TECHNICAL MANUAL.

GENERAL SUPPORT MAINTENANCE MANUAL

TEST SET,

TELEPHONE AN USM-181B

This copy is a reprint which includes current pages from Change 1.

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y
JULY 1972

Change No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 15 April 1986

General Support Maintenance Manual

TEST SET, TELEPHONE AN/USM-181B
(NSN 6625-00-740-0344)

TM 11-6625-602-40-1, 21 July 1972, is changed as follows:

1. The title of the manual is changed as shown above.
2. 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*
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i and ii	i and ii
1-1	1-1/(1-2 blank)
3-7 through 3-14	3-7 through 3-14
5-5 through 5-8	5-5 through 5-8
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Index 1 and Index 2	Index 1 and Index 2

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

1 DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

2 IF 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 RESUSCITATION

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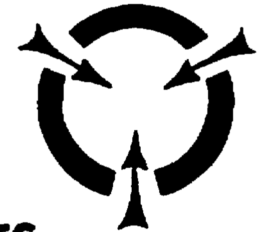
CAUTION



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

ESD
CLASS 1

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
- HANDLE 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 REPLACEMENTS 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 I 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

TECHNICAL MANUAL

No. 11-6625-602-40-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 21 JULY 1972

General Support Maintenance Manual

TEST SET, TELEPHONE AN/USM-181B
(NSN 6625-00-740-0344)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS
You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Communications Electronics Command and Fort Monmouth, ATTN: AMSELIME-MP, Fort Monmouth, New Jersey 07703-5007.
In either case, a reply will be furnished direct to you.

CHAPTER 1

INTRODUCTION

1-1. Scope

a. This manual covers general support and depot maintenance instructions for Test Set, Telephone AN/USM-181B. It includes instructions appropriate to general support maintenance for troubleshooting, testing, aligning, and repairing the equipment. It also lists the tools, materials, and test equipment for general support and depot maintenance. Functional analysis of the equipment is covered in this chapter.

b. The complete technical manual for this equipment includes TM 11-6625-602-12-1 and TM 11-6625-602-40-1.

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

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

1-3. 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 738-750 as contained in Maintenance Management Update.

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

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 5538/NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D/DLAR 4500.15.

1-4. Reporting Equipment Improvement Recommendations (EIR)

If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, New Jersey 07703-5007. We'll send you a reply.

1-5. Administrative Storage

Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the PMCS charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Repacking of equipment for shipment or limited storage is covered in TM 740-90-1.

1-6. Destruction of Army Electronics Materiel

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

CHAPTER 2

FUNCTIONING OF EQUIPMENT

2-1. Block Diagram Analysis
(fig. 2-1)

Test Set, Telephone AN/USM-181B consists of Voltmeter, Electronic ME-260B/U; Generator, Signal SG-548B/U; and Attenuator, Impedance Matching CN-947B/USM-181 and is used to test the performance of telephone transmission lines.

The signal path is shown in the block diagram and is discussed in a through c below. For complete circuit details, refer to the schematic diagrams (figs. 5-14, 5-15, and 5-16).

a. Generator, Signal SG-543B/U.

(1) *RC Bridge*. The signal generator RC bridge is divided into two networks, the frequency selective network and the negative feedback network. The frequency selective network determines the frequency of oscillation and supplies positive feedback to sustain oscillations. The negative feedback network supplies negative feedback to the amplifier and establishes a constant oscillator output level.

(2) *Amplifiers*. Amplifiers Q1 and Q3 through Q6 amplify the signal and apply it to complementary emitter followers Q7 and Q8. The amplifier output is proportional to the difference between the feedback signals.

(3) *Emitter followers*: Emitter followers Q7 and Q8 are complementary to provide sufficient output power. The output is applied to the attenuator and feedback networks.

(4) *Peak Comparator*. Peak comparator Q9 compares the negative peak of the amplifier output to a 7.2 volt reference. If the voltage varies above or below the reference voltage, a difference voltage will be supplied to the AGC circuit.

(5) *Automatic gain control (AGC).* The dynamic resistance of the AGC circuit is field effect transistor Q2 with the gate controlled by the difference signal from the peak comparator. This holds the signal generator output at a constant level.

(6) *Attenuator*. The attenuator, R46A and R46B, controls the signal generator output level while maintaining constant output impedance.

b. Attenuator, Impedance Matching CN-947B/ USM-181.

(1) *Manual attenuator*. The manual attenuator has two cascaded sections. The signal is manually attenuated in steps of 1 or 10 decibels (db).

(2) *Output transformer*. Output transformer T1 or T2 matches the equipment to the input impedance of the transmission line under test. Switch S10 selects the secondary of the transformer in impedance of 135, 600, or 900 ohms, Transformer T1 or T2 is manually selected to correspond to the frequency of the signal. Transformer T1 is used for frequencies from 50 cycles per second (cps) to 5 kilocycles (kc); T2 is used for frequencies from 5 kc to 560 kc.

(3) *MEAS-CAL switch*. MEAS-CAL switch S12 is used to apply the output to the transmission line (MEAS), or to internally connect the output to the input for calibrating the equipment (CAL).

(4) *Input transformer*. Input transformer T3 or T4 matches the impedance of the transmission line to the equipment. Switch S11 selects the transformer impedance to match the impedance of the transmission line at either 135, 600, 900, or 10K ohms (bridging). Transformer T3 or T4 is manually selected to correspond to the frequency range applied to the transmission line. Transformer T3 is used for frequencies from 50 cps to 5 kc; T4 is used for frequencies from 5kc to 560 kc.

c. Voltmeter, Electronic ME-260B/U.

(1) *First and second cascade attenuators*. The first and second cascade attenuators provide the necessary attenuation to produce a 1, 3, 10 sequence for correct meter operation and to prevent overloading the input circuit.

(2) *Fuse.* Fuse F1 is a 1/16-ampere fuse which protects the voltmeter circuits against continuous input signal overload.

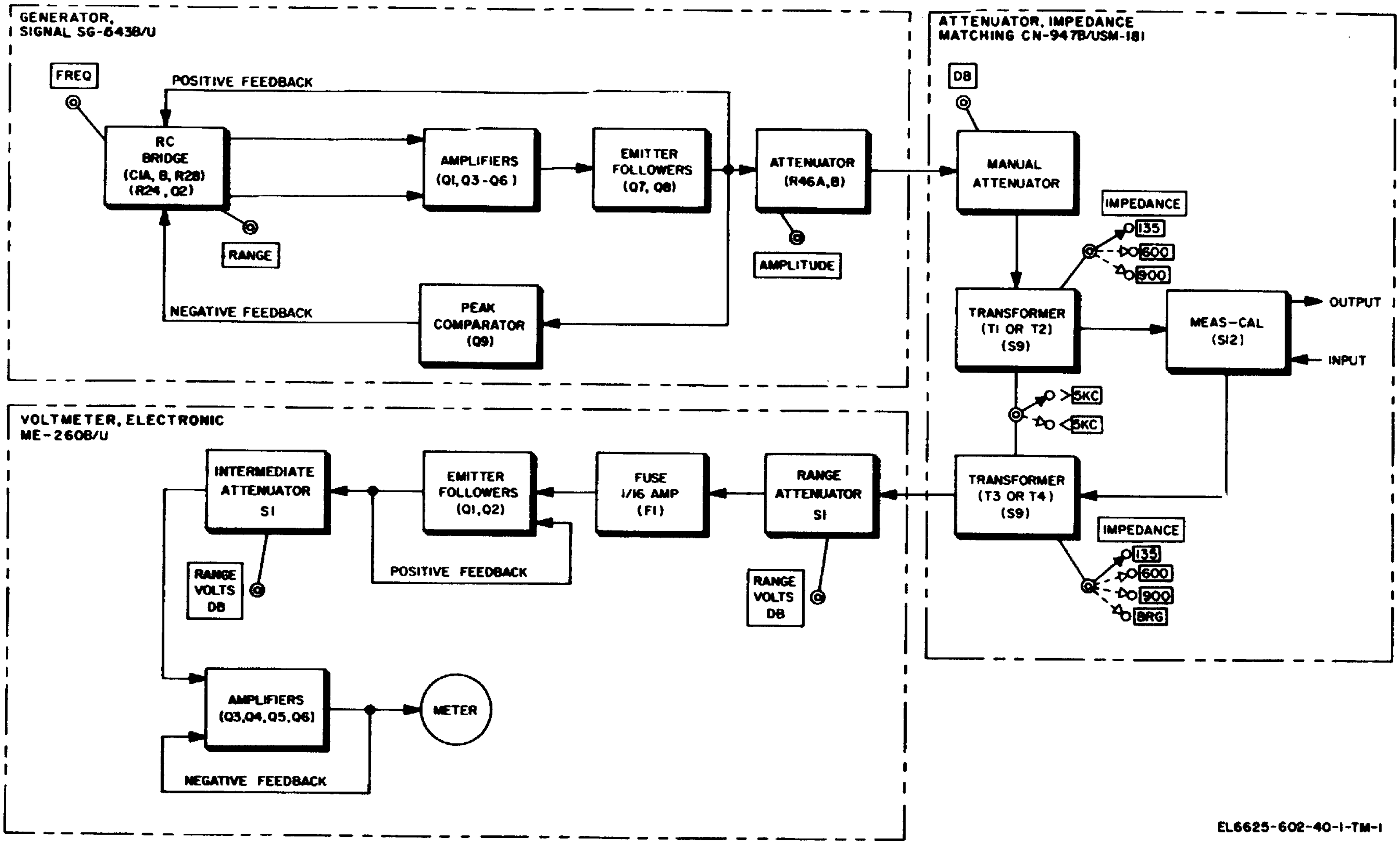


Figure 2-1. Test Set, Telephone AN/USM-181B
Block Diagram

(3) *Emitter followers*. Emitter followers Q1 and Q2 are cascaded and provide a high input impedance. The output is applied to the second cascade attenuator and at this point is sampled for use as positive alternating-current (ac) feedback.

(4) *Amplifiers*. Amplifiers Q3 through Q6 amplify the signals to be measured by the meter and provide the meter circuit with a high-impedance source for linear operation at all current levels. The amplifier output provides a direct-current (dc) feedback path to minimize dc drift due to temperature changes.

(5) *Meter*. The meter indicates voltages of decibels (referred to 1 milliwatt in 600 ohms (dbm)).

2-2. Signal Generator SG-543B/U Stage Analysis (fig. 5-14).

The output frequency of the signal generator is selected by the front panel controls and is adjustable from 5 Hz to 1.2 MHz. The signal generator consists of an rc bridge oscillator circuit, a peak comparator and automatic gain control circuit, an output attenuator, and a power supply circuit. The output is applied to Attenuator, Impedance Matching CN-947B/USM-181.

a. Rc Bridge Oscillator Circuit (fig. 2-2). The bridge oscillator consists of the bridge, an amplifier and two emitter followers. The output from these circuits is a sine wave signal which is returned to the bridge as feedback, and is also applied to the output attenuator. The bridge in the oscillator circuit consists of an rc frequency-selective network and a negative feedback network. The frequency-selective network is one leg of a Wien bridge, and the negative feedback network is the other leg.

(1) The frequency-selective network consists of capacitor C1A, capacitor C1B, and resistors R1 through R17. The frequency-selective network determines the frequency of oscillation and supplies a, positive feedback voltage to the amplifier to sustain oscillation.

(2) The components of the frequency-selective network maintain the proper phase relationship. at the desired frequency. The combination of component for desired frequencies are selected by front panel RANGE switch S1. For the frequency at which Xc = R (capacitive reactance equals resistance) in the frequency-selective network, the positive feedback voltage to the amplifier is maximum and in phase with the oscillator circuit output voltage. This supplies the maximum ratio of output voltage to the amplifier. The characteristics of the Wien bridge are such that the output voltage to the plug input of the amplifier (Q1) is one third the amplitude of the positive feedback voltage. Therefore, to maintain unity gain and sustain oscillation, the negative feedback network has a divider ratio of two to one, to give the amplifier a gain of three.

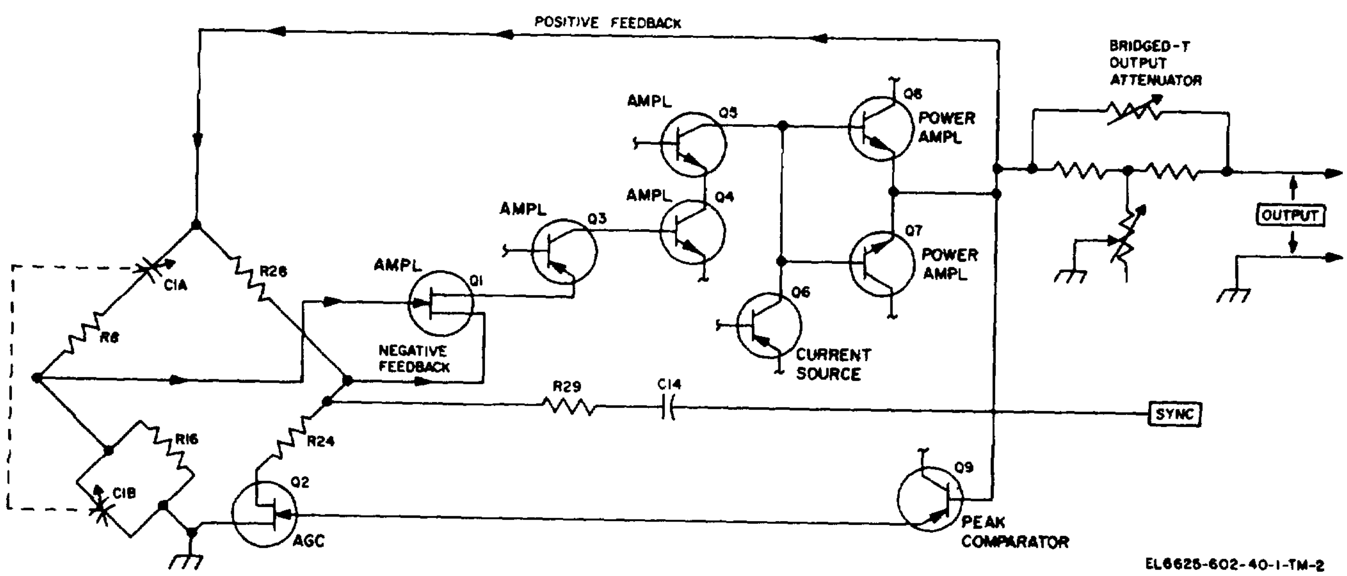


Figure 2-2. Generator, Signal SG-543B/U simplified schematic diagram.

(3) The negative feedback network consists of resistors R28, R23, R24, R25, and the AGC circuit. The negative feedback network provides negative feedback voltage to the amplifier to maintain the oscillator circuit output signal at a constant level. The technique used for maintaining unity gain in the oscillator circuit at all operating frequencies is to have a dynamic resistance in the negative feedback network. This is accomplished with the combination of a peak comparator circuit and an AGC circuit.

(4) The signal from the bridge is applied to the gate of amplifier Q1, which is an N-channel field effect transistor (FET). Resistor R21 provides bias for Q1. The signal at the drain (D) of Q1 is applied to the emitter of amplifier Q8. The collector of Q8 is biased by resistor R26 and the base is biased by diode CR1 and resistor R27. The signal at the collector of Q8 is applied to the base of amplifier Q4. The emitter of Q4 is directly coupled to the emitter of amplifier QS. The base of Q5 is biased by diodes CR6, CR7, C8, and resistor R48. Capacitor C9 provides a stable rolloff at high frequencies.

(5) The amplified signal at the collector of Q5 is applied to the base of complementary output transistors Q7 and Q8. Diodes CR4 and CR5 provides proper bias for emitter followers Q7 and Q8. Transistor Q6 provides a current source for Q4 and Q5. Bias for the base of Q6 is provided by diodes CR2 and CR8 and resistor R40. The emitter of Q6 is biased by resistors R38 and R39. Under a no-signal condition, emitter followers Q7 and Q8 are conducting slightly to minimize crossover distortion. The output from the emitter of Q7 is applied to the output attenuator and the peak comparator circuit through resistor R41. The output from the emitter of Q8 is applied to the output attenuator and the peak comparator circuit through resistor R42.

b. Peak Comparator and AGC Circuit. The peak comparator consists of transistors Q9 and associated components and the automatic gain control (AGC) consists of Q2 and associated components. The peak comparator compares the negative peak of the oscillator amplifier output to a 7.2 volt reference. If the output varies above or below the reference voltage, a difference voltage is supplied to the AGC circuit. When the oscillator is first turned on, the AGC gives the amplifier a gain greater than three, noise in the amplifier is amplified greatly, and the frequency selective network in the wien bridge selects the noise at the tuned frequency. The selected noise becomes positive feedback to the amplifier, and the amplifier starts oscillating at the tuned frequency. As the output amplitude approaches 7.2 volts peak, the AGC reduces the gain of the amplifier to three, and stable oscillation is achieved.

(1) The negative feedback arm of the wien bridge depends upon the ratio of the impedance of R28 to the total impedance of R23, R24, R25, and FET Q2 to increase stability. FET Q2 provides AGC for the amplifier by varying impedance to obtain the proper negative feedback. The conduction of Q2 is controlled by peak comparator Q9.

(2) Any increase in the oscillator output is detected at the base of Q9 through capacitor C12, resistor R84 and diode CR9. The collector of Q9 is biased by resistor R86. Transistor Q9 conducts when the voltage at the junction of R84 and R86 equals the total of the voltage drops through CR9, Q9, and CR10, which occurs during the most negative portion of each negative half cycle, developing a negative charge across C16 and its parallel capacitors (C17 through C20). As the amplifier output amplitude increases, Q9 conducts more and C16 becomes more negatively charged. This makes Q2 gate voltage more negative, increasing its impedance and increasing the negative feedback to reduce the output amplitude of the amplifier.

c. *Output Attenuator*. The output attenuator is a bridged T-type attenuator which provides continuous control of the oscillator output voltage while maintaining constant output impedance. The output signal is connected to Attenuator, Impedance Matching CN-947B/USM-181.

(1) The signal from the oscillator circuit is applied to the output attenuator through resistor R45 and capacitor C11. Capacitor C11 blocks dc voltage at the output terminals.

(2) The T-pad consists of resistors R46A, R46B, R47, and R48, AMPLITUDE variable resistors R46A and R46B changes the effective resistance and varies the output voltage amplitude. The output attenuator circuit remains at a constant 600 ohm output impedance throughout the oscillator frequency range.

d. Power Supply. The power supply consists of four 6.25 volt rechargeable nickel-cadmium batteries and a battery charging circuit. The battery charging circuit, when connected to an ac source, supplies a charging current to the batteries. The batteries may be charged at a slow rate (6 milliamps) or at a fast rate (20 milliamps) depending upon the position of S4. The signal generator may be operated while the batteries are being charged.

(1) The batteries are connected in series and center tapped to circuit ground to provide positive and negative voltages. Switch S8 connects the two primary windings of T21 in series for a voltage of 230 volts ac. The T21 secondary voltage remains approximately the same for either voltage source.

(2) The secondary of T21 is connected to full-wave bridge rectifier CR21 through CR24. Capacitor C21, across the output of the full-wave bridge rectifier, filters the rectified voltage.

(3) Changing position of switch S4 varies the output current at the collector of regulator Q21. When S4 is in the SLOW position R23 is connected to the emitter of Q21. When S4 is in the FAST position both R23 and R24 are connected to the emitter of Q21. The base of Q21 is biased by resistor R22 and breakdown diode CR26 to maintain a constant current output at the collector of Q21 to charge the batteries.

(4) Diode CR25 prevents the batteries from discharging through the battery charging circuit when the circuit is disconnected from the ac source.

(5) When the signal generator is turned off and remains connected to the ac source, resistor R21 is connected across the battery charging circuit by the RANGE switch (S1C) to supply a load for the battery charging circuit to maintain the battery charging rate.

2-3. Attenuator, Impedance Matching CN-947B/USM-181 Stage Analysis (fig. 5-15).

The attenuator consists of two impedance-matching circuits. The output circuit matches the output impedance of the signal generator assembly to the transmission line impedance, and the input circuit matches the transmission line impedance to the voltmeter assembly input impedance. The attenuator is used to insert 0 to 110-db attenuation in the transmission line under test.

a. Attenuator. The signal from the signal generator is applied direct to the attenuator assembly. When the front panel DB controls are in the 0 positions, the signal is applied to output transformer T1 or T2 without attenuation. When the DB controls are set to the signal generator signal, resistances in the attenuator assembly are inserted in the output circuit. The resistance selected by the DB controls attenuates the output signal by the amount selected. The DB control is calibrated in 1-DB steps from 0 to 10 DB, and in 10-DB steps from 0 to 100 DB. The maximum attenuation of the signal is 110 DB when both controls are in the maximum DB position.

b. Output Transformers (fig. 2-3). The signal from the attenuator circuit is applied to the primary of output transformer T1 or T2 by front panel FREQ switch S9.

(1) When S9 is in the < (less than) 5 KC position, the primary of T1 is connected to the signal generator output. When S9 is in the > (greater than) 5 KC position, the primary of T2 is connected to the signal generator output.

(2) Transformer T1 is a low-frequency transformer for frequencies of 50 cps to 5 kc, and T2 is a high-frequency transformer for frequencies of 5 kc to 560 kc. Transformers T1 and T2 each have a 600-ohm primary to match them to the output impedance of the signal generator.

(3) Transformers T1 and T2 have tapped secondaries to provide impedances 135, 600, and 900 ohms as selected by front panel OUTPUT IMPEDANCE switch S10. This matches the output impedance of the transformers to the impedance of the transmission line connected to the OUTPUT terminals.

(4) The signal from the secondary of T1 or T2 is applied to the front panel FREQ switch. The FREQ switch selects the output of transformer T1 or T2, depending on the frequency of the signal required. The output signal is applied to MEAS-CAL switch S12.

(5) When S12 is in the MEAS position, the signal is applied to the OUTPUT terminals.

(6) When S12 is in the CAL position, the signal is applied to the VM INPUT terminal to calibrate the voltmeter assembly. With S12 in the CAL position, the OUTPUT and INPUT terminals are disconnected from the circuit.

c. Input Transformer (fig. 2-3). The input signal from the transmission line is applied to the primary of transformer T3 or T4, through the INPUT terminals, MEAS-CAL switch S12, and FREQ switch S9. Transformer T3 is used for frequencies of 50 cps to 5 kc, and T4 is for frequencies of 5 kc to 560 kc.

(1) The secondaries of T3 and T4 are tapped to provide impedances of 135, 600, 900, and 10K (BRG) ohms which are selected by INPUT IMPEDANCE switch All. This matches the transmission line impedance to the transformer. When

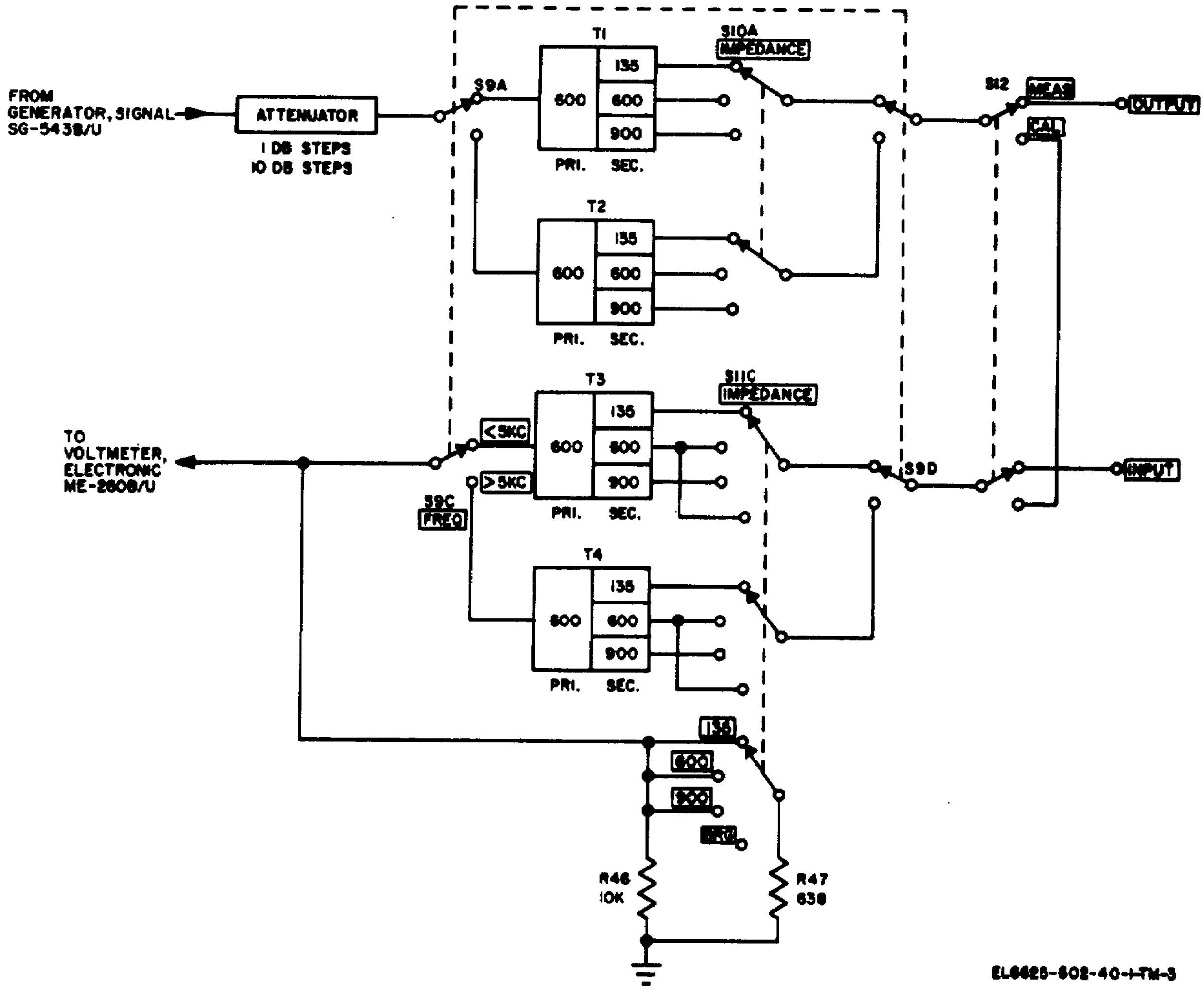


Figure 2-3. Attenuator, Impedance Matching CN947B/USM-181 simplified schematic diagram.

S11 is in the BRG position, T8 and T4 have a 1:1 turns ratio between the secondary and the primary, and a 10K resistor (R46) is in parallel with the primary. When S11 is in the BRG position, the voltmeter will indicate volts only, unless the transmission line is terminated in 600 ohms.

(2) In all other positions of S11 (185, 600, or 900), transformers TS and T4 are terminated in 600 ohms by resistors R46 and R47, and the voltmeter indications are in dbm. The primaries of TS and T4 are connected to FREQ switch S9, which selects the transformer to coincide with the frequency of the input signal. The signal from S9 is applied to the VM connector to provide an input to the voltmeter assembly.

2-4. Voltmeter, Electronic ME-260B/U Stage Analysis

(fig. 5-5).

The ME-260B/U consists of a preliminary attenuator, an input amplifier, a meter rectifier, and a power supply. It is used to indicate the output signal strength of the SG-543B/U before and after the transmission line is inserted in the circuit. The signal from the CN-947B/USM-181 is applied through the ME-260B/U INPUT terminal to the preliminary attenuator circuit.

a. Range Attenuator. RANGE switch S1 is divided into two sections: the range attenuator, located between the input terminals and the input amplifier circuit, and the intermediate attenuator, located between the input amplifier circuit and the fixed amplifier circuit. The range attenuator circuit has two ranges, 100: 1, which are selected by S1 to keep the input voltage to the input amplifier circuit less than 0.08 volt. This prevents overloading the input system and provides the necessary attenuator to work with the intermediate attenuator circuit to produce a conventional 1, 3, 10 sequence for correct meter scale indication.

(1) The range attenuator is a compensated rc type, with the capacitive reactance division ratio equal to the resistive ratio of all frequencies. RANGE switch S1, in the .001, .003, .01, and .03 positions, applies the signal from the input terminal direct to the input amplifier circuit, through coupling capacitors C1 and C7, fuse F1, and resistor R11.

(2) In switch S1 positions .1, .3, 1, 3, 10, 30, 100, and 300, the input is attenuated by the rc network consisting of resistors R1, R2, R3, R4, and R5, and capacitors C2, C3, C4, and C5. Resistor R3 (CAL.1V 400CPS) adjusts the shunt resistance to approximately 20 ohms for S1 positions .1, .3, 1, and 3. Resistor R4 (CAL 30V 400 CPS) is used to adjust the shunt resistance to approximately 200 ohms for S1 positions 10, 30, 100, and 300. Capacitors C2 (CAL .IV 300 KC) and C3 (CAL 30V 300 KC) are used to adjust the reactance of the range attenuator to obtain a flat frequency response.

b. Input Amplifier Circuits. The signal from the range attenuator is applied to the input amplifier circuit through coupling capacitor C7.

(1) The Q2 output is applied to the intermediate attenuator through coupling capacitor C12. The input amplifier presents high-impedance input circuits.

(2) A limiting circuit, consisting of resistor R11 and diodes CR1 and CR2. is used to prevent high instantaneous voltages from being impressed on the base of Q1.

(3) Fuse F1 is a 1/16-ampere fuse used to protect the voltmeter against a continuous or repeated overload.

(4) The output of Q2 is applied to the junction of resistors R7, R8, and R9 through capacitor C9. An ac voltage exists at this junction, which is almost of the same amplitude as that of the input voltage. This limits the input current to a very low value, and the apparent input impedance is very high.

(5) The input resistance of Q1 is increased by applying the emitter voltage of Q2 to the collector of Q1, through R13 and C10, and the emitter of 02. through C11 and R14.

(6) The emitter output of Q2 is applied to the intermediate attenuator through coupling capacitor C12. Resistors R14 and R15 bias the emitter of Q1 and the base of Q2. Resistor R12 biases the collector of Q1. The base of Q1 is biased by resistors R7, R9, and R11. Resistor R16 biases the emitter of Q2.

(7) Resistor R10 and capacitor C8 form a low-frequency-compensating network.

(8) Resistor R6 and capacitor C1, of the range attenuator, form a high-pass filter.

c. Intermediate Attenuator. The signal from the input amplifier circuit is applied to the intermediate attenuator through coupling capacitor C12 and RANGE switch S1. The intermediate attenuator is a voltage divider which provides a 1, 3, 10 sequence resulting in 10-db steps.

(1) Switch S1 selects the attenuation inserted in the signal path by the intermediate attenuator. In positions 1, 5, and 9, resistor R17 is inserted. In positions 2, 6, and 10, resistor R18 is inserted. In positions 3, 7, and 11, resistors R18, R19, and R20 are inserted. In positions 4, 8, and 12, resistors R18, R19, R21, and R22 are inserted.

(2) The intermediate and range attenuators apply approximately the same signal strength to the fixed gain amplifier in all positions of RANGE switch S1.

d. Fixed Gain Amplifier Circuit. The output from the intermediate attenuator is applied to the fixed gain amplifier through coupling capacitor C13. The fixed gain amplifier circuit consists of transistors Q3 through Q6. The fixed gain amplifier develops the current for meter deflection and provides the meter circuit with a high impedance source for linear operation at all current levels.

(1) Transistors Q3, Q4, Q5, and Q6 are direct coupled and each stage is biased by the adjoining stage. The signal applied to the base of Q3 is compared with the feedback signal applied to the emitter of Q3 from the meter rectifier circuit. The difference signal at the collector of Q3 is applied to the base of Q4. The output of Q4 is direct coupled to Q5. Common emitter Q5 is direct coupled to common base Q6.

(2) Resistors R24, R25, and R26 comprise the dc feedback loop which minimizes dc drift due to surrounding temperature change.

(3) Variable resistor R33, LOOP GAIN ADJ, adjusts the total gain of Q3, Q4, Q5, and Q6.

(4) A negative feedback from the output of the meter rectifier circuit, through resistors R28, R29, and R30, and capacitors C15 and C16, to the emitter of Q3, increases the meter source impedance. Capacitors C15 and C16 correct the phase of the feedback signal at high frequencies.

(5) Variable resistor R29 (METER CAL 1MV RANGE) adjusts the gain of the feedback signal.

(6) Variable capacitor C16 (CAL 1MV 2MC) is used to adjust the phase of the feedback signal to obtain a flat frequency response at high frequencies.

(7) The base of Q3 is biased by the voltage-divider network composed of resistors R34, R24, R25, and R26. Capacitor C20 shunts the ac to the common ground and prevents the ac at the collector of Q5 from being applied as negative feedback. Capacitor C14 and resistor R25 from a decoupling network. The collector of Q3 and base of Q4 are biased by resistor R32. The emitter of Q4 is biased by resistor R46 and variable resistor R33 LOOP GAIN ADJ, which adjusts the total amplifier gain. The collector of Q5 is biased by the voltage-divider network of R34, R24, R25, and R26. The collector of Q6 is biased by resistors R35 and R36 in series. The signal at the collector of Q6 is applied to the meter rectifier circuit.

e. Meter Rectifier Circuit. The meter rectifier circuit consists of diodes CR3 and CR4, capacitors C17, C18, and C19, and a dc microammeter.

(1) The meter rectifier circuit is arranged in a bridge with diode CR3 or CR4, and capacitor C17 and C18 in each branch. Capacitor C19 filters the rectifier output, and microammeter M1 is connected across the rectifier.

(2) The signal from the fixed gain amplifier is applied to the meter rectifier circuit and to the meter. The current through the meter is proportional to the average value of the input voltage waveform. Diode rectifier CR3 and CR4 permit current flow in only one direction through R42 and the meter.

(3) The voltage across the meter is held constant by the large capacitance of capacitor C19 and the resistance of resistor R42. Capacitors C17 and C18 act as a voltage divider with resistor R31 as the load resistor.

(4) The ac voltage across R31 and the feedback voltage at the junction of C17 and C18 are proportional to the root mean square (rms) value of the input value.

f. Power Supply. The power supply consists of four 6.25-volt rechargeable nickel-cadmium batteries, BT1, BT2, BT3, and BT4, and a battery-charging circuit. The batteries supply operating power to the voltmeter circuits.

(1) The battery-charging circuit, supplies a charging current to the batteries when it is connected to an ac source and FUNCTION switch S2 is in the ON position. The voltmeter may be operated while the batteries are being charged.

(2) The batteries are connected in series and tapped to a common ground to provide a 12.5-volt negative supply and a 12.5-volt positive supply.

(3) The negative supply is center tapped to provide a negative 6.25-volt supply.

(4) In the battery-charging circuit, the two primary windings of transformer T1 are connected in series for a source voltage of 230 volts ac, or in parallel for a source voltage of 115 volts ac.

(5) The voltage of the secondary remains approximately the same for either source voltage.

Switch S3 (115-230) on the rear of the voltmeter (fig. 3-7) is used to connect the primary windings in series or parallel, depending on the source voltage.

(6) The BATT. CHARGE indicator is connected across one of the primary windings in series with current-limiting resistor R38, and lights white when the voltmeter is connected to an ac source and FUNCTION switch S2 is in the ON position.

(7) The secondary of T1 is connected to a full-wave bridge rectifier through current-limiting resistor R47. The full-wave bridge rectifier consists of diodes CR5 through CR8.

(8) Capacitor C21 is connected across the output of the full-wave bridge and filters the rectified voltage.

(9) The emitter of transistor Q7 is connected to the positive rectified voltage through resistor R37 and variable resistor R$9 CHARGE RATE ADJ. Resistor R89 is used to adjust the collector output current of Q7. The base of Q7 is biased by resistor R41. When diode CR9 breaks down, it maintains a constant base-to-emitter biasing relationship to obtain a constant current output at the collector. The collector current of Q7 charges the batteries.

(10) Diode CR10 prevents the batteries from discharging through the battery-charging circuit when this circuit is disconnected from the ac source.

(11) When FUNCTION switch S2 is held in the BATT. TEST position, the total voltage of the four batteries is connected to the meter in series with resistors R44 and variable resistor R45 (BATT. TEST CAL) and in parallel with shunt resistor R48.

(12) Resistor R45 varies the resistance of the battery test circuit to calibrate the meter.

CHAPTER 3

GENERAL SUPPORT TROUBLESHOOTING

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

3-1. General Instructions

Troubleshooting at the general support maintenance category includes all the techniques outlined for organizational maintenance and any special or additional techniques required to isolate a defective part. Section II describes localizing and isolating techniques to be used by general support maintenance personnel.

3-2. Organization of Troubleshooting Procedures.

a. General. The first step in servicing a defective test set is to localize the fault. Localization means tracing the fault to a defective stage or circuit responsible for the abnormal condition. The second step is isolation. Isolation means the localizing of the defective part or parts. Some defective parts, such as burned resistors and arcing or shorted transformers, can often be located by sight, smell, and hearing. Most defective parts, however, must be isolated by checking voltages.

b. Localization. The first step in tracing trouble is to locate the faulty component, localize the trouble to a single stage or circuit, and then isolate the trouble within that circuit by voltage measurements.

(1) *Visual inspection*. The purpose of visual inspection is to locate faults without testing or measuring voltages. Meter indications or other visual signs should be observed and an attempt made to localize the fault to a particular chassis.

(2) *Operational tests*. Operational tests frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault. The daily maintenance service and inspection chart in TM 11-6625-602-12-1 contains an operational test. Additional operational tests are given in paragraph 3-4.

(3) *Voltage measurements*. This equipment is transistorized. Observe all precautions given to prevent transistor damage. Make voltage measurements in this equipment only as specified. When measuring voltages, use tape or sleeving to insulate the entire test prod except the extreme tip. A momentary short circuit can damage a transistor. (For example, if the bias is shorted out, excessive current between the emitter and base would damage the transistor.) Use resistor and capacitor color codes (figs. 5-12 and 5-13) to find the values of the components. Use the schematic diagrams (figs. 5-14, 5-15, 5-16) to find normal voltage indications, and compare them with the test indications.

(4) *Troubleshooting chart*. The trouble symptoms listed in the charts (para 3-6, 3-10, and 3-13) will aid in localizing trouble to a component part.

(5) *Intermittent troubles*. In all these tests, the possibility of intermittent trouble must not be overlooked. If present, this type of trouble often may be made to reappear by rapping or jarring the equipment. Check the wiring and connections to the assemblies of the set.

3-3. Test Equipment Required.

The following chart lists the test equipments required for troubleshooting Test Set, Telephone AN/USM-181B, as well as the associated manuals and the assigned common names.

Test equipment	*Technical manual*	*Common Name*
Voltmeter, Electronic ME-207/U.		Vtvm
Multimeter ME-26B/U.		Multimeter
Frequency Meter AN/USM-26.	TM 11-6625-212-15	Frequency meter
Oscilloscope AN/USM-281A.	TM 11-6625-1703-15	Oscilloscope
100K shielded resistor		Shielded resistor
600-ohm resistor ±1%		Resistor
Test Set, Transistor TS-1836/U.	TM 11-6625-539-15	Transistor test set

Section II. TROUBLESHOOTING TEST SET, TELEPHONE AN/USM-181B

CAUTION

Do not attempt removal or replacement of parts before reading the instructions in paragraph 4-1.

3-4. Improper Frequency Response
(figs. 5-14, 5-15, 5-16).

Faulty frequency response operation may be caused by a defective signal generator assembly, attenuator assembly transformer, or voltmeter assembly. If the operational check fail to localize the trouble to a defective assembly, follow the procedure outlined in a through d below. Determine which chassis is defective, and follow the procedure outlined in paragraphs 3-5 through 3-14, as applicable.

NOTE

Each of the following checks is independent of the others; the equipment should be connected completely, except as specified for the particular procedure involved. Checks must be completed in the sequence given.

a. Set the signal generator RANGE switch to the X1K position and the AMPLITUDE control fully clockwise. Disconnect the output cable, and, using the ME-207/U, check the voltage (approximately 5 volts ac) at the output terminals. Absence of an ac voltage indicates a defective signal generator. Isolate the trouble as outlined in paragraph 3-7. Reconnect the output cable.

b. Set the signal generator RANGE switch to X1K, the AMPLITUDE fully clockwise, and the FREQ. dial to 5 the attenuator DB control to 0, the FREQ switch < 5KC, the IMPEDANCE switches to 600, and the MEAS-CAL switch to CAL. Disconnect the VM connector from the attenuator and use an ME-207/U to check for an ac voltage of approximately 2.3 volts at the output terminals. Absence of an ac voltage indicates a defective attenuator low-frequency circuit.

c. Set the signal generator RANGE switch to X1OK, the AMPLITUDE fully clockwise, and the FREQ dial to 5, the attenuator DB control to 0, the Freq switch to > 5KC, the IMPEDANCE switches to 600, and the MEAS-CAL switch to CAL. Disconnect the VM connector from the attenuator and check for approximately 2.3 volts ac at the output terminals with the ME-207/U. Absence of an ac voltage indicates a defective attenuator high-frequency circuit.

d. Set the signal generator and attenuator controls for 1 kc, the voltmeter FUNCTION switch to ON, and the RANGE switch to 3 volts. Observe the meter on the voltmeter for an indication. Absence of an indication of approximately 2.3 volts indicates a defective voltmeter.

3-5. Generator, Signal SG-543B/U Test Setup
(fig. 5-14).

Bench tests of the signal generator require connection to various test equipments. The signal generator may be connected to an ac power source for dynamic servicing procedures; the test equipment connections vary from test to test. Remove the signal generator from the carrying case. Connect the test equipment (oscillator, meters, etc.) as specified for the particular tests (para 3-6, 3-7, and 3-8).

3-6. Generator, Signal SG-543B/U Trouble Localization
(fig. 5-14).

a. General. In the troubleshooting chart (d below), the procedures are outlined for localizing troubles to a stage within the signal generator. The parts locations are indicated in figures 3-1, 3-2, and 3-3. The voltage measurements are shown in the overall schematic diagram (fig. 5-14). The nature of the operational symptom will determine which of the localizing procedures will be necessary.

b. Use of Chart. The troubleshooting chart supplements the operational checks given in TM 11-6625-602-12-1. If previous operational checks have resulted in references to a particular item of this chart, go direct to the referenced item. If no operational symptoms are known, perform the procedures outlined in paragraphs 3-6, 3-7, and 3-8 in TM 11-6625-602-12-1, until a symptom of trouble appears.

c. Conditions of Tests. All checks outlined in the chart are to be conducted with the signal generator connected to an ac source as described in paragraph 3-5.

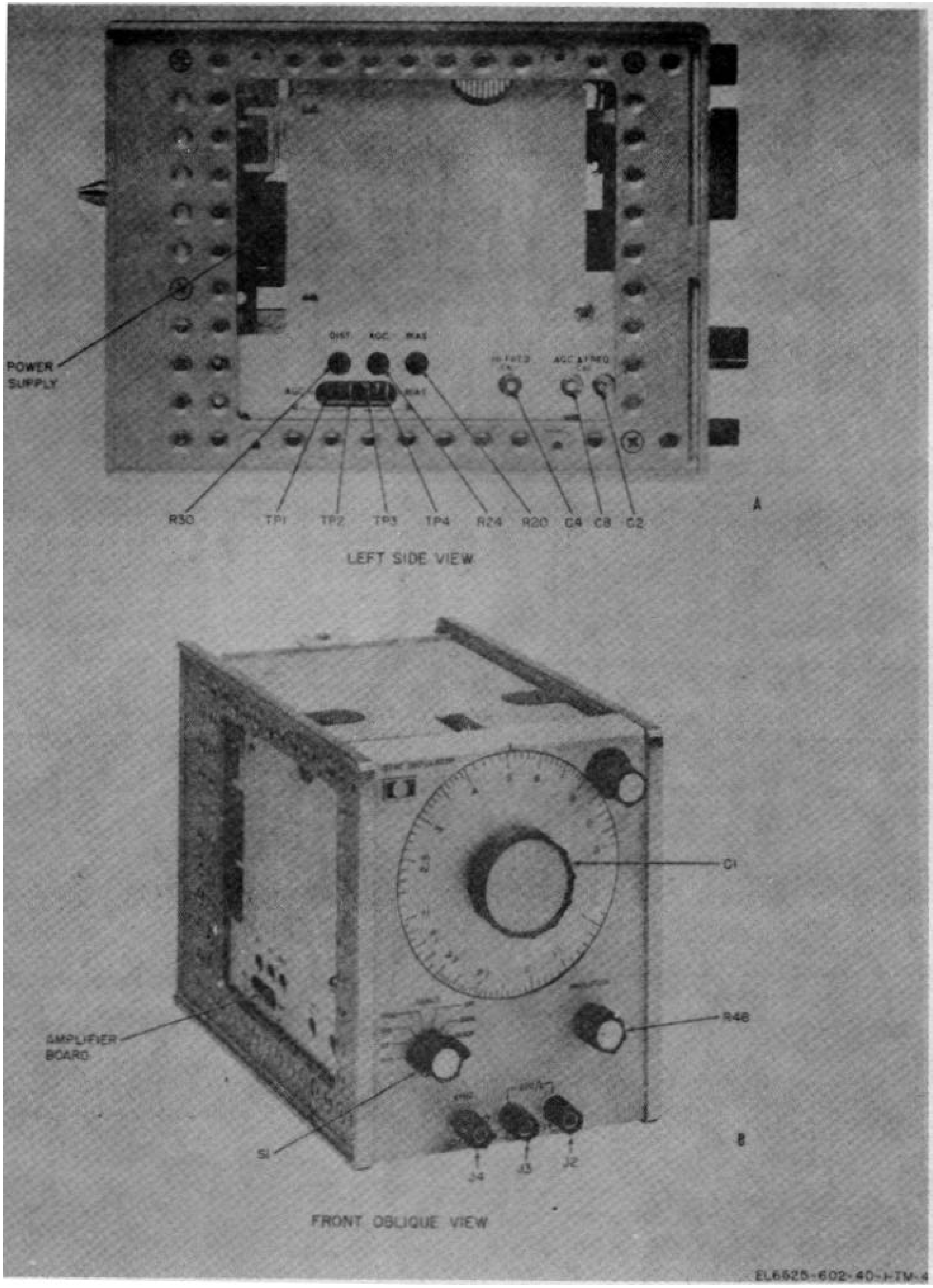


Figure 3-1. Generator, Signal SG-543B/U parts location diagram, front and side views.

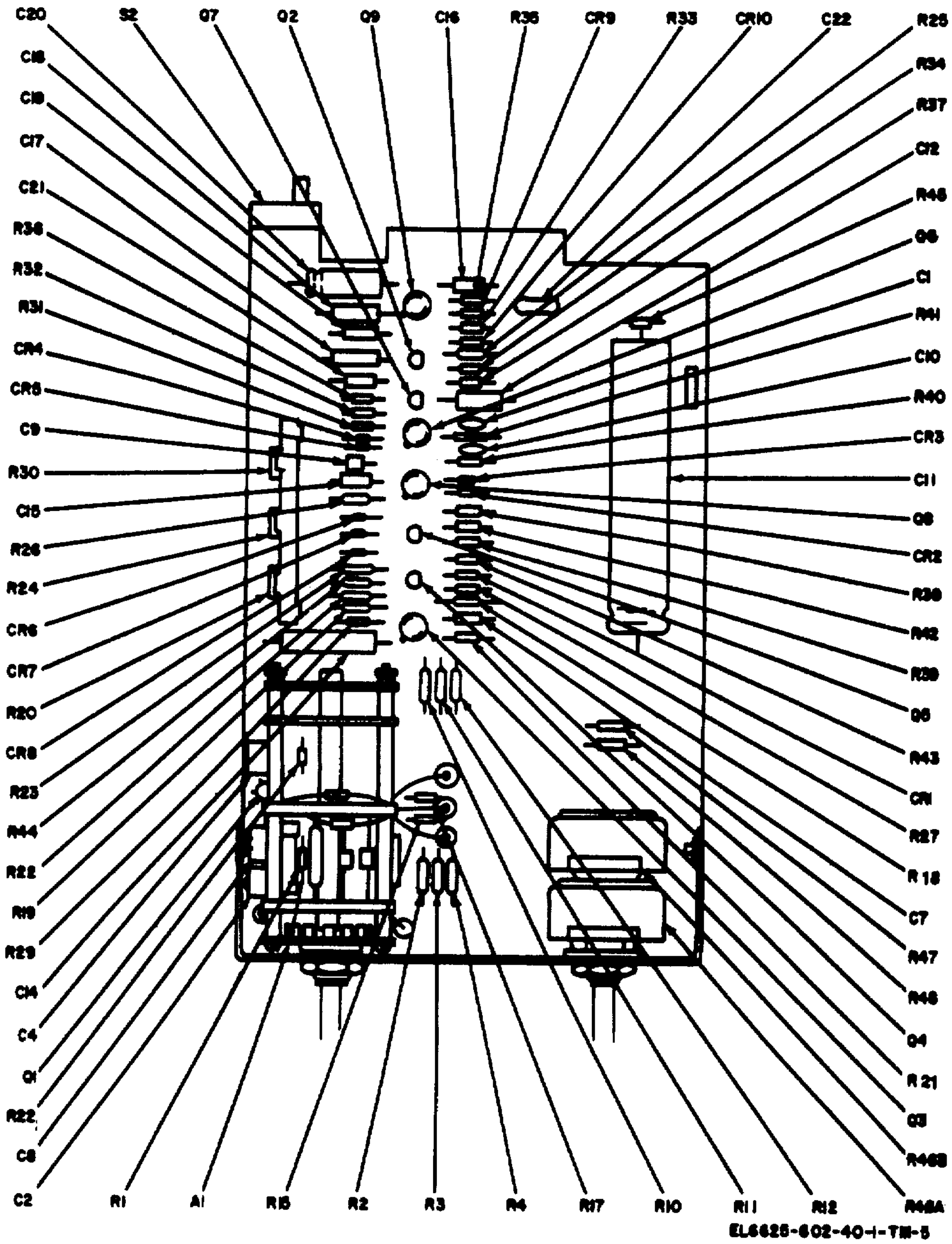


Figure 3-2. Generator, Signal SG-543B/U parts location diagram, amplifier board.

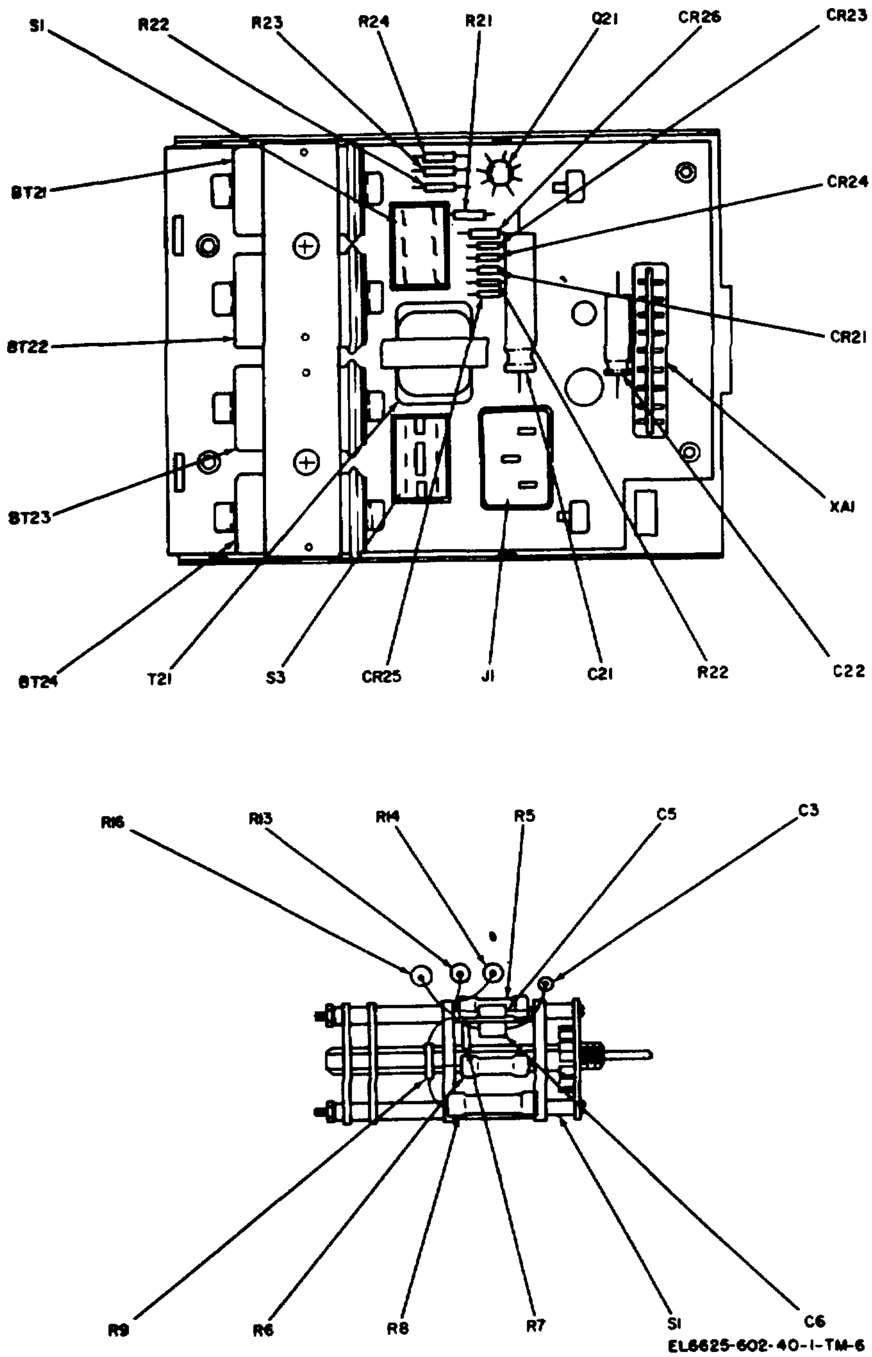


Figure 3-3. Generator, Signal SG-543B/U parts location diagram, power supply board.

d. Generator, Signal SG-543B/U Troubleshooting Chart (fig. 5-14).

Perform the operational procedures (TM 11-6625-602-12-1) before using this chart, unless trouble has already been localized.

Indication	Probable trouble	Procedure
1. No output signal; normal dc voltage at junction of R41 and R42 of approximately 0 volt.	Defective power supply	Make voltage check of power supply and replace defective components.
	Defective rc bridge circuit	Make voltage checks and replace defective components.
	Defective 01, 03, 04, or 05 -	Make voltage checks (para 3-7) and waveform checks (para 3-8) and replace defective transistor.
	Defective peak comparator circuit.	Make voltage checks Q9 and other components and replace defective component.
2. No output on one or more ranges	Defective range switch contacts.	Check for corroded, bent, or broken contacts. Repair or replace defective component.
	Defective rc bridge circuit	Make voltage check of components in circuit of defective range and replace defective component.
3. Output amplitude is not correct or is distorted.	Defective power supply	Make voltage check and replace defective component.
4. Output amplitude is not correct or is distorted on more than one range, but not all ranges.	Defective peak comparator or ACC circuit.	Make voltage check on Q2 and Q9 (para 3-7) and related components. Replace defective component.
5. Crossover distortion present	Defective CR4, CR5, R41, or R42.	Check components and replace defective component.
6. Waveform clipping	Defective power supply .	Check components in power supply and replace defective component.
	Improper setting of BIAS control.	Check BIAS control at Q1 gate. If ineffective, check S1 and bias path. If good check voltage of Q3, Q7, and Q8 and replace defective component.
7. High frequency oscillations -	Improper value of C9	Check in NORM mode at 100 Hz on X100 RANGE. If oscillations are present, replace C9 with a higher value. Perform high frequency calibration (para 420).
8. Insufficient range of HI FREQ CAL C4.	Capacitor C9 value too high	Change C9 to a lower value. Check for high frequency oscillations after change.
9. Microphonics present	Defective contacts on C1	Check C1 wiper contacts on both rotor sections and repair or replace.
10. Batteries will not charge	Defective charging circuit	Check voltages on Q21 (para 3-7) and related components. Replace defective component.
	Defective batteries	Replace batteries.
11. Rotation of AMPLITUDE control has no effect on output voltage.	Defective potentiometer R46A and R46B.	Check potentiometer. Replace if necessary.

3-7. Generator, Signal SG-543B/U Trouble Isolation (fig. 5-14)

a. When trouble has been localized to a stage either through 'operational checks or through some other means, isolate the defective part by voltage measurements at the transistor terminals (*c* below) and other points related to the stage in question.

CAUTION

Do not make any resistance measurements on the signal generator assembly. The multimeter battery can destroy the transistors by causing excessive current to flow through them. In some cases 0.1 volt applied between the base and emitter in the reverse direction can destroy a transistor.

b. Use the schematic diagram to help trace the circuits and isolate the faulty component.

c. The transistor terminal voltage indications below ,were made on an average chassis. A measurement that differs widely from those in the chart can, when used with the schematic diagram, often isolate the trouble to a specific part.

NOTE

The voltages measured at the emitter and base terminals of replaced transistors may vary 15 to 20 percent from the voltages listed below. Collector voltages should not vary more than 10 percent. Bias (voltage between emitter and base) should remain approximately the same.

Voltages Measured Chassis

Transistor	*Emitter or source*	*Collector drain*	*Base or gate*
Q1 (FET)	0.23 vdc	8.8 vdc	-1.1 vdc
Q2 (FET)	0 dc	-0.01 vdc	-1 vdc
Q3 (PNP)	8.8 vdc	-13.0 vdc	9.15 vdc
Q4 (NPN)	-13.5 vdc	-10.5 vdc	-13 vdc
Q5 (NPN)	-10.5 vdc	0.96 vdc	-12.4 vdc
Q6 (PNP)	13.8 vdc	-0.03 vdc	13 vdc
Q7 (NPN)	-0.39 vdc	13.9 vdc	0.03 vdc
Q8 (PNP)	-0.72 vdc	-14 vdc	-0.98 vdc
Q9 (PNP)	-8.9 vdc	-14 vdc	-6.75 vdc
Q21 (NPN)	-28.8 vdc	17 vdc	-28.2 vdc

3-8. Generator, Signal SG-543B/U Waveform Checks

Waveform checks help to localize troubles to a stage or component. The oscillator amplifier may be disabled by turning AGC ADJUST R24 (fig. 3-1) fully counterclockwise. A one volt RMS sine wave may be injected into the gate of Q1. The various stages of the amplifier may now be monitored with an oscilloscope for proper operation. The amplifier should have a gain of three for all frequencies up to 100 KHz.

3-9. Attenuator, Impedance Matching CN-947B/USM-181 Test Setup

Bench tests of the attenuator require connection to ,various test equipments. The test equipment connections vary from test to test. Remove the attenuator from the carrying case. Connect the test equipment (oscillator, meters, etc.) as specified for the particular tests (para 3-10 and 3-11).

3-10. Attenuator, Impedance Matching CN-947B/USM-181 Trouble Localization

a. General. In the troubleshooting chart (c below), procedures are outlined for localizing troubles to a stage within the attenuator. The parts locations are indicated in figure 3-4. Voltage and resistance measurements are shown on the schematic diagram (fig. 5-15). The nature of the operational symptoms will determine which of the localizing procedures will be necessary.

b. Use of Chart. The troubleshooting chart supplements the operational check given in TM 116625-602-12-1. If previous operational checks have resulted in reference to a particular item of this chart, go direct to the referenced item. If no operational symptoms are known, begin with item 1 of the equipment operational procedures (TM 11-6625--602-12-1) and proceed until a symptom of trouble appears.

c. Attenuator Assembly Troubleshooting Chart.

WARNING

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

Note

Perform the operational procedures (TM 11-6625-602-12-1) before using this chart, unless trouble has already been localized.

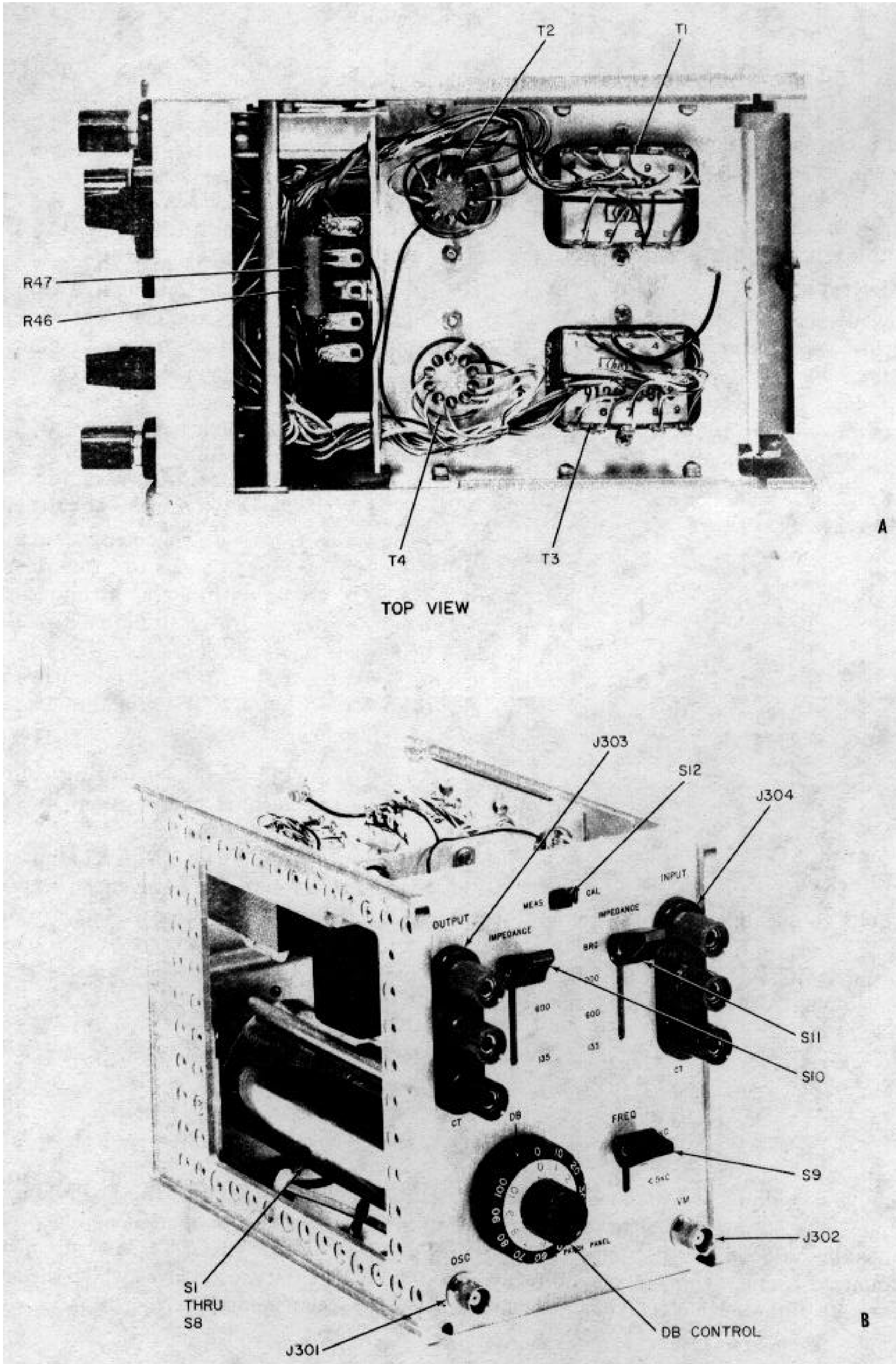


Figure 3-4. Attenuator, Impedance Matching CN-947B/USM-181 parts location diagram.

Indication	Probable trouble	Procedure
1. No output at OUTPUT terminals with input at OSC terminal below 5 kc.	Dirty or broken contacts on FREQ switch S9 or IMPEDANCE switch S10.	Clean switch contacts. Repair or replace faulty switch (para 4-7 or 4-8) if necessary.
	Defective MEAS-CAL switch S12.	Check for resistance across S12 (figs. 3-4 and 5-15). Replace if necessary.
	Defective transformer T1	Check transformer T1 (figs. 3-4 and 5-15) for an open. Replace (para 4-6) if necessary.
	Defective DB control	Replace control (para 4-10).
2. No output at OUTPUT terminals with input at OSC terminal above 5 kc.	Dirty or broken contacts on FREQ switch S9 at IMPEDANCE switch S10.	Clean switch contacts. Repair or replace faulty switch (para 4-7 or 4-8). Replace if necessary.
	Defective MEAS-CAL switch S12.	Check for resistance across S12 (figs. 3-4 and 5-15) for an open. Replace (para 4-6) if necessary.
	Defective transformer T2	Check transformer T2 (figs. 3-4 and 5-15) for an open. Replace (para 4-6) if necessary.
	Defective DB control	Replace control (para 4-10).
3. No output at VM connector with input signals at INPUT terminals below 5 kc.	Dirty or broken contacts on FREQ switch S9 or IMPEDANCE switch S11.	Clean switch contacts. Repair or replace faulty switch (para .1-7 or 4-9) if necessary.
	Defective MEAS-CAL switch S12.	Check resistance across S12 (figs. 3-4 and 5-15) for an open. Replace if necessary.
	Defective transformer T3	Check transformer T3 (figs. 3-4 and 5-15) for an open. Replace (para 4-fi) if necessary.
4. No output at VM connector with input signals at INPUT terminals above 5 kc.	Dirty or broken contacts on FREQ switch S9 or IMPEDANCE switch S11.	Clean switch contacts. Repair or replace faulty switch (para 4-7 or 4-9) if necessary.
	Defective MEAS-CAL switch S12.	Check resistance across S12 (figs. 3-4 and 5-15). Replace if necessary.
	Defective transformer T4	Check transformer T4 (figs. 3-4 and 5-15) for an open. Replace (para 4-6) if necessary.
5. Poor low-frequency response (below 5 kc) indicated at OUTPUT terminals.	Faulty transformer T1	Check transformer T1 (figs. 3-4 and 5-15) for an open. Replace transformer (para 4-6) if necessary.
6. Poor low-frequency response (below 5 kc) indicated at VM OUTPUT terminals.	Faulty transformer T3	Check transformer T3 (figs. 3-4 and 5-15). Replace transformer (para 4-6) if necessary.
7. Poor high-frequency response (above 5 kc) indicated at OUTPUT terminals.	Faulty transformer T2	Check transformer T2 (figs. 3:-4 and 5-15). Replace transformer (para 4-6).
8. Poor high-frequency response (above 5 kc) indicated at MV OUTPUT terminals.	Faulty transformer T4	Check transformer T4 (figs. 3-4 and 5-15). Replace, transformer (para 4-6).

3-11. Attenuator, Impedance Matching CN-947B/USM-181 Trouble Isolation

a. When trouble has been localized to a stage, either through operational checks or through some other means, isolate the defective part by resistance measurements. The resistances of various components in the attenuator are shown in the schematic diagram (fig. 5-15).

NOTE

Before making resistance checks, disconnect any external equipment.

b. Use the schematic diagram (fig. 5-15) to trace circuits and isolate the faulty component.

3-12. Voltmeter, Electronic ME-260B/U Test Setup

Bench tests on the voltmeter require connections to various test equipment. The voltmeter may be connected to an ac power source for dynamic servicing procedures; the test equipment connections vary from test to test. Remove the voltmeter from the carrying case. Connect the test equipment (oscillator, meters, etc.) is specified for the particular tests (para 3-13 and 3-14).

3-13. Voltmeter, Electronic ME-260B/U Trouble Localization

a. General. In the troubleshooting chart (d below), procedures are outlined for localizing troubles to a stage within the voltmeter. Parts locations are indicated in figures 3-5, 3-6, and 3-7. The voltage measurements are shown in the overall schematic diagram (fig. 5-16).

b. Use of Chart. The troubleshooting chart supplements the operational checks indicated in TM 11-6625-602-12-1. If previous operational checks halve resulted in references to particular items of this chart, go direct to the referenced item. If no operational symptoms are known, begin with item 1 of the equipment operational procedures (TM 11-6625-602-12-1) and proceed until a symptom of trouble appears.

c. Condition of Tests. All checks outlined in the chart are to be conducted with the voltmeter connected to an ac source as described in paragraph 3-12.

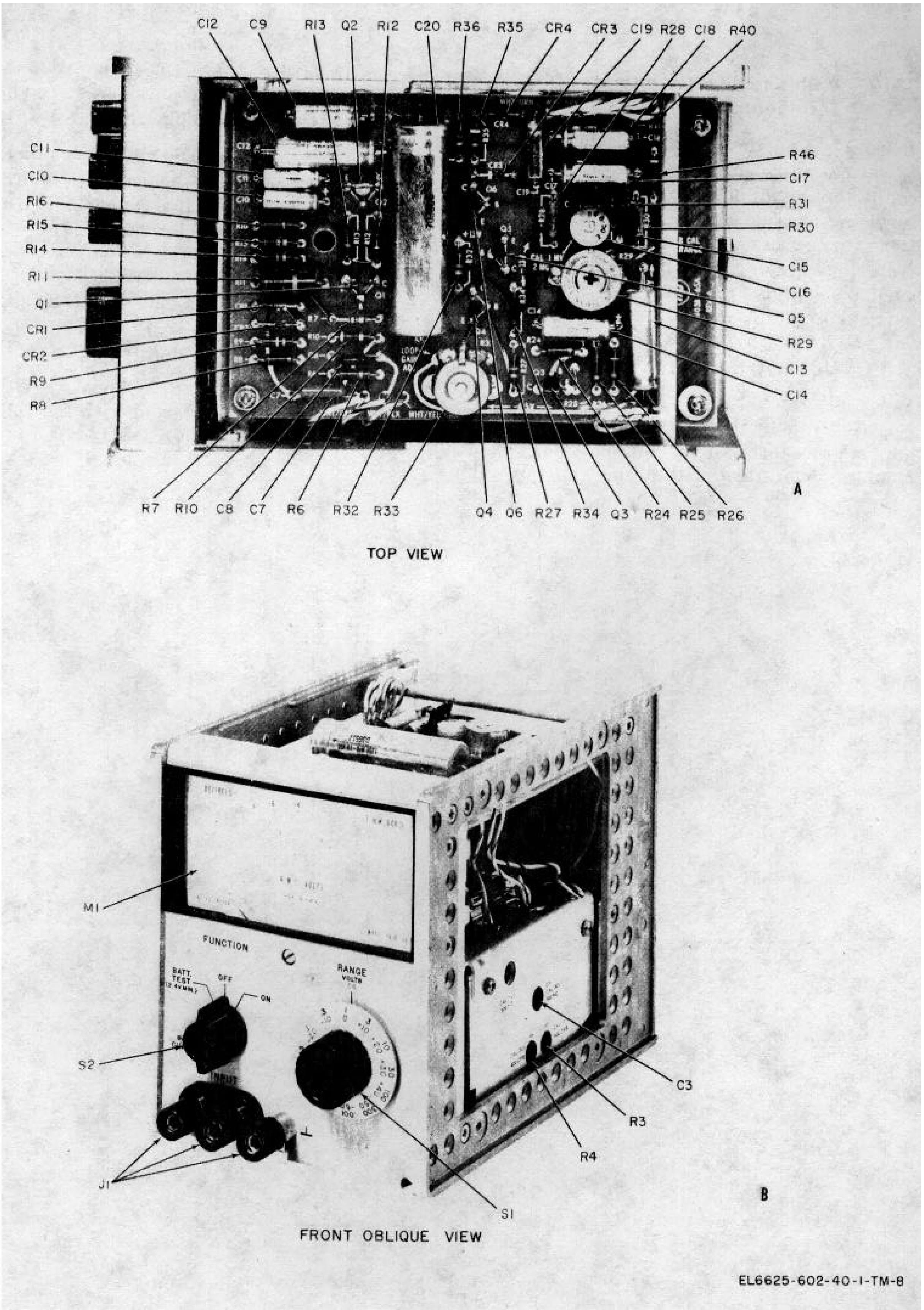


Figure 3-5. Voltmeter, Electronic ME-260B/U parts location diagram.

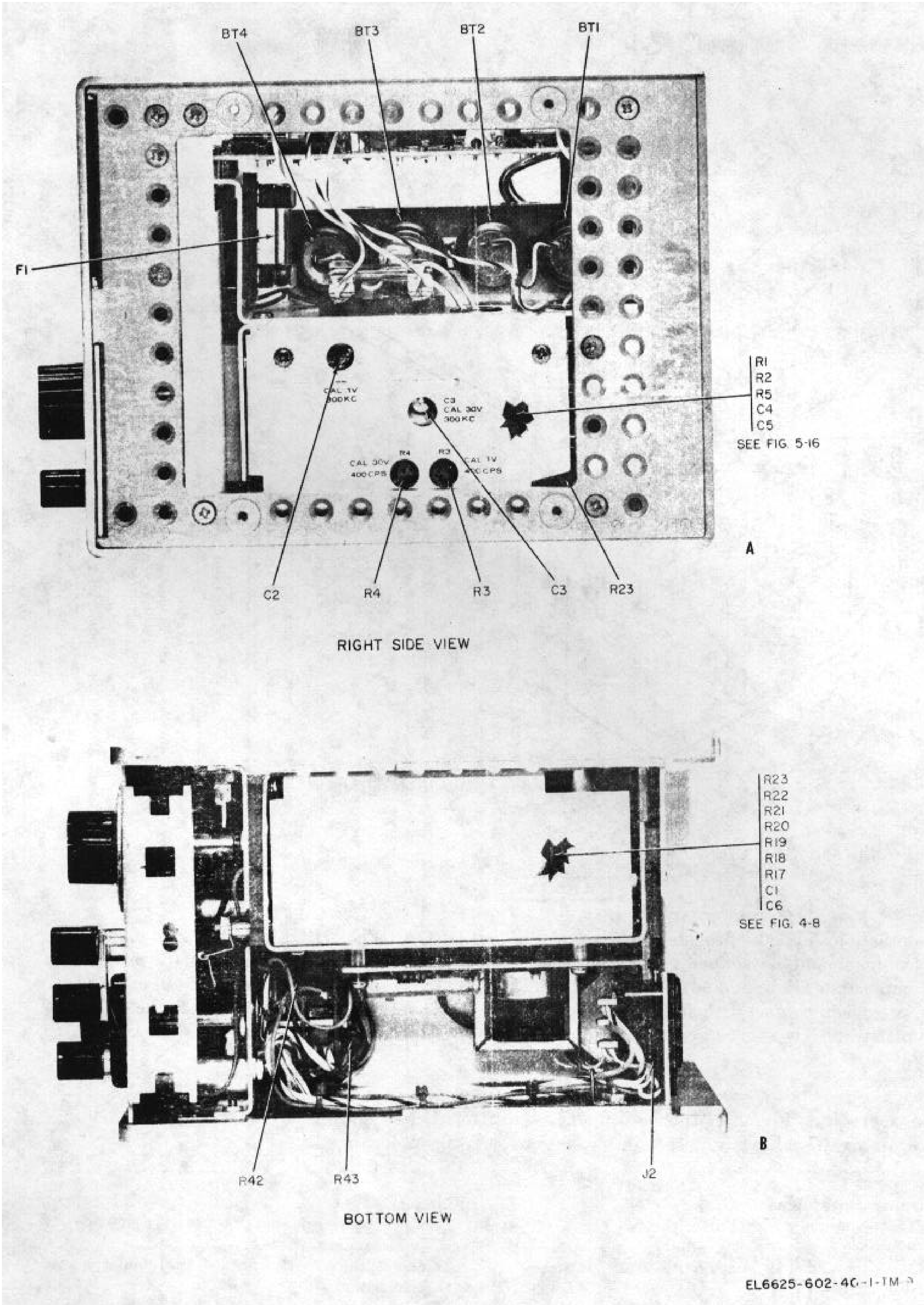


Figure 3-6. Voltmeter, Electronic ME-260/U parts location diagram.

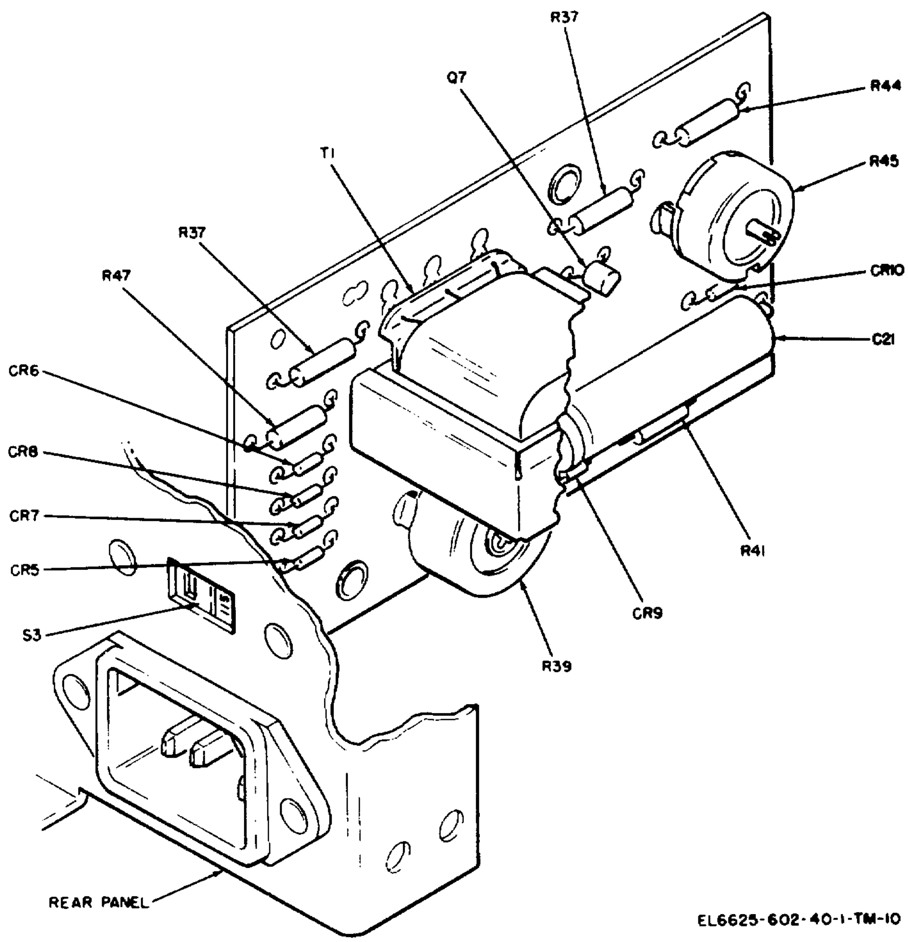


Figure 3-7. Voltmeter, Electronic ME-260B/U parts location diagram.

d. Voltmeter Troubleshooting Chart.

WARNING

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

NOTE

Perform the operations given in the equipment operational procedures (TM 11-6625-60212-1) before using this chart, unless trouble has already been localized.

Indication	*Probable trouble*	*Procedure*
1. No meter indication with signal applied to INPUT terminals.	Open fuse F1	Replace fuse.
	Batteries low	Charge batteries (para 4-22a), or replace if necessary (para 4-11).
	Defective transistor	Make voltage check (para 4-14c) and replace transistor.
	Defective diode CR1 or CR2	Replace diode CR1 or CR2 (fig. .3-5).
	Open contacts on RANGE switch.	Replace (para 4-13) or repair RANGE switch.

Indication	Probable trouble	Procedure
2. Low indication on meter when FUNCTION switch is in BATT. TEST position.	Low battery voltage	Recharge (para 4-22*a*) or replace batteries para 4-11).
3. Meter pointer off-scale when rotating through positions of RANGE switch.	Dirty contacts on RANGE switch.	Clean switch contacts (fig. 3-5).
	Leaky capacitor in range attenuator circuit.	Replace capacitor.
4. Meter pointer pulsates at frequencies below 15 cps.	Leaky or open C17, C18, or C20.	Replace defective capacitor (fig. 3-5).
5. Meter calibration incorrect on ranges above .03.	Defective capacitors or resistors in range attenuator.	Adjust input attenuator. Replace defective component or RANGE switch (para 4-13) if necessary.
6. Meter calibration incorrect on ranges below .1.	Dirty contacts on RANGE switch.	Clean switch contacts (fig. 3-5).
7. Meter calibration incorrect on ranges .001, .1, and 10.	Defective R17 on intermediate attenuator.	Replace R17 (fig. 3 6).
8. Meter calibration incorrect on on ranges .003, .3, and 30.	Defective R18 on intermediate attenuator.	Replace R18 (fig. 3-6).
9. Meter calibration incorrect on ranges .01, 1 and 100.	Defective R19 or R20 on intermediate attenuator.	Replace R19 or R20 (fig. 3-6).
10. Meter calibration incorrect on ranges .03, 3, and 300.	Defective R21 or R22 on intermediate attenuator.	Replace R21 or R22 (fig. 3-6).
11. Batteries will not hold charge	CR10 shorted	Replace CR10 (fig. 3-7).
	Shorted cell in battery	Replace battery (para 4-11).
12. Power supply inoperative	Defective CR5, CR6, CR7, CR8, CR9, and/or C21 in power supply circuit.	Replace components (fig. 3-7).
	Ac power supply selection switch on 230 volts when connected to 115 volts ac source.	Set switch to correspond to ac line voltage supplied.
13. METER CAL 1MC RANGE adjustment R29 will not adjust for full range indication.	Defective CR1, CR2, CR3, CR4, Q1, Q2, Q3, Q4, Q5, or Q6.	Make voltage check (figs. 3-5 and 5-16 and para 3-14*c*). Replace defective component.
14. Spurious voltages indicated on voltmeter when input terminals are connected across 100K ohm shielded resistor.	Defective Q1, or Q2, CRI or CR2 or T1.	Replace defective transistor, diode, or transformer T1 (figs. 3-5 and 3-6).
15. Voltmeter does not indicate .0075 to .0095 volt (1.5- to 2.5-megohm input resistance).	Defective Q1, Q2, C9, C10, C11, or R6.	Make voltage check (figs. 3-5 and 5-16 and para 3-14c). Replace defective component.
16. Meter consistently indicates above or below actual values on all meter scale divisions.	Defective CR3 or CR4	Replace CR3 or CR4 (fig. 3-5).
	R35 out of tolerance	Replace R35) (fig. 3-5).
17. Meter indicates above actual voltages values on some scale division and below on others.	Defective CR3 or CR4	Replace CR3 or CR4 (fig. 3-5).
	Defective meter Ml1	Replace meter (para 4-14).
18. Poor low-frequency response	Leaky C1, C7, C12, C13, C17, C18, or C19.	Replace defective component (figs. 3-5 and 3-6).
19. In voltmeter overload test ME-207/U indicates more than 3.3 volts.	Defective CR1 or CR2	Replace CR1 or CR2 (fig. 3-5).
20. Power supply has excessive charging rate, and varying CHARGE RATE ADJ (R39) has no effect.	Defective CR9, Q7, or R39	Check Q7 and CR9 voltages (figs. 3-7 and 5-5). Check R39 resistance (fig. 3-7).
21. All ranges except .001, .1, and 10 out of calibration at 400 cps.	Defective C13	Replace C13 (fig. 3-5).

Indication	Probable trouble	Procedure
22. Only one or two ranges out of calibration.	Defective Q3	Replace Q3 (fig. 3-5)
23. Meter pointer pins on all ranges when voltmeter is turned on.	Defective R31	Replace R31 (fig. 3-5)

3-14. Voltmeter, Electronic ME-260B/U Trouble Isolation

a. When trouble has been localized to a stage either through operational checks or through some other means, isolate the defective part by voltage measurements at the transistor terminals (*c* below) and other points related to the stage in question.

CAUTION

Do not make any resistance measurements on the voltmeter assembly. The multimeter battery can destroy the transistors by causing excessive current to flow through them. In some cases 0.1 volt applied between the base and emitter in the reverse direction can destroy a transistor.

b. Use the schematic diagram to help trace the circuits and isolate the faulty component.

c. The transistor terminal voltage indications below were made on an average chassis. A measurement that differs widely from those in the chart can, when used with the schematic diagram, often isolate the trouble to a specific part.

NOTE

The voltages measured at the emitter and base terminals of replaced transistors may vary 15, to 20 percent from the voltages listed below. Collector voltages should not vary more than 10 percent. Bias (voltage between emitter and base) should remain approximately the same.

Voltage measurements

Transistor	Emitter	Collector	Base
Q1 (PNP)	-9.0 vdc	-9.25 vdc	-9.5 vdc
Q2 (PNP)	-8.4 vdc	-14 vdc	-9 vdc
Q3 (PNP)	-0.03 vdc	-6 vdc	-0.66 vdc
Q4 (NPN)	-6.8 vdc	-1.24 vdc	-6.0 vdc
Q5 (PNP)	-0.6 vdc	-5.2 vdc	-1.24 vdc
Q6 (NPN)	-0.6 vdc	+4.5 vdc	0 vdc
Q7 (PNP)	+27.2 vdc	+15.2 vdc	+26.7 vdc

Note. All measurements made to chassis ground.

CHAPTER 4

GENERAL SUPPORT REPAIRS AND ALIGNMENT

Section I. REPAIRS

4-1. General Parts Replacement Techniques

Most of the parts of the equipment can be reached and replaced easily without special procedures. The following precautions apply to this equipment.

a. When removing a component from the circuit boards, apply heat to the component lead on the conductor side of the board. Remove the component with a straight upward pull. Use a toothpick or wooden splinter to clean the hole. Solder the replacement component from the conductor side of the board.

b. Use a pencil-type soldering iron with a 25-watt maximum capacity. If the iron must be used with ac, use an isolating transformer between the iron and the line. DO NOT use a soldering gun; damaging voltages can be induced into the components.

c. When soldering transistor leads, solder quickly; whenever wiring permits, use a heat sink (such as long-nosed pliers) between the solder joint and the transistor. Use approximately the same length and dress of transistor leads as used originally.

4-2. Generator, Signal SG-543B/U Power Supply Replacement

a. Removal of Power Supply.

(1) Remove the signal generator from the carrying case.

(2) Unplug the power cord from the rear of the unit.

(3) Remove the side, top, and bottom panels.

(4) Remove the rear panel mounting screws from each side casting.

(5) Remove the power supply by pulling out the bottom first and then unhooking the top from the mounting slots.

b. Replacement of Power Supply.

(1) Replace the power supply by hooking the top into the mounting slots first and then pushing the bottom into the casting.

(2) Replace the rear panel mounting screws on each side casting.

(3) Replace the top, bottom, and side panels.

(4) Plug in the power cord at the rear of the unit.

(5) Replace the signal generator in the carrying case.

4-3. Generator, Signal SG-543B/U Battery Replacement (fig. 4-1)

a. Removal of Old Batteries.

(1) Remove the signal generator from the carrying case.

(2) Unplug the power cord from the rear of the unit.

(3) Remove the power supply (para 4-2).

(4) Remove the two battery retainer screws and remove the battery retainer and plastic separators.

(5) Remove batteries from battery clips.

b. Replacement of New Batteries.

(1) Replace the new batteries as shown in figure 4-1.

(2) Replace the battery retainer and plastic separators and secure with the two screws.

(3) Replace the power supply (para 4-2).

(4) Plug in the power cord at the rear of the unit.

(5) Replace the signal generator in the carrying case.

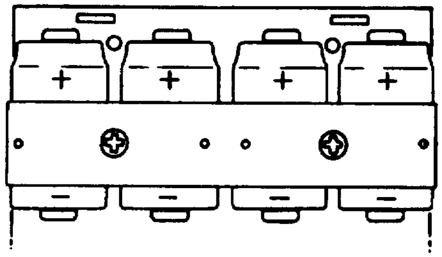


Figure 4-1. Generator, Signal SG-54SB/U battery diagram.

4-4. Generator, Signal SG-543B/U Oscillator Assembly Replacement

a. Removal of Oscillator Assembly.

(1) Remove signal generator from the carrying case.

(2) Unplug the power cord from the rear of the unit.

(3) Remove the top, side and bottom panels.

(4) Remove power supply (para 4-2).

(5) Remove screws holding electrical shield and remove shield.

(6) Remove RANGE knob and AMPLITUDE knob from front panel.

(7) Disconnect and tag white, green, and blue wires connected to tuning capacitor.

(8) Pull oscillator assembly out from front panel.

b. Replacement of Oscillator Assembly.

(1) Replace oscillator assembly through front panel.

(2) Replace RANGE knob and AMPLITUDE knob.

(3) Connect white, green, and blue to tuning capacitor.

(4) Replace shield and secure with screws.

(5) Replace power supply (para 4-2).

(6) Replace top, side, and bottom panels.

(7) Plug in the power cord at the rear of the unit.

(8) Replace signal generator in the carrying case.

4-5. Generator, Signal SG-543B/U RANGE Switch S1 Replacement (fig. 4-2)

a. Removal of Old Switch.

(1) Remove the signal generator from the carrying case.

(2) Unplug the power cord at the rear of the unit.

(8) Remove the top, side, and bottom panels.

(4) Remove the power supply (para 4-2).

(5) Remove the oscillator assembly (para 4-4).

(6) Remove the retaining nut from the switch shaft.

(7) Unsolder or clip the leads at the switch terminals and the pins from the circuit board and remove switch.

b. Installations of New Switch.

(1) Install the new switch on the circuit board and secure with the retaining nut.

(2) Solder the leads to the replacement switch and solder the pins to circuit board.

(3) Replace the oscillator assembly (para 4-4).

(4) Replace the power supply (para 4-2).

(5) Replace the top and bottom panels.

(6) Perform the frequency calibration (para 4-19).

(7) Replace the side panels.

(8) Plug in the power cord at the rear of the unit.

(9) Replace the signal generator in the carrying case.

4-6. Attenuator, Impedance Matching CN-947B/USM-181 Transformer Replacement (fig.3-4)

a. Removal of Old Transformers.

(1) Remove the attenuator from the carrying case.

(2) Remove the side, bottom, and top panels.

(3) Unsolder the leads to the defective transformer.

NOTE

When removing T2, it will be necessary to remove the screw that holds the DB control rear mounting bracket. This will allow the DB control to be moved slightly away from T2 so that T2 may be removed through the nearest side frame.

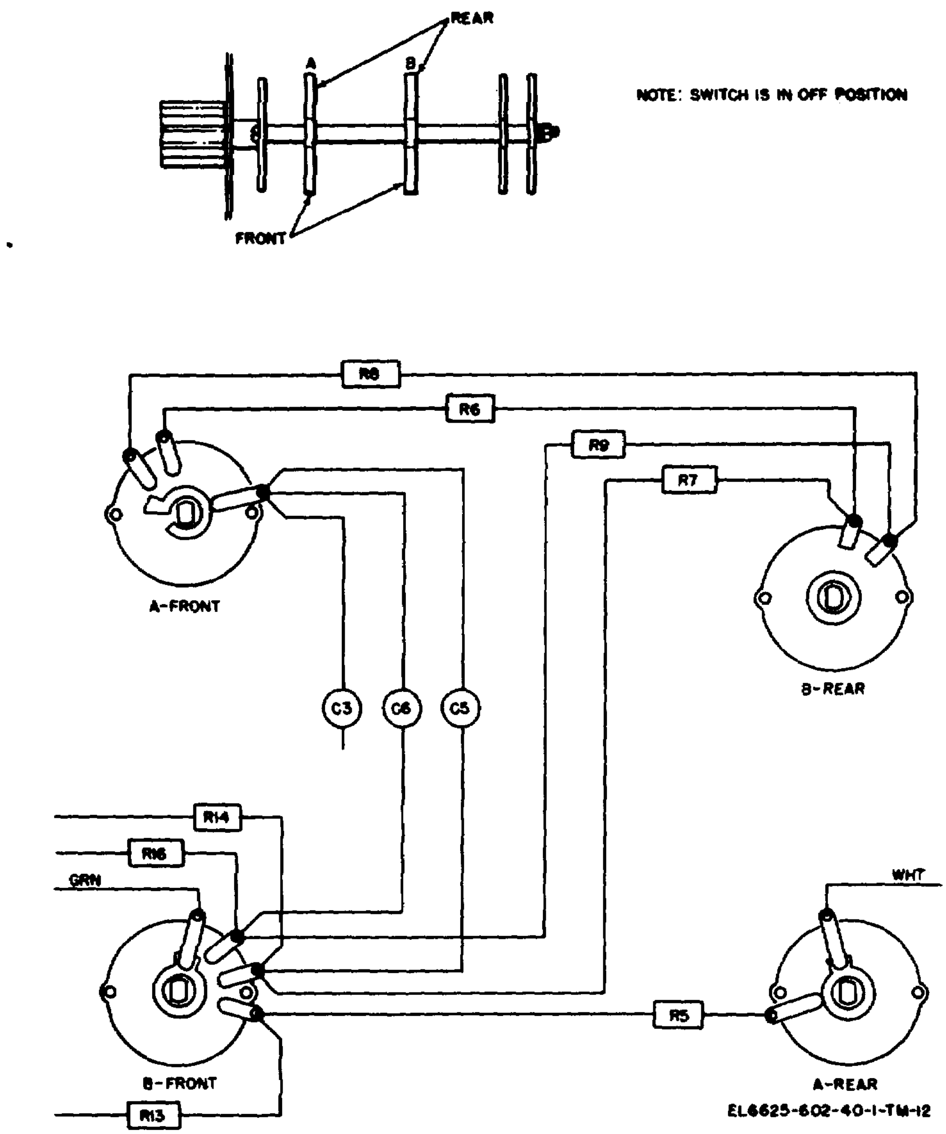


Figure 4-2. Generator, Signal SG-543B/U RANGE switch wiring diagram.

(4) Remove the nuts that hold the transformer to the chassis, and remove the transformer.

b. installation of New Transformer.

(1) Install the replacement transformer and the nuts that hold the transformer.

(2) Solder the leads to the replacement transformer as shown in c below.

NOTE

Replace the DB control rear mounting bracket screw if T2 has been replaced.

(3) Replace the side, bottom, and top panels and replace the attenuator in the carrying case.

c. Attenuator Transformer Wiring chart.

(1) Transformer T2.

Pin 1 . ... Red.
Pin 2 .... Black (two).
Pin 3 .... White, black, and red.
Pin 4 .... White, black, and orange.
Pin 5 .... White, black, and yellow.
Pin 6 .... Blue.
Pin 7 .... White, black, and green.

Pin 8 .... White, black, and blue.
Pin 9 .... White. black, and violet.

(2) Transformer T2.

Pin 1 .... Orange.
Pin 2 .... Black.
Pin 3 .... White, brown, and red.
Pin 4 .... White, brown, and orange.
Pin 5 .... White, brown, and yellow.
Pin 6; .... Violet.
Pin .... White, brown, and green.
Pin 8 .... White, brown, and blue.
Pin 9 .... 'White brown, and violet.
Pin 10 .... None.

(3) Transformer T3.

Pin 1 .... Brown.
Pin 2 .... Black (two).
Pin 3 .... White, black, and red.
Pin 4 .... White, black, and orange.
Pin 5 .... White, black, and yellow.
Pin 6 .... .Gray.
Pin 7 .... White, black and green.

Pin 8 .... White, black, and blue.
Pin 9 .... White, black, and violet.

(4) Transformer T4.

Pin 1 .... Yellow.
Pin 2 .... Black.
Pin 3 .... White, brown, and red.
Pin 4 .... White, brown, and orange.
Pin 5 .... White, brown, and yellow.
Pin 6 .... White.
Pin 7 .... White, brown, and green.
Pin 8 .... White, brown, and blue.
Pin 9 .... White, brown, and violet.
Pin 10 .... None.

4-7. Attenuator, Impedance Matching CN-947B/USM-181 FREQ Switch S9 Replacement
(fig. 8-4 and 4-8)

a. Removal of Old Switch.

(1) Remove the attenuator from the carrying case.

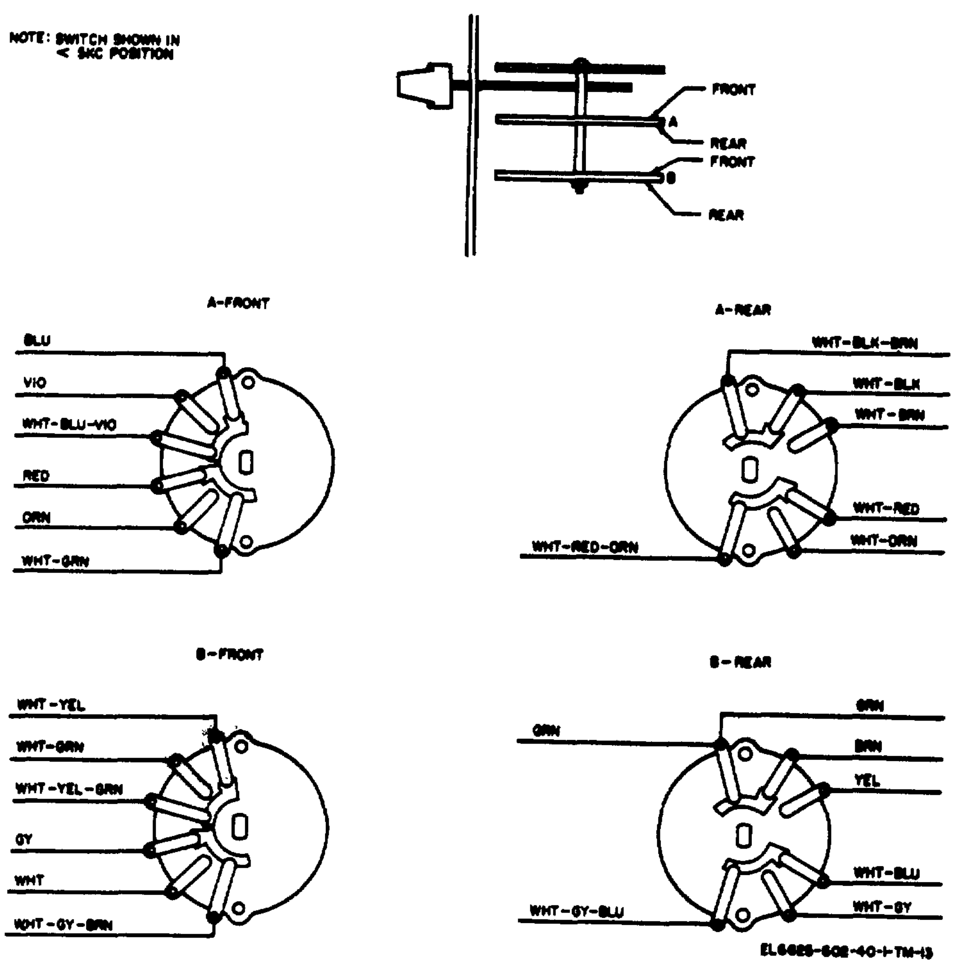


Figure 4-3. Attenuator, Impedance Matching CN-947B/USM-181 FREQ switch wiring diagram.

(2) Remove the top, bottom, and side panels.

(3) Remove all knobs and terminals from the front panel, to free the front panel from the switch mounting plate.

(4) Remove the top and bottom support posts and slightly spread the side frames; remove the front panel and switch mounting plate.

(5) Remove the hardware (screws or blind rivets) that hold the switch to the mounting plate.

(6) Unsolder the leads and remove the switch.

b. Installation of New Switch.

(1) Solder the leads to the replacement switch as shown in figure 4-3.

(2) Fasten the switch to the mounting plate with threaded hardware.

(3) Replace the front panel, switch mounting plate and support posts.

(4) Replace the knobs and terminals on the front panel.

(5) Replace the top, bottom, and side panels.

(6) Replace the attenuator in the carrying case.

4-8. Attenuator, Impedance Matching CN-947B/USM-181 OUTPUT IMPEDANCE Switch Replacement
(figs. 3-4 and 4-4)

a. Removal of Old Switch.

(1) Remove the attenuator from the carrying case.

(2) Remove the top, bottom, and side panels.

(3) Remove all knobs and terminals from the front panel.

(4) Remove the top and bottom support posts and slightly spread the side frames; remove the front panel and switch mounting plate.

(5) Remove the hardware holding the switch to the mounting plate.

(6) Unsolder the leads and remove the switch.

b. Installation of New, Sititch.

(1) Solder the leads to the replacement switch as shown in figure 4-4.

(2) Fasten the switch to the mounting plate with threaded hardware.

(3) Replace the front panel, switch mounting plate and support posts.

(4) Replace the knobs and terminals on the front panel.

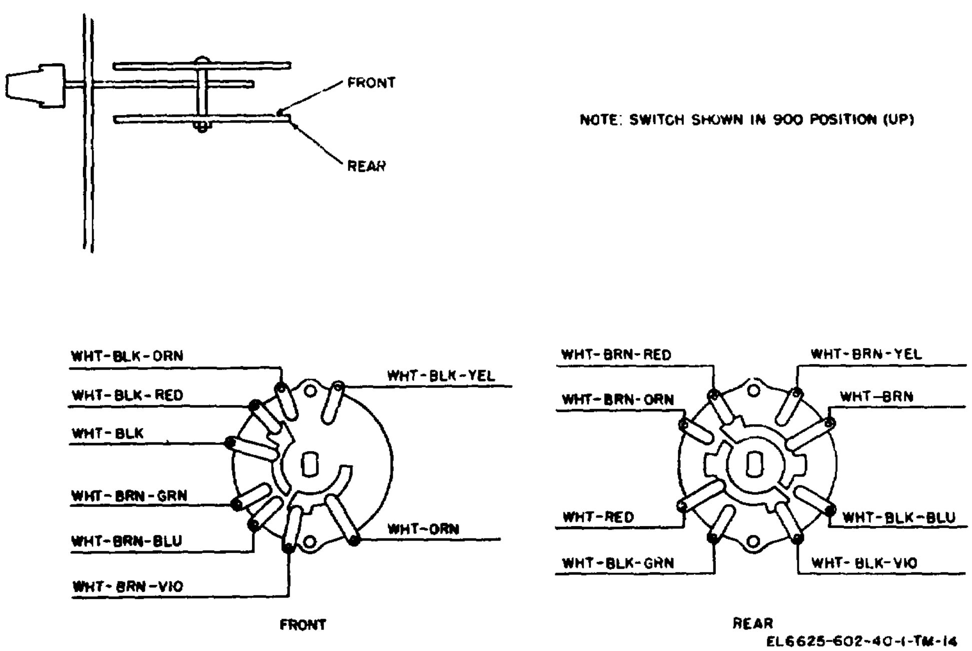


Figure 4-4. Attenuator, Impedance Matching CN-947B/ USM-181 OUTPUT IMPEDI1NCE switch wiring diagram.

(5) Replace the top, bottom, and side panels.

(6) Replace the attenuator in the carrying case.

4-9. Attenuator, Impedance Matching 947B/USM-181 INPUT IMPEDANCE Switch Replacement (figs. 3-4 and 4-5).

a. Removal of Old Switch.

(1) Remove the attenuator from the carrying case.

(2) Remove the top, bottom, and side panels.

(3) Remove all knobs and terminals from the front panel.

(4) Remove the top and bottom support posts and slightly spread the side frames; remove the front panel and switch mounting plate.

(5) Remove the hardware holding the switch to the mounting plate.

(6) Unsolder the leads and remove the switch.

b. Installation of New Switch.

(1) Solder the leads to the replacement switch as shown in figure 4-5.

(2) Fasten the switch to the mounting plate with threaded hardware.

(3) Replace the front panel, switch mounting plate and support posts.

(4) Replace the knobs and terminals on the front panel.

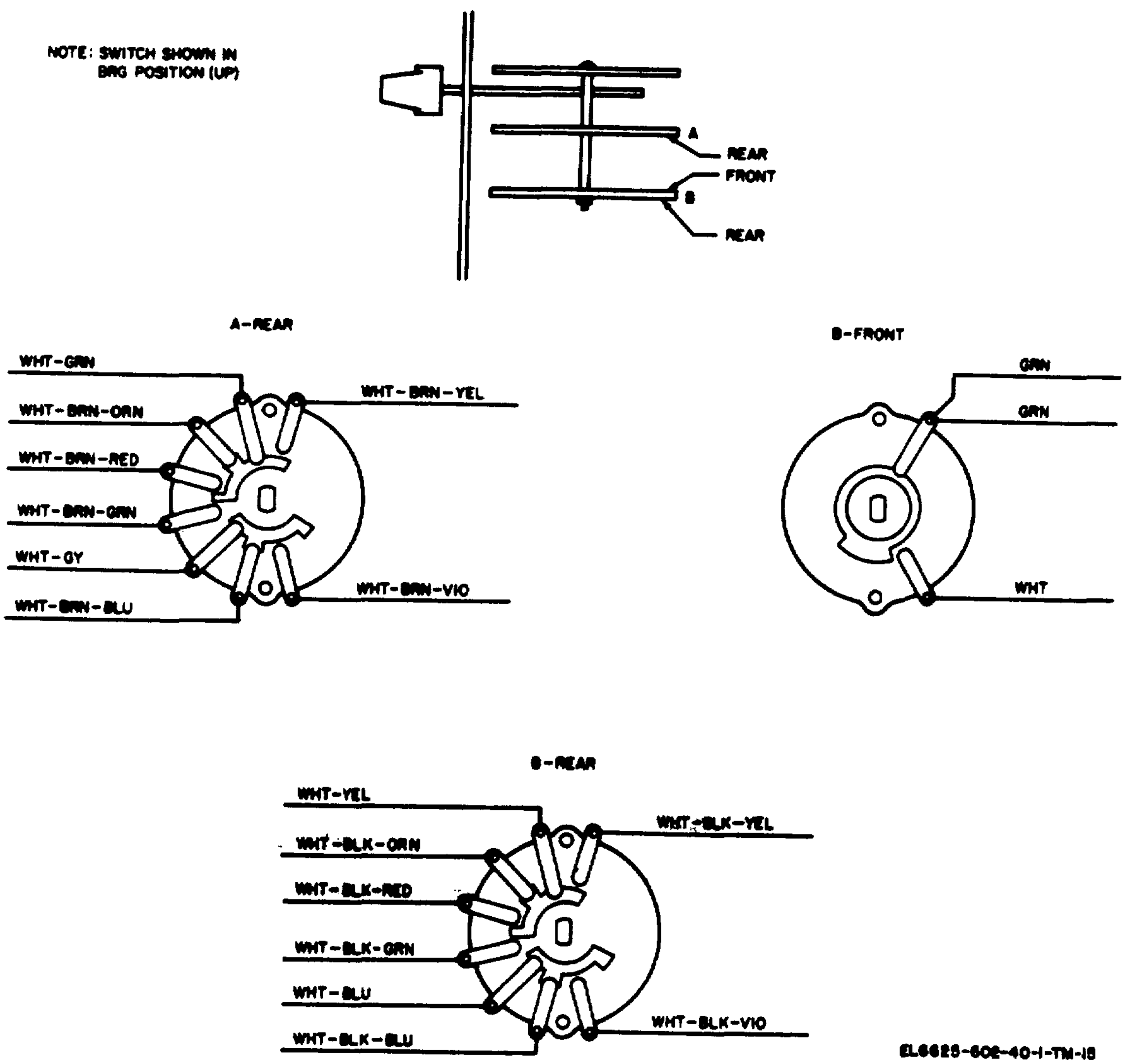


Figure 4-5. Attenuator, Impedance Matching CN-947B/USM-181 INPUT IMPEDANCE switch wiring diagram.

(5) Replaced the top, bottom, and side panels.

(6) Replace the attenuator in the carrying case.

4-10. Attenuator, Impedance Matching CN-947B/USM-181 DB Control Replacement (figs. 3-4)

a. Removal of Old Control.

(1) Remove the attenuator from the carrying case.

(2) Remove the bottom and the left side panel.

(3) Remove the knobs from the front panel.

(4) Remove the nut and washer from the control shaft.

(5) Remove the screw that holds the rear mounting bracket.

(6) Unsolder the white/green lead from the FREQ switch.

(7) Unsolder the leads to the OSC terminal and remove the nylon cable clamp holding the OSC leads.

(8) Remove the DB control from the chassis.

b. Installation of New Control.

(1) Install the DB control and resolder the leads to the OSC terminals and the white/green lead to the FREQ switch.

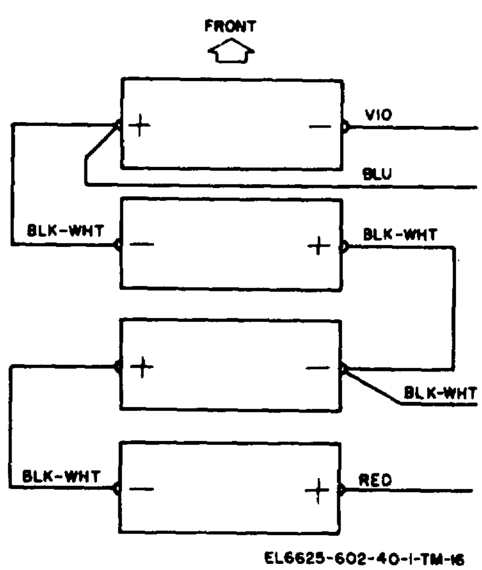


Figure 4-6. Voltmeter, Electronic ME-260B/U battery wiring diagram.

(2) Replace the nylon cable clamp to hold the OSC leads to the OSC terminals.

(3) Replace the rear mounting bracket.

(4) Replace the nut and washer on the control shaft.

(5) Replace the knobs or. the front panel controls.

(6) Make the attenuator frequency response, attenuator accuracy, insertion loss and balance tests (para 5-7 through 5-12).

(7) Replace top, bottom and side panels.

(8) Replace the attenuator in the carrying case.

4-11. Voltmeter, Electronic ME--260B/U Battery Replacement (fig. 4-6).

a. Removal of Old Batteries.

(1) Remove the voltmeter from the carrying case.

(2) Remove the top and side panels.

(3) Remove the fuse.

(4) Remove the four screws and star washers that mount the amplifier PC board to the frame and remove the PC board.

(5) Remove the battery retainer screws and remove the battery retainer.

(6) Unsolder the battery leads and remove the batteries.

CAUTION

Be careful when soldering the new leads to the new batteries. Do not allow the batteries to become heated.

b. Installation of New Batteries.

(1) Install the batteries.

(2) Replace the battery retainer and screws.; replace the amplifier PC board, star washers and mounting screws.

(3) Solder the leads to the new batteries as shown in figure 4-6.

(4) Replace the fuse.

(5) Replace the top and side panels.

(6) Replace the voltmeter in the carrying case.

4-12. Voltmeter, Electronic ME-260B/U FUNCTION Switch Replacement (figs. 3-5 and 4-7)

a. Removal of Old Switch.

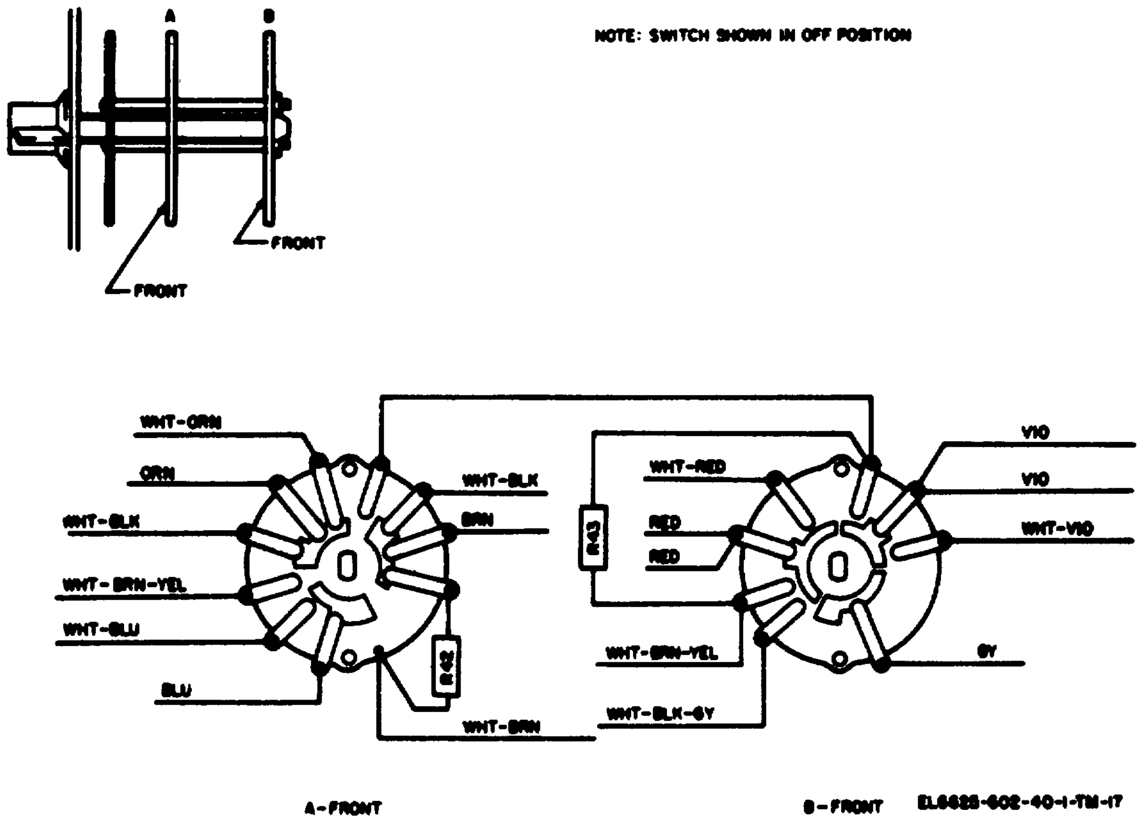


Figure 4-7. Voltmeter, Electronic ME-260B/U FUNCTION switching wiring diagram.

(1) Remove the voltmeter from the carrying case.

(2) Remove the top, bottom, and side panels.

(3) Remove the FUNCTION knob.

(4) Loosen the three screws holding the printed-circuit board behind the FUNCTION switch and slide out the printed-circuit board from the voltmeter as far as the attached leads permit.

(5) Remove the nut and washer that hold the switch in the assembly.

(6) Pull the switch to the rear to free the shaft from the front panel.

(7) Pull the switch to the side and unsolder the leads. Remove the switch.

b. installation of New Switch.

(1) Solder the leads to the replacement switch as shown in figure 4-7.

(2) Replace the switch shaft in the chassis.

(3) Replace the nut and washer on the switch shaft and tighten the switch to the chassis.

(4) Replace the circuit board and FUNCTION knob.

(5) Replace the top, bottom, and side panels.

(6) Replace the voltmeter in the carrying case.

4-13. Voltmeter, Electronic ME-260B/U, RANGE Switch Replacement (figs. 3-5 and 4-8)

a. Removal of Old Switch.

(1) Remove the voltmeter from the carrying case.

(2) Align the RANGE switch dial with the .1 position.

(3) Remove the top, bottom, and side panels and the attenuator shield.

(4) Use an Allen wrench to loosen the front and rear setscrews on the sleeve between the front panel and switch.

(5) Pull the knob shaft out of the front of the unit.

(6) Remove the nut and washer on the switch shaft. Pull the switch to the side and unsolder the leads. Remove the switch assembly.

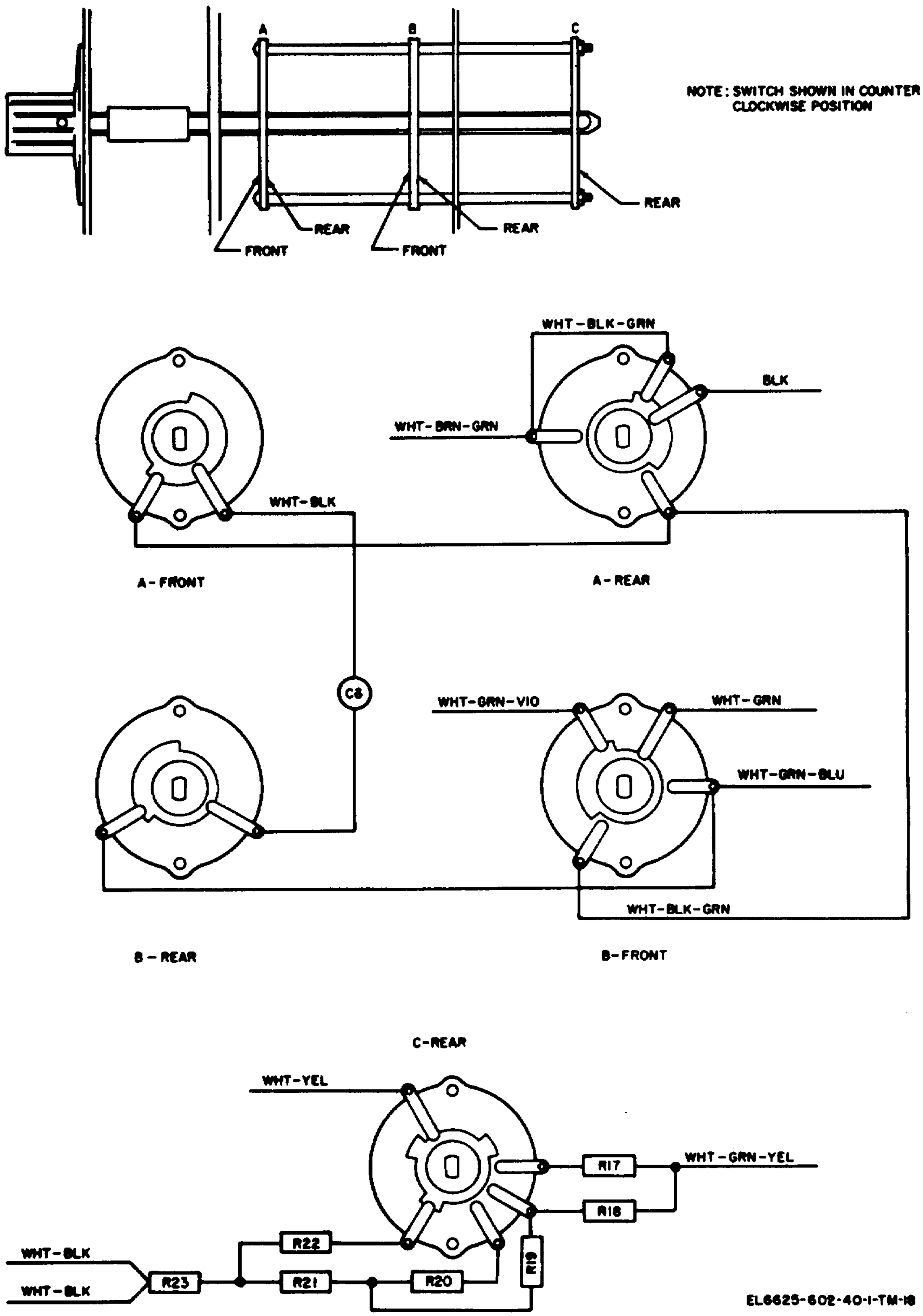


Figure 4-8. Voltmeter, Electronic ME-260B/U RANGE switch wiring diagram.

b. Installation of New Switch.

(1) Install the switch in the chassis. Solder the leads to the switch as shown in figure 4-8.

(2) Replace the nut and washer on the switch shaft (do not tighten). Replace and tighten the sleeve to the switch shaft.

(3) Replace and tighten the knob shaft to the sleeve. Align the RANGE switch dial with the .1 position and tighten the nut on the switch shaft.

(4) Make the tracking calibration, frequency response calibration, and 30-volt response calibration, and 30-volt response calibration of the voltmeter (para 4-24, 4-25, and 4-26).

(5) Replace the attenuator shield and the top, bottom, and side panels.

(6) Replace the voltmeter in the carrying case.

4-14. Voltmeter, Electronic ME-260B/U, Meter MI Replacement (fig. 3-5)

a. Removal of Meter M1.

(1) Remove the voltmeter from the carrying case.

(2) Remove the top, bottom, and side panels.

(3) Remove all knobs from the front panel.

(4) Remove the five front screws on both side frames.

(5) Spread the front of the side frame and pull the front panel out just far enough to allow removal of the meter.

(6) Unsolder the leads from the rear of the meter.

b. Installation of Meter M1.

(1) Solder the leads to the rear of the meter (orange to positive and brown to negative).

(2) Insert the meter and replace the five front screws on the side frames.

(3) Replace the knobs on the front panel.

(4) Replace the top, bottom, and side panels.

(5) Replace the voltmeter in the carrying case.

(6) Adjust the voltmeter pointer (para 4-15).

4-15. Voltmeter, Electronic ME-260B/U, Pointer Adjustment

After the voltmeter has been repaired, adjust the pointer to maintain meter accuracy as follows:

a. Set the FUNCTION switch to OFF.

b. Rotate the adjusting screw (below the meter) clockwise until the pointer is below zero. Continue clockwise rotation until the pointer is exactly on zero.

c. If the pointer passes zero, repeat b above.

d. Rotate the adjusting screw counterclockwise approximately 156 to disconnect the adjusting screw from the meter movement.

e. If the pointer moves off zero, repeat b, c, and d above.

Section II. ALIGNMENT

4-16. Characteristics of Test Equipment Required for Alignment

The equipment required for alignment of Test Set, Telephone AN/USM-181B is indicated in *a* through *j* below.

a. Voltmeter ME-30A/U (or Equal). An ac voltmeter with a frequency range of 10 Hz to 4 MHz, voltage range of 1 millivolt (mv) to 5 volts, accuracy of ±2 percent, and a scale readable to ±0.2 db.

b. Multimeter ME-26B/U (or Equal). A dc voltmeter that can measure positive and negative voltages from 100 mv to 15 volts. It has an input impedance of at least 10 megohms, and sensitivity of 1-volt full scale minimum. Circuit ground must be isolated from power line ground.

c. Frequency Meter AN/USM-26 (or Equal). A frequency meter with a range of 5 Hz to 1.2 MHz, and an accuracy of ±0.03 percent.

d. Voltmeter, Electronic ME-207/U (or Equal). An ac voltmeter with a frequency range of 5 Hz to 600 KHz, voltage range of 1 mv to 5 volts, and accuracy of ±1 percent.

e. Spectrum Analyzer TS-723A/U (or Equal). A spectrum analyzer that will measure distortion to -40 db at 1 KHz.

f. Meter Test Set TS-682A/GSM-1 (or Equal). A voltmeter calibration equipment with output voltage of 0.001 to 300 volts, and accuracy of ±0.25 percent.

g. Oscillator, Hewlett-Packard Model No. 200 CD (or Equal). A general purpose oscillator with a frequency range of 5 Hz to 600 KHz output of 20 volts into an open circuit, and distortion of 0.5 percent below 500 KHz.

h. Clip-On Dc Milliammeter, Hewlett-Packard Model No. 428A (or Equal). A dc milliammeter with a clip-on probe and a current range of 3 milliamperes (ma) to 1 ampere, accuracy of ±3 percent.

i. 600 Ohm Resistor, I Watt (Noninductive).

4-17. Generator, Signal SG-543B/U Bias Calibration

a. Before making any of the following adjustments, use the multimeter to check the power supply voltages at test points TP2 and TP3 (fig. 3-1). They should indicate +12 volts and -12 volts respectively. If the voltages are off more than ±2 volts troubleshoot the power supply before making any adjustments. Use a dc voltmeter too for the bias calibration.

b. Adjust the bias as follows:

(1) Set the RANGE switch to X1K position and the frequency dial to 1.

(2) Remove the signal generator from the carrying case and remove side panel.

(3) Connect the multimeter to test point TP4 (fig. 3-1).

(4) Adjust the BIAS control (fig. 3-1) for 0 volt indication on the multimeter.

(5) Replace side panel and replace signal generator in the carrying case.

4-18. Generator, Signal SG-543B/U AGC Calibration

a. The AGC adjustments is for adjusting the proper negative feedback voltage to obtain a stable output signal level.

b. Adjust the AGC as follows:

(1) Set the RANGE switch to X1K position and the frequency dial to 1.

(2) Remove the signal generator from the carrying case and remove side panel.

(3) Connect the multimeter to test point TP1 (fig. 3-1).

(4) Adjust the AGC control (fig. 3-1) for -2.0 volts indication on the multimeter.

(5) Replace side panel and replace signal generator in the carrying case.

4-19. Generator, Signal SG-543B/U, AGC and Frequency Calibration

a. Frequency calibration adjustments should be performed, if necessary, only after repairs are made to frequency-sensitive components. Make this adjustment after performing the adjustment in paragraph 4-18. Use a frequency meter and a dc voltmeter for this test.

b. Adjust the AGC and frequency control as follows:

(1) Remove the signal generator from its carrying case and remove side panel.

(2) Connect the frequency meter to the signal generator output terminals(600Ω) and connect the multimeter to test point TP-1 (fig. 3-1).

(3) Set the RANGE switch to X1K and the dial to 10.

(4) Adjust the AGC and FREQ CAL controls (fig. 3-1) for 10 KHz indication on frequency meter and -2.0 volt indication on the multimeter.

NOTE

The AGC and FREQ CAL controls are interacting controls. Make one half the apparent needed correction in each adjustment. Several adjustments will be necessary.

(5) Repeat paragraph 4-18 and (1) through (4) above if the voltage at 1 KHz has changed from 2.0 volts.

(6) With the RANGE switch set on X1K, adjust the dial for 10 KHz ±10 Hz indication on the frequency meter.

(7) Without moving the dial, check the frequency on the X5 through X10K ranges and record the error in percent (of setting).

(8) Calculate the average (in percent) of the most positive and the most negative error and multiply the result times 10 KHz.

(9) Readjust the AGC and FREQ CAL controls for the following readings on the X1K range:

Frequency .... 10 KHz minus average which is greater than that calculated in step (8) ±10 Hz.
AGC .... -2 volts ±0.1 V.
Example ref steps (8) and (9)
X5 .... +5%

X10 .... +1%
X100 .... -1%
X1K 0
X10K............................... +2%
Most positive error
Moat negative error
Average error (+5%) + (-1%)
2%· X10KHz = 200 Hz
10 KHz - 200 Hz - 9800 Hz
Adjust frequency for 9800 Hs
+10 Hs

(10) Replace the side panel and replace the signal generator in the carrying case.

4-20. Generator, Signal SO-543B/U High Frequency Calibration

a. The high frequency adjustment is an adjustment for the X100K range. Use a frequency meter to perform this adjustment.

b. Adjust the high frequency as follows:

(1) Remove the signal generator from its carrying case.

(2) Connect the frequency meter to the signal generator output.

(3) Set the RANGE switch to X100K and the dial to 10.

(4) Adjust the HI FREQ CAL control for an indication of 1 MHz on the frequency meter.

(5) Replace the signal generator in the carrying case.

4-21. Generator, Signal SG-543B/U Distortion Adjustment

a. The distortion adjustment adjusts the negative feedback voltage to minimize the distortion of the output waveform. Use Spectrum Analyzer TS-728A/U (or equivalent) for this test.

b. Adjust for minimum distortion as follows:

(1) Remove the signal generator from the carrying case.

(2) Connect the spectrum analyzer across the signal generator output terminals. (600n).

(8) Set the RANGE switch to X1K and dial to 10.

(4) Set the spectrum analyzer FUNCTION to SET LEVEL, MODE to MANUAL, and FREQUENCY RANGE to XIK.

(6) Set the spectrum analyzer dial and balance controls for minimum (O DB) indication.

(6) Set the spectrum analyzer MODE to AUTOMATIC and adjust the DIST control (fig. 3-1) for a meter indication of greater than 60 db down from 0 db reference.

(7) Replace the signal generator in the carrying case.

4-22. Voltmeter, Electronic ME-260B/U, Battery-Charging Rate Calibration

The battery-charging rate is set at the factory and will not normally need readjustment. When the ME-260B/U is used in the field, a fast-charging rate is necessary. When the ME-260B/U is used for bench work, a slow-charging rate is used to prolong battery life.

a. Hold the FUNCTION switch on BATT. TEST and observe the indication on the meter. If the voltage is below 2.4 volts on the 0-3 range, recharge the batteries.

NOTE

To charge the voltmeter batteries connect the voltmeter to an ac source and turn the FUNCTION switch to ON.

b. Remove the voltmeter from the carrying case.

c. Connect the voltmeter power cord to the ac power source.

d. Set the FUNCTION switch to ON and allow a 2-minute warmup.

e. Clip the dc milliammeter probe to the violet battery lead (fig. 4-7).

f. Adjust R89 (fig. 3-7) for a 6.2-ma indication on the dc milliammeter.

g. Remove the dc milliammeter probe and replace the voltmeter in the carrying case.

NOTE

If the indication is in a negative direction, reverse the clip-on probe. Resistor R39 may be adjusted for a charging rate of 11-ma indication on the milliammeter (fast charge) when the equipment is used primarily in the field, where an ac charging source is not readily available. When the equipment is used primarily for bench work and connected to an ac source, do not adjust R39 for the fast charge rate. If the equipment is adjusted for the fast charge, attach a tag to the front of the equipment stating that the equipment is adjusted for fast charge, and the prolonged charging will shorten the battery life.

4-23. Voltmeter, Electronic ME-260B/U, BATT. TEST Indication Calibration

a. The calibration is made when the voltmeter fails to give an accurate indication of the battery condition. Use Multimeter ME-26B/U (or equivalent) for this adjustment.

b. Calibrate the BATT. TEST circuit as follows:

(1) Remove the voltmeter from the carrying case.

(2) Hold the FUNCTION switch at BATT. TEST.

CAUTION The ME-26B/U must be isolated from the chassis of the voltmeter being tested.

(3) Connect the negative lead of the ME26B/U to the violet wire on the batteries. Connect the positive lead to the red wire on the batteries (fig. 4-7).

(4) Adjust R45 (fig. 3-7) until the voltmeter meter being tested indicates exactly 1/10 of the value indicated on the ME-26B/U.

NOTE

If the ME26B/U does not indicate a minimum of 24 volts, recharge the batteries of the voltmeter being tested by connecting the power cord to an ac source.

(5) Release the FUNCTION switch, remove the ME-26B/U and replace the voltmeter in the carrying case.

4-24. Voltmeter, Electronic ME-260B/U, Tracking Calibration

a. These adjustments are made when the meter indication fails to go full-scale. Use Meter Test Set TS-682A/GSM-1 (or equivalent) for this test. Disconnect the voltmeter under test from the ac source.

b. Adjust the tracking calibration as follows:

(1) Remove the voltmeter from the carrying ease.

(2) Set the RANGE VOLTS DB switch to .001 on the voltmeter.

(3) Connect the center- voltmeter INPUT jack to the TS-682A/GSM-1 COMMON jack.

(4) Turn the TS-682A/GSM-1 AC VOLTS COARSE CONTROL and the AC VOLTS FINE CONTROL fully counterclockwise.

(5) Connect the voltmeter left-hand INPUT jack to the TS-682A/GSM-1 AC VOLTS 1V jack.

(6) Set the TS-682A/GSM-1 left-hand, center, and the right-hand selector switches to ALL OTHER AC and DC SCALES, AC VOLTS, and DC VOLTS, respectively.

(7) Adjust the TS-682A/GSM-1 AC VOLTS COARSE and AC VOLTS FINE CONTROLS until the left-hand meter indicates .001 volt.

(8) Set voltmeter FUNCTION switch to ON (fig. 3-5).

(9) Adjust R29 (fig. 3-5) for a full-scale voltmeter indication.

(10) Set the voltmeter RANGE VOLTS DB switch to .1.

(11) Adjust the TS-682A/GSM-1 AC VOLTS COARSE CONTROL and AC VOLTS FINE CONTROL until the left-hand meter indicates .1 volt.

(12) Adjust R3 (fig. 3-5) for a full-scale voltmeter indication.

(13) Set the voltmeter RANGE VOLTS DB switch to the 30-volt position.

(14) Connect the voltmeter left-hand INPUT jack to the TS-682A/GSM-1 AC VOLTS 50V jack.

(15) Adjust the TS-682A/GSM-1 AC VOLTS COARSE CONTROL and AC VOLTS FINE CONTROL until the left-hand meter indicates 30 volts.

(16) Adjust R4 (fig. 3-5) for a full-scale voltmeter indication.

(17) Disconnect the equipment and replace the voltmeter in the carrying case.

4-25. Voltmeter, Electronic ME-260b/U, High-Frequency Response Calibration
(figs. 3-5 and 3-6)

a. The following adjustments are made when the ME-260B/U has poor high-frequency response. Resistor R33 in the amplifier section and capacitor C2 in the first section of the cascade attenuator are adjusted for a fiat frequency response. Use Voltmeter, electronic ME-207/U and a general purpose oscillator (Hewlett-Packard Model No. 200CDR) or equivalents for these adjustments.

b. Adjust resistor R33 and capacitor C2 for flat frequency response as follows:

(1) Remove the voltmeter from the carrying case.

(2) Connect the oscillator to an ME-207/U and to the ME-260B/U (fig. 4-9).

(3) Set the oscillator RANGE switch to X10 and the frequency to 400 cps.

(4) Adjust the oscillator AMPLITUDE control until the ME-207/U indicates .001 volt.

(6) Set the voltmeter RANGE VOLTS DB switch to .001 volt.

(6) Adjust the oscillator AMPLITUDE control until the voltmeter indicates .9 of full-scale.

(7) Note and record the indication on the ME-207/U.

(8) Set the oscillator RANGE switch to X10K and the frequency to 300 kc.

(9) Readjust the oscillator AMPLITUDE control until the ME-207/U indication is the same as that recorded in (7) above.

(10) Adjust R33 (fig. 3-5) until the voltmeter indicates exactly 9 mv.

(11) Rotate the oscillator frequency dial from 50 kc to 600 kc.

(12) The voltmeter indication must remain steady at 9 mv, within .02 mv (2 percent).

NOTE

If the voltmeter indication does not remain steady at 9 mv, within .02 mv, repeat the voltmeter tracking calibration (para 4-24).

(13) Set the voltmeter RANGE VOLTS DB switch to .1 volt.

(14) Set the oscillator RANGE switch to X10K and the frequency to 300 kc.

(15) Adjust the oscillator AMPLITUDE control until the voltmeter indicates 90 mv.

(16) Rotate the oscillator frequency dial from 50 kc to 600 kc.

(17) Adjust C2 (fig. 3-6) for a steady 90mv indication, within 2 percent, on the voltmeter as the oscillator frequency dial is rotated from 50 kc to 600 kc.

(18) Disconnect the equipment and replace the voltmeter in the carrying case.

4-26. Voltmeter, Electronic ME-260B/U, 30-Volt Response Calibration

a. This adjustment is made when the 30-volt range becomes inaccurate. Use oscillator (Hewlett-Packard Model No. 200 CD) and Voltmeter, Electronic ME-207/U for this adjustment.

b. Perform the 30-volt response calibration as follows:

(1) Remove the voltmeter from the carrying case.

(2) Set the RANGE switch on the voltmeter to the 30-volt range.

(8) Set the oscillator for a 400 cps output.

(4) Connect the oscillator to the ME-207/U and to the voltmeter (fig. 4-10).

(5) Adjust the oscillator amplitude control until the voltmeter meter indicates 20 volts. Note the indication on the ME-207/U (reference level).

(6) Adjust the oscillator output to 300 kc.

(7) Adjust the oscillator amplitude until the ME-207/U indicates the reference level obtained in (5) above.

(8) Adjust C8 (fig. 3-6) until the voltmeter meter indicates 20 volts.

(9) Remove the oscillator and the ME-207/U and replace the voltmeter in the carrying case.

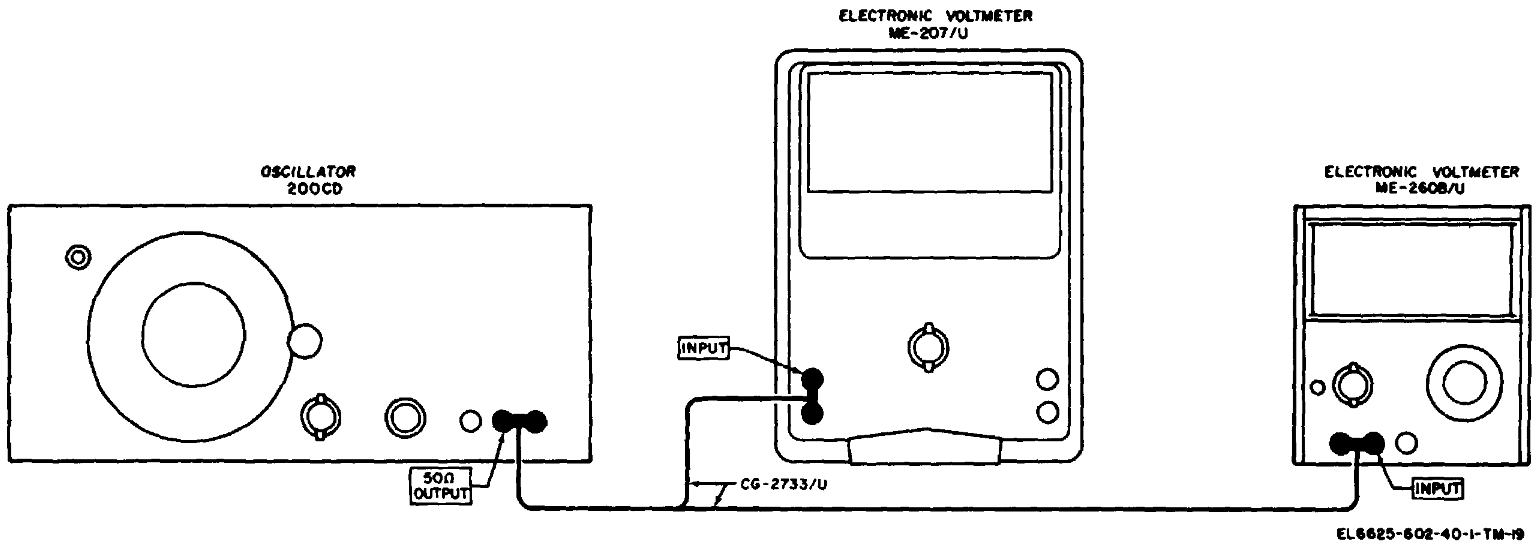


Figure 4-9. Voltmeter, Electronic ME-260B/U high frequency response calibration connections

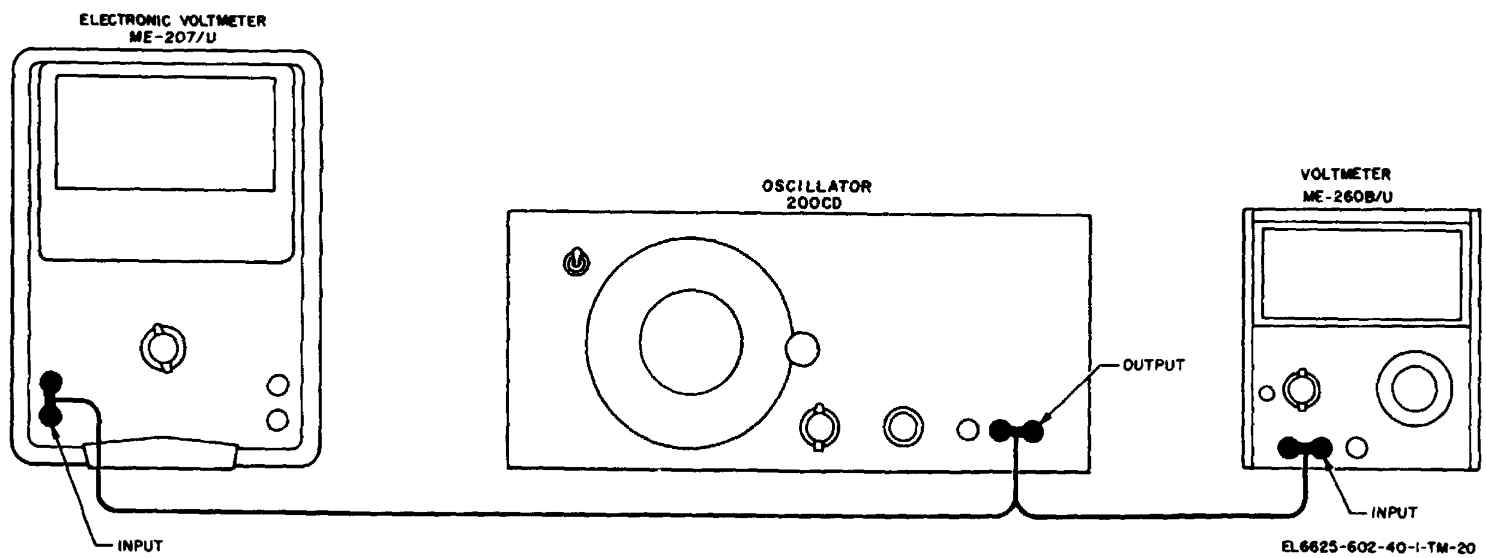


Figure 4-10. Voltmeter, Electronic ME-26OB/U 30-volt response calibration connections

CHAPTER 5
GENERAL SUPPORT TESTING PROCEDURES

5-1. General

a. Testing procedures are prepared for use by Electronics Field Maintenance Shops and Electronics Service Organizations responsible for general support maintenance of electronics equipment to determine the acceptability of repaired equipment. These procedures set forth specific requirements that repaired equipment must meet before it is returned to the using organization. These procedures may also be used as a guide for testing equipment that has been repaired at the direct support level if the proper tools and test equipment are available.

b. Comply with the instructions preceding each chart before proceeding to the chart. Perform each step in sequence. Do not vary the sequence. For each step, perform all the actions required in the Control settings columns; then perform each specific test procedure and verify it against its performance standard.

5-2. Test Equipment, Tools, and Materials

All test equipment, materials, and other equipment required to perform the testing procedure given in this section are listed in the following chart.

a. Test Equipment.

Nomenclature	*Technical manual*
Voltmeter, Meter ME-30E/U	TM 11-6625-320-12.
Frequency Meter AN/USM-26	TM 11-6625-212-15.
General purpose oscillator (Hewlett-Packard Model No. 200 CD).	TM 11-6625-1537-165.
Multimeter ME-26B/U	TM 11-6625-200-15.
Spectrum Analyzer TS-723A/U	TM 11-5097.
Test Set, Meter TS-682A/GSM-1	TM 11-2535B.
Voltmeter, Electronic ME-207/U (Hewlett-Packard Model 400H).	TM 11-6625-1514-15.

b. Materials. In addition to the equipment listed in a above, the following materials are required:

(1) 67.5-ohm resistor ± 1 percent, 1 watt (2 required matched to within ±0.1 percent).

(2) 150-ohm resistor ±5 percent, 1 watt (3 required matched to within ±0.1 percent).

(3) 300-ohm resistor ±1 percent, 1 watt (2 required matched to within ±0.1 percent).

(4) 450-ohm resistor ±1 percent, 1 watt (2 required matched to within ±0.1 percent).

(5) 600-ohm resistor ±1 percent, 1 watt.

(6) 100K precision ohm shielded load.

(7) 200K-ohm resistor ± 1 percent, 1 watt.

5-3. Physical Tests and Inspections

a. Test Equipment and Materials. Electronic Light Assembly MX-1292/PAQ.

b. Test Connections and Conditions. No connections necessary.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	None	Controls may be in any position.	a. Inspect case and chassis for damage, missing parts, and condition of paint. **NOTE** **Touch-up painting is recommended in lieu or refinishing whenever practical. Screwheads, binding posts, receptacles, and other plated parts must not be painted or polished with abrasives.**	a. No damage evident or parts missing. External surfaces intended to be painted must not show bare metal. Panel lettering must be legible.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
		b. Inspect all controls and mechanical assemblies for loose or missing screws, bolts, and nuts. c. Inspect all connectors, sockets, receptacles, fuse holders, and meter for looseness, damage, or missing parts.	b. Screws, bolts and nuts must be tight; none missing. c. No loose, damaged or missing parts.	
2	None	Controls may be in any position.	a. Rotate all panel controls throughout their limits of travel. b. Operate all switches	a. Controls must rotate freely without binding or excesive looseness. b. Switches must operate properly.

5-4. Generator, Signal SG-543B/U Dial Accuracy Test

a. Test Equipment and Materials. Frequency meter AN/USM-26; or equivalent; 600 ohm resistor, ±1 percent.

b. Test Connections and Conditions. Connect equipment as shown in figure 5-1.

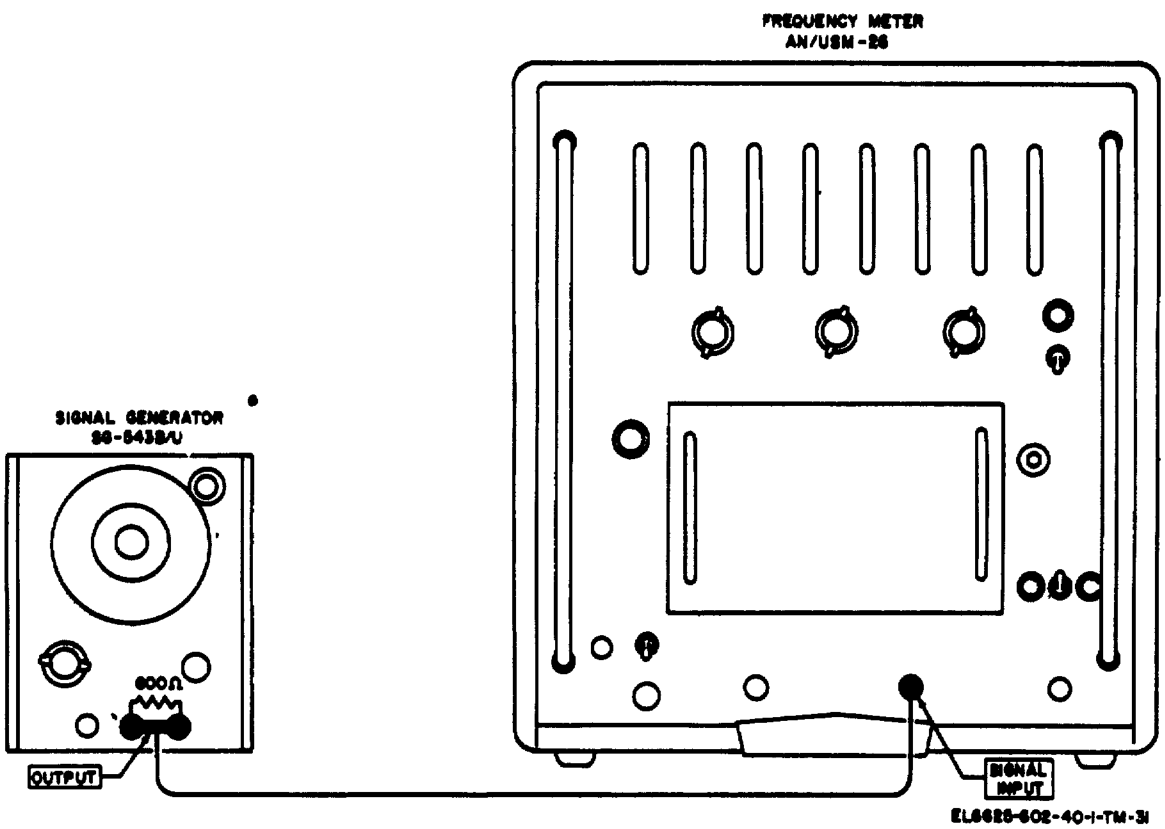


Figure 5-1. Generator, Signal SG-543B/U dial accuracy test.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	*AN/USM-26* FUNCTION SELECTOR: PERIOD TIME UNIT: MILLISEC DISPLAY TIME: Maximum Counter-clockwise.	RANGE: X5 FREQ: 1 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 200 MS ±6.
2	*AN/USM-26* FUNCTION SELECTOR: FREQUENCY FREQUENCY UNIT: 10	RANGE: X5 FREQ: 6 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 30 Hz ±0.9 Hz.
3	*AN/USM-26* FREQUENCY UNIT: 10	RANGE: X5 FREQ: 12 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 60 Hz ±1.8 Hz.
4	*AN/USM-26* FREQUENCY UNIT: 10	RANGE: X10 FREQ: 1 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 10 Hz ±0.3 Hz.
5	*AN/USM-26* FREQUENCY UNIT: 10	RANGE: X10 FREQ: 6 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 60 Hz :±1.8 Hz.
6	*AN/USM-26* FREQUENCY UNIT: 10	RANGE: X10 FREQ: 12 AMPLITUDE: MAX	Observe frequency meter -	AN/USM-26 must indicate 120 Hz ±3.6 Hz.
7	*AN/USM-26* FREQUENCY UNIT: 1	RANGE: X100 FREQ: 1 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 100 Hz ±3.0 Hz.
8	*AN/USM-26* FREQUENCY UNIT: 1	RANGE: X100 FREQ: 6 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 600 Hz ±18 Hz.
9	*AN/USM-26* FREQUENCY UNIT: 1	RANGE: X100 FREQ: 12 AMPLITUDE: MAX	Observe frequency meter.	AN/USM-26 must indicate 1.2 KHz ±36 Hz.
10	*AN/USM-26* FREQUENCY UNIT: 1	RANGE: X1K FREQ: 1 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 1 KHz ±-30 Hz.
11	*AN/USM-26* FREQUENCY UNIT: 1	RANGE: X1K FREQ: 6 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 6 KHz ±180 Hz.
12	*AN/USM-26* FREQUENCY UNIT:	RANGE: X1K FREQ: 12 AMPLITUDE: MAX	Observe frequency meter .	AN/USM-26 must indicate 12 KHz ±360 Hz.
13	*AN/USM-26* FREQUENCY UNIT: .1	RANGE: X10K FREQ: 1 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 10 KHz ±300 Hz.
14	*AN/USM-26* FREQUENCY UNIT: .1	RANGE: X10K FREQ: 6 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 60 KHz ±1.8 KHz.
15	*AN/USM-26* FREQUENCY UNIT: .1	RANGE: X10K FREQ: 12 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 120 KHz ±3.6 KHz.
16	*AN/USM-26* FREQUENCY UNIT: .1	RANGE: X100K FREQ: 1 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 100 KHz ±3 KHz.
17	*AN/USM-26* FREQUENCY UNIT: .1	RANGE: X100K FREQ: 6 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 600 KHz ± 18 KHz.
18	*AN/USM-26* FREQUENCY UNIT: .1	RANGE: X100K FREQ: 12 AMPLITUDE: MAX	Observe frequency meter	AN/USM-26 must indicate 1.2 MHz +36 KHz.

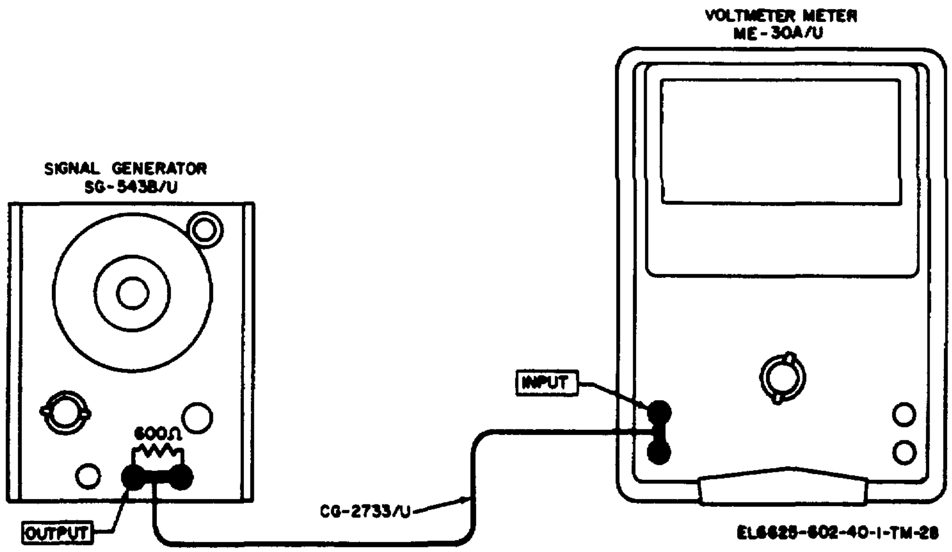


Figure 5-2. Generator, Signal SG-543B/U output control test.

5-5. Generator, Signal SG-543B/U Output Control Test

a. Test Equipment and Material. Voltmeter, ME-SOA/U.

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-3.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	*ME-30A/U* Range switch to +30 db.	RANGE: X100 DIAL: 10 AMPLITUDE: MAX	Note the ME-30A/U indication on the db scale. Adjust the signal generator output to minimum. Note the ME-80A/U indication.	ME-30A/U must Indicate greater than 80 db below the level noted with the output at maximum.

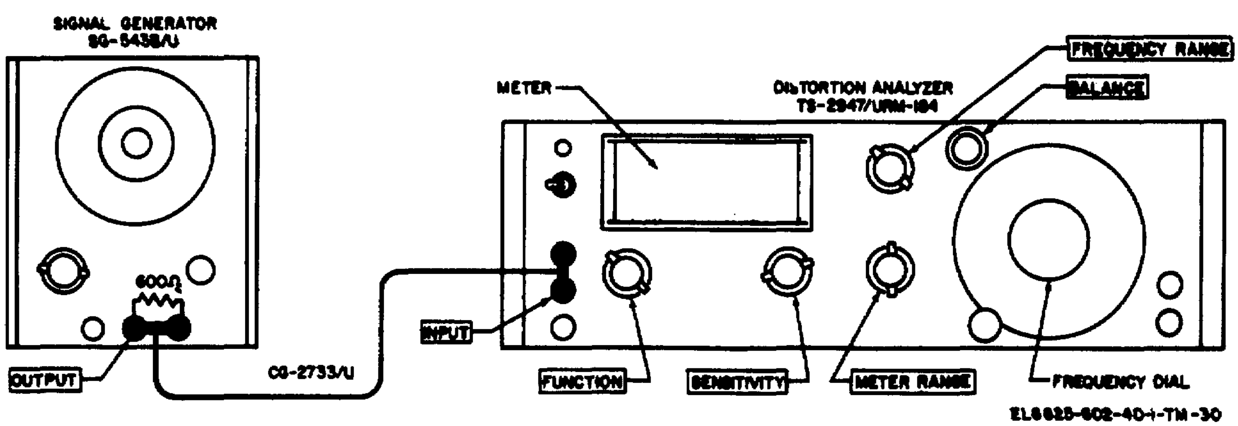


Figure 5-3. Generator, Signal SG-543B/U distortion test.

5-6. Generator, Signal SG-543B/U Distortion Test

a. Test Equipment arid Materials. Distortion Analyzer TS-2947/URM-184 or equivalent; 600 ohm resistor, ±1 percent.

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-3.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	*TS-2947/URM-184* RANGE: X100 DIAL 10 METER RANGE: 0 db FUNCTION: SET LEVEL SENSITIVITY: MIN MODE: MANUAL	RANGE: X100 DIAL: 10 AMPLITUDE: MAX NORM/LOW DIST: NORM	On TS-2947/URM-184: Increase the SENSITIVITY to obtain a 0 db indication on meter. Set the FUNCTION switch to DISTORTION and adjust the dial and BALANCE controls for a null indication on the meter. Set the MODE switch to AUTOMATIC for minimum meter indication.	Meter on TS-2947/URM must indicate greater than 60 db down from the 0 db reference.
2	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X5 DIAL: 1	Perform procedure as indicated in 1.	Meter on TS-2947/URM must Indicate greater than 40 db down in NORM and greater than 44 db down in LOW DIST. from the 0 db reference.
3	SENSITIVITY. No not adjust. Return all other controls as indicated in step 1.	RANGE: X5 DIAL: 2	Perform procedure as indicated in 1.	Meter on TS-2947/URMmust Indicate greater than 40 db down in NORM and greater than 50 db down in LOW DIST. from the 10 db reference.
4	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X10 DIAL: 3	Perform procedure as indicated in 1.	Meter on TS-2947/URM must indicate greater than 44 db down in NORM and greater than 60 db down in LOW DIST. from the 0 db reference.
5	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X10 DIAL: 10	Perform procedure as indicated in 1.	Meter on TS-2947/URM must indicate greater than 54 db down in NORM and greater than 60 db down in LOW DIST. from the 0 db reference.
6	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X100 DIAL: 1	Perform procedure as indicated in 1.	Meter on TS-2947/URM must Indicate greater than 60 db down from the 0 db reference.
7	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X100 DIAL: 10	Perform procedure as indicated in 1.	Meter on TS-2947/URM must indicate greater than 60 db down from the 0 db reference.
8	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X1K DIAL: 1	Perform procedure as indicated in 1.	Meter on TS-2947/URM must Indicate greater than 60 db down from the 0 db reference.
9	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X1K DIAL: 10	Perform procedure as indicated in 1.	Meter on TS-2947/URM must Indicate greater than 60 db down from the 0 db reference.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
10	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X10K DIAL: 1	Perform procedure as indicated in 1.	Meter on TS-2947;URM must Indicate greater than 60 db down from the 0 db reference.
11	SENSITIVITY. Do not adjust. Return all other controls as indicated in step 1.	RANGE: X10K DIAL: 10 reference.	Perform procedure as indicated in 1.	Meter on TS-2947 'URM must Indicate greater than 60 db down from the 0 db
12	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X100K DIAL: 1	Perform procedure as indicated in 1.	Meter on TS-2947 URM must Indicate greater than 60 db down from the 0 db reference.
13	SENSITIVITY: Do not adjust. Return all other controls as indicated in step 1.	RANGE: X100K DIAL: 6	Perform procedure as indicated in 1.	Meter on TS-2947/URM must indicate greater than 45 db down from the 0 db reference.

5-7. Attenuator, Impedance Matching CN-947B/USM-181 Frequency Response Test

a. Test Equipment and Material. Voltmeter, Electronic ME-207/U; Voltmeter ME-30A/U; Oscillator U (Hewlett-Packard No. 200CD).

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-4.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	*200 CD* Frequency control to 1 kc. *ME-30A/U* Range switch to +10 db.	INPUT IMPEDANCE: 600 OUTPUT IMPEDANCE: 600 MEAS-CAL: CAL FREQ: <5 KC DB: 0	A. Adjust oscillator amplitude control until ME-30A/U indicates exactly +10 db. b. Record indication on ME-207 U for a reference level.	a. None. b. None.
2	200 CD Frequency control to 50 cps.	Leave controls in positions indicated in step 1.	Adjust oscillator amplitude control until ME-207/U indicated- exactly the reference level established in step 1.	ME-30A/U must indicate + 10 db ±1.
3	200 CD Frequency control to 500 cps.	Leave controls in positions indicated in step 1.	Adjust oscillator amplitude control until ME-207/U indicates exactly the reference level.	ME-30A/U must indicate +10 db ±1.
4	200 CD Frequency control to 5 kc.	a. Leave controls in positions indicated in step 1 except, b. FREQ: >5 KC	Adjust oscillator amplitude control until ME-207/U indicates exactly the reference level.	ME-30A/U must indicate +10 db ±1.
5	200 CD Frequency control to 50 kc.	Leave controls in positions indicated in step 4.	Adjust oscillator amplitude control until ME-207,U indicates exactly the reference level.	ME-30A/U must indicate +10 db ±1.
6	200 CD Frequency control to 560 kc.	Leave controls in positions indicated in step 4.	Adjust oscillator amplitude control until ME-207/U indicates exactly the reference level.	ME-30A/U must indicate +10 db ±1.

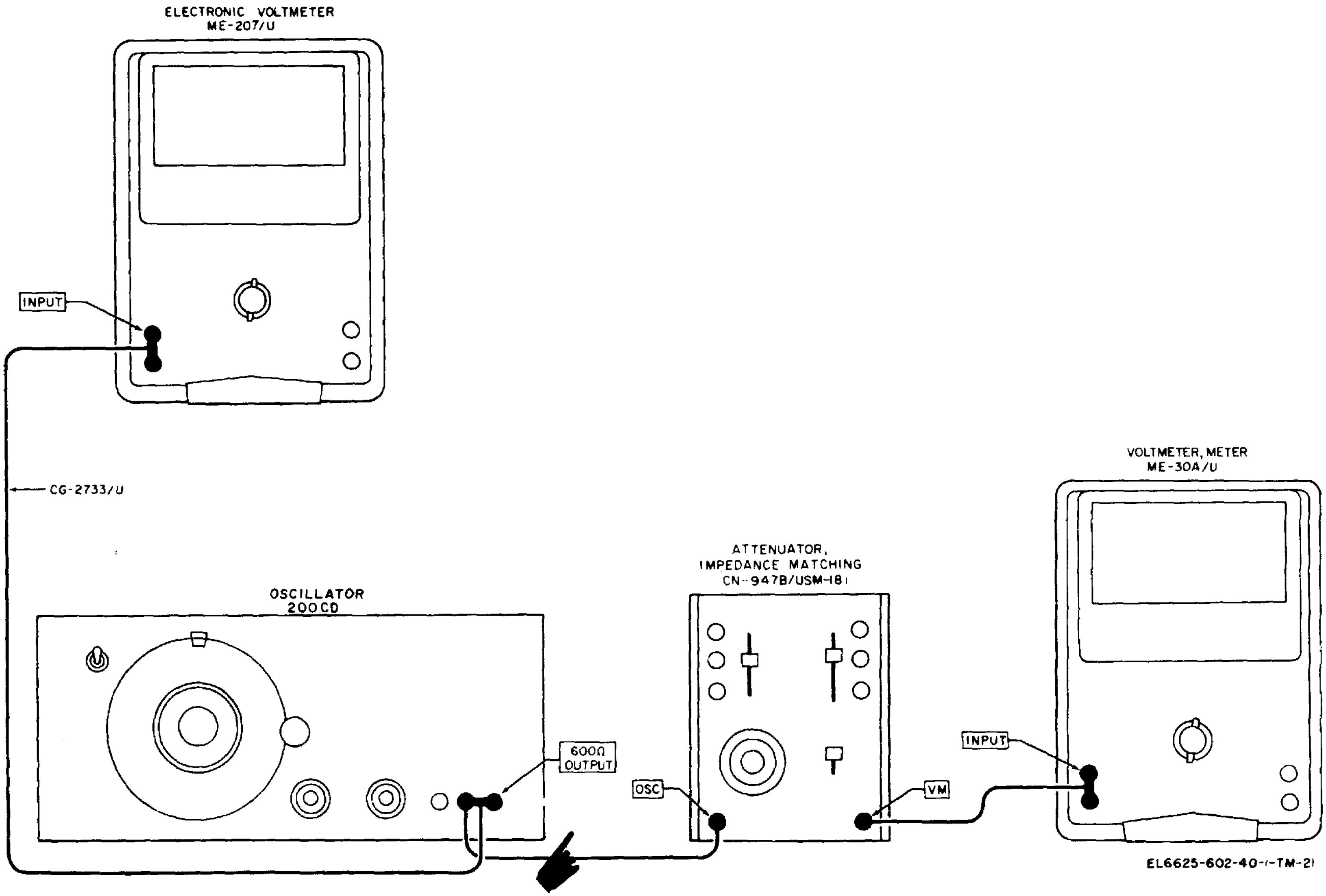


Figure 5-4. Attenuator, Impedance Matching CN-947B/USM-181 frequency response and attenuator accuracy tests.

5-8. Attenuator, Impedance Matching CN-947B/USM-181 Attenuator Accuracy Test

a. Test Equipment and Materials. Voltmeter, Electronic ME-207/U; Voltmeter ME-30A/U; Oscillator (Hewlett-Packard No. 200 CD).

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-4.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	200 CD Frequency control to 5 cps. *ME-30A/U* Range switch to +10 db.	INPUT IMPEDANCE: 600 OUTPUT IMPEDANCE: 600 FREQ: <5 KC MEAS-CAL: CAL DB: 0	a. Adjust oscillator amplitude control until ME-30A/U indicates +10 db. b. Record indication on ME-207/U for a reference level.	a. None. b. None.
2	Leave controls in positions indicated in step 1.	Leave controls in positions indicated in step 1.	a. Adjust attenuator DB Control counterclockwise in 1 db steps to 10 db. b. Adjust oscillator amplitude control until ME-207/U indicates the reference level established in step 1 after each adjustment.	a. ME-30A/U must track from +10 db to 0 db within ±0.25 db. b. None.
3	Leave controls in positions indicated in step 1.	Return controls to positions indicated in step 1.	a. Adjust oscillator amplitude control until ME-30A/U indicates +10 db. b. Adjust attenuator DB control counterclockwise in 10 db steps to 70 db. Adjust ME-30A/U range control in 10 db steps in sequence with the attenuator. c. Adjust oscillator amplitude control until ME-207/U indicates the reference level established in step 1 after each adjustment.	a. None. b. ME-30A/U must track from 10 db to -60 db within ±0.5 db. c. None.
4	200 CD Frequency control to 560 kc. *ME-30A/U* Range switch to +10 db.	INPUT IMPEDANCE: 600 OUTPUT IMPEDANCE: 600 FREQ: >5 KC MEAS-CAL: CAL DB: 0	a. Adjust oscillator amplitude control until ME-30A/U indicates +10 db. b. Record indication on ME-207/U for a reference level.	a. None. b. None.
5	Leave controls in positions indicated in step 4.	Leave controls in positions indicated in step 4.	a. Adjust attenuator DB Control counterclockwise in 1 db steps to 10 db. b. Adjust oscillator amplitude control until ME-207/U indicates the reference level established in step 4 after each adjustment.	a. ME-30A/U must track from + 10 db to 0 db within ±0.25 db. b. None.
6	Leave controls in positions indicated in step 4.	Return controls to positions indicated in step 4.	a. Adjust oscillator amplitude control until ME-30A/U indicates +10 db. b. Adjust attenuator DB control counterclockwise in 10 db steps to 70 db. Adjust ME-30A/,U range control in 10 db steps in sequence with the attenuator.	a. None. b. ME-30A/U must track from +10 db to -60 db within ±0.5 db.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
			c. Adjust oscillator amplitude control until ME-207/U indicates the reference level established in step 4 after each adjustment.	

5-9. Attenuator, Impedance Matching CN-947B/USM-181 Output Insertion Loss Test

a. Test Equipment and Material. Voltmeter ME-30A/U; oscillator (Hewlett-Packard Model No. 200 CD); 600-ohm resistor, ±1 percent.

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-5.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	200 CD Frequency control to 1 kc. *ME-30A/U* Range switch to +10 db.	OUTPUT IMPEDANCE: 600 MEAS-CAL: MEAS FREQ: <5 KC DB: 0	Adjust amplitude of oscillator until ME-30A/U indicates +10 db.	None.
2	Leave controls in positions indicated in step 1.	Leave controls in positions indicated in step 1.	a. Disconnect ME-30A/U from OUTPUT of attenuator. b. Connect ME-30A/U across output of the oscillator.	a. None. b. ME-30A/U must indicate +10 db within 3/4 db.

5-10. Attenuator, Impedance Matching CN-947B/USM-181 Input Insertion Loss Test

a. Test Equipment and Material. Voltmeter ME-30A/U; oscillator(Hewlett-Packard Model No. 200 CD); 600 ohm resistor, ±1 percent.

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-6.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	200 CD Frequency control to 1 kc. *ME-30A/U* Range switch to + 10 db.	INPUT IMPEDANCE: 600 MEAS-CAL: MEAS FREQ: <5 KC DB: 0	Adjust amplitude of oscillator until ME-30A/U indicates +10 db.	None.
2	Leave controls in positions indicated in step 1.	Leave controls in positions indicated in step 1.	a. Disconnect ME-30A/U from INPUT terminals of attenuator. b. Connect ME-30A/U across output of the oscillator.	a. None. b. ME-30A/U must indicate + 10 db within 3/4 db.

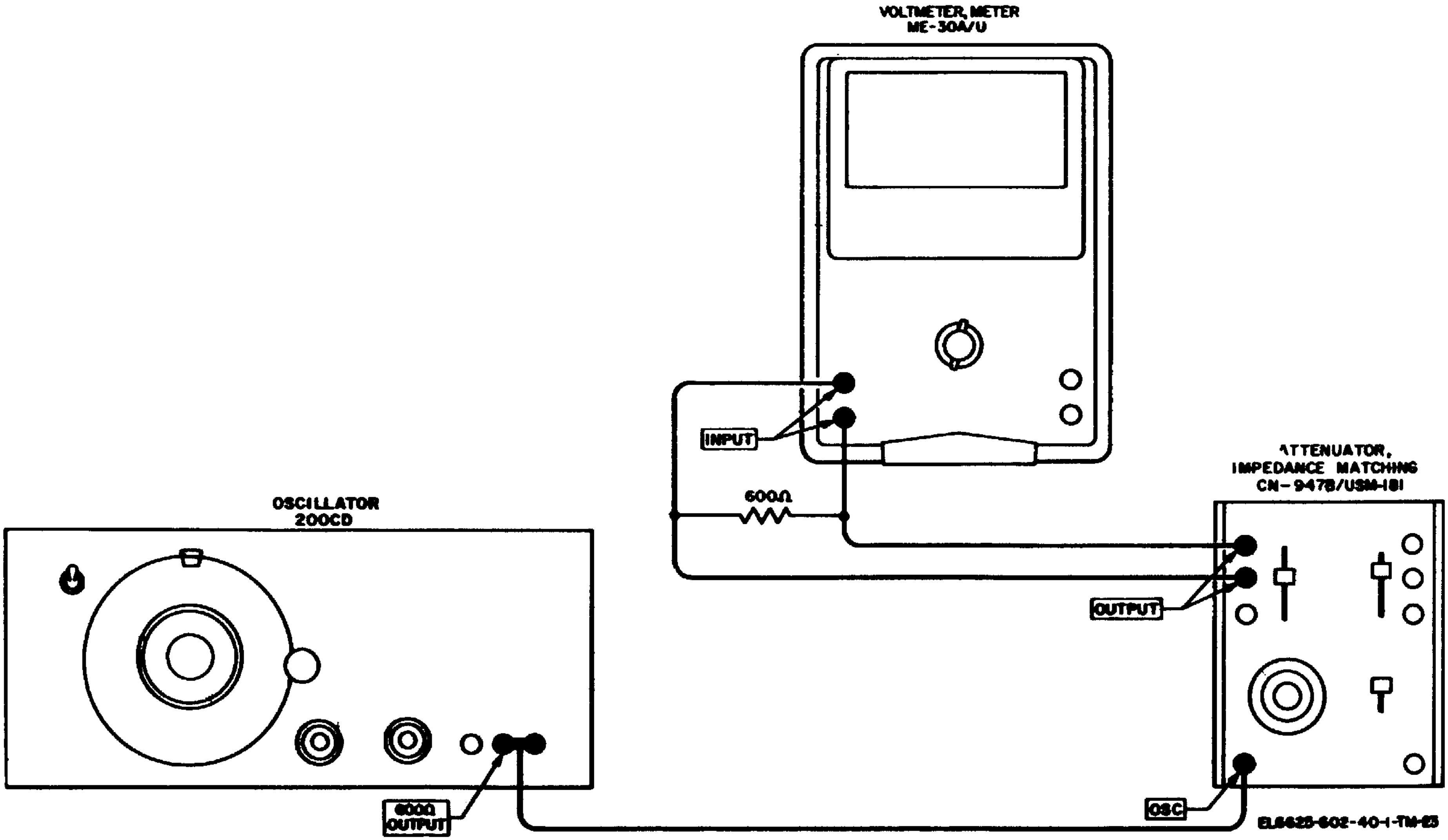


Figure 5-5. Attenuator, Impedance Matching CN-947B/USM-181 output insertion loss test.

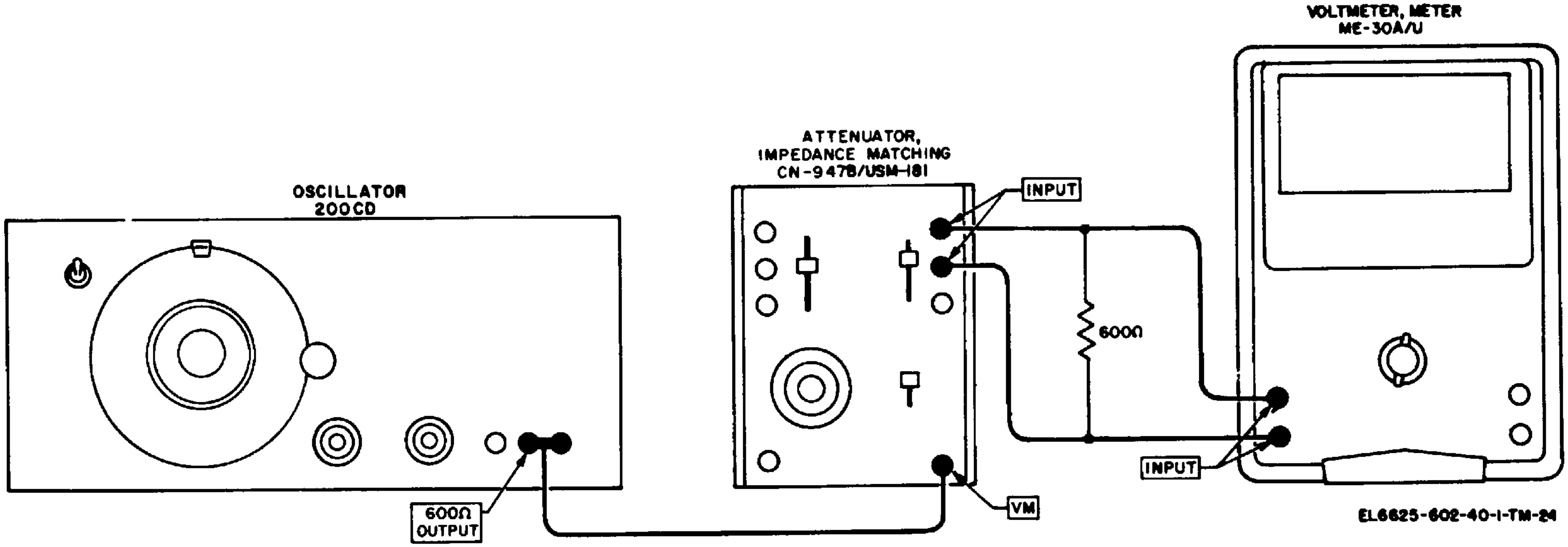


Figure 5-6. Attenuator, Impedance Matching CN-947B/USM-181 input insertion loss test.

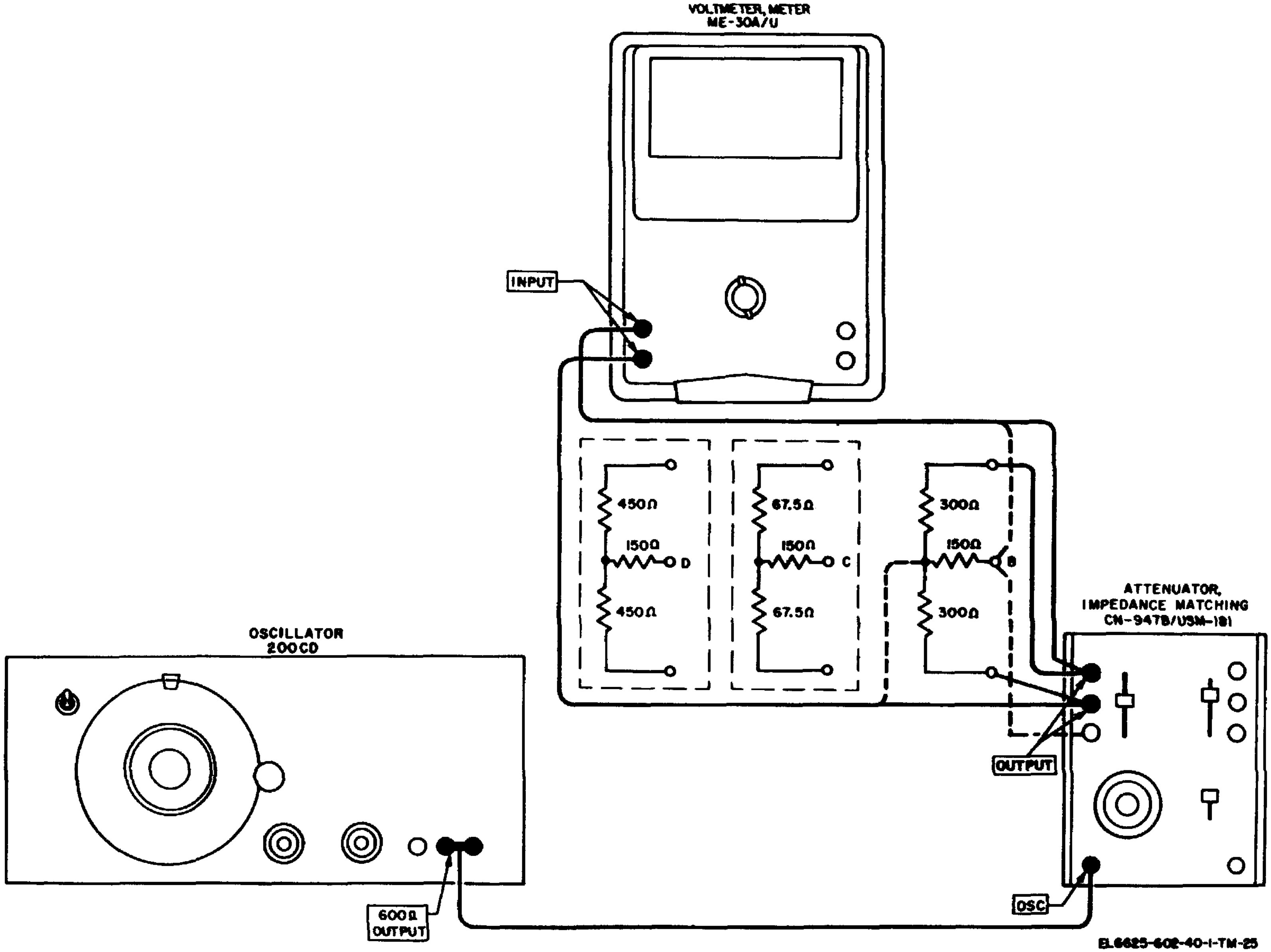


Figure 5-7. Attenuator, Impedance Matching CN-947B/USM-181 output balance test.

5-11. Attenuator, Impedance Matching CN-947B/USM-181 Output Balance Test

a. Test Equipment and Materials. Voltmeter ME-30A/U; oscillator (Hewlett-Packard Model No. 200CD); 67.5 ohm resistor, ±1 percent (2 required); 150 ohm resistor, ±1 percent (3 required); 300 ohm resistor, ± 1 percent (2 required); 450 ohm resistor, ±1 percent (2 required).

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-7.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	200 CD Frequency control to 1 kc. *ME-30A/U7* Range switch to +10 db.	OUTPUT IMPEDANCE: 600 MEAS-CAL: MEAS FREQ: <5 KC DB: 0	Adjust amplitude of oscillator until ME-30A/U indicates +10 db.	None.
2	Leave 200 CD controls in positions indicated in step 1. *ME-30A/U* Range switch to -30 db.	Leave controls in positions indicated in step 1.	a. Disconnect ME-30A/U from OUTPUT terminals of attenuator. b. Connect ME-30A/U across the 150 ohm resistor of the 600 ohm resistive network. Connect point "B" of the resistive network to the OUTPUT CT terminal (black) of the attenuator. c. Disconnect the ME-30/U and the resistors.	a. None. b. ME-30A/U must indicate at least 40 db below +10 db (-30 db). c. None.
3	Leave 200 CD controls in positions indicated in step 1. ME-30A/U Range switch to +10 db.	INPUT IMPEDANCE: 135 MEAS-CAL: MEAS FREQ: <5 KC DB: 0	a. Connect ME-30A/U and the 135 ohm resistive network across the OUTPUT terminals of the attenuator. b. Adjust amplitude of oscillator until ME-30A/U indicates +10 db.	a. None. b. None.
4	Leave 200 CD in positions indicated in step 3. ME-30A/U Range switch to -30 db.	Leave controls in positions indicated in step 3.	a. Disconnect ME-30A/U from OUTPUT terminals of attenuator. b. Connect ME-30A/U across the 150 ohm resistor of the 135 ohm resistive network. Connect point "C" of the resistive network to the OUTPUT CT terminal (black) of the attenuator. c. Disconnect the ME-30/U and the resistors.	a. None. b. ME-30A/U must indicate at least 40 db below +10 db (-30 db). c. None.
5	Leave 200 CD controls in positions indicated in step 1. *ME-30A/U* Range switch to +10 db.	OUTPUT IMPEDANCE: 900 MEAS-CAL: MEAS FREQ: <5 KC	a. Connect ME-30A/U and the 900 ohm resistive network across the OUTPUT terminals of the attenuator. b. Adjust amplitude of oscillator until ME-30A/U indicates +10 db.	a. None. b. None.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
6	Leave 200 CD controls in positions indicated in step 5. *ME-30A/U* Range switch to -30 db.	Leave controls in positions indicated in step 5.	a. Disconnect ME-30A/U from OUTPUT terminals of attenuator. b. Connect ME-30A/U across the 150 ohm resistor of the 900 ohm resistive network. Connect point "D" of the resistive network to the OUTPUT CT terminal (black) of the attenuator. c. Disconnect the ME-30/U and the resistors.	a. None. b. ME-30A/U must indicate at least 40 db below +10 db (-30 db). c. None.

5-12. Attenuator, Impedance Matching CN-947B/USM-181 Input Balance Test

a. Test Equipment and Materials. Voltmeter ME-30A/U; oscillator(Hewlett-Packard Model No. 200 CD); 67.5 ohm resistor, ±1 percent (2 required); 150 ohm resistor, ±1 percent (3 required); 300 ohm resistor, ±1 percent (2 required); 450 ohm resistor, ±1 percent (2 required).

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-8.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	200 CD Frequency control to 1 kc. ME-30A/U Range switch to +10 db.	INPUT IMPEDANCE: 600 MEAS-CAL: MEAS FREQ: <5 KC DB: 0	Adjust amplitude of oscillator until ME-30A/U indicates +10 db.	None.
2	Leave 200 CD controls in positions indicated in step 1. ME-30( )/U Range switch to -30 db.	Leave controls in positions indicated in step 1.	a. Disconnect ME-30A/U from INPUT terminals of attenuator. b. Connect ME-30A/U across the 150 ohm resistor of the 600 ohm resistor network. Connect "B" of the resistor network to the INPUT CT terminal of the attenuator. c. Disconnect the voltmeter and resistors.	a. None. b. ME-30A/U must indicate at least 40 db below +10 db (-30 db). c. None.
3	Leave 200 CD controls in positions indicated in step 1. ME-30A/U Range switch to +10 db.	INPUT IMPEDANCE: 135 MEAS-CAL: MEAS FREQ: <5 KC DB: 0	a. Connect ME-30A/U and the 135 ohm resistor network across the INPUT terminals of the attenuator. b. Adjust amplitude of oscillator until ME-80A/U indicates +10 db.	a. None. b. None.
4	Leave 200 CD controls in positions indicated in step 3. *ME-30A/U* Range switch to -30 db.	Leave controls in positions indicated in step 3.	a. Disconnect ME-30A/U from INPUT terminals of attenuator. b. Connect ME-30A/U across the 150 ohm resistor of the 135 ohm resistor network. Connect "C" of the resistor network to the INPUT CT ter. minal of the attenuator. c. Disconnect the voltmeter and resistors.	a. None. b. ME-30A/U must indicat at least 40 db below +10 db (-30 db). e. None.

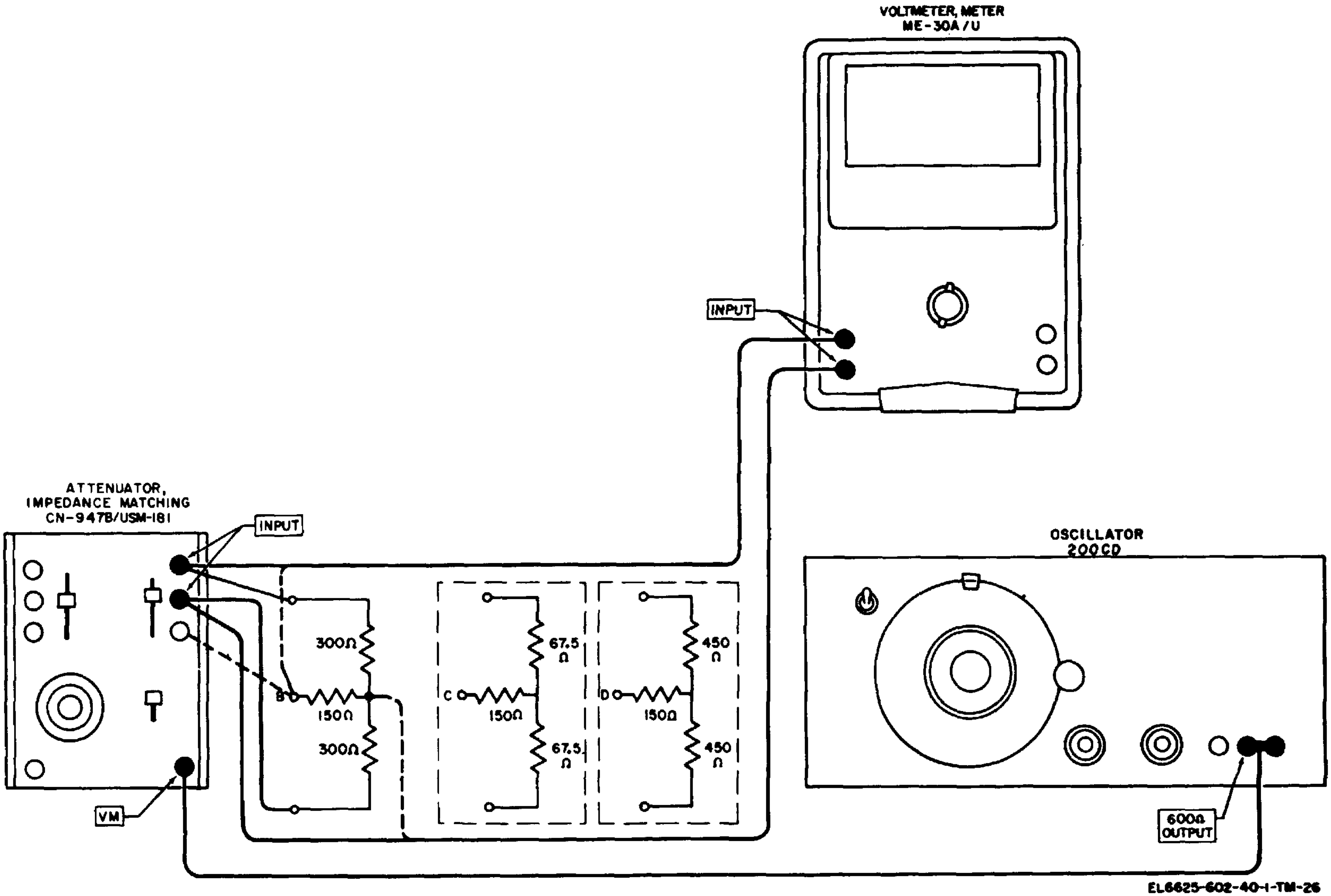


Figure 5-8. Attenuator, Impedance Matching CN-947B/USM-181 input balance test.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
5	Leave 200 CD in positions indicated in step 1. *ME-30A/U* Range switch to +10 db.	INPUT IMPEDANCE: 900 MEAS-CAL: MEAS FREQ: <5 KC DB: 0	a. Connect ME-30A/U and the 900 ohm resistor network across the INPUT terminals of the attenuator. b. Adjust amplitude of oscillator until ME-30A/U indicates + 10 db.	a. None. b. None.
6	Leave 200 CD controls in positions indicated in step 5. ME-30A/U Range switch to -30 db.	Leave controls in positions indicated in step 5.	a. Disconnect ME-30A/U from INPUT terminals of attenuator. b. Connect ME-30A/U across the 150 ohm resistor of the 900 ohm resistor network. Connect "D" of the resistor network to the INPUT CT terminal of the attenuator. c. Disconnect the voltmeter and resistors.	a. None. b. ME-SOA/U must indicate at least 40 db below +10 db (-30 db). c. None.

5-13. Attenuator, Impedance Matching CN-9473/USM-181 Distortion Test

a. Test Equipment and Materials. Voltmeter ME-30A/U; oscillator(Hewlett-Packard Model No. 200 CD); Spectrum analyzer TS-723A/U; 600 ohm resistor, ±1 percent.

b. Test Connections and Conditions. Connect the attenuator to the 200 CD and ME-30A/U only as shown in figure 5-9.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	200 CD Frequency control to 1 kc. ME-30A/U Range switch to +10 db.	OUTPUT IMPEDANCE: 600 MEAS-CAL: MEAS FREQ: <5 KC DB: 0	a. Connect 600 ohm resistor and TS-723A/U as shown in figure 5-9. b. Adjust amplitude of oscillator until ME-30A/U indicates + 10 db.	a. None. b. None.
2	TS-723A/U RANGE switch to X100. Adjust FREQUENCY controls to 10 on tuning dial. Meter range switch to 100%.	Same as 1	Turn INPUT sensitivity control of TS-723A/U clockwise until meter indicates full scale of exactly 1.	None.
3	TS-723A/U Function switch to DISTORTION.	Same as 1 above	a. Adjust coarse FREQUENCY control of TS-723A/U until meter pointer drops sharply. b. Adjust fine FREQUENCY control of TS-723A/U for maximum dip of meter pointer. c. As adjustment progresses decrease setting of TS-723A/U meter range switch to maintain upscale meter indication. d. Adjust BALANCE control of TS-723A/U for a minimum meter reading.	a. None. b. None. c. None. d. TS-723A/U must indicate less than 1%.

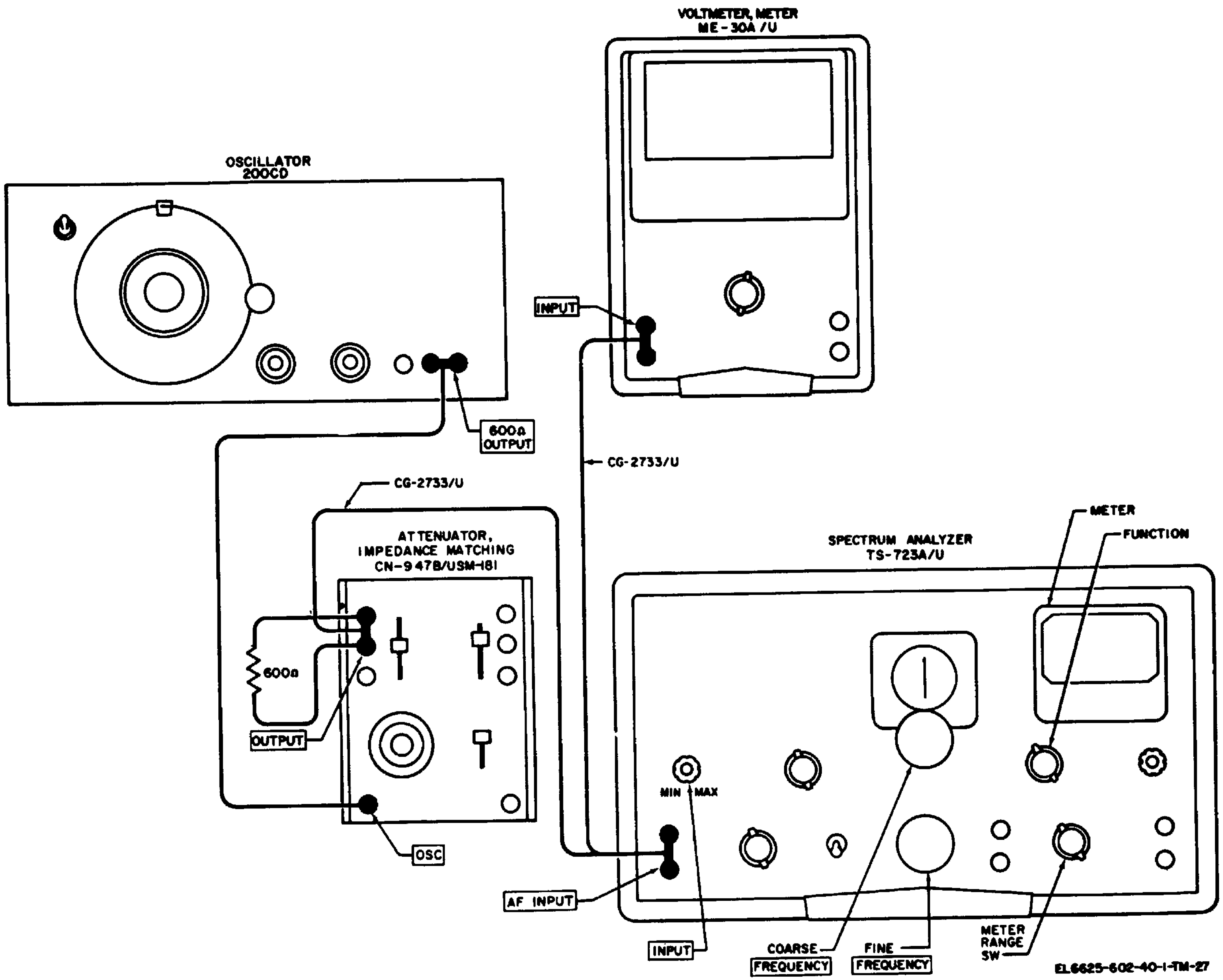


Figure 5-9. Attenuator, Impedance Matching CN-947B/USM-181 distortion test.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
4	*200 CD* Frequency control to 50 cps.	Same as 1 above	Adjust amplitude of oscillator until ME-30A/U indicates +10 db.	None.
5	*TS-723A/U* Range switch to X1. Adjust FREQUENCY controls to 50 on tuning dial. Meter range switch to 100w.	Same as 1 above	Turn INPUT sensitivity control of TS-723A/U clockwise until meter indicates full scale of exactly 1.	None.
6	*TS-723A/U* Function switch to DIS-	Same as 1 above	a. Adjust coarse FREQUENCY CONTROL of TORTION. pointer drops sharply. b. Adjust fine FREQUENCY control of TS-723A/U for maximum dip of meter pointer. c. As adjustment progresses decrease the setting of TS-723A/U meter range switch to maintain upscale meter indication. d. Adjust BALANCE control of TS-723A/U for a minimum meter reading.	a. None. TS-723A/U until meter b. None. e. None. d. TS-723A/U must indicate less than 1%.

5-14. Attenuator, Impedance Matching CN-947B/USM-181 Input-Output Isolation Test

a. Test Equipment and Material. Voltmeter ME-30A/U; oscillator(Hewlett-Packard Model No. 200 CD);

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-10.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	200 CD Frequency control to 560 kc. *ME-30A/U* Range switch to + 10 db.	INPUT IMPEDANCE: 600 OUTPUT IMPEDANCE: 600 MEAS-CAL: CAL FREQ: >5 KC DB: 0	Adjust amplitude of oscillator until ME-30A/U indicates +10 db.	None.
2	Leave 200 CD controls in positions indicated in step 1. ME-30A / U Range switch to -60 db.	Leave controls in positions indicated in step 1.	Set attenuator MEAS-CAL switch to MEAS.	ME-30A/U must indicate at least 70 db down from the +10 db reference.

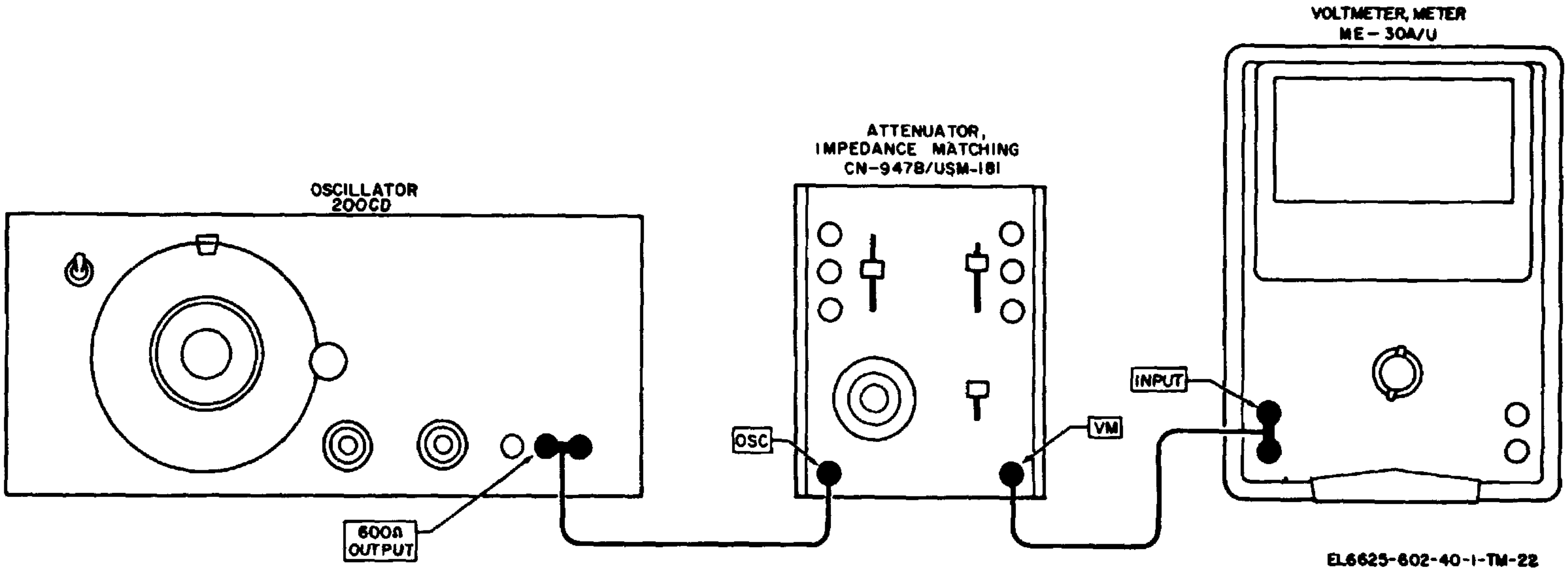


Figure 5-10. Attenuator, Impedance Matching CN-947B/USM-181 input-output isolation test.

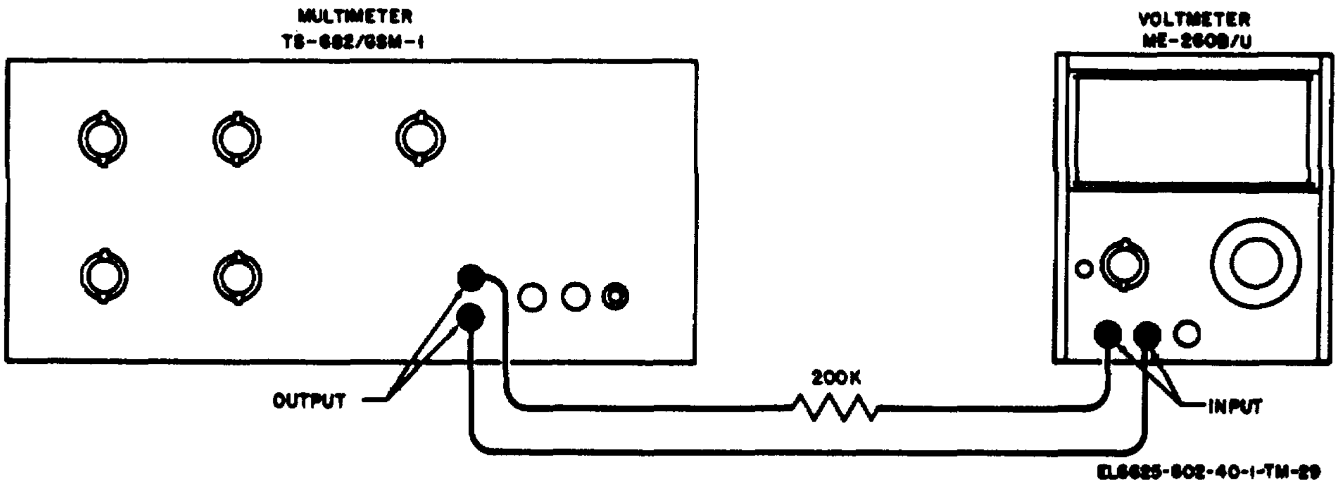


Figure 5-11. Voltmeter, Electronic ME-260 B/U calibration test.

Figure 5-12. Color code markings for MIL-STD resistors.
(Located in back of the manual)

Figure 5-13. Color code markings for MIL-STD capacitors.
(Located in back of the manual)

Figure 5-14. Generator, Signal SG-543B/U, schematic diagram.
(Located in back of the manual)

Figure 5-15. Attenuator, Impedance Matching CN-947B/USM-181, schematic diagram.
(Located in back of the manual)

Figure 5-16. Voltmeter, Electronic ME-260B/U, schematic diagram.
(Located in back of the manual)

5-15. Voltmeter, Electronic ME-260B/U Calibration Test

a. Test Equipment and Materials. Test Set, Meter TS-682A/GSM-1.

b. Test Connections and Conditions. Connect the equipment as shown in figure 5-11.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	TS-682A/GSM-1 Left-hand Selector Switch: ALL OTHER AC AND DC SCALES. Center Selector Switch: AC VOLTS. Right-hand Selector Switch: AC AND DC VOLTS. Rotate AC VOLTS COARSE and AC VOLTS FINE controls clockwise until left-hand meter indicates .001.	RANGE: 001	Observe Voltmeter	Voltmeter must indicate between 0.98 mv and 1.02 mv.
2	Repeat step 1 with voltmeter left-hand INPUT jack connected to the appropriate AC VOLTS jack and rotate AC VOLTS COARSE and AC VOLTS FINE controls until left-hand meter indicates .003, .01, .03, .1, .3,1, 3, 10, 30, 100, and 300, respectively.	RANGE: .003, .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 respectively.	Observe Voltmeter .	Voltmeter must indicate as follows: RANGE Minimum Maximum .003 2.94 mv 3.06 mv .01 9.8 mv 10.2 m .03 29.2 mv 30.6 my .1 .098 v .102 v .3 .294 v .306 v 1 .98 v 1.02 v 3 2.94 v 3.06 v 10 9.8 v 10.2 v 30 29.4 v 30.6 v 100 98v 102 v 300 294 v 306 v

5-16. Voltmeter, Electronic ME-260B/U Input Resistance Test

a. Test Equipment and Materials. Test Set, Meter TS-682A/GSM-1; 200K resistor.

b. Test Connections and Conditions. Connect equipment as shown in figure 5-11.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	*TS-682A/GSM-1* Left-hand Selector Switch: ALL OTHER AC AND DC SCALES. Center Selector Switch: AC VOLTS. Right-hand Selector Switch: AC AND DC VOLTS. Rotate the AC VOLTS COARSE and AC VOLTS FINE controls clockwise until left-hand meter indicates .01.	RANGE: .01 FUNCTION: ON	Observe voltmeter and 0.0095 volt.	Voltmeter indicates 0.0075

5-17. Voltmeter, Electronic ME-260B/U Noise Test

a. Test Equipment and Materials. 100K ohm shielded load.

b. Connections and Conditions. Connect the 100K ohm shielded load across the INPUT terminals.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	None	FUNCTION: ON RANGE: .001	a. Disconnect ac power from voltmeter. b. Rotate RANGE switch on voltmeter through en. tire range.	a. Voltmeter must indicate less than 3% (0.00003). b. Voltmeter must indicate less than 3% of full scale on each range.
2	None	FUNCTION: ON RANGE: .001	a. Connect ac power to volt. meter. b. Rotate RANGE switch on voltmeter through entire range.	a. Voltmeter must indicate less than 8% (0.00008). b. Voltmeter must indicate less than 8% of full scale on each range.

5-18. Voltmeter, Electronic ME-260B/U Frequency Response Test

a. Test Equipment and Materials. Oscillator, Hewlett-Packard Model 200 CD Electronic voltmeter ME-207/U.

b. Test Connections and Conditions. Connect equipment as shown in figure 49.

c. Procedure.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
1	200 CD Frequency control to 400 cps. ME-207/U RANGE control to .001.	RANGE: .001 FUNCTION: ON	Adjust amplitude of 200 CD until voltmeter indicates 0.9 of full scale. Note and record ME-207/U indication.	None.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
2	*200 CD* Frequency controls to 10 cps.	Leave controls in positions indicated in step 1.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 1.	Voltmeter must indicate 0.9 of full scale ±2%.
3	*200 CD* Frequency controls to 5 cps.	Leave controls in positions indicated in step 1. the same as in step 1.	Adjust amplitude of 200 CD until ME-207/U indicates	Voltmeter must indicate 0.9 of full scale ±5%.
4	*200 CD* Frequency controls to 500 kc.	Leave controls in positions indicated in step 1.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 1.	Voltmeter must indicate 0.9 of full scale ±2%.
5	*200 CD* Frequency controls to 400 cps. *ME-207/U* RANGE control to .003.	RANGE: .003 FUNCTION: ON	Adjust amplitude of 200 CD until voltmeter indicates 0.9 of full scale. Note and record ME-207/U indication.	None.
6	200 CD Frequency controls to 10 cps.	Leave controls in positions indicated in step 5.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 5.	Voltmeter must indicate 0.9 of full scale ±2%.
7	*200 CD* Frequency controls to 5 cps.	Leave controls in positions indicated in step 5. the same as in step 5.	Adjust amplitude of 200 CD until ME-207/U indicates	Voltmeter must indicate 0.9 of full scale ±5%tc.
8	*200 CD* Frequency controls to 500 kc.	Leave controls in positions indicated in step 5.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 5.	Voltmeter must indicate 0.9 of full scale ± 2%.
9	*200 CD* Frequency controls to 400 cps. *ME-207/U* RANGE control to .01.	RANGE: .01 FUNCTION: ON	Adjust amplitude of 200 CD until voltmeter indicates 0.9 of full scale. Note and record ME-207/U indication.	None.
10	*200 CD* Frequency controls to 10 cps.	Leave controls in positions indicated in step 9.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 9.	Voltmeter must indicate 0.9 of full scale ±2%.
11	*200 CD* Frequency controls to 5 cps.	Leave controls in positions indicated in step 9.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 9.	Voltmeter must indicate 0.9 of full scale ±5%.
12	*200 CD* Frequency controls to 500 kc.	Leave controls in positions indicated in step 9.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 9.	Voltmeter must indicate 0.9 of full scale +2%.
13	*200 CD* Frequency controls to 400 cps. ME-207/U RANGE control to .03.	RANGE: .03 FUNCTION: ON	Adjust amplitude of 200 CD until voltmeter indicates 0.9 of full scale. Note and record ME-207/U indication.	None.
14	*200 CD* Frequency controls to 10 cps.	Leave controls in positions indicated in step 13.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 13.	Voltmeter must indicate 0.9 of full scale ±2%.
15	*200 CD* Frequency controls to 5 cps.	Leave controls in positions indicated in step 13.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 13.	Voltmeter must indicate 0.9 of full scale ±5%.
16	*200 CD* Frequency controls to 500 kc.	Leave controls in positions indicated in step 13.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 13.	Voltmeter must indicate 0.9 of full scale +2%.
17	*200 CD* Frequency controls to 400 cps. *ME-207/U* RANGE control to .1.	RANGE: .1 FUNCTION: ON	Adjust amplitude of 200 CD until voltmeter indicates 0.9 of full scale. Note and record ME-207/U indication.	None.

Step No.	Test equipment Control settings	Equipment under test control settings	Test procedure	Performance standard
18	*200 CD* Frequency controls to 10 cps.	Leave controls in positions indicated in step 17.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 17.	Voltmeter must indicate 0.9 of full scale ±2%.
19	*200 CD* Frequency controls to 5 cps.	Leave controls in positions indicated in step 17.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 17.	Voltmeter must indicate 0.9 of full scale ±5%.
20	*200 CD* Frequency controls to 500 kc.	Leave controls in positions indicated in step 17. the same as in step 17.	Adjust amplitude of 200 CD until ME-207/U indicates	Voltmeter must indicate 0.9 of full scale ±2%.
21	*200 CD* Frequency controls to 400 cps. *ME-207/U* RANGE control to 3.	RANGE: 8 FUNCTION.: ON	Adjust amplitude of 200 CD until voltmeter indicates 0.9 of full scale. Note and record ME-207/U indication.	None.
22	200 CD Frequency controls to 10 cps.	Leave controls in positions indicated In step 21.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 21.	Voltmeter must indicate 0.9 of full scale ±2%.
23	*200 CD* Frequency controls to 5 cps.	Leave controls in positions indicated in step 21.	Adjust amplitude of 200 CD until ME-207/U Indicates the same as in step 21.	Voltmeter must indicate 0.9 of full scale ±5%.
24	*200 CD* Frequency controls to 500 kc.	Leave controls in positions indicated in step 21.	Adjust amplitude of 200 CD until ME-207/U indicates the same as in step 21.	Voltmeter must indicate 0.9 of full scale ±2%.

APPENDIX A
REFERENCES

Following is a list of applicable references available to General Support maintenance of Test Set, Telephone AN/USM-181B.

AR 380-40	Policy for Safeguarding and Controlling COMSEC Information.
AR 735-11-2	Reporting of Transportation Discrepancies in Shipment.
DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
DA Pam 738-750	The Army Maintenance Management System (TAMMS).
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies and Equipment used by the Army.
TB SIG 222	Solder and Soldering.
TB 9-6625-081-35	Calibration Procedures for Test Oscillator SG-188/FQQ and Hewlett-Packard Models 200CD, 200CDR, and E-19-200CDR.
TB 9-6625-775-50	Calibration Procedures for Meter Test Set TS-682/GSM-1 and TS682/ GSM-1; Meter Calibrator AN/USM-270 (Hewlett-Parkard Models J02-6920A and 6920B).
TB 9-6625-1188-35	Calibration Procedure for Clip-On DC Milliammeters, AN/USM-277 (Hewlett-Packard Models 428A and 428AR) including ME-488U (Hewlett-Packard Models 428B and 428BR).
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment. Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 11-2535B	Meter Test Set TS-682A/GSM-1.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, TS-723C/U, and TS-723D/U.
TM 11-6625-200-15	Operator's, Organizational, Direct Support, General Support and Depot Maintenance Manual: Multimeters ME-26A/U (NSN 6625-00-360-2493), ME-26B/U and ME-26C/U (6625-00-646-9409) and ME-26D/U (6625-00-913-9781).
TM 11-6625-200-24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools: Multimeters, ME-26A/U (NSN 6625-00-360-2493), ME-26B/U, ME-26C/U (6625-00-646-9409) and ME-26D/U (6625-00-913-9781).
TM 11-6625-212-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Frequency Meters AN/USM-26 and AN/USM-26A.
TM 11-6625-255-20P	Organizational Maintenance Repair Parts and Special Tool Lists: Spectrum Analyzers TS-723/U, TS-723A/U, TS-723B/U, TS-723C/U and TS-723D/U (NSN 6625-00-668-9418).
TM 11-6625-255-34P	Direct Support and General Support Maintenance Repair Parts and Special Tools List for Spectrum Analyzer TS-723/U, TS-723A/UI, TS-723B/U, TS-723C/U and TS-723D/U (NSN 6625-00-668-9418).
TM 11-6625-277-20P	Organizational Maintenance Repair Parts and Special Tool Lists: Meter Test Set TS-682/GSM-1 and TS-682A/GSM-1.
TM 11-6625-277-34P	Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools): Meter Test Sets, TS-682/GSM-1 and TS-682A/GSM-1 (FSN 6625-669-0747).

TM 11-6625-320-12	Operator's and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.
TM 11-6625-320-24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Voltmeters, Electronic: ME-30A/U, ME-30B/U, ME-30C/U and ME-30E/IJ (NSN 6625-00-64.3-1670).
TM 11-6625-320-35	DS, GS, and Depot Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U and ME-30C/U.
TM 11-6625-345-12	Operators and Organizational Maintenance Manual: Calibrator Set, Frequency AN/URM-18A.
TM 11-6625-345-20P	Organizational Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Calibrator Sets, Frequency AN/IURM-18 (NSN 6625-00-376-9793) and AN/URM-18A (6625-00-985-5292).
TM 11-6625-345-25P/1	Organizational, DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Calibrator Set, Frequency AN/URM-18A.
TM 11-6625-345-40P	General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools): Calibrator Sets, Frequency, AN/URM-18 (NSN 6625-00-376-9793) and AN/URM-18A (6625-00-985-5292).
TM 11-6625-345-45	GS and Depot Maintenance Manual: Calibrator Set, Frequency AN/URM-18A.
TM 11-6625-366-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS-352B/U (NSN 6625-00-553-0142).
TM 11-6625-366-24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Multimeter TS-:352R//U (NSN 6625-00-553-0142).
TM 11-6625-539-15	Operator, Organizational, Field and Depot Maintenance Manual: Transistor Test Set TS-1836/U.
TM 11-6625-539-15-1	Organizational, DS, GS, and Depot Maintenance Manual: Test Set, Transistor TS-1836A/U (NSN 6625-00-432-2195).
TM 11-6625-539-15-2	Operator, Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Test Set, Transistor TS-1836B/U.
TM 11-6625-539-14-3	Operator's Organizational, Direct Support and General Support Maintenance Manual: Test Set, Transistor TS-1836C/U (NSN 6625-00-159-2263).
TM 11-6625-539-14-4	Operator's Organizational, Direct Support and General Support Maintenance Manual: Test Set, Transistor TS-1836D/U (NSN 6625-00-138-7320).
TM 11-6625-1514-15	Organizational, DS. GS, and Depot Maintenance Manual: Hewlett-Packard Vacuum Tube Voltmeter. Models 400D, 400H, 400L, and H02-400D (NSN 6625-00-643-1670).
TM 11-6625-1537-15	Organizational, DS, (;S, and Depot Maintenance Manual: Wide Range Oscillator Hewlett-Packard Model 200CD/CDR.
TM 11-6625-1703-15	Operator's Organizational, DS, GS, and Depot Maintenance Manual: Oscilloscope AN/USM-281A. (NSN 6625-00-228-2201).
TM 11-6625-1703-24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair and Special Tools) for Oscilloscope AN/USM-281A (NSN 6625-00-228-2201).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of' Electronics Materiel to Prevent Enemy Use (Electronics Command).

INDEX

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Acting Chief of Staff.

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Major General, United States Army,
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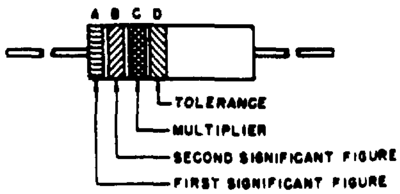
USARYIS (2)
Units org under fol TOE:
(1 cy each)
11-95
11-117
11-158
11-500(AA-AC)
29-1
29-15
29-16
29-21
29-25
29-26
29-35
29-36
29-134
29-136
29-205

NG: None.
USAR: None.
For explanation of abbreviations used, see AR 310-50.

* U. S. GOVERNMENT PRINTING OFFICE : 1992 0 - 311-831 (45114)

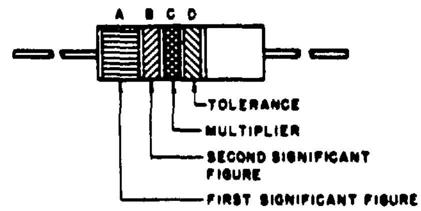
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A—Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS



BAND A—Double Width Signifies Wire-wound Resistor

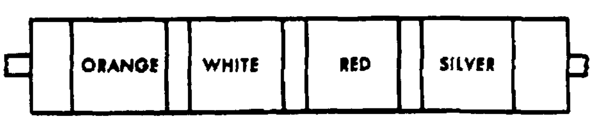
COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

EXAMPLES OF COLOR CODING

BAND

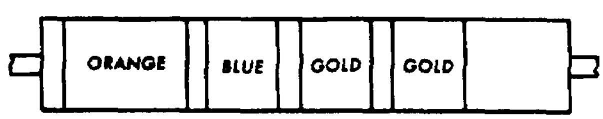
A B C D*



3 9 X100 ± 10%

BAND

A B C D*



3 6 X0.1 ± 5%

NOMINAL RESISTANCE	3,900 Ohms	3.6 Ohms
RESISTANCE TOLERANCE	± 10 percent	± 5 percent

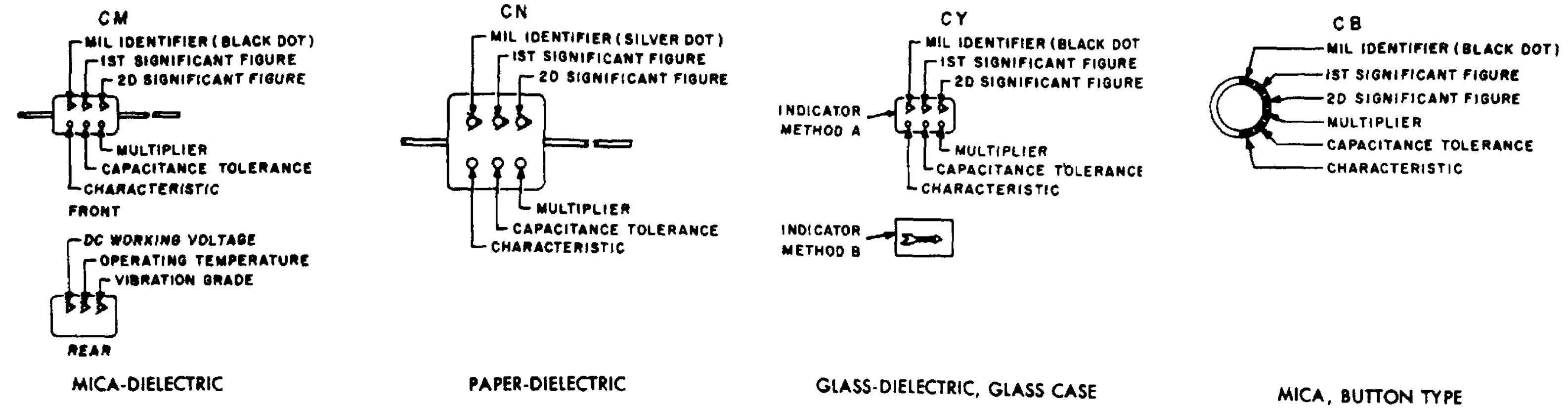
STD-R2

*If Band D is omitted, the resistor tolerance is ±20%, and the resistor is not Mil-Std.

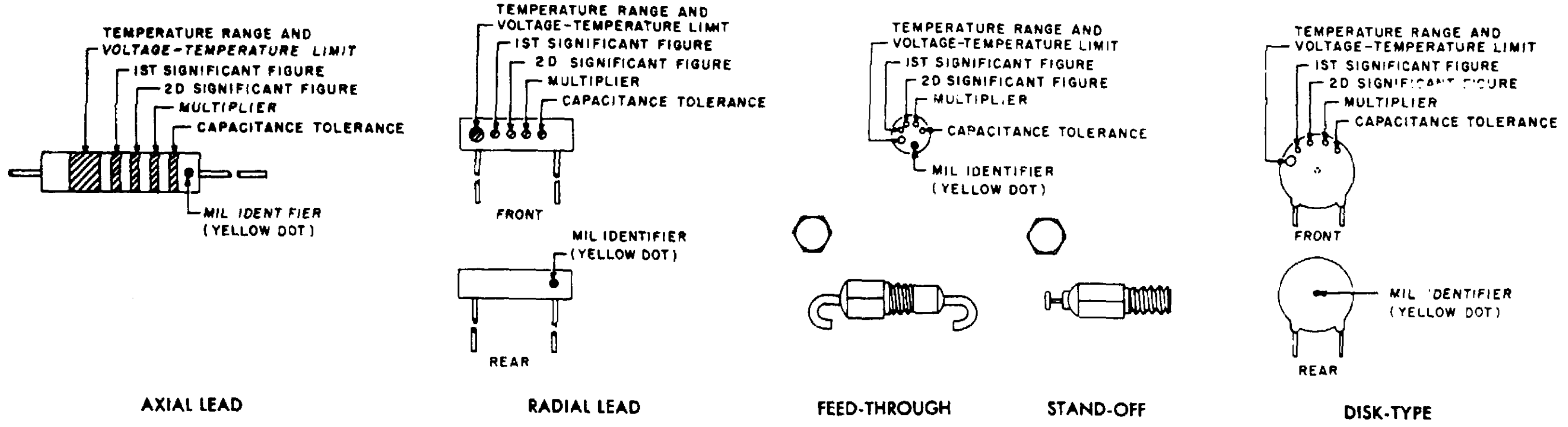
Figure 5-12. Color code markings for MIL-STD resistors.

COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

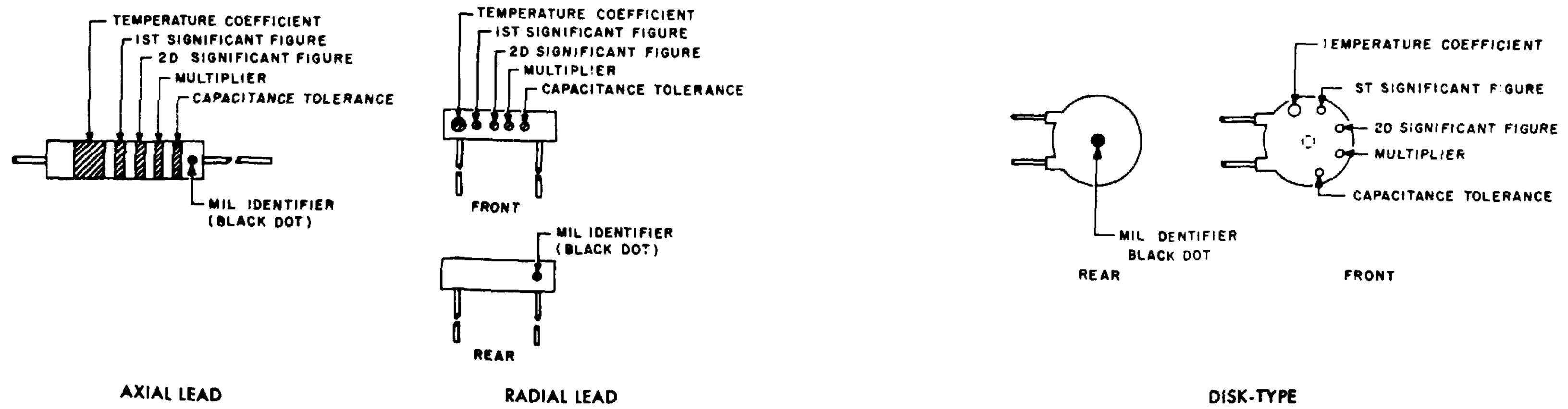
GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



GROUP III Capacitors, Fixed, Ceramic-Dieletric (Temperature Compensating) Style CC



COLOR CODE TABLES

TABLE I – For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]				DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CY	CB	CM	CM	CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				−55° to +70°C	10–55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			−55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					−55° to +125°C	10–2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											−55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CN				± 10%	± 10%	± 10%	± 10%							

TABLE II – For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE – TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

TABLE III – For use with Group III, Temperature Compensating, Style CC

COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	−30	1	1	10	± 1%		
RED	−80	2	2	100	± 2%	± 0.25uuf	
ORANGE	−150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5		± 5%	± 0.5uuf	
BLUE	−470	6	6				
PURPLE (VIOLET)	−750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL–C–5, MIL–C–91, MIL–C–11272 and MIL–C–10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL–C–11015.
4. Temperature coefficient in parts per million per degree centigrade.

STD–C2

Army-Ft Monmouth,NJ-MON 524-61

Figure 5-13. Color code markings for MIL-STD capacitors.

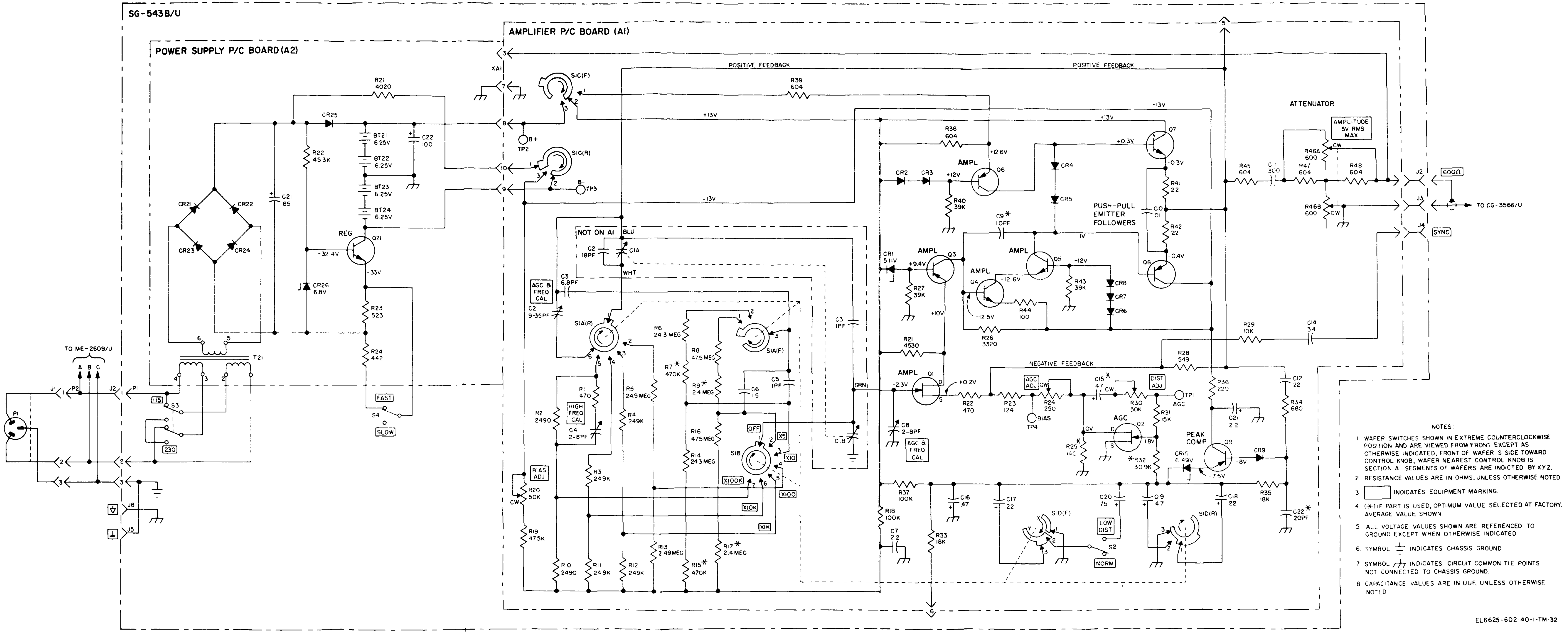


Figure 5-14. Generator, signal SG-543B/U, schematic diagram.

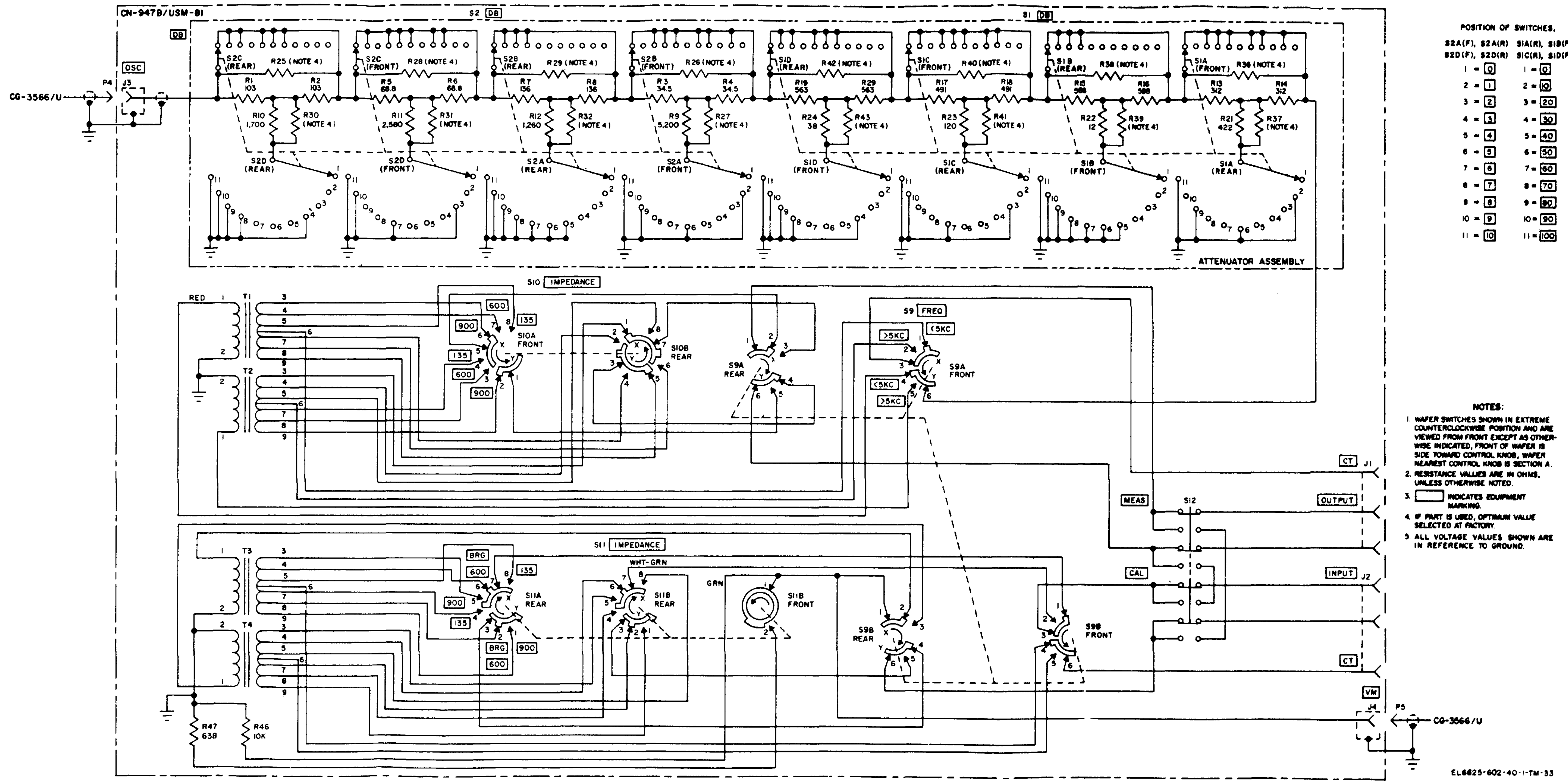
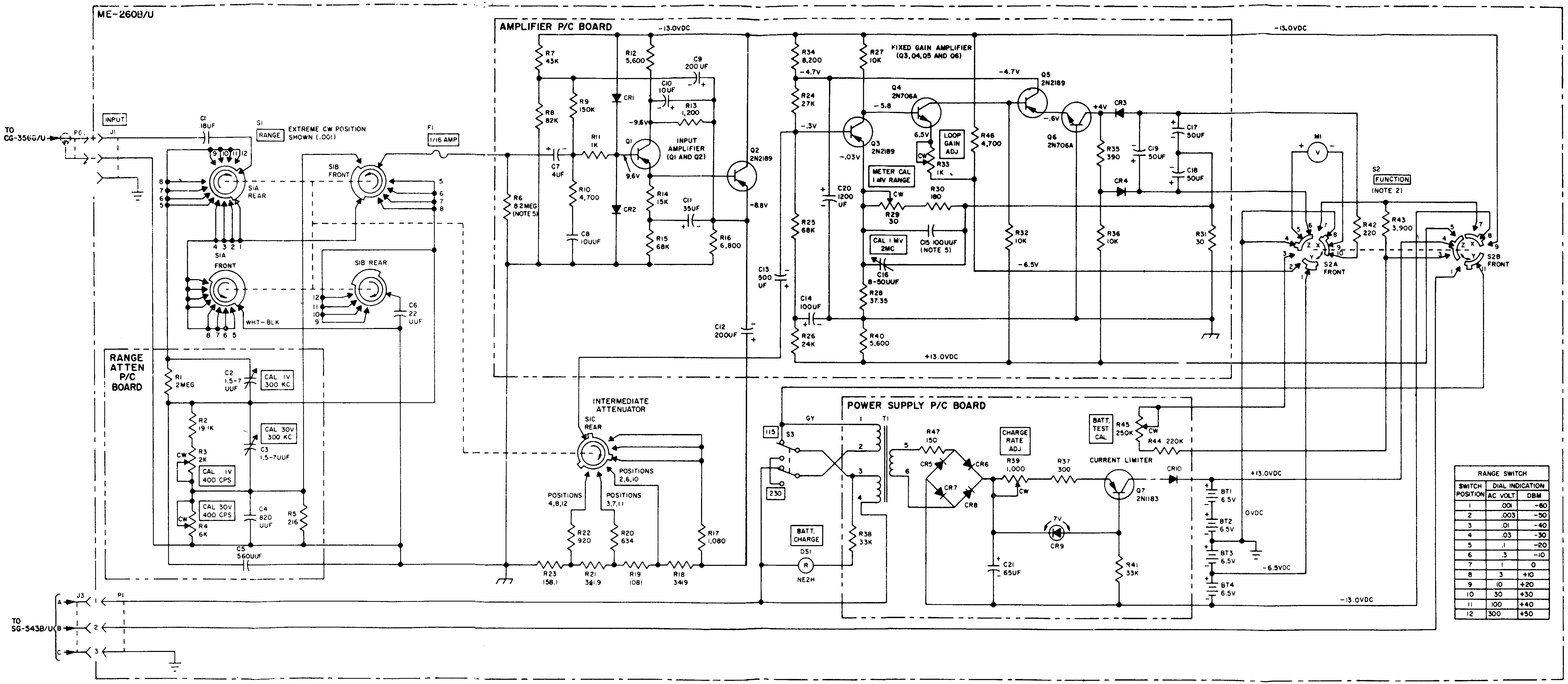


Figure 5-15. Attenuator, Impedance Matching CN-947B/USM-181, schematic diagram.



NOTES:

1. WAFER SWITCHES SHOWN IN EXTREME COUNTERCLOCKWISE POSITION AND ARE VIEWED FROM FRONT, EXCEPT AS OTHERWISE INDICATED. FRONT OF WAFER IS SIDE TOWARD CONTROL KNOB. WAFER NEAREST CONTROL KNOB IS SECTION A. SEGMENTS OF WAFERS ARE INDICATED BY X,Y,Z.
2. OFF POSITION SHOWN. ON POSITION IS CW. BAT. TEST POSITION IS CCW.
3. RESISTANCE VALUES ARE IN OHMS, UNLESS OTHERWISE NOTED.
4. [ ] INDICATES EQUIPMENT MARKING.
5. IF PART IS USED, OPTIMUM VALUE SELECTED AT FACTORY. AVERAGE VALUE SHOWN.
6. ALL VOLTAGE VALUES SHOWN ARE IN REFERENCE TO GROUND EXCEPT AS OTHERWISE INDICATED.
7. SYMBOL ⏚ INDICATES CHASSIS GROUND.
8. SYMBOL ⊥ INDICATES CIRCUIT COMMON TIE POINTS NOT CONNECTED TO CHASSIS GROUND.

RANGE SWITCH		
SWITCH POSITION	DIAL INDICATION	
	AC VOLT	DBM
1	.001	-60
2	.003	-50
3	.01	-40
4	.03	-30
5	.1	-20
6	.3	-10
7	1	0
8	3	+10
9	10	+20
10	30	+30
11	100	+40
12	300	+50

Figure 5-16. Voltmeter, Electronic ME-260B/U, schematic diagram.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

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PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

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DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 020899-001