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[NAVY] NAVWEPS AN16-30TRM1-1

HANDBOOK
OPERATION INSTRUCTIONS

RADIO TEST SET AN/TRM-1

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND BY DIRECTION OF THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

1 OCTOBER 1956

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RADIO TEST SET AN/TRM-1

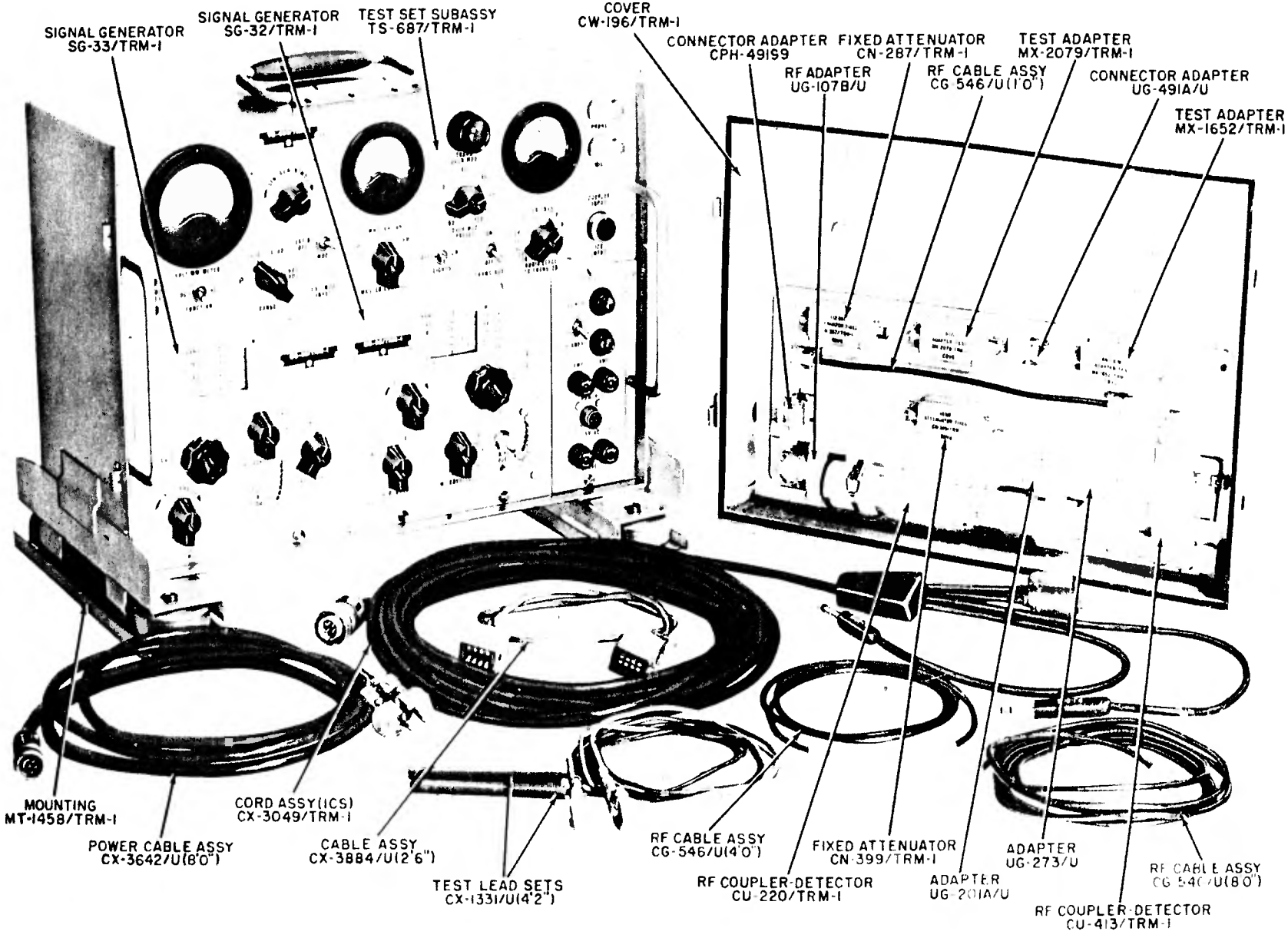

Figure 1-1. Radio Test Set AN/TRM-1, Equipment Supplied

SECTION I

GENERAL DESCRIPTION

1-1. PURPOSE OF HANDBOOK.

1-2. The purpose of this handbook is to present information required for the operation and basic maintenance that may be performed by operating personnel on Radio Test Set AN/TRM-1. This section includes description of the physical and electrical characteristics of the equipment, as well as a brief explanation of its theory of operation.

1-3. PURPOSE OF THE EQUIPMENT.

1-4. Radio Test Set AN/TRM-1 provides, in a composite portable test instrument, the facilities necessary to perform go-no go pre-flight performance tests on aircraft receiving, transmitting, and navigation equipment in the frequency range from 190 kc to 400 mc, and voice inter-communication equipment in the audio frequency range. The application and use of this equipment depends, to a large extent, upon statistical data listing satisfactory readings for equipments in various installations.

1-5. GENERAL PHYSICAL CHARACTERISTICS. (See figure 1-1.)

1-6. Radio Test Set AN/TRM-1 is contained in a gray aluminum combination case and cover, with a carrying handle located on top of the case. Two crash handles mounted on the front panel serve to protect the panel meters and operating controls from damage. The unit is mounted on a removable two-piece shock absorbing base, and is attached with pull-down type spring latches. All operating controls, receptacles, and fuses are conveniently located on the front panel; these are functionally arranged and clearly labeled for easy identification. Also located on the front panel are the meters, indicating dials, indicator lamps, and spare fuses. All accessory cables, adapters, terminations, and instruction books, are stowed in the front cover.

1-7. The test set contains two separate RF signal generators (SG-32/TRM-1 and SG-33/TRM-1). Plug-in type construction permits their easy removal for

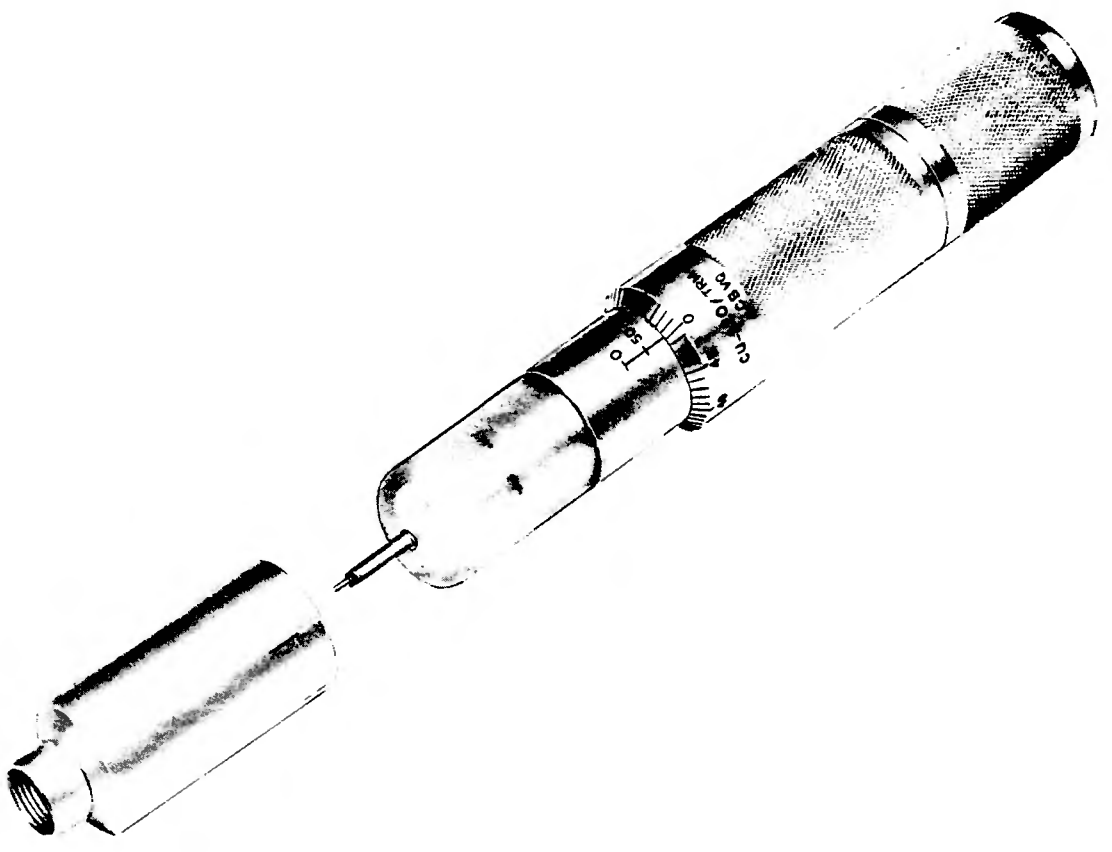

Figure 1-2. RF Coupler-Detector CU-220/TRM-1

inspection and service. Each signal generator is separately housed in a rugged aluminum casting which minimizes radiation leakage caused by circulating rf currents, and affords excellent mechanical and thermal stability.

1-8. Test Set Subassembly TS-687/TRM-1, constructed to facilitate disassembly for maintenance and repairs, consists of the protective outer case, frame structure, meter panel, power panel, and chassis subassembly; it also contains the mounting and electrical connecting facilities for the signal generator units.

1-9. R.F. Coupler-Detector CU-220/TRM-1 contains a conical shaped, air dielectric coupling capacitor that is variable axially by means of a micrometer type screw drive. The degree of mesh of the capacitor, and therefore the amount of coupling, is indicated by a 0-400 numerical scale inscribed on the barrel of the coupler assembly. Index markings are inscribed on the movable sleeve (See figure 1-2.). This coupler is terminated in a tip designed to contact the antenna binding post of the transmitter under test. It may be hand-held in contacting single-wire antenna systems. Using furnished adapters, connection can be made to coaxial cable fittings. This coupler is used at radio frequencies lower than 100 megacycles.

1-10. R. F. Coupler-Detector CU-413/TRM-1 (See figure 1-3.) functions similarly to the coupler described above except that it is "Tee" shaped and designed for insertion into coaxial rf transmission lines. It is used at frequencies between 100 and 400 megacycles.

1-11. GENERAL ELECTRICAL CHARACTERISTICS.

1-12. RADIO TEST SET AN/TRM-1 consists of circuitry and accessory items required to evaluate the pre-flight performance of communications and certain navigation equipments installed in aircraft. Its electrical design incorporates three basic test functions as follows:

a. Radio transmitter performance
b. Radio receiver performance
c. General purpose ac or dc voltage measurements

Detailed description of the electrical characteristics of the major components of Radio Test Set AN/TRM-1 is given in the following paragraphs, and a technical summary of these characteristics appears in Table III.

1-13. SIGNAL GENERATOR SG-32/TRM-1 CIRCUIT. (See figure 4-3).

1-14. This signal generator is active only in LMHF position of MASTER CONTROL switch S101 (Item 3 on figure 2-1.). It consists essentially of a hartley circuit RF Oscillator using a type 6AU6WA, V301, and an RF Amplifier stage V302, using a type 6AN5WA tube. The output frequency range is from 190 kc to 30 mc, covered in five bands that are switched by means of FREQ BAND control on the front panel. Frequency is indicated directly on an illuminated drum dial. The signal output voltage is adjusted by the panel control marked R.F. LEVEL. The RF Amplifier stage increases the signal voltage and serves to minimize the effect on the RF Oscillator of variations in output loading and also to reduce undesirable frequency modulation. Audio amplitude modulation from the internal Audio Oscillator V105, or from an external source, is applied to the RF Amplifier. The degree of modulation is indicated as a percentage on the top scale of % MODULATION panel meter, M102. Measured rf output voltage, indicated by the red arrow mark on the CARRIER LEVEL panel meter M101, is supplied to the precision MICROVOLTS step-attenuator AT301. This nine position step-attenuator has a 50 ohm resistive output impedance, on any step, over the entire frequency range. RF signal output voltage is available at R.F. OUTPUT jack J301, on the front panel, in 100K, 10K, 1K, 100, 50, 25, 10, 5, and 2.5 microvolt steps and is correctly indicated when the output jack is terminated in 50 ohms. Plate and screen operating voltages for the Oscillator, V301, and RF Amplifier, V302, tubes, are supplied only when the MASTER CONTROL switch S101 is in the LMHF position; in the other positions of this switch Signal Generator SG-32/TRM-1 is inoperative.

1-15. SIGNAL GENERATOR SG-33/TRM-1 CIRCUIT.

1-16. This signal generator uses a type 6F4 acorn tube, V201, in an ultra-audion type oscillator circuit. The signal frequency is continuously variable from 30 to 400 mc. This range is covered in three overlapping bands, selected by FREQ BAND switch S201. The output frequency, indicated directly on an illuminated drum dial, is adjusted by the panel control marked FREQ. Audio modulating voltage from the internal Audio Oscillator stage or from an external source is applied to the plate circuit of the R.F. Oscillator stage. The degree of modulation of the carrier is indicated on the top scale of the panel meter, % MODULATION, M102. The rf output level is measured by CARRIER LEVEL meter M101. The metered signal, adjusted to a known level by the RF LEVEL panel control R201, is fed to a precision step-attenuator AT201, marked MICROVOLTS on the front panel. The output impedance of the step-attenuator is 50 ohms on any step, over the entire frequency range. Therefore, when the R.F. OUT jack J202 is terminated externally in 50 ohms, the actual output voltage is available in 100K, 10K, 1K, 100, 50, 10, 5, and 2.5 microvolt steps. Plate voltage to operate Signal Generator SG-33/TRM-1 is supplied only when the MASTER CONTROL switch, S101, is in the V/UHF position.

1-17. TEST SET SUBASSEMBLY TS-687/TRM-1 CIRCUIT.

1-18. Test Set Subassembly TS-687/TRM-1 contains circuitry which performs the function of (1) audio signal source, (2) transmitter performance tester, (3) volt/milliwatt meter, (4) power supply, (5) meter and control panel, and (6) a fuse and lamp panel.

1-19. The internal audio signal source consists of an audio oscillator and a modulator stage. The Audio Oscillator tube, V105, is a type 5814 connected in a Wien bridge type circuit fixed in frequency at 1000 cps. It is active only when the MOD switch S105 is in the INT position. The MODULATOR tube, V106 is a type 6005 operating as a class A audio amplifier. Audio voltage is applied to the modulator stage from either the AUDIO OSCILLATOR, or from an external source through EXT MOD INPUT panel jack J109, depending on the position of the MOD switch S105. When the MASTER CONTROL switch S101 is in either the LMHF or V/UHF position the MODULATOR stage provides sufficient audio voltage to amplitude modulate the rf signal output of Signal Generators SG-32/TRM-1 and SG-33/TRM-1. The modulating voltage is varied in amplitude by the SIGNAL GENERATOR % MOD control R154, and measured by the MODULATION VOLTMETER, V102, using a type 5726 tube. The voltage is indicated on the top scale meter M102, % MODULATION, which is calibrated to indicate the degree of modulation in percent. The function of the audio signal generator, with regard to the transmitter performance test (TPT) circuits, is given in paragraph 1-20.

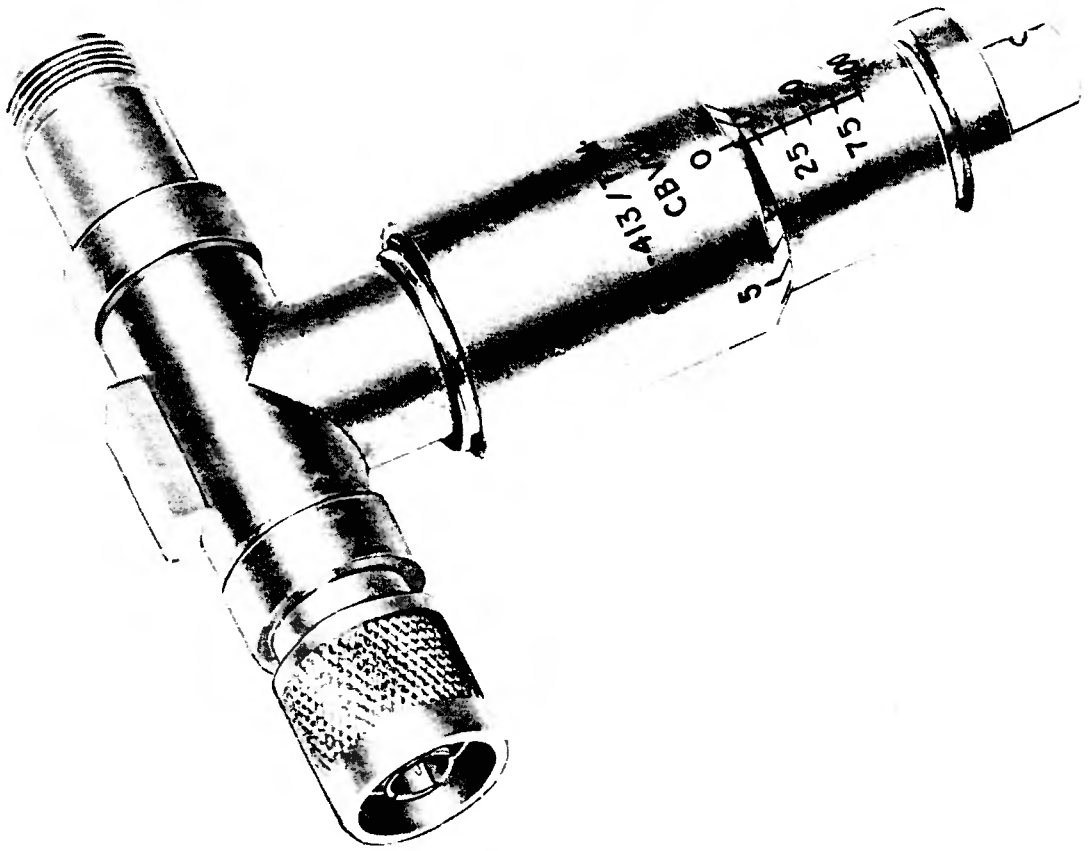

Figure 1-3. RF Coupler-Detector CU-413/TRM-1

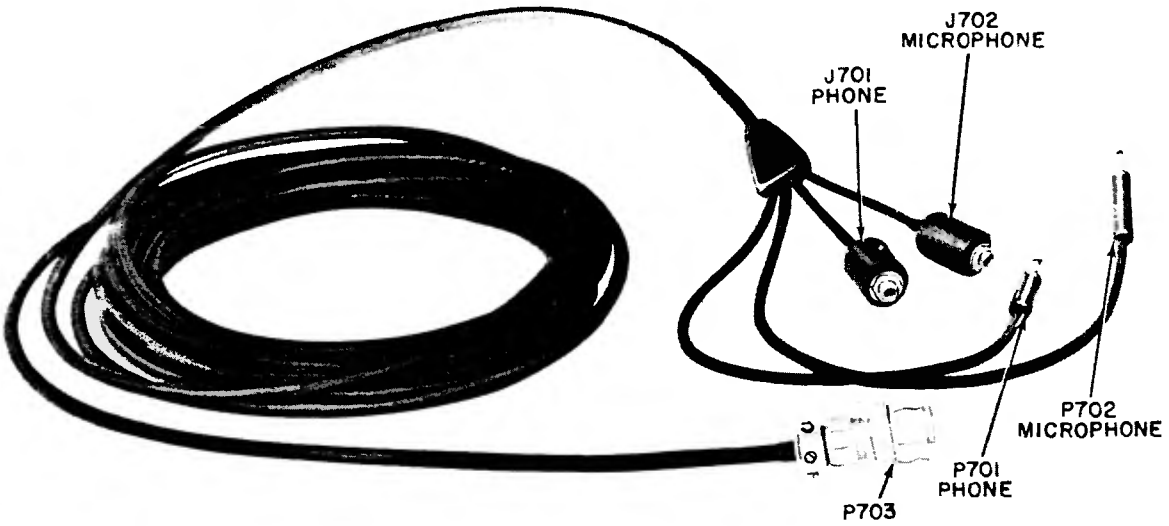

Figure 1-4. Electrical Cord Assembly CX-3049/TRM-1

1-20. The transmitter performance test circuits are activated when MASTER CONTROL switch S101 is placed in TPT position. These circuits, in conjunction with the separate RF Coupler-Detector CU-220/TRM-1 or CU-413/TRM-1, are arranged to: (1) determine the relative power output of the transmitter under test, (2) furnish a calibrated test audio signal to the microphone input circuits of radio transmitters and audio intercom systems, (3) measure the percentage of modulation of the transmitted carrier signal, and (4) detect the presence of over-modulation and carrier-level shift. The R.F. Coupler-Detectors CU-220/TRM-1 and CU-413/TRM-1 contain crystal diode rectifying circuits which produce dc voltage output proportioned to the peak rf carrier voltage connected at the coupler input. This dc output voltage is applied through COUPLER INPUT jack J103, to the CARRIER LEVEL meter M101 which deflects to a red arrow mark when the output voltage from the probe reaches a pre-determined reference level. The degree of coupling to the transmitter required to produce the reference voltage on CARRIER LEVEL meter M101 is proportional to the transmitter power output and is indicated by the scale reading on the barrel of the probe (See paragraphs 1-9. and 1-10.). The carrier level setting, just described, is always made without any modulation being applied to the transmitter being tested. In the TPT function the audio output of the MODULATOR tube, V106, is applied to the calibrated attenuator AT101, AUDIO LEVEL TO TRANS- DB which adjusts the level of audio output from 0 db to minus 36 db (0 db equals 3 volts across 82 ohms). When the TRANS KEY S104 is placed on, the adjustable audio test signal is present at the ICS jack, J108, and can be connected via the ICS Cord CX-3049/TRM-1 to the microphone input of the transmitter under test. Output carrier modulation voltage is detected in the R.F. Coupler Detector circuits and the degree of transmitter carrier-level shift resulting from modulation is directly indicated on the LEVEL SHIFT scale of meter M101. The detected modulation voltage is amplified by V101 Amplifier-Cathode Follower and coupled to the Modulation Voltmeter, V106, circuits including % MODULATION meter M102 the bottom scale of which is calibrated to indicate the degree of carrier modulation directly in percent. The Over Mod Amplifier, V104, is calibrated to indicate over-modulation peaks from any degree pre-set on panel control R137, OVER MOD. PRESET, scaled from 60 to 120 percent. For any setting of R137, the TRANS OVER MOD panel indicator flashes intermittently on excessive transient or recurrent modulation peaks which are larger in amplitude than in the preset values. Over modulation is indicated by excessive flashing or continuous glowing.

1-21. For the purpose of explanation the volt/milli-watts metering circuits are considered separately. The milliwatt meter functions only when the MASTER CONTROL switch S101 is in either LMHF or V/UHF postion. The milliwatt meter is used together with either Signal Generator SG-32/TRM-1 or SG-33/TRM-1 in the preflight evaluation of radio receivers. The modulated rf signal, from the signal generator selected, is applied to the antenna input of the radio receiver, resulting in an audio tone output which can be heard in headset. The receiver phone output is connected to the milliwatt meter circuits of the test set at the ICS INPUT jack J108 by means of the ICS Cord Assembly CX-3049/TRM-1. Full-scale ranges of 10, 100, and 1000 milliwatts are selected by the RANGE switch S120. The received audio signal is amplified by V101A and is applied via the Cathode Follower V101B to the milliwatt circuit of the Volt/Milliwatt stage V103. In this function the VOLT/MW meter M103 is calibrated in milliwatts, and the upper scale marked MILLIWATTS is read. The actual reading in milliwatts is the product of the scale reading times the multiplier indicated by the pointer on the RANGE switch S102.

1-22. The voltmeter section of the VOLT/MILLI-WATT METER circuits is activated only when the MASTER CONTROL switch S101 is in the VM position. It is designed for general purpose use in measuring dc or ac voltages at external points. Test Lead Set CX-1331/U (4'2") is supplied for making connections to the input terminals J104 and J105 marked AC-DC volts.

1-23. The dc voltmeter is selected by placing the FUNCTION switch S103 in the DC position. The positive voltage is connected to the red colored terminal J104. The black colored (negative) input terminal, J105 is internally grounded to the chassis of the test set. Any one of four full-scale ranges of 3, 30, 300 and 600 volts DC may be selected by the RANGE switch S102, which switches the required multiplier resistors in series with VOLT/MW meter M103. There are two DC voltage scales on M103. The upper scale 0-3 applies only in the X1, X10 and X100 scale multiplying positions of RANGE switch S102. The lower dc scale 0-6 is used only when the RANGE switch, S102 is in the 600 VDC position where a scale multiplying factor of 100 is used. No vacuum tubes are used in the dc voltmeter circuits and therefore the test set need not be turned on to measure D.C. volts.

1-24. The AC voltmeter circuits are selected by placing the FUNCTION switch, S103, in the AC position. Jacks J104 and J105, AC-DC VOLTS, are used to connect Test Lead Set CX-1331/U (4'2"). J105 (black) is internally connected to the chassis. The RANGE switch S102 selects one of three multiplier positions: X1, X10 and X100. The 600 VDC position is not used in the AC function. AC voltage from the multiplier circuit is amplified by the Amplifier section of V101 and, via the Cathode Follower section of the same tube, is applied to the AC voltmeter circuit of the Volt/Milliwatt stage, V103. This stage uses a type 5726 double diode tube. In this function the VOLT/MW meter M103 is calibrated to indicate ac volts and the upper meter scale marked VAC is read. The actual reading in ac volts is the product of the scale reading times the multiplier indicated by the pointer on RANGE switch S102.

1-25. A nominal 115 volts - 50 to 1000 cps - is applied to the primary of the power transformer T102. This transformer has two secondary windings. One winding is the source of 6.3 V ac for all vacuum tube heaters, and the meter and dial lamps. These lamps are controlled by the toggle switch S-106, marked LIGHTS. The other secondary winding furnishes high-voltage to a full wave rectifier circuit employing a type 6X4W tube. Unregulated plus 200 volts dc is supplied to non-critical portions of the test set. A voltage regulator circuit using a type OA2WA tube furnishes regulated plus 150 volts dc to Signal Generator SG-32/TRM-1 and SG-33/TRM-1, and to critical points in Test Set Subassembly TS-687/TRM-1.

1-26. EQUIPMENT SUPPLIED.

1-27. The complete Radio Test Set AN/TRM-1 equipment supplied by the manufacturer is listed in the table below, and is illustrated in figure 1-1. A complete list of replaceable parts appears in the Illustrated Parts Breakdown handbook for the equipment.

TABLE I. TABLE OF COMPONENTS

Qty. Per Equip.	Name of Unit	Type Designation	Overall Dimensions Height	Width	Depth	Volume	Wt.
1	Test Set Subassembly	TS-687/TRM-1	12-3/8	17-1/4	6-7/8	1468	19
1	Signal Generator (LMHF)	SG-32/TRM-1	6-13/16	6-7/8	6-5/8	310	6-1/2
1	Signal Generator (V/UHF)	SG-33/TRM-1	6-13/16	6-7/8	6-5/8	310	8
1	R.F. Coupler-Detector (LMHF)	CU-220/TRM-1					
1	R.F. Coupler-Detector (V/UHF)	CU-413/TRM-1					
1	Test Set Cover	CW-196/TRM-1					
2	Mounting (shock)	MT-1458/TRM-1					
1	Test Adapter (antenna simulator)	MX-1652/TRM-1					
1	Test Adapter (50 ohm shunt)	MX-2079/TRM-1					
1	Fixed Attenuator (6 db)	CN-399/TRM-1					
1	Fixed Attenuator (12 db)	CN-287/TRM-1					
2	Test Lead Set	CX-1331/U (4' 2")					
1	Electrical Cord Assembly (ICS)	CX-3049/TRM-1					
1	Electrical Power Cable Assembly	CX-3642/U (8' 0")					
1	Radio Frequency Cable Assembly	CG-546/U (1' 0")					
1	Radio Frequency Cable Assembly	CG-546/U (4' 0")					
1	Radio Frequency Cable Assembly	CG-546/U (8' 0")					
1	Radio Frequency Adapter	UG-107B/U					
1	Connector Adapter	UG-491A/U					
1	Connector Adapter	CPH-49199					
1	Adapter	UG-201A/U					
1	Adapter	UG-273/U					
1	Special Purpose Electrical Cable Assembly	CX-3884/U (2' 6")					

1-28. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

1-29. Radio Test Set AN/TRM-1 is supplied complete and ready for operation. The only additional requirement is the power source described below.

1-30. POWER SOURCE REQUIREMENTS.

1-31. The equipment operates from a power source of 115-volt ac, 50 to 1000 cycle per second, single phase. The voltage regulated power supply within the test set allows operation with line voltage variations from 103.5 to 126.5.

1-32. ELECTRON TUBE, FUSE, AND INDICATOR LAMP COMPLEMENT.

1-33. Table II below, lists in numerical order the types of electron tubes, fuses and indicator lamps used in the equipment.

TABLE II. TUBE, FUSE AND INDICATOR LAMP COMPLEMENT

REFERENCE SYMBOL	FUNCTION	TYPE DESIGNATION	LOCATION
		TUBES	
V101	Amplifier-Cathode Follower	5814A	Test Set Subassembly
V102	Modulation Voltmeter	5726	TS-687/TRM-1
V103	Volt/Mw Meter	5726	"
V104	Over-Mod Amplifier	6AU6WA	"
V105	Audio Oscillator	5814A	"
V106	Modulator	6005	"
V107	Full-Wave Rectifier	6X4W	"
V108	Voltage Regulator	OA2WA	"
V201	Oscillator (V/UHF)	6F4	Signal Generator SG-33/TRM-1
V301	Oscillator (LMHF)	6AU6WA	Signal Generator SG-32/TRM-1
V302	RF Amplifier	6AN5WA	Signal Generator SG-32/TRM-1
		INDICATOR LAMPS	
I 101	TRANS OVER MOD Indicator	NE-48	Front panel, Test Set Subassembly TS-687/TRM-1
I 102	POWER Pilot Lamp	No. 47	Power Panel, Test Set Subassembly TS-687/TRM-1
I 103	STANDBY Pilot Lamp	NE-51	Power Panel, Test Subassembly TS-687/TRM-1
I 104 I 105 I 106	Meter Illuminating Lamp	No. 47	Test Set Subassembly TS-687/TRM-1
I 201 I 202	Dial Illuminating Lamp	No. 47	Signal Generator SG-33/TRM-1
I 301 I 302	Dial Illuminating Lamp	No. 47	Signal Generator SG-32/TRM-1
		FUSES	
F 101 F 102	Operating Fuses	F02G1R00B (MDL-1) 1 Amp.	Power Panel
	Spare Fuses	F02G1R00B (MDL-1) 1 Amp.	Power Panel

1-34. TECHNICAL SUMMARY.

1-35. The following table contains reference data and a summary of the technical characteristics of Radio Test Set AN/TRM-1.

TABLE III. TECHNICAL DATA

a. Overall Nomenclature	Radio Test Set AN/TRM-1
b. Contract Number	NOas-51-819a
c. Contractor	Trad Electronics Corporation 1001 First Avenue, Asbury Park, N. J.
d. Cognizant Naval Inspector	Inspector of Naval Material, USN Naval Industrial Reserve Shipyard, Port Newark, Newark 5, New Jersey
e. Signal Generator SG-32/TRM-1 (LMHF)	
(1) Frequency Range:	0.19 to 30 mc
(2) Frequency Bands:	5
(3) Band Ranges:	Band A .19 - .54 mc B .54 - 1.5 mc C 1.5 - 4.0 mc D 4.0 - 12 mc E 12 - 30 mc
(4) Frequency Dial Accuracy:	±1% of indicated frequency
(5) RF Output Voltage:	2.5 to 100,000 microvolts across 50 ohm external load. Attenuator adjustable in nine separate steps - 2.5, 5, 10, 25, 50, 100, 1K, 10K, 100K microvolts. (±10% from .19 to 12 mc. ±20% from 12 to 30 mc.) ±10% at all frequencies when corrected with calibration chart. See page 13.
(6) Modulation Capability:	0 to 60% from 200 to 6000 cps.
(7) Internal Modulation:	1000 cps (±10%)
(8) External Modulation:	200 to 6000 cps. Applicable at EXT MOD INPUT jack J109 located on the front panel.
f. Signal Generator SG-33/TRM-1 (V/UHF)	
(1) Frequency Range:	30 to 400 megacycles
(2) Frequency Bands:	3
(3) Band Ranges:	Band A 30 - 70 mc B 70 - 170 mc C 170 - 400 mc
(4) Frequency Dial Accuracy:	±2% of indicated frequency
(5) RF Output Voltage:	2.5 to 100,000 microvolts across 50 ohm external load. Attenuator adjustable in nine separate steps - 2.5, 5, 10, 25, 50, 100, 1K, 10K, 100K microvolts. (±10% from 30 to 200 mc. ±20% from 200 to 400 mc.)
(6) Modulation Capability:	0 to 60% from 200 to 6000 cps.
(7) Internal Modulation:	1000 cps (±10%)
(8) External Modulation:	200 to 6000 cps. Applicable at EXT MOD INPUT jack J109 located on the front panel.
g. Test Set Subassembly TS-687/TRM-1	
(1) Transmitter Performance Tests	
(a) Frequency Range:	190 kc to 400 mc
(b) Power Range:	For use only with transmitters capable of power output from 3 to 100 watts.
(c) Modulation Metering:	0 to 100 percent modulation (within 10% positive peak modulation.)
(d) Over-modulation Peaks:	60 to 120%
(e) Audio Output Voltage	
(1) Frequency:	1000 cps (±10%)
(2) Output:	3 volts rms across external 82 ohm load (0 db)
(3) Attenuator:	Output voltage continuously variable from 0 db to minus 36 db (±2 db)
h. Volt/Milliwatt Meter:	
(1) Milliwatt meter	
(a) Range:	0-10, 0-100, 0-1000 milliwatts.
(b) Accuracy:	Within 5% of full scale reading between 200-6000 cps.
(c) Input Impedance:	300 ohms.
(2) AC Voltmeter	
(a) Ranges:	0-3, 0-30, 0-300 volts ac
(b) Accuracy:	Within 5% of full scale reading between 50-6000 cps.
(c) Sensitivity:	5000 ohms per volt.

TABLE III. TECHNICAL DATA Cont'd.

h. Volt/Milliwatt Meter (cont'd.):	
(3) DC Voltmeter:	
(a) Ranges:	0-3, 0-30, 0-300 and 0-600 volts dc.
(b) Accuracy:	Within 5% of full scale reading.
(c) Sensitivity:	20,000 ohms per volt.
i. Power Requirements:	103.5 to 126.5 volts, 50 to 1000 cycles per second, single phase ac. Nominal 115 volts ac.
k. Power Consumption Requirements:	Approximately 60 watts, at 115 v.

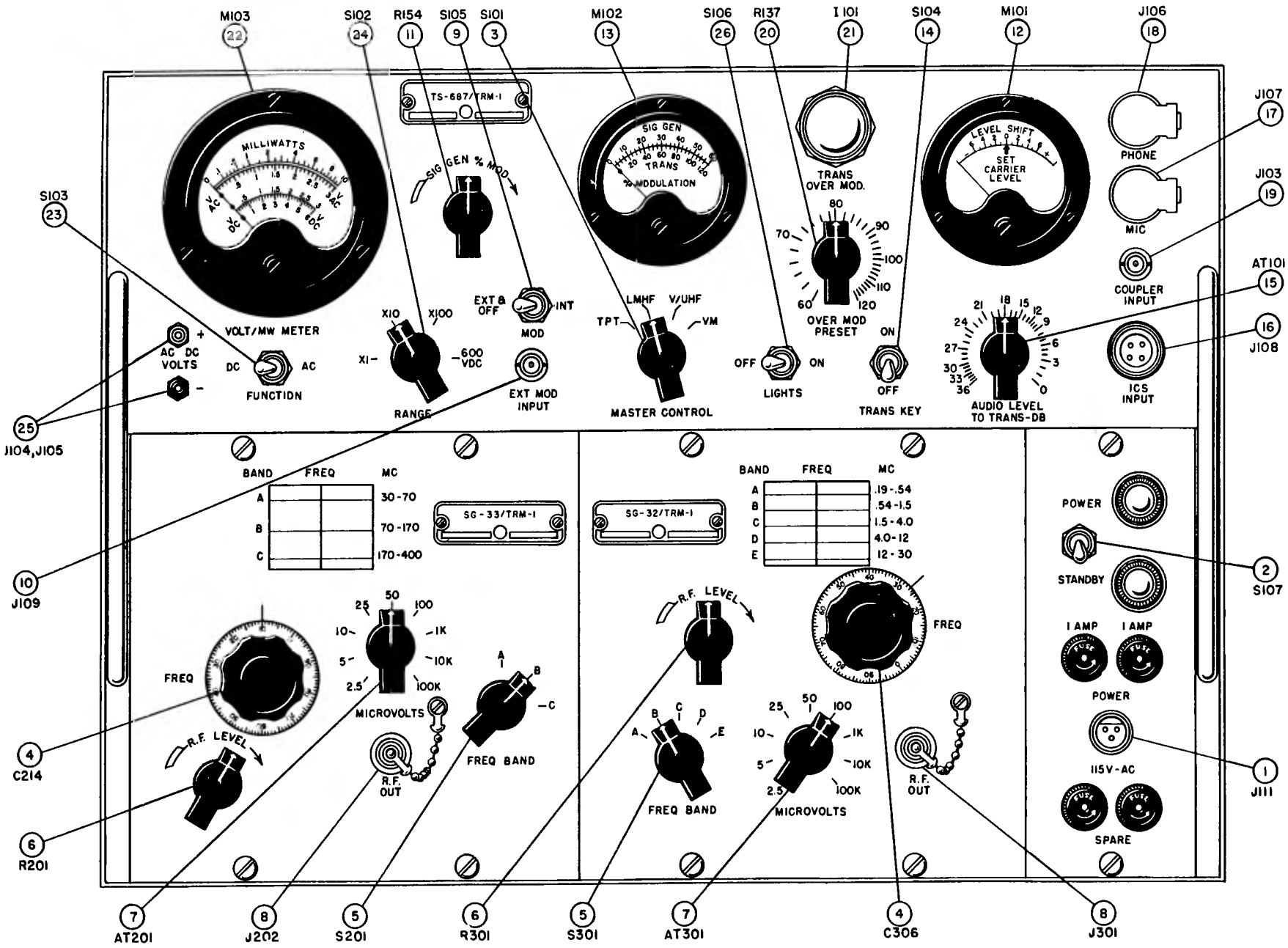

Figure 2-1. Operating Controls and Connectors, Radio Test Set AN/TRM-1

SECTION II

OPERATING PROCEDURES

2-1. GENERAL.

2-2. The complete step-by-step procedures for obtaining each function of Radio Test AN/TRM-1 are given in paragraphs 2-6 through 2-35 below. The controls and connectors referred to in the operating procedure are shown in figure 2-1, and their functions are listed in Table IV.

2-3. PRELIMINARY ADJUSTMENT.

2-4. To prevent possible damage to the equipment, and to assure proper operation, it is required to follow the pre-operation check and adjustment procedures outlined in Section III (paragraph, 3-3) of this publication.

2-5. OPERATION.

2-6. SELECTING TYPE OF OPERATION. Radio Test Set AN/TRM-1 has three principal functions:
a. Transmitter performance testing.
b. Receiver performance testing.
c. General purpose AC and DC voltmeter.
The desired function is selected by the position of the MASTER CONTROL switch S101 (Item 13 in figure 2-1). The position marked TPT selects the transmitter performance measuring circuits. LMHF and V/UHF positions select the receiver performance test circuits depending on the radio frequency range desired. The fourth position, VM, selects the AC-DC voltmeter when such measurements are to be made in junction boxes, dynamotors, power supplies and the like. The following paragraphs give detailed procedures for setting the panel control during operation of the test set.

2-7. POWER CONNECTION.

2-8. Apply operating power to the equipment as directed below.
a. Connect nominal 115-volt, 50 to 1000 cps, power source to the POWER receptacle, J111, via Electrical Power Cable Assembly CX-3642/U(8'0"). Follow pre-operating procedures given under paragraph 3-1 of this handbook.
b. Allow at least a 10 minute warm-up period, or longer when ambient temperature is below approximately 10 degrees C (50 degrees F).

2-9. RADIO TRANSMITTER PERFORMANCE TESTS (TPT). (See figure 2-3)

2-10. GENERAL. In this function the MASTER CONTROL switch in TPT position selects two separate circuit groups located in Test Set Subassembly TS-687/TRM-1. One circuit group produces a calibrated test audio signal suitable for introduction into the microphone input circuits of the transmitter under test. The second circuit group measures the characteristics of the RF output signal of the transmitter and indicates the following:
a. The relative power output.
b. The relative amount of carrier level shaft.
c. Degree of modulation of the transmitted carrier.
d. Overmodulation peaks from a value pre-set on a panel calibrated scale.

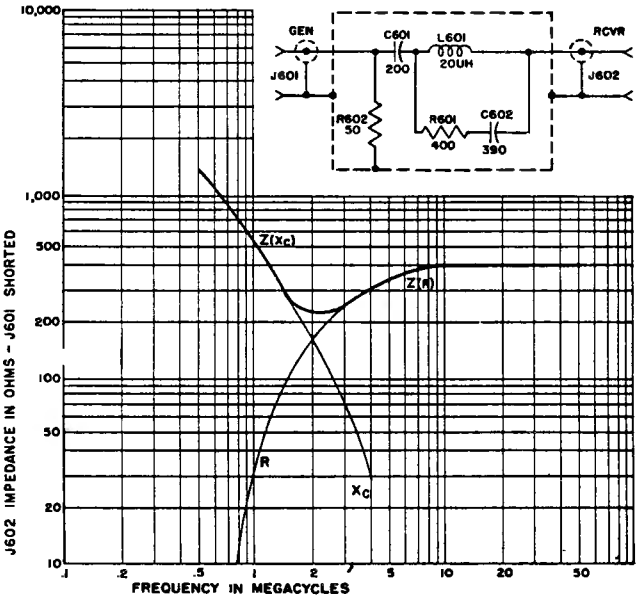

Figure 2-2. Test Adapter MX-1652/TRM-1, Input Impedance/Frequency Curve

2-11. TO MEASURE RELATIVE POWER OUTPUT OF A RADIO TRANSMITTER.

2-12. To measure the relative output power of a radio transmitter proceed as follows:
a. Depending upon the output frequency of the transmitter, either R.F. coupler-Detector CU-220/TRM-1 or CU-413/TRM-1, operating in the frequency ranges from 200 kc to 100 mc and 100 mc to 400 mc respectively, must be used. The couplers are furnished with the test set, and are stored in the cover. Connect the Output jack of the coupler elected to the test set at the COUPLER INPUT jack, J103, using RF Cable Assembly CG-546/U (8'0").
b. Turn the thimble of the micrometer type screw

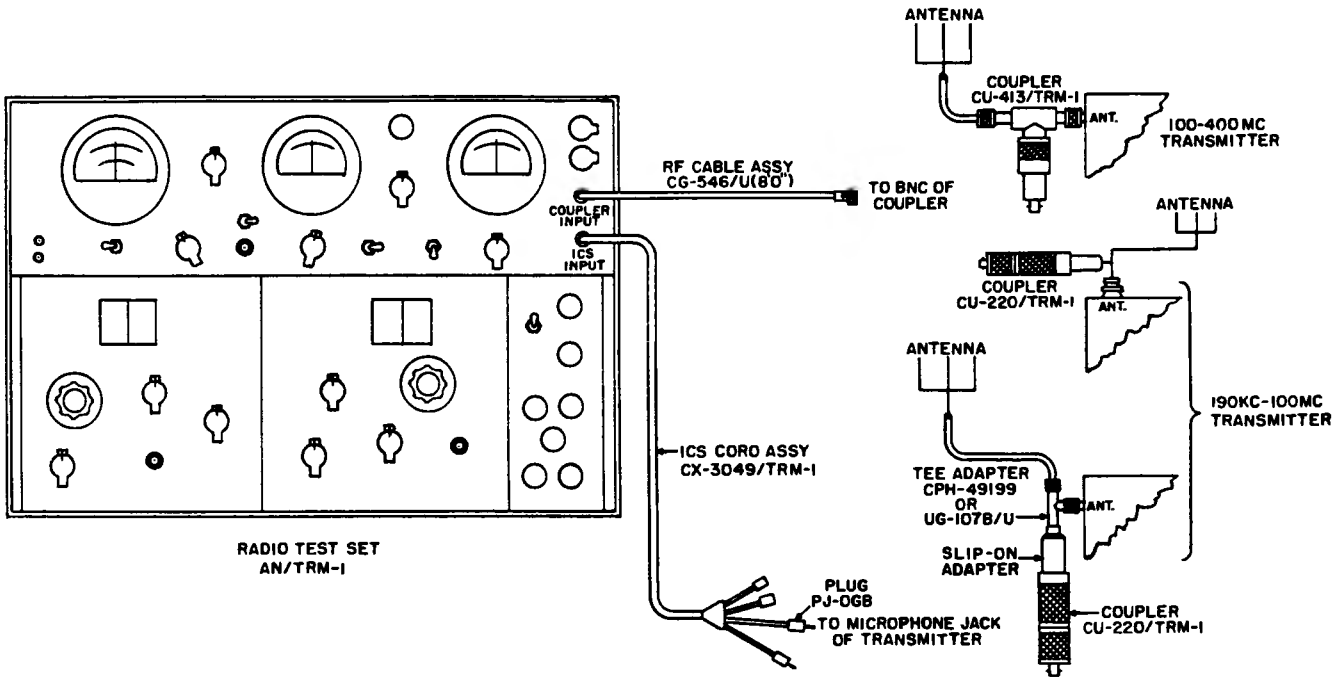

Figure 2-3. Typical Connections for Radio Transmitter Performance Tests

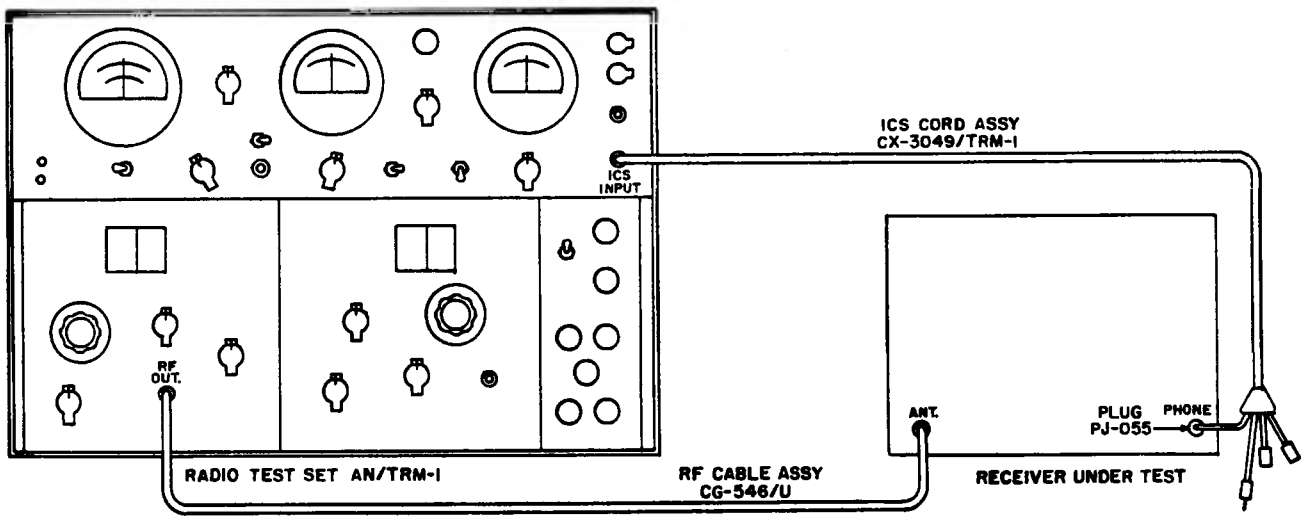

Figure 2-4. Typical Connections for Radio Receiver Performance Tests

of the coupler completely counterclock-wise, for minimum value of coupling.

WARNING

In order to avoid bodily contact with dangerous voltage which may be present on radio transmitting antennas, and to prevent possible damage to the test set, make sure that before connection the micrometer screw of the RF Coupler-Detector used is turned completely counterclock-wise for minimum coupling.

c. Connect the ICS Cord Assembly CX-3049/TRM-1 to the ICS INPUT jack J108 of the test set.

d. Connect the Plug PJ-068 terminal of the ICS cord to the microphone jack of the radio transmitter being tested. This connects the calibrated audio output circuit of the test set to the modulation of the transmitter.
e. Insert the RF Coupler in the antenna transmission line at the transmitter antenna terminal. Accessory "Tee" adapters are furnished to facilitate the attachment of coupler CU-220/TRM-1 to coaxial antenna feed systems. When using UHF connectors, such as the furnished Tee adapter CPH49199, remove the small adapter tip at the end of the Coupler. This tip is used only with type "N" coaxial fittings such as the "Tee" adapter UG-107B/U. Where an open wire antenna feed system is employed, remove the slip on adapter from Coupler CU-220/TRM-1, thus exposing the tip. This coupler may be hand-held to contact the tip to the antenna post.

CAUTION

To avoid excessive arcing and possible damage to the tip of coupler CU-220/TRM-1, make antenna contact firmly and break quickly.

f. Put the MASTER CONTROL switch S101 at TPT position to activate transmitter performance testing circuits.
g. Turn the AUDIO LEVEL TO TRANS-DB control, AT101, completely counterclock-wise.
h. Place the MOD switch, S105, to EXT & OFF position.
i. Run-up the transmitter to be tested in VOICE emission.
j. Place the TRANS KEY switch, S104, to ON position, This action keys the transmitter which will remain in "key-down" condition.
k. Rotate the knurled thimble of the RF Coupler-Detector clockwise until the needle of the CARRIER LEVEL meter points to the red arrow marked SET.
l. Relative power output is now given by the indicated number and divisions inscribed on the barrel of the coupler.

2-13. TO APPLY AUDIO AMPLITUDE MODULATION TO THE TRANSMITTER UNDER MEASUREMENT.

2-14. To apply a 1000 cps modulating signal, at a known level, to the microphone input circuit of a radio transmitter proceed as follows:
a. Follow the procedure given in paragraphs 2-7 through 2-12 above.
b. Check that, with no modulation, the CARRIER LEVEL meter indicates at the red arrow when the RF coupler is connected in the antenna circuit of the transmitter.
c. Place the MOD switch of the test set to INT position; thus activating the audio signal generator.
d. Advance the AUDIO LEVEL TO TRANS-DB control, AT101, to the required audio output level setting. The panel dial scale for this control is marked from 36 to 0 decibels, clockwise. The "O" db marking indicates the least attenuation level, that is, maximum output signal level. The level at zero db is 3 volts across 82 ohms external load.

2-15. TO DETERMINE THE RELATIVE LEVEL SHIFT OF THE TRANSMITTED CARRIER.

2-16. To ascertain the relative level shift of the transmitted carrier, perform the procedures given in the preceding paragraphs 2-7 through 2-14. When the required audio level, from the 1000 cps source in the test set, is set on the AUDIO LEVEL TO TRANS DB control AT101, the degree of carrier level unbalance will be indicated directly on the LEVEL SHIFT scale of the CARRIER LEVEL meter M101.

2-17. TO DETERMINE THE DEGREE OF MODULATION OF THE TRANSMITTED CARRIER.

2-18. To determine the degree of modulation of the carrier from the transmitter, carry out the operations outlined in paragraphs 2-7 through 2-14 of this section. When these requirement have been met, the degree of audio modulation will be indicated directly in percent on the lower scale of the % MODULATION METER, M102.

2-19. TRANSMITTER OVERMODULATION PEAK VISUAL INDICATION.

2-20. The existence of overmodulation peaks may be determined at the same time that the degree of modulation is measured (paragraph 2-17) by placing the OVERMOD PRESET control R137 to the setting required for the particular installation. Intermittent flashing of the TRANS OVERMOD indicator lamp I101 indicates the presence of overmodulation peaks.

2-21. RADIO RECEIVER PERFORMANCE TESTS (LMHF and V/UHF)
(See figure 2-4)

2-22. GENERAL. This function of the MASTER CONTROL switch, in either LMHF or V/UHF positions, selects two separate circuit groups. One circuit is a source capable of supplying either an amplitude modulated or cw rf test signal calibrated in frequency range from 190 kc to 400 mc. Because of the extreme frequency range covered, two separate standard Signal Generators - SG-32/TRM-1 (190 kc to 30 mc) and SG-33/TRM-1 (30 mc to 400 mc) are used. These generators function in LMHF and V/UHF positions, respectively, of the MASTER CONTROL switch. The signal generators, and accessory items described in paragraphs 2-38 and 2-40 are for use in applying a test signal to the rf input circuits of radio receivers to determine overall receiver sensitivity, signal-to-noise ratio, and for similar measurements as required. The second circuit used in testing receiver performance consists of an output meter that is designed to measure audio power output, in milliwatts, from the radio receiver under test; it is active in both LMHF and V/UHF position of MASTER CONTROL switch S101, and is thus available to measure receiver power output when either Signal Generator is used.

2-23. TO OBTAIN CW OUTPUT FROM THE SIGNAL GENERATORS.

2-24. Similar panel controls are used with both Signal Generator SG-32/TRM-1 and SG-33/TRM-1, therefore the following operating procedures apply to either. The signal generator used depends upon the frequency

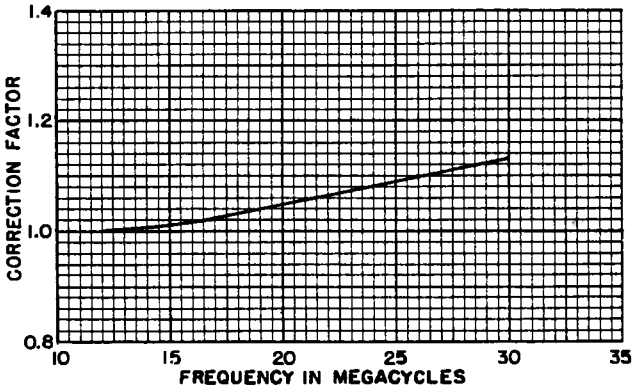

Figure 2-5. Correction Factor/Frequency Curve for Output Voltage on Band E of Signal Generator SG-32/TRM-1 (LMHF)

range desired, as discussed in paragraph 2-22 above. To obtain a cw (unmodulated) rf signal proceed as follows:

a. Rotate the SIG GEN % MOD and R.F. LEVEL completely counterclockwise.

b. Place the MOD switch to EXT & OFF position, thus completely disabling the internal audio modulation circuits.

c. Connect the test set to the power source as outlined in paragraph 2-7 of this section.

d. Set the FREQ BAND switch to the required scale.

e. Turn the FREQ dial control until the desired frequency is indicated on the illuminated dial scale.

NOTE

The vernier scale inscribed on the FREQ knob is useful for interpolating frequencies between main dial divisions and for resetting to frequencies which are not at exact main dial divisions.

f. Adjust the RF LEVEL control until the needle of the CARRIER LEVEL meter M101 indicates at the red arrow SET.

g. Set the MICROVOLTS step-attenuator to the required rf output level.

h. Connect one end of an RF cable CG-546/U of suitable length to the RF OUTPUT jack on the front panel.

i. Connect the other end of the rf cable to the radio receiver under test as required. Information regarding correct termination of the signal generators is contained under paragraph 2-38 of this section.

2-25. TO AUDIO AMPLITUDE MODULATE THE RF SIGNAL OUTPUT.

2-26. INTERNAL MODULATION. To obtain audio modulation of the rf signal from the internal 1000 cps source proceed as follows:

a. Perform the operations listed in paragraphs 2-23 and 2-24 above.

b. Place the MOD switch, S105, to INT position. This activates the internal audio modulation circuits.

c. Advance the SIG GEN % MOD control, R154, clockwise. At the same time, observe the % MODULATION meter M102. The degree of modulation of the rf signal is indicated directly in percent on the SIG GEN (upper) scale of the meter.

2-27. EXTERNAL MODULATION. To obtain audio modulation of the rf signal from an external source of audio frequency of between 200 and 6000 cps, make connections as follows:

a. Complete the procedures given in paragraphs 2-23 and 2-24.

b. Place the MOD switch, S105, to EXT & OFF.

c. Using Cable CG-546/U, connect the audio signal from the external oscillator at the panel jack EXT MOD INPUT, J109. The degree of modulation of the rf signal can be varied by the SIG GEN % MOD control, R154, located on the front panel of the test set. Modulation is indicated directly in percent on the % MODULATION panel meter, M102.

2-28. TO MEASURE AUDIO OUTPUT POWER FROM A RADIO RECEIVER.

2-29. To measure audio power output from a radio receiver proceed as follows:

a. Place the MASTER CONTROL switch S101 in either LMHF (190 kc-30 mc) or V/UHF (30 mc-400 mc) position, according to the required radio frequency input to the receiver. Either of these positions connect the milliwatt meter circuits to the ICS INPUT jack.

b. Connect the ICS Cord Assembly CX-3049/TRM-1 to the ICS INPUT connector of the test set.

c. Connect the phone plug PJ-055 terminal of ICS Cord CX-3049/TRM-1 to the phones output jack of the radio receiver. The input impedance to the test set is 300 ohms in this arrangement.

d. Initially, set the meter RANGE switch, S102, to the X100 position.

e. Apply a modulated rf test signal to the receiver input as described in paragraphs 2-23 through 2-25. Information regarding the proper termination of the Signal Generators is outlined in paragraph 2-38 and 2-40 of this section.

2-30. GENERAL PURPOSE AC AND DC VOLTAGE MEASUREMENTS (VM)

2-31. GENERAL. In the VM position, MASTER CONTROL switch S101 selects two separate voltmeter circuits which are located in Test Set TS-687/TRM-1 portion of the equipment. The ac voltmeter circuit is activated by positioning the meter FUNCTION switch S103 to AC position. The DC position of the FUNCTION switch selects the dc voltage measuring circuits. AC voltage - between 50 and 6000 cps in frequency - up to 300 volts, and dc voltage up to 600 volts, can be measured. Technical characteristics of the voltmeter circuits are given in Table III of this handbook. Test Lead Set CX-1331/U(4'2"), stored in the equipment cover, is supplied for use with the voltmeters.

2-32. TO MEASURE DC VOLTAGE.

2-33. To measure dc voltage make the following settings of panel controls. It is not required to connect the AN/TRM-1 to a power source in order to perform DC voltage measurements.

a. Place the MASTER CONTROL switch S101 to VM position.

b. Put the meter, FUNCTION, switch S103 in DC position.

c. Rotate the RANGE switch to the desired multiplier position. In measuring unknown dc voltage under 600 volts, it is considered safe practice to use the 600 VDC position of the range switch initially.

d. Remove Test Lead Set CX-1331/U(4'2") from its position in the equipment cover. Connect the test leads to the AC-DC volts pin jack terminals J104 and J105. Red and black leads represent positive and negative polarity respectively.

CAUTION

When voltage measurement is to be made on equipment having its chassis returned directly to the AC power line, the black voltmeter terminal (J105) should be connected only to the grounded side of the equipment.

e. To obtain an actual value in volts, multiply the 0-3 VDC scale reading by the factor indicated on the RANGE switch S102. The 0-6 VDC scale is used only when the RANGE switch is in the 600 VDC position

2-34. TO MEASURE AC VOLTAGE.

2-35. In measuring ac voltage, set the panel controls as follows:
a. Perform the start procedure outlined in paragraphs 2-7 and 2-8 of this section.
b. Place the MASTER CONTROL switch, S101, to VM position.
c. Put the FUNCTION Switch, S103, to AC position.
d. Connect Test Lead Set CX-1331/U(4'2") to the pin jack terminals J104 and J105. The black (negative) terminal is directly connected (internally) to the chassis of the test set.
e. To obtain the actual voltage value, multiply the reading on the 0-3 VAC scale, of meter M103, times the factor indicated by the position of the RANGE switch, S102.
f. Technical characteristics of the AC voltmeter are given in Table III of this handbook.

2-36. OPERATING CONTROLS AND CONNECTORS. (See figure 2-1)

2-37. Table IV, following, lists the item number (these numbers are encircled on figure 2-1), panel designation, and function of all operating controls and connectors located on the front panel of Radio Test Set AN/TRM-1. More complete information on the operation of the equipment is given in paragraphs 2-7 through 2-35 of this handbook.

2-38. USE OF ACCESSORIES. (See figure 1-1).

2-39. USE OF TEST ADAPTER MX-1652/TRM-1.

2-40. Test adapter MX-1652/TRM-1 is an antenna simulator used only with Signal Generator SG-32/TRM-1 when making overall sensitivity, and other measurements as required, on radio receivers in the LMHF range that are designed for use with an open wire antenna. The antenna simulator approximates the electrical conditions that exist when a signal is coupled into the antenna circuit of the receiver. Therefore, the significant voltage is the input voltage to the simulator and not the actual input voltage at the receiver. In order to insure that the rf input voltage to the antenna simulator is that indicated directly on the MICROVOLTS scale, the input impedance of the IN terminals of the simulator is 50 ohms which properly terminates the signal generator. The impedance of the OUT terminals approximates that of an open-wire antenna at the frequency used (See figure 2-2). Always connect the terminals marked IN to the Signal Generator, and the OUT terminals to the receiver.

2-41. TEST ADAPTER MX-2079/TRM-1.

2-42. Test Adapter MX-2079/TRM-1 is a feed through connection with a shunt 50 ohm resistance to ground. It is used as required with either Signal Generator SG-32/TRM-1 or SG-33/TRM-1 to match the 50 ohm output impedance of the RF out jacks when operating into a high impedance load. The value of the input signal to the load is then directly indicated at the step-attenuator MICROVOLTS. When using either Fixed Attenuator CN-399/TRM-1 (6 db) or CN-287/TRM-1 (12 db) into a high load impedance and accurate rather than relative readings are desired, insert the Test Adapter MX-2079/TRM-1 between the Fixed Attenuator and the load.

2-43. FIXED ATTENUATOR CN-399/TRM-1 (6 db).

2-44. Fixed Attenuator CN-399/TRM-1 can be used with either Signal Generator to accurately reduce the rf signal voltage in the ratio of two to one (6 db). When this attenuator is used with a receiver having an input impedance of 50 ohms, the voltage at the receiver is then one-half the reading indicated directly on the MICROVOLTS switch; when it is used with a receiver having a high impedance antenna input circuit, the direct two to one relationship can be maintained by inserting the 50 ohm shunt Test Adapter MX-2079/TRM-1 between the attenuator and the receiver.

2-45. FIXED ATTENUATOR CN-287/TRM-1 (12 db).

2-46. Fixed Attenuator CN-287/TRM-1 is physically similar to Fixed Attenuator CN-399/TRM-1 described in paragraph 2-44. It can be used with either Signal Generator to reduce accurately the RF signal output voltage in the ratio of four to one (12 db). When this attenuator is used with a receiver having an input impedance of 50 ohms, the actual input voltage to the receiver is then one-fourth that directly indicated by the MICROVOLTS switch; when it is used with a receiver having a high impedance antenna circuit, the direct four to one relationship can be maintained by inserting the 50 ohm shunt Test Adapter MX-2079/TRM-1 between the attenuator and the receiver.

2-47. RADIO FREQUENCY CABLE ASSEMBLY CG-546/U (8'0").

2-48. Radio Frequency Cable Assembly CG-546/U (8'0") is an eight foot length of type RG-55/U flexible coaxial cable terminated at each end in a type UG-88C/U (BNC) connector. This cable is used to connect the test set, at COUPLER INPUT jack J103, to either RF COUPLER DETECTOR CU-220/TRM-1, or CU-413/TRM-1 in making transmitter performance tests.

2-49. RADIO FREQUENCY CABLE ASSEMBLY CG-546/U (4'0").

2-50. Radio Frequency Cable Assembly CG-546/U (4'0") is a four foot length of type RG-55/U coaxial cable terminated at each end in a type UG-88C/U BNC connector. This cable is used in connecting the RF output of either Signal Generator SG-32/TRM-1 or SG-33/TRM-1 to accessory test adapters and to equipment being tested.

2-51. RADIO FREQUENCY CABLE ASSEMBLY CG-546/U (1'0").

2-52. Radio Frequency Cable Assembly CG-546/U (1'0") is a twelve-inch length of type RG-55/U coaxial cable terminated at each end in a type UG-88C/U BNC connector to facilitate the insertion of accessory adapters in the RF output of either Signal Generator SG-32/TRM-1 or SG-33/TRM-1.

2-53. RADIO FREQUENCY ADAPTER UG-107B/U.

2-54. Radio Frequency Adapter UG-107B/U is a "tee" shape, three plug, series "N" connector. The plug

TABLE IV. OPERATING CONTROLS AND CONNECTORS

ITEM	PANEL DESIGNATION	SYMBOL	FUNCTION
1	POWER 115V-AC connector	J111	Power input connector attaches the test set to the nominal 115-volt ac 50-1000 cps source by means of the three wire power cable CX-3642/U (8'0"). The third wire (green) connects the chassis of the test set to ground.
2	POWER-STANDBY switch	S107	Power input switch in POWER position applies nominal 115-volt ac power to power transformer T102. In STANDBY position operating power is applied to a space-heater (R161) and to the STANDBY indicator lamp (I103). The power input circuit is fused by two 1 AMP fuses. One fuse is in each side of the line.
3	MASTER CONTROL rotary switch	S101	A four-position multi-circuit rotary type switch used to select the basic functions of Radio Test Set AN/TRM-1. a. In TPT (Transmitter Performance Tests) position the circuitry and meters of the test set are switched to the function in which radio transmitters may be pre-flight checked for proper operation. The R.F. Coupler-Detectors CU-220/TRM-1 and CU-413/TRM-1 are used in the TPT function. DC power is removed from the Signal Generators in this position. b. The LMHF and V/UHF positions select the function in which radio receivers may be preflight tested. The LMHF positon activates Signal Generator SG-32/TRM-1, operating in the frequency range from 190 kc to 30 mc. In the V/UHF position, Signal Generator SG-33/TRM-1 is powered. Its frequency range is from 30 to 400 mc. The modulating and metering circuits for each signal generator, are also selected by the action of this switch. In both LMHF and V/UHF positions the milliwatt meter circuit is active and the audio output power of the receiver under test can be measured on the MILLIWATT scale of the VOLT/MW METER M103. c. The VM position of MASTER CONTROL switch selects the general purpose voltmeter function of the test set. In this function dc voltages up to 600 volts, and ac voltages up to 300 volts may be measured. Test Lead Set CX-1331/U (4'2") is supplied for use with the voltmeter. NOTE The controls and connectors associated with Signal Generators SG-32/TRM-1 and SG-33/TRM-1 are similar in function, only the frequency ranges differ. Therefore, the items 4 thru 8 below apply to both.
4	FREQ control and dial	C306, C214	This control varies the output frequency of the rf signal and drives the tuning dial. The main dial scales directly indicate frequency in megacycles. A 100 division scale on the FREQ knob is provided for ease of interpolating between divisions on the main dial.
5	FREQ BAND switch	S301, S201	This rotary switch selects the desired frequency band. Each band is designated with a letter of the alphabet. The output frequency is read directly on the corresponding scale of the tuning dial.
6	R. F. LEVEL control	R301, R201	A variable resistor controlling the plate voltage of the OSCILLATOR tube; it adjusts the rf output voltage to a calibrated level as indicated by the position of the needle at the red arrow on CARRIER LEVEL meter M101.
7	MICROVOLTS selector switch	AT301, AT201	This is a precision step-attenuator that varies the rf output signal magnitude in nine steps, from 100K down to 2.5 microvolts, which indicate correctly when the pointer of CARRIER LEVEL meter M101 is set to the red arrow, and when its output is terminated in 50 ohms.
8	R. F. OUT jack	J301, J202	A type BNC panel connector serving as the rf output terminal for the signal generator. Active only when the MASTER CONTROL switch is in the LMHF or V/UHF position, it facilitates connection of coaxial cables CG-546/U. The internal impedance of either signal generator is 50 ohms resistive for any position of the MICROVOLTS attenuator.

ITEM	PANEL DESIGNATION	SYMBOL	FUNCTION
9	MOD switch	S105	This toggle switch selects audio modulation voltage. It turns on the internal 1000 cps audio oscillator in INT position. In EXT & OFF position it permits the application of external audio signals thru EXT MOD INPUT jack J109.
10	EXT MOD INPUT jack	J109	This jack is a BNC type connector active only when the MOD switch is in EXT and OFF position. It facilitates the connection of external audio modulating signals, to the MODULATOR stage V106, of the test set.
11	SIG GEN % MOD control	R154	This variable resistor is active only in the LMHF and V/UHF position of the MASTER CONTROL switch. It controls the degree of modulation of the rf test signal for either signal generator. The panel meter % MODULATION, M102 indicates the degree of modulation in percent.
12	CARRIER LEVEL meter	M101	A panel meter having two scales. One scale has simply a red arrow marked SET. The other scale, marked LEVEL SHIFT is calibrated from - 6 to + 6, with zero at center scale, to indicate the percentage change from -60% to +60% of the detected average carrier voltage level. When the MASTER CONTROL switch S101 is in TPT position, and when either R.F. Coupler-Detector is connected to the unmodulated output of the transmitter under test, the coupling is increased by the CARRIER SET variable capacitor (within the coupler) until the meter needle positions at the red arrow. When modulation is applied to the transmitter the degree of carrier level shift is directly indicated on the LEVEL SHIFT scale.
13	% MODULATION meter	M102	This panel meter has two scales. When the test set is in LMHF or V/UHF function the upper scale, 0-60, indicates the degree of audio modulation (supplied from either the internal, or an external source) of the rf test signal from the rf signal generators. The lower scale, 0 to 120, indicates the degree of modulation of the rf carrier from a transmitter, when the test set is in the TPT function.
14	TRANS KEY switch	S104	A toggle switch used only when test set is in TPT function. It connects audio test signals to ICS INPUT jack J108 and MIC jack J107, and acts as a remote key for the transmitter under test.
15	AUDIO LEVEL TO TRANS-DB control	AT101	This continuously variable "T" audio-attenuator operates only when the test set is in TPT function. It is normally fed with 1000 cps audio from the internal AUDIO OSCILLATOR, via the MODULATOR stage, and is calibrated for an attenuation of from 0 to 36 db. When TRANS KEY is closed, the output audio signal is connected to the ICS INPUT jack J108 and MIC jack J107. 0 db is equivalent to 3 volts output when terminated in 82 ohms.
16	ICS INPUT connector	J108	A four terminal panel connector that mates with Cord Assembly CX-3049/TRM-1, and connects the equipment being tested to the test set as follows: TERMINAL A - Active in TPT position of MASTER CONTROL switch S101. Returns the keying circuit of the transmitter under test to ground, via the ring contact of the microphone plug PJ-068 terminal of Cord Assembly CX-3049/TRM-1, when the TRANS KEY switch S104 is placed ON. TERMINAL B - Active in both LMHF and V/UHF positions of MASTER CONTROL switch S101. The audio output of the receiver under test is connected to the MILLIWATT metering circuits of meter M103 via the phone plug PJ-055B terminal of Cord Assembly CX-3049/TRM-1. TERMINAL C - Active in TPT position of MASTER CONTROL switch S101 when the TRANS KEY switch S104 is on, and the MOD switch is in INT position. It supplies modulating audio test voltage, controlled by the AUDIO LEVEL TO TRANS-DB attenuator, to the transmitter under test via the tip contact of microphone plug PJ-068 terminal of Cord Assembly CX-3049/TRM-1. TERMINAL D - Chassis ground.

ITEM	PANEL DESIGNATION	SYMBOL	FUNCTION
17	MIC jack	J107	A microphone jack active in TPT function of the test set. It accepts a standard military aircraft carbon microphone plug, such as Plug PJ-068, including the transmitter control circuit, and allows the operator to voice modulate the transmitter, or the inter-com system from the test set.
18	PHONE jack	J106	This closed circuit jack accepts standard headset plug, such as Plug PJ-055B. It allows aural monitoring of audio signal input from receiver or inter-com system. Active in LMHF and V/UHF positions of MASTER CONTROL switch S101.
19	COUPLER INPUT jack	J103	This jack is active only when the test set is operating in the TPT function. It provides the input connection for the rectified rf carrier voltage from either R.F. Coupler-Detector CU-220/TRM-1 or CU-413/TRM-1. Interconnecting cable CG-546/U (8'0") is used with the rf couplers.
20	OVERMOD PRESET control	R137	This variable resistor, active only when the test set is operating in TPT function, adjusts the overmodulation detection and indicating circuits to function at any point within the range of 60 to 120 percent modulation. For any given setting, the TRANS OVERMOD indicator normally flashes only on excessive modulation peaks. Rapid flashing or a continuous glow during modulation indicates a degree of modulation higher than the percentage indicated by this control.
21	TRANS OVERMOD indicator	I101	This indicator light is active only in the TPT function of the test set, it operates in conjunction with the OVERMOD PRESET control R137 as described in item 20 above.
22	VOLT/MW METER	M103	Panel meter operative in LMHF, V/UHF and VM positions of the MASTER CONTROL switch. In the LMHF and V/UHF function of the test set, the MILLIWATTS scale functions to indicate the output power level of radio receivers connected at ICS input jack J108. In the VM function the meter indicates ac or dc volts as applied at the AC-DC VOLTS jacks, depending on the position of the meter FUNCTION switch. In order to obtain an actual value of volts or milliwatts the meter indication must be multiplied by the factor indicated by the RANGE switch. The 600 VDC position of the RANGE switch has a factor of 100 which applies only to the lower VDC scale marked 0 to 6.
23	DC-AC FUNCTION switch	S103	This toggle switch is operative when the MASTER CONTROL switch is in VM position. It selects the circuitry required for either the DC or AC function of VOLT/MW METER M103, depending upon its position. When using the MW function of M103 in LMHF and V/UHF function of the test set, the FUNCTION switch may be in either AC or DC position.
24	RANGE switch	S102	The RANGE switch is a four position rotary type switch which selects multiplier circuits used with the MILLIWATTS, AC volts and DC volts measuring functions of the VOLT/MW METER M103. The first three positions, XI, X10, and X100, are multiplying factors used with the corresponding scale functions, MILLIWATTS, VAC, and 0-3 VDC. The 600 VDC position applies only to the VDC scale marked 0-6.
25	AC-DC VOLTS jacks	J104 J105	These tip jacks are active only when the MASTER CONTROL switch is in the VM function. Test lead set CX-1331/U (4'2") is supplied to assist in making general purpose test measurments in connection with VAC and VDC voltmeter functions of the test set. The black colored jack J105 is the negative terminal and it is connected directly to the chassis of the test set in both DC and AC functions. The red colored jack J104 is the positive terminal for DC measurements.
26	LIGHTS OFF-ON switch	S106	This toggle switch allows the meter and dial illumination lamps to be placed on or off, at any time when using the test set.

take-off mates with a female series "N" connector. The straight section mates with a series "N" male connector. This adapter is used with RF Coupler-Detector CU-220/TRM-1 when connecting to coaxial antenna feed systems using type "N" fittings.

2-55. TEST LEAD SET CX-1331/U (4'2").

2-56. Test Lead Set CX-1331/U consists of two standard test leads approximately four feet in length, one black and one red in color, having detachable alligator clips. This set is supplied for use with the voltmeter function of Radio Test Set AN/TRM-1, in measuring ac and dc voltages. Connection is made to the test set at panel jacks J104 (red and J105 (black).

2-57. ELECTRICAL CORD ASSEMBLY CX-3049/TRM-1 (See figure 1-4)

2-58. Electrical Cord Assembly CX-3049/TRM-1 is used to connect the input circuits of the test set, at the ICS INPUT jack J108, to the intercommunication system (ICS) jack-box of the aircraft under preflight performance check. It consists of a shielded 4 conductor audio cable terminated in a four contact AN connector at one end, and at the other in a molded junction branching into two plugs and two jacks. The plugs are microphone plug type PJ-068, and phone plug type PJ-055B. The jacks are microphone type JJ-033, and phone jack type JJ-089. The plug terminals of the cord assembly are inserted into the mating jacks in the aircraft jack-box. The jack terminals of this cord are not normally used in testing. They provide means for the insertion of a military type microphone into the audio input circuit for control of the transmitter, and headphones for monitoring the audio output of the radio receiver.

2-59. ELECTRICAL POWER CABLE ASSEMBLY CX-3642/U (8'0").

2-60. Electrical Power Cable Assembly CX-3642/U is an eight foot length of flexible, three conductor, power line cable terminated in one end in a male connector, and in the other end in a three contact AN connector. This cable is used to connect Radio Test Set AN/TRM-1 to a source of nominal 115 V ac power. The wire extending from the side of the power plug is connected to the chassis of the test set, and provides a means for grounding it.

2-61. CONNECTOR ADAPTER UG-491A/U.

2-62. Connector Adapter UG-491A/U is a straight type series BNC coaxial adapter. It adapts a series BNC female connector to a series BNC female connector. It is for use in connecting the attenuator and adapter units to RF OUTPUT panel jacks.

2-63. ADAPTER UG-201A/U.

2-64. Adapter UG-201A/U is a straight type coaxial adapter. It adapts a series BNC male connector to a series N female connector. It is used to connect rf cable CG-546/U, or accessory test adapters to equipment having series N type rf connectors.

2-65. ADAPTER UG-273/U.

2-66. Adapter UG-273/U is a straight type coaxial fitting adapting a series BNC male connector to an UHF, type female coaxial connector. It is used to connect Cables CG-546/U, or accessory test adapter, to equipments having UHF type rf connectors.

2-67. CONNECTOR ADAPTER CPH-49199.

2-68. Connector Adapter CPH-49199 is a "tee" type coaxial adapter. The plug take-off mates with female UHF type connectors. The straight section mates with male UHF type connectors. This adapter is used to insert RF COUPLER-DETECTOR CU-220/TRM-1 into rf transmission systems using UHF type coaxial fittings.

2-69. SPECIAL PURPOSE ELECTRICAL CABLE ASSEMBLY CX-3884/U (2'6").

2-70. This cable assembly consists of a 2-1/2 foot length of 6 conductor cable terminating at one end in an Amphenol receptacle type 26-183, and at the other end in an Amphenol plug type 26-182. It is used to extend the plug-in power connection between either Signal Generator SG-32/TRM-1 or SG-33/TRM-1, and Test Set TS-687/TRM-1, when one of the signal generators is removed for maintenance purposes.

SECTION III

OPERATING CHECKS AND ADJUSTMENTS

3-1. INSTALLATION PROCEDURE.

3-2. Radio Test Set AN/TRM-1 is complete in one portable unit, and is ready for use upon delivery. No permanent or special installation procedures are necessary. Upon receipt of the equipment make the following initial inspection.

a. Unlatch the four fasteners holding Cover CW-196/TRM-1. Remove the cover and check its contents for possible physical damage.

b. Check the front panel of the test set for damage, such as cracked meter glass, broken control knobs, and the like.

c. Check the condition of the 1 amp fuses located over the POWER input receptacle J111.

d. Before applying power to the test set place the panel controls in the positions indicated in the following paragraph.

3-3. PRE-OPERATION ADJUSTMENTS.

3-4. To prevent possible damage to the equipment, make the following settings of the panel controls before applying power to the test set.

a. POWER switch, S107, to STANDBY position.

b. SIG GEN % MOD control, R154, fully counterclockwise.

c. RF LEVEL controls (both signal generators) R201, R301 fully counterclockwise.

d. AUDIO LEVEL TO TRANS-DB control, AT101, fully counterclockwise.

3-5. OPERATION CHECKS.

3-6. To determine that the equipment is in operating condition, perform the following checks.

a. Follow the precedure stated in paragraphs 3-3 and 3-4 above.

b. Place the controls listed below in the position indicated:

(1) POWER switch, S107, to STANDBY.

(2) RANGE switch, S103, to AC.

(3) MOD switch, S105, to INT position.

c. Remove power cable CX-3642/U (8'0") from its storage position in the equipment cover. Insert the three contact connector into the POWER receptacle J111, located in the lower right corner of the front panel. Connect the male connector to a source of nominal 115 volt, 50-1000 cps, single phase, power

d. With the POWER switch in STANDBY position, the front panel indicator lamp designated STANDBY will be illuminated, indicating that power is applied to the equipment space heater. In the event that the equipment has been subject to excessive humidity, the space heater should be left on as long as practicable in order to dry out condensed or absorbed moisture.

e. Place the AC switch to POWER position. The STANDBY panel lamp should now extinguish and the POWER lamp should light. This indicates that power has been removed from the internal space heater and is applied to the test set circuitry.

f. Allow the test set to warm up for at least 10 minutes with the AC switch in POWER position.

g. Place the MASTER CONTROL switch S101 in LMHF position. This setting activates Signal Generator SG-32/TRM-1. The pointer of the VOLT/MW METER should indicate zero on the MILLIWATTS scale. Make the following adjustments and checks.

(1) Rotate the FREQ control. Check that the frequency indicating dial rotates smoothly. Set at any desired frequency.

(2) Adjust the RF LEVEL control until the pointer of the CARRIER LEVEL meter M101 deflects to the red arrow marked SET. This setting indicates that the RF output voltage can be set to the proper reference value. When the signal generator output voltage at the RF OUT jack is properly terminated in 50 ohms, the value of output voltage in microvolts is indicated directly by the position of the MICROVOLTS selector.

(3) Rotate the SIG GEN % MOD control clockwise. The degree of audio modulation will be indicated on the upper scale, SIG GEN, of the % MODULATION meter.

(4) Place the FREQ BAND switch, and then the MICROVOLTS control, in each detented position. Check that the action is smooth and the detent firm for each position. Check the position of the pointer knob.

h. Turn the MASTER CONTROL switch to V/UHF position. Repeat for Signal Generator SG-33/TRM-1 the same checks and adjustments outlined under subparagraph g. above.

i. Rotate the MASTER CONTROL switch to VM position; thus placing the general purpose voltmeter circuits in operation. Make the following checks:

(1) Throw the FUNCTION switch to DC position.

(2) Check that the pointer of the VOLT/MW METER M103 indicates zero. If necessary, carefully move the zero adjustment located on the meter case until the pointer indicates zero.

(3) Connect Test Lead Set CX-1331/U (4'2") (stowed in the equipment cover) to the tip jacks, AC-DC volts, located at the left side of the front panel.

(4) Place the FUNCTION switch, S103, to AC position, and the RANGE switch S102, to X1.

(5) Touch the ends of the test leads together; make firm contact. The pointer of the VOLT/MW should indicate zero on the VAC scale.

(6) While the leads are shorted, successively switch the RANGE switch to X10 and X100 positions. The meter should remain at zero for both of these positions.

j. Turn the MASTER CONTROL switch to TPT position. Make the following checks:

(1) The pointer of the CARRIER LEVEL meter should indicate at the index marking located at the extreme left side of the LEVEL SHIFT scale. If not, turn the zero adjustment located on the meter case until the pointer position is at the index line.

(2) The pointer of the % MODULATION panel meter should indicate at zero. If necessary, turn the zero set adjustment on the meter case until the pointer positions at zero.

k. Place the toggle switch labeled LIGHTS to the ON position. Check that the dial lamps of the signal generators and the three panel meters are illuminated. If it is necessary to replace a dial, or meter illuminating lamp, refer to Section IV of this handbook.

3-7. PREPARATION FOR RESHIPMENT.

3-8. To prepare Radio Test Set AN/TRM-1 for reshipment proceed as follows:

a. Remove power cable CX-3642/U (8'0") from the power source outlet and from the test set. Replace the cable in its position in the equipment cover.

b. Disconnect all test leads, or RF cables in use and restore them to their positions in the cover.

c. Make sure that all accessory items, such as the connector adapters and fixed attenuators, are fastened securely in their respective positions in the cover. These items are shown in Figure 1-1 and are itemized

in Table I of this publication.

d. After checking that all cables and other accessory items are present, and in position, replace the cover on the test set. Fasten the four pull-down type catches. The equipment is now ready for normal transit.

e. In the event that the equipment is being prepared for domestic, or foreign shipment, it must be packaged in accordance with existing regulations governing the particular method.

SECTION IV

EMERGENCY OPERATION AND REPAIR

4-1. EMERGENCY OPERATION.

4-2. Since Radio Test Set AN/TRM-1 is a test equipment, no emergency operation is permissable. Any malfunctioning of the test set will warrant suspending the use of the equipment until such time as necessary corrective measures have been taken in accordance with the Handbook of Service Instructions for the test set.

4-3. OPERATORS MAINTENANCE.

4-4. Due to the nature of the equipment, the operators maintenance is necessarily restricted to external mechanical upkeep and the replacement of fuses, dial and pilot lamps.

4-5. REPLACING FUSES. Two active fuses, F101 and F102, are located in the front panel receptacles marked 1 AMP. If replacement of either or both of these fuses is indicated, replacement should be made with one or both of the SPARE fuses located directly below the active fuses. A new fuse should be placed in the spare receptacle as soon as possible after the original spare has been placed in service.

CAUTION

Do not replace a fuse with one of higher current rating unless continued operation is more important than probable damage to the equipment. If a fuse blows immediately after replacement do not replace it a second time until the cause of malfunctioning has been determined and remedied by service personnel.

4-6. REPLACING PILOT LAMPS.

4-7. The POWER pilot lamp, I102, and the STANBY pilot lamp, I103, are bayonet-based and are replaceable directly at the front panel. Unscrew the colored jewel by turning its knurled retainer counter-clockwise. This exposes the lamp. Using the finger-tips, press on the lamp and rotate counter-clockwise 1/4 turn. Release the pressure and remove the lamp.

4-8. REPLACING TRANS OVER MOD INDICATOR LAMP.

4-9. The TRANS OVER MOD indicator lamp may be replaced directly at the front panel in the same manner as the pilot lamps described in paragraph 4-6 above.

NOTE

Difference in characteristics of neon lamps may affect the calibration of the OVER MOD circuit. If it becomes necessary to replace the TRANS OVER MOD indicator lamp, the calibration must be checked by qualified personnel as directed in paragraph 6-7 of the Handbook of Service Instructions for this equipment.

4-10. REMOVING SIGNAL GENERATORS SG-32/TRM-1 and SG-33/TRM-1 FROM THE EQUIPMENT.

4-11. Both Signal generators contained in Radio Test Set AN/TRM-1 are of plug-in type construction. Each signal generator is retained in the test set with four captive type slotted screws located at the top and bottom of each signal generator front panel. After loosening of the four captive screws the respective signal generator may be removed from the test set. Pull directly out on the loosened screws until the plug is detached from the internal receptacle. Pull the unit straight out until it completely clears the test set.

4-12. REPLACING DIAL LAMPS IN SIGNAL GENERATOR SG-32/TRM-1.

4-13. To replace the two dial lamps, type No. 47, I301 and I302, in Signal Generator SG-32/TRM-1 remove the signal generator from its mounting in the test set. Use the method outlined in paragraph 4-10 above. The two dial lamp holders used with this signal generator are mounted on the main casting directly behind the front panel, one on each side of the tuning dial drum. Two screws fasten each lampholder. In order to replace a dial lamp the front screw must be removed. The lampholder may then be angled outward sufficiently to permit the removal and replacement of the lamp. After the lamp has been changed, carefully replace the screw.

4-14. REPLACING DIAL LAMPS IN SIGNAL GENERATOR SG-33/TRM-1.

4-15. Replacing the two type No. 47 dial lamps, I201 and I202, contained in Signal Generator SG-33/TRM-1, requires that the signal generator unit be removed from the test set as described under paragraph 4-10 of this section. The two lampholders used are mounted on the front panel; located one on each side of the tuning dial drum, at the escutcheon opening. In this particular unit the dial lamps may be replaced without moving their holders.

4-16. REMOVING THE TEST SET SUB-ASSEMBLY TS-687/TRM-1 FROM THE EQUIPMENT CASE.

CAUTION

Always replace and securely tighten all screws that have been removed from the equipment case during maintenance operations. This is necessary not only for mechanical reasons, but also to maintain radio frequency leakage at its safe minimum level.

4-17. Test Set Subassembly TS-687/TRM-1 must be removed from the equipment case to replace the vacuum tubes, panel meter illuminating lamps, and to gain access to the component parts mounted on the front panel and chassis assembly. This procedure is best accomplished as follows:

CAUTION

Do not remove any screws from the front panel of the test set when removing it from the equipment case.

a. Place the test set on a flat surface with the front panel facing upwards.

b. Remove the binding head screws located on the bottom of the test set. Do not remove the four feet upon which the test set normally rests.

c. Replace the test set to its normal upright position on its feet with the front panel facing away from the operator.
d. Remove the four binding head screws located on the back of the test set.
e. Turn the test set around so that the front panel faces inward.
f. Remove the six binding head screws that fasten the carrying handle to the top of the equipment case. Remove the carrying handle. Place the handle, and the 12 screws removed, in a container for safe keeping.
g. The test set is now free from the equipment case. Remove it by grasping the two crash handles located on the front panel, and gently pulling the test set straight out until it clears the equipment case.

4-18. REPLACING METER ILLUMINATING LAMPS.

4-19. To replace the panel meter illuminating lamps I104, I105, and I106, each a type No. 47 bayonet base incandescent lamp, Test Set Sub-assembly TS-687/TRM-1 must be removed from the equipment case. The procedure for removing the case is given in paragraph 4-10 of this section. The lampholder for each panel meter is bracket mounted, with a single round head screw, directly on the back of each meter case. To replace a lamp remove the screw and pull the lampholder outward until the lamp clears the meter case. After changing the illuminating lamp, carefully place the lampholder back into its original position. Avoid overtightening the roundhead retaining screw.

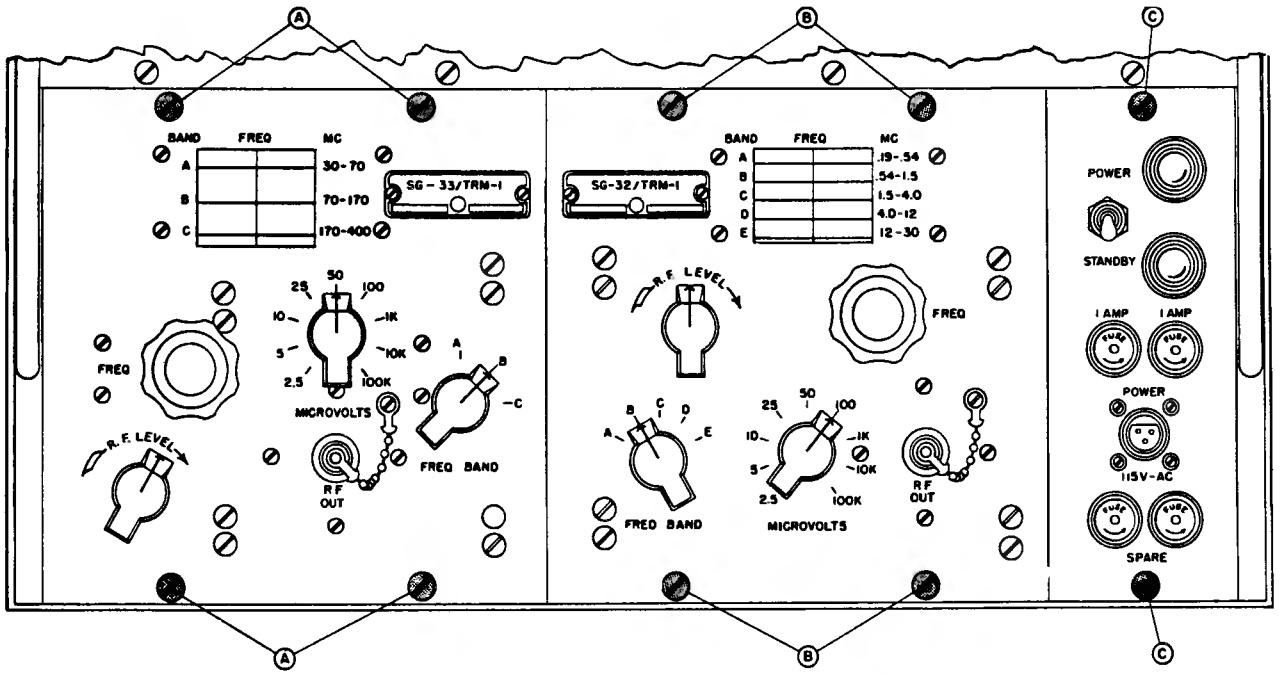

Figure 4-1. Front View for Removal of Signal Generators from the Equipment Case

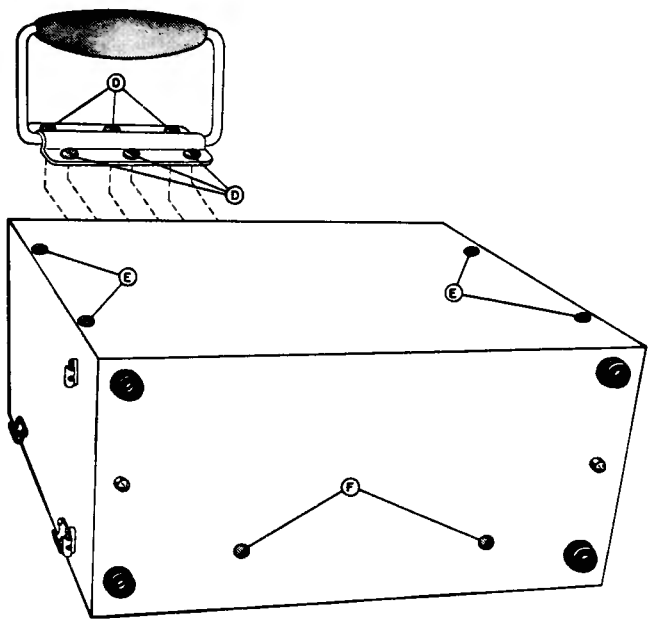

Figure 4-2. Rear-Bottom View for Removal of Test Set TS-687/TRM-1 from the Equipment Case

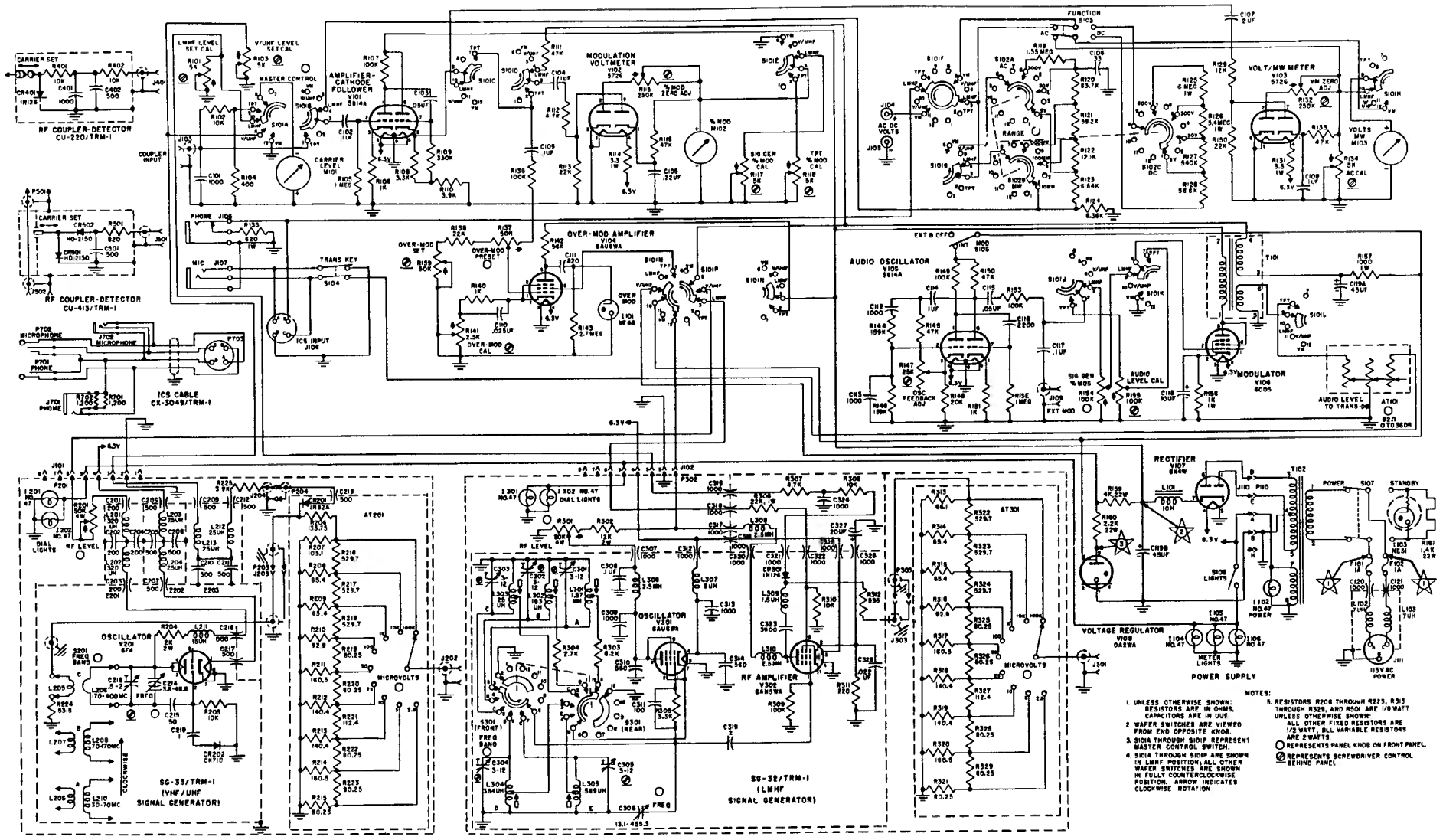

Figure 4-3. Radio Test Set AN/TRM-1, Schematic Diagram

(USAF) T.O. 33A1-3-256-2
(NAVY) NAVWEPS AN16-30TRM1-2

HANDBOOK
SERVICE INSTRUCTIONS

RADIO TEST SET AN/TRM-1

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND BY DIRECTION OF THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

1 OCTOBER 1956

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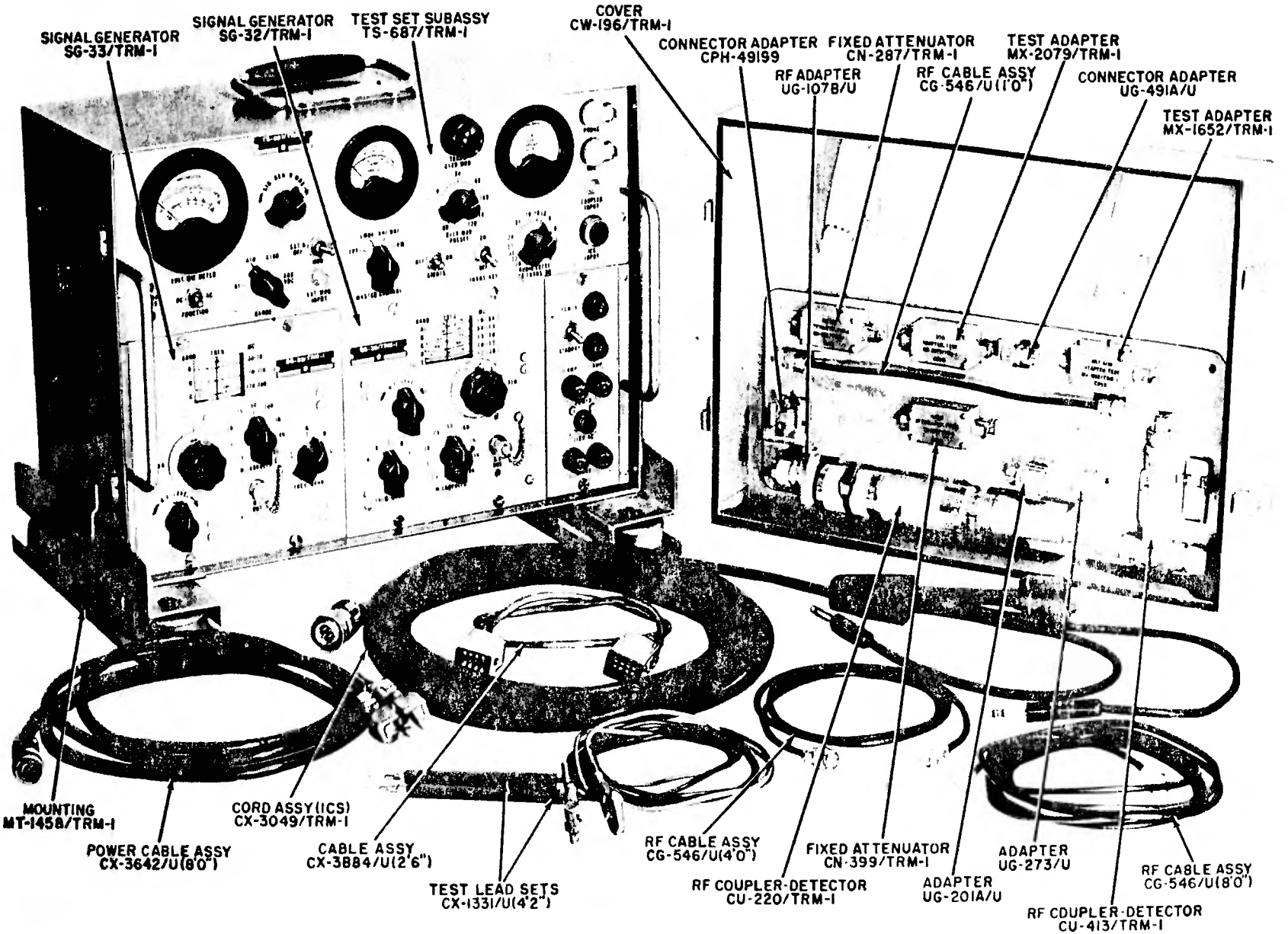


Figure 1-1. Radio Test Set AN/TRM-1, Equipment Supplied

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. PURPOSE OF HANDBOOK.

1-2. This publication comprises service instructions for the Radio Test Set AN/TRM-1, Contract No. NOas-51819a.

1-3. The purpose of this handbook is to present information required for the performance of certain repairs, replacements, and adjustments of Radio Test Set AN/TRM-1. Coverage includes procedures concerning that servicing which may be performed at Organizational and Field maintenance level by qualified personnel. Sections I and IV of this handbook cover the description and theory of operation of the equipment in detail.

1-4. PURPOSE OF THE EQUIPMENT.

1-5. Radio Test Set AN/TRM-1 provides, in a composite portable test instrument, the facilities necessary to perform go-no go pre-flight performance test on aircraft receiving, transmitting, and navigation equipment in frequency range from 190 kc to 400 mc, and voice inter-communication equipment in the audio range. The application and use of this equipment depends, to a large extent, upon the availability of statistical data listing satisfactory readings for equipments in various installations.

1-6. GENERAL PHYSICAL CHARACTERISTICS. (See figure 1-1)

1-7. Radio Test Set AN/TRM-1 is contained in a gray colored combination case and cover with a carrying handle located on top of the case. Two additional handles provided on the front panel serve to protect the panel meters and operating controls from damage. The unit is mounted on a shock absorbing base. The shock mounts are made removable by slide-action type latches. All operating controls, receptacles, and fuses are located on the front panel. They are functionally arranged, and clearly labeled for easy identification. Also located on the front panels are the spare fuses, meters, indicating dials, and indicator lamps. All accessory cables, adapters, terminations and instruction books are stowed in the front cover.

1-8. The equipment contains two separate signal generators (SG-32/TRM-1 and SG-33/TRM-1); plug-in type construction permits their easy removal for inspection and service. Each signal generator is separately housed in a heavy aluminum shield casting that minimizes radiation leakage caused by circulating RF current, and affords excellent mechanical and thermal stability.

1-9. Test Set Subassembly TS-687/TRM-1 is constructed to facilitate disassembly for maintenance and repairs. It consists of the protective case, frame structure, meter panel, power panel and a chassis subassembly. It contains the mounting and electrical connection facilities for the signal generators. Eleven internal adjustment controls are mounted at the rear of the chassis sub-subassembly.

1-10. R. F. Coupler-Detector CU-220/TRM-1 contains a conical air dielectric capacitor variable axially by means of a micrometer type adjustment. The degree of mesh and therefore the amount of coupling, is indicated by a 0-400 numerical scale inscribed on the barrel of the coupler. Index markings are inscribed on the screw sleeve. This coupler is terminated in a tip designed to contact the antenna binding post of the transmitter under test. It may be hand-held for single wire antenna systems. With the use of furnished adapters, connections can be made to the terminal fittings of coaxial RF transmission systems.

1-11. R.F. Coupler-Detector CU-413/TRM-1 functions similarly to the probe described above. It is "Tee" shape and designed for insertion into coaxial RF transmission systems. It is used at frequencies above 100 mc.

1-12. GENERAL ELECTRICAL CHARACTERISTICS. (See figure 4-15)

1-13. RADIO TEST SET AN/TRM-1 consists of circuitry and accessory items required to evaluate the pre-flight performance of communications and navigation equipments installed in aircraft. Its electrical design incorporates three basic test functions as follows:

a. Transmitter performance.
b. Receiver performance.
c. General purpose AC or DC voltage measurements.

Detailed description of the electrical characteristics of the components of Radio Set AN/TRM-1 is given in the following paragraphs, and a technical summary of these characteristics appears in paragraph 1-39.

1-14. SIGNAL GENERATOR SG-32/TRM-1 CIRCUIT.

1-15. This signal generator is active only in LMHF position of MASTER CONTROL switch S101 (Item 3 on figure 2-1). It consists essentially of a Hartley type oscillator circuit using a tube type 6AU6WA, V301, and an RF AMPLIFIER stage V302, using a type 6AN5WA tube. The output frequency range, 190 kc to 30 mc, is covered in five bands that are switched by means of the FREQ BAND control located on the front panel. Frequency is indicated directly on an illuminated drum dial. The RF AMPLIFIER stage acts as a buffer to isolate the OSCILLATOR stage, V301, from the effects of variations in output loading, and the application of audio modulation. Audio voltage from the internal audio oscillator, or from an external source, is applied to the RF AMPLIFIER, and results in the modulation of the RF signal. The degree of modulation is indicated as a percentage on % MODULATION panel meter, M102. Measured RF output voltage, indicated by the red arrow on the CARRIER LEVEL panel meter M101, is supplied to precision MICROVOLTS step-attenuator AT301. This nine position step-attenuator has a 50 ohm output impedance on any step; over the entire frequency range. RF signal output voltage is available at R.F. OUTPUT jack J301, on the front panel, in 100K, 10K, 1K, 100, 50, 25, 10, 5 and 2.5 microvolt steps. Plate and screen operating voltages for the OSCILLATOR, V301, and RF AMPLIFIER, V302, tubes, are supplied only when the MASTER CONTROL switch S101 is in the LMHF position. In other positions of this switch Signal Generator SG-32/TRM-1 is inoperative.

1-16. SIGNAL GENERATOR SG-33/TRM-1 CIRCUIT.

1-17. Signal Generator SG-33/TRM-1 uses a type 6F4 tube, V201, in an ultra-audion oscillator circuit. The

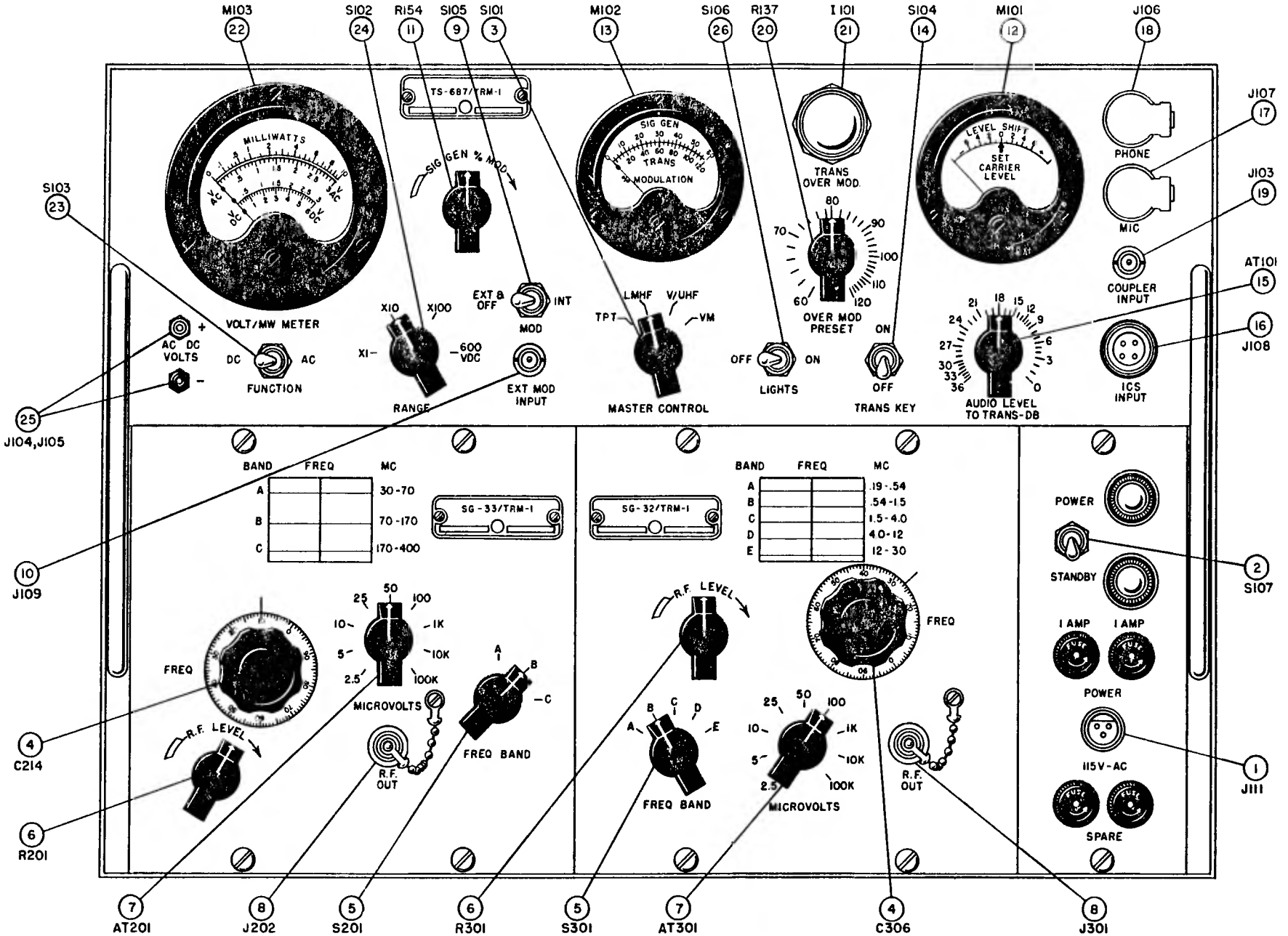


Figure 1-2. Operating Controls and Connectors, Radio Test Set AN/TRM-1

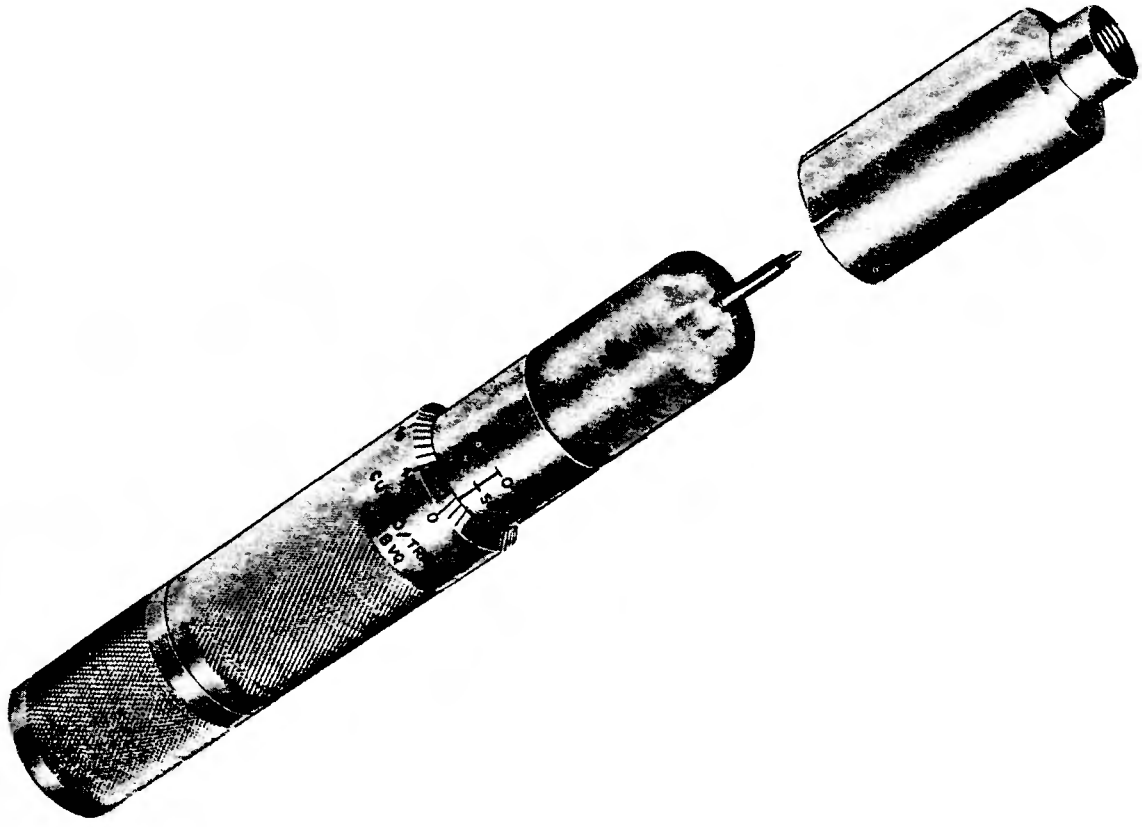


Figure 1-3. RF Coupler-Detector CU-220/TRM-1

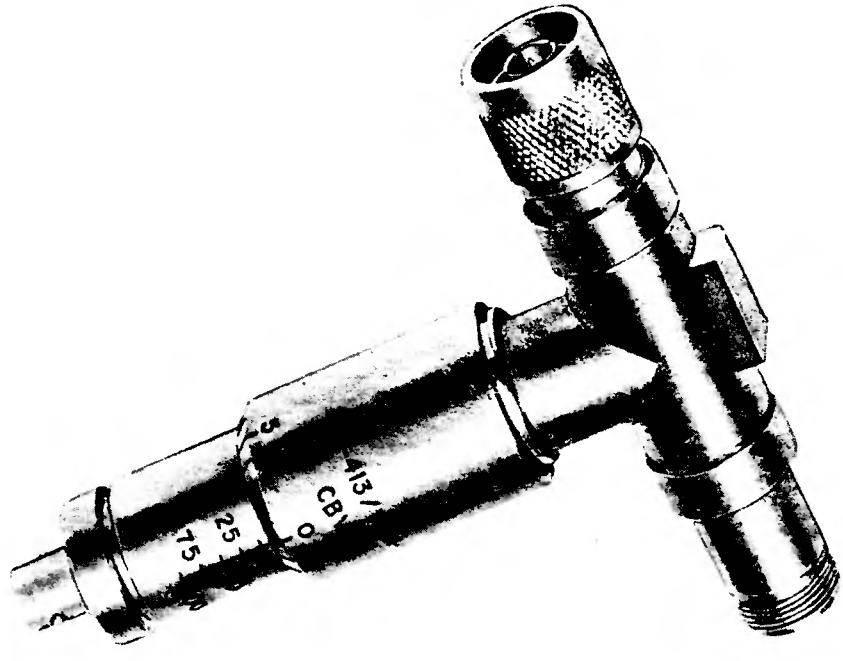


Figure 1-4. RF Coupler-Detector CU-413/TRM-1

signal frequency is continuously variable from 30 to 400 mc. The frequency range is covered in three overlapping bands, selected by FREQ BAND switch S201. Output frequency is indicated directly on an illuminated drum dial, and is varied by the panel control marked FREQ. Audio modulating voltage from the internal AUDIO OSCILLATOR, or from an external source is applied to the plate circuit of the OSCILLATOR stage. The degree of modulation is indicated on the panel meter, % MODULATION, M102. RF output level is measured by CARRIER LEVEL meter M101. The metered signal, adjusted to a known level by the R.F. LEVEL panel control R201, is fed to a precision step-attenuator AT201 marked MICROVOLTS on the front panel. This attenuator has an impedance of 50 ohms for any output step over the entire frequency range. When the RF OUT jack J202 is terminated externally in 50 ohms, the output voltage is variable in 100K, 10K, 1K, 100, 50, 25, 10, 5 and 2.5 microvolt steps. Plate voltage to operate Signal Generator SG-33/TRM-1, is supplied only when the MASTER CONTROL switch, S101, is in the V/UHF position.

1-18. TEST SET SUBASSEMBLY TS-687/TRM-1 CIRCUIT.

1-19. Test Set Subassembly TS-687/TRM-1 contains circuitry which performs the function of (1) audio signal source (2) transmitter performance tester, (3) volt/milliwatt meter, (4) power supply, (5) meter and control panel and (6) a fuse and lamp panel.

1-20. The audio signal source consists of an internal audio oscillator and a modulator stage. The AUDIO OSCILLATOR tube, V105, is a type 5814A in a Wien bridge type circuit fixed in frequency at 1000 cps. It is active only when the MOD switch S105 is in the INT position. The MODULATOR tube, V106 is a type 6005 used as a class A audio amplifier. Audio voltage is applied to the modulator stage from either the AUDIO OSCILLATOR, or from an external source through EXT MOD INPUT panel jack J109, depending on the position of the MOD switch S105. When the MASTER CONTROL switch S101 is in either the LMHF or V/UHF positions, the MODULATOR stage provides sufficient audio voltage to amplitude modulate the RF signal of Signal Generators SG-32/TRM-1 and SG-33/TRM-1. The modulating voltage is varied in amplitude by the SIG. GEN % MOD control R154, and measured by the MODULATION VOLTMETER, V102, using a type 5726 tube. The voltage is indicated on meter M102, % MODULATION, which is calibrated to indicate the degree of modulation in percent. The function of the audio signal generator, with regard to the transmitter performance test (TPT) circuits, is given in paragraph 1-21 below.

1-21. The transmitter performance test circuits are activated when MASTER CONTROL switch S101 is placed in TPT position. These circuits, in conjunction with the separate R.F. Coupler-Detector CU-220/TRM-1 or CU-413/TRM-1, are arranged to: (1) furnish a calibrated test audio signal to the microphone input circuits of radio transmitters and audio intercom systems, (2) measure the percentage of modulation of the transmitted carrier signal, (3) detect the presence of over-modulation and carrier-level shift, and (4) determine the relative power output of the transmitter under test. In TPT function the audio output of the MODULATOR, V106 is applied to the microphone input circuit of radio transmitters via the calibrated attenuator AT101, AUDIO LEVEL TO TRANS-DB. When the TRANS KEY switch S104 is placed ON, the audio test signal, variable from 0 to minus 36 db level, is present at the ICS INPUT jack J108, and at the MIC jack J107. The Audio signal level at 0 db is 3 volts across 82 ohms. The R.F. Coupler-Detectors CU-220/TRM-1 and CU-413/TRM-1 contain crystal diode rectifying circuits which produce dc voltage output proportional to the peak RF carrier voltage connected at the coupler input. The dc output voltage is applied, through COUPLER INPUT jack J103, to the CARRIER LEVEL meter M101. This meter deflects to a red arrow indicator when the dc output voltage of the probe reaches a pre-determined reference level. The amount of coupling required to produce the reference voltage on CARRIER LEVEL meter M101 is indicated by the scale reading on the barrel of the probe. See paragraph 1-10 and 1-11. The carrier level adjustment for relative power determination is always made without any modulation being applied to the transmitter. When the desired level of audio voltage, from the modulation circuits is applied to the transmitter microphone input, the degree of carrier level shift resulting is indicated on the --6-0-6+ scale of CARRIER LEVEL meter M101. The carrier modulation voltage is detected in the R.F. Coupler-Detector circuits, amplified by the first triode portion of V101 AMPLIFIER type 5814A tube, and then coupled via the second triode of V101, CATHODE FOLLOWER, to the input circuits of the MODULATION VOLTMETER V102, and the OVER MOD AMPLIFIER V104. The MODULATION VOLTMETER stage consists of a double diode type 5726, tube V102, and % MODULATION meter M102, calibrated to indicate the degree of carrier modulation directly in percent. The OVER MOD AMPLIFIER, V104 is a type 6AU6WA tube. This stage is calibrated to indicate overmodulation from any degree pre-set on panel control R137, OVER MOD PRESET, scaled from 60 to 120 percent. When voice modulation of the percentage indicated by the setting of R137 is applied to this circuit, the panel lamp, TRANS OVER MOD, I101, will flash intermittently on peaks. Overmodulation is indicated by excessive flashing, or continuous glowing of the lamp.

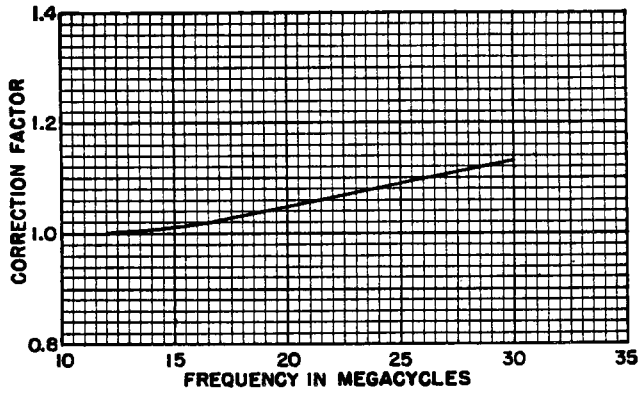


Figure 1-5. Correction Factor/Frequency Curve for Output Voltage on Band E of Signal Generator SG-32/TRM-1 (LMHF)

1-22. For the purpose of explanation, the volt/milliwatt metering circuits will be considered separately. The milliwatt meter functions only when the MASTER CONTROL switch S101, is in either the LMHF or V/UHF position. The milliwatt meter is used in conjunction with either Signal Generator SG-32/TRM-1 or SG-33/TRM-1 in the pre-flight evaluation of radio receivers. The modulated RF signal, from either signal generator selected is applied to the input circuit of the radio receiver, and results in an audio output voltage. The receiver output voltage is connected to the milliwatt meter circuits of the test set via the ICS INPUT jack J108. The FUNCTION switch S103 may be set in AC or DC positions. Full-scale ranges of 10, 100 and 1000 milliwatts are selected by the RANGE switch S102. The received signal is amplified by the AMPLIFIER portion of V101, and, via the CATHODE FOLLOWER

section of the same tube, is applied to the milliwatt circuit of the VOLT/MILLIWATT stage V103, which uses a type 5726 tube. In this function the VOLT/MW meter M103 is calibrated in milliwatts, and the upper scale marked MILLIWATTS is read. The actual reading in milliwatts is the product of the scale reading times the multiplier indicated by the pointer on the RANGE switch S102.

1-23. The voltmeter section of the VOLT/MILLIWATT METER circuits is activated only when the MASTER CONTROL switch S101 is in the VM position. This circuit is designed for general purpose use in measuring dc or ac voltages at external points. Test Lead Set CX-1331/U (4'2") is supplied for connection to the input terminals J104 and J105 marked AC-DC volts.

1-24. The DC voltmeter is selected by placing the FUNCTION switch S103 in the DC position. The positive voltage is connected to the red colored terminal J104. The black colored (negative) input terminal, J105 is internally grounded to the chassis of the test set. RANGE switch S102 selects the multiplier resistors for the full-scale ranges - 3, 30, 300 or 600 VDC of the VOLT/MW meter, M103. There are two DC voltage scales on meter M103. The upper scale 0-3, applies in the X1, X10, and X100 positions of RANGE switch S102. The lower scale 0-6 applies only in the 600 VDC position. Actual voltage values are obtained by multiplying the meter scale reading times the factor indicated by the RANGE switch S102. A scale multiplying factor of 100 is used in the 600 VDC setting. No vacuum tubes are used in the DC voltmeter circuits.

1-25. The AC voltmeter circuits are selected by placing the FUNCTION switch, S103, in the AC position. Jacks J104 and J105, AC-DC VOLTS, are used to connect Test Lead Set CX-1331/U(4'2"). J105 (black) is internally connected to the chassis. The RANGE switch S102 selects one of three multiplier positions; X1, X10, and X100. The 600 VDC position is not used in the AC function. AC voltage from the multiplier circuit is amplified by the AMPLIFIER section of V101 and, via the CATHODE FOLLOWER section of the same tube, is applied to the AC voltmeter circuit of the VOLT/MILLIWATT stage, V103, using a type 5726 tube. In this function the VOLT/MW meter M103 is calibrated to indicate ac volts and the upper meter scale marked VAC is read. The actual reading in ac volts is the product of the scale reading times the multiplier indicated by the pointer on RANGE switch S102.

1-26. A nominal 115 volts ac - 50 to 1000 cps - is applied to the primary of the power transformer T102. This transformer has two secondary windings. One winding is the source of 6.3 V ac for all vacuum tube heaters, and panel lamps. These lamps are controlled by the toggle switch S106, marked LIGHTS. The other secondary winding furnishes high-voltage to a full wave rectifier circuit employing a type 6X4W tube. Unregulated +265 volts is supplied to non-critical portions of the test set. A voltage regulator circuit using a type 0A2WA tube furnishes regulated +150 volts dc to Signal Generator SG-32/TRM-1 and SG-33/TRM-1, and to critical points in Test Set Subassembly TS-687/TRM-1.

1-27. EQUIPMENT SUPPLIED.

1-28. The complete Radio Test Set AN/TRM-1 equipment supplied by the manufacturer is listed in the table below, and is illustrated in figure 1-1. A complete list of replaceable parts appears in the Illustrated Parts Breakdown handbook for the equipment.

TABLE I. TABLE OF COMPONENTS

Qty. Per Equip.	Name of Unit	Designation	Overall Dimensions Height	Width	Depth	Volume	Wt.
1	Test Set Subassembly	TS-687/TRM-1	12-3/8	17-1/4	6-7/8	1468	19
1	Signal Generator	SG-32/TRM-1	6-13/16	6-7/8	6-5/8	310	6
1	Signal Generator	SG-33/TRM-1	6-13/16	6-7/8	6-5/8	310	8
1	R. F. Coupler-Detector	CU-220/TRM-1					
1	R. F. Coupler-Detector	CU-413/TRM-1					
1	Test Set Cover	CW-196/TRM-1					
2	Mounting	MT-1458/TRM-1					
1	Test Adapter	MX-1652/TRM-1					
1	Test Adapter	MX-2079/TRM-1					
1	Fixed Attenuator	CN-287/TRM-1					
1	Fixed Attenuator	CN-399/TRM-1					
2	Test Lead	CX-1331/U (4'2")					
1	Electrical Cord Assembly	CX-3049/TRM-1					
1	Electrical Power Cable Assy.	CX-3642/U (8'0")					
1	Radio Frequency Cable Assy.	CG-546/U (1'0")					
1	Radio Frequency Cable Assy.	CG-546/U (4'0")					

TABLE I (Continued)

Qty. Per Equip.	Name of Unit	Designation	Overall Dimensions Height Width Depth Volume Wt.
1	Radio Frequency Cable Assy.	CG-546/U (8'0")	
1	Radio Frequency Adapter	UG-107B/U	
1	Connector Adapter	UG-491A/U	
1	Connector Adapter	CPH-49199	
1	Adapter	UG-201A/U	
1	Adapter	UG-273/U	
1	Special Purpose Electrical Cable Assembly	CX-3884/U (2'6")	

1-29. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

1-30. Radio Test Set AN/TRM-1 is supplied complete and ready for operation. The only additional requirement is a power source of nominal 115-volt ac output, within the frequency range from 50 to 1000 cycles per second; single phase.

1-31. POWER SOURCE REQUIREMENTS.

1-32. The equipment operates from a 115-volt, 50 to 1000 cycle per second, ac power source, single phase. The voltage regulated power supply within the test set allows operation with line voltage variation from 103.5 to 126.5 rms.

1-33. ELECTRON TUBE, FUSE, AND INDICATOR LAMP COMPLEMENT.

1-34. Table II below, lists in numerical order the types of electron tubes, fuses, and indicator lamps used in the equipment.

TABLE II. TUBE, FUSE AND INDICATOR LAMP COMPLEMENT

REFERENCE SYMBOL	FUNCTION	TYPE DESIGNATION	LOCATION
		TUBES	
V101	AMPLIFIER-CATHODE FOLLOWER	5814A	Test Set Subassembly
V102	MODULATION VOLTMETER	5726	TS-687/TRM-1
V103	VOLT/MW METER	5726	"
V104	OVER-MOD AMPLIFIER	6AU6WA	"
V105	AUDIO OSCILLATOR	5814A	"
V106	MODULATOR	6005	"
V107	FULL-WAVE RECTIFIER	6X4W	"
V108	VOLTAGE REGULATOR	OA2WA	"
V201	OSCILLATOR (V/UHF)	6F4	Signal Generator SG-33/TRM-1
V301	OSCILLATOR (LMHF)	6AU6WA	Signal Generator SG-32/TRM-1
V302	RF AMPLIFIER	6AN5WA	Signal Generator SG-32/TRM-1

TABLE II. (Continued)

REFERENCE SYMBOL	FUNCTION	TYPE DESIGNATION	LOCATION
		INDICATOR LAMPS	
I101	OVER MOD INDICATOR	NE-48	Front panel, Test Set Subassembly TS-687/TRM-1
I102	POWER PILOT LAMP	NO. 47	Power Panel, Test Set Subassembly TS-687/TRM-1
I103	STANDBY PILOT LAMP	NE-51	Power Panel, Test Set Subassembly TS-687/TRM-1
I104 I105 I106	METER ILLUMINATING LAMP	NO. 47	Test Set Subassembly TS-687/TRM-1
I201 I202	DIAL ILLUMINATING LAMP	NO. 47	Signal Generator SG-33/TRM-1
I301 I302	DIAL ILLUMINATING LAMP	NO. 47	Signal Generator SG-32/TRM-1
		FUSES	
F101 F102	OPERATING FUSES	F02G1R00B (MDL-1) 1 Amp.	Power Panel
	SPARE FUSES	F02G1R00B (MDL-1) 1 Amp.	Power Panel

1-35. OPERATING CONTROLS AND CONNECTORS. (See figure 1-2)

1-36. Table III, below, lists the item number (these numbers are encircled on figure 1-2), panel designation and function of all operating controls and connectors located on the front panel of Radio Test Set AN/TRM-1. More complete information on the operation of the equipment is given in the Handbook of Operation Instructions.

TABLE III. OPERATING CONTROLS AND CONNECTORS

ITEM	PANEL DESIGNATION	SYMBOL	FUNCTION
1	POWER 115V-AC connector	J111	Power input connector attaches the test set to nominal 115-volt 50-1000 cps source by means of power cable CX-3642/U (8'0").
2	POWER-STANDBY switch	S107	Power input switch in POWER position applies nominal 115-volt ac power to power transformer T102. In STANDBY position operating power is applied to a space heater (R161) and to the STANDBY indicator lamp (I103). The power input circuit is fused by two 1 AMP fuses. One fuse is in each side of the line.
3	MASTER CONTROL rotary switch	S101	A four-position multi-circuit rotary type switch used to select the basic functions of Radio Test Set AN/TRM-1. a. In TPT (Transmitter Performance Tests) position the circuitry and meters of the test set are switched to the function in which radio transmitters may be pre-flight checked for proper operation. The R.F. Coupler-Detectors CU-220/TRM-1 and CU-413/TRM-1 are used in the TPT function. b. The LMHF and V/UHF positions select the function in which radio receivers may be tested. The LMHF position activates Signal Generator

TABLE III. (Continued)

ITEM	PANEL DESIGNATION	SYMBOL	FUNCTION
			SG-32/TRM-1, operating in the frequency range from 190 kc to 30 mc. In the V/UHF position, Signal Generator SG-33/TRM-1 is powered. Its frequency range is from 30 to 400 mc. The modulating and metering circuits for each signal generator, are also selected by the action of this switch. In both LMHF and V/UHF positions the audio output power of the receiver under test can be measured on the MILLIWATT scale of the VOLT/MW METER M103. c. The VM position of MASTER CONTROL switch selects the general purpose voltmeter function of the test set. In this function dc voltages up to 600 volts, and ac voltages up to 300 volts may be measured. Test Lead Set CX-1331/U (4'2") is supplied for use with the voltmeter.
			NOTE The controls and connectors associated with Signal Generators SG-32/TRM-1 and SG-33/TRM-1 are identical in function; only the frequency ranges differ. Therefore, the items 4 thru 8 below apply to both.
4	FREQ control and dial	C306, C214	This control varies the output frequency of theRF signal and drives the tuning dial; it has a vernier scale of 100 divisions for use in interpolating frequency between main dial divisions. The main dial scales indicate frequency in megacycles.
5	FREQ BAND switch	S301, S201	This rotary switch selects the desired frequency band. Each band is designated with a letter of the alphabet. The output frequency is read on the corresponding scale of the tuning dial.
6	R. F. LEVEL control	R301, R201	A variable resistor controlling the plate voltage of the OSCILLATOR tube. Adjusts the RF output voltage to a calibrated level as indicated by the position of the needle at the red arrow on CARRIER LEVEL meter M101.
7	MICROVOLTS selector switch	AT301, AT201	This is a precision step-attenuator that varies the RF output signal magnitude in eights steps, from 100K down to 2.5 microvolts, when the pointer of CARRIER LEVEL meter M101 is set to the red arrow.
8	R. F. OUT jack	J301, J202	A type BNC panel connector serving as the RF output terminal for the signal generator. Active only when the MASTER CONTROL switch is in the LMHF or V/UHF position, it facilitates connection of coaxial cable CG-546/U. The internal impedance of either signal generator is 50 ohms resistive for any position of the MICROVOLTS attenuator.
9	MOD switch	S105	This toggle switch selects audio modulation voltage. It turns on the internal 1000 cps audio oscillator in INT position. In EXT & OFF position it permits the application of external audio signals thru EXT MOD INPUT jack J109.
10	EXT MOD INPUT jack	J109	This jack is a BNC type connector active only when the MOD switch is in EXT and OFF position. It facilitates the connection of external audio modulating signals, to the MODULATOR stage, V106, of the test set.
11	SIG GEN % MOD control	R154	This variable resistor is active only in the LMHF and and V/UHF position of the MASTER CONTROL switch. It controls the degree of modulation of the RF test sig-

TABLE III. (Continued)

ITEM	PANEL DESIGNATION	SYMBOL	FUNCTION
			nal for either signal generator. The panel meter % MODULATION, M102, indicates the degree of modulation in percent.
12	CARRIER LEVEL meter	M101	A panel meter having two scales. One scale has simply a red arrow marked SET. The other scale, marked LEVEL SHIFT is calibrated in the range from minus 6, through zero to plus 6. When the MASTER CONTROL switch S101 is in TPT position, and when either R.F. Coupler-Detector is connected to the unmodulated output of the transmitter under test, the amount of coupling is increased by the CARRIER SET variable capacitor (within the coupler) until the meter needle positions at the red arrow. When modulation is applied to the transmitter the degree of carrier level shift is indicated on the LEVEL SHIFT scale. In LMHF or V/UHF functions the red arrow indicates the proper carrier level of both signal generators.
13	% MODULATION meter	M102	This panel meter has two scales. When the test set is in LMHF or V/UHF function the upper scale, 0-60, indicates the degree of audio modulation, supplied from either the internal, or an external source, of the rf test signal from the rf signal generators. The lower scale, 0 to 120, indicates the degree of modulation of the rf carrier from a transmitter, when the test set is in the TPT function.
14	TRANS KEY switch	S104	A toggle switch used only when test set is in TPT function. It connects audio test signals to ICS INPUT jack J108 and MIC jack J107, and acts as a remote closed key for the transmitter under test.
15	AUDIO LEVEL TO TRANS-DB control	AT101	This continuously variable "T" audio attenuator operates only when the test set is in TPT function. It is normally fed with 1000 cps audio from the internal AUDIO OSCILLATOR via the MODULATOR stage, and is calibrated for a loss of from 0 to 36 db. The output audio signal is connected through the TRANS KEY to the ICS INPUT jack J108 and MIC jack J107. 0 db is equivalent to 3 volts when terminated in 82 ohms.
16	ICS INPUT connector	J108	A four terminal panel connector, that mates with Cord Assembly CX-3049/TRM-1, connecting the equipment being tested to the test set as follows: TERMINAL A - Active in TPT position of MASTER CONTROL switch S101. Returns the keying circuit of the transmitter under test to ground, via the ring contact of the microphone plug, PJ-068, terminal of Cord Assembly CX-3049/TRM-1, when the TRANS KEY switch S104 is on, and the MOD switch is in INT position. It supplies modulating audio test voltage, controlled by the AUDIO LEVEL TO TRANS-DB attenuator, to the transmitter under test via the tip contact of microphone plug, PJ-068, terminal of Cord Assembly CX-3049/TRM-1. TERMINAL D - Chassis ground.
17	MIC jack	J107	A microphone jack active in TPT function of the test set. Accepts a standard military aircraft carbon microphone plug, such as Plug PJ-068, including the transmitter control circuit. Allows the operator to voice modulate the transmitter, or the inter-com system, from the test set.
18	PHONE jack	J106	This closed circuit jack accepts standard headset plug, such as Plug PJ-055. Allows aural monitoring of audio signal input from receiver or inter-com system. Active in LMHF and V/UHF positions of MASTER CONTROL switch S101.

TABLE III. (Continued)

ITEM	PANEL DESIGNATION	SYMBOL	FUNCTION
19	COUPLER INPUT jack	J103	This jack is active only when the test set is operating in the TPT function. It provides the input connection for the detected rf carrier voltage from either R. F. Coupler-Detector CU-220/TRM-1 or CU-413/TRM-1. Interconnecting cable CG-546/U (8'0") is used with the rf couplers.
20	OVERMOD PRESET control	R137	This variable resistor, active only when the test set is operating in TPT function, adjusts the overmodulation detection and indicating circuits to function at any point within the range of 60 to 120 percent modulation. For any given setting, the TRANS OVERMOD indicator normally flashes only on voice modulation peaks. Rapid flashing or a continuous glow during voice modulation indicates a degree of modulation higher than the percent indicated by this control.
21	TRANS OVERMOD indicator	I101	This indicator light is active only in the TPT function of the test set; it operates in conjunction with the OVERMOD PRESET control R137 as described in item 20 above.
22	VOLT/MW METER	M103	Panel meter operative in LMHF, V/UHF and VM positions of the MASTER CONTROL switch. In the LMHF and V/UHF function of the test set, the MILLIWATTS scale functions to indicate the output power level of radio receivers connected at ICS input jack J108. In the VM function the meter indicates AC or DC volts as applied at the AC-DC VOLTS jacks, depending on the position of the meter FUNCTION switch. In order to obtain an actual value of volts or milliwatts the meter indication must be multiplied by the factor indicated by the RANGE switch. The 600 VDC position of the RANGE switch has a factor of 100 which applies only to the lower VDC scale marked 0 - 6.
23	DC-AC FUNCTION switch	S103	This toggle switch is operative when the MASTER CONTROL switch is in VM position. It selects the circuitry required for either the DC or AC functions of VOLT/MW METER M103, depending upon its position.
24	RANGE switch	S102	The RANGE switch is a four position rotary type switch which selects multiplier circuits used in conjunction with the MILLIWATTS, AC volts and DC volts measuring functions of the VOLT/MW METER M103. The first three positions, X1, X10, and X100, are multiplying factors used in conjunction with the scale functions, MILLIWATTS, VAC and 0-3 VDC. The 600 VDC position applies only to the VDC scale marked 0-6.
25	AC-DC VOLTS jacks	J104 J105	These tip jacks are active only when the MASTER CONTROL switch is in theVM function. Test Lead Set CX-1331/U (4'2") is supplied to assist in making general purpose test measurements in connection with VAC and VDC voltmeter functions of the test set. The black colored jack J105 is the negative terminal connected directly to the chassis of the test set in both DC and AC functions. The red colored jack J104 is the positive terminal for DC measurements.
26	LIGHTS OFF - ON switch	S106	This toggle switch allows the meter and dial illumination lamps to be placed on or off, at any time when using the test set.

1-37. ADJUSTMENT CONTROLS.

1-38. Table IV below describes briefly the eleven chassis-mounted adjustment controls for Radio Test Set AN/TRM-1. All of these controls are arranged in a group located at the rear of the chassis assembly of Test Set Subassembly TS-687/TRM-1. They are easily accessible when the test set is removed from its protective case. Field maintenance personnel must take care to avoid disturbing the locked adjustments of these controls. Should recalibration of any of these controls be indicated, procedures describing permissible adjustments are discussed in Section VI, FIELD AND FASRON MAINTENANCE. When more complex alignment or adjustment is required, Overhaul and Repair Department personnel (of the Navy) or Depot personnel (of the Air Force) are directed to the detailed step-by-step procedure located in the Handbook of Overhaul Instruction for this equipment.

TABLE IV. ADJUSTMENT CONTROLS

ITEM	CHASSIS DESIGNATION	SYMBOL	FUNCTION
1	LMHF LEVEL SET CAL.	R101	Effective only in the LMHF position of the MASTER CONTROL switch S101 activating Signal Generator SG-32/TRM-1, this adjustment is part of an rf voltmeter circuit allowing the input to the MICROVOLTS step-attenuator, AT301, to be maintained at a standard reference voltage level. During recalibration, the signal voltage input to the step-attenuator is made equal to the proper value and then the LMHF LEVEL SET CAL. adjustment is varied until the needle of panel meter SET CARRIER LEVEL is positioned at the red arrow marked SET.
2	V/UHF LEVEL SET CAL.	R103	This adjustment is effective only in the VHF/UHF function of the MASTER CONTROL switch activating Signal Generator SG-33/TRM-1. It is part of an rf voltmeter circuit allowing the input to the MICROVOLTS step-attenuator, AT201, to be maintained at a standard reference level. During recalibration, the signal voltage input to the step-attenuator is made equal to the proper reference level and then the V/UHF LEVEL SET CAL. adjustment is varied until the needle of panel meter SET CARRIER LEVEL is positioned at the red arrow marked SET.
3	SIG GEN % MOD CAL	R117	Calibrates the SIG GEN scale of % MODULATION meter, M102, to indicate the degree of modulation of the rf signal output of either signal generator, depending upon the position of the MASTER CONTROL switch in LMHF or VHF/UHF position. This adjustment is not active in TPT and VM functions of the test set.
4	TPT & MOD CAL	R118	This adjustment is active only in the TPT function of the test set. It calibrates the TRANS scale of the % MODULATION meter M103 to indicate the degree of audio modulation of the rf carrier from the transmitter under test.
5	% MOD ZERO ADJ	R115	Sets the % MOD VOLTMETER circuits to indicate zero on % MODULATION meter M102. It is adjusted under no-signal conditions, and is active in TPT, LMHF and VHF/UHF functions of the MASTER CONTROL switch S101.
6	OVER MOD SET	R139	Adjusts the effective sensitivity range of OVER MOD PRESET R137, panel control in the input circuit of the OVERMOD AMPLIFIER stage, V104 active only in the TPT function of the MASTER CONTROL switch.
7	OVERMOD CAL	R141	Cathode bias adjustment of the OVERMOD AMPLIFIER stage, V104. It controls the gain of the amplifier and thus the sensitivity of the TRANS OVERMOD indicator lamp I101. This adjustment is active only in the TPT function of the test set.
8	VM ZERO ADJ	R132	Sets the VOLT/MW METER circuit to indicate no-signal zero on VOLT/MW METER, M103. The adjustment is active in the LMHF, VHF/UHF (milliwatts), and also in the VM position (when the FUNCTION switch, S103 is in AC position) of the MASTER CON-

TABLE IV. (Continued)

ITEM	CHASSIS DESIGNATION	SYMBOL	FUNCTION
8			TROL switch S101.
9	AC CAL	R134	Variable shunt resistor controlling the amount of rectified current from the linear diode of the VOLT/MW METER stage, V103, that passes through meter M103, thus allowing the calibration of the VAC and MILLIWATT scales.
10	OSC FEEDBACK ADJ	R147	Adjusts the degree of feedback voltage required to sustain oscillations in the AUDIO OSCILLATOR, V105, stage.
11	AUDIO LEVEL CAL	R155	This adjustment is active only in the TPT function of the test set. It adjusts the audio voltage input to the MODULATOR stage, V106, and establishes the reference input voltage level to the audio attenuator AUDIO LEVEL to TRANS-DB.

1-39. TECHNICAL SUMMARY.

1-40. The following table contains reference data and and a summary of the technical characteristics of Radio Test Set AN/TRM-1.

TABLE V. TECHNICAL DATA

a. Overall Nomenclature	Radio Test Set AN/TRM-1
b. Contract Number	NOas-51-819a
c. Contractor	Trad Electronics Corporation 1001 First Avenue, Asbury Park, N. J.
d. Cognizant Naval Inspector	Inspector of Naval Material, USN Naval Industrial Reserve Shipyard Port Newark, Newark 5, New Jersey
e. Signal Generator SG-32/TRM-1 (LMHF)	
(1) Frequency Range:	0.19 to 30 mc
(2) Frequency Bands:	5
(3) Band Ranges:	Band A .19 - .54 mc B .54 - 1.5 mc C 1.5 - 4.0 mc D 4.0 - 12 mc E 12 - 30 mc
(4) Frequency Dial Accuracy:	+ 1% of indicated frequency
(5) R F Output Voltage:	2.5 to 100,000 microvolts across 50 ohm external load. Attenuator adjustable in nine separate steps - 2.5, 5, 10, 25, 50, 100, 1K, 10K, 100K microvolts. (+ 10% from .19 to 12 mc. + 20% from 12 to 30 mc) ± 10% at all frequencies when corrected with a calibration chart. See figure 1-5.
(6) Modulation Capability:	0 to 60% from 200 to 6000 cps
(7) Internal Modulation:	1000 cps (+ 10%)
(8) External Modulation:	200 to 6000 cps. Applicable at EXT MOD INPUT jack J109 located on the front panel.
f. Signal Generator SG-33/TRM-1 (V/UHF)	
(1) Frequency Range:	30 to 400 megacycles
(2) Frequency Bands:	3
(3) Band Ranges:	Band A 30 - 70 mc B 70 - 170 mc C 170 - 400 mc
(4) Frequency Dial Accuracy:	+ 2% of indicated frequency
(5) R.F. Output Voltage:	2.5 to 100,000 microvolts across 50 ohm external load. Attenuator adjustable in nine separate steps- 2.5, 5, 10, 25, 50, 100, 1K, 10K, 100K microvolts. (± 10% from 30 to 200 mc. ±20% from 200 to 400 mc.)

TABLE V. (Continued)

(6) Modulation Capability:	0 to 60% from 200 to 6000 cps
(7) Internal Modulation:	1000 cps (+10%)
(8) External Modulation:	200 to 6000 cps. Applicable to EXT MOD INPUT jack J109 located on the front panel.
g. Test Set Subassembly TS-687/TRM-1	
(1) Transmitter Performance Tests	
(a) Frequency Range:	190 kc to 400 mc
(b) Power Range:	For use only with transmitters capable of power output from 3 to 100 watts.
(c) Modulation Metering:	0 to 100 percent modulation (within 10% positive peak modulation)
(d) Peak Over-modulation: Detector (Preset):	60 to 120%
(e) Audio Output Voltage	
(1) Frequency:	1000 cps (± 10%)
(2) Output:	3 volts rms across external 82 ohm load (0 db)
(3) Attenuator:	Output voltage continuously variable from 0 db to minus 36 db (± 2 db)
h. Volt/Milliwatt Meter:	
(1) Milliwatt meter	
(a) Ranges:	0-10, 0-100, 0-1000 milliwatts
(b) Accuracy:	Within 5% of full scale reading between 200 - 6000 cps
(c) Input Impedance:	300 ohms
(2) AC Voltmeter	
(a) Ranges:	0-3, 0-30, 0-300 volts ac
(b) Accuracy:	Within 5% of full scale reading between 50 - 6000 cps
(c) Sensitivity:	5000 ohms per volt
(3) DC Voltmeter	
(a) Ranges:	0-3, 0-30, 0-300 and 0-600 volts dc.
(b) Accuracy:	Within 5% of full scale reading
(c) Sensitivity:	20,000 ohms per volt
i. Power Requirements:	103.5 to 126.5 volts, 50 to 1000 cycles per second, single phase ac. Nominal 115 volts ac.
k. Power Consumption Requirements:	Approximately 60 watts at 115 volts at a power factor of approximately 85%.

SECTION II

SPECIAL TEST EQUIPMENT AND SPECIAL TOOLS

2-1. SPECIAL TEST EQUIPMENT.

2-2. No special test equipment is required for field maintenance of Radio Test Set AN/TRM-1. A general purpose multimeter having a sensitivity of 20,000 ohms per volt is required for measurements at tubes, socket terminals, or at test points indicated on the schematic diagram, figure 7-1. Multimeter TS-352/U or equivalent is suitable for this purpose. Where the use of a vacuum tube voltmeter is indicated, AN type TS-375/U or equivalent is satisfactory.

2-3. SPECIAL TOOLS.

2-4. No special tools are required in the field maintenance of Radio Test Set AN/TRM-1. Two Allen set screw wrenches are supplied to use in tightening knobs, and in the disassembly of certain component parts. These wrenches are stored with the accessory units in the cover CW-196/TRM-1, shown in figure 1-1.

SECTION III

PREPARATION FOR USE AND RESHIPMENT

3-1. PREPARATION FOR USE.

3-2. Radio Test Set AN/TRM-1 is complete in one portable unit, and is ready for use upon delivery. No permanent or special installation procedures are necessary. Upon receipt of the equipment make the following initial inspection:

a. Unlatch the four fasteners holding Cover CW-196/TRM-1. Remove the cover and check its contents for possible physical damage.

b. Check the front panel of the test set for damage, such as cracked meter glass, broken control knobs, and the like.

c. Check the condition of the 1 amp fuses located over the POWER input receptacle J111.

d. Before applying power to the test set place the panel controls in the positions indicated in the following paragraph.

3-3. PRE-OPERATING ADJUSTMENTS.

3-4. To prevent possible damage to the equipment, make the following settings of the panel controls before applying power to the test set.

a. POWER switch, S107, to STANDBY position.

b. SIG GEN % MOD control, R154, fully counter-clockwise.

c. RF LEVEL TO TRANS-DB control, AT101, fully counter-clockwise.

3-5. OPERATION CHECKS.

3-6. To determine that the equipment is in operating condition, perform the following checks.

a. Follow the procedure stated in paragraphs 3-3 and 3-4 above.

b. Place the controls listed below in the position indicated.

(1) FUNCTION switch, S107, to STANDBY.

(2) RANGE switch, S103, to AC.

(3) MOD switch, S105, to INT position.

c. Remove power cable CX-3642/U (8'0") from its storage position in the equipment cover. Insert the three contact connector into the POWER receptacle J111, located in the lower right corner of the front panel. Insert the male connector into a source of nominal 115 volt, 50-1000 cps, single phase, power.

d. With the POWER switch in STANDBY position, the front panel indicator lamp designated STANDBY will be illuminated, indicating that power is applied to the equipment space heater. In the event that the equipment has been subject to excessive humidity, the space heater should be left on as long as practicable in order to dry out condensed or absorbed moisture.

e. Place the AC switch to POWER position. The STANDBY panel lamp should now extinguish and the POWER lamp should light. This indicates that power has been removed from the internal space heater and is applied to the test set circuitry.

f. Allow the test set to warm up for at least 10 minutes with the AC switch in POWER position.

g. Place the MASTER CONTROL switch S101 in LMHF position. This setting activates Signal Generator SG-32/TRM-1. The pointer of the VOLT/MW METER should indicate zero on the MILLIWATTS scale. Make the following adjustments and checks.

(1) Rotate the FREQ. control. Check that the frequency indicating dial rotates smoothly. Set at any desired frequency.

(2) Adjust the RF LEVEL control until the pionter of the CARRIER LEVEL meter M101 deflects to the red arrow marked SET. This setting indicates that the RF output voltage can be set to the proper reference value. When the signal generator output voltage at the RF OUT jack is properly terminated in 50 ohms, the value of output voltage in microvolts is indicated directly by the position of the MICROVOLTS selector.

(3) Rotate the SIG GEN % MOD control clockwise. The degree of audio modulation will be indicated on the upper scale, SIG GEN, of the % MODULATION meter.

(4) Place the FREQ BAND switch, and then the MICROVOLTS control, in each detented position. Check that the action is smooth and the detent firm for each position. Check the position of the pointer knob.

h. Turn the MASTER CONTROL switch to V/UHF position. Repeat for Signal Generator SG-33/TRM-1 the same checks and adjustments outlined under subparagraph, g. above.

i. Rotate the MASTER CONTROL switch to VM position; thus placing the general purpose voltmeter circuits in operation. Make the following checks:

(1) Throw the FUNCTION switch to DC position.

(2) Check that the pointer of the VOLT/MW METER M103 indicates zero. If necessary carefully move the zero adjustment located on the meter case until the pointer indicates zero.

(3) Connect Test Lead Set CX-1331/U (4'2") (stowed in the equipment cover) to the tip jacks, AC-DC volts, located at the left side of the front panel.

(4) Place the FUNCTION switch, S103, to AC position, and the RANGE switch S102, to X1.

(5) Touch the ends of the test leads together; make firm contact. The pointer of the VOLT/MW should indicate zero on the VAC scale.

(6) Successively, switch the RANGE switch to X10 and X100 positions. The meter should remain at zero for both these positions.

k. Turn the MASTER CONTROL switch to TPT position. Make the following checks:

(1) The pointer of the CARRIER LEVEL meter should indicate at the index marking located at the extreme left side of the LEVEL shift scale. If not, turn the zero adjustment located on the meter case until the pointer position is at the index line.

(2) The pointer of the % MODULATION panel meter should indicate at zero. If necessary turn the zero set adjustment on the meter case until the pointer positions at zero.

l. Place the toggle switch labeled LIGHTS to the ON position. Check that the dial lamps of the signal generators and the three panel meters are illuminated. If it is necessary to replace a dial or meter illuminating lamp, refer to Section V of this handbook.

3-7. PREPARATION FOR RESHIPMENT.

3-8. To prepare Radio Test Set AN/TRM-1 for reshipment proceed as follows:

a. Remove power cable CX-3642/U (8'0") from the power source outlet and from the test set. Replace the cable in its position in the equipment cover.

b. Disconnect all test leads, or RF cables in use, and restore them to their positions in the cover.

c. Make sure that all accessory items, such as the connector adapters and fixed attenuators, are fastened securely in their respective positions in the cover. These items are shown in Figure 1-1 and are itemized

in Table I of this publication.

d. After checking that all cables and other accessory items are present, and in position, replace the cover on the test set. Fasten the four pull-down type catches. The equipment is now ready for normal transit.

e. In the event that the equipment is being prepared for domestic, or foreign shipment, it must be packaged in accordance with existing regulation governing the particular method.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. Radio Test Set AN/TRM-1 provides the necessary facilities to the pre-flight "on the line" determination of receiver sensitivity, transmitter relative power output, transmitter modulation, and overall system operation, including the intercommunication facilities operating in the audio range, and antenna systems functioning in the frequency range from 190 kc to 400 mc. This test set has sufficient accuracy and stability so that successive pre-flight checks have the same significance relative to a statistically obtained standard.

4-3. Radio Test Set AN/TRM-1 has three principal functions:

a. Transmitter Performance Testing
b. Receiver Performance Testing
c. DC and AC Voltmeter

The desired function of the test set is selected by the position of the MASTER CONTROL switch S101. The position marked TPT selects the transmitter performance test circuits. LMHF and V/UHF positions select the receiver performance test circuits depending on the radio frequency range desired. The fourth position, VM, selects the AC-DC voltmeter when such measurements are to be made at terminals in junction boxes, dynamotors, and the like.

4-4. BLOCK DIAGRAM (See figure 4-15)

4-5. TRANSMITTER PERFORMANCE TEST CIRCUITS

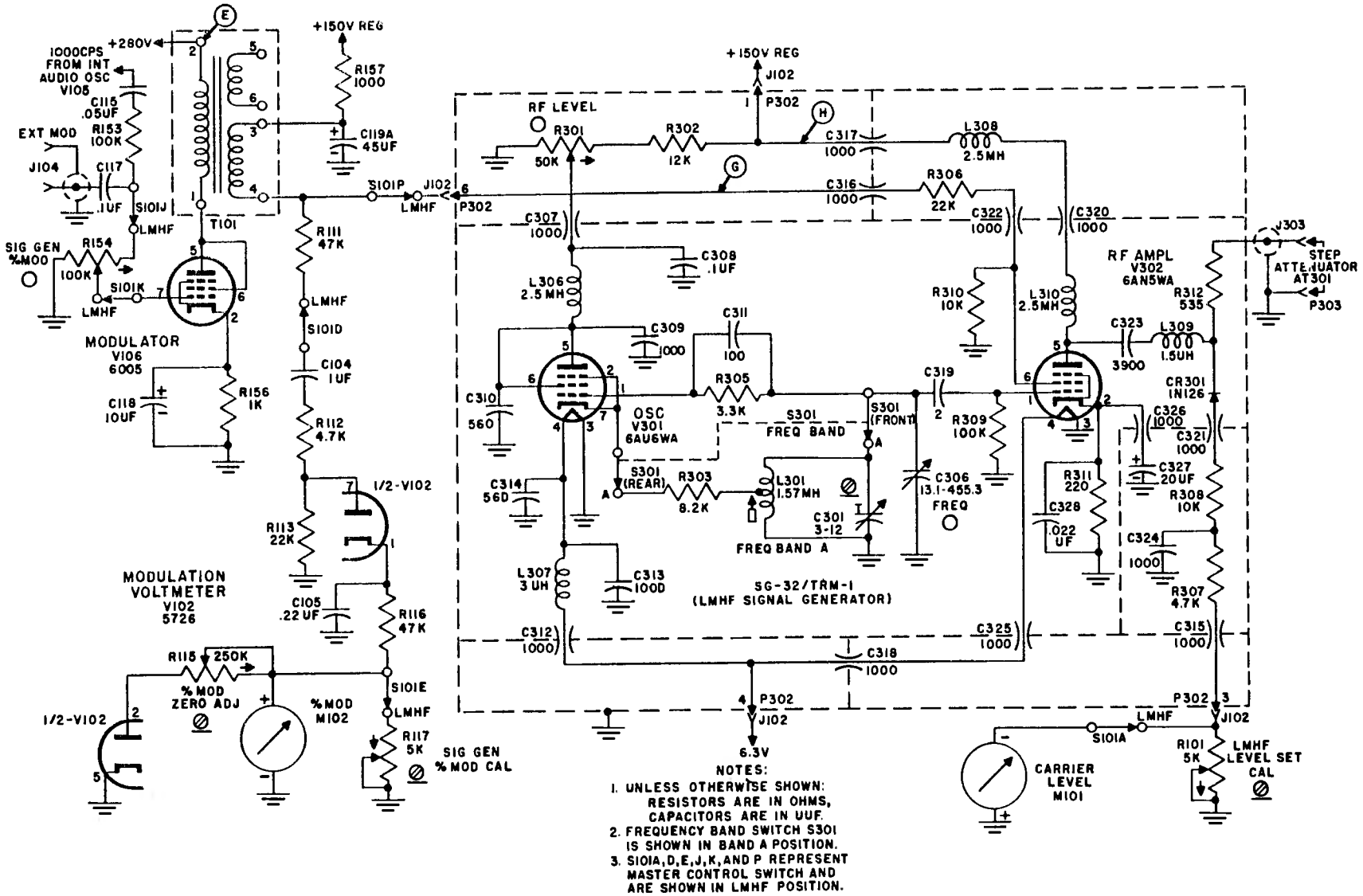
4-6. In this function, the MASTER CONTROL switch S101, in TPT position selects two basic circuits. One circuit produces a test audio signal of known level which is to be fed into the micropone input circuit of the transmitter being tested as follows: When the MOD switch S105 is placed in INT position the 1000 cps AUDIO OSCILLATOR V105 is energized. The audio signal from the oscillator is coupled into the MODULATOR stage V106 and the standardized output of the modulator is connected by switch section S101 to the AUDIO LEVEL TO TRANS-DB attenuator AT101. Closing the TRANS KEY, S104, applies the audio signal to the micropone input circuit of the transmitter under test, via the ICS INPUT jack J108 and Electrical Cord Assembly CX-3049/TRM-1. The second circuit concerned in the transmitter performance test function is designed (1) to give relative indication of transmitter power output, (2) to measure the degree of modulation of the transmitted carrier, and (3) to show the relative amount of carrier level shift. Depending upon the output frequency, one of the two esternal RF couplers must be used. Coupler-Detector CU-220/TRM-1 and Coupler-Detector CU-413/TRM-1 operating in the frequency ranges from 200 kc to 100 mc and 100 mc to 400 mc respectively, are supplied with the test set. When the coupler is connected to antenna post a fraction of the unmodulated transmitter radio frequency output is detected. The output of the coupler-detector is transferred to the panel jack COUPLER INPUT, J103, with R.F. Cable Assembly CG-546/U(8'0"). The relative amount of rectified current is indicated on the CARRIER LEVEL meter M101. The adjustable coupling in the coupler is varied until the meter pointer is at the red arrow marked SET. At this point, audio modulation (originating from the MODULATOR stage in the test set) may be applied to the transmitter. The audio frequency portion of the detected signal is coupled through S101B to the AC AMPLIFIER V101A, and via the CATHODE FOLLOWER V101B, through switch sections S101C and S101D to the % MODULATION METER V102. The degree of carrier modulation is indicated in percent (of positive peak) on the panel meter M102 marked % MODULATION. Peak overmodulation is indicated from a nominal value preset on OVER MOD PRESET control R137. The modulation peaks are amplified by OVERMOD AMPLIFIER V104, and are indicated by the flashing of TRANS OVERMOD lamp, I101.

4-7. RECEIVER PERFORMANCE TEST CIRCUITS

4-8. When the MASTER CONTROL switch is placed in either LMHF or V/UHF position, the circuits of Radio Test Set AN/TRM-1 are switched in function to measure radio receiver performance prior to flight. Receiver performance is measured by two separate circuits. One circuit supplies a measured radio frequency signal to the antenna input circuits of the receiver under test. The other circuit is connected to the audio output circuit of the receiver and measures the power output. In the LMHF position receivers operating in the frequency range from 190 kc to 30 mc may be tested.

4-9. Signal Generator SG-32/TRM-1 supplies the rf test signal to R.F.OUT jack J301. The rf output frequency is selected by the FREQ control C306 and the FREQ BAND selector S301. The RF LEVEL control R301 allows the input voltage level to the step attenuator MICROVOLTS, AT301, to be maintained at a standard value indicated by the red arrow on CARRIER LEVEL meter, M101. The output signal is connected to the antenna circuit of the receiver under test by means of R.F. Cable Assembly CG-546/U and combinations of accessory adapters described fully in the Handbood of Operation Instruction, AN16-30-TRM-1 for this equipment. Audio modulation for the rf carrier signal is supplied, by way of section S101P of the MASTER CONTROL switch, from the MODULATOR stage V106. The audio modulating signal may originate in an external source or in the internal AUDIO OSCILLATOR V105, depending upon the position of the MOD switch S105. When the MOD switch is in EXT & OFF position, an audio signal from 200 to 6000 cps may be applied to the EXT MOD INPUT jack J109. When the MOD switch is in the INT position, the 1000 cps internal AUDIO oscillator is activated. In either case, the degree of audio modulation of the rf carrier is varied by the SIG GEN % MOD control R154 connected in the MODULATOR V106 input circuit by section S101K of the master control switch. The output of the MODULATOR V106 is measured by the % MODULATION METER stage V102, and the degree of modulation is indicated directly on the SIG GEN scale of the panel meter M102 marked % MODULATION.

4-10. The audio power output of the receiver under test is connected to the test set, via the Cord Assembly CX-3049/TRM-1, at ICS INPUT J108, pin B. The receiver output may be heard by plugging headset phones into PHONE jack J106. The audio signal from the receiver is transferred by sections S101F and S101G of the master control switch to the RANGE switch S102, and then to the milliwatt scale multipliers. From the multipliers, the audio signal is applied through switch section S101B to the AC AMPLIFIER V101A driving the CATHODE FOLLOWER V101B. The output of the CATHODE FOLLOWER is measured by the VOLT/MILLIWATT METER stage V103, and the power out-



NOTES:
1. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. FREQUENCY BAND SWITCH S301 IS SHOWN IN BAND A POSITION.
3. S101A,D,E,J,K, AND P REPRESENT MASTER CONTROL SWITCH AND ARE SHOWN IN LMHF POSITION.

Figure 4-1. Signal Generator SG-32/TRM-1, Simplified Schematic Diagram

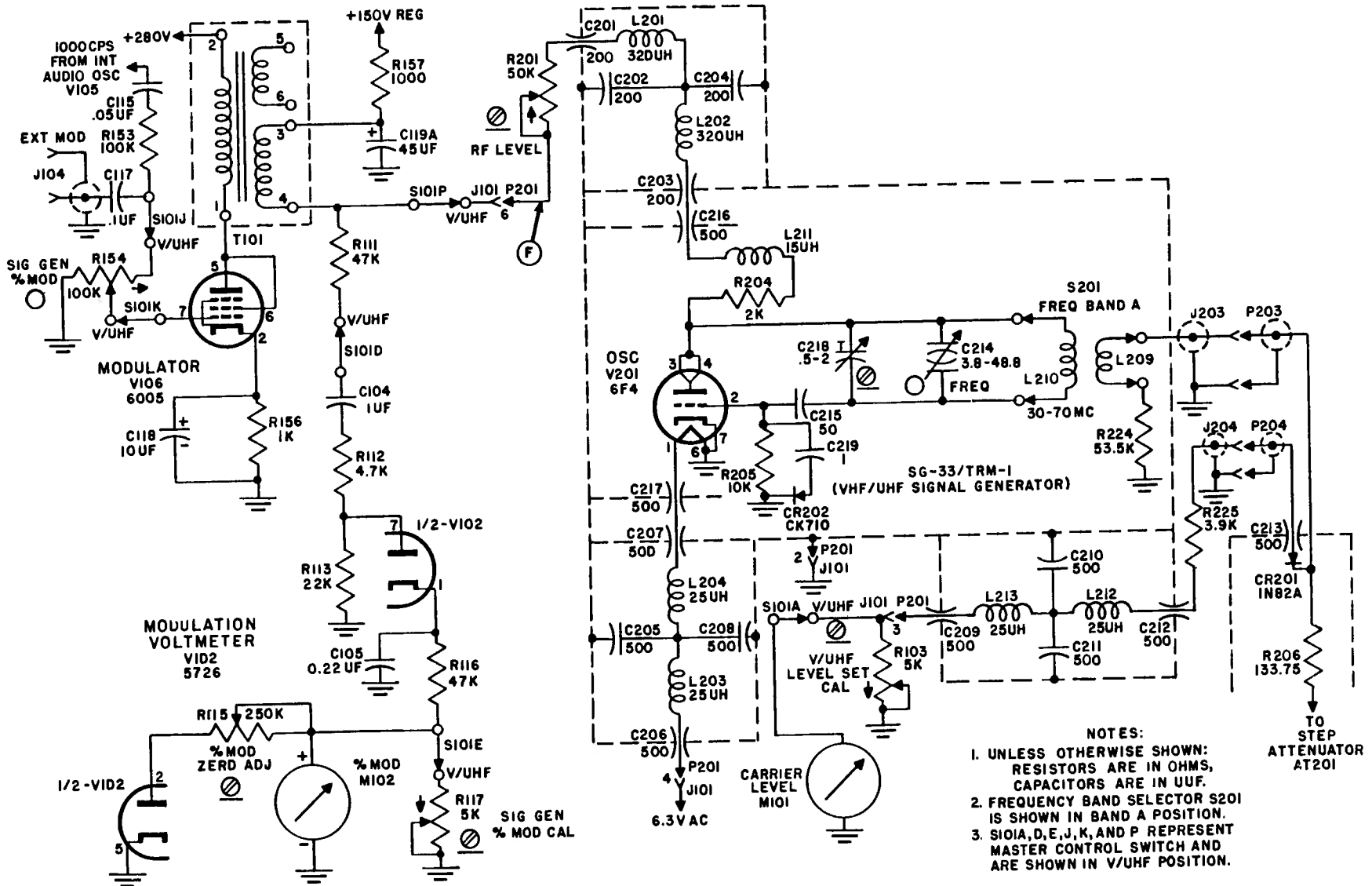


Figure 4-2. Signal Generator SG-33/TRM-1, Simplified Schematic Diagram

put of the receiver in milliwatts is indicated as the product of the reading on the MILLIWATTS scale of VOLT/MW meter, times the setting of the RANGE switch S102.

4-11. When the MASTER CONTROL switch S101 is placed in VHF/UHF position, Signal Generator SG-33/TRM-1 is activated and radio receivers in the frequency range from 30 to 400 megacycles may be tested. In this position of the master control switch, the function of the test set is identical with that in LMHF position described in paragraphs 4-5 through 4-10 above, excepting the frequency range of the signal generator.

4-12. Certain accessory items are used in conjunction with the rf signal generators. For example, Test Adapter MX-1652/TRM-1 is an antenna simulator for use only with Signal Generator SG-32/TRM-1 when sensitivity measurements are to be made on a receiver using a single-wire antenna. The use of the adaptors and fixed attenuators is explained fully in the Handbook of Operation Instructions for this equipment. The electrical functioning of the various adapters is explained in paragraphs 4-58 thru 4-70 of this section.

4-13. DC AND AC VOLTMETER CIRCUITS

4-14. In the VM function the MASTER CONTROL switch S101 selects two basic voltmeter circuits. One circuit is a simple 20,000 ohms per volt DC voltmeter using no vacuum tubes. The other circuit is an AC vacuum tube voltmeter that uses two dual-purpose type tubes.

4-15. The DC voltmeter circuit is selected by placing the FUNCTION switch S103 to the DC position. Test Lead Set CX-1331/U (4' 2"), red and black, is connected to the correspondingly colored jacks marked AC-DC VOLTS; J104 and J105 respectively. J105 is the negative terminal and it is connected directly to the instrument case, i.e., grounded. The positive terminal, J104, connects through switch section S101F, and the FUNCTION switch S103 to the DC SCALE MULTIPLIERS. In the DC function VOLT/MW METER M103 is connected by switch section S101H directly to the multiplying resistors. The DC voltage indicated is the product of the 0-3 VDC scale times the multiple indicated by the RANGE switch S102. The 0-6 VDC scale is read only when the RANGE switch is in 600 VDC position.

4-16. The AC vacuum tube voltmeter circuit is selected by placing the FUNCTION switch S103 to the AC position. This action connects the panel jack J104 (jack J105 remains grounded to the case) through switch sections S101F and S101G, to the AC SCALE MULTIPLIERS. The ac voltage is then applied, via switch section S101B, to the AC AMPLIFIER, V101A, and CATHODE FOLLOWER V101B stages. The output voltage of the cathode follower is measured by the VOLT/MILLIWATT METER stage V103. The voltage is indicated on the 0-3 VAC scale of METER M103, connected through FUNCTION switch S103, and switch section S101H. The actual value of the measured voltage is the product of the direct scale reading times the factor indicated by the RANGE switch S102.

4-17. ANALYSIS OF TRANSMITTER PERFORMANCE TESTING CIRCUITS
(See figure 4-10)

4-18. GENERAL - The transmitter performance test circuits and tubes, excepting the RF coupler-detectors, are located in the Test Set TS-687/TRM-1 chassis and panel assembly. These circuits are activated in this function by the switching accomplished when

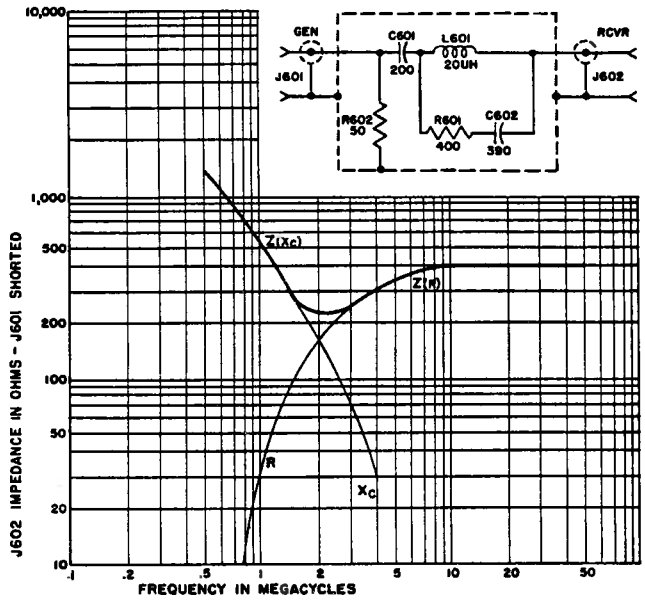


Figure 4-3. Test Adapter MX-1652/TRM-1, Schematic Digram and Input Impedance-Frequency Curve (Antenna Simulator)

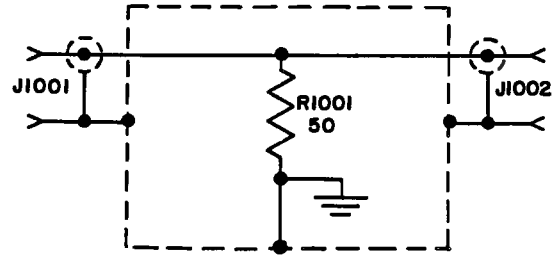


Figure 4-4. Test Adapter MX-2079/TRM-1 (50 ohm termination); Schematic Diagram

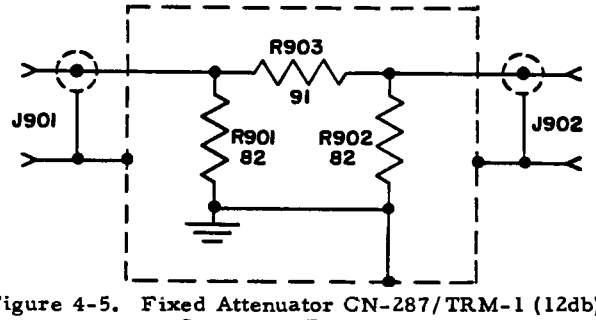


Figure 4-5. Fixed Attenuator CN-287/TRM-1 (12db), Schematic Diagram

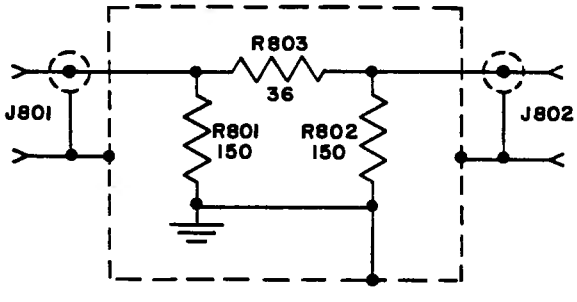


Figure 4-6. Fixed Attenuator CN-399/TRM-1 (6db), Schematic Diagram

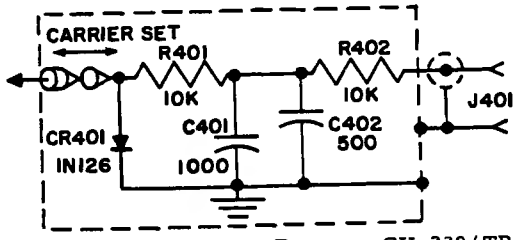


Figure 4-7. R.F. Coupler-Detector CU-220/TRM-1, Schematic Diagram

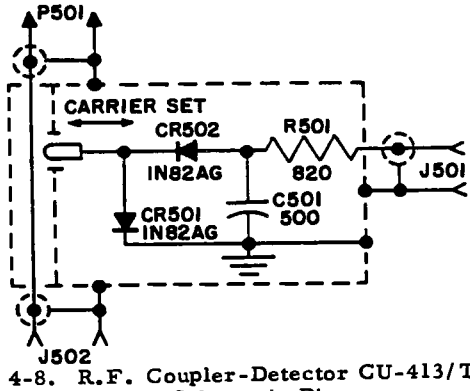


Figure 4-8. R.F. Coupler-Detector CU-413/TRM-1, Schematic Diagram

placing the MASTER CONTROL switch S101 in the TPT position. There are two separate test circuit. used in this function. One circuit supplies an audio signal of known level to the voice circuits of the transmitter under test (via Electrical Cord Assembly CX-3049/TRM-1 connected at ICS INPUT jack J108). It uses the AUDIO OSCILLATOR TUBE V105, a dual triode JAN type 5814, in a Wien bridge type circuit. The audio output is fixed at 1000 cps. The audio test signal is amplified by the MODULATOR stage V106, using a type 6005 power pentode tube. This stage furnishes audio input voltage to a calibrated "T" variable attenuator, AUDIO LEVEL TO TRANS-DB. The output level of the attenuator is indicated directly on the front panel scale. The other transmitter test circuit receives a sample of the output of the transmitter as demodulated by the R.F. Coupler-Detector CU-220/TRM-1 or CU-413/TRM-1, whichever one is being used. This circuit contains the AMPLIFIER-CATHODE FOLLOWER stages V101, dual triode type 5814. The output voltage of the cathode follower is measured and indicated as percentage of modulation by the MODULATION VOLTMETER stage V102. A dual diode tube 5726 is used in the voltmeter circuit. The output of the cathode follower portion of V101 is monitored for overmodulation peaks by the OVER-MOD AMPLIFIER, V104, which uses a type 6AU6WA tube operating a neon glow lamp to provide visual indication of overmodulation.

4-19. UNMODULATED CARRIER DETECTION CIRCUIT

4-20. When the tip of RF COUPLER-DETECTOR CU-220/TRM-1 is contacted to the antenna post (with the antenna connected) of the transmitter being tested, the unmodulated carrier RF voltage appearing at that point is coupled through the variable conical capacitor CARRIER SET to a shunt crystal diode detector circuit within the probe.

CAUTION

Always set the variable conical capacitor for minimum capacitance before using either R F Coupler-Detector CU-220/TRM-1 or CU-413/TRM-1.

The crystal diode is a type JAN IN126. The probe capacitors C401 and C402, resistors R401 and R402, form a low pass filter circuit that removes the rf component of the carrier. With no modulation of the carrier, the output of the coupler-detector is a dc voltage proportional to the peak of the carrier rf voltage. The dc output voltage is connected at the COUPLER INPUT jack, J103. Capacitor C101 by-passes any residual radio frequency component that may exist at J103. The dc signal voltage from the coupler is divided across series resistors R102 and R104. R104 is the shunt resistor for the CARRIER LEVEL METER, M101. In this arrangement meter M101 is connected as a peak reading voltmeter. In operation, the CARRIER SET capacitor of the coupler is adjusted until the pointer of CARRIER LEVEL METER indicates at the red arrow marked SET. The peak voltage of the sample of the rf carrier is then maintained at a standard level suitable for test. After the carrier level has been standardized, a modulating audio signal of known level is applied. from the test set, to the input circuit of the transmitter.

4-21. TRANSMITTING MODULATING CIRCUIT

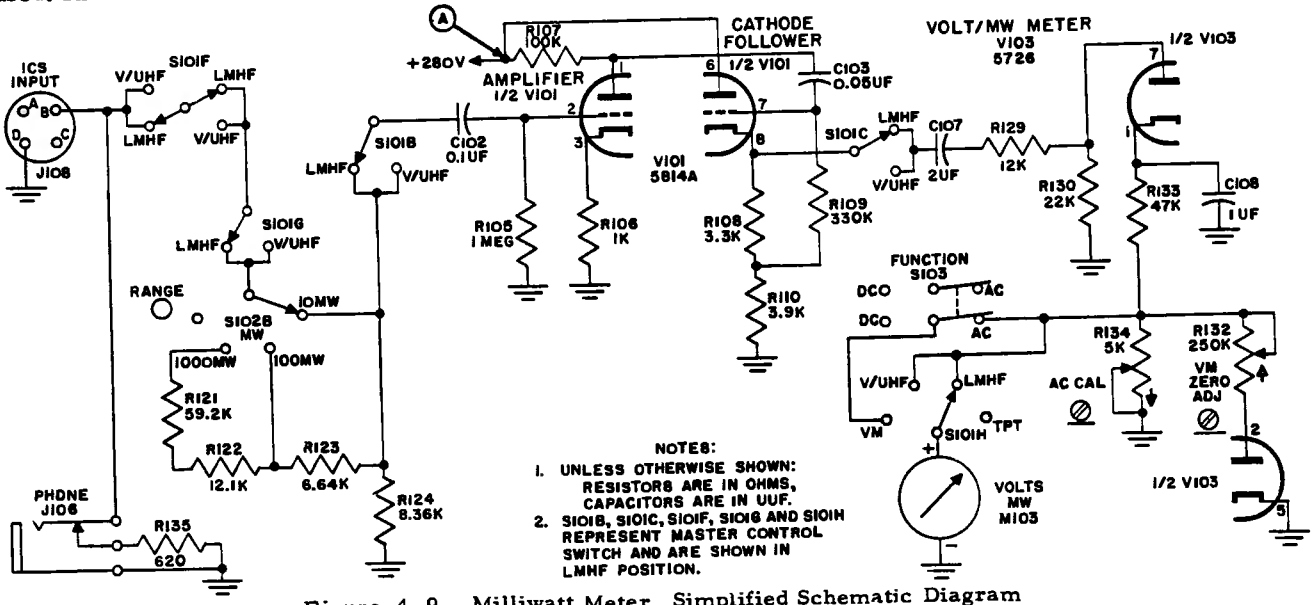
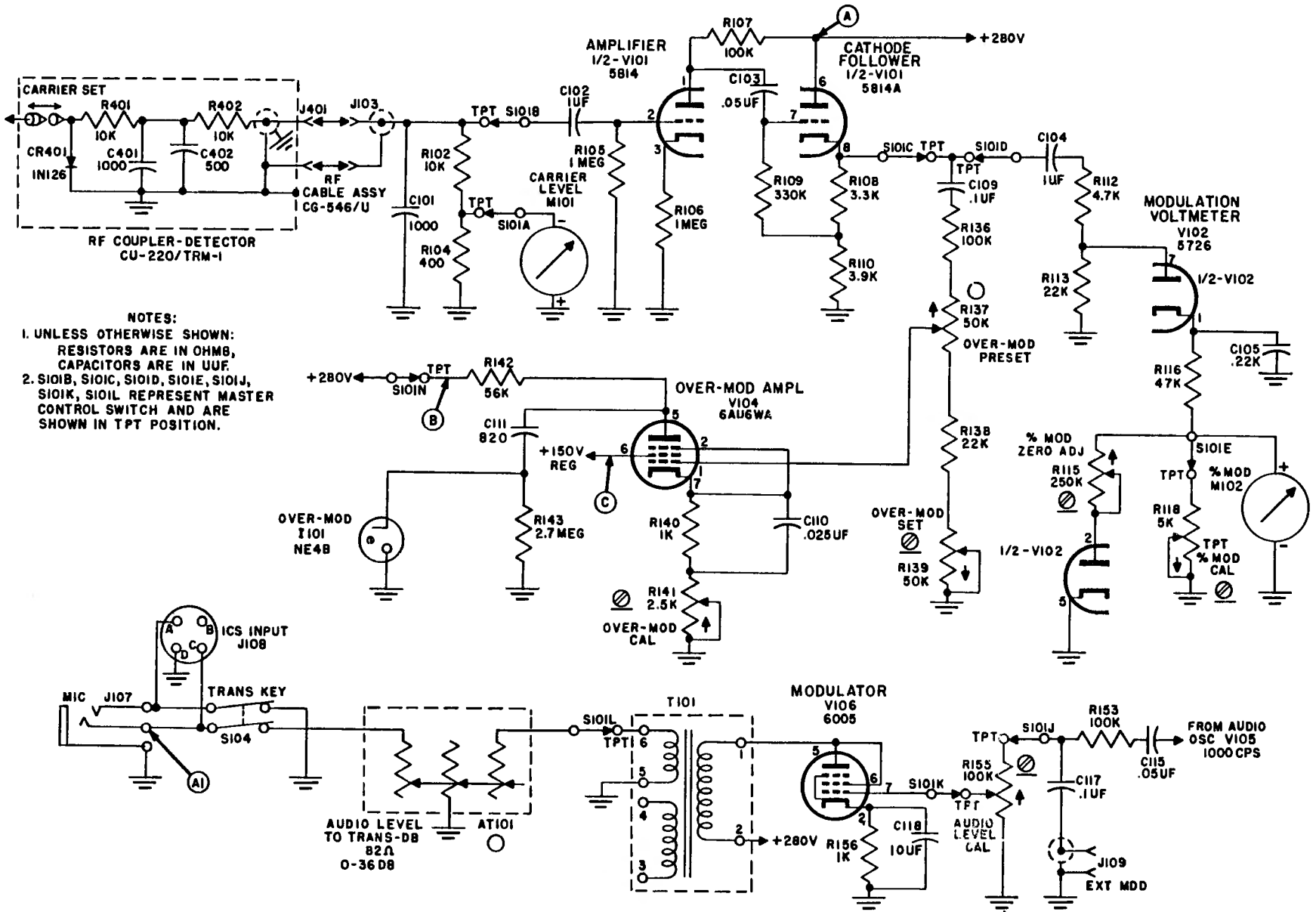


Figure 4-9. Milliwatt Meter, Simplified Schematic Diagram



4-10. Transmitter Performance Test (TPT) Simplified Schematic Diagram

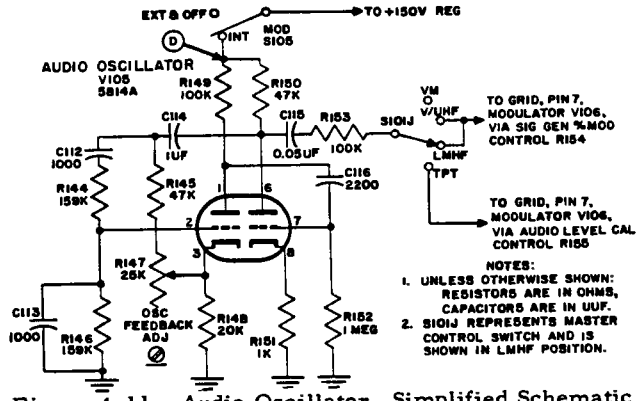


Figure 4-11. Audio Oscillator, Simplified Schematic Diagram

4-22. The transmitter modulating signal of the test set is originated by placing the MOD switch S105 to the INT position, thus activating the internal AUDIO OSCILLATOR stage V105. (See figure 4-11.) The 1000 cps signal from the audio oscillator is coupled through the blocking capacitor C115, and appears across the resistors R153, and R155 AUDIO LEVEL CAL, connected in series by switch section S101J. The AUDIO LEVEL CAL adjustment, located behind the front panel, is the gain control for the MODULATOR stage, V106. It is used to adjust the 0 db reference voltage at attenuator AT101. The arm of AUDIO LEVEL CAL, R155, connects through switch section S101K to the grid, pin 7, of the type 6005 MODULATOR tube, V106, operating as a tride audio amplifier. Cathode bias is furnished by the combination of resistor R156 and electrolytic capacitor C118. The screen, pin 6, and the plate, pin 5, are connected directly together and supplied voltage through the impedance of the primary winding of the modulation transformer T101. The modulating signal output appears across the secondary winding, 3 and 4, of the T101 and is applied to AUDIO LEVEL TO TRANS-DB attenuator AT101, through switch section S101L. The AUDIO LEVEL TO TRANS-DB attenuator is designed to operate into an 82 ohm load external to the test set. It attenuates the modulating signal from a value of 0 db down to minus 36 db. 0 db is equal to 3 volts rms. The modulating audio signal is connected through one section of the TRANS KEY switch S104, in the "ON" position, to pin C of the ICS INPUT jack J108. Connection is made to the transmitter by means of Electrical Cord Assembly CX-3049/TRM-1. (See figure 1-1). The TRANS KEY switch S104 is used to close the keying circuit of the transmitter, simulating the action of the military microphone "ON" button. A military type microphone may be plugged into jack J107 marked MIC and the transmitter controlled in that manner. However, the normal procedure is to use the TRANS KEY of the test set. The AUDIO LEVEL TO TRANS-DB control is adjusted for the desired input voltage level to the transmitter.

4-23. MODULATION DETECTION AND AMPLIFICATION CIRCUITS

4-24. The audio modulation envelope contained in the transmitted rf carrier is demodulated by the detector circuit in the coupler, and appears across the series resistors R102 and R104. The envelope is super-imposed on the dc voltage proportional to the unmodulated rf carrier. The 1000 cps modulating voltage frequency is too high for the meter CARRIER LEVEL METER M101 to follow. The meter therefore indicates the average amplitude of the 1000 cycle signal voltage. If the detected modulation envelope is symmetrical, the pointer of the CARRIER LEVEL meter will remain at 0 on the LEVEL SHIFT scale. The degree of nonsymmetrical distortion is indicated by the displacement of the meter pointer on the LEVEL SHIFT scale. The detected audio signal envelope is coupled from resistor R102 through switch section S101B, and blocking capacitor C102 to the grid circuit of the linear AMPLIFIER triode portion of V101, the AMPLIFIER-CATHODE FOLLOWER stage. The grid is returned to ground by resistor R105. Cathode bias is furnished by resistor R106. The amplified envelope signal across the plate load resistor R107 is coupled via capacitor C103 to the grid of the CATHODE FOLLOWER triode section of V101. The cathode follower serves to efficiently couple the high impedance output of the linear amplifier portion of V101 to the relatively low impedance of the modulation metering circuits that follow. The grid, pin 7, is returned to ground through resistors R109 and R110. The envelope audio signal output voltage of the CATHODE FOLLOWER is developed across resistors R110 and R108 (pin 8) and connected

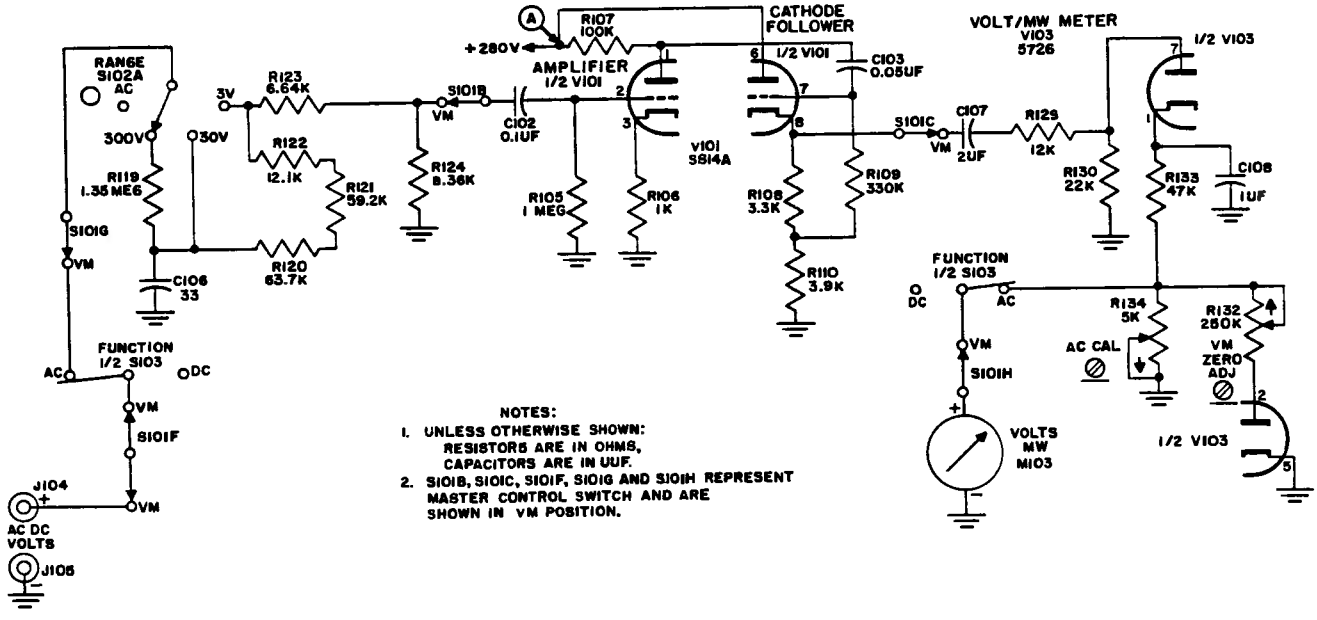


Figure 4-12. A-C Voltmeter, Simplified Schematic Diagram

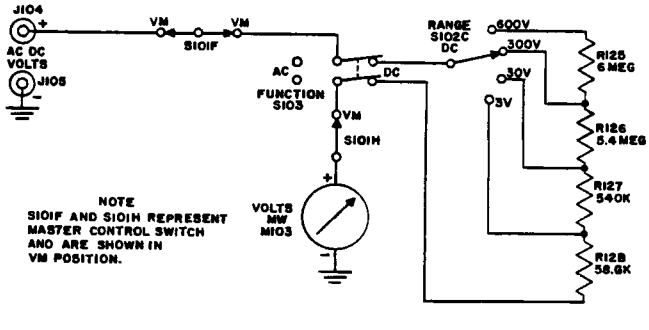
through switch sections S101C and S101D to the junction of coupling capacitors C109 and C104 of the % MODULATION METER tube V102, and to the OVER-MOD AMPLIFIER V104 stage respectively.

4-25. PERCENT MODULATION METERING CIRCUIT

4-26. The modulation envelope voltage coupled by C104, is divided across resistors R112 and R113. From their junction, the voltage is connected to the plate, pin 7, of one diode section of the dual diode tube V102. This diode, in conjunction with resistor R116 and capacitor C105 in the cathode circuit, forms a peak reading voltmeter circuit. The rectified dc voltage appearing across the variable shunt resistance R118, TPT % MOD CAL, causes a current to flow through the % MODULATION meter M102 such that when the peak of the modulation envelope is equal to twice the no-modulation carrier voltage, the meter (M102) indicates 100% modulation. The other diode section of V102, pins 2 and 5, is used in conjunction with the internal adjustment, % MOD ZERO ADJ, to balance out the no-signal current flowing through the % MODULATION meter M102.

4-27. OVER-MODULATION INDICATOR CIRCUIT

4-28. The modulation envelope signal output voltage of the CATHODE FOLLOWER V101 developed across resistors R108, R110, is coupled, via capacitor C109 and the voltage dividing network R136, R137, R138 and R139, to the OVER-MOD AMPL tube V104. The circuit of V104 is arranged so that OVER-MOD neon lamp I101 flashes whenever the positive modulation voltage peaks from the transmitter exceed any value in the range from 60 to 120 percent previously set on the OVER-MOD PRESET control R137. When the amplified signal output of V104 developed across R142 plate load resistor exceeds approximately 50 volts, the OVER-MOD neon lamp I101 fires. The OVER-MOD PRESET panel control is adjusted to follow the percentage of modulation calibrated on the % MODULATION meter M102. With a signal indicating 60% modulation on M102 and with R137 OVER-MOD PRESET turned fully counter-clockwise to its 60% (most sensitive) position, the gain control OVER-MOD CAL R141 is set at the point where the OVER-MOD neon lamp begins to glow. Then, with a signal indication of 120 percent on M102 the OVER-MOD PRESET is turned clockwise to 120 percent position and the OVER-MOD SET adjustment R139 is set to the point where the OVER-MOD lamp I101 again begins to glow. The resistance value of R138 plus R139 should then equal the total resistance of R137. R139 is set at the factory and rarely will require readjustment. When the neon lamp I101 is changed, or to compensate for its aging, adjust R141 OVER-MOD CAL with R137 set at 60 percent as described above.



4-13. D-C Voltmeter, Simplified Schematic Diagram

4-29. SIGNAL GENERATOR SG-32/TRM-1 CIRCUIT ANALYSIS
(See figure 4-1)

4-30. GENERAL - Signal Generator SG-32/TRM-1 is a plug-in unit covering low, medium, and high frequencies (LMHF) between 190 kc and 30 mc. It is active only when the MASTER CONTROL switch S101 is in the LMHF position. The frequency range is covered in five bands (A through E), anyone of which may be selected by the FREQ BAND switch located on the front panel. Within each band the frequency is varied with a straight line frequency capacitor, C306. The frequency generated is indicated directly on the dial scale which is geared to the variable capacitor. The RF output voltage is variable by means of the MICROVOLTS attenuator AT301 in nine separate positions ranging from 100,000 down to 2.5 microvolts. The RF output is available at the R.F. OUT jack J301. The calibrated MICROVOLTS scale markings on the front panel apply only when the output at jack J301 is terminated in 50 ohms. The RF output may be either modulated or unmodulated. Internal modulation of 1000 cps is available, and is variable in degree. External modulation may be applied at panel jack J109, marked EXT MOD INPUT. The signal generator circuits are contained in a rugged aluminum casting that increases the mechanical and thermal stability of the unit, as well as minimizing radio frequency radiation. The circuits consist of a variable radio frequency oscillator and a buffer amplifier supplying a step-attenuator with RF voltage. The RF level at the input side of the attenuator is measured by a crystal diode metering circuit, and indicated on a panel meter. Audio modulation is applied to the buffer stage. The percent of modulation is indicated on a separate meter. The indicating and modulation circuits are located in Test Set Subassembly TS-687/TRM-1 external to the signal generator. Complete description of the individual circuit follows in paragraphs 4-31 through 4-37 below. Accessory items for use with the signal generator are described in paragraph 4-58 thru 4-68 of this section.

4-31. OSCILLATOR CIRCUIT

4-32. The oscillator circuit is completely enclosed in the cast aluminum shield housing the RF circuits. The OSCILLATOR tube V301 and the tuned circuits are located on the left side of the signal generator unit (See figure 5-4). A removable cover permits access to the tube and adjustments. The oscillator uses a JAN type 6AU6WA tube connected in Hartley type circuit with adjustable iron core inductances (L301 through L305), and trimmer capacitors (C301 through C305).

4-33. The desired frequency band (A through E) is selected by the FREQ BAND switch S301. It selects the applicable "inductance - capacitance" combination. When the switch is rotated from the lowest frequency band (A) to the higher frequency determining combinations, the lower frequency L-C combinations are short circuited at the frequency range selected. For the purpose of explanation the FREQ BAND switch S301 is positioned at band A. The parallel combination of resistor R305 and capacitor C311 provides a grid leak bias for the tube, and is returned to dc ground through tuning coil L301. L301 is adjusted to the proper frequency range by trimmer capacitor C301, and a variable powdered iron core. Resistor R303 functions to stabilize the oscillator by isolating the tuning circuit from the tube. Plate (pins 5 and 6) voltage is obtained from the regulated plus 150 volt source (V108) in the power supply, via pin 1 of plug P302. The supply voltage is divided across fixed resistor R302 and the RF LEVEL control R301 (located on the front panel). The

RF LEVEL control varies the actual plate voltage of the oscillator stage, thus controlling the RF output of the signal generator. The combination of capacitor C309, choke L306, and capacitor C308, forms an RF filter network that prevents the appearance of radio frequency outside of the shielded enclosure. C307 is a feed thru type bypass capacitor located in the wall of the aluminum shield. The heater voltage for the tube, supplied through pin 4 of plug P302, is bypassed for RF by capacitor C314, and similarly filtered by the network of capacitor C313, Choke L307, and feed thru capacitor C312. The RF output signal is coupled from the OSCILLATOR, V301, to the succeeding RF AMPLIFIER, V302 via capacitor C319. The value of this capacitor (2UUF) is as small as possible consistent with adequate driving voltage for the RF AMPLIFIER. This minimum value of capacitance isolates the OSCILLATOR from load variations caused by modulating the RF AMPLIFIER tube.

4-34. RF AMPLIFER CIRCUIT ANALYSIS - An untuned RF amplifier circuit, using a pentode tube type 6AN5WA, V302, is placed between the OSCILLATOR stage, V301, and the output step-attenuator AT301. This stage serves to isolate the OSCILLATOR stage from effects of output loading, and to introduce amplitude modulation of the RF signal. The RF AMPLIFIER tube is located in the right side of the cast aluminum shield inclosure. A removable cover permits access to the tube.

CAUTION

In order to maintain radio frequency radiation at its minimum always replace all machine screws in the cover of the signal generator main casting. Tighten the screws firmly; be careful not to overtighten and strip threads.

4-35. The RF signal from the OSCILLATOR, V301, is applied to the control grid, pin 1, of the amplifier. The grid is returned to ground through resistor R309. Bias for this stage is obtained by the voltage drop across the cathode (pin 2) resistor R311. The cathode is bypassed to ground for RF by capacitor C328, and for audio frequencies by capacitor, C327. A low-pass filter network composed of capacitors C317, C320, and the rf choke L308, located in a separate shielded compartment in the casting, prevents the appearance of stray RF external to the shield. The amplified RF signal voltage is developed across the impedance of the RF choke, L310, at the plate (pin 5) of the tube, and is coupled via capacitor C323, and the small inductance of L309, to resistor R312 and step-attenuator AT301, forming the output load circuit for the amplifier stage. In order to set and maintain the input signal at a standard level, the RF voltage input to the step-attenuator is measured by a peak voltmeter circuit connected at the junction of inductance L309 and load resistor R312. The voltmeter circuit consists of crystal rectifier CR301, type IN126, and the low pass filter network composed of capacitors C321, C324, C315 and resistors R307 and R308. This network prevents the appearance of stray RF voltages external to the shield casting. The external dc circuit is continued to ground through the LMHF LEVEL SET CAL adjustment, R101, shunting the CARRIER LEVEL METER M101. R101 is adjusted so that when the RF output voltage at jack J303 is correctly indicated (in microvolts), by the position of the pointer of the step-attenuator, the pointer of meter M101 indicates at the red arrow marked SET. Audio modulation for the RF signal output of Signal Generator SG-32/TRM-1 is furnished by the MODULATOR stage, V106, located in Test Set TS-687/TRM-1. The modulator superimposes the audio voltage on the dc voltage supplied to the screen circuit of the RF AMPLIFIER, via pin 6, of plug P302. After passing through the RF filter network composed of capacitors C316, C322 and resistor R306, the modulating voltage appears across the screen resistor R310 and is injected into the tube, resulting in the desired amplitude modulation of the RF signal output.

4-36. MODULATOR AND MODULATION VOLTMETER CIRCUIT
(See figure 4-1)

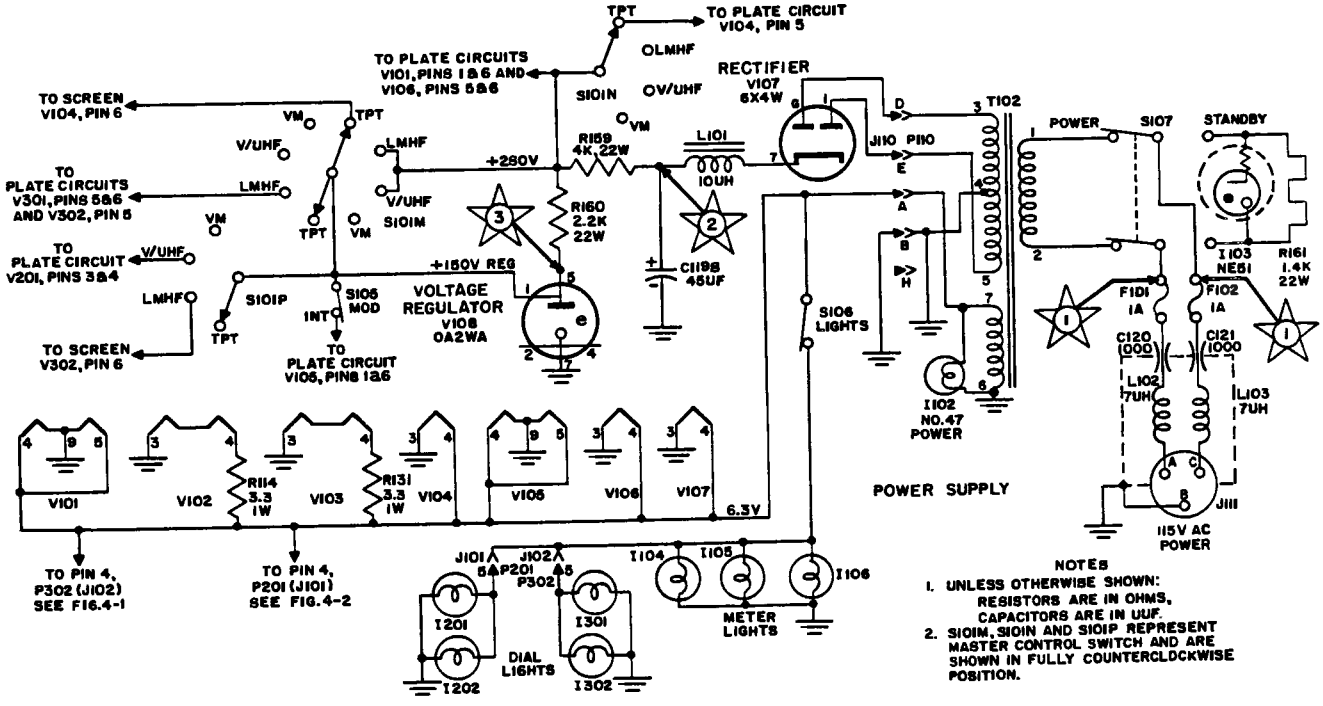


Figure 4-14. Power Supply, Simplified Schematic Diagram

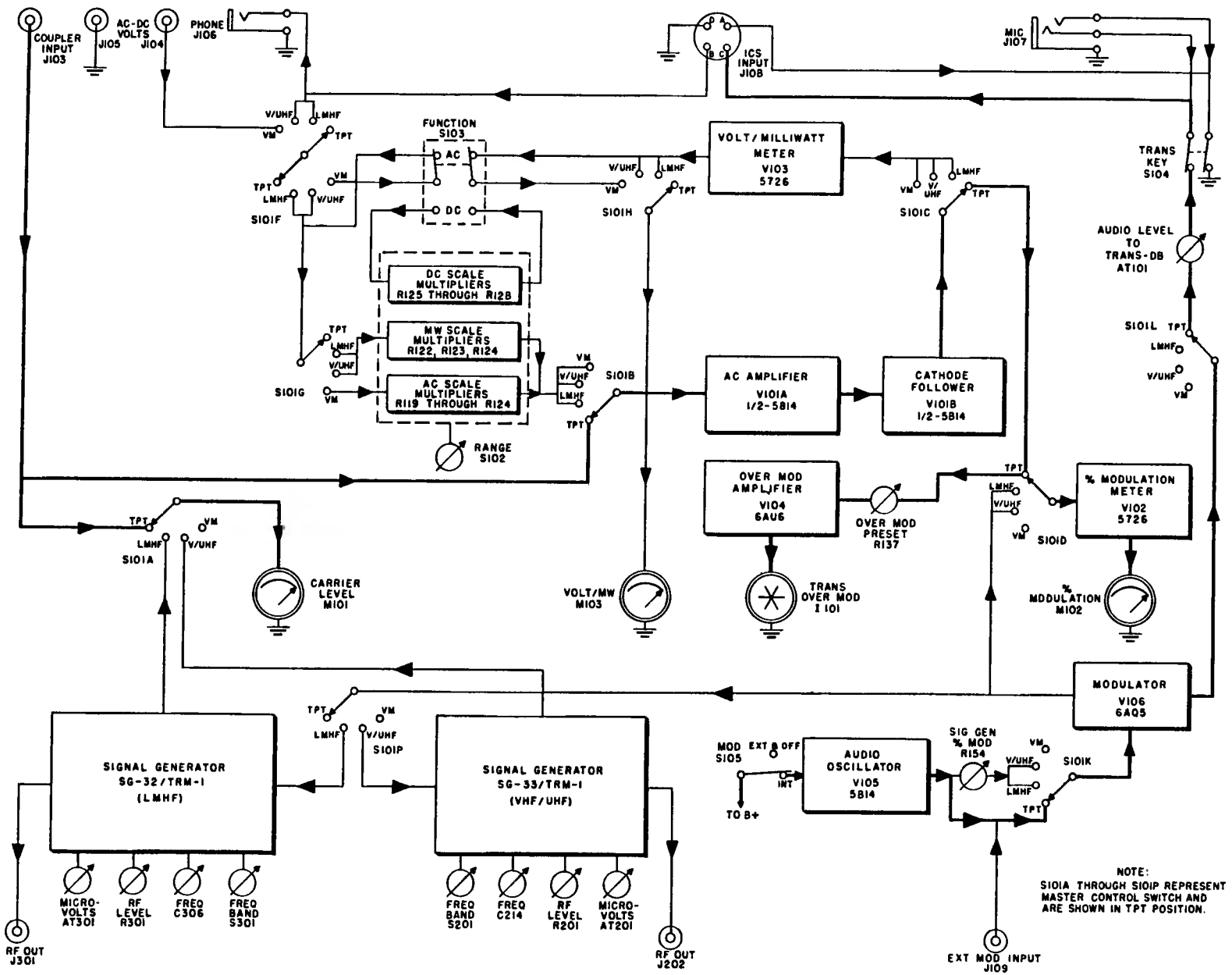


Figure 4-15. Master Block Diagram

4-37. The modulating and modulation metering circuits contained in the Test Set Subassembly TS-687/TRM-1 chassis, are switched to the signal generator modulating function when the MASTER CONTROL switch, S101, is placed in either LMHF or V/UHF positions. The MODULATOR tube, V106, is a type 6005 triode operated in a class "A" audio amplifier circuit. It amplifies the audio signal from either the internal AUDIO OSCILLATOR stage V105, when the MOD switch is in INT position or from an external source of audio (200 to 6000 cps) applied at panel jack J109, EXT MOD INPUT, when the MOD switch is placed at EXT & OFF position. The audio output voltage is fed to the modulation transformer, T101, where it is superimposed on the dc supply voltage for the screen circuit of the RF AMPLIFIER V302 of Signal Generator SG-32 (via pin 6 of plug P302), or to the plate circuit of the OSCILLATOR tube of Signal Generator SG-33/TRM-1 (via pin 6 of plug P201), depending on the position of the MASTER CONTROL switch S101. The degree of modulation of the RF output of either Signal Generator SG-32/TRM-1 or SG-33/TRM-1 is variable by the panel control SIGNAL GEN % MOD, and is measured by the MODULATION VOLTMETER stage V102, a double-diode type 5726. The panel meter M102, % MODULATION, indicates the degree of modulation in percent.

4-38. The audio modulating voltage appears across the SIG GEN % MOD variable resistor, R154, controlling the amplitude of the input signal to the grid, pin 7, of the MODULATOR tube, V106. Bias voltage for the tube is furnished by the voltage drop across the cathode resistor R156 bypassed to ground for audio frequencies with capacitor C118. The amplified modulating signal is developed across the primary winding (terminals 1 and 2) of the modulation transformer T101, and coupled to the secondary winding (terminals 3 and 4) which passes the dc current to the screen (pin 6) of the RF AMPLIFIER, V302, of Signal Generator SG-32/TRM-1 (in LMHF position of the MASTER CONTROL switch), or to the plate (pins 3 & 4) of the OSCILLATOR tube V201 (in V/UHF position). The modulating voltage is thus superimposed on the supply voltage of these circuits, resulting in the modulation of the RF signal output of the generators. The output audio voltage of the MODULATOR stage, V106, is measured by the MODULATION VOLTMETER, V102, circuit at the secondary (terminal 4) of the modulation transformer T101. The modulating voltage is divided across the series network of resistor R111, capacitor C104 and resistors R112 and R113. The voltage drop across R113 is rectified by one diode section (pins 7 and 1) of tube V102. The rectified voltage appearing across the diode load resistors R116 and R117 is proportional to the peak of the modulating audio voltage, due to the time constant of capacitor C105. Panel meter M102, % MODULATION is shunted by the variable resistor SIG GEN % MOD CAL which calibrates it to indicate the degree of modulation of the RF output of the signal generator, directly in percent. The 0-60 SIG GEN scale applies in this function of meter M102. The second diode portion of V102 (pins 2 and 5) is connected inversely, through the variable resistance R115 % MOD ZERO ADJ, to the junction of resistors R116 and R117. This diode connection serves to cancel out the residual no-signal current through the rectifying section of V102 (pins 7 and 1) thus affording a convenient method of zeroing the % MOD meter M102.

4-39. STEP ATTENUATOR CIRCUIT
(See figure 7-1)

4-40. The RF output voltage of both Signal Generator SG-32/TRM-1, and SG-33/TRM-1 is controlled by means of separate precision-built step-attenuators. These controls, reference symbols AT301 in SG-32/TRM-1, and AT201 in SG-33/TRM-1, are marked MICROVOLTS on the front panel of each signal generator. Since the two step-attenuators are similar in construction the following description applies to either, except where specifically noted. A scale on the front panel of each signal generator shows nine indexed position values of 100K, 10K, 1K, 100, 50, 25, 10, 5, and 2.5 microvolts. The step-attenuator incorporates an unbalanced ladder network composed of seventeen miniature, high-stability, deposited-carbon resistors. An aluminum die-casting houses the network. Individual resistors are located in cavities proportioned to minimize residual reactance effect at high frequencies. Input RF voltage from the signal generator proper is fed to the attenuator through a detachable coaxial cable. The useful output voltage from the R.F. OUT panel jack (a type BNC connector) is always based on terminating this jack in a resistance equal to its internal impedance of 50 ohms. The internal impedance of the R.F. OUT connector is constant at 50 ohms for any step of the attenuator. To obtain an accurate output voltage the RF LEVEL panel control must be adjusted so that the needle of the CARRIER LEVEL meter M101 indicates at the red line marked SET. Under these conditions the voltage appearing across the external 50 ohm load resistance will be that indicated on the panel scale by the pointer of the MICROVOLTS control. Details of the voltmeter CARRIER LEVEL circuits are given in paragraphs 4-29 and 4-41 of this section describing the theory of operation of Signal Generators SG-32/TRM-1 and SG-33/TRM-1.

4-41. SIGNAL GENERATOR SG-33/TRM-1CIRCUIT ANALYSIS
(See figure 4-2)

4-42. GENERAL - Signal Generator SG-33/TRM-1 covers the frequency range between 30 mc and 400 mc (V/UHF) in three bands - A, B, and C. It is a plug-in type unit, active only in the V/UHF position of MASTER CONTROL switch S101. Within each band the frequency is varied with a straight-line frequency capacitor, C214. The frequency generated is indicated directly on the dial scale which is geared to the tuning capacitor. The output voltage at the R.F. OUT jack J202, is variable by means of the MICROVOLTS step-attenuator, AT301, in nine separate positions ranging from 100,000 down to 2.5 microvolts. The internal impedance of the signal generator at J202, RF OUT, is 50 ohms. The MICROVOLT scale markings on the front panel apply only when the output is terminated in 50 ohms. The RF output signal may be modulated or unmodulated. Internal modulation of 1000 cps is available, and is variable in degree. External modulation can be applied at the panel jack J109, marked EXT MOD INPUT, in Test Set TS-687/TRM-1. The RF circuit of the signal generator is contained in a rugged aluminum casting. This type of construction adds to the required mechanical and thermal stability of the unit as well as minimizing radio frequency leakage. The circuit consists of a variable frequency oscillator whose metered output voltage is supplied to the step-attenuator AT201. The input signal level to the step-attenuator is standardized by maintaining the needle of the CARRIER LEVEL meter M101, at the red arrow marked SET. Audio modulating voltage is applied to the plate of the OSCILLATOR tube, V201. The degree of modulation is indicated on the panel meter % MODULATION, M102. The indicating meters and modulation circuits are located in the Test Set TS-687/TRM-1 external to the signal generator. A complete description of the individual circuit follows in paragraphs 4-43 and 4-44 below. Accessory items for use with the signal generator are described in paragraphs 4-58 through 4-68 of this section.

4-43. OSCILLATOR CIRCUIT - The rf oscillator stage of Signal Generator SG-33/TRM-1 is completely en-

closed in the cast aluminum shield. The OSCILLATOR tube V201 and the tuned circuits are located in the main cavity of the casting (See figure 5.5) and are accessible through the removable cover located on the right side of the signal generator. The oscillator uses a type 6F4 tube in an ultra-audion circuit using inductances (L206, L208, and L210).

4-44. The desired frequency band (A, B or C) is selected by the FREQ BAND switch S201. This switch selects the applicable inductance to be tuned by the main tuning capacitor, C214, that is used for all bands. For the purpose of explanation the FREQ BAND switch, S202, is positioned at band "A" (30 to 70 mc). Operating grid leak bias is furnished by grid resistor R205, and stray capacitance to ground. Rf feedback voltage from the plate circuit (pins 3 and 4) is fed back to the grid, pin 2, via capacitor C215, which also prevents the plate dc voltage from appearing at the grid. Capacitor C219 and crystal diode CR202 combine to reduce the effect of incidental frequency-modulation. Plate voltage, originating in the regulated + 150 supply, and coming from the secondary winding (terminals 3 and 4) of the modulation transformer via switch section S101P, enters the signal generator on pin 6 of plug P201. The variable resistor R201, RF LEVEL, is a panel control varying the plate voltage reaching the oscillator tube and therefore the rf voltage output of the signal generator. In order to minimize rf leakage from the oscillator compartment, the filament and plate voltage leads entering the casting are well filtered of rf energy by composite low-pass filter assemblies (See figure 4-2). Filter network Z201 is used in the plate circuit wiring. Resistor R204 is the plate load resistor. Capacitor C216 is feed through type rf bypass capacitor located near the tube socket. The cathode, pin 7, is returned directly to ground. The filament circuit is grounded at pin 6 of the socket. The 6.3 volts ac is applied at pin 1; this side of the filament is maintained at rf ground potential with bypass capacitor C217. The output energy of the oscillator developed in the tank circuit, composed of inductance L210 and tuning capacitor C214, is coupled by a secondary winding L209, to a section of coaxial transmission line terminating at the output end in the step-attenuator AT201. The input end of the coaxial transmission line and coupling coil L210 are terminated in R224 preventing the formation of excessive standing-waves. The level of the rf voltage input to the step attenuator is measured by a voltmeter circuit consisting of the crystal diode CR201 and the CARRIER LEVEL meter M101. The rectified voltage is filtered of radio frequency by capacitor C213 and the composite filter assembly Z203. The resulting dc voltage, proportional to the peak amplitude of the rf signal, passes through pin 3 of plug P201 to the calibrating variable resistance R103, V/UHF LEVEL SET CAL shunting the CARRIER LEVEL meter M101. The meter is calibrated so that the needle points at the red arrow marked SET when the MICROVOLTS attenuator AT201 indicates the correct rms value of output voltage. The output rf voltage as indicated by the pointer of AT201 is accurate only when the step attenuator is terminated in 50 ohms at panel jack J202, RF OUT.

4-45. MILLIWATT METER CIRCUIT ANALYSIS (See figure 4-9)

4-46. The milliwatt meter circuit is active in LMHF and V/UHF positions of MASTER CONTROL switch S101. The circuit, located in Test Set Subassembly TS-687/TRM-1, is calibrated to indicate receiver output power based on an input impedance of 300 ohms. This value of impedance is the result of the parallel combination of 600 ohms resistance contained within Cord Assembly CX-3049/TRM-1 (See figure 6-7), and 600 ohms resistance located in the test set. Therefore, Cord Assembly CX-3049/TRM-1 must always be used when making receiver output power measurements. The load resistors contained in the cord, and in the test set are placed across closed circuit type jacks, (PHONE). The insertion of a headset plug into the jack opens the resistor circuit and substitutes the impedance of the headset (600 ohms). The milliwatt meter circuit is actually an electronic voltmeter which measures power in terms of the voltage appearing across 300 ohms load resistance. Two electron tubes are used: the AMPLIFER CATHODE FOLLOWER, V101, and the VOLT/MW METER, V103. Receiver power output is indicated by the VOLT/MW METER, M103, located on the left side of the front panel. Meter ranges of 0-10, 0-100, and 0-1000 milliwatts are selected by the RANGE switch, S102.

4-47. Cord Assembly CX-3049/TRM-1 (See figure 6-7) is used to connect between the radio receiver PHONES output jack and the ICS INPUT jack, J108, located on the front panel of the test set. The audio signal enters the test set at pin B of J108, which is internally connected to the tip contact of the PHONE jack, J106, and to the load resistor R135. The function of J106 is explained in item 18 of paragraph 1-35. The power input to the test set is proportional to the voltage appearing across R135. This voltage is transferred by MASTER CONTROL switch sections S101F and S101G, to RANGE switch section S102B selecting combinations of resistors R121, R122, R123, and R124, that give the required meter scale multiplying factor. The signal from the combination of multiplier resistors selected is coupled by capacitor C102 to the standard AMPLIFIER- CATHODE FOLLOWER stage, V101, through switch section S101B. The signal voltage output of this stage appears at the cathode (pin 8), and is connected by switch section S101C, and coupling capacitor C107, to series resistors, R129 and R130, where it divides in proportion to the resistance of each. One diode section, pins 7-1 of V103, rectifies this voltage. Due to the long time constant of capacitor C108 and R133 a dc current, proportional to the peak voltage value, flows through resistor R133 and the combination of the VOLT/MW METER, M103, and its shunting resistance R134, AC CAL. The meter is connsected to its shunt resistor, R134, by means of switch section S101H. Meter M103 is scaled to read milliwatts in this function. The receiver power output value is obtained by multiplying the value indicated on the MILLIWATT scale times the factor indicated by the position of the RANGE switch S102. The pins 2-5 diode section of tube, V103, is used to cancel the residual potential across the rectifying diode section (pins 7-1), and in conjunction with variable resistor VM ZERO ADJ, R132, affords a convenient method of electrically zeroing the meter, M103.

4-48. DC AND AC VOLTMETER CIRCUITS

4-49. GENERAL - The purpose of the voltmeter circuits is to provide a means for making any required DC or AC voltage measurements at specified test points in radio equipment, or its associates external wiring. The voltmeter function of the test set is selected by placing the MASTER CONTROL switch S101 in its VM position. The voltmeter circuit used is selected by placing the FUNCTION switch S103 to either AC or DC position. To obtain the actual voltage value, the voltmeter scales, located on the VOLT/MW meter, M103, are multiplied by the factor indicated by RANGE switch S102. The AC voltmeter is a vacuum tube type having an input sensitivity of 5000 ohms per volt. It uses the AMPLIFIER-CATHODE FOLLOWER stage, V101, and the VOLT/MW METER stage, V103. These tubes are part of Test Set Subassembly TS-687/TRM-1.

The DC voltmeter uses no vacuum tubes. It has a sensitivity of 20,000 ohms per volt. Test Leads CX-1331/U(4'2") are furnished for use with the voltmeter. Tip jacks J104 and J105, AC-DC VOLTS, on the front panel provide means for making connection to the voltmeter circuits.

4-50. AC VOLTMETER (See figure 4-12) -The AC voltmeter circuits are placed in operation when the MASTER CONTROL switch S101 is placed in VM position. The FUNCTION switch S103 must be in its AC position. The test leads connect to the pin jacks J104 and J105 marked AC-DC VOLTS, located on the front panel. J105 is directly grounded to the equipment case. The ac voltage to be measured is applied to a multiplier resistance network through switch section S101F and the FUNCTION switch S103. Section S102A of the RANGE switch selects combinations of the multiplying resistors that permit ranges of from 0-3, 0-30, and 0 to 300 volts ac to be read on VOLT/MW METER, M103. The resistors R119, R120, R121, R122, R123, in series with resistor R124 form the multiplier circuit. A capacitor, C106, provides high frequency compensation for the ac voltage being measured on the 300V scale. The ac voltage drop across R124 is connected by switch section S101B to capacitor C102 coupling the voltage to the grid, pin 2, of the AMPLIFIER position of tube V101. The grid is returned to ground via resistor R105. R107 is the plate load resistor for V101 and the ac voltage developed is coupled through capacitor C103 to the grid pin 7 of the CATHODE FOLLOWER section of V101. This grid is returned to ground via resistors R109 and R110. The ac voltage appearing at the cathode, pin 8, of V101 is connected through switch section S101C, capacitor C107, and appears across the series combination of resistors R129 and R130. The ac voltage drop developed across R130 is rectified by the pins 7-1 section of the VOLTMETER DIODE stage V103. The filter capacitor C108 charges to the peak value of the rectified ac voltage, thus causing a proportional dc current to flow thru resistors R133 and R134. Since R134, AC CAL, is the shunt resistor for VOLT/MW METER, M103 (connected through the FUNCTION switch S103, and switch section S101H) the current through the meter is proportional to the input ac voltage. The pins 2-5 diode section of V103 is connected at the junction of resistors R133 and R134, AC CAL, through variable resistor, R132, VM ZERO ADJUST. This diode serves to cancel the residual, no-signal, current of the pins 7-1 diode section, and also provides a convenient method of zeroing the VOLT/MW METER M103.

4-51. DC VOLTMETER (See figure 4-13). The dc voltmeter circuit, activated by placing the FUNCTION switch S103 in its DC position, consists simply of the VOLT/MW METER, M103 in series with the meter scale multiplying resistors R125 thru R128. When measuring voltage, Test Lead Set CX-1331/U (4'2") is connected to the panel jacks J104 and J105, marked AC-DC VOLTS. These jacks are switched to their DC function by switch section S101F in VM position; J105 remains grounded directly to the equipment case. The dc voltage being measured is connected through one side of the FUNCTION switch S103, to the arm of the RANGE switch section S102C. The position of the arm of the range switch selects the required meter scale multiplying resistor. The VOLT/MW METER, M103, is connected to the multiplier resistors through the lower section of FUNCTION switch S103, and switch section S101H. The meter has basically a 50 microampere movement with a sensitivity of 20,000 ohms per volt. The meter face contains two DC scales, one is inscribed 0-3 and one 0-6. The 0-3 scale is multiplied by the factor indicated by the arrow on the RANGE switch S102. The X1, X10, and X100 factors apply only to the 0-3 scale, and result in full scale ranges of 3, 30 and 300 volts. The 0-6 DC scale is used only in the 600 VDC position of the RANGE switch and corresponds to 600 volts full scale.

4-52. POWER SUPPLY CIRCUITS
(See figure 4-14)

4-53. The power supply component parts are located in the test set sub-assembly TS-687/TRM-1. The dc power supply consists of a standard full-wave circuit using a tube type 6X4W rectifying the ac high voltage output of power transformer T102. A voltage regulator circuit, using a type OA2WA tube, furnishes regulated plus 150 volts dc. A 6.3 volt winding on the transformer supplies voltage for the panel lamps and the heaters of all vacuum tubes in the test set. The power transformer T102 is mounted on the frame of the test set beneath the main chassis sub-assembly. It is connected to the chassis wiring by a plug and receptacle, P110 and J110 respectively.

4-54. The test set is connected to an external source of 115V ac, 50 to 1000 cps, with Electrical Power Cable Assembly CX-3642/U (8'0"). Connection is made to the panel receptacle J111, POWER 115V-ac. J111 is built into a shielded compartment containing rf chokes L102, L103 one in each side of the line. Each side of the ac line, leading to the primary winding of the power transformer T102, is protected by a 1 ampere fuse, F101 and F102. In STANDBY position the double-pole double-throw ac line switch S107 connects the line voltage to a space heating resistor, R161. The STANDBY neon pilot lamp, L103, indicates when power is applied to the heater circuit. Placing the ac line switch to POWER position applies voltage to the primary winding of power transformer T102. The secondary winding of the power transformer, pins D, E, and B of plug P110, is center tapped and supplies high voltage of approximately 300 volts to the plates of the full wave rectifier tube, 6X4W, V107. In this type circuit the tube acts similarly to a switch in that it conducts only in the portion that has positive plate voltage with respect to the grounded center tap of the power transformer. Each plate is alternately (and oppositely) positive and negative; the cathode is common to both plates and thus becomes positive twice during each cycle of the ac voltage supplied, thus producing a pulsating dc voltage at the cathode, pin 7, at 120 cps. This voltage is smoothed into useable constant dc by the filtering action of the choke L101, and capacitor C119B. The reactance of the choke offers a high impedance to the varying voltage component and tends to hold the current constant. In the absence of any load, the filter capacitor would charge to the peak value of the pulsating dc voltage and remain at that dc level. The value of C119B was chosen to have a very long discharge time constant through the load presented by the circuits of the test set. It maintains the output voltage of the choke L101 at nearly plus 270 volts dc with a low level of ripple voltage. This dc voltage is supplied to the following points in the equipment,

a. Plate circuits, pins 1 and 6, of the AMPLIFIER-CATHODE FOLLOWER tube, V101, type 5814A.

b. Plate circuit, pins 5 and 6, of the MODULATOR tube, V106, type 6005.

c. Plate circuit, pin 5, of the OVER-MOD AMPLIFIER tube, V104, type 6AU6WA; supplied only in the TPT position of MASTER CONTROL switch section S101N.

4-55. A source of regulated plus 150 volts is provided in the power supply by the combination of a gaseous glow tube, type OA2WA, and the series resistors R159 and R160. In a voltage regulator of this type the output voltage remains constant over a fairly wide range of current. This property exists because the degree

of ionization of the gas contained in the regulator tube varies with the amount of current that the tube conducts. The greater the degree of ionization the lower is the internal resistance of the tube. The regulated voltage is that which is dropped across the series resistors R159 and R160. The current range of the voltage regulator circuit is increased by shorting out the series resistor R160 when switch section S101M of the MASTER CONTROL switch is in either the LMHF or VHF/UHF positions. In these positions maximum load is offered to the voltage regulator circuit. In the TPT and VM positions the least load is presented to the circuit, and resistor R160 is placed back into the circuit to prevent an excessive current flow through the voltage regulator tube.

4-56. The following points are furnished regulated plus 150 volts in various positions of the MASTER CONTROL switch S101.

a. TPT position - (1) Plate circuits, pins 1 and 6, of the AUDIO OSCILLATOR tube V105, type 5814A via INT position of MOD switch S105. (2) Screen, pin 6, of the OVER-MOD AMPLIFIER tube, V104, type 6AU6WA via switch section S101M.

b. LMHF position - (1) Plate circuit, pins 5 and 6, of the OSCILLATOR tube, V301, type 6AU6WA via switch section S101M, and pin 1 of jack J102. (2) Plate circuit, pin 5 of the RF AMPLIFIER tube V302, type 6AN5WA via switch section S101M and pin 1 of jack J102. (3) Screen circuit, pin 6 of the RF AMPLIFIER tube V302 via the modulation transformer T101 (terminals 3 and 4), switch section S101P, and pin 6 of jack J102.

c. VHF/UHF position - Plate circuit, pins 3 and 4, of the OSCILLATOR tube V201, type 6F4 via the modulation transformer T101, terminals 3 and 4, through switch section S101P and pin 6 of jack J101.

d. VM position - None.

4-57. The meter and panel lamps as well as all vacuum tube heater circuits are supplied with 6.3 volts ac from the third winding on the power transformer T102, connected at pin A on plug P110. The illuminating lamps are controlled by the LIGHTS switch S106, located on the front panel of the test set. The heater, pin 4, voltage for the MODULATION VOLTMETER tube V102, and the VOLT/MW METER tube V103, is reduced from 6.3 volts to approximately 5.5 volts by the series resistors R114 and R131 respectively. This has the effect of lowering the temperature of the cathode. The cathode emission characteristic at the lower temperature is such that the current through the tube varies less with changes in filament voltage. This allows the zero adjustment of the voltmeters to hold over a wider range of line voltage change.

4-58. ACCESSORY ITEMS CIRCUIT ANALYSIS

4-59. TEST ADAPTER MX-1652/TRM-1 (See figure 4-3)

4-60. Test Adapter MX-1652/TRM-1 is an antenna simulator used in conjunction with Signal Generator SG-32/TRM-1 in making sensitivity measurements of radio receivers designed for use with open wire antennas. The circuit component parts are contained in an aluminum case approximately 2 inches long x 1 inch high x 1 inch wide. One type UG-88C/U connector is provided at each end for connecting to RF Cable CG-546/U.

4-61. The circuit consists of a shunt 50-ohm resistor R602, connected from J601 GEN to ground, which properly terminates the signal generator step-attenuator, and an antenna simulation network consisting of a 200 uuf capacitor C601 in series with the combination of L601 shunted by R601, C602. At frequencies above 2.5 megacycles the output impedance at the RCVR jack J602 appears as a pure resistance of from 220 to 400 ohms. Below 1.6 megacycles the output acts as a capacitance of 200 uuf in series with an inductance of 200 uh and a resistance of 15 ohms.

4-62. RF Cable CG-546/U is used for connecting the signal generator to the GEN jack of the antenna simulator. The significant voltage is the input voltage, and not the output voltage; for example, if the output of the signal is at 20 megacyles the output impedance is 400 ohms resistive (See figure 4-3). Under these conditions, the input to the antenna simulator is the voltage indicated by the position of the MICROVOLTS attenuator of the Signal Generator. For accurate receiver output voltage indications the total load impedance presented by the antenna simulator plus the load offered by the receiver under test should be at least 500 ohms. Figure 4-3 shows that the accuracy is sufficiently good at frequencies above 5 megacycles. Below this frequency the impedance falls off to approximately 220 ohms, and the receiver input load should be sufficiently high, 280 ohms or greater, to maintain accuracy.

4-63. TEST ADAPTER MX-2079/TRM-1 (See figure 4-4)

4-64. Test Adapter MX-2079/TRM-1 is used with both Signal Generator SG-32/TRM-1 and Signal Generator SG-33/TRM-1. The adapter consists of a rectangular aluminum case 2-7/8" long X 15/16" high X 1-1/8" deep with one female BNC connector on each end. It contains a straight through coaxial wire lead from which a 50 ohm resistor is connected to ground. This test adapter is used to provide correct termination of the signal generator when the input impedance of the equipment under test is greater than the internal impedance (50 ohms) of the signal generator. When the receiver input impedance is above 500 ohms always insert the 50 ohm termination MX-2079/TRM-1.

4-65. FIXED ATTENUATOR CN-399/TRM-1 (6db) (See figure 4-5)

4-66. Fixed Attenuator CN-399/TRM-1 is used with both Signal Generator SG-32/TRM-1 and Signal Generator SG-33/TRM-1. It consists of a rectangular aluminum case 2-7/8" long X 15/16" wide by 1-1/8" high with one female BNC connector on each end. It contains a pi-type resistance network composed of resistors R801, 150 ohms, R803, 36 ohms, and R802, 150 ohms. This attenuator is designed to give a 2:1 voltage reduction when terminated by approximately 50 ohms. The design of the pi network is such that 50 ohms will be reflected to the signal generator when the attenuator is terminated in 50 ohms. This attenuator is used to accurately reduce any step of the MICROVOLTS step attenuator, of the signal generator, by a factor of 2. For example the 2.5 microvolt output step of the signal generator may be accurately reduced to 1.25 microvolts by inserting attenuator CN-399/TRM-1 and terminating it in 50 ohms. This attenuator may also be used when performing signal plus noise to noise ratio measurements on radio receivers. For details on making noise and sensitivity measurements, consult the instruction book for the particular receiver being tested.

4-67. FIXED ATTENUATOR CN-287/TRM-1 (12db) (See figure 4-5)

4-68. The Fixed Attenuator CN-287/TRM-1 is physically similar to Fixed Attenuator CN-399/TRM-1 described in paragraph 4-66 above. It contains a pi-type resistance network consisting of resistors, R901, 82 ohms, R903, 91 ohms, and R902, 82 ohms. This attenuator gives a voltage attenuation of 4:1. The design is such that 50 ohms is reflected to the signal gener-

ator when terminated in 50 ohms load. This attenuator is also used to reduce the output voltage of the MICROVOLTS step attenuator, located in the signal generator, by a factor of 4. In this manner output voltage between the values indicated on the signal generator step attenuator may be accurately obtained.

SECTION V

ORGANIZATIONAL MAINTENANCE

5-1. INTRODUCTION.

5-2. Radio Test Set AN/TRM-1 is a carefully calibrated test instrument, therefore organizational and operational maintenance is necessarily limited to replacement of protective fuses, pilot, dial, and indicator lamps. Replacement of vacuum tubes and certain internal adjustments may be performed by qualified personnel at field (FASRON) level as outlined in Section VI of this handbook. Any other malfunctioning of the major portions of the test set will require corrective measures that can be taken only by Aircraft Overhaul and Repair Units (of the Navy) or Depot maintenance personnel (of the Air Force) in accordance with the Handbook of Overhaul Instructions for Radio Test Set AN/TRM-1.

5-3. REPLACEMENT OF FUSES.

5-4. Two active fuses, F101 and F102, are located in the front panel receptacles marked 1 AMP. If replacement of either or both of these fuses is indicated, replacement should be made with one or both of the SPARE fuses located directly below the active fuses. A new fuse should be placed in the spare receptacle as soon as possible after the original spare has been placed in service.

CAUTION

Do not replace a fuse with one of higher current rating unless continued operation is more important than probable damage to the equipment. If a fuse blows immediately after replacement do not replace it a second time until the cause of malfunctioning has been determined and remedied by service personnel.

5-5. REPLACEMENT OF PILOT LAMPS.

5-6. The POWER pilot lamp, I102, and the STAND-BY pilot lamps, I103, are bayonet based lamps and are replaceable directly at the front panel. Unscrew the colored jewel by turning its knurled retainer counter-clockwise. This exposes the lamp. Using the fingertips, press on the lamp and rotate counter-clockwise 1/4 turn. Release the pressure and remove the lamp.

5-7. REPLACING TRANS OVER MOD INDICATOR LAMP.

5-8. The TRANS OVER MOD indicator lamp, I101, may be replaced directly at the front panel in the same manner as the pilot lamps described in paragraph 5-5 above.

NOTE

Differences in characteristics of neon lamps may effect the calibration of the OVER MOD circuit. After replacing the TRANS OVER MOD indicator lamp, follow the checking procedure given in paragraph 6-27 of Section VI.

5-9. REMOVING SIGNAL GENERATORS SG-32/TRM-1 AND SG-33/TRM-1 FROM THE EQUIPMENT (See figure 5-2)

5-10. Both signal generators contained in Radio Test Set AN/TRM-1 are of plug-in type construction. Each signal generator is retained in the test set with four captive-typeslotted screws located at the top and bottom of each signal generator front panel. After loosening the four captive screws, the respective signal generator may be removed from the test set. Pull directly out on the loosened screws until the power plug is detached from the internal receptacle. Pull the unit straight out until it completely clears the test set.

5-11. REPLACING DIAL LAMPS IN SIGNAL GENERATOR SG-32/TRM-1. (See figure 5-4)

5-12. To replace the two dial lamps, type No. 47,

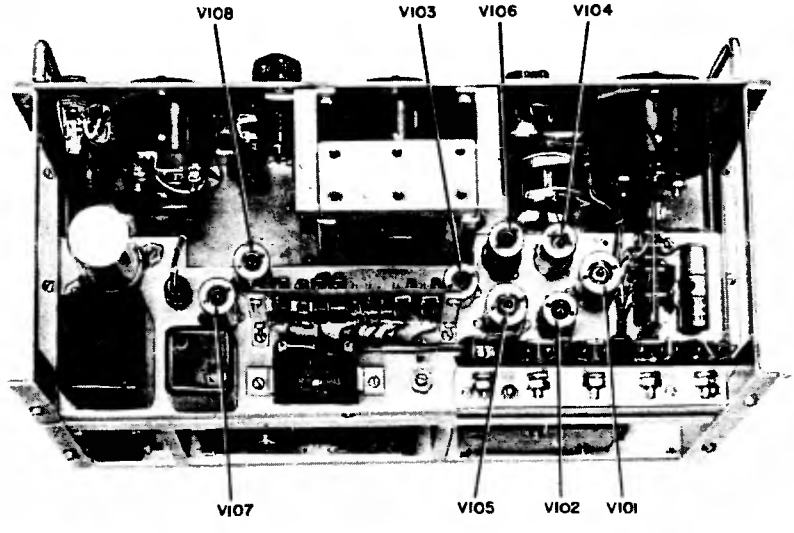


Figure 5-1. Test Set Subassembly TS-687/TRM-1, Tube Locations

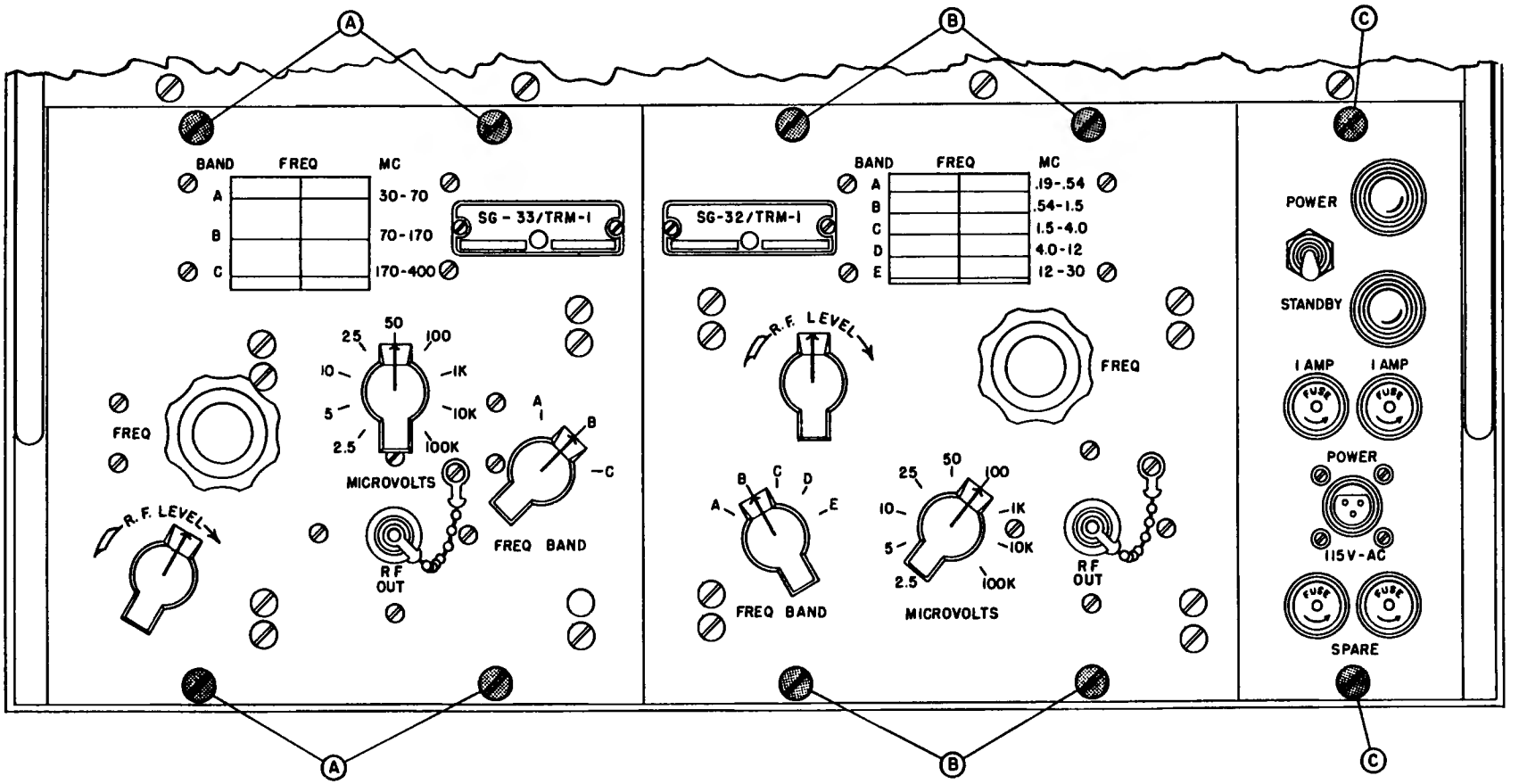


Figure 5-2. Removal of Signal Generators and Power Panel from the Equipment Case

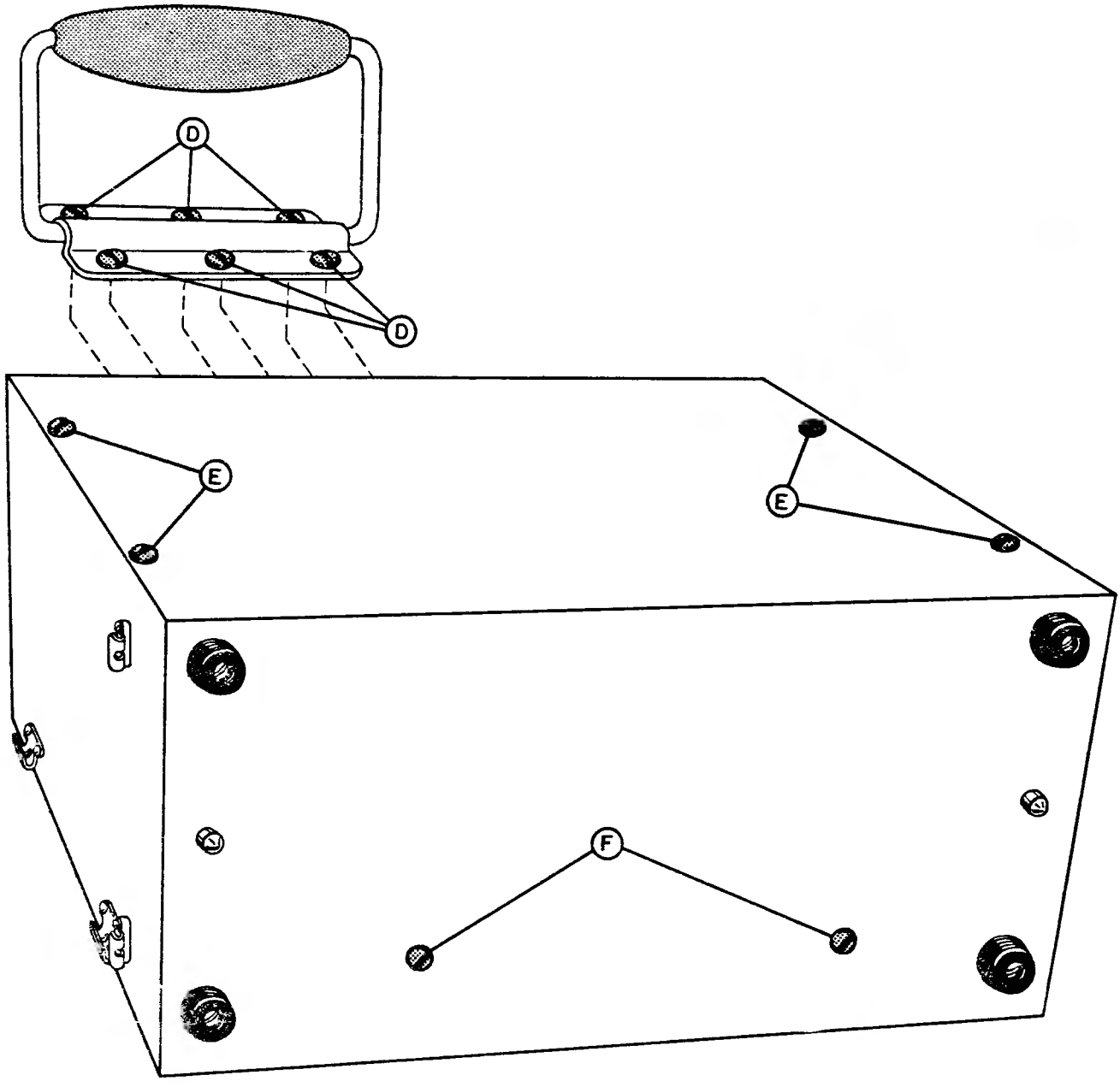


Figure 5-3. Removal of Test Set TS-687/TRM-1 from the Equipment Case

I301 and I302, in Signal Generator SG-32/TRM-1 remove the signal generator from its mounting in the test set. Use the method outlined in paragraph 5-9 above. The two dial lamp holders used with this signal generator are mounted on the main casting directly behind the front panel, one on each side of the tuning dial drum. Two screws fasten each lampholder. The screw nearest the front panel is used to position the dial lamps, in order to replace a dial lamp this screw must be removed. The lampholder may then be angled outward sufficiently to permit the lamp to be removed and replaced. After the lamp has been changed, carefully replace the positioning screw.

5-13. REPLACING DIAL LAMPS IN SIGNAL GENERATOR SG-33/TRM-1
(See figure 5-5)

5-14. Replacing the two types No. 47 dial lamps, I201

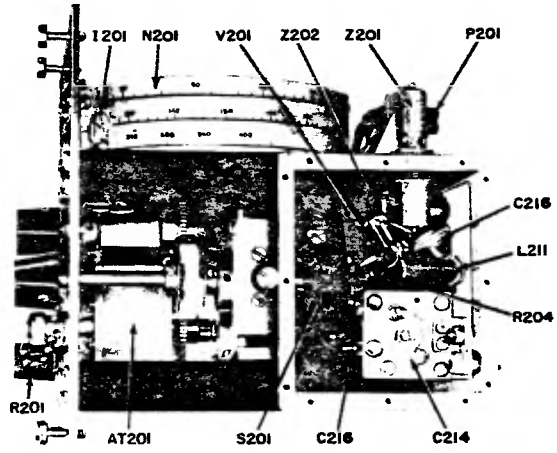


Figure 5-5. Signal Generator SG-33/TRM-1, Location of Tubes and Component Parts

and I202, contained in Signal Generator SG-33/TRM-1, requires that the signal generator unit be removed from the test set as described under paragraph 5-1 of this section. The two lampholders used are mounted on the inside of the front panel, one on each side of the tuning dial drum, at the panel escutcheon opening. In this particular unit the dial lamps are easily accessible and they may be replaced without moving their holders.

5-15. REMOVING TEST SET SUB-ASSEMBLY TS-687/TRM-1 FROM THE EQUIPMENT CASE
(See figure 5-3)

5-16. Test Set Sub-assembly TS-687/TRM-1 must be removed from the equipment case to replace the vacuum tubes, panel meter illuminating lamps and to gain access to the component parts mounted on the front panel and chassis assembly. This procedure is best accomplished as follows:

CAUTION

Do not remove any screws from the front panel of Test Set TS-687/TRM-1 when removing it from the equipment case.

a. Place the test set on a flat surface with the front panel facing upwards.

b. Remove the binding head screws located on the bottom of the test set.

c. Replace the test set to its normal upright position on its feet with the front panel facing away from the operator.

d. Remove the four binding head screws located on the back of the test set.

e. Turn the test set around so that the front panel faces toward the operator.

f. Remove the six binding head screws that fasten the carrying handle to the top of the equipment case. Remove the carrying handle. Place the handle along with the 12 screws removed, in a container for safe keeping.

g. The test set is now free from the equipment case. Remove it by grasping the two plated guard rails, located on the front panel, and gently pull the test set straight out until it clears the equipment case.

5-17. REPLACING METER ILUMINATING LAMPS

5-18. To replace the panel meter illuminating lamps I104, I105 and I106, each a type No. 47 bayonet base incandescent lamp, Test Set Sub-assembly TS-687/

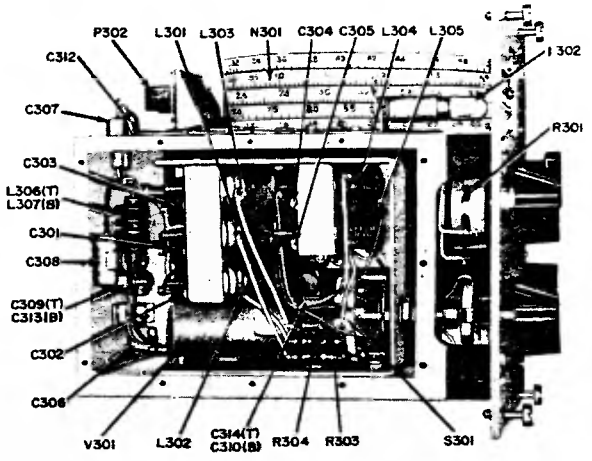


Figure 5-4A. Signal Generator SG-32/TRM-1, Location of Tubes and Component Parts

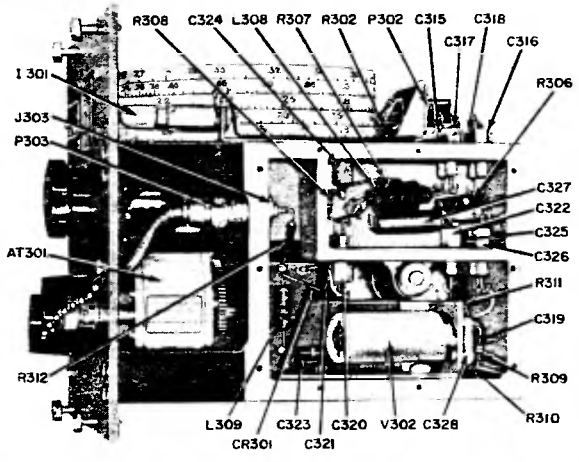


Figure 5-4B. Signal Generator SG-32/TRM-1, Location of Tubes and Component Parts

TRM-1 must be removed from the equipment case. The procedure for removing the case is given in paragraph 5-15 of this section. The lampholder for each panel meter is bracket mounted, with a single round head screw, directly on the back of each meter case. To replace a lamp remove the screw, and pull the lampholder outward until the lamp clears the meter case. After replacing the illuminating lamp carefully place the lampholder back into its original position. Avoid overtightening the roundhead retaining screw.

CAUTION

Always replace and securely tighten all screws that have been removed from the equipment case during maintenance operations. This is necessary not only for mechanical reasons, but also to maintain radio frequency leakage at its safe minimum level.

SECTION VI

FIELD AND FASRON MAINTENANCE

6-1. INTRODUCTION

6-2. RADIO TEST SET AN/TRM-1 is a calibrated instrument which performs a variety of functions in measuring pre-flight performance of communications equipment. Field maintenance is necessarily limited to tube replacement and minor corrective adjustments specifically mentioned in this section.

6-3. IDENTIFICATION OF MAJOR TEST POINTS (See figure 6-2 and 7-1)

6-4. Three star-encircled arabic numerals are used on the main schematic circuit diagram, figure 7-1, to identify and designate test points used in checking potentials in the equipment power supply. The physical location of the test points is shown in figure 6-2. Test point 1 is indicated at the output of fuses F101 and F102 and serves as a check of the power source voltage and fuse continuity. The fuseholders located on the front panel are provided with test prod holes in the center of their caps, as a convenient means of checking the ac input voltage to the test set. The other test points, designated 2 and 3 on figure 7-1 are dc measurements and are accessible as described below.

a. Test point 2 is a check of the unregulated dc output of the power supply. This test point is located in the Test Set Subassembly TS-687/TRM-1 at resistor R159, which is located on the top, and at the extreme rear, of the main chassis near the modulation transformer T102. It is the upper of two stacked 22 watt resistors (the lower resistor is R160). With the test set upright, and the front panel facing the operator the check is made at the right hand terminal of resistor R159, that is, the side nearer to the modulation transformer.

b. Test point 3 is a check of the regulated plus 150 volt dc output of the power supply. This test point is located in the Test Set Subassembly TS-687/TRM-1 at resistor R160, which is located on top, and at the extreme rear, of the chassis. It is the lower of the pair of 12 watt resistors (the upper resistor is R159 mentioned in a. above). The check is made at the right hand terminal of the resistor, that is, the terminal nearer to modulation transformer T102.

6-5. IDENTIFICATION OF SECONDARY TEST POINTS (See figures 6-2, 6-3 and 6-4)

6-6. Eight encircled capital letters, A through H, are used on the simplified schematic circuit diagrams figures 4-1 through 4-14 for checking input supply voltages to the various vacuum tubes located in Test Set Subassembly TS-687/TRM-1, and in Signal Generators SG-32/TRM-1 and SG-33/TRM-1. These test points are all dc measurements and are accessible as described below.

a. Test point A is a check of the plus 280 volt dc input to the plate load resistor R107 of the AMPLIFIER portion, and the plate (pin 6) circuit of the CATHODE FOLLOWER portion, of tube V101. Check the input voltage on terminal board TB101 located on the underside of the chassis of TS-687/TRM-1.

b. Test point B checks the presence of input plus 280 volts unregulated to the plate load resistor R142, of the OVER-MOD AMPLIFIER tube, V104. The MASTER CONTROL switch, S101, must be placed in TPT position when making a check at this test point. The voltage is measured at terminal board TB101 located on the underside of the chassis of TS-687/TRM-1.

c. Test point C checks the presence of plus 150 volts dc regulated at the screen of the OVER-MOD AMPLIFIER tube, V104. The MASTER CONTROL switch, S101 must be placed in TPT position when making a check at this point. The voltage is measured at pin 6 of the tube socket XV104. This tube socket is located on the chassis directly behind the panel switch, S102, marked RANGE.

d. Test point D is a check of the plus 150 volts dc regulated input to resistors R149 and R150 in the plate circuits of the AUDIO OSCILLATOR tube, V105. The panel switch marked MOD must be placed in the INT position when testing this voltage. The test point is located on terminal board TB104 mounted on top of the chassis directly behind the % MODULATION panel meter M102.

e. Test point E is a check of the plus 280 volts unregulated at the primary winding of the audio modulation transformer T101. Check this voltage at terminal number 2 of the modulation transformer, on the underside of the chassis.

f. Test point F is a check of the plus 135 volts dc input to plate circuit of the OSCILLATOR tube V201 in the Signal Generator SG-33/TRM-1. It is necessary to remove the signal generator unit from the equipment when making this test. Use the furnished cable W1101 to extend power connections from the internal power receptacle. Check the input voltage at the variable resistor R201 (RF LEVEL panel control). This control is mounted on the front panel. It has three terminals. The voltage is measured at either of the two inside terminals, both of which are tied directly together. The MASTER CONTROL switch S101 must be placed in V/UHF position for this test.

g. Test point G is a check of the plus 135 volts dc to the screen circuit of the RF AMPLIFIER tube, V302, in the Signal Generator SG-32/TRM-1. Since the signal generator must be removed from the test set to gain access to this test point, it is necessary to use the furnished extension cable W1101 for making connection to the signal generator. Check the input voltage to the screen of the RF AMPLIFIER tube V302 at the feed-through capacitor, C316, accessible at the rear of the main casting. The MASTER CONTROL switch S101 must be placed to LMHF position when making this test.

h. Test point H is a check of the plus regulated 150 volts input to the voltage dividing resistors R302 and R301 (RF LEVEL control) of the OSCILLATOR tube V301, plate circuit. It also checks the input to the plate circuit of the RF AMPLIFIER tube V302. Check the input voltage at the feed through capacitor C317 located on the back of the main casting. The MASTER CONTROL switch S101, must be placed in LMHF position when testing at this point.

6-7. DISASSEMBLY OF TEST SET SUBASSEMBLY TS-687/TRM-1 (See figure 6-1)

6-8. To gain access to parts and terminals located on the underside of the panel-chassis portion of Test

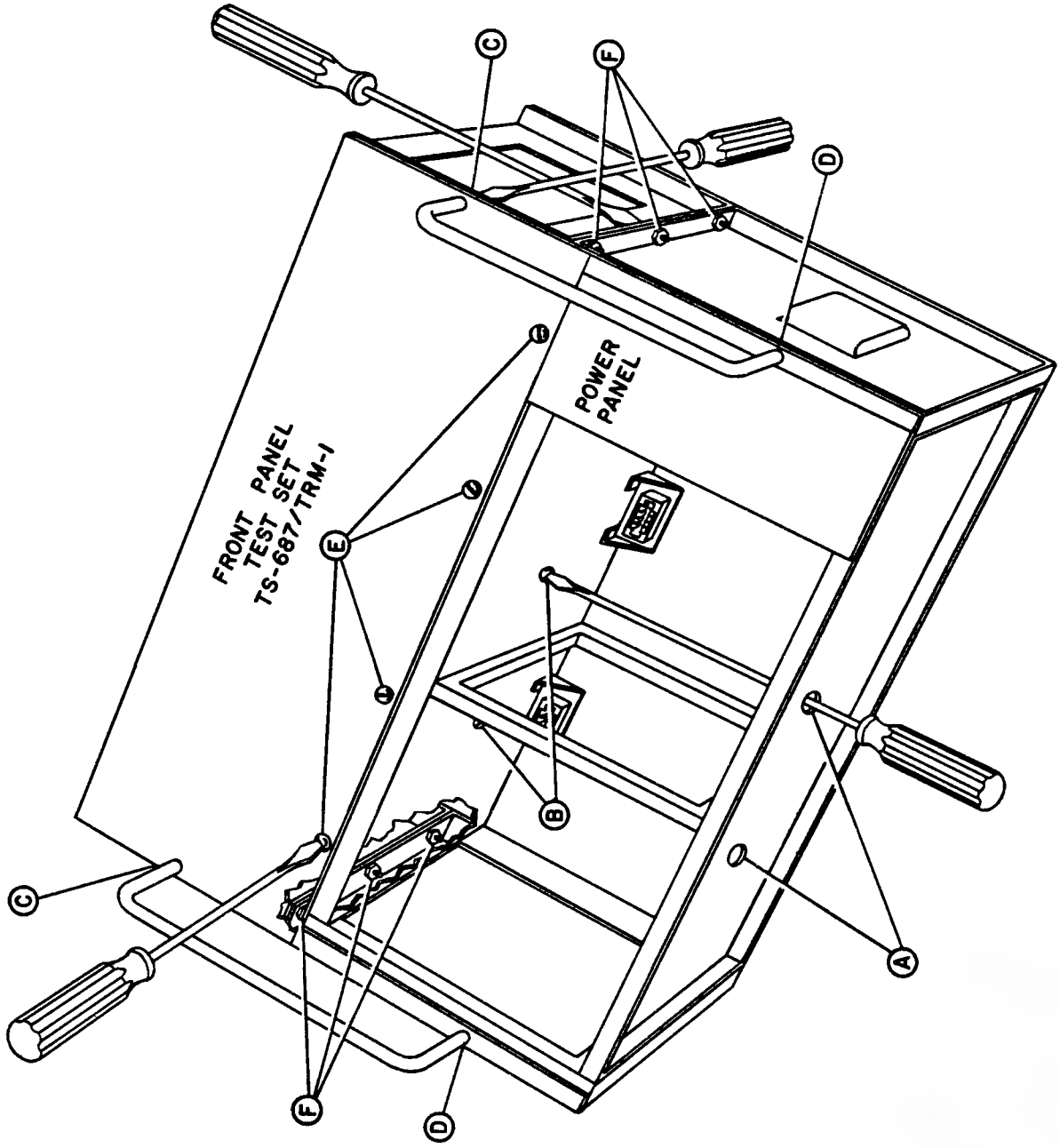


Figure 6-1. Disassembly for Test Set TS-687/TRM-1

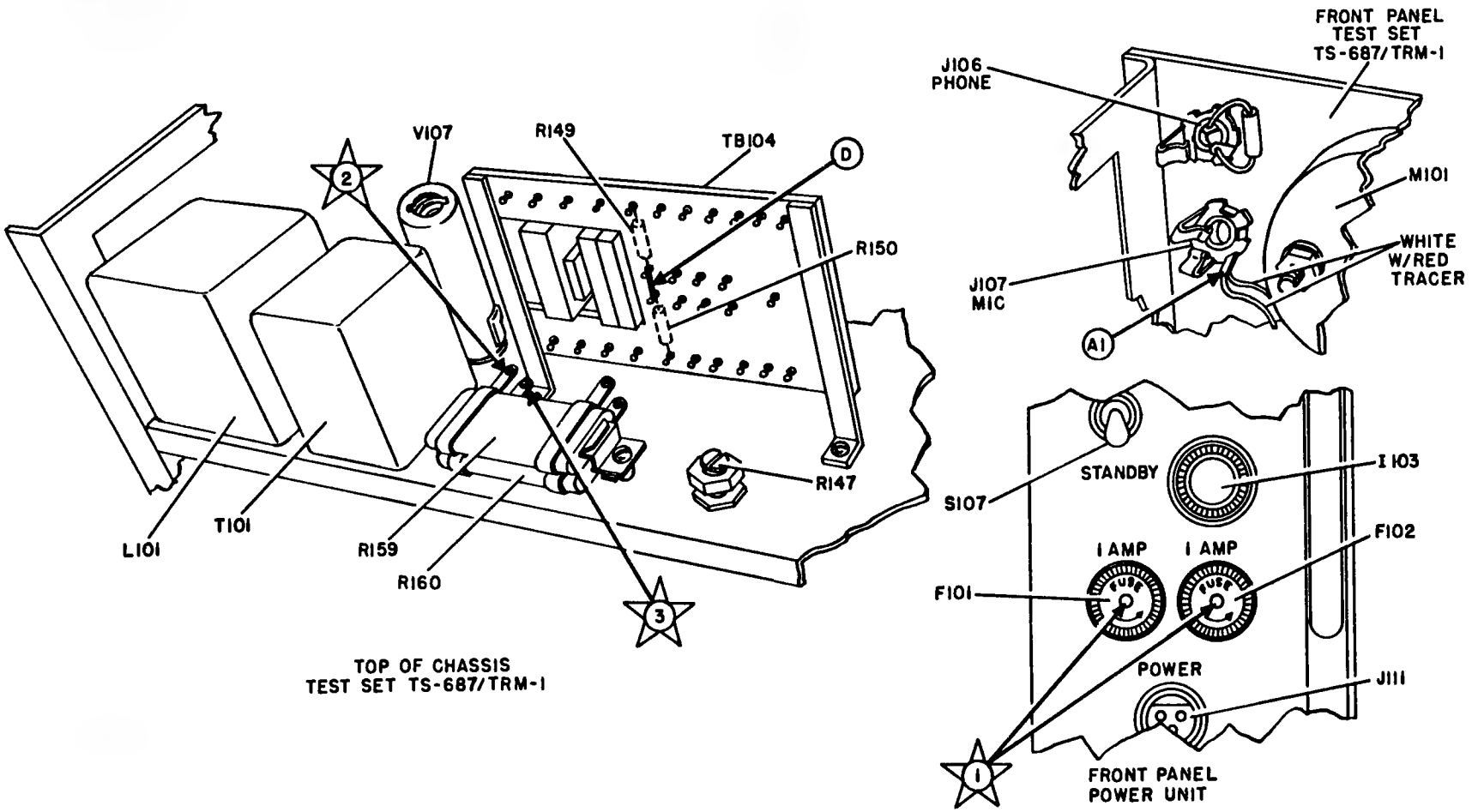


Figure 6-2. Location of Test Points, Top of Chassis and Front Panel, Test Set TS-687/TRM-1

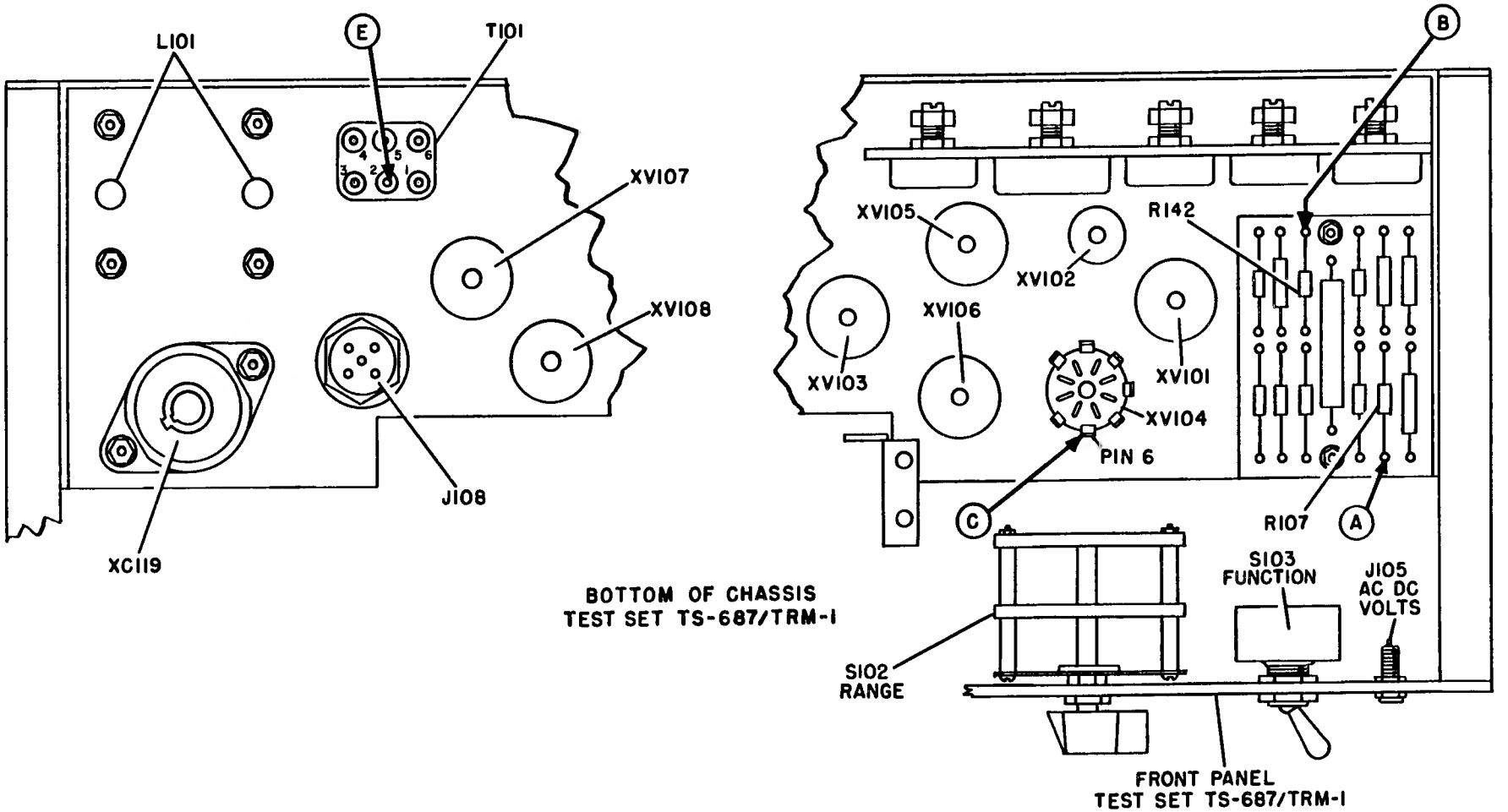
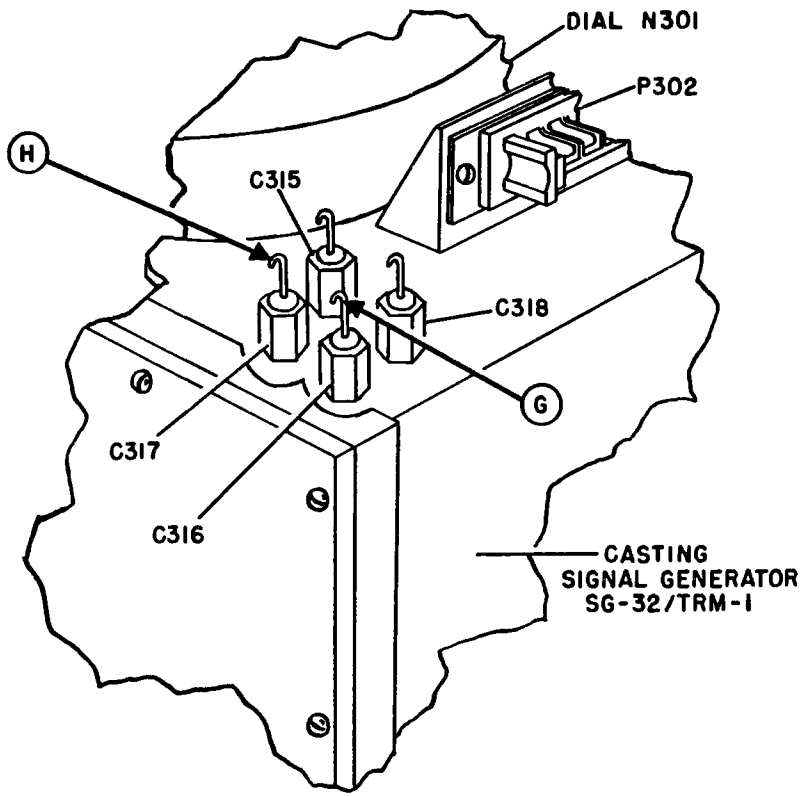
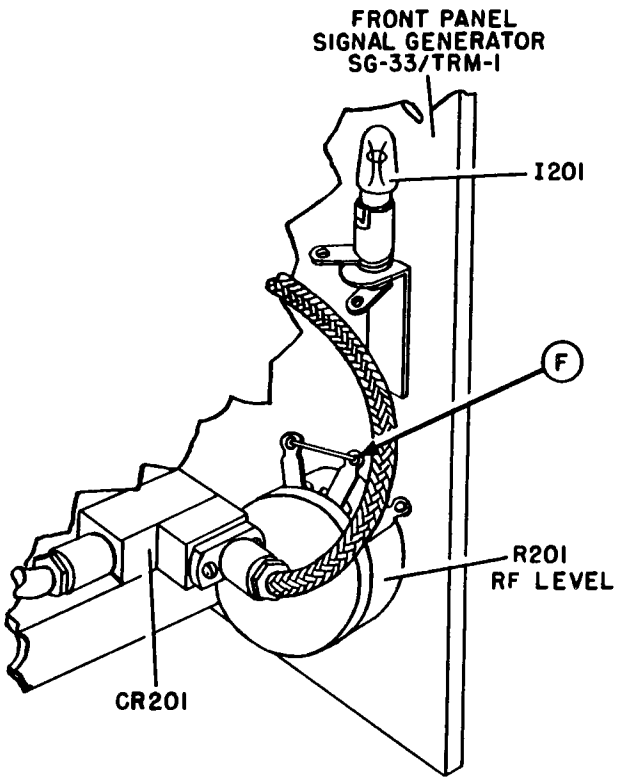


Figure 6-3. Location of Test Points, Bottom of Chassis, Test Set TS-687/TRM-1



REAR OF CASTING
SIGNAL GENERATOR
SG-32/TRM-1



REAR OF FRONT PANEL
SIGNAL GENERATOR
SG-33/TRM-1

Figure 6-4. Location of Test Points, Signal Generators SG-32/TRM-1 and SG-33/TRM-1

Set TS-687/TRM-1, it is necessary to remove the panel-chassis assembly from the frame. This is accomplished as follows:

a. Remove the test set from the equipment case in the manner described in paragraph 5-15 of this handbook. (See figure 5-3.)

b. Remove both signal generators from the frame as described in paragraph 5-9. (See figure 5-2.)

c. Turn the test set bottom-side up.

d. Located on the bottom panel of the signal generator walls, there are two clearance holes (marked A on figure 6-1), placed there to provide access to the corresponding two binding head screws (marked B on figure 6-1) holding the carrying handle support assembly. Pass a long-bladed screwdriver through each access hole and remove its corresponding screw.

NOTE

The retaining nuts for the screws marked B, C, D, and E in figure 6-1 are captive type, and need not be held when removing or replacing the screws. The three screws, marked F, holding each side bracket are retained by hex nuts, with lockwashers, and must be held when removing or replacing the screws.

e. Return the subassembly to its normal upright position with the front panel facing the operator.

f. Loosen slightly the bottom screws (marked D on figure 6-1) retaining the panel handles.

g. Remove the top screws (marked C on figure 6-1) retaining the panel handles.

h. Push each panel handle in the outward direction far enough so that they clear the front panel. Be careful not to scratch the paint on the front panel when performing this step.

i. Remove the four binding head screws (labeled E in figure 6-1) from the bottom edge of the front panel of TS-687/TRM-1.

j. Take out six screws (labeled F in figure 6-1), three on each side of the subassembly. These screws, having removable nuts and lockwashers, fasten together the upper and lower side brackets of the frame.

k. Detach the power supply plug P110 from the jack J110. This plug is located on top of the chassis directly behind the AUDIO LEVEL TO TRANS-DB panel control (AT101).

l. The panel and chassis subassembly is now free; remove it by lifting gently straight up. Do not bring the subassembly forward until it is well clear of the remainder of the frame.

m. After removal, the panel-chassis subassembly can be connected to the power sources in the remainder of the frame (See figure 7-4).

(1) Stand the frame on one end with the power transformer down, and with the power panel facing the operator.

(2) Place the panel-chassis assembly on the right side of the frame with the bottom side up, and the front panel facing the operator.

(3) With the equipment placed in the position described above, the power cable, terminated in plug P110, will easily reach the matching jack J110.

(4) The signal generator units SG-32/TRM-1 and SG-33/TRM-1 may be returned to their wells in the frame for test purposes.

n. To reassemble the subassembly, reverse the pro-

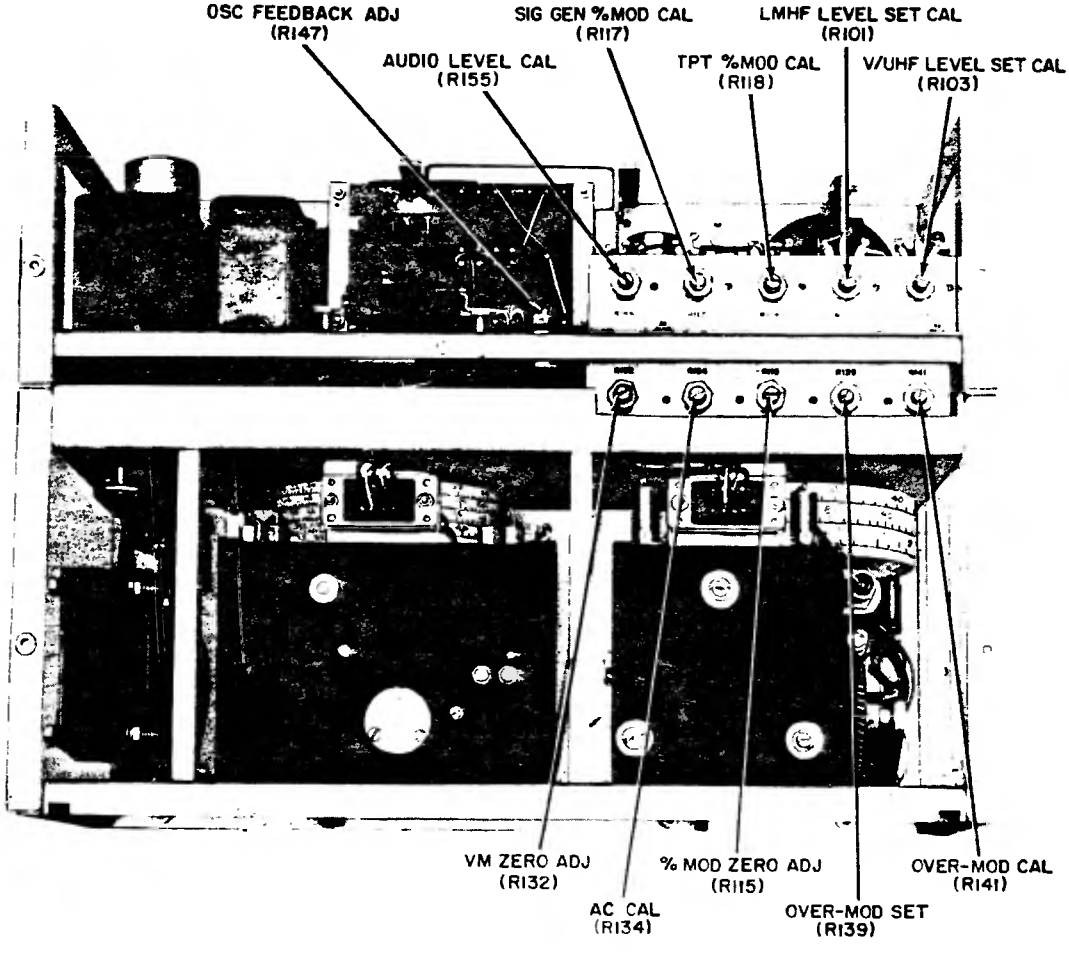


Figure 6-5. Radio Test Set AN/TRM-1, Adjustment Controls Location

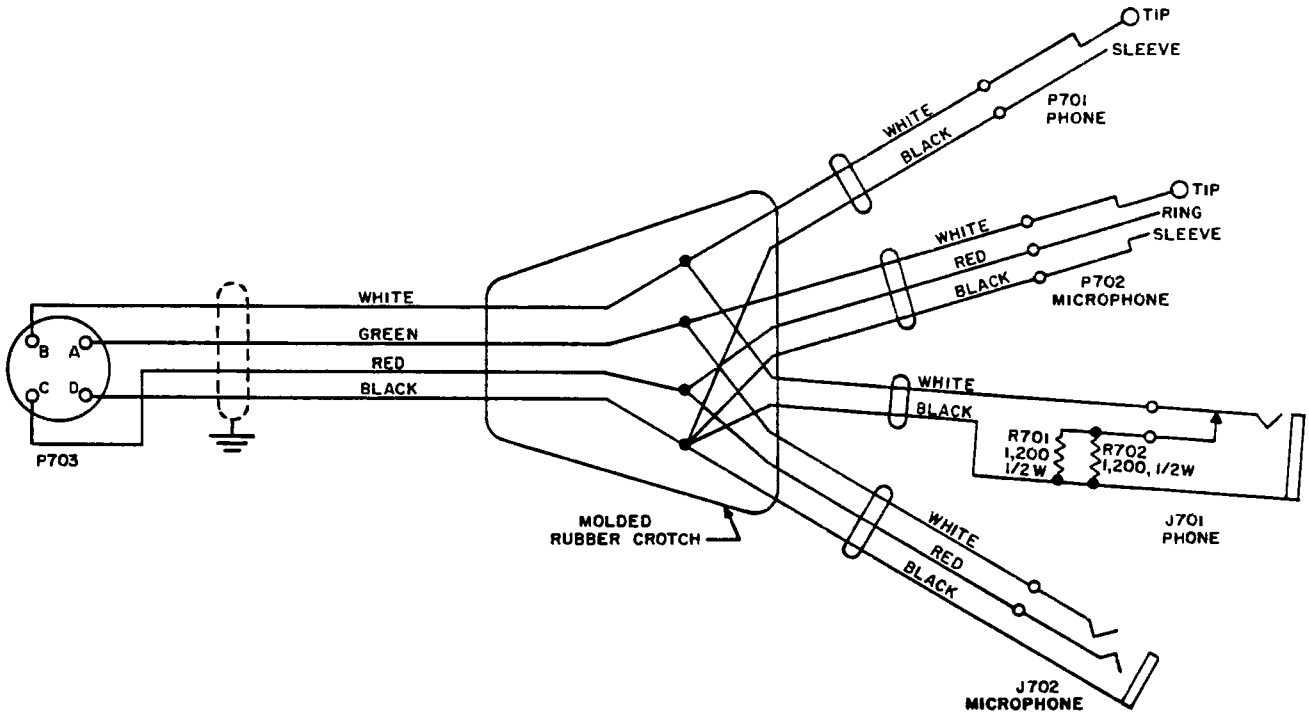


Figure 6-6. Electrical Cord Assembly CX-3049/TRM-1, Schematic Diagram

cedure outlined in steps a. thru m. above.

6-9. REPLACING TUBES

6-10. GENERAL - Any of the vacuum tubes contained in Radio Test Set AN/TRM-1 may be replaced at field maintenance level. However, certain readjustments may become necessary after tube replacements have been made. These adjustments are described fully in paragraphs 6-15 thru 6-33 as indicated in the table under paragraph 6-12 below. After a tube has been replaced in either Signal Generator SG-32/TRM-1 or SG-33/TRM-1 it is recommended that the frequency calibration be checked against a frequency standard.

6-11. REPLACING TUBES IN TEST SUBASSEMBLY TS-687/TRM-1 (See figure 5-1)

6-12. To replace the vacuum tubes in Test Set Subassembly TS-687/TRM-1, the test set must be removed from the equipment case as described in paragraph 5-15 of Section V of this handbook. The following table lists the tubes contained in this subassembly together with minor readjustment procedures which may be necessary after tube replacement.

JAN TYPE	TUBE	SYMBOL	ADJUST
5814A	AMPLIFIER-CATHODE FOLLOWER	V101	None
5726	MODULATION VOLTMETER	V102	See paragraph 6-18
5726	VOLT/MW METER	V103	See paragraph 6-22
6AU6WA	OVER-MOD AMPLIFIER	V104	See paragraph 6-27
5814A	AUDIO OSCILLATOR	V105	See paragraph 6-29
6005	MODULATOR	V106	See paragraph 6-31
6X4WA	RECTIFIER	V107	None
0A2WA	VOLTAGE REGULATOR	V108	None

6-13. MINOR INTERNAL ADJUSTMENTS (See figure 6-5)

6-14. GENERAL - Remove the equipment from the test set as described in paragraph 5-15. All chassis control shafts are accessible from the top of the subassembly chassis. There are eleven such adjustments grouped at the rear of the chassis as shown in figure 6-5. Before making any adjustments, allow the equipment to warm up for at least 20 minutes. The ac line voltage during adjustments should be 115V ac within 2 percent. It may be measured with Navy type Electronic Multimeter ME-6/U series or equivalent.

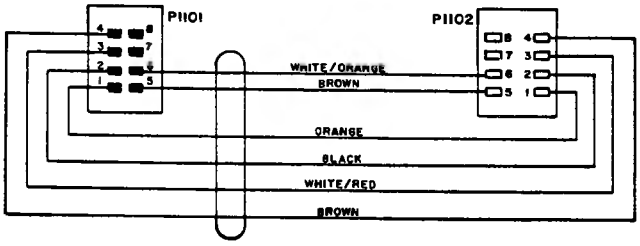


Figure 6-7. Special Purpose Electrical Cable Assembly CX-3884/U, Schematic Diagram

NOTE

Each chassis control shaft is provided with a locking nut. Use a hexagon spin-type wrench to loosen the lock before attempting to rotate the screwdriver slotted shaft. After satisfactory adjustment has been performed, be sure to lock the shaft in its final position. Recheck that tightening of the shaft lock has not affected the control setting.

6-15. ZERO SETTING THE % MODULATION METER

6-16. MECHANICAL ZERO SETTING

6-17. The mechanical zero setting adjustment for the % MODULATION meter is accessible at the front panel. It is a screwdriver adjustment located in the meter case at the bottom of the glass window. To check the mechanical zero of this meter use the following procedure:

a. Connect the test set to source of 115V ac power source.

b. Turn on the set and allow it to warm up for at least 20 minutes, thus allowing the meter to come up to normal temperature.

c. Turn the MASTER CONTROL switch S101 to VM position. In this position the meter is disconnected from the internal circuits, and grounded.

d. Adjust the indicator needle to the zero mark by carefully turning the screwdriver adjustment in the meter case. Observe the meter face at right angles to avoid parallax error.

6-18. ELECTRICAL ZERO SETTING

6-19. After replacing the MODULATION VOLTMETER tube, V102 or when it is desired to check the electrical zero setting of the % MODULATION METER, V102, circuit proceed as outlined below.

a. Check and adjust the mechanical zero setting of the meter by the method given in paragraph 6-16 above.

b. Remove the test set from the equipment case in the manner described in paragraph 5-15.

c. Connect the test set to the 115V $\pm$ 2% ac power source. Turn on the equipment and allow it to warm up for at least 20 minutes.

d. Place the panel switch S105 marked MOD to its EXT & OFF position, thus removing the audio oscillator from the modulating circuits.

e. Turn the MASTER CONTROL switch S101 to LMHF position.

f. Rotate the front panel control SIG GEN & MOD fully counter-clockwise.

g. Loosen the hex locknut clamping the shaft of the % MOD ZERO ADJ chassis adjustment R115.

h. Using a screwdriver, adjust R115 until the meter needle indicates at the zero mark of the calibrated meter face. Observe the meter at right angles to minimize parallax error.

i. Retighten the shaft locking nut. Recheck the zero positioning of the meter to make sure that the locking operation did not disturb the adjustment.

6-20. ZERO SETTING THE VOLT/MW METER

6-21. MECHANICAL ZERO SETTING - Follow the same general procedure for mechanical zeroing this meter as that given in paragraph 6-16 above, except that the MASTER CONTROL switch S101 should be placed at TPT position.

6-22. ELECTRICAL ZERO SETTING - After replacing the VOLT/MW METER tube, V103, or when it is desired to check the electrical zero setting of this circuit, proceed as follows:

a. Check and if necessary adjust the mechanical meter zero adjustment of the meter as given in paragraph 6-21 above.

b. Remove the test set from the equipment case in the manner described in paragraph 5-15.

c. Connect the test set to the 115V ac power source and allow it to warm up for at least 20 minutes.

d. Place the front panel switch S103 marked FUNCTION to the AC position.

e. Turn the RANGE switch S102 to X100 position.

f. Rotate the MASTER CONTROL switch, S101, to VM position.

g. Loosen the hex locknut holding the shaft of the VM ZERO ADJ chassis adjustment R132.

h. Using a screwdriver, turn R132 until the indicating needle of the VOLT/MW METER, M103, points to zero. Observe the meter at right angles to avoid parallax error.

i. Retighten the shaft locking nut. Recheck the zero positioning of the meter. Make sure that the locking operation did not distrub the setting.

6-23. ZERO SETTING THE CARRIER LEVEL METER

6-24. GENERAL - Because of the fact that a crystal type rectifier diode is used with the carrier level metering circuits of both signal generators, there is negligible contact potential present, and therefore an electrical zero setting is not required.

6-25. MECHANICAL ZERO SETTING

6-26. Follow the general procedure for mechanically zeroing this meter as that given in paragraph 6-21. above, except that the MASTER CONTROL switch S101 is placed in VM position.

6-27. OVER-MOD AMPLIFIER CALIBRATION

6-28. The OVER-MOD AMPLIFIER tube, V104, is normally adjusted so that when modulation of a sine waveform is applied to the transmitter performance test circuits (at the COUPLER INPUT jack J103) the panel lamp TRANS OVER MOD indicator, I101, just begins to flash at a level setting of the OVER MOD PRESET control that agrees numerically with the percentage of modulation indicated on the % MODULATION meter M102. After replacing either the neon panel lamp, TRANS OVER MOD 1101, indicator or the OVER MOD AMPLIFIER tube, V104, or when it is desired to check and adjust the over-modulation indicating circuit, follow the procedure given below.

a. Place the following panel controls in the positions listed:

(1) MASTER CONTROL switch S101 to TPT position.

(2) OVER MOD PRESET control, R137, completely counter-clockwise. The dial should indicate "60".

(3) AUDIO LEVEL TO TRANS-DB control, AT101, completely counter-clockwise.

(4) MOD switch, S105, to INT position.

(5) TRANS KEY switch, S104 to ON position.

b. Clip a jumper wire from the coaxial COUPLER INPUT connector, J103, to the MIC jack J107 at the

ring contacting terminal test point A1 (Red and White wire). See figure 6-2. Make these connections at the back of the panel. Do not force wires into the terminal openings of the connectors involved.

c. Slowly advance the AUDIO LEVEL TO TRANS-DB attenuator until the % MODULATION meter M102 indicates at 60 on the TRANS scale. At this point the TRANS OVER MOD indicator lamp should begin to flicker.

d. If the lamp does not flicker at this point, or if it fires at a lower percentage then 60, make the following adjustments.

(1) Check that the panel control OVER MOD PRESET control is turned completely counter-clockwise, and that in that position its knob points at 60 on the scale.

(2) Adjust the AUDIO LEVEL TO TRANS-DB attenuator until the % MODULATION meter reads 60 percent.

(3) Unloosen the shaft locking nut on the OVER MOD CAL chassis adjustment, R141. Rotate the shaft until the panel indicating lamp I101, TRANS OVER MOD just begins to flicker.

e. Reset the AUDIO LEVEL TO TRANS-DB control until the % MODULATION meter indicates at 120 percent.

f. Advance the OVER MOD PRESET panel control to its 120 percent position.

g. Unloosen the shaft locking nut on the OVER MOD SET R139 and set this adjustment to the point where the OVER MOD lamp again begins to glow.

h. When the OVER MOD neon lamp is changed, or to compensate for its aging adjust R141 OVER MOD CAL with OVER MOD PRESET R137. Set at 60 percent as described in steps a. thru d. above.

6-29. AUDIO OSCILLATOR FEEDBACK ADJUSTMENT

6-30. After the AUDIO OSCILLATOR tube V105 is replaced, it is possible that the characteristics of the new tube will be such that the amount of feedback voltage should be decreased for optimum operation with minimum distortion; or the feedback may not be sufficient to cause the oscillator to perform stably. The procedure for adjusting the audio oscillator stage is given below:

a. Remove the test set from the equipment case. (See paragraph 5-15.)

b. Connect to 115V ac source and allow to warm up for 20 minutes. (See paragraph 6-14.)

c. Place the MASTER CONTROL switch to TPT position.

d. Put the MOD switch to INT position.

e. Throw the TRANS KEY switch on.

f. Rotate the AUDIO LEVEL TO TRANS - DB fully counter-clockwise.

g. Connect a set of headphones from the ring contact terminal of the panel jack J107, marked MIC (Red and White wires), test point A1 in figure 6-2. Advance the setting of the AUDIO LEVEL TO TRANS-DB until a comfortable level is reached.

h. Loosen the shaft locking nut of the OSC FEEDBACK ADJ, R147.

i. Turn R147 counter-clockwise until oscillations cease.

j. Now rotate the adjustment clockwise just past the point where oscillations resume. In order to maintain the stability of the oscillator consistent with good waveform turn the adjustment a few degrees further clockwise. This completes the feedback adjustment.

6-31. CALIBRATION OF AUDIO LEVEL TO TRANS-DB ATTENUATOR

6-32. In the transmitter performance test function of the test set, the MODULATOR tube V106 supplies the AUDIO LEVEL TO TRANS-DB attenuator AT101 with audio voltage used in modulating the voice circuits of radio transmitters. The 0 db output level of this attenuator is 3 volts when it is terminated in 82 ohms.

6-33. The following steps describe the adjustment procedure.

a. Remove the test set from the equipment case. (See paragraph 5-15.)

b. Connect the 115V ac power source.

c. Allow the test set to warm up for at least 20 minutes.

d. Turn the MASTER CONTROL switch to TPT position.

e. Rotate the AUDIO LEVEL TO TRANS-DB fully clockwise. The pointer on the knob should now indicate at "0" on the scale.

f. Put the MOD switch to the INT position.

g. Place the TRANS KEY switch to the ON position.

h. Using clips, connect an 82 ohm, plus or minus 5 percent, 1 watt, resistor from the ring contacting terminal (Red and White wires) of the panel jack marked MIC and ground. Test point A1 (See figure 6-2).

i. Connect the Electronic Multimeter ME-6/U, or equivalent, across the 82 ohm test resistor.

j. Loosen the shaft locking nut of the AUDIO LEVEL CAL chassis adjustment, R155.

k. Turn the screwdriver slotted shaft of R155 until the voltmeter reads 3 volts.

l. Retighten the shaft locking nut. This completes the adjustment.

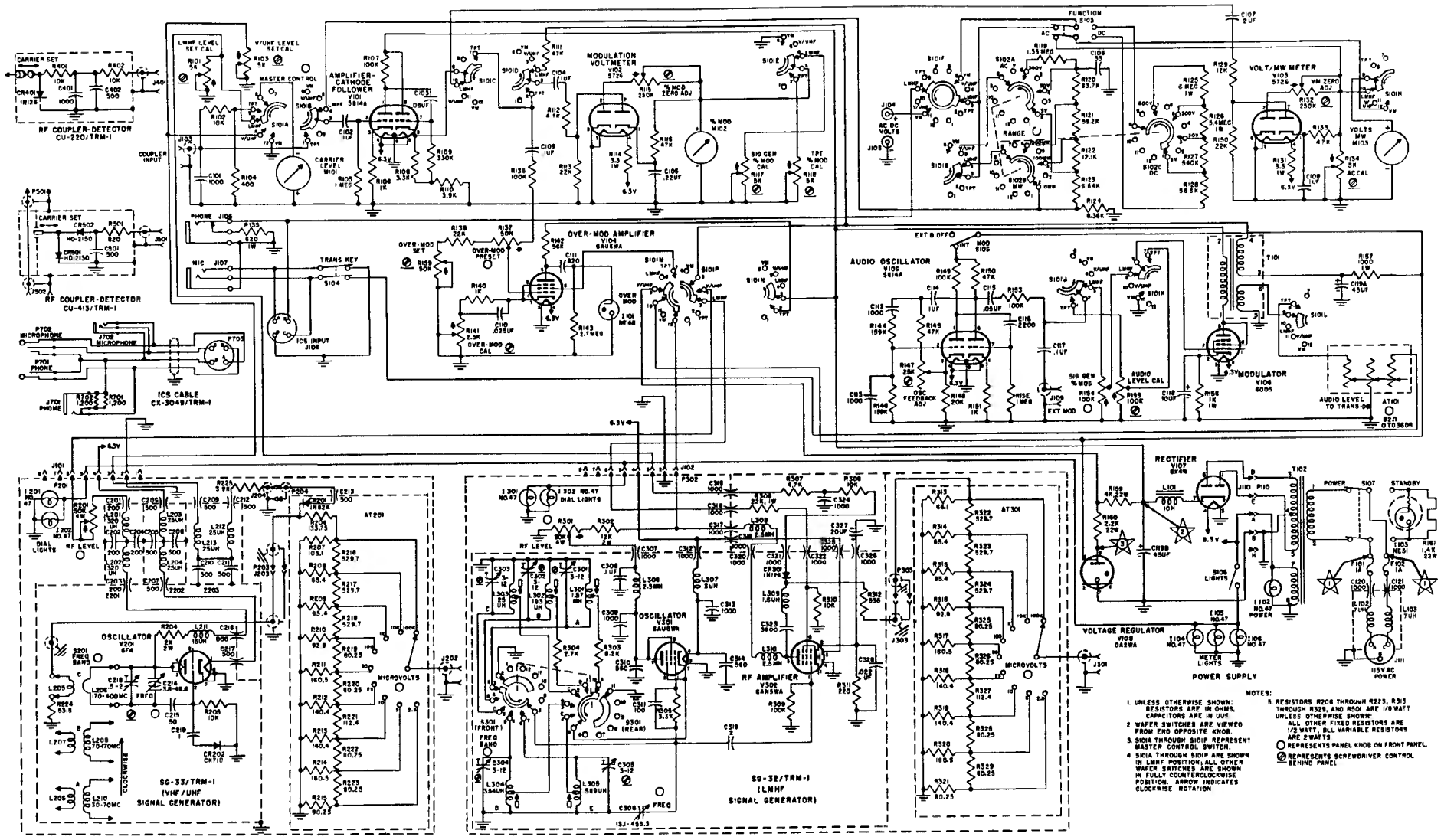
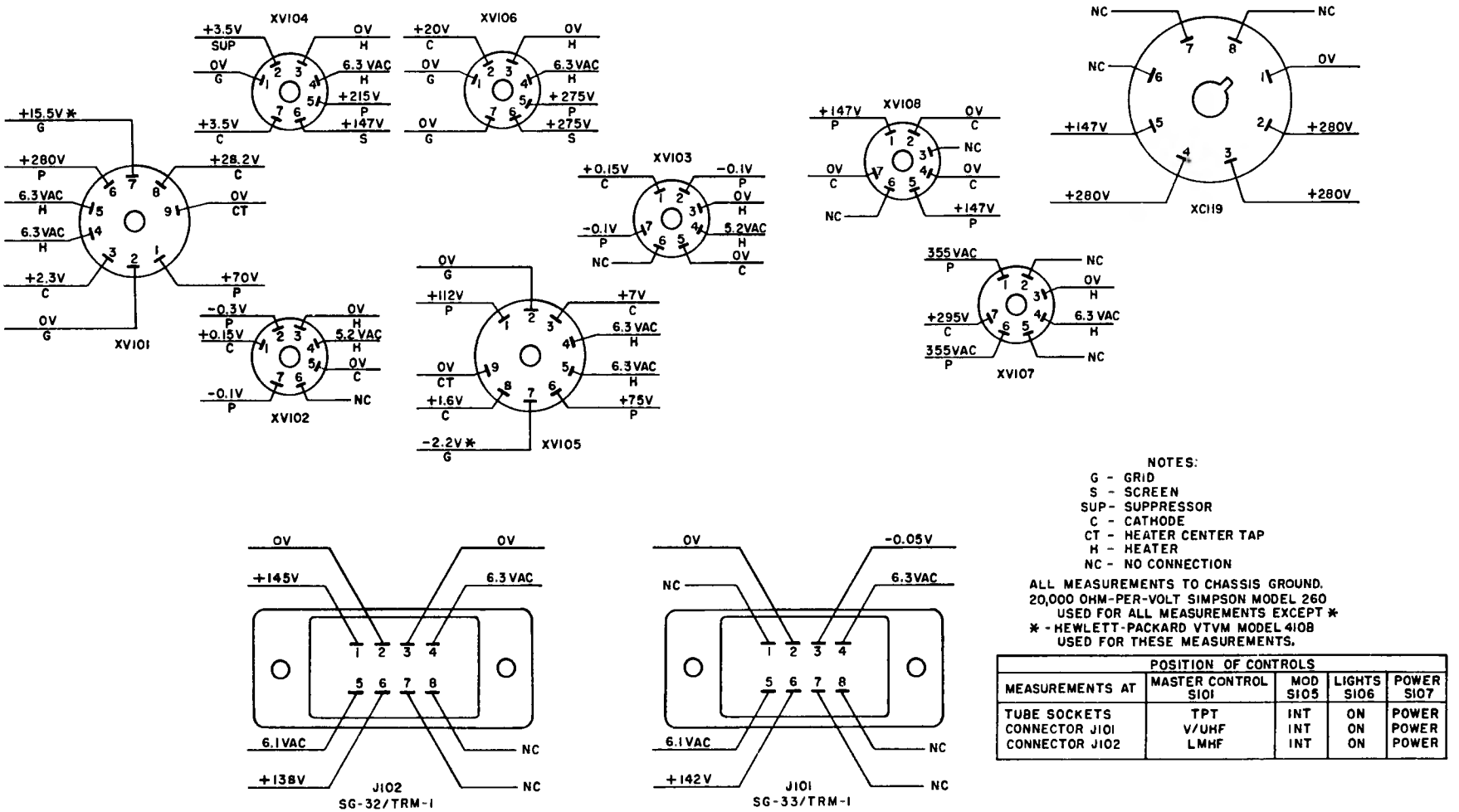
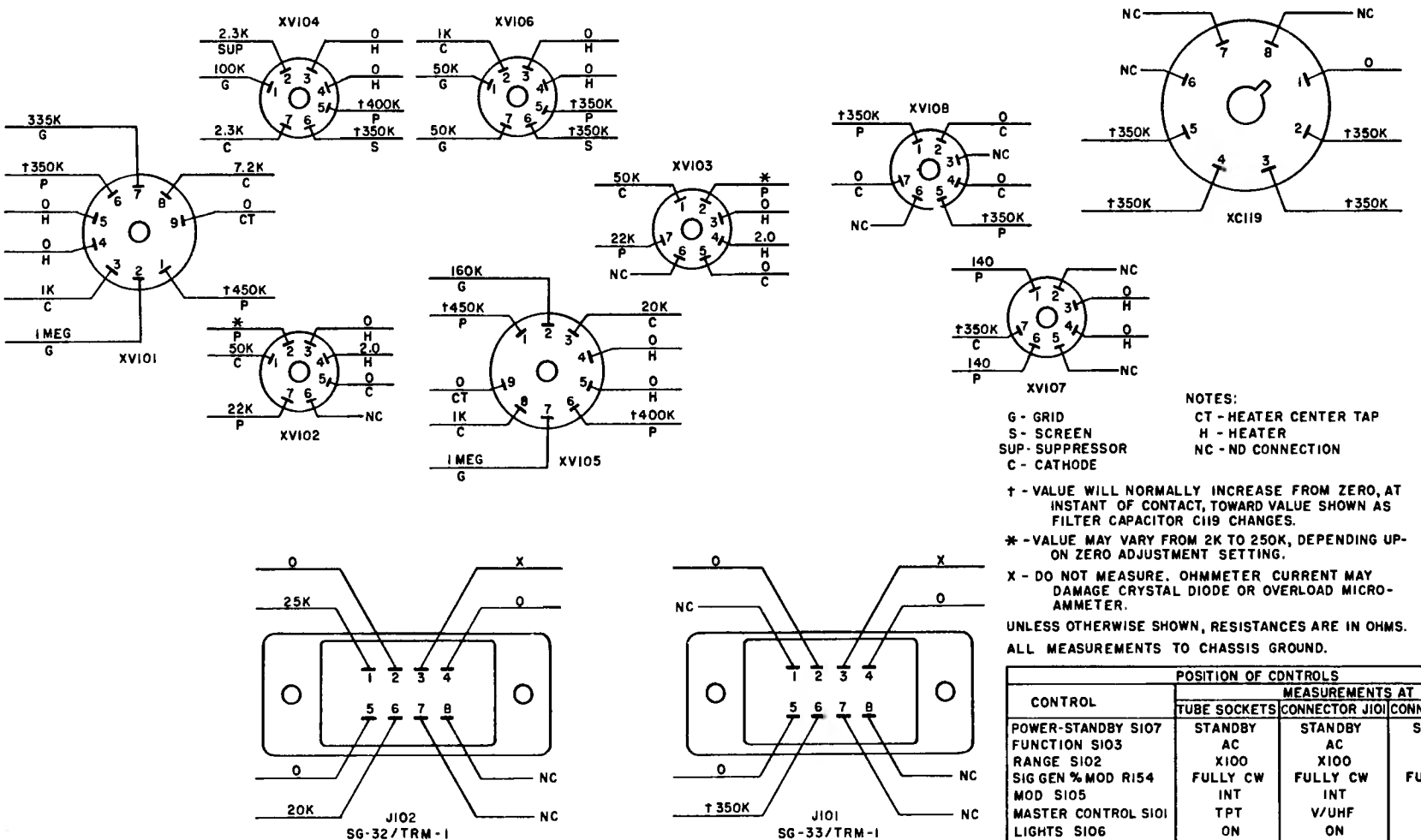


Figure 7-1. Radio Test Set AN/TRM-1, Overall Schematic Diagram



	POSITION OF CONTROLS			
MEASUREMENTS AT	MASTER CONTROL S101	MOD S105	LIGHTS S106	POWER S107
TUBE SOCKETS	TPT	INT	ON	POWER
CONNECTOR J101	V/UHF	INT	ON	POWER
CONNECTOR J102	LMHF	INT	ON	POWER

Figure 7-2. Radio Test Set AN/TRM-1, Voltage Chart



NOTES:

G - GRID
S - SCREEN
SUP - SUPPRESSOR
C - CATHODE
CT - HEATER CENTER TAP
H - HEATER
NC - NO CONNECTION

† - VALUE WILL NORMALLY INCREASE FROM ZERO, AT INSTANT OF CONTACT, TOWARD VALUE SHOWN AS FILTER CAPACITOR C119 CHANGES.

* - VALUE MAY VARY FROM 2K TO 250K, DEPENDING UPON ZERO ADJUSTMENT SETTING.

X - DO NOT MEASURE. OHMMETER CURRENT MAY DAMAGE CRYSTAL DIODE OR OVERLOAD MICROAMMETER.

UNLESS OTHERWISE SHOWN, RESISTANCES ARE IN OHMS.

ALL MEASUREMENTS TO CHASSIS GROUND.

CONTROL	POSITION OF CONTROLS	MEASUREMENTS AT	
	TUBE SOCKETS	CONNECTOR J101	CONNECTOR J102
POWER-STANDBY S107	STANDBY	STANDBY	STANDBY
FUNCTION S103	AC	AC	AC
RANGE S102	X100	X100	X100
SIG GEN % MOD R154	FULLY CW	FULLY CW	FULLY CW
MOD S105	INT	INT	INT
MASTER CONTROL S101	TPT	V/UHF	LMHF
LIGHTS S106	ON	ON	ON
OVER-MOD PRESET R137	FULLY CCW	FULLY CCW	FULLY CCW
TRANS KEY S104	ON	ON	ON
AUDIO LEVEL TO TRANS DB AT101	FULLY CCW	FULLY CCW	FULLY CCW
RF LEVEL R201 & R301	—	FULLY CW	FULLY CW
FREQ BAND S201 & S301	—	A	A
MICROVOLTS AT201 & AT301	—	2.5	2.5

Figure 7-3. Radio Test Set AN/TRM-1, Resistance Chart

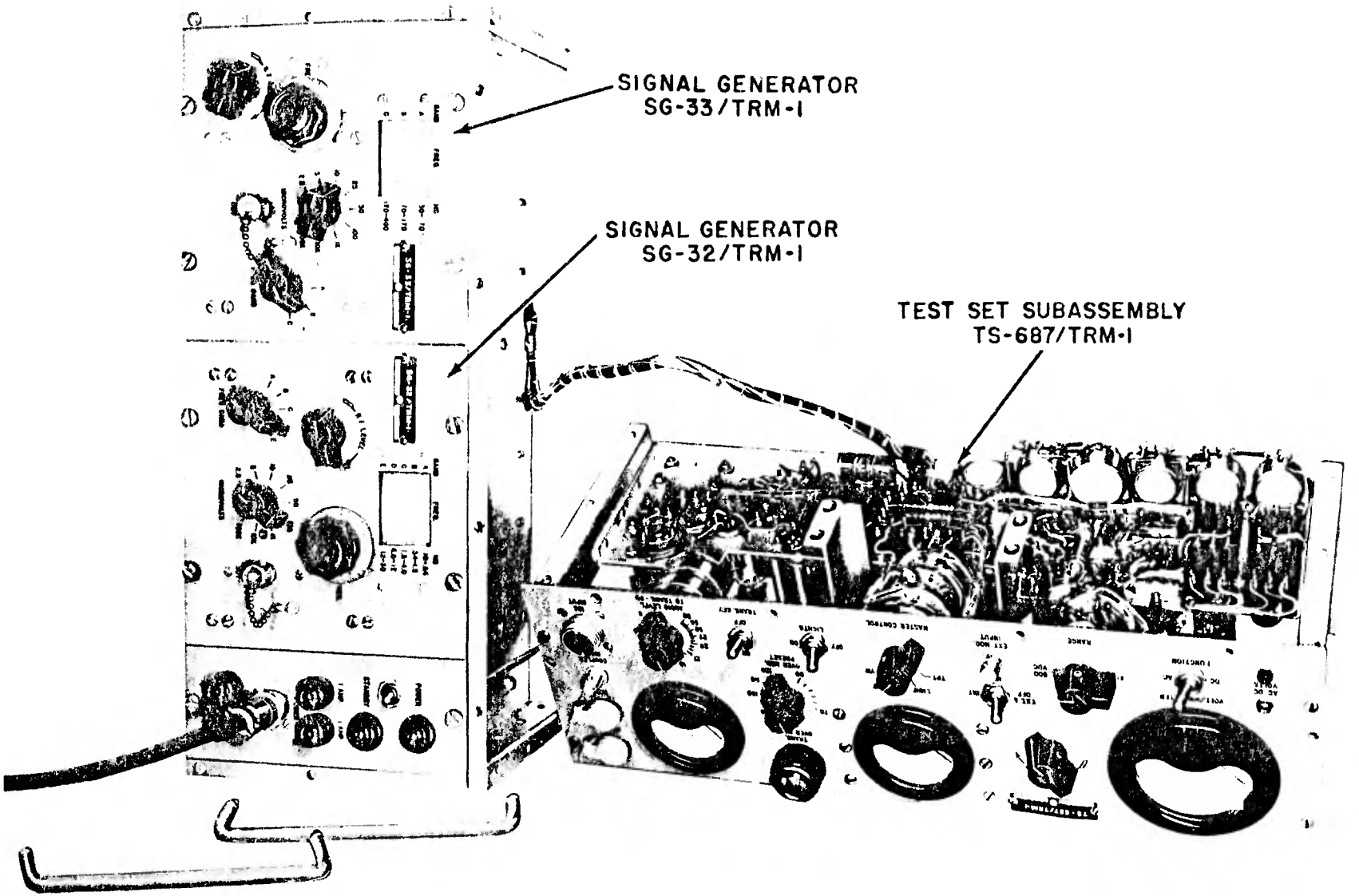


Figure 7-4. Test Set TS-687/TRM-1, Power Connected for Test

ALPHABETICAL INDEX

ALPHABETICAL INDEX (Cont'd)

(USAF) T.O. 33A1-3-256-3
(NAVY) NAVWEPS AN16-30TRM1-3

HANDBOOK

OVERHAUL INSTRUCTIONS

RADIO TEST SET

AN/TRM-1

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND BY DIRECTION OF THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

15 JANUARY 1958

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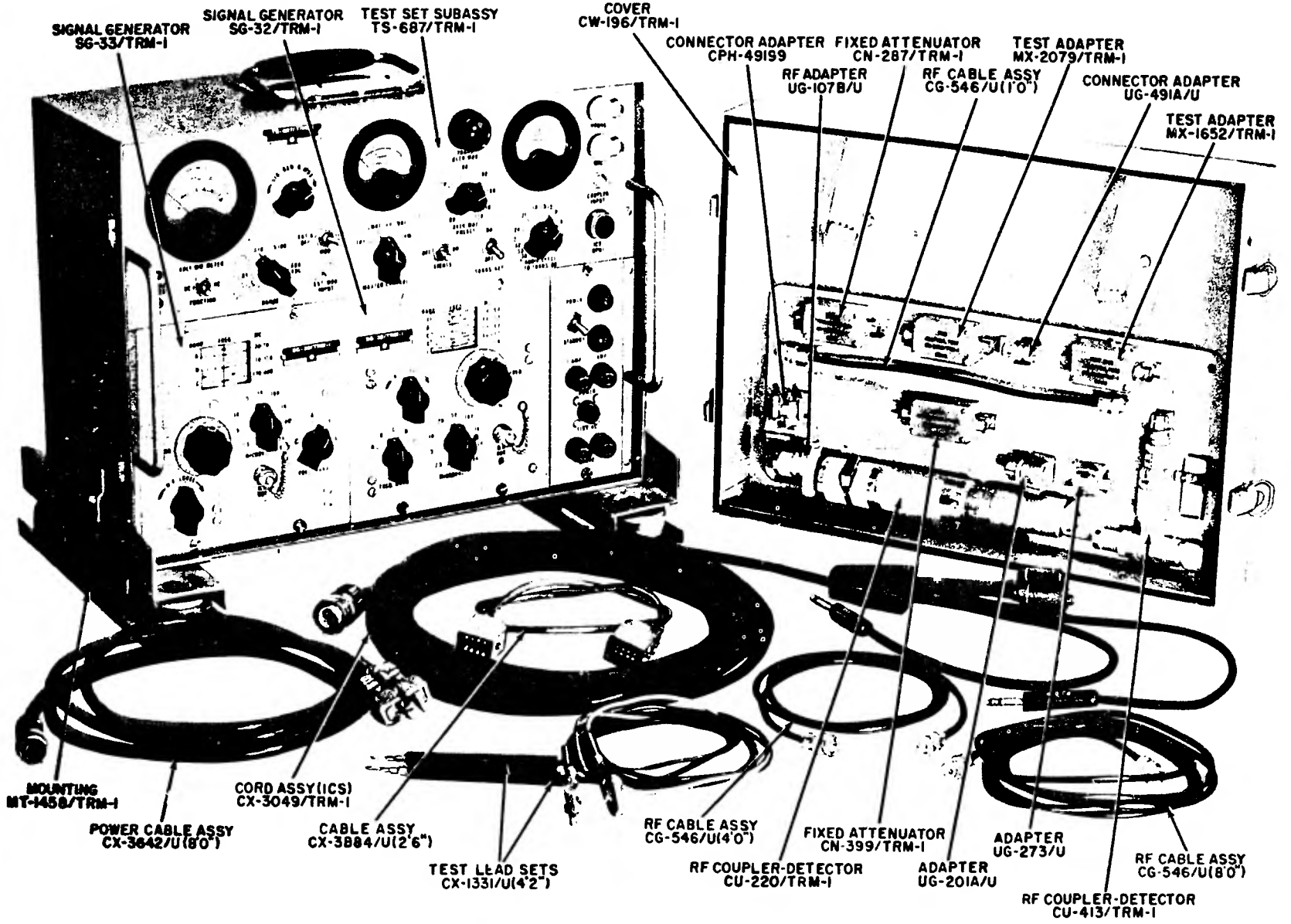

Figure 1-1. Radio Test Set AN/TRM-1

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. SCOPE AND GENERAL INFORMATION.

1-2. This publication comprises overhaul instructions for Radio Test Set AN/TRM-1 as manufactured by Trad Electronics Corp., 1001 First Avenue, Asbury Park, New Jersey. Coverage includes information necessary for servicing and maintaining the equipment by Overhaul and Repair Units of the Navy beyond the capabilities of FASRON and Field Maintenance activities.

1-3. Radio Test Set AN/TRM-1 is capable of performing preflight performance tests on aircraft receivers, transmitters, and navigation equipment in the frequency range from 190 kc to 400 mc, and on voice intercommunication equipment in the audio frequency range. Complete electrical and physical characteristics of Radio Test Set AN/TRM-1 are included in the Handbook of Service Instructions AN16-30TRM1-2. The equipment, complete with cables and accessory units, is shown in figure 1-1. The operating controls and connectors for Radio Test Set AN/TRM-1 are shown in figure 1-2. Refer to Table IV of Handbook of Operation Instructions AN16-30TRM1-1 for explanation of these controls.

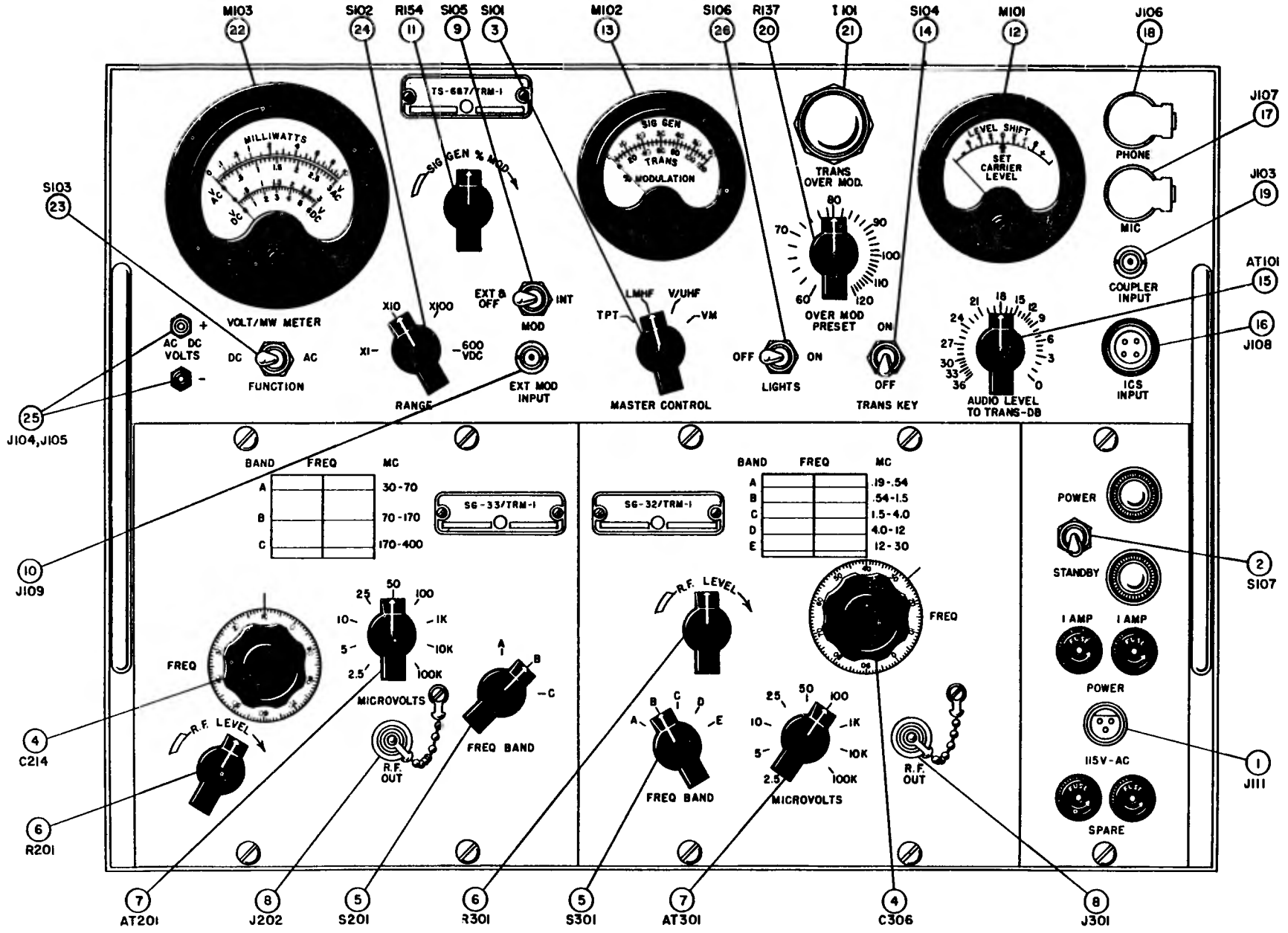

Figure 1-2. Operating Controls and Connectors, Radio Test Set AN/TRM-1

SECTION II

SPECIAL OVERHAUL TOOLS AND TEST EQUIPMENT

2-1. LIST OF SPECIAL TEST EQUIPMENT.

2-2. Table I, below, lists special test equipment required to perform the adjustment and recalibration procedures described in this handbook.

2-3. LIST OF SPECIAL TOOLS.

2-4. No special tools are required in the specialized overhaul and maintenance of Radio Test Set AN/TRM-1, other than the usual bench tools, such as pliers, screwdrivers, etc. Two Allen set-screw wrenches, sizes #6 and #8, are supplied with the subject equipment for use in tightening knobs and in the disassembly of certain component parts. These wrenches are stored with the accessory units in Cover CW-196/TRM-1, shown in figure 1-1.

TABLE I. SPECIAL TEST EQUIPMENT REQUIRED FOR OVERHAUL

FIGURE & INDEX NO.	NAME	AN TYPE DESIGNATION	ALTERNATE	APPLICATION
	Voltmeter, 20,000 ohms per volt sensitivity	Multimeter TS-352/U	Simpson Model 260 Weston Model 790	For checking voltages at designated test points and from tube socket terminals to chassis ground.
	Voltmeter, vacuum-tube type. High input impedance type	TS-375/U	Ballantine Model 643 General Radio Model 726A Hewlett-Packard Model 400A	For checking voltages at those test points where electrical loading by the voltmeter would introduce error in measurement.
11-3	RF Wattmeter	AN/URM-43		For use in percentage modulation performance test.
	Frequency meters	LM-13 (125 kc to 20 mc) TS-323/UR (20 mc to 480 mc)		For use in recalibrating the frequency dials of Signal Generators SG-32 and SG-33/TRM-1 (190 kc to 400 mc).
11-4	Oscilloscope	AN/USM-24 or AN/USM-38	TS-239/UP TS-34/AP Dumont Model 29 4A Tektronix Models 511AD or 514D Trad Model PO-400	For use in checking audio oscillator performance; checking % modulation characteristics of Signal Generators SG-32 and 33/TRM-1; recalibrating meter M102.
11-3 11-2	Audio-oscillator	TS-382/U	Hewlett-Packard Model 200C	For use in checking the calibration of meter M102 as % modulation indicator; for use as a source of external modulation for Signal Generators SG-32 and SG-33/TRM-1; also used for checking ac volts and mw on meter M103.

TABLE I. SPECIAL TEST EQUIPMENT REQUIRED FOR OVERHAUL (Cont)

FIGURE & INDEX NO.	NAME	AN TYPE DESIGNATION	ALTERNATE	APPLICATION
11-3	Audio Modulation Monitor		General Radio Type No. 1931-A	For use in checking the calibration of meter M102 as % modulation indicator.
11-1	Regulated DC Power Supply, Adjustable between 550 and 600v at 100 ma		Any suitable type	For use in checking the accuracy of dc meter M103.
11-3	AM Transmitter, 30 mc carrier, 65-100 watts		Any suitable type	For use in checking the % modulation indication performance of meter M102 and in checking the internal modulation characteristics of Test Set AN/TRM-1.
	Headset	HS-30		For use in checking frequency calibration of Signal Generators SG-32 and SG-33/TRM-1.
11-2	AC Voltmeter		Ballantine Model 300	For use in checking the accuracy of ac volts/mw meter M103.
11-2	Voltage Divider Network		Shop manufacture. See figure 11-2 for schematic diagram	For use in checking the accuracy of ac volts/mw meter M103.
11-4	Mixer Rectifier		General Radio 874-MR	For use in checking audio oscillator performance; checking % modulation characteristics of Signal Generators SG-32 and SG-33/TRM-1; recalibrating meter M102.
11-4	Oscillator and Power Supply		General Radio Model 1208A Unit Oscillator (65-500 mc) General Radio Model 1205-A Unit Power Supply	For use in checking % modulation characteristics of Signal Generators SG-32 and SG-33/TRM-1; recalibrating meter M102.
11-1	DC Voltmeter, 0-750v dc-1,000 ohms/volt, 0.5% accuracy		Weston Model 901 Weston Model 931	For use in checking accuracy of dc voltmeter M103.
11-1	Calibrated Voltage Divider Network		Shop manufacture. See figure 11-1 for schematic diagram	For use in checking accuracy of dc voltmeter M103.

SECTION III

SPECIALIZED MAINTENANCE AND REPAIR

3-1. TROUBLESHOOTING DATA.

3-2. Radio Test Set AN/TRM-1 has been completely tested and calibrated at the manufacturer's plant before shipment. When recalibration or adjustment is required, Radio Test Set AN/TRM-1 must be recalibrated by using more precise test equipment. Repairs should be performed only by authorized overhaul unit and depot personnel. Attempts to modify the subject equipment should not be undertaken as they might adversely affect the critical electrical characteristics of the set.

3-3. This last precaution is especially true for the mechanical drive systems in Radio Test Set AN/TRM-1. These drive systems are designed for use beyond the normal life of the electrical sections of the equipment and should never be tampered with unless, of course, a mechanical breakdown of the drive systems occurs.

3-4. LOCALIZING TROUBLE.

3-5. The first step in troubleshooting is to determine whether a trouble actually does exist. It is possible that certain indications of trouble may be present when there is nothing wrong with the equipment other than improper operation. Overhaul personnel should be thoroughly familiar with the Handbook of Operating Instructions AN16-30TRM1-1 before attempting to analyze any indicated defect.

3-6. After a positive determination is made that the equipment requires repair or adjustment, the next step is to sectionalize the fault. Sectionalization means tracing the fault to the major component (such as a Signal Generator) or circuit (such as the internal audio modulating circuit) responsible for the abnormal condition. The next step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal operation. It is possible that either operators or field maintenance personnel have already traced the defective part by use of the major and secondary test points described in Section VI, Handbook of Service Instructions AN16-30TRM1-2. In this case, all that is necessary is to disassemble the equipment and replace the defective part, unless a recheck of this previous servicing is desired by overhaul maintenance personnel to substantiate these findings.

3-7. A preliminary visual check should be made before proceeding with any further troubleshooting procedure. This check should include the inspection of such items as indicator lamps, position of power switches, fuses, loose cables, charred insulation, broken wires, control settings, physical damage, etc.

3-8. Table II, Routine Check Chart, and Table III, Typical Troubles Chart, provide a convenient method of checking normal indications of operating circuitry. If an indication is not normal, the section or part at fault has been isolated, and repair can be made. Major and secondary test points are described and identified in Section IV, Handbook of Service Instructions AN16-30TRM1-2.

3-9. ROUTINE OPERATIONAL CHECK. (See figure 1-2.)

3-10. Table II provides a chart for a routine check on the operation of the equipment. The first column shows what is being checked, the second column provides instructions on how to check, while the third column indicates normal performances and precautions.

TABLE II. ROUTINE CHECK CHART

WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS AND REMARKS
1. INSTALLATION	Before applying power to the equipment, make sure that the equipment is properly set up in accordance with the preliminary adjustment instructions of Section III, Handbook of Operations Instructions. Set the panel controls as follows: a. POWER switch S107 to STANDBY position. b. SIG GEN % MOD control R154 fully counterclockwise. c. RF LEVEL TO TRANS-DB control AT101 fully counterclockwise.	Check the front panel of the equipment for damage, such as cracked meter glass, broken control knobs, etc. Check that all cables and wires are in good condition and that connections are properly made. The front panel indicator lamp designated STANDBY will be illuminated, indicating that power is applied to the equipment space heater. In the event that the equipment has been subjected to excessive humidity, the space

TABLE II. ROUTINE CHECK CHART (Cont)

WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS AND REMARKS
	d. FUNCTION switch S103 to AC position.	heater should be left on as long as practicable to dry out any accumulated moisture.
	e. MOD switch S105 to INT position.	
2. AC POWER CIRCUITS	Place POWER switch S107 to POWER position.	The STANDBY panel indicator lamp should not light and the POWER indicator lamp should be illuminated. This indicates that ac power has been removed from the internal space heater and is now applied to the equipment's circuitry.
3. Signal Generator SG-32/TRM-1	Allow the test set to warm up for 20 minutes before proceeding with the routine check of operation.	
	a. Place MASTER CONTROL switch S101 in LMHF position.	a. The pointer of VOLT/MW meter M103 should indicate zero on the MILLIWATTS scale.
	b. Rotate FREQ control C306.	b. Check that the frequency indicating dial rotates smoothly.
	c. Set FREQUENCY BAND switch S301 to A band. Set frequency indicating dial to read .19 mc.	
	d. Adjust RF LEVEL control R301 until the pointer of CARRIER LEVEL meter M101 deflects to the red arrow marked SET.	d. This setting indicates that the rf output voltage can be set to the proper reference value.
	e. Change the setting of the frequency indicating dial to .54 mc in the A band. Repeat step d above.	
	f. Check BANDS B, C, D and E by repeating step d above at both ends of each band.	f. If CARRIER LEVEL meter M101 can be set at the red arrow for all bands, the value of the output voltage, in microvolts, is indicated directly by the position of MICROVOLT selector AT301, provided RF OUTPUT jack J301 is properly terminated in 50 ohms.
	g. Rotate SIG GEN % MOD control R154 clockwise.	g. The degree of audio modulation will be indicated on the upper scale of SIG GEN % MODULATION meter M102.
	h. Place FREQ BAND switch S301 and MICROVOLTS control AT301 in each detented position.	h. Check that the detent action is smooth and firm in each position. Check proper position of the pointer knobs.
4. Signal Generator SG-33/TRM-1	Turn MASTER CONTROL switch S101 to VHF/UHF position. Repeat all procedures, checks, and adjustments listed for Signal Generator SG-32/TRM-1 in step 3 above.	

TABLE II. ROUTINE CHECK CHART (Cont)

WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS AND REMARKS
5. VOLTMETER CIRCUITS	Rotate MASTER CONTROL switch S101 to VM position.	This places the general purpose voltmeter and MW meter circuits of the AN/TRM-1 into operation.
	a. Place FUNCTION switch S103 to DC position.	
	b. Check that the pointer of VOLT/MW METER M103 indicates zero.	b. If necessary, carefully move the mechanical zero adjustment located on the meter face until the pointer is set to indicate zero.
	c. Connect Test Lead Set CX1331/U (stored in the equipment cover) to the tip jacks, marked "AC-DC" volts, located at the left side of the front panel.	
	d. Place FUNCTION switch S103 to AC position; set RANGE switch S102 to X1.	
	e. Touch the ends of the test leads together, making firm contact.	e. The pointer of VOLT/MW METER M103 should indicate zero on the V AC scale.
	f. Switch RANGE switch S102 successively to X10 and X100 positions. At each position, touch the ends of the test leads together firmly.	f. The meter should indicate zero on the V AC scale for both positions of RANGE switch S102.
6. Test Set Subassembly TS-687/TRM-1	Turn MASTER CONTROL switch S101 to TPT position.	
	a. The pointer of CARRIER LEVEL meter M101 should indicate at the index marking located at the extreme left side of the LEVEL SHIFT scale.	a. If not, turn the mechanical zero adjustment located on the meter face until the pointer position is at the index line.
	b. The pointer of % MODULATION panel meter M102 should indicate at zero.	b. If necessary, turn the mechanical zero adjustment located on the meter face until the pointer indication is at zero.
7. DIAL AND METER LIGHTS	Place LIGHTS switch S106 to the ON position.	Check that the dial lamps of Signal Generators SG-32 and SG-33/TRM-1 and the three panel meters are illuminated.

3-11. TYPICAL TROUBLES CHART.

3-12. Table III provides a list of typical troubles which may be encountered. The first column shows the set-up conditions for performing the check. The second column shows the normal indication when the equipment is operating properly. The third column shows symptoms of abnormal operation. The last column lists the recommended or suggested remedy. Follow the steps in the "Remedy" column in the order shown. If the first step checks out satisfactorily, proceed to the succeeding steps until the cause of the trouble is located.

3-13. TUBE SOCKET ELECTRICAL MEASUREMENT.

3-14. The majority of faults may be localized by checking the voltage and resistance at the tube sockets. Figures 7-2 and 7-3, Handbook of Service Instructions AN16-30TRM1-2, indicate the proper voltage and resistance measurements, respectively, for each tube socket within the equipment.

3-15. MAJOR AND SECONDARY TEST POINTS.

3-16. Many equipment troubles can be localized by checking the voltage and resistance at the major and secondary test points within the circuitry of the equipment. Paragraphs 6-3 and 6-5, Section VI, Handbook of Service Instructions AN16-30TRM1-2, identify the major and secondary test points, respectively.

3-17. TUBE REPLACEMENT.

3-18. Any of the electron tubes contained in Radio Test Set AN/TRM-1 may be replaced at the field maintenance or depot levels. However, certain readjustments may become necessary after the tubes have been replaced. These adjustments are described in paragraph 6-13, Section VI, Handbook of Service Instructions AN16-30TRM1-2. It is also recommended that the frequency calibration be checked against a frequency standard. To actually replace the tubes, the test set must be removed from the equipment case as described in paragraph 5-15, Section V, Handbook of Service Instructions AN16-30TRM1-2. The table in paragraph 6-12, Section VI, Handbook of Service Instructions AN16-30TRM1-2, lists the tubes contained in the test set subassembly, together with minor readjustment procedures which may be necessary after tube replacement.

TABLE III. TYPICAL TROUBLES CHART

SET-UP CONDITION	NORMAL INDICATION	NATURE OF TROUBLE	REMEDY
1. POWER INPUT Master CONTROL switch S101 in TPT position. POWER switch S107 to POWER, and LIGHT switch S106 to ON. (See figure 1-2)	Pilot lamp I102 and meter lamps I104, I105, and I106 light.	No lamps are illuminated.	Indicates no ac applied to primary of power transformer. a. Check pilot lamps I102, I104, I105, and I106. b. Check front panel fuses F101 and F102. c. Check the ac source and continuity through power cord CX-3642/U. d. Check continuity through line filter. e. Check continuity between terminals 6 and 7 of power transformer T102.
2. VOLT/MW meter M103 MASTER CONTROL switch S101 to VM position. (See figure 1-2)	Meter needle should be capable of being set at zero by adjusting variable resistor R132. (See figure 4-3)	a. No response from meter needle when R132 is varied. b. Meter needle remains below zero and does not move when R132 is varied.	a. Indicates defective tube V103. Replace tube. b. Indicates shorted variable resistor R132. Replace variable resistor.

TABLE III. TYPICAL TROUBLES CHART (Cont)

SET-UP CONDITION	NORMAL INDICATION	NATURE OF TROUBLE	REMEDY
3. MODULATION voltmeter M102. MASTER CONTROL switch S101 in TPT, LMHF, or V/UHF position. (See figure 1-2)	Meter needle should be capable of being set at zero by adjusting variable resistor R115. (See figure 4-3)	a. Meter needle remains below zero and does not move when R115 is varied. b. No response from meter needle when R115, is varied.	a. Indicates shorted variable resistor R115. Replace variable resistor. b. Indicates defective tube V102. Replace tube.
4. CARRIER LEVEL meter M101. MASTER CONTROL switch S101 in LMHF position. Slowly rotate RF LEVEL control R301 clockwise. (See figure 1-2)	The needle of meter M101 should rise towards the right-hand end of the scale and should be capable of being set at zero of the center scale.	No reading of M101.	Indicates no rf signal from Signal Generator SG-32/TRM-1. a. Check similar operation on each band of the signal generator. If it occurs only on one band, it indicates a defective coil for that band. Remove coil and replace. b. If the trouble exists on all bands, check for proper B+ voltage at plate, pin 5, of oscillator tube V301. c. If the voltage is correct, check tube V301. Replace if defective. d. Check for proper B+ voltage at plate, pin 5, of the rf amplifier tube V302. e. If the voltage is correct, check tube V302. Replace if defective. f. Check plug P302 connection to J302 located at rear of Signal Generator SG-32/TRM-1, for proper mating. g. Check RF LEVEL control R301 for open circuit. Remove and replace this control, if defective. h. If all other checks prove satisfactory, check for defective crystal CR301. Remove and replace crystal, if defective.

TABLE III. TYPICAL TROUBLES CHART (Cont)

SET-UP CONDITION	NORMAL INDICATION	NATURE OF TROUBLE	REMEDY
5. CARRIER LEVEL meter M101 as used for Signal Generator SG-33/TRM-1 MASTER CONTROL switch S101, in V/UHF position. Slowly rotate RF LEVEL control R201 clockwise. (See figure 1-2)	The needle of meter M101 should rise towards the right-hand end of the scale and should be capable of being set at zero of the center scale.	No reading of meter M101	Indicates no rf signal from Signal Generator SG-33/TRM-1. a. Check for similar operation on each band of the signal generator. If it occurs on only one band, it indicates a defective coil for that band. Remove coil and replace. b. If the trouble exists for all bands, check for proper B+ voltage at plate, pin 4 or 3, of oscillator tube V201. c. If the voltage is correct, check tube V201. Replace if defective. d. Check plug P201 connection to J201, located at rear of Signal Generator SG-33/TRM-1, for proper mating. e. Check RF LEVEL control R201 for open circuit. Remove and replace this control, if defective. f. If all above checks prove satisfactory, check for defective crystal CR201 in attenuator AT201. If defective, the complete attenuator should be replaced.
6. REGULATED 147V CIRCUIT. This voltage measured at pin 5 of tube V108.	Regulated voltage remains constant at 147 volts.	a. Regulated voltage is higher than 147 volts. b. Regulated voltage is lower than 147 volts. c. No voltage.	a. Indicates a defective voltage regulation circuit. Check voltage regulator tube, V108. b. Check for leaky filter capacitor C119B. Check unregulated B+ voltage as given in step 7 of this table. c. Check resistors R159 and R160 for open circuit. Check unregulated B+ voltage as given in step 7 of this table.

TABLE III. TYPICAL TROUBLES CHART (Cont)

SET-UP CONDITION	NORMAL INDICATION	NATURE OF TROUBLE	REMEDY
7. UNREGULATED B+ CIRCUIT.			
This voltage measured at test point No. 2, the junction of inductance L101 and resistor R159.	Unregulated B+ approximately 270 volts.	a. Unregulated voltage much lower than 270 volts, with no regulated voltage output.	a. Check rectifier tube V107. Check filter capacitor C119B. Check plug P110 and jack J110 for proper mating.
		b. No voltage output at test point No. 2.	b. Check rectifier tube V107. Check filter capacitor C119B for short circuit. Check L101 for open circuit. Check for continuity between terminals 3, 4, and 5 of power transformer T102.
8. AUDIO OSCILLATOR, MODULATION CIRCUITS.			
MOD switch S105 to INT position. MASTER CONTROL switch S101 to LMHF position. RF LEVEL control R301 rotated clockwise until meter M101 reads center scale. Signal Generator % MOD control R154 rotated clockwise.	% MOD meter M102 should read percent modulation up to 60%, depending upon setting of R154.	No reading on meter M102.	a. Check audio-oscillator tube V105, modulator tube V106, and modulator voltmeter tube V102. Replace any tube, if defective. b. Check B+ voltage on plates of V105, pins 1 and 6. c. Check oscillator-feedback-adjustment variable resistor R147 for open circuit. Replace R147 if defective. (See figure 4-2). d. Check B+ voltage on plate of modulator tube V106, pin 5. e. Check for continuity between terminals 1 and 2 of modulation transformer T101. f. Check capacitor C104 for open circuit. Replace capacitor, if defective. g. Check switch S101, sections D and E for continuity.
9. TRANSMITTER MODULATION.			

TABLE III. TYPICAL TROUBLES CHART (Cont)

SET-UP CONDITION	NORMAL INDICATION	NATURE OF TROUBLE	REMEDY
Modulated signal from a transmitter applied through suitable coupler detector (either CU-220/TRM-1 or CU-413/TRM-1) to coupler input jack J103.	% MOD meter M102 should read percent modulation up to 120%, depending on the capabilities of the transmitter.	a. No reading on meter M102. Reading on SET CARRIER LEVEL meter M101 is satisfactory.	a. Check audio oscillator tube V105, modulator tube V106, amplifier cathode follower tube V101, and modulation voltmeter tube V102. Replace any and all tubes, if defective. Check B+ voltage on plates of V105, pins 5 and 6. Check oscillator-feedback-adjustment resistance R147 and audio-level-calibration variable resistor R155 for open circuit. Replace either or both resistors, if defective. Check B+ voltage on plate of V106, pin 5. Check continuity between terminals 1 and 2, 5 and 6, of transformer T101. Check TRANS KEY switch S104 for continuity. Check connection of ICS input jack J108. Check capacitors C102 and C103 for open circuit. Replace either or both capacitors, if defective. Check switch S101 sections C and D, for continuity. Check capacitor C104 for open circuit. Replace if defective. Check switch S101 section E, for continuity. Check B+ voltage on plates of amplifier cathode follower V101, pins 1 and 6.
		b. No reading on CARRIER LEVEL meter M101. Reading on % MODULATION meter M102 is satisfactory.	b. Check MASTER CONTROL switch S101, section A, for continuity.

TABLE III. TYPICAL TROUBLES CHART (Cont)

SET-UP CONDITION	NORMAL INDICATION	NATURE OF TROUBLE	REMEDY
		c. No indication on OVER-MOD neon lamp I101, with MOD meter M102 reading 100% and CARRIER LEVEL meter M101 reading at center scale. The over-modulation preset variable resistor R137 is rotated to its extreme counterclockwise position.	c. Check over-modulation amplifier tube V104. Replace tube, if defective. Check OVER-MOD neon lamp I101. Replace, if defective. Check plate voltage of over-modulation amplifier tube V104, pin 5. Check capacitor C111 for open circuit. Replace capacitor, if defective.
10. DC VOLTMETER. DC voltages applied to jacks J104, J105 through test leads CX-1331/U. FUNCTION switch S103 in DC position. RANGE switch at X1, X10, X100, 600 volts, depending on value of dc voltage applied.	Meter reading on appropriate scale should agree with value of known dc voltage applied.	No reading on VOLT/MW meter M103 for any setting of RANGE switch S102.	Check resistors R125, R126, R127, and R128 for open circuit. Remove and replace any and all resistors, if defective. Check MASTER CONTROL switch S101, sections F and H, for continuity. Check RANGE switch S102, section C, for continuity. Check FUNCTION switch S103 for continuity. Check meter M103 for open or burnout.
11. AC VOLTMETER. AC voltages applied to jacks J104, J105 through appropriate test leads CX-1331/U. FUNCTION switch S103 in AC position. RANGE switch S102, at X1, X10, X100, depending on value of ac voltage applied.	Meter reading on appropriate scale should agree with value of known ac voltage applied.	No reading on meter M103 for any setting of RANGE switch S102.	a. Check MASTER CONTROL switch S101, section F, for continuity. b. Check FUNCTION switch S103 for continuity. c. Check RANGE switch S102, section A, for continuity. d. Check MASTER CONTROL switch S101, section G, for continuity. e. Check resistors R119 through R124, inclusive, for open circuit. Remove and replace any and all resistors, if defective.

TABLE III. TYPICAL TROUBLES CHART (Cont)

SET-UP CONDITION	NORMAL INDICATION	NATURE OF TROUBLE	REMEDY
			f. Check MASTER CONTROL switch S101, section B, for continuity. g. Check capacitor C102 for open circuit. Remove and replace the capacitor, if defective. h. Check the B+ voltage on plates of amplifier-cathode follower tube V101, pins 1 and 6. i. Check capacitor C103 for open circuit. Remove and replace capacitor, if defective. j. Check MASTER CONTROL switch S101, section C, for continuity. k. Check capacitor C107 for open circuit. Remove and replace, if defective. l. Check tube V103. Replace if defective. m. Check MASTER CONTROL switch S101, section H, for continuity.

SECTION IV

DISMANTLING AND DISASSEMBLY

4-1. INTRODUCTION.

4-2. The following paragraphs contain procedures for the dismantling and disassembly of the major component sections of the Radio Test Set AN/TRM-1 whenever it becomes necessary to replace a part or repair a circuit fault. Some of these procedures have already been listed in the Handbook of Service Instructions AN16-30TRM1-2, and the corresponding paragraphs will be referred to when these procedures are presented in the following paragraphs.

4-3. Caution should be exercised when handling the mechanical drive system coupling the tuning capacitors of the signal generator components with their respective dials. This mechanical system is designed to last beyond the life of the electrical portions of the equipment. Overhaul of the mechanical coupling drive should be required only if the signal generator component has been dropped or has received a sharp blow which might result in bent shafts or misalignment of gears. One must be cautioned again that any such mechanical readjustment or replacement should be performed only when absolutely necessary and when the malfunctioning cannot be remedied by the electrical adjustments described in Section III of this handbook.

4-4. REMOVING EQUIPMENT FROM PACKING BOX.

4-5. Precautions should be taken to prevent damage to the equipment when unpacking. Cut metal bands with appropriate cutters. If packed in a wooden box, remove nails from the lid with a nail puller. Do not use a pinch bar, chisel, or any similar tool which may damage the equipment. Remove packing material and examine carefully before discarding to make sure that no parts or accessories of the equipment, or packing slips, special instructions, etc. are packed separately from the equipment case. Grasp the carrying handle and carefully lift the equipment from the packing box.

4-6. REMOVING SIGNAL GENERATORS SG-32/TRM-1 AND SG-33/TRM-1 FROM THE EQUIPMENT.

4-7. Refer to paragraph 5-9, Handbook of Service Instructions AN16-30TRM1-2, for procedures to remove the signal generator components from Radio Test Set AN/TRM-1.

4-8. REMOVING TEST SET SUBASSEMBLY TS-687/TRM-1 FROM THE EQUIPMENT CASE.

4-9. Refer to paragraph 5-15, Handbook of Service Instructions AN16-30TRM1-2, for procedures necessary to remove the complete test set subassembly from the equipment case.

4-10. REMOVING POWER PANEL. (See figure 4-1.)

4-11. Two captive screws C (in figure 4-1) hold the power panel in place. After these two screws have been loosened, the panel may then be partially lifted from the frame to permit replacement of any component on the power panel. In the event it is necessary to unsolder the leads to the panel, see figure 4-1 for the wiring diagram of connections from the power panel to the chassis proper.

4-12. PRELIMINARY DISASSEMBLY OF TEST SET SUBASSEMBLY TS-687/TRM-1.

4-13. Refer to paragraph 6-8 c thru n inclusive, Handbook of Service Instructions AN16-30TRM1-2, for the procedures necessary to complete the preliminary disassembly of the test set subassembly.

4-14. COMPLETE DISASSEMBLY OF TEST SET SUBASSEMBLY TS-687/TRM-1.

4-15. After the preliminary disassembly (paragraph 4-12 above) has been completed, Test Set Subassembly TS-687/TRM-1 will consist of two chassis connected together by two power cables. Plug P110 and its associated cable connect power transformer T102 to the circuitry of the upper chassis. Plug P110 is removed from J110 by lifting the plug straight up and out. The other cable terminates in jacks J101 and J102 of the lower chassis, but is not detachable.

4-16. For further disassembly, refer to exploded views, figures 4-2, 4-3, and 4-4. Detailed instructions for removal of certain components are as follows:

a. To remove meter M102 and switches S101, S105, and S106, first remove the handle support bracket by unscrewing the four binding head screws located on the front panel, two on either side of meter M102. Meter M102 and switches S105 and S106 may then be removed without further disassembly. To remove switch S101, the front panel must also be detached from the subassembly frame and pulled forward.

b. To remove jacks J103, J106, J107, and J108, first detach the front panel as in subparagraph a above.

c. Terminal board TB103 may be removed by unscrewing the two binding-head screws holding the brackets to the chassis. The nuts on the under side of the chassis are captive type and need not be held.

d. To remove variable resistors R101, R103, R117, R118, and R155, first detach their mounting bracket from the chassis. Variable resistors R115, R132, R134, R139, and R141 may be removed individually without detaching their mounting bracket.

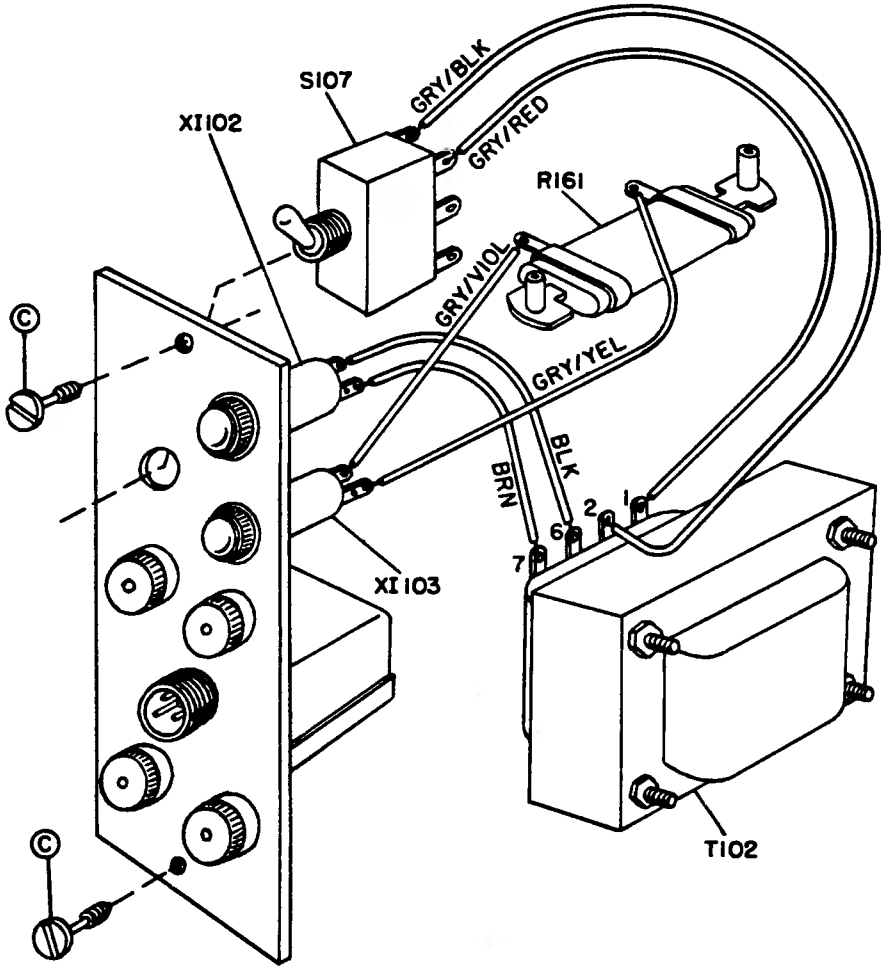

Figure 4-1. Connections from Power Panel to Chassis

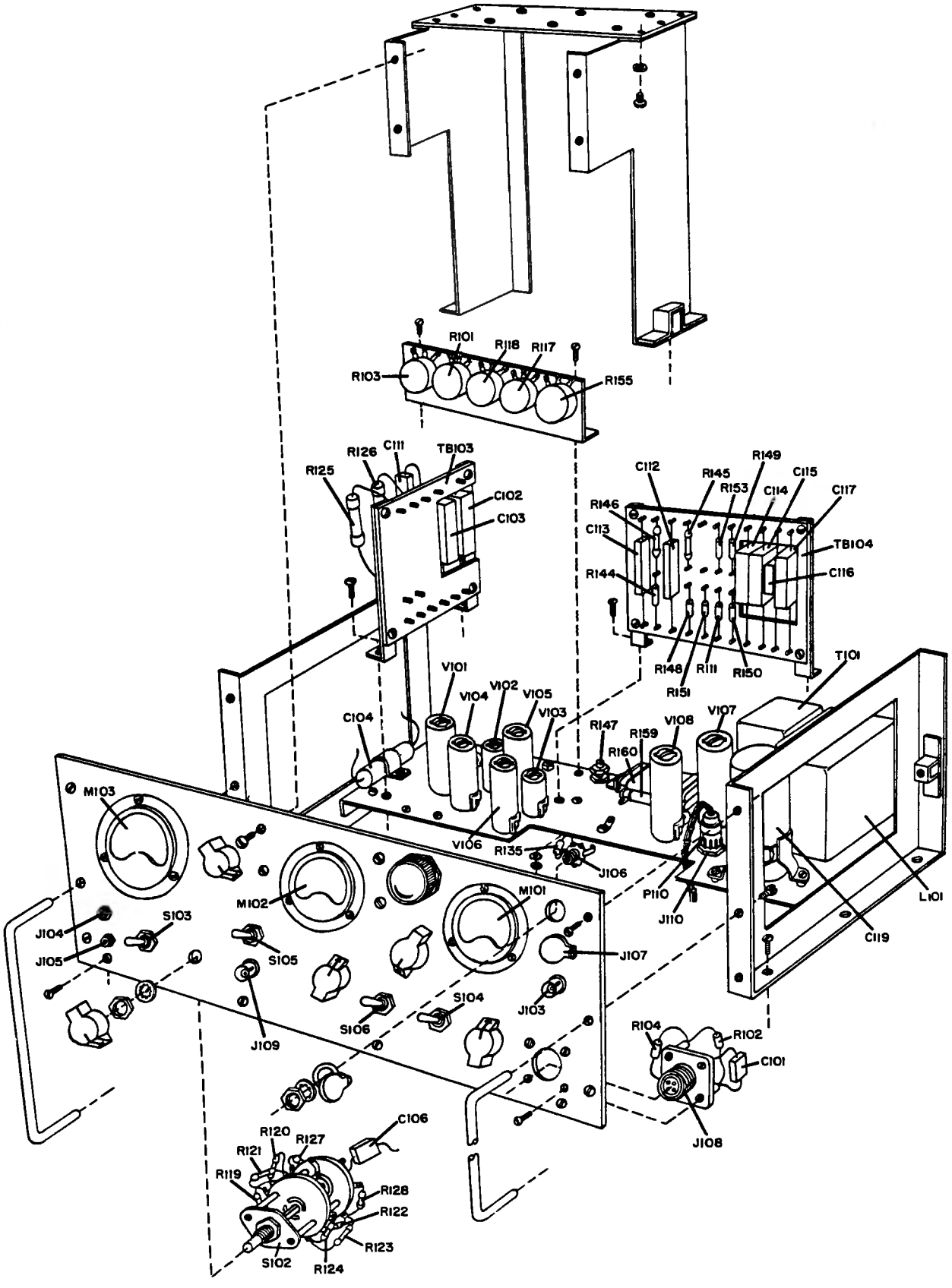

Figure 4-2. Test Set Subassembly TS-687/TRM-1, Exploded View

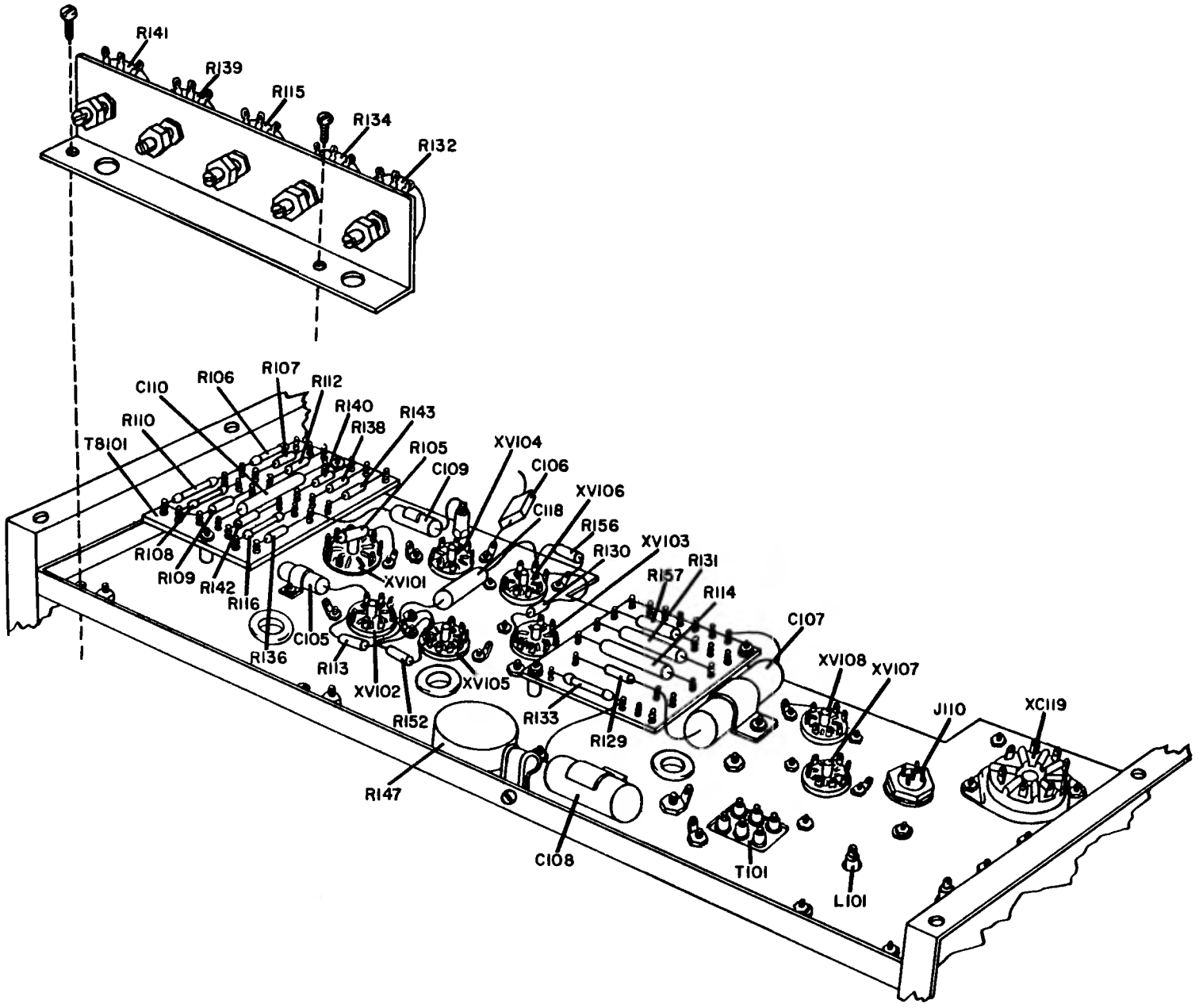

Figure 4-3. Chassis, Test Set Subassembly TS-687/TRM-1, Bottom View

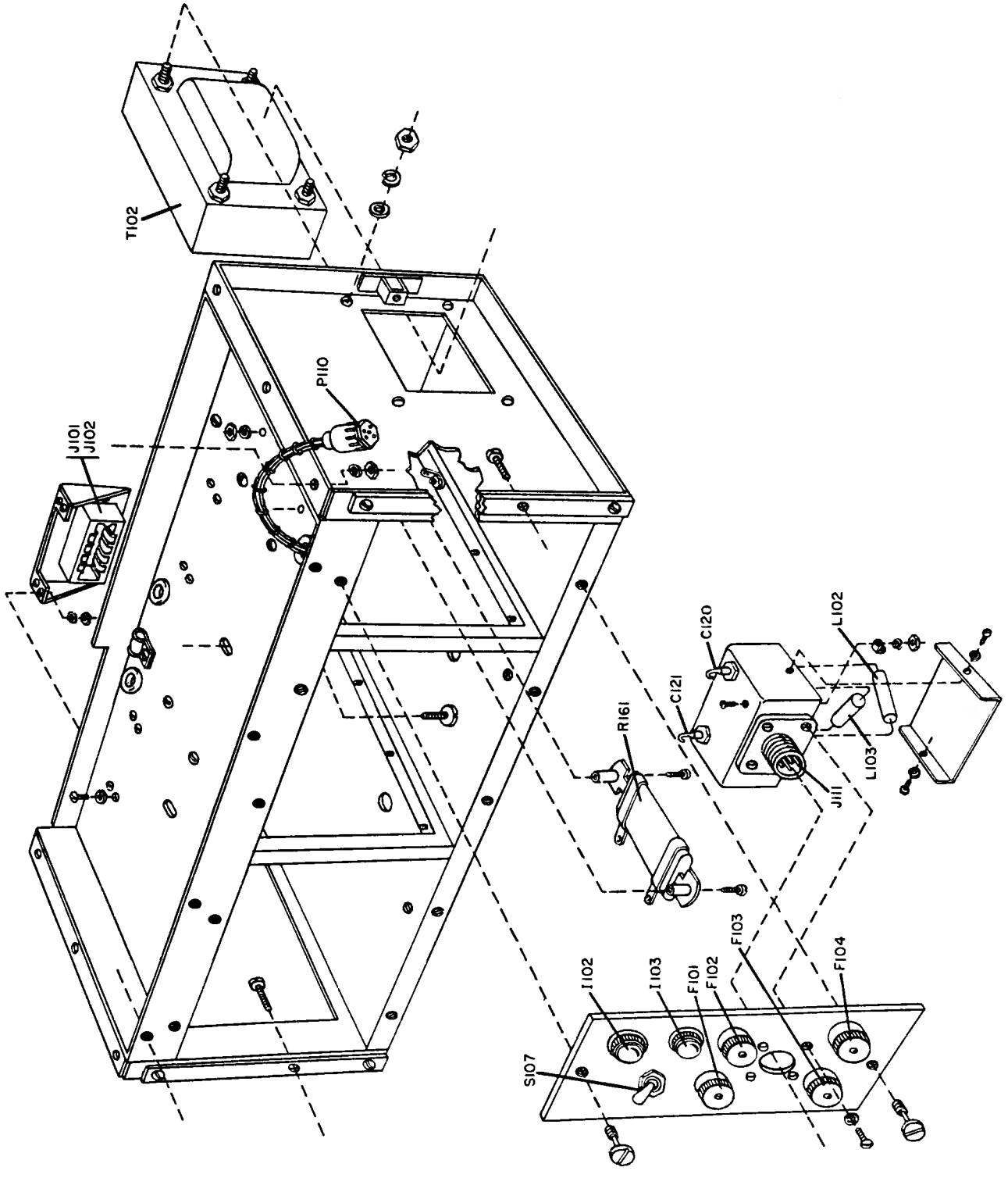

Figure 4-4. Power Supply Components, Exploded View

4-17. DISASSEMBLY OF SIGNAL GENERATOR SG-33/TRM-1. (See figures 4-5 and 4-6.)

4-18. Refer to exploded views, figures 4-5 and 4-6, for disassembly of Signal Generator SG-33/TRM-1.

4-19. To remove resistor R225, disconnect plug P204 from connector J204. Unscrew hexagonal adapter and carefully pull toward front panel until clear of filter body; gently pull to the side, bending the inside wire lead sufficiently to clear front panel; and then pull straight out to release center female contact from connector J204. Before unsoldering R225, accurately measure total length from filter body to end of contact. Leads of a replacement resistor must be carefully dressed to assure the same total length as the original assembly.

4-20. To remove filter Z203, remove the hexagonal adapter as outlined in paragraph 4-19 above. Unsolder the wire from the end of the filter. Unscrew the filter from its bracket.

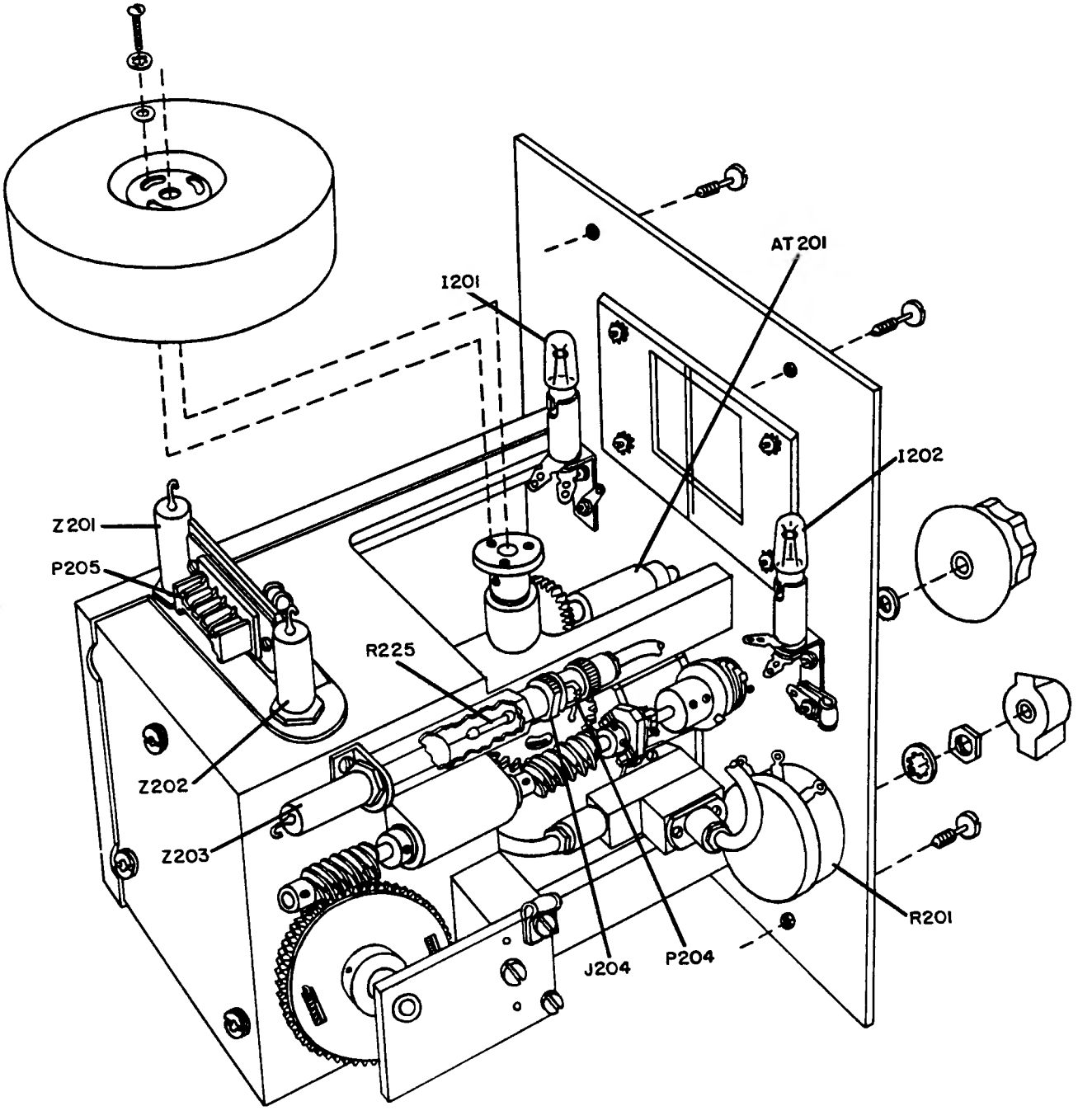

Figure 4-5. Signal Generator SG-33/TRM-1, Exploded View, Left Side

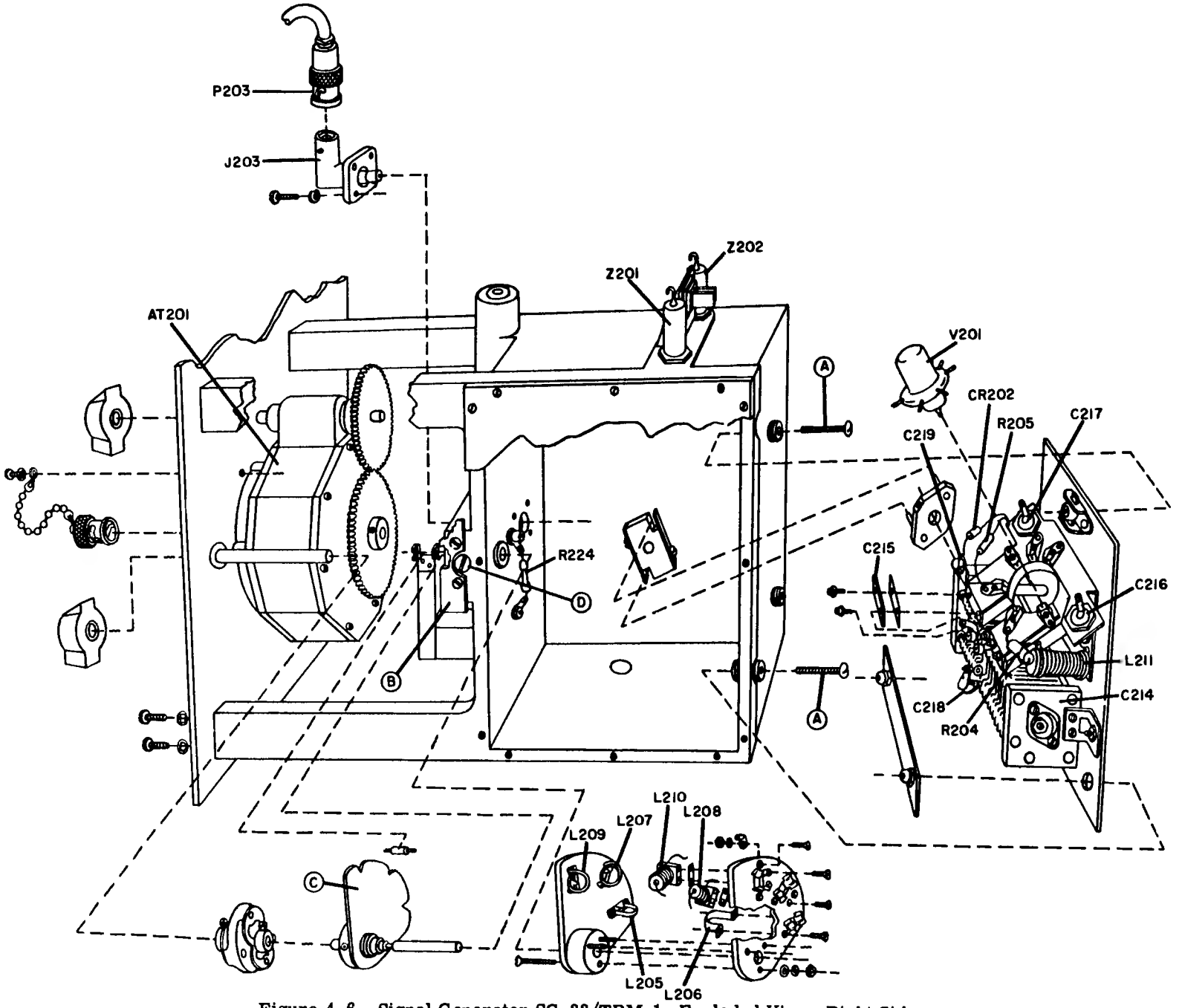

Figure 4-6. Signal Generator SG-33/TRM-1, Exploded View, Right Side

4-21. To remove the oscillator subassembly, remove side cover plate from the oscillator compartment, remove oscillator tube V201 by gently prying it up from its radial connectors. Unsolder and disconnect connections to filters Z201 and Z202, using a pencil-type soldering iron. Remove three binding-head screws A, figure 4-6, from back of casting. Remove detent stop plate B, figure 4-6, and rotate detent plate C, figure 4-6, until coil turret protrudes from casting. Gently pull the oscillator subassembly from the casting.

4-22. After removing the oscillator subassembly as outlined in paragraph 4-21 above, the coil turret may be removed by loosening the two setscrews. The coil turret may also be removed as follows without removing the oscillator subassembly. Remove detent stop plate B, figure 4-6, and loosen shaft locking screw D, figure 4-6. Rotate detent plate C, figure 4-6, until it protrudes from the casting, and slide the shaft assembly toward the front panel sufficiently to remove coil turret.

4-23. To remove attenuator AT201, proceed as follows:

a. Remove the frequency scale drum dial by removing the three binding-head screws.

b. Unsolder and remove leads from RF LEVEL control R201 and tag them for identification. Unsolder brown lead from lamp sockets.

c. Remove FREQ BAND and MICROVOLTS knobs from front panel.

d. Disconnect cable connectors P203 and P204.

e. Rotate FREQ knob fully clockwise.

f. Stand the generator with the front panel facing up.

g. Remove FREQ knob. Remove the eight screws holding the front panel to the casting mounting posts. Replace FREQ knob.

h. Carefully lift up the front panel, disengaging one end of the flexible coupling on the frequency tuning shaft assembly.

i. Remove attenuator AT201 by unscrewing the four flat-head screws from the front panel.

4-24. DISASSEMBLY OF SIGNAL GENERATOR SG-32/TRM-1.

4-25. Refer to exploded views, figures 4-7 and 4-8, for disassembly of Signal Generator SG-32/TRM-1.

4-26. Remove cover plates on each side of casting. Remove access plate from the back of the casting.

4-27. To remove rf amplifier subassembly A, figure 4-7, unsolder leads of resistor R312, crystal CR301, and capacitor C319. Access to the lead of C319 is through the opening in the back of the casting. Unsolder and tag the four leads from the feed-through capacitors C320, C322, and C326.

4-28. Remove two screws B, figure 4-7, from bottom of casting and lift out the rf amplifier subassembly.

4-29. To remove panel lamp I301 or I302, remove one of the screws holding the lampholder to the casting and loosen the other screw. Turn the lampholder sufficiently to permit the lamp to be removed. After lamp replacement, replace and tighten the screws.

4-30. To remove oscillator subassembly C, figure 4-8, proceed as follows:

a. Unsolder the ribbon conductor with insulating sleeve from standoff terminal D, figure 4-8. Unsolder the other ribbon conductor from the dummy terminal of switch S301.

b. Unsolder and tag for identification the two leads from standoff capacitors C309 and C313.

c. Loosen the two rear setscrews of the flexible shaft coupling. These setscrews are accessible from the side or the bottom of the generator.

d. Remove the two binding-head screws G, figure 4-8, holding the oscillator subassembly to the casting.

e. Slide the oscillator subassembly to the rear, and lift out.

4-31. To remove tuning capacitor C306, proceed as follows:

a. Remove side cover plate and rear access plate.

b. Remove the rf oscillator subassembly as outlined in paragraph 4-30.

c. Unsolder capacitor C319 lead from the solder lug terminal of C306. Access to C319 is through opening in the back of the casting.

d. Remove the grounding screw fastening bracket E, figure 4-8, from the casting.

e. Remove the three binding-head screws which form a triangle in the center of the bottom of the casting.

f. Remove the tuning capacitor by drawing straight out to disengage coupling block F, figure 4-8, from the two pins on the driving gear; and then drawing out at slight angle to clear standoff capacitors C309 and C313.

4-32. To remove attenuator AT301, proceed as follows:

a. Rotate FREQ control fully clockwise.

b. Remove frequency scale drum dial by removing the three binding-head screws.

c. Unsolder and tag for identification the three wires from RF LEVEL control R301.

d. Remove FREQ BAND control knob.

e. Loosen the two setscrews fastening the flexible shaft coupling to the FREQ control shaft.

f. Place the generator with the front panel facing up.

g. Remove the seven binding-head screws fastening the front panel to the casting mounting posts.

h. Carefully lift up the front panel to disengage the FREQ shaft from the flexible coupling.

i. Lift the front panel sufficiently to disconnect cable connector P303 from J303.

j. Remove connector dust cap from the RF OUT panel jack.

k. Remove attenuator AT201 by unscrewing the four flat-head screws from the front panel.

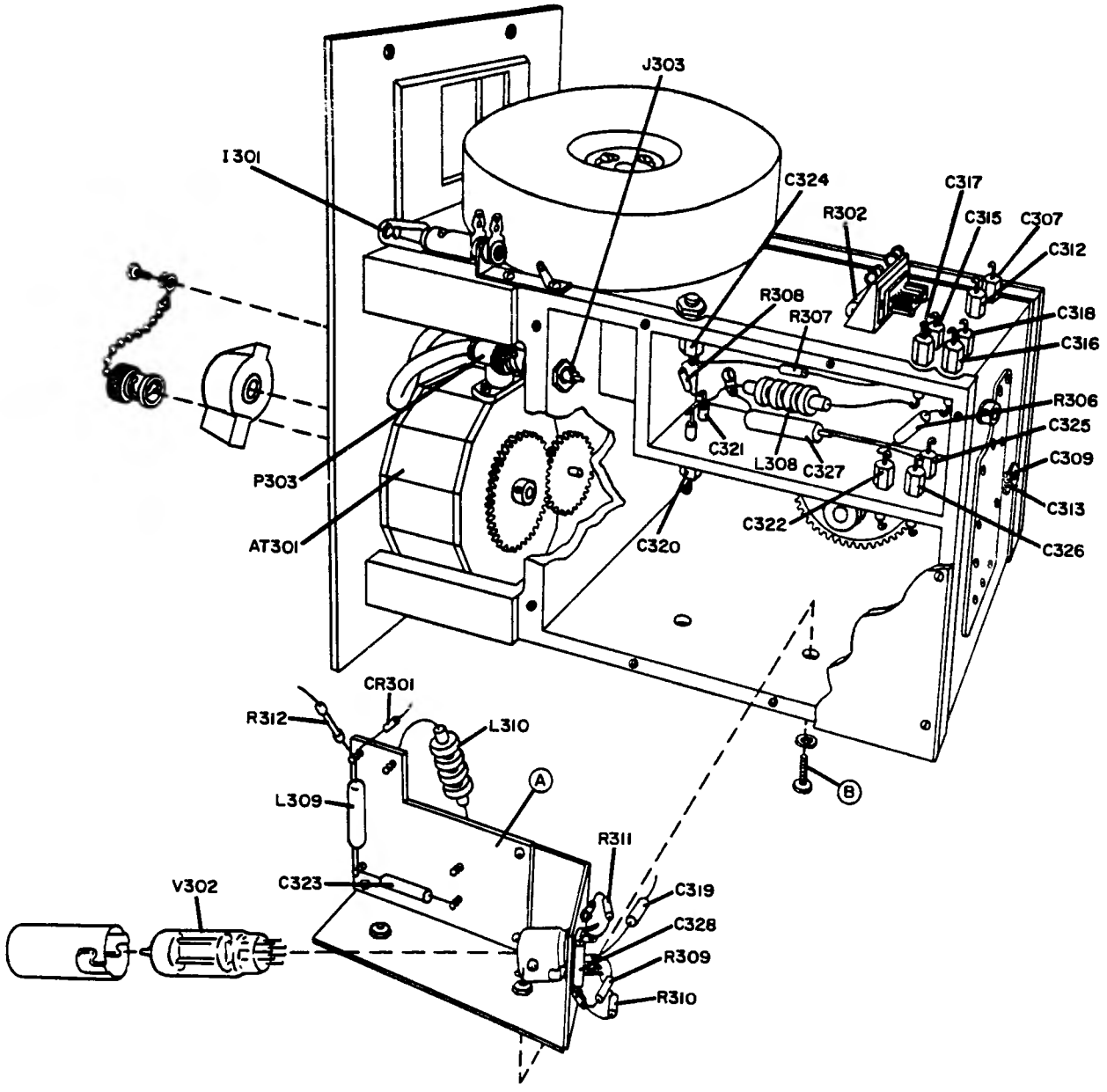

Figure 4-7. Signal Generator SG-32/TRM-1, Exploded View, Right Side

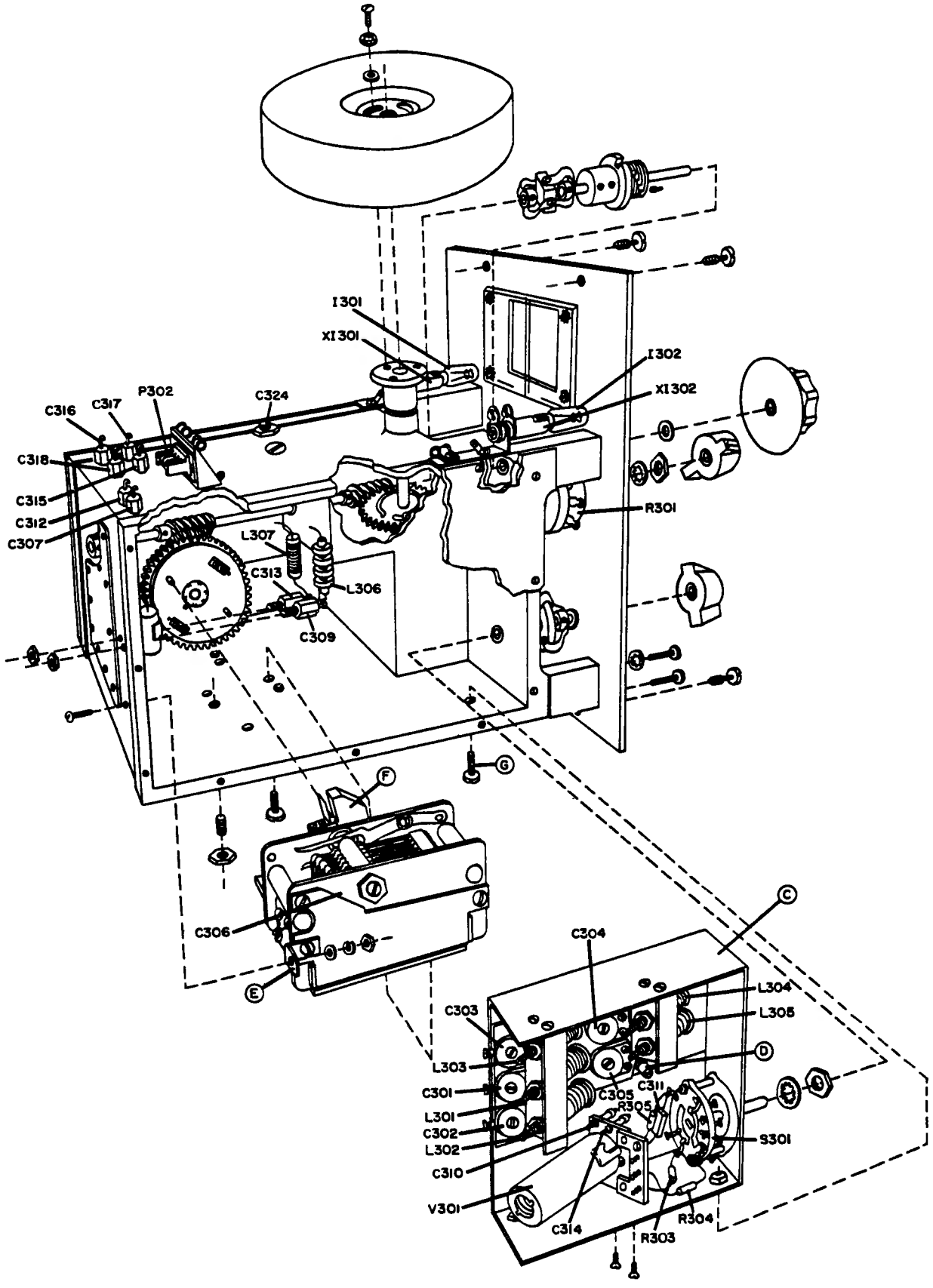

Figure 4-8. Signal Generator SG-32/TRM-1, Exploded View, Left Side

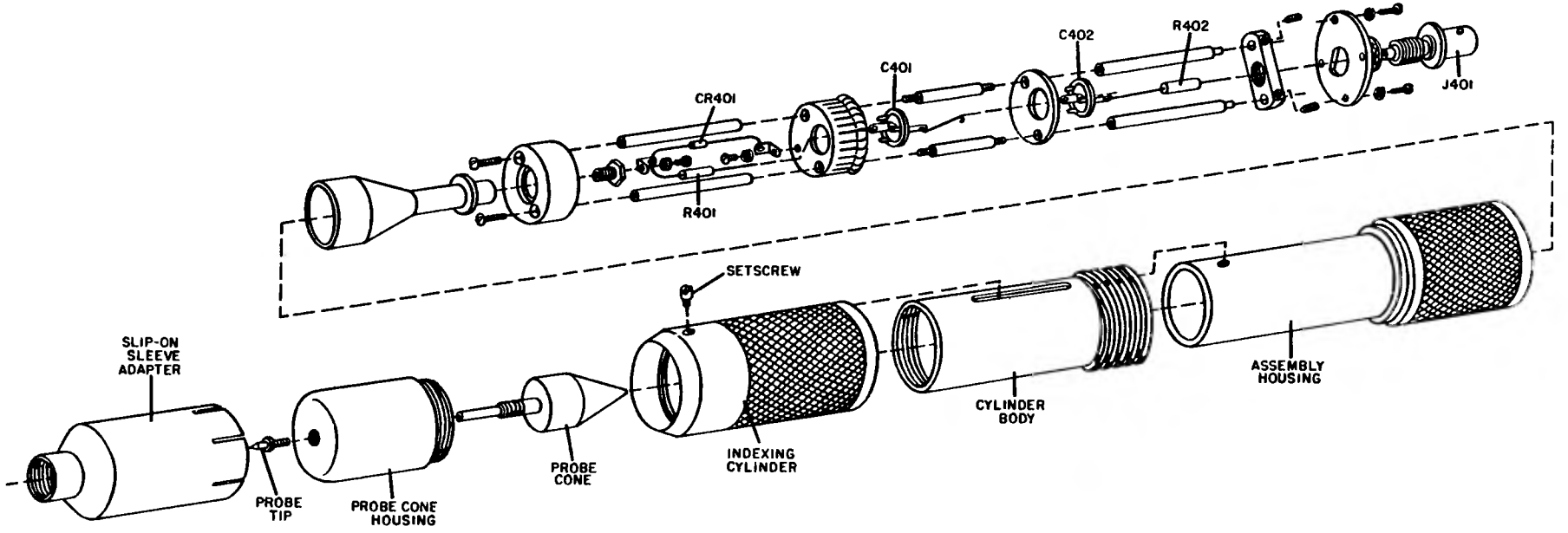

Figure 4-9. RF Coupler-Detector CU-220/TRM-1, Exploded View

4-33. DISASSEMBLY OF RF COUPLER-DETECTOR CU-220/TRM-1.

4-34. Refer to exploded view, figure 4-9, for disassembly of CU-220/TRM-1.

4-35. Disassembly procedure is as follows:

a. Remove slip-on sleeve adapter from the probe end.

b. Remove the four screws from the end plate which holds BNC connector J401.

c. Withdraw the probe assembly from the assembly housing.

d. Unscrew the polystyrene probe cone housing from the cylinder body.

e. The probe tip may be removed by unscrewing.

f. The probe cone may be removed by first removing the probe tip and then unscrewing the cone.

g. All components are now accessible for repair or replacement.

4-36. DISASSEMBLY OF RF COUPLER-DETECTOR CU-413/TRM-1.

4-37. Refer to exploded view, figure 4-10, for disassembly of CU-413/TRM-1.

4-38. Disassembly procedure is as follows:

a. Rotate the indexing sleeve until the slotted-head setscrew appears through the hole in the sleeve. Remove the setscrew.

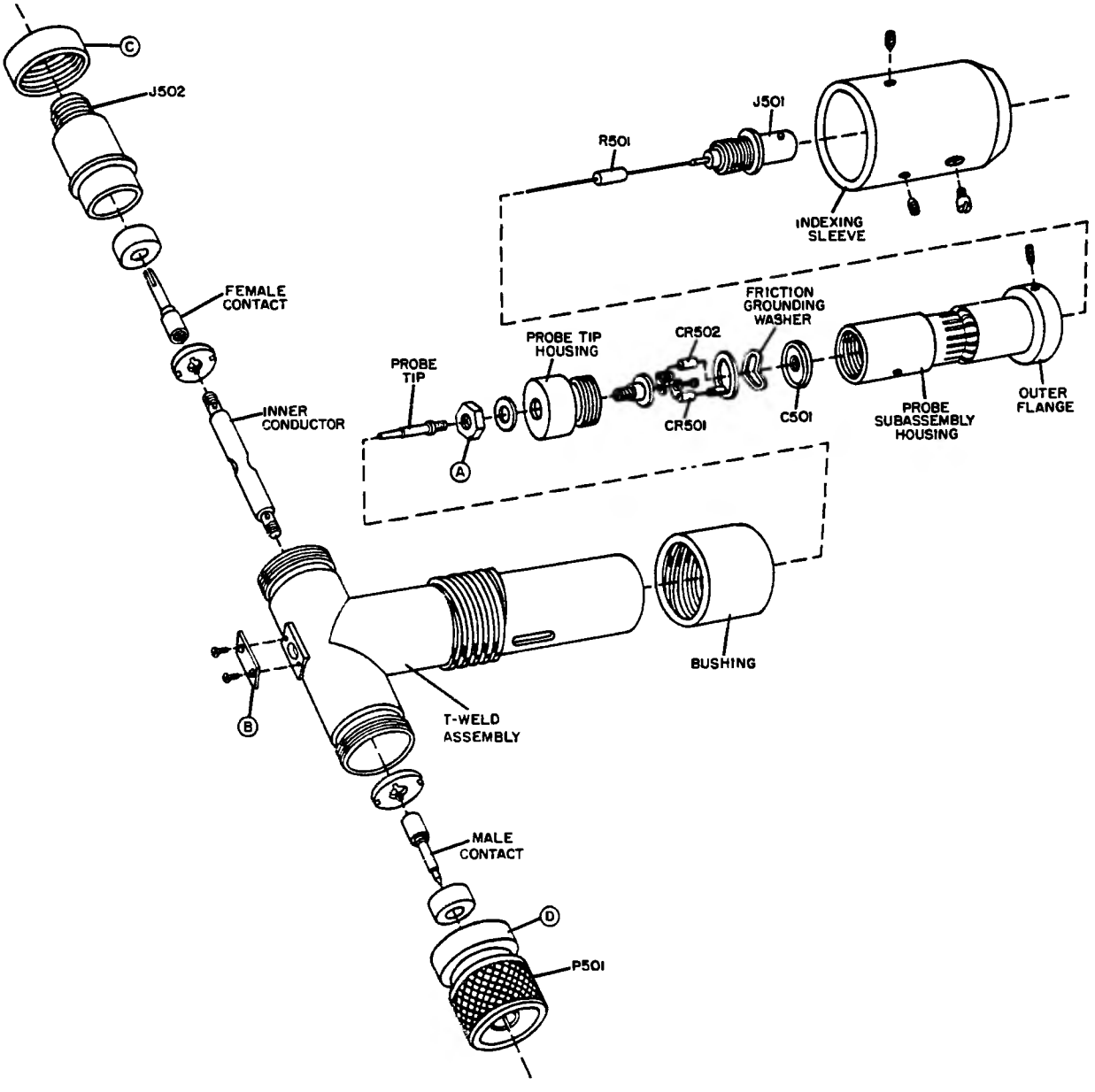

Figure 4-10. RF Coupler-Detector CU-413/TRM-1, Exploded View

b. It is not necessary to remove the indexing sleeve to proceed with the following steps. If desired, the sleeve may be removed by rotating counterclockwise. Do not separate the indexing sleeve from the bushing, since the factory-set calibration will be affected.

c. Remove the probe subassembly by pulling the probe subassembly housing out of the T-weld assembly.

4-39. To disassemble the probe subassembly, proceed as follows:

a. Remove nut A.

b. Unscrew the nylon probe tip housing.

c. Using a small pencil-type soldering iron with an extremely narrow tip, unsolder the connection of crystal diode CR502 from the R501 lead which passes through the center hole of button capacitor C501.

d. Remove the probe tip subassembly by pulling it out. Care must be taken to prevent loss of the friction grounding washer which is not attached to any other component.

4-40. To remove connector J501 and resistor R501, proceed as follows:

a. Follow procedure outlined in paragraphs 4-38 and 4-39 above.

b. Straighten the hook on the end of the resistor lead passing through the center of capacitor C501.

c. Holding the assembly nearly vertical, with the BNC connector up, apply heat to the solder around the wire through the center of the capacitor. At the same time, gently, but firmly, tap the assembly against the work bench to release the capacitor from the housing.

d. Loosen the setscrew in the flange of the assembly housing and unscrew the BNC connector.

e. Draw out the connector and resistor.

4-41. Connectors J502 and P501 may be disassembled by unscrewing sleeve nuts C and D, respectively. The center contacts may be removed by unscrewing. If disassembly of these connectors is performed, it is suggested that one connector be reassembled before disassembly of the other. Otherwise, realignment of the inner conductor will be necessary, as described in section IX. Removal of cover plate B provides for visual inspection of the inner conductor alignment with the probe tip.

4-42. DISASSEMBLY OF FIXED ATTENUATOR CN-399/TRM-1 (6 db). (See figure 4-11.)

4-43. Remove cover. Remove the six binding-head screws from the grounding shield. Turn the attenuator with the shield down. Touch a hot soldering iron to the two solder points on the shield until the solder is fluid at both points; then quickly tap the attenuator body against the work bench to release the shield.

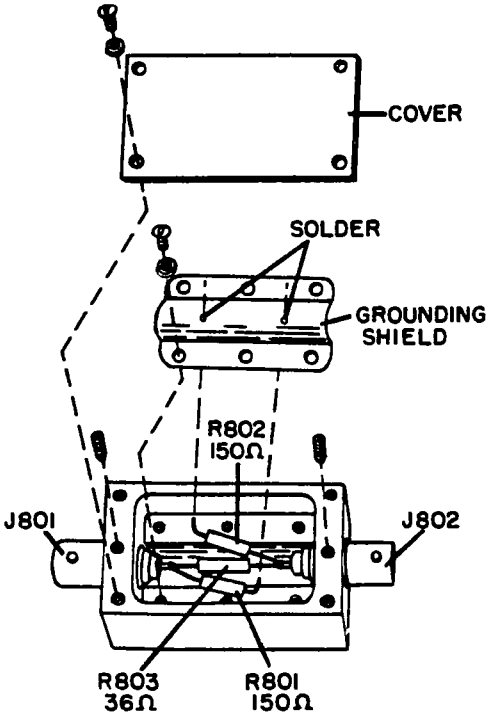

Figure 4-11. Attenuator, Fixed CN-399/TRM-1, (6 db), Exploded View

4-44. To remove connectors J801 and J802, unsolder connections, remove setscrews, then unscrew the connectors.

4-45. DISASSEMBLY OF FIXED ATTENUATOR CN-287/TRM-1 (12 db). (See figure 4-12.)

4-46. Follow same procedure as outlined in paragraphs 4-43 and 4-44 above.

4-47. DISASSEMBLY OF TEST ADAPTER MX-2079/TRM-1 (50-ohm Shunt). (See figure 4-13.)

4-48. Disassembly procedure is the same as outlined in paragraphs 4-43 and 4-44 above, except that there is only one solder point on the grounding shield.

4-49. DISASSEMBLY OF TEST ADAPTER MX-1652/TRM-1 (Antenna Simulator). (See figure 4-14.)

4-50. Remove cover. All components are then accessible. To remove connectors J601 and J602, unsolder connections, remove the two setscrews, which are in the same threaded holes as two of the cover retaining screws; and unscrew the connectors from the adapter body.

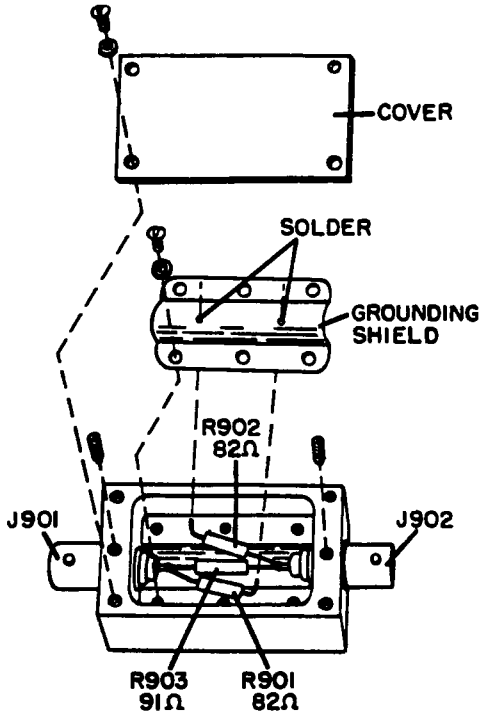

Figure 4-12. Attenuator, Fixed CN-287/TRM-1 (12 db), Exploded View

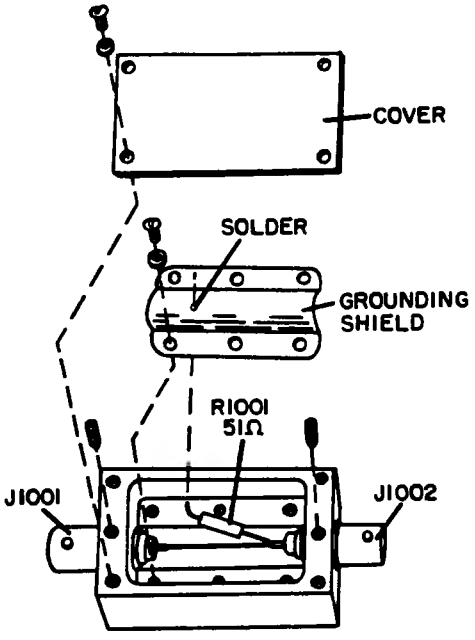

Figure 4-13. Adapter, Test MX-2079/TRM-1 (50 ohm Shunt), Exploded View

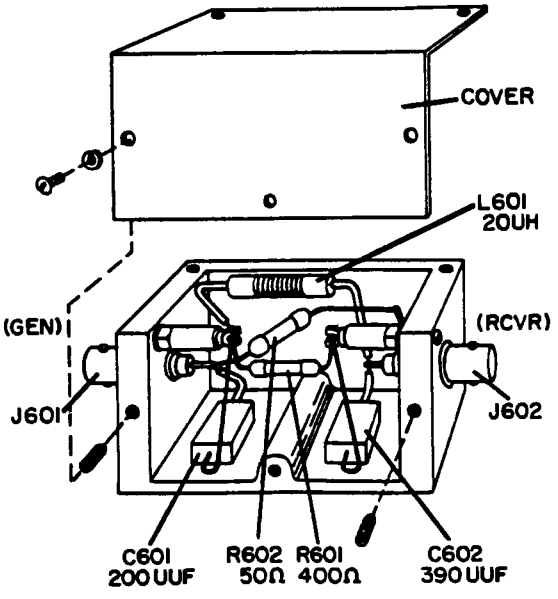

Figure 4-14. Adapter, Test MX-1652/TRM-1 (Antenna Simulator), Exploded View

SECTION V

CLEANING

5-1. DUST AND CORROSION.

5-2. Dust is a constant source of trouble in high-frequency equipment, as is corrosion. Regular maintenance will insure the cleanliness required for maximum performance and operation.

5-3. The following materials are required for cleaning Radio Test Set AN/TRM-1:

a. Clean, lint-free cloth.

b. Emery cloth.

c. A small brush.

d. Solvent, dry-cleaning, Specification P-S-661, Type II, obtainable from GSSO.

5-4. CLEANING CHECKLIST.

5-5. Table IV provides instructions for the cleaning of parts after disassembly of the major components of Radio Test Set AN/TRM-1. The table consists of two columns; the first column indicates what is to be cleaned, the second column indicates how the part or component should be cleaned.

TABLE IV. CLEANING CHECKLIST

WHAT TO CLEAN	HOW TO CLEAN
1. Chassis, case, and cover	1. Wherever possible, clean with dry, clean cloth. Use dry, filtered, compressed air at approximately 150 psi pressure to blow out accumulated dirt and dust. Repair scratched, rusted, and chipped surfaces.
2. Fuses	2. Clean fuse terminals with emery cloth and wipe with clean cloth.
3. Capacitors	3. Clean cases of fixed capacitors. The cases can usually be cleaned with a dry cloth. If deposits of dirt are hard to remove, moisten cloth in solvent.
4. Resistors	4. Clean resistors with a small brush. NOTE Discoloration of resistors usually indicates overheating. Check for possible cause.
5. Insulators	5. Wipe insulators with a dry cloth dampened with solvent.
6. Electron tube sockets	6. Clean with compressed air at approximately 150 psi pressure or a small brush.
7. Miscellaneous components and wiring	7. Clean all connectors, connector dust caps, switches, terminal boards, meters, wiring, etc., with compressed air at approximately 150 psi pressure or a small brush.

SECTION VI

INSPECTION

6-1. INSPECTION CHECK.

6-2. A system for routine inspection following the disassembly of Radio Test Set AN/TRM-1 is needed to determine evidences of damage, wear, or deterioration of the components, subassemblies, assemblies, or parts. Such information will aid the depot and overhaul maintenance personnel in determining the extent and nature of the fault in the equipment that must be corrected. A record of such inspection findings will provide valuable information towards the determination of the actual difficulties and faults in other equipment of the identical type.

6-3. INSPECTION PROCEDURES.

6-4. Wiring should be checked for burned, damaged or frayed insulation, shorts to other wires or chassis, and for corrosion. Any one of these conditions may cause malfunctioning of the radio test set.

6-5. Inspect capacitors for loose connections. Inspect capacitor cases for swelling and discoloration. Check the rotor and stator plates of the variable capacitors to make certain they are not touching. To check a capacitor for capacitance value, use a capacitor analyzer such as Signal Corps Impedance Bridge TS-460/U, or similar test equipment. To perform a quick capacitor check, use a VTVM (vacuum tube voltmeter) set to its highest resistance range. Connect the capacitor across the VTVM test prods and note the indications as follows:

a. If needle kicks and the resistance reading increases to approximately 1,000 megohms, the capacitor is good. Electrolytic capacitors may show readings considerably lower.

b. If needle remains at infinity, the capacitor is open.

c. If needle moves to a definite resistance reading and remains fixed, the capacitor may be considered as leaky.

d. If needle kicks back and forth, the capacitor is intermittent.

NOTE

Capacitors having a capacitance value below 1,000 uuf will not give sufficient kick on the meter for an accurate check.

6-6. RF filters should be checked for continuity, using an ohmmeter.

6-7. Individual subassemblies should be checked for the following:

a. Tightness of fastenings.

b. Proper positioning of component parts and dressing of leads.

c. Proper tension of springs, such as used on the detent switches.

d. Securely soldered connections.

6-8. Gear and switch shafts should be inspected for proper fit in bushings and smoothness of operation.

6-9. The entire radio test set, components and assemblies should be checked as follows:

a. Fuses and fuseholders for corrosion, cracks, and lack of tension sufficient to insure good contact.

b. Meters for zero adjustment.

c. Tube sockets and pins for loose contacts, dirt, and corrosion.

d. Resistors for blistering, discoloration, and other evidence of overheating.

e. Switches for dirt, corrosion, loose contacts, and unsatisfactory mechanical action.

f. Terminal boards for cracks, dirt, and loose connections.

g. Variable resistors for unsatisfactory electrical and mechanical operation.

h. Mountings, machine screws, and nuts for looseness.

i. Coils for dirt, corrosion, and damaged turns.

j. Insulators for cracks and dirt.

k. Variable capacitors for dirt and corrosion.

l. Gears for dirt, bent or broken teeth, and proper mechanical operation.

SECTION VII

REPAIR AND REPLACEMENT

7-1. GENERAL.

7-2. Instructions for dismantling those parts of Radio Test Set AN/TRM-1 which can be economically repaired or replaced in subassembly form are described in Section IV of this handbook. For disassembly of any of these components, refer to the following paragraphs:

COMPONENT	SEE PARAGRAPH NO.	SEE FIGURE NO.
Fixed Attenuator CN-287/TRM-1, Disassembly	4-45	4-12
Fixed Attenuator CN-399/TRM-1, Disassembly	4-42	4-11
Power Panel	4-10	4-1
RF Coupler-Detector CU-220/TRM-1	4-33	4-9
RF Coupler-Detector CU-413/TRM-1	4-36	4-10
Signal Generator SG-32/TRM-1, Disassembly	4-24	4-7, 4-8
Signal Generator SG-33/TRM-1, Disassembly	4-17	4-5, 4-6
Signal Generator SG-32 and SG-33/TRM-1, Removing from Equipment	4-6	
Test Adapter MX-2079/TRM-1, Disassembly	4-47	4-13
Test Set Subassembly TS-687/TRM-1, Removal From Case	4-8	
Test Set Subassembly TS-687/TRM-1, Preliminary Disassembly	4-12	
Test Set Subassembly TS-687/TRM-1, Complete Disassembly	4-14	4-2, 4-3, 4-4
Test Adapter MX-1652/TRM-1, Disassembly	4-49	4-14

7-3. Readjustment of the equipment is necessary after replacing certain components of the Radio Test Set AN/TRM-1. See section VI, Handbook of Service Instructions AN16-30TRM1-2, for readjustment procedures after repair or replacement of any of the following components:

COMPONENT	For readjustment, see paragraph of HANDBOOK SERVICE INSTRUCTIONS
Neon panel lamp I101	6-27
Over-mod amplifier V104	6-27
Audio-Oscillator V105	6-29
Modulator V106	6-31
Modulation Voltmeter V102	6-15
VOLT/MW meter V103	6-20

7-4. METERS.

7-5. Three meters are used in Radio Test Set AN/TRM-1. Their repair and replacement calls for special attention. Replacement stock meters not actually connected into a circuit should have shorting conductors connected across the meter's terminals for electric damping. When replacing a meter, observe the proper polarity of the meter's terminals for the circuitry involved. After replacement, the meters should be mechanically and electrically zero set. Procedures for zero-setting each meter are described in the following listed paragraphs:

a. Zero setting the CARRIER LEVEL meter -- see paragraph 6-23 Section VI, Handbook of Service Instructions AN16-30TRM1-2.

b. Zero setting the VOLT/MW meter -- see paragraph 6-20 Section VI, Handbook of Service Instructions AN16-30TRM1-2.

c. Zero setting the % MODULATION meter -- see paragraph 6-15 Section VI, Handbook of Service Instructions AN16-30TRM1-2.

7-6. SWITCHES.

7-7. Replacement of switches may be treated similarly to the replacement of any other component with, however, one difference. Switch S102 contains several precision resistors which must be given special treatment. In the event it becomes necessary to replace a faulty S102 with a new switch, follow the preliminary disassembly procedures for Test Set Subassembly TS-687/TRM-1 given in paragraph 6-7 of Handbook of Service Instructions AN16-30TRM1-2, so placing the upper chassis on the lower one that the back of S102 is exposed for servicing, Remove the precision resistors while the switch is still in place on the front panel. To prevent damaging the resistors, necessary precautions should be taken to avoid application of excessive heat. Carefully tag each resistor as it is removed. Then remove the switch and replace with a new one. Reassemble the switch with its component resistors when the switch is mounted on the chassis, observing the same precautions to avoid damaging the precision resistors with excessive heat.

SECTION VIII

REASSEMBLY AND TESTING OF SUBASSEMBLIES AND ASSEMBLIES

8-1. REASSEMBLY PROCEDURES.

8-2. In general, the reassembly procedures for subassemblies and assemblies are the reverse of the disassembly procedures outlined in Section IV of this handbook.

8-3. It is impracticable to repair attenuators AT201 and AT301 and rf filters Z201, Z202, and Z203. These assemblies should be replaced as units, if defective.

8-4. TESTING PROCEDURES.

8-5. No tests of subassemblies or assemblies are necessary.

SECTION IX

REASSEMBLY AND TESTING OF COMPONENTS

9-1. REASSEMBLY PROCEDURES, GENERAL.

9-2. In general, reassembly of components is the reverse of disassembly procedures outlined in Section IV. Instructions for certain reassembly procedures are detailed in the following paragraphs.

9-3. REASSEMBLY OF TEST SET SUBASSEMBLY TS-687/TRM-1. (See figures 4-2, 4-3 and 4-4.)

9-4. Mount switch S101 and connectors J103, J106, J107, and J108 on the front panel before securing the panel to the frame.

9-5. Mount meter M102 and switches S101, S105, and S106 on the front panel before replacing the handle support bracket.

9-6. REASSEMBLY OF SIGNAL GENERATOR SG-33/TRM-1. (See figures 4-5 and 4-6.)

9-7. If both the oscillator subassembly and the oscillator coil turret have been removed, replace the oscillator subassembly first. In replacing the oscillator subassembly, if the position of the coupling block on the variable capacitor shaft has been disturbed since the oscillator subassembly was removed, refer to paragraph 9-8 for reassembly procedure. If the position of the coupling block has not been disturbed, proceed as follows:

a. Remove electron tube V201 from the subassembly.

b. Turn the FREQ knob on the front panel of the generator to its fully clockwise position.

c. Turn the capacitor shaft until the capacitor plates are fully meshed.

d. Place the generator with the front panel facing up.

e. Carefully slide the oscillator subassembly into position. The two pins of the capacitor shaft coupling block must engage in the two notches of the mating coupling block. A dentist's mirror, if available, will be of assistance in this operation.

f. Tilt the generator forward and replace the top retaining screw from the back of the generator, through the floating captive screw of the oscillator mounting plate. Do not fully tighten.

CAUTION

Do not disturb the position of the three threaded bushings in the back of the generator. These bushings have been carefully positioned at the factory to align the capacitor shaft with its mating shaft.

g. Slide the plate, containing the two captive nuts, into the compartment to the left of the capacitor with the nuts facing to the right, then turn the plate until the nuts face up, at the same time sliding the plate between the capacitor and its mounting plate. Line up the nuts with the bushing holes and replace the other two retaining screws from the back of the generator. Do not tighten.

h. Place the generator bottom down, with the front panel facing left.

i. Remove detent stop plate B, figure 4-6, and loosen shaft locking screw D, figure 4-6, Rotate detent plate C, figure 4-6, until it protrudes from the casting and slide the shaft assembly toward the front panel sufficiently to replace the coil turret on the shaft.

j. Slide the shaft assembly back into position and tighten the shaft locking screw.

k. Turn the detent plate to FREQ BAND A position and replace the detent stop plate.

l. Place the coil turret in the BAND A position, carefully engaging its contacts with those on the oscillator subassembly.

m. Tighten the three oscillator retaining screws from the back of the generator and the two coil turret set screws.

n. Rotate the FREQ BAND knob to each band position and check the engagement of the coil turret and oscillator subassembly contacts.

o. With a small, pencil-type soldering iron, reconnect filters Z201 and Z202 to capacitors C216 and C217, respectively. Replace electron tube V201.

9-8. To replace the oscillator subassembly if the position of the coupling block on the capacitor shaft has been disturbed, proceed as follows:

a. Remove electron tube V201 from the subassembly.

b. Place the generator with the front panel facing up.

c. Rotate the FREQ knob until the two notches of the coupling block inside the oscillator compartment are in a vertical plane with the center shaft.

d. Rotate the tuning capacitor shaft until the two pins on the shaft coupling are in a vertical plane.

e. Carefully slide the oscillator subassembly into position. The two pins of the shaft coupling block must engage in the two notches of the mating coupling block. A dentist's mirror, if available, will be of assistance in this operation.

f. Follow steps f through o of paragraph 9-7.

g. Loosen the two setscrews at the front end of the flexible coupling immediately behind the front panel FREQ knob.

h. Turn the FREQ knob fully clockwise.

i. While observing the variable tuning capacitor, turn the FREQ shaft coupling until the capacitor plates are fully meshed. This adjustment must be as accurately made as can be determined by eye.

j. Retighten the two setscrews in the flexible shaft coupling.

k. Rotate the FREQ knob counterclockwise to test smoothness of operation, then return to fully clockwise position and check that the plates of the variable capacitor are in fully meshed position.

9-9. To replace the front panel of Signal Generator SG-33/TRM-1, proceed as follows:

a. Place generator front side up.

b. While observing the variable tuning capacitor in the oscillator compartment, rotate the flexible shaft coupling next to the worm gear in a clockwise direction until the capacitor plates are fully meshed.

c. Rotate FREQ knob on the front panel fully clockwise.

d. Carefully lower the front panel in place, engaging the two mating sections of the flexible FREQ shaft coupling.

e. Remove the FREQ knob, replace and tighten the eight front panel retaining screws, and replace the FREQ knob.

f. Connect cable connectors P203 and P204 and replace all front panel knobs.

g. Reconnect wire leads to RF LEVEL control and lampholder.

h. Replace frequency scale drum dial as outlined in paragraph 9-10.

i. Rotate FREQ knob counterclockwise to check smoothness of operation, return to fully clockwise position and check to see that the plates of the variable tuning capacitor are fully meshed.

9-10. To replace the frequency scale drum dial, proceed as follows:

a. Turn the FREQ knob to its fully clockwise position.

b. Place the frequency scale drum dial on its mounting hub and rotate until the index lines, at the low-frequency end of the scale, are in line with the index mark on the dial window.

c. Replace and tighten the three retaining screws.

d. Test the frequency calibration as outlined in paragraph 11-40 of Section XI.

9-11. REASSEMBLY OF SIGNAL GENERATOR SG-32/TRM-1. (See figures 4-7 and 4-8.)

9-12. To replace rf amplifier subassembly A, figure 4-7, place in position, replace and tighten the two retaining screws from the bottom of the casting.

9-13. Reconnect leads of resistor R312, crystal CR301, and capacitor C319. The C319 lead is connected to the terminal lug of variable capacitor C306 through the access opening in the back of the generator casting.

9-14. Reconnect the four leads to the feed-through capacitors C320, C322, C325, and C326.

9-15. To replace oscillator subassembly C, figure 4-8, proceed as follows:

a. Place the two ribbon conductors, one insulated and one uninsulated, leading from the variable tuning capacitor, in such position that when the oscillator subassembly is placed in position, the conductors will be accessible through the opening in the subassembly bracket.

b. Place the subassembly to the rear of its final position, lining up the switch shaft with its hole in the casting, and then slide the subassembly forward, engaging the switch shaft in the flexible coupling collar. This operation must be carefully performed to avoid damaging coils L306 and L307 by contact with the terminals of trimmer capacitors C301, C302, and C303.

c. Replace the two subassembly retaining screws from the bottom of the casting. Tighten the flexible coupling setscrews.

d. Solder the ribbon conductor with insulating sleeve to the standoff terminal. Solder the uninsulated ribbon conductor to the dummy terminal of switch S301, taking precautions that the conductor does not touch the variable capacitor frame or the casting.

e. Solder the two leads to standoff capacitors C309 and C313.

9-16. To replace tuning capacitor C306, if the position of the flexible coupling block on the capacitor shaft has been disturbed since the capacitor was removed, refer to paragraph 9-17. If the coupling block has not been disturbed, proceed as follows:

a. Turn the front panel FREQ knob fully clockwise.

b. Turn the capacitor shaft until the plates are fully meshed.

c. Carefully slide the capacitor into position, observing through the access opening in the rear of the generator that the two pins of the drive gear engage the two notches of the coupling block.

d. Replace the three retaining screws through the bottom of the casting. Replace grounding screw through bracket E, figure 4-8.

CAUTION

Do not disturb the position of the three socket drive setscrews on the bottom of the generator. These setscrews have been carefully positioned at the factory to align the capacitor shaft in proper position.

e. Rotate the FREQ knob to test smoothness of operation, return to fully clockwise position and check that the capacitor plates are fully meshed.

f. Solder the lead of capacitor C319 to the terminal lug of the variable capacitor.

g. Replace the oscillator subassembly as outlined in paragraph 9-15.

9-17. To replace tuning capacitor C306 if the position of the shaft coupling block has been disturbed, proceed as follows:

a. Turn the FREQ knob until the two pins on the capacitor drive gear are in a vertical plane.

b. Turn the capacitor shaft until the two notches in the coupling block are in a vertical plane.

c. Follow steps c, d, f, and g of paragraph 9-16.

d. Loosen the two setscrews on the front end of the flexible coupling immediately behind the front panel FREQ knob.

e. Rotate the FREQ knob fully clockwise.

f. Rotate the flexible coupling until the variable capacitor plates are fully meshed.

g. Tighten the flexible coupling setscrews.

h. Follow step e of paragraph 9-16.

9-18. To replace the front panel of Signal Generator SG-32/TRM-1, proceed as follows:

a. Place the generator front side up.

b. Rotate FREQ knob fully clockwise.

c. Rotate the frequency shaft flexible coupling until the variable tuning capacitor plates are fully meshed.

d. Holding the front panel in its approximate final position, connect connector P303 to J303.

e. Carefully lower the front panel in position, engaging the FREQ shaft in the collar of the flexible coupling.

f. Replace and tighten the seven front panel retaining screws.

g. Tighten the setscrews of the FREQ shaft flexible coupling.

h. Resolder the three wire leads to the RF LEVEL control.

i. Replace all front panel knobs.

9-19. To replace the frequency scale drum dial of Signal Generator SG-32/TRM-1, proceed as follows:

a. Rotate FREQ knob fully clockwise.

b. Place the frequency scale dial on its hub and rotate until the index marks at the low-frequency end of the scale line up with the index mark on the dial window.

c. Replace and tighten the three dial retaining screws.

d. Check accuracy of calibration as outlined in paragraph 11-42, Section XI.

9-20. REASSEMBLY OF RF COUPLER-DETECTOR CU-413/TRM-1. (See figure 4-10.)

9-21. Reassembly of RF Coupler-Detector CU-413/TRM-1 is, in general, the reverse of the disassembly procedure outlined in paragraph 4-36.

9-22. If connector J501, resistor R501, and capacitor C501 have been removed, reassemble as follows:

a. Dress one lead of R501 in such manner that, in the final assembly, R501 will lie between J501 and C501.

b. Solder the dressed lead of R501 to the terminal of J501.

c. Insert the R501-J501 assembly into the flange end of the probe subassembly housing. Screw J501 in place and tighten the setscrew in the housing outer flange.

d. Holding the housing in a vertical position, with J501 down, thread the hole of C501 over the resistor lead, and drop C501 into position.

e. Using a small pencil-type soldering iron, solder the resistor lead to the center hole of C501.

f. Using miniature wire cutters, cut the resistor lead to approximately 1/4-inch length.

g. Using needle-nose pliers, bend a small hook in the end of the resistor lead.

h. Replace the friction grounding washer.

i. Replace the CR501-CR502 assembly and engage the hook of the CR502 lead with the hook of the resistor lead. Solder this connection.

j. Replace the nylon probe tip housing, taking precautions that the threaded portion and the shoulder of the probe tip bushing are fully seated in the housing. Replace the flat washer, nut, and probe tip.

9-23. If R501, C501, and J501 have not been removed, but crystals CR501 and CR502 have been removed, reassemble by following steps g through j of paragraph 9-22.

9-24. If the indexing sleeve has been removed, replace it by rotating in a counterclockwise direction.

9-25. To replace the probe subassembly, proceed as follows:

a. Rotate the indexing sleeve to a position in which the radial hole in the sleeve coincides with the slot in the T-weld assembly.

b. Insert the probe subassembly.

c. Rotate the subassembly and slide it longitudinally until the radial threaded hole in the subassembly is in line with the T-weld assembly slot and the indexing sleeve hole.

d. Insert and tighten the slot-drive setscrew.

9-26. Rotate the indexing sleeve clockwise to "0" on the calibrated scale. Remove access cover plate B, figure 4-10, and through the access port observe that the probe tip enters the center of the hole in the inner conductor. If not, remove the sleeve nuts C and D of J502 and P501, figure 4-10, and adjust the position of the inner conductor by partially unscrewing one center contact and screwing in the other center contact.

9-27. TESTING POWER SUPPLY.

9-28. Power transformer T102 may be given a dynamic test by unplugging P110, figure 4-4, and reading its voltages with Multimeter TS-352/U while the equipment is turned on. AC voltages from D to E should read 700 volts ac; from D to B, 350 volts ac; and from A to B, 6.3 volts. An additional dc check with P110 plugged in should read as follows:

a. DC voltage from pin 5 of XV108 to ground: 150 volts.

b. DC voltage from pin 2 of XC119 to ground: 270 to 280 volts. The dc voltages above represent dynamic voltages with the power supply operating properly.

9-29. Turn LIGHT ON-OFF switch S106 to the ON position and check whether all panel meter lights and frequency dial lights become illuminated.

9-30. TESTING SIGNAL GENERATORS SG-32/TRM-1 AND SG-33/TRM-1.

9-31. Refer to items No. 3 and 4, table II, ROUTINE CHECK CHART, Section III, of this handbook for nominal operation procedures for the major signal generator units of Radio Test Set AN/TRM-1.

SECTION X

FINAL REASSEMBLY

10-1. REPLACING TEST SET SUBASSEMBLY TS-687/TRM-1 IN THE EQUIPMENT CASE.

10-2. Signal Generators SG-32/TRM-1 and SG-33/TRM-1 need not be removed before replacing the test set subassembly in the case.

10-3. Grasping the two panel guards, carefully slide the test set subassembly into the case.

10-4. Replace the carrying handle on the top of the case, replacing and tightening the six securing screws.

10-5. Replace the four screws from the back of the case.

10-6. Turn the assembly face up and replace the two securing screws from the bottom of the case.

10-7. REPLACING SIGNAL GENERATORS SG-32/TRM-1 AND SG-33/TRM-1.

10-8. Replace the signal generators by sliding them carefully into their compartments, automatically engaging the connectors. Signal Generator SG-33/TRM-1 fits in the extreme left-hand compartment while SG-32/TRM-1 fits the center compartment. If either generator is placed in the incorrect compartment, its connector will not engage the matching connector on the test set subassembly.

10-9. Secure the signal generators in place by tightening the four captive-type screws on the front panel of each.

10-10. REPLACING MOUNTINGS MT-1458/TRM-1.

10-11. Place the test set, front panel facing up, on a work bench with the bottom of the test set case projecting a few inches beyond the edge of the bench.

10-12. Open the two sliding lock plates on each mounting. Place one mounting on each bottom side corner by sliding the back plate of the mounting under the projecting plate of the case, at the same time allowing the two feet of the case to pass through the two holes in the mounting. Lock the mounting in place by closing the two sliding lock plates, which enter grooves in the case feet.

10-13. Return the test set to its upright position and replace Cover CW-196/TRM-1.

SECTION XI

INSPECTION AND TESTING

11-1. OVERHAUL MARKINGS.

11-2. Marking of equipments required by Government TO's or other instructions to indicate overhaul or the incorporation of changes shall be applied during inspection and test (if not previously applied to subassemblies, assemblies, or components during overhaul and assembly).

11-3. PERFORMANCE TESTS.

11-4. The following sections or characteristics of the equipment shall be tested after repair, readjustment, and reassembly of the major components of Radio Test Set AN/TRM-1.

a. DC voltmeter circuits.

b. AC voltmeter performance.

c. MW meter performance.

d. % modulation of an external transmitter characteristic.

e. Internal modulation characteristic.

f. Audio level to transmitter characteristic.

g. % modulation of signal generator components.

h. Frequency calibration of signal generator components.

11-5. PERFORMANCE TEST OF DC VOLTMETER.

11-6. Because electron tubes are not used in the operation of the dc voltmeter circuits, Radio Test Set AN/TRM-1 need not be turned on to check the performance of the dc voltmeter function of the equipment. Just placing FUNCTION switch S103 in the DC position will put the dc voltmeter circuits of the radio test set into operation.

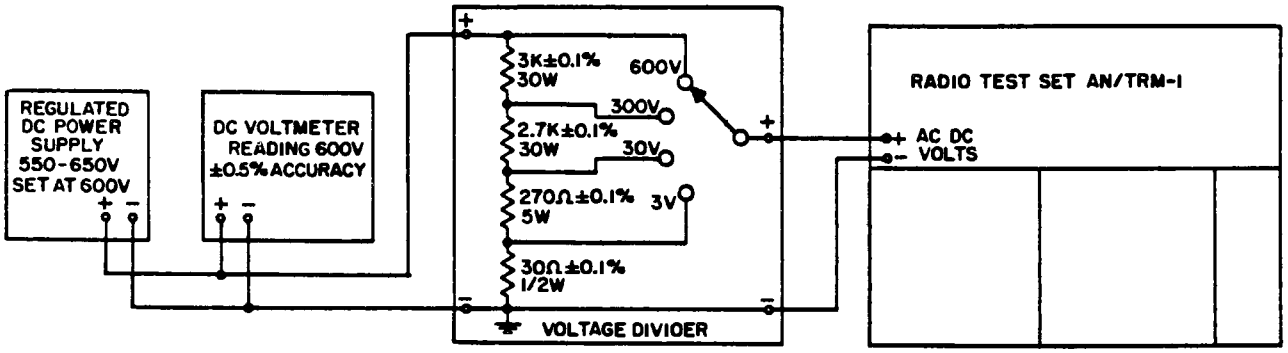

Figure 11-1. Set-up for Performance Test of DC Voltmeter

11-7. Any regulated power supply capable of supplying 600 volts dc total to a divider network, as shown in figure 11-1, may be used for the performance test. The divider resistor network shall be such that dc test voltages of 3, 30, 300, and 600 volts can be applied to the terminals labeled AC DC VOLTS on the front panel of Test Set Subassembly TS-687/TRM-1.

11-8. Utilizing Test Lead Set CX-1331/U, contained in the cover of Radio Test Set AN/TRM-1, connect the positive polarity of the particular test voltage selected to the red-colored jack terminal J104. The negative polarity of the test voltage can be connected to the black (negative) input jack terminal J105, which is internally grounded to the chassis of the test set. The RANGE switch S102 must be set to the proper position depending upon the value of the test voltage selected. The multiplying factors of X1, X10 and X100 are used with the 3, 30, and 300 volts test voltages, respectively.

11-9. After the test voltage selected has been applied properly to the jack terminals, J104 and J105, and the correct setting of RANGE switch S102 has been made, observe the reading of meter M103 on the appropriate V DC scale. The reading should correspond to the value of the test voltage applied, within an accuracy of ±5%. The upper scale 0-3 applies when the test voltages of 3, 30, and 300 volts are used. The lower scale, 0-6, applies when the test voltage of 600 volts dc is supplied and the RANGE switch has been positioned to the 600 V DC setting.

11-10. PERFORMANCE TEST OF AC VOLTMETER. (See figure 11-2.)

11-11. To check the performance of the ac voltmeter circuitry within Radio Test Set AN/TRM-1, the equipment must first be turned on and allowed to warm up for a period of 15 minutes. The ac voltmeter circuits are placed in operation by positioning FUNCTION switch S103 to the AC setting. Set MASTER CONTROL switch S101 to the VM position.

11-12. Performance is checked by setting up an audio-oscillator at 1,000 cps with an external ac voltmeter (precision VTVM type) connected across the oscillator's terminals to monitor the source of variable ac voltage. Figure 11-2 illustrates a typical test set-up whereby three different ac voltage levels of 3, 30, and 300 volts are supplied for application to the ac voltmeter circuitry of Radio Test Set AN/TRM-1. Voltage of 300 volts is obtained by applying 30 volts, as indicated on the auxiliary ac voltmeter connected across the audio-oscillator terminals, to the primary of a 1:10 step-up transformer (audio-interstage type). With an auxiliary ac voltmeter connected across the secondary of the 1:10 transformer, the output voltage can be set to 300 volts by adjusting the variable resistor marked "CAL," which is connected in series with the primary of the 1:10 transformer, as indicated in figure 11-2.

11-13. Utilizing the Test Lead Set CX-1331/U, contained in the cover of Radio Test Set AN/TRM-1, connect the particular test voltage selected to the jack terminals J104, J105, AC DC VOLTS. The RANGE switch S102 must be set to the proper position depending upon the value of the test voltage selected. The multiplying factors of X1, X10, and X100 are used with the 3, 30, and 300 volt test voltage, respectively. The 600 V DC position of the RANGE switch is not used in this performance test.

11-14. After the test voltage selected has been applied properly to jack terminals J104 and J105 and the correct setting of the RANGE switch S102 has been made, observe the reading of meter M103 on the 0-3 V AC scale of the meter. The reading should correspond to the value of the test voltage applied, within an accuracy of ±5%.

11-15. PERFORMANCE TEST OF MW METER. (See figure 11-2.)

11-16. Meter M103 functions as a milliwatt meter when MASTER CONTROL switch S101 is in either the LMHF or V/UHF position and FUNCTION switch S103 in the MW position.

11-17. Performance is checked by setting up an audio-oscillator with an auxiliary ac voltmeter connected across the terminals of the oscillator, and resistance networks for different power levels. Figure 11-2 illustrates a typical test set-up whereby different ac power levels of 10, 100, and 1,000 milliwatts are supplied for application through a telephone plug to a phone jack in Radio Test Set AN/TRM-1.

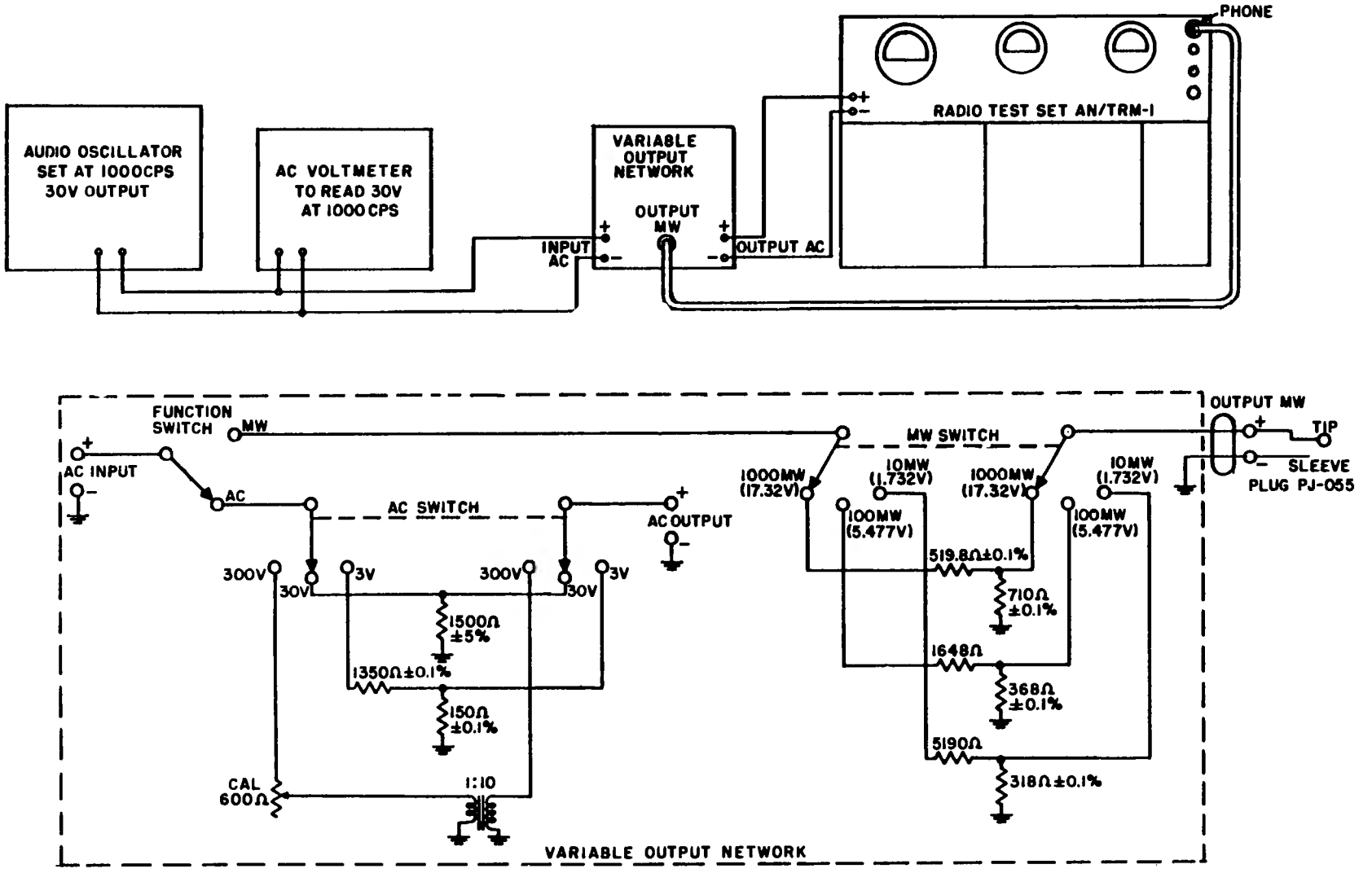

Figure 11-2. Set-up for Performance Test of AC Voltmeter and MW Meter

11-18. After the particular test power level has been selected from the test circuitry, connect the phone plug of the test set-up into phone jack J106, located at the upper right-hand corner of Test Set Subassembly TS-687/TRM-1. The RANGE switch, S102 must be set to the proper position depending upon the value of the test power level selected. The multiplying factors of X1, X10, and X100 are used with the 10, 100, and 1,000 milliwatt test power levels, respectively.

11-19. After the test power level has been applied properly to jack J106 and the correct setting of RANGE switch S102 has been made, observe the reading of meter M103 on the top milliwatt scale, reading 0-10. The reading should correspond to the value of the test power level applied, within an accuracy of ±5%.

11-20. PERCENTAGE MODULATION PERFORMANCE TEST. (See figure 11-3.)

11-21. Performance of this characteristic is checked by using the following equipment in a typical test set-up illustrated in figure 11-3:

a. A 65- to 100-watt transmitter, capable of transmitting a 30-mc amplitude-modulated signal.

b. An audio-oscillator, such as TS-382A/U, or equal.

c. An rf wattmeter, such as AN/URM-43, or equal.

d. An amplitude-modulation monitor, such as General Radio Type No. 1931-A.

e. Radio Test Set AN/TRM-1, equipment under test, with:

1. RF cable assemblies.

2. RF Coupler-Detector CU-220/TRM-1.

3. Two Adapters UG-201A/U.

4. Two Radio Frequency Adapters UG-107B/U.

11-22. Turn all equipment on and permit a warm-up period of 15 minutes. Perform the zero setting of % MODULATION meter M102 of Radio Test Set AN/TRM-1 according to paragraph 6-15, Handbook of Service Instructions AN16-30TRM1-2. Proceed with the test as follows:

a. Turn the output control on the test audio-oscillator to provide minimum or no output. Referring to figure 11-3, it can be seen that the 30-mc transmitter would be then operating under cw conditions, that is, with no modulation.

b. Adjust the output coupling of the transmitter so that its normal power output can be read on the connected rf wattmeter, within the accuracy and loading limitations of the wattmeter. This adjustment will permit minimum standing waves to exist on the rf cable assemblies.

c. The amplitude-modulation monitor should next be adjusted to receive a 30-mc signal. Refer to the instruction book covering the particular type and make of equipment used for full details of the required adjustment. If the General Radio Type No. 1931-A is used, adjust the monitor tuning for a maximum meter reading. Then adjust the monitor with its proper control to position the needle to the red reference mark.

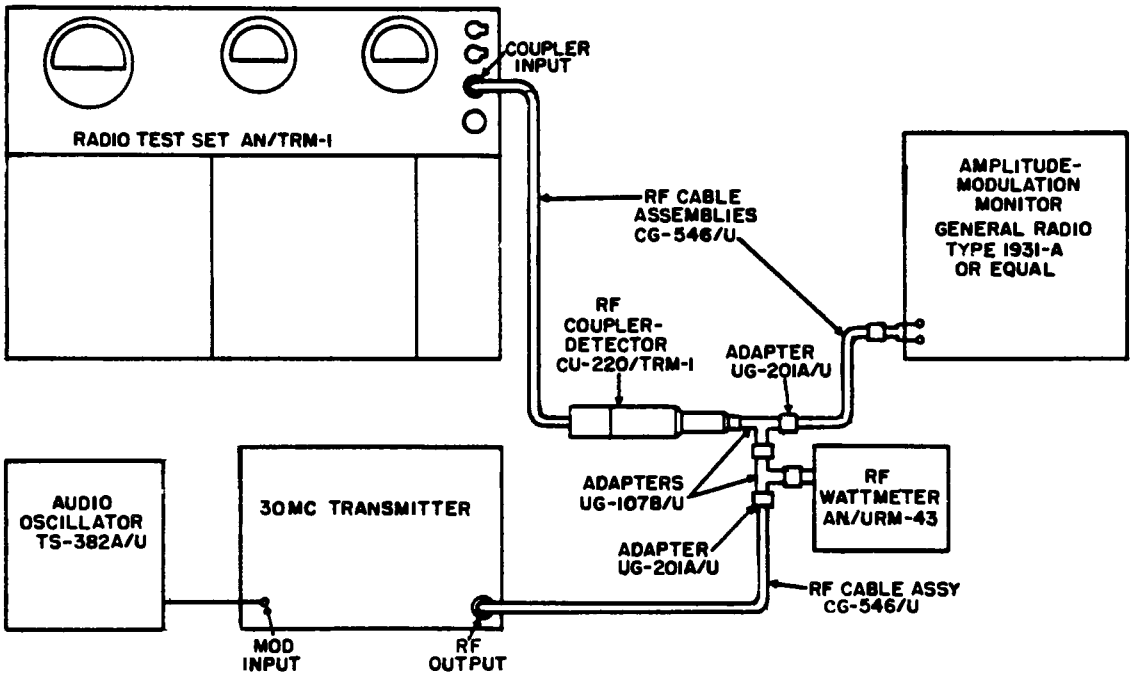

Figure 11-3. Set-up for Percentage Modulation Performance Test

d. Set MASTER CONTROL switch S101 of Radio Test Set AN/TRM-1 to the TPT position.

e. Adjust RF Coupler-Detector CU-220/TRM-1 so that meter M101 of the radio test set reads at the red line.

f. Increase the output of the audio-oscillator (modulating the 30-mc transmitter) until the amplitude-modulation monitor indicates 50% modulation. Observe the reading of % MODULATION meter M102 of Radio Test Set AN/TRM-1. If this meter does not read 50%, adjust R118 (see figure 4-2) until the meter does read 50%. This procedure calibrates the radio test set % MODULATION meter against Amplitude-Modulation Monitor, General Radio Type No. 1931-A, or equal, which is the standard.

g. Check the over-modulation dial and indicator and if necessary, adjust in accordance with instructions provided in paragraph 6-27, Handbook of Service Instructions AN16-30TRM1-2.

11-23. INTERNAL MODULATION PERFORMANCE TEST.

11-24. Performance of this characteristic is checked by using the same equipment indicated in the typical test set-up illustrated in figure 11-3, with the exception that Radio Test Set AN/TRM-1 under test is used in place of the audio-oscillator to modulate the 30-mc transmitter.

11-25. Connect ICS Cord Assembly CX-3049/TRM-1 to ICS INPUT jack J108 of Test Set Subassembly TS-687/TRM-1. Connect plug PJ-068 terminal of the ICS cord to the microphone jack of the 30-mc transmitter. In this manner the calibrated audio-output circuit of Radio Test Set AN/TRM-1 is connected to modulate the transmitter.

11-26. To continue with the performance test of the internal modulation characteristic, proceed as follows after following steps a through e, paragraph 11-21, of this handbook:

a. Set MASTER CONTROL switch S101 of the radio test set to the TPT position.

b. Place MOD switch S105 to INT position.

c. Advance AUDIO LEVEL TO TRANS-DB control AT101 to a sufficient level to produce 50% modulation, as indicated on the amplitude-modulation monitor. If this reading is obtained, this test has checked the performance of the internal modulation circuits of Radio Test Set AN/TRM-1 and has partially tested the ICS cord assembly. Additional check of the waveform characteristic of the internal-modulation frequency is described in paragraph 11-28 of this handbook.

11-27. PERFORMANCE TEST OF AUDIO LEVEL TO TRANSMITTER FUNCTION.

11-28. Radio Test Set AN/TRM-1 is capable of providing a calibrated test audio signal to the microphone input circuits of radio transmitters and audio intercom systems. This is accomplished as follows:

a. After Radio Test Set AN/TRM-1 has been turned on and permitted to warm-up for 15 minutes, set MASTER CONTROL switch S101 to the TPT position.

b. Position MOD switch S105 to INT position.

c. Set TRANS key S104 to ON position. Radio Test Set AN/TRM-1 can now supply the calibrated test audio signal.

11-29. To check the performance of this calibrated audio signal, proceed as follows:

a. Connect the vertical input of Oscilloscope AN/USM-38, or equal, to pin C of ICS INPUT jack J108, located at the lower right-hand corner of the front panel of Test Set Subassembly TS-687/TRM-1. Set oscilloscope controls for the presentation of a 1,000-cycle vertical input voltage. Refer to the instruction book covering the oscilloscope for full detailed instructions.

b. Adjust OSC FEEDBACK ADJ control R147 for the best sine waveform on the oscilloscope. This control is located at the rear of the chassis of Test Set Subassembly TS-687/TRM-1 (see figure 4-2). This waveform represents the internal modulation frequency of Radio Test Set AN/TRM-1.

c. Rotate the AUDIO LEVEL TO TRANS-DB control fully clockwise. The pointer on the knob should now indicate at "0" on the scale.

d. Using clips, connect an 82-ohm, plus or minus 5%, 1-watt resistor between the ring contacting terminal of the panel jack marked MIC and ground.

e. Connect an ac voltmeter, Ballantine Model 300, or equivalent, across the 82-ohm test resistor.

f. Adjust AUDIO LEVEL CAL control R155 until the ac meter reads 3 volts. Control R155 is located at the rear of the chassis of Test Set Subassembly TS-687/TRM-1 in the lower bank of variable resistors (see figure 4-2).

11-30. CHECKING PERCENTAGE MODULATION OF LMHF AND V/UHF SIGNAL GENERATORS.

11-31. Signal Generators SG-32/TRM-1 and SG-33/TRM-1 are capable of being internally modulated up to 60% at a frequency of 1,000 cps. The percentage modulation of these generators is checked as follows:

a. Turn Radio Test Set AN/TRM-1 on and permit a warm-up of at least 20 minutes before proceeding with the test.

b. Connect the rf output of Signal Generator SG-32/TRM-1 to the vertical input of Oscilloscope AN/USM-38, or equal (see figure 11-4). Set the FREQ dial to read 1 mc and position MICROVOLTS step attenuator AT301 to 100K.

c. Set MOD switch S105 to INT, and MASTER CONTROL switch S101 to LMHF position.

d. Adjust RF LEVEL control R301 until CARRIER

LEVEL meter M101 reads to the red line, SET CARRIER LEVEL. Adjust SIG GEN % MOD control R154 until % MOD meter M102 reads approximately 50%.

11-32. After these settings and adjustments have been made, proceed with the test as follows:

a. Synchronize the modulation envelope observed on the oscilloscope. Adjust the gain of the oscilloscope so that the maximum peaks of the modulation envelope coincide with the maximum markings and the minimum peaks coincide with the minimum markings, as illustrated in figure 11-4. If the peaks do not coincide, readjust SIG GEN % MOD control R154 and the vertical gain of the oscilloscope until both maximum and minimum peaks of the modulation envelope coincide with the maximum and minimum scale markings.

b. The ratio of maximum to minimum scale markings is 3 to 1 and this ratio corresponds to 50% modulation, as adjusted. To determine the exact value of the degree of modulation of any applied modulating voltage, use the following formula:

$$\% \text{ modulation} = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} \times 100$$

From the particular test set-up used and the ratio of maximum to minimum scale markings, it can be seen the $E_{max} = 3$ equal spaces, $E_{min} = 1$ space. Therefore the % modulation = $\frac{3-1}{3+1} \times 100 = \frac{2}{4} \times 100 = 50\%$

c. Note the percentage modulation as read on % MODULATION meter M102. For satisfactory operation, this reading should be between 40 and 60%.

11-33. If % MODULATION meter M102 (upper scale) does not agree with the percentage modulation as indicated on the oscilloscope, follow the procedure given below for recalibration of the % MODULATION meter to within the required tolerance limits:

a. Repeat paragraph 11-30 and paragraph 11-31a above. Make certain that the modulation envelope on the oscilloscope is exactly 50% as determined by the 3 equal spaces marked on the scale covering the face of the oscilloscope.

b. Loosen the shaft locking nut of SIG GEN % MOD CAL. variable resistor R117. This screwdriver control is located at the rear of the chassis of Test Set Subassembly TS-687/TRM-1 in the upper bank of variable resistors. (See figure 4-2.)

c. Turn the slotted shaft of R117 until % MODULATION meter M102 (upper scale) reads 50%. Retighten the shaft locking nut of R117.

d. Recheck the 50% setting of % MODULATION meter M102 against the oscilloscope indication of 50%.

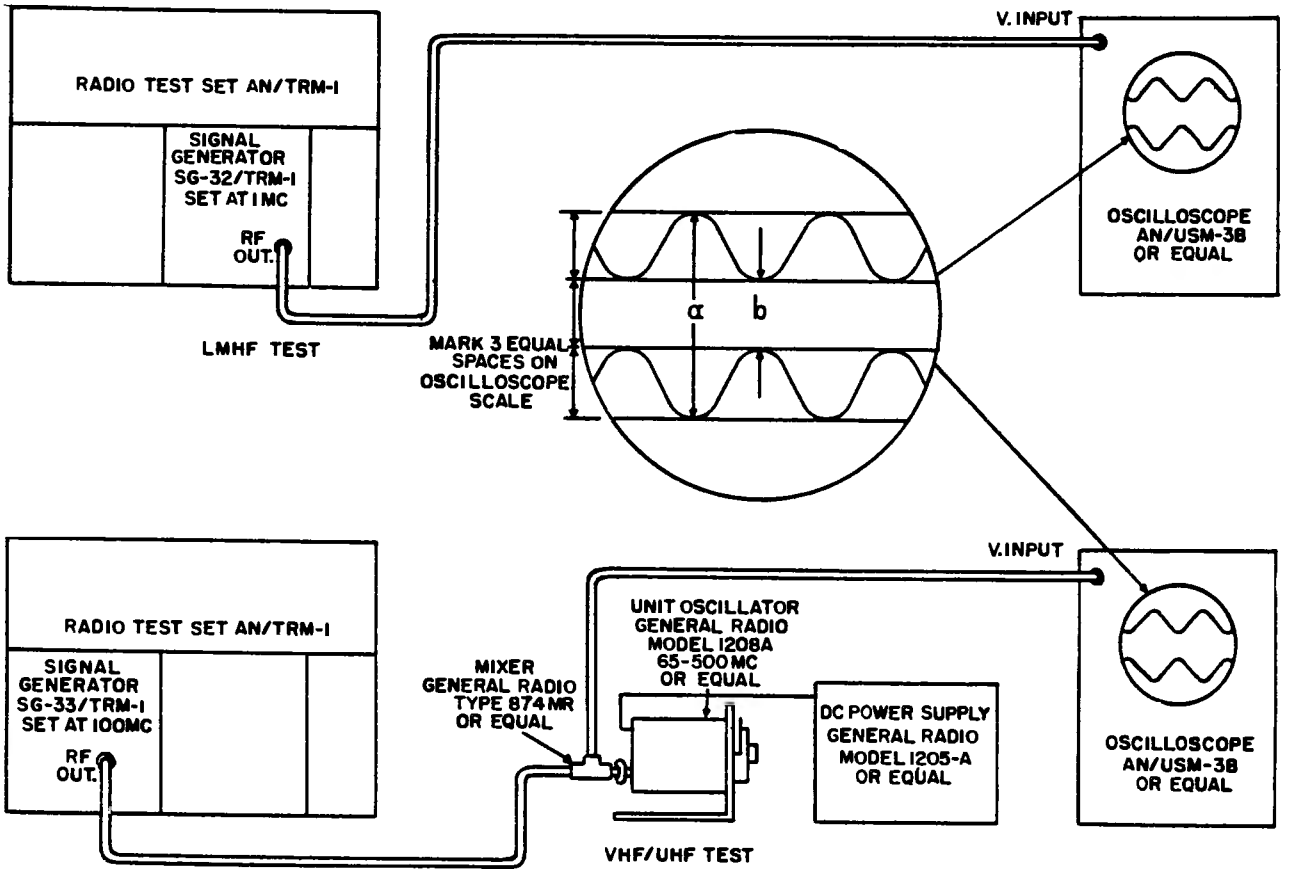

Figure 11-4. Set-up for Checking Percentage Modulation of Signal Generators SG-32/TRM-1 and SG-33/TRM-1

11-34. To check the percentage modulation for Signal Generator SG-33/TRM-1, first make these preliminary adjustments and settings:

a. Switch MASTER CONTROL switch S101 to V/UHF.

b. Place MOD switch S105 to INT.

c. Set the FREQ dial to read 100 mc.

d. Adjust RF LEVEL control R201 until CARRIER LEVEL meter M101 reads to the red line, SET CARRIER LEVEL.

11-35. After these settings and adjustments have been made, proceed as follows:

a. Connect the rf output of Signal Generator SG-33/TRM-1 to a General Radio Mixer, Type 874MR. The mixer is connected to the General Radio Unit Oscillator, Type 1208A, and Oscilloscope AN/USM-38, or equal, as illustrated in figure 11-4.

b. Set the frequency of the General Radio unit oscillator at approximately 99 mc.

c. The General Radio mixer will heterodyne the two signals (one from Signal Generator SG-33/TRM-1 and one from the GR unit oscillator), producing a 1-mc output which will be displayed on the oscilloscope screen.

d. Adjust the coupling between the unit oscillator and the GR mixer to obtain good symmetry in the modulation waveform.

e. Check the percentage modulation in the same manner as described in paragraph 11-31b above.

f. Note the reading of %MODULATION meter M102. For satisfactory operation, this reading should be between 40 and 60%.

11-36. If %MODULATION meter M102 does not agree with the percentage modulation shown on the oscilloscope display, follow the procedure given in paragraph 11-32 above for recalibrating % MODULATION meter M102.

11-37. CHECKING FREQUENCY CALIBRATION OF LMHF AND V/UHF SIGNAL GENERATORS.

11-38. Frequency Meter TS-323/UR and Navy Model LM-13 Frequency Meter are used to check the frequency calibration of Signal Generator SG-33/TRM-1 and SG-32/TRM-1, respectively. Headset HS-30 is used to hear the aural beat note obtained by beating the frequency of the signal generator under test against the frequency of the frequency meter.

11-39. In general, the check of frequency is accomplished as follows:

a. Couple output of the signal generator being checked to its appropriate frequency meter.

b. Select a test frequency point, one for each band.

c. Tune the appropriate frequency meter to the desired frequency.

d. Vary the FREQ dial of the signal generator in the region of the desired frequency, rocking the dial slowly back and forth to find the exact frequency until a sound is heard in Headset HS-30. This sound is the beat note between the frequency meter's output and the signal generator output.

e. The beat note will go down in frequency as the FREQ dial of the signal generator approaches the desired frequency. At the desired frequency there will be zero beat or null.

e. If properly calibrated, the signal generator dial frequency marking should agree with the frequency meter, within permitted tolerance.

g. It must be noted that the audio beat will appear on both sides of the null. It is the null (no signal) point, however, which is the calibration point.

11-40. ADJUSTMENT FOR CALIBRATION OF LMHF AND V/UHF SIGNAL GENERATORS.

11-41. In the event that Signal Generator SG-33/TRM-1 requires adjustment to bring the dial frequency within the required tolerance of ±2%, the following chart may be used for recalibration (use frequency meter TS-323/UR for this calibration):

BAND	SET LOW END OF DIAL	ADJUST COIL	SET HIGH END OF DIAL	ADJUST TRIMMER
A	30 mc	L210	70 mc	C218
B	70 mc	L208	Check at 170 mc	See paragraph 11-42
C	170 mc	L206	Check at 400 mc	See paragraph 11-42

11-42. Coils L208 and L210 are provided with slugs for adjustment. Coil L206 is adjusted by manually squeezing or expanding the coil until the desired calibration is obtained at the low end of BAND C. Adjust Trimmer C218 for the high end of BAND A. Check the high ends of BANDS B and C and, if necessary, make a slight refinement of the C218 adjustment. Recheck the high end of BAND A.

11-43. To check the frequency calibration of Signal Generator SG-32/TRM-1, replace Frequency Meter TS-323/UR with Navy Model LM-13 Frequency Meter. In the event that the signal generator requires adjustment to bring the dial frequency within the required tolerance of ±1%, the following chart may be used for recalibration:

11-44. Coils L301, L302, L303, L304, and L305 are provided with slugs for adjustment of the low ends of their respective bands. Trimmers C301, C302, C303, C304, and C305 are for adjusting the high ends of their respective bands. See figure 5-4A in Handbook of Service Instructions AN16-30TRM1-2 for the location of these coils and trimmers.

BAND	SET LOW END OF DIAL	ADJUST COIL	SET HIGH END OF DIAL	ADJUST TRIMMER
A	0.2 mc	L301	0.50 mc	C301
B	0.60 mc	L302	1.40 mc	C302
C	1.60 mc	L303	3.90 mc	C303
D	4.20 mc	L304	11.00 mc	C304
E	12.00 mc	L305	27.00 mc	C305

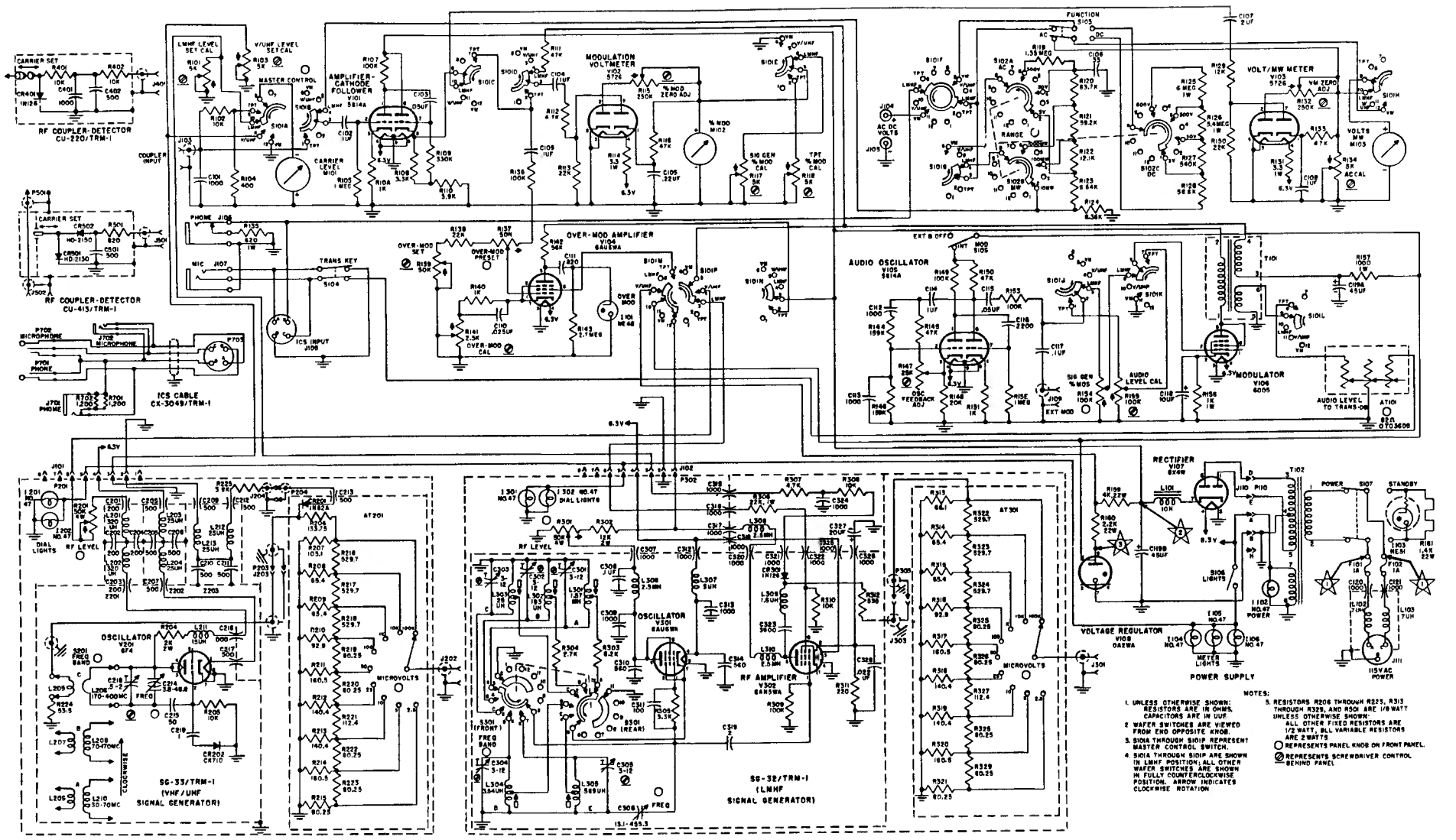

Figure 11-5. Radio Test Set AN/TRM-1, Schematic Diagram

ALPHABETICAL INDEX

ALPHABETICAL INDEX (Cont)