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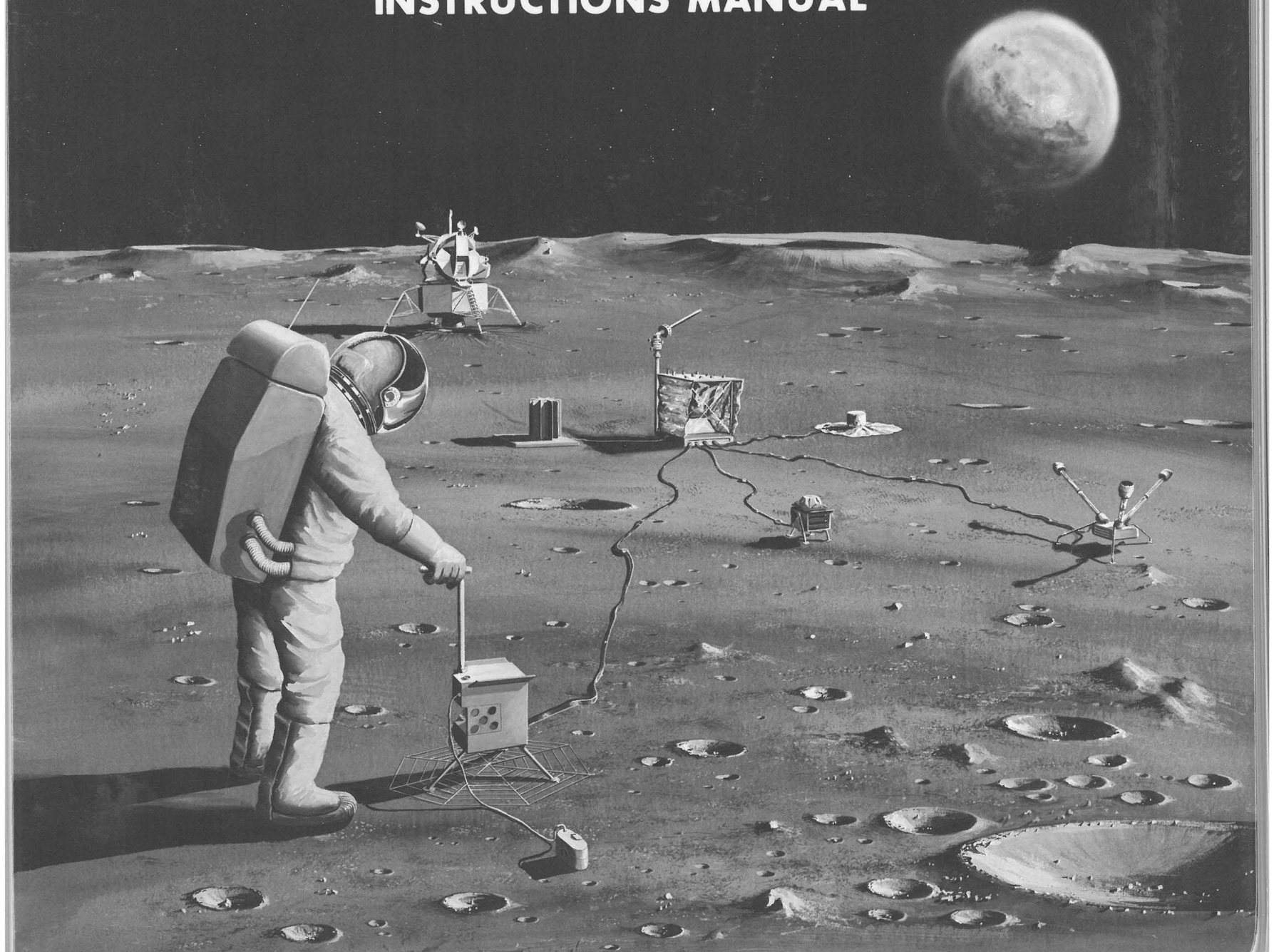
ALSEP-LS-07

APOLLO LUNAR SURFACE EXPERIMENTS PACKAGE (ALSEP)

GRENADE LAUNCH ASSEMBLY TEST SET INSTRUCTIONS MANUAL



Published Under Authority of NASA/Manned Spacecraft Center

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EXPERIMENTS PACKAGE
(ALSEP)

GRENADE LAUNCH ASSEMBLY TEST SET INSTRUCTIONS MANUAL

APPROVED BY NASA
LUNAR SURFACE PROJECT OFFICE
MANNED SPACECRAFT CENTER

THE BENDIX CORPORATION
AEROSPACE SYSTEMS DIVISION

CONTRACT NUMBER
NAS 9-5829

1 FEBRUARY 1969

LIST OF EFFECTIVE PAGES

The total number of pages in this publication is 83, consisting of the following:

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i through vi	Original; 1 February 1969
1-1 through 1-4	Original; 1 February 1969
2-1 through 2-16	Original; 1 February 1969
3-1 through 3-4	Original; 1 February 1969
4-1 through 4-10	Original; 1 February 1969
5-1 through 5-14	Original; 1 February 1969
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FOREWARD

This manual contains information on the Grenade Launch Assembly Test Set and Mechanical Attitude Reference Positioning Device, ground support equipments for the Active Seismic Experiment, one of the experiments in the Apollo Lunar Surface Experiments Package (ALSEP).

The ALSEP will be used to measure various parameters of the Moon and its surface environment consistent with the objectives of the Apollo Program. The Apollo Lunar Module will transport the ALSEP to the surface of the Moon. Here, the ALSEP experiments will be deployed and left, when the astronauts return to Earth, to transmit scientific information to the Manned Space Flight Network.

This manual contains information formalized and released on or before 1 February 1969.

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SECTION I

INTRODUCTION

1-1. GENERAL INFORMATION

This manual contains information for operating and maintaining the grenade launch assembly test set (GLATS), Bendix Aerospace Systems Division part number 2331657, and the mechanical attitude reference positioning device (MARPD), Bendix Aerospace System Division part number 2331455. The GLATS and MARPD are ground support equipments used to test the grenade launch assembly (GLA), a part of the Apollo lunar surface experiments package (ALSEP).

The GLA is a 9.0 by 13.7 by 6.2 inch assembly that mounts in the active seismic experiment (ASE) mortar package. The GLA consists of a vertical sensor assembly, safety switches, firing circuits, and four fiberglass launch tubes, each containing a grenade. Each grenade contains a rocket motor, a safe slide plate, an explosive, an ignition device, a thermal battery, and a transmitter.

Because the GLA contains explosives, all GLA testing is accomplished while the GLA and MARPD are in an ordnance test bunker and the GLATS is in a nearby operating cell. The GLATS provides for interface connections with the GLA over a distance of 80 feet.

1-2. SCOPE

WARNING

This manual contains procedures concerning the test equipment only and does not contain procedures for operating and maintaining the GLATS when it is connected to the GLA, so do not connect the GLATS to the GLA for any procedure in this manual. To do so could cause severe injury and, possibly, loss of life.

To test the GLA, the GLATS and the MARPD are used in conjunction with an Apollo initiator resistance measuring equipment (AIRME) and an ordnance voltmeter. The four test equipments are shown in Figure 1-1. Instructions for use of the AIRME are contained in the instruction manual on AIRME, AIRME FM-B2419.

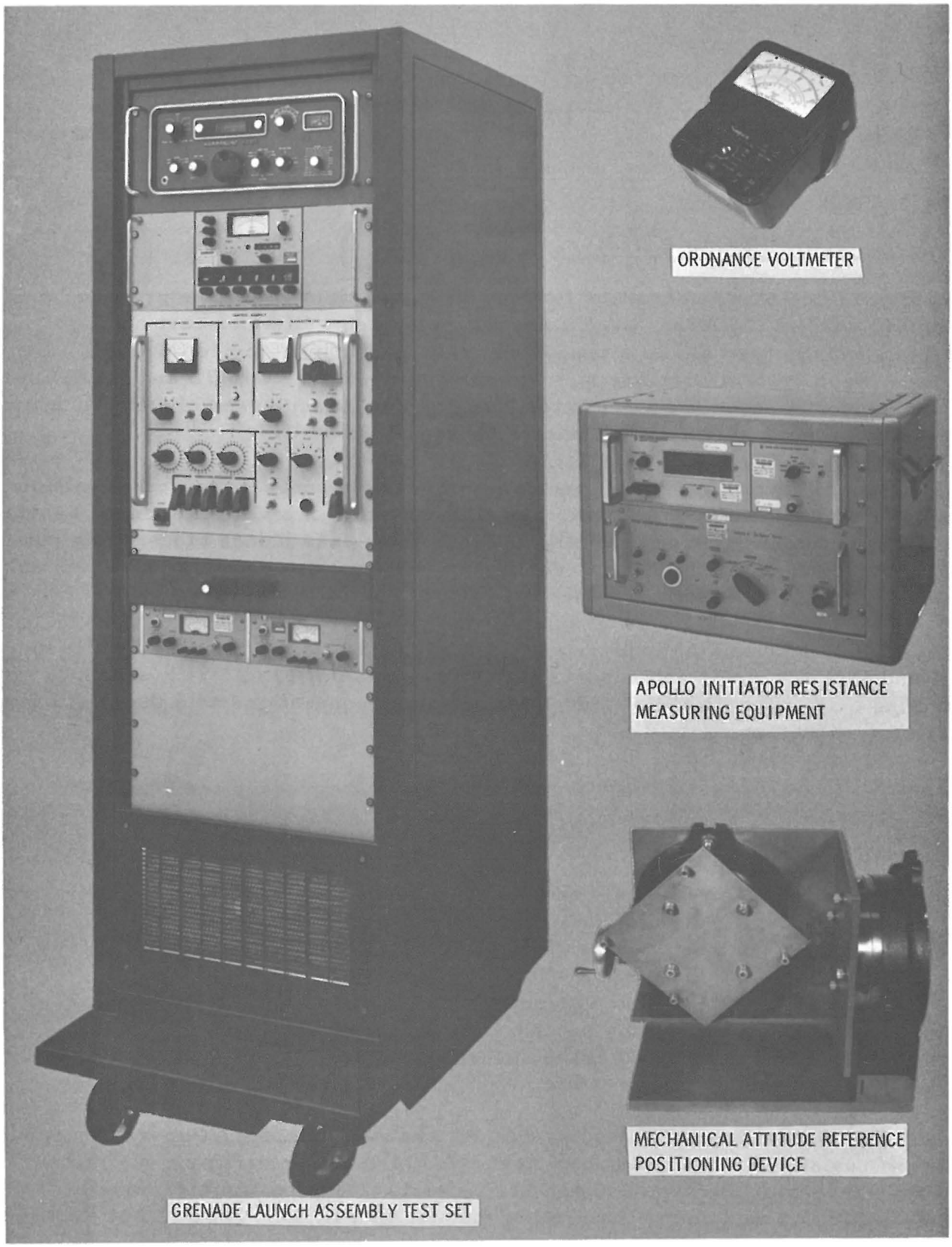


Figure 1-1. Grenade Launch Assembly Test Equipment

Instructions for use of the ordnance voltmeter are contained in the Simpson Company Manual for the Model 260 volt-ohm-milliammeter.

WARNING

Whenever the volt-ohm-milliammeter is used as an ordnance voltmeter, make sure that all batteries have been removed from its case.

Section I of this manual contains an introduction to the manual. Sections II and III contain a description of the GLATS and procedures for unpacking and initially installing the GLATS. Sections IV, V, and VI contain information for operating and maintaining the GLATS. Section VII contains information on the MARPD. Section VIII lists abbreviations commonly used when discussing the GLATS and the MARPD.

1-3. APPLICABLE DOCUMENTS

The following documents contain information pertaining to the GLATS and MARPD and to their use in testing the GLA:

a. Instruction Manual on Apollo Initiator Resistance Measuring Equipment, AIRME FM-B2419.

b. ALSEP Flight System Familiarization Manual, ALSEP-MT-03.

c. ALSEP Flight System Maintenance Manual ALSEP-LS-04.

d. ALSEP System Test Equipment Maintenance Manual, ALSEP-LS-06.

e. ALSEP Transportation and Handling Manual, ALSEP-LS-03.

f. Hammarlund manual for Model HQ215 Communications Receiver.

g. John Fluke Manufacturing Company manual for Model 881A DC Digital Voltmeter.

h. Hewlett-Packard Harrison Division manual for STB Series Model 6101A DC Power Supply.

i. Hewlett-Packard Harrison Division manual for Model 6916A Overvoltage Protector.

j. Simpson Instruments Incorporated manual for Model 260 Volt-ohm-milliammeter.

k. Bendix Aerospace Systems Division procedure 2337024

l. Bendix Aerospace Systems Division procedure 2338645

SECTION II

GLATS DESCRIPTION

2-1. PHYSICAL DESCRIPTION

The grenade launch assembly test set (GLATS) consists of a rack, eleven cables, a cable junction box, a set of headphones, and 15 shorting plugs. The GLATS rack is shown in Figure 2-1.

The rack is a 75-inch-high, blue-gray equipment rack mounted on four casters to permit the rack to be moved about a laboratory area easily. Cable connections to the rack are made to a cable entry panel mounted on the lower rear of the rack. A communications receiver, a digital-readout dc voltmeter, a control assembly, and two power supplies are mounted on standard 19-inch-wide panels at the front of the rack. A flat, rectangular, horizontal drawer can be extended from the front of the rack to provide an area on which to write or lay papers and in which to store the headphones and shorting plugs.

The GLATS provides cables that connect to the GLA at the mortar box connector J56, located on the side of the GLA, and at the grenade test point extender cable connectors J59A through J59D.

Additional physical and electrical characteristics of the GLATS are shown in Table 2-1.

Table 2-1. GLATS Characteristics

Characteristic	Description
Height	75 inches.
Width	24 inches.
Depth	38 inches.
Weight	About 600 pounds.
Source power	115 ± 11.5 volts, 60 hertz, single phase.
Source power circuit breaker operating point	7.5 amperes.

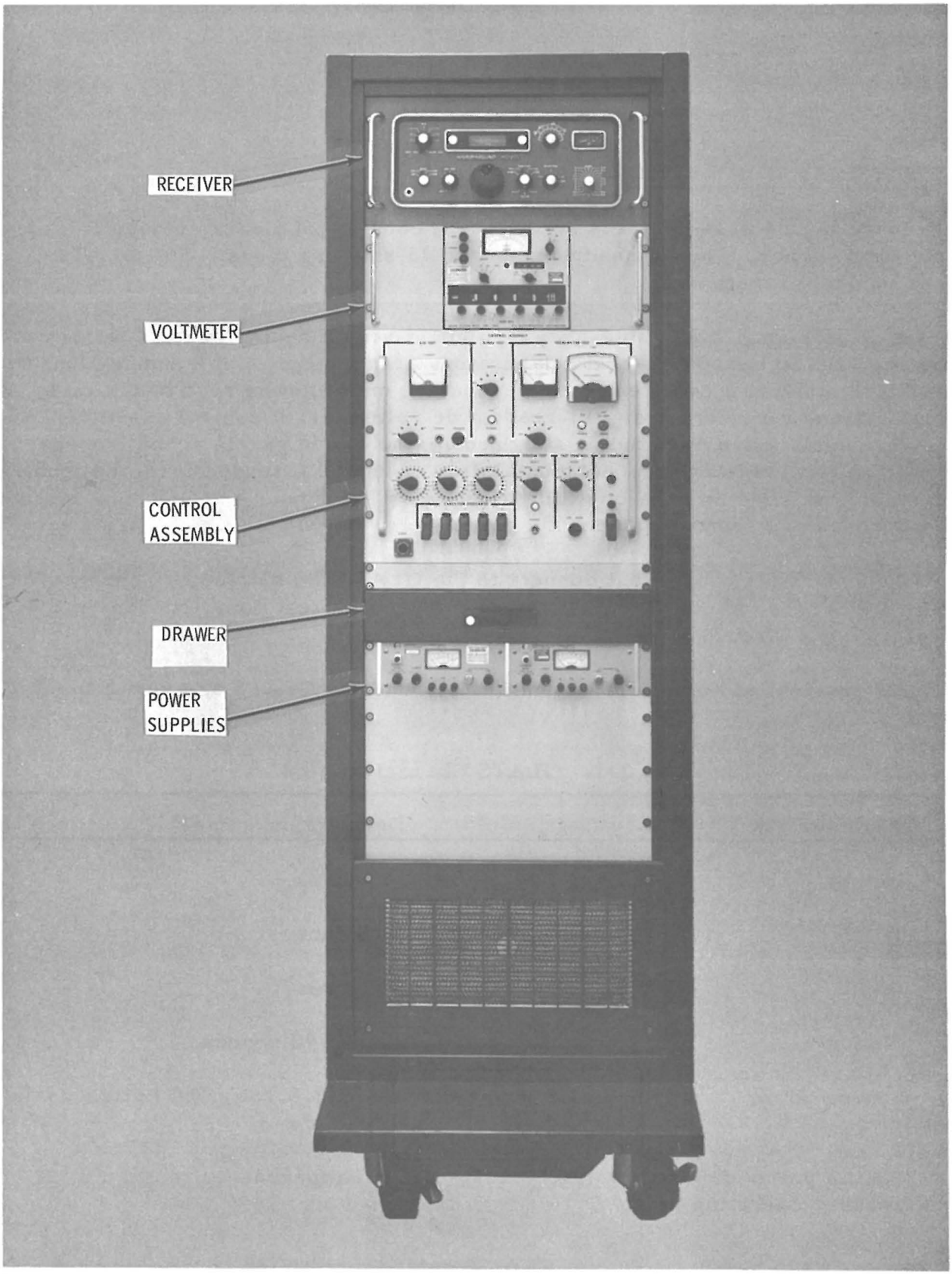


Figure 2-1. The Grenade Launch Assembly Test Set

2-2. FUNCTIONAL DESCRIPTION

2-3. INTRODUCTION

The GLATS, the mechanical attitude reference positioning device (MARPD), the Apollo initiator resistance measuring equipment (AIRME), and an ordnance voltmeter can be used to make the following tests on the GLA:

a. Continuity tests

b. SCR tests

c. Zener diode tests

d. Transmitter tests

e. Angle transducer tests

f. ASI resistance tests

A block diagram of the GLATS applicable to making the first five tests is shown in Figure 2-2. A block diagram of the GLATS as used for making the ASI resistance test is shown in Figure 2-3.

Single phase source power at 115 volts, 60 hertz enters the rack through cable W4 and connector 1J4. The current flows through filter FL1, circuit breaker CB1, and AC POWER switch S1 to front panel AC POWER ON indicator lamp DS1 and a transmitter test circuit. It also flows through connector J6 to the rack plugmold for distribution to a receiver, a voltmeter, and two power supplies.

2-4. RECEIVER

The receiver, a Hammarlund Model HQ215 communications receiver, operates on the 115 volt, 60 hertz, single phase power distributed by the rack plugmold. The receiver is shown in Figure 2-4. An antenna and cable attached to rack connector 1J3 connects to the receiver antenna connector. The receiver is adjusted to receive a 30 megahertz, continuous wave signal whenever the signal is transmitted by any of the four GLA grenades transmitters. Additional characteristics of the receiver are shown in Table 2-2.

2-5. VOLTMETER

The voltmeter, a John Fluke Manufacturing Company Model 881A dc digital voltmeter, is completely solid state and operates on the 115 volt, 60 hertz, single phase power distributed by the rack plugmold. The voltmeter is shown in Figure 2-5. The voltmeter indicates voltages during zener diode tests and angle transducer tests. Characteristics of the voltmeter are shown in Table 2-3.

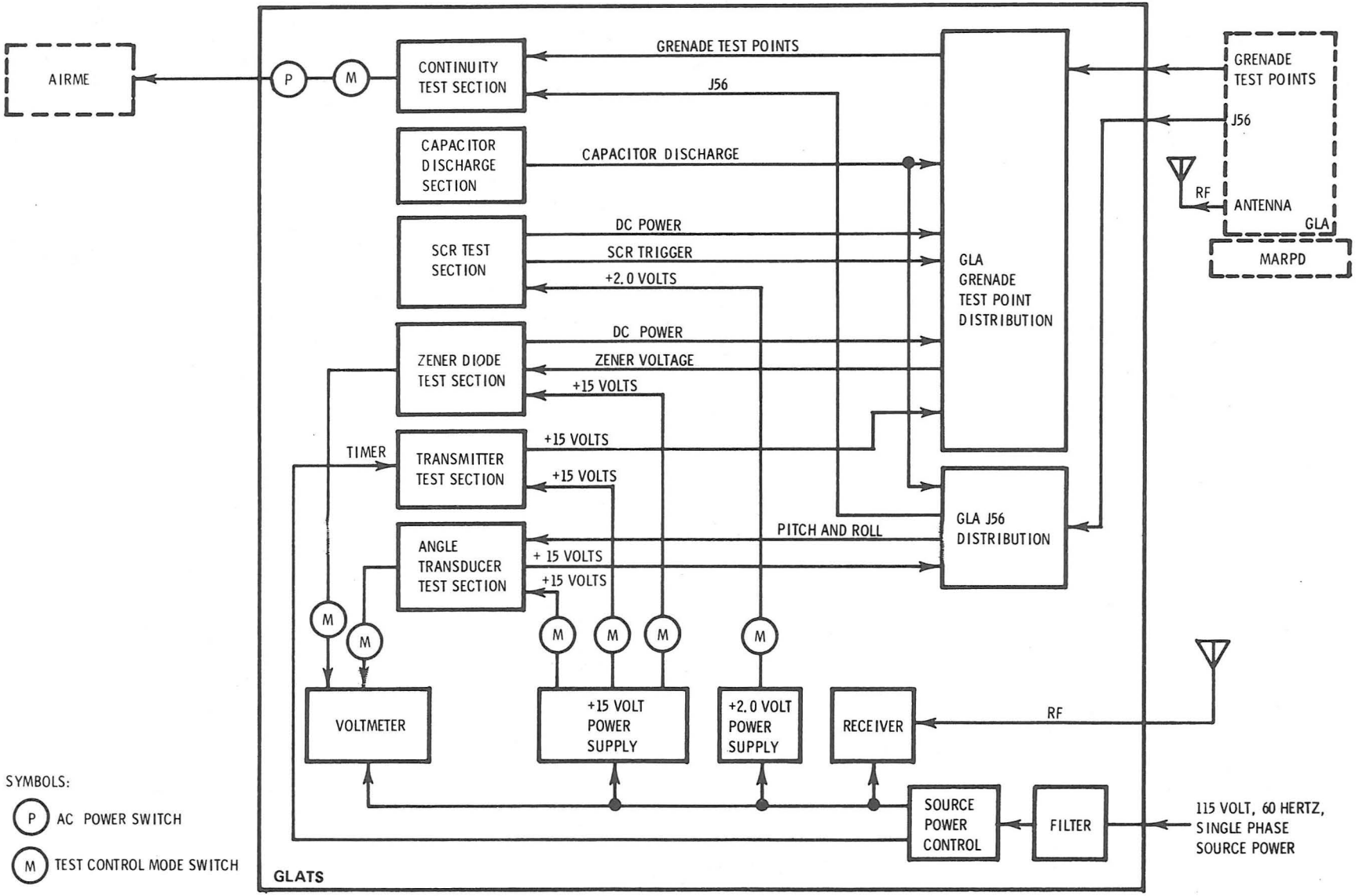


Figure 2-2. Block Diagram of the GLATS for Five Tests

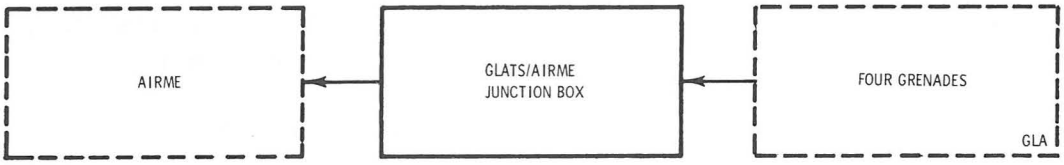


Figure 2-3. Block Diagram of the GLATS for the ASI Resistance Test

Figure 2-4. The Receiver

Table 2-2. Receiver Characteristics

Characteristic	Description
Height	6.8 inches.
Width	15.8 inches.
Depth	14.0 inches.

Table 2-2. Receiver Characteristics (Cont)

Characteristic	Description
Weight	21 pounds.
Source power	110 volt, 50 to 60 hertz, single phase power at about 19 watts.
Input impedance	50 to 75 ohms unbalanced.
Input frequency range	1.0 to 32 megahertz.
Sensitivity for cw	Less than 0.5 microvolt for 10 decibel signal-plus-noise to noise ratio
Output impedance	3.2 and 500 ohms.
Output power	More than 1.5 watts with less than 10 percent distortion
Frequency drift	Less than 100 hertz per hour.
Additional features	Entirely solid state, containing 26 transistors, 13 diodes, and two voltage reference diodes. Dual conversion. 2.1 kilohertz mechanical filter. Crystal-controlled beat frequency oscillator. 100,000 ± 100 hertz crystal calibrator. S meter.

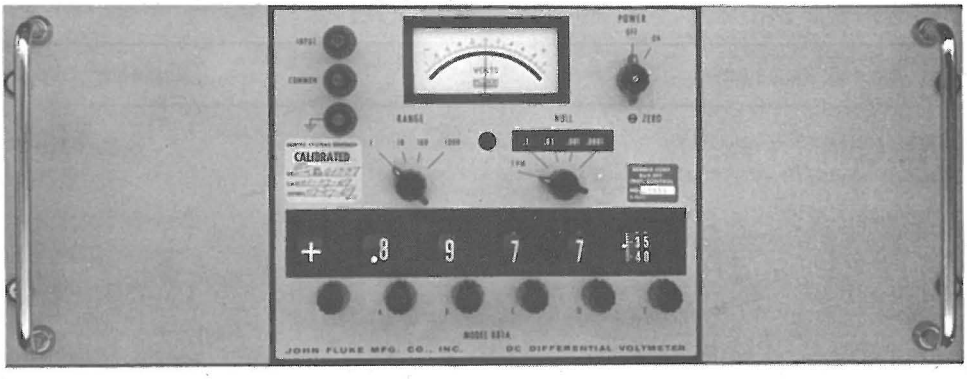


Figure 2-5. The Voltmeter

Table 2-3. Voltmeter Characteristics

Characteristic	Description
Height	7 inches.
Width	19 inches.
Depth	14.8 inches.
Weight	Approximately 13 pounds.
Source power	115 ± 11.5 volts, 50 to 440 hertz at approximately 0.03 amperes.
Voltage range	0 to 1,000 volts dc.
Input impedance	Infinite from 0 to 11 volts; 10 megohms above 11 volts.
Accuracy	±0.01 percent of input plus 0.005 volt dc when temperature is from 55 to 95 degrees Fahenheit and relative humidity is less than 80 percent.
Warm-up time	15 seconds.

2-6. CONTROL ASSEMBLY

The control assembly is shown in Figure 2-6. The control assembly contains switches that control power and make connections for the various tests, and indicators that indicate test results. The panel is a standard 19-inch-wide panel.

2-7. POWER SUPPLIES

The GLATS uses two Hewlett-Packard, Harrison Division, STB Series, Model 6101A power supplies. The power supplies are shown in Figure 2-7. The supplies use 115 volt, 60 hertz, single phase power to produce dc power. Characteristics of the supplies are shown in Table 2-4. The supplies utilize silicon transistors throughout.

Each power supply has a Hewlett-Packard, Harrison Division, Model 6916A overvoltage protector mounted on the power supply rear panel and connected in series with the power supply output. The overvoltage protectors are shown in Figure 2-8. If an overvoltage occurs, a virtual short circuit is placed across the load within ten microseconds after the overvoltage occurs.

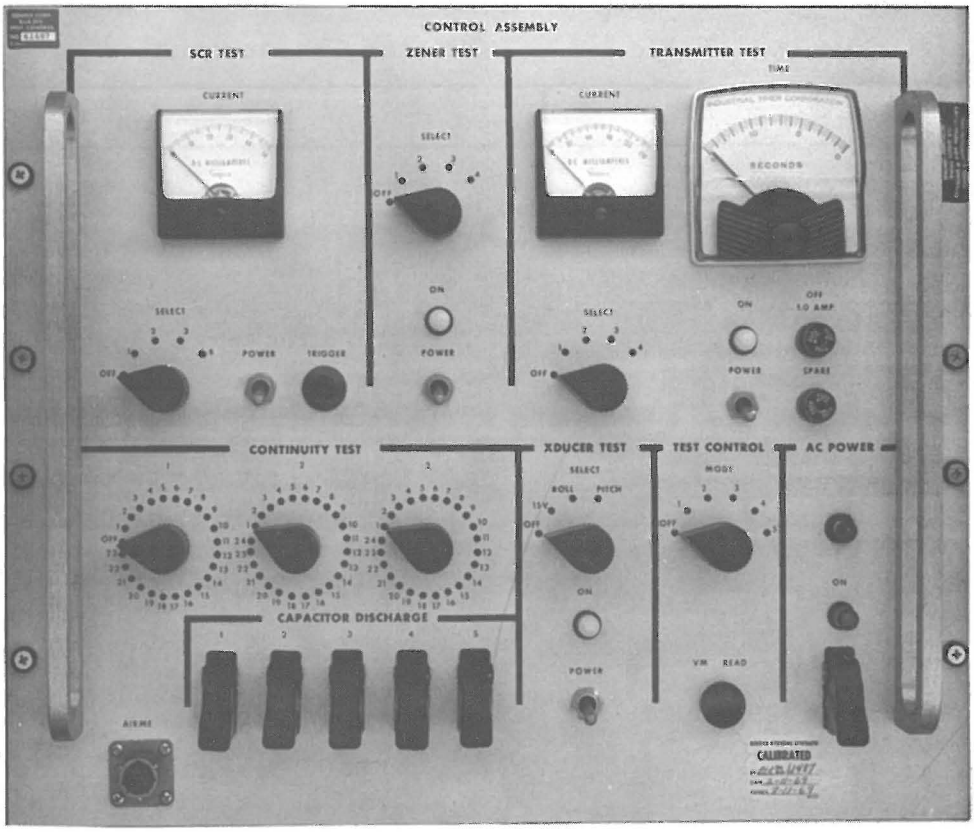


Figure 2-6. The Control Assembly

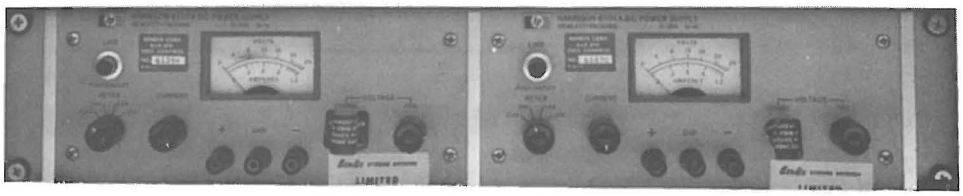


Figure 2-7. The Power Supplies

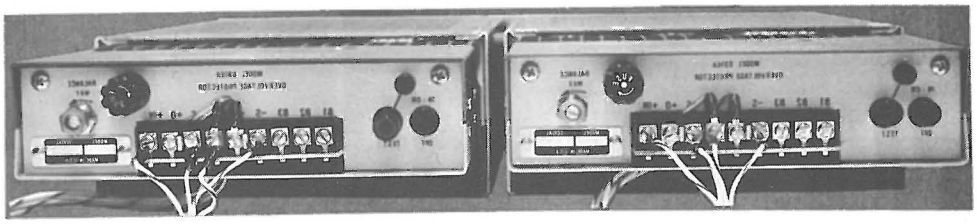


Figure 2-8. The Overvoltage Protectors

Table 2-4. Power Supply Characteristics

Characteristic	Description
Height	3.5 inches.
Width	8.5 inches.
Depth	12.6 inches.
Weight	10 pounds.
Input	105 to 125 volt, 48 to 63 hertz, single phase at 0.5 amperes.
Output	
Voltage range	0 to 20 volts dc.
Current range	0 to 1.0 ampere.
Ripple and noise	Less than 100 microvolts peak-to-peak.
Impedance	Less than 0.002 ohm from dc to 100 hertz.
Regulation	Less than 0.001 percent change in output voltage for any change in input voltage between 105 and 125 volts ac. Less than 0.001 percent plus 100 microvolts change in output voltage for any change in load from 0 to 1.0 ampere.

This will cause the fuse in series with the power supply output to open, thereby separating the load from the power supply. Characteristics of the overvoltage protector are shown in Table 2-5.

One power supply and overvoltage protector furnishes +15 volts for the zener diode tests, transmitter tests, and angle transducer tests. The other power supply and overvoltage protector furnishes +2.0 volts for the SCR tests.

2-8. CONTINUITY TESTS

Continuity tests check GLA circuitry for required continuity and resistance values. During the continuity tests, the GLATS connects the GLA with the AIRME and the

Table 2-5. Overload Protector Characteristics

Characteristics	Description
Height	2.0 inches.
Width	7.9 inches.
Depth	4.0 inches.
Weight	2.0 pounds.
Overvoltage margin	Adjustable by a screwdriver inserted through a hole in the top cover from 1.0 to 4.0 volts above nominal voltage.
Time of operation	Less than 10 microseconds.
Power required	15 milliamperes. Whenever push-to-test button is depressed, 50 milliamperes is required.

AIRME indicates the continuity and resistance of the various test points in the GLA. A simplified circuit of the continuity test circuit is shown in Figure 2-9.

The cables connect the desired GLA test point to the AIRME through CONTINUITY TEST 1 switch S4, TEST CONTROL MODE switch S3, and AC POWER switch S1. The CONTINUITY TEST 1 switch connects the desired GLA test point to the GLATS circuitry. Connection of the GLA test point to the AIRME is made only if the AC POWER switch is in its ON or closed position and if the TEST CONTROL MODE switch is in position 1. No source power is connected to the GLATS during the continuity tests and the AC POWER switch provides shutdown of any test whenever the switch is placed in its off or open position. The TEST CONTROL MODE switch ensures that only those GLATS circuits associated with the continuity tests are in use during continuity tests. Voltage limiting diode CR1 shorts out any voltage greater than approximately 2.4 volts.

CAPACITOR DISCHARGE 1, 2, 3, 4, and 5 switches S16 through S20 and their associated resistors permit controlled discharge of any of the GLA grenade storage capacitors that may have charged during any test. To prevent inadvertent movement of the switches and to facilitate rapid identification of the switches, red safety switch guards cover the switch buttons. Voltage limiting diodes CR3 through CR6 limit the voltage that the capacitors can store to a maximum of approximately 2.4 volts, a value below the firing point of the grenade Apollo standard initiator (ASI).

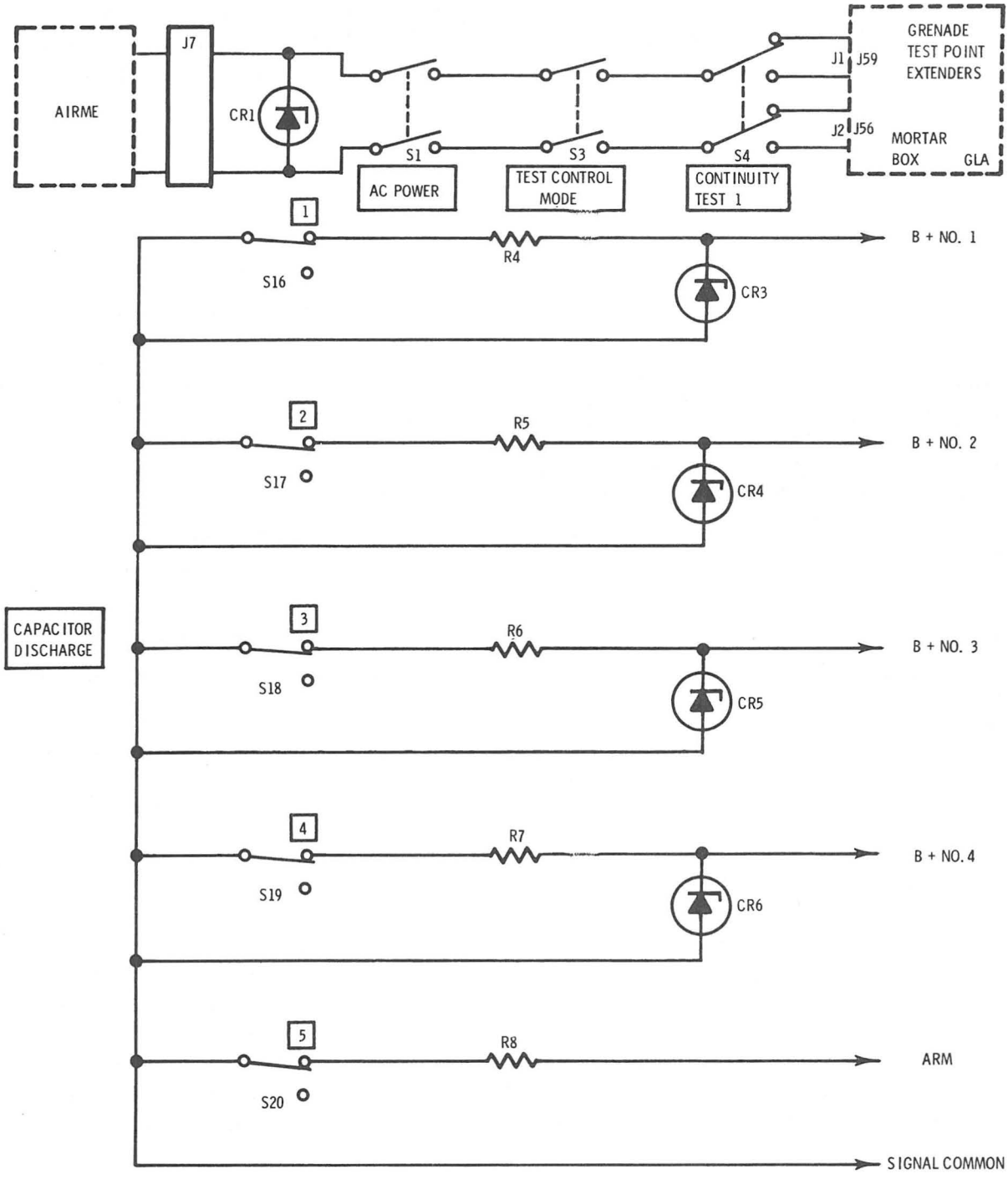


Figure 2-9. Continuity Test Circuit, Simplified Schematic Diagram

2-9. SCR TESTS

The SCR tests check the four firing SCR's of the GLA grenades functionally, at reduced voltage, for required forward current when gated on by a simulated trigger voltage. A simplified schematic diagram of the SCR test circuit is shown in Figure 2-10. With this circuit, the forward current of any SCR should be 37± 5.0 milliamperes.

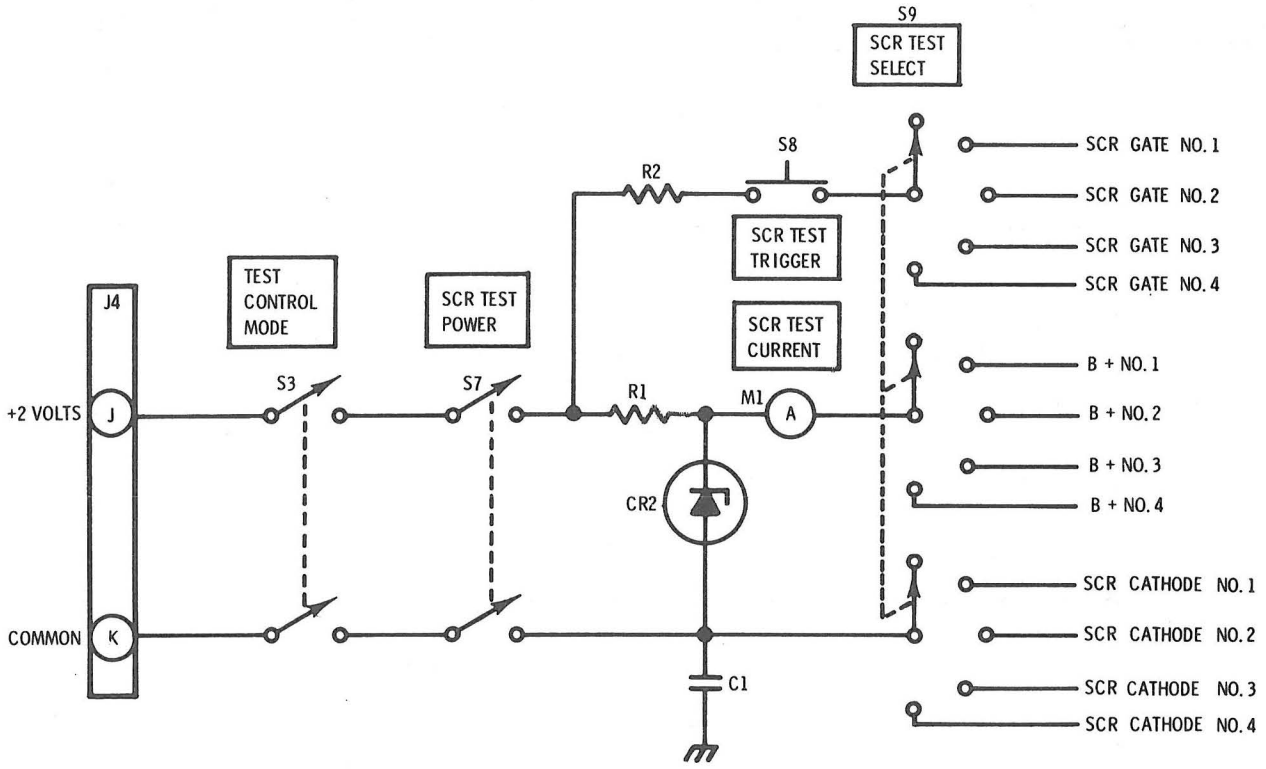


Figure 2-10. SCR Test Circuit, Simplified Schematic Diagram

When TEST CONTROL MODE switch S3 is in position 2 and SCR TEST POWER switch S7 is closed, voltage from the power supply is applied through resistor R1, across diode CR2, and through SCR TEST CURRENT meter M1 to the SCR under test. Diode CR2 limits the voltage applied to the SCR to approximately 2.4 volts. The grenade circuit SCR to be tested is selected by SCR TEST SELECT switch S9. When momentary SCR TEST TRIGGER switch S8 is closed, current flows through the SCR TEST CURRENT meter. Capacitor C1 precludes spurious triggering of the SCR.

2-10. ZENER DIODE TESTS

Zener diode tests indicate the voltage at which any of the four GLA grenade zener diodes fire. A simplified schematic diagram of the zener diode test circuit is shown in Figure 2-11. The firing voltage of any diode should be 8.0± 0.5 volts.

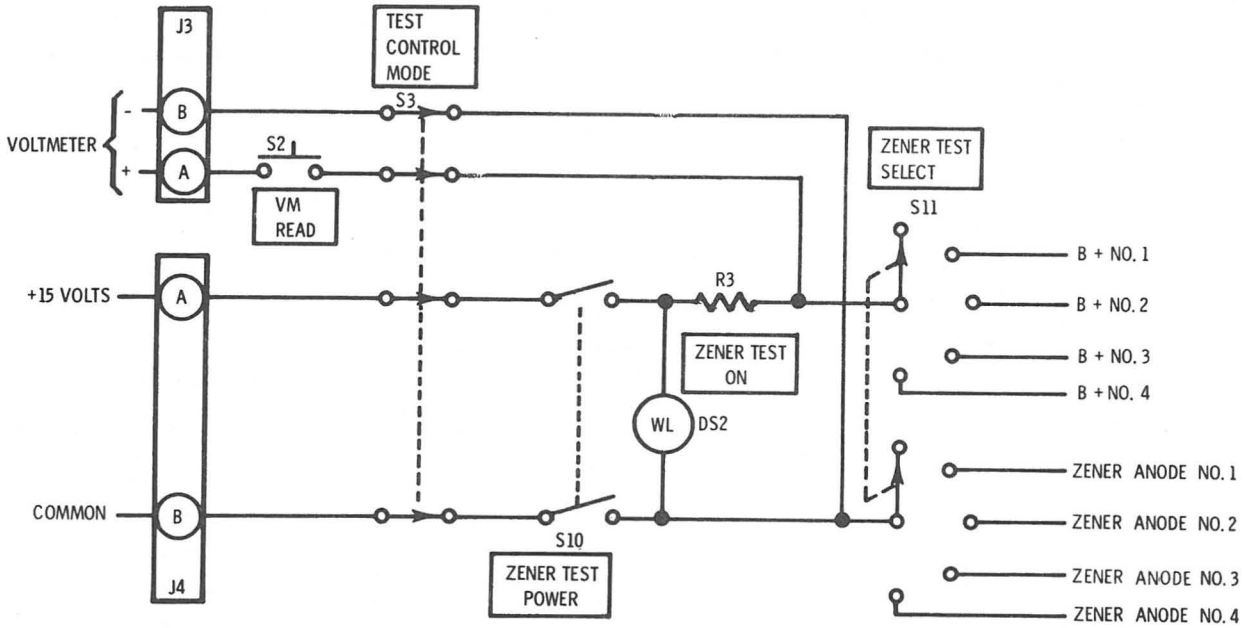


Figure 2-11. Zener Diode Test Circuit, Simplified Schematic Diagram

When TEST CONTROL MODE switch S3 is in position 3 and ZENER TEST POWER switch S10 is closed, voltage from the power supply is applied across ZENER TEST ON lamp DS2 and through resistor R3 and ZENER TEST SELECT switch S11 to the zener diode under test. Since the TEST CONTROL MODE switch is in position 3, the voltmeter will indicate the voltage applied to the diode whenever momentary VM READ switch S2 is pressed. Resistor R3 limits current through the diode to an amount that will not reduce performance or reliability of the diode.

2-11. TRANSMITTER TESTS

During the transmitter tests, the GLATS supplies power to one of the four grenade transmitters and indicates the amount of current the transmitter uses and the frequency at which the transmitter transmits. Each transmitter shall use from 60 to 130 milliamperes and shall transmit at a frequency from 29.9 to 30.1 megahertz. A simplified schematic diagram of the transmitter test circuit is shown in Figure 2-12.

For the transmitter tests, TEST CONTROL MODE switch S3 is placed in position 4. DC power from the power supply is applied through the TEST CONTROL MODE switch, the TRANSMITTER TEST POWER switch S12, a contact of TRANSMITTER TEST TIME relay K1, the TRANSMITTER TEST CURRENT meter M2, and TRANSMITTER TEST SELECT switch S13 to the grenade transmitter under test. After an interval determined by the adjustment of the TRANSMITTER TEST TIME relay, power is disconnected from the grenade transmitter. This prevents operation of the transmitter for excessive intervals. While power is connected to the transmitter, the indication of the TRANSMITTER TEST CURRENT meter can

be noted to determine the amount of current the transmitter uses and the indications of the receiver S meter and frequency indicator can be noted to determine the frequency at which the transmitter transmits. The test is repeated for the remaining three transmitters.

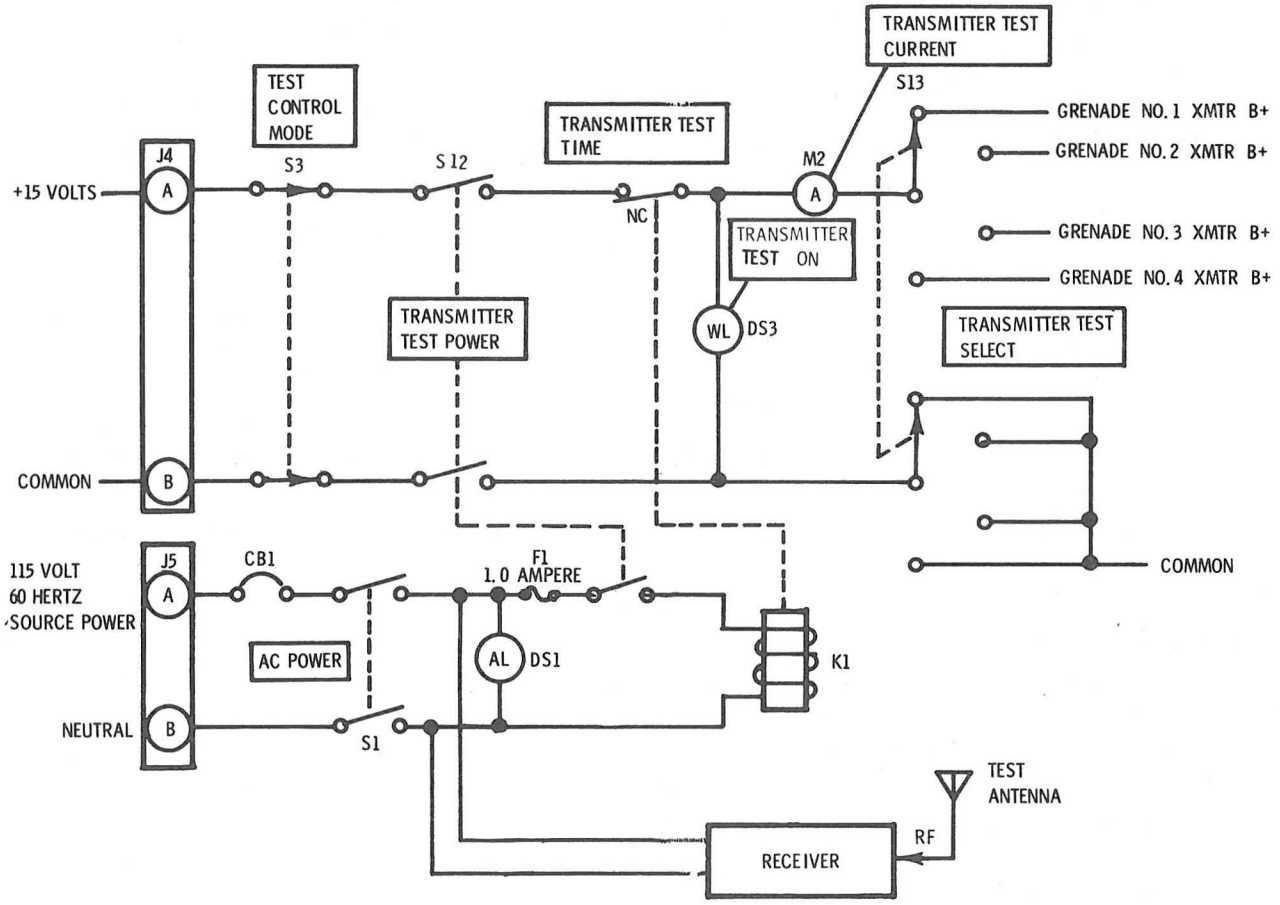


Figure 2-12. Transmitter Test Circuit, Simplified Schematic Diagram

2-12. ANGLE TRANSDUCER TESTS

During the angle transducer tests, the Grenade Launch Assembly (GLA) is mounted on the Mechanical Attitude Reference Positioning Device (MARPD). The MARPD is adjusted to sequentially maintain the GLA in five specified positions of its pitch axis and in five specified positions of its roll axis. While the GLA is at each position, the voltage produced by a GLA angle transducer is indicated on the GLATS voltmeter. For either pitch or roll axis angles of -10, -5, 0, 5, or 10 degrees with respect to the horizontal, the output voltages shall conform within ±0.001 volt to individual GLA calibration curves, after correction for zero angle offset. A simplified schematic diagram of the angle transducer test circuit is shown in Figure 2-13.

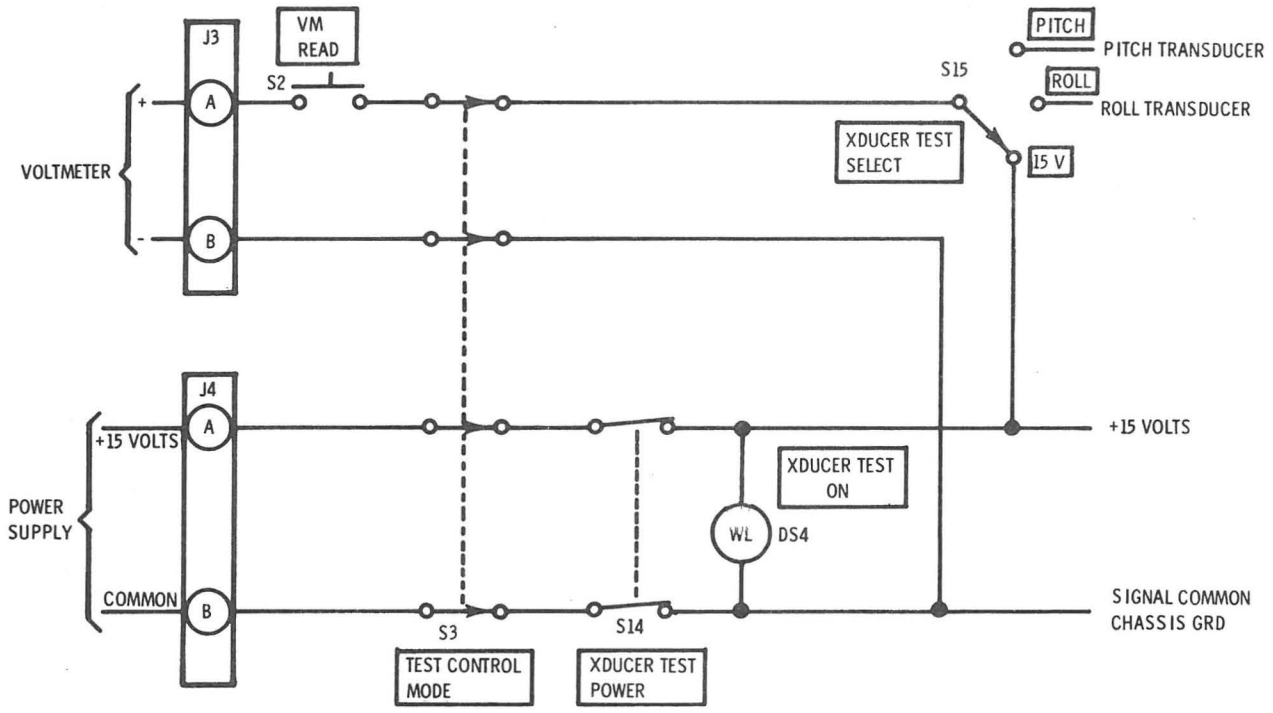


Figure 2-13. Angle Transducer Test Circuit, Simplified Schematic Diagram

For the angle transducer tests, TEST CONTROL MODE switch S3 is placed in position 5 and XDUCER TEST POWER switch S14 is closed. With the switches in these positions, +15 volt power is connected across XDUCER TEST ON lamp DS4 to the angle transducer circuit of the GLA. When momentary VM READ switch S2 is pressed, the voltmeter will indicate +15 volts, the output voltage of the roll axis angle transducer, or the output voltage of the pitch axis angle transducer, depending on the position of XDUCER TEST SELECT switch S15.

2-13. ASI RESISTANCE TESTS

ASI resistance tests check the resistance of the eight Apollo standard initiators (ASI's) of the GLA. For these tests, the circuit shown in Figure 2-9 is used and resistances are measured with the Apollo initiator resistance measuring equipment (AIRME). GLATS external cables provide the necessary cabling interface from the AIRME to the GLA grenade test point extender cables and the mortar box connector, J56. The GLATS/AIRME junction box provides interface between the AIRME test cable and the GLA grenade ASI's.

SECTION III

GLATS INSTALLATION, SHIPPING, AND STORAGE

3-1. GENERAL INFORMATION

The grenade launch assembly test set (GLATS) consists of a 75-inch-high, 24-inch-wide, 38-inch-deep rack, GLATS/AIRME junction box, a set of eleven cables, 15 shorting plug assemblies, and headphones. The rack is mounted on four wheels and weighs about 600 pounds.

For initial shipment to the Kennedy Space Center (KSC), the GLATS rack will be crated standing in an upright position in a plywood box. The set of external cables, the headphones, and the junction box will be shipped in a separate metal shipping and storage container having a readily removable cover. The shorting plug assemblies will be placed in the rack drawer and the drawer fasteners will be secured to prevent movement during shipment. The interior of the box containing the rack will be lined with durable elastic dunnage to protect the contents. To protect the rack from any moisture, dust, and abrasion, the rack will be enclosed in a Vinyl sheet. Cable ends will be wrapped with Vinyl sheeting and, then, with waterproof, pressure-sensitive adhesive tape. Desiccant will be placed in each container. The containers will be shipped to Florida by air freight and handled by forklift.

No special facility is required for the GLATS. However, since the grenade launch assembly (GLA) contains live ordnance, the GLA must be tested in an explosion-proof bunker separated from the GLATS. The GLATS cables provide for test interface connections to the GLA for a distance of at least 80 feet. The GLATS requires 115 ± 11.5 volt, 60 hertz, single-phase source power.

3-2. INITIAL INSTALLATION

Unpack the GLATS rack from its box as follows:

a. Remove end of box marked "FRONT."

b. Remove packing from front of box.

c. Remove end of box marked "TOP".

d. Remove packing from top of box.

e. Remove three remaining sides of box.

f. With hoist and hoist slings, carefully lift rack from box bottom.

No special instructions are required to unpack GLATS cabling, shorting plug assemblies, junction box, and headphones.

Inspect GLATS in accordance with Bendix Aerospace Systems Division procedure 2337024.

A diagram of GLATS interconnecting cabling is shown in Figure 3-1.

3-3. SHIPPING

Reshipping the GLATS shall be accomplished by packing the containers in the same manner as they were packed for initial shipment to KSC. To reship the GLATS cabling, wrap the cable ends with Vinyl sheeting and, then, with waterproof, pressure-sensitive adhesive tape. Lay cellulose packing along the inside of the container and, then, coil the cabling along the inside of the container. Fold the excess packing down over the cabling toward the middle of the container.

During air shipment, the barometric pressure to which the GLATS is subjected shall not be less than that of the Earth's atmosphere at 35,000 feet, for a period greater than eight hours.

3-4. STORAGE

The packaging described for shipping the GLATS is adequate for storage in an enclosed storage area. If storage may exceed one month, place desiccant bags in each container.

Temperature within the storage area shall be maintained between 0 and 120 degrees Fahrenheit and the relative humidity shall be maintained at 95 percent or less.

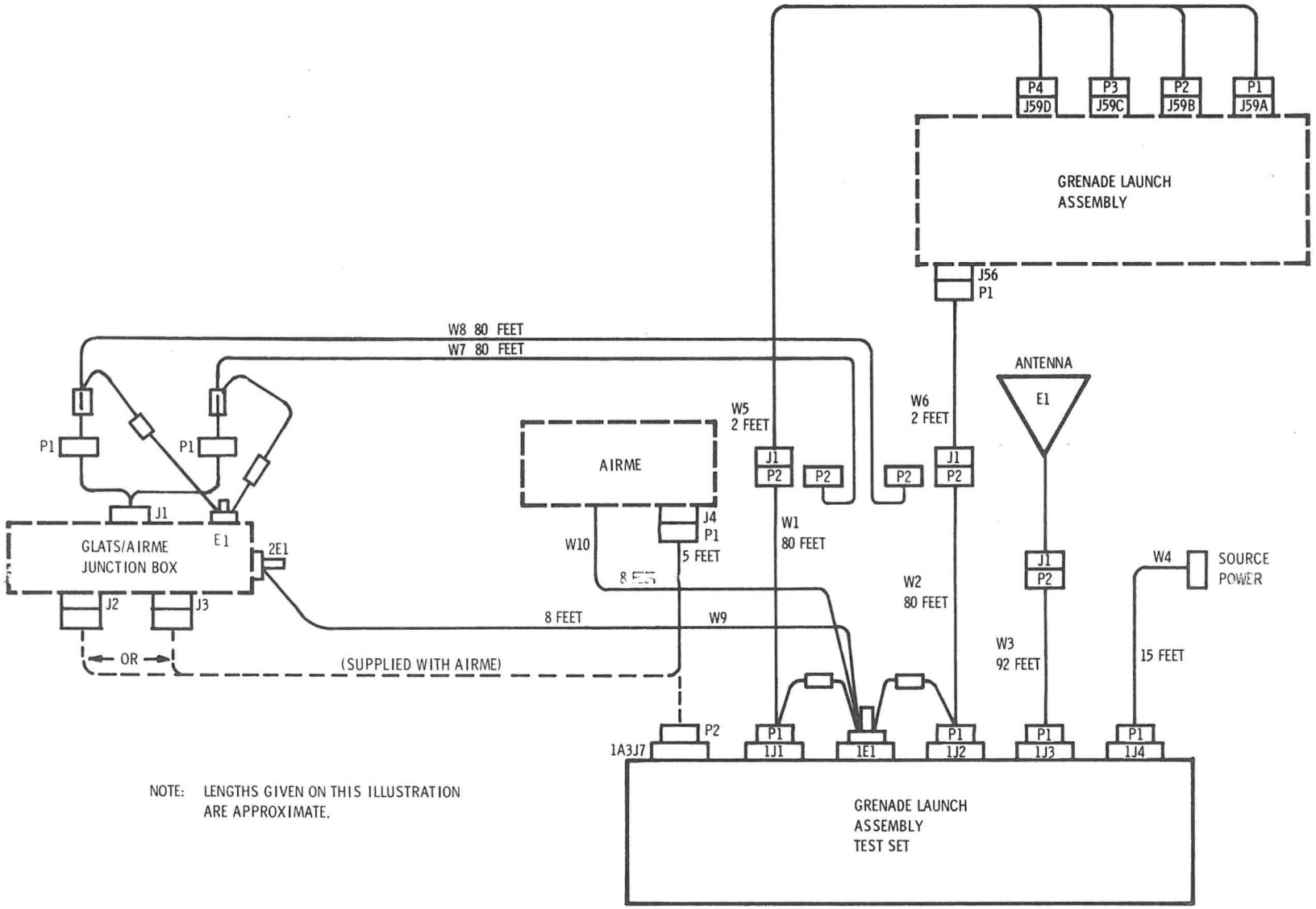


Figure 3-1. GLATS Interconnecting Cabling

SECTION IV

GLATS OPERATION

4-1. GENERAL INFORMATION

To test the grenade launch assembly (GLA), the grenade launch assembly test set (GLATS) is used in conjunction with a mechanical attitude reference positioning device (MARPD), an Apollo initiator resistance measuring equipment (AIRME), and an ordnance voltmeter. Operating procedures for the MARPD are contained in section VII of this manual. Operating procedures for the AIRME are contained in instruction manual AIRME FM-B2419. Operating procedures for the ordnance voltmeter are contained in the manual for the Model 260 Volt-ohm-milliammeter listed in paragraph 1-3 of this manual.

Operating procedures presented in this section of the manual are for the operation of the GLATS alone and are not for operation of the GLATS while it is connected to the GLA or to any other equipment.

4-2. CONTROLS AND INDICATORS

Control assembly panel controls and indicators are shown in Figure 4-1. The reference designations and functions of the controls and indicators are shown in Table 4-1. For operational controls of the receiver, voltmeter, power supplies, and overload protectors, refer to the manufacturers' manuals listed in paragraph 1-3 of this manual.

4-3. OPERATING PROCEDURES

The function of each control and indicator on the control assembly front panel is given in Table 4-1. The table, together with the remainder of the material in Section IV and the functional descriptions of each test as presented in paragraphs 2-8 through 2-13, describe the operating procedures of the GLATS.

Prior to testing a GLA, the GLATS shall be calibrated in accordance with the procedures in Bendix Aerospace Systems Division document 2338645.

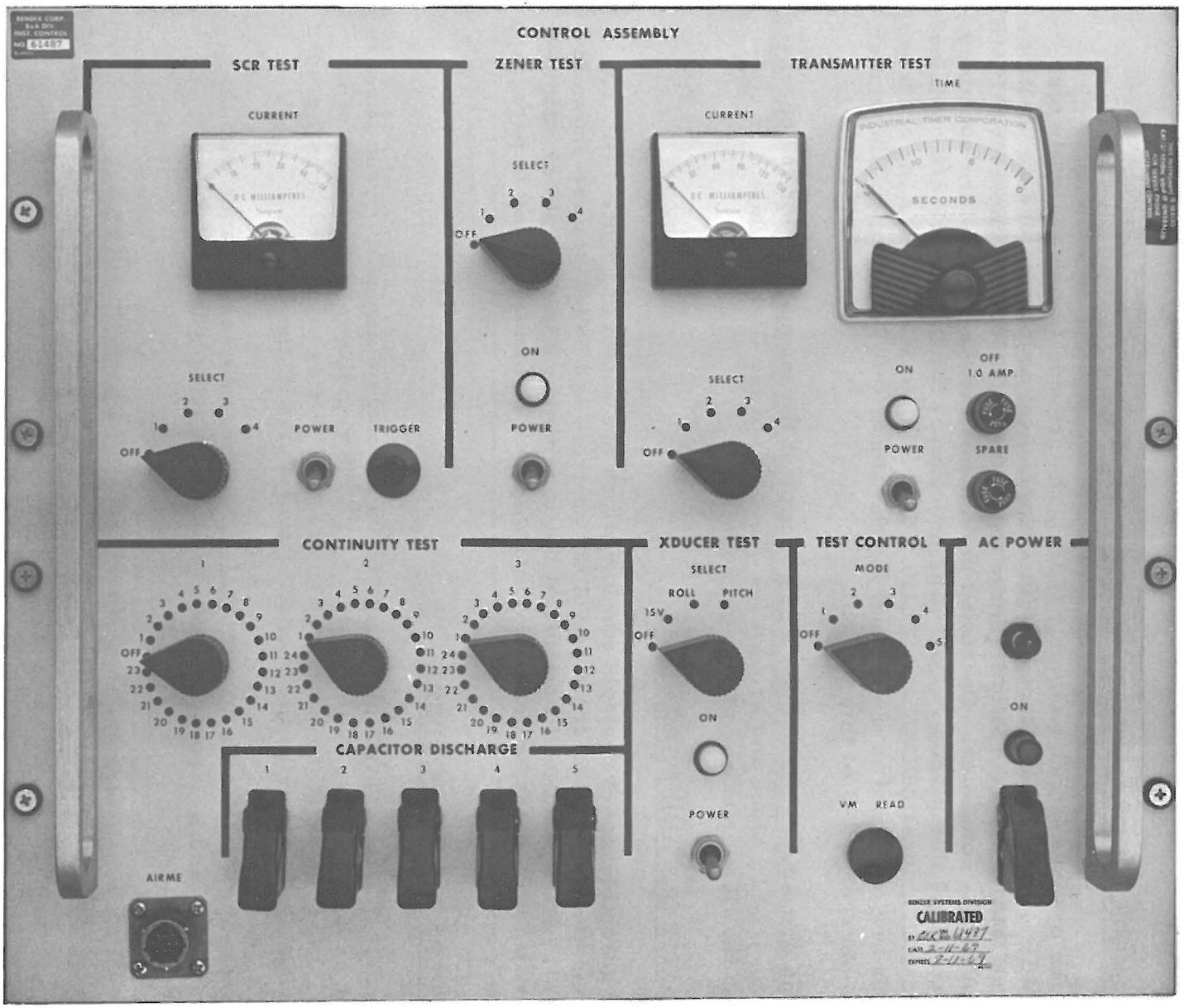


Figure 4-1. Control Assembly Controls and Indicators

WARNING

The GLA contains explosive propellant charges. Procedures presented in this manual do not include those in which the GLATS is connected to the GLA, so do not connect the GLATS to the GLA during any procedure presented in this manual. To do so could cause severe injury and, possibly, loss of life.

4-4. TURN-OFF PROCEDURE

To turn the GLATS off, push the AC POWER switch off (down).

4-5. TURN-ON PROCEDURE

To turn the GLATS on, :

a. Make sure front panel switches listed in Table 4-2 are initially in positions given in table.

b. Make sure that safety covers over CAPACITOR DISCHARGE 1, 2, 3, 4, and 5 switches S16 through S20 and over AC POWER switch S1 are down.

c. Make sure that push-button of AC POWER circuit breaker CB1 is pulled out.

d. Make sure that TRANSMITTER TEST TIME relay K1 indicates 15 ± 0.5 seconds.

e. Make sure that cable W4 connector P1 is connected to GLATS connector 1J4.

f. Make sure that cable W4 connector P2 is connected to 115 ± 11.5 volt, 60 hertz, single phase source power capable of supplying 10 or more amperes of current.

g. Depress push-button of AC POWER circuit breaker CB1.

h. Place AC POWER switch S1 in its closed (up) position. Make sure that AC POWER ON lamp DS1 lights.

i. Place receiver RF AF switch to its mid-position.

j. Place voltmeter POWER switch to its ON position.

k. Depress each of two power supply LINE PUSH ON/OFF switches.

NOTE

Allow at least five minutes warm-up time before GLATS calibration or GLA testing.

Table 4-1. Control Assembly Controls and Indicators

Control or Indicator	Reference Designation	Function
SCR TEST CURRENT meter	M1	Indicates current through GLA grenade 1, 2, 3, or 4 SCR.
SCR TEST SELECT switch	S9	Connects SCR test circuit to GLA grenade 1, 2, 3, or 4 SCR.
SCR TEST POWER switch	S7	Applies dc voltages to GLA grenade 1, 2, 3, or 4 SCR.
SCR TEST TRIGGER switch	S8	Applies gating voltage through SCR TEST SELECT switch to GLA grenade 1, 2, 3, or 4 SCR.
ZENER TEST SELECT switch	S11	Connects zener test circuit to GLA grenade 1, 2, 3, or 4 zener diode.
ZENER TEST ON lamp	DS2	Illuminates to indicate when +15 volts are present in zener diode test circuit.
ZENER TEST POWER switch	S10	Connects +15 volts to zener diode test circuit.
TRANSMITTER TEST CURRENT meter	M2	Indicates current through GLA grenade 1, 2, 3, or 4 transmitter.
TRANSMITTER TEST TIME relay	K1	Determines time +15 volts is applied to transmitter test circuit and indicates time remaining until +15 volts is disconnected.
TRANSMITTER TEST SELECT switch	S13	Connects +15 volts to GLA grenade 1, 2, 3, or 4 transmitter.
TRANSMITTER TEST ON lamp	DS3	Illuminates to indicate when +15 volts are present in transmitter test circuit.
TRANSMITTER TEST POWER switch	S12	Connects +15 and 115 volt, 60 hertz power to transmitter test circuit.

Table 4-1. Control Assembly Controls and Indicators (Cont)

Control or Indicator	Reference Designation	Function
TRANSMITTER TEST OFF 1.0 AMP fuse	F1	Opens connection between rack 115 volt, 60 hertz power line and transmitter test circuit if circuit draws more than 1.0 ampere.
TRANSMITTER TEST SPARE fuse	—	Spare fuse for TRANSMITTER TEST OFF 1.0 AMP fuse.
CONTINUITY TEST 1 switch	S4	In conjunction with CONTINUITY TEST 2 and 3 switches, connects continuity test circuit to GLA circuit under test.
CONTINUITY TEST 2 switch	S5	In conjunction with CONTINUITY TEST 1 and 3 switches, connects continuity test circuit to GLA circuit under test.
CONTINUITY TEST 3 switch	S6	In conjunction with CONTINUITY TEST 1 and 2 switches, connects continuity test circuit to GLA circuit under test.
AIRME connector	J7	Provides connector for cable from GLATS to AIRME.
CAPACITOR DISCHARGE 1 switch	S16	Controls discharge of voltage from GLA grenade 1 firing capacitor.
CAPACITOR DISCHARGE 2 switch	S17	Controls discharge of voltage from GLA grenade 2 firing capacitor.
CAPACITOR DISCHARGE 3 switch	S18	Controls discharge of voltage from GLA grenade 3 firing capacitor.
CAPACITOR DISCHARGE 4 switch	S19	Controls discharge of voltage from GLA grenade 4 firing capacitor.
CAPACITOR DISCHARGE 5 switch	S20	Controls discharge of voltage from GLA arm circuit.

Table 4-1. Control Assembly Controls and Indicators (Cont)

Control or Indicator	Reference Designation	Function
XDUCER TEST SELECT switch	S15	Connects angle transducer test circuit to +15 volts, GLA roll transducer, or GLA pitch transducer.
XDUCER TEST ON lamp	DS4	Illuminates to indicate when +15 volts are present in angle transducer test circuit.
XDUCER TEST POWER switch	S14	Connects +15 volts to GLA roll and pitch angle transducers.
TEST CONTROL MODE switch	S3	Opens test circuits or completes continuity test circuit, SCR test circuit, zener diode test circuit, transmitter test circuit, or angle transducer test circuit, assuring that only one test circuit is active at any one time.
TEST CONTROL VM READ switch	S2	When depressed, connects voltmeter to TEST CONTROL MODE switch to produce voltmeter indications during zener diode tests and angle transducer tests.
AC POWER ON lamp	DS1	Illuminates to indicate when power is applied to transmitter test circuit, receiver, voltmeter, and two power supplies.
AC POWER circuit breaker	CB1	Opens connection of rack to source power if rack draws more than 7.5 amperes of current.
AC POWER switch	S1	Controls 115 volt, 60 hertz source power to rack and completes continuity test circuit.

Table 4-2. Initial Positions of Front Panel Switches and Controls

Switch	Reference Designation	Initial Position
AC POWER circuit breaker	CB1	pulled out
AC POWER switch	S1	open (down)
Receiver RF AF	—	OFF
Voltmeter POWER	—	OFF
TEST CONTROL MODE	S3	OFF
TRANSMITTER TEST POWER	S12	open (down)
TRANSMITTER TEST SELECT	S13	OFF
SCR TEST POWER	S7	open (down)
SCR TEST SELECT	S9	OFF
ZENER TEST POWER	S10	open (down)
ZENER TEST SELECT	S11	OFF
XDUCER TEST POWER	S14	open (down)
XDUCER TEST SELECT	S15	OFF
CONTINUITY TEST 1	S4	OFF
CONTINUITY TEST 2	S5	1
CONTINUITY TEST 3	S6	1
CAPACITOR DISCHARGE 1	S16	open (down)
CAPACITOR DISCHARGE 2	S17	open (down)
CAPACITOR DISCHARGE 3	S18	open (down)
CAPACITOR DISCHARGE 4	S19	open (down)
CAPACITOR DISCHARGE 5	S20	open (down)

Table 4-2. Initial Positions of Front Panel Switches and Controls (Cont.)

Switch	Reference Designation	Initial Position
Receiver FAST AGC/ SLOW AGC	—	FAST AGC
Receiver BFO	—	0
Receiver Dial Zero Adjust	—	Not applicable
Receiver Lamp Dimmer	—	Mid-range
Receiver Preselector	—	Approximately 28
Receiver Band	—	28A
Receiver REJECTION	—	OFF
Receiver FILTER	—	B
Receiver FUNCTION	—	REC
Receiver Frequency Tuning	—	Not applicable
Receiver RF Gain	—	Full clockwise
Receiver AF Gain	—	OFF
Receiver MODE	—	CW
Voltmeter POWER OFF ON	—	OFF
Voltmeter RANGE	—	100
Voltmeter NULL	—	TVM/
Voltmeter Readout Dials A, B, C, D, and E	—	00.0000
Voltmeter Polarity Switch	—	+
Voltmeter Mechanical ZERO	—	Zero set meter
Power Supply PSI LINE PUSH ON/OFF	—	off

Table 4-2. Initial Positions of Front Panel Switches and Controls (Cont.)

Switch	Reference Designation	Initial Position
Power Supply PS1 METER	—	24V
Power Supply PS1 CURRENT	—	Full clockwise
Power Supply PS1 VOLTAGE COARSE	—	Not applicable (sealed)
Power Supply PS1 VOLTAGE FINE	—	Not applicable
Rear of Power Supply PS1 on Overvoltage Protector IN-ON OFF	—	On
Power Supply PS2 LINE PUSH ON/OFF	—	Off
Power Supply PS2 METER	—	2.4V
Power Supply PS2 CURRENT	—	Full clockwise
Power Supply PS2 VOLTAGE COARSE	—	Not applicable (sealed)
Power Supply PS2 VOLTAGE FINE	—	Not applicable
Rear of Power Supply PS2 on Overvoltage Protector IN-ON OFF	—	On

SECTION V

GLATS MAINTENANCE

5-1. PREVENTIVE MAINTENANCE

Preventive maintenance procedures presented in this section are to be performed at 45-day intervals and before each test. The calibration cycles of commercial equipment in the GLATS are specified on calibration tags on the front panels of the equipment or defined in the manufacturers' manuals supplied with the equipment. To perform preventive maintenance:

a. Inspect all cables and connectors for bent or broken pins, frayed insulation, proper mating, and cleanliness. Remove dust, dirt, and other foreign matter from connectors using ethyl alcohol conforming to federal specification O-E-760 or a good grade of commercial isopropyl alcohol.

b. Remove dust, dirt, and other foreign matter from cabinet and panel assemblies using a damp cotton cloth or soft brush.

c. Check all switches for positive action and proper mounting.

d. Inspect test points for cleanliness, chipped or broken insulation, and proper mounting. Clean test points using a small brush and the cleaning solvent specified in step a.

e. Check indicator lamp operation using turn-on procedures described in paragraph 4-5. Replace any lamp that has been found to be defective. Inspect indicator lamps for broken, missing, or improperly mounted lenses.

f. Inspect the slide mechanism of the control assembly drawer for proper action and cable clearance and adjust as necessary.

5-2. CORRECTIVE MAINTENANCE

Troubleshooting procedures presented in Table 5-1 are provided for fault isolation within the GLATS. Troubleshooting procedures include test steps, normal indications, and corrective action required. When a fault can immediately be isolated to a defective test function, such as the transmitter test or SCR test, in most cases, the troubleshooting procedure associated with that particular function will be adequate to locate the trouble without reference to other functional test procedures. A schematic diagram, Figure 5-1, is provided to facilitate maintenance.

NOTE

Troubleshooting procedures presented in Table 5-1 assume that the test set is connected to primary power, that all cables are connected to the test set but not to the GLA, and that the turn-off procedures presented in paragraph 4-4 have been performed.

Table 5-1. Troubleshooting Procedures

Test Set Power Distribution Test			
Step	Action	Normal Indication	Corrective Action
1	Place circuit breaker CB1 in on position. Place AC POWER switch S1 in the up (on) position.	AC POWER ON indicator DS1 illuminates	Check DS1. Check S1. Check CB1. Check wiring to and from J5 and at TB8 pins 1 and 2.
2	Place TEST CONTROL MODE switch S3 in position 5. Place XDUCER TEST SELECT switch S15 to 15 V. Set XDUCER TEST POWER switch S14 to on (up). Press VM READ Switch S2, record voltmeter indication, and release S2.	Voltmeter indicates 15 volts DC	Check voltmeter. Check S2. Check cabling to and from J6 and J4. Check S3. Check 15 volt power supply. Check S14 and S15.
3	Set the SELECT switch S15 and the POWER switch S14 off.		

Table 5-1. Troubleshooting Procedures (Cont.)

SCR Test			
Step	Action	Normal Indication	Corrective Action
4	Place TEST CONTROL MODE switch S3 in position 2. Place SCR TEST POWER switch S7 in the up (on) position. Connect external voltmeter across connector pins W5P1-1 (+) and W5P1-B (-). Place SCR TEST SELECT switch S9 in position 1.	External voltmeter indicates 2 volts DC	Check S7. Check M1. Check R1. Check CR2. Check wiring to and from TB1-1 and TB1-10. Check wiring of cables 1W1, W1, and W5.
5	Connect external voltmeter across connector pins W5P2-1 (+) and W5P2-8 (-). Place SCR TEST SELECT switch S9 in position 2.	External voltmeter indicates 2 volts DC	Check S9 and associated wiring. Check wiring to and from TB2-2 and TB2-10. Check cables 1W1, W1, and W5.
6	Connect external voltmeter across connector pins W5P3-1 (+) and W5P3-8 (-). Place SCR TEST SELECT switch S9 in position 3.	External voltmeter indicates 2 volts DC	Check S9 and associated wiring. Check wiring to and from TB3-1 and TB3-9. Check cables 1W1, W1 and W5.
7	Connect external voltmeter across connector pins W5P4-1 (+) and W5P4-8 (-). Place SCR TEST SELECT switch S9 in position 4.	External voltmeter indicates 2 volts DC	Check S9 and associated wiring. Check wiring to and from TB4-1 and TB4-9. Check cables 1W1, W1, and W5.

Table 5-1. Troubleshooting Procedures (Cont.)

SCR Test (Cont.)			
Step	Action	Normal Indication	Corrective Action
8	Place SCR TEST SELECT switch S9 in position OFF. Connect external voltmeter across connector pins W5P1-2 (+) and W5P1-8 (-). Place SCR TEST SELECT switch S9 in position 1. Press (on) SCR TEST TRIGGER switch S8, record indication, and release (off).	External voltmeter indicates 2 volts DC when S8 is depressed and 0 volts when released	Check R1 and R2. Check CR2. Check S8. Check S9 and associated wiring. Check wiring to and from TB1-1 and TB1-4. Check cables 1W1, W1, and W5
9	Connect external voltmeter across connector pins W5P2-2 (+) and W5P2-8 (-). Place SCR TEST SELECT switch S9 in position 2. Press (on) SCR TEST TRIGGER switch S8, record indication, and release (off).	External voltmeter indicates 2 volts DC when S8 is depressed and 0 volts when released	Check S8. Check S9 and associated wiring. Check wiring to and from TB2-10 and TB2-4. Check cables 1W1, W1, and W5.
10	Connect external voltmeter across connector pins W5P3-2 (+) and W5P3-8 (-). Place SCR TEST SELECT switch S9 in position 3. Press (on) SCR TEST TRIGGER switch S8, record indication, and release (off).	External voltmeter indicates 2 volts DC when S8 is depressed and 0 volts when released	Check S8. Check S9 and associated wiring. Check wiring to and from TB3-9 and TB3-4. Check cables 1W1, W1, and W5.
11	Connect external voltmeter across connector pins W5P4-2 (+) and W5P4-8 (-). Place SCR TEST SELECT switch S9 in position 4. Press (on) SCR TEST TRIGGER switch S8, record indication, and release (off).	External voltmeter indicates 2 volts DC when S8 is depressed and 0 volts when released	Check S8. Check S9 and associated wiring. Check wiring to and from TB4-4 and TB4-9. Check cables 1W1, W1, and W5.
12	Place POWER and SELECT switches S7 and S9 to their respective OFF positions.		

Table 5-1. Troubleshooting Procedures (Cont.)

Zener Test			
Step	Action	Normal Indication	Corrective Action
13	Place TEST CONTROL MODE switch S3 in position 3. Place ZENER TEST POWER switch S10 in up (on) position.	ZENER TEST ON indicator DS2 illuminates.	Check DS2. Check S10. Check wiring to and from TB7-2, and -1 and J4.
14	Connect external voltmeter across connector pins W5P1-1 (+) and (-). Place ZENER TEST SELECT switch S11 in position 1.	External voltmeter indicates 15 volts DC	Check R3. Check S1 and associated wiring. Check wiring to and from TB1-2 and TB1-6. Check cables 1W1, W1, and W5.
15	Connect external voltmeter across connector pins W5P2-1 (+) and W5P2-4 (-). Place ZENER TEST SELECT switch S11 in position 2.	External voltmeter indicates 15 volts DC	Check S1 and associated wiring. Check wiring to and from TB-2 and TB1-6. Check cables 1W1, W1, and W5.
16	Connect external voltmeter across connector pins W5P3-1 (+) and W5P3-4 (-). Place ZENER TEST SELECT switch S11 in position 3.	External voltmeter indicates 15 volts DC	Check S1 and associated wiring. Check wiring to and from TB3-2 and TB3-6. Check cables 1W1, W1, and W5.
17	Connect external voltmeter across connector pins W5P4-1 (+) and W5P4-4 (-). Place ZENER TEST SELECT switch S11 in position 4.	External voltmeter indicates 15 volts DC	Check S1 and associated wiring. Check wiring to and from TB4-2 and TB4-6. Check cables 1W1, W1, and W5.

Table 5-1. Troubleshooting Procedures (Cont.)

Zener Test (Cont.)			
Step	Action	Normal Indication	Corrective Action
18	Place ZENER TEST SELECT switch S11 and POWER switch S10 in the OFF positions.		
	Transmitter Test		
19	Place TEST CONTROL MODE switch S3 in position 4. Set the TIME indicator to 15 seconds. Place TRANSMITTER TEST POWER switch S12 in up (on) position.	TRANSMITTER TEST ON indicator illuminates and remains on for 15 seconds and then extinguishes.	Check F1. Check DS3. Check delay timer K1. Check S12 and associated wiring.
20	Place TRANSMITTER TEST POWER switch S12 in down (off) position. Set the TIME indicator to 15 seconds. Connect external voltmeter across connector pins W5P1-6 (+) and W6P1-10 (-). Place TRANSMITTER TEST SELECT switch S13 in position 1. Place TRANSMITTER TEST POWER switch S12 in up (on) position.	External voltmeter indicates 15 volts DC for 15 seconds and then 0 volts	Check M2. Check K1. Check S13 and associated wiring. Check wiring to and from TB1-9 and TB6-8. Check cables 1W1, 1W2, W1, W2, W5 and W6.
21	Place TRANSMITTER TEST POWER switch S12 in down (off) position. Set the TIME indicator to 15 seconds. Connect external voltmeter across connector pins W5P2-6 (+) and W6P1-10 (-). Place TRANSMITTER TEST SELECT switch S13 in position 2. Place TRANSMITTER TEST POWER switch S12 in up (on) position.	External voltmeter indicates 15 volts DC for 15 seconds and then 0 volts	Check S13 and associated wiring. Check wiring at TB2-9. Check cables 1W1, 1W2, W1, W2, W5 and W6.

Table 5-1. Troubleshooting Procedures (Cont.)

Transmitter Test (Cont.)			
Step	Action	Normal Indication	Corrective Action
22	Place TRANSMITTER TEST POWER switch S12 in down (off) position. Set the TIME indicator to 15 seconds. Connect external voltmeter across connector pins W5P3-6 (+) and W6P1-10 (-). Place TRANSMITTER TEST SELECT switch S13 in position 3. Place TRANSMITTER TEST POWER switch S12 in up (on) position.	External voltmeter indicates 15 volts DC for 15 seconds and then 0 volts	Check S13 and wiring. Check wiring at TB3-8. Check cables 1W1, 1W2, W1, W2, W5 and W6.
23	Place TRANSMITTER TEST POWER switch S12 in down (off) position. Set the TIME indicator to 15 seconds. Connect external voltmeter across connector pins W5P4-6 (+) and W6P1-10 (-). Place TRANSMITTER TEST SELECT switch in position 4. Place TRANSMITTER TEST POWER switch S12 in up (on) position.	External voltmeter indicates is volts DC for 15 seconds and then 0 volts	Check S13 and associated wiring. Check wiring at TB4-8. Check cables 1W1, 1W2, W1, W2, W5 and W6.
24	Place POWER and SELECT switches S12 and S13 to off positions.		
	Transducer Test		
25	Place TEST CONTROL MODE switch S3 in position 5. Place XDUCER TEST POWER switch S14 in up (on) position.	XDUCER TEST ON indicator DS4 illuminates	Check DS4. Check S3. Check S14. Check wiring to and from TB5-1 and TB6-9.

Table 5-1. Troubleshooting Procedures (Cont.)

Transducer Test (Cont.)			
Step	Action	Normal Indication	Corrective Action
26	Connect external voltmeter across connector pins W6P1-2 (+) and W6P1-10 (-).	External voltmeter indicates 15 ± 0.2 volts DC	Check S15 and associated wiring. Check wiring to and from TB5-1 and TB6-9. Check cables 1W2, W2 and W6.
27	Connect external power supply set for 2 VDC across connector pins W6P1-3 (+) and W6P1-10 (-). Place XDUCER TEST SELECT switch S15 in position ROLL. Press VM READ switch S2, record voltmeter indication, release S2.	Voltmeter indicates 2 volts DC	Check S15 and associated wiring. Check wiring to and from TB5-2. Check cables 1W2, W2 and W6.
28	Connect external power supply set for 2 VDC across connector pins W6P1-4 (+) and W6P1-10 (-). Place XDUCER TEST SELECT switch S15 in position PITCH. Press VM READ switch S2, record voltmeter indication, release S2.	Voltmeter indicates 2 ± 0.25 volts DC	Check S15 and associated wiring. Check wiring to and from TB5-3. Check cables 1W2, W2 and W6.
29	Place POWER and SELECT switches S14 and S15 to their respective off positions.		

Table 5-1. Troubleshooting Procedures (Cont.)

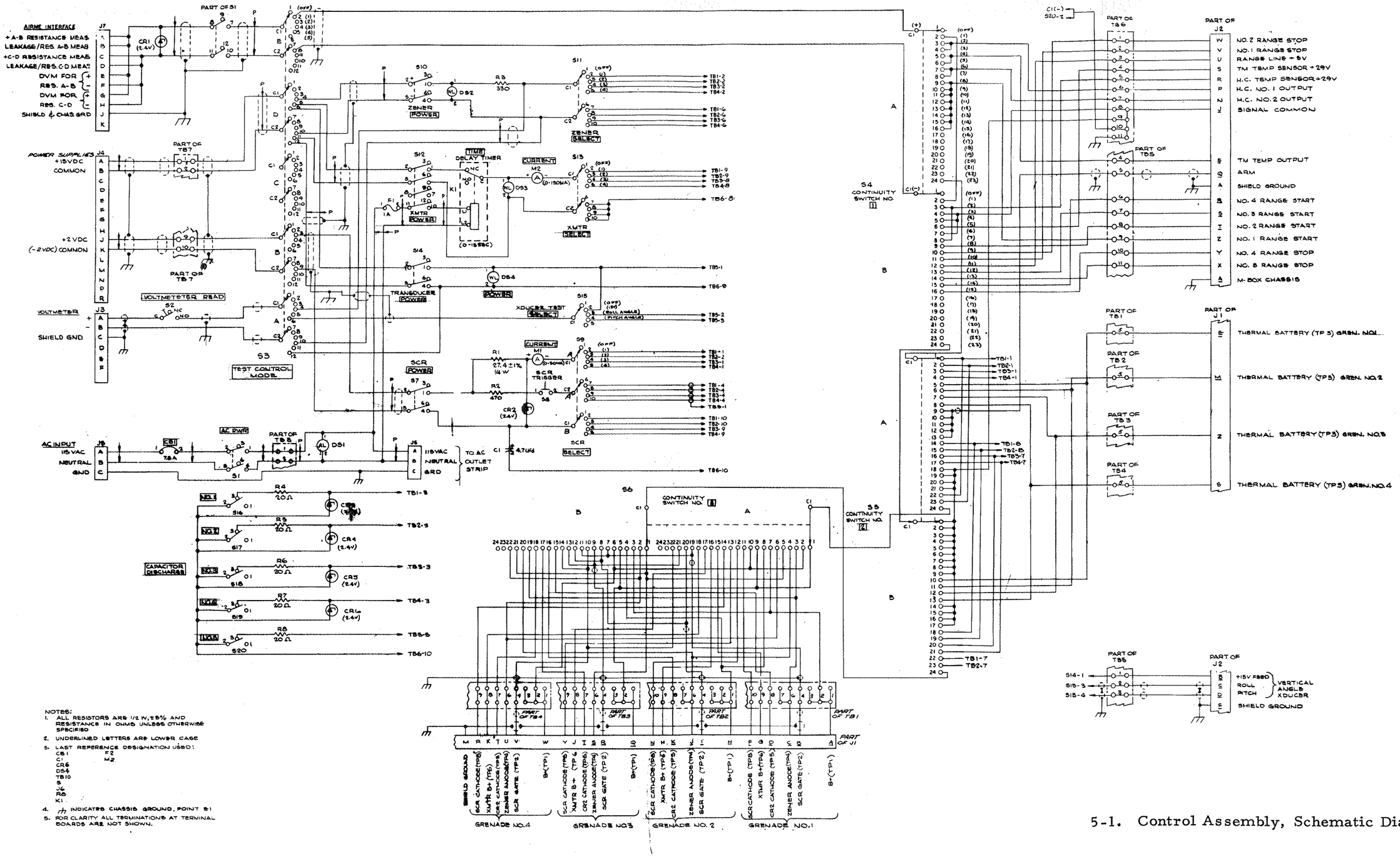
Capacitor Discharge Test			
Step	Action	Normal Indication	Corrective Action
30	Verify that all CAPACITOR DISCHARGE switches are in the down position with the red covers down. Connect the negative lead of an ohmmeter to W6P1-10 and connect the positive lead to W5P1-1.	Ohmmeter indicates 22 ± 3 ohms	Check S16. Check R4. Check wiring at TB1-3 and to J1.
31	Set the CAPACITOR DISCHARGE switch 1 to the up position and observe ohmmeter.	Ohmmeter indicates 1.0K ohms or more	Check CR3. Check S16.
32	Reverse the polarity of the ohmmeter (switch to -DC) and observe ohmmeter.	Ohmmeter indicates 20 ± 5 ohms	Check CR3.
33	Return the ohmmeter polarity switch to +DC and set the CAPACITOR DISCHARGE switch 1 to the down position.		
34	Connect the positive lead of the ohmmeter to W5P2-1 and observe the ohmmeter.	Ohmmeter indicates 22 ± 3 ohms	Check S17. Check R5. Check wiring at TB2-3.
35	Set the CAPACITOR DISCHARGE switch 2 to the up position and observe ohmmeter.	Ohmmeter indicates 1.0K ohms or more	Check CR4. Check S16.
36	Reverse the polarity of the ohmmeter (switch to -DC) and observe ohmmeter.	Ohmmeter indicates 16 ± 5 ohms	Check CR4.
37	Return the ohmmeter polarity switch to +DC and set the CAPACITOR DISCHARGE switch 2 to the down position.		

Table 5-1. Troubleshooting Procedures (Cont.)

Capacitor Discharge Test (Cont.)			
Step	Action	Normal Indication	Corrective Action
38	Connect the positive lead of the ohmmeter to W5P3-1 and observe the ohmmeter.	Ohmmeter indicates 22 ± 3 ohms	Check S18. Check R6. Check wiring at TB3-3.
39	Set the CAPACITOR DISCHARGE switch 3 to the up position and observe ohmmeter.	Ohmmeter indicates 1.0K ohms or more	Check CR5. Check S18.
40	Reverse the polarity of the ohmmeter (switch to -DC) and observe ohmmeter.	Ohmmeter indicates 16 ± 5 ohms	Check CR5.
41	Return the ohmmeter polarity switch to +DC and set the CAPACITOR DISCHARGE switch 3 to the down position.		
42	Connect the positive lead of the ohmmeter to W5P4-1 and observe the ohmmeter.	Ohmmeter indicates 22 ± 3 ohms	Check S19. Check R7. Check wiring at TB4-3.
43	Set the CAPACITOR DISCHARGE switch 4 to the up position and observe ohmmeter.	Ohmmeter indicates 1.0K ohms or more	Check CR6. Check S19.
44	Reverse the polarity of the ohmmeter (switch to -DC) and observe ohmmeter.	Ohmmeter indicates 16 ± 5 ohms	Check CR6.
45	Return the ohmmeter polarity switch to +DC and set the CAPACITOR DISCHARGE switch 4 to the down position.		
46	Connect the positive lead of the ohmmeter to W6P1-15 and observe the ohmmeter.	Ohmmeter indicates 22 ± 3 ohms	Check S20. Check R8. Check wiring at TB5-5

Table 5-1. Troubleshooting Procedures (Cont.)

Capacitor Discharge Test (Cont.)			
Step	Action	Normal Indication	Corrective Action
47	Set the CAPACITOR DISCHARGE switch 5 to the up position and observe ohmmeter.	Ohmmeter indicates 1.0K ohms	Check S20.
48	Reverse the polarity of the ohmmeter (switch to -DC) and observe ohmmeter.	Ohmmeter indicates 16 ± 5 ohms	Check S20
49	Return the ohmmeter polarity switch to +DC and set the CAPACITOR DISCHARGE switch 5 to the down position.		
50	Remove ohmmeter from GLATS.		



NOTES:
1. ALL RESISTORS ARE 1/2 W, ±5% AND RESISTANCE IN OHMS UNLESS OTHERWISE SPECIFIED
2. UNDERLINED LETTERS ARE LOWER CASE
3. LAST REFERENCE DESIGNATION USED:
   CB1 — F2
   J7 — M2
   CR6
   DS4
   TB10
   S
   J6
   R8
   K1
4. ⏚ INDICATES CHASSIS GROUND, POINT E1
5. FOR CLARITY ALL TERMINATIONS AT TERMINAL BOARDS ARE NOT SHOWN.

5-1. Control Assembly, Schematic Diagram

SECTION VI

GLATS SPARE PARTS

6-1. GENERAL INFORMATION

To ensure that the grenade launch assembly test set (GLATS) will be operational within a short time if a part should fail, spare parts for the GLATS are stored at Bendix Aerospace System Division facilities in Michigan (BxA) and at Bendix Aerospace System Division facilities in the Kennedy Space Center (KSC).

6-2. SPARE PARTS LIST

Table 6-1 lists the spare parts for the GLATS. The table gives reference designations, descriptions, manufacturers' codes, and manufacturers' part numbers for the parts. The table also indicates whether a part is stored at BxA or at KSC. To indicate that a part is part of another part, the description of the smaller part is placed below and to the right of the description of the larger part.

6-3. LIST OF MANUFACTURERS

The spare parts list, Table 6-1, gives federal manufacturers' codes. To relate a code to the name and location of a manufacturer, refer to Table 6-2.

Table 6-1. Grenade Launch Assembly Test Set Spare Parts

Reference Designation	Description	Part Number	Manufacturer's Part Number	Manufacturer's Code*	Storage Location**	Quantity Stored
-	Grenade Launch Assembly Test Set	2331657		07038		0
	Control Assembly	2331663		07038		0
J1	Connector		MS3127E20-41SW	96906	BxA	1
J2	Connector		MS3127E20-41SY	96906	BxA	1
J3	Connector		MS3127E10-6S	96906	BxA	1
J4	Connector		MS3127E14-15P	96906	BxA	1
J5	Connector		MS3127E12-3P	96906	BxA	1
J6	Connector		MS3127E12-3S	96906	BxA	1
J7	Connector		MS3127E12-10P	96906	BxA	1
TB10	Terminal Board Assembly	2331642		07038		0
	Terminal Board		1402-45-01-02	71279		0
R1	Resistor		RN60D27R4F	81349	BxA	2
R2	Resistor		RC20GF471J	81349	BxA	2
R3	Resistor		RC20GF331J	81349	BxA	2
R4 thru R8	Resistor		RC20GF200J	81349	BxA	2
C1	Capacitor		CS13BC475K	81349	BxA	2
CR1 thru CR6	Diode		1N5221B	04713	BxA	2
S7, S10, S14, and S16 thru S20	Switch, Toggle		MS35059-23	96906	BxA	2
S1 and S12	Switch, Toggle		MS25068-23	96906	BxA	1

Table 6-1. Grenade Launch Assembly Test Set Spare Parts (Cont.)

Reference Designation	Description	Part Number	Manufacturer's Part Number	Manufacturer's Code*	Storage Location**	Quantity Stored
S4, S5, and S6	Switch, Rotary		PA670529	71785	BxA	1
S9	Switch, Rotary		PA6013	71785	BxA	1
S11, S13, and S15	Switch, Rotary		PA6003	71785	BxA	1
S3	Switch, Rotary		PA2033	71785	BxA	1
S2	Switch, Pushbutton		W9606B	81640	BxA	1
S8	Switch, Pushbutton		W106PB3	81640	BxA	1
CB1	Circuit Breaker		105-507-101		KSC	1
K1	Timer, Time Delay, 0-15 sec.		MTD15S	30703	KSC	1
M1	Ammeter, 0-50ma		6230	87243	KSC	1
M2	Ammeter, 0-150ma		6250	87243	KSC	1
-	Switch Guard, Toggle, Red		MS25224-1	96906	KSC	2
XF1	Fuseholder		HKP	71400	BxA	2
F1	Fuse, 1 ampere		MDL-1	71400	KSC	10
XDS1	Lampholder Assembly, Neon		137-8836-1533-522	72619		0
XDS2, XDS3, and XDS4	Lampholder Assembly		162-8430-0975-502	72619		0
DS2, DS3, and DS4	Lamp, Incandescent		370	06157	KSC	10
DS1	Lamp, Neon		NE2D	72619	KSC	10
Unit 2	Junction Box Assembly	2331689		07038		0
J2, J3	Connector		MS3127E12-10P	96906	BxA	1
J1	Connector		MS3127E20-39S	96906	BxA	1

Table 6-1. Grenade Launch Assembly Test Set Spare Parts (Cont.)

Reference Designation	Description	Part Number	Manufacturer's Part Number	Manufacturer's Code*	Storage Location**	Quantity Stored
FL1	Filter, Modified, 20 ampere	2331654-3	WCF202A2	07038	BxA	1
1W1	Cable Assembly	2331669		07038		0
P1	Connector		MS3126F20-41PW	96906	BxA	1
J1	Connector		MS3128F20-41SW	96906	BxA	1
1W2	Cable Assembly	2331670		07038		0
P1	Connector		MS3126F20-41PY	96906	BxA	1
J2	Connector		MS3128F20-41SY	96906	BxA	1
1W3	Cable Assembly	2331671		07038		0
P1	Connector R.F.		UG88/U	81349	BxA	10
P2	Connector		13A	71785	BxA	1
1W4	Cable Assembly	2331672		07038		0
P1	Connector		MS3126F10-6P	96906	BxA	1
P2	Connector		274NK	24655	BxA	1
1W5	Cable Assembly	2331673		07038		0
-	Connector		MS3126F14-15S	96906	BxA	1
1W8	Cable Assembly	2331676-1		07038		0
J4	Connector		MS3100A16S5P	96906	BxA	1
1W9	Cable Assembly	2331676-2		07038		0
P1	Connector		MS3126F12-3S	96906	BxA	1
1W10	Cable Assembly	2331678		07038		0
P1	Connector		MS3126F12-3P	96906	BxA	1
W1	Cable Assembly	2331679		07038		0
P1	Connector		MS3126F20-41PW	96906	BxA	1
P2	Connector		MS3126F20-41PX	96906	BxA	1

Table 6-1. Grenade Launch Assembly Test Set Spare Parts (Cont.)

Reference Designation	Description	Part Number	Manufacturer's Part Number	Manufacturer's Code*	Storage Location**	Quantity Stored
-	Adapter, R. F. I.		G1721K20A30B3C	06324	BxA	2
-	Cap and Chain Connector		10-101957-20-3	77820	BxA	2
W2	Cable Assembly	2331680		07038		0
P1	Connector		MS3126F20-41PY	96906	BxA	1
P2	Connector		MS3126F20-41P	96906	BxA	1
-	Adapter, R. F. I.		G1721K20A30B3C	06324	BxA	2
-	Cap and Chain Connector		10-101957-20-3	77820	BxA	2
W3	Cable Assembly	2331681		07038		0
-	Connector, R. F.		UG88/U	81349	BxA	10
-	Shorting Cap and Chain		17575	02660	BxA	1
W4	Cable Assembly	2331682		07038		0
P1	Connector		MS3106A16S5S	96906	BxA	1
P2	Connector		5208	74545	BxA	1
W5	Cable Assembly	2331683		07038		0
J1	Connector		MS3120F20-41SX	96906	BxA	1
-	Connector	2331618-1	321K1K	07038	BxA	1
-	Connector	2331618-2	K65K4	07038	BxA	1
-	Connector	2331618-3	98KK7	07038	BxA	1
-	Connector	2331618-4	521K1K	07038	BxA	1
-	Contacts, Male Connector		220P02	02660	BxA	16
W6	Cable Assembly	2331684		07038		0
J1	Connector		MS3120F20-41S	96906	BxA	1
P1	Connector	2331194		07038	BxA	1

Table 6-1. Grenade Launch Assembly Test Set Spare Parts (Cont.)

Reference Designation	Description	Part Number	Manufacturer's Part Number	Manufacturer's Code*	Storage Location**	Quantity Stored
-	Contacts, Female Connector		220S02	02660	BxA	29
-	Guide Pin, Connector		221-535	02660	BxA	1
W7	Cable Assembly	2331685		07038		0
P1	Connector		MS3126F20-39P	96906	BxA	1
P2	Connector		MS3126F20-41PX	96906	BxA	1
-	Adaptor, R.F.I.		G1721K20A30B3C	06324	BxA	2
W8	Cable Assembly	2331686		07038		0
P1	Connector		MS3126F20-39P	96906	BxA	1
P2	Connector		MS3126F20-41P	96906	BxA	1
-	Adapter, R.F.I.		G1721K20A30B3C	06324	BxA	2
-	Shorting Plug Assembly	2331677-1		07038	BxA	1
-	Shorting Plug Assembly	2331677-2		07038	BxA	1
-	Shorting Plug Assembly	2331677-3		07038	BxA	1
-	Shorting Plug Assembly	2331677-4		07038	BxA	1
-	Shorting Plug Assembly	2331677-5		07038	BxA	1
-	Shorting Plug Assembly	2331677-6		07038	BxA	1
-	Shorting Plug Assembly	2331677-7		07038	BxA	1
-	Shorting Plug Assembly	2331677-8		07038	BxA	1
-	Shorting Plug Assembly	2331677-9		07038	BxA	1
-	Shorting Plug Assembly	2331677-10		07038	BxA	1
-	Shorting Plug Assembly	2331677-11		07038	BxA	1
-	Shorting Plug Assembly	2331677-12		07038	BxA	1
-	Shorting Plug Assembly	2331677-13		07038	BxA	1

Table 6-1. Grenade Launch Assembly Test Set Spare Parts (Cont.)

Reference Designation	Description	Part Number	Manufacturer's Part Number	Manufacturer's Code*	Storage Location**	Quantity Stored
-	Shorting Plug Assembly	2331677-14		07038	BxA	1
-	Shorting Plug Assembly	2331677-15		07038	BxA	1
-	Cable Assembly, Grounding	2331612-1		07038		0
1A4	Power Supply, Trip Point	2338385		07038		0
1A2	Voltmeter, D.C.	2338387		07038		0
1A1	Receiver	2338386		07038		0
1J3	Adapter, Bulkhead, R.F.		UG492A/U	81349	BxA	1
-	Antenna & Cable Assembly	2331692		07038		0

Notes:

*Refer to Table 6-2 for the manufacturer's name and address.

**BxA indicates that the part is stored at the Bendix Aerospace Systems Division of Ann Arbor, Michigan. KSC indicates that the part is stored at the Bendix Aerospace Systems Division facilities of the Kennedy Space Center. No entry in this column indicates that the part is not a spare part but is listed in the table so that succeeding parts can be referenced to it.

Table 6-2. Spare Part Manufacturers

Manufacturers' Federal Code	Manufacturer and Address
02660	Amphenol Corp.; Broadview, Illinois
04713	Motorola, Inc.; Semiconductor Products Div.; Phoenix, Ariz.
06324	Glenair, Inc.; Glendale, Cal.
07038	Bendix Corp.; Aerospace Systems Div.; Ann Arbor, Mich.
07980	Hewlett-Packard Co.; Rockaway Div.; Rockaway, N. J.
17660	Hammerlund Mfg. Co., Inc.; Mars Hill, N.C.
24655	General Radio Co.; West Concord, Mass.
30703	Industrial Timer Corp.; Parsippany, N. J.
71279	Cambridge Thermionic Corp.; Cambridge, Mass.
71400	Bussmann Mfg. Div.; McGraw-Edison Co.; St. Louis, Mo.
71785	Cinch Mfg. Co.; Howard B. Jones Div.; Chicago, Ill.
72619	Dialight Corp.; Brooklyn, N. Y.
74545	Hubbell Harvey Inc.; Bridgeport, Conn.
77820	Bendix Corp.; Electrical Components Div.; Sidney, N. Y.
81349	Military Specifications
81640	Control Switch Div.; Controls Co. of America; Folcroft, Pa.
84536	Fleck Co.; Camden, N. J.
87243	Simpson Industries; Seattle, Wash.
96906	Military Standards

SECTION VII

MECHANICAL ATTITUDE REFERENCE POSITIONING DEVICE

7-1. INTRODUCTION

The mechanical attitude positioning device (MARPD) is used in conjunction with the grenade launch assembly test set (GLATS) to test the grenade launch assembly (GLA) of the Apollo lunar surface experiments package (ALSEP). Tests are performed on the GLA to determine angle transducer electrical outputs versus index table position indications. Testing is carried out on both pitch and roll angle transducers independently as the GLA is rotated about its pitch and roll axes. The MARPD is a two-axis tilt-table that permits successive adjustment of the GLA to various pitch and roll positions about the vertical axis. Indicating scales are provided to indicate these positions.

Prior to testing, and before the GLA is mounted on the MARPD, the test and scribe plates and angle, roll and pitch level brackets are mounted, adjusted, and locked into position on the GLA casing to provide a position reference point of 45° pitch and 0° roll. After the GLA casing, with the plates and brackets affixed, is mounted on the MARPD, two bubble levels are positioned on their respective pitch and roll brackets and the pitch and roll handwheels of the respective MARPD index tables are adjusted to obtain a level indication for both pitch and roll planes. At this time, electrical values are read from the outputs of the pitch and roll angle transducers and recorded to establish the electrical equivalent of the position reference point (45° pitch and 0° roll) that is used as position reference data in subsequent GLA angle transducer testing as described in Section II.

7-2. PHYSICAL DESCRIPTION

Figure 7-1 shows the basic MARPD with the pitch index table mounted to the roll index table by six screws (not shown) through the side plate into the back plate and three screws (also not shown) through the bottom plate into the back plate. The MARPD is assembled so that the back plate, bottom plate, and side plate are mutually perpendicular. The table plate is secured to the pitch index table with four screws. The GLA mounts to the table plate by fastening four screws through four spacers on the table plate.

Figure 7-2 shows the GLA component mounted on the MARPD with four screws fastened through the four table plate spacers. The test plate is mounted to the GLA component with four screws aligning the scribe line with the scribe lines on the scribe plates bonded to the GLA component. The pitch level bracket is

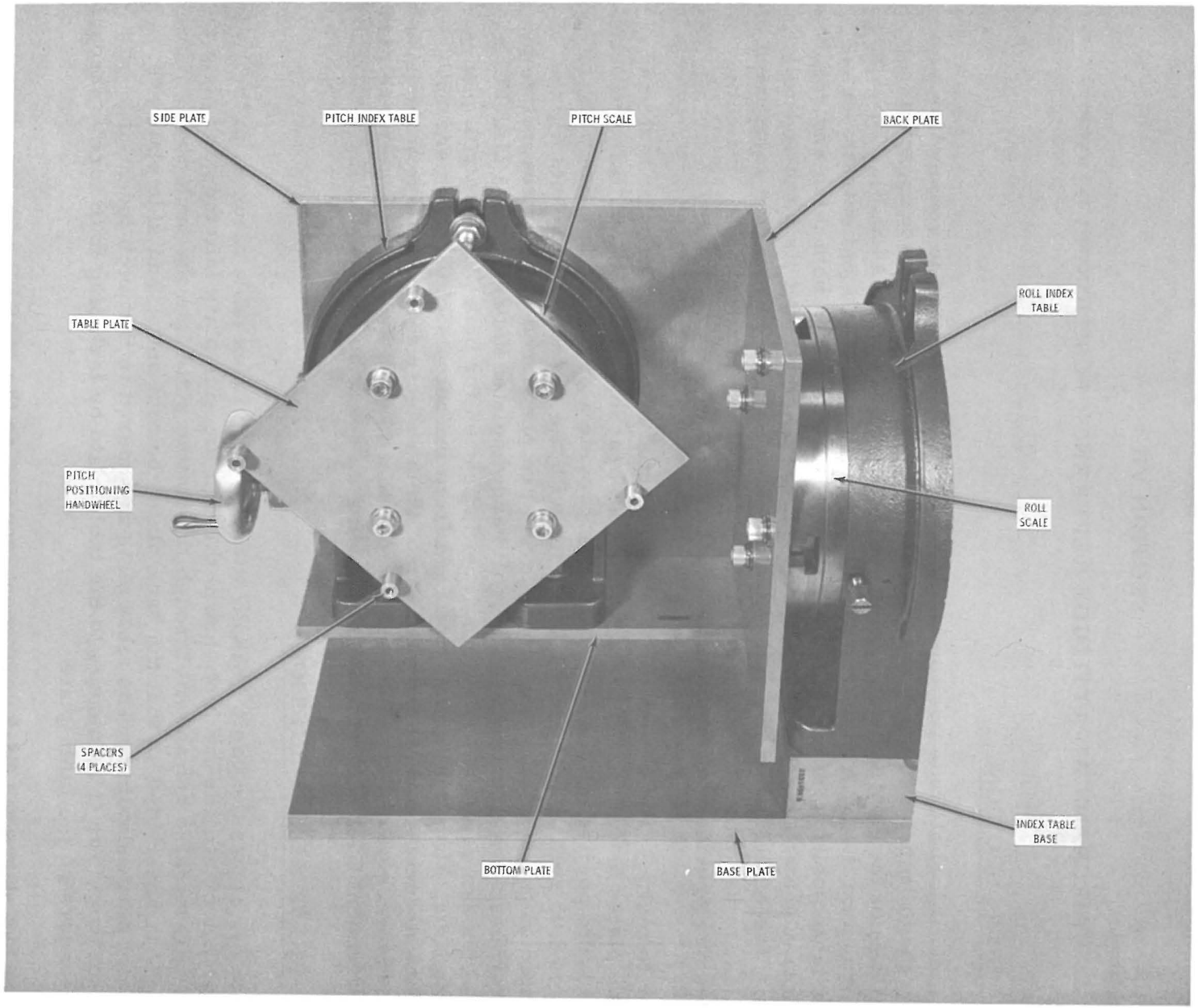


Figure 7-1. Mechanical Attitude Reference Positioning Device (MARPD)

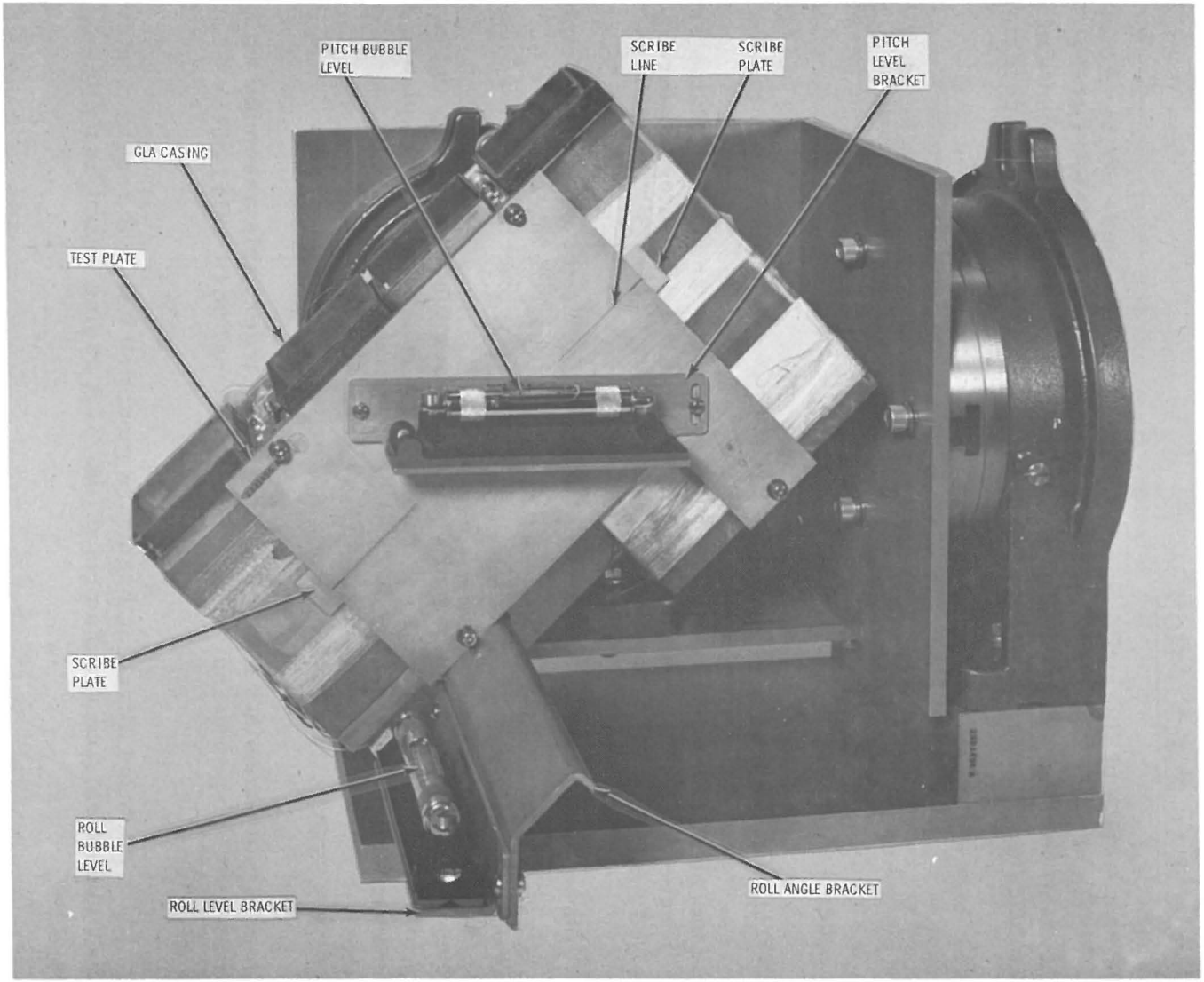


Figure 7-2. MARPD with GLA Casing Mount Assembly

secured to the test plate by one fixed screw and a second screw fastened in an adjustable slot. The roll level bracket is secured to the GLA angle bracket with four screws.

The two levels are carefully positioned onto their respective brackets whenever leveling information is required during the calibration testing. The levels are removed from their respective positions to prevent damage whenever the GLA is rotated in either the pitch or roll direction.

7-3. FUNCTIONAL DESCRIPTION

The MARPD consists of five primary assemblies which include the base plate assembly, interface plate assembly, pitch assembly, roll assembly, and the GLA casing mount assembly. Figures 7-1 and 7-2 indicate major components of the five assemblies and paragraphs 7-4 through 7-8 provide a functional description.

7-4. BASE PLATE ASSEMBLY

The base plate assembly consists of the base plate and the index table base and provides a sturdy, level, mounting platform for securement of the roll assembly and subsequently, the other assemblies.

7-5. INTERFACE PLATE ASSEMBLY

The interface plate assembly consists of the side, back, and bottom plates secured mutually perpendicular to each other to insure position data integrity throughout the pitch and roll ranges of GLA rotation.

The side and bottom plates are two components of the interface plate assembly that contain attaching hardware mounting holes at required intervals for correct placement and securement of the pitch assembly to the interface plate assembly.

The back plate is the third component of the interface plate assembly and contains attaching hardware mounting holes at required intervals for correct placement and securement to the roll assembly.

7-6. PITCH ASSEMBLY

The pitch assembly consists of the table plate and index table assembly which provide a means for mounting and incremental rotational positioning of the GLA in the pitch plane.

The table plate contains attaching hardware mounting holes at required intervals for correct placement and securement of the GLA casing mount assembly to the pitch assembly.

The index table assembly consists of the scale, index pointer, and handwheel. The scale displays numerical designators on a rotating ring operated by rotation of the pitch index table using the handwheel. The numerical designators represent the amount of rotation in degrees of pitch.

The index pointer is a stationary arrowhead indicator that functions as a fixed reference point while the rotating scale moves to various positions as determined by movement of the pitch index table by the pitch handwheel.

7-7. ROLL ASSEMBLY

The roll assembly consists of the roll index table assembly which provides a means for incremental rotational positioning of the GLA in the roll plane through the interface plate assembly.

The index table base contains attaching hardware mounting holes at required intervals for correct placement and securement of the roll assembly to the MARPD base plate.

The index table assembly consists of identical components and functions exactly as the pitch index table assembly described in paragraph 7-6 except that the numerical designators represent the amount of rotation in degrees roll and independent operation is available through the movement of the roll handwheel.

7-8. GLA CASING MOUNT ASSEMBLY

The GLA casing mount assembly consists of scribe plates, test plate, angle bracket, pitch and roll level brackets, and bubble levels. Except for the bubble levels, the GLA casing mount assembly is secured to the GLA casing in a definite, measured manner, and locked for the duration of GLA testing.

The scribe plates and test plate are bonded and bolted to the GLA casing and marked with scribe lines to indicate the calibrated reference points for required orientation (45° pitch and 0° roll) when mounted to the MARPD. This setting is established by a separate precision positioning text fixture. In addition, the test plate contains attaching hardware spacer mounting holes at required intervals for correct alignment, placement, and securement of the GLA casing to the pitch assembly test plate.

The angle bracket provides a means for correct placement of the roll level bracket.

The pitch and roll brackets are angle brackets mounted, adjusted, and secured into position to serve as holders for the pitch and roll bubble levels. In addition, the pitch and roll level brackets contain adjustable slots at one end to accomplish minor adjustments.

The bubble levels are standard, commercially available, level indicators.

7-9. OPERATION

After the GLA is mounted and adjusted to a reference zero setting, operation of the MARPD requires the repositioning of the GLA to various pitch and roll settings through the use of the pitch and roll controls and indicators. For a general outline covering these operations, refer to paragraph 7-10 for mounting and reference zero setting and to paragraph 7-11 for repositioning during test. Refer to Figure 7-3 for a view of the pitch index table controls and indicators. The roll index table controls and indicators are identical to the controls and indicators shown in Figure 7-3 for the pitch index table.

7-10. GLA MOUNTING AND REFERENCE ZERO SETTING

Perform the following steps to mount and zero reference the GLA.

a. Check scribe plates and test plate scribe lines for correct alignment. If required alignment is offset, realign and rebond parts using suitable epoxy.

b. Position GLA casing mount assembly test plate so that mounting holes are aligned with spacers on pitch index table plate.

c. Secure GLA casing mount assembly to pitch index table plate using appropriate attaching hardware.

d. Before using bubble level indicators, adjust pitch and roll handwheels until each corresponding level bracket is approximately level.

e. Position bubble levels on pitch and roll brackets, respectively.

f. Carefully rotate pitch and roll handwheels in small increments to achieve a level indication reading on both levels.

g. Lock each setting by tightening set screws appearing directly over each index pointer.

h. Record pitch reading as indicated on pitch index table ring scale. This numerical designator represents 45° pitch.

i. Record roll reading as indicated on roll index table ring scale. This numerical designator represents 0° roll.

NOTE

The numbers recorded in steps h and i are to be used as reference zero setting data for subsequent GLA testing.

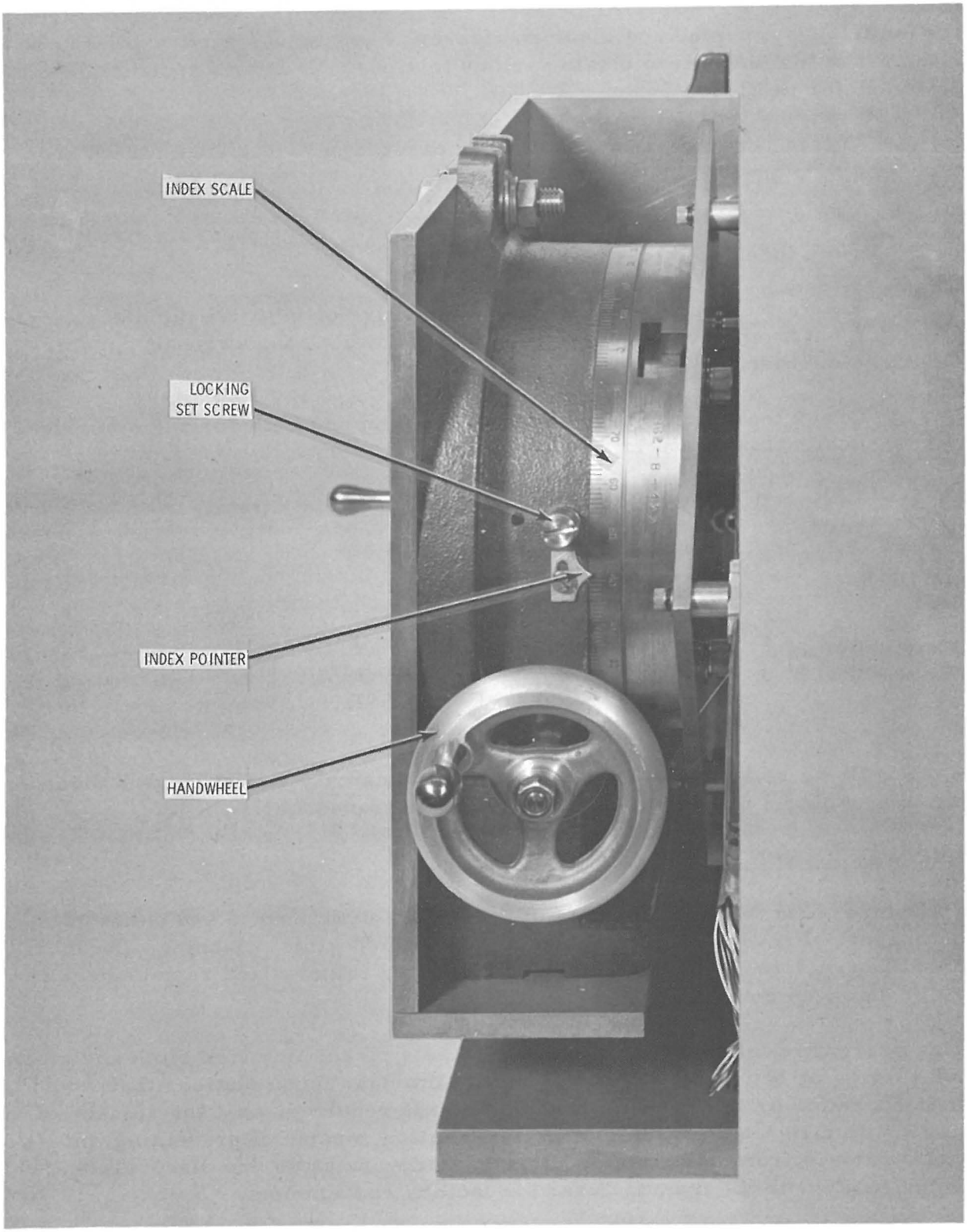


Figure 7-3. Pitch Index Table Controls and Indicators

7-11. REPOSITIONING DURING TEST

After the GLA is mounted and the zero reference setting has been acquired, repositioning of the MARPD to obtain various test position data is accomplished as follows: Refer to Figure 7-3.

a. Obtain zero setting as outlined in paragraph 7-10 for both pitch and roll planes.

b. Unlock pitch index table by loosening set screw appearing directly over pitch index pointer.

c. Rotate pitch handwheel to desired positive or negative pitch displacement from zero setting by rotating handwheel clockwise or counterclockwise.

d. Check that pitch index pointer is in alignment with desired numerical designator appearing on ring scale.

e. Lock setting by tightening set screw appearing directly over pitch index pointer.

NOTE

The GLA is now positioned in the desired pitch plane and electrical measurements from the pitch angle transducer can be taken.

f. Using roll index table controls and indicators, repeat steps b through e to obtain position data from roll angle transducer.

7-12. MAINTENANCE

Maintenance of the MARPD consists of preventive maintenance and corrective maintenance. Preventive maintenance includes inspection, cleaning, and lubrication. Corrective maintenance is essentially the removal and replacement of worn or damaged components.

During preventive maintenance inspection, use a clean, lint-free cloth and a soft brush to wipe or brush the surface clean to eliminate accumulations that would impair operation or inspection. If lubrication is required, coat the surface of the MARPD with a light oil or some other preparation capable of preventing the MARPD surface from oxidizing. If damaged or worn parts are discovered, return the MARPD to the manufacturer for factory replacement.

7-13. UNPACKING, REPACKING, AND STORAGE

The MARPD is shipped as one main assembly along with two bubble level assemblies. The basic MARPD assembly is packed in a single plywood container along with the two bubble level assemblies. The GLA with MARPD mounting hardware attached is packed in a separate shipping container and is mounted on the MARPD at its destination. The MARPD, GLA, and two bubble level assemblies are wrapped in Vinyl sheeting to protect them from dust and moisture.

CAUTION

Because hands exude organic substances that can hasten deterioration of MARPD surfaces, do not touch the level brackets, side index, or the back index with bare hands.

Unpack the MARPD by removing the top of the plywood container and removing the basic MARPD assembly and the two bubble level assemblies. Check to ascertain that no damage has resulted to the assemblies during shipment. The packing material and plywood container may be retained for repacking prior to storage or shipping.

To repack the MARPD, disassemble the MARPD into three main assemblies; the two bubble level assemblies, the GLA assembly—with MARPD hardware attached, and the basic MARPD assembly. Wrap the basic MARPD and two bubble level assemblies in Vinyl sheeting to protect them from dust and moisture and place the assemblies in a suitable container padded with durable cushioning material.

Before storing the MARPD for any period longer than several weeks, coat the surface of the MARPD with a light coating of oil, a light grease, or some other preparation capable of preventing the MARPD surface from oxidizing. Pack the MARPD in the manner previously described and store the MARPD in a dry place.

SECTION VIII

ABBREVIATIONS

AIRME	Apollo Initiator Resistance Measuring Equipment
ALSEP	Apollo Lunar Surface Experiments Package
ASE	Active Seismic Experiment
ASI	Apollo Standard Initiator
BxA	Bendix Aerospace Systems Division
GLA	Grenade Launch Assembly
GLATS	Grenade Launch Assembly Test Set
KSC	Kennedy Space Center
MARPD	Mechanical Attitude Reference Positioning Device
SCR	Silicon Controlled Rectifier