TM 11-6625-2953-14

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL,

DIRECT SUPPORT,

AND

GENERAL SUPPORT MAINTENANCE MANUAL

MULTIMETER AN/USM-451

(NSN 6625-01-060-6804)

This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY

AUGUST 1979

WARNING

To avoid safety hazard, electrical shock or instrument damage, do not connect COMMON input connector to any signal which exceeds 500 volts with respect to earth ground.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

WARNING

To be usable for cleaning, the compressed air source must limit the nozzle pressure to no more than 29 pounds per square inch gauge (PSIG). Goggles must be worn at all times while cleaning with compressed air.

CHANGE

No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 12 October 1983

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

MULTIMETER AN/USM-451 (NSN 6625-01-060-6804)

TM 11-6625-2953-14, 23 August 1979, is changed as follows:

1. New or revised material is indicated by a vertical bar in the margin. Where an entire chapter, section, or illustration is added or revised, the vertical bar is placed opposite the identification number and title.

2. Remove old pages and insert new pages as follows:

Remove pages	*Insert pages*
i through 1-0	i through 1-0
1-1 through 1-4	1-1 through 1-4
3-1 and 3-2	3-1 and 3-2
3-7 through 3-10	3-7 through 3-10
3-13 through 3-16	3-13/(3-14 blank)
A-1/(A-2 blank)	A-1/(A-2 blank)
D-3 through D-6	D-3 through D-6
E-1 and E-2	E-1 and E-2
Figure FO-1	Figure FO-1

3. File this change sheet in front of the publication.

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CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 23 *September* 1980

Operator's Organizational, Direct Support, and General Support Maintenance Manual
MULTIMETER AN/USM-451
(NSN 6625-01-060-6804)

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iii through v	iii through v
1-0 through 1-2	1-0 through 1-2
1-5 and 1-6	1-5 through 1-7/1-8
2-1 through 2-10	2-1 through 2-10
3-3 and 3-4	3-3 and 3-4
3-9 through 3-14	3-9 through 3-16
D-3 and D-4	D-3 and D-4
E-1 and E-2	E-1 and E-2

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29-610

ARNG: None
USAR: None

For explanation of abbreviations used, see AR 310-50.

Technical Manual

No. 11-6625-2953-14

TM 11-6625-2953-14
Headquarters
Department of the Army
Washington, DC,
23 August 1979

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

MULTIMETER AN/USM-451

(NSN 6625-01-060-6804)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, New Jersey 07703. A reply will be furnished to you.

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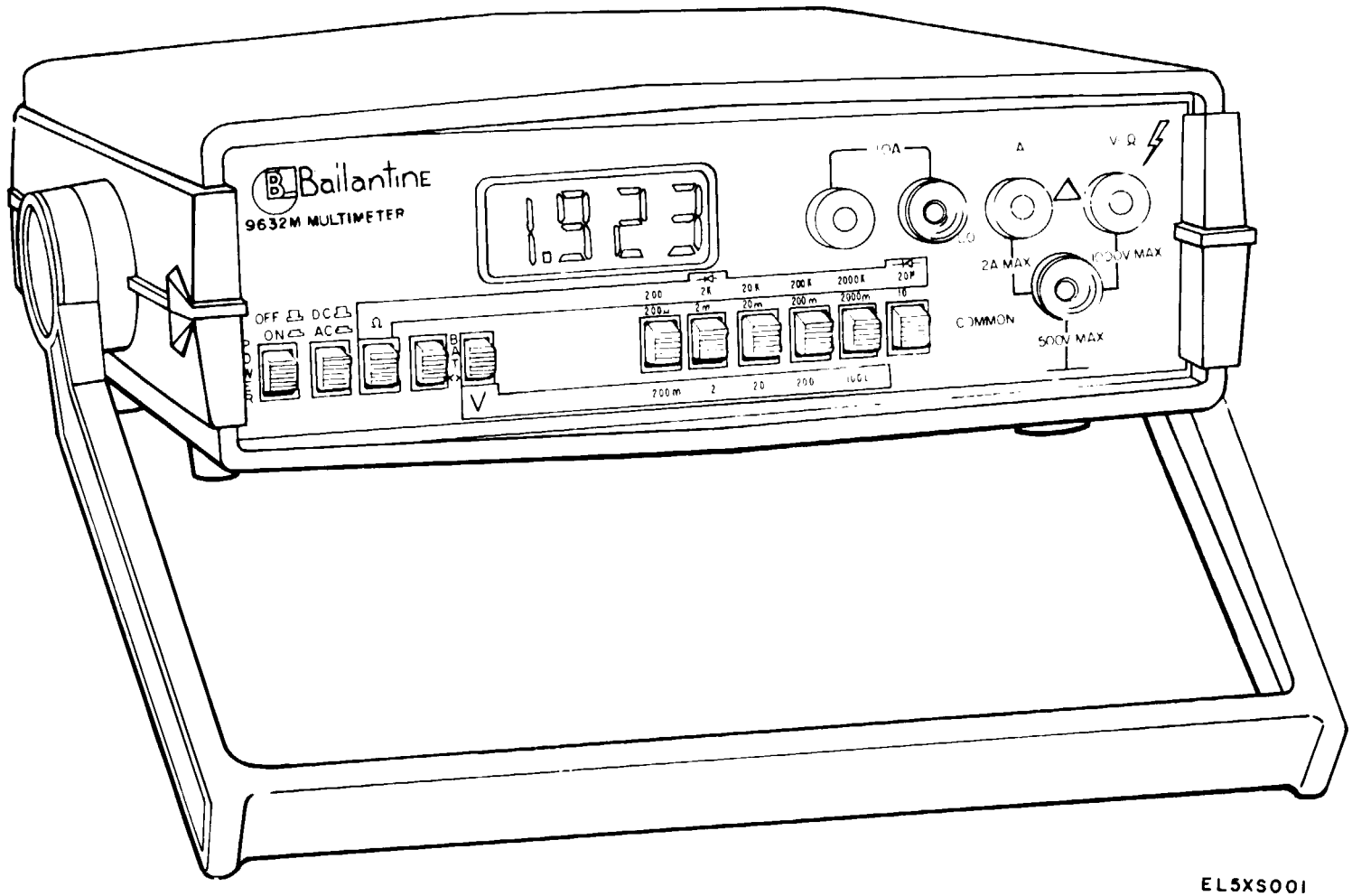

Figure 1-1. Multimeter, AN/USM-451

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope.

a. This manual describes Multimeter, AN/USM-451 (fig. 1-1) and provides instructions for operation, organizational maintenance, and general support (GS) maintenance. It includes a maintenance allocation chart (appx. D.) Instructions are provided for the operator and organizational technician for operation and preventive maintenance. Circuit functioning is included for general support maintenance, together with instructions appropriate to these categories of maintenance for troubleshooting, testing, adjusting, aligning, and repairing the equipment and replacing maintenance parts.

b. No direct support maintenance is authorized.

1-2. Consolidated Index of Army Publications and Blank Forms

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the equipment.

1-3. Reports of Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System (TAMMS).

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) os prescribed in AR 735-11-2/DLAR 4140.55/ NAVMATINST 4355.73 A/AFR 400-54/MCO 4430.3F.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/ NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D/ /DLAR 4500.15.

1-4. Administrative Storage.

Refer to Chapter 5 for administrative instructions,

1-5. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-6. Reporting Equipment Improvement Recommendations (EIR)

If your equipment needs improvement, let us know. Send us an EIR. You, the user are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on on SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, New Jersey 07703. We'll send you a reply.

Section II. DESCRIPTION AND DATA

1-7. Description.

a. This manual provides operation and maintenance instructions for Multimeter AN/USM-451 manufactured by Ballantine Laboratories, Inc., Boonton, New Jersey. This mu!timeter is also identified as Ballantine Model 9632M; however, only the government assigned nomenclature is used in this manual. The term “multimeter” is used interchangeably in the text as a common name reference to Multimeter AN/USM-451.

b. The AN/USM-451 is a compact, protable, light weight 3-1/2 digit multi meter incorporating push button selection of six functions; Volts DC, Volts AC, Amperes DC, Amperes AC, Ohms and a Battery Test. It has a daylight viewing liquid crystal display with easy to read 0.5 inch (13mm) high numerals. Readout is automatic for polarity and decimal point position. Full scale resolution is plus or minus 1999 digits and overrange is indicated by all digits except the most significant “1” being blanked. Zero drift is prevented by an auto-zero circuit, particularly useful for low level and downscale measurements. Overload protection is provided on all ranges by electronic limiters. Current ranges are protected by a replaceable fuse.

c. The instrument features battery power from two “D” cells that provide more than 200 hours of operation. A battery test mode permits a measure of remaining battery life.

NOTE

The battery test mode does not check the condition of the four re-chargeable Nickel Cadmium “D” cells that provide power for the Liquid Crystal Display (LCD) heater. (Optional Heater Battery Pack)

d. Push button controls permit the selection of all functions and ranges. The measurement capabilities include 28 ranges and battery test.

e. The AN/USM-451 is well suited for demanding environments. It includes protection against electromagnetic interference, 5°F to 131°F operation, extended humidity exposure as well as reliability under vibration and shock. The rugged plastic case is completely coated on the interior surfaces with a conducting material which provides full electrical shielding.

f. The AN/USM-451 case is provided with a carry handle that also serves as a tilt stand. To change the position of the handle, simply pull one side of the handle at a time outward from the case to disengage the detent mechanism; then, rotate the handle to the desired position, push the handle back toward the case and rotate slightly until it detents in place. The handle may be detached by first removing the decorative discs from each of the handle bearing sections. Then remove the retaining screws, washers and spring in each handle bearing and snap the handle out of the sockets in the plastic side sections.

NOTE

Some instruments are not equipped with the spring type handle retaining mechanisms. For these units, remove the handle by carefully holding the instrument and pulling both sides of the handle away from the case until each side has snapped out and the handle is separated from the case.

1-8. Tabulated Data.

a. Electrical.

The electrical specifications apply over the following reference environment:

Temperature 68°F to 86°F
Humidity to 90% relative humidity (R.H.)

(1) Dc Voltage:

Table 1-1. Dc Voltage

RANGE	RESOLUTION	ACCURACY
± 200 mV ± 2 V ±20V ±200V ± 1000 V	100µV 1 mV 10 mV 100 mV 1V	± [0.2% of reading + 1 Least Significant Digit (LSD) on all ranges.]

(a) Input Impedance: 10 Megohms (MΩ) all ranges.

(b) Normal Mode Noise Rejection Ratio: >60 dB at 50 Hz and at 60 Hz.

(c) Common Mode Noise Rejection Ratio: >120 dB at 50 Hz and at 60 Hz with 1 KΩ unbalance in the COMMON lead.

(d) Over Voltage Protection: 1200 V dc or 1000 V ac rms (sinusoidal) on all ranges.

(e) Response Time: 1 second

(2) Ac Voltage:

Table 1-2. Ac Voltage

RANGE	RESOLUTION	ACCURACY		
		40 Hz to 420 Hz	420 Hz to 1 kHz	420 Hz to 10 kHz
200 mV	100µV	±(0.5% of reading +5 LSD)	±(2% or reading +5 LSD)	±(1% of reading +5 LSD)
2 V	1 mV	±(0.5% of reading +5 LSD)	±(2% or reading +5 LSD)	±(1% of reading +5 LSD)
20 V	10 mV	± (0.5% of reading +5 LSD)	±(2% or reading +5 LSD)	±(1% of reading +5 LSD)
200 v	100 mV	± (0.5% of reading +5 LSD)	±(2% or reading +5 LSD)	±(1% of reading +5 LSD)
1000 v	1V	±(2% of reading +5 LSD)	±(3.75% of reading ±5 LSD)	

(a) Extended Frequency Response: Typically 20 Hz to 25 kHz.

(b) Response: Average responding calibrated in rms of sine wave.

(c) Common Mode Noise Rejection Ratio: >80 dB at 50 Hz and 60 Hz.

(d) Over Voltage Protection: ±120 V dc or 1000 V ac rms (sinusoidal) on any range. Do not exceed 10^7 V ● Hz product.

CAUTION

On 200 mV range do not exceed overvoltage of greater than 300 volts for longer than 10 seconds.

(e) Response Time: 3 seconds (within any one range).

(3) Direct Current:

Table 1-3. Direct Current

RANGE	RESOLUTION	ACCURACY	INPUT RESISTANCE
±200µA	100 nA	± (1% of reading +1 LSD)	1000Ω
±2mA	1µA	± (0.75% of reading +1 LSD)	100Ω
± 20 mA	10 A	± (0.75% of reading +1 LSD)	10.2Ω
± 200 mA	100µA	± (0.75% of reading +1 LSD)	1.25 Ω
± 2000 mA	1 mA	± (0.75% of reading +1 LSD)	0.1Ω
±10 A	10 mA	± (0.75% of reading +1 LSD)	0.01 Ω

(a) Voltage Burden at Full Scale: Less than 0.30V on all ranges except 0.5V on 200 mA range and 0.12V on 10A range.

(b) Maximum Input: 2 Amperes maximum on 200 µA to 2000 mA ranges. Ranges to 2000 mA fuse protected when measuring current in circuits with open circuit voltage of 250 volts or less and with maximum' short circuit current of 15 amperes. 10 A input is not protected but may tolerate up to 20A intermittently. (para 2-3C ● 3)

(c) Response Time: Less than 1 second.

(4) Alternating Current:

Table 1-4. Alternating Current

RANGE	RESOLUTION	ACCURACY		INPUT RESISTANCE
		40 Hz to 420 Hz	420 Hz to 1 kHz	
200µA	100nA	± (3.5% of reading +5 LSD)	± (5% of reading +5 LSD)	1000 Ω
2 mA	1 µA	± (1.5% of reading +5 LSD)	± (4% of reading +5 LSD)	100 Ω
20 mA	10µA	± (1 .5% of reading +5 LSD)	± (4% of reading +5 LSD)	10.2 Ω
200 mA	100µA	± (1.5% of reading +5 LSD)	± (4% of reading +5 LSD)	1.25 Ω
2000 mA	1 mA	± (1.5% of reading +5 LSD)	± (4% of reading +5 LSD)	0.1 Ω
10 A	10 mA	± (1.5% of reading +5 LSD)	± (4% of reading +5 LSD)	0.01 Ω

(a) Response: Average responding, calibrated in rms of a sinewave.

(b) Voltage Burden at Full Scale: Less than 0.30 volts rms on all ranges except 0.5 volts on 2000 mA range and 0.12 volts on 10 A range.

(c) Maximum Input: 2 amperes maximum on 200 µ A to 2000 mA ranges. Fuse protected when measuring currents in circuits with open circuit voltage of 250 volts or less with maximum short circuit current of 15 amperes. 10 ampere input is not protected.

(d) Response Time: Lass than 3 secends (within any one range),

(5) Resistance:

Table 1-5. Resistance

RANGE	RESOLUTION	ACCURACY	FULL SCALE VOLTS	MAX. TEST CURRENT
200 Ω	0.1 Ω	± (0.5% of reading + 1 LSD)	110 mV	0.65 mA
2 κ Ω	1 Ω	± (0.5% of reading + 1 LSD)	800 mV	0.95 mA
20 κΩ	10 Ω	± (0.5% of reading + 1 LSD)	175 mV	25 uA
200 k Ω	100 Ω	± (0.5% of reading + 1 LSD)	195 mV	3.5 uA
2000 k Ω	1 k Ω	± (0.5% of reading + 1 LSD)	200 mV	350 nA
20 M Ω	10 k Ω	±(1% of reading + 2 LSD)	670 mV	100 nA

(a) Maximum Open Circuit Voltage: Less than 6 volts on all ranges.

(b) Diode Test: The 2 κΩ and 20 MΩ ranges have sufficient voltage to turn on silicon junctions to check for proper front-to-back resistance. The 2 κΩ range is preferred for diode tests. The other four resistance ranges will not turn on silicon junctions. These ranges are recommended for in-circuit resistance measurements.

(c) Overvoltage Protection: 250 volts dc or ac rms (sine wave) on all ranges.

(d) Response Time: Less than 1 second on 200 Ω to 200 κΩ ranges and less than 5 seconds on 2000 κΩ and 20 MΩ ranges.

b. Environmental.

(1) Temperature: +5°F to +131°F operating. -40°F to +131°F operating when Optional Heater Battery Pack is installed. -67°F to +161°F storage.

(2) Relative Humidity: 0 to 90% to 113°F; 0 to 85% to 131°F. Usable 0 to 98% without condensation.

(3) Altitude: 0 to 15,000 ft. (4.5 km); operating derated linearly above 300 volts to half rating at 15,000 ft. Storage; 0 to 50,000 ft. (15 km).

(4) Shock and Vibration: 15G shocks. 2G vibration 10 to 55 Hz to 10 Hz. Transit and bench drop tests to 12 inches.

(5) Electromagnetic Interference: From 14 kHz to 1 GHz at susceptibility level of 1 volt per meter.

c. General.

(1) Display: 3-1/2 digit, reflective liquid crystal display with 0.5 inch (13mm) high numerals. Readable from a distance of 10 ft.

(2) Power: Two “D” cell batteries. Battery Life: 200 to 250 hours with carbon zinc cells; 600 to 750 hours with alkaline cells.

NOTE

Use alkaline batteries for operation below +5°F.

(3) Power, Optional Heater Battery Pack: Four re-chargeable Nickel Cadmium “D” cell batteries, providing 5 hours of operation at -15°F derated to 2 hours at -40°F.

(4) Battery Indicator: The display reads a voltage proportional to remaining battery life and indicates need for battery replacement when a negative voltage is indicated.

d. Physical Characteristics.

(1) Case: Shock resistant, plastic enclosure with internal metallized shielding and carry handle which detents in 12 positions and serves as tilt stand.

(2) Height: 2.75 inches (70 mm)

(3) Width: 8.2 inches (208 mm). with bandie, 9.46 inches (240 mm)

(4) Depth: 9.02 inches (229 mm); with handle, 11.37 inches (301 mm)

(5) Weight: 1 lb. 11 oz. (758 gm) with batteries; 4 lbs. 10 oz. (2.08 kg) with Optional Heater Battery Pack installed.

(6) Shipping Weight: 4 lbs. (1.8 kg.); 7 lbs. (3.15 kg) with Optional Heater Battery Pack installed.

1-9. Safety and Grounding Requirements.

a. The manual contains information, cautions, and warnings which must be followed by the service person to ensure safe operation and to retain the instrument in safe condition.

b. The multimeter is normally used on internal batteries. No return earth ground is required, but the LO input test lead must be connected to the COMMON input connector. Failure to do so will cause incorrect readings. Never allow the COMMON to exceed 500 Volts dc or ac rms to earth ground.

WARNING

Before connecting the AN/USM-451 test leads to other equipment, check that the earth terminals of this other equipment are properly connected to ground.

CAUTION

The symbol  , which appears on the instrument means: Read and understand the instruction manual BEFORE operating the instrument. If the instrument is operated without reading and understanding the instructions, the instrument may be damaged or it may not operate correctly.

CHAPTER 2

FUNCTIONING OF EQUIPMENT

Section I. OPERATING PRINCIPLES

2-1. Functional Description.

a. The following paragraphs describe the functioning of the circuits in the AN/USM-451. Refer to the block diagram, Fig. 2-1, and the schematic diagram, Fig. FO-1.

b. The heart of the multimeter is LSI chip U3 which contains the analog to digital (A/D) converter and the driving circuits for the liquid crystal display (LCD), Other components incidental to U3 are the function selector switches, the range switches, the display, the signal conditioners and the power supply regulator, The LCD assembly has an integral heater element and temperature control switch that permits operation down to -40°F when the Optional Heater Battery Pack is installed.

c. When an input signal is applied to the multimeter it is routed through the range switches to one of four signal conditioners as selected by the function switches. Each signal conditioner scales and, in ac mode, converts the signal to dc so that a dc voltage of -0.2V to +0.2V dc is applied to the input of U3, the A/D converter.

d. The voltage reference for A/D converter U3 is the highly stable, temperature insensitive band gap reference diode, CR2. The clock for the A/D converter is a stable oscillator located monolithically within U3. C7 and R17 determine the frequency of kHz which is a near multiple of 50 and 60 Hz. This optimizes common mode and normal mode rejection. Other circuits associated with U3 provide a nominal display rate of 3 readings per second. The LCD display presents measured data with three 7-segment numerals whose decimal points are driven through the gates of U2 and automatically positioned by the range switches.

2-2. Circuit Description.

a. Input Signal Conditioners.

The A/D converter uses two external input voltages to execute a complete measurement cycle. One voltage is the reference and the other is an unknown dc voltage. This unknown voltage is always in the range of ± 200 millivolts. Any input signal not dc or within this range must be scaled or conditioned before it is measured and digitized by U3. The following paragraphs give details on the operation of the signal conditioners for each measurement function.

b. Resistance Measurements,

Resistance measurements use the ratio technique. See Figure FO-1, the schematic diagram. When the ohm (Ω) function is chosen, a series circuit is formed consisting of the internal current source Q1, the reference resistor chosen by the range switches from the voltage divider, and the external unknown resistor under test. The A/D converter and the signal and reference inputs are connected, each across one of the resistors. The ratio of the unknown and reference resistors are equal to the ratio of their voltage drops because the constant current supplied by Q1 passes through both resistors. The level of current is selected by R5 and R6. R5 parallels R6 to increase current when the 2k and 20M diode test ranges are used. R6 maintains a minimal measuring current which does not cause voltage drops over 200 mV for in-circuit resistance measurements. Therefore, since the value of the reference resistor in the voltage divider is known, the value of the unknown resistance can be determined by using the voltage drop across the known resistor as

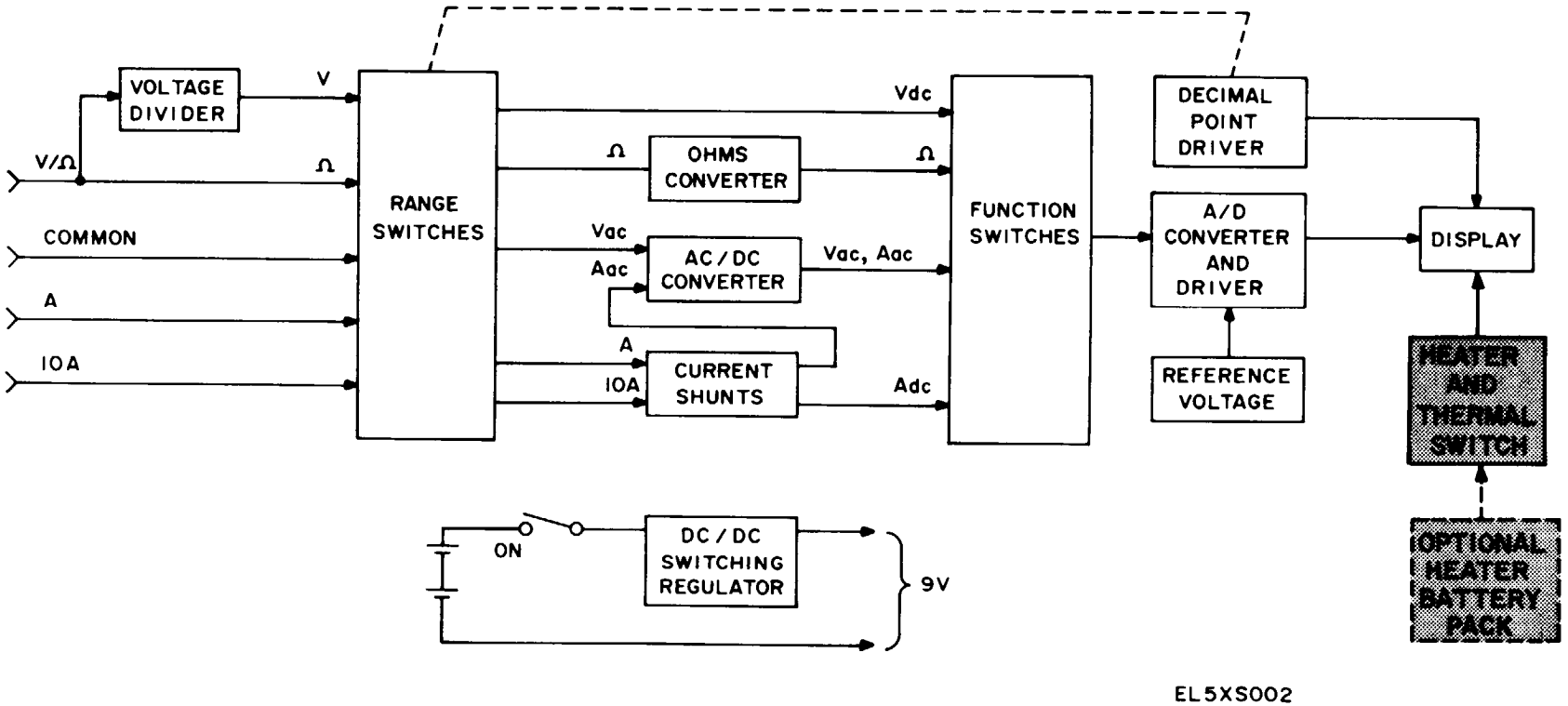

Figure 2-1. Block Diagram

the reference. The A/D converter makes this ratio voltage measurement and is set up to display the unknown resistance.

c. Dc and Ac Measurements.

(1) Current measurements to 2 amperes are made using shunt network RN2 which contains four terminal 0.1 ohm, 1 ohm, 10 ohm, 100 ohm, and 1000 ohm shunts, RN2 is fuse protected. These shunt resistors are selected by the range switches and convert the current into a voltage. The shunt resistances are chosen to provide 200 millivolts for full scale indication by the A/D converter. If the input is current and dc mode is selected the IR drop across the shunt is directed to the signal input of the A/D converter U3 through the low pass filter comprised of R4 and C2. When the input current is ac and ac mode is selected, the ac IR drop voltage is converted to dc by ac to dc converter U1 and then measured by the A/D converter.

(2) A separate, high power 0.01 ohm shunt is provided for the 10A range. It is not fuse protected.

d. Ac to Dc Converter.

(1) The ac to dc converter responds to the average of the input ac signal and is calibrated in the rms of a sine wave. Ac to dc converter U1 drives the rectifying circuit which not only provides the dc output, but also is in the feedback loop of the amplifier. The feedback loop is capacitor coupled so that amplifier dc drifts do not affect measurement accuracy. The dc output is filtered and then measured by A/D converter U3.

(2) Ac to dc converter U1 has a FET input which has very high input impedance to avoid loading the frequency compensated resistive input divider diodes CR8 and CR9 protect the FET input from overvoltage and R18 limits the maximum current to the protective diodes under all rated overvoltage conditions.

e. Dc and Ac Voltage Measurements.

Input voltage divider RN 1 is used for both dc and ac voltage measurements. It provides a full scale input of ±200 millivolts to the A/D converter through five decades steps to permit a range of input signals from 200 millvolts to 1000 volts full scale. When ac inputs are applied, dc blocking capacitor C8 is inserted in series with RN 1. Additional capacitors compensate the frequency response of RN 1 to assure ac measurement accuracy on all ranges. In the ac mode, ac to dc converter U1 conditions the signal from the input divider before it is filtered by R4 and C2 and measured by A/D converter U3.

f. Regulated Power Supply,

Power Supply IC U4 is a monolithic switching regulator dc to dc converter. Although U4 takes almost no power to operate, it provides a constant output voltage of approximately 9 volts dc even though the battery voltage varies from 2.2 volts to 3.3 volts, The battery output voltage changes as the battery discharges and with the effects of temperature. The constant output voltage from this unique switching regulator assures measuring accuracy for the multimeter under all battery and ambient temperature conditions. An additional feature of the regulator is that, by stepping up the voltage, only two “D” cells are needed to power the instrument.

g. Optional Heater Battery Pack

(1) The multimeter contains a heater and temperature control integral with the LCD assembly that extends operation down to -40°F when the Optional Heater Battery Pack is installed. The battery pack contains four re-chargeable Nickel Cadmium “D” cells that provide power for the LCD heater.

(2) Thermal switch S 101 closes whenever the ambient temperature drops below +5°F, providing the POWER ON/OFF switch is pushed to the ON position. This applies power to the heater in the LCD assembly. When the LCD temperature rises to +5°F, the thermal switch cyles the heater on and off, maintaining a minimum ambient of +5°F yet conserving battery power and preventing overheating of the LCD.

Section II. OPERATING INSTRUCTIONS

2-3. General.

This section contains instruction and information required for the operation of the AN/USM-451. Included are an explanation of the controls, indicators, and connectors.

a . Display Readings.

(1) Normal operation is indicated by an on-scale display and include decimal point and negative polarity indication. The decimal point placement is automatically performed by the range switches. Polarity is indicated only in the negative mode by a minus sign and applies to the dc voltage and dc current functions. A minus sign appears when the signal at the input connector is negative with respect to COMMON.

(2) The minus sign may flash momentarily when the multimeter recovers from an overload. In the ohms function, the minus sign may occur if a voltage or discharging capacitor is influencing the resistance being measured. When the minus sign remains on for in-range resistance readings it indicates an incorrect resistance measurement.

b. "Off Ground" Measurements.

(1) In the "off ground" mode the COMMON input connector potential is limited to 500 volts dc or ac rms with respect to earth ground.

WARNING

To avoid safety hazard, electrical shock or instrument damage do not connect COMMON input connector to any signal which exceeds 500 volts with respect to earth ground.

(2) Connect the low side of the signal to be measured to the COMMON input connector.

NOTE

The signal low has the least potential with respect to earth ground, thus minimizing common mode measurement errors.

(3) See Table 2-1 for operational limits on the desired function and range.

NOTE

Current ranges to 2000mA are protected by a 2A/250 Volt fuse. The 10A range is not protected and currents exceeding 10A, but never above 20A, can be accommodated on a "20 seconds on/60 seconds off" basis.

CAUTION

Never exceed 20A or the instrument may be damaged. To prolong range switch life, never use the range switches when measuring over 10mA or from open circuit sources which exceed 30 volts.

(4) To replace the current range protection fuse in the instrument see paragraph 2-6.

2-4. Description of Controls,

The controls, indicators, and connectors located on the front panel of the AN/USM-451 are shown in Figure 2-2. The functions are described in Table 2-2.

2-5. Battery Check.

Refer to paragraph 3-4b (2) for battery check procedure.

NOTE

The display reading does not indicate actual battery voltage but checks remaining battery life. Table 2-3 indicates the approximate life in hours remaining in the battery for different display readings for both carbon zinc and alkaline cells.

Table 2-1. AN/USM-451 Operational Limits

SELECTED FUNCTION	SELECTED RANGE	MAXIMUM INPUT OVERLOAD LIMITS	INPUT CONNECTIONS
V DC	200mV, 2, 20, 200, or 1000 V	1200 V dc or 1000 V ac rms (sinusoidal)	V- Ω and COMMON
V AC	200mV, 2, 20, 200, or 1000 V	1200 V dc or 1000 V ac rms 15 sec. Max on 200µv range (sinusoidal)	V- Ω and COMMON
A DC	200 µA, 2, 20, 200, or 2000 A	2A dc or ac rms 15 sec. max on 200mV range.	A and COMMON
	10A	Fuse protected to 15 A peak and 250 V not protected.	10A–HI/LO
A AC	200 µA, 2, 20, 200, or 2000 A	2 A dc or ac rms.	A and COMMON
	10A	Fuse protected to 15 A peak and 250 V not protected.	10A – HI/LO
Ω	200, 2k	250 V dc plus ac rms (sinusoidal)	V- Ω and COMMON
	20k, 200k, 2000k , or 20M Ω	500 V dc plus ac rms (sinusoidal)	V- Ω and COMMON
OFF GROUND	All Ranges	500 V DC + AC rms	Earth Ground and COMMON

2-6. Battery Installation and Fuse Replacement. See Figure 2-3.

WARNING

Before installing batteries or replacing fuse, disconnect AN/USM-451 test leads from any other equipment and push POWER ON/OFF switch to OFF.

a. Disconnect all leads from AN/USM-451.

b. Remove the top cover as detailed in paragraph 3-5a (1) and 3-5a (2).

NOTE

Do not misplace metal spacers from the side sections as they provide electrical contact between the top and side covers, insuring Electro Magnetic Interference (EMI) shielding.

c. Install or replace batteries or current range protection fuse.

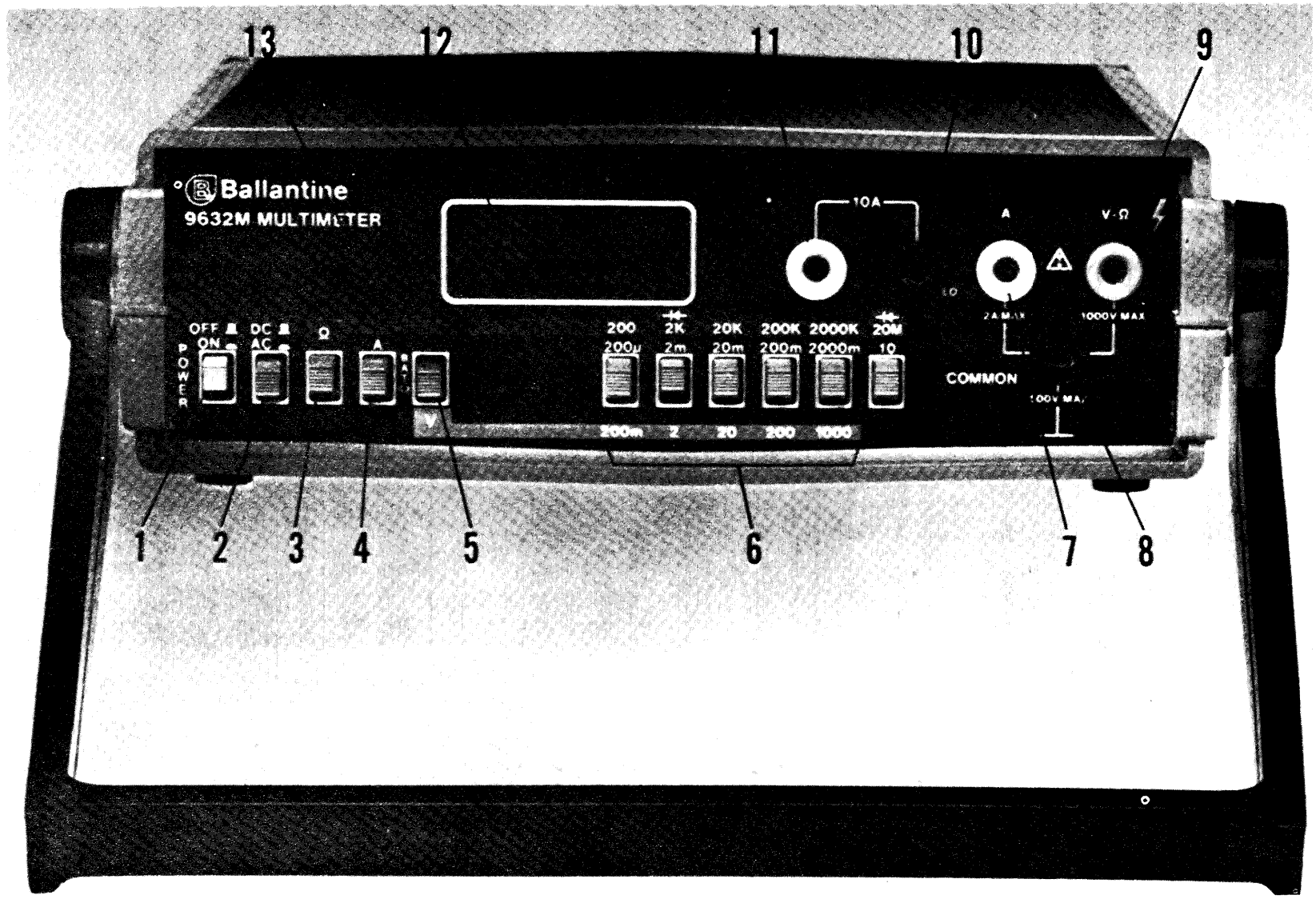

Figure 2-2. Controls, Indicators and Connectors

Table 2-2. Controls, Indicators, and Connectors

INDEX NO. (FIG. 2-2)	CONTROL, INDICATOR, CONNECTOR	SYMBOL NO. (FIG. FO-1)	FUNCTION
1	POWER ON/OFF Switch	S1	Push on/push off switch that turns power on when in (▬) and turns power off when in the out (▯) position.
2	AC/DC Mode Switch	S2	Push on/push off switch that selects ac mode when in (▬) and dc mode when in the out (▯) Position.
3	Ω Ohms Mode Switch	S3	Push button switch that selects resistance mode when pushed in.
4	A Amperes Mode Switch	S4	Push button switch that selects voltage mode when pushed in.
5	V Volts Mode Switch	S5	Push button switches that selects voltage mode when pushed in.
6	Range Switches	S7 through S12	Push button switches that select 5 voltage, 6 current and 6 resistance ranges.
7	A Input	J1	Banana jack input connector for current mode up to 2 Amps.
8	COMMON Input	J3	Banana jack input connector for A and V - Ω return (common).
9	V- Ω Input	J2	Banana jack input connector for voltage and resistance modes.
10	10A LO	J4	Banana jack input for 10 Amp current range (low input).
11	10A	J5	Banana jack input for 10 Amp current range (high input),
12	Digital Display	DS1	Digital readout consisting of 3 seven segment numerics and 1 plus a polarity indicator.
13	BAT <> Test		Tests condition of multimeter operational batteries when both A and V push buttons are depressed simultaneously. (This does not test the condition of the rechargeable Nickel Cadmium Batteries used to power the LCD heater)

Table 2-3. Battery Life

DISPLAY READING	TYPICAL HOURS REMAINING AT 77°F (1)	
	CARBON ZINC CELLS	ALKALINE CELLS (2)
1900	250	750
1500	195	600
1200	165	500
1000	125	380
750	95	285
500	65	100
200	25	75
0 (or lower)	Replace	Replace

(1) For operation between +5°F and -40°F, the display reading must be greater than 1000 when checked at 77°F.

(2) For operation between +5°F and -40°F (Optional Heater Battery Pack installed) use only alkaline cells for multimeter operational batteries.

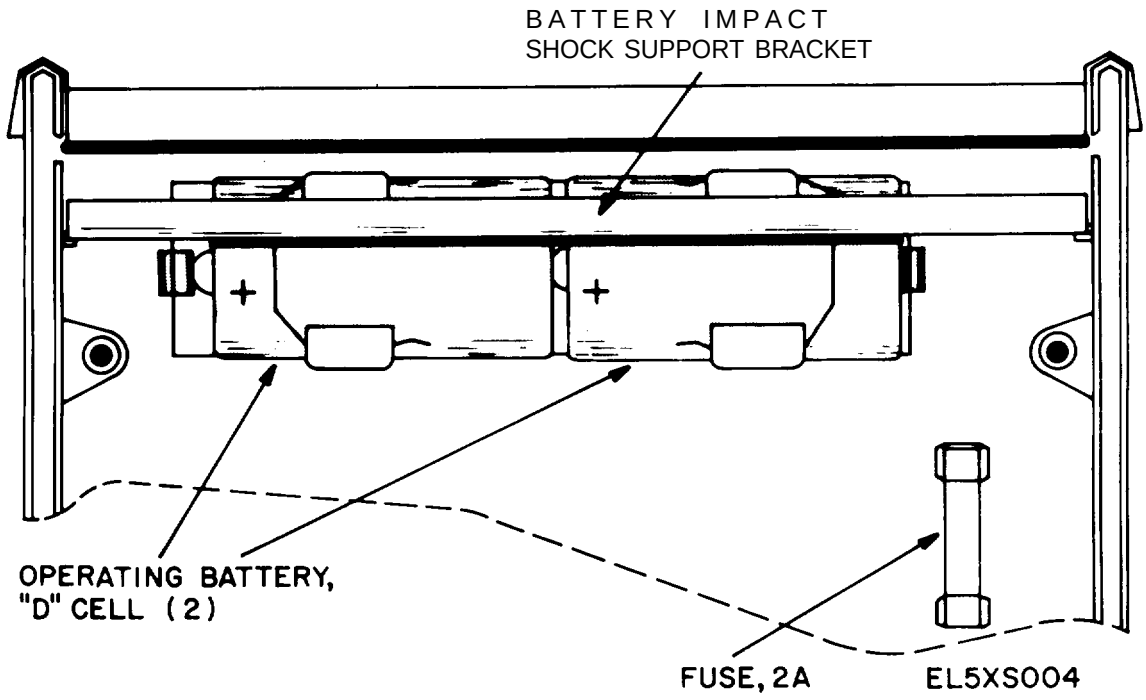

Figure 2-3. Battery and Fuse Location

CAUTION

Replace batteries with leakproof only, "D" cells and OBSERVE POLARITY when installing the cells in the battery holders. Replace fuse with 3AG type 2A/250V fast blow fuse only. DO NOT SUBSTITUTE FUSE TYPE OR RATING.

CAUTION

Use only Alkaline cells for multimeter power when the Optional Heater Battery Pack is installed.

d. Replace any metal spacer that may have come detached from the side rails.

e. Replace the battery retaining clips and the impact shock support bracket.

f. Replace the top cover as described in paragraphs 3-7b (4) and 3-7b (5).

2-7. Initial Check-out of Multimeter (See Figure 2-2).

NOTE

If a problem is encountered, refer to paragraph 3-3, Trouble Shooting.

a. Set the multimeter controls as follows:

POWER ON/OFF	OFF (OUT)
AC/DC	DC (OUT)
Mode	A (Depressed)
Range	200 µ (Depressed)

b. Push the POWER ON/OFF switch in to the ON position and note a display reading of 00.0 ±2 digits.

c. Push each of the remaining range pushbutton switches and observe that the display reads zero ±2 digits with the following decimal point positions:

2m	.000
20m	0.00
200m	00.0
2000m	000
10A	0.00

d. Push the Ω pushbutton in and note that the A pushbutton automatically releases to the out position. Push each of the six ohms range pushbuttons and observe the following;

(1) The display reads only "1" as the most significant digit.

(2) Observe that the decimal point automatically positions as in step c.

e. Connect one end of either test lead to the COMMON input connector and the other end of the test lead to the \/- Ω input connector. Again push each of the six ohms range pushbuttons. The display should read zero at each range setting but will indicate the test lead resistance of 0.1 ohms to 0.5 ohms on the 200 ohm range.

f. Disconnect the test lead end from the COMMON input connector.

g. Reconnect that test lead end to the A input connector. (Leave the other test lead end connected to the V- Ω input connector.)

h. Push the 200 Ω range switch and observe an overrange display indication of "1".

i. Push the 2k Ω range switch. Note that the display reads .100 to .103 k Ω; the resistance of the shunt network, RN2 on the 2k Ω range. Remove the test lead.

j. Push the multimeter AC/DC switch into the AC position. Push the V push button in,

k. Select the 1000V range by depressing the 1000 push button.

l. Connect the banana plug of the red test lead to the V- Ω input connector and the banana plug of the black test lead to the COMMON input connector.

WARNING

The local ac line voltage is measured in the next step. Work carefully since hazardous voltages in the range of 90 to 260 volts ac will be involved. Do not touch the test lead probe tips with your fingers or allow the probe tips to contact each other.

NOTE

If no ac power outlet is available, omit step m.

m. Measure the voltage at an accessible ac power outlet receptacle.

(1) Connect the black test lead to one side of the ac line.

(2) Connect the red test lead to other side of the ac line. The multimeter should read the ac line voltage.

NOTE

The correct ac voltage should be displayed with a tolerance of one volt. The display may show a fluctuation of a few volts due to variations in local ac power.

(3) Disconnect the test leads from the ac line and turn the POWER to OFF.

n. If the multimeter has responded as required in the preceding steps, it is now ready for use.

2-8. Measurements.

a. Dc Voltage Measurement.

(1) Push the POWER ON/OFF switch into the ON position.

(2) Select the voltage mode by depressing the V push button.

(3) Check that the AC/DC switch is released to the DC (out) position.

(4) Select the 1000 V full scale range by depressing the 1000 push button.

(5) Insert the banana pin of the black test lead in the COMMON jack.

(6) Insert the banana pin of the red test lead in the V- Ω jack,

(7) Connect the test leads across the voltage signal that is to be measured.

(8) Determine the correct measuring range by pushing, in succession, lower full-scale range push buttons until the display indicates three or four significant digits of information.

(9) Disconnect the test leads and turn the POWER to OFF.

NOTE

A display of only a “1” indicates an overload. Switch to the next higher range until a steady display of three or four digits appears.

b. Ac Voltage Measurement.

(1) Push the POWER ON/OFF switch into the ON position.

(2) Select the voltage mode by depressing the V push button.

(3) Check that the AC/DC switch is pushed into the AC position.

(4) Select the 1000 V full scale range by depressing the 1000 push button.

(5) Insert the banana pin of the black test lead in the COMMON jack.

(6) Insert the banana pin of the red test lead in the V- Ω jack.

(7) Connect the test leads across the voltage signal that is to be measured,

(8) Determine the correct measuring range by pushing, in succession, lower full-scale range push buttons until the display indicates three or four significant digits of information.

NOTE

A display of only a “1” indicates an overload, Switch to the next higher range until a steady display of the three or four digits appears.

(9) Disconnect the test leads and turn the POWER to OFF.

c. Dc Mode Measurement (Currents up to 2000 mA).

(1) Push the POWER ON/OFF switch into the ON position.

(2) Select the Current Mode by depressing the A push button.

(3) Check that the AC/DC switch is released to the DC (out) position.

(4) Select the 2000 mA full scale range by depressing the 2000 m push button.

(5) insert the banana pin of the black test lead in the COMMON jack.

(6) Insert the banana pin of the red test lead in the A jack.

(7) Connect the test leads to the signal that is to be measured.

(8) Determine the correct measuring range by pushing, in succession, lower full-scale range push buttons until the display indicates three or four significant digits of information.

NOTE

A display of only a “1” indicates an overload. Switch to the next higher range until a steady display of three or four digits appears.

(9) Disconnect the test leads and turn the POWER to OFF.

d, Dc Mode Measurement (Currents between 2000mA and 10A).

(1) Push the POWER ON/OFF switch into the ON position.

(2) Select the Current Mode by depressing the A push button.

(3) Check that the AC/DC switch is released to the DC (out) position.

(4) Select the 10A full scale range by depressing the 10 push button,

(5) Insert the banana pin of the black test lead in the 10A LO jack.

(6) Insert the banana pin of the red test lead in the yellow 10 A jack.

(7) Connect the test leads to the signal that is to be measured. Note the current reading.

(8) Disconnect the test leads and turn the POWER to OFF.

e. Ac Mode Measurement (Currents up to 2000 mA).

(1) Push the POWER ON/OFF switch into the ON position.

(2) Select the Current Mode by depressing the A push button.

(3) Check that the AC/DC switch is pushed into the AC position.

(4) Select the 2000 mA full scale range by depressing the 2000 m pushbutton.

(5) Insert the banana pin of the black test lead in the COMMON jack.

(6) Insert the banana pin of the red test lead in the A jack.

(7) Connect the test leads to the signal that is to be measured.

(8) Determine the correct measuring range by pushing, in succession, lower full-scale range push buttons until the display indicates three or four significant digits of information.

NOTE

A display of only a “1” indicates an overload, Switch to the next higher range until a steady display of three or four digits appears.

(9) Disconnect the test leads and turn the POWER to OFF.

f. Ac Mode Measurement (Currents between 2000 mA and 10 A).

(1) Push the POWER ON/OFF switch into the ON position.

(2) Select the Current Mode by depressing the A push button.

(3) Check that the AC/DC switch is pushed into the AC position.

(4) Select the 10 A full scale range by depressing the 10 push button.

(5) Insert the banana pin of the black test lead in the 10A LO jack.

(6) Insert the banana pin of the red test lead in the yellow 10A jack.

(7) Connect the test leads to the signsl that is to be measured. Note the current reading.

(8) Disconnect the test leads and turn the POWER to OFF.

g. Resistance Measurement.

(1) Push the POWER ON/OFF switch into the ON position.

(2) Select the Resistance Mode by depressing the Ω push button.

(3) Select the 200 Ω full scale range.

(4) Insert the banana pin of the black test lead in the COMMON jack.

(5) Insert the banana pin of the red test lead in the V- Ω jack.

(6) Connect the test leads across the resistance to be measured.

(7) Determine the correct measuring range by pushing, in succession, higher full-scale range push buttons until the display indicates three or four significant digits of information.

NOTE

A display of only a “1” indicates over ranging. Switch to the next lower range until a steady display of three or four digits appears.

(8) Disconnect the test leads and turn the POWER to OFF.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE

3-1. Checks and Services.

a. General.

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to maintain the equipment in serviceable condition. Defects that cannot be corrected must be reported to personnel at a higher maintenance category.

b. Routine Checks.

Routine checks like cleaning, dusting, washing, checking for frayed cables, stowing items not in use, covering unused receptacles and checking for frayed cables, stowing items not in use, covering unused receptacles and checking for loose nuts and screws are not listed as preventive maintenance checks or services. They are things that you should do anytime you see they must be done.

c. PMCS Periods.

Preventive maintenance checks and services for the test set are required at the intervals shown in Table 3-1. These checks must be performed during the specified intervals.

3-2. Lubrication.

Lubricate all switch contacts with a light application of spray lubricant. (Table 3-1.)

3-3. Troubleshooting,

a. Table 3-2 lists typical troubles that may be encountered with the test set. The first column indicates the trouble, the second column indicates the probable cause, and the third column indicates the remedy.

b. Use a high impedance dc voltmeter to make the checks of Table 3-3. Set the multimeter controls as follows:

POWER ON/OF F Switch	ON
AC/DC Mode Switch	AC
A Amperes Mode Switch	A
Range Switch	10A

Table 3-1. Preventive Maintenance Checks and Services

NOTE: Within designated interval, these checks are to be performed in the order listed.

B – Before
D – During
A - After
W – Weekly
M – Monthly
S — Semiannually

ITEM NO.	INTERVAL					ITEM TO BE INSPECTED	CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NECESSARY	FOR READINESS REPORTING, EQUIPMENT IS NOT READILY AVAILABLE IF:
	B	D	A	M	S			
1					•	Multimeter	Performance Assurance Test (para 3-4 b).	Doesn't pass all of the performance tests
2	•					Exterior of instrument	Wipe with soft lint-free cloth dampened with solution of a mild detergent mixed equally with water.	
3				•		Interior of instrument	Remove dust with low pressure compressed air. Clean contacts and component terminals with brush dipped in Freon TF. Check that batteries and battery holders are free of corrosion.	Battery holder terminals are corroded.
4				•		Pushbutton switches	Lubricate switch contacts with a light application of spray lubricant.	Pushbutton switches perform intermittently

WARNING

Compressed air shall not be used for cleaning purposes except where reduced to less than 29 pounds per square inch (psi) and then only with effective chip guarding and personnel protective equipment. Do not use compressed air to dry parts when TRICHLOROTRIFLUOROETHANE has been used. Compressed air is dangerous and can cause serious bodily harm if protective means or methods are not observed to prevent chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

Table 3-2. Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Display does not turn on when POWER switch is to ON,	Defective batteries.	Replace batteries (para 2-6).
	Defective switching regulator, U4.	Replace U4. (para 3-6).
	Defective A/D converter, U3.	Replace U3. (para 3-6).
Display does not turn on when the POWER switch is to ON. (Optional Heater Battery Pack installed.) +5°F to -40°F operation.	Defective heater batteries.	Re-charge or replace Nickel Cadmium heater batteries (para 3-8).
	Defective multimeter operational batteries.	Replace batteries (para 2-6).
	Carbon Zinc Cells installed for multi-meter operational batteries.	Replace multimeter operational batteries with Alkaline cells (para 2-6).
Decimal points either do not appear or stay on continuously.	Defective U2.	Replace U2. (para 3-6).
	Problem in switching.	Check associated switching.
Display does not indicate 00.0 with 200 mV, DC, V selected and input shorted.	Switching in DC V input to U3.	Check associated switching.
	Power supply.	Check power supply for presence of correct voltages. (Table 3-3.)
	Ripple greater than 200 mV P-P.	Check switching regulator U4, C16, C17 and L1.
Display reads approximately zero in current mode.	Current protection fuse F1 blown.	Replace F1 (para 2-6).
+190 mV Dc performance check exceeds accuracy limits.	Defective voltage reference diode, CR2. Not within 1.15 to 1.3 volt limits.	Replace CR2. (para 3-6).
	Defective A/D converter, U3.	Replace U3. (para 3-6).
Ac voltage does not meet performance check at 40 to 400 Hz.	Defective Ac to Dc converter, U1 or associated component.	Replace U1 or associated component, (para 3-6).
Display always indicates overload condition of “1”.	Defective A/D converter, U3 or associated components,	Check U3 and associated components
	Defective switch.	Check range switching.
Some or all of the segments in the display do not illuminate.	Defective display, BL1.	Replace BL1. (para 3-6).
	Defective A/D converter, U3.	Replace U3. (para 3-6).
	Power supply.	Check power supply for presence of correct voltages. (Table 3-3.)
Intermittent switch contacts.	Switch contacts contaminated.	Lubricate switch contacts with spray lubricant.
Ohmmeter function inoperable.	Defective Q1 transistor.	Replace Q1. (para 3-6).

Table 3-3. Dc Voltage Checks

TEST POINT		NOMINAL VOLTAGE	VOLTAGE LIMIT	
FROM	TO		LOW	HIGH
TP1	TP2	9.6V	7.8V	10.5V
TP1	COMMON	-6.8V	-5.2V	-7.5V
COMMON	TP3	+1.23V	+1.20V	+1.25V
COMMON	TP2	+2.8V	+2.2V	+3.5V
COMMON	TP4	-2.8V	-2.2V	-3.5V

Section II. TESTING

3-4. Range and Accuracy Check.

a. Test Equipment.

Appendix D provides a list of test equipment required to check, and maintain the AN/USM-451. Equivalent test equipment meeting all the minimum requirements as shown in Table 3-4, maybe substituted if the recommended items are not available.

b. Performance Assurance Test.

(1) The performance assurance tests are "incabinet" checks that compare the instrument with the applicable performance specifications. Beginning with incoming inspection checks periodic performance asaaurance tests should be made in the sequence detailed below and before any attempt is -made to calibrate the instrument, The performance assurance tests should also be used es part of the troubleshooting procedure and before returning the instrument to regular service after repair, recalibration, or extended storage. All checks are made et 73°F ±4°F and with COMMON connected to power line earth ground.

NOTE

Before making the following tests exercise each of the pushbutton switches several times to clean contacts by self wiping action.

(2) Battery Check.

(a) Set AN/USM-451 controls as follews:

Power	ON/OFF ON (IN)
AC/DC	DC (OUT)
Mode	BAT (A end V Depress simulteneously)

(b) A stable display reading above 000 should be indicated to insure that batteries are sufficient to power the instrument. If the reading is negative, replace batteries before proceeding. (para 2-6)

(3) Dc Voltage Accuracy Checks

(a) Set the multimeter controls as follows:

Power	ON/OFF ON (IN)
A C / D C	DC (OUT)
M o d e	V (Depressed)
Range	200m (Depressed)

(b) short the V- Ω and COMMON input connectors.

(c) Note a display reading of 00.0 ± 2 counts.

(d) Remove the short from the V- Ω and COMMON input connectors.

(e) Connect the DC Voltage Calibrator positive output to the V- Ω input connector of the AN/USM-451 and connect the negative calibrator output to the COMMON connector. Check again that COMMON is also connected to earth ground to avoid common mode errors.

(f) Proceed to check dc voltage accura cy at each setting of the voltege calibrator listed In Table 3-5. In each case the digital readout display of the multimeter should be within the tolerance shown.

(g) For negative readings reverse the input leads at the Dc Voltage Calibrator.

(4) Dc Accuracy Checks.

(a) Set the AW/USM-451 controls as follows:

(b) Power ON/OFF ON (IN}

(c) AC/DC DC (OUT)

(d) Mode A (Depressed)

(e) Range 2000m(Depressed)

Table 3-4. Required Test Equipment Speciftcations

INSTRUMENT TYPE	PURPOSE	SPECIFICATIONS
Dc Voltage Calibrator	Dc Voltage Performance Test	1.0mV to 1100V dc. Five-digit resolution. 0.03% accuracy.
Ac Voltage Calibrator	Ac Voltage Performance Test	1.0mV to 1100V ac.10Hz to 110 kHz. Five-digit resolution. 0.05% accuracy.
Dc Calibrator	DC Performance Test	10 µA to 10A 0.05% accuracy
Resistance Standard	Ohmmeter Performance Test	10 Ω to 10M Ω . ±0.1% accuracy Decade dials.
Digital Multimeter	Troubleshooting Tool	Dc volts to 1.2kV. AC volts to 1.2kV. 20 Hz to 100kHz. LO Ω . 100 to 2M Ω. Hl Ω. 1k Ω to 20M Ω. Ac current to 2A. Dc to 2A. 3-1/2 digits.
Oscilloscope with probes	Troubleshooting Tool	Dual Trace. 5mV, dc to 20 MHz. 100 ns/cm to 1 sec/cm. 10:1 divider probes.
Ac Source	Ac Performance Test	10 µA to 10A, ac ±0.2% accuracy.

Table 3-5. Dc Voltage Accuracy Checks (COMMON tied to earth ground)

DC VOLTAGE CALIBRATOR VOLTAGE	AN/USM-451		READOUT DISPLAY LIMITS
	RANGE	FUNCTION	
0.0000 (short)	200m	VDC	-00.2 to 00.2
+0.0100	200m	VDC	9.8 to 10.2
+0.1000	200m	VDC	99.7 to 100.3
-0.1000	200m	VDC	-99.7 to 100.3
+0.1900	200m	VDC	189.5 to 190.5
+1.9000	2	VDC	1.895 to 1.905
+19.000	20	VDC	18.95 to 19.05
+190.00	200	VDC	189.5 to 190.5
+1000.0	1000	VDC	997 to 1003

(f) Connect the A input connector of the multimeter to the positive output of the Dc Calibrator and the COMMON input connector to the negative terminal of the current calibrator. Check again that COMMON is also connected to earth ground to avoid COMMON mode errors.

(g) Check the accuracy at each setting of the Dc Calibrator listed in Table 3-6. In each case the displayed readout must be within the tolerances shown.

(h) Remove the connections between the multimeter and the Dc Calibrator.

(i) Connect the 10A LO jack of the multimeter to the negative terminal of the Dc Calibrator and the 10A (HI) jack to the positive output of the current calibrator.

(j) Check the accuracy of the 10A setting of the Dc Calibrator as listed in Table 3-6.

(5) Ac Voltage Accuracy Checks.

(a) Set the AN/USM-451 controls as follows:

(b) Power ON/OFF ON (IN)

(c) AC/DC AC (IN)

(d) Mode V (Depressed)

(e) Range 1000 (Depressed)

(f) Connect the Ac Voltage Calibrator to the V- Ω and COMMON input connectors of the multimeter. Make certain that COMMON is also connected to earth ground to avoid common mode signal errors.

(g) Check the accuracy at each setting of voltage and frequency of the Ac Voltage Calibrator as listed in Table 3-7. In each case, the displayed readout must be within the tolerances shown.

Table 3-6. DC Accuracy Checks (COMMOIN/L0) tied to earth ground)

DC CALIBRATOR	AM/USM-451	
	RANGE	READOUT LIMITS
00.0 µA	200µ	-00.2 to 00.2
+100µA	200µ	98.9 to 101.1
+1.000mA	2m	0.991 to 1.009
+10.00mA	20m	9.91 to 10.09
+100.0mA	200m	99.1 to 100.9
+1000mA	2000m	991 to 1009
+10.00A	10A	9.91 to 10.09

Table 3-7. Ac Voltage Accuracy Checks (COMMON tied to earth ground)

AC VOLTAGE CALIBRATOR		AN/USM451	
VOLTAGE	FREQUENCY	RANGE	DISPLAY LIMITS
0000mv	(Short)	200m	-0.03 to 00.6
10.00mV	40Hz	200m	9.3 to 10.7
100.0mV	420Hz	200m	99.0 to 101.0
100.0mV	1kHz	200m	97.5 to 102.5
100.0mV	10kHz	200m	97.5 to 102.5
190mV	40Hz	200m	188.5 to 191.5
190mV	1kHz	200m	187.6 to 192.4
190mV	10kHz	200m	187.6 to 192.4
1900V	40Hz	2	1.885 to 1.915
1900V	1kHz	2	1.876 to 1.924
1900V	10kHz	2	1.876 to 1.924
19.00V	40Hz	20	18.85 to 19.15
19.00V	10kHz	20	18.76 to 19.24
190.0V	40Hz	200	188.5 to 191.5
190.0V	10kHz	200	187.6 to 192.4
1000.0V	40Hz	1000	975 to 1025
1000.0V	1kHz	1000	957 to 1043

(6) Ac Accuracy Checks.

(a) The following procedure is given for reference only and need not be regularly performed.

(b) Set multimeter controls as follows:

(c) Power ON/OFF ON (IN)

(d) AC/DC AC (IN)

(e) Mode A (Depressed)

(f) Range 200m (Depressed)

(g) Connect the Ac Calibrator to the A and COMMON input connectors of the AN/USM-451, Check that COMMON is also connected to earth ground.

(h) Check the accuracy at each setting of current and frequency of the Ac Calibrator as listed in Table 3-8.

(i) For calibration check of the 10A range, remove the connection from the COMMON and A input jacks on the AN/USM-451 and re-connect them to the 10A LO and (Hi) input jacks respectively.

(7) Ohms Ranges Accuracy Checks.

(a) Set multimeter controls as follows:

(b) Power ON/OFF ON (IN)

(c) Mode Ω (Depressed)

(d) Range 200 (Depressed)

(e) Connect the Resistance Standard to the V- Ω and COMMON input connectors of the multimeter. Check that COMMON is also connected to earth ground.

(f) Check the resistance accuracy of the Ω ranges of the multimeter at each setting of the Resistance Standard listed in Table 3-9. In each case the displayed readout must be within the tolerances shown.

Table 3-8. Ac Accuracy Checks (COMMON/LO tied to earth ground)

AC CALIBRATOR		AN/USM-451	
CURRENT	FREQUENCY	RANGE	DISPLAY LIMITS
0000	(Short)	200µ	-0.03 to 00.6
100.0µA	40Hz	200µ	96.0 to 104.0
100.0µA	1kHz	200µ	94.5 to 105.5
1.000mA	40Hz	2m	0.98 to 1.020
1.000mA	1kHz	2 m	.955 to 1.045
10.000mA	40Hz	20m	9.80 to 10.20
10.000mA	1kHz	20m	9.55 to 10.45
100.00mA	40Hz	200m	98.0 to 102,0
100.00mA	1kHz	200m	95.5 to 104.5
1000.0mA	40Hz	2000m	980 to 1020
1000.0mA	1kHz	2000m	955 to 1045
10.00A	400Hz	10A	9.80 to 10.20

Table 3-9. Resistance Accuracy Checks (COMMON tied to earth ground)

RESISTANCE STANDARD	FUNCTION	AN/USM-451	
		RANGE	DISPLAY LIMITS
0000 (Short)	Ω	200	-00.2 to 00.8
100.00	Ω	200	99.4 to 100.6
1.0000k	Ω	2K	0.994 to 1.006
10.000k	Ω	20K	9.94 to 10.06
100.00k	Ω	200K	99.4 to 100.6
1.000M	Ω	2000K	994 to 1006
10.OOM	Ω	20M	9.88 to 10.12

Section III. DISASSEMBLY, REPLACEMENT, AND REASSEMBLY

3-5. Disassembly of Parts and Subassemblies.

a. Case Assembly.

(1) Remove the four screws accessible through the bumper feet on the bottom of the multimeter case.

(2) Remove the top cover by pulling it up from the side sections.

CAUTION

Be careful when removing the top cover in case the Optional Heater Battery Pack has been installed.

(3) If Optional Heater Battery Pack has been installed, disconnect the cable plug from the LCD assembly.

(4) Remove the two side sections and handle assembly by pulling them up from the bottom cover.

NOTE

Do not lose or misplace any of the spacer sleeves from the two side sections,

(5) Remove the three self-tapping screws that secure the printed circuit board assembly to the bottom cover.

(6) Remove the printed circuit board/panel assembly by pulling it up from the bottom cover.

b. Display (BL1).

(1) Remove the two 4-40 hex nuts from the rear of the display printed circuit board.

(2) Remove the No. 4 insulated washer.

(3) Pull the display board assembly to the rear and free of the two 4-40 studs.

(4) Swing the display board out to either side of the printed circuit board/panel assembly.

(5) Remove the display (BL1) from the pin sockets.

3-6. Replacement of Parts and Subassemblies.

a. A “grounded” type, low wattage soldering iron such as the 35 Watt Weller Model W-TCP is recommended to avoid over voltage damage to integrated circuits, transistors and capacitors.

b. Refer to Figure 3-1, Location of Parts. Replace the part or parts that have been determined to be defective.

CAUTION

When replacing an integrated circuit, transistor or diode; observe the correct polarity to avoid damage to the component or instrument.

3-7. Reassembly of Parts and Subassemblies.

a. Display (BL1).

(1) Slide the display printed circuit board down over the two 4-40 studs.

(2) Install the insulated washer over the stud closest to the center of the display printed circuit board.

(3) Thread the 4-40 nuts onto the studs and tighten them.

(4) Apply a small amount of glyptol to each nut.

b. Case Assembly.

(1) Insert the printed circuit board/panel assembly down into the bottom cover.

(2) Align the printed circuit holes with the three bosses in the bottom cover. Fasten the printed circuit board to the bottom cover with the two self-tapping screws.

(3) Make sure that the four spacer sleeves are installed on the upper plastic supports of the side sections that face the top cover. Insert the two side sections down into the bottom cover.

(4) Install the top cover.

NOTE

If the Optional Heater Battery Pack has been installed, connect the battery pack cable to the two-pin male connector on the LCD printed circuit board before installing the top cover.

(5) Secure the top cover by inserting the four screws through the bumper feet and up through the bottom cover, screwing them into the top cover.

3-8. Optional Heater Battery Pack Installation.

a. Disassembly.

(1) Remove the four screws accessible through the bumper feet on the bottom of the multimeter case.

(2) Remove the top cover by pulling it up from the side sections.

(3) Remove the four metal spacers from the plastic supports on the side sections.

b. Reassembly.

(1) Replace the four metal spacers that were removed in step a. (3) with the four shorter length spacers supplied with the Heater Battery Pack Kit.

(2) Refer to Figures 3-1 and 3-2. Using the new top cover containing the heater battery pack, connect the battery pack cable to the two-pin male connector located on the LCD printed circuit board.

(3) Install the replacement top cover.

(4) Secure the top cover by inserting the four screws through the bumper feet and up through the bottom cover, screwing them into the top cover.

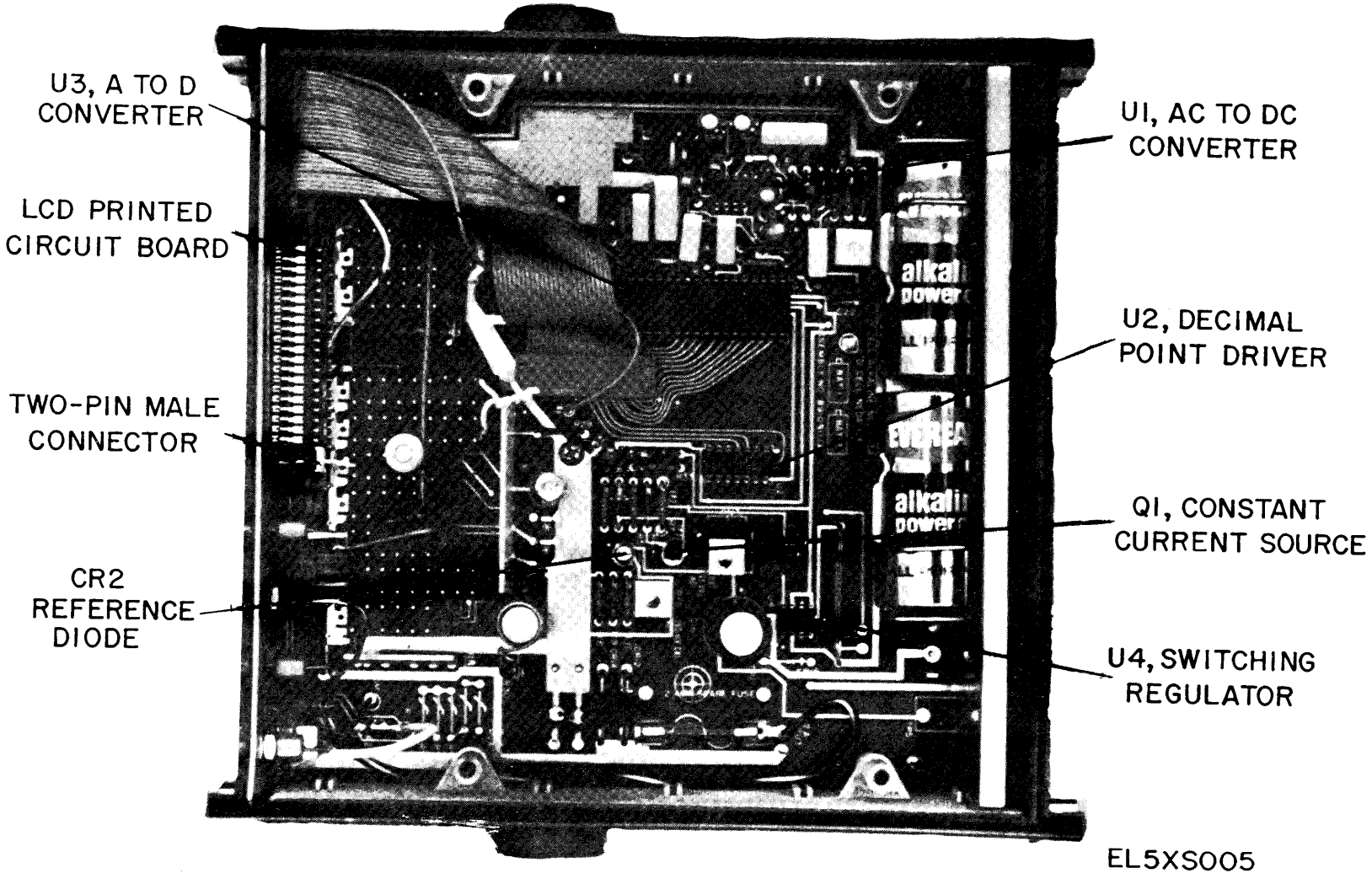

Figure 3-1. Location of Parts

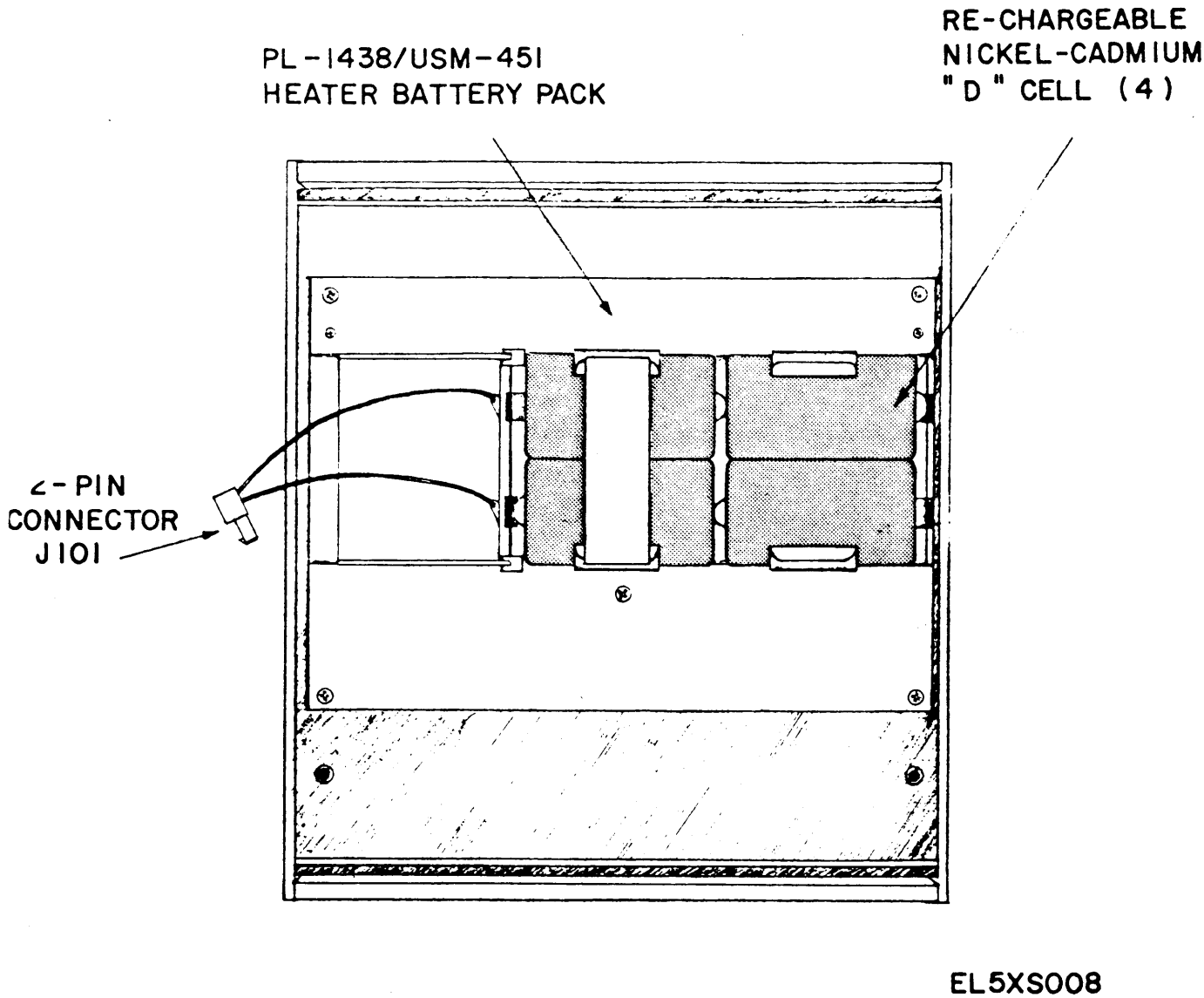

Figure 3-2. Optional Heater Battery Pack
(Inside Cover)

All data on pages 3-14, 3-15 and 3-16 deleted.

Table 3-10. AN/USM-451 Replaceable Parts

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 2	07-10338-0A	CBM 33.0NF 400.0 V +-10%	80031	MEPCO C280MCF/A33K
C 3	07-10430-0A	CBM 220.0NF 100.0 VK	80031	MEPCO C280MAH/A220K
C 4	07-10341-0A	CBM 470.0NF 100.0 v +-10%	80031	MEPCO C280MCH/A470K
C 5	07-10339-0A	CBM 100.0NF 100.0 V +-10%	80031	MEPCO C280MCH/A100K
C 6	07-10467-0A	CMD 750. PF 300. VG	631	CMD 750. PF 300. VG
C 7		DELETE		
C 8	07-10555-0A	CCD 0.023UF 2KV +-20%	0	ERIE 3888-2KV 25U 233M
C 9	07-10179-0A	CET 22.0UF 15.0 VM	56289	SPRAGUE 196D226X0015KE3
C 10	07-10179-0A	CET 22.0UF 15.0 VM	56289	SPRAGUE 1960226X0015KE3
C 11	07-10341-0A	CBM 470.0NF 100.0 v +-10%	80031	MEPCO C280MCH/A470K
C 12	07-10179-0A	CET 22.0UF 15.0 VM	56289	SPRAGUE 196D226X0015KE3
C 13	07-10179-0A	CET 22.0UF 15.0 VM	56289	SPRAGUE 196D226X0015KE3
C 14	07-10338-0A	CBM 33.0NF 400.0 v +-10%	80031	MEPCO C280MCF/A33K
C 16	07-10447-0A	CEA 2200.0UF 16.0 V	50423	CAPAR CRE 2200UF/16V
C 17	07-10575-0A	CEA 220.0UF 10.0V	0	STET-TRUSH EK 220/10
C 18	07-10349-0A	CMD 560.0PF 500.0 V TCE 1%	84171	ARCO DM15ED560F03 ARCO
C 19	07-10179-0A	CET 22.0UF 15.0 VM	56289	SPRAGUE 196D226X0015KE3
C 20	07-10557-0A	CMD4300.PF 50.0 A	0	ARCO CM06FY432FN3
C 21	07-10556-0A	CMD 320.PF 50.0 A	0	ARCO CM05FY321FN3
C 22	07-10350-0A	CMD 470.0PF 500.0 V TCE 2%	84171	ARCO DM15ED470G03 ARCO
C 23	07-10338-0A	CBM 33.0NF 400.0 V +-10%	80031	MEPCO C280MCF/A33K
C 50	07-10456-0A	CVC 2-10.0 PF 380.0V	80031	MEPCO C010 EA/10E
C 51	07-10247-0A	CVC 10.0 - 40 PF 250V	50423	STET-TRUSH 10 S-06 TRIKO
C R . . . 1	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
C R . . . 2	05-10119-1A	DZG 1.2V01+ REFERENCE	50423	ICL 8069CCQ
C R . . . 8	05-10103-0A	DXS PAD50 35.0V .50M	17856	SIL PAD50 PICOAMP 51
C R . . . 9	05-10103-0A	DXS PAD50 35.0V .50M	17856	SIL PAD50 PICOAMP 51
CR 10	05-10021-0A	DGP 5082-2855 LOW OFF-SET	28480	HP SCHOTTKY.34 FWD 5VRVS
CR 11	05-10021-0A	DGP 5082-2835 LOW OFF-SET	28480	HP SCHOTTKY.34 FWD 5VRVS
CR 12	05-10063-0A	DRP 1N5400 50 3A	4713	MOT SI
CR 14	05-10063-0A	DRP 1N5400 50 3A	4713	HOT SI
F 1	19-10042-0A	FUS 2.0.A REG.BLO 3AG	75915	LITTELFUSE 2A3AG
F 2		DELETE		
L 1	03-03015-0A	CRF 39.0UH IODUCTOR	0	J.W.MILLER #4628
Q . . . 1	10-10152-0A	TRQ MPSA92 300V 30MA TO92	0	MOTOROLA
R 3	12-13206-0A	RFF 3.0 500.0MW F+-1%	0	IRC RN60 3.0M 1% CCA TYPE
R 4	12-01277-0A	RFC 1.0M 1.0 W J+- 5%	1121	A-8 TYP GB
R 5	12-12316-0A	RFF 1.47K 250 MW F+-1%	16299	CGW RN55D 1471 F
R 6	12-12424-0A	RFF 17.8 K 250.0MW F+-1%	16299	CGW RN55D 1782 F
R 7	12-12344-0A	RFF 2.87K 205.0MW F+-1%	16299	CGW RN55D 2871 F
R 8	12-12320-0A	RFF 1.62K 250 MW F+-1%	16299	CGW RN55D 1621 F
R 9	12-12424-0A	RFF 17.8 K 250.0MW F+-1%	16299	CGW RN55D 1782 F
R 10	09-10001-0A	RVC 500.0 0.5 W K	73138	HEL TYP 72PM
R 11	12-12316-0A	RFF 1.47K 250 MW F+-1%	16299	CGW RN55D 1471 F
R 12	12-01023-0A	RFC 200.0 K 500.0MW J+- 5%	1121	A-B TYP EB
R 13	12-01023-0A	RFC 200.0 K 500.0MW J+- 5%	1121	A-B TYP EB
R 16	12-12472-0A	RFF 56.2 K 250.0MW F+-1%	16299	CGW RN55D 5622 F
R 17	12-01007-0A	RFC 2.0M 500 MW J+-5%	01121	A-B TYP EB
R 18	12-12863-0A	RFC 150.0 K 2.0 W 5%	1121	A-B HB
R 19	12-01007-0A	RFC 2.0 M 500.0MW J+-5%	1121	A-B TYP EB
R 22	12-01007-0A	RFC 2.0 M 500.0MW J+-5%	1121	A-B TYP EB
R 23	12-12372-0A	RFF 5.62K 250.0MW F+-1%	16299	CGW RN55D 5621 F
R 24	12-12333-0A	RFF 2.21K 250.0MW F+-1$	16299	CGW RN55D 2211 F
R 25	09-10001-0A	RVC 500.7 0.5 W K	73138	HEL TYP 72PM
R 26	12-12550-0A	RFF 332.0 K 500 MW F+-1%	16299	CGW RN60D 3323 F
R 27	12-12955-1A	0.01 OHM 10 AMP SHUNT	50423	BLI 3028A-21 SHUNT
R 28	12-13205-0A	RFW 100.0 250.0MW A	0	RCD Q-60 100 .1%
R 29	12-12404-0A	RFF 11.0 K 250.0MW F+-1%	16299	CGW RN55D 1102 F
R 30	89-10938-1A	A ASY 9632M 2 AMP SHUNT	50423	BLI
R 31	12-08029-0A	RFC 1.0 M 25.0MW J+-5%	1121	A-B TYP CB
R 32	09-10111-0A	RVF 2.0 M 0.5 W CER	73138	HEL TYPE 72P
R 33	12-12500-0A	RFF 100.0 K 250.0MW F+-1%	16299	CGW RN55D 1003 F
R 34	12-12344-0A	RFF 2.87K 205.0Md F+-1%	16299	CGW RN55D 2871 F

Table 3-10. AN/USM-451 Replaceable Parts (continued)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R. 36	12-12448-0A	RFF 31.6 K 250.0MW F+-1%	16299	CGW RN55D 3162 F
R. 37		DELETE		
R. 38		DELETE		
R. 39	12-12550-0A	RFF 332.0 K 500 MW F+-1%	16299	CGW RN60D 3323 F
R N . . . 1	13-10078-1A	RNF 9632M ATTEN	0	CADDOCK 1776-24
R N . . . 2	13-10079-1A	RNF 9632M CURRENT SHUNT	0	CADDOCK 1787-412
R N . . . 3	13-10077-0A	RNF 9632M (4) 1MEG RESISTOR	0	DALE C5P08E03 1.0M J
S. 1	25-10191-1M	SWC 9632M FUNCTION 6 STAT	50423	
S. 2	25-10191-1M	SWC 9632M FUNCTION 6 STAT	50423	
S. 3	25-10191-1M	SWC 9632M FUNCTION 6 STAT	50423	
S. 4	25-10191-1M	SWC 9632M FUNCTION 6 STAT	50423	
S. 5	25-10191-1M	SWC 9632M FUNCTION 6 STAT	50423	
S 6		DELETE		
S. 7	25-10192-1M	SWC 9632M RANGE 7 STAT	50423	
S. 8	25-10192-1M	SWC 9632M RANGE 7 STAT	50423	
S . . . 9	25-10192-1M	SWC 9632M RANGE 7 STAT	50423	
S. 10	25-10192-1M	SWC 9632M RANGE 7 STAT	50423	
S. 11	25-10192-1M	SWC 9632M RANGE 7 STAT	50423	
S. 12	25-10192-1M	SWC 9632M RANGE 7 STAT	50423	BLI
U. . . 1	24-10275-0A	LOW POWER OP AMP TL061	0	TI TL061
U. . . 2	24-10277-0A	QUAD EXCL. OR GATE CD4070B	0	RCA C04030B
U. . . 3	24-10274-1A	ICP ICL7106 FOR LCD DISPLAY	0	ICL7106
U. . . 4	24-10276-0A	7-9V SWITCHING REG TL496	0	TI TL496
Y. . . 1	04-10019-0A	CRS 40.0KHZ 0.05%	0	STATEK CX-1H-40/H101-CAL.C

CHAPTER 4

PREPARATION FOR SHIPMENT

If the instrument is to be repackaged for shipment, as a general guide, repackage the instrument, as shown in Figure 4-1. Use either the original packing material, if available, or material similar to that specified.

NOTE

It is recommended that the batteries be removed from the instrument if extreme environments or storage in excess of six months is anticipated.

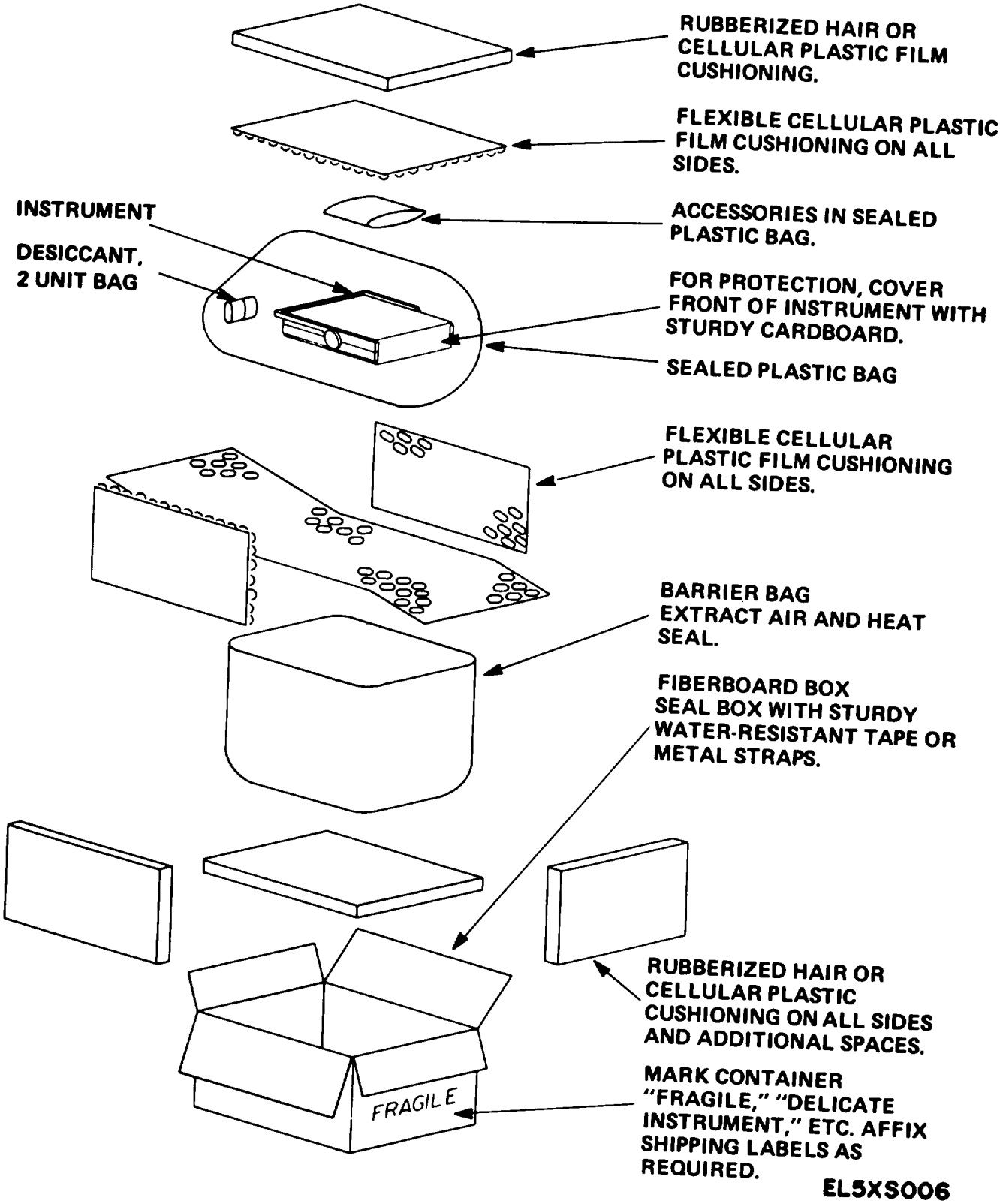

Figure 4-1. AN/USM Packing Diagram

CHAPTER 5

STORAGE

Pack the AN/USM-451 Multimeter as outlined in Chapter 4 or place it in a suitably sized carton or box with adequate packing material. seal the container with waterproof tape. Store the container in a clean dry place.

NOTE

It is recommended that the batteries be removed from the instrument if extreme environments or storage in excess of six months is anticipated.

APPENDIX A

REFERENCES

DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 11-6625-2953-40P	General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Multimeter AN/USM-451 (NSN 6625-01-060-6804).
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX B

COMPONENTS OF END ITEM LIST

Section I. INTRODUCTION

B-1. Scope.

This appendix lists integral components of and basic issue items for the Multimeter, AN/USM-451 to help you inventory items required for safe and efficient operation.

B-2. General.

This Components of End Item List is divided into the following sections:

a. Section II.

Integral Components of the End Item. These items, when assembled, comprise the Multimeter, AN/USM-451 and must accompany it whenever it is transferred or turned in. The illustrations will help you identify these items.

b. Section III.

Basic Issue Items. These are the minimum essential items required to place the Multimeter, AN/USM-451 in operation, to operate it, and to perform emergency repairs, Although shipped separately packed they must accompany the Multimeter, AN/USM-451 during operation and whenever it is transferred between accountable officers. The illustrations will assist you with hard-to-identify items. This manual is your authority to requisition replacement BII, based on TOE/MTOE authorization of the end item.

B-3. Explanation of Columns.

a. Illustration.

This column is divided as follows:

(1) Figure Number.

Indicates the figure number of the illustration on which the item is shown.

(2) Item Number.

The number used to identify item called out in the illustration.

b. National Stock Number.

Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. Description.

Indicates the Federal item name and, if required, a minimum description to identify the item. The part number indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items. Following the part number, the Federal Supply Code for Manufacturers (FSCM) is shown in parentheses.

d. Location.

The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

e. Usable on Code. Not applicable.

f. Quantity Required (Qty. Reqd.).

This column lists the quantity of each item required for a complete major item.

g. Quantity.

This column is left blank for use during an inventory. Under the Rec'd. column, list the quantity you actually receive on your major. item. The Date columns are for your use when you inventory the major item at a later date; such as for shipment to another site.

Section II. INTEGRAL COMPONENTS OF END ITEM

(1) Illustration (a) Figure No.	(1) Illustration (b) Item No.	(2) National Stock Number	(3) Part No.	(4) Description	(5) Location	(6) Usable On Code	(7) Qty Reqd	(8) Quantity Rcv'd	(8) Quantity Date	(8) Quantity Date	(8) Quantity Date
			85-	Carry Case			1				
				Alligator Clip			2				
			85-10062-0	Probe Test Lead, Black			1				
				Probe Test Lead, Red			1				

Section III. BASIC ISSUE ITEM

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No.	Description	Location	Usable On Code	Qty Reqd	Rcv'd	Date	Date	Date
				TM 11-6625-2953-14							
1-1				AN/USM-451							

APPENDIX C

ADDITIONAL AUTHORIZATION LIST

(Not Applicable)

APPENDIX D

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

D-1. General.

This appendix provides a summary of the maintenance operations for Multimeter, AN/USM-451. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

D-2. Maintenance Function.

Maintenance functions will be limited to and defined as follows:

a. Inspect.

To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test.

To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service.

Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/ hydraulic fluids or compressed air supplies.

d. Adjust.

Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align.

To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate.

To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install.

The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace.

The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair.

The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceabllity to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component, assembly, end item or system.

j. Overhaul.

That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e. g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild.

Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with the original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

D-3. Column Entries.

a. Column 1, Group Number.

Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly.

Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions.

Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purposes of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category.

Column 4 specifies, by the listing of a “worktime” figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate “worktime” figures will be shown for each category. The number of man-hours specified by the “worktime” figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C - Operator/Crew
C - Organizational
F - Direct Support
H - General Support
D - Depot

e. Column 5, Tools and Equipment.

Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks.

Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

D-4. Tool and Test Equipment Requirements (Sect. III).

a. Tool or Test Equipment Reference Code.

The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category.

The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature.

This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number.

This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number.

This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

D-5. Remarks (Sect. IV).

a. Reference Code.

This code refers to the appropriate item in section II, column 6,

b. Remarks.

This column provides the required explanatory information necessary to clarify items appearing in section II.

Section II. MAINTENANCE ALLOCATION CHART FOR DIGITAL MULTIMETER, AN/USM-451

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT.	(6) REMARKS
			c	o	F	H	D		
00	AN/USM-451	Inspect		0.5					A
		Test				1.0		5, 6	B
		Repair				1.5		7, 8	
		Replace				0.5		8	
		Calibrate				-1.5		1-6	c
		Overhaul					4.0	1-9	
01	PCB – Mother board	Inspect		0.3					A
		Test				1.0		5, 6	B
		Repair				1.5		7, 8	
		Calibrate				1.5		1-6	c
02	PCB - LCD board	Inspect		0.3					A
		Test				0.2		6	B
		Repair				0.5		7, 8	
03	Battery	Inspect		0.1					A
		Test		0.1				6	B
		Replace		0.1					
04	Test Lead Accessory	Inspect		0.1					A
		Repair				0.2		7, 8	
		Replace				0.2			
05	Optional Heater Battery Pack	Inspect		0.1					
		Repair				0.2			
		Replace				0.2			

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR DIGITAL MULTIMETER, AN/USM-451

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER
1	H, D	* John Fluke Mdl 760A Meter Calibrator	6625-00-935-7002
2	H, D	* Digital Voltmeter H.P. 3490A	6625-00-557-8305
3	H, D	* Oscilloscope H.P. 180D	6625-00-022-8228
4	H, D	* Transformer, Variable Gen Rad WIOMT3AS3	6120-00-168-3705
5	H, D	Frequency Counter CP-772A/U	6625-00-973-4837
6	H,D,O	Multimeter AN/USM-451	6625-01-060-6804
7	H, D	Maintenance Kit MK-772/U	5999-00-757-7042
8	H, D	Tool Kit, Electronic Equipment TK-100/G	5160-00-605-0079
9	D	Tools and Test Equipment as authorized to the repairman user because of his assigned task.	
		* Commercial items used for calibration of this equipment are found in the AN/GSM-256 Calibration Van (the AN/GSM-256 has been designated as the Calibration Facility).	

Section IV. REMARKS

REFERENCE CODE	REMARKS
A	Visual
B	Verify Performance
C	Verify accuracy as compared to calibration standard

APPENDIX E

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1. Scope.

This appendix lists expendable supplies and materials you will need to operate and maintain the Multimeter, AN/USM-451. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

E-2. Explanation of Columns.

a. Column 1 – Item Number.

This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App. D"),

b. Column 2 – Level.

This column identifies the lowest level of maintenance that requires the listed item.

C – Operator/Crew
O – Organizational Maintenance
F – Direct Support Maintenance
H – General Support Maintenance

c. Column 3 – National Stock Number.

This is the National Stock Number assigned to the item; use it to request or requisition the item.

d. Column 4 – Description.

Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

e. Column 5 – Unit of Measure (U/M).

Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e. g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	0	6850-00-105-3084	Freon, Type TF	OZ
2	0	8305-00-205-3496	Cloth, Cotton, Cheesecloth, Lint-Free	YD
3	0		Commercial Detergent	QT
4	0	6135-00-930-0030	Battery, 1.5 Volt “D” Cell,	PR
5	0		Spray Iubricant, Centralab Spray Lubricant or equivalent	CN
6	H		Glyptol	OZ
7	0		Battery, 1.2 Volt “D” cell, Nickel Cadmium (Rechargeable)	
			NOTE	
			National Stock Numbers that are missing have been applied for and will be added to this TM by a change to the list upon receipt.	

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

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THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

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Stateside Army Depot
ATTN: AMSTA-US
Stateside, N.J. 07703

DATE: 10 July 1975

PUBLICATION NUMBER	DATE	TITLE
TM 11-5840-340-12	23 Jan 74	Radar Set AN/[illegible]-76

BE EXACT. . .PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.	
2-25	2-28			Recommend that the installation antenna alignment procedure be changed throughout to specify a 2° IFF antenna lag rather than 1°. REASON: Experience has shown that with only a 1° lag, the antenna servo system is too sensitive to wind gusting in excess of [illegible] knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2° without degradation of operation.
3-10	3-3		3-1	Item 5, Function column. Change "2 db" to "3db." REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.
5-6	5-8			Add new step f.1 to read, "Replace cover plate removed in step e.1, above." REASON: To replace the cover plate.
		F03		Zone C 3. On J1-2, change "+24 VDC to "+5 VDC." REASON: This is the output line of the 5 VDC power supply. + 24 VDC is the input voltage.

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER
SSG I. M. DeSpiritof 999-1776

SIGN HERE: SSG I. M. DeSpiritof

DA FORM 1 AUG 74 2028-2

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PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO

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NG: None

USAR : None

For explanation of abbreviations used, see AR 310-50.

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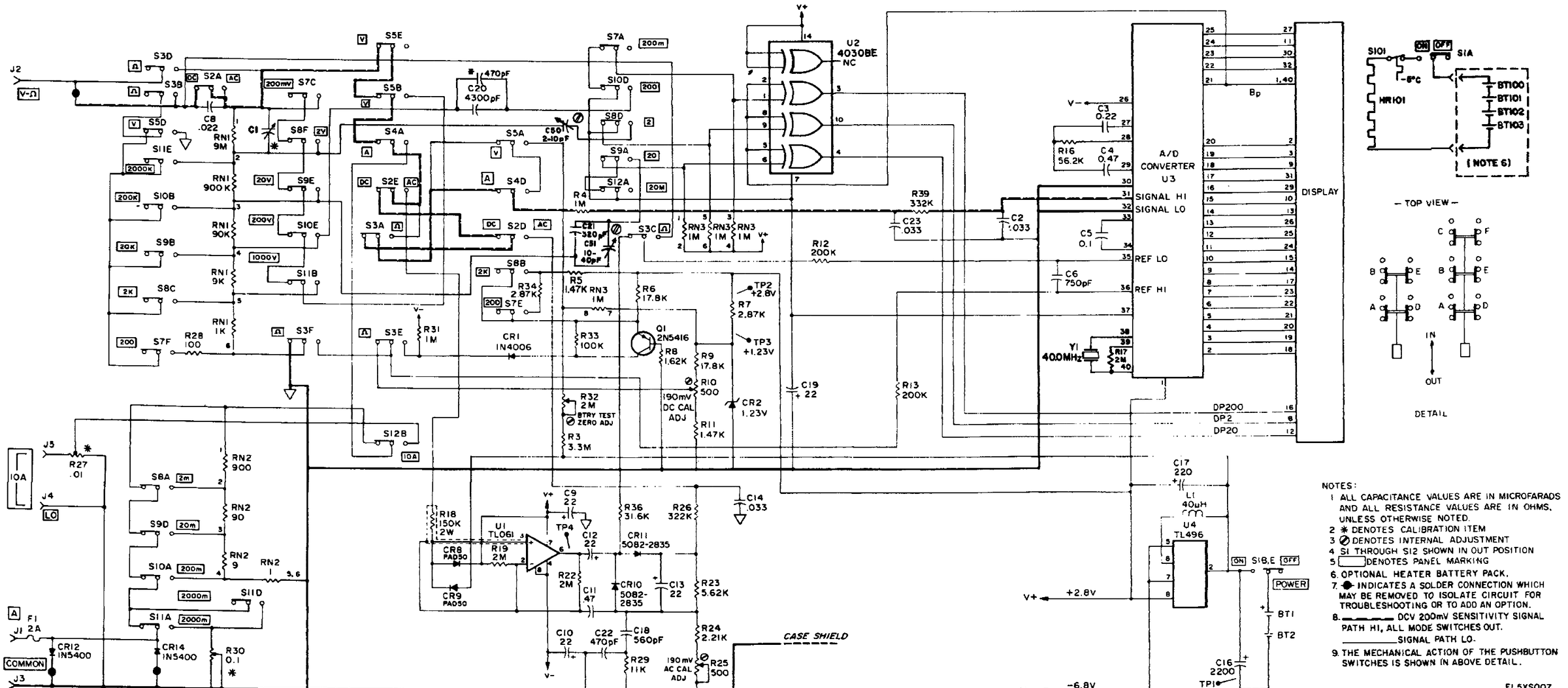

NOTES:
1. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL RESISTANCE VALUES ARE IN OHMS, UNLESS OTHERWISE NOTED.
2. ✱ DENOTES CALIBRATION ITEM
3. ⊘ DENOTES INTERNAL ADJUSTMENT
4. S1 THROUGH S12 SHOWN IN OUT POSITION
5. [ ] DENOTES PANEL MARKING
6. OPTIONAL HEATER BATTERY PACK.
7. ● INDICATES A SOLDER CONNECTION WHICH MAY BE REMOVED TO ISOLATE CIRCUIT FOR TROUBLESHOOTING OR TO ADD AN OPTION.
8. _ _ _ _ _ DCV 200mV SENSITIVITY SIGNAL PATH HI, ALL MODE SWITCHES OUT.
   _____ SIGNAL PATH LO.
9. THE MECHANICAL ACTION OF THE PUSHBUTTON SWITCHES IS SHOWN IN ABOVE DETAIL.

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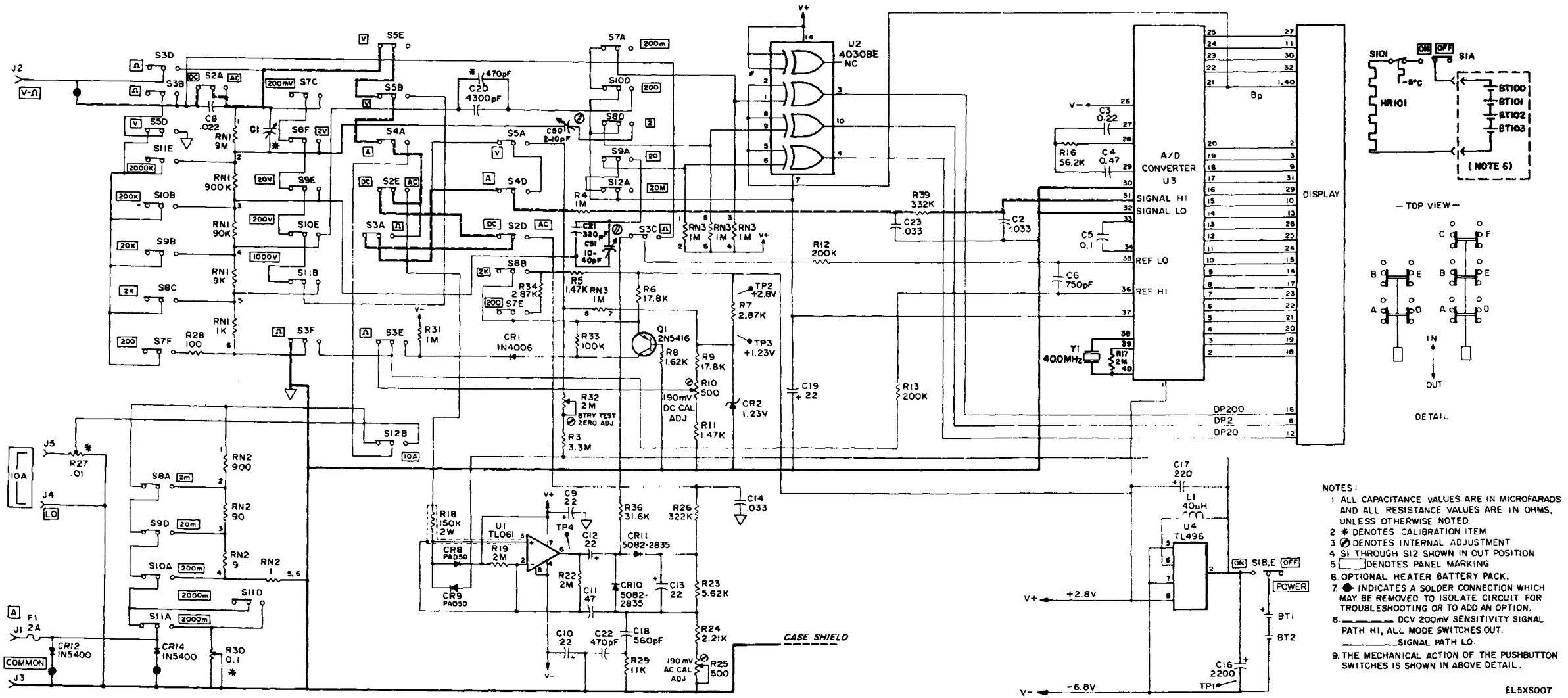

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