z_E N-frame direction cosine	±1		
VEJ115E	X_W^5 (window 6) to X_E N-frame direction cosine	±1		
VEJ125E	V_W^5 (window 6) to X_E N-frame direction cosine	±1		
VEJ135E	Z_W^5 (window 6) to X_E N-frame direction cosine	±1		
VEJ215E	X_W^5 (window 6) to Y_E N-frame direction cosine	±1		
VEJ315E	X_W^5 (window 6) to Z_E N-frame direction cosine	±1		
VEJP	Parameter defined by equation V1447	0, 1		
VEJT	Parameter defined by equation V1448	0, 1		
VESBEN	Trigonometric function of SCT LOS azimuth	-1, 1		
VECBEN	Trigonometric function of SCT LOS azimuth	-1, 1		
VESALN	Trigonometric function of SCT LOS elevation	-1, 1		
VECALN	Trigonometric function of SCT LOS elevation	-1, 1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V979	SCT LOS intersection condition Boolean	-1, 1		
VESINZE	Parameter defined by equation V1454	-1, 1		
VECOSZE	Parameter defined by equation V1455	-1, 1		
VESINGA	Trigonometric function of earth referenced central angle between NADIR and SCT LOS intersection point	-1, 1		
VECOSGA	Trigonometric function of earth referenced central angle between NADIR and SCT LOS intersection point	-1, 1		
VESINLP	Trigonometric function of film referenced latitude of the SCT LOS intersection point	-1, 1		
VECOSLP	Trigonometric function of film referenced latitude of the SCT LOS intersection point	-1, 1		
VEDELAN	Film oriented change in longitude of SCT LOS intersection point relative to NADIR	- /2, π /2π		
VEDELN	Film oriented change in latitude of SCT LOS intersection point relative to NADIR	- /2, π /2π		
VEXN	X, N-frame coordinate of SCT LOS intersection point	-5000.0, 5000.0 N Mi		
VEYN	Y, N-frame coordinate of SCT LOS intersection point	-5000.0 5000.0 N Mi		
VERNP	Parameter defined by equation V1464	-5000.0 5000.0 N Mi		
VETANALP	MEP scanning mirror film parameter	-100, 100		
VESINPSN	MEP scanning mirror film parameter	-1, 1		
VECOSPSN	MEP scanning mirror film parameter	-1, 1		
VETANAL	MEP scanning mirror film parameter	-1, 1		
VERNPC	Parameter defined by equation V1469	-5000.0, 5000.0 N Mi		
VERNC	Parameter defined by equation V1470	0, 5000.0 N Mi		
VEYNC	Parameter defined by equation V1471	-5000.0, 5000.0 N Mi		
VEXNC	Parameter defined by equation V1472	-5000.0, 5000.0 N Mi		
VEJ115S	X_W^5 to X_N direction cosine ~ corrected mirror for scanning	-1, 1		
VEJ215S	X_W^5 to Y_N direction cosine ~ corrected mirror for scanning	-1, 1		
VEJ315S	X_W^5 to Z_N direction cosine ~ corrected mirror for scanning	-1, 1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V980	1 if $j_{31}^{5} \geq 0.6427876$	Boolean		
VETSM1	Parameter defined by equation V1477	0, 10000 sec		
VETSM2	Parameter defined by equation V1478	0, 10000 sec		
AXIEV	X I_E-frame coordinate of vehicle position			
AYIEV	Y I_E-frame coordinate of vehicle position			
VEJ115C	Corrected X_W^5 to X_N direction cosine	-1, 1		
VEJ215C	Corrected X_W^5 to Y_N direction cosine	-1, 1		
VEJ315C	Corrected X_W^5 to Z_N direction cosine	-1, 1		
VEVCCXI	I_E-frame ~ X-component of cloud cover velocity	20000, 30000 ft/sec		
VEVCCYI	I_E-frame ~ Y-component of cloud cover velocity	20000, 30000 ft/sec		
VEVCCZI	I_E-frame ~ Z-component of cloud cover velocity	20000, 30000 ft/sec		
VEVCCXN	N-frame ~ X-component of cloud cover velocity	20000, 30000 ft/sec		
VEVCCYN	N-frame ~Y-component of cloud cover velocity	20000, 30000 ft/sec		
V574	Boolean defined by equation V1487	Boolean		
V570	Boolean defined by equation V1488	Boolean		
V572	Boolean defined by equation V1489	Boolean		
V571	Boolean defined by equation V1490	Boolean		
V573	Boolean defined by equation V1491	-1, 1		
V575	Boolean defined by equation V1492	-1, 1		
V576	Boolean defined by equation V1493	-1, 1		
VEZETF1	The (X), N-frame component of a unit vector from the center of the earth to the sun (parameter)	-1, 1		
VEETTF1	The (Y), N-frame component of a unit vector from the center of the earth to the sun (parameter)	-1, 1		
VEXITF1	The (Z), N-frame component of a unit vector from the center of the earth to the sun (parameter)	-1, 1		
VEZETF	The (X), N-frame component of a unit vector from the center of the earth to the sun (positive when S/C going day to night)	-1, 1		
VEETTF	The (Y), N-frame component of a unit vector from the center of the earth to the sun (positive when S/C going day to night)	-1, 1		
VEXITF	The (Z), N-frame component of a unit vector from the center of the earth to the sun (positive when S/C going day to night)	-1, 1		
VETATF	Parameter defined by equation V1500	-1, 1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEXIETF	The (X), I_E-frame coordinate of a unit vector along the intersection of day-night terminator line and film centerline	-1, 1		
VEYIETF	The (Y), I_E-frame coordinate of a unit vector along the intersection of day-night terminator line and film centerline	-1, 1		
VEZIETF	The (Z), I_E-frame coordinate of a unit vector along the intersection of day-night terminator line and film centerline	-1, 1		
VERTFP	Parameter defined by equation V1504	0, 1		
VESNLATF	Trig. function of inertial longitude of the day-night terminator line and film centerline intersection	-1, 1		
VECSLATF	Trig. function of inertial longitude of the day-night terminator line and film centerline intersection	-1, 1		
VESNLTF	Trig. function of inertial latitude of the day-night terminator line and film centerline intersection	-1, 1		
VECSLTF	Trig. function of inertial latitude of the day-night terminator line and film centerline intersection	-1, 1		
V577	Boolean defined by equation V1509	Boolean		
V578	Boolean defined by equation V1510	Boolean		
V579	Boolean defined by equation V1511	Boolean		
VEDELAD1	Parameter defined by equation V1512	$-\pi, \pi$ radians		
VEDELADN	The angular difference in longitude between $\lambda_{T/F}$ and λ_E	$-\pi, \pi$ radians		
VEYT	The unscaled distance to day-night terminator line from NADIR	-1000, 1000 N Mi		
VEYTS	The scaled small circle distance to the day-night terminator line	-10, 10 inches		
VECSTHTF	Trig. function of reference orbit arc length (ground track) measured from $\lambda_{T/F}$ to λ_E	-1, 1		
VESNTHTF	Trig. function of reference orbit arc length (ground track) measured from $\lambda_{T/F}$ to λ_E	-1, 1		
V580	1 if Sin $\theta_{T/F} \geq 0.0000004768$	Boolean		
VESNUDNT	Trig. function of positive angle measured between day-night terminator line and $\theta_{T/F}$ at longitude $\lambda_{T/F}$	0, 90		
VEPHDNT1	Angular difference between $\pi/2$ and δ_{DNT}	0, 90		
VEPHDNT	The angle of clockwise (positive) rotation of the day-night terminator line from the film ground track	0, 90		
VEFNE	Parameter defined by table 1			
VEFNEQ	Parameter defined by table 1			
VEFNEG	f (ascending node)	+1, +19		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEPX	X_{I_E} frame plane component of $\bar{r} \times \bar{v}$	$\pm 150 \times 10^{10}$		
VEPY	Y_{I_E} frame plane component of $\bar{r} \times \bar{v}$	$\pm 150 \times 10^{10}$		
VERP	Parameter defined by equation V1525	$\pm 225 \times 10^{10}$		
VESINLAN	Right ascension of ascending node	±1		
VECOSLAN	Right ascension of ascending node	±1		
V800	Parameter defined by equation V1528	Boolean		
VETHN1	Parameter defined by equation V1529	0, 360		
VETHN	Angular displacement to next ascending node	0, 360		
VETC	Parameter defined by equation V1531	0, +360000		
VELARNP	Predicted longitude of ascending node	0, +360		
V647	Orbit prediction film number	Boolean		
VETHG	Parameter from table 1	0, +360		
VEDT	Step ahead film No. prediction parameter from equation V1534	±1		
VEDD	Step ahead film No. prediction parameter from equation V1535	0, +16		
VELARW	Step ahead film No. prediction parameter from equation V1536	0, +360		
V413	Earth-moon illumination varifocal fast drive Boolean term parameter from equation V1537	Boolean		
V410	Earth-moon illumination varifocal fast drive Boolean term parameter from equation V1538	Boolean		
V473	Earth-moon illumination varifocal fast drive Boolean term parameter from equation V1539	Boolean		
V483	Earth-moon illumination varifocal fast drive Boolean term parameter from equation V1540	Boolean		
V411	Earth-moon illumination varifocal fast drive Boolean term	Boolean		
V421	Earth-moon illumination varifocal fast drive Boolean term	Boolean		
V431	Earth-moon illumination varifocal fast drive Boolean term	Boolean		
V441	Earth-moon illumination varifocal fast drive Boolean term	Boolean		
V451	Earth-moon illumination varifocal fast drive Boolean term	Boolean		
V423	Earth-moon illumination varifocal fast drive Boolean term	Boolean		
V433	Earth-moon illumination varifocal fast drive Boolean term	Boolean		
V443	Earth-moon illumination varifocal fast drive Boolean term	Boolean		
V453	Earth-moon illumination varifocal fast drive Boolean term	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V673	Desired film position in resolver, revolutions plus degrees parameter from equation V1550	Boolean		
VENFD	Desired film position in resolver, revolutions plus degrees	±160		
VENDED	Desired film position in resolver, revolutions plus degrees	0, 360		
V662	Present film position in resolver, revolutions plus degrees parameter from equation V1553	Boolean		
V663	Present film position in resolver, revolutions plus degrees parameter from equation V1554	Boolean		
V660	Present film position in resolver, revolutions plus degrees parameter from equation V1555	Boolean		
V499	Present film position in resolver, revolutions plus degrees parameter from equation V1556	Boolean		
V659	Present film position in resolver, revolutions plus degrees parameter from equation V1557	Boolean		
VEFNE	Present film position in resolver, revolutions plus degrees parameter from equation V1558	1, 19		
VENF	Present film position in resolver, revolutions plus degrees parameter from equation V1559	±160		
VEDENF	Present film position in resolver, revolutions plus degrees parameter from equation V1560	0, 360		
VENFP	Present film position in resolver, revolutions plus degrees	±160		
VENDEP	Present film position in resolver, revolutions plus degrees	0, 360		
V668	Earth-orbital film drive parameter from equation V1563	Boolean		
VENDEA	Earth-orbital film drive parameter from equation V1564	0, 360		
VENFA	Earth-orbital film drive parameter from equation V1565	±160		
V670	Earth-orbital film drive parameter from equation V1566	Boolean		
V669	Earth-orbital film drive parameter from equation V1567	Boolean		
V666	Earth-orbital film drive parameter from equation V1568	Boolean		
VENFI	Earth-orbital film drive parameter from equation V1569	0, +160		
V667	Earth-orbital film drive parameter from equation V1570	Boolean		
VERHE	Earth-orbital film drive	±360		
V479	Pre-quick dissolve mirror logic parameter from equation V1592	Boolean		
V561	Pre-quick dissolve mirror logic parameter from equation V1593	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V562	Pre-quick dissolve mirror logic parameter from equation V1574	Boolean		
V563	Pre-quick dissolve mirror logic parameter from equation V1575	Boolean		
V564	Pre-quick dissolve mirror logic parameter from equation V1576	Boolean		
V565	Pre-quick dissolve mirror logic parameter from equation V1577	Boolean		
V571	Pre-quick dissolve mirror logic parameter from equation V1578	Boolean		
V572	Pre-quick dissolve mirror logic parameter from equation V1579	Boolean		
V573	Pre-quick dissolve mirror logic parameter from equation V1580	Boolean		
V574	Pre-quick dissolve mirror logic parameter from equation V1581	Boolean		
V575	Pre-quick dissolve mirror logic parameter from equation V1582	Boolean		
V581	Pre-quick dissolve mirror logic parameter from equation V1583	Boolean		
V582	Pre-quick dissolve mirror logic parameter from equation V1584	Boolean		
V583	Pre-quick dissolve mirror logic parameter from equation V1585	Boolean		
V584	Pre-quick dissolve mirror logic parameter from equation V1586	Boolean		
V585	Pre-quick dissolve mirror logic parameter from equation V1587	Boolean		
V471	Pre-quick dissolve mirror logic parameter from equation V1588	Boolean		
V472	Pre-quick dissolve mirror logic parameter from equation V1589	Boolean		
V743	Pre-quick dissolve mirror logic parameter from equation V1590	Boolean		
V474	Pre-quick dissolve mirror logic parameter from equation V1591	Boolean		
V475	Pre-quick dissolve mirror logic parameter from equation V1592	Boolean		
V491	Pre-quick dissolve mirror logic	Boolean		
V492	Pre-quick dissolve mirror logic	Boolean		
V493	Pre-quick dissolve mirror logic	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V494	Pre-quick dissolve mirror logic	Boolean		
V495	Pre-quick dissolve mirror logic	Boolean		
V401	Quick dissolve mirror Boolean, window 1 display	Boolean		
V402	Quick dissolve mirror Boolean, window 2 display	Boolean		
V403	Quick dissolve mirror Boolean, window 4 display	Boolean		
V404	Quick dissolve mirror Boolean, window 5 display	Boolean		
V405	Quick dissolve mirror Boolean, telescope display	Boolean		
V407	Boolean defined by equation V1503	Boolean		
VEEEMV11	Earth-moon illumination varifocal drive signal (turret 1), window 1 display	-10, 10 volts		
VEEEMV21	Earth-moon illumination varifocal drive signal (turret 1), window 2 display	-10, 10 volts		
VEEEMV31	Earth-moon illumination varifocal drive signal (turret 1), window 4 display	-10, 10 volts		
VEEEMV41	Earth-moon illumination varifocal drive signal (turret 1), window 5 display	-10, 10 volts		
VEEEMV51	Earth-moon illumination varifocal drive signal (turret 1), telescope display	-10, 10 volts		
VEEEMV12	Earth-moon illumination varifocal drive signal (turret 2), window 1 display	-10, 10 volts		
VEEEMV22	Earth-moon illumination varifocal drive signal (turret 2), window 2 display	-10, 10 volts		
VEEEMV32	Earth-moon illumination varifocal drive signal (turret 2), window 4 display	-10, 10 volts		
VEEEMV42	Earth-moon illumination varifocal drive signal (turret 2), window 5 display	-10, 10 volts		
VEEEMV52	Earth-moon illumination varifocal drive signal (turret 2), telescope display	-10, 10 volts		
V412	E/M illumination varifocal normal drive Boolean (j = 2), window 1 display	Boolean		
V422	E/M illumination varifocal normal drive Boolean (j = 2), window 2 display	Boolean		
V432	E/M illumination varifocal normal drive Boolean (j = 2), window 4 display	Boolean		
V442	E/M illumination varifocal normal drive Boolean (j = 2), window 5 display	Boolean		
V452	E/M illumination varifocal normal drive Boolean (j = 2), telescope display	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V414	E/M illumination varifocal normal drive Boolean (j = 4), window 1 display	Boolean		
V424	E/M illumination varifocal normal drive Boolean (j = 4), window 2 display	Boolean		
V434	E/M illumination varifocal normal drive Boolean (j = 4), window 4 display	Boolean		
V444	E/M illumination varifocal normal drive Boolean (j = 4), window 5 display	Boolean		
V454	E/M illumination varifocal normal drive Boolean (j = 4), telescope display	Boolean		
V420	Boolean defined by equation V1545	Boolean		
VEEOFA11	Orbital film Angenieux lens, drive signal (turret 1), window 1 display	-10, 10 volts		
VEEOFA21	Orbital film Angenieux lens, drive signal (turret 1), window 2 display	-10, 10 volts		
VEEOFA31	Orbital film Angenieux lens, drive signal (turret 1), window 4 display	-10, 10 volts		
VEEOFA41	Orbital film Angenieux lens, drive signal (turret 1), window 5 display	-10, 10 volts		
VEEOFA51	Orbital film Angenieux lens, drive signal (turret 1), telescope display	-10, 10 volts		
VEEOFA12	Orbital film Angenieux lens, drive signal (turret 2), window 1 display	-10, 10 volts		
VEEOFA22	Orbital film Angenieux lens, drive signal (turret 2), window 2 display	-10, 10 volts		
VEEOFA32	Orbital film Angenieux lens, drive signal (turret 2), window 4 display	-10, 10 volts		
VEEOFA42	Orbital film Angenieux lens, drive signal (turret 2), window 5 display	-10, 10 volts		
VEEOFA52	Orbital film Angenieux lens, drive signal (turret 2), telescope display	-10, 10 volts		
V512	Orbital film Angenieux lens, fast drive Boolean (j = 2), window 1 display	Boolean		
V522	Orbital film Angenieux lens, fast drive Boolean (j = 2), window 2 display	Boolean		
V532	Orbital film Angenieux lens, fast drive Boolean (j = 2), window 4 display	Boolean		
V542	Orbital film Angenieux lens, fast drive Boolean (j = 2), window 5 display	Boolean		
V552	Orbital film Angenieux lens, fast drive Boolean (j = 2), telescope display	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V514	Orbital film Angenieux lens, fast drive Boolean (j = 4), window 1 display	Boolean		
V524	Orbital film Angenieux lens, fast drive Boolean (j = 4), window 2 display	Boolean		
V534	Orbital film Angenieux lens, fast drive Boolean (j = 4), window 4 display	Boolean		
V544	Orbital film Angenieux lens, fast drive Boolean (j = 4), window 5 display	Boolean		
V554	Orbital film Angenieux lens, fast drive Boolean (j = 4), telescope display	Boolean		
V513	Orbital film Angenieux lens, normal drive Boolean (j = 3), window 1	Boolean		
V523	Orbital film Angenieux lens, normal drive Boolean (j = 3), window 2	Boolean		
V533	Orbital film Angenieux lens, normal drive Boolean (j = 3), window 4	Boolean		
V543	Orbital film Angenieux lens, normal drive Boolean (j = 3), window 5	Boolean		
V553	Orbital film Angenieux lens, normal drive Boolean (j = 3), telescope	Boolean		
V515	Orbital film Angenieux lens, normal drive Boolean (j = 5), window 1	Boolean		
V525	Orbital film Angenieux lens, normal drive Boolean (j = 5), window 2	Boolean		
V535	Orbital film Angenieux lens, normal drive Boolean (j = 5), window 4	Boolean		
V545	Orbital film Angenieux lens, normal drive Boolean (j = 5), window 5	Boolean		
V555	Orbital film Angenieux lens, normal drive Boolean (j = 5), telescope	Boolean		
VEEID1	Iris diaphragm drive signal, window 1 display	-10, 10 volts		
VEEID2	Iris diaphragm drive signal, window 2 display	-10, 10 volts		
VEEID3	Iris diaphragm drive signal, window 4 display	-10, 10 volts		
VEEID4	Iris diaphragm drive signal, window 5 display	-10, 10 volts		
VEEID5	Iris diaphragm drive signal, telescope display	-10, 10 volts		
VEYFPL	The limited value of Y_F'(function of h_{NM})	250, 500 N Mi		
V417	Boolean defined by equation V1661	Boolean		
V418	Boolean defined by equation V1662	Boolean		
VEYFPER	The actual off-course distance from film centerline	-250, 250 N Mi		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEDER	The extended range off-course servo displacement (from $Y_F' = 0$)	-1.1, 1.1 inches		
VEEER1	Extended range off-course drive signal, window 1 display	-10, 10 volts		
VEEER2	Extended range off-course drive signal, window 2 display	-10, 10 volts		
VEEER3	Extended range off-course drive signal, window 4 display	-10, 10 volts		
VEEER4	Extended range off-course drive signal, window 5 display	-10, 10 volts		
VEEER5	Extended range off-course drive signal, telescope display	-10, 10 volts		
V511	Extended range off-course fast drive Boolean, window 1 display	Boolean		
V521	Extended range off-course fast drive Boolean, window 2 display	Boolean		
V531	Extended range off-course fast drive Boolean, window 4 display	Boolean		
V541	Extended range off-course fast drive Boolean, window 5 display	Boolean		
V551	Extended range off-course fast drive Boolean, telescope display	Boolean		
VEDDNT	Day-night terminator time drive servo displacement	-2.13585, 2.13585 inches		
VEEDNT1	Day-night terminator time drive signal, window 1 display	-10, 10 volts		
VEEDNT2	Day-night terminator time drive signal, window 2 display	-10, 10 volts		
VEEDNT3	Day-night terminator time drive signal, window 4 display	-10, 10 volts		
VEEDNT4	Day-night terminator time drive signal, window 5 display	-10, 10 volts		
VEEDNT5	Day-night terminator time drive signal, telescope display	-10, 10 volts		
V516	Day-night terminator time fast drive Boolean, window 1 display	Boolean		
V526	Day-night terminator time fast drive Boolean, window 2 display	Boolean		
V536	Day-night terminator time fast drive Boolean, window 4 display	Boolean		
V546	Day-night terminator time fast drive Boolean, window 5 display	Boolean		
V556	Day-night terminator time fast drive Boolean, telescope display	Boolean		
V517	Day-night terminator time drive re-indexing Boolean, window 1 display	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V527	Day-night terminator time drive re-indexing Boolean, window 2 display	Boolean		
V537	Day-night terminator time drive re-indexing Boolean, window 4 display	Boolean		
V547	Day-night terminator time drive re-indexing Boolean, window 5 display	Boolean		
V557	Day-night terminator time drive re-indexing Boolean, SCT display	Boolean		
VEEDNA1	Day-night terminator angular position drive signal, window 1 display	-10, 10 volts		
VEEDNA2	Day-night terminator angular position drive signal, window 2 display	-10, 10 volts		
VEEDNA3	Day-night terminator angular position drive signal, window 4 display	-10, 10 volts		
VEEDNA4	Day-night terminator angular position drive signal, window 5 display	-10, 10 volts		
VEEDNA5	Day-night terminator angular position drive signal, SCT display	-10, 10 volts		
V505	1 if $t_{EBS} \leq 4.8$ sec	Boolean		
V506	1 if $(Y_T)_S \leq -1.067925$	Boolean		
VETEBS	Parameter defined by equation V1698	0, 10 seconds		
V507	1 if $V_{505} = V_{506} = 1$	Boolean		
V518		Boolean		
V528		Boolean		
V538		Boolean		
V548		Boolean		
V558		Boolean		
D501	Boolean denotes drogue chute deployment	Boolean		
V519	Earth blanking shutter solenoid drive logic	Boolean		
V529	Earth blanking shutter solenoid drive logic	Boolean		
V539	Earth blanking shutter solenoid drive logic	Boolean		
V549	Earth blanking shutter solenoid drive logic	Boolean		
V559	Earth blanking shutter solenoid drive logic	Boolean		
VEJ111I	Integrated image orientation direction cosine	±1		
VEJ121I	Integrated image orientation direction cosine	±1		
VEJ131I	Integrated image orientation direction cosine	±1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEJ211I	Integrated image orientation direction cosine	±1		
VEJ311I	Integrated image orientation direction cosine	±1		
VEJ112I	Integrated image orientation direction cosine	±1		
VEJ122I	Integrated image orientation direction cosine	±1		
VEJ132I	Integrated image orientation direction cosine	±1		
VEJ212I	Integrated image orientation direction cosine	±1		
VEJ312I	Integrated image orientation direction cosine	±1		
VEJ113I	Integrated image orientation direction cosine	±1		
VEJ123I	Integrated image orientation direction cosine	±1		
VEJ133I	Integrated image orientation direction cosine	±1		
VEJ213I	Integrated image orientation direction cosine	±1		
VEJ313I	Integrated image orientation direction cosine	±1		
VEJ114I	Integrated image orientation direction cosine	±1		
VEJ124I	Integrated image orientation direction cosine	±1		
VEJ134I	Integrated image orientation direction cosine	±1		
VEJ214I	Integrated image orientation direction cosine	±1		
VEJ314I	Integrated image orientation direction cosine	±1		
VEJ115I	Integrated image orientation direction cosine	±1		
VEJ125I	Integrated image orientation direction cosine	±1		
VEJ135I	Integrated image orientation direction cosine	±1		
VEJ215I	Integrated image orientation direction cosine	±1		
VEJ315I	Integrated image orientation direction cosine	±1		
VESTHSC1	MEP pitch scanning servo D/A signal, window 1	±1		
VECTHSC1	MEP pitch scanning servo D/A signal, window 1	±1		
VESTHSC2	MEP pitch scanning servo D/A signal, window 2	±1		
VECTHSC2	MEP pitch scanning servo D/A signal, window 2	±1		
VESTHSC3	MEP pitch scanning servo D/A signal, window 4	±1		
VECTHSC3	MEP pitch scanning servo D/A signal, window 4	±1		
VESTHSC4	MEP pitch scanning servo D/A signal, window 5	±1		
VECTHSC4	MEP pitch scanning servo D/A signal, window 5	±1		
V961	Boolean defined by equation V1743	Boolean		
V962	Boolean defined by equation V1744	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V963	Boolean defined by equation V1745	Boolean		
V964	Boolean defined by equation V1746	Boolean		
VESPSSC1	MEP yaw scanning servo D/A signal, window 1	-1, 1		
VECPSSC1	MEP yaw scanning servo D/A signal, window 1	-1, 1		
VESPSSC2	MEP yaw scanning servo D/A signal, window 2	-1, 1		
VECPSSC2	MEP yaw scanning servo D/A signal, window 2	-1, 1		
VESPSSC3	MEP yaw scanning servo D/A signal, window 4	-1, 1		
VECPSSC3	MEP yaw scanning servo D/A signal, window 4	-1, 1		
VESPSSC4	MEP yaw scanning servo D/A signal, window 5	-1, 1		
VECPSSC4	MEP yaw scanning servo D/A signal, window 5	-1, 1		
VESPHSD1	Parameter defined by equation V1755	-1, 1		
VECPHSD1	Parameter defined by equation V1756	-1, 1		
VESPHSD2	Parameter defined by equation V1757	-1, 1		
VECPHSD2	Parameter defined by equation V1758	-1, 1		
VESPHSD3	Parameter defined by equation V1759	-1, 1		
VECPHSD3	Parameter defined by equation V1760	-1, 1		
VESPHSD4	Parameter defined by equation V1761	-1, 1		
VECPHSD4	Parameter defined by equation V1762	-1, 1		
VESPHSC1	MEP roll scanning servo D/A signal, window 1	-1, 1		
VECPHSC1	MEP roll scanning servo D/A signal, window 1	-1, 1		
VESPHSC2	MEP roll scanning servo D/A signal, window 2	-1, 1		
VECPHSC2	MEP roll scanning servo D/A signal, window 2	-1, 1		
VESPHSC3	MEP roll scanning servo D/A signal, window 4	-1, 1		
VECPHSC3	MEP roll scanning servo D/A signal, window 4	-1, 1		
VESPHSC4	MEP roll scanning servo D/A signal, window 5	-1, 1		
VECPHSC4	MEP roll scanning servo D/A signal, window 5	-1, 1		
VECTHBC5	Parameter defined by equation V1771	0, 1		
VESTHSC5	Telescope MEP scanning servo D/A signal (PITCH)	-1, 1		
VECTHSC5	Telescope MEP scanning servo D/A signal (PITCH)	-1, 1		
V965	Boolean defined by equation V1774	Boolean		
VESPSSC5	Telescope MEP scanning servo D/A signal (YAW)	-1, 1		
VECPSSC5	Telescope MEP scanning servo D/A signal (YAW)	-1, 1		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VESPHSD5	Parameter defined by equation V1777	Boolean		
VECPHSD5	Parameter defined by equation V1778	Boolean		
VESPHSC5	Telescope MEP scanning servo D/A signal (ROLL)	-1, 1		
VECPHSC5	Telescope MEP scanning servo D/A signal (ROLL)			
VETHSF1	MEP PITCH scanning servo digital word output drive signal (fine angle), window 1 display	0, 360 deg		
VETHSF2	MEP PITCH scanning servo digital word output drive signal (fine angle), window 2 display	0, 360 deg		
VETHSF3	MEP PITCH scanning servo digital word output drive signal (fine angle), window 4 display	0, 360 deg		
VETHSF4	MEP PITCH scanning servo digital word output drive signal (fine angle), window 5 display	0, 360 deg		
VETHSF5	MEP PITCH scanning servo digital word output drive signal (fine angle), telescope display	0, 360 deg		
VEPSSF1	MEP YAW scanning servo digital word output drive signal (fine angle), window 1 display	0, 360 deg		
VEPSSF2	MEP YAW scanning servo digital word output drive signal (fine angle), window 2 display	0, 360 deg		
VEPSSF3	MEP YAW scanning servo digital word output drive signal (fine angle), window 4 display	0, 360 deg		
VEPSSF4	MEP YAW scanning servo digital word output drive signal (fine angle), window 5 display	0, 360 deg		
VEPSSF5	MEP YAW scanning servo digital word output drive signal (fine angle), telescope display	0, 360 deg		
VEPHSF1	MEP ROLL scanning servo digital word output drive signal (fine angle), window 1 display	0, 360 deg		
VEPHSF2	MEP ROLL scanning servo digital word output drive signal (fine angle), window 2 display	0, 360 deg		
VEPHSF3	MEP ROLL scanning servo digital word output drive signal (fine angle), window 4 display	0, 360 deg		
VEPHSF4	MEP ROLL scanning servo digital word output drive signal (fine angle), window 5 display	0, 360 deg		
VEPHSF5	MEP ROLL scanning servo digital word output drive signal (fine angle), telescope display	0, 360 deg		
VEMFN1	Moon-parachute film positioning parameter equation V1796	1, 33		
VEMFN2	Moon-parachute film positioning parameter equation V1797	1, 33		
VEMFN3	Moon-parachute film positioning parameter equation V1798	1, 33		
VEMFN4	Moon-parachute film positioning parameter equation V1799	1, 33		
VEMFN5	Moon-parachute film positioning parameter equation V1800	1, 33		
VEEOC11	Orbital film off-course drive signal, (turret 1), window 1 display	-10, 10 volts		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEEOC2i	Orbital film off-course drive signal, (turret 1), window 2 display	-10, 10 volts		
VEEOC31	Orbital film off-course drive signal, (turret 1), window 4 display	-10, 10 volts		
VEEOC41	Orbital film off-course drive signal, (turret 1), window 5 display	-10, 10 volts		
VEEOC51	Orbital film off-course drive signal, (turret 1), telescope display	-10, 10 volts		
VEEOC12	Orbital film off-course drive signal, (turret 2), window 1 display	-10, 10 volts		
VEEOC22	Orbital film off-course drive signal, (turret 2), window 2 display	-10, 10 volts		
VEEOC32	Orbital film off-course drive signal, (turret 2), window 4 display	-10, 10 volts		
VEEOC42	Orbital film off-course drive signal, (turret 2), window 5 display	-10, 10 volts		
VEEOC52	Orbital film off-course drive signal, (turret 2), telescope display	-10, 10 volts		
V611	Orbital film off-course fast drive Boolean, (j = 1), window 1 display	Boolean		
V621	Orbital film off-course fast drive Boolean, (j = 1), window 2 display	Boolean		
V631	Orbital film off-course fast drive Boolean, (j = 1), window 4 display	Boolean		
V641	Orbital film off-course fast drive Boolean, (j = 1), window 5 display	Boolean		
V651	Orbital film off-course fast drive Boolean, (j = 1), telescope display	Boolean		
V612	Orbital film off-course fast drive Boolean, (j = 2), window 1 display	Boolean		
V622	Orbital film off-course fast drive Boolean, (j = 2), window 2 display	Boolean		
V632	Orbital film off-course fast drive Boolean, (j = 2), window 4 display	Boolean		
V642	Orbital film off-course fast drive Boolean, (j = 2), window 5 display	Boolean		
V652	Orbital film off-course fast drive Boolean, (j = 2), telescope display	Boolean		
VETHO11A	Orbital film drive signal, (turret 1), window 1 display	0, 360 deg		
VETHO21A	Orbital film drive signal, (turret 1), window 2 display	0, 360 deg		
VETHO31A	Orbital film drive signal, (turret 1), window 4 display	0, 360 deg		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VETHO41A	Orbital film drive signal, (turret 1), window 5 display	0, 360 deg		
VETHO51A	Orbital film drive signal, (turret 1), telescope display	0, 360 deg		
VETHO12A	Orbital film drive signal, (turret 2), window 1 display	0, 360 deg		
VETHO22A	Orbital film drive signal, (turret 2), window 2 display	0, 360 deg		
VETHO32A	Orbital film drive signal, (turret 2), window 4 display	0, 360 deg		
VETHO42A	Orbital film drive signal, (turret 2), window 5 display	0, 360 deg		
VETHO52A	Orbital film drive signal, (turret 2), telescope display	0, 360 deg		
V613	Orbital film rapid reset Boolean, (j = 3), window 1 display	Boolean		
V623	Orbital film rapid reset Boolean, (j = 3), window 2 display	Boolean		
V633	Orbital film rapid reset Boolean, (j = 3), window 4 display	Boolean		
V643	Orbital film rapid reset Boolean, (j = 3), window 5 display	Boolean		
V653	Orbital film rapid reset Boolean, (j = 3), telescope display	Boolean		
V614	Orbital film rapid reset Boolean, (j = 4), window 1 display	Boolean		
V624	Orbital film rapid reset Boolean, (j = 4), window 2 display	Boolean		
V634	Orbital film rapid reset Boolean, (j = 4), window 4 display	Boolean		
V644	Orbital film rapid reset Boolean, (j = 4), window 5 display	Boolean		
V654	Orbital film rapid reset Boolean, (j = 4), telescope display	Boolean		
V615	Orbital film fast drive Boolean, (j = 5), window 1 display	Boolean		
V625	Orbital film fast drive Boolean, (j = 5), window 2 display	Boolean		
V635	Orbital film fast drive Boolean, (j = 5), window 4 display	Boolean		
V645	Orbital film fast drive Boolean, (j = 5), window 5 display	Boolean		
V655	Orbital film fast drive Boolean, (j = 5), telescope display	Boolean		
V616	Orbital film fast drive Boolean, (j = 6), window 1 display	Boolean		
V626	Orbital film fast drive Boolean, (j = 6), window 2 display	Boolean		
V636	Orbital film fast drive Boolean, (j = 6), window 4 display	Boolean		
V646	Orbital film fast drive Boolean, (j = 6), window 5 display	Boolean		
V656	Orbital film fast drive Boolean, (j = 6), telescope display	Boolean		
V617	Orbital film return to normal operation Boolean, (j = 7), window 1 display	Boolean		
V627	Orbital film return to normal operation Boolean, (j = 7), window 2 display	Boolean		
V637	Orbital film return to normal operation Boolean, (j = 7), window 4 display	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V647	Orbital film return to normal operation Boolean, (j = 7), window 5 display	Boolean		
V657	Orbital film return to normal operation Boolean, (j = 7), telescope display	Boolean		
V618	Orbital film return to normal operation Boolean, (j = 8), window 1 display	Boolean		
V628	Orbital film return to normal operation Boolean, (j = 8), window 2 display	Boolean		
V638	Orbital film return to normal operation Boolean, (j = 8), window 4 display	Boolean		
V648	Orbital film return to normal operation Boolean, (j = 8), window 5 display	Boolean		
V658	Orbital film return to normal operation Boolean, (j = 8), telescope display	Boolean		
V713	Turret indexing Boolean, (j = 3), window 1 display	Boolean		
V723	Turret indexing Boolean, (j = 3), window 2 display	Boolean		
V733	Turret indexing Boolean, (j = 3), window 4 display	Boolean		
V743	Turret indexing Boolean, (j = 3), window 5 display	Boolean		
V753	Turret indexing Boolean, (j = 3), telescope display	Boolean		
V714	Turret indexing Boolean, (j = 4), window 1 display	Boolean		
V724	Turret indexing Boolean, (j = 4), window 2 display	Boolean		
V734	Turret indexing Boolean, (j = 4), window 4 display	Boolean		
V744	Turret indexing Boolean, (j = 4), window 5 display	Boolean		
V754	Turret indexing Boolean, (j = 4), telescope display	Boolean		
V715	Turret indexing Boolean, (j = 5), window 1 display	Boolean		
V725	Turret indexing Boolean, (j = 5), window 2 display	Boolean		
V735	Turret indexing Boolean, (j = 5), window 4 display	Boolean		
V745	Turret indexing Boolean, (j = 5), window 5 display	Boolean		
V755	Turret indexing Boolean, (j = 5), telescope display	Boolean		
V716	Turret indexing Boolean, (j = 6), window 1 display	Boolean		
V726	Turret indexing Boolean, (j = 6), window 2 display	Boolean		
V736	Turret indexing Boolean, (j = 6), window 4 display	Boolean		
V746	Turret indexing Boolean, (j = 6), window 5 display	Boolean		
V756	Turret indexing Boolean, (j = 6), telescope display	Boolean		
V717	Spherical distortion lens insertion Boolean, (j = 7), window 1 display	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V727	Spherical distortion lens insertion Boolean, (j = 7), window 2 display	Boolean		
V737	Spherical distortion lens insertion Boolean, (j = 7), window 4 display	Boolean		
V747	Spherical distortion lens insertion Boolean, (j = 7), window 5 display	Boolean		
V757	Spherical distortion lens insertion Boolean, (j = 7), telescope display	Boolean		
V718	Spherical distortion lens insertion Boolean, (j = 8), window 1 display	Boolean		
V728	Spherical distortion lens insertion Boolean, (j = 8), window 2 display	Boolean		
V738	Spherical distortion lens insertion Boolean, (j = 8), window 4 display	Boolean		
V748	Spherical distortion lens insertion Boolean, (j = 8), window 5 display	Boolean		
V758	Spherical distortion lens insertion Boolean, (j = 8), telescope display	Boolean		
VEETV1	Transboundary illumination varifocal drive signal, window 1 display	-10, 10 volts		
VEETV2	Transboundary illumination varifocal drive signal, window 2 display	-10, 10 volts		
VEETV3	Transboundary illumination varifocal drive signal, window 4 display	-10, 10 volts		
VEETV4	Transboundary illumination varifocal drive signal, window 5 display	-10, 10 volts		
VEETV5	Transboundary illumination varifocal drive signal, telescope display	-10, 10 volts		
V810	Transboundary illumination varifocal fast drive, window 1 display	Boolean		
V820	Transboundary illumination varifocal fast drive, window 2 display	Boolean		
V830	Transboundary illumination varifocal fast drive, window 4 display	Boolean		
V840	Transboundary illumination varifocal fast drive, window 5 display	Boolean		
V850	Transboundary illumination varifocal fast drive, telescope display	Boolean		
V811	Transboundary illumination varifocal normal drive, window 1 display	Boolean		
V821	Transboundary illumination varifocal normal drive, window 2 display	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V831	Transboundary illumination varifocal normal drive, window 4 display	Boolean		
V841	Transboundary illumination varifocal normal drive, window 5 display	Boolean		
V851	Transboundary illumination varifocal normal drive, telescope display	Boolean		
VEVCCP	Peripheral area cloud cover velocity	20000, 30000 ft/sec		
VETHP	Peripheral area cassette orbital film drive dependent angle	0, 360 deg		
VESTHP1	Peripheral area cassette orbital drive signal, window 1 display	-1, 1		
VECTHP1	Peripheral area cassette orbital drive signal, window 1 display	-1, 1		
VESTHP2	Peripheral area cassette orbital drive signal, window 2 display	-1, 1		
VECTHP2	Peripheral area cassette orbital drive signal, window 2 display	-1, 1		
VESTHP3	Peripheral area cassette orbital drive signal, window 4 display	-1, 1		
VECTHP3	Peripheral area cassette orbital drive signal, window 4 display	-1, 1		
VESTHP4	Peripheral area cassette orbital drive signal, window 5 display	-1, 1		
VECTHP4	Peripheral area cassette orbital drive signal, window 5 display	-1, 1		
VESTHP5	Peripheral area cassette orbital drive signal, telescope display	-1, 1		
VECTHP5	Peripheral area cassette orbital drive signal, telescope display	-1, 1		
V812	Peripheral area cassette orbital film rapid reset, window 1 display	Boolean		
V822	Peripheral area cassette orbital film rapid reset, window 2 display	Boolean		
V832	Peripheral area cassette orbital film rapid reset, window 4 display	Boolean		
V842	Peripheral area cassette orbital film rapid reset, window 5 display	Boolean		
V852	Peripheral area cassette orbital film rpaid reset, telescope display	Boolean		
V813	Peripheral area cassette orbital film fast drive, window 1 display	Boolean		
V823	Peripheral area cassette orbital film fast drive, window 2 display	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V833	Peripheral area cassette orbital film fast drive, window 4 display	Boolean		
V843	Peripheral area cassette orbital film fast drive, window 5 display	Boolean		
V853	Peripheral area cassette orbital film fast drive, telescope display	Boolean		
V814	Peripheral area cassette orbital film return, window 1 display to normal operation Boolean	Boolean		
V824	Peripheral area cassette orbital film return, window 2 display to normal operation Boolean	Boolean		
V834	Peripheral area cassette orbital film return, window 4 display to normal operation Boolean	Boolean		
V844	Peripheral area cassette orbital film return, window 5 display to normal operation Boolean	Boolean		
V854	Peripheral area cassette orbital film return, telescope display to normal operation Boolean	Boolean		
VEPHPA	Peripheral area cassette angular drive	-1, 1 radians		
VEEPAA1	Peripheral area cassette angular position drive signal, window 1 display	-10, 10 volts		
VEEPAA2	Peripheral area cassette angular position drive signal, window 2 display	-10, 10 volts		
VEEPAA3	Peripheral area cassette angular position drive signal, window 4 display	-10, 10 volts		
VEEPAA4	Peripheral area cassette angular position drive signal, window 5 display	-10, 10 volts		
VEEPAA5	Peripheral area cassette angular position drive signal, telescope drive	-10, 10 volts		
VEETAL1	Transboundary peripheral area Angenieux lens, window 1 display varifocal drive signal	-10, 10 volts		
VEETAL2	Transboundary peripheral area Angenieux lens, window 2 display varifocal drive signal	-10, 10 volts		
VEETAL3	Transboundary peripheral area Angenieux lens, window 4 display varifocal drive signal	-10, 10 volts		
VEETAL4	Transboundary peripheral area Angenieux lens, window 5 display varifocal drive signal	-10, 10 volts		
VEETAL5	Transboundary peripheral area Angenieux lens, telescope display varifocal drive signal	-10, 10 volts		
V815	Transboundary peripheral area Angenieux lens, window 1 display fast drive Boolean	Boolean		
V825	Transboundary peripheral area Angenieux lens, window 2 display fast drive Boolean	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V835	Transboundary peripheral area Angenieux lens, window 4 display fast drive Boolean	Boolean		
V845	Transboundary peripheral area Angenieux lens, window 5 display fast drive Boolean	Boolean		
V855	Transboundary peripheral area Angenieux lens, telescope display fast drive Boolean	Boolean		
V816	Transboundary peripheral area Angenieux lens, window 1 display normal operation Boolean	Boolean		
V826	Transboundary peripheral area Angenieux lens, window 2 display normal operation Boolean	Boolean		
V836	Transboundary peripheral area Angenieux lens, window 4 display normal operation Boolean	Boolean		
V846	Transboundary peripheral area Angenieux lens, window 5 display normal operation Boolean	Boolean		
V856	Transboundary peripheral area Angenieux lens, telescope display normal operation Boolean	Boolean		
V800	Boolean defined by equation V1848	Boolean		
V801	Boolean defined by equation V1849	Boolean		
VETSA	The time associated with sunrise annuli real-time clock	0, 30 sec		
V817	Sunrise annuli drive Boolean, window 1 display	Boolean		
V827	Sunrise annuli drive Boolean, window 2 display	Boolean		
V837	Sunrise annuli drive Boolean, window 4 display	Boolean		
V847	Sunrise annuli drive Boolean, window 5 display	Boolean		
V857	Sunrise annuli drive Boolean, telescope display	Boolean		
VEEHMV1	Horizon mask varifocal drive signal, window 1 display	-10, 10 volts		
VEEHMV2	Horizon mask varifocal drive signal, window 2 display	-10, 10 volts		
VEEHMV3	Horizon mask varifocal drive signal, window 4 display	-10, 10 volts		
VEEHMV4	Horizon mask varifocal drive signal, window 5 display	-10, 10 volts		
VEEHMV5	Horizon mask varifocal drive signal, telescope display	-10, 10 volts		
V818	Horizon mask varifocal fast drive Boolean, window 1 display	Boolean		
V828	Horizon mask varifocal fast drive Boolean, window 2 display	Boolean		
V838	Horizon mask varifocal fast drive Boolean, window 4 display	Boolean		
V848	Horizon mask varifocal fast drive Boolean, window 5 display	Boolean		
V858	Horizon mask varifocal fast drive Boolean, telescope display	Boolean		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V819	Horizon mask varifocal normal drive Boolean, window 1 display	Boolean		
V829	Horizon mask varifocal normal drive Boolean, window 2 display	Boolean		
V839	Horizon mask varifocal normal drive Boolean, window 3 display	Boolean		
V849	Horizon mask varifocal normal drive Boolean, window 4 display	Boolean		
V859	Horizon mask varifocal normal drive Boolean, window 5 display	Boolean		
V910	Peripheral area scene blanking Boolean, window 1 display	Boolean		
V920	Peripheral area scene blanking Boolean, window 2 display	Boolean		
V930	Peripheral area scene blanking Boolean, window 4 display	Boolean		
V940	Peripheral area scene blanking Boolean, window 5 display	Boolean		
V950	Peripheral area scene blanking Boolean, telescope display	Boolean		
V917	Mission film lamp 1/2-power signal Boolean, window 1 display	Boolean		
V927	Mission film lamp 1/2-power signal Boolean, window 2 display	Boolean		
V937	Mission film lamp 1/2-power signal Boolean, window 4 display	Boolean		
V947	Mission film lamp 1/2-power signal Boolean, window 5 display	Boolean		
V957	Mission film lamp 1/2-power signal Boolean, telescope display	Boolean		
V918	Transboundary lamp 1/2 power signal Boolean, window 1 display	Boolean		
V928	Transboundary lamp 1/2 power signal Boolean, window 2 display	Boolean		
V938	Transboundary lamp 1/2 power signal Boolean, window 4 display	Boolean		
V948	Transboundary lamp 1/2 power signal Boolean, window 5 display	Boolean		
V958	Transboundary lamp 1/2 power signal Boolean, telescope display	Boolean		
V919	Solar lamp 1/2-power signal Boolean, window 1 display	Boolean		
V929	Solar lamp 1/2-power signal Boolean, window 2 display	Boolean		
V939	Solar lamp 1/2-power signal Boolean, window 4 display	Boolean		
V949	Solar lamp 1/2-power signal Boolean, window 5 display	Boolean		
VELAR	Orbital longitudinal true position	-180, 180 deg		

Table 6-13. Visual Displays — Mission Effects Projector Drive Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V999	1 if $\lambda_r \geq -49°$	Boolean		
VEFNM	Mark film number	Boolean		
VETHDP	Desired angle for positioning moon and parachute	0, +2200		
VEDEL	Moon parachute film positioning (transearth and transmoon drive)	±2200		
V998	Moon parachute film positioning (transearth and transmoon drive)	±2200		
V997	Moon parachute film positioning (transearth and transmoon drive)	±2200		
VERHFA	Moon parachute film positioning (transearth and transmoon drive)	±2200		
VERHF1	Moon parachute film positioning (transearth and transmoon drive)	±2200		
VERHF2	Moon parachute film positioning (transearth and transmoon drive)	±2200		
VERHF3	Moon parachute film positioning (transearth and transmoon drive)	±2200		
VERHF4	Moon parachute film positioning (transearth and transmoon drive)	±2200		
VERHF5	Moon parachute film positioning (transearth and transmoon drive)	±2200		

Table 6-14. Visual Displays-Sun Image Projector

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEBB	X B-frame component of a unit vector from earth to sun	-1, 1		
VECB	Y B-frame component of a unit vector from earth to sun	-1, 1		
VEDB	Z B-frame component of a unit vector from earth to sun	-1, 1		
VEBW1	X W_1-frame component of a unit vector from earth to sun	-1, 1		
VECW1	Y W_1-frame component of a unit vector from earth to sun	-1, 1		
VEDW1	Z W_1-frame component of a unit vector from earth to sun	-1, 1		
VEBW2	X W_2-frame component of a unit vector from earth to sun	-1, 1		
VECW2	Y W_2-frame component of a unit vector from earth to sun	-1, 1		
VEDW2	Z W_2-frame component of a unit vector from earth to sun	-1, 1		
VEBW3	X W_3-frame component of a unit vector from earth to sun	-1, 1		
VECW3	Y W_3-frame component of a unit vector from earth to sun	-1, 1		
VEDW3	Z W_3-frame component of a unit vector from earth to sun	-1, 1		
VEBW4	X W_4-frame component of a unit vector from earth to sun	-1, 1		
VECW4	Y W_4-frame component of a unit vector from earth to sun	-1, 1		
VEDW4	Z W_4-frame component of a unit vector from earth to sun	-1, 1		
V210	Sun shafting servo turn-on Boolean	Boolean		
V220	Sun shafting servo turn-on Boolean	Boolean		
V230	Sun shafting servo turn-on Boolean	Boolean		
V240	Sun shafting servo turn-on Boolean	Boolean		
VEBW1P	Sun image servo signal parameter defined by equation 520	0.6453, 2.6453		
VEBW2P	Sun image servo signal parameter defined by equation 521	0.6453, 2.6453		
VEBW3P	Sun image servo signal parameter defined by equation 522	0.6453, 2.6453		
VEBW4P	Sun image servo signal parameter defined by equation 523	0.6453, 2.6453		
VECW1P	Sun image servo signal parameter defined by equation 524	-0.27982, 1.72018		
VECW2P	Sun image servo signal parameter defined by equation 525	-0.27982, 1.72018		
VECW3P	Sun image servo signal parameter defined by equation 526	-0.27982, 1.72018		
VECW4P	Sun image servo signal parameter defined by equation 527	-0.27982, 1.72018		
VERPS1	Sun image servo signal parameter defined by equation 528	30.15467, 37.92908 inches		
VERPS2	Sun image servo signal parameter defined by equation 529	30.15467, 37.92908 inches		
VERPS3	Sun image servo signal parameter defined by equation 530	30.15467, 37.92908 inches		
VERPS4	Sun image servo signal parameter defined by equation 531	30.15467, 37.92908 inches		

Table 6-14. Visual Displays-Sun Image Projector (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VEMPS1	Sun image focus parameter	5.36068, 5.60650 inches		
VEMPS2	Sun image focus parameter	5.36068, 5.60650 inches		
VEMPS3	Sun image focus parameter	5.36068, 5.60650 inches		
VEMPS4	Sun image focus parameter	5.36068, 5.60650 inches		
VETALPS1	Trigonometric function of α_{PS}^{1}	-0.04200, 0.69500		
VETALPS2	Trigonometric function of α_{PS}^{2}	-0.04200, 0.69500		
VETALPS3	Trigonometric function of α_{PS}^{3}	-0.04200, 0.69500		
VETALPS4	Trigonometric function of α_{PS}^{4}	0.04200, 0.69500		
VETBEPS1	Trigonometric function of β_{PS}^{1}	-0.35220, 0.35220		
VETBEPS2	Trigonometric function of β_{PS}^{2}	-0.35220, 0.35220		
VETBEPS3	Trigonometric function of β_{PS}^{3}	-0.35220, 0.35220		
VETBEPS4	Trigonometric function of β_{PS}^{3}	-0.35220, 0.35220		
VENUPS1	Solar blanking shutter parameter	-1, 1		
VENUPS2	Solar blanking shutter parameter	-1, 1		
VENUPS3	Solar blanking shutter parameter	-1, 1		
VENUPS4	Solar blanking shutter parameter	-1, 1		
VEZEPS1	Solar blanking shutter parameter	-1, 1		
VEZEPS2	Solar blanking shutter parameter	-1, 1		
VEZEPS3	Solar blanking shutter parameter	-1, 1		
VEZEPS4	Solar blanking shutter parameter	-1, 1		
VEEMPS1	Sun image focus-drive signal voltage	-10, 10 volts		
VEEMPS2	Sun image focus-drive signal voltage	-10, 10 volts		
VEEMPS3	Sun image focus-drive signal voltage	-10, 10 volts		
VEEMPS4	Sun image focus-drive signal voltage	-10, 10 volts		
VEEALPS1	Scanning mirror pitch angle-drive signal voltage	-10, 10 volts		
VEEALPS2	Scanning mirror pitch angle-drive signal voltage	-10, 10 volts		
VEEALPS3	Scanning mirror pitch angle-drive signal voltage	-10, 10 volts		
VEEALPS4	Scanning mirror pitch angle-drive signal voltage	-10, 10 volts		
VEEBEPS1	Scanning mirror yaw angle-drive signal voltage	-10, 10 volts		
VEEBEPS2	Scanning mirror yaw angle-drive signal voltage	-10, 10 volts		
VEEBEPS3	Scanning mirror yaw angle-drive signal voltage	-10, 10 volts		
VEEBEPS4	Scanning mirror yaw angle-drive signal voltage	-10, 10 volts		

Table 6-14. Visual Displays-Sun Image Projector (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V212	Boolean defined by equation 564	Boolean		
V242	Boolean defined by equation 565	Boolean		
V213	Boolean defined by equation 566	Boolean		
V243	Boolean defined by equation 567	Boolean		
V211	Solar blanking shutter	Boolean		
V241	Solar blanking shutter	Boolean		
V222	Boolean defined by equation 570	Boolean		
V232	Boolean defined by equation 571	Boolean		
V223	Boolean defined by equation 572	Boolean		
V233	Boolean defined by equation 574	Boolean		
V221	Solar blanking shutter Boolean	Boolean		
V231	Solar blanking shutter Boolean	Boolean		

Table 6-15. Visual Displays — Occultation Mask

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VFEDO1EM	Window 1 occultation mask earth diameter signals	-10, 10 volts		
VFEDO2EM	Window 2 occultation mask earth diameter signals	-10, 10 volts		
VFEDO3EM	Window 4 occultation mask earth diameter signals	-10, 10 volts		
VFEDO4EM	Window 5 occultation mask earth diameter signals	-10, 10 volts		
VFEDO5EM	SCT occultation mask earth diameter signals	-10, 10 volts		
VFXBEM	X B-frame coordinate of earth position	-2275000, 2275000 ft		
VFYBEM	Y B-frame coordinate of earth position	-2275000, 2275000 ft		
VFZBEM	Z B-frame coordinate of earth position	-2275000, 2275000 ft		
VFXW1EM	X-window coordinate of earth position	-22750000, 22750000 ft		
VFYW1EM	Y-window coordinate of earth position	-22750000, 22750000 ft		
VFZW1EM	Z-window coordinate of earth position	-22750000, 22750000 ft		
VFXW2EM	X-window coordinate of earth position	-22750000, 22750000 ft		
VFYW2EM	Y-window coordinate of earth position	-22750000, 22750000 ft		
VFZW2EM	Z-window coordinate of earth position	-22750000, 22750000 ft		
VFXW3EM	X-window coordinate of earth position	-22750000, 22750000 ft		
VFYW3EM	Y-window coordinate of earth position	-22750000, 22750000 ft		
VFZW3EM	Z-window coordinate of earth position	-22750000, 22750000 ft		
VFXW4EM	X-window coordinate of earth position	-22750000, 22750000 ft		
VFYW4EM	Y-window coordinate of earth position	-22750000, 22750000 ft		
VFZW4EM	Z-window coordinate of earth position	-22750000, 22750000 ft		
VFXW5EM	X-window coordinate of earth position	-22750000, 22750000 ft		
VFYW5EM	Y-window coordinate of earth position	-22750000, 22750000 ft		
VFZW5EM	Z-window coordinate of earth position	-22750000, 22750000 ft		

Table 6-15. Visual Displays — Occultation Mask (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VFXOM1EM	X-mask coordinate of earth position	-22750000, 22750000 ft		
VFYOM1EM	Y-mask coordinate of earth position	-22750000, 22750000 ft		
VFZOM1EM	Z-mask coordinate of earth position	-22750000, 22750000 ft		
VFXOM2EM	X-mask coordinate of earth position	-22750000, 22750000 ft		
VFYOM2EM	Y-mask coordinate of earth position	-22750000, 22750000 ft		
VFZOM2EM	Z-mask coordinate of earth position	-22750000, 22750000 ft		
VFXOM3EM	X-mask coordinate of earth position	-22750000, 22750000 ft		
VFYOM3EM	Y-mask coordinate of earth position	-22750000, 22750000 ft		
VFZOM3EM	Z-mask coordinate of earth position	-22750000, 22750000 ft		
VFXOM4EM	X-mask coordinate of earth position	-22750000, 22750000 ft		
VFYOM4EM	Y-mask coordinate of earth position	-22750000, 22750000 ft		
VFZOM4EM	Z-mask coordinate of earth position	-22750000, 22750000 ft		
VFXOM5EM	X-mask coordinate of earth position	-22750000, 22750000 ft		
VFYOM5EM	Y-mask coordinate of earth position	-22750000, 22750000 ft		
VFZOM5EM	Z-mask coordinate of earth position	-22750000, 22750000 ft		
VFRO1EMP	Variable defined by equation 239	0, 22750000 ft		
VFRO2EMP	Variable defined by equation 240	0, 22750000 ft		
VFRO3EMP	Variable defined by equation 241	0, 22750000 ft		
VFRO4EMP	Variable defined by equation 242	0, 22750000 ft		
VFRO5EMP	Variable defined by equation 243	0, 22750000 ft		
VFROM1EM	Variable defined by equation 244	0, 22750000 ft		
VFROM2EM	Variable defined by equation 245	0, 22750000 ft		
VFROM3EM	Variable defined by equation 246	0, 22750000 ft		
VFROM4EM	Variable defined by equation 247	0, 22750000 ft		
VFROM5EM	Variable defined by equation 248	0, 22750000 ft		

Table 6-15. Visual Displays — Occultation Mask (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VFSBE1EM	The trigonometric function of $(\beta^1_{OM})_{E/M}$	0, 1		
VFCBE1EM	The trigonometric function of $(\beta^1_{OM})_{E/M}$	-1, 1		
VFSBE2EM	The trigonometric function of $(\beta^2_{OM})_{E/M}$	0, 1		
VFCBE2EM	The trigonometric function of $(\beta^2_{OM})_{E/M}$	-1, 1		
VFSBE3EM	The trigonometric function of $(\beta^3_{OM})_{E/M}$	0, 1		
VFCBE3EM	The trigonometric function of $(\beta^3_{OM})_{E/M}$	-1, 1		
VFSBE4EM	The trigonometric function of $(\beta^4_{OM})_{E/M}$	0, 1		
VFCBE4EM	The trigonometric function of $(\beta^4_{OM})_{E/M}$	-1, 1		
VFSBE5EM	The trigonometric function of $(\beta^5_{OM})_{E/M}$	0, 1		
VFCBE5EM	The trigonometric function of $(\beta^5_{OM})_{E/M}$	-1, 1		
V017	Boolean denoting that $(X^1_{OM})_{E/M}$ is non-negative	Boolean		
V027	Boolean denoting that $(X^2_{OM})_{E/M}$ is non-negative	Boolean		
V037	Boolean denoting that $(X^3_{OM})_{E/M}$ is non-negative	Boolean		
V047	Boolean denoting that $(X^4_{OM})_{E/M}$ is non-negative	Boolean		
V057	Boolean denoting that $(X^5_{OM})_{E/M}$ is non-negative	Boolean		
VFBOM1EM	Linear combination of SIN $(\beta^1_{OM})_{E/M}$ and $/\cos(\beta^1_{OM})_{E/M}/$	-7071068, 7071068		
VFBOM2EM	Linear combination of SIN $(\beta^2_{OM})_{E/M}$ and $/\cos(\beta^2_{OM})_{E/M}/$	-7071068, 7071068		
VFBOM3EM	Linear combination of SIN $(\beta^3_{OM})_{E/M}$ and $/\cos(\beta^3_{OM})_{E/M}/$	-7071068, 7071068		
VFBOM4EM	Linear combination of SIN $(\beta^4_{OM})_{E/M}$ and $/\cos(\beta^4_{OM})_{E/M}/$	-7071068, 7071068		
VFBOM5EM	Linear combination of SIN $(\beta^5_{OM})_{E/M}$ and $/\cos(\beta^5_{OM})_{E/M}/$	-7071068, 7071068		
VFBEO1EM	The angle between the optical axis of window 1 and the line from the spacecraft to the earth	0, π radians		
VFBEO2EM	The angle between the optical axis of window 2 and the line from the spacecraft to the earth	0, π radians		
VFBEO3EM	The angle between the optical axis of window 3 and the line from the spacecraft to the earth	0, π radians		

Table 6-15. Visual Displays — Occultation Mask (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VFBEO4EM	The angle between the optical axis of window 4 and the line from the spacecraft to the earth	0, π radians		
VFBEO5EM	The angle between the optical axis of window 5 and the line from the spacecraft to the earth	0, π radians		
V011	Boolean defined by equation 274	Boolean		
V021	Boolean defined by equation 275	Boolean		
V031	Boolean defined by equation 276	Boolean		
V041	Boolean defined by equation 277	Boolean		
V051	Boolean defined by equation 278	Boolean		
VFLYO1EM	Y-scaled mask coordinate of earth position	-5, 5 inches		
VFLZO1EM	Z-scaled mask coordinate of earth position	-5, 5 inches		
VFLYO2EM	Y-scaled mask coordinate of earth position	-5, 5 inches		
VFLZO2EM	Z-scaled mask coordinate of earth position	-5, 5 inches		
VFLYO3EM	Y-scaled mask coordinate of earth position	-5, 5 inches		
VFLZO3EM	Z-scaled mask coordinate of earth position	-5, 5 inches		
VFLYO4EM	Y-scaled mask coordinate of earth position	-5, 5 inches		
VFLZO4EM	Z-scaled mask coordinate of earth position	-5, 5 inches		
VFLYO5EM	Y-scaled mask coordinate of earth position	-5, 5 inches		
VFLZO5EM	Z-scaled mask coordinate of earth position	-5, 5 inches		
V014	Boolean defined by equation 289	Boolean		
V024	Boolean defined by equation 290	Boolean		
V034	Boolean defined by equation 291	Boolean		
V044	Boolean defined by equation 292	Boolean		
V054	Boolean defined by equation 293	Boolean		
V015	Boolean defined by equation 294	Boolean		
V025	Boolean defined by equation 295	Boolean		
V035	Boolean defined by equation 296	Boolean		
V045	Boolean defined by equation 297	Boolean		
V055	Boolean defined by equation 298	Boolean		
V016	Boolean defined by equation 299	Boolean		
V026	Boolean defined by equation 300	Boolean		
V036	Boolean defined by equation 301	Boolean		

Table 6-15. Visual Displays — Occultation Mask (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V046	Boolean defined by equation 302	Boolean		
V056	Boolean defined by equation 303	Boolean		
VFK11	Variable defined by equation 304	-1, 1 volts		
VFK12	Variable defined by equation 305	-1, 1 volts		
VFK13	Variable defined by equation 306	-1, 1 volts		
VFK14	Variable defined by equation 307	-1, 1		
VFK15	Variable defined by equation 308	-1, 1		
VFK21	Variable defined by equation 309	-1, 1		
VFK22	Variable defined by equation 310	-1, 1		
VFK23	Variable defined by equation 311	-1, 1		
VFK24	Variable defined by equation 312	-1, 1		
VFK25	Variable defined by equation 313	-1, 1		
V012	Variable defined by equation 314	Boolean		
V022	Variable defined by equation 315	Boolean		
V032	Variable defined by equation 316	Boolean		
V042	Variable defined by equation 317	Boolean		
V052	Variable defined by equation 318	Boolean		
VFEYO1EM	Y-occultation mask voltage	-10, 10 volts		
VFEZO1EM	Z-occultation mask voltage	-10, 10 volts		
VFEYO2EM	Y-occultation mask voltage	-10, 10 volts		
VFEZO2EM	Z-occultation mask voltage	-10, 10 volts		
VFEYO3EM	Y-occultation mask voltage	-10, 10 volts		
VFEZO3EM	Z-occultation mask voltage	-10, 10 volts		
VFEYO4EM	Y-occultation mask voltage	-10, 10 volts		
VFEZO4EM	Z-occultation mask voltage	-10, 10 volts		
VFEYO5EM	Y-occultation mask voltage	-10, 10 volts		
VFEZO5EM	Z-occultation mask voltage	-10, 10 volts		
V010	Earth diameter fast drive command Boolean	Boolean		
VFXB6TW	X CSM B-frame component transposition model to window position	-130000, 130000 ft		
VFYB6TW	Y CSM B-frame component transposition model to window position	-130000, 130000 ft		

Table 6-15. Visual Displays — Occultation Mask (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VFZB6TW	Z CSM B-frame component transposition model to window position	-130000, 130000 ft		
VFXB7TW	X CSM B-frame component transposition model to window position	-130000, 130000 ft		
VFYB7TW	Y CSM B-frame component transposition model to window position	-130000, 130000 ft		
VFZB7TW	Z CSM B-frame component transposition model to window position	-130000, 130000 ft		
VFRTW6	Variable defined by equation	0, 130000 ft		
VFEDOM6T	Voltage signal to the target vehicle (transposition model) occultation mask diameter servo	-10, 10 volts		
VFEDOM7T	Voltage signal to the target vehicle (transposition model) occultation mask diameter servo	-10, 10 volts		
VFXW6T	X-window component of transposition model to window position	-130000, 130000 ft		
VFYW6T	Y-window component of transposition model to window position	-130000, 130000 ft		
VFZW6T	Z-window component of transposition model to window position	-130000, 130000 ft		
VFXW7T	X-window component of transposition model to window position	-130000, 130000 ft		
VFYW7T	Y-window component of transposition model to window position	-130000, 130000 ft		
VFZW7T	Z-window component of transposition model to window position	-130000, 130000 ft		
VFXOM6T	X-mask coordinate of target position	-130000, 130000 ft		
VFYOM6T	Y-mask coordinate of target position	-130000, 130000 ft		
VFZOM6T	Z-mask coordinate of target position	-130000, 130000 ft		
VFXOM7T	X-mask coordinate of target position	-130000, 130000 ft		
VFYOM7T	Y-mask coordinate of target position	-130000, 130000 ft		
VFZOM7T	Z-mask coordinate of target position	-130000, 130000 ft		
VFRTW6P	Variable defined by equation	0, 130000 ft		
VFRTW7P	Variable defined by equation	0, 130000 ft		
VFSBEO6T	Trigonometric function of $(\beta^{6}_{OM})_T$	0, 1		
VFCBEO6T	Trigonometric function of $(\beta^{6}_{OM})_T$	-1, 1		
VFSBEO7T	Trigonometric function of $(\beta^{7}_{OM})_T$	0, 1		
VFCBEO7T	Trigonometric function of $(\beta^{7}_{OM})_T$	-1, 1		

Table 6-15. Visual Displays — Occultation Mask (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
VFBOM6T	Linear combination of SIN $(\beta^{6}_{OM})_T$ and $\lvert\cos(\beta^{6}_{OM})_T\rvert$	-7071068, 7071068		
VFBOM7T	Linear combination of SIN $(\beta^{7}_{OM})_T$ and $\lvert\cos(\beta^{7}_{OM})_T\rvert$	-7071068, 7071068		
V067	Boolean = 1 when $(X^{6}_{OM})_T \geq 0$	Boolean		
V077	Boolean = 1 when $(X^{7}_{OM})_T \geq 0$	Boolean		
VFBEOM6T	The angle between the optical axis of window 2 and the line from the S/C to the earth	0, π radians		
VFBEOM7T	The angle between the optical axis of window 4 and the line from the S/C to the earth	0, π radians		
V061	Boolean = 1 when $(\tau^{6}_{T/W})^{1} \geq .49591$	Boolean		
V071	Boolean = 1 when $(\tau^{7}_{T/W})^{1} \geq .49591$	Boolean		
VFLYOM6T	Y-scaled mask coordinate of target position	-5, 5 inches		
VFLZOM7T	Z-scaled mask coordinate of target position	-5, 5 inches		
VFLYOM7T	Y-scaled mask coordinate of target position	-5, 5 inches		
VFLZOM7T	Z-scaled mask coordinate of target position	-5, 5 inches		
V064	Boolean = 1 when $(\ell^{6}_{Y_{OM}})_T \geq 0$	Boolean		
V074	Boolean = 1 when $(\ell^{7}_{Y_{OM}})_T \geq 0$	Boolean		
V065	Boolean = 1 when $(\ell^{6}_{Z_{OM}})_T \geq 0$	Boolean		
V075	Boolean = 1 when $(\ell^{7}_{Z_{OM}})_T \geq 0$	Boolean		
V066	Boolean defined by equation V377	Boolean		
V076	Boolean defined by equation V378	Boolean		
VFK16	Variable defined by equation V379	-1, 1 volts		
VFK17	Variable defined by equation V380	-1, 1 volts		
VFK26	Variable defined by equation V381	-1, 1 volts		
VFK27	Variable defined by equation V382	-1, 1 volts		
V063	Boolean = 1 if $(\beta^{6}_{OM})_T < 2.3561945$ rad	Boolean		
V073	Boolean = 1 if $(\beta^{7}_{OM})_T < 2.3561945$ rad	Boolean		
V002	Bcolean = 1 $\tau^{6}_{T/W} \leq 400$ ft	Boolean		
D516	Boolean = 1 upon TPM separation	Boolean		

Table 6-15. Visual Displays — Occultation Mask (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
V062	Boolean defined by equation V386	Boolean		
V072	Boolean defined by equation V386	Boolean		
VFEYOM6T	Occultation mask position drive signals	-10, 10 volts		
VFEZOM6T	Occultation mask position drive signals	-10, 10 volts		
VFEYOM7T	Occultation mask position drive signals	-10, 10 volts		
VFEZOM7T	Occultation mask position drive signals	-10, 10 volts		
V060	Target vehicle diameter fast-drive command Boolean term	Boolean		

Table 6-16. Guidance and Navigation System — Inertial Measurement

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GSXTQ	Sin of angle through which outer gimbal is torqued	0, 1		
GCXTQ	Cos of angle through which outer gimbal is torqued	1, 0		
GSYTQ	Sin of angle through which inner gimbal is torqued	0, 1		
GCYTQ	Cos of angle through which inner gimbal is torqued	1, 0		
GSZTQ	Sin of angle through which middle gimbal is torqued	0, 1		
GCZTQ	Cos of angle through which middle gimbal is torqued	1, 0		
GN11P	Dir cos relating stable member before and after torque	-1, +1		
GN12P	Dir cos relating stable member before and after torque	-1, +1		
GN13P	Dir cos relating stable member before and after torque	-1, +1		
GN21P	Dir cos relating stable member before and after torque	-1, +1		
GN22P	Dir cos relating stable member before and after torque	-1, +1		
GN23P	Dir cos relating stable member before and after torque	-1, +1		
GN31P	Dir cos relating stable member before and after torque	-1, +1		
GN32P	Dir cos relating stable member before and after torque	-1, +1		
GN33P	Dir cos relating stable member before and after torque	-1, +1		
*P_b	B-frame ABS rotational vel vector proj on X-axis			
*q_b	B-frame ABS rotational vel vector proj on Y-axis			
*r_b	B-frame ABS rotational vel vector proj on Z-axis			
*C_{11}	Dir cos proj inertial frame cos body frame	-1, +1		
*C_{12}	Dir cos proj inertial frame cos body frame	-1, +1		
*C_{13}	Dir cos proj inertial frame cos body frame	-1, +1		
*C_{21}	Dir cos proj inertial frame cos body frame	-1, +1		
*C_{12}	Dir cos proj inertial frame cos body frame	-1, +1		
*C_{23}	Dir cos proj inertial frame cos body frame	-1, +1		
*C_{31}	Dir cos proj inertial frame cos body frame	-1, +1		
*C_{32}	Dir cos proj inertial frame cos body frame	-1, +1		
*C_{33}	Dir cos proj inertial frame cos body frame	-1, +1		
GSIG1XT	Trig functions of 1X gimbal resolvers - telemetry inputs	-1, +1	118(A)/118	
GCIG1XT	Trig functions of 1X gimbal resolvers - telemetry inputs	-1, +1	119(A)/119	
GSMG1XT	Trig functions of 1X gimbal resolvers - telemetry inputs	-1, +1	120(A)/120	
GCMG1XT	Trig functions of 1X gimbal resolvers - telemetry inputs	-1, +1	58(A)/58	

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-16. Guidance and Navigation System — Inertial Measurement (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GSOG1XT	Trig functions of 1X gimbal resolvers - telemetry inputs	-1, +1	125(A)/125	
GCOG1XT	Trig functions of 1X gimbal resolvers - telemetry inputs	-1, +1	128(A)/128	
GSE1GT	IMU servo error in phase - telemetry inputs	0, 6.0 degrees	8(A)/8	
GSEMGT	IMU servo error in phase - telemetry inputs	0, 6.0 degrees	9(A)/9	
GSEOGT	IMU servo error in phase - telemetry inputs	0, 6.0 degrees	10(A)/10	
GSEKPON	Servo error constant - 3200-cps power on (0.1 vac)			
GSEKPOFF	Servo error constant - 3200-cps power off (6.0 vac)			
GDIFIGAT	CDU 1X resolver error in phase - telemetry inputs	0, +180 degrees	129(A)/129	
GDIFMGAT	CDU 1X resolver error in phase - telemetry inputs	0, +180 degrees	168(A)/168	
GDIFOGAT	CDU 1X resolver error in phase - telemetry inputs	0, +180 degrees	169(A)/169	
GER11	Dir cos proj nav base frame on inertial frame	-1, +1		
GER12	Dir cos proj nav base frame on inertial frame	-1, +1		
GER13	Dir cos proj nav base frame on inertial frame	-1, +1		
GER21	Dir cos proj nav base frame on inertial frame	-1, +1		
GER22	Dir cos proj nav base frame on inertial frame	-1, +1		
GER23	Dir cos proj nav base frame on inertial frame	-1, +1		
GER31	Dir cos proj nav base frame on inertial frame	-1, +1		
GER32	Dir cos proj nav base frame on inertial frame	-1, +1		
GER33	Dir cos proj nav base frame on inertial frame	-1, +1		
GU11	Dir cos proj inertial frame on stable member	-1, +1		
GU12	Dir cos proj inertial frame on stable member	-1, +1		
GU13	Dir cos proj inertial frame on stable member	-1, +1		
GU21	Dir cos proj inertial frame on stable member	-1, +1		
GU22	Dir cos proj inertial frame on stable member	-1, +1		
GU23	Dir cos proj inertial frame on stable member	-1, +1		
GU31	Dir cos proj inertial frame on stable member	-1, +1		
GU32	Dir cos proj inertial frame on stable member	-1, +1		
GU33	Dir cos proj inertial frame on stable member	-1, +1		
GN11	Dir cos proj stable member on nav base frame	-1, +1		
GN12	Dir cos proj stable member on nav base frame	-1, +1		
GN13	Dir cos proj stable member on nav base frame	-1, +1		
GN21	Dir cos proj stable member on nav base frame	-1, +1		

Table 6-16. Guidance and Navigation System — Inertial Measurement (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GN22	Dir cos proj stable member on nav base frame	-1, +1		
GN23	Dir cos proj stable member on nav base frame	-1, +1		
GN31	Dir cos proj stable member on nav base frame	-1, +1		
GN32	Dir cos proj stable member on nav base frame	-1, +1		
GN33	Dir cos proj stable member on nav base frame	-1, +1		
GAMGA	Actual middle gimbal angle	±360 degrees		
GAIGA	Actual inner gimbal angle	±360 degrees		
GAOGA	Actual outer gimbal angle	±360 degrees		
GAXIMU	Normalized acceleration comp of X-stable member axis	-1, +1		
GAYIMU	Normalized acceleration comp of Y-stable member axis	-1, +1		
GAZIMU	Normalized acceleration comp of Z-stable member axis	-1, +1		
*$\ddot{X}_{IE}$	X acceleration component of S/C in inertial frame			
*$\ddot{Y}_{IE}$	Y acceleration component of S/C in inertial frame			
*$\ddot{Z}_{IE}$	Z acceleration component of S/C in inertial frame			
GTHDD	Outer gimbal angle dynamic error	$(4.802 \times 10^{-12})^{1/2}$ $(13.5716 \times 10^{-12})^{1/2}$ DEG/ITER		
GPHDD	Middle and inner gimbal angle dynamic error	$(4.802 \times 10^{-12})^{1/2}$ $(13.5716 \times 10^{-12})^{1/2}$ DEG/ITER		
GDELTYSP	Inner axis displacement at start of iteration	0, 180 degrees		
GDELTZSP	Middle axis displacement at start of iteration	0, 180 degrees		
GDELTXSP	Outer axis displacement at start of iteration	0, 180 degrees		
GTHDYS	Inner axis displacement velocity	0, 95.0 DEG/ITER		
GTHDZS	Middle axis displacement velocity	0, 44.1 DEG/ITER		
GTHDXS	Outer axis displacement velocity	0, 23.25 DEG/ITER		
GDELTHYS	Inner axis displacement at end of iteration	0, +180 degrees		
GDELTHZS	Middle axis displacement at end of iteration	0, +180 degrees		
GDELTHXS	Outer axis displacement at end of iteration	0, +180 degrees		
GYUPDATE	Inner axis displacement per iteration	±180 degrees		
GZUPDATE	Middle axis displacement per iteration	±180 degrees		
GXUPDATE	Outer axis displacement per iteration	±180 degrees		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-16. Guidance and Navigation System — Inertial Measurement (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GDELTHCY	Comm rot about Y_{SM}	±180.0 degrees		
GDELTHCZ	Comm rot about Z_{SM}	±180.0 degrees		
GDELTHCX	Comm rot about X_{SM}	±180.0 degrees		
GSINAIGA	Sin of A_{IG}	±1.0 degrees		
GCOSAIGA	Cos of A_{IG}	±1.0 degrees		
GSINAMGA	Sin of A_{MG}	±1.0 degrees		
GCOSAMGA	Cos of A_{MG}	±1.0 degrees		
GSINAOGA	Sin of A_{OG}	±1.0 degrees		
GCOSAOGA	Cos of A_{OG}	±1.0 degrees		
GDELTHY	Actual rot about Y_{SM} during fine align	±180 degrees		
GDELTHZ	Actual rot about Z_{SM} during fine align	±180 degrees		
GDELTHX	Actual rot about X_{SM} during fine align	±180 degrees		
GLA11	Dir cos proj stable member on inertial frame	±1		
GLA12	Dir cos proj stable member on inertial frame	±1		
GLA13	Dir cos proj stable member on inertial frame	±1		
GLA21	Dir cos proj stable member on inertial frame	±1		
GLA22	Dir cos proj stable member on inertial frame	±1		
GLA23	Dir cos proj stable member on inertial frame	±1		
GLA31	Dir cos proj stable member on inertial frame	±1		
GLA32	Dir cos proj stable member on inertial frame	±1		
GLA33	Dir cos proj stable member on inertial frame	±1		
GAIGE	Inner gimbal angle error	0, +360 degrees		
GAMGE	Middle gimbal angle error	-360, 0 degrees		
GAOGE	Outer gimbal angle error	±360 degrees		
GTHYTRQP	Angle thru which A_{IG} is actually torqued	±360 degrees		
GTHZTRQP	Angle thru which A_{MG} is actually torqued	±360 degrees		
GTHXTRQP	Angle thru which A_{OG} is actually torqued	±360 degrees		
GTHYTRQ	Sum of error plus act-angle through which A_{IG} torqued	±360 degrees		
GTHZTRQ	Sum of error plus act-angle through which A_{MG} torqued	±360 degrees		
GTHXTRQ	Sum of error plus act-angle through which A_{OG} toruqed	±360 degrees		
GDIFFIGA	Difference between A_{IG} and Y CDU	±180 degrees		

Table 6-16. Guidance and Navigation System — Inertial Measurement (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GDIFFMGA	Difference between A_{MG} and Z CDU	±180 degrees		
GDIFFOGA	Difference between A_{OG} and X CDU	±180 degrees		
GO11	Dir cos of angle between X_I and X_{SM} axes	-1, +1		
GO12	Dir cos of angle between X_I and Y_{SM} axes	-1, +1		
GO13	Dir cos of angle between X_I and Z_{SM} axes	-1, +1		
GO21	Dir cos of angle between Y_I and X_{SM} axes	-1, +1		
GO22	Dir cos of angle between Y_I and Y_{SM} axes	-1, +1		
GO23	Dir cos of angle between Y_I and Z_{SM} axes	-1, +1		
GO31	Dir cos of angle between Z_I and X_{SM} axes	-1, +1		
GO32	Dir cos of angle between Z_I and Y_{SM} axes	-1, +1		
GO33	Dir cos of angle between Z_I and Z_{SM} axes	-1, +1		
GACTRQX	Accumulated torque X-axis	0, 360 degrees		
GACTRQY	Accumulated torque Y-axis	0, 360 degrees		
GACTRQZ	Accumulated torque Z-axis	0, 360 degrees		
GCACTRQX	Cos accumulated torque X-axis	-1, +1		
GSACTRQX	Sin accumulated torque X-axis	1, 1		
GCACTRQY	Cos accumulated torque Y-axis	-1, +1		
GSACTRQY	Sin accumulated torque Y-axis	-1, +1		
GCACTRQZ	Cos accumulated torque Z-axis	-1, +1		
GSACTRQZ	Sin accumulated torque Z-axis	-1, +1		
GRAVT	Constant equal to 32.1740 4856			
GRPDRSQ	Constant equal to 4.802×10^{-12}			
GMUNBSQ	Constant equal to 4.32×10^{-12}			
GANESSQ	Constant equal to 0.0432×10^{-12}			
GDELPHS2	Constant equal to 269.1×10^{-6}			
GIGTK	Constant equal to 1.25			
GMGTK	Constant equal to 0.269			
GOGTK	Constant equal to 0.15			
GFATR	Constant equal to 0.05489342			
GZERO	Constant equal to 0.0			
GS33D	Constant equal to sine 33 degrees			
GC33D	Constant equal to cosine 33 degrees			

Table 6-16. Guidance and Navigation System — Inertial Measurement (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*G090	ACG on, powered, operating	Boolean		
*G301	Manual align pushbutton, 1 = pushed	Boolean		
*G326	Coarse align mode relay, 1 = energized	Boolean		
*G331	IMU time delay relay 1 = energized	Boolean		
*G328	Fine align mode relay 1 = energized	Boolean		
*G345	800-cps 1% power supply output, 0 = fail	Boolean		
*G370	800-cps 5% power supply output, 0 = fail	Boolean		
*G371	Middle gimbal servo error out of spec	Boolean		
*G372	Inner gimbal servo error out of spec	Boolean		
*G376	Flag, X-PIPA error signal out of spec	Boolean		
*G377	Flag, Y-PIPA error signal out of spec	Boolean		
*G378	Flag, Z-PIPA error signal out of spec	Boolean		
*G383	Flag for IMU temperature out of spec	Boolean		
*G385	IMU basic 28v power, 0 = fail	Boolean		
*G388	IMU 3200-cps power supply output 0 = fail	Boolean		
*G389	IMU 28v 800-cps power to gyro wheels, 0 = fail	Boolean		
*G392	Outer gimbal servo error out of spec	Boolean		
*G469	PIPA switching and interrogating pulses	Boolean		
*G580	Prelaunch mode = 1	Boolean		
*G650	Is Y ICDU coarse aligned? yes = 1	Boolean		
*G651	Is Z ICDU coarse aligned? yes = 1	Boolean		
*G656	1 if cos A_{MG} ≤ 0.00175	Boolean		
*G661	Does gaftimer = 90 seconds? yes = 1	Boolean		
*G662	Is Y_{SM} aligned? yes = 1	Boolean		
*G664	Is Z_{SM} aligned? yes = 1	Boolean		
*G667	Is X_{SM} aligned? yes = 1	Boolean		
*G669	0 if A_{MG} ≤ 0 degrees	Boolean		
*G674	Examine for coarse align mode, yes = 1	0, 1		
*G679	Examine for fine align mode, yes = 1	0, 1		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-16. Guidance and Navigation System — Inertial Measurement (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*G681	0 if (GYUPDATE) < |GDIFFIGA|	Boolean		
*G682	0 if (GZUPDATE) <| GIFFMGA|	Boolean		
*G683	0 if (GXUPDATE) <| GDIFFOGA|	Boolean		
*G684	1 if $\|\Delta\theta_{CY} - \Delta\theta_{Y}\| \leq 0.055$ degrees	Boolean		
*G689	1 if $\|\Delta\theta_{CZ} - \Delta\theta_{Z}\| \leq 0.055$ degrees	Boolean		
*G696	1 if $\|\Delta\theta_{CX} - \Delta\theta_{X}\| \leq 0.055$ degrees	Boolean		
*G697	1 if manual align and 800 cps 1% fail	Boolean		
*G751	Flag for IMU PIPAS sensing acceleration	Boolean		
*G830	40-second warmup for manual align, yes = 1	Boolean		
*G831	40-sec warmup for man. align or gactimer, yes = 1	Boolean		
*G832	40-sec warmup for man. align or gactimer, yes = 1	Boolean		
*G833	0 if gyro wheel fail or 800 cps 5% fail	Boolean		
*MG053	Failure of PIPA heater supply voltage	Malfunction		
*AXDDB	Acceleration applied along X-body axis	ft/sec^2		
*AYDDB	Acceleration applied along Y-body axis	ft/sec^2		
*AZDDB	Acceleration applied along Z-body axis	ft/sec^2		
GB2SM11	Transformation, body to stable, element (1, 1)	±1		
GB2SM12	Transformation, body to stable, element (1, 2)	±1		
GB2SM13	Transformation, body to stable, element (1, 3)	±1		
GB2SM21	Transformation, body to stable, element (2, 1)	±1		
GB2SM22	Transformation, body to stable, element (2, 2)	±1		
GB2SM23	Transformation, body to stable, element (2, 3)	±1		
GB2SM31	Transformation, body to stable, element (3, 1)	±1		
GB2SM32	Transformation, body to stable, element (3, 2)	±1		
GB2SM33	Transformation, body to stable, element (3, 3)	±1		
GDELTAVX	Change in velocity sensed by X-accelerometer	±644 ft/sec		
GDELTAVY	Change in velocity sensed by Y-accelerometer	±644 ft/sec		
GDELTAVZ	Change in velocity sensed by Z-accelerometer	±644 ft/sec		
GOVT1	Special output register in AGC	Special		
GPIPAX	X-axis PIPA counters in AGC	±16383 pulses		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-16. Guidance and Navigation System — Inertial Measurement (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GPIPAY	Y-axis PIPA counters in AGC	±16383 pulses		
GPIPAZ	Z-axis PIPA counters in AGC	±16383 pulses		
GPIPASF	Actual scale factor, PIPA	0.5511744, 0.30642672 ft/sec/pulse		
GPIPASFC	Commanded scale factor, PIPA	ft/sec/pulse		
GPULSEX	X-axis PIPA output pulses			
GPULSEY	Y-axis PIPA output pulses			
GPULSEZ	Z-axis PIPA output pulses			
GRANDNUM	Random number, magnitude between 1/2 and 1	±1		
GSMAX	Acceleration sensed by X-accelerometer			
GSMAY	Acceleration sensed by Y-accelerometer			
GSMAZ	Acceleration sensed by Z-accelerometer			
GXACC	X-axis incremental accelerations, in AGC			
GYACC	Y-axis incremental accelerations, in AGC			
GZACC	Z-axis incremental accelerations, in AGC			
GPIPBIAS	PIPA factor for bias	Constant		
GPIDRIF	PIPA scale factor error, coefficient	Constant		
GPIPTEMP	PIPA scale factor temp dependent coefficient	Constant		
GPIPMAYE	Constant PIPA max error	Constant		

Table 6-17. Guidance and Navigation System - IMU Temperature Control

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GB1FACA	Temp factor to determine operating point	0, 64.9°F		
GB1FACB	Temp factor to determine operating point	0, 65.0°F		
GB1FACC	Temp factor to determine operating point	0, 85.0°F		
GB1FACD	Temp factor to determine operating point	0, 84.9°F		
GQ7	Outer gimbal electronics dissipation	0, 20 watts		
GQININST	Instantaneous input power	0, 104.732 watts		
GCACT	Heat transfer factor	0.211, 1.20 watts °F		
GQINACT	Actual input power	0, 104.732 watts		
GQOUTPER	Max permissible heat transfer to coolant	18.99, 186.0 watts		
GQOUTACT	Heat into coolant	0, 104.732 watts		
GQIMUCP	Heat into coolant	0, 945.0 inch/ pounds/sec		
GTRISE	Temperature rise factor	0, 104.732		
GTFALL	Temperature fall factor	0, 19.0		
GB1INST	Instantaneous IRIG temperature	50, 200°F		
GB1ACT	Actual IRIG temperature	50, 200°F		
GB1	Readout IRIG temperature	50, 200°F		
GB4INST	Instantaneous PIPA temperature	50, 200°F		
GB4ACT	Actual PIPA temperature	50, 200°F		
GB4	Readout PIPA temperature	50, 200°F		
FTOIMUG	Average coolant temp in IMU	504, 570°R		
G385	Operate +28 volts dc applied = 1	Boolean		
G386	Standby +28 volts dc applied = 1	Boolean		
G395	IMU temp mode bit 1	Boolean		
G384	IMU temp mode bit 2	Boolean		
G316	IMU temp gain - PIPA, button pressed = 1	Boolean		
G317	IMU temp gain - IRIG, button pressed = 1	Boolean		
G314	IMU temp zero check, button pressed = 1	Boolean		
G383	IMU temperature out of limits = 1	Boolean		
G389	Gyro wheel rotating = 1	Boolean		
G751	PIPA sensing acceleration = 1	Boolean		
G758	Stable member thermostat, closed = 1	Boolean		
G759	Emer htr mercury switch, closed = 1	Boolean		
G770	Relay K2, energized position = 1	Boolean		
G771	Proportional, or backup mode = 1	Boolean		
G772	Emergency mode = 1	Boolean		

Table 6-17. Guidance and Navigation System - IMU Temperature Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G777	Either transistor shorted when corresponding mode selected = 1	Boolean		
G778	Either transistor opened when corresponding mode selected = 1	Boolean		
G779	Any combination of conditions turning blowers off = 1	Boolean		
G780	Any combination of conditions turning blowers on full = 1	Boolean		
G781	Inner gimbal torqued = 1	Boolean		
G782	Middle gimbal torqued = 1	Boolean		
G783	Outer gimbal torqued = 1	Boolean		
G788	If stable member temp < 144°F = 1	Boolean		
G789	If stable member temp < 156°F = 1	Boolean		
G790	If IRIG temperature >138°F = 1	Boolean		
G791	If IRIG temperature >132°F = 1	Boolean		
G792	If IRIG temperature >134.95°F = 1	Boolean		
G793	If IRIG temperature >130.0°F = 1	Boolean		
G794	If IRIG temperature < 140°F = 1	Boolean		
G795	If IRIG temperature >134°F = 1	Boolean		
G796	If IRIG temperature < 136°F = 1	Boolean		
G797	Heaters (excepting fixed htr) operating = 1	Boolean		
MG051	Fuse of IMU blower 1, fuse blown = 1	Malfunction		
MG052	Fuse of IMU blower 2, fuse blown = 1	Malfunction		
MG053	+28-volt regulator for fixed PIPA htr, fail = 1	Malfunction		
MG054	Pwr transistor Q1, opened = 1	Malfunction		
MG055	Pwr transistor Q1, shorted = 1	Malfunction		
MG056	Pwr transistor Q2, opened = 1	Malfunction		
MG057	Pwr transistor Q2, shorted = 1	Malfunction		
MG060	Mag amp pwr supply fail = 1	Malfunction		
MG061	Relay K1 hung in energized position = 1	Malfunction		
MG062	Relay K2 coil opened = 1	Malfunction		
MG063	Relay K2 hung in energized position = 1	Malfunction		
MG027	Relay K1 coil opened = 1	Malfunction		
GZERO	Integer constant equal to 0			
GONE	Integer constant equal to 1			
GFOUR	Integer constant equal to 4			

Table 6-17. Guidance and Navigation System - IMU Temperature Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GFIVE	Integer constant equal to 5			
GTEN	Integer constant equal to 10			
GHUND	Integer constant equal to 100			
G1P5	Constant equal to 1.50			
G7P5	Constant equal to 7.50			
G8P6	Constant equal to 8.60			
GH30	Constant equal to 130.00			
GH32	Constant equal to 132.00			
GH34	Constant equal to 134.00			
GH34P9	Constant equal to 134.90			
GH34P95	Constant equal to 134.95			
GH35	Constant equal to 135.00			
GH35P1	Constant equal to 135.10			
GH36	Constant equal to 136.00			
GH38	Constant equal to 138.00			
GH40	Constant equal to 140.00			
GH44	Constant equal to 144.00			
GH56	Constant equal to 156.00			
GYWHPWR	Constant equal to 15.812			
GHTPRX10	Constant equal to 439.200			
GHTPR	Constant equal to 43.920			
GHTPRXP5	Constant equal to 21.960			
GFXDHT	Constant equal to 3.000			
GCMINLIM	Constant equal to 0.211			
GDELCALT	Constant equal to 0.049.45			
GQINSMTH	Constant equal to 0.142 857 14			
GRANKFAC	Constant equal to 459.720			
GJLTOINP	Constant equal to 8.850 732 40			
GQMINPER	Constant equal to 19.000			
GTRATE	Constant equal to 1.700			
GB1SMTH	Constant equal to 0.013 333 33			
GB4SMTH	Constant equal to 0.526 315 79			

Table 6-18. Guidance and Navigation System — Error Warning

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G090	AGC operating, not failed, not off			
G092	Or of AGC malfunctions			
G193	CDU fail signal, input to AGC	Boolean		
G194	PIPA fail signal, input to AGC	Boolean		
G195	IMU fail signal, input to AGC	Boolean		
G201	Computer requesting zero encode	Boolean		
G202	Computer requesting coarse align	Boolean		
G203	Computer requesting CDU manual	Boolean		
G204	Computer requesting fine align	Boolean		
G206	CDU fail signal, output from AGC	Boolean		
G207	PIPA fail signal, output from AGC	Boolean		
G208	IMU fail signal, output from AGC	Boolean		
G210	Computer requesting attitude control	Boolean		
G211	Computer requesting entry control	Boolean		
G215	AGC 13 vdc failed			
G216	AGC 3 vdc failed			
G217	AGC 28 vdc failed			
G302	IMU delay timer on less than 40 sec	Boolean		
G304	Check condition lamps pushbutton	Boolean		
G315	Check coolant pushbutton	Boolean		
G316	PIPA gain pushbutton	Boolean		
G317	IRIG gain pushbutton	Boolean		
G325	Zero encode mode relay			
G326	Coarse align mode relay			
G328	Fine align mode relay			
G331	IMU time delay relay			
G338	Gimbal lock condition exists, signal from IMU	Boolean		
G339	Discrete from G&N error detector	Boolean		
G340	Discrete from AGC power fail detector	Boolean		
G341	Discrete for IMU temperature warning	Boolean		
G342	Discrete for CDU zero encoding	Boolean		
G357	G&N error indicator light	Boolean		

Table 6-18. Guidance and Navigation System — Error Warning (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G358	IMU fail indicator light	Boolean		
G359	CDU fail indicator light	Boolean		
G360	PIPA fail indicator light	Boolean		
G361	Gimbal lock indicator light	Boolean		
G362	AGC power fail indicator light	Boolean		
G363	IMU temp warning indicator light	Boolean		
G364	Zero encoding warning light	Boolean		
G365	IMU delay warning light	Boolean		
G366	Spare warning lamp No. 1	Boolean		
G367	Spare warning lamp No. 2	Boolean		
G368	G&N fail indicator light	Boolean		
G369	Coolant check lamps	Boolean		
G371	Middle gimbal servo error out of spec			
G372	Inner gimbal servo error out of spec			
G373	Inner CDU error signal out of spec			
G374	Middle CDU error signal out of spec			
G375	Outer CDU error signal out of spec			
G376	X-PIPA error signal out of spec			
G377	Y-PIPA error signal out of spec			
G378	Z-PIPA error signal out of spec			
G379	Inner gimbal CDU display, 1 = not zero			
G380	Middle gimbal CDU display, 1 = not zero			
G381	Outer gimbal CDU display, 1 = not zero			
G382	Total gimbal lock condition exists			
G383	IMU temperature out of tolerance			
G384	Second bit of IMU temperature switch position	Boolean		
G385				
G387	IMU-CDU encoder excitation (25.6 kc)			
G388	IMU 3200-cps power supply output			
G389	IMU 28v, 800-cycle power to gyro wheels			
G390	Flag for 40-sec timer not elapsed	Boolean		
G391	Flag for CDU fail timer elapsed	Boolean		

Table 6-18. Guidance and Navigation System — Error Warning (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G392	Outer gimbal servo error out of spec			
G393	Flag for IMU fail timer elapsed	Boolean		
G396	6v, 400-cycle power available			
MG026	Power failed to "IMUTEMP", MDV	Boolean		
MG027	IMUTEMP control relay coil open	Boolean		
MG030	Power failed to "accel fail", MDV	Boolean		
MG031	Power failed to "CDU fail", MDV	Boolean		
MG106	CDU error signal greater than 5.4 volts, malf = 1	Boolean		
GAMG	Actual middle gimbal angle	Degrees		
G30SEC	Timer for CDU error signal	Seconds		
G30SEC2	Timer for IMU fail signal	Seconds		
G40SEC1	Timer for IMU turn-on delay	Seconds		
GPIPAT	Telemetry input ~PIPA temperature	100, 160°F	237(A)/237	
GIRIGT	Telemetry input ~IRIG temperature	100, 160°F	249(A)/249	
G451	Telemetry input ~IMU+28v operate		GP26-1(D)/201	
G452	Telemetry input ~IMU+28 standby		GP26-2(D)/202	
G453	Telemetry input ~PIPA fail signal		GP26-5(D)/205	
G454	Telemetry input ~IMU fail signal		GP26-6(D)/206	
G455	Telemetry input ~CDU fail signal		GP26-7(D)/207	
G456	Telemetry input ~IMU pressure light (measurement G5004)			
G457	Telemetry input ~AGC power fail light		GP28-8(D)/224	
G486	Telemetry input ~IMU temp warning signal		GP27-3(D)/211	
G487	Telemetry input - gimbal lock warning		GP26-8(D)/208	
G488	Telemetry input - error detector output		GP27-2(D)/210	
G489	Telemetry input - IMU delay warning		GP27-5(D)/213	
G490	Telemetry input - zero encoder warning		GP27-4(D)/212	
T998	Signal conditioner internal power ok	Boolean		
T999	Signal conditioner +5 vdc available	Boolean		
G386	IMU 28 vdc standby available	Boolean		
GB4	PIPA temperature	50, 200°F		
GB1	IRIG temperature	50, 200°F		

Table 6-19. Guidance and Navigation System — IMU CDU Drive

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*G090	AGC ~on, operating, and powered = 1	Boolean		
*G327	CDU manual mode relay, 1 = energized	Boolean		
*G370	G&N 28v, 800-cps power, 1 = available	Boolean		
*G379	Inner gimbal CDU display, 1 = not zero	Boolean		
*G380	Middle gimbal CDU display, 1 = not zero	Boolean		
*G381	Outer gimbal CDU display, 1 = not zero	Boolean		
*G412	Outer gimbal CDU excitation, 1 = available	Boolean		
*G413	Middle gimbal CDU excitation, 1 = available	Boolean		
*G414	Inner gimbal CDU excitation, 1 = available	Boolean		
*G387	CDU encoders, 1 = excitation present	Boolean		
*G420	CDU, outer gimbal slew switch, 1 = increase	Boolean		
*G421	CDU, outer gimbal slew switch, 1 = decrease	Boolean		
*G422	CDU, middle gimbal slew switch, 1 = increase	Boolean		
*G423	CDU, middle gimbal slew switch, 1 = decrease	Boolean		
*G424	CDU, inner gimbal slew switch, 1 = increase	Boolean		
*G425	CDU, inner gimbal slew switch, 1 = decrease	Boolean		
*GDETP05	Constant = 0.05	Seconds		
*GSLEWRT		Degrees/sec		
*G32PT0	Constant = 32.0			
*G180PT0	Constant = 180.0	Degrees		
*GZERO	Zero			
*MG114	Roll slew switch fail open in increase position	Boolean		
*MG115	Roll slew switch fail open in decrease position			
*MG116	Pitch slew switch fail open in increase position			
*MG117	Pitch slew switch fail open in decrease position			
*MG120	Yaw slew switch fail open in increase position			
*MG121	Yaw slew switch fail open in decrease position			
*G480	CDU roll slew sw comm increase, no malf, 1 = increase			
*G481	CDU roll slew sw comm decrease, no malf, 1 = decrease			
*G482	CDU yaw slew sw comm increase, no malf, 1 = increase			
*G483	CDU yaw slew sw comm decrease, no malf, 1 = decrease			

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-19. Guidance and Navigation System — IMU CDU Drive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*G484	CDU pitch slew sw comm increase, no malf, 1 = increase	Boolean		
*G485	CDU pitch slew sw comm decrease, no malf, 1 = decrease			
*GAGCIGA	Inner gimbal angle stored in AGC	0, +360 degrees		
*GAGCMGA	Middle gimbal angle stored in AGC	0, +360 degrees		
*GAGCOGA	Outer gimbal angle stored in AGC	0, +360 degrees		
*GCDUIGA	Inner CDU actual angle	0, +360 degrees		
*GCDUMGA	Middle CDU actual angle	0, +360 degrees		
*GCDUOGA	Outer CDU actual angle	0, +360 degrees		
*GCOMICDU	Commanded inner CDU angle	0, +360 degrees		
*GCOMMCDU	Commanded middle CDU angle	0, +360 degrees		
*GCOMMOCDU	Commanded outer CDU angle	0, +360 degrees		
*GDAIG	Inner gimbal angle signal to D/A converter	0, +360 degrees		
*GDAMG	Middle gimbal angle signal to D/A converter	0, +360 degrees		
*GDAOG	Outer gimbal angle signal to D/A converter	0, +360 degrees		
*GDESICDU	Desired inner CDU angle ~AGC output	±360 degrees		
*GDESMCDU	Desired middle CDU angle ~AGC output	±360 degrees		
*GDESOCDU	Desired outer CDU angle ~AGC output	±360 degrees		
*GDR32IG	Output to D/R converter, inner CDU	0, 360 degrees		
*GDR32MG	Output to D/R converter, middle CDU	0, 360 degrees		
*GDR32OG	Output to D/R converter, outer CDU	0, 360 degrees		
*GENCIG6	Input from inner CDU encoder	0, 360 degrees		
*GENCMG	Input from middle CDU encoder	0, 360 degrees		
*GENCOG	Input from outer CDU encoder	0, 360 degrees		
*GIOSCDWD	Octal code word for crossbar drive	1, 7		
*GIOSANGL	BCD format word for driving IOS displays	0, 360.00		
*GCDURPT	Output word to IOS crossbar drive			
*GENCSH	Encoder output ~ shaft CDU	0, 360 degrees		
*GENCTR	Encoder output ~trunnion CDU	0, 360 degrees		
*GTSPIFB	Encoder output ~telescope indicator shaft	0, 360 degrees		
*GTTPIFB	Encoder output ~telescope indicator trunnion	0, 360 degrees		
G325	Zero encode mode relay	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-19. Guidance and Navigation System — IMU CDU Drive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G326	Coarse align mode relay	Boolean		
G328	Fine align mode relay	Boolean		
G329	Entry mode relay	Boolean		
G336	Attitude control relay	Boolean		
G345	IMU 28v, 800-cycle, 1% power supply	Boolean		
G470	Flag for continuity, attitude control, inner	Boolean		
G471	Flag for continuity, attitude control, middle	Boolean		
G596	Exec. command att cont angles flag "A"	Boolean		
G597	Exec. command att cont angles flag "B"	Boolean		
G650	Flag for Y-axis ICDU aligned	Boolean		
G651	Flag for Z-axis ICDU aligned	Boolean		
G652	Flag for X ICDU at command position	Boolean		
G653	Flag for Y ICDU at command position	Boolean		
G653	Flag for Z ICDU at command position	Boolean		
G657	Continue to coarse align			
G680	Proceed and coarse align to desired			
G17PT2	Constant equal to 17.2	Constant degrees		
GTHETAD	Desired outer CDU position	±360 degrees		
GTHETAD1	Desired inner CDU position	±360 degrees		
GTHETAD2	Desired middle CDU position	±360 degrees		
GPHICN	Commanded entry roll angle	±180 degrees		
GIGA	Inner gimbal angle, 1X resolver output	±360 degrees		
GMGA	Middle gimbal angle, 1X resolver output	±360 degrees		
GOGA	Outer gimbal angle, 1X resolver output	±360 degrees		

Table 6-20. Guidance and Navigation System — IMU CDU Difference Signals

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GAIGA	Inner gimbal angle, actual position	0, 360 degrees		
GAMGA	Middle gimbal angle, actual position	0, 360 degrees		
GAOGA	Outer gimbal angle, actual position	0, 360 degrees		
GIGA	Inner gimbal angle, 1X resolver output	0, 360 degrees		
GMGA	Middle gimbal angle, 1X resolver output	0, 360 degrees		
GOGA	Outer gimbal angle, 1X resolver output	0, 360 degrees		
GCDUIGA	CDU, inner gimbal, 1X resolver angle	0, 360 degrees		
GCDUMGA	CDU, middle gimbal, 1X resolver angle	0, 360 degrees		
GCDUOGA	CDU, outer gimbal, 1X resolver angle	0, 360 degrees		
GDIFFIGA	Inner gimbal IMU - CDU error signal	±180 degrees		
GDIFFMGA	Middle gimbal IMU - CDU error signal	±180 degrees		
GDIFFOGA	Outer gimbal IMU - CDU error signal	±180 degrees		
GDAIGAE	Inner gimbal IMU - CDU difference to D/A	-1, 1		
GDAMGAE	Middle gimbal IMU - CDU difference to D/A	-1, 1		
GDAOGAE	Outer gimbal IMU - CDU difference to D/A	-1, 1		
GEROLNB	Error in roll, ref to nav base - to SCS	±180 degrees		
GEROLBA	Error in roll, ref to body axis - to SCS	±180 degrees		
GEPCHNBA	Error in pitch, ref to either axis - to SCS	±180 degrees		
GEYAWNB	Error in yaw, ref to nav base - to SCS	±180 degrees		
GEYAWBA	Error in yaw, ref to body axis - to SCS	±180 degrees		
GZERO	Constant = zero			
G1PTO	Constant = 1.0			
G16PTO	Constant = 16.0			
GPT54	Constant = sine of 33° = 0.54464			
GPT83	Constant = cosine of 33° = 0.83867			
GD2PTO	Constant = 2.0 degrees			
GD3PT75	Constant = 3.75 degrees			
GD5PTO	Constant = 5.0 degrees			
GSLP1	Slope, meter shaping function, $0 \leq E < 2.0°$			
GSLP2	Slope, meter shaping function, $2° \leq E < 3.75°$			
GSLP3	Slope, meter shaping function, $3.75° \leq E < 5.0°$			
GCON1	Intercept, meter shaping function, $2° \leq E < 3.75°$			
GCON2	Intercept, meter shaping function, $3.75° \quad E < 5.0°$			

Table 6-20. Guidance and Navigation System — IMU CDU Difference Signals (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G325	Zero encode mode relay, 1 = energized	Boolean		
G326	Coarse align mode relay, 1 = energized	Boolean		
G329	Entry mode relay, 1 = energized	Boolean		
G349	IMU positional resolvers, 1 = excited	Boolean		
G389	28v, 800 cps, IMU gyro power, 1 = available	Boolean		
MG130	IMU-CDU diff ind outer pointer fails at zero	Boolean		
MG131	IMU-CDU diff ind inner pointer fails at zero	Boolean		
MG132	IMU-CDU diff ind middle pointer fails at zero	Boolean		

Table 6-21. Guidance and Navigation System — IMU Mode Switching

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G094	AGC on standby power			
G103	AGC 28-volt d-c power	Boolean		
G201	Computer requesting zero encode mode = 1	Boolean		
G202	Computer requesting coarse align mode = 1	Boolean		
G203	Computer requesting CDU manual mode = 1	Boolean		
G204	Computer requesting fine align mode = 1	Boolean		
G210	Computer requesting attitude control = 1	Boolean		
G211	Computer requesting entry mode = 1	Boolean		
G215	AGC 13-volt d-c failure			
G216	AGC 3-volt d-c failure			
G300	Transfer switch, IMU cont panel, 1 = manual	Boolean		
G301	Manual align pushbutton, 1 = pushed	Boolean		
G302	IMU delay timer, 1 = on less than 40 sec			
G303	Check mode lamps pushbutton, 1 = pushed	Boolean		
G305	IB~zero encode pushbutton, 1 = pushed last cycle	Boolean		
G306	IB~coarse align pushbutton, 1 = pushed last cycle	Boolean		
G307	IB~CDU manual pushbutton, 1 = pushed last cycle	Boolean		
G308	IB~fine align pushbutton, 1 = pushed last cycle	Boolean		
G309	IB~attitude control pushbutton, 1 = pushed last cycle	Boolean		
G310	IB~entry mode pushbutton, 1 = pushed last cycle	Boolean		
G312	G&N sync switch, 1 = ON	Boolean		
G319	Zero encode pushbutton, 1 = pushed	Boolean		
G320	Coarse align pushbutton, 1 = pushed	Boolean		
G321	CDU manual pushbutton, 1 = pushed	Boolean		
G322	Fine align pushbutton, 1 = pushed	Boolean		
G323	Att. control pushbutton, 1 = pushed	Boolean		
G324	Entry pushbutton, 1 = pushed	Boolean		
G325	Zero encode mode relay, 1 = energized	Boolean		
G326	Coarse align mode relay, 1 = energized	Boolean		
G327	CDU manual mode relay, 1 = energized	Boolean		
G328	Fine align mode relay, 1 = energized	Boolean		
G329	Entry mode relay, 1 = energized	Boolean		

Table 6-21. Guidance and Navigation System — IMU Mode Switching (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G330	Relay in timer circuit, 1 = energized	Boolean		
G331	IMU time delay relay, 1 = energized	Boolean		
G332	Zero encode latching relay, 1 = energized	Boolean		
G333	Coarse align latching relay, 1 = energized	Boolean		
G334	CDU manual latching relay, 1 = energized	Boolean		
G335	Fine align latching relay, 1 = energized	Boolean		
G336	Attitude control relay, 1 = energized	Boolean		
G337	Entry latching relay, 1 = energized	Boolean		
G345	IMU, 28v 800-cycle 1% power supply output	Boolean		
G351	Zero encode mode light, 1 = ON	Boolean		
G352	Coarse align mode light, 1 = ON	Boolean		
G353	CDU manual mode light, 1 = ON	Boolean		
G354	Fine align mode light, 1 = ON	Boolean		
G355	Attitude control mode light, 1 = ON	Boolean		
G356	Entry mode light, 1 = ON	Boolean		
G370	IMU, 28v 800-cycle 5% power supply output	Boolean		
G385	IMU 28v basic power	Boolean		
G386	IMU heater standby 28v power	Boolean		
G387	IMU-CDU encoder excitation (25.6 kc)	Boolean		
G388	IMU 3200-cps power supply output	Boolean		
G389	IMU, 28v 800-cycle power to gyro wheels	Boolean		
G397	Mode lights 6v 400-cycle power = 1	Boolean		
G412	CDU, outer gimbal, 1 = motor excited			
G413	CDU, middle gimbal, 1 = motor excited			
G414	CDU, outer gimbal, 1 = motor excited			
G430	M&DV, power and brightness switch, 1 = low	Boolean		
G430	M&DV, power and brightness switch, 1 = med	Boolean		
G442	M&DV switch, panel 1A22, 1 = "A" position	Boolean		
G444	Map and data viewer, ac power	Boolean		
G491	IMU control transfer switch, 1 = manual position, not failed	Boolean		
G492	IMU control transfer switch, 1 = computer position, not failed	Boolean		

Table 6-21. Guidance and Navigation System — IMU Mode Switching (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G493	Telemetry input, AGC 28-vdc power	Boolean	GP26-3(D)/203	
G494	Telemetry input, 2.5-vdc TM bias	Boolean	267(A)/267	
G495	TM bias 2.5-vdc power	Boolean		
G797	Standby heaters operating	Boolean		
H083	G&N synch relay, 1 = energized	Boolean		
G28PTO	Constant equal to 28.0			
GM28VST	Telemetry input, -28-vdc power supply	-28.0, 0 volts	102(A)/102	
MG021	Malfunction, zero encode light fails to light			
MG022	Malfunction, coarse align light fails to light			
MG023	Malfunction, CDU manual light fails to light			
MG024	Malfunction, entry light fails to light			
MG025	Malfunction, 28 vdc to mode latching relays			
MG032	Malfunction, open circuit in relay C-1			
MG033	Malfunction, open circuit in relay C-2			
MG034	Malfunction, open circuit in relay C-4			
MG035	Malfunction, open circuit in relay C-10			
MG036	Malfunction, open circuit in relay C-11			
MG037	Malfunction, 28v 800 cps 1% power fail			
MG040	Malfunction, 28v 3200 cps power supply fail			
MG041	Malfunction, 25.6 kc IMU encoder excitation			
MG071	Malfunction, 28v 800 cps 5% power supply fail			
MG072	Malfunction, 28v 800 cps power to gyros			
MG112	Malfunction, IMU control transfer sw, open in counter pos			
MG113	Malfunction, IMU control transfer sw, open in manual pos			
MG127	Malfunction, 40-sec time delay relay, coil open circuit			
GCURRAGC	Current drawn by AGC	0, 4.75 amps		
GCURRISS	Current drawn by inertial subsystem	0, 8.80 amps		
GCURRMDV	Current drawn by M and DV	0, 0.9 amps		
GCURRSBY	Current drawn by heaters, standby	0, 2.115 amps		
G4C28	Current drawn from C15A5CB93	0, .9 amps		
G4C29	Current drawn from C15A5CB62	0, .9 amps		
G4C84	Current drawn from C15A5CB61	0, 2.115 amps		

Table 6-21. Guidance and Navigation System — IMU Mode Switching (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G4C90	Current drawn from C15A5CB59	0, 8.80 amps		
G4C92	Current drawn from C15A5CB57	0, 4.75 amps		
G5C10	Current drawn from C15A5CB60	0, 2.115 amps		
G5C16	Current drawn from C15A5CB58	0, 8.80 amps		
G5C18	Current drawn from C15A5CB56	0, 4.75 amps		
C200	C/M main d-c bus "A"	Boolean		
C201	C/M main d-c bus "B"	Boolean		
C204	3-phase a-c bus "A"	Boolean		
C205	3-phase a-c bus "B"	Boolean		
C428	G&N map and data viewer, ØB, bus 1	Boolean		
C429	G&N map and data viewer, ØB, bus 2	Boolean		
C484	IMU heater system "A"	Boolean		
C490	IMU system "A" (OPERATE/STANDBY)	Boolean		
C492	Computer "A", G&N, (ON-OFF)	Boolean		
C510	IMU heater, system "B"	Boolean		
C516	IMU system "B" (OPERATE/STANDBY)	Boolean		
C518	Computer "B", G&N (ON-OFF)	Boolean		
	IMU pressure		220(A)/220	

Table 6-22. Guidance and Navigation System — Executive

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G001	Main keyboard keycode - bit value (1) 1A14	Boolean		
G002	Main keyboard keycode - bit value (2) 1A14	Boolean		
G003	Main keyboard keycode - bit value (4) 1A14	Boolean		
G004	Main keyboard keycode - bit value (8) 1A14	Boolean		
G005	Main keyboard keycode - bit value (16) 1A14	Boolean		
G007	Main keyboard key reset 1A14	Boolean		
G010	AGC mode switch in "ON" position (=1)	Boolean		
G011	Nav keyboard keycode - bit value (1) 1A33	Boolean		
G012	Nav keyboard keycode - bit value (2) 1A33	Boolean		
G013	Nav keyboard keycode - bit value (4) 1A33	Boolean		
G014	Nav keyboard keycode - bit value (8) 1A33	Boolean		
G015	Nav keyboard keycode - bit value (16) 1A33	Boolean		
G017	Nav keyboard key reset 1A33	Boolean		
G020	Nav keyboard test alarm 1A33	Boolean		
G027	MDP E/L display fail	Boolean		
G029	Uplink blocked pnl 18A9	Boolean		
G037	NDP E/L display fail	Boolean		
G039	IOS NDP test alarm repeat 16A17	Boolean		
G040	(O) Non-integr mode uplink panel active	Boolean		
G090	AGC normal operation	Boolean		
G092	"OR" or AGC malfunctions	Boolean		
G095	Verb/noun flasher fail	Boolean		
G099	AGC freq ref discrete	Boolean		
G101	Keyboard delay Boolean	Boolean		
G102	"ON" means keyboard was active last iteration	Boolean		
G103	AGC 28-vdc power available at circuit breaker	Boolean		
G130	TEST ALARM key depressed	Boolean		
G161	Program alarm light	Boolean		
G163	Telemetry failure flag	Boolean		
G215	AGC 13 vdc failure	Boolean		
G216	AGC 3 vdc failure	Boolean		
G217	AGC 28 vdc failure	Boolean		
G218	AGC freq ref (1.024 MC) failed	Boolean		

Table 6-22. Guidance and Navigation System — Executive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G219	AGC failed	Boolean		
G275	Key release control Boolean	Boolean		
G277	AGC exec end of job requested	Boolean		
G249	AGC exec joblist request received	Boolean		
G439	Optics mark button active	Boolean		
G642	Indicates recognition of reset activity	Boolean		
G644	Indicates recognition of step-ahead activity	Boolean		
G276		Boolean		
MG001	Uplink logic always blocked (inop)	Malfunction		
MG002	Uplink logic not blocked	Malfunction		
MG003	AGC fail — loss of 13 vdc power	Malfunction		
MG004	AGC fail — loss of 3 vdc power	Malfunction		
MG005	AGC fail — loss of 28 vdc power	Malfunction		
MG006	AGC fail — loss of 2.048 mc freq ref	Malfunction		
MG007	C/M 1A14 panel E/L indicator 800 cps fail	Malfunction		
MG011	C/M 1A14 keyboard 13 vdc supply failure	Malfunction		
MG012	C/M 1A33 keyboard 13 vdc supply failure	Malfunction		
MG013	Display flasher 1.5 cps ref fail	Malfunction		
MG014	C/M 1A14 panel indicator R13 always "4"	Malfunction		
MG016	C/M 1A33 panel indicator P35 always "0"	Malfunction		
MG017	5-bit key code from 1A14 or 1A33 panels	Malfunction		
G288	Malfunction reset (assumes 1 mf at a time 1: means malfunction is in effect)			
T500	Bit 1 (LSB) uplink keyword, non-int	0, 1		
T501	Bit 2 (LSB) uplink keyword, non-int	0, 1		
T502	Bit 3 (LSB) uplink keyword, non-int	0, 1		
T503	Bit 4 (LSB) uplink keyword, non-int	0, 1		
T504	Bit 5 (MSB) uplink keyword, non-int	0, 1		
T505	Uplink display activity indicator	0, 1		
T506	Bit 1 uplink address, non-integrated	0, 1		
T507	Bit 2 uplink address, non-integrated	0, 1		
T511	Simulator integrated mode selected	0, 1		
T940	Liftoff discrete	0, 1		
T907	Step-ahead discrete	0, 1		

Table 6-22. Guidance and Navigation System — Executive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T914	Reset discrete	0, 1		
TW71	3-bit int uplink address	0, 00077		
TW72	5-bit int uplink keyword	0, 77777		
GAVGPR	Job priority for average G job	0, $(77777)_8$		
GAGCIGA	Mark inner gimbal angle data	±360 degrees		
GAGCMGA	Mark middle gimbal angle data	±360 degrees		
GAGCOGA	Mark outer gimbal angle data	±360 degrees		
GAGCSHF	Mark shaft angle data	0, 360 degrees		
GAGCTRN	Mark trunnion angle data	0, 360 degrees		
GCADR	Temporary storage for waitlist call address	0, any machine address		
GCHARPR	Job priority for charin job	0, 77777 octal		
GEXCTR	Temporary counter for 2 cps job	0, 10		
GEXCTR1	Temporary counter for 10 cps job 1	0, 10		
GEXCTR2	Temporary counter for key release activity	0, 10		
GEXCTR3	Temporary counter for 10 cps job 2	0, 10		
GI	Dummy index set in exec	-20, 20		
GMMRTEM	Interrupted job return address list	0, any machine address		
GKWD	DSKY keycode	-77777, 77777 octal		
GKEYCTR	Counter indicates which keyboard is active	-5, 5		
GL	Temporary storage	-10, 10		
GMARKIG	Mark inner gimbal angle	±360 degrees		
GMARKMG	Mark middle gimbal angle	±360 degrees		
GMARKOG	Mark outer gimbal angle	±360 degrees		
*GM	Temporary storage	-10, 10		
GMDSPWD	Main DSKY display word	0, 77777		
GMKRWD	IOS main DSKY repeat keycode	0, 77777		
GMARKAT	Mark trunnion angle	Degrees		
GMODE	Temporary storage for requested mode	0, 77 octal		
GMARKT1	HI-order time of mark	0, 2.7×10^6		
GMARKT2	LO-order time of mark	0, 83886.07 sec		
GMARKAS	Mark shaft angle	0, 360 degrees		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-22. Guidance and Navigation System — Executive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GN	Temporary exec storage	-20, 20		
GNI	Temporary exec storage	-10, 10		
GNDO	I/O code word	0, 7777 octal		
GNDSPWD	Nav. DSKY display word	0, 77777 octal		
GNKRWD	IOS nav DSKY repeat keycode	0, 77777 octal		
GNEWPR	List of new job priorities	0, 77777 octal		
GNWCTR	Counter indicates No. of jobs to be entered	0, 10		
GN3	Temporary exec storage	-77777, 77777		
GNEWPR(1)	Part of symbol 109	0, 77777 octal		
GNDW	Code word - indicates new display word	0, 7777 octal		
GMKRCNT	Number of markers remaining to be sent	0, 3		
GORBNPR	Orbital nav. job priority	0, 77777 octal		
GPR1	Intermediate exec computation	-10, 10		
GPR2	Intermediate exec computation	-10, 10		
GPR3	Intermediate exec computation	-10, 10		
GPR4	Intermediate exec computation	-77777, 77777 octal		
GPRCTEM	Exec counter	-10, 10		
GPRCTR	Exec counter	-10, 10		
GPRCTR1	Exec counter	-10, 10		
GPRION	List of job priorities	-77777, 77777 octal		
GPRIOR	Priority of last requested job	0, 77777 octal		
GPRIRADD	Address list for jobs called by joblist			
GPRION(1)	Part of symbol 128	-77777, 77777		
GSTOP	Intermediate exec computation	-20, 20		
GSTWPR	STEERLAW priority	0, 77777 octal		
GTMWD	Word selected from output TM list			
GT	AGC reference time w/o liftoff	-60.00, 2.7×10^6 sec		
GTMINDEX	Downlink counter	-60, 2.7×10^6		
GUDLKWD	Uplink keycode			
GUPLKPR	Uplink job priority	0, 77777 octal		
GTMDUMMY	Dummy variable	0, 5		
GTMTEMP	Temporary storage	Temporary buffer		

Table 6-22. Guidance and Navigation System — Executive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GWT1	Temporary storage for waitlist time	0, any machine address		
GWT2	Temporary storage for waitlist call address	0, 300.00		
GWTCAD	List of waitlist call addresses	0, any machine address		
GWTCTR	Exec counter (No. of waitlist jobs)	0, 10		
GWTCTEM	Exec counter	0, 10		
GWTIME	Waitlist execution times	0, 300.00 sec		
GWTLSTDT	Latest time entry to waitlist	0, 300.00 sec		
TDIFTIME	Step-ahead time increment	seconds		
TOFROMB1	To time from register No. 1	seconds		
TOFROMB2	To time from binary register No. 2	seconds		
G265	MM21 has been called	Boolean		
G286	New highest priority exists	Boolean		
G385	CDU power control	Boolean		
G401	CDU power control	Boolean		
G597	CDU drive control	Boolean		
GCHARPR1	I/O monitor priority	0, 77777		
GDWNGOTO	Downlink phase address storage	Any machine address		
GDNLSTAD	Downlink data list address storage	Any machine address		
GCOMLSTA	Basic address of common list A	0, machine address		
GCOMLSTB	Basic address of common list B	0, machine address		
GLSTAI	Basic address of particular list A1	0, machine address		
GLDATLST	Temporary storage for particular list basic	0, machine address		
GMKRCNT	Marker counter	0, 10		
GOUTI	AGC "OUT REGISTER" 1			
GTMDUMMY	Dummy variable	0, 10		
GTMMKR	Marker buffer	$0, 77777_8$		

Table 6-23. Guidance and Navigation System — Computer Input/Output

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G026	IOS 16A17 indicator, C/M keyboard active	Boolean		
G056	1A14 and 18A9 indicator, key release	Boolean		
G057	1A14 and 18A9 indicator, comp. fail	Boolean		
G058	1A14 and 18A24 indicator, comp. active	Boolean		
G076	1A33 and 16A2 indicator, prog alm.	Boolean		
G077	1A33 and 16A17 indicator, comp. active	Boolean		
G078	1A33 and 16A2 indicator, T/L fail	Boolean		
G079	1A33 and 16A2 indicator, check fail	Boolean		
G080	1A33 and 16A2 indicator, scalar fail	Boolean		
G081	1A33 and 16A2 indicator, parity fail	Boolean		
G082	1A33 and 16A2 indicator, counter fail	Boolean		
G083	1A33 and 16A2 indicator, key release	Boolean		
G084	1A33 and 16A2 indicator, rupt lock	Boolean		
G085	1A33 and 16A2 indicator, TC trap	Boolean		
G086	1A33 and 16A2 indicator, spare	Boolean		
G087	1A33 and 16A2 indicator, spare	Boolean		
G088	1A33 and 16A2 indicator, spare	Boolean		
G027	1A14 E/L display failure	Boolean		
G037	1A33 E/L display failure	Boolean		
G169	Rupt lock alarm flag	Boolean		
G170	TC trap alarm flag	Boolean		
G218	AGC freq ref (1.024 mc) failed	Boolean		
MG042	AGC locked in interrupt stage	Malfunction		
MG043	AGC in endless control loop	Malfunction		
MG044	AGC parity fail	Malfunction		
MG045	AGC counter fail	Malfunction		
G101	Any DSKY key depressed (except TEST ALM)	Boolean		
G102	UDL key data present	Boolean		
G118	Up-data link active	Boolean		
G130	TEST ALM key depressed	Boolean		
G136	First display clear function completed	Boolean		
G139	Displays under astro. or UDL control	Boolean		

Table 6-23. Guidance and Navigation System — Computer Input/Output (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G144	ERROR RESET key depressed	Boolean		
G145	Display decimal data flag	Boolean		
G146	Neg sign display flag	Boolean		
G161	Program alarm flag	Boolean		
G162	Comp active flag	Boolean		
G163	Telem failure flag	Boolean		
G166	Parity failure flag	Boolean		
G167	Counter failure flag	Boolean		
G168	Key release command	Boolean		
GMODE	Major mode buffer register	$00, 77_8$		
GIN2	AGC in2 register equiv	$00000, 77777_8$		
GOUT1	AGC out 1 register equiv	$00000, 77777_8$		
GNDS	Command DSPTAB load of sign or spec funct bits	$0000, 7777_8$		
GNDO	Flag specifying display table output reqd	$0000, 7777_8$		
*GASTRO	Flag for keyboard commands to AGC routings	$0, 7_8$		
*GENTCNT	Consecutive keyword enter counts	$0, 15_{10}$		
*GR1	R1 data buffer register	-99999_{10}, $+99999_{10}$		
*GR2	R2 data buffer register	-99999_{10} $+99999_{10}$		
*GR3	R3 data buffer register	-99999_{10} $+99999_{10}$		
*GNN	Noun buffer register	$00_8, 77_8$		
*GNNCW	Noun control word	$00_8, 77_8$		
*GNNB1	Bit 1 of noun control word (LSD)	$0_2, 1_2$		
*GNNB2	Bit 2 of noun control word (LSD)	$0_2, 1_2$		
*GNNB3	Bit 3 of noun control word (LSD)	$0_2, 1_2$		
*GNNB4	Bit 4 of noun control word (LSD)	$0_2, 1_2$		
*GNNAMAX	Max value of GR1	See math model (012)3173-19.		
*GNNBMAX	Max value of GR2			
*GNNCMAX	Max value of GR3			
*GNDX	Commands DSPTAB load or blanks data digits	$0000008, 777777_8$		
*GNUMCNT	Consecutive numerical keyword count	$0, 31_{10}$		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-23. Guidance and Navigation System — Computer Input/Output (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*GVB	Verb buffer register	00_8, 77_8		
*GVBFLG	Original verb, before first enter	00_8, 77_8		
*GTME	Double precision time in seconds	$(0000000000)_{10}$, $(9999999999)_{10}$		
*GCRITCON				
*GDECBRCH				
*G137	Verb/noun flash command			
*G151	Check fail alarm command			
*G279	GNVSUB has been activated			
GDADI	Display table word 1, 15 bits	54000_8, 55777_8		
GDAD2	Display table word 2, 15 bits	50000_8, 53777_8		
GDAD3	Display table word 3, 15 bits	44000_8, 45777_8		
GDAD4	Display table word 4, 15 bits	40000_8, 43777_8		
GDAD5	Display table word 5, 15 bits	34000_8, 37777_8		
GDAD6	Display table word 6, 15 bits	30000_8, 33777_8		
GDAD7	Display table word 7, 15 bits	24000_8, 27777_8		
GDAD8	Display table word 8, 15 bits	20000_8, 23777_8		
GDAD9	Display table word 9, 15 bits	14000_8, 15777_8		
GDAD10	Display table word 10, 15 bits	10000_8, 13777_8		
GDAD11	Display table word 11, 15 bits	04000_8, 07777_8		
GKWD	5-bit code from 1A14 or 1A33 keyboards	0, 31_{10}		
GKWDIN	5-bit key code input to GCHARIN	0, 31_{10}		
GERRSTC				
GSFLOUTO				
GWTLSTDT	Delta time loaded in waitlist	0.00, 120.00		
GCADR	Waitlist job address			
GIDAD1TM	Temporary storage for addresses	Store machine address		
GIDAD2TM	Temporary storage for addresses	Store machine address		
GIDAD3TM	Temporary storage for addresses	Store machine address		
GMIXBR	Temporary storage register	-10, 10		

*Program symbols are not available at publication date. Math models are given for information only.

Table 6-23. Guidance and Navigation System — Computer Input/Output (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GNOUNAD2	Temporary storage register (addresses)	Store machine address		
GNOUNAD3	Temporary storage register (addresses)	Store machine address		
GACCUM	Temporary storage register	Store machine address		
GIDADTB1	Address in table	Store machine address		
GIDADTB2	Address in table	Store machine address		
GMIXSFR1	Temporary storage register (addresses)	-77777, 77777 oct		
GMIXSFR2	Temporary storage register (addresses)	-77777, 77777 oct		
GMIXSFR3	Temporary storage register (addresses)	-77777, 77777 oct		
GDECOUNT	Temporary storage register (addresses)	-10, +10		
GNOUNTEM	Temporary storage register (addresses)	-77777, 77777 oct		
GLOWVRB				
GACC				
GSFOUTB				
GDISTEM	Temporary storage register	-77777, 77777		
GDECTEM	Temporary storage register	-77777, 77777		
GRABLOCK	Temporary storage register	-77777, 77777		
GSAMPTME	Double precision time sample	-77777, 77777 secs		
GT	Double precision AGC time	-70 2.7×10^6 secs		
GMONSAVE	Temporary storage register	-77777, 77777 octal		
GPRIOR	Priority of last job requested	-77777, 77777 octal		
GMONSAV1	Monitor storage register for MATBS	-77777, 77777 oct		
GNOUN	Temporary noun storage	-77777, 77777 oct		
GVRB	Temporary verb storage	-77777, 77777 oct		
GNDS	Code word recognized by display table	-77777, +77777		
GNNADTEM	Temporary noun address storage	-77777, +77777		
GNOUNAD	Temporary storage for display data	Store any machine address		
GMPAC	Temporary storage for display data	Store any machine address		
GMPAC1	Temporary storage for display data	Store any machine address		
GMPAC2	Temporary storage for display data	Store any machine address		

Table 6-23. Guidance and Navigation System — Computer Input/Output (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GLODSTAT	Load status register	-10, +10		
GCLPASS	Clear pass status register	-10, +10		
GLST2		0, 777 oct		
GLST2CON	First list 2 verb	0, 777 oct		
GIOTEM1	Temporary storage register	Store any machine address		
GIOTEM2	Temporary storage register	Store any machine address		
GIO1	Temporary storage register	-77777, 77777 octal		
GSFTEMP1	Temporary storage register	-77777, 77777 octal		
GSFTEMP2	Temporary storage register	-77777, 77777 octal		
GNNTYPTM	Temporary storage register	0, 77777777 oct		
GNNADTAB	Temporary storage register	0, 77777777 oct		
GNNTYPTB	Temporary storage register	0, 77777777 oct		
GMONN	Monitor noun	-77777, 77777 octal		
GCHARPR1	Monitor priority	-77777, 77777 octal		
GCADRSTR	Display waiting list address storage	-77777, 77777 octal		
GWTLSTDT	Waitlist event time	-77777, 77777 octal (secs)		
GCADR	Waitlist call address storage	-77777, 77777 octal		
GMONVB	Monitor verb	-77777, 77777 octal		
GTHOURS	Present time in hours	-77777, 77777 octal (hrs)		
GCDUX	IMU CDU X-axis	-77777, 77777 octal		
GPIPAX	X PIPA output	-77777, 77777 octal		
GTHETAD	New ICDU angle	-77777, 77777 octal (deg)		
GDSPTEM2	Temporary storage for display data	-77777, 77777 octal (deg)		
GDSPTEM1	Temporary storage for display data	-77777, 77777 octal		
GSMODE	Undefined — included for AGC capability	-77777, 77777 octal		
GFAILREG	Undefined — included for AGC capability	-77777, 77777 octal		
GTDEC	Midcourse decision time	-77777, 77777 octal (secs)		
GTET	Midcourse ephemeris time	-77777, 77777 octal (secs)		
GMEASQ	Undefined — provides AGC capability	-77777, 77777 octal		

Table 6-23. Guidance and Navigation System — Computer Input/Output (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GROLL		-77777, 77777 octal (deg)		
GLANDMK	Landmark data 1	-77777, 77777 octal		
GLANDMK3	Landmark data 2	-77777, 77777 octal		
GB1ASX	Gyro drift due to bias	-77777, 77777 octal		
GADIAX	Gyro input axis accel. drift	-77777, 77777 octal		
GADSRAX	Gyro spin axis accel. drift	-77777, 77777 octal		
G289	AGC alarm 1 (program)		GP27-6(D)/214	
G290	AGC alarm 2 (AGC activity)		GP27-7(D)/215	
G291	AGC alarm 3 (T/M)		GP27-8(D)/216	
G292	AGC alarm 4 (prog CK fail)		GP28-1(D)/217	
G293	AGC alarm 5 (scalar fail)		GP28-2(D)/218	
G294	AGC alarm 6 (parity fail)		GP28-3(D)/219	
G295	AGC alarm 7 (counter fail)		GP28-4(D)/220	
G296	AGC alarm 8 (key release)		GP28-5(D)/221	
G297	AGC alarm 9 (rupt lock)		GP28-6(D)/222	
G298	AGC alarm 10 (TC trap)		GP28-7(D)/223	
T999	SCE +5.0 vdc output available			

Table 6-24. Guidance and Navigation System — AGC Prelaunch

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G240	Gyrocompassing perpetuate Boolean	Boolean		
T939	Guidance reference release signal	Boolean		
GIN2	AGC input register No. 2			
G04PRIO	Priority of major mode 04			
G250	Guidance reference release flag	Boolean		
GTGRR	AGC time of guidance ref release	$-60, 2^{28}$ sec		
GT	AGC clocktime	Seconds		
G241	Average g perpetuate Boolean	Boolean		
T940	Liftoff discrete	Boolean		
GPRIOR	Priority of latest requested job			
G11PRIO	Priority of major mode 11			
GWTLSTDT	Time to elapse before a waitlist call	Seconds		
G896	Backup liftoff discrete	Boolean		

Table 6-25. Guidance and Navigation System — Boost Monitor

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G244	ΔV monitor self-perpetuate Boolean	Boolean		
G253	TFF & ΔVins routine SPB	Boolean		
G245	G_{MAX} routine SPB	Boolean		
G252	PIPA termination Boolean	Boolean		
G251	Thrust-off discrete	Boolean		
G254	ΔR routine SPB	Boolean		
G960	Powered flight flag for W matrix update	Boolean		
G963	Navigation update flag	Boolean		
G71PR1O	Priority of MM71			
GDVTH	ΔV monitor threshold	0, 5.0 ft/sec		
GSIVBTHR	S-IVB V monitor threshold	0, 5.0 ft/sec		
GWTLSTDT	Waitlist delay	seconds		
G911	STRLAWA subroutine self-perpetuate Boolean	Boolean		
H107	Hand controller in abort position	Boolean		
GIN2	AGC input register No. 2	00000, 77777_8		
G250	AGC guidance reference release flag	Boolean		
G240	Gyrocompassing S-F Boolean	Boolean		
G241	Average g self-perpetuate Boolean	Boolean		
GISSMOD	G&N mode switching code word	00, 77_8		
G242	Polyfit routine S-P Boolean	Boolean		
GVRB	I/O program code word for verb	0, 77_8		
GNOUN	I/O program code word for noun	0, 77		
GNDW	I/O program code word for display job	0000, 7777		
GT	G&N reference time	0, $(.01)2^{28}$ sec		
GIZPRIO	Priority for major mode 12	0, 40000		
GPRIOR	Priority of latest requested job	0, 40000		
DS50	CM-SM separation discrete	Boolean		
GTLO	Effective time of liftoff	0, 83886 sec		
GT11	Time (w/o liftoff) to stop CDU polynom fit	0, 800		
GT11A	Stored time of LET jettison	0, 800		
G597	CDU drive control	Boolean		

Table 6-25. Guidance and Navigation System — Boost Monitor (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G258	GALTANG self-perpetuate Boolean	Boolean		
G580	IMU in prelaunch configuration	Boolean		
GAVGT	Time step for average "g"	.05, 3.99 sec		

Table 6-26. Guidance and Navigation System — Coast

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*G168	Flag for keyboard busy	Boolean		
*G263	Flag for gimbal lock possible (1 = not possible)	Boolean		
*G264	VERTASK self-perpetuating Boolean	Boolean		
*G265	Flag for major mode 21 (1 = in progress)	Boolean		
*GNOUN	Desired noun for display	$00, 77_8$		
*GVRB	Desired verb for display	$00, 77_8$		
*GNDW	Code word for display program	$0000, 7777_8$		
*GCHKLIST	Checklist register in AGC	$00000, 77777_8$		
*GASTRO	Flag indicating astronaut action	0, 7		
*G954	Flag to nav integ for No. W matrix storage	Boolean		
*G955	Flag to nav integ for time stop	Boolean		
*G956	Flag to nav integ for time stop	Boolean		
*G999	Flag to nav integ for safe storage necessary	Boolean		
GTSP	Time to stop navigation integration	$0, 268.6 \times 10^4$ sec		
*GT	Present time in AGC	Seconds		
*G597	Flag to CDU drive for all CDUs being driven	Boolean		
*$\overrightarrow{GEPS}$	Unit vector in the direction of desired X_{SM}	±1		
GEPSX	X-comp of vector in the direction of desired X_{SM}	±1		
GEPSY	Y-comp of vector in the direction of desired Y_{SM}	±1		
GEPSZ	Z-comp of vector in the direction of desired Z_{SM}	±1		
*$\overrightarrow{U}_{TANG}$	Unit vector in direction of (RXVXR)	±1		
GUTANGX	X-component in direction of (RXVXR)	±1		
GUTANGY	Y-component in direction of (RXVXR)	±1		
GUTANGZ	Z-component in direction of (RXVXR)	±1		
*$\overrightarrow{Y}_{SCD}$	Unit vector in direction of desired Y_{SC} orientation	±1		
GYSCDX	X-component in direction of desired Y_{SC} orientation	±1		
GYSCDY	Y-component in direction of desired Y_{SC} orientation	±1		
GYSCDZ	Z-component in direction of desired Y_{SC} orientation	±1		
*$\overrightarrow{GRHO}$	Unit vector in the direction of desired Y_{SM}	±1		

*Program symbols are not available at publication date.
Match model symbols are given for information only.

Table 6-26. Guidance and Navigation System — Coast (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GRHOX	X-comp of vector in the direction of desired Y_{SM}	±1		
GRHOY	Y-comp of vector in the direction of desired Y_{SM}	±1		
GRHOZ	Z-comp of vector in the direction of desired Y_{SM}	±1		
*GVRB	Desired verb for display	0, 77		
*GNOUN	Desired noun for display	0, 77		
*GCKLIST	Checklist No. in AGC	00000, 77777		
*GNDW	Code word for display program	0000, 7777		
*GPRIOR	Priority associated with request for mode change			
*G168	Flag for keyboard busy	Boolean		
*GASTRO	Flag indicating astronaut action	0, 6		
*GNOMINDX	Nominal number of marks to be taken	0, 6		
*GMININDX	Minimal number of marks to be taken	0, 6		
*G268	Target flag (1 = landmark)	Boolean		
*G269	Response for known landmark (1 = known)	Boolean		
*G999	Flag to nav integ for safe storage necessary	Boolean		
*G953	Flag to nav integ for coordinate shift	Boolean		
*G954	Flag to nav integ for No. W matrix update	Boolean		
*G955	Flag to nav integ for time stop	Boolean		
*G956	Flag to nav integ for time stop	Boolean		
GTSP	Time to stop navigation integration	Boolean		
GCOUNT	Mark data now being processed	0, 6		
*GNM	Number of marks taken by astronaut	0, 6		
$*\underrightarrow{Y}_R$	Position vector in I_E from nav integration			
GXR	X-comp of position vector at time T_N	$\pm 53.8 \times 10^6$ ft		
GYR	Y-comp of position vector at time T_N	$\pm 53.8 \times 10^6$ ft		
GZR	Z-comp of position vector at time T_N	$\pm 53.8 \times 10^6$ ft		
$*\underrightarrow{V}_R$	Velocity vector in I_E from nav integration			
GXDR	X-comp of velocity vector at time T_N	±32.768 ft/sec		
GYDR	Y-comp of velocity vector at time T_N	±32.768 ft/sec		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-26. Guidance and Navigation System — Coast (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GZDR	Z-comp of velocity vector at time T_N	±32.768 ft/sec		
GTN	Present time at which the nav integ is	0, 268.6×10^4 sec		
GTREC	Time of rectification	0, 268.6×10^4 sec		
GTAU	Time elapsed since rectification in nav int	0, 26600 sec		
*$\underset{\rightarrow}{\gamma}_{FIN}$	Position vector at time of final mark			
GXFIN	X-comp of position vector at time of final mark	$\pm 53.8 \times 10^6$ ft		
GYFIN	Y-comp of position vector at time of final mark	$\pm 53.8 \times 10^6$ ft		
FZFIN	Z-comp of position vector at time of final mark	$\pm 53.8 \times 10^6$ ft		
*$\underset{\rightarrow}{V}_{FIN}$	Velocity vector at time of final mark			
GXDFIN	X-comp of velocity vector at time of final mark	±32768 ft/sec		
GYDFIN	Y-comp of velocity vector at time of final mark	±32768 ft/sec		
GZDFIN	Z-comp of velocity vector at time of final mark	±32768 ft/sec		
*$\underset{\rightarrow}{\gamma}_{ST}$	Safe-stored position vector			
GXST	X-comp of safe stored position vector	$\pm 53.8 \times 10^6$ ft		
GYST	Y-comp of safe stored position vector	$\pm 53.8 \times 10^6$ ft		
GZST	Z-comp of safe stored position vector	$\pm 53.8 \times 10^6$ ft		
*$\underset{\rightarrow}{V}_{ST}$	Safe-stored velocity vector			
GXDST	X-comp of safe stored velocity vector	±32.768 ft/sec		
GYDST	Y-comp of safe stored velocity vector	±32.768 ft/sec		
GZDST	Z-comp of safe stored velocity vector	±32.768 ft/sec		
*$\underset{\rightarrow}{\delta}$	Vector for position deviation			
GDEX	X-component position deviation	-52.5×10^3, 52.5×10^3 ft		
GDEX	Y-component position deviation	-52.5×10^3, 52.5×10^3 ft		
GDEX	Z-component position deviation	-52.5×10^3, 52.5×10^3 ft		
*$\underset{\rightarrow}{\delta}_V$	Vector for velocity deviation			
GDEDX	X-component velocity deviation	±126.5 ft/sec		
GDEDY	Y-component velocity deviation	±126.5 ft/sec		
GDEDZ	Z-component velocity deviation	±126.5 ft/sec		
*$\underset{\rightarrow}{\gamma}_{REC}$	Position vector at time of rectification			

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-26. Guidance and Navigation System — Coast (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GXREC	X-comp of position vector at time of rectification	$\pm 53.8 \times 10^6$ ft		
GYREC	Y-comp of position vector at time of rectification	$\pm 53.8 \times 10^6$ ft		
GZREC	Z-comp of position vector at time of rectification	$\pm 53.8 \times 10^6$ ft		
*$\vec{V}$REC	Velocity vector at time of rectification			
GXDREC	X-comp of velocity vector at time of rectification	±32768 ft/sec		
GYDREC	Y-comp of velocity vector at time of rectification	±32768 ft/sec		
GZDREC	Z-comp of velocity vector at time of rectification	±32768 ft/sec		
GW11ST	Element 1, 1 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		
GW12ST	Element 2, 1 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		
GW13ST	Element 3, 1 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		
GW11DST	Element 4, 1 of the W_{ST} MATRIX	-126.5, 126.5 ft/sec		
GW12DST	Element 5, 1 of the W_{ST} MATRIX	-126.5, 126.5 ft/sec		
GW13DST	Element 6, 1 of the W_{ST} MATRIX	-126.5, 126.5 ft/sec		
GW21ST	Element 1, 2 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		
GW22ST	Element 2, 2 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		
GW23ST	Element 3, 2 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		
GW21DST	Element 4, 2 of the W_{ST} MATRIX	-126.5, 126.5 ft/sec		
GW22DST	Element 5, 2 of the W_{ST} MATRIX	-126.5, 126.5 ft/sec		
GW23DST	Element 6, 2 of the W_{ST} MATRIX	-126.5, 126.5 ft/sec		
GW31ST	Element 1, 3 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		
GW32ST	Element 2, 3 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		
GW33ST	Element 3, 3 of the W_{ST} MATRIX	-52.5×10^3, 52.5×10^3 ft		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-26. Guidance and Navigation System — Coast (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GW31DST	Element 4, 3 of the W_{ST} MATRIX	-126.5, 126.5 ft/sec		
GW32DST	Element 5, 3 of the W_{ST} MATRIX	-126.5, 126.5 ft/ sec		
GW33DST	Element 6, 3 of the W_{ST} MATRIX	-126.5 126.5 ft/sec		
GW41ST	Element 1, 4 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ ft		
GW42ST	Element 2, 4 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ ft		
GW43ST	Element 3, 4 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ ft		
GW41DST	Element 4, 4 of the W_{ST} MATRIX	±126.5 ft/sec		
GW42DST	Element 5, 4 of the W_{ST} MATRIX	±126.5 ft/sec		
GW43DST	Element 6, 4 of the W_{ST} MATRIX	±126.5 ft/sec		
GW51ST	Element 1, 5 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ sec		
GW52ST	Element 2, 5 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ sec		
GW53ST	Element 3, 5 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ sec		
GW51DST	Element 4, 5 of the W_{ST} MATRIX	±126.5 ft/sec		
GW52DST	Element 5, 5 of the W_{ST} MATRIX	±126.5 ft/sec		
GW53DST	Element 6, 5 of the W_{ST} MATRIX	±126.5 ft/sec		
GW61ST	Element 1, 6 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ ft		
GW62ST	Element 2, 6 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ ft		
GW63ST	Element 3, 6 of the W_{ST} MATRIX	$\pm 52.5 \times 10^3$ ft		
GW61DST	Element 4, 6 of the W_{ST} MATRIX	±126.5 ft/sec		
GW62DST	Element 5, 6 of the W_{ST} MATRIX	±126.5 ft/sec		
GW63DST	Element 6, 6 of the W_{ST} MATRIX	±126.5 ft/sec		
*W				
*W_{11}	Element 1, 1 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*W_{12}	Element 2, 1 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*W_{13}	Element 3, 1 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*$\dot{W}_{11}$	Element 4, 1 of the W MATRIX	±126.5 ft/sec		
*$\dot{W}_{12}$	Element 5, 1 of the W MATRIX	±126.5 ft/sec		
*$\dot{W}_{13}$	Element 6, 1 of the W MATRIX	±126.5 ft/sec		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-26. Guidance and Navigation System — Coast (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*W_{21}	Element 1, 2 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*W_{22}	Element 2, 2 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*W_{23}	Element 3, 2 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*$\dot{W}_{21}$	Element 4, 2 of the W MATRIX	±126.5 ft/sec		
*$\dot{W}_{22}$	Element 5, 2 of the W MATRIX	±126.5 ft/sec		
*$\dot{W}_{23}$	Element 6, 2 of the W MATRIX	±126.5 ft/sec		
*W_{31}	Element 1, 3 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*W_{32}	Element 2, 3 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*W_{33}	Element 3, 3 of the W MATRIX	$\pm 52.5 \times 10^3$ ft		
*$\dot{W}_{31}$	Element 4, 3 of the W MATRIX	±126.5 ft/sec		
*$\dot{W}_{32}$	Element 5, 3 of the W MATRIX	±126.5 ft/sec		
*$\dot{W}_{33}$	Element 6, 3 of the W MATRIX	±126.5 ft/sec		
*W_{41}	Element 1, 4 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*W_{42}	Element 2, 4 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*W_{43}	Element 3, 4 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*$\dot{W}_{41}$	Element 4, 4 of the W MATRIX	-126.5, 126.5 ft/sec		
*$\dot{W}_{42}$	Element 5, 4 of the W MATRIX	-126.5, 126.5 ft/sec		
*$\dot{W}_{43}$	Element 6, 4 of the W MATRIX	-126.5, 126.5 ft/sec		
*W_{51}	Element 1, 5 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*W_{52}	Element 2, 5 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*W_{53}	Element 3, 5 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*$\dot{W}_{51}$	Element 4, 5 of the W MATRIX	-126.5, 126.5 ft/sec		
*$\dot{W}_{52}$	Element 5, 5 of the W MATRIX	-126.5, 126.5 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-26. Guidance and Navigation System — Coast (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*$\dot{W}_{53}$	Element 6, 5 of the W MATRIX	-126.5, 126.5 ft/sec		
*W_{61}	Element 1, 6 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*W_{62}	Element 2, 6 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*W_{63}	Element 3, 6 of the W MATRIX	-52.5×10^3, 52.5×10^3 ft		
*$\dot{W}_{61}$	Element 4, 6 of the W MATRIX	-126.5, 126.5 ft/sec		
*$\dot{W}_{62}$	Element 5, 6 of the W MATRIX	-126.5, 126.5 ft/sec		
*$\dot{W}_{63}$	Element 6, 6 of the W MATRIX	-126.5, 126.5 ft/sec		
*G278	Flag indicating AGC receipt of mark	Boolean		
*GVRB	Desired verb for display	0, 77		
*GNOUN	Desired noun for display	0, 77		
*GNDW	Code word for display program	0000, 7777		
*G168	Flag for keyboard busy (1 = in use)	Boolean		
*GASTRO	Flag indicating astronaut action	0, 7		
*GPRIOR	Priority associated with mode change	0, 40000		
*G00PRIO	Priority associated with major mode 00			
G953	Flag to nav integ for coordinate shift	Boolean		
G954	Flag to nav integ for No. w matrix update	Boolean		
G955	Flag to nav integ for time stop	Boolean		
G956	Flag to nav integ for time stop	Boolean		
G999	Flag to nav integ for safe storage necessary	Boolean		
GTSP		Seconds		
	Earth return aim point update ~ latitude	Degrees		
	Earth return aim point update ~ longitude	Degrees		
	Earth return aim point update ~ maneuver ΔV	Ft/sec		
	Earth return aim point update ~ pitch trim	Degrees		
	Earth return aim point update ~yaw trim	Degrees		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-26. Guidance and Navigation System — Coast (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
	Earth return aim point update ~ ΔV tail off	Ft/sec		
*$\underline{\delta}_r$	Vector for position deviation			
GDEX	X-component position deviation	±52.5 x 10^3 ft		
GDEY	Y-component position deviation	±52.5 x 10^3 ft		
GDEZ	Z-component position deviation	±52.5 x 10^3 ft		
*$\underline{\delta}_v$	Vector for velocity deviation			
GDEDX	X-component velocity deviation	±126.5 ft/sec		
GDEDY	Y-component velocity deviation	±126.5 ft/sec		
GDEDZ	Z-component velocity deviation	±126.5 ft/sec		
GUD1	Ground update word 1	±1.0		
GUD2	Ground update word 2	±1.0		
GUD3	Ground update word 3	±1.0		
GUD4	Ground update word 4	±1.0		
GUD5	Ground update word 5	±1.0		
GUD6	Ground update word 6	±1.0		
GUD7	Ground update word 7	±1.0		
GUD8	Ground update word 8	±1.0		
GTHD	Orbit change aim update ~ latitude	Degrees		
GPHD	Orbit change aim update ~ longitude	Degrees		
GN	Orbit change aim update ~ altitude	Nautical miles		
GDEVMAX	Orbit change aim update ~ delta V max	Ft/sec		
GTHTRIM	Orbit change aim update ~ pitch trim	Degrees		
GPSTRIM	Orbit change aim update ~ yaw trim	Degrees		
GDEVTO	Orbit change aim update ~ delta V tail off	Ft/sec		
GTIGN	Orbit change aim update ~ time of ignition	Seconds		
*GVB	Present verb	0, 77		
*GNN	Present noun	0, 77		
*GT	Present value of the AGC clock			
* R	Position vector in I_E frame from nav integration			

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-26. Guidance and Navigation System — Coast (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GXR	X-comp of position vector at time T_N	$\pm 53.8 \times 10^6$ ft		
GYR	Y-comp of position vector at time T_N	$\pm 53.8 \times 10^6$ ft		
GZR	Z-comp of position vector at time T_N	$\pm 53.8 \times 10^6$ ft		
*$\vec{V}_R$	Velocity vector in I_E frame from nav integration			
GXDR	X-comp of velocity vector at time T_N	±32768 ft/sec		
GYDR	Y-comp of velocity vector at time T_N	±32768 ft/sec		
GZDR	Z-comp of velocity vector at time T_N	±32768 ft/sec		
*$\vec{Y}_{REC}$	Position vector at time of rectification			
GXREC	X-comp of position vector at time of rectification	$\pm 53.8 \times 10^6$ ft		
GYREC	Y-comp of position vector at time of rectification	$\pm 53.8 \times 10^6$ ft		
GZREC	Z-comp of position vector at time of rectification	$\pm 53.8 \times 10^6$ ft		
*$\vec{V}_{REC}$	Velocity vector at time of rectification			
GXDREC	X-comp of velocity vector at time of rectification	±32768 ft/sec		
GYDREC	Y-comp of velocity vector at time of rectification	±32768 ft/sec		
GZDREC	Z-comp of velocity vector at time of rectification	±32768 ft/sec		
GTN	Present time to the navigation integration	0, 268.6×10^4 sec		
GTAU	Time elapsed since rectification in nav int	0, 268.6×10^4 sec		
GTREC	Time of rectification	0, 268.6×10^4 sec		
GASTRO	Flag indicating astronaut action	0, 7		
GCONV	Conversion from meters to feet	Ft/meter		
GPRIOR	Priority associated with mode change request	0, 40000		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-27. Guidance and Navigation System - Prethrusting

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G274	Pre-thr MM flag; 1: MM31; 0: MM32	Boolean		
G273	Flag indicating MM51 initiated by MM31 or 32	Boolean		
G917	Flag indicating MM53 initiated by MM31 or 32	Boolean		
G168	Keyboard busy Boolean	Boolean		
G914	Steerlaw $i_{\underrightarrow{T}}$ flag; 0: compute $i_{\underrightarrow{T}}$	Boolean		
G916	CSM abort to contingency orbit flag	Boolean		
GNOUN	I/O code word for noun			
GVRB	I/O code word for verb			
GNDW	I/O code word for display job			
GPRIOR	Priority of latest job requested			
G51PRIO	Priority of MM51			
G00PRIO	Priority of MM00			
GOHKLST	Checklist register in AGC			
GASTRO	Flag indicating astro action			
*G272	GTTE routines SPB	Boolean		
*$\underrightarrow{\Gamma}_R$	Inertial position vector			
GXR	X-comp of inertial position vector	$\pm 53.8 \times 10^6$ ft		
GYR	Y-comp of inertial position vector	$\pm 53.8 \times 10^6$ ft		
GZR	Z-comp of inertial position vector	$\pm 53.8 \times 10^6$ ft		
*$\underrightarrow{\Gamma}_N$	GAYGINIT notation for pos vector			
GRXN	X-comp of GAYGINIT notation for pos vector	$\pm 53.8 \times 10^6$ ft		
GRYN	Y-comp of GAYGINIT notation for pos vector	$\pm 53.8 \times 10^6$ ft		
GRZN	Z-comp of GAYGINIT notation for pos vector	$\pm 53.8 \times 10^6$ ft		
GRN	Magnitude of $\underrightarrow{N}$	0, $\pm 53.8 \times 10^6$ ft		
*$\underrightarrow{\Gamma}_{SS}$	Safe-stored position vector			
GXSS	X-comp of safe-stored position vector	$\pm 53.8 \times 10^6$ ft		
GYSS	Y-comp of safe-stored position vector	$\pm 53.8 \times 10^6$ ft		
GZSS	Z-comp of safe-stored position vector	$\pm 53.8 \times 10^6$ ft		
*$\underrightarrow{V}_N$	GAYGINIT velocity vector			
GVXN	X-comp of GAYGINIT velocity vector	±32767 ft/sec		
GVYN	Y-comp of GAYGINIT velocity vector	±32767 ft/sec		
GVZN	Z-comp of GAYGINIT velocity vector	±32767 ft/sec		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-27. Guidance and Navigation System - Prethrusting (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GVN	Mag of GAVGINIT velocity vector	0, +32767 ft/sec		
*$\vec{V}_{SS}$	Safe-stored velocity vector			
GXDSS	X-comp of safe-stored velocity vector	±32767 ft/sec		
GYDSS	Y-comp of safe-stored velocity vector	±32767 ft/sec		
GZDSS	Z-comp of safe-stored velocity vector	±32767 ft/sec		
*$\vec{V}_{REQN}$	Vel-req vector at time N			
GVXREQN	X-comp of vel-req vector at time N	±32767 ft/sec		
GVYREQN	Y-comp of vel-req vector at time N	±32767 ft/sec		
GVZREQN	Z-comp of vel-req vector at time N	±32767 ft/sec		
*$\vec{V}_{REQN-1}$	Vel-req vector at time N-1			
GVXREQNM	X-comp of vel-req vector at time N-1	±32767 ft/sec		
GVYREQNM	Y-comp of vel-req vector at time N-1	±32767 ft/sec		
GVZREQNM	Z-comp of vel-req vector at time N-1	±32767 ft/sec		
*$\vec{i}_T$	Inertial unit vector in dir of initial thrust			
GITX	X-comp of inertial unit vector in dir of initial thrust	±1		
GITY	Y-comp of inertial unit vector in dir of initial thrust	±1		
GITZ	Z-comp of inertial unit vector in dir of initial thrust	±1		
*$\vec{\epsilon}$	Inertial unit vector in dir of +XSM axis			
GEPSX	X-comp of inertial unit vector in dir of +XSM axis	±1		
GEPSY	Y-comp of inertial unit vector in dir of +XSM axis	±1		
GEPSZ	Z-comp of inertial unit vector in dir of +XSM axis	±1		
*$\vec{P}$	Inertial unit vector in dir of -ZSM axis			
GRHOX	X-comp unit vector in dir of -ZSM axis	±1		
GRHOY	Y-comp unit vector in dir of -ZSM axis	±1		
GRHOZ	Z-comp unit vector in dir of -ZSM axis	±1		
GTSTAR	GTTE input	0, 2.686×10^6 sec		
GTIGN	Time of SPS ignition	0, 2.686×10^6 sec		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-28. Guidance and Navigation System - Thrusting

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G244	SPB of ΔV monitor routine	Boolean		
G271	Type of thrusting MM keyed in; 1: orbit-change	Boolean		
G274	Type of pre-thrusting MM just accomp; 1: orbit-change	Boolean		
G914	STEERLAW flag	Boolean		
G911	SPB of steerlaw routine	Boolean		
G283				
G919	GDVXMTR flag	Boolean		
G920	Secondary thrust on Boolean	Boolean		
G922	SPB of DVXTRMR routine	Boolean		
G960	Duration of burn Boolean	Boolean		
G963	Powered flight nav update flag	Boolean		
G168	Keyboard busy flag	Boolean		
G280	GAVGINIT one-shot flag	Boolean		
GT	Current time	0, 2680000 sec		
GTIGN	Time of ignition	0, 2680000 sec		
GTTE	Time to event	0, 2680000 sec		
GDVTH	Threshold ΔV	.10, 1.00 ft/sec^2		
GTJP	Time of GAVGINIT exit	0, 2680000 sec		
G251	Primary thrust Boolean; 1 = thrust on	Boolean		
GSCS	On Boolean for SCS discrete monitor	Boolean		
G954	Flag to nav integration for No W-matrix update	Boolean		
GTSP	Time to stop nav integration	0, 2680000 sec		
GAVGT	Waitlist time decrement used in GAVGINIT routine	0.5, 255 sec		
GDVACO	Simulated PIPA output vector			
GXACC	X-comp of simulated PIPA output vector	±1021 ft/sec		
GYACC	Y-comp of simulated PIPA output vector	±1021 ft/sec		
GZACC	Z-comp of simulated PIPA output vector	±1021 ft/sec		
G161	Program alarm Boolean	Boolean		
G241	SPB of GANGINIT routine			
GYRB	I/O code word for verb	00, 77_8		
GNOUN	I/O code word for noun	00, 77_8		
GNDW	I/O code word for display job	0000, 7777_8		

Table 6-28. Guidance and Navigation System - Thrusting (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GASTRO	Flag indicating astronaut action	0, 7		
GPRIOR	Priority of latest job requested			
GOOPRIO	Priority of MM00			
GMODE	I/O code word for mode			

Table 6-29. Guidance and Navigation System — In-Flight Align

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GISSMOD				
GTHETAD	Desired outer CDU position, computer	0, 360 deg		
GTHETAD1	Desired inner CDU position, computer	0, 360 deg		
GTHETAD2	Desired middle CDU position, computer	0, 360 deg		
GVRB				
GNOUN				
GWTLSTDT		0, 100.00		
GNDW				
G596	Attitude cont command to fixed angles	0, 1		
GOOPRIO				
GMARK1AT	Trunnion angle at MARK 1	0, 360 deg		
GMARK1AS	Shaft angle at MARK 1	0, 360 deg		
GMARK1OG	Outer gimbal angle at MARK 1	0, 360 deg		
GMARK1MG	Middle gimbal angle at MARK 1	0, 360 deg		
GMARK1IG	Inner gimbal angle at MARK 1	0, 360 deg		
GSTAR1SX	X-coordinate of selected STAR 1	±1		
GSTAR1SY	Y-coordinate of selected STAR 1	±1		
GSTAR1SZ	Z-coordinate of selected STAR 1	±1		
GMARK2AT	Trunnion angle at MARK 2	0, 360 deg		
GMARK2AS	Shaft angle at MARK 2	0, 360 deg		
GMARK2OG	Outer gimbal angle at MARK 2	0, 360 deg		
GMARK2MG	Middle gimbal angle at MARK 2	0, 360 deg		
GMARK2IG	Inner gimbal angle at MARK 2	0, 360 deg		
GSTAR2SX	X-coordinate of selected STAR 2	±1		
GSTAR2SY	Y-coordinate of selected STAR 2	±1		
GSTAR2SZ	Z-coordinate of selected STAR 2	±1		
GPRIOR		1		
GMARKAAT	Trunnion angle at MARK A	0, 360 deg		
GMARKAAS	Shaft angle at MARK A	0, 360 deg		

Table 6-29. Guidance and Navigation System — In-Flight Align (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GMARKAOG	Outer gimbal angle at MARK A	0, 360 deg		
GMARKAMG	Middle gimbal angle at MARK A	0, 360 deg		
GMARKA1G	Inner gimbal angle at MARK A	0, 360 deg		
GSTARASX	X-coordinate of selected STAR A	±1		
GSTARASY	Y-coordinate of selected STAR A	±1		
GSTARASZ	Z-coordinate of selected STAR A	±1		
GOOPRIO				
G248				
GT	AGC present time double precision			
G901				

Table 6-30. Guidance and Navigation System — Re-Entry

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G266	Boost abort flag	Boolean		
G253	T_{FF} & ΔV_{INS} routine SPB	Boolean		
G260	GDEVINS computation	Boolean		
GVRB	I/O program code word for verb			
GNOUN	I/O program code word for noun			
GNDW	I/O program code word for display job			
G168	DSKY busy	Boolean		
GASTRO	Keyboard entry via DSKY			
GTE	Entry delay time counter	0, 2.7×10^6 sec		
GCHKCST	I/O code word			
GTEMAK	Entry delay time	0, 2.7×10^6 sec		
D501	Drogue chute deployed Boolean	Boolean		
G182	Start final phase Boolean	Boolean		
GPRIOR	Priority of last job on priority list			
D550	CM/SM SEB discrete	Boolean		
GTWAIT	Time delay constant	0, 2.7×10^6 sec		
G183	Entry targeting Boolean	Boolean		
G181	GENTDSPT SPB	Boolean		
G184	Bank $\angle$ and lateral miss Boolean	Boolean		
GT	AGC clock time			
G171	Entry control Boolean	Boolean		
G561	Inhibit stop-ahead hence	Boolean		

Table 6-31. Guidance and Navigation System — CSM Boost Abort Control

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*G266	Boost abort flag	Boolean		
*G244	DV monitor SPB discrete	Boolean		
*G251	DV monitor thrust ON/OFF discrete	Boolean		
*G252	Accelerometer activity discrete	Boolean		
GDVLACT	Total ΔVEL avail. for landing area control	0, 1638.3 ft/sec		
GDVINLD	Total ΔVEL initially loaded for SPS thrusting	Const 6200 ft/sec		
GDVT	ΔV accumulated total of SPS burn	0, 1638.3 ft/sec		
GDVAOI	Total ΔVEL avail for orbit insertion from SPS	0, 1638.3 ft/sec		
GLONGA	Longitude of desired landing site GE_{2GR}	Const 331.0 deg		
GLAMA	Latitude of desired landing site GE_{2GR}	Const 28.5 deg		
GT	AGC ref time	0, 2.686×10^6 sec		
GDELVTH	ΔV threshold	Const 1.0 ft/sec^2		
GVRB	Verb code word	-77, 77 octal		
GNOUN	Noun code word	-77, 77 octal		
GNDW	Display code word	-7777, -7777 octal		
GSCS	SCS discrete mon ON/OFF variable	0, 3		
GCOUNT	Counter for ΔT that VEL less than THLD			
G916	MM73 - 74 flag 0:73, = 1:74	Boolean		
GTASTK	Time at which MM73 - 74 negate GAVGINIT SPB	0, 2.686×10^6 sec		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G001	Main kybd key code-bit value (1) 1A14	Boolean		
G002	Main kybd key code-bit value (2) 1A14	Boolean		
G003	Main kybd key code-bit value (4) 1A14	Boolean		
G004	Main kybd key code-bit value (8) 1A14	Boolean		
G005	Main kybd key code-bit value (16) 1A14	Boolean		
G007	Main kybd key reset 1A14	Boolean		
G009	DBI, switch position; UDL blocked	Boolean		
G010	1 = AGC mode sw in ON pos	Boolean		
G011	Nav kybd key code-bit value (1) 1A33	Boolean		
G012	Nav kybd key code-bit value (2) 1A33	Boolean		
G013	Nav kybd key code-bit value (4) 1A33	Boolean		
G014	Nav kybd key code-bit value (8) 1A33	Boolean		
G015	Nav kybd key code-bit value (16) 1A33	Boolean		
G017	Nav kybd key reset 1A33	Boolean		
G020	Nav kybd test alarm 1A33	Boolean		
G026	IOS main kybd active	Boolean		
G027	MDP E/L display fail	Boolean		
G028	V/N display inhibited (=1)	Boolean		
G029	Uplink blocked panel 18A9	Boolean		
G037	NDP E/L display fail	Boolean		
G039	IOS NDP test alarm repeat 10A17	Boolean		
G040	Non-int uplink (UPRUPT)	Boolean		
G056	1A14 and 18A9 indicator, key release	Boolean		
G057	1A14 and 18A24 indicator, comp fail	Boolean		
G058	1A14 and 18A24 indicator, comp active	Boolean		
G076	1A33 and 16A2 indicator, prog alm	Boolean		
G077	1A33 and 16A17 indicator, comp active	Boolean		
G078	1A33 and 16A2 indicator, T/L fail	Boolean		
G079	1A33 and 16A2 indicator, check fail	Boolean		
G080	1A33 and 16A2 indicator, scalar fail	Boolean		
G081	1A33 and 16A2 indicator, parity fail	Boolean		
G082	1A33 and 16A2 indicator, counter fail	Boolean		
G083	1A33 and 16A2 indicator, key release	Boolean		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G084	1A33 and 16A2 indicator, RUPT lock	Boolean		
G085	1A33 and 16A2 indicator, TC trap	Boolean		
G086	1A33 and 16A2 indicator, spare	Boolean		
G087	1A33 and 16A2 indicator, spare	Boolean		
G088	1A33 and 16A2 indicator, spare	Boolean		
G090	AGC normal operation	Boolean		
G092	Or or AGC malfunctions	Boolean		
G095	Verb/noun flasher fail	Boolean		
G099	AGC freq ref discrete	Boolean		
G101	Keyboard delay Boolean	Boolean		
G102	Any NAVR18D key depressed (bell of test alarm)	Boolean		
G103	AGC 28 vdc pwr avail at ckt brkr	Boolean		
G110	Display reg R1, R2, or R3 flash command	Boolean		
G111	R1 blank discrete	Boolean		
G112	R2 blank discrete	Boolean		
G113	R3 blank discrete	Boolean		
G118	Uplink active	Boolean		
G125	1 = LM No. selected from IOS	Boolean		
G126	1 = LM selected by IDS in error	Boolean		
G130	Test alarm key depressed	Boolean		
G136	First display clear function completed	Boolean		
G137	Verb/noun flash command	Boolean		
G139	Main or nav kybd, or uplink active	Boolean		
G144	Error reset function active	Boolean		
G145	Positive sign function active	Boolean		
G146	Negative sign function active	Boolean		
G151	Illegal data active	Boolean		
G161	Program alarm light	Boolean		
G162	Comp. active flag	Boolean		
G163	Telem failure flag	Boolean		
G166	Parity failure flag	Boolean		
G167	Counter failure flag	Boolean		
G168	DSKY busy	Boolean		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G169	RUPT lock alarm flag	Boolean		
G170	TC trap alarm flag	Boolean		
G171	Entry control	Boolean		
G172	Primary thrust Boolean; 1:thrust on	Boolean		
G173	G&N ΔV mode in SCS	Boolean		
G176	SCS in G&N delta V mode	Boolean		
	SCS in G&N att cont mode	Boolean		
G178		Boolean		
G182	Start final phase Boolean	Boolean		
G183	Entry targeting	Boolean		
G184	Bank L and lateral miss	Boolean		
G187	Drogue parachute deployed Boolean	Boolean		
G193	CDU fail alarm	Boolean		
G201	Computer requesting zero encode	Boolean		
G202	Computer requesting coarse align	Boolean		
G203	Computer requesting CDU manual	Boolean		
G204	Computer requesting fine align	Boolean		
G206	CDU fail, AGC output	Boolean		
G207	PIPA fail, AGC output	Boolean		
G208	IMU fail, AGC output	Boolean		
G210	Computer requesting attitude control	Boolean		
G211	Computer requesting entry	Boolean		
G215	AGC 13 vdc failure	Boolean		
G216	AGC 3 vdc failure	Boolean		
G217	AGC 28 vdc failure	Boolean		
G218	AGC freq ref (1024 mc) failed	Boolean		
G219	AGC failed	Boolean		
G240	Gyro compassing perpetuate Boolean	Boolean		
G241	Average G perpetuate Boolean	Boolean		
G242	Polyfit routine S-P Boolean	Boolean		
G243	Orbit display rt started Boolean	Boolean		
G244	ΔV monitor self-perpetuate Boolean	Boolean		
G245	GMAX routine SPB	Boolean		
G246	Interim platform flag	Boolean		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G248	Sighting flag on initial	Boolean		
G249	Priority list to be checked (exec)	Boolean		
G250	Guidance reference release flag	Boolean		
G251	Thrust off discrete; (0 = thrust off)	Boolean		
G252	PIPA termination Boolean	Boolean		
G253	T_{FF} & ΔV_{INS} routine SPB	Boolean		
G254	ΔR routine SPB	Boolean		
G256	Orbit display rt. finished Boolean	Boolean		
G257	Launch pad state indicator; 0 = on pad	Boolean		
G258	GALTANG self-perpetuate Boolean	Boolean		
G259	GDEVINS update rate	Boolean		
G260	GDEVINS computation	Boolean		
G261	Discrete for selection of MM61; 1 = MM61	Boolean		
G262	Monitor for request of MM61; 1 : MM61 requested	Boolean		
G263	Flag for gimbal lock possible (1 = not possible)	Boolean		
G264	VERTASK SPB	Boolean		
G265	Flag for major mode 21 (1 = in progress)	Boolean		
G266	Boost abort flag	Boolean		
G268	Target flag (1 = landmark)	Boolean		
G269	Response for known landmark (1 = known)	Boolean		
G271	Type of thrusting MM keyed in J	Boolean		
G272	GTTE routines SPB	Boolean		
G273	MM51 initiated during MM31 or MM32	Boolean		
G274	Type of prethrusting MM just accomplished	Boolean		
G275	Key release control	Boolean		
G276		Boolean		
G277		Boolean		
G278	Flag indicating AGC receipt of mark	Boolean		
G279	GNVSUB has been activated	Boolean		
G280	Subroutine GTTE SPB discrete	Boolean		
G302	IMU flag; 0 = IMU energized and operational	Boolean		
G328	ISS is in fine align mode	Boolean		
G336	ISS is in attitude control mode	Boolean		
G385	IMU flag; 1 = IMU energized	Boolean		
G403	Optics mode switch	Boolean		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G439		Boolean		
G460	Optics mode switch	Boolean		
G480	CDU roll slew sw command inc, not malf	Boolean		
*G481	CDU roll slew sw command dec, not malf	Boolean		
*G482	CDU yaw slew sw command inc, not malf	Boolean		
*G483	CDU yaw slew sw command dec, not malf	Boolean		
*G484	CDU pitch slew sw command inc, not malf	Boolean		
*G485	CDU pitch slew sw command dec, not malf	Boolean		
*G486	Telemetry input, IMU temp. warn sig.	Boolean		
*G487	Telemetry input, gimbal lock warn	Boolean		
*G488	Telemetry input, error detect sig.	Boolean		
*G489	Telemetry input, IMU delay warn	Boolean		
*G490	Telemetry input, zero encode sig.	Boolean		
*G491	IMU control transfer sw, 1 = man, not malf	Boolean		
*G492	IMU control transfer sw, 1 = comp, not malf	Boolean		
*G493	Telemetry input, IMU 28v supply	Boolean		
*G494	Telemetry input, 2.5 vdc telemetry bias	Boolean		
*G495	T/M bias 2.5 vdc, power	Boolean		
*G496	Not assigned			
*G497	Not assigned			
*G498	Not assigned			
*G499	Not assigned			
G561	G&N has reached entry mode	Boolean		
G593	Steering computations in progress	Boolean		
G596	Exec. command att cont angles flag A	Boolean		
G597	CDU drive control	Boolean		
G623	Flag for gimbal lock; 1 = not possible	Boolean		
G642	Reset activity discrete	Boolean		
G644	Step-ahead activity discrete	Boolean		
G646	Simulated UDL transmission in progress	Boolean		
G670	Attitude control flag	Boolean		
G675	S-IVB called by CSM	Boolean		
G680	Interim vehicle flag	Boolean		
G682	Z_{NB} already determined	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G683	Return address Boolean	Boolean		
G698	AGC is controlling the optics	Boolean		
G700	Relative velocity switch	Boolean		
G701	Final phase switch	Boolean		
G704	No lateral control when on	Boolean		
G705	Indicates overshoot of target	Boolean		
G706	Entry control Boolean	Boolean		
G875	Steer or no steer maneuver Boolean	Boolean		
G891	Boolean used to determine abort mode	Boolean		
G892	Boolean used to determine abort mode	Boolean		
G895	Equation GS5212			
G896	Backup liftoff discrete	Boolean		
G901	Platform alignment Boolean	Boolean		
G9021	Engine on discrete; (1 = engine on)	Boolean		
G903	Criterion for program entry; 0 : first pass	Boolean		
G904	Criterion for skipping guidance; 1 : skip	Boolean		
G905	Steerlaw flag; 1 = 2nd pass through V_{REQ} EONS.	Boolean		
G906	GRTEMPC 1st pass flag; 1 = 1st pass	Boolean		
G911	SPB of STEERLAW routine	Boolean		
G912	Boolean ensuring subs monitor instr. box	Boolean		
G914	Steerlaw flag: 0 = determine it	Boolean		
G916	CSM abort to contingency orbit flag	Boolean		
G917	MM53 initiation during MM31 or MM32	Boolean		
G919	DVXMTR flag	Boolean		
G927	Criterion for initializing d DOT; 0 : initialize	Boolean		
G953	Coordinate system Boolean	Boolean		
G954	Flag to nav integration for no w. matrix update	Boolean		
G955	Flag to nav integration for time stop	Boolean		
G956	Flag to nav integration for time stop	Boolean		
G959	Flag for conic velocity calculation (1 = not req'd)	Boolean		
G960	Powered flight flag for W matrix update	Boolean		
G963	Navigation update flag	Boolean		
G998	Flag for last update conditions (1 = safe storage)	Boolean		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G999	Flag to nav integ for safe storage necessary	Boolean		
GAV6PR	Avg G priority	Const 26000 octal		
GATTPR	Attitude priority	Const 26000 octal		
GASTRO	Keyboard entry via DSKY	0, 2^3		
GA13A	Direction cosine to star A from S/M	±1		
GA23A	Direction cosine to star A from S/M	±1		
GA33A	Direction cosine to star A from S/M	±1		
GAVGT	Waitlist time increment used in GAVG routine	0.05, 3.99 sec		
GATE	Estimated magnitude of acceleration	±323 ft/sec^2		
*$\vec{a}_N$	Acc vect normal to present plane			
GANX	X-comp of acc vect normal to present plane	±80 ft/sec^2		
GANY	Y-comp of acc vect normal to present plane	±80 ft/sec^2		
GANZ	Z-comp of acc vect normal to present plane	±80 ft/sec^2		
GAN	Mag of acc vect normal to present plane	0, +80 ft/sec^2		
GAMLOOK	Angle between thrust and horizon	Const 0.553 rad		
GAMATT	Angle between thrust and local vertical	0, 2.124 rad		
GALPH	Angle between earth vector and star LOS	0, 2^9 deg		
GAREC	Conic parameter	0, 14700 ft$^{1/2}$		
GALREC	Conic parameter ~ inverse semimotor axis	1.85 x 10^{-8}, 4.79 x 10^{-8} ft^{-1}		
GA1	Conic coefficient	0, 108 x 10^6 ft		
GA2	Conic coefficient	0, 248 x 10^{10} ft$^{3/2}$		
GA3	Conic coefficient	0, 65536 ft$^{1/2}$		
GA4	Conic coefficient	-2.6, 2.6		
GA5	Conic coefficient	0, 26600 sec		
GA6	Conic coefficient	±0.0179 sec^{-1}		
GA7	Conic coefficient	-2.6, 2.6		
GA8	Conic parameter for X expansion by MIT	0, 4 x 10^{-4} ft$^{-1/2}$		
GAGCIGA	AGC inner gimbal angle	±360 deg		
GAGCMGA	AGC middle gimbal angle	±360 deg		
GAGCOGA	AGC outer gimbal angle	±360 deg		
GXACC	X-comp of simulated PIPA output vector	±400 ft/sec		
GYACC	Y-comp of simulated PIPA output vector	±400 ft/sec		
GZACC	Z-comp of simulated PIPA output vector	±400 ft/sec		

*Program symbols are not available at publication date.
Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GAT	Acc due to SPS thrusting	0, 330 ft/sec^2		
GASM	Semimajor axis of vehicle orbit	4.1711096 x 10^7, 4.3 x 10^7 ft		
GAPOGEE	Vehicle altitude at apogee in n mi			
GAPOGEF	Vehicle altitude at apogee in feet			
GA2E	Second harmonic earth constant	Const 66.71217938 x 10^{26}		
GA3E	Third harmonic earth constant	Const -296.6648514 x 10^{30}		
GA4E	Fourth harmonic earth constant	Const -48.58380796 x 10^{38}		
GA	Dummy variable in Y (encke's) acceleration	-5.66 x 10^{12}, 5.66 x 10^{12} ft^2		
GABSVEL	Absolute value of velocity due to thrust-	0 ft/sec		
GAA	Launch azimuth	Const 77.9901 deg		
*A	E-frame to I_E frame trans matrix			
GA11	Element (1, 1): geographic to inertial trans.	±1.0		
GA12	Element (1, 2): geographic to inertial trans.	±1.0		
GA13	Element (1, 3): geographic to inertial trans.	±1.0		
GA21	Element (2, 1): geographic to inertial trans.	±1.0		
GA22	Element (2, 2): geographic to inertial trans.	±1.0		
GA23	Element (2, 3): geographic to inertial trans.	±1.0		
GA31	Element (3, 1): geographic to inertial trans.	±1.0		
GA32	Element (3, 2): geographic to inertial trans.	±1.0		
GA33	Element (3, 3): geographic to inertial trans.	±1.0		
*α	Velocity transformed into nav base			
GALX	X-comp of velocity transformed into nav base	±32767 ft/sec		
GALY	Y-comp of velocity transformed into nav base	±32767 ft/sec		
GALZ	Z-comp of velocity transformed into nav base	±32767 ft/sec		
GAI	Dummy variable inner gimble angle	0, 360 deg		
GAM	Dummy variable middle gimble angle	0, 360 deg		
GAO	Dummy variable outer gimble angle	0, 360 deg		
GANGLEX	Angle btwn Z_{NB} and X_{IE} axis	±2.9 deg		
GANGLEY	Angle btwn Z_{NB} and Y_{IE} axis	±2.9 deg		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GANGLEZ	Angle btwn Z_{NB} and Z_{IE} axis	±2.9 deg		
GANGLEDX	Angle btwn Z_{NB} and X_{IE} axis	±2.9 deg		
GANGLEDY	Angle btwn Z_{NB} and Y_{IE} axis	±2.9 deg		
GANGLEDZ	Angle btwn Z_{NB} and Z_{IE} axis	±2.9 deg		
GALPH1	Angle earth and star LOS	-2.9, 2.9 deg		
GATZE	Test register, initially equals GCDUOGA	0, 360 deg		
GAOSTAR1	Contents are star target desired	0, 28		
GAGCTRUN	AGC trun input to optics drive	0, 360 deg		
GAGCSHFT	AGC shaft input to optics drive	0, 360 deg		
GACC1	Intermediate storage No. 1	0, 5000		
GACC2	Intermediate storage No. 2	0, 5000		
GAREF	Reference trajectory functions	0, 130		
GAREFO	Equation GS6003	0, 130		
GARRNGE	Equation GS600A	±1000		
GAPR	Squared magnitude of u vector	0, 60×10^3		
GALBRSQ	Mean squared estimation error	0, 10^{-5} rad		
GALBRSQS	Mean squared sextant error	Const $2.350443053 \times 10^{-9}$ rad		
GALBRSQT	Mean squared telescope error	Const 1×10^{-6} rad		
GAUP	Update equations parameter	0, 10^6		
GAN	Total acceleration vector	0, 400 ft/sec^2		
GAAN	Ma6 total acceleration vector	±323 ft/sec^2		
GAREFI	Reference trajectory parameter	6.4, 125.2 ft/sec^2		
GAREFI1	Reference trajectory parameter	6.4, 125.2 ft/sec^2		
GAJAY	Total no. of LM on J^{th} film strip	0, 63		
GAIPLJ	Notation for any LM on J^{th} film strip	0, 511		
GAS	Current semimajor axis of desired orbit	$+2.08 \times 10^7$, 5.38×10^7 ft		
GAME	Entry flight path angle	90, 179.99 deg		
GASQMT	Square root of sum of $(S_{SCDX})^2 + (Y_{SCDZ})^2$	0, $2^{1/2}$		
*a^{N-1}	ACC vector during previous cycle			
GANM1X	X-comp of ACC vector during previous cycle	±7.0 ft/sec^2		
GANM1Y	Y-comp of ACC vector during previous cycle	±7.0 ft/sec^2		

*Program symbols are not available at publication date. Math model symbols are given for information only

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GANMIZ	Z-comp of ACC vector during previous cycle	± 7.0 ft/sec^2		
GAREF1	Reference trajectory parameter	Const 6.4 FPSS		
GAREF2	Reference trajectory parameter	Const 6.4 FPSS		
GAREF3	Reference trajectory parameter	Const 28.1 FPSS		
GAREF4	Reference trajectory parameter	Const 95.4 FPSS		
GAREF5	Reference trajectory parameter	Const 120.4 FPSS		
GAREF6	Reference trajectory parameter	Const 125.2 FPSS		
GAREF7	Reference trajectory parameter	Const 118.7 FPSS		
GAREF8	Reference trajectory parameter	Const 102.3 FPSS		
GAREF9	Reference trajectory parameter	Const 98.5 FPSS		
GAREF10	Reference trajectory parameter	Const 93.9 FPSS		
GAREF11	Reference trajectory parameter	Const 81.5 FPSS		
GAREF12	Reference trajectory parameter	Const 60.0 FPSS		
GAREF13	Reference trajectory parameter	Const 42.6 FPSS		
GAREF14	Reference trajectory parameter	Const 34.1 FPSS		
GAREF15	Reference trajectory parameter	Const 34.1 FPSS		
GAMDS	Entry flt path angle to be displayed	± 90 deg		
GALPOC	Angle between two vectors	0, 180 deg		
GASQ1	Square root of sum of $(X^2_{BSMX}) + (Y^2_{BSMZ})$	0, $2^{1/2}$		
GAMGD	Middle gimbal desired angle	± 360		
GAIGD	Inner gimbal desired angle	± 360		
GAOGD	Outer gimbal desired angle	± 360		
GBXZ	X-comp of velocity in body coord	± 32767 ft/sec		
* $\underrightarrow{B}$	STEERLAW BEE vector			
GBX	X-component of velocity required dot minus gain	± 127		
GBY	Y-component of velocity required dot minus gain	± 127		
GBZ	Z-component of velocity required dot minus gain	± 127		
* $^{2B}_{dg}$				
GXD2BG	X-component of velocity to be gained	± 16383 ft/sec		
GYD2BG	Y-component of velocity to be gained	± 16383 ft/sec		
GZD2BG	Z-component of velocity to be gained	± 16383 ft/sec		
GB	Earth polar radius	Const 2.0855598×10^7 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GBETA1	Angle between earth vector and earth tangent	0, 2^9 deg		
GBREC	Conic parameter	-1, 1		
GBXA	X-component of velocity inbody coordinate	±32767 ft/sec		
GBURNT	Burn time for events timer	-10.0, 100.0 sec		
GBETA2	Angle between stars A and B	-2^9, 2^9 deg		
GBTZE	Test quantity	0, 1		
GCHARPR	Subroutine charin priority	Const 30000 octal		
GCOSATA	Cosine of trunnion angle for mark A	±1		
GCOSATB	Cosine of trunnion angle for mark B	±1		
GCOSASA	Cosine of shaft angle for mark A	±1		
GCOSASB	Cosine of shaft angle for mark B	±1		
GCOSOGA	Cosine of outer gimble angle for mark A	±1		
GCOSOGB	Cosine of outer gimble angle for mark B	±1		
GCOSMGA	Cosine of middle gimble angle for mark A	±1		
GCOSMGB	Cosine of middle gimble angle for mark B	±1		
GCOSIGA	Cosine of inner gimble angle for mark A	±1		
GCOSIGB	Cosine of inner gimble angle for mark B	±1		
GCA	Error term for ΔV computation	±66		
*$\overrightarrow{CROSS}$	Steerlaw cross vector			
GCROSSX	X-component of V_{2BG} crossed into ΔM	±1.65 x 10^7 ft/sec		
GCROSSY	Y-component of V_{2BG} crossed into ΔM	±1.65 x 10^7 ft/sec		
GCROSSZ	Z-component of V_{2BG} crossed into ΔM	±1.65 x 10^7 ft/sec		
GCONV	Conversion from meters to feet	Const 3.280833 ft/meter		
GCOUNT	Mark data now being processed	0, 6		
GCMAX	Max No. of iterations to be performed	Const 20		
GCP	Battins special function c	0, 2.93		
*$\overrightarrow{V_c}$	Velocity vector as defined by the conic			
GXDC	X-comp of conic defined velocity vector	±32768 ft/sec		
GYDC	Y-comp of conic defined velocity vector	±32768 ft/sec		
GZDC	Z-comp of conic defined velocity vector	±32768 ft/sec		
*Yc	Position vector as defined by conic			
GXC	X-comp of conic defined position vector	±53.8 x 10^6 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GYC	Y-comp of conic defined position vector	$\pm 53.8 \times 10^6$ ft		
GZC	Z-comp of conic defined position vector	$\pm 53.8 \times 10^6$ ft		
GRC	Magnitude of conic defined position vector	$\pm 53.8 \times 10^6$ ft		
GC	Steerlaw coefficient	00000, 77777		
GCHKLST	Checklist register in AGC	±1		
*$\mathfrak{C}$	C matrix			
GC11	Equation GS4102	±1		
GC12	Equation GS4103	±1		
GC13	Equation GS4104	±1		
GC21	Equation GS4105	±1		
GC22	Equation GS4106	±1		
GC23	Equation GS4107	±1		
GC31	Equation GS4108	±1		
GC32	Equation GS4109	±1		
GC33	Equation GS4110	±1		
GCAPQ	Dummy variable in Υ (encke's) acceleration	-7.61×10^{-3}, 7.61×10^{-3}		
GCONV	Conversion factor, ft to meters	Const 3.280833		
GCDTHCZ	Cos of Z-gyro torqing angle	±1.0		
GCAPT	Period of conic orbit	0, 26600 sec		
GCOSTHCO	Cos θ_{CO}	±1		
GCOS33	Cos 33 degrees	Const 0.8386705679		
GC1	Ref traj param	-927, 1508		
GC2	Ref traj param	-927, 1508		
GCCCC	Ref traj param	-927, 1508		
GCI	Nom lat of any stored landmark	±180 deg		
GCEE	Angle error between GCI and GLMLAT	±360 deg		
GCIM	Max. landmark number storage	Const 273		
GCDRAT	Inclination of present orbit	±10		
*$\overrightarrow{CRAS}$	Vector prod of present pos vect with target vector			
GCRASSX	X-comp of present pos vect with target vector	-2.9×10^{15}, 2.9×10^{15} ft2		
GCRASSY	Y-comp of present pos vect with target vector	-2.9×10^{15} 2.9×10^{15} ft^2		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GCRASSZ	Z-comp of present pos vect with target vector	-2.9×10^{15}, 2.9×10^{15} ft^2		
GC01	Nominal landmark lat No. 1	Const -34.03 deg		
GC02	Nominal landmark lat No. 2	Const -34.2 deg		
GC03	Nominal landmark lat No. 3	Const -34.83 deg		
GC04	Nominal landmark lat No. 4	Const -34.35 deg		
GC05	Nominal landmark lat No. 5	Const -32.7 deg		
GC06	Nominal landmark lat No. 6	Const -28.63 deg		
GC07	Nominal landmark lat No. 7	Const -29.87 deg		
GC08	Nominal landmark lat No. 8	Const -28.8 deg		
GC09	Nominal landmark lat No. 9	Const -26.63 deg		
GC10	Nominal landmark lat No. 10	Const -22.88 deg		
GC12	Nominal landmark lat No. 12	Const -09.25 deg		
GC13	Nominal landmark lat No. 13	Const -15.52 deg		
GC14	Nominal landmark lat No. 14	Const -17.12 deg		
GC15	Nominal landmark lat No. 15	Const -25.25 deg		
GC16	Nominal landmark lat No. 16	Const -00.62 deg		
GC17	Nominal landmark lat No. 17	Const -3.38 deg		
GC18	Nominal landmark lat No. 18	Const 00.35 deg		
GC19	Nominal landmark lat No. 19	Const -4.77 deg		
GC20	Nominal landmark lat No. 20	Const 14.73 deg		
GC21	Nominal landmark lat No. 21	Const -12.27 deg		
GC28	Nominal landmark lat No. 28	Const 20.77 deg		
GC29	Nominal landmark lat No. 29	Const -12.93 deg		
GC30	Nominal landmark lat No. 30	Const -14.27 deg		
GC32	Nominal landmark lat No. 32	Const 7.57 deg		
GC33	Nominal landmark lat No. 33	Const 8.5 deg		
GC35	Nominal landmark lat No. 35	Const 7.95 deg		
GC37	Nominal landmark lat No. 37	Const 11.88 deg		
GC38	Nominal landmark lat No. 38	Const 13.45 deg		
GC39	Nominal landmark lat No. 39	Const 9.45 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GC40	Nominal landmark lat No. 40	Const -25.87 deg		
GC41	Nominal landmark lat No. 41	Const -23.73 deg		
GC42	Nominal landmark lat No. 42	Const -21.52 deg		
GC43	Nominal landmark lat No. 43	Const -19.85 deg		
GC44	Nominal landmark lat No. 44	Const 14.95 deg		
GC45	Nominal landmark lat No. 45	Const -16.52 deg		
GC46	Nominal landmark lat No. 46	Const -8.75 deg		
GC47	Nominal landmark lat No. 47	Const -6.67 deg		
GC49	Nominal landmark lat No. 49	Const -00.4 deg		
GC50	Nominal landmark lat No. 50	Const 2.63 deg		
GC51	Nominal landmark lat No. 51	Const 4.08 deg		
GC52	Nominal landmark lat No. 52	Const 30.62 deg		
GC53	Nominal landmark lat No. 53	Const -6.47 deg		
GC54	Nominal landmark lat No. 54	Const -2.1 deg		
GC55	Nominal landmark lat No. 55	Const -7.63 deg		
GC56	Nominal landmark lat No. 56	Const -5.73 deg		
GC57	Nominal landmark lat No. 57	Const -4.88 deg		
GC58	Nominal landmark lat No. 58	Const 28.45 deg		
GC59	Nominal landmark lat No. 59	Const 28.33 deg		
GC60	Nominal landmark lat No. 60	Const 28.58 deg		
GC61	Nominal landmark lat No. 61	Const 28.18 deg		
GC62	Nominal landmark lat No. 62	Const 28.07 deg		
GC63	Nominal landmark lat No. 63	Const 23.67 deg		
GC64	Nominal landmark lat No. 64	Const 10.55 deg		
GC65	Nominal landmark lat No. 65	Const 12.22 deg		
GC66	Nominal landmark lat No. 66	Const 10.13 deg		
GC67	Nominal landmark lat No. 67	Const 5.48 deg		
GC68	Nominal landmark lat No. 68	Const 6.85 deg		
GC69	Nominal landmark lat No. 69	Const 6.28 deg		
GC75	Nominal landmark lat No. 75	Const 10.58 deg		
	Nominal landmark lat No. 76			

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GC77	Nominal landmark lat No. 77	Const 6.95 deg		
GC80	Nominal landmark lat No. 80	Const -0.6 deg		
GC81	Nominal landmark lat No. 81	Const -17.7 deg		
GC82	Nominal landmark lat No. 82	Const -23.97 deg		
GC83	Nominal landmark lat No. 83	Const -23.0 deg		
GC84	Nominal landmark lat No. 84	Const -21.62 deg		
GC85	Nominal landmark lat No. 85	Const -20.32 deg		
GC86	Nominal landmark lat No. 86	Const 31.78 deg		
GC88	Nominal landmark lat No. 88	Const -6.97 deg		
GC90	Nominal landmark lat No. 90	Const -10.52 deg		
GC91	Nominal landmark lat No. 91	Const -13.02 deg		
GC95	Nominal landmark lat No. 95	Const -3.7 deg		
GC96	Nominal landmark lat No. 96	Const -30.43 deg		
GC97	Nominal landmark lat No. 97	Const -28.43 deg		
GC98	Nominal landmark lat No. 98	Const -32.15 deg		
GC99	Nominal landmark lat No. 99	Const -5.78 deg		
G1C00	Nominal landmark lat No. 100	Const -4.67 deg		
G1C01	Nominal landmark lat No. 101	Const -11.3 deg		
G1C03	Nominal landmark lat No. 103	Const -9.23 deg		
G1C04	Nominal landmark lat No. 104	Const -12.07 deg		
G1C05	Nominal landmark lat No. 105	Const -13.83 deg		
G1C06	Nominal landmark lat No. 106	Const -15.37 deg		
G1C07	Nominal landmark lat No. 107	Const -16.25 deg		
G1C08	Nominal landmark lat No. 108	Const -17.72 deg		
G1C09	Nominal landmark lat No. 109	Const -18.72 deg		
G1C10	Nominal landmark lat No. 110	Const -16.05 deg		
G1C11	Nominal landmark lat No. 111	Const -34.97 deg		
G1C13	Nominal landmark lat No. 113	Const 32.65 deg		
G1C14	Nominal landmark lat No. 114	Const 33.47 deg		
	Nominal landmark lat No. 115			
G1C16	Nominal landmark lat No. 116	Const 32.3 deg		
G1C17	Nominal landmark lat No. 117	Const 34.58 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G1C18	Nominal landmark lat No. 118	Const 33.85 deg		
G1C19	Nominal landmark lat No. 119	Const 29.27 deg		
G1C25	Nominal landmark lat No. 125	Const 27.68 deg		
G1C27	Nominal landmark lat No. 127	Const 24.54 deg		
G1C28	Nominal landmark lat No. 128	Const 25.67 deg		
G1C30	Nominal landmark lat No. 130	Const 27.83 deg		
G1C31	Nominal landmark lat No. 131	Const 27.85 deg		
G1C32	Nominal landmark lat No. 132	Const 26.72 deg		
G1C33	Nominal landmark lat No. 133	Const 24.32 deg		
G1C34	Nominal landmark lat No. 134	Const 24.18 deg		
G1C36	Nominal landmark lat No. 136	Const 22.87 deg		
G1C37	Nominal landmark lat No. 137	Const 23.18 deg		
G1C38	Nominal landmark lat No. 138	Const 20.42 deg		
G1C39	Nominal landmark lat No. 139	Const 22.27 deg		
G1C44	Nominal landmark lat No. 144	Const 10.9 deg		
G1C45	Nominal landmark lat No. 145	Const 9.57 deg		
G1C46	Nominal landmark lat No. 146	Const 8.08 deg		
G1C47	Nominal landmark lat No. 147	Const 8.88 deg		
G1C48	Nominal landmark lat No. 148	Const 7.33 deg		
G1C49	Nominal landmark lat No. 149	Const 15.95 deg		
G1C53	Nominal landmark lat No. 153	Const 26.68 deg		
G1C54	Nominal landmark lat No. 154	Const 25.03 deg		
G1C55	Nominal landmark lat No. 155	Const 24.87 deg		
G1C56	Nominal landmark lat No. 156	Const 25.43 deg		
G1C57	Nominal landmark lat No. 157	Const 22.85 deg		
G1C58	Nominal landmark lat No. 158	Const 24.13 deg		
G1C59	Nominal landmark lat No. 159	Const 22.12 deg		
G1C60	Nominal landmark lat No. 160	Const 22.37 deg		
G1C61	Nominal landmark lat No. 161	Const 21.12 deg		
G1C62	Nominal landmark lat No. 162	Const 21.43 deg		
G1C63	Nominal landmark lat No. 163	Const 17.93 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G1C64	Nominal landmark lat No. 164	Const 18.27 deg		
G1C65	Nominal landmark lat No. 165	Const 18.17 deg		
G1C66	Nominal landmark lat No. 166	Const 17.15 deg		
G1C67	Nominal landmark lat No. 167	Const 10.83 deg		
G1C68	Nominal landmark lat No. 168	Const 10.13 deg		
G1C69	Nominal landmark lat No. 169	Const 19.38 deg		
G1C70	Nominal landmark lat No. 170	Const 19.9 deg		
G1C71	Nominal landmark lat No. 171	Const 20.07 deg		
G1C72	Nominal landmark lat No. 172	Const 17.77 deg		
G1C73	Nominal landmark lat No. 173	Const 19.35 deg		
G1C74	Nominal landmark lat No. 174	Const 17.93 deg		
G1C75	Nominal landmark lat No. 175	Const 18.37 deg		
G1C76	Nominal landmark lat No. 176	Const 18.47 deg		
G1C77	Nominal landmark lat No. 177	Const 16.25 deg		
G1C78	Nominal landmark lat No. 178	Const 14.77 deg		
G1C79	Nominal landmark lat No. 179	Const 18.92 deg		
G1C80	Nominal landmark lat No. 180	Const 19.52 deg		
G1C81	Nominal landmark lat No. 181	Const 21.57 deg		
G1C82	Nominal landmark lat No. 182	Const 21.15 deg		
G1C83	Nominal landmark lat No. 183	Const -35.57 deg		
G1C84	Nominal landmark lat No. 184	Const -34.9 deg		
G1C86	Nominal landmark lat No. 185	Const -34.58 deg		
G1C86	Nominal landmark lat No. 186	Const -36.07 deg		
G1C87	Nominal landmark lat No. 187	Const -34.45 deg		
G1C88	Nominal landmark lat No. 188	Const -32.48 deg		
G1C89	Nominal landmark lat No. 189	Const -32.43 deg		
G1C90	Nominal landmark lat No. 190	Const -33.85 deg		
G1C91	Nominal landmark lat No. 191	Const -34.03 deg		
G1C92	Nominal landmark lat No. 192	Const -34.0 deg		
G1C93	Nominal landmark lat No. 193	Const -35.03 deg		
G1C94	Nominal landmark lat No. 194	Const -33.53 deg		
G1C95	Nominal landmark lat No. 195	Const -34.38 deg		
G1C96	Nominal landmark lat No. 196	Const -32.05 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G1C97	Nominal landmark lat No. 197	Const -28.87 deg		
G1C98	Nominal landmark lat No. 198	Const -25.53 deg		
G1C99	Nominal landmark lat No. 199	Const -25.3 deg		
G2C00	Nominal landmark lat No. 200	Const -27.42 deg		
G2C01	Nominal landmark lat No. 201	Const -27.03 deg		
G2C02	Nominal landmark lat No. 202	Const -25.93 deg		
G2C03	Nominal landmark lat No. 203	Const -24.7 deg		
G2C04	Nominal landmark lat No. 204	Const -21.82 deg		
G2C05	Nominal landmark lat No. 205	Const -20.35 deg		
G2C06	Nominal landmark lat No. 206	Const -20.97 deg		
G2C07	Nominal landmark lat No. 207	Const -21.72 deg		
G2C08	Nominal landmark lat No. 208	Const -17.98 deg		
G2C09	Nominal landmark lat No. 209	Const -19.32 deg		
G2C10	Nominal landmark lat No. 210	Const -18.77 deg		
G2C11	Nominal landmark lat No. 211	Const -13.43 deg		
G2C12	Nominal landmark lat No. 212	Const -14.05 deg		
G2C13	Nominal landmark lat No. 213	Const -12.47 deg		
G2C14	Nominal landmark lat No. 214	Const -14.92 deg		
G2C15	Nominal landmark lat No. 215	Const -12.55 deg		
G2C16	Nominal landmark lat No. 216	Const -12.85 deg		
G2C17	Nominal landmark lat No. 217	Const -11.97 deg		
G2C18	Nominal landmark lat No. 218	Const -10.95 deg		
G2C19	Nominal landmark lat No. 219	Const -10.4 deg		
G2C20	Nominal landmark lat No. 220	Const -8.75 deg		
G2C21	Nominal landmark lat No. 221	Const -8.45 deg		
G2C22	Nominal landmark lat No. 222	Const -9.25 deg		
G2C23	Nominal landmark lat No. 223	Const -8.42 deg		
G2C24	Nominal landmark lat No. 224	Const -6.75 deg		
G2C25	Nominal landmark lat No. 225	Const -5.92 deg		
G2C27	Nominal landmark lat No. 227	Const -5.65 deg		
G2C28	Nominal landmark lat No. 228	Const -6.5 deg		
G2C29	Nominal landmark lat No. 229	Const -2.57 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G2C30	Nominal landmark lat No. 230	Const -0.3 deg		
G2C31	Nominal landmark lat No. 231	Const -0.63 deg		
G2C32	Nominal landmark lat No. 232	Const -2.62 deg		
G2C33	Nominal landmark lat No. 233	Const -3.57 deg		
G2C34	Nominal landmark lat No. 234	Const -0.02 deg		
G2C35	Nominal landmark lat No. 235	Const -3.55 deg		
G2C36	Nominal landmark lat No. 236	Const 1.55 deg		
G2C37	Nominal landmark lat No. 237	Const 2.6 deg		
G2C38	Nominal landmark lat No. 238	Const 1.25 deg		
G2C39	Nominal landmark lat No. 239	Const 2.08 deg		
G2C40	Nominal landmark lat No. 240	Const 1.55 deg		
G2C41	Nominal landmark lat No. 241	Const 2.22 deg		
G2C42	Nominal landmark lat No. 242	Const 0.2 deg		
G2C43	Nominal landmark lat No. 243	Const 7.05 deg		
G2C44	Nominal landmark lat No. 244	Const 4.58 deg		
G2C45	Nominal landmark lat No. 245	Const 7.58 deg		
G2C46	Nominal landmark lat No. 246	Const -8.43 deg		
G2C47	Nominal landmark lat No. 247	Const -10.35 deg		
G2C48	Nominal landmark lat No. 248	Const -4.32 deg		
G2C49	Nominal landmark lat No. 249	Const -5.32 deg		
G2C50	Nominal landmark lat No. 250	Const -2.77 deg		
G2C51	Nominal landmark lat No. 251	Const -1.6 deg		
G2C52	Nominal landmark lat No. 252	Const -0.85 deg		
G2C53	Nominal landmark lat No. 253	Const 6.25 deg		
G2C55	Nominal landmark lat No. 255	Const 11.77 deg		
G2C56	Nominal landmark lat No. 256	Const 14.5 deg		
G2C57	Nominal landmark lat No. 257	Const 16.03 deg		
G2C58	Nominal landmark lat No. 258	Const 3.52 deg		
G2C59	Nominal landmark lat No. 259	Const -9.8 deg		
G2C60	Nominal landmark lat No. 260	Const -4.9 deg		
G2C61	Nominal landmark lat No. 261	Const 5.0 deg		
G2C62	Nominal landmark lat No. 262	Const -6.52 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G2C63	Nominal landmark lat No. 263	Const -14.62 deg		
G2C64	Nominal landmark lat No. 264	Const -14.92 deg		
G2C65	Nominal landmark lat No. 265	Const -20.92 deg		
G2C66	Nominal landmark lat No. 266	Const -21.6 deg		
G2C67	Nominal landmark lat No. 267	Const 10.37 deg		
G2C68	Nominal landmark lat No. 268	Const 10.32 deg		
G2C69	Nominal landmark lat No. 269	Const 12.57 deg		
G2C70	Nominal landmark lat No. 270	Const 7.72 deg		
G2C71	Nominal landmark lat No. 271	Const 9.43 deg		
G2C72	Nominal landmark lat No. 272	Const 13.45 deg		
G2C73	Nominal landmark lat No. 273	Const 12.62 deg		
GDVMONTH	ΔV monitor threshold	0, 5.0 ft/sec		
GDIFFANS	Difference measured and actual angle	-90, +90 deg		
GDAD1	Display table word 1, 15 bits	54000_8, 55777_8		
GDAD2	Display table word 2, 15 bits	50000_8, 53777_8		
GDAD3	Display table word 3, 15 bits	44000_8, 45777_8		
GDAD4	Display table word 4, 15 bits	40000_8, 43777_8		
GDAD5	Display table word 5, 15 bits	34000_8, 37777_8		
GDAD6	Display table word 6, 15 bits	30000_8, 33777_8		
GDAD7	Display table word 7, 15 bits	24000_8, 27777_8		
GDAD8	Display table word 8, 15 bits	20000_8, 23777_8		
GDAD9	Display table word 9, 15 bits	14000_8, 15777_8		
GDAD10	Display table word 10, 15 bits	10000_8, 13777_8		
GDAD11	Display table word 11, 15 bits	04000_8, 07777_8		
GD	Angle error between GDI and GLMLONG	-360, +360 deg		
GDVX	Anticipated ΔV along S1C + X-axis	-1021, +1021		
GDVTH	Threshold ΔV	0.10, 1.00 ft/sec^2		
GDT	Time remaining until burnout	-5, 1021 sec		
GDVTO	Tailoff velocity magnitude	0, 17 ft/sec		
GDET	General iteration cycle time duration	0.05, 0.80 sec		
GDEVINS	Change in velocity required for insertion into orbit	0, 22550 ft/sec		
GDTAUDNU	Derivative of tau with respect to nu	0, 2.6×10^8 ft		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GDEVX	X-component of simulated PIPA output	-400, +400 ft/sec		
GDEVY	Y-component of simulated PIPA output	-400, +400 ft/sec		
GDEVZ	Z-component of simulated PIPA output	-400, +400 ft/sec		
GDI	Nom long. of any stored landmark	-180, +180 deg		
GDETO	Time of flight between 2 specified vectors	0 sec		
GDELUTH	ΔV threshold	Const 1.0 sec		
GDEE	Diff between eccentric anomalies of 2 vectors	-6.2832, +6.2532 ft/sec^2		
GDETO	Time of flt bet 2-position vectors	0, 7450 rad		
GDEOT	Modified position-velocity DOT product	-1, +1 ft/sec		
GDUPE	Lower limit on COT function			
GDEV	Simulated PIPA output	0, 1021 ft/sec		
GXACC	X-comp of simulated PIPA output	-1021, 1021 ft/sec		
GYACC	Y-comp of simulated PIPA output	-1021, 1021 ft/sec		
GZACC	Z-comp of simulated PIPA output	-1021, 1021 ft/sec		
GDEVMAX	Orbit change aim update: delta ΔV max	0, 2^{14}		
GDEVTO	Orbit change aim update: delta ΔV tailoff	0, 2^{14}		
*$\delta\vec{Y}$	Vector for position deviation			
GDEX	X-comp for position deviation	-52.5×10^3, $+52.5 \times 10^3$ ft		
GDEY	Y-comp for position deviation	-52.5×10^3, $+52.5 \times 10^3$ ft		
GDEZ	Z-comp for position deviation	-52.5×10^3, $+52.5 \times 10^3$ ft		
GDET2P00	ΔT equal to 2 sec	Const 2.0 sec		
GDET1P00	ΔT equal to 1 sec	Const 1.0 sec		
*$\delta\vec{V}$	Vector for velocity duration			
GDEDX	X-comp for velocity duration	-126.5, +126.5 ft/sec		
GDEDY	Y-comp for velocity duration	-126.5, +126.5 ft/sec		
GDEDZ	Z-comp for velocity duration	-126.5, +126.5 ft/sec		
GDELTAUP	Modified time of flight increment	0, $3.16 \times 10^{12} ft^{3/2}$		
GDELT	Integration time step	0, 14400 sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GDELTA	Small No. prohibiting interminacy of $\Delta\vec{B}$	Const 10^{-6}		
*$\delta\vec{IN}$	Subroutine 76 input position dev vector			
GDEXIN	X-comp of subroutine 76 input position dev vector	-52.5×10^3, 52.5×10^3 ft		
GDEYIN	Y-comp of subroutine 76 input position dev vector	-52.5×10^3, 52.5×10^3 ft		
GDEZIN	Z-comp of subroutine 76 input position dev vector	-52.5×10^3, 52.5×10^3 ft		
*$\delta\ddot{\vec{T}}$	Subroutine (76) acceleration vector			
GDEDDTX	X-comp of subroutine (76) acceleration vector	-0.95, +0.95 ft/sec^2		
GDEDDTY	Y-comp of subroutine (76) acceleration vector	-0.95, +0.95 ft/sec^2		
GDEDDTZ	Z-comp of subroutine (76) acceleration vector	-0.95, +0.95 ft/sec^2		
GDADVDGT	Noninteg. VOL verb register	00_8, 77_8		
GDADCNTR	Noninteg. VOL key enter counter	0, 15_{10}		
GDTHCX	X-gyro torquing angle	-2^9, 2^9 deg		
GDTHCY	Y-gyro torquing angle	-2^9, 2^9 deg		
GDTHCZ	Z-gyro torquing angle	-2^9, 2^9 deg		
GDAD12	Display table word 12, 15 bits			
GDETN1	Normal AGC nav integration time step	Const 259.2		
GDET	Actual AGC nav integration time step	0, 259.2 sec		
GDUMMY	Temporary counter			
*$\delta\dot{\vec{T}}$	Deviation acceleration output from subroutine			
GDEDDTX	X-component of output deviation acceleration	-0.95, +0.95 ft/sec^2		
GDEDDTY	Y-component of output deviation acceleration	-0.95, +0.95 ft/sec^2		
GDEDDTZ	Z-component of output deviation acceleration	-0.95, +0.95 ft/sec^2		
*$\ddot{\delta}1$	Deviation acceleration vector at start of time step			
GDEDD1X	X-component of dev accel at start of time step	-0.95, +0.95 ft/sec^2		
GDEDD1Y	Y-component of dev accel at start of time step	-0.95, +0.95 ft/sec^2		
GDEDD1Z	Z-component of dev accel at start of time step	-0.95, +0.95 ft/sec^2		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
* $\ddot{\delta}_2$	Deviation acceleration vector at middle of time step			
GDEDD2X	X-component of dev accel at middle of time step	-0.95, +0.95 ft/sec^2		
GDEDD2Y	Y-component of dev accel at middle of time step	-0.95, +0.95 ft/sec^2		
GDEDD2Z	Z-component of dev accel at middle of time step	-0.95, +0.95 ft/sec^2		
* $\ddot{\delta}_3$	Deviation acceleration vector at end of time step			
GDEDD3X	X-component of dev accel at end of time step	-0.95, +0.95 ft/sec^2		
GDEDD3Y	Y-component of dev accel at end of time step	-0.95, +0.95 ft/sec^2		
GDEDD3Z	Z-component of dev accel at end of time step	-0.95, +0.95 ft/sec^2		
GDAVAIL	Max. veh delta vel available	0, +32.768 ft/sec		
GDVTBG	Max. delta vel to be gained	0, 10,000 ft/sec		
GDETG	Time interval for target to earch present orb. pl.	0, 2.686×10^6 sec		
* δN	Positional dev at intermediate time steps			
GDENX	X-comp of positional dev at intermediate time steps	-52.5×10^3, 52.5×10^3 ft		
GDENY	Y-comp of positional dev at intermediate time steps	-52.5×10^3, 52.5×10^3 ft		
GDENZ	Z-comp of positional dev at intermediate time steps	-52.5×10^3, 52.5×10^3 ft		
* $\Delta\delta R$	Change in positional deviation for time step			
GDEDERX	X-comp of positional deviation for time step	-52.5×10^3, 52.5×10^3 ft		
GDEDERY	Y-comp of positional deviation for time step	-52.5×10^3, 52.5×10^3 ft		
GDEDERZ	Z-comp of positional deviation for time step	-52.5×10^3, 52.5×10^3 ft		
* $\Delta\delta V$	Change in velocity deviation for time step			
GDEDEVX	X-comp of velocity deviation for time step	-126.5, 126.5 ft/sec		
GDEDEVY	Y-comp of velocity deviation for time step	-126.5, 126.5 ft/sec		
GDEDEVZ	Z-comp of velocity deviation for time step	-126.5, 126.5 ft/sec		
GDEVXN	Incremental output of X PIPA	-400, +400 ft/sec		
GDEVYN	Incremental output of Y PIPA	-400, +400 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GDEVZN	Incremental output of Z PIPA	-400, +400 ft/sec		
GDN	Total acceleration	-400, +400 ft/sec		
GDELAND	Angular rotation desired	-2^9, 2^9 deg		
*$\vec{D}_N$	Total acceleration			
GDXN	X-comp of total acceleration	-400, +400 ft/sec^2		
GDYN	Y-comp of total acceleration	-400, +400 ft/sec^2		
GDZN	Z-comp of total acceleration	-400, +400 ft/sec^2		
*$\vec{\Delta Y}_r$	Incremental position vector			
GDEXR	X-component of incremental position vector	-52.8×10^5, 52.8×10^8 ft		
GDEYR	Y-component of incremental position vector	-52.8×10^5, 52.8×10^8 ft		
GDEZR	Z-component of incremental position vector	-52.8×10^5, 52.8×10^8 ft		
*$\vec{\Delta V}_r$	Incremental velocity vector			
GDEXDR	X-component of incremental velocity vector	-10^3, $+10^3$ ft/sec^{-1}		
GDEYDR	Y-component of incremental velocity vector	-10^3, $+10^3$ ft/sec^{-1}		
GDEZDR	Z-component of incremental velocity vector	-10^3, $+10^3$ ft/sec^{-1}		
*$\vec{\Delta w}$	Incremental W vector			
GDEW1	First component of incremental W vector	-52.5×10^3, 52.5×10^3 ft		
GDEW2	Second component of incremental W vector	-52.5×10^3, 52.5×10^3 ft		
GDEW3	Third component of incremental W vector	-52.5×10^3, 52.5×10^3 ft		
*$\vec{\Delta \dot{w}}$	Incremental W vector			
GDEWD1	First component of incremental WDOT vector	-126.5, +126.5 ft/sec^{-1}		
GDEWD2	Second component of incremental WDOT vector	-126.5, +126.5 ft/sec^{-1}		
GDEWD3	Third component of incremental WDOT vector	-126.5, +126.5 ft/sec^{-1}		
GDELTRN	Actual miss distance	-10000, +10000 n mi		
GDELF	Subroutine target threshold	0, 1		
*$\vec{\Delta m}$	Steerlaw delta M vector			
GDELMX	X-comp of Steerlaw delta M vector	-80.0, +80.0 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GDELMY	Y-comp of Steerlaw delta M vector	-80.0, +80.0 ft/sec		
GDELMZ	Z-comp of Steerlaw delta M vector	-80.0, +80.0 ft/sec		
*$\delta\vec{n}$	Diff vect between two successive $\vec{a}^{NS}$			
GDELTANX	X-comp of diff vect between two successive $\vec{a}^{NS}$	-80.0, +80.0 ft/sec^2		
GDELTANY	Y-comp of diff vect between two successive $\vec{a}^{NS}$	-80.0, +80.0 ft/sec^2		
GDELTANZ	Z-comp of diff vect between two successive $\vec{a}^{NS}$	-80.0, +80.0 ft/sec^2		
GDELTAN	Mag of diff vect between two successive $\vec{a}^{NS}$	0, +80.0 ft/sec^2		
*$\Delta\vec{v}imp$	Impulsive ΔV vector			
GDEVIMPX	X-comp of impulsive ΔV vector	-1638.3, +1638.3 ft/sec		
GDEVIMPY	Y-comp of impulsive ΔV vector	-1638.3, +1638.3 ft/sec		
GDEVIMPZ	Z-comp of impulsive ΔV vector	-1638.3, +1638.3 ft/sec		
GDEVSP	Specified ΔV to be used in maneuver	0, +1638.3 ft/sec		
GDEVLAC	Vel change required for landing area cont.	0, 6200 ft/sec		
GDEVEDO	ΔV req for abort deorbit			
*$\vec{d}$	Diff bet. actual and desired re-entry vectors			
GDX	X-comp of actual and desired re-entry vectors	-5.38 x 10^7, +5.38 x 10^7 ft		
GDY	Y-comp of actual and desired re-entry vectors	-5.38 x 10^7, +5.38 x 10^7 ft		
GDZ	Z-comp of actual and desired re-entry vectors	-5.38 x 10^7, +5.38 x 10^7 ft		
GD	Mag of actual and desired re-entry vectors	0, +5.38 x 10^7 ft		
GDELD	Mag of diff bet. 2 successive entry vectors	0, 65535 ft		
GDEVN	Mag of PIPA output vector	-1638.3, 1638.3 ft/sec		
GDEVP	Des vel increment along $\vec{ip}$	-1638.3, 1638.3 ft/sec		
GDERMISS	± miss disatnce along ground track	-12500, +12500 nm		
GDOMER	Difference to correct range angle	-2π, +2π rad		
GD01	Nominal landmark long. No. 1	Const 25.7 deg		
GD02	Nominal landmark long. No. 2	Const 24.83 deg		
GD03	Nominal landmark long. No. 3	Const 20.02 deg		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GD04	Nominal landmark long. No. 4	Const 18.48 deg		
GD05	Nominal landmark long. No. 5	Const 17.97 deg		
GD06	Nominal landmark long. No. 6	Const 16.45 deg		
GD07	Nominal landmark long. No. 7	Const 31.05 deg		
GD08	Nominal landmark long. No. 8	Const 32.08 deg		
GD09	Nominal landmark long. No. 9	Const 15.08 deg		
GD10	Nominal landmark long. No. 10	Const 14.43 deg		
GD12	Nominal landmark long. No. 12	Const 28.48 deg		
GD13	Nominal landmark long. No. 13	Const 49.77 deg		
GD14	Nominal landmark long. No. 14	Const 49.82 deg		
GD15	Nominal landmark long. No. 15	Const 44.35 deg		
GD16	Nominal landmark long. No. 16	Const 8.72 deg		
GD17	Nominal landmark long. No. 17	Const 10.66 deg		
GD18	Nominal landmark long. No. 18	Const 9.35 deg		
GD19	Nominal landmark long. No. 19	Const 11.82 deg		
GD20	Nominal landmark long. No. 20	Const -17.53 deg		
GD21	Nominal landmark long. No. 21	Const 44.5 deg		
GD26	Nominal landmark long. No. 26	Const 29.23 deg		
GD28	Nominal landmark long. No. 28	Const -17.05 deg		
GD29	Nominal landmark long. No. 29	Const 34.32 deg		
GD30	Nominal landmark long. No. 30	Const 35.13 deg		
GD32	Nominal landmark long. No. 32	Const -12.95 deg		
GD33	Nominal landmark long. No. 33	Const -13.28 deg		
GD35	Nominal landmark long. No. 35	Const 38.87 deg		
GD37	Nominal landmark long. No. 37	Const 37.3 deg		
GD38	Nominal landmark long. No. 38	Const -16.38 deg		
GD39	Nominal landmark long. No. 39	Const -13.83 deg		
GD40	Nominal landmark long. No. 40	Const 32.75 deg		
GD41	Nominal landmark long. No. 41	Const 35.42 deg		
GD42	Nominal landmark long. No. 42	Const 35.48 deg		
GD43	Nominal landmark long. No. 43	Const 34.83 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GD44	Nominal landmark long. No. 44	Const -24.35 deg		
GD45	Nominal landmark long. No. 45	Const 11.7 deg		
GD46	Nominal landmark long. No. 46	Const 13.27 deg		
GD47	Nominal landmark long. No. 47	Const 12.33 deg		
GD49	Nominal landmark long. No. 49	Const 34.28 deg		
GD50	Nominal landmark long. No. 50	Const 36.62 deg		
GD51	Nominal landmark long. No. 51	Const 36.03 deg		
GD52	Nominal landmark long. No. 52	Const -9.9 deg		
GD53	Nominal landmark long. No. 53	Const 29.83 deg		
GD54	Nominal landmark long. No. 54	Const 33.2 deg		
GD55	Nominal landmark long. No. 55	Const 39.92 deg		
GD56	Nominal landmark long. No. 56	Const 39.3 deg		
GD57	Nominal landmark long. No. 57	Const 39.68 deg		
GD58	Nominal landmark long. No. 58	Const -17.83 deg		
GD59	Nominal landmark long. No. 59	Const -16.92 deg		
GD60	Nominal landmark long. No. 60	Const -16.12 deg		
GD61	Nominal landmark long. No. 61	Const -15.4 deg		
GD62	Nominal landmark long. No. 62	Const -14.5 deg		
GD63	Nominal landmark long. No. 63	Const -16.03 deg		
GD64	Nominal landmark long. No. 64	Const 51.17 deg		
GD65	Nominal landmark long. No. 65	Const -72.17 deg		
GD66	Nominal landmark long. No. 66	Const -75.7 deg		
GD67	Nominal landmark long. No. 67	Const -77.55 deg		
GD68	Nominal landmark long. No. 68	Const -77.7 deg		
GD69	Nominal landmark long. No. 69	Const -77.47 deg		
GD75	Nominal landmark long. No. 75	Const -66.05 deg		
GD77	Nominal landmark long. No. 77	Const -58.33 deg		
GD80	Nominal landmark long. No. 80	Const -80.42 deg		
GD81	Nominal landmark long. No. 81	Const -39.13 deg		
GD82	Nominal landmark long. No. 82	Const -45.25 deg		
GD83	Nominal landmark long. No. 83	Const -41.98 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GD84	Nominal landmark long. No. 84	Const -41.02 deg		
GD85	Nominal landmark long. No. 85	Const -40.27 deg		
GD86	Nominal landmark long. No. 86	Const -52.23 deg		
GD88	Nominal landmark long. No. 88	Const -34.83 deg		
GD90	Nominal landmark long. No. 90	Const -36.4 deg		
GD91	Nominal landmark long. No. 91	Const -38.55 deg		
GD95	Nominal landmark long. No. 95	Const -38.47 deg		
GD96	Nominal landmark long. No. 96	Const -50.9 deg		
GD97	Nominal landmark long. No. 97	Const -48.83 deg		
GD98	Nominal landmark long. No. 98	Const -52.67 deg		
GD99	Nominal landmark long. No. 99	Const -81.67 deg		
G1D00	Nominal landmark long. No. 100	Const -81.33 deg		
G1D01	Nominal landmark long. No. 101	Const -77.65 deg		
G1D03	Nominal landmark long. No. 103	Const -78.57 deg		
G1D04	Nominal landmark long. No. 104	Const -77.17 deg		
G1D05	Nominal landmark long. No. 105	Const -76.45 deg		
G1D06	Nominal landmark long. No. 106	Const -75.2 deg		
G1D07	Nominal landmark long. No. 107	Const -73.72 deg		
G1D08	Nominal landmark long. No. 108	Const -71.38 deg		
G1D09	Nominal landmark long. No. 109	Const -67.2 deg		
G1D10	Nominal landmark long. No. 110	Const -69.13 deg		
G1D11	Nominal landmark long. No. 111	Const -54.95 deg		
G1D13	Nominal landmark long. No. 113	Const -117.23 deg		
G1D14	Nominal landmark long. No. 114	Const -118.6 deg		
G1D16	Nominal landmark long. No. 116	Const -80.67 deg		
G1D17	Nominal landmark long. No. 117	Const -76.53 deg		
G1D18	Nominal landmark long. No. 118	Const -77.97 deg		
G1D19	Nominal landmark long. No. 119	Const -94.85 deg		
G1D25	Nominal landmark long. No. 125	Const -97.24 deg		
G1D27	Nominal landmark long. No. 127	Const -81.8 deg		
G1D28	Nominal landmark long. No. 128	Const -80.15 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G1D30	Nominal landmark long. No. 130	Const -110.88 deg		
G1D31	Nominal landmark long. No. 131	Const -115.08 deg		
G1D32	Nominal landmark long. No. 132	Const -113.62 deg		
G1D33	Nominal landmark long. No. 133	Const -111.7 deg		
G1D34	Nominal landmark long. No. 134	Const -110.33 deg		
G1D36	Nominal landmark long. No. 136	Const -109.9 deg		
G1D37	Nominal landmark long. No. 137	Const -106.42 deg		
G1D38	Nominal landmark long. No. 138	Const -105.71 deg		
G1D39	Nominal landmark long. No. 139	Const -97.8 deg		
G1D44	Nominal landmark long. No. 144	Const -85.97 deg		
G1D45	Nominal landmark long. No. 145	Const -85.12 deg		
G1D46	Nominal landmark long. No. 146	Const -82.87 deg		
G1D47	Nominal landmark long. No. 147	Const -79.53 deg		
G1D48	Nominal landmark long. No. 148	Const -81.6 deg		
G1D49	Nominal landmark long. No. 149	Const -88.62 deg		
G1D53	Nominal landmark long. No. 153	Const -79.0 deg		
G1D54	Nominal landmark long. No. 154	Const -77.58 deg		
G1D55	Nominal landmark long. No. 155	Const -76.33 deg		
G1D56	Nominal landmark long. No. 156	Const -76.6 deg		
G1D57	Nominal landmark long. No. 157	Const -74.85 deg		
G1D58	Nominal landmark long. No. 158	Const -75.27 deg		
G1D59	Nominal landmark long. No. 159	Const -74.33 deg		
G1D60	Nominal landmark long. No. 160	Const -73.18 deg		
G1D61	Nominal landmark long. No. 161	Const -73.67 deg		
G1D62	Nominal landmark long. No. 162	Const -71.15 deg		
G1D63	Nominal landmark long. No. 163	Const -76.85 deg		
G1D64	Nominal landmark long. No. 164	Const -78.37 deg		
G1D65	Nominal landmark long. No. 165	Const -63.18 deg		
G1D66	Nominal landmark long. No. 166	Const -62.57 deg		
G1D67	Nominal landmark long. No. 167	Const -60.9 deg		
G1D68	Nominal landmark long. No. 168	Const -60.98 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G1D69	Nominal landmark long. No. 169	Const -81.37 deg		
G1D70	Nominal landmark long. No. 170	Const -75.17 deg		
G1D71	Nominal landmark long. No. 171	Const -72.98 deg		
G1D72	Nominal landmark long. No. 172	Const -71.7 deg		
G1D73	Nominal landmark long. No. 173	Const -69.2 deg		
G1D74	Nominal landmark long. No. 174	Const -67.2 deg		
G1D75	Nominal landmark long. No. 175	Const -67.27 deg		
G1D76	Nominal landmark long. No. 176	Const -66.12 deg		
G1D77	Nominal landmark long. No. 177	Const -61.18 deg		
G1D78	Nominal landmark long. No. 178	Const -60.88 deg		
G1D79	Nominal landmark long. No. 179	Const -155.68 deg		
G1D80	Nominal landmark long. No. 180	Const -154.82 deg		
G1D81	Nominal landmark long. No. 181	Const -158.28 deg		
G1D82	Nominal landmark long. No. 182	Const -156.72 deg		
G1D83	Nominal landmark long. No. 183	Const 137.63 deg		
G1D84	Nominal landmark long. No. 184	Const 137.0 deg		
G1D85	Nominal landmark long. No. 185	Const 135.1 deg		
G1D86	Nominal landmark long. No. 186	Const 136.63 deg		
G1D87	Nominal landmark long. No. 187	Const 137.37 deg		
G1D88	Nominal landmark long. No. 188	Const 137.77 deg		
G1D89	Nominal landmark long. No. 189	Const 152.52 deg		
G1D90	Nominal landmark long. No. 190	Const 151.28 deg		
G1D91	Nominal landmark long. No. 191	Const 123.15 deg		
G1D92	Nominal landmark long. No. 192	Const 122.08 deg		
G1D93	Nominal landmark long. No. 193	Const 117.92 deg		
G1D94	Nominal landmark long. No. 194	Const 115.0 deg		
G1D95	Nominal landmark long. No. 195	Const 115.13 deg		
G1D96	Nominal landmark long. No. 196	Const 115.73 deg		
G1D97	Nominal landmark long. No. 197	Const 153.58 deg		
G1D98	Nominal landmark long. No. 198	Const 113.48 deg		
G1D99	Nominal landmark long. No. 199	Const 113.08 deg		
G2D00	Nominal landmark long. No. 200	Const 153.55 deg		
G2D01	Nominal landmark long. No. 201	Const 153.47 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G2D02	Nominal landmark long. No. 202	Const 153.18 deg		
G2D03	Nominal landmark long. No. 203	Const 153.27 deg		
G2D04	Nominal landmark long. No. 204	Const 114.18 deg		
G2D05	Nominal landmark long. No. 205	Const 116.83 deg		
G2D06	Nominal landmark long. No. 206	Const 115.35 deg		
G2D07	Nominal landmark long. No. 207	Const 150.35 deg		
G2D08	Nominal landmark long. No. 208	Const 122.17 deg		
G2D09	Nominal landmark long. No. 209	Const 147.42 deg		
G2D10	Nominal landmark long. No. 210	Const 146.7 deg		
G2D11	Nominal landmark long. No. 211	Const 129.88 deg		
G2D12	Nominal landmark long. No. 212	Const 129.47 deg		
G2D13	Nominal landmark long. No. 213	Const 130.85 deg		
G2D14	Nominal landmark long. No. 214	Const 135.68 deg		
G2D15	Nominal landmark long. No. 215	Const 141.65 deg		
G2D16	Nominal landmark long. No. 216	Const 143.53 deg		
G2D17	Nominal landmark long. No. 217	Const 141.92 deg		
G2D18	Nominal landmark long. No. 218	Const 132.6 deg		
G2D19	Nominal landmark long. No. 219	Const 105.75 deg		
G2D20	Nominal landmark long. No. 220	Const 114.35 deg		
G2D21	Nominal landmark long. No. 221	Const 114.4 deg		
G2D22	Nominal landmark long. No. 222	Const 119.93 deg		
G2D23	Nominal landmark long. No. 223	Const 116.42 deg		
G2D24	Nominal landmark long. No. 224	Const 105.2 deg		
G2D25	Nominal landmark long. No. 225	Const 104.55 deg		
G2D27	Nominal landmark long. No. 227	Const 120.43 deg		
G2D28	Nominal landmark long. No. 228	Const 120.48 deg		
G2D29	Nominal landmark long. No. 229	Const 106.83 deg		
G2D30	Nominal landmark long. No. 230	Const 105.0 deg		
G2D31	Nominal landmark long. No. 231	Const 119.75 deg		
G2D32	Nominal landmark long. No. 232	Const 118.8 deg		
G2D33	Nominal landmark long. No. 233	Const 118.93 deg		
G2D34	Nominal landmark long. No. 234	Const 119.67 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G2D35	Nominal landmark long. No. 235	Const 127.92 deg		
G2D36	Nominal landmark long. No. 236	Const 98.72 deg		
G2D37	Nominal landmark long. No. 237	Const 98.68 deg		
G2D38	Nominal landmark long. No. 238	Const 103.82 deg		
G2D39	Nominal landmark long. No. 239	Const 109.63 deg		
G2D40	Nominal landmark long. No. 240	Const 125.28 deg		
G2D41	Nominal landmark long. No. 241	Const 127.95 deg		
G2D42	Nominal landmark long. No. 242	Const 128.9 deg		
G2D43	Nominal landmark long. No. 243	Const 116.75 deg		
G2D44	Nominal landmark long. No. 244	Const 113.97 deg		
G2D45	Nominal landmark long. No. 245	Const 100.3 deg		
G2D46	Nominal landmark long. No. 246	Const 127.32 deg		
G2D47	Nominal landmark long. No. 247	Const 123.43 deg		
G2D48	Nominal landmark long. No. 248	Const 133.6 deg		
G2D49	Nominal landmark long. No. 249	Const 147.08 deg		
G2D50	Nominal landmark long. No. 250	Const 131.95 deg		
G2D51	Nominal landmark long. No. 251	Const 135.42 deg		
G2D52	Nominal landmark long. No. 252	Const 134.13 deg		
G2D53	Nominal landmark long. No. 253	Const 126.18 deg		
G2D55	Nominal landmark long. No. 255	Const 121.83 deg		
G2D56	Nominal landmark long. No. 256	Const 120.9 deg		
G2D57	Nominal landmark long. No. 257	Const 121.98 deg		
G2D58	Nominal landmark long. No. 258	Const 124.2 deg		
G2D59	Nominal landmark long. No. 259	Const 161.55 deg		
G2D60	Nominal landmark long. No. 260	Const 152.88 deg		
G2D61	Nominal landmark long. No. 261	Const 150.1 deg		
G2D62	Nominal landmark long. No. 262	Const 155.17 deg		
G2D63	Nominal landmark long. No. 263	Const 166.62 deg		
G2D64	Nominal landmark long. No. 264	Const 168.1 deg		
G2D65	Nominal landmark long. No. 265	Const 167.03 deg		
G2D66	Nominal landmark long. No. 266	Const 167.83 deg		
G2D67	Nominal landmark long. No. 267	Const 103.85 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G2D68	Nominal landmark long. No. 268	Const 107.08 deg		
G2D69	Nominal landmark long. No. 269	Const 109.43 deg		
G2D70	Nominal landmark long. No. 270	Const 134.62 deg		
G2D71	Nominal landmark long. No. 271	Const 138.07 deg		
G2D72	Nominal landmark long. No. 272	Const 144.62 deg		
G2D73	Nominal landmark long. No. 273	Const -70.07 deg		
*$\vec{\Delta m}$	Steerlaw delta M vector			
GDELMX	X-comp of Steerlaw delta M vector	-80.0, +80.0 ft/sec		
GDELMY	Y-comp of Steerlaw delta M vector	-80.0, +80.0 ft/sec		
GDELMZ	Z-comp of Steerlaw delta M vector	-80.0, +80.0 ft/sec		
*$\vec{\delta n}$	Diff vect between two successive $\vec{a}^{NS}$			
GDELTANX	X-comp of diff vect between two successive $\vec{a}^{NS}$	-80.0, +80.0 ft/sec^2		
GDELTANY	Y-comp of diff vect between two successive $\vec{a}^{NS}$	-80.0, +80.0 ft/sec^2		
GDELTANZ	Z-comp of diff vect between two successive $\vec{a}^{NS}$	-80.0, +80.0 ft/sec^2		
GDELTAN	Mag of diff vect between two successive $\vec{a}^{NS}$	0, +80.0 ft/sec^2		
* $\vec{vimp}$	Impulsive ΔV vector			
GDEVIMPX	X-comp of impulsive ΔV vector	-1638.3, +1638.3 ft/sec		
GDEVIMPY	Y-comp of impulsive ΔV vector	-1638.3, +1638.3 ft/sec		
GDEVIMPZ	Z-comp of impulsive ΔV vector	-1638.3, +1638.3 ft/sec		
GDEVSP	Specified ΔV to be used in maneuver	0, +1638.3 ft/sec		
GDEVLAC	Vel change required for landing area cont.	0, +1638.3 ft/sec		
* $\vec{d}$	Diff bet actual and desired re-entry vectors			
GDX	X-comp of actual and desired re-entry vectors	-5.38×10^7, $+5.38 \times 10^7$ ft		
GDY	Y-comp of actual and desired re-entry vectors	-5.38×10^7, $+5.38 \times 10^7$ ft		
GDZ	Z-comp of actual and desired re-entry vectors	-5.38×10^7, $+5.38 \times 10^7$ ft		
GD	Mag of actual and desired re-entry vectors	0, $+5.38 \times 10^7$ ft		
GDELD	Mag of diff bet. two successive entry vectors	0, 65535 ft		
GDEVN	Mag of PIPA output vector	-1638.3, 1638.3 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GDEVP	Des vel increment along $\overset{ip}{\rightarrow}$	-1638.3, 1638.3 ft/sec		
GDERMISS	± miss distance along ground track	-12500, +12500 n mi		
GEXCTR	Executive counter	-10, 10		
GEXCTR1	Executive counter No. 1	-10, 10		
GEXCTR2	Executive counter No. 2	-10, 10		
*ℭENTCNT	Consecutive keyword enter count	$0, 15_{10}$		
GEPD	Small constant greater than 0	Const 1.745×10^{-4}		
GEL	Difference of X and tailoff velocities	-32767, +32767 ft/sec		
GEP	Minimum sensible acceleration change	Const 0.1712578 ft/sec		
GE	Earth eccentricity	0, +1		
GEPC	Angle between telescope IOS and star LOS	$0, 2^9$ deg		
GEPC1	Comparison value for CSM routine	$0, 2^7$ deg		
GEPC2	Comparison value for CSM routine	$0, 2^7$ deg		
GEPC3	Comparison value for CSM routine	$0, 2^7$ deg		
GEPC4	Comparison value for CSM routine	$0, 2^7$ deg		
GEPC5	Comparison value for CSM routine	$0, 2^7$ deg		
*ℭEPS	Unit vector in the direction of desired X_{SM}			
GEPSX	X-comp of unit vector in the direction of desired X_{SM}	-1.0, +1.0		
GEPSY	Y-comp of unit vector in the direction of desired X_{SM}	-1.0, +1.0		
GEPSZ	Z-comp of unit vector in the direction of desired X_{SM}	-1.0, +1.0		
GEPSTAU	Time convergence constant	Const 0.01 sec		
GEPSTAUP	Modified time convergence constant	Const 0.1 $ft^{3/2}$		
GERF	$1/\sqrt{\lvert\vec{H}\rvert \lvert\vec{E}\rvert}$	0.00125, +1.0		
GEOR	Eccentricity of vehicle orbit	0, 1		
GEANO	Eccentric anomaly of vehicle orbit at TO	0, 2 rad		
GEPDEL	Convergency criterion state vector	0, 26246.7192 ft		
*ℭERO	GERO matrix			
GERO11	Element 11 of GERO matrix	-1, +1		
GERO12	Element 12 of GERO matrix	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GERO13	Element 13 of GERO matrix	-1, +1		
GERO21	Element 21 of GERO matrix	-1, +1		
GERO22	Element 22 of GERO matrix	-1, +1		
GERO23	Element 23 of GERO matrix	-1, +1		
GERO31	Element 31 of GERO matrix	-1, +1		
GERO32	Element 32 of GERO matrix	-1, +1		
GERO33	Element 33 of GERO matrix	-1, +1		
GELMSX	Geocentric X-coord of selected earth LM	$-21(10^6)$, $+21(10^6)$ ft		
GELMSY	Geocentric Y-coord of selected earth LM	$-21(10^6)$, $+21(10^6)$ ft		
GELMSZ	Geocentric Z-coord of selected earth LM	$-21(10^6)$, $+21(10^6)$ ft		
GEVTIME	Event time	-50.0, 1000.0 sec		
*ℭERMG	Desired IMU inertial orientation SM			
GERMG11	Desired IMU inertial orientation SM	-1, +1		
GERMG12	Desired IMU inertial orientation SM	-1, +1		
GERMG13	Desired IMU inertial orientation SM	-1, +1		
GERMG21	Desired IMU inertial orientation SM	-1, +1		
GERMG22	Desired IMU inertial orientation SM	-1, +1		
GERMG23	Desired IMU inertial orientation SM	-1, +1		
GERMG31	Desired IMU inertial orientation SM	-1, +1		
GERMG32	Desired IMU inertial orientation SM	-1, +1		
GERMG33	Desired IMU inertial orientation SM	-1, +1		
*ℭERH	Matrix SM_{BT} to SM_{AT}			
GERH11	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
GERH12	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
GERH13	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
GERH21	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
GERH22	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
GERH23	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
GERH31	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
GERH32	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
GERH33	Matrix SM_{BT} to SM_{AT}	-1.0, +1.0		
*ℭERG	Matrix SM_{BT} to I_E			

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GERG11	Matrix SM_{BT} to I_E	-1.0, +1.0		
GERG12	Matrix SM_{BT} to I_E	-1.0, +1.0		
GERG13	Matrix SM_{BT} to I_E	-1.0, +1.0		
GERG21	Matrix SM_{BT} to I_E	-1.0, +1.0		
GERG22	Matrix SM_{BT} to I_E	-1.0, +1.0		
GERG23	Matrix SM_{BT} to I_E	-1.0, +1.0		
GERG31	Matrix SM_{BT} to I_E	-1.0, +1.0		
GERG32	Matrix SM_{BT} to I_E	-1.0, +1.0		
GERG33	Matrix SM_{BT} to I_E	-1.0, +1.0		
GELL	Landmark No. increment counter	0, 511		
GEFF	Earth oblateness coefficient	Const 3.35233 x 10^{-3}		
GEPSTH	Small No. which prohibits indeterminacy of COT 80/2	Const 6.2 x 10^{-7}		
GELDI	GPERECVA input longitude	0, 360		
GEP1P	1 angle stored Z_{NB} and star	-2^9, 2^9 deg		
GEP2P	2 angle stored Z_{NB} and star	-2^9, 2^9 deg		
GEP3P	3 angle stored Z_{NB} and star	-2^9, 2^9 deg		
GEP4P	4 angle stored Z_{NB} and star	-2^9, 2^9 deg		
GEP5P	5 angle stored Z_{NB} and star	-2^9, 2^9 deg		
GEYE	Counter	0, 15		
GEYEMAX	Counter maximum value	Const 15		
GETA	Ratio	-1, +1		
GERT	Error in time from rotation of earth	0, 2.686 x 10^6 sec		
GEPSRE	GREN vect position diff squared threshold	Const 10^4 sec		
GEPSE	GREN vect eccentricity threshold	Const 10^{-8}		
GF	Program fast iteration rate	0, 140		
*$\overrightarrow{YFIN}$	Position vector at time of final mark			
GXFIN	X-comp of vector at time of final mark	-53.8 x 10^6, +53.8 x 10^6 ft		
GYFIN	Y-comp of vector at time of final mark	-53.8 x 10^6, +53.8 x 10^6 ft		
GZFIN	Z-comp of vector at time of final mark	-53.8 x 10^6, +53.8 x 10^6 ft		
*$\overrightarrow{VFIN}$	Velocity vector at time of final mark			

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GXDFIN	X-comp of velocity vector at time of final mark	-32768, +32768 ft/sec		
GYDFIN	Y-comp of velocity vector at time of final mark	-32768, +32768 ft/sec		
GZDFIN	Z-comp of velocity vector at time of final mark	-32768, +32768 ft/sec		
GF1N	Reference trajectory functions	-10, 0 n mi/ft/sec		
GF2N	Reference trajectory functions	0, 1 n mi/ft/sec		
GF3N	Reference trajectory functions	0, 1600 n mi/ft/sec		
GFY	Geocentric latitude	-180, +180 deg		
*f_2	Accel vector due to second earth harmonic			
GF2X	X-component of second earth harmonic	-0.95, 0.95 ft/sec^2		
GF2Y	Y-component of second earth harmonic	-0.95, 0.95 ft/sec^2		
GF2Z	Z-component of second earth harmonic	-0.95, 0.95 ft/sec^2		
*f_3	Accel vector due to third earth harmonic			
GF3X	X-component of third earth harmonic	-0.95, 0.95 ft/sec^2		
GF3Y	Y-component of third earth harmonic	-0.95, 0.95 ft/sec^2		
GF3Z	Z-component of third earth harmonic	-0.95, 0.95 ft/sec^2		
*f_4	Accel vector due to fourth earth harmonic			
GF4X	X-component of fourth earth harmonic	-0.95, 0.95 ft/sec^2		
GF4Y	Y-component of fourth earth harmonic	-0.95, 0.95 ft/sec^2		
GF4Z	Z-component of fourth earth harmonic	-0.95, 0.95 ft/sec^2		
*f_t	Total vector of earth nonspherical forces			
GFX	X-component of earth nonspherical forces	-0.95, 0.95 ft/sec^2		
GFY	Y-component of earth nonspherical forces	-0.95, 0.95 ft/sec^2		
GFZ	Z-component of earth nonspherical forces	-0.95, 0.95 ft/sec^2		
GF1V1	Reference trajectory parameter	Const -7.569 n mi FPSS		
GF1V2	Reference trajectory parameter	Const -7.569 n mi FPSS		
GF1V3	Reference trajectory parameter	Const -2.021 n mi FPSS		
GF1V4	Reference trajectory parameter	Const 0.6483 n mi FPSS		
GF1V5	Reference trajectorh parameter	Const 0.4956 n mi FPSS		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GF1V6	Reference trajectory parameter	Const -0.3605 n mi FPSS		
GF1V7	Reference trajectory parameter	Const -0.3305 n mi FPSS		
GF1V8	Reference trajectory parameter	Const-0.2372 n mi FPSS		
GF1V9	Reference trajectory parameter	Const-0.1973 n mi FPSS		
GF1V10	Reference trajectory parameter	Const -0.1410 n mi FPSS		
GF1V11	Reference trajectory parameter	Const -0.09034 n mi FPSS		
GF1V12	Reference trajectory parameter	Const -0.05551 n mi FPSS		
GF1V13	Reference trajectory parameter	Const -0.03629 n mi FPSS		
GF1V14	Reference trajectory parameter	Const -0.02695 n mi FPSS		
GF1V15	Reference trajectory parameter	Const -0.02695 n mi FPSS		
GF3V1	Reference trajectory parameter	Const 1508 n mi		
*2	Reference trajectory parameter	Const 1508 n mi		
*3	Reference trajectory parameter	Const 1385 n mi		
*4	Reference trajectory parameter	Const 980.5 n mi		
*5	Reference trajectory parameter	Const 682.7 n mi		
*6	Reference trajectory parameter	Const 465.5 n mi		
*7	Reference trajectory parameter	Const 329.4 n mi		
*8	Reference trajectory parameter	Const 282.2 n mi		
*9	Reference trajectory parameter	Const 187.44 n mi		
GF2V1	Reference trajectory parameter	Const 0.3046		
GF2V2	Reference trajectory parameter	Const 0.3046		
GF2V3	Reference trajectory parameter	Const 0.2175		
GF2V4	Reference trajectory parameter	Const 0.1335		
GF2V5	Reference trajectory parameter	Const 0.09982		
GF2V6	Reference trajectory parameter	Const 0.07683		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GF2V7	Reference trajectory parameter	Const 0.06139		
GF2V8	Reference trajectory parameter	Const 0.03391		
GF2V9	Reference trajectory parameter	Const 0.02479		
GF2V10	Reference trajectory parameter	Const 0.01446		
GF2V11	Reference trajectory parameter	Const 0.007039		
GF2V12	Reference trajectory parameter	Const 0.003582		
GF2V13	Reference trajectory parameter	Const 0.002591		
GF2V14	Reference trajectory parameter	Const 0 n mi		
GF2V15	Reference trajectory parameter	Const 0 n mi		
GF3V10	Reference trajectory parameter	Const 96.70 n mi		
GF3V11	Reference trajectory parameter	Const 4328 n mi		
GF3V12	Reference trajectory parameter	Const 21.82 n mi		
GF3V13	Reference trajectory parameter	Const 12.88 n mi		
GF3V14	Reference trajectory parameter	Const 1.0 n mi		
GF3V15	Reference trajectory parameter	Const 1.0 n mi		
GGAMN	Desired flight path angle	-90, +90 deg		
GGAMMA4	Re-entry flt path angle at 400,000 ft	$0, \pi$		
GGN	Current magnitude of oblate gravity vector	ft/sec^2		
GGEFFECT	Present radial acceleration	ft/sec^2		
GGAH	Flight path angle W/R to local horizontal	deg		
*$\underrightarrow{YGEO}$	Geographic position vector			
GXGEO	X-comp of geographic position vector	-53.8×10^6, 53.8×10^6 ft		
GYGEO	Y-comp of geographic position vector	-53.8×10^6, 53.8×10^6 ft		
GZGEO	Z-comp of geographic position vector	-53.8×10^6, 53.8×10^6 ft		
GGO	Dummy variable in subroutine (77)	0.03123×10^{-21}, 3.55×10^{-21}		
*$\underrightarrow{Y}$	Spherical force acceleration vector			
GGAX	X-comp of spherical force acceleration vector	-0.95, +0.95 ft/sec^2		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GGAY	Y-comp of spherical force acceleration vector	-0.95, +0.95 ft/sec^2		
GGAZ	Z-comp of spherical force acceleration vector	-0.95, +0.95 ft/sec^2		
GGHA	GHA with respect to (GTAIN)	0, 360 deg		
* $\mathfrak{C}$		Malfunction		
GG11	Element (1, 1) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GG12	Element (1, 2) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GG13	Element (1, 3) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GG21	Element (2, 1) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GG22	Element (2, 2) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GG23	Element (2, 3) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GG31	Element (3, 1) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GG32	Element (3, 2) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GG33	Element (3, 3) of the gravity gradient matrix	-4.63×10^{-6}, 4.63×10^{-6} sec^{-2}		
GHOVEL	DOT product of unit horizontal and velocity	0, +32.767 ft/sec		
GHN	Vehicle altitude in nautical miles	0 n mi		
GH	Orbit change aim update-altitude	n mi		
* $\underline{h}$	Battins h vector			
GHX	X-comp of battins h vector	-6.25×10^{-4}, 6.25×10^{-4} ft^{-1}		
GHY	Y-comp of battins h vector	-6.25×10^{-4}, 6.25×10^{-4} ft^{-1}		
GHZ	Z-comp of battins h vector	-6.25×10^{-4}, 6.25×10^{-4} ft^{-1}		
GHS	Atmospheric scale height	Const 28500 ft		
GHA	Altitude at apogee	0, 1638.3 n m		
GHHPOGEE	Contingency orb des apogee	Const 105 n mi		
GHALT	Altitude at altitude for perigee angular momentum vector	0, 5×10^6 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GHPALT	Mag of alt at per given apo, or alt of apo given per	0, 4212000 ft		
* $\vec{h}$	Modified angular momentum vector			
GHPRX	X-comp of modified angular momentum vector	-1.26×10^{-4}, $+1.26 \times 10^{-4}$ sec		
GHPRY	Y-comp of modified angular momentum vector	-1.26×10^{-4}, $+1.26 \times 10^{-4}$ sec		
GHPRZ	Z-comp of modified angular momentum vector	-1.26×10^{-4}, $+1.26 \times 10^{-4}$ sec		
GHPR	Mag of modified angular momentum vector	0, 1.26×10^{-4} sec		
GI	Priority list-update storage	0, 10		
GINZ	AGC input registar No. 2	00000, 77777_8		
GISSMOD	G&N mode switching code word	00, 77_8		
* $\vec{iTE}$	Unit vector indirection of initial thrust			
GITX	X-component of unit thrust	-1, +1		
GITY	Y-component of unit thrust	-1, +1		
GITZ	Z-component of unit thrust	-1, +1		
GINCTR	Value of index counter	0, 2		
GIP	Special parameter (function), conic			
GI0	Coeff No. 0 in the series expansion for Ip	Const 0.8164965809		
GI1	Coeff No. 1 in the series expansion for Ip	Const -0.3265986324		
GI2	Coeff No. 2 in the series expansion for Ip	Const 0.0590988001		
GI3	Coeff No. 3 in the series expansion for Ip	Const -0.0040090414		
GI4	Coeff No. 4 in the series expansion for Ip	Const 0.0002791786		
GI5	Coeff No. 5 in the series expansion for Ip	Const -0.0000106230		
* $\vec{YIN}$	Input position vector to subroutine (76)			
GXIN	X-comp. of input position vector to subroutine (76)	-53.8×10^6, $+53.8 \times 10^6$ ft		
GYIN	Y-comp. of input position vector to subroutine (76)	-53.8×10^6, $+53.8 \times 10^6$ ft		
GZIN	Z-comp. of input position vector to subroutine (76)	-53.8×10^6, $+53.8 \times 10^6$ ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GRIN	Magnitude of input position vector to subroutine (76)	-53.8×10^6, $+53.8 \times 10^6$ ft		
*$\vec{iR}$	Unit vector-landmark pos wrt S/C			
GIRX	X-component landmark pos wrt S/C	-1, 1		
GIRY	Y-component landmark pos wrt S/C	-1, 1		
GIRZ	Z-component landmark pos wrt S/C	-1, 1		
*$\vec{iN}$	Unit vector normal to desired orbit plane			
GINX	X-comp. of unit vector normal to desired orbit plane	-1, +1		
GINY	Y-comp. of unit vector normal to desired orbit plane	-1, +1		
GINZ	Z-comp. of unit vector normal to desired orbit plane	-1, +1		
*$\vec{iPITCH}$	Unit vector in dir of present pitch axis			
GIPITCHX	X-comp. of unit vector in dir of present pitch axis	-1, +1		
GIPITCHY	Y-comp. of unit vector in dir of present pitch axis	-1, +1		
GIPITCHZ	Z-comp. of unit vector in dir of present pitch axis	-1, +1		
*$\vec{iH}$	Unit local horizontal vector			
GIHX	X-comp. of unit local horizontal vector	-1, +1		
GIHY	Y-comp. of unit local horizontal vector	-1, +1		
GIHZ	Z-comp. of unit local horizontal vector	-1, +1		
*$\vec{iE}$	Local east unit vector			
GIEX	X-comp of local east unit vector	-1, +1		
GIEY	Y-comp of local east unit vector	-1, +1		
GIEZ	Z-comp of local east unit vector	-1, +1		
*$\vec{iT74}$	Unit vector for unit dir of thrust			
GIT74X	X-comp of unit vector for unit dir of thrust	-1, +1		
GIT74Y	Y-comp of unit vector for unit dir of thrust	-1, +1		
GIT74Z	Z-comp of unit vector for unit dir of thrust	-1, +1		
*$\vec{iT73}$	Unit vector for initial dir of thrust	±1		
GIT73X	X-comp of unit vector for initial dir of thrust	±1		
GIT73Y	Y-comp of unit vector for initial dir of thrust	±1		
GIT73Z	Z-comp of unit vector for initial dir of thrust	±1		
GIPZ	Cos angle bet. normal to orbit and N pole unit vector	±1 units		
*$\vec{iE}$	Unit vect norm to pres orbit plane and z-plane	±1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GXIE	X-comp of unit vect norm to pres orbit plane and z-plane	±1		
GYIE	Y-comp of unit vect norm to pres orbit plane and z-plane	±1		
GZIE	Z-comp of unit vect norm to pres orbit plane and z-plane	±1		
*$\vec{iP}$	UN vect orthogonal to orbital plane	±1		
GIPX	X-comp of orthogonal to orbital plane	±1		
GIPY	Y-comp of orthogonal to orbital plane	±1		
GIPZ	Z-comp of orthogonal to orbital plane	±1		
GJ	Coefficient of the first gravitational harmonic	0, 1.62345×10^{-3}		
GJP	Special function parameter, conic	0, 2.93		
GJ0	Coeff No. 0 in the series expansion for J_p	Const 0.7071067812		
GJ1	Coeff No. 1 in the series expansion for J_p	Const-0.4714045208		
GJ2	Coeff No. 2 in the series expansion for J_p	Const 0.0942809042		
GJ3	Coeff No. 3 in the series expansion for J_p	Const-0.0089791337		
GJ4	Coeff No. 4 in the series expansion for J_p	Const 0.0004988408		
GJ5	Coeff No. 5 in the series expansion for J_p	Const-0.0000181397		
GIN	No. of delta T vel can be less than T/H			
GJAY	No. of any film strip	0, 31		
GKEYCTR	Keyboard identification counter			
GKWD	5-bit key code from 1A14 or 1A33 panels	0, 31_{10}		
GKWDIN	5-bit key code input to GCHARIN	0, 31_{10}		
GK	Steerlaw gain	Const $-125\ sec^{-1}$		
GKP	Battins special variable	0, $1.0\ sec^{-1}$		
GKEYTIME	Time keyed in by astronaut for GRUNOTRK	0, 2.684×10^6 sec		
GKIROLL	Constant lateral logic	0, 2^4		
GKC	W matrix update factor for powered flight	0, 10		
GKPF	W matrix update constant for powered flight	Const 2.0		
GKMC	W matrix update constant for minor correction	Const 1.0		
GKTETA	Time of flight calculation gain	Const 1000 sec rad		
GKDMIN	Increment to Q7 to end KEPLER	Const 0.5 ft/sec		
GKLAT	Lateral switch gain	Const 0.0075		
GKZROLL	Constant lateral logic	0, 24		
GKAP	Constant used to define re-entry angle	Const 18.7		
GKAR1	Constant used to define	Const 16.867×10^{-4}		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GKAR2	Constant used to define	Const 3.836 x 10^{-8}		
GKTOM	Constant used to define TATMOS	Const 1440 sec		
GKA44	First coefficient of GMAX polynomial	Const -0.65290796		
GKB44	Second coefficient of GMAX polynomial	Const 0.77557138 x 10^{-1}		
GKC44	Third coefficient of GMAX polynomial	Const -0.23646390 x 10^{-3}		
GKD44	Fourth coefficient of GMAX polynomial	Const 0.61853793 x 10^{-6}		
GKE44	Fifth coefficient of GMAX polynomial	Const -0.71129403 x 10^{-9}		
GLCGCOS	Cos of actual sighting angle	-1, +1		
GLCGSIN	Sin of actual sighting angle	-1, +1		
GLCDCOS	Cos of measured sighting angle	-1, +1		
GLCDSIN	Sin of measured sighting angle	-1, +1		
GLSTTOLR	Sighting angle tolerance	+5 x 10^{-5}, +10^{-4} deg		
GLF	Geodetic latitude of vehicle position	-90, +90 deg		
GLEF	Geocentric latitude of vehicle position	-90, +90 deg		
GLCDFAC	Inv square root of one minus square of star STG DOT PR	+1.0, cosecant 15°		
*$\vec{F}^{SM}$	(SS1XSS2)XSS1 in inertial frame			
GLCF1	First-comp of (SS1XSS2)XSS1 in inertial frame	-1.0, +1.0		
GFCF2	Second-comp of (SS1XSS2)XSS1 in inertial frame	-1.0, +1.0		
GLCF3	Third-comp of (SS1XSS2)XSS1 in inertial frame	-1.0, +1.0		
*$\vec{E}^{SM}$	Cross product of star sightings			
GLCE1	First-comp of cross product of star sightings	-1.0, +1.0		
GLCE2	Second-comp of cross product of star sightings	-1.0, +1.0		
GLCE3	Third-comp of cross product of star sightings	-1.0, +1.0		
*$\vec{H}^{I}$	(S1XS2) in inertial frame			
GLCH1	First-comp of (S1XS2) in inertial frame	-1.0, +1.0		
GLCH2	Second-comp of (S1XS2) in inertial frame	-1.0, +1.0		
GLCH3	Third-comp of (S1XS2) in inertial frame	-1.0, +1.0		
*$\vec{Q}^{I}$	(S1XS2)XS1 inertial frame			
GLCQ1	First-comp. of (S1 x S2) x S1 inertial frame	-1, +1		
GLCQ2	Second-comp. of (S1 x S2) x S1 inertial frame	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GLCQ3	Third-comp. of (S1 x S2) x S1 inertial fram3	-1, +1		
*GLLM--X	Selenocentric X coord of selected lunar LM	$-21(10^6)$, $+21(10^6)$ ft		
*GLLM--Y	Selenocentric Y coord of selected lunar LM	$-21(10^6)$, $+21(10^6)$ ft		
*GLLM--Z	Selenocentric Z coord of selected lunar LM	$-21(10^6)$, $+21(10^6)$ ft		
GLMSX	Geo. or selen Y coord of selected landmark	$-21(10^6)$, $+21(10^6)$ ft		
GLMSY	Geo. or selen Y coord of selected landmark	$-21(10^6)$, $+21(10^6)$ ft		
GLMSZ	Geo. or selen Z coord of selected landmark	$-21(10^6)$, $+21(10^6)$ ft		
GLAPR	Update equations parameter	-3.20, 3.20		
GLA	Update equations parameter	-1.0, 1.0		
GLEQN	Excess cf over gravity	0, 81 ft/sec^2		
GLATANGN	Cos lateral range complement	-1, +1		
GLDN	Desired lift to drag ratio vertical plane	-2.0, +2.0		
GLAD	Max. L/D ratio	Const 0.3		
GLATBIAS	Lateral switch bias term	Const 0.4 n mi		
GLDCMNR	Lad. cos 15	Const 0.2895		
GLOD	Final phase L/P	Const 0.18		
GLMLAT	Landmark latitude input (geographic)	-180, +180 deg		
GLMLONG	Landmark longitude input (geographic)	-180, +180 deg		
GLAMDI	GDERECVA input latitude	-90, +90 deg		
GLATD	Geocentric latitude desired	±90 deg		
GLONGD	Geocentric longitude desired	0, 360 deg		
GLE	Lateral angular miss distance	Radians		
GM	Priority list-update storage	-10, 10		
GMKRWD	IOS MDP repeat keycode-5 bits 18A24	0, 11111 octal		
GMDSPWD	MDP and IOS MDP repeat display word-15 bits	-77777, 77777 octal		
GMANUPP	Priority for maneuver job	0, 24000 octal		
GMODE	Major mode display requested	0, 77 octal		
GMARKAAT	Trunnion angle at mark A	-360, 360 deg		
GMARKBAT	Trunnion angle at mark B	-360, 360 deg		
GMARKAAS	Shaft angle at mark A	-360, 360 deg		
GMARKBAS	Shaft angle at mark B	-360, 360 deg		
GMARKAOB	Outer gimbal angle at mark A	-360, 360 deg		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GMARKBOG	Outer gimbal angle at mark B	-360, 360 deg		
GMARKAMG	Middle gimbal angle at mark A	-360, 360 deg		
GMARKBMG	Middle gimbal angle at mark B	-360, 360 deg		
GMARKAIG	Inner gimbal angle at mark A	-360, 360 deg		
GMARKBIG	Inner gimbal angle at mark B	-360, 360 deg		
GMU	General gravitational constant	1.730×10^{-14}, 1.4076×10^{-16} ft/sec^2		
GMUE	Earth gravitational constant	Const 1.4076455×10^{16} ft/sec^2		
GMUM	Moon gravitational constant	Const $1.73138932 \times 10^{14}$ ft/sec^2		
GMARK1AT	Trunnion angle at mark 1	0, 360 deg		
GMARK1AS	Shaft angle at mark 1	0, 360 deg		
GMARK1OG	Outer gimbal angle at mark 1	0, 360 deg		
GMARK1MG	Middle gimbal angle at mark 1	0, 360 deg		
GMARK1IG	Inner gimbal angle at mark 1	0, 360 deg		
GMININDX	Minimal No. of marks to be taken	0, 6 deg		
GMARK2AT	Trunnion angle at mark 2	0, 360 deg		
GMARK2AS	Shaft angle at mark 2	0, 360 deg		
GMARK2OG	Outer gimbal angle at mark 2	0, 360 deg		
GMARK2MG	Middle gimbal angle at mark 2	0, 360 deg		
GMARK2IG	Inner gimbal angle at mark 2	0, 360 deg		
GMM	Major mode buffer register	00, 77_8		
*ΔM	Steerlaw ΔM vector			
GDELMX	X-comp of Steerlaw ΔM vector	-511, +511 ft/sec		
GDELMY	Y-comp of Steerlaw ΔM vector	-511, +511 ft/sec		
GDELMZ	Z-comp of Steerlaw ΔM vector	-511, +511 ft/sec		
GMAM	Massless angular momentum magnitude	0, 1.13×10^{13} ft^2/sec		
GMAN0	Mean anomaly of vehicle orbit at to	0, 2π rad		
GMODE	I/O code word for mode			
GMTYPE	Flag designating type of expected mark	0, 7_8		
GMKPBLF	Mark interrupt last frame	0, 1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GMKCNTR	A mark counter	0, 6		
GMCOUNT	Counter used in updating W matrix	1, 6		
GMAXINDX	Maximum No. of marks to be taken			
GMARKT1	Present AGC time, major part	0, $+2.7 \times 10^6$ sec		
GMARKT2	Present AGC time, minor part	0, +83,886.07 sec		
GMARKSH	Present shift angle	0, 360 deg		
GMARKTR	Present trunnion angle	0, 360 deg		
GMARKIG	Present inner gimbal angle	-360, 360 deg		
GMARKMG	Present middle gimbal angle	-360, 360 deg		
GMARKOG	Present outer gimbal angle	-360, 360 deg		
*$\vec{M}$	Unit vector for direction of telescope wrtnb			
GMX	X-component of unit vector, dir. of tel			
GMY	Y-component of unit vector, dir. of tel	-1, 1		
GMZ	Z-component of unit vector, dir. of tel	-1, 1		
GMAX	G limit	-1, 1 ft/sec^2		
GMAN	No. of g's on astronaut	Const 323 g's		
GMASS	Mass of CM	Const -20, +20 slugs		
*$\vec{WA}$	Unit vector of $\vec{X}^{sc} \otimes \vec{X}^{scd}$	Const 292.1977		
GMXWP	X-comp of unit vector of $\vec{X}^{sc} \otimes \vec{X}^{scd}$	-1, +1		
GMYWP	Y-comp of unit vector of $\vec{X}^{sc} \otimes \vec{X}^{scd}$	-1, +1		
GMZWP	Z-comp of unit vector of $\vec{X}^{sc} \otimes \vec{X}^{scd}$	-1, +1		
*$\vec{Y}^{SC}$	Spacecraft axes			
GMXSC	Spacecraft X axis	-1, +1		
GMYSC	Spacecraft Y axis	-1, +1		
GMZSC	Spacecraft Z axis	-1, +1		
GMAX	Maximum predicted g for reentry	0, 128		
*$\vec{\nu}^{SM}$	Stable member axes			
GMXSM	Stable member X axis	-1, +1		
GMYSM	Stable member Y axis	-1, +1		
GMZSM	Stable member Z axis	-1, +1		
*$\vec{\nu}^{NB}$	Navigation base axes			
GMXNB	Navigation base X axis	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GMYNB	Navigation base Y axis	-1, +1		
GMZNB	Navigation base Z axis	-1, +1		
GMA12	$\lvert GO12\ GO22\ GO32 \rvert \cdot \overrightarrow{XSC}$	-1, +1		
GMA22	$\lvert GO12\ GO22\ GO32 \rvert \cdot \overrightarrow{YSC}$	-1, +1		
GMA32	$\lvert GO12\ GO22\ GO32 \rvert \cdot \overrightarrow{ZSC}$	-1, +1		
GMWX	Command roll maneuver	-180, +180		
GMWY	Command pitch maneuver	-180, +180		
GMWZ	Command yaw maneuver	-180, +180		
GMWXO	Maximum roll maneuver	-180, +180		
GMWYO	Maximum pitch maneuver	-180, +180		
GMWZO	Maximum yaw maneuver	-180, +180		
GMTWTLST	$\lvert GTHETAD + THETAD1 + THETAD2 \rvert \div 3.0$	0, 500 sec		
GMCOSAMG	Cos of desired middle gimbal angle	-1, +1 deg		
*$\overrightarrow{iM}$	Un vect in dir of max. decl of present orbit plane			
GXMDC	X-comp of dir of max. decl of present orbit plane	-1, +1		
GYMDC	Y-comp of dir of max. decl of present orbit plane	-1, +1		
GZMDC	Z-comp of dir of max. decl of present orbit plane	-1, +1		
GMISSOC	Miss distance to desired target vector	0, 53.8×10^6 ft		
*$\overrightarrow{M}$				
GM11	M matrix element 11	±1		
GM12	M matrix element 12	±1		
GM13	M matrix element 13	±1		
GM21	M matrix element 21	±1		
GM22	M matrix element 22	±1		
GM23	M matrix element 23	±1		
GM31	M matrix element 31	±1		
GM32	M matrix element 32	±1		
GM33	M matrix element 33	±1		
GN1	Priority list-update	0, 10		
GNEWPR	Priority of new highest priority JOB	0, 40000 octal		
GN	Display table word counter			
GNDO	Flag specifying display table output req'd	0000, 7777_8		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GNDSPWD	Nav and IOS nav repeat display word-15 bits			
GNKRWD	IOS ndp repeat keycode-5 bits 16A17			
GNOUN	I/O program code word for noun	0, 77		
GNDW	I/O program code word for display job	0000, 7777		
*GNDX	Data buffer register or blank display data	000000, 777777_8		
GNN	Noun buffer register	00, 77_8		
*GNUMCNT	Consecutive numeral keyword count	0, 31_{10}		
$*\vec{N}$	Vector normal to the trajectory plane			
GPX	X component of vector normal to trajectory plane	-1.099478×10^{12}, $+1.099478 \times 10^{12}$		
GPY	Y component of vector normal to trajectory plane	-1.099478×10^{12}, $+1.099478 \times 10^{12}$		
GPZ	Z component of vector normal to trajectory plane	-1.099478×10^{12}, $+1.099478 \times 10^{12}$		
*GNDS	Command DSPTAB load of sign or spec funct bits	0000, 7777_8		
GNMTFTC	Feet per nautical mile	Const 6076.115 ft		
*GNOMINDX	Nominal No. of marks to be taken	0, 6		
*GNM	No. of marks taken by astronaut	0, 6		
GNU	Equivalent to Battins x	0, 46100 $ft^{1/2}$		
$*\vec{G}_N$	Gravity vector			
GXN	X-comp of gravity vector	-33, +33 ft/sec^2		
GYN	Y-comp of gravity vector	-33, +33 ft/sec^2		
GZN	Z-comp of gravity vector	-33, +33 ft/sec^2		
*N	Trans stable member-nav base element			
GN11	Trans stable member-nav base element 11	-1, +1		
GN12	Trans stable member-nav base element 12	-1, +1		
GN13	Trans stable member-nav base element 13	-1, +1		
GN21	Trans stable member-nav base element 21	-1, +1		
GN22	Trans stable member-nav base element 22	-1, +1		
GN23	Trans stable member-nav base element 23	-1, +1		
GN31	Trans stable member-nav base element 31	-1, +1		
GN32	Trans stable member-nav base element 32	-1, +1		
GN33	Trans stable member-nav base element 33	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
$*\vec{G}_N$	Acc due to gravity at T_{IGN} vector			
GXNST	X-comp. of acc due to gravity at T_{IGN} vector	-33, +33 ft/sec^2		
GYNST	Y-comp. of acc due to gravity at T_{IGN} vector	-33, +33 ft/sec^2		
GZNST	Z-comp. of acc due to gravity at T_{IGN} vector	-33, +33 ft/sec^2		
GNST	Current magnitude of oblate gravity vector	0, 32.3 ft/sec^2		
GND11	Desired IMU inertial orientation	-1.0, +1.0		
GND12	Desired IMU inertial orientation	-1.0, +1.0		
GND13	Desired IMU inertial orientation	-1.0, +1.0		
GND21	Desired IMU inertial orientation	-1.0, +1.0		
GND22	Desired IMU inertial orientation	-1.0, +1.0		
GND23	Desired IMU inertial orientation	-1.0, +1.0		
GND31	Desired IMU inertial orientation	-1.0, +1.0		
GND32	Desired IMU inertial orientation	-1.0, +1.0		
GND33	Desired IMU inertial orientation	-1.0, +1.0		
*GNNCW	Noun control word	00_8, 77_8		
*GNNB1	Bit 1 of noun control word (LSD)	0_2, 1_2		
*GNNB2	Bit 2 of noun control word (LSD)	0_2, 1_2		
*GNNB3	Bit 3 of noun control word (LSD)	0_2, 1_2		
*GNNB4	Bit 4 of noun control word (LSD)	0_2, 1_2		
*GNNAMAX	Max. value of GR1	See math model (012)3179-19		
*GNNBMAX	Max. value of GR2			
*GNNCMAX	Max. value of GR3			
*GNDX	Commands DSPTAB load or blanks data digits	000000_8, 777777_8		
GXNMI	Previous oblate gravity along X-axis	-32.3, +32.3 ft/sec^2		
GYNMI	Previous oblate gravity along Y-axis	-32.3, +32.3 ft/sec^2		
GZNMI	Previous oblate gravity along Z-axis	-32.3, +32.3 ft/sec^2		
GN12O	Element of W matrix at start of local vertical	-1, +1		
GN13O	Element of W matrix at start of local vertical	-1, +1		
GNCOUNT	Counter register	0, 16		
GNMN	Miss distance lateral	-4000, +4000 n mi		
$*\vec{Z}$	North pole unit vector			
GNPZX	X-comp of north pole unit vector	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GNPZY	Y-comp of north pole unit vector	-1, +1		
GNPZZ	Z-comp of north pole unit vector	-1, +1		
GO11	Dir cos of angle between X_I and X_{SM} axes	-1.0, +1.0		
GO12	Dir cos of angle between X_I and Y_{SM} axes	-1.0, +1.0		
GO13	Dir cos of angle between X_I and Z_{SM} axes	-1.0, +1.0		
GO21	Dir cos of angle between Y_I and X_{SM} axes	-1.0, +1.0		
GO22	Dir cos of angle between Y_I and Y_{SM} axes	-1.0, +1.0		
GO23	Dir cos of angle between Y_I and Z_{SM} axes	-1.0, +1.0		
GO31	Dir cos of angle between Z_I and X_{SM} axes	-1.0, +1.0		
GO32	Dir cos of angle between Z_I and Y_{SM} axes	-1.0, +1.0		
GO33	Dir cos of angle between Z_I and Z_{SM} axes	-1.0, +1.0		
GOUT1	AGC out 1 register equiv	00000, 77777_8		
GOBA	First star/landmark No. entered	0, 511_{10}		
GOBB	Second star/landmark No. entered	0, 511_{10}		
GOA	Earth rotation rate	Const 7.29210635 x 10^{-5} rad/sec		
GOPTTRUN	Desired optics trunnion angle	0, 360 deg		
GOPTSHFT	Desired optics shaft angle	0, 360 deg		
GORK	Altitude of 80 nautical mi converted to ft	Const 486090 ft		
GOME	Earth rotational rate	Const 7,29211504 x 10^{-5} sec^{-1}		
GOMER	Entry empherical range angle	-2π, $+2\pi$		
GPRIOR	Priority of last job on priority list	0, 40000		
GPR1	Priority list-update storage	-10, 10		
GPR2	Priority list-update storage	-10, 10		
GPR3	Priority list-update storage	-10, 10		
GPR4	Priority list-update storage	-77777, 77777		
GPRCTR	Priority list counter	-10, 10		
GPRION	Priority list job priority	-77777, 77777		
GPRCTEM	Priority list temporary counter	-10, 10		
GPOVEL	DOT product of $\underrightarrow{unith}$ and $\underrightarrow{univn}$			
GPAST	Current semilatus vectum of desired orbit	0, 5.38 x 10^7 ft		
GPHD	Orbit change aim update: longitude	0, 360 deg		
GPSTRIM	Orbit change aim update: yaw trim	-90, +90 deg		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GPIPTIME	Time at which PIPAS are read	0, 2.68×10^6 sec		
GPERIGEE	Veh altitude at perigee in n mi	0, 750 n.m.		
GPERIGEF	Veh altitude at perigee in feet	0, 4.5×10^6 ft		
GPHTOES	Earth radius corres to geocentric latitude O	2.0855548×10^7, 2.0925700×10^7 ft		
GP1	First legendre polynomial	-1.0, +1.0		
GP2	Second legendre polynomial	-0.5, +1.0		
GP2P	Second legendre polynomial derivative	-3, +3		
GP3	Third legendre polynomial	-1, +1		
GP3P	Third legendre polynomial derivative	-1.5, 6		
GP4	Fourth legendre polynomial	0.3, +1.0		
GP4P	Fourth legendre polynomial derivative	-10.0, +10.0		
GP5P	Fifth legendre polynomial derivative	-10.0, +15		
*$\vec{GP}$	Vector normal to gyd and GUVA			
GXP	X-comp of $\vec{GP}$	-1, +1 ft/sec		
GYP	Y-comp of $\vec{GP}$	-1, +1 ft/sec		
GZP	Z-comp of $\vec{GP}$	-1, +1 ft/sec		
GPSI	Cos of angle btwn position and target vectors	-1, +1		
GPHIE	Entry range angle	Const 0.21866 rad		
GPSTRIM	Yaw trim angle	-180, +180 rad		
*P	0 hr launch day to tm of launch transformation			
GP11	Equation GS5203	-1, +1		
GP12	Equation GS5204	-1, +1		
GP13	Equation GS5205	-1, +1		
GP21	Equation GS5206	-1, +1		
GP22	Equation GS5207	-1, +1		
GP23	Equation GS5208	-1, +1		
GP31	Equation GS5209	-1, +1		
GP32	Equation GS5210	-1, +1		
GP33	Equation GS5211	-1, +1		
GPREDGLN	Predicted range	0, 1080 n mi		
GPHIPR	Angle from horizon to local vertical	0, 1.5708 rad		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GPPR	Normalized semi-latus rectum	0, 2.55		
GP	Pitch angle	0, 360 deg		
GQC	Conic parameter for X expansion by mit	$ft^{1/2}$		
*$\vec{Q}$	Steerlaw Q vector			
GQX	X-comp of Steerlaw Q vector	-330, +330 ft/sec^{-2}		
GQY	Y-comp of Steerlaw Q vector	-330, +330 ft/sec^{-2}		
GQZ	Z-comp of Steerlaw Q vector	-330, +330 ft/sec^{-2}		
GQD	Dummy variable in λ(Encke's) acceleration	-5.04×10^{-3}, 5.04×10^{-3}		
GQM	Measured angle	-2π, 2π rad		
GQR	Reference angle	0, rad		
GDEQ	Difference between measured and ref angle	-2π, 2π rad		
GQ7	Minimum drag for up control	Const 6 ft/sec^2		
GFOLLPR	Roll job priority			
GRTDK	Degrees per radian			
*GR1	R1 data buffer register	-99999_{10}, $+99999_{10}$		
*GR2	R2 data buffer register	-99999_{10}, $+99999_{10}$		
*GR3	R3 data buffer register	-99999_{10}, $+99999_{10}$		
GR	Roll angle	0, 360 deg		
GRP	Magnitude of position vector at perigee	0, 33,554,431 ft		
*$\vec{R}_{jt}$	Burnout inertial position vector			
GXRJP	X-component of position at program exit	-5.38×10^7, $+5.38 \times 10^7$ ft		
GYRJP	Y-component of position at program exit	-5.38×10^7, $+5.38 \times 10^7$ ft		
GZRJP	Z-component of position at program exit	-5.38×10^7, $+5.38 \times 10^7$ ft		
*$\vec{R}_N$	Vehicle position vector			
GRXN	X-component of position vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
GRYN	Y-component of position vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
GRZN	Z-component of position vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
GRN	Magnitude of earth centered position vector	0, 5.38×10^7 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GRENTRAV	Average radius at 300,000 ft altitude	Const 21190622 ft		
GRE	Earth equatorial radius	0, 22 x 10^6 ft		
GREVU	Unit vector apollo to earth c.g.			
*$\overrightarrow{VR}$	Position vector in I_E-frame from nav integ			
GXR	X-comp of position vector at time TN	-53.8 x 10^6, +53.8 x 10^6 ft		X
GYR	Y-comp of position vector at time TN	-53.8 x 10^6, +53.8 x 10^6 ft		X
GZR	Z-comp of position vector at time TN	-53.8 x 10^6, +53.8 x 10^6 ft		X
*$\overrightarrow{V_R}$	Velocity vector in I_E-frame from nav integ			
GXDR	X-comp of velocity vector at time TN	-32768, +32768 ft/sec		X
GYDR	Y-comp of velocity vector at time TN	-32768, +32768 ft/sec		X
GZDR	Z-comp of velocity vector at time TN	-32768, +32768 ft/sec		X
*$\overrightarrow{YREC}$	Position vector at time of rectification			
GXREC	X-comp of position vector at time of rectification	-53.8 x 10^6, +53.8 x 10^6 ft		
GYREC	Y-comp of position vector at time of rectification	-53.8 x 10^6, +53.8 x 10^6 ft		
GZREC	Z-comp of position vector at time of rectification	-53.8 x 10^6, +53.8 x 10^6 ft		
*$\overrightarrow{VREC}$	Velocity vector at time of rectification			
GXDREC	X-comp velocity vector at time of rectification	-32768, 32768 ft/sec		
GYDREC	Y-comp velocity vector at time of rectification	-32768, 32768 ft/sec		
GZDREC	Z-comp velocity vector at time of rectification	-32768, 32768 ft/sec		
*$\overrightarrow{GRHO}$ and ϵI	Unit vector in the direction of desired X_{SM}			
GRHOX	X-comp of vector in the direction of desired X_{SM}	-1.0, +1.0		
GRHOY	Y-comp of vector in the direction of desired X_{SM}	-1.0, +1.0		
GRHOZ	Z-comp of vector in the direction of desired X_{SM}	-1.0, +1.0		
GRR	Magnitude of position vector at time TN	-53.8 x 10^6, +53.8 x 10^6 ft		
GRREC	Magnitude of position vector at time of rectification	-53.8 x 10^6, +53.8 x 10^6 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GR4TH	Eq rad of earth + 400,000 ft	Const 21325700 ft		
*$\vec{R}_{GEO}$	Geoc lat vehicle position at perigee	feet		
GRXGEO	X-comp of geoc lat vehicle position at perigee	-33554431, +33554431 ft		
GRYGEO	Y-comp of geoc lat vehicle position at perigee	-33554431, +33554431 ft		
GRZGEO	Z-comp of geoc lat vehicle position at perigee	-33554431, +33554431 ft		
*$\vec{P}_P$	Orbit of vehicle at perigee			
GRXPER	X-comp of orbit of vehicle at perigee	-33554431, +33554431 ft		
GRYPER	Y-comp of orbit of vehicle at perigee	-33554431, +33554431 ft		
GRZPER	Z-comp of orbit of vehicle at perigee	-33554431, +33554431 ft		
*R_X	General X-axis rotational matrix			
GRX11	X-axis rotation matrix element 11	-1, +1		
GRX12	X-axis rotation matrix element 12	-1, +1		
GRX13	X-axis rotation matrix element 13	-1, +1		
GRX21	X-axis rotation matrix element 21	-1, +1		
GRX22	X-axis rotation matrix element 22	-1, +1		
GRX23	X-axis rotation matrix element 23	-1, +1		
GRX31	X-axis rotation matrix element 31	-1, +1		
GRX32	X-axis rotation matrix element 32	-1, +1		
GRX33	X-axis rotation matrix element 33	-1, +1		
GRXNMI	Previous position component along X_{SM}-axis	-5.38×10^7, $+5.38 \times 10^7$ ft		
GRYNMI	Previous position component along Y_{SM}-axis	-5.38×10^7, $+5.38 \times 10^7$ ft		
GRZNMI	Previous position component along Z_{SM}-axis	-5.38×10^7, $+5.38 \times 10^7$ ft		
*R_Y	General Y-axis rotation matrix	±1		
GRY11	Y-axis rotation matrix element 11	Const 0		
GRY12	Y-axis rotation matrix element 12	±1		
GRY13	Y-axis rotation matrix element 13	±1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GRY21	Y-axis rotation matrix element 21	Const 0		
GRY22	Y-axis rotation matrix element 22	Const 1		
GRY23	Y-axis rotation matrix element 23	Const 0		
GRY31	Y-axis rotation matrix element 31	±1		
GRY32	Y-axis rotation matrix element 32	Const 0		
GRY33	Y-axis rotation matrix element 33	±1		
*R_Z	General Z-axis rotation matrix			
GRZ11	Z-axis rotation matrix element 11	±1		
GRZ12	Z-axis rotation matrix element 12	±1		
GRZ13	Z-axis rotation matrix element 13	Const 0		
GRZ21	Z-axis rotation matrix element 21	±1		
GRZ22	Z-axis rotation matrix element 22	±1		
GRZ23	Z-axis rotation matrix element 23	Const 0		
GRZ31	Z-axis rotation matrix element 31	Const 0		
GRZ32	Z-axis rotation matrix element 32	Const 0		
GRZ33	Z-axis rotation matrix element 33	Const 1		
*$\vec{r}_{R1}$	Position vector at start of time step			
GXR1	X-component at start of time step	-53.8×10^6, 53.8×10^6 ft		
GYR1	Y-component at start of time step	-53.8×10^6, 53.8×10^6 ft		
GZR1	Z-component at start of time step	-53.8×10^6, 53.8×10^6 ft		
*$\vec{r}_{R2}$	Position vector at middle of time step			
GXR2	X-component at middle of time step	-53.8×10^6, 53.8×10^6 ft		
GYR2	Y-component at middle of time step	-53.8×10^6, 53.8×10^6 ft		
GZR2	Z-component at middle of time step	-53.8×10^6, 53.8×10^6 ft		
*$\vec{r}_{R3}$	Position vector at end of time step			
GXR3	X-component at end of time step	-53.8×10^6, 53.8×10^6 ft		
GYR3	Y-component at end of time step	-53.8×10^6, 53.8×10^6 ft		
GZR3	Z-component at end of time step	-53.8×10^6, 53.8×10^6 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*$\overrightarrow{GRVEU}$	Unit vector sc to earth c.g.			
GRVEUX	X-comp of unit vector sc to earth c.g.	-1.0, +1.0		
GRVEUY	Y-comp of unit vector sc to earth c.g.	-1.0, +1.0		
GRVEUZ	Z-comp of unit vector sc to earth c.g.	-1.0, +1.0		
GROLLCN	Roll angle about X of SM	0, π		
*R	Matrix body to NB			
GR11	Matrix body to NB	-1.0, 1.0		
GR12	Matrix body to NB	-1.0, 1.0		
GR13	Matrix body to NB	-1.0, 1.0		
GR21	Matrix body to NB	-1.0, 1.0		
GR22	Matrix body to NB	-1.0, 1.0		
GR23	Matrix body to NB	-1.0, 1.0		
GR31	Matrix body to NB	-1.0, 1.0		
GR32	Matrix body to NB	-1.0, 1.0		
GR33	Matrix body to NB	-1.0, 1.0		
GRD1REF	Reference trajectory functions	-1000, 300 ft/sec		
GRTGO	Reference trajectory functions	0, 700		
*$\overrightarrow{R_{TE}}$	Vector east at initial target			
GRTEX	X-comp of vector east at initial target	-1, +1 ft		
GRTEY	Y-comp of vector east at initial target	-1, +1 ft		
GRTEZ	Z-comp of vector east at initial target	-1, +1 ft		
*$\overrightarrow{\sqrt{LM}}$	Position vector of landmark in I_E-frame			
GRLMX	X-component of landmark in I_E-frame	-53.8×10^6, 53.8×10^6 ft		
GRLMY	Y-component of landmark in I_E-frame	-53.8×10^6, 53.8×10^6 ft		
GRLMZ	Z-component of landmark in I_E-frame	-53.8×10^6, 53.8×10^6 ft		
*$\overrightarrow{\sqrt{VL}}$	Position vector of lndmark wrt S/C			
GRVLX	X-component of lndmark posit vector	-53.8×10^6, 53.8×10^6 ft		
GRVLY	Y-component of lndmark posit vector	-53.8×10^6, 53.8×10^6 ft		
GRVLZ	Z-component of lndmark posit vector	-53.8×10^6, 53.8×10^6 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GROLLCN	Roll command	-2 , +2 rad		
GRDOTN	Altitude rate	-32767, +32767 ft/sec		
GRTGOI1	Equation GS7915	n mi		
GRH	Geocentric distance of A, B	-21×10^6, $+21 \times 10^6$ ft		
* $\vec{\lambda}_d$	Orbital maneuver target vector			
GRXD	X-comp of orbital maneuver target vector	-5.38×10^7, 5.38×10^7 ft		
GRYD	Y-comp of orbital maneuver target vector	-5.38×10^7, 5.38×10^7 ft		
GRZD	Z-comp of orbital maneuver target vector	-5.38×10^7, 5.38×10^7 ft		
GRD	Mag of orbital maneuver target vector	2.08×10^7, 5.38×10^7 ft		
* $\vec{\rho}$	Inertial un vect in dir of -Z SM-axis			
GRHOX	X-comp of inertial un vect in dir of -Z SM-axis	-1, +1		
GRHOY	Y-comp of inertial un vect in dir of -Z SM axis	-1, +1		
GRHOZ	Z-comp of inertial un vect in dir of -Z SM axis	-1, +1		
GRDREF1	Reference trajectory parameter	Const -820 ft/sec		
GRDREF2	Reference trajectory parameter	Const -820 ft/sec		
GRDREF3	Reference trajectory parameter	Const -927 ft/sec		
GRDREF4	Reference trajectory parameter	Const -781 ft/sec		
GRDREF5	Reference trajectory parameter	Const -566 ft/sec		
GRDREF6	Reference trajectory parameter	Const -416 ft/sec		
GRDREF7	Reference trajectory parameter	Const -352 ft/sec		
GRDREF8	Reference trajectory parameter	Const -416 ft/sec		
GRDREF9	Reference trajectory parameter	Const -493 ft/sec		
GRDREF10	Reference trajectory parameter	Const -609 ft/sec		
GRDREF11	Reference trajectory parameter	Const -694 ft/sec		
GRDREF12	Reference trajectory parameter	Const -719 ft/sec		
GRDREF13	Reference trajectory parameter	Const -693 ft/sec		
GRDREF14	Reference trajectory parameter	Const -331 ft/sec		
GRDREF15	Reference trajectory parameter	Const -331 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
$*\vec{\nu}^{IN}$	Routine input position vector			
GR1NX	X-comp of routine input position vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
GR1NY	Y-comp of routine input position vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
GR1NZ	Z-comp of routine input position vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
GR1N	Mag of routine input position vector	0, 5.38×10^7 ft		
$*\vec{P}^{IN}$	GURCOIN unit position vect			
GRHO1NX	X-comp of GURCOIN unit position vect	-1, +1		
GRHO1NY	Y-comp of GURCOIN unit position vect	-1, +1		
GRHO1NZ	Z-comp of GURCOIN unit position vect	-1, +1		
GRTOGOV1	Reference trajectory parameter	Const 643 n mi		
GRTOGOV2	Reference trajectory parameter	Const 643 n mi		
GRTOGOV3	Reference trajectory parameter	Const 504.8 n mi		
GRTOGOV4	Reference trajectory parameter	Const 344.3 n mi		
GRTOGOV5	Reference trajectory parameter	Const 266.8 n mi		
GRTOGOV6	Reference trajectory parameter	Const 210.3 n mi		
GRTOGOV7	Reference trajectory parameter	Const 170.9 n mi		
GRTOGOV8	Reference trajectory parameter	Const 99.9 n mi		
GRTOGOV9	Reference trajectory parameter	Const 75.4 n mi		
GRTOGOV10	Reference trajectory parameter	Const 46.3 n mi		
GRTOGOV11	Reference trajectory parameter	Const 22.1 n mi		
GRTOGOV12	Reference trajectory parameter	Const 8.9 n mi		
GRTOGOV13	Reference trajectory parameter	Const 2.7 n mi		
GRTOGOV14	Reference trajectory parameter	Const 0 n mi		
GRTOGOV15	Reference trajectory parameter	Const 0 n mi		
$*\vec{Y}_d*$	Contingency orbit target vect			
GRDASTX	X-comp of contingency orbit target vect	-2.1563696×10^7, $+2.1563696 \times 10^7$ ft		
GRDASTY	Y-comp of contingency orbit target vect	-2.1563696×10^7, $+2.1563696 \times 10^7$ ft		
GRDASTZ	Z-comp of contingency orbit target vect	-2.1563696×10^7 $+2.1563696 \times 10^7$ ft		
GRDAST	Magnitude of contingency orbit target vect	Const 2.1563696×10^7 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*$\vec{Y}_d$	Vect in dir of intersection of LS and orb pl.			
GXRD	X-comp of vect in dir of intersection of LS and orb pl.	-5.38×10^7, $+5.38 \times 10^7$ ft		
GYRD	Y-comp of vect in dir of intersection of LS and orb pl.	-5.38×10^7, $+5.38 \times 10^7$ ft		
GZRD	Z-comp of vect in dir of intersection of LS and orb pl.	-5.38×10^7, $+5.38 \times 10^7$ ft		
*$\vec{Y}_{LA}$	Inertial landing pt vector			
GRLAX	X-comp of inertial landing pt vector	-2.0925700×10^7, $+2.0925700 \times 10^7$ ft		
GRLAY	Y-comp of inertial landing pt vector	-2.0925700×10^7, $+2.0925700 \times 10^7$ ft		
GRLAZ	Z-comp of inertial landing pt vector	-2.0925700×10^7, $+2.0925700 \times 10^7$ ft		
*$\vec{Y}_L$	Inertial FLS vector			
GRLX	X-comp of inertial FLS vector	-2.0925700×10^7, $+2.0925700 \times 10^7$ ft		
GRLY	Y-comp of inertial FLS vector	-2.0925700×10^7, $+2.0925700 \times 10^7$ ft		
GRLZ	Z-comp of inertial FLS vector	-2.0925700×10^7, $+2.0925700 \times 10^7$ ft		
*$\vec{Y}_{L'}$	Inertial desired land site vector			
GRLXPR	X-comp of inertial desired land site vector	-2.12×10^7, $+2.12 \times 10^7$ ft		
GRLYPR	Y-comp of inertial desired land site vector	-2.12×10^7, $+2.12 \times 10^7$ ft		
GRLZPR	Z-comp of inertial desired land site vector	-2.12×10^7, $+2.12 \times 10^7$ ft		
*$\vec{Y}_{ed}$	Desired re-entry vector			
GREDX	X-comp of desired re-entry vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
GREDY	Y-comp of desired re-entry vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
GREDZ	Z-comp of desired re-entry vector	-5.38×10^7, $+5.38 \times 10^7$ ft		
*$\vec{Y}_{en-1}$	Backdated entry vector			
GRENMX	X-comp of backdated entry vector	-5.38×10^7, $+5.38 \times 10^7$		
GRENMY	Y-comp of backdated entry vector	-5.38×10^7 $+5.38 \times 10^7$		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GRENMZ	Z-comp of backdated entry vector	-5.38×10^7, $+5.38 \times 10^7$		
*$\overrightarrow{YREQN}$	Vel required to perform maneuver			
GREQNX	X-comp of vel required to perform maneuver	-32,767, +32,767 ft/sec		
GREQNY	Y-comp of vel required to perform maneuver	-32,767, +32,767 ft/sec		
GREQNZ	Z-comp of vel required to perform maneuver	-32,767, +32,767 ft/sec		
*$\overrightarrow{Yh}$	Vect from earth ctr to intersect of desir lat and orbit pl.			
GXRH	X-comp of vect from earth ctr to intersect of desir lat and orbit pl.	-53.8×10^6, $+53.8 \times 10^6$ ft		
GYRH	Y-comp of vect from earth ctr to intersect of desir lat and orbit pl.	-53.8×10^6, $+53.8 \times 10^6$ ft		
GZAH	Z-comp of vect from earth ctr to intersect of desir lat and orbit pl.	-53.8×10^6, $+53.8 \times 10^6$ ft		
GRHM	Mag of vect from earth ctr to intersect of desir lat and orbit pl.	0, $+53.8 \times 10^6$ ft		
*$\overrightarrow{Y'd}$	Earth ctr geo vect to desired lat and long at alt desired			
GXTPD	X-comp of earth ctr geo vect to desired lat and long at alt desired	-53.8×10^6, $+53.8 \times 10^6$ ft		
GYRPD	Y-comp of earth ctr geo vect to desired lat and long at alt desired	-53.8×10^6, $+53.8 \times 10^6$ ft		
GZRPD	Z-comp of earth ctr geo vect to desired lat and long at alt desired	-53.8×10^6, $+53.8 \times 10^6$ ft		
*$\overrightarrow{YER}$	Veh target vector error			
GRXERR	X-comp of veh target vector error	-53.8×10^6, $+53.8 \times 10^6$ ft		
GRYERR	Y-comp of veh target vector error	-53.8×10^6, $+53.8 \times 10^6$ ft		
GRZERR	Z-comp of veh target vector error	-53.8×10^6, $+53.8 \times 10^6$ ft		
GRERR	Mag of veh target vector error	0, $+53.8 \times 10^6$ ft		
*$\overrightarrow{YSS}$	Position vector safe stored			
GXRSS	X-comp of position vector safe stored	-53.8×10^6, $+53.8 \times 10^6$ ft/sec		
GYRSS	Y-comp of position vector safe stored	-53.8×10^6, $+53.8 \times 10^6$ ft/sec		
GZRSS	Z-comp of position vector safe stored	-53.8×10^6, $+53.8 \times 10^6$ ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
* $\underline{Y'L}$	Actual inertial landing pt vector			
GRPLX	X-comp of actual inertial landing pt vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
GRPLY	Y-comp of actual inertial landing pt vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
GRPLZ	Z-comp of actual inertial landing pt vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
GSTOP	Stop joint for GN count			
GS4BPR	Priority for JOB S4B separation	Const 27000 (oct)		
GSEPPR	Priority for AGC CM/SM separation	Const 27000 (oct)		
GSERVPR	Priority for AGC servicer JOB	Const 26000 (oct)		
GSIVBTHR	S-IVB ΔV MONITOR THRESHOLD	0, 5.0 ft/sec		
GS1NATA	Sine of trunnion angle for mark A	-1.0, +1.0		
GS1NATB	Sine of trunnion angle for mark B	-1.0, +1.0		
GS1NASA	Sine of shaft angle for mark A	-1.0, +1.0		
GS1NASB	Sine of shaft angle for mark B	-1.0, +1.0		
GS1NOGA	Sine of outer gimbal angle for mark A	-1.0, +1.0		
GS1NOGB	Sine of outer gimbal angle for mark B	-1.0, +1.0		
GS1NMGA	Sine of middle gimbal angle for mark A	-1.0, +1.0		
GS1NMGB	Sine of middle gimbal angle for mark B	-1.0, +1.0		
GS1NIGA	Sine of inner gimbal angle for mark A	-1.0, +1.0		
GS1NIGB	Sine of inner gimbal angle for mark B	-1.0, +1.0		
GSTARASX	X-axis dir cos to star A in iner frame	-1.0, +1.0		
GSTARBSX	X-axis dir cos to star B in iner frame	-1.0, +1.0		
GSTARASY	Y-axis dir cos to star A in iner frame	-1.0, +1.0		
GSTARASY	Y-axis dir cos to star B in iner frame	-1.0, +1.0		
GSTARASZ	Z-axis dir cos to star A in iner frame	-1.0, +1.0		
GSTARBSZ	Z-axis dir cos to star B in iner frame	-1.0, +1.0		
GSMX		-32767, +32767		
GSMY		-32767, +32767		
GSMZ		-32767, +32767		
GSTRSEL	Flag for star search to output star A, B, both	$0, 7_8$		
GSTARA	Star possessing GEPC1 value for CSM routine	$1, 2^7$		
GSTARB	Star possessing GEPC2 value for CSM routine	$1, 2^7$		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GSTARC	Star possessing GEPC3 value for CSM routine	1, 2^7		
GSTARD	Star possessing GEPC4 value for CSM routine	1, 2^7		
GSTARE	Star possessing GEPC5 value for CSM routine	1, 2^7		
GSTARN1	First star meeting sighting limits	1, 2^9		
GSTARN2	Second-star meeting sighting limits	1, 2^9		
GSTAR1SX	X coordinate of select star 1	-1, +1		
GSTAR1SY	Y coordinate of select star 1	-1, +1		
GSTAR2SZ	Z coordinate of select star 1	-1, +1		
GSTAR2SX	X coordinate of select star 2	-1, +1		
GSTAR2SY	Y coordinate of select star 2	-1, +1		
GSTAR2SZ	Z coordinate of select star 2	-1, +1		
GSP	BATTINS special function S	0, 2.93		
GSTRNOA	Any star in catalog	0, 2^6		
GSTRNOB	Any star in catalog	0, 2^6		
*$\overrightarrow{Y_{ST}}$	Safe stored position vector			
GXST	X-comp of safe stored position vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
GYST	Y-comp of safe stored position vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
GZST	Z-comp of safe stored position vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
*$\overrightarrow{V_{ST}}$	Safe stored velocity vector			
GXDST	X-comp of safe stored velocity vector	-32768, -32768 ft/sec		
GYDST	Y-comp of safe stored velocity vector	-32768, -32768 ft/sec		
GZDST	Z-comp of safe stored velocity vector	-32768, -32768 ft/sec		
GSCS	SCS disc mon	-1, +1		
GSTRASX	Star A X dir cos to visual	-1, +1		
GSTRASY	Star A Y dir cos to visual			
GSTRASZ	Star A Z dir cos to visual	-1, +1		
GSTRBSX	Star B X dir cos to visual	-1, +1		
GSTRBSY	Star B Y dir cos to visual	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GSTRBSZ	Star B Z dir cos to visual	-1, _1		
GSINA	Sin 13 degrees	Const 0.2250		
GCOSA	Cos 13 degrees	Const 0.9744		
GS	SIGNUM (Rd $-R_N$)	-1, +1		
* $\overrightarrow{\gamma SS}$	Safe stored position vector			
GXSS	X-comp of safe stored position vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
GYSS	Y-comp of safe stored position vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
GZSS	Z-comp of safe stored position vector	-53.8×10^6, $+53.8 \times 10^6$ ft		
* $\overrightarrow{VSS}$	Safe stored velocity vector			
GXDSS	X-comp of safe stored velocity vector	-32768, +32768 ft/sec		
GYDSS	Y-comp of safe stored velocity vector	-32768, +32768 ft/sec		
GZDSS	Z-comp of safe stored velocity vector	-32768, +32768 ft/sec		
GSINTHCO	Sine θ co	-1, +1		
GSIN33	Sine 33 degrees	Const		
GSIN60	Sine 60 degrees	Const		
GSTRESE	Code word for LM or star storage	0, 3		
GSIGPR	SIGNUM (sin θ o)	-1, +1		
GSRE	Nominal earth radius for entry	Const 21202909 ft		
GSWAT	Flag set equal 0 or 1 or 2	0, 2 ft 0, 53.8×10^6		
GSIGK	SIGNUM (sin angle between $\overrightarrow{\gamma N}$ and $\overrightarrow{\gamma d}$)	-1, +1		
GSTAR01X	X-coord star alpha andromedae (Alpherate)	Const 0.8752313699		
GSTAR01Y	Y-coord star alpha andromedae (Alpherate)	Const 0.02460030242		
GSTAR01Z	Z-coord star alpha andromedae (Alpherate)	Const 0.4830785384		
GSTAR02X	X-coord star beta ceti (Diphda)	Const 0.9343112418		
GSTAR02Y	Y-coord star beta ceti (Diphda)	Const 0.1719839331		
GSTAR02Z	Z-coord star beta ceti (Diphda)	Const -0.3122243268		
GSTAR03X	X-coord star alpha eridani (Achernar)	Const 0.4914473046		

*Program symbols are not available at production date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GSTAR03Y	Y-coord star alpha eridani (Achernar)	Const 0.2196634297		
GSTAR03Z	Z-coord star alpha eridani (Achernar)	Const -0.8427499775		
GSTAR04X	X-coord star alpha ursae minoris (Polaris)	Const 0.01499887279		
GSTAR04Y	Y-coord star alpha ursae minoris (Polaris)	Const 0.007724927097		
GSTAR04Z	Z-coord star alpha ursae minoris (Polaris)	Const 0.9998576695		
GSTAR05X	X-coord star alpha arietis (Hamal)	Const 0.7850931932		
GSTAR05Y	Y-coord star alpha arietis (Hamal)	Const 0.4767812848		
GSTAR05Z	Z-coord star alpha arietis (Hamal)	Const 0.3953584253		
GSTAR06X	X-coord star alpha fornax (Hamal)	Const 0.5898334766		
GSTAR06Y	Y-coord star alpha fornax (Hamal)	Const 0.6436902868		
GSTAR06Z	Z-coord star alpha fornax (Hamal)	Const -0.4876056650		
GSTAR07X	X-coord star alpha persei (Mirfar)	Const 0.4118512784		
GSTAR07Y	Y-coord star alpha persei (Mirfar)	Const 0.4981670824		
GSTAR07Z	Z-coord star alpha persei (Mirfar)	Const 0.7630256106		
GSTAR08X	X-coord star alpha tauri (Aldebaran)	Const 0.3523051245		
GSTAR08Y	Y-coord star alpha tauri (Aldebaran)	Const 0.8920948821		
GSTAR08Z	Z-coord star alpha tauri (Aldebaran)	Const 0.2829274156		
GSTAR09X	X-coord star alpha canis majoris (Sirius)	Const -0.1808520018		
GSTAR09Y	Y-coord star alpha canis majoris (Sirius)	Const 0.9407722588		
GSTAR09Z	Z-coord star alpha canis majoris (Sirius)	Const -0.2867753658		
GSTAR10X	X-coord star beta geminorum (Pollux)	Const -0.3833902140		
GSTAR10Y	Y-coord star beta geminorum (Pollux)	Const 0.7943186780		
GSTAR10Z	Z-coord star beta geminorum (Pollux)	Const 0.4712428053		
GSTAR11X	X-coord star alpha velorum	Const -0.3601621462		
GSTAR11Y	Y-coord star alpha velorum	Const 0.5763799181		
GSTAR11Z	Z-coord star alpha velorum	Const -0.7335321523		
GSTAR12X	X-coord star beta carinae (Miaplacidus)	Const -0.2604007618		
GSTAR12Y	Y-coord star beta carinae (Miaplacidus)	Const 0.2327025095		
GSTAR12Z	Z-coord star beta carinae (Miaplacidus)	Const -0.9370384119		
GSTAR13X	X-coord star alpha hydrae (Alphard)	Const -0.7734093316		
GSTAR13Y	Y-coord star alpha hydrae (Alphard)	Const 0.6164475128		
GSTAR13Z	Z-coord star alpha hydrae (Alphard)	Const -0.1477517572		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GSTAR14X	X-coord star alpha leonis (Pegulus)	Const -0.8599497863		
GSTAR14Y	Y-coord star alpha leonis (Pegulus)	Const 0.4649731143		
GSTAR14Z	Z-coord star alpha leonis (Pegulus)	Const 0.2104432656		
GSTAR15X	X-coord star alpha ursae majoris (Dubhe)	Const -0.4550277564		
GSTAR15Y	Y-coord star alpha ursae majoris (Dubhe)	Const 0.1188510553		
GSTAR15Z	Z-coord star alpha ursae majoris (Dubhe)	Const 0.8825101515		
GSTAR16X	X-coord star gamma centauri	Const -0.6506840359		
GSTAR16Y	Y-coord star gamma centauri	Const -0.1118079659		
GSTAR16Z	Z-coord star gamma centauri	Const -0.7510720766		
GSTAR17X	X-coord star alpha virginis (Spica)	Const -0.9177286596		
GSTAR17Y	Y-coord star alpha virginis (Spica)	Const -0.3487040618		
GSTAR17Z	Z-coord star alpha virginis (Spica)	Const -0.1902093179		
GSTAR18X	X-coord star eta ursae majoris (Alkaid)	Const -0.5812053172		
GSTAR18Y	Y-coord star eta ursae majoris (Alkaid)	Const -0.2899471334		
GSTAR18Z	Z-coord star eta ursae majoris (Alkaid)	Const 0.7603492876		
GSTAR19X	X-coord star alpha bootis (Arc Turus)	Const -0.7867819904		
GSTAR19Y	Y-coord star alpha bootis (Arc Turus)	Const -0.5204962451		
GSTAR19Z	Z-coord star alpha bootis (Arc Turus)	Const 0.3317495417		
GSTAR20X	X-coord star alpha centauri (Rigil Kent)	Const -0.3791951529		
GSTAR20Y	Y-coord star alpha centauri (Rigil Kent)	Const -0.3099258121		
GSTAR20Z	Z-coord star alpha centauri (Rigil Kent)	Const -0.8718698452		
GSTAR21X	X-coord star alpha scorpii (Antares)	Const -0.3533995730		
GSTAR21Y	Y-coord star alpha scorpii (Antares)	Const -0.8234841390		
GSTAR21Z	Z-coord star alpha scorpii (Antares)	Const -0.4438272351		
GSTAR22X	X-coord star alpha ophiuchi (Rasal Hague)	Const -0.1139514374		
GSTAR22Y	Y-coord star alpha ophiuchi (Rasal Hague)	Const -0.9692921837		
GSTAR22Z	Z-coord star alpha ophiuchi (Rasal Hague)	Const 0.2179160157		
GSTAR23X	X-coord star alpha lyrae (Vega)	Const 0.1208370845		
GSTAR23Y	Y-coord star alpha lyrae (Vega)	Const -0.7706228932		
GSTAR23Z	Z-coord star alpha lyrae (Vega)	Const 0.6257305774		
GSTAR24X	X-coord star beta capricornus	Const 0.5472766238		
GSTAR24Y	Y-coord star beta capricornus	Const -0.7962924283		
GSTAR24Z	Z-coord star beta capricornus	Const -0.2576949081		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GSTAR25X	X-coord star alpha pavonis (Peacock)	Const 0.3187842712		
GSTAR25Y	Y-coord star alpha pavonis (Peacock)	Const -0.4441804478		
GSTAR25Z	Z-coord star alpha pavonis (Peacock)	Const -0.8373053913		
GSTAR26X	X-coord star alpha cygni (Deneb)	Const 0.4536421924		
GSTAR26Y	Y-coord star alpha cygni (Deneb)	Const -0.5399914627		
GSTAR26Z	Z-coord star alpha cygni (Deneb)	Const 0.7089555568		
GSTAR27X	X-coord star epsilon pegasi (Enif)	Const 0.8131592824		
GSTAR27Y	Y-coord star epsilon pegasi (Enif)	Const -0.5570945311		
GSTAR27Z	Z-coord star epsilon pegais (Enif)	Const 0.1685753977		
GSTAR28X	X-coord star alpha piscis aistrini (Fomalhaut)	Const 0.8335154667		
GSTAR28Y	Y-coord star alpha piscis aistrini (Fomalhaut)	Const -0.2406606782		
GSTAR28Z	Z-coord star alpha piscis aistrini (Fomalhaut)	Const -0.4973272612		
GSAST	SIGNUM ($\gamma_d - \gamma_n$)	-1.0, +1.0		
GT	AGC ref time	0, $(.01)\ 2^{28}$ sec		
GTGRR	AGC time of guidance ref release	-6, 2^{28} sec		
GTLO	Effective time of liftoff	0, 83886 sec		
GT11	Time (W/O liftoff) to stop CDU polynom update	0, 800 sec		
GT11A	Stored time of LET jettison	0, 800 sec		
GTHETAD	Desired outer CDU position	0, 360 deg		
GTIGN	Time of ignition	0, 268.6×10^4 sec		
GTTE	Time to event (delta time)	0, 83886 sec		
GTJP	Time of burnout	0, $(.01)\ 2^{28}$ sec		
GTHETAD1	Desired inner CDU position	0, 360 deg		
GTHETAD2	Desired middle CDU position	0, 360 deg		
GTSP	Time to stop nav integration	0, 268.6×10^4 sec		
GTJM	Time of thruster ignition	0, 83886 sec		
GTJP	Time of program exit (thrust termination)	0, 83886 sec		
GTSPS	Nominal SPS engine thrust magnitude	Const 21900 lb		
GTFF	Time of free fall to 300,000 ft altitude	0, 83886 sec		
GTHD	Orbit change aim update: latitude	-90, +90 deg		
GTHTRIM	Orbit change aim update: pitch trim	-90, +90 deg		
GTN	Present time to the navigation integ	0, 268.6×10^4 sec		
GTAU	Time elapsed since rectification in nav int	0, 26600 sec		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GTREC	Time of rectification	0, 268.8×10^4 sec		
GTAUPR	Modified time of flight	0, 3.16×10^{12} ft		
GTHI	AGC inner gimbal angle	-2π, $+2\pi$ rad		
GTHM	ACG middle gimbal angle	-2π, $+2\pi$ rad		
*$\underrightarrow{\Delta\theta}$	Steering signal in gimb coord vector			
GDETHX	X-comp of steering signal in gimb coord vector	-360, +360 deg		
GDELTHY	Y-comp of steering signal in gimb coord vector	-360, +360 deg		
GDELTHZ	Z-comp of steering signal in gimb coord vector	-360, +360 deg		
*$\underrightarrow{\Delta\theta}$	Steering signal in SM frame vect			
GDELTHPX	X-comp of steering signal in SM frame vect	-360, +360 deg		
GDELTHPY	Y-comp of steering signal in SM frame vect	-360, +360 deg		
GDELTHPZ	Z-comp of steering signal in SM frame vect	-360, +360 deg		
GTAIN	Input time to determine input GHA	0, 2.68×10^6 sec		
GTDLONG	Ground track determined long for display	-180, +180 deg		
GTDLAT	Ground track determined lat for display	-90, +90 deg		
GTE	Entry delay time counter	0, 2.7×10^6		
GTEMAX	Entry delay time	0, 2.7×10^6 sec		
GTWAIT	Time delay constant	0, 2.7×10^6 sec		
GTAN	True anomaly of vehicle orbit at T_0	0, 2 rad		
TLAUNCH2	Time from 0h launch day to launch	0, 432,000 sec		
GTAULP	Time of last perigee passage veh orbit $<T_0$	0, 2.686×10^6 sec		
GTNPP	Time of next perigee passage veh orbit $>T_0$	0, 2.686×10^6 sec		
GTRS	Time of start of roll	0, 800 sec		
GTRE	Time of end of roll	0, $(.01)\ 2^{28}$ sec		
GTA	Time since IMU alignment last performed	0, 2.68×10^6 sec		
GTCLOCK	Time at which IMU alignment last performed	0, 2.68×10^6 sec		
GTIGNB	Ignition time bias	-10.0, 50.0 sec		
GTHUDV	Thrust value used in delta V equation	0, 200000 lb		
GTME	Double precision time in seconds	$(0000000000)_{10}$, $(9999999999)_{10}$ sec		
GTSS	Value of time safe stored	0, 268.6×10^4 sec		
GT2	Nav time at middle of time step	0, 2.68×10^6 sec		
GT3	Nav time at end of time step	0, 2.686×10^6 sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GTA2	Time from rectification at middle of time step	0, 26600 sec		
GTA3	Time from rectification at end of time step	0, 26600 sec		
GTAMAX	Maximum conic time	Const 26600 sec		
GTHCO	Rotation about Y_{SC} producing max AMG excursion	$-\pi$, $+\pi$ rad		
GTSTAR	Time of event	-60, 2.7×10^6 sec		
G15T	Time of new computation for AS and AT	sec		
G15DET	Delta time for recomputing AS and AT	sec		
GTIGNHRS	Ignition time hr	hr		
GTIGNSEC	Ignition time sec	sec		
GTNE	Present time to determine orbit modes	0, 1021 sec		
GTU	Julian centuries in (ET) 1950.0 to 0 of launch	0, 1		
GDTU	Julian centuries in (ET) 0 of launch to launch	0, 10^{-3}		
GTHETA	Central angle	0, π rad		
GTHETNM	Desired range	-10000, 10000 n mi		
GTG	Time remaining before burnout	-15, +255 sec		
GTHETIP	Inclination of present orbit	0, 180 deg		
GTHETAO	Central angle bet. 2 vectors input to GTIMOFLT	0, 6.2832 deg		
GTATMOS	Time of free fall from entry to splash-down	Const 480 sec		
GTMIN	Minimum time at which SPS ignition could occur	0, 2.68×10^6 sec		
GTASTK	Time at which MM73-74 negate GAVINIT SPB	0, 2.68×10^6 sec		
GTGPR	Pseudo time-to-go-to-burnout	0, 255		
GT1AB	Presen time	0, 2.686×10^6 sec		
GT1NAB	Reference time for position vector	0, 2.686×10^6 sec		
GTMAN	Time to perform maneuver	0, 135		
GT28	Reference time for GDVXTRMR	0, 2.686×10^6 sec		
GTIGNO1	Time of SPS ignition	0, 2.686×10^6 sec		
GTIGNO2	Time of SPS ignition	0, 2.686×10^6 sec		
GTPAB	Time of parabolic flight computations	0, 2.686×10^6 sec		
GTIGN74	Time of SPS ignition for cont orbit insertion	0, 2.686×10^6 sec		
GTIGN73	Time of SPS ignition for abort landing	0, 2.686×10^6 sec		
GTPAD	Time to prepare for maneuver	Const 20 sec		
GTABLS	Time of abort to landing site	Const 1250 sec		
GTMLACA1	Time to perform land area cont man.	0, 2.686×10^6 sec		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GTMLACA2	Time to perform land area cont man.	0, 2.686×10^6 sec		
GTMLACA73	Time to perform land area cont man.	0, 2.686×10^6 sec		
GTMO1H	Time to perform land area cont man.	0, 2.686×10^6 sec		
GTIMP	Time of impulsive velocity change	0, 2.686×10^6 sec		
GTIGNAS	Time of ignition specified by astro	0, 2.686×10^6 sec		
GTHETIP	Angle bet. orbit plane and equatorial plane	0, 180 deg		
GTHETAO	Central angle between two vectors	0, 180 deg		
GTAOC	Time of arrival at desired target	0, 2.686×10^6 sec		
GTHETAF	Central angle bet. ^{YIN} and re-entry vect	0, 360 deg		
GTFFAST	Time of free fall between 2-position vect	0, 2.686×10^6 sec		
GTATMOS	Time of flight return through atmosphere	Const 480 sec		
TLAUNCH1	January 0th launch year-to-launch day	1, 366 days		
GTENT	Time of entry initialization	0, $(.01)\,2^{28}$ sec		
GTN	Time from entry initialization	0, 3600 sec		
GUDLKWD	Uplink code word	Const 30000		
GUPDLPR	Uplink priority	Const 3000		
*$\overrightarrow{\text{UNIT } V_N}$	Unit vector of unit velocity			
GUNVXN	X-component of unit velocity vector	-1, +1		
GUNVYN	Y-component of unit velocity vector	-1, +1		
GUNVZN	Z-component of unit velocity vector	-1, +1		
*$\overrightarrow{\text{UNIT } R_N}$	Unit vector of vehicle position			
GUNRXN	X-component of unit position vector	-1, +1		
GUNRYN	Y-component of unit position vector	-1, +1		
GUNRZN	Z-component of unit position vector	-1, +1		
*$\overrightarrow{\text{UNIT N}}$	Unit vector normal to the trajectory plane			
GUNNX	X-component of unit vector normal to the trajectory plane	-1, +1		
GUNNY	Y-component of unit vector normal to the trajectory plane	-1, +1		
GUNNZ	Z-component of unit vector normal to the trajectory plane	-1, +1		
*$\overrightarrow{\text{UNITH}}$	Unit vector along local horizontal			
GUNHX	X-component of unit vector along local horizontal	-1, +1		
GUNHY	Y-component of unit vector along local horizontal	-1, +1		
GUNHZ	Z-component of unit vector along local horizontal	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*$\overrightarrow{\text{U TANG}}$	Unit vector in direction of (RAVXR)			
GUTANGX	X-comp of vector in direction of (RAVXR)	-1, +1		
GUTANGY	Y-comp of vector in direction of (RAVXR)	-1, +1		
GUTANGZ	Z-comp of vector in direction of (RAVXR)	-1, +1		
GUPTIME	Register for update time values	-2.68×10^6, $+2.68 \times 10^6$ sec		
GUDREG	Main update word counter	$0, 15_{10}$		
GUD1	Ground update word 1	-1.0, +1.0		
GUD2	Ground update word 2	-1.0, +1.0		
GUD3	Ground update word 3	-1.0, +1.0		
GUD4	Ground update word 4	-1.0, +1.0		
GUD5	Ground update word 5	-1.0, +1.0		
GUD6	Ground update word 6	-1.0, +1.0		
GUD7	Ground update word 7	-1.0, +1.0		
GUD8	Ground update word 8	-1.0, +1.0		
GULXIEV	X-comp of vehicle position	-2^{24}, $+2^{24}$ meters		
GULYIEV	Y-comp of vehicle position	-2^{24}, $+2^{24}$ meters		
GULZIEV	Z-comp of vehicle position	-2^{24}, $+2^{24}$ meters		
GULDXIEV	X-comp of vehicle velocity	-2^{24}, $+2^{24}$ meters		
GULDYIEV	Y-comp of vehicle velocity	-2^{24}, $+2^{24}$ meters		
GULDZIEV	Z-comp of vehicle velocity	-2^{24}, $+2^{24}$ meters		
GUD	Temp register for AGC single prec word	-2^{24}, $+2^{24}$		
GUDA	Temp register for AGC single prec word	-2^{24}, $+2^{24}$		
GUDCTR	Counter for indexing GUD and GUDA digits	$0, 15_{10}$		
*$\overrightarrow{\text{GUVA}}$	Wind velocity unit vector			
GUVXA	X-comp of wind velocity unit vector	-1, +1 ft/sec		
GUVYA	Y-comp of wind velocity unit vector	-1, +1 ft/sec		
GUVZA	Z-comp of wind velocity unit vector	-1, +1 ft/sec		
*$\overrightarrow{\text{GUYA}}$	Y-axis wind velocity unit vector			
GUYXA	X-comp of Y-axis velocity unit vector	-1, +1 ft/sec		
GUYYA	Y-comp of Y-axis velocity unit vector	-1, +1 ft/sec		
GUYZA	Z comp of Y-axis velocity unit vector	-1, +1 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*$\overrightarrow{GUNA}$	Unit vector normal to GUYA and GUVA			
GUNXA	X-comp of unit vector normal to GUYA and GUVA	-1, +1		
GUNYA	Y-comp of unit vector normal to GUYA and GUVA	-1, +1		
GUNZA	Z-comp of unit vector normal to GUYA and GUVA	-1, +1		
*$\overrightarrow{GUP}$	Unit vector in direction of $\overrightarrow{GP}$			
GUXP	X-comp of unit vector in direction of $\overrightarrow{GP}$	-1, +1		
GUYP	Y-comp of unit vector in direction of $\overrightarrow{GP}$	-1, +1		
GUZP	Z-comp of unit vector in direction of $\overrightarrow{GP}$	-1, +1		
*$\overrightarrow{U_Z}$	Polar vector			
GUZX	X-comp of U_Z	-1, +1 ft		
GUZY	Y-comp of U_Z	-1, +1 ft		
GUZZ	Z-comp of U_Z	-1, +1 ft		
*$\overrightarrow{U_{RTO}}$	Initial target vector			
GURTOX	X-comp of initial target vector	-1, +1 ft		
GURTOY	Y-comp of initial target vector	-1, +1 ft		
GURTOZ	Z-comp of initial target vector	-1, +1		
*$\overrightarrow{U_Z}$	Unit vector north inertial			
GUZXP	X-comp of unit vector north inertial	-1, +1 ft		
GUZYP	Y-comp of unit vector north inertial	-1, +1 ft		
GUZZP	Z-comp of unit vector north inertial	-1, +1 ft		
*$\overrightarrow{U_{TR}}$	UTR vector			
GUTRX	X-comp of UTR vector	-1, +1 ft		
GUTRY	Y-comp of UTR vector	-1, +1 ft		
GUTRZ	Z-comp of UTR vector	-1, +1 ft		
*$\overrightarrow{UNIT_{RN}}$	Unit earth radius vector CM			
GUNITRXN	X-comp of unit earth radius vector CM	-1, +1 ft		
GUNITRYN	Y-comp of unit earth radius vector CM	-1, +1 ft		
GUNITRZN	Z-comp of unit earth radius vector CM	-1, +1 ft		
*$\overrightarrow{UNIN}$	Unit normal vector			
GUNIXN	X-comp of unit normal vector	-1, +1 ft		
GUNIYN	Y-comp of unit normal vector	-1, +1 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GUNIZN	Z-comp of unit normal vector	-1, +1 ft		
*$\overrightarrow{URT_N}$	Target vector			
GURTXN	X-comp of target vector	-1, +1 ft		
GURTYN	Y-comp of target vector	-1, +1 ft		
GURTZN	Z-comp of target vector	-1, +1 ft		
*$\overrightarrow{\mu}$	Burke's U vector			
GU1	Comp No. 1 of U vector	-100, +100		
GU2	Comp No. 2 of U vector	-100, +100		
GU3	Comp No. 3 of U vector	-100, +100		
GU4	Comp No. 4 of U vector	-100, +100		
GU5	Comp No. 5 of U vector	-100, +100		
GU6	Comp No. 6 of U vector	-100, +100		
*$\overrightarrow{\mu M}$	Unit vector for direction of telescope WRTIE			
GUMX	X-component of unit vector, I_E dir of tele	-1, 1		
GUMY	Y-component of unit vector, I_E dir of tele	-1, 1		
GUMZ	Z-component of unit vector, I_E dir of tele	-1, 1		
*$\overrightarrow{\mu S}$	Unit vector for direction of actious star			
GUSX	X-component of unit vector for direction of actious star	-1, 1		
GUSY	Y-component of unit vector for direction of actious star	-1, 1		
GUSZ	Z-component of unit vector for direction of actious star	-1, 1		
*UNh'	Angular momentum vector			
GUNHPRX	X-comp of angular momentum vector	-1, +1 ft^2/sec		
GUNHPRY	Y-comp of angular momentum vector	-1, +1 ft^2/sec		
GUNHPRZ	Z-comp of angular momentum vector	-1, +1 ft^2/sec		
GVLHUNPR		25000 octal		
GVERTPR		24000 octal		
GVRB	I/0 program code word for verb	0, 77_8		
GVB	Verb buffer register	00, 77_8		
GVBFLG	Original verb, before first enter	00, 77_8		
GVXG	X-component of velocity to be gained	-1021, +1021		
GVYG	Y-component of velocity to be gained	-1021, +1021		
GVZG	Z-component of velocity to be gained	-1021, +1021		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GVXNMI	Previous velocity comp along X-axis	-32767, +32767 ft/sec		
GUYNMI	Previous velocity comp along Y-axis	-32767, +32767 ft/sec		
GUZNMI	Previous velocity comp along Z-axis	-32767, +32767 ft/sec		
GVPF	Vehicle velocity, total magnitude	-32767, +32767 ft/sec		
GVG	Magnitude of velocity to be gained	0, 32767 ft/sec		
GVGM	Component of V_G directed along M	-1.7×10^4, $+1.7 \times 10^4$ ft/sec		
GVCO	V_{gm} minus ΔV_{to}	-1.7×10^4, $+1.7 \times 10^4$ ft/sec		
GVGP	Component of V_{CO} along I_A of PIPA X	-1.7×10^4, $+1.7 \times 10^4$ ft/sec		
GVREQ	Velocity required at end of maneuver	-32767, +32767 ft/sec		
GVN	Magnitude of vehicle velocity vector	0, +32767 ft/sec		
	Vehicle velocity vector			
GVXN	X-component of velocity vector	-32767, +32767 ft/sec		
GVYN	Y-component of velocity vector	-32767, +32767 ft/sec		
GVZN	Z-component of velocity vector	-32767, +32767 ft/sec		
GVRAD	Present radial velocity	-32767, +32767 ft/sec		
GVRC	Velocity required for insertion into safe orbit			
GVINSCTR	Temporary counter used as dummy index	-20, 0		
GVREC	Magnitude of velocity vector at time of rectification	-32768, 32768 ft/sec		
*$\overrightarrow{V_{REQN-1}}$	Velocity required vector at time N-1			
GVXREQNM	X-comp of velocity required vector at time N-1	-32767, +32767 ft/sec		
GVYREQNM	Y-comp of velocity required vector at time N-1	-32767, +32767 ft/sec		
GVZREQNM	Z-comp of velocity required vector at time N-1	-32767, +32767 ft/sec		
*$\overrightarrow{V_{REQN}}$	Velocity required vector at time N			
GVXREQN	X-comp of velocity required vector at time N	-32767, +32767 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GVYREQN	Y-comp of velocity required vector at time N	-32767, +32767 ft/sec		
GVZREQN	Z-comp of velocity required vector at time N	-32767, +32767 ft/sec		
$\vec{V}_{REQN-1}$	Velocity reqd at T_{IGN} vector			
GVXRST	X-comp of velocity reqd at T_{IGN} vector	-32767, +32767 ft/sec		
GVYRST	Y-comp of velocity reqd at T_{IGN} vector	-32767, +32767 ft/sec		
GVZRST	Z-comp of velocity reqd at T_{IGN} vector	-32767, +32767 ft/sec		
*V_{REQN+1}	Velocity reqd vector at time N+1			
GVXREQNP	X-comp of velocity reqd vector at time N+1	-32767, +32767 ft/sec		
GVYREQNP	Y-comp of velocity reqd vector at time N+1	-32767, +32767 ft/sec		
GVZREQNP	Z-comp of velocity reqd vector at time N+1	-32767, +32767 ft/sec		
$\vec{V}_N$	Velocity vector at T_{IGN}			
GVXNST	X-comp of velocity vector at T_{IGN}	-32767, -32767 ft/sec		
GVYNST	Y-comp of velocity vector at T_{IGN}	-32767, -32767 ft/sec		
GVZNST	Z-comp of velocity vector at T_{IGN}	-32767, -32767 ft/sec		
GVNO	Reference trajectory functions	0, 35000 ft/sec		
GVRNGE	Reference trajectory functions	0, 35000 ft/sec		
	Film number at mark No. 1			
	Film number at mark No. 2			
	Film number at mark No. 3			
	Film number at mark No. 4			
	Film number at mark No. 5			
	Film number at mark No. 6			
GVEFNM	Present film number			
*$\vec{V}_{CO}$	Vehicle vel vector reqd for cont insert orbit			
GXVCOIN	X-comp of vehicle vel vector reqd for cont insert orbit	-32768, +32768 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GYVCOIN	Y-comp of vehicle vel vector reqd for cont insert orbit	-32768, +32768 ft/sec		
GZVCOIN	Z-comp of vehicle vel vector reqd for cont insert orbit	-32768, +32768 ft/sec		
GVECOIN	Mag of vehicle vel vector reqd for cont insert orbit	0, 2.0 ft/sec		
GVSQN	Normalized velocity squared			
GVSAT	Normalization factor velocity	Const 12833 ft/sec		
GVMINN	Vel to switch to rec vel	Const 1000 ft/sec		
GVQUIT	Velocity to stop steering	0, 35000 ft/sec		
GVI	Comparison velocity	0, 35000 ft/sec		
GV1R	Comparison velocity	0, 35000 ft/sec		
GV2R	Comparison velocity	-32767, +32767 ft/sec		
GVPSI	Current horizontal component of reqd vel			
GDVLACT	To TAL Δvel avail for landing area control	0, 6200 ft/sec		
GDVINLD	To TAL Δvel initially loaded for SPS thrusting			
GDVT	ΔV accumulated total of SPS turn	0, 6200 ft/sec		
GDVAOI	Total Δvel avail for orbit insertion from SPS	0, 6200 ft/sec		
*$\vec{V}$	Burke's V vector			
GV1	No. 1 comp of Burke's V vector	-5×10^8, 5×10^8 ft		
GV2	No. 2 comp of Burke's V vector	-5×10^8, 5×10^8 ft		
GV3	No. 3 comp of Burke's V vector	-5×10^8, 5×10^8 ft		
GV4	No. 4 comp of Burke's V vector	-5×10^8, 5×10^8 ft		
GV5	No. 5 comp of Burke's V vector	-5×10^8, 5×10^8 ft		
GV6	No. 6 comp of Burke's V vector	-5×10^8, 5×10^8 ft		
GVREQN	Mag of vel reqd for orbital maneuver vectors	0, 32767 ft/sec		
*$\vec{V}$ IN	Routine input vel vector			
GV1NX	X-comp of routine input vel vector	-32767, +32767 ft/sec		
GV1NY	Y-comp of routine input vel vector	-32767, +32767 ft/sec		
GV1NZ	Z-comp of routine input vel vector	-32767, +32767 ft/sec		
GVRAD	Radial component of vel reqd	-32767, 32767 ft/sec		
		0, 32767 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GUH	Horizontal component of vel reqd	0, 32767 ft/sec		
*$\overrightarrow{\text{VREQN}}$	Velocity required vector			
GVREQNX	X-comp of velocity required vector	-32767, +32767 ft/sec		
GVREQNY	Y-comp of velocity required vector	-32767, +32767 ft/sec		
GVREQNZ	Z-comp of velocity required vector	-32767, +32767 ft/sec		
GVEV	Velocity of vehicle at Yh	0, 32767 ft/sec		
GVERH	Vel proportional to earth rotation rate	1500, 4000 ft/sec		
GVEN	Magnitude of entry velocity	ft/sec		
GVEYEONE	Reference trajectory parameter	Const 35000 ft/sec		
GVEYETWO	Reference trajectory parameter	Const 23500 ft/sec		
GVEYTHR	Reference trajectory parameter	Const 23090 ft/sec		
GVEFOUR	Reference trajectory parameter	Const 20829 ft/sec		
GVEFIVE	Reference trajectory parameter	Const 18357 ft/sec		
GVESIX	Reference trajectory parameter	Const 15951 ft/sec		
GVESVEN	Reference trajectory parameter	Const 14014 ft/sec		
GVEIGHT	Reference trajectory parameter	Const 10101 ft/sec		
GVENINE	Reference trajectory parameter	Const 8531 ft/sec		
GVETEN	Reference trajectory parameter	Const 6295 ft/sec		
GVELEVEN	Reference trajectory parameter	Const 3922 ft/sec		
GVETWLVE	Reference trajectory parameter	Const 2103 ft/sec		
GVETHRTN	Reference trajectory parameter	Const 1080 ft/sec		
GVEFOUTN	Reference trajectory parameter	Const 337 ft/sec		
GVEFIFTN	Reference trajectory parameter	Const 0 ft/sec		
*$\overrightarrow{\Delta\text{VDSP}}$	DSP and veh vel vect chng to reach target			
GDVXDSP	X-comp of DSP and veh vel vect chng to reach target	-1638.3, +1638.3 ft/sec		
GDVYDSP	Y-comp of DSP and veh vel vect chng to reach target	-1638.3, +1638.3 ft/sec		
GDVZDSP	Z-comp of DSP and veh vel vect chng to reach target	-1638.3, +1638.3 ft/sec		
GDVDSP	Mag of DSP and veh vel vect chng to reach target	0, +1638.3 ft/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GDVALL	Mag of stored max vel change allowed	Const 1638.3 ft/sec		
*$\vec{V}$SS	Veh vel vector as safe stored			
GXVSS	X-comp of veh vel vector as safe stored	-32768, +32768 ft/sec		
GYVSS	Y-comp of veh vel vector as safe stored	-32768, +32768 ft/sec		
GZVSS	Z-comp of veh vel vector as safe stored	-32768, +32768 ft/sec		
*$\vec{V}$RVT	Vel vect at GAVGINIT exit			
GVXRJP	X-comp of vel vect at GAVGINIT exit	-32767, +32767 ft/sec		
GVYRJP	Y-comp of vel vect at GAVGINIT exit	-32767, +32767 ft/sec		
GVZRJP	Z-comp of vel vect at GAVGINIT exit	-32767, +32767 ft/sec		
GWTLSTDT	Increment of time to be counted by wait list	0, 120.00 sec		
GWTCTR	Wait list counter			
GWTCTEM	Wait list temporary counter			
GWT1				
GWT2				
GWTIME	Wait list counter time			
GW11ST	Element 1,1 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW12ST	Element 2,1 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW13ST	Element 3,1 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW11DST	Element 4,1 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW12DST	Element 5,1 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW13DST	Element 6,1 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW21ST	Element 1,2 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW22ST	Element 2,2 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW23ST	Element 3,2 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GW21DST	Element 4, 2 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW22DST	Element 5, 2 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW23DST	Element 6, 2 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW31ST	Element 1, 3 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW32ST	Element 2, 3 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW33ST	Element 3, 3 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW31DST	Element 4, 3 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW32DST	Element 5, 3 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW33DST	Element 6, 3 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW41ST	Element 1, 4 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW42ST	Element 2, 4 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW43ST	Element 3, 4 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW41DST	Element 4, 4 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW42DST	Element 5, 4 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW43DST	Element 6, 4 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW51ST	Element 1, 5 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW52ST	Element 2, 5 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW53ST	Element 3, 5 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW51DST	Element 4, 5 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW52DST	Element 5, 5 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW53DST	Element 6, 5 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW61ST	Element 1, 6 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GW62ST	Element 2, 6 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW63ST	Element 3, 6 of the W_{ST} matrix	-52.5×10^3, 52.5×10^3 ft		
GW61DST	Element 4, 6 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW62DST	Element 5, 6 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GW63DST	Element 6, 6 of the W_{ST} matrix	-126.5, 126.5 ft/sec		
GWY	Error between input and tested LM No.	-360, +360 deg		
*$\underset{\rightarrow}{W}_1$	Second derivative of a W vector at time step start			
GWDD11	First comp of 2nd derivative of W at time step start	-0.95, 0.95 ft/sec^{-2}		
GWDD12	Second comp of 2nd derivative of W at time step start	-0.95, 0.95 ft/sec^{-2}		
GWDD13	Third comp of 2nd derivative of W at time step start	-0.95, 0.95 ft/sec^{-2}		
*$\ddot{\underset{\rightarrow}{W}}_2$	Second derivative of a W vector at middle of time step			
GWDD21	First comp of 2nd derivative of W at middle of step	-0.95, 0.95 ft/sec^{-2}		
GWDD22	Second comp of 2nd derivative of W at middle of step	-0.95, 0.95 ft/sec^{-2}		
GWDD23	Third comp of 2nd derivative of W at middle of step	-0.95, 0.95 ft/sec^{-2}		
	Second derivative of a W vector at end of time step			
GWDD31	First comp of 2nd derivative of W at end of time step	-0.95, 0.95 ft/sec^{-2}		
GWDD32	Second comp of 2nd derivative of W at end of time step	-0.95, 0.95 ft/sec^{-2}		
GWDD33	Third comp of 2nd derivative of W at end of time step	-0.95, 0.95 ft/sec^{-2}		
*$\underset{\rightarrow}{W}_E$	Earth rotation vector			
GWEX	X-comp of earth rotation vector	0, 8×10^{-5} rad/sec		
GWEY	Y-comp of earth rotation vector	0, 8×10^{-5} rad/sec		
GWEZ	Z-comp of earth rotation vector	0, 8×10^{-5} rad/sec		
GWE	Earth spin rate	Const 7.2911581×10^{-5} rad/sec		
GW11	Element 1, 1 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW12	Element 2, 1 of the W matrix	-52.5×10^3, 52.5×10^3 ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GW13	Element 3, 1 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GWD11	Element 4, 1 of the W matrix	-126.5, 126.5 ft/sec		
GWD12	Element 5, 1 of the W matrix	-126.5, 126.5 ft/sec		
GWD13	Element 6, 1 of the W matrix	-126.5, 126.5 ft/sec		
GW21	Element 1, 2 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW22	Element 2, 2 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW23	Element 3, 2 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GWD21	Element 4, 2 of the W matrix	-126.5, 126.5 ft/sec		
GWD22	Element 5, 2 of the W matrix	-126.5, 126.5 ft/sec		
GWD23	Element 6, 2 of the W matrix	-126.5, 126.5 ft/sec		
GW31	Element 1, 3 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW32	Element 2, 3 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW33	Element 3, 3 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GWD31	Element 4, 3 of the W matrix	-126.5, 126.5 ft/sec		
GWD32	Element 5, 3 of the W matrix	-126.5, 126.5 ft/sec		
GWD33	Element 6, 3 of the W matrix	-126.5, 126.5 ft/sec		
GW41	Element 1, 4 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW42	Element 2, 4 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW43	Element 3, 4 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GWD41	Element 4, 4 of the W matrix	-126.5, 126.5 ft/sec		
GWD42	Element 5, 4 of the W matrix	-126.5, 126.5 ft/sec		
GWD43	Element 6, 4 of the W matrix	-126.5, 126.5 ft/sec		

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GW51	Element 1, 5 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW52	Element 2, 5 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW53	Element 3, 5 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GWD51	Element 4, 5 of the W matrix	-126.5, 126.5 ft/sec		
GWD52	Element 5, 5 of the W matrix	-126, 5, 126.5 ft/sec		
GWD53	Element 6, 5 of the W matrix	-126.5, 126.5 ft/sec		
GW61	Element 1, 6 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW62	Element 2, 6 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GW63	Element 3, 6 of the W matrix	-52.5×10^3, 52.5×10^3 ft		
GWD61	Element 4, 6 of the W matrix	-126.5, 126.5 ft/sec		
GWD62	Element 5, 6 of the W matrix	-126.5, 126.5 ft/sec		
GWD63	Element 6, 6 of the W matrix	-126.5, 126.5 ft/sec		
*$\vec{W}$	Weighting vector			
GW1	No. 1 comp of weighting vector	-5×10^8, 5×10^8 ft		
GW2	No. 2 comp of weighting vector	-5×10^8, 5×10^8 ft		
GW3	No. 3 comp of weighting vector	-5×10^8, 5×10^8 ft		
GW4	No. 4 comp of weighting vector	-5×10^8, 5×10^8 ft/sec		
GW5	No. 5 comp of weighting vector	-5×10^8, 5×10^8 ft/sec		
GW6	No. 6 comp of weighting vector	-5×10^8, 5×10^8 ft/sec		
GXSCDX	X-component of unit X-body axis in inertial coordinates	-1, +1		
GXSCDY	Y-component of unit X-body axis in inertial coordinates	-1, +1		
GXSCDZ	Z-component of unit X-body axis in inertial coordinates	-1, +1		
*$\vec{GXNB}$	X-nav base in I_E			
GXNBXIE	X-nav base in I_E	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GYNBYIE	Y-nav base in I_E	-1, +1		
GYNBZIE	Y-nav base in I_E	-1, +1		
	Y-axis wind velocity vector			
	X-comp of Y-axis wind velocity vector			
	Y-comp of Y-axis wind velocity vector			
	Z-comp of Y-axis wind velocity vector			
*$\overrightarrow{GYD}$	Y desired vector			
GYDX	X-comp of Y desired vector	-1, +1		
GYDY	Y-comp of Y desired vector	-1, +1		
GYDZ	Z-comp of Y desired vector	-1, +1		
GYNP	Lat miss limit	0, 2 n mi		
GYIPLJ	Corr long of any LM on J^{th} film strip	-180, +180 deg		
*$\overrightarrow{YT}$	Unit vect dir of desired thrust S/C Y-axis			
GYTX	X-comp of unit vect dir of desired thrust S/C Y-axis	-1, +1		
GYTY	Y-comp of unit vect dir of desired thrust S/C Y-axis	-1, +1		
GYTZ	Z-comp of unit vect dir of desired thrust S/C Y-axis	-1, +1		
*$\overrightarrow{YBT}$	Y-body axis vector WRT t vector			
GYBTX	X-comp of Y-body axis vector WRT t vector	-1, +1		
GYBTY	Y-comp of Y-body axis vector WRT t vector	-1, +1		
GYBTZ	Z-comp of Y-body axis vector WRT t vector	-1, +1		
*$\overrightarrow{YBSM}$	Y-body axis vector WRT SM axis			
GYBSMX	X-comp of Y-body axis vector WRT SM axis	-1, +1		
GYBSMY	Y-comp of Y-body axis vector WRT SM axis	-1, +1		
GYBSMZ	Z-comp of Y-body axis vector WRT SM axis	-1, +1		
GYA	Cot of half the central angle	-53.8×10^6, $+53.8 \times 10^6$		
GYNPRN	Intermediate term	0, 0.1		
GZIEN	Polar component of position in I_E-frame at t_N	-5.28×10^7, $+5.28 \times 10^7$ ft		
GZNB	Z-axis (nav base)			
GZNBXIE	X-component LOS (I_E)	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GXNBYIE	X-nav base in I_E	-1, +1		
GXNBZIE	X-nav base in I_E	-1, +1		
*$\overrightarrow{GXD}$	X desired vector			
GXDX	X-comp of X desired vector	-1, +1 ft/sec		
GXDY	Y-comp of X desired vector	-1, +1 ft/sec		
GXDZ	Z-comp of X desired vector	-1, +1 ft/sec		
GXNP	Intermediate variable used in G limiter	0, 4000 ft/sec		
GXIPLJ	Coor lat of any LM on J^{th} film strip	-180, +180 deg		
GXOC	Relative distance traveled	-66.5×10^6, $+66.5 \times 10^6$ ft		
*$\overrightarrow{XT}$	Unit vect dir of desired thrust S/C X-axis			
GXTX	X-comp of unit vect dir of desired thrust S/C X-axis	-1, +1		
GXTY	Y-comp of unit vect dir of desired thrust S/C X-axis	-1, +1		
GXTZ	Z-comp of unit vect dir of desired thrust S/C X-axis	-1, +1		
*$\overrightarrow{XBT}$	X-body axis vector WRT TOT vector			
GXBTX	X-comp of X-body axis vector WRT TOT vector	-1, +1		
GXBTY	Y-comp of X-body axis vector WRT TOT vector	-1, +1		
GXBTZ	Z-comp of X-body axis vector WRT TOT vector	-1, +1		
*$\overrightarrow{X\ BSM}$	X-body axis vector WRTSM axis			
GXBSMX	X-comp of X-body axis vector WRTSM axis	-1, +1		
GXBSMY	Y-comp of X-body axis vector WRTSM axis	-1, +1		
GXBSMZ	Z-comp of X-body axis vector WRTSM axis	-1, +1		
GXNPRN	Intermediate term	-32767, +32767 ft/sec		
GYROITR	Iteration delta time-one second			
GY	Yaw angle	0, 2 deg		
*$\overrightarrow{YSCD}$	Unit vect in dir of desired Y_{SC} orient			
GYSCDX	X-comp of unit vec in dir of desired Y_{SC} orient	-1, +1		
GYSCDY	Y-comp of unit vec in dir of desired Y_{SC} orient	-1, +1		
GYSCDZ	Z-comp of unit vec in dir of desired Y_{SC} orient	-1, +1		
*$\overrightarrow{GYNB}$	Y-nav base in I_E			
GYNBXIE	Y-nav base in I_E	-1, +1		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GZNBYIE	Y-component LOS (I_E)	-1, +1		
GZNBZIE	Z-component LOS (I_E)	-1, +1		
GZE	Polar component of position in I_E-frame	-33554431, 33554431		
*$\vec{ZSCD}$	Unit vect in dir of desired Z_{SM} orient			
GZSCDX	X-comp of unit vect in dir of desired Z_{SM} orient	-1, +1		
GZSCDY	Y-comp of unit vect in dir of desired Z_{SM} orient	-1, +1		
GZSCDZ	Z-comp of unit vect in dir of desired Z_{SM} orient	-1, +1		
	Dir cos Z_{NB} desired			
GZNBXIED	X-dir cos Z_{NB} desired	-1.0, 1.0		
GZNBYIED	Y-dir cos Z_{NB} desired	-1.0, 1.0		
GZNBZIED	Z-dir cos Z_{NB} desired	-1.0, 1.0		
*$\vec{GZD}$	Z desired vector			
GZDX	X-comp of Z desired vector	-1, +1 ft/sec		
GZDY	Y-comp of Z desired vector	-1, +1 ft/sec		
GZDZ	Z-comp of Z desired vector	-1, +1 ft/sec		
*$\vec{Z1}$	Unit vect normal to pl max declination & $\vec{Z}$			
GXZ1	X-comp of unit vect normal to pl max declination & $\vec{Z}$	-1, +1		
GYZ1	Y-comp of unit vect normal to pl max declination & $\vec{Z}$	-1, +1		
GZZ1	Z-comp of unit vect normal to pl max declination & $\vec{Z}$	-1, +1		
*$\vec{Z2}$	Unit vector normal to pl of $\vec{Z}$ and $\vec{Z}$			
GXZ2	X-comp of unit vector normal to pl of $\vec{Z}$ and $\vec{Z}$	-1, +1		
GYZ2	Y-comp of unit vector normal to pl of $\vec{Z}$ and $\vec{Z}$	-1, +1		
GZZ2	Z-comp of unit vector normal to pl of $\vec{Z}$ and $\vec{Z}$	-1, +1		
*$\vec{Z3}$	Vector projection of targ in pl of targ lat			
GXZ3	X-comp of vector projection of targ in pl of targ lat	-53.8×10^6, $+53.8 \times 10^6$		
GYZ3	Y-comp of vector projection of targ in pl of targ lat	-53.8×10^6, $+53.8 \times 10^6$		
GZZ3	Z-comp of vector projection of targ in pl of targ lat	-53.8×10^6, $+53.8 \times 10^6$		
*$\vec{Z4}$	Vect proj in target lat pl of int of pres or pl and tar lat pl			
GXZ4	X-comp of vect proj in target lat pl of int of pres or pl and tar lat pl	-53.8×10^6, $+53.8 \times 10^6$		
GYZ4	Y-comp of vect proj in target lat pl of int of pres or pl and tar lat pl	-53.8×10^6, $+53.8 \times 10^6$		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GZZ4	Z-comp of vect proj in target lat pl of int of pres or pl	-53.8×10^6, $+53.8 \times 10^6$		
*$\overrightarrow{ZT}$	Unit vect dir of desired thrust S/C Z-axis			
GZTX	X-comp of unit vect dir of desired thrust S/C Z-axis	-1, +1		
GZTY	Y-comp of unit vect dir of desired thrust S/C Z-axis	-1, +1		
GZTZ	Z-comp of unit vect dir of desired thrust S/C Z-axis	-1, +1		
*$\overrightarrow{ZBT}$	Z-body axis vector WRTT vector			
GZBTX	X-comp of Z-body axis vector WRTT vector	-1, +1		
GZBTY	Y-comp of Z-body axis vector WRTT vector	-1, +1		
GZBTZ	Z-comp of Z-body axis vector WRTT vector	-1, +1		
*$\overrightarrow{ZBSM}$	Z-body axis vect WRT SM axis			
GZBSMX	X-comp of Z-body axis vect WRT SM axis	-1, +1		
GZBSMY	Y-comp of Z-body axis vect WRT SM axis	-1, +1		
GZBSMZ	Z-comp of Z-body axis vect WRT SM axis	-1, +1		
*Z	R_Y times R_z matrix			
GZ11	R_Y times R_z matrix element 11	-1, +1		
GZ12	R_Y times R_z matrix element 12	-1, +1		
GZ13	R_Y times R_z matrix element 13	-1, +1		
GZ21	R_Y times R_z matrix element 21	-1, +1		
GZ22	R_Y times R_z matrix element 22	-1, +1		
GZ23	R_Y times R_z matrix element 23	-1, +1		
GZ31	R_Y times R_z matrix element 31	-1, +1		
GZ32	R_Y times R_z matrix element 32	-1, +1		
GZ33	R_Y times R_z matrix element 33	-1, +1		
G04PRIO	Priority of major mode 04			
G11PRIO	Priority of major mode 11			
G71PRIO	Navigation update MM 71			
GO0PRIO	Priority of MM00			
G12PRIO	Priority for major mode 11			
G51PRIO	Priority for major mode 51			
G53PRIO	Priority for major mode 53			
G72PRIO	Priority for major mode 72			

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
UOMGE	Rotational rate of the earth ω_E	4.15×10^{-3}, 4.17×10^{-3} deg/sec		
UGHAL	Greenwich hour angle at 0^h date of launch	0, 360 deg		
UDAY	No. of days from (Jan. 1, 1950 to problem time)	5860, 13530 deg		
VEFNSD	Film strip No. for suppl displays	0, 16		
VEFNM	Film strip No. for mark displays	0, 16		
T940	Lift-off discrete	Boolean		
T907	Step-ahead discrete	Boolean		
T914	Reset discrete	Boolean		
T500	Bit 1 (LSB) uplink keyword, non-int	Boolean		
T501	Bit 2 uplink keyword, non-int	Boolean		
T502	Bit 3 uplink keyword, non-int	Boolean		
T503	Bit 4 uplink keyword, non-int	Boolean		
T504	Bit 5 (MSB) uplink keyword, non-int	Boolean		
T506	Bit 1 uplink address non-int	Boolean		
T507	Bit 2 uplink address non-int	Boolean		
TW71	3 bit int uplink address	Boolean		
TW72	5 bit int uplink keyword	Boolean		
T939	Guidance reference release signal	Boolean		
T505	IOS UDL in data display mode (DBI)	Boolean		
ARVE	Vector Apollo to earth c.g.	20.8×10^6, 2^{26} ft		
AXIEV	X-comp vector Apollo to earth	-2^{26}, 2^{26} ft		
AYIEV	Y-comp vector Apollo to earth	-2^{26}, 2^{26} ft		
AZIEV	Z-comp vector Apollo to earth	-2^{26}, 2^{26} ft		
AXDIEV	X-comp of vehicle velocity from EOM	-2^{26}, 2^{26} ft/sec		
AYDIEV	Y-comp of vehicle velocity from EOM	-2^{26}, 2^{26} ft/sec		
AZDIEV	Z-comp of vehicle velocity from EOM	-2^{26}, 2^{26} ft/sec		
D550	C/M-S/M separation discrete			
D516	S/M-adapter physical sep			
* $\vec{r}_{EOM}$				
AXIEVS	X-component of EOM position vector	$-2^{26}+1$, $+2^{26-1}$ ft		
AYIEVS	Y-component of EOM position vector	$-2^{26}+1$, $+2^{26-1}$ ft		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-32. Guidance and Navigation System-AGC Subroutines (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
AZIEVS	Z-component of EOM position vector	$-2^{25}+1$, $+2^{25-1}$		
* $\frac{V}{\rightarrow}$ EOM				
AXDIEVS	X-component of EOM velocity vector	-32.768+1, +32768-1 ft/sec		
AYDIEVS	Y-component of EOM velocity vector	-32.768+1, +32768-1 ft/sec		
AZDIEVS	Z-component of EOM velocity vector	-32.768+1, +32768-1 ft/sec		
MG001	Uplink logic always blocked (inoperative)	Malfunction		
MG002	Uplink logic not blocked	Malfunction		
MG003	AGC fail, loss of 13 vdc pwr	Malfunction		
MG004	AGC fail, loss of 3 vdc pwr	Malfunction		
MG005	AGC fail, loss of 28 vdc pwr	Malfunction		
MG006	AGC fail, loss of 2.048 mc freq ref	Malfunction		
MG007	C/M 1A14 panel E/L indicator 800 cps fail	Malfunction		
MG012				
MG013	Display flasher 1.5 cps ref fail	Malfunction		
MG014	C/M 1A14 panel indicator R13 always 4	Malfunction		
MG016	C/M 1A33 panel indicator R35 always 0	Malfunction		
MG017	1A33 keyboard failure S switch inoperative	Malfunction		
*MG042	AGC locked in interupt state	Malfunction		
*MG043	AGC in endless control loop	Malfunction		
*MG044	AGC parity failed	Malfunction		
*MG045	AGC counter failed	Malfunction		
TOIFTIME	Step ahead time increment			
TOFROMB1	To-from binary register No. 1			
TOFROMB2	To-from binary register No. 2			
BM	Total vehicle mass; spacecraft plus fuel	270.5, 11026.73 slugs		
H219	Att-MON-ENTRY SCS switch: 1 = entry	Boolean		
H213	Local vertical SCS switch: 0 = off	Boolean		
H215	Delta V SCS switch: 0 = off	Boolean		
H214	ATT-MON-ENTRY switch in attitude	Boolean		
H190	(G&N-SCS switch) H190 = 0 in G&N	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-33. Guidance and Navigation—Optics CDU Drive

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
G090	AGC on, powered and operating			
G400	Optics, speed control, 1 = med position	Boolean		
G401	Optics, speed control, 1 = high position	Boolean		
G402	Optics, mode control switch, 1 = resolved	Boolean		
G403	Optics, mode select switch, 1 = zero optics	Boolean		
G404	Hand controller, 1 = trunnion not in deadband	Boolean		
G405	Hand controller, 1 = shaft not in deadband	Boolean		
G406	Optics 28V basic DC power	Boolean	GP26-4(D)/204	
G407	Optics, 800 cps, 5% power supply output	Boolean		
G408	Optics, 25.6 kc excitation for optical CDUs	Boolean		
G410	Trunnion CDU motor excitation	Boolean		
G411	Shaft CDU motor excitation	Boolean		
G428	Telescope power	Boolean		
G436	Optics, slave tele, switch, 1 = 25° offset	Boolean		
G437	Optics, slave tele, switch, 1 = landmark LOS	Boolean		
G445	Optics, sextant shaft motor amp power			
G446	Optics, sextant trunnion motor amp power			
G447	Optics, 800 cps 1% power supply output			
G448	Optics, 800 cps 1% power for shaft CDU			
G449	Optics, 800 cps 1% power for trunnion CDU			
GAGCTRIN	Input from AGC commanding trunnion CDU	±360 degrees		
GAGCTRIN	Input from AGC commanding shaft CDU	±360 degrees		
C200	C/M main dc bus A			
C201	C/M main dc bus B			
C491	Optics A, G&N (ON-OFF) sw			
C517	Optics B, G&N (ON-OFF) sw			
GADSHFT	Hand controller shaft input	±1.0		
GADTRUN	Hand controller trunnion input	±1.0		
GAGCSHF	Shaft angle stored in AGC	0, +360 degrees		
GAGCTRN	Trunnion angle stored in AGC	0, +360 degrees		
GASDOT	Hand controller output rate, shaft	-17.12, 17.12 deg/sec		
GATDOT	Hand controller output rate, trunnion	-17.12, 17.12 deg/sec		

Table 6-33. Guidance and Navigation—Optics CDU Drive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GASUBS	Shaft LOS angle to visual, telescope	0. 360 degrees		
GASUBT	Trunnion LOS angle to visual, telescope	0. 360 degrees		
GCOMAS	Commanded shaft angle	±360 degrees		
GCOMAT	Commanded trunnion angle	±360 degrees		
GCDUSHF	Actual shaft CDU angle	0, +360 degrees		
GCDUSHF	Actual trunnion CDU angle	0, +360 degrees		
GDASH	Shaft signal to D/A converter	±1. 0		
GDATR	Trunnion signal to D/A converter	±1. 0		
GDELAS	Incremental angle due to hand cont., shaft	±0. 3424 deg		
GDECAT	Incremental angle due to hand cont., trunnion	±0. 3424 deg		
GDR32SH	Output to D/R, shaft CDU	0, +360 degrees		
GDR32TR	Output to D/R, trunnion CDU	0, +360 degrees		
GENCSH	Shaft CDU encoder position	0, +360 degrees		
GENCTR	Trunnion CDU encoder position	0, +360 degrees		
GKS	Max rate command, shaft hand controller	0, 17. 12 deg/sec		
GKT	Max rate command, trunnion hand controller	0, 17. 12 deg/sec		
GRPTSHF	Desired telescope shaft repeater angle	0 +360 degrees		
GRPTTRN	Desired telescope trunnion repeater angle	0 +360 degrees		
GSHFTCDU	Desired shaft CDU angle	0, +360 degrees		
GTRUNCDU	Desired trunnion CDU angle	0, +360 degrees		
GTSPE	Output to D/A, telescope shaft position	±1.0		
GTTPE	Output to D/A, telescope trunnion position	±1.0		
GTSPIFB	Telescope shaft indicator encoder	0, +360 degrees		
GTTPIFB	Telescope trunnion indicator encoder	0, +360 degrees		
GXAS	Shaft LOS angle to visual, sextant	0, +360 degrees		
GXAT	Trunnion LOS angle to visual, sextant	0, +360 degrees		
GCURROPT	Current drawn by optical subsystem	0, +4.546 amps		
G5C17	Current drawn from C15A5CB 54	0, +4.546 amps		
G4C91	Current drawn from C15A5CB 55	0, +4.546 amps		
MG046	Malfunction, sextant trun MDA power fail	Malfunction		
MG047	Malfunction, sextant shaft MDA power fail	Malfunction		
MG064	Malfunction, optics, 28V, 800 cps, 5% power fail	Malfunction		
MG065	Malfunction, optics, 28V, 800 cps, 1% power fail	Malfunction		

Table 6-33. Guidance and Navigation—Optics CDU Drive (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MG066	Malfunction, 25.6 kc optics encoder excitation	Malfunction		
MG067	Malfunction, trunnion CDU motor excitation	Malfunction		
MG070	Malfunction, shaft CDU motor excitation	Malfunction		
MG073	Malfunction, optics HC trun axis fails to increase	Malfunction		
MG075	Malfunction, optics HC shaft axis fails cw	Malfunction		
MG076	Malfunction, optics HC shaft axis fails ccw	Malfunction		
MG077	Malfunction, optics telescope - LM LOS 0° sw fails open	Malfunction		
MG100	Malfunction, optics telescope - OFFSET 25° sw fails open	Malfunction		
MG101	Malfunction, optics HC - DIRECT sw fails open	Malfunction		
MG102	Malfunction, optics HC - RESOLVED sw fails open	Malfunction		
MG103	Malfunction, optics mode - ZERO sw fails open	Malfunction		
MG104	Malfunction, optics mode - MANUAL sw fails open	Malfunction		
MG105	Malfunction, optics mode - COMPUTER sw fails open	Malfunction		

Table 6-34. Guidance and Navigation System—AGC Up-Data Link

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GKWDIN	5-bit key code input to GCHARIN	0_{10}, 31_{10}		
GUDLKWD	5 bit up-data link key word	0_{10}, 31_{10}		
GDADVDGT	Noninteg UDL verb register	00_8, 77_8		
GDADCNTR	Noninteg UDL key entry counter	0, 15_{10}		
GOBA	First star/landmark no. entered	0, 511_{10}		
GOBB	Second star/landmark no. entered	0, 511_{10}		
GMTYPE	Flag designating type of expected mark	0, 7_8		
GSTRNOA	Star A number	0, 511		
GSTRNOB	Star B number	0, 511		
GSTRSEL	Flag for star search to output star A, B, both	0, 7_8		
GSTARASX	Star A X dir cos	±1.0		
GSTRASX	Star A X dir cos to visual			
GSTARASY	Star A Y dir cos			
GSTRASY	Star A Y dir cos to visual			
GSTARASZ	Star A Z dir cos			
GSTRASZ	Star A Z dir cos to visual			
GSTARBSX	Star B X dir cos			
GSTRBSX	Star B X dir cos to visual			
GSTARBSY	Star B Y dir cos			
GSTRBSY	Star B Y dir cos to visual			
GSTARBSZ	Star B Z dir cos			
GSTRBSZ	Star B Z dir cos to visual	±1.0		
GELMSX	Geocentric X coord of selected earth LM	±21(10^6) feet		
GELMSY	Geocentric Y coord of selected earth LM	±21(10^6) feet		
GELMSZ	Geocentric Z coord of selected earth LM	±21(10^6) feet		
GLLM--X	Selenocentric X coord of selected lunar LM	±21(10^6) feet		
GLLM--Y	Selenocentric Y coord of selected lunar LM	±21(10^6) feet		
GLLM--Z	Selenocentric Z coord of selected lunar LM	±21(10^6) feet		
GLMSX	Geo or selen X coord of selected landmark	±21(10^6) feet		
GLMSY	Geo or selen Y coord of selected landmark	±21(10^6) feet		
GLMSZ	Geo or selen Z coord of selected landmark	±21(10^6) feet		
GUPTIME	Register for update time values	±2.68(10^6) seconds		
GUDREG	Main update word counter	0, 15_{10}		

Table 6-34. Guidance and Navigation System—AGC Up-Data Link (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
GT	AGC time	-70.0, +2.68(10^6) sec		
TOFROMB1	Time to/from launch to unit seconds	31 days 23:59':59"		
TOFROMB2	Time to/from launch, 0.05 sec	1.0 second		
GWTLSTDT	Delay time loaded in waitlist	0.00, 500.00 seconds		
GULXTEV	X comp of veh position	$\pm 2^{24}$ meters		
AXIEV	X comp of veh position from EOM	$\pm 2^{26}$ feet		
GULYIEV	Y comp of veh position	$\pm 2^{24}$ meters		
AYIEV	Y comp of veh position, from EOM	$\pm 2^{26}$ feet		
GULZIEV	Z comp of veh position	$\pm 2^{24}$ meters		
AZIEV	Z comp of veh position from EOM	$\pm 2^{26}$ feet		
GULDXIEV	X comp of veh velocity	±12800 meters/sec		
AXDIEV	X comp of veh velocity, from EOM	$\pm 2^{15}$ feet/sec		
GULDYIEV	Y comp of veh velocity	±12800 meters/sec		
AYDIEV	Y comp of veh velocity, from EOM	$\pm 2^{15}$ feet/sec		
GULDZIEV	Z comp of veh velocity	±12800 meters/sec		
AZDIEV	Z comp of vehicle velocity, from EOM	$\pm 2^{15}$		
GUDCTR	Counter for indexing GUD and GUDA digits	0, 15_{10}		
GCONV	Conversion factor, feet to meters	Constant 3.280833		
GPRIOR	G&N executive priority	00, 77_8		
GUD	Temp register for AGC single prec word	$\pm 2^{24}$		
GUDA	Temp register for AGC single prec word	$\pm 2^{24}$		
G009	DBI, switch position; UDL blocked			
G040	DBI, any IOS UDL key pressed			
G646	Simulated UDL transmission in progress			
MG001	Malf; UDL blocked			
MB002	Malf; block UDL switch (G009) inoperative			
T505	IOS UDL in DATA DISPLAY mode (DBI)			

Table 6-35. Sequential Events Control System — Emergency Detection

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
DBA11	Internal input to bar alt D/A M1 1A1	-9.200, +9.800 volts		
E016	ABORT REQUEST light on 1A3	Boolean		
E020	L/V AOA - SPS PC sw 1A3	Boolean		
EAASPS	ANGLE OF ATTACK - chamber press. ind 1A3	0, 10.000 volts		
D121	Adapter sep sw ON initiate 1A5	Boolean		
D005	Drogue deploy sw ON 1A5	Boolean		
D006	Main chute deploy sw ON 1A5	Boolean		
E014	LIFT OFF light on 1A5	Boolean		
E004	LIFT OFF/no auto abort switch 1A5	Boolean		
E003	NO AUTO ABORT light on 1A5	Boolean		
D015	Canard deploy sw ON 1A5	Boolean		
D115	LES motor fire sw ON 1A5	Boolean		
D004	Apex cover jett sw on JETT 1A5	Boolean		
D019	Apex cover not separated light 1A5	Boolean		
E021	No. 1 eng chamber press fail light 1A5	Boolean		
E022	No. 2 eng chamber press fail light 1A5	Boolean		
E023	No. 3 eng chamber press fail light 1A5	Boolean		
E024	No. 4 eng chamber press fail light 1A5	Boolean		
E025	No. 5 eng chamber press fail light 1A5	Boolean		
E026	No. 6 eng chamber press fail light 1A5	Boolean		
E027	No. 7 eng chamber press fail light 1A5	Boolean		
E028	No. 8 eng chamber press fail light 1A5	Boolean		
D002	ELS logic sw ON 1A8	Boolean		
D012	C/M propellant jett logic sw ON 1A8	Boolean		
D106	C/M propellant jett dump sw ON 1A8	Boolean		
D108	C/M propellant jett purge sw ON 1A8	Boolean		
E006	Event timer reset switch ON	Boolean		
E007	Event timer start switch ON	Boolean		
E008	Event timer power switch OFF	Boolean		
E009	Event timer count down switch ON	Boolean		
E010	Event timer slew seconds tens switch ON	Boolean		
E011	Event timer slew seconds units switch ON	Boolean		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
E015	Event timer slew minutes tens switch ON	Boolean		
E017	Event timer slew minutes units switch ON	Boolean		
EWH1A	Seconds units synchro output A	±9.945 volts		
EWH1B	Seconds units synchro output B	±9.945 volts		
EWH2A	Seconds tens synchro output A	±9.945 volts		
EWH2B	Seconds tens synchro output B	±9.945 volts		
EWH3A	Minutes units synchro output A	±9.945 volts		
EWH3B	Minutes units synchro output B	±9.945 volts		
EWH4A	Minutes tens synchro output A	±9.945 volts		
EWH4B	Minutes tens synchro output B	±9.945 volts		
E825	Event timer seconds units 1-bit	Boolean		
E826	Event timer seconds units 2-bit	Boolean		
E827	Event timer seconds units 4-bit	Boolean		
E828	Event timer seconds units 8-bit	Boolean		
E829	Event timer seconds tens 1-bit	Boolean		
E830	Event timer seconds tens 2-bit	Boolean		
E831	Event timer seconds tens 4-bit	Boolean		
E832	Event timer minutes units 1-bit	Boolean		
E833	Event timer minutes units 2-bit	Boolean		
E834	Event timer minutes units 4-bit	Boolean		
E835	Event timer minutes units 8-bit	Boolean		
E836	Event timer minutes tens 1-bit	Boolean		
E837	Event timer minutes tens 2-bit	Boolean		
E838	Event timer minutes tens 4-bit	Boolean		
E839	Event timer minutes tens 8-bit	Boolean		
D104	Abort sys oxid dump sw on AUTO 1A16	Boolean		
E005	Abort sys EDS auto sw ON 1A16	Boolean		
D105	RCS C/M pressure sw ON 1A16	Boolean		
E001	Abort sys 2 eng out auto sw ON 1A16	Boolean		
E002	Abort sys L/V rates auto sw ON 1A16	Boolean		
D110	RCS command sw ON (armed) 1A16	Boolean		
D111	RCS command sw OFF (safe) 1A16	Boolean		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
D017	RCS transfer sw on C/M 1A16	Boolean		
D018	RCS transfer sw on S/M 1A16	Boolean		
D016	Abort sys LES mode - twr jett sps mode sw 1A16	Boolean		
D126	C/M - S/M sep sw on 1A16	Boolean		
D003	Main chute release sw ON 1A16	Boolean		
E000	EDS power sw ON 1A24	Boolean		
D100	Master event seq control pyro arm 1A24	Boolean		
D102	Master event seq control logic ON 1A24	Boolean		
E032	EDS lamp test sw A	Boolean		
E033	EDS lamp test sw B	Boolean		
E030	Lamp test output A	Boolean		
E031	Lamp test output B	Boolean		
E018	Excess launch veh rate light 1A5	Boolean		
E019	Launch veh guidance fail light 1A5	Boolean		
C202	EPS batt bus A	Boolean		
C203	EPS batt bus B	Boolean		
C212	EPS pyro batt A	Boolean		
C213	EPS pyro batt B	Boolean		
C200	EPS main dc bus A	Boolean		
C201	EPS main dc bus B	Boolean		
CDCVBBA	EPS dc volts batt bus A	0, 45 volts		
CDCVBBB	EPS dc volts batt bus B	0, 45 volts		
C459	EPS circuit breaker C15A6CB8	Boolean		
C462	EPS circuit breaker C15A6CB7	Boolean		
C460	EPS circuit breaker C15A5CB19	Boolean		
C463	EPS circuit breaker C15A5CB18	Boolean		
C461	EPS circuit breaker C15A5CB21	Boolean		
C464	EPS circuit breaker C15A5CB20	Boolean		
C447	EPS circuit breaker C14CB15	Boolean		
C448	EPS circuit breaker C14CB16	Boolean		
C446	EPS circuit breaker C14CB14	Boolean		
C449	EPS circuit breaker C14CB17	Boolean		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C543	EPS circuit breaker C15A6CB14	Boolean		
C527	EPS circuit breaker C15A6CB13	Boolean		
C485	EPS circuit breaker event timer - bus A	Boolean		
C511	EPS circuit breaker event timer - bus B	Boolean		
D205	Mission seq. logic bus A arming relay	Boolean		
D206	Mission seq. logic bus B arming relay	Boolean		
D207	Mission seq pyro bus A arming relay	Boolean		
D208	Mission seq pyro bus B arming relay	Boolean		
D920	Mission seq logic bus A	Boolean		
D921	Mission seq logic bus B	Boolean		
D922	Mission seq pyro bus A	Boolean		
D923	Mission seq pyro bus B	Boolean		
D825	RCS control power A	Boolean		
D826	RCS control power B	Boolean		
E844	EDS power avail 1	Boolean		
E845	EDS power avail 3	Boolean		
C565	Circuit breaker C15A6CB52	Boolean		
C567	Circuit breaker C15A6CB53	Boolean		
C505	Circuit breaker C15A6CB37	Boolean		
D690	Propellant logic power A	Boolean		
D691	Propellant control power A	Boolean		
D693	Propellant logic power B	Boolean		
D694	Propellant control power B	Boolean		
D900	ELS pyro/logic bus arm A	Boolean		
D901	ELS pyro/logic bus arm B	Boolean		
D902	Mission seq pyro/logic bus arm A	Boolean		
D903	Mission seq pyro/logic bus arm B	Boolean		
D904	Logic batt bus A - mission seq	Boolean		
D905	Logic batt bus B - mission seq	Boolean		
D908	Pyro batt bus A - mission seq	Boolean		
D909	Pyro batt bus B - mission seq	Boolean		
CVPYROA	Pyro batt A voltage mission seq	0, 45 volts dc		
CVPYROB	Pyro batt B voltage mission seq	0, 45 volts dc		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
Q040	MSCC/tape - lift off	Boolean		
Q007	MSCC/tape - S-IB eng No. 1 out	Boolean		
Q010	MSCC/tape - S-IB eng No. 2 out	Boolean		
Q011	MSCC/tape - S-IB eng No. 3 out	Boolean		
Q012	MSCC/tape - S-IB eng No. 4 out	Boolean		
Q013	MSCC/tape - S-IB eng No. 5 out	Boolean		
Q014	MSCC/tape - S-IB eng No. 6 out	Boolean		
Q015	MSCC/tape - S-IB eng No. 7 out	Boolean		
Q016	MSCC/tape - S-IB eng No. 8 out	Boolean		
Q017	MSCC/tape - L/V guidance fail	Boolean		
Q020	MSCC - GSE pad or RSO abort request	Boolean		
Q021	MSCC - auto abort	Boolean		
Q025	MSCC/tape - L/V rates excessive	Boolean		
E052	EDS bus 1 armed	Boolean		
MD046	Translational controller abort inhibit	Malfunction		
E053	EDS bus 2 armed	Boolean		
C569	EDS bus 2 circuit breaker	Boolean		
C207	EDS post landing bus	Boolean		
E054	EDS bus 3 armed	Boolean		
T621	Up-data link abort RTC	Boolean		
T627	Up-data link abort RTC	Boolean		
ME201	EDS malf - abort request light on or shorted	Malfunction		
ME202	EDS malf - abort request light off or open	Malfunction		
ME203	EDS malf - booster eng No. 1 light on or shorted	Malfunction		
ME204	EDS malf - booster eng No. 1 light off or open	Malfunction		
ME205	EDS malf - booster eng No. 2 light on or shorted	Malfunction		
ME206	EDS malf - booster eng No. 2 light off or open	Malfunction		
ME207	EDS malf - booster eng No. 3 light on or shorted	Malfunction		
ME210	EDS malf - booster eng No. 3 light off or open	Malfunction		
ME211	EDS malf - booster eng No. 4 light on or shorted	Malfunction		
ME212	EDS malf - booster eng No. 4 light off or open	Malfunction		
ME213	EDS malf - booster eng No. 5 light on or shorted	Malfunction		
ME214	EDS malf - booster eng No. 5 light off or open	Malfunction		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
ME231	EDS fail to initiate 2 eng out abort	Malfunction		
ESIN12	10 sine 12 degrees	Const 2.079 volts		
ESIN24	10 sine 24 degrees	Const 4.067 volts		
ESIN48	10 sine 48 degrees	Const 7.431 volts		
ESIN60	10 sine 60 degrees	Const 8.660 volts		
ESIN84	10 sine 84 degrees	Const 9.945 volts		
ME200	Event timer count failure	Malfunction		
ME233	Event timer failure to reset & start at liftoff	Malfunction		
T329	Central timing equipment logic OK	Boolean		
T904	Freeze	Boolean		
E081	Event timer abort condition	Boolean		
E082	Start one shot computation	Boolean		
E083	Event timer run condition	Boolean		
E084	Reset one shot computation	Boolean		
E804	Event timer liftoff condition	Boolean		
E805	Slew seconds units condition	Boolean		
E806	Slew seconds tens condition	Boolean		
E807	Slew minutes units condition	Boolean		
E808	Slew minutes tens condition	Boolean		
E809	Event timer slew mode	Boolean		
E822	Event timer seconds tenths 2-bit	Boolean		
E823	Event-timer seconds tenths 4-bit	Boolean		
E824	Event-timer seconds tenths 8-bit	Boolean		
E850	Power on Boolean abbreviation	Boolean		
E851	Power-down Boolean abbreviation	Boolean		
E852	Non-abort Boolean abbreviation	Boolean		
E853	Non-abort; non-lift-off Boolean abbreviation	Boolean		
E854	Non-reset one- shot Boolean abbreviation	Boolean		
E855	Non-start one-shot Boolean abbreviation	Boolean		
E856	Event-timer counting Boolean abbreviation	Boolean		
E857	Non-count, non-reset Boolean abbreviation	Boolean		
E858	Normal count-up Boolean abbreviation	Boolean		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
ME215	EDS malf - booster eng No. 6 light on or shorted	Malfunction		
ME216	EDS malf - booster eng No. 6 light off or open	Malfunction		
ME217	EDS malf - booster eng No. 7 light on or shorted	Malfunction		
ME220	EDS malf - booster eng No. 7 light off or open	Malfunction		
ME221	Eds malf - booster eng No. 8 light on or shorted	Malfunction		
ME222	EDS malf - booster eng No. 8 light off or open	Malfunction		
ME223	EDS malf - LV rates light on or shorted	Malfunction		
ME224	EDS malf - LV rates light off or open	Malfunction		
ME225	EDS malf - LV guidance light on or shorted	Malfunction		
ME226	EDS malf - LV guidance light off or open	Malfunction		
ME227	EDS malf - liftoff light on or shorted	Malfunction		
ME230	EDS malf - liftoff light off or open	Malfunction		
E104	EDS - auto abort enable relay - sys A	Boolean		
E204	EDS - auto abort enable relay - sys B	Boolean		
E101	EDS - abort voting logic input 1 relay	Boolean		
E102	EDS - abort voting logic input 2 relay	Boolean		
E103	EDS - abort voting logic input 3 relay	Boolean		
E105	EDS - bus change over relay	Boolean		
E106	EDS - les mode enable relay sys A	Boolean		
E206	EDS - les mode enable relay sys B	Boolean		
E107	EDS - booster engine cutoff request sys A	Boolean		
E207	EDS - booster engine cutoff request sys B	Boolean		
Q027	MSCC/tape - 2 engine out auto abort can occur	Boolean		
T511	IOS integrated mode sw (1 = integrated mode)	Boolean		
E050	EDS auto abort signal (non-integrated mode)	Boolean		
ME251	EDS auto abort inhibit by instructor	Malfunction		
E209	Booster engine cutoff signal	Boolean		
ME232	Auto abort enable circuit fail	Malfunction		
ME250	EDS malf - instructor initiated abort	Malfunction		
H107	SCS - hand controller in abort position	Boolean		
E060	Up-data link abort RTC latch A	Boolean		
E061	Up-data link abort RTC latch B	Boolean		
E800	EDS auto abort enable	Boolean		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
E859	Count-down Boolean abbreviation	Boolean		
E860	Seconds tens add done Boolean abbreviation	Boolean		
E861	Seconds tens subtract done Boolean abbreviation	Boolean		
EI86	Digital event timer reset-current	Const 1.5 amps		
E4C85	Circuit breaker C485 current	0, 1.5 amps		
E5C11	Circuit breaker C511 current	0, 1.5 amps		
C370	Main bus A voltage ≥ main bus B voltage			
EWHB5	B signal for synchro (five)	±9.945 volts		
EWHB6	B signal for synchro (six)	±9.945 volts		
EWHB7	B signal for synchro (seven)	±9.945 volts		
EWHB8	B signal for synchro (eight)	±9.945 volts		
EWHB9	B signal for synchro (nine)	±9.945 volts		
E086	Event-timer reset Boolean abbreviation	Boolean		
E840	Seconds units add one Boolean abbreviation	Boolean		
E841	Seconds tens add one Boolean abbreviation	Boolean		
E842	Minutes units add one Boolean abbreviation	Boolean		
E843	Minutes tens add one Boolean abbreviation	Boolean		
E846	Seconds units subtract one Boolean abbreviation	Boolean		
E847	Seconds tens subtract one Boolean abbreviation	Boolean		
E848	Minutes units subtract one Boolean abbreviation	Boolean		
E849	Minutes tens subtract one Boolean abbreviation	Boolean		
EWHA0	A signal for synchro (zero)	±0.9945 volts		
EWHA1	A signal for synchro (one)	±0.9945 volts		
EWHA2	A signal for synchro (two)	±0.9945 volts		
EWHA3	A signal for synchro (three)	±0.9945 volts		
EWHA4	A signal for synchro (four)	±0.9945 volts		
EWHA5	A signal for synchro (five)	±0.9945 volts		
EWHA6	A signal for synchro (six)	±0.9945 volts		
EWHA7	A signal for synchro (seven)	±0.9945 volts		
EWHA8	A signal for synchro (eight)	±0.9945 volts		
EWHA9	A signal for synchro (nine)	±0.9945 volts		
EWHB0	B signal for synchro (zero)	±0.9945 volts		
EWHB1	B signal for synchro (one)	±0.9945 volts		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
EWHB2	B signal for synchro (two)	±0.9945 volts		
EWHB3	B signal for synchro (three)	±0.9945 volts		
EWHB4	B signal for synchro (four)	±0.9945 volts		
D861	C/M-S/M deadface follow-up rly - sys A	Boolean		
D862	C/M-S/M deadface follow-up rly - sys B	Boolean		
D804	C/M-S/M deadface initiate - sys A	Boolean		
D805	C/M-S/M deadface initiate - sys B	Boolean		
MD050	C/M-S/M sep bolts fail to ignite (les abort)	Malfunction		
D570	C/M-S/M deadface squibs fired	Boolean		
D550	C/M-S/M separation and umbilical destruct	Boolean		
D839	LES & PITCH motors fire initiate - sys A	Boolean		
D840	LES & PITCH motors fire initiate - sys B	Boolean		
MD055	LES & PITCH motors fail to fire (LES abort)	Malfunction		
MD051	LES & PITCH motors squibs fail to fire	Malfunction		
D512	LES & PITCH motor squibs fired	Boolean		X
D841	C/M RCS pressure relay - sys A	Boolean		
D842	C/M RCS pressure relay - sys B	Boolean		
MD072	C/M RCS fails to pressurize - sys A	Malfunction		
MD073	C/M RCS fails to pressurize - sys B	Malfunction		
D530	C/M RCS sys A helium press. squibs fired	Boolean		
D531	C/M RCS sys B helium press. squibs fired	Boolean		
DLESTT	LES motor - resultant thrust	0, 154.000 force/lb		
DLESTTA	LES motor - thrust from 0 to 1.30 sec	139.000, 154.000 force/lb		
DLESTTB	LES motor - thrust from 1.30 to 3.35 sec	117.000, 154.000 force/lb		
DLESTTC	LES motor - thrust from 3.35 to 4.20 sec	25.000, 117.000 force/lb		
DLESTTD	LES motor - thrust from 4.20 to 6.25 or 7.45 sec	2.000, 25.000 force/lb		
DLESTTXB	LES motor - thrust along X body axis	0, 154.000 force/lb		
DLESTTYB	LES motor - thrust along Y body axis	0, 0 force/lb		
DLESTTZB	LES motor - thrust along Z body axis	0, 7.392 force/lb		
DPCMTT	PITCH motor resultant thrust	0, 2.900 force/lb		
DPCMTTA	PITCH motor thrust from 0 to 0.6 sec	2.000, 2.900 force/lb		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
DPCMTTB	PITCH motor thrust from 0.6 to 1.25 sec	0, 0.500 force/lb		
DLEPMTZB	LES & PITCH motor thrust - Z body axis	0, -9.572 force/lb		
DMTXB	LES & PITCH motor moment about X body axis	0, 0 moment/ft-lb		
DMTYB	LES & PITCH motor moment about Y body axis	0, 115.402		
DMTZB	LES & PITCH motor moment about Z body axis	0, 0 moment/ft-lb		
DLESF	LES & PITCH motor propellant mass depletion	0, 93.168 mass/ slugs		
D513	LES & motor thrust ON signal to aural cue	Boolean		
D403	11.0-second time delay - sys A (ELS seq)	Boolean		
D404	11.0-second time delay - sys B (ELS seq)	Boolean		
MD017	Canard deploy fail	Malfunction		
D800	Canard deploy initiate - sys A	Boolean		
D801	Canard deploy initiate - sys B	Boolean		
D571	Canards deployed	Boolean		
D802	3.0-second time delay - sys A (ELS seq)	Boolean		
D803	3.0-second time delay - sys B (ELS seq)	Boolean		
D827	ELS transistor switch A armed	Boolean		
D828	ELS transistor switch B armed	Boolean		
D050	24,000 ft baro sw closed	Boolean		
MD047	Mission seq fails to arm ELS during LES abort	Malfunction		
MD001	24,000 ft baro sw fails open	Malfunction		
D307	ELS logic relay A	Boolean		
D310	ELS logic relay B	Boolean		
MD005	ELS transistor sw fails to fire	Malfunctior		
D831	E/T jett fire tower sep initiate A	Boolean		
D832	E/T jett fire tower sep initiate B	Boolean		
D833	E/T jett fire tower sep relay A	Boolean		
D834	E/T jett fire tower sep relay B	Boolean		
MD045	E/T fails to jettison during LES abort	Malfunction		
MD074	E/T jett fire and twr sep relay fails	Malfunction		
D510	Launch escape tower jettisoned	Boolean		
D835	0.4-second time delay - sys A	Boolean		
D836	0.4-second time delay - sys B	Boolean		
MD010	Apex cover jettison fail	Malfunction		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
D021	Apex cover jettison relay A	Boolean		
D024	Apex cover jettison relay B	Boolean		
D500	Apex cover jettisoned	Boolean		
D041	2.0-second time delay - sys A (ELS seq)	Boolean		
D042	2.0-second time delay - sys B (ELS seq)	Boolean		
MD002	T D sw before drogue deploy relay fails	Malfunction		
D022	Drogue 1 and 2 igniter relay - sys A	Boolean		
D025	Drogue 1 and 2 igniter relay - sys B	Boolean		
D501	Drogue chutes deployed	Boolean		
D051	10,000 ft barometer sw closed	Boolean		
MD003	10,000 ft baro switches fail to open	Malfunction		
D043	14.0-second time delay - sys A	Boolean		
D044	14.0-second time delay - sys B	Boolean		
MD016	Main chute fails to deploy automatically	Malfunction		
D023	Main chutes deploy and drogue release - relay A	Boolean		
D026	Main chutes deploy and drogue release - relay B	Boolean		
D502	Drogue chutes released and main chutes deployed	Boolean		
D845	Direct ullage control on (arm) - sys A	Boolean		
D846	Direct ullage control on (arm) - sys B	Boolean		
D747	12.0-second time delay - sys A (direct ullage off)	Boolean		
D749	12.0-second time delay - sys B (direct ullage off)	Boolean		
D849	Direct ullage latching relay - sys A	Boolean		
D850	Direct ullage latching relay - sys B	Boolean		
D822	Ullage maneuver relay - sys A	Boolean		
D823	Ullage maneuver relay - sys B	Boolean		
D519	PITCH & YAW inhibit signals (to SCS)	Boolean		
D741	1.6-second time delay - sys A (SPS abort seq)	Boolean		
D742	1.6-second time delay - sys B (SPS abort seq)	Boolean		
MD054	SPS abort progm 1.7-second time delay sw fails open)	Malfunction		
D731	Adapter separation relay - sys A	Boolean		
D732	Adapter separation relay - sys B	Boolean		
MD004	CSM - S-IVB staging fail	Malfunction		
D516	S/M - adapter phys sep squibs fired	Boolean		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
D851	0.8-second time delay - sys A (S-band rly)	Boolean		
D852	0.8-second time delay - sys B (S-band rly)	Boolean		
MD012	S-band antenna relay fail	Malfunction		
D843	1.0-second time delay - sys A	Boolean		
D844	1.0-second time delay - sys B	Boolean		
MD015	OX DUMP/RCS CMD sw fails open in RCS CMD pos	Malfunction		
MD070	RCS CMD sw fails to turn on (LES abort)	Malfunction		
D301	RCS control relay on (arm) - sys A	Boolean		
D302	RCS control relay on (arm) - sys B	Boolean		
MD011	RCS latch rly fails to close during sps abort	Malfunction		
MD013	RCS COMMAND sw fails in on position	Malfunction		
D331	RCS control relay off (safe) - sys A	Boolean		
D332	RCS control relay off (safe) - sys B	Boolean		
MD071	RCS CMD sw fails to turn off (LES abort)	Malfunction		
D213	RCS latching relay - sys A	Boolean		
D214	RCS latching relay - sys B	Boolean		
D560	SCS RCS on-off signal	Boolean		
D537	C/M RCS sys B fuel and oxid bypass squibbs fired	Boolean		
D863	C/M RCS fuel dump/burn initiate - sys A	Boolean		
D864	C/M RCS fuel dump/burn initiate - sys B	Boolean		
D640	42.0-second timer - sys A	Boolean		
D641	42.0-second timer - sys B	Boolean		
D855	Initiate RCS transfer to S/M - sys A	Boolean		
D856	Initiate RCS transfer to S/M - sys B	Boolean		
D857	Initiate RCS transfer to C/M - sys A	Boolean		
D858	Initiate RCS transfer to C/M - sys B	Boolean		
MD014	Auto RCS transfer fails following sep	Boolean		
D538	C/M - S/M RCS transfer - sys A	Boolean		
D539	C/M - S/M RCS transfer - sys B	Boolean		
D520	± PITCH S/M RCS fire signal	Boolean		
D521	± YAW S/M RCS fire signal	Boolean		
D522	± PITCH C/M RCS fire signal	Boolean		
D523	± YAW C/M RCS fire signal	Boolean		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
D540	C/M RCS sys A fuel dump activate signal	Boolean		
D541	C/M RCS sys B fuel dump activate signal	Boolean		
D623	RCS purge activate relay - sys A	Boolean		
D627	RCS purge activate relay - sys B	Boolean		
D859	RCS auto oxid dump relay - sys A	Boolean		
D860	RCS auto oxid dump relay - sys B	Boolean		
D535	C/M RCS He & fuel interconnect squibbs fired	Boolean		
D532	C/M RCS sys A oxidizer dump squibb fired	Boolean		
D533	C/M RCS sys B oxidizer dump squibb fired	Boolean		
D534	C/M RCS He and oxid interconnect squibbs fired	Boolean		
D536	C/M RCS sys A fuel and oxid bypass squibbs fired	Boolean		
MD006	Malf - baro alt - static pressure port plugged			
MD007	Malf - baro alt - diaphragm puncturer			
DFBA	Baro alt - equiv volts for 0 to 100 K ft	-9.200, +9.800 volts		
DFBAA	Baro alt - equiv volts for 0 to 15 K ft	-9.200, +0.600 volts		
DFBAB	Baro alt - equiv volts for 15 to 25 K ft	-0.600, +4.550 volts		
DFBAC	Baro alt - equiv volts for 25 to 30 K ft	+4.550, +5.800 volts		
DFBAD	Baro alt - equiv volts for 30 to 40 K ft	+5.800, +6.840 volts		
DFBAE	Baro alt - equiv volts for 40 to 50 K ft	+6.840, +7.570 volts		
DFBAF	Baro alt - equiv volts for 50 to 60 K ft	+7.570, +8.160 volts		
DFBAG	Baro alt - equiv volts for 60 to 80 K ft	+8.160, +9.120 volts		
DFBAH	Baro alt - equiv volts for 80 to 100 K ft	+9.120, +9.800 volts		
AH	Geometric alt - ref. equations of flight mech	0 feet		
DKBA1	Baro alt - constant = -9.200 volts	Constant		
DKBA2	Baro alt - constant = -8.325 volts	Constant		
DKBA3	Baro alt - constant = -1.750 volts	Constant		
DKBA4	Baro alt - constant = +2.720 volts	Constant		
DKBA5	Baro alt - constant = +3.860 volts	Constant		
DKBA6	Baro alt - constant = +4.720 volts	Constant		

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
DKBA7	Baro alt - constant = +5.230 volts	Constant		
DKBA8	Baro alt - constant = +6.370 volts	Constant		
QATOT	Indicator total angle of attack	0, 150.000 percent		
EKAASPS	AOA - CP1 constant = 10,000 volts	Constant		
EKAOA	Angle-of-attack constant = 150 percent	Constant		
EKSPS	Chamber pressure constant = 150 psi	Constant		
PPCW	Engine chamber pressure readout	0, 150.000 psi		
TLLBARDY	LES logic bus A ready voltage T/M	0, 37 volts dc	95(A)/95	
TLLBBRDY	LES logic bus B ready voltage T/M	0, 37 volts dc	98(A)/98	
T999	Signal conditioner + 5 vdc OK	Boolean		
E108	T/M input - LES abort initiate A	Boolean	GP21-1(D)/161	
E208	T/M input - LES abort initiate B	Boolean	GP21-7(D)/167	
E110	T/M input - EDS auto abort enable A	Boolean	GP32-2(D)/249	
E210	T/M input - EDS auto abort enable B	Boolean	GP20-6(D)/158	
E111	T/M input - manual abort A	Boolean	GP29-3(D)/227	
E211	T/M input - manual abort b	Boolean	GP24-6(D)/190	
E112	T/M input - LV engine cutoff signal A	Boolean	GP25-8(D)/200	
E212	T/M input - LV engine cutoff signal B	Boolean	GP32-4(D)/251	
E810	T/M input - EDS abort voting logic output A	Boolean	GP35-7(D)/279	
E811	T/M input - EDS abort voting logic output B	Boolean	GP36-5(D)/285	
E812	T/M input - launch veh guidance fail	Boolean		
E813	T/M input - launch veh. excessive rate	Boolean		
E814	T/M input - engine No. 1 out A	Boolean		
E815	T/M input - engine No. 2 out A	Boolean		
E816	T/M input - engine No. 3 out A	Boolean		
E817	T/M input - engine No. 4 out A	Boolean		
E818	T/M input - engine No. 5 out A	Boolean		
E819	T/M input - engine No. 6 out A	Boolean		
E820	T/M input - engine No. 7 out A	Boolean		
E821	T/M input - engine No. 8 out A	Boolean		
E801	T/M input - EDS abort request A	Boolean		
T370	Launch vehicle guidance fail T/M	Boolean	GP32-6(D)/254	
T371	Launch vehicle rate excessive T/M	Boolean	GP33-1(D)/257	

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T372	Engine No. 1 out A T/M	Boolean	GP33-3(D)/259	
T373	Engine No. 2 out A T/M	Boolean	GP33-4(D)/260	
T374	Engine No. 3 out A T/M	Boolean	GP33-5(D)/261	
T375	Engine No. 4 out A T/M	Boolean	GP33-6(D)/262	
T376	Engine No. 5 out A T/M	Boolean	GP33-7(D)/263	
T377	Engine No. 6 out A T/M	Boolean	GP33-8(D)/264	
T378	Engine No. 7 out A T/M	Boolean	GP34-1(D)/265	
T379	Engine No. 8 out A T/M	Boolean	GP34-2(D)/266	
T380	Liftoff signal A T/M	Boolean	GP34-3(D)/267	
T381	Liftoff signal B T/M	Boolean	GP34-4(D)/268	
T382	EDS abort request T/M	Boolean	GP34-7(D)/271	
T354	C/M-S/M phys sep monitor A T/M	Boolean	GP35-1(D)/273	
T355	C/M-S/M phys sep monitor B T/M	Boolean	GP35-2(D)/274	
T356	S/M adapter phys sep monitor A T/M	Boolean	GP35-5(D)/277	
T357	S/M adapter phys sep monitor B T/M	Boolean	GP35-6(D)/278	
TTPSMA	Tower phys sep monitor A T/M	0, 5 volts dc	116(A)/116	
TTPSMB	Tower phys sep monitor B T/M	0, 5 volts dc	117(A)/117	
KOAP	Outside air pressure	0, 15 psia		
TQBVSO	Q-ball vector sum output T/M	0, 5 volts dc	110(A)/110	
TBAROPSR	Barometric press. static ref T/M	0, 15 psia	210(A)/210	
TLPBAARM	LES pyro bus A arm voltage T/M	0, 37 volts dc	91(A)/91	
TLPBBARM	LES pyro bus B arm voltage T/M	0, 37 volts dc	92(A)/92	
D837	T/M conditioner input tower phys sep monitor A	Boolean		
D838	T/M conditioner input tower phys sep monitor B	Boolean		
D847	T/M conditioner input baro sw lock-in A	Boolean	GP23-8(D)/184	
D848	T/M conditioner input baro sw lock-in B	Boolean	GP24-1(D)/185	
D032	T/M conditioner input drogue deploy relay close A	Boolean	GP23-4(D)/180	
D033	T/M conditioner input drogue deploy relay close B	Boolean	GP23-5(D)/181	
D034	T/M conditioner input drogue release & main deploy A	Boolean	GP23-6(D)/182	
D035	T/M conditioner input drogue release & main deploy B	Boolean	GP23-7(D)/183	
D250	T/M conditioner input RCS activate signal A	Boolean	GP22-6(D)/174	
D251	T/M conditioner input RCS activate signal B	Boolean	GP22-7(D)/175	
D252	T/M conditioner input C/M RCS press. A	Boolean	GP22-8(D)/176	

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
D253	T/M conditioner input C/M RCS press. B	Boolean	GP23-1(D)/177	
D254	T/M conditioner input C/M-S/M phys sep monitor A	Boolean		
D255	T/M conditioner input C/M-S/M phys sep monitor B	Boolean		
D256	T/M conditioner input S/M adapter phys sep monitor A	Boolean		
D257	T/M conditioner input S/M adapter phys sep monitor B	Boolean		
DLLBA	T/M conditioner input LES logic bus A ready volt	0, 37 volts dc		
DLLBB	T/M conditioner input LES logic bus B ready volt	0, 37 volts dc		
DLPBA	T/M conditioner input pyro bus A arm voltage	0, 37 volts dc		
DLPBB	T/M conditioner input pyro bus B arm voltage	0, 37 volts dc		
DBAROPSR	T/M conditioner input barometric press. static ref	0, 15 psia		
DQBVSO	T/M conditioner input Q-ball vector sum output	0, 150 percent		
T383	T/M conditioner input EDS abort logic in 1	Boolean	GP25-1(D)/193	
T384	T/M conditioner input EDS abort logic in 2	Boolean	GP25-2(D)/194	
E802	T/M input liftoff signal A	Boolean		
E803	T/M input liftoff signal B	Boolean		
T998	Signal conditioner internal power OK	Boolean		
D853	T/M input S/M adapter sep initiate A	Boolean	GP22-1(D)/169	
D854	T/M input S/M adapter sep initiate B	Boolean	GP22-2(D)/170	
D806	T/M input canard deploy A	Boolean	GP24-5(D)/189	
D807	T/M input canard deploy B	Boolean	GP25-7(D)/199	
D808	T/M input main chute disconnect-relay A	Boolean	GP24-2(D)/186	
D809	T/M input main chute disconnect-relay B	Boolean	GP24-3(D)/187	
D810	T/M input LE/PC motor fire initiate A	Boolean	GP20-7(D)/159	
D811	T/M input LE/PC motor fire initiate B	Boolean	GP29-2(D)/226	
D812	T/M input fwd hs jett sys A	Boolean	GP20-3(D)/155	
D813	T/M input fwd hs jett sys B	Boolean	GP36-8(D)/288	
D814	T/M input adapter sep A	Boolean	GP21-2(D)/162	
D815	T/M input adapter sep B	Boolean	GP20-2(D)/154	
D816	T/M input tower jett A	Boolean	GP37-2(D)/290	
D817	T/M input tower jett B	Boolean	GP37-3(D)/291	
D818	T/M input C/M-S/M sep relay close A	Boolean	GP21-3(D)/163	
D819	T/M input C/M-S/M sep relay close B	Boolean	GP21-4(D)/164	
D820	T/M input direct ullage on A	Boolean	GP21-6(D)/166	

Table 6-35. Sequential Events Control System — Emergency Detection (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
D821	T/M input direct ullage on B	Boolean	GP21-8(D)/168	
D829	T/M input ELS seq initiate A	Boolean	GP20-4(D)/156	
D830	T/M input ELS seq initiate B	Boolean	GP29-1(D)/225	
T385	T/M input EDS abort logic in 3	Boolean	GP25-3(D)/195	

Table 6-36. Communication and Instrumentation Systems - Power and Switching Logic

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C454	Comm group 5 C15A5CB45	Boolean		
C453	Comm group 3 C15A5CB47	Boolean		
C455	Comm group 4 C15A5CB46	Boolean		
C450	HF antenna deploy (C/B 18)	Boolean		
C253	Power essential T/C-PCM T/M	Boolean		
C254	Power non essential T/C group 1	Boolean		
C256	Power essential T/C group 2	Boolean		
C255	Power essential T/C SCE & S-band PA	Boolean		
C207	Flight & Postlanding bus	Boolean		
C509	Master timing system B	Boolean		
C483	Master timing system A	Boolean		
C200	C/M main dc bus A	Boolean		
C201	C/M main dc bus B	Boolean		
G099	AGC freq ref (1.024 mc) operating	Boolean		
C213	Pyro bat B OK	Boolean		
C564	B/O med comm MN A C15A6CB59	Boolean		
C566	B/O med comm MN B C15A6CB60	Boolean		
D516	S/M - adapter physical separation	Boolean		
Q023	UHF DCS Xmit mode true (INT)	Boolean		
Q030	Sta outside of scin X-axis null cones (INT)	Boolean		
Q031	Reception possible on lwr scin ant (INT)	Boolean		
T201	DSE pwr sw in record S16 panel No. 20	Boolean		
T202	DSE pwr sw in play S16	Boolean		
T203	DSE transport sw in fwd S17	Boolean		
T204	DSE transport sw in rev S17	Boolean		
T209	PCM mode selector in hi S20 panel No. 20	Boolean		
T210	SCE pwr on S22	Boolean		
T211	PMP pwr on S23	Boolean		
T212	VHF/AM T/R S14	Boolean		
T213	VHF/AM rec S14	Boolean		
T214	VHF/AM recv, freq 2	Boolean		
T215	UHF/VHF/HF ant lower S35	Boolean		
T216	UHF/VHF/HF recovery S35	Boolean		

Table 6-36. Communication and Instrumentation Systems - Power and Switching Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T217	HF pwr on S10	Boolean		
T218	VHF bcn on S11	Boolean		
T220	VHF/FM PCM S12	Boolean		
T221	Ranging A (RNG) S5	Boolean		
T222	Ranging B (RNG ONLY) S5 panel No. 20	Boolean		
T225	S-band normal mode TV S7 panel No. 20	Boolean		
T228	S-band pwr high S2 panel No. 20	Boolean		
T230	S-band emerg mode voice S4 panel No. 20	Boolean		
T231	S-band emerg mode key S4	Boolean		
T232	Up-data s-band S8	Boolean		
T234	C-band 1 pulse S13	Boolean		
T235	C-band 2 pulse S13	Boolean		
T236	Recovery HF mode SSB S9	Boolean		
T237	Recovery HF mode BCN S9	Boolean		
T238	Xponder S1	Boolean		
T239	Xponder amp S1 panel No. 20	Boolean		
T243	HF antenna orbital S1 (A17)	Boolean		
T244	HF antenna deploy A S16 (A25)	Boolean		
T245	HF antenna deploy B S8 (A25)	Boolean		
T258	Scimitar auto S32 (panel no. 20)	Boolean		
T264	Astro mike audio out	Boolean		
T602	Real time command 02 set	Boolean		
T603	Real time command 03 set	Boolean		
T604	Real time command 04 set	Boolean		
T605	Real time command 05 set	Boolean		
T301	Flight & postldg bus & CB 45 OK	Boolean		
T302	Flight & postldg bus & CB 46 OK	Boolean		
T303	Flight & postldg bus & CB 47 OK	Boolean		
T304	Bus 1 or bus 2, 3Ø OK & selected and CB 47 OK	Boolean		
T305	PMP 28 vdc OK	Boolean		
T306	PCM OK	Boolean		
T310	Delayed C-band 1 pulse light	Boolean		
T311	Delayed C-band 2 pulse light	Boolean		
T312	Delayed S-band pwr low light	Boolean		

Table 6-36. Communication and Instrumentation Systems - Power and Switching Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T313	Delayed S-band pwr high light	Boolean		
T314	Delayed VHF/AM mode T/R light	Boolean		
T315	Delayed VHF/FM light	Boolean		
T321	Astro No. 1 audio center fail	Boolean		
T322	Astro No. 2 audio center fail	Boolean		
T323	Astro No. 3 audio center fail	Boolean		
T324	S-band up-voice killed	Boolean		
T325	S-band dn-voice killed	Boolean		
T326	VHF/AM up-voice killed	Boolean		
T327	VHF/AM dn-voice killed	Boolean		
T328	UDL logic OK	Boolean	GP3-1 through 8 (D)/17 through 24	
T329	CTE logic OK	Boolean	GP36-1(D)/281	
T330	Emerg key OK	Boolean		
T333	C-band transponder smoke	Boolean		
T345	C/B 45 overloaded	Boolean		
T346	C/B 47 overloaded	Boolean		
T347	C/B 47 overloaded	Boolean		
T348	C/B 48 overloaded	Boolean		
T400	S-band pwr amp relay	Boolean		
T401	C28-1A18 S-band pwr amp on	Boolean		
T402	C28-1A36 2 kmc ant sw on	Boolean		
T403	115/200V 400~ S-band C23-1A14 15 VDC ON	Boolean		
T405	C28-1A10 C-band transponder on	Boolean		
T406	C28-1A5 signal cond equip. pwr on	Boolean		
T407	C28-1A4 DSE pwr on	Boolean		
T408	15 vdc pmp neg pwr sup C28-A2 on	Boolean		
T409	C28-1A8 up-data link pwr on	Boolean		
T410	HF xcvr equip. 1A13A2 on	Boolean		
T411	VHF/AM transceiver equip. on	Boolean		
T412	VHF recovery bcn equip. on C281A9	Boolean		
T413	VHF/FM xmtr equip. C281A13	Boolean		
T415	Sel S-band ant OK	Boolean		
T460	DCS C-band transponder on command	Boolean		
T420	Signal cond pwr sup latch relay	Boolean		

Table 6-36. Communication and Instrumentation Systems - Power and Switching Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T433	Reception possible on upper scin ant (N-INT)	Boolean		
T432	Reception possible on lwr scin ant (N-INT)	Boolean		
T444	AHF antenna deployed and active	Boolean		
T511	Integrated mode selected	Boolean		
T997	Signal cond 10V OK	Boolean		
T998	Signal cond internal pwr OK	Boolean		
T999	Signal cond 5V OK	Boolean		
T060	Astro No. 1 vox fail off output	Boolean		
T061	Astro No. 2 vox fail off output	Boolean		
T062	Astro No. 3 vox fail off output	Boolean		
T063	Astro No. 1 vox fail on output	Boolean		
T064	Astro No. 2 vox fail on output	Boolean		
T065	Astro No. 3 vox fail on output	Boolean		
T066	Astro No. 1 ptt fail output	Boolean		
T067	Astro No. 2 ptt fail output	Boolean		
T070	Astro No. 3 ptt fail output	Boolean		
T334	HE up- or down-voice killed	Boolean		
T390	Nav & eng biomed pwr avail	Boolean		
T391	Commander biomed pwr avail	Boolean		
T359	DCS VHF/FM on command	Boolean		
TCPSBAND	Unified S-band 0.07 amp ac	Const 0.07 amps		
TCPPMP	PMP 0.0425 amp ac	Const 0.0425 amps		
TCPSIGC	Sig cond 0.25 amp ac	Const 0.25 amps		
TCPSAMPW	S-band pwr amp warmup 0.035 amp ac	Const 0.035 amps		
TCPSAMPR	S-band pwr amp reduced 0.14 amp ac	Const 0.14 amps		
TCPSAMPF	S-band pwr amp full 0.365 amp ac	Const 0.365 amps		
TCPTVDC	Television EQ 0.252 amp dc	Const 0.252 amps		
TCPCBNDC	C-band trans 0.4 amp dc	Const 0.4 amps		
TCPPMPDC	PMP 0.4 amp dc	Const 0.4 amps		
TCPFMDC	VHF/FM Xmtr 0.013 amp dc	Const 0.013 amps		
TCPRCODC	VHF recovery BCN 0.357 amp dc	Const 0.357 amps		
TCPRECDC	HF XCVR REC 0.0357	Const 0.0357 amps		
TCPSSBDC	HF XCVR SSB 1.14 amp dc	Const 1.14 amps		
TCPAMDC	HF XCVR AM 0.785 amp dc	Const 0.785 amps		

Table 6-36. Communication and Instrumentation Systems - Power and Switching Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TCPADODC	Audio ctr equip. 0.456 amp dc	Const 0.456 amps		
TCCTECDC	Central timing equip. 0.894 amp dc	Const 0.894 amps		
T5C09	Current through CB 52	Const amps		
T4C83	Current through CB 53	Const amps		
TR0	S-band pwr amp delay timer	0, 113 sec		
TR1	Delayed C-band 1 pulse light timer	0, 150 sec		
TR2	Delayed C-band 2 pulse light timer	0, 150 sec		
TR3	Delayed VHF/FM PCM mode T/R light timer	0, 75 sec		
TR5	Delayed VHF/AM mode T/R light timer	0, 75 sec		
TCS1X0	60 sec constant	Const 74 sec		
TCHN1NE0	90 sec constant	Const 112 sec		
TCITWO0	120 sec constant	Const 149 sec		
T4C54	Current through CB 45	0, 1.065 amps		
T4C53	Current through CB 47	0, 0.357 amps		
T4C55	Current through CB 46	0, 2.49 amps		
T2C53	Current per Ø CB 50	0, 0.035 amps		
T2C54	Current per Ø CB 49	0, 0.765 amps		
T2C56	Current per Ø CB 48	0, 0.1125 amps		
T2C55	Current per Ø CB 51	0, 0.65 amps		
TCPPCM	PCM 0.035 amp ac	Const 0.035 amps		
TCPVHFFM	VHF/FM Xmtr 0.25 amp ac	Const 0.25 amps		
TCPCBAND	C-band transponder 0.35 amp ac	Const 0.35 amps		
TCPDSE	DSE 0.165 ac	Const 0.165 amps		
MT001	S-band 20 w pwr supply, power amp failed	Boolean		
MT002	S-band 5 w pwr supply, power amp failed	Boolean		
MT003	Normal down-voice failed	Boolean		
MT004	Emerg down-voice failed	Boolean		
MT005	S-band up-voice failed	Boolean		
MT006	Astro No. 1 audio center fail (NAV)	Boolean		
MT007	Astro No. 2 audio center fail (COM)	Boolean		
MT021	Astro No. 3 audio center fail (ENG)	Boolean		
MT022	Lower VHF scimitar antenna failed	Boolean		
MT010	Upper VHF scimitar antenna failed	Boolean		
MT011	VHF/AM down-voice failed	Boolean		

Table 6-36. Communication and Instrumentation Systems - Power and Switching Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MT012	VHF/AM up-voice failed	Boolean		
MT013	VHF/AM rcvr freq No. 2 failed	Boolean		
MT014	VHF/AM rcvr freq No. 1 failed	Boolean		
MT015	Up-data s-band failed	Boolean		
MT016	Up-data UHF failed	Boolean		
MT020	CTE Xtal osc failed	Boolean		
MT023	Sig cond 5V failed	Boolean		
MT024	Sig cond int pwr failed	Boolean		
MT025	PCM failed	Boolean		
MT026	Sig cond 10V failed	Boolean		
MT043	Complete C-band fail	Boolean		
MT044	VHF/FM transmitter fail	Boolean		
MT045	Complete CTE fail	Boolean		
MT046	C-band transponder overheat	Boolean		
MT047	VHF rec bcn short of overload	Boolean		
MT054	S-band TV ckt short of overload	Boolean		
MT055	HF Xcvr equip. short of overload	Boolean		
MT057	PMP equip. short of overload	Boolean		
MT060	Astro No. 1 VOX fail off	Boolean		
MT061	Astro No. 2 VOX fail off	Boolean		
MT062	Astro No. 3 VOX fail off	Boolean		
MT063	Astro No. 1 VOX fail off	Boolean		
MT064	Astro No. 2 VOX fail off	Boolean		
MT065	Astro No. 3 VOX fail off	Boolean		
MT066	Astro No. 1 PTT fail	Boolean		
MT067	Astro No. 2 PTT fail	Boolean		
MT070	Astro No. 3 PTT fail	Boolean		
TVHFRFO	VHF/FM Xmtr PA detected RF output	-10, 02 volts	160(A)/160	
TVHADRO	VHF/AM Xmtr detected RF output	-10, 10 volts	16(A)/16	
TUDLRSS	UDL rec signal strength	-10, 4 volts	158(A)/158	
TCBNDDEC	C-band decoder output	-10, 0 volts	162(A)/162	
TCBNDTRA	C-band Xmtr output monitor	-10, 0 volts	167(A)/167	
TEXCSENS	Sensor excitation 5 volts	-10, 10 volts	146(A)/146	
TEXCSE10	Sensor excitation 10 volts	-10, 10 volts	147(A)/147	

Table 6-36. Communication and Instrumentation Systems - Power and Switching Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TPSVSCEN	Signal conditioner neg supply volts	-10, 10 volts	140(A)/140	
TPSVSCEP	Signal conditioner pos supply volts	-10, 10 volts	138(A)/138	
TSCENPSV	Signal conditioner neg or pos supply volts	0, 1 volts		
TSENEX10	Sensor excitation 10 volts	0, 1 volts		
TSENEXC5	Sensor excitation 5 volts	0, 1 volts		
TVHFFDRO	VHF/FM Xmtr PA detected RF output	0, 0.4 volts		
TVHADRF	VHF/AM Xmtr detected RF output	0 volts		
TCBXPOND	C-band Xmtr and decoder output monitor	0, 0.5 volts		
RUDLAGC	UDL rcvr sig strength	0, 0.7 volts		

Table 6-37. Communication and Instrumentation Systems—Antenna Effects

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T215	UHF/VHF/HF ant VHF lower selected	Boolean		
T216	UHF/VHF/HF ant recovery selected	Boolean		
T241	UHF/VHF/HF ant VHF upper selected	Boolean		
T258	Scimitar notch (SCIN) auto.	Boolean		
T259	Scimitar notch (SCIN) lower	Boolean		
T260	Scimitar notch (SCIN) upper	Boolean		
T301	Flt & postlanding bus and C/B45 OK	Boolean		
T403	115/200V 400 ~ S-band power on	Boolean		
T408	Ant switching relays - power logic	Boolean		
T415	Selected S-band ant OK	Boolean		
T426	Rec S-band sig on upper or lwr scin ant	Boolean		
T433	Reception possible on upper scin ant (N-INT)	Boolean		
T432	Reception possible on lwr scin ant (N-INT)	Boolean		
T511	Integrated mode selected	Boolean		
T804	Up scin ant sel or auto scin oper failed	Boolean		
T805	Auto scin sel, not failed	Boolean		
Q022	S-band Xmtr on and in range (INT)	Boolean		
Q030	Sta outside of scin X-axis null cones (INT)	Boolean		
Q031	Reception possible on lwr scin ant (INT)	Boolean		
MT027	Scin ant auto switch fail	Malfunction		
MT030	Scin ant upper fail	Malfunction		
MT031	Scin ant lower fail	Malfunction		
MT036	S-band tune for max meter fail	Malfunction		
TETSCR	Earth to S/C transit time D/A	0, 1319630400 ft		
TTFMAX	S-band tune for max D/A	0, +1		
TSBAGC	S-band AGC signal	0, +1		
TSBRAGCV	S-band rec AGC voltage	0, +1	163(A)/163	
TSBSPHE	S-band rec static phase error	0, +1	165(A)/165	

Table 6-38. Communication and Instrumentation Systems—Antenna Effects Station Location

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T431	At least one station in LOS range of spacecraft (N-INT)	Boolean		
T432	Recept possible on lwr notch ant (N-INT)	Boolean		
T433	Recept possible on upper notch ant (N-INT)	Boolean		
TSINLA01	Sta 1 sin lat Cape Kennedy NSIF	Const 0.474395		
TSINLA02	Sta 2 sin lat Kauai NSIF	Const 0.374444		
TSINLA03	Sta 3 sin lat Bermuda NSIF	Const 0.532433		
TSINLA04	Sta 4 sin lat Grand Canary NSIF	Const 0.462831		
TSINLA05	Sta 5 sin lat Guaymas NSIF	Const 0.466232		
TSINLA06	Sta 6 sin lat Carnarvon NSIF	Const -0.418184		
TSINLA07	Sta 7 sin lat Corpus Christi NSIF	Const 0.461748		
TSINLA08	Sta 8 sin lat insertion ship	Const 0.642790		
TSINLA09	Sta 9 sin lat injection ship	Const -0.173650		
TSINLA10	Sta 10 sin lat re-entry ship	Const 0.00000		
TRMAXVE	Max S/C to sta los range possible	0, +63762943 ft		
TXI01	X-comp in I frame of rad vector to grd sta 1	±20925742 ft		
TXI02	X-comp in I frame of rad vector to grd sta 2	±20925742 ft		
TXI03	X-comp in I frame of rad vector to grd sta 3	±20925742 ft		
TXI04	X-comp in I frame of rad vector to grd sta 4	±20925742 ft		
TXI05	X-comp in I frame of rad vector to grd sta 5	±20925742 ft		
TXI06	X-comp in I frame of rad vector to grd sta 6	±20925742 ft		
TXI07	X-comp in I frame of rad vector to grd sta 7	±20925742 ft		
TXI08	X-comp in I frame of rad vector to grd sta 8	±20925742 ft		
TXI09	X-comp in I frame of rad vector to grd sta 9	±20925742 ft		
TXI10	X-comp in I frame of rad vector to grd sta 10	±20925742 ft		
TYI01	Y comp in I frame of rad vector to grd sta 1	±20925742 ft		
TYI02	Y comp in I frame of rad vector to grd sta 2	±20925742 ft		
TYI03	Y comp in I frame of rad vector to grd sta 3	±20925742 ft		
TYI04	Y comp in I frame of rad vector to grd sta 4	±20925742 ft		
TYI05	Y comp in I frame of rad vector to grd sta 5	±20925742 ft		
TYI06	Y comp in I frame of rad vector to grd sta 6	±20925742 ft		
TYI07	Y comp in I frame of rad vector to grd sta 7	±20925742 ft		
TYI08	Y comp in I frame of rad vector to grd sta 8	±20925742 ft		

Table 6-38. Communication and Instrumentation Systems—Antenna Effects Station Location (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TYI09	Y comp in I frame of rad vector to grd sta 9	±20925742 ft		
TYI10	Y comp in I frame of rad vector to grd sta 10	±20925742 ft		
TZI01	Z comp in I frame of rad vector to grd sta 1	±20925742 ft		
TZI02	Z comp in I frame of rad vector to grd sta 2	±20925742 ft		
TZI03	Z comp in I frame of rad vector to grd sta 3	±20925742 ft		
TZI04	Z comp in I frame of rad vector to grd sta 4	±20925742 ft		
TZI05	Z comp in I frame of rad vector to grd sta 5	±20925742 ft		
TZI06	Z comp in I frame of rad vector to grd sta 6	±20925742 ft		
TZI07	Z comp in I frame of rad vector to grd sta 7	±20925742 ft		
TZI08	Z comp in I frame of rad vector to grd sta 8	±20925742 ft		
TZI09	Z comp in I frame of rad vector to grd sta 9	±20925742 ft		
TZI10	Z comp in I frame of rad vector to grd sta 10	±20925742 ft		
TLONG01	Sta 1 longitude Cape Kennedy NSIF	Const -80.57651 deg		
TLONG02	Sta 2 Kauai NSIF	Const -159.6710 deg		
TLONG03	Sta 3 Bermuda NSIF	Const -64.65355 deg		
TLONG04	Sta 4 Grand Canary NSIF	Const -15.60000 deg		
TLONG05	Sta 5 Guaymas NSIF	Const -110.7207 deg		
TLONG06	Sta 6 Carnarvon NSIF	Const +113.6333 deg		
TLONG07	Sta 7 Corpus Christi NSIF	Const -97.38025 deg		
TLONG08	Sta 8 insertion ship	Const -40.00000 deg		
TLONG09	Sta 9 injection ship	Const +55.00000 deg		
TLONG10	Sta 10 longitude re-entry ship	Const 180.00000 deg		
TXISV01	X comp in I frame of sta 1 to S/C vector	±88034606 ft		
TXISV02	X comp in I frame of sta 2 to S/C vector	±88034606 ft		
TXISV03	X comp in I frame of sta 3 to S/C vector	±88034606 ft		
TXISV04	X comp in I frame of sta 4 to S/C vector	±88034606 ft		
TXISV05	X comp in I frame of sta 5 to S/C vector	±88034606 ft		
TXISV06	X comp in I frame of sta 6 to S/C vector	±88034606 ft		
TXISV07	X comp in I frame of sta 7 to S/C vector	±88034606 ft		
TXISV08	X comp in I frame of sta 8 to S/C vector	±88034606 ft		
TXISV09	X comp in I frame of sta 9 to S/C vector	±88034606 ft		
TXISV10	X comp in I frame of sta 10 to S/C vector	±88034606 ft		

Table 6-38. Communication and Instrumentation Systems—Antenna Effects Station Location (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TYISV01	Y comp in I frame of sta 1 to S/C vector	±88034606 ft		
TYISV02	Y comp in I frame of sta 2 to S/C vector	±88034606 ft		
TYISV03	Y comp in I frame of sta 3 to S/C vector	±88034606 ft		
TYISV04	Y comp in I frame of sta 4 to S/C vector	±88034606 ft		
TYISV05	Y comp in I frame of sta 5 to S/C vector	±88034606 ft		
TYISV06	Y comp in I frame of sta 6 to S/C vector	±88034606 ft		
TYISV07	Y comp in I frame of sta 7 to S/C vector	±88034606 ft		
TYISV08	Y comp in I frame of sta 8 to S/C vector	±88034606 ft		
TYISV09	Y comp in I frame of sta 9 to S/C vector	±88034606 ft		
TYISV10	Y comp in I frame of sta 10 to S/C vector	±88034606 ft		
TZISV01	Z comp in I frame of sta 1 to S/C vector	±88034606 ft		
TZISV02	Z comp in I frame of sta 2 to S/C vector	±88034606 ft		
TZISV03	Z comp in I frame of sta 3 to S/C vector	±88034606 ft		
TZISV04	Z comp in I frame of sta 4 to S/C vector	±88034606 ft		
TZISV05	Z comp in I frame of sta 5 to S/C vector	±88034606 ft		
TZISV06	Z comp in I frame of sta 6 to S/C vector	±88034606 ft		
TZISV07	Z comp in I frame of sta 7 to S/C vector	±88034606 ft		
TZISV08	Z comp in I frame of sta 8 to S/C vector	±88034606 ft		
TZISV09	Z comp in I frame of sta 9 to S/C vector	±88034606 ft		
TZISV10	Z comp in I frame of sta 10 to S/C vector	±88034606 ft		
TRSTAV01	Range from S/C to sta 1	0, 88034606 ft		
TRSTAV02	Range from S/C to sta 2	0, 88034606 ft		
TRSTAV03	Range from S/C to sta 3	0, 88034606 ft		
TRSTAV04	Range from S/C to sta 4	0, 88034606 ft		
TRSTAV05	Range from S/C to sta 5	0, 88034606 ft		
TRSTAV06	Range from S/C to sta 6	0, 88034606 ft		
TRSTAV07	Range from S/C to sta 7	0, 88034606 ft		
TRSTAV08	Range from S/C to sta 8	0, 88034606 ft		
TRSTAV09	Range from S/C to sta 9	0, 88034606 ft		
TRSTAV10	Range from S/C to sta 10	0, 88034606 ft		
TCOSLA01	Sta 1 cos lat Cape Kennedy NSIF	Const 0.880312		
TCOSLA02	Sta 2 cos lat Kauai NSIF	Const 0.927249		

Table 6-38. Communication and Instrumentation Systems—Antenna Effects Station Location (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TCOSLA03	Sta 3 cos lat Bermuda NSIF	Const 0.846472		
TCOSLA04	Sta 4 cos lat Grand Canary NSIF	Const 0.886446		
TCOSLA05	Sta 5 cos lat Guaymas NSIF	Const 0.884662		
TCOSLA06	Sta 6 cos lat Carnarvon NSIF	Const 0.908362		
TCOSLA07	Sta 7 cos lat Corpus Christi NSIF	Const 0.887010		
TCOSLA08	Sta 8 cos lat insertion ship	Const 0.766040		
TCOSLA09	Sta 9 cos lat injection ship	Const 0.984810		
TCOSLA10	Sta 10 cos lat re-entry ship	Const 1.000000		
TXBSV01	X comp in B frame of vector S/C to sta 1	±88034606 ft		
TXBSV02	X comp in B frame of vector S/C to sta 2	±88034606 ft		
TXBSV03	X comp in B frame of vector S/C to sta 3	±88034606 ft		
TXBSV04	X comp in B frame of vector S/C to sta 4	±88034606 ft		
TXBSV05	X comp in B frame of vector S/C to sta 5	±88034606 ft		
TXBSV06	X comp in B frame of vector S/C to sta 6	±88034606 ft		
TXBSV07	X comp in B frame of vector S/C to sta 7	±88034606 ft		
TXBSV08	X comp in B frame of vector S/C to sta 8	±88034606 ft		
TXBSV09	X comp in B frame of vector S/C to sta 9	±88034606 ft		
TXBSV10	X comp in B frame of vector S/C to sta 10	±88034606 ft		
TZBSV01	Z comp in B frame of vector S/C to sta 1	±88034606 ft		
TZBSV02	Z comp in B frame of vector S/C to sta 2	±88034606 ft		
TZBSV03	Z comp in B frame of vector S/C to sta 3	±88034606 ft		
TZBSV04	Z comp in B frame of vector S/C to sta 4	±88034606 ft		
TZBSV05	Z comp in B frame of vector S/C to sta 5	±88034606 ft		
TZBSV06	Z comp in B frame of vector S/C to sta 6	±88034606 ft		
TZBSV07	Z comp in B frame of vector S/C to sta 7	±88034606 ft		
TZBSV08	Z comp in B frame of vector S/C to sta 8	±88034606 ft		
TZBSV09	Z comp in B frame of vector S/C to sta 9	±88034606 ft		
TZBSV10	Z comp in B frame of vector S/C to sta 10	±88034606 ft		
TALPHA01	Angle bet XB axis and vector S/C to sta 1	0, 180 deg		
TALPHA02	Angle bet XB axis and vector S/C to sta 2	0, 180 deg		
TALPHA03	Angle bet XB axis and vector S/C to sta 3	0, 180 deg		
TALPHA04	Angle bet XB axis and vector S/C to sta 4	0, 180 deg		

Table 6-38. Communication and Instrumentation Systems—Antenna Effects Station Location (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TALPHA05	Angle bet XB axis and vector S/C to sta 5	0, 180 deg		
TALPHA06	Angle bet XB axis and vector S/C to sta 6	0, 180 deg		
TALPHA07	Angle bet XB axis and vector S/C to sta 7	0, 180 deg		
TALPHA08	Angle bet XB axis and vector S/C to sta 8	0, 180 deg		
TALPHA09	Angle bet XB axis and vector S/C to sta 9	0, 180 deg		
TALPHA10	Angle bet XB axis and vector S/C to sta 10	0, 180 deg		

Table 6-39. Communication and Instrumentation Systems—Central Timing and Simulated Master Timing

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T954	Freeze	Boolean		
T964	Reset	Boolean		
T965	Go	Boolean		
T969	Hold	Boolean		
T972	Recycle	Boolean		
TGMTDWO1	True GMT output word No. 1	Days, hr, min X 10		
TGMTDWO2	True GMT output word No. 2	Min X 1, sec		
TOFRDWO1	To/from time output word No. 1	Days, hr, min X 10		
TOFRDWO2	To/from time output word No. 2	Min X 1, sec		
TT1	Trajectory link time tag {AMS to MCC}	1/5 second		X
TW61	BCD GMT output word	Hr, min, sec	GP5-1 through 8 (D)/33 through 40 GP6-1 through 8 (D)/41 through 48	
TW62	BCD GMT output word	Day of month	GP7-1 through 8 (D)/49 through 56 GP8-1 through 8 (D)/57 through 64	
TW72	Up-data link word	Days, hr, min, sec		
T925	Presimulation typewriter enable	Boolean		
T930	Start to/from time	Boolean		
T939	= 1 at T-5 seconds and after	Boolean		
T940	To/from sign (0=+)	Boolean		
T528	Integrated CTE message received	Boolean		
T529	Nonintegrated CTE message received	Boolean		
TDELTA1	Step ahead time increment in days	Days		
TDELTA2	Step ahead time increment in 1/5 sec	1/5 second		
TITCOUNT	Step ahead time increment in 0.8 sec-cycles	Iterations		
TRUGMTB2	GMT - hr, min, sec	1/5 second		
TLAUNCH1	GMT at launch	Days		
TLAUNCH2	GMT at launch	1/5 second		
TYPEGMT1	Typewriter input same format as TRGMTB1			
TYPEGMT2	Typewriter input same format as TRGMTB2			
TYPEDAYM	Typewriter input same format as TDAYMO			
TYPELDAY	Typewriter input same format as TLASTDAY			

Table 6-39. Communication and Instrumentation Systems—Central Timing and Simulated Master Timing (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TAPELCH1	Stored on magnetic tape, format same as TLAUNCH1			
TAPELCH2	Stored on magnetic tape, format same as TLAUNCH2			
TOFROMB1	To/from binary reg No. 1	Days		X
TOFROMB2	To/from binary reg No. 2	1/20 sec, sec, min, hr		X
TRGMTB1	True GMT binary reg No. 1	Days		X
TRGMTB2	True GMT binary reg No. 2	1/20 sec, sec, min, hr		X
TDAYMO	Day of month binary	Days		X
TCMGMT	Command module GMT binary [failable]	sec, min, hr, days		X
TQTT1	Trajectory link 1/20 sec counter	1/20 sec		
TAPETF1	Stored on tape - same format as TOFROMB1			
TAPEGMT1	Stored on tape - same format as TRGMTB1			
TAPECMT	Stored on tape - same format as TCMGMT			
TAPETF2	Stored on tape - same format as TOFROMB2			
TAPEGMT2	Stored on tape - same format as TRGMTB2			
TLASTDAY	Numeric value of last day of month			X
TAPEDAYM	Stored on tape - same format as TDAYMO			
TAPELDAY	Stored on tape - same format as TLASTDAY			
TAPETTAG	Stored on tape - same format as TT1			
TDIFTIME	Step ahead time increment	1/5 sec		
TDELTIME	Step ahead time format	Hr, min, sec		

Table 6-40. C/M and S/M Reaction Control System

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R270	S/M qty gaging power sw S-1 on 1A15	Boolean		
R271	S/M qty gaging power sw S-2 on test 1A15	Boolean		
R272	S/M A RCS He 1 sw S-3 on 1A15	Boolean		
R273	S/M A RCS He 1 sw S-3 off 1A15	Boolean		
R274	S/M B RCS He 1 sw S-4 on 1A15	Boolean		
R275	S/M B RCS He 1 sw S-4 off 1A15	Boolean		
R276	S/M C RCS He 1 sw S-5 on 1A15	Boolean		
R277	S/M C RCS He 1 sw S-5 off 1A15	Boolean		
R278	S/M D RCS He 1 sw S-6 on 1A15	Boolean		
R279	S/M D RCS He 1 sw S-6 off 1A15	Boolean		
R170	C/M RCS A He sw S-7 on 1A15	Boolean		
R171	C/M RCS A He sw S-7 off 1A15	Boolean		
R172	C/M RCS B He sw S-8 on 1A15	Boolean		
R173	C/M RCS B He sw S-8 off 1A15	Boolean		
R280	S/M A RCS He 2 sw S-9 on 1A15	Boolean		
R281	S/M A RCS He 2 sw S-9 off 1A15	Boolean		
R282	S/M B RCS He 2 sw S-10 on 1A15	Boolean		
R283	S/M B RCS He 2 sw S-10 off 1A15	Boolean		
R284	S/M C RCS He 2 sw S-11 on 1A15	Boolean		
R285	S/M C RCS He 2 sw S-11 off 1A15	Boolean		
R286	S/M D RCS He 2 sw S-12 on 1A15	Boolean		
R287	S/M D RCS He 2 sw S-12 off 1A15	Boolean		
R174	C/M A prop iso sw S-13 on 1A15	Boolean		
R175	C/M A prop iso sw S-13 off 1A15	Boolean		
R176	C/M B prop iso sw S-14 on 1A15	Boolean		
R177	C/M B prop iso sw S-14 off 1A15	Boolean		
R288	S/M A prop iso sw S-15 on 1A15	Boolean		
R289	S/M A prop iso sw S-15 off 1A15	Boolean		
R290	S/M B prop iso sw S-16 on 1A15	Boolean		
R291	S/M B prop iso sw S-16 off 1A15	Boolean		
R292	S/M C prop iso sw S-17 on 1A15	Boolean		
R293	S/M C prop iso sw S-17 off 1A15	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R294	S/M D prop iso sw S-18 on 1A15	Boolean		
R295	S/M D prop iso sw S-18 off 1A15	Boolean		
R300	RCS ind sw S-1 on C/M A 1A12	Boolean		
R301	RCS ind sw S-1 on C/M B 1A12	Boolean		
R302	RCS ind sw S-1 on S/M A 1A12	Boolean		
R303	RCS ind sw S-1 on S/M B 1A12	Boolean		
R304	RCS ind sw S-1 on S/M C 1A12	Boolean		
R305	RCS ind sw S-1 on S/M D 1A12	Boolean		
R306	RCS ind C/M A on IOS 18A10	Boolean		
R307	RCS ind C/M B on IOS 18A10	Boolean		
R308	RCS ind S/M A on IOS 18A10	Boolean		
R309	RCS ind S/M B on IOS 18A10	Boolean		
R310	RCS ind S/M C on IOS 18A10	Boolean		
R311	RCS ind S/M D on IOS 18A10	Boolean		
R500	S/M A RCS He 1 tlkbk on 1A15	Boolean		
R501	S/M B RCS He 1 tlkbk on 1A15	Boolean		
R502	S/M C RCS He 1 tlkbk on 1A15	Boolean		
R503	S/M D RCS He 1 tlkbk on 1A15	Boolean		
R400	C/M A RCS He 1 tlkbk on 1A15	Boolean		
R401	C/M B RCS He 1 tlkbk on 1A15	Boolean		
R504	S/M A RCS He 2 tlkbk on 1A15	Boolean		
R505	S/M B RCS He 2 tlkbk on 1A15	Boolean		
R506	S/M C RCS He 2 tlkbk on 1A15	Boolean		
R507	S/M D RCS He 2 tlkbk on 1A15	Boolean		
R402	C/M A RCS prop iso tlkbk on 1A15	Boolean		
R403	C/M B RCS prop iso tlkbk on 1A15	Boolean		
R508	S/M A RCS prop iso tlkbk on 1A15	Boolean		
R509	S/M B RCS prop iso tlkbk on 1A15	Boolean		
R510	S/M C RCS prop iso tlkbk on 1A15	Boolean		
R511	S/M D RCS prop iso tlkbk on 1A15	Boolean		
R512	Fuel quantity blanking	Boolean		
R513	Oxid quantity blanking	Boolean		
ROCREW	S/M RCS fuel tank qty 1A15	0, 140 lb		X
RFCREW	S/M RCS oxid tank qty 1A15	0, 70 lb		X

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RTCREW	C/M He tank or S/M pkg temp M1A 1A12	-390, 190°F		
RPCREWA	RCS C/M or S/M He tank press M1B 1A12	-1250, 6250 psia		
RPCREWB	RCS C/M fuel tank press. or S/M-O M2A 1A12	-100, 500 psia		
RPCREWC	C/M oxid tank press. or S/M manif press. M2B 1A12	-100, 500 psia		
RFINST	RCS C/M fuel tank quantity	0, 70 lb		X
ROINST	RCS C/M oxid tank quantity	0, 140 lb		X
RTINST	C/M He tank temp or S/M pkg temp M1A IOS 18AB	-390, 190°F		
RPINSTA	RCS C/M or S/M He tank press. M1B IOS 18AB	-1250, 6250 psia		
RPINSTB	RCS C/M fuel tank press. or S/M-O M2A 18A8	-100, 100 psia		
RPINSTC	C/M oxid tank press. or S/M manif press. M2B IOS	-100, 100 psia		
RPHEAS	S/M sys A He reservoir press.	0, 5000 psia		
RPHEBS	S/M sys B He reservoir press	0, 5000 psia		
RPHECS	S/M sys C He reservoir press.	0, 5000 psia		
RPHEDS	S/M sys D He reservoir press	0, 5000 psia		
RTHEAS	S/M sys A storage tank He temp	100, 600°R		
RTHEBS	S/M sys B storage tank He temp	100, 600°R		
RTHECS	S/M sys C storage tank He temp	100, 600°R		
RTHEDS	S/M sys D storage tank He temp	100, 600°R		
RTCS	S/M instr control temp	500, 560°R		
RTMAS	S/M sys A engine mounting temp	40, 101°F		
RTMBS	S/M sys B engine mounting temp	40, 101°F		
RTMCS	S/M sys C engine mounting temp	40, 101°F		
RTMDS	S/M sys D engine mounting temp	40, 101°F		
RTBHEAS	S/M sys A storage tank bottle temp	100, 600°F		
RTBHEBS	S/M sys B storage tank bottle temp	100, 600°F		
RTBHECS	S/M sys C storage tank bottle temp	100, 600°F		
RTBHEDS	S/M sys D storage tank bottle temp	100, 600°F		
RQPIHEAS	S/M sys A modified He tank heat input	-4.93547, 4.93547 lb-°R/sec		
RQPIHEBS	S/M sys B modified He tank heat input	-4.93547, 4.93547 lb-°R/sec		
RQPIHECS	S/M sys C modified He tank heat input	-4.93547, 4.93547 lb-°R/sec		
RQPIHEDS	S/M sys D modified He tank heat input	-4.93547, 4.93547 lb-°R/sec		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RTDBHEAS	S/M sys A, He tank temp rate	-8.0, 8.0°R/sec		
RTDBHEBS	S/M sys B, He tank temp rate	-8.0, 8.0°R/sec		
RTDBHECS	S/M sys C, He tank temp rate	-8.0, 8.0°R/sec		
RTDBHEDS	S/M sys D, He tank temp rate	-8.0, 8.0°R/sec		
RTDHEAS	S/M sys A storage tank He temp rate	-20.0, 10.0°R/sec		
RTDHEBS	S/M sys B storage tank He temp rate	-20.0, 10.0°R/sec		
RTDHECS	S/M sys C storage tank He temp rate	-20.0, 10.0°R/sec		
RTDHEDS	S/M sys D storage tank He temp rate	-20.0, 10.0°R/sec		
RWHEAS	S/M sys A storage tank He weight	0, 0.523 lb		
RWHEBS	S/M sys B storage tank He weight	0, 0.523 lb		
RWHECS	S/M sys C storage tank He weight	0, 0.523 lb		
RWHEDS	S/M sys D storage tank He weight	0, 0.523 lb		
RWDLEHAS	S/M sys A storage tank He leakage rate	0, 0.02 lb/sec		
RWDLEHBS	S/M sys B storage tank He leakage rate	0, 0.02 lb/sec		
RWDLEHCS	S/M sys C storage tank He leakage rate	0, 0.02 lb/sec		
RWDLEHDS	S/M sys D storage tank He leakage rate	0, 0.02 lb/sec		
RWDHEAS	S/M sys A storage tank He weight flow rate	-0.0476, 0 lb/sec		
RWDHEBS	S/M sys B storage tank He weight flow rate	-0.0476, 0 lb/sec		
RWDHECS	S/M sys C storage tank He weight flow rate	-0.0476, 0 lb/sec		
RWDHEDS	S/M sys D storage tank He weight flow rate	-0.0476, 0 lb/sec		
RWDCVFAS	S/M sys A fuel side ck valve flow rate	0, 0.0137564 lb/sec		
RWDCVFBS	S/M sys B fuel side ck valve flow rate	0, 0.0137564 lb/sec		
RWDCVFCS	S/M sys C fuel side ck valve flow rate	0, 0.0137564 lb/sec		
RWDCVFDS	S/M sys D fuel side ck valve flow rate	0, 0.0137564 lb/sec		
RWDCVOAS	S/M sys A, oxid side ck valve flow rate	0, 0.0137564 lb/sec		
RWDCVOBS	S/M sys B, oxid side ck valve flow rate	0, 0.0137564 lb/sec		
RWDCVOCS	S/M sys C, oxid side ck valve flow rate	0, 0.0137564 lb/sec		
RWDCVODS	S/M sys D, oxid side ck valve flow rate	0, 0.0137564 lb/sec		
RPPMNFAS	S/M sys A, uncorrected no flow reg outlet press.	181, 188 psia		
RPPMNFBS	S/M sys B, uncorrected no flow reg outlet press.	181, 188 psia		
RPPMNFCS	S/M sys C, uncorrected no flow reg outlet press.	181, 188 psia		
RPPMNFDS	S/M sys D, uncorrected no flow reg outlet press.	181, 188 psia		
RPMNFAS	S/M sys A, corrected no flow reg outlet press.	0, 188 psia		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RPMNFBS	S/M sys B corrected no flow reg outlet press.	0, 188 psia		
RPMNFCS	S/M sys C corrected no flow reg outlet press.	0, 188 psia		
RPMNFDS	S/M sys D corrected no flow reg outlet press.	0, 188 psia		
RPPMAS	S/M sys A, uncorrected reg outlet press.	0, 188 psia		
RPPMBS	S/M sys B, uncorrected reg outlet press.	0, 188 psia		
RPPMCS	S/M sys C, uncorrected reg outlet press.	0, 188 psia		
RPPMDS	S/M sys D, uncorrected reg outlet press.	0, 188 psia		
RPPPMAS	S/M sys A, no free He path reg outlet press.	0, 240 psia		
RPPPMBS	S/M sys B, no free He path reg outlet press.	0, 240 psia		
RPPPMCS	S/M sys C, no free He path reg outlet press.	0, 240 psia		
RPPPMDS	S/M sys D, no free He path reg outlet press.	0, 240 psia		
RPMAS	S/M sys A, corrected reg outlet press.	0, 240 psia		
RPMBS	S/M sys B, corrected reg outlet press.	0, 240 psia		
RPMCS	S/M sys C, corrected reg outlet press.	0, 240 psia		
RPMDS	S/M sys D, corrected reg outlet press.	0, 240 psia		
RWDREGAS	S/M sys A, He weight flow rate thru reg	0, 0.0275128 lb/sec		
RWDREGBS	S/M sys B, He weight flow rate thru reg	0, 0.0275128 lb/sec		
RWDREGCS	S/M sys C, He weight flow rate thru reg	0, 0.0275128 lb/sec		
RWDREGDS	S/M sys D, He weight flow rate thru reg	0, 0.0275128 lb/sec		
RPFAS	S/M sys A, fuel tank press.	0, 340 psia		
RPFBS	S/M sys B, fuel tank press.	0, 340 psia		
RPFCS	S/M sys C, fuel tank press.	0, 340 psia		
RPFDS	S/M sys D, fuel tank press.	0, 340 psia		
RPOAS	S/M sys A, oxid tank press.	0, 340 psia		
RPOBS	S/M sys B, oxid tank press.	0, 340 psia		
RPOCS	S/M sys C, oxid tank press.	0, 340 psia		
RPODS	S/M sys D, oxid tank press.	0, 340 psia		
RVHEFTAS	S/M sys A, fuel tank ullage vol	175, 2805.2 $in.^3$		
RVHEFTBS	S/M sys B, fuel tank ullage vol	175, 2805.2 $in.^3$		
RVHEFTCS	S/M sys C, fuel tank ullage vol	175, 2805.2 $in.^3$		
RVHEFTDS	S/M sys D, fuel tank ullage vol	175, 2805.2 $in.^3$		
RVHEOTAS	S/M sys A, oxid tank ullage vol	270, 3409 $in.^3$		
RVHEOTBS	S/M sys B, oxid tank ullage vol	270, 3409 $in.^3$		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RVHEOTCS	S/M sys C, oxid tank ullage vol	270, 3409 $in.^3$		
RVHEOTDS	S/M sys D, oxid tank ullage vol	270, 3409 $in.^3$		
RRHFAS	S/M sys A, fuel density	0.03206, 0.04233 $lb/in.^3$		
RRHFBS	S/M sys B, fuel density	0.03206, 0.04233 $lb/in.^3$		
RRHFCS	S/M sys C, fuel density	0.03206, 0.04233 $lb/in.^3$		
RRHFDS	S/M sys D, fuel density	0.03206, 0.04233 $lb/in.^3$		
RRHOAS	S/M sys A, oxid density	0.05079, 0.07622 $lb/in.^3$		
RRHOBS	S/M sys B, oxid density	0.05079, 0.07622 $lb/in.^3$		
RRHOCS	S/M sys C, oxid density	0.05079, 0.07622 $lb/in.^3$		
RRHODS	S/M sys D, oxid density	0.05079, 0.07622 $lb/in.^3$		
RWHEFAS	S/M sys A, fuel tank ullage	0, 0.60012 lb		
RWHEFBS	S/M sys B, fuel tank ullage	0, 0.60012 lb		
RWHEFCS	S/M sys C, fuel tank ullage	0, 0.60012 lb		
RWHEFDS	S/M sys D, fuel tank ullage	0, 0.60012 lb		
RWHEOAS	S/M sys A, oxid tank ullage	0, 0.587 lb		
RWHEOBS	S/M sys B, oxid tank ullage	0, 0.587 lb		
RWHEOCS	S/M sys C, oxid tank ullage	0, 0.587 lb		
RWHEODS	S/M sys D, oxid tank ullage	0, 0.587 lb		
RTFAS	S/M sys A, fuel ullage temp	100, 600°R		
RTFBS	S/M sys B, fuel ullage temp	100, 600°R		
RTFCS	S/M sys C, fuel ullage temp	100, 600°R		
RTFDS	S/M sys D, fuel ullage temp	100, 600°R		
RTOAS	S/M sys A, oxid ullage temp	100, 600°R		
RTOBS	S/M sys B, oxid ullage temp	100, 600°R		
RTOCS	S/M sys C, oxid ullage temp	100, 600°R		
RTODS	S/M sys D, oxid ullage temp	100, 600°R		
RWDRVFAS	S/M A He wt fl rate thru fuel side rlf vlv	0, 0.001 lb/sec		
RWDRVFBS	S/M B He wt fl rate thru fuel side rlf vlv	0, 0.001 lb/sec		
RWDRVFCS	S/M C He wt fl rate thru fuel side rlf vlv	0, 0.001 lb/sec		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RWDRVFDS	S/M D He wt fl rate thru fuel side rlf vlv	0, 0.001 lb/sec		
RWDRVOAS	S/M A He wt fl rate thru oxid side rlf vlv	0, 0.001 lb/sec		
RWDRVOBS	S/M B He wt fl rate thru oxid side rlf vlv	0, 0.001 lb/sec		
RWDRVOCS	S/M C He wt fl rate thru oxid side rlf vlv	0, 0.001 lb/sec		
RWDRVODS	S/M D He wt fl rate thru oxid side rlf vlv	0, 0.001 lb/sec		
RWDOFTAS	S/M A He wt fl rate out of fuel tank	0, 0.0038 lb/sec		
RWDOFTBS	S/M B He wt fl rate out of fuel tank	0, 0.0038 lb/sec		
RWDOFTCS	S/M C He wt fl rate out of fuel tank	0, 0.0038 lb/sec		
RWDOFTDS	S/M D He wt fl rate out of fuel tank	0, 0.0038 lb/sec		
RWDOOTAS	S/M A He wt fl rate out of oxid tank	0, 0.0038 lb/sec		
RWDOOTBS	S/M B He wt fl rate out of oxid tank	0, 0.0038 lb/sec		
RWDOOTCS	S/M C He wt fl rate out of oxid tank	0, 0.0038 lb/sec		
RWDOOTDS	S/M D He wt fl rate out of oxid tank	0, 0.0038 lb/sec		
RWDLEFAS	S/M sys A, fuel tank ullage leakage rate	0, 0.0028 lb/sec		
RWDLEFBS	S/M sys B, fuel tank ullage leakage rate	0, 0.0028 lb/sec		
RWDLEFCS	S/M sys C, fuel tank ullage leakage rate	0, 0.0028 lb/sec		
RWDLEFDS	S/M sys D, fuel tank ullage leakage rate	0, 0.0028 lb/sec		
RWDLEOAS	S/M sys A, oxid tank ullage leakage rate	0, 0.0028 lb/sec		
RWDLEOBS	S/M sys B, oxid tank ullage leakage rate	0, 0.0028 lb/sec		
RWDLEOCS	S/M sys C, oxid tank ullage leakage rate	0, 0.0028 lb/sec		
RWDLEODS	S/M sys D, oxid tank ullage leakage rate	0, 0.0028 lb/sec		
RWDHEFAS	S/M sys A, He/fuel weight flow rate	-0.0038, 0.0137564 lb/sec		
RWDHEFBS	S/M sys B, He/fuel weight flow rate	-0.0038, 0.0137564 lb/sec		
RWDHEFCS	S/M sys C, He/fuel weight flow rate	-0.0038, 0.0137564 lb/sec		
RWDHEFDS	S/M sys D, He/fuel ullage weight flow rate	-0.0038, 0.0137564 lb/sec		
RWDHEOAS	S/M sys A, He/oxid ullage weight flow rate	-0.0038, 0.0137564 lb/sec		
RWDHEOBS	S/M sys B, He/oxid ullage weight flow rate	-0.0038, 0.0137564 lb/sec		
RWDHEOCS	S/M sys C, He/oxid ullage weight flow rate	-0.0038, 0.0137564 lb/sec		
RWDHEODS	S/M sys D, He/oxid ullage weight flow rate	-0.0038, 0.0137564 lb/sec		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RTBFAS	S/M sys A, fuel bottle temperature	100, 600°R		
RTBFBS	S/M sys B, fuel bottle temperature	100, 600°R		
RTBFCS	S/M sys C, fuel bottle temperature	100, 600°R		
RTBFDS	S/M sys D, fuel bottle temperature	100, 600°R		
RTBOAS	S/M sys A, oxid bottle temperature	100, 600°R		
RTBOBS	S/M sys B, oxid bottle temperature	100, 600°R		
RTBOCS	S/M sys C, oxid bottle temperature	100, 600°R		
RTBODS	S/M sys D, oxid bottle temperature	100, 600°R		
RQPIFAS	S/M sys A, modified fuel heat-input rates	-4.11936, 4.11936 lb °R/sec		
RQPIFBS	S/M sys B, modified fuel heat-input rates	-4.11936, 4.11936 lb °R/sec		
RQPIFCS	S/M sys C, modified fuel heat-input rates	-4.11936, 4.11936 lb °R/sec		
RQPIFDS	S/M sys D, modified fuel heat-input rates	-4.11936, 4.11936 lb °R/sec		
RQPIOAS	S/M sys A, modified oxid heat-input rates	-4.11936, 4.11936 lb °R/sec		
RQPIOBS	S/M sys B, modified oxid heat-input rates	-4.11936, 4.11936 lb °R/sec		
RQPIOCS	S/M sys C, modified oxid heat-input rates	-4.11936, 4.11936 lb °R/sec		
RQPIOCS	S/M sys D, modified oxid heat-input rates	-4.11936, 4.11936 lb °R/sec		
RTDBFAS	S/M sys A, fuel bottle temp rate	-4.6283, 4.6283°R/sec		
RTDBFBS	S/M sys B, fuel bottle temp rate	-4.6283, 4.6283°R/sec		
RTDBFCS	S/M sys C, fuel bottle temp rate	-4.6283, 4.6283°R/sec		
RTDBFDS	S/M sys D, fuel bottle temp rate	-4.6283, 4.6283°R/sec		
RTDBOAS	S/M sys A, oxid bottle temp rate	-4.6283, 4.6283°R/sec		
RTDBOBS	S/M sys B, oxid bottle temp rate	-4.6283, 4.6283°R/sec		
RTDBOCS	S/M sys C, oxid bottle temp rate	-4.6283, 4.6283°R/sec		
RTDBODS	S/M sys D, oxid bottle temp rate	-4.6283, 4.6283°R/sec		
RTDFAS	S/M sys A, fuel tank He temp rate	-15.0, 15.0°R/sec		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RTDFBS	S/M sys B, fuel tank He temp rate	-15.0, 15.0°R/sec		
RTDFCS	S/M sys C, fuel tank He temp rate	-15.0, 15.0°R/sec		
RTDFDS	S/M sys D, fuel tank He temp rate	-15.0, 15.0°R/sec		
RTDOAS	S/M sys A, oxid tank He temp rate	-15.0, 15.0°R/sec		
RTDOBS	S/M sys B, oxid tank He temp rate	-15.0, 15.0°R/sec		
RTDOCS	S/M sys C, oxid tank He temp rate	-15.0, 15.0°R/sec		
RTDODS	S/M sys D, oxid tank He temp rate	-15.0, 15.0°R/sec		
RFAS	S/M sys A, fuel quantity	0, 70 lb		
RFBS	S/M sys B, fuel quantity	0, 70 lb		
RFCS	S/M sys C, fuel quantity	0, 70 lb		
RFDS	S/M sys D, fuel quantity	0, 70 lb		
ROAS	S/M sys A, oxid quantity	0, 138 lb		
ROBS	S/M sys B, oxid quantity	0, 138 lb		
ROCS	S/M sys C, oxid quantity	0, 138 lb		
RODS	S/M sys D, oxid quantity	0, 138 lb		
RFDPAAS	S/M sys A, modified avail fuel wt flow rate	0, 0.184786 lb/sec		
RFDPABS	S/M sys B, modified avail fuel wt flow rate	0, 0.184786 lb/sec		
RFDPACS	S/M sys C, modified avail fuel wt flow rate	0, 0.184786 lb/sec		
RFDPADS	S/M sys D, modified avail fuel wt flow rate	0, 0.184786 lb/sec		
RODPAAS	S/M sys A, modified avail oxid wt flow rate	0, 0.393265 lb/sec		
RODPABS	S/M sys B, modified avail oxid wt flow rate	0, 0.393265 lb/sec		
RODPACS	S/M sys C, modified avail oxid wt flow rate	0, 0.393265 lb/sec		
RODPADS	S/M sys D, modified avail oxid wt flow rate	0, 0.393265 lb/sec		
RFDAAS	S/M sys A, avail fuel wt flow rate	0, 0.184786 lb/sec		
RFDABS	S/M sys B, avail fuel wt flow rate	0, 0.184786 lb/sec		
RFDACS	S/M sys C, avail fuel wt flow rate	0, 0.184786 lb/sec		
RFDADS	S/M sys D, avail fuel wt flow rate	0, 0.184786 lb/sec		
RODAAS	S/M sys A, avail oxid wt flow rate	0, 0.393265 lb/sec		
RODABS	S/M sys B, avail oxid wt flow rate	0, 0.393265 lb/sec		
RODACS	S/M sys C, avail oxid wt flow rate	0, 0.393265 lb/sec		
RODADS	S/M sys D, avail oxid wt flow rate	0, 0.393265 lb/sec		
RTMAXAAS	S/M sys A, max thrust avail	0, 163 lb		
RTMAXABS	S/M sys B, max thrust avail	0, 163 lb		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RTMAXACS	S/M sys C, max thrust avail	0, 163 lb		
RTMAXADS	S/M sys D, max thrust avail	0, 163 lb		
RQAS	S/M sys A, tca solenoid valves on-time parameter	0, 35 8(lb/sec/ lb/sec)		
RQBS	S/M sys B, tca solenoid valves on-time parameter	0, 35 8(lb/sec/ lb/sec)		
RQCS	S/M sys C, tca solenoid valves on-time parameter	0, 35 8(lb/sec/ lb/sec)		
RQDS	S/M sys D, tca solenoid valves on-time parameter	0, 35 8(lb/sec/ lb/sec)		
RFDAS	S/M sys A, fuel wt flow rate	0, 0.739144 lb/sec		
RFDBS	S/M sys B, fuel wt flow rate	0. 0.739144 lb/sec		
RFDCS	S/M sys C, fuel wt flow rate	0, 0.739144 lb/sec		
RFDDS	S/M sys D, fuel wt flow rate	0, 0.739144 lb/sec		
RODAS	S/M sys A, oxid wt flow rate	0, 1.37406 lb/sec		
RODBS	S/M sys B, oxid wt flow rate	0, 1.37406 lb/sec		
RODCS	S/M sys C, oxid wt flow rate	0, 1.37406 lb/sec		
RODDS	S/M sys D, oxid wt flow rate	0, 1.37406 lb/sec		
REOT1	C/M sys A or S/M sys C EOT for pos PITCH thruster	0, 5000 sec		
REOT2	C/M sys A or S/M sys A EOT for neg PITCH thruster	0, 5000 sec		
REOT3	C/M sys B or S/M sys A EOT for pos PITCH thruster	0, 5000 sec		
REOT4	C/M sys B or S/M sys C EOT for neg PITCH thruster	0, 5000 sec		
REOT5	C/M sys A or S/M sys D EOT for pos YAW thruster	0, 5000 sec		
REOT6	C/M sys B or S/M sys B EOT for neg YAW thruster	0, 5000 sec		
REOT7	C/M sys B or S/M sys B EOT for pos YAW thruster	0, 5000 sec		
REOT8	C/M sys A or S/M sys D EOT for neg YAW thruster	0, 5000 sec		
REOT9	C/M sys A or S/M sys B EOT for pos ROLL thruster	0, 5000 sec		
REOT10	C/M sys B or S/M sys D EOT for neg ROLL thruster	0, 5000 sec		
REOT11	C/M sys B or S/M sys D EOT for pos ROLL thruster	0, 5000 sec		
REOT12	C/M sys A or S/M sys B EOT for neg ROLL thruster	0, 5000 sec		
REOT13	S/M sys A EOT for pos ROLL thruster	0, 5000 sec		
REOT14	S/M sys C EOT for neg ROLL thruster	0, 5000 sec		
REOT15	S/M sys C EOT for pos ROLL thruster	0, 5000 sec		
REOT16	S/M sys A EOT for neg ROLL thruster	0, 5000 sec		
HR1	C/M sys A or S/M sys C pos PITCH thrust ratio	0, 1		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
HR2	C/M sys A or S/M sys A neg PITCH thrust ratio	0, 1		
HR3	C/M sys B or S/M sys A pos PITCH thrust ratio	0, 1		
HR4	C/M sys B or S/M sys C neg PITCH thrust ratio	0, 1		
HR5	C/M sys A or S/M sys D pos YAW thrust ratio	0, 1		
HR6	C/M sys B or S/M sys B neg YAW thrust ratio	0, 1		
HR7	C/M sys B or S/M sys B pos YAW thrust ratio	0, 1		
HR8	C/M sys A or S/M sys D neg YAW thrust ratio	0, 1		
HR9	C/M sys A or S/M sys B pos ROLL thrust ratio	0, 1		
HR10	C/M sys B or S/M sys D neg ROLL thrust ratio	0, 1		
HR11	C/M sys B or S/M sys D pos ROLL thrust ratio	0, 1		
HR12	C/M sys A or S/M sys B neg ROLL thrust ratio	0, 1		
HR13	S/M sys A pos ROLL thrust ratio	0, 1		
HR14	S/M sys C neg ROLL thrust ratio	0, 1		
HR15	S/M sys C pos ROLL thrust ratio	0, 1		
HR16	S/M sys A neg ROLL thrust ratio	0, 1		
RZ1	C/M A or S/M C No. consec tms pos PITCH full open	0, 200000		
RZ2	C/M A or S/M A No. consec tms neg PITCH full open	0, 200000		
RZ3	C/M B or S/M A No. consec tms pos PITCH full open	0, 200000		
RZ4	C/M B or S/M C No. consec tms neg PITCH full open	0, 200000		
RZ5	C/M A or S/M D No. consec tms pos YAW full open	0, 200000		
RZ6	C/M B or S/M B No. consec tms neg YAW full open	0, 200000		
RZ7	C/M B or S/M B No. consec tms pos YAW full open	0, 200000		
RZ8	C/M A or S/M D No. consec tms neg YAW full open	0, 200000		
RZ9	C/M A or S/M B No. consec tms pos ROLL full open	0, 200000		
RZ10	C/M B or S/M D No. consec tms neg ROLL full open	0, 200000		
RZ11	C/M B or S/M D No. consec tms pos ROLL full open	0, 200000		
RZ12	C/M A or S/M B No. consec tms neg ROLL full open	0, 200000		
RZ13	S/M A No. of consec tms pos ROLL full open	0, 100000		
RZ14	S/M C No. of consec tms neg ROLL full open	0, 100000		
RZ15	S/M C No. of consec tms pos ROLL full open	0, 100000		
RZ16	S/M A No. of consec tms neg ROLL full open	0, 100000		
RFUNCT3S	See table, look up function definitions.	148.8, 280.8 sec		
RFUNCT4S	See table, look up function definitions	0.60, 1.046 sec		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RTHEAC	C/M sys A, storage tank helium temp	50, 630°R		
RTHEBC	C/M sys B, storage tank helium temp	50, 630°R		
RWHEAC	C/M sys A, storage tank helium weight	0, 0.523 lb		
RWHEBC	C/M sys B, storage tank helium weight	0, 0.523 lb		
RTFAC	C/M sys A fuel temp	50, 630°R		
RTFBC	C/M sys B fuel temp	50, 630°R		
RTOAC	C/M sys A oxid temp	50, 630°R		
RTOBC	C/M sys B oxid temp	50, 630°R		
RWHEFAC	C/M sys A fuel ullage quantity	0, 0.6337 lb		
RWHEFBC	C/M sys B fuel ullage quantity	0, 0.6337 lb		
RWHEOAC	C/M sys A oxid ullage quantity	0, 0.6360 lb		
RWHEOBC	C/M sys B oxid ullage quantity	0, 0.6360 lb		
RPHEAC	C/M sys A He reservoir press.	0, 5000 psia		
RPHEBC	C/M sys B He reservoir press.	0, 5000 psia		
RPPMNFAC	C/M sys A uncorrected reg outlet press.	289.5, 299.5 psia		
RPPMNFBC	C/M sys B uncorrected reg outlet press.	289.5, 299.5 psia		
RPMNFAC	C/M sys A reg outlet press.	0, 299.5 psia		
RPMNFBC	C/M sys B reg outlet press.	0, 299.5 psia		
RFAC	C/M sys A fuel quantity	0, 45 lb		X
RFBC	C/M sys B fuel quantity	0, 45 lb		X
ROAC	C/M sys A oxid quantity	0, 89 lb		X
ROBC	C/M sys B oxid quantity	0, 89 lb		X
RPFAC	C/M sys A fuel tank pressure	0, 450 psia		
RPFBC	C/M sys B fuel tank pressure	0, 450 psia		
RPOAC	C/M sys A oxid tank pressure	0, 450 psia		
RPOBC	C/M sys B oxid tank pressure	0, 450 psia		
RFD1TAC	C/M A mod single thruster fuel rts avail at tank	0, 0.02643 0.125 lb/sec		
RFD1TBC	C/M B mod single thruster fuel rts avail at tank	0, 0.02643 0.125 lb/sec		
ROD1TAC	C/M A mod single thruster oxid rts avail at tank	0, 0.058 0.125 lb/sec		
ROD1TBC	C/M B mod single thruster oxid rts avail at tank	0, 0.058 0.125 lb/sec		
RFDP1TAC	C/M A mod sngl thster fuel rts avail at thster	0, 0.02643 0.125 lb/sec		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RFDP1TBC	C/M B mod sngl thster fuel rts avail at thster	0, 0.02643 0.125 lb/sec		
RODP1TAC	C/M A mod sngl thster oxid rts avail at thster	0, 0.058 0.125 lb/sec		
RODP1TBC	C/M B mod sngl thster oxid rts avail at thster	0, 0.058 0.125 lb/sec		
RTBHEAC	C/M sys A, helium tank temp	50, 630°R		
RTBHEBC	C/M sys B, helium tank temp	50, 630°R		
RTDBHEAC	C/M sys A He tank temp rate	-50, 50°R/sec		
RTDBHEBC	C/M sys B He tank temp rate	-50, 50°R/sec		
RQPIHEAC	C/M sys A mod He tank heat input rates	-25, 25 lb °R/sec		
ROPIHEBC	C/M sys B mod He tank heat input rates	-25, 25 lb °R/sec		
RTDHEAC	C/M sys A reservoir He temp rates	-20, 20°R/sec		
RTDHEBC	C/M sys B reservoir He temp rates	-20, 20°R/sec		
RWDHEAC	C/M sys A He reserv He wt flow rate	-0.074, 0 lb/sec		
RWDHEBC	C/M sys B He reserv He wt flow rate	-0.074, 0 lb/sec		
RWDLERAC	C/M sys A He reserv He leakage rate	0, 0.02 lb/sec		
RWDLERBC	C/M sys B He reserv He leakage rate	0, 0.02 lb/sec		
RWDCVFAC	C/M sys A, fuel side ck vlv He wt fl rate	0, 0.027 lb/sec		
RWDCVFBC	C/M sys B, fuel side ck vlv He wt fl rate	0, 0.027 lb/sec		
RWDCVOAC	C/M sys A, oxid side ck vlv He wt fl rate	0, 0.027 lb/sec		
RWDCVOBC	C/M sys B, oxid side ck vlv He wt fl rate	0, 0.027 lb/sec		
RRHFAC	C/M sys A, fuel density	0.029, 0.04216 $lb/in.^3$		
RRHFBC	C/M sys B, fuel density	0.029, 0.04216 $lb/in.^3$		
RRHOAC	C/M sys A, oxid density	0.047, 0.07672 $lb/in.^3$		
RRHOBC	C/M sys B, oxid density	0.047, 0.07672 $lb/in.^3$		
RWDHEFAC	C/M sys A, fuel tank ullage quantity rates	-0.57671, 0.027 lb/sec		
RWDHEFBC	C/M sys B, fuel tank ullage quantity rates	-0.06855, 0.5352 lb/sec		
RWDHEOAC	C/M sys A, oxid tank ullage quantity rates	-0.66700, 0.027 lb/sec		
RWDHEOBC	C/M sys B, oxid tank ullage quantity rates	-0.1538, 0.5406 lb/sec		
RWDRVFAC	C/M sys A, fuel side rlf vlv He wt fl rate	0, 0.001 lb/sec		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RWDRVFBC	C/M sys B, fuel side rlf vlf He wt fl rate	0, 0.001 lb/sec		
RWDRVOAC	C/M sys A, oxid side rlf vlv He wt fl rate	0, 0.001 lb/sec		
RWDRVOBC	C/M sys B, oxid side rlf vlv He wt fl rate	0, 0.001 lb/sec		
RWDBPFAC	C/M sys A, fuel side bypass wt fl rate	0, 0.064449 lb/sec		
RWDBPFBC	C/M sys B, fuel side bypass wt fl rate	0, 0.064449 lb/sec		
RWDBPOAC	C/M sys A, oxid side bypass wt fl rate	0, 0.150003 lb/sec		
RWDBPOBC	C/M sys B, oxid side bypass wt fl rate	0, 0.150003 lb/sec		
RWDLEFAC	C/M sys A, fuel ullage leakage rates	0, 0.0028 lb/sec		
RWDLEFBC	C/M sys B, fuel ullage leakage rates	0, 0.0028 lb/sec		
RWDLEOAC	C/M sys A, oxid ullage leakage rates	0, 0.0028 lb/sec		
RWDLEOBC	C/M sys B, oxid ullage leakage rates	0, 0.0028 lb/sec		
RWDLER	Represents possible C/M-S/M reserv leakage	0, 0.020 lb/sec		
RWDIABFC	C/M sys A He interconnect weigh fl rates	-0.45529, 0.45530 lb/sec		
RWDIABOC	C/M sys B He interconnect weigh fl rates	-0.513548, 0.51355 lb/sec		
RTDFAC	C/M sys A fuel temp rate	-50, 15°R/sec		
RTDFBC	C/M sys B fuel temp rate	-50, 15°R		
RTDOAC	C/M sys A, oxid temp rate	-50, 15°R		
RTDOBC	C/M sys B, oxid temp rate	-50, 15°R		
RQPIFAC	C/M sys A, mod fuel heat input rates	-11.0, 11.0 lb-°R/sec		
RQPIFBC	C/M sys B, mod fuel heat input rates	-11.0, 11.0 lb-°R/sec		
RQPIOAC	C/M sys A, mod oxid heat input rates	-12.5, 12.5 lb-°R/sec		
RQPIOBC	C/M sys B, mod oxid heat input rates	-12.5, 12.5 lb-°R/sec		
RTBFAC	C/M sys A, fuel bottle temp	50, 630°R		
RTBFBC	C/M sys B, fuel bottle temp	50, 630°R		
RTBOAC	C/M sys A, oxid bottle temp	50, 630°R		
RTBOBC	C/M sys B, oxid bottle temp	50, 630°R		
RTDBFAC	C/M sys A, fuel bottle temp rate	-20, 20°R/sec		
RTDBFBC	C/M sys B, fuel bottle temp rate	-20, 20°R/sec		
RTDBOAC	C/M sys A, oxid bottle temp rate	-20.0, 20°R/sec		
RTDBOBC	C/M sys B, oxid bottle temp rate	-20,0, 20°R/sec		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RFDAC	C/M sys A fuel flow rate	-0.70, 0 lb/sec		
RFDBC	C/M sys B fuel flow rate	-0.70, 0 lb/sec		
RQDAC	C/M sys A oxid flow rate	-38.672, 0 lb/sec		
RQDBC	C/M sys B oxid flow rate	-38.672, 0 lb/sec		
RTMAXAAC	C/M sys A maximum thrust avail	0, 183 lb		
RTMAXABC	C/M sys B maximum thrust avail	0, 183 lb		
RTCC	C/M instructor control temp	490, 570°R		
RFUNCT3C	See table, look up function definition.	233.5, 270 sec		
RFUNCT4C	See table, look up function definition.	0.615, 1.024		
RFUNCT1	See table, look up function definition.	4.0, 48.5		
RFUNCT2	See table, look up function definition.	0.00010, 0.000430		
RFPASII	Corr indicator input-S/M-A, fuel qty ind	0, 70 lb		
RFPBSII	Corr indicator input-S/M-B, fuel qty ind	0, 70 lb		
RFPCSII	Corr indicator input-S/M-C, fuel qty ind	-17.5, 87.5 lb		
RFPDSII	Corr indicator input-S/M-D, fuel qty ind	-17.5, 87.5 lb		
ROPASII	Corr indicator input-S/M-A, oxid qty ind	-35.0, 173 lb		
ROPBSII	Corr indicator input-S/M-B, oxid qty ind	-35.0, 173 lb		
ROPCSII	Corr indicator input-S/M-C, oxid qty ind	0, 138 lb		
ROPDSII	Corr indicator input-S/M-D, oxid qty ind	0, 138 lb		
R801	Cren sel C/M ind/S/M prop gauge pwr, TEST sw OFF	Boolean		
RQAC	C/M A, TCA sol valves on-time parameter	0, 50 8(lb/sec)/(lb/sec)		
RQBC	C/M B, TCA sol valves on-time parameter	0, 50 8(lb/sec)/(lb/sec)		
RWDLEF	Represents possible C/M-S/M fuel ullage leakage	0, 0.0028 lb/sec		
RWDLEO	Represents possible C/M-S/M oxid ullage leakage	0, 0.0028 lb/sec		
R931	S/M sensors output zero	Boolean		
RW11	DWO to telemetry from S/M prop sys	0, 1640		
RW1	Specifies first bit in telemetry output RW11	0, 820		
RW2	Specifies second bit in telemetry output RW11	0, 410		
RW3	Specifies third bit in telemetry output RW11	0, 205		
RQFRAC	C/M sys A, oxidizer to fuel ratio	0, 100		
RQFRBC	C/M sys B, oxidizer to fuel ratio	0, 100		
RVHEFTAC	C/M sys A, fuel tank ullage volume	0, 2509 $in.^3$		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RVHEFTBC	C/M sys B, fuel tank ullage volume	0, 2509 $in.^3$		
RVHEOTAC	C/M sys A, oxid tank ullage volume	0, 2830 $in.^3$		
RVHEOTBC	C/M sys B, oxid tank ullage volume	0, 2830 $in.^3$		
RWDHEL	Variable instru controlled He leakage	0, 1.0 lb/sec		
RCGS	S/M current cons by qty gauging-last 0.2 sec	0, 4 amp		
RCPHIV	Cur cons by RCS pro and He ISO vlv-last 0.2 sec	0, 72 amp		
RTHEACII	Ind input to mtr M1A, C/M-A, He res temp	-259.7, 170.3°F		
RTHEBCII	Ind input to mtr M1A, C/M-B, He res temp	-334.7, 245.3°F		
RTMASII	Ind input to mtr M1A, S/M-A eng mnt temp	40, 101°F		
RTMBSII	Ind input to mtr M1A, S/M-B eng mnt temp	40, 101°F		
RTMCSII	Ind input to mtr M1A, S/M-C eng mnt temp	40, 101°F		
RTMDSII	Ind input to mtr M1A, S/M-D eng mnt temp	40, 101°F		
RPHEACII	Ind input to mtr M1B, C/M-A, He res press.	-1250, 6250 psia		
RPHEBCII	Ind input to mtr M1B, C/M-B, He res press.	0, 5000 psia		
RPHEASII	Ind input to mtr M1B, S/M-A, He res press.	-1250, 5780 psia		
RPHEBSII	Ind input to mtr M1B, S/M-B, He res press.	0, 4530 psia		
RPHECSII	Ind input to mtr M1B, S/M-C, He res press.	-1250, 5780 psia		
RPHEDSII	Ind input to mtr M1B, S/M-D, He res press.	0, 4530 psia		
RPFACII	Ind input to mtr M2A, C/M-A, fuel press.	0, 450 psia		
RPFBCII	Ind input to mtr M2A, C/M-B, fuel press.	-100, 550 psia		
RPOACII	Ind input to mtr M2B, C/M-A oxid press.	-100, 550 psia		
RPOBCII	Ind input to mtr M2B, C/M-B oxid press.	0, 450 psia		
RPMASII	Ind input to mtr M2B, S/M-A reg press.	0, 240 psia		
RPMBSII	Ind input to mtr M2B, S/M-B reg press.	-100, 340 psia		
RPMCSII	Ind input to mtr M2B, S/M-C reg press.	0, 240 psia		
RPMDSII	Ind input to mtr M2B, S/M-D reg press.	-100, 340 psia		
RFASII	Indicator input-S/M sys A, fuel quantity	0, 70 lb		
RFBSII	Indicator input-S/M sys B, fuel quantity	0, 70 lb		
RFCSII	Indicator input-S/M sys C, fuel quantity	-17.5, 87.5 lb		
RFDSII	Indicator input-S/M sys D, fuel quantity	-17.5, 87.5 lb		
ROASII	Indicator input-S/M sys A, oxid quantity	-35.0, 173 lb		
ROBSII	Indicator input-S/M sys B, oxid quantity	-35.0, 173 lb		
ROCSII	Indicator input-S/M sys C, oxid quantity	0, 138 lb		
RODSII	Indicator input-S/M sys D, oxid quantity	0, 138 lb		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
REPS	Inst control fractional sensor error	-1.0, 1.0 lb		
RTGT	Time since S/M prop gauging test sw ON	0, 4000000 sec		
RTAS	Time since crew selection of S/M-A display qty	0, 4000000 sec		
RTBS	Time since crew selection of S/M-B display qty	0, 4000000 sec		
RTCS	Time since crew selection of S/M-C display qty	0, 4000000 sec		
RTDS	Time since crew selection of S/M-D display qty	0, 4000000 sec		
RTPS	Time since S/M prop gauging pwr sw ON	0, 4000000 sec		
RTSEL	Instr sel readout for mtr M1-A	-334.7, 246°F		
RPSELA	Instr sel readout for mtr M1-B	-1250, 6250 psia		
RPSELB	Instr sel readout for mtr M2-A	-100, 550 psia		
RPSELC	Instr sel readout for mtr M2-B	-100, 450 psia		
RFSEL	Instr sel readout for fuel qty gauge	-17.5, 87.5 lb		
ROSEL	Instr sel readout for oxid qty gauge	-35.0, 173.0 lb		
RPSMTEL	Output to tel of S/M prop quantity	-35.0, 173.0 lb		
RFASTEL	S/M sys A fuel qty outputted to telem	-17.5, 87.5 lb		
RFBSTEL	S/M sys B fuel qty outputted to telem	-17.5, 87.5 lb		
RFCSTEL	S/M sys A fuel qty outputted to telem	-17.5, 87.5 lb		
RFDSTEL	S/M sys D fuel qty outputted to telem	-17.5, 87.5 lb		
ROASTEL	S/M sys A, oxid qty outputted to telem	-35.0, 173 lb		
ROBSTEL	S/M sys B, oxid qty outputted to telem	-35.0, 173 lb		
ROCSTEL	S/M sys C, oxid qty outputted to telem	-35.0, 173 lb		
RODSTEL	S/M sys D, oxid qty outputted to telem	-35.0, 173 lb		
RTTEL	Time since tel starts to monitor prop qty	0, 81 sec		
MR101	Analog failure to temp sensor measuring RTHEBC	Malfunction		
MR102	Analog failure to press sensor measuring RPHEAC	Malfunction		
MR105	Analog failure to press sensor measuring RPFBC	Malfunction		
MR106	Analog failure to press sensor measuring RPOAC	Malfunction		
MR110	Incr changes in C/M cont temp; rt_{cc}-530 pos	Malfunction		
MR111	Qty/rt_{cc}-530/increased by incr of 10°R	Malfunction		
MR112	Qty/rt_{cc}-530/ increased by incr of 15°R	Malfunction		
MR113	Qty/rt_{cc}-530 /increased by incr of 15°R	Malfunction		
MR116	C/M sys A He isol vlvs failed closed	Malfunction		
MR117	C/M sys B He isol vlvs failed closed	Malfunction		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MR120	C/M sys A He isol vlvs failed open	Malfunction		
MR121	C/M sys B He isol vlvs failed open	Malfunction		
MR125	C/M A one of five press. reg failed full open	Malfunction		
MR126	C/M B one of five press. reg failed full open	Malfunction		
MR127	He leak defined by MR330-MR333 pertain to C/M A	Malfunction		
MR130	He leak defined by MR330-MR333 pertain to C/M B	Malfunction		
MR140	C/M A fuel isol vlv is failed closed	Malfunction		
MR141	C/M sys B, fuel iso vlv failed closed	Malfunction		
MR142	C/M sys A, fuel iso vlv failed open	Malfunction		
MR143	C/M sys B, fuel iso vlv failed open	Malfunction		
MR144	C/M sys A, oxid iso vlv failed closed	Malfunction		
MR145	C/M sys B, oxid iso vlv failed closed	Malfunction		
MR146	C/M sys A, oxid iso vlv failed open	Malfunction		
MR147	C/M sys B, oxid iso vlv failed open	Malfunction		
MR151	Press indicator mtr M2-A failed, reads min	Malfunction		
MR152	C/M sys A, He iso vlv TB flag failed up	Malfunction		
MR153	C/M sys A, He iso vlv TB flag failed down	Malfunction		
MR154	C/M sys B, He iso vlv TB flag failed up	Malfunction		
MR155	C/M sys B, He iso vlv TB flag failed down	Malfunction		
MR156	C/M sys A prop iso vlv TB flag failed up	Malfunction		
MR157	C/M sys A prop iso vlv TB flag failed down	Malfunction		
MR160	C/M sys B prop iso vlv TB flag failed up	Malfunction		
MR161	C/M sys B prop iso vlv TB flag failed down	Malfunction		
MR001	Applic S/M PR1 He iso vlv TB flag failed up	Malfunction		
MR002	Applic S/M PR1 He iso vlv TB flag failed down	Malfunction		
MR003	Applic S/M sec He iso vlv TB flag failed up	Malfunction		
MR004	Applic S/M sec He iso vlv TB flag failed down	Malfunction		
MR005	Applic S/M prop iso vlv TB flag failed up	Malfunction		
MR006	Applic S/M prop iso vlv TB flag failed down	Malfunction		
MR0011	Failure defined by MR001-MR006 pertain to sys A	Malfunction		
MR012	Failure defined by MR001-MR006 pertain to sys B	Malfunction		
MR013	Failure defined by MR001-MR006 pertain to sys C	Malfunction		
MR014	Failure defined by MR001-MR006 pertain to sys D	Malfunction		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MR200	S/M fuel qty indicator remains frozen	Malfunction		
MR201	S/M oxid qty indicator remains frozen	Malfunction		
MR202	S/M sys A, fuel isol vlv failed open	Malfunction		
MR203	S/M sys B, fuel isol vlv failed open	Malfunction		
MR204	S/M sys C, fuel isol vlv failed open	Malfunction		
MR205	S/M sys D, fuel isol vlv failed open	Malfunction		
MR206	Analog failure to press. sensor measuring RPHEAS	Malfunction		
MR207	He leak defined by MR330-MR335 pertain S/M sys A	Malfunction		
MR210	Analog failure to press. sensor measuring RPHECS	Malfunction		
MR211	He leak defined by MR335 pertain S/M sys B	Malfunction		
MR212	He leak defined by MR335 pertain S/M sys C	Malfunction		
MR213	Analog failure to press. sensor measuring RPMBS	Malfunction		
MR214	He leak defined by MR330-MR335 pertain S/M D	Malfunction		
MR215	Analog failure to press. sensor measuring RPMDS	Malfunction		
MR220	Analog failure to qty sensor measuring RFCS	Malfunction		
MR221	Analog failure to qty sensor measuring RFDS	Malfunction		
MR223	Analog failure to qty sensor measuring ROAS	Malfunction		
MR224	Analog failure to qty sensor measuring ROBS	Malfunction		
MR225	Fuel qty ind is failed and is blank	Malfunction		
MR226	Oxid qty ind is failed and is blank	Malfunction		
MR230	Incr chngs in S/M cont temp; rt_{c_s} -530 pos	Malfunction		
MR231	Quant $/rt_{c_s}$ -530/incr by incr of 10°R	Malfunction		
MR232	Quant $/rt_{c_s}$ -530/incr by incr of 20°R	Malfunction		
MR233	S/M sys A He iso vlv failed open	Malfunction		
MR234	S/M sys B He iso vlv failed open	Malfunction		
MR235	S/M sys C He iso vlv failed open	Malfunction		
MR236	S/M sys D He iso vlv failed open	Malfunction		
MR237	S/M sys A He iso vlv failed closed	Malfunction		
MR240	S/M sys B He iso vlv failed closed	Malfunction		
MR241	S/M sys C He iso vlv failed closed	Malfunction		
MR242	S/M sys D He iso vlv failed closed	Malfunction		
MR243	S/M press. reg failure is present	Malfunction		
MR244	S/M press. reg failure pertains to PR1 branch	Malfunction		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MR245	S/M press. reg failure is in full open pos	Malfunction		
MR246	S/M press. reg failure applies to sys A	Malfunction		
MR247	S/M press. reg failure applies to sys B	Malfunction		
MR250	S/M press. reg failure applies to sys C	Malfunction		
MR251	S/M press. reg failure applies to sys D	Malfunction		
MR253	S/M sys A, fuel iso vlv failed closed	Malfunction		
MR254	S/M sys B, fuel iso vlv failed closed	Malfunction		
MR255	S/M sys C, fuel iso vlv failed closed	Malfunction		
MR256	S/M sys D, fuel iso vlv failed closed	Malfunction		
MR257	S/M sys A, oxid iso vlv failed closed	Malfunction		
MR260	S/M sys B, oxid iso vlv failed closed	Malfunction		
MR261	C/M sys C, oxid iso valve failed closed	Malfunction		
MR262	C/M sys D, oxid iso valve failed closed	Malfunction		
MR263	C/M sys A, oxid iso valve failed open	Malfunction		
MR264	C/M sys B, oxid iso valve failed open	Malfunction		
MR265	C/M sys C, oxid iso valve failed open	Malfunction		
MR266	C/M sys D, oxid iso valve failed open	Malfunction		
MR313	Error in C/M-S/M sensor causes output to be large	Malfunction		
MR314	Absol value of C/M-S/M incr sensor error 1/7 max	Malfunction		
MR315	Absol value of C/M-S/M incr sensor error 2/7 max	Malfunction		
MR316	Absol value of C/M-S/M incr sensor error 4/7 max	Malfunction		
MR320	C/M-S/M temp ind meter M1-A is failed	Malfunction		
MR321	C/M-S/M press. ind A, meter M1-B is failed	Malfunction		
MR323	C/M-S/M press. ind C, meter M2-B is failed	Malfunction		
MR324	Incr He leakage rate 1/7 max leakage rate	Malfunction		
MR330	Incr He leakage rate 2/7 max leakage rate	Malfunction		
MR331	Incr He leakage rate 4/7 max leakage rate	Malfunction		
MR332		Malfunction		
MR333		Malfunction		
MR334		Malfunction		
MR335		Malfunction		
R798	C/M sys A, res press. greater than, eql to 400 psia	Boolean		
R799	C/M sys B, res press. greater than, eql to 400 psia	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RWDCVLAC	C/M sys A, max check valve flow rate	0, 0.027		
RWDCVLBC	C/M sys B, max check valve flow rate	0, 0.027		
R719	C/M sys A fuel tank relief valve open	Boolean		
R720	C/M sys B fuel tank relief valve open	Boolean		
R721	C/M sys A oxid tank relief valve open	Boolean		
R722	C/M sys B oxid tank relief valve open	Boolean		
R727	C/M sys A fl depl and ox depl or intrc opn descr	Boolean		
R728	C/M sys B fl depl and ox depl or intrc opn descr	Boolean		
R729	C/M sys A all time subs to He free path discrete	Boolean		
R730	C/M sys B all time subs to He free path discrete	Boolean		
R731	C/M sys A all time prior to He free path discrete	Boolean		
R732	C/M sys B all time prior to He free path discrete	Boolean		
R733	C/M sys A He path exists no flow thru ck vlv discr	Boolean		
R734	C/M sys B He path exists no flow thru ck vlv discr	Boolean		
R739	C/M sys A, He sol shutoff valves open	Boolean		
R741	C/M sys B, He sol shutoff valves open	Boolean		
R743	C/M sys A fuel iso sol valve open	Boolean		
R744	C/M sys A oxid iso sol valve open	Boolean		
R745	C/M sys B fuel iso sol valve open	Boolean		
R746	C/M sys B oxid iso sol valve open	Boolean		
R764	C/M sys A no free helium path	Boolean		
R765	C/M sys B no free helium path	Boolean		
R770	C/M sys A He reservoir low press. discrete	Boolean		
R771	C/M sys B He reservoir low press. discrete	Boolean		
R772	C/M sys A fuel quantity depleted discrete	Boolean		
R773	C/M sys A oxid quantity depleted discrete	Boolean		
R774	C/M sys B fuel quantity depleted discrete	Boolean		
R775	C/M sys B oxid quantity depleted discrete	Boolean		
R776	VHEFAC greater than or equal to VHEFBC	Boolean		
R777	VHEOAC greater than or equal to VHEOBC	Boolean		
R778	C/M sys A fuel press. grtr than or eq to 5 psia	Boolean		
R779	C/M sys B fuel press. grtr than or eq to 5 psia	Boolean		
R780	C/M sys A oxid press. grtr than or eq to 5 psia	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R781	C/M sys B oxid press. grtr than or eq to 5 psia	Boolean		
R782	C/M A FU depl either FU B depl or FU interc clos	Boolean		
R783	C/M A OX depl either OX B deplor or OX interc clos	Boolean		
R784	C/M B FU depl either FU B depl or FU interc clos	Boolean		
R785	C/M B OX depl either OX B depl or OX interc clos	Boolean		
R786	C/M A fuel press. grtr than or eq to 120 psia	Boolean		
R787	C/M B fuel press. grtr than or eq to 120 psia	Boolean		
R788	C/M A oxid press. grtr than or eq to 120 psia	Boolean		
R789	C/M B oxid press. grtr than or eq to 120 psia	Boolean		
R790	C/M A fuel press grtr than or eq to 240 psia	Boolean		
R791	C/M B fuel press grtr than or eq to 240 psia	Boolean		
R792	C/M A oxid press grtr than or eq to 240 psia	Boolean		
R793	C/M B oxid press grtr than or eq to 240 psia	Boolean		
R794	All time subs to bursting of C/M-A FU burst disc	Boolean		
R795	All time subs to bursting of C/M-B FU burst disc	Boolean		
R796	All time subs to bursting of C/M-A OX burst disc	Boolean		
R797	All time subs to bursting of C/M-B OX burst disc	Boolean		
R800	S/M gauge sys pwr sw on test sw off discrete	Boolean		
R803	S/M sys A prop quantity unbalance discrete	Boolean		
R806	S/M sys B prop quantity unbalance discrete	Boolean		
R809	S/M sys C prop quantity unbalance discrete	Boolean		
R812	S/M sys D prop quantity unbalance discrete	Boolean		
R813	S/M sys A primary He sol valve open	Boolean		
R814	S/M sys A redundant He sol valve open	Boolean		
R815	S/M sys B primary He sol valve open	Boolean		
R816	S/M sys B redundant He sol valve open	Boolean		
R817	S/M sys C primary He sol valve open	Boolean		
R818	S/M sys C redundant He sol valve open	Boolean		
R819	S/M sys D primary He sol valve open	Boolean		
R820	S/M sys D redundant He sol valve open	Boolean		
R821	S/M sys A fuel isolator valve open	Boolean		
R822	S/M sys A, oxid isolation valve open	Boolean		
R823	S/M sys B, fuel isolation valve open	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R824	S/M sys B, oxid isolation valve open	Boolean		
R825	S/M sys C, fuel isolation valve open	Boolean		
R826	S/M sys C, oxid isolation valve open	Boolean		
R827	S/M sys D, fuel isolation valve open	Boolean		
R828	S/M sys D, oxid isolation valve open	Boolean		
R829	S/M sys A, fuel tank relief valve open	Boolean		
R830	S/M sys B, fuel tank relief valve open	Boolean		
R831	S/M sys C, fuel tank relief valve open	Boolean		
R832	S/M sys D, fuel tank relief valve open	Boolean		
R833	S/M sys A, oxid tank relief valve open	Boolean		
R834	S/M sys B, oxid tank relief valve open	Boolean		
R835	S/M sys C, oxid tank relief valve open	Boolean		
R836	S/M sys D, oxid tank relief valve open	Boolean		
R837	S/M sys A, fuel quantity depleted discrete	Boolean		
R838	S/M sys A, oxid quantity depleted discrete	Boolean		
R839	S/M sys B, fuel quantity depleted discrete	Boolean		
R840	S/M sys B, oxid quantity depleted discrete	Boolean		
R841	S/M sys C, fuel quantity depleted discrete	Boolean		
R842	S/M sys C, oxid quantity depleted discrete	Boolean		
R843	S/M sys D, fuel quantity depleted discrete	Boolean		
R844	S/M sys D, oxid quantity depleted discrete	Boolean		
R845	S/M sys A, reg weight flow discrete	Boolean		
R846	S/M sys B, reg weight flow rate discrete	Boolean		
R847	S/M sys C, reg weight flow rate discrete	Boolean		
R848	S/M sys D, reg weight flow rate discrete	Boolean		
R849	Prop qty spec by R860, R850, R853 pertain to FU	Boolean		
R850	S/M sys A, TLM is monitoring prop quantity	Boolean		
R851	S/M sys B, TLM is monitoring prop quantity	Boolean		
R852	S/M sys C, TLM is monitoring prop quantity	Boolean		
R853	S/M sys D, TLM is monitoring prop quantity	Boolean		
R854	S/M 10-sec since prop gauging sw pos ON	Boolean		
R855	10-sec since crew selection of S/M RCS A	Boolean		
R856	10-sec since crew selection of S/M RCS B	Boolean		
R857	10-sec since crew selection of S/M RCS C	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R858	10-sec since crew selection of S/M RCS D	Boolean		
R859	120 sec since S/M prop gauging sw is pos ON	Boolean		
R860	TLM is monitoring S/M prop quantity	Boolean		
R861	S/M sys A no free He path	Boolean		
R862	S/M sys B no free He path	Boolean		
R863	S/M sys C no free He path	Boolean		
R864	S/M sys D no free He path	Boolean		
R915	S/M-C or C/M-A pos pitch thrust ratio discrete	Boolean		
R916	S/M-A or C/M-A neg pitch thrust ratio discrete	Boolean		
R917	S/M-A or C/M-B pos pitch thrust ratio discrete	Boolean		
R918	S/M-C or C/M-B neg pitch thrust ratio discrete	Boolean		
R919	S/M-D or C/M-A pos yaw thrust ratio discrete	Boolean		
R920	S/M-B or C/M-B, neg yaw thrust ratio discrete	Boolean		
R921	S/M-B or C/M-B, pos yaw thrust ratio discrete	Boolean		
R922	S/M-D or C/M-A, neg yaw thrust ratio discrete	Boolean		
R923	S/M-B or C/M-A, pos roll thrust ratio discrete	Boolean		
R924	S/M-D or C/M-B, neg roll thrust ratio discrete	Boolean		
R925	S/M-D or C/M-B, pos roll thrust ratio discrete	Boolean		
R926	S/M-B or C/M-A, neg roll thrust ratio discrete	Boolean		
R927	S/M-A pos roll thrust ratio discrete	Boolean		
R928	S/M-C neg roll thrust ratio discrete	Boolean		
R929	S/M-C pos roll thrust ratio discrete	Boolean		
R930	S/M-A neg roll thrust ratio discrete	Boolean		
R881	S/M-A fuel press. less than ox press.	Boolean		
R882	S/M-B fuel press. less than ox press.	Boolean		
R883	S/M-C fuel press. less than ox press.	Boolean		
R884	S/M-D fuel press. less than ox press.	Boolean		
R885	40 sec since TLM starts to monitor S/M prop qty	Boolean		
R886	10 sec since TLM starts to monitor S/M prop qty	Boolean		
R887	30 sec since TLM starts to monitor S/M prop qty	Boolean		
R888	50 sec since TLM starts to monitor S/M prop qty	Boolean		
R889	70 sec since TLM starts to monitor S/M prop qty	Boolean		
R893	Determine second bit of TLM word coding	Boolean		
R894	Power is available to S/M prop gauging sys	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R895	S/M-A He reservoir low press. discrete	Boolean		
R896	S/M-B He reservoir low press. discrete	Boolean		
R897	S/M sys C, He reservoir low press. discrete	Boolean		
R898	S/M sys D, He reservoir low press. discrete	Boolean		
R899	Determines first bit of tel word coding	Boolean		
R900	Instructor is depressing selector indicator	Boolean		
R901	Crew meters are not reading S/M sys A, B, C, or D	Boolean		
R903	RCS indicator sel S/M sys with a sensor error	Boolean		
R911	Pwr avail to oper He, prop iso vlv and TB flags	Boolean		
D530	C/M RCS sys A helium press. squibs fire	Boolean		
D531	C/M RCS sys B helium press. squibs fire	Boolean		
D532	C/M RCS sys A oxidizer dump squib fire	Boolean		
D533	C/M RCS sys B oxidizer dump squib fire	Boolean		
D534	C/M RCS oxid and oxid side He intrc sqbs fire	Boolean		
D535	C/M RCS fuel and fuel side He intrc sqbs fire	Boolean		
D536	C/M RCS sys A fuel, oxid byp squibs fire	Boolean		
D537	C/M RCS sys B fuel, oxid byp squibs fire	Boolean		
D538	C/M-S/M RCS transfer mtr sw A	Boolean		
D539	C/M-S/M RCS transfer mtr sw B	Boolean		
D540	C/M RCS sys A fuel dump activate signal	Boolean		
D541	C/M RCS sys B fuel dump activate signal	Boolean		
D542	C/M RCS sys A oxid iso solenoid off	Boolean		
D543	C/M RCS sys B oxid iso solenoid off	Boolean		
D550	C/M-S/M phys sep and umbilical destruct	Boolean		
C200	Pwr avail from bus A	Boolean		
C201	Pwr avail from bus B	Boolean		
C261	Pwr avail to RCS sensors	Boolean		
C542	Circuit bkr A to RCS prop iso vlv is closed	Boolean		
C526	Circuit bkr B to RCS prop iso vlv is closed	Boolean		
C541	Circuit bkr A to S/M prop gauging sys is clos	Boolean		
C525	Circuit bkr B to S/M prop gauging sys is clos	Boolean		
R950	Mark signal changed from off to on	Boolean		
R949	Mark signal in present	Boolean		
R933	Displayed nav time is grtr than zero	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R934	Man mode mk occurs, but no time-reset or mk rel	Boolean		
R932	Internal nav clock is running	Boolean		
RTINT	Internal nav clock time	0, 1000 sec		
RT1	Stored nav mark time No. 1	0, 10000 sec		
RT2	Stored nav mark time No. 2	0, 10000 sec		
RT3	Stored nav mark time No. 3	0, 10000 sec		
R936	Stored nav mark time No. 1 less than 10,000	Boolean		
R937	Stored nav mark time No. 2 less than 10,000	Boolean		
R938	Stored nav mark time No. 3 less than 10,000	Boolean		
R939	Nav mark time No. 1, 2, or 3 less than 10,000	Boolean		
R940	Nav mark time No. 1 less than nav mk time No. 2	Boolean		
R941	Nav mark time No. 1 less than nav mk time No. 3	Boolean		
R942	Nav mark time No. 2 less than nav mk time No. 3	Boolean		
RT4	Represents lowest of nav mk times No. 1, 2, and 3	0, 1000 sec		
RRCST	Displayed nav sighting time	0, 1000 sec		
RT5	Time since nav mk time No. 1 initially displayed	0, 10 sec		
RT6	Time since nav mk time No. 2 initially displayed	0, 10 sec		
RT7	Time since nav mk time No. 3 initially displayed	0, 10 sec		
R946	RT5 greater than or equal to 3	Boolean		
R947	RT6 greater than or equal to 3	Boolean		
R948	RT7 greater than or equal to 3	Boolean		
R943	RT5 clock is running	Boolean		
R944	RT6 clock is running	Boolean		
R945	RT7 clock is running	Boolean		
R951	Displayed nav prop usage grtr than 0	Boolean		
R935	Man mode mk occurs, but no prop-reset or mk rec	Boolean		
R952	Internal prop. used is increasing	Boolean		
RRCSFD	RCS prop. flow rate	0, 85 lb/sec		
RFINT	Internal prop. used	0, 1000 lb		
RF1	Stored prop. usage No. 1	0, 10000 lb		
RF2	Stored prop. usage No. 2	0, 10000 lb		
RF3	Stored prop. usage No. 3	0, 10000 lb		
R953	RF1 less than 10,000	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R954	RF2 less than 10,000	Boolean		
R955	RF3 less than 10,000	Boolean		
R956	RF1 or RF2 or RF3 less than 10,000	Boolean		
R957	RF1 less than RF2	Boolean		
R958	RF1 less than RF3	Boolean		
R959	RF2 less than RF3	Boolean		
RF4	Represents the lowest of RF1, RF2, or RF3	0, 1000 lb		
RRCSF	Displayed nav prop usage	0, 1000 lb		
RT8	Time since RF1 initially displayed	0, 10 sec		
RT9	Time since RF2 initially displayed	0, 10 sec		
RT10	Time since RF3 initially displayed	0, 10 sec		
R960	RT8 grtr than or equal to 3			
R961	RT9 grtr than or equal to 3	Boolean		
R962	RT10 grtr than or equal to 3	Boolean		
R963	RT8 clock is running	Boolean		
R964	RT9 clock is running	Boolean		
R965	RT10 clock is running	Boolean		
R890	S/M sys A fuel tank press. greatr than 5 psia	Boolean		
R802	S/M sys B fuel tank press. greatr than 5 psia	Boolean		
R804	S/M sys C fuel tank press. greatr than 5 psia	Boolean		
R805	S/M sys D fuel tank press. greatr than 5 psia	Boolean		
R807	S/M sys A ox tank press. greatr than 5 psia	Boolean		
R808	S/M sys B ox tank press. greatr than 5 psia	Boolean		
R810	S/M sys C ox tank press. greatr than 5 psia	Boolean		
R811	S/M sys D ox tank press. greatr than 5 psia	Boolean		
R966	S/M TB indicators freeze discrete	Boolean		
R970	S/M sys A prop qty update discrete	Boolean		
R971	S/M sys B prop qty update discrete	Boolean		
R972	S/M sys C prop qty update discrete	Boolean		
R973	S/M sys D prop qty update discrete	Boolean		
R5C41	Current consumed by circuit breaker C541	0, 4 amps		
R5C25	Current consumed by circuit breaker C525	0, 4 amps		
R5C42	Current consumed by circuit breaker C542	0, 72 amps		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
R5C26	Current consumed by circuit breaker C526	0, 72 amps		
R870	S/M quad A thermal control switch, 1 = closed	Boolean		
R871	S/M quad B thermal control sw, 1 = closed	Boolean		
R872	S/M quad C thermal control sw, 1 = closed	Boolean		
R873	S/M quad D thermal control sw, 1 = closed	Boolean		
R312	IOS G&N panel fuel readout—G&N program by-pass 1 = override	Boolean		
R5C90	S/M quad A current used by heater	0, 1 amp		
R5C76	S/M quad B current used by heater	0, 1 amp		
R5C77	S/M quad C current used by heater	0, 1 amp		
R5C78	S/M quad D current used by heater	0, 1 amp		
R989	S/M PQGS timing discrete - T<60 sec and pwr ON	Boolean		
R887	PQGS power sw ON and power avail discrete	Boolean		
R849	PQGS power switch ON time discrete ≤ 20 sec	Boolean		
R850	PQGS power switch ON time discrete ≥ 60 sec	Boolean		
R851	PQGS power switch ON time discrete = 60 sec	Boolean		
R800	S/M PQGS gauging test ON <50 sec discrete	Boolean		
R886	PQGS test switch time discrete< 50 sec	Boolean		
R853	S/M position is selected discrete	Boolean		
R859	S/M quantity blanking discrete	Boolean		
R899	Sensor error to selected S/M oxidizer system	Boolean		
R852	PQGS timing discrete - 20≤ time ≤ 60 sec	Boolean		
R865	S/M system A fuel flow available discrete	Boolean		
R866	S/M system B fuel flow available discrete	Boolean		
R867	S/M system C fuel flow available discrete	Boolean		
R868	S/M system D fuel flow available discrete	Boolean		
RNASI	S/M quad A I_E frame I axis normal comp of eng mounting	-1, +1		
RNASJ	S/M quad A I_E frame J axis normal comp of eng mounting	-1, +1		
RNASK	S/M quad A I_E frame K axis normal comp of eng mounting	-1, 1		
RNBSI	S/M quad B I_E frame I axis normal comp of eng mounting	-1, 1		
RNBSJ	S/M quad B I_E frame J axis normal comp of eng mounting	-1, 1		
RNBSK	S/M quad B I_E frame K axis normal comp of eng mounting	-1, 1		
RNCSI	S/M quad C I_E frame I axis normal comp of eng mounting	-1, 1		
RNCSJ	S/M quad C I_E frame J axis normal comp of eng mounting	-1, 1		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RNCSK	S/M quad C I_E frame K axis normal comp of eng mounting	-1, 1		
RNDSI	S/M quad D I_E frame I axis normal comp of eng mounting	-1, 1		
RNDSJ	S/M quad D I_E frame J axis normal comp of eng mounting	-1, 1		
RNDSK	S/M quad D I_E frame K axis normal comp of eng mounting	-1, 1		
AC21	Projection of a unit vector along Y B-frame axis on the X_1 I-frame axis	-1, +1		
AC22	Projection of a unit vector along Y B-frame axis on the Y_1 I-frame axis	-1, +1		
AC23	Projection of a unit vector along Y B-frame axis on the Z_1 I-frame axis	-1, +1		
AC31	Projection of unit vector along Z B-frame axis on the X_1 I-frame axis	-1, +1		
AC32	Projection of unit vector along Z B-frame axis on the Y_1 I-frame axis	-1, +1		
AC33	Projection of unit vector along Z B-frame axis on the Z_1 I-frame axis	-1, +1		
UXVSUN	X_{I_E} component of sun's direction from earth	-1, +1		
UYVSUN	Y_{I_E} component of sun's direction from earth	-1, +1		
UZVSUN	Z_{I_E} component of sun's direction from earth	-1, +1		
LAA	I_E frame dir cosine of vector from earth to vehicle	-1, +1		
LBB	I_E frame dir cosine of vector from earth to vehicle	-1, +1		
LCC	I_E frame dir cosine of vector from earth to vehicle	-1, +1		
RCOSSAS	Cosine of angle between unit normal vector, vehicle to sun	-1, +1		
RCOSSBS	Cos of angle between unit normal vector from vehicle to sun	-1, +1		
RCOSSCS	Cos of angle between unit normal vector from vehicle to sun	-1, +1		
RCOSSDS	Cos of angle between unit normal vector from vehicle to sun	-1, +1		
RCOSEAS	Cos of angle between unit normal vector from vehicle to sun	-1, +1		
RCOSEBS	Cos of angle between unit normal vector from vehicle to sun	-1, +1		
RCOSECS	Cos of angle between unit normal vector from vehicle to sun	-1, +1		
RCOSEDS	Cos of angle between unit normal vector from vehicle to sun	-1, +1		
RAREASAS	Eng A mounting area perpendicular to sun	0, +1 ft^2		
RAREASBS	Eng B mounting area perpendicular to sun	0, 1 ft^2		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
RAREASCS	Eng C mounting area perpendicular to sun	0, 1 ft^2		
RAREASDS	Eng D mounting area perpendicular to sun	0, 1 ft^2		
RAREAEAS	Eng A mounting area perpendicular to earth	0, 1 ft^2		
RAREAEBS	Eng B mounting area perpendicular to earth	0, 1 ft^2		
RAREAECS	Eng C mounting area perpendicular to earth	0, 1 ft^2		
RAREAEDS	Eng D mounting area perpendicular to earth	0, 1 ft^2		
LSP	Energy received by vehicle directly from sun	0, 500 Btu/hr/ft^2		
LFRE	View factor of spacecraft with respect to earth	0, 1		
LCOSSE	Cosine of reflection angle of sunlight from earth	-1, +1		
RCVQ	Specific heat of S/M jet quad metal cover	0, 0.4 Btu/lb/°F		
RALQ	Absorbtivity of quad surface	0, 1		
RESQ	Emissivity of S/M engine surface	0, 1.0		
RKHEAT	Heating rate of 30W electric quad heater	0, 150 Btu/hr		
RT_{A_1}	C/M sys A or S/M sys C pos PITCH thrust	0, 183 lb		
RT_{A_2}	C/M sys A or S/M sys A neg PITCH thrust	0, 183 lb		
RT_{A_3}	C/M sys B or S/M sys A pos PITCH thrust	0, 183 lb		
RT_{A_4}	C/M sys B or S/M sys C neg PITCH thrust	0, 183 lb		
RT_{A_5}	C/M sys A or S/M sys D pos YAW thrust	0, 183 lb		
RT_{A_6}	C/M sys B or S/M sys B neg YAW thrust	0, 183 lb		
RT_{A_7}	C/M sys B or S/M sys B pos YAW thrust	0, 183 lb		
RT_{A_8}	C/M sys A or S/M sys D neg YAW thrust	0, 183 lb		
RT_{A_9}	C/M sys A or S/M sys B pos ROLL thrust	0, 183 lb		
$RT_{A_{10}}$	C/M sys B or S/M sys D neg ROLL thrust	0, 183 lb		
$RT_{A_{11}}$	C/M sys B or S/M sys D pos ROLL thrust	0, 183 lb		
$RT_{A_{12}}$	C/M sys A or S/M sys B neg ROLL thrust	0, 183 lb		
$RT_{A_{13}}$	C/M sys A positive ROLL thrust	0, 183 lb		
$RT_{A_{14}}$	S/M sys C negative ROLL thrust	0, 183 lb		
$RT_{A_{15}}$	S/M sys C positive ROLL thrust	0, 183 lb		
$RT_{A_{16}}$	S/M sys A negative ROLL thrust	0, 183 lb		
MR015	S/M quad A He press reg No. 1 failure, slightly high	Malfunction		
MR016	S/M quad B He press reg No. 1 failure, slightly high	Malfunction		
MR017	S/M quad C He press reg No. 1 failure, slightly high	Malfunction		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MR020	S/M quad D He press reg No. 1 failure, slightly high	Malfunction		
MR021	S/M quad A He press. reg No. 2 failure, slightly high	Malfunction		
MR022	S/M quad B He press. reg No. 2 failure, slightly high	Malfunction		
MR023	S/M quad C He press. reg No. 2 failure, slightly high	Malfunction		
MR024	S/M quad D He press. reg No. 2 failure, slightly high	Malfunction		
MR025	S/M quantity sensing computer quad A fuel leg low	0, 1		
MR026	S/M quant sensing computer quad B fuel leg low	0, 1		
MR027	S/M quant sensing computer quad C fuel leg low	0, 1		
MR030	S/M quant sensing computer quad D fuel leg low	0, 1		
MR031	S/M quad A injector fuel valve fails open	0, 1		
MR032	S/M quad B injector fuel valve fails open	0, 1		
MR033	S/M quad C injector fuel valve fails open	0, 1		
MR034	S/M quad D injector fuel valve fails open	0, 1		
MR035	S/M sys A fuel qty sensor fails - at minimum	0, 1		
MR036	S/M sys B fuel qty sensor fails - at minimum	0, 1		
MR037	S/M sys C fuel qty sensor fails - at minimum	0, 1		
MR040	S/M sys D fuel qty sensor fails - at minimum	0, 1		
MR041	S/M sys A fuel qty sensor fails at maximum	0, 1		
MR042	S/M sys B fuel qty sensor fails at maximum	0, 1		
MR043	S/M sys C fuel qty sensor fails at maximum	0, 1		
RTDMAS	S/M quad A eng mount rate of temp change	-1.0, +1.0°R/sec		
RTDMBS	S/M quad B eng mount rate of temp change	-1.0, 1.0°R/sec		
RTDMCS	S/M quad C eng mount rate of temp change	-1.0, 1.0°R/sec		
RTDMDS	S/M quad D eng mount rate of temp change	-1.0, 1.0°R/sec		
C590	RCS heater sys A MN B C/B	0, 1		
C576	RCS heater sys B MN A C/B	0, 1		
C577	RCS heater sys C MN B C/B	0, 1		
C578	RCS heater sys D MN A C/B	0, 1		
TPHETA	Helium pressure, tank A scaled for T/M	0, +5000 psia	251(A)/251	
TPHETB	Helium pressure, tank B scaled for T/M	0, +5000 psia	253(A)/253	
TPFTA	Fuel pressure, tank A scaled for T/M	0, +300 psia	152(A)/152	
TPFTB	Fuel pressure, tank B scaled for T/M	0, +300 psia	159(a)/159	

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TPOXTA	Oxidizer press., tank A scaled for T/M	0, +400 psia	124(A)/124	
TPOXTB	Oxidizer press., tank B scaled for T/M	0, +400 psia	126(A)/126	
TSPHETA	Helium press., tank A scaled for T/M	0, +5000 psia	259(A)/259	
TSPHETB	Helium press., tank B scaled for T/M	0, +5000 psia	261(A)/261	
TSPHETC	Helium press., tank C scaled for T/M	0, +5000 psia	263(A)/263	
TSPHETD	Helium press., tank D scaled for T/M	0, +5000 psia	266(A)/266	
TTEPA1	Engine package temp A1 scaled for T/M	0, +300°F	265(A)/265	
TTEPB1	Engine package temp B1 scaled for T/M	0, +300°F	232(A)/232	
TTEPC1	Engine package temp C1 scaled for T/M	0, +300°F	268(A)/268	
TTEPD1	Engine package temp D1 scaled for T/M	0, +300°F	270(A)/270	
TPHEMA	A He manifold pressure scaled for T/M	0, +400 psia	127(A)/127	
TPHEMB	B He manifold pressure scaled for T/M	0, +400 psia	133(A)/133	
TPHEMC	C He mainfold pressure scaled for T/M	0, +400 psia	134(A)/134	
TPHEMD	D He manifold pressure scaled for T/M	0, +400 psia	136(A)/136	
TTHETA	Helium temp, tank A scaled for T/M	0, +300°F	222(A)/222	
TTHETB	Helium temp, tank B scaled for T/M	0, +300°F	225(A)/225	
TQFTA	Fuel quantity, tanks A, B, C, D scaled for T/M	0, +70 lb	GP12-1 thru 8 (D)/1 thru 8	
TQOXTA	Oxidizer quantity, tanks A, B, C, D scaled for T/M	0, +140 lb	GP13-1 thru 8 (D)/1 thru 8	
RGAMAF	Fluctuating fuel flow output	0, 120 lb		
RTCM	Time since selection of a C/M position	0, 1×10^6 sec		
R983	C/M selection time ≥ 10 sec discrete	Boolean		
R981	Time since start of prop. output to T/M ≤ 10 sec	Boolean		
R982	Time since start of prop. output to T/M ≤ 30 sec	Boolean		
R984	Time since start of prop. output to T/M ≤ 24 sec	Boolean		
R985	Time since start of prop. output to T/M ≤ 34 sec	Boolean		
R986	Status of 3rd bit to T/M - S/M fuel qty	Boolean		
R987	Status of 1st bit to T/M - if time > 10 sec	Boolean		
R988	Status of 1st bit to T/M - if 10 ≤ time ≤ 20 sec	Boolean		
R989	Status of 1st bit to T/M - if R988 or time > 30 sec	Boolean		
R990	T/M time discrete - 20 ≤ time < 60 sec	Boolean		
R991	T/M time > 10 sec in any selected position	Boolean		
H066	Minimum impulse switch and pwr logic	Boolean		

Table 6-40. C/M and S/M Reaction Control System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
D859	RCS auto ox dump relay ~ syst A	Boolean		
D860	RCS auto ox dump relay – syst B	Boolean		
D570	Deadface squibs fired	Boolean		
RTM1	C/M-A or S/M-C sys +PITCH max thrust avail	0, 163 lb		
RTM2	C/M-A or S/M-A sys -PITCH max thrust avail	0, 163 lb		
RTM3	C/M-B or S/M-A sys +PITCH max thrust avail	0, 163 lb		
RTM4	C/M-B or S/M-C sys -PITCH max thrust avail	0, 163 lb		
RTM5	C/M-A or S/M-D sys +YAW max thrust avail	0, 163 lb		
RTM6	C/M-B or S/M-B sys -YAW max thrust avail	0, 163 lb		
RTM7	C/M-B or S/M-B sys +YAW max thrust avail	0, 163 lb		
RTM8	C/M-A or S/M-D sys -YAW max thrust avail	0, 163 lb		
RTM9	C/M-A or S/M-B sys +ROLL max thrust avail	0, 163 lb		
RTM10	C/M-B or S/M-D sys -ROLL max thrust avail	0, 163 lb		
RTM11	C/M-B or S/M-D sys +ROLL max thrust avail	0, 163 lb		
RTM12	C/M-A or S/M-B sys -ROLL max thrust avail	0, 163 lb		
RTM13	S/M system A positive ROLL max thrust avail	0, 163 lb		
RTM14	S/M system C negative ROLL max thrust avail	0, 163 lb		
RTM15	S/M system C positive ROLL max thrust avail	0, 163 lb		
RTM16	S/M system A negative ROLL max thrust avail	0, 163 lb		

Table 6-41. Service Propulsion System—Thermodynamics

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PDETP2	Time per system iteration	Const 0.20 secs		
PTT	Temperature of helium tank	400, 600°R		
PK1	Weight of He tank x specific heat of tank	Const 601700 in.-lb/°R		
PTHE1	Helium temperature	300, 600°R		X
PWHE1	Weight of helium in helium tank	0.0, 110 lb		X
PPHE1	Helium tank pressure	0.0, 4500 $lb/in.^2$		
PK2	Gas constant ÷ volume of He tank	Const 0.0690896 $1/in.^2-°R$		
PK3	Helium compressibility constant No. 1	Const 0.00000005928 $in.^2/lb-°R$		
PK4	Helium compressibility constant No. 2	Const 0.00006661 $lb/in.^2$		
PWDHEL1	Helium tank leakage mass flow rate	.0, .03 lb/sec		
PK5	Helium tank leakage flow constant	Const .00001666 $in.^2-°R$ 1/2/sec		
MP001	Helium tank leakage malfunction No. 1	Boolean		
MP002	Helium tank leakage malfunction No. 2	Boolean		
MP003	Helium tank leakage malfunction No. 3	Boolean		
PWDHE1	Mass flow rate of helium out of He tank	0.0, 0.85 lb/sec		
PQHE1	Heat transfer into helium	0.0, 100000 in.-lb/sec		
PK6	He tank to He heat transfer constant	Const 86.0965 $in.^3/sec$		
PQHT	Heat transfer from surroundings to He tank	.0, 100000 in.-lb/sec		
PK7	He tank heat transfer constant No. 1	Const 0.000002 in.-lb/sec-$°R^4$		
PTDHE1	Temperature flow rate into He in He tank	-10, +10°R/sec		
PK8	He tank volume	Const 67.047 $in.^3$		
PK9	Const volume specific heat of He	Const 6952.0 $in.^3$/°R		
PK91T	He tank heat transfer const No. 2	Const 157440 in.-lb/sec		
PDETP2N	Non-frozen delta T	Const 0.20 sec		
P210	He isolation valve A position	Boolean		
P009	C/M valve A switch ON	Boolean		
P010	C/M valve A switch AUTO	Boolean		

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H998	SPS engine ON signal No. 1	Boolean		
H999	SPS engine ON signal No. 2	Boolean		
C549	SPS He sov. MN A circuit breaker	Boolean		
C200	+ main dc bus A	Boolean		
MP004	Iso valve A freeze malfunction	Boolean		
P212	He iso valve B position	Boolean		
P011	C/M valve B switch ON	Boolean		
P012	C/M valve B switch AUTO	Boolean		
C533	SPS He sov MN B circuit breaker	Boolean		
C201	+ main dc bus B	Boolean		
MP005	Iso valve B freeze malfunction	Malfunction		
P001	Valve A TLKBK position	Boolean		
MP012	Fail TLKBK to zero	Malfunction		
P002	Valve B TLKBK position	Boolean		
MP013	He iso valve B TLKBK fails to zero	Malfunction		
P211	Reg branch A status	Boolean		
MP006	Reg A fail closed	Malfunction		
P213	Reg branch B status	Boolean		
MP010	He reg B fails closed	Malfunction		
P214	One reg operating norm status	Boolean		
MP007	He reg A fails open	Malfunction		
MP011	He reg B fails open	Boolean		
P215	Both reg oper norm with flow	Boolean		
P216	One or both reg oper with pri open	Boolean		
P240	No flow thru reg status	Boolean		
P5C33	He valve A current drain	0, 2 amps		
PK12	Current req of solenoid valve	Const 2 lb/sec		
P5C49	He valve B current drain	0, 2 amps		
PVDUF	Rate of change of ullage volume	0, 2000 $in.^3/sec$		
PK27	Fuel density	Const 0.03254 $lb/in.^3$		
PVUF	Volume of fuel ullage	0, 10000000 $in.^3$		X
PVDUO	Rate of change of oxid ullage volume	0, 4000 $in.^3/sec$		

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PK41	Oxid density	Const 0.0517 lb/in.^{3}		
PVUO	Volume of oxid ullage	0, 10000000 in.^{3}		X
PPR	Regulator output pressure	0, 300 lb/in.^{2}		
PWDR	Reg mass flow rate	0, 0.85 lb/sec		
PWDRO	Mass flow rate of He thru reg into oxid tk.	0, 0.5 lb/sec		
PWDRF	Mass flow rate of He thru reg into fuel tank	0, 0.5 lb/sec		
PS	Reg. equ loop counter	0, 1 lb/sec		
PDPHEIR	Upstream pressure effecting reg press.	0, 4000 lb/in.^{2}		
PK20	Min upstream press. effecting reg output press.	Const 700 lb/in.^{2}		
PK13	Norm reg lockup pressure	Const 189.500 lb/ in.^{2}		
PK14	Slope of upstream press. on norm reg.	Const 0.001		
PK15	Norm flow rate vs press. slope	Const 15 sec/in.^{2}		
PK16	2-norm flow rate vs press. slope	Const 7.5 sec/in.^{2}		
PK17	Prl fail lockup pressure	Const 192 lb/in.^{2}		
PK18	Slope of upstream press. prl failed	Const 0.0015		
PK19	Prl fail flow rate vs press. slope	Const 30 sec/in.^{2}		
PK21	Reg minimum press const	Const 182.5 lb/in.^{2}		
PWDRO1	Reg oxid system flow rate No. 1	0, 0.5 lb/sec		
PK23	CV threshold pressure	Const 2.5 lb/in.^{2}		
PK24	Flow const for fuel CV and HX	Const 740.0 sec/ lb$^{1/2}$-in.		
PWDRF1	Reg fuel sys flow rate No. 1	0, 0.5 lb/sec		
PK22	Flow const for oxidizer CV and HX	Const 470.0 sec/ lb$^{1/2}$-in.		
PPUFT	Reg test pressure No. 1	0, 250.0 lb/in.^{2}		
PPUOT	Reg test pressure No. 2	0, 250.0 lb/in.^{2}		
PWUFT	Reg test weight No. 1	0, 75 lb		
PWUOT	Reg test weight No. 2	0, 75 lb		
PK49	Gas constant for He	Const 4632.0 in./°R		
PWDRF2	Reg fuel system flow rate No. 2	0, 0.5 lb/sec		
PWDRO2	Reg oxid system flow rate No. 2	0, 0.5 lb/sec		
P248	Reg system flow rate control Boolean	Boolean		
P247	Oxid system flow rate control Boolean	Boolean		

Table 6-41. Service Propulsion System — Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PWDRFB	Partial fuel system flow rate No. 1	0, 0.5 lb/sec		
PWDROB	Partial oxid system flow rate No. 1	0, 0.5 lb/sec		
PWDRFA	Partial fuel sys. flow rate No. 1 storage	0, 0.5 lb/sec		
PWDROA	Partial oxid sys. flow rate No. 1 storage	0, 0.5 lb/sec		
P241	Fuel relief valve Boolean No. 1	Boolean		
PK38	Relief valve const No. 1	Const 240 $lb/in.^2$		
P242	Fuel relief valve Boolean No. 2	Boolean		
PK39	RV reseat constant	Const 212.0 $lb/in.^2$		
P243	Fuel RV open Boolean	Boolean		
PWDRVF	Mass flow rate thru fuel RV	0, 0.05 lb/sec		
PK40	RV slope	Const 0.0017857 $in.^2/sec$		
P244	Oxid relief valve Boolean No. 1	Boolean		
P245	Oxid relief valve Boolean No. 2	Boolean		
P246	Oxid relief valve open Boolean	Boolean		
PWDRVO	Mass flow rate thru oxid RV	0, 0.01 lb/sec		
PTHXO	Temp of He out of exchanger into oxid tank	400, 600°R		
PK51	Heat exchanger (oxid) const	Const 0.16037 lb/sec		
PK92	Fuel and oxid temperature	Const 529.69		
PK36	Natural log base	Const 2.71828		
PTHXF	Temp of He out of exchanger into fuel tank	400, 600°R		
PK37	Heat exchanger (fuel) const			
PWDVFL	Mass flow rate of ullage out of fuel tank	0, 0.05 lb/sec		
PK34	Fuel ullage leakage const	Const 0.000003 $in.^2/sec$		
MP030	Fuel sys He leakage area 1/7 of max	Boolean		
MP031	Fuel sys He leakage area 2/7 of max	Boolean		
MP032	Fuel sys He leakage area 4/7 of max	Boolean		
PWDUF	Flow rate of He into fuel ullage	-0.05, +0.5 lb/sec		
PWUF	Weight of He in fuel ullage	0, 50.0 lb		X
PTDUF	Fuel ullage temperature rate	-100, +100°R/sec		
PK31	Const. pressure spec heat of helium	Const 11584.0 in./°R		

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PK32	Heat transfer coeff between fuel and ullage	Const 500.0 in.-lb/sec-°R		
PK88	PK32 x PK92 or PK45 x PK92	Const 2648.45 lb-in./sec		
PTUF	Temp of fuel ullage	400, 800°R		
PPUF	Fuel ullage pressure	0, 250.0 lb/in.^{2}		
PWDUOL	Oxidizer ullage mass ullage rate	0, 0.10 lb/sec		
PK48	Oxid ullage leakage constant	Const 0.000006 in.^{2}/sec		
MP022	Oxid system He leakage area 1/7 of max	Boolean		
MP023	Oxid system He leakage area 2/7 of max	Boolean		
MP024	Oxid system He leakage area 4/7 of max	Boolean		
PWDUO	Flow rate of He into oxid ullage	0.05, 0.5 lb/sec		
PWUO	Wt of He in oxid ullage	0, 75 lb		X
PTDUO	Oxid ullage temp rate	-100, +100°R/sec		
PK45	Heat transfer coeff between oxid and ullage	Const 500.0 in.-lb/sec-°R		
PTUO	Temp of oxid ullage	400, 800°R		X
PPUO1	Oxidizer ullage He partial press.	0, 250 lb/in.^{2}		
PPOV	Oxid ullage oxid vapor partial press.	0, 20 lb/in.^{2}		
PK35	Const vol spec heat of fuel vapor	Const 150.7902 in.-°R		
PK28	Fuel vapor press. curve intersection	Const 0.624897 lb/in.^{2}		
PK29	Fuel vapor press. slope	Const 0.00065 lb/in.^{2}-°R		
PPUO	Oxidizer ullage press.	0, 250 lb/in.^{2}		
PWDFL	Fuel leakage rate	0, 0.252 lb/sec		
PK54	Prop leak constant	Const 0.0001 in.^{2}/sec		
MP033	Fuel sys fuel leakage area 1/7 of max	Malfunction		
MP034	Fuel sys fuel leakage area 2/7 of max	Malfunction		
MP035	Fuel sys fuel leakage area 4/7 of max	Malfunction		
PWDF	Fuel flow rate	-2, 80 lb/sec		
PWF	Weight of fuel	0, 16000 lb		X
PWF1	Weight of fuel in sump tank	0, 8000 lb		
PK53	Max weight of fuel in sump tank	Const 7919.6 lb		

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PWF2	Weight of fuel in storage tank	0, 8000 lb		
PRF	Fuel flow resistance	0.14, 0.15 sec^2/ lb-$in.^2$		
PK51T	Fuel flow resistance No. 1	Const 0.14949 sec^2/lb-$in.^2$		
PK52	Fuel flow resistance No. 2	Const 0.14209 sec^2/lb-$in.^2$		
PWDOL	Oxid leakage rate	0, 0.252 lb/sec		
MP025	Oxid sys oxid leakage area 1/7 of max	Malfunction		
MP026	Oxid sys oxid leakage area 2/7 of max	Malfunction		
MP027	Oxid sys oxid leakage area 4/7 of max	Malfunction		
PWDO	Oxid flow rate	-2, 60 lb/sec		
PWO	Weight of oxid	0, 32000 lb		X
PWO1	Weight of oxid in sump tank	0, 16000 lb		
PK60	Max weight of oxid in sump tank	Const 15634 lb		
PWO2	Weight of oxid in storage tank	0, 16000 lb		
PK56	Oxid tank const	Const 705770 in.		
PK57	Specific heat of oxid	Const 3867 in./°R		
PRO	Oxid flow resistance	0.03, 0.10 sec^2/ lb-$in.^2$		
PK58	Oxid flow const No. 1	Const 0.0327 sec^2/ lb-$in.^2$		
PK59	Oxid flow const	Const 0.032 sec^2/ lb-$in.^2$		
P200	Injector prevalve No. 5 Boolean	Boolean		
MP113	Injector prevalve No. 5 sticks closed	Malfunction		
P201	Injector prevalve No. 6 Boolean	Boolean		
MP114	Injector prevalve No. 6 sticks closed	Malfunction		
P202	Pilot valve No. 1 Boolean	Boolean		
MP036	Engine injector valve actuator No. 1 sticks	Malfunction		
P203	Pilot valve No. 2 Boolean	Boolean		
MP037	Eng inj valve actuator No. 2 sticks	Malfunction		
P204	Pilot valve No. 3 Boolean	Boolean		
MP040	Eng inj valve actuator No. 3 sticks	Malfunction		
P205	Pilot valve No. 4 Boolean	Boolean		
MP041	Eng inj valve actuator No. 4 sticks	Malfunction		

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
P206	Engine commanded on Boolean	Boolean		
PTE1	Engine ON time	0, 700 sec		
PTE2	Engine OFF time	0, 2,000,000 sec		
P199	Engine control Boolean No. 1	Boolean		
P209	Engine normal thrust Boolean	Boolean		
PK91	Engine ON time delay	Const 0.39 sec		
P208	Eng transient Boolean No. 2	Boolean		
PK62	Eng transient const No. 1	Const 1.59 sec		
PK98	Eng transient const No. 2	Const 0.59 sec		
P207	Engine transient Boolean No. 1	Boolean		
PWDFE	Mass flow rate of fuel into engine	lb/sec		
PK63	Fuel transient flow rate into eng.	Const 11.25 lb/sec		
PWDOE	Mass flow rate of oxid into engine	0, 80 lb/sec		
PK64	Oxid transient flow rate into eng.	Const 22.5 lb/sec		
PPC1	Eng chamber press. last computed value	0, 185 $lb/in.^2$		
PPC	Eng chamber pressure	0, 185 $lb/in.^2$		
PK69	Chamber press. const No. 1	Const 103 $lb/in.^2$		
PK68	Chamber press. const No. 2	Const 3720 $lb/in.^2$		
PK99	Chamber press. const No. 3	Const 125 $lb/in.^2$		
PMR	Propellant mixture ratio	0, 3		
PCSTAR	Engine C star characteristic	6300, 7000 $sec/in.^2$		
PK65	C star const No. 1	Const 6374 $sec/in.^2$		
PK66	C star const No. 2	Const 380 $sec/in.^2$		
PISP	Specific impulse	200, 400 sec		
PK71	ISP const No. 1	Const 309.7 sec		
PK72	ISP const No. 2	Const 53 sec		
PK73	ISP const No. 3	Const 400 sec		
PT1	SPS engine thrust last computed value No. 1	0, 25000 sec		
PT2	SPS engine thrust last computed value No. 2	0, 25000 sec		
PT	SPS engine thrust	0, 25000 lb		
PK67	Eng thrust transient const No. 1	Const 0.075 lb		
PK70	Eng thrust transient const No. 2	Const 0.05 lb		
PPEFS	Press. main vlv eng fuel sensor output	0, 250 $lb/in.^2$		

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PK75	Fuel eng sensor flow const	Const 0.123		
C261	SPS and RCS sensor pwr available	Boolean		
PPEOS	Press. main vlv eng oxid sensor output	0, 250 lb/in.^{2}		
PK74	Oxid eng sensor flow const	Const 0.0293		
PPHES	Helium tank press. sensor output	0, 5000 lb/in.^{2}		
MP053	Sensor fail to zero	Malfunction		
PPHE	Me, N_2A or N_2B tank press. C/M, readout	0, 5000 lb/in.^{2}		
MP014	He bottle press. readout ind fails	Malfunction		
PTHE	He tank He temp readout to C/M	0, 300		
PK76	°R to °F conv factor and 100° offset	Const 359.69		
MP015	He bottle temp readout ind fails	Malfunction		
PPOS	Oxid ullage press. sensor output	0, 250 lb/in.^{2}		
PK77	Heat exchanger flow const - oxid	Const 346.819 sec^2/in.^{2}-lb		
MP054	Oxid ullage press. sensor output to 0	Malfunction		
PPO	Oxid ullage press. C/M readout	0, 10 volts		
PK78	SPS ind const No. 1	Const 0.016 volts-in.^{2}/lb		
PK79	SPS ind const No. 2	Const 150 lb/in.^{2}		
PK80	SPS const No. 3	Const 136 $\frac{\text{volts-in.}^2}{\text{lb}}$		
PK81	SPS const No. 4	Const 18 volts		
PK82	SPS const No. 5	Const 200 lb/in.^{2}		
PK83	SPS const No. 6	Const 6 volts		
MP020	Oxid ullage press. sensor output	Malfunction		
PPFS	Fuel ullage press. sensor output	0, 250 lb/in.^{2}		
PK89	Heat exchanger flow const fuel	Const 540.5 sec^2/in.^{2}/lbs		
PPF	Fuel ullage press. C/M readout	0, 10 volts		
MP021	Fuel ullage press. ind fails	Malfunction		
PPEO	Press. main vlv oxid C/M readout	0, 10 volts		
MP056	Oxid main vlv eng ind fails	Malfunction		
PPEF	Press. main vlv eng fuel C/M readout	0, 10 volts		
MP055	Press. main vlv eng ind fails	Malfunction		
PAP1S	Eng inj vlv No. 1 pos TLM	0, 90 deg		
T999	+5 volts available when = 1	Boolean		

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PK87	Inj vlv readout const	Const 90		
PAP2S	Eng inj vlv No. 2 pos TLM	0, 90 deg		
PAP3S	Eng inj vlv No. 3 pos TLM	0, 90 deg		
PAP4S	Eng inj vlv No. 4 pos TLM	0, 90 deg		
PAP1	Eng inj vlv No. 1 pos ind C/M	0, 10 volts		
PK84	Inj vlv ind const No. 1	Const volts		
MP042	Eng inj vlv actd. No. 1 pos ind fails	Malfunction		
PAP2	Eng inj vlv No. 2 position ind C/M	0, 10 volts		
MP043	Eng inj vlv actr No. 3 pos ind fails	Malfunction		
PAP3	Eng inj vlv 3 pos C/M	0, 10 volts		
MP044	Eng inj vlv actr No. 3 pos ind fails	Malfunction		
PK85	Eng inj vlv const No. 2	Const 3.3333 volts		
PAP4	Eng inj vlv No. 4 pos ind C/M	0, 10 volts		
MP045	Eng inj vlv actr No. 3 posn. ind fails	Malfunction		
PK86	Eng inj vlv const No. 2	Const 6.6666 volts		
PTOS	Eng outer skin temp No. 1	0, 500°F		
PK93	Eng outer skin temp No. 1 const No. 1	Const 0.01		
PK94	Eng outer skin temp No. 1 const No. 2	Const 70°F		
PK95	Eng outer skin temp No. 1 const No. 3	Const 0.1		
PK96	Eng outer skin temp No. 1 const No. 4	Const 500°F		
PK97	Eng outer skin temp No. 1 const No. 5	Const 300°F		
MP071	Engine temperature malfunction	Malfunction		
PROPU	Propellant utilization valve flow resist	0.00200, 0.007 $sec^2/lb\text{-}in.^2$		
PPCW	Engine chamber pressure readout	0.0, 185.0 $lb/in.^2$		
PK2T	Engine chamber press. readout limit	Const 185.0 $lb/in.^2$		
MP115	Prl and sec regulators branch A fail open	Malfunction		
PR101	Regulator overpressure due to MP115	Const 241 psia		
PDC1S	Combustion instability selected delay Δt	0, 600 sec		
PDC1A	Combustion instability actual delay	0, 600 sec		
MP116	Combustion instability $\Delta t = 0$	Malfunction		
MP117	Combustion instability $\Delta t = 1/7$ max	Malfunction		
MP118	Combustion instability $\Delta t = 2/7$ max	Malfunction		
MP119	Combustion instability $\Delta t = 4/7$ max	Malfunction		

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PK102	Combustion instability 1/7 max delay	Const 85.7 sec		
P251	Combustion unstable	Boolean		
P252	FCSM relay latched	Boolean		
P253	FCSM relay unlatched	Boolean		
P037	FCSM pwr sw ON	Boolean		
P038	FCSM pwr sw RESET	Boolean		
PTN	Nitrogen temp	300, 600°R		
PWND	Mass of nitrogen discharged per actuator	0.0039, 0.0078 lb		
PK103	Nitrogen reg press./gas constant	Const 2.35 lb-°R		
PWNA	Mass of nitrogen in N_2A tank	0, 0.653 lb		
PWNB	Mass of nitrogen in N_2B tank	0, 0.653 lb		
PPNA	N_2A tank press.	0, 2830 psia		
P254	N_2A tank min press. for regulation	Boolean		
PPNB	N_2B tank press.	0, 2830 psia		
P255	N_2B tank min press. for regulation	Boolean		
PK105	Gas constant/nitrogen tank vol	Const 7.23 $1/in.^2$-°R		
PK106	Min nitrogen tank press. for regulation	Const 630 psia		
P249	C/M inject prevalve A sw ON	Boolean		
P250	C/M inject prevalve B sw ON	Boolean		
P039	FCSM override sw in override	Boolean		
PPNAS	N_2A tank press. sensor output	0, 5000 psia		
PPNBS	N_2B tank press. sensor output	0, 5000 psia		
P030	C/M tank press. readout sw He	Boolean		
P030	C/M tank press. readout sw N_2B	Boolean		
PPHEIOS	He, N_2A or N_2B tank press. IOS readout	0, 5000 psia		
P032	IOS tank press. readout sw He	Boolean		
P033	IOS tank press. readout sw N_2A	Boolean		
P036	IOS tank press. readout sw N_2B	Boolean		
TPHE	He press. tank	0, 5000 psia	111(A)/111	
TTHE	He temp tank	-100, +200°F	142(A)/142	
PK107	°R to °F conversion	Const 460		
TPOX	Press. oxidizer tanks	0, 300 psia	113(A)/113	

Table 6-41. Service Propulsion System—Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TPFUEL	Press. fuel tanks	0, 300 psia	115(A)/115	
TPMVEOX	Press. main vlv eng oxidizer in	0, 300 psia	121(A)/121	
TPMVEF	Press. main vlv eng fuel in	0, 300 psia	122(A)/122	
TTCSK1	Temp chamber outer skin No. 1	0, 500°F	254(A)/254	
TPOXV1	Position fuel/oxidizer vlv No. 1	0, 90 deg	148(A)/148	
TPFOXV2	Position fuel/oxidizer vlv No. 2	0, 90 deg	150(A)/150	
TPFOXV3	Position fuel/oxidizer vlv No. 3	0, 90 deg	155(A)/155	
TPFOXV4	Position fuel/oxidizer vlv No. 4	0, 90 deg	156(A)/156	
TTNSK1	Temp nozzle outer skin No. 1	-250, +2500°F	255(A)/255	
PK100	Nozzle outer skin temp constant	Const 1500°F		
TPEVASA	Eng valve act sys tank press. PR1	0, 3000 psia	248(A)/248	
TPEVASB	Eng valve act sys tank press. sec	0, 3000 psia	170(A)/170	
TPWOXT1	Qty SPS oxidizer tank No. 1	0, 16000 lb	258(A)/258	
TPWOXT2	Qty SPS oxidizer tank No. 2	0, 16000 lb	260(A)/260	
TPWFT1	Qty SPS fuel tank No. 1	0, 8000 lb	262(A)/262	
TPWFT2	Qty SPS fuel tank No. 2	0, 8000 lb	264(A)/264	
TPPEC	Press. engine chamber	0, 150 psia	15(A)/15	
PTNOS	Engine nozzle outer skin temp	-250, 2500°F		

Table 6-42. Service Propulsion System—Propellant Utilization

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
P100	PU system time delay Boolean	Boolean		
PK1A	PU system time delay	Const 4.5 sec		
PTE1	Engine ON time	sec		
P101	PU sys ac bus No. 1 pwr avail from sw	Boolean		
C430	Gauging ac bus 1 C15A6CB20	Boolean		
C687	Switch position for ac bus No. 1 (25S51)	Boolean		
P102	PU sys ac bus No. 2 pwr avail from sw	Boolean		
C431	C/B ac bus 2 C15A6CB19	Boolean		
C688	Switch position for ac bus No. 2 (25S51)	Boolean		
P103	PU sys dc bus A pwr avail at panel	Boolean		
C548	DC C/B main A C15A6CB22	Boolean		
P104	PU sys dc bus B pwr avail at panel	Boolean		
C532	DC circuit breaker B	Boolean		
P105	PU sys test power available	Boolean		
P106	PU sys in operating mode	Boolean		
P110	PU system in operating mode for 4.5 sec	Boolean		
P111	PU system in test mode	Boolean		
P019	Test switch in test No. 1 pos	Boolean		
P020	Test switch in test No. 2 pos	Boolean		
P4C30	PU system current drawn off ac bus No. 1	0, 1.1 amps		
PK2A	PU system ac current draw	Const 1.1 amps		
P4C31	PU sys current drawn from ac bus No. 2	0, 1.1 amps		
P5C48	PU sys current drawn from dc bus No. 2	0, 12 amps		
PK3A	PU dc load const No. 1	Const 12 amps		
PK4A	PU dc load const No. 2	Const 6 amps		
P5C32	PU sys current drawn from dc bus B	0, 12 amps		
P107	PU sys displays and CWS operational	Boolean		
P108	PU sys sensors operational	Boolean		
P109	Sec cont on valve (PU) frozen	Boolean		
MP047	PU sec valve cont frozen	Malfunction		
P015	PU valve sw in SEC pos	Boolean		

Table 6-42. Service Propulsion System—Propellant Utilization (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
P112	PU valve cont sys freeze	Boolean		
MP046	PR1 cont on valve frozen	Malfunction		
P113	PU valve sw in effective INCR pos	Boolean		
P013	PU valve sw in INCR pos	Boolean		
P114	PU valve sw in effective DECR pos	Boolean		
P014	PU valve sw in DCR pos	Boolean		
P115	PU valve sw in effective normal pos	Boolean		
PROPU	Effective flow resistance of PU valve	0.00120, 0.00642 $sec^2/lb\text{-}in^2$.		
PK5A	DECR pu valve const	Const 0.000184 $sec^2/lb\text{-}in.^2$		
PK6A	INCR pu valve const	Const -0.000162 $sec^2/lb\text{-}in.^2$		
PK8	INCR pu valve flow resistance	Const 0.00120 $sec^2/lb\text{-}in.^2$		
PK9A	DECR pu valve flow resistance	Const 0.00642 $sec^2/lb\text{-}in.^2$		
PK10A	NORM pu valve flow resistance	Const 0.00366 $sec^2/lb\text{-}in.^2$		
PPVTB	PU valve pos to indicator	-10.00, 10.00 volts		
MP050	PU valve pos ind failure No. 1	Malfunction		
MP051	PU valve pos ind failure No. 2	Malfunction		
MP052	PU valve pos ind failure No. 3	Malfunction		
PK11A	ACT sys zero output volt = DECR pos	Const -9.51465 volts		
PK12A	IND max orifice ind = incr	Const 3.4011 volts		
PK13A	PU valve pos const No. 1	Const 5.97612 volts		
PK14A	PU valve pos const No. 2	Const -2.110.69 $volt/lb\text{-}in.^2/sec^2$		
PK15A	PU valve pos const No. 3	Const 8.54893 volts		
PK16A	PU valve pos const No. 4	Const -2813.64 $volt/lb\text{-}in.^2/sec^2$		
P034	IOS pu vlv INCR pos tlkbk repeater			

Table 6-42. Service Propulsion System—Propellant Utilization (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PK17A	PU valve safety factor for IOS ind	Const 0.04 volts		
P035	IOS ind of PU vlv pos ind decr pos	Boolean		
PPUFW1	PR1 sys sump fuel tank sensor output	0, 8000 lb		
PK21A	PU PR1 fuel test flow per 0.2 sec	Const 1.5 lb/0.2 sec		
MP100	Sensor fails to max	Malfunction		
PK22A	Max quantity in fuel sump tank	Const 7500 lb		
PWF1	Wt of fuel in sump tank	Lb		
PPUFW2	PR1 sys storage fuel tank sensor	0, 8000 lb		
MP057	Sensor fails to zero	Malfunction		
PWF2	Wt of fuel in storage tank	Lb		
PPUOW1	PR1 sys sump oxid tank sensor output	0, 16,000 lb		
PK23A	PU prl oxid test flow per 0.2 sec	Const 3 lb/0.2 sec		
MP060	Sensor fails to zero	Malfunction		
PWO1	Wt of oxid in sump tank	Lb		
PPUOW2	PR1 sys storage oxid tank sensor output	0, 16,000 lb		
MP072	Sensor fails to max	Malfunction		
PK25A	Oxid tank max qty	Const 15,000 lb		
PWO2	Vvt of oxid in storage tank	Lb		
PPUPSF	Aux sensing sys fuel pt sensor valve	0, 16,000 lb		
PK27A	Fuel pt sensor constant No. 1	Const 14,500.4 lb		
PK28A	Fuel pt sensor const. No. 2	Const 14,305.2 lb		
PK29A	Fuel pt sensor const No. 3	Const 14,155.3 lb		
PK30A	Fuel pt sensor const No. 4	Const 13,410.3 lb		
PK31A	Fuel pt sensor const No. 5	Const 12, 210.0 lb		
PK32A	Fuel pt sensor const No. 6	Const 10,285.6		
PK33A	Fuel pt sensor const No. 7	Const 8335.0		
PK34A	Fuel pt sensor const No. 8	Const 6810.4		
PK35A	Fuel pt sensor const No. 9	Const 5610.5		
PK36A	Fuel pt sensor const No. 10	Const 4860.2		
PK37A	Fuel pt sensor const No. 11	Const 3660.3		
PK38A	Fuel pt sensor const No. 12	Const 1693.4		
PK39A	Fuel pt sensor const No. 13	Const 1276.2		
PK40A	Fuel pt sensor const No. 14	Const 928.2		

Table 6-42. Service Propulsion System—Propellant Utilization (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
PK41A	Fuel pt sensor const No. 15	Const 345.5		
PWF	Wt of fuel	Lb		
P122	Aux sense sys fuel pt sensor update	Boolean		
PPUPSFL	Last computed valve of PPUPSF	0, 16, 000 lb		
PPUFWA	Aux sensing sys fuel weight output	0, 16, 000 lb		
MP073	Point sensor system fail	Malfunction		
MP061	PU aux sys fuel norm flow rate integ fail	Malfunction		
PK42A	PU aux fuel norm flow per 0.2 sec	Const -4.45 lb/ 0.2 sec		
PK43A	PU aux fuel test flow per 0.2 sec	Const 3 lb/0.2 sec		
PWO	Wt of oxid	Lb		
PPUPSO	Aux sense sys oxid pt sensor value	0, 32, 000 lb		
PK44A	Oxid pt sensor const No. 1	Const 29000.7 lb		
PK45A	Oxid pt sensor const No. 2	Const 28610.7 lb		
PK46A	Oxid pt sensor const No. 3	Const 28310.7 lb		
PK47A	Oxid pt sensor const No. 4	Const 26820.6 lb		
PK48A	Oxid pt sensor const No. 5	Const 24420.1 lb		
PK49A	Oxid pt sensor const No. 6	Const 20570.7 lb		
PK50A	Oxid pt sensor const No. 7	Const 16670.2 lb		
PK51A	Oxid pt sensor const No. 8	Const 13620.7 lb		
PK52A	Oxid pt sensor const No. 9	Const 11220.7 lb		
PK53A	Oxid pt sensor const No. 10	Const 9720.7 lb		
PK54A	Oxid pt sensor const No. 11	Const 7320.7 lb		
PK55A	Oxid pt sensor const No. 12	Const 3387.0		
PK56A	Oxid pt sensor const No. 13	Const 2551.9 lb		
PK57A	Oxid pt sensor const No. 14	Const 1856.0 lb		
PK58A	Oxid pt sensor const No. 15	Const 701.6 lb		
P123	Aux sensing sys oxid pt sensor update	Boolean		
PPUPSOL	Last computed value of PPUPSO	0, 32, 000 lb		
PPUOWA	Aux sensing sys fuel weight output	0, 32, 000 lb		
MP062	PU aux sensing sys oxid pt sensor sys fail (no change)	Malfunction		
MP074	PU aux sensing sys oxid norm flow fail	Malfunction		
PK59A	PU aux oxid norm flow per 0.2 sec	Const -8.9 lb/ 0.2 sec		
PK60A	PU aux oxid test flow rate per 0.2 sec	Const 6 lb/0.2 sec		

Table 6-42. Service Propulsion System—Propellant Utilization (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
P120	PR1 sensing sys drives indicator			
P017	PU sensor sw on primary			
P018	PU sensor sw on auxiliary			
PWFTM1	TLM output for fuel weight No. 1	0, 16,000 lb		
PWFTM2	TLM output for fuel wt No. 2	0, 16,000 lb		
PWOTM1	TLM output for oxid wt No. 1	0, 32,000 lb		
PWOTM2	TLM output for oxid wt No. 2	0, 32,000 lb		
PFQCM	Output voltage to fuel qty display C/M	-10,000 10.00 volts		
MP063	PU fuel qty ind fails to max	Malfunction		
MP064	PU fuel qty ind fails to zero	Malfunction		
PK62A	Outpuf of D/A for 0 lb prop in tanks	Const -9.98096 volts		
PR63A	Change in voltage per lb of fuel	Const 0.001265826 volts/lb		
PK64A	Output of D/A for nominal prop in tanks	Const 8.98739 volts		
POQCM	Output voltage to oxid qty display C/M	-10.00, 10.00 volts		
MP065	PU oxid qty ind fail (MAX)	Malfunction		
MP066	PU oxid qty ind fail (ZERO)	Malfunction		
PK67A	Change in voltage per lb of oxid	Const 0.000632913 volts/lb		
PPUBCM	Output voltage to unbal display C/M	-10.00, 10.00 volts		
PK70A	Change in D/A output volt per lb unbal	Const 0.01108287 volts/lb		
MP067	PU unbalance ind fail (MAX INCR)	Malfunction		
MP070	PU unbalance ind fail (MAX DECR)	Malfunction		
MP075	PU unbalance indicator failed	Malfunction		
PK71A	Ratio of ideal wt of oxid to ideal wt of fuel	Const 2		
PK73A	D/A output for 2x (fuel wt) 300 lb > oxid wt	Const +3.32486		
PK72A	D/A output for 2 x (fuel wt) 300< oxid wt	Const -3.32486		
PFQIOS	Output to the ios fuel qty. display	0, 16000 lb		
PK75A	Max fuel qty in binary	Const 15000 lb		
PK76A	Min fuel or oxid qty in binary	Const 0 lb		

Table 6-42. Service Propulsion System—Propellant Utilization (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
POQIOS	Output to the IOS oxid qty display	0, 32,000 lb		
PK77A	Max oxid qty in binary	Const 30,000 lb		
PPUBIOS	Output to PU unbal display IOS	-300, +300 lb		
PK79A	Ratio of IOS to C/M unbal voltages	Const 1.155		
P145	Boolean stating prl sens system caution/warn	Boolean		
PK81A	Percent unbal which will give an output to CWS	Const 0.02		
P146	Boolean stating aux sens sys caution/warning	Boolean		
P147	Boolean prl to aux oxid caution/warning	Boolean		
PK84A	Difference btwn prl and aux oxid sens sys	Const 300 lb		
P148	Boolean prl to aux fuel caution/warn	Boolean		
PK85A	Diff between prl and aux fuel sensing sys	Const 150 lb		
P150	PU system caution/warning	Boolean		
MP076	Ind PU sys prop unbalance	Malfunction		
MP077	Does not ind when prop unbal occurs	Malfunction		

Table 6-43. Electrical Power System — Cryogenic Storage, Oxygen

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*N913	O_2 TANK 1/SURGE TANK sw — O_2 TK 1			
*NPO1'	Indicated O_2 pressure for meter 1	0.0, 1050.0 lb/in.^{2}		
*FP03TLM	Press. of O_2 in surge tank	0.0, 1050.0 lb/in.^{2}		
*N460	Tank 1, minimum pressure limit discrete	Boolean		
*N560	Tank 2, minimum pressure limit discrete	Boolean		
*N102	Tank 1, check valve and solenoid valve open	Boolean		
*N202	Tank 2, check valve and solenoid valve open	Boolean 1050.0 lb/in.^{2}		
*NCWDO1	Tank 1, flow rate of oxygen to fuel cells	0, $16x10^{-4}$ lb/sec		
*NCWDO2	Tank 2, flow rate of oxygen to fuel cells	0, $16x10^{-4}$ lb/sec		
*NTOL	Oxygen temperature after mixing in ECS manifold	0, 600°R		
*NWDTO1	Tank 1, total flow rate of oxygen	0, 0.03 lb/sec		
*NWDTO2	Tank 2, total flow rate of oxygen	0, 0.03 lb/sec		
*NWO1	Total weight remaining in tank 1	0, 322.4 lb		
*NWO2	Total weight remaining in tank 2	0, 322.4 lb		
*NWO1R	T/M indication of weight of O_2 in tank 1	0, 322.4 lb		
*NWO2R	T/M indication of weight of O_2 in tank 2	0, 322.4 lb		
*NWO1CM	C/M indication of weight of O_2 in tank 1	0, 322.4 lb		
*NWO2CM	C/M indication of weight of O_2 in tank 2	0, 322.4 lb		
*NRHOO1	Tank 1 oxygen density	0, 76.6 lb/ft^3	X	
*NRHOO2	Tank 2 oxygen density	0, 76.6 lb/ft^3	X	
*NFUNCT4(X)	Oxygen expansion function	0, 36352.77 lb/ft^2-°R		
*NTD3	Time derivative of inner tank 1 temperature	0, 10°R/sec		
*NTD4	Time derivative of inner tank 2 temperature	0, 10°R/sec		
*NTDO1	Time derivative of tank 1 O_2 temperature	0, 10°R/sec		
*NTDO2	Time derivative of tank 2 O_2 temperature	0, 10°R/sec		
*NT3	Inner tank 1 temperature	0, 550°R		
*NT4	Inner tank 2 temperature	0, 550°R		
*NTO1	Tank 1 oxygen temperature	0, 550°R		
*NTO2	Tank 2 oxygen temperature	0, 550°R		
*NTO1R	Tank 1, oxygen temperature to T/M	0, 102°F		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-43. Electrical Power System — Cryogenic Storage, Oxygen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*NTO2R	Tank 2, oxygen temperature to T/M	0, 102°F		
*NPO1	Tank 1, oxygen pressure	0, 1050 lb/in.^{2}		
*NPO2	Tank 2, oxygen pressure	0, 1050 lb/in.^{2}		
*NPO1CM	Tank 1, oxygen pressure to C/M and IOS	0, 10 lb/in.^{2}		
*NPS1AO1	Tank 1, oxygen pressure to T/M and CWS	0, 1050 lb/in.^{2}		
*NPO2CM	Tank 2, oxygen pressure to C/M and IOS	0, 1.0 lb/in.^{2}		
*NPS1AO2	Tank 2, oxygen pressure to T/M and CWS	0, 1050 lb/in.^{2}		
*NWDLO1	Tank, 1 oxygen leakage rate	0, 0.1 lb/sec		
*NWDLO2	Tank 2, oxygen leakage rate	0, 0.1 lb/sec		
*NFUNCT5(X)	Oxygen specific heat function	0, 0.3225 Btu/ lb-°R		
*N117	Oxygen tank 1 temperature dependent Boolean	Boolean		
*N115	Oxygen tank 1 temperature switch status	Boolean		
*N215	Oxygen tank 2 temperature switch status	Boolean		
*N120	Oxygen tank 1 pressure dependent Boolean	Boolean		
*N121	Oxygen tank 1 pressure dependent Boolean	Boolean		
*N116	Oxygen tank 1 pressure switch status	Boolean		
*N220	Oxygen tank 2 pressure dependent Boolean	Boolean		
*N221	Oxygen tank 2 pressure dependent Boolean	Boolean		
*N216	Oxygen tank 2 pressure switch status	Boolean		
*N403	Oxygen tank 1 heater current available	Boolean		
*N404	Oxygen tank 2 heater current available	Boolean		
*NFWDO1	Oxygen tank 1 flow rate to ECS	0, 0.001 lb/sec		
*NFWDO2	Oxygen tank 2 flow rate to ECS	0, 0.001 lb/sec		
*C200	Power available from C/M dc bus A	Boolean		
*C201	Power available from C/M dc bus B	Boolean		
*C204	Power available from S/M ac bus A	Boolean		
*C205	Power available from S/M ac bus B	Boolean		
*C488	Circuit breaker C15A5CB5 status	Boolean		
*C514	Circuit breaker C15A5CB4 status	Boolean		
*C434	Circuit breaker C15A5CB44 status	Boolean		
*C435	Circuit breaker C15A5CB90 status	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-43. Electrical Power System — Cryogenic Storage, Oxygen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*CDCVBASM	DC voltage S/M bus A	0, 45 volts		
*CDCVBBSM	DC voltage S/M bus B	0, 45 volts		
*CDCVBACM	DC voltage C/M bus A	0, 45 volts		
*CDCVBBCM	DC voltage C/M bus B	0, 45 volts		
*CWDO	Required oxygen flow rate to fuel cells	0, 32×10^{-4} lb/sec		
*N123	NP01 ≥ relief valve crack pressure	Boolean		
*N124	NP01 ≥ relief valve reseat pressure	Boolean		
*N125	Relief valve open, O_2 tank 1	Boolean		
*NWDRO1	Relief valve flow rate	0, 0.05 lb/sec		
*N223	NP02 ≥ relief valve crack pressure	Boolean		
*N224	NP02 ≥ relief valve reseat pressure	Boolean		
*N225	Relief valve open, O_2 tank 2	Boolean		
*NWDRO2	Relief valve flow rate	0, 0.05 lb/sec		
*MN006	Tank 1 heater current sensor output is maximum	Boolean		
*MN010	Tank 1 quantity signal conditioner output is maximum	Boolean		
*MN012	Tank 1 pressure signal conditioner output is maximum	Boolean		
*MN014	Tank 2 temperature signal conditioner output is maximum	Boolean		
*MN020	Tank 1 C/M quantity meter reads zero	Boolean		
*MN022	Tank 1 C/M pressure meter reads zero	Boolean		
*MN026	Tank 1 pressure switch fails to respond to open command	Boolean		
*MN030	Tank 1 temperature switch fails to respond to open command	Boolean		
*MN040	Tank 2 heater manual power supply line is grounded	Boolean		
*MN041	Tank 1 rupture	Boolean		
*MN042	Tank 2 rupture	Boolean		
*MN043	Tank 1 relief valve fails to respond to open command	Boolean		
*MN046	Tank 1 heater auto power supply line is grounded	Boolean		
*MN063	Tank 2 pressure switch fails to respond to open command	Boolean		
*N462	Pressure leakage inhibit discrete tank 1	Boolean		
*N562	Pressure leakage inhibit discrete tank 2	Boolean		
*NFUNCT3(X)	Density, temperature relationship at P=17 ATM	0.0847, 0.3333 $ft^3/in.^2\text{-}°R$		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-43. Electrical Power System — Cryogenic Storage, Oxygen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*N461	Oxygen flow available to fuel cells discrete	Boolean		
*N103	Tank 1 ECS flow rate limit discrete	Boolean		
*N203	Tank 2 ECS flow rate limit discrete	Boolean		
*N112	Tank 1 pressure discrete	Boolean		
*N113	Tank 1 pressure discrete	Boolean		
*N114	Tank 1 pressure discrete	Boolean		
*N212	Tank 2 pressure discrete	Boolean		
*N213	Tank 2 pressure discrete	Boolean		
*N214	Tank 2 pressure discrete	Boolean		
*NPO1R	Tank 1 voltage to C/M pressure meter	0, 10 volts		
*NPO2R	Tank 2 voltage to C/M pressure meter	0, 10 volts		
*N229	DBO to trip C/M circuit breaker	Boolean		
*N105	Tank 1 heater mode switch in manual position	Boolean		
*N106	Tank 1 heater mode switch in auto position	Boolean		
*N205	Tank 2 heater mode switch in manual position	Boolean		
*N206	Tank 2 heater mode switch in auto position	Boolean		
*F093	ECS isolation valve is open	Boolean		
*FP06	ECS manifold pressure	0, 1050 $lb/in.^2$		
*NX1	Mathematical artifice for use in eq N130	-34, 0 $\frac{\#}{sec}\ ft^2$		
*NX2	Mathematical artifice for use in eq N131	-34, 0 $\frac{\#}{sec}\ ft^2$		
N101	Tank 1 fan switch in manual positions	Boolean		
N100	Tank 1 fan switch in automatic positions	Boolean		
N201	Tank 2 fan switch in manual positions	Boolean		
N200	Tank 2 fan switch in automatic positions	Boolean		
MN005	O_2 tank 1 pressure switch failure	Malfunction		
MN004	O_2 tank 2 pressure switch failure	Malfunction		
MN001	O_2 tank 2 quantity sensor failure	Malfunction		
C204	115/200 v 3Ø 400-cycle power BUS 1	Boolean		
C205	115/200 v 3Ø-400-cycle power BUS 2	Boolean		
C570	AC CB 101 is closed	Boolean		
C487	AC CB 102 is closed	Boolean		
C586	AC CB 103 is closed	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-43. Electrical Power System — Cryogenic Storage, Oxygen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C257	S/M instrumentation power available	Boolean		
N050	Tank 1 fan current available	Boolean		
N051	Tank 2 fan current available	Boolean		
NHCO1	Oxygen tank 1 heater current	0, 1 amp		
NHCO2	Oxygen tank 2 heater current	0, 1 amp		
TWO2T1	O_2 tank 1 quantity scaled for T/M	-10V = 0, +10V = +320 lb	216(A)/216	
TWO2T2	O_2 tank 2 quantity scaled for T/M	-10V = 0, +10V = +320 lb	217(A)/217	
TPO2T1	O_2 tank 1 pressure scaled for T/M	-10V = +50 +10V = +1050 psia	221(A)/221	
TPO2T2	O_2 tank 2 pressure scaled for T/M	-10V = +50, +10V = +1050 psia	223(A)/223	
TTO2T1	O_2 tank 1 temperature scaled for T/M	-10V = -325, +10V = +80°F	229(A)/229	
TTO2T2	O_2 tank 2 temperature scaled for T/M	-10V = -325, +10V = +80°F	231(A)/231	

Table 6-44. Electrical Power System — Cryogenic Storage, Hydrogen

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*N860	Tank 1, minimum pressure limit discrete	Boolean		
*N960	Tank 2, minimum pressure limit discrete	Boolean		
*N502	Tank 1, check valve and solenoid valve open	Boolean		
*N602	Tank 2, check valve and solenoid valve open	Boolean		
*NCWDH1	Tank 1, flow rate of hydrogen to fuel cells	0, $2x10^{-4}$ lb/sec		
*NCWDH2	Tank 2, flow rate of hydrogen to fuel cells	0, $2x10^{-4}$ lb sec		
*NWDTH1	Tank 1, total flow rate of hydrogen	0, $3.2x10^{-3}$ lb-sec		
*NWDTH2	Tank 2, total flow rate of hydrogen	0, $3.2x10^{-3}$ lb-sec		
*NWH1	Total weight remaining in tank 1	0, 28.7 lb		X
*NWH2	Total weight remaining in tank 1	0, 28.7 lb		X
*NWH1TM	T/M indication of weight of H_2 in tank 1	0, 28.7 lb		
*NWH2TM	T/M indication of weight of H_2 in tank 2	0, 28.7 lb		
*NWH1CM	C/M indication of weight of H_2 in tank 1	0, 28.7 lb		
*NWH2CM	C/M indication of weight of H_2 in tank 2	0, 28.7 lb		
*NRHOH1	Tank 1 hydrogen density	0, 5.0 lb/ft^3		X
*NRHOH2	Tank 2 hydrogen density	0, 5.0 lb/ft^3		X
*NFUNCT2	Hydrogen expansion function	0, 11000 $lb\text{-}ft^2/°R$		
*NTD1	Time derivative of inner tank 1 temperature	0, 10°R/sec		
*NTD2	Time derivative of inner tank 2 temperature	0, 10°R/sec		
*NTDH1	Time derivative of tank 1 H_2 temperature	0, 10°R/sec		
*MTDH2	Time derivative of tank 2 H_2 temperature	0, 10°R/sec		
*NT1	Inner tank 1 temperature	0, 550°R		
*NT2	Inner tank 2 temperature	0, 550°R		
*NTH1	Tank 1, hydrogen temperature	0, 550°R		
*NTH2	Tank 2, hydrogen temperature	0, 550°R		
*NTH1TM	Tank 1, hydrogen temperature to T/M	0, 102°F		
*NTH2TM	Tank 2, hydrogen temperature to T/M	0, 102°F		
*NPH1	Tank 1, hydrogen pressure	0, 300 $lb/in.^2$		
*NPH2	Tank 2, hydrogen pressure	0, 300 $lb/in.^2$		
*NPH1CM	Tank 1, hydrogen pressure to C/M	0, 300 $lb/in.^2$		
*NPH1TM	Tank 1, hydrogen pressure to T/M	0, 300 $lb/in.^2$		
*NPH2CM	Tank 2, hydrogen pressure to C/M	0, 300 $lb/in.^2$		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-44. Electrical Power System — Cryogenic Storage, Hydrogen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*NPH2TM	Tank 2 hydrogen pressure to T/M	0, 300 lb/in.^{2}		
*NWDLH1	Tank 1 hydrogen leakage rate	0, 1 lb/sec		
*NWDLH2	Tank 2 hydrogen leakage rate	0, 1 lb/sec		
*N517	Hydrogen tank 1 temperature dependent Boolean	Boolean		
*N515	Hydrogen tank 1 temperature switch status	Boolean		
*N615	Hydrogen tank 2 temperature switch status	Boolean		
*N520	Hydrogen tank 1 pressure dependent Boolean	Boolean		
*N521	Hydrogen tank 1 pressure dependent Boolean	Boolean		
*N516	Hydrogen tank 1 pressure switch status	Boolean		
*N620	Hydrogen tank 2 pressure dependent Boolean	Boolean		
*N621	Hydrogen tank 2 pressure dependent Boolean	Boolean		
*N616	Hydrogen tank 2 pressure switch status	Boolean		
*N811	Hydrogen tank 1 heater selector switch in MAN	Boolean		
*N911	Hydrogen tank 1 heater selector switch in AUTO	Boolean		
*N812	Hydrogen tank 2 heater selector switch in MAN	Boolean		
*N912	Hydrogen tank 2 heater selector switch in AUTO	Boolean		
*N803	Hydrogen tank 1 heater current available	Boolean		
*N804	Hydrogen tank 2 heater current available	Boolean		
*C200	Power available from C/M dc bus A	Boolean		
*C201	Power available from C/M dc bus B	Boolean		
*C204	Power available from S/M ac bus A	Boolean		
*C205	Power available from S/M ac bus B	Boolean		
*C489	Circuit breaker C15A5CB7 status	Boolean		
*C515	Circuit breaker C15A5CB6 status	Boolean		
*C434	Circuit breaker C15A5CB44 status	Boolean		
*C435	Circuit breaker C15A5CB90 status	Boolean		
*CDCVBASM	DC voltage, S/M bus A	0, 45 volts		
*CDCVBBSM	DC voltage S/M bus B	0, 45 volts		
*CDCVBACM	DC voltage C/M bus A	0, 45 volts		
*CDCVBBCM	DC voltage C/M bus B	0, 45 volts		
*CWDH	Required hydrogen flow rate to fuel cells	0, 2x10^{-4} lb/sec		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-44. Electrical Power System — Cryogenic Storage, Hydrogen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*N523	NPHL ≥ relief valve crack pressure	Boolean		
*N524	NPH1 ≥ relief valve reseat pressure	Boolean		
*N525	Relief valve open, H_2 tank 1	Boolean		
*NWDRH1	Relief valve flow rate	0, 0.02 lb/sec		
*N623	NPH2 ≥ relief valve crack pressure	Boolean		
*N624	NPH2 ≥ relief valve reseat pressure	Boolean		
*N625	Relief valve open, H_2 tank 2	Boolean		
*NWDRH2	Relief valve flow rate	0, 0.02 lb/sec		
*MN007	H_2 tank 2, heater current sensor failed off			
*MN011	H_2 tank 1, quantity signal conditioner, zero output			
*MN013	H_2 tank 1, pressure signal conditioner, zero output			
*MN015	H_2 tank 1, temperature signal conditioner, zero output			
*MN021	H_2 tank 1, quantity meter, pointer frozen			
*MN023	H_2 tank 1, pressure meter, pointer frozen			
*MN031	H_2 tank 1, temp limit switch, contacts open			
*MN052	H_2 tank , pressure switch frozen closed			
*MN053	H_2 tank 2, pressure switch frozen closed			
*MN054	H_2 tank 1, tank rupture			
*MN055	H_2 tank 2, tank rupture			
*N861	Hydrogen flow available to fuel cells discrete	Boolean		
*N862	Hydrogen leakage inhibit discrete tank 1	Boolean		
*N962	Hydrogen leakage inhibit discrete tank 2	Boolean		
*NFUNCT1	Density, temperature relationship at P=17 ATM	0, 6.0 $ft^3/in.^2 °R$		
*N500	Tank 1 fan switch in manual position	Boolean		
*N501	Tank 1 fan switch in automatic position	Boolean		
*N600	Tank 2 fan switch in manual position	Boolean		
*N601	Tank 2 fan switch in automatic position	Boolean		
*MN002	H_2 tank 2 pressure transducer failure	Malfunction		
*MN003	H_2 heater 1 switch failure	Malfunction		
*MN027	Tank 1 press. sw fails open	Malfunction		
*C585	AC CB #98 is closed	Boolean		
*C584	AC CB #99 is closed	Boolean		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-44. Electrical Power System — Cryogenic Sotrage, Hydrogen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
*C583	AC CB #100 is closed	Boolean		
*C257	S/M instrumentation power available	Boolean		
*N070	Tank 1 fan current available	Boolean		
*N071	Tank 2 fan current available	Boolean		
*NHCH1	Hydrogen tank 1 heater current	0, 2 amps		
*NHCH2	Hydrogen tank 2 heater current	0, 2 amps		
TWH2T1	Tank 1 indicated hydrogen quantity	-10V = 0, +10V = +28 lb	211(A)/211	
TWH2T2	Tank 2 indicated hydrogen quantity	-10V = 0, +10V = +28 lb	213(A)/213	
TPH2T1	Tank 1 indicated hydrogen pressure	-10V = 0, +10V = +350 psia	226(A)/226	
TPH2T2	Tank 2 indicated hydrogen pressure	-10V = 0, +10V = +350 psia	227(A)/227	
TTH2T1	Tank 1 indicated hydrogen temperature	-10V = -425, +10V = -200°F	233(A)/233	
TTH2T2	Tank 2 indicated hydrogen temperature	-10V = -425, +10V = -200°F	236(A)/236	

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-45. Electrical Power System — Fuel Cell Thermodynamics

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CZID	Current gradient	-300, +300 amp/sec		
CZI	Internal current	0, 360 amps		
CPWR	Internal power level	0, 14,400 watts		
CWH2	Hydrogen consumed	0, 0.0003 lb/sec		
CWDH2C	H_2 flow out of cell	0, 0.007 lb/sec		
CWDH2OC	H_2O flow out of cell	0, 02 lb/sec		
CWHP	Total mass flow rate out of cell	0, 0.03 lb/sec		
CMP1	Fluid mass heat capacity out of cell	0, 0.03 Btu/°F-sec		
CTOD	Module temperature gradient	-0.2, +0.2°F/sec		
CTO	Module temperature	0, 550°F		
CWDHR	Primary bypass valve rate	-0.0001, +0.0001 lb/sec		
CWHR	Flow thru primary regenerator hot side	0, 0.03 lb/sec		
CPRGQA	Primary regenerator energy available	0, 3 Btu/sec		
CT1	Primary regenerator exit temp hot side	0, 550°F		
CT2	Condenser inlet temp	0, 550°F		
CT12	Module inlet temp	0, 550°F		
CEFFON	Condenser effectiveness	0, 3		
CCQG	Condenser energy available from glycol	0, 5 Btu/sec		
CWDTB	Water flow rate at temperature T8	0, 0.03 lb/sec		
CCQH	Condenser energy available from gas steam	0, 3 Btu/sec		
CCQAD	Condenser available energy gradient	0, 3		
CCQA	Condenser transfer energy available	0, 5		
CT3	Condenser exit glycol temp	0, 550°F		
CTSATCON	Saturation temp of steam entering condenser	0, 550°F		
CTNOCON	Condenser exit temp - no condensation	0, 550°F		
CT10	Condenser exhaust temp	0, 550°F		
CT11	Temp into primary regeneration	0, 550°F		
CWDH2OO	Steam flow rate out of condenser	0, 0.03 lb/sec		
CMASH2O	Mass of H_2O in cell	0, 0.2 lb		
CWDATER	Water removed from gas steam	0, 0.003 lb/sec		
CWATER	Water not removed by ECS	0, 1 lb		
CH2OWD	Water flow rate to ECS	0, 0.0008 lb/sec		

Table 6-45. Electrical Power System — Fuel Cell Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CPH2O	H_2O partial pressure at condenser exit	0, 60 psi		
CWDH2IN	H_2 flow into system	0, 0.001 lb/sec		
CWDH2S	H_2 flow rate into cell	0, 0.007 lb/sec		
CMASH2	Mass of H_2 in cell	0, 0.1 lb		
CMP2	Fluid mass heat capacity into cell	0, 0.03 Btu/°F-sec		
CWDGR	Secondary bypass valve rate	0, 0.0005 lb/sec		
CWGR	Flow thru secondary regenerator cold side	0, 0.02 lb/sec		
CSRGQA	Secondary regenerator energy available	0, 3 Btu/sec		
CT7	Secondary regenerator exit temp	0, 550°F		
CT4	Radiator inlet temp	0, 550°F		
CT8	Condenser inlet glycol temp	0, 550°F		
CB1	Intercept—H_2O flow vs temp plat	lb/hr		
CM1	Slope—H_2O flow vs temp plat	lb/hr-°F		
CDETPB	Iteration interval	0.8 sec		
CDETPBN	Iteration interval - freeze	0.8 sec		
CFC1A	F/C 1 current	-10, 360 amps		
CFC2A	F/C 2 current	-10, 360 amps		
CFC3A	F/C 3 current	-10, 360 amps		
CSKTFC1	Module skin temperature - F/C 1	0, 550°F		
CSKTFC2	Module skin temperature - F/C 2	0, 550°F		
CSKTFC3	Module skin temperature - F/C 3	0, 550°F		
CWGRFC1	Glycol recirculation cold side of regenerator - F/C 1	0, 0.01389°F/sec		
CWGRFC2	Glycol recirculation cold side of regenerator - F/C 2	0, 0.01389°F/sec		
CWGRFC3	Glycol recirculation cold side of regenerator - F/C 3	0, 0.01389°F/sec		
CWHRFC1	H_2 flow rate hot side primary regenerator - F/C 1	0, 0.03°F/sec		
CWHRFC2	H2 flow rate hot side primary regenerator - F/C 2	0, 0.03°F/sec		
CWHRFC3	H_2 flow rate hot side primary regenerator - F/C 3	0, 0.03°F/sec		
CT5	Radiator outlet temp - in subroutine	-50, 256°F		
CWGP	Glycol flow rate - in subroutine	0, 0.01389°F/sec		
CFC1DT	Module error temperature - F/C 1	-460, +100°F		
CFC2DT	Module error temperature - F/C 2	-460, +100°F		
CFC3DT	Module error temperature - F/C 3	-460, +100°F		

Table 6-45. Electrical Power System — Fuel Cell Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CPFC1	Power output - F/C 1	-1000, -14400 watts		
CPFC2	Power output - F/C 2	-1000, -14400 watts		
CPFC3	Power output - F/C 3	-1000, -14400 watts		
CWDH2FC1	H_2 flow rate - F/C 1	0, 1.9 lb/hr		
CWDH2FC2	H_2 flow rate - F/C 2	0, 1.9 lb/hr		
CWDH2FC3	H_2 flow rate - F/C 3	0, 1.9 lb/hr		
CWDO2FC1	O2 flow rate - F/C 1	0, 7.9 lb/hr		
CWDO2FC2	O2 flow rate - F/C 2	0, 7.9 lb/hr		
CWD02FC3	O2 flow rate - F/C 3	0, 7.9 lb/hr		
CN2PFC1	N_2 regulator output pressure - F/C 1	0, 80 psi		
CN2PFC2	N_2 regulator output pressure - F/C 2	0, 80 psi		
CN2PFC3	N_2 regulator output pressure - F/C 3	0, 80 psi		
CH2PFC1	H_2 regulator output pressure - F/C 1	0, 80 psi		
CH2PFC2	H_2 regulator output pressure - F/C 2	0, 80 psi		
CH2PFC3	H_2 regulator output pressure - F/C 3	0, 80 psi		
CO2PFC1	O_2 regulator output pressure - F/C 1	0, 80 psi		
CO2PFC2	O_2 regulator output pressure - F/C 2	0, 80 psi		
CO2PFC3	O_2 regulator output pressure - F/C 3	0, 80 psi		
CPHFC1	pH factor - F/C 1	0, 12		
CPHFC2	pH factor - F/C 2	0, 12		
CPHFC3	pH factor - F/C 3	0, 12		
CH2OWD1	Potable water production rate - F/C 1	0, 0.0008 lb/sec		
CH2OWD2	Potable water production rate - F/C 2	0, 0.0008 lb/sec		
CH2OWD3	Potable water production rate - F/C 3	0, 0.0008 lb/sec		
CFC1TRI	Radiator inlet temperature - F/C 1	0, 550°F		
CFC2TRI	Radiator inlet temperature - F/C 2	0, 550°F		
CFC3TRI	Radiator inlet temperature - F/C 3	0, 550°F		
CETFC1	Condenser exhaust temperature - F/C 1	0, 550°F		
CETFC2	Condenser exhaust temperature - F/C 2	0, 550°F		
CETFC3	Condenser exhaust temperature - F/C 3	0, 550°F		
CWDH	Total hydrogen demand of fuel cells	0, 0.0009 lb/sec		
CWDO	Total oxygen demand of fuel cells	0, 0.004 lb/sec		

Table 6-45. Electrical Power System — Fuel Cell Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MC105	F/C 1 H_2 leak	Boolean		
MC106	F/C 1 O_2 leak	Boolean		
MC100	F/C 1 N_2 pressure high	Boolean		
MC101	F/C 1 H_2 pressure high	Boolean		
MC102	F/C 1 O_2 pressure high	Boolean		
MC112	F/C 2 primary bypass valve sticks open	Boolean		
MC113	F/C 2 primary bypass valve sticks closed	Boolean		
MC114	F/C 3 secondary bypass valve sticks open	Boolean		
MC115	F/C 3 secondary bypass valve sticks closed	Boolean		
MC111	F/C 2 pH high	Boolean		
MC133	F/C 2 H_2 pressure high	Boolean		
MC134	F/C 3 H_2 pressure high	Boolean		
MC135	F/C 2 H_2 leaks	Boolean		
MC136	F/C 3 H_2 leaks	Boolean		
MC137	F/C 1 pH high	Boolean		
MC140	F/C 3 pH high	Boolean		
MC141	F/C 1 primary bypass valve sticks open	Boolean		
MC142	F/C 3 primary bypass valve sticks open	Boolean		
MC143	H_2 pressure low	Boolean		
MC144	F/C 2 H_2 pressure low	Boolean		
MC145	F/C 3 H_2 pressure low	Boolean		
MC146	F/C 2 O_2 pressure high	Boolean		
MC147	F/C 3 O_2 pressure high	Boolean		
MC150	F/C 1 O_2 pressure low	Boolean		
MC151	F/C 2 O_2 pressure low	Boolean		
MC152	F/C 3 O_2 pressure low	Boolean		
MC153	F/C 2 N_2 pressure high	Boolean		
MC154	F/C 3 N_2 pressure high	Boolean		
MC155	F/C 1 N_2 pressure low	Boolean		
MC156	F/C 2 N_2 pressure low	Boolean		
MC157	F/C 3 N_2 pressure low	Boolean		

Table 6-45. Electrical Power System — Fuel Cell Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MC160	F/C 2 O_2 leaks	Boolean		
MC161	F/C 3 O_2 leaks	Boolean		
MC131	F/C 1 primary bypass valve sticks closed	Boolean		
MC132	F/C 3 primary bypass valve sticks closed	Boolean		
CK47FC	Current time const	Const 0.8 1/sec		
CK1FC	Fuel cell energy const	Const 7.15×10^{-7} lb/amp		
CK52FC	Pump flow divided by volume of cell	Const 0.1 1/sec		
CK8FC	Const press specific heat H_2	Const 3.45 Btu/ lb · °F		
CK9FC	Const press specific heat H_2O	Const 0.50075 Btu/lb · °F		
CK41FC	Specific heat of O_2 x Mol wt of O_2	Const 0.37318 Btu/sec-°F		
CK43FC	Heat of formation of H_2O	Const 51333 Btu/16		
CK44FC	Heat loss to ambient	Const 0.0555 Btu/sec		
CK45FC	Rate of change of heat loss	Const 0.000417 Btu/sec-°F		
CK46FC	Mod temp ref	Const 460°F		
CK6FC	Electrical energy conversion factor	Const 9.48×10^{-4} Btu/watt-sec		
CK7FC	Cell mass x specific heat	Const 25 Btu/°F		
CK10FC	Fuel cell max operating temp	Const 495°F		
CK11FC	PRI regen valve control range	Const 70°F		
CK12FC	PRI regen valve time const	Const 0.03333 1/sec-°F		
CK13FC	PRI regen efficiency	Const 0.992		
CK16FC	Mixture H_2 and H_2O effect on efficiency	Const 0.2		
CK15FC	Max eff of condenser	Const 0.8		
CK17FC	Specific heat of glycol	Const 0.75 Btu/lb°F		
CK36FC	Slope below breakpoint 1	Const 0.0000125 lb/sec-°F		
CK35FC	Intercept below breakpoint 1	Const 0.00125 lb/sec		
CK38FC	Slope above breakpoint 1	Const 0.0000375 lb/sec-°F		

Table 6-45. Electrical Power System — Fuel Cell Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CK37FC	Intercept above breakpoint 1	Const 0.00575 lb/sec		
CK40FC	Breakpoint 1 valve of CT10	Const 180°F		
CK20FC	Heat of vaporization	978 Btu/4		
CK48FC	Condenser energy time const	0.5 1/sec		
CK39FC	Breakpoint 1 on CWDH2OC vs TEMP PLOT	0.0010 lb/sec		
CK49FC	Primary pump temp rise	9.6°F		
CK2FC	Molecular weight of H_2O	8.94		
CK22FC	Water vapor press const 1	3.3684084 lb/in.^{2}		
CK23FC	Water vapor press const 2	0.11152066 lb/in.^{2}°F		
CK24FC	Water vapor press const 3	0.0011743973 lb/in.^{2}°F^2		
CK25FC	Water vapor press const 4	0.0000049551275 lb/in.^{2}°F^3		
CK28FC	System total press	60 lb/in.^{2}		
CK29FC	Volumetric flow rate H_2	7.9992 in.^{2}ft/sec		
CK30FC	Gas const for H_2	766 ft lb/lb°R		
CK31FC	°F to °R conv	460		
CK32FC	Condenser max operating temp	165°F		
CK33FC	Secondary regenerator valve contr range	10°F		
CK34FC	Secondary regen efficiency	0.985		
CK100FC	Sec to hr conversion	3600 sec/hr		
CK101FC	H_2 purge rate	0.55 lb/hr		
CK102FC	H_2 leak rate	0.075 lb/hr		
CK103FC	Molecular weight of O_2	7.94		
CK104FC	O_2 purge	0.92 lb/hr		
CK105FC	O_2 leak rate	0.35 lb/hr		
CK106FC	N_2 nominal pressure	52 psi		
CK107FC	N_2 pressure change	28 psi		
CK108FC	H_2 pressure differential	8.5 psi		
CK109FC	H_2 pressure increase	20 psi		
CK110FC	O_2 pressure differential	10.5 psi		
CK111FC	Nominal water pH	7		

Table 6-45. Electrical Power System — Fuel Cell Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CK112FC	pH increase	3		
CK113FC	H_2 leak rate	0.035 lb/hr		
CK114FC	Intercept above breakpoint 2	0.03119192 lb/sec		
CK115FC	Slope above breakpoint 2	0.00013846 lb/ sec-°F		
CK116FC	Breakpoint 2 valve of CT10	252°F		
CK117FC	Breakpoint 2 on CWDH2OC vs TEMP PLOT	0.0037 lb/sec		
CZIDEM	Current demand (desired)	0, 360		
CZI1	F/C 1 internal current	0, 360		
CZI2	F/C 2 internal current	0, 360		
CZI3	F/C 3 internal current	0, 360		
CIE	Power output	0, 14400		
CMASH21	F/C 1 mass of H_2 in cell	0, 0.1		
CMASH22	F/C 2 mass of H_2 in cell	0, 0.1		
CMASH23	F/C 3 mass of H_2 in cell	0, 0.1		
CMASH2O1	F/C 1 mass of H_2O in cell	0, 0.2		
CMASH2O2	F/C 2 mass of H_2O in cell	0, 0.2		
CMASH2O3	F/C 3 mass of H_2O in cell	0, 0.2		
CMP21	F/C 1 fluid mass heat capacity into cell	0, 0.03		
CMP22	F/C 2 fluid mass heat capacity into cell	0, 0.03		
CMP23	F/C 3 fluid mass heat capacity into cell	0, 0.03		
CT121	F/C 1 module inlet temp	0, 550		
CT122	F/C 2 module inlet temp	0, 550		
CT123	F/C 3 module inlet temp	0, 550		
CT111	F/C 1 temp int prim regen - cold side	0, 550		
CT112	F/C 2 temp int prim regen - cold side	0, 550		
CT113	F/C 3 temp int prim regen - cold side	0, 550		
CPHL	Lower power heater output			
CHC1A	F/C 1 lower power heater output			
CHC2A	F/C 2 lower power heater output			
CHC3A	F/C 3 lower power heater output			

Table 6-45. Electrical Power System — Fuel Cell Thermodynamics (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CT81	F/C 1 condenser inlet glycol temp	0, 550		
CT82	F/C 2 condenser inlet glycol temp	0, 550		
CT83	F/C 3 condenser inlet glycol temp	0, 550		
CCQA1	F/C 1 condenser transfer energy	0, 5		
CCQA2	F/C 2 condenser transfer energy	0, 5		
CCQA3	F/C 3 condenser transfer energy	0, 5		
CWATER1	F/C 1 water not removed by ECS	0, 1		
CWATER2	F/C 2 water not removed by ECS	0, 1		
CWATER3	F/C 3 water not removed by ECS	0, 1		

Table 6-46. Electrical Power System — EPS Control Logic

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C001	F/C bus Disconnect (caution warning)	Boolean		
C002	F/C 1 overload or reverse current bus A	Boolean		
C003	F/C 2 overload or reverse current bus A	Boolean		
C004	F/C 3 overload or reverse current bus A	Boolean		
C005	F/C 1 overload or reverse current bus B	Boolean		
C006	F/C 2 overload or reverse current bus B	Boolean		
C007	F/C 3 overload or reverse current bus B	Boolean		
C011	Start O/L timer F/C 1 BUS A	Boolean		
C012	Start O/L timer F/C 2 BUS A	Boolean		
C013	Start O/L timer F/C 3 BUS A	Boolean		
C014	Start O/L timer F/C 1 BUS B	Boolean		
C015	Start O/L timer F/C 2 BUS B	Boolean		
C016	Start O/L timer F/C 3 BUS B	Boolean		
C200	C/M main dc bus A	Boolean		
C201	C/M main dc bus B	Boolean		
C202	+ Battery Bus A	Boolean		
C203	+ Battery Bus B	Boolean		
C204	115/120 v 3-phase 400 CPS bus 1	Boolean		
C205	115/120 v 3-phase 400 CPS bus 2	Boolean		
C206	Nonessential bus	Boolean		
C207	Flight and postlanding bus	Boolean		
C208	Battery relay bus	Boolean		
C215	Inverter 1 on	Boolean		
C216	Inverter 2 on	Boolean		
C217	Inverter 3 on	Boolean		
C218	Battery charger "on"	Boolean		
C219	Inverter 1 voltage less than 100 vac	Boolean		
C220	Inverter 2 voltage less than 100 vac	Boolean		
C221	Inverter 3 voltage less than 100 vac	Boolean		
C223	Inverter 1 voltage grtr than 130 vac	Boolean		
C224	Inverter 2 voltage grtr than 130 vac	Boolean		
C225	Inverter 3 voltage grtr than 130 vac	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C226	S/M d-c bus A	Boolean		
C227	S/M d-c bus B	Boolean		
C229	Inv bus 1 disconnect O/V or O/L	Boolean		
C230	Inv bus 2 disconnect O/V or O/L	Boolean		
C243	A-C bus 1 voltage less than 100 vac	Boolean		
C244	A-C bus 2 voltage less than 100 vac	Boolean		
C245	AC BUS 1 voltage greater than 130 vac	Boolean		
C246	AC BUS 2 voltage greater than 130 vac	Boolean		
C250	Pump power FUEL CELL 1	Boolean		
C251	Pump power FUEL CELL 2	Boolean		
C252	Pump power FUEL CELL 3	Boolean		
C253	Power essential T/C-PCM T/M	Boolean		
C254	Power essential T/C-GROUP 1	Boolean		
C255	Power essential T/C-S BAND PA & SIG COMD	Boolean		
C256	Power essential T/C-GROUP 2	Boolean		
C257	Non-essential bus power to FC sensors	Boolean		
C261	SPS and RCS sensor power available	Boolean		
C264	BUS 1 overload disconnect	Boolean		
C265	BUS 2 overload disconnect	Boolean		
C266	AC BUS 1 under-overvoltage	Boolean		
C267	AC BUS 2 under-overvoltage	Boolean		
C268	DC BUS A<26.25 vdc	Boolean		
C269	DC BUS B<26.25 vdc	Boolean		
C270	DC BUS A latch on - undervoltage	Boolean		
C271	DC BUS B latch on - undervoltage	Boolean		
C273	Battery charger tied to postlanding battery	Boolean		
C274	Battery charger tied to battery bus B	Boolean		
C275	Battery charger tied to battery bus A	Boolean		
C278	Motor switch ON - BAT BUS A to MN A and BATT C to MN B	Boolean		
C279	Motor switch ON - BAT BUS B to MN B and BATT C to MN A	Boolean		
C280	Motor switch ON - inverter 1 C14S1	Boolean		
C281	Motor switch ON - inverter 2 C14S2	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C283	Motor switch ON - inv 1 bus 1 tie C14A155	Boolean		
C284	Motor switch ON - F/C 1 bus A tie S14A1S7	Boolean		
C285	Motor switch ON - inv 1 bus 2 tie C14A1S4	Boolean		
C286	Motor switch ON - F/C 1 bus B tie S14A1S10	Boolean		
C287	Motor switch ON - inv 2 bus 1 tie C14A1S7	Boolean		
C288	Motor switch ON - F/C 2 bus A tie S14A1S9	Boolean		
C289	Motor switch ON - inv 2 bus 2 tie C14A1S6	Boolean		
C290	Motor switch ON - F/C 2 bus B tie S14A1S6	Boolean		
C291	Motor switch ON - inv 3 bus 1 tie C14A1S9	Boolean		
C292	Motor switch ON - F/C 3 bus A tie S14A1S5	Boolean		
C293	Motor switch ON - inv 3 bus 2 tie C14A1S8	Boolean		
C294	Motor switch ON - F/C 3 bus B tie S14A1S8	Boolean		
C298	F/C 1 reactants on S14A2L1+2	Boolean		
C299	F/C 2 reactants on S14A2L3+4	Boolean		
C300	F/C 3 reactants on S14A2L 5 and 6	Boolean		
C301	F/C 1 O_2 purge	Boolean		
C302	F/C 2 O_2 purge	Boolean		
C303	F/C 3 O_2 purge	Boolean		
C304	F/C 1 H_2 purge	Boolean		
C305	F/C 2 H_2 purge	Boolean		
C306	F/C 3 H_2 purge	Boolean		
C307	Start O/L timer inv 1 phase A	Boolean		
C308	Start O/L timer inv 1 phase B	Boolean		
C309	Start O/L timer inv 1 phase C	Boolean		
C310	Start O/L timer inv 2 phase A	Boolean		
C311	Start O/L timer inv 2 phase B	Boolean		
C312	Start O/L timer inv 2 phase C	Boolean		
C313	Start O/L timer inv 3 phase A	Boolean		
C314	Start O/L timer inv 3 phase B	Boolean		
C315	Start O/L timer inv 3 phase C	Boolean		
C316	Inv 1 - bus 1 phase A O/L disconnect	Boolean		
C317	Inv 1 - bus 2 phase A O/L disconnect	Boolean		
C318	Inv 1 - bus 1 phase B O/L disconnect	Boolean		
C319	Inv 1 - bus 2 phase B O/L disconnect	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C320	Inv 1 - bus 1 phase C O/L disconnect	Boolean		
C321	Inv 1 - bus 2 phase C O/L disconnect	Boolean		
C322	Inv 2 - bus 1 phase A O/L disconnect	Boolean		
C323	Inv 2 - bus 2 phase A O/L disconnect	Boolean		
C324	Inv 2 bus 1 phase B O/L disconnect	Boolean		
C325	Inv 2 bus 2 phase B O/L disconnect	Boolean		
C326	Inv 2 bus 1 phase C O/L disconnect	Boolean		
C327	Inv 2 bus 2 phase C O/L disconnect	Boolean		
C328	Inv 3 bus 1 phase A O/L disconnect	Boolean		
C329	Inv 3 bus 2 phase A O/L disconnect	Boolean		
C330	Inv 3 bus 1 phase B O/L disconnect	Boolean		
C331	Inv 3 bus 2 phase B O/L disconnect	Boolean		
C332	Inv 3 bus 1 phase C O/L disconnect	Boolean		
C333	Inv 3 bus 2 phase C O/L disconnect	Boolean		
C334	Inv 1 phase A current ldg greater than CK24	Boolean		
C335	Inv 1 phase B current ldg greater than CK24	Boolean		
C336	Inv 1 phase C current ldg greater than CK24	Boolean		
C337	Inv 2 phase A current ldg greater than CK24	Boolean		
C338	Inv 2 phase B current ldg greater than CK24	Boolean		
C339	Inv 2 phase C current ldg greater than CK24	Boolean		
C340	Inv 3 phase A current ldg greater than CK24	Boolean		
C341	Inv 3 phase B current ldg greater than CK24	Boolean		
C342	Inv 3 phase C current ldg greater than CK24	Boolean		
C343	Motor switch ON BUS A to INV 3	Boolean		
C344	Motor switch ON BUS B to INV 3	Boolean		
C358	AC BUS 1 undervoltage latch	Boolean		
C359	AC BUS 1 overvoltage latch	Boolean		
C360	AC BUS 2 undervoltage latch	Boolean		
C361	AC BUS 2 overvoltage latch	Boolean		
C362	Ground applied to F/C 1 MN BUS A off T/M	Boolean		
C363	Ground applied to F/C 2 MN BUS A off T/M	Boolean		
C364	Ground applied to F/C 3 MN BUS A off T/M	Boolean		
C365	Ground applied to F/C 1 MN BUS B off T/M	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C366	Ground applied to F/C 2 MN BUS B off T/M	Boolean		
C367	Ground applied to F/C 3 MN BUS B off T/M	Boolean		
C370	C/M MN A voltage ≥ C/M MN B voltage	Boolean		
C401	AC sensor signal AC1 C15A6CB48	Boolean		
C402	AC sensor signal AC2 C15A6CB47	Boolean		
C403	FUEL CELL 1 cir and sep motors C15A5CB64	Boolean		
C404	FUEL CELL 2 cir and sep motors C15A5CB83	Boolean		
C405	FUEL CELL 3 cir and sep motors C15A5CB87	Boolean		
C406	ECS glycol pump AC1 ØA C15A5CB27	Boolean		
C407	ECS glycol pump AC1 ØB C15A5CB26	Boolean		
C408	ECS glycol pump AC1 ØC C15A5CB25	Boolean		
C409	ECS glycol pump AC2 ØA C15A5CB24	Boolean		
C410	ECS glycol pump AC2 ØB C15A5CB23	Boolean		
C411	ECS glycol pump AC2 ØC C15A5CB22	Boolean		
C412	ECS suit compressor AC1 ØA C15A5CB33	Boolean		
C413	ECS suit compressor AC1 ØB C15A5CB32	Boolean		
C414	ECS suit compressor AC1 ØC C15A5CB31	Boolean		
C415	ECS suit compressor AC2 ØA C15A5CB30	Boolean		
C416	ECS suit compressor AC2 ØB C15A5CB29	Boolean		
C417	ECS suit compressor AC2 ØC C15A5CB28	Boolean		
C418	ECS cabin air fan 1 AC1 ØA C15A5CB76	Boolean		
C419	ECS cabin air fan 1 AC1 ØB C15A5CB75	Boolean		
C420	ECS cabin air fan 1 AC1 ØC C15A5CB74	Boolean		
C421	ECS cabin air fan 2 AC2 ØA C15A5CB73	Boolean		
C422	ECS cabin air fan 2 AC2 ØB C15A5CB72	Boolean		
C423	ECS cabin air fan 2 AC2 ØC C15A5CB71	Boolean		
C424	ECS radiator AC1 1A C15A5CB70	Boolean		
C425	ECS radiator AC1 2B C15A5CB69	Boolean		
C426	ECS radiator AC2 1A C15A5CB68	Boolean		
C427	ECS radiator AC2 2C C15A5CB67	Boolean		
C428	G&N viewer AC1 C15A5CB93	Boolean		
C429	G&N viewer AC2 C15A5CB62	Boolean		
C430	SPS gauging AC1 C15A6CB20	Boolean		
C431	SPS gauging AC2 C15A6CB19	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C432	SCS group 1 AC1 C15A6CB46	Boolean		
C433	SCS group 1 AC2 C15A6CB45	Boolean		
C434	Cryogenic system qty ampl 1 AC1 ØC C15A5CB44	Boolean		
C435	Gryogenic system qty ampl 2 AC2 ØC C15A5CB90	Boolean		
C436	Postlanding vent fan BAT C C15A6CB63	Boolean		
C437	SCS group 2 AC1 C15A6CB67	Boolean		
C438	SCS group 2 AC2 C15A6CB66	Boolean		
C439	Telecomm PCM T/M C15A5CB50	Boolean		
C440	Telecomm GP1 C15A5CB49	Boolean		
C441	Telecomm sig cond S-band PA C15A5CB51	Boolean		
C442	Telecomm GP2 C15A5CB48	Boolean		
C443	Inverter cont No. 1 C15A5CB39	Boolean		
C444	Inverter cont No. 2 C15A5CB38	Boolean		
C445	Inverter cont No. 3 C15A5CB37	Boolean		
C446	SEQ A C14CB14	Boolean		
C447	RCS fuel pump (CB15) C14CB15	Boolean		
C448	RCS fuel pump (CB16) C14CB16	Boolean		
C449	SEQ B C14CB17	Boolean		
C450	HF ANT DEPLOY (CB18) C14CB18	Boolean		
C451	Battery charger BAT C CHARGE C14CB20	Boolean		
C452	BAT C power panel MN A & B C14CB19	Boolean		
C453	Telecomm group No. 3 C15A5CB47	Boolean		
C454	Telecomm group No. 5 C15A5CB45	Boolean		
C455	Telecomm group No. 4 C15A5CB46	Boolean		
C456	Sensor unit AC BUS 1 C22-2A70CB7	Boolean		
C457	Sensor unit AC BUS 2 C22-2A70CB8	Boolean		
C458	Bat relay bus BAT A C15A5CB13	Boolean		
C459	Earth landing system A BAT A C15A6CB8	Boolean		
C460	Master event seq cont arm A BAT A C15A5CB19	Boolean		
C461	Master event seq cont logic A BAT A C15A5CB21	Boolean		
C462	Earth landing system B BAT B C15A6CB7	Boolean		
C463	Master event seq cont arm B BAT B C15A5CB18	Boolean		
C464	Master event seq cont logic B BAT B C15A5CB20	Boolean		
C465	Bat relay bus BAT B C15A5CB12	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C466	Postlanding bat BUS A C14A7CB8	Boolean		
C467	BAT A power - ENTRY C14CB21	Boolean		
C468	Bat charger BAT A CHARGE C15A5CB78	Boolean		
C469	Bat charger BAT B CHARGE C15A5CB77	Boolean		
C470	Postlanding bat BUS B C14A7CB7	Boolean		
C471	BAT C power MN B C14A7CB10	Boolean		
C472	Bat bus B MN B C14A7CB9	Boolean		
C473	Postlanding MN A C14A7CB6	Boolean		
C474	Envir cont sys xducer press. GROUP 1 MN A C15A5CB9	Boolean		
C475	Envir cont sys xducer temp MN A C15A5CB11	Boolean		
C476	INV PWR 1 MN A C14A7CB4	Boolean		
C477	INV PWR 3 MN A C14A7CB2	Boolean		
C478	Batt charger MN A C15A5CB80	Boolean		
C479	Floodlights and couch atten MN A C15A5CB38	Boolean		
C480	DC sensor sig MN A C15A5CB15	Boolean		
C482	Potable water heater MN A C15A5CB3	Boolean		
C483	Central timing sys A C15A5CB53	Boolean		
C484	G&N imu htr MN A C15A5CB61	Boolean		
C485	Event timer MN A C15A6CB57	Boolean		
C486	Instrument ess MN A C15A5CB41	Boolean		
C487	Cryo sys tank fan motor 2 AC2 ØB C15A5CB102	Boolean		
C488	Cryogenic sys O_2 TK HTR 1 MN A C15A5CB5	Boolean		
C489	Cryogenic sys H_2 TK HTR 1 MN A C15A5CB7	Boolean		
C490	G&N IMU MN A C15A5CB59	Boolean		
C491	G&N optics MN A C15A5CB55	Boolean		
C492	G&N computer MN A C15A5CB57	Boolean		
C493	FUEL CELL 1 bus cont C15A5CB65	Boolean		
C494	FUEL CELL 2 bus cont C15A5CB84	Boolean		
C495	FUEL CELL 3 bus cont C15A5CB88	Boolean		
C496	Instrument NON ESS C15A5CB42	Boolean		
C497	Instr NON ESS BUS C15A5CB1	Boolean		
C498	Instruments scien C15A5CB97	Boolean		
C499	Envir cont sys xducer press. GROUP 1 MNB C15A5CB8	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C500	Envir cont sys xducer temp MN B C15A5CB10	Boolean		
C501	INV PWR 2 MN B C14A7CB3	Boolean		
C502	INV PWR 3 MN B C14A7CB1	Boolean		
C503	Batt charger MN B C15A5CB79	Boolean		
C504	Postlanding MN B C14A7CB5	Boolean		
C505	Floodlights and couch atten MN B C15A6CB37	Boolean		
C506	DC sensor sig MN B C15A5CB14	Boolean		
C508	Potable water htr MN B C15A5CB2	Boolean		
C509	Central timing sys MN B C15A5CB52	Boolean		
C510	G&N IMU htr MN B C15A5CB60	Boolean		
C511	Event timer MN B C15A6CB58	Boolean		
C512	Instruments ESS MN B C15A5CB40	Boolean		
C513	Instruments PAM XMTR NON ESS C15A5CB96	Boolean		
C514	Cryogenic system O_2 TK HTR 2 MN B C15A5CB4	Boolean		
C515	Cryogenic system H_2 TK HTR 2 MN B C15A5CB6	Boolean		
C516	G&N IMU MN B C15A5CB58	Boolean		
C517	G&N optics MN B C15A5CB54	Boolean		
C518	G&N computer MN B C15A5CB56	Boolean		
C519	SCS direct cont MN B C15A6CB41	Boolean		
C520	SCS pitch 2 MN B C15A6CB39	Boolean		
C521	SCS A and C ROLL MN B C15A6CB35	Boolean		
C522	SCS B and D ROLL MN B C15A6CB33	Boolean		
C523	SCS YAW 2 MN B C15A6CB31	Boolean		
C524	SCS GROUP 1 MN B C15A6CB43	Boolean		
C525	RCS gauging MN B C15A6CB17	Boolean		
C526	RCS prop ISO MN B C15A6CB15	Boolean		
C527	RCS C/M-S/M transfer MN B C15A6CB9	Boolean		
C529	Spare	Boolean		
C530	SPS gimbal motor control YAW 2 BAT B C15A6CB23	Boolean		
C531	SPS gimbal motor control PITCH 2 AUX BAT B C15A6CB25	Boolean		
C532	SPS gauging MN B C15A6CB21	Boolean		
C533	SPS He valve MN B C15A6C327	Boolean		
C534	CAUTION/WARNING MN B C15A6CB51	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C535	SCS direct cont MN A C15A6CB42	Boolean		
C536	SCS PITCH 1 MN A C15A6CB40	Boolean		
C537	SCS A and C ROLL MN A C15A6CB36	Boolean		
C538	SCS B and D ROLL MN A C15A6CB34	Boolean		
C539	SCS YAW 1 MN A C15A6CB32	Boolean		
C540	SCS GROUP 1 MN A C15A6CB44	Boolean		
C541	RCS gauging MN A C15A6CB18	Boolean		
C542	RCS prop ISO MN A C15A6CB16	Boolean		
C543	RCS C/M-S/M transfer MN A C15A6CB10	Boolean		
C545	Spare	Boolean		
C546	SPS gimbal motor control YAW 1 BAT A C15A6CB24	Boolean		
C547	SPS gimbal motor control PITCH 1 BAT A C15A6CB26	Boolean		
C548	SPS gauging MN A C15A6CB22	Boolean		
C549	SPS He valve MN A C15A6CB28	Boolean		
C550	CAUTION/WARNING MN A C15A6CB50	Boolean		
C551	Sensor unit DC BUS A C22-2A70CB5	Boolean		
C552	Sensor unit DC BUS B C22-2A70CB6	Boolean		
C553	Batt charger AC PWR C15A5CB81	Boolean		
C554	FUEL CELL 1 H_2 and O_2 valve C15A5CB63	Boolean		
C555	FUEL CELL 2 H_2 and O_2 valve C15A5CB82	Boolean		
C556	FUEL CELL 3 H_2 and O_2 valve C15A5CB86	Boolean		
C557	Inst gas anal AC1 C15A5CB116	Boolean		
C558	MN A BATT BUS A C14A7CB10	Boolean		
C559	MN A BATT C C14A7CB11	Boolean		
C560	Batt B pwr - ENTRY C14CB22	Boolean		
C561	Fuel cell No. 1 purge C15A5CB66	Boolean		
C562	Fuel cell No. 2 purge C15A5CB85	Boolean		
C563	Fuel cell No. 3 purge C15A5CB89	Boolean		
C564	Biomed comm MN A C15A6CB59	Boolean		
C565	EDS 1 BAT A C15A6CB52	Boolean		
C566	Biomed comm MN B C15A6CB60	Boolean		
C567	EDS 3 BAT B C15A6CB53	Boolean		
C568	Postlanding float bag BAT C C15A6CB68	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C569	EDS 2 bat C C15A6CB54	Boolean		
C570	Cryo sys tank fan motor 2 AC2 ØC C15A5C101	Boolean		
C571	SCS group 2 MN A C15A6CB65	Boolean		
C572	SCS group 2 MN B C15A6CB64	Boolean		
C573	ECS H_2O accum MN A C15A5CB94	Boolean		
C574	ECS H_2O accum MN B C15A5CB95	Boolean		
C575	Postlanding bus BATT C C14A7CB13	Boolean		
C576	RCS heaters B MN A C22-2A70CB2	Boolean		
C577	RCS heaters C MN B C22-2A70CB3	Boolean		
C578	RCS heaters D MN A C22-2A70CB4	Boolean		
C579	ECS waste and potable H_2O MN A C15A5CB92	Boolean		
C580	ECS waste and potable H_2O MN B C15A5CB91	Boolean		
C581	ECS transducer press. group 2 MN A C15A5CB43	Boolean		
C582	ECS transducer press. group 2 MN B C15A5CB34	Boolean		
C583	Cryo sys tank fan motor 1 AC1 ØA C15A5CB100	Boolean		
C584	Cryo sys tank fan motor 1 AC1 ØB C15A5CB99	Boolean		
C585	Cryo sys tank fan motor 1 AC1 ØC C15A5CB98	Boolean		
C586	Cryo sys tank fan motor 2 AC2 ØA C15A5CB103	Boolean		
C587	Scien equip SEB 1 C15A5CB117	Boolean		
C588	Scien equip SEB 2 C15A5CB118	Boolean		
C589	Scien equip hatch C15A5CB119	Boolean		
C590	RCS htrs A MN B C22-2A7CB1	Boolean		
C600	Fuel cell pump 1 BUS 1	Boolean		
C601	Fuel cell pump 1 BUS 2	Boolean		
C602	Fuel cell pump 2 BUS 1	Boolean		
C603	Fuel cell pump 2 BUS 2	Boolean		
C604	Fuel cell pump 3 BUS 1	Boolean		
C605	Fuel cell pump 3 BUS 2	Boolean		
C606	Nonessential T/C BUS 1	Boolean		
C607	Nonessential T/C BUS 2	Boolean		
C608	Essential T/C BUS 1	Boolean		
C609	Essential T/C BUS 2	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C610	Battery charger BUS 2	Boolean		
C611	Nonessential bus BUS A	Boolean		
C612	Nonessential bus BUS B	Boolean		
C613	Inverter 3 BUS A	Boolean		
C614	Main bus battery A and C tie ON	Boolean		
C615	Main bus battery B and C tie ON	Boolean		
C616	Fuel cell 1 O_2 purge	Boolean		
C617	Fuel cell 1 H_2 purge	Boolean		
C618	Fuel cell 2 O_2 purge	Boolean		
C619	Fuel cell 2 H_2 purge	Boolean		
C620	Fuel cell 3 O_2 purge	Boolean		
C621	Fuel cell 3 H_2 purge	Boolean		
C622	Fuel cell 1 reactants ON	Boolean		
C623	Fuel cell 1 reactants OFF	Boolean		
C624	Fuel cell 2 reactants ON	Boolean		
C625	Fuel cell 2 reactants OFF	Boolean		
C626	Fuel cell 3 reactants ON	Boolean		
C627	Fuel cell 3 reactants OFF	Boolean		
C628	Fuel cell 1 ON-BUS A	Boolean		
C629	Fuel cell 1 OFF-BUS A	Boolean		
C630	Fuel cell 2 ON-BUS A	Boolean		
C631	Fuel cell 2 OFF-BUS A	Boolean		
C632	Fuel cell 3 ON-BUS A	Boolean		
C633	Fuel cell 3 OFF-BUS A	Boolean		
C634	BUS A reset ON	Boolean		
C636	Fuel cell 1 ON-BUS B	Boolean		
C637	Fuel cell 1 OFF-BUS B	Boolean		
C638	Fuel cell 2 ON-BUS B	Boolean		
C639	Fuel cell 2 OFF-BUS B	Boolean		
C640	Fuel cell 3 ON-BUS B	Boolean		
C641	Fuel cell 3 OFF-BUS B	Boolean		
C642	BUS B reset ON	Boolean		
C644	IFTS ON	Boolear		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C645	IFTS OFF	Boolean		
C646	AC inverter 1 ON	Boolean		
C647	AC inverter 2 ON	Boolean		
C648	AC inverter 3 ON	Boolean		
C649	AC BUS 1 reset ON	Boolean		
C651	AC inverter 1 ON-BUS 1	Boolean		
C652	AC inverter 2 ON-BUS 1	Boolean		
C653	AC inverter 3 ON-BUS 1	Boolean		
C654	AC BUS 2 reset ON	Boolean		
C656	AC inverter 1 ON-BUS 2	Boolean		
C657	AC inverter 2 ON-BUS 2	Boolean		
C658	AC inverter 3 ON-BUS 2	Boolean		
C659	Fuel cell 2 indicators	Boolean		
C660	Fuel cell 3 indicators	Boolean		
C661	Batt charger OFF	Boolean		
C662	Batt charger ON-A	Boolean		
C663	Batt charger ON-B	Boolean		
C664	Batt charger ON-POSTLANDING	Boolean		
C665	Batt charger ON-SUIT PACK	Boolean		
C666	DC indicators FUEL CELL 1	Boolean		
C667	DC indicators FUEL CELL 2	Boolean		
C668	DC indicators FUEL CELL 3	Boolean		
C669	DC indicators MAIN BUS A	Boolean		
C670	DC indicators MAIN BUS B	Boolean		
C671	DC indicators BAT BUS A	Boolean		
C672	DC indicators BAT BUS B	Boolean		
C673	DC indicators BAT CHARGER	Boolean		
C674	DC indicators POST LAND. BATTERY	Boolean		
C675	DC indicators PYRO BATT A	Boolean		
C676	DC indicators PYRO BATT B	Boolean		
C681	AC indicator BUS 1 ØA	Boolean		
C682	AC indicator BUS 1 ØB	Boolean		
C683	AC indicator BUS 1 ØC	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C684	AC indicator BUS 2 ØA	Boolean		
C685	AC indicator BUS 2 ØB	Boolean		
C686	AC indicator BUS 2 ØC	Boolean		
C687	SPS gauging BUS 1	Boolean		
C688	SPS gauging BUS 2	Boolean		
C650	AC inverter 3 BUS B	Boolean		
C689	Main bus tie batt A and C to AUTO	Boolean		
C690	Main bus tie batt B and C to AUTO	Boolean		
C691	FDAI lighting AC1	Boolean		
C692	FDAI lighting AC2	Boolean		
C801	pH HJ-talkback DS 1	Boolean		
C802	Fuel cell rad temp low-talkback DS 2	Boolean		
C803	Reg pressure HI O_2 talker DS 12	Boolean		
C804	Reg pressure HI H_2 talker DS 13	Boolean		
C805	Reg pressure HI N_2 talker DS 14	Boolean		
C806	Fuel cell 1 reactants off-talkback DS 3	Boolean		
C807	Fuel cell 2 reactants off-talkback DS 4	Boolean		
C808	Fuel cell 3 reactants off-talkback DS 5	Boolean		
C809	Fuel cell 1 main bus A off-talkback DS 6	Boolean		
C810	Fuel cell 2 main bus A off-talkback DS 7	Boolean		
C811	Fuel cell 3 main bus A off-talkback DS 8	Boolean		
C812	Fuel cell 1 main bus B off-talkback DS 9	Boolean		
C813	Fuel cell 2 main bus B off-talkback DS 10	Boolean		
C814	Fuel cell 3 main bus B off-talkback DS 11	Boolean		
C828	Couch unlocked	Boolean		
C829	FDAI lighting power available	Boolean		
	MN A C/M floodlights ON	Boolean		
	MN B C/M floodlights ON	Boolean		
E381	CWS lamp power BUS A	Boolean		
E383	CWS MN A and B power available	Boolean		
E403	CWS F/C 1 N_2 reg output pressure out of tolerance	Boolean		
E404	CWS F/C 2 N_2 reg output pressure out of tolerance	Boolean		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
E405	CWS F/C 3 N_2 reg output pressure out of tolerance	Boolean		
E415	CWS F/C 1 O_2 reg output pressure out of tolerance	Boolean		
E416	CWS F/C 2 O_2 reg output pressure out of tolerance	Boolean		
E417	CWS F/C 3 O_2 reg output pressure out of tolerance	Boolean		
E418	CWS F/C 1 H_2 reg output pressure out of tolerance	Boolean		
E419	CWS F/C 2 H_2 reg output pressure out of tolerance	Boolean		
E420	CWS F/C 3 H_2 reg output pressure out of tolerance	Boolean		
E424	CWS F/C 1 radiator outlet temperature out of tolerance	Boolean		
E425	CWS F/C 2 radiator outlet temperature out of tolerance	Boolean		
E426	CWS F/C 3 radiator outlet temperature out of tolerance	Boolean		
E427	CWS F/C 1 water pH factor out of tolerance	Boolean		
E428	CWS F/C 2 water pH factor out of tolerance	Boolean		
E429	CWS F/C 3 water pH factor out of tolerance	Boolean		
D538	C/M-S/M RCS transfer motor switch—SYS A	Boolean		
D539	C/M-S/M RCS transfer motor switch—SYS B	Boolean		
D550	C/M-S/M phys sep and umbilical destruct	Boolean		
D570	Pyro interrupter switch	Boolean		
CK1	AC overload curve breakpoint	Const 8.80 amps		
CK2	AC overload curve breakpoint	Const 6.40 amps		
CK3	Maximum inverter output current	Const 3.63 amps		
CK4	Max time to disconnect dc bus overload	Const 60.00 sec		
CK5	DC overload curve slope	Const 0.5714 sec/ amp		
CK6	Max F/C output current	Const 75.00 amps		
CK7	Max F/C reverse current	Const -5.00 amps		
CK8	Lower ac voltmeter voltage limit	Const 90.00 volts		
CK9	Undervoltage ac bus voltage limit	Const 100.00 volts		
CK10	Overvoltage ac bus voltage limit	Const 130.00 volts		
CK11	Lower dc voltage limit	Const 20.00 volts		
CK12	DC undervoltage	Const 26.25 volts		
CDET1	O/L timer update rate	Const 0.40 sec		
CK15	AC overload delay curve intercept	Const 283.35 sec		
CK16	AC overload delay curve slope	Const 39.75 sec/ amp		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CK17	AC overload delay curve intercept	Const 83.80 sec		
CK18	AC overload delay curve slope	Const 8.57 sec/amp		
CK19	AC overload delay curve intercept	Const 22.4 sec		
CK20	AC overload delay curve slope	Const 1.613 sec/ amp		
CK21	Nominal inverter voltage	Const 115 vac		
CK22	Inverter voltage curve intercept	Const 220 vac		
CK23	Inverter current limiting factor	Const 0.13043 $(amp)^{-1}$		
CK24	Start inverter current limiting	Const 7.00 amps		
CK25	Additional ac load - partial short F/C 2 pumps	Const 1.50 amps		
CK77	AC BUS 2 O/L by malfunction	Const 10.0 amps		
CK63	F/C pump current per phase	Const 0.35 amps		
CK64	Battery charger current/phase	Const 0.16 amps		
CK65	Inverter dc input scale factor	Const 0.134 amps		
CK66	Battery charger dc load current	Const 2.5 amps		
CK67	Nonessential inst current	Const 16 amps		
CK68	NASA inst current	Const 3.5 amps		
CK69	Cont motor switch current	Const 1.7 amps		
CK78	Blower motor phase current	Const 0.62 amps		
MC 001	INV 1 MOTOR switch failed OFF	Malfunction		
MC 110	Purge valve fails closed O_2	Malfunction		
MC 003	INV 3 MOTOR switch failed OFF	Malfunction		
MC 004	INV 1 TO BUS 1 motor switch failed OFF	Malfunction		
MC 005	INV 3 TO BUS 2 motor switch failed OFF	Malfunction		
MC 020	Battery charger failed	Malfunction		
MC 045	Nonessential bus failed	Malfunction		
MC 046	Bus A undervoltage sensor—inoperative	Malfunction		
MC 047	Bus 1 undervoltage—erroneous indication	Malfunction		
MC 050	Bus B RESET switch failed in ON position	Malfunction		
MC 053	Bus B undervoltage—erroneous indication	Malfunction		
MC 054	Bus 1 overvoltage—erroneous indication	Malfunction		
MC 055	Bus 2 U/V, O/V, O/L sensor inoperative	Malfunction		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MC 117	F/C 1 to BUS A motor switch failed in last position	Malfunction		
MC 120	F/C 1 to BUS B motor switch failed in last position	Malfunction		
MC 124	F/C 2 to BUS A erroneous disconnect	Malfunction		
MC 125	F/C 2 to BUS B erroneous disconnect	Malfunction		
MC 013	F/C 2 pumps draw excessive current	Malfunction		
MC 014	AC bus 2 overload	Malfunction		
MC 057	Inverter 1 failed	Malfunction		
MC 010	Inverter 2 voltage high	Malfunction		
MC 011	Inverter 3 voltage low	Malfunction		
MC 107	F/C 1 H_2 purge valve fails closed	Malfunction		
MC 103	F/C 2 H_2 supply valve fails closed	Malfunction		
MC 104	F/C 2 O_2 supply valve fails closed	Malfunction		
CVENTBA	Entry batt A voltage	volts		
CVENTBB	Entry batt B voltage	volts		
CVPLBC	Postlanding batt C voltage	volts		
CVSPB	Suit pack batt voltage	volts		
CFC1V	F/C 1 voltage	volts		X
CFC2V	F/C 2 voltage	volts		X
CFC3V	F/C 3 voltage	volts		
CFC1IBA	F/C 1 current BUS A	amps		X
CFC1IBB	F/C 1 current BUS B	amps		X
CFC2IBA	F/C 2 current BUS A	amps		X
CFC2IBB	F/C 2 current BUS B	amps		X
CFC3IBA	F/C 3 current BUS A	amps		X
CFC3IBB	F/C 3 current BUS B	amps		X
CTOLFC1A	Elapsed overload time F/C 1 BUS A	0, 75 sec		
CTOLFC1B	Elapsed overload time F/C 1 BUS B	0, 75 sec		
CTOLFC2A	Elapsed overload time F/C 2 BUS A	0, 75 sec		
CTOLFC2B	Elapsed overload time F/C 2 BUS B	0, 75 sec		
CTOLFC3A	Elapsed overload time F/C 3 BUS A	0, 75 sec		
CTOLFC3B	Elapsed overload time F/C 3 BUS B	0, 75 sec		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CTDCON1A	Time to disconnect F/C 1 BUS A	0, 75 sec		
CTDCON1B	Time to disconnect F/C 1 BUS B	0, 75 sec		
CTDCON2A	Time to disconnect F/C 2 BUS A	0, 75 sec		
CTDCON2B	Time to disconnect F/C 2 BUS B	0, 75 sec		
CTDCON3A	Time to disconnect F/C 3 BUS A	0, 75 sec		
CTDCON3B	Time to disconnect F/C 3 BUS B	0, 75 sec		
CTI1PA	Output current INV 1 PHASE A	0, 20 amps		
CTI1PB	Output current INV 1 PHASE B	0, 20 amps		
CTI1PC	Output current INV 1 PHASE C	0, 20 amps		
CTI2PA	Output current INV 2 PHASE A	0, 20 amps		
CTI2PB	Output current INV 2 PHASE B	0, 20 amps		
CTI2PC	Output current INV 2 PHASE C	0, 20 amps		
CTI3PA	Output current INV 3 PHASE A	0, 20 amps		
CTI3PB	Output current INV 3 PHASE B	0, 20 amps		
CTI3PC	Output current INV 3 PHASE C	0, 20 amps		
CTOL1A	Overload duration INV 1 PHASE A	0, 400.00 sec		
CTOL1B	Overload duration INV 1 PHASE B	0, 400.00 sec		
CTOL1C	Overload duration INV 1 PHASE C	0, 400.00 sec		
CTOL2A	Overload duration INV 2 PHASE A	0, 400.00 sec		
CTOL2B	Overload duration INV 2 PHASE B	0, 400.00 sec		
CTOL2C	Overload duration INV 2 PHASE C	0, 400.00 sec		
CTOL3A	Overload duration INV 3 PHASE A	0, 400.00 sec		
CTOL3B	Overload duration INV 3 PHASE B	0, 400.00 sec		
CTOL3C	Overload duration INV 3 PHASE C	0, 400.00 sec		
COLDT1A	Overload delay time INV 1 PHASE A	0, 400.00 sec		
COLDT1B	Overload delay time INV 1 PHASE B	0, 400.00 sec		
COLDT1C	Overload delay time INV 1 PHASE C	0, 400.00 sec		
COLDT2A	Overload delay time INV 2 PHASE A	0, 400.00 sec		
COLDT2B	Overload delay time INV 2 PHASE B	0, 400.00 sec		
COLDT2C	Overload delay time INV 2 PHASE C	0, 400.00 sec		
COLDT3A	Overload delay time INV 3 PHASE A	0, 400.00 sec		
COLDT3B	Overload delay time INV 3 PHASE B	0, 400.00 sec		
COLDT3C	Overload delay time INV 3 PHASE C	0, 400.00 sec		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CB1CL	Bus 1 common 3-phase loading phase	0, 20.00 amps		X
CB1PAL	Bus 1 phase A current loading	0, 20.00 amps		
CB1PBL	Bus 1 phase B current loading	0, 20.00 amps		
CB1PCL	Bus 1 phase C current loading	0, 20.00 amps		
CB2CL	Bus 2 common 3-phase loading phase	0, 20.00 amps		X
CB2PAL	Bus 2 phase A loading	0, 20.00 amps		
CB2PBL	Bus 2 phase B loading	0, 20.00 amps		
CB2PCL	Bus 2 phase C loading	0, 20.00 amps		
C4C43	Inv 1 cont motor current	0, 20.00 amps		X
C2C50	AC power input F/C 1 pump loading	0, 20.00 amps		
C2C51	AC power input F/C 2 pump loading	0, 20.00 amps		
C2C52	AC power input F/C 3 pump loading	0, 20.00 amps		
C5C53	AC power input batt charger loading	0, 20.00 amps		
*C4C44	Inverter control motor current	0, 20.00 amps		X
CDCVBBB	Battery B voltage			X
CINV1PAL	Inverter 1 phase A current loading	0, 100 amps		
CINV1PBL	Inverter 1 phase B current loading	0, 100 amps		
CINV1PCL	Inverter 1 phase C current loading	0, 100 amps		
CINV2PAL	Inverter 2 phase A current loading	0, 100 amps		
CINV2PBL	Inverter 2 phase B current loading	0, 100 amps		
CINV2PCL	Inverter 2 phase C current loading	0, 100 amps		
CINV3PAL	Inverter 3 phase A current loading	0, 100 amps		
CINV3PBL	Inverter 3 phase B current loading	0, 100 amps		
CINV3PCL	Inverter 3 phase C current loading	0, 100 amps		
CDCVBACM	Command module bus A	0, 45 volts		
CDCVBBCM	Command module bus B	0, 45 volts		
CVBTCHR	Battery charger voltage	0, 45 volts		
CVINV1A	Inverter 1 phase A voltage	0, 150 volts		
CVINV1B	Inverter 1 phase B voltage	0, 150 volts		
CVINV1C	Inverter 1 phase C voltage	0, 150 volts		
CVINV2A	Inverter 2 phase A voltage	0, 150 volts		

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CVINV2B	Inverter 2 phase B voltage	0, 150 volts		
CVINV2C	Inverter 2 phase C voltage	0, 150 volts		
CVINV3A	Inverter 3 phase A voltage	0, 150 volts		
CVINV3B	Inverter 3 phase B voltage	0, 150 volts		
CVINV3C	Inverter 3 phase C voltage	0, 150 volts		
CDCVBASM	Service module bus A			
CDCVBBSM	Service module bus B			
CDCVBBA	Battery A voltage			X
H4C37	SCS ac power group 2 loading	0, 20 amps		
T2C53	Current per phase CB50	0, 20 amps		
T2C54	Current per phase CB49	0, 20 amps		
T2C55	Current per phase CB51	0, 20 amps		
T2C56	Current per phase CB48	0, 20 amps		
F4C26	Current drawn from C426	0, 20 amps		
F4C21	Current drawn from C421	0, 20 amps		
F4C15	Current drawn from C415	0, 20 amps		
F4C09	Current drawn from C409	0, 20 amps		
F4C22	Current drawn from C422	0, 20 amps		
F4C16	Current drawn from C416	0, 20 amps		
F4C10	Current drawn from C410	0, 20 amps		
C4C45	Inverter 3 control motor current	0, 20 amps		
H4C32	SCS ac power group 1 loading	0, 20 amps		X
F4C27	SCS ac power group 1 C427	0, 20 amps		
F4C23	SCS ac power group 1 C423	0, 20 amps		
F4C17	SCS ac power group 1 C417	0, 20 amps		
F4C11	SCS ac power group 1 C411	0, 20 amps		
F4C06	SCS ac power group 1 C406	0, 20 amps		
F4C12	SCS ac power group 1 C412	0, 20 amps		
F4C18	Current drawn from C418	0, 20 amps		
F4C24	Current drawn from C424	0, 20 amps		
F4C07	Current drawn from C407	0, 20 amps		
F4C13	Current drawn from C413	0, 20 amps		

Table 6-46. Electrical Power System — EPS Control Logic (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F4C19	Current drawn from C419	0, 20 amps		
F4C25	Current drawn from C425	0, 20 amps		
G4C28	Current drawn from C15A5CB93	0, 20 amps		
F4C08	Current drawn from C408	0, 20 amps		
F4C14	Current drawn from C419	0, 20 amps		
F4C20	Current drawn from C420	0, 20 amps		
P4C30	Current drawn from C430	0, 20 amps		
P4C31	Current drawn from C431	0, 20 amps		
G4C29	Current drawn from C15A5CB62	0, 20 amps		
CDCVPLB	Postlanding battery voltage	0, 20 volts		X
C4C76	Inverter 1 dc input current	0, 20 volts		
C5C01	Inverter 2 dc input current	0, 20 volts		
C4C77	Inverter 3 dc input current	0, 20 volts		
C5C02	Inverter 3 bus B dc input current	0, 20 volts		
C4C78	Battery charger—bus A dc input current	0, 20 volts		
C5C03	Battery charger—bus B dc input current	0, 20 volts		
C4C96	Nonessential bus current	0, 20 volts		
C4C93	F/C 1 control motor current	0, 20 volts		
C4C94	F/C 2 control motor current	0, 20 volts		
C4C95	F/C 3 control motor current	0, 20 volts		
C2C50	F/C 1 ac pump current phase	0, 20 amps		
C2C51	F/C 2 ac pump current phase	0, 20 amps		
C2C52	F/C 3 ac pump current phase	0, 20 amps		
C5C53	Batt charger ac current phase	0, 20 amps		
H4C33	SCS group 1 AC 2 loading			
H4C38	SCS group 2 AC 2 loading			
N050	Tank 1 O_2 blower current on			
N051	Tank 2 O_2 blower current on			
N070	Tank 1 H_2 blower current on			
N071	Tank 2 H_2 blower current on			

Table 6-47. Electrical Power System — EPS DC Buses

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CEFC1	Open circuit voltage of fuel cell 1	0, 40 volts		
CEFC2	Open circuit voltage of fuel cell 2	0, 40 volts		
CEFC3	Open circuit voltage of fuel cell 3	0, 40 volts		
CEBA	Open circuit voltage of battery A	0, 40 volts		
CEPLB	Open circuit voltage of postlanding batt	0, 40 volts		
CEBB	Open circuit voltage of battery B	0, 40 ohms		
CRFC1	Internal resistance of fuel cell 1	0.04, 21 ohms		
CRFC2	Internal resistance of fuel cell 2	0.04, 21 ohms		
CRFC3	Internal resistance of fuel cell 3	0.04, 21 ohms		
CRBA	Internal resistance of battery A	0.206, 0.214 ohms		
CRPLB	Internal resistance of postlanding batt	0.206, 0.214 ohms		
CRBB	Internal resistance of battery B	0.206, 0.214 ohms		
CGCMBA	Load conductance on MAIN BUS A	0, 50 MHOS		
CGCMBB	Load conductance on MAIN BUS B	0, 50 MHOS		
CGBBA	Load conductance on BATT BUS A	0, 50 MHOS		
CGPLBB	Load conductance on POSTLANDING BUS	0, 50 MHOS		
CGBBB	Load conductance on BATT BUS B	0, 50 MHOS		
CGBRB	Load conductance on BATT RELAY BUS	0, 50 MHOS		
CGSMBA	Load conductance on S/M BUS A	0, 7 MHOS		
CGSMBB	Load conductance on S/M BUS B	0, 7 MHOS		
CRFC1O1A	Resistance of F/C 1 or quantity 1	0.04, 21.0 ohms		
CRFC2O1A	Resistance of F/C 2 or quantity 1	0.04, 21.0 ohms		
CRFC3O1A	Resistance of F/C 3 or quantity 1	0.04, 21.0 ohms		
CTHVSMA	THEVENIN equiv voltage of S/M BUS A	0, 40 volts		
CTHRSMA	THEVENIN equiv resistance of S/M BUS A	0.01, 1000 ohms		
CTHVSMB	THEVENIN equiv voltage of S/M BUS B	0, 40 volts		
CRFC1O1B	Resistance of F/C 1 or quantity 1	0, 4 ohms		
CRFC2O1B	Resistance of F/C 2 or quantity 1	0, 4 ohms		
CRFC3O1B	Resistance of F/C 3 or quantity 1	0, 4 ohms		
CTHRSMB	THEVENIN equiv resistance of S/M BUS B	0, 1000 ohms		
CVBTCHR	Battery charger voltage	0, 40 volts		
CIBCHR	Current through batt charger	0, 2.5 amps		
CCCT1	Coefficient common terms	0, 1.25		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CCCT2	Coefficient common terms	0, .75		
CNE1C1	Coefficient MN BUS A equation	0, 7.5		
CNE1C2	Coefficient MN BUS A equation	0, 1		
CNE1C3	Coefficient MN BUS A equation	0, 2		
CNE1C4	Coefficient MN BUS A equation	0, 20		
CNE1C5	Coefficient MN BUS A equation	0, 1		
CNE2C1	Coefficient MN BUS B equation	0, 4		
CNE2C2	Coefficient MN BUS B equation	0, 1		
CNE2C3	Coefficient MN BUS B equation	0, 1		
CNE2C4	Coefficient MN BUS B equation	0, 20		
CNE3C1	Coefficient BATT BUS A equation	0, 2.3		
CNE3C2	Coefficient BATT BUS A equation	0, 1.1		
CNE4C1	Coefficient BATT BUS B equation	0, 2.3		
CNE4C3	Coefficient BATT BUS B equation	0, 1.1		
CNE5C1	Coefficient FLIGHT & P/L BUS equation	0, 2.8		
CNE5C3	Coefficient FLIGHT & P/L BUS eq	0, 1.1		
CDCVBRB	Voltage on batt relay bus	0, 40 volts		
CVABACM	Voltage approximation C/M MN BUS A	0, 40 volts		
CVABBCM	Voltage approximation C/M MN BUS B	0, 40 volts		
CVABBA	Voltage approximation BATT BUS A	0, 40 volts		
CVABBB	Voltage approximation BATT BUS B	0, 40 volts		
CVAPLB	Voltage approximately FLIGHT & P/L BATT	0, 40 volts		
CVABH	Node with highest voltage conn to P/L BUS	0, 40 volts		
CDCVBACM	Voltage on MN BUS A	0, 40 volts		
CDCVBBCM	Voltage on MN BUS B	0, 40 volts		
CDCVBBA	Voltage on BATT BUS A	0, 40 volts		
CDCVBBB	Voltage on BATT BUS B	0, 40 volts		
CDCVPLBI	Voltage on FLIGHT & P/L BATT ISO node	0, 40 volts		
CID1	Current from MN BUS A to BATT BUS A	-100, +100 amps		
CID2	Current from MN BUS A to BATT C ISOLATION node	-100, +100 amps		
CID3	Current from MN BUS A to FLIGHT & P/L BUS	0, +20 amps		
CID4	Current from MN BUS B to FLIGHT & P/L BUS	0, +20 amps		
CID5	Current from MN BUS B to BATT C iso node	-100, +100 amps		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CID6	Current from MN BUS B to BATT BUS B	-100, +100 amps		
CID7	Current from BATT BUS A to BATT RELAY BUS	0, +40 amps		
CID8	Current from BATT BUS B to BATT RELAY BUS	0, +40 amps		
CID9	Current from BATT C iso node to FLIGHT & P/L BUS	0, +50 amps		
CIENTBA	Current thru entry BATT A	-20, 120 amps		
CIPLBC	Current thru postlanding batt	-20, 120 amps		
CIENTBB	Current thru entry BATT B	-20, 120 amps		
CISMCMA	Current from S/M BUS A to C/M BUS A	-200, 540 amps		
CISMCMB	Current from S/M BUS B to C/M BUS B	-200, 540 amps		
CDCVBASM	Voltage on S/M BUS A	0, 40 volts		
CDCVBBSM	Voltage on S/M BUS B	0, 40 volts		
CFC1A	Current thru FUEL CELL 1	-10, 360 amps		
CFC2A	Current thru FUEL CELL 2	-10, 360 amps		
CFC3A	Current thru FUEL CELL 3	-10, 360 amps		
CFC1IBA	Current from F/C 1 to S/M BUS A	-100, 180 amps		X
CFC1IBB	Current from F/C 1 to S/M BUS B	-100, 180 amps		X
CFC2IBA	Current from F/C 2 to S/M BUS A	-100, 180 amps		X
CFC2IBB	Current from F/C 2 to S/M BUS B	-100, 180 amps		X
CFC3IBA	Current from F/C 3 to S/M BUS A	-100, 180 amps		X
CFC3IBB	Current from F/C 3 to S/M BUS B	-100, 180 amps		X
CFC1DT	F/C 1 module error temperature	-100, 100°F		
CFC2DT	F/C 2 module error temperature	-100, 100°F		
CFC3DT	F/C 3 module error temperature	-100, 100°F		
CAHBA	Amp-hours BATT A	0, 50 amp-hr		
CAHBB	Amp-hours BATT B	0, 50 amp-hr		
CAHPLB	Amp-hours postlanding batt	0, 50 amp-hr		
CVPYROA	Pyro BATT A voltage	0, 45 volts		
CVPYPOB	Pyro BATT B voltage	0, 45 volts		
CPFC1	Power drawn from FUEL CELL 1	-1000, +14400 watts		
CPFC2	Power drawn from FUEL CELL 2	-1000, +14400 watts		
CPFC3	Power drawn from FUEL CELL 3	-1000, +14400 watts		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CHC1A	Power consumption F/C 1 htr	0, 500 watts		
CHC2A	Power consumption F/C 2 htr	0, 500 watts		
CHC3A	Power consumption F/C 3 htr	0, 500 watts		
CF1C1A	Current from F/C 1	-10, 360 amps		
CF1C2A	Current from F/C 2	-10, 360 amps		
CFC3A	Current from F/C 3	-10, 360 amps		
CHIFC1	Current in F/C 1 low pwr output htr	0, +10 amps		
CHIFC2	Current in F/C 2 low pwr output htr	0, +10 amps		
CHIFC3	Current in F/C 3 low pwr output htr	0, +10 amps		
CECF1	Electrolyte correction factor F/C 1	0, 1		
CECF2	Electrolyte correction factor F/C 2	0, 1		
CECF3	Electrolyte correction factor F/C 3	0, 1		
CWATER1	Accumulated H_2O F/C 1	lb		
CWATER2	Accumulated H_2O F/C 2	lb		
CWATER3	Accumulated H_2O F/C 3	lb		
CK1A00	Forward resistance of a diode	Const 0.005 ohms		
CK1A01	Voltage at breakpoint of batt chgr curve	Const 37 volts		
CK1A02	Current at breakpoint of batt chgr curve	Const 2.09 amps		
CK1A03	Current change between 37 and 0 volts	Const 0.41 amps		
CK1A04	Voltage change between 2.09 and 0 amps	Const 3 volts		
CK1A05	Open circuit voltage of batt chgr	Const 40 volts		
CK1A06	Change in open circuit voltage per F°	Const 0.021 volts/ °F		
CK1A07	Internal resistance at 0°Δt	Const 0.1411 ohms		
CK1A08	Change in resistance per F° at low current	Const 0.001865 ohms/°F		
CK1A09	Change in resistance per F° at high current	Const 0.000525 ohms/°F		
CK1A10	Current at breakpoint in fuel cell curve	Const 20 amps		
CK1A11	Current rating of circuit breaker	Const 80 amps		
CK1A12	Current rating of circuit breaker	Const 10 amps		
CK1A13	Current rating of circuit breaker	Const 20 amps		
CK1A14	Conversion factor - seconds to hours	Const 0.000278 hr/sec		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CK1A15	Open circuit voltage for low loading	Const 33.077 volts		
CK1A16	Ratio of malfunction current to normal current	Const 0.5		
CDETP4	Iteration time	Const 0.4 sec		
CK32	Nominal dc voltage	Const 28 volts		
CK57	Bus overboard by malfunction	Const 500 amps		
CK58	Pyro battery no load voltage	Const 37.2 volts		
CK1A17	Charged open circuit voltage of battery	Const 37.2 volts		
CK1A18	Rate open circuit voltage change of battery	Const 0.0915 volts/ amp-hr		
CK1A19	Internal resistance of charged battery	Const 0.206 ohms		
CK1A20	Rate of change of battery int resistance	Const 0.000228 ohms/amp-hr		
CK1A21	Current rating of circuit breaker	Const 100 amps		
CK1A22	Forward voltage drop of a single diode	Const 0.75 volts		
CK1A23	Forward voltage drop of two diodes in series	Const 1.5 volts		
CK1A25	Current rating of circuit breaker	Const 25 amps		
CK80	Nominal pressure differential (H_2 vs N_2)	Const 8.5 psi		
CK81	Change in nom diff press. moving reaction off electrode	Const 2 psi		
CK82	Pressure differential at which electrolyte floods H_2	Const 6.5 psi		
CK83	Nominal pressure differential (O_2 vs N_2)	Const 10.5 psi		
CK84	Conversion factor	Const 1.3333333		
CK85	Conversion factor	Const 26.925		
CK86	Resistance of F/C low power heater	Const 4.9 ohms		
CK87	Conversion factor	Const 8.9750		
CK88	Electrode contamination rate	Const .00009325 ohms/sec		
CK89	Electrode contamination rate	Const .00223800 ohms/sec		
CK90	Temperature at which in-line htr is activated	Const 380°F		
CK91	Temperature at which in-line htr is deactivated	Const 390°F		
C100	S/M BUS A connected to S/M bus B	Boolean		
C101	Forward current in diode MN BUS B BATT BUS A	Boolean		
C103	Forward current in diode BATT C iso node - MN A	Boolean		
C104	Forward current in diode BATT C iso node - MN B	Boolean		
C106	Forward current in diode MN B - BATT BUS B	Boolean		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C109	C/M bus A connected to C/M BUS B	Boolean		
C110	F/C connected to S/M BUS A	Boolean		
C111	F/C connected to S/M BUS B	Boolean		
C112	F/C 1 connected to S/M BUS A	Boolean		
C113	F/C 2 connected to S/M BUS A	Boolean		
C114	F/C 3 connected to S/M BUS A	Boolean		
C115	Voltage is less than the breakpoint	Boolean		
C116	Closed circuit from MN BUS A to BATT BUS A	Boolean		
C118	Closed ckt from BATT C iso node - MN BUS A	Boolean		
C119	Closed ckt from BATT C iso node - MN BUS B	Boolean		
C121	Closed ckt from MN BUS B to BATT BUS B	Boolean		
C124	Value of C101 from last iteration	Boolean		
C126	Value of C103 from last iteration	Boolean		
C127	Value of C104 from last iteration	Boolean		
C129	Value of C106 from last iteration	Boolean		
C132	Diode current direction unchanged	Boolean		
C147	Average F/C current less than 20 amps	Boolean		
C152	Batt relay bus draws current BATT BUS A and/or B	Boolean		
C153	Batt relay bus draws current BATT BUS B	Boolean		
C151	BATT BUS A voltage = BATT BUS B voltage	Boolean		
C212	PYRO BATT A OK	Boolean		
C213	PYRO BATT B OK	Boolean		
C345	Postlanding bus draws current from MN A	Boolean		
C346	Postlanding bus draws current from MN B	Boolean		
C347	Postlanding bus draws current from BATT BUS B	Boolean		
C348	Postlanding bus draws current from BATT BUS A	Boolean		
C349	F/C 1 H_2N_2 reaction off electrode	Boolean		
C350	F/C 1 O_2N_2 reaction off electrode	Boolean		
C351	F/C 2 H_2N_2 reaction off electrode	Boolean		
C352	F/C 2 O_2N_2 reaction off electrode	Boolean		
C353	F/C 3 H_2N_2 reaction off electrode	Boolean		
C354	F/C 3 O_2N_2 reaction off electrode	Boolean		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C355	Low power htr thermostat - on F/C 1	Boolean		
C356	Low power htr thermostat - on F/C 2	Boolean		
C357	Low-power htr thermostate on - F/C 3	Boolean		
C368	Closed circuit from postlanding bus to BATT C	Boolean		
C369	Postlanding bus draws current from BATT C	Boolean		
C371	F/C 1 electrolyte floods into H_2	Boolean		
C372	F/C 2 electrolyte floods into H_2	Boolean		
C373	Electrolyte floods H_2	Boolean		
C452	Batt C pwr - entry	Boolean		
C458	Batt relay bus - BATT BUS A	Boolean		
C465	Batt relay bus - BATT BUS B	Boolean		
C466	Postlanding bus - BATT BUS B	Boolean		
C467	Batt A pwr - ENTRY	Boolean		
C470	Postlanding bus - BATT BUS B	Boolean		
C471	Postlanding batt - MN BUS B	Boolean		
C472	Batt bus B - MN BUS B	Boolean		
C473	Postlanding bus - MN BUS A	Boolean		
C504	Postlanding bus - MN BUS B	Boolean		
C558	Battery bus A - MN BUS A	Boolean		
C559	Postlanding batt - MN BUS A	Boolean		
C560	Batt B pwr - entry	Boolean		
C611	Non-essential BUS A	Boolean		
C612	Non-essential BUS B	Boolean		
MC163	F/C 2 electrode contamination	Malfunction		
MC103	H_2 supply valve for F/C 2 failed closed	Malfunction		
MC162	F/C 1 electrode contamination	Malfunction		
MC027	PYRO BATT A failed	Malfunction		
MC030	PYRO BATT B failed	Malfunction		
MC031	DC BUS A overload	Malfunction		
MC032	DC BUS A overload	Malfunction		
MC033	Batt bus A overload	Malfunction		
MC034	Batt bus B overload	Malfunction		
MC035	Postlanding bus overload	Malfunction		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MC036	Batt relay bus overload	Malfunction		
MC164	F/C 3 electrode contamination	Malfunction		
C815	Circuit brkr tripped MN BUS A to BATT BUS B	Boolean		
C816	Circuit brkr tripped BATT C iso node - MN A	Boolean		
C817	Circuit brkr tripped postlanding bus - MN A	Boolean		
C818	Circuit brkr tripped postlanding bus - MN B	Boolean		
C819	Circuit brkr tripped BATT C iso node - MN B	Boolean		
C820	Circuit brkr tripped BATT BUS B - MN B	Boolean		
C821	Circuit brkr tripped BATT BUS A - BATT RELAY BUS	Boolean		
C822	Circuit brkr tripped BATT BUS B - BATT RELAY BUS	Boolean		
C825	Circuit brkr tripped BATT A pwr	Boolean		
C826	Circuit brkr tripped BATT C to postlanding bus	Boolean		
C827	Circuit brkr tripped BATT B pwr	Boolean		
CH2PFC1	H_2 regulator pressure F/C 1	0, 80 psia		
CH2PFC2	H_2 regulator pressure F/C 2	0, 80 psia		
CH2PFC3	H_2 regulator pressure F/C 3	0, 80 psia		
CN2PFC1	N_2 regulator pressure F/C 1	0, 80 psia		
CN2PFC2	N_2 regulator pressure F/C 2	0, 80 psia		
CN2PFC3	N_2 regulator pressure F/C 3	0, 80 psia		
CO2PFC1	O_2 regulator pressure F/C 1	0, 80 psia		
CO2PFC2	O_2 regulator pressure F/C 2	0, 80 psia		
CO2PFC3	O_2 regulator pressure F/C 3	0, 80 psia		
CCRFC1	Contamination resistance F/C 1	0, +20 ohms		
CCRFC2	Contamination resistance F/C 2	0, +20 ohms		
CCRFC3	Contamination resistance F/C 3	0, +20 ohms		
CSKTFC1	Module skin temp F/C 1	0, 550°F		
CSKTFC2	Module skin temp F/C 2	0, 550°F		
CSKTFC3	Module skin temp F/C 3	0, 550°F		
CEIFC1	Open circuit voltage - F/C 1	0, 40 vdc		
CEIFC2	Open circuit voltage - F/C 2	0, 40 vdc		
CEIFC3	Open circuit voltage - F/C 3	0, 40 vdc		
CRIFC1	Internal resistance of F/C 1	0.04785, 20.23435 ohms		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CRIFC2	Internal resistance of F/C 2	0.04785, 20.23435 ohms		
CRIFC3	Internal resistance of F/C 3	0.04785, 20.23435 ohms		
C4C76	Inv 1 dc input current	0, 80 amps		
C4C77	Inv 3 mn A input current	0, 80 amps		
C4C78	Batt charger input current - MN A	0, 20 amps		
C5C01	Inv 2 dc input current	0, 80 amps		
C4C79	Mn a floodlight current loading	0, 20 amps		
C4C97	Non-ess bus current loading	0, 20 amps		
C5C02	Inv 3 MN B input current	0, 80 amps		
C5C03	Batt charger input current - MN B	0, 20 amps		
C5C05	MN B floodlight current loading	0, 20 amps		
C4C43	Inv 1 control current loading	0, 20 amps		X
C4C44	Inv 2 control current loading	0, 20 amps		X
C4C45	Inv 3 control current loading	0, 20 amps		X
C4C93	F/C 1 control current loading	0, 20 amps		
C4C94	F/C 2 control current loading	0, 20 amps		
C4C95	F/C 3 control current loading	0, 20 amps		
F4C74	MN A to postlanding bus C474			
F4C75	MN A to postlanding bus C475			
F4C82	Current drawn from C482	0, 1 amps		
E5C11	Current drawn from C15A6CB58			
G4C84	Current drawn from C15A5CB61	0, 2.115 amps		
G4C85	Current drawn from C15A6CB57			
NHCO1	O_2 tank No. 1 heater current			
NHCH1	H_2 tank No. 1 heater current			
G4C90	Current drawn from C15A5CB59	0, 8.80 amps		
G4C91	Current drawn from C15A5CB55	0, 4.546 amps		
G4C92	Current drawn from C15A5CB57	0, 4.75 amps		
H5C35	Direct control MN A current loading	0, 3 amps		
H5C36	PITCH MN A current loading	0, 3 amps		
H5C37	ROLL ch A-C MN A current loading	0, 3 amps		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H5C38	ROLL ch B-D MN A current loading	0, 3 amps		
H5C39	YAW ch B-D MN A current loading (CB15A6CB32)	0, 3 amps		
H5C40	SCS system MN A current loading	0, 3 amps		
R5C41	RCS gauging MN A current loading	0, 4 amps		
R5C42	RCS prop iso MN A current loading	0, 72 amps		
R5C76	RCS heaters in S/M C22-2A70CB2			
R5C78	RCS heaters in S/M C22-2A70CB4			
	Current drawn from C15A6CB32			
P5C48	Current drawn from C15A6CB22	0, 12 amps		
P5C49	Current drawn from C15A6CB28	0, 2 amps		
E5C50	Current drawn from C15A6CB50	0, 5 amps		
H5C71	Jet pwr sw. MN A current loading	0, 3 amps		
F4C99	Current drawn from C15A5CB8	0,		
F5C00	Current drawn from C15A5CB10	0,		
F5C08	Current drawn from C15A5CB2	0, 1 amps		
T5C09	Current drawn from CBA5CB52	0, 2 amps		
G5C10	Current drawn from C15A5CB60	0, 2.115 amps		
NHCO2	O_2 tank 2 htr current	0, 2 amps		
NHCH2	H_2 tank 2 htr current	0, 2 amps		
G5C16	Current drawn from C15A5CB58	0, 8.80 amps		
G5C17	Current drawn from C15A5CB54	0, 4.546 amps		
G5C18	Current drawn from C15A5CB56	0, 4.75 amps		
H5C19	Dir control MN B current loading (C15A6CB41)	0, 3 amps		
H5C21	Roll ch A-C MN B current loading (C15A6CB35)	0, 3 amps		
H5C22	Roll ch B-D MN B current loading (C15A6CB33)	0, 3 amps		
H5C24	SCS system MN B current loading	0, 3 amps		
R5C25	RCS gauging MN B current loading			
R5C26	RCS prop iso MN B current loading			
R5C90	RCS heaters in S/M C22-2A70CB1			
R5C77	RCS heaters in S/M C22-2A70CB3			
H5C20	Current drawn from C15A6CB39	0, 3 amps		
H5C23	Current drawn from C15A6CB31	0, 3 amps		
P5C32	Current drawn from C15A6CB21	0, 12 amps		

Table 6-47. Electrical Power System — EPS DC Buses (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
P5C33	Current drawn from C15A6CB27	0, 2 amps		
E5C34	Current drawn from C15A6CB51	0, 5 amps		
H5C72	JET PWR sw MN B current loading	0, 3 amps		
H2C09A	Pitch gimbal motor current loading MN A	0, 100 amps		
H2C10B	Pitch gimbal motor current loading MN B	0, 100 amps		
H2C11B	Yaw gimbal motor current loading MN B	0, 100 amps		
H2C12A	Yaw gimbal motor current loading MN A	0, 100 amps		
T4C53	Current through C15A5CB47	0 amps const.		
T4C54	Current through C15A5CB45	0 amps const.		
T4C55	Current through C15A5CB46	0 amps const.		
F5C70	Current drawn from C570 (C15A5CB34)	0 amps const.		

Table 6-48. Electrical Power System — EPS Displays

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C231	Inverter 1 failed	Boolean		
C232	Inverter 2 failed	Boolean		
C233	Inverter 3 failed	Boolean		
C234	Inverter 1 smoke	Boolean		
CK26	Inverter frequency	Const 400 cycles-sec		
CK27	Inv frequency drift amplitude	Const 7 cycles-sec		
CK28	Inv frequency drift frequency	Const 0.4π radians		
CK29	Inv 2 freq - synchronization lost	Const 405 cycles-sec		
CK30	Inv 3 - freq - synchronization lost	Const 396 cycles-sec		
CK31	Temp battery case	Const 80°F		
CK32	DC sequence batt voltage	Const 28 volts		
CK33	Press batt comp manifold	Const 15 psia		
CK34	Battery charger scale factor	Const 20 psia		
CK36	AC voltmeter scaling scope (90 to 130 vac)	Const 0.24 dc volts-ac volts		
CK39	AC frequency meter scaling slope (380 to 420 cycles)	Const 0.2449 dc volts-cycles		
CK43	DC voltmeter scaling scope (20 to 45 vdc)	Const 0.384 dc volts-dc volts		
CK45	DC voltmeter reads low by 25%	Const 0.75		
CK46	DC ammeter scaling slope	Const 0.1 dc volts/amps		
CK47	Hydrogen flowmeter scaling slope	Const 50. dc volts/lb-hr		
CK48	Hydrogen flowmeter reads high by 150%	Const 1.5		
CK49	Oxygen flowmeter scaling slope	Const 6.25 dc volts/lb-hr		
CK50	Minimum skin temp readable on meter	75°F		
CK51	Skin temp meter scaling slope (75° to 400°F)	0.01538 vdc/°F		
CK52	Skin temp meter scaling slope (400° to 550°F)	0.03333 vdc/°F		
CK53	Skin temp meter scaling intercept (400° to 550°F)	5.833 vdc		
CK54	Skin temp meter scaling breakpoint (400° to 550°F)	400°F		
CK55	Cond exhaust temp meter scaling slope	0.1 vdc/°F		

Table 6-48. Electrical Power System — EPS Displays (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CK56	Minimum cond exhaust temp reading	150°F		
CK13	Zero	0		
CK60	Minimum ac voltage readable on meter	88.333 vac		
CK61	Minimum ac frequency readable on meter	379.167 cps		
CK62	Minimum dc voltage readable on meter	18.958 vdc		
CK70	Inverter heat production factor	$0.553 \frac{\text{ft-lb}}{\text{watt-sec}}$		
CK71	Inverter heat conduction factor	$39.63 \frac{\text{ft-lb}}{°\text{F-sec}}$		
CK72	Inverter temp gradient factor	$0.000157 \frac{°\text{F}}{\text{ft-lb}}$		
CK73	Inverter temp increase by malfunction	50°F		
CK74	Inverter fail temp	150°F		
CK75	Inverter 2 frequency decreased by malf	380 cps		
CK76	Inverter 3 frequency increased by malf	420 cps		
CVACB1PA	AC voltage bus 1 phase A	0, 150 volts		
CVACB1PB	AC voltage bus 1 phase B	0, 150 volts		
CVACB1PC	AC voltage bus 1 phase C	0, 150 volts		
CVACB2PA	AC voltage bus 2 phase A	0, 150 volts		
CVACB2PB	AC voltage bus 2 phase B	0, 150 volts		
CVACB2PC	AC voltage bus 2 phase C	0, 150 volts		
CFACB1PA	AC frequency bus 1 phase A	420 cycles/sec		
CFACB2PA	AC frequency bus 2 phase A	420 cycles/sec		
CTBCASA	Temp battery A case	250°F		
CTBCASB	Temp battery B case	250°F		
CVSBA	DC sequence battery A voltage	45 volts		
CVSBB	DC sequence battery B voltage	45 volts		
CPBCMAN	Battery comp manifold pressure	50 psia		
CTIME	Time	0, sec		
CN2PFC1	F/C 1 nitrogen regulator press	0, 80 psia		
CN2PFC2	F/C 2 nitrogen regulator press	0, 80 psia		
CN2PFC3	F/C 3 nitrogen regulator press	0, 80 psia		
CH2PFC1	F/C 1 hydrogen regulator press	0, 80 psia		
CH2PFC2	F/C 2 hydrogen regulator press	0, 80 psia		
CH2PFC3	F/C 3 hydrogen regulator press	0, 80 psia		

Table 6-48. Electrical Power System — EPS Displays (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CO2PFC1	F/C 1 oxygen regulator press	0, 80 psia		
CO2PFC2	F/C 2 oxygen regulator press	0, 80 psia		
CO2PFC3	F/C 3 oxygen regulator press	0, 80 psia		
CPHFC1	F/C 1 water pH factor	0, 12		
CPHFC2	F/C 2 water pH factor	0, 12		
CPHFC3	F/C 3 water pH factor	0, 12		
CWDH2FC1	F/C 1 hydrogen flow rate	0, 1.9 lb/hr		
CWDH2FC2	F/C 2 hydrogen flow rate	0, 1.9 lb/hr		
CWDH2FC3	F/C 3 hydrogen flow rate	0, 1.9 lb/hr		
CWDO2FC1	F/C 1 oxygen flow rate	0, 7.9 lb/hr		
CWDO2FC2	F/C 2 oxygen flow rate	0, 7.9 lb/hr		
CWDO2FC3	F/C 3 oxygen flow rate	0, 7.9 lb/hr		
CETFC1	F/C 1 condenser exh temp	0, 250°F		
CETFC2	F/C 2 condenser exh temp	0, 250°F		
CETFC3	F/C 3 condenser exh temp	0, 250°F		
CSKTFC1	F/C 1 module skin temp	0, 550°F		
CSKTFC2	F/C 2 module skin temp	0, 550°F		
CSKTFC3	F/C 3 module skin temp	0, 550°F		
CTINV1	Inverter 1 temperature	0, 248°F		
CTINV2	Inverter 2 temperature	0, 248°F		
CTINV3	Inverter 3 temperature	0, 248°F		
CFINV1	Inverter 1 frequency	0, 420 cycles/sec		
CFINV2	Inverter 2 frequency	0, 420 cycles/sec		
CFINV3	Inverter 3 frequency	0, 420 cycles/sec		
CVPAACB1	AC voltage bus 1 phase A - T/M	0, 150 volts		
CVPBACB1	AC voltage bus 1 phase B - T/M	0, 150 volts		
CVPCACB1	AC voltage bus 1 phase C - T/M	0, 150 volts		
CVPAACB2	AC voltage bus 2 phase A - T/M	0, 150 volts		
CVPBACB2	AC voltage bus 2 phase B - T/M	0, 150 volts		
CVPCACB2	AC voltage bus 2 phase C - T/M	0, 150 volts		
CVDCBACM	DC voltage main bus A C/M - T/M	0, 45 volts		
CVDCBBCM	DC voltage main bus B C/M - T/M	0, 45 volts		
CVDCBBA	DC voltage battery bus A - TM	0, 45 volts		

Table 6-48. Electrical Power System — EPS Displays (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CVDCBBB	DC voltage battery bus B - TM	0, 45 volts		
CPLBCV	Postlanding battery C voltage - T/M	0, 45 volts		
CPYROAV	Pyro battery A voltage - T/M	0, 45 volts		
CPYROBV	Pyro battery B voltage - T/M	0, 45 volts		
CFPAACB1	AC frequency bus 1 phase A - T/M	0, 420 cycles/sec		
CFPAACB2	AC frequency bus 2 phase A - T/M	0, 420 cycles/sec		
CVDCBRB	DC voltage battery relay - T/M	0, 45 volts		
CFC1N2P	F/C 1 nitrogen reg press. - T/M	0, 80 psia		
CFC2N2P	F/C 2 nitrogen reg. press. - T/M	0, 80 psia		
CFC3N2P	F/C 3 nitrogen reg. press. - T/M	0, 80 psia		
CFC1H2P	F/C 1 hydrogen reg. press. - T/M	0, 80 psia		
CFC2H2P	F/C 2 hydrogen reg. press. - T/M	0, 80 psia		
CFC3H2P	F/C 3 hydrogen reg. press. - T/M	0, 80 psia		
CFC1O2P	F/C 1 oxygen reg. press. - T/M	0, 80 psia		
CFC2O2P	F/C 2 oxygen reg. press. - T/M	0, 80 psia		
CFC3O2P	F/C 3 oxygen reg. press. - T/M	0, 80 psia		
CFC1PH	F/C 1 water pH factor	0, 12		
CFC2PH	F/C 2 water pH factor	0, 12		
CFC3PH	F/C 3 water pH factor	0, 12		
LFC1ROT	F/C 1 radiator outlet temp - T/M	-50, 256°F		
LFC2ROT	F/C 2 radiator outlet temp - T/M	-50, 256°F		
LFC3ROT	F/C 3 radiator outlet temp - T/M	-50, 256°F		
CFC1WDH2	F/C 1 hydrogen flow rate - T/M	0, 1.9 lb/hr		
CFC2WDH2	F/C 2 hydrogen flow rate T/M	0, 1.9 lb/hr		
CFC3WDH2	F/C 3 hydrogen flow rate T/M	0, 1.9 lb/hr		
CFC1WDO2	F/C 1 oxygen flow rate T/M	0, 7.9 lb/hr		
CFC2WDO2	F/C 2 oxygen flow rate T/M	0, 7.9 lb/hr		
CFC3WDO2	F/C 3 oxygen flow rate T/M	0, 7.9 lb/hr		
CFC1CET	F/C 1 condenser exh temp	0, 225°F		
CFC2CET	F/C 2 condenser exh temp	0, 225°F		
CFC3CET	F/C 3 condenser exh temp	0, 225°F		
CFC1SKT	F/C 1 module skin temp - T/M	0, 550°F		
CFC2SKT	F/C 2 module skin temp - T/M	0, 550°F		

Table 6-48. Electrical Power System — EPS Displays (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CFC3SKT	F/C 3 module skin temp - T/M	0, 550°F		
CINVIT	Inverter 1 temperature - T/M	0, 248°F		
CINV2T	Inverter 2 temperature - T/M	0, 248°F		
CINV3T	Inverter 3 temperature - T/M	0, 248°F		
CACVMCM	AC voltmeter - C/M	0, 10 volts		
CACFMCM	AC frequency meter - C/M	0, 10 cycles/sec		
CDCVMCM	DC voltmeter - C/M	0, 10 volts		
CDCAMCM	DC ammeter - C/M	0, 10 amp		
CWDO2MCM	Oxygen flow rate meter - C/M	0, 10 lb/hr		
CWDH2MCM	Hydrogen flow rate meter - C/M	0, 10 lb/hr		
CSKTMCM	Module skin temp meter - C/M	0, 10°F		
CETMCM	Cond exh temp meter - C/M	0, 10°F		
CACVMI	AC voltmeter - IOS	0, 10 volts		
CACFMI	AC frequency meter - IOS	0, 10 cycles/sec		
CDCVMI	DC voltmeter - IOS	0, 10 volts		
CDCAMI	DC ammeter - IOS	0, 10 amps		
CWDO2MI	Oxygen flow rate meter - IOS	0, 10 lb/hr		
CWDH2MI	Hydrogen flow rate meter - IOS	0, 10 lb/hr		
CSKTMI	Module skin temp meter - IOS	0, 10°F		
CETMI	Cond exh temp meter - IOS	0, 10°F		
C901	DC ind F/C-1 IOS	Boolean		
C902	DC ind F/C-2 IOS	Boolean		
C903	DC ind F/C-3 IOS	Boolean		
C904	DC ind MAIN BUS A IOS	Boolean		
C905	DC ind MAIN BUS B IOS	Boolean		
C906	DC ind BATT BUS A	Boolean		
C907	DC ind BATT BUS B	Boolean		
C908	DC ind BATT CHARGER IOS	Boolean		
C909	DC ind BATT POSTLANDING IOS	Boolean		
C910	DC ind PYRO BATT A IOS	Boolean		
C911	DC ind PYRO BATT B IOS	Boolean		
C912	AC ind BUS 1 ØA IOS	Boolean		
C913	AC ind BUS 1 ØB IOS	Boolean		

Table 6-48. Electrical Power System — EPS Displays (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C914	AC ind BUS 1 ØC IOS	Boolean		
C915	AC ind BUS 2 ØA IOS	Boolean		
C916	AC ind BUS 2 ØB IOS	Boolean		
C917	AC ind BUS 2 ØC IOS	Boolean		
C918	FUEL CELL 1 ind IOS	Boolean		
C919	FUEL CELL 2 ind IOS	Boolean		
C920	FUEL CELL 3 ind IOS	Boolean		
MC037	AC voltmeter - open coil	Malfunction		
MC040	AC frequency meter - open coil	Malfunction		
MC042	DC voltmeter - open coil	Malfunction		
MC043	DC voltmeter reads low by 25%	Malfunction		
MC044	DC ammeter - open coil	Malfunction		
MC121	H_2 flowmeter - open coil	Malfunction		
MC126	H_2 flowmeter reads high by 150%	Malfunction		
MC127	O_2 flowmeter - open coil	Malfunction		
MC122	Module skin temp meter - open coil	Malfunction		
MC130	Cond exhaust temp. meter - open coil	Malfunction		
MC057	Inverter 1 failed	Malfunction		
MC007	Inverter 1 internal oscillator failed	Malfunction		
MC006	Inverter 1 smoke	Malfunction		
MC023	Inverter 2 freq low	Malfunction		
MC024	Inverter 3 freq high	Malfunction		
CQPINV1	Heat produced inverter No. 1	0, 1000 ft-lb/ sec		
CQPINV2	Heat produced inverter No. 2	0, 1000 ft-lb/ sec		
CQPINV3	Heat produced inverter No. 3	0, 1000 ft-lb/ sec		
CQINV1	Inverter No. 1 heat output to ECS	-2000, +2000		
CQINV2	Inverter No. 2 heat output to ECS	-2000, +2000		
CQINV3	Inverter No. 3 heat output to ECS	-2000, +2000		
CDTINV1	Inverter No. 1 temp rate	-2.0, +2.0°F/ sec		
CDTINV2	Inverter No. 2 temp rate	-2.0, +2.0°F/ sec		

Table 6-48. Electrical Power System — EPS Displays (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
CDTINV3	Inverter No. 3 temp rate	-2.0, +2.0°F/sec		
CDETI	Iteration time interval	sec		
T360	F/C 1 bus A disconnect T/M	Boolean	GP19-1(D)/145	
T361	F/C 2 bus A disconnect T/M	Boolean	GP19-2(D)/146	
T362	F/C 3 bus A disconnect T/M	Boolean	GP19-3(D)/147	
T363	F/C 1 bus B disconnect T/M	Boolean	GP19-4(D)/148	
T364	F/C 2 bus B disconnect T/M	Boolean	GP19-5(D)/149	
T365	F/C 3 bus B disconnect T/M	Boolean	GP19-6(D)/150	
T366	F/C 1 shutoff monitor (reactants off) T/M	Boolean	GP19-7(D)/151	
T367	F/C 2 shutoff monitor (reactants off) T/M	Boolean	GP19-8(D)/152	
T368	F/C 3 shutoff monitor (reactants off) T/M	Boolean	GP20-1(D)/153	
TT5I1	Temp static inverter 1 T/M	32, 248°F	179(A)/179	
TT5I2	Temp static inverter 2 T/M	32, 248°F	181(A)/181	
TT5I3	Temp static inverter 3 T/M	32, 248°F	183(A)/183	
TTBCA	Temp battery A case T/M	32, 212°F	186(A)/186	
TTBCB	Temp battery B case T/M	32, 212°F	187(A)/187	
TMB1PHA	AC voltage main bus 1 ØA T/M	0, 150 vac	46(A)/46	
TMB1PHB	AC voltage main bus 1 ØB T/M	0, 150 vac	50(A)/50	
TMB1PHC	AC voltage main bus 1 ØC T/M	0, 150 vac	53(A)/53	
TMB2PHA	AC voltage main bus 2 ØA T/M	0, 150 vac	47(A)/47	
TMB2PHB	AC voltage main bus 2 ØB T/M	0, 150 vac	54(A)/54	
TMB2PHC	AC voltage main bus 2 ØC T/M	0, 150 vac	55(A)/55	
TDCMBA	DC voltage main bus A T/M	0, 45 vdc	49(A)/49	
TDCMBB	DC voltage main bus B T/M	0, 45 vdc	51(A)/51	
TDCBBA	DC voltage battery bus A T/M	0, 45 vdc	56(A)/56	
TDCBBB	DC voltage battery bus B T/M	0, 45 vdc	57(A)/57	
TDCVPLB	DC voltage battery bus C T/M	0, 45 vdc	60(A)/60	
TFB1PHA	Frequency AC BUS 1 ØA T/M	380, 420 cps	188(A)/188	
TDCCBC	DC current battery charger out T/M	0, 5 amps	52(A)/52	
TFB2PHA	Frequency AC BUS 2 ØA T/M	380, 420 cps	190(A)/190	
TDCCBA	DC current battery A T/M	0, 100 amps	66(A)/67	
TDCCBB	DC current battery B T/M	0, 100 amps	67(A)/67	

Table 6-48. Electrical Power System — EPS Displays (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TDCCPLB	DC current battery C T/M	0, 100 amps	68(A)/68	
TDCPBA	DC voltage PYRO BATT A T/M	0, 40 vdc	64(A)/64	
TDCPBB	DC voltage PYRO BATT B T/M	0, 40 vac	153(A)/153	
TDCBRB	DC voltage BATT RELAY BUS T/M	0, 45 vdc	59(A)/59	
TPN2FC1	N_2 pressure F/C 1 regulated T/M	0, 75 psia	192(A)/192	
TPN2FC2	N_2 pressure F/C 2 regulated T/M	0, 75 psia	194(A)/194	
TPN2FC3	N_2 pressure F/C 3 regulated T/M	0, 75 psia	195(A)/195	
TPO2FC1	O_2 pressure F/C 1 regulated T/M	0, 75 psia	69(A)/69	
TPO2FC2	O_2 pressure F/C 2 regulated T/M	0, 75 psia	70(A)/70	
TPO2FC3	O_2 pressure F/C 3 regulated T/M	0, 75 psia	73(A)/73	
TPH2FC1	H_2 pressure F/C 1 regulated T/M	0, 75 psia	75(A)/75	
TPH2FC2	H_2 pressure F/C 2 regulated T/M	0, 75 psia	78(A)/78	
TPH2FC3	H_2 pressure F/C 3 regulated T/M	0, 75 psia	79(A)/79	
TTCEFC1	Temp F/C 1 cond exhaust T/M	150, 250°F	171(A)/171	
TTCEFC2	Temp F/C 2 cond exhaust T/M	150, 250°F	173(A)/173	
TTCEFC3	Temp F/C 3 cond exhaust T/M	150, 250°F	176(A)/176	
TTSKFC1	Temp F/C 1 skin exhaust T/M	80, 550°F	189(A)/189	
TTSKFC2	Temp F/C 2 skin exhaust T/M	80, 550°F	191(A)/191	
TTSKFC3	Temp F/C 3 skin T/M	80, 550°F	193(A)/193	
TTROFC1	Temp F/C 1 radiator outlet T/M	-50, 300°F	196(A)/196	
TTROFC2	Temp F/C 2 radiator outlet T/M	-50, 300°F	197(A)/197	
TTROFC3	Temp F/C 3 radiator outlet T/M	-50, 300°F	199(A)/199	
TDCIFC1	DC current F/C 1 output T/M	0, 100 amp	61(A)/61	
TDCIFC2	DC current F/C 2 output T/M	0, 100 amp	63(A)/63	
TDCIFC3	DC current F/C 3 output T/M	0, 100 amp	65(A)/65	
TWDH2FC1	Flow rate H_2 F/C 1 T/M	0, 0.2 lb/hr	80(A)/80	
TWDH2FC2	Flow rate H_2 F/C 2 T/M	0, 0.2 lb/hr	81(A)/81	
TWDH2FC3	Flow rate H_2 F/C 3 T/M	0, 0.2 lb/hr	82(A)/82	
TWDO2FC1	Flow rate O_2 F/C 1 T/M	0, 1.6 lb/hr	85(A)/85	
TWDO2FC2	Flow rate O_2 F/C 2 T/M	0, 1.6 lb/hr	87(A)/87	
TWDO2FC3	Flow rate O_2 F/C 3 T/M	0, 1.6 lb/hr	89(A)/89	
TPHFC1	pH factor water cont F/C 1 T/M	6, 12 pH	GP37-5(D)/293	

Table 6-48. Electrical Power System — EPS Displays (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TPHFC2	pH factor water cond F/C 2 T/M	6, 12 pH	GP37-6(D)/294	
TPHFC3	pH factor water cond F/C 3 T/M	6, 12 pH	GP37-7(D)/295	
TDCVBC	DC volt batt charger output T/M	0, 45 vdc	62(A)/62	

Table 6-49. Electrical Power System — Space Radiators

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
LMUFF11	ECS coolant viscosity, RADIATOR 1, SECTION 1	.00315, 0.1104 lb/ft sec		
LMUFF12	ECS coolant viscosity, RADIATOR 1, SECTION 2	.00315, 0.1104 lb/ft sec		
LMUFF21	ECS coolant viscosity, RADIATOR 2, SECTION 1	.00315, 0.1104 lb/ft sec		
LMUFF22	ECS coolant viscosity, RADIATOR 2, SECTION 2	.00315, 0.1104 lb/ft sec		
LFC1WDR	FUEL CELL 1, coolant flow rate	0, 0.05 lb/sec		
LFC2WDR	FUEL CELL 2, coolant flow rate	0, 0.05 lb/sec		
LFC3WDR	FUEL CELL 3, coolant flow rate	0, 0.05 lb/sec		
LRF11	Flow conductance, ECS RADIATOR 1, SECTION 1	0, 3.9×10^{-4} sec/ft^2		
LRF12	Flow conductance, ECS RADIATOR 1, SECTION 2	0, 2.7×10^{-4} sec/ft^2		
LRF21	Flow conductance, ECS RADIATOR 2, SECTION 1	0, 3.9×10^{-4} sec/ft^2		
LRF22	Flow conductance, ECS RADIATOR 2, SECTION 2	0, 2.7×10^{-4} sec/ft^2		
L205	1 if all solenoid valves are open (flow possible closing)			
LRFF	ECS radiator flow resistance	0, 0.1336×10^{6} sec/ft^2		
LPOF	Pressure drop across ECS radiators	0, 9352 lb/ft^2		
LWD11	ECS RADIATOR 1, SECTION 1 flow rate	0, 0.07 lb/sec		
LWD12	ECS RADIATOR 1, SECTION 2 flow rate	0, 0.07 lb/sec		
LWD21	ECS RADIATOR 2, SECTION 1 flow rate	0, 0.07 lb/sec		
LWD22	ECS RADIATOR 2, SECTION 2 flow rate	0, 0.07 lb/sec		
*UXVSUN	X_{I_E} component of sun's direction from earth	-1, +1		
*UYVSUN	Y_{I_E} component of sun's direction from earth	-1, +1		
*UZVSUN	Z_{I_E} component of sun's direction from earth	-1, +1		
LY	Component of vehicle position 11 to terminator	20.8×10^{6}, 1.358×10^{6}		
R_E	Radius of earth			
LSP	Energy received by vehicle directly from sun	0, 442.39 Btu/hr-ft^2		
LFRE	View factor of spacecraft with respect to earth	0, 1		
LNU1I	I_E -frame X component or EPS RADIATOR 1 normal	-1, 1		

*Program symbols are not available at date of publication.
Math model symbols are given for information only.

Table 6-49. Electrical Power System — Space Radiators (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
LNU1J	I_E-frame Y component of EPS RADIATOR 1 normal	-1, 1		
LNU1K	I_E-frame Z component of EPS RADIATOR 1 normal	-1, 1		
LNU1I	I_E-frame X component of EPS RADIATOR 2 normal	-1, 1		
LNU2J	I_E-frame Y component of EPS RADIATOR 2 normal	-1, +1.0		
LNU2K	I_E-frame Z component of EPS RADIATOR 2 normal	-1, +1.0		
LFNU1I	I_E-frame X component of ECS RADIATOR 1 normal	-1, +1.0		
LFNU1J	I_E-frame Y component of ECS RADIATOR 1 normal	-1, +1.0		
LFNU1K	I_E-frame Z component of ECS RADIATOR 1 normal	-1, +1.0		
LFNU2I	I_E-frame X component of ECS RADIATOR 2 normal	-1, +1.0		
LFNU2T	I_E-frame Y component of ECS RADIATOR 2 normal	-1, +1.0		
LFNU2K	I_E-frame Z component of ECS RADIATOR 2 normal	-1, +1.0		
LCOSS1	Cosine of the angle between the normal to EPS RADIATOR 1 and the unit vector from vehicle to sun	0, +1		
LCOSS2	Cosine of the angle between the normal to EPS RADIATOR 2 and the unit vector from vehicle to sun	0, +1		
LFCOSS1	Cosine of the angle between the normal to ECS RADIATOR 1 and the unit vector from vehicle to sun	0, +1		
LFCOSS2	Cosine of the angle between the normal to ECS RADIATOR 2 and the unit vector from vehicle to sun	0, +1		
LAA	I_E frame direction cosine of vector from earth to vehicle	±1		
LBB	I_E frame direction cosine of vector from earth to vehicle	±1		
LCC	I_E frame direction cosine of vector from earth to vehicle	±1		
LCOSE1	Cosine of the angle between the normal to EPS RADIATOR 1 and the unit vector from vehicle to earth	0, +1		
LCOSE2	Cosine of the angle between the normal to EPS RADIATOR 2 and the unit vector from vehicle to sun	0, +1		
LFCOSE1	Cosine of the angle between the normal to ECS RADIATOR 1 and the unit vector from vehicle to earth	0, +1		
LFCOSE2	Cosine of the angle between the normal to ECS RADIATOR 2 of the unit vector from vehicle to earth	0, +1		
LAREAS1	EPS RADIATOR 1, area perpendicular to sun	0, 44 ft^2		
LAREAS2	EPS RADIATOR 2, area perpendicular to sun	0, 44 ft^2		
LFAREAS1	ECS RADIATOR 1, area perpendicular to sun	0, 30 ft^2		
LFAREAS2	ECS RADIATOR 2, area perpendicular to sun	0, 30 ft^2		
LAREAE1	EPS RADIATOR 1, area perpendicular to earth	0, 44 ft^2		
LAREAE2	EPS RADIATOR 2, area perpendicular to earth	0, 44 ft^2		

Table 6-49. Electrical Power System — Space Radiators (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
LFAREAE1	ECS RADIATOR 1, area perpendicular to earth	0, 30 ft^2		
LFAREAE2	ECS RADIATOR 2, area perpendicular to earth	0, 30 ft^2		
LCOSSE	Cosine of reflection angle of sunlight from earth	0, 30 ft^2		
LET1	Energy received by EPS RADIATOR 1 from environment	0, 2.5 Btu/sec		
LET2	Energy received by EPS RADIATOR 2 from environment	0, 2.5 Btu/sec		
LFET1	Energy received by ECS RADIATOR 1 from environment	0, 2.0 Btu/sec		
LFET2	Energy received by ECS RADIATOR 2 from e nvironment	0, 2.0 Btu/sec		
LTDRAD1	Time derivative of EPS RADIATOR 1 temperature	-128, +128		
LTDRAD2	Time derivative of EPS RADIATOR 2 temperature	-128, +128°F/sec		
LFTDRAD1	Time derivative of ECS RADIATOR 1 temperature	-128, +128°F/sec		
LFTDRAD2	Time derivative of ECS RADIATOR 2 temperature	-128, +128°F/sec		
LTDOUT11	Time derivative of EPS RADIATOR 1, COOLANT 1 outlet temperature	-128, +128°F/sec		
LTDOUT12	Time derivative of EPS RADIATOR 1, COOLANT 2 outlet temperature	-128, +128°F/sec		
LTDOUT13	Time derivative of EPS RADIATOR 1, COOLANT 3 outlet temperature	-128, +128°F/sec		
LTDOUT21	Time derivative of EPS RADIATOR 2, COOLANT 1 outlet temp	-128, +128°F/sec		
LTDOUT22	Time derivative of EPS RADIATOR 2, COOLANT 2 outlet temp	-128, +128°F/sec		
LTDOUT23	Time derivative of EPS RADIATOR 2, COOLANT 3 outlet temp	-128, +128°F/sec		
LTDOTF11	Time derivative of ECS RADIATOR 1, SECTION 1 cool out temp	-128, +128°F/sec		
LTDOTF12	Time derivative of ECS RADIATOR 1, SECTION 2 cool out temp	-128, +128°F/sec		
LTDOTF21	Time derivative of ECS RADIATOR 2, SECTION 1 cool out temp	-128, +128°F/sec		
LTDOTF22	Time derivative of ECS RADIATOR 2, SECTION 2 cool out temp	-128, +128°F/sec		
LROTFC1	FUEL CELL 1 coolant temp from RADIATOR 2	-50, 256°F		
LROTFC2	FUEL CELL 2 coolant temp from RADIATOR 2	-50, 256°F		
LROTFC3	FUEL CELL 3 coolant temp from RADIATOR 2	-50, 256°F		
LTGP	ECS coolant temperature into RADIATOR 1 and 2	-50, 256°F		
FTGP	ECS coolant temperature into RADIATOR 1 and 2	409, 716°R		
LFFROT	ECS coolant temperature after mixing	-64, 256°F		

Table 6-49. Electrical Power System — Space Radiators (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
LTRAD1	EPS RADIATOR 1, temperature	-64, 256°F		
LTRAD2	EPS RADIATOR 2, temperature	-64, 256°F		
LTOUT11	EPS RADIATOR 1, COOLANT 1 outlet temp	-64, 256°F		
LTOUT12	EPS RADIATOR 1, COOLANT 2 outlet temp	-64, 256°F		
LTOUT13	EPS RADIATOR 1, COOLANT 3 outlet temp	-64, 256°F		
LFTRAD1	ECS RADIATOR 1 temperature	-64, 256°F		
LFTRAD2	ECS RADIATOR 2 temperature	-64, 256°F		
CFC1TRI	EPS RADIATOR 1, COOLANT 1, inlet temp	0, 256°F		
CFC2TRI	EPS RADIATOR 1, COOLANT 2, inlet temp	0, 256°F		
CFC3TRI	EPS RADIATOR 1, COOLANT 3, inlet temp	0, 256°F		
C250	FUEL CELL 1 coolant pump on	0, 1		
C251	FUEL CELL 2 coolant pump on	0, 1		
C252	FUEL CELL 3 coolant pump on	0, 1		
MC116	FUEL CELL 1 coolant pump failed	0, 1		
LTOUTF11	ECS coolant temperature RADIATOR 1, SECTION 1	-128, +256°F		
LTOUTF12	ECS coolant temperature RADIATOR 1, SECTION 2	-128, +256°F		
LTOUTF21	ECS coolant temperature RADIATOR 2, SECTION 1	-128, +256°F		
LTOUTF22	ECS coolant temperature RADIATOR 2, SECTION 2	=128, +256°F		
LT	Term for simplifying equation L86	0, 18 (lb/sec)(°F)		

Table 6-50. Environmental Control System—Oxygen

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FWD56	Net flow out of oxygen supply manifold	0.0, 0.0160 lb/m/sec		
FWD56C	Input to oxygen flowmeter	0.0, 1.0 lb/m/hr	219(A)/219	X
MF016	Oxygen flowmeter fails	Malfunction		
FWD08	Total oxygen flow from CSS	0.0, 0.0010 lb/m/sec		
MF021	O_2 pressure regulator 1 fails closed	Malfunction		
MF022	O_2 pressure regulator 2 fails closed	Malfunction		
F094	O_2 pressure regulator selector on 1	Boolean		
F095	O_2 pressure regulator selector on 2	Boolean		
F800	There is oxygen flow through regulators	Boolean		
FP06	Gauge pressure in oxygen supply line	0.0, 1050.0 lb/in.^{2}		
F801	If equal to 1 O_2 relief flow is possible	Boolean		
MF020	O_2 pressure regulator No. 1 fails open	Malfunction		
MF023	O_2 pressure regulator No. 2 fails open	Malfunction		
FWD37	Oxygen flow through relief valves	0.0, 0.0050 lb/m		
FWD01	Total oxygen flow through O_2 regulator assembly	0.0, 0.0210 lb/m		
F093	ECS-CSS isolation valve is open	Boolean		
FWD04	Oxygen accumulation rate in supply line	-0.021, +0.021 lb/sec		
FT08	Temperature of O_2 downstream of CSS ISO VAL	0.0, 600.0°R		
F802	1 if FWD04 is positive or zero			
F168	1 if surge tank isolation valve is open			
FWD05	Oxygen flow into surge tank	0.0, 0.021 lb/m/sec		
FWD02	Oxygen flow out of surge tank	0.0, 0.021 lb/m/sec		
FWD03	Oxygen accumulation rate in surge tank	-0.021, 0.021 lb/m/sec		
FW03	Mass of oxygen in surge tank	0.0, 3.60 lb/m		X
FTD22	Oxygen temperature in surge tank	0.0, 800.0°R		X
FT03	Cabin air temperature	0.0, 600.0°R		
FTD22	Rate of change of O_2 temp in surge tank	-5, +5°R/sec		
FP03	Pressure of oxygen in surge tank	0.0, 1050.0 lb/in.^{2}		
F803	Used to obtain FP04 as function of FP06			

Table 6-50. Environmental Control System—Oxygen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FP04	Oxygen pressure in supply manifold	0.0, 150.0 lb/in.^{2}		
FT14	Temperature of oxygen in supply manifold	0.0, 800.0°R		
FWD565	Sensor output indicated flow rate	0.2, 50.00 lb/m/hr		
FP03TLM	O_2 surge tank pressure, output to T/M	0.0, 1050.0 psia		
FP04TLM	O_2 regulator supply outlet pressure, output to T/M	0.0, 150.0 psia		
FK1	Conversion factor—seconds to hours	Const 3000 sec/hr		
FK2	Limit above which an alarm is actuated	Const 0.002.08333 lb_m/sec		
FK3	Minimum supply line pressure to function relief valve	Const 120 lb_f/in.^{2}		
FK4	Maximum relief flow of oxygen	Const 0.005 lb_m/sec		
FK5	Y intercept on the plot of FT08 versus NFTOL	Const 358.160°R		
FK6	Slope of curve FT08 versus NFTOL	Const 0.324		
FK7	Change in S.L. pressure per unit change in mass	Const 2.0000 lb_f - sec/lb_m-in.^{2}		
FK8	Limit above which O_2 regulators function	Const 150.0 lb_f/in.^{2}		
FK9	Change in manifold pressure per unit change in mass	Const 2000.0 lb_f-sec/lb_m-in.^{2}		
FK10	Normal oxygen manifold gauge pressure	Const 100.0 lb/in.^{2}		
FK11	O_2 manifold gauge pressure when FP06 < FK8 + FP05	Const 0.66666		
FK12	Multiple factor for O_2 manifold pressure - no relief flow	Const 1.0		
FK13	Multiple factor for O_2 manifold pressure - relief flow	Const 0.2		
FK14	O_2 manifold pressure drop per unit change in mass	Const 9.0		
FK15	Prevents FT14 to approach infinity if flow is zero	Const 0.00000001 lb_m/sec		
FK16	O_2 manifold temp drop per unit change in mass	Const 6000.0°R-sec/lb_m		
FK17	Specific gas gas constant ÷ surge tank volume	Const 0.51070 lb_f/lb_m-in.^{2}-°R		
FK18	GAMMA = CP ÷ CV	Const 1.390		
FK19	GAMMA minus one	Const 0.39		
FK20	Temperature change due to cabin S.T. heat transfer	Const 0.00083333 1/sec		
FDETP8	Time difference per iteration	Const 0.8 sec		
FK99	Maximum flow rate indicated on flow rate indicator	Const 1.0 lb/sec		

Table 6-50. Environmental Control System—Oxygen (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FWDSTC	Mass flow from surge tank leak to cabin	0, 5.0 lb/hr		
FK26	O_2 supply manifold flow constant	0, 5.0 lb/hr		
FK25	S/M O_2 supply regulator valve 2 leak constant	0, 5.0 lb/hr		
MF057	Surge tank leak = 1/7 max malfunction	Boolean		
MF067	Surge tank leak = 2/7 max malfunction	Boolean		
MF070	Surge tank leak = 4/7 max malfunction	Boolean		
MF076	S/M supply regulator valve 2 fails leaking	Boolean		
FK22	Surge tank leak constant = 1/7 max	Const 0.5 lb/hr		
FK23	Surge tank leak constant = 2/7 max	Const 1.0 lb/hr		
FK24	Surge tank leak constant = 4/7 max	Const 2.0 lb/hr		
TPST	O_2 surge tank pressure, scaled for TM	+50, +1050 psia	212(A)/212	
TPO2REG	O_2 regulated supply outlet pressure scaled for TM	0, +150 psia	230(A)/230	

Table 6-51. Environmental Control System - Water Supply

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FVD01	Volumetric flow rate of oxygen out of water system	ft^3/sec		
FK1W	Specific volume of water	Const 0.0164 ft^3-lb		
FK2W	Specific volume of water-glycol	Const 0.0145 ft^3-lb		
FV01	Volume of oxygen in water storage system	0, 3.0 ft^3		X
FDETP8	Iteration period	Const 0.8 sec		
FDETP8N	Non-frozen iteration interval	Const 0.8 sec		
F820	Flow possible from oxygen system to water system	Boolean		
F127	Tank inlet oxygen reg. select position No. 1	Boolean		
F128	Tank inlet oxygen reg. select position No. 2	Boolean		
F130	Tank outlet oxygen reg. select position 1	Boolean		
F131	Tank outlet oxygen reg. select position 2	Boolean		
FK6W	Norm. water system oxy. pressure	Const 20 $lb/in.^2$		
FP07	Water system pressure	0, 100 $lb/in.^2$		
FP05	Cabin pressure	$lb/in.^2$		
FK3W	Pressure stab. rate through relief valve	Const 0.2 lb/sec		
FK4W	Relief valve crack pressure	Const 25 $lb/in.^2$		
FK5W	Press. stab. rate through regulator	Const 0.5 lb/sec		
FK7W	Gas const for oxygen	Const .335416 $ft^3/°R\text{-}in.^2$		
FT03	Cabin air temperature	°R		
FW07L	Last computed value of FW07	0, 0.1 lb		
FW07	Weight of oxygen in water sys.	0, 0.1 lb		
FWD06	Mass flow rate of oxygen into water sys.	0, 0.01 lb/sec		
FWD12	Mass flow rate of oxygen thru relief valves	0, 0.01 lb/sec		
FCD2OWD	Flow rate of water poss. from fuel cells	lb/sec		
F821	Fuel cell water flows into potable tank	Boolean		
F104	Potable water shutoff ON	Boolean		
FK8W	Max. capacity of potable tank	Const 35 lb		
FK9W	Water relief valve crack pressure	Const 35 $lb/in.^2$		
FD10W	Fuel cell flow stop back pressure	Const 56 $lb/in.^2$		
F107	Water relief manual valve position 1	Boolean		
F108	Water relief manual valve position 2	Boolean		
FLB3	Fuel cell water flows into waste tank	Boolean		
F133	Potable water relief valve ON	Boolean		

Table 6-51. Environmental Control System - Water Supply (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK11W	Maximum capacity of waste tank	Const 56 lb		
FK12W	Eff water r.y. crack press. for waste tank	Const 29 lb/in.^{2}		
FK13W	Eff waste tank back pressure to stop fuel cell flow	Const 50 lb/in.^{2}		
F823	Fuel cell water flow possible	Boolean		
FWD16	Net flow rate of water into potable tank	±0.6 lb/sec		
F105	H_2O valve - potable water drain OPEN	Boolean		
FK14W	Potable water drain normal flow rate	Const 0.25 lb/sec		
FK15W	Drinking water and food probe normal el. rate	Const 0.0625 lb/sec		
F151	Drinking water cont. valve ON	Boolean		
F110	Food probe water valve HOT	Boolean		
F111	Food probe water valve COLD	Boolean		
FW20	Weight of water in potable tank	0, 40.0 lb		
FW20TLM	Telemetry signal for potable tank	0, 36.0 lb		
F825	Potable water available	Boolean		
FT31	Food probe water heater temperature	-100, +200°F		
FK19W	Temperature rate due to large heater	Const 0.013272°F/ sec		
FK20W	Temperature rate due to small heater	Const 0.0037922 °F/sec		
FK17W	Temperature rate due to conduction	Const 0.0001°F/sec		
FK18W	Temperature rate due to water flow	Const 2.25°F/sec		
F828	Power available for water heaters	Boolean		
C482	Water heater CBA ON	Boolean		
C508	Water heater CB ON	Boolean		
F826	Food probe large heater ON	Boolean		
FK21W	Large heater upper limit	Const 155°F		
FK22W	Large heater lower limit	Const 153°F		
F827	Food probe small water heater ON	Boolean		
FK23W	Small heater upper limit	Const 159°F		
FK24W	Small heater lower limit	Const 157°F		
F4C82	Elect. loading on cb C482	0, 2.0 amps		
FK25W	One-half current drawn by large heater	Const 0.678 amps		
FK26W	One-half current drawn by small heater	Const 0.1923 amps		
F5C08	Elect. loading on cb C508	0, 2.0 amps		

Table 6-51. Environmental Control System - Water Supply (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FWD17	Net flow rate of water into waste tank	±1 lb/sec		
F106	Waste tank drain ON	Boolean		
FWD23	Flow rate of water required for glycol cooling	0, 0.1 lb/sec		
FW19	Weight of water in waste tank	0, 70 lb		X
FW19TLM	Telemetry signal for waste water tank	0, 56 lb		
F835	Water acc No. 1 manual mode	Boolean		
F112	Water acc No. 1 mv in MANUAL position	Boolean		
F113	Water acc No. 1 mv in AUTO position	Boolean		
F065	Elect. cont sw in AUTO 1 position	Boolean		
F064	Elect. cont sw in AUTO 2 position	Boolean		
MF051	Malf. to fail acc No. 1 automatic valve CLOSED	Malfunction		
F062	Water accum No. 1 ON sw position	Boolean		
F830	Water acc No. 1 in auto mode	Boolean		
F837	Water acc No. 2 in manual mode	Boolean		
F114	Water acc No. 2 manual valve in MANUAL position	Boolean		
F161	Water acc No. 2 manual valve in AUTO position	Boolean		
F063	Water acc No. 2 ON sw position	Boolean		
MF052	Water acc No. 2 AUTO control valve fails OPEN	Malfunction		
F836	Water acc No. 2 in auto mode	Boolean		
FCWA	Water acc purge clock	0, 600.0 sec		
FK30W	Purge clock reset time	Const 601.5 sec		
F843	Last comp value of F841	Boolean		
F841	Water acc No. 1 purge Boolean	Boolean		
FK31W	Auto purge start time	Const 591.9 sec		
FWD87	Water acc No. 1 purge flow rate	0, 0.1 lb/sec		
FK32W	Purge flow rate constant	Const 0.08 lb/sec		
F844	Last comp value of F842	Boolean		
F842	Water acc No. 2 purge Boolean	Boolean		
MF053	Water acc No. 2 diaphragm leak	Malfunction		
FWD88	Water acc No. 2 purge flow rate	0, 0.1 lb/sec		
FWD86	Flow rate from ACC into waste tank	0, 0.2 lb/sec		
FWD36A	Flow rate of water into acc No. 1	0, 0.01 lb/sec		
FWD36	Flow rate of water available from suit HX	lb/sec		
FK34W	Max. capacity of each acc in pounds of water	Const 0.324		
FK35W	Water acc. flow rate sharing constant	Const 0.5		

Table 6-51. Environmental Control System - Water Supply (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FWD36B	Flow rate of water into acc No. 2	0, 0.01 lb/sec		
FW87	Weight of water in acc No. 1	0, 0.4 lb		X
FW88	Weight of water in acc No. 2	0, 0.4 lb		X
FW01L	Last computer value of FW01	0, 0.01 lb		
FW01	Weight of oxy. in both acc	0, 0.01 lb		
FK37W	Gas const of oxy/spec. volume of water	Const 0.04777 $in.^2$-°R/lb		
FK36W	Max. possible weight of water in both acc	Const 0.648 lb		
FWD57	Flow rate oxy. into acc	0.0, 0.001 lb/sec		
FWD58	Flow rate oxy. out of acc	0.0, 0.01 lb/sec		
F840	Power available for water quantity ind	Boolean		
FEWQCM	Output volt for C/M water quantity ind	0, 10.0 volts		
MF054	Indicator fails to zero - water quantity	Malfunction		
F071	Water quantity ind sel sw in WASTE position	Boolean		
FK40W	Waste water quantity to output volt const	Const 0.178571 volts/lb		
FK41W	Potable water quantity to output volt const	Const 0.27777 volts/lb		
FEWQIOS	Water quantity ind. output volt to IOS	0, 10.0 volts		
F148	IOS water quantity ind sel POTABLE TANK	Boolean		
F149	IOS water quantity ind sel WASTE TANK	Boolean		
F847	Caution/warning dp output of ac	Boolean		
F849	Waste water avialable	Boolean		
MF152	Tank pressure control inlet selector fail leak	Malfunction		
MF153	Tank pressure control outlet selector fail leak	Malfunction		
MF146	Tank pressure control relief valve 1 fail	Malfunction		
MF147	Tank pressure control relief valve 2 fail	Malfunction		
FK43W	Leak rate of O_2 for tank pressure r. fail	Const 0.001888 lb/sec		
FK44W	Leak rate of slow O_2 leaks into cabin	Const 0.000097222 lb/sec		
MF150	Tank pressure control relief valve No. 1 fail leak	Boolean		
MF151	Tank pressure control relief valve No. 2 fail leak	Malfunction		
F850	Boolean for O_2 pressure avail. for added water tanks	Boolean		
FWDAWT1	Flow available from added water tank No. 1	0, 0.2 lb/sec		
FWDAWT2	Flow available from added water tank No. 2	0, 0.2 lb/sec		

Table 6-51. Environmental Control System - Water Supply (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F052	Waste water tank refill No. 1			
F053	Waste water tank refill No. 2			
FK45W	Max. rate of flow from added tanks for refill	Const 0.2 lb/sec		
FK46W	Outlet flow rate for relief valve fails open	Const 0.1 lb/sec		
MF060	Water pressure relief valve No. 1 fail open	Malfunction		
MF155	Water pressure relief valve No. 2 fail open	Malfunction		
FWDOFRV	Relief flow rate from water tanks for relief valve open	0, 0.2 lb/sec		
F058	Potable water heaters on MN A	Boolean		
F057	Potable water heaters on MN B	Boolean		
FK42W	Waste water tank leak rate	Const .04 lb/sec		
MF065	Waste water tank leaking slowly	Malfunction		
FW18	Weight of water in added waste tank No. 1	0, 56		X
FW17	Weight of water in added waste tank No. 2	0, 56		X
FWD36PR	Adjusted flow rate of water available from SHX	0, 0.01 lb/sec		
FK47W	Max flow rate to relief valve from acc for fail	Const 0.01 lb/sec		
TWWH20	Quantity waste water tank	0, 100%	177(A)/177	
TWPH20	Quantity potable water tank	0, 100%	246(A)/246	

Table 6-52. Environmental Control System—Water-Glycol

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F700	Glycol pump bus 1 power available	Boolean		
F701	Glycol pump bus 2 power available	Boolean		
F090	Cool pump select sw PUMP 1 BUS 1 pos	Boolean		
F089	Cool pump select sw PUMP 1 BUS 2 pos	Boolean		
ME126	Pump No. 1 fails	Malfunction		
F703	Glycol pump No. 2 operation	Boolean		
F091	Cool pump select sw PUMP 2 BUS 1 pos	Boolean		
F092	Cool pump select sw PUMP 2 BUS 2 pos	Boolean		
MF127	Cool pump 2 fails	Malfunction		
F704	Radiator flow possible	Boolean		
F120	ECS radiator isolation valve	Boolean		
F705	Flow possible through relief valves	Boolean		
F135	Radiator bypass relief branch A OPEN	Boolean		
MF100	Radiator relief valve branch A fails CLOSED	Malfunction		
F136	Radiator bypass relief branch B OPEN	Boolean		
F706	Flow possible through storage tank or bypass	Boolean		
F156	Storage tank bypass valve OPEN	Boolean		
F134	Storage tank input valve OPEN	Boolean		
F117	Storage tank output valve OPEN	Boolean		
F707	Flow possible through heat bypass valve	Boolean		
FPGCTV	Position of heat bypass valve	0, 10 volts		
FK2G	Heat bypass valve effective closed position 1	Const 0.1 volts		
F711	Cabin temp control valve position COOL	Boolean		
FPCTCV	Position cabin temperature control valve	0, 10 volts		
FK12G	Cabin temperature control valve 5	Const 5.0 volts		
F712	Cabin temperature control valve MAX COOL	Boolean		
FK13G	CTCV MAX COOL constant = .02	Const 0.2 volts		
F713	Cabin temperature control valve MAX HEAT	Boolean		
FK15G	CTCV MAX HEAT constant = 9.8	Const 9.8 volts		
F708	Possible system short circuit condition	Boolean		
F171	Glycol pump bypass valve OPEN	Boolean		
F714	System flow short circuit	Boolean		
FWDLFF	Mass flow rate through radiator	0.00, 0.07 lb/sec		
FWDSTG	Mass flow rate through storage	0.00, 0.06 lb/sec		
FWD13G	Mass flow rate through heat bypass branch	0.00, 0.06 lb/sec		
FWDGEG	Mass flow rate in glycol evaporator	0.00, 0.06 lb/sec		
FTINGSTG	Temperature into storage tank	300, 600°R		
FKGG	Conversion constant from °F to °R	Const 460.0°R		
FTINGEG	Temperature into glycol evaporator	300, 600°R		
FK14G	Rad relief valve pressure drop	Const 15.0 lb/in.^{2}		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FPDGP	Differential pressure across glycol	0, 60 lb/in.^{2}		
FK9G	Area constant	Const 0.0069444 ft^2/in.^{2}		
F715	Normal system flow possible	Boolean		
F119	Cabin heat bypass valve	Boolean		
FK1GG	No flow pump pressure	Constant 33 lb/in.^{2}		
FR1G	Effective flow resistance across hx loop	0, 100.0 sec/in.^{2}		
F115	Suit hx glycol valve OPEN	Boolean		
F116	Suit hx glycol valve OPEN	Boolean		
FK21G	IMU and cabin branch parallel flow resistance	Const 40.0 $\frac{\text{sec}}{\text{in.}^2}$		
FK22G	IMU flow resistance	Const 100.0 sec/in.^{2}		
FR13G	Effective flow resistance heat bypass valve	0, 1500 sec/in.^{2}		
FK7G	Heat bypass valve resistance characteristics	Const 100.0 $\frac{\text{sec-in.}^2}{\text{volts}}$		
FK8G	Heat bypass valve constant No. 1	Const 10.2 volts		
FPOGSTG	Temperature of glycol out of st. tank	300, 600°R		
F709	200 lb/hr flow thru bypass no relief valve necessary	Boolean		
FK3G	Bypass flow resist creating 15 lb/in.^{2} press. drop	Const 272.72 sec/in.^{2}		
F710	Flow thru bypass and system possible	Boolean		
FK10G	Max. system flow resist for 200 lb/hr flow rate	Const 600.0 sec/in.^{2}		
FK11G	Max. system Delta pressure	Const 33 lb/in.^{2}		
F716	Glycol storage tank connect to system	Boolean		
F717	Glycol accumulator not empty	Boolean		
F718	Glycol accumulator not full	Boolean		
FK30G	Max. mass of glycol in accumulator	Const 1.35706		
F719	Glycol storage tank not empty	Boolean		
F720	Glycol storage tank not full	Boolean		
FK31G	Max. mass of glycol in storage tank	Const 9.15 lb		
F721	Glycol accumulator press. higher than storage tank	Boolean		
FWDSG	Max. mass flow rate of glycol into system	0, .06 lb/sec		
FK32G	Glycol system quantity flow rate constant	Const 0.05 lb/sec		
FK33G	Mass of glycol req to fill system	Const 1.0 lb		
FDETP8	Delta time No. 1	0, 0.8 sec		
FDETP8N	Iteration rate No. 1 not zero on freeze	0.8, 0.8 sec		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F118	Glycol accumulator valve OPEN	Boolean		
FWDSTAG	Mass flow rate from st. to accum	0, 0.06 lb/sec		
FK34G	Glycol storage tank to accum flow constant	Const 0.01 $in.^2$/sec		
FWD33	Mass flow rate into storage tank	0, 0.06 lb/sec		
FWDAG	Mass flow rate out of accumulator	0, 0.06 lb/sec		
MF101	One-seventh max. acc leak malfunction	Malfunction		
FK35G	One-seventh max. accumulator leakage rate	Const 0.00001 lb/sec		
MF102	Two-seventh max. acc leak malfunction	Malfunction		
MF103	Four-sevenths max. acc leak malfunction	Malfunction		
FWSG	Mass of glycol in system	0, FK33G lb		
FK36G	Radiator leakage flow rate	Const 0.0001 lb/sec		
MF104	Radiator leak malf	Malfunction		
MF105	Suit hx leak malf	Malfunction		
FK37G	Suit hx leakage flow rate	Const 0.0001 lb/sec		
FWAG	Mass of glycol in accumulator	0, 1.5 lb		
FPAG	Glycol accumulator pressure	0, 20.0 $lb/in.^2$		
FK38G	Zero quantity acc pressure	Const 5.0 $lb/in.^2$		
FK39G	Accumulator mass - pressure slope	Const 11.0533 $1/in.^2$		
FWSTG	Mass of glycol in storage tank	0, 9.5 lb		
FK99H	Cold soak initializing value	Const 505.0°R		
FM1G	Max. flow rate poss from pumps	0, 0.06 lb/sec		
FK40G	System max. flow limit constant	Const $\frac{.0555}{FK33G}\left(\frac{1}{sec}\right)$		
F722	Auto. control possible for heat bypass valve	Boolean		
F147	Glycol evap switch in auto. mode	Boolean		
MF106	Glycol evap control ampl malfunction	Malfunction		
MF107	Heat bypass valve motor malfunction	Malfunction		
F723	Auto. control possible for bypass valve	Boolean		
F798	Heat bypass valve area increase Boolean	Boolean		
FK41G	Glycol evap input control temperature No. 1	Const 503.0°R		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F799	Heat bypass valve area decrease Boolean	Boolean		
FK42G	Gly evap input control temperature No. 2	Const 507.0°R		
F727	Auto. control demanded for bypass valve	Boolean		
F724	Manual control possible for bypass valve	Boolean		
FQDRG	Delta Q req for glycol evaporator	0, 10000 in. lb/sec		
FK78G	Specific heat of glycol	Const 5380.55 in./°R		
FK5GG	Desired evap output temp	Const 505.0°R		
FWDRISGE	Mass flow rate required of water into steam	0, 0.06 lb/sec		
FK79G	Heat of vaporization of water	Const 9.35748×10^6 in.		
FPRSGEG	Steam press. desired in glycol evaporator	0, 2.0 lb/in.^{2}		
FK52G	Simulated water vapor no flow pressure	Const 2.0 lb/in.^{2}		
FK53G	Simulated water vapor press. vs flow rate slope	Const 1092.16 sec/in.^{2}		
FADGEG	Desired bp valve effective orifice area	0, 0.01 in.^{2}		
FK54G	Water vapor sonic flow const	Const 11 1/sec		
FK55G	Max. eff orifice area of bpv	Constant .01 in.^{2}		
FABPVGEG	Back pressure valve orifice area	0, 0.01 in.^{2}		
FK46G	Alt at which evaporation occurs	Const 100,000 ft		
FK58G	Auto. mode rate of BPU	Const 0.0005 in.^{2}/sec		
FK59G	FK58G ÷ 5	Const 0.0001 in.^{2}/sec		
FWDSIGEG	Mass flow rate of water to steam in glycol evap	0, 0.00222 lb/sec		
FK62G	0 psia water vapor flow rate	Const 0. 0.0018312 lb/in.^{2}		
FK63G	Water vapor flow rate vs press. slope	Const 0.0009156 in.^{2}/sec		
FWDSOGEG	Mass flow rate of steam out of glycol evap	0, 0.00222 lb/sec		
FWSGEG	Mass of steam in glycol evaporator	0, 0.01 lb		
FK60G	Saturated steam press. weight const	Const 623.7 lb/in.^{2}		
FPSGEG	Steam press. in glycol acc	0, 2.0 lb/in.^{2}		
FW WGEG	Mass of water in glycol evaporator	0, 0.1 lb		
FWDWGEG	Mass flow rate of water into gly evap	0, .02222 lb/sec		
FK64G	Nominal water flow into evap	Constant 0.00222 lb/sec		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
	Power available water heaters	Boolean		
FK65G		Const 0.05 lb		
FTDOGEG	Glycol evaporator temp	300, 600°R		
FK66G	Mass of glycol in evaporator x FK78G	Const 591.86 $\frac{\text{in.-lb}}{\text{sec}}$		
FTOGEG	Temperature of glycol in evaporator	300, 600°R		
FTSOGEG	Output temp of steam glycol evaporator	300, 600°R		
FK71G	Steam sat. const No. 1	Const 493.0°R		
FK51G	FK72G ÷ volume of steam chamber	Const 57000.0°R/lb		
FK45G	FK73G x volume of steam chamber	Const 0.00095 lb		
FK74G	Steam sat. const No. 4	Const 520.0°R		
FK57G	FK75G ÷ volume of steam chamber	Const 26600.0°R/lb		
FWDIMUG	Mass flow rate of glycol into IMU CP	0, 0.06 lb/sec		
FK23G	Portion of glycol flow thru IMU	Const 0.165%		
FWDCB	Mass flow rate into cabin branches	0, 0.06 lb/sec		
FTDIMUG	Temporate rate of glycol in IMU CP	-10, +10°R/sec		
FTOIMUG	Temperature of glycol IMU CP	300, 600°R		
FK95G	(FK78G) (ma of gly in evap) (ma of gly in sys)	Const 10000 in./°R		
FMCBPV	Glycol evap manual ON counter	0, 20		
F066	Glycol evap manual switch COOL position	Boolean		
F067	Glycol evap manual switch HEAT position	Boolean		
F796	Suit evaporator valve control Boolean open	Boolean		
F068	Suit evap valve AUTO sw position	Boolean		
FK93G	Suit evaporator upper differential	Const 512.0°R		
FTOOSHX	Temperature oxygen out SHX	400.0, 600.0°R		
MF110	SHX amplifier failure	Malfunction		
MF111	SHX motor failure	Malfunction		
F797	Suit evaporator valve control Boolean closed	Boolean		
FK94G	Suit evaporator lower differential	Const 508.0°R		
F793	Manual control possible for SHX valve	Boolean		
FVSPOSHX	Specific volume incoming oxygen XHS	0, 300,000 $\text{in.}^3/\text{lb}$		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK70G	Gas const for oxygen			
FPPOISHX	Partial pressure of oxygen into SHX	0, 15.13 lb/in.^{2}		
FTOINSHX	Input temp of oxy into SHX-from ECS suit sys EQ	300, 600°R		
FVDOSHX	Volumetric flow rate of oxygen in SHX	0, 10000 in.^{3}/sec		
FWDOSHX	Mass flow rate of oxy into SHX-from ECS suit EQ	0, 0.03 lb/sec		
FWDGSHX	Mass flow rate of glycol-SHX	0, 0.05 lb/sec		
FMFCVO	Eff mass flow rate x CV for incoming oxy-SHX	0, 500 in.-lb/°R-sec		
FK76G	CV for oxygen	Const 1413.0 in./°R		
FK77G	CV for water vapor	Const 3368.69 in./°R		
FWDMISHX	Mass flow rate of moisture into ECS suit	0, 0.01 lb/sec		
FTMIST	Saturation temp of input moisture SHX	0, 700.0°R		
FK72G	Steam saturation temp const, No. 2	Const 4.9248×10^7 °R-in.^{3}/lb		
SK73G	Steam saturation temp const No. 3	Const 1.108×10^{-6} lb/in.^{3}		
FK75G	Steam saturation temp const No. 5	Const 2.2924×10^7 °R-in.^{3}/lb		
FTGONC	Temp out of glycol - oxygen HX if no condensation occurs	300.0, 600.0°R		
F726	Glycol - oxygen heat exchanger Boolean No. 1 SHX	Boolean		
FTOSHXG	Temperature of glycol out SHX	300.0, 600°R		
FK85G	FK79G x FK83G - intrcpt of density curve below breakpoint	-93.5748 lb/in.^{2}		
FK86G	FK79G x FK84G slope of density curve below breakpoint	Const -.1895323 lb/°R-in.^{2}		
FK87G	Breakpoint density - temperature curve	547.0°R		
FK88G	FK79G x FK90G X - intrcpt of density curve above breakpoint	-212.0054 lb/in.^{2}		
FK89G	FK79G x FK91G slope of density curve above breakpoint	-0.406141 lb/°R-in.^{2}		
FK83G	Intercept of density curve below breakpoint	Const -1×10^{-5} lb/in.^{3}		
FK84G	Slope of density curve below breakpoint	-2.0254×10^{-8} lb/in.^{3}-°R		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK90G	Intercept of density curve above breakpoint	-2.2656×10^{-5} lb/in.^{3}		
FK91G	Slope of density curve above breakpoint	-4.3403×10^{-8} lb/in.^{3}-°R		
FWDWSHX	Mass flow rate of water into SHX evaporator	0, 0.00222 lb/sec		
FPWCV	Water inflow valve position	0, 10.0 lb/sec		
FK81G	Valve flow constant	Const 0.000222 lb/sec-volt		
FWDMOSHX	Mass flow rate of moisture out of SHX	0, 0.01 lb/sec		
FQE1SHX	Energy required to obtain saturation temperature SHX	0, 50.000 in.-lb/sec		
FWWASHX	Water accumulation in SHX	0, 0.001 lb		
FWD36	Flow rate of water available from SHX	0, 0.01 lb/sec		
FK92G	Flow const No. 1 suit HX	Const 0.1 $\frac{1}{\text{sec}}$		
FWDCB1G	Cabin circuit branch No. 1 flow rate	0, 0.06 lb/sec		
FK24G	Cabin temp control valve constant No. 1	Const 5.0		
FK25G	Cabin temp control valve constant No. 2	Const 0.2		
FWDCB2G	Cabin circuit branch No. 2 flow rate	0, 0.06 lb/sec		
FTICG	Input glycol temp to cabin HX branch	300.0, 600.0°R		
FTICHXG	Input temp into cabin HX	300.0, 600.0°R		
FDTOCHX	Temp differential out of cabin HX	-20, +20°R		
FTIOCHX	Temp of oxy into CHX	300.0, 600.0°R		
FK27G	CHX constant	Const 2.0 sec/lb		
FTOOCHX	Output temp of oxygen CHX	300.0, 600.0°R		
FWDOCHX	Mass flow rate of oxy CHX	0, .25 lb/sec		
FTOCHX	Output temp of glycol CHX	300.0, 600.0°R		
MF113	Amp cabin HX fail	Malfunction		
MF114	Valve motor fail cabin HX	Malfunction		
F072	CHX switch auto position	Boolean		
FTACT	Cabin automatic control temp	300.0, 600.0°R		
FTACT1	Cabin auto. control pot. pos	0, 10 volts		
MF115	Cabin auto. temp cont fail	Malfunction		
FK1H	Bottom of cabin temp control range	Const 530.0°R		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK2H	Slope of cabin temp control	Const 1.0°R/volt		
FDTACT	Cabin automatic control temp differential	-50, +50 deg R		
FTACO	Cabin auto. cont temp	300.0, 600.0°R		
FK3H	Cabin auto. cont temp const No. 1	Const 2.0		
FCCVIH	Cabin control valve increase heat	-1, 25		
FK4H	Cabin temp control valve rate constant	Const 4.0 lb/°R		
FCCVIC	Cabin control valve increase cool	-1, 25		
F794	Cabin control valve heat Boolean	Boolean		
F795	Cabin control valve cool Boolean	Boolean		
FCCVIH	Cabin cont valve incr heat	-1, 20		
FCCVIC	Cabin cont valve incr cool	-1, 20		
FWDCCPG	Mass flow rate of gly into cabin coldplate	0, .06 lb/sec		
F740	Cabin cold plate glycol flow Boolean	Boolean		
FTICCPE	Input glycol temp to cabin cold plate	300, 600°R		
FQICCPG	Energy input to cabin cold plate	0, 30,000 in.-lb/ sec		
FK5H	Data storage heat load	Const 291.9 in.-lb/sec		
FK6H	Signal condition heat load	Const 443.5 in.-lb/sec		
FK7H	CTE heat load	Const 221.8 in.-lb/sec		
FK8H	Dsif PA reduced heat load	Const 266.4 in.lb/sec		
FK9H	Dsif PA high heat load	Const 620.0 in.-lb/sec		
FK10H	VHF-FM XMIT heat load	Const 355.1 in.-lb/sec		
FK11H	Scientific equip heat load	Const 385.0 in.-lb/sec		
FK12H	C-band xponder	Const 620.0 in.-lb/sec		
FK13H	Rate gyro heat load	Const 452.5 in.-lb/sec		
FK14H	ΔV-accel heat load	Const 945.0 in.-lb/sec		
FK15H	AGAP heat load	Const 995.0 in.-lb/sec		
FK16H	SCS general heat load	Const 1125.0 in.-lb/sec		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK17H	G&N computer heat load	Const 1060.0 in.-lb/sec		
FK18H	CDU each heat load	Const 78.0 in.-lb/sec		
FK19H	G&N PSA standby heat load	Const 247.8 in.-lb/sec		
FK20H	G&N PSA basic heat load	Const 1770.0 in.-lb/sec		
FK77H	Thermal load EPS inv lb 1	Const 12.0 in./ft		
FQCCPC	Energy rate cabin air - cold plate	±10000 in.-lb/°R		
FTDCCPG	Cabin cold plate temp rate	±10°R/sec		
FK21H	Mass equip. CCP x CV			
FTOCCPG	Temp of glycol in cabin cold plate	300.0, 600.0°R		
FTACPG	Temp at output of both cold plates	300.0, 600.0°R		
FTGP	Temp of glycol in cold plates	300.0, 600.0°R		
FWD23	Mass flow rate of water from water sys	0 lb/sec		
F777	ECS glycol system ind power available ind	Boolean		
FPOGP	Glycol pressure at sensor	0, 100.0 $lb/in.^2$		
FPGS	Glycol discharge pressure desired readout	0, 54.0 $lb/in.^2$		
FK52H	Disc pressure readout limit	Const 54.0 $lb/in.^2$		
FK53H	Ind constant	Const 5.0		
FPGCM	Glycol discharge pressure CM readout	0, 54.0 $lb/in.^2$		
MF116	Glycol discharge pressure sensor malf	Malfunction		
MF117	Glycol discharge pressure C/M ind malf	Malfunction		
FPGTLM	Glycol discharge pressure TLM	0, 60 $lb/in.^2$		
FTGR	Input glycol temp from space radiators	300.0, 600.0°R		
FK98H	FK99H - 460 (initial value)	°F		
FK51H	Glycol temperature rate	Const 10^{-4} $\frac{1}{sec}$		
FT03	Cabin air temperature	°R		
FTGRS	Glycol temperature from space radiators desired RO	-50.0, +100.0°F		
FK54H	Temp ind scaling constant	Const 460°R		
FK55H	Ind limit max	Const 100°F		
FK56H	Ind limit min	Const -50°F		
FTGRCM	Gly temp from space rad C/M ind	-50, +100°F		
FGTCW	Gly temp from space rad TLM and CW ind	-50, +100°F		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FTGES	Gly evap outlet temp sensor readout	25.0, 75.0°F		
FK60H	Gly evap temp sensor lower limit	Const 25.0°F		
FK61H	Gly evap temp sensor upper limit	Const 75.0°F		
FTGECM	Gly evap outlet temp C/M ind	25.0, 75.0°F		
FTGETLM	Gly evap outlet temp TLM ind	25.0, 75.0°F		
FTSOS	Effective system output steam temp	300.0, 600.0°R		
FTSOSS	Steam outlet temp sensor readout	20.0, 90.0°F		
FK62H	Lower limit steam temp sensor	Const 20.0°F		
FK63H	Upper limit steam temp sensor	Const 90.0°F		
FTSOSCM	Steam outlet temp C/M ind	20.0, 90.0°F		
FTSOSTLM	Steam outlet temp TLM indication	20.0, 90.0°F		
FPSOS	Evap steam output press	0.0, 1.0 lb/in.^{2}		
FK50H	Steam output flow const	Const 2.7°R$^{1/2}$-sec/in.^{2}		
FPSOSS	Steam outlet press sensor readout	0, 0.3 lb/in.^{2}		
FK65H	Upper limit steam outlet pressure sensor	Const 0.3 lb/in.^{2}		
FPSOSTLM	Steam outlet pressure TLM indication	0, 0.3 lb/in.^{2}		
FWGAS	Gly quantity sensor readout in %	0, 100%		
FK67H	Gly acc sensor const No. 1	Const 73.6887 pct/lb		
FK67H	Max sensor output	Const 100.0 pct		
FWAGCM	Gly acc qty C/M readout	0, 100.0%		
FWAGTLM	Gly acc qty TLM indication	0, 100.0%		
MF120	Temp sensor fail minimum	Malfunction		
MF121	Gly temp C/M ind fail	Malfunction		
MF122	Gly evap outlet temp sensor fail	Malfunction		
MF123	Gly evap outlet temp C/M ind fail	Malfunction		
MF124	Steam outlet temp sensor fail	Malfunction		
MF125	Steam outlet temp C/M ind fail	Malfunction		
MF130	Steam outlet pressure sensor fail	Malfunction		
MF131	Gly acc qty sensor malf	Malfunction		
MF132	Gly acc qty C/M ind malf	Malfunction		
F762	Rad valve No. 1 is on (last iteration)	Boolean		
F763	Rad valve No. 2 is on (last iteration)	Boolean		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F764	Rad valve No. 3 is on (last iteration)	Boolean		
F765	Rad valve No. 4 is on (last iteration)	Boolean		
F201	Rad valve No. 1 is on	Boolean		
F076	Rad select No. 1 ON	Boolean		
MF133	Rad valve No. 1 MALF	Malfunction		
F202	Rad valve No. 2 ON	Malfunction		
F078	Rad select No. 2 ON	Malfunction		
MF134	Rad valve No. 2 MALF	Malfunction		
F203	Rad valve No. 3 ON	Boolean		
F080	Rad select No. 3 ON	Boolean		
MF135	Rad valve No. 3 MALF	Malfunction		
F204	Rad valve No. 4 ON	Boolean		
MF136	Rad valve No. 4 MALF	Malfunction		
F082	Rad select No. 4 ON	Boolean		
F206	Flow possible thru rad valves	Boolean		
F4C24	Load drawn by rad valve No. 1 motor	0, 0.5 amps		
FK32H	Current drawn by rad valve motors	Const .5 amps		
F4C25	Load drawn by rad valve No. 2 motor	0, 0.5 amps		
F4C26	Load drawn by rad valve No. 3 motor	0, 0.5 amps		
F4C27	Load drawn by rad valve No. 4 motor	0, 0.5 amps		
F760	AC buss 1, deliv pwr to gly pumps	Boolean		
F761	AC bus 2, deliv pwr to gly pumps	Boolean		
FK30H	Current drawn by 1 Φ of pump motor	Const 0.1 amps		
F4C09	Load drawn by Φ A bus 2 gly pumps	0, 1.0 amps		
F4C10	Load drawn by Φ B bus 2 gly pumps	0, 1.0 amps		
F4C11	Load drawn by Φ C bus 2 gly pumps	0, 1.0 amps		
FK35H	Current drawn by control amplifier	Const 0.05 amps		
FK36H	Current drawn by cont motor	Const 0.2 amps		
FK46H	Current drawn by ampl sect SHX	Const 0.05 amps		
FK47H	Current drawn by motor section SHX	Const 0.2 amps		
FK33H	Current drawn by cont amp bpv	Const 0.05 amps		
FK34H	Current drawn by control motor	Const 0.2 amps		
F4C06	Total load on CB27Φ A BUS 1	0, 1.0 amps		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F4C07	Total load on CB26ΦB BUS 1	0, 1.0 amps		
F4C08	Total load on CB25ΦC BUS 1	0, 1.0 amps		
F5C57	Load drawn by CHX AC BUS 1	0, 1.0 amps		
FK37H	Current drawn by cont amp CHX	Const 0.05 amps		
F4C82	DC load drawn thru C482	0, 1.0 amps		
FK38H	Current drawn by gly evap water vlv	Const 0.1 amps		
F5C08	DC load drawn thru C508	0, 1.0 amps		
F5C08A	Water heater load C508	0, 1.0		
MF154	Glycol relief valve No. 2 fails in open	Malfunction		
FK5G	Drop in differential dump pressure due to leak	Const 2.0 lb/in.^{2}		
MF064	Glycol pump outlet check valve fail leak	Malfunction		
FK17G	Reduced flow through heat by pass due to motor failure	Const 0.001 lb/sec		
MF024	Glycol temp cont valve motor fails	Malfunction		
FK18G	Mass flow rate of slow glycol leaks	Const 0.0002777 lb/sec		
MF041	Space radiator 1B leaking	Malfunction		
MF042	Space radiator 2A leaking	Malfunction		
MF062	Space radiator 2B leaking	Malfunction		
MF145	Glycol check valve leaking venting glycol to GSE conn	Malfunction		
FK1G	Max flow from pumps no malfunction	Const 1.0		
MF137	Glycol pump outlet check valve leak	Malfunction		
FK4G	Reduced flow through pump No. 1 for malfunction			
F061	Glycol evap back pressure automatic	Boolean		
MF056	Wetness control amp malfunction	Malfunction		
F059	Glycol evap H_2O flow auto	Boolean		
F060	Glycol evap H_2O flow on	Bolean		
MF071	Suit evap water control vlv fail closed	Malfunction		
MF061	Suit evap temp control fail	Malfunction		
FK80G	Suit evap water valve leak	Const 0.0001388 lb/sec		
MF015	Suit evap water inflow valve leak	Malfunction		
FK19G	Increase temp diff due to cabin blower No. 2 failure	Const 1.0°R/sec		
MF077	Cabin recir blower No. 2 fails	Malfunction		
F088	Cabin fan No. 2 on (refer to Cabin/Suit.)	Malfunction		

Table 6-52. Environmental Control System—Water-Glycol (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MF041	Cabin temp control motor fails	Malfunction		
FK20G	Temp rise due to wetness cont amp failure	°R		
TWGACC	Quantity glycol accumulator	0, 100%	239(A)/239	
TPSTGE	Pressure glycol evaporator outlet steam	0, +0.3 psia	108(A)/108	
TTSTGE	Temperature glycol evaporator outlet steam	+20, +95°F	224(A)/224	
TPGLPUMP	Pressure glycol pump outlet	0, 33 psia	256(A)/256	
TTLQGE	Temperature glycol evaporator outlet liquid	+25, +75°F	257(A)/257	
TTRADOUT	Temperature space radiator outlet	-50, +100°F	209(A)/209	

Table 6-53. Environmental Control System—Cabin and Suit

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FA07	Cabin press. reg and repress valve eff. area	0, 0.01 $in.^2$		
F121	Repress valve OPEN	Boolean		
FK1C	Orifice area of repress valve	Const 0.00069 $in.^2$		
MF034	Cabin reg. No. 1 fails OPEN	Malfunction		
F978	Cabin reg. No. 1 capped - loose wire	Boolean		
MF037	Cabin reg. No. 2 fails OPEN	Malfunction		
F979	Cabin reg. No. 2 capped - loose wire	Boolean		
FK4C	Max. orifice area of one cabin reg. valve	Const 0.0001115 $in.^2$		
MF035	Cabin reg. No. 1 fails CLOSED	Malfunction		
MF036	Cabin reg. No. 2 fails CLOSED	Malfunction		
FK5C	Slope of one cabin reg curve	Const 0.0000192 $in.^2$/lb		
FK6C	Min flow press of reg valve	Const 3.5 lb/$in.^2$		
FK3C	Lock up press. oxygen cabin reg	Const 5.2 lb/$in.^2$		
FA09	Eff orifice area of cabin emerg valve	0, 0.0049 $in.^2$		
F097	Emerg selector #1 POS	Boolean		
MF044	Emerg valve No. 1 fails OPEN	Malfunction		
F100	Emerg valve pressure to test	Boolean		
F098	Emerg selector #2 POS	Boolean		
FK2C	Max orifice area of one emerg valve	Const 0.0049 $in.^2$		
MF043	Emerg valve No. 2 fails CLOSED	Malfunction		
FK7C	Slope of one emerg valve	Const 0.0105 $in.^4$/lb		
FK8C	Emerg valve min FLOW PRESS	Const 4.3 lb/$in.^2$		
FK9C	Emerg valve max FLOW PRESS	Const 4.7 lb/$in.^2$		
FWD07	Mass flow rate of oxygen from mfld to cabin	0, 0.025 lb/sec		
FK10C	Oxygen sonic flow const	Const 0.5567°R1/2/sec		
FTAOSC	Ambient temp. outside spacecraft	520.0°R		
FK11C	Standard day temp at sea level	Const 520°R		
FK12C	Temp - altitude slope	Const 0.0036°R/ft		
FK13C	Reference altitude for outside air temp	Const 35332.0 ft		
FK14C	Ambient temp constant No. 2	Const 390.3°R		
FPAOSC	Ambient press. outside spacecraft	0, 20 lb/$in.^2$		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK15C	Ambient press. const No. 1	Const 10.0 volts		
FK16C	Ambient press. const No. 1	Const 0.76562 lb/ volt - in.^{2}		
F997	Cabin press relief valve cont Boolean	Boolean		
FA05	Eff orifice area cabin press. relief valves	0, 0.5		
F101	INNER cabin RV Boolean No. 1	Boolean		
F102	INNER cabin RV Boolean No. 2	Boolean		
MF045	Cabin INNER press. RV fail OPEN	Malfunction		
F103	OUTER cabin RV AUTO	Boolean		
MF047	Cabin OUTER press. RV fail OPEN	Malfunction		
FK17C	One cabin RV max. orifice area	Const 0.19635 in.^{2}		
MF046	Cabin INNER press. RV fails CLOSED	Malfunction		
MF050	Cabin OUTER press. RV fails CLOSED	Malfunction		
FK18C	Cabin RV const No. 1	Const 0.490875 in.^{4}/lb		
FK19C	Cabin RV const No. 2	Const 5.8 lb/in.^{2}		
FK20C	Cabin RV const No. 3	Const 0.31612 in.^{4}/lb		
FK21C	Cabin RV const No. 4	Const 0.289 lb/in.^{2}		
FA14	Effective orifice leakage area	0, 0.5 in.^{2}		
FK22C	Normal cabin leakage area	Const 0.000464 in.^{2}		
MF030	C/M inner structure punctured	Malfunction		
FK23C	Punctured cabin leakage area	Const 0 in.^{2}		
FWD14	Eff. mass flow rate out of cabin into amb	-0.125, 0.125 lb/sec		
FWD04C	Net mass flow rate of oxygen into cabin	-0.5, 0.5 lb/sec		
FW04	Mass of oxygen in cabin	0, 50.0 lb		
FDETP8	Delta time No. 1	Const 0.8 sec		
FSV03	Specific volume of gas in cabin	5.0, 100.0 ft^3/lb		
FK98C	Limit f ν 03	Const 100.0 ft^3/		
FK24C	Cabin volume	Const 200.0 ft^3		
F996	Cabin fan No. 1 ON	Boolean		
F087	Cabin air blower No. 1 ON	Boolean		
MF026	Cabin fan No. 1 fails	Malfunction		
F995	Cabin fan No. 2 ON	Boolean		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F088	Cabin air blower No. 2 ON	Boolean		
MF027	Cabin fan No. 2 fails	Malfunction		
F925	Simulator system fans ON Boolean	Boolean		
F500	Lid ON cabin fan No. 1	Boolean		
F501	Lid ON cabin fan No. 2	Boolean		
FWDOCHX	Mass flow rate of oxygen across cabin HX	0, 0.25 lb/in.^{2}		
FK25C	Eff reduction of cabin fans	0.40%		
FK26C	Cabin fans flow const	Const 0.992 #1/2 in.-°R1/2/sec		
FT03	Temp of cabin air	300, 600°R		
FECB1	Power used by cabin blower No. 1	0, 100 watts		
FK27C	Power used by cabin fan with lid ON	Const 0.2 watts		
FK28C	Cabin fan power const	Const 0.00935 watts - #1/2/°R1/2-in.		
FECB2	Power used by cabin blower No. 2	0, 100 watts		
F994	Cabin fan No. 1 operating on 3 phases	Boolean		
F993	Cabin fan No. 2 operating on 3 phases	Boolean		
F4C18	Current drain from C418	0, 1.0 amps		
F4C19	Current drawn from C419	0, 1.0 amps		
F4C20	Current drawn from C420	0, 1.0 amps		
F4C21	Current drawn from C421	0, 1.0 amps		
F4C22	Current drawn from C422	0, 1.0 amps		
F4C23	Current drawn from C423	0, 1.0 amps		
FQCCPC	Rate of energy exch between cabin and CP	±15000 in.-lb/°R		
FK31C	Heat transfer const cabin - cold plate	Const 9.333 in.^{3}/°R		
FQNRE	Energy input due to normal radiation	±2048.0 in.-lb/sec		
FK35C	Max rad energy input	Const 259.9 in.-lb/sec		
FK34C	Change of max rad energy input for orbit	Const -1039.27 in.-lb/sec		
FK99C		Const 1.0 in.^{3}/sec		
FK33C	Rate of energy exchange	Const 0.001 lb/sec		
FQCREH	Cabin re-entry heat	±1000 in.-lb/sec		
FQTC	Total energy into the cabin	±32000 in.-lb/sec		
FK36C	Sensible heat per astronaut	±10000 in.-lb/sec		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FTD03	Temperature rate of cabin air	-5.0, 5.0 °R/sec		
FK37C	Sup. oxygen	Const 2091.397 in./°R		
FK38C	Cy oxygen	Const 1506.55 in./°R		
FTOOCHX	Temp oxy cutoff heat exchanger	300.0, 600.0		
FTIOCHX	Temp off into heat exchanger	300.0, 600.0		
FP05	Cabin air pressure	0, 50 lb/in.^{2}		
FK39C	R oxygen ÷ volume	Const 0.001694 lb/°R - in.^{2}		
F989	Power avail. cabin temp ind	Boolean		
F990	Power avail. cabin press. ind	Boolean		
FP05TLM	Cabin press. TLM indication	0, 17.0		
MF025	Cabin press. sensor fail	Malfunction		
FK40C	Cabin press. sensor limit	Const 17 lb/in.^{2}		
FP05CM	Cabin press C/M indication	0, 17		
FK41C	Cabin press. C/M ind const No. 1	Const 1.4167 lb/in.^{2}		
MF031	Cabin press. indicator fail	Malfunction		
FK42C	Cabin press. C/M ind const No. 2	Const 6.0 lb/in.^{2}		
FK43C	Cabin press. C/M ind const No. 3	Const 0.77277 lb/in.^{2}		
FK44C	Cabin press. C/M ind const No. 4	Const 3.86358 lb/in.^{2}		
FT03TLM	Cabin temp TLM indication	20.0, 95.0°F		
FK45C	Deg (R) to deg (F) const	Const 460.0°R		
MF032	Cabin temp sensor fail (minimum)	Malfunction		
MF033	Cabin temp sensor fail (maximum)	Malfunction		
FK46C	Cabin temp ind upper limit	Const 95.0°F		
FK47C	Cabin temp ind lower limit	Const 20.0°F		
FT03CM	Cabin temp CM indication	20.0, 95.0°F		
MF040	Cabin temp ind fail	Malfunction		
FDETCAB	Cabin temperature differential	±1000		
FDETSUIT	Suit temperature differential	±128°R		
FTSELC	Cabin temperature selected	410, 560°R		
FTSELS	Suit temperature selected	410, 560°R		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FTACTCC	Actual cabin temperature	492, 592°R		
FTACTSC	Actual suit temperature	492, 592°R		
F950	Cabin heating required	Boolean		
F915	Re-entry period	Boolean		
F951	Out of deadband cabin	Boolean		
F952	Out of normal range cabin	Boolean		
F953	Out of normal rate range cabin	Boolean		
F954	Suit heating required	Boolean		
F955	Out of deadband - suit	Boolean		
F956	Out of normal range - suit	Boolean		
F957	Out of normal rate range - suit	Boolean		
F958	Compressor off control	Boolean		
F959	Cabin heater control	Boolean		
F960	Suit heater control	Boolean		
FTLIMITC	Computed temperature limit	520, 560°R		
FTLIMIT	Re-entry heat override control	0, 40°F		
FKAC1	Deadband limit	Const 1.5°R		
FKAC2	Normal range limit	Const 10.0°R		
FKAC3	Normal rate limit	Const 1.0°R/sec		
FKAC4	Low limit - override	Const 520°R		
FKAC5	Sensor offset	Const 500°R		
FTACTCS	Cabin sensor input	+32.0, +132°F		
FTACTSS	Suit sensor input	+32.0, +132°F		
F167	Cabin press. less than 3.75 psia	Boolean		
F051	Suit pressurization Boolean	Boolean		
FP15	Demand press. reg ref press.	3.75, 17 $lb/in.^2$		
F169	Demand reg and relief valve press. to test	Boolean		
FK1S	Critical press. for cabin depressurization	3.75 $lb/in.^2$		
FPDROP	Press. diff between dem reg ref and suit	±0.5 $lb/in.^2$		
F035	Demand reg press. greater than suit press.	Boolean		
FAA	Area od demand reg valves	0, 0, 03125 $in.^2$		
FK3S	Conversion to area with cube of pressure drop	Const 0.082517 $in.^8/lb^3$		
FA17	Area of dem reg relief valve	0, +2.0 $in.^2$		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK4S	Converts to area with cube of press. drop	Const 23.337		
FK6S	Max dem reg press. area	Const 0.0004865 $in.^2$		
FA15	Demand press. reg vlv area	0.0, 0.00059075 $in.^2$		
F124	Demand press. reg and relf valve sel. No. 1 position	Boolean		
FK13S	Const for failure	Const 0.0000695 lb/sec		
MF001	No. 1 suit rlf and demand reg valve	Malfunction		
F125	Sel No. 2 posn; demd press. and rlf valve	Boolean		
FK5S	Area, max demand press. reg	Const 0.0059075 $in.^2$		
MF002	Failure, No. 2 suit demd reg	Malfunction		
FWD41	Flow of O_2 thru demand reg	0.0, 0.03125 lb/sec		
FK19S	Flow const for press. ratio less than critical	Const 0.5567°R1/2/sec		
FRATIO	Ratio of cabin to suit press.	0, 1.0		
F916	Cabin to suit press. less than 0.5	Boolean		
FK20S	Critical press. ratio	Const 0.53		
FK49S	Amount of flow out for suit leak	0.005 lb/sec		
FWD53	Suit demand press. reg rlf flow	0.0, 015625 lb/sec		
MF013	Suit leak malfunction	Malfunction		
FK21S	Flow const for ratio where press. ratio gtr than crit	Const 4.8507°R1/2		
FK22S	Flow const for sq ratio where press. ratio gtr than crit	Const 3.909°R1/2		
FK23S	Flow adj const for press. ratio gtr than crit	Const 0.9147°R1/2		
FTOOSHX	Temp of oxy out of suit HX	300.0, 600.0°R		
FWDMOSHX	Mass flow rate of moisture out of suit HX	0.0, FWD53 lb/sec		
F900	Suit inlet mnfld press. less than const	Boolean		
FK24S	Max press. ref in orbit	Const 6.0 $lb/in.^2$		
F902	Diff betw cabin and suit press.	Boolean		
FK26S	Min press. required for flow	Const 0.03613 $lb/in.^2$		
FWDINS	Total flow rate into suit manifold from SHX	0.0, 0.08333 lb/sec		
FV06	Volume of suit inlet manifold	Const 1.0 ft^3		
FSV06	Spec vol of suit inlet manifold	5.0, 600 ft^3		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FP25	Press. drop from suit input to output	0.0, 20.0 in. H_2O		
FK29S	Conversion from psi to in. of H_2O	Const 0.03613 lb/in./in. H_2O		
FPPH200T	Moisture input partial pressure	lb/in.^{2}		
FPP02I	Partial pressure of oxygen	0.0, 17.0 lb/in.^{2}		
FCPIN	Const press. temp coeff for suit input	0.1988, 0.447		
FK30S	Temp coeff for CO_2	Const 0.1992		
FK31S	Temp coeff of H_2O	Const 0.447		
FK32S	Temp coeff of O_2	Const 0.2188		
FCVIN	Const vol temp coeff suit input	1542447		
FK33S	Diff in const press. and const vol temp coeff	Const 0.0673		
FCT3	Inlet temp coeff	1.175, 1.575		
FCT4	Output temp coeff	0.175, 0.575		
FK34S	Diff of temp coeff for inlet and outlet	Const 1.0		
FSBP	Suit bypass area	0, 1.0		
FK35S	Min press. diff for suit bypass norm flow	Const 4.8 lb/in.^{2}		
FSWG	Spec wt of suit gas	12.0, 44.0		
FK36S	Min suit press. diff for bypass normal flow	Const 12.0 lb/in.^{2}		
FWD44	Suit bypass flow	0.0, 0.35 lb/sec		
F122	Suit bypass valve	Boolean		
FK37S	Const for flow conv for spec vol for bypass	Const 1.6667		
FK38S	Const for min flow for bypass	Const 1.0 lb/in.^{2}		
FK39S	Change rate const for bypass flow with press	Const 2.5		
FK7S	Spec wt of H_2	Const 12.0 lb		
FK8S	Spec wt of O_2	Const 32.0 lb		
FK9S	Spec wt of O_2	Const 44.0 lb		
FWDOT1	Flowout of suit inlet manifold	-0.5, 0.5 lb/sec		
FWD10	Oxy flow thru manual metering valve	0.0, 0.0165 lb/sec		
FA02	Manual metering valve	0.0, 1.0 in.^{2}		
FK52S	Flow const for oxy manual metering valve	Const 0.00470049°R/sec		
FQDINS	Heat transfer rate into suit inlet manifold	-5.0, 5.0 Btu/sec		
FK40S	Conversion const between Btu and °R	Const 0.223		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FTD05	Suit inlet manifold temp change rate	-100.0, 100.0°R/sec		
FT05	Suit inlet manifold temp	300, 600°R		
F913	Suit temp greater than ind min	Boolean		
FK41S	Min temp on suit temp ind	Const 480°R		
F914	Suit temp less than ind max	Boolean		
FK42S	Max temp on suit temp ind	Const 555.0°R		
FTSMETER	Indicated suit temp	20, 98°F		
FK43S	Temp conv °R to °F	Const 460.0		
FK44S	Max temp of suit ind	Const 95.0°R		
FK45S	Min temp of suit temp ind	Const 20.0°R		
FWD66	Total mass flow in suit inlet manifold	-0.2, 0.2 lb/sec		
FP20	Suit inlet manifold press.	0, 17 $lb/in.^2$		
FK47S	Normal suit press. drop	Const 0.10837 $lb/in.^2$		
FK48S	Const for press. adj for flow	Const 4.973692 $sec/in.^2$		
FW12	Suit inlet manifold quantity	0.0015, 0.2 lb		
FWDCSPY	Computed flow thru suit hose to suit or cabin	0.000137, 0.03333 lb/sec		
F143	Suit Connected No. 1	Boolean		
FK10S	Constant to limit suit hose input	Const 0.166667 lb^2/ft^3-sec		
F144	Suit No. 2 (center) connected	Boolean		
F145	Suit No. 3 (rh) connected	Boolean		
FK11S	Suit hose min flow	Const 0.083333 lb/sec		
FWYX	Number of suits connected	0, 3.0		
FWDSPLY	Flow to suit	0.017313 lb/sec		
FWDCABN	Flow into cabin	0, 0.1 lb/sec		
FK71S	Const for correction to computed suit/cabin flow	Const 0.00995 lb/sec		
FK72S	Flow const to convert press. drop with spec. vol	Const 0.00785 $in.^3 \sqrt{ft^3/lb^2}$-sec		
FK73S	Const for flow difference with change of specific vol	Const 0.0000435 $in.^2$ lb/ft^3 sec		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK53S	Diff in quantity flow thru suit	Const 0.00014236 lb/sec		
FWDSRTN	Return flow through suit hoses	0, 0.1		
FPD09	Suit pressure change limited	±0.3613 lb/in.^{2}-sec		
FK14S	Constant to convert quantity and temp change to press.	Const 0.82878 in.^{2}-°R/lb		
FK15S	Constant for difference of specific weight	Const 30.48 lb		
FK16S	Limit of suit pressure change	Const 0.3613 lb/in.^{2} sec		
FWD43	Suit return flow from cabin	0, 0.001		
F123	Suit return air open	Boolean		
FK54S	Flow flow const for press. diff in suit sys return	Const 0.001		
FWDOT2	Suit manifold flow out	±0.18 lb/sec		
FWD40	Suit manifold total flow	-0.18, +2.5 lb/sec		
FP09	Suit manifold press.	0, 17 lb/in.^{2}		
MF003	No. 1 suit compressor motor fail	Malfunction		
FK55S	Press. change due to loss of No. 1 comp pwr	Const -0.18065 lb/in.^{2}		
MF004	No. 2 suit compressor motor fail	Malfunction		
FK56S	Press. change due to loss of No. 2 comp rpm	Const -18.065 lb/in.^{2}		
MF010	Suit press. ind fail	Malfunction		
F924	Suit press. in nonlinear portion of indicator	Boolean		
FK57S	Max indicated suit press.	Const 17.0		
FK58S	Press. ind conversion	Const 1.4167		
FK59S	Diff in press. ind conv for nonlin portion	Const 0.64393		
FK60S	Max ind	Const 17.0 lb/in.		
FPSMETER	Suit press. ind	17.0 lb/in.^{2}		
FVFC	Computed vol flow thru suits (not limited)	-5.0, 30.0 ft^3/min		
FK61S	Heat generated per astronaut	Const 0.0432098 Btu/sec		
FV01C	Computed spec vol of suit outlet manifold	5.0, 100.0 ft^3/lb		
FQDO2	Total suit heat generated	Btu/sec		
FV02	Suit manifold vol	Const 0.4625 ft^3		
FVF	Vol flow thru suits (limited)	-5.0, 15.0 ft^3/min		
FK63S	Conversion sec to min	Const 60.0		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK64S	Ref vol flow (cfm)	Const 15.0 ft^3/min		
FTD16	Rate of change of suit temp	±15.0°R/sec		
FSV01	Suit outlet manifold spec vol	5.0, 100.0 ft^3/lb		
FK93S	Max outlet spec vol	Const 45.87 ft^3/lb		
FK75S	Ref press. for change of vol	Const 9.5 in. of H_2O		
FK94S	Adjmnt for ref press. change	Const 2.8961 W^2ft^3/lb		
FK95S	Change of spec vol with quantity	Const 0.010597 min in. of H_2O/$in.^2$		
FK96S	Change of spec vol with vol. flow	Const 0.22973 min/lb		
FW08	Suit outlet manifold mass	0.004625, 0.093 lb		
FSV01 I	Spec vol of suit outlet (not limited)	5.0, 100.0 ft^3/lb		
FK36L	Moisture generation rate for man. in suit	Const 0.00013785 lb/sec		
FK65S	Moisture gen rate for man. out of suit	Const 0.00006485 lb/sec		
FT16	Temp of suit outlet manifold	300.0, 600.0°R		
FP13	Press. incr thru compressor	0, 27.6778 in. H_2O		
FK75S	Compressor press incr ref press.	Const 9.5 in. H_2O		
FK76S	Change of press. incr. with sys ref press.	Const 0.793813 in. H_2O-$in.^2$/lb		
FK77S	System ref press.	Const 5.10837 psi		
MF005	No. 1 comp outlet ck valve leaking	Malfunction		
FK78S	Press. change for dem. reg. No. 1 leak failure	Const 5.0 in. H_2O		
MF006	No. 2 comp. outlet ck valve leaking	Malfunction		
FK79S	Press. change for dem reg. No. 2 leak failure	Const 3.0 in. H_2O		
FWXY	Normal flow thru compressor	0.00005, 0.125 lb/sec		
FK80S	Max normal flow through compressor	Const 0.52975 lb/sec		
FK81S	Drop in normal flow through compressor with volume flow	Const 0.0013 lb min/ft^3 sec		
FK82S	Constant for flow due to press./specific vol	Const 0.0051665 $in.^2$/lb-sec		
FK83S	Drop in normal compressor flow with pressure density	Const 0.02045 lb-$in.^2$/sec ft^3		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK84S	Anticipation flow constant	Const 0.4		
FWXZ	Reduced flow thru comp for failure	±0.125 lb/sec		
FK85S	Conversion from density of compressor outlet to flow	Const 0.013533 ft^3/sec		
FK86S	Conversion from pressure and density of comp to flow	Const 0.0189858 in. ft^3/sec		
FWDCOMP1	Mass flow thru compressor #1	-0.125, 0.125 lb/sec		
FWDCOMP2	Mass flow thru compressor #2	-0.125, 0.125 lb/sec		
F918	Flow thru comp No. 1 greater than 0	Boolean		
F919	Flow thru comp No. 2 greater than 0	Boolean		
FWD42	Comp No. 1 flow	-0.125, 0.125 lb/sec		
FWD50	Comp No. 2 flow	-0.125, 0.125 w/sec		
FWDCC	Flow through CO_2 absorbers	-0.125, 0.125 lb/sec		
FWZX	Number of CO_2 absorbers	0.0, 2.0		
FK90S	Flow due to failure of compressor check valve	Const 0.0005 lb/sec		
FWDFLO	Total mass flow through CO_2 absorbers	-0.125, 0.125 lb/sec		
FK18S	Conversion to flow of pressure and specific volume	4.0		
FQDCOMP	Heat transfer through compressor	Const 0.07667		
FK17S	Conversion to bypass flow of press. and spec vol	Const 0.3518		
FK40S	Conversion const between Btu and °R	Const 0.223 lb °R/Btu		
FP12	Comp outlet manifold press.	15.249		
FK48S	Lead const for change of press. with flow	Const 1.1728279		
FK97S	Conversion between in. H_2O and psi	Const 0.03613		
MF007	Delta P comp ind fail (min)	Malfunction		
FK1L	Min press. diff across compressor	Const 0.0001 psi		
FP13CI	Ind press. diff across compressor	0, 1 psi		
FP18	Press. drop through CO_2 absorber	-1, 1 lb/$in.^2$		
F138	CO_2 absorber No. 1 sel	Boolean		
F141	CO_2 absorber No. 1 fitted	Boolean		
F139	CO_2 absorber No. 2 sel	Boolean		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FWD55	Mass flow through CO_2 bypass	0.0, 0.24 lb/sec		
F142	CO_2 absorber No. 2 fitted	Boolean		
FK7L	Number of CO_2 absorbers	Const 2.0		
F164	Manual CO_2 absorber bypass valve	Boolean		
FWD62	CO_2 generated flow	0.0, 0.0001 lb/sec		
FK8L	CO_2 gen. rate for man in suit	Const 0.0000087577 lb/sec		
FK9L	CO_2 rate for man out of suit	Const 0.00000844155 lb/sec		
FWD63	CO_2 thru absorber No. 1	0.0, 0.001 lb/sec		
FWD64	CO_2 thru absorber No. 2	0.0, 0.001 lb/sec		
FW24	Quantity in CO_2 absorber No. 1	0.0, 0.001 lb		
FW25	Quantity in CO_2 absorber No. 2	0.0, 3.46 lb		
FQD04	Heat transfer rate for compressors and CO_2 absorbers	0.0, 3.46 Btu/sec		
FK10L	Heat generation rate per lb of CO_2	Const 815.0 lb/sec		
FWD65	Water generated by CO_2 absorbers	0.0, 0.02 lb/sec		
FK11L	Water gen rate for 1 lb of CO_2 absorbed	Const 0.41		
FWDMISHX	Total moisture to heat exchanger	0, 0.1 lb/sec		
FWD61	Total flow in CO_2 absorber outlet mnfld	-1, 1 lb/sec		
FP16	CO_2 absorber outlet press.	0, 17 lb/in.^{2}		
FK15L	Min CO_2 absolute output press.	Const 5.19 lb/in.^{2}		
FK16L	Chg. rate with press. ref	Const 1.02474		
FK17L	Ref pressure	Const 5.10837 lb/in.^{2}		
FK18L	Diff in press. for re-entry	Const 0.01 lb/in.^{2}		
FV05	Volume of CO_2 absorber outlet manifold	Const 1.0 ft^3		
FSV05	CO_2 absolute outlet mnfld spec vol	5, 100 ft^3/lb		
FPPC021	Partial press. CO_2	0.0, 17 lb/in.^{2}		
FPPH20	Partial press. moisture	0.0, 17 lb/in.^{2}		
FPP02ISHX	Partial press. oxygen	0.0, 17 lb/in.^{2}		
FCPOT	CO_2 absolute outlet mnfld temp coeff.	0.1992, 0.45		
FCVOT	CO_2 absolute outlet mnfld temp	0.1319, 0.3797		
FCT1	CO_2 absolute outlet mnfld temp	1.17, 1.52		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FCT2	CO_2 absolute outlet mnfld temp	0.17, 0.52		
FTD18	CO_2 absolute outlet temp change rate	-1000, 1000 °R/ sec		
FWDCABNI	Total cabin supply flow (suit hoses) since last transfer	0.0, 0.5 lb/sec		
FWD43I	Total suit return flow since last transfer	0.0, 0.004 lb/sec		
FTOINSHX	CO_2 absorber outlet mnfld temp	300.0, 600.0 °R		
FWD53I	Total suit relief flow since last transfer	0.0, 0.11552 lb/ sec		
FWD59	CO_2 absolute outlet mnfld flow to heat exch	0.0, 0.2 lb/sec		
FTT	Interface counter	0.0, 17.0		
FK20L	Units and rate of change of temp coeff const.	Const 5.639537 $(lb\text{-}ft^3)$ 1/2 $(°R)$ /$in.^2$ sec		
F901	Interface transfer Boolean	Boolean		
FW23	CO_2 absorber outlet mnfld. quantity	0.00002, 0.1		
MF011	CO_2 partial press. ind. fail (max.)	Malfunction		
FPPC02	CO_2 partial press. sensor	0.0, 30.0		
MF012	CO_2 partial press. sensor fail	Malfunction		
FK21L	Conv from psi to mm mercury	Const 51.7145		
F165	CO_2 absorber No. 1 full	Boolean		
FPPC02IN	CO_2 partial press. indication	0.0, 30.0 mm Hg		
FK40L	Max qty of CO_2 in absorber	Const 3.46 lb		
FK22L	Max partial pressure indication	Const 30.0 mm Hg		
F164	CO_2 absorber and heat exchange inputs	Boolean		
FWDOSHX	Oxygen flow to heat exchanger	0.0, 0.1 lb/sec		
F166	CO_2 absorber No. 2 full	Boolean		
F906	Pwr avail. from ac bus No. 2 for compressor	Boolean		
F907	Pwr. avail. from ac bus No. 2 for compressor	Boolean		
F908	Compressor No. 1 power available	Boolean		
F909	Compressor No. 2 power available	Boolean		
F912	CO_2 abs selected is not fitted	Boolean		
FCW	Compressor power	0, 175.0 watts		
FK30L	Chg. of power with incr press. across comp	Const 9.1954 $in.^2$ watts/lb		
FK31L	Ref press. for comp power	Const 5.10837 lb/$in.^2$		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
F083	Suit comp No. 1 bus 2	Boolean		
FK32L	Normal power for compressor operation	Const 95.0 watts		
F084	Suit comp No. 1 bus 1	Boolean		
FCW1	Power for compressor No. 1	0, 175.0 watts		
F085	Suit comp No. 2 bus 1	Boolean		
FCW2	Power for compressor No. 2	0, 175.0 watts		
F086	Suit comp. No. 2 bus 2	Boolean		
F4C12	Load drawn through C412	0, 0.50725 amps		
FK34L	Conversion from power to current	Const 0.00289855 amps/watts		
FK13L	Conversion between interation rates	Const 4.0		
F4C13	Load drawn through C413	0, 0.50725 amps		
FWDCABN	O_2 supply flow to cabin (thru suit hoses)(for cabin comp)	0, 0.1 lb/sec		
F4C14	Load drawn through C414	0, 0.50725 amps		
FWD43C	Suit return flow from cabin (for cabin comp)	0, 0.001 lb/sec		
F4C15	Load drawn through C415	0, 0.50725 amps		
FWD53C	Suit relief flow (for cabin comp)	0, 0.015625 lb/sec		
F4C16	Load drawn through C416	0, 0.50725 amps		
FRHSO	Suit inlet rel humidity telemetry signal	0, 100.0 percent		
F4C17	Load drawn through C417	0, 050725 amps		
FTO5TLM	Suit temp telemetry signal	20.0, 95.0°F		
FP09TLM	Suit pressure telemetry signal	0.0, 17.0 lb/in.^{2}		
FP13TLM	Suit compressor telemetry signal	0.0, 1.0 lb/in.^{2}		
FPPCOTLM	Suit partial pressure of CO_2 telemetry signal	0.0, 30.0 mm Hg		
F998	Power available for waste mgt blowers	Boolean		
F999	Waste sw in u&f or vac position	Boolean		
FK25L	Current drawn per phase for waste mgt sys	Const 0.35 amps		
F4C36	Current through C/B 436	0.0, 0.35 amps		
F4C37	Current through C/B 437	0.0, 0.35 amps		
F4C38	Current through C/B 438	0.0, 0.35 amps		
FK50C	Area for cabin press. rv leak	Const 0.003762 in.^{2}		
MF055	Cabin press. rv leak	Malfunction		
MF077	Cabin recirculating blower No. 2 fail (W/G)	Boolean		

Table 6-53. Environmental Control System—Cabin and Suit (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
FK46S	Max press. diff betw dem reg and suit	Const 0.5 lb/in.^{2}		
FK89S	Max area of valve	Const 0.03125 in.^{2}		
MF140	Manual O_2 metering valve failure (leaking when closed)	Malfunction		
FK92S	Min suit inlet qty	Const 0.0015 lb		
F920	Compressor No. 1 flow greater than min	Boolean		
F921	Compressor No. 2 flow greater than min	Boolean		
FK27S	Incr rate of delta P for comp turn on	Const 1.2 in. H_2O		
FK28S	Decr rate of delta P for comp turn off	Const 0.8 in. H_2O		
FK98S	Min compressor flow rate	Const 0.00545 lb/sec		
FK88S	Press. change for check valve leak failure No. 1	Const 3.0 in. H_2O		
MF073	Compressor outlet check valve No. 1 leak	Malfunction		
FK87S	Constant for flow due to specific volume	Const 0.0072175 lb^2/cu ft sec		
FK99S	Min CO_2 absorber outlet qty	Const 0.0002 lb		
FK32C	Gas constant for O_2	Const 584.847 in./°R		
FKAC6	Suit inlet temperature rate limit const	Const 8.0 °R/sec		
FK37L		Const 0.00013785		
FK66S		Const 3.0		
FK91S		Const 0.0005		
TPCAB	Pressure cabin	0, +17 psia	201(A)/201	
TTCAB	Temperature cabin	+20, +95°F	203(A)/203	
TPPCO2	Pressure CO2 partial	0, 30 mm Hg	206(A)/206	
TTSUIT	Temperature suit supply manifold	+20, +95°F	214(A)/214	
TPSUIT	Pressure suit demand regulator sense	0, 17 psia	247(A)/247	
TCOMPDEP	Pressure suit compressor differential	0, +1 psid	207(A)/207	

Table 6-54. Environmental Control System—Smoke Simulation

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
M126	Turn on smoke system	Boolean		
M127	Smoke direction - left	Boolean		
M128	Smoke direction - up	Boolean		
ME774	Smoke direction - upper left	Malfunction		
ME775	Smoke direction - lower left	Malfunction		
ME776	Smoke direction - upper right	Malfunction		
ME777	Smoke direction - lower right	Malfunction		
C234	Inv. No. 1 smoking - direction lower left	Boolean		
F997	Cabin depressurization	Boolean		
H383	A gap package overtemp - direction upper left	Boolean		

Table 6-55. Environmental Control System—Aural Cue

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MT	Aural cue simulation system clock	0, 240 sec		
MLBA	Booster engines aerodynamic noise (frequency)	-10, +10 volts		
MLBB	Booster engines aerodynamic noise (amplitude)	-10, +10 volts		
MLESA	Launch escape main engine (frequency)	-10, +10 volts		
MLESB	Launch escape main engine (amplitude)	-10, +10 volts		
MO25	= 1 if geometric altitude is less than 400K ft	Boolean		
MPEA	Re-entry aerodynamic noise (frequency)	-10, +10 volts		
MREB	Re-entry aerodynamic noise (amplitude)	-10, +10 volts		
	Main stage ignition (t = -3 sec)	Boolean		
	Booster engine cut-off signal	Boolean		
	Drogue parachute deployed	Boolean		
	C/M-S/M physical separation and umbilical destruct	Boolean		
	S/M adapter physical separation squibs fire	Boolean		
	Freeze	Boolean		
MO26	= 1 if geometric altitude is more than 500K ft	Boolean		
MLBAM02	LB A frequency curve slope section 1	Const 0		
MLBAB02	LB A frequency curve Y - intercept section 1	Const 2.7		
MLBAM03	LB A frequency curve slope section 2	Const 0		
MLBAB03	LB A frequency curve Y - intercept section 2	Const 2.7		
MLBAM04	LB A frequency curve slope section 3	Const 0.117		
MLBAB04	LB A frequency curve Y - intercept section 3	Const 0.36		
MLBAM05	LB A frequency curve slope section 4	Const 0.117		
MLBAB05	LB A frequency curve Y - intercept section 4	Const 0.36		
MLBAM06	LB A frequency curve slope section 5	Const 0.117		
MLBAB06	LB A frequency curve Y - intercept section 5	Const 0.36		
MO27	Latch for MO26 in equation MACS6	Boolean		
MLBBB02	LB B amplitude curve Y - intercept section 1	Const 0.09531		
MLBBM02	LB B amplitude curve slope section 1	Const -0.03964		
MLBBB03	LB B amplitude curve Y - intercept section 2	Const -0.30111		
MLBBM03	LB B amplitude curve slope section 2	Const 0		
MLESAM1	LES A frequency curve slope section 1	Const -0.02		
MLESAB1	LES A frequency curve Y - intercept section 1	Const 0.52		
MLESAM2	LES A frequency curve slope section 2	Const 0.11		

Table 6-55. Environmental Control System—Aural Cue (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MLESAB2	LES A frequency curve Y - intercept section 2	Const 0.26		
MLESAM3	LES A frequency curve slope section 3	Const 0.2		
MLESAB3	LES A frequency curve Y - intercept section 3	Const -0.1		
MLESBB1	LES B amplitude curve Y - intercept section 1	Const 2.01490		
MLESBM1	LES B amplitude curve slope section 1	Const 0.143845		
MLESBB2	LES B amplitude curve Y - intercept section 2	Const 2.81342		
MLESBM2	LES B amplitude curve slope section 2	Const -0.255415		
MLESBB3	LES B amplitude curve Y - intercept section 3	Const 3.75342		
MLESBM3	LES B amplitude curve slope section 3	Const -0.490415		
MLESBB4	LES B amplitude curve Y - intercept section 4	Const 6.5697		
MLESBM4	LES B amplitude curve slope section 4	Const -0.959795		
MREAM01	RE A frequency curve slope section 1	Const 0.0		
MREAB01	RE A frequency curve Y - intercept section 1	Const 2.0		
MREAM02	RE A frequency curve slope section 2	Const 0.0		
MREAB02	RE A frequency curve Y - intercept section 2	Const 2.0		
MREAM03	RE A frequency curve slope section 3	Const 0.0		
MREAB03	RE A frequency curve Y - intercept section 3	Const 2.0		
MREAM04	RE A frequency curve slope section 4	Const 0.0		
MREAB04	RE A frequency curve Y - intercept section 4	Const 2.0		
MREAM05	RE A frequency curve slope section 5	Const -0.02		
MREAB05	RE A frequency curve Y - intercept section 5	Const 3.6		
MREBB01	RE B amplitude curve Y - intercept section 1	Const -15.34157		
MREPM01	RE B amplitude curve slope section 1	Const 0.0		
MREBB02	RE B amplitude curve Y - intercept section 2	Const -15.34157		
MREBM02	RE B amplitude curve slope section 2	Const 0.3065615		
MREBB03	RE B amplitude curve Y - intercept section 3	Const -13.24029		
MREBM03	RE B amplitude curve slope section 3	Const 0.2540295		
MREBB04	RE B amplitude curve Y - intercept section 4	Const 1.09815		
MREBM04	RE B amplitude curve slope section 4	Const 0.0150555		
MREBB05	RE B amplitude curve Y - intercept section 5	Const 5.77263		
MREBM05	RE B amplitude curve slope section 5	Const -0.0433755		
MDETP05	Iteration constant	Const .05 sec		

Table 6-55. Environmental Control System—Aural Cue (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MLBAM07	LB A frequency curve slope section 6	Const -0.12		
MLBAB07	LB A frequency curve Y - intercept section 6	Const 12.2		
MLBAM08	LB A frequency curve slope section 7	Const -0.3		
MLBAB08	LB A frequency curve Y - intercept section 7	Const 23		
MLBAM09	LB A frequency curve slope section 8	Const -0.12		
MLBAB09	LB A frequency curve Y - intercept section 8	Const 10.4		
MLBAM10	LB A frequency curve slope section 9	Const 0.0		
MLBAB10	LB A frequency curve Y - intercept section 9	Const 0.8		
MLBAM11	LB A frequency curve slope section 10	Const 0.0		
MLBAB11	LB A frequency curve Y - intercept section 10	Const 0.8		
MLBAM12	LB A frequency curve slope section 11	Const 0.08		
MLBAB12	LB A frequency curve Y - intercept section 11	Const -7.2		
MLBAM13	LB A frequency curve slope section 12	Const 0.04		
MLBAB13	LB A frequency curve Y - intercept section 12	Const -2.8		
MLBAM14	LB A frequency curve slope section 13	Const 0.0		
MLBAB14	LB A frequency curve Y - intercept section 13	Const 2.0		
MLBAM15	LB A frequency curve slope section 14	Const 0.0		
MLBAB15	LB A frequency curve Y - intercept section 14	Const 2.0		
MLBAM16	LB A frequency curve slope section 15	Const 0.0		
MLBAB16	LB A frequency curve Y - intercept section 15	Const 2.0		
MLBBB04	LB B amplitude curve Y - intercept section 3	Const -1.26797		
MLBBM04	LB B amplitude curve slope section 3	Const 0.048343		
MLBBB05	LB B amplitude curve Y - intercept section 4	Const -2.85248		
MLBBM05	LB B amplitude curve slope section 4	Const 0.10116		
MLBBB06	LB B amplitude curve Y - intercept section 5	Const -1.69808		
MLBBM06	LB B amplitude curve slope section 5	Const 0.0723		
MLBBB07	LB B amplitude curve Y - intercept section 6	Const -0.01143		
MLBBM07	LB B amplitude curve slope section 6	Const 0.038567		
MLBBB08	LB B amplitude curve Y - intercept section 7	Const 6.97177		
MLBBM08	LB B amplitude curve slope section 7	Const -0.077653		
MLBBB09	LB B amplitude curve Y - intercept section 8	Const 4.75551		
MLBBM09	LB B amplitude curve slope section 8	Const -0.046135		

Table 6-55. Environmental Control System—Aural Cue (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MLBBB10	LB B amplitude curve Y - intercept section 9	Const 5.82239		
MLBBM10	LB B amplitude curve slope section 9	Const -0.059471		
MLBBB11	LB B amplitude curve Y - intercept section 10	Const 8.17094		
MLBBM11	LB B amplitude curve slope section 10	Const -0.085566		
MLBBB12	LB B amplitude curve Y - intercept section 11	Const 6.84434		
MLBBM12	LB B amplitude curve slope section 11	Const -0.0723		
MLBBB13	LB B amplitude curve Y - intercept section 12	Const 7.5644		
MLBBM13	LB B amplitude curve slope section 12	Const -0.078846		
MLBBB14	LB B amplitude curve Y - intercept section 13	Const 7.95464		
MLBBM14	LB B amplitude curve slope section 13	Const -0.082098		
MLBBB15	LB B amplitude curve Y - intercept section 14	Const 6.29285		
MLBBM15	LB B amplitude curve slope section 14	Const -0.069315		
MLBBB16	LB B amplitude curve Y - intercept section 15	Const 9.63059		
MLBBM16	LB B amplitude curve slope section 15	Const -0.093156		
MLESAM4	LES A frequency curve slope section 4	Const 0.45		
MLESAB4	LES A frequency curve Y - intercept section 4	Const -1.6		
MREAM06	RE A frequency curve slope section 6	Const -0.04		
MREAB06	RE A frequency curve Y - intercept section 6	Const 5.6		
MREAM07	RE A frequency curve slope section 7	Const 0.0		
MREAB07	RE A frequency curve Y - intercept section 7	Const 0.8		
MREAM08	RE A frequency curve slope section 8	Const 0.0		
MREAB08	RE A frequency curve Y - intercept section 8	Const 0.8		
MREAM09	RE A frequency curve slope section 9	Const 0.02		
MREAB09	RE A frequency curve Y - intercept section 9	Const -2.4		
MREAM10	RE A frequency curve slope section 10	Const 0.04		
MREAB10	RE A frequency curve Y - intercept section 10	Const -6.0		
MREAM11	RE A frequency curve slope section 11	Const 0.09		
MREAB11	RE A frequency curve Y - intercept section 11	Const -16.0		
MREAM12	RE A frequency curve slope section 12	Const 0.12		
MREAB12	RE A frequency curve Y - intercept section 12	Const -22.6		
MREBB06	RE B amplitude curve Y - intercept section 6	Const 6.26048		
MREBM06	RE B amplitude curve slope section 6	Const -0.048254		
MREBB07	RE B amplitude curve Y - intercept section 7	Const 1.27118		
MREBM07	RE B amplitude curve slope section 7	Const -0.0066785		

Table 6-55. Environmental Control System—Aural Cue (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MREBB08	RE B amplitude curve Y - intercept section 8	Const 3.05079		
MREBM08	RE B amplitude curve slope section 8	Const -0.019388		
MREBB09	RE B amplitude curve Y - intercept section 9	Const 4.46791		
MREBM09	RE B amplitude curve slope section 9	Const -0.028245		
MREBB10	RE B amplitude curve Y - intercept section 10	Const 14.56141		
MREBM10	RE B amplitude curve slope section 10	Const -0.08432		
MREBB11	RE B amplitude curve Y - intercept section 11	Const 7.83991		
MREBM11	RE B amplitude curve slope section 11	Const -0.0497125		
MREBB12	RE B amplitude curve Y - intercept section 12	Const 3.47014		
MREBM12	RE B amplitude curve slope section 12	Const -0.030759		
MO28	1 if inverter No. 1 on	Boolean		
MO29	1 if inverter No. 2 on	Boolean		
MO30	1 if inverter No. 3 on	Boolean		
MO31	1 if SCS attitude gyro No. 1 on	Boolean		
MO32	1 if SCS attitude gyro No. 2 on	Boolean		
MO33	1 if SCS attitude gyro No. 3 on	Boolean		
MO34	1 if SCS rate gyro No. 1 on	Boolean		
MO35	1 if SCS rate gyro No. 2 on	Boolean		
MO36	1 if SCS rate gyro No. 3 on	Boolean		
MO37	1 if glycol pump No. 1 or 2 on	Boolean		
MO38	1 if cabin fan No. 1 on	Boolean		
MO39	1 if cabin fan No. 2 on	Boolean		
MO40	1 if ECS suit compressor 1 or 2 on	Boolean		

Table 6-56. Master Caution and Warning System

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
E301	CDU annunciator fail 1A10	Boolean		
E302	G&N accel fail on 1A10	Boolean		
E303	AGC PWR fail on 1A10	Boolean		
E304	SPS rough engine C/O 1A10	Boolean		
E305	S/M RCS A fail on 1A10	Boolean		
E306	C/M RCS A fail on 1A10	Boolean		
E307	IMU fail on 1A10	Boolean		
E308	G&N error on 1A10	Boolean		
E309	Spare CWS light DS6 on panel 1A10	Boolean		
E310	Spare CWS light DS18 on panel 1A10	Boolean		
E311	S/M RCS B fail on 1A10	Boolean		
E312	C/M RCS B fail on 1A10	Boolean		
E313	IMU temp 1A10	Boolean		
E314	GIMBAL lock on 1A10	Boolean		
E316	Spare CWS light DS11 on panel 1A10	Boolean		
E317	S/M RCS C fail on 1A10	Boolean		
E318	Spare CWS light DS 12 on panel 1A10	Boolean		
E319	C/W fail 1A11	Boolean		
E320	Spare CWS light DS 17 on panel 1A10	Boolean		
E321	AGAE temp on 1A10	Boolean		
E322	Partial press CO_2 HI 1A11	Boolean		X
E323	S/M RCS D fail on 1A10	Boolean		
E324	Spare CWS light DS24 on panel 1A10	Boolean		
E325	H_2O accum fail on 1A11	Boolean		
E326	Pitch GIMBAL drive fail 1A11	Boolean		
E327	SPS wall temp. HI on 1A11	Boolean		
E328	SFS wall temp. HI on 1A11	Boolean		X
E329	SPS press. fail on 1A11	Boolean		
E330	$-O_2$ press. fail on 1A10	Boolean		X
E331	FC BUS disconnect fail on 1A11	Boolean		
E332	YAW GIMBAL drive fail 1A11	Boolean		
E333	Spare 1A10	Boolean		

Table 6-56. Master Caution and Warning System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
E334	Inverter 1 temp HI 1A11	Boolean		
E335	FC 1 fail on 1A11	Boolean		
E336	H_2 press. fail on 1A10	Boolean		X
E337	MN BUS A undervolts ind. 1A11	Boolean		X
E338	AC BUS 1 volt fail ON 1A11	Boolean		
E339	AC BUS 1 overload ON 1A11	Boolean		X
E340	Inverter 2 temp HI 1A11	Boolean		
E341	FC 2 fail on 1A11	Boolean		
E342	Spare CWS light DS5 ON panel 1A11	Boolean		
E343	MN BUS B undervolts ind 1A11	Boolean		X
E344	AC BUS 2 volt fail ON 1A11	Boolean		X
E345	AC BUS 2 overload ON 1A11	Boolean		X
E346	Inverter 3 temp HI 1A11	Boolean		
E347	FC 3 fail on 1A11	Boolean		
E348	Glycol temp LO ON 1A11	Boolean		X
E349	Master alarm on 1A3	Boolean		X
E350	Master alarm on 1A18	Boolean		
E351	CWS lamp mode sw 35 in NORM 1A13	Boolean		
E352	Alarm tone gen (flip-flop out)	Boolean		
E353	CWS lamp mode sw 35 in ACK 1A13	Boolean		
E360	MASTER ALARM sw ON 1A3	Boolean		
E361	MASTER ALARM sw ON 1A18	Boolean		
E362	POWER sw S-2 in CSM 1A11	Boolean		
E363	CW sw S-1 pwr supply No. 1 ON 1A11	Boolean		
E367	Lamp test switch test 2 1A23	Boolean		
E364	CW sw S-1 pwr supply No. 2 ON 1A11	Boolean		
E368	Lamp test switch test 1 1A23	Boolean		
E369	O_2 FLOW HI light on 1A11	Boolean		
E379	CWS master caution acknowledge signal (reset)	Boolean		
E380	CWS lamp power BUS B	Boolean		
E381	CWS lamp power BUS A	Boolean		
E382	CWS-ECS O_2 flow out of supply mnfld out-of-tol	Boolean		

Table 6-56. Master Caution and Warning System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
E383	CWS MN A/B pwr avail.	Boolean		
E384	CWS ±12v available	Boolean		
E385	SPS oxidizer tank press. out-of-tol.	Boolean		
E386	SPS oxidizer tank press. out-of-tol	Boolean		
E387	CWS-ECS-glycol temp out-of-tol	Boolean		
E388	CWS-CSS - H_2 tank 1 press. out-of-tol	Boolean		
E389	CWS-CSS - H_2 tank 2 press. out-of-tol	Boolean		
E390	CWS-SPS-fuel tank pressure out-of-tol	Boolean		
E391	CWS-SPS - temp chamber outer skin out-of-tol	Boolean		
E392	CWS-RCS - A eng mntg temp out-of-tol	Boolean		
E393	CWS-RCS - A reg press. out-of-tol	Boolean		
E394	CWS-RCS - B reg press. out-of-tol	Boolean		
E395	CWS-RCS - C reg press. out-of-tol	Boolean		
E396	CWS-RCS - D reg press. out-of-tol	Boolean		
E399	CWS-RCS - A fuel press. out-of-tol	Boolean		
E400	CWS-RCS - B fuel press. out-of-tol	Boolean		
E401	CWS-RCS - A oxid press. out-of-tol	Boolean		
E402	CWS-RCS - B oxid press. out-of-tol	Boolean		
E403	CWS-FC1 N_2 reg output press. out-of-tol	Boolean		
E404	CWS-FC2 N_2 reg output press. out-of-tol	Boolean		
E405	CWS-FC3 N_2 reg output press. out-of-tol	Boolean		
E406	CWS-FC1 H_2 flow rate out-of-tol	Boolean		
E407	CWS-FC2 H_2 flow rate out-of-tol	Boolean		
E408	CWS-FC3 H_2 flow rate out-of-tol	Boolean		
E409	CWS-FC1 condenser exhaust temp out-of-tol	Boolean		
E410	CWS-FC2 condenser exhaust temp out-of-tol	Boolean		
E411	CWS-FC3 condenser exhaust temp out-of-tol	Boolean		
E412	CWS-FC1 module skin temp out-of-tol	Boolean		
E413	CWS-FC2 module skin temp out-of-tol	Boolean		
E414	CWS-FC3 module skin temp out-of-tol	Boolean		
E415	CWS-FC1 O_2 reg output press. out-of-tol	Boolean		
E416	CWS-FC2 O_2 reg output press. out-of-tol	Boolean		

Table 6-56. Master Caution and Warning System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
E417	CWS-FC3 O_2 reg output press. out-of-tol	Boolean		
E418	CWS-FC1 H_2 reg output press. out-of-tol	Boolean		
E419	CWS-FC2 H_2 reg output press. out-of-tol	Boolean		
E420	CWS-FC3 H_2 reg output press. out-of-tol	Boolean		
E421	CWS-FC1 O_2 flow rate out-of-tol	Boolean		
E422	CWS-FC2 O_2 flow rate out-of-tol	Boolean		
E423	CWS-FC3 O_2 flow rate out-of-tol	Boolean		
E424	CWS-FC1 radiator outlet temp out-of-tol	Boolean		
E425	CWS-FC2 radiator outlet temp out-of-tol	Boolean		
E426	CWS-FC3 radiator outlet temp out-of-tol	Boolean		
E427	CWS-F/C1 water pH factor out-of-tol	Boolean		
E428	CWS-F/C2 water pH factor out-of-tol	Boolean		
E429	CWS-F/C3 water pH factor out-of-tol	Boolean		
E430	CWS-RCS - B eng. mntg temp out-of-tol	Boolean		
E431	CWS-RCS - C eng mntg temp out-of-tol	Boolean		
E432	CWS-RCS - D eng mntg temp out-of-tol	Boolean		
E450	CWS-CSS-O_2 tank 1 press. out-of-tol	Boolean		
E451	CWS-CSS-O_2 tank 2 press. out-of-tol	Boolean		
E452	CWS-Spare sys variable out-of-tol	Boolean		
E453	CWS-Spare sys variable out-of-tol	Boolean		
E454	CWS-Spare sys variable out-of-tol	Boolean		
E455	CWS-Spare sys variable out-of-tol	Boolean		
E456	CWS-Spare sys variable out-of-tol	Boolean		
E457	CWS-Spare sys variable out-of-tol	Boolean		
E458	CWS-inverter No. 1 out-of-tol	Boolean		
E459	CWS-inverter No. 2 out-of-tol	Boolean		
E460	CWS-inverter No. 3 out-of-tol	Boolean		
E461	CWS-E343 minus short malfunction ME304	Boolean		
E462	CWS-E330 minus short malfunction ME306	Boolean		
E463	CWS-E328 minus short malfunction ME308	Boolean		
E464	CWS-E311 minus short malfunction ME310	Boolean		
E468	CWS-E347 minus short malfunction ME316	Boolean		

Table 6-56. Master Caution and Warning System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
E469				
E495	Spare Boolean for CWS light DS200N 1A10	Boolean		
E496	Spare Boolean for CWS light DS12 1A10	Boolean		
E497				
E501	CWS-MSTR alarm lt arm	Boolean		
E502	CWS-C/M RCS A fail condition	Boolean		
E503	CWS-C/M RCS B fail condition	Boolean		
E505	CWS-S/M RCS A fail condition	Boolean		
E506	CWS-S/M RCS C fail condition	Boolean		
E507	CWS-S/M RCS D fail condition	Boolean		
E508	CWS-H_2 press fail condition	Boolean		
ME300	CWS malfunction CW pwr supply No. 1 fail	Malfunction		
ME301	CWS malf. - CO_2 PP HI cmprtr ref volt drift LO	Malfunction		
ME302	CWS malf. - CO_2 PP HI lamp driver shorted	Malfunction		
ME303	CWS malf. - glycol temp cmprtr ref volt drift LO	Malfunction		
ME304	CWS malf. - glycol temp lamp driver shorted	Malfunction		
ME305	CWS malf. - O_2 tank 2 ref drifts HI-HI or LO-LO	Malfunction		
ME306	CWS malf. - CSS O_2 lamp driver shorted	Malfunction		
ME307	CWS malf. - SPS temp. cmprtr ref volt drift HI	Malfunction		
ME310	CWS malf. - S/M RCS (B) lamp driver shorted	Malfunction		
ME311	CWS malf. - S/M RCS C light wire open	Malfunction		
ME312	CWS malf. - S/M RCS D refs drifts HI-LO or LO-HI	Malfunction		
ME313	CWS malf. - C/M RCS A light wire open	Malfunction		
ME314	CWS malf. - C/M RCS A lamp driver shorted	Malfunction		
ME315	CWS malf. - F/C2 light wire open	Malfunction		
ME316	CWS malf. - F/C3 lamp driver shorted	Malfunction		
ME320	CWS malf. - H_2 flow F/C 1 ref drifts HI-HI: LO-LO	Malfunction		
ME321	CWS malf. - SKT temp F/C 2 ref drifts HI-LO: LO-HI	Malfunction		
ME322	CWS malf. - PH F/C 1 ref drifts low	Malfunction		
ME323	CWS malf. - H_2 press. F/C 1 ref drifts high	Malfunction		
ME324	CWS malf-rad. temp F/C 2 ref drifts high	Malfunction		
ME325	CWS malf. - N_2 press. F/C 2 ref drifts high	Malfunction		

Table 6-56. Master Caution and Warning System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
ME326	CWS malf. - O_2 press. F/C 3 ref drifts low	Malfunction		
ME327	CWS malf. - O_2 flow F/C 2 ref drifts: HI-HI, LO-LO	Malfunction		
ME340	CWS malf. - SPS press. lamp driver shorted	Malfunction		
ME341	CWS malf. - S/M reg press. A drifts HI-HI or LO-LO	Malfunction		
ME342	CWS malf. - DS11 panel 1A10 ref drift: HI-LO or LO-HI	Malfunction		
ME343	CWS malf. - DS5 panel 1A11 ref drift: HI-LO or LO-HI	Malfunction		
ME344	CWS malf. - cond exh. F/C 3 ref drift: HI-LO, LO-HI	Malfunction		
ME345	CWS malf. - open wire to master ctn lights	Malfunction		
ME360	CWS malfunction - IMU temp light wire open	Malfunction		
ME361	CWS malfunction - G&N accel. fail light wire open	Malfunction		
ME362	CWS malfunction - DC BUS B light wire open	Malfunction		
ME363	CWS malfunction - H_2O accum. light wire open	Malfunction		
ME364	CWS malfunction - SPS PU fail light wire open	Malfunction		
EK52	CWS voltage comparator constant = 7.2 mm Hg	Const 7.200 mm of Hg		
EK53	CWS voltage comparator constant = 29.9°F	Const -29.900°F		
EK54	CWS voltage comparator constant = 245.0 psia	Const 245.000 psia		
EK55	CWS voltage comparator constant = 25.0 psia	Const 25.000 psia		
EK56	CWS voltage comparator constant = 180.0 psia	Const 180.000 psia		
EK57	CWS voltage comparator constant = 20.0 psia	Const 20.000 psia		
EK58	CWS voltage comparator constant = 485.0°F	Const 485.000 psia		
EK59	CWS voltage comparator constant = 119.0°F	Const 119.000 psia		
EK60	CWS voltage comparator constant = 56°F	Const 56.000 psia		
EK61	CWS voltage comparator constant = 185.0 psia	Const 185.000 psia		
EK62	CWS voltage comparator constant = 30.0 psia	Const 30.000 psia		
EK63	CWS voltage comparator constant = 85.0°F	Const 85.000°F		
EK64	CWS voltage comparator constant = 65.0°F	Const 65.000°F		
EK65	CWS voltage comparator constant = 120.0 psia	Const 120.000 psia		
EK66	CWS voltage comparator constant = 100.0 psia	Const 100.000 psia		
EK67	CWS voltage comparator constant = 295.0 psia	Const 295.000 psia		
EK68	CWS voltage comparator constant = 70.0 psia	Const 70.000 psia		
EK69	CWS voltage comparator constant = 0.100 lb/hr	Const 0.100 lb/hr		

Table 6-56. Master Caution and Warning System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
EK70	CWS voltage comparator constant = 0.064 lb/hr	Const 0.064 lb/hr		
EK71	CWS voltage comparator constant = 165.0°F	Const 165.000°F		
EK72	CWS voltage comparator constant = 10.0°F	Const 10.000°F		
EK73	CWS voltage comparator constant = 430°F	Const 430.000°F		
EK74	CWS voltage comparator constant = 70°F	Const 70.000°F		
EK75	CWS voltage comparator constant = 75.0 psia	Const 75.000 psia		
EK76	CWS voltage comparator constant = 0.796 lb/hr	Const 0.796 lb/hr		
EK77	CWS voltage comparator constant = 0.508 lb/hr	Const 0.508 lb/hr		
EK78	CWS voltage comparator constant = 35.0°F	Const -35.000°F		
EK79	CWS voltage comparator constant = 9.9	Const 9.900°F		
EK80	CWS voltage comparator constant = 7.5 lb/hr	Const 7.500 lb/hr		
EK81	CWS voltage comparator constant = 875.0 psia	Const 875.000 psia		
EK82	CWS voltage comparator constant = 75.0 psia	Const 75.000 psia		
EK83	CWS voltage comparator constant = 0	Const 0.000		
EK84	CWS voltage comparator constant = 0	Const 0.000		
EK85	CWS voltage comparator constant = 0	Const 0.000		
EK86	CWS voltage comparator constant = 0	Const 0.000		
EK87	CWS voltage comparator constant = 0	Const 0.000		
EK88	CWS voltage comparator constant = 0	Const 0.000		
EK89	CWS voltage comparator constant = 0	Const 0.000		
EK90	CWS voltage comparator constant = 0	Const 0.000		
EK91	CWS voltage comparator constant = 0	Const 0.000		
EK92	CWS voltage comparator constant = 0	Const 0.000		
EK93	CWS voltage comparator constant = 0	Const 0.000		
EK94	CWS voltage comparator constant = 0	Const 0.000		
EK95	CWS voltage comparator constant = 241.0°F	Const 0.000		
C649	EPS - AC BUS 1 RESET sw ON	Boolean		
C654	EPS - AC BUS 2 RESET sw ON	Boolean		
G398	Master caution light on 1A57	Boolean		
G399	Master warning light on 1A57	Boolean		
C550	EPS - D&C comparator unit main A C/B	Boolean		

Table 6-56. Master Caution and Warning System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
C534	EPS - D&C comparator unit main B C/B	Boolean		
C479	EPS - interior flood light main A C/B	Boolean		
*T369	CWS MASTER ALARM ON telemetry		GP36-6(D)/286	
E5C50	CWS amps used at C15A6CB50	0, 5.00 amps		
E5C34	CWS amps used at C15A6CB51	0, 5.00 amps		
E4C79	CWS amps used at C15A6CB38	0, 2.00 amps		
EKAMP1	CWS constant = 0.100 amps	Const 0.100 amps		
EKAMP2	CWS constant = 0.040 amps	Const 0.040 amps		
EKAMP3	CWS constant = 0.080 amps	Const 0.080 amps		
ENOLITES	CWS summation of lamps lit	0, 51		
EKAMP4	CWS constant = 0.200	Const 0.200 amps		
EKAMP5	CWS constant = 2.00 amps	Const 200 amps		
E510	CWS pitch gimbal fail condition	Boolean		
E511	CWS SPS PU sensor fail condition	Boolean		
E512	CWS SPS press.fail condition	Boolean		
E513	CWS F/C disconnect fail condition	Boolean		
E514	CWS YAW gimbal fail condition	Boolean		
E515	CWS F/C 1 fail condition	Boolean		
E516	CWS F/C 2 fail condition			

*Program symbols are not available at publication date. Math model symbols are given for information only.

Table 6-57. MSCC Interface—Up-Data Link System

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T500	Nonintegrated UDL keyboard bit 1	Boolean		
T501	Nonintegrated UDL keyboard bit 2	Boolean		
T502	Nonintegrated UDL keyboard bit 3	Boolean		
T503	Nonintegrated UDL keyboard bit 4	Boolean		
T504	Nonintegrated UDL keyboard bit 5	Boolean		
T505	Nonintegrated UDL display data bit	Boolean		
T506	Nonintegrated UDL address bit 1	Boolean		
T507	Nonintegrated UDL address bit 2	Boolean		
T508	UDL normal message received	Boolean		
T509	UDL test message A received	Boolean		
T510	UDL test message B received	Boolean		
T511	Integrated mode select	Boolean		X
TUDLVALD	UDL validation code	Boolean		
MT017	UDL validation failed	Boolean		
TSTMSG A	Test message A (24 bit-octal coded)	Const 37000002_8		
TSTMSG B	Test message B (24 bit-octal coded)	Const 37777775_8		
C_1	244_8 standby validation code constant	Const 244_8		
C_2	133_8 normal message received constant	Const 133_8		
C_3	270_8 test message A received constant	Const 270_8		
C_4	104_8 test message B received constant	Const 104_8		
G009	UP-TEL switch block position $\lfloor(\overline{G009}) = \text{accept}\rfloor$	Boolean		
G040	Nonintegrated UDL UPRUPT			
TW71	Integrated UDL address word in			
TW72	Integrated UDL data word in			
T528	Integrated CTE message received	Boolean		
T529	Nonintegrated CTE message received	Boolean		
T530	Set RTC relays---integrated mode	Boolean		
T531	Set RTC relays---nonintegrated mode	Boolean		
T532	State of (G040) in the previous iteration	Boolean		
T328	UDL OK	Boolean		
TZERO	Numerical 0	Const 0		
TONE	Numerical 1	Const 1		
TTWO	Numerical 2	Const 2		

Table 6-57. MSCC Interface—Up-Data Link System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
TTHREE	Numerical 3	Const 3		
TFOUR	Numerical 4	Const 4		
TFIVE	Numerical 5	Const 5		
TSIX	Numerical 6	Const 6		
TSEVEN	Numerical 7	Const 7		
TTEN	Numerical 10	Const 10		
TTWO0	Numerical 20	Const 20		
TTHREE0	Numerical 30	Const 30		
TFOUR0	Numerical 40	Const 40		
TFIVE0	Numerical 50	Const 50		
TSIX0	Numerical 60	Const 60		
TSEVEN0	Numerical 70	Const 70		
TKEYCTR	Key counter			
TKEYTEN	Key tens position			
TKEYUNIT	Key units position			
T600	Real-time command 00	Boolean		
T601	Real-time command 01	Boolean		
T602	Real-time command 02	Boolean		
T603	Real-time command 03	Boolean		
T604	Real-time command 04	Boolean		
T605	Real-time command 05	Boolean		
T606	Real-time command 06	Boolean		
T607	Real-time command 07	Boolean		
T610	Real-time command 10	Boolean		
T611	Real-time command 11	Boolean		
T612	Real-time command 12	Boolean		
T613	Real-time command 13	Boolean		
T614	Real-time command 14	Boolean		
T615	Real-time command 15	Boolean		
T616	Real-time command 16	Boolean		
T617	Real-time command 17	Boolean		
T620	Real-time command 20	Boolean		
T621	Real-time command 21	Boolean		

Table 6-57. MSCC Interface—Up-Data Link System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T622	Real-time command 22	Boolean		
T623	Real-time command 23	Boolean		
T624	Real-time command 24	Boolean		
T625	Real-time command 25	Boolean		
T626	Real-time command 26	Boolean		
T627	Real-time command 27	Boolean		
T630	Real-time command 30	Boolean		
T631	Real-time command 31	Boolean		
T632	Real-time command 32	Boolean		
T633	Real-time command 33	Boolean		
T634	Real-time command 34	Boolean		
T635	Real-time command 35	Boolean		
T636	Real-time command 36	Boolean		
T637	Real-time command 37	Boolean		
T640	Real-time command 40	Boolean		
T641	Real-time command 41	Boolean		
T642	Real-time command 42	Boolean		
T643	Real-time command 43	Boolean		
T644	Real-time command 44	Boolean		
T645	Real-time command 45	Boolean		
T646	Real-time command 46	Boolean		
T647	Real-time command 47	Boolean		
T650	Real-time command 50	Boolean		
T651	Real-time command 51	Boolean		
T652	Real-time command 52	Boolean		
T653	Real-time command 53	Boolean		
T654	Real-time command 54	Boolean		
T655	Real-time command 55	Boolean		
T656	Real-time command 56	Boolean		
T657	Real-time command 57	Boolean		
T660	Real-time command 60	Boolean		
T661	Real-time command 61	Boolean		

Table 6-57. MSCC Interface—Up-Data Link System (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T662	Real-time command 62	Boolean		
T663	Real-time command 63	Boolean		
T664	Real-time command 64	Boolean		
T665	Real-time command 65	Boolean		
T666	Real-time command 66	Boolean		
T667	Real-time command 67	Boolean		
T670	Real-time command 70	Boolean		
T671	Real-time command 71	Boolean		
T672	Real-time command 72	Boolean		
T673	Real-time command 73	Boolean		
T674	Real-time command 74	Boolean		
T675	Real-time command 75	Boolean		
T676	Real-time command 76	Boolean		
T677	Real-time command 77	Boolean		

Table 6-58. MSCC Interface - PCM Telemetry

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MT753	PCM unit fault No. 1		Boolean	
MT754	PCM unit fault No. 2		Boolean	
MT755	PCM unit fault No. 3		Boolean	
MT756	PCM unit fault No. 4		Boolean	
MT757	PCM unit fault No. 5		Boolean	
MT760	PCM unit fault No. 6		Boolean	
MT761	PCM unit fault No. 7		Boolean	
MT762	PCM unit fault No. 8		Boolean	
MT763	PCM unit fault No. 9		Boolean	
T753	PCM unit fault No. 1 output			
T754	PCM unit fault No. 2 output			
T755	PCM unit fault No. 3 output			
T756	PCM unit fault No. 4 output			
T757	PCM unit fault No. 5 output			
T760	PCM unit fault No. 6 output			
T761	PCM unit fault No. 7 output			
T762	PCM unit fault No. 8 output			
T763	PCM unit fault No. 9 output			

Table 6-59. Instructor's Operating Station—Data Output

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
SSDG1W1	Data output, GMT, T, TF, RCSF, RCST, OPLO, OPLA, OPAL	Variable		
SSDG1W2	Data output, GMT, TTF, RCSF, RCST, OPLO, OPLA, OPAL	Variable		
SSDG2W1	Data output, MEMA, MERA, SHA, DEC, LOS	Variable		
SSDG3W1	Data output, LOSHA, LADEC, TAP, TAR, TAY	Variable		
TGMTDWO	θMT data	Day, hour, min, sec		
TOFRDWO	TTF data	Day, hour, min, sec		
RRCSF	RCSF data	Pounds		
RRCST	RCST data	Seconds		
A LA SUB R	$A\lambda_R$ = OPLO data	Degrees		
A L SUB E	AL_E = OPLA data	Degrees		
A H SUP DIS	Ah = OPAL data	Miles		
SEPS	ϵ_S = MEMA data	Degrees		
SEPT	ϵ_T = MERA data	Degrees		
SSHAS	$(SHA)_S$ = SHA data	Degrees		
SDES	δ_S = DEC data	Degrees		
SPHT	ϕ_T = LOS data	Degrees		
SSD1	$(SD)_1$ = LOSHA data	Degrees		
SSD2	$(SD)_2$ = LADEC	Degrees		
A TH SUB VB	$A\theta_{VB\rightarrow VE}$, $A\theta_{VB\rightarrow I}$, or $A\theta_{VB\rightarrow VM}$ = TAP data	Degrees		
A PH SUB VB	$A\phi_{VB\rightarrow VE}$, $A\phi_{VB\rightarrow I}$, or $A\phi_{VB\rightarrow VM}$ = TAR data	Degrees		
A PS SUB VB	$A\psi_{VB\rightarrow VE}$, $A\psi_{VB\rightarrow I}$, or $A\psi_{VB\rightarrow VM}$ = TAY data	Degrees		

Table 6-60. Instructor's Operating Station—Visual System Supplementary Display

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
H110	Boolean term denoting that the minimum impulse switch is on	Boolean		
G404	Boolean term denoting that the optics hand control is not in the deadband	Boolean		
G405	Boolean term denoting that the optics hand control is not in the deadband	Boolean		
S078	Boolean term which is equal to 1 while the time display reset pushbutton is depressed	Boolean		
S350	Activating command to the SCT/SXT and error signal displays	Boolean		
SSINGHA	Trigonometric function of the Greenwich hour angle	-1, 1		
SCOSGHA	Trigonometric function of the Greenwich hour angle	-1, 1		
SXIELM	X I_E-frame coordinate of the selected landmark	-21000000, 21000000 ft		
SYIELM	Y I_E-frame coordinate of the selected landmark	-21000000, 21000000 ft		
SZIELM	Z I_E-frame coordinate of the selected landmark	-21000000, 21000000 ft		
SXLMV	X I_E-frame component of the selected landmark with respect to the command module	-7508900, 7508900 ft		
SYLMV	Y I_E-frame component of the selected landmark with respect to the command module	-7508900, 7508900 ft		
SZLMV	Z I_E-frame component of the selected landmark with respect to the command module	-7508900, 7508900 ft		
SRLMV	Magnitude of the position of the LM with respect to the command module	500000, 7508900 ft		
SLLMV	X I_E-frame component of a unit vector directed along a LM LOS	-1, 1		
SMLMV	Y I_E-frame component of a unit vector directed along a LM LOS	-1, 1		
SNLMV	Z I_E-frame component of a unit vector directed along a LM LOS	-1, 1		
S371	Boolean equals 1 if GMTYPE = 1	Boolean		
S373	Boolean equals 1 if GMTYPE = 3	Boolean		
S374	Boolean equals 1 if GMTYPE = 4	Boolean		
SXIDS	X I_E-frame component of a unit vector along the desired star line of sight	-1, 1		

Table 6-60. Instructor's Operating Station—Visual System Supplementary Display (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
SYIDS	Y I_E-frame component of a unit vector along the desired star line of sight	-1, 1		
SZIDS	Z I_E-frame component of a unit vector along the desired star line of sight	-1, 1		
SXORDS	X optics reference frame component of a unit vector along the desired star line of sight	-1, 1		
SYORDS	Y optics reference frame component of a unit vector along the desired star line of sight	-1, 1		
SZORDS	Z optics reference frame component of a unit vector along the desired star line of sight	-1, 1		
SXORDLM	X OR-frame component of a unit vector along the desired landmark line of sight	-1, 1		
SYORDLM	Y OR-frame component of a unit vector along the desired landmark line of sight	-1, 1		
SZORDLM	Z OR-frame component of a unit vector along the desired landmark line of sight	-1, 1		
S372	Boolean equals 1 if GMTYPE = 2	Boolean		
S075	Boolean which indicates that a sextant scale has been selected at the SCT/SXT display	Boolean		
S375	Boolean defined by equation 35	Boolean		
SCOSXATD	Trig function of desired sextant trunnion angle	-1, 1		
SABSXATD	Absolute value of trig function of desired sextant trunnion angle	0, 1		
SSINATA	Trig function of the actual trunnion angle of the telescope or sextant	-1, 1		
S340	Boolean equals 1 if SIN $(A_T)_A$ is non-negative	Boolean		
SSINXATD	Trig function of desired sextant trunnion angle	-1, 1		
SABSTATD	Absolute value of trig function of desired telescope trunnion angle	0, 1		
SSINTATD	Trig function of desired telescope trunnion angle	-1, 1		
SCOSATD	Trig function of desired trunnion angle of the telescope or sextant	-1, 1		
SSINATD	Trig function of desired trunnion angle of the telescope or sextant	-1, 1		
S341	Boolean defined by equation 39	Boolean		
SSINXASD	Trig function of desired sextant shaft angle	-1, 1		
SSINASA	Trig function of actual shaft angle of the telescope or sextant	-1, 1		
SCOSASA	Trig function of actual shaft angle of the telescope or sextant	-1, 1		

Table 6-60. Instructor's Operating Station—Visual System Supplementary Display (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
SSINTASD	Trig function of desired telescope shaft angle	-1, 1		
SCOSXASD	Trig function of desired sextant shaft angle	-1, 1		
SCOSTASD	Trig function of desired telescope shaft angle	-1, 1		
SSINASD	Trig function of desired shaft angle of the telescope or sextant	-1, 1		
SCOSASD	Trig function of desired shaft angle of the telescope or sextant	-1, 1		
SCOSATA	Trig function of the actual trunnion angle of the telescope or sextant	-1, 1		
SSINEPS	Sine of the shaft angle error signal	-1, 1		
SSINEPT	Sine of the trunnion angle error signal	-1, 1		
SEPS	Shaft angle error signal	-10, 10 deg		
SEPT	Trunnion angle error signal	-10, 10 deg		
SRADS	Scaled output signal which generates the SCT cross hairs, or SXT reticle	-10, 10 volts		
SRADC	Scaled output signal which generates the SCT cross hairs, or SXT reticle	-10, 10 volts		
SRAD9S	Scaled output signal which generates the SCT cross hairs, or SXT reticle	-10, 10 volts		
SRAD9C	Scaled output signal which generates the SCT cross hairs, or SXT reticle	-10, 10 volts		
SXIT	X I_E-frame component of a unit vector along the sextant trunnion axis	-1, 1		
SYIT	X I_E-frame component of a unit vector along the sextant trunnion axis	-1, 1		
SZIT	Z I_E-frame component of a unit vector along the sextant trunnion axis	-1, 1		
SSINDES	Trig function of the declination of sextant shaft axis	-1, 1		
SCOSDES	Trig function of the declination of sextant shaft axis	0, 1		
S351	Boolean defined by equation 65	Boolean		
SSINSHAS	Trig function of the sidereal hour angle of sextant shaft axis	-1, 1		
SCOSSHAS	Trig function of the sidereal hour angle of sextant shaft axis	-1, 1		
SSINPHT	Trig function of the angle the SXT trunnion axis makes with the celestial sphere meridians	-1, 1		
SCOSPHT	Trig function of the angle the SXT trunnion axis makes with the celestial sphere meridians	-1, 1		

Table 6-60. Instructor's Operating Station—Visual System Supplementary Display (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
SYWD	Telescope window frame components of a unit vector along the desired line of sight	-1, 1		
SZWD	Telescope window frame components of a unit vector along the desired line of sight	-1, 1		
S376	Boolean defined by equation 72	Boolean		
S076	Input from IOS	Boolean		
S352	Boolean denoting a 60° FOV at the SCT/SXT display	Boolean		
S353	Boolean denoting a 12° FOV at the SCT/SXT display	Boolean		
S354	Boolean denoting a 1.8° FOV at the SCT/SXT display	Boolean		
S355	Boolean denoting a .36° FOV at the SCT/SXT display	Boolean		
SXDLM	X SCT/SXT display landmark image drive signals	-10, 10 volts		
SYDLM	Y SCT/SXT display landmark image drive signals	-10, 10 volts		
SXDSTR	X SCT/SXT display star image drive signals	-10, 10 volts		
SYDSTR	Y SCT/SXT display star image drive signals	-10, 10 volts		
S360	Boolean defined by equation 81	Boolean		
S364	Boolean defined by equation 82	Boolean		
AH	Altitude of spacecraft in feet.	Feet		
ARETH	Radius of the earth in feet.	Feet		
SRFLOS	Distance from the CSM to the foot of the telescope line of sight	500000, 7,508,900 ft		
SXIELOS	Parameter used to compute the longitude and latitude of the foot of the SCT line of sight	-20925742, 20,925,742 ft		
SYIELOS	Parameter used to compute the longitude and latitude of the foot of the SCT line of sight	-20925742, 20,925,742 ft		
SZIELOS	Parameter used to compute the longitude and latitude of the foot of the SCT line of sight	-20925742, 20,925,742 ft		
SRLOSP	Parameter used to compute the longitude and latitude of the foot of the SCT line of sight	20000000, 30,000,000 ft		
SSNRALOS	Trig function of the SCT line-of-sight rt. ascension	-1, 1		
SCSRALOS	Trig function of the SCT line-of-sight rt. ascension	-1, 1		
SSINLLOS	Trig function of latitude of the foot of the telescope line of sight	-1, 1		
SCOSLLOS	Trig function of latitude of the foot of the telescope line of sight	-1, 1		
SLALOS	Longitude of the telescope line of sight	0, 360 deg		
S362	Boolean defined by equation 96	Boolean		

Table 6-60. Instructor's Operating Station—Visual System Supplementary Display (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
S363	Boolean equals 1 if SXT longitude is not positive	Boolean		
SSD1	Shared navigational parameter display drive signal	0, 360 deg		
SSD2	Shared navigational parameter display drive signal	-90, 90 deg		
S365	Boolean defined by equation 97	Boolean		
S380	Boolean = 1 if h_{NM} is greater than 100 n mi	Boolean		
SXORLOS	X OR-frame component of desired sighting along LM LOS	Const 63.63796 in.		
SYORLOS	Y OR-frame component of desired sighting along LM LOS	Const 63.63796 in.		
SZORLOS	Z OR-frame component of desired sighting along LM LOS	Const 63.63796 in.		
SNORLOS	Magnitude of vector to desired sighting along LM LOS	Const 63.63796 in.		
SCOSTATD	Cosine of desired SCT trunnion angle	-1, 1		
SFNSD	Supplementary display film number	1, 211		
S390	Boolean = 1 if earth LM number less than 65	Boolean		
S391	Boolean = 1 if longitude of CSM nadir not less than 180°	Boolean		
S392	Boolean = 1 if longitude of CSM nadir not greater than 311°	Boolean		

Table 6-61. Instructor's Operating Station—True Position and Attitude

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
SOPAL	Orbital altitude	0, 999.9 n mi		
S400	Boolean = 1 if VELAR negative	Boolean		
SOPLO	Orbital longitude	-179.9, +180.0 deg		
SOPLA	Orbital latitude	-90.0, +90.0 deg		
S401	Boolean = 1 if pitch non-negative			
S402	Boolean = 1 if roll non-negative			
S403	Boolean = 1 if yaw non-negative			
STAP	True attitude pitch	0, 359 deg		
STAR	True attitude roll	0, 359 deg		
STAY	True attitude yaw	0, 359 deg		
STPRP	True attitude pitch rate	-10, +10 deg/sec		
STRRP	True attitude roll rate	-10, +10 deg/sec		
STYRP	True attitude yaw rate	-10, +10 deg/sec		
STPR	Analog-scaled pitch rate	-10, +10 volts		
STRR	Analog-scaled roll rate	-10, +10 volts		
STYR	Analog-scaled yaw rate	±10 volts		

Table 6-62. Instructor's Operating Station—Master Control

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
M002	Run DBIM common core	Boolean		
M003	Run DBIM computer C	Boolean		
M005	Freeze DBIM common core	Boolean		
M006	Freeze DBIM computer C	Boolean		
M008	Step ahead DBIM common core	Boolean		
M009	Step ahead DBIM computer C	Boolean		
M011	Store DBIM common core	Boolean		
M012	Store DBIM computer C	Boolean		
M014	Reset DBIM common core	Boolean		
M015	Reset DBIM computer C	Boolean		
M017	Go DBIM common core	Boolean		
M018	Go DBIM computer C	Boolean		
M020	Hold DBIM common core	Boolean		
M021	Hold DBIM computer C	Boolean		
M023	Recycle DBIM common core	Boolean		
M024	Recycle DBIM computer C	Boolean		
T901	Run computer C	Boolean		X
T902	Ready/run computer C	Boolean		
T904	Freeze computer C	Boolean		X
T907	Step ahead computer C	Boolean		
T910	Store computer C	Boolean		X
T914	Reset computer C	Boolean		X
T915	Go computer C	Boolean		X
T916	Ready/go computer C	Boolean		
T919	Hold computer C	Boolean		X
T922	Recycle computer C	Boolean		X
T932	Minute pulse computer C	Boolean		
T951	Run common core	Boolean		
T952	Ready/run common core	Boolean		
T954	Freeze common core	Boolean		
T957	Step ahead common core	Boolean		
T960	Store common core	Boolean		

Table 6-62. Instructor's Operating Station—Master Control (Cont)

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
T964	Reset common core	Boolean		
T965	Go common core	Boolean		
T966	Ready/go common core	Boolean		
T969	Hold common core	Boolean		
T972	Recycle common core	Boolean		
T982	Minute pulse common core	Boolean		
A102	Eom double precision integration not in process	Boolean		
G561	G&N entry mode	Boolean		
H220	SCS/G&N entry mode	Boolean		
H224	SCS entry mode	Boolean		
K020	C/M configuration	Boolean		
K040	h < 500,000 ft.	Boolean		
Q024	Trajectory link hold	Boolean		
Q026	Trajectory link go (T-60)	Boolean		
T511	Integrated mode	Boolean		X
T940	To/from sign +	Boolean		X

Table 6-63. X/T and X/Y Recorders

Program Symbol	Signal Description	Range Lower and Upper Limits	TM Console Channel/ Patchboard No.	Online Recorder
MXT1CH1	Input to channel 1 of XT rec 1	±10 volts		
MXT1CH2	Input to channel 2 of XT rec 1	± 10 volts		
MXT1CH3	Input to channel 3 of XT rec 1	± 10 volts		
MXT1CH4	Input to channel 4 of XT rec 1	±10 volts		
MXT1CH5	Input to channel 5 of XT rec 1	±10 volts		
MXT1CH6	Input to channel 6 of XT rec 1	±10 volts		
MXT1CH7	Input to channel 7 of XT rec 1	±10 volts		
MXT1CH8	Input to channel 8 of XT rec 1	±10 volts		
MXT2CH1	Input to channel 1 of XT rec 2	±10 volts		
MXT2CH2	Input to channel 2 of XT rec 2	±10 volts		
MXT2CH3	Input to channel 3 of XT rec 2	±10 volts		
MXT2CH4	Input to channel 4 of XT rec 2	±10 volts		
MXT2CH5	Input to channel 5 of XT rec 2	±10 volts		
MXT2CH6	Input to channel 6 of XT rec 2	±10 volts		
MXT2CH7	Input to channel 7 of XT rec 2	±10 volts		
MXT2CH8	Input to channel 8 of XT rec 2	±10 volts		
MXT3CH1	Input to channel 1 of XT rec 3	±10 volts		
MXT3CH2	Input to channel 2 of XT rec 3	±10 volts		
MXT3CH3	Input to channel 3 of XT rec 3	±10 volts		
MXT3CH4	Input to channel 4 of XT rec 3	±10 volts		
MXT3CH5	Input to channel 5 of XT rec 3	±10 volts		
MXT3CH6	Input to channel 6 of XT rec 3	±10 volts		
MXT3CH7	Input to channel 7 of XT rec 3	±10 volts		
MXT3CH8	Input to channel 8 of XT rec 3	±10 volts		
MXY1PEN1	Input to pen 1 of XY rec 1	±10 volts		
MXY1ARM1	Input to arm 1 of XY rec 1	±10 volts		
MXY1PEN2	Input to pen 2 of XY rec 1	±10 volts		
MXY1ARM2	Input to arm 2 of XY rec 1	±10 volts		
MXY2PEN1	Input to pen 1 of XY rec 2	±10 volts		
MXY2ARM1	Input to arm 1 of XY rec 2	±10 volts		
MXY2PEN2	Input to pen 2 of XY rec 2	±10 volts		
MXY2ARM2	Input to arm 2 of XY rec 2	±10 volts		

Table 6-64. Measurement Data Group 1 - G&N and SCS Attitude Control

X-T RECORDERS	PROGRAM SYMBOL
1. True attitude - pitch	STAP
2. True attitude - roll	STAR
3. True attitude - yaw	STAY
4. SCS delta V mode	H223
5. G&N delta V mode	H219
6. Delta V remaining	THDV1
7. DEADBAND switch - MAX	H205
8. DIRECT ULLAGE switch	H306
9. THRUST ON switch	H311
10. NORMAL/THRUST OFF switch - NORMAL	H304
11. SPS PU VALVE switch - SEC	P015
12. SPS OX FLOW switch - NORM	P115
30 X 30 X-Y PLOTTER	**PROGRAM SYMBOL**
1. Spacecraft longitude position (pen A, X-axis)	VELAR
2. Spacecraft latitude position (pen A, Y-axis)	VELE

Table 6-65. Measurement Data Group 2 - IMU Alignment, AGCU Alignment

X-T RECORDERS	PROGRAM SYMBOL
1. True attitude - pitch	STAP
2. True attitude - roll	STAR
3. True attitude - yaw	STAY
4. MARK pushbutton - ON	G439
5. MARK REJECT pushbutton - ON	G463
6. Coarse align mode	G326
7. Fine align mode	G328
8. Telescope shaft angle	GASUBS
9. Telescope trunnion angle	GASUBT
10. Sextant shaft angle	GXAS
11. Sextant trunnion angle	GXAT
12. Transfer switch - MANUAL position	G300
30 X 30 X-Y PLOTTER	**PROGRAM SYMBOL**
1. Spacecraft longitude position (pen A, X-axis)	VELAR
2. Spacecraft latitude position (pen A, Y-axis)	VELE

Table 6-66. Measurement Data Group 3 - Entry and Earth Landing

X-T RECORDERS	PROGRAM SYMBOL
1. C/M-S/M separation and umbilical destruct	D550
2. G&N attitude mode select	H218
3. SCS entry mode	H224
4. G&N entry mode	H220
5. Backup rate - pitch ON	H207
6. Backup rate - yaw ON	H208
7. Backup rate - roll ON	H206
8. DEADBAND switch - MAX	H205
9. DIRECT RCS switch ON	H189
10. ELS switch ACTIVATE	D002
11. FUEL DUMP switch ACTIVATE	D106
12. RCS PURGE switch - ACTIVATE	D108
13. True attitude - pitch	STAP
14. True attitude - roll	STAR
15. True attitude - yaw	STAY
30 X 30 X-Y PLOTTER	**PROGRAM SYMBOL**
1. Spacecraft longitude position (pen A, X-axis)	VELAR
2. Spacecraft latitude position (Pen A, Y-axis)	VELE

Table 6-67. Measurement Data Group 4 - Abort Procedures

X-T RECORDER	PROGRAM SYMBOL
1. LES Abort initiate	E108
2. LES MTR FIRE switch ON	D115
3. ELS switch ACTIVATE	D002
4. LES tower jettison	D016
5. RCS-C/M PRESS switch ON	D105
6. FUEL DUMP switch - ACTIVATE	D106
7. RCS PURGE switch - ACTIVATE	D108
8. DROGUE DEPLOY switch ON	D005
9. MAIN CHUTE DEPLOY switch ON	D006
10. Abort request light on	ME201
11 X 17 X-Y PLOTTER	**PROGRAM SYMBOL**
1. Spacecraft altitude (pen A, Y-axis)	AH
2. Spacecraft range from launch point (pen A, X-axis)	TRSTAV01

Table 6-68. Measurement Data Group 5 - Mission Parameters

X-T RECORDERS	PROGRAM SYMBOL
1. Lift-off light on	E014
2. LES tower jettison	D016
3. ADAP SEP switch ON	D121
4. True attitude - pitch	STAP
5. True attitude - roll	STAR
6. True attitude - yaw	STAY
7. SCS attitude control mode	H214
8. SCS delta V mode	H223
9. G&N attitude mode select	H218
10. G&N delta V mode	H219
11. G&N entry mode	H220
12. SCS entry mode	H224
13. SCS local vertical control mode	H213
14. Delta V remaining	THDV1
15. DEADBAND switch MIN	H205
16. Quantity oxidizer (SPS)	PWO
17. Quantity fuel (SPS)	PWF
18. THRUST ON switch ON	H311
19. NORMAL/THRUST OFF switch - NORMAL	H304
20. >0.05g sensed	H204
21. C/M-S/M separation and umbilical destruct	D550
22. ELS switch ACTIVATE	D002
23. Fuel dump switch ACTIVATE	D106
24. MASTER ALARM light ON	E350
30 X 30 X-Y PLOTTER	**PROGRAM SYMBOL**
1. Spacecraft longitude position (pen A, X-axis)	VELAR
2. Spacecraft latitude position (pen A, Y-axis)	VELE
11 X 17 X-Y PLOTTER	**PROGRAM SYMBOL**
1. Spacecraft altitude (pen A, Y-axis)	AH
2. Spacecraft range from launch point (pen A, X-axis)	TRSTAV01