

G Silver
FRONT.

BACK

RETREAD 50 VERB/NOUN CODES

VERBS	NO	NOUNS
ILLEGAL	00	NOT IN USE
DISPLAY OCTAL COMP 1 (R1)	01	SPECIFY MACHINE ADDRESS (FRACTIONAL)
DISPLAY OCTAL COMP 2 (R1)	02	SPECIFY MACHINE ADDRESS (WHOLE)
DISPLAY OCTAL COMP 3 (R1)	03	SPECIFY MACHINE ADDRESS (MIDCOURSE)
DISPLAY OCTAL COMP 1, 2 (R1, R2)	04	SPECIFY MACHINE ADDRESS (OURS)
DISPLAY OCTAL COMP 1, 2, 3(R1, R2, R3)	05	SPECIFY MACHINE ADDRESS (SECONDS)
DECIMAL DISPLAY	06	SPECIFY MACHINE ADDRESS (CYRO DELTA)
DP DECIMAL DISPLAY (R1, R2)	07	SPECIFY MACHINE ADDRESS (T OPT DEGREE)
SPARE	10	CHANNEL TO BE SPECIFIED
MONITOR OCT COMP 1 (R1)	11	SPARE
MONITOR OCT COMP 2 (R1)	12	SPARE
MONITOR OCT COMP 3 (R1)	13	SPARE
MONITOR OCT COMP 1, 2 (R1)	14	SPARE
MONITOR OCT COMP 1, 2, 3 (R1, R2, R3)	15	INCREMENT MACHINE ADDRESS
MONITOR DECIMAL	16	TIME SECONDS
MONITOR DP DECIMAL (R1, R2)	17	TIME HOURS
SPARE	20	ICDU
LOAD COMP 1 (R1)	21	PIRMS
LOAD COMP 2 (R2)	22	NEW ANGLES 1
LOAD COMP 3 (R2)	23	DELTA ANGLES 1
LOAD COMP 1, 2 (R1, R2)	24	DELTA TIME (HOURS)
LOAD COMP 1, 2, 3 (R1, R2, R3)	25	CHECKLIST
SPARE	26	PRO/DELAY, ADDRESS, MCOIN
FIXED MEMORY DISPLAY	27	SELF TEST ON/OFF SWITCH
REQUEST EXECUTIVE	30	STAR NUMBERS
REQUEST WAIT/LEFT	31	PARLEGO
CR20 INTO R2, CR11 INTO R2	32	DECISION TIME (MIDCOURSE)
POCKETED WITHOUT DATA	33	ENGAGEMENT TIME (MIDCOURSE)
TERMINATE	34	MEASURED QUANTITY (MIDCOURSE)
TEST LIGHTS	35	ROLL, PITCH, YAW
FRESH START	36	LANDMARK DATA 1
CHANGE MAJOR MODE	37	LANDMARK DATA 2
SS CDU-ZERO	40	SPARE
CHANGE ALIGN	41	SPARE
FINE ALIGN	42	SPARE
IRC PULSE TORQUING	43	SPARE
SS TURN-ON	44	SPARE
	45	SPARE
	46	SPARE
	47	SPARE
	50	SPARE
	51	SPARE
	52	CYRO RIAS DRIFT
	53	CYRO INPUT AXIS ACCELERATION DRIFT
	54	CYRO SPIN AXIS ACCELERATION DRIFT
	59	ICDU
	56	UNCALLED MARK DATA (CCDU & TIME)
	57	NEW ANGLES CCDD
	60	SPARE
	61	TARGET AZIMUTH AND ELEVATION
	62	CCDUX AND TIME
	63	CCDUY AND TIME
	64	CCDUZ AND TIME
	65	SAMPLED TIME (HOURS AND SECONDS)
	66	SYSTEM TEST RESULTS
	67	DELTA CYRO ANGLES
	70	PIVA BEAS
	71	PIVA SCALE FACTOR ERROR
	72	DELTA POSITION
	73	DELTA VELOCITY
	74	MEASUREMENT DATA (MIDCOURSE)
	75	MEASUREMENT DEVIATIONS (MIDCOURSE)
	76	POSITION VECTOR
	77	VELOCITY VECTOR

AURORA VERB/NOUN CODES

VERBS	CODE	NOUNS
ILLEGAL	00	NOT IN USE
DISPLAY OCTAL COMP 1	01	SPECIFY MACHINE ADDRESS (FRACTION)
DISPLAY OCTAL COMP 2	02	SPECIFY MACHINE ADDRESS (WHOLE)
DISPLAY OCTAL COMP 3	03	SPECIFY MACHINE ADDRESS (TENS)
DISPLAY OCTAL COMP 1, 2	04	SPECIFY MACHINE ADDRESS (HOURS)
DISPLAY OCTAL COMP 1, 2, 3	05	SPECIFY MACHINE ADDRESS (SECONDS)
DIGITAL DISPLAY	06	SPECIFY MACHINE ADDRESS (CYRO DEGR)
DP DECIMAL DISPLAY	07	SPACE
ILLEGAL	10	CHANNEL TO BE SPECIFIED
MONITOR OCT COMP 1	11	SPACE
MONITOR OCT COMP 2	12	SPACE
MONITOR OCT COMP 3	13	SPACE
MONITOR OCT COMP 1, 2	14	SPACE
MONITOR OCT COMP 1, 2, 3	15	INCREMENT MACHINE ADDRESS
MONITOR DECIMAL	16	TIME SECONDS
MONITOR DP DECIMAL	17	TIME HOURS
ILLEGAL	20	ICRU
LOAD COMP 1	21	RPMS
LOAD COMP 2	22	NEW ANGLES 1
LOAD COMP 3	23	DELTA ANGLES 1
LOAD COMP 1, 2	24	DELTA TIME (SECONDS)
LOAD COMP 1, 2, 3	25	CHECKLIST
ILLEGAL	26	PRIO DELAY ADRES. BROWN
FIELD MEMORY DISPLAY	27	SELF TEST ON OFF SWITCH
REQUEST EXECUTIVE	30	STAR NUMBERS
REQUEST WAITLIST	31	FAILURE, SH ALT, ERRCOINT
CRJ) INTO RL, CRJ) INTO RL	32	DECRIMIN TIME (MIDCOURSE)
PROCEED WITHOUT DATA	33	EPHEMERIS TIME (MIDCOURSE)
TERMINATE	34	MEASURED QUANTITY (MIDCOURSE)
TEST LIGHTS	35	INBT MESSAGE
TRCS) START	36	LANDMARK DATA 1
CHANGE MAJOR MODE	37	LANDMARK DATA 2
ZERO	40	RA ANGLES (TRUNK, SHAFT)
CHANGE ALIGN	41	NEW RA ANGLES (TRUNK, SHAFT)
TRC) ALIGN IMU	42	AOI ROTATION ANGLES
LOAD IMU ATTITUDE ERROR METERS	43	AOI DUCTN CODE
ILLEGAL	44	FORWARD VELOCITY, LATERAL VELOCITY
COMMAND LR TO POSITION 2	45	ROTATIONAL HAND CONTROLLER ANGLE RATES
SAMPLE RADAR ONCE PER SEC	46	SPACE
PERFORM LEM FCS TEST	47	SPACE
PLEASE POSITION	50	SPACE
PLEASE MARK	51	SPACE
PLEASE MARK Y	52	CYRO RAS DRIFT
PLEASE MARK X OR Y	53	CYRO INBT AXIS ACCELERATION DRIFT
PLM) TORQUE CYROS	54	CYRO SPIN AXIS ACCELERATION DRIFT
ALIGN TIME	55	LR ALTITUDE, TIME
PERFORM BANG/CM	56	LR VEL., TIME
PERFORM SYSTEM TEST	57	LR VEL., TIME
ILLEGAL	60	LR VEL., TIME
ILLEGAL	61	TARGET AZIMUTH AND ELEVATION
RCAY LEM INBT	62	SR RANGE, TRUNK, SHAFT
INITIALISE AGS	63	SR RANGE RATE, TRUNK, SHAFT
ILLEGAL	64	INITIAL ALT., FINAL ALT., ALT. RATE
ILLEGAL	65	SAMPLED TIME (HOURS AND SECONDS)
LOTS FRESH START	66	SYSTEM TEST RESULTS
ILLEGAL	67	DELTA CYRO ANGLES
ACQUIRE WITH LOTS	70	LOTS ANGLES (AZIMUTH, ELEVATION)
LOTS SELF TEST	71	DESIRED LOTS ANGLES (AZIMUTH, ELEVATION)
RETURN LOTS TO STOW	72	DELTA POSITION
ILLEGAL	73	DELTA VELOCITY
ILLEGAL	74	MEASUREMENT DATA (MIDCOURSE)
ILLEGAL	75	MEASUREMENT DEVIATIONS (MIDCOURSE)
ILLEGAL	76	POSITION VECTOR
ILLEGAL	77	VELOCITY VECTOR

AURORA ERROR CODES

OPIC SUB-SYSTEM

00105 MARK BUTTONS NOT AVAILABLE
 00111 MARK IS MISSING AFTER ENTER
 00112 MARK NOT BEING ACCEPTED
 00113 NO MARKS
 00114 MARK MADE BUT NOT DESIRED
 00115 X MARK NOT MADE

IMU SUB-SYSTEM

00210 IMU NOT OPERATING
 00211 COARSEST ALIGN ERROR
 00212 REF. EMB. BUT REF. IS NOT BEING USED
 00215 IMU NOT OPERATING WITH TURN-ON REQUEST
 00216 PROGRAM USING IMU WHEN TURNED OFF

OPTICAL TRACKER ALARMS

00600 +AZIMUTH LIMIT STOP
 00602 -AZIMUTH LIMIT STOP
 00603 +ELEVATION LIMIT STOP
 00604 -ELEVATION LIMIT STOP
 00611 MORE THAN ONE PROGRAM TRYING TO USE OPTICAL TRACKER
 00612 CANNOT GET OUT OF SLOW
 00613 STAR/BEACON MODE SWITCH FAILURE
 00614 UNABLE TO ACHIEVE DESIRED LOS WITHIN 30 SECONDS
 00615 15 MINUTE POWER OFF WARNING
 00616 CANNOT GET BACK TO SLOW
 00621 LOCK ON DATA GOOD ILLEGALLY PRESENT DURING SELF TEST
 00622 SLOW COORDINATES NOT WITHIN LIMITS
 00623 LOCK ON FAILING DURING SELF TEST
 00624 DATA GOOD FAILURE DURING SELF TEST
 00625 SELF TEST LIGHT COORDINATES NOT WITHIN LIMITS
 00631 COULD NOT GET LOCK ON AFTER INSURANCE OF TRACK ENABLE
 00632 COULD NOT GET DATA GOOD AFTER INSURANCE OF TRACK ENABLE
 00633 LOSS OF DATA GOOD DURING TRACKING
 00634 LOSS OF LOCK ON DURING TRACKING
 00635 TRACKER CDU FAIL

PROCRUAL DIFFICULTY

00401 DESIRED GEMINAL ANGLE YIELD GEMINAL LOCK
 00402 STAR OUT OF FIELD OF VIEW
 00403 STAR OUT OF FIELD OF VIEW

RAJAR ERRORS

00901 RADAR ANTENNA OUT OF LIMITS
 00902 BAD RADAR GEMINAL ANGLE INPUT
 00903 RADAR ANTENNA DESIGNATE FAIL
 00904 RADAR AUTO DESIGNATE NOT PRESENT
 00914 RADAR CODES OUT OF AUTO MODE WHILE BEING USED
 00920 NO RADAR BUFT EXPECTED
 00921 RADAR DATA CODE NOT BE READ
 00922 WRONG LR POSITION
 00923 LR ANTENNA DID NOT MAKE IT
 00924 BAD RADAR TARGET

COMPUTER HARDWARE MALFUNCTIONS

01102 ACC REP TEST ERROR
 01103 UNDESired OSCILATION EXECUTED ABORT
 01105 DOWNLINK TOO FAST
 01106 UPLINK TOO FAST

USE OVERFLOWS (ALL ABORTS)

01201 EXECUTIVE OVERFLOW-NO VAC AREAS
 01202 EXECUTIVE OVERFLOW-NO CODE SETS
 01203 WAITLIST OVERFLOW-TOO MANY TASKS
 01204 FORWARD AND DISPLAY WAITING LINE OVERFLOW
 01207 NO VAC AREA FOR MARKS
 01210 TWO PROGRAMS USING DEVICE AT SAME TIME

INTERPRETER ERRORS

01301 ALIGN ANGLE-ABOCC INPUT ANGLE TOO LARGE -ABORT
 01302 SORT CALLED WITH NEGATIVE ARGUMENT -ABORT

DISPLAY ALARMS

02101 TEMPORARY JST FAIL
 02111 CDU DOES NOT AGREE WITH COMMAND TO INCREASE

KEYBOARD AND DISPLAY PROGRAM

03001 KEYBOARD AND DISPLAY ALARM DURING INTERNAL USE OVERFLOW, ABORT

SUNDIAL C VERB/NOUN CODES

VERBS

01 DELAYAL OCTAL COMP 1
 02 DELAYAL OCTAL COMP 2
 03 DELAYAL OCTAL COMP 3
 04 DELAYAL OCTAL COMP 1, 2
 05 DELAYAL OCTAL COMP 1, 2, 3
 06 DECIMAL DISPLAY
 07 10 DECIMAL DISPLAY
 10 ILLEGAL
 11 MONITOR OCT COMP 1
 12 MONITOR OCT COMP 2
 13 MONITOR OCT COMP 3
 14 MONITOR OCT COMP 1, 2
 15 MONITOR OCT COMP 1, 2, 3
 16 MONITOR DECIMAL
 17 MONITOR 10 DECIMAL
 18 ILLEGAL
 19 LOAD COMP 1
 21 LOAD COMP 2
 22 LOAD COMP 3
 24 LOAD COMP 1, 2
 25 LOAD COMP 1, 2, 3
 26 ILLEGAL
 27 TIVED MEMORY DISPLAY
 28 REQUEST EXECUTIVE
 29 REQUEST WAITLIST
 32 (R) INTO AL (R) INTO BR (R)
 33 TERMINATE WITHOUT DATA
 34 TERMINATE
 35 TEST LIGHTS
 36 FROM START
 37 CHANGE MAJOR MODE
 40 ZERO
 41 COARSE ALIGN
 42 TIME ALIGN INFO
 43 LOAD INFO ATTITUDE ERROR METERS
 44 ILLEGAL
 45 ILLEGAL
 46 ILLEGAL
 47 JPLFORM COSM & SATURN TESTS
 48 PLEASE PLATFORM
 49 PLEASE MARK
 53 TESTFORM PRELAUNCH ALIGNMENT
 OPTICAL VERIFICATION
 53 ILLEGAL
 54 TESTFORM ZENOS
 55 ALIGN TIME
 56 PERFORM BANKSUM
 57 DELTA GEM SYSTEM TEST
 60 PREPARE FOR COS STANDBY

NOUNS

01 MISCOPY ADDRESS (FRACTUREAL)
 02 MISCOPY ADDRESS (POWER)
 03 MISCOPY ADDRESS (EQUINOX)
 04 MISCOPY ADDRESS (BOULES)
 05 MISCOPY ADDRESS (EQUINOX)
 06 MISCOPY ADDRESS (EQUINOX)
 07 MISCOPY ADDRESS (1 OF 2 DEGREES)
 08 MISCOPY ADDRESS (2 OF 2 DEGREES)
 09 CHANNEL TO BE SPECIFIED
 11 SCALE
 12 SCALE
 13 SCALE
 14 SCALE
 15 INCREMENT ADDRESS
 16 TIME STRECHES
 17 TIME HOURS
 18 RCTU
 21 RFA
 22 NEW ANGLES 1
 23 DELTA ANGLES 1
 24 DELTA TIME (SECONDS)
 25 CHECKLIST
 26 PRE-DELAY, ADDRESS, BECON
 27 SELF CHECK ON/OFF SWITCH
 30 STAR NUMBER
 31 FAD-BU, SERIAL, ESCORT
 32 DECORUM TIME (MIDCOURSE)
 33 EPHEMERIS TIME (MIDCOURSE)
 34 MESSAGES QUANTITY (MIDCOURSE)
 35 INET MESSAGE
 36 LANDMARK DATA 1
 37 LANDMARK DATA 2
 40 SCALE
 41 SCALE
 42 SCALE
 43 SCALE
 44 SCALE
 45 SCALE
 46 SCALE
 47 SCALE
 48 SCALE
 49 SCALE
 51 SCALE
 52 UTRO-NO
 53 GYRO AIDA
 54 GYRO AIDRA
 55 COCU
 56 UNCALLED MARK POSIT, OPTY, TIME
 57 NOW OCTAL ADDRESS
 60 DELTA GEM ANGLE POS PRELAUNCH
 OPTICAL VERIFICATION
 61 TARGET ADDRESS AND ELEVATION
 62 KICZ AND TIME
 63 OCSX AND TIME
 64 OCSY AND TIME
 65 SAMPLED TIMES (DURK & BECHER)
 66 SYSTEM TEST ERRORS
 67 DELTA GEM ANGLE
 70 RFA BUS
 71 RFA SCALE FACTOR ERROR
 72 DELTA POSITION
 73 DELTA VELOCITY
 74 MESSAGES/INSET DATA (MIDCOURSE)
 75 MESSAGES/INSET DATA (MIDCOURSE)
 76 POSITION VECTOR
 77 VELOCITY VECTOR

SUNDIAL C ERROR CODES

OPRCS SUB-SYSTEM

00105 MARK BUTTON NOT AVAILABLE
 00110 NO MARK SINCE LAST MARK REJECT
 00112 MARK NOT BEING ACCEPTED
 00113 NO PAGES
 00114 MARK MADE BUT NOT DESIRED
 00115 OPTICS TORQUE REQUEST WITH SWITCH NOT AT OCC
 00116 OPTICS SWITCH ALIGNED BEFORE 15 SEC. ZERO TIME ELAPSED
 00117 OPTICS TORQUE REQUEST WITH OPTICS NOT AVAILABLE (OPTFND - 4)
 00120 OPTICS TORQUE REQUEST WITH OPTICS NOT ZEROED

IMU SUB-SYSTEM

00207 150 TURN-AN ALIGNMENT NOT PRESENT FOR 30 SEC
 00210 IMU NOT OPERATING
 00211 ERROR ALIGN ERROR
 00213 FPN TAIL BUT FPN IS NOT BEING USED
 00215 IMU NOT OPERATING WITH TURN-ON REQUEST
 00214 PROGRAM USING IMU WHEN TURNED OFF

TROCBARAL DISPLAY

00401 DESIRED CRIBAL ANGLES YIELD CRIBAL LOCK
 00402 STAR-OUT OF FIELD OF VIEW
 00403 STAR-OUT OF FIELD OF VIEW

COMPUTE HARDWARE MAINTENANCE

04202 ACC RELY CHECK ERROR
 04203 UNEXPECTED BRANCH EXECUTED. ABORT
 04205 DOWNLINK TOO FAST
 04206 UPLINK TOO FAST
 04207 TRACE TABLE MISMATCH. DOPSTART

USE OVERFLOW (SU, ADRS)

02301 EXCESSIVE OVERFLOW - NO YAC AREAS
 02302 EXCESSIVE OVERFLOW - NO CORE SECS
 02303 WAITLIST OVERFLOW - TOO MANY TASKS
 02306 KEYBOARD AND DISPLAY WAITING LINE OVERFLOW
 02307 NO YAC AREA FOR MARKS
 02310 TWO PROGRAMS USING SAME DEVICE AT SAME TIME

INTERFERE ERRORS

01300 ALIGN-ACCOS INPUT ANGLE TOO LARGE. ABORT
 01302 SIGHT CALLED WITH NEGATIVE ALIGNMENT. ABORT

DISPLAY ERRORS

01400 TEXTING TOO LARGE IN CSM & SATURN TEST. ENDTST
 01401 AN ILLEGAL QUANTITY LOADED IN THE INT OR ENGINE TASK ERASABLE TABLE.
 ENDTST
 01403 AN ILLEGAL QUANTITY LOADED IN THE INT OR SATURN STEERING TASK
 ERASABLE TABLE. ENDTST
 01404 CSM & SATURN TEST FLANGE PERFORM TASK 461, 482, OR 483 FAILED. ENDTST
 01405 XDSLS BLSV DURING SATURN STEERING TEST. ENDTST
 01411 A) UPRDL, IMU IS NOT ON, IN IMU OPERATIONAL CHECK.
 B) DERRANGE, CSM DOES NOT AGREE WITH COMMAND IN IMU OF CHECK.
 C) SILLLOCK, FIRST CDU PULSE WAS MISSED IN BLSV TEST
 D) SCOPFRST, LAST CDU PULSE WAS MISSED OR CYRO TORQUE LOOP-OUT OF
 LIBRYS IN BLSV TEST

KEYBOARD AND DISPLAY PROGRAM

01504 KEYBOARD AND DISPLAY ALARM DURING INTERNAL USE (MRSLS). ABORT

SYSTEM TEST ALARMS

01900 DRIFT TEST MISSED IN TIME STEP
 01901 DRIFT TEST INTERFERENCE OVERFLOW
 01902 DRIFT TEST ERROR IN CYRO TORQUING. ENDTST

SUNDIAL B VERB/NOUN CODES

VERBS

00N1 AT LOCAL COMP 1
 00N2 AT LOCAL COMP 2
 00N3 AT LOCAL COMP 3
 00N4 AT OCTAL COMP 1, 2
 00N5 AT OCTAL COMP 1, 2, 3
 00N6 AT OCTAL COMP 1, 2, 3
 00N7 OCT COMP 1
 00N8 OCT COMP 2
 00N9 OCT COMP 3
 00N10 OCT COMP 1, 2, 3
 00N11 OCT COMP 1, 2, 3
 00N12 OCT COMP 1, 2, 3
 00N13 OCT COMP 1, 2, 3
 00N14 OCT COMP 1, 2, 3
 00N15 OCT COMP 1, 2, 3
 00N16 OCT COMP 1, 2, 3
 00N17 OCT COMP 1, 2, 3
 00N18 OCT COMP 1, 2, 3
 00N19 OCT COMP 1, 2, 3
 00N20 OCT COMP 1, 2, 3
 00N21 OCT COMP 1, 2, 3
 00N22 OCT COMP 1, 2, 3
 00N23 OCT COMP 1, 2, 3
 00N24 OCT COMP 1, 2, 3
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 00N26 OCT COMP 1, 2, 3
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 00N96 OCT COMP 1, 2, 3
 00N97 OCT COMP 1, 2, 3
 00N98 OCT COMP 1, 2, 3
 00N99 OCT COMP 1, 2, 3
 00N100 OCT COMP 1, 2, 3

CODE WORDS

01 SPECIFY ADDRESS @ RATIONAL
 02 SPECIFY ADDRESS @ RATIONAL
 03 SPECIFY ADDRESS @ RATIONAL
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 100 SPECIFY ADDRESS @ RATIONAL



SUNDIAL B ERROR CODES

OPIC3 SUB SYSTEM

0000 MARK BUTTON NOT AVAILABLE
 0001 NO MARK SPACE LAST MARK ACCEPT
 0002 MARK NOT BEING ACCEPTED
 0003 NO TURNS
 0004 MARK MAJOR BUT NOT DESIRED
 0005 OPIC3 TORQUE SENSORS WITH SWITCH NOT AT OSG
 0006 OPIC3 SWITCH AT 150000 HOURS IN ENG. ZERO TIME ELASSED
 0007 OPIC3 TORQUE SENSORS WITH OPIC3 NOT AVAILABLE (OPIC3 = 0)
 0008 OPIC3 TORQUE SENSORS WITH OPIC3 NOT SENSITIVE

SMU SUB SYSTEM

0001 10S TURN ON REQUEST NOT PROMPT FOR 90 SEC
 0002 RMU NOT OPERATING
 0003 CHANGE ALARM ENGINE
 0004 FUEL A.L. BUT 10S IN NEXT PROGRAM
 0005 RMU NOT OPERATING WITH 10S TURN ON REQUEST
 0006 PROGRAM OVER 10S WHEN RUNNING OFF

PROCEDURAL DEFECTS

0000 IMPROVED CIRCULAR ANGLES YIELD CIRCULAR LOCK
 0001 STAR OUT OF POSITION NEW
 0002 3.14159 OUT OF TOLERANCE NEW

COMPUTER HARDWARE MALFUNCTIONS

0000 ACC SELF CHECK ERROR
 0001 DRIVE DISK DRIVE IS IDENTIFIED, AUBT
 0002 DOWN INC. TOO FAST
 0003 DISK TOO FAST
 0004 DRIVE LABEL MISMATCHING, DISK START

SSI OVERSHOOTS (SEE ABOVE)

0001 EXCESSIVE OVERFLOW - NO VAC AHEAD
 0002 EXCESSIVE OVERFLOW - NO CIRCULAR SELLS
 0003 WAIT 1ST OVERFLOW - TOO MANY TURNS
 0004 KEYBOARD AND DISPLAY WAITING LINE OVERFLOW
 0005 NO VAC AREA FOR AHEADS
 0006 TWO PROGRAMS USING SAME DEVICE AT SAME TIME

INTERPRET ERRORS

0000 AHEAD-AHEADS DRIVE ANGLE TOO LARGE, AUBT
 0001 SQRT CALL ID WITH NEGATIVE ARGUMENT, AUBT

DISPLAY ALARMS

0000 TORQUE TOO LARGE IN COM & SATURN TEST, ENDTEST
 0001 AN ALARM CANNOT LOADED IN THE BIT ON ENGINE TASK (EASABLE TABLE, INTERVAL)
 0002 AN ALARM CANNOT LOADED IN THE SPS OR SATURN STEERING TASK (EASABLE TABLE, INTERVAL)
 0003 COM & SATURN TEST RELEASE PERFORMANCE TEST, 90, 0, ON 400 PAH ID, ENDTEST
 0004 EGRS NOT OPENING SATURN STEERING TEST, ENDTEST
 0005 CRK, SMU IS NOT ON, IN IMU OPERATIONAL CHECK
 0006 SPM:AK: CTM DOES NOT AGREE WITH COMMANDS IN SMU OF CTMPC
 0007 SILENCE, 100000 CTM PULSE WAS MISSED IN ONE OF TESTS
 0008 STOPPING, LAST COM PULSE WAS MISSED ON CTM TORQUE LOOP OUT OF LIMITS IN 900 OF TEST

KEYBOARD AND DISPLAY PROGRAM

0000 KEYBOARD AND DISPLAY ALARM DURING INTERVAL USE (INVALID, AUBT)

SYSTEM TEST ALARMS

0000 DRIFT TEST MISSED IN TIME STEP
 0001 DRIFT TEST INTEGRATION OVERFLOW
 0002 DRIFT TEST ERROR IN CYCLE TURNING, ENDTEST

OUTPUT CHANNEL 05

RICH AND YAW RCS

BIT POSITION	CHANNEL OUTPUT SIGNAL	S/M	C/M	S/M
1	RZ = X + P	R1 RCS = X + P	R1 RCS = P + X + YW	R1 RCS 40
2	RZ = X - P	R4 RCS = X - P	R4 RCS = P + X - Y	R1 RCS 40
3	RZ = X + P	R3 RCS = X + P	R3 RCS = P + X + YW	R1 RCS 30
4	RZ = X - P	R5 RCS = X - P	R5 RCS = P + X - Y	R5 RCS 30
5	RZ = X + P	R5 RCS = X + YW	R5 RCS = YW + X + P	R5 RCS 30
6	RZ = X - Y	R4 RCS = X - Y	R4 RCS = YW + X - P	R4 RCS 30
7	RZ = X + Y	R1 RCS = X + YW	R1 RCS = YW + X - P	R1 RCS 40
8	RZ = X - Y	R5 RCS = X - YW	R5 RCS = YW + X - P	R4 RCS 30

OUTPUT CHANNEL 06

BDU RCS

BIT POSITION	CHANNEL OUTPUT SIGNAL	S/M	C/M	S/M
1	RZ = Z + S	R9 RCS = Z + S	R9 RCS = R + Y + Z	R7 RCS 3P
2	RZ = Z - S	R10 RCS = Z - S	R10 RCS = R - Y - Z	R7 RCS 4P
3	RZ = Z + S	R11 RCS = Z + S	R11 RCS = R + Y + Z	R7 RCS 4P
4	RZ = Y - S	R10 RCS = Y - S	R10 RCS = R - Y + Z	R7 RCS 3P
5	RZ = Y + S	R11 RCS = Y + S	R11 RCS = R + Y + Z	R7 RCS 3P
6	RZ = Y - S	R10 RCS = Y - S		R7 RCS 3P
7	RZ = Y + S	R11 RCS = Y + S		R4 RCS 4S
8	RZ = Y - S	R10 RCS = Y - S		R4 RCS 1S

OUTPUT CHANNEL 10

DSKY A RELAYS

BIT POSITION	CHANNEL OUTPUT SIGNAL	CM	LSM
1	RLY001	RELAY BIT 1	* Sense on CM
2	RLY002	RELAY BIT 2	*
3	RLY003	RELAY BIT 3	*
4	RLY004	RELAY BIT 4	*
5	RLY005	RELAY BIT 5	*
6	RLY006	RELAY BIT 6	*
7	RLY007	RELAY BIT 7	*
8	RLY008	RELAY BIT 8	*
9	RLY009	RELAY BIT 9	*
10	RLY010	RELAY BIT 10	*
11	RLY011	RELAY BIT 11	*
12	RLY012	RELAY ADDRESS 1	*
13	RLY013	RELAY ADDRESS 2	*
14	RLY014	RELAY ADDRESS 3	*
15,16	RLY015	RELAY ADDRESS 4	*

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OUTPUT CHANNEL II

DUCK A RELAYS

BIT POSITION	CHANNEL OUTPUT SIGNAL	CM	LEM
1	DSWAL	ISS WARNING	* SAME AS CM
2	COMACT	LIGHT COMPUTER ACTIVITY LAMP	*
3	SRFACT	LIGHT UPLINK ACTIVITY LAMP	*
4	TEMPOUT	LIGHT TEMP CAUTION LAMP	*
5	RYELS	LIGHT KEY RELEASE LAMP (LAMP)	*
6	YNFLSI	FLASH WERE AND HOUR LAMP	*
7	OPTR06	LIGHT OPERATOR ERROR LAMP (FL)	*
8	OT1008	TEST CONNECTOR OUTLET	*
9	OT1009	TEST CONNECTOR OUTLET	*
10	OT1110	CAUTION RESET	*
11	OT1111		
12	OT1112		
13	OT1113		ENGINE ON
14	OT1114		ENGINE OFF
15/16	OT1116		

OUTPUT CHANNEL 12

GN & C

BIT POSITION	CHANNEL OUTPUT SIGNAL	CM	LEM
1	Z0PC00	ZERO OPTIC CTR	ZERO RR CTR
2	Z0N000	DISABLE OPTIC ERG CTR	CHANGE ERG ERG CTR
3	STANON	ENABLE STAR TRACKER	100% VELOCITY LD SCALE
4	COARIE	COARSE ALCH ENABLE	* SAME AS CM
5	Z0PC00	ZERO (M) CTR	*
6	Z0N000	ENABLE (M) ERG CTR	*
7			
8	TVCBAR	TVC ENABLE	DISPLAY INERTIAL DATA
9	SRITAK	ENABLE SIVE TAKE OVLA	PITCH GMBAL TRIM
10	Z0300P	ZERO OPTIC	+ROLL GMBAL TRIM
11	DEGMAC	DISENGAGE OPTIC DAC	+ROLL GMBAL TRIM
12	MROLEGT		+ROLL GMBAL TRIM
13	Z0400Q	DRIVE INQ ERG START	L.R. POS COMMAND
14	Z0400P	DRIVE INQ STOP	DR. ENABLE AUTO TRACK
15	B0700	DRIVE INQ DELAY COMPLETED	

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OUTPUT CHANNEL 13

RADAR AND AGC

BIT POSITION	CM	LEM
1	RADAR MODE SELECTION 1	* SAME AS CM
2	RADAR MODE SELECTION 2	*
3	RADAR MODE SELECTION 3	*
4	RADAR ACTIVITY	*
5	DRIFT UPLINK (CHAR E SLINK)	*
6	BLACK INLINK	*
7	DOWNLINK WORD ORDER	*
8	RANGE TRNG COUNTERS	RNC COUNTERS ENABLE
9		DRIFT RNC BRAD
10	TRIP ALARM	*
11	RANGE STANDBY	*
12	RESET TRAP 1-A	*
13	RESET TRAP 14-B	*
14	RESET TRAP 13	*
15	ENABLE TRIPPT	*
RADAR SELECTION		
a b c		
0 0 0		NONE
0 0 1		RR RANGE
0 1 0		RR RANGE RATE
0 1 1		NRNC
1 0 0		L.R. 3 VELOCITY
1 0 1		L.R. 2 VELOCITY
1 1 0		L.R. 1 VELOCITY
1 1 1		L.R. RANGE

OUTPUT CHANNEL 14

GYRO AND CDU DRIVES

BIT POSITION	CM	LEM
1	DRIFTSN ACTIVITY	* SAME AS CM
2		ALTITUDE RATE SELECTION
3		ALTITUDE METRIC ACTIVITY
4		
5		
6	DRIVE VELOCITY DRIVE START	THRUST DRIVE
7	GYRO ENABLE	DOWNLINK INCS DRIVE START
8	GYRO SELECTION 1	*
9	GYRO SELECTION 2	*
10	GYRO SELECTION 3	*
11	GYRO SELECTION 4	*
12	GYRO SELECTION 5	*
13	GYRO ACTIVITY	*
14	DRIVE OCTU SHUNT	*
15	DRIVE OCTU TRANSDUCER	*
GYRO SELECTION		GYRO
a b		
0 0		NONE
0 1		DRIVE X GYRO
1 0		DRIVE Y GYRO
1 1		DRIVE Z GYRO

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AD ELECTRONICS

INPUT CHANNEL 15

MAIN PANEL KEYBOARD

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM	TRAP	SOFT
1	MRKY1	KEY IM	* NAME AS CM	15	5
2	MRKY2	KEY TM	*	15	3
3	MRKY3	KEY SM	*	15	7
4	MRKY4	KEY OM	*	15	5
5	MRKY5	KEY SM	*	12	3

INPUT CHANNEL 16

NAVIGATION PANEL KEYBOARD

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM	TRAP	SOFT
1	MRKY1	KEY1	-	12A	0
2	MRKY2	KEY2	-	12A	0
3	MRKY3	KEY3	MARK X	12A	0
4	MRKY4	KEY4	MARK Y	12A	0
5	* MRKY5	KEY5	MARK REJECT	12A	0
6	MRK6	MRK6	DISCENT +	12B	0
7	MRK7	MARK REJECT	DISCENT -	12B	0

INPUT CHANNEL 30 (INVERTED LOGIC)

ON & C

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM
1	ULLTRM	ULLTRM TRUST POSITION	ARREST
2	SMAG2R	SM MAGNETS	STAGE VERIFICATION
3	SPRDY	SPS READY	ARMING ARMED
4	SRM2P	SRM2 PREPARE, ARREST	ARREST STAGE
5	LFRDPP	LEFT OFF SAFE	AUTO THROTTLE
6	GRMEL	CLEARANCE SAF RELEASE	DISPLAY INSTANT DATA
7	OCDFL	OPTICS COU FAIL	IR COU FAIL
8	RVGR		
9	IRKDFR	IRMF OPERATE	* NAME AS CM
10	CTLK2E	S/C CONTROL OF SAT	S/CN CONTROL OF S/C
11	IMK2AC	IMC CAGE	*
12	GRM2AL	IRMF COU FAIL	*
13	IRMFAL	IRMF FAIL	*
14	SDTOR	SD TRSN OR REQUEST	*
15	CLM2RH	TRM IN LIBERTY	*

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INPUT CHANNEL 31 (INVERTED LOGIC)

TELEVISION AND SCROTION

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM
1	MRM2P	-RITCH MAN ROT	-REL (L/FOL -4PM)
2	MRM2F	-RITCH MAN ROT	-REL (L/FOL -5PM)
3	MRM2Y	-YAW MAN ROT	-YRM
4	MRM2F	-YAW MAN ROT	-YRM
5	MRM2C	-ROLL MAN ROT	-RAZ (L/FOL -4AM)
6	MRM2C	-ROLL MAN ROT	-RAZ (L/FOL -5AM)
7	TRM2K	-X TRANSLATION	* NAME AS CM
8	TRM2K	-X TRANSLATION	*
9	TRM2Y	-Y TRANSLATION	*
10	TRM2Y	-Y TRANSLATION	*
11	TRM2E	-Z TRANSLATION	*
12	TRM2E	-Z TRANSLATION	*
13	TRM2E	-Z TRANSLATION	*
15	WDFUN	WDFUN FUNCTION	ATTITUDE HOLD
14	FDFUN	FDFUN FUNCTION	AUTO STABILIZATION
15	OCARCL	G-C AUTO PILOT CONTROL	ATTITUDE CONTROL OUT OF LIMIT

INPUT CHANNEL 32 (INVERTED LOGIC)

IMPULE

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM
1	MRM2P	-RITCH MAN IMPULSE	THRUSTERS 2-4 FAIL
2	MRM2F	-RITCH MAN IMPULSE	THRUSTERS 5-8 FAIL
3	MRM2Y	-YAW MAN IMPULSE	THRUSTERS 1-3 FAIL
4	MRM2Y	-YAW MAN IMPULSE	THRUSTERS 6-7 FAIL
5	MRM2K	-ROLL MAN IMPULSE	THRUSTERS 10-11 FAIL
6	MRM2C	-ROLL MAN IMPULSE	THRUSTERS 12-13 FAIL
7	TRM2Y	-	THRUSTERS 9-12 FAIL
8	TRM2E	-	THRUSTERS 10-11 FAIL
9	TRM2C	-	ROLL GEMAL OFF
10	BOLODF	-	ROLL GEMAL OFF
11	LSM2YT	-	
12	IRM2E	LEM ATTACHED	
13	IRM2E		
14	IRM2E		
15	IRM2E		

INPUT CHANNEL 33 (INVERTED LOGIC)

OPTICS AND A/C

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM
1	SRM2A		SR RANGE LOW SCALE
2	SRM2A		SR RANGE LOW SCALE
3	SRM2A		SR RANGE LOW SCALE
4	ZR2OP	ZERO OPTICS	LR DATA GOOD
5	OM2R2	AGC CONTROL	LR DATA GOOD
6	OM2R2	STARS TRACKER ON	LR POSITION 1 (GEMOCT)
7	TRM2E	STARS TRACKER	LR POSITION 2 (MOVERS)
8	LR2L2C		LR RANGE LOW SCALE
9	LR2L2C		LR RANGE LOW SCALE
30	LR2L2C	BLOCK UNLOCK INPUT	* NAME AS CM
31	NO NAME 3	UPLINE TOO FAST	*
32	NO NAME 4	DOWNLINE TOO FAST	*
35	IRMFAL	IRMF FAIL	*
36	ACCR AS 2	AGC WARNING	*
37	OCALM 2	OSCILLATOR ALARM	*

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INPUT CHANNEL 31 (INVERTED LOGIC)
TRANSLATION AND ROTATION
CARLY

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM
1	MANB+P	+PTCH MAN ROT	-
2	MANB-Z	-PTCH MAN ROT	-
3	MANB-Y	+YAW MAN ROT	ATTITUDE CONTROL
4	MANB-Y	+YAW MAN ROT	OUT OF DETENTION
5	MANB+Z	+ROLL MAN ROT	-
6	MANB-Z	-ROLL MAN ROT	-
7	TRAN-X	+X TRANSLATION	* SAME AS CM
8	TRAN-X	-X TRANSLATION	*
9	TRAN-Y	+Y TRANSLATION	*
10	TRAN-Y	-Y TRANSLATION	*
11	TRAN-Z	+Z TRANSLATION	*
12	TRAN-Z	-Z TRANSLATION	*
13	HOLD-FUN	HOLD FUNCTION	AUTO THROTTLES
14	FREELN	FREE FUNCTION	AUTO STABILIZATION
15	GCAPCL	GUIDANCE CONTROL	ARM CONTROL
		AUTO PILOT CONTROL	

INPUT CHANNEL 32 (INVERTED LOGIC)
IMPULSE

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM
1	MNM+P	+PTCH MIN IMPULSE	THRUSTER 2-4 FAIL
2	MNM-P	-PTCH MIN IMPULSE	THRUSTER 2-4 FAIL
3	MNM+Y	+YAW MIN IMPULSE	THRUSTER 1-3 FAIL
4	MNM-Y	-YAW MIN IMPULSE	THRUSTER 6-7 FAIL
5	MNM+R	+ROLL MIN IMPULSE	THRUSTER 14-18 FAIL
6	MNM-R	-ROLL MIN IMPULSE	THRUSTER 13-15 FAIL
7	TRST9	-	THRUSTER 9-11 FAIL
8	TRST10	-	THRUSTER 10-11 FAIL
9	PCSD0P	-	WTCR GENRAL OFF
10	ROLLOFF	-	ROLL GENRAL OFF
11	LEMATT	LEM ATTACHED	ATTITUDE HOLD
12	DS212	-	-
13	DS213	-	-
14	DS214	-	-
15	DS215	-	-

INPUT CHANNEL 33 (INVERTED LOGIC)
OFFCS AND AGC

BIT POSITION	CHANNEL INPUT SIGNAL	CM	LEM
1	-	-	-
2	REFORA	-	RE ON AUTOMATIC
3	REFCSC	-	RE ON LOW SCALE
4	ZDRAP	ZERO OFFCS	RE ON DATA GOOD
5	OPMSW2	AGC REAS CONTROL	LR DATA GOOD
6	OPMSW3	STAR TRACKER ON	LR POSITION 1 (DESCENT)
7	ETUREB	STAR PRESENT	LR POSITION 2 (HOVER)
8	LVAAGD	-	LANDING VELOCITY DATA GOOD
9	LRLOSC	-	LR ON LOW SCALE
10	REURPL	ACCEPT UPLINK DATA	* SAME AS CM
11	NO NAME 3	IN LINK TOO FAST	*
12	NO NAME 4	DOWNLINK TOO FAST	*
13	TEA F A L L	TEA FAIL	*
14	AGCW AR 2	AGC WARNING	*
15	OSCALM 2	OSCILLATOR ALARM	*

BLOCK 11 APOLLO G&N EQUIPMENT-

SEPT. 1, 1968

FUNCTIONAL DESCRIPTION OF BLOCK 11 APOLLO G&N EQUIPMENT

1. **INERTIAL MEASUREMENT UNIT (IMU) AND ASSOCIATED EQUIPMENT PERFORMS THREE MAJOR FUNCTIONS:** (A) MEASURES CHANGES IN SPACECRAFT ATTITUDE, (B) ASSISTS IN GENERATING STEERING COMMANDS AND (C) MEASURES SPACECRAFT VELOCITY CHANGES DUE TO THRUST. THIS UNIT MANUFACTURED BY AC ELECTRONICS.
2. **NAVIGATION BASE (NAV BASE) - PROVIDES AN ACCURATE MOUNTING BASE FOR THE OPTICAL UNIT AND INERTIAL MEASUREMENT UNIT. THIS UNIT MANUFACTURED BY AC ELECTRONICS.**
3. **OPTICAL UNIT ASSEMBLY - PROVIDES (A) THE CMC WITH DATA OBTAINED BY MEASURING ANGLES BETWEEN LINES OF SIGHT TO CELESTIAL OBJECTS (B) THE MEASUREMENTS FOR ESTABLISHING THE INERTIAL REFERENCE, AND (C) AUTOMATIC TRACKING OF A STAR. OPTICS MANUFACTURED BY KOLLGREN INSTRUMENT COMPANY, ELECTROOPTICS BY AC ELECTRONICS.**
4. **NAVIGATION PANEL DISPLAY AND KEYBOARD (NSK) - PROVIDES A TWO WAY COMMUNICATION LINK BETWEEN THE OPERATOR AND THE CMC AND THE FOLLOWING FUNCTIONS MAY BE PERFORMED: (1) LOADING OF DATA INTO CMC, (2) DISPLAY OF DATA AND SYSTEM CONFIGURATION TO OPERATOR. MANUFACTURED BY RAYTHEON COMPANY.**
5. **COMMAND MODULE COMPUTER (CMC) - PERFORMS FIVE MAJOR FUNCTIONS (A) CALCULATES STEERING SIGNALS AND ENGINE DISCRETES NECESSARY TO KEEP THE SPACECRAFT ON THE REQUIRED TRAJECTORY, (B) POSITIONS THE STABLE MEMBER IN THE IMU TO A COORDINATE SYSTEM DEFINED BY PRECISE OPTICAL MEASUREMENT, (C) POSITIONS THE OPTICAL UNIT TO CELESTIAL OBJECTS, (D) CONDUCTS LIMITED MALFUNCTION ISOLATION OF THE G&N SYSTEM BY MONITORING THE LEVEL AND RATE OF SYSTEM SIGNALS AND (E) SUPPLIES PERTINENT SPACECRAFT CONDITION INFORMATION TO THE DISPLAY AND CONTROL PANEL. THIS UNIT MANUFACTURED BY RAYTHEON COMPANY.**
6. **COUPLING DATA UNIT (CDU) - THE CDU, AN ALL ELECTRONIC DEVICE IS USED AS AN INTERFACE ELEMENT BETWEEN (A) THE INERTIAL SUBSYSTEM AND COMPUTER SUBSYSTEM, (B) THE OPTICAL SUBSYSTEM AND COMPUTER SUBSYSTEM, (C) COMPUTER SUBSYSTEM AND THE CONTROL. THIS UNIT IS PRIMARILY AN ANALOG TO DIGITAL OR DIGITAL TO ANALOG CONVERTER AND IS MANUFACTURED BY AC ELECTRONICS.**
7. **POWER & SHELVES ASSEMBLY (PSA) - PROVIDES A CENTRALIZED PACKAGING FOR THE G&N SYSTEM POWER SUPPLIES AND A MAJORITY OF G&N SYSTEM ELECTRONICS. THIS UNIT MANUFACTURED BY AC ELECTRONICS**
8. **G&N INDICATOR CONTROL PANEL - PROVIDES THE OPERATOR WITH CONTROLS FOR (1) MANUAL POSITIONING OF THE OPTICS (2) MANUAL SELECTION OF OPTICAL MODE CONTROL (3) MANUAL MANEUVERING OF THE SPACECRAFT. THIS UNIT MANUFACTURED BY AC ELECTRONICS.**
9. **PPA ELECTRONICS ASSEMBLY (PEA) - CONTAINS THE MAJORITY OF THE ELECTRONICS REQUIRED IN THE OPERATION OF THE ACCELEROMETER LOOPS FOR ΔV MEASUREMENTS. THIS UNIT MANUFACTURED BY AC ELECTRONICS.**
10. **SIGNAL CONDITIONER - THE SIGNAL CONDITIONER RECEIVES VARIOUS SIGNALS FROM THE G&N SYSTEM AND CONDITIONS THEM INTO A FORM ACCEPTABLE FOR TELEMETRYING. THIS UNIT MANUFACTURED BY AC ELECTRONICS.**

AC ELECTRONICS

Division of General Motors, Warrendale, Pa.

APOLLO LUNAR EXCURSION MODULE PGNC'S EQUIPMENT

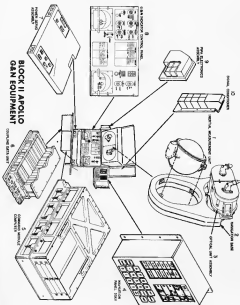


1 OCTOBER 1966

FUNCTIONAL DESCRIPTION OF A POLLO LEM PGNC'S EQUIPMENT

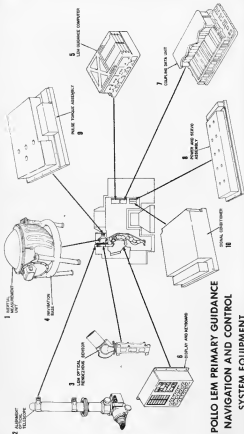
1. **INERTIAL MEASUREMENT UNIT (IMU)** AND ASSOCIATED EQUIPMENT PERFORMS THREE MAJOR FUNCTIONS: (A) MEASURES CHANGES IN LEM ATTITUDE; (B) ASSISTS IN GENERATING STEERING COMMANDS; AND (C) MEASURES LEM VELOCITY CHANGES DUE TO THRUST. THIS UNIT MANUFACTURED BY AC ELECTRONICS.
2. **ALIGNMENT OPTICAL TELESCOPE (AOT)** - PROVIDES STAR SIGHTING DATA WHICH IS MANUALLY INSERTED INTO THE LEM GUIDANCE COMPUTER FOR ESTABLISHING THE INERTIAL REFERENCE. THIS UNIT MANUFACTURED BY KOLLMANN INSTRUMENT COMPANY.
3. **LEM OPTICAL RENDEZVOUS SENSOR (LORS)** (REPLACES AOT) PROVIDES STAR SIGHTING DATA FOR ESTABLISHING THE INERTIAL REFERENCE AND TRACKS THE COMMAND SERVICE MODULE DURING ASCENT, DESCENT AND RENDEZVOUS. THIS UNIT IS AN ALL ELECTRONIC DEVICE REQUIRING NO VISUAL SIGHTINGS BY THE OPERATOR. THIS UNIT MANUFACTURED BY HUGHES AIRCRAFT COMPANY.
4. **NAVIGATION BASE (NAV BASE)** - PROVIDES AN ACCURATE MOUNTING BASE FOR THE ALIGNMENT OPTICAL TELESCOPE (AOT) AND THE INERTIAL MEASUREMENT UNIT. THIS UNIT MANUFACTURED BY AC ELECTRONICS.
5. **LEM GUIDANCE COMPUTER (LGC)** - PERFORMS FIVE MAJOR FUNCTIONS: (A) CALCULATES STEERING SIGNALS AND ENGINE DESIGNS NECESSARY TO KEEP THE LEM ON THE REQUIRED TRAJECTORY; (B) POSITIONS THE STABLE MEMBER IN THE IMU TO A COORDINATE SYSTEM DEFINED BY PRECISE OPTICAL MEASUREMENTS; (C) POSITIONS THE LOGS TO CELESTIAL OBJECTS; (D) CONDUCTS LIMITED MALFUNCTION ISOLATION OF THE SENSORS BY MONITORING THE LEVEL AND RATE OF SYSTEM SIGNALS; AND (E) SUPPLIES PERTINENT LEM CONDITION INFORMATION TO THE DISPLAY AND CONTROL PANELS. THIS UNIT MANUFACTURED BY MATTHEWSON COMPANY.
6. **DISPLAY AND KEYBOARD (DSKY)** - PROVIDES A TWO-WAY COMMUNICATION LINK BETWEEN THE OPERATOR AND THE LGC AND THE FOLLOWING FUNCTIONS MAY BE PERFORMED: (A) LOADING OF DATA INTO THE LGC; (B) DISPLAY OF DATA AND SYSTEM CONFIGURATION TO THE OPERATOR. THIS UNIT MANUFACTURED BY MATTHEWSON COMPANY.
7. **COUPLING DATA UNIT (CDU)** - THE CDU, AN ALL-ELECTRONIC DEVICE, IS USED AS AN INTERFACE ELEMENT BETWEEN THE FOLLOWING: (A) THE INERTIAL SUBSYSTEM AND COMPUTER SUBSYSTEM; (B) OPTICAL SUBSYSTEM AND COMPUTER SUBSYSTEM; (C) AND THE COMPUTER SUBSYSTEM AND THE CONTROLS. THIS UNIT FUNCTIONS PRIMARILY AS AN ANALOG TO DIGITAL OR DIGITAL TO ANALOG CONVERTER. THIS UNIT MANUFACTURED BY AC ELECTRONICS.
8. **POWER AND SERVO ASSEMBLY (PSA)** - PROVIDES A CENTRALIZED PACKAGING FOR THE PGNC'S POWER SUPPLIES AND A MAJORITY OF PGNC'S ELECTRONICS. THIS UNIT MANUFACTURED BY AC ELECTRONICS.
9. **PULSE TORQUE ASSEMBLY (PTA)** - CONTAINS A POWER SUPPLY AND THE MAJORITY OF THE ELECTRONICS REQUIRED FOR ACCELEROMETRIC LOG ΔV MEASUREMENTS. THIS UNIT MANUFACTURED BY AC ELECTRONICS.
10. **SIGNAL CONDITIONER** - THE SIGNAL CONDITIONER RECEIVES VARIOUS SIGNALS FROM THE PGNC'S AND CONDITIONS THEM INTO A FORM ACCEPTABLE FOR TELEMETRYING. THIS UNIT MANUFACTURED BY AC ELECTRONICS.

BLOCK II APOLLO GAN EQUIPMENT



AC ELECTRONICS

Division of General Motors, Milwaukee, Wisconsin



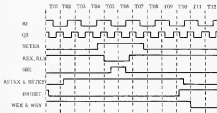
**APOLLO LEM PRIMARY GUIDANCE
NAVIGATION AND CONTROL
SYSTEM EQUIPMENT**

BLOCK II BASIC INSTRUCTIONS

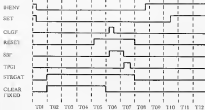
INSTRUC- TION	ORDER CODE	DESCRIPTION	INSTRUC- TION	ORDER CODE	DESCRIPTION
AD K	06	ADD K	LXCH E	02.2	EXCHANGE L AND E
AD S E	02.5	ADD TO STORAGE E	MAK K	07.	MASK WITH K
AUG E	02.4	ARGUMENT E	MP K	17.	MULTIPLY K
BZF F	31.2 31.4 31.6	BRANCH ON ZERO TO FIXED F	MSK K	07.	MASK K
BZMF F	31.2 31.4 31.6	BRANCH ON ZERO OR MINUS TO FIXED F	MSU E	02.0	MODULAR SUBTRACT
CA K	03.	CLEAR AND ADD K	NIX E	05.0	INDEX E
CAE E	03.	CLEAR AND ADD E	NEX K	15.	INDEX K
CAF F	03.	CLEAR AND ADD F	NDOP	03.0000	NO OPERATION (E)
CCS E	06.0	COUNT, COMPARE, AND SKIP ON E	NDOP	7C7 (4)	NO OPERATION (F)
COM	04.0000	COMPLEMENT A	OVSK	05.4000	OVERFLOW SKIP, TS
CS K	04.	CLEAR AND SUBTRACT K	QXCH E	12.2	EXCHANGE Q AND E
CYL	.0022	CYCLE LEFT	RAND H	10.2	READ AND "AND" H
CYR	.0020	CYCLE RIGHT	READ H	10.0	READ H
DAS E	06.0	DOUBLE ADD TO STORAGE E	REINT	00.0003	RELEASE INHIBIT INTERRUPT
DCA K	13.	DOUBLE CLEAR AND ADD K	RESUME	05.0047	RESUME INTERRUPT PROGRAM
DCS K	14	DOUBLE CLEAR AND SUBTRACT K	RETURN	06.0002	RETURN, TO Q
DOOM	14.0000	DO COMPLEMENT	ROB H	10.4	READ AND "OR" H
DOOALE	02.0000	DO OADRLE	ROK H	10.6	READ AND EXCLUSIVE "OR" H
DM E	12.6	DIMINISH E	SR	.0021	SHIFT RIGHT
DOUBLE	06.0000	DOUBLE A	SE E	16.0	SUBTRACT E
DTCB	05.3005	DP TRANSFER CONTROL, BOTH BANKS	TCAA	06.4005	TRANSFER CONTROL TO ADDRESS IN A, T
DV E	11.0	DIVIDE BY E	TC K	00.	TRANSFER CONTROL TO K
DVCH E	05.2	DOUBLE EXCHANGE A AND E	TCF F	01.2 01.4 01.6	TRANSFER CONTROL TO FIXED F
EDOP	.0023	EDIT OPERATOR	TCR K	00.	TC K
EXTEND	0.0008	EXTEND	TS E	05.4	TRANSFER TO STORE E
INCR E	02.4	INCREMENT E	WAND H	10.3	WRITE AND "AND" H
INDEX E	05.0	INDEX NEXT BASIC INSTRUCTION WITH E	WOR H	10.5	WRITE AND "OR" H
INDEX K	15.	INDEX NEXT EXTRA- ORDINARY INSTRUCTION WITH K	WRITE H	10.1	WRITE H
INHBT	00.0004	INHIBIT INTERRUPT	XCH E	05.0	EXCHANGE A AND E
			ZL	02.2007	ZERO L, LXCH ZERO
			ZQ	12.2008	ZERO Q, QXCH ZERO



BLOCK II ERASABLE MEMORY TIMING DIAGRAM



BLOCK II ROPE MEMORY TIMING DIAGRAM



3 MARCH 1966

AC ELECTRONICS

CHANNEL ASSIGNMENTS LIST

CHANNEL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
CHANNEL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	

