TM 11-6625-3200-14

TECHNICAL MANUAL

OPERATOR'S, UNIT AND INTERMEDIATE DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL VOLTMETER

ME-545/G

NSN 6625-01-255-4547

(EIC: KDO)

HEADQUARTERS, DEPARTMENT OF THE ARMY

15 MAY 1989

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1. DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL IF

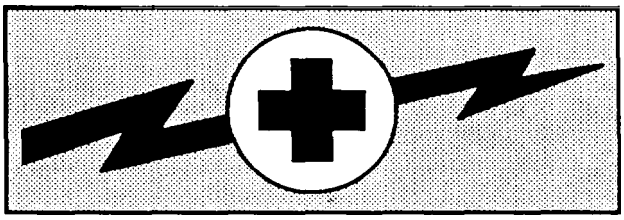
2. POSSIBLE, TURN OFF THE ELECTRICAL POWER

3. IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A DRY WOODEN POLE OR A DRY ROPE OR SOME OTHER INSULATING MATERIAL

4. SEND FOR HELP AS SOON AS POSSIBLE

5. AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESPIRATION

WARNING



HIGH VOLTAGE

is used in the operation of this equipment

DEATH ON CONTACT

may result if personnel fail to observe safety precautions

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When technicians are aided by operators, they must warn them about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after the power has been turned off, always ground every part before touching it.

Be careful not to contact high-voltage connections of 115 –volt ac input when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

WARNING

Do not be misled by the term “LOW VOLTAGE”. Potentials as low as 50 volts may cause death under adverse conditions.

For Artificial Respiration refer to FM 4-25.11.

CAUTION

THIS EQUIPMENT CONTAINS PARTS AND ASSEMBLIES SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). USE ESD PRECAUTIONARY PROCEDURES WHEN TOUCHING, REMOVING OR INSETTING PRINTED CIRCUIT BOARDS.

ESD
CLASS 1

NOTE

The symbol for static sensitive devices in military inventory is as depicted in the caution block above.

GENERAL HANDLING PROCEDURES FOR ESDS ITEMS

- USE WRIST GROUND STRAPS OR MANUAL GROUNDING PROCEDURES
- KEEP ESDS ITEMS IN PROTECTIVE COVERING WHEN NOT IN USE
- GROUND ALL ELECTRICAL TOOLS AND TEST EQUIPMENT
- PERIODICALLY CHECK CONTINUITY AND RESISTANCE OF GROUNDING SYSTEM
- USE ONLY METALIZED SOLDER SUCKERS
- HANDLING ESDS ITEMS ONLY IN PROTECTED AREAS

MANUAL GROUNDING PROCEDURES

- MAKE CERTAIN EQUIPMENT IS POWERED DOWN
- TOUCH GROUND PRIOR TO REMOVING ESDS ITEMS
- TOUCH PACKAGE OF REPLACEMENT ESDS ITEM TO GROUND BEFORE OPENING
- TOUCH GROUND PRIOR TO INSERTING REPLACEMENT ESDS ITEMS

ESD PROTECTIVE PACKAGING AND LABELING

- INTIMATE COVERING OF ANTISTATIC MATERIAL WITH AN OUTER WRAP OF EITHER TYPE 1 ALUMINIZED MATERIAL OR CONDUCTIVE PLASTIC FILM OR HYBRID LAMINATED BAGS HAVING AN INTERIOR OF ANTISTATIC MATERIAL WITH AN OUTER METALIZED LAYER
- LABEL WITH SENSITIVE ELECTRONIC SYMBOL AND CAUTION NOTE

CAUTION

Devices such as CMOS, NMOS, MNOS, VMOS, HMOS, thin-film resistors PMOS, and MOSFET used in many equipments can be damaged by static voltages present in most repair facilities. Most of the components contain internal gate protection circuits that are partially effective, but sound maintenance practice and the cost of equipment failure in time and money dictate careful handling of all electrostatic sensitive components.

The following precautions should be observed when handling all electrostatic sensitive components and units containing such components.

CAUTION

Failure to observe all of these precautions can cause permanent damage to the electrostatic sensitive device. This damage can cause the device to fail immediately or at a later date when exposed to an adverse environment.

STEP 1 Turn off and/or disconnect all power and signal source and loads used with the unit.

STEP 2 Place the unit on grounded conductive work surfaces.

STEP 3 Ground the repair operator using a conductive wrist strap or other device using a 1-M series resistor to protect the operator.

STEP 4 Ground any tools (including soldering equipment) that will contact the unit. Contact with the operator's hand provides a sufficient ground for tools that are otherwise electrically isolated.

STEP 5 All electrostatic sensitive replacement components are shipped in conductive foam or tubes and must be stored in the original shipping container until installed.

STEP 6 When these devices and assemblies are removed from the unit, they should be placed in the conductive work surface or in conductive containers.

STEP 7 When not being worked on, wrap disconnected circuit boards in aluminum foil or in plastic bags that have been coated or impregnated with a conductive material.

STEP 8 Do not handle these devices unnecessarily or remove from their packages until actually used or tested.

CHANGE)
)
No. 3)

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 30 August 2006

**OPERATOR'S, UNIT AND INTERMEDIATE DIRECT SUPPORT,
AND GENERAL SUPPORT MAINTENANCE MANUAL
VOLTMETER ME-545/G
NSN 6625-01-255-4547 (EIC: KDO)**

HAZARDOUS MATERIAL INFORMATION – This document has been reviewed for the presence of solvents containing hazardous materials as defined by the EPCRA 302 and 313 lists by the AMCOM G-4 (Logistics) Environmental Division. As of the base document, dated 15 March 1990, through Change 01, all references to solvents containing hazardous materials have been removed from this document by substitution with non-hazardous or less hazardous materials where possible.

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1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the outer margin of the page. Illustration changes are indicated by a pointing hand. New or changed part numbers are indicated by an asterisk (*). Completely revised sections or chapters are indicated by a vertical bar next to the title only.

Remove Pages	Insert Pages
a,b	a,b
A/(B blank)	A/(B blank)
i, ii	i, ii
1-1, 1-2	1-1, 1-2
5-3, 5-4	5-3, 5-4
A-1/(A-2 blank)	A-1/(A-2 blank)
E-1/E-2 blank)	E-1/(E-2 blank)
COVER	COVER

2. File this change sheet in front of the publication for reference purposes.

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0619804

DISTRIBUTION:

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TM 11-6625-3200-14
C2

CHANGE
No. 2

Headquarters
Department of the Army
Washington, D.C., 30 September 2005

OPERATOR'S UNIT, AND INTERMEDIATE DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

FOR

VOLTMETER
ME-545/G
(NSN 6625-01-255-4547)

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2. This change implements Army Maintenance Transformation and changes the Maintenance Allocation Chart (MAC) to support Field and Sustainment Maintenance.

Remove Pages	**Insert Pages**
None	E/(F blank)
i, ii	i, ii
B-1 thru B-6	B-1 thru B-7/(B-8 blank)
COVER	COVER

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TM 11-6625-3200-14
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By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

Official:

SANDRA R. RILEY
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CHANGE

No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, l5 March 1990

OPERATOR'S, UNIT, AND INTERMEDIATE DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR VOLTMETER ME-545/G (NSN 6625-O l-255-4547)

TM 1 l-6625-3200-14, 15 May 1989, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page. Added or revised illustrations are indicated by a vertical bar adjacent to the identification number.

Remove pages	*Insert pages*
5-25 and 5-26	**5-25 and 5-26**
5-35 and 5-36	**5-35 and 5-36**

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CARL E. VUONO
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Brigadier General, United States Army
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INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

NOTE

ON CHANGED PAGES, THE PORTION OF THE TEXT AFFECTED BY THE LATEST CHANGE IS INDICATED BY A VERTICAL LINE OR OTHER CHANGE SYMBOL IN THE OUTER MARGIN OF THE PAGE.

Dates of issue for original and changed pages are:

Original	0	15 MAY 1989
Change	1	15 MAR 1990
Change	2	30 SEP 2005
Change	3	30 AUG 2006

Total number of pages in this publication is 197 consisting of the following:

Page No.	*Change No.
Cover	3
a	0
b	3
c	0
d	0
i and ii	3
iii	0
1-0	0
1-1 and 1-2	3
1-3 through 1-22	0
2-1 through 2-20	0
2-21/(2-22 blank)	0
3-1 through 3-6	0
3-7/(3-8 blank)	0
4-1/(4-2 blank)	0
5-1 and 5-2	0
5-3	3
5-4 through 5-66	0
5-67/(5-68 blank)	0
A-1/(A-2 blank)	0
B-1 through B-6	0
C-1 and C-2	0
D-1/(D-2 blank)	0
E-1/(E-2 blank)	3
F-1 through F-12	0

Page No.	*Change No.
Index 1	0
Index 2	0
Index 3	0
Index 4	0
Index 5	0
Index 6	0
Index 7	0
Index 8	0
FO-1	0
FO-2 (SH 1 thru 4)	0
FO-3 (SH 1 and 2)	0
FO-4 (SH 1 and 2)	0
FO-5	0
FO-6	0

* Zero in this column indicates an original page.

Technical Manual)
)
No. 11-6625-3200-14)

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 15 May 1989

OPERATOR'S, UNIT, AND INTERMEDIATE DIRECT SUPPORT GENERAL SUPPORT MAINTENANCE MANUAL FOR VOLTMETER, ME-545/G (NSN 6625-01-255-4547) (EIC: KDO)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can 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 or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U.S. Army Aviation and Missile Command, AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via email, fax or the World Wide Web. Our fax number is DSN 788-6546 or Commercial 256-842-6546. Our email address is: 2028@redstone.army.mil. Instruction for sending an electronic 2028 may be found at the back of this manual immediately preceding the hardcopy 2028. For the World Wide Web use:https://amcom2028.redstone.army.mil.

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Table of Contents-(continued)

HOW TO USE THIS MANUAL

This manual tells about the Voltmeter ME-545/G and contains instructions about how to use it during maintenance on other electronic equipment.

The technical manual for the electronic equipment being maintained will tell where to make certain connections and when to use various accessories which are part of the ME-545/G.

When first receiving the ME-545/G, start at the front of the manual and go all the way through to the back. Become familiar with every part of the manual and the ME-545/G.

This manual has an edge index which will help find specific information in a hurry. Simply spread the pages on the right edge of the manual until the printed blocks can be seen. Open the manual where the block on the edge of the page lines up with the selected topic printed on the front cover block.

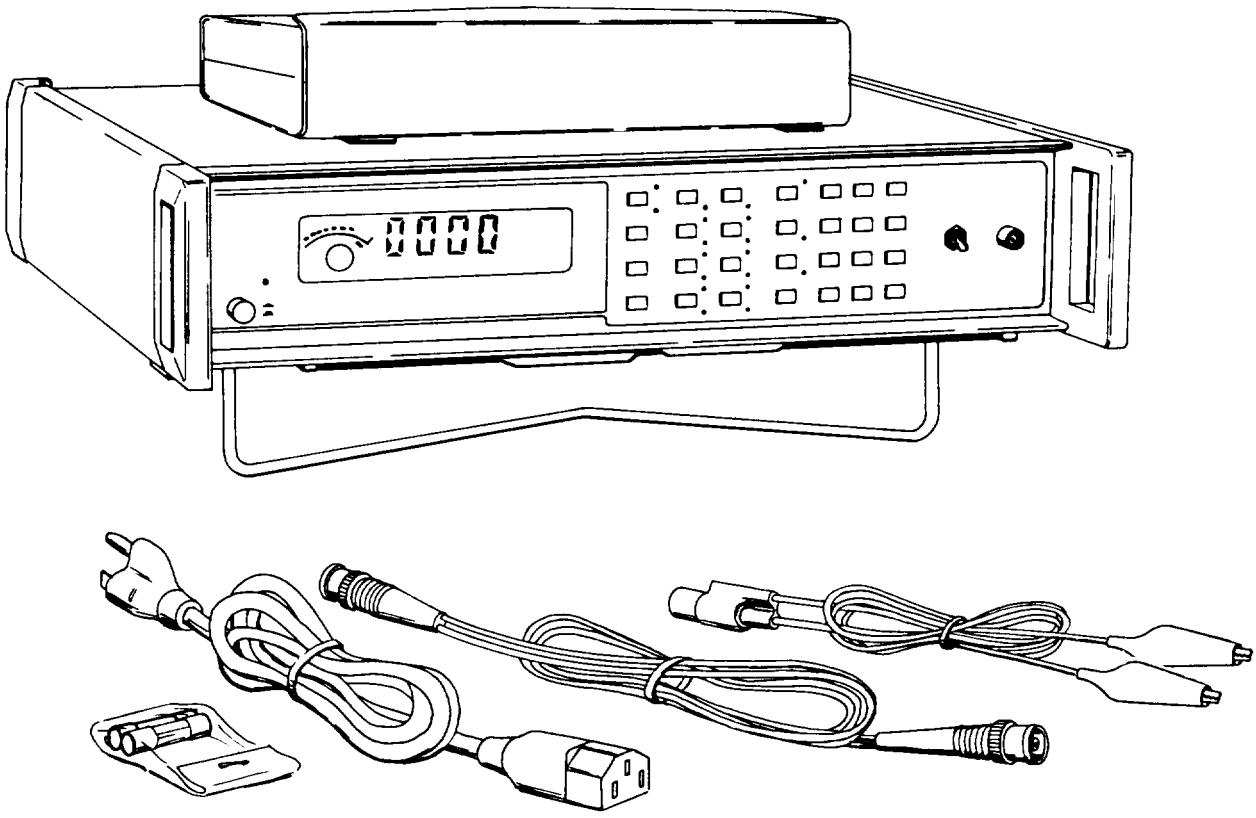

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Figure 1-1. Voltmeter ME-545/G.

CHAPTER 1
INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE.

a. *Type of Manual:* Operator's, Unit, and Intermediate Direct Support, and General Support Maintenance Manual.

b. *Equipment Name and Model Number:* Voltmeter ME-545/G.

c. *Purpose of Equipment: The* Voltmeter is designed to provide level measurements from 100µV to 316V at DC to 20 MHz.

1-2. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS.

Refer to the latest issue of DA Pam 25-30 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. 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 DA Pam 750-8 contained in the Army Maintenance Management System (TAMMS) Users Manual.

b. Reporting of Item and Packaging Discrepancies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55 SEC NAVINST 4355.18 AFR 400-54 MCO 4430.3J.

c. Transportation Discrepancy Report (TDR) (SF 361). Fill out and forward Transportation Discrepancy Report (TDR) (SF 361) as prescribed in DA Pam 25-30 NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D/DLAR 4500.15.

1-4. DESTRUCTION OF ARMY ELECTRONICS MATERIEL TO PREVENT ENEMY USE.

Destruction of Army materiel to prevent enemy use is described in TM 750-244-2.

1-5. PREPARATION FOR STORAGE OR SHIPMENT.

Preparation instructions for storage and shipment are found in Chapter 2, Section V.

1-6. SAFETY, CARE, AND HANDLING.

Observe all WARNINGS, CAUTIONS, and NOTES in this manual. This equipment can be extremely dangerous if these instructions are not followed.

1-7. NOMENCLATURE CROSS-REFERENCE LIST.

Common names will be used when the Voltmeter ME-545/G is mentioned in this manual.

NOTE

Official nomenclature must be used when filling out report forms or looking up technical manuals.

Common Name	*Official Nomenclature*
ME-545/G	Voltmeter ME-545/G
Voltmeter	Voltmeter ME-545/G

1-8. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your equipment needs improvement, let us know. Send us on 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 or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to: Commander, US Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NM, Redstone Arsenal, AL 35898-5000. We'll send you a reply.

1-9, WARRANTY INFORMATION.

The Voltmeter is warranted by Racal–Dana Instruments Incorporated for one year. Warranty starts on the date of shipment to the original buyer. Report all defects in material or workmanship to your supervisor who will take appropriate action.

1-10. LIST OF ABBREVIATIONS.

This list identifies abbreviations and descriptions that are used in this manual.

CF	Crest Factor
FF	Form Factor
GPIA	General Purpose Interface Adaptor
GPIB	General Purpose Interface Bus
I/P	Input
O/P	output
Or	Overrange
PIA	Peripheral Interface Adapter
SF	Special Function
Ur	Underrange

Section II. EQUIPMENT DESCRIPTION

1-11. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.

a. CHARACTERISTICS.

- Allows for measurement of:
  - True RMS voltages.
  - Mean AC and DC voltages.
  - Positive and negative peak voltages.
- Computes and displays:
  - Average or peak power.
  - Ratio of measured level to stored levels.
  - Difference (% or unit) of measured level and stored levels. Form and Crest factor.
  - Mean value scaled to RMS levels.
  - Peak-to-peak levels.
- Designed for bench top use.

b. CAPABILITtES AND FEATURES.

- Pushbutton control allows for easy operation of equipment.
- Indicator lights on front panel for constant operational status.
- Large 4 character liquid crystal display for:

  Measurement information.

  Data entry information.

  Error messages.

  Analog meter.

  Various display indicators.
- Twelve location non-volatile memory for saving front panel set-ups.
- Programmed interface for remote operation.

1-12. EQUIPMENT DATA.

WEIGHTS AND DIMENSIONS

Net Weight	14.9 lb (6.8 kg)
Shipping Weight	24.2 lb (11.0kg)
Depth	15.9 in. (403 mm)
Width	17.4 in. (440 mm)
Height	3.5 in. (89 mm)

POWER REQUIREMENTS

Voltage:

100Vac operation	90 to 110 Vac
120Vac operation	103 to 127Vac
220Vac operation	193 to 237Vac
240Vac operation	207 to 253Vac

Frequency	45 to 440Hz
Power	≈ 40 VA

Fuse Rating:

100/120Vac operation	0.50 amp, 250 volt
220/240Vac operation	0.25 amp, 250 volt

ENVIRONMENTAL

Operating temperature range	0 to +55° c
Operating temperature range for specified accuracy	+18 to +28° C
Storage temperature range	-40 to +75” c
Relative humidity	95% at +40° C

PERFORMANCE

Frequency Range:

True RMS	10 Hz to 20 MHz
Mean and peak	10 Hz to 10 MHz

Voltage Range:

True RMS	100µV to 316V
Mean and peak	1mV to 316V

Voltage Resolution:

<2mV	1µV
2mV to 20mV	10µV
20mV to 200mV	100µV
200mV to 2V	1mV
2V to 20V	10mV
20 Vto200V	100mV
>200V	1V

Voltage Measurement Accuracy (AC Coupled):

True RMS:

10 Hz to 50 Hz . . . . . ±5%
50 Hz to 100 kHz . . . . . ±37. (>lmV), ±5% (<1mV)
100 k Hz to 1 MHz *50/0
1 MHz to 10 MHz . . . . . ±10%
10 MHz to 20 MHz . . . . . *150/!

Mean . . . . . ±5% at 1kHz

Peak . . . . . ±5% at 1kHz

Voltage Measurement Accuracy (AC +DC Coupled): ..... better than twice AC coupled accuracy

Decibel Measurements:

Span . . . . . 130 dB
Resolution 0.01dB
dBm Reference Impedance . . . . . Select able from 0.001 Ω to 9999Ω

Power Range (computed):

True . . . . . 0.1 pW to 9 kW
Peak . . . . . 100 pW to 9 kW

Measurement Ranges . . . . . Fourteen, 100µV to 316V

Crest Factor:

316µV to 100V range . . . . . better than 4:1

Averaging Time . . . . . 0.1 to 99.9sec in 0.1 sec steps

Analog Settling Time . . . . . 2 sec

Response Time . . . . . <3 sec

Signal Input Connector:

Common Mode Voltage . . . . . 600mVp to 5.0Vp
Common Mode Rejection . . . . . >60dB to 400Hz
Filter . . . . . selectable, 200 kHz Low Pass (–3dB)
Isolation . . . . . selectable, chassis ground or isolated
Impedance . . . . . ≈IMQ

Capacitance:

316mV range and below . . . . . ≈65pF
1V range and above . . . . . ≈4opF

Maximum Input Level:

RMS:

316mV range and below . . . . . 5×10^7 V•Hz
IV range and above . . . . . 3×10^8 V•Hz

Mean and peak . . . . . <500V(Dc + peak AC)

Connector Type . . . . . BNC female

Analog Output Connector:

Voltage . . . . . 0 to 5Vdc
Connector Type . . . . . BNC female

Digital Interface:

Addresses 31
Subsets . . . . . SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, and C0
Type . . . . . IEEE Standard 488-1978

Section III. TECHNICAL PRINCIPLES OF OPERATION

1-13. GENERAL FUNCTIONAL DESCRIPTION.

The Voltmeter (fig. 1-2) measures true RMS, mean, and positive or negative peak voltages of input signals. Measurements of 100µV to 316V from DC to 20 MHz are possible. Display units shown as voltage or converted to power. Computed measurements include dB or dBm, voltage or power ratios, and voltage or power differences (in units or percent). All computed measurements use operator stored levels.

Signal measurement information, entry information, and error messages are shown in the display. Units indicators, analog meter, and instrument status indicators are also shown in the display. Various LED indicators provide additional operational status.

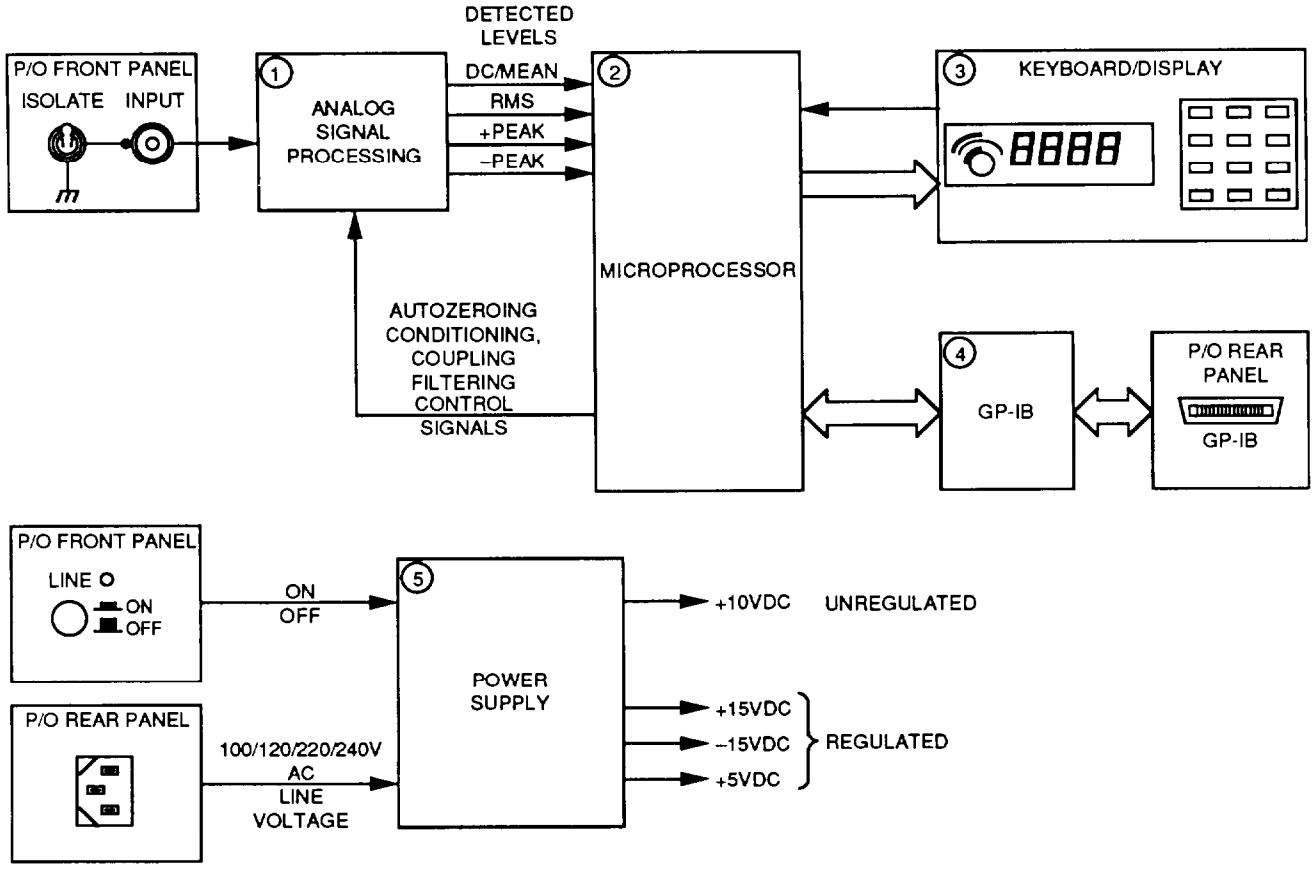

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Figure 1-2. Voltmeter ME-545/G Simplified Block Diagram.

(1) The Analog Signal Processing block processes input signals connected to front panel INPUT connector. The input signal is routed to five separate detectors (DC, RMS, + peak, – peak, and mean) to perform actual signal measurement. Detected outputs are sampled by Microprocessor block every 100msec for measurement display. The Analog Signal Processing block also provides the following functions under control of the Microprocessor block.

- Coupling (AC or AC+DC).
- Signal conditioning (amplification/attenuation).
- 200 kHz low pass filtering.
- Auto-zeroing (RMS and peak).

Input connector chassis ground isolation is also provided using the front panel switch.

(2) The Microprocessor block performs two separate functions.

- It processes measurement information. Detected levels from Analog Signal Processing block are processed based on the functions selected by Keyboard/Display block. Processing includes detector selection, digital conversion, averaging, math calculations, etc. Selected measurement information is then routed to the GP-IB block and Keyboard/Display block for display to the operator.
- It provides overall control of the internal circuitry in the Voltmeter. Data, control signals, and interrupts are sent to/received from all other blocks (except Power Supply) as required to perform all Voltmeter operations.

(3) The Keyboard/Display block performs two separate functions.

- It allows the Voltmeter to communicate with the operator. Measurement information, entry information, error messages, operational status, and instrument status are provided to the operator. Under control of the Microprocessor block, the four digit liquid crystal display with analog meter, and LED indicators display all operator information.
- It allows the operator to communicate with the Voltmeter. When one of 28 front panel keys are pressed, the information is processed and sent to the Microprocessor block for execution. Keyboard input allows the operator to enter new data values, select desired measurement modes, special functions, and display parameters.

(4) The GPIB block allows the Voltmeter to be operated remotely using an external controller connected to rear panel GPIB connector. All functions except LINE ON/OFF switch are programmable using the interface.

(5) The Power Supply block provides internal operating voltages for the Voltmeter. Fuse protection is provided on the rear panel. When front panel LINE ON/OFF switch is on, the following voltages are provided to all blocks for operation.

- Regulated +5Vdc, +15Vdc, and –15Vdc,
- Unregulated ±10 Vdc.

1-14. DETAILED FUNCTIONAL DESCRIPTION (FIG FO-1).

(1) ANALOG SIGNAL PROCESSING (Fig 1-3). This block contains all the circuits to process the input signal, and provide measurement information to the Microprocessor block for display. This block is contained on the following circuit card assemblies:

ž A2 Detector Assembly (Fig FO-3).

- A3 Amplifier Assembly (Fig FO-4).
- Front panel components.

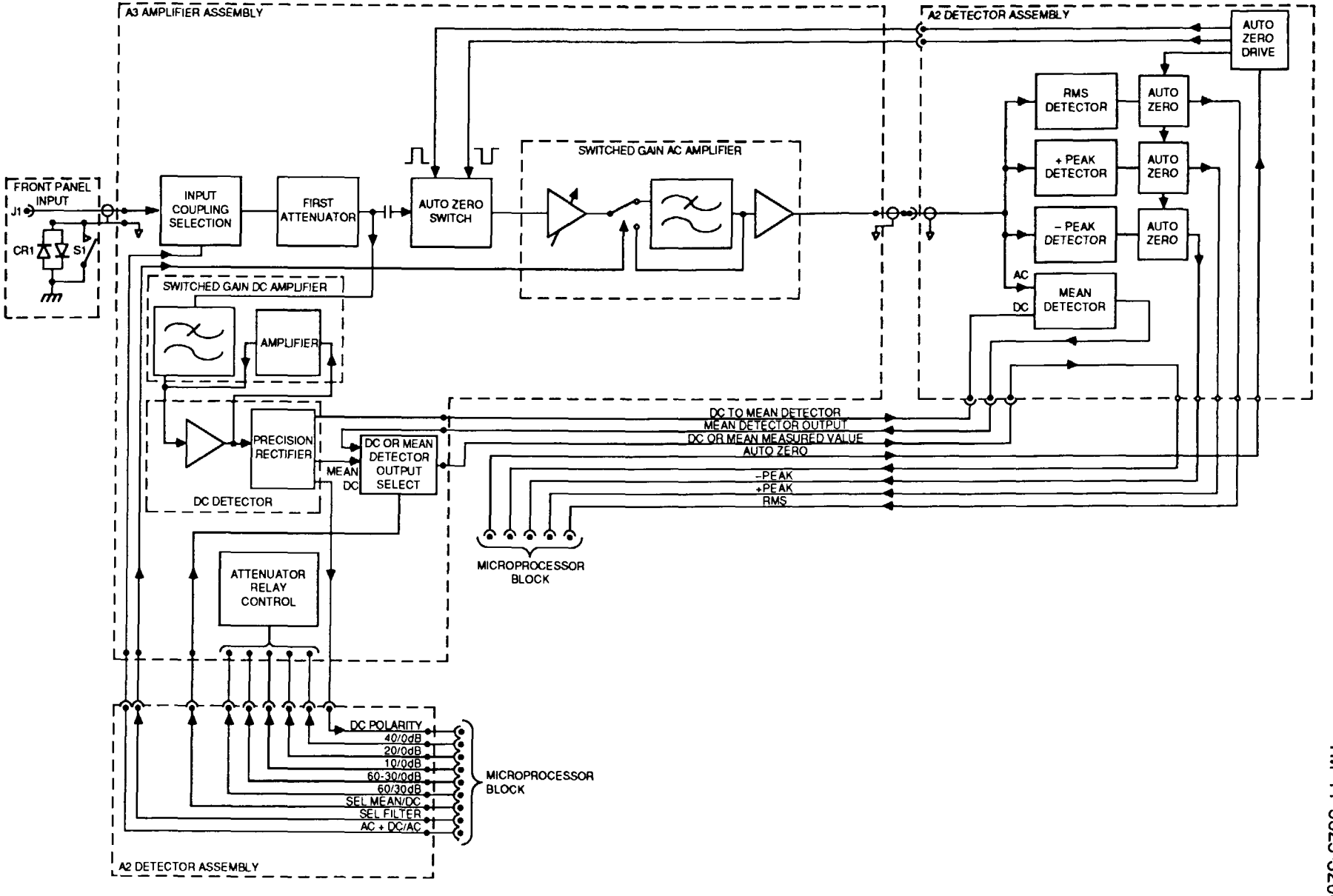

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Figure 1-3. Analog Signal Processing Block Diagram.

The Analog Signal Processing block can be divided into the following major circuits:

- Input.
- input Coupling Selection.
- First Attenuator.
- Auto-Zero Switch.
- Switched Gain AC Amplifier.
- Switched Gain DC Amplifier.
- Attenuator Relay Control.
- DC Detector.
- RMS Detector.
- Peak Detectors.
- Auto Zero Drive.
- Mean Detector.
- DC or Mean Detector Output Selection.

Input. J1 INPUT connector body is connected to signal ground, but isolated from chassis ground by diode bridge CR1. J1 INPUT connector body can be connected to chassis ground using ISOLATE switch S1. The input signal is applied to A3R1.

Input Coupling Selection. Provides AC or AC+DC coupling as selected by the front panel. Relay state is controlled by the Microprocessor block using logic level set on AC+DC/AC control line P11 pin 13. Coupling is selected as follows:

- When AC+DC coupling selected, A3U3 pin 11 is set logic 1. A3U3 then energizes A3KA and the input signal is DC coupled to the measuring circuits. A3R2 limits current surge in A3KA which occurs when the contacts are closed with A3C1 charged.
- When AC coupling selected, A3KA is de-energized and the input signal is AC coupled to measuring circuits using A3C1.

First Attenuator. Provides attenuation of 0, 30, or 60 dB according to the range selected. Relay states are controlled by the Microprocessor block using logic levels set on the 60-30/OdB and 60/30dB control lines (P11 pins 14 and 18). Attenuation is provided as follows:

- When input range is 100µV to 316mV, A3U3 pins 9 and 10 are set logic 0. A3KC is energized and the input signal is attenuated by 0dB. When input range is 1V to 10V, A3U3 pin 9 is set logic 0 and pin 10 is set logic 1. A3KC is de-energized. A3KB and KD are energized, and the input signal is attenuated by 30dB. When input range is 31V to 316V, A3U3 pins 9 and 10 are logic 1. A3KD is de-energized. A3KB and KE are energized, and the input signal is attenuated by 60dB.

A3C5 and C6 allow adjustment of high frequency attenuation. A3Q1 and Q2 provide protection against excessive voltage levels. A3Q11 switches A3KB.

Auto-Zero Switch. Opens the input signal line during auto-zero. The attenuated input signal is passed to the Switched Gain AC Amplifier circuit through A3C13 and A3U1. A3U1 opens during auto-zero. This reduces both the input signal and any circuit noise introduced from J1 to A3U1 to zero. A3U2 is driven out of phase with A3U1 to increase noise cancellation. A3C14 and A3R17 form an equivalent noise source.

Switched Gain AC Amplifiers. Used in AC signal path for the RMS, +peak, -peak, and mean detectors. Provides approximately 0 to 70 dB gain according to the range selected using four feedback amplifier stages. The input signal is routed through buffer A3Q3 and Q4.

The first three amplifier stages A3U5, U6, and U7 are preceded by switchable 20 dB attenuators (A3R27-30, R37-40, and R46-47). Operation of the first three stages is identical except A3C33, C36, R45, and R48 provide frequency response adjustment on the third stage. A3Q5 switches A3KF.

The fourth amplifier stage A3Q9 and Q10 is preceded by a switchable 10 dB attenuator (A3R54, 56-58). This stage contains a selectable low-pass filter. When filter is selected, A3Q7 is cut off, A3Q8 conducts, and the filter formed by A3C43 and FX1 is inserted into the amplifier circuit.

Relays A3KF-KK switch the attenuators to provide from 0 to 70dB of attenuation (70-0dB gain). Relay states are controlled by the Microprocessor block using logic levels set on the 40/0dB, 20/0dB and 10/0dB control lines (P11 pins 10, 9, and 12). Filter state is controlled by the Microprocessor block using logic level set on the SEL FILTER control line (P11 pin 2).

Switched Gain DC Amplifiers. Used in DC signal path for the DC Detector. Provides approximately 0 to 70 dB gain according to the range selected using one feedback amplifier. The input signal is routed through low pass filter A3C52 and R15 which provides the filtered mean of the input signal.

A3U4 is connected as a feedback amplifier using switched attenuators of 40 dB, 20 dB and 10 dB in the feedback path. Gain is reduced by switching the attenuators out.

A3KK and KL switch the 10 and 20 dB attenuators. A3Q12 and Q13 switch the 40dB attenuator. Relay states are controlled by the Microprocessor block using logic levels set on the 40/0 dB, 20/0 dB and 10/0 dB control lines (P11 pins 10, 9, and 12). A3KK is energized by A3U7. A3KL is energized by A3U6. A3R66 corrects any offset at the input to A3U4. A3U9 controls A3Q12 and Q13 as follows.

- With 40/0 dB control line (P11 pin 10) set logic 0, A3U9 pins 9 and 10 are set to +15 V (A3KG). A3U9 pin 15 is +15 V (A3U9 pin 1), while A3U9 pin 4 is connected to the junction of A3R91 and section of R90 (A3U9 pin 3). A3Q12 is switched on and A3Q13 switched off.
- With 40/0 dB control line set logic 1, A3U9 pin 9 and 10 are pulled down by A3U5. This connects A3U9 pin 4 to +15 V (A3U9 pin 5) and A3U9 pin 15 to the A3R90 and R91 junction (A3U9 pin 2). A3Q13 is switched on and A3Q12 switched off.

Attenuator Relay Control Circuit. Provides selection of attenuation/gain in the First Attenuator, Switched Gain AC Amplifier, and Switched Gain DC Amplifier circuits.

First Attenuator: A3U3 controls A3KB-KE to provide attenuation of 0, 30, or 60 dB. Microprocessor controlled using the 60-30/OdB and 60/30dB control lines (P11 pins 14 and 18).

Switched Gain AC Amplifier: Relays A3KF-KK provide from 0 to approximately 70dB of attenuation (70-0dB gain). Microprocessor controlled using the 40/0dB, 20/0dB and 10/0 dB control lines (P11 pins 10, 9, and 12).

Switched Gain DC Amplifier: Relays A3KK-KL and transistors A3Q12-13 provide from 0 to approximately 70dB of attenuation (70-OdB gain). Microprocessor controlled using the 40/0 dB, 20/0 dB and 10/0 dB control lines (P11 pins 10, 9, and 12).

DC Detector. Provides three outputs for use in measuring the DC component of the input signal.

MEAN DC. A DC output proportional to the filtered mean of the signal applied to the detector. Used as the measured value when the MEAN measurement function is selected with AC+DC input coupling. The output from A3U4 pin 10 is fed to precision rectifier (A3U8a and b, and A3Q14). The output at A3U8b pin 7 is always positive, and proportional to the level of the detector input.

- When A3U4 pin 10 is positive, A3U8a pin 1 will be negative and A3Q14 will cut off. A3U4 pin 10 output is also applied to A3U8b pins 5 and 6, and the amplifier has a net gain of +5.
- When A3U4 pin 10 is negative, A3U8a pin 1 allows A3Q14 to conduct holding A3U8b pin 5 at 0 volts. Input to A3U8b is through A3R84, and the net gain is –5.

A3R88 provides adjustment of the output level. A3R80 corrects any offset at the input of A3U8b.

DC POLARITY: An output indicating the polarity of MEAN DC. A3U8a pin 1 switches A3Q15 to provide the DC detector input polarity indication.

- For positive inputs A3Q15 is cut off and the polarity indication line is set logic 1 by A2R79.
- For negative inputs A3Q15 conducts, clamping the line to 0V (logic 0).

DC TO MEAN DETECTOR: An output similar to MEAN DC but at a lower level. Provides the input to the Mean Detector circuit. A3U4 pin 10 is routed to the Mean Detector circuit (P11 pin 15).

RMS Detector. Provides a DC output proportional to the input signal AC component true RMS level. The circuit uses a feedback loop containing a differential multiplier, an integrator, and an amplifier. It also uses an auto-zeroing circuit to cancel out noise, and the effects of the multiplier input offsets. The input signal is provided from the Switched Gain AC Amplifier circuit (J7).

Multiplier A2U2 and multiplier linear rising network (A2U3) are specially selected to obtain the required degree of matching. The base/emitter diodes of these microcircuits form the loads for the input currents from A2U1 pins 8 and 14. This provides an exponential relationship between the input currents and the voltages applied to the multiplier A2U2 pins 4, 9, 2 and 6 to offset similar non-linearities in A2U2.

The multiplier input is driven by A2U1. A2U1 is connected to A2Q3 and Q4 to form two long-tailed-pair differential amplifiers. Both the transistors and microcircuit are specially selected to obtain the required degree of matching.

A2CR1 and CR2 compensate for non-linearity when measuring signals of high crest factor as follows:

- As the differential signal at the amplifier inputs becomes large, A2Q3 and Q4 are driven close to cut off at the signal peaks. A2CR1 and CR2 conduct when the differential signal is large to reduce the emitter coupling resistor value and increase the amplifier gain.

The differential output of multiplier A2U2 is routed to A2U4d. A2Q7 and Q8 are held in the conducting state, while A2Q10 is held in the high impedance state. Feedback is applied to A2U4d pin 13 through A2C12, and the circuit acts as an integrating amplifier. The voltage at A2TP7 is proportional to the mean level of the multiplier output, and to the true RMS value of the measured signal.

The output of A2U4b is fed back to the input of the multiplier at A2U1 pins 2 and 12 as follows:

- For positive voltage, through A2R25 and R33.
- For negative voltage, through A2U4a, Q5, Q6, R24, and R28. Switched at 20 Hz by Q5 and Q6.

A2U4a gain is set to 0.665 by A2R34 and R36. Ratios R28/R33 and R24/R25 are chosen to make the negative signal from A2U4a twice the positive signal. This provides total feedback signals at A2U1 pins 2 and 12 that are equal amplitude but opposite sign. Feedback switching circuit is driven by clock circuit A2U5b.

RMS Detector Sample and Hold is provided as follows:

- A2Q11 in the low impedance state charges A2C16 to the voltage at A2TP9. This voltage is provided to the Microprocessor block through A2U4b,
- During the auto-zeroing period A2Q11 is set in the high impedance state, and output voltage is maintained at the level held in A2C16.

A2R45 controls RMS Detector output by adjusting the gain of A2U4b.

***PEAK* Detectors.** Two separate detectors provide DC outputs proportional to the input signal AC component positive and negative peak level. The circuit uses a feedback loop containing a differential multiplier, an integrator, and an amplifier. The feedback loop acts as a unidirectional voltage tracking circuit. Because of signal inversion in the Switched Gain AC Amplifier circuit, the negative peak detector is used to measure the positive peak of the waveform, and the positive peak detector is used to measure the negative peak of the waveform . It also uses an auto-zeroing circuit to cancel out noise. The input signal is provided from the Switched Gain AC Amplifier circuit (J7).

Both + and – PEAK detector inputs are routed through A2C32 and filter circuit (A2R81, R135, R138, C43, and C46) to provide HF boost.

Negative peak detector operation is performed as follows:

- When comparator input at A2U1 1 is more positive than the inverter output at A2U13a pin 1, reservoir capacitor A2C35 charges more negative with respect to 0 V, making the inverter output more positive.
- Charging continues until feedback reduces the comparator differential input to zero, indicating the output voltage tracks the input voltage.
- Any time the signal input at A2U11 pin 2 goes less positive than the feedback at A2U11 pin 3, the comparator output at A2U11 pins 5 and 6 goes positive and diode A2Q14 is reverse biased.
- The measured peak value is held in reservoir capacitor A2C35, so that voltage tracking occurs in one direction only.
- At the end of each measurement cycle a, positive pulse occurs on P11 pin 2 (PEAK DISCHARGE control) from Microprocessor block. This signal switches A2Q16 on and FET switch A2Q15 conducts discharging reservoir capacitor A2C35.

Differential amplifiers A2Q12 and Q13 convert the comparator outputs to unipolar form. A2U13b amplifies the voltage stored in reservoir capacitor A2C35 by approximately four. The inverted signal at A2U13a pin 1 is amplified by a factor of two using A2U15a.

Positive peak detector operation is identical to negative peak detector, except the signal input and feedback connections to the comparator are reversed. This causes reservoir capacitor A2C41 to be charged more negative when the comparator input at A2U12 is more negative than the feedback voltage. The polarity of the feedback is reversed by taking it from the input to the inverter A2U14a. The positive peak detector output is still taken from the inverter output, so that both detectors have positive going outputs.

A2R83 and R111 provide adjustment of the feedback path attenuation.

Auto Zero Drive. Provides auto-zeroing for RMS and Peak Detector circuits.

Every 500 ms an auto-zeroing cycle is performed. The cycle lasts 1 ms. During this cycle, the measured signal input is reduced to zero, and the residual signal at the output of the amplifier (A2U4d, U15a, or U16a) is used to generate a correction voltage. This correction voltage is stored, and during the next measurement cycle, is injected into the feedback loop of the RMS or Peak detectors, canceling the zero error.

RMS Auto-zeroing is performed as follows:

- AUTO ZERO drive signal from the Microprocessor block is applied to two comparators (A2U5C and d). The outputs at A2TP11 and TP14 are 180° out of phase. A2TP11 is low during measurement and high during auto-zeroing.
- The 180° out of phase signals-from A2TP11 and TP14 are routed to the input to the Auto-Zero Switch circuit to disconnect the input signal. A2CR4 prevents lock-up without an input signal to the RMS detector by becoming reverse biased if the voltage at A2TP7 is negative.
- The negative signal at A2TP14 is applied to A2Q8 and Q7 through A2CR7 and breaks the normal feedback path for A2U4d.

- The positive signal at A2TP11 allows A2Q10 to go to the conducting state. This connects the residual loop output, which exists at A2U4d pin 14, to the integrator A2U4c. The output of A2U4c is applied to A2U4d pin 12, providing an input which drives the loop output to 0V.
- At the end of the auto-zeroing period the circuit is reset to the measurement mode. The input of A2U4c is disconnected from the signal path as A2Q10 returns to the high impedance state, but the zero error correction voltage at A2TP10 remains connected to the input of A2U4d. This maintains the zero correction during the following measurement period.

Negative Peak Detector auto-zeroing is performed **as** follows:

- AUTO ZERO drive signal from the Microprocessor block causes A2Q17 to conduct. Any residual signal at A2TP32 is applied to integrator A2U15b. The integrator output A2U15b pin 7 ramps up or down and injects a signal to A2U15a pin 3 to drive A2TP32 to o v.
- At the end of the auto-zeroing cycle the circuit is reset to the measurement mode. A2Q17 returns to the non-conducting state, but the zero error correction voltage at A2U15b pin 7 is maintained during the following measurement cycle. A2R107 provides zero error correction voltage adjustment.

Positive Peak Detector auto-zeroing is identical to negative peak detector auto-zeroing operation.

Mean Detector. Provides a DC output proportional to the rectified mean of the sum of:

- The AC component of the measured signal. The input signal for this measurement is provided from the Switched Gain AC Amplifier circuit (J7),
- A DC level, generated in the DC detector, proportional to the DC component of the measured signal. The input signal for this measurement is provided from the DC Detector circuit P11 pin 15.

When AC coupling is selected:

- The DC input to the mean detector is held at zero by A2Q2 under control of the Microprocessor block.

When AC+ Decoupling is selected:

- The outputs of the crossing detector A2U6 change level whenever the AC input at A2U6 pin 2 crosses the DC input level at A2U6 pin 3. These outputs form the switching signals applied to balanced modulator A2U9 pins 7 and 8.
- In one state, the AC input at A2U9 pin 1 is routed to A2U9 pin 9 (inverted) and to A2U9 pin 6 (non-inverted). For the other state the routing is reversed.
- Signal path switching occurs when the AC and DC signals (A2U9 pins 6 and 9) are at the same voltage. The difference between the outputs is the same as the measured signal with those parts of the waveform below 0V inverted, so that the system operates as a precision rectifier. The mean value of the difference waveform is the rectified mean value required.
- The outputs of A2U9 are filtered by A2C20 and C22 to obtain the mean values, and applied to the differential inputs of integrator A2U10. A2U10 pin 2 is an inverting input so the output is positive.

A2R49 adjusts the DC level applied to A2U9. A2R60 nulls the offsets in A2U6. A2R56 and R65 adjust balance and CAL of A2U9. A2R78 allows the mean DC level of A2U9 to be set.

DC or Mean Detector Output Selection. Provides selection of the Mean Detector or DC Detector for measurement by the Microprocessor block. The output of the Mean Detector is applied to multiplexer A3U9 pin 13. The output of the DC Detector is applied to multiplexer A3U9 pin 12. The output of A3U9 pin 14 will be the DC Detector output if AC+DC input coupling is in use, and the Mean Detector output if AC input coupling (or special function 50.1 is used). Output at A3U9 pin 14 is passed to the Microprocessor block, P4 pin 8.

(2) MICROPROCESSOR (Fig 1-4). This block performs digital signal processing and overall Voltmeter control.

The digital processing function includes the following:

- Conversion of the detector outputs to digital form, and storing the digitized measurements.
- Averaging a number of measurements, or selecting the greatest measurement, made in a time interval stored in AVERAGE.
- Arithmetic processing in accordance with the measurement functions selected by the operator.
- Conversion of the processed data into a serial data string for the Keyboard/Display block.
- Conversion of the processed data into the 12-byte data word for the GPIB.
- Transmission of the serial data string to the display, and clock pulses for display shift registers.

The Voltmeter control function includes the following:

- Acceptance of control instructions from the Keyboard/Display or the GPIB blocks.
- Acceptance and storage of numerical data from the Keyboard/Display or the GPIB blocks.
- Setting the attenuator control line logic levels.
- Setting the low pass filter selection line logic level.
- Setting the input coupling selection line logic level.
- Providing the auto-zero system timing pulses.
- Providing the peak detector discharge pulses.

This block is contained on the following circuit card assembly:

- Al Processor Assembly (Fig FO-2).

The Microprocessor block can be divided into the following major circuits:

- Select Detector Output.
- Analog to Digital Converter.
- 100Hz Clock.
- Measured Signal PIA.
- Digital Data Processing.
- Control PIA.
- Chip Select.

Detector Output Selectlon. Selects ail four detector outputs (RMS, +Peak, –Peak, DC or Mean), in turn, for conversion. Detector inputs at J15 pins 13, 14, 16 and 18 pass to the quad bilateral switch A1U8. The microprocessor A1U30 instructs A1U11 to select each detected level at A1U8 every 20ms. This routes each detector output in turn to the Analog to Digital Converter A1U9.

Analog to Digital Conversion. The detector output signals from A1U8 are converted to 3 1/2 digits of BCD on 13 output lines at A1U9. The converted signal is sent to A1U12 pins 2 to 14. Additional signals from A1U9 include:

- Signal to A1U12 pins 16, 17, and 18 indicates the conversion cycle is completed,
- Signal to AIU12 pin 15 indicates that the converted output data is valid.

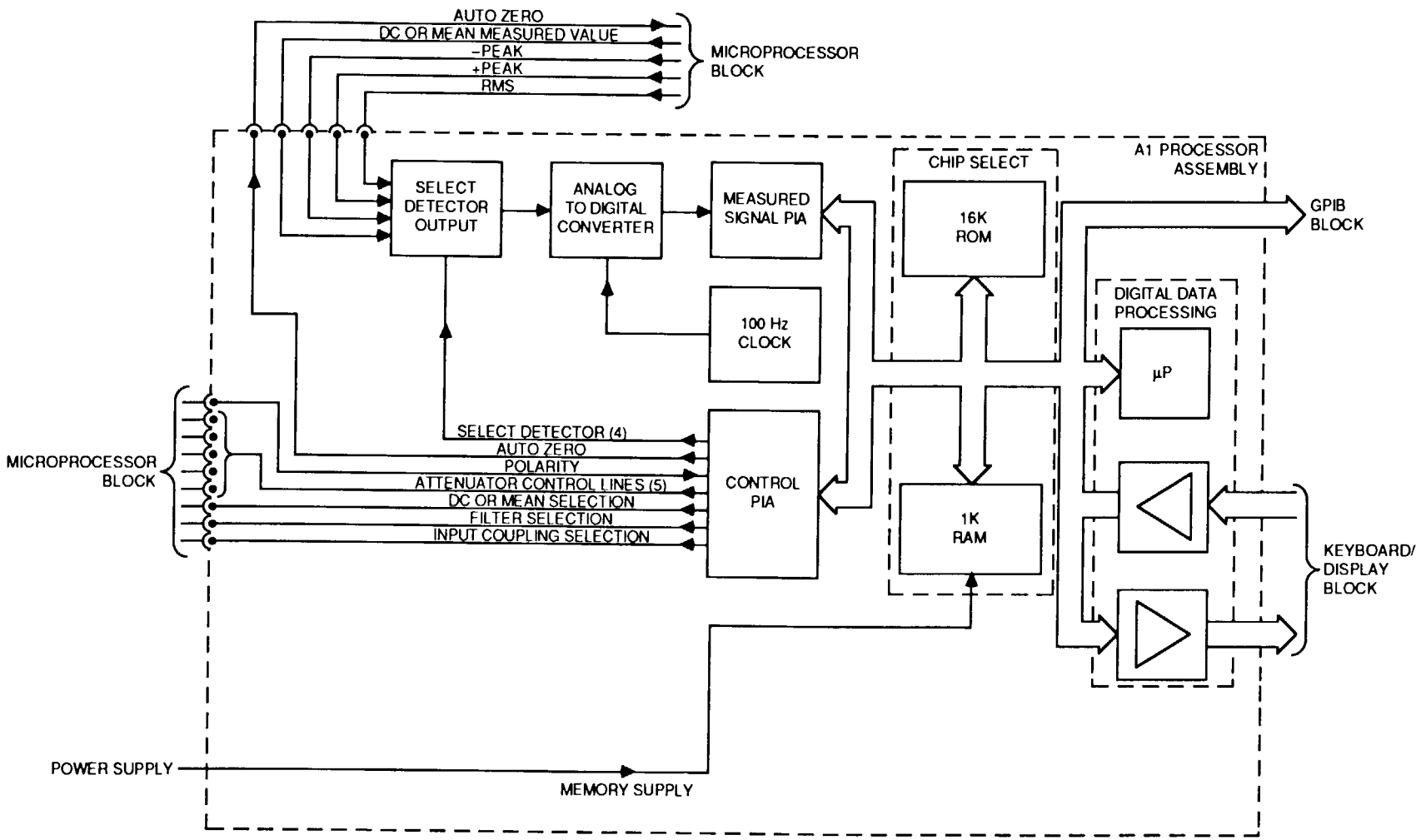

Figure 1-4. Microprocessor Block Diagram.

A1CR14 and CR15 provide positive and negative supply voltages for A1U9. A1R15 adjusts the reference current at A1U9 pin 13.

100Hz Clock. Astable circuit at A1U3 pin 14 drives a monstable circuit in A1U14. The output pulses at A1U14 pin 5 are sent to A1U9 pin 21. A1R9 and C7 control output pulse duration.

Measured Signal PIA. The digital data output from A1U9 is sent to the data-in registers of the Measured Signal PIA A1U12, At the end of each A1U9 Analog-to-Digital conversion cycle:

- A1U12 pin 18 is set logic 0.
- IRQ signal generated at A1U12 pin 37.

Microprocessor A1U30 establishes that Measured Signal PIA A1U12 was the source of the interrupt, and then reads the data.

Digital Data Processing. Digital data processing is performed by the Microprocessor A1U30 in accordance with instructions stored in memory. Averaging is performed when RMS, Mean or DC detectors are selected. If selected, the numeric values stored in memory (%, Ω, ratio, null, dB) are used to perform computed measurement functions.

Microprocessor A1U30 is interrupt controlled. Interrupt requests are generated:

- Every 100ms by the Measured Signal PIA circuit.
- Every selection of a key in the Keyboard/Display block.
- Every data byte received or transmitted by the GPIB block.

Data elements are processed as follows:

- Serial Data Output to the Display. A 96-bit data string is used to update the display. This contains the numeric value along with non-numeric data items to be displayed. The data string is fed to the display on Microprocessor data line DO using A1U36 and U33.

  A series of 96 clock pulses is sent in sync with the 96-bit data string. 32 pulses are directed to each of the display clock lines (A1U33 pins 2, 12, and 4). The clock pulses are sent to the correct lines by address lines A0, Al and A2 using A1U32. A1U32 is enabled by the Chip Select circuit setting the logic level at A1U32 pin 4.

- Parallel Data Output to GPIB block. After the display has been updated, the measured value is converted to nine data bytes of the GPIB interface output word. The exponent indicator byte, CR, and LF terminating bytes are incorporated to complete the 12 byte output word. The first byte is passed to the data-out register of General Purpose Interface Adaptor (GPIA) A5U2.

  When the first data byte has been read, GPIA chip A5U2 generates an interrupt request. The Microprocessor A1U30 then transfers another byte. The process is repeated until the final byte has been transferred.

- Data Input from GPIB block. When a byte has been written from the bus into the data-in register of GPIA A5U2, an interrupt request is generated. The Microprocessor AIU30 establishes the reason for the interrupt and the data is read.

  After the first byte has been read, GPIA A5U2 is able to send another byte. The process is repeated until no further data is available.

- Data Input from the Keyboard. Each operation of a key generates an interrupt request. The Microprocessor AIU30 establishes the keyboard as being the source of the interrupt. A data byte determined by the key selected is stored, and the IRQ line is reset.

  The interrupt request signal is generated by A1U27 and U31. The key row lines are normally set logic 0 by A1U37. The column lines are set logic 1 by A1R30. The selection of a key pulls one on the column lines to logic 0, A1U27 pin 8 is set logic 1, and clocks A1U31 logic 0. This output, buffered by A1U33, forms the IRQ signal at A1U33 pin 8.

A1U28 pins 1 and 19 are set logic 0. A1U37 pins 2, 5, 9 and 12 are set logic 1 by the Chip Select circuit. Both devices are then in the enabled state. The address lines A0, A1, A2 and A3 are set logic 1, and then used to set each keyboard row line to logic O using A1U37. When a key is selected, the row and column line for that key will set logic 0, The corresponding output of A1U28 will go to logic 1, providing a data byte on the bus which is unique to the selected key. This byte is transferred into the Microprocessor A1U30.

When the byte from the key has been read, the interrupt request is cleared by a logic O set to A1U31 pin 1 from the Chip Select circuit.

The LED indicator associated with the selected key lights immediately the data input occurs. The digits associated with a numerical data input are displayed as the bytes are stored.

Control PIA. The logic levels for all the control lines external to the Microprocessor block are set by transferring data into the data-out register of A1U11. The logic levels in this register are put onto the control lines using the peripheral data bus ports. The levels remain set when A1U11 is deselected at the completion of the data transfer. Control is provided for:

- Detector selection (4 lines).
- Auto-zero control.
- Attenuator control (5 lines).
- DC or Mean detector output selection.
- Low-pass filter control.
- Input coupling selection.

Attenuator control lines, auto-zero, and DC/mean detector output selection signal are buffered by A1U5 and U6.

The DC POLARITY signal generated in the Analog Signal Processing block DC Detector circuit is read by the Microprocessor A1U30 every 100 ms using AI U11.

Chip Select. The logic levels within the Microprocessor block are generated by A1U25, U26 and U34. The valid memory address (VMA) line from Microprocessor A1U30 pin 5 is used to enable A1U25 whenever chip selection is required.

The ROM enabling signals (logic O level) are set from A1U25 pins 7, 9, 10 and 11. These levels are set according to the logic levels applied to A1U25 pins 1, 2 and 3 by address lines A12, A13 and A14. For all other chip enabling signals these address lines are set to give a logic 0 at A1U25 pin 15, to enable A1U26.

When A1U26 is enabled, an output is generated according to the logic levels set on address lines A10, A9 and A8.

- A1U26 pin 4, RAM selection signal (M). When the RAM is selected the NMI line sets A1U15 pin 11 to logic 0. The RAM is then enabled by the E signal from A1U13 pin 2.
- A1U26 pin 12, keyboard servicing enable for A1U28 and U37.
- A1U26 pin 11, display clock enable (OPE) for Al U32.
- A1U26 pin 9, enables A1U22 or U29.
- A1U26 pin 10, enables A1U34. When enabled, A1U34 generates the enabling signal for PIA's A1U11 and A1U12, or for GPIA A5U2, according to the logic levels set on address lines A6, AS and A4.

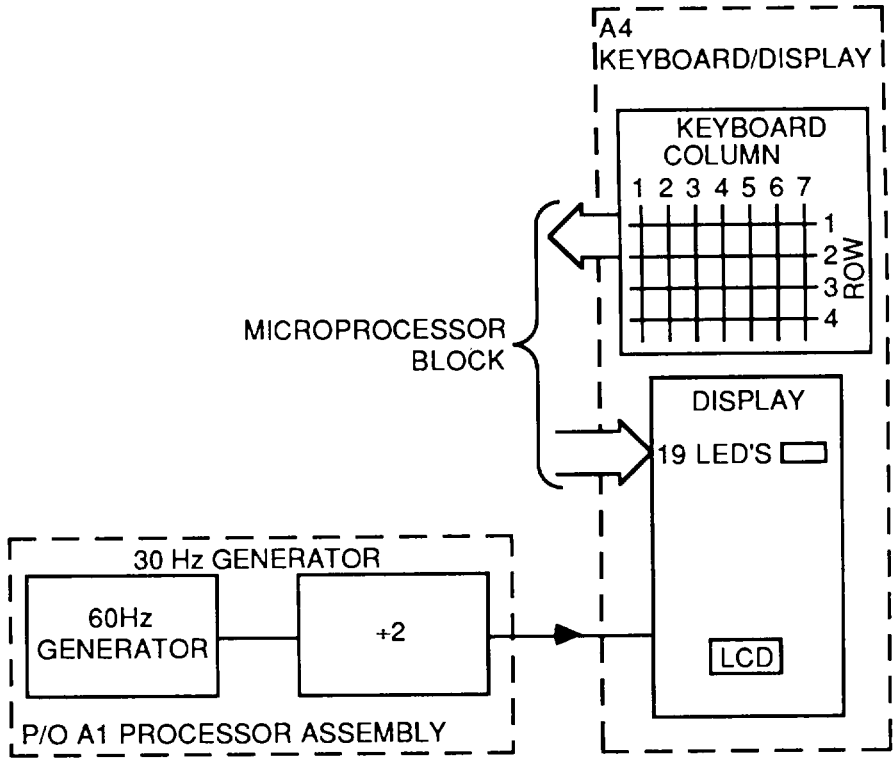

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Figure 1-5. Keyboard/Display Block Diagram.

3 KEY BOARD/DISPLAY (Fig 1-5). This block contains all the circuits to allow the operator to control measurement functions, and to display measurement results. This block is comprised of a 7 x 4-line keyboard, a liquid crystal display (LCD) and a number of light emitting diode (LED) indicators. Although the LED indicators are related to particular keys, all connection between the keyboard and the display is via the Microprocessor block. This block is contained on the following circuit card assemblies:

- A1 Processor Assembly (Fig FO-2).
- A4 Keyboard/Display Assembly (Fig FO-5).

The Keyboard/Display block can be divided into the following major circuits:

- Keyboard.
- 30Hz Generator.
- LCD Display.
- LED Indicator.

Keyboard. Formed by a 7 x 4-line matrix used to give instructions to the Microprocessor block, or to enter stored values for digital signal processing. Each key operation generates an interrupt request, and is serviced individually by the Microprocessor block.

When the numeric keys are selected, the data is stored and displayed, but the Voltmeter continues to make measurements. The display will continue to show the numeric entry until the Voltmeter is returned to the measurement mode.

The keyboard switches are mechanical push-operated type. When the microprocessor is not servicing the keyboard, all four row lines at P3 pins 7, 8, 11 and 12, are set logic 0. The seven column lines at P3 pins 13 to 19 are set logic 1.

Closure of any switch will result in the selected column line being set logic 0. This generates an IRQ for the Microprocessor block.

30Hz Generator. A 30 Hz switching waveform is required for Liquid Crystal Display (LCD) operation. The signal is generated by A1U3 and U31.

LCD Display. Display is constantly updated to show the operator measurement information, the stored values, error codes, and numeric entries.

The LCD has 79 segments. The information to be displayed is sent from the Microprocessor block in the form of a 96-bit data string. This is applied to the data input pins of shift registers A4U1, U2 and U3, in parallel. The waveforms on three clock lines P3 pins 20, 21 and 10 are controlled by the Microprocessor block so that 32 bits of the data string are clocked into each register.

All the shift register outputs are switched between logic 0 and logic 1 at 30 Hz by the signal applied to each register at pin 1. Shift register outputs loaded with logic 0 from the 96-bit data string change level are in phase with the signal at pin 1, while those loaded with logic 1 are 180° out of phase.

The back plane of the LCD is driven from A4U2 pin 36 through A4R1. The display segments are driven from the remaining shift register outputs. Those segments driven 180° out of phase to A4U2 pin 36 will be darker.

LED Indlcators. All LED indicators, except LINE, are controlled by shift registers A4U4, U5 and U6. The LED will light when the associated shift register output is held logic 0. The LINE indicator DS1 lights whenever +5 V is available.

When a change is required, data strings are generated in the Microprocessor block, and applied to A4U4, US, and U6 pin 1 in parallel. The clock line waveforms, generated in the Microprocessor block, are applied to A4U4, U5, and U6 pin 8 to clock the data into the appropriate register.

(4) GPIB (Fig 1-6). This block allows remote operation of the Voltmeter using an external controller.

The following functions are carried out by the GPIB block without involvement of the Microprocessor block:

- Distinguishing between universal and addressed commands occurring on the bus.
- Talk and listen address recognition.
- Generation of the signals required by the handshake protocol.

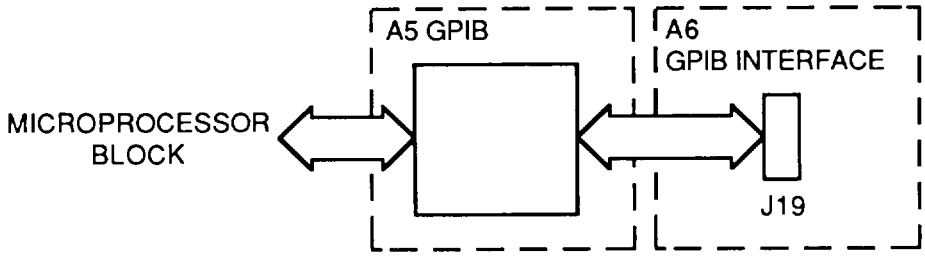

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Figure 1-6. GPIB Block Diagram.

The interface passes device dependent data, and certain universal bus commands, between the bus and the Microprocessor block. An interrupt is generated for each of the following situations:

- A device dependent data byte is held in the data-in register for the Microprocessor to read.
- The last data byte loaded into the data-out register has been read by the bus.
- DCL or SDC received.
- GET received.
- SPE or SPD received.
- Instruction to change remote/local status (RLC) received. REN message received false, GTL command received when in the remote control mode, or REN and the listen address received when in the local control mode.

The GPIB block is contained on the following circuit card assemblies:

- A5 GPIB Assembly (Fig FO-6).
- A6 GPIB Interface Assembly (Fig FO-6).

The GPIB block performs the following functions:

- Address Setting and Recognition,
- Listener Operation.
- Talker Operation.
- Serial Poll Disable Message.

Address Setting and Recognition. The address set on the rear panel switch is read by the Microprocessor block and written into the GPIA address register every 10 ms. When the interface address is set on the bus by the external Controller, it is recognized by General Purpose Interface Adaptor (GPIA) A5U2, as being the same as the contents of an internal address register,

The Microprocessor uses the rear panel address switch as an addressable register within the GPIA, When the GPIA receives the address it responds by generating an enable signal (A SE) at A5U2 pin 4. This enables A5U12, sending the logic levels set by the address switch onto the data bus.

Listener Operation. When the interface is addressed as listen, GPIA conducts the handshake procedure up to the point where the ready for data (RFD) indication is given. At this point A5U2 pin 27 is logic 0. This sets the data bus buffers in A5U3 and U13 to the receive condition. Data from the bus enters the GPIA data-in register, and an interrupt request is generated by A5U2 pin 40 going to logic 0. This puts A5U18 pin 8 to logic 1 and enables A5U9C, setting the Microprocessor IRQ line to 0 V (logic 0).

The Microprocessor interrupt routine will establish the reason for the interrupt. A5U2 and A5U19 are enabled by the GCS signal. The direction of data transfer through A5U19 is set by the R/W signal. The GPIA data-in register is addressed, and the data is transferred to the Microprocessor block.

When the data transfer is complete, GPIA A5U2 cancels the interrupt request and allows the data accepted (DAC) line to set logic 1. The handshake routine then continues, and if another byte is available, is loaded into the data-in register. The interrupt and data transfer sequence is then repeated.

Talker Operation. When the interface is addressed to talk, the data-out register will normally be empty. Under these conditions an interrupt request is generated by setting A5U2 pin 40 to logic 0. This output is used to generate an interrupt request for the Microprocessor using A5U18, U14d and U9C.

When A5U10a is set, A5U11 pin 10 is set logic 1. A5U10b is normally reset and A5U2 pin 27 is set logic 1. A5U11 pins 9 and 11 are set logic 1 setting A5U11 pin 8 to logic 0. This open circuits bilateral switch A5U6 between A5TP1 and TP2, breaking the RFD line to A5U2 pin 18. GPIA A5U2 will not attempt to load the contents of its data-out register onto the bus, because A5U2 pin 18 is held logic 0 by the bilateral switch in A5U6. A5U6 is driven by A5U4b,

The microprocessor interrupt routine will establish the reason for the interrupt. The GPIA A5U2 data-out register is addressed and a data byte is written into the register.

Following the data transfer, the Microprocessor block sets data bus line BDO to logic 0. A5U15 is addressed using address lines A0, Al and A2. Microprocessor enable (E) pulse is then sent to A5U10a pin 11. This clocks A5U10a to the reset condition, setting A5U11 pin 10 to logic 0. The bilateral switches in A5U6 reconnect the RFD line to A5U2, and release A5U2 pin 18 from 0V (logic 0). When the RFD line puts A5U2 pin 18 to logic 1, A5U2 loads the contents of the data-out register onto the bus and continues with the handshake sequence.

If, for any reason GPIA A5U2 is taken out of the talk state part way through a message, the data-out register will be left containing an untransmitted data byte. This situation can arise if the controller stops the message in order to conduct a serial poll.

When GPIA A5U2 is re-addressed to talk:

- The GPIA may be required to continue with the interrupted message.
- The GPIA may be required to transmit a byte (e.g. the status byte) other than that held in the data-out register.

The two situations are distinguished by whether there has, or has not, been a data transfer between the GPIA and the microprocessor since GPIAA5U2 left the talk state.

- If a data transfer from GPIA A5U2 to the Microprocessor block <u>has not</u> occurred since GPIA left the talk state, A5U10a will be in the reset condition, setting a logic 0 at A5U10a pin 9 and a logic 1 at A5U11 pin 8. The bilateral switches of A5U6 between TP1 and TP2 will be in the conducting condition, so the RFD line to A5U2 pin 18 is unbroken. When the GPIA is addressed to talk, the byte in the data-out register will be transmitted, followed by the remainder of the interrupted message.
- If a data transfer from GPIA A5U2 to the Microprocessor block <u>has</u> occurred since the GPIA left the talk state, A5U10a will have been set by the last interrupt request from A5U2 pin 40. When the GPIA is addressed to talk, A5U2 pin 27 is set logic 1, and the RFD is broken by A5U6 (because A5U11 pins 9 and 10 are set logic 1). When the listener sets the RFD line high, A5U18 pin 1 is set logic 1. Since A5U18 pins 2 and 13 are set logic 1, an interrupt request to the Microprocessor block is generated using A5U14d and U9C. The Microprocessor block will see this as a demand for fresh data from GPIA A5U2, and will update the byte held in the status byte register.

After transfer ring the status byte to A5U2, the Microprocessor block addresses A5U15 to direct the enable (E) signal to A5U10b, clocking it to the set state. A5U11 pin 8 will go to logic 1, and the RFD input will be connected by A5U6 to U2 pin 18. The status byte will then be transmitted.

Detection of the Serial Poll Disable Message. When a serial poll sequence has been completed, the Controller sends the serial poll disable (SPD) message. This is detected by A5U8b/c/d, and A5U1, setting A5U1 pin 8 to logic 0. A5U10b returns to the reset condition, setting A5U11 pin 9 to logic 1. This disconnects the RFD line from A5U2 pin 18 at A5U6.

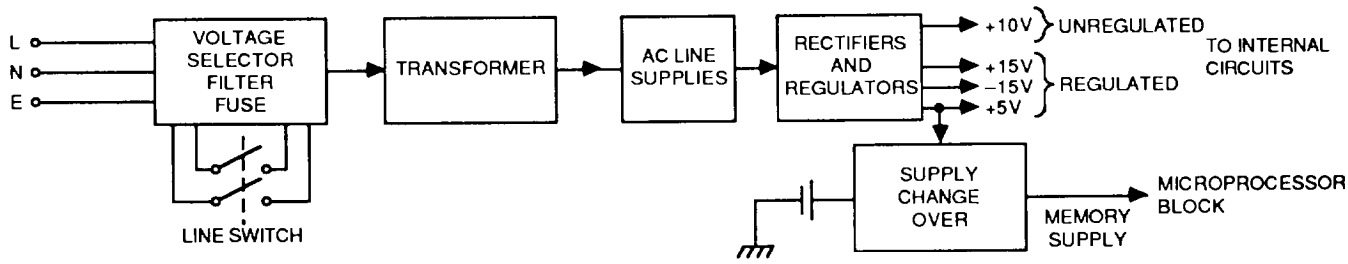

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Figure 1-7. Power Supply Block Diagram.

5 POWER SUPPLY (Fig 1-7). This block is responsible for supplying power for operation of the Voltmeter. This section is contained on the following circuit card assembly:

The Power Supply block is contained on the following circuit card assemblies:

- Al Processor Assembly (Fig FO-2).
- Front and Rear panel components,

The Power Supply block can be divided into the following major circuits:

- AC Line Supplies.
- Rectifiers and Regulators,
- Reset and Memory Supply Changeover.

AC Line Supplies. The line module LF1 filters noise, has a protective fuse, and sets the line voltage as AC line power is brought into the power supply. From FL1, AC power goes to the transformer T1 which provides approximately 9Vac (P25 pins 4-5) for the +5V supply, approximately 35Vac (P25 pins 7-9) center tap for positive and negative 15V supply, and approximately 10Vac (P25 10-11) for +10V supply.

Rectifiers and Regulators. The AC line supplies are rectified and regulated to provide the following output voltages:

- +5Vdc Regulated output. The AC line supplies 9Vac output is rectified by A1CR1 and capacitively filtered by Al Cl. A1U41 provides regulation of the +5Vdc output. Additional fuse protection of the +5Vdc circuit is provided by A1F1.

- +10Vdc output. The AC line supplies 10Vac output is rectified by A1CR6-9, and capacitively filtered by A1C4. The unregulated output is provided to the GPIB block where it is regulated at +5V.
- ±15Vdc Regulated output. The AC line supplies 35Vac center tap output is rectified by A1CR2-5 and capacitively filtered by A1C2-3. A1U38 provides regulation of the –15Vdc output. A1U39 provides regulation of the +15Vdc output. A1R44 and R49 provide adjustment of the ±15Vdc output.

Reset and Memory Supply Changeover. When the AC power is disconnected or switched off, A1U15, and U42-U45 are powered from battery BT1.

Voltage level detectors A1U44 and U45 detect the low voltage on the +5 V supply, and both A1U45 pin 6 and U44 pin 5 are set logic 0. A1U42a pin 3 and U42d pin 13 are set logic 1. The bistable circuit formed by AlU15b and U15C will have been reset when the AC supply was switched off. This sets A1U15C pin 8 to logic 1. AlU42d pins 2 and 14 are set logic 1, and AlU42d pin 11 (RESET) is set logic 0. The logic 1 at A1U15C pin 8 holds the R/Wline in the read condition. The RAM select line is set logic 1, using A1U43b and U43C. This prevents access to the memory.

When power is applied, the +5 V supply increases until A1U45 pin 6 and U44 pin 5 go to logic 1, and A1U42a pin 3 goes to logic 0. A1U42d pin 11 is set logic 1, releasing the microprocessor from reset. A1U42C pin 10 is set logic 1. As part of its start-up procedure, the Microprocessor block sets A1U1l pin 19 and A1U42C pin 9 to logic 1. The bistable circuit A1U15b and U15c is placed in the set state. A1U15C pin 8 is set logic 0, releasing the R/Wand CS lines.

When AC power fails or is switched off, the reduction in the voltage on the +5 V supply is sensed, and A1U44 pin 6 is set logic 1. A1U15d pin 12 is set logic 1 by U15b. A1U15d pin 11 is set logic 0, providing a non-mask able interrupt (N MI) at A1U30 pin 6. At the completion of the current instruction, the Microprocessor block enters its non-maskable interrupt routine. As part of this routine, A1U11 pin 39 is set logic 0, and applied to A1U15C pin 9. This puts the bistable circuit formed by A1U15b and U15c to the reset state, with U15C pin 8 set logic 1. The R/W line is held in the read state and the RAM select line is held logic 1 using A1U43b and U43C. This prevents corruption of memory contents with spurious data which may be generated during the AC power failure.

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS, INDICATORS, AND CONNECTORS

2-1. INTRODUCTION.

This section describes all of the operator controls, indicators, and connectors for the Voltmeter. Due to the large number of controls, indicators, and connectors on the front panel, it is necessary to separate the panel into three different portions. Figure 2-1 (views A thru C) shows each portion of the front panel. The rear panel is shown in figure 2-2.

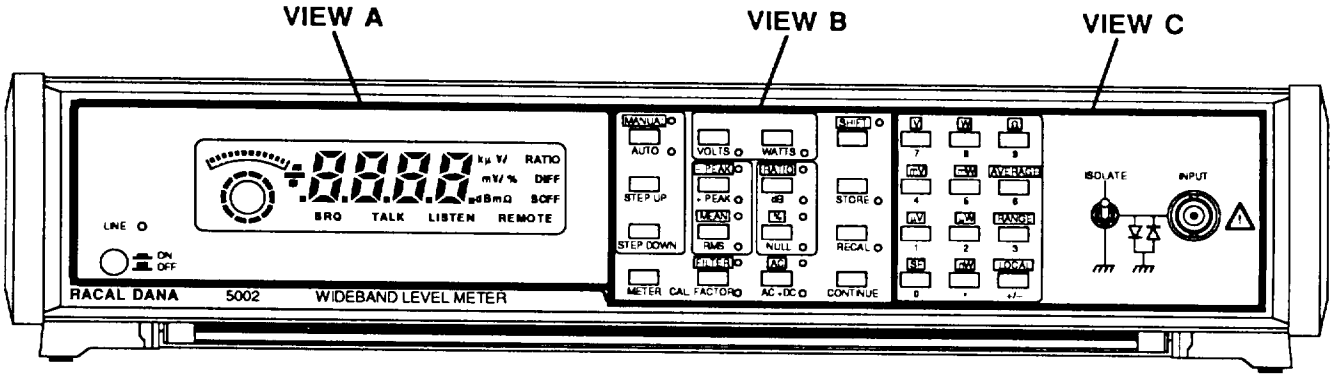

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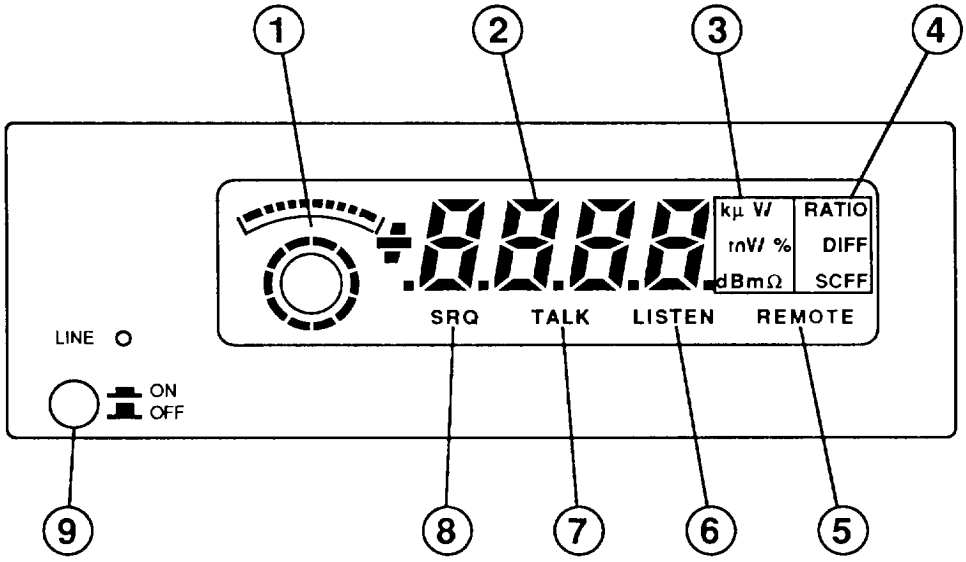
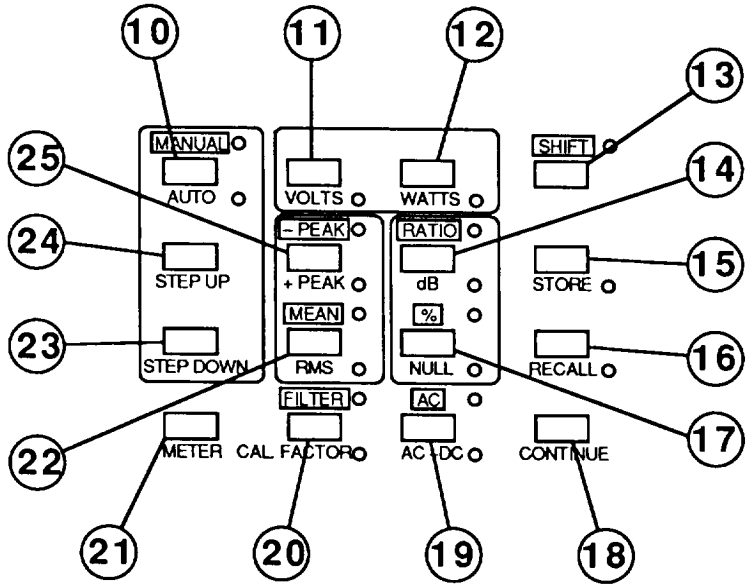
Figure 2-1. Operator's Controls, Indicators, and Connectors, front view.



VIEW A

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
1	Analog Meter	Used to indicate where displayed value falls within the selected range. Top ten segments indicate coarse value from 10%. to 100% in 10% increments of full scale. Bottom segments indicate fine value from % to 9% in 1%. increments of coarse indication, Press METER key to activate. Defaults to on at turn-on.
2	Display	Indicates measurement information, entry information, and error codes. Liquid crystal four digit alphanumeric display with decimal point, plus, and minus sign. Blank sign also indicates positive.
3	Units Indicators	When on, indicates the units used in interpreting displayed data. Voltage displayed in nV, μV, mV, and V. Power displayed in nW, μW, mW, W, and kW. Additional units are seconds (S), percent (%), dB, dBm, and ohms (Ω).
4	Compute/Special Function Indicators	When on, indicates computed measurement information is being displayed. Used with UNITS indicators. Indicates if RATIO, difference (DIFF), Crest Factor (C F), or Form Factor (FF) are displayed. Also indicates if Special Functions (S F) are selected.
5	REMOTE Indicator	Functions only when an external Controller is connected to Voltmeter during remote operation. When on, indicates Voltmeter is operating in remote mode.

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
6	LISTEN Indicator	Functions only when an external Controller is connected to Voltmeter during remote operation. When on, indicates Voltmeter is receiving data.
7	TALK Indicator	Functions only when an external Controller is connected to Voltmeter during remote operation. When on, indicates Voltmeter is sending data.
8	SRQ Indicator	Functions only when an external Controller is connected to Voltmeter during remote operation. When on, indicates Voltmeter is generating service request message.
9	LINE ON/OFF button	Used to turn Voltmeter on or off. ON when button is in and indicator is on. OFF when button is out and indicator is off. Press for on, press again for off.



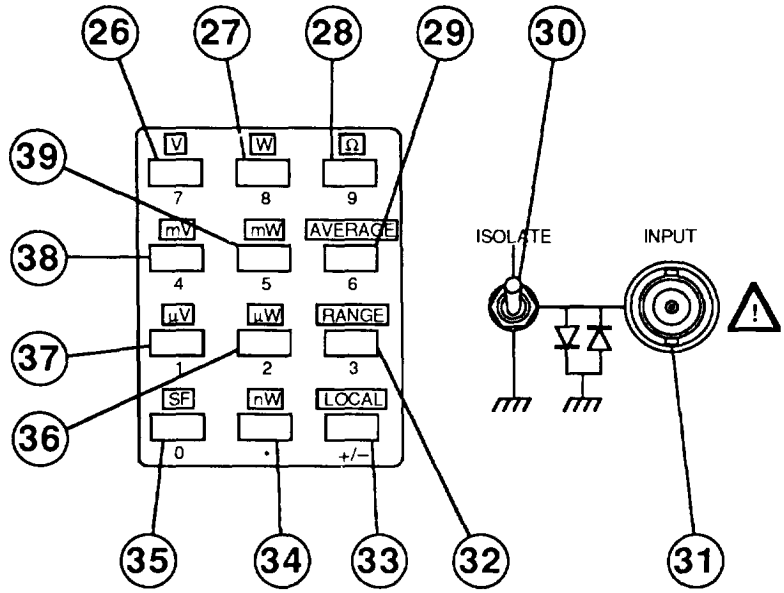
VIEW B

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
10	AUTO key	Used to automatically select measurement range. In automatic mode, correct range is continuously calculated and entered by Voltmeter. Press key until AUTO LED lights for on. Defaults to AUTO at turn-on.
	MANUAL	Used to manually select measurement range. In manual mode, operator selects and enters one of 14 measurement ranges. Press key until MANUAL LED lights for on.
11	VOLTS key	Used to select displayed values in voltage units. Measured or computed values shown in display as nV, µV, mV, or V. VOLTS LED on when selected. Press for on. Active WATTS, RATIO, DB, 70, NULL, or Special functions will cancel when VOLTS is selected. Defaults to VOLTS at turn-on.
12	WATTS key	Used to select displayed values in wattage (power) units. Calculated values shown in display as nW, µW, µW, W, or kW. WATTS LED on when selected. Press for on. Active VOLTS, RATIO, DB, %, NULL, or Special functions will cancel when WATTS is selected. Special Note: Watts calculated as follows: measured voltage 2 ÷ stored Ω value.

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
13	SHIFT key	Used to select shifted functions indicated on front panel (bordered in white). When shift LED is on, shifted functions (MANUAL, -PEAK, MEAN, FILTER, RATIO, %, AC, V, mV, µV, SF, W, mW, µW, nW, Ω, AVERAGE, RANGE, and LOCAL) can be selected or performed. When shift LED is off, keys perform non-shifted functions, Shift LED turns off after selection of all shifted functions. Press for on, press again for off.
14	dB key	Used to display, enter, and activate computed dB measurement. dB calculated as follows: 20 log x (measured volts ÷ stored dB value). Level displayed in dB or dBm (see special note below). Shift key LED must be off. To display stored value, select RECALL and dB keys. To store present value of display, select STORE then dB keys. To store new value, enter using numeric and unit keys, select STORE, then dB keys. Range from 0.1nV to 9999V (0.0001n W to 9999 W). To activate, select desired units (VOLTS or WATTS) key. Press dB key and verify dB LED is on and dB/dBm is shown in display. To deactivate, press VOLTS or WATTS key, and verify dB LED is off. Defaults to 774.6mV (999.9µW) at turn-on. Special Note: If values stored in dB and Ω represent power of 1mW, display units will be dBm (see para 2-13).
	RATIO	Used to display, enter, and activate computed ratio measurement. Ratio calculated as follows: (measured volts - stored ratio value). Ratio displayed in voltage or power units. Shift key LED must be on, To display stored value, select RECALL, SHIFT, then RATIO keys. To store present value of display, select STORE, SHIFT, then RATIO keys. To store new value, enter using numeric and unit keys, select STORE, SHIFT, then RATIO keys. Range from 0.1nV to 9999V (0.0001nW to 9999 W). To activate, select desired units (VOLTS or WATTS) key. Press SHIFT then RATIO keys and verify ratio LED is on and RATIO is shown in display. To deactivate, press VOLTS or WATTS key, and verify ratio LED is off. Defaults to 1.000V (1.667mW) at turn-on.
15	STORE key	Used to store up to 12 front panel setups. Select STORE key, then enter desired location (01 to 12) to store current front panel setup. STORE key also used to change numeric values stored for computation and operation. To store new value, enter using numeric and unit keys, select STORE, SHIFT (if necessary), then desired function key (RATIO, DE, %, NULL, Ω, AVERAGE, and CAL FACTOR). Store LED turns off after selection of location or function. Press for on, press again for off.
16	RECALL key	Used to recall one of 12 previously stored front panel setups. Select RECALL key, then enter previously stored location (numeric 01 to 12) to recall stored setup. Recall LED turns off after selection. RECALL key also used to display numeric values presently stored for computation and operation, To display value, select RECALL, SHIFT (if necessary), then desired function key (CAL FACTOR, RATIO, DE, %, NULL, Ω, SF (SPECIAL FUNCTION), AVERAGE, and LOCAL), Recall LED remains on after selection of function. Press for on. Press twice for off, or press CONTINUE key.

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
17	NULL key	Used to display, enter, and activate computed null difference measurement. Null difference calculated as follows: (measured volts – stored null value). Difference displayed in voltage or power units. Shift key LED must be off. To display stored value, select RECALL and NULL keys. To store present value of display, select STORE then NULL keys. To store new value, enter using numeric and unit keys, select STORE, then NULL keys. Range from 0.1nV to 9999V (0.0001nW to 9999 W). To activate, select desired units (VOLTS or WATTS) key. Press NULL key and verify null LED is on and DIFF is shown in display. To deactivate, press VOLTS or WATTS key, and verify null LED is off. Defaults to 1.000V (1.667mW) at turn-on.
	%	Used to display, enter, and activate computed percentage difference measurement. Percentage difference calculated as follows: [(measured volts -stored % value) + stored % value] x 100. Difference, in percent, displayed for voltage or power. Shift key LED must be on. To display stored value, select RECALL, SHIFT, then % keys. To store present value of display, select STORE, SHIFT, then % keys. To store new value, enter using numeric and unit keys, select STORE, SHIFT, then % keys. Range from 0.1nV to 9999V (0.0001nW to 9999 W). To activate, select desired units (VOLTS or WATTS) key. Press SHIFT then %. keys and verify % LED is on and %DIFF is shown in display. To deactivate, press VOLTS or WATTS key, and verify % LED is off. Defaults to 1.000V (1.667mW) at turn-on.
18	CONTINUE key	Used to clear display of numeric entry or recalled data, and to restart measurement. Press to activate.
19	AC+ DC key	Used to select AC + DC coupling of input signal. Press key until AC+ DC LED lights for on.
	AC	Used to select AC coupling of input signal. Press key until AC LED lights for on. Defaults to AC at turn-on.
20	CAL. FACTOR key	Used to display, enter, and activate scaling factor. Used to set reference when performing signal source measurements. Factor calculated as follows: (measured volts + stored cal factor value). Factored result displayed in voltage or power units. Shift key LED must be off. To display stored value, select RECALL, then CAL. FACTOR keys. To store present value of display, select STORE, then CAL. FACTOR keys. To store new value, enter using numeric keys, select STORE, then CAL. FACTOR keys. Range from 0.0001 to 9999. To activate, select CAL. FACTOR key and verify LED is on. To deactivate, press CAL. FACTOR key, and verify LED is off. Defaults to 1.000 at turn-on.
	FILTER	Used to introduce a low pass filter to the input signal. Filter reduces input bandwidth to 200kHz (–3dB). To activate filter, select SHIFT, then FILTER keys and verify LED is on. To deactivate filter, press SHIFT, then FILTER key, and verify LED is off.

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
21	METER key	Used to select ANALOG METER. Press to blank meter, press to display meter. Defaults to on at turn-on.
22	RMS key	Used to activate true RMS measurement mode. Displays result in voltage or power units. Measures RMS value of an external signal connected to INPUT connector from 100µV to 316V at 10 Hz to 20MHz. Display resolution is four digits. Press key until RMS LED lights for on. Active +PEAK, –PEAK, or MEAN mode will cancel when RMS selected. Defaults to RMS at turn-on.
	MEAN	Used to activate MEAN measurement mode. Displays result in voltage or power units. Measures rectified mean AC level or DC level (dependent on coupling selected) of an external signal connected to lNPUT connector from 1mV to 316V at DC and 10 Hz to 10 MHz. Display resolution is four digits. Press key until MEAN LED lights for on. Active +PEAK, –PEAK, or RMS mode will cancel when MEAN selected.
23	STEP DOWN key	Used to select next lower measurement range in manual mode. Press key to select next lower range. 14 ranges available from 316.2V to 100µV. If key pressed while in AUTO mode, will automatically switch to MANUAL mode and decrease to next range. To display range, select SHIFT then press RANGE key.
24	STEP UP key	Used to select next higher measurement range in manual mode. Press key to select next higher range. 14 ranges available from 100µV to 316.2V. If key pressed while in AUTO mode, will automatically switch to MANUAL mode and increase to next range. To display range, select SHIFT then press RANGE key.
25	+ PEAK key	Used to activate +PEAK measurement mode. Displays result in voltage or power units. Measures positive peak value of an external signal connected to INPUT connector from +1mV to +316V at 10Hz to 10 MHz. Display resolution is four digits. Press key until +PEAK LED lights for on. Active –PEAK, MEAN, or RMS mode will cancel when +PEAK selected.
	- PEAK	Used to activate –PEAK measurement mode. Displays result in voltage or power units. Measures negative peak value of an external signal connected to INPUT connector from –10mV to –316V at 10Hz to 10MHz. Display resolution is four digits. Press key until –PEAK LED lights for on. Active +PEAK, MEAN, or RMS mode will cancel when –PEAK selected.

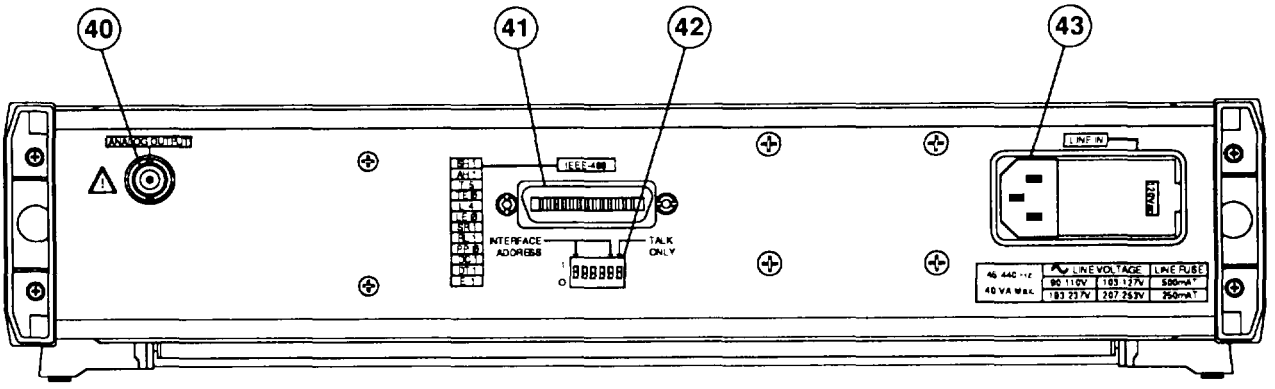


VIEW C

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
26	7 key	Used to enter a numeric 7 for data entry. Shift key LED must be off.
	V	Used to terminate a numeric data entry in volts. Shift key LED must be on.
27	8 key	Used to enter a numeric 8 for data entry. Shift key LED must be off,
	W	Used to terminate a numeric data entry in watts. Shift key LED must be on.
28	9 key	Used to enter a numeric 9 for data entry. Shift key LED must be off.
	Ω	Used to terminate a numeric data entry in ohms. Shift key LED must be on. Also used to display and enter a resistance constant. Stored value used when computing watts. Does not change the input impedance. To display stored value, select RECALL, SHIFT, then Ω keys. To store new value, enter using numeric and unit keys, select STORE, SHIFT, then Ω keys. Range from 0.0001Ω to 9999Ω. Defaults to 600.0Ω at turn-on. Special Note: If values stored in dB and Ω represent power of 1mW, display units will be dBm (see para 2-13).

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
29	6 key	Used to enter a numeric 6 for data entry. Shift key LED must be off.
	AVERAGE	Used to display and enter the time, in seconds, for measurements to be averaged and the display updated. Used to minimize display jitter. Shift key LED must be on. To display stored value, select RECALL, SHIFT, then AVERAGE keys. To store new value, enter using numeric keys, select STORE, SHIFT, then AVERAGE keys. Range from 0.1 to 99.9. Defaults to 1.0 seconds at turn-on.
30	ISOLATE switch	Used to select INPUT connector shell (common terminal) grounding. Up position isolates from chassis ground. Down position connects to chassis ground. Maximum allowable current between shell and chassis ground is 5A. Maximum allowable voltage difference is ±0.5V.
31	INPUT connector	BNC female connector used to connect 100µV to 316V at DC to 20MH2 signal for measurement. Input resistance is ≒MΩ. Maximum input is 500V (DC + peak AC).
32	3 key	Used to enter a numeric 3 for data entry. Shift key LED must be off.
	RANGE	Used to display and enter measurement range. Shift key LED must be on. To display current range, select RECALL, SHIFT, then RANGE keys. To change range, use STEP UP or STEP DOWN keys to select one of 14 ranges from 100.0µV to 316.2V. If range changed while in AUTO mode, will automatically switch to MANUAL mode, and increase/decrease one range.
33	+/ - key	Used to enter a positive or negative sign for numeric data entry. Blank or + indicates positive, – indicates negative. Press to change sign.
	LOCAL	Used to return Voltmeter to front panel control from remote (GPIB) operation. Shift key LED must be on. Press SHIFT then LOCAL key to activate. Also used to display current GPIB address. To display current address, select RECALL, SHIFT, then LOCAL keys. Factory set at 15.
34	(decimal) key	Used to enter a decimal for numeric data entry. Shift key LED must be off.
	nW	Used to terminate a numeric data entry in nanowatts. Shift key LED must be on.

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
35	D key	Used to enter a numeric 0 for data entry. Shift key LED must be off.
	S F	Used to display, enter, and activate special functions. Shift key LED must be on. To activate special function, enter special function number using numeric keys, then select SHIFT and SF keys. When active, SF is shown in display. To display active special function, select RECALL, SHIFT, then SF keys. To deactivate special functions, press 0, select SHIFT then SF keys. Defaults to 0 at turn-on.
36	2 key	Used to enter a numeric 2 for data entry. Shift key LED must be off,
	µw	Used to terminate a numeric data entry in microwatt. Shift key LED must be on.
37	1 key	Used to enter a numeric 1 for data entry. Shift key LED must be off.
	µV	Used to terminate a numeric data entry in microvolt. Shift key LED must be on.
38	4 key	Used to enter a numeric 4 for data entry. Shift key LED must be off.
	mV	Used to terminate a numeric data entry in millivolts. Shift key LED must be on.
39	5 key	Used to enters numeric 5 for data entry. Shift key LED must be off.
	mW	Used to terminate a numeric data entry in milliwatts. Shift key LED must be on.



CE1RL009

Figure 2-2. Operator's Controls, Indicators, and Connectors, rear view.

KEY	CONTROL, INDICATOR, OR CONNECTOR	FUNCTION
40	ANALOG OUTPUT CONN	BNC female connector provides 5Vdc output when measurement range at full scale.
41	GPIB connector	Used to connect an external Controller to Voltmeter during remote operation. Connector has 24 pins and threaded posts conforming to IEEE-488-1978.
42	GPIB switch	Functions only when an external Controller is connected to Voltmeter during remote operation. Six position switch used to configure Voltmeter to Controller. Positions one to five set Voltmeter interface address from 00 to 31. Position six controls talk/ listen function. To display interface address on front panel, select RECALL, SHIFT, then LOCAL keys,
43	INPUT POWER CONN	Used as AC power input connector for Voltmeter. Also contains line fuse and voltage selection facilities. Voltage selection from 100/120/220/240Vac. Number visible indicates nominal line voltage for which Voltmeter is set to operate. Power input connector accepts female end of power cable (supplied). Protective grounding conductor connects Voltmeter through this connector. Line power fuse is 0.50 amp, 250V for 100/120Vac and 0.25 amp, 250V for 220/240Vac operation.

Section II. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES

2-2. GENERAL.

To be sure that the equipment is always ready for the mission, perform scheduled preventive maintenance checks and services (PMCS). When doing any PMCS or routine checks, keep in mind the WARNINGS and CAUTIONS about electrical shock and bodily harm.

2-3. PMCS PROCEDURES.

a. Tools, Materials, and Equipment Required for Preventive Maintenance. No tools or equipment are required for operator preventive maintenance. Cleaning materials required are listed in Appendix E, items 2 and 3.

b. PMCS for Voltmeter is limited to routine checks such as shown below.

- cleaning,
- dusting,
- wiping,
- checking for frayed cables,
- storing items not in use,
- covering unused receptacles,
- checking for loose nuts, bolts, and screws.

c. Perform these routine checks anytime they must be done.

Section III. OPERATION UNDER USUAL CONDITIONS

2-4. INTRODUCTION.

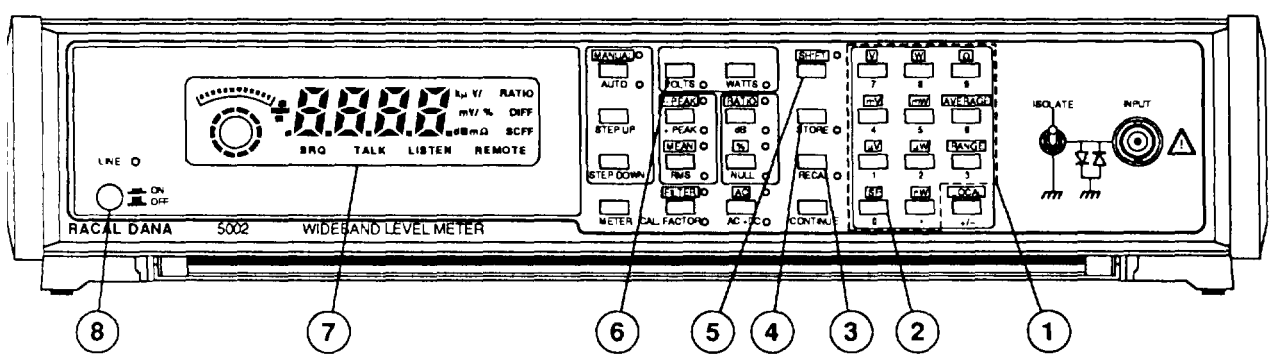
This section provides the information required to set up and operate the Voltmeter. Information required for operation in the remote mode is provided in Appendix F. Operation is divided into five separate procedures. Individual measurement procedures for RMS, mean, and peak are provided, along with procedures for selecting computed and special functions.

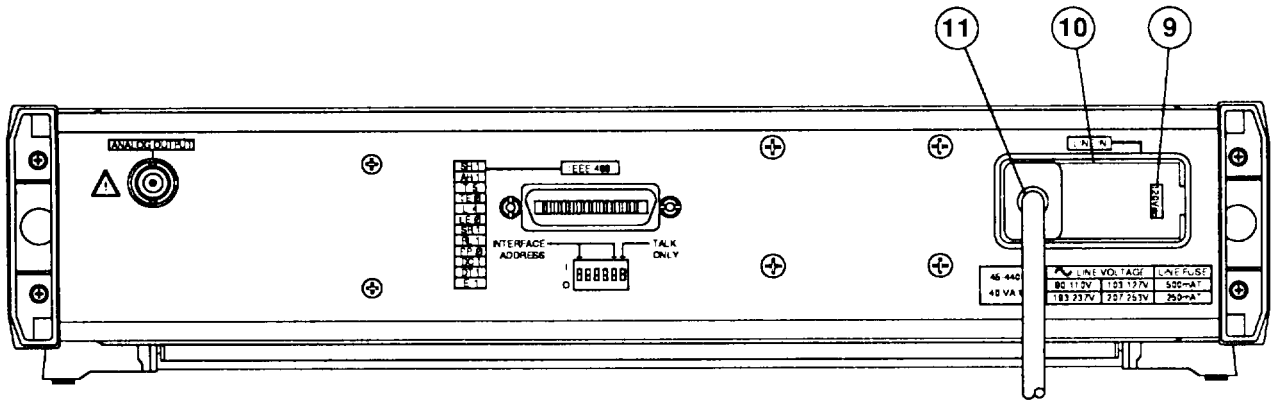
Table 2-1 lists error codes along with the probable cause and corrective action.

2-5. PREPARATION FOR USE.

WARNING

The Voltmeter is equipped with a three-wire power cable. When connected to a grounded AC power receptacle, this cable grounds the instrument front panel and cabinet. Do not use extension cords or AC adapters without a ground.





a. Verify that LINE ON/OFF switch (8) is set to OFF.

b. Verify VOLTAGE WINDOW (9) on rear panel indicates line voltage available in your area. Connect power cable (11) to AC POWER connector (10) on rear panel.

2-6. TURN-ON PROCEDURE.

a. Verify that only the power cable (11) is connected to Voltmeter. All other cables should be disconnected.

b. Set LINE ON/OFF switch (8) from OFF to ON. Verify that the DISPLAY (7) shows the analog meter and briefly indicates "5002".

NOTE

- If any error code except "Ur" is shown in display, see table 2-1 for probable cause and corrective action.
- Volts displayed if VOLTS key is selected, or power displayed if WATTS key is selected.

c. Verify the following front panel condition exists:

DISPLAY	Analog meter and either "Ur" or random numbers
LINE indicator	ON
AUTO LED	ON
VOLTS LED	ON
RMS LED	ON
AC LED	ON
All other indicators	OFF
CAL FACTOR key	1.000*
RATIO key	1.000 V/1.667mW**
dB key	774.6mV/999.9µW*
% key	1.000V/1.667mW**
NULL key	1.000V/1.667mW*
SF key	0**
Ω key	600.0Ω**
AVERAGE key	1.0S**
LOCAL	15**

* Default value. Press RECALL then key to display value(s). Press CONTINUE to clear display.
** Default value. Press RECALL, SHIFT then key to display value(s). Press CONTINUE to clear display.

d. Press 9 , 8 , decimal (.) , 1 using numeric keys (1), SHIFT (5), then SF (2) keys. Verify all display indicators and LEDs light.

e. Press VOLTS (6) key. Verify display indicators and front panel LEDs return to normal.

f. If all above conditions are correct, Voltmeter is ready for operation. If indication is incorrect, notify next higher level maintenance.

2-7. STORE-RECALL PROCEDURES.

Up to twelve front panel control settings and entry parameters can be stored for recall at a later time. The parameters remain stored even with Voltmeter in off or with the power cable disconnected.

1. To store a set-up:
   - Press STORE key (4) and desired number from 01 to 12 using numeric keys (1). If a setup has been stored at location selected (01 thru 12), it will be erased and new setup will be stored in its place.
2. To recall a set-up:
   - Press RECALL key (3) and desired number from 01 to 12 using numeric keys (l). Setup stored at that location will be activated.
3. To reset Voltmeter to the turn-on condition:
   - Press RECALL (3) key, and then number 0 (1) key twice.
4. To reset Voltmeter to the condition prior to selecting LINE OFF or removing power:
   - Press RECALL (3) key, and then number 9 (1) key twice.

2-8. ERROR CODES.

Some operator actions and internal circuit failures cause error codes to appear in the display. See table 2-1 for a list of error codes and probable cause.

NOTE

If an indication appears that is not listed in table 2-1, notify next higher level maintenance.

Table 2-1. Error Codes.

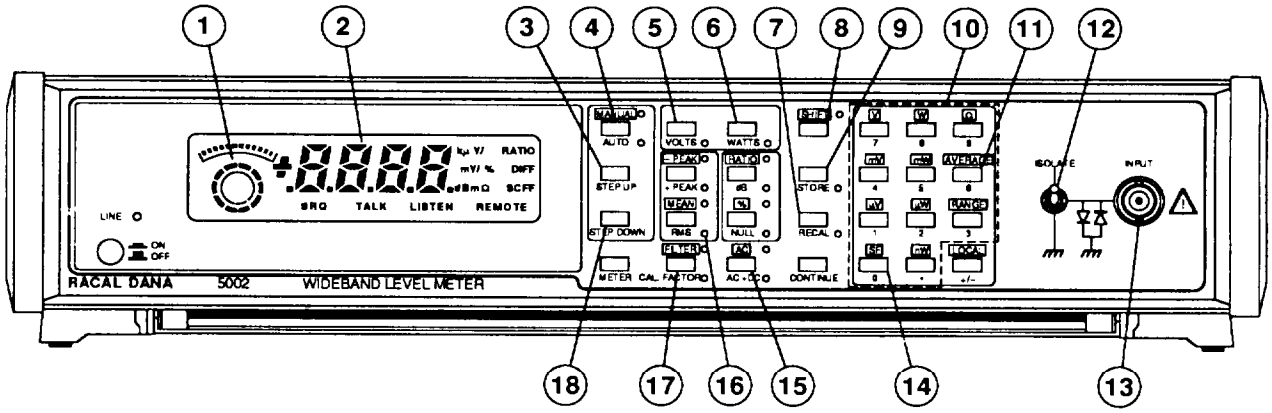
DISPLAY	PROBABLE CAUSE	CORRECTIVE ACTION
AC Or	AC input over range selected.	Increase measurement range using STEP UP keys. If AUTO selected, decrease input AC signal level.
dC Or	DC input over range selected.	Increase measurement range using STEP UP keys. If AUTO selected, decrease input DC signal level.
Er 11	Computed result exceeds 9999.	Verify stored values (CAL FACTOR, RATIO, dB, %, NULL, or Ω) used in calculations are correct. Re-enter as required.
Er 12	Invalid entry.	Re-enter correct data.
Er 13	Attempted to store numeric 0.	Re-enter correct data.
Or	Input over range selected.	Increase measurement range using STEP UP keys. If AUTO selected, decrease input signal level.
OUCH	Maximum input exceeded (500 V).	Reduce input level (100µV to 316 V).
P HI	AC peak excessive for range selected.	Increase measurement range using STEP UP keys. If AUTO selected, decrease input signal level.
Ur	Input under range selected.	Decrease measurement range using STEP DOWN keys. If AUTO selected, increase input signal level. Normal if input not connected.

2-9. OPERATING PROCEDURES.

Operation of the Voltmeter is provided in paragraphs 2-10 thru 2-14. Refer to paragraph 2-1 for a further description of the controls, indicators, and connectors.

2-10. RMS MEASUREMENT.

Perform the following steps to measure RMS value, in voltage or power units, of a 100µV to 316V 10 Hz to 20 MHz signal.



1. Press RECALL (7) key, then 0 key (14) twice. Verify RMS LED (16) is on.
2. Select VOLTS (5) or WATTS (6) measurement units.
   - If WATTS, verify resistance value stored in Ω is set to desired impedance.
3. Select AC (15) or AC + DC input coupling.

CAUTION

When connecting signal to INPUT connector, do not exceed levels of 500V (DC + peak AC).

4. Connect signal to be measured to the IN PUT (13) connector.
5. Set ISOLATION (12) switch to chassis ground or isolate position.

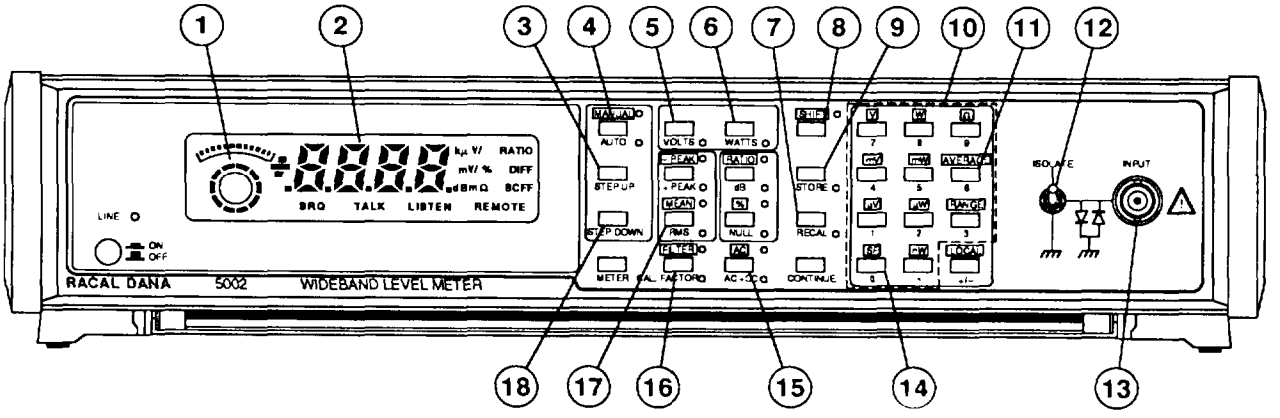
NOTE

Maximum allowable displayed voltage difference from isolate to chassis ground switch position is ±0.5V.

6. Select AUTO (4) or MANUAL measurement range.
   - If MANUAL, select correct range using STEP UP (3) or STEP DOWN (18) keys until ANALOG METER (1) indicates approximately midrange Verify Ur or Or not shown in DISPLAY (2).
7. Select additional functions as required.
   - For averaging other than 1 second, enter time from 0.1 to 99.9 using numeric keys (10), then press STORE (9), SHIFT (8), then AVERAGE (11) keys.
   - For input signals below 200kHz, select SHIFT (8) then FILTER (17) keys. Note that Voltmeter accuracy may be affected if filter is selected.
   - For special functions available, see paragraph 2-14.
8. RMS level shown in DISPLAY (2).

2-11. MEAN MEASUREMENT.

Perform the following steps to measure mean value, in voltage or power units, of a 1mV to 316V DC and 10 Hz to 10 MHz signal.



1. Press RECALL (7) key, then 0 key (14) twice. Press MEAN (17) key and verify LED lights.
2. Select VOLTS (5) or WATTS (6) measurement units.
   - If WATTS, verify resistance value stored in Ω is set to desired impedance.
3. Select AC (15) or AC+ DC input coupling.
   - If AC coupling selected, input signal rectified mean AC component will be displayed.
   - If AC+ Decoupling selected, input signal DC level will be displayed.

CAUTION

When connecting signal to INPUT connector, do not exceed levels of 500V (DC + peak AC).

4. Connect signal to be measured to the INPUT (13) connector.
5. Set ISOLATION (12) switch to chassis ground or isolate position.

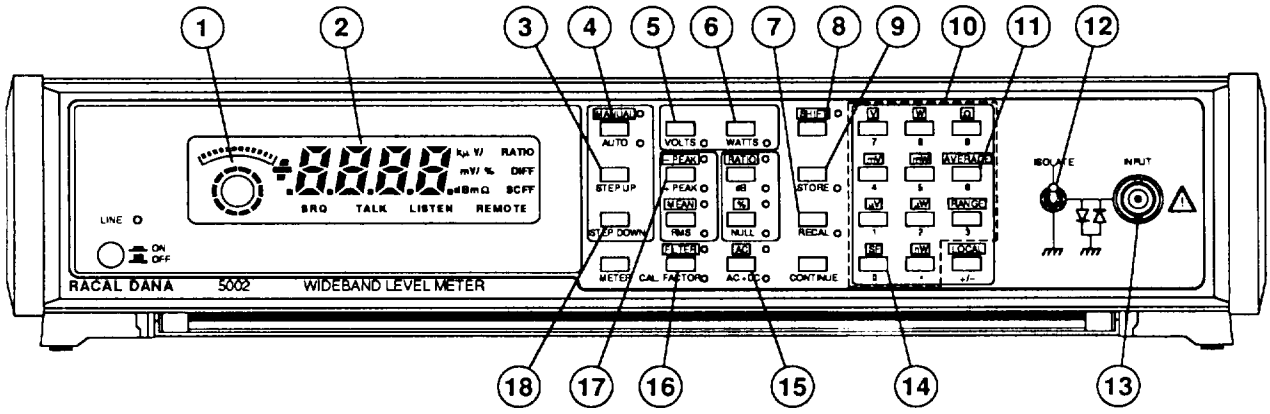
NOTE

Maximum allowable displayed voltage difference from isolate to chassis ground switch position is ±0.5V.

6. Select AUTO (4) or MANUAL measurement range.
   - If MANUAL, select correct range using STEP UP (3) or STEP DOWN (18) keys until ANALOG METER (1) indicates approximately midrange Verify Ur or Or not shown in DISPLAY (2).
7. Select additional functions as required.
   - For averaging other than 1 second, enter time from 0.1 to 99.9 using numeric keys (10), then press STORE (9), SHIFT (8), then AVERAGE (11) keys.
   - For input signals below 200kHz, select SHIFT (8) then FILTER (16) keys, Note that Voltmeter accuracy may be affected if filter is selected.
   - For special functions available, see paragraph 2-14.
8. Mean level shown in DISPLAY (2).

2-12. PEAK MEASUREMENT,

Perform the following steps to measure +peak or -peak, in voltage or power units, of a 1mV to 316V 10 Hz to 10 MHz signal.



1. Press RECALL (7) key, then 0 key (14) twice.
2. Press –PEAK (17) or +PEAK key for desired measurement.
3. Select VOLTS (5) or WATTS (6) measurement units.

   If WATTS, verify resistance value stored in Ω is set to desired impedance.
4. Select AC (15) or AC+ DC input coupling.

CAUTION

When connecting signal to INPUT connector, do not exceed levels of 500V (DC + peak AC).

5. Connect signal to be measured to the INPUT (13) connector.
6. Set ISOLATION (12) switch to chassis ground or isolate position.

NOTE

Maximum allowable displayed voltage difference from isolate to chassis ground switch position is +0.5V.

7. Select AUTO (4) or MANUAL measurement range.
   - If MANUAL, select correct range using STEP UP (3) or STEP DOWN (18) keys until ANALOG METER (1) indicates approximately midrange Verify Ur or Or not shown in DISPLAY (2).
8. Select additional functions as required.

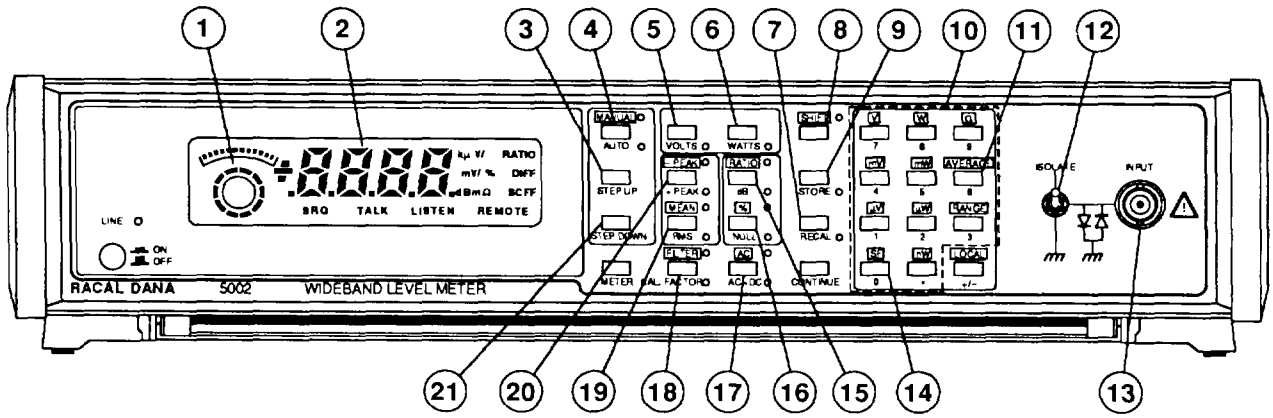
   For averaging other than 1 second, enter time from 0.1 to 99.9 using numeric keys (10), then press STORE (9), SHIFT (8), then AVERAGE (11) keys.

   For input signals below 200kHz, select SHIFT (8 then FILTER (16) keys. Note that Voltmeter accuracy may be affected if filter is selected.

   For special functions available, see paragraph 2-14.
9. +Peak or-Peak level shown in DISPLAY (2).

2-13. COMPUTED FUNCTIONS.

Perform the following steps to display computed ratio, dB, percentage difference, and null difference measurements.



1. Press RECALL (7) key, then 0 key (14) twice.
2. Select VOLTS (5) or WATTS (6) measurement units.
   - If WATTS, verify resistance value stored in Ω is set to desired impedance.
3. Select RMS (19), MEAN (19), +PEAK (20), or –PEAK (20) measurement function.
4. Select AC (17) or AC + DC input coupling.

CAUTION

When connecting signal to INPUT connector, do not exceed levels of 500V (DC + peak AC).

5. Connect signal to be measured to the INPUT (13) connector.
6. Set ISOLATION (12) switch to chassis ground or isolate position.

NOTE

Maximum allowable displayed voltage difference from isolate to chassis ground position is ±0.5V.

7. Select AUTO (4) or MANUAL measurement range.
   - If MANUAL, select correct range using STEP UP (3) or STEP DOWN (21) keys until ANALOG METER (1) indicates approximately midrange Verify Ur or Or not shown in DISPLAY (2).
8. Select additional functions as required.
   - For averaging other than 1 second, enter time from 0.1 to 99.9 using numeric keys (10), then press STORE (9), SHIFT (8), then AVERAGE (11) keys.
   - For input signals below 200kHz, select SHIFT (8) then FILTER (18) keys. Note that Voltmeter accuracy may be affected if filter is selected.

NOTE

Computed measurements require use of stored values for Ω, RATlO, dB, %, or NULL. Verify/change these values, if necessary, before selecting desired function below. To display present values, press RECALL (7) key then desired function key. Use SHIFT (8) key if required.

9. Performed desired function:
   - For RATIO measurement (measured volts + stored ratio value), press SHIFT (8) then RATlO (15) keys. Calculated ratio result and RATIO indicator are shown in DISPLAY (2). Ratio is for voltage or power units as selected in step 2.
   - For DB measurement [20_{log} x (measured volts ÷ stored dB value)], press dB (15) key. Calculated dB result and dB/dBm indicator are shown in DISPLAY (2). If values stored in dB and Ω represent power of 1mW, display units will be dBm.

     Example of settings required for dBm;

     223.6 mV in dB store and 50Ω in ohms store.
     273.9 mV in dB store and 75Ω in ohms store.
     774.6 mV in dB store and 600Ω in ohms store*.

     * Default value.
   - For PERCENTAGE DIFFERENCE measurement [(measured volts – stored % value) - stored % value] x 100, press SHIFT (8) then % (16) keys. Calculated difference value in percent, and % DIFF indicator are shown in DISPLAY (2). Difference for voltage or power units as selected in step 2.
   - For NULL DIFFERENCE measurement (measured volts – stored null value), press NULL (16) key. Calculated difference value in volts or watts (selected in step 2), and DIFF indicator are shown in DISPLAY (2).

2-14. SPECIAL FUNCTIONS.

Perform the following steps to use special functions for:

- Crest factor measurements.
- Form factor measurements.
- Mean scaled to RMS measurements.
- Peak-to-peak measurements.
- AC+DC rectified mean measurements.
- Continuous average measurement mode.
- Average peak measurement.
- Peak hold measurements.
- Display test.

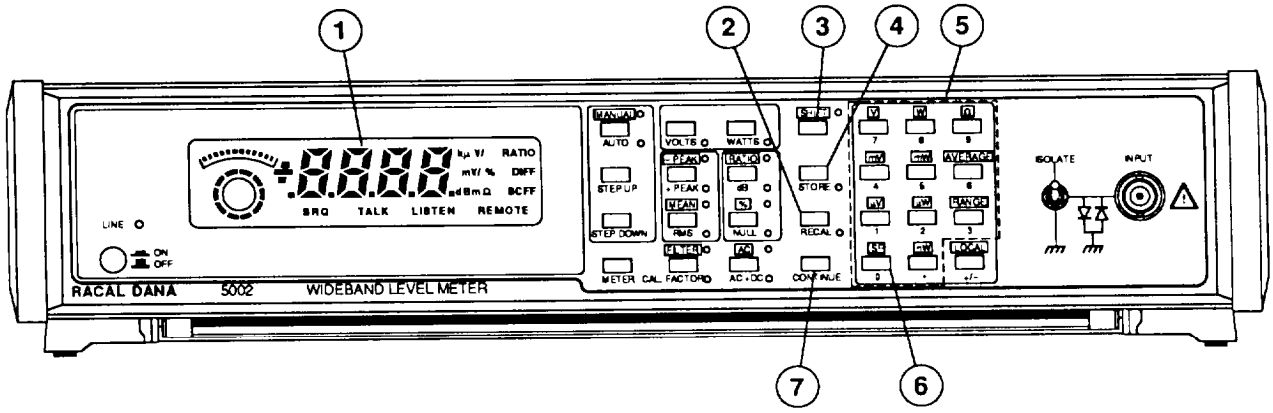
Table 2-2 lists all special functions.

Table 2-2. Special Functions.

Special Function Number	Control, Indicator, or Function	Description	Note
0	Cancel	Deactivates selected special function.	Default at turn-ln.
10.1	Crest Factor	Calculates and displays crest factor (highest peak value +RMS value),	C F displayed.
10.2		Calculates and displays crest factor (positive peak value + RMS value).	
10.3		Calculates and displays crest factor (negative peak value + RMS value).	
20.1	Form Factor	Calculates and displays form factor (R MS value + rectified mean value).	F F displayed.
30.1	Mean	Calculates and displays mean value scaled to RMS (mean value x 1.111). When activated, automatically selects mean measurement,	S F displayed.
40.1	Peak	Displays peak-to-peak value of input signal. When activated, automatically selects + and - peak measurement.	S F displayed.
50.1	Mean	Displays rectified mean value with AC + DC coupling selected. When activated, automatically selects mean measurement and AC+DC coupling.	S F displayed.
60.1	Average	Continuous averaging mode. Display updated every 0.1 seconds using a percent of the present display value and combining it with a percent of the new measured value, Percent determined by averaging time set by operator. Automatically disabled if >5% difference in displayed and measured value,	RMS/Mean only
70.1	Peak	Average peak measurement. Measures all input signal peak levels for a specified time, then calculates and displays average. Time used stored in AVERAGE.	+ or -Peak only
70.2		Peak hold measurement. Measures all input signal peak levels. To display the highest held peak value, press CONTINUE (7) key.	
98.1	Display	Performs display test. All displays, indicators, and LEDs light	See para 2-6.

PROCEDURE

Only one special function can be activated at one time. Entry of a second special function will cancel previously selected special function. Special functions of 50.1 and below are canceled if active and VOLTS, WATTS, +PEAK, -PEAK, MEAN. or RMS keys are pressed. Use the following procedure to display, enter, and activate special functions.



1. Display selected special function.
   - Press RECALL (2) key.
   - Select SHIFT (3) key.
   - Press SF(6) key.
2. Enter and activate special function.
   - Enter desired special function using numeric keys (5).
   - Select SHIFT (3) key.
   - Press SF(6) key.
   - DISPLAY (1) will show SF, CF, or FF to indicate special function is active.

NOTE

If special function number incorrect, front panel will return to previous setup.

3. Deactivate special functions
   - Select 0 (6) key.
   - Select SHIFT (3) key.
   - Select SF (6) key.

CHAPTER 3
UNIT MAINTENANCE

Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

3-1. COMMON TOOLS AND EQUIPMENT.

Common tools and equipment required for unit maintenance of Voltmeter ME-545/G are listed in the Maintenance Allocation Chart (MAC) (Appendix B).

3-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

There are no special tools, TMDE, or support equipment required.

3-3. REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List, TM 11-6625-3200-24P.

Section II. SERVICE UPON RECEIPT

3-4. SERVICE UPON RECEIPT OF MATERIAL.

a. Unpacking. Special design reusable packing material inside this shipping carton provides maximum protection for Voltmeter. Avoid damaging carton and packing material during equipment unpacking. Use the following steps for unpacking Voltmeter:

- Cut and remove paper sealing tape on carton top and open carton.
- Grasp Voltmeter firmly while restraining shipping carton and lift equipment and packing material vertically.
- Place Voltmeter and end cap packing material on a suitable flat clean and dry surface.
- Remove end cap packing material while firmly supporting Voltmeter.
- Remove protective plastic bag from Voltmeter, Place desiccant bags back inside protective plastic bag.
- Place protective plastic bag and end cap packing material inside shipping carton.
- Return shipping carton to supply system.

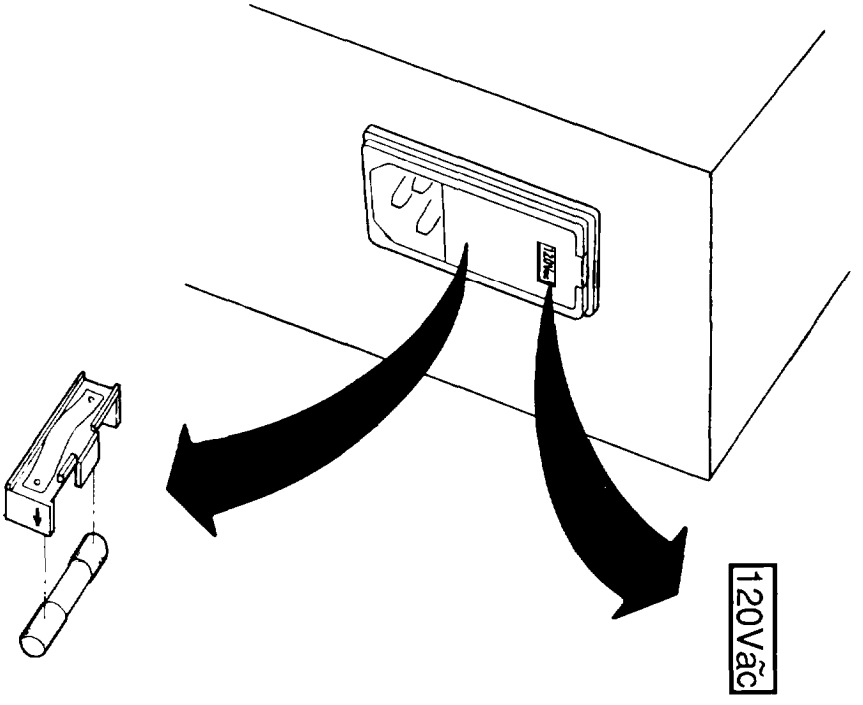
b. Checking Unpacked Equipment.

- Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364, Report of Discrepancy (ROD).
- Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA Pam 738-750.
- Check to see whether the equipment has been modified.

3-5. PRELIMINARY SERVICING AND ADJUSTMENT OF EQUIPMENT.

a. Remove rear panel fuse (para 3-7). Check that fuse is correct for the line voltage available in your area.

b. Verify voltage selection wheel is set to line voltage available in your area. If not, remove and reinstall to correct voltage (para 3-7).



Input Voltage	Voltage Selection Wheel Position	Rear Panel Fuse
90 to 110	100	1/2 amp slo-blo
103 to 127	120	1/2 amp slo-blo
193 to 237	220	1/4 amp slo-blo
207 to 253	240	1/4 amp slo-blo

c. Perform turn on procedures (para 2-6).

Section III. TROUBLESHOOTING

SYMPTOM INDEX

3-6. TROUBLESHOOTING TABLE.

Table 3-1 lists common malfunctions which you may find during operation or maintenance of the Voltmeter. You should perform the tests/inspections and corrective actions in the order listed.

NOTE

This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. if a malfunction is not listed or is not corrected by listed corrective actions, notify next higher level of maintenance.

Table 3-1. Troubleshooting

MALFUNCTION / TEST OR INSPECTION / CORRECTIVE ACTION
1. VOLTMETER DISPLAYS ERRORS.
AC Or displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.
dC Or displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.
Er 01 displayed.
Step 1. Disconnect all external cables except power cable.
Step 2. Press RECALL key, then number 0 key twice. Enter 97. 1 using numeric keys. Press SHIFT then SF keys. Verify display shows <50µV and Ur.
• If correct, unit operational.
• If incorrect, notify next higher level maintenance.
Er 11 displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.

Table 3-1. Troubleshooting—Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. VOLTMETER DISPLAYS ERRORS—Continued.
Er 12 displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.
Er 13 displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.
Er 23 displayed.
• Notify next higher level maintenance.
Er 24 displayed.
• Notify next higher level maintenance.
Er 25 displayed.
• Notify next higher level maintenance.
Er 26 displayed.
• Notify next higher level maintenance.
All LEDs displayed.
• Enter 0 then select SHIFT and SF keys.
• If still incorrect, notify next higher level maintenance.
Or displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.
OUCH displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.
P HI displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.
Ur displayed.
• Verify proper operating procedure (Chapter 2, Table 2-1).
• Notify next higher level maintenance.

Table 3-1. Troubleshooting—Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
2. VOLTMETER NOT OPERATING.
Step 1. Check to see if rear panel fuse is blown or broken.
• Replace rear panel fuse (para 3-7).
Step 2. Verify voltage selection wheel is installed and set for correct voltage.
• Reinstall voltage selection wheel (para 3-7).
• If correct, notify next higher level maintenance.
3. VOLTMETER NOT MEASURING.
Step 1. Verify operating procedure.
• Refer to paragraphs 2-1 through 2-12 for proper operating procedure.
Step 2. Verify computed functions selected are not causing malfunction.
• Refer to paragraph 2-13 for computed function operating procedure.
Step 3. Verify special functions selected are not causing malfunction.
• Refer to paragraph 2-14 for special function operating procedure.
• If correct, notify next higher level maintenance.

Section IV. MAINTENANCE PROCEDURES

3-7. REPLACE REAR PANEL FUSE.

DESCRIPTION

This procedure covers: Remove. Install.

REMOVE

1. Set POWER ON/OFF switch (1) to OFF.

2. Unplug power cable (2).

3. Pry receptacle cover (4) open.

4. Pull both fuse carrier (7) and fuse (8) out of fuseholder (3).

INSTALL

1. Insert fuse (8) into the fuse carrier (7).

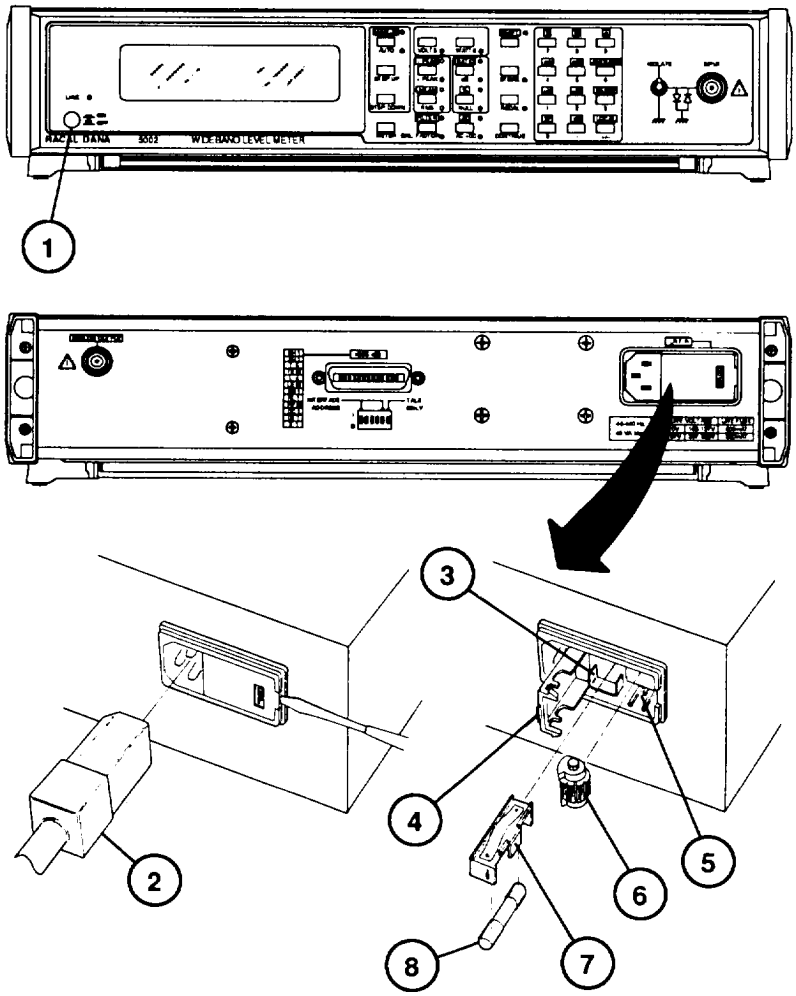
2. Insert both fuse carrier (7) with fuse (8) into fuseholder (3).

3. If necessary, reinstall voltage select wheel (6) with desired line voltage indicator facing out into receptacle (5).

4. Close receptacle cover (4).

5. Install power cable (2).

Set LINE ON/OFF switch (1) to ON .



END OF TASK

Section V. PREPARATION FOR STORAGE OR SHIPMENT

3-8. PACKAGING.

Package Voltmeter in original shipping container. When using packing materials other than the original, use the following guidelines:

- Wrap Voltmeter in non-static generating plastic packing material.
- Use double-wall cardboard shipping container.
- Protect all sides with shock-absorbing material to prevent Voltmeter movement within the container.
- Seal the shipping container with approved sealing tape.
- Mark “FRAGILE” on all sides, top, and bottom of shipping container.

3-9. TYPES OF STORAGE.

- Short-Term (administrative)=1 to 45 days.
- Intermediate=46 to 180 days.
- Long term=over 180 days. After long term storage, perform turn-on procedure (para 2-6). If this procedure fails, notify next higher level maintenance.

3-10. ENVIRONMENT.

The Voltmeter should be stored in a clean, dry environment. In high humidity environments, protect the Voltmeter from temperature variations that could cause internal condensation. The following environmental conditions apply to both shipping and storage:

Temperature	–40°C to +75°C
Relative Humidity	less than 95% at 40°C

CHAPTER 4
INTERMEDIATE DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

Intermediate Direct Support Maintenance Not Authorized for Volmeter ME-545/G.

CHAPTER 5
INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

5-1. COMMON TOOLS AND EQUIPMENT.

Common tools and equipment required for intermediate general support maintenance of Voltmeter ME-545/G are listed in the Maintenance Allocation Chart (MAC), Appendix B.

5-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

There are no special teals, TMDE, or support equipment required.

5-3. REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List, TM 11-6625-3200-24P.

Section II. SERVICE UPON RECEIPT

5-4. SERVICE UPON RECEIPT OF MATERIAL.

a. Unpacking. The Voltmeter is packed in its own shipping carton. Unpack the equipment as follows:

- Open shipping carton and remove equipment.
- Place Voltmeter on a suitable flat clean and dry surface far inspection.
- Keep all shipping materials far use in repacking and reshipping.

b. Checking Unpacked Equipment.

- Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364, Report of Discrepancy (ROD).
- Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA Pam 738-750.
- Check to see whether the equipment has been modified.

5-5. PRELIMINARY SERVICING AND ADJUSTMENT OF EQUIPMENT.

a. Perform Preliminary Servicing and Adjusting of Equipment (para 3-5) for Unit Maintenance.

b. Complete performance tests (para 5-16).

Section III. TROUBLESHOOTING

SYMPTOM INDEX

5-6. GENERAL.

Troubleshooting at the intermediate general support maintenance level requires you to locate any malfunction as quickly as possible. The amount of troubleshooting you can do is based on what the Maintenance Allocation Chart says you can fix. Because of this, the only trouble symptoms you will find here are those that could be caused by faulty items you can fix.

NOTE

- Before using the troubleshooting table, check your work order and talk to unit maintenance, if possible, for a description of the symptoms and the steps that have been taken to correct them.
- Check all forms and tags attached to, or accompanying, the equipment to determine the reason for removal from service.

5-7. TROUBLESHOOTING GUIDELINES.

The following is a list of aids that you can use when troubleshooting the Voltmeter:

a. The Voltmeter has built-in special functions that are used in troubleshooting. Procedures for special functions are specified in troubleshooting procedures.

b. Refer to the principles of operation, Chapter 1, Section Ill as required. This provides circuit theory of the assembly or section you are troubleshooting with references to the schematic diagrams. Functional Block diagrams are located in figures 1-2 thru 1-7. Functional Block diagram and assembly locator is located on figure FO-1. Schematic diagrams and assembly component locators are located on figures FO-2 thru FO-6.

c. Circuit cooler freezing compound (Appendix E, item 4) can be used in isolating problems. The most generally used method is to spray suspected components to see if the malfunction can be temporarily fixed. This can be used to isolate a bad component. This method will not work all the time, but it can be a great timesaver. It is especially helpful on intermittent problems that get worse with a rise in temperature.

d. Use signature analysis. The Signature Analyzer is a good troubleshooting tool when testing digital circuits to give ago/no-go test. Logic levels are 1 = ≥ +2.8V and 0 = ≤ +0.4V unless otherwise specified.

Many problems on Voltmeters that have been in service for awhile are caused by corrosion. Sometimes removing and reseating the affected cable will correct a malfunction. Cleaning connector pins and/or switch contacts with alcohol (Appendix E, item 1) will repair many types of digital and analog circuit malfunctions.

f. For microcircuit orientation, pin one is identified by a "1" on printed circuit board.

g. Use extender cables (Appendix B, Section III, item 12) as necessary for troubleshooting A2 and A3 Circuit Cards.

5-8. EQUIPMENT INSPECTION.

The following inspection procedures shall be used to locate obvious malfunctions with the Voltmeter.

a. Inspect all external surfaces of Voltmeter for physical damage, breakage, loose or dirty contacts, and missing components.

b. Remove top and bottom covers (para 5-27) and A2/A3 circuit card covers (para 5-26) as required to access components.

WARNING

Voltmeter contains high voltages. After power is removed, discharge capacitors to ground through 100Ω resistor before working inside Voltmeter to prevent electrical shock.

CAUTION

Do not disconnect or remove any board assemblies in the Voltmeter unless the instrument is unplugged. Some board assemblies contain devices that can be damaged if the board is removed when the power is on. Several components, including MOS devices, can be damaged by electrostatic discharge. Use conductive foam and grounding straps when servicing is required around sensitive components. Use care when unplugging IC'S from high-grip sockets.

c. Inspect printed circuit board surfaces for discoloration, cracks, breaks, and warping.

d. Inspect printed circuit board conductors for breaks, cracks, cuts, erosion, or looseness.

e. Inspect all assemblies for burnt or loose components.

f. Inspect all chassis-mounted components for looseness, breakage, loose contacts or conductors.

g. Inspect Voltmeter for disconnected, broken, cut, loose, or frayed cables or wires.

5-9. TROUBLESHOOTING TABLE.

The Troubleshooting table (table 5-1) lists common malfunctions which may be found during normal operation or maintenance of the Voltmeter or its components. You should perform the tests or inspections and corrective actions in the order listed.

NOTE

- After repair of ME-545/G verify malfunction is cleared. If not, perform the proper adjustment (table 5-2).
- All voltage readings referenced to A1TP4 (fig. FO-2 sheet 2) unless otherwise specified.
- See figure FO-1 for assembly and cable location diagram.

Table 5-1. Troubleshooting.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. Voltmeter Displays Errors.
Er 01 displayed.
Step 1. Press RECALL key, then number 0 key twice. Enter 97 . 1 using numeric keys. Press SHIFT then SF keys. Verify display shows <50µV and Ur.
• If incorrect, proceed with step 3.
Step 2. Using Digital Voltmeter, verify BT1 voltage ≥ 2.5Vdc (fig. FO-2, sheet 2).
• If correct, Voltmeter is operational.
• If incorrect, replace BT1 (para 5-36).
Step 3. Troubleshoot around RAM A1U20 and U21 using (fig. FO-2, sheet 4).
• Replace faulty component.
Er 20 displayed.
Step 1. Perform Al Processor Test (para 5-11) signature analysis (signal A0 to A13).
• Replace faulty component.
Step 2. Troubleshoot around RAM A1U20 and U21 circuit using (fig. FO-2, sheet 4).
• Replace faulty component.
Er 23 displayed.
Step 1. Perform Al Processor Test (para 5-11) signature analysis (signal A0 to All).
• Replace faulty component.
Step 2. Troubleshoot around ROM A1U16 circuit using (fig. FO-2, sheet 4).
• Replace faulty component.
Er 24 displayed.
Step 1. Perform Al Processor Test (para 5-11) signature analysis (signal A0 to All).
• Replace faulty component.
Step 2. Troubleshoot around ROM A1U17 circuit using (fig. FO-2, sheet 4).
• Replace faulty component.
Er 25 displayed.
Step 1. Perform Al Processor Test (para 5-11) signature analysis (signal A0 to All).
• Replace faulty component.
Step 2. Troubleshoot around ROM A1U18 circuit using (fig. FO-2, sheet 4).
• Replace faulty component.

Table 5-1. Troubleshooting — Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. Voltmeter Displays Errors — Continued.

   Er 26 displayed.

   Step 1. Perform Al Processor Test (para 5-11) signature analysis (signal A0 to A11).

   • Replace faulty component.

   Step 2. Troubleshoot around ROM A1U19 circuit using (fig. FO-2, sheet 4).

   • Replace faulty component.

2. All ME-545/G Failures.

   Step 1. Set LINE switch to OFF.

   • Disconnect all external cables except power cable.

   Step 2. Set LINE switch to ON. Verify front panel line indicator turns on.

   • If indications are correct, proceed with step 4.

   Step 3. Perform Power Supply Test (para 5-10).

   • Replace faulty component.

   Step 4. Verify Voltmeter performs correct turn-on (para 2-6).

   • If Turn-on correct, proceed with step 5.

   • If “Er” errors displayed, perform malfunction number 1.

   • If display blank or incorrect, perform A4 Keyboard/Display Test (para 5-14).

   • If keyboard inoperative, perform A4 Keyboard/Display Test (para 5-14).

   Step 5. Complete performance tests (para 5-16).

   • If ail performance test pass, unit is operational.

   • If performance tests fail, troubleshoot malfunction using table 5-1, malfunctions 3 through 15.

NOTE

Complete as many performance tests as possible to assist in isolating malfunction.

   • If malfunction is only in remote operation mode, perform A5/A6 GPIB Test (para 5-15).

Table 5-1. Troubleshooting — Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
3. True RMS Test Failure.
Step 1. Adjust RMS Detector (para 5-26).
Step 2. Perform A2 Detector Test (para 5-12).
• Replace faulty component.
Step 3. Perform A3 Amplifier Test (para 5-13).
• Replace faulty A3 Circuit Card Assembly (para 5-32).
Step 4. Perform A1 Processor Test (para 5-11).
• Replace faulty component.
4. Mean Test Failure.
Step 1. Adjust Mean Detector (para 5-24).
Step 2. Perform A2 Detector Test (para 5-12).
• Replace faulty component.
Step 3. Perform A3 Amplifier Test (para 5-13).
• Replace faulty A3 Circuit Card Assembly (para 5-32).
Step 4. Perform Al Processor Test (para 5-11).
•l Replace faulty component.
5. Peak Test Failure.
Step 1. Adjust Peak Detector (para 5-25).
Step 2. Perform A2 Detector Test (para 5-12).
•l Replace faulty component.
Step 3. Perform A3 Amplifier Test (para 5-13)
• Replace faulty A3 Circuit Card Assembly (para 5-32).
Step 4. Perform A1 Processor Test (para 5-11).
• Replace faulty component.
6. DC Coupling Test Failure.
Step 1. Adjust DC Response (para 5-23).
Step 2. Perform A3 Amplifier Test (para 5-13).
• Replace faulty A3 Circuit Card Assembly (para 5-32).
Step 3. Perform A2 Detector Test (para 5-12).
• Replace faulty component.
Step 4. Perform A1 Processor Test (para 5-11).
• Replace faulty component.

Table 5-1. Troubleshooting — Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
7. Range Selection Test Failure.
Step 1. Adjust Low/Mid Frequency Response (para 5-21).
Step 2. Perform A3 Amplifier Test (para 5-13).
•Replace faulty A3 Circuit Card Assembly (para 5-32).
Step 3. Perform Al Processor Test (para 5-11).
•Replace faulty component.
8. Display and Resolution Test Failure.
Step 1. Adjust Low/Mid Frequency Response (para 5-21).
Step 2. Perform A3 Amplifier Test (para 5-13).
•Replace faulty A3 Circuit Card Assembly (para 5-32).
Step 3. Perform A4 Keyboard/Display Test (para 5-14).
•Replace faulty A4 Circuit Card Assembly (para 5-33).
9. dB Range Test Failure.
Step 1. Adjust Low/Mid Frequency Response (para 5-21).
Step 2. Perform A3 Amplifier Test (para 5-13).
•Replace faulty A3 Circuit Card Assembly (para 5-32).
Step 3. Perform Al Processor Test (para 5-11).
•Replace faulty component.
10. Voltage Accuracy Test Failure.
Step 1, Adjust Low/Mid Frequency Response (para 5-21).
Step 2. Adjust High Frequency Response (para 5-22).
Step 3. Perform A3 Amplifier Test (para 5-13).
•Replace faulty A3 Circuit Card Assembly (para 5-32).
Step 4. Perform A2 Detector Test (para 5-12).
•Replace faulty component.
Step 5. Perform Al Processor Test (para 5-11).
•Replace faulty component.
11. Response Time Test Failure.
Perform A2 Detector Test (para 5-12).
•Replace faulty component.
12. Input Connector Test Failure.
Troubleshoot around CR1 using (fig. FO-4, sheet 1).
•Replace faulty component.

Table 5-1. Troubleshooting — Continued.

MALFUNCTION TEST OR INSPECTION	CORRECTIVE ACTION
13. Common Mode Voltage Test Failure. Troubleshoot around CR1 using (fig. FO-4, sheet 1).	• Replace faulty component.
14. Common Mode Rejection Test Failure. Troubleshoot around CR1 using (fig. FO-4, sheet 1).	• Replace faulty component,
15. DC Output Test Failure. Perform A2 Detector Test (para 5-12).	• Replace faulty component.

5-10. POWER SUPPLY TEST.

DESCRIPTION

This test is used to correct a malfunction in the Power Supply Circuits (fig. FO-2, sheet 1).

WARNING

Dangerous voltages are present whenever power is applied to rear panel regardless of line switch position.

1. Connect ME-545/G power cable to Variable AC Power Supply.
2. Set Variable AC Power Supply to provide 120Vac.
3. On ME-545/G,
   - Set line voltage selection wheel to 120V (para 3-5).
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
4. Set Variable AC Power Supply output to the levels and verify ME-545/G voltages as displayed on Digital Voltmeter are within specified limits at the test points shown (fig. FO-2, sheet 2 for Al, fig-. FO-3, sheet 1 for A2). Use A1TP4 for ground.

VARIABLE AC POWER SUPPLY	ME-545/G TEST POINT	DIGITAL VOLTMETER READING
120Vac	A2TP16	+14.5 to +15.5Vdc
120Vac	A2TP2	–14.5 to –15.5Vdc
120Vac	A1TP3	+4.75 to +5.25Vdc
120Vac	A1R34 pin 1	+8.3 to +10.3Vdc
120Vac	A1TP10	+4.5 to +5.3Vdc
103Vac	A2TP16	+14.4 to +15.4Vdc
103Vac	A2TP2	–14.4 to –15.4Vdc
103Vac	A1TP3	+4.65 to +5.15Vdc
103Vac	A1R34 pin 1	+8.2 to +10.2Vdc
127Vac	A2TP16	+14.6 to +15.6Vdc
127Vac	A2TP2	–14.6 to –15.6Vdc
127Vac	A1TP3	+4.85 to +5.35Vdc
127Vac	A1R34 pin 1	+8.4 to +10.4Vdc

   - If incorrect, perform Adjust Power Supply (para 5-19). If adjustment does not correct problem, proceed with step 5.
5. Troubleshoot all other malfunctions in the Power Supply circuit using figure FO-2, sheet 1.
   - Replace faulty component.
6. Remove power and disconnect test equipment. Set voltage selection wheel to line voltage available (para 3-5).

5-11. A1 PROCESSOR TEST.

DESCRIPTION

This test is used to correct a malfunction in the Al Processor Circuit Card Assembly (fig. FO-2, sheet 1 to 4).

SIGNATURE ANALYSIS TEST

CAUTION

Use care when checking signatures on ROM, RAM, and Microprocessor circuits as these devices are static sensitive.

1. On ME-545/G,
   - Set LINE ON/OFF to OFF.
   - Remove A5 Circuit Card Assembly (para 5-34).
   - Cut cable ties and remove A1U11 and A1U12 (fig. FO-2, sheet 2).
   - Jumper A1U43 pin 10 to pin 14.
   - Jumper A1TP8 to TP4.
   - Set A1S30 position 1 to on. Set positions 2 to 8 to off.
2. Connect Signature Analyzer as follows:

   CLOCK A1Tp5
   STOP A1TP11
   START A1TP11
   GROUND A1TP4
3. On ME-545/G,
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
4. Set Signature Analyzer controls as follows:

   CLOCK . . . . . on falling edge
   STOP . . . . . on rising edge
   START . . . . . on rising edge

5-11. AI PROCESSOR TEST — SIGNATURE ANALYSIS TEST — Continued.

5. Verify signatures are as shown below.

IC and pin number	Signal	Signature	Note
A1TP6	U26 Enable	6H49	
A1U16 pin 18	R1	F2A6	
A1U17 pin 18	R2 ROM	PC01	
A1U18 pin 18	R3 Enable	12U3	
A1U19 pin 18	R4	4POA	
A1U23 pin 3	A6	52F8	
A1U23 pin 5	A4	OAFA	
A1U23 pin 7	A2	7F7F	
A1U23 pin 9	A0	5555	
A1U23 pin 12	A1	CCCC	
A1U23 pin 14	A3	5H21	
A1U23 pin 16	A5	UPFH	
A1U23 pin 18	A7	HC89	
A1U24 pin 3	A8	2H70	
A1U24 pin 7	A11	HAP7	
A1U24 pin 9	A10	1293	
A1U24 pin 14	A9	HPPO	
A1U25 pin 1	A12	3C96	
A1U25 pin 2	A13	3827	
A1U26 pin 4	RAM ENABLE	A8C1	
A1U26 pin 9	U22 pin 29 Enable	H814	
A1U26 pin 10	U34 ENABLE	86F3	
A1U26 pin 11	$\overline{\text{OPE}}$	47F9	
A1U26 pin 12	Keyboard Service Enable	HFP6	
A1U27 pin 8	ROW 1 SCAN	6F35	2
A1U27 pin 8	ROW 2 SCAN	495A	2
A1U27 pin 8	ROW 3 SCAN	AP73	2
A1U27 pin 8	ROW 4 SCAN	U45C	2
A1U29 pin 3	Data Bus	0000	3
A1U29 pin 5	Data Bus	0000	3
A1U29 pin 7	Data Bus	0000	3
A1U29 pin 9	Data Bus	0001	3
A1U29 pin 12	Data Bus	0000	3
A1U29 pin 14	Data Bus	0000	3
A1U29 pin 16	Data Bus	0000	3
A1U29 pin 18	Data Bus	0000	3
A1U32 pin 10		C3C6	
A1U32 pin 11		FPHH	
A1U32 pin 12	CLOCKS	3C72	
A1U32 pin 13	SERIAL DATA	PHFP	
A1U32 pin 14		C73F	
A1U32 pin 15		HFU5	
A1U34 pin 12	GPIB ENABLE	PHHO	
A1U34 pin 14	U11 ENABLE	UFUA	
A1U34 pin 15	U12 ENABLE	OP84	
A1U36 pin 12	Keyboard Service Enable	HFP7	
A1U37 pin 3	ROW 4 SCAN	U45A	1
A1U37 pin 6	ROW 2 SCAN	495C	1
A1U37 pin 8	ROW 1 SCAN	6F34	1
A1U37 pin 11	ROW 3 SCAN	AP72	1

5-11. A1 PROCESSOR TEST — SIGNATURE ANALYSIS TEST — Continued.

NOTE

1 The same ROW SCAN signature is obtained when any key in a row is pressed. A check of every key within each row should be made. Top row is one, bottom is four.

2 A signature is obtained at A1U27 pin 8 when any key is pressed. Although the probe is applied to a single point, each key row has its own signature. A check of every key within each row should be made. Top row is one, bottom is four.

3 The data bus signatures depend upon the hardware build state of the instrument and the issue number of the software fitted. For this reason no table of signatures is given. It is essential that the ROMS fitted belong to the same hardware compatible set, that they are of the same issue number, and that they are fitted in the correct positions. Select special function 81.0 during turn-on to display software issue number. Press CONTINUE key to clear display.

- If incorrect, troubleshoot using figure FO-2, sheets 1 to 4. Replace faulty component.

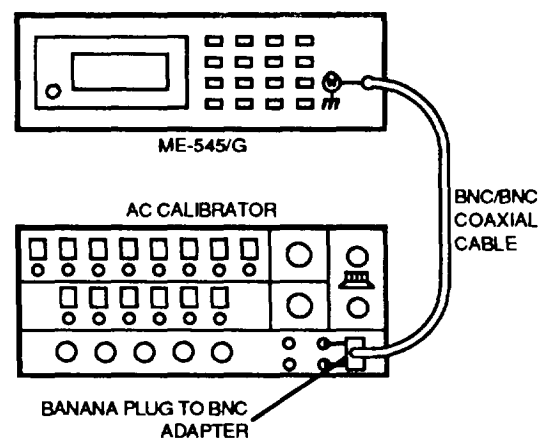
6. Remove power and disconnect Signature Analyzer.
7. On ME-545/G,
   - Set LINE ON/ OFF to OFF.
   - Install A1U11 and A1U12 using cable ties (Appendix E, item 5).
   - Remove jumper connected to A1U43 pin 10 to pin 14 and A1TP8 to TP4.
   - Set A1S30 position 8 to on. Set positions 1 to 7 to off.
   - Reinstall A5 Circuit Card Assembly (para 5-34).
   - Set LINE ON/ OFF to ON.
8. Troubleshoot all other malfunctions in the Al Processor Circuit Card using figure FO-2, sheets 1 to 4.
   - Replace faulty component.
9. Remove power and disconnect test equipment.

5-12. A2 DETECTOR TEST.

DESCRIPTION

This test is used to correct a malfunction in the A2 Detector Circuit Card Assembly (fig. FO-3).

1. Connect test equipment as shown.



2. Set AC Calibrator output to 316.2mVrms at 1kHz.
3. On ME-545/G,
   - Set ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Using STEP UP/DOWN keys, select 316.2mV range.
   - Press CONTINUE key.
   - Verify AC selected (LED on),
   - Verify VOLTS selected (LED on).
   - Verify RMS selected (LED on).
4. Troubleshoot A2 Detector Circuit Card Assembly using figure FO-3, sheets 1 and 2,
   ❩ Replace faulty component.

NOTE

Malfunction of detector or auto zero circuit may be caused by Al Processor Assembly. Perform Al Processor Test Signature Analysis of A1U11, U12, and U34 as required.

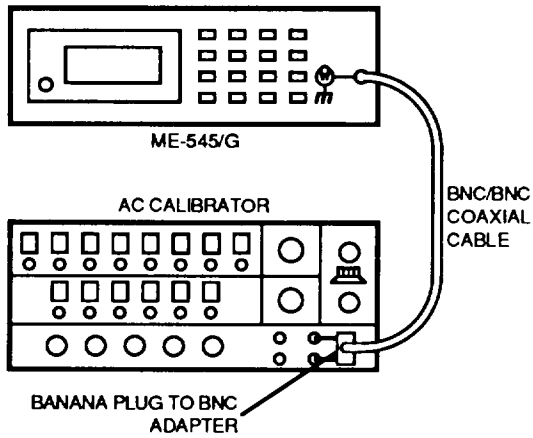
5. Remove power and disconnect test equipment.

5-13. A3 AMPLIFIER TEST.

DESCRIPTION

This test is used to correct a malfunction in the A3 Amplifier Circuit Card Assembly (fig. FO-4).

1. Connect test equipment as shown.



2. Set AC Calibrator output to 316.2mVrms at 1kHz.
3. On ME-545/G,
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Using STEP UP/DOWN keys, select 316.2mV range,
   - Press CONTINUE key.
   - Verify AC selected (LED on).
   - Verify VOLTS selected (LED on),
   - Verify RMS selected (LED on).
4. Troubleshoot A3 Amplifier Circuit Card Assembly using figure FO-4, sheets 1 and 2.
   - Replace faulty A3 Circuit Card Assembly (para 5-32).

NOTE

- It may be necessary to remove shield (para 5-32) to make measurements.
- Special Function 99.1 selects 3 V range using 60 dB, 20 dB and 10 dB attenuators (Relays KB, KD, KH, KJ, KK and KL energized) for troubleshooting, Press VOLTS key to resume normal operation.
- Malfunction of range, detector, input coupling or filter selection may be caused by Al Processor Assembly, Perform Al Processor Test Signature Analysis of A1U11, U12, and U34 as required.

5. Remove power and disconnect test equipment.

5-14. A4 KEYBOARD/DISPLAY TEST.

DESCRIPTION

This test is used to correct a malfunction in the A4 Keyboard/Display Circuit Card Assembly (fig. FO-5).

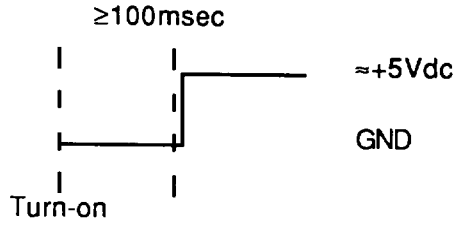
CAUTION

Use care when checking signatures on certain microcircuits as some of these devices are static sensitive.

1. Verify that Al Processor Assembly is not causing malfunction using indications as specified below.

MALFUNCTION OF SOME DISPLAY/LED INDICATORS

1. Verify that **RESET** pulse occurs (only once) at A1U30 pin 40 (fig. FO-2, sheet 2) when LINE switch is set to ON.
2. Verify that A1TP9 is logic 'O'.
3. Perform Al Processor Signature Analysis (para 5-11) on the following components:



IC and pin number	Signal		Note
A1U16-19 pin 1	A7	HC89	
A1U16-19 pin 2	A6	52F8	
A1U16-19 pin 3	A5	UPFH	
A1U16-19 pin 4	A4	OAFA	
A1U16-19 pin 5	A3	5H21	
A1U16-19 pin 6	A2	7F7F	
A1U16-19 pin 7	A1	CCCC	
A1U16-19 pin 8	A0	5555	
A1U16-19 pin 19	A10	1293	
A1U16-19 pin 21	A11	HAP7	
A1U16-19 pin 22	A9	HPPO	
A1U16-19 pin 23	A8	2H70	
A1U32 pin 4	$\overline{\text{OPE}}$	47F9	
A1U32 pin 10		C3C6	
A1U32 pin 11		FPHH	
A1U32 pin 12	CLOCKS	3C72	
A1U32 pin 13	SERIAL DATA	PHFP	
A1U32 pin 14		C73F	
A1U32 pin 15		HFU5	

- If incorrect, troubleshoot using figure FO-2, sheets 1 to 4 and figure FO-5. Replace faulty component/assembly.

5-14. A4 KEYBOARD/DISPLAY TEST — MALFUNCTION OF ALL DISPLAY/LED INDICATORS

1. Verify that a 30Hz waveform with 50% duty cycle is at A1U33 pin 10 (fig. FO-2, sheet 2).
2. Perform Al Processor Signature Analysis (para 5-11) on the following components:

IC and pin number	Signal	Signature	Note
A1U32 pin 1	A0	5555	
A1U32 pin 2	A1	CCCC	
A1U32 pin 3	A2	7F7F	
A1U32 pin 4	$\overline{OPE}$	47F9	
A1U32 pin 10		C3C6	
A1U32 pin 11		FPHH	
A1U32 pin 12	CLOCKS	3C72	
A1U32 pin 13	SERIAL DATA	PHFP	
A1U32 pin 14		C73F	
A1U32 pin 15		HFU5	

- If incorrect, troubleshoot using figure FO-2, sheets 1 to 4 and figure FO-5. Replace faulty component/assembly.

MALFUNCTION OF KEYBOARD

1. Perform A1 Processor Signature Analysis (para 5-11) on the following components:

IC and pin number	Signal	Signature	Note
A1U27 pin 8	ROW 1 SCAN	6F35	2
A1U27 pin 8	ROW 2 SCAN	495A	2
A1U27 pin 8	ROW 3 SCAN	AP73	2
A1U27 pin 8	ROW 4 SCAN	U45C	2
A1U28 pin 19	Keyboard Service Enable	HFP6	
A1U37 pin 9	**Keyboard Service Enable**	HFP7	
A1U37 pin 3	ROW 4 SCAN	U45A	1
A1U37 pin 6	ROW 2 SCAN	495C	1
A1U37 pin 8	ROW 1 SCAN	6F34	1
A1U37 pin 11	ROW 3 SCAN	AP72	1

NOTE

1 The same ROW SCAN signature is obtained when any key in a row is pressed. A check of every key within each row should be made. Top row is one, bottom is four.

2 A signature is obtained at A1U27 pin 8 when any key is pressed. Although the probe is applied to a single point, each key row has its own signature. A check of every key within each row should be made. Top row is one, bottom is four.

- If incorrect, troubleshoot using figure FO-2, sheets 1 to 4 and figure FO-5. Replace faulty component/assembly.

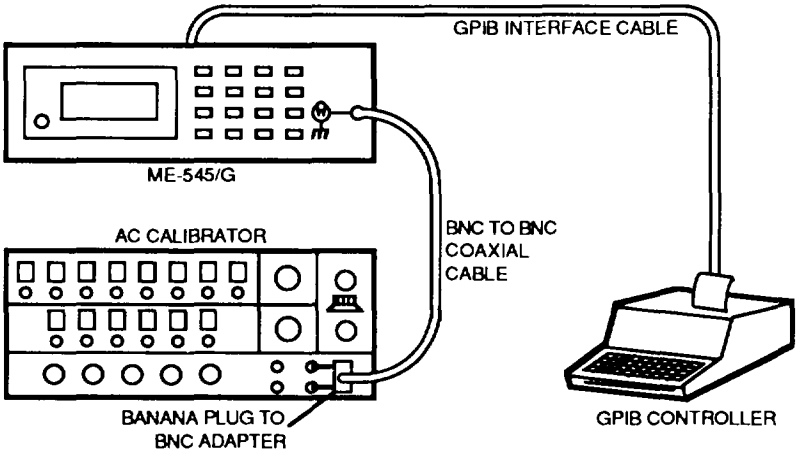
2. Troubleshoot all other malfunctions using figure FO-5.
   - Replace faulty assembly.
3. Remove power and disconnect test equipment.

5-15. A5/A6 GPIB TEST.

DESCRIPTION

This test is used to correct a malfunction in the A5 GPIB and A6 GPIB Interconnect Circuit Card Assemblies (fig. FO-6).

1. Connect test equipment as shown.



2. Set AC Calibrator output to 1.000Vrms at 1kHz.
3. On ME-545/G,
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE,
   - Record present setting and set rear panel address switch to address 1.
4. On Controller, enter and run a program to perform the following functions:

   Reset the Voltmeter.

   Read Vrms.

   Display Vrms.

   Repeat read and display.

   The following example is for an HP 85 controller.

```
10   OUTPUT 701; "B 00"
20   ENTER  701; A$
30   DISP       A$
40   GOTO    20
```

5. Verify ME-545/G displays REMOTE and TALK. Verify ME-545/G reading is repeated at Controller display.
   - If incorrect, perform SIGNATURE ANALYSIS TEST below.

5-15. A5/A6 GPIB TEST — Continued.

6. On ME-545/G rear panel, set the address switch position six to on. Verify the front panel TALK indicator appears in the display.
   - If incorrect, verify A1S30 position 8 is on. If correct, replace A5 GPIB Circuit Card Assembly (para 5-34).
7. On ME-545/G rear panel, set the address switch position six to off.
8. If malfunction still exists, perform SIGNATURE ANALYSIS TEST below.
   - If incorrect, replace A5 GPIB Circuit Card Assembly (para 5-34).
9. Remove power and disconnect test equipment.

SIGNATURE ANALYSIS TEST

CAUTION

Use care when checking signatures on GPIB circuits as some of these devices are static sensitive.

1. On ME-545/G,
   - Set LINE ON/OFF to OFF.
   - Remove A5 Circuit Card Assembly (para 5-34).
   - Cut cable ties and remove A1U1l and A1U12 (fig. FO-2, sheet 2).
   - Cut cable tie and remove A5U2 (fig. FO-6).
   - Jumper A1U43 pin 10 to pin 14.
   - Jumper Al TP8 to TP4.
   - Set A1S30 positions 1 to on. Set positions 2 to 8 to off.
2. Connect Signature Analyzer as follows:

   CLOCK A1TP5
   STOP A1TP11
   START A1TP11
   GROUND A1TP4

3 On ME-545/G,
   - Reconnect A5 Circuit Card Assembly cables (para 5-34).
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
4. Set Signature Analyzer controls as follows:

   CLOCK . . . . . on falling edge
   STOP . . . . . on rising edge
   START . . . . . on rising edge

5-15. A5/A6 GPI3 TEST — SIGNATURE ANALYSIS TEST — Continued.

5. Verify signatures are as shown below.

IC and pin number	Signal	Signature	Note
A5U11 pin 6	U2 SELECT	341A	
A5U14 pin 4	$\overline{A3}$	5H20	
A5U14 pin 6	GPIB ENABLE	PHH1	
A5U15 pin 11	U9b ENABLE	8304	
A5U15 pin 12	U7a RESET	OF15	
A5U15 pin 13	U9a ENABLE	3052	
A5U15 pin 14	U10a CLOCK	F14U	
A5U15 pin 15	U10b CLOCK	053A	

NOTE

If signatures incorrect, verify Al Processor Assembly (para 5-1) signatures are correct before replacing A5 GPIB Assembly.

- If incorrect, troubleshoot using figure FO-6. Replace faulty assembly.

6. Remove power and disconnect Signature Analyzer.
7. On ME-545/G,
   - Set LINE ON/OFF to OFF.
   - Disconnect A5 Circuit Card Assembly cables (para 5-34).
   - Install A1U11, A1U12, and A5U2 using cable ties (Appendix E, item 5).
   - Remove jumper connected to A1U43 pin 10 to pin 14 and A1TP8 to TP4.
   - Set A1S30 position 8 to on. Set positions 1 to 7 to off.
   - Reinstall A5 Circuit Card Assembly (para 5-34).
   - Set LINE ON/OFF to ON.
   - Return rear panel address switch to recorded setting above.
8. Troubleshoot all other malfunctions in the A5 GPIB and A6 GPIB Interconnect Circuit Cards using figure FO-6.
   - Replace faulty assembly.
9. Remove power and disconnect test equipment.

Section IV. MAINTENANCE PROCEDURES

5-16. PERFORMANCE TEST.

DESCRIPTION

This procedure covers:

- True RMS Test.
- Peak Test.
- Range Selection Test.
- dB Range Test.
- Response Time Test.
- Common Mode Voltage Test.
- DC Output Test.
- Mean Test.
- DC Coupling Test.
- Display and Resolution Test.
- Voltage Accuracy Test.
- Input Connector Test.
- Common Mode Rejection Test.

NOTE

- Performance test procedure steps should be done in the order given.
- ep test equipment interconnecting cables as short as possible. Performance tests must be completed with all covers installed.
- A performance test checklist is provided at the end of the performance test procedures. Use the checklist while doing the test procedures.
- To guarantee specifications listed in Chapter 1, performance tests must be completed within the temperature range of +18°C to +28°C (+64°F to +82°F).
- Allow an initial 30 minute warm-up period when performing the first performance test to allow the Voltmeter to stabilize.
- Allow Voltmeter 10 minutes to stabilize if turned off during performance tests for less than 30 minutes.
- The initialized setup of Voltmeter controls and indicators is to be performed prior to each performance test.

INITIALIZED SETUP.

1. Initialization of Voltmeter controls and indicators is accomplished by selecting LINE switch to OFF then to ON, or pressing RECALL key, then number 0 key twice.
2. Initialized state of Voltmeter should be as follows:

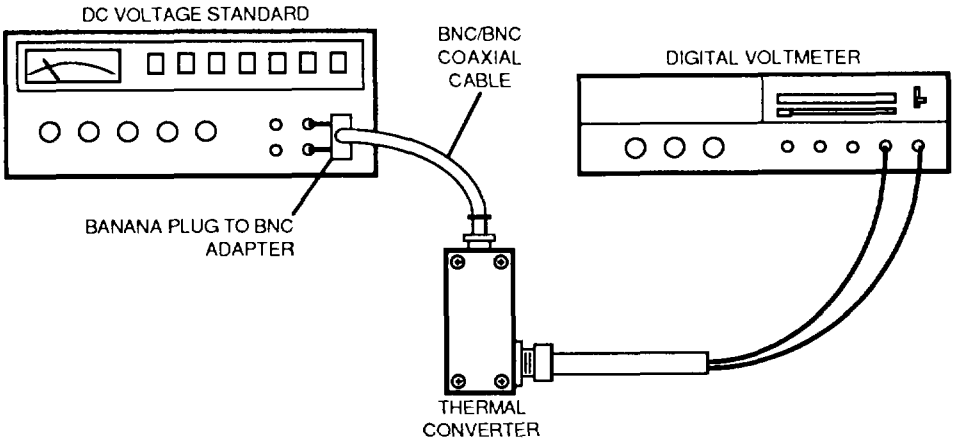
DISPLAY	Analog meter and either “Ur” or random numbers
LINE indicator	ON
AUTO LED	ON
VOLTS LED	ON
RMS LED	ON
AC LED	ON
All other indicators	OFF
CAL FACTOR key	1.000*
RATIO key	1.000V/1.667mW**
dB key	774.6mV/999.9µW*
% key	1.000V/1.667mW**
NULL key	1.000V/1.667mW*
SF key	0**
Ω key	600.0Ω **
AVERAGE key	1.0S**
LOCAL	15**

- Default value. Press RECALL then key to display value(s). Press CONTINUE to clear display. Volts displayed if VOLTS key is selected, or power displayed if WATTS key is selected,

** Default value. Press RECALL. SHIFT then key to display value(s). Press CONTINUE to clear display. Volts displayed if VOLTS key is selected, or power displayed if WATTS key is selected.

TRUE RMS TEST.

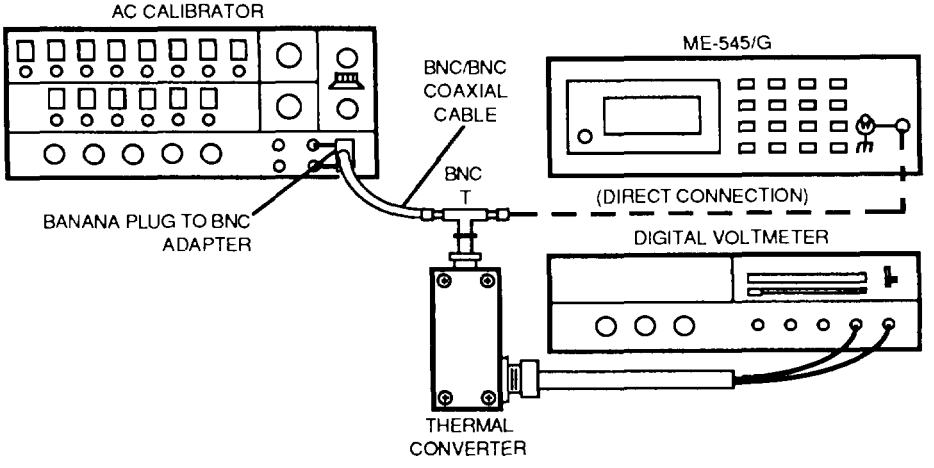
1. Connect test equipment as shown.



2. Set DC Voltage Standard output to 1.000Vdc.
3. Measure and record to three decimal places Thermal Converter DC output as indicated on Digital Voltmeter.
4. Connect test equipment as shown.

NOTE

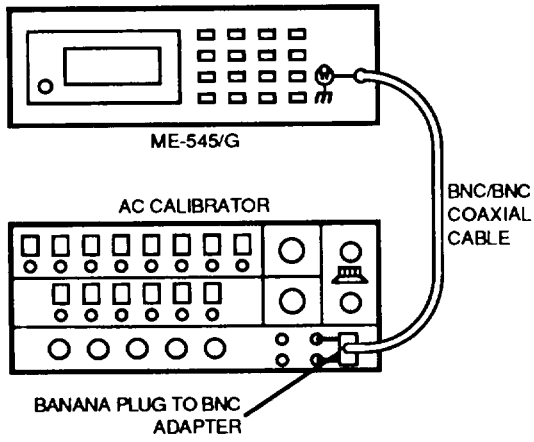
Connect the Thermal Converter directly to the ME-545/G input.



5. Set AC Calibrator output to 1.000Vrms at 1kHz.
6. On ME-545/G,
   - Verify LINE ON/OFF to ON,
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE,
7. Adjust AC Calibrator output level until Thermal Converter DC output as indicated on Digital Voltmeter is the same as recorded in step 3.
8. Verify ME-545/G display reads 1.000V ±0.030V.
9. Disconnect test equipment.

MEAN TEST.

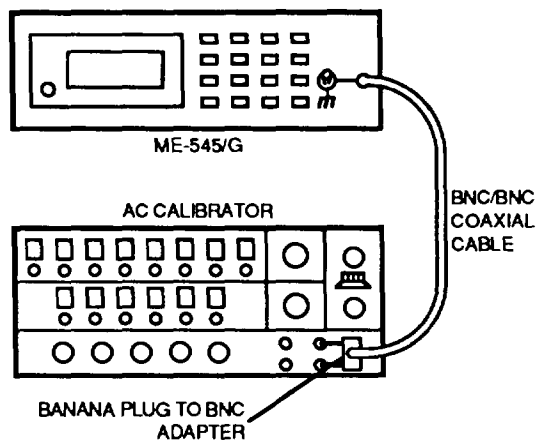
1. Connect test equipment as shown.



2. Set AC Calibrator output to 111.10mVrms at 1kHz.
3. On ME-5451G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 100mV range.
   - Press CONTINUE key.
   - Select MEAN key.
   - Verify ME-545/G display reads 100mV ±5mV.
4. Set AC Calibrator output to 351.30 mVrms at 1kHz.
5. On ME-5451G,
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 316.2m V range.
   - Press CONTINUE key.
   - Verify ME-545/G display reads 316.2mV ±15.8mV.

PEAK TEST.

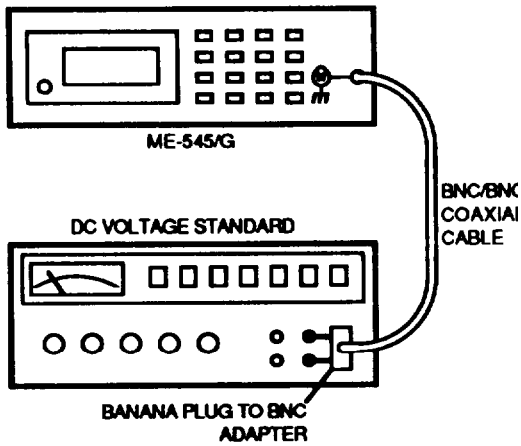
1. Connect test equipment as shown.



2. Set AC Calibrator output to 70.71mVrms at 1kHz.
3. On ME-545/G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 100mV range.
   - Press CONTINUE key.
   - Select +PEAK key.
   - Verify ME-545/G display reads 100mV ±5mV.
4. On ME-545/G,
   - Select –PEAK key.
   - Verify ME-545/G display reads -100mV ±5mV.
5. Set AC Calibrator output to 223.61mVrms at 1kHz.
6. On ME-545/G,
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 316.2mV range.
   - Press CONTINUE key.
   - Verify ME-545/G display reads -316.2mV ±15.8mV.
7. On ME-545/G,
   - Select +PEAK key.
   - Verify ME-545/G display reads 316.2mV ±15.8mV,
8. Disconnect test equipment.

DC COUPLING TEST.

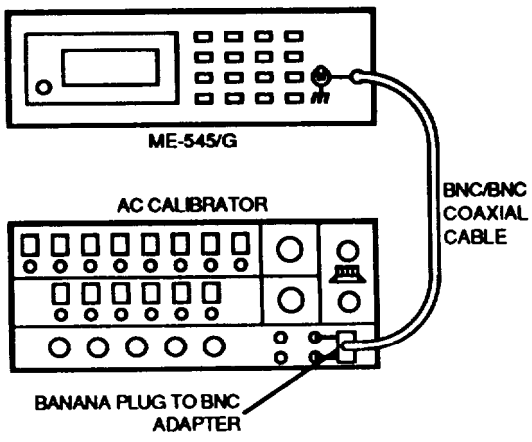
1. Connect test equipment as shown.



2. Set DC Voltage Standard output to 1.000Vdc.
3. On ME-545/G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 1.000V range.
   - Press CONTINUE key.
   - Select AC+DC key.
   - Select MEAN key.
   - Verify ME-545/G display reads +l .000V ±0.020V.
4. Disconnect test equipment.

RANGE SELECTION TEST.

1. Connect test equipment as shown.

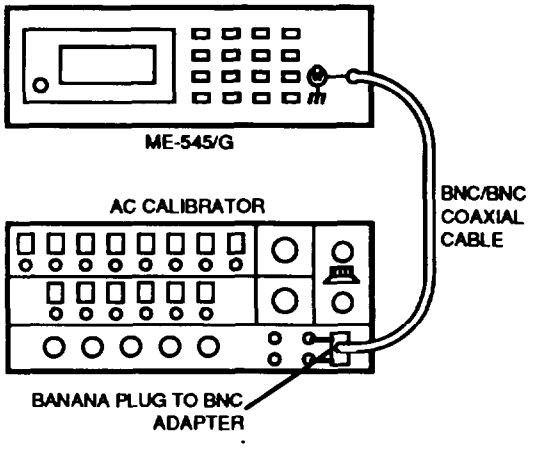


RANGE SELECTION TEST - Contlnued.

2. Set AC Calibrator output to 1 .000Vrms at 1 kHz.
3. On ME-545/G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Verify ME-545/G display reads 1 .000V ±0.030V.
   - Select MANUAL key.
4. Set AC Calibrator output to l.l00Vrms at 1 kHz.
5. On ME-545/G, verify display indicates “Or’.
6. Set AC Calibrator output to 270mVrms at 1kHz.
7. On ME-545/G, verify display indicates ‘Ur”.

DISPLAY AND RESOLUTION TEST.

1. Connect test equipment as shown.



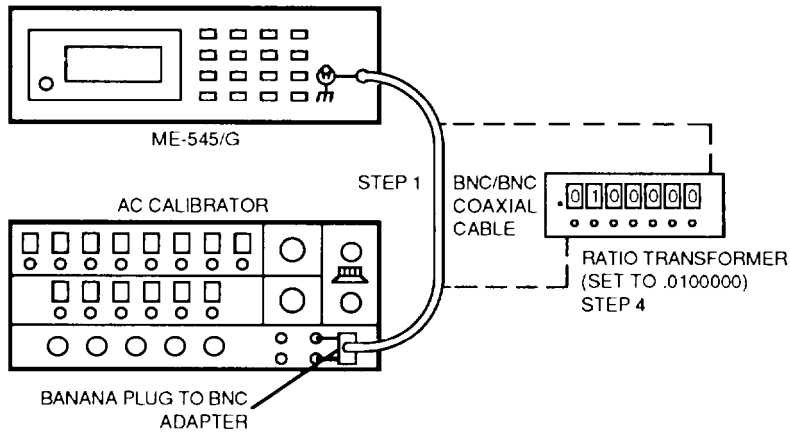
2. Set AC Calibrator output to l.000Vrms at 1kHz.

DISPLAY AND RESOLUTION TEST — Continued.

3. On ME-545/G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice,
   - Set ISOLATE switch to ISOLATE.
   - Enter 9 8. 1 using numeric keys, select SHIFT key, then press SF key.
   - Verify all display indicators are shown.
   - Enter 0 using numeric keys, select SHIFT key, then press SF key.
4. On ME-545/G, record the number of coarse segments displayed on the analog meter top scale (coarse).
5. Set AC Calibrator output to 0.990Vrms at 1kHz.
6. On ME-545/G,
   - Verify the number of coarse segments displayed on the analog meter top scale decreased by one from number recorded in step 5.
   - Record the numeric display value.
7. Set AC Calibrator output to 0.991 Vrms at 1kHz.
8. On ME-545/G, verify the value shown in the display increased by 1mV from value recorded in step 7.

dB RANGE TEST.

1. Connect test equipment as shown.



2. Set AC Calibrator output to 31.62mVrms at 1kHz

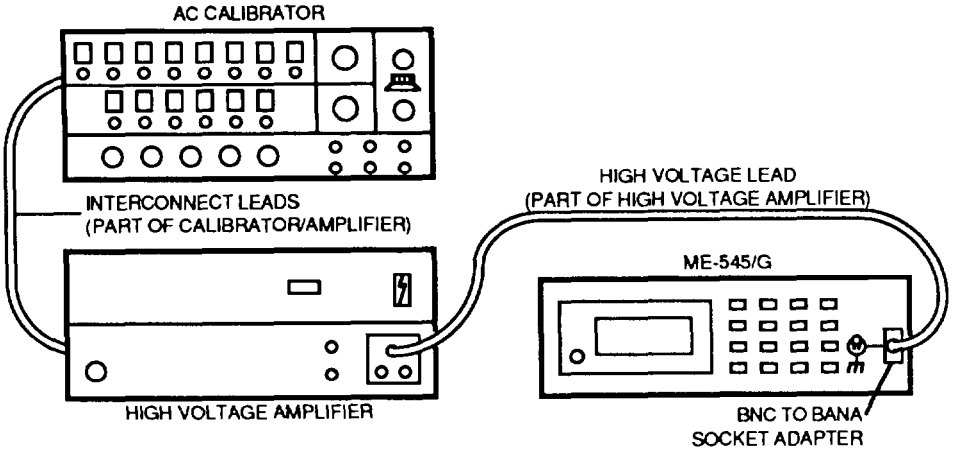
dB RANGE TEST — Continued.

3. On ME-545/G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 31.62mV range.
   - Press CONTINUE key.
   - Record display reading.
4. Connect test equipment as shown previously.
5. Set AC Calibrator controls as follows:
   - Output to 3.162Vrms at 1kHz.
   - Adjust CALIBRATE ERROR vernier until ME-545/G display indicates same value recorded in step 3.
6. On ME-545/G,
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 100µV range.
   - Press CONTINUE key.
7. Set AC Calibrator output to 10mVrms at 1kHz.

NOTE

ME-545/G display should indicate approximately 100µV.

8. On ME-545/G,
   - Select STORE key then press dB key.
   - Select dB key.
   - Verify display indicates 0 dB ±0.5dB.
   - Select AUTO key.
9. Connect test equipment as shown.

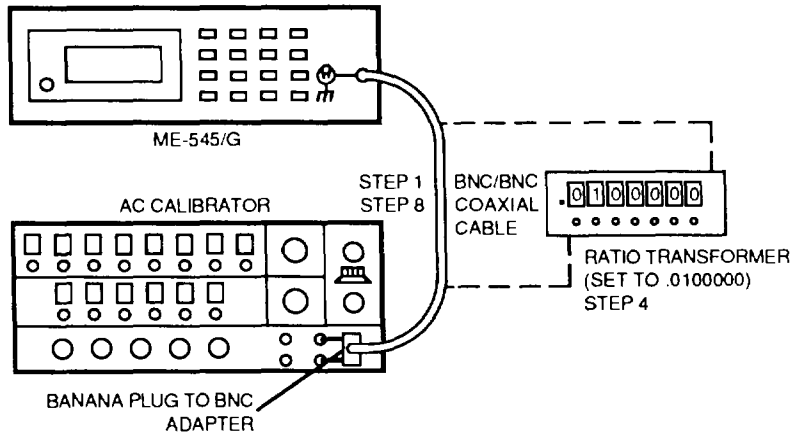


dB RANGE TEST — Continued.

10. Adjust AC Calibrator/High Voltage Amplifier output level to 316.000 Vrms at 1kHz
11. On ME-545/G, verify display reads +130dB ±1dB.
12. Disconnect test equipment.

VOLTAGE ACCURACY TEST.

1. Connect test equipment as shown.



2. Set AC Calibrator output to 31.62mVrms at 1kHz.
3. On ME-545/G,
   - Verify LINE ON/ OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 31.62m V range.
   - Press CONTINUE key.
   - Record display reading.
4. Connect test equipment as shown above.

VOLTAGE ACCURACY TEST — Continued

5. Set AC Calibrator controls as follows:

   .Output to 3.162Vrms at 1kHz.

   .Adjust CALIBRATE ERROR vernier until ME-545/G display indicates same value recorded in step 3.

NOTE

Do not readjust CALIBRATE ERROR vernier.

6. On ME-545/G,

   .Select AUTO key.

   .Select FILTER key (LED to ON),

7. Set AC Calibrator and ME-545/G controls as shown. Verify ME-545/G voltage readings are within specified limits.

AC CALIBRATOR FREQ	AC CALIBRATOR LEVEL	ME-545/G COUPLING	FILTER	ME-545/G DISPLAY VOLTAGE
1kHz	10mV	AC	ON	95 to 105µV
1kHz	10mV	AC+DC	ON	90 to 110µV
1kHz	100mV	AC	ON	0.970 to 1.030mV
1kHz	100mV	AC+DC	ON	0.940 to 1.060mV
1kHz	1V	AC	ON	9.700 to 10.30mV
1kHz	1V	AC+DC	ON	9.400 to 10.60mV

8. Connect test equipment as shown previously.

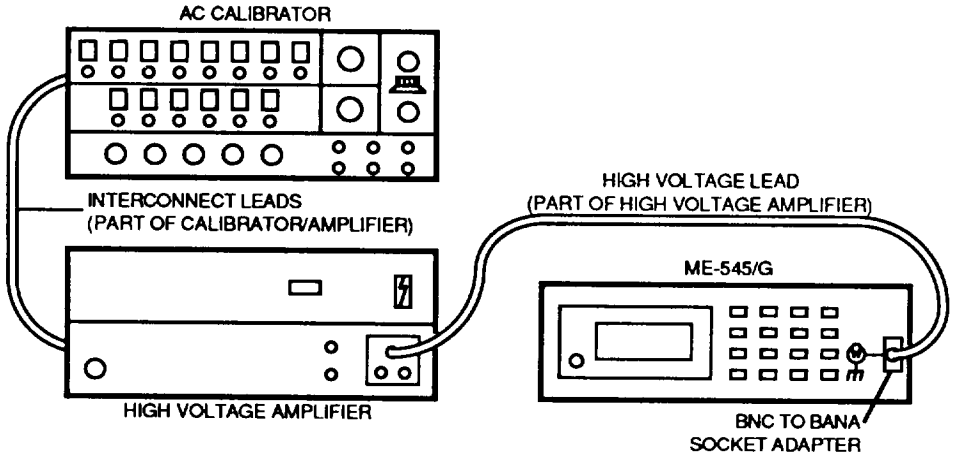
9. On AC Calibrator, adjust CALIBRATE ERROR vernier to 0.

10. Set AC Calibrator and ME-545/G controls as shown. Verify ME-545/G voltage readings are within specified limits.

AC CALIBRATOR FREQ	AC CALIBRATOR LEVEL	ME-545/G COUPLING	FILTER	ME-545/G DISPLAY VOLTAGE
1kHz	100mV	AC	ON	97.00 to 103.0mV
1kHz	100mV	AC+DC	ON	94.00 to 106.0mV
1kHz	1V	AC	ON	0.970 to 1.030V
1kHz	1V	AC+DC	ON	0.940 to 1.060V
1kHz	10V	AC	ON	9.700 to 10.30V
1kHz	10V	AC+DC	ON	9.400 to 10.60V
1kHz	100V	AC	ON	97.00 to 103.0V
1kHz	100V	AC+DC	ON	94.00 to 106.0V
10Hz	1V	AC	ON	0.950 to 1.050V
10Hz	1V	AC+DC	ON	0.900 to 1.100V
100Hz	1V	AC	ON	0.970 to 1.030V
100Hz	1V	AC+DC	ON	0.940 to 1.060V
10kHz	1V	AC	OFF	0.970 to 1.030V
10kHz	1V	AC+DC	OFF	0.940 to 1.060V
100kHz	1V	AC	OFF	0.970 to 1.030V
100kHz	1V	AC+DC	OFF	0.940 to 1.060V

VOLTAGE ACCURACY TEST — Continued.

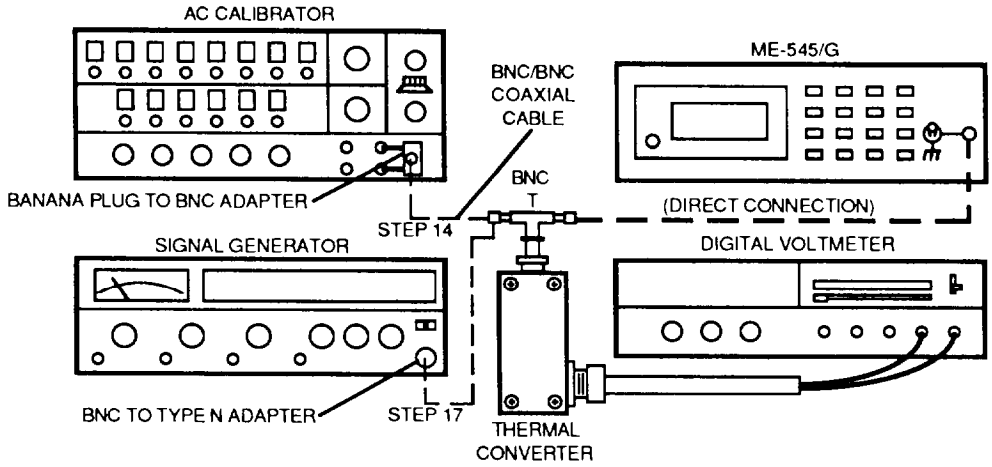
11. Connect test equipment as shown.



12. Set AC Calibrator/High Voltage Amplifier output level to 300.000 V at 1kHz.
13. On ME-545/G,
    - Verify FILTER is not selected (LED to OFF).
    - Select AC key. Verify displayed voltage is from 291 to 309V.
    - Select AC+DC key. Verify displayed voltage is from 282 to 318V.
14. Connect test equipment as shown.

NOTE

Connect the Thermal Converter directly to the ME-545/G input.



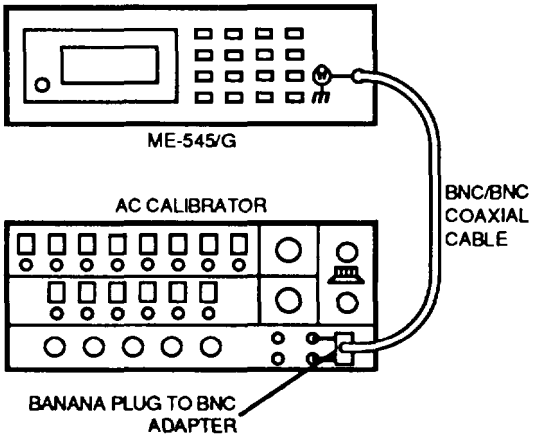
15. Set AC Calibrator output to 1.000 Vrms at 100kHz.
16. Measure and record to three decimal places Thermal Converter DC output as indicated on Digital Voltmeter.
17. Connect test equipment as shown above.

VOLTAGE ACCURACY TEST — Continued.

18. Set Signal Generator controls as follows:
    - Output level to 1Vrms.
    - Output frequency to 10MHz.
    - Adjust output level until Thermal Converter DC output as indicated on Digital Voltmeter is the same as recorded in step 16.
19. On ME-545/G,
    - Select AC key. Verify displayed voltage is from 0.900 to 1.100V.
    - Select AC+DC key. Verify displayed voltage is from 0.800 to 1.200V.
20. Set Signal Generator controls as follows:
    - Output frequency to 20MHz.
    - Adjust output level until Thermal Converter DC output as indicated on Digital Voltmeter is the same as recorded in step 16.
21. On ME-545/G,
    - Select AC key. Verify displayed voltage is from 0.850 to 1.150V.
    - Select AC+DC key. Verify displayed voltage is from 0.700 to 1.300V,
22. Disconnect test equipment.

RESPONSE TIME TEST.

1. Connect test equipment as shown.



2. Set AC Calibrator output to 1.000Vrms at 1kHz.

RESPONSE TIME TEST — Continued.

3. On ME-545/G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Verify display reads approximately 1.000V.
   - Select MANUAL key.
   - Press STEP DOWN key one time.
   - Verify ME-545/G display reads AC Or.

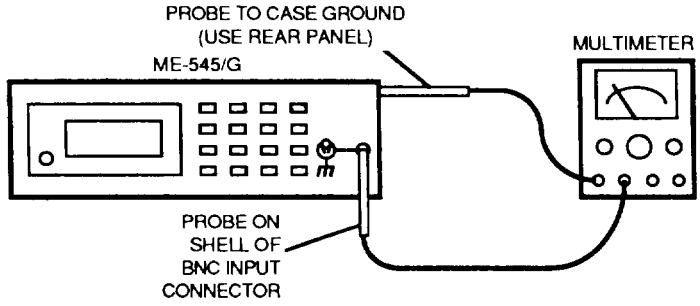
NOTE

Completely read step 4 before performing key selection.

4. On ME-545/G, press STEP UP key one time and verify within three seconds display reads from 0.970 to 1.030V.
5. Disconnect test equipment.

INPUT CONNECTOR TEST.

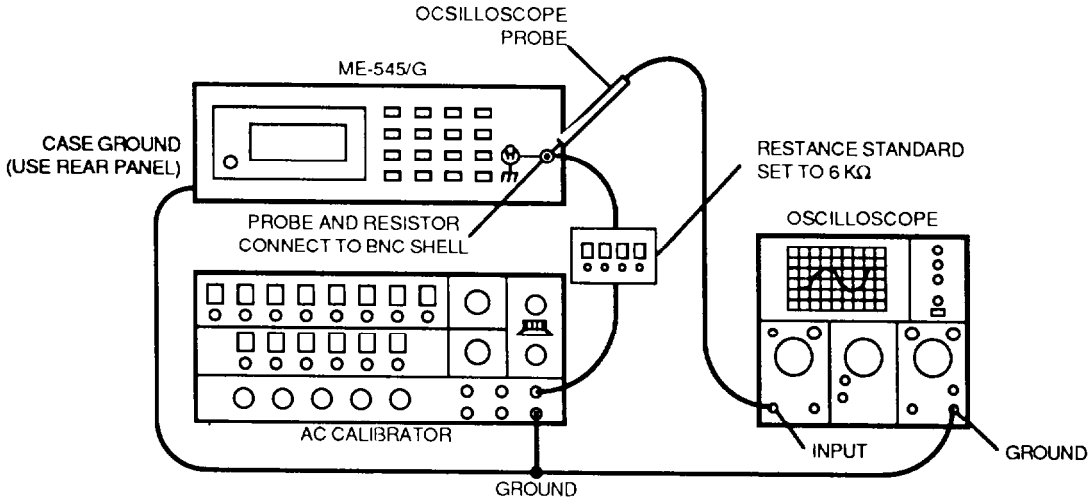
1. Connect test equipment as shown.



2. On ME-545/G,
   - Verify LINE ON/OFF to OFF.
   - Set ISOLATE switch to GROUND (down).
3. Verify Multi meter reads $<1\Omega$ (using Rx1 setting).
4. On ME-545/G, set ISOLATE switch to ISOLATE.
5. Verify Multi meter reads $\geq 100\Omega$ (using Rx100 setting).
6. Disconnect test equipment.

COMMON MODE VOLTAGE TEST.

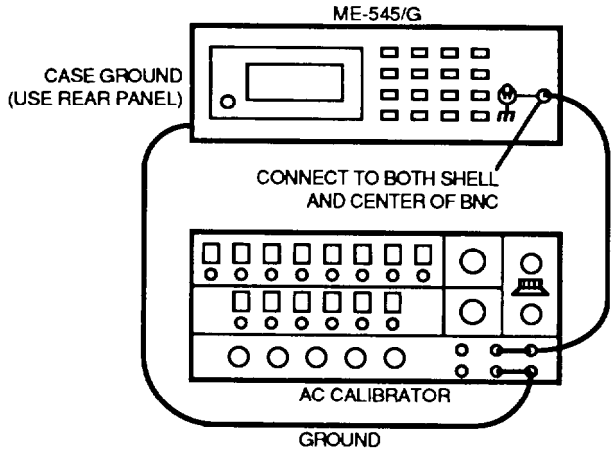
1. Connect test equipment as shown.



2. Set AC Calibrator output to 10Vrms at 1kHz.
3. On ME-545/G,
   - Verify LINE ON/OFF to OFF.
   - Set ISOLATE switch to ISOLATE.
4. Verify amplitude as displayed on Oscilloscope is ±600mV to ±5V.
5. Disconnect test equipment.

COMMON MODE REJECTION TEST.

1. Connect test equipment as shown.



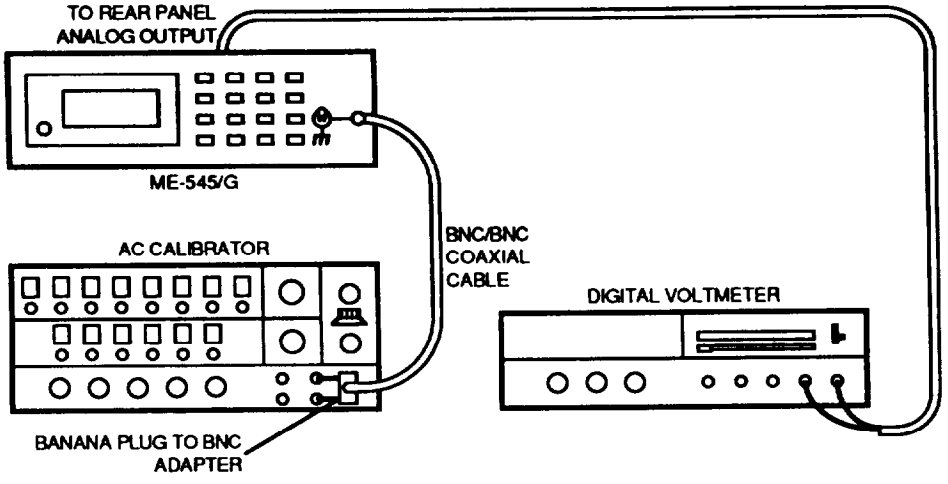
2. Set AC Calibrator output to 500mVrms at 400 Hz.

COMMON MODE REJECTION TEST - Continued.

3. On ME-545/G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFTkey, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select l.000mV range.
   - Press CONTINUE key.
   - Verify display reads <0.5mV.
4. Disconnect test equipment.

DC OUTPUT TEST.

1. Connect test equipment as shown.



2. Set AC Calibrator output to l.000Vrms at 1 kHz.
3. On ME-545/G,
   - l Verify LINE ON/OFF to ON.
   - l Press RECALL key, then number 0 key twice.
   - l Set ISOLATE switch to ISOLATE.
   - l Press MANUAL key.
   - l Select SHIFT key, then press RANGE key.
   - l Use STEP UP or STEP DOWN keys to select l.000V range.
   - l Press CONTINUE key.
4. Verify Digital Voltmeter reads +5.0Vdc ±0.5Vdc.
5. Disconnect test equipment.

PERFORMANCE TEST CHECKLIST.

Test and step		Measured value	Desired value
TRUE RMS TEST			
1 .000V 1 kHz	Step 8	_____ Vrms	0.970 to 1 .0B0Vrms
MEAN TEST			
111.1mV 1kHz	Step 3	_____ mV	95.0 to 105.0mV
351.3mV 1 kHz	step 5	_____ mV	300.4 to 332.0mV
PEAK TEST			
+Peak 70.71 mV	step 3	_____ mV	95.0 to 105.0mV
-Peak 70.71 mV	step 4	_____ mV	95.0 to l0S.OmV
-Peak 223.61 mV	Step 8	_____ mV	300.4 to 332.0mV
+Peak 223.61 mV	step 7	_____ mV	300.4 to 332.0mV
DC COUPLING TEST			
1 .ooov	step 3	_____ Vdc	+0.980 to +1 .020Vdc
RANGE SELECTION TEST			
1 .000V 1 kHz	Step 3	_____ Vrms	0.970 to 1.030Vrms
l.l00V 1kHz	step 5	_____ "Or" display indication	
0.27OV 1 kHz	Step 7	_____ "Ur" display indication	
DISPLAY AND RESOLUTION TEST			
SF 98.1	step 3	-All display indicators on	
Analog Meter	Step 6	-Analog meter segments	Decrease by one
Four Digit Display	Step 8	- Four Digit Display LSD	Increase by 1mV
dB RANGE TEST			
31.62mV 1 kHz	Step 8	_____ dB	-0.5 to +0.5dB
316.0V 1 kHz	Step 11	_____ dB	+129 to +131dB
VOLTAGE ACCURACY TEST			
1 0mV 1 kHz AC	step 7	_____ µV	95 to 105µv
10mV 1kHz AC+DC	step 7	_____ µV	90 to 110µV
1OOmV 1 kHz AC	Step 7	_____ mV	0.970 to 1.030mV
100mV 1 kHz AC+DC	Step 7	_____ mV	0.940 to 1.060mV
IV 1kHz AC	Step 7	_____ mV	9.700 to 10.30mV
1V 1kHz AC+DC	Step 7	_____ mV	9.400 to 10.60mV
100mV 1kHz AC	Step 10	_____ mV	97.00 to 103.0mV
100mV 1 kHz AC+DC	Step 10	_____ mV	94.00 to 106.0mV

100V 1kHz AC	Step 10	_____ V	97.00 to 103.0V
100V 1kHz AC+DC	Step 10	_____ V	94.00 to 106.0V
1V 10Hz AC	Step 10	_____ V	0.950 to 1.050V
1V 10Hz AC+DC	Step 10	_____ V	0.900 to 1.100V
1V 100Hz AC	Step 10	_____ V	0.970 to 1.030V
1V 100Hz AC+DC	Step 10	_____ V	0.940 to 1.060V
1V 10kHz AC	Step 10	_____ V	0.970 to 1.030V
1V 10kHz AC+DC	Step 10	_____ V	0.940 to 1.060V
1V 100kHz AC	Step 10	_____ V	0.970 to 1.030V
1V 100kHz AC+DC	Step 10	_____ V	0.940 to 1.060V
300V 1kHz AC	Step 13	_____ V	291 to 309V
300V 1kHz AC+DC	Step 13	_____ V	282 to 318V
1V 10MHz AC	Step 19	_____ V	0.900 to 1.100V
1V 10MHz AC+DC	Step 19	_____ V	0.800 to 1.200V
1V 20MHz AC	Step 21	_____ V	0.850 to 1.150V
1V 20MHz AC+DC	Step 21	_____ V	0.700 to 1.300V

RESPONSE TIME TEST

Response Time	Step 4	_____ V	0.970 to 1.030V
Response Time	Step 4	_____ seconds	≤3 seconds

INPUT CONNECTOR TEST

Ground	Step 3	_____ Ω	<1Ω
Isolation	Step 5	_____ Ω	≥100Ω

COMMON MODE VOLTAGE TEST

10Vrms 1kHz	Step 4	_____ V	±600mV to ±5V

COMMON MODE REJECTION TEST

500mVrms 400Hz	Step 3	_____ mV	<0.5mV

DC OUTPUT TEST

1Vrms 1kHz	Step 4	_____ V	+4.5 to +5.5Vdc

5-17. ADJUSTMENTS.

DESCRIPTION

The adjustment procedures cover:

Adjust Power Supply (para 5-19).
Adjust Analog-to-Digital Converter (para 5-20).
Adjust Low/Mid Frequency Response (para 5-21).
Adjust High Frequency Response (para 5-22).
Adjust DC Response (para 5-23).
Adjust Mean Detector (para 5-24).
Adjust Peak Detector (para 5-25).
Adjust RMS Detector (para 5-26).

NOTE

- Specific adjustments may be necessary after repair/replacement of specific assemblies in the Voltmeter or failure of a performance test. Adjustment is not required if malfunction has been cleared after repair.
- Never perform all adjustments from para 5-19 thru 5-26 at one time.
- The adjustment needed after repair/replacement of specific assemblies are as shown in table 5-2.
- To guarantee specifications listed in Chapter 1, adjustments must be completed within the temperature range of +18°C to +28°C (+64°F to +82°F).
- All voltages are referenced to A1TP4 unless otherwise specified,
- Assembly and cable location diagram is figure FO-1. Individual circuit card component locator diagrams are on figures FO-2 thru FO-6.
- After adjust procedure is completed remove power and install top cover (para 5-27).

Table 5-2. Post Repair/Replace Adjustments.

Repaired/Replaced Assembly	Adjust
A1 Processor Assembly	Adjust Power Supply (para 5-19). Adjust Analog-to-Digital Converter (para 5-20).
A2 Detector Assembly	Adjust Low/Mid Frequency Response (para 5-21). Adjust RMS Detector (para 5-26). Adjust Mean Detector (para 5-24). Adjust Peak Detector (para 5-25).
A3 Amplifier Assembly	Adjust Low/Mid Frequency Response (para 5-21). Adjust High Frequency Response (para 5-22). Adjust DC Response (para 5-23). Adjust RMS Detector (para 5-26).
A4 Keyboard/Display Assembly	None.
A5 GPIB Assembly	None.
A6 GPIB Interface Assembly	None.

5-18. INITIAL SETUP

1. Remove top cover (para 5-27).

WARNING

Dangerous voltages are present with the covers removed. Where maintenance can be performed without power applied, the power should be removed. Battery voltage is present even with AC power cable removed.

NOTE

If performing adjustment or making connections to the A2 Detector Circuit Card Assembly it will be necessary to remove the circuit card covers (para 5-28). If performing adjustment or making connections to the A3 Amplifier Circuit Card Assembly, it will be necessary to remove the bottom cover (para 5-27) and circuit card covers (para 5-28).

2. Perform turn-on procedures (para 2-6).

NOTE

Allow a 30 minute warm-up before performing adjustments.

5-19. ADJUST POWER SUPPLY.

1. On ME-545/G,
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
2. Connect Digital Voltmeter to A2TP16 (fig. FO-3 sheet 1). Verify Digital Voltmeter reads +15Vdc ±0.5V.
   - If incorrect, adjust A1R44 (fig. FO-2 sheet 2) until reading is within specified limits.
3. Connect Digital Voltmeter to A2TP2. Verify Digital Voltmeter reads -15Vdc +0.5V.
   - If incorrect, adjust A1R49 until reading is within specified limits.
4. Connect Digital Voltmeter to test points shown and verify voltages as are within specified limits.

ME-545/G TEST POINT	DIGITAL VOLTMETER READING
A1TP3	+4.75 to +5.25Vdc
A1R34 pin 1	+8.3 to +10.3Vdc
A1TP10	+4.5 to +5.3Vdc

5-19. ADJUST POWER SUPPLY — Continued.

5. Set ON/OFF switch to OFF and disconnect test equipment. Install circuit card covers (para 5-28). Install top cover (para 5-27).

5-20. ADJUST ANALOG-TO-DIGITAL CONVERTER GAIN.

1. On ME-545/G,
   - Set LINE ON/OFF to OFF.
   - Unplug 20 pin cable connected at A1J15 (fig. FO-2 sheet 2).
2. Connect DC Voltage Standard + lead to A1J15 pin 14 and – lead to A1J15 pin 20.
3. On ME-5451G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 1.000V range.
   - Press CONTINUE key.
4. Set DC Voltage Standard to +5V ±0.5mV.
5. On ME-545/G, verify display shows 1.000 ±0.001.
   - If incorrect, adjust A1R15 until reading is within specified limits.
6. Disconnect DC Voltage Standard.
7. Install a jumper between A1TP2 and A1TP1.
8. On ME-545/G, verify display shows 0 ± 0.002.

NOTE

Disregard Ur display indication

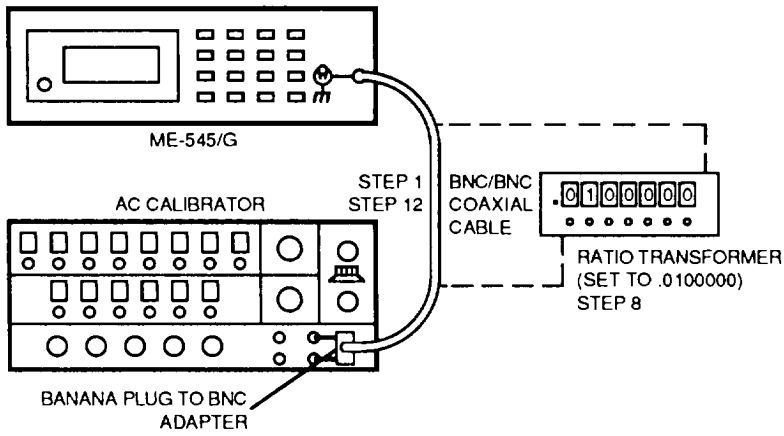
9. Set ON/OFF switch to OFF , disconnect jumper, and reconnect 20 pin cable to A1J15. Install top cover (para 5-27).

5-21. ADJUST LOW/MID FREQUENCY RESPONSE.

NOTE

Perform adjustment at 23°C±1°C.

1. Connect test equipment as shown.



2. Set AC Calibrator output to 31.62mVrms at 1kHz.
3. On ME-545/G,
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
4. Connect Oscilloscope to A2TP7 (fig. FO-3 sheet 1) using X10 probe (GND to A2TP25). Set controls to 10msec/DIV and 50mV/DIV.
5. On ME-545/G, adjust A2R27 for a single in phase waveform (minimum 20 Hz) as shown on Oscilloscope display.
6. Disconnect Oscilloscope.
7. On ME-545/G,
   - Press RECALL key, then number 0 key twice.
   - Select SHIFT, then FILTER keys. Verify LED is on.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 31.62m V range.
   - Press CONTINUE key.
   - Record display reading.
8. Connect test equipment as shown above.

5-21. ADJUST LOW/MID FREQUENCY RESPONSE — Continued.

9. Set AC Calibrator controls as follows:
   - Output to 3.162Vrms at 1kHz.
   - Adjust CALIBRATE ERROR vernier until ME-545/G display indicates same value recorded in step 7

NOTE

Do not readjust CALIBRATE ERROR vernier.

10. On ME-545/G, select AUTO key.
11. Set AC Calibrator controls as shown. Verify ME-545/G display readings are within specified limits.
    - If readings not within specified limits, perform adjustment.
    - Repeat adjustments until both readings are within specified limits.

NOTE

- Verify ME-545/G analog meter is at full scale when verifying display limits. If not, use step up/down keys for a full scale indication.
- Do not perform adjustment if readings are within specified limits.

AC CALIBRATOR FREQ)	LEVEL	ME-545/G DISPLAY LIMITS	ME-5451G ADJUSTMENT
1kHz	100mV	0.999 to 1.001mV	A2R45
1kHz	316.2mV	3.159 t0 3.165mV	A3R58

12. Connect test equipment as shown previously.
13. On AC Calibrator, adjust CALIBRATE ERROR vernier to 0.
14. Set AC Calibrator controls as shown. Verify ME-545/G display readings are within specified limits.
    - If readings not within specified limits, perform adjustment.
    - Repeat adjustments until all readings are within specified limits.

NOTE

- Verify ME-545/G analog meter is at full scale when verifying display limits. If not, use step up/down keys for a full scale indication.
- Do not perform adjustment if readings are within specified limits.

AC CALIBRATOR FREQ	LEVEL	ME-545/G DISPLAY LIMITS	ME-545/G ADJUSTMENT
1kHz	31.62mV	31.59 to 31.65mV	A3R38
1kHz	31.62mV	315.9 to 316.5mV	A3R27

5-21. ADJUST LOW/MID FREQUENCY RESPONSE — Continued.

15. On ME-545/G, select SHIFT then FILTER keys. Verify FILTER LED is OFF.
16. Set AC Calibrator output to 100mV at 100kHz.
17. Verify ME-545/G displays 99.9 to 100.1mV.
    - If incorrect, adjust A3C11 until reading is within specified limits.
18. On ME-545/G, enter 99 . 1 using numeric keys. Select SHIFT then SF keys.
19. Set AC Calibrator output to 3.162V at 100kHz. Verify ME-545/G displays 3.159 to 3.165V.
    - If incorrect, adjust A3C5 until reading is within specified limits.
20. On ME-545/G, enter 0, then select SHIFT and SF keys. Verify ME-545/G displays 3.159 to 3.165V.
    - If incorrect, adjust A3C6 until reading is within specified limits.
    - If adjustment was performed, repeat steps 18 through 20 until both readings are within specified limits.
21. Set ON/OFF switch to OFF and disconnect test equipment. Install circuit card covers (para 5-28). Install top and bottom covers (para 5-27).

5-22. ADJUST HIGH FREQUENCY RESPONSE.

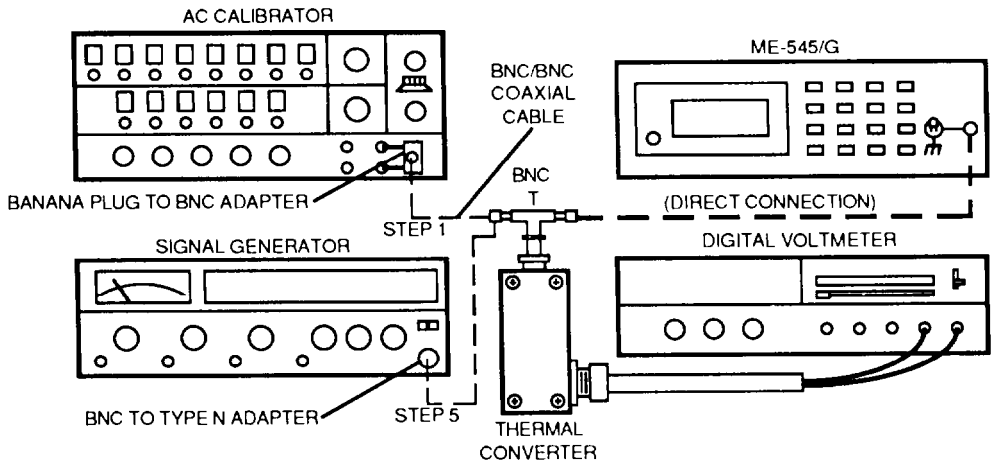
NOTE

Perform adjustment at 23°C±1°C.

1. Connect test equipment as shown.

NOTE

Connect the Thermal Converter directly to the ME-545/G input.



2. Set AC Calibrator output to 1.000Vrms at 100kHz.

5-22. ADJUST HIGH FREQUENCY RESPONSE — Continued.

3. On ME-545/G,

   .Set LINE ON/OFF to ON.

   .Press RECALL key, then number 0 key twice.

   .Set ISOLATE switch to ISOLATE.

4. Measure and record to three decimal places Thermal Converter DC output as indicated on Digital Voltmeter.

5. Connect test equipment as shown previously.

6. Set Signal Generator controls as follows:

   .Output level to 1Vrms.

   • Output frequency to 10MHz.

   .Adjust output level until Thermal Converter DC output as indicated on Digital Voltmeter is the same as recorded in step 4.

7. On ME-545/G,

   .Press MANUAL key.

   .Select SHIFT key, then press RANGE key.

   .Use STEP UP or STEP DOWN keys to select 1.000V range.

   .Press CONTINUE key.

8. On ME-545/G, verify display indicates 0.980 to 1.020V.

   • If incorrect, adjust A3C33 until reading is within specified limits.

9. Set Signal Generator controls as follows:

   .Output frequency to 20 MHz.

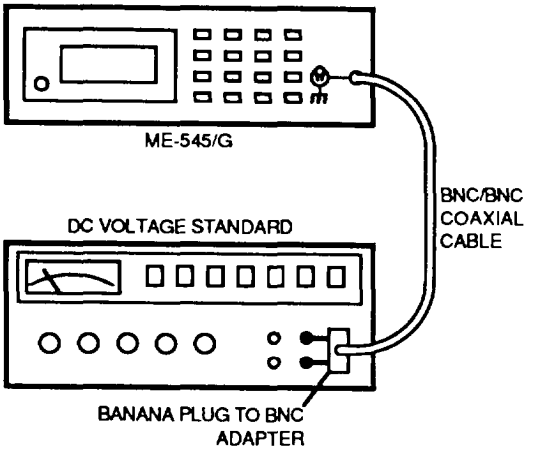
   .Adjust output level until Thermal Converter DC output as indicated on Digital Voltmeter is the same as recorded in step 4.

10. On ME-545/G, verify display indicates 0.850 to 1.150V.

11. Set ON/OFF switch to OFF and disconnect test equipment. Install circuit card covers (para 5-28). Install top and bottom covers (para 5-27).

5-23. ADJUST DC RESPONSE.

1. Connect test equipment as shown.



2. Set DC Voltage Standard output to 316.20mV.
3. On ME-545/G,
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Select MEAN key.
   - Select AC+ DC key.
4. On ME-545/G, verify display indicates 315.9 to 316.5mV.
   - If incorrect, adjust A3R88 (fig. FO-4 sheet 2) until reading is within specified limits.
5. Set DC Voltage Standard output to 100.00mV.
6. On ME-545/G, verify display indicates 99.9 to 100.1mV.
   - If incorrect, adjust A3R80 until reading is within specified limits.
7. Set DC Voltage Standard output to 316.20mV.
8. Repeat steps 4 thru 7 until readings are within specified limits.
9. Disconnect DC Voltage Standard. Connect LOAD to ME-545/G input connector.
10. On ME-545/G,
    - Press MANUAL key.
    - Select SHIFT key, then press RANGE key.
    - Use STEP UP or STEP DOWN keys to select 1.000mV range.
    - Press CONTINUE key.
11. On ME-545/G, verify display indicates 0 ±0.01.
    - If incorrect, adjust A3R66 until reading is within specified limits.

NOTE

Disregard UR indication.

5-23. ADJUST DC RESPONSE — Continued.

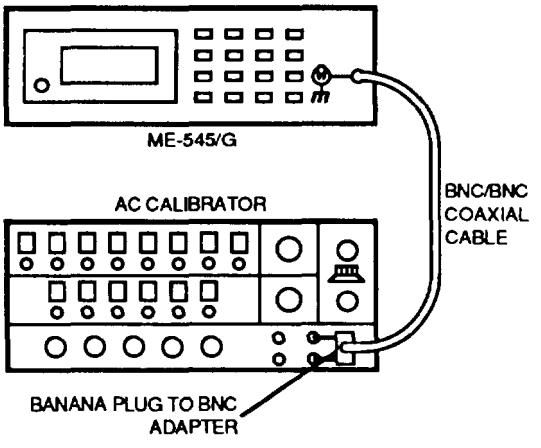
12. Set ON/OFF switch to OFF and disconnect test equipment. Install circuit card covers (para 5-28). Install top and bottom covers (para 5-27).

5-24. ADJUST MEAN DETECTOR.

1. Connect Oscilloscope using 10:1 probe 10 A2TP20 (fig. FO-3 sheet 1). Connect ground to A2TP25.
2. Set Oscilloscope controls as follows:
   - Vertical scale to 500mV/division.
   - Horizontal scale to 200µS/division.
   - Select AC Coupling.

     Select Internal Trigger.
3. On ME-545/G,

   Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 316.2mV range.
4. On ME-545/G,
   - Adjust A2R60 as required until oscillating waveform is displayed on Oscilloscope.
   - Adjust A2R60 clockwise until waveform ceases oscillating. Record position of A2R60.
   - Adjust A2R60 counter-clockwise until waveform ceases oscillating again. Record position of A2R60.
   - Adjust A2R60 to center point of both recorded positions.
5. Disconnect Oscilloscope.
6. Connect test equipment as shown.

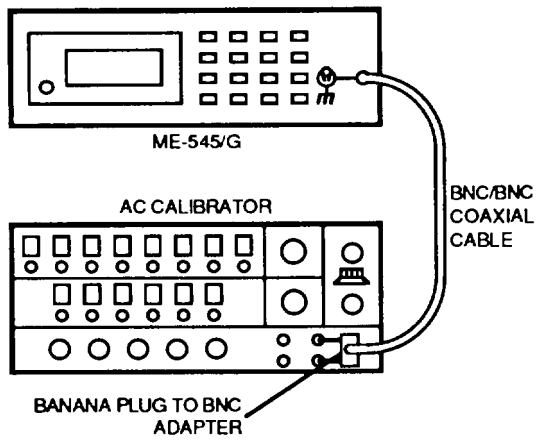


5-24. ADJUST MEAN DETECTOR — Continued.

7. Set AC Calibrator output to 351.30mVrms at 1kHz.
8. On ME-545/G,
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 316.2mV range.
   - Press CONTINUE key.
   - Select MEAN key.
9. On ME-545/G, verify display reads 316.2mV ±15.8mV.
   - If incorrect, adjust A2R56 until reading is within specified limits.
10. Set AC Calibrator output to 111.10mVrms at 1kHz.
11. On ME-545/G,
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 100mV range.
   - Press CONTINUE key.
12. On ME-545/G, verify display reads 100mV ±5mV.
   - If incorrect, adjust A2R65 until reading is within specified limits.
13. Repeat steps 7 through 12 until both readings are within specification.
14. Set ON/OFF switch to OFF and disconnect test equipment. Install circuit card covers (para 5-28). Install top and bottom covers (para 5-27).

5-25. ADJUST PEAK DETECTOR.

1. Connect test equipment as shown.

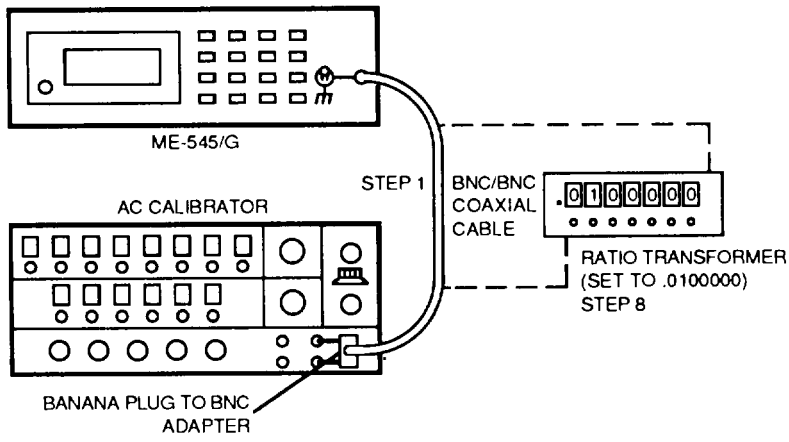


5-25. ADJUST PEAK DETECTOR — Continued.

2. On ME-545/G,
   - Verify LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
   - Press MANUAL key.
   - Select +Peak key.
3. Set AC Calibrator output to 223.61mVrms at 1kHz.
4. On ME-545/G,
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 316.2mV range.
   - Press CONTINUE key.
5. On ME-545/G, verify display reads 316.2mV ±15.8mV.
   - If incorrect, adjust A2R111 (fig. FO-3 sheet 1) until reading is within specified limits.
6. Set AC Calibrator output to 70.71mVrms at 1kHz.
7. On ME-545/G,
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 100mV range.
   - Press CONTINUE key.
8. On ME-545/G, verify display reads 100mV ±5mV.
   - If incorrect, adjust A2R133 until reading is within specified limits.
9. Repeat steps 3 through 8 until both readings are within specification.
10. Set AC Calibrator output to 223.61mVrms at 1kHz.
11. On ME-545/G,
    - Select SHIFT key, then press RANGE key.
    - Use STEP UP or STEP DOWN keys to select 316.2mV range.
    - Press CONTINUE key.
    - Verify –Peak key selected.
12. On ME-545/G, verify display reads –316.2mV ±15.8mV.
    - If incorrect, adjust A2R83 until reading is within specified limits.
13. Set AC Calibrator output to 70.71mVrms at 1kHz.
14. On ME-545/G,
    - Select SHIFT key, then press RANGE key.
    - Use STEP UP or STEP DOWN keys to select 100mV range.
    - Press CONTINUE key.
15. On ME-545/G, verify display reads –100mV ±5mV.
    - If incorrect, adjust A2R107 until reading is within specified limits.
16. Repeat steps 10 through 15 until both readings are within specification.
17. Set ON/OFF switch to OFF and disconnect test equipment. Install circuit card covers (para 5-28). Install top and bottom covers (para 5-27),

5-26. ADJUST RMS DETECTOR.

1. Connect test equipment as shown.



2. Set AC Calibrator output to 31.62mVrms at 1kHz.
3. On ME-5451G,
   - Set LINE ON/OFF to ON.
   - Press RECALL key, then number 0 key twice.
   - Set ISOLATE switch to ISOLATE.
4. Connect Oscilloscope to A2TP7 (fig. FO-3 sheet 1) using X10 probe (GND to A2TP25). Set controls to 10msec/DIV and 50mV/DIV.
5. On ME-545/G, adjust A2R27 for a single in phase waveform (minimum 20 Hz) as shown on Oscilloscope display.
6. Disconnect Oscilloscope.
7. On ME-545/G,
   - Press RECALL key, then number 0 key twice.
   - Select SHIFT, then FILTER keys. Verify LED is on.
   - Press MANUAL key.
   - Select SHIFT key, then press RANGE key.
   - Use STEP UP or STEP DOWN keys to select 31.62mV range.
   - Press CONTINUE key.
   - Record display reading.
8. Connect test equipment as shown above.

5-26. ADJUST RMS DETECTOR — Continued.

9. Set AC Calibrator controls as follows:
   - Output to 3.162Vrms at 1kHz.
   - Adjust CALIBRATE ERROR vernier until ME-545/G display indicates same value recorded in step 7.

NOTE

Do not readjust CALIBRATE ERROR vernier.

10. Set AC Calibrator output to 100mVrms at 1klHz.
11. On ME-545/G,
    - Select SHIFT key, then press RANGE key.
    - Use STEP UP or STEP DOWN keys to select 1.000 mV range.
    - Press CONTINUE key.
12. On ME-545/G, verify display reads 1.000mV ±0.001mV.
    - If incorrect, adjust A2R45 until reading is within specified limits.
13. Set AC Calibrator output to 30mVrms at 1kHz.
14. On ME-5451G,
    - Select SHIFT key, then press RANGE key.
    - Use STEP UP or STEP DOWN keys to select 316.2µV range.
    - Press CONTINUE key.
15. On ME-545/G, verify display reads 300.0µV ±3.0µV.
    - If incorrect, adjust A2R27 until reading is within specified limits.
16. Repeat steps 10 through 15 until both readings are within specification.
17. Set ON/OFF switch to OFF and disconnect test equipment. Install circuit card covers (para 5-28). Install top and bottom covers (para 5-27).

5-27. REPLACE TOP/BOTTOM/SIDE COVERS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

WARNING

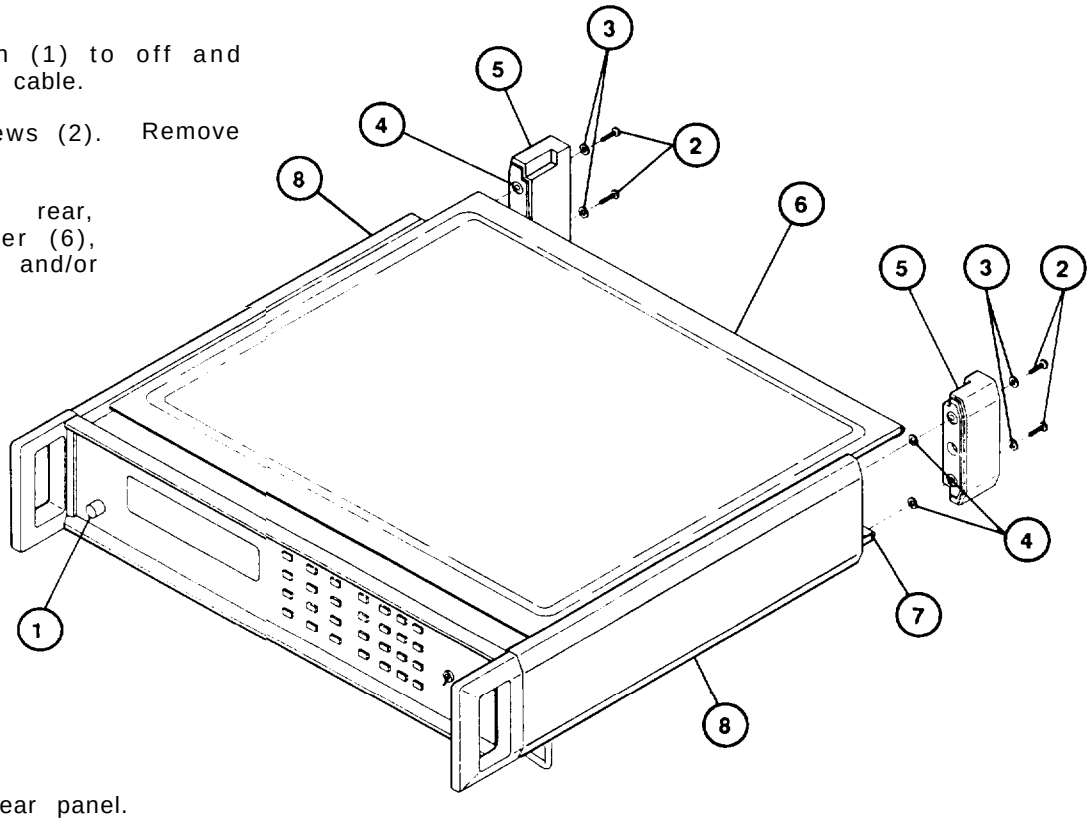
Dangerous voltages are present with covers removed.

NOTE

Task same for top, bottom, and side covers. Remove both top and bottom covers to remove side covers.

REMOVE

1. Set LINE switch (1) to off and remove AC power cable.
2. Loosen four screws (2). Remove bumpers (5).
3. Pulling toward rear, remove top cover (6), bottom cover (7), and/or side covers (8).



INSTALL

1. Install side c cover (7), and seated fully on rear panel.
2. Install four bumpers (5). Verify flat washers (3) and nylon washers (4) are installed. Tighten screws (2).
3. Reconnect AC power cable and set LINE switch (1) to ON.

END OF TASK

5-28. REPLACE A2/A3 CIRCUIT CARD COVERS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

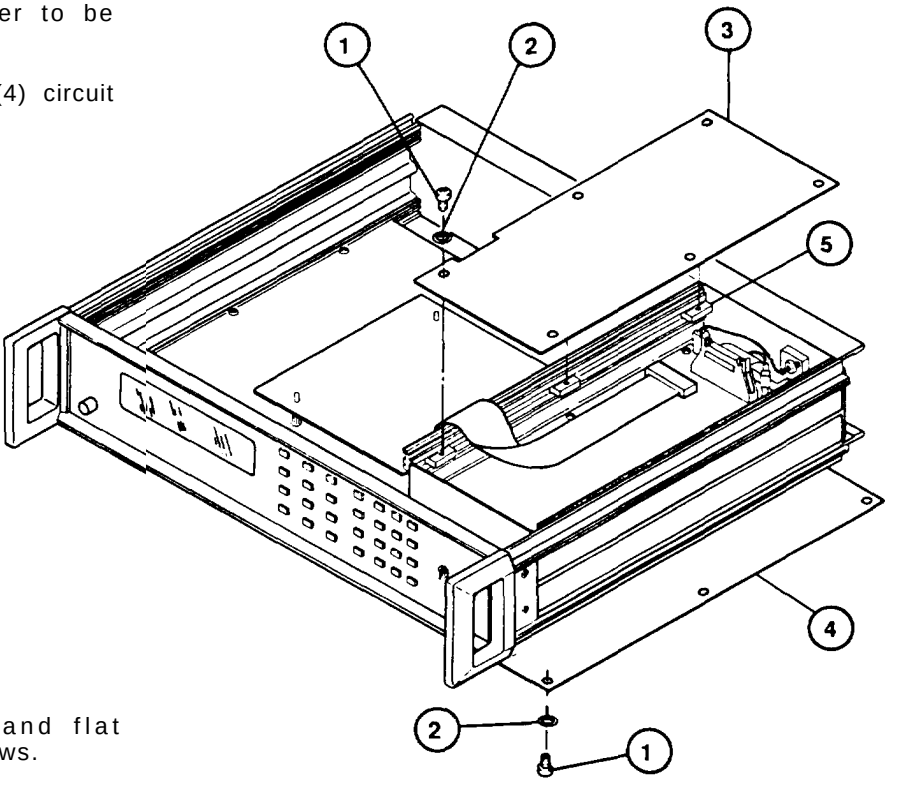
NOTE

PRELIMINARY PROCEDURES:

- If removing A2 circuit card cover, remove top cover (para 5-27).
- If removing A3 circuit card cover, remove bottom cover (para 5-27),
- Task is the same for both covers.

REMOVE

1. Remove six screws (1) and flat washers (2) retaining cover to be removed.
2. Remove A2 (3) and/or A3 (4) circuit card cover.



INSTALL

1. Position captive nuts correct alignment to cover.
2. Install A2 (3) and/or A3 card cover.
3. Install six screws (1) and flat washers (2). Tighten screws.

NOTE

FOLLOW-ON MAINTENANCE:

- Install top and bottom covers (para 5-27).

END OF TASK

5-29. REPLACE FRONT PANEL.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

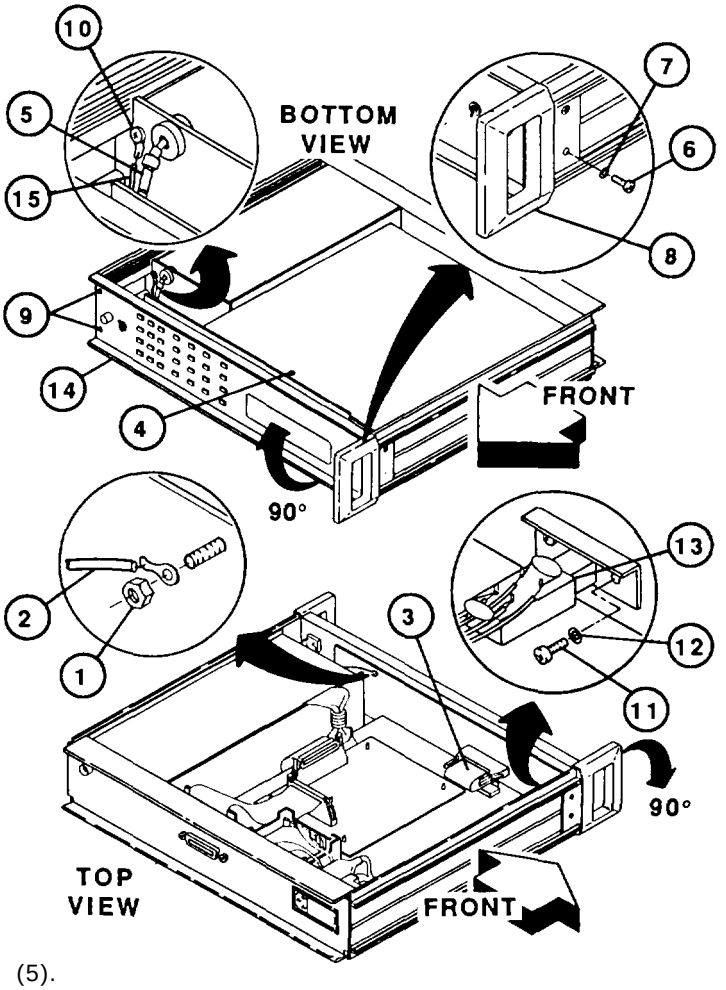
NOTE

PRELIMINARY PROCEDURES:

- Remove top, bottom, and both side covers (para 5-27).

REMOVE

1. Remove nut (1). Disconnect short ground wire (2) and 26 pin Al ribbon cable (3).
2. Remove screw (4) and disconnect input cable (5).
3. Remove four screws (6) and flat washers (7), Slide forward and remove both front handles (8).
4. Remove four screws (9). Rotate front panel 90° and remove screw (10).
5. Remove two screws (11) and flat washers (12). Remove Line Switch (13) from front panel (14).
6. Remove front panel (14).



INSTALL

NOTE

Installation of front panel must be performed on flat surface.

1. Position front panel (14) lying face down directly in front of Voltmeter.
2. Install Line switch (13) in front panel (14). Install two screws (11) and flat washers (12).
3. Install long ground wire (15) and screw **(lo).**
4. Position front panel (14) on front of Voltmeter. Install four screws (9).
5. Install both front handles (8), four screws (6) and flat washers (7).
6. Install screw (4) and reconnect input cable (5).
7. Reconnect short ground wire (2) and install nut (1). Reconnect 26 pin Al ribbon cable (3),

NOTE

FOLLOW-ON MAINTENANCE:

- Install top, bottom, and both side covers (para 5-27).

END OF TASK

5-30. REPLACE AI CIRCUIT CARD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

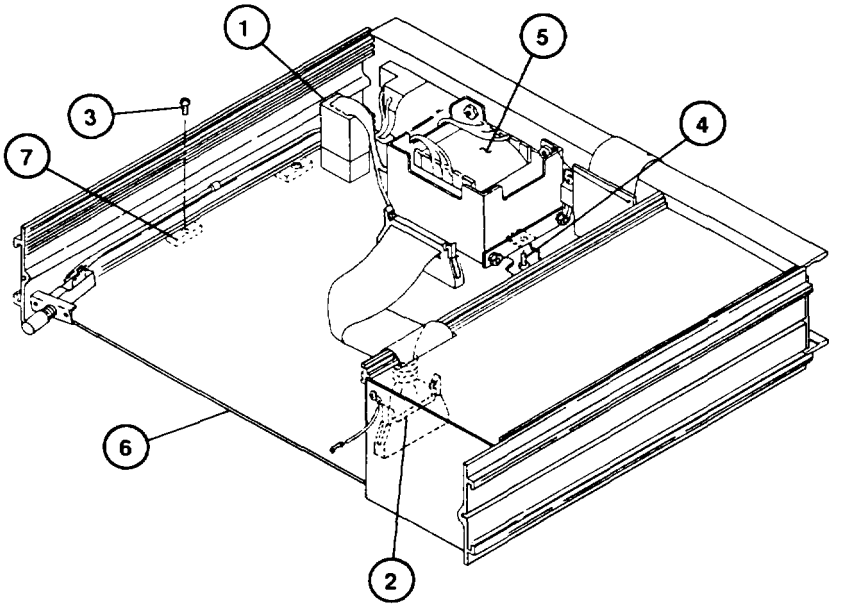
INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove top, bottom, and both side covers (para 5-27).
- Remove front panel (para 5-29).
- Remove A5 Circuit Card Assembly (para 5-34),

REMOVE



1. Disconnect 12 pin transformer cable (1) and 20 pin A2 ribbon cable (2).
2. Remove six screws (3).
3. Remove screw (4) holding transformer T1 (5).
4. Slide A1 Circuit Card Assembly (6) forward and remove taking care not to allow six captive nuts (7) in housing channel to slide out.

INSTALL

1. Align A1 Circuit Card Assembly (6) in housing channel with components facing up and slide toward rear.
2. Align A1 Circuit Card Assembly (6) and install screw (4).
3. Position captive nuts (7) for correct alignment to holes in A1 Circuit Card Assembly (6) and install six screws (3).
4. Reconnect 12 pin transformer cable (1) and 20 pin A2 ribbon cable (2).

NOTE

FOLLOW-ON MAINTENANCE:

- Install A5 Circuit Card Assembly (para 5-34).
- Install front panel (para 5-29).
- Install top, bottom, and both side covers (para 5-27).

END OF TASK

5-31. REPLACE A2 CIRCUIT CARD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

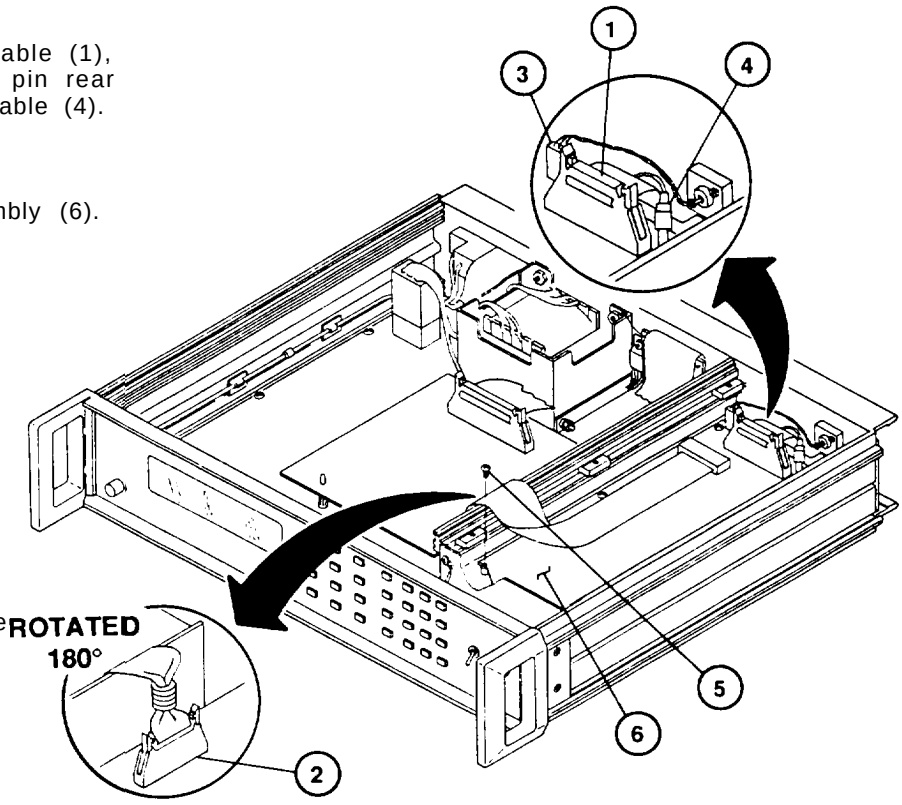
- Remove top cover (para 5-27).
- Remove A2 circuit card cover (para 5-28).

REMOVE

1. Disconnect 20 pin A3 ribbon cable (1), 20 pin A2 ribbon cable (2), 3 pin rear panel cable (3), and A3 SMC cable (4).
2. Remove six screws (5).
3. Remove A2 Circuit Card Assembly (6).

INSTALL

1. Install A2 Circuit Card Assembly (6) with components facing up and connectors toward rear.
2. Install six screws (5).
3. Reconnect 20 pin A3 ribbon cable (1), 3 pin rear panel cable (3), A3 SMC cable (4), and 20 pin A2 ribbon cable (2).



NOTE

FOLLOW-ON MAINTENANCE:

- Install A2 circuit card cover (para 5-28).
- Install top cover (para 5-27)

END OF TASK

5-32. REPLACE A3 CIRCUIT CARD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

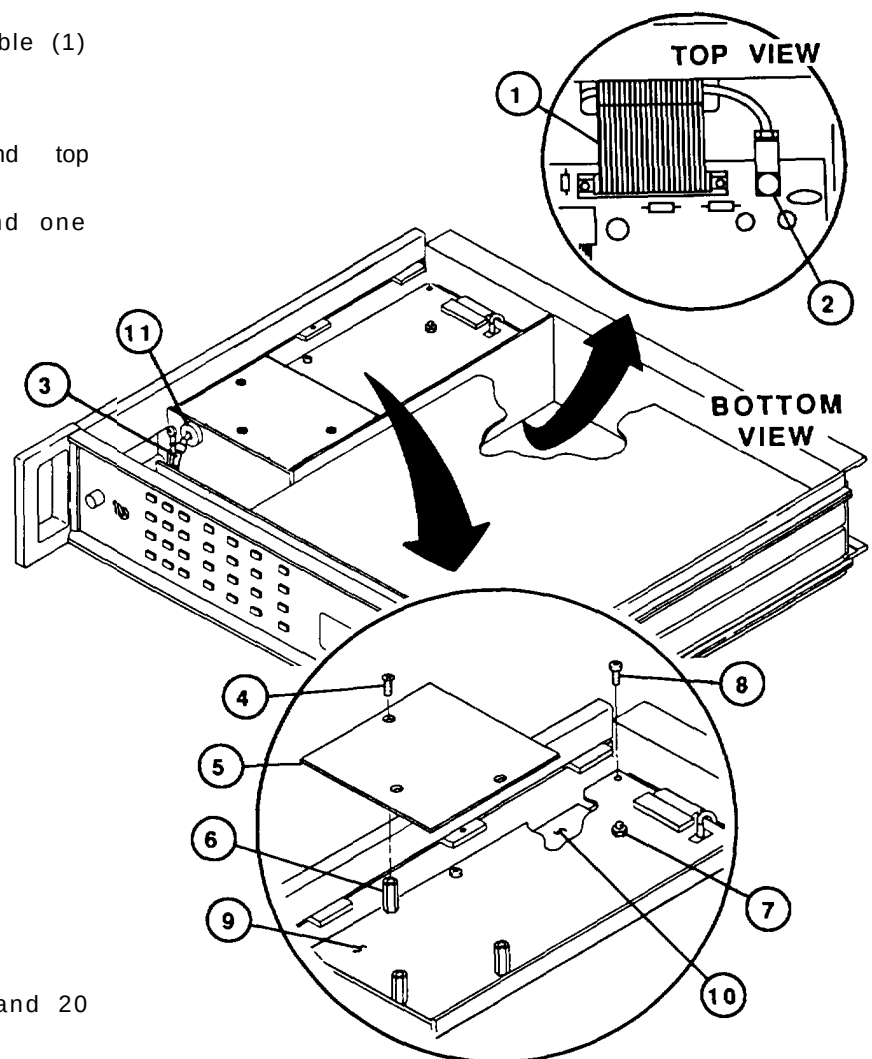
NOTE

FOLLOW-ON MAINTENANCE:

- Remove top and bottom covers (para 5-27).
- Remove A2 and A3 circuit card covers (para 5-28).

REMOVE

1. Disconnect 20 pin A3 ribbon cable (1) and A3 SMC cable (2).
2. Disconnect input cable (3).
3. Remove three screws (4) and top shield (5).
4. Remove three standoffs (6) and one nut (7).
5. Remove six screws (8).
6. Remove A3 Circuit Card Assembly (9) taking care to feed cables through slot.



INSTALL

1. Verify bottom shield (10) is installed. Install A3 Circuit Card Assembly (9) with components facing up so bottom shield screws align.
2. Feed 20 pin A3 ribbon cable (1) SMC cable (2) cables through Install grommet (11) in Reconnect input cable (3).
3. Install three standoffs (6) and (7).
4. Install six screws (8).
5. Install top shield (5) and three (4).
6. Reconnect A3 SMC cable (2) and 20 pin A3 ribbon cable (1).

NOTE

FOLLOW-ON MAINTENANCE:

- Install A2 and A3 circuit card covers (para 5-28).
- Install top and bottom covers (para 5-27).

END OF TASK

5-33. REPLACE A4 CIRCUIT CARD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove top, bottom, and side covers (para 5-27).
- Remove front panel (para 5-29).

REMOVE

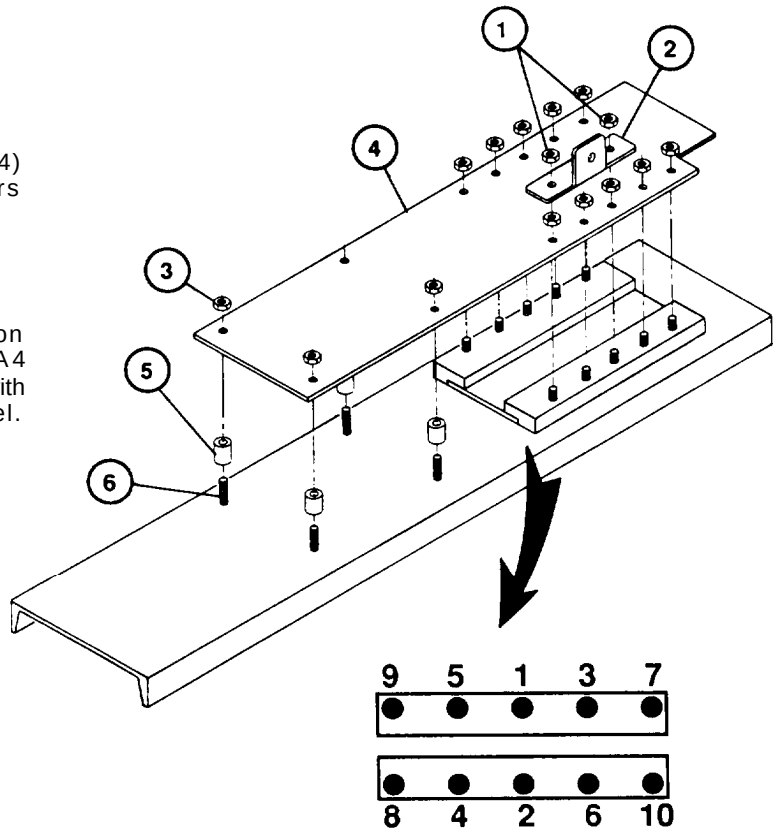
1. Remove two nuts (1) and bracket (2).
2. Remove thirteen nuts (3).
3. Remove A4 Circuit Card Assembly (4) taking care not to lose four spacers (5).

INSTALL

1. Verify four spacers (5) are installed on front panel studs (6). Install A4 Circuit Card Assembly (4) with components facing toward front panel. Take care to align key slots.
2. Install thirteen nuts (3).
3. Install bracket (2) and two nuts (1).

NOTE

When installing LCD nuts, tighten in sequence as shown.



NOTE

FOLLOW-ON MAINTENANCE:

- Install front panel (para 5-29).
- Install top, bottom, and side covers (para 5-27).

END OF TASK

5-34. REPLACE A5 CIRCUIT CARD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

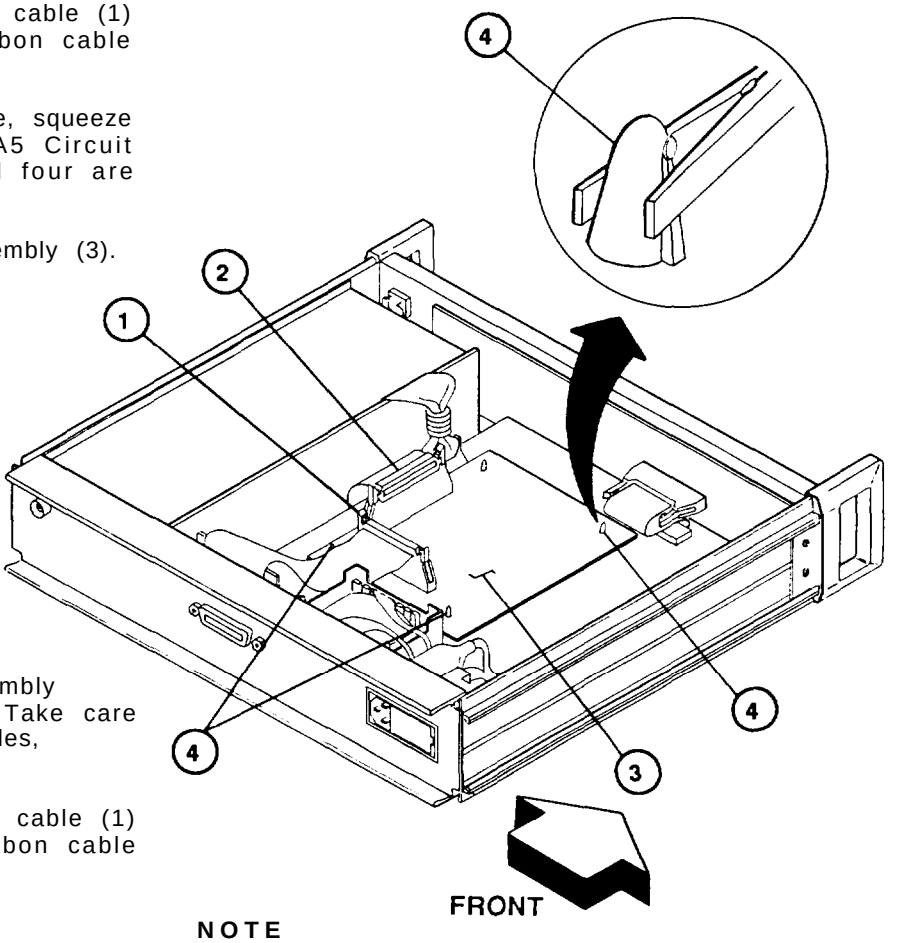
NOTE

PRELIMINARY PROCEDURES:

- Remove top cover (para 5-27),

REMOVE

1. Disconnect 34 pin A6 ribbon cable (1) and 34 pin interconnect ribbon cable (2).
2. Working one corner at a time, squeeze retainers (4) while lifting A5 Circuit Card Assembly (3) until all four are unlocked.
3. Remove A5 Circuit Card Assembly (3).



INSTALL

1. Install A5 Circuit Card Assembly with components facing up. Take care to align retainers (4) with holes, until all four retainers lock.
2. Reconnect 34 pin A6 ribbon cable (1) and 34 pin interconnect ribbon cable (2).

NOTE

FOLLOW-ON MAINTENANCE:

- Install top cover (para 5-27)

END OF TASK

5-35. REPLACE A6 CIRCUIT CARD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

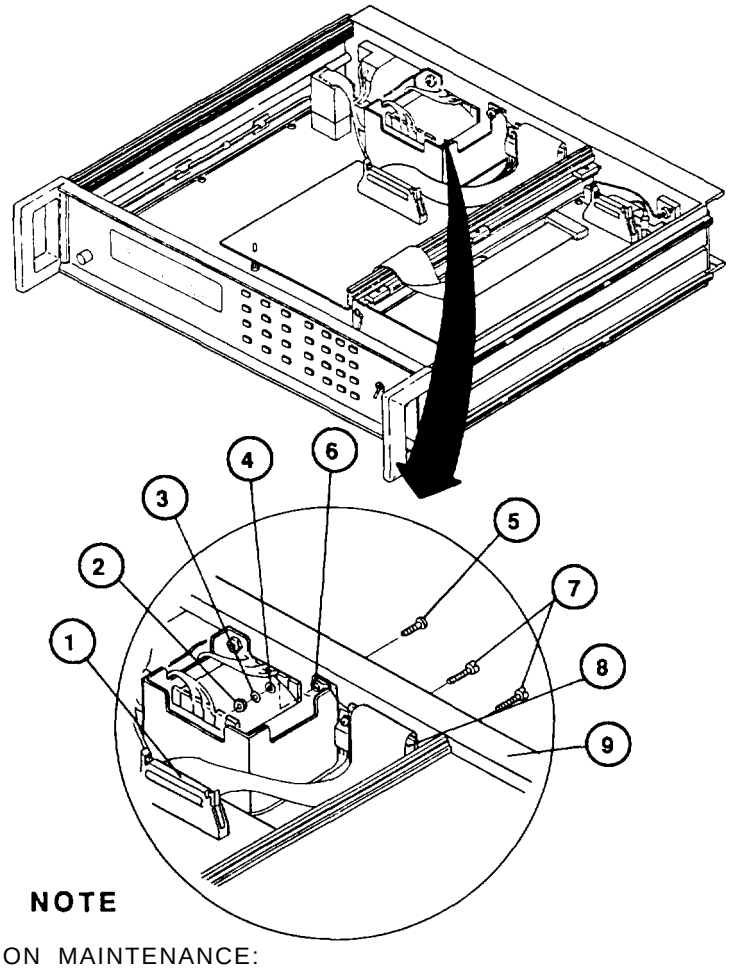
- Remove top cover (para 5-27).

REMOVE

1. Disconnect 34 pin A6 ribbon cable (1).
2. Remove nut (2), lockwasher (3), flat washer (4), screw (5), and A6 ground wire (6).
3. Remove two standoffs (7).
4. Remove A6 Circuit Card Assembly (8).

INSTALL

1. Install A6 Circuit Card Assembly (8) with connector in rear panel (9).
2. Install two standoffs (7).
3. Install screw (5), A6 ground wire (6), flat washer (4), lockwasher (3), and nut (2).
4. Reconnect 34 pin A6 ribbon cable (1).



NOTE

FOLLOW-ON MAINTENANCE:

- Install top cover (para 5-27).

END OF TASK

5-36. REPLACE BT1 BATTERY.

DESCRIPTION

This procedure covers: Remove, Install.

INITIAL SETUP

WARNING

DO NOT heat, short circuit, crush, puncture, mutilate, or disassemble battery. DO NOT USE any battery which shows signs of damage, such as bulging, swelling, disfigurement, brown liquid in the plastic wrap, a swollen plastic wrap, etc. DO NOT test lithium batteries for capacity. DO NOT recharge lithium batteries.

CAUTION

DO NOT dispose of lithium batteries with ordinary trash/refuse. Turn-in batteries to your local serving Defense Reutilization and Marketing Office.

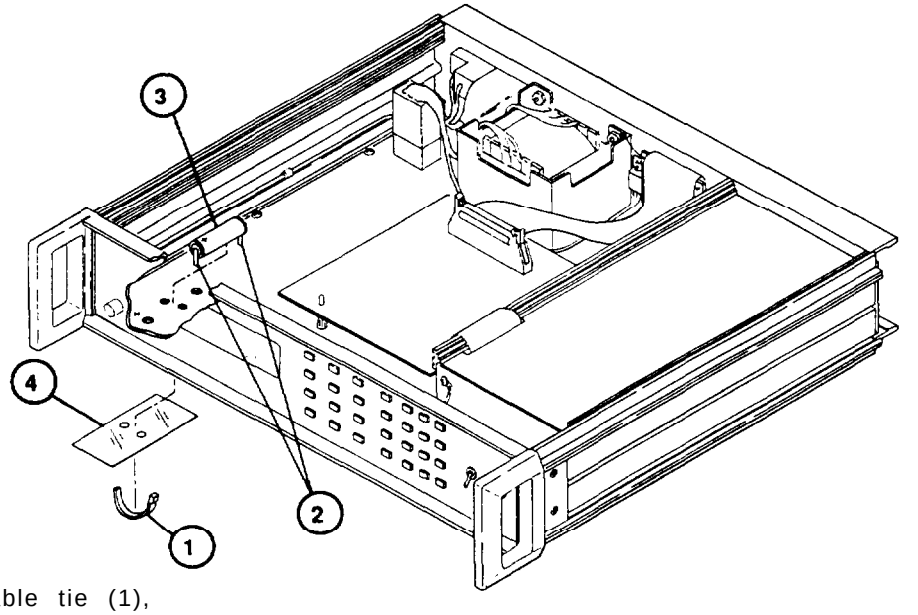
NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 5-27).

REMOVE

1. Cut and remove cable tie (1).
2. Unsolder battery terminals (2).
3. Remove BT1 Battery (3).



INSTALL

1. Install BT1 Battery (3) observing polarity (+ forward).
2. Resolder battery terminals (2) using heat sink.
3. Using a Digital Voltmeter, verify voltage between – terminal of battery and A1TP4 is $\leq$ 300mV.
4. Install insulator (4) and cable tie (1), Appendix E, item 5.

NOTE

FOLLOW-ON MAINTENANCE:

- Install top and bottom covers (para 5-27).

END OF TASK

5-37. REPLACE CR1 BRIDGE RECTIFIER,

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

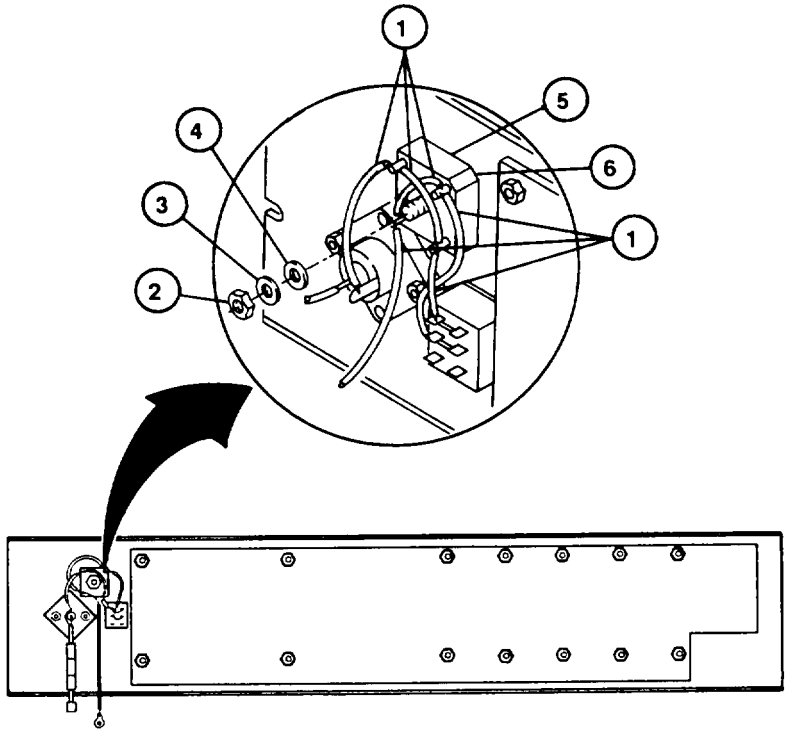
- Remove top cover (para 5-27).

REMOVE

1. Tag and unsolder six wires (1).
2. Remove nut (2), lockwasher (3), and flat washer (4).
3. Remove CR1 Bridge Rectifier (5).

INSTALL

1. Install CR1 Bridge Rectifier (5) with key (6) facing towards top and inboard.
2. Install flat washer (4), lockwasher (3), and nut (2).
3. Resolder six wires (1).



BACK VIEW FRONT PANEL

NOTE

FOLLOW-ON MAINTENANCE:

- Install top cover (para 5-27).

END OF TASK

5-38. REPLACE J1/J20 BNC CONNECTORS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

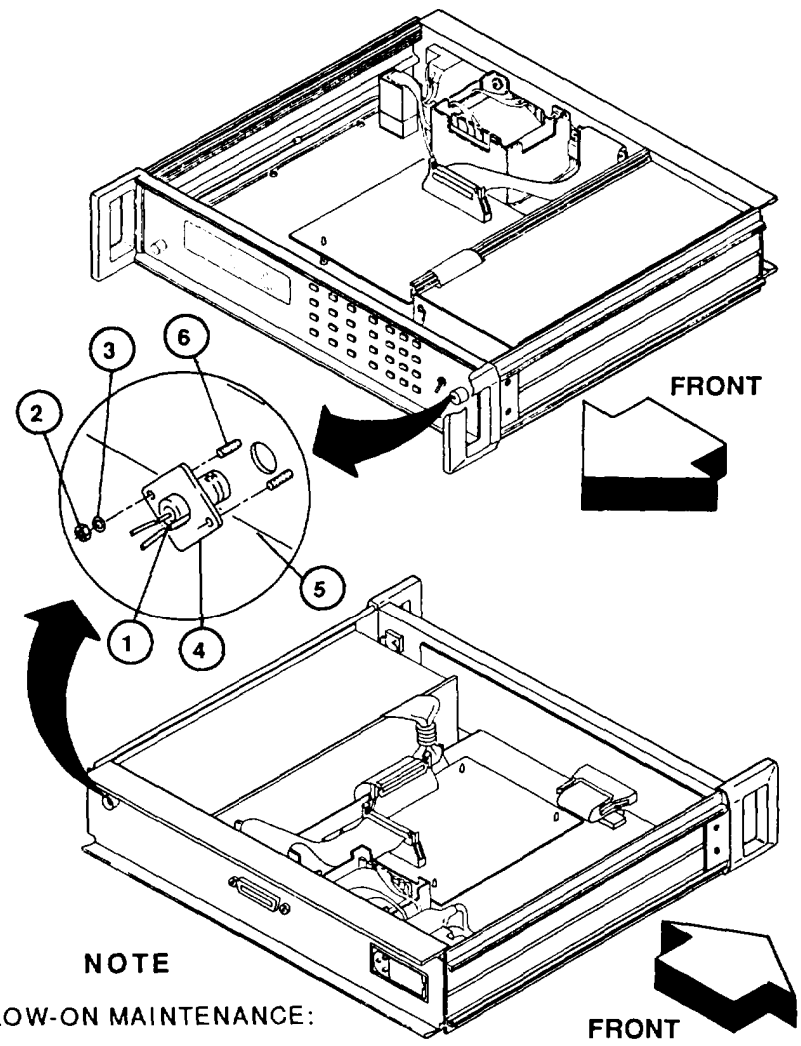
- Remove top cover (para 5-27).
- Remove A2 circuit card cover (para 5-28) if replacing J20.
- Task the same for both connectors. J1 located on front panel, J20 located on rear.

REMOVE

1. Tag and unsolder wires (1).
2. Remove two nuts (2) and lockwasher (3).
3. Remove J1/J20 BNC Connector (4).

INSTALL

1. Install J1/J20 BNC Connector (4) through panel (5) on studs (6).
2. Install two lockwashers (3) and nuts (2).
3. Resolder wires (1).



NOTE

FOLLOW-ON MAINTENANCE:

- Install A2 circuit card cover (para 5-28) if removed.
- Install top cover (para 5-27).

END OF TASK

5-39. REPLACE S1 ISOLATION SWITCH.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

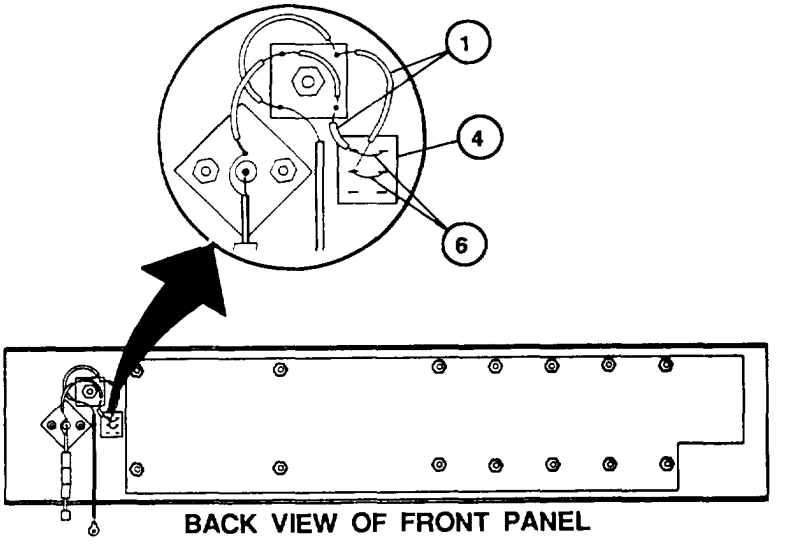
- Remove top cover (para 5-27).

REMOVE

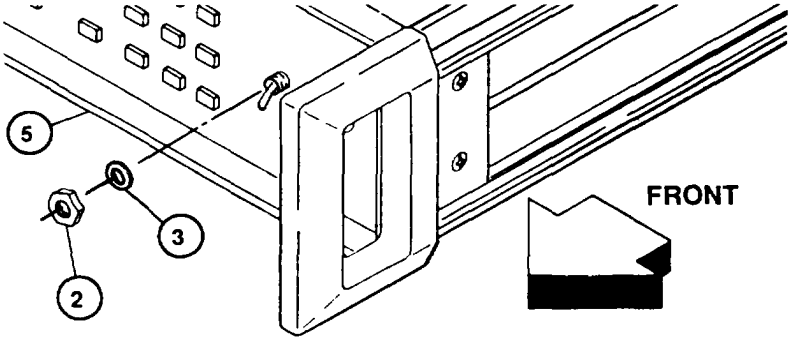
1. Tag and unsolder two wires (1).
2. Remove nut (2) and lockwasher (3).
3. Remove S1 Isolation Switch (4).

INSTALL

1. Install S1 Isolation Switch (4) in front panel (5). Verify top two contacts are shorted (6).
2. Install lockwasher (3) and nut (2).
3. Resolder two wires (1).



BACK VIEW OF FRONT PANEL



NOTE

FOLLOW-ON MAINTENANCE:

- Install top cover (para 5-27).

END OF TASK

5-40. REPLACE S29 POWER SWITCH.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

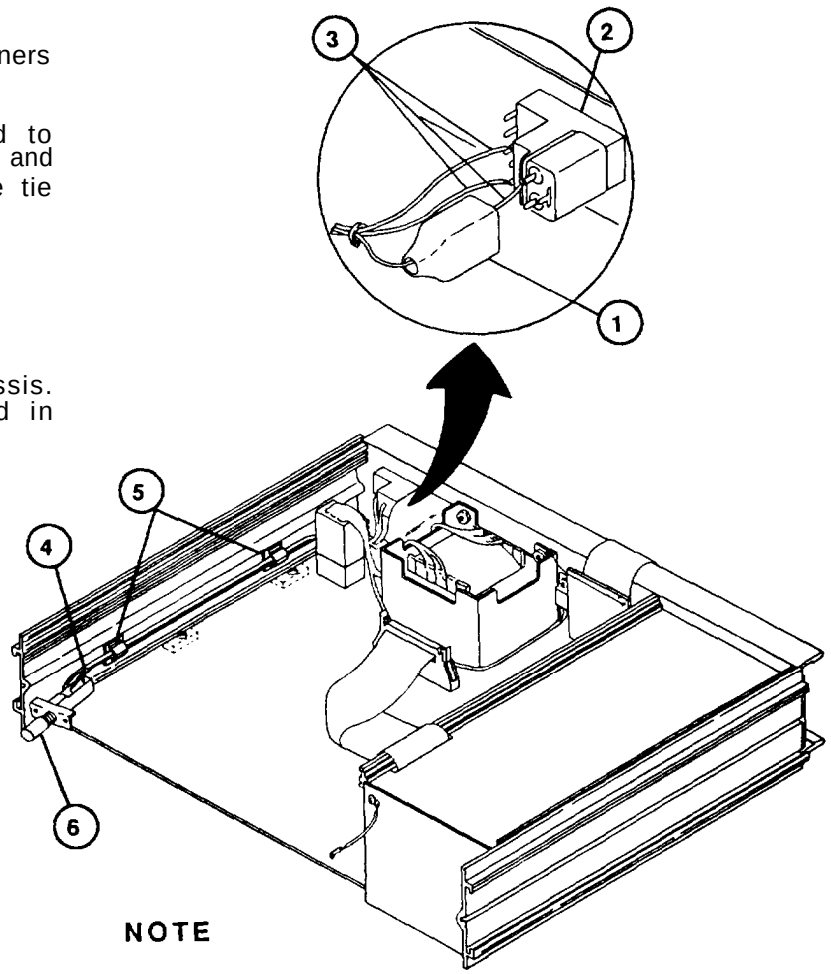
- Remove top, bottom, and both side covers (para 5-27).
- Remove front panel (para 5-29).

REMOVE

1. Remove wire bundle (4) from retainers (5).
2. Slide protective boot (1) forward to expose connector (2). Tag and unsolder four wires (3). Cut cable tie if necessary.
3. Remove S29 Power Switch (6).

INSTALL

1. Position line Switch (6) in chassis. Verify blue wire (3) is installed in protective boot (1).
2. Resolder four wires (3). Slide protective boot (1) towards rear to cover connector (2).
3. Install wire bundle (4) in retainers (5). Replace cable tie (Appendix E, item 5) if removed.



NOTE

FOLLOW-ON MAINTENANCE:

- Install front panel (para 5-29).
- Install top, bottom, and both side covers (para 5-27).

END OF TASK

5-41. REPLACE T1 TRANSFORMER.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

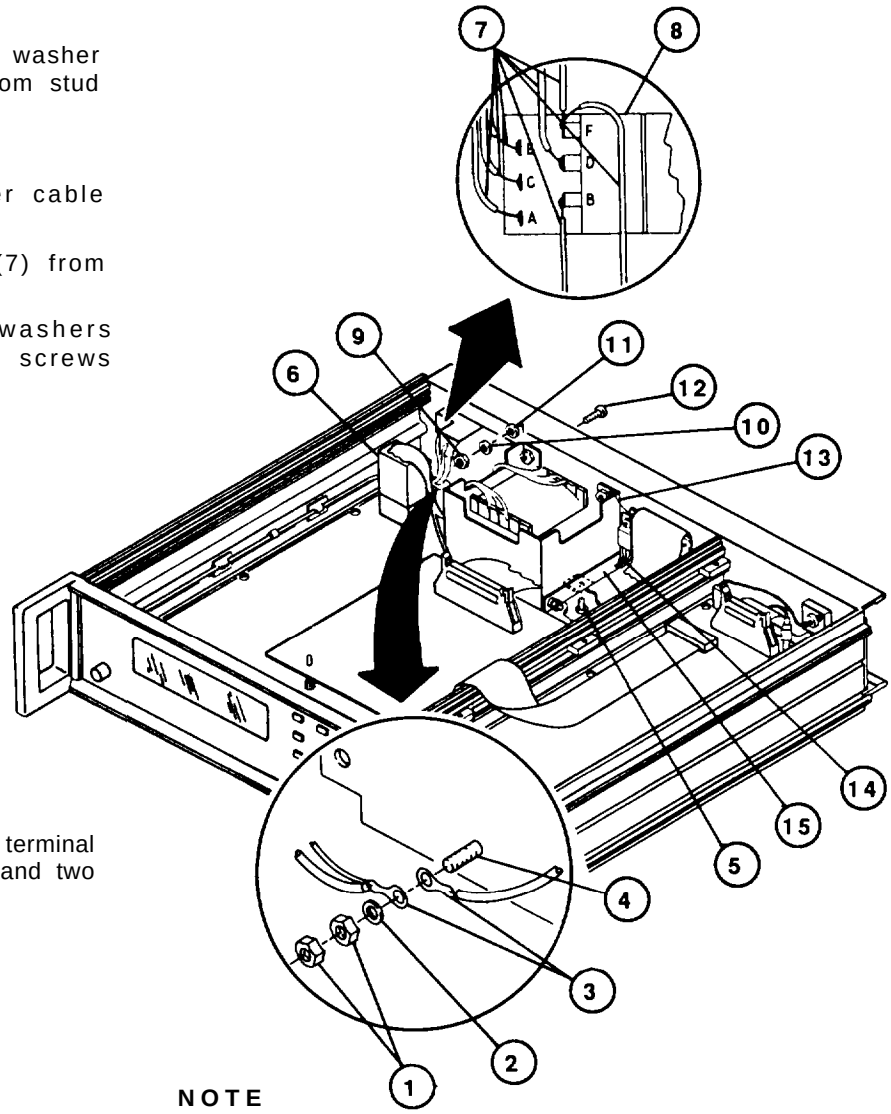
- Remove top and bottom covers (para 5-27).
- Remove U41 Power Regulator (para 5-42).

REMOVE

1. Remove two nuts (1), one flat washer (2), and two terminal lugs (3) from stud (4).
2. Remove screw (5).
3. Disconnect 12 pin transformer cable (6).
4. Tag and unsolder five wires (7) from rear panel connector (8).
5. Remove four nuts (9), lockwashers (10), flat washers (11), and screws (12). Remove ground wire (13).
6. Remove T1 Power Transformer (14).

INSTALL

1. Install T1 Power Transformer (14) on rear panel (15).
2. Install four screws (12), ground wire (13), flat washers (11), lockwashers (10), and nuts (9).
3. Resolder five wires (7) to rear panel connector (8). Reconnect 12 pin transformer cable (6).
4. Install screw (5). Install two terminal lugs (3), one flat washer (2), and two nuts (1) on stud (4)



NOTE

FOLLOW-ON MAINTENANCE:

- Install U41 Power Regulator (para 5-42).
- Install top and bottom covers (para 5-27).

END OF TASK

5-42. REPLACE U41 POWER REGULATOR.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

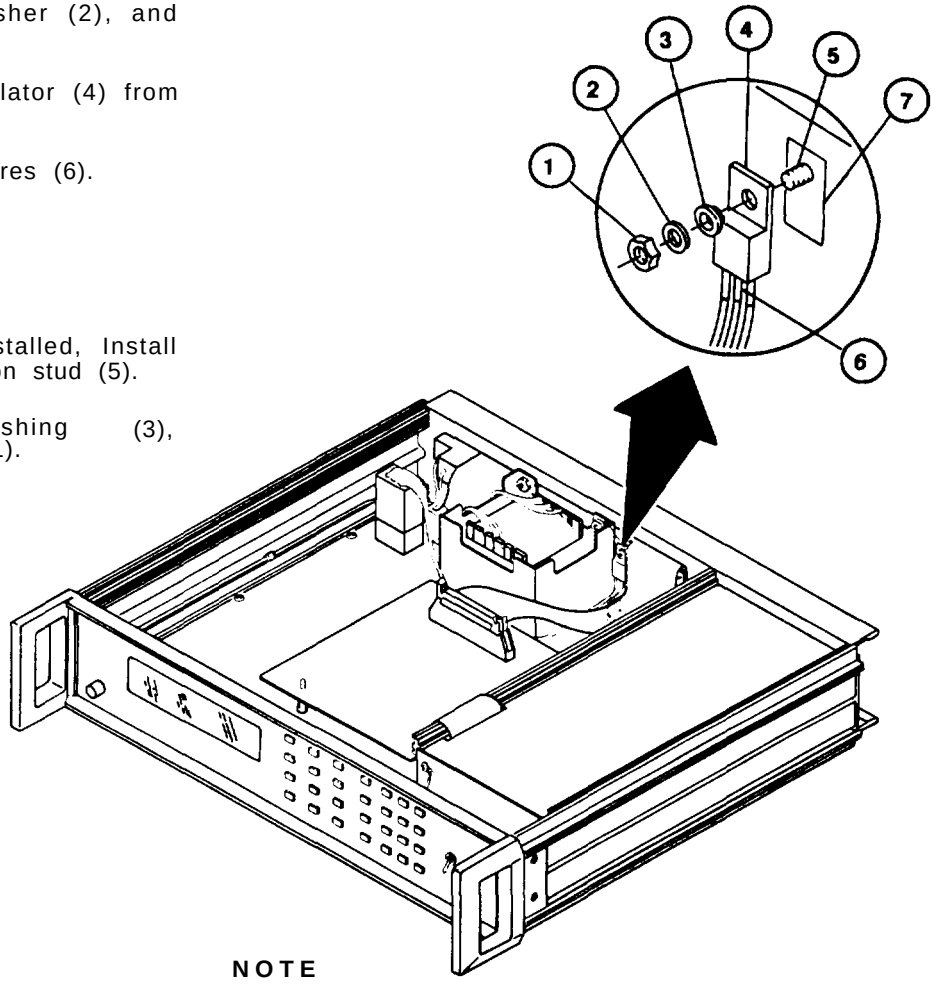
- Remove top cover (para 5-27).

REMOVE

1. Remove nut (1), lockwasher (2), and insulator bushing (3).
2. Remove U41 Power Regulator (4) from stud (5).
3. Tag and unsolder three wires (6).

INSTALL

1. Resolder three wires (6).
2. Verify insulator (7) is installed, Install U41 Power Regulator (4) on stud (5).
3. Install insulator bushing (3), lockwasher (2), and nut (1).



NOTE

FOLLOW-ON MAINTENANCE:

- Install top cover (para 5-27).

END OF TASK

Section V. PREPARATION FOR STORAGE OR SHIPMENT

5-43. PACKAGING.

Package Voltmeter in original shipping container. When using packing materials other than the original, use the following guidelines:

- Wrap Voltmeter in non-static generating plastic packing material.
- Use double-wall cardboard shipping container.
- Protect all sides with shock-absorbing material to prevent Voltmeter movement within the container.
- Seal the shipping container with approved sealing tape.
- Mark “FRAGILE” on all sides, top, and bottom of shipping container.

5-44. TYPES OF STORAGE.

- Short-Term (administrative)-1 to 45 days.
- Intermediate=46 to 180 days.
- Long term=over 180 days.

5-45. ENVIRONMENT.

The Voltmeter should be stored in a clean, dry environment. In high humidity environments, protect the Voltmeter from temperature variations that could cause internal condensation. The following environmental conditions apply to both shipping and storage:

Temperature	- 40° C to + 75° C
Relative Humidity	less than 95% at 40° C

APPENDIX A
REFERENCES

A - 1. SCOPE.

This appendix lists all forms, field manuals, technical manuals, and miscellaneous publications referenced in this manual.

A - 2. FORMS.

Equipment Inspection and Maintenance Worksheet ..... DA Form 2404

Product Quality Deficiency Report ..... Form SF 368

Recommended Changes to Publications and Blank Forms ..... DA Form 2028

Report of Discrepancy (ROD) ..... Form SF 364

Transportation Discrepancy Report (TDR) ..... Form SF 361

A - 3. TECHNICAL MANUALS.

Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command) ..... TM 750-244-2

Unit and Direct Support and General Support Repair Parts and Special Tools List, for Voltmeter ME-545/G ..... TM 11-6625-3200-24P

A - 4. MISCELLANEOUS.

Abbreviations for Use on Drawings, Specifications, Standards and in Technical Documents MIL-STD-12

Interactive Electronic Technical Manual for Calibration and repair Requirement for the Maintenance of Army Material ..... EM 0022

Common Table of Allowances ..... CTA 50-970

Consolidated Index of Army Publications and Blank Forms ..... DA Pam 25-30

First Aid ..... FM 4-25.11

Safety Precautions for Maintenance of Electrical/Electronic Equipment ..... TB 385-4

The Army Maintenance Management System (TAMMS) Users Manual ..... DA Pam 750-8

APPENDIC B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General.

a. This appendix provides a general explanation of all maintenance and repair function authorized at the two maintenance levels under the Two-Level Maintenance System concept for the Voltmeter ME-545/G.

b. The Maintenance Allocation Chart (MAC) in SECTION II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component levels, which are shown on the MAC in column (4) as:

1. Field – includes two columns, Unit maintenance and Direct Support maintenance. The Unit maintenance column is divided again into two more subcolumns, C for Operator or Crew and O for Unit maintenance.
2. Sustainment – includes two subcolumns, general support (H) and depot (D).

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from the MAC.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2. Maintenance Functions

Maintenance functions are 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 (e.g. by sight, sound, or feel). This includes scheduled inspection and gagings and evaluation of cannon tubes.

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards on a scheduled basis, i.e., load testing of lift devices and hydrostatic testing of pressure hoses.

c. Service. Operations required periodically to keep an item in proper operating condition; e.g., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases. This includes scheduled exercising and purging of recoil mechanisms. The following are examples of service functions:

1. Unpack. To remove from packing box for service or when required for the performance of maintenance operations.
2. Repack. To return item to packing box after service and other maintenance operations.
3. Clean. To rid the item of contamination.
4. Touch up. To spot paint scratched or blistered surfaces.
5. Mark. To restore obliterated identification.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper position, or by setting the operating characteristics to specified parameters.

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

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments of test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons 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. Remove/install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Paint. To prepare and spray color coats of paint so that the ammunition can be identified and protected. The color indicating primary use is applied, preferably, to the entire exterior surface as the background color of the item. Other markings are to be repainted as original so as to retain proper ammunition identification.

i. Replace. To remove an unserviceable item and install a serviceable counterpart in its place "Repair" is authorized by the MAC and assigned maintenance level is shown as the third position code of the Source, Maintenance and Recoverability (SMR) code.

j. Repair. The application of maintenance services, including fault location/troubleshooting, removal/installation, disassembly/assembly procedures and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item or system.

NOTE

The following definitions are applicable to the "repair" maintenance function:

1. Services. Inspect, test, service adjust, align, calibrate, and/or replace.
2. Fault location/troubleshooting. The process of investigating and detecting the case of equipment malfunctioning; the act of isolating a fault within a system or Unit Under Test (UUT).
3. Disassembly/assembly. The step-by-step breakdown (taking apart) of a spare/functional group coded item to the level of its least component, that is assigned an SMR code for the level of maintenance under consideration (i.e., identified as maintenance significant).
4. Actions. Welding, grinding, riveting, straightening, facing, machining, and/or resurfacing.

k. Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards 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.

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

B-3. Explanation of Columns in the MAC, SECTION II.

a. Column (1) Group Number. Column (1) lists FGC numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the Next Higher Assembly (NHA).

b. Column (2) Component/Assembly. Column (2) contains the item names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column (3) Maintenance Function. Column (3) lists the functions to be performed on the item listed in column (2). (For a detailed explanation of these functions, refer to "Maintenance Functions" outlined above.)

d. Column (4) Maintenance Level. Column (4) specifies each level of maintenance authorized to perform each function listed in column (3), by indicating work time required (expressed as man hours in whole hours or decimals) in the appropriate subcolumn. The work time figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance levels, appropriate work time figures are to be shown for each level. The work time 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 (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the MAC. The symbol designations for the various maintenance levels are as follows:

1. Field:
   - C Operator or Crew maintenance
   - O Unit maintenance
   - F Direct Support maintenance

2. Sustainment:
   - L Specialized Repair Activity
   - H General Support maintenance
   - D Depot maintenance

NOTE

The "L" maintenance level is not included in column (4) of the MAC. Functions to this level of maintenance are identified by work time figure in the "H" column of column (4), and an associated reference code is used in the REMARKS column (6). This code is keyed to the remarks and the SRA complete repair application is explained there.

e. Column (5) Tools and Equipment Reference Code. Column (5) specifies, by code, those common tool sets (not individual tools), common Test, Measurement and Diagnostic Equipment (TMDE), and special tools, special TMDE and special support equipment required to perform the designated function. Codes are keyed to the entries in the tools and test equipment table.

f. Column (6) Remarks Code. When applicable, this column contains a letter code, in alphabetical order, which is keyed to the remarks table entries.

B-4. Explanation of Columns in the Tools and Test Equipment Requirements, SECTION III.

a. Column (1) Tool or Test Equipment Reference Code. The tool or test equipment reference code correlates with a code used in column (5) of the MAC.

b. Column (2) Maintenance Level. The lowest level of maintenance authorized to use the tool or test equipment.

c. Column (3) Nomenclature. Name or identification of the tool or test equipment.

d. Column (4) National Stock Number (NSN). The NSN of the tool or test equipment.

e. Column (5) Tool Number. The manufacturer's part number, model number, or type number.

B-5. Explanation of Columns in the Remarks, SECTION IV.

a. Column (1) Remarks Code. The code recorded in column (6) of the MAC.

b. Column (2) Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC."

Section II. MAINTENANCE ALLOCATION CHART FOR VOLTMETER ME-545/G

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT REFENENCE CODE	(6) REMARKS
			FIELD			SUSTAINMENT			
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	True RMS Voltmeter ME-545	INSPECT		0.2					A
		INSPECT			0.2				A
		REPAIR		0.2					B
01	Meter	INSPECT		0.2					
		INSPECT			0.2			2	C
		TEST		0.1					D
		CALIBRATE			2.6			2-13	E
		TEST			0.3			2-17, 19	F
		REPAIR		0.1				1	G
		REPAIR			1.0			2-16, 19	H
0101	Processor I/B CCA A1	INSPECT						2	
		TEST						2-14	
		REPAIR						2-14	J
0102	Detector CCA A2	INSPECT						2	
		TEST						2-16	
		REPAIR						2-18	K
0103	Amplifier CCA A3	REPLACE			0.1			2	
		ADJUST			0.5			2-9, 13, 16, 17	
		INSPECT					0.5		
		TEST					0.6		
		REPAIR					1.5		L
99	Cable Kit Extender	INSPECT			0.1				M
		REPAIR			0.1				

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR VOLTMETER ME-545/G

(1) TOOLS OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) TOOL NUMBER
1	O	Tool Kit, Electronic Equipment	5180-01-064-5178	TK-101/G
2	F	Tool Kit, Electronic Equipment	4931-01-073-3845	JTK-17AL
3	F	Voltage Standard, DC		332B/AF
4	F	Oscilloscope, Mainframe	6625-01-034-3269	5440
5	F	Amplifier, Dual trace	6625-01-008-1480	5A48
6	F	Time Base Delay	6625-01-008-1479	5B42
7	F	Voltmeter, Digital	6625-00-557-8305	3490A-060
8	F	Generator, Signal	4931-01-085-4229	MIS-28707 TYPE 1
9	F	Calibrator, AC	6695-00-458-4605	745A
10	F	Multimeter	6625-01-092-1198	260-8
11	F	Amplifier, High Voltage	6695-01-109-9110	746A
12	F	Kit, Cable Extender	4931-01-294-5529	404622
13	F	Probe. Oscilloscope	6625-00-098-8141	P6106A OPT 1
14	F	Analyzer, Signature	6625-01-149-0280	5006A
15	F	Controller/Display *	6625-01-515-1593	1722A
16	F	Ratio Transformer	6625-00-714-4216	DT72A
17	F	Converter, Thermal	4931-00-178-1054	1394-1
18	F	Variable AC Power Supply	6120-00-168-3705	W10MT3A
19	F	Resistance Standard	6625-00-071-5343	7910328
20	F	* OPTIONAL – For automatic Test Procedures Only		

Section IV. REMARKS FOR VOLTMETER ME-545/G

REMARKS CODE	REMARKS
A	Inspect exterior of unit.
B	Repair by replacing power cable and test leads.
C	Inspect exterior and interior of unit.
D	Power-up instrument. Record displayed self-test error messages, use diagnostic special functions.
E	Perform Calibration procedure as listed in TB 43-180.
F	Run Performance Verification Tests.
G	Repair unit by replacing line fuse (F2).
H	Repair by replacing throwaway assemblies Keyboard/Display (A4), GPIB (A5), GPIB Interface Board (A6) and piece parts Power Transformer (T1), BNC Connector (J20), Power Regulator (U41), Toggle Switch (S1), BNC Connector (J1) Bridge Rectifier (CR1) and Power Switch (S29).
J	Repair by replacement of battery (BT1), fuse (F1) and faulty components.
K	Repair by replacing faulty component(s).
L	Contractor Repair.
M	Repair by replacing of defective cable.

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LIST

Section 1. INTRODUCTION

C-1. SCOPE.

This appendix lists components of the end item and basic issue items for the Voltmeter ME-545/G to help you inventory items required for safe and efficient operation.

C-2. GENERAL.

The components of End Item and Basic Issue Items List (Bll) are divided into the following sections:

a. Section *II—Cornponents of End Item.* This listing is for information purposes only and is not authority to requisition replacements. These are part of the end item, but are removed and/or separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. Section ///—Basic Issue Items. These are the minimum essential items required to place the Voltmeter ME-545/G in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, Bll must be with the Voltmeter ME-545/G during operation and whenever it is transferred between property accounts. This manual is your authority to request/requisition replacement Bll, based on TOE/MTOE authorization of the end item.

C-3. EXPLANATION OF COLUMNS.

a. Column (1)—Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.

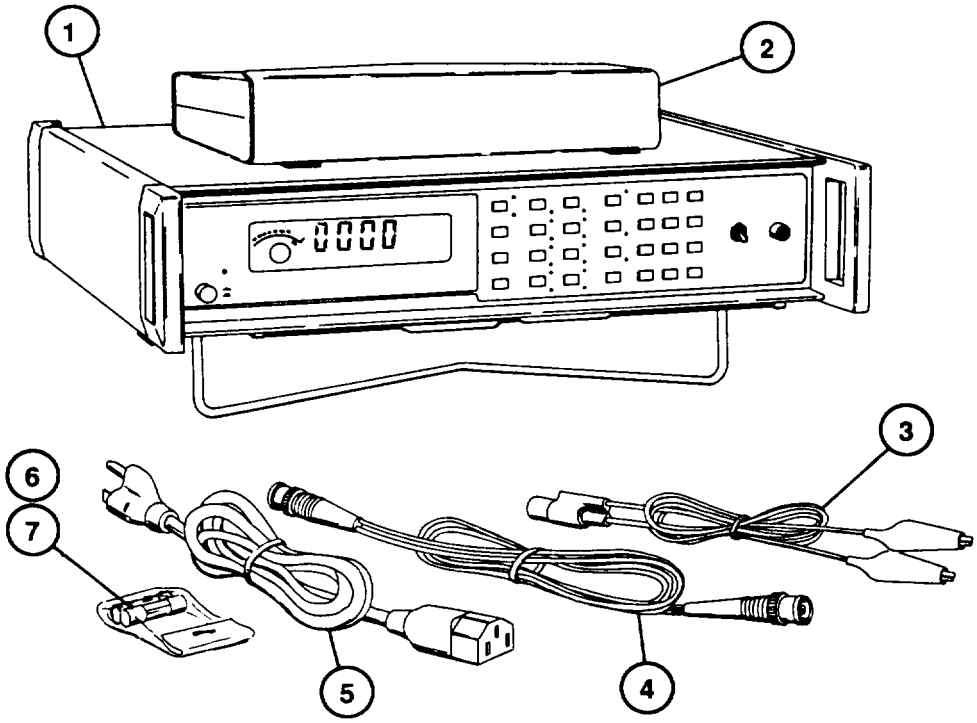
b. Column (2)—National Stock Number. This column indicates the national stock number assigned to the item and will be used for requisitioning purposes.

c. *Column (3)—Description.* This column indicates the federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

d. Column (4) —Unit of Measure (U/M). This column indicates the measure used in performing the actual operation/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e. g., ea, in, pr).

e. Column (5)—Quantity Required (Qty Rqr). This column indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM



(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM and PART NUMBER	(4) U/M	(5) QTY RQR
1		VOLTMETER (21793) 5002	EA	1
2		CASE, ACCESSORY (21793) 454602	EA	1
3		ADAPTER, COAXIAL (21793) 601773	EA	1
4		CABLE ASSEMBLY, RAD FREQ (21793) 601772	EA	1
5		CABLE ASSEMBLY, POWER (21793) 600620	EA	1
6		FUSE, CARTRIDGE, 1/4 AMP, 250V (21793) 920756	EA	1
7		FUSE, CARTRIDGE, 1-6/10 AMP, 250V (21793) R-23-0055	EA	1

APPENDIX D

ADDITIONAL AUTHORIZATION LIST

Section I. INTRODUCTION

D-1. SCOPE.

This appendix lists additional items you are authorized for the support of the Voltmeter ME-545/G.

D-2. GENERAL.

This list identifies items that do not have to accompany the Voltmeter ME-545/G and that do not have to be turned in with it. These items are all authorized to you by CTA, MTOE, TDA, or JTA.

D-3. EXPLANATION OF LISTING.

National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment. The items are listed in alphabetical sequence by item name under the type document (i. e., CTA, MTOE, TD, or JTA) which authorized the item(s) to you.

Section II. ADDITIONAL AUTHORIZATION LIST

(1) NATIONAL STOCK NUMBER	(2) DESCRIPTION FSCM and PART NUMBER USABLE ON CODE	(3) U/M	(4) QTY AUTH
	FUSE, CARTRIDGE, 1/4 AMP, 250V (21793) 920756	EA	1
	FUSE, CARTRIDGE, 1-1/6 AMP, 250V (21793) R-23-0055	EA	1

APPENDIX E

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E - 1. SCOPE.

This appendix lists expendable supplies you will need for maintenance on Voltmeter ME-545/G. 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 (l)—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.
H - General Support Maintenance.

c. *Column (3)—National Stock Number,* This column indicates the national stock number assigned to the item and will be used for requisitioning purposes.

d. *Column (4)—Description.* This column indicates the federal item name and if required, a minimum description to identify the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

e. *Column (5)—Unit of Measure (U/M).* This column 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	O	6810-00-753-4993	Alcohol, Isopropyl, 8OZ Can, TT-I-735, Grade A (81349)	CN
2	C	8305-00-267-3015	Cloth, Cheesecloth, Cotton, Lintless, CCC-C-440, Type II, Class 2 (81349)	YD
3	C		Detergent, Mild, Liquid	CN
4	H	6850-00-405-2602	Circuit Cooler, Freezing Compound (18598)	CN
5	H		Cable Ties TY23M-8 (59730)	E A

APPENDIX F

REMOTE OPERATION

F-1. SCOPE.

This appendix describes Voltmeter ME-545/G remote operation (GPIB) procedures using an external controller. GPIB Digital Interface conforms to IEEE 488-1978 subsets SH1, AH1, T5, TE0, L4, LE0, SRI, RL1, PP0, DC1, DT1, and C0.

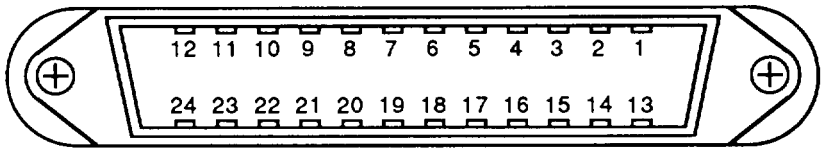
F-2. GENERAL.

Remote operation of the Voltmeter is very similar to local operation. Refer as necessary to Chapter 2 for descriptions of controls, indicator-s, and connectors (para 2-1), and individual operating procedures (para 2-9 through 2-14). Rear panel GPIB connector input and output information is supplied below.

Logic Levels

1=Low= $\leq$ 0.8V

0=High= $\geq$ 2.0V



Pin	Assignment	Nomenclature	Description
1	DIO 1	Data In/Out Bit 1 (LSB)	Data Line*
2	DIO 2	Data In/Out Bit 2	Data Line*
3	DIO 3	Data In/Out Bit 3	Data Line*
4	DIO 4	Data In/Out Bit 4	Data Line*
5	EOI	End or Identify	Interface Line***
6	DAV	Data Valid	Handshake Line**
7	NRFD	Not Ready for Data	Handshake Line**
8	NDAC	Not Data Accepted	Handshake Line**
9	IFC	Interface Clear	Interface Line***
10	SRQ	Service Request	Interface Line***
11	ATN	Attention	Interface Line***
12	SHIELD		
13	DIO5	Data In/Out Bit 5	Data Line*
14	DIO6	Data In/Out Bit 6	Data Line*
15	DIO7	Data In/Out Bit 7	Data Line*
16	DIO8	Data In/Out Bit 8	Data Line*
17	REN	Remote Enable	Interface Line***
18	GND, (6)		Ground
19	GND, (7)		Ground
20	GND, (8)		Ground
21	GND, (9)		Ground
22	GND, (10)		Ground
23	GND, (11)		Ground
24	GND, (5 & 17)		Ground

* Data lines are used to transfer data from one Instrument to another.
** Handshake lines operate in a proper time sequence for complete communication between instruments.
*** Interface lines are used to provide an orderly flow of information between units.

F-3. OPERATING PROCEDURES.

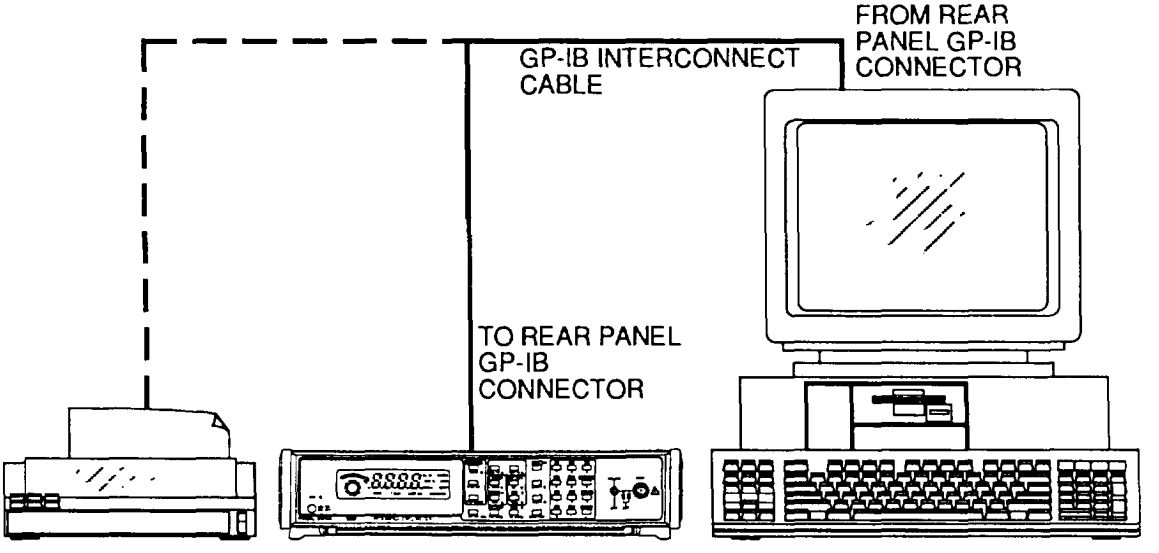
Perform the following steps for remote operation of Voltmeter.

1. Connect the equipment as shown below.

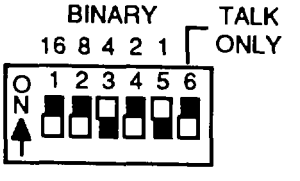
NOTE

Keep GPIB interconnect cable length below 6.6 feet (2m) and must be shielded.

TALK ONLY MODE **ADDRESSED MODE**



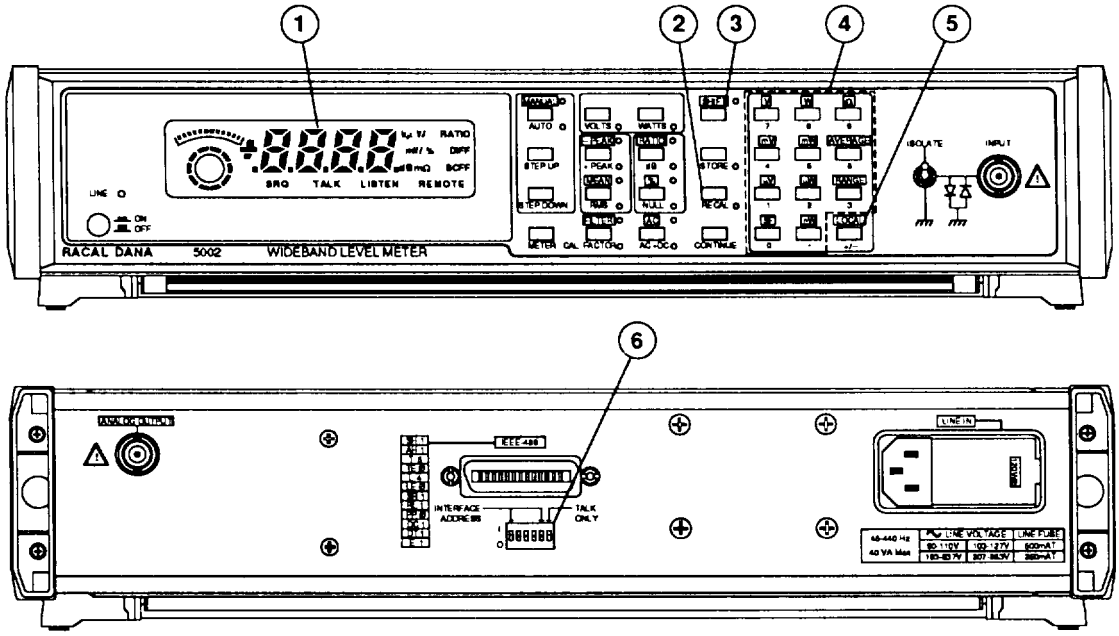
2. Perform turn-on procedure (para 2-6).
3. On Voltmeter front panel, select RECALL (2), SHIFT (3), then LOCAL (5) keys (4) and read interface address in DISPLAY (1),
   - If incorrect address displayed, change rear panel GPIB switch (6) positions one to five to correct setting. Repeat step to verify correct setting. Acceptable selection is decimal 00 to 30 (binary 0000 to 1110). Switch positions indicated in binary value (decimal 10 shown).



F-4. TALK ONLY MODE.

Talk-Only Mode is used in systems not having a controller (i.e. connected to a printer or other listen only device), The Voltmeter is controlled from the front panel. Only remote reading of Voltmeter measurement data is available.

1. On Voltmeter rear panel, set GPIB address switch (6) position six to on (Talk)
2. Voltmeter is operated using front panel controls. Refer as necessary to Chapter 2 for descriptions of controls, indicators, and connectors (para 2-1), and individual operating procedures (para 2-9 through 2-14).



F-5. ADDRESSED MODE.

Addressed Mode is used in systems having a controller (i.e. connected to a computer). The Voltmeter is controlled from the external controller. Voltmeter measurement data and status is transmitted to the controller. Measurement commands are received from the controller and executed.

1. On Voltmeter rear panel, set GPIB address switch (6) position six to off (Listen).
2. All Voltmeter functions (except LINE ON/OFF) can be controlled using the external controller. Control is maintained by use of device-dependent commands (para F-6 to F-26). Refer as necessary to Chapter 2 for descriptions of controls, indicators, and connectors (para 2-1), and individual operating procedures (para 2-9 through 2-14).

F-6. REMOTE/LOCAL CHANGEOVER.

The Voltmeter is switched from local to remote control by the following sequence of control and data line messages:

1. Remote enable (REN) true (low).
2. Attention (ATN) true (low).
3. Listen address. (enters the listener addressed state (LADS) on recognition of listen address).
4. ATN false (high).

The Voltmeter is switched from remote to local control:

1. By pressing the front panel LOCAL key.
2. Receiving the go to local (GTL) command when in the LADS.
3. Receiving the REN message false (high).

F-7. LOCAL LOCKOUT (LLO).

Operation of the front panel LOCAL key during the transfer of data to the Voltmeter could result in the instrument being switched from remote to local control with the control settings in an unknown state, To prevent this the LOCAL key can be disabled by setting local lockout.

Local lockout may be set at any time when the REN message is true (low). The-recognition of the LLO message is not dependent on the addressed state of the instrument. Apart from the disablement of the LOCAL key it causes no changes to the operation of the Voltmeter. The only method of canceling LLO is to send the REN message false (high). This affects all instruments on the bus, putting thereto the local control state (LOCS).

F-8. VOLTMETER TO CONTROLLER OUTPUT MESSAGE FORMATS.

Completed measurement readings, stored values, and Voltmeter status information that are read over the bus from the Voltmeter to controller.

The output message consists of a string of 12 ASCII characters for each transmitted value. No parity check is included. Each byte is accompanied by the full handshake procedure on the NRFD, DAV and NDAC control lines. Measurement units should be assumed as volts, watts, dB, ohms, percentage, ratio, or difference, depending on commands previously sent to the Voltmeter. Output messages should be interpreted using table shown.

Byte No	Interpretation Characters	Permitted ASCII
	Measurement sign	+ or -
2	Digit (MSD)	0 to 9
3	Decimal Point	"."
4	Digit	0 to 9
5	Digit	0 to 9
6	Digit (LSD)	0 to 9
7	Exponent indicator	E
8	Exponent sign	+ o r -
9	More significant digit	0 to 9
10	Less significant digit	0 to 9
11	Carriage return	C R
12	Line Feed	L F

F-9. STATUS BYTE.

Informs controller of Voltmeter status. The Voltmeter assembles and transmits a status message referred to as a status byte. The controller generates a serial poll enable cycle to determine which bus member has requested service and the purpose of the request. When the Voltmeter receives the SPE command, and has been made a talker, it outputs the status byte to the controller. Format of the status byte is shown below.

DIO Line	Function
1	Not Used
2	Not Used
3	Not Used
4	Not Used
5	1=Busy
6	1=Error detected
7	1=Service requested
8	Not used

NOTE

The status byte does not provide information about the nature of any error which has been detected. The addressed command 14 can be used to have the error number loaded into the output buffer. This will then be transmitted via the bus when the instrument is addressed to talk.

F-10. SERVICE REQUEST (SRQ).

The front-panel SRQ indicator lights when an SRQ message is asserted. The Voltmeter can be set, by means of device-dependent commands, to enable an SRQ message whenever:

- Data is available.
- An error state is detected,

When the Voltmeter is being used in the triggered mode, a delay (equal to the value stored in AVERAGE) will occur between the generation of the SRQ output and the appearance of the SRQ indicator on the front panel.

Service Request Interrupt Commands are listed below.

Function	Code
No service requests generated.	I0
Service request generated when measured value is available.	I1
Service request generated when error is detected.	I2
Service request generated when measured value is available or when error is detected.	I3
Load error code number into output buffer.	I4

NOTE

- After loading the error number into the output buffer, the Voltmeter must be put to the talker active state for the data to be put onto the bus. The instrument will return to the measurement mode once the output buffer is loaded, but failure to read the buffer contents will prevent measurement data being entered.
- The loading of the error code into the output buffer does not cancel the error code. Error codes other than 01, 20, 23, 24, 25 and 26 are cancel led using the cancellation code C2.

F-11. CONTROLLER TO VOLTMETER INPUT COMMANDS.

Measurement commands that are read over the bus from the controller to the Voltmeter.

The Voltmeter responds to device-dependent commands in a “deferred” mode. This means that the GPIB interface continues to accept commands until a terminating character or message is received, then the entire string will be executed. There is no “immediate” mode in which commands are obeyed as they are received.

When the Voltmeter is addressed to listen, it is controlled by device-dependent commands. These commands are explained in paragraphs F-12 through F-26.

F-12. TERMINATORS.

Device-dependent commands are executed sequentially beginning with the first one sent and ending with the last. If more than one command is to be sent, no delimiters are required. If necessary, commas, spaces, and semicolons may be included in the command strings for clarification without affecting Voltmeter operation. Each command string must be followed by an end-of-string terminating group. Valid terminator groups are shown below.

	1	2	3	4	5
	CR EOI	LF	CR, LF	CR LF EOI	LF EOI

Where LF=Line feed, CR=carriage return; EOI is considered true

F-13. MEASUREMENT UNITS.

The following codes select measurement units as described in para 2-1, and 2-9 to 2-14.

Function	Code
volts	F0
Watts	F1

F-14. STORED Ω.

The following codes are used to display or store values in Ω as described in para 2-1, and 2-9 to 2-14.

Function	Code
Store contents of numerical input buffer in Ω.	Q 1
Load contents of Ω into the output buffer.	Q 2

NOTE

After loading the contents of Ω into the output buffer, the Voltmeter must be put to the talker active state for the data to be put onto the bus. The instrument will return to the measurement mode once the output buffer is loaded, but failure to read the buffer contents will prevent measurement data being entered.

F-15. MEASUREMENT FUNCTION.

The following codes are used to select measurement functions as described in para 2-1, and 2-9 to 2-14.

Function	Code
RMS	DO
Mean	D1
+Peak	D2
-Peak	D3

F-16. COMPUTED FUNCTION.

The following codes are used to select computed functions as described in para 2-1, and 2-13.

Function	Code
Select RATIO.	G1
Store the contents of numerical input buffer in RATIO. If the numerical input buffer is empty, stores last measured value.	G2
Load the stored RATIO contents into the output buffer.	G3
Select dB.	L 1
Store the contents of the numerical input buffer in dB. If the numerical input buffer is empty, stores last measured value.	L2
Load the stored dB contents into the output buffer.	L3
Select NULL.	N1
Store the contents of the numerical input buffer in NULL. If the numerical input buffer is empty stores last measured value.	N2
Load the stored NULL contents into the output buffer,	N3
Select %.	P1
Store the contents of the numerical input buffer in %. If the numerical input buffer is empty, stores last measured value.	P2
Load the stored % contents into the output buffer.	P3

NOTE

- Selection of one compute function will automatically cancel any other compute function. Cancellation code C0 allows cancellation of all computed functions.
- The numerical input buffer is cleared, if required, by means of cancellation code C1.
- After loading the contents of RATIO, dB, %, or NULL into the output buffer, the Voltmeter must be put to the talker active state for the data to be put onto the bus. The instrument will return to the measurement mode once the output buffer is loaded, but failure to read the buffer contents will prevent measurement data being entered.

F-17. RANGE.

The following codes are used to select ranges as described in para 2-1, and 2-9 to 2-14.

Range	Code
Autorange	R00
100 µV	R01
300 µV	R02
1 mV	R03
3 mV	R04
10mV	R05
30 mV	R06
100 mV	R07
300 mV	R08
1 V	R09
3 V	R10
10V	R11
30 v	R12
100V	R13
300 v	R14
Manual Range	RM
Load the output buffer with the full scale valueof the range in use.	RZ

NOTE

- The use of code RM will take the instrument from the autorange mode to the manual range mode without changing the range in use.
- After loading the range in the output buffer, the Voltmeter must be put to the talker active state for the data to be put onto the bus. The instrument will return to the measurement mode once the output buffer is loaded, but failure to read the buffer contents will prevent measurement data being entered.

F-18. INPUT COUPLING.

The following codes are used to select input coupling as described in para 2-1, and 2-9 to 2-14.

Range	Code
AC	H0
AC+DC	H1

F-19. FRONT PANEL SETUPS.

Use codes A01 to A12 to store front panel setups as described in para 2-7. Storage location 00 always contains the values set when the instrument is first switched on, and cannot be overwritten.

Use codes B01 to B12 to recall stored front panel setups as described in para 2-7. Code B00 sets controls to initialized state. Code B99 sets controls to last setup before power was removed.

NOTE

- The data stored in location 99 is overwritten as each change of instrument setting is made. The facility for recalling the settings in use when the instrument was switched off is only available immediately after switching on.
- Either the Device Clear (DCL) or the Selective Device Clear (S DC) command may be used instead of B00.

F-20. CALIBRATION FACTOR.

The following codes are used to select calibration factor as described in para 2-1.

Function	Code
Disable calibration factor.	U0
Enable calibration factor.	U1
Store the contents of numerical input buffer in calibration factor.	U2
Load the stored contents of calibration factor into the output buffer.	U3

NOTE

After loading the contents of calibration factor into the output buffer, the Voltmeter must be put to the talker active state for the data to be put onto the bus. The instrument will return to the measurement mode once the output buffer is loaded, but failure to read the buffer contents will prevent measurement data being entered.

F-21. AVERAGING.

The following codes are used to select averaging as described in para 2-1, and 2-9 through 2-14.

Function	Code
Select fixed averaging mode.	S0
Select continuous averaging mode.	S1
Store contents of numerical input buffer in the AVERAGE.	S5
Load stored contents of AVERAGE into the output buffer.	S6

NOTE

After loading the contents of average into the output buffer, the Voltmeter must be put to the talker active state for the data to be put onto the bus. The instrument will return to the measurement mode once the output buffer is loaded, but failure to read the buffer contents will prevent measurement data being entered.

F-22. INPUT FILTER.

The following codes are used to select input filter as described in para 2-1, and 2-9 to 2-14.

Function	Code
Filter out	J0
Filter in	J1

F-23. TRIGGER.

The following codes are used to select triggering as described in para 2-1, and 2-9 through 2-14.

Function	Code
Perform continuous measurement cycles, updating the output buffer at the end of each cycle.	To
Leave the continuous measurement mode and enter the triggered measurement mode.	T1
If in the triggered measurement mode, perform one measurement and update the output buffer.	T2
If in the triggered measurement mode, perform one measurement after a delay and update the output buffer.	T3

NOTE

- After a change of range a three second delay is automatically inserted after the trigger command.
- The Group Execute Trigger (GET) command may be used instead of code T2 using the following procedure:

  Send command T1.

  Send command T2. The Voltmeter will perform one measurement cycle.

  Send the GET command each time a further measurement cycle is required. Note that when the GET command, the Voltmeter must be put to the talker active state after each measurement cycle.
- The use of the GET command after code T0 has been used will terminate the current measurement cycle. A new cycle will begin immediately.
- The instrument will revert to continuous measurement if the continuous averaging mode is selected (para F-21). If the continuous averaging mode is cancel led the instrument will return to the last trigger mode enabled.

F-24. CANCELLATION.

The following codes are used to cancel selected functions or conditions.

Function	Code
Cancel compute functions.	C0
Clear numerical input buffer.	C1
Clear error code.	C2

NOTE

Code C2 will not cancel error codes 01, 20, 23, 24, 25 or 26.

F-25. SPECIAL FUNCTIONS.

The following codes are used to select special functions described in para 2-1, and 2-14.

Special Function No.	Function	Code
0	Cancel special function.	Y 0
10.1	Crest factor (highest peak/r.m.s.).	Y 1
10.2	Crest factor (positive peak/r,m.s.).	Y2
10.3	Crest factor (negative peak/r.m.s.).	Y3
20.1	Form factor (r.m.s./rectified mean).	Y4
30.1	Mean scaled to r.m.s. (mean x 1.111).	Y5
40.1	Peak-to-peak.	Y6
50.1	AC+DC rectified mean.	Y7
--	Load stored SF number into the output buffer.	Y8
60.1	Continuous average mode.	S1
70.0	True peak measurement.	S2
70.1	Averaged peak measurement.	S3
70.2	Peak hold measurement.	S4

NOTE

After loading contents of special function into the output buffer, the Voltmeter must be put to the talker active state for the data to be put onto the bus. The instrument will return to the measurement mode once the output buffer is loaded, but failure to read the buffer contents will prevent measurement data being entered.

F-26. NUMERIC INPUT.

Some of the device-dependent commands require additional numerical input data. Numerical input format is shown below.

Byte No.	Interpretation	Permitted ASCII Characters
1	Sign of mantissa	+ or - or space
2	Digit (MSB)	0 to 9 or decimal
3	Digit	0 to 9 or decimal
4	Digit	0 to 9 or decimal
5	Digit	0 to 9 or decimal
6	Digit (LSD)	0 to 9 or decimal
7	Exponent indicator	E or e
8	Exponent sign/space	+ or –or space
9	Exponent digit	0 to 9

NOTE

- An unsigned mantissa or exponent is assumed positive. Bytes 1 and/or 8 may be omitted when the sign is positive.
- The string may be terminated with CR, LF or by the first byte of the succeeding command.
- If the exponent group is not required bytes 7 to 9 may be omitted.
- The exponent group replaces the units keys used when entering values in local control. The units assumed by the numbers held in store are Ω, volts, watts, seconds, or number as required.

INDEX

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INDEX — Continued

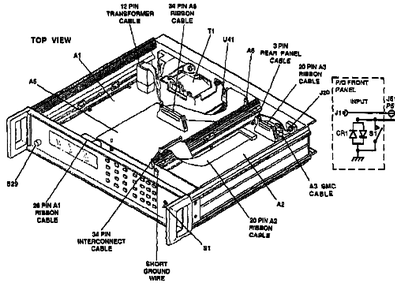
INDEX — Continued

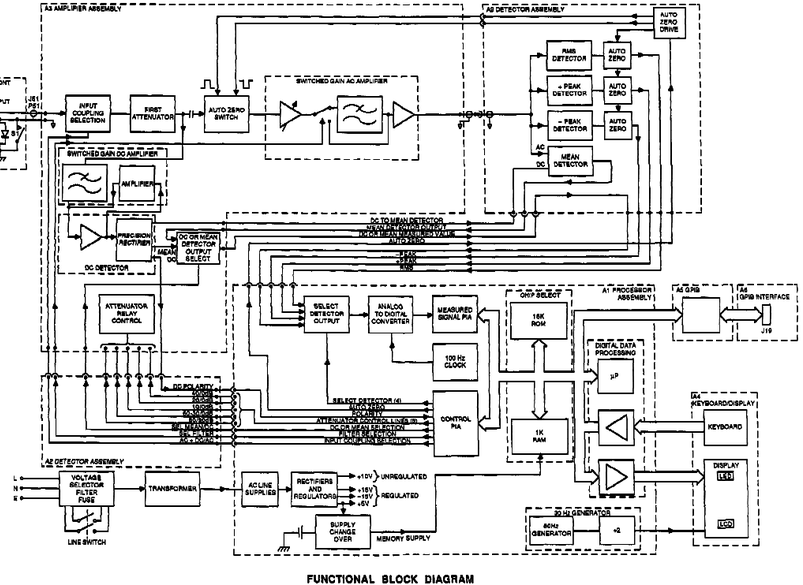
INDEX — Continued

INDEX — Continued

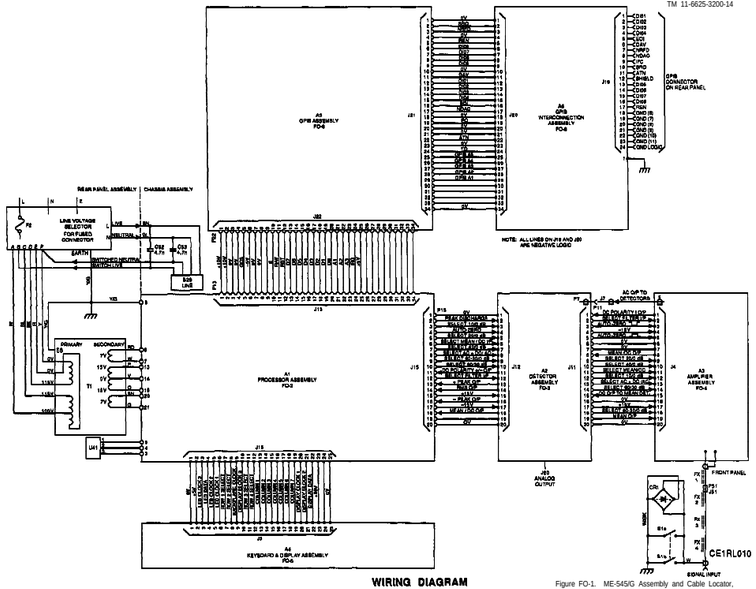
INDEX — Continued

INDEX — Continued





FUNCTIONAL BLOCK DIAGRAM



WIRING DIAGRAM

Figure FO-1. ME-545/G Assembly and Cable Locator, Functional Block Diagram, and Wiring Diagram

NOTES:

1. Reference designators within this assembly are abbreviated. Add A1 to abbreviation for complete reference designator.
2. Unless otherwise specified:
   Resistance in Ω.
   Capacitance in µF.
   Inductance in µH.
3. Resistance values measured from rear panel AC connector hot and neutral pins with power cable disconnected, LINE switch set to on, and voltage selection wheel as indicated. Verify 120V reading > 100V reading and 240V reading > 220V reading.
4. Resistance values measured using Multimeter, with A1S80 position 1-8 off and ~ lead to ground (TP4).
5. Resistance values measured using Multimeter, with A1S80 position 1-8 off and + lead to ground (TP4).
6. Normal setting for A1S80 is position 1-7 off and position 8 on.
7. Unless otherwise specified, logic levels are:
   1= 2-3V, and 0 = 0-0.4V.
8. Special Function 81.0 displays software revision number.
9. U1, U2, U10 and J14 not installed. Circuit pattern given for troubleshooting purposes only (i.e. trace problems).

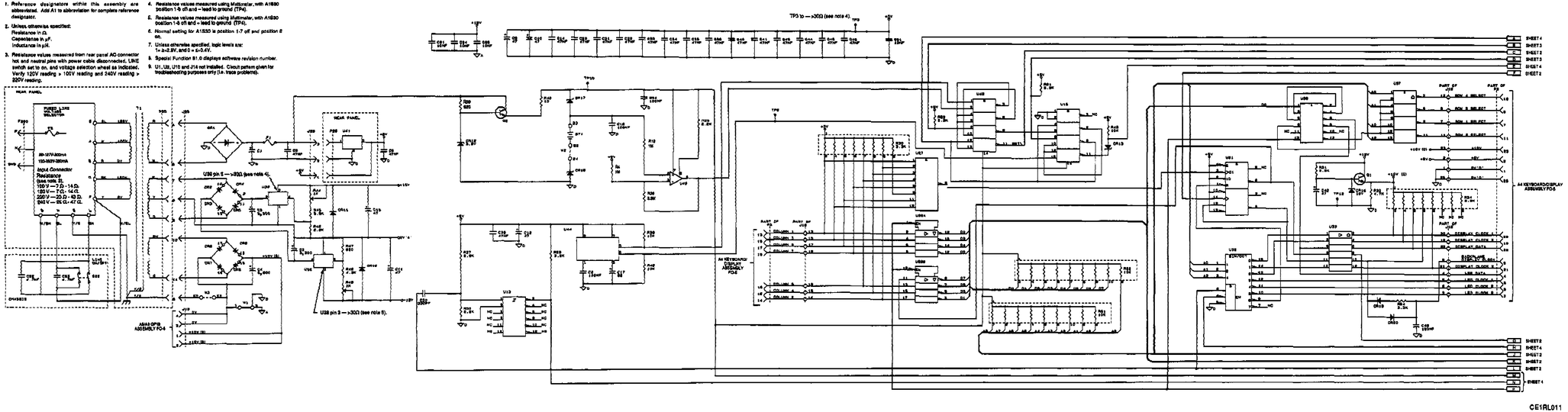
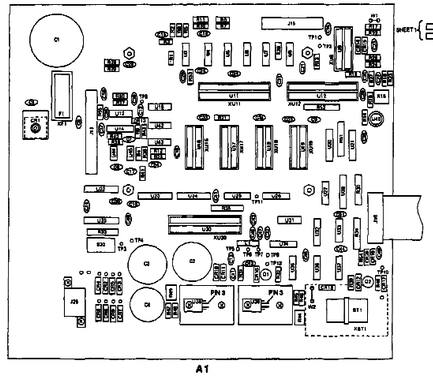
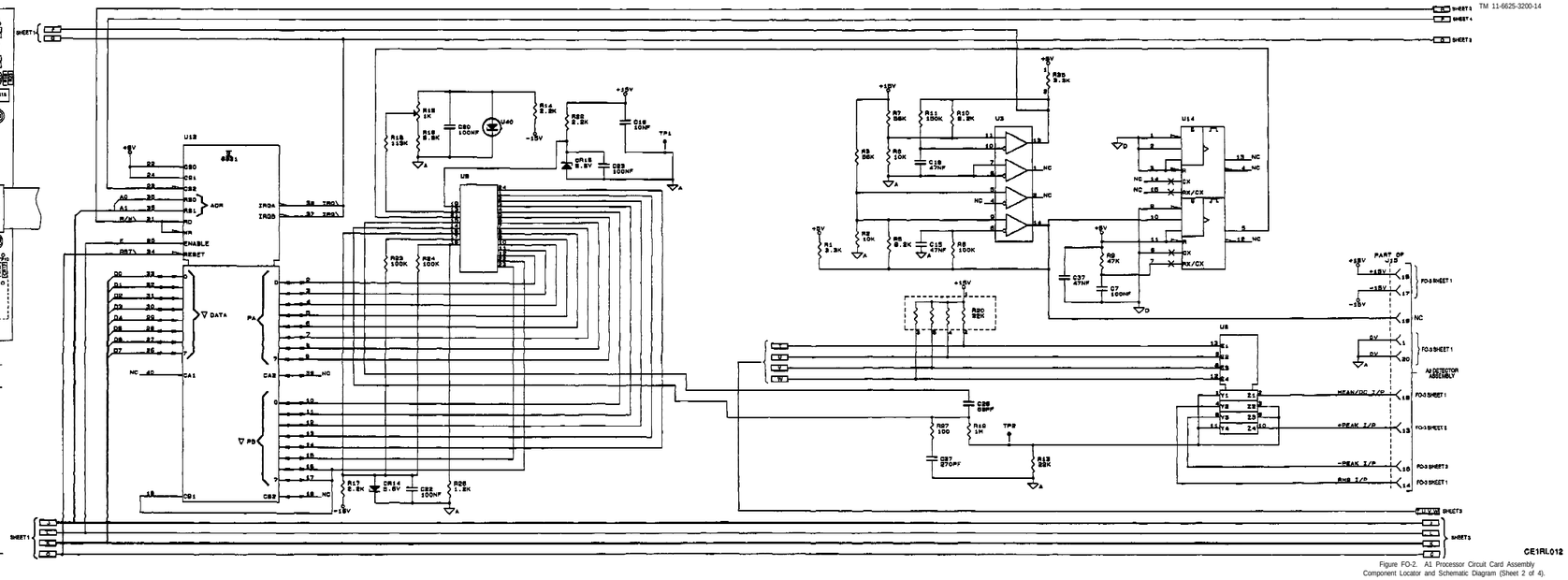


Figure FO-2. A1 Processor Circuit Card Assembly Component Locator and Schematic Diagram (Sheet 1 of 4).



REF. DES.	+5V PIN NO.	+15V PIN NO.	A GND PIN NO.	D GND PIN NO.
U1		3	12	
U2		3	12	
U3		3	12	
U4		3	12	
U5		3	12	
U6		3	12	
U7		3	12	
U8		14	7	
U9			20	
U10	20			1
U11	20			1
U12	20			1
U13	14			7
U14	14			7
U15				7
U16	24			12
U17	24			12
U18	24			12
U19	24			12
U20				9
U21				9

REF. DES.	+5V PIN NO.	+15V PIN NO.	A GND PIN NO.	D GND PIN NO.
U22	20			10
U23	20			10
U24	20			10
U25	16			8
U26	16			8
U27	14			7
U28	20			10
U29	20			10
U30	8,36			1,21
U31	14			7
U32	16			8
U33	14			7
U34	16			8
U35	14			7
U36	14			7
U37	14			7
U42				7
U43				7
U44	5			4
U45				4



CE1RL012

Figure FO-2. A1 Processor Circuit Card Assembly
Component Locator and Schematic Diagram (Sheet 2 of 4).

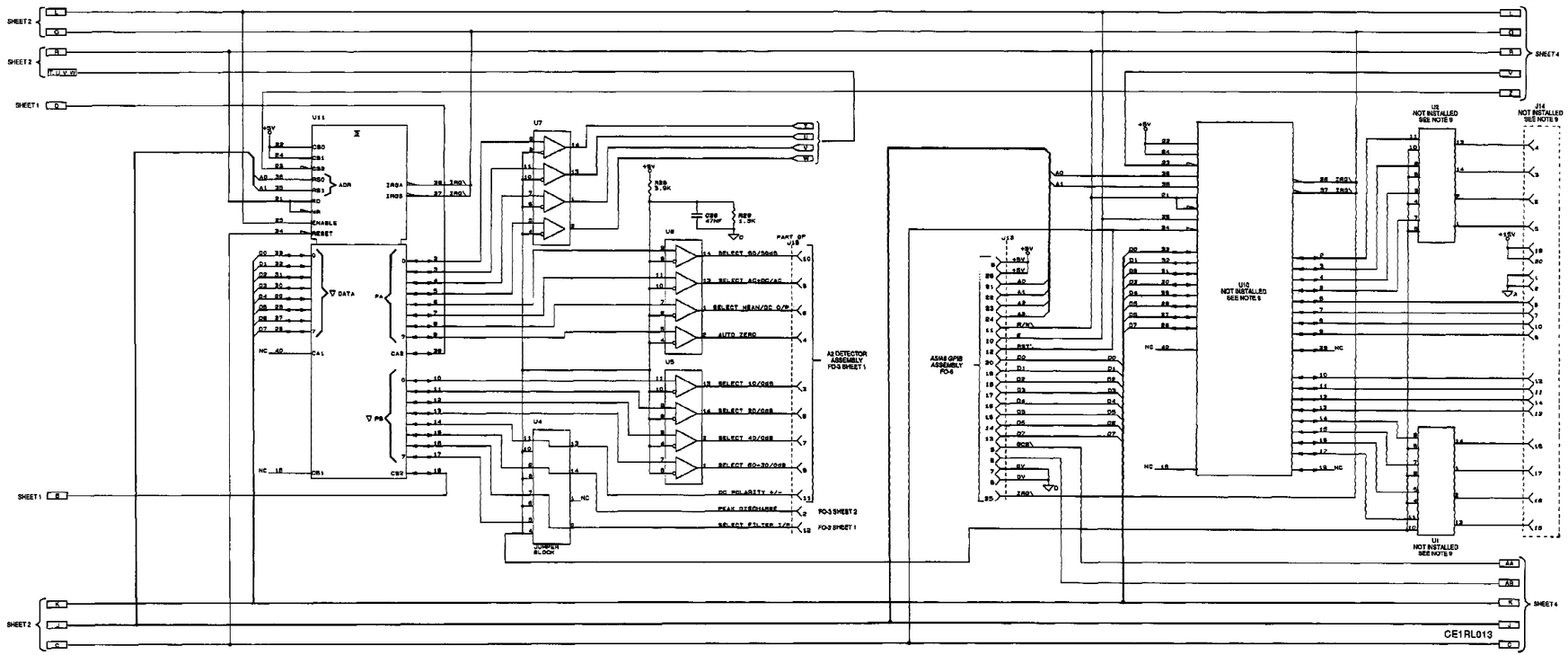
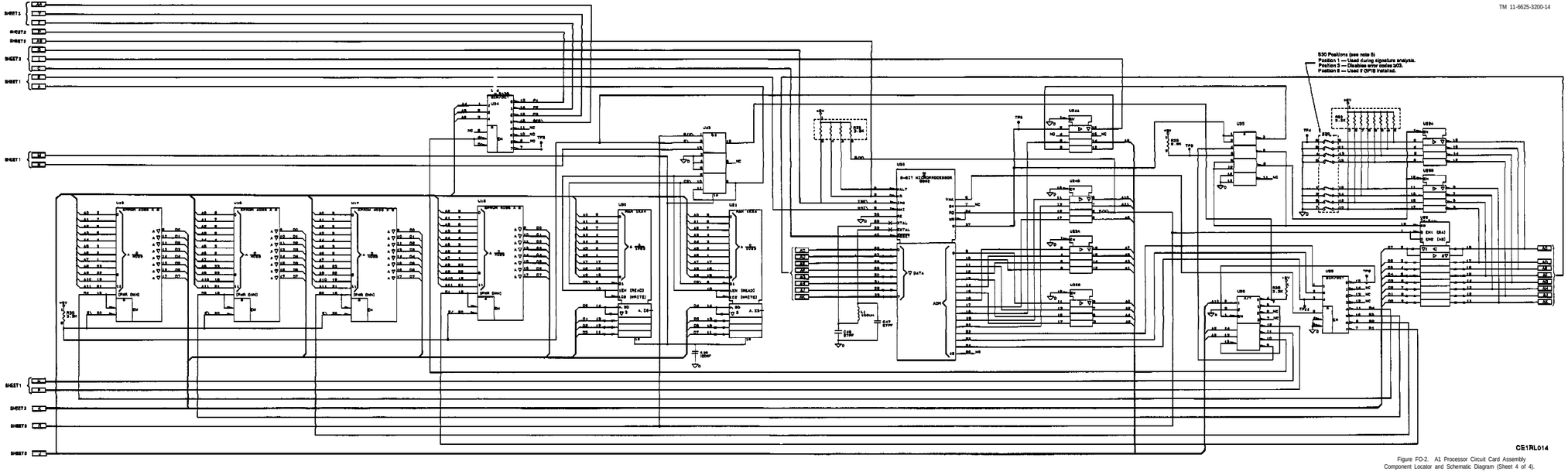
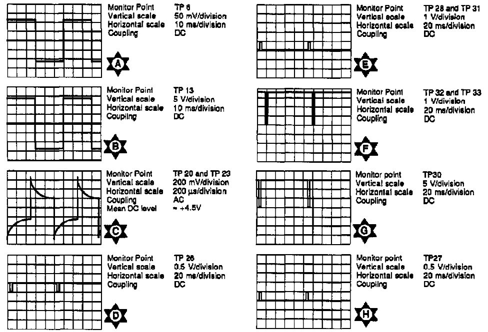


Figure FO-2. A1 Processor Circuit Card Assembly
Component Locator and Schematic Diagram (Sheet 3 of 4).



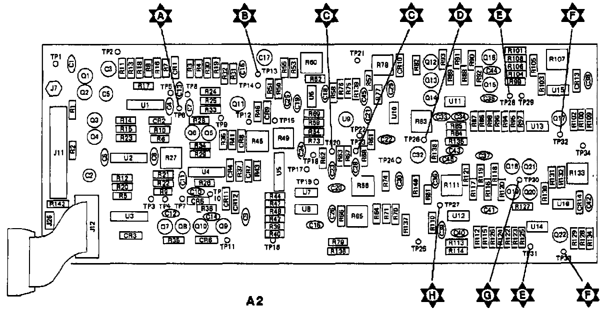
CE1RL014

Figure FO-2. A1 Processor Circuit Card Assembly
Component Locator and Schematic Diagram (Sheet 4 of 4).

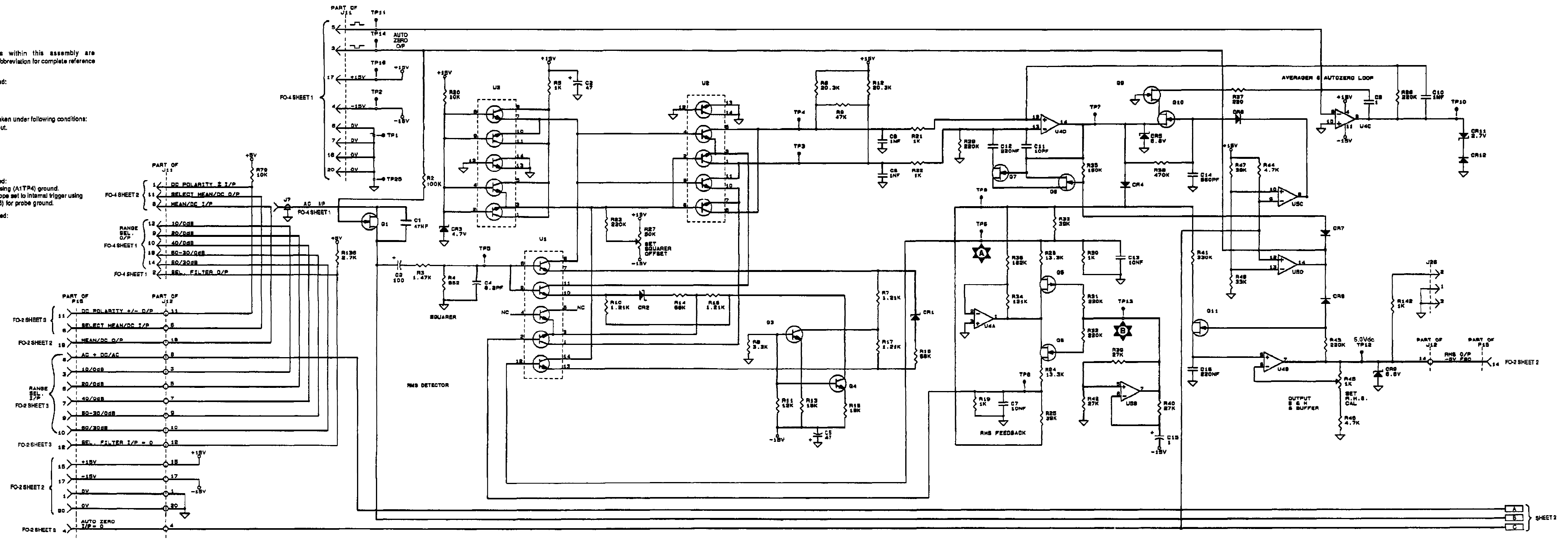


NOTES:

1. Reference designators within this assembly are abbreviated. Add A2 to abbreviation for complete reference designator.
2. Unless otherwise specified:
   Resistance in Ω.
   Capacitance in µF.
   Inductance in µH.
3. Measurement readings taken under following conditions:
   316.2mVrms at 1 kHz input.
   MANUAL selected.
   316.2mV range selected.
   VOLTS selected.
   RMS selected.
   AC selected.
4. Unless otherwise specified:
   Voltage readings taken using (A1TP4) ground.
   Waveforms taken with scope set to internal trigger using 10:1 probe. Use (A2TP25) for probe ground.
5. Unless otherwise specified:
   1=First function.
   0=Second function.



A2



CE1RL015

Figure FO-3. A2 Detector Circuit Card Assembly Component Locator and Schematic Diagram (Sheet 1 of 2).

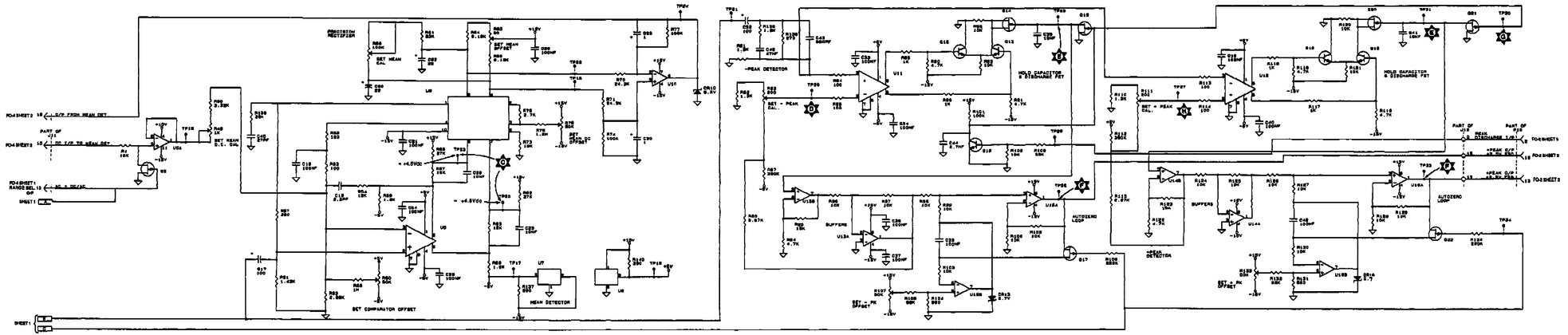


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Figure FO-3. A2 Detector Circuit Card Assembly
Component Locator and Schematic Diagram (Sheet 2 of 2).

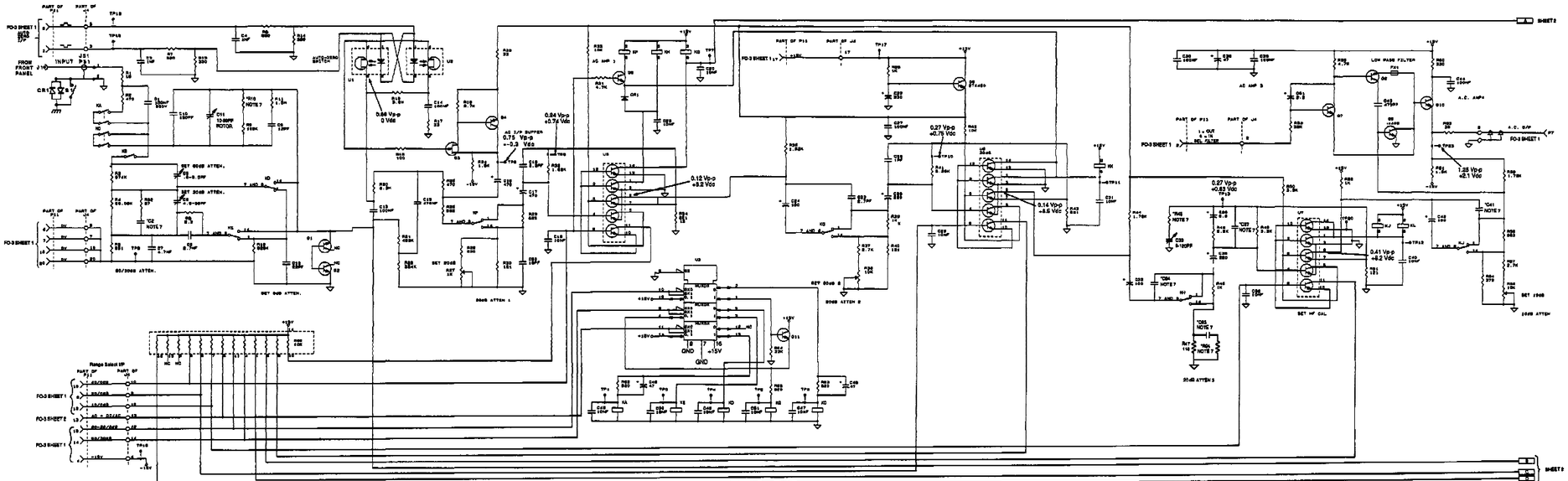
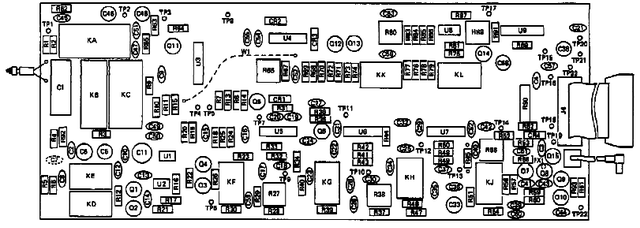


Figure FO-4. A3 Amplifier Circuit Card Assembly
Component Locator and Schematic Diagram (Sheet 1 of 2).



A3

NOTES:

1. Reference designators within this assembly are abbreviated. Add A3 to abbreviation for complete reference designator.
2. Unless otherwise specified:
   Resistance in Ω.
   Capacitance in µF.
   Inductance in µH.
3. Measurement readings taken under following conditions:
   316.2mVrms at 1 kHz input.
   MANUAL selected.
   316.2mV range selected.
   VOLTS selected.
   RMS selected.
   AC selected.
4. Unless otherwise specified:
   Voltage readings taken using (A3TP20) ground.
5. Unless otherwise specified:
   1=First function.
   0=Second function.
6. Special Function 99.1 sets 3V range using 60, 20, and 10dB attenuators (KB, KD, KH, KJ, KK, and KL energized).
7. Selected at test.

First Attenuator Relays/Control Lines

Ranges	First Attenuator Attenuation	Relay State (1 = Energized)				Logic Levels at J4/P11	
		KB	KC	KD	KE	Pin 18	Pin 14
30V to 300 V	60 dB	1	0	0	1	1	1
1V to 10V	30 dB	1	0	1	0	1	0
100µV to 300mV	0 dB	0	1	0	0	0	1

AC and DC Amplifier Relay/FET Conditions

Ranges	ATTEN dB	Relay/FET State (1 = Energized)							
		KF	KG	KH	KJ	KK	KL	Q12	Q13
300mV, 10V and 300V	70	1	1	1	1	1	0	0	1
100mV, 3 V and 100V	60	1	1	1	1	0	0	0	1
30mV, 1V and 30V	50	0	1	1	1	0	1	0	1
10mV	40	0	1	1	1	0	0	0	1
3mV	30	0	0	1	1	1	0	1	0
1mV	20	0	0	1	1	0	1	1	0
300µV	10	0	0	0	1	1	0	1	0
100µV	0	0	0	0	0	0	0	1	0

KF to KJ for AC Amplifier, KK, KL, Q12, and Q13 for DC Amplifier.

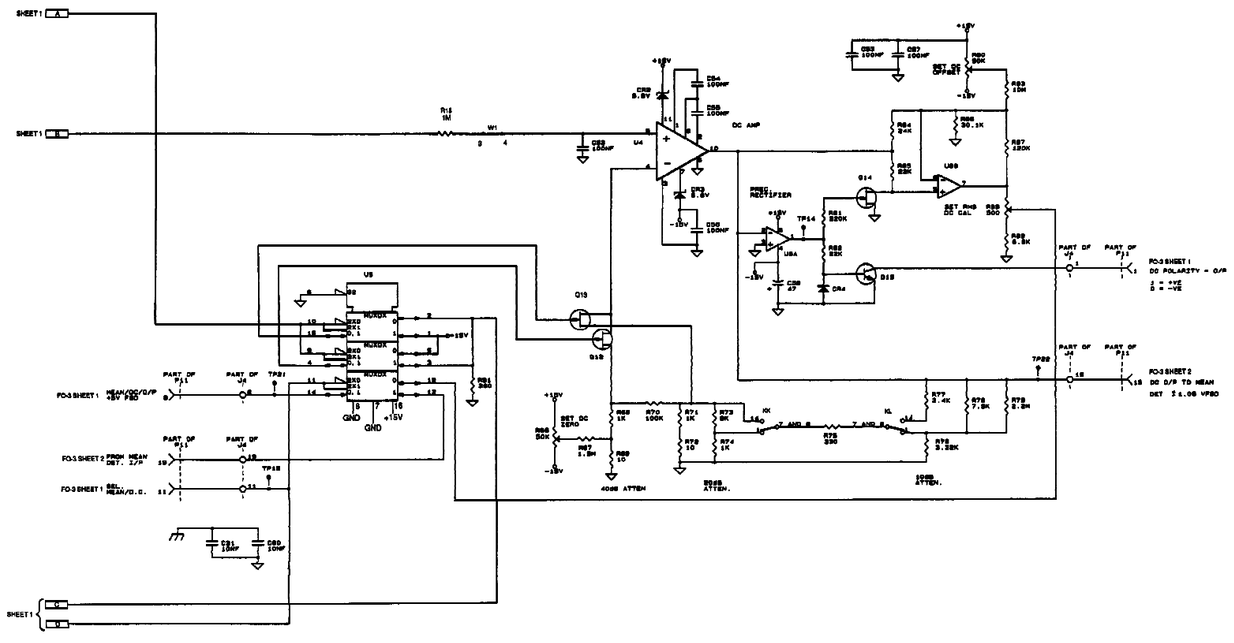


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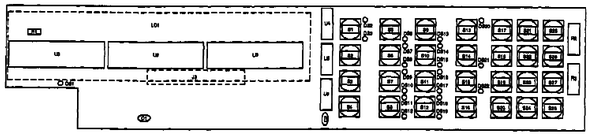
Figure FO-4. A3 Amplifier Circuit Card Assembly Component Locator and Schematic Diagram (Sheet 2 of 2).



NOTES:

1. Reference designators within this assembly are abbreviated. Add A4 to abbreviation for complete reference designator.
2. Unless otherwise specified:
   Resistance in Ω.
   Capacitance in µF.
   Inductance in µH.
3. Special Function 98.1 turns all LED's and DISPLAY indicators on.

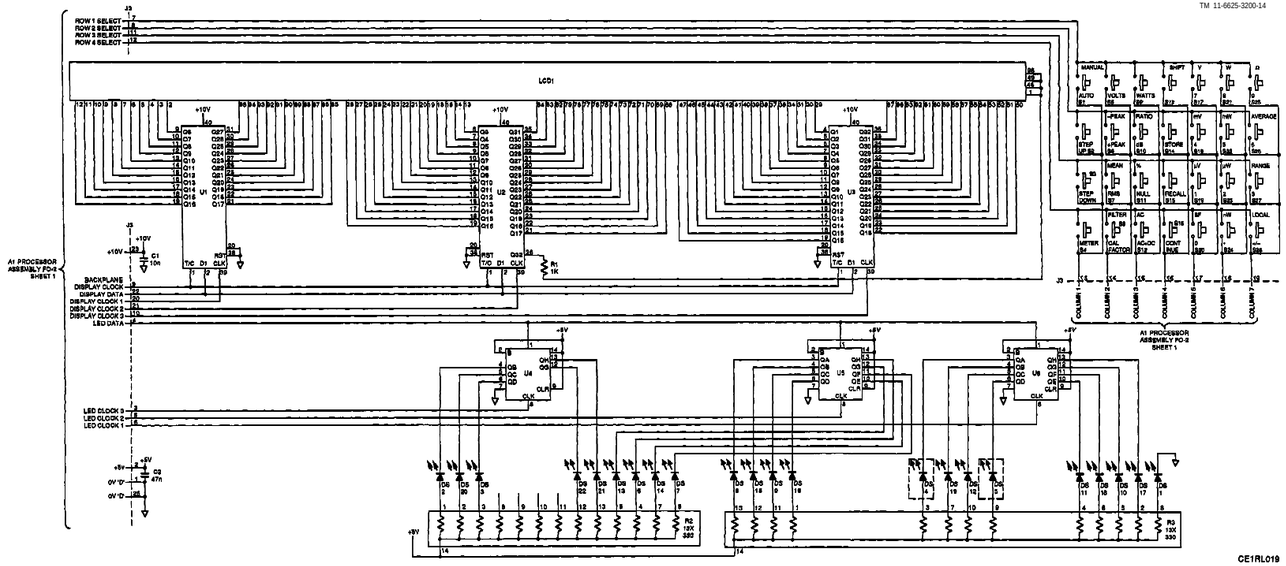
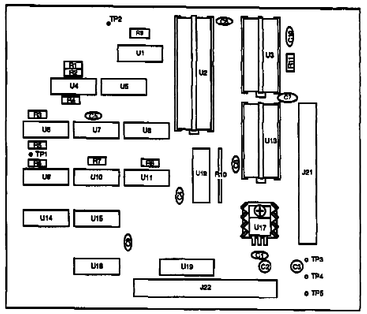
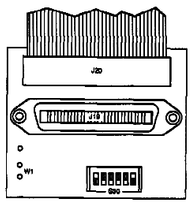


Figure FO-5. A4 Keyboard/Display Circuit Card Assembly Component Locator and Schematic Diagram.





NOTES:

1. Reference designators within this assembly are abbreviated. Add A5 or A6 as indicated to abbreviation for complete reference designator.
2. Unless otherwise specified:
   Resistance in Ω.
   Capacitance in μF.
   Inductance in μH.
3. All J21 line negative logic.

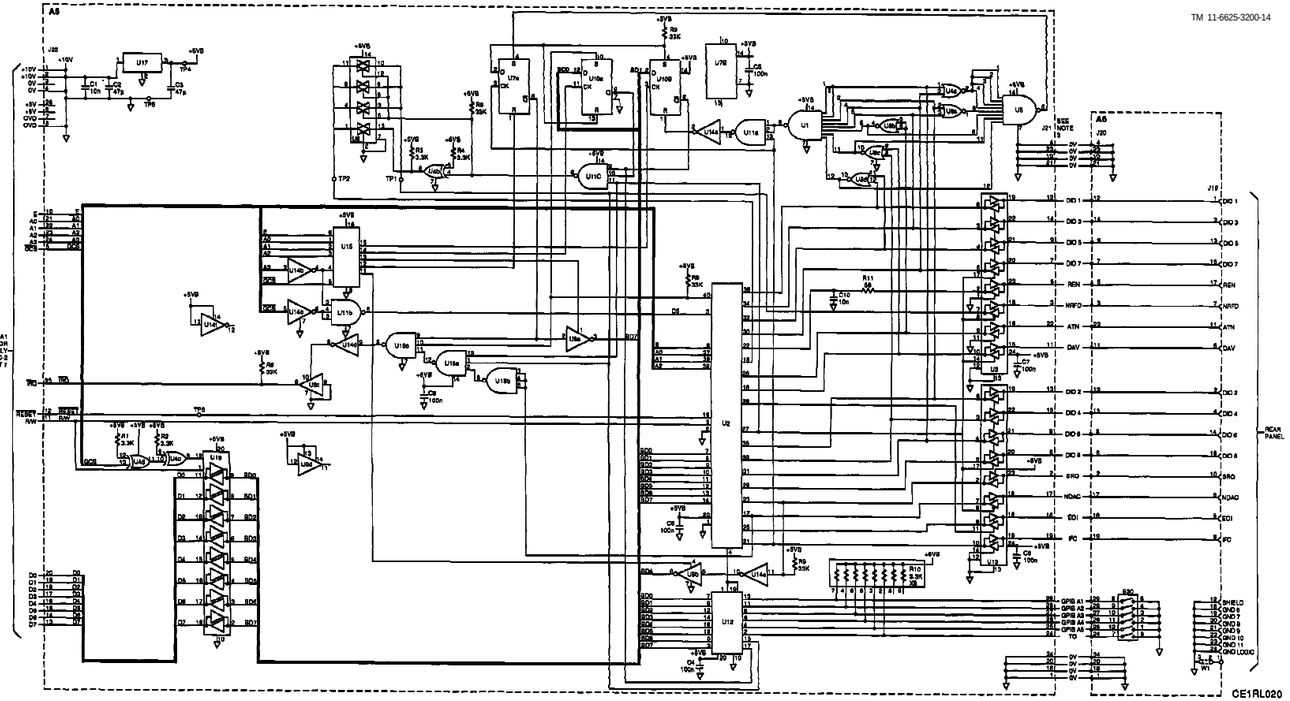


Figure FO-6. A5 GPIB Circuit Card Assembly and A6 GPIB Interconnect Circuit Card Assembly Component Locator and Schematic Diagram.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army
The Adjutant General

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To: 2028@redstone.army.mil

Subject: DA Form 2028

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2. *Unit:* home
3. ***Address:*** 4300 Park
4. ***City:*** Hometown
5. ***St:*** MO
6. ***Zip:*** 77777
7. ***Date Sent:*** 19−OCT−93
8. ***Pub no:*** 55−2840−229−23
9. ***Pub Title:*** TM
10. ***Publication Date:*** 04−JUL−85
11. *Change Number:* 7
12. *Submitter Rank:* MSG
13. ***Submitter FName:*** Joe
14. *Submitter MName:* T
15. ***Submitter LName:*** Smith
16. ***Submitter Phone:*** 123−123−1234
17. ***Problem:*** **1**
18. *Page:* 2
19. *Paragraph:* 3
20. *Line:* 4
21. *NSN:* 5
22. *Reference:* 6
23. *Figure:* 7
24. *Table:* 8
25. *Item:* 9
26. *Total:* 123
27. ***Text:***

This is the text for the problem below line 27.

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PUBLICATION/FORM NUMBER	DATE	TITLE
TM 9–1005–433–24	16 Sep 2002	Organizational, Direct Support, And General Support Maintenance Manual for Machine Gun, .50 Caliber M3P and M3P Machine Gun Electrical Test Set Used On Avenger Air Defense Weapon System

ITEM NO.	PAGE NO.	PARA–GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON
1	WP0005 PG 3		2			Test or Corrective Action column should identify a different WP number.

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE
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PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

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ITEM NO.	PAGE NO.	PARA–GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE

TO: (*Forward direct to addressee listed in publication)*	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

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RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25–30; the proponent agency is ODISC4.	Use Part II (*reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE
TO: (*Forward to proponent of publication or form)(Include ZIP Code)*	FROM: (*Activity and location)(Include ZIP Code)*	

PART 1 – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE

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