

INSTRUMENTATION

STUDY GUIDE

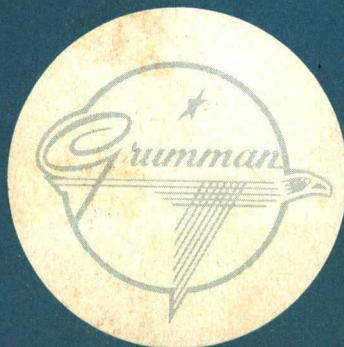
LUNAR MODULE

LM-3

CONTRACT NAS 9-1100

EXHIBIT E; PARAGRAPH 3.7.4

TYPE III DOCUMENT



INSTRUMENTATION

STUDY GUIDE

LUNAR MODULE

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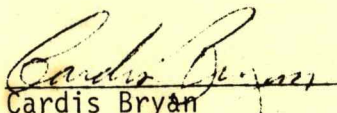
CONTRACT NAS 9-1100

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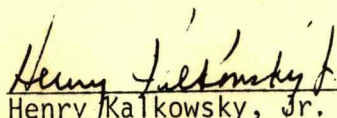
TYPE III DOCUMENT

FOR TRAINING PURPOSES ONLY; IN
SUPPORT OF LM-3 SUBSYSTEM BRIEFINGS

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TABLE OF CONTENTS

| | <u>Page</u> |
|---|---------------|
| List of Illustrations | iii thru iv |
| Abbreviation List | v |
| Chapter 1 - Introduction | 1-1 thru 1-10 |
| A - Block Diagram Explanation | |
| B - Physical and Electrical Characteristics | |
| C - Power | |
| D - Sensors | |
| Chapter 2 - Signal Conditioning Electronics Assembly (SCEA) | 2-1 thru 2-7 |
| A - Functional Description - SCEA | |
| B - Component Description | |
| Chapter 3 - Pulse Code Modulation Timing Electronics Assembly (PCMTEA) | 3-1 thru 3-17 |
| A - Functional Description - PCMTEA | |
| B - Timing Electronics | |
| C - Pulse Code Modulation Section | |
| Chapter 4 - Data Storage Electronics Assembly (DSEA) | 4-1 thru 4-7 |
| A - Functional Description - DSEA | |
| B - Component Description | |
| C - Modes of Operation | |
| Chapter 5 - Caution and Warning Electronics Assembly (CWEA) | 5-1 thru 5-38 |
| A - Function Description - CWEA | |
| B - Block Diagram | |
| C - Master Alarm Circuitry | |
| D - CWEA Power Supply | |
| E - Lamp/Tone Test Circuit | |
| F - Annun/Comp Lighting | |
| G - Caution and Warning Logic Circuits | |

TABLE OF CONTENTS (Continued)

| | <u>Page</u> |
|--|---------------|
| Chapter 6 - Developmental Flight Instrumentation (DFI) | 6-1 thru 6-11 |
| A - System Summary | |
| B - Component Description | |
| Chapter 7 - Real Time Instrumentation Telemetry | 7-1 thru 7-14 |
| A - General | |
| B - Table 7-1 | |
| C - Table 7-2 | |

LIST OF ILLUSTRATIONS

| | <u>Page</u> |
|--|-------------|
| Instrumentation Subsystem Simplified Block Diagram | 1-8 |
| AFT Equipment Bay - ERA Arrangement | 1-9 |
| Instrumentation Power and Control LM-3 | 1-10 |
| SCEA Assembly (Pictorial) | 2-4 |
| SCEA ERA Subassemblies Table 2-1 | 2-5 |
| SCEA Subassemblies Table 2-2 | 2-6 |
| Output Data Formats | 2-7 |
| PCMTEA System Assembly | 3-8 |
| Panel 12 LM-3 | 3-9 |
| Timing Electronics Block Diagram | 3-10 |
| Serial Time Data Format | 3-11 |
| Pulse Code Modulation Block Diagram | 3-12 |
| Identification of PCM Channel Designation | 3-13 |
| PCM Frame Format | 3-14 |
| Hi Bit Rate Format | 3-15 |
| PCM Prime Frame Synchronization | 3-16 |
| Lo Bit Rate Format | 3-17 |
| DSEA | 4-4 |
| DSEA Functional Block Diagram | 4-5 |
| DSEA Controls and Displays | 4-6 |
| DSEA Inputs and Controls | 4-7 |
| CWEA Configuration | 5-5 |
| Panel 1 LM-3 | 5-6 |
| Panel 2 LM-3 | 5-7 |
| Caution and Warning Displays | 5-8 |
| Caution and Warning Electronics Assembly Simplified Block Diagram | 5-9 |
| Lamp/Tone Test Circuit | 5-10 |
| Annun/Comp Lighting | 5-11 |
| Master Alarm and CWEA Fail Logic | 5-12 |
| Measurement Identification, Table 5-1 | 5-13 |
| ASC Press Warning Logic | 5-14 |
| DES REG and DES QTY Warning Logic | 5-15 |
| CES AC Warning Logic | 5-16 |
| CES DC Warning Logic | 5-17 |
| AGS Warning Logic | 5-18 |
| LGC/ISS Warning Logic | 5-19 |

LIST OF ILLUSTRATIONS (Continued)

| | <u>Page</u> |
|-----------------------------------|-------------|
| RCS TCA Warning Logic | 5-20 |
| RCS A REG & B REG Warning Logic | 5-21 |
| DC BUS Warning Logic | 5-22 |
| CABIN Warning Logic | 5-23 |
| SUIT/FAN Warning Logic | 5-24 |
| ASC HI REG/ASC QTY Caution Logic | 5-25 |
| GDA/RCCA Caution Logic | 5-26 |
| INVERTER Caution Logic | 5-27 |
| BATTERY Caution Logic | 5-28 |
| LDG RDR & RNDZ RDR Caution Logic | 5-29 |
| PREAMPS Caution Logic | 5-30 |
| ED RELAYS Caution Logic | 3-31 |
| RCS Caution Logic | 5-32 |
| HEATER Caution Logic | 5-33 |
| ECS Caution Logic | 5-34 |
| O ₂ QTY Caution Logic | 5-35 |
| GLYCOL Caution Logic | 5-36 |
| WATER QTY Caution Logic | 5-37 |
| S-BD RCVR Caution Logic | 5-38 |
| Instrumentation Subsystem DFI | 6-11 |
| PCMTEA Block Diagram | 7-14 |

ABBREVIATION LIST

| | |
|------------|--|
| ACA | Attitude Control Assembly |
| AEA | Abort Electronics Assembly |
| AGS | Abort Guidance Section |
| AHL | Analog High Level |
| ASA | Abort Sensor Assembly |
| ASC Hi Reg | Ascent High Regulator |
| ASC Press | Ascent Pressure |
| ASC Qty | Ascent Quantity |
| ATCA | Attitude and Translational Control Assembly |
| CDR | Commander |
| CDU | Control Data Unit/Coupling Data Unit |
| CES | Control Electronics Section |
| CWEA | Caution and Warning Electronics Assembly |
| D&C | Displays and Controls |
| DES Reg | Descent Regulator |
| DES Qty | Descent Quantity |
| DFC | Dual Feed Coupler Assembly |
| DFI | Developmental Flight Instrumentation |
| DSEA | Data Storage Electronics Assembly |
| ECA | Electronic Control Assembly |
| ECS | Environmental Control Section |
| ED Relays | Explosive Devices Relays |
| EPS | Electrical Power Subsystem |
| ERA | Electronic Replaceable Assembly |
| FWD | Forward |
| GDA | Gimbal Drive Actuator |
| GN&C | Guidance, Navigation and Control Subsystem |
| ICS | Internal Communication System |
| IMU | Inertial Measurement Unit |
| INV | Inverter |
| ISS | Inertial Subsystem |
| KBS | Kilo Bits per Second |
| LDG RDR | Landing Radar |
| LGC | LM Guidance Computer |
| LM | Lunar Module |
| MET | Mission Elapsed Time |
| MSFN | Manned Space Flight Network |
| NRZ | Non Return to Zero |
| PA | Power Amplifier |
| PAM | Pulse Amplitude Modulation |
| PCMTEA | Pulse Code Modulation and Timing Electronics Assembly |
| PIPA | Pulsed Integrating Pendulous Accelerometer |
| PTT | Push to Talk |

ABBREVIATION LIST (Continued)

| | |
|-------------------|--|
| PWD | Pulse Width Discriminator |
| RCCA | Rough Combustion Cutoff Assembly |
| RCS | Reaction Control Subsystem |
| RFI | Radio Frequency Interference |
| RZ | Return to Zero |
| SCEA | Signal Conditioning Electronics Assembly |
| SLA | Spacecraft Launch-Vehicle Adapter |
| Split \emptyset | Split Phase |
| TCA | Thrust Chamber Assembly |
| TE | Timing Electronics |
| TTCA | Thrust-Translation Control Assembly |
| VHF | Very High Frequency |
| VOX | Voice Operated Transmitter |
| XCVR | Transceiver |

CHAPTER 1

INTRODUCTION

A. Instrumentation Subsystem LM-3

The Instrumentation Subsystem (I.S.) contains the equipment in which the various parameters of the Lunar Module (LM)-3 subsystems are detected and prepared for transmission to the Manned Space Flight Network (MSFN). The I.S. interfaces directly with the Communications Subsystem to provide a constant telemetry update link from the LM to the MSFN.

The primary functions of the LM-3 Instrumentation Subsystem are as follows:

1. Collect data from the subsystems and structures of the LM.
2. To prepare the data collected for transmission to the MSFN, to allow the MSFN to:
 - a. Participate in major decisions to abort or modify the mission.
 - b. Assist in spacecraft management during crew high activity phases.
 - c. Maintain a detailed system status/performance flight history.
3. To provide the above data, via umbilical, for pre-launch system checkout and verification up to the time of launch.
4. To supply synchronized timing signals to the LM subsystems and mission elapsed time for transmission to earth.
5. To provide for voice data storage with time correlation.
6. To monitor the LM system status and alert the crew to the presence of a malfunction or abnormal condition.

To accomplish these functions the LM-3 Instrumentation Subsystem utilizes the following units:

1. Sensors: Various transducers are placed throughout the LM to allow constant monitoring of the varying system parameters. This allows the crew and MSFN to determine the LM operational status.
2. Signal Conditioning Electronics Assembly (SCEA): The SCEA accepts the unconditioned sensor outputs and converts them into either a 0 to 5 VDC scaled analog voltage or in the case of a switch closure a 0 or 5 VDC output for an Off-On switch position.

3. Pulse Code Modulation and Timing Electronics Assembly (PCMTEA): The PCM section changes analog inputs to a digital format to be multiplexed with other digital inputs. The PCM is capable of operating in the Hi Bit Rate (51.2 KBS) or the Lo Bit Rate (1.6 KBS). The outputs are: NRZ (Non Return to Zero); RZ (Return to Zero); and, Split Phase (Lo Bit Rate Only).

The TE section provides sync signals for the subsystems and timing pulses for Mission Elapsed Time.

4. Data Storage Electronics Assembly (DSEA): The DSEA is a voice tape recorder with a 10 hour tape time, capable of recording intercom conversations or, with the proper switch selections, voice signals within the Communications subsystem. No playback capability exists on the LM. The entire DSEA will be returned to Earth.
5. Caution and Warning Electronics Assembly (CWEA): The CWEA is the means by which the crew and MSFN are notified of an out of tolerance condition on the LM. Selected SCEA and Sensor outputs are compared to a reference within the CWEA. The crew is notified of a malfunction by lights, 20 Warning lights on Panel 1 and 20 Caution lights on Panel 2, and MSFN by telemetry.

- B. The Instrumentation Subsystem Simplified Block Diagram, see page 1-8, depicts the units of the I.S. and signal flow.

The I.S. interfaces, by the use of the subsystem sensors, with all of the LM-3 Subsystems. The sensors, for the purpose of signal flow, are of two basic types: those requiring external signal conditioning; and, those containing their own signal conditioning. With the various subsystems to be monitored, the sensor output will be in many formats.

A sensor which changes its measurement into a 0 to 5 VDC scaled output is one which contains its own signal conditioning. The signal lines from the subsystems sensor marked Pre-conditioned inputs are from this type of sensor. The measurement is a 0 to 5 VDC scaled voltage representing the detected measurement, or a 0 or 5 VDC representing a switch Off-On position. These signals will go directly to the Caution and Warning Electronics Assembly (CWEA) and to the Pulse Code Modulation and Timing Electronics Assembly (PCMTEA).

Sensors requiring external conditioning will send signals directly to Signal Conditioning Electronics Assembly (SCEA). The SCEA is made up of two electronic replaceable assemblies (ERA's); which contain plug-in assemblies to convert the varying parameters to a 0 to 5 VDC scaled analog signal or, in the case of a switch closure, a 0 or 5 VDC representing a switch off or a switch on. The plug-ins are of 11 different types, and the LM-3 SCEA contains 39 plug-in assemblies. Outputs from the SCEA go to the PCMTEA and the CWEA.

From the SCEA there are two paths for signal flow. The primary path is first through the PCMTEA to the Communications Subsystem and the second path would be through the CWEA then to PCMTEA and Communications. The first signal path discussed will be the primary path to the PCMTEA.

The PCMTEA is divided into 2 sections: the Pulse Code Modulation (PCM); and Timing Electronics (TE). Signals into the PCM are of two types: analog and discrete. Analog signals from the sensors and the SCEA are sampled by the coder chain and changed into an 8 bit parallel binary format. The sampling rate of the signal is hard wired and controlled by the PCM programmer. The coder chain calibrator develops 2 voltages (+0.75 VDC and +4.25 VDC) to check out the coder chain. These represent an analog low and an analog high voltage point.

Discrete signals are multiplexed with the coder chain output and routed to the Output Register.

The parallel binary format will be changed into one of three serial formats: Return-to-Zero (RZ) to the Ground Station Equipment (GSE) prior to launch; Non Return-to-Zero (NRZ); and, Split Phase.

The PCM is capable of operating in one of two modes; Hi Bit Rate (51.2KBS) or, Low Bit Rate (1.6KBS). This is controlled by the PCM switch on Panel 12.

Housed in the same unit as the PCM is the Timing Electronics which develops timing signals for the PCM, the LM-3 subsystems and Mission Elapsed Time. A 1024KC signal from the LM Guidance Computer (LGC) is the base frequency for the TE assembly. As a precaution in the event of the loss of the LGC the Timing Electronics contains a back-up crystal oscillator. Three Detectors monitor the operation of the back up oscillator and send status information through the PCM to the MSFN. In the event that the LGC signal did fail, the switch-over to the back up oscillator is automatic.

Mission elapsed time signals, seconds, minutes, hours and days, are sent to the Data Storage Electronics Assembly (DSEA) to be placed on tape with voice conversations. This will allow time correlation of conversations during replay. The DSEA, or Voice Tape Recorder, is capable of recording for 10 hours. A Voice Operated Transmitter (VOX) key signal and a voice signal from the Communications Subsystems are required for the DSEA to pull tape and record. A tape status flag, on Panel 12, indicates Red and White (barber pole) stripe for tape not being pulled and Gray for tape being pulled. The tape On/OFF switch next to the Tape flag only partially enables the DSEA.

A second path for signal flow from the SCEA is to the CWEA. The inputs into the CWEA are Discretes and scaled Analogs from the SCEA and the System Sensors that have pre-conditioned outputs. The Caution and Warning Electronics Assembly compares the input signals, with a CWEA reference to determine the operational status of selected LM-3 parameters. If an out of tolerance condition is detected, the crew is notified by three sets of lights and a 3KC tone in both headsets. The malfunctions are divided into two types:

1. Warning Malfunctions - those that would effect crew safety and require immediate attention. The warning lights are red indicators on Panel 1. On LM-3 there are presently 14 Warning lights.
2. Caution Malfunctions - those that do not immediately effect crew safety but could effect the mission if action were not taken. The caution lights are amber indicators on Panel 2. On LM-3 there are presently 17 Caution lights.

With either a Warning Malfunction or a Caution Malfunction, two Master Alarm lights, one on Panel 1 and one on Panel 2, and a 3KC tone in both crew members headsets alert the crew that there is an out of tolerance condition on the vehicle. The Master Alarm lights, red indicators, are push button lights which can be reset by pushing in either Master Alarm light. The 3KC tone resets with the Master Alarm lights.

Signals to the PCMTEA are: a Master Alarm indication, which alerts MSFN to search the telemetry for the out of tolerance measurement; CES AC power failure; CES DC power failure; AGS power failure; and, a Caution and Warning power failure.

- C. The Instrumentation Subsystem, with the exception of the DSEA, is mounted in the AFT Equipment Bay, see page 1-9. The equipment is mounted on a cold rail, with water glycol solution flowing through it for cooling. The I.S. equipment, in the AFT equipment bay, is on the primary and secondary glycol loops. The DSEA is on the primary glycol loop only.

The following table is a list of physical and electrical characteristics of the equipment in the LM-3 Instrumentation Subsystem.

Table I

SCEA - 2 units manufactured by ARMA Div., American Bosch ARMA Corp.

| | | |
|----------|--------------------|---------------------|
| SCERA #1 | Height 8" | Power Requirements: |
| | Width 5.25" | Excitation 28 VDC |
| | Length 23.9" | Consumption 16.04 W |
| | Weight 34.428 lbs. | |

| | |
|----------|--|
| SCERA #2 | Height, Width, Length same as for SCERA #1 |
| | Weight 34.787 lbs. |
| | Power Requirements: Excitation 28 VDC |
| | Consumption 14.23 W |

PCMTEA - manufactured by Radiation Inc.

| | |
|----------------|---------------------|
| Height 6.72" | Power Requirements: |
| Width 5.12" | Excitation 28 VDC |
| | Consumption 10 W |
| Length 19.75" | |
| Weight 23 lbs. | |

CWEA - manufactured by ARMA Div., American Bosch ARMA Corp.

| | |
|-------------------|--|
| Height 7.0" | Power Requirements: |
| Width 6.75" | Excitation 28 VDC |
| Length 11.75" | Consumption 13 W |
| Weight 19.75 lbs. | (with 6 indicators and Master Alarms on) |

DSEA - manufactured by Leach Corp.

| | |
|------------------|---------------------|
| Height 4.0" | Power Requirements: |
| Width 2.05" | Excitation 115 VAC |
| Length 6.22" | 400 cps |
| Weight 38 ounces | |

- D. Page 1-10 shows the DC Bus and circuit breaker arrangement for the I.S. equipment, less the DSEA which is on an AC bus. Prior to launch the circuit breakers will be pulled. During pre-launch checkout power is applied to the GSE connector to energize relay 4K6. Voltage is taken from the Commander's DC Bus to turn on the equipment, the CWEA is not on this circuit.
- E. Sensors

During the LM-3 mission, the status of the subsystems will be constantly monitored. Transducers are utilized to change variation in physical moment into an electrical voltage.

Types of Transducers

1. Pressure (Absolute and Differential)*: Absolute pressure transducers check the ascent engine firing, and monitor the fuel and oxidizer system. A diaphragm pressure sensing element with a piezoresistive strain gage bridge produces a signal output proportional to the pressure being monitored.

The strain gage is a resistive element in a standard bridge circuit used for measuring compression and tension forces. The strain gage is bonded to a structural member. (When the member reacts to compression or tension forces, the resulting resistance change produces an output from the bridge circuit.)

A gage for the measurement of liquid or gas pressure that is used on LM-3 is the Bourdon tube. It consists of a curved tube which is mechanically linked to an indicating or recording device. One end of the tube is closed, and application of pressure to the open end causes the curvature to be reduced slightly, and the indicator to be operated through the mechanical linkage. Over a certain range, the degree of movement obtained is proportional to the applied pressure.

A differential pressure transducer measures the pressure differential within the fuel and oxidizer systems. Pressures in these two systems are applied to a pressure sensitive diaphragm in the transducer thru two tubes.

The pressure sensitive diaphragm is displaced in a magnetic field, causing changes in a bridge output proportional to the pressure differential.

Pressure measurements are made in the following systems:

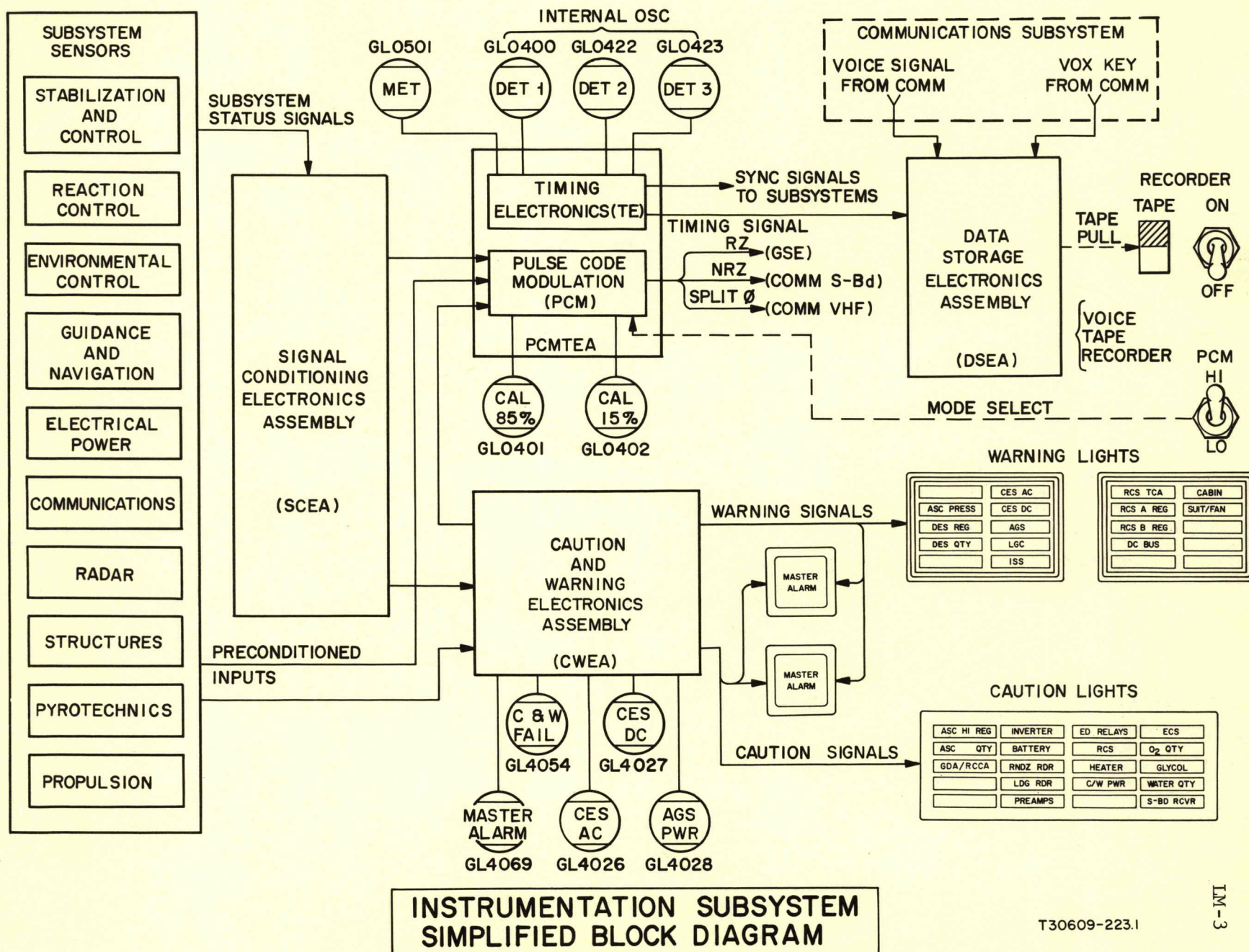
- a. Propulsion - Helium (Ascent, Descent, RCS)
Fuel and Oxidizer (Ascent)
RCS Thrust Chamber
 - b. ECS - Oxygen (Descent, Ascent Tanks #1 and 2)
CO₂ Partial Pressure
Glycol pump (switch closure with low pressure)
Suit pressure
2. Resistance Thermometer**: The resistance thermometer is a high response time instrument for the precise measure of temperature. This instrument consists of a temperature sensing element of pure platinum and an amplifying circuit. The platinum element is supported so that it will not be subjected to mechanical strain.

Resistance Thermometer measurements are made in the following systems:

- a. ECS - Glycol water separator
 - b. EPS - Over temperature of batteries
 - c. Heaters - Radar, Communication, RCS, AGS
3. Quantity Measuring Devices (Water and RCS propellant)*: Measures temperature-to-pressure ratio of the pressurant to determine the volume of the pressurant. The volume of the pressurant remaining in the tank will indicate the remaining volume of the water or RCS propellant.
- a. Water Pressurant - Nitrogen
 - b. RCS propellant pressurant - Helium
4. Accelerometers*: The Ascent engine firing is monitored by two redundant accelerometers in the Rough Combustion Cutoff Assembly (RCCA). An excess of vibration detected will cutoff the Ascent engine.

Note: * Signal Conditioning self contained.

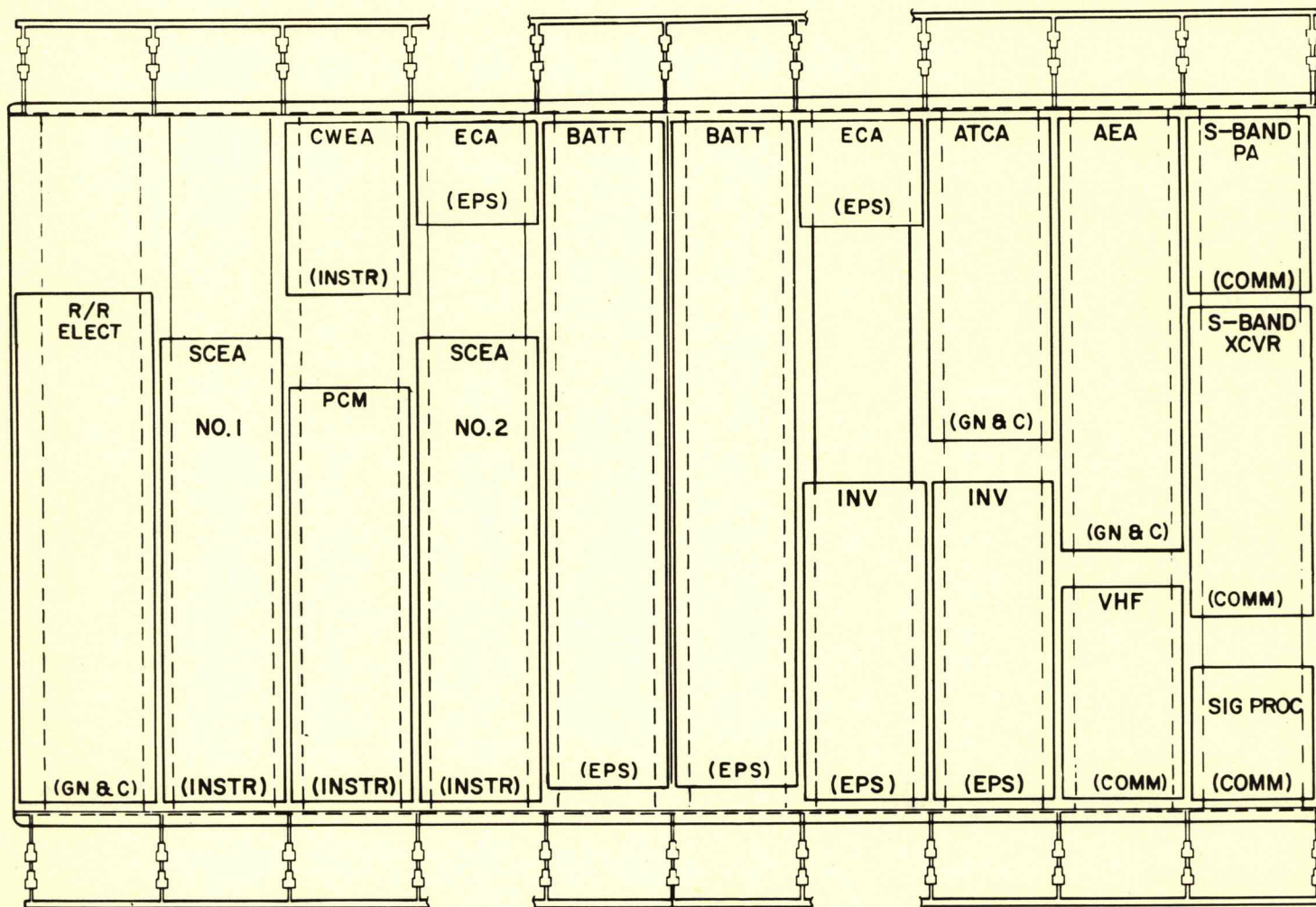
** External Signal Conditioning required.



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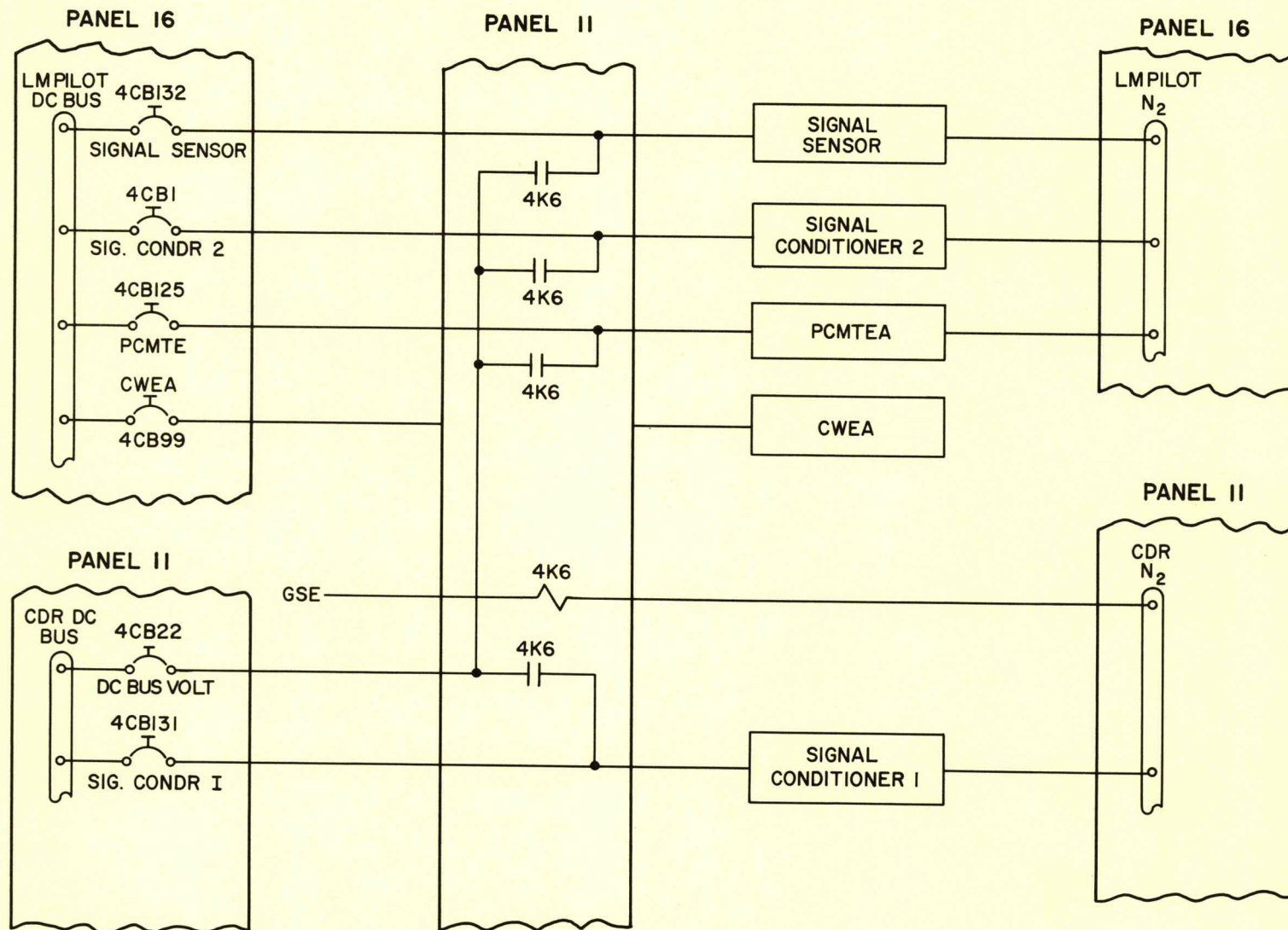
AFT EQUIPMENT BAY-ERA ARRANGEMENT

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Page 1-10



INSTRUMENTATION POWER AND CONTROL

T30609.-208.5

LM-3

CHAPTER 2

SIGNAL CONDITIONING ELECTRONIC ASSEMBLY (SCEA)

A. SCEA

The Signal Conditioning Electronics Assembly (SCEA) accepts inputs from the Subsystem Sensors and changes the various formats into a scaled analog of 0 to 5 VDC. In the case of a switch position the output will be a step voltage: 0 VDC as a switch open, and 5 VDC as a switch closure.

The SCEA is made up of the Electronic Replaceable Assemblies (ERA's): SCERA #1 and SCERA #2. Each SCERA has the capability to house up to 22 plug-in subassemblies, of eleven different types. The LM-3 SCEA contains 39 subassemblies. Table 2-1 lists the arrangement, by types, of the subassemblies; and the number of each in both SCERA's.

The outputs from the SCEA go to the PCMTEA, CWEA and Crew Displays.

B. Component Description

Table 2-2 indicates the types of subassemblies, input ranges and output scaling of the eleven different types of subassemblies. Each subassembly contains its own power supply, which is isolated from the other subassemblies. The loss of one subassembly, due to a power supply failure, would not effect the operation of the remaining subassemblies.

The following list indicates the types of subassemblies and a brief description of each:

1. 501-1, DC Amplifier

This subassembly has two modes of operation: Unipolar and Bipolar. In the Unipolar mode, the input level will be in the range of 0 to (200mV DC to 5V DC). The gain of the 501-1 is continuously adjustable, 1 to 25. The output scaling is as follows:

0V in - 0V out

Max. pos. in - 5V out

In the Bipolar mode the input level will be in the range of (-2.5V DC to -100mV DC) to (+100mV DC to +2.5V DC). The gain is 1 to 25 and is continuously adjustable. The output scaling is as follows:

Max. neg. in - 0V out

Max. pos. in - 5V out

The 501-1 has four operational channels with a single output per channel.

2. 502-2, DC Attenuator

This subassembly has two modes of operation: Unipolar and Bipolar. In the Unipolar mode the input level will be 0 to (5V DC to 40V DC). In the Bipolar mode the input will be (-20V DC to -2.5V DC) to (+2.5V DC to +20V DC). The 502-2 has four operational channels with a single output per channel. The gain is continuously adjustable between 1 and 0.125. The output is 0 to 5V DC scaled analog.

3. 503-2, AC to DC Converter

The 503-2 accepts two input ranges of AC RMS voltages: 0 to (21V AC to 31V AC) and 0 to (100V AC to 150V AC). The input voltage must be in the frequency ranges of 400±20 cps or 800±40 cps. Channel level selection is by jumper wire arrangement. The 503-2 has three operational channels with a single output per channel. The output is 0 to 5V DC scaled analog.

4. 504-1, Analog Signal Buffer

The 504-1 is a unity gain device accepting 0 to 5V DC and isolating it through buffer stages. The unit has four operational channels with a single 0 to 5V DC output.

5. 504-2, Discrete Signal Buffer

The input to the 504-2 is a switch position, On or Off. The unit has ten operational channels with two outputs per channel. The outputs will be a step voltage of 0V DC as a switch Off, or open and 5V DC as a switch On, or closure.

6. 504-3, Discrete Signal Buffer

The input to the 504-3 is a switch position, On or Off. The unit has twelve operational channels with two parallel outputs per channel. The outputs will be a step voltage of 0V DC as a switch Off, or open and 5V DC as a switch On, or closure.

7. 504-4, Discrete Signal Buffer

The input to the 504-4 is a switch position. The unit has twelve operational channels with two outputs per channel. One output is a step voltage, as the 504-3, and the second is a switch closure. The switch closure allows an external current path to be completed through the 504-4.

8. 504-5, Discrete Signal Buffer

The input to the 504-5 is a switch position. The unit has twelve operational channels with two outputs per channel. The outputs are step voltages.

9. 505-1, Frequency to DC Converter

The inputs to the 505-1 are frequencies in the range of 380 to 420 cps, in the voltage range of 20V AC to 130V AC. The unit has three operational channels with one output per channel. The output is 0 to 5V DC scaled analog.

10. 506-3, Resistance to DC Converter

The 506-3 has five input resistance ranges: 1363 to 1670 ohms, 1363 to 1791 ohms, 1363 to 1913 ohms, 666 to 1913 ohms, and 666 to 2792 ohms. The 506-3 converts the input resistance into a 0 to 5V DC scaled analog voltage. The unit has four operational channels with two outputs per channel.

11. 507-1, Phase Demodulator

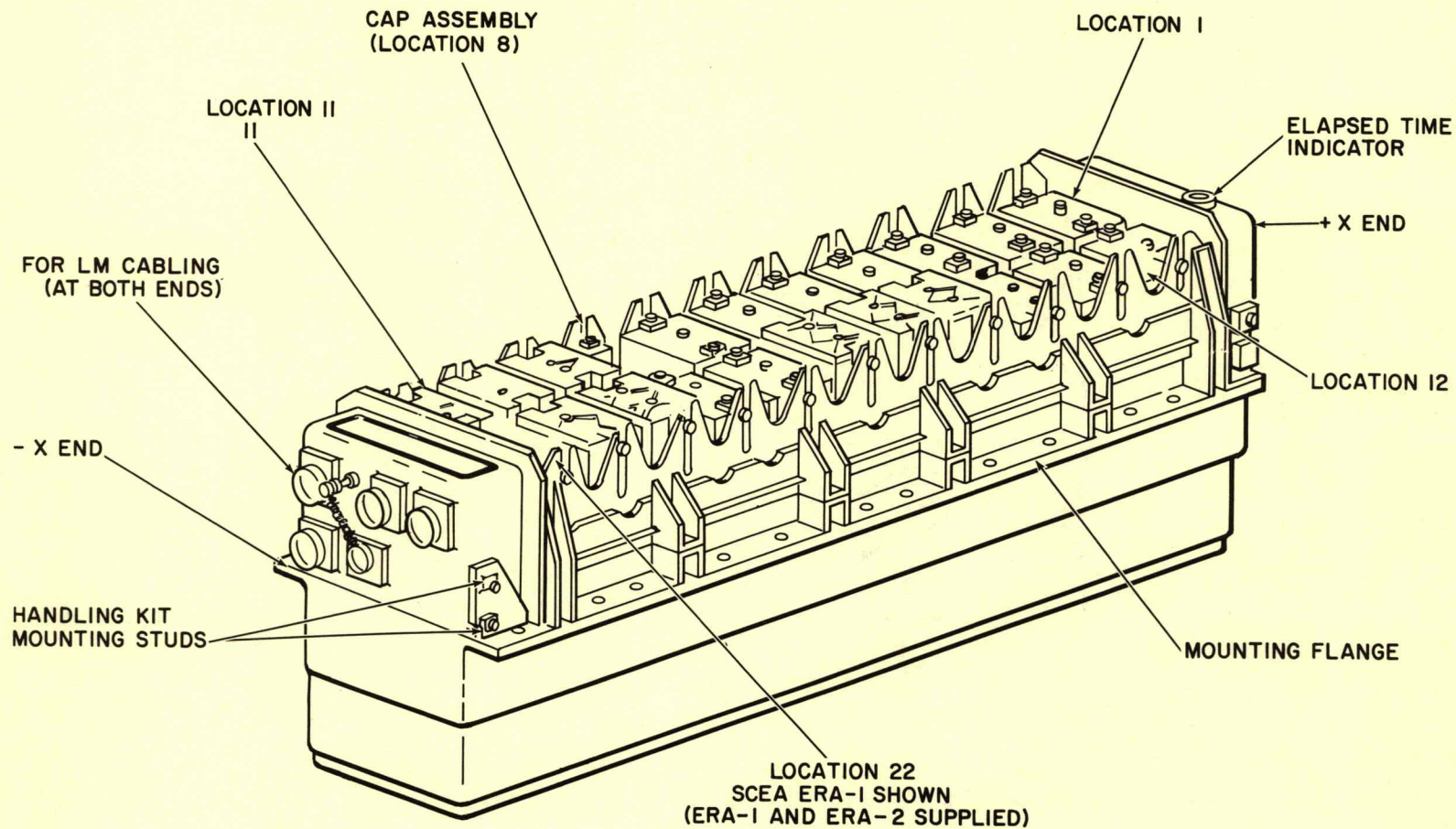
The 507-1 compares the input signal in phase and amplitude to a reference voltage. The scale for comparison is shown on Table 2-2. The unit has four operational channels with one output per channel.

Each channel of the subassemblies is isolated. Example: the loss of one channel of a 504-5 would not effect the output of the remaining 11 channels.

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Page 2-4



SCEA ASSEMBLY (PICTORIAL)

T30609-127.3

| 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------|
| 504-4 | 504-4 | 504-5 | 502-2 | 505-1 | 503-2 | 504-1 | 504-1 | 506-3 | 506-3 | CAP ASS'Y |
| GSE | 504-2 | 504-2 | 504-2 | 504-1 | 504-1 | 504-1 | 504-1 | 506-3 | 506-3 | 504-2 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

ERA-1

| 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------|
| 504-4 | 504-5 | 504-5 | 502-2 | 502-2 | 502-2 | 502-2 | 502-2 | 506-3 | 506-3 | CAP ASS'Y |
| GSE | 504-3 | 504-3 | 504-4 | 504-5 | 506-3 | 503-2 | 501-1 | 507-1 | 507-1 | CAP ASS'Y |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

ERA-2

| SUBASSEMBLY | ERA-1 | ERA-2 | TOTAL |
|-----------------------------------|-----------|-----------|-----------|
| DC AMPLIFIER 501-1 | 0 | 1 | 1 |
| ATTENUATOR 502-2 | 1 | 5 | 6 |
| AC-TO-DC CONVERTER 503-2 | 1 | 1 | 2 |
| SIGNAL ISOLATING BUFFER 504-1 | 6 | 0 | 6 |
| ↑ 504-2 | 4 | 0 | 4 |
| 504-3 | 0 | 2 | 2 |
| ↓ 504-4 | 2 | 2 | 4 |
| SIGNAL ISOLATING BUFFER 504-5 | 1 | 3 | 4 |
| FREQUENCY-TO-DC CONVERTER 505-1 | 1 | 0 | 1 |
| RESISTANCE-TO-DC CONVERTER 506-3 | 4 | 3 | 7 |
| PHASE SENSITIVE DEMODULATOR 507-1 | 0 | 2 | 2 |
| | <u>20</u> | <u>19</u> | <u>39</u> |

**SCEA ERA SUBASSEMBLIES
TABLE 2-1**

T30609-205.3

| TYPE | INPUT | | OUTPUT |
|------------------------------|---------------------------------|--|---|
| 501-1 DC AMP | UNIPOLAR MODE | 0 TO 200 MVDC 0 TO 5VDC | 4 CHANNELS, SINGLE OUTPUT 0 TO 5VDC |
| | BIPOLAR MODE | -100MV TO +100MV -2.5V TO +2.5V | |
| 502-2 DC ATTN | UNIPOLAR MODE | 0 TO 40VDC 0 TO 5VDC | 4 CHANNELS, SINGLE OUTPUT 0 TO 5VDC |
| | BIPOLAR MODE | - 20V TO +20V - 2.5V TO +2.5V | |
| 503-2 AC TO DC | 380 TO 840 ~ | 0 TO 21VAC 0 TO 31VAC 0 TO 100VAC 0 TO 150VAC | 3 CHANNELS, SINGLE OUTPUT 0 TO 5VDC |
| 504-1 ANALOG | | 0 TO 5VDC | 4 CHANNELS, SINGLE OUTPUT 0 TO 5VDC |
| 504-2 DISCRETE | SWITCH POSITION DISCRETE | ON OR OFF CLOSE OR OPEN | 10 CHANNELS, TWO OUTPUTS PER CHANNEL OFF, 0VDC; ON, 5VDC |
| 504-3 DISCRETE | SWITCH POSITION DISCRETE | ON OR OFF CLOSE OR OPEN | 12 CHANNELS, TWO OUTPUTS PER CHANNEL OFF 0 VDC; ON, 5VDC |
| 504-4 DISCRETE | SWITCH POSITION DISCRETE | ON OR OFF CLOSE OR OPEN | 12 CHANNELS, TWO OUTPUTS PER CHANNEL STEP, 0 OR 5VDC; SWITCH CLOSURE |
| 504-5 DISCRETE | SWITCH POSITION DISCRETE | ON OR OFF CLOSE OR OPEN | 12 CHANNELS, TWO OUTPUTS PER CHANNEL OFF, 0 VDC; ON, 5VDC |
| 505-1 FREQ TO DC | 380 TO 420 ~ 20VAC TO 130VAC | | 3 CHANNELS, SINGLE OUTPUT 0 TO 5VDC |
| 506-3 RESISTANCE TO DC | RANGE 1 2 3 4 5 | 1363 Ω TO 1670 Ω 1363 Ω TO 1791 Ω 1363 Ω TO 1913 Ω 666 Ω TO 1913 Ω 666 Ω TO 2792 Ω | 4 CHANNELS, SINGLE OUTPUT 0 TO 5VDC |
| 507-1 PHASE DEMOD | 360 - 880 ~ | 0 TO 2.8 VAC 0 TO 3.5 VAC 0 TO 15 VAC 0 TO 26 VAC REF. 115VAC OR 28VAC | INPUT SIG MAX 1/2 MAX 0 1/2 MAX MAX PHASE ANGLE 180° 180° 180°/ 0° 0° 0° OUTPUT 0VDC 1.25VDC 2.50VDC 3.75VDC 5VDC 4 CHANNELS, SINGLE OUTPUT |

SCEA SUBASSEMBLIES
TABLE 2-2

T 30609 -254.2

OUTPUT DATA FORMATS

DIGITAL DATA

DIGITAL DATA SHALL CONSIST OF CONDITIONED DISCRETE EVENT FUNCTIONS.

A. DISCRETE "ON" OR DIGITAL ONE AND A DISCRETE "OFF" OR DIGITAL ZERO.

1. A DIGITAL ONE SHALL BE INDICATED BY A VOLTAGE BETWEEN 3.4 VDC TO 6 VDC.
2. A DIGITAL ZERO SHALL BE INDICATED BY A VOLTAGE BETWEEN 0 VDC TO 0.5 VDC.

B. DISCRETE SIGNALS WHICH ARE TO BE MONITORED BY ADVISORY LIGHTS OR FLAGS SHALL BE IN THE FORM OF SWITCH CLOSURES OR ITS SOLID STATE EQUIVALENT.

ANALOG DATA

HIGH LEVEL ANALOG (AHL) - A SIGNAL VOLTAGE VARYING BETWEEN 0VDC TO 5VDC.

T30609-224.1

CHAPTER 3

PULSE CODE MODULATION AND TIMING ELECTRONICS ASSEMBLY (PCMTEA)

A. PCMTEA

The Pulse Code Modulation and Timing Electronics Assembly is divided into two separate sections: The Timing Electronics (TE) and the Pulse Code Modulation unit (PCM). The Timing Electronics develops timing signals for the PCM, the LM-3 subsystems and the Mission Elapsed Timer. The Pulse Code Modulation unit accepts Analog and Digital signals and places them into one of three formats: Non-Return-to-Zero (NRZ); Return-to-Zero (RZ); and, Split Phase.

B. Timing Electronics (see page 3-10)

The functional units of the Timing Electronics are as follows:

1. Doublers (A & B)
2. Phase Lock Oscillator
3. Decision Network
4. Timing Generator
5. Timing Accumulator
6. Serial Time Code Generator

The base frequency of the TE is a 1024KC square wave signal from the LM Guidance Computer (LGC). The LGC signal is applied to two Signal Doublers. The primary path for signal flow is through Doubler B to the Decision Network. The secondary path is through Doubler A, the Phase Lock Oscillator, to the Decision Network.

The output of Doubler B is 2048KC into a Schmitt Trigger device which will develop a 2048KC square wave output, triggered by the input signal.

The 2048KC output from Doubler A is applied to a free running 2048KC sine wave oscillator. The Oscillator is phase locked with the incoming base frequency. Three failure detectors monitor the operation of the oscillator circuit. These detector measurements, GLO400, GLO422, and GLO433, are sent to the PCM unit to be multiplexed and put into the proper format. The oscillator is a back-up device to be used in the event of the loss of the LGC signal. The switch-over from LGC to oscillator is automatic and accomplished in the Decision Network.

The primary path Schmitt Trigger square wave signal and the oscillator sine wave signal are summed and applied to a second Schmitt Trigger in the Decision Network. The fast rise leading edge of the square wave input will trigger on the second Schmitt Trigger. If the LGC signal, the Doubler B signal or the primary path Schmitt Trigger signal is lost, the Oscillator sine wave will trigger on the Decision Network. The output of the Decision Network is a 2048KC square wave into the Timing Generator.

The Timing Generator will divide down the input frequency through a series of frequency divider networks. The outputs are as follows:

1. 512KC

- a. To the Communications Subsystem, through the Output Buffers in the PCM (page 7-14), as a Subcarrier reference.
- b. To the Communications Subsystem as an Emergency Key carrier and 1.25MC subcarrier generation.
- c. To the Alt/Alt Rate Indicator, Panel 1, as a sync signal.

2. 6.4KC

- a. To Inverter #1 as a sync signal to produce a frequency stability of ± 1 cps.
- b. To Inverter #2.
- c. To the EPS 28V/6 VDC converter, page 5-11.

3. 1.6KC

To the Control Electronics Section (CES) as a sync for the CES power supply.

4. 100 cps

To the Serial Time Code Generator as the bit rate developing signal

5. 10 cps

- a. To the Event Timer
- b. To the Mission Elapsed Timer

6. 1 cps

To the Timing Accumulator

The Timing Accumulator is comprised of a series of counters to develop a Binary Coded Decimal (BCD) time output: Seconds, Minutes, Hours and Days, see page 3-11. The maximum accumulative time developed is 39 days, 23 hours, 59 minutes and 59 seconds. The Timing Accumulator will automatically reset and continue counting.

Outputs from the Timing Accumulator go to the PCM and to the Serial Time Code Generator.

If the PCMTEA is turned off or power is lost during the mission, the Timing Accumulator resets to all zeros. A remote control signal from the GSE Connector resets the Timing Accumulator during test prior to launch.

The Serial Time Code Generator combines the 100 cps signal from the Timing Generator and the BCD time from Timing Accumulator. It develops an output to the DSEA Storage Electronics Assembly (DSEA), of 2 words/sec, 50 bits/word, NRZ data.

C. Pulse Code Modulation section (see page 3-12)

The functional units of the Pulse Code Modulation section are as follows:

1. Programmer
2. Calibrator
3. Coder Chain
 - a. Analog Multiplexer Driver
 - b. Analog Multiplexer
 - c. High Speed Gates
 - d. Analog to Digital Converter
4. Digital Multiplexer
5. Output Register and Data Transfer Buffers

The heart of the PCM section is the Programmer, which develops commands for the PCM and controls its operation. The PCM operates in two modes: High Bit Rate, 51.2 Kilo Bits per second (KBS); and, Low Bit Rate (1.6KBS). The mode selection is made by a switch position on Panel 12 labeled PCM, see page 3-9. The functions of the Programmer are as follows:

1. Establish the basic intervals for timing periods: bits, words, prime frame and subframes. (See page 3-14)
2. Generate commands for analog and digital sampling in conformance with a fixed program.
3. Generate commands for coder operation and data transfer operation.
4. Generate patterns for synchronization and format ID words and the commands for inserting these words into the output of the PCM.

The Calibrator accepts a 5 VDC input and produces two precision voltages for system calibration: 4.25 VDC which corresponds to 85% (GL0401); and 0.75 VDC which corresponds to 15% (GL0402). The 85% and 15% voltages are sent to MSFN as telemetry, via the Communications Subsystem, representing high and low voltage points. This allows the ground stations to determine the operational status of the coder chain.

Positive going Row and Column commands developed in the Programmer turn on the Row and Column drivers in the Analog Multiplexer Driver. The column command has the longest duration and partially enables the Analog Multiplexer. The row command enables the input gates of the Analog Multiplexer for the proper sampling sequence.

The Analog Multiplexer has the capability of 277 high level analog input channels. The inputs are from the SCEA and Sensors with preconditioned outputs. The analog inputs are formed into pulse amplitude modulated (PAM) outputs, see signal labeled PAM-(see page 3-12). The pulses occur at the sampling rate of the channel. A more critical signal will be sampled at a higher rate than one that is less critical. The higher sampling rate provides better resolution in the read out at the ground station.

The sampling rates of the input measurements are as follows:
200 samples per second (s/s), 100 s/s, 50 s/s, 10 s/s and 1 s/s.
The input channels are divided into groups of five and gated by sequencer gates.

These groups are formed into four PAM outputs and fed to the High Speed Gates.

The High Speed Gates have two purposes:

1. To shape the PAM signals
2. To produce one PAM output

The Analog Multiplexer primary gates do not turn off sharply. This causes the trailing edges of the PAM signals to decay slowly. The first purpose of the High Speed Gates is to cutoff the trailing edges of the PAM signal, which reduces cross-talk caused by a second signal coming in before the trailing edge of the first signal has decayed.

There are four High Speed Gates and these are controlled by the Programmer to allow each PAM input to be sequenced into one PAM output to be sent to the Analog to Digital Converter.

PAM signals from the High Speed Gates are converted into a parallel digital data format. Each pulse input is changed into an 8 bit binary word. Upon command, labeled Sample and Hold, from the Programmer the Analog to Digital Converter allows a capacitor to charge to the value of the input pulse amplitude. The Programmer then issues the Coder Control command and the capacitor discharges through a resistance lattice network which develops the 8 bit parallel output (see the pulse to parallel signal diagram on page 3-12).

Parallel Digital signals from the Analog to Digital Converter and LM digital measurements are combined in the Digital Multiplexer. The LM digital measurements are as follows:

1. Discrete and Parallel Digital Data from the subsystems.
2. Master Alarm On - GL4069
3. CWEA
 - a. C & W Pwr Fail - GL4054

- b. CES AC - GL4026
- c. CES DC - GL4027
- d. AGS Pwr - GL4028

The Output Register accepts the parallel input and converts it into a serial format. It also receives a 40 bit input from the LGC and a 24 bit input from the AGS, in a serial format.

The serial information from the Output Register is shifted into three buffer stages which develop three signal outputs. The outputs of the Data Transfer Buffers (see page 7-14) are as follows:

1. NRZ (D01) - Non-Return-to-Zero to the S-Band communications section, High or Low Bit Rate.
2. RZ (D02) - Return-to-Zero to GSE.
3. Split Phase Data (D03) - to the VHF Communications section, low bit rate only.
4. Data Rate Timing - Timing output to sync external electronics to the output data, 51.2KC or 1.6KC.
5. Subcarrier Reference No. 1 (D05) - 512KC from TE (page 3-10) to the Communications Subsystem.
6. Subcarrier Reference No. 2 (D06) - 512KC to GSE
7. Subframe Sync (D07) - see page 3-16
8. 40 Bit Serial Start (D08) - Enables LGC serial input into the High Bit Rate Format, words 121-125.
9. 40 Bit Serial Stop 1 (D09) - Inhibits LGC input
10. 40 Bit Serial Sync 1 (D010) - Synchronizes LGC input to the PCM format.
11. 40 Bit Serial Stop 2 (D011) - Enables AGS serial input into the High Bit Rate Format, words 126-128.
12. 40 Bit Serial Sync 2 (D012) - Syncs LGC and AGS

13. 24 Bit Serial Stop (D013) - Inhibits AGS input
14. 24 Bit Serial Sync (D014) - Syncs AGS input with PCM Format.

Pages 3-12 and 3-6 provide an example of NRZ, RZ and Split Phase. Pages 3-15 and 3-17 show High Bit Rate and Low Bit Rate Format.

The overall PCMTEA Block Diagram on page 7-14 indicates the inputs and outputs to the units of the PCMTEA.

D. Test Points for GSE (page 7-14)

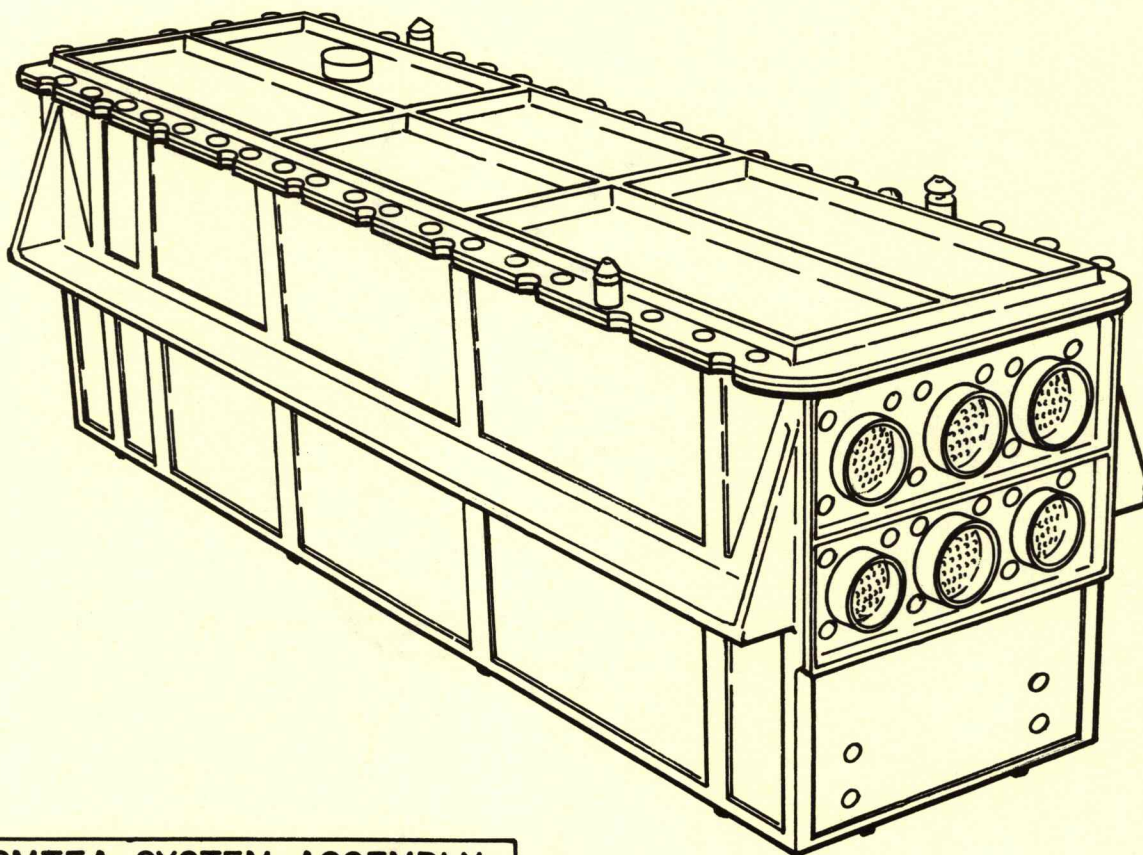
Test points for ground support equipment used during checkout are as follows:

1. All DO outputs from PCM.
2. All RO outputs from TE.
3. LO1 - 85% calibration output.

Date: February 1968

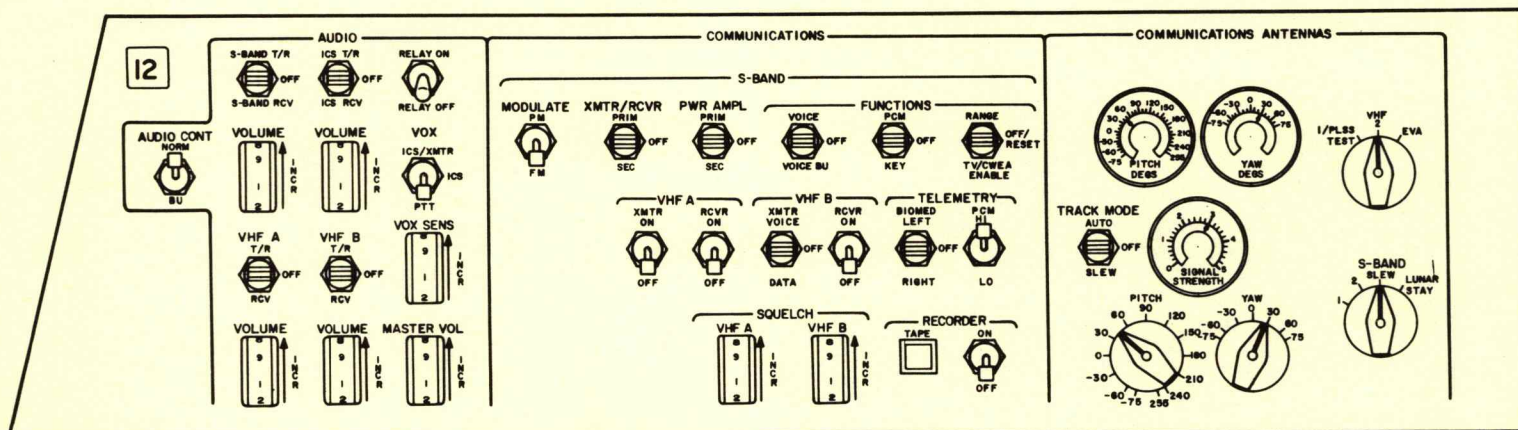
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Page 3-8



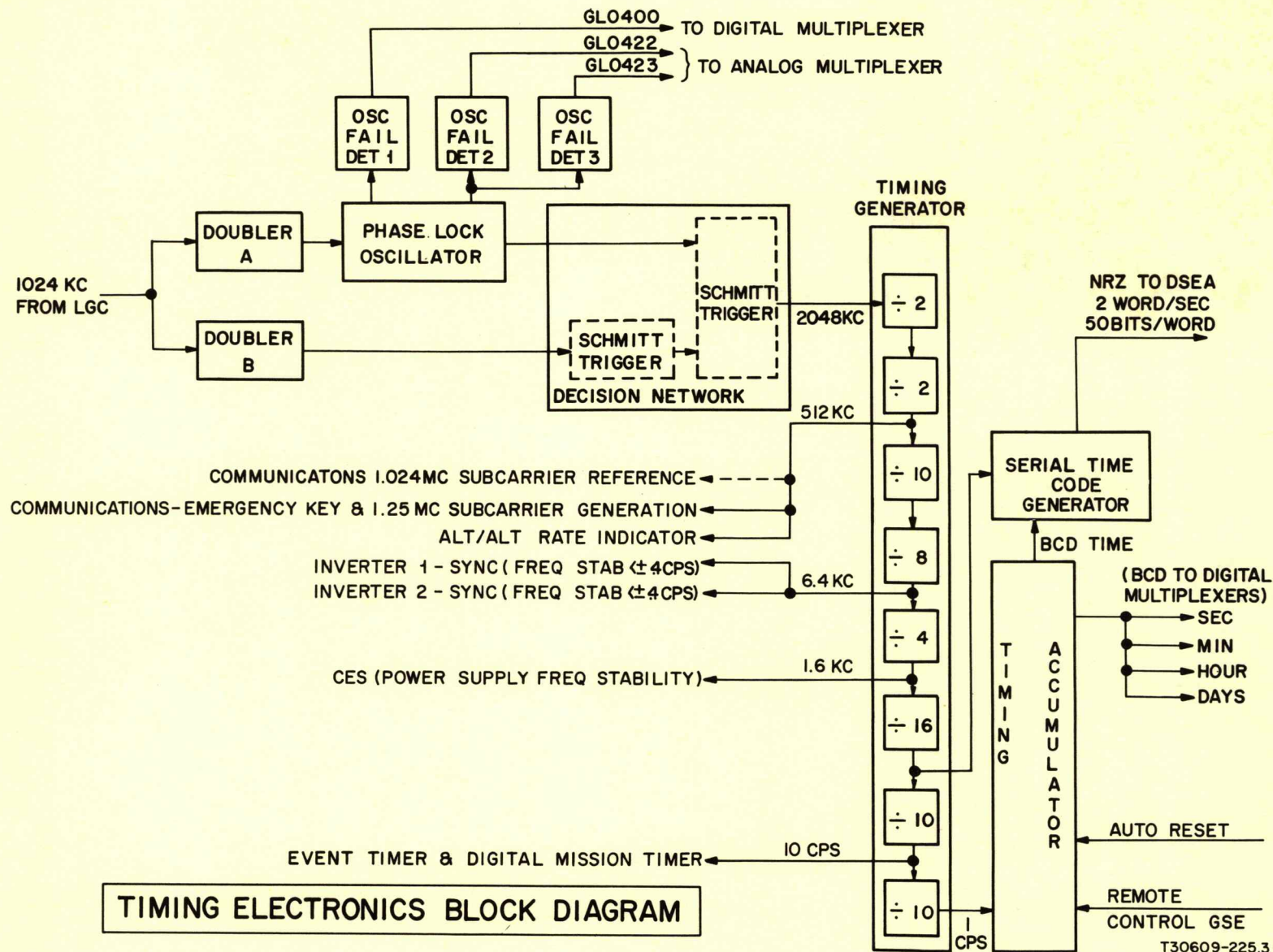
PCMTEA SYSTEM ASSEMBLY

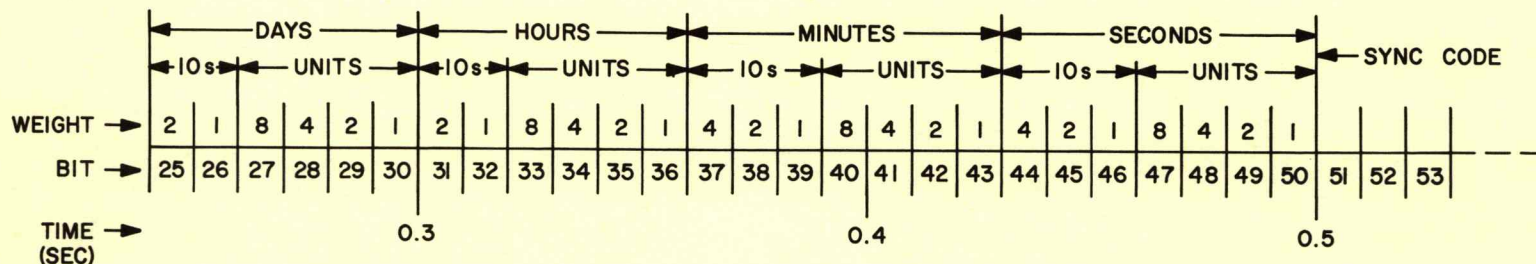
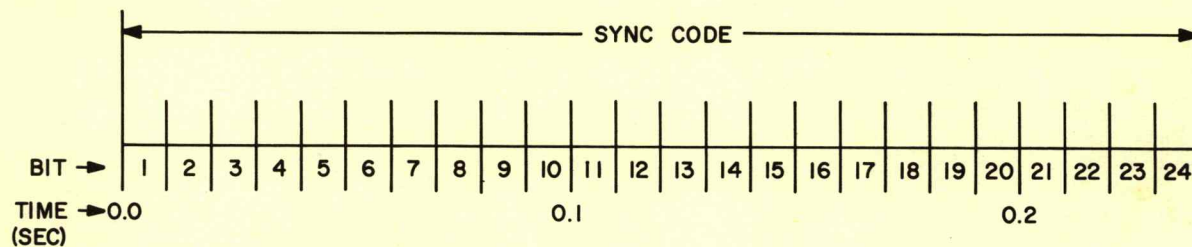
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PANEL 12
LM-3

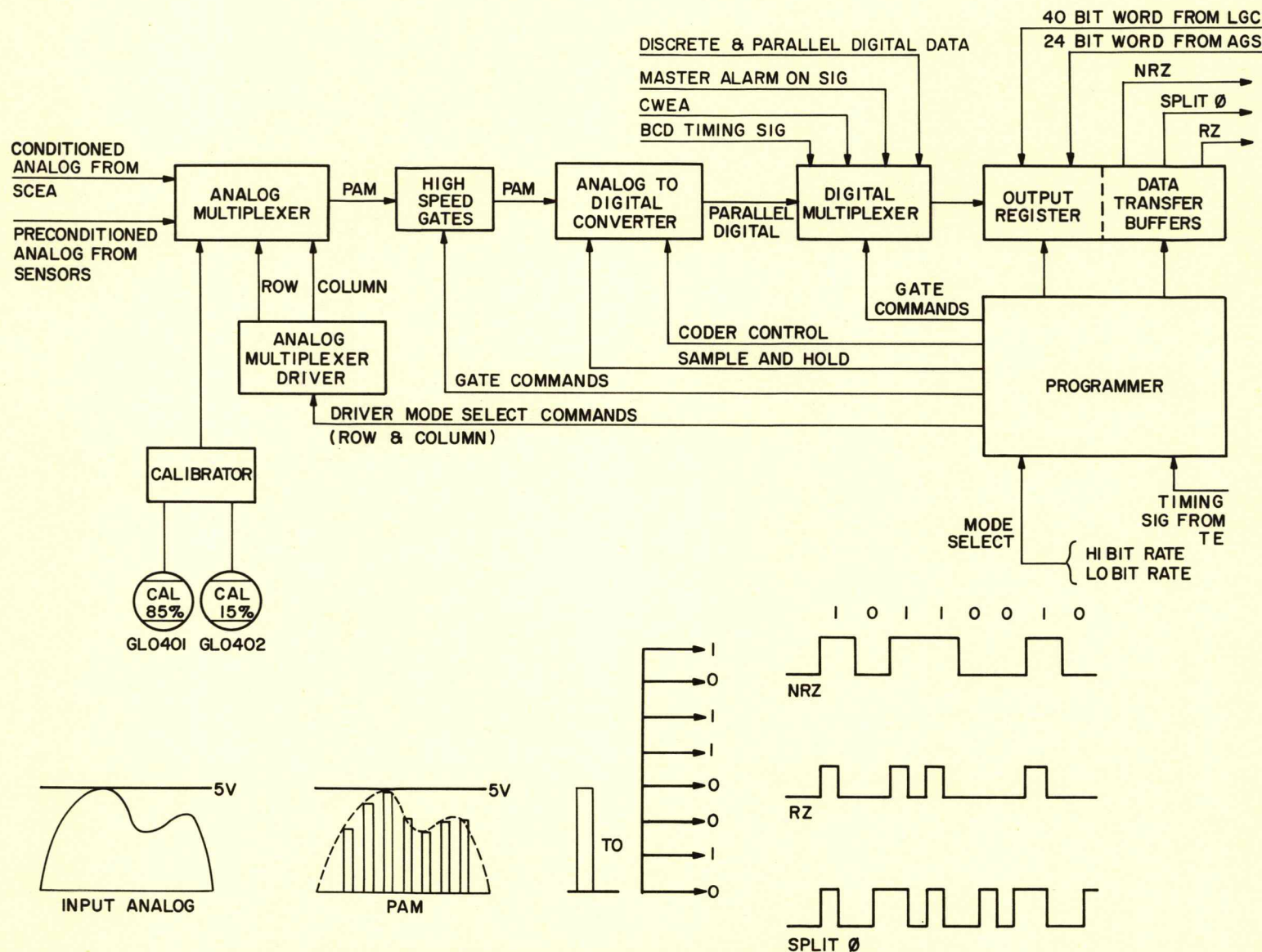
T30900-7.2





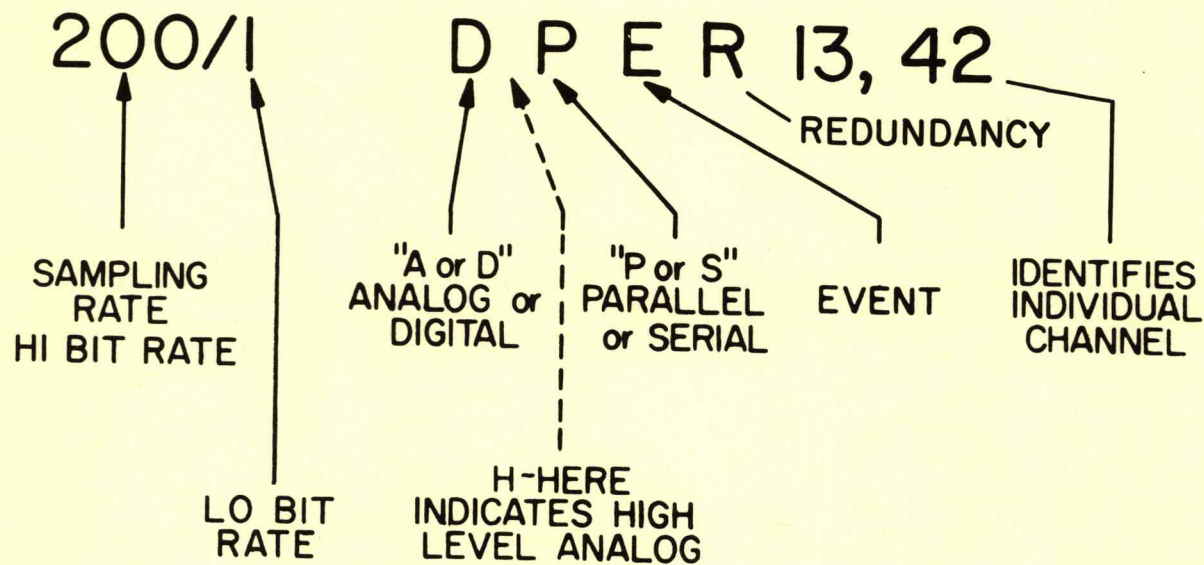
SERIAL TIME DATA FORMAT

T30609-26.1



PULSE CODE MODULATION BLOCK DIAGRAM

EXAMPLE:



IDENTIFICATION OF PCM CHANNEL DESIGNATION

T30609-147.2

HI BIT RATE

PERIOD = 1.95 μ SEC

BIT = 10 PERIODS

WORD = 8 BITS

FRAME = 128 WORDS

SUBFRAME = 50 FRAMES

PRIME FRAMES IDENTIFIED - F1 - F50

LO BIT RATE

PERIOD = 1.95 μ SEC

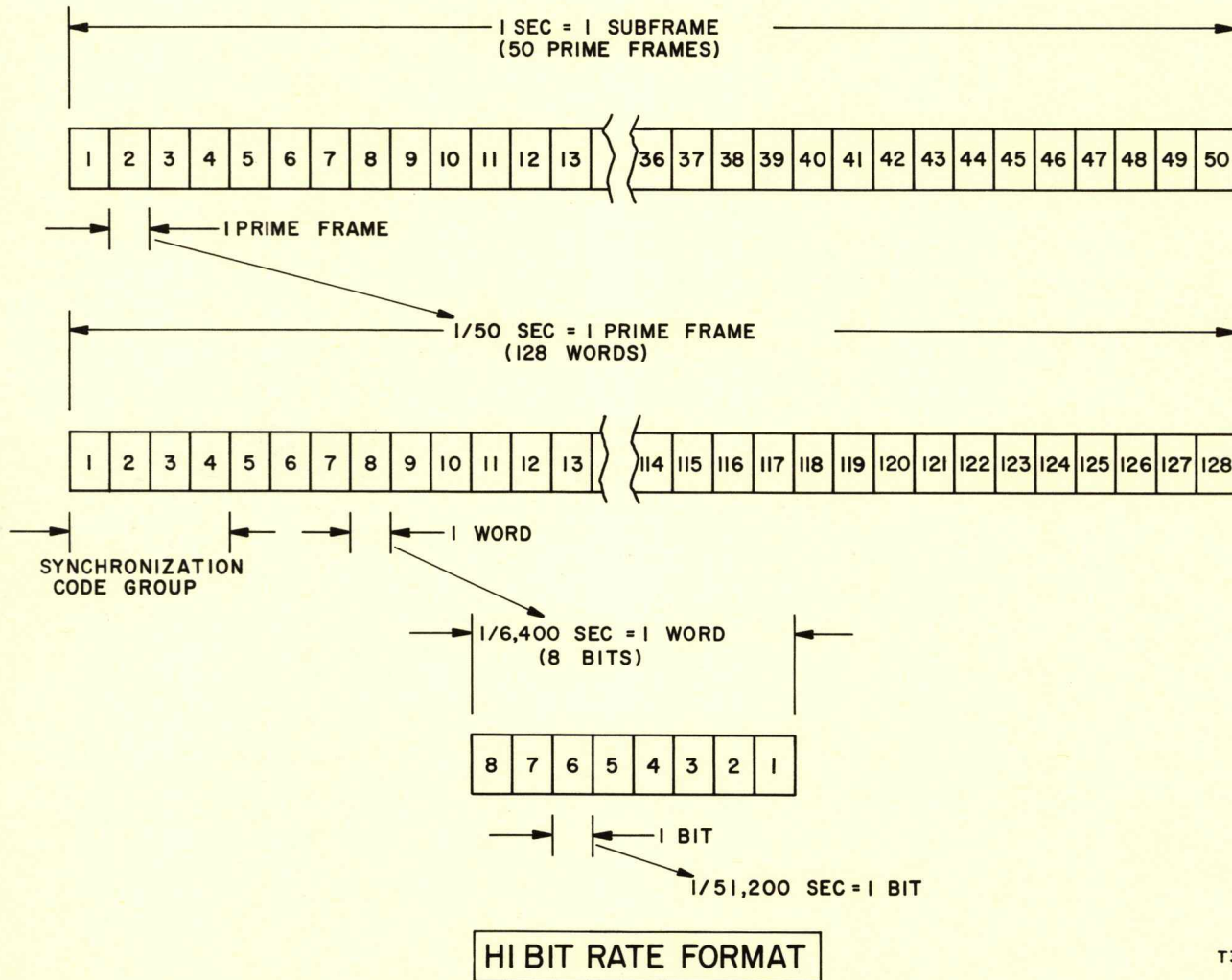
BIT = 320 PERIODS

WORD = 8 BITS

FRAME/SUBFRAME = 200 WORDS

PCM FRAME FORMAT

T30609-146.2

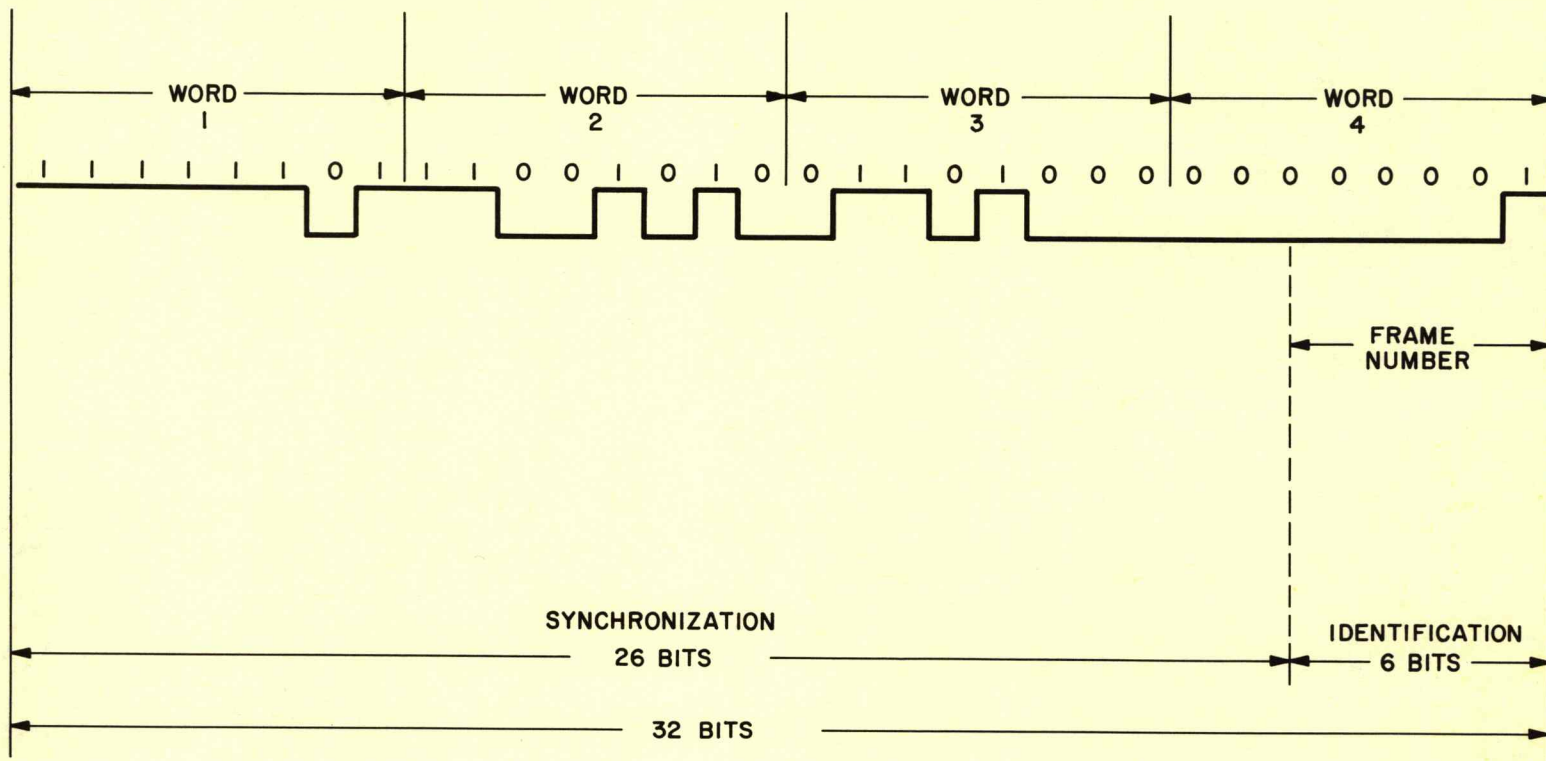


T30609-16.2

Date: August 1968

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Page 3-16



WORD 4 - BITS 6 THRU 1 INDICATE FI THRU F50

FI = 000001

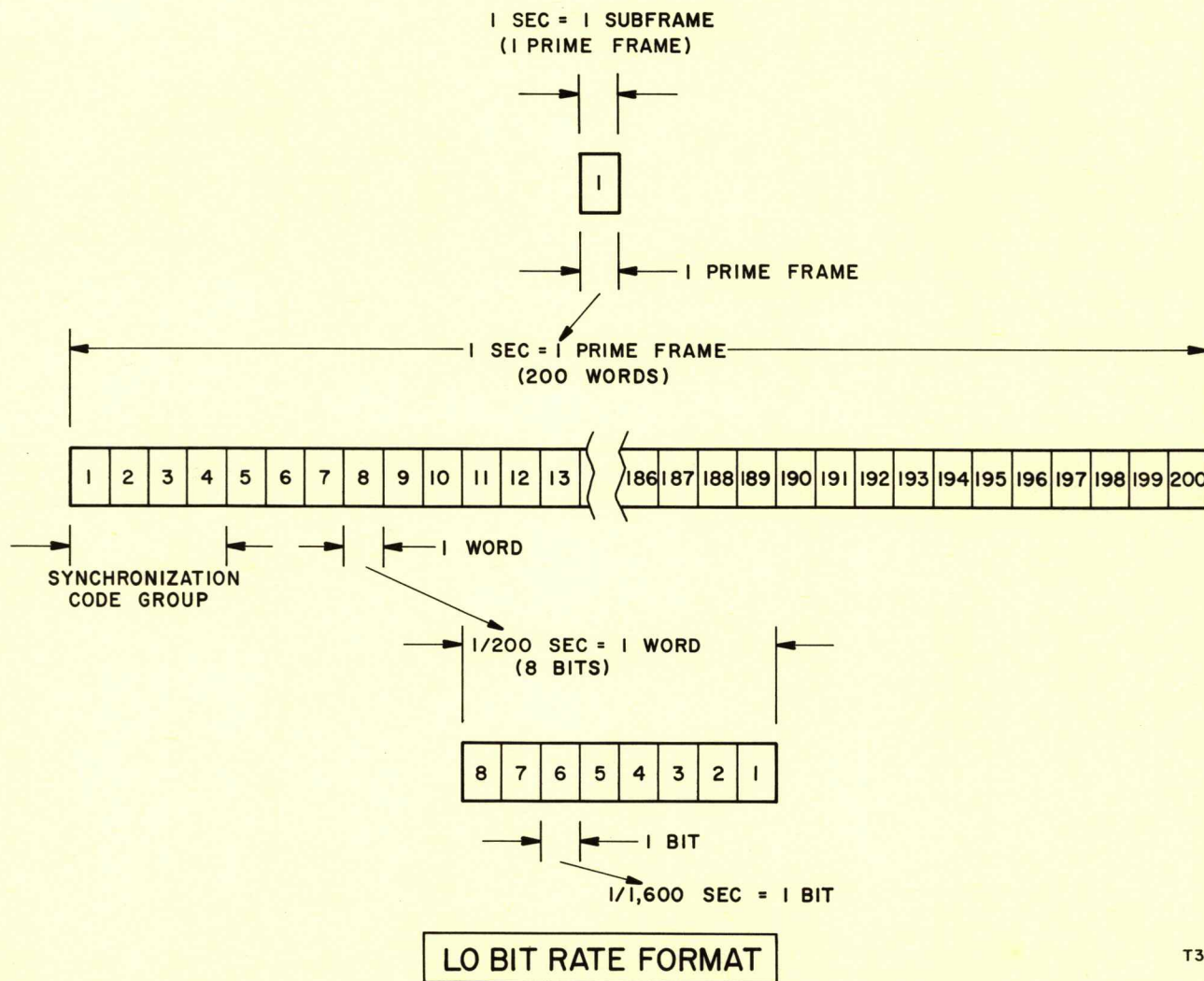
F50 = 110010

PCM PRIME FRAME SYNCHRONIZATION

Date: February 1968

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Page 3-17



T30609-17.2

CHAPTER 4

DATA STORAGE ELECTRONICS ASSEMBLY (DSEA)

A. DSEA

The Data Storage Electronics Assembly (DSEA) is a single speed, four track, magnetic tape recorder which will be used to record voice communications originating from the LM-3 and conference communications between the CSM, MSFN and the LM-3 crew. The simultaneous recording of LM mission time and voice signals provide a time reference during playback. The DSEA has a 10 hour recording capability but does not have a playback capability on the LM-3 vehicle.

B. Component Description

The functional block diagram, page 4-5, is an illustration of the DSEA electrical and mechanical components. The Voice Amplifier will condition audio signals in the 300 cps to 3000 cps range. Pre-emphasis of high frequencies (2KC to 3KC) is employed to take maximum advantage of the available tape dynamic range. The control logic will direct the amplifier output to the appropriate record head during each tape pass.

A frequency coded representation of the LM-3 mission time will be recorded with each selected communication. The Time Correlation Data (TCD) Modulator will accept and convert serial binary coded decimal data from the Timing Electronics (see page 3-10), to frequency coded data for recording. The frequency of a voltage controlled oscillator is varied. A binary one will cause an operating frequency of 4175 cps; a binary zero will shift the frequency to 4625 cps. The modulator output is capacitively coupled to the record head select logic and then applied to the recording head.

AC bias is utilized to operate the recording media in the linear portion of its characteristic curve. A 33KC Bias Oscillator generates the required signal. Mixing of the bias and amplified audio is accomplished at a common point prior to being applied to the selected recording head.

The Reference Oscillator operates at 5.2KC and is used to synchronize the speed of the playback servoamplifiers with the recorded speed. This frequency is only for use on the Ground Station equipment.

Control Logic circuits govern the action of the tape transport, power relays and track switching relays during the four recording passes of the tape. The sequencing of relays facilitates the selection of recording heads and the direction of drive for the capstan motor. Conditions such as "end of tape pass" or "end of tape" are recognized and acted upon the logic circuits. Control of input power switching is also provided. The combination of inputs from the Voice Operated Transmitter, VOX, circuits in the Communications Subsystem and the Tape On/Off switch, on Panel 12 (see page 3-9), in the On position, activate the Power on/off relay providing 115 VAC 400 cps to the Power Converter.

The tape transport provides 450 feet of .25 inch, .5 mil, magnetic tape, contained in a compact reeling mechanism. This tape capacity, when operated at a speed of .6 inches per second, provides 2.5 hours recording time for each complete pass of the tape. By utilizing four individual tracks, automatic sequential head switching and automatic tape reversals, a total recording time of 10 hours is obtained.

A flag indicator on Panel 12, see page 3-9, will signify tape motion and provide an indication of recording assurance during the first tape pass. The tape motion amplifier receives its signal input from the track #1 reproduce head. The signal is then amplified and filtered so that the output is derived from signals in the 300 cps to 3000 cps range. A flag control relay is driven by the amplifier when audio is sensed signify tape in motion, a gray flag will appear in the tape window. A red and white striped flag indicates the tape is not being moved.

C. Modes of Operation

The DSEA operates in either the manual or semiautomatic mode, page 4-7. In the manual mode the ICS T/R switch on the audio portion of Panels 8 and 12 is set to ICS T/R and the VOX switch on either panel is set to PTT. The tape On/Off switch, on Panel 12, must be in the On position. The PTT position bypasses the automatic voice sense circuits. The Commander or LM Pilot can close a push-to-talk (PTT) switch (on the attitude controller assemblies). The push-to-talk switch energizes the VOX key relay, providing a ground for activation of the power control logic in the DSEA. In the energized state, this relay routes operating power to be applied to the recorder electronics. The audio signal generated by the astronaut is conditioned by the Signal Processing Assembly (SPA), in the Communications Subsystem, and fed to the recorder for transfer to tape.

For operation in the semiautomatic mode, the VOX switch is set to ICS/XMTR. With the switch set to this position, the VOX trigger circuit is enabled. The VOX sense circuit senses a voice input within the cabin or from the communication receivers and feeds the signal to the VOX Trigger circuit. With the Tape switch in the On position and a voice signal of at least 30 msec duration, the Tape Control Logic circuit will allow ground to be applied to the DSEA power supply. At the absence of a voice input for over .8 sec., the circuit will open.

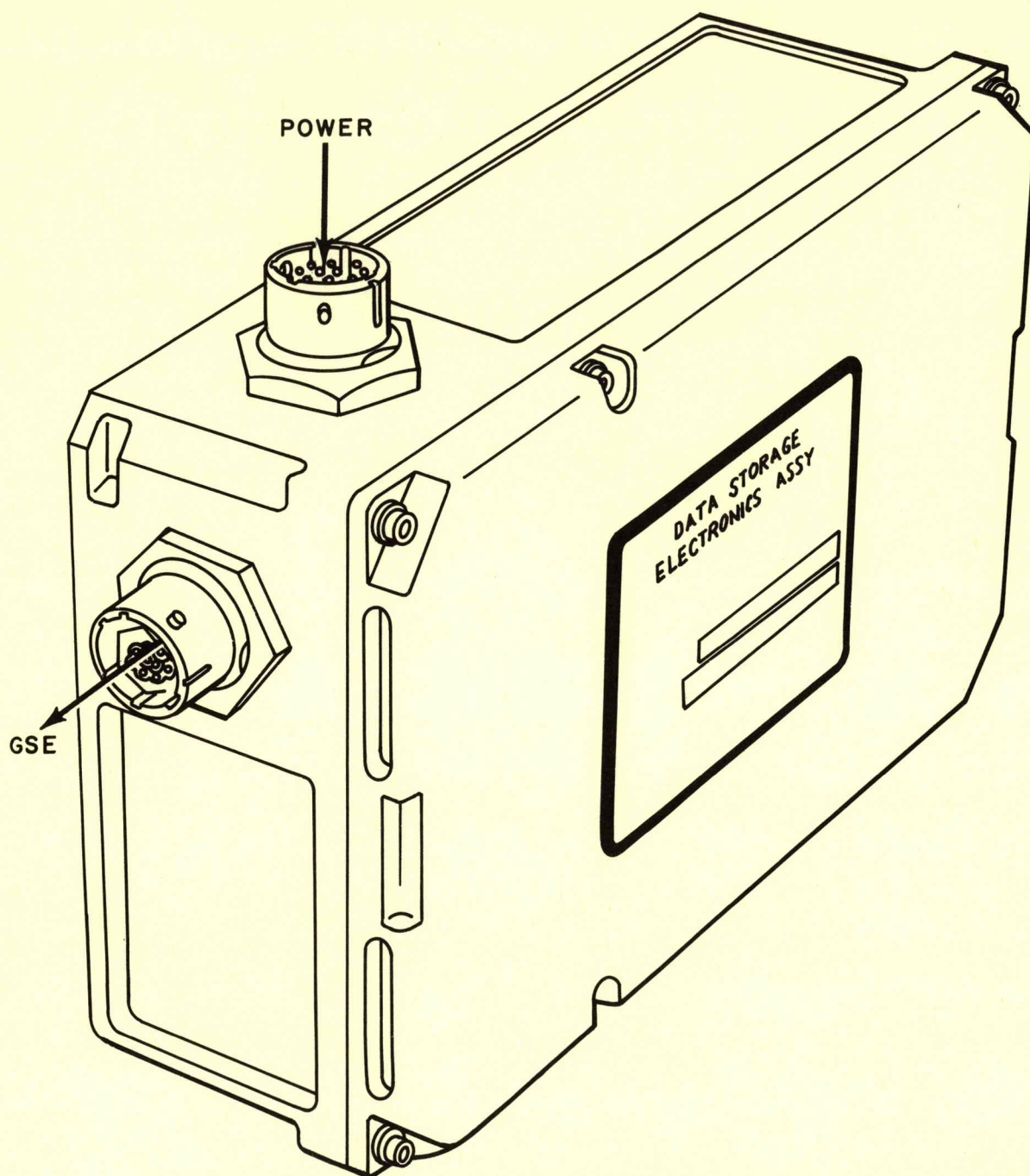
Setting the VOX switch to ICS results in a continuous key for the recorder. When operating in this mode the recorder motion is manually controlled with the Tape switch.

During the final phase of the mission the Commander will transfer the DSEA to the CSM for subsequent return to earth.

Date: February 1968

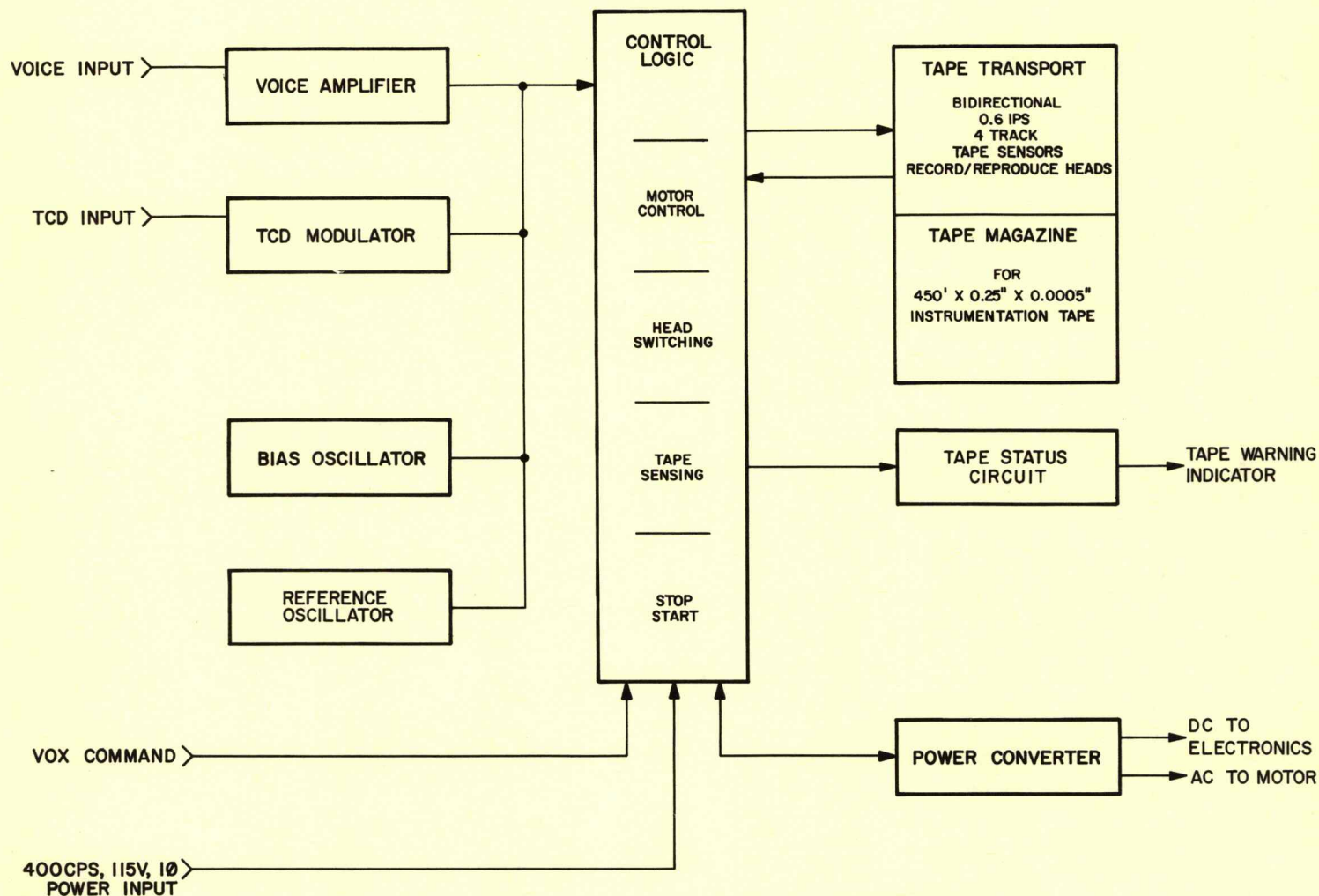
Page 4-3

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DSEA

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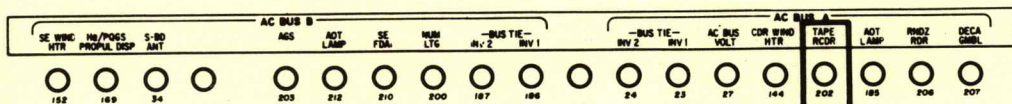


DSEA FUNCTIONAL BLOCK DIAGRAM

T30609-7.2

Date: February 1968

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COMMANDER
UPPER SIDE
CONSOLE
(PANEL XI)

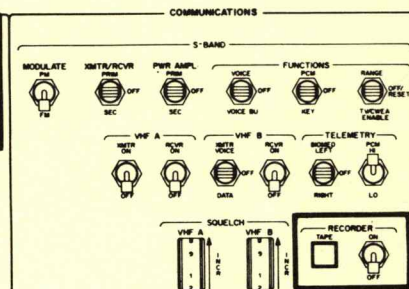
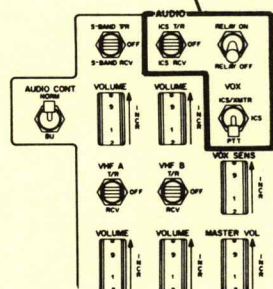
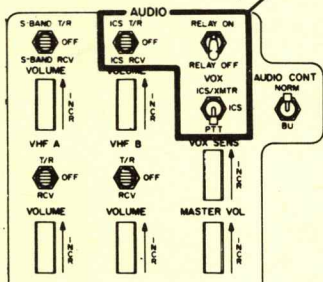
COMMANDER
LOWER SIDE
CONSOLE
(PANEL VIII)

LM PILOT
LOWER SIDE
CONSOLE
(PANEL XII)

TTCA

PUSH TO TALK
SWITCH
ATTITUDE CONTROL
ASSEMBLY

DSEA CONTROLS AND DISPLAY

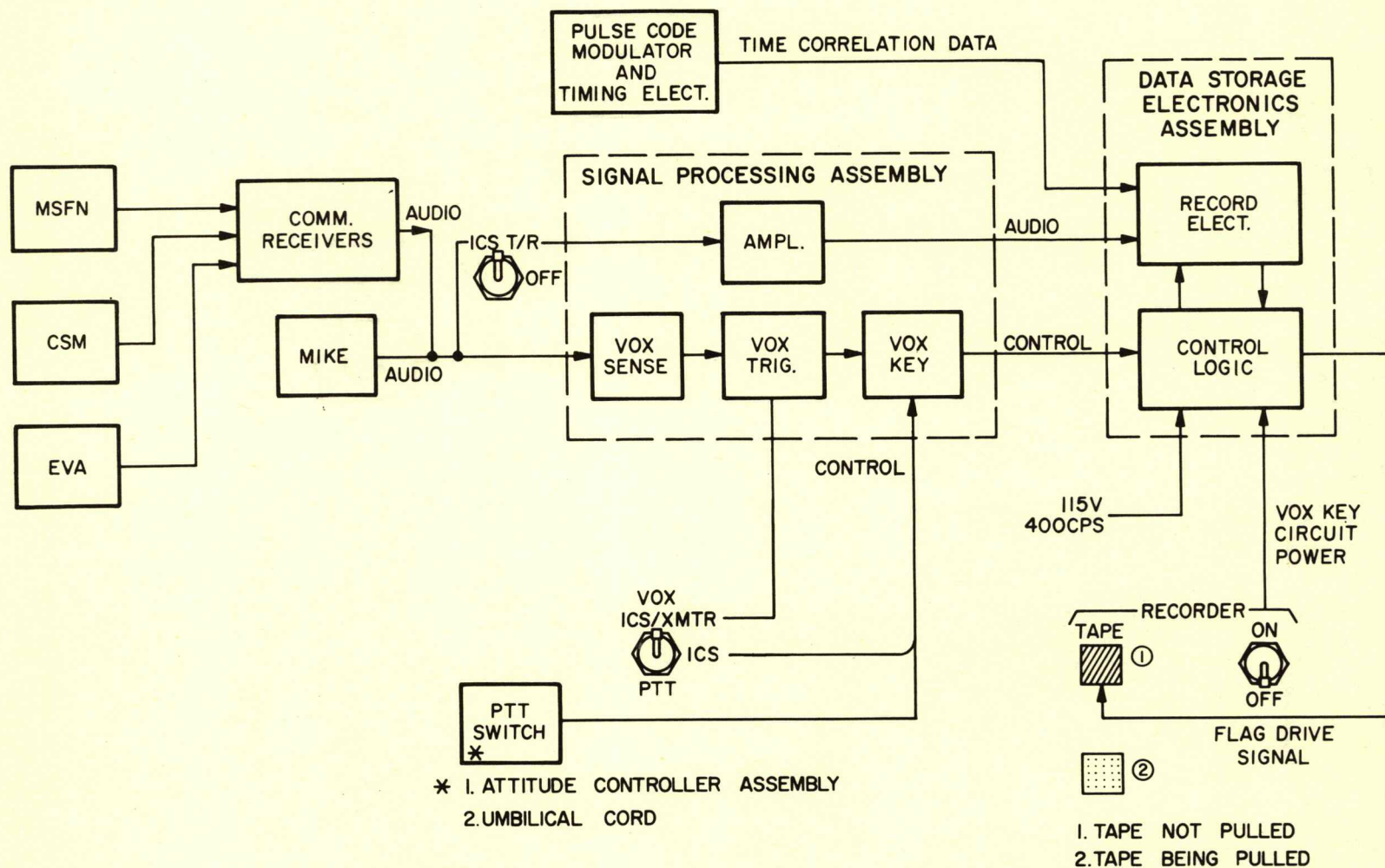


T30615-25.2

Date: April 1968

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Page 4-7



DSEA INPUTS AND CONTROLS

T30609-93.3

CHAPTER 5

CAUTION AND WARNING ELECTRONICS ASSEMBLY (CWEA)

A. CWEA

The inputs for the Caution and Warning Electronics Assembly will be from the Signal Conditioning Electronics Assembly and the Subsystem sensors which provide pre-conditioned outputs. The inputs will be of an Analog or Discrete form and will be indicative of the LM-3 subsystem status. These signals will be separated into Warning or Caution channels, depending upon the importance of the measurement.

1. Warning Malfunction - those that would affect crew safety and require immediate attention. The Warning lights are red indicators on Panel 1. On LM-3 there are 14 Warning indicators; the maximum capability is 20.
2. Caution Malfunction - those that do not immediately affect crew safety but could effect their safety or the mission if action were not taken. The Caution lights are amber indicators on Panel 2. On LM-3 there are 17 Caution indicators; the maximum capability is 20.

B. Block Diagram

The Caution and Warning Electronics Assembly Simplified Block Diagram, page 5-9, depicts only one channel of signal flow, for ease of discussion. The Caution or Warning channel would be of the same arrangement as shown. Specific malfunction logic drawings will appear at the end of this chapter.

Input signals will be routed to detector stages. The detector stage compares the input signal with a reference developed within the CWEA. The detectors, page 5-9, are divided into 3 types: Analog, Discrete and TCA. The Analog and Discrete detectors apply to the type of input signal. The Thrust Chamber Assembly (TCA) Detector refers to the Reaction Control Subsystem commands and jet responses, see page 5-20.

The TCA Detectors monitor the RCS for 3 types of malfunctions: 7 minimum impulse commands of <80 msec and no response, a counter circuit detects the 7 commands; 1 command of >80 msec and no response, detected in the Pulse Width Discriminator (PWD); and, opposing jets on.

An output from any one of the three types of detectors would indicate an out of tolerance condition and would be in the form of a Logic One. The Logic One will be routed to a Control Logic network. In most cases the control logic network is an "And Gate". The "And Gate" must have all of the inputs present to produce an output Logic One Signal. A typical two input "And Gate" would be as follows: One input from the detector and the second input from an enable/inhibit control. The presence of the detectors Logic One and the enable Logic One would allow the "And Gate" to produce an output.

The Control Logic output will go to a relay or relay driver to energize a light or flag, indicating a malfunction. The indications are separated as follows:

1. TCA flags - On Panel 2, page 5-7, eight flags indicate the status of the RCS jets. Gray - On, Red and White Stripe - Off, and Red - Malfunction.
2. Warning lights - Red lights on Panel 1, page 5-6
3. Caution lights - Amber lights on Panel 2, page 5-7
4. Component Caution lights - Amber lights on Panel 2.

H₂O separator, CO₂ partial pressure, Glycol pump, and Suit Fan. These lights are provided as trouble shooting aids due to the fact that all of these malfunctions will energize the ECS Caution light, see page 5-7.

In addition to energizing the indicators, the relay driver output will go to the Master Alarm multivibrator stage as a set pulse. The Master Alarm multivibrator stage will energize both Master Alarm lights on Panel 1 and Panel 2, and the 3KC tone generator.

C. Master Alarm Circuitry

The Master Alarm multivibrator and relay driver stages are shown on page 5-12. The stage is a majority voting network made up of 3 parallel circuits which contain a multivibrator, relay driver and relay. An input signal from either a Caution or Warning malfunction relay circuit would set the multivibrator and energize relays K1, K2 and K3. Contact K1B, normally closed, would open sending an Open Logic signal, GL4069 Master Alarm On, indication to the PCM. Contacts K1A, K2A and B and K3A and B close providing a path for ground, N2 is DC ground, to light both Master Alarm lights and turn on the 3KC tone generator.

Date: February 1968

Page 5-2

In the event that one of the relay circuits were to fail, the two remaining relay circuits would be sufficient to complete the path for ground.

Example: Relay K3 fails open. Relay contacts K1A and K2A would provide a path for ground.

Relay K3 fails closed. Relay contacts K3A and K3B are closed but no path for ground is provided until K1 or K2 is energized.

The 3KC tone is hard wired directly, via the umbilicals, to the headsets of both crew members; the signal does not go through the Communications Subsystem.

To remove the 3KC tone and turn off both Master Alarm lights, push in either of the Master Alarm lights. This resets the Master Alarm multivibrator stages and de-energizes K1, K2 and K3.

D. CWEA Power Supply

1. DC to DC Converter

The DC to DC Converter converts the 28 VDC from the LM Pilot's DC Bus to an AC voltage then back to a series of DC voltages. This is done to isolate the CWEA circuitry from the DC Bus.

2. Auto Reset

When the CWEA is initially turned on the Automatic Reset circuit sends a reset pulse to all of the multivibrators in the Caution and Warning circuits to allow a malfunction that is present prior to initial turn on, to energize an indicator.

3. P/S Failure Detector

The Power Supply Failure Detector monitors the -3V DC, +4V DC, 9V DC, and +23V DC outputs, see page 5-12. If all of the power supply voltages are present K5, K6 and K7 are energized. A malfunction would de-energize K5, K6 and K7. Contact K6B0 opens sending an open logic signal, GL4054 C&W Fail, to the PCM. Contact K7BC closes energizing the C/W Pwr caution light on Panel 2. (Note: the normal de-energized position of K7 is K7BC closed. Prior to applying power to the CWEA K7BC is closed and if the Annun/Dock/Compnt circuit breaker is in, the C&W Pwr caution light will be on. When power is applied the light will go out.)

Date: April 1968

Page 5-3

De-energizing K5, K6 and K7 will cause contacts K5AC, K5BC, K6AC and K7AC to close; and K5B0 to open. This provides a path for ground to both Master Alarm lights and the 3KC tone generator. Depressing the Master Alarm lights will not reset the Master Alarm lights and the 3KC tone for this malfunction. The Master Alarm circuit breaker, Panel 16, must be pulled to turn off the lights and tone generator.

E. Lamp/Tone Test Circuit, see page 5-10

A rotary select switch, located on Panel 3, is provided to test all of the Caution and Warning lights. By rotating the switch through its positions, ground is applied to the lights. Only the lights are checked at this time; not the Caution and Warning circuitry. The Master Alarm reset capability is not present during this test. The crew does not carry replacement lights nor the replacement tool. Knowledge of a disabled light informs the crew to closely monitor the meters, or rely on the MSFN to notify them in the event of a detected malfunction in the disabled lights logic circuitry.

F. Annun/Comp Lighting, see page 5-11

Power from the Annun/Dock/Compnt circuit breakers, redundant EPS circuit breakers (one on Panel 11 one on Panel 16), is applied to 28V/6V DC converter. A 6.4KC sync signal from the Timing Electronics, page 3-10, maintains frequency stability in the conversion stage. The voltage is applied to the Annun/Comp Dimmer Circuit. If the Annunicator Override switch, Panel 5, is in the Off position, the Annun/Numeric control switch, Panel 5, can control the voltage applied to the Caution and Warning lights from 2 VDC to 5 VDC. In the On position, the maximum voltage is applied to the lights. The Master Alarm and C&W Pwr Fail lights are not dimmed.

G. Caution and Warning Logic Circuits

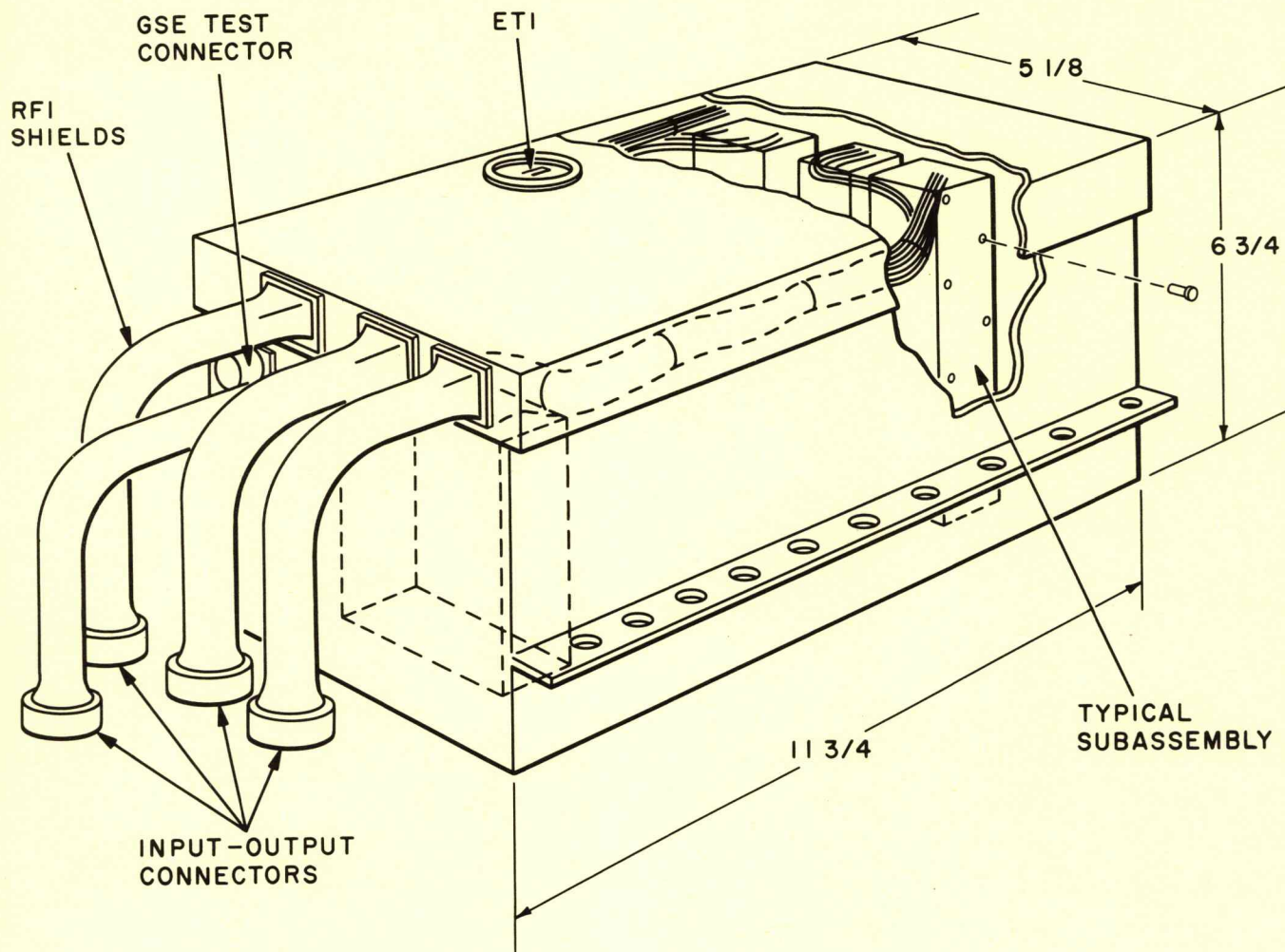
Logic circuits for each of the Caution and Warning lights are present at the end of this chapter. As an aid, Table 5-1, Measurement Identification, is provided to explain the code used in the measurement numbers.

With each logic diagram a table is present indicating measurement, number, malfunction and check or action to be taken.

Date: February 1968

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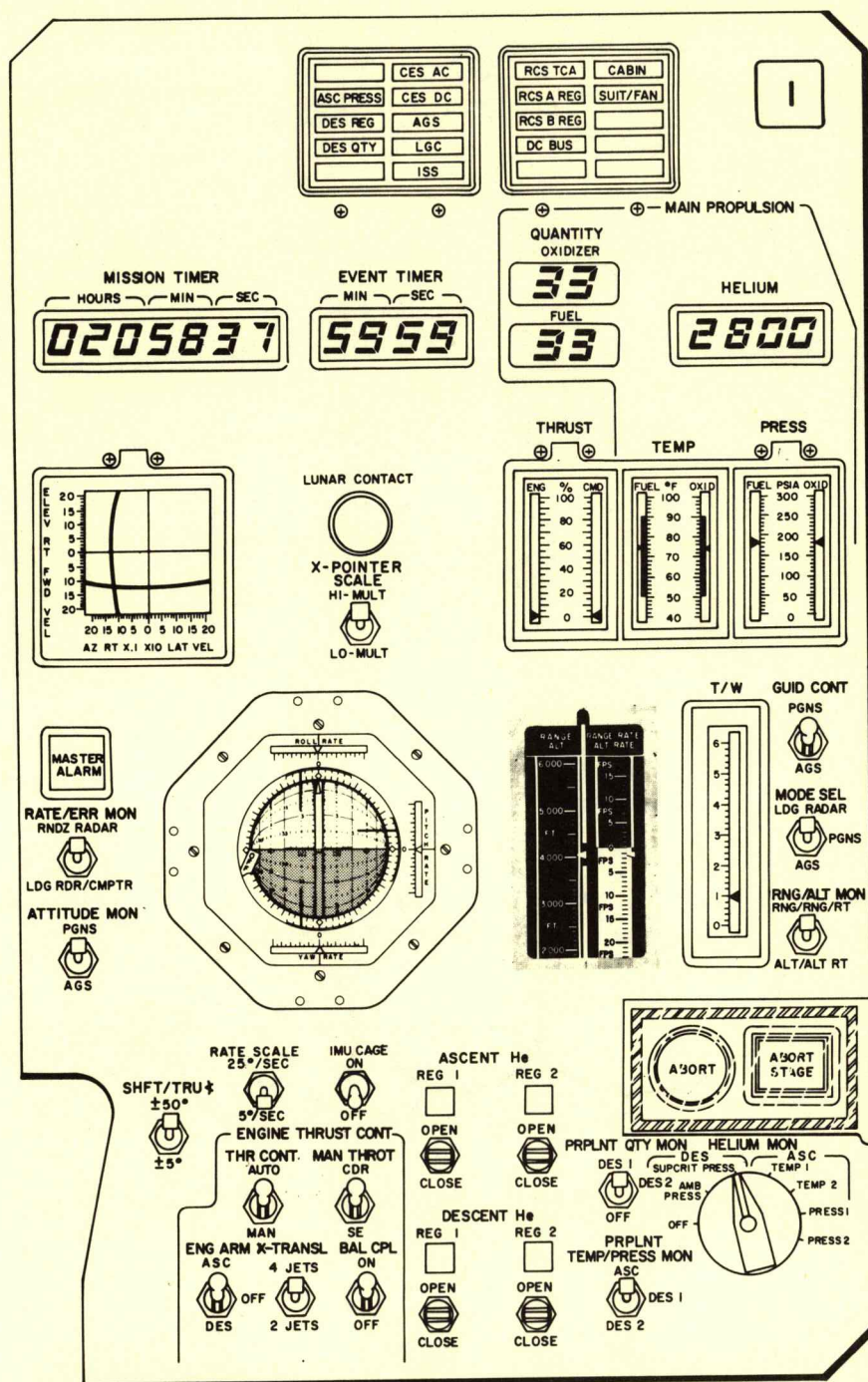
Page 5-5



CWEA CONFIGURATION

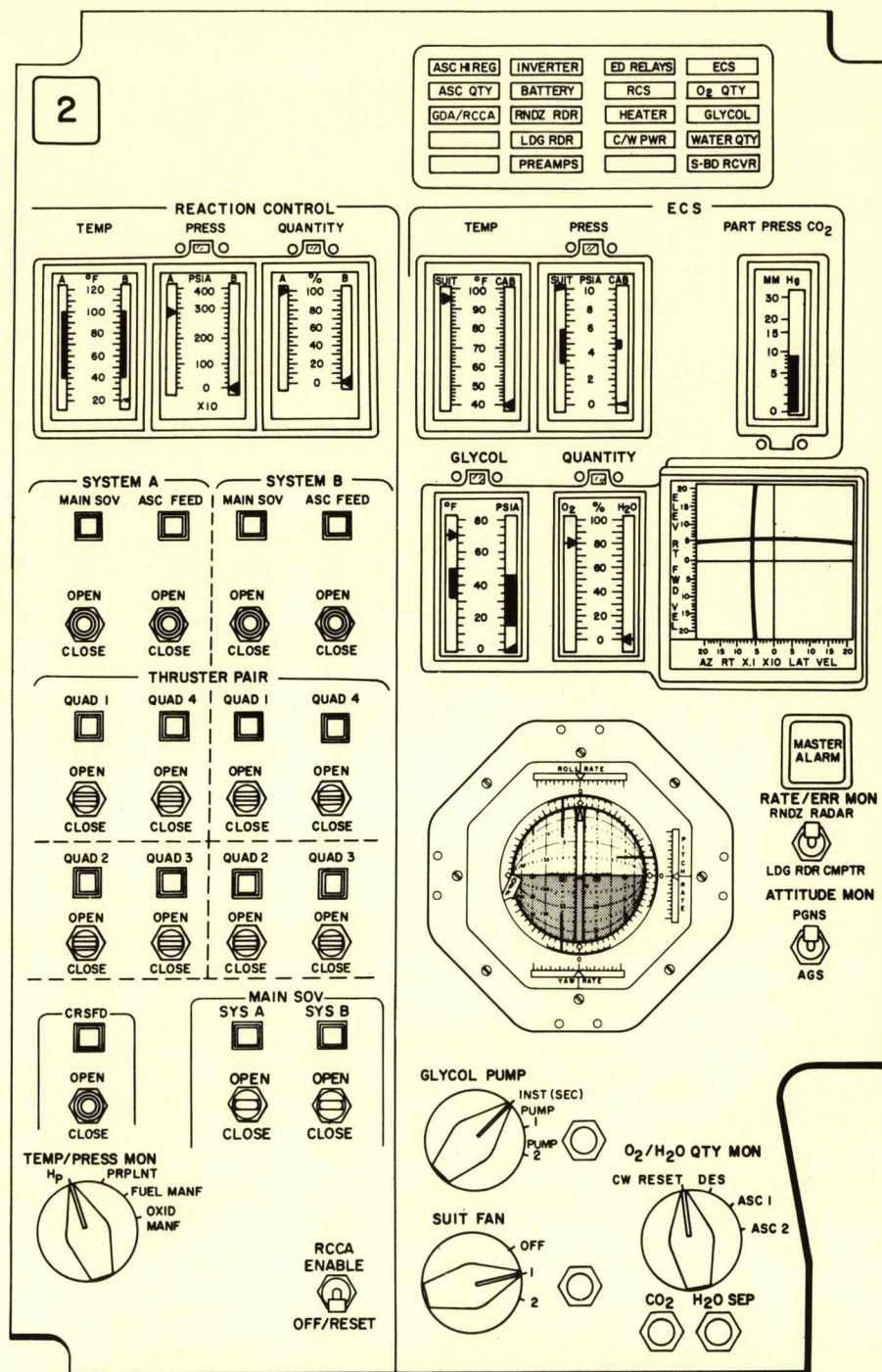
T30609-121.1

LM-3



PANEL I
LM3

T30900-155.3



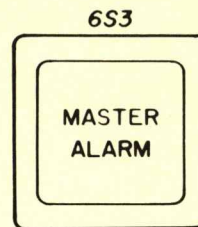
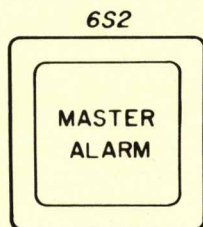
PANEL 2
LM3

T30900-154.3

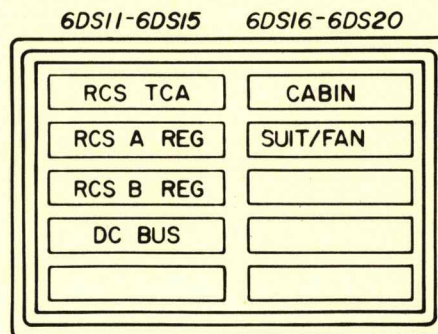
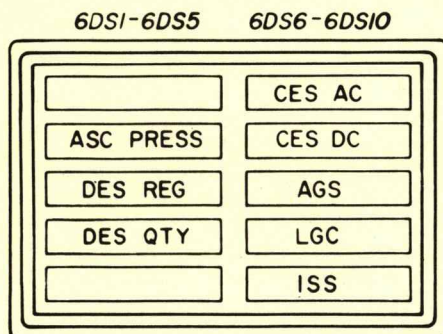
Date: February 1968

Page 5-7

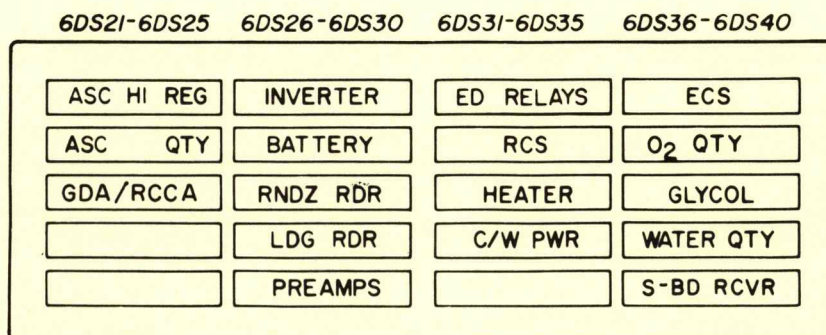
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MASTER ALARM LIGHTS (PANELS I AND II)



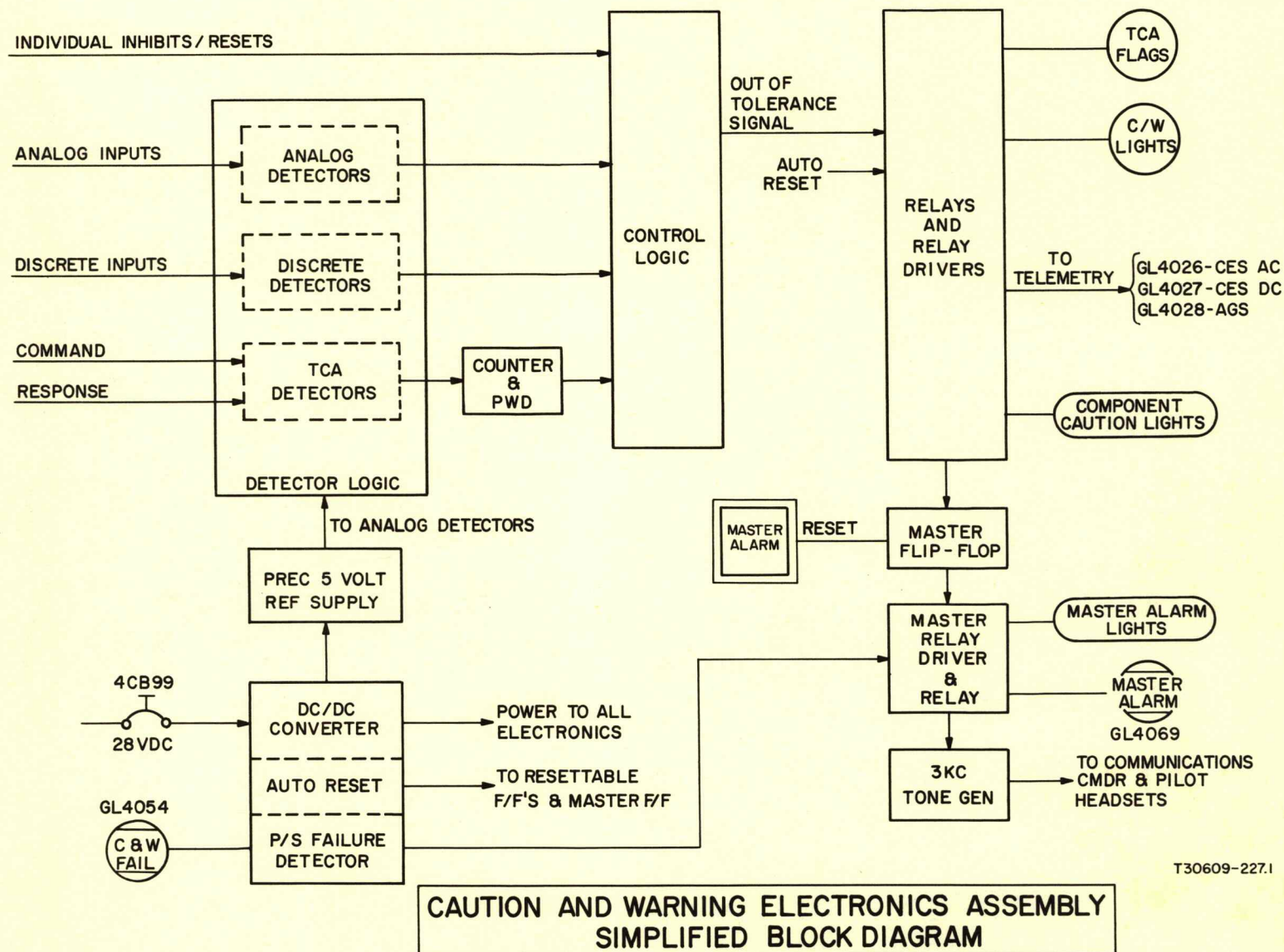
WARNING LIGHTS (PANEL I)



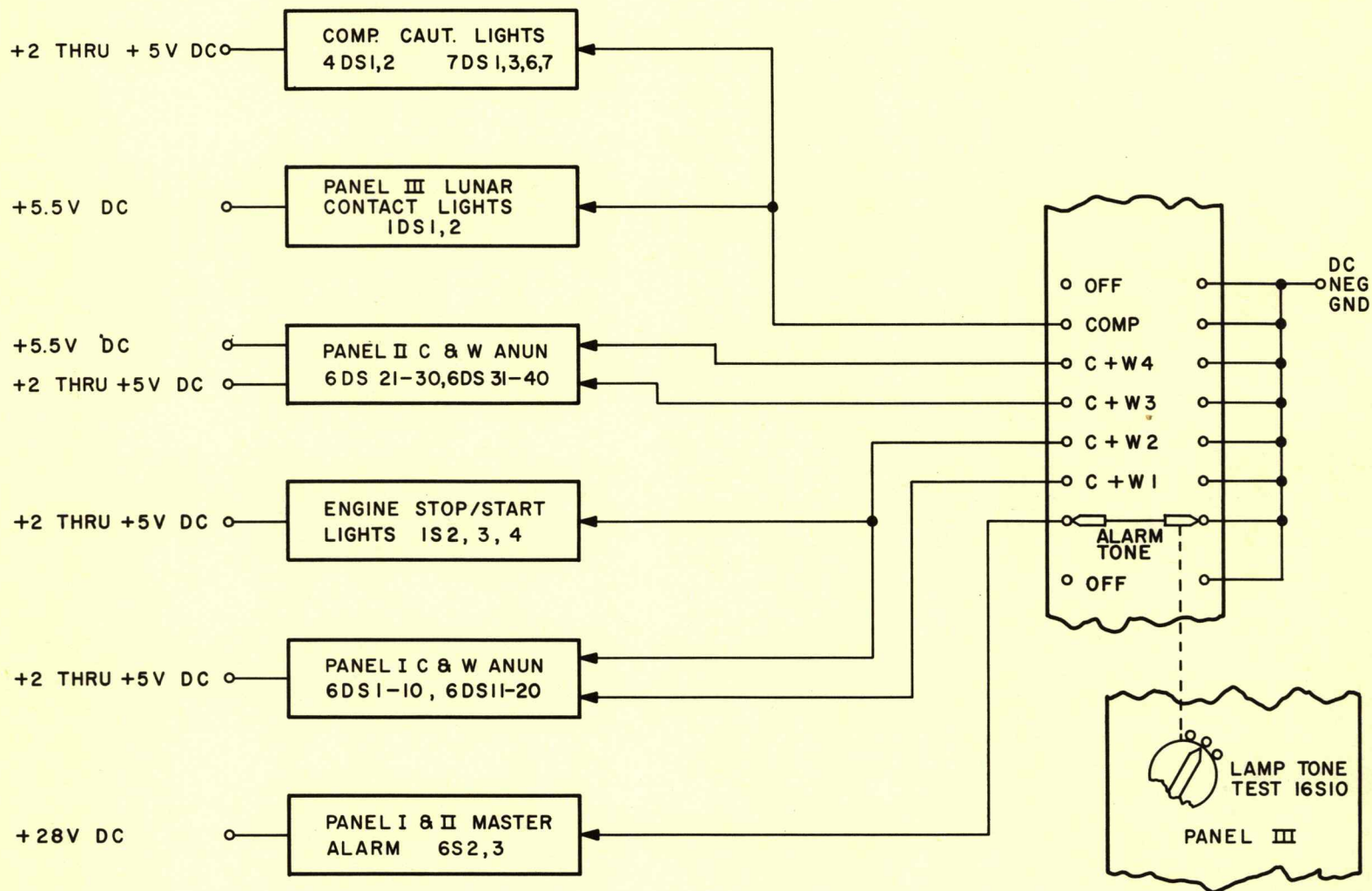
CAUTION LIGHTS (PANEL II)

CAUTION AND WARNING DISPLAYS

T 30900-22.2

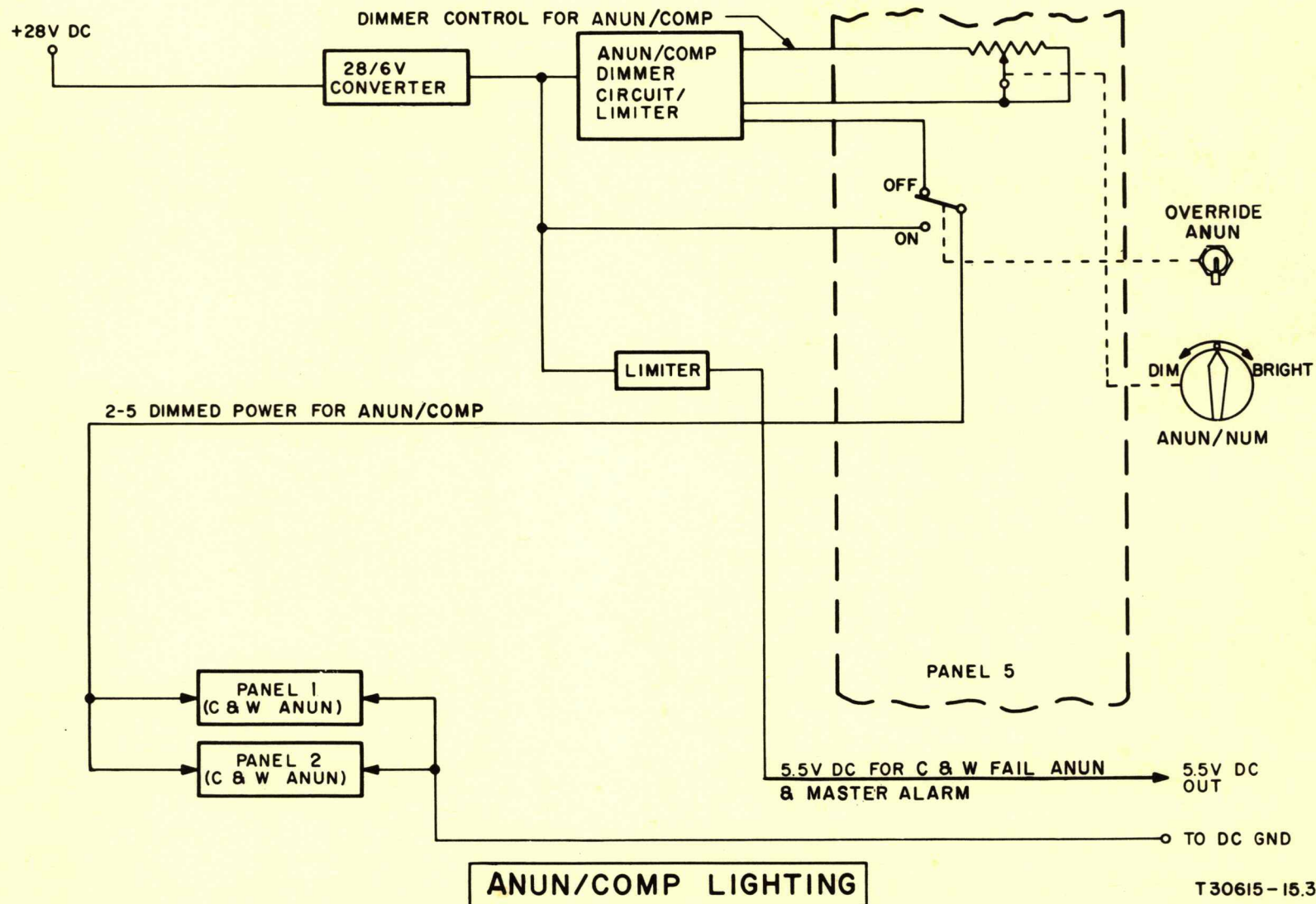


T30609-227.1



LAMP/TONE TEST CIRCUIT

T30900-39.1

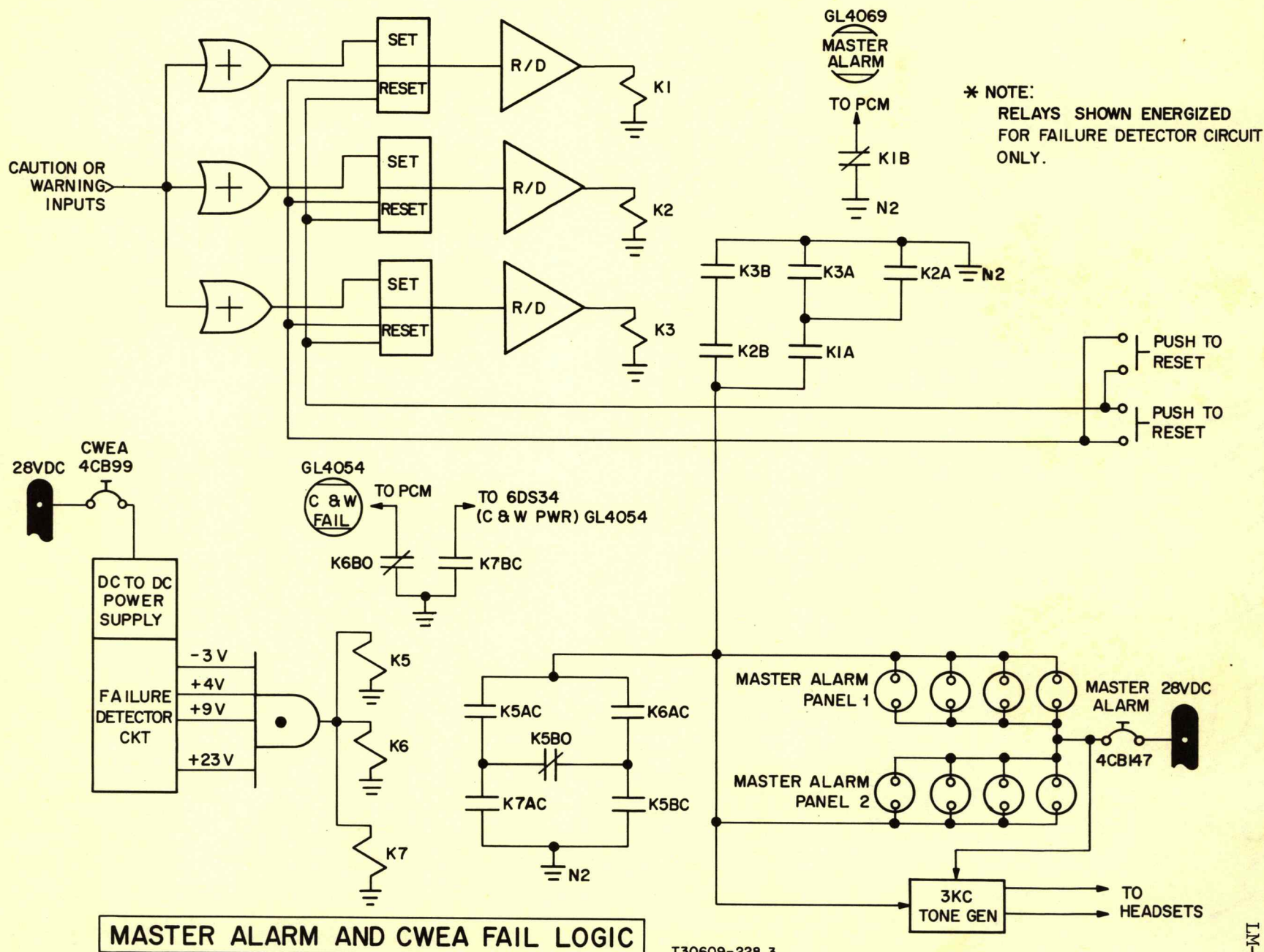


T30615-15.3

Date: August 1968

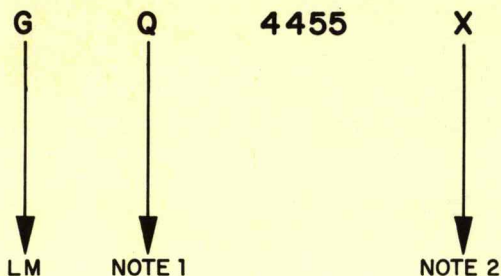
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Page 5-12



T30609-228.3

LM-3

NOTE 1

A = STRUCTURES
 B = THERMODYNAMICS
 C = ELECTRICAL PWR
 F = ENVIRONMENTAL CONTROL
 G = NAV. & GUIDANCE
 H = STAB & CONTROL (CES)
 I = STAB & CONTROL (AGS)
 L = INSTRUMENTATION
 M = MECHANICAL DESIGN
 N = RADAR
 P = PROP-ASCENT
 Q = PROP-DESCENT
 R = RCS
 S = EXPLOSIVE DEVICES
 T = COMMUNICATION

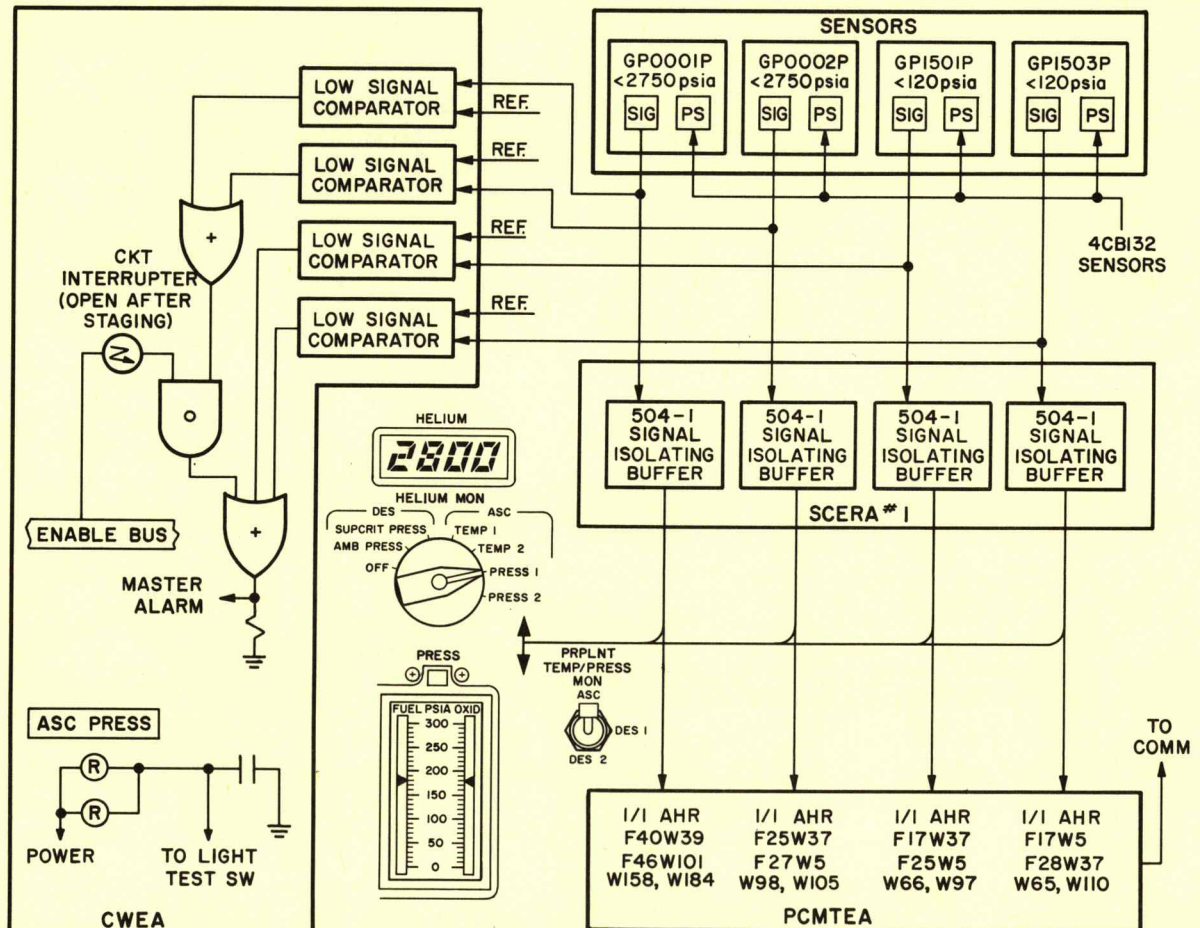
NOTE 2

A = ACCELERATION
 B = PHASE
 C = CURRENT
 D = VIBRATION
 E = POWER
 F = FREQ
 G = FORCE / MECH IMPEDANCE
 H = POSITION
 J = BIOMEDICAL
 K = RADIATION
 L = VELOCITY
 M = MASS
 N = RESISTANCE / CONTINUITY
 P = PRESSURE
 Q = QUANTITY
 R = RATE
 S = STRAIN
 T = TEMP
 U = COMBINATION
 V = VOLTAGE
 W = TIME
 X = SWITCH CLOSURE
 Y = ACOUSTICAL
 Z = PH- ACIDITY

| |
|----------------------------|
| MEASUREMENT IDENTIFICATION |
|----------------------------|

T30609-229.3

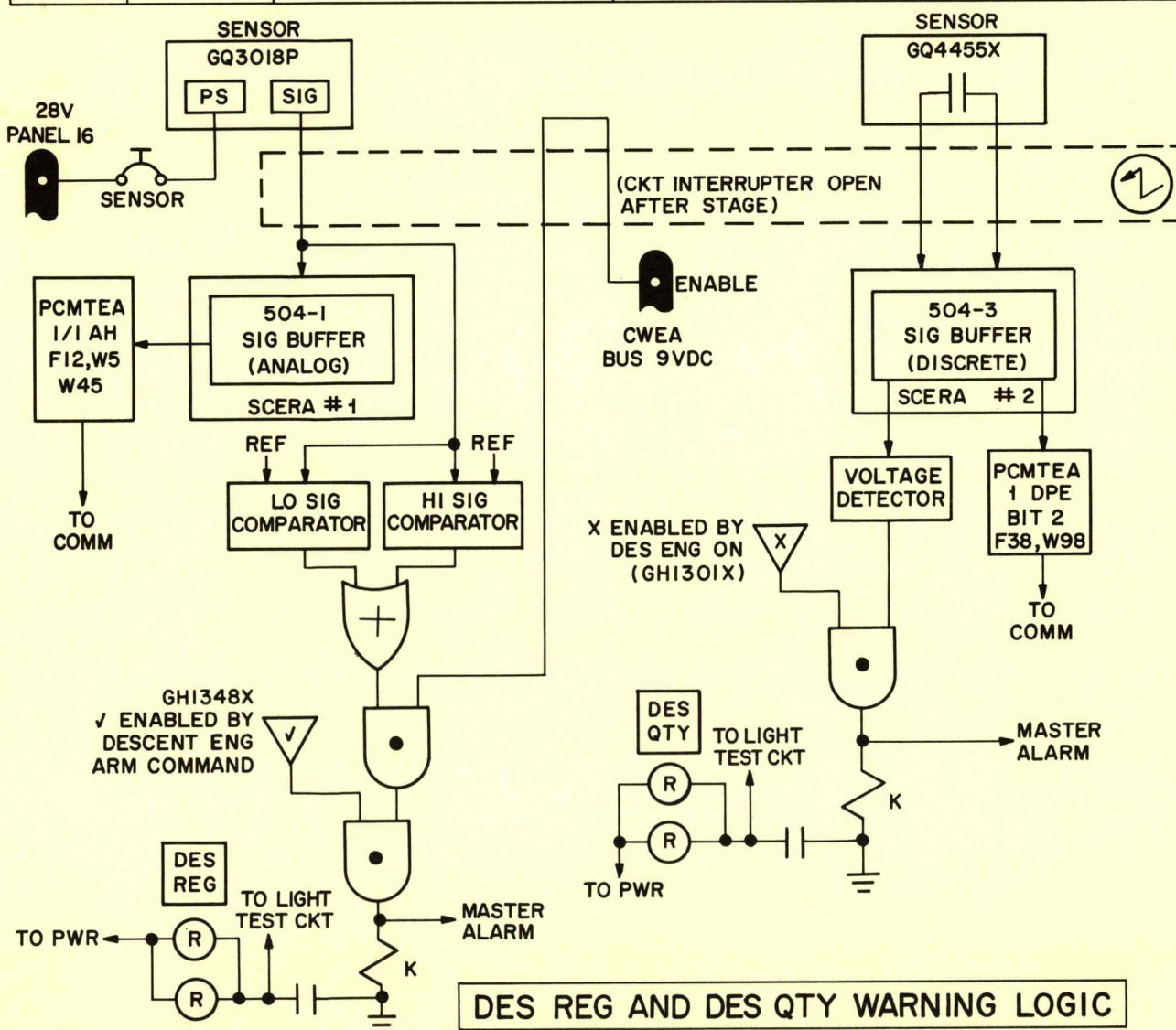
| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|---------------------|--------------------|---|--|
| ASC PRESS GL4022 | GP0001P | LO He PRESS (<2750psia) IN ASCENT TANK # 1 | PRIOR TO STAGING: PLACE HELIUM MON SW (PANEL 1) IN ASC-PRESS 1. CHECK HELIUM PRESSURE INDICATOR FOR He PRESSURE (>2750psia NORMAL) AFTER STAGING: MEASUREMENT INHIBITED TO LIGHT. |
| | GP0002P | LO He PRESS (<2750psia) IN ASCENT TANK #2 | PRIOR TO STAGING: SAME AS ABOVE-SELECT ASC-PRESS 2. AFTER STAGING: MEASUREMENT INHIBITED TO LIGHT. |
| | GPI501P | LO FUEL PRESS (<120 psia) AT ISOLATION VALVE INLET. | PLACE PRPLNT TEMP/PRESS MON SW IN ASC. CHECK FUEL PRESS METER FOR FUEL PRESSURE. |
| | GPI503P | LO OXIDIZER PRESS (<120psia) AT OXIDIZER ISOLATION VALVE INLET. | SAME AS GPI501P ABOVE -CHECK OXIDIZER PRESS FOR OXIDIZER PRESSURE. |



ASC PRESS WARNING LOGIC

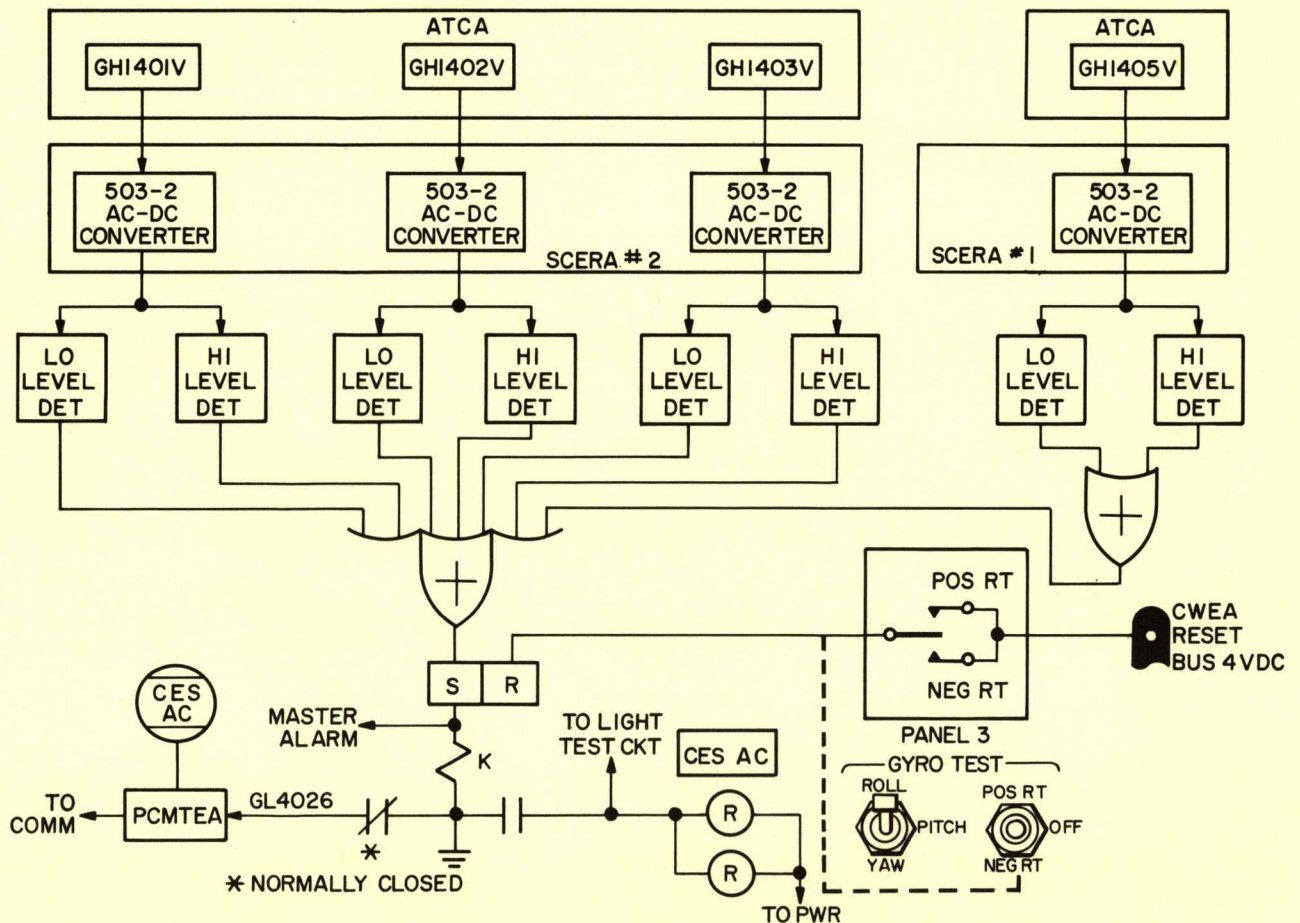
T30609-222.2

| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|--|---|
| DES REG GL4023 | GQ3018P | HI (>260 PSIA) OR LO (<220 PSIA) FROM SENSOR IN DESCENT H ₀ LINE DOWNSTREAM OF THE REGULATOR. | CLOSE DESCENT H ₀ REG 1 SWITCH, ON PANEL 1. REG 1 FLAG WILL TURN TO BARBER POLE. OPEN DESCENT H ₀ REG 2 SWITCH. REG 2 FLAG WILL TURN TO GRAY. IF WARNING LIGHT GOES OUT CONTINUE MISSION. |
| DES QTY GL4024 | GQ4455X | DESCENT PROPELLENT LO LEVEL. (120 SEC OF BURN TIME REMAINS @ 24 % THRUST) | ON A LUNAR MISSION: IF TIME TO LUNAR LANDING IS < 2 MIN CONTINUE MISSION, MONITOR FUEL CONSUMPTION. IF TIME TO LUNAR LANDING IS > 2 MIN, PLACE PRPLNT QTY MON SWITCH, PANEL 1, IN DES 1 AND MONITOR OXIDIZER QUANTITY AND FUEL QUANTITY INDICATORS. REPEAT FOR DES 2 (2 MIN \pm 5%) |



T30609-230.2

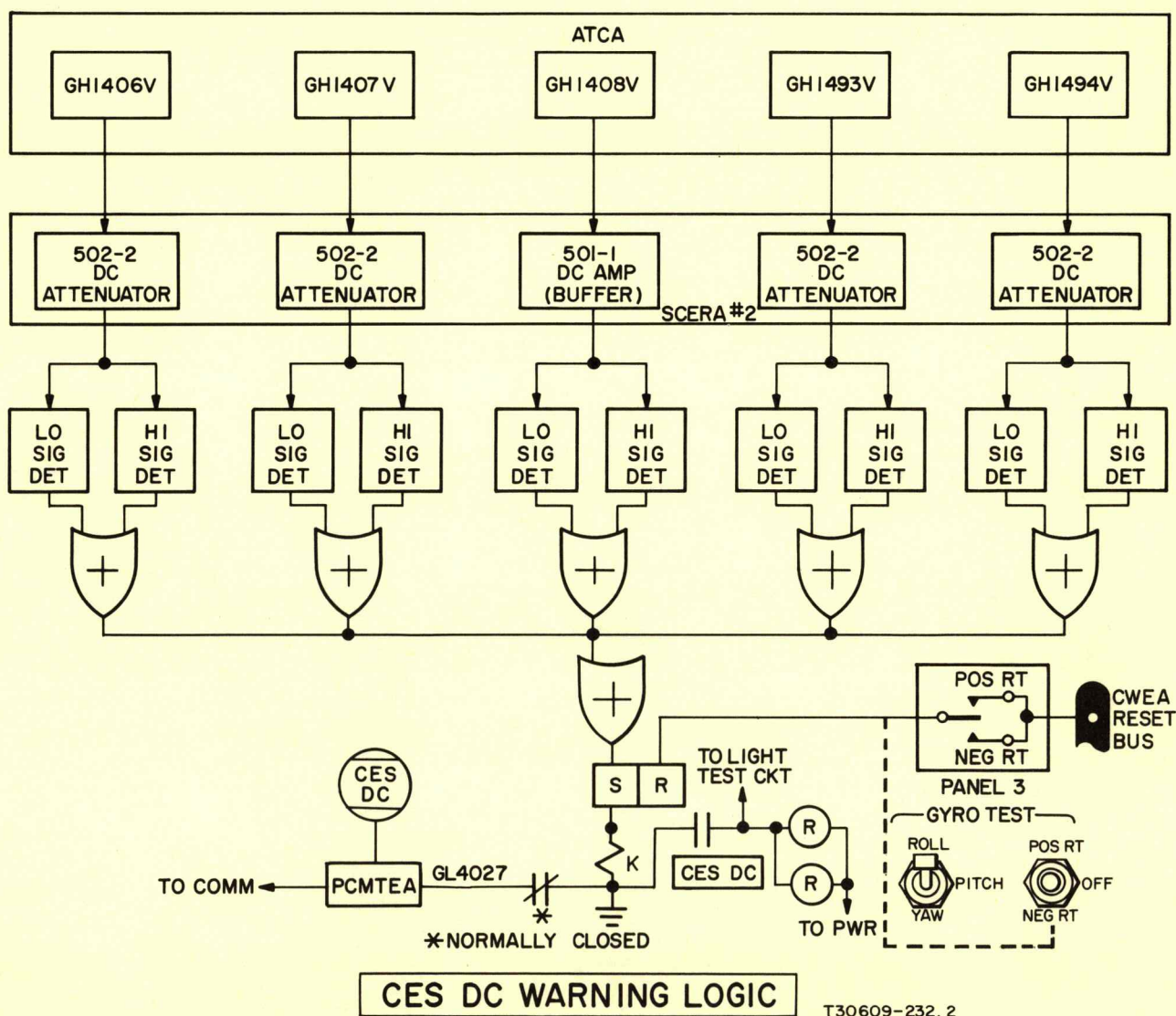
| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|-------------------------------|--|--|
| CES AC GL4026 | GHI401V GHI402V GHI403V | 26V, 800 \sim , 3 \emptyset POWER SUPPLY PHASE A <23V OR >29V PHASE B <23V OR >29V PHASE C <23V OR >29V (MOTOR SUPPLY) | IF 26V FAILS: RATE GYROS OUT; HAND CONTROLLERS IN AGS AND MANUAL MODES OUT; AGS MODE OF ATTITUDE CONTROL OUT. IF 26V IS OUT OF TOLERANCE: RATE GYROS PERFORMANCE DEGRADED; HAND CONTROLLERS DELIVER INCORRECT SCALED DATA; AGS MODE DEGRADED PERFORMANCE FOR ATT CONTROL. |
| | GHI405V | 28V, 800 \sim , 1 \emptyset POWER SUPPLY <26V OR >30V (PICK OFF COIL EXCITATION) | IF 28V FAILS: RATE GYROS OUT. IF 28V IS OUT OF TOLERANCE: DEGRADED PERFORMANCE IN AGS AND MANUAL MODE-INCORRECT FEEDBACK DATA. LIGHT RESET BY RATE GYRO TEST SW, PANEL 3, IN POS OR NEG RT. SELECT AGS MODE OF OPERATION AND CHECK ATT HOLD AND HAND CONTROLS. |



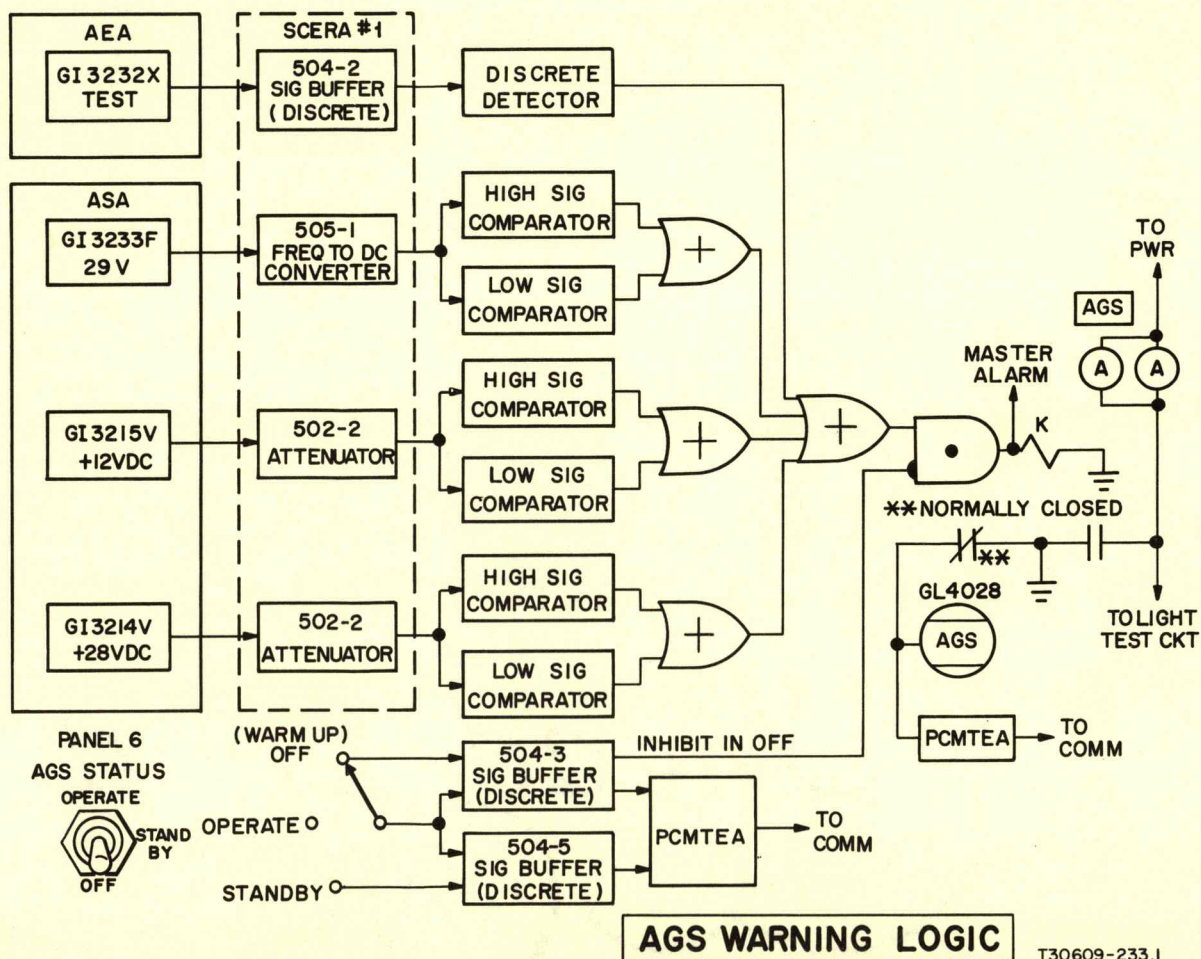
CES AC WARNING LOGIC

T30609-231.2

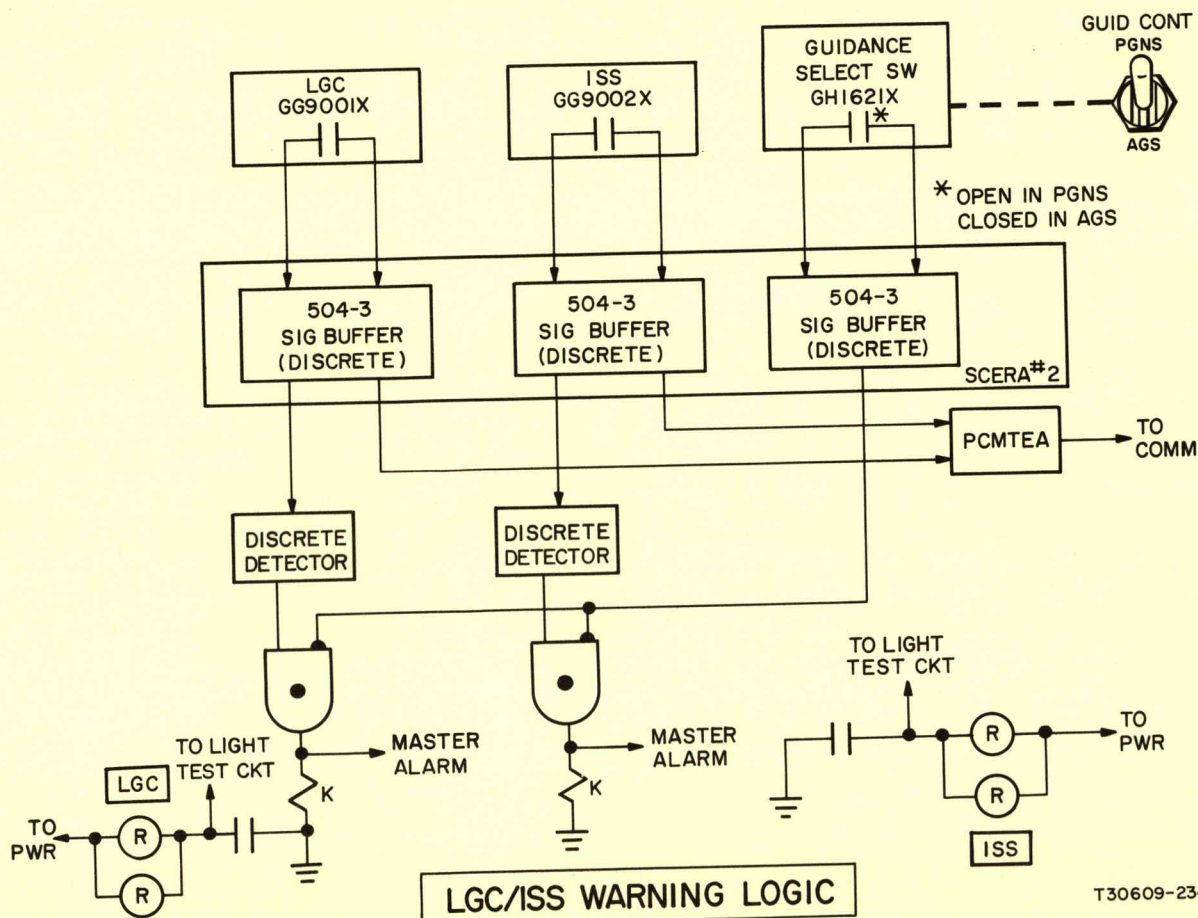
| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|---|---|---|
| CES DC GL4027 | GH1406V GH1407V GH1408V GH1493V GH1494V | ATCA DC POWER SUPPLIES +15V SUPPLY <14V OR >16V -15V SUPPLY <-14V OR >-16V +4.3V SUPPLY <3.8V OR >4.8V +6V SUPPLY <5.4V OR >6.6V -6V SUPPLY <-5.4V OR >-6.6V | IF ANY SUPPLY FAILS: AGS MODE OF OPERATION OUT. SUPPLY OUT OF TOLERANCE: DEGRADED AGS PERFORMANCE. LIGHT RESET BY RATE GYRO SW, PANEL 3, IN POS OR NEG RT POSITION. |



| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|---|---|
| AGS * | GI 3214V | +28V PWR SUPPLY $\leq 25.2V$ OR $> 30.8V$ | POSSIBLE LOSS OF PWR FROM DC BUS CKT BREAKER 4CB79 (PANEL 16), ASA. |
| | GI 3215V | +12V SUPPLY $\leq 10.8V$ OR $> 13.2V$ OR $150^{\circ}F \pm 5^{\circ}$ (RESETS AT $130^{\circ}F \pm 5^{\circ}$) | |
| | GI 3233F | 29V, 400 \sim PWR SUPPLY $\leq 385 \sim$ OR $> 415 \sim$ | |
| | GI 3232X | AEA TEST FAILURE (DEDA IS CONSTANTLY TESTING AEA) | |
| | | | INSERT CLEAR-412-READOUT INTO DEDA. IF READOUT IS 10000 THE TEST IS GOOD. *GROUND STATION MUST COMPARE PGNS & AGS INFO TO DETERMINE IF AGS IS OPERATIONAL. |



| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|---|---|
| LGC | GG9001X | OUT OF TOLERANCE VOLTAGE FROM ONE OF THE FOLLOWING SUPPLIES: +28VDC, +4VDC, +14V. | INHIBITED BY PLACING GUID CONT SWITCH, PANEL 1, IN AGS. |
| ISS | GG9002X | 1. FAILURE OF THE IMU, EXCESSIVE SERVO ERRORS OR FAILURE OF THE 3.2KC OR 800CPS PWR SUPPLIES. 2. FAILURE OF THE PIPA (PULSED INTEGRATING PENDULOUS ACCELEROMETER) MAIN ENGINE THRUSTING. 3. FAILURE OF THE IMU CDU. | INHIBITED BY PLACING GUID CONT SWITCH, PANEL 1, IN AGS |

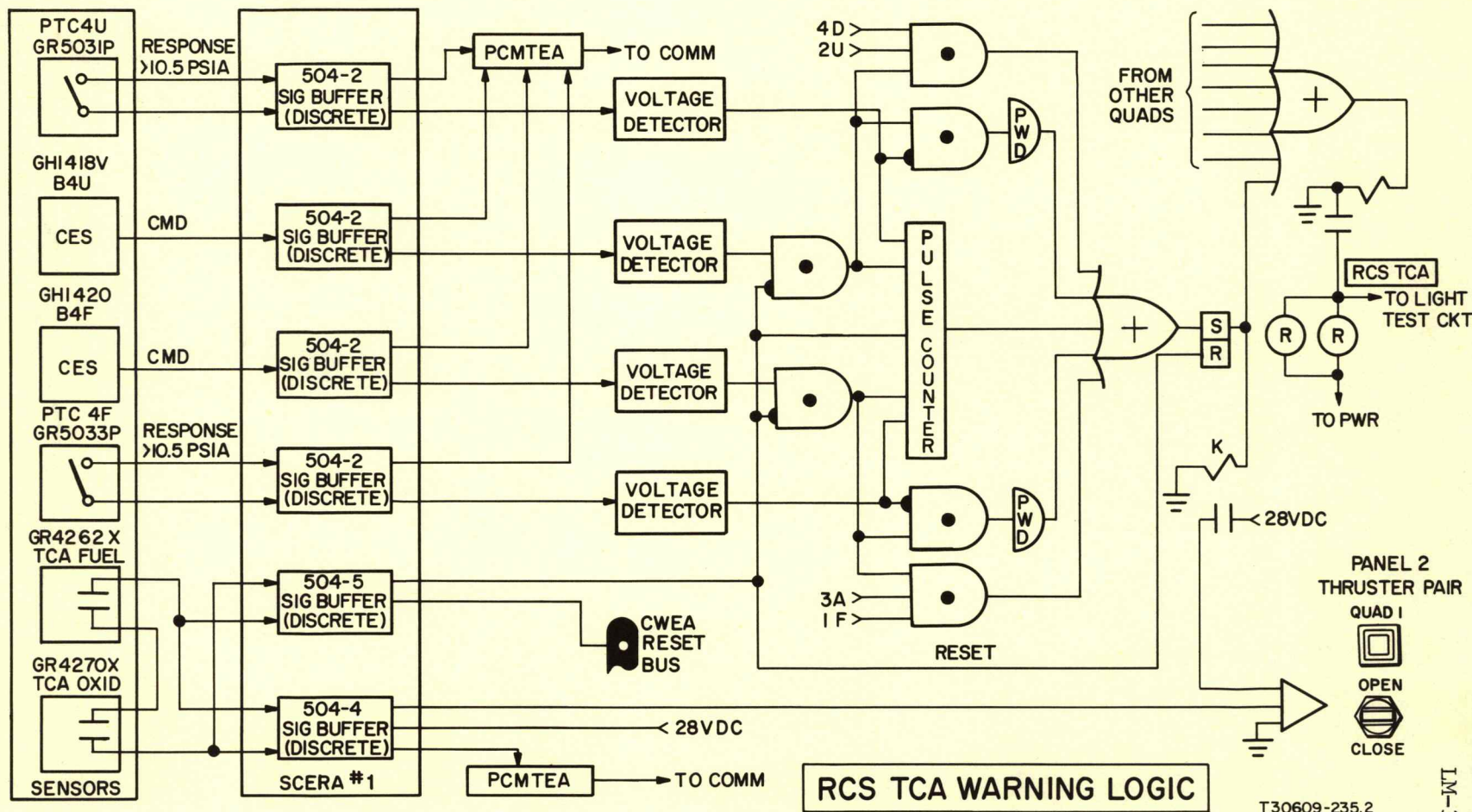


Date: August 1968

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Page 5-20

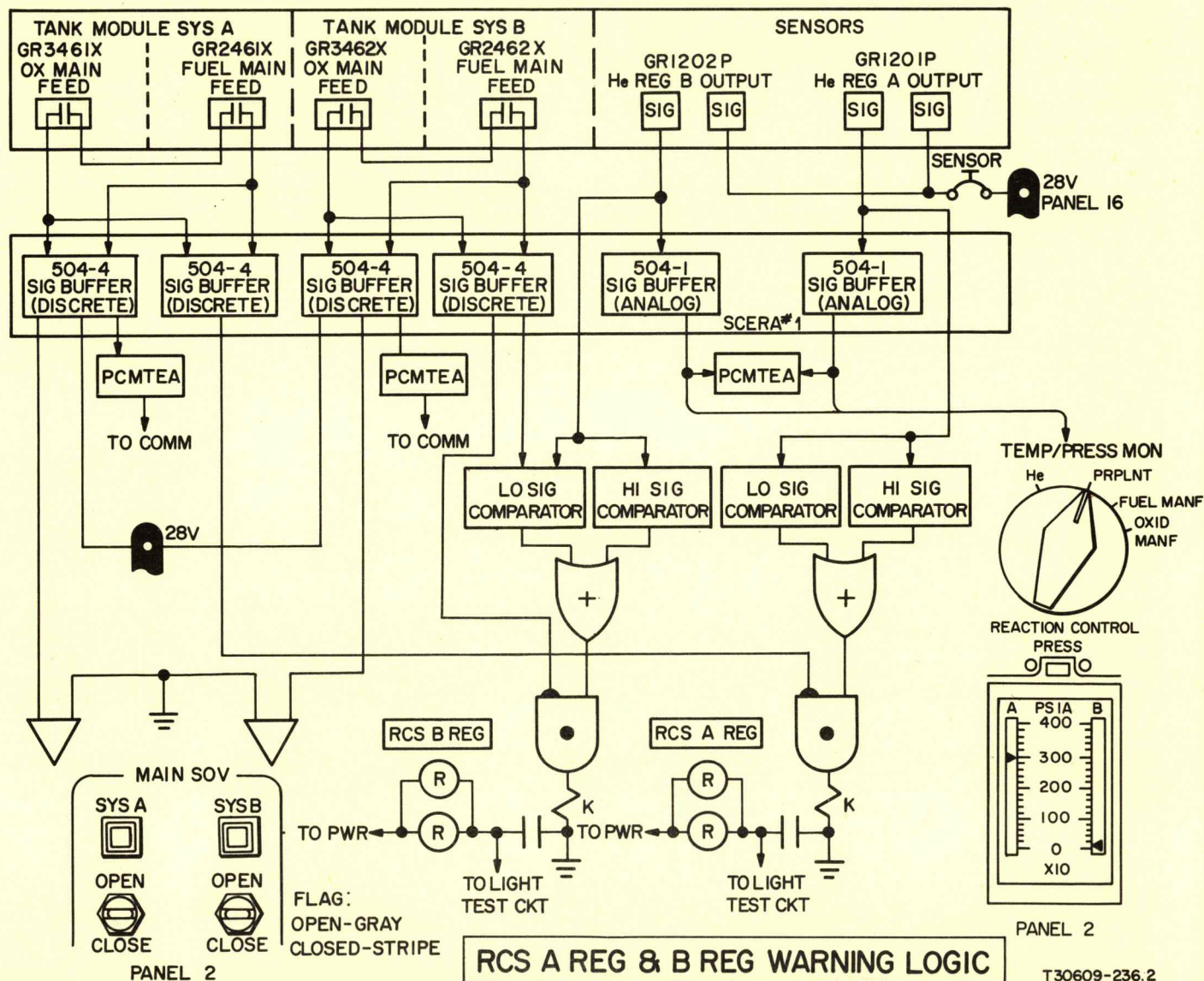
| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--|---|--|
| RCS TCA GL4031 | GHI418V THRU GHI433V GR5031P THRU GR5046P | ANY ONE OF THREE: 1. COMMAND OF $>80 \text{ MSEC} \pm 15 \text{ MSEC}$ AND NO RESPONSE. 2.7 COMMANDS, $<80 \text{ MSEC}$, AND NO RESPONSE. 3. OPPOSING JETS ON. | PANEL 2: CHECK THRUSTER PAIR QUAD STATUS FLAGS. GRAY - ON RED - MALFUNCTION BLACK & WHITE STRIPE - OFF CLOSE MALFUNCTIONING PAIR WITH THRUSTER PAIR VALVE SWITCH UNDER FLAG. |



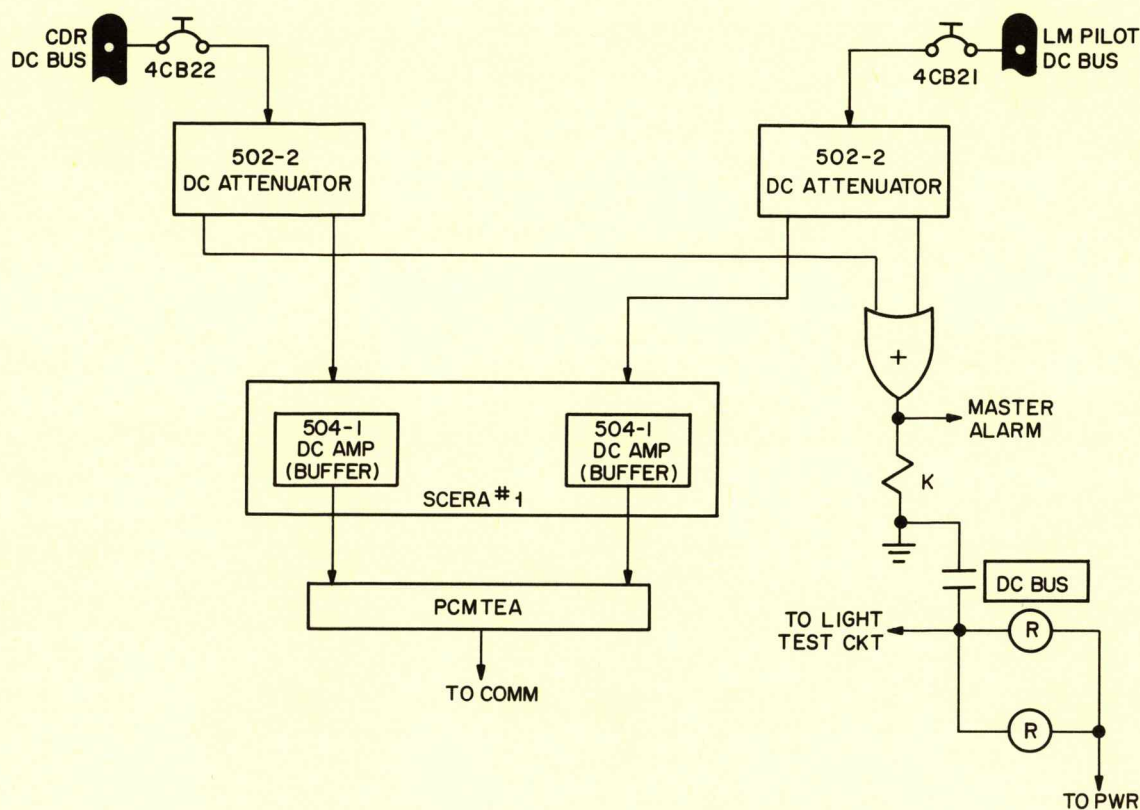
T30609-235.2

LM-3

| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|--|--|
| RCS A REG | GR1201P | HI (>205 PSIA) OR LO (<165 PSIA) He PRESSURE IN RCS SYSTEM A | PANEL 2: PLACE TEMP/PRESS MON SWITCH TO PRPLNT. MONITOR REACTION CONTROL PRESS METER "A" SIDE FOR PRESSURE INDICATION. IF OUT OF TOLERANCE CLOSE MAIN SOV SYS A SW. LIGHT RESET BY CLOSING MAIN SOV SYS A SW. |
| RCS B REG | GR1202P | SAME LIMITS AS SYSTEM A. | SAME LOGIC AS SYSTEM A - USE "B" SIDE OF METER AND MAIN SOV SYS B SWITCH. |



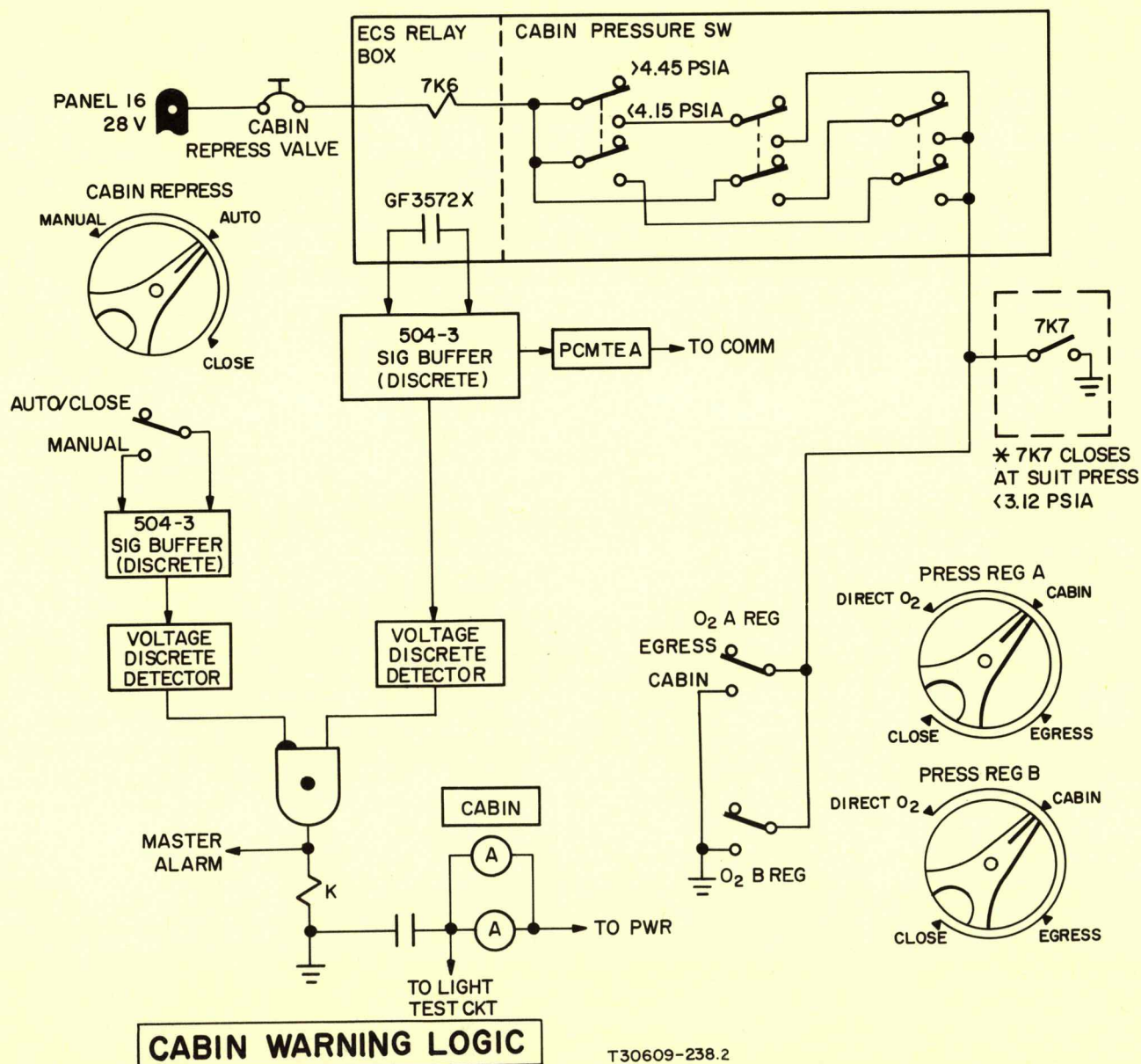
| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|----------------------|---|---|
| DC BUS | GC 0301V GC 0302V | COMMANDER'S DC BUS <26.5VDC LM PILOT'S DC BUS <26.5VDC | TO DETERMINE THE FAULTY BUS ROTATE THE POWER/TEMP MON. SWITCH FIRST TO CDR THEN TO LM PILOT. CHECK THE VOLTAGE ON THE ELECTRICAL POWER VOLTMETER, PANEL 14. |



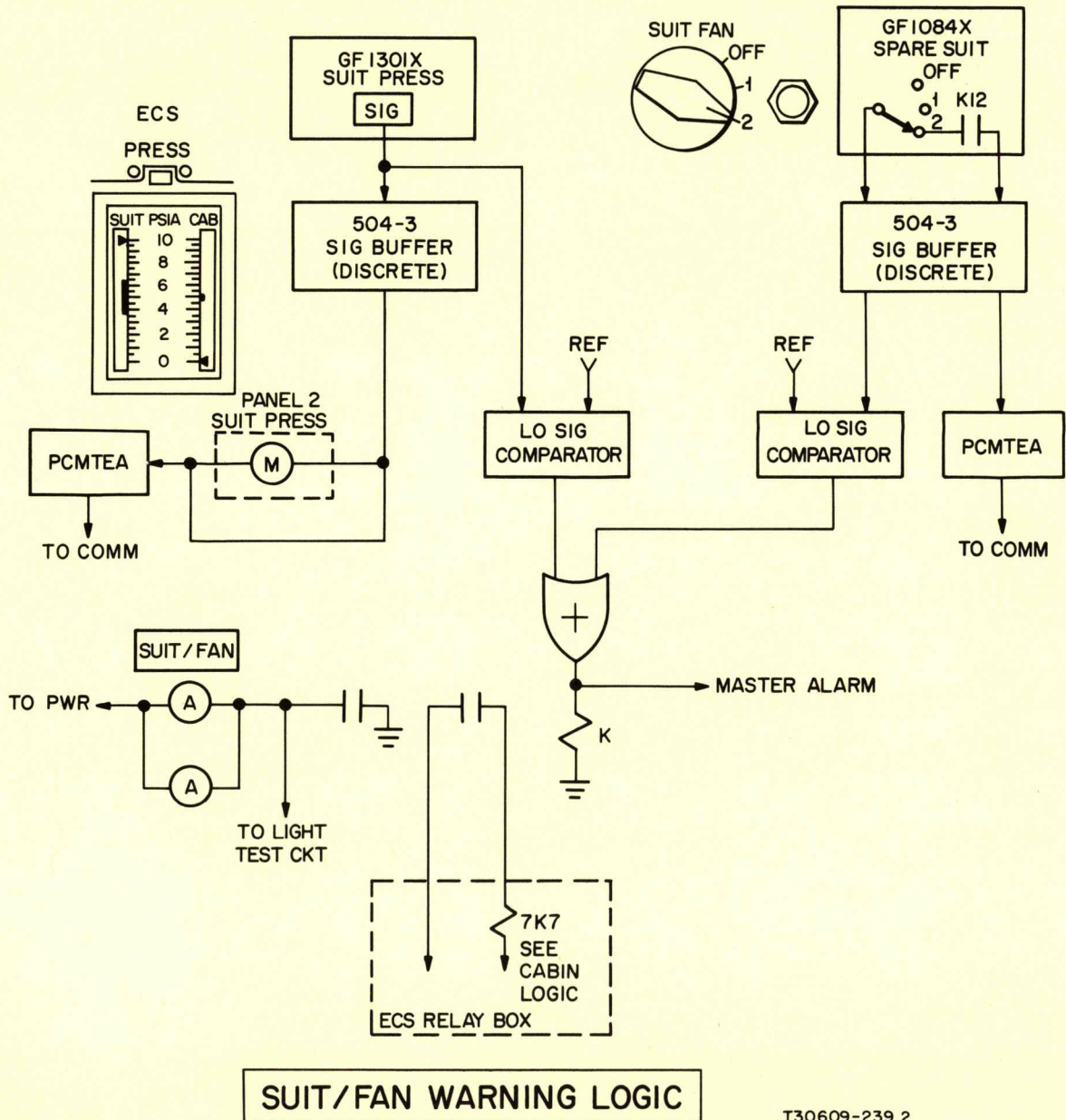
DC BUS WARNING LOGIC

T30609-237.1

| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|---|--|
| CABIN | GF3572X | CABIN PRESSURE <4.15 PSIA \pm .15 FROM CABIN PRESSURE SWITCH. (GF1301X) SUIT PRESSURE <3.12 PSIA, IF CABIN IS UNPRESSURIZED. | MONITOR ECS PRESS CAB METER FOR CABIN PRESSURE. INHIBITED WHEN CABIN REPRESS VALVE IS MANUALLY OPENED. |

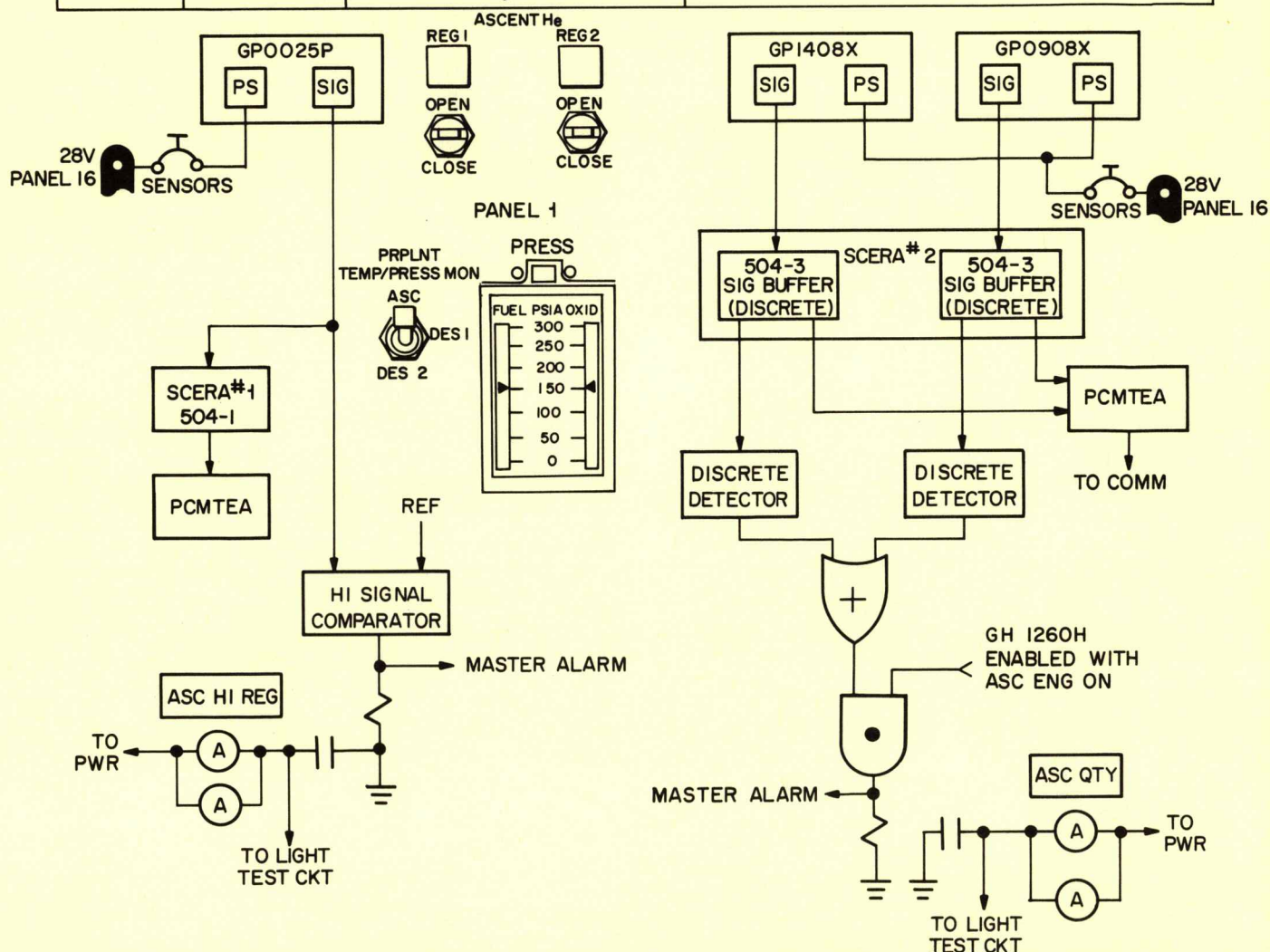


| WARNING INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|------------------------|---|---|
| SUIT / FAN | GF1301X GF1084X | SUIT PRESSURE <3.12 PSIA <6" H ₂ O - LO Δ PRESS IN SUIT FAN #2 | MONITOR ECS PRESS SUIT METER FOR SUIT PRESSURE, PANEL 2. CABIN LIGHT WILL COME ON IF THE CABIN IS PRESSURIZED. INHIBITED IF SUIT FAN SW, PANEL 2 IS IN #1 OR OFF. * FAN COMPONENT LIGHT COMES ON FOR EITHER PROBLEM. |



T30609-239.2

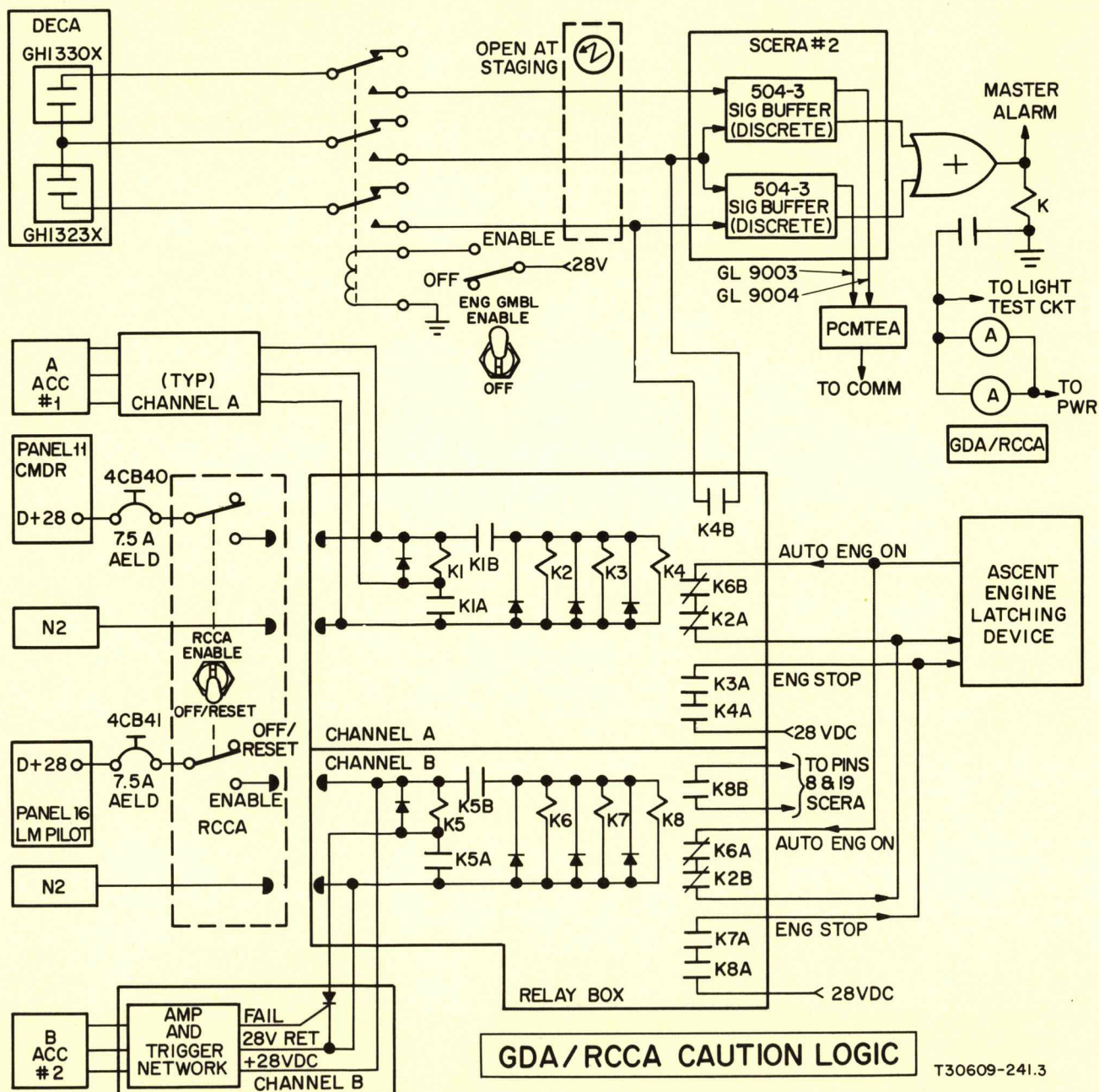
| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|--|---|
| ASC HI REG | GPO025P | HI PRESSURE (>220 PSIA) FROM SENSOR IN ASCENT H _e LINES DOWN LINE OF REG. | BEFORE PRESSURIZATION: FAILED CAUTION LIGHT CIRCUIT. AFTER PRESSURIZATION: CLOSE BOTH ASCENT H _e REG SWITCHES, PANEL 1. FLAGS WILL TURN TO BARBER POLE. PLACE PRPLNT QTY MON SWITCH IN ASC POSITION AND MONITOR MAIN PROPULSION PRESS. (NORMAL READING 180) |
| ASC QTY | GPO908X GPI408X | ASC FUEL LO } 10 SEC BURN ASC OX LO } TIME REMAINING | ALLOW PRESSURE TO DROP UNTIL LIGHT GOES OUT. OPEN ONE REG SW. (IF LIGHT REAPPEARS CLOSE SW AND OPEN OTHER REG SW.) ENABLED ONLY IF ASCENT ENGINE IS ON |



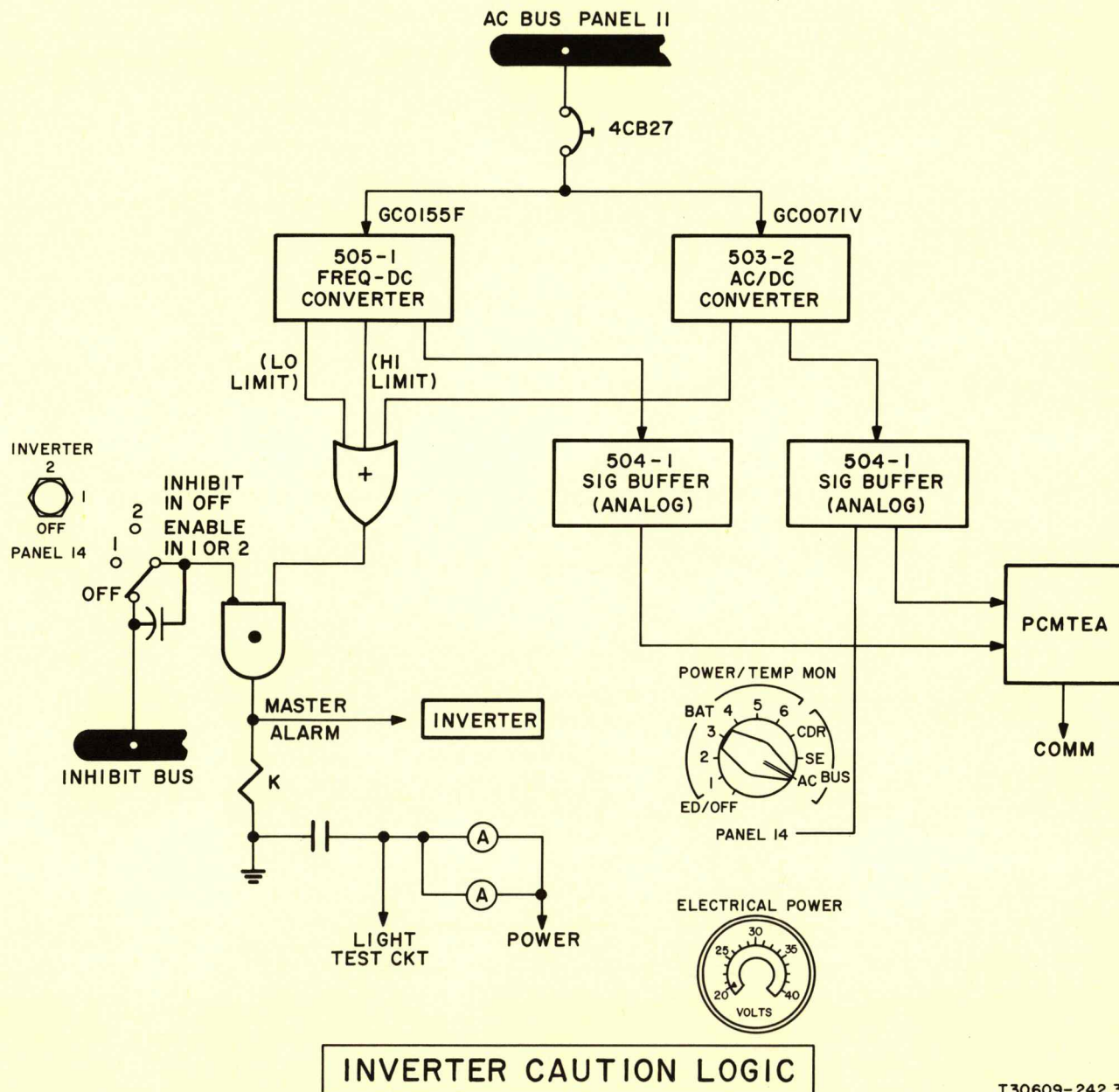
ASC HI REG / ASC QTY CAUTION LOGIC

T30609-240.2

| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|---|---|
| GDA/RCCA | GH1323X | DESCENT ENG PITCH (Y AXIS) GIMBAL FAIL. | PRIOR TO STAGING: ENABLED BY THE DESCENT ENG ARMING SIGNAL AND THE ENG GIMBAL ENABLE SW, PANEL 3, ON. INHIBITED AT SEPARATION. |
| | GH1330X | DESCENT ENG ROLL (Z AXIS) GIMBAL FAIL. | |
| | GP7723X GP7724X | ACC#1 ACC#2 | 1200 G'S IN ASC ENG FOR 30 MSEC ± 10 |



| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|--|--|
| INVERTER | GC0071V GC0155F | AC BUS VOLTAGE < 112V AC BUS FREQ < 398~ OR > 402~ | PLACE POWER/TEMP MON SWITCH, PANEL 14, IN THE AC BUS POSITION AND MONITOR VOLTMETER. SELECT INVERTER NO.1, LIGHT WILL GO OUT WHEN INVERTER NO.1 IS IN TOLERANCE. INHIBITED BY INVERTER SWITCH IN OFF POSITION. |



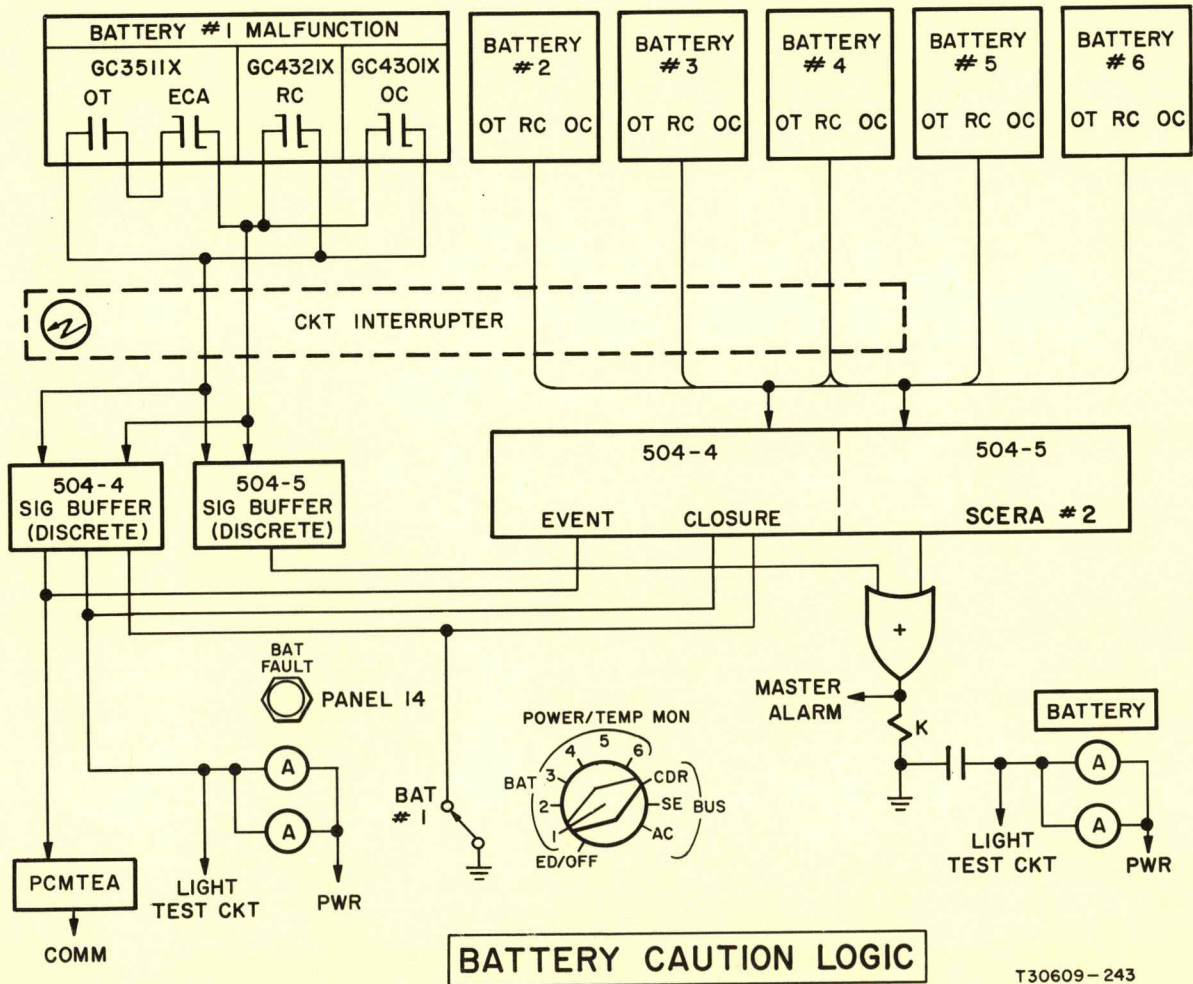
T30609-242.3

Date: August 1968

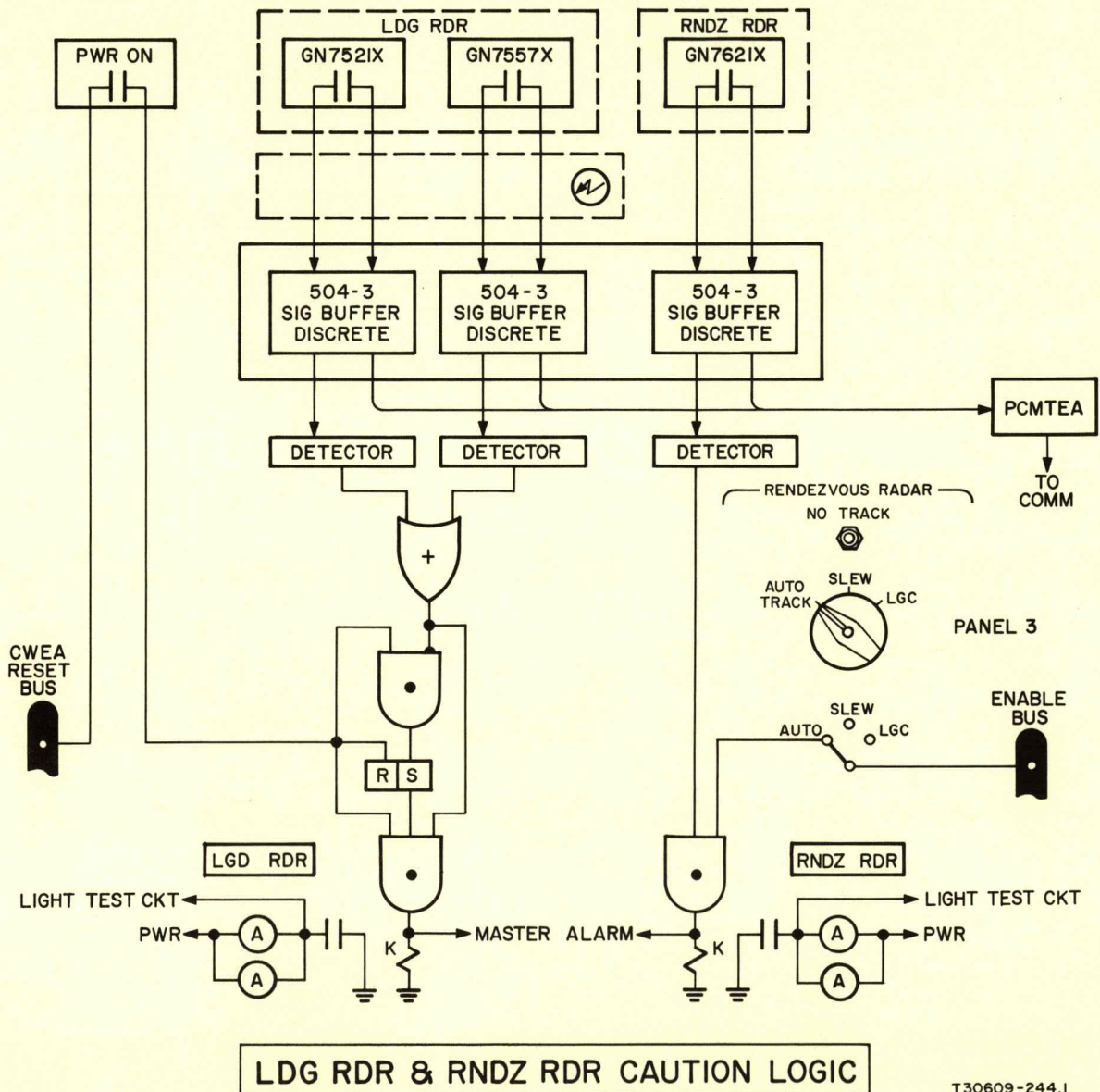
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Page 5-27

| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|----------------------|---|--|
| BATTERY | GC351IX THRU GC3516X | OVER TEMP. CONDITION IN BATTERIES 1 THRU 6 (OT=145° ±5° F) | BATTERY LIGHT WILL COME ON. |
| | GC430IX THRU GC4306X | OVER CURRENT IN BATTERIES 1 THRU 6 OC=150A TO 200A FOR 10 SEC. 1000A FOR 4 SEC (ASC.) 1000A FOR .7 SEC (DES.) | MALFUNCTIONING BATTERY WILL AUTOMATICALLY TURN OFF. (PANEL 14-FLAG WILL TURN TO BARBER POLE). RESET BATTERY. IF PROBLEM STILL EXISTS THE BATTERY WILL TURN OFF AGAIN. |
| | GC432IX THRU GC4326X | REVERSE CURRENT IN BATTERIES 1 THRU 6 RC=-5A TO -10A FOR 4 TO 6 SEC | FOR OT & RC-ROTATE ELECTRICAL POWER POWER/TEMP MON SWITCH, PANEL 14, UNTIL THE BAT FAULT LIGHT COMES ON. THIS WILL INDICATE THE BATTERY AT FAULT. THE BATTERY CAUTION LIGHT WILL NOT GO OUT UNTIL THE FAULTY BATTERY IS OFF. |

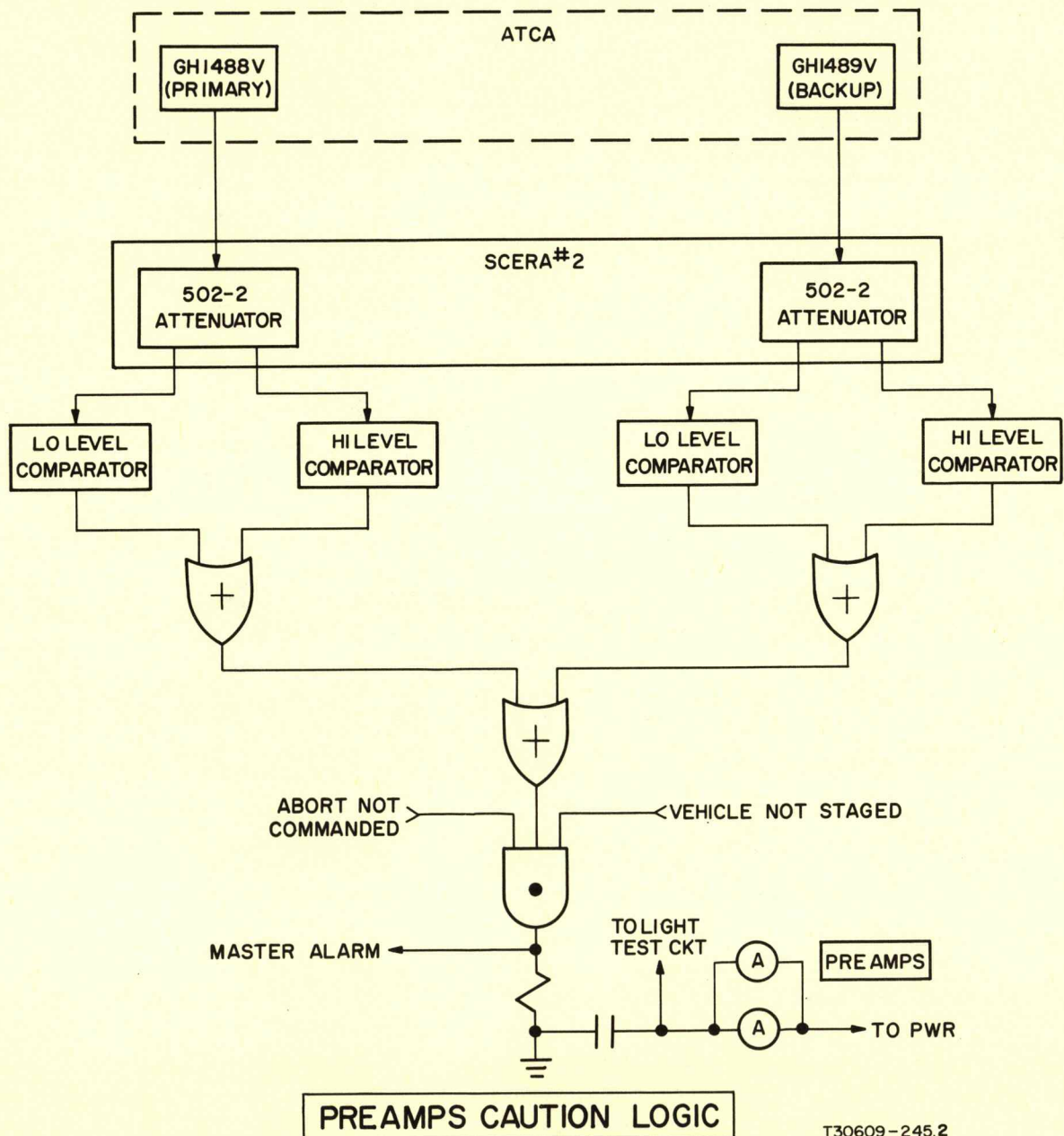


| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|---|---|
| RNDZ RDR | GN762IX | RENDEZVOUS RADAR DATA NOT GOOD. NO TRACK INDICATION | RENDEZVOUS RADAR NO TRACK LIGHT, PANEL 3, ON. ENABLE ONLY IF RNDZ RDR IS IN AUTO TRACK MODE |
| LDG RDR | GN752IX GN7557X | RANGE DATA NO GOOD VELOCITY DATA NO GOOD | LIGHT IS NOT ENABLE UNTIL RANGE AND VELOCITY DATA ARE BOTH GOOD. LM3 WIRED IN RADAR TO GIVE RANGE AND VELOCITY GOOD SIGNALS. DUE TO RELAY CONSTRUCTION THE LIGHT WILL GO ON THEN OFF WHEN PWR IS TURNED OFF |

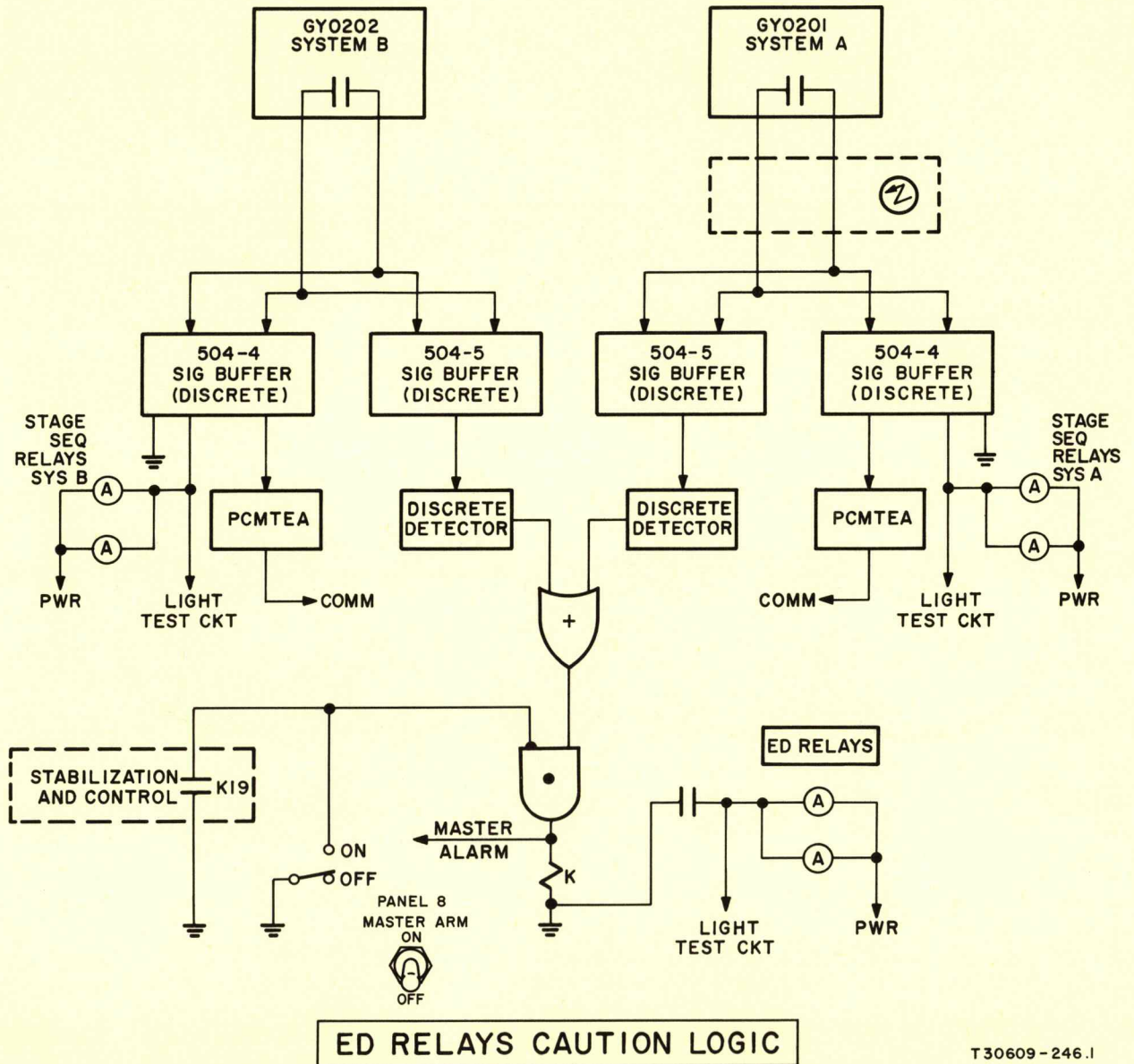


T30609-244.1

| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|--|---|
| PREAMPS | GHI488V | ATCA -4.7 V PWR SUPPLY <-4.2V OR >-5.2V | IF BOTH SUPPLIES FAIL: SIGNAL TRANSIENTS COULD FIRE THE RCS JETS. SEVEN SIGNAL TRANSIENTS IN THE SAME JET CIRCUIT, WHICH DID NOT FIRE THE JET, COULD LIGHT THE RCS TCA LIGHT. |
| | GHI489V | ATCA - 4.7 PWR SUPPLY' <-4.2V OR >-5.2V | INHIBITED BY: VEHICLE STAGING OR ABORT PUSH BUTTON ACTIVATED. |

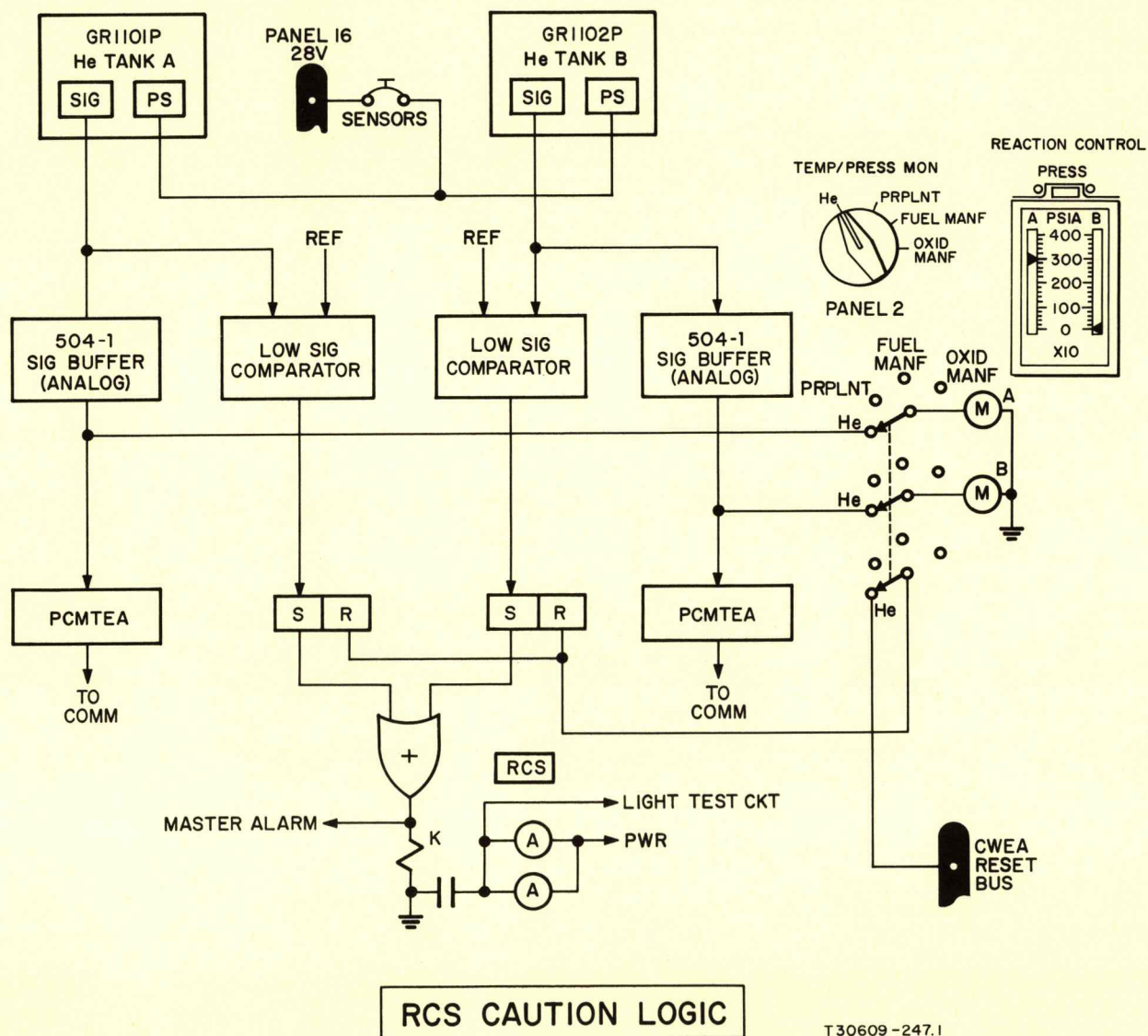


| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|-------------------------|---|
| ED RELAYS | GY0201 | SYSTEM A RELAY TRANSFER | PRIOR TO ARMING - ED INDICATIONS MEAN RELAY FAILURE. INHIBITED AFTER MASTER ARM SWITCH, PANEL 8 IS ON OR K19 IN THE STABILIZATION AND CONTROL ASSEMBLY CLOSSES (ABORT STAGE ON) |
| | GY0202 | SYSTEM B RELAY TRANSFER | |



T30609-246.1

| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|---|---|
| RCS | GR1101P GR1102P | LO He PRESSURE IN SYS A He TANK LO He PRESSURE IN SYS B He TANK (LO He IS <1700 PSIA) | PLACE TEMP/PRESS MON SW, PANEL #2, IN He POSITION. MONITOR REACTION CONTROL PRESS METER. LIGHT IS RESET IN THE TEMP/PRESS MON SW He POSITION. |

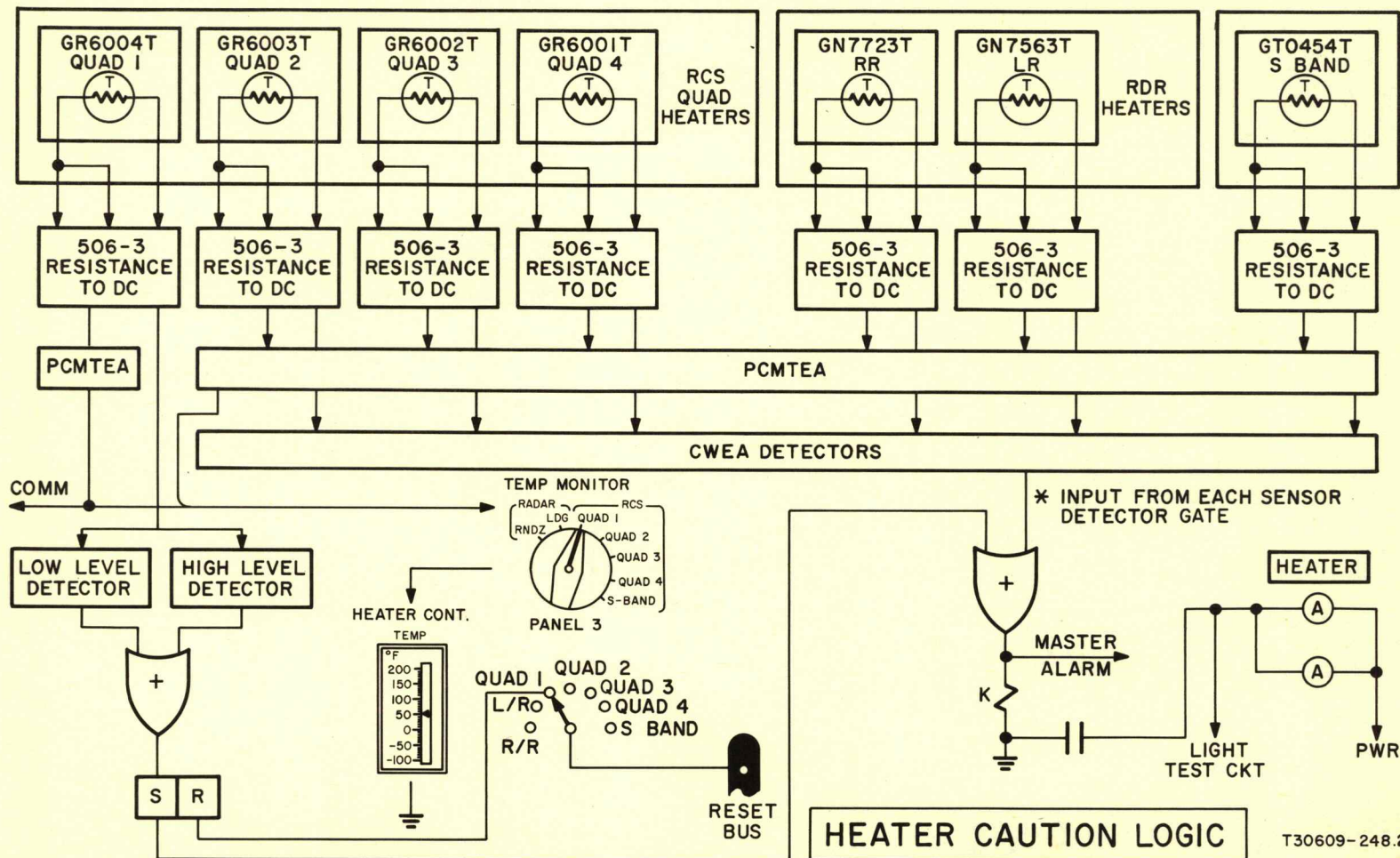


Date: April 1968

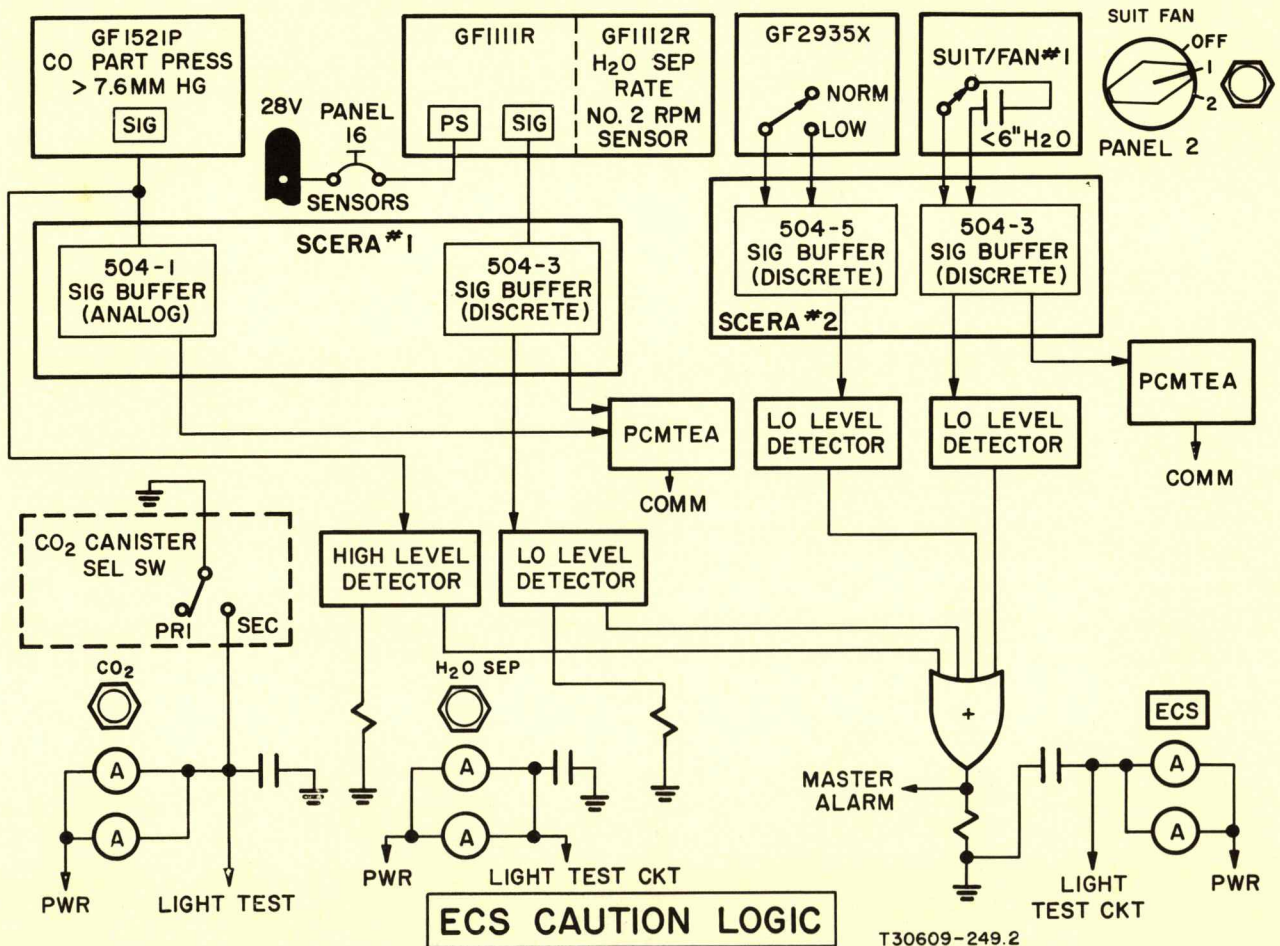
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Page 5-33

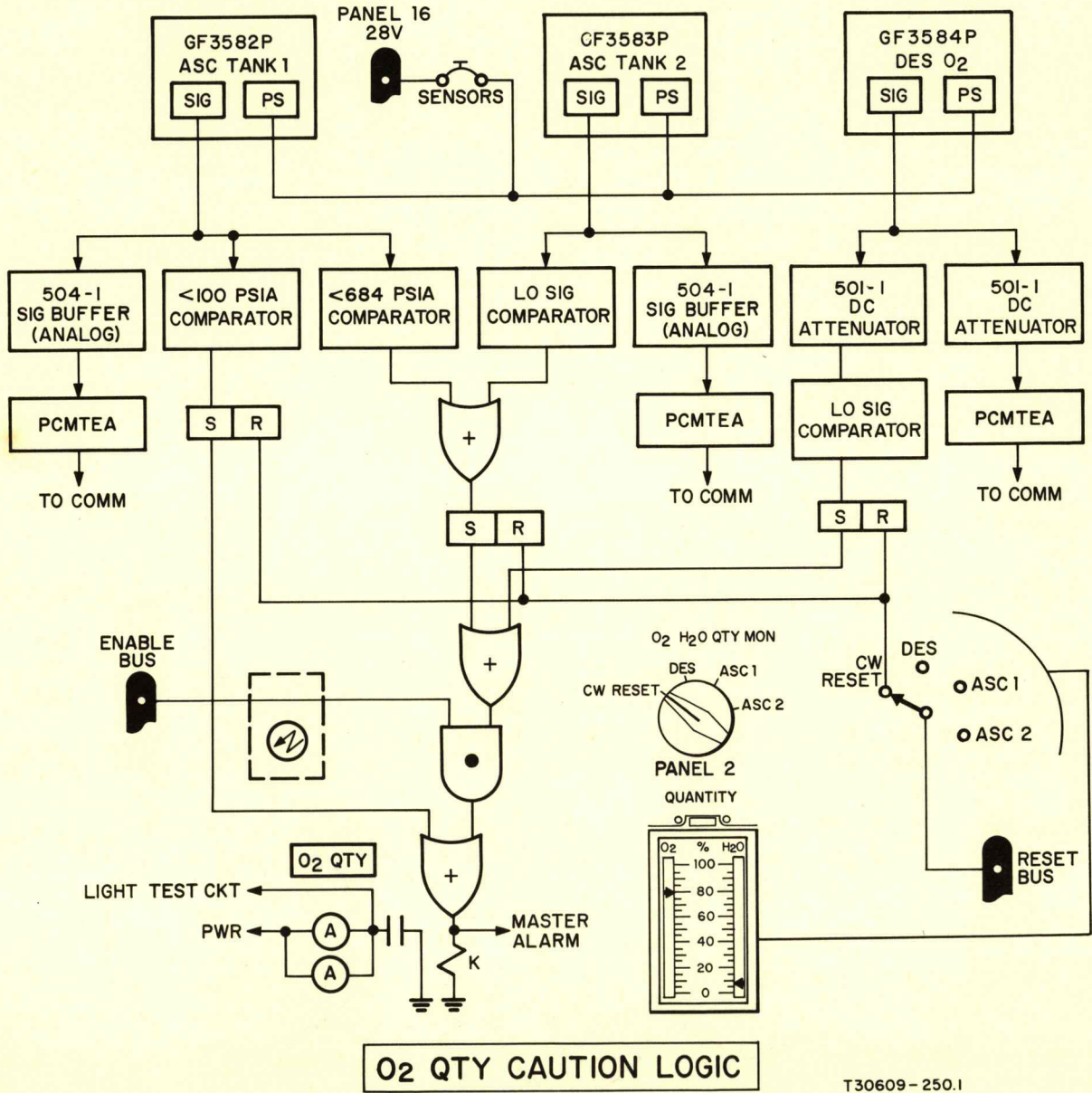
| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|----------------------|--|--|
| HEATER | GR6001T THRU GR6004T | RCS QUAD HEATERS QUAD 4-1 <120°F OR >190°F | TURN RR OFF FOR HI TEMP CONDITION TURN LR OFF FOR HI TEMP CONDITION FOR ALL MEASUREMENTS: ROTATE TEMP MONITOR SW, PANEL 13, UNTIL THE HEATER CAUTION LIGHT GOES OUT. THIS INDICATES THE OUT OF TOLERANCE HEATER. MONITOR TEMP METER. |
| | GN7723T | RNDZ RDR HEATER <-50°F OR >+150°F | |
| | GN7563T | LDG RDR HEATER <-15°F OR >+150°F | |
| | GT0454T | S BAND ANT HEATER <-60°F OR >155°F | |



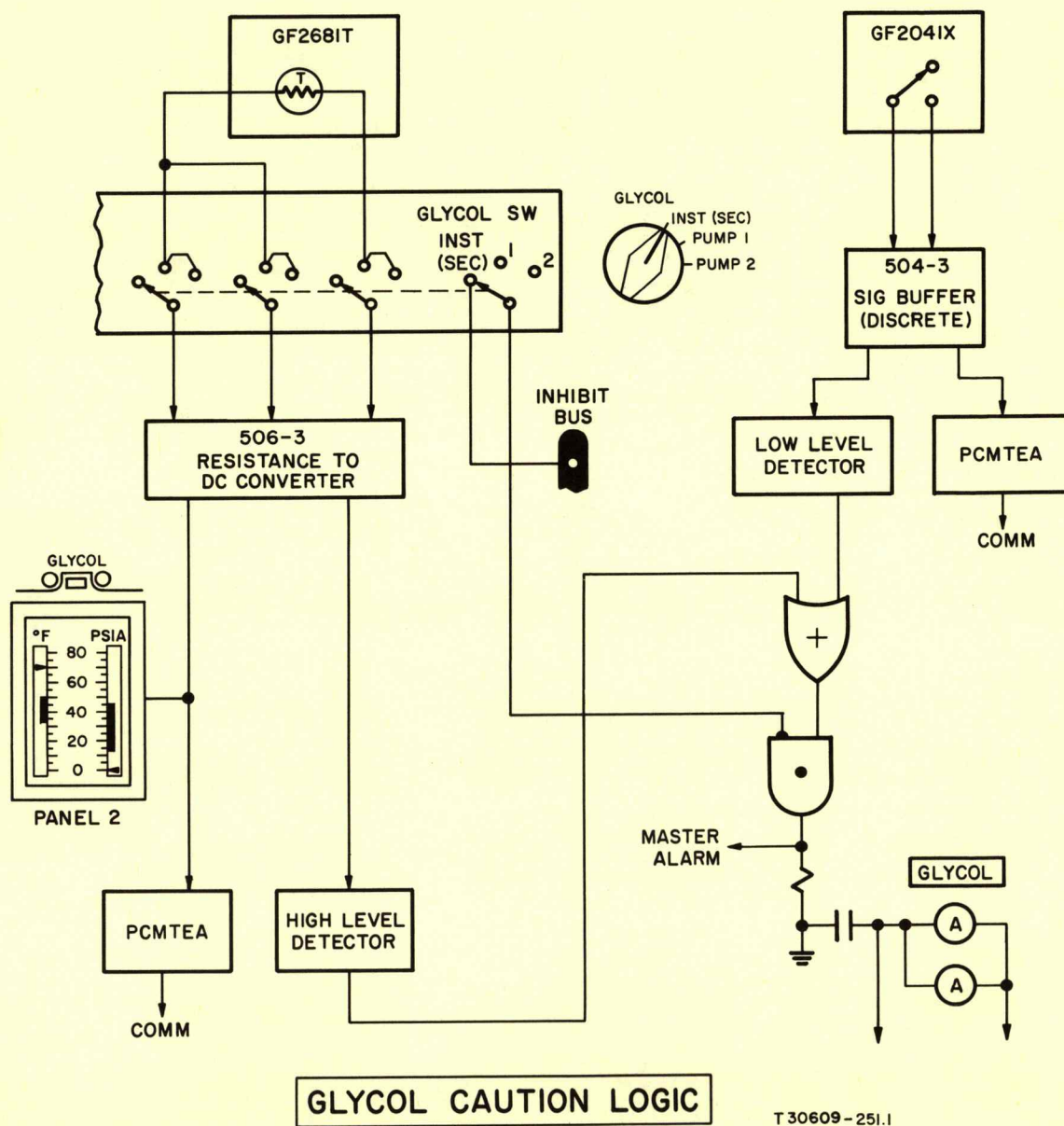
| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|--|---|
| ECS | GF2935X | FAILURE OF THE SELECTED GLYCOL PUMP <3 PSID FROM A SENSOR IN THE COOLANT LINE DOWN STREAM FROM THE PUMP. | COMPONENT LIGHT, PANEL 2 NEXT TO GLYCOL SWITCH IF PUMP #1 WAS SELECTED AUTOMATIC SWITCHING CKTS SELECT PUMP #2. THIS WILL RESET THE ECS CAUTION LIGHT BUT NOT THE COMPONENT LIGHT. PUMP #2 MUST BE SELECTED TO TURN OFF THE LIGHT. THE ECS LIGHT IS INHIBITED BY THE GLYCOL INST/SEC POSITION. |
| | GF152IP | CO ₂ PARTIAL PRESSURE HI, >7.6MM OF HG. | COMPONENT LIGHT, PANEL 2 COMES ON. SELECT SECONDARY CANISTER POSITION ON THE CO ₂ CANISTER SEL VALVE. REPLACE THE PRIMARY CANISTER AND RETURN VALVE TO THE PRIMARY POSITION. |
| | GF111IR GF1112R | WATER SEPARATOR #1 LOW RPM WATER SEP #2 LOW RPM (<800RPM) | } COMPONENT LIGHT, PANEL 2, COMES ON. |
| | GF1083 | SUIT FAN #1 FAILURE (<6" H ₂ O) L _o ΔP ACROSS SUIT FAN ASSY. | |



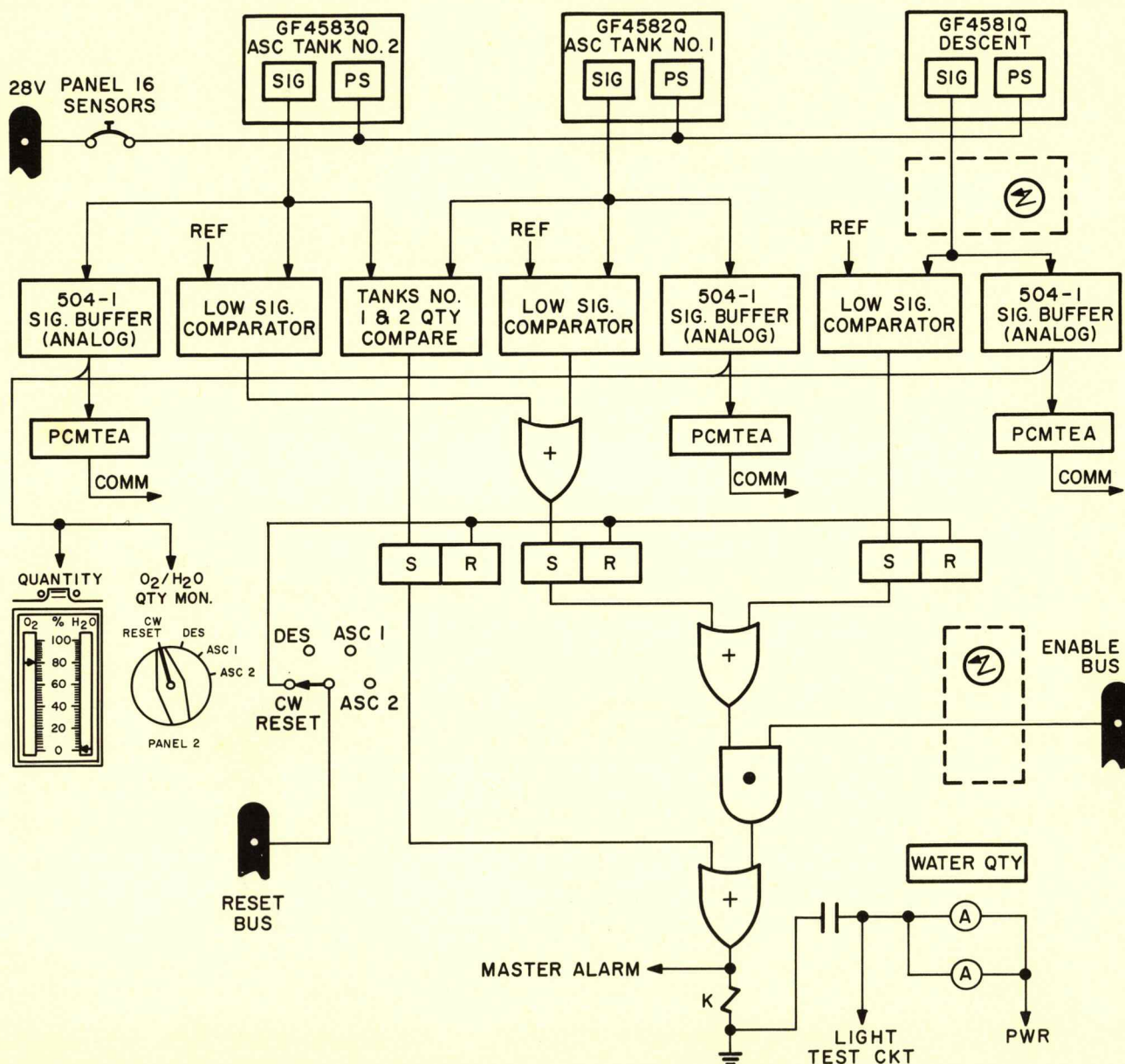
| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|--------------------|--------------------|---|--|
| O ₂ QTY | GF3582P | <684 PSIA IN ASC O ₂ TANK #1 <100 PSIA IN ASC O ₂ TANK #1 AFTER STAGING | INHIBITED AT STAGING INHIBITED AT STAGING INHIBITED AT STAGING LIGHT RESET BY O ₂ /H ₂ O QTY MON SW IN CW RESET. MONITOR O ₂ /H ₂ O QTY METER, PANEL 2 |
| | GF3583P | <684 PSIA IN ASC O ₂ TANK #2 | |
| | GF3584P | <135 PSIA IN DES O ₂ TANK | |



| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|--|--|
| GLYCOL | GF204IX | LOW GLYCOL QUANTITY, <10% VOLUME REMAINING | INHIBITED BY PLACING GLYCOL SWITCH IN INST (SEC) |
| | GF268IT | COOLANT TEMP UPSTREAM OF CRITICAL ELECTRONICS > 50°F | |



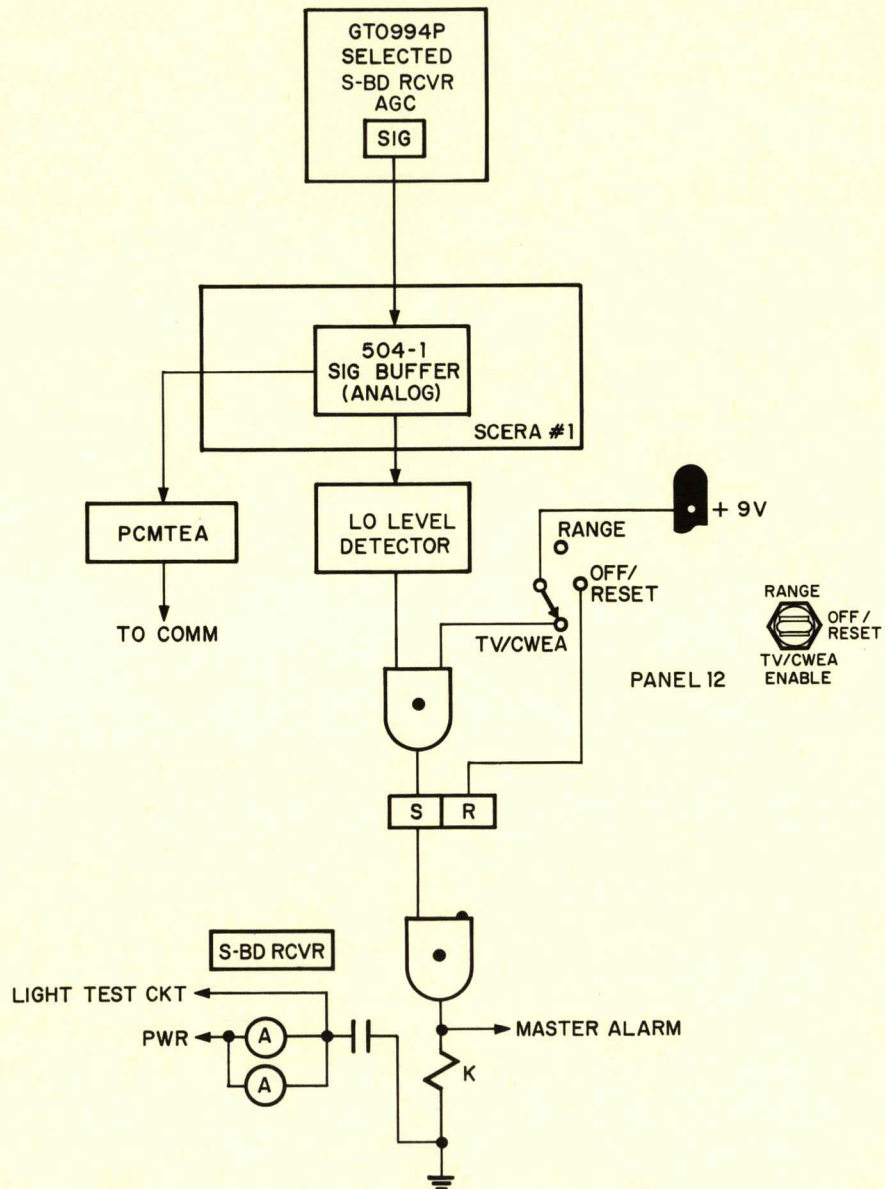
| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|---|--|
| WATER QTY | GF4581Q | 16% H ₂ O REMAINING IN DES H ₂ O TANK | INHIBITED AFTER VEH. STAGE |
| | GF4582Q | ASC TANK NO. 1 < FULL (<95%) | PRIOR TO STAGE. INHIBITED AFTER STAGE. |
| | GF4583Q | ASC TANK NO. 2 < FULL (<95%) ≠QTY (15% Δ) IN TANKS NO. 1 AND NO. 2 | PRIOR TO STAGE. INHIBITED AFTER STAGE. NO INHIBIT. LIGHT RESET BY O ₂ /H ₂ O QTY MON SW IN CW RESET. |



WATER QTY CAUTION LOGIC

T30609-252.2

| CAUTION INDICATOR | MEASUREMENT NUMBER | MALFUNCTION | CHECK OR ACTION TO BE TAKEN |
|-------------------|--------------------|--|---|
| S-BD RCVR | GT0994V | S BAND RECEIVER AGC <1V ON SELECTED RECEIVER | ENABLED BY PLACING THE RANGE SW, PANEL 12 IN THE TV/CWEA ENABLE POSITION. |



S-BD RCVR CAUTION LOGIC

T30609 -253.1

CHAPTER 6

DEVELOPMENTAL FLIGHT INSTRUMENTATION (DFI)

A. System Summary

The Developmental Flight Instrumentation/Communication Subsystem on the LM vehicle consists of four VHF Telemetry links which radiate LM generated data not required in real time and one PCM/VHF telemetry link for real time control. It also includes the C-Band Transponder beacon tracking system.

The VHF Telemetry links will consist of three IRIG standard proportional BW PAM/FM/FM systems, one AIA standard constant bandwidth FM/FM system and one PCM/FM transmitting system which will radiate the output of the operational PCMTEA.

These telemetry systems will contain all components necessary to sense, condition, commutate, multiplex, modulate, and radiate the data requirements.

The individual components that make up the DFI system are listed below:

1. Transducers
 - a. Pressure
 - b. Thermocouples
 - c. Resistance Thermometers
 - d. Strain Gage
 - e. Accelerometers
 - f. Vibration Pickups
 - g. Separation Distance Monitor
 - h. Position - Gear
2. DC Amplifiers
3. Signal Conditioner
4. Power Supplies (5 VDC and 25 VDC)

5. Main Control CB's
6. Vibration Commutator
7. Temp/Strain Sig. Cond.
8. Power and Control Box
9. PAM Commutators
10. Modulation Packages
11. Dual Feed Coupler
12. Transmitters
13. RF Multiplexer
14. Diplexer
15. RF Switch
16. LM VHF Antennas
17. SLA VHF Antennas
18. C-Band Transponder System

B. Component Description - DFI Instrumentation/Communication

1. Transducers

a. Pressure Transducer

The pressure sensors used in this system are silicon strain gages with bodies of machined corrosion-resistant steel. Pressure is sensed electrically by an integrally machined diaphragm containing four bonded active semi-conductors with necessary signal conditioning electronics to accept unregulated 28V vehicle power and provide a 0 - 5 VDC output which is directly proportional to the sensed pressure.

b. Thermocouples

The thermocouple consists of the hot thermocouple junction and the reference junction compensator. The thermocouple itself is a chromel - alumel type which generates a voltage that is proportional to its temperature as described in National Bureau of Standards Document No. 561. The reference junction compensator, or temperature zone box, is designed to compensate for ambient temperature changes from -60°F to 160°F . This is accomplished by application of a fixed current to a temperature sensitive resistor which matches the temperature characteristics of the chromel - alumel junction and applying the resistor output as temperature compensation.

c. Resistance Thermometers

The resistance thermometers consist of a platinum resistance sensing element which varies in resistance proportionally to a variation of temperature. The platinum element has a resistance of $1400 \pm .5$ ohms at a temperature of 32°F and will vary in direct proportion to the temperature changes.

d. Strain Gages

The strain gage circuitry consists of four active 350 ohms bonded wire strain sensitive temperature compensated Wheatstone bridge. Each active strain gage circuit will have a redundant or backup circuit installed.

e. Accelerometers

Two types of accelerometers are being utilized in the DFI system; linear and angular. Both of these accelerometers utilize an internal unbonded strain gage as a measuring device and are mounted along each orthogonal axis. The electrical output of these accelerometers is directly proportional to the acceleration experienced in its appropriate axis.

There is a requirement for three linear and three angular accelerometers to be utilized on IM.

f. Vibration

The vibration system is composed of a quartz crystal piezo electric transducer whose output is transmitted to a charge amplifier via a coaxial cable. This amplifier serves to signal condition the transducer output to a DC signal varying at a rate identical to the transducer vibration.

g. Separation Distance Monitor

The component is contained in a 3 x 3 x 4 inch case, weighs one pound, and requires 300 milliwatts of power. It consists of an isolated power supply, a potentiometer connected to a cable reel, a cable, and electronic elements to provide low output impedance and voltage limiting. Four of these transducers are attached to the ascent stage at points that are known distances from the center-line of the ascent engine. These four points are used to determine the separation plane. The cable is attached to the descent stage. Upon separation, the cable unwinds from the reel, and provides a zero to five volt signal representing zero to four feet of separation distance.

h. Position - Gear

The LM has two locking mechanisms per gear. One switch assembly is installed on each locking mechanism, and actuates when the gear is deployed and locked.

The switch assembly contains redundant switch modules for high reliability. Each switch module is a single pole, double throw unit. The switch assembly weighs 2 oz., excluding leads.

The switch assemblies are so wired that when all four gears (eight locking mechanisms) are deployed and locked, a 28 VDC signal is transferred to SCEA.

2. DC Amplifier

The DC amplifiers accept either single ended or differential low level transducer outputs. The amplified output will be 0 to 5 VDC isolated from the input. It will contain a gain adjustment variable from 1 to 1000 and is capable of 1000 cps response.

Calibration relays are provided within the amplifier which, when energized by external command, introduce an input of sufficient magnitude to produce an output of 15% and 85% of full scale. These amplifiers will be capable of operating continuously for 1000 hours without adjustment.

3. Signal Conditioner

The signal conditioning box is basically a junction box which serves as the accessibility point for DFI measurements. All measurements are routed via a series of terminal strips through this box, and programming of the data channels is accomplished. This component contains, in addition to the terminal strips, control relays, calibration sequencers, fuses and semi-conductor circuitry.

4. Power Supplies - 5 VDC and 25 VDC

The 5 VDC and the 25 VDC precision reference power supplies are essentially similar in application and design. They draw unregulated 28 volt power from the ships supply via the power and control box, and provide their respective precision outputs regulated to within .1%. These outputs are routed to the signal conditioner busses which distribute this power as required. The 5 volt power supply requires an input of 28 VDC at 200 milliamps to provide 500 milliamps of regulated output. The 25 volt power supply requires an input of 28 VDC at 350 milliamps to provide 250 milliamps of regulated output.

5. Main Control CB's

The control circuit breakers give the astronauts the capability to electrically control the instrumentation manually. It applies ships 28 VDC power to the power and control box for further distribution. The opening of these circuit breakers serve to shut down the total DFI system.

6. Vibration Commutator

The vibration multiplexer provides time division operation of a non-interference basis. It is designed to accept a series of continuous tri-axial vibrations and divides these units into three equally time shared periods of 1-1/4 seconds each for presentation as a single input to a modulation package. This multiplexer is designed to accept six tri-axial vibrations (18 msmts) and multiplex them into six outputs. Channel identification and frame synchronization are internally supplied to all six channels every revolution of the multiplexer.

7. Strain/Temperature Signal Conditioner

The strain temperature box is basically a pre-wired chassis designed to accept a series of plug-in strain or temperature modules. These modules are also pre-wired and serve as bridge completion networks. Each plug-in module is capable of handling eleven measurements. The chassis contains an internal precision 10 volt power supply for bridge excitation.

8. Power Control Box

The power and control box for the DFI system serves as the nerve center for electrical power distribution and control. It provides fusing, bussing, and relay control inputs which accept ground control directly through the umbilical or LM Mission Programmer control. Provisions have been incorporated to assure the command receiver of the 28 volt battery supply when normal 28 volt ships supply is removed from the control box. In normal manned flights, the power and control box is commanded by the manual operation of the DFI circuit breakers.

9. P.A.M Commutators

The pulse amplitude modulation commutators are solid state devices which accept a maximum of 86 continuous data inputs and, through time division multiplexing, produce a single data train of pulse RZ amplitude intelligence at a 50 percent duty cycle. In addition to the 86 data inputs there is applied on channels 1 and 2 a zero and full scale calibration signal and on channels 89 and 90, a frame sync pulse.

There are requirements for three basic types of PAM Commutators on LM-3. A quantity of two 90 point, 10 samples per second, high level input (0 - 5 volt) are required; a single 90 point, 10 samples per second, low level (0 - 10MV) is required and a single 90 point, 1-1/4 samples per second, low lever (0 - 40MV) is required. These commutators can be crossed strapped with data in order to achieve more samples of a given measurement than the frame rate indicates.

NOTE: All commutators utilize a 50% duty cycle.

10. Proportional Bandwidth Modulation Package

The PBW Mod package consists of sixteen solid state voltage controlled subcarrier oscillators (VCO), two solid state amplifiers, one solid state calibrator module and a plug-in component mounting chassis.

The sixteen VCO's are configured to accept either a 0 - 5 VDC or 0 - 10MV DC input based on detail measurement requirements. These VCO's are IRIG standard channels, No.'s 2 through 16 plus "E", and will deviate proportionately to the input voltage and center frequency.

The two amplifiers are configured to accept the outputs of the sixteen mixed VCO outputs and amplify for presentation to the RF transmitters. These amplifiers supply an individual and independent frequency modulated waveform for utilization as a ground test point as well as for FM transmission.

The calibrator module is configured to apply an inflight calibration, in lieu of the applied data signal upon command. This calibration sequence will sequentially apply two discrete precision voltages simultaneously to the input of all VCO's with a dwell time of 100 milliseconds at each level. Upon completion of a calibration cycle, the module will automatically return to its data input. This is a self-contained unit and has incorporated all necessary timing circuitry and precision power supplies.

The component mounting chassis is designed to mechanically and electrically accept the previously mentioned components. This chassis will contain all interconnecting wiring and will serve as the electrical and mechanical connection between the PBW package and the vehicle. Contained in this chassis are also a 28V line filter and the mixer/pre-emphasis resistors. These resistors provide linear mixing of the VCO outputs and pre-emphasis of the upper frequencies in order to equalize the signal-to-noise ratio for all channels.

11. Constant Bandwidth Modulation Package

The CBW Mod package consists of eleven solid state voltage controlled subcarrier oscillators (VCO), two solid state amplifiers, one solid state calibrator, one reference oscillator, and a plug-in component mounting chassis.

The eleven VCO's are configured to accept a 0 to 5 VDC input. The multivibrator frequency is set at AIA center frequency at an input of 2.5 VDC. At 0 VDC or 5 VDC input, the output frequency will be respectively, 2KC below or above the center frequency. The VCO's are AIA standard for channels 1A through 11A and will deviate 2KC independent of the center frequency.

The two amplifiers are configured to accept the outputs of the sixteen mixed VCO outputs and amplify for presentation to the RF transmitters. These amplifiers supply an individual and independent frequency modulated waveform for utilization as a ground test point as well as for FM transmission.

The calibrator module is configured to apply an in-flight calibration, in lieu of the applied data signal upon command. This calibration sequence will sequentially apply two discrete precision voltages simultaneously to the input of all VCO's with a dwell of 100 milliseconds at each level. Upon completion of a calibration cycle, the module will automatically return to its data input. This is a self-contained unit and has incorporated all necessary timing circuitry and precision power supplies.

The reference oscillator is crystal controlled and contains an output amplifier, a voltage regulator and a low pass filter to eliminate second and higher order harmonics. The 100KC output is transmitted in order to assure accurate timing during ground station playbacks.

The component mounting chassis is designed to mechanically and electrically accept the previously mentioned components. This chassis will contain all interconnecting wiring and will serve as the electrical and mechanical connection between the CBW package and the vehicle. Contained in this chassis are also a 28V line filter and the mixer/pre-emphasis resistors. These resistors provide linear mixing of the VCO outputs and pre-emphasis of the upper frequencies in order to equalize the signal-to-noise ratio for all channels.

12. Dual Feed Coupler Assembly (DFC)

The DFC is an active device inserted in the signal wire between the PCM output and the SPA input. This will provide dual transmission capability of the operational instrumentation via "S" Band communications and DFI VHF communications. It will provide adequate levels to both transmission systems and have incorporated failure isolation between systems.

13. VHF Transmitters

The RF transmitters to be used on LM-3 are identical in design and configuration. The five units in this system are set at 230.9, 237.8, 228.2, 247.3 and 257.3 megacycles per second. They are designed to accept the outputs of the appropriate modulation packages, apply the RF carrier, and produce a power output of nominally 10 watts to the RF Multiplexer.

14. RF Multiplexer

The RF Multiplexer is a device which permits connecting the five VHF transmitter outputs to form a single line output to the diplexer. It will have an insertion loss of less than 1.5 db, and an isolation of 20 db between transmitters.

15. Diplexer

The UHF/VHF diplexer serves to connect the output of the 5 channel multiplexer and the digital command assembly of the LM mission programmer to a common antenna system. The diplexer has a 0.2 db insertion loss over the 230-260 VHF band, and a 1.0 db insertion loss at the 450 mc of the DCA. Isolation between the receiver and transmitter is 60 db.

16. RF Switch

The RF switch is a coaxial device to switch the output of the diplexer to either the LM mounted antenna system or the SLA mounted antenna system. This switching function is accomplished once during the LM-3 mission. This switchover occurs at the time LM is separated from the SLA.

17. LM VHF Antennas

This antenna system is frequency shared by the five VHF transmitters and the digital command assembly. It is composed of two broadband (230-450 mc) scimitar antennas fed by a power divider. The system is basically linearly polarized and receives or transmits equally well to/from RCP or LCP antennas. The gain of the antenna is greater than -9 db with respect to an RCP isotropic source over 85% of the sphere.

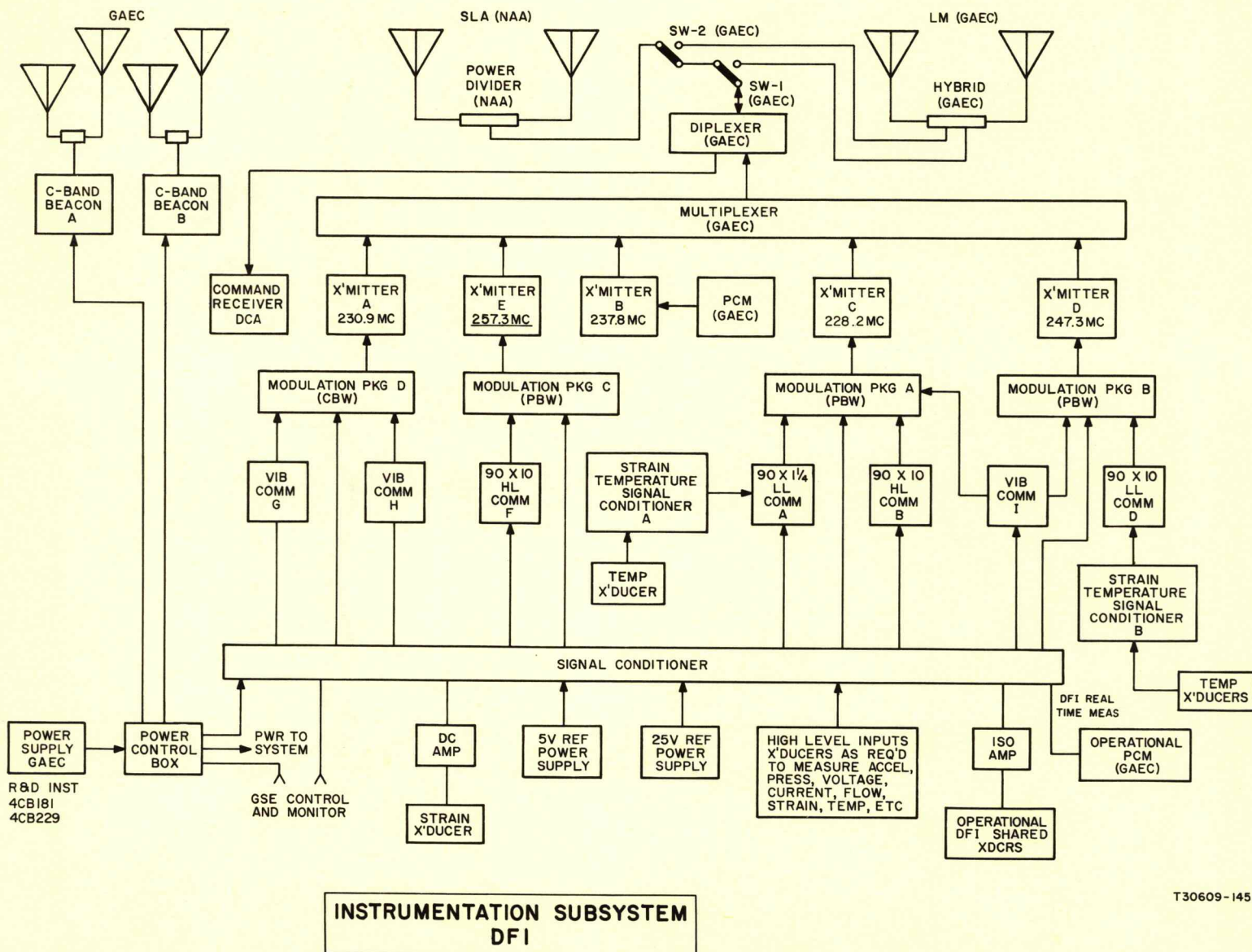
18. SLA VHF Antennas

This antenna system for the LM is composed of two broadband (230-450 mc) scimitar antennas fed by a power divider, via the RF switch and mounted 180° apart on the lower portion of the Saturn/LM adapter panels. The coverage is greater than 80% at the -9 db with the panels closed and greater than 75% at the -9 db level with the panels deployed to 45°. This system is required to transmit LM data and receive commands from launch until separation of the LM vehicle from the SLA.

19. C-Band Transponder System

This system is comprised of two +28 VDC line filters, two AN/DPN 66 transponders, two power dividers and four antennas. The systems provide radar tracking of the LM vehicle during near earth missions. To accomplish this function, the transponder receives a pulse type signal via its antennas and transmits back to earth a pulse type signal at a different frequency over the same antennas. The transmit frequency is 5765 mc, and the receiver frequency is 5690 mc at a power level of 500 watts minimum.

A power divider and a pair of antennas is installed to receive and radiate to and from each transponder. These antennas are mounted in pairs which are diametrically opposed 90° apart.



T30609-145.2

CHAPTER 7

LM-3 TELEMETRY MEASUREMENT IDENTIFICATION
AND CIRCUIT LOCATION

A. General

This chapter has been developed to identify the LM-3 real time telemetry measurements. The information contained in Tables 7-1 and 7-2 is taken from the following documents:

1. LED-360-22, Rev J - LM-1, 2, 3 Measurement List (GAEC Document)
2. LED-360-318 - LM-3 Measurement Requirements and Configuration Data (GAEC Document)
3. LED-360-44, Rev F - LM-3 SCEA Signal Routing (GAEC Document)
4. LM Pulse Code Modulation and Timing Electronics Assembly, Support Manual, 1 April 1967 (Radiation, Inc. Document)
5. LED-360-138, Time Slot Allocation, LM-3 (GAEC Document)

B. Table 7-1

Table 7-1 is a list of the Instrumentation Subsystem real time telemetry measurements.

Definitions

1. Meas. ID - see page 5-13
2. Measurement Description - A brief, definitive title given to each measurement
3. Range - Low, Nominal and High values of the measurement
4. Units - Engineering units of the measurement range
5. Ref. Page - Page within the text or diagrams to identify the measurement

C. Table 7-2

The information in Table 7-2 has been collected from five different tables and placed in this format to give an overall picture of the signal flow of all of the LM-3 real time telemetry measurements. Many more measurements exist on the LM-3 vehicle but they do not appear in the telemetry format and will not be discussed in this chapter. (For information concerning these measurements see LED-360-22.)

Definitions

1. Meas. ID - see page 5-13
2. Measurement Description - same as Table 7-1
3. Fuse No. - Certain Transducers power lines are fused to protect the sensor circuit breaker. These fuses are located in 3 units: 4A9, 4A10, and the ECS Relay Box.
4. ERA No. - SCERA #1 and SCERA #2.
5. Subassembly - The identifying number (see Chapter 2); location in SCERA (1 of 22 plug-in locations); and the Circuit, this corresponds to the operational channels.
6. PCM ID - See page 3-13
7. Programmer Commands - Analog measurements require a Row and a Column command. Digital measurements require a Digital command. Where the PCM ID calls for a redundant measurement, the Programmer Commands will be separated by commas.

Example: GC0302V; 1/1 AHR 134,143; Rows 7,8; Column 37,38; PAMs 3,1

R7, Column 37 and PAM 3 is the prime measurement.

R8, Column 39 and PAM 1 is the redundant measurement.

8. Bit No. - Location of a digital measurement within an eight bit word.
9. High Bit Rate - Frame and Word location. Commas separate the redundant measurements.
10. Lo Bit Rate - Word location. Commas separate the redundant measurement.

This table may be used in malfunction analysis. By knowing what SCERA circuits are common and which Programmer Commands affect the same PAM lines, it is possible to identify possible malfunctioning areas.

In multiple sample per second measurements the first frame and word of the PCM format are given. To identify the additional frame-word combinations, use the following scale:

- 200 s/s add 32 to word number (4 times each frame)
- 100 s/s add 64 to word number (2 times each frame)
- 50 s/s add 1 to frame number (1 time each frame)
- 10 s/s add 5 to frame number (every fifth frame)

Date: April 1968

TABLE 7-1

LM-3 INSTRUMENTATION SUBSYSTEM REAL TIME TELEMETRY MEASUREMENTS

| MEAS. ID | MEASUREMENT DESCRIPTION | RANGE | | | UNITS | REFERENCE PAGE |
|----------|--------------------------------|-------|------|------|-----------------|-------------------|
| | | LOW | NOM | HIGH | | |
| GL0300 | Frame Sync and ID | | | | | 3-16 |
| GL0302 | Format ID | | | | | 3-16 |
| GL0400X | Internal Osc Fail Det #1 | | | | | 3-10 |
| GL0401V | Volt, Calib 85% | 0 | 4.25 | 5.0 | VDC | 3-12 |
| GL0402V | Volt, Calib 15% | 0 | 0.75 | 5.0 | VDC | 3-12 |
| GL0422 | Internal Osc Fail Det #2 | | | | | 3-10 |
| GL0423 | Internal Osc Fail Det #3 | | | | | 3-10 |
| GL0501W | Time, Mission Elapsed | | | | Sec | 3-11 |
| GL0501W | Time, Mission Elapsed | | | | Min | 3-11 |
| GL0501W | Time, Mission Elapsed | | | | Hours | 3-11 |
| GL0501W | Time, Mission Elapsed | | | | Day | 3-11 |
| GL4026X | CES AC Pwr Supply Fail | | | | Contact Closure | 5-16 |
| GL4027X | CES DC Pwr Supply Fail | | | | Contact Closure | 5-17 |
| GL4028X | AGS Pwr Supply Fail | | | | Contact Closure | 5-18 |
| GL4054X | CWEA Pwr Supply Fail | | | | Contact Closure | 5-12 |
| GL4069X | CWEA Master Alarm ID | | | | Contact Closure | 5-12 |
| GL9003 | Pitch Trim Fail/RCCA Channel A | | | | Contact Closure | 5-6,7-8,7-10 |
| GL9004 | Roll Trim Fail/RCCA Channel B | | | | Contact Closure | 5-6,7-8,7-10 |

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TABLE 7-2

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|----------------------------|-------------|------------|-------------|-----|-----|-----------------|---------------------|----------------|-----|-----------------|------------|------------------|--------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GC0071V | AC Bus Volt | | 1 | 503-2 | 17 | 01 | 1/1 AH 82 | 5 | 34 | 3 | | | 22 | 69 | 87 |
| GC0155F | AC Bus Freq | | 1 | 504-1 | 18 | 01 | 1 AH 158 | 9 | 33 | 3 | | | 41 | 69 | |
| GC0201V | Bat 1 Volt | | 2 | 502-2 | 16 | 01 | 1 AH 72 | 4 | 41 | 1 | | | 19 | 101 | |
| GC0202V | Bat 2 Volt | | 2 | 502-2 | 16 | 02 | 1 AH 41 | 3 | 38 | 1 | | | 11 | 101 | |
| GC0203V | Bat 3 Volt | | 2 | 502-2 | 16 | 03 | 1 AH 79 | 5 | 38 | 1 | | | 21 | 101 | |
| GC0204V | Bat 4 Volt | | 2 | 502-2 | 16 | 04 | 1 AH 57 | 3 | 42 | 1 | | | 15 | 101 | |
| GC0205V | Bat 5 Volt | | 2 | 502-2 | 17 | 01 | 1/1 AH 9 | 1 | 30 | 2 | | | 3 | 37 | 10 |
| GC0206V | Bat 6 Volt | | 2 | 502-2 | 18 | 01 | 1/1 AH 36 | 2 | 32 | 2 | | | 10 | 37 | 38 |
| GC0301V | CDR Bus Volt | | | | | | 1/1 AH 174 | 9 | 37 | 3 | | | 45 | 69 | 179 |
| GC0301V | CDR Bus Volt | | 1 | 504-1 | 18 | 03 | 1/1 AH 126 | 7 | 35 | 3 | | | 33 | 69 | 131 |
| GC0302V | LM Pilot Bus Volt | | 2 | 501-1 | 08 | 04 | 1/1 AHR 134,143 | 7,8 | 37,39 | 3,1 | | | 35,37 | 69,101 | 139,148 |
| GC1201C | Bat 1 Cur | | | | | | 1/1 AHR 91,106 | 5,6 | 41,35 | 1,3 | | | 24,28 | 101,69 | 96,111 |
| GC1202C | Bat 2 Cur | | | | | | 1/1 AHR 122,167 | 7,9 | 34,40 | 3,1 | | | 32,43 | 69,101 | 127,172 |
| GC1203C | Bat 3 Cur | | | | | | 1/1 AHR 63,95 | 4,5 | 34,42 | 3,1 | | | 17,25 | 69,101 | 67,100 |
| GC1204C | Bat 4 Cur | | | | | | 1/1 AHR 67,94 | 4,5 | 35,37 | 3,3 | | | 18,25 | 69,69 | 71,99 |
| GC1205C | Bat 5 Cur | | | | | | 1/1 AHR 68,102 | 4,6 | 40,34 | 1,3 | | | 18,27 | 101,69 | 72,107 |
| GC1206C | Bat 6 Cur | | | | | | 1/1 AHR 75,87 | 4,5 | 37,40 | 3,1 | | | 20,23 | 69,101 | 79,92 |
| GC4361X | Bat 1 Hi Tap | | 2 | 504-4 | 04 | 01 | 1 DPE 30 | | | | 51 | 1 | 35 | 98 | |
| GC4362X | Bat 1 Lo Tap | | 2 | 504-4 | 04 | 02 | 1 DPE 30 | | | | 51 | 2 | 35 | 98 | |
| GC4363X | Bat 2 Hi Tap | | 2 | 504-4 | 04 | 03 | 1 DPE 30 | | | | 51 | 3 | 35 | 98 | |
| GC4364X | Bat 2 Lo Tap | | 2 | 504-4 | 04 | 04 | 1 DPE 30 | | | | 51 | 4 | 35 | 98 | |
| GC4365X | Bat 3 Hi Tap | | 2 | 504-4 | 04 | 05 | 1 DPE 30 | | | | 51 | 5 | 35 | 98 | |
| GC4366X | Bat 3 Lo Tap | | 2 | 504-4 | 04 | 06 | 1 DPE 30 | | | | 51 | 6 | 35 | 98 | |
| GC4367X | Bat 4 Hi Tap | | 2 | 504-4 | 04 | 07 | 1 DPE 30 | | | | 51 | 7 | 35 | 98 | |
| GC4368X | Bat 4 Lo Tap | | 2 | 504-4 | 04 | 08 | 1 DPE 30 | | | | 51 | 8 | 35 | 98 | |
| GC4369X | Bat 5 B/U CDR | | 2 | 504-4 | 04 | 09 | 1 DPE 33 | | | | 54 | 1 | 39 | 98 | |
| GC4370X | Bat 6 Norm CDR | | 2 | 504-4 | 04 | 10 | 1 DPE 33 | | | | 54 | 2 | 39 | 98 | |
| GC4371X | Bat 5 Norm LM Pilot | | 2 | 504-4 | 04 | 11 | 1 DPE 33 | | | | 54 | 3 | 39 | 98 | |
| GC4372X | Bat 6 B/U LM Pilot | | 2 | 504-4 | 04 | 12 | 1 DPE 33 | | | | 54 | 4 | 39 | 98 | |
| GC9961U | Bat 1 Mal | | 2 | 504-4 | 12 | 07 | 1 DPE 29 | | | | 50 | 1 | 34 | 100 | |
| GC9962U | Bat 2 Mal | | 2 | 504-4 | 12 | 08 | 1 DPE 29 | | | | 50 | 2 | 34 | 100 | |
| GC9963U | Bat 3 Mal | | 2 | 504-4 | 12 | 09 | 1 DPE 29 | | | | 50 | 3 | 34 | 100 | |
| GC9964U | Bat 4 Mal | | 2 | 504-4 | 12 | 10 | 1 DPE 29 | | | | 50 | 4 | 34 | 100 | |
| GC9965U | Bat 5 Mal | | 2 | 504-4 | 12 | 11 | 1 DPE 29 | | | | 50 | 5 | 34 | 100 | |
| GC9966U | Bat 6 Mal | | 2 | 504-4 | 12 | 12 | 1 DPE 29 | | | | 50 | 6 | 34 | 100 | |

Date: April 1968

Page 7-4

FOR TRAINING PURPOSES ONLY

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|--------------------------------|-------------|------------|-------------|-----|-----|-----------------|---------------------|----------------|-----|-----------------|------------|------------------|--------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GF1083X | Suit Fan 1 Mal | | 2 | 504-3 | 03 | 02 | 1/1 DPER 5,16 | | | | 26 | 1 | 7,20 | 98,98 | 113,155 |
| GF1084X | Suit Fan 2 Mal | | 2 | 504-3 | 03 | 06 | 1/1 DPER 5,16 | | | | 26 | 2 | 7,20 | 98,98 | 113,155 |
| GF1201X | CDR Suit Disconnect | | 2 | 504-5 | 05 | 11 | 1/1 DPER 3,14 | | | | 24 | 1 | 4,18 | 98,98 | 84,153 |
| GF1202X | LM Pilot Suit Disc | | 2 | 504-5 | 05 | 12 | 1/1 DPER 3,14 | | | | 24 | 2 | 4,18 | 98,98 | 84,153 |
| GF1211X | Suit RLF CLSD | | 2 | 504-5 | 05 | 03 | 1/1 DPER 5,16 | | | | 26 | 3 | 7,20 | 98,98 | 113,155 |
| GF1212X | Suit RLF OPEN | | 2 | 504-5 | 05 | 04 | 1/1 DPER 5,16 | | | | 26 | 4 | 7,20 | 98,98 | 113,155 |
| GF1221X | Suit DIV EGRESS | | 2 | 504-5 | 05 | 02 | 1/1 DPER 5,16 | | | | 26 | 5 | 7,20 | 98,98 | 113,155 |
| GF1231X | Cabin RET CLSD | | 2 | 504-5 | 05 | 09 | 1/1 DPER 4,15 | | | | 25 | 1 | 5,19 | 98,98 | 101,154 |
| GF1232X | Cabin RET OPEN | | 2 | 504-5 | 05 | 10 | 1/1 DPER 4,15 | | | | 25 | 2 | 5,19 | 98,98 | 101,154 |
| GF1241X | SEC CO ₂ SEL | | 2 | 504-5 | 05 | 01 | 1/1 DPER 5,16 | | | | 26 | 6 | 7,20 | 98,98 | 113,155 |
| GF1281T | Suit Temp | | 1 | 506-3 | 21 | 01 | 1/1 AHR 172,177 | 9,10 | 27,28 | 4,2 | | | 45,46 | 5,37 | 177,182 |
| GF1291T | Suit 1 Temp Out | | 2 | 506-3 | 06 | 02 | 1/1 AH 137 | 8 | 28 | 2 | | | 36 | 37 | 142 |
| GF1292T | Suit 2 Temp Out | | 2 | 506-3 | 06 | 03 | 1/1 AH 180 | 10 | 24 | 4 | | | 47 | 5 | 185 |
| GF1301P | Suit Press | F8/ECS | 1 | 504-1 | 05 | 01 | 1/1 AHR 130,147 | 7,8 | 36,40 | 3,1 | | | 34,38 | 69,101 | 135,152 |
| GF1521P | CO ₂ Part Press | | 1 | 504-1 | 05 | 02 | 1/1 AHR 17,46 | 1,3 | 32,25 | 2,4 | | | 5,13 | 37,5 | 18,49 |
| GF1651T | Cabin Temp | | 1 | 506-3 | 21 | 02 | 1/1 AH 128 | 7 | 26 | 4 | | | 34 | 5 | 133 |
| GF2021P | PRI GLY PMP DEL P | F6/ECS | | | | | 1/1 AHR 59,99 | 4,6 | 33,38 | 3,1 | | | 16,26 | 69,101 | 63,104 |
| GF2041X | GLY Level Lo | | 2 | 504-3 | 03 | 03 | 1/1 DPER 3,14 | | | | 24 | 3 | 4,18 | 98,98 | 84,153 |
| GF2936X | SEL GLY PMP Fail | | 2 | 504-4 | 12 | 02 | 1/1 DPER 4,15 | | | | 25 | 7 | 5,19 | 98,98 | 101,154 |
| GF3071X | DMD REG A CLSD | | 2 | 504-5 | 05 | 05 | 1/1 DPER 4,15 | | | | 25 | 3 | 5,19 | 98,98 | 101,154 |
| GF3072X | DMD REG A DIR | | 2 | 504-5 | 05 | 06 | 1/1 DPER 4,15 | | | | 25 | 4 | 5,19 | 98,98 | 101,154 |
| GF3073X | DMD REG B CLSD | | 2 | 504-5 | 05 | 07 | 1/1 DPER 4,15 | | | | 25 | 5 | 5,19 | 98,98 | 101,154 |
| GF3074X | DMD REG B DIR | | 2 | 504-5 | 05 | 08 | 1/1 DPER 4,15 | | | | 25 | 6 | 5,19 | 98,98 | 101,154 |
| GF3571P | Cabin Press | F3/ECS | | | | | 1/1 AHR 83,98 | 5,6 | 39,33 | 1,3 | | | 22,26 | 101,69 | 88,103 |
| GF3572X | Repr Elec Open | | 2 | 504-3 | 03 | 08 | 1/1 DPER 3,14 | | | | 24 | 4 | 4,18 | 98,98 | 84,153 |
| GF3582P | ASC 1 O2 Press | F1/4A9 | 1 | 504-1 | 07 | 01 | 1/1 AHR 12,28 | 1,2 | 26,30 | 4,2 | | | 4,8 | 5,37 | 13,30 |
| GF3583P | ASC 2 O2 Press | F2/4A9 | 1 | 504-1 | 07 | 02 | 1/1 AHR 73,97 | 4,6 | 27,28 | 4,2 | | | 20,26 | 5,37 | 77,102 |
| GF3584P | DES O2 Press | F3/4A9 | 2 | 501-1 | 08 | 02 | 1/1 AHR 131,142 | 7,8 | 41,34 | 1,3 | | | 34,37 | 101,69 | 136,147 |
| GF3585T | ASC 1 O2 Temp | | | | | | 1 AH 39 | 3 | 28 | 2 | | | 11 | 37 | |
| GF3586T | ASC 2 O2 Temp | | | | | | 1 AH 32 | 2 | 31 | 2 | | | 9 | 37 | |
| GF3587T | DES O2 Temp | | | | | | 1/1 AH 182 | 10 | 34 | 3 | | | 47 | 69 | 187 |
| GF3589P | O2 MAINFOLD Press | F10/ECS | | | | | 1/1 AHR 90,103 | 5,6 | 36,39 | 3,1 | | | 24,27 | 69,101 | 95,108 |
| GF3591P | U/H RLF Press | F4/ECS | | | | | 1/1 AH 194 | 10 | 37 | 3 | | | 50 | 69 | 199 |
| GF3592P | F/H RLF Press | F5/ECS | | | | | 1/1 AH 183 | 10 | 39 | 1 | | | 47 | 101 | 188 |
| GF4101P | PRI H ₂ O Reg Del P | F9/ECS | 1 | 504-1 | 18 | 04 | 1/1 AHR 141,168 | 8,9 | 29,26 | 2,4 | | | 37,44 | 37,5 | 146,173 |
| GF4511T | PRI W/B H ₂ O TEMP | | 2 | 506-3 | 06 | 04 | 1/1 AHR 154,163 | 8,9 | 37,39 | 3,1 | | | 40,42 | 69,101 | 159,168 |
| GF4541T | Suit W/B H ₂ O TEMP | | 2 | 506-3 | 06 | 01 | 1/1 AH 184 | 10 | 25 | 4 | | | 48 | 5 | 189 |

Date: April 1968

Page 7-5

FOR TRAINING PURPOSES ONLY

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|----------------------------|-------------|------------|-------------|-----|-----|----------|---------------------|----------------|-------|-----------------|------------|------------------|--------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GF4581Q | DES H ₂ O QTY | F6/4A9 | 1 | 504-1 | 07 | 03 | 1/1 AHR | 58,88 | 4,5 | 28,26 | 2,4 | | 16,24 | 37,5 | 62,93 |
| GF4582Q | ASC 1 H ₂ O QTY | F7/4A9 | 1 | 504-1 | 08 | 01 | 1/1 AHR | 20,54 | 2,3 | 28,27 | 2,4 | | 6,15 | 37,5 | 22,57 |
| GF4583Q | ASC 2 H ₂ O QTY | F8/4A9 | 1 | 504-1 | 08 | 02 | 1/1 AHR | 24,50 | 2,3 | 29,26 | 2,4 | | 7,14 | 37,5 | 26,53 |
| GF9997U | GLY Pump Press | | | | | | 1/1 AHR | 19,29 | 1,2 | 42,35 | 3,3 | | 5,8 | 101,69 | 20,31 |
| GF9998U | GLY Temp | | 1 | 506-3 | 10 | 01 | 1/1 AHR | 120,169 | 7,9 | 24,31 | 4,2 | | 32,44 | 5,37 | 125,174 |
| GF9999U | H ₂ O SEP | F7/ECS | 1 | 504-1 | 05 | 03 | 1/1 AH | 25 | 2 | 34 | 3 | | 7 | 69 | 27 |
| GG0001X | PGNS Down Link, LGC | | | | | | 50 DS | 1,E | | | | | 1 | 125 | |
| GG0001X | PGNS Down Link, LGC | | | | | | 50 DS | 1,D | | | | | 1 | 124 | |
| GG0001X | PGNS Down Link, LGC | | | | | | 50 DS | 1,C | | | | | 1 | 123 | |
| GG0001X | PGNS Down Link, LGC | | | | | | 50 DS | 1,B | | | | | 1 | 122 | |
| GG0001X | PGNS Down Link, LGC | | | | | | 50 DS | 1,A | | | | | 1 | 121 | |
| GG1040V | PLS TORQ REF | | | | | | 1 AHR | 2,49 | 1,3 | 33,40 | 3,1 | | 1,13 | 69,101 | |
| GG1110V | 2.5 VDC TM Bias | | | | | | 1R/1 AH | 23,51 | 2,3 | 24,31 | 4,2 | | 7,14 | 5,37 | 25 |
| GG1201V | IMU 28 VAC 800 | | | | | | 1/1 AH | 121 | 7 | 29 | 2 | | 32 | 37 | 126 |
| GG1331V | IRIG SUSP 3.2KC | | | | | | 1/1 AH | 5 | 1 | 29 | 2 | | 2 | 37 | 6 |
| GG1513X | IMU STBY | | | | | | 1/1 DPER | 6,17 | | | | 27 | 1 | 8,22 | 98,98 |
| GG1523X | LGC OPR | | | | | | 1/1 DPER | 6,17 | | | | 27 | 2 | 8,22 | 98,98 |
| GG2001V | X-PIPA OUT IN PHASE | | | | | | 50 AHR | 2,5 | 16,19 | 47,47 | 2,1 | | 1,1 | 58,61 | |
| GG2021V | Y-PIPA OUT IN PHASE | | | | | | 50 AH | 1 | 15 | 47 | 1 | | 1 | 57 | |
| GG2041V | Z-PIPA OUT IN PHASE | | | | | | 50 AHR | 3,6 | 17,20 | 47,47 | 3,2 | | 1,1 | 59,62 | |
| GG2107V | IG SVO ERR IN PHASE | | | | | | 100 AH | 15 | 15 | 46 | 1 | | 1 | 49 | |
| GG2107V | IG SVO ERR IN PHASE | | | | | | 100 AHR | 1,9 | 15,16 | 44,45 | 1,2 | | 1,1 | 17,26 | |
| GG2110C | IG TORQ MTR Cur | | | | | | 100 AHR | 21 | 21 | 46 | 3 | | 1 | 55 | |
| GG2112V | IG RSVR Out Sine | | | | | | 10/1 AH | 16 | 13 | 39 | 3 | | 2 | 99 | 48 |
| GG2113V | IG RSVR Out Cos | | | | | | 10/1 AH | 14 | 13 | 34 | 3 | | 2 | 67 | 47 |
| GG2121V | IG X1 RSVR Sin X | | | | | | 100 AH | 6 | 20 | 44 | 2 | | 1 | 22 | |
| GG2137V | MG SVO ERR IN PH | | | | | | 100 AH | 17 | 17 | 46 | 3 | | 1 | 51 | |
| GG2137V | MG SVO ERR IN PH | | | | | | 100 AHR | 3,16 | 17,16 | 44,46 | 3,2 | | 1,1 | 19,50 | |
| GG2140C | MG TORQ MTR Cur | | | | | | 100 AH | 14 | 21 | 45 | 3 | | 1 | 31 | |
| GG2142V | MG RSVR Out Sine | | | | | | 10R/1 AH | 9,40 | 12,14 | 29,32 | 2,4 | | 2,5 | 34,36 | 46 |
| GG2143V | MG RSVR Out Cos | | | | | | 10 AH | 12 | 11 | 34 | 1 | | 2 | 65 | |
| GG2143V | MG RSVR Out Cos | | | | | | 1/1 AH | 7 | 1 | 39 | 1 | | 2 | 101 | 8 |
| GG2151V | MG X1 RSVR Sin X | | | | | | 100 AH | 2 | 16 | 44 | 2 | | 1 | 18 | |
| GG2167V | OG SVO ERR IN PH | | | | | | 100 AHR | 13,19 | 20,19 | 45,47 | 2,1 | | 1,1 | 30,53 | |
| GG2167V | OG SVO ERR IN PH | | | | | | 100 AH | 5 | 19 | 44 | 1 | | 1 | 21 | |
| GG2170C | OG TORQ MTR Cur | | | | | | 100 AH | 7 | 21 | 44 | 3 | | 1 | 23 | |

Date: February 1968

Page 7-6

FOR TRAINING PURPOSES ONLY

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|----------------------------|-------------|------------|-------------|-----|-----|-----------------|---------------------|----------------|-----|-----------------|------------|------------------|--------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GG2172V | OG RSVR Out Sin | | | | | | 10/1 AH 24 | 13 | 35 | 3 | | | 3 | 67 | 51 |
| GG2173V | OG RSVR Out Cos | | | | | | 10 AH 28 | 11 | 30 | 1 | | | 4 | 33 | |
| GG2173V | OG RSVR Out Cos | | | | | | 1/1 AH 64 | 4 | 39 | 1 | | | 17 | 101 | 68 |
| GG2181 | OG 1X RSVR Sin X | | | | | | 100 AH 20 | 20 | 46 | 2 | | | 1 | 54 | |
| GG2219V | PITCH ATT ERR | | | | | | 10 AH 35 | 14 | 36 | 4 | | | 4 | 68 | |
| GG2249V | YAW ATT ERR | | | | | | 10 AH 17 | 14 | 39 | 4 | | | 2 | 100 | |
| GG2279V | ROLL ATT ERR | | | | | | 10 AH 23 | 12 | 35 | 2 | | | 3 | 66 | |
| GG2300T | PIPA TEMP | | | | | | 1/1 AHR 123,166 | 7,9 | 39,35 | 1,3 | | | 32,43 | 101,69 | 128,171 |
| GG2301T | IRIG TEMP | | | | | | 1 AH 118 | 7 | 33 | 3 | | | 31 | 69 | |
| GG3304V | RR SHFT Sin | | | | | | 10 AH 32 | 11 | 36 | 1 | | | 4 | 65 | |
| GG3305V | RR SHFT Cos | | | | | | 10 AH 10 | 13 | 29 | 3 | | | 2 | 35 | |
| GG3324V | RR TRUN Sin | | | | | | 10 AH 11 | 14 | 29 | 4 | | | 2 | 36 | |
| GG3325V | RR TRUN Cos | | | | | | 10 AH 20 | 13 | 30 | 3 | | | 3 | 35 | |
| GG6020T | PIPA Cal Temp | | | | | | 1 AH 111 | 6 | 41 | 1 | | | 29 | 101 | |
| GG9001X | LGC Warning | | 2 | 504-3 | 03 | 11 | 1/1 DPER 2,13 | | | | 23 | 1 | 3,17 | 98,98 | 83,141 |
| GG9002X | ISS Warning | | 2 | 504-3 | 03 | 12 | 1/1 DPER 2,13 | | | | 23 | 2 | 3,17 | 98,98 | 83,141 |
| GH1204X | Out Det | | 2 | 504-3 | 14 | 05 | 1 DPE 31 | | | | 52 | 1 | 37 | 98 | |
| GH1214X | Auto On | | 2 | 504-5 | 14 | 06 | 1/1 DPE 23 | | | | 44 | 1 | 29 | 98 | 193 |
| GH1217X | Auto Off | | 2 | 504-5 | 14 | 07 | 1 DPE 31 | | | | 52 | 2 | 37 | 98 | |
| GH1230X | APS ARM | | 1 | 504-2 | 03 | 02 | 1 DPE 41 | | | | 62 | 1 | 47 | 98 | |
| GH1240V | X Trans Cmd | | 2 | 502-2 | 17 | 02 | 10 AH 1 | 11 | 33 | 1 | | | 1 | 65 | |
| GH1241V | Y Trans Cmd | | 2 | 502-2 | 17 | 03 | 10 AH 8 | 11 | 29 | 1 | | | 2 | 33 | |
| GH1242V | Z Trans Cmd | | 2 | 502-2 | 17 | 04 | 10 AH 18 | 11 | 30 | 1 | | | 3 | 33 | |
| GH1247V | Yaw Err Cmd | | 2 | 502-2 | 18 | 03 | 10 AH 25 | 14 | 35 | 4 | | | 3 | 68 | |
| GH1247V | Yaw Err Cmd | | 2 | 502-2 | 18 | 03 | 1/1 AH 139 | 8 | 38 | 1 | | | 36 | 101 | 144 |
| GH1248V | Pitch Err Cmd | | 2 | 502-2 | 18 | 04 | 10 AH 33 | 12 | 36 | 2 | | | 4 | 66 | |
| GH1248V | Pitch Err Cmd | | | | | | 1/1 AH 155 | 8 | 42 | 1 | | | 40 | 101 | 160 |
| GH1249V | Roll Err Cmd | | 2 | 502-2 | 18 | 02 | 10 AH 5 | 12 | 38 | 2 | | | 1 | 98 | |
| GH1249V | Roll Err Cmd | | | | | | 1/1 AH 175 | 9 | 42 | 1 | | | 45 | 101 | 180 |
| GH1260X | APS On | | 2 | 504-3 | 02 | 01 | 50/1 DPER 1,2 | | | | 8 | 1 | 1,1 | 24,32 | 43,44 |
| GH1283X | Abort Stage | | 2 | 504-5 | 14 | 01 | 50/1 DPER 1,2 | | | | 8 | 2 | 1,1 | 24,32 | 43,44 |
| GH1286X | Eng Fire Override | | 2 | 504-5 | 14 | 02 | 1 DPE 31 | | | | 52 | 3 | 37 | 98 | |
| GH1301X | DPS ON | | 2 | 504-3 | 03 | 04 | 1/1 DPE 23 | | | | 44 | 2 | 29 | 98 | 193 |
| GH1311V | Man Thrust On | | 1 | 502-2 | 15 | 02 | 1/1 AH 132 | 7 | 27 | 4 | | | 35 | 5 | 137 |
| GH1313V | Pitch GDA POS | | 2 | 507-1 | 09 | 01 | 10 AH 30 | 13 | 31 | 3 | | | 4 | 35 | |
| GH1313V | Pitch GDA POS | | | | | | 1/1 AH 22 | 2 | 38 | 1 | | | 6 | 101 | 24 |

Date: April 1963

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | ROW (FS) | PROGRAMMER COMMANDS | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|---------------------------------|-------------|------------|-------------|-----|-----|----------------|----------|---------------------|-----|-----------------|------------|------------------|--------|------------------------|
| | | | | TYPE | LOC | CKT | | | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GH1314V | ROLL GDA POS | | 2 | 507-1 | 09 | 02 | 10 AH 31 | 14 | 31 | 4 | | | 4 | 36 | |
| GH1314V | ROLL GDA POS | | | | | | 1/1 AH 11 | 1 | 40 | 1 | | | 3 | 101 | 12 |
| GH1323X | P Trim Fail (Changed to GL9003) | 2 | | 504-3 | 03 | 09 | 1/1 DPE 23 | | | | 44 | 3 | 29 | 98 | 193 |
| GH1330X | R Trim Fail (Changed to GL9004) | 2 | | 504-3 | 03 | 10 | 1/1 DPE 23 | | | | 44 | 4 | 29 | 98 | 193 |
| GH1331V | Auto Thrust Cmd | 1 | | 502-2 | 15 | 01 | 10 AH 21 | 14 | 30 | 4 | | | 3 | 36 | |
| GH1331V | Auto Thrust Cmd | | | | | | 1/1 AH 186 | 10 | 35 | 3 | | | 48 | 69 | 191 |
| GH1348X | DPS Arm | 1 | | 504-2 | 03 | 09 | 1 DPE 41 | | | | 62 | 2 | 47 | 98 | |
| GH1418V | JD 4U Output | 1 | | 504-2 | 04 | 03 | 100 DPER 1,2 | | | | 5 | 8 | 1,1 | 8,16 | |
| GH1419V | JD 4D Output | 1 | | 504-2 | 04 | 05 | 100 DPER 1,2 | | | | 5 | 7 | 1,1 | 8,16 | |
| GH1420V | JD 4F Output | 1 | | 504-2 | 04 | 04 | 100 DPE 4 | | | | 7 | 8 | 1 | 48 | |
| GH1421V | JD 4R Output | 1 | | 504-2 | 04 | 06 | 100 DPE 4 | | | | 7 | 7 | 1 | 48 | |
| GH1422V | JD 3U Output | 1 | | 504-2 | 04 | 07 | 100 DPER 1,2 | | | | 5 | 6 | 1,1 | 8,16 | |
| GH1423V | JD 3D Output | 1 | | 504-2 | 04 | 08 | 100 DPER 1,2 | | | | 5 | 5 | 1,1 | 8,16 | |
| GH1424V | JD 3A Output | 1 | | 504-2 | 04 | 09 | 100 DPE 4 | | | | 7 | 6 | 1 | 48 | |
| GH1425V | JD 3R Output | 1 | | 504-2 | 04 | 10 | 100 DPE 4 | | | | 7 | 5 | 1 | 48 | |
| GH1426V | JD 2U Output | 1 | | 504-2 | 02 | 01 | 100 DPER 1,2 | | | | 5 | 4 | 1,1 | 8,16 | |
| GH1427V | JD 2D Output | 1 | | 504-2 | 02 | 02 | 100 DPER 1,2 | | | | 5 | 3 | 1,1 | 8,16 | |
| GH1428V | JD 2A Output | 1 | | 504-2 | 02 | 03 | 100 DPE 4 | | | | 7 | 4 | 1 | 48 | |
| GH1429V | JD 2L Output | 1 | | 504-2 | 02 | 04 | 100 DPE 4 | | | | 7 | 3 | 1 | 48 | |
| GH1430V | JD 1U Output | 1 | | 504-2 | 02 | 05 | 100 DPER 1,2 | | | | 5 | 2 | 1,1 | 8,16 | |
| GH1431V | JD 1D Output | 1 | | 504-2 | 02 | 06 | 100 DPER 1,2 | | | | 5 | 1 | 1,1 | 8,16 | |
| GH1432V | JD 1F Output | 1 | | 504-2 | 02 | 08 | 100 DPE 4 | | | | 7 | 2 | 1 | 48 | |
| GH1433V | JD 1L Output | 1 | | 504-2 | 02 | 07 | 100 DPE 4 | | | | 7 | 1 | 1 | 48 | |
| GH1455V | Yaw Att Err | 2 | | 507-1 | 09 | 03 | 10 AHR 15,39 | 14,13 | 34,32 | 4,3 | | | 2,5 | 68,35 | |
| GH1455V | Yaw Att Err | | | | | | 1/1 AH 26 | 2 | 39 | 1 | | | 7 | 101 | 28 |
| GH1456V | Pitch Att Err | 2 | | 507-1 | 09 | 04 | 10 AHR 7,42 | 14,12 | 38,37 | 4,2 | | | 1,5 | 100,66 | |
| GH1456V | Pitch Att Err | | | | | | 1/1 AH 60 | 4 | 38 | 1 | | | 16 | 101 | 64 |
| GH1457V | Roll Att Err | 2 | | 507-1 | 10 | 01 | 10 AHR 13,37 | 12,11 | 34,32 | 2,1 | | | 2,5 | 66,33 | |
| GH1457V | Roll Att Err | | | | | | 1/1 AHR 115 | 6 | 42 | 1 | | | 30 | 101 | 120 |
| GH1461V | RGA Yaw Rate | 2 | | 507-1 | 10 | 02 | 10/1 AHR 19,43 | 12,13 | 30,37 | 2,3 | | | 3,5 | 34,67 | 50,59 |
| GH1462V | RGA Pitch Rate | 2 | | 507-1 | 10 | 03 | 10/1 AHR 29,45 | 12,13 | 31,42 | 2,3 | | | 4,5 | 34,99 | 54,60 |
| GH1463V | RGA Roll Rate | 2 | | 507-1 | 10 | 04 | 10/1 AHR 38,34 | 12,13 | 32,36 | 2,3 | | | 5,4 | 34,67 | 58,55 |
| GH1603X | Min Dead Band | 1 | | 504-2 | 03 | 01 | 1 DPE 41 | | | | 62 | 3 | 47 | 98 | |
| GH1608X | Auto Mode | 2 | | 504-5 | 14 | 03 | 1 DPE 31 | | | | 52 | 4 | 37 | 98 | |
| GH1609X | Att Hold | 2 | | 504-5 | 14 | 04 | 1 DPE 31 | | | | 52 | 5 | 37 | 98 | |
| GH1621X | AGS Sel | 2 | | 504-3 | 03 | 05 | 1/1 DPE 23 | | | | 44 | 5 | 29 | 98 | 193 |

Date: April 1968

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|----------------------------|-------------|------------|-------------|-----|-----|----------------|---------------------|----------------|-----|-----------------|------------|------------------|--------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GH1628X | Roll Plsd/Dir | | 2 | 504-5 | 13 | 01 | 1 DPE 27 | | | | 48 | 1 | 33 | 98 | |
| GH1629X | Pitch Plsd/Dir | | 2 | 504-5 | 13 | 02 | 1 DPE 27 | | | | 48 | 2 | 33 | 98 | |
| GH1630X | Yaw Plsd/Dir | | 2 | 504-5 | 13 | 06 | 1 DPE 27 | | | | 48 | 3 | 33 | 98 | |
| GH1893X | X Trans Override | | 1 | 504-2 | 03 | 10 | 1 DPE 41 | | | | 62 | 4 | 47 | 98 | |
| GH1896X | Unbal CPLS | | 2 | 504-5 | 14 | 08 | 1 DPE 31 | | | | 52 | 6 | 37 | 98 | |
| GI0001X | AGS Dwn Link TM | | | | | | 50 DS 2,C | | | | | | 1 | 128 | |
| GI0001X | AGS Dwn Link TM | | | | | | 50 DS 2,B | | | | | | 1 | 127 | |
| GI0001X | AGS Dwn Link Tm | | | | | | 50 DS 2,A | | | | | | 1 | 126 | |
| GI3301T | ASA Temp | | 1 | 506-3 | 10 | 02 | 1/1 AHR 65,89 | 4,5 | 25,31 | 4,2 | | | 18,24 | 5,37 | 69,94 |
| GI3305X | AGS Warm Up | | 2 | 504-3 | 02 | 11 | 1 DPE 27 | | | | 48 | 4 | 33 | 98 | |
| GI3306X | AGS Stby | | 2 | 504-5 | 13 | 05 | 1 DPE 27 | | | | 48 | 5 | 33 | 98 | |
| GL0300 | Frame Synch & ID | | | | | | 50/1 DP 1,D | | | | 15 | 1 | 4 | 4 | |
| GL0300 | Frame Synch & ID | | | | | | 50/1 DP 1,C | | | | 14 | 1 | 3 | 3 | |
| GL0300 | Frame Synch & ID | | | | | | 50/1 DP 1,B | | | | 13 | 1 | 2 | 2 | |
| GL0300 | Frame Synch & ID | | | | | | 50/1 DP 1,A | | | | 12 | 1 | 1 | 1 | |
| GL0302 | Format ID | | | | | | 1/1 DP 1 | | | | 67 | 1 | 5 | 5 | |
| GL0400X | Osc Fail Detct 1 | | | | | | 1/1 DPER 7,18 | | | | 28 | 8 | 9,23 | 98,98 | 115,161 |
| GL0401V | Cal 85 Pct | | | | | | 10R/1 AH 26,41 | 13,11 | 40,37 | 3,1 | | | 3,5 | 99,65 | 52 |
| GL0402V | Cal 15 Pct | | | | | | 10R/1 AH 36,27 | 13,14 | 41,40 | 3,4 | | | 4,3 | 99,100 | 56 |
| GL0422 | Osc Fail Detct 2 | | | | | | 1/1 AH 171 | 9 | 41 | 1 | | | 44 | 101 | 176 |
| GL0423 | Osc Fail Detct 3 | | | | | | 1/1 AH 85 | 5 | 30 | 2 | | | 23 | 37 | 90 |
| GL0501W | MET | | | | | | 10/1 DP 1,D | | | | 20 | | 1 | 36 | 36 |
| GL0501W | MET | | | | | | 10/1 DP 1,C | | | | 19 | | 1 | 35 | 35 |
| GL0501W | MET | | | | | | 10/1 DP 1,B | | | | 18 | | 1 | 34 | 34 |
| GL0501W | MET | | | | | | 10/1 DP 1,A | | | | 17 | | 1 | 33 | 33 |
| GL4026X | CES AC Pwr Fail | | 2 | 504-3 | 02 | 01 | 1/1 DPER 7,18 | | | | 28 | 1 | 9,23 | 98,98 | 115,161 |
| GL4027X | CES DC Pwr Fail | | 2 | 504-3 | 02 | 12 | 1/1 DPER 7,18 | | | | 28 | 2 | 9,23 | 98,98 | 115,161 |
| GL4028X | AGS Pwr Fail | | 2 | 504-3 | 02 | 02 | 1/1 DPER 7,18 | | | | 28 | 3 | 9,23 | 98,98 | 115,161 |
| GL4054X | CWEA Pwr Fail | | 2 | 504-4 | 12 | 01 | 1/1 DPER 7,18 | | | | 28 | 4 | 9,23 | 98,98 | 115,161 |
| GL4069X | Master Alarm On | | 2 | 504-3 | 02 | 08 | 1/1 DPER 7,18 | | | | 28 | 5 | 9,23 | 98,98 | 115,161 |
| GL4221X | DFI Cal On | | | | | | 1 DPE 39 | | | | 60 | 3 | 44 | 100 | |
| GL4222X | LM/SLA SEP | | | | | | 1 DPE 39 | | | | 60 | 4 | 44 | 100 | |
| GM0064T | Land Gear Temp | | 2 | 506-3 | 21 | 01 | 1/1 AH 113 | 6 | 32 | 2 | | | 30 | 37 | 118 |
| GM5000U | Land Gear Deploy | | 1 | 504-4 | 13 | 09 | 1 DPE 40 | | | | 61 | 1 | 45 | 98 | |

Date: April 1968

Page 7-9

FOR TRAINING PURPOSES ONLY

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|--------------------------------|-------------|------------|-------------|-----|-----|-----------------|---------------------|----------------|-----|-----------------|------------|------------------|--------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GN7521X | LR Range Bad | | 2 | 504-3 | 02 | 03 | 1/1 DPER 1,12 | | | | 22 | 1 | 2,15 | 98,98 | 82,124 |
| GN7557X | LR Vel Bad | | 2 | 504-3 | 02 | 04 | 1/1 DPER 1,12 | | | | 22 | 2 | 2,15 | 98,98 | 82,124 |
| GN7563T | LR Ant Temp | | 1 | 506-3 | 21 | 04 | 1R/1 AH 164,149 | 9,8 | 25,31 | 4,2 | | | 43,39 | 5,37 | 169 |
| GN7621X | RR No. Trak | | 2 | 504-3 | 02 | 05 | 1/1 DPER 1,12 | | | | 22 | 3 | 2,15 | 98,98 | 82,124 |
| GN7723T | RR Ant Temp | | 1 | 506-3 | 21 | 03 | 1 AHR 31,55 | 2,3 | 26,32 | 4,2 | | | 9,15 | 5,37 | |
| GP0001P | APS HE 1 Press | F23/4A9 | 1 | 504-1 | 08 | 04 | 1/1 AHR 153,179 | 8,10 | 32,38 | 2,1 | | | 40,46 | 37,101 | 158,184 |
| GP0002P | APS HE 2 Press | F24/4A9 | 1 | 504-1 | 19 | 01 | 1/1 AHR 93,100 | 5,6 | 32,24 | 2,4 | | | 25,27 | 37,5 | 98,105 |
| GP0018P | Reg Out MNFLD | F31/4A9 | | | | | 1 AH 70 | 4 | 31 | 2 | | | 19 | 37 | |
| GP0025P | APS HE Reg Press | F25/4A9 | 1 | 504-1 | 08 | 03 | 1/1 AH 37 | 2 | 37 | 3 | | | 10 | 69 | 39 |
| GP0201T | APS HE 1 Temp | | 2 | 506-3 | 21 | 03 | 1/1 AHR 135,170 | 7,9 | 42,36 | 1,3 | | | 35,44 | 101,69 | 140,175 |
| GP0202T | APS HE 2 Temp | | 2 | 506-3 | 21 | 04 | 1/1 AHR 13,27 | 1,2 | 31,25 | 2,4 | | | 4,8 | 37,5 | 14,29 |
| GP0318X | APS HE 1 CLSD | | 1 | 504-4 | 12 | 06 | 1 DPE 43 | | | | 64 | 1 | 49 | 98 | |
| GP0320X | APS HE 2 CLSD | | 1 | 504-4 | 12 | 07 | 1 DPE 43 | | | | 64 | 2 | 49 | 98 | |
| GP0718T | APS Fuel Temp | | 1 | 506-3 | 09 | 03 | 1/1 AH 114 | 6 | 37 | 3 | | | 30 | 69 | 119 |
| GP0908X | APS Fuel Lo | F26/4A9 | 2 | 504-3 | 02 | 06 | 1/1 DPE 24 | | | | 45 | 1 | 29 | 100 | 194 |
| GP1218T | APS OX Temp | | 1 | 506-3 | 09 | 04 | 1/1 AHR 129,144 | 7,8 | 31,25 | 2,4 | | | 34,38 | 37,5 | 134,149 |
| GP1408T | APS OX Lo | F27/4A9 | 2 | 504-3 | 02 | 07 | 1/1 DPE 24 | | | | 45 | 2 | 29 | 100 | 194 |
| GP1501P | APS Fuel Press | F28/4A9 | 1 | 504-1 | 19 | 03 | 1/1 AHR 62,92 | 4,5 | 29,27 | 2,4 | | | 17,25 | 37,5 | 66,97 |
| GP1503P | APS OX Press | F29/4A9 | 1 | 504-1 | 19 | 04 | 1/1 AHR 61,105 | 4,6 | 24,30 | 4,2 | | | 17,28 | 5,37 | 65,110 |
| GP2010P | APS TCP | F30/4A9 | | | | | 1/1 AHR 173,178 | 9,10 | 32,33 | 2,3 | | | 45,46 | 37,69 | 178,183 |
| GP2997U | APS DELTA PCS A | | | | | | 100 DPE 3 | | | | 6 | 1 | 1 | 40 | |
| GP2997U | APS DELTA PCS A | | 2 | 504-5 | 14 | 11 | 1 DPE 32 | | | | 53 | 3 | 38 | 98 | |
| GP2998U | APS DELTA PCS B | | | | | | 100 DPE 3 | | | | 6 | 2 | 1 | 40 | |
| GP2998U | APS DELTA PCS B | | 2 | 504-5 | 14 | 12 | 1 DPE 32 | | | | 53 | 4 | 38 | 98 | |
| GP7723X | RCCA A Acc (Changed to GL9003) | | 2 | 504-3 | 03 | 09 | 1/1 DPE 23 | | | | 44 | 3 | 29 | 98 | 193 |
| GP7724X | RCCA B Acc (Changed to GL9004) | | 2 | 504-3 | 03 | 10 | 1/1 DPE 23 | | | | 44 | 4 | 29 | 98 | 193 |
| GQ3015P | START TANK PRESS | F5/4A10 | | | | | 1 AH 40 | 3 | 33 | 3 | | | 11 | 69 | |
| GQ3018P | DPS HE REG Press | F32/4A9 | 1 | 504-1 | 19 | 02 | 1/1 AH 42 | 3 | 24 | 4 | | | 12 | 5 | 45 |
| GQ3025P | DPS HE REG Press | F37/4A9 | | | | | 1 AH 108 | 6 | 26 | 4 | | | 29 | 5 | |
| GQ3309X | DPS HE 1 CLSD | | | | | | 1 DPE 38 | | | | 59 | 3 | 44 | 98 | |
| GQ3310X | DPS HE 2 OPEN | | | | | | 1 DPE 38 | | | | 59 | 4 | 44 | 98 | |
| GQ3435P | DPS HE Press | F34/4A9 | | | | | 1/1 AHR 6,30 | 1,2 | 34,40 | 3,1 | | | 2,8 | 69,101 | 7,32 |
| GQ3603Q | DPS Fuel 1 Qty | | | | | | 1R/1 AH 104,77 | 6,5 | 25,28 | 4,2 | | | 28,21 | 5,37 | 109 |
| GQ3604Q | DPS Fuel 2 Qty | | | | | | 1R/1 AH 101,69 | 6,4 | 29,26 | 2,4 | | | 27,19 | 37,5 | 106 |

Date: April 1968

Page 7-10

FOR TRAINING PURPOSES ONLY

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|----------------------------|-------------|------------|-------------|-----|-----|-----------------|---------------------|----------------|-------|-----------------|------------|------------------|--------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GQ3611P | DPS Fuel Press | F33/4A9 | | | | | 1/1 AH 18 | 1 | 37 | 3 | | | 5 | 69 | 19 |
| GQ3718T | DPS Fuel 1 Temp | | 1 | 506-3 | 09 | 01 | 1 AHR 4,47 | 1,3 | 24,30 | 4,2 | | | 2,13 | 5,37 | |
| GQ3719T | DPS Fuel 2 Temp | | 1 | 506-3 | 09 | 02 | 1 AH 117,148 | 7,8 | 28,26 | 2,4 | | | 31,39 | 37,5 | |
| GQ4103Q | DPS OX 1 Qty | | | | | | 1R/1 AH 165,116 | 9,7 | 30,23 | 2,4 | | | 43,31 | 37,5 | 170 |
| GQ4104Q | DPS OX 2 Qty | | | | | | 1R/1 AH 133,176 | 7,10 | 32,23 | 2,4 | | | 35,46 | 37,5 | 138 |
| GQ4111P | DPS OX Press | F36/4A9 | | | | | 1/1 AH 10 | 1 | 35 | 1 | | | 3 | 69 | 11 |
| GQ4218T | DPS OX 2 Temp | | 1 | 506-3 | 10 | 03 | 1 AHR 3,48 | 1,3 | 38,35 | 1,3 | | | 1,13 | 101,69 | |
| GQ4219T | DPS OX 2 Temp | | 1 | 506-3 | 10 | 04 | 1 AHR 34,56 | 2,3 | 41,37 | 1,3 | | | 9,15 | 101,69 | |
| GQ4455X | DPS PROP LO | | 2 | 504-3 | 02 | 09 | 1 DPE 32 | | | | 53 | 2 | 38 | 98 | |
| GQ6510P | DPS TCP | F35/4A9 | | | | | 1/1 AHR 76,86 | 4,5 | 42,35 | 1,3 | | | 20,23 | 101,69 | 80,91 |
| GQ6806H | Var Inj Act Pos | | | | | | 50 AH 8 | 22 | 47 | 4 | | | 1 | 64 | |
| GQ6806H | Var Inj Act Pos | | | | | | 50 AH 4 | 18 | 46 | 4 | | | 1 | 60 | |
| GQ6806H | Var Inj Act Pos | | | | | | 1/1 AH 193 | 10 | 32 | 2 | | | 50 | 37 | 198 |
| GQ7498U | DPS Delta Pct A | | | | | | 100 DPE 3 | | | | 6 | 3 | 1 | 40 | |
| GQ7498U | DPS Delta Pct A | | 2 | 504-5 | 14 | 09 | 1 DPE 32 | | | | 53 | 5 | 38 | 98 | |
| GQ7499U | DPS Delta Pct B | | | | | | 100 DPE 3 | | | | 6 | 4 | 1 | 40 | |
| GQ7499U | DPS Delta Pct B | | 2 | 504-5 | 14 | 10 | 1 DPE 32 | | | | 53 | 6 | 38 | 98 | |
| GR1085Q | RCS Prop A Qty | | | | | | 1R/1 AH 162,151 | 9,8 | 34,41 | 3,1 | | | 42,39 | 69,101 | 167 |
| GR1095Q | RCS Prop B Qty | | | | | | 1R/1 AH 146,119 | 8,7 | 35,38 | 3,1 | | | 38,31 | 69,101 | 151 |
| GR1101P | RCS A HE Press | F10/4A9 | 1 | 504-1 | 06 | 01 | 1/1 AHR 125,160 | 7,9 | 30,24 | 2,4 | | | 33,42 | 37,5 | 130,165 |
| GR1102P | RCS B HE Press | F11/4A9 | 1 | 504-1 | 06 | 02 | 1/1 AHR 124,145 | 7,8 | 25,30 | 4,2 | | | 33,38 | 5,37 | 129,150 |
| GR1201P | RCS A Reg Press | | | | | | 1/1 AH 112 | 6 | 27 | 4 | | | 30 | 5 | 117 |
| GR1201P | RCS A Reg Press | F12/4A9 | 1 | 504-1 | 06 | 03 | 1 AH 110 | 6 | 36 | 3 | | | 29 | 69 | |
| GR1202P | RCS B Reg Press | | | | | | 1/1 AH 140 | 8 | 24 | 4 | | | 37 | 5 | 145 |
| GR1202P | RCS B Reg Press | F13/4A9 | 1 | 504-1 | 06 | 04 | 1/1 AH 138 | 8 | 33 | 3 | | | 36 | 69 | 143 |
| GR2121T | RCS A Fuel Temp | | 2 | 506-3 | 20 | 02 | 1/1 AH 66 | 4 | 30 | 2 | | | 18 | 37 | 70 |
| GR2122T | RCS B Fuel Temp | | 2 | 506-3 | 20 | 03 | 1/1 AH 74 | 4 | 32 | 2 | | | 20 | 37 | 78 |
| GR2201P | A Fuel MFLD Press | | | | | | 200 AHR 1,4 | 15,18 | 43,43 | 1,4 | | | 1,1 | 9,12 | |
| GR2201P | A Fuel MLFD Press | F16/4A9 | | | | | 1R/1 AH 14,15 | 1,3 | 36,39 | 3,1 | | | 4,12 | 69,101 | 15 |
| GR2202P | B Fuel MFLD Press | | | | | | 200 AH 3 | 17 | 43 | 3 | | | 1 | 11 | |
| GR2202P | B Fuel MFLD | F17/4A9 | | | | | 1R/1 AH 15,44 | 1,1,3 | 41,41,34 | 1,4,3 | | | 4,12 | 101,69 | 16 |
| GR3201P | A OX MFLD Press | | | | | | 200 AH 6 | 20 | 43 | 2 | | | 1 | 14 | |
| GR3201P | A OX MFLD Press | F20/4A9 | | | | | 1R/1 AH 21,53 | 2,3 | 33,41 | 3,1 | | | 6,14 | 69,101 | 23 |
| GR3202P | B OX MFLD Press | | | | | | 200 AHR 2,5 | 16,19 | 43,43 | 2,1 | | | 1,1 | 10,13 | |
| GR3202P | B OX MFLD Press | F21/4A9 | | | | | 1R/1 AH 38,52 | 2,3 | 42,36 | 1,3 | | | 10,14 | 101,69 | 40 |
| GR5031X | Press Thr Chm 4U | | 1 | 504-2 | 11 | 01 | 200 DPE 1,A | | | | 2 | 8 | 1 | 6 | |

Date: April 1968

Page 7-11

FOR TRAINING PURPOSES ONLY

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|----------------------------|-------------|------------|-------------|-----|-----|----------------|---------------------|----------------|-----|-----------------|------------|------------------|-------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GR5032X | Press Thr Chm 4D | | 1 | 504-2 | 11 | 02 | 200 DPE 1,A | | | | 2 | 7 | 1 | 6 | |
| GR5033X | Press Thr Chm 4F | | 1 | 504-2 | 11 | 03 | 200 DPE 1,A | | | | 2 | 6 | 1 | 6 | |
| GR5034X | Press Thr Chm 4R | | 1 | 504-2 | 11 | 04 | 200 DPE 1,A | | | | 2 | 5 | 1 | 6 | |
| GR5035X | Press Thr Chm 3U | | 1 | 504-2 | 11 | 05 | 200 DPE 1,A | | | | 2 | 4 | 1 | 6 | |
| GR5036X | Press Thr Chm 3D | | 1 | 504-2 | 11 | 06 | 200 DPE 1,A | | | | 2 | 3 | 1 | 6 | |
| GR5037X | Press Thr Chm 3A | | 1 | 504-2 | 11 | 07 | 200 DPE 1,A | | | | 2 | 2 | 1 | 6 | |
| GR5038X | Press Thr Chm 3R | | 1 | 504-2 | 11 | 08 | 200 DPE 1,A | | | | 2 | 1 | 1 | 6 | |
| GR5039X | Press Thr Chm 2U | | 1 | 504-2 | 11 | 09 | 200 DPE 1,B | | | | 3 | 8 | 1 | 7 | |
| GR5040X | Press Thr Chm 2D | | 1 | 504-2 | 11 | 10 | 200 DPE 1,B | | | | 3 | 7 | 1 | 7 | |
| GR5041X | Press Thr Chm 2A | | 1 | 504-2 | 03 | 03 | 200 DPE 1,B | | | | 3 | 6 | 1 | 7 | |
| GR5042X | Press Thr Chm 2L | | 1 | 504-2 | 03 | 04 | 200 DPE 1,B | | | | 3 | 5 | 1 | 7 | |
| GR5043X | Press Thr Chm 1U | | 1 | 504-2 | 03 | 05 | 200 DPE 1,B | | | | 3 | 4 | 1 | 7 | |
| GR5044X | Press Thr Chm 1D | | 1 | 504-2 | 03 | 06 | 200 DPE 1,B | | | | 3 | 3 | 1 | 7 | |
| GR5045X | Press Thr Chm 1F | | 1 | 504-2 | 03 | 07 | 200 DPE 1,B | | | | 3 | 2 | 1 | 7 | |
| GR5046X | Press Thr Chm 1L | | 1 | 504-2 | 03 | 08 | 200 DPE 1,B | | | | 3 | 1 | 1 | 7 | |
| GR6001T | Quad 4 Temp | | 1 | 506-3 | 20 | 04 | 1/1 AH 8 | 1 | 25 | 4 | | | 3 | 5 | 9 |
| GR6002T | Quad 3 Temp | | 1 | 506-3 | 20 | 01 | 1/1 AH 35 | 2 | 27 | 4 | | | 10 | 5 | 37 |
| GR6003T | Quad 2 Temp | | 1 | 506-3 | 20 | 02 | 1/1 AH 80 | 5 | 24 | 4 | | | 22 | 5 | 85 |
| GR6004T | Quad 1 Temp | | 1 | 506-3 | 20 | 03 | 1/1 AH 84 | 5 | 25 | 4 | | | 23 | 5 | 89 |
| GR9609U | RCS Main A Clsd | | 1 | 504-4 | 12 | 08 | 1/1 DPER 10,21 | | | | 31 | 3 | 13,27 | 98,98 | 122,164 |
| GR9610U | RCS Main B Clsd | | 1 | 504-4 | 12 | 10 | 1/1 DPER 10,21 | | | | 31 | 4 | 13,27 | 98,98 | 122,164 |
| GR9613U | A/B X Feed Open | | 1 | 504-4 | 13 | 12 | 1/1 DPER 10,21 | | | | 31 | 7 | 13,27 | 98,98 | 122,164 |
| GR9631U | Sys A FL Inct Vlv Open | | 1 | 504-4 | 13 | 10 | 1/1 DPER 10,21 | | | | 31 | 5 | 13,27 | 98,98 | 122,164 |
| GR9632U | Sys B FL Inct Vlv Open | | 1 | 504-4 | 13 | 11 | 1/1 DPER 10,21 | | | | 31 | 6 | 13,27 | 98,98 | 122,164 |
| GR9641U | Sys A OX Inct Vlv Open | | 1 | 504-4 | 13 | 03 | 1/1 DPER 10,21 | | | | 31 | 1 | 13,27 | 98,98 | 122,164 |
| GR9642U | Sys B OX Inct Vlv Open | | 1 | 504-4 | 12 | 04 | 1/1 DPER 10,21 | | | | 31 | 2 | 13,27 | 98,98 | 122,164 |
| GR9661U | 4A Iso Clsd | | 1 | 504-4 | 12 | 01 | 1 DPE 42 | | | | 63 | 1 | 48 | 98 | |
| GR9662U | 4B Iso Clsd | | 1 | 504-4 | 13 | 02 | 1 DPE 42 | | | | 63 | 2 | 48 | 98 | |
| GR9663U | 3A Iso Clsd | | 1 | 504-4 | 13 | 03 | 1 DPE 42 | | | | 63 | 3 | 48 | 98 | |
| GR9664U | 3B Iso Clsd | | 1 | 504-4 | 13 | 04 | 1 DPE 42 | | | | 63 | 4 | 48 | 98 | |
| GR9665U | 2A Iso Clsd | | 1 | 504-4 | 13 | 05 | 1 DPE 42 | | | | 63 | 5 | 48 | 98 | |
| GR9666U | 2B Iso Clsd | | 1 | 504-4 | 13 | 06 | 1 DPE 42 | | | | 63 | 6 | 48 | 98 | |
| GR9667U | 1A Iso Clsd | | 1 | 504-4 | 13 | 07 | 1 DPE 42 | | | | 63 | 7 | 48 | 98 | |
| GR9668U | 1B Iso Clsd | | 1 | 504-4 | 13 | 08 | 1 DPE 42 | | | | 63 | 8 | 48 | 98 | |
| GT0201E | S-Band Pwr Amp PO | | | | | | 1/1 AH 187 | 10 | 40 | 1 | | | 48 | 101 | 192 |
| GT0202E | S-Band RFLT Pwr | | | | | | 1 AH 159 | 9 | 38 | 1 | | | 41 | 101 | |

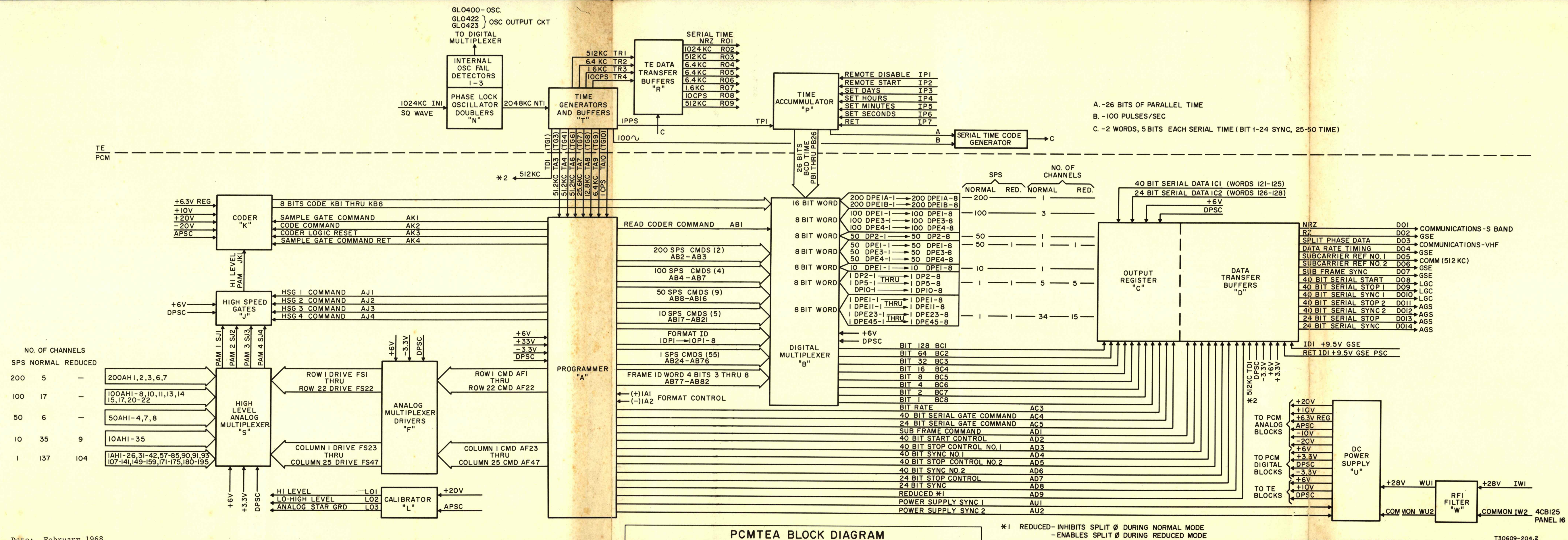
Date: April 1968

Page 7-12

FOR TRAINING PURPOSES ONLY

TABLE 7-2 (Continued)

| MEAS. ID | MEASUREMENT DESCRIPTION | FUSE NO. | ERA NO. | SUBASSEMBLY | | | PCM ID | PROGRAMMER COMMANDS | | | DIGITAL (AB) | BIT NO. | HIGH BIT RATE | | LO BIT RATE WORD |
|-------------|----------------------------|-------------|------------|-------------|-----|-----|-----------------|---------------------|----------------|-----|-----------------|------------|------------------|-------|------------------------|
| | | | | TYPE | LOC | CKT | | ROW (FS) | COLUMN (FS) | PAM | | | FRAME | WORD | |
| GT0441X | DCA Status | | | | | | 50 DP 2 | | | | 16 | | 1 | 97 | |
| GT0619V | UHF SIG STR | | | | | | 1 AH 1 | 1 | 28 | 2 | | | 1 | 37 | |
| GT0992B | S-BND ST PH ERR | | | | | | 10 AH 2 | 12 | 33 | 2 | | | 1 | 66 | |
| GT0992B | S-BND ST PH ERR | | | | | | 1/1 AH 185 | 10 | 30 | 2 | | | 48 | 37 | 190 |
| GT0993E | S-BND XMTR PO | | | | | | 1/1 AH 195 | 10 | 42 | 1 | | | 50 | 101 | 200 |
| GT0994V | S-BND RCVR SIG | | 1 | 504-1 | 05 | 04 | 1/1 AHR 152,161 | 8,9 | 27,29 | 4,2 | | | 40,42 | 5,37 | 157,166 |
| GY0050X | ABORT CMD | | 1 | 504-2 | 02 | 09 | 1/1 DPER 11,22 | | | | 32 | 1 | 14,28 | 98,98 | 123,181 |
| GY0201X | ED A REL XFER | | 1 | 504-4 | 12 | 11 | 1/1 DPER 11,22 | | | | 32 | 6 | 14,28 | 98,98 | 123,181 |
| GY0202X | ED B REL XFER | | 1 | 504-4 | 12 | 12 | 1/1 DPER 11,22 | | | | 32 | 7 | 14,28 | 98,98 | 123,181 |
| GY0231X | A EED RLYS CLSD | | 1 | 504-5 | 14 | 09 | 1/1 DPER 11,22 | | | | 32 | 4 | 14,28 | 98,98 | 123,181 |
| GY0232X | B EED RLYS CLSD | | 1 | 504-5 | 14 | 10 | 1/1 DPER 11,22 | | | | 32 | 5 | 14,28 | 98,98 | 123,181 |
| IN SH | Internal Short | | | | | | 200 AH 7 | 21 | 43 | 3 | | | 1 | 15 | |
| IN SH | Internal Short | | | | | | 200 AH 22 | 22 | 46 | 4 | | | 1 | 56 | |
| IN SH | Internal Short | | | | | | 100 AH 11 | 18 | 45 | 4 | | | 1 | 28 | |
| IN SH | Internal Short | | | | | | 100 AH 8 | 15 | 45 | 1 | | | 1 | 25 | |
| IN SH | Internal Short | | | | | | 100 AHR 4,12 | 18,19 | 44,44 | 4,1 | | | 1 | 20,29 | |
| IN SH | Internal Short | | | | | | 50 AH 7 | 21 | 47 | 3 | | | 1 | 63 | |
| IN SH | Internal Short | | | | | | 10 AHR 6,44 | 13,14 | 38,37 | 3,4 | | | 1,5 | 98,68 | |
| IN SH | Internal Short | | | | | | 10 AH 4 | 14 | 33 | 4 | | | 1 | 68 | |





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