DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

TEST SET TS-140/PCM SIGNAL GENERATOR SG-15/PCM AND SG-15A/PCM AND DECIBEL METER ME-22/PCM AND ME-22A/PCM

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

HEADQUARTERS, DEPARTMENT OF THE ARMY
JULY 1966

WARNING

Be careful when working on the 115- or 230-volt ac line connections and the + 750-, l 450-, 4 370-, + 250-, and -+ 220-volt dc circuits. Serious injury or death may result from contact with these terminals.

DON'T TAKE CHANCES!

EXTREMELY DANGEROUS VOLTAGES EXIST IN THE FOLLOWING UNITS OF TEST SET TS-140/PCM:
SIGNAL GENERATOR SG-15(*)/PCM 370 volts
DECIBEL METER ME-22(*')/PCM 750 volts

TM 11-6625-251-15
C1

CHANGE No. 1

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *16 May 1974*

Organizational, Direct Support, General Support,
and Depot Maintenance Manual
Test Set TS-140/PCM,
SIGNAL GENERATOR SG-15/PCM AND SG-15A/PCM AND
DECIBEL METER ME-22/PCM AND ME-22A/PCM

TM 11-6625-251-15, 13 July 1966, is changed as follows:

1. A vertical bar appears opposite changed material.
2. Remove and insert pages as indicated in the page list below:

Remove	*Insert*
i	i
1-1 and 1-2	1-1 and 1-2
1-5 and 1-6	1-5 through 1-6.1
2-3	2-3
AII-1 through AII-6	AII-1 and AII-2

3. File this change sheet in the front of the manual for reference purposes.

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

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The Adjutant General

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NG: Sate AG (2)
USAR: None
For explanation f abbreviations used, see AR 310-50.

TECHNICAL MANUAL
No. 11-6625-251-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *13 July, 1966*

Organizational, DS, GS, and Depot Maintenance Manual

TEST SET TS-140/PCM, SIGNAL GENERATOR SG-15/PCM, AND SG-15A/PCM AND DECIBEL METER ME-22/PCM AND ME-22A/PCM

*This manual supersede TM 11-2096, 7 December 1953 Including C 1, 7 April 1955; C 2, 29 May 1958; C 4, 15 May 1962; C 7, 23 September 1963; and C 8, 20 November 1963.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual contains a description of Test Set TS-140/PCM (fig. 1-1), and includes operating instructions, organizational maintenance information, the theory of operation, repair of the equipment, instructions for removing the equipment from service and repacking for shipment or limited storage, and instructions for demolishing the equipment to prevent enemy use.

b. Appendix I contains a list of references including supply manuals, technical manuals on associated equipment, and other available publications applicable to the equipment. Appendix II contains maintenance allocation charts for Test Set TS-140/PCM, Signal Generators SG-15/PCM, SG-15A/PCM, and Decibel Meters ME-22/PCM, ME-22A/PCM. Appendix III contains the basic issue items list for Test Set TS-140/PCM, Signal Generator SG-15/PCM, SG-15A/PCM and Decibel Meters ME-22/PCM, ME-22A/PCM.

c. Official nomenclature followed by (*) is used to indicate all models of equipment covered in this manual. Thus, Signal Generator SG-15(*)PCM represents Signal Generator SG-15/PCM and Signal Generator SG-15A/PCM. Decibel Meter ME-22(*)/PCM represents Decibel Meter ME-22/PCM and Decibel Meter ME-22A/PCM.

1-2. Indexes of Publications

a. DA Pam $10-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58/NAVSUP PUB 378/AFR 71-4/MCO P403029, and DSAR 41458.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP)(SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33/AFM 75-18/MCO P4610.19A, and DSAR 4500.15.

1-3.1. Reporting of Errors

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-C, Fort Monmouth, NJ 07703.

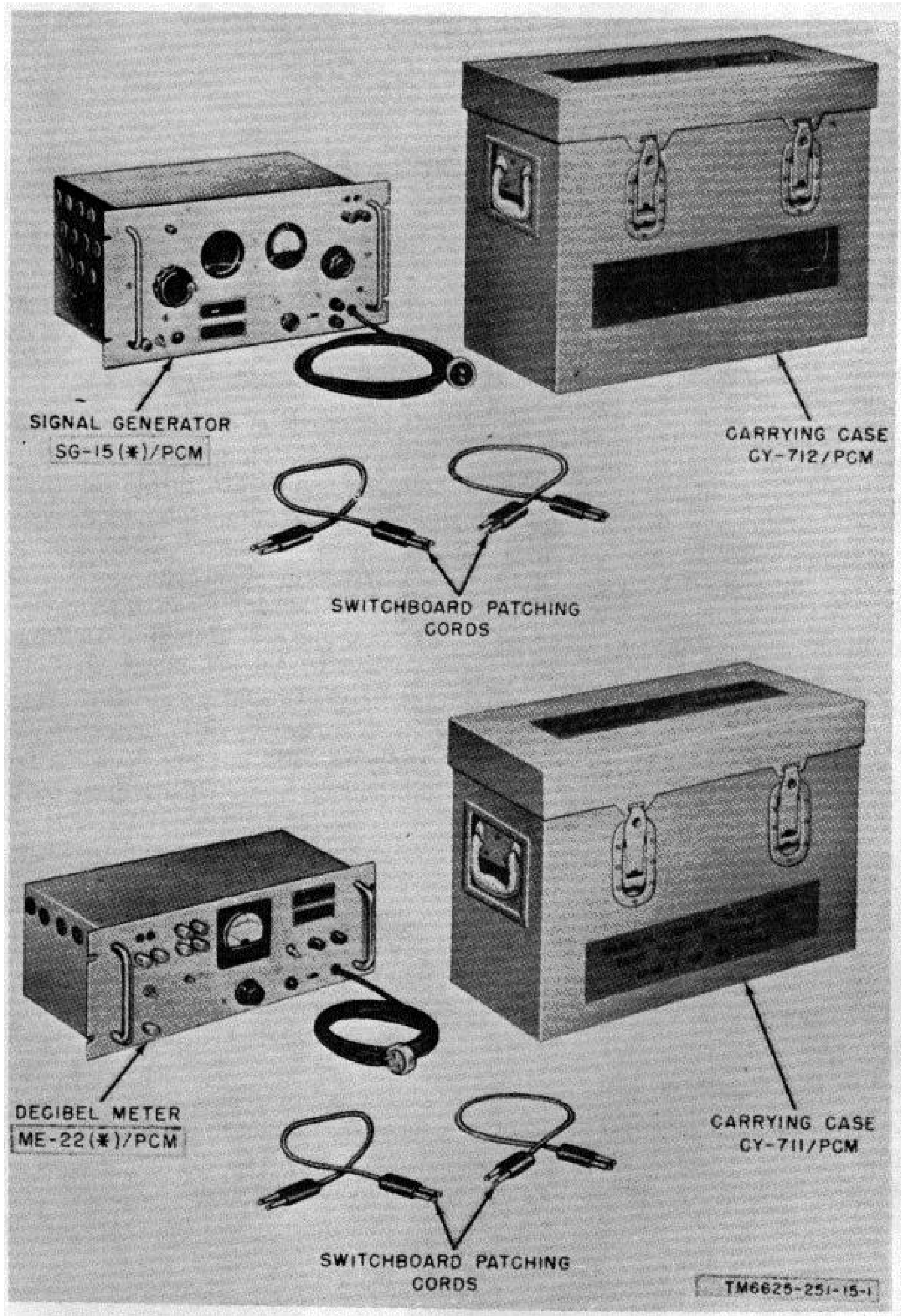


Figure 1-1. Test Set TS-140/PCM less running spares and technical manuals.

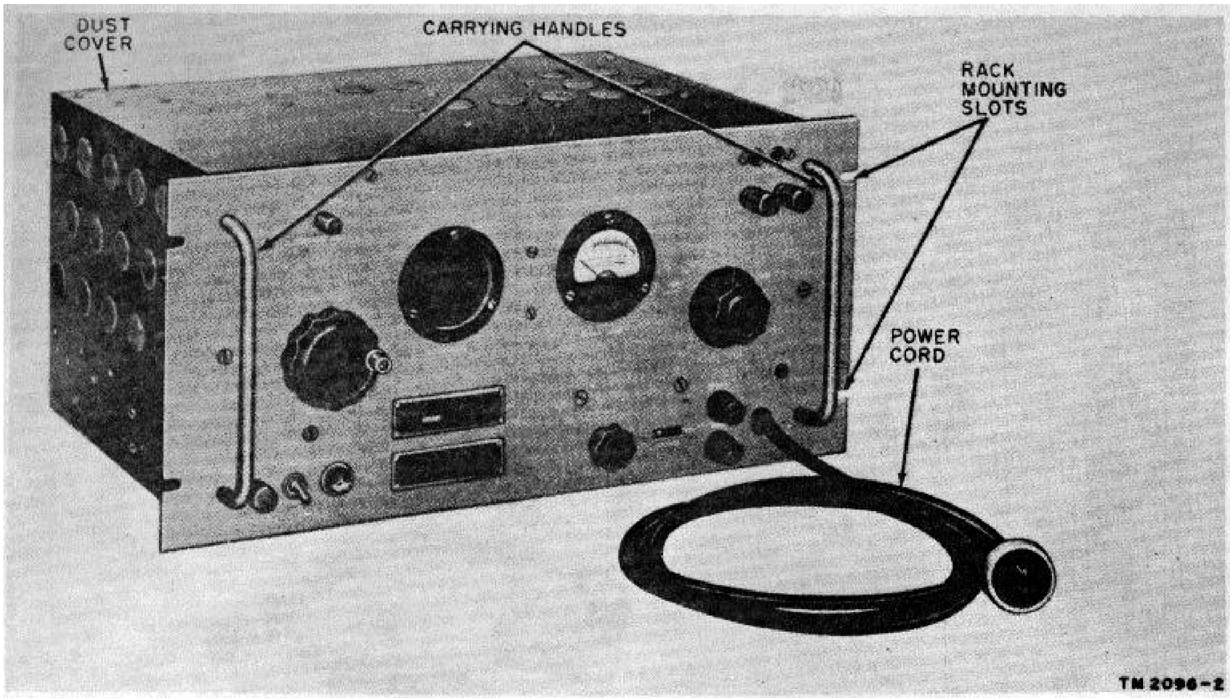


Figure 1-2. Signal Generator SG-15(*)/PCM.

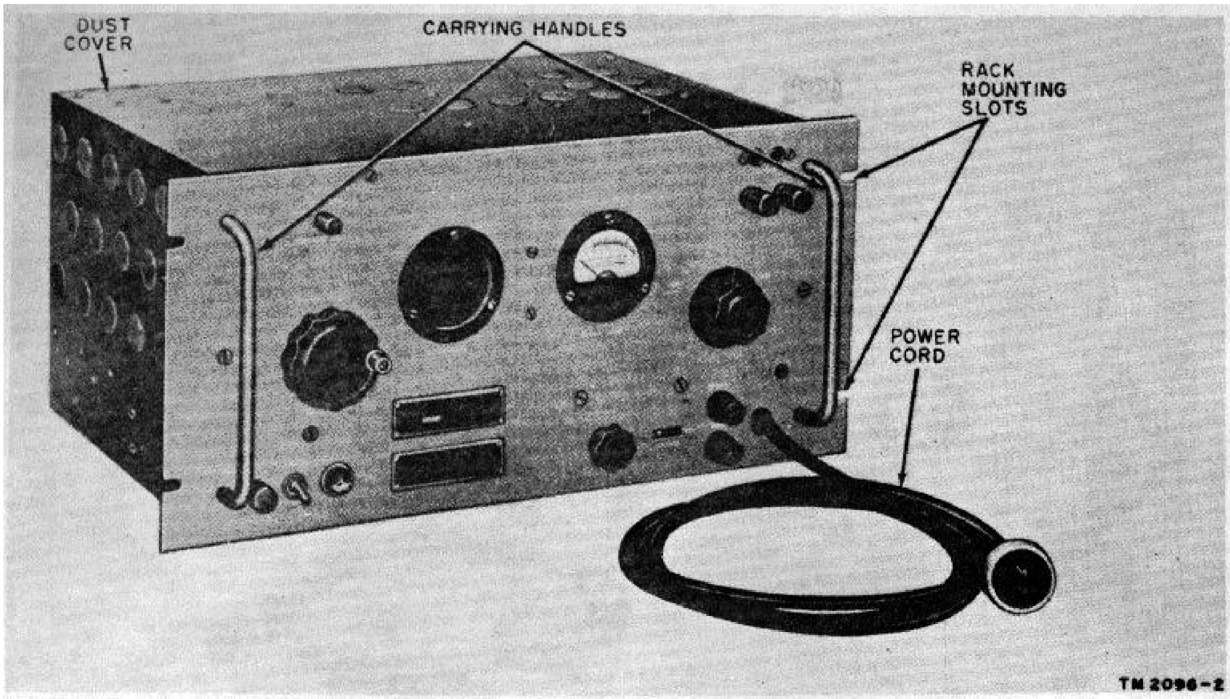


Figure 1-3. Decibel Meter ME-22(*)/PCM.

Section II. DESCRIPTION AND DATA

1-4. Purpose and Use

Test Set TS-140/PCM (fig. 1-1) which consists of Signal Generator SG-15(*)/PCM (*a* below) and Decibel Meter ME-22(*)/ PCM (*b* below), is a portable test set designed for making transmission measurements of v-f (voice-frequency) and carrier equipment in the frequency range of 200 cycles through 35 kilocycles. It also is used for testing wire and cable lines to determine their suitability for use with such equipment in communication systems. Gain and loss may be measured directly by Test Set TS-140/PCM since the front panel controls and meters of both the signal generator and the decibel meter indicate power levels in dbm (decibels referred to 1 milliwatt in 600 ohms). Cross talk also may be measured by using the gain and loss measurement technique and making measurements through the entire frequency range of the equipment or wire line under test.

a. Signal Generator SG-15(*)/PCM. Signal Generator SG-15(*)/PCM (fig. 1-2) is a portable, heterodyne-type, vacuum-tube oscillator which provides a source of testing power for transmission measurements of carrier equipment and wire and cable lines. The signal generator is capable of supplying an output of -54 through +26 dbm to a 600-ohm load over a frequency range of 200 cycles through 35 kilocycles. It operates from a power source of 115- or 230-volt, 50- to 60-cycle a-c (alternating current) and has an output impedance of 600 ohms balanced. Signal Generator SG-15(*)/PCM also may be used as a source of testing power whenever there is a requirement for an audio oscillator or a signal generator in the same frequency range.

b. Decibel Meter ME-22(*)/PCM. Decibel Meter ME-22(*)/PCM (fig. 1-3) is designed to measure received testing power. The unit is arranged for an input impedance of 600 or 8,000 ohms to permit direct or bridged connection to the circuit under test. The decibel meter is capable of measuring received power from -45 through + 25 dbm in six steps over a frequency range of 200 through 35,000 cps (cycles per second). It operates from a power source of 115- or 230-volt, 50- to 60-cycle a-c. An external source of testing power, such as Signal Generator SG-15(*)/PCM, is required for making gain, loss, or cross talk measurements.

1-5. Technical Characteristics

a. Signal Generator SG-15(*)/PCM.

(1) *General*.

Frequency range .... -200 through 35,000 cps.
Frequency accuracy .... ±10 cps (for the SG-15, ± 20 cps for the SG-15A) in range from 200 through 1,000 cps.
±20 cps (for the SG-15, ± 35 cps for the SG-15A) in range from 1,000 through 2,000 cps.
± 50 cps (for both the SG-15, and the SG-15A) in range from 2,000 through 35,000 cps.
Power output .... -54 dbm through +26 dbm ±.5 db (decibel).
Output impedance .... -600 ohms ± 5 percent at 1,000 cps and 600 ohms ±10 percent at all other frequencies

(2) *Power requirements*.

Voltage .... 115- or 230-volt a-c ± 10 percent.
Frequency .... 50 to 70 cps, single phase.
Power.............................. 96 watts.

(3) *Tube complement*.

Quantity				
SG-15/PCM	SG-15A/PCM	TYPE	FUNCTION	REFERENCE DESIGNATION
3	....	6J5 or 6J5WGT	Fixed-frequency oscillator, variable-frequency oscillator, and third amplifier.	V1, V2, V3
	2	6J65 or 6J5WGT	Variable oscillator and first audiofrequency amplifier.	V2, V3
1	....	6SL7GT or 6SL7WGT	Fourth amplifier and phase inverter	V4
	1	6SL7GT or 6SL7WGT	Second audiofrequency amplifier and phase inverter.	V4
2	....	6SJ7 or 6SJ7WGT	First and second amplifiers.	V7, V8
	2	6SJ7 or 6SJ7WGT	Fixed-frequency amplifier and variable-frequency amplifier.	V7, V8
	1	6SN7 or 6SN7WGTA	Fixed oscillator	V1
1	1	6L6GAY or 6L6WGB	Voltage control	V12
1	1	6SA7Y	Mixer	V9
1	1	6SQ7	Voltage control amplifier	V10
2	2	6V6GTY or 6V6Y	Power amplifier	V5, V6
1	1	5Y3GT or 5Y3WGTA	Rectifier	V13
1	1	OC3/VR105 or OC3W	Voltage regulator	V11

b. Decibel Meter ME-22(*)/PCM.

(1) *General*.

Range..............-45 to +25 dbm.
Accuracy...........± .5 db in frequency range from 200 to 35,000 cps. when calibrated at 1,000 cps.
Meter scales....SCALE A: o to + 156 db.
SCALE B: -15 to 0 db.
Input impedance ....600 or 8,000 ohms.

(2) *Power requirements*.

Voltage ....115- or 230-volt a-c ± 10 percent.
Frequency ....50 to 70 cps, single phase.
Power50 watts.

(3) *Tube complement*.

Quantity	*Type*	*Function*	*Designation reference*
3	6SJ7 or 6SJ7WGT	First, second, and third amplifiers	V1, V2, V3
1	6H6	Meter rectifier	V4
1	6L6GAY or 6L6WGB	Voltage Control	V5
1	OC3/VR105 or OC3W	Voltage control regulator	V6
1	6SQ7	Voltage control amplifier	V7
1	5Y3GT or 5Y3WGTA	Rectifier	V8

1-6. Items Comprising an Operable Equipment and Running Spares

a. Items Comprising an Operable Equipment

FSN	QTY	Nomenclature part No. and mfr code	Fig. No.	Dimensions Height	Depth	Width	Weight (lb)
6625-243-4888		Test Set TS-140/PCM consisting of:	1-1				
6625-498-3469	1	Decibel Meter ME-22/PCM; ME-22A/PCM	1-1	7	10-5/8	19	25
6625-229-1087	1	Signal Generator SG-15/CM; SG-15A/PCM	1-1	8-3/4	13	19	52
		Decibel Meter ME-22/PCM; ME-22A/PCM which includes:					
6625-498-2910	2	Cord Assembly, Electrical: ECOM dwg SM-169374	1-1				
		Signal Generator SG-15/PCM; SG-15A/PCM which includes:					
6625-498-2910	2	Cord Assembly, Electrical: ECOM dwg SM-C-169374	1-1				

b. Running spares for SG-15(*)/PCM.

Quantity	*Item*	*Figure No.*
1	Fuse, cartridge: Littlefuse Ser. No. 117002 (SG-15/PCM only)	3-1
1	Fuse, cartridge: MIL type F02G2R00A (SG-15A/PCM only)	3-1
1	Electron tube, OC3W, or OC3/VR105	1-4, 1-5
1	Electron tube, 5Y3GT or 5Y3WGTA	1-4, 1-5
1	Electron tube, 6J5 or 6J5WGT	1-4, 1-5
1	Electron tube, 6L6GAY or 6L6WGB	1-4, 1-5
1	Electron tube, 6SA7Y	1-4, 1-5
1	Electron tube, 6SJ7WGT	1-4, 1-5
1	Electron tube, 6SL7GT or 6SL7WGT	1-4, 1-5
1	Electron tube, 6SN7WGT or 6SN7WGTA	1-5
1	Electron tube, 6SQ7	1-4, 1-5
1	Electron tube, 6V6Y or 6V6GTY	1-4, 1-5

c. Running Spares for ME-22(*)/PCM.

Quantity	*Item*	*Figure No.*
1	Fuse, cartridge: 1 amp; 250 V; Bussman No. AGS-1	3-2
1	Fuse, Cartridge: MIL type FO2A25OVL1A	3-2
1	Electron tube OC3W	1-6
1	Electron tube 5Y3WGTA	1-6
1	Electron tube, 6H6	1-6
	Electron tube, 6L6WGB	1-6
1	Electron tube, 6SJ7WGT	1-6
1	Electron tube 6SQ7	1-6

1-7. Description of Signal Generator SG-15(*)PCM and Components

a. Signal Generator SG-15(*)/PCM.

(1) Signal Generator SG-15(*)/PCM (fig. 1-1) is a self-contained unit mounted in a metal case provided with a dust cover. The front panel is slotted at both ends to permit rack mounting on a standard 19-inch rack, and metal handles are provided at either end of the front panel for convenience in carrying the equipment. The unit has a gray enamel finish.

(2) All operating controls and the jack and terminals for external connections are located on the front panel of the signal generator. A meter which indicates the output power of the unit and a circuit protecting 2-ampere fuse mounted in an extractor post holder also are located on the front panel. The cover over the top and rear of the equipment ease and the bottom plate are removable. All parts and assemblies mounted on the chassis and on the back of the front panel can be reached for maintenance purposes when the cover over the top and rear of the equipment and the bottom plate are removed.

b. Carrying Case CY-712/PCM. Carrying Case CY-712/PCM (fig. 1-1) is an aluminum case with a smooth, gray enamel finish. The case is used for storing the equipment and for transportation. It is provided with a shockmounted rack for semipermanent installation of the signal generator and a compartment for holding the technical manual. The detachable cover contains clips for storing two switchboard patching cords. Two flush-type handles are provided, one on each end of the case. The cover is fastened by four flush-type spring fasteners.

c. Switchboard Patching Cords. Two switchboard patching cords (fig. 1-1) are provided with each signal generator. The cords are 24 inches long, excluding terminations. and are equipped with twin plugs at each end. The cords are stored in the cover of the carrying case.

d. Operating Spares. A spare fuse (fig. 3-1) in an extractor post holder is mounted below the circuit fuse on the front panel of the signal generator. A complete set of spare tubes (fig. 1-4 or 1-5) is mounted on a panel inside the top of the cover.

1-8. Description of Decibel Meter ME-22 (*)/PCM and Components

a. Decibel Meter ME-22(*)/PCM.

(1) Decibel Meter ME-22(*)/PCM (figs. 1-1 and 1-3) is a self-contained unit mounted in a metal case provided with a dust cover. The front panel is slotted to permit mounting on a standard 19-inch rack, and metal handles-one at each end of the front panel-are used for carrying the decibel meter or lifting the instrument from the carrying case. The unit has a gray enamel finish.

(2) All operating controls and the jack and terminals for external connections are located on the front panel of the decibel meter. A meter, calibrated in two scales, also is mounted on the front panel. In addition to operating parts, a circuit-protecting 1-ampere fuse in an extractor post holder is located on the front of the unit. All parts mounted on the chassis or on the front panel can be reached for maintenance purposes by removing the cover over the top and rear of the equipment and the bottom plate.

b. Carrying Case CY-711/PCM: Carrying Case CY-711/PCM (fig. 1-1) is an aluminum carrying case finished in gray enamel. The case is used for transporting the decibel meter and for storing the equipment. It is provided with a shockmounted rack for semipermanent installation of the decibel meter. A compartment in the carrying case holds the technical manuals, and the detachable cover contains clips for storing two switchboard patching cords. There are two flush-type carrying handles, one on each end of the case, and the cover is fastened by four spring fasteners.

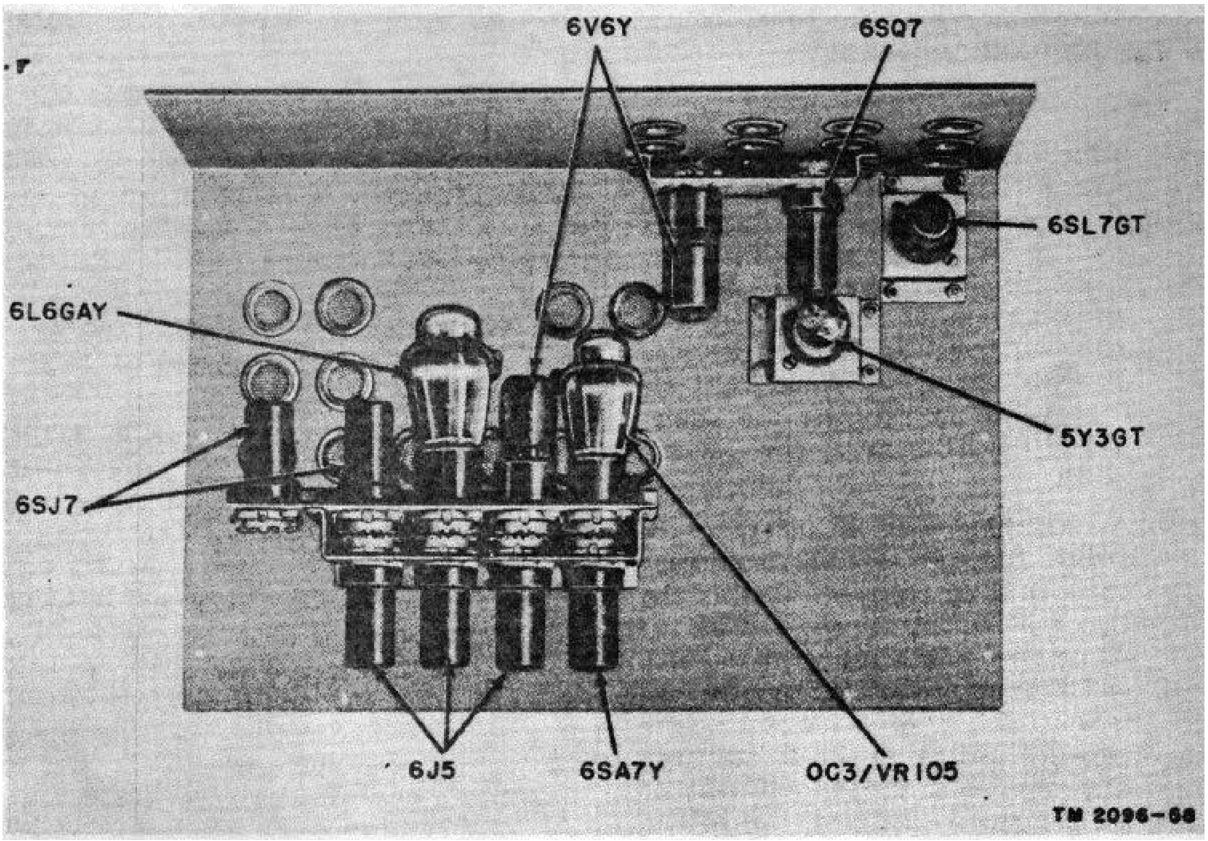


Figure 1-4. Signal Generator SG-15/PCM, spare tubes mounted in top of cover.

c. Switchboard Patching Cords. The decibel meter is provided with two switchboard patching cords (fig. 1-1). Each cord is 24 inches long and is equipped with a twin plug at each end.

d. Operating Spares. A spare fuse (fig. 3-2) is mounted next to the circuit fuse on the front panel of the decibel meter. A complete set of spare tubes (fig. 1-6) mounted on a panel inside the top of the cover also is provided with the equipment.

1-9. Differences in Equipment

a. SG-15/PCM and SG-15A/PCM.

Item No.	Differences	SG-15/PCM	SG-15A/PCM (Order No. 37681-Phila-53)	SG-15A/PCM Order No. 56057-Phila-57, 39193-PP-58, 3437-PP-59, 4837-PP-60 and 52752-PP-61)
		Terminals *Function*	*Terminals* *Function*	*Terminals* *Function*
1	Terminals on oscillator assembly used for fixed frequency oscillator (V1).	1 Output 2 B+ 3 Filament 4 Filament	5 Output 6 B+ 7 Filament 8 Filament	5 Output 6 B+ 7 Filament 8 Filament
2	Binding posts on oscillator assembly used for variable frequency oscillator (V2).	5 Output 6 B+ 7 Filament 8 Filament	1 Output 2 B+ 3 Filament 4 Filament	1 Output 3 B+ 3 Filament 4 Filament
3	ZERO BEAT ADJ control	C1 of fixed frequency oscillator.	C11 of variable frequency oscillator.	C11 of variable frequency oscillator.
4	COARSE DBM control	Variable attenuator E4.	Variable attenuator E4.	Variable attenuator AT1.
5	Placement of spare tubes	As shown in figure 1-4.	As shown in figure 1-5	As shown in figure 1-4.

b. ME-22/PCM and ME-22A/PCM

Item No.	Item	ME-22/PCM	ME-22A/PCM (bearing Order No. 52752-PP-61, and 15880-PP-62)	ME-22A/PCM (bearing other order numbers)
1	Chassis wiring colors.	As shown in figure 10-7	As shown in figure 10-8.....	As shown in figure 10-8.
2	Resistor R9..................	100 ohms on equipment bearing.......... order No. 21672-P-50 (serial numbers 51 through 85); and 150 ohms on equipment bearing order No. 21672-P-50 (serial numbers 86 through 687).	150 ohms	150 ohms.
3	Resistor R10.................	150 ohms..	100 ohms	100 ohms.
4	Resistor R11.................	150 ohms on equipment bearing.......... order No. 21672-P-50 (serial numbers 51 through 85); and 100 ohms on equipment bearing order No. 21672-P-50 (serial numbers 86 through 687).	100 ohms	100 ohms.
5	Resistor R21.................	6.8 ohms..	3.9 ohms	3.9 ohms.
6	Resistor R29.................	Not provided..................................	4.7K[a]	Not provided.
7	Resistor R2...................	47K to 100K (selected in..................... manufacture).	47K.................................	Not provided.
8	Capacitor C3.................	22 to 100 μμf (selected in .... manufacture).	560 μμf[a]	Not provided.

[a] On equipments provided with components of these values, resistor R29 is connected between capacitor C3 and the junction of resistor R2 and chassis ground (fig. 7-8).

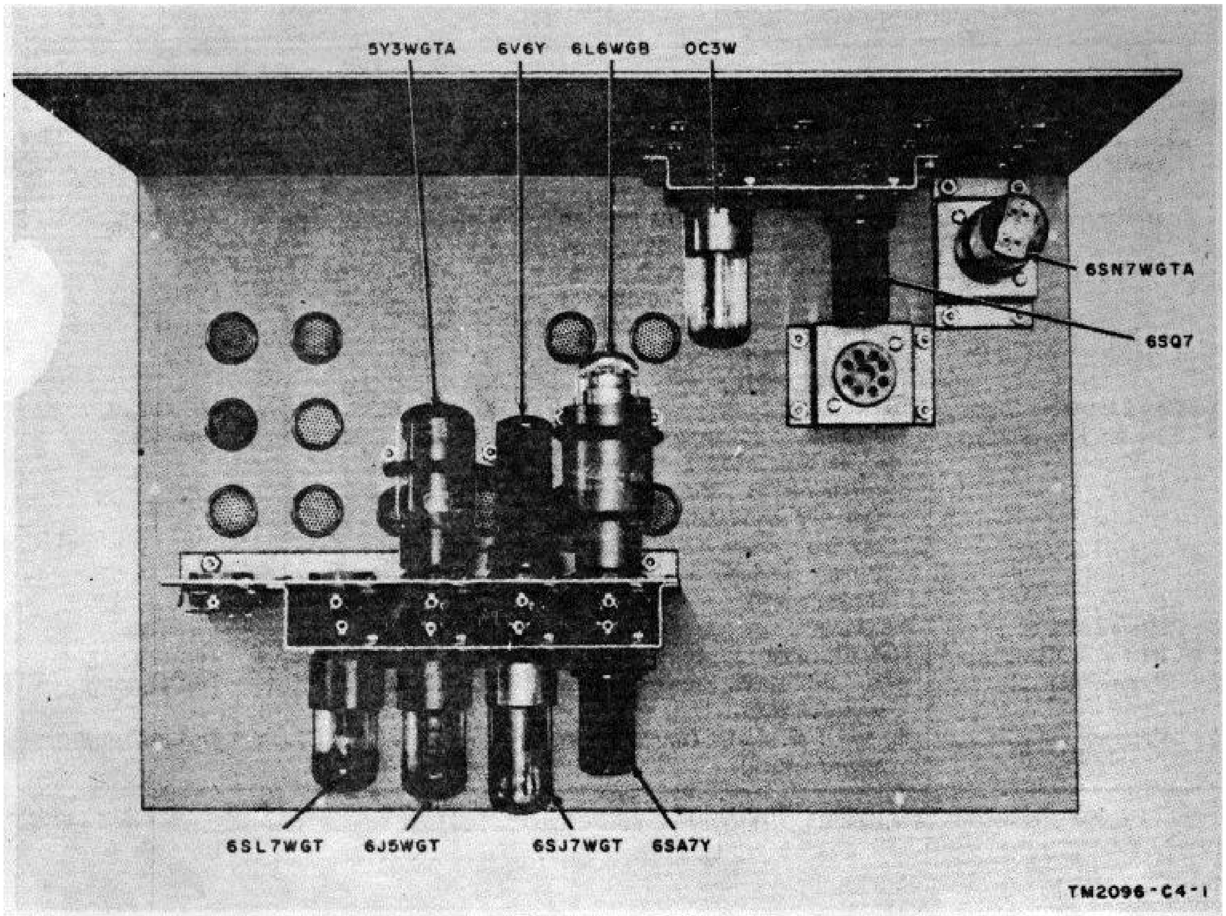


Figure 1-5. Signal Generator SG-15A/PCM (Order No. 52752-PP-61), location of spare tubes mounted in top of cover.

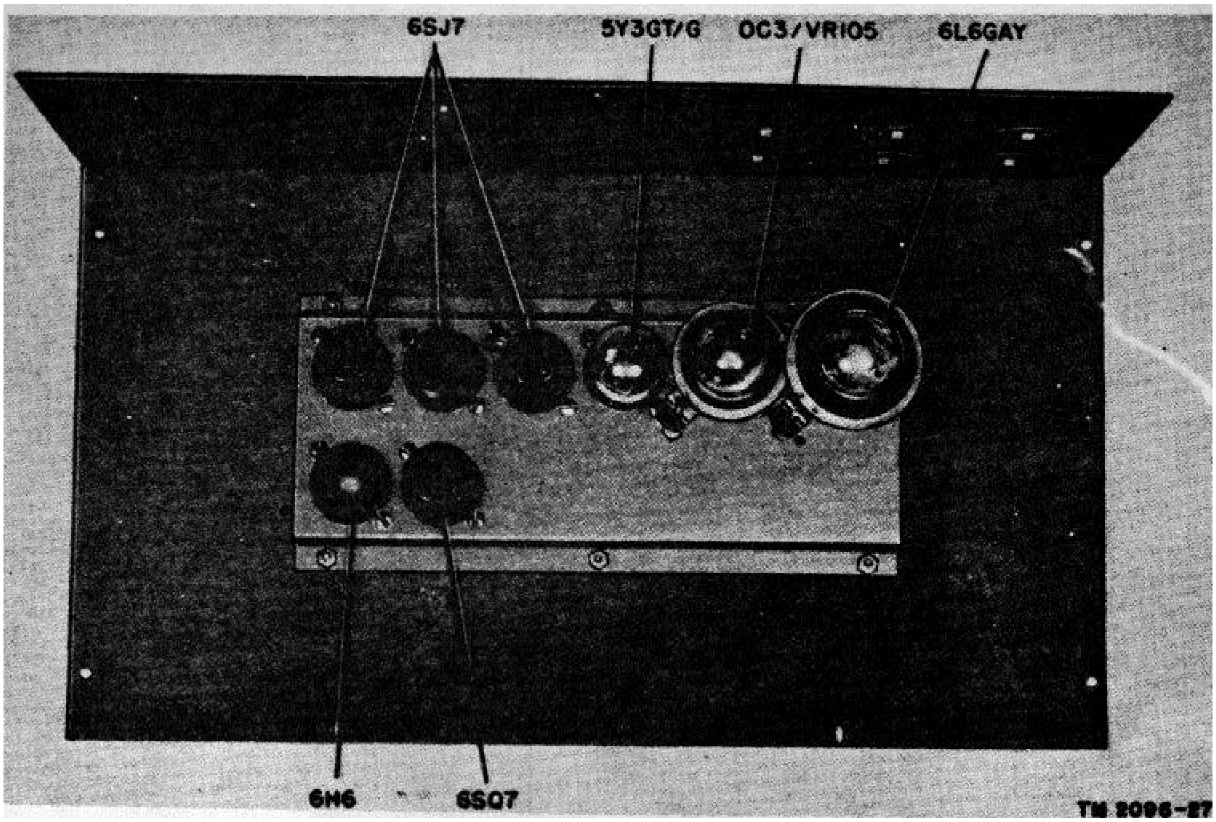


Figure 1-6. Decibel Meter ME-22(*)/PCM, spare tubes mounted in top cover.

CHAPTER 2

INSTALLATION

2-1. Unpacking

a. General. Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM may be packaged for oversea or domestic shipment. When new equipment is received, select a location where it may be unpacked without exposure to dust, dirt, or excessive moisture. Be careful when uncrating and unpacking the equipment. Avoid thrusting tools into the interior of the wooden box. When unpacking, do not damage the packaging materials any more than is necessary. These materials may be used when repacking the equipment for storage or for shipment to base maintenance repair shops. Store the interior packaging materials carefully in the wooden shipping container. Be careful when handling the equipment-it may be damaged easily when it is not protected by the shipping container.

b. Packaging Data. Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM may be shipped as single items or as Test Set TS-140/PCM. In addition, the equipment may be packaged for either domestic or oversea shipment. The package containing the decibel meter is designated CASE 1 OF 2 CASES and the package containing the signal generator is designated CASE 2 OF 2 CASES (fig. 2-1).

Packaging Data (Domestic Shipment)

Box No.	Contents	Dimensions (in.)	Volume (cu. ft.)	Weight (lb.)
1 of 2	Decibel Meter ME-22(*)/PCM	21-3/8 x 15-1/16 x 11	2.0	56
2 of 2	Signal Generator SG-15(*)/PCM...........................	21-3/8 x 16-15/16 x 127/8	2.69	90

Packaging Data (Overseas Shipment)

Box No.	Contents	Dimensions (in.)	Volume (cu. ft.)	Weight (lb.)
1 of 2	Decibel Meter ME-22(*)/PCM	43 x 22-1/4 x 20-3/4	6.3	122
2 of 2	Signal Generator SG-15(*)/PCM...........................	43 x 24-1/4 x 22-3/4	13.72	160

c. Step-By-Step Instructions for Unpacking Equipment Packed for Domestic Shipment.

(1) Cut the seals of the corrugated fiberboard box.

(2) Remove the equipment from the box.

(3) Save the corrugated box for use in repacking the equipment.

d. Step-By-Step Instructions for Uncrating and Unpacking Equipment Packed for Oversea Shipment.

(1) Cut the metal straps with a suitable cutting tool or twist them with pliers until the straps break.

(2) Remove the nails from the top of the wooden box with a nail puller. Remove the technical manuals.

(3) Remove the excelsior which covers the packaged equipment. The spare tubes are packed in a second fiberboard box. Remove the excelsior covering this box.

Note

Unpacking instructions in (4) through (6) below apply to the package containing the spare tubes as well as to the package containing the equipment.

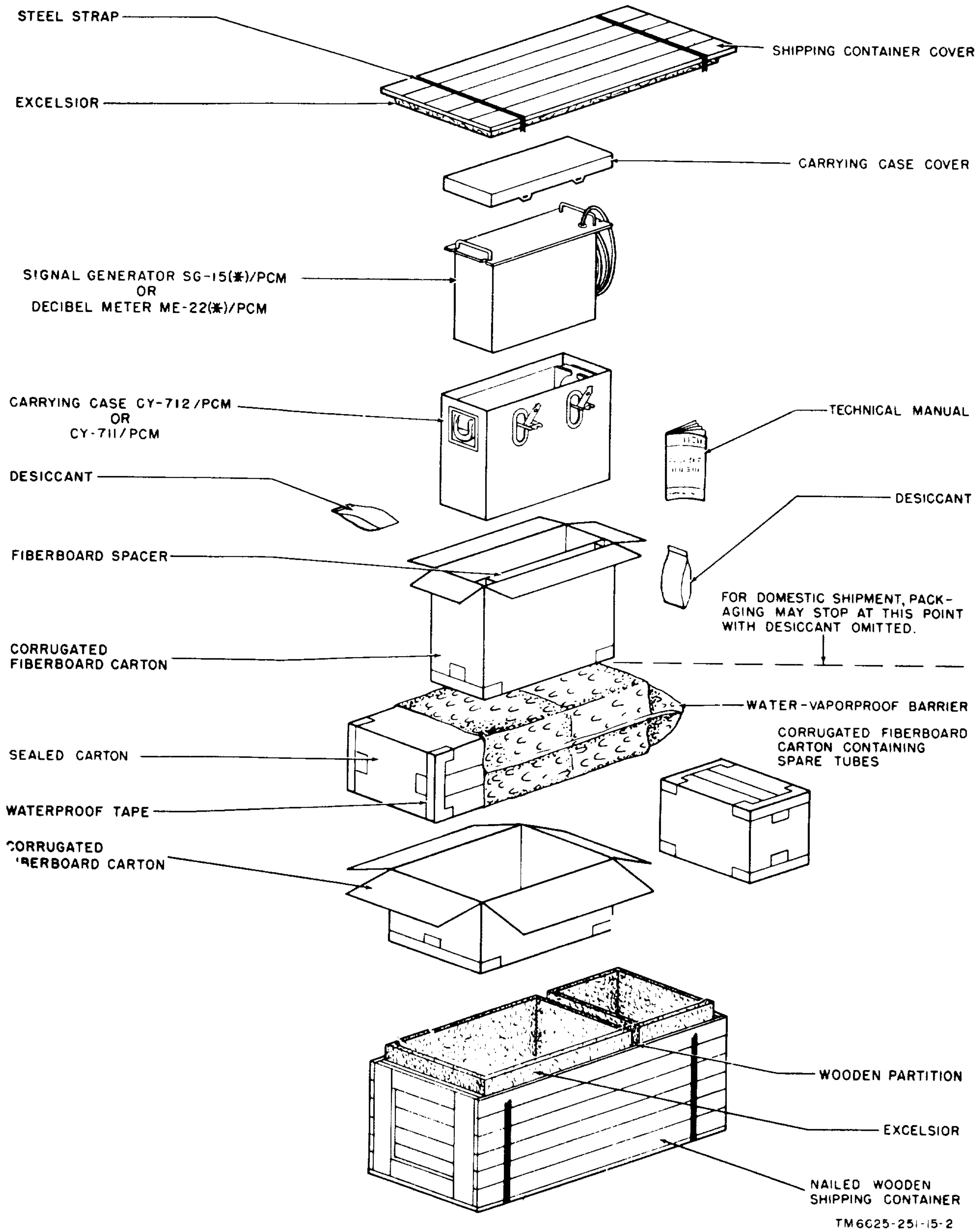


Figure 2-1. Signal generator SG-15(*)/PCM or decibel meter ME-22(*)PCM, packaging details for domestic and overseas shipment.

(4) Cut the seals of the corrugated fiberboard box and remove the boxed equipment.

(5) Cut the adhesive tape that seals the water-vaporproof barrier and remove the inner corrugated fiberboard box. Be careful not to damage the barrier material.

(6) Cut the seals of the inner corrugated fiberboard box and remove the equipment.

(7) Loosen the fastenings of the carrying case cover. Open the cover and remove the corrugated paper masking on the front panel of the equipment.

(8) Loosen the fastenings which secure the equipment to the shock-mounted rack and remove the unit front the carrying case.

(9) Unpack the spate tubes and place them in the normal positions on the inside of the top of the dust cover.

(10) Place the cushioning material and the inner cartons in the outer shipping container for use in repacking the equipment.

2-2. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the (damage on DD Form 6 (para 1-3).

b. See that the equipment is complete as listed on the packing slip. Report discrepancies in accordance with TM 38-750. Shortage of a minor assembly or part that does not affect proper functioning of the equipment should not prevent use of the equipment.

c. If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If the equipment has been modified, the MWO number will appeal on the front panel near the nomenclature plate. If modified, see that any operational instruction changes resulting from the modification have been entered in the equipment manual.

Note

Current MWO's applicable to the equipment are listed in DA Pam 310-4.

2-3. Placement of Equipment

No special instructions are necessary for siting Signal Generator SG-15(*)/PCM or Decibel Meter ME-22(*)/PCM. A suitable source of 115- or 230-volt, 50- to 70-cycle a-c must be available. A water-pipe ground or a comparable ground connection near the operating location of each unit also will be required.

2-4. Installation of Equipment

a. Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM are portable, and each unit may be set up in its carrying case near the equipment to be tested. The units also may be mounted on a standard 19-inch rack by placing mounting screws in the slots provided at both ends of the front panels (fig. 1-2 and 1-3).

CAUTION

Never connect the ground wire to a pipe that is used as an electric power protection panel ground or to a conduit which protects electric wiring.

b. Connect an external ground to the GND terminal on the front panel of both the signal generator (fig. 3-1) and the decibel meter (fig. 3-2). These terminals are thumbscrew-type binding posts, each with a wire slot in the neck for convenience in making a ground connection. If available, a cold water pipe can be used for the ground connection. Connect a ground wire to the pipe with a suitable pipe clamp equipped with a soldering lug. Before connecting the clamp, thoroughly clean the pipe where the connection is to be made with emery cloth.

CAUTION

Do not use fuses in either unit rated above the value specified for that unit.

c. Before operating the equipment, check to be sure that the operating and spare fuses in each unit are of the correct value. The fuseholders in the signal generator (fig. 3-1) should be equipped with 2-ampere fuses and the fuseholders in the decibel meter (fig. 3-2) should be equipped with 1-ampere fuses.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. OPERATOR'S CONTROLS, INDICATORS, TERMINALS, AND JACKS

Note: This section describes, locates, illustrates, and furnishes the operator sufficient information pertaining to the various controls provided for the proper operation of the equipment.

3-1. Signal Generator SG-15(*)/PCM

a. Controls. The table below lists the controls of Signal Generator SG-15(*)/PCM and gives the function of each. The location of these controls is shown in figure 3-1.

Control or indicator	Function
Power ON-OFF switch	In ON position, connects primary of power transformer T3 to a-c source.
PRIMARY VOLTAGE switch.	In 115V position, connects primary windings of power transformer T3 in parallel for operation with 115-volt a-c power source. In 230V position, connects these windings in series for operation with 230-volt a-c power source.
Indicator light	Lights when power is applied to signal generator.
FREQUENCY control	Used to set signal generator to desired frequency by tuning variable frequency oscillator.
ZERO BEAT ADJ control.	Used to adjust the frequency oscillator to obtain zero beat between this oscillator and the variable frequency oscillator.
KILOCYCLES dial	Mechanically coupled to the FREQUENCY control, this dial indicates the output frequency of the signal generator. The dial is calibrated in equal gradations of 10 cps in the frequency range of 200 through 1,000 cps 20 cps in the frequency range of 1,000 through 2,000 cps, and 50 cps in the frequency range of 2,000 through 35,000 cps.
FINE DBM potentiometer.	Variable attenuator which permits adjustment of the output of -4 db through +6 db above or below the setting of the COARSE DBM control.
COARSE DBM attenuator.	A stepped attenuator which provides selection of output ranges in eight steps: -50 dbm, 40 dbm, -30 dbm, -20 dbm, -10 dbm, 0 dbm, + 10 dbm, and +20 dbm. A ninth step, ZERO OUTPUT, short-circuits the output terminals of the attenuator. The output power of the signal generator is the sum of the setting of this attenuator and the reading of the OUTPUT LEVEL meter.

b. Indicator. The only indicator used in Signal Generator SG-15/CPM is OUTPUT LEVEL meter M1 (fig. 3-1). It is a d-c (direct-current) milliammeter calibrated in db with reference to 1 mw (milliwatt) and extends over a range of 10 db from -4 through +6 db.

The meter reading is determined by adjustment of FINE DBM control R11. With COARSE DBM attenuator control on the setting nearest the desired output, the meter reading indicates the difference between the' output power of the signal generator and the setting of the COARSE DBM control.

c. Terminals and Jacks. The table below lists all the terminals and jacks located on the front panel, of the signal generator and gives the function of each. To locate these parts, refer to figure 3-1.

Terminal or Jack	Function
OUTPUT terminals	Thumbscrew-type binding posts for connecting output of signal generator to equipment to be tested through wire leads.
OUTPUT jack	Twin jack connected in parallel with terminals E1 and E2. For connecting output of signal generator to equipment to be tested through switchboard patching cords provided with the signal generator.
GND terminal	Thumbscrew-type binding post. For connecting chassis of signal generator to external ground.
Power cable assembly	For connecting signal generator to source of 115- or 230-volt, 50- to 70-cycle a-c.

3-2. Decibel Meter ME-22(*)/PCM

a. Controls. The following table lists the controls of Decibel Meter ME-22(*)/PCM and gives the function of each control. The location of these controls is shown in figure 3-2.

Control	Function
Power ON-OFF switch	In the ON position, connects primary of power transformer T2 to a-c power source.
PRIMARY VOLTAGE switch.	In the 115 position, connects primary windings of power transformer T2 in parallel for operation with a 115-volt a-c power source. In the 230 position, connects these windings in series for operation with a 230-volt a-c power source.
Indicator light	Lights when power is applied to decibel meter.
INPUT IMPEDANCE switch.	In the 600 OHM position, connects input transformer T1 for 600-ohm input impedance. In the BRIDGING position, connects input transformer T1 for 8,000-ohm input impedance.
CAL ADJ potentiometer R10.	Adjust zero level of meter M1.
DBM switch	Selects attenuation setting required for use of meter M1 with any given signal. Switch provides six steps in two scales as follows: SCALE A, 0 db and +10 db; SCALE B, -30db, -20 db, -10 db, and 0 db.

b. Indicator. The only indicator used in Decibel Meter ME-22(*)/PCM is meter M1 (fig. 3-2). This is a 0- to 1-ma (milliampere) meter calibrated in two scales as follows: SCALE A, 0 db through +15 db; SCALE B, -15 db through 0 db. The reading of Decibel Meter ME-22(*)/PCM is the sum of the reading of meter M1 on either scale and the setting of DBM switch S2 on the corresponding scale.

c. Terminals and Jacks. The following table lists the terminals and jacks located on the front panel of the decibel meter and gives the function of each. To locate these parts, refer to figure 3-2.

Terminal or Jack	Function
INPUT terminals	Thumbscrew-type binding posts for connecting output of equipment being tested to input of decibel meter through wire leads.
INPUT jack	Twin jacks connected in parallel with INPUT terminals. For connecting output of equipment being tested to input of decibel meter through switchboard patching cords provided with the decibel meter.

Terminal or Jack	Function
TERMINATING RESISTORS -600 OHMS and 475 OHMS.	A 600-ohm, 2-watt resistor is connected across terminals designated 600 OHMS, and a 475-ohms, 2 watt resistor is connected across the terminals designated 475 OHMS. These resistors are used, when required, as terminating resistors, for external equipment.

Terminal or Jack	Function
GND terminal..........................	Thumbscrew-type binding post. For connecting chassis of decibel meter to external ground.
Power cable assembly W1.	For connecting decibel meter to source of 115- or 230-volt, 50- to 70-cycle a-c.

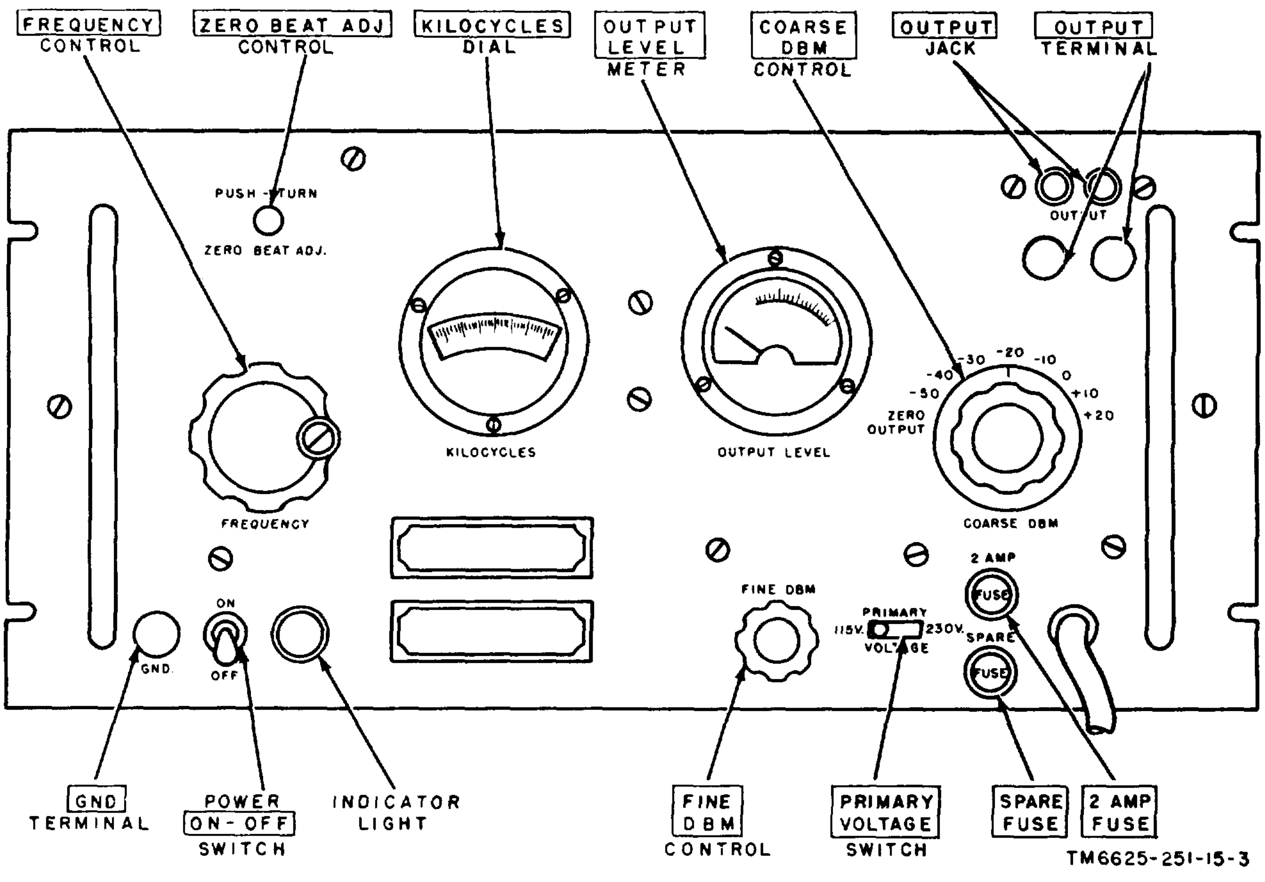


Figure 3-1. Signal Generator SG-15(*)/PCM, front panel showing location of controls, indicator, terminals, and jacks.

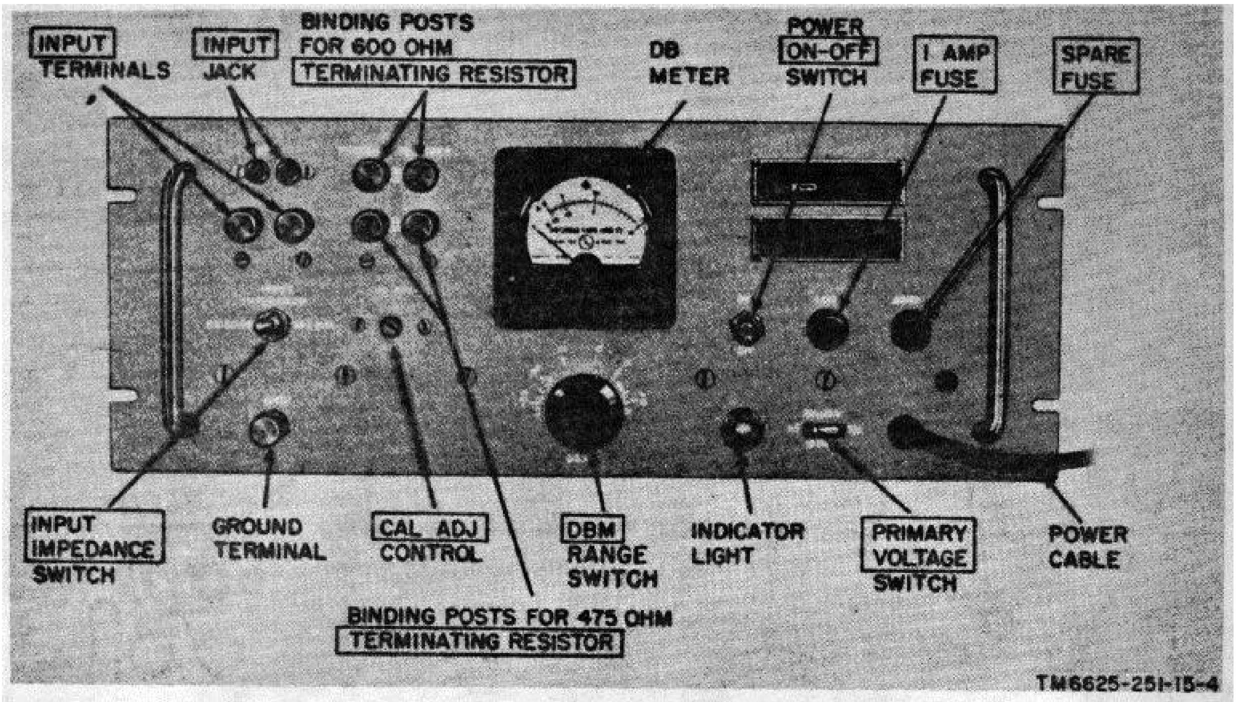


Figure 3-2. Decibel Meter ME-22(*)/PCM, front panel, showing location of controls, indicator, terminals, and jacks.

Section II. OPERATION OF SIGNAL GENERATOR SG-15(*)/PCM UNDER USUAL CONDITIONS

3-3. Preliminary Starting Procedures

a. Determine whether the power source to be used is 115- or 230-volt.

b. Set the toggle switches on the front panel in the following positions:

Switch	Position
Power ON-OFF switch	OFF
PRIMARY VOLTAGE switch.	In the 116V position if a 115-volt power source is to be used. In the 230V position if a 230-volt power source is to be used.

c. Connect the power cable to an a-c outlet.

Note

Be sure that the GND terminal is connected to an external ground before operating the equipment (para 2-4*b*).

3-4. Starting Procedures

a. Set the FREQUENCY control of Signal Generator SG-15(*)/PCM (fig. 3-1) to the minimum frequency of 200 cps as indicated on the KILOCYCLES dial.

b. Set the FINE DBM control to midposition.

c. Set the COARSE DBM control to ZERO OUTPUT.

d. Set the power ON-OFF switch to ON. Allow the equipment to warm up for 10 to 15 minutes before proceeding.

3-5. Calibration

a. Set the FINE DBM control for a reading of approximately +6 on the OUTPUT LEVEL meter.

b. Set the FREQUENCY control to 0 as indicated on the KILOCYCLES dial.

c. Adjust the ZERO BEAT ADJ control for zero beat as indicated by no deflection of the OUTPUT LEVEL meter. The meter indicator will deflect a number of times per second, decreasing in frequency as adjustment is made until there is no deflection at zero beat.

Note

As the FREQUENCY control is varied above and below 0 on the KILOCYCLES dial, note that the zero beat region is about one-eighth inch wide. Set the ZERO BEAT ADJ control so that zero frequency is in the center of this region.

3-6. Operation

a. Set the FREQUENCY control to indicate the desired frequency on the KILOCYCLES dial.

b. Set the COARSE DBM control to the attenuation setting nearest to the desired output.

c. Set the FINE DBM control for a reading on the OUTPUT LEVEL meter which, when added to the setting of the COARSE DBM control, will give the desired output. For example, if an output of -18 dbm is required, set the COARSE DBM control to -20 and the FINE DBM control for a reading of +2 on the OUTPUT LEVEL meter; the algebraic sum of -20 dbm and +2 db is -18 dbm. If an output of -22 dbm is required, set the COARSE DBM control to -20 and the FINE DBM control for a reading of -2 on the OUTPUT LEVEL meter; the algebraic sum of -20 dbm and -2db equals -22 dbm.

d. Connect the output of the signal generator to the input of the equipment to be tested. Note that the dbm calibration of the signal generator holds only when the output is applied to equipment which has an input impedance of 600 ohms (para 1-4*a*).

e. If it may become necessary to disconnect the output of the signal generator from the equipment being tested and later apply the signal again, do not turn off the signal generator. Turning off the equipment would entail another warm-up period and recalibration of the ZERO BEAT ADJ control. Set the COARSE DBM control to ZERO OUTPUT or disconnect the leads. When the signal is required again, set the COARSE DBM control to the proper attenuation setting.

3-7. Stopping Procedure

a. Set the power ON-OFF switch to OFF.

b. Disconnect the output leads from the OUTPUT terminals, or remove the switchboard patching cord from the OUTPUT jack.

c. Disconnect the power cable from the a-c power source.

d. If the equipment is to be moved to a new location, disconnect the ground lead from the GND terminal and return the signal generator to its carrying case.

Section III. OPERATION OF DECIBEL METER ME-22(*)/PCM UNDER USUAL CONDITIONS

3-8. Preliminary Starting Procedures

a. Determine whether the power source to be used is 115- or 230-volt a-c.

b. Determine the impedance of the load across which the decibel meter is to be connected.

c. Set the three toggle switches on the front panel in the following positions:

Switch	Position
Power ON-OFF switch	OFF
PRIMARY VOLTAGE switch.	In the 115 position if a 115-volt line is to be used. In the 230 position if a 230-volt line is to be used.
INPUT IMPEDANCE switch.	In the 600 OHM position if the decibel meter terminates the circuit. In the BRIDGING position if making a bridging measurement on a through circuit terminated in 600 ohms.

d. Connect the power cable to an a-c outlet.

Note

Be sure that the GND terminal is connected to an external ground before operating the equipment (para. 2-4*b*).

3-9. Starting Procedures

a. Set the power ON-OFF switch of Decibel Meter ME-22(*)/PCM (fig. 3-2) the ON position. Allow the equipment to warm up for a period of 5 to 10 minutes.

b. Set the DBM switch to 0 on SCALE B.

c. Connect a Signal Generator SG-15(*)/PCM or an equivalent signal source having a 600-ohm output impedance to the INPUT jack or terminals of the decibel meter. Apply a signal of 1,000 cps at 0 dbm.

d. Adjust the CAL ADJ potentiometer until the meter reads exactly 0 db on SCALE B.

e. Set the DBM switch to 0 on SCALE A. The meter should read 0 db ± .5 db on SCALE A.

Note

If abnormal meter readings occur, refer to the operational check for Decibel Meter ME-22(*)/PCM (para. 4-6).

3-10. Operation

a. Set the DBM switch at + 10 on SCALE A for maximum attenuation.

b. Connect the output of the equipment under test to the INPUT jack of the decibel meter if a switchboard patching cord is used. Connect the output of the equipment under test to the INPUT terminals if the conductor method of connection is used.

c. If the meter indicates no reading or reads too near the low end of the scale, reduce the attenuation by setting the DBM switch to 0 on SCALE A. If the meter still does not read in a significant portion of the scale, set the DBM switch to 0 on SCALE B and, if necessary, to -10, -20, and -30 successively until a suitable reading is obtained.

d. Note the setting of the DBM switch and the reading on the meter. The reading of the decibel meter is the sum of the setting of the DBM switch and the reading on the corresponding scale of the meter. For example, if the meter reads -11 db on SCALE B when the DBM switch is at -20 on SCALE B, the reading of the decibel meter is -11 ±20, or -31 dbm.

3-11. Stopping Procedure

a. Set the power ON-OFF switch to OFF.

b. Disconnect the equipment under test from the INPUT terminals or the INPUT jack.

c. Disconnect the power cable from the a-c receptacle.

d. If the equipment is to be moved to a new location, disconnect the ground lead from the GND terminal and return the decibel meter to its carrying case.

Section IV. OPERATION OF TEST SET TS-140/PCM UNDER USUAL CONDITIONS

3-12. Preliminary Starting Procedures

a. *General*. Determine whether the power source to be used is 115- or 230-volt a-c.

b. *Signal Generator SG-15(*)/PCM.*

(1) Set the power ON-OFF switch to the OFF position.

(2) Set the PRIMARY VOLTAGE switch to the 115V position if a 115-volt line is to be used. Set the switch to the 230V position if a 230-volt line is to be used.

(3) Make a ground connection to the GND terminal.

(4) Connect the power cable to the a-c power source.

c. *Decibel Meter ME-22(*)/PCM.*

(1) Set the power ON-OFF switch to the OFF position.

(2) Set the PRIMARY VOLTAGE switch to the 115 position if a 115-volt line is to be used. Set the switch to the 230 position if a 230-volt line is to be used.

(3) Make a ground connection to the GND terminal.

(4) Connect the power cable to the a-c power source.

3-13. Starting Procedures

a. *Signal Generator SG-15(*) /PCM*.

(1) Set the FREQUENCY control to indicate minimum frequency on the KILOCYCLES dial.

(2) Set the FINE DBM control to obtain a zero reading on the OUTPUT LEVEL meter.
(3) Set the COARSE DBM control to the ZERO OUTPUT position.
(4) Set the power ON-OFF switch to ON and allow the unit to warm up for 10 to 15 minutes before proceeding with adjustments.

b. Decibel Meter ME-22(*)/PCM. Set the power ON-OFF switch to ON and allow the equipment to warm up for 5 to 10 minutes.

c. Signal Generator SG-15(*)/PCM after Warm-up. When the signal generator has warmed up sufficiently, make the following adjustments:

(1) Set the FINE DBM control for a reading of approximately +6 on the OUTPUT LEVEL meter.
(2) Set the FREQUENCY control to 0 as indicated on the KILOCYCLES dial.
(3) Adjust the ZERO BEAT ADJ control for zero beat. There should be no deflection of the OUTPUT LEVEL meter indicator. The indicator deflects a number of times per second, decreasing in frequency as adjustment is made until the indicator is stationary at zero beat. As the FREQUENCY control is varied above and below 0 on the KILOCYCLES dial, note that the *zero beat region* is about one-eighth inch wide. Set the ZERO BEAT ADJ control so that zero frequency is in the center of this region.
(4) Set the FREQUENCY control for an output frequency of 1,000 cycles as indicated on the KILOCYCLES dial.
(5) Set the COARSE DBM control to 0 and set the FINE DBM control for a reading of 0 dbm on the OUTPUT LEVEL meter.

d. Decibel Meter ME-22(*)/PCM after Warm-up. When the warmup period of the decibel meter has been completed, proceed as follows:

(1) Set the DBM switch to 0 on SCALE B.
(2) Set the INPUT IMPEDANCE switch to the 600 OHM position.

3-14. Final Adjustment

a. Use one of the switchboard patching cords provided with Test Set TS-140(*)/PCM to connect the OUTPUT jack of the signal generator to the INPUT jack of the decibel meter.

b. On the decibel meter, adjust the CAL ADJ potentiometer until the meter reads exactly 0 db on SCALE B. Then set the DBM switch to 0 on SCALE A. The meter indicator should remain at 0 db ± .5 db.

c. Disconnect the signal generator from the decibel meter by disconnecting the switchboard patching cord from the OUTPUT jack of the signal generator.

3-15. Gain and Loss Measurements

a. Definition of Gain and Loss. Gain may be defined as the ratio of the output power of any equipment to the input power. When this ratio represents an increase in power, it is referred to as gain. When it represents a decrease, it is referred to as loss.

b. Method of Measurement. Gain and loss may be measured directly with Test Set TS-140/PCM since the front panel controls and meters of both the signal generator and the decibel meter indicate power levels in dbm. When the test set has been calibrated in accordance with instructions in paragraphs 3-13 and 3-14 proceed with gain and loss measurement (para 3-16 and 3-17). The circuit under measurement must have an impedance of approximately 600 ohms at -the points of connection to the signal generator and the decibel meter. This requirement must be met whether the circuit is terminated or bridged by the connection to the test equipment.

3-16. Point-to-Point Gain and Loss Measurements

a. Connect the OUTPUT (jack or terminals) of the signal generator to the input of the circuit to be measured (fig. 3-3).

b. Set the INPUT IMPEDANCE switch of the decibel meter to 600 OHM, and connect the INPUT (jack or terminals) to the output of the circuit to be measured. If the measurement is to be made at a bridging point, however, set the INPUT IMPEDANCE switch to BRIDGING and connect the INPUT of the decibel Meter to the bridging point of the circuit to be measured (fig. 3-4).

c. Set the FREQUENCY control of the signal generator to indicate the appropriate test frequency on the KILOCYCLES dial. Adjust the output power (dbm) as required for proper circuit performance.

d. Adjust the DBM range switch of the decibel meter to obtain a reading on the meter scale (para 3-10).

e. Read the output signal power of the signal generator in dbm by algebraically adding the setting of the COARSE DBM control to the reading of the OUTPUT LEVEL meter. For example, if the COARSE DBM control is set at -20 and the OUTPUT LEVEL meter reads +3, the output signal power in dbm equals -20 + 3, or -17 dbm.

f. Read the power, in dbm, of the test signal received at the INPUT jack or terminals of the decibel meter by algebraically adding the meter reading on SCALE A or B and the setting of the DBM range switch on its corresponding SCALE A or B. To do this, substitute the meter scale reading on SCALE A or B for the scale letter, A or B, on which the DBM range switch is set. For example, if the DBM range switch setting is -20 on SCALE B (B -20) and the meter SCALE B reading is -7, the received power in dbm equals B-20 or (-7) -20, or -27 dbm.

g. Compute the gain or loss in db of the circuit being measured by subtracting the test signal power in dbm (*e* above) from the received signal power in dbm (*f* above). For example, if the test signal power applied to a circuit is -17 dbm and the received signal power is -27 dbm, the difference between the applied and received signals equals -27-(-17) or -27+17, or -10 db. The negative sign of the difference denotes loss, and the quantity is expressed as a loss of 10 db. A positive sign denotes gain.

3-17. Looped-Back Gain and Loss Measurements

a. Disconnect all equipment at both terminations of both lines under test.

b. At the far ends of each line connect jumpers to make the lines loop back (fig. 3-5).

c. Connect the OUTPUT of the signal generator to the input of the circuit to be measured.

d. Set the INPUT IMPEDANCE switch of the decibel meter to 600 OHM and connect the INPUT to the output of the circuit to be measured.

e. Set the FREQUENCY control of the signal generator to indicate 1,000 cycles on the KILOCYCLES dial. Adjust the output power (dbm) as required for proper circuit performance.

f. Adjust the DBM range switch of the decibel meter to obtain a reading on the meter scale.

g. Compute the looped-back gain or loss in db of the circuit bearing measured by subtracting the output signal power in dbm (para 3-16*e*) from the received signal power in dbm (para 3-16*f*) and dividing by 2. A negative sign of the quantity denotes loss, and a positive sign denotes gain.

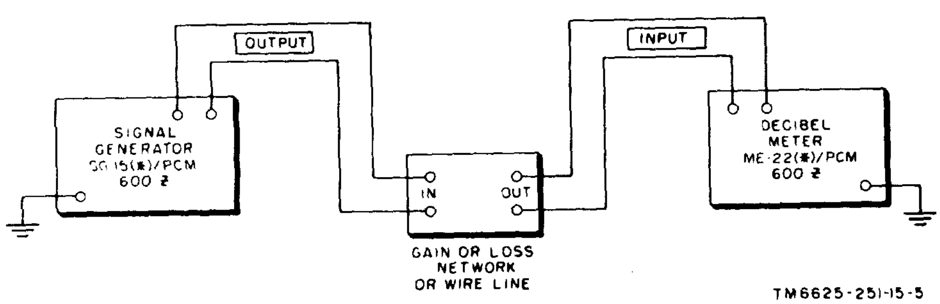


Figure 3-3. Point to point gain or loss measurements, connection diagram.

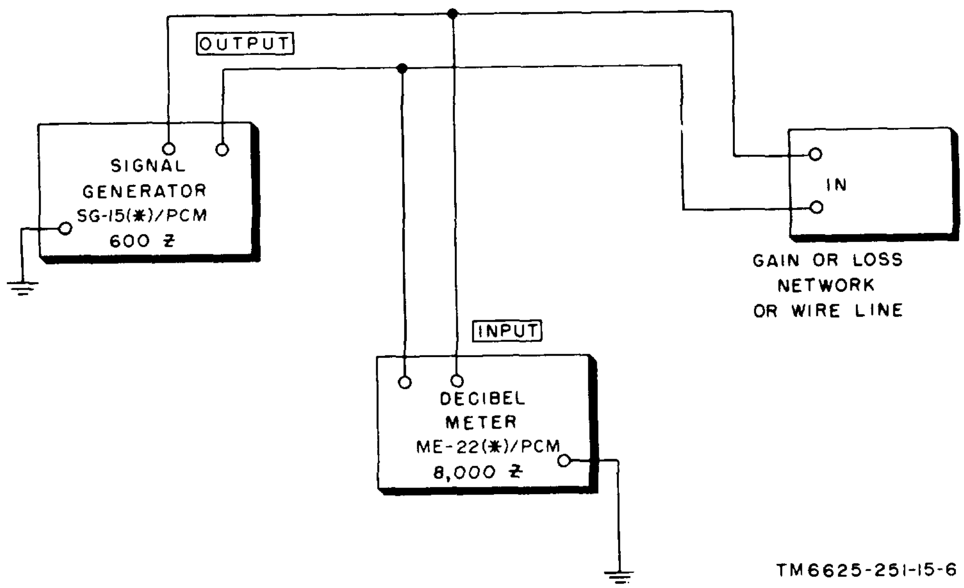


Figure 3-4. Gain or loss measurements by bridging, connection diagram.

3-18. Cross Talk Measurements

a. Definition of Cross Talk and Cross Talk Coupling.

(1) *Cross talk*. Cross talk is the phenomenon in which a signal transmitted in one circuit or channel of a transmission system is detectable in another circuit or channel.

(2) *Cross talk coupling*. Cross talk coupling between a disturbing and a disturbed circuit is the ratio of the power in the disturbing circuit to the induced power in the disturbed circuit observed at definite points of the circuit under specified terminal conditions. It is expressed in db.

b. Method of Measurement.

(1) Cross talk may be measured directly with Test Set TS-140/PCM by using the gain and loss measurement technique. Calibrate the test set in accordance with instructions in paragraphs 3-13 and 3-14 and proceed with cross talk measurements (para. 3-19 through 3-22). The circuit under measurement must have an impedance of approximately 600 ohms at the points of connection to the signal generator and the decibel meter. This requirement must be met whether the circuit is terminated or bridged by the connection to the test equipment.

(2) With the signal generator connected to the disturbing circuit and the decibel meter connected to the disturbed circuit, a measurement of loss will indicate cross talk. Since the source of cross talk is voice frequencies comprised of complex waveshapes, a warbler tone generator will produce results more closely approximating actual talking conditions. Therefore, when Test Set TS-140/PCM is used to measure cross talk, make measurements through the entire frequency range with the output signal power of the signal generator constant.

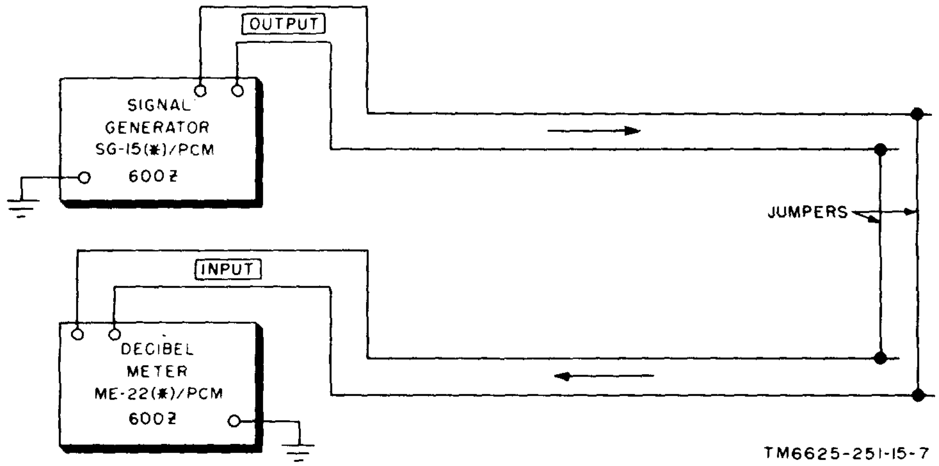


Figure 3-5. Looped back gain or loss measurements, connection diagrams

3-19. Near-End Cross Talk Between Adjacent Voice-Frequency Circuits

a. Disconnect all equipment at both terminations of the disturbing and disturbed circuits.

b. Connect 600-ohm carbon resistors at the far end of the disturbing and disturbed circuits (fig. 3-6).

c. Connect the OUTPUT of the signal generator to the near end of the disturbing circuit.

d. Set the INPUT IMPEDANCE switch of the decibel meter to the 600 OHM position and connect the INPUT to the near end of the disturbed circuit.

e. Set the FREQUENCY control of the signal generator to indicate the desired frequency on the KILOCYCLES dial. Adjust the output power (dbm) as required for proper circuit performance.

f. Adjust the DBM range switch of the decibel meter to obtain a reading on the meter scale.

g. Compute the cross talk coupling (loss in db) of the circuit being measured by subtracting the output signal power in dbm (para 3-16*e*) from the received signal power in dbm (para 3-16*f*).

h. Repeat the steps in *e* through *g* above, making measurements through the entire frequency range of the v-f (voice-frequency) circuit under test.

3-20. Far-End Cross Talk Between Adjacent Voice-Frequency Circuits

a. Disconnect all equipment at both terminations of the disturbing and disturbed circuits.

b. Connect a 600-ohm carbon resistor at the far end of the disturbing circuit (fig. 3-7). Connect a 600-ohm carbon resistor at the near end of the disturbed circuit.

c. Connect the OUTPUT of the signal generator to the near end of the disturbing circuit.

d. Set the INPUT IMPEDANCE switch of the decibel meter to 600 OHM and connect the INPUT to the far end of the disturbed circuit.

e. Set the FREQUENCY control of the signal generator to indicate the desired frequency on the KILOCYCLES dial. Adjust the output power (dbm) as required for proper circuit performance.

f. Adjust the DBM range switch of the decibel meter to obtain a reading on the meter scale.

g. Compute the cross talk coupling (loss in db) of the circuit-being measured by subtracting the output signal power in dbm (para 3-16*e*) from the received signal power in dbm (para 3-16*f*).

h. Repeat the steps in *e* through *g* above through the entire frequency range of the v-f circuit under test.

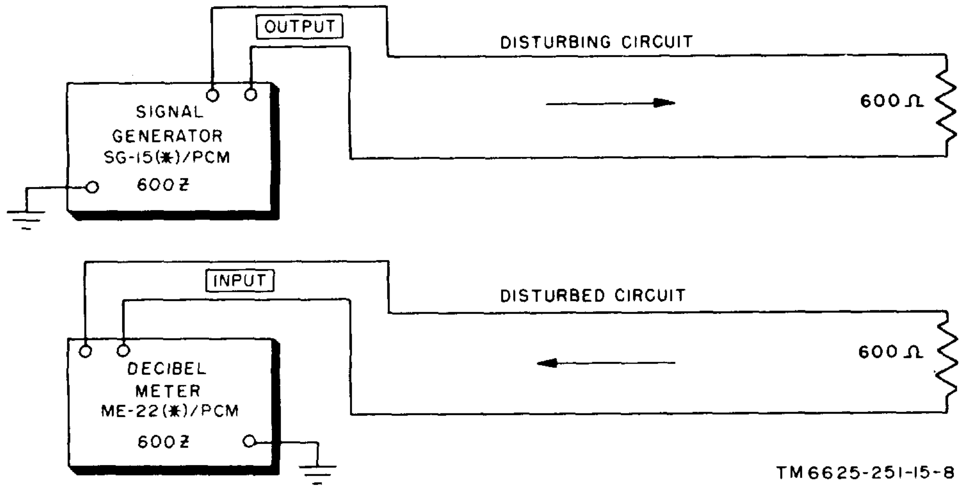


Figure 3-6. Near-end cross talk measurements on v-f circuit, connection diagram.

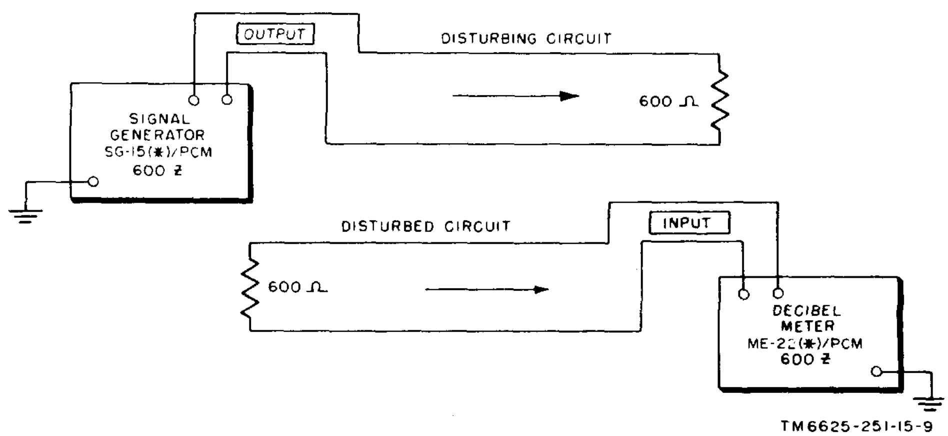


Figure 3-7. Far-end cross talk measurements on v-f circuit, connection diagram.

3-21. Near-End Cross Talk on Carrier Circuits

a. Disconnect all equipment at both terminations of the disturbing and disturbed circuits.

b. Connect 600-ohm carbon resistors at the far end of the disturbing and disturbed circuits (fig. 3-8).

c. Connect the OUTPUT of the signal generator to the near end of the disturbing circuit.

d. Set the INPUT IMPEDANCE switch of the decibel meter to 600 OHM and connect the INPUT to the near end of the disturbed circuit.

e. Set the FREQUENCY control of the signal generator to indicate a frequency on the KILOCYCLES dial in the frequency range of the carrier channel under test. Adjust the output power (dbm) as required for proper circuit performance.

f. Adjust the DBM range switch of the decibel meter to obtain a reading on the meter scale.

g. Compute the cross talk coupling (loss in db) of the circuit being measured by subtracting the output signal power in dbm (para 3-16*e*) from the received signal power in dbm (para 3-16*f*).

h. Repeat the steps in e through g above through the entire frequency range of the carrier channel under test.

3-22. Measuring Cross Talk by Bridging

a. Disconnect the equipment at the near end of the disturbing circuit.

b. Check the impedance at the far ends of the disturbing and disturbed circuits. The impedance should be 600 ohms.

c. Connect the OUTPUT of the signal generator to the near end of the disturbing circuit.

d. With equipment having a 600-ohm impedance connected at the near end of the disturbed circuit, set the INPUT IMPEDANCE switch of the decibel meter to the BRIDGING position and connect the INPUT of the decibel meter to the bridging point.

e. Set the FREQUENCY control of the signal generator to indicate the desired frequency on the KILOCYCLES dial. Adjust the output power (dbm) as required for proper circuit performance.

f. Adjust the DBM range switch of the decibel meter to obtain a reading on the meter scale.

g. Compute the cross talk coupling (loss in db) of the circuit being measured by subtracting the output signal power in dbm (para 3-16*e*) from the received signal power in dbm (para 3-16*f*).

h. Repeat the steps in e through g above through the entire frequency range of the circuit under test.

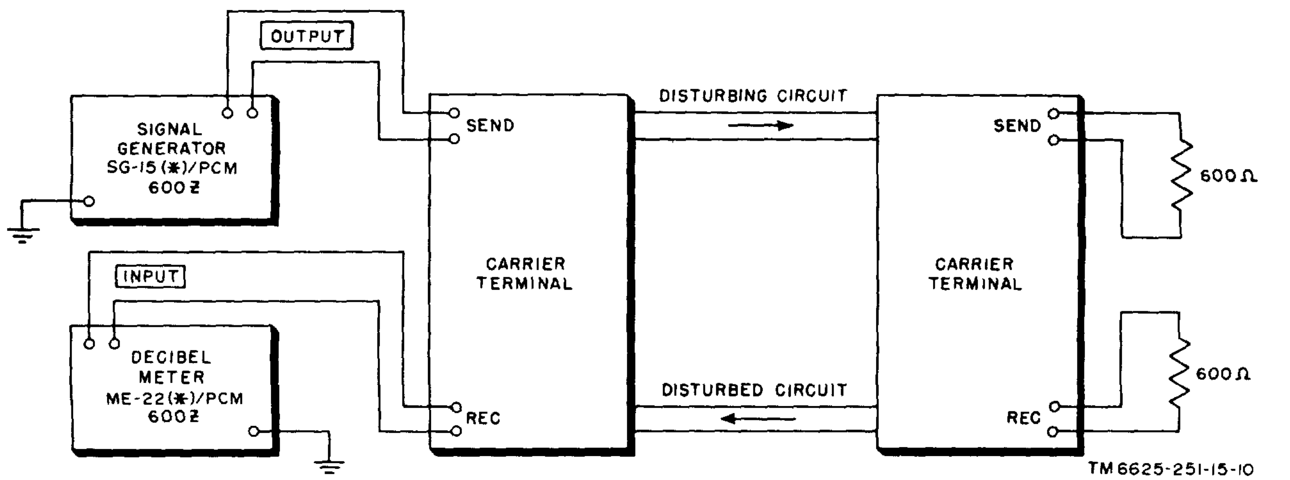


Figure 3-8. Near-end cross talk measurements on carrier circuit, connection diagram.

CHAPTER 4

MAINTENANCE

4-1. Scope of Maintenance

The maintenance duties assigned to the operator of Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM are listed below together with a reference to the paragraphs covering the specific maintenance function.

a. Daily preventive maintenance checks and services (para 4-5).

b. Weekly preventive maintenance checks and services (para 4-6).

c. Monthly preventive maintenance checks and services (para 4-7).

d. Weather proofing (para 4-8).

e. Cleaning (para 4-9).

f. Touchup painting instructions (para 4-10).

g. Visual inspection (para 4-11).

h. Troubleshooting (para 4-12 through 4-14).

4-2. Special Tools and Equipment Required

There are no special tools and special equipment required to maintain Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*) /PCM.

4-3. Preventive Maintenance

Preventive maintenance is the systematic care, servicing and inspection of equipment to prevent occurrence of trouble, to reduce downtime and to insure that the equipment is serviceable.

a. *Systematic Care*. The procedures given in paragraphs 4-5 through 4-7 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. *Preventive Maintenance Checks and Services*. The preventive maintenance checks and services charts (para 4-5 through 4-7) outline functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check and what the normal conditions are; the *references* column lists the illustrations, paragraphs or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by the corrective action indicated, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750. Paragraph 4-8 details any additional or special precautions to take when operating the equipment under severe climatic conditions.

4-4. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services on the Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM are required on a daily, weekly, and monthly basis.

a. Paragraph 4-5 specifies checks and services which must be accomplished daily or under the special conditions listed below:

(1) When the equipment is initially installed.

(2) When the equipment is reinstalled after removal for any reason.

b. Paragraphs 4-6 and 4-7 specify *additional* checks and services that must be performed on a weekly and monthly basis respectively.

4-5. Daily Preventive Maintenance Checks and Services Chart, Test Set TS-146/PCM

Sequence No.	Item	Procedures	References
1	Completeness.	See that equipment is complete	App. II
2	Case exteriors.	Inspect for cleanliness; clean as necessary.	Para 4-9
3	Indicator lamps.	While performing operating checks (steps 6-17 below) and whenever the equipment is operated, check for burned out indicator lamps.	
4	Meter glasses.	Inspect meter glasses for cracks.	
5	Controls and indicators.	While performing operating checks (sequence No. 6 through 17) and whenever equipment is being operated, observe that mechanical action of each knob, dial, and switch is smooth and free of external or internal binding or excessive looseness. Tap controls gently to determine if cutout occurs. Also, check meters for bent or sticking pointers.	
6	Signal Generator SG-15 (*) / PCM, preliminary.	Perform the following steps: *a*. Set the power ON-OFF switch to OFF *b*. Set the PRIMARY VOLTAGE switch to the 115V or 230 V position, depending on the power source.	
7	Signal Generator SG-15 (*) / PCM, starting.	Perform the following procedures: *a*. Set the FREQUENCY control for a reading of 200 cps on the KILOCYCLES dial. *b*. Set the FINE DBM control to midposition. *c*. Set the COARSE DBM control to ZERO OUTPUT. *d*. Set the power ON-OFF switch to ON, observe that pilot lamp lights, and allow a 15-minute warm-up period.	
8	Signal Generator SG-15 (*)/ PCM, FINE DBM control	Adjust for a reading of approximately +6 on the OUTPUT LEVEL meter.	Para 3-5
9	Signal Generator SG-15 (*) / PCM, ZERO BEAT ADJ control.	Adjust for zero beat on OUTPUT LEVEL meter. Deflections of meter should decrease to zero as control is adjusted.	Para 3-5
10	Signal Generator SG-15(*) / PCM, ZERO BEAT ADJ control.	Connect SG-15 (*) to equipment being tested and repeat number 9 above.	Para 3-5
11	Signal Generator SG-15 (*) / PCM, FREQUENCY control.	Set to desired frequency on KILOCYCLES dial.	
12	Signal Generator SG-16 (C) / PCM, output.	Set to attenuation setting (-60 to +20) nearest desired output. Reading on OUTPUT LEVEL meter should not change (with a 600-ohm load only).	Para 3-6

Sequence No.	Item	Procedures	References
13	Signal Generator SG-15 (*) / PCM, stopping.	Set the power ON-OFF switch to OFF.	
14	Decibel Meter 22(*) / PCM, preliminary.	Perform the following steps. *a*. Set the power ON-OFF switch to OFF. *b*. Set the PRIMARY VOLTAGE switch to the 115V or 230V position, depending on the power source. *c*. Set the INPUT IMPEDANCE switch to the 600 OHM position.	
15	Decibel Meter ME-22 (*) / PCM, Power ON-OFF switch.	Set the ON position. Allow 5- to 10- minute warm-up period; observe that pilot lamp lights.	
16	Decibel Meter ME-22 (*) / PCM, operation.	Perform the following steps: *a*. Set DBM switch to zero on SCALE B. *b*. Apply a 100 cps 0 dbm signal to INPUT jack or terminals and adjust CAL ADJ potentiometer for zero reading on meter *c*. Set DBM switch to 0 on SCALE A. Observe that meter reads 0 db ± 5db on SCALE A. *d*. Set DBM switch to +10 on SCALE A, and connect decibel meter to equipment under test. Observe that meter reads in a significant portion of SCALE A. If meter reads below scale or near edge of scale, set to 0 on SCALE A and then to 0, -10, -20, and -30 on SCALE B until a significant reading is obtained.	
17	Decibel Meter ME-22-(*) / PCM, stopping.	Set the power ON-OFF switch to OFF.	

4-6. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedures	References
1	Power cords, patch cords, and plugs.	Inspect power cords for cuts, kinks, cracks, frays, or other signs of deterioration. Inspect power cord plugs for loose, bent, or missing prongs.	
2	Case exteriors .	Inspect exterior surfaces for paint chips, cracks, rust, or corrosion.	
3	Carrying handles, hinges, and rack mounting screws.	Inspect carrying handles for tightness. If equipment is rackmounted, check to see that rack-mounting screws are securely tightened.	
4	Binding posts, fuses, and nomenclature plates.	Inspect for tightness .	

4-7. Monthly Preventive Maintenance Checks and Services Chart, Test Set TS-140/PCM

Sequence No.	Item	Procedures	References
1	Accessible pluckout parts.	Inspect seating of pluckout parts	
2	Wiring and components.	Inspect wiring and components for broken, shorted or open connections or other signs of damage.	
3	Mechanical shafts and gears.	Inspect gears for wear and broken, teeth. Check for dirt and excess lubrication.	
4	RANGE switch and input jack (MF-22/ PCM and ME-22A/ PCM), and OUTPUT jacks (SG-15/PCM and SG-15A/ PCM).	Check contacts or dirt. Remove dirt with cleaning compound.	
5	Component mountings	Inspect and tighten as necessary	
6	Terminal boards	Inspect for loose connections, cracked, or broken terminals.	
7	Variable capacitors	Inspect variable capacitors for dirt, corrosion, or deformed plates.	
9	Spare parts	Check spare parts available to organizational maintenance personnel.	App. II and Figs. 1-4 - 1-6

4-8. Weatherproofing

a. General. Army electronic equipment, when operated under severe climatic conditions such as prevail in tropical, arctic and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moisture-proofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions are necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures. These precautions are explained fully in TG SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions are necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust. These precautions are explained in TB SIG 75.

4-9. Cleaning

Inspect the exterior surfaces of the Test Set TS-140/PCM, The exterior surfaces should be clean and free of dust, dirt, grease and fungus.

a. Remove exterior dust and loose dirt with a clean, soft cloth.

Warning: Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation. DO NOT use near a flame.

b. Remove exterior grease, fungus and ground-in dirt from the cases; use a cloth dampened (not wet) with cleaning compound.

c. Remove dust or dirt from plugs and jacks with a brush.

Caution: Do not press on meter faces (glass) when cleaning; the meter may be damaged.

d. Clean the front panels, meters and control knobs; use a soft, clean cloth. If dirt is difficult to remove, dampen the cloth with water; use mild soap if necessary.

(1) Clean the crimps of the tip springs which make contact with the plugs by using a clean plug. Insert and withdraw the plug two or three times. If it is necessary to disassemble the spring assembly for any reason, wipe the parts with a clean, dry cloth.

(2) Make a solution of solvent (SD) and light oil, using 17 drops of oil to each ounce of solvent (SD). Make

the solution in quantities of 2 ounces or less, and keep it tightly covered when not in use.

(3) Fold a piece of lint-free cloth, about 5 inches long by 1 1/2 inches wide, lengthwise so that the strip will be about 3/4 inch wide. Insert one end of an orange stick into the fold at one end of the cloth and wrap the cloth spirally around the stick so that the folded edge is exposed. There should be about three turns of cloth per inch of length. Hold the end of the cloth with the fingers or fasten it by some suitable means.

(4) Moisten the end of the cloth with the solution. Insert the wrapped orange stick into the sleeve of the jack and rub back and forth, contacting all surfaces of the sleeve. Be careful not to touch the springs of the jack any more than is necessary. Repeat this process until the cloth is clean when it is removed from the sleeve.

4-10. Touchup Painting Instructions

Remove rust and corrosion from metal by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TB SIG 364. Field Instructions for painting and Preserving Electronics Command Equipment.

4-11. Visual Inspection

When the signal generator or decibel meter fails to operate properly, inspect the equipment for the following faults:

(1) Power cables for improper connections.

(2) Cords and plugs for wear, breaks and disconnection.

(3) Wiring for loose or poorly soldered connections, frayed or burned insulation, stretched leads or breaks caused by excessive vibration.

(4) Terminal boards for broken lugs and signs of arcing.

(5) Fuses for corrosion or burn-out.

(6) Resistors and power transformers for overheating and burn-out.

(7) Vacuum tubes for defects.

(8) Jacks and switches for dirty or broken contacts.

4-12. General Troubleshooting Information

Troubleshooting Test Set TS-140/PCM is based upon the operational checks contained in the daily preventive maintenance checks and services chart. To troubleshoot the equipment, perform all the functions from item number 6 (for Signal Generator SG-15(*)/PCM) or number 14 (for Decibel Meter ME-22(*)/PCM) in the daily preventive maintenance checks and services chart (para 4-5) and proceed through the items until an abnormal condition or result is obtained.

Perform the checks and corrective actions indicated in the troubleshooting chart. If the measures indicated do not correct the trouble, higher echelon maintenance is required. Paragraphs 3-3 through 3-11 (referenced in the chart) contain additional information and step by-step instructions for performing equipment tests and adjustments to be used during the troubleshooting procedures. If troubles occur that are not covered in the chart, refer to higher echelon maintenance.

4-13. Troubleshooting Chart, Test Set TS-140/PCM

Item NO.	Trouble Symptom	Probable Trouble	Checks and Corrective Measures
1	Pilot lamp does not light.	Power not properly supplied, fuse defective, or pilot lamp defective.	Check power source (para 3-3). Check power cable and connectors. Repair and replace as necessary. Check fuse and pilot lamp. Replace as necessary.

Item NO.	Trouble Symptom	Probable Trouble	Checks and Corrective Measures
2	No output from Signal Generator.	One or more defective tubes.	If in the operational check ,the signal generator fails to operate properly, tubes may be replaced by the substitution method (paras 4-14a and 4-15a).
3	Pilot lamp does not light.	Power not properly supplied, fuse de- fective or pilot lamp defective .	Check power source (para 3-8). Check power cable and connectors. Repair and replace as necessary
4	a. Meter does not read 0 ± 5 db on SCALE A	a. Tube V4 defective.	a. Recheck zero calibration on SCALE B (para 3-9). If calibration is still out on SCALE A replace tube V4 (fig. 7-5, and para 4-15*a*).
	b. No meter reading.	b. One or more tubes defective	b. If at item 15 or some other point in the operational check, the decibel meter fails to operate properly, tubes may be replaced by the substitution method (para 4-14*b* and 4-15*a*).

414. Supplementary Troubleshooting Information

a. Signal Generator SG-15(*)/PCM. In addition to the measures found in the troubleshooting chart, tubes may be replaced. To replace tubes by the substitution method, replace a suspected tube with a new tube. If the equipment still does not work, remove the new tube and put back the old one. Repeat this procedure with each tube in the unit until the defective tube is found. See paragraph 415 for instructions on the removal of tubes.

Note

If tube V2 (fig. 7-14) is replaced, the ZERO BEAT ADJ control will have to be readjusted for zero beat (para 3-5), and there will be a minor loss in calibration accuracy. No not replace tube V2 unless absolutely necessary.

b. Decibel Meter ME-22(*)/PCM. In addition to the measures found in the troubleshooting chart, tubes may be replaced. The procedure found in a above will apply.

4-15. Repairs, Test Set TS-140/PCM

a. Replacement of Vacuum Tubes.

(1) Remove cover of signal generator or decibel meter with a straight upward movement. Lateral movement may damage the spare tubes mounted inside the top flange of the cover.

(2) Allow tubes to cool.

(3) Remove tube by pulling up with fingers. Grip glass tubes by base. Do not rock tubes or jiggle it in its socket if it can be removed by an upward pull, since this spreads the socket contacts. If a tube does not release easily, move it gently from side to side.

(4) Label tube as it is removed so that it can be replaced in its proper socket.

(5) Insert new tube in socket by pushing downward gently and observing the socket keyway.

b. replacement of Indicator Lens.

(1) Remove lens by unscrewing from front panel of signal generator or decibel meter.

(2) Install new lens.

c. Replacement of Pilot Lamps.

(1) Remove red indicator lens (b above).

(2) Remove lamp by pushing it in and turning it counterclockwise to unlock bayonet base, and replace with new lamp.

(3) Replace red indicator lens.

d. Replacement of Fuse Caps.

(1) Remove cap by pushing in and turning in direction indicated by arrow on the top, and remove fuse.

(2) Insert fuse in new cap.

(3) Install fuse and cap.

e. Replacement of Fuses.

(1) Remove cap (*d* above).

(2) Remove and replace fuse.

(3) Install fuse and cap.

f. Replacement of Knobs.

(1) Loosen setscrew on knob body.

(2) Remove and replace knob.

(3) Tighten setscrew on new knob.

CHAPTER 5

FUNCTIONING OF TEST SET TS-140/PCM

Section I. GENERAL

5-1. Test Set TS-140/PCM

a. Test Set TS-140/PCM is a set of transmission measuring equipment containing two units, Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM. The signal generator supplies definite amounts of test power in the frequency range of 200 cycles through 35 kilocycles; the decibel meter measures the amount of power received at the far end of the line. Stepped and variable attenuators, contained in the signal generator, apply desired amounts of attenuation to the circuit under test.

b. The signal generator contains two oscillator circuits, each of which supplies a different frequency. The outputs of the two oscillators produce a third, or beat, frequency which is present across the output of the signal generator. The power and frequency usually used for testing is 1 mw at 1,000 cycles. However, when it is necessary to know how a circuit responds to different frequencies, the signal generator is used to supply these frequencies; the power output of 1 mw remains the same. The loss in db applied by the stepped and variable attenuators is the same at all frequencies.

c. The decibel meter is of the direct-reading type. It consists of an amplifier used to increase the signal power received and a dc milliameter calibrated in db which measures the amount of attenuation or gain in the circuit under test. A bridge rectifier circuit changes a-c to d-c to eliminate the possibility of distortion in the meter circuit.

5-2. Signal Paths, Signal Generator SG-15 (*)/PCM

The general functioning of the various stages and circuits of Signal Generator SG-15 (*)/PCM, shown in the block diagram (fig. 5-1), is explained in a through k below. For a detailed analysis of the functioning of the stages and circuits which comprise the signal generator, refer to paragraphs 5-5 through 512 and the schematic diagram (fig. 10-4).

a. Fixed-Frequency Oscillator Stage. The fixed-frequency oscillator stage consists of tube V1, a triode connected as a tuned-grid, cathode-coupled oscillator (SG-15/PCM only). In Signal Generator SG-15A/PCM, the fixed frequency oscillator stage consists of tube V1, a twin triode connected as a crystal-controlled, cathode-coupled oscillator. The fixed-frequency oscillator produces a constant output at approximately 100 kc +2 kc. The exact frequency of the oscillator at zero beat, measured at 68° F., is stamped on the oscillator assembly housing. Oscillations generated by the fixed-frequency oscillator circuit are fed to the grid circuit of first amplifier tube V7.

b. Variable-Frequency Oscillator Stage. Like the fixed-frequency oscillator, the variable-frequency oscillator stage consists of tube V2, a triode connected as a tuned-grid, cathode-coupled oscillator. The variable-frequency oscillator produces an output variable from approximately 100 kc to approximately 135 kc, depending on the setting of the FREQUENCY control. The setting of the FREQUENCY control is indicated by the reading on the KILOCYCLES dial, which is geared mechanically to the FREQUENCY control and indicates the output frequency of, the signal generator. Oscillations generated by the variable-frequency oscillator circuit, as determined by the setting of the FREQUENCY control, are fed to the control grid of second amplifier tube V8.

c. First Amplifier Stage. The first amplifier stage, which consists of tube V7, a pentode, amplifies the signal applied by the fixed-frequency oscillator. The output of tube V7, developed across the primary of the transformer and induced into the secondary of this transformer, is applied to control grid 1 of mixer tube V9, which is a penta-grid converter.

d. Second Amplifier Stage. The second amplifier stage, which consists of tube VS, a pentode, amplifies the signal applied by the variable-frequency oscillator. The output of tube V8 is applied to control grid 3 of mixer tube V9.

e. Mixer Stage. The mixer stage consists of tube V9, a penta-grid converter having two control grids, 1 and 3. The amplified 100-kc signal from the first amplifier is applied to control grid 1; the signal from the second amplifier, which depends on the setting of the FREQUENCY control is applied to control grid 3. The signals are mixed in the tube; this produces a beat frequency-the difference between the two applied signal frequencies-as well as other undesired frequencies. The output of the plate circuit of mixer tube V9 is applied to filter Z1, which has a 40-kc cutoff.

f. Filter Stage. The filter stage consists of filter Z1, a 0- to 40-kc filter, which is an inductance-capacitance network presenting a low-impedance path to beat frequencies in the 0to 40-kc band, and a high-impedance path to other frequencies present in the output of mixer tube V9. Fine adjustment is accomplished by FINE DBM potentiometer R11; this permits control of the amplitude of the signal. The output of filter Z1 is applied to the grid of third amplifier tube V3, a triode amplifier.

g. Third Amplifier Stage. The third amplifier stage consists of tube V3, a triode amplifier. The third amplifier receives the signal applied by filter Z1 through FINE DBM potentiometer R11, amplifies it, and applied it to the grid of fourth amplifier tube V4A, a 6SL7GT twin triode.

h. Fourth Amplifier Stage and Phase Inverter. The fourth amplifier stage consists of one-half of tube V4, designated V4A. The fourth amplifier receives the signal applied by the output of third amplifier tube V3, further amplifies it, and applies the amplified signal to the grid of phase inverter V4B, the second ,half of the twin triode tube V4, and to the control grid of power amplifier tube V5. Phase inverter tube V4B produces a signal which is equal in amplitude and opposite in phase to the signal of tube V4A and applies it to the control grid of power amplifier tube V6.

i. Power Amplifier Stage. Power amplifier tubes V5 and V6 are beam-power tubes connected as push-pull power amplifiers. These tubes are operated as triodes with the screens tied to the plates. Tubes V5 and V6 are driven by the signals, equal in amplitude and opposite in phase, from third and fourth amplifier tubes V3 and V4A, and a push-pull output signal is developed across the primary of output transformer T2. Transformer T2 couples the output of these tubes to the input of COARSE DBM attenuator E4. The tertiary winding of transformer T2, connected in a negative feedback arrangement to the cathode of fourth amplifier tube V4A, and an output resistance network are the controlling factors in maintaining an output impedance of 600 ohms.

j. Meter Rectifier Circuit. The meter rectifier circuit consists of rectifiers CR1, CR2, CR3, and CR4, IN69 crystal diodes connected in a full-wave bridge rectifier circuit. This circuit converts the a-c signal to d-c and applies it to OUTPUT LEVEL meter M1, a d-c milliameter calibrated in db. The meter rectifier circuit response is flat over the entire frequency range of the signal generator.

k. Power Supply. The power supply supplies a regulated + 250 vdc and an unregulated + 370 volts dc, for B + source in the generator.
It also supplies two 6.3 volts 26 unregulated voltages for the filaments in the generator.

5-3. Signal Paths, Decibel Meter ME-22 (*)/PCM

The general functioning of the stages and circuits of Decibel Meter ME-22(*)/PCM, illustrated in figure 5-2, is explained in a through e below. A detailed analysis of the stages and circuits of the decibel meter is given

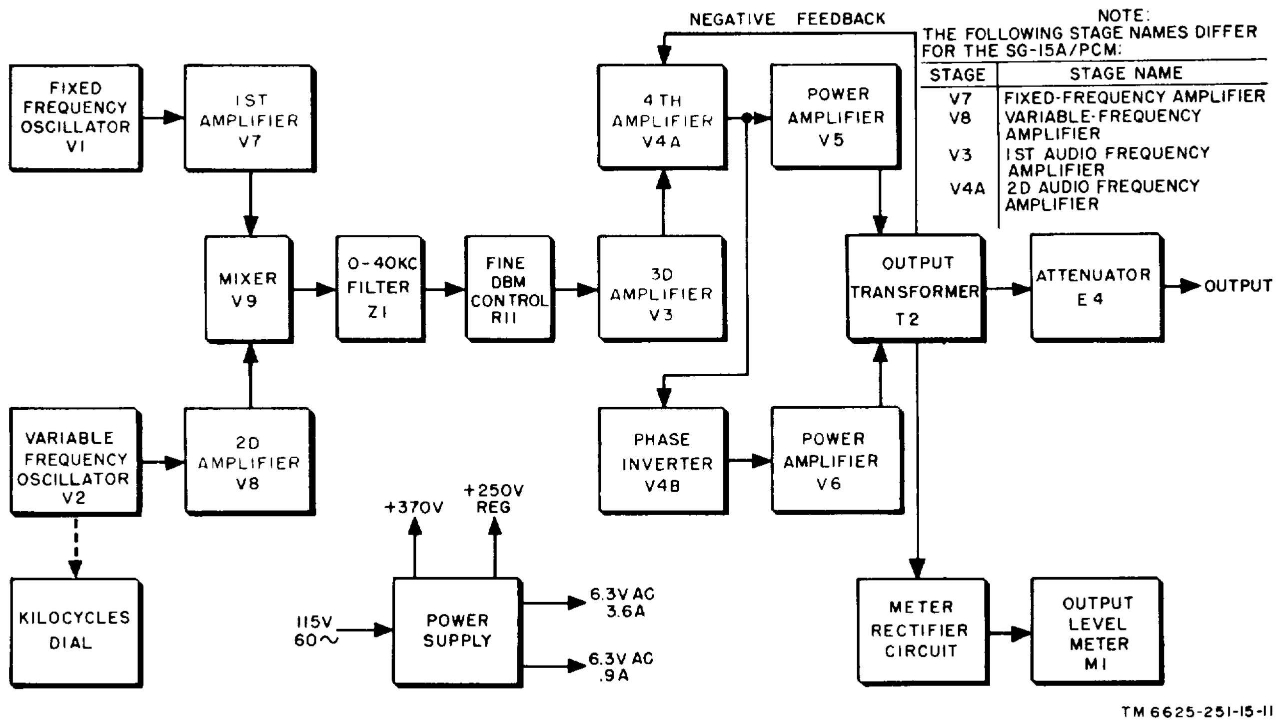


Figure 5-1. Signal Generator SG-15(*) /PCM, functional block diagram.

in paragraphs 5-13 through 5-17. In addition, refer to the schematic diagram (fig. 5-3).

a. Input Circuit. The input circuit consists of an impedance-adjusting arrangement in the form of a double-pole, double-throw toggle switch which sets the impedance to either 600 or 8,000 ohms, an input transformer, and associated circuit elements. The output signal of the equipment under test is applied across input transformer T1. INPUT IMPEDANCE switch S1 connects the primary of this transformer for the desired input-600 ohms with switch S1 in the 600 OHM position, or 8,000 ohms with the switch in the BRIDGING position.

b. Voltage Divider. A voltage divider, which consists of resistors R3 and R4, makes it possible to adjust the attenuation of the incoming signal. Resistors R3 and R4 are arranged with six taps, each of which is connected to terminals of DBM switch S2, a six position rotary switch. The setting of switch S2 adjusts the attenuation of the incoming signal, thus setting the meter to the required operating level.

c. First, Second, and Third Amplifier Stages. The first, second, and third amplifier stages are three conventional amplifier stages connected in cascade. They consist of tubes V1, V2, and V3, each of which is a sharp cutoff pentode. Tube V3, however, is operated as a triode with the suppresser and screen grids tied to the plate. The attenuated signal from the equipment under test is coupled directly from DBM switch S2 (fig. 5-3) to the control grid of first amplifier tube VI. The amplified signal at the plate of tube V1 is applied through capacitor C5, to the control grid of second amplifier tube V2 and, in like manner, the amplified signal at the plate of tube V2 is applied, through capacitor C5, to the control grid of third amplifier tube V3. The output of tube V3 is applied to one side of the meter rectifier. In addition, an output voltage from the cathode circuit of second amplifier tube V2 is applied to the other side of the meter rectifier through CAL ADJ potentiometer R10.

d. Meter Rectifier Circuit. The meter rectifier circuit consists of tube V4, meter M1, and associated circuit elements. Tube V4 is a twin diode operated as a full-wave rectifier and connected in a bridged circuit with resistors R19 and R20 and meter M1. The output voltage from the cathode circuit of second amplifier tube V2 is applied to one side of the rectifier circuit through CAL ADJ potentiometer 10 (fig. 5-3); the amplified signal from the plate of third amplifier tube V3 is applied to the other side of the rectifier. The voltage from the plate of tube V3 and the voltage from the cathode of tube V2 are alike in phase. However, the plate voltage exceeds the cathode voltage and produces a voltage across the rectifier circuit alternately positive and negative. The voltage produced across the rectifier circuit is rectified and current flows in the same direction through resistor R11. Feedback voltage produced in the cathode circuit of tube V2 is controlled by the setting of CAL ADJ potentiometer R10 (fig. 5-3). Thus the setting of the CAL ADJ potentiometer controls the adjustment of the 0 dbm level of meter M1.

e. Power Supply. (fig. 5-3). Line voltage is applied to the primary of transformer T2 when switch S4, a double-pole, double-throw toggle switch, is in the ON position. The primary of the transformer has two windings. PRIMARY VOLTAGE switch S3, a double-pole, single-throw toggle switch, connects these windings in parallel for use with a 115-volt power supply When the switch is in the 115 position, and in series for use with a 230-volt power supply when the switch is in the 230 position. The secondary of transformer T2 consists of four windings. Winding 11-13 delivers 750 volts across the plates of rectifier tube V8, a 5Y3GT full-wave rectifier, winding 9-10 delivers 5 volts to the filament of tube V8, winding 7-8 delivers 6.3 volts to the filament of voltage control tube V5, and winding 5-6 supplies 6.3 volts to the filaments of all remaining tubes in the decibel meter. The rectified voltage at the filament of tube V8 is applied to a filter network which consists of choke coil L1 and capacitors C10 and C11. From the filter network, +450 volts unregulated screen and plate voltage is applied to third amplifier tube V3. The +450-volt output of the rectifier filter also is applied to voltage control tube V5 and voltage control amplifier V7, the circuits of which supply +220-volt regulated voltage for first, second and third amplifier tubes V1, V2, and V3.

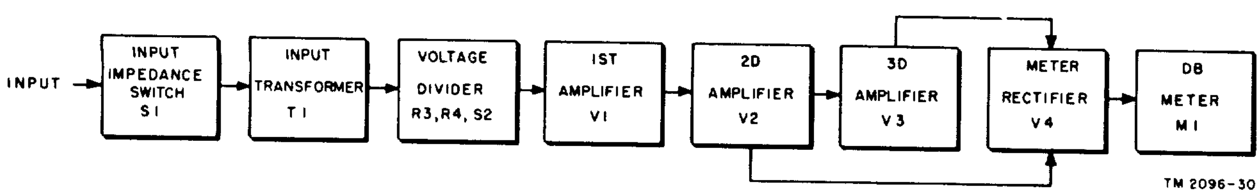


Figure 5-2. Decibel meter ME-23 (*) / PCM, functional block diagram.

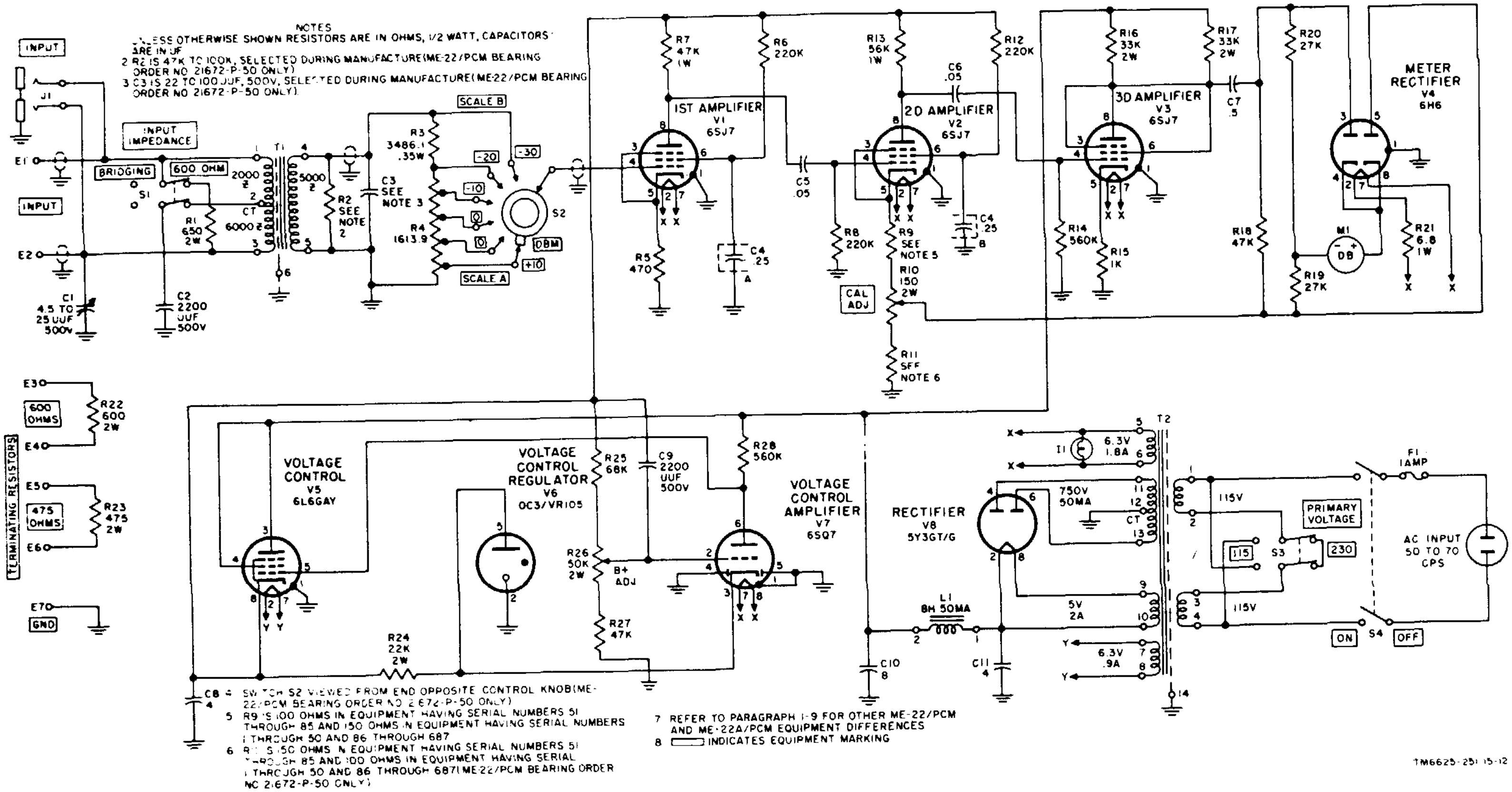


Figure 5-3. Decibel Meter ME-22(*)/PCM, schematic diagram.

Section II. FUNCTIONING OF SIGNAL GENERATOR SG-15(*)/PCM

5-4. Fixed-Frequency Oscillator, SG15/PCM

a. The fixed-frequency oscillator consists of tube V1 and associated circuit elements. Tube V1 is a type 6J5 triode connected as a tuned-grid cathode-coupled oscillator. Figure 5-4 shows a simplified schematic diagram of this circuit.

b. When plate voltage is applied to fixed frequency oscillator tube V1, plate current begins to flow and a positive voltage appears at the cathode of this tube. The positive voltage from the cathode of tube V1 is applied to the grid tank circuit; this creates an unbalance in this circuit and causes it to begin to oscillate. Tube V1 is self-biased by the flow of current through cathode resistor R3, which develops d-c bias for the grid of the tube.

c. The tank circuit for tube V1 is a network consisting of inductor L1 and four parallel branches of capacitance-the first, capacitor C1, the second, capacitor C2, the third, capacitor C3, and the fourth, capacitor C5 in series with parallel capacitors C6 and C7. The oscillatory voltage in this tank circuit is applied to the grid of tube V1 and amplified. In addition to d-c bias, a self-biasing voltage is developed across cathode resistor R3, This voltage is fed back to the tank circuit through resistor R2 to maintain oscillation.

d. Resistor R1 is the plate resistor of tube V1. Capacitor C4 is the plate bypass capacitor and serves as an r-f (radio-frequency) connection from the plate of tube V1 to ground and to the grounded end of the tank circuit. The r-f voltage across resistor R3 is the output voltage of the oscillator. Resistor R45 and capacitor C31A form a filter network which decouples the plate of tube V1 from the B + supply.

e. The fixed-frequency oscillator circuit is tuned to approximately 100 kc by means of capacitor C2. Readjustment of this circuit will i)e necessary after major repairs (para 712). Fine tuning is accomplished by adjustment of ZERO BEAT ADJ capacitor C1. This control is used to obtain zero beat between the fixed-frequency oscillator and the variable-frequency oscillator (para 3-5c).

f. The rf voltage developed across cathode resistor R3 is coupled by capacitor C8 to a voltage-divider network consisting of resistors R4 and R5. The common point of the resistors is connected to the control grid (pin 4) of first amplifier tube V7.

5-5. Fixed-Frequency Oscillator, Signal Generator SG-15A/PCM

a. The fixed-frequency oscillator of the SG-15A/PCM consists of tube V1 and associated circuit elements. Tube V1 is a 6SN7 twin triode connected as a crystal-controlled, cathode-coupled oscillator. Figure 5-5 shows a simplified schematic diagram of this circuit.

b. When plate voltage is applied to fixed frequency oscillator tube V1, plate current begins to flow and a positive voltage appearing at the cathode of tube VIA is built up across cathode resistor R2. This positive voltage is coupled to the cathode of tube V1B by crystal Y1, thus creating a positive feed-back voltage that causes the circuit to oscillate.

c. The positive voltage coupled to cathode resistor R4 of tube V1B causes a negative bias, and the plate current of V1B decreases while the plate voltage increases. This positive voltage at the plate of V1B is coupled to the grid of tube V1A by capacitor C7. The grid of V1A becomes positive, causing more current to flow through the tube which, in turn, causes the cathode to become more positive; thus oscillation is maintained.

d. Resistor R3 is the plate resistor for tube V1B. Resistor R1 is the grid resistor for tube V1A. The voltage across cathode resistor R4 is coupled to fixed-frequency amplifier V7 by capacitor C8. Resistor R5 is the grid resistor for amplifier V7.

e. frequency of the oscillator is held at approximately 100 kc by crystal Y1, which maintains oscillations at this frequency but attenuates all other frequencies.

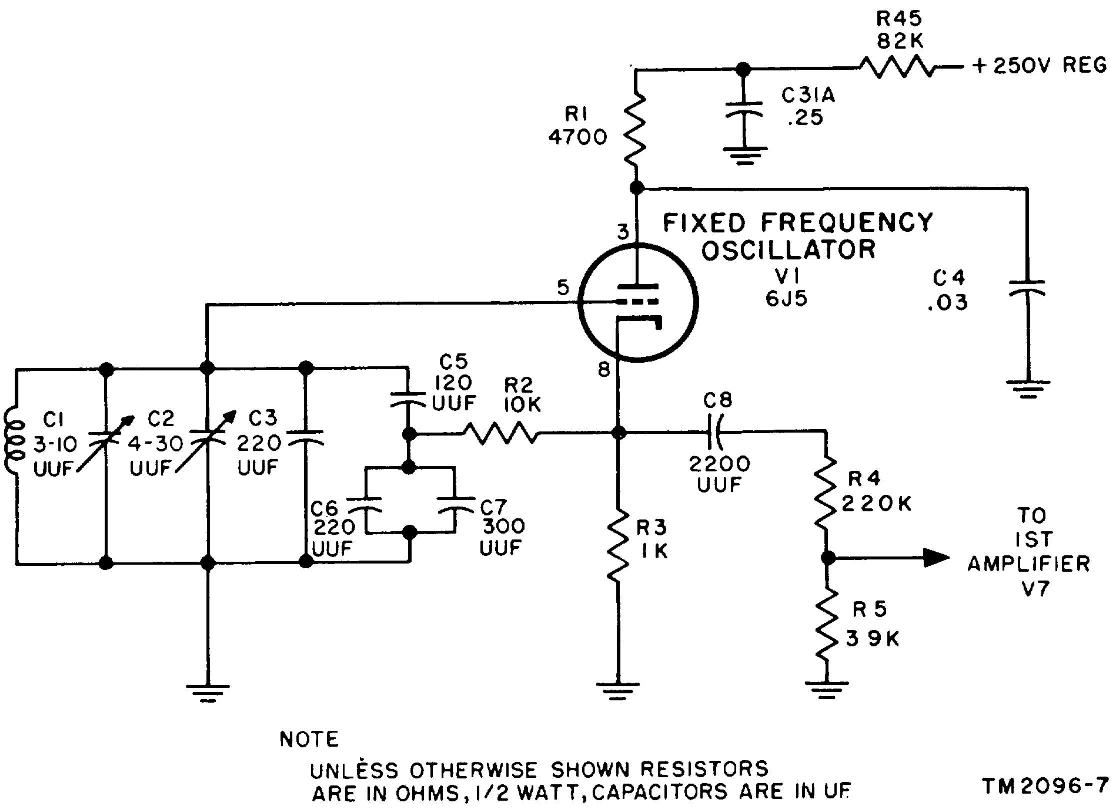


Figure 5-4. Signal Generator SG-15/PCM, fixed-frequency oscillator circuit, schematic diagram.

5-6. Variable-Frequency Oscillator

a. Circuit Analysis.

(1) The variable-frequency oscillator (fig. 5-6) consists of tube V2 and associated circuit elements. Tube V2 is a type 6J5 triode connected as a tuned-grid cathode-coupled oscillator in a manner similar to that of fixed-frequency oscillator tube V1 (para 54).

(2) As with fixed-frequency oscillator tube V1, plate voltage applied to variable-frequency oscillator tube V2 causes a positive voltage to appear at the cathode of the tube. This cathode voltage, applied to the grid tank circuit, creates an unbalance in the tank circuit and causes it to oscillate. Resistor R8 develops d-c bias for the grid of tube V2.

(3) The tank circuit for tube V2 consists of inductor L2 and four parallel branches of capacitance (capacitors C9. C10, C11, and C13 in series with parallel capacitors C14 and C15. Unlike capacitors C2 and C3 in the tank circuit of tube V1, capacitors C10 and C11 are variable temperature compensating capacitors with a negative coefficient of 500 parts per million per degree Centigrade. In Signal Generator SG-15A/PCM, capacitor C11 is not a temperature-compensating capacitor. This capacitor is adjusted to maintain the drift of the output frequency of the signal generator within limits. Oscillatory voltage created

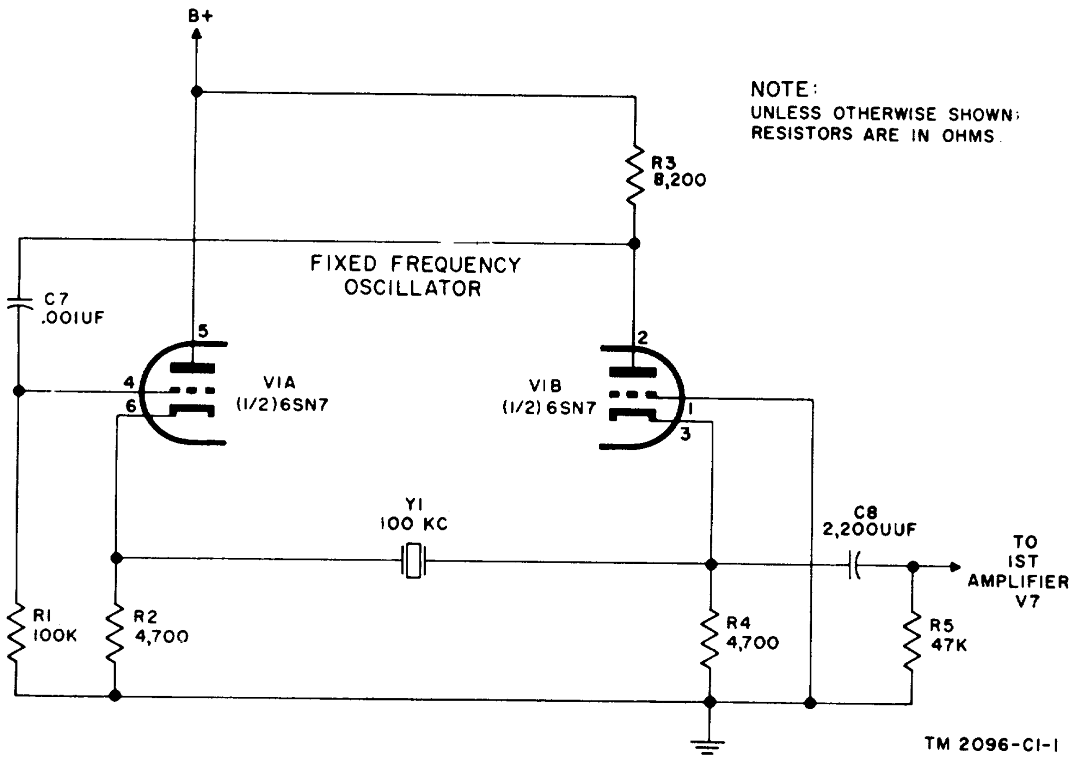


Figure 5-5. Signal Generator SG-15A/PCM, fixed -frequency oscillator, partial schematic diagram.

in the tank circuit is applied to the grid of tube V2 and amplified. Oscillation is maintained by a voltage developed across cathode resistor R8 and fed back to the tank circuit through resistor R7.

(4) Resistor R6 is the plate load resistor for tube V2. Plate bypass capacitor C12 shunts the r-f voltage from the plate of tube V2 to ground, and the r-f voltage across cathode resistor R8 is the output voltage of the oscillator. A filter network is formed by resistor R46 and capacitor C31B, which decouples the plate voltage of tube V2 from the B + supply.

(5) The signal output of tube V2, developed across cathode resistor R8, is coupled to a voltage dividing network by capacitor C16. The signal at the junction of voltage dividing resistors R9 and R10 is applied to the control grid (pin 4) of second amplifier tube V8.

(6) The variable-frequency oscillator circuit is variable in frequency from slightly below 100 kc to slightly above 135 kc. FREQUENCY capacitor C9 is the main tuning control (b below). The KILOCYCLES dial, which is coupled mechanically to this control, indicates the output frequency of the signal generator as adjusted by the FREQUENCY control. The KILOCYCLES dial is calibrated as follows: equal gradations

of 10 cps in the frequency range of 200 through 1,000 cps, equal gradations of 20 cps in the frequency range of 1,000 through 2,000 cps, and equal gradations of 50 cps in the frequency range of 2,000 through 35,000 cps. The range of the variable-frequency oscillator is determined at the time of manufacture by adjustment of variable FREQUENCY capacitor C9 and variable capacitor C10. Readjustment of this circuit should not be necessary except after major repairs (para 7-12).

Caution:

Be extremely careful not to interfere with the electrical and mechanical elements of the variable frequency oscillator. Loss of calibration accuracy will result.

b. Mechanical Theory. FREQUENCY capacitor C9 and the KILOCYCLES dial (fig. 5-7) are positioned through the oscillator gear train as follows:

(1) The upper drive gear, located on the FREQUENCY knob shaft, rotates as the knob is turned and drives the lower drive gear.

(2) The lower drive gear is mounted on a shaft extension connected directly to capacitor C9. As the FREQUENCY knob is turned and the shaft rotates, the capacitance of capacitor C9 changes, thus varying the frequency output of the oscillator.

(3) The lower drive gear also meshes with the idler gear assembly on its right. The idler gear assembly in turn causes rotation of the dial and dial gear assembly. The hairline indicator

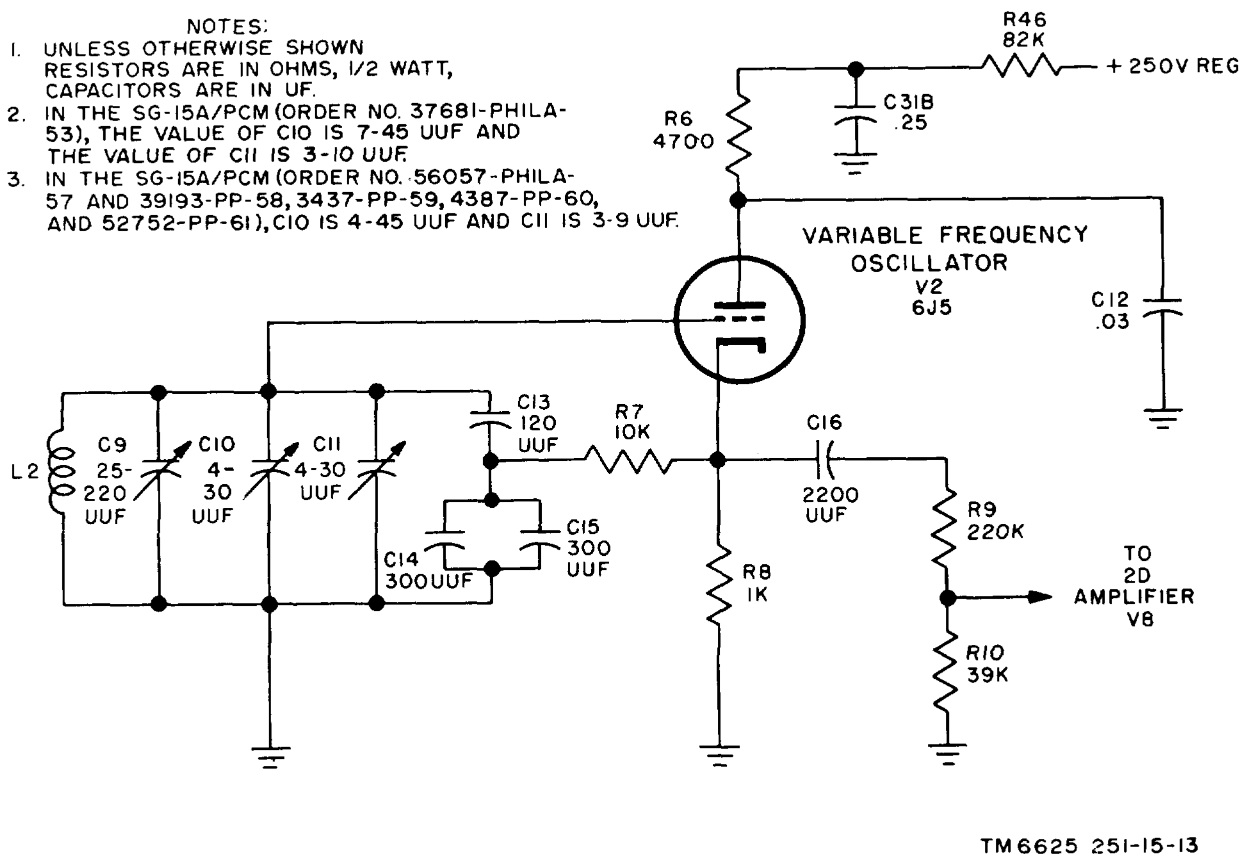


Figure 5-6. Signal Generator SG-15(*)/PCM, variable-frequency oscillator circuit, schematic diagram.

is secured to the dial gear shaft, which is stationary.

(4) Since the calibrations on the dial face form a spiral, a sliding shutter is provided to section off a small area of the scale.

(5) As the dial gear assembly rotates, the intermediate gear turns, causing its shaft and the rack driving gear to rotate.

(6) The shutter assembly and slide bracket are mounted on the upper end of the rack. As the rack drive gear rotates, the rack and shutter assembly are raised and lowered to provide a viewing area on the dial corresponding to the variation of capacitor C9. Thus, the output frequency of the oscillator can be read directly from the dial.

(7) The lower drive gear also meshes with the stop gear located on the left side of the oscillator assembly. This gear is mounted on a shaft with 17 stop washers. Each washer is provided with a stop which engages the stop of the next washer.

(8) When the shaft is rotated, the first washer engages the stop of the second washer. Further rotation of the shaft causes both washers to rotate.

(9) As each additional rotation is made, the adjacent stop washer turns until the stop of the final washer engages a stationary stop and the shaft cannot be rotated farther. This stopping arrangement limits rotation of the shaft in both directions.

5-7. Amplifier and Mixer Circuit

The amplifier and mixer circuit (fig. 5-8) consists of first amplifier tube V7, second amplifier tube V8, mixer tube V9, and the circuit elements associated with these tubes. The outputs of the fixed- and variable-frequency oscillators are amplified in the corresponding amplifier stages and applied to the mixer, which produces a beat frequency. The beat frequency is the difference in cps between the two applied signal frequencies.

a. First Amplifier.

(1) The first amplifier consists of tube V7, transformer T1, and their associated circuit elements. Tube V7 is self-biased by the voltage drop across cathode resistor R29. Resistor R28 is the dropping resistor for the screen of tube V7, and capacitor C24A is the bypass capacitor for the screen of this tube.

(2) The plate of tube V7 is connected to the ± 250-volt regulated supply through the primary of transformer T1. This transformer is a double-tuned transformer used as an inter-stage transformer to apply the output of tube V7 to the mixer. Both the primary and the secondary of transformer T1 are tuned to 100 kc by fixed capacitors which are part of the transformer assembly. Transformer T1 is adjusted for maximum output by means of tuning slugs which vary the inductance of the primary and secondary coils. This adjustment is made at the time of manufacture and, ordinarily, readjustment should not be necessary (para 7-15).

(3) The output of the fixed-frequency oscillator tube V1 is applied to tube V7 where it is amplified and applied to transformer T1. The output, which is developed across the primary of transformer T1, is induced into the secondary of this transformer and applied through a voltage divider consisting of resistors R30 and R34 to control grid 1 (pin 5), one of the two control grids of mixer tube V9.

b. Second Amplifier. The second amplifier consists of tube V8 and its associated circuit elements. This tube is self-biased by the voltage drop across cathode resistor R31. Screen voltage is applied through screen-dropping resistor R32, and the screen of tube V8 is bypassed by capacitor C24B. The output of variable-frequency oscillator tube V2 is applied to the control grid of tube V8. The amplified signal developed across plate load resistor R33 is coupled through capacitor C26 to control grid 3 (pin 8) of mixer tube V9.

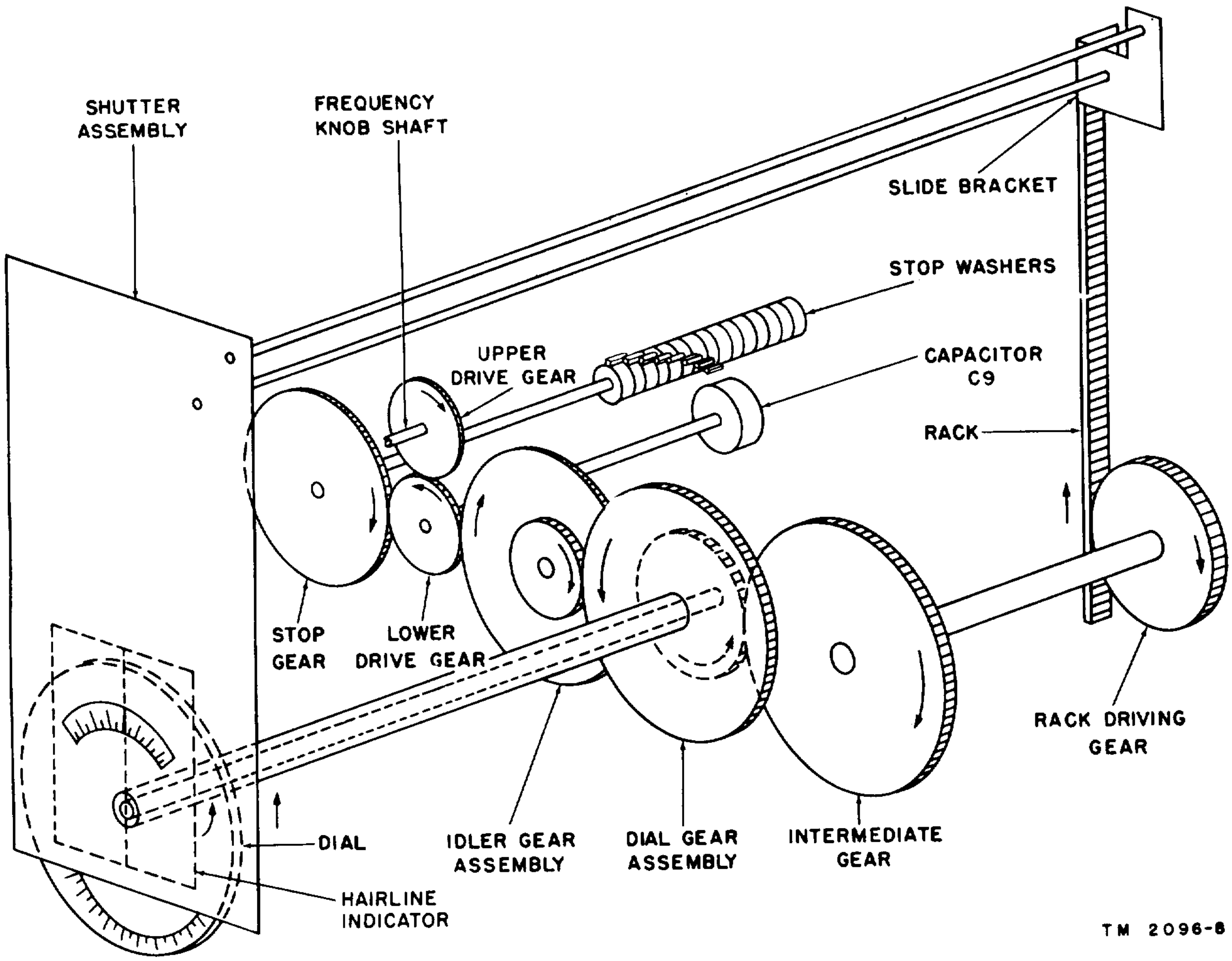


Figure 5-7. Signal Generator SG-15 (*)/PCM, oscillator gear assembly, simplified mechanical diagram

c. Mixer.

(1) The mixer consists of tube V9 and its associated circuit elements. The amplified 100-kc output of tube V7 is applied to control grid 1 (pin 5) of tube V9. Voltage-dividing resistors R34 and R30 and the secondary winding of transformer T1 provide d-c connection from this grid to ground. Grid bias is obtained from the voltage drop caused by the flow of current through the cathode resistor, which consists of resistors R38 and R39 in series. The signal from second amplifier tube V-100 kc to 135 kc, depending on the setting of the FREQUENCY control-is coupled through capacitor C26 and an a-c voltage divider consisting of resistors R35 and R36 to control grid 3 (pin 8) of mixer tube V9.

(2) Capacitor C27A serves as the r-f ground return for this voltage divider. Control grid 3 (pin 8) bias is obtained from the voltage drop resulting from current flow through resistor R39, one of the two series connected cathode resistors. Capacitor C28 is the cathode bypass capacitor. Further filtering of the d-c bias voltage for control grid 3 (pin 8) of tube V9 is provided by the network

comprised of resistor R37 and capacitor C27A. Resistor R41 is the screen-dropping resistor and capacitor C27B is the screen bypass capacitor. As a result of the application of the two signals to the' mixer, various signals are present at the plate of this tube. These are, principally the two applied signals-their sum and their difference, or the beat frequency. The output of the' plate circuit is coupled through capacitor C17 to the 0- to 40kc filter Z1. Resistor R40 is the plate load resistor of mixer V9.

5-8. Filter Z1

The output of mixer tube V9 is applied to 0- to 40-kc filter Z1 (fig. 5-9). This applied signal consists of both the desired beat frequency, which is the difference between the output of the variable-frequency oscillator and that of the fixed-frequency oscillator, and various undesired frequencies (the frequencies of the two respective oscillators, their sum, their harmonics, etc.). To be usable, the beat frequency must be separated from these undesired frequencies. This is accomplished by the 0- to 40-kc filter Z1. This filter is an inductance-capacitance network which presents a low-impedance path to frequencies in the 0- to 40-kc band and a very high impedance to others. Thus, the desired frequencies are passed by filter Z1 and all others are rejected. The output of the filter appears across FINE DBM potentiometer R11. This potentiometer is used as a voltage divider to permit adjustment of the amount of filter output voltage which is applied to third amplifier tube V3.

5-9.. Third Amplifier

The third amplifier consists of tube V3 and its associated circuit elements (fig. 5-9). This tube is self-biased by the voltage drop across, cathode resistor R13. Resistor R12 is the plate load resistor of tube V3.

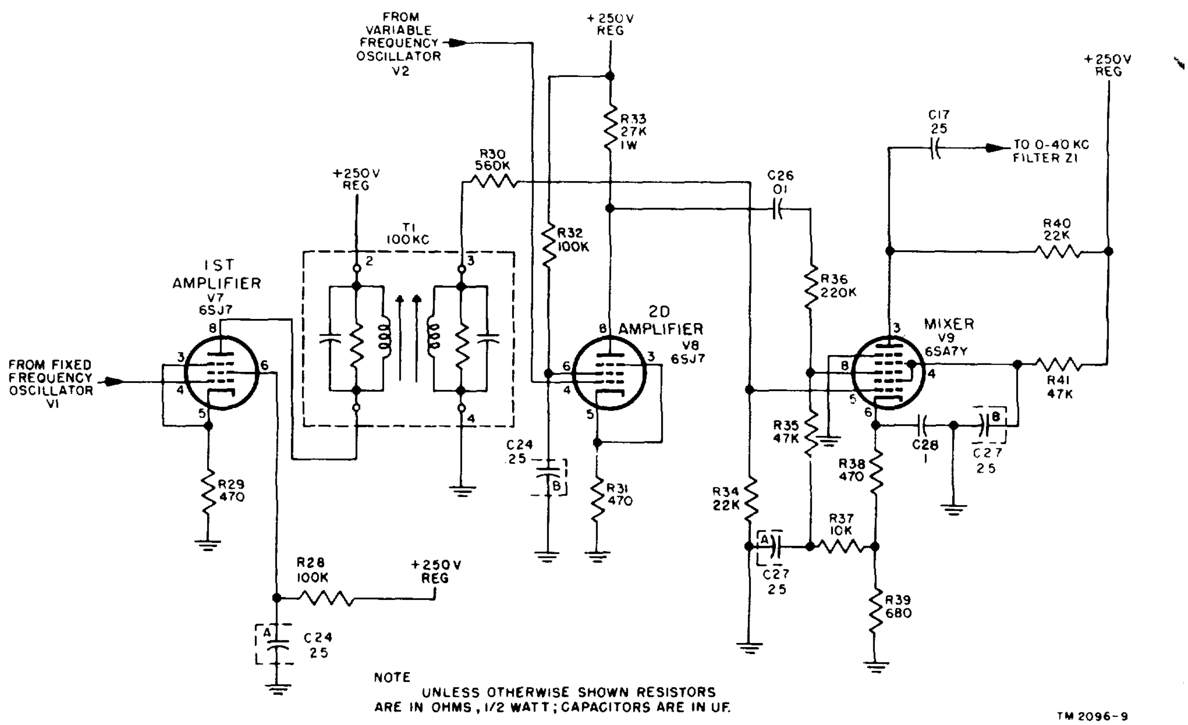


Figure 5-8. Signal Generator SG-15 (*)/PCM, amplifier and mixer circuits, schematic diagram.

The output of the 0- to 40-kc filter is applied through the FINE DBM control to the grid of tube V3. The amplified output signal of tube V3 is coupled through capacitor C18 to the grid of fourth amplifier tube V4A.

5-10. Fourth Amplifier and Phase Inverter

The fourth amplifier and phase inverter consists of tube V4 and its associated circuit elements (fig. 5-10). The first section of tube V4, designated V4A, is the fourth amplifier used to increase the amplitude of the signal applied from tube 3. The second section of tube V4, designated V4B, is the phase inverter. Tube V4B is used as an inverter and amplifier to produce a signal of the same amplitude but of opposite polarity to the output of tube V4A to drive a pair of push-pull power amplifier tubes, tubes V5 and V6.

a. Fourth Amplifier. The output of third amplifier tube V3 is coupled through capacitor C18 to the grid of fourth amplifier tube V4A. Resistor R14 is the grid resistor for tube V4A. Resistor R16 is the cathode bias resistor. Resistor R15 is the plate load resistor. The signal applied to tube V4A is amplified, and the output at the plate is applied through capacitor C19 to the control grid of power amplifier tube V5 and to voltage dividing resistors R21 and R22 in series. Negative feedback from the tertiary (terminals 4-5) of transformer T2 (para 5-11b) to the cathode of tube V4A improves frequency response and stabilizes operation.

b. Phase Inverter.

(1) The signal from fourth amplifier tube V4A, impressed on voltage dividing resistors R21 and R22, is coupled through capacitor C20 to the grid of tube V4B. This signal is amplified and inverted by tube V4B, and the output at the plate is coupled through capacitor C21 to the control grid of power amplifier tube V6.

(2) The output of tube V4A passes through capacitor C19 to resistors R21 and R22, which form an a-c voltage divider for tube V4A (a above); the output of tube V4B passes through capacitor C21 to resistors R23 and R22, which form an a-c voltage divider for tube V4B. The out

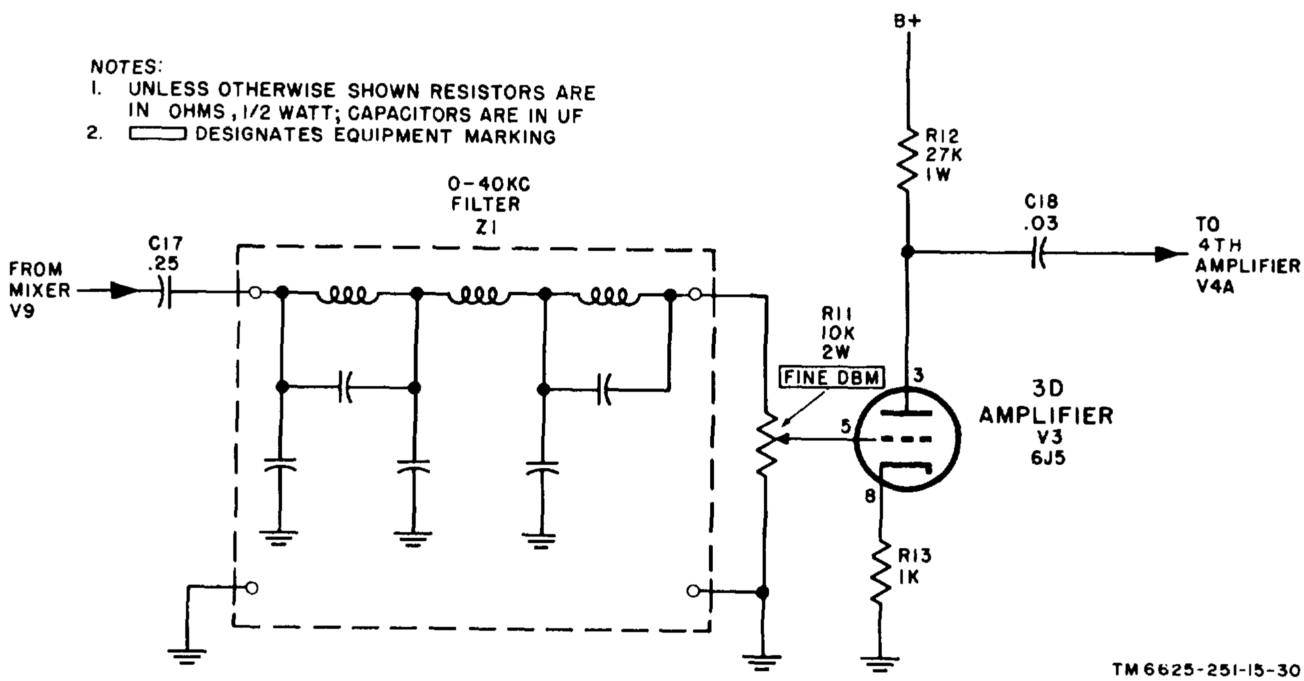


Figure 5-9. Signal generator SG-15 (*) /PCM, filter and third amplifier, schematic diagram.

put of both tubes, V4A and V4B, appears across resistor R22. Since the signal voltage across resistors R21 and R23 are always of opposite polarity, the voltage across resistor R22 is the difference between the two applied voltages.

(3) Normally, the voltage across resistor R22 is very small. The circuit constants are such that, under normal conditions, the voltages applied to the grids of tubes V5 and V6 are equal in amplitude and opposite in phase. If any unbalance should occur between the circuits of tubes V4A and V4B, however, thus causing a variation in output of one of the two tubes, the voltage drop across resistor R22 would increase or decrease in a direction tending to counteract the effect of the unbalance. For example, if the amplitude of the signal at the plate of tube V4B should decrease, the voltage drop caused by this signal across resistor R22 would decrease and the signal applied to tube V4B would be greater. This would increase the output of tube V4B and re-establish the balance between the two circuits. Likewise, if the output of tube were to increase, it would tend to cancel out more of the signal from tube V4A across resistor R22. Thus, the input to the tube V4B would be decreased, tending to reduce the output of tube V4B and to re-establish

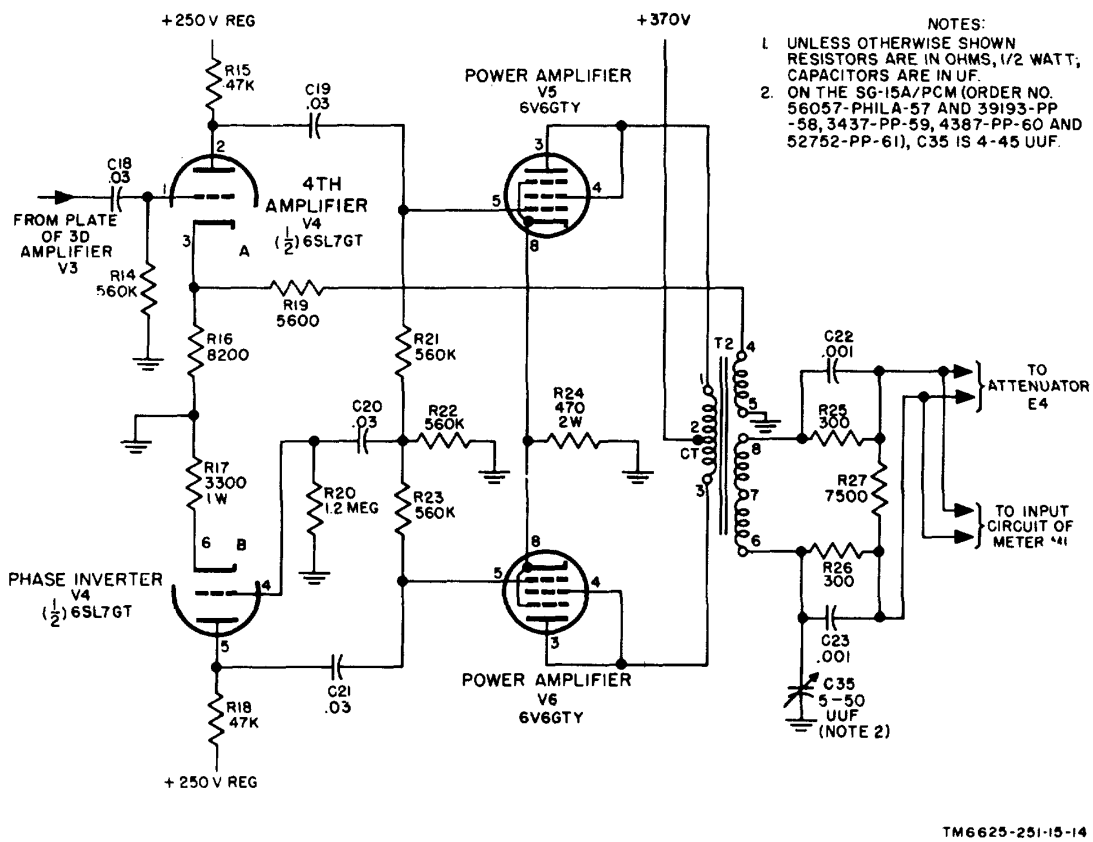


Figure 5-10. Signal Generator SG-15 (*)/PCM, fourth amplifier, phase inventer and power amplifier circuits, schematic diagram.

the balance between the two circuits.

5-11. Power Amplifier Stage and Meter Rectifier Circuit

The power amplifier stage (fig. 5-10) consists of power amplifier tubes V5 and V6, transformer T2, and their associated circuit elements.

a. Power Amplifier Tubes V5 and V6. Tubes V5 and V6 are two type 6V6GTY beam-power tubes connected as push-pull power amplifiers. The signal from tube V4A is applied to the control grid of tube V5. The signal from tube V4B is applied to the control grid of tube V6. These signals are equal in amplitude and opposite in phase. Resistors R21 and R23 act as the grid resistors for tubes V5 and V6, respectively, with resistor R22 in common for both tubes (para 5-10b(2)). Resistor R24 is the common cathode' resistor. Tubes V5 and V6 are operated as triodes with the screens tied to the plates. A +370-volt unregulated d-c voltage is supplied to the plate's from the power supply through the center tap of the primary of output transformer T2. The applied signals are amplified in tubes V5 and V6, and a push-pull output is developed across the primary of output transformer T2.

b. Output and Meter Rectifier Circuits.

(1) The signal impressed across the primary of output transformer T2 causes a corresponding signal to be induced in the secondary winding (terminals 6-8) of this transformer. A tertiary winding (terminals 4-5) is connected in a negative feedback arrangement, through resistor R19, to the cathode of fourth amplifier tube V4A. This negative feedback reduces the output impedance of transformer T2 (terminals 6-8) to approximately 100 ohms. Resistors R25 and R26, together with capacitors C22 and C23 and resistor R27, from an output impedance network. The impedance in the output circuit, looking back from the input to attenuator E4, combine to equal a balanced 600 ohms. The output impedance balance is adjusted at the time of manufacture by capacitor C35.

(2) The signal from the output impedance network consisting of resistors R25 and R26, capacitors C22 and C23, and resistor R27 goes through COARSE DBM attenuator E4 (fig 5-11). This attenuator has a balanced impedance of 600 ohms in the frequency range of 200 cycles through 35 kc. The attenuator has eight steps of attenuation of 10 db per step from 0 through 70 db, and a ninth step which short-circuits the output terminals. The output is taken either at OUTPUT terminals E1 and E2, or at OUTPUT jack J1 which is connected in parallel with the OUTPUT terminals. GND terminal E3 is the chassis ground connection.

(3) OUTPUT LEVEL meter M1, complete with a crystal diode full-wave bridge-type rectifier consisting o f CR1, CR2, CR3, and CR4, monitors the input voltage applied to attenuator E4 (fig. 5-11). Series resistors R42 and R43 reduce the bridging loss of this connection with respect to the transmission path through attenuator E4 and apply the proper voltage to the rectifier circuit. Signals entering this rectifier circuit are passed on to OUTPUT LEVEL meter M1. This meter is a d-c milliameter with a 0- to 1-ma range. It has a single scale calibrated from -4 to + 6 db. The response of the metering circuit is flat over the entire output frequency range of the signal generator. Initial calibration of the metering circuit is accomplished by adjustment of potentiometer R44. This adjustment is made at the time' of manufacture. Resistor R52 is an accurate, fixed, film resistor which shunts resistor R44 and meter M1.

(4) The output power of the signal generator is the sum of the setting of the COURSE DBM control (-50 through +20 dbm graduated in steps of 10 db) and the reading of OUTPUT LEVEL meter M1 (-4 through + 6 db).

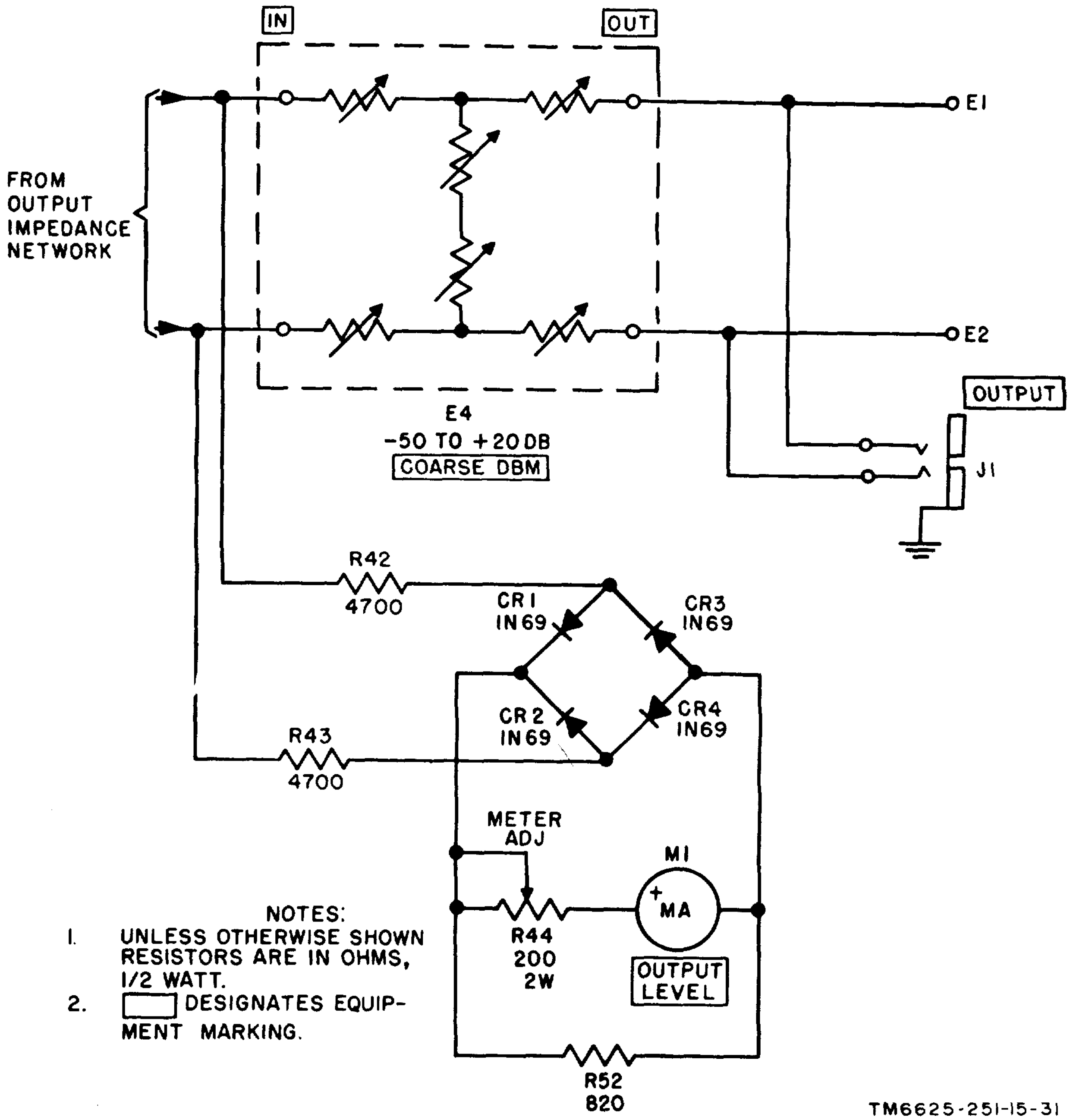


Figure 5-11. Signal generator SG-15(*)/PCM, output and meter rectifier circuit, schematic diagram.

5-12. Power Supply Circuits

a. General. Signal Generator SG-15(*)/ PCM is provided with an internal power supply which furnished +370 volts unregulated voltage for tubes V5 and V6, +250 volts regulated voltage for tubes V1 through V4 and V7 through V9, and filament voltage for all the tubes used in the signal generator.

b. Rectifier Power Circuit.

(1) Input.

(a) Primary, transformer T3. Line voltage is applied to the primary of power transformer T3 when power ON-OFF switch S2 is in the ON position (fig. 5-12). This switch is a double-pole, single-throw toggle switch mounted on the front panel of the generator. The primary of transformer T3 consists of two separate windings which are connected by means of PRIMARY VOLTAGE switch S1. This is a double-pole, double-throw toggle switch mounted on the front panel of the generator with positions designated 115V and 230V. 'When switch S1 is set to the 115V position, the two sections of the transformer primary are connected in parallel for use with 115-volt line. When the switch is in the 230V position, the two transformer primary windings are connected in series for use with a 230-volt line. Fuse Fl is connected in series with one side of the line and the primary windings of transformer T3 to protect this circuit from overload.

(b) Secondary, Transformer T3. Transformer T3 has four secondary windings. The high-voltage winding (taps 5-6-7) is center-tapped and applies 750 volts at 110 ma across the plates of rectifier tube V13. Three filament windings deliver the following voltages: winding A (taps 12-13) delivers 2 amperes at 5 volts to the filament of tube V13, winding B (taps 10-11) delivers .9 ampere at 6.3 volts to the filament of tube' V12, and winding C (taps 8-9) delivers 3.6 amperes at 6.3 volts to the filaments of the remaining tubes, which -re connected in parallel. Indicator lamp I 1, located on the front panel of the generator, is connected across winding C and lights when power is applied to the signal generator.

(2) Rectifier. Rectifier tube V13 is a type 5Y3GT full-wave rectifier. The 750 volt output of the high-voltage secondary (taps 5-7) of transformer T3 is applied across the plates of tube V13. These plate's conduct alternately on each half-cycle of the applied voltage and a pulsating d-c appears at their common filament. This rectified voltage is applied to a filter network.

(3) Filter network. The rectified voltage at the filament of tube V13 is applied to the filter network, a pi-type capacitor input network consisting of capacitor C34, choke coil L3, and capacitor C33. This network reduces the ripple content in the' pulsating d-c output of the rectifier. The + 370-volt output of the filter network is applied to tubes V5 and V6 through the center tap of the primary of output transformer T2 and to tubes V10 and V12 of the regulated + 250-volt power supply.

c. Regulator +250-Volt Power Supply. The regulated +250-volt power supply consists of voltage control tube V12, voltage control amplifier V10, voltage control regulator V11, and their associated circuit elements (fig. 5-13). This circuit provides a regulated output of +250 volts which is independent of wide fluctuations in either the applied voltage or the load.

(1) Voltage control tube V12. Voltage control tube V12 is a type 6L6GAY beam-power tube connected as a triode with the screen tied to the plate. The cathode of this tube is the' output point of the circuit. A voltage divider consisting of resistor R49, B + ADJ potentiometer R50, and resistor R51 in series is connected between this point and ground. Plate voltage' is supplied by the +370-volt output of the rectifier filter.

(2) Voltage control amplifier V10. The voltage control amplifier tube V10 is a 6SQ7 duplex-diode high-mu triode. Only the triode section of this tube is used and shown in figure 5-13.

The two diode plates are grounded and do not function in this circuit. The grid of tube V10 is connected to the movable arm of B + ADJ potentiometer R50. This potentiometer is set to apply slightly less than 105 volts from the voltage divider to the grid of tube V10. This places the grid at a small negative bias, because the cathode is held at approximately +105 volts by voltage control regulator tube V11, which is connected between the cathode of tube V10 and ground. The setting of potentiometer R50 thus sets the operating level of the circuit. Any change in the voltage across the voltage divider. whether due to fluctuations in the output of the rectifier or changes in the load, is applied to the grid of tube V10. Capacitor C32 applies the full voltage change to the grid at once; without this capacitor, every change in grid voltage would be subject to a time delay. Any change in grid voltage is applied to the grid of tube V12; this causes a change in conduction in tube V12 in a direction to compensate for the original voltage fluctuation. Resistor R48 is the plate load resistor of tube V10.

(3) Voltage control regulator. Voltage control regulator tube V11 is a type OC3/VR105 glow discharge tube connected between the cathode of tube V10 and ground. The internal resistance of this tube varies inversely with the applied voltage so that tube V11 maintains the cathode of tube V10 constantly at + 105 volts. Resistor R47 drops the applied voltage to the level required for proper operation of tube V11. Capacitor C25 provides additional filtering of the output voltage.

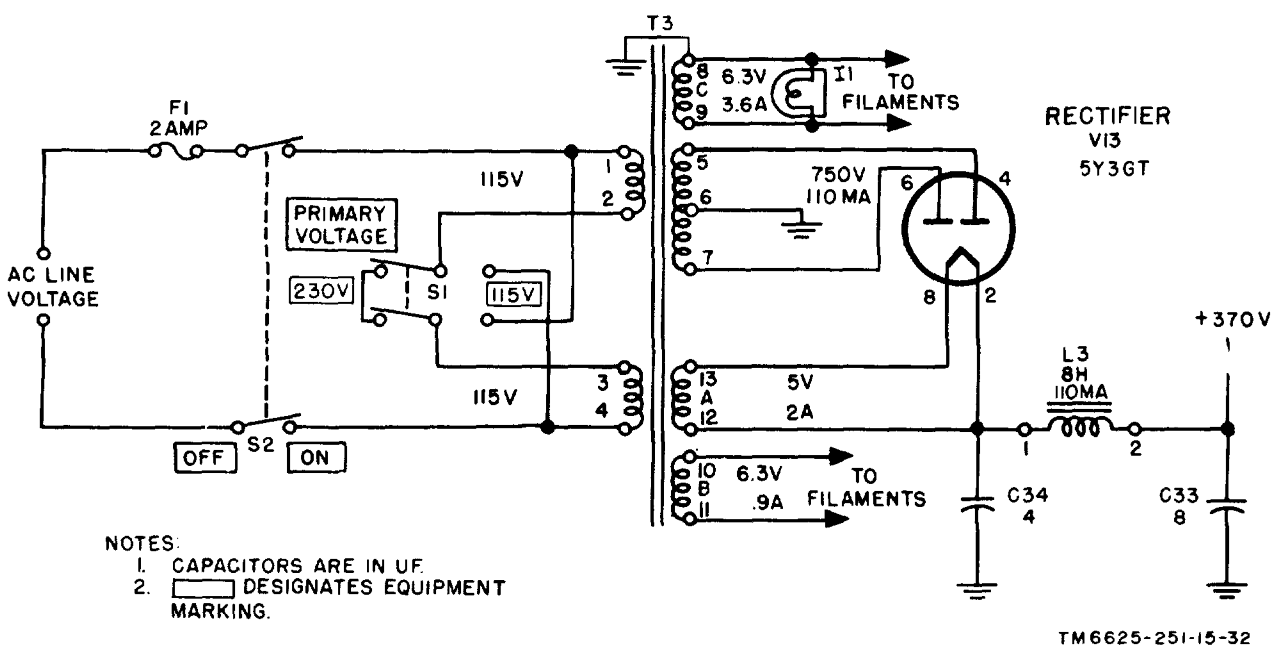


Figure 5-12. Signal Generator SG-15 (*)/PCM, rectifier power circuit, schematic diagram.

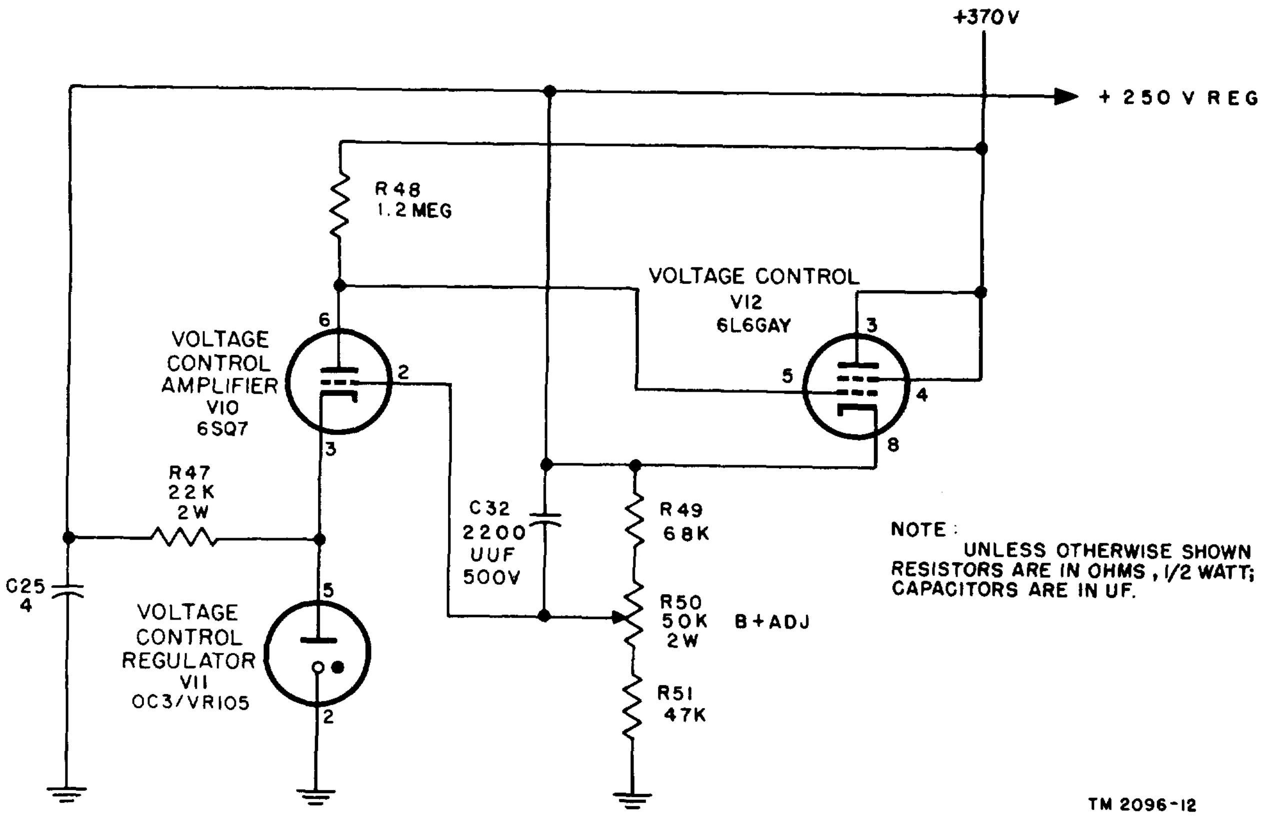


Figure 5-13. Signal Generator SG-15(*)/PCM, regulated + 250-volt power supply circuit, schematic diagram.

Section III. FUNCTIONING OF DECIBEL METER ME 22(*)/PCM

5-13. Input Circuit

The input circuit (fig. 5-14) consists of an impedance-adjusting arrangement, an input transformer, and associated circuit elements. The signal from the equipment under test is applied either across INPUT terminals El and E2 or to the parallel-connected INPUT jack J1, as required. INPUT IMPEDANCE switch S1, a double-pole, double-throw switch, provides a choice of two input impedances. When this switch is set to the 600 OHM position, resistor R1 is connected across the primary of transformer T1 and capacitor C2 is connected to the center tap of the primary of this transformer; this results in an input impedance of 600 ohms. When switch S1 is set to the BRIDGING position, resistor RI and capacitor C2 are disconnected and the full 8,000-ohm impedance of the primary of transformer T1. is used. Capacitor C1 provides an adjustment of the input impedance balance. Transformer T1 is an audio-input transformer which provides a flat response over the range of 200 to 35,000 cps The input impedance is determined by resistor R2 and capacitor C3. These elements have fixed values and are selected to compensate for differences in the transformer iron cores. Resistor R2 and capacitor C3 are omitted from Decibel Meter ME-22A/PCM.

5-14. Voltage Divider

The voltage divider formed by resistors R3 and R4 (fig. 5-14), together with DBM switch S2, provides a means of setting the meter to the required operating level. Resistors R3 and R4 are connected in series across the secondary of transformer T1. These resistors form a

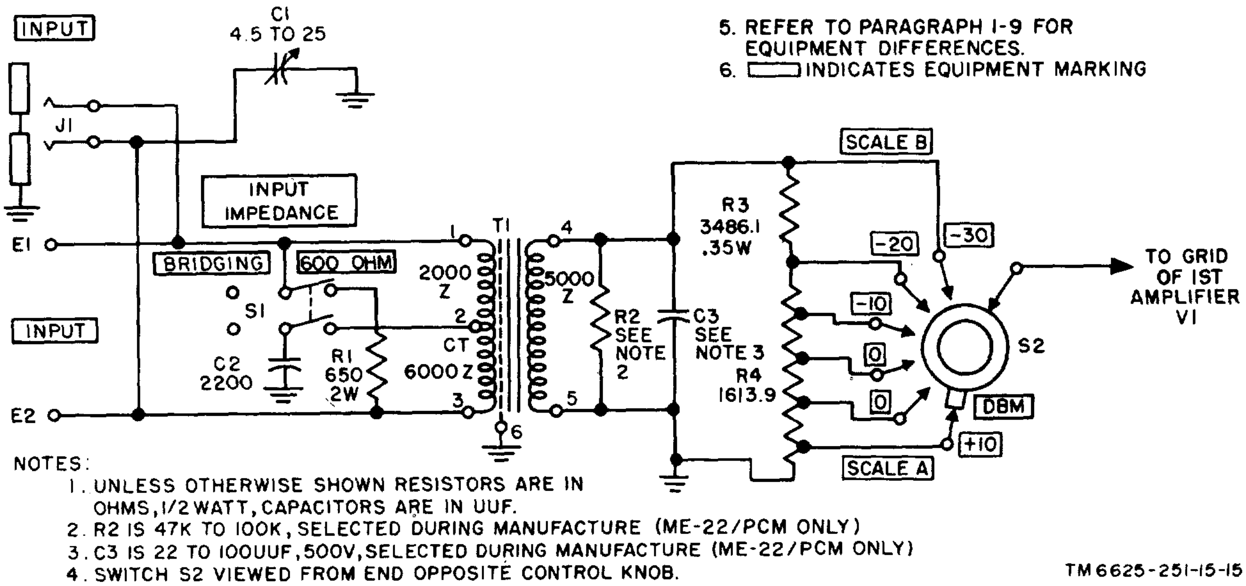


Figure 5-14. Decibel Meter ME-22(*)/PCM, input circuit, schematic diagram.

voltage divide which permits the application of different amounts of the energy from the transformer secondary to the grid of first amplifier tube V1. Resistor R4 is tapped at four points. The voltage divider is arranged in two scales, A and B, which correspond to the two calibrated scales of meter M1.

5-15. Amplifier Circuit

a. First Amplifier. The first amplifier (fig. 5-15) consists of tube V1 and its associated circuit elements. The attenuated signal is coupled directly from DBM switch S2 to the grid of tube V1. Grid bias is obtained through the voltage drop across cathode resistor R5. Plate and screen voltages are obtained from the +220-volt regulated power supply. Resistor R7 is the plate load resistor. Resistor R6 is the screen-dropping resistor, and capacitor C4A is the screen bypass capacitor. The amplified signal at the plate of first amplifier tube V1 is applied to second amplifier tube V2.

b. Second Amplifier. The second amplifier consists of tube V2 and its associated circuit elements (fig. 5-15). The output of first amplifier tube V1 is coupled through capacitor C5 to the grid of second amplifier tube V2 Resistor R8 is the grid leak resistor. Grid bias is obtained through the voltage drop across resistor R9, potentiometer R10, and resistor R11, which are connected in series to form the cathode resistor. Plate and screen voltages are obtained from the regulated +220-volt power supply. Resistor R13 is the plate load resistor, resistor R12 is the screen-dropping resistor, and capacitor C4B is the screen bypass capacitor. The movable arm of CAL ADJ potentiometer R10 is connected to the meter rectifier circuit (para 5-16). The amplified signal at the plate of second amplifier tube V2 is applied to third amplifier tube V3.

c. Third Amplifier. The third amplifier consists of tube V3 and its associated circuit elements (fig. 5-15). The output of second amplifier tube V2 is coupled to the grid of third amplifier tube V3 through capacitor C6. Resistor R14 is the grid leak resistor. Grid bias is obtained through the voltage drop across cathode resistor R15. Resistors R16 and R17, connected in parallel, form the plate load resistor. These resistors are rated at 2 watts each, and the parallel combination is used to provide sufficient wattage to dissipate the' heat generated by the high current in this circuit. Plate and screen voltages are supplied directly from the + 450-volt output of the power supply filter formed by coil L1 and capacitors C10 and C11. The amplified signal at the plate of tube V3 is applied to meter rectifier tube V4.

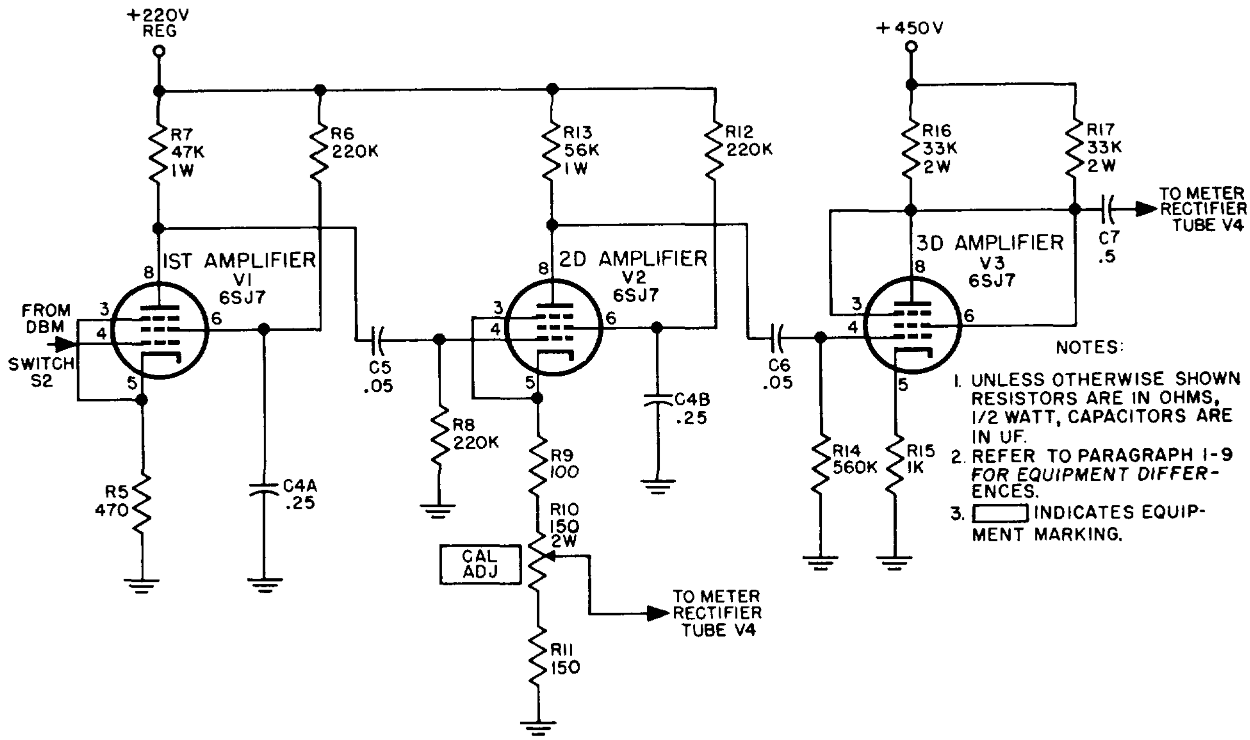


Figure 5-15. Decibel Meter ME-22(*)/PCM, amplifier circuit, schematic diagram.

5-16. Meter Rectifier Circuit

The meter rectifier circuit consists of tube V4, meter M1, and associated circuit elements. Meter rectifier tube V4 is connected in a bridge circuit with resistors R19 and R20 and meter M1. Figure 5-16 shows a simplified schematic diagram of this circuit. The two sections of tube V4 are designated V4A and V4B for convenience in this discussion.

a. The signal at the plate of third amplifier tube V3 is applied through capacitor C7 to one side of the rectifier circuit, point A in figure 5-16. The voltage at the movable arm of CAL ADJ potentiometer R10 is applied to the other side of the rectifier circuit, point B in figure 5-16. The voltage applied from the plate of tube V3 and the voltage from the cathode of second amplifier tube V2 are in phase. The applied voltage across the rectifier circuit is alternately positive and negative. When the voltage at point A is positive with respect to point B, current flows through resistor R19, meter Ml, and tube V4A into capacitor C7. When point A is negative with respect to point B, current flows out of capacitor C7 through resistor R20, meter M1, and tube V4B into the cathode circuit of second amplifier tube V2. Thus, the applied signal is rectified and current always flows in the same direction through meter M1. Resistor R18 is connected in parallel with the actual rectifier circuit.

b. The current through the bridge circuit, plus the current through resistor R18, flows through resistor R11 and part of potentiometer R10. This produces a negative feedback voltage in the cathode circuit of second amplifier tube V2. The magnitude of this feedback voltage is controlled by the setting of the movable arm of CAL ADJ potentiometer R10.
When the movable arm is nearest to ground, the feedback voltage is at its minimum amplitude and the net gain of tube V2 is at a maximum. As a result, the signal from the plate of third amplifier tube V3, the voltage applied to the rectifier circuit, and the rectified current through meter MI are at a maximum. Thus the setting of CAL ADJ potentiometer R1() is used to adjust the 0-dbm level of the meter.

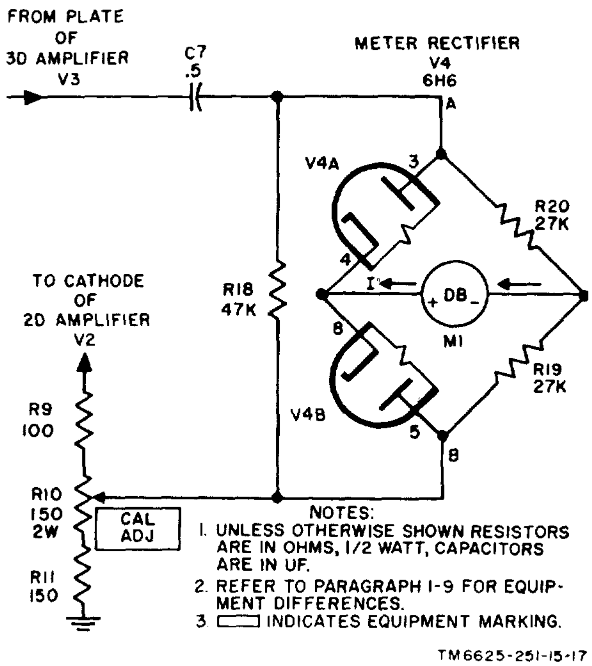


Figure 5-16. Decibel Meter ME-22(*)/PCM, meter rectifier circuit, simplified schematic diagram.

5-17. Power Supply Circuits

Decibel Meter ME-22(*)/PCM is provided with an internal power supply which furnishes +450 volts unregulated for third amplifier tube V3, +220 volts regulated for first and second amplifier tubes V1 and V2, and filament voltage for all the tubes used in the decibel meter.

a. Rectifier Circuit.

(1) Input. The line voltage is applied to the primary of power transformer T2 (fig. 5-17) when power ON-OFF switch S4 is in the ON position. The primary of transformer T2 consists of two separate windings which are connected by PRIMARY VOLTAGE switch S3. This switch has two positions designated 115 and 230. When switch S3 is set to the 115 position, the two sections of the primary of transformer T2 are connected in parallel for operation with a 115-volt power supply. With the switch set to the 230 position, the two transformer primary windings are connected in series for operation with a 230-volt power supply. Fuse F1 is connected in series with one side of the line and the primary windings of transformer T2 to protect this circuit frond overload. Transformer T2 has form secondary windings, a high-voltage, winding and three filament windings. The high-voltage winding 11-12-13 is center-tapped and applies 750 volts at 50 ma across the plates of rectifier tube V8. The three filament windings deliver the following voltages: winding 9-10 delivers 5 volts at 2 amperes to the filament of tube V8, winding 7-8 delivers 6.3 volts at .9 ampere to the filament of tube V5, and winding 5-6 delivers 6.3 volts at 1.8 amperes to the paralleled-connected filaments of tubes V1, V2, V3, V4, and V7. Indicator light I 1, which is connected across winding 5-6, lights when power is applied to the decibel meter.

(2) Rectifier tube V8. The 750-volt output of the secondary of transformer T2 is applied across the plates of rectifier tube V8. These plates conduct alternately on each half-cycle of the applied voltage. The +450 volt rectified voltage developed between filament and ground is applied to a filter network.

(3) Filter network. The filter network is a pi-type network consisting of capacitor C11, choke coil L1, and capacitor C10. This network reduces the ripple content in the pulsating d-c output of rectifier tube V8. The +450-volt output of the filter network is applied to third amplifier tube V3, voltage control tube V5, and voltage control amplifier tube V7.

b. Regulated +220-Volt Power Supply. The regulated +220-volt power supply (fig. 5-18) consists of voltage control tube V5, voltage control amplifier tube V7, voltage control regulator tube V6, and associated circuit elements. This circuit provides a regulated output of

+ 220 volts (+ 150 to + 300 volts, normally adjusted to +220 volts) which is virtually independent of fluctuations in either the applied voltage or the load.

(1) Voltage control tube V5. The output of voltage control tube V5 is connected to ground through a voltage divider which consists of resistor R25, B+ ADJ potentiometer R26, and resistor R27 connected in series. Plate voltage is supplied by the +450 volt output of the rectifier filter.

(2) Voltage control amplifier tube V7. Only the triode section of voltage control amplifier tube V7 is used; the two diode plates are grounded and do not function. The grid of tube V7 is connected to the movable arm of B + ADJ potentiometer R26. Potentiometer R26 is set to apply slightly less than + 105 volts from the voltage divider to the grid of tube V7 in the steady-state condition. This places the grid at a small negative bias since the cathode is held at approximately +105 volts by voltage-control regulator tube V6 which is connected between the cathode of tube V7 and ground. The setting of B + ADJ potentiometer R26 thus sets the operating level of the circuit. Any change in the voltage across the voltage divider, whether due to fluctuations in the output of the rectifier or changes in the load, is applied to the grid of tube V7. Capacitor C9 applies the full change to the grid at once. Without capacitor C9, there would be a slight time delay, and then the voltage from ground to the arm of potentiometer R26 only would be applied to the grid of tube V7. Any change in grid voltage is amplified by tube V7, and the output at the plate is applied to the grid of tube V5. This causes a change in conduction in tube V5 in a direction to compensate for the original voltage fluctuation. Resistor R28 is the plate load resistor of tube V7.

(3) Voltage control regulator tube V6. Voltage control regulator tube V6 is connected between the cathode of tube V7 and ground. The internal

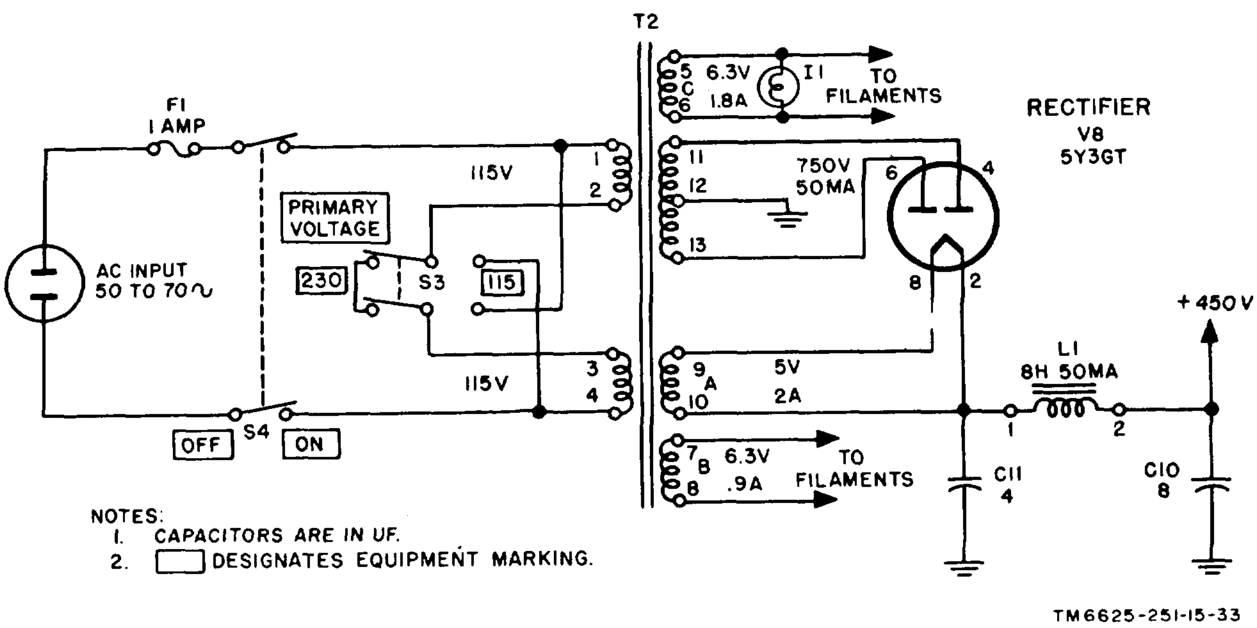


Figure 5-17. Decibel Meter ME-22(*) /PCM rectifier circuit schematic diagram.

resistance of this tube varies inversely with the applied voltage so that tube V6 maintains the cathode of tube V7 constantly at + 105 volts. Resistor R24 drops the applied voltage to the level required for proper operation of tube V6. Capacitor C8 provides additional filtering of the output voltage.

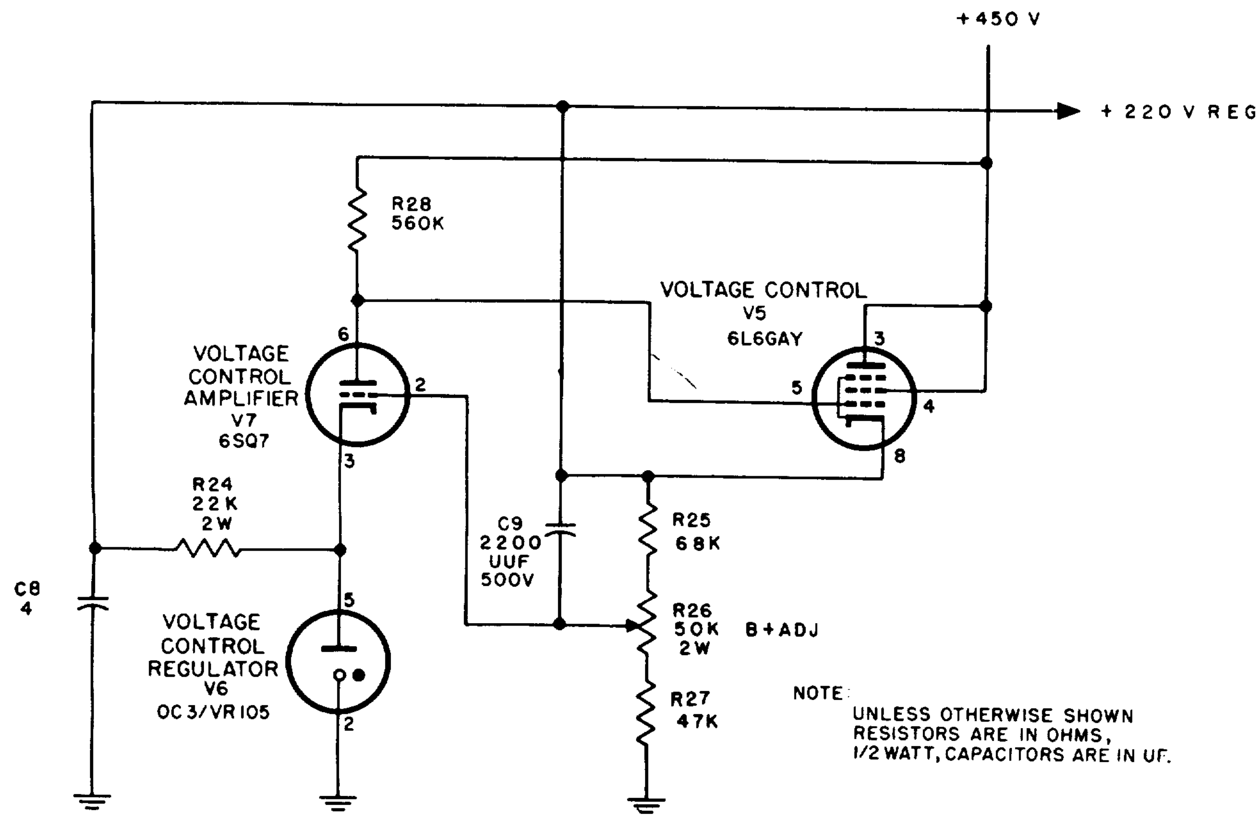


Figure 5-18. Decibel Meter ME-22(*)/PCM, regulated +220-volt power supply circuit, schematic diagram.

CHAPTER 6

TROUBLESHOOTING

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

Warning
High voltage is used in the operation of this equipment.
Death or serious injury may result if operating personnel do not observe safety precautions.

6-1. General Instructions

Troubleshooting at general support and depot maintenance levels include all the techniques outlined for organizational maintenance and any special or additional techniques required to isolate a defective part. Paragraphs 6-8 through 6-10 provide troubleshooting charts for the Signal Generator SG-15(*)/ PCM and Decibel Meter ME-22(*)/PCM for use by general support maintenance personnel. Paragraphs 6-11 through 6-13 outline the techniques to be used for circuit tracing in the SG-15(*)/PCM and the ME-22(*)/PCM. The test equipment needed for troubleshooting the Test Set TS-140/PCM is adequate to trace the circuits.

6-2. Organization of Troubleshooting Procedures

The first step is locating a fault in defective equipment is to sectionalize the fault.
Sectionalization means tracing the fault to the circuit or stage responsible for the abnormal operation. The second step is to localize the fault-that is, to trace it to the defective part responsible for the abnormal operation. Careful observation of the performance of the signal generator or decibel meter may aid in the sectionalization of a fault to a particular circuit or stage. For example, meter readings under various conditions of operation may indicate whether various switches or controls and their associated circuits are functioning properly. Failure of a pilot lamp to light may indicate trouble in the power supply circuit of the unit in which the lamp is used. Some faults can be located by smell, sight, or hearing, such as burned-out resistors, arcing, or shorted transformers. However, the majority of faults must be localized by checking voltage and resistance. The tests outlined below and discussed in paragraphs 6-6 and 6-7 will help to isolate the source of trouble.

a. Visual Inspection. Carefully inspect the equipment to be sure there is no mechanical binding of switches and controls which might damage the equipment. As instructed in paragraph 7-3a, make a visual inspection of the equipment for any sign of damage such as loose or missing screws, nuts, and bolts, loose or poorly soldered connections, dirty jack contacts, overheated resistors, damaged insulation exposed wiring which might cause short circuits with other wiring, terminals, or ground. Through such visual inspection, frequently it is possible to discover the trouble or to determine in which circuit the trouble exists. In addition, visual inspection is valuable in that further damage to the equipment as a result of improper maintenance methods may be avoided and future failures forestalled.

b. Power Supply Test. The power supply test for the signal generator (para 6-6a) or the decibel meter (para 6-6b) prevents further damage to the equipment from possible short circuits in the power supply circuit.

c. Operational Test. The operational test (para 6-7) may indicate the general location of trouble in the signal generator or decibel meter. In many instances, the information obtained will determine the exact location of the fault. So that this information may be utilized fully, all symptoms must be interpreted in relation to one another.

d. Troubleshooting Chart. Trouble symptoms in the signal generator or decibel meter can be sectionalized and, in some cases, localized by checking the symptoms on the applicable troubleshooting chart para 6-9 or 6-10).

e. Intermittent Conditions. When making the tests and inspections outlined in a through d above, do not overlook the possibility of intermittent trouble. If an intermittent trouble is present, try to make it appear by tapping or jarring the equipment. The trouble may not be in the signal generator or decibel meter but in the installation, in the power cable or output or input connection, or the trouble may be caused by external conditions such as the power source. Test for such conditions if possible.

63. Troubleshooting Data

Several factors must be considered before proceeding with the actual location of trouble. A knowledge of the functioning of the equipment and the theory of operation is necessary for properly applying the techniques of troubleshooting. Detailed functioning of Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM is covered in paragraphs 5-4 through 5-12 and 5-13 through 5-17 respectively. The troubleshooting charts for the signal generator (para 6-9) and the decibel meter (para 6-10) are intended to provide step-by-step procedures that can be used as references when attempting to locate trouble in the equipment. Consult the following troubleshooting data when necessary:

a. Complete schematic diagrams (figs. 5-3 and 10-4).

b. Functional block diagrams (figs. 5-1 and 5-2).

c. Partial schematic diagrams (figs. 5-4 through 5-18).

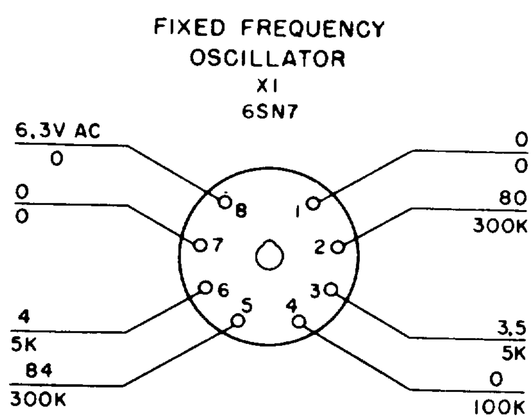
d. Theory of operation (paras 5-4 through 5-17).

e. Tube socket voltage and resistance diagrams (figs. 10-1, 6-1, and 6-2).

f. Illustrations showing location of parts (figs. 7-1 through 7-8 and 7-10 through 7-14).

g. Wiring diagrams (figs. 7-4, 7-8, 10-5, 10-6, 10-7, and 10-8).

h. Illustrations showing resistor and capacitor color codes (figs. 10-1 and 10-2).



NOTES:
1 ALL READINGS TAKEN FROM PINS TO GROUND WITH TUBES IN SOCKETS
2 ALL READINGS DC, EXCEPT AS NOTED
3 RESISTANCE MEASUREMENTS TAKEN BY OHMMETER WITH POWER SUPPLY CABLE DISCONNECTED.
4 VOLTAGE MEASUREMENTS TAKEN WITH 20,000 OHMS-PER-VOLT VOLTMETER.

Figure 6-1. Tube socket voltage and resistance diagram for fixed- frequency oscillator V1. Signal Generator SG-15A/PCM.

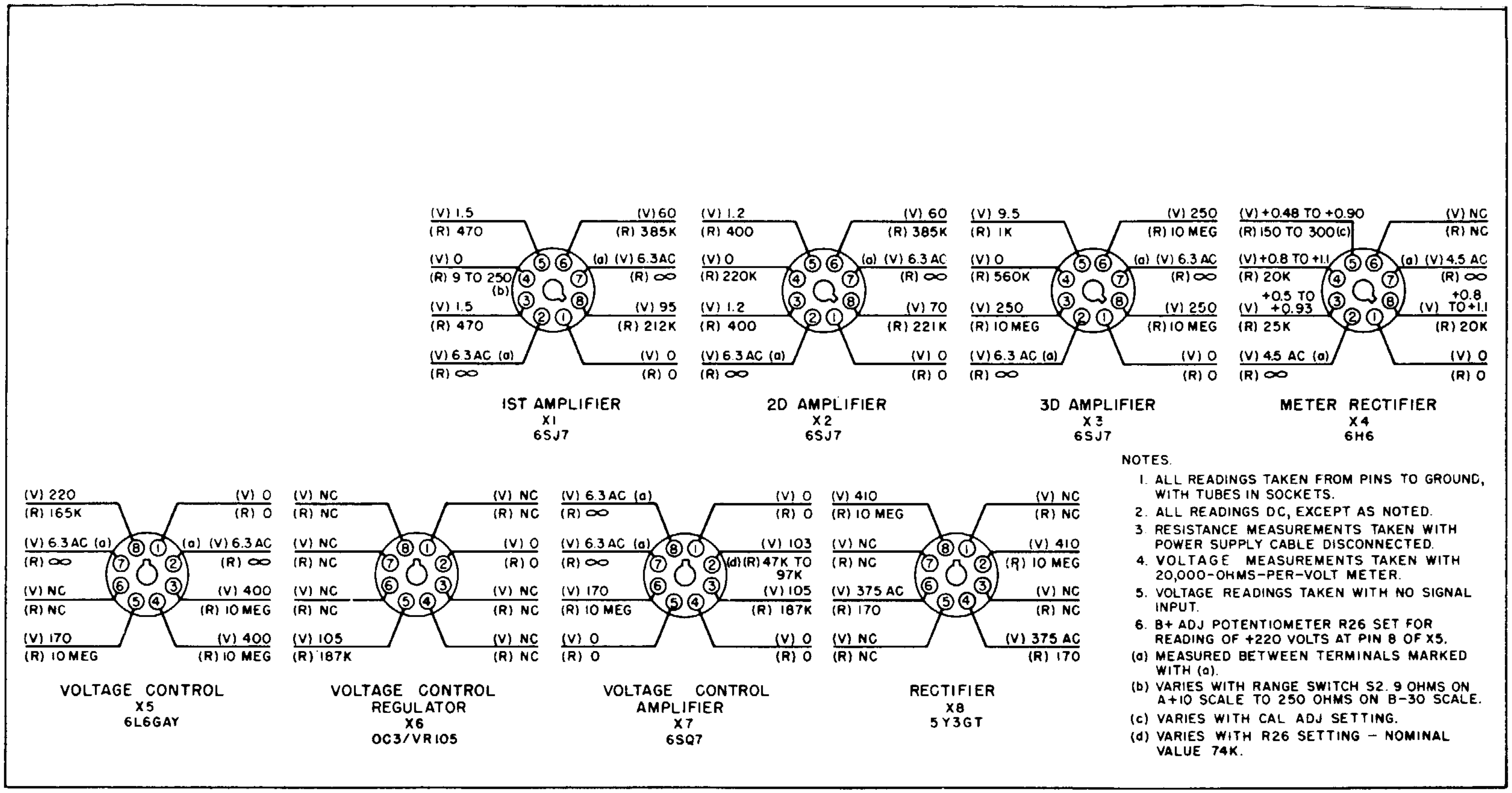


Figure 6-2. Decibel Meter ME-22(*)/PCM, tube socket voltage and resistance diagram.

6-4. Test Equipment Required for Troubleshooting

a. Signal Generator SG-15(*)/PCM. The test equipment listed below is required for troubleshooting Signal Generator SG-15(*)/ PCM:

(1) Voltmeter ME-30A/U (TM 11-6625-320-12).

(2) Frequency Meter AN/TSM-16 (TM 11-6625-218-12).

(3) Multimeter TS-352/U (TM 11-5527).

(4) Tube Tester TU-7( )/U (TM 11-6625-274-12).

b. Decibel Meter ME-22(*)/PCM. With the exception of Frequency Meter FR-67/U, the same test equipment used for trouble shooting the signal generator (a above) is used when testing the decibel meter for trouble. The only other equipment required is a source of testing power such as Signal Generator SG-15(*)/PCM or another signal generator or audio oscillator in the same frequency range.

6-5. Precautions

Certain precautions should be observed when Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM are being repaired. Observing these rules during the repair process may save time and future repair of the equipment. Special precautions pertaining only to the signal generator or to the decibel meter are given in b and c below:

a. General Precautions.

(1) Only competent personnel supplied with adequate tools and equipment are authorized to service and to repair this equipment. An inexperienced operator attempting to make repairs may damage the equipment to such an extent that major repairs may be necessary rather than the original minor repairs. Careless replacement of parts often makes new faults inevitable.

(2) Test tubes before making any repair. Tubes are the most common cause of trouble.

(3) When removing and replacing defective parts and circuit elements, be careful not to damage leads or other parts by pulling or pushing them out of the way. Before attempting repairs, make sure that proper tools and test equipment are available.

(4) Make a careful record of the connections to each part removed and of the position of each part in the unit. Keep all leads as short as possible. Be sure to use the same ground point as was used in the original wiring. Avoid using more solder than is necessary to make a sure connection. Solder carelessly dropped in the unit may cause short circuits which will create a new fault. It is very important to make well-soldered joints since a poorly soldered joint is one of the most difficult faults to find.

(5) When replacing a part, place the new part exactly as the original part was placed. Use leads of the same length as the original leads.

b. Precautions for Signal Generator SG-15 (*)/PCM.

(1) All the parts of the signal generator, with the exception of the oscillator assembly gears and main tuning capacitor, can be reached for replacement by removing the cover and the bottom plate. Always remove the cover in a straight upward movement to avoid damaging the spare tubes mounted inside the top of the cover.

(2) Do not replace circuit elements in the oscillator assembly. However, the oscillator assembly may be replaced as a unit without loss of calibration accuracy. Directions for removal and replacement of the oscillator assembly are given in paragraph 7-6.

c. Precautions for Decibel Meter ME-22(*) /PCM.

(1) All parts of the decibel meter can be reached for replacement by removing the cover and the bottom plate. Always remove the cover in a straight

upward movement to avoid damaging the spare tubes mounted inside the top of the cover.

(2) When replacing tube V4, select a tube which permits a zero reading on both scales of the meter to within ±.5 db. Directions for selecting tube V4 are given in paragraph 7-10.

(3) The values of resistor R2 and capacitor C3, used to adjust the input impedance of the decibel meter, must be selected to compensate for variations in the iron cores of individual transformers T1. Directions for selecting resistor R2 and capacitor C3 for replacement are given in paragraph 7-9.

6-6. Power Supply Test

a. Signal Generator SG-15(*)/PCM.

(1) Make the resistance measurements indicated for tubes V10 through V13 in the tube socket voltage and resistance diagram (fig. 10-3). Make any necessary repairs before proceeding.

(2) After necessary repairs have been made, or if the resistance readings are normal, apply power to the signal generator (paras. 3-3 and 3-4). The pilot lamp should light. If the pilot lamp does not light, check fuse F1 (para 7-3*a*(3)) and lamp I (paras 7-3*a*(2) and c(2)). If the fuse is defective and a new fuse burns out, do not continue to change fuses but check the power supply circuits (para 5-12). If the pilot lamp lights, inspect the signal generator as it warms up for evidence of arcing or cracking or other signs of abnormal operation.

(3) If abnormal indications are present, turn off the power. Locate the cause of the abnormality by checking each component in the circuit in which the abnormality was observed (paras 5-4 through 5-12). Replace any faulty part and correct any trouble before proceeding.

(4) If no abnormal indication appears, measure the voltage at the terminals of tubes V13, V12, V11, and V10 in the order given (fig. 10-3). Correct voltage readings indicate that the power supply circuit is functioning properly. Incorrect readings indicate improper operation of the power supply circuit.

(5) After the signal generator has been turned on for about 10 or 15 minutes, feel the tubes cautiously. No tube should remain cold. If a tube does not warm up, test the tube with test set electron tube TV-7( )/U. or by placing it in another signal generator known to be in good operating condition (para 7-3*c*(1)).

b. Decibel Meter ME-22(*)/PCM.

(1) Make the resistance measurements indicated for tubes V5 through V8 in the tube socket voltage and resistance diagram (fig. 6-2). Make any necessary repair before proceeding.

(2) After necessary repairs have been made, or if the resistance readings are normal, apply power to the decibel meter (paras 3-8 and 3-9). The pilot lamp should light. If the pilot lamp does not light, check fuse F1 (para 7-3*a*(3)) and lamp I1 (para 7-3*a*(2) and c(2)). If a new fuse burns out check the power supply circuit (para 5-17). If the pilot lamp lights, inspect the decibel meter, as it warms up, for signs of abnormal operation such as arcing or crackling. Try to detect any odors that indicate overheating of parts, insulation, etc.

(3) If abnormal indications are present, turn the power off. Locate the cause of the abnormality by checking each component in the circuit i n which the abnormality was observed (paras 5-13 through 5-17). Replace any defective part and correct any other trouble.

(4) If no abnormal indication appears, measure the voltage at the terminals of tubes V8, V7, V6, and VF in the order given (fig. 6-2). If the voltage readings are correct, the power supply circuit is functioning properly.

Incorrect voltage readings indicate

improper operation of the power supply circuit.

(5) After the decibel meter has been turned on for about 10 minutes, feel the tubes cautiously. No tube should be cold. If a tube has not warmed up, test the tube with a tube tester or place it in another decibel meter known to be in good operating condition (para 7-3*c*(1)).

67. Operational Test

Operate the signal generator or the decibel meter as described in the daily preventive maintenance checks and services chart (para 4-5). Frequently, the operational test will indicate the general location of the trouble.

Section II. TROUBLESHOOTING CHARTS

8. General

The troubleshooting chart is an aid in locating trouble in Signal Generator SG-15(*)/ PCM or Decibel Meter ME-22(*)/PCM. This chart lists the symptoms that can be observed during operation, the probable cause or causes, and the procedures for correcting the defect. Point-to-point voltage tests can be used to supplement these procedures. Once the trouble has been localized to a stage or circuit, a tube check or voltage and resistance measurements of the stage or circuit usually should be sufficient to isolate the defective part. Normal voltage and resistance measurements for Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM are given in figures 10-3, 61, and 6-2. For, voltage and resistance readings of fixed frequency oscillator tube V1 in the SG-15A(*)/PCM, refer to figure 6-1.

6-9. Troubleshooting Charts, Signal Generator SG-15(*)/PCM

Trouble symptom	Probable cause	Checks and corrective measures
Signal generator inoperative. Pilot lamp and tubes do not light.	Fuse F1 burned out -	Check fuse (para 7-3*a* (3) and replace if necessary.
	Power ON-OFF switch S2 defective	Check switch and replace if necessary.
	PRIMARY VOLTAGE switch S1 defective.	Check switch and replace if necessary.
No output from signal generator, and no reading on OUTPUT LEVEL meter. Pilot lamp and tubes light.	0- to 40 kc filter Z1 open	Check continuity of filter at terminals 1 and 3 (para 6-11). Replace if necessary.
	FINE DBM potentiometer R11 open or defective.	Check potentiometer and control. Replace potentiometer R11 and/ or control if necessary.
	One of following tubes defective: V1, V7, V2, V8, V9, V10, V11, V12, or V13.	Test voltage at pin 8 of tube V12 (fig. 10-3). If this voltage is abnormal trouble is in the power supply circuit. Replace tubes V13, V12, V11, and V10, one at a time and in the order given, to locate defective tube. If changing tubes does not locate the trouble, return original tubes to sockets and troubleshoot the power supply circuit (para 6-6). If there is no apparent trouble in the power supply, replace tubes V5, V6, V4, V9., V9, VS, V2, V7, and VI, one at a time in the order given, to locate defective

Trouble symptom	Probable cause	Checks and corrective measures
		tube. If changing tubes does not locate the trouble, return original tubes to sockets and troubleshoot the circuits of these tubes (para 5-4 through 5-12). *Do not change tube V2 unless absolutely necessary.* If tube V2 must be replaced, refer to paragraph 7-13*a*.
No output at OUTPUT terminals and/or jack. Meter reading normal.	OUTPUT terminals El and E2 and/or jack J1 defective.	Check terminals and jack. Repair or replace if necessary.
	COARSE DBM attenuator E4 defective.	Check continuity of attenuator in all positions of control. Replace if necessary.
No reading on OUTPUT LEVEL meter. Output of signal generator normal at OUTPUT terminals and jack.	Connections to OUTPUT LEVEL meter loose or defective.	Check meter connections and repair if necessary.
	Potentiometer R44 defective -	Check potentiometer and replace if necessary.
	Meter rectifier CR1, CR2, CR3, or CR4 defective.	Check rectifiers (para 6-11) and replace if necessary.
	Resistor R42, R43, or R52 defective.	Check resistors, and replace it necessary.
	OUTPUT LEVEL meter M1 defective.	Check meter (para 6-11) necessary

6-10. Troubleshooting Chart, Decibel Meter ME-22(*)/PCM

Trouble symptom	Probable cause	Checks and corrective measures
Decibel meter inoperative	Fuse F1 burned out	Check fuse (para 7-3*a*(3)) and replace if necessary.
	Power ON-OFF switch S4 defective.	Check switch and replace if necessary.
	PRIMARY VOLTAGE switch S3 defective.	Check switch and replace if necessary.
Pilot lamp does not light. Decibel meter functions normally.	Lamp 11 defective	Check lamp (para 7-3*a*(3) and *c* (2)) and replace if necessary.
	Lamp socket E8 defective	Check socket and repair or replace if necessary.
Meter does not indicate reading when input is applied to INPUT terminals but functions normally when INPUT jack is used.	INPUT terminals E1 and/or E2 defective or connections loose.	Check terminals and repair or replace if necessary.
Meter does not indicate reading when input is applied to INPUT jack but functions normally when/ INPUT terminals are used.	INPUT jack J1 defective or connection loose.	Check jack and repair or replace if necessary.
No reading on meter when INPUT IMPEDANCE switch is in 600 OHM position but functions normally with switch in BRIDGING position.	INPUT IMPEDANCE switch S1 defective.	Check switch and repair or replace.
	Resistor R1 defective	Check resistor R1 and replace if necessary.
No reading when INPUT IMPEDANCE switch is in BRIDGING position but functions normally with switch in 600 OHM position..	INPUT IMPEDANCE switch S1 defective.	Check switch and replace if necessary.

Trouble symptom	Probable cause	Checks and corrective measures
Meter reading low	Zero calibration of meter M1 out of adjustment.	Recalibrate meter (para 3-10*c*).
	One of tubes weak or defective	Test output of +220-volt power supply at cathode (pin 8) of tube V5. If the reading is +220-volts, the trouble is not in the power supply. Change tubes V4 (para 7-10), V3, V2, and V1, one at a time in the order given, to locate the defective tube. If this does not locate and clear the trouble, return the original tubes to their sockets and troubleshoot the associated circuits (paras 5-13 through 5-17). If trouble was indicated in the power supply, however, check tubes V8, V7, V6, and V6, in the same manner as described above.
Na reading on meter	Resistors R3 and/or R4 defective	Check resistors and replace if necessary.
	DBM switch S2 defective	Check switch and repair or replace.
	Meter M1 defective	Check meter and replace if necessary.
	Tube V1, V2, V3, V4, Vs, or V8 defective.	Check tubes V8, V5, V4, (para 7-10), V3, V2, and V1 by changing one tube at a time in the order given. If the trouble cannot be located and cleared by changing the tubes, troubleshoot the associated circuits (para 5-15 through 5-17).
	Open resistor or shorted bypass capacitor.	Check all resistors and capacitors and repair or replace, as necessary.
Meter does not hold its zero calibration within ± .5 db on either A or B scale when switched to other scale.	Tube V4 weak or defective	Replace tube V4 (para 7-10) necessary.
	DBM switch S2 defective	Check switch and repair or replace.
	Resistors R3 and/or R4 defective	Check resistors and replace if necessary.

Section III. CIRCUIT TRACING

6-11. General Instructions

a. General. Circuit tracing means to take measurements to ascertain the condition of the signal through all the stages of the signal generator or decibel meter. It is accomplished by taking readings of various points in the circuits and comparing these readings with known voltage values.

(1) *Signal Generator SG-15(*)/PCM.* When tracing the circuit of Signal Generator SG-15(*)/PCM, follow the signal through all the stages from the fixed-frequency oscillator and first amplifier, the variable-frequency oscillator and second amplifier, and through the mixer and the

third and fourth amplifier stages to the output. Once the trouble is traced to a circuit, disconnect the signal generator and take voltage and resistance measurements to locate the affected part.

(2) *Decibel Meter ME-22(*)/PCM.* When tracing the circuit of Decibel Meter ME-22(*)/PCM, follow the signal through all the stages from the input through the first, second, and third amplifiers to the meter rectifier. Take voltage and resistance measurements and troubleshoot the defective equipment in conjunction with the information contained in the voltage and resistance diagram (fig. 6-2) to locate the defective part.

b. Procedures.

(1) Read and record the a-c voltages at various points in the circuit (para 6-12 or 6-13) and compare the readings with the typical voltages.

(2) Check the wiring and soldered connections in each stage during the procedure.

(3) Misalignment of one or more stages of a unit will cause reduced output. Do not change the setting of a fixed adjustment unless the trouble has been traced to that adjustment.

(4) When trouble has been localized to a stage, first test the tube, then measure the voltages at the tube socket terminals, and finally measure the resistance between the tube socket terminals and ground with the power off. Refer to the applicable voltage and resistance chart (figs. 10-3, 6-1, and 6-2).

(5) Trouble in a circuit or stage may not cause changes in voltage and/or resistance measurements at tube socket terminals. The procedures given here and in paragraph 6-12 or 6-13 are intended as a guide and should suggest other procedures to the repairman.

(6) Remove only one tube at a time when testing. Test the tube and, if it is not defective, return it to its proper socket before removing the next tube.

(7) Each step presupposes the satisfactory completion of all previous steps. Isolate and clear any trouble located before continuing with succeeding steps.

6-12. Circuit Tracing in Signal Generator SG-15(*)/PCM

a. Put the signal generator into operation in accordance with instructions in paragraphs 33 through 3-5. Set the signal generator for an output of 0 dbm at 1,000 cps.

b. Use Voltmeter ME-30A/U to measure the a-c signal voltages at the points indicated in the table below, in the order given, and record them. All measurements are from the points indicated to ground unless otherwise specified in the table. The values in the typical signal voltage column are measurements typical of a normally functioning set. These values will vary slightly from one equipment to another, but a voltage differing greatly from the corresponding typical voltage usually indicates trouble in the circuit where the measurements made.

Part or component	Pin or terminal No.	Typical signal voltage (volts)
V1	8 (SG-15/PCM)	1.8
	3 (SG-15A/PCM	1.8
V2	8	1.8
V7	4	.2
	3, 5	.13
	8	12.0
V8	4	.6
	3, 5	.4
	8	10.0
V9	3	3.0
	5	.7
	8	1.3
Z1	1	3.0
	3	.7
V3	3	2.3
	5	.23
	8	.1
V4	1	2.3
	2	5.5
	3	2.0
	4	.5
	5	4.0

Part or component	Pin or terminal No.	Typical signal voltage (volts)
	6	.35
V5	3, 4	30.0
	5	5.0
	8	.6
V6	3,4	30.0
	5	5.0
	8	.6
T2	4	2.8
	Across 6 to 8 (terminal 8 grounded).	15.5
E4	Across input (terminals inside grounded)	7.75
L3	1 (input)	35.0
	2 (output)	.8
OUTPUT terminal	E1 to E2 (E2 grounded, no load	1.55
OUTPUT LEVEL meter rectifier	Junction of CR1 and CR3 to junction of CR2 and CR4	.8

6-13. Circuit Tracing in Decibel Meter ME-22(*.)/PCM

a. Put the decibel meter into operation in accordance with instructions in paragraphs 3-8 and 3-9. Set the INPUT IMPEDANCE switch to the 600 OHM position.

b. Apply a signal of 1,000 cps at .775 volt as measured on Voltmeter ME-30A/U to the INPUT jack or terminals of the decibel meter.

c. Use Voltmeter ME-30A/U to measure the a-c signal voltages at the points indicated in the following .table, in the order given, and record them. All measurements are made from the point indicated to ground and with the DBM switch set to the 0 position on SCALE B unless otherwise indicated in the table. The values in the typical signal voltage column are measurements typical of a normally functioning set. These values will vary slightly from one equipment to another, but a voltage differing greatly from the corresponding typical voltage usually indicates trouble in the circuit where the measurement is made.

Part or component	Pin or terminal No.	Typical signal voltage (volts)
T1	4	0.56
V1 socket (V1 removed).	3, 5	.0086
	4 (S2 at -30, SCALE B)	.56
	4 (S2 at -20, SCALE B)	.18
	4 (S2 at -10, SCALE B)	.056
	4 (S2 at 0, SCALE B	.018
	4 (S2 at 0, SCALE A)	.0032
	4 (S2 at +10, SCALE A)	.001
	6 (S2 at 0, SCALE A)	.0033
	8	.52
V2	3, 5	.46
	4	.52
	6	.028
	8	6.5
V3	3, 6, 8	35.0
	4	6.5
	5	3.3
V4	3	35.0
	4, 8	17.0
	5	.46
Bridge rectifier circuit supply of meter.	Junction of R19 and R20	17.0

CHAPTER 7
REPAIR AND ALIGNMENT

Section I. PREREPAIR PROCEDURES

7-1. Tools, Materials, and Test Equipment

The tools, materials, and test equipment required for reconditioning, adjusting, and repairing Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM are listed below.

Item	Technical manual	Common name
Resistor Decade ZM-16(*)/U	11-5102	Decade Resistor
Voltmeter ME-30A/U	11-6625-320-12	Voltmeter
Frequency Meter AN/TSM-16..................................	11-6625-21-12	Frequency Meter
Multimeter TS-352/U..	11-5527	Multimeter
Tube Tester TN-7(*)/U..	11-6625-274-12	Tube Tester

7-2. Removal of Pluck-Out Parts

The vacuum tubes, pilot lamps, and fuses of Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM can be removed without unsoldering parts. These parts are called pluck-out parts because they do not require complicated disconnection procedures. No disassembly of the equipment is necessary except the removal of the covers when vacuum tubes are to be removed.

a. Vacuum Tubes. Remove the cover of the signal generator or the decibel meter with a straight upward movement. Lateral movement may damage the spare tubes mounted inside the top flange of the cover. When the tubes have cooled sufficiently, remove the tubes by pulling up with the fingers. Grip glass tubes by the base. Do not rock a tube or jiggle it in its socket if it can be extracted by a straight upward pull. Jiggling a tube in its socket during removal spreads the socket contacts. If a tube does not release easily, move it gently from side to side. Label each tube as soon as it is removed so that it can be replaced in its proper socket.

b. Pilot Lamp. To remove a pilot lamp, unscrew the red lens covering the lamp and remove the bayonet-base lamp by pushing it in and turning it counterclockwise.

c. Fuse-. To remove a fuse, push the fuse cap in and turn it in the direction indicated by ,the arrow on the top. Pull out the cap and fuse. Remove the spare fuse in the same manner.

7-3. Inspecting, Cleaning, and Testing Removed Parts

a. Inspecting.

(1) *Tubes.* Be sure that the labels on the tubes in the various sockets correspond to the correct tube numbers for those positions. Check with figures 10-3, 6-1, 7-1, and 7-11. Signal GENERATOR SG-15(*)/PCM and figures 6-2 and 7-5 for Decibel Meter ME-22(*)/PCM. Inspect for cracked bases and for loose or cracked envelopes on glass tubes. Check for bent or broken prongs.

(2) *Pilot lamp.* Inspect the pilot lamp of each unit for burned base and broken filament.

(3) *Fuse.* Inspect the fuse visually for continuity and loose ferrules.

b. Cleaning. Clean the vacuum tubes which have been removed from the equipment with a clean cloth moistened with Solvent, Dry Cleaning (SD). If necessary, clean the prongs of the tubes with crocus cloth.

c. Testing.

(1) *Vacuum tubes.* Use a tube tester to test the vacuum tubes for inadequate emission, leakage, and short circuits. If a tube tester is not available, place doubtful tubes in a signal generator or decibel meter known to be operating normally.

(2) *Pilot lamp.* Test pilot lamps for filament continuity with an ohmmeter, or place the lamps in a signal generator or decibel meter known to be in good operating condition.

7-4. Reassembling Equipment

Replace the tubes and the pilot lamp in their respective sockets in the signal generator or decibel meter. Be sure that each tube is in the correct socket. Refer 'to figures 10-3, 6-1, 7-1 and 7-14 for location of tubes in Signal Generator SG-15(*)/PCM and to figures 6-2 and 7-5 for location of tubes in Decibel Meter ME-22(*)/PCM. Place a fuse in the fuse cap and reinsert the cap and fuse. If a fuse is burned out, replace it with one of equal rating-a 2-ampere fuse in the signal generator and a 1-ampere fuse in the decibel meter. If a newly replaced fuse blows, test the power supply circuit of the signal generator (para 6-6*a*) or the decibel meter (para 66*b*) before replacing the fuse.

Section II. REPAIR OF SIGNAL GENERATOR SG-15(*)/PCM

7-5. Replacement of Parts

All parts in Signal Generator SG-15(*)/ PCM can be reached easily for replacement by removing the cover and the plate on the under side of the chassis. With the exception of removing and replacing the oscillator assembly as a unit (para 7-6), no special instructions are necessary. When removing wiring from terminals, either by unsoldering or by loosening screw-type terminals, tag each wire to facilitate correct rewiring when a new part is installed. Be careful not to damage adjacent parts when removing, installing, and connect, ing new circuit parts. To remove covered circuit parts, remove the protective cover, the mounting hardware, and then the defective part. A replacement part should be identical with the original and installed in the same physical position as the part which it replaces. When replacing wiring, be sure that each new piece of wire is the same length as the wire being replaced. If wiring with different color coding is used, mark the change on the wiring diagram (figs. 7-4 and 10-5). To locate parts in Signal Generator SG-15(*)/PCM, refer to figures 7-1, 7-2, and 7-3.

7-6. Removal and Replacement of Oscillator Assembly

Do not attempt to disassemble the oscillator assembly as calibration accuracy will be lost. Each oscillator assembly is calibrated individually at the time of manufacture, and recalibration should be attempted only by experienced repair personnel equipped with the proper tools and test equipment. However, the oscillator assembly may be replaced as a unit without loss of calibration accuracy. Proceed as follows:

a. Unsolder and tag all connections to the oscillator assembly.

b. Remove the two screws which are used to fasten the slide window to the rack,.

c. Remove the FREQUENCY knob and its shaft by loosening the two setscrews in the drive gear behind the panel. Leave the knob on the shaft. Note that there are flats on the shaft where the setscrews seat when the unit is reassembled.

d. Remove the six screws which enter the base of the oscillator assembly from the under side of the chassis. Four of these screws also are used to hold filter Z1 in place but, for

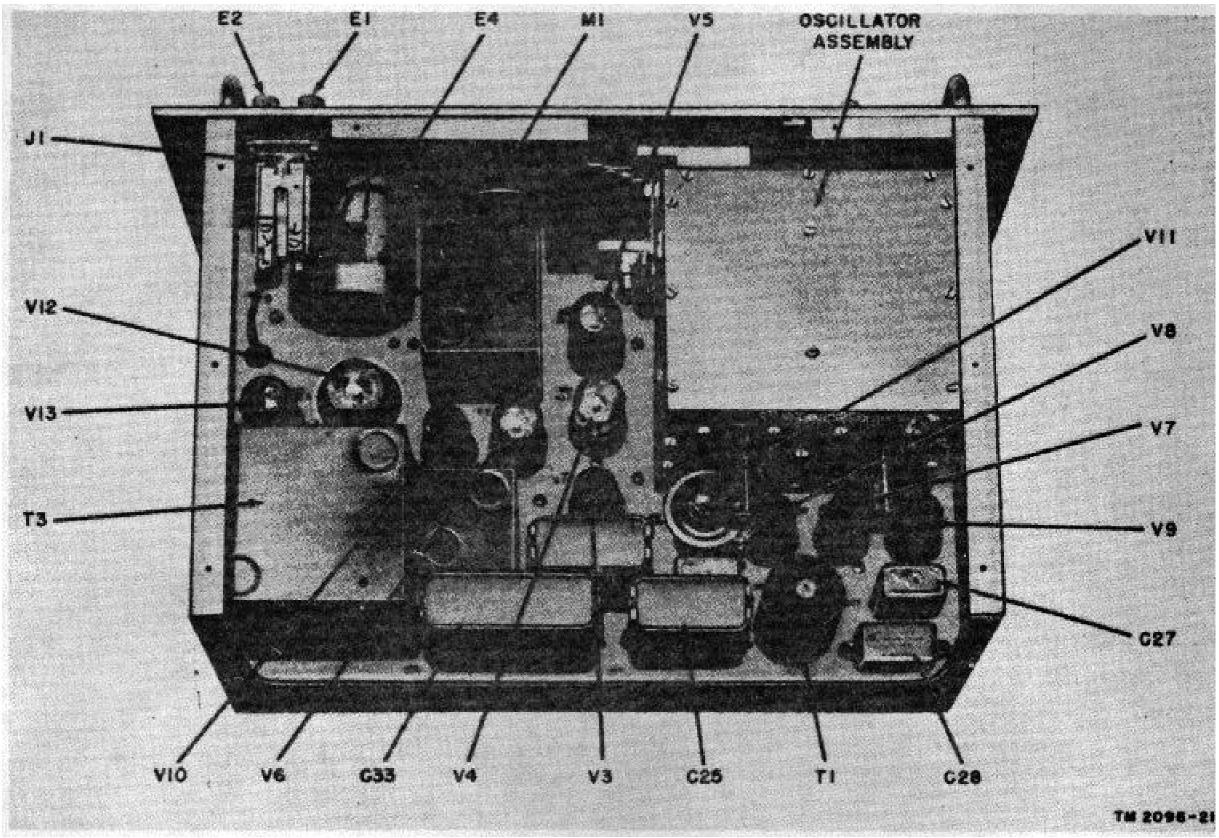


Figure 7-1. Signal Generator SG-15(*)/PCM, top of chassis showing location of parts.

the short period of time it takes to replace the oscillator assembly, the filter can be supported by its leads without damage to the unit.

e. Lift the oscillator assembly straight up. At the same time, push the spring on the ZERO BEAT ADJ shaft toward the panel far enough so that the oscillator assembly will clear the shaft.

f. If it is necessary to remove the top and bottom plates of the oscillator assembly, remove the screws at each end of both plates and the screws across the center of the top plate and lift off the plates.

Caution

Do not adjust or disturb the main tuning section, the KILOCYCLES dial, or the gear train.

g. Replace the oscillator assembly. Aline the mounting holes in the base of the unit with the mounting holes on the chassis and fasten the oscillator assembly and filter Z1 securely in place from the under side of the chassis. Replace the FREQUENCY knob and its shaft, and replace the screws which are used to fasten the slide window to the rack. Resolder the leads to the correct terminals.

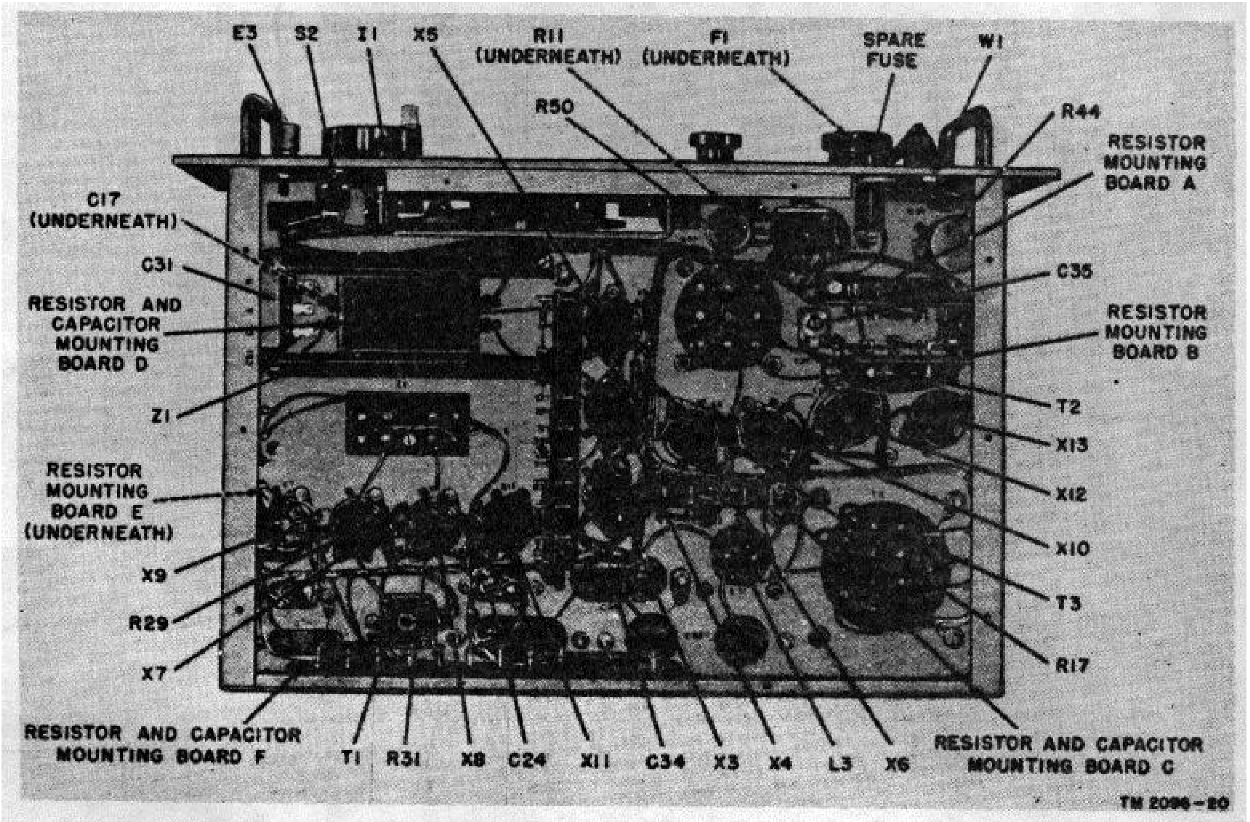


Figure 7-2. Signal Generator SG-15(*)/PCM, bottom of chassis showing location of parts.

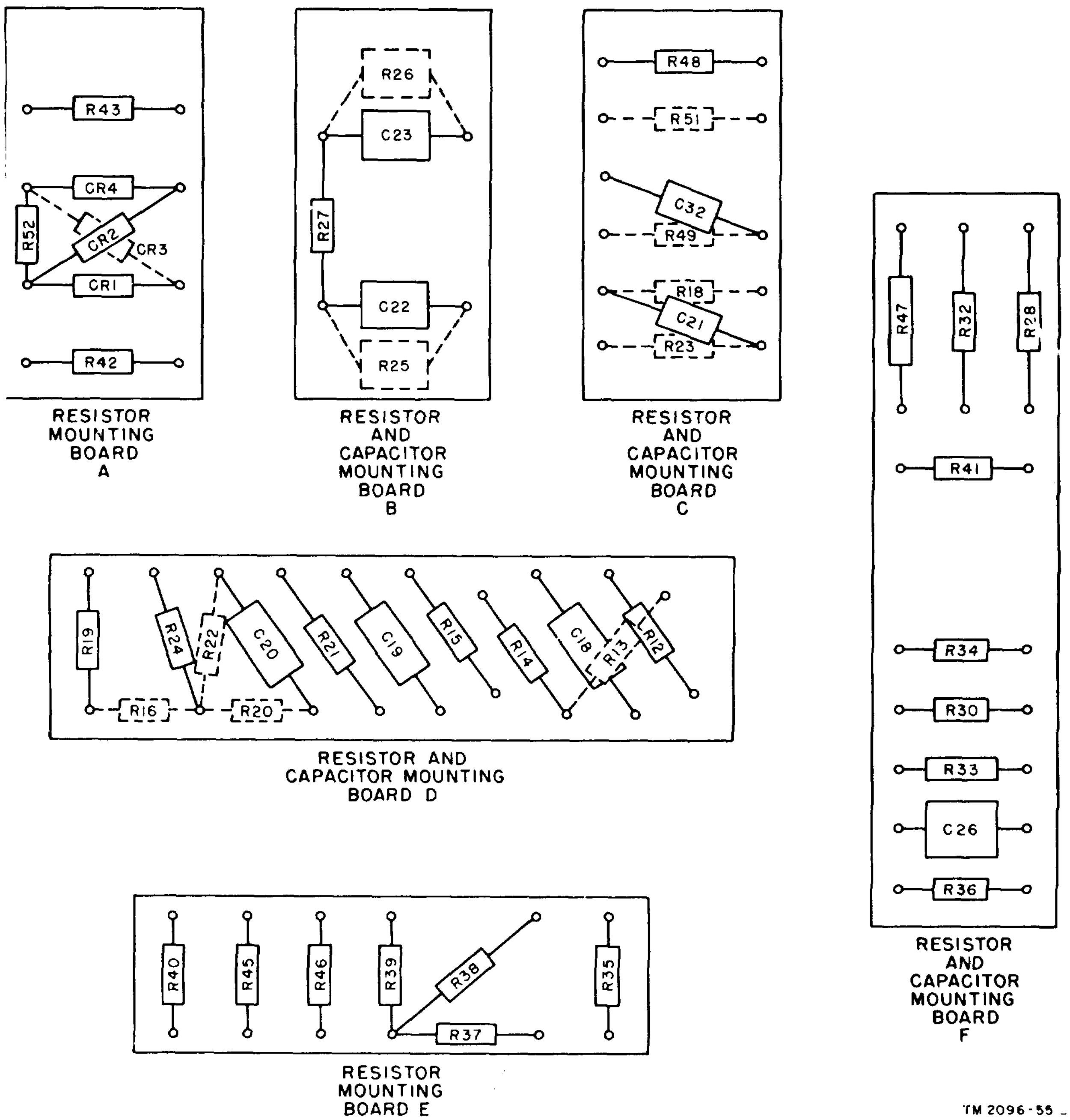


Figure 7-3. Signal Generator SG-15(*)/PCM, resistor and capacitor mounting boards located on bottom of chassis.

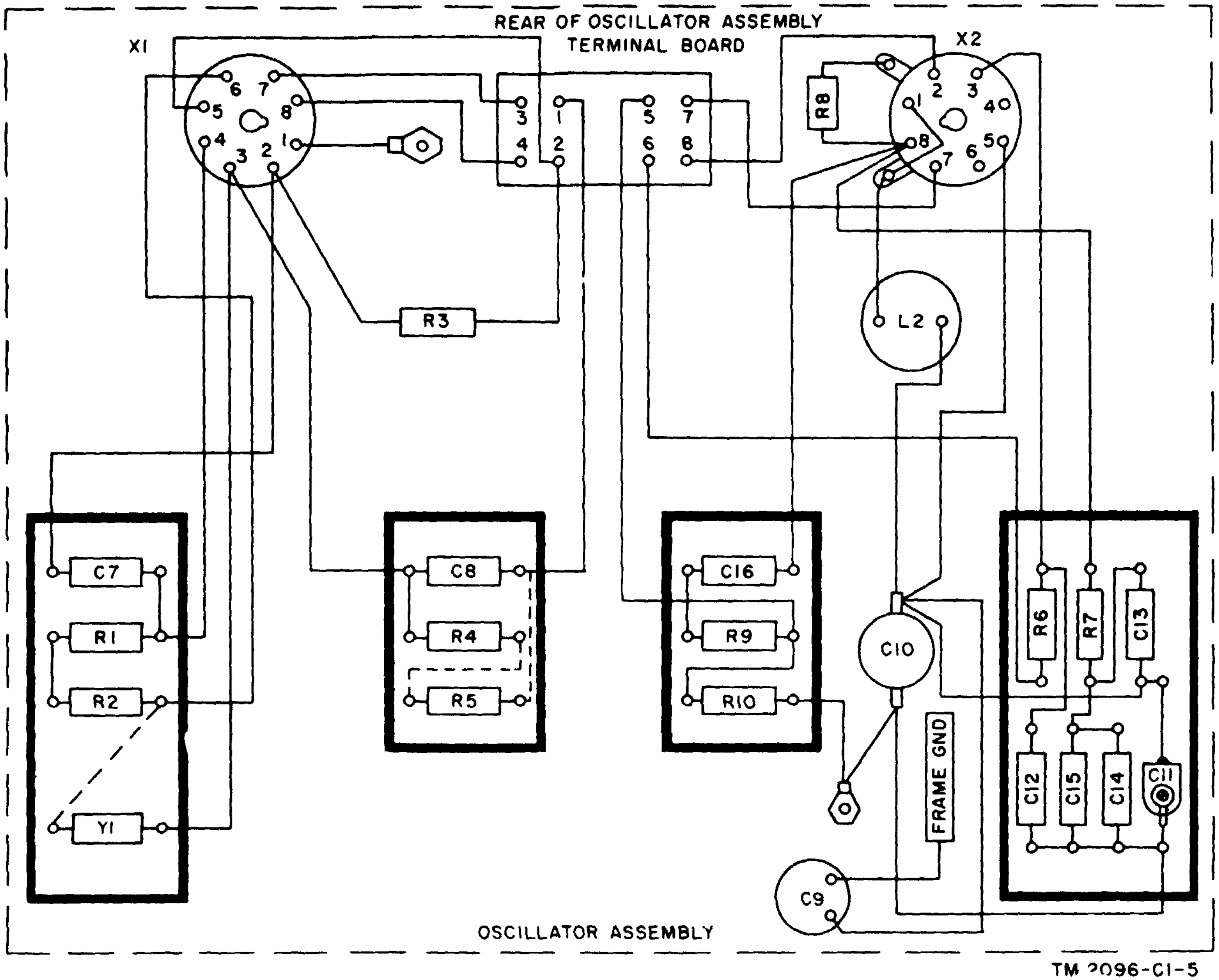


Figure 7-4. Signal Generator SG-15A/PCM, wiring diagram of fixed frequency oscillator.

Section III. REPAIR OF DECIBEL METER ME-22(*)/PCM

7-7. Replacement of Parts

No special instructions are necessary for the replacement of parts in Decibel Meter ME-22 (*)/PCM. All parts can be reached easily by removing the cover and the bottom plate. However, a selection must be made of resistor R2 and capacitor C3 (para 7-9) and tube V4 (para 7-10) when these circuit elements must be replaced. When removing wiring from terminals, either by unsoldering or by removing screw-type terminals, tag each wire to facilitate correct wiring when a new part is installed. The new part should be an exact duplicate of the original. When replacing wiring, be sure that each new piece of wire is the same length as the wire being replaced. If wiring with different color-coding is used, mark the change on the wiring diagram (figs. 10-7 and 10-8). For the location of parts in Decibel Meter ME-22(*)/PCM, refer to figures 7-5, 7-6 and 7-7.

Caution

Be sure the power plug is removed from the a-c outlet when temporarily connecting circuit elements in the test set circuit.

7-8. Test Equipment Required for Selection of Resistor R2 and Capacitor C3, Decibel Meter ME-22/PCM

The following test equipment is required for selection of resistor R2 and capacitor C3 for replacement:

a. Decade Resistor ZM-16(*)/U (TM 11-5102).

b. Voltmeter ME-30A/U (TM 11-6625-320-12).

c. Signal Generator SG-15(*)/PCM.

d. Resistor, noninductive, 600 ohms ±.5 percent.

e. Switch, double-pole, double-throw.

7-9. Selection of Resistor R2 and Capacitor C3 for Replacement, Decibel Meter ME-22/PCM

Resistor R2 and capacitor C3 provide correct input impedance of Decibel Meter ME-22/PCM. The values of these circuit elements must be selected to compensate for the variations in the iron cores of the individual transformers T1. Replace resistor R2 and capacitor C3 in accordance with *b* and *c* below.

a. Selecting Resistor R2.

(1) Connect the test equipment to the decibel meter as shown in the test circuit (fig. 7-9).

(2) On the decibel meter, set the INPUT IMPEDANCE switch to BRIDGING.

(3) Set Decade Resistor ZM-16(*)/U to 8,000 ohms.

(4) Set the double-pole, double-throw switch to connect the decade resistor into the circuit.

(5) Set the frequency of Signal Generator SG-15(*)/PCM to 1,000 cps and adjust the output power until Voltmeter ME-30A/U reads .250 volt.

(6) Set the switch to connect the decibel meter into the circuit.

(7) Select a resistor between 47K and 100K; starting with the lowest value, connect the resistors, one at a time, across the connections S or R2. Voltmeter ME-30A/U should read .250 volt. The resistor that causes a reading nearest .250 volt is the correct resistor R2.

b. Selecting Capacitor C3.

(1) Use the test circuit shown in figure 7-9 to select capacitor C3.

(2) Set the INPUT IMPEDANCE switch of the decibel meter to BRIDGING.

(3) Set Decade Resistor ZM-16(*)/U to 8,000 ohms.

(4) Set the double-pole, double-throw switch to connect the decade resistor into the circuit.

(5) Set the frequency of Signal Generator SG-15(*)/PCM to 35,000 cps. Adjust the output power until Voltmeter ME-30A/U reads .250 volt.

(6) Set the switch to connect the decibel meter into the circuit.

(7) Temporarily connect a capacitor with a value between 22 and 100 μμ & d, across the connections S or capacitor C3 in the decibel meter until Voltmeter ME-30A/U reads .250 volt. Connect the capacitors one at a time starting with the lowest valve. The

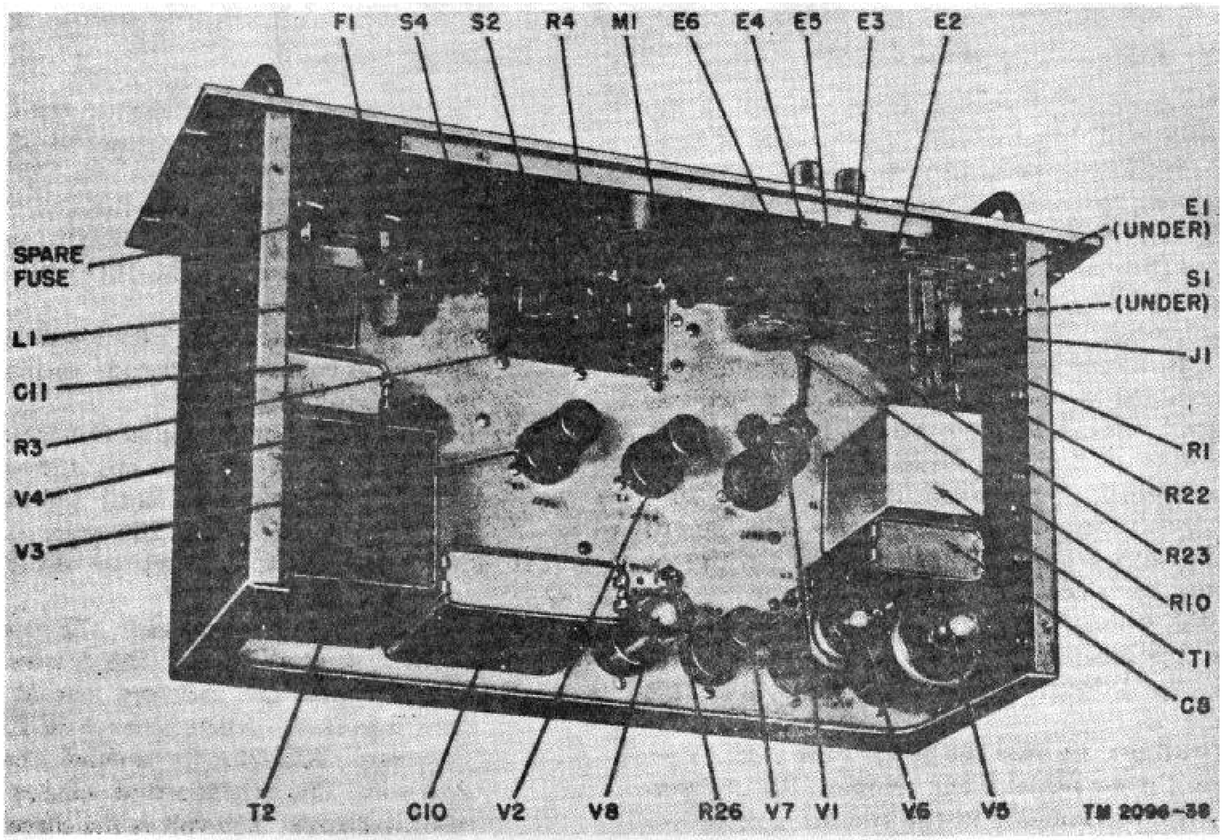


Figure 7-5. Decibel Meter ME-22(*)/PCM, top of chassis showing location of parts.

capacitor that causes a reading nearest .250 volt is the correct capacitor C3.

7-10. Selection of Tube V4 for Replacement Decibel Meter ME-22(*)/PCM

When it is necessary to replace tube V4 in Decibel Meter ME-22(*)/PCM, proceed as follows:

a. Replace tube V4 with a good 6H6 twin diode.

b. Perform the preliminary procedures according to paragraph 3-8 and set the power ON-OFF switch to the ON position.

c. Set the DBM switch to 0 on SCALE B.

d. Connect Signal Generator SG-15/PCM to the INPUT jack or terminals of the decibel meter and apply a signal of 1,000 cps at 0 dbm.

e. Adjust the CAL ADJ potentiometer until the meter reading on SCALE B is 0 db.

f. Set the DBM switch to 0 on SCALE A. The meter should read 0 db ±..5 db on SCALE A.

g. If the first tube tested does not give a reading of 0 dbm ±.5 db on both SCALE A and SCALE B, use another tube. If none of the tubes tested provides a correct reading or if there is no selection of tubes available, calibrate the scale on which the reading is to be made, SCALE A or SCALE B.

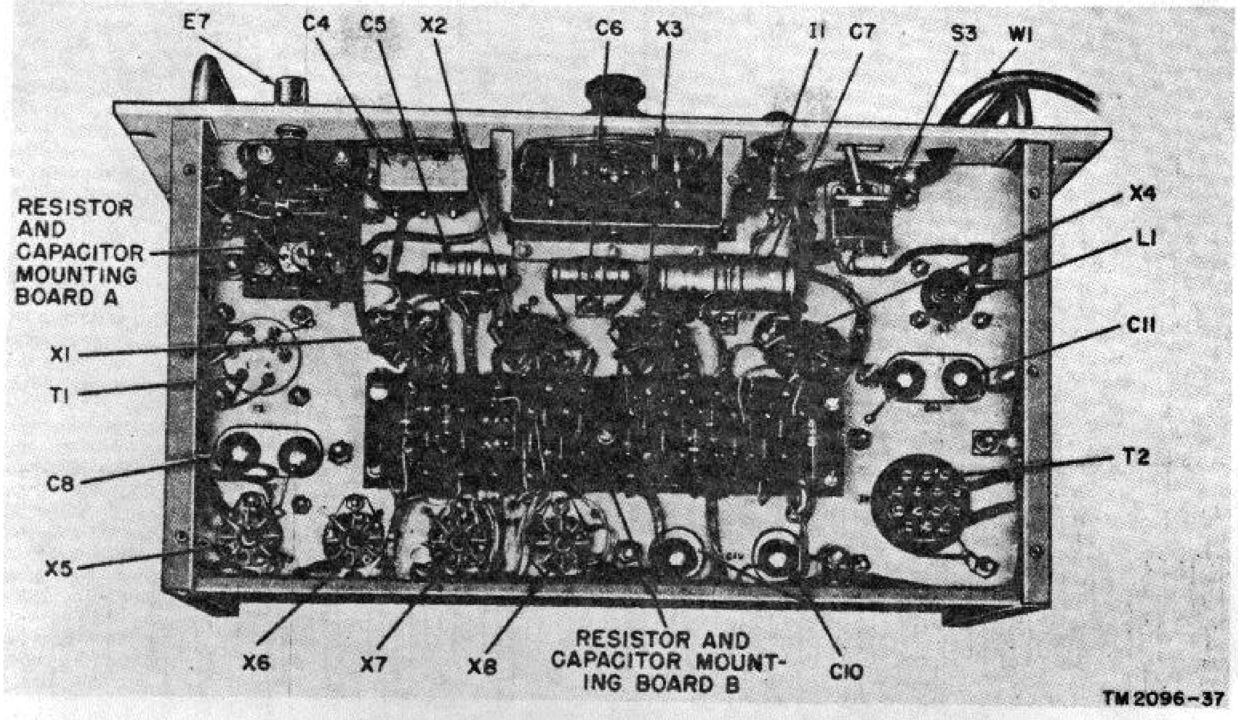


Figure 7-6. Decibel Meter ME-22(*)/PCM, bottom of chassis showing location of parts.

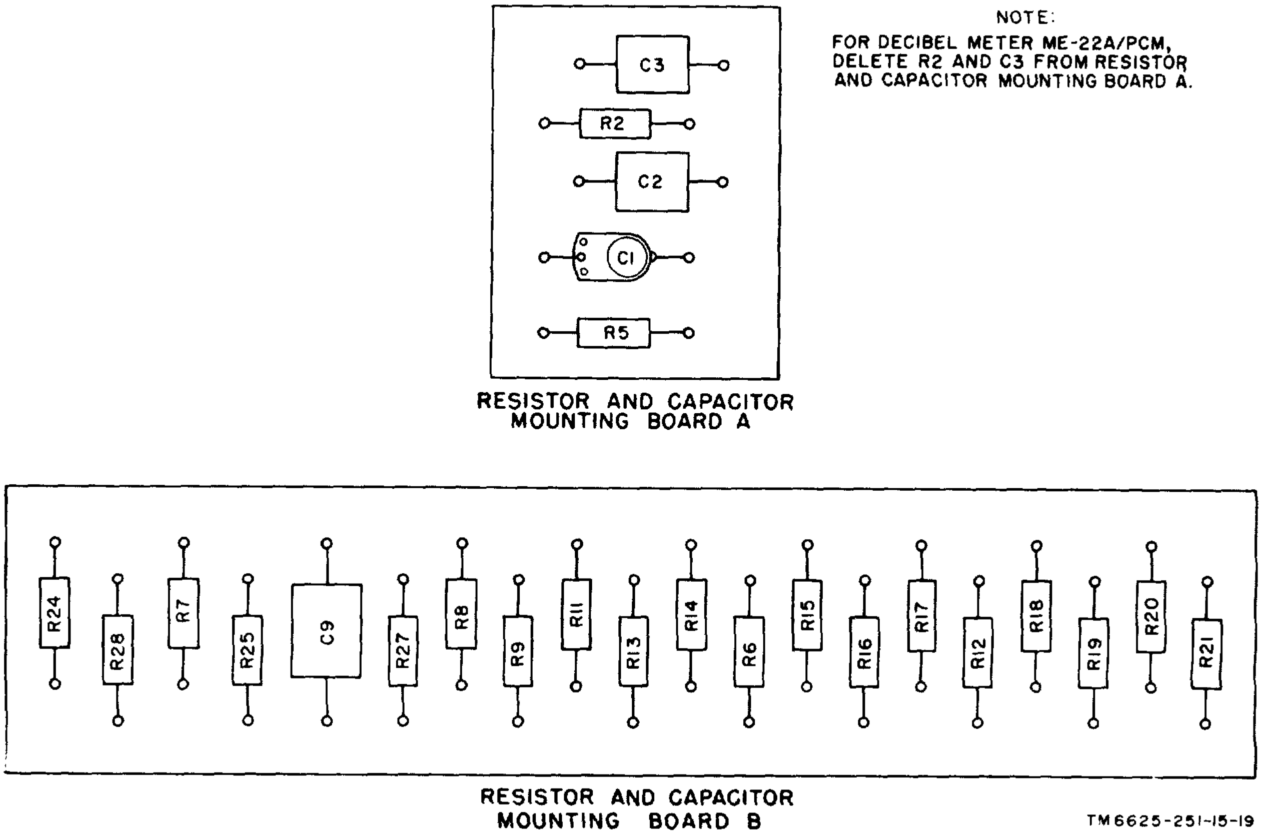


Figure 7-7. Decibel Meter ME-22(*)/PCM, resistor and capacitor mounting boards located on bottom of chassis.

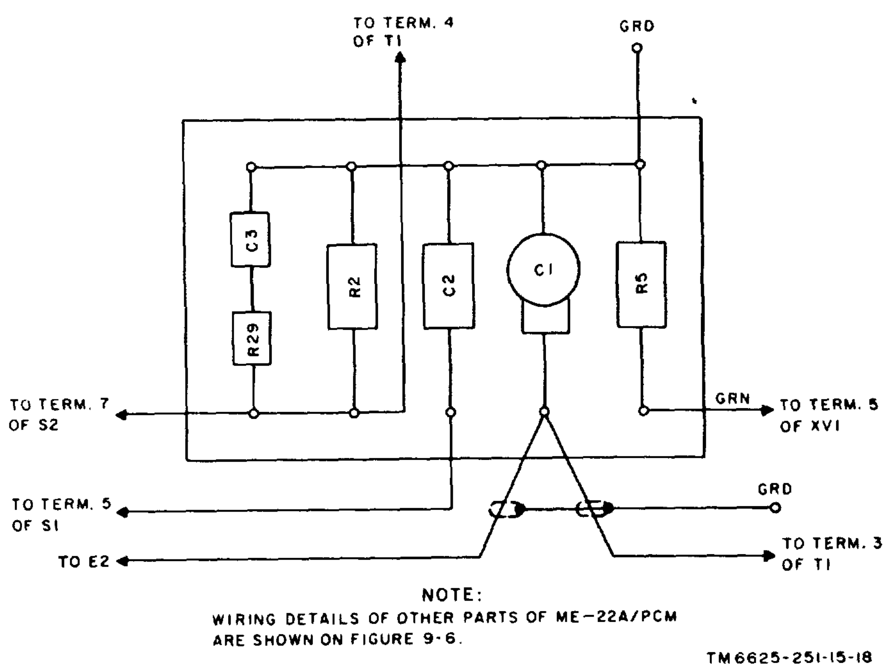


Figure 7-8. Wiring Details for resistors R2 and R29 and capacitor C3 on ME-22A/PCM bearing Order No. 52752-PP-61 and 15880-PP-62.

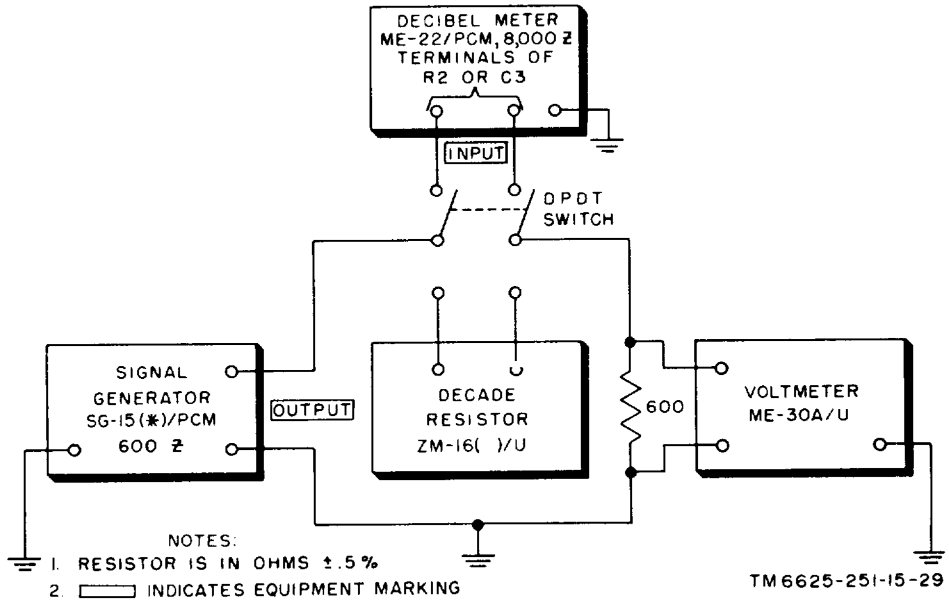


Figure 7-9. Test circuit for selecting resistor R2 and capacitor C3, Decibel Meter ME-22/PCM.

Section IV. ALINEMENT, SIGNAL GENERATOR SG-15(*)/PCM

Caution

Be sure the power plug is removed from the a-c outlet when replacing circuit elements.

7-11. Test Equipment Required for Alinement

The test equipment listed below is required when realining circuits of Signal Generator SG-15(*)/PCM.

a. Voltmeter ME-30A/U, (TM 11-6625-320-12).

b. Frequency Meter AN/TSM-16 (TM 11-6625-218-12).

c. Multimeter TS-352/U (TM 11-5527).

d. Five 600-ohm precision resistors ±.1 percent, noninductive.

7-12. Alinement of Fixed-Frequency Oscillator

The fixed-frequency oscillator is adjusted to approximately 100 kc at the time of manufacture and ordinarily will not require realinement. Its frequency when in zero beat with the variable-frequency oscillator, at room temperature and with the KILOCYCLES dial at 0, is stamped on the oscillator housing.

Caution

Do not realine the fixed-frequency oscillator unless it is absolutely necessary. However, replacement of oscillator coil L1, capacitor C1 or C2, or other major circuit elements may make realinement of the oscillator necessary.

a. After Replacing Circuit Element. After a circuit element associated with the fixed-frequency oscillator in the oscillator assembly has been replaced, turn the signal generator on and allow it to warm up from 10 to 15 minutes with the oscillator assembly cover in place. Set the FREQUENCY control for a 0 reading on the KILOCYCLES dial, and set the ZERO BEAT ADJ control (capacitor C1) for zero beat on the OUTPUT LEVEL meter (para 3-5). If the zero-beat point cannot be reached, proceed as follows:

(1) With the KILOCYCLES dial on 0, remove the oscillator assembly cover. Set the ZERO BEAT ADJ control to the midpoint of its range.

(2) Adjust trimmer capacitor C2 (fig. 710) for zero beat. Note the reading on the OUTPUT LEVEL meter.

Note

Capacitor C2 is not used in Signal Generator SG15A/PCM.

(3) Replace the oscillator assembly cover and adjust the ZERO BEAT ADJ control for zero beat.

b. After Replacing Tube V1. If tube V1 (fig. 7-14) is replaced, readjust the ZERO BEAT ADJ control for zero beat.

c. Final Test. Use Frequency Meter FR67/U to check to see that the frequency of the fixed-frequency oscillator at zero beat is the same as the frequency stamped on the housing. Measure this frequency at pin 5 of tube V9.

7-13. Alinement of Variable-Frequency Oscillator, Signal Generators SG15 S/PCM and SG-15A/PCM

The variable-frequency oscillator is alined at the time of manufacture and ordinarily will not require any adjustment. On the SG-15/PCM, the frequency at room temperature and of the variable-frequency oscillator with the KILOCYCLES dial at 0, is stamped on the outside of the oscillator assembly housing.

Caution

All adjustments on the variable frequency oscillator affect the calibration of the KILOCYCLES dial. Do not attempt any adjustments unless it is absolutely necessary. When alining the SG-15/PCM, do *not* vary the adjustment of temperature compensating capacitor C11 (fig. 7-12) at any time.

a. After Replacing Tube V2. If tube V2 (fig. 7-14) is replaced, normally it will be necessary to readjust the ZERO BEAT ADJ control for zero beat (para 3-5). However, there will be a minor loss in calibration accuracy. Do not replace tube V2 unless it is absolutely necessary.

b. After Replacing Resistor or Capacitor, Signal Generator SG-15/PCM. After a resistor or capacitor in the variable-frequency oscillator has been replaced, it will become necessary to adjust capacitor C10 (fig. 7-10). If

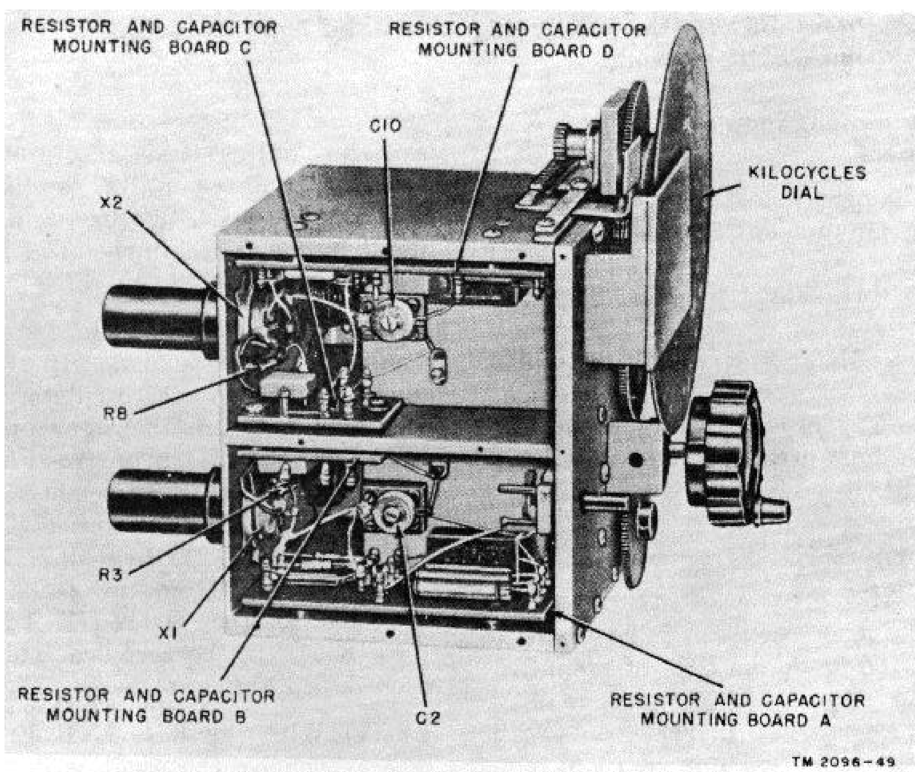


Figure 7-10. Signal Generator SG-15/PCM, top view of oscillator assembly showing location of parts.

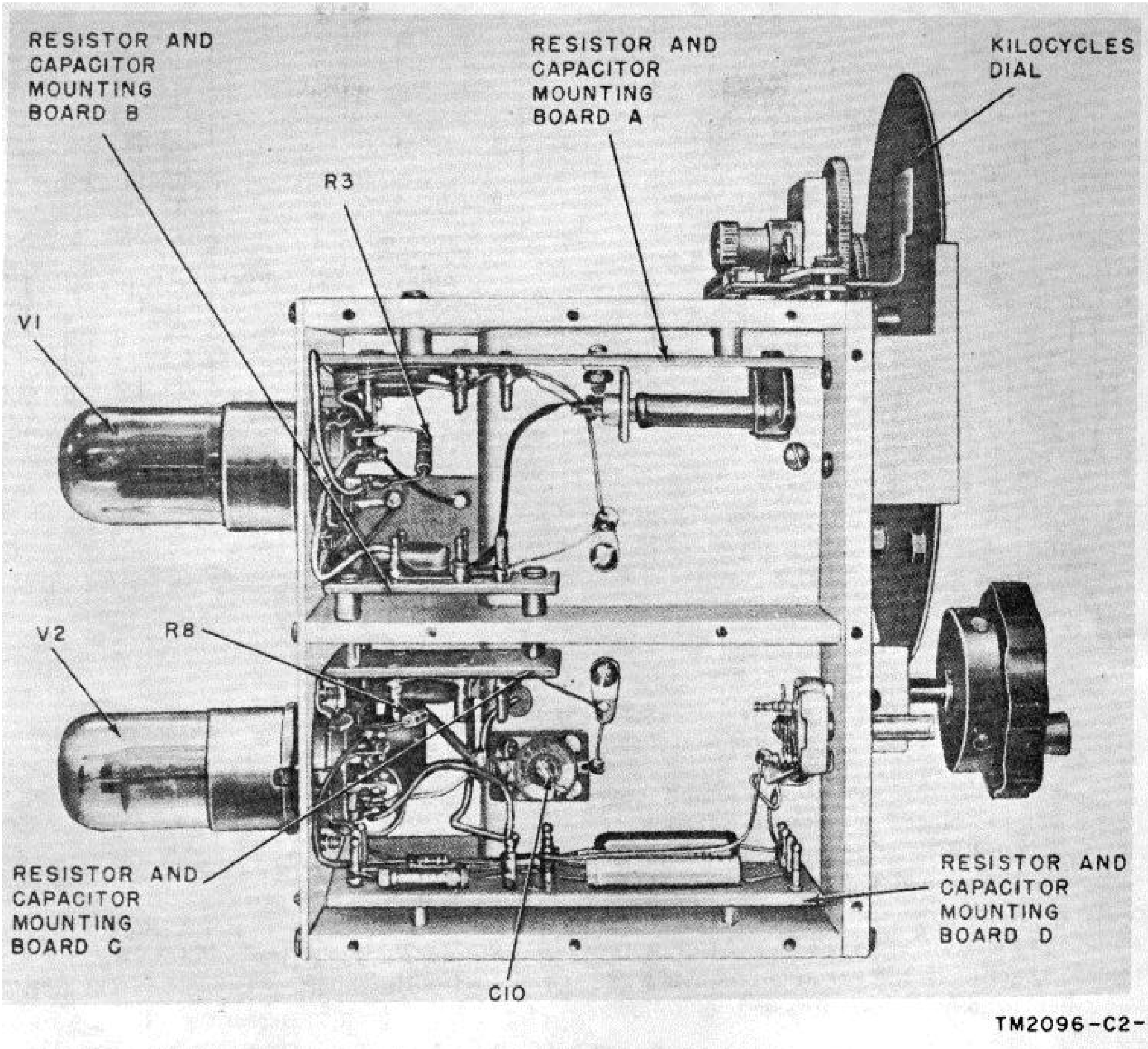


Figure 7-11. Signal Generator SG-15A/PCM, top view of oscillator assembly showing location of parts.

capacitor C9 (fig. 7-14) is replaced, however, there also will be a loss of calibration accuracy of the KILOCYCLES dial. Do not replace capacitor C9 unless it is absolutely necessary. After replacing a capacitor or resistor, proceed as follows:

(1) With Frequency Meter AN/TSM-16 connected to pin 5 of tube V9, set the fixed-frequency oscillator to the zero-beat frequency stamped on the oscillator assembly housing. Make this adjustment of the ZERO BEAT ADJ control (para 3-5) with the oscillator assembly cover in place.

(2) Set the FREQUENCY control so that the KILOCYCLES dial indicates 0.

(3) Adjust trimmer capacitor C10 so that the variable-frequency oscillator is at zero beat with the fixed-frequency oscillator when the oscillator assembly cover is in place.

(4) Use Frequency Meter AN/TSM-16 to measure the frequency of the variable-frequency oscillator at zero beat at pin 8 of tube V9.

(5) Advance the FREQUENCY control until the KILOCYCLES dial reads 35

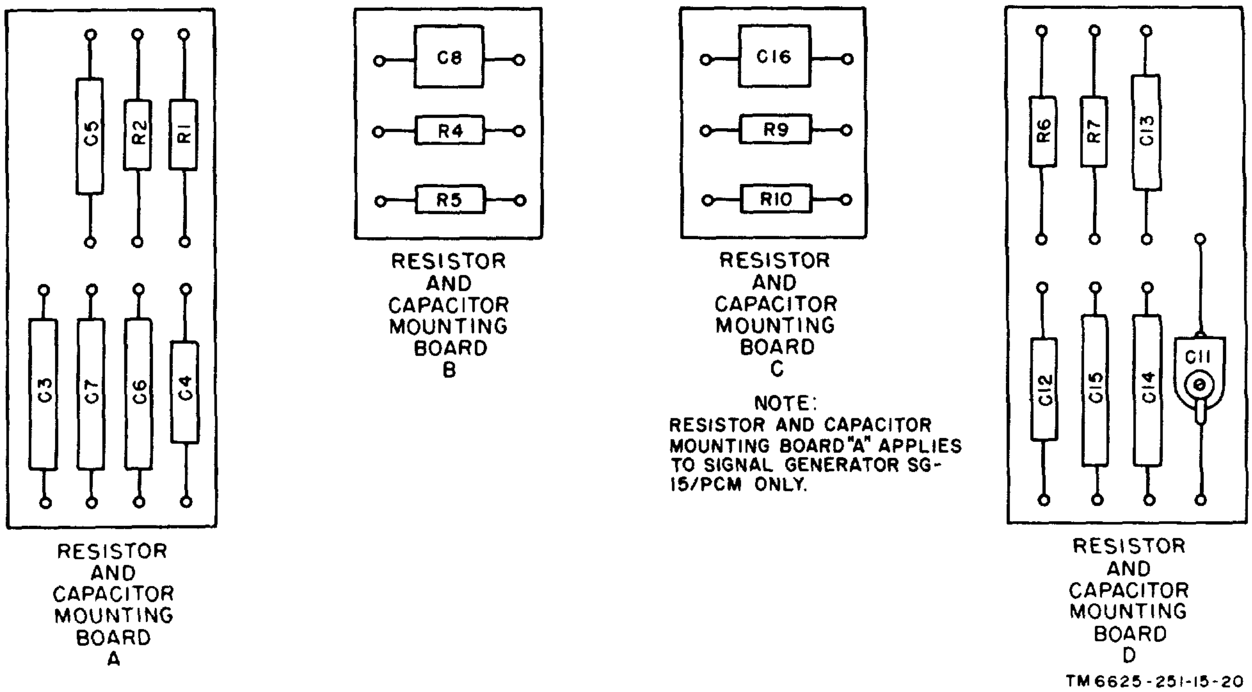


Figure 7-12. Signal Generator SG-15(*)/PCM, resistor and capacitor mounting boards located on top of oscillator assembly.

kc. With the oscillator assembly cover in place, check the frequency at OUTPUT terminals E1 and E2 with Frequency Meter AN/TSM-16.

c. After Replacing Resistor or Capacitor, Signal Generator SG-15A/PCM. After a resistor or capacitor in the variable-frequency oscillator has been replaced, proceed as follows to aline the oscillator.

(1) Set ZERO BEAT ADJ control C11 to its midposition.

(2) Set the FREQUENCY control so that the KILOCYCLES dial indicates 0.

(3) Adjust capacitor C10 (fig. 7-11) so that the variable-frequency oscillator is at zero beat with the fixed-frequency oscillator when the oscillator assembly cover is in place.

(4) Advance the FREQUENCY control until the KILOCYCLES dial indicates 35 kc with the oscillator assembly cover in place; check the frequency at OUTPUT terminals E1 and E2 with Frequency Meter AN/TSM-16.

Note

If capacitor C9 (fig. 7-14) is replaced, there will be a loss of accuracy in the KILOCYCLES dial calibration. Realine the KILOCYCLES dial by following the instructions in paragraph 7-14.

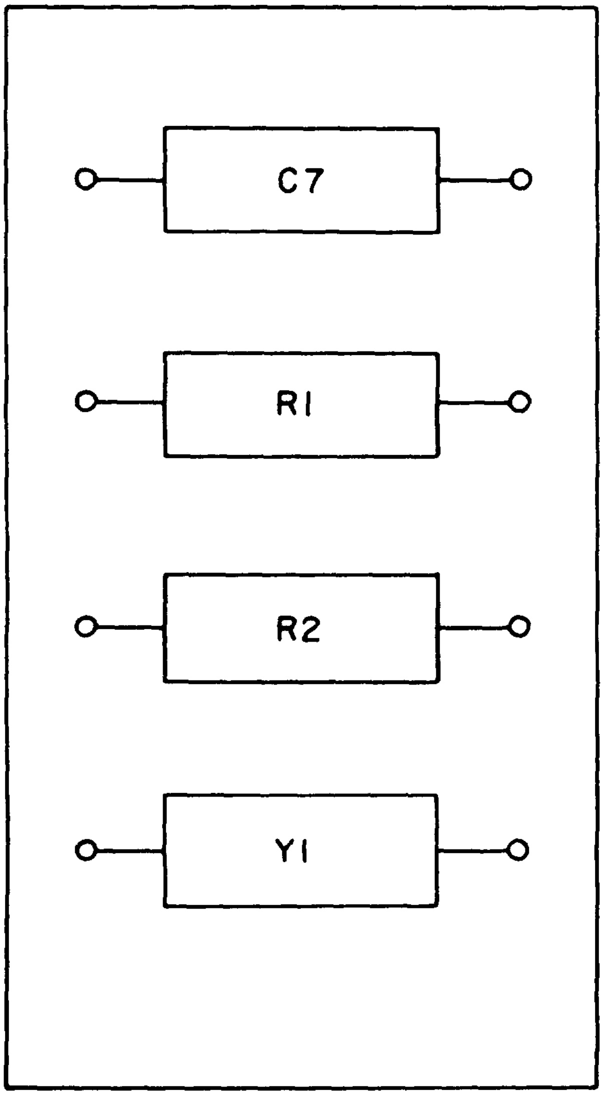
d. After Replacing Coil L2, Signal Generator SG-15/PCM. After coil L2 (fig. 7-14) is replaced, adjustment of capacitors C2 and C10 (fig. 7-14) becomes necessary. Do not replace coil L2 unless it is absolutely necessary. If coil L2 has been replaced, however, use the following alinement procedure:

(1) With the oscillator assembly cover in place, set the FREQUENCY control for 0 on the KILOCYCLES dial.

(2) In the fixed-frequency oscillator, adjust trimmer capacitor C2 for zero beat. Check with the oscillator assembly cover in place.

(3) Advance the FREQUENCY control until the KILOCYCLES dial reads 35 kc.

(4) Adjust trimmer capacitor C10 in the variable-frequency oscillator until the output frequency measures 35 kc with the oscillator assembly cover in place.



RESISTOR AND CAPACITOR MOUNTING BOARD A

TM 2096-CI-3

Figure 7-13. Signal Generator SG-15A/PCM, resistor and capacitor mounting board A located on top of oscillator assembly.

(5) Reset the FREQUENCY control until the KILOCYCLES dial is on 0.

(6) Restore zero beat by adjusting the ZERO BEAT ADJ control with the oscillator assembly cover in place.

(7) Repeat the instructions in (3) through (6) above until no further adjustment is required. Calibration of the KILOCYCLES dial may be slightly inaccurate at some intermediate points between 0 and 35 kc.

(8) The zero-beat frequency stamped on the oscillator housing is no longer applicable. Use Frequency Meter (AN/TSM-16) to measure the zero-beat frequencies at pin 5 of tube V9 for the fixed-frequency oscillator and at pin 8 of tube V9 for the variable frequency oscillator. Record these frequencies on the oscillator housing as the new zero-beat frequencies.

e. After Replacing Coil L2, Signal Generator SG-15A/PCM. After coil L2 (fig. 7-14) has been replaced, proceed as follows to aline the oscillator:

(1) With the oscillator assembly cover in place, set the FREQUENCY control until the KILOCYCLES dial indicates 0.

(2) Set ZERO BEAT ADJ capacitor C11 to its midposition.

(3) Remove the cover and adjust capacitor C10 for zero beat. Check with the oscillator assembly cover in place.

(4) Advance the FREQUENCY control until the KILOCYCLES dial indicates 35 kc.

(5) Check the frequency at OUTPUT terminals E1 and E2 with Frequency Meter AN/TSM-16. The output frequency should measure 35 kc with the oscillator assembly cover in place.

Note

If there is a deviation of 50 cycles between the output frequency and the KILOCYCLES dial when the KILOCYCLES dial is set at 35 kc, record the output at approximately every 500 cycles. Take readings more frequently within the frequency range of the equipment with which the signal generator is used. Mount this list on the cover of the signal generator.

7-14. Mechanical Alinement of KILOCYCLES Dial Calibration

Do not disturb the mechanical alinement between the KILOCYCLES dial and the shaft of capacitor C9 (figs. 5-7 and 7-14) unless it is absolutely necessary. It is very difficult to restore frequency calibration accuracy once this alinement has been disturbed. If the alinement

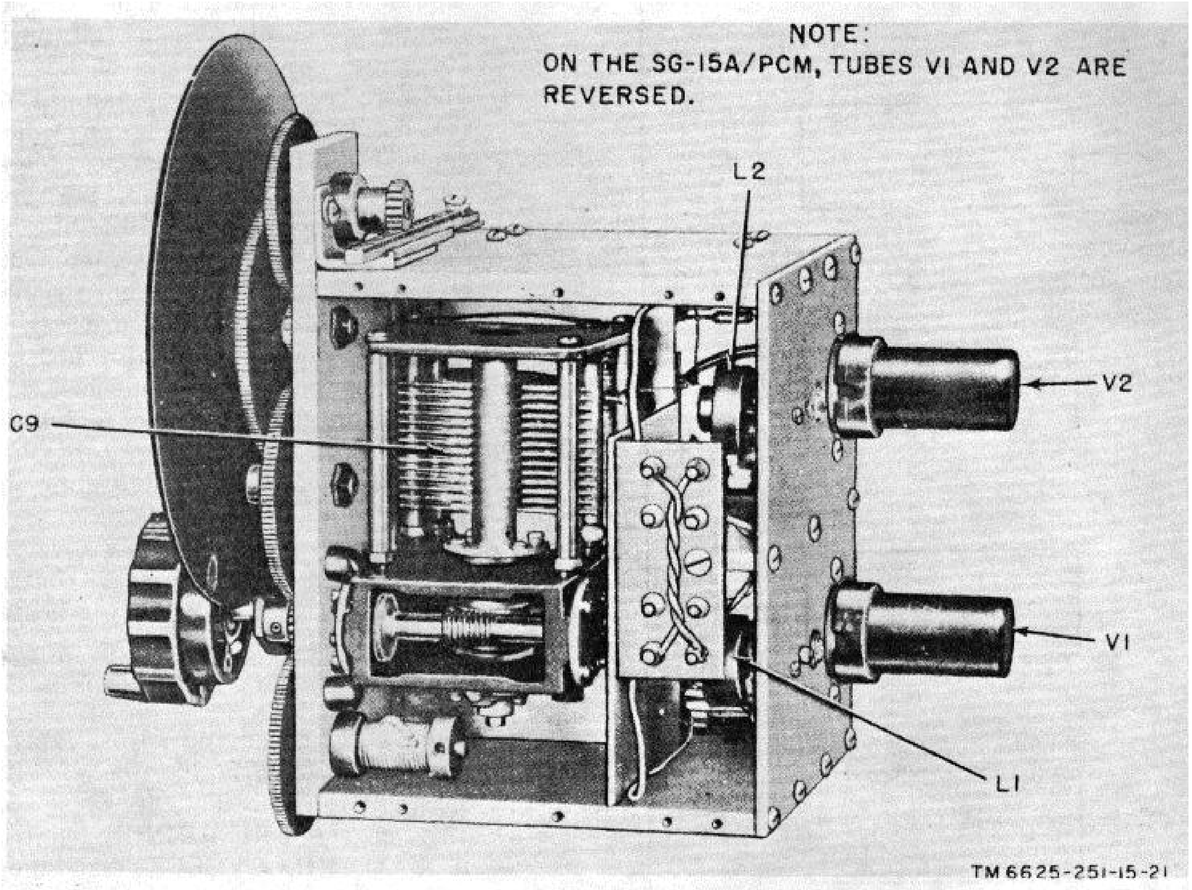


Figure 7-14. Signal Generator SG-15(*)/PCM, bottom of oscillator assembly showing location of parts.

of the KILOCYCLES dial is known to be in error, however, use the following procedure in attempting to restore it:

a. Remove the oscillator assembly from the signal generator (para 7-6a through e).

b. Remove the bottom plate from the oscillator assembly by removing the four flathead screws.

c. Set capacitor C9 so that the long edges of its rotor plates are meshed and flush with the edges of the stator plates. Use the end of a straightedge to check that the edges of these plates are flush.

d. With capacitor C9 set as in c above, the short straight line (not the dot) marked on the outer edge of the KILOCYCLES dial should be flush with the lower edge of the angle bracket which supports the assembly. If it is not, loosen the setscrews in FREQUENCY knob shaft. If this relationship is not true, loosen the setscrews in the small gear on the shaft of capacitor C9 and, while holding capacitor C9 stationary, slip the dial clockwise or counterclockwise, as required. Tighten the setscrews.

e. With capacitor C9 set as in c above and adjusted as in d above, the top of the bracket which carries the dial window shutter should be one-eighth of an inch below the bottom edge of the hairline indicator mounting block. If it is not, loosen the setscrews in the small gear which drives the rack. Slip the rack up or down, as required, while holding the other gears stationary.

f. With capacitor C9 adjusted as in c and d above, the stop mechanism should be at the end of its rotation in a counterclockwise direction as viewed from the front of the oscillator the collar on the inside end of the stop mechanism shaft and rotate the collar counterclockwise as far as it will go. Hold all gears stationary while making this adjustment. Tighten the setscrews.

g. Check to see that the flush plates (*c* above). the dial line marker (*d* above), the shutter bracket (*e* above), and the stop mechanism (*f* above) are set as desired. If they are, seal all setscrews with glyptal or paint.

h. Replace the bottom cover of the oscillator assembly, and replace the oscillator assembly in the signal generator.

i. If the oscillator unit still is not on calibration when alinement procedures are completed, draw a calibration chart; use the numbers on the dial and the new zero-beat frequencies.

7-15. Alinement of Transformer T1

Transformer T1 (fig. 7-1) is adjusted at the time of manufacture. Ordinarily, realinement should be necessary only if the transformer tuning slugs lose their adjustment after long periods of operation or after replacement of the transformer itself. Check the adjustment of the tuning slugs if the signal generator has an abnormally low output.

a. Loosen the locking bushings of the tuning slugs, top and bottom, one-half turn.

b. Set the FINE DBM control to give any convenient output reading, such as +1 db. on the OUTPUT LEVEL meter.

c. Use a suitable screwdriver and q pair of pliers to adjust the tuning slugs of the transformer for maximum output on the OUTPUT LEVEL meter. Use the setting of the FINE DBM control (b above) as a reference level.

d. Tighten the locking bushings of the transformer tuning slugs.

7-16. Alinement of Potentiometer R44

Potentiometer R44 (fig. 7-2) is used to calibrate the metering circuit. This potentiometer is adjusted at the time of manufacture, but changes in the value of resistor R42, R43, or R52, meter M1, rectifier CR1, CR2, CR3, or CR4, or potentiometer R44 itself, is well as the replacement of any of these parts, will make realinement of the potentiometer necessary.

a. Set the COARSE DBM control to -50.

b. Place Voltmeter ME-30A/U across the input terminals of attenuator E4.

c. Adjust the FINE DBM control to give a reading of 7.74 volts on the voltmeter.

d. Set potentiometer R44 so that the OUTPUT LEVEL meter on the signal generator reads 0 db.

7-17 Alinement of B+ ADJ Potentiometer R50

B+ ADJ potentiometer R50 (fig. 7-2) is used to adjust the operating level of the regulated +250-volt power supply. This adjustment should be made whenever tube V10, V11, or V12 is replaced.

a. Connect Multimeter TS-352,/U between pin 8 of tube V12 and ground.

b. Adjust potentiometer R50 for a reading of + 250 volts.

7-18. Alinement of Capacitor C35

Capacitor C35 (fig. 7-2) is a trimmer capacitor which is used to minimize longitudinal output-that is, to compensate for any difference in capacitance to ground which may exist between the two branches of the output circuit of transformer T2.

a. Put the signal generator into operation in accordance with instructions in paragraphs 3-3 and 3-4. After the equipment has warmed up from 10 to 15 minutes, adjust the signal generator for an output of + 20 dbm at 35.000 cps.

b. Use Voltmeter ME-30A/U and the five 600-ohm precision resistors to connect the signal generator into the test circuit shown in figure 7-15.

c. Adjust capacitor C35 for a minimum reading on Voltmeter ME-30A/U. This reading must be less than .0245 volt a-c.

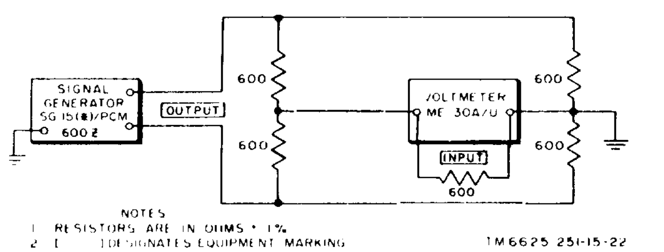


Figure 7-15. Signal Generator SG-15(*)/PCM, test circuit for adjusting longitudinal output.

Section V. ALINEMENT, DECIBEL METER ME-22(*)/PCM

Caution
Be sure the power plug is removed from the a-c outlet when replacing vacuum tubes or circuit elements.

7-19. Test Equipment Required for Alinement

The following test equipment is required when realining parts and circuits of Decibel Meter ME-22 (*)/PCM.

a. Voltmeter ME-30A/U.

b. Multimeter TS-352/U (TM 11-5527).

c. Signal Generator SG-15/PCM.

d. Four 600-ohm precision resistors ± .1 percent.

7-20. Alinement of Capacitor C1

Capacitor C1 (figs. 7-6 and 7-7) is used to minimize longitudinal input-that is, to compensate for any difference in distributed capacitance which may exist between the two sections of the primary of transformer T1. Any unbalance which may exist is eliminated by the proper adjustment of capacitor C1.

a. Put the decibel meter into operation in accordance with instructions in paragraph 3-8 3-9 *a* and *b.*

b. Connect the decibel meter into the test circuit shown in figure 7-16.

c. Set Signal Generator SG-15(*)/PCM for an output frequency of 35 kc.

d. On the decibel meter, set the DBM switch to -30 on SCALE B.

e. Adjust the output power of the signal generator to give a reading in the midportion of the meter scale of the decibel meter.

f. Adjust capacitor C1 for *minimum* output on the meter.

g. Adjust the output of the signal generator to give a reading on -45 on the decibel meter.

h. Add the total output power of the signal generator to the reading (-45) of the decibel meter. Disregard algebraic signs when adding these two readings. The sum of these two readings will exceed 50.

7-21. Alinement of B+ADJ Potentiometer R26

B+ADJ potentiometer R26 (fig. 7-5) is used to adjust the operating level of the regulated +220-volt power supply. To aline potentiometer R26, proceed as follows:

a. Connect Multimeter TS-252/U between pin 8 of tube V5 and ground.

b. Adjust potentiometer R26 for a voltmeter reading of + 220 volts.

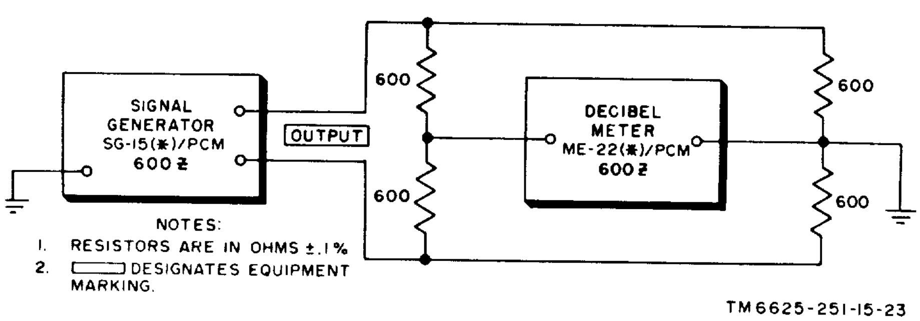


Figure 7-16. Decibel Meter ME-22(*)/PCM, test circuit for adjusting longitudinal input.

Section VI. REFINISHING

7-22. General

Check the appearance and condition of the finish of all metal surfaces. The finish should show no decided wear, and no bare metal should be exposed because of chipping or scratches on the surface. Refinish surfaces where the finish has been removed completely or worn through. Retouch such surfaces if the bare parts are restricted to small areas, but refinish the entire surface if the bare or damaged areas are large. Discolored, spotted, stained, or faded surfaces are permissible if the original finish is intact.

7-23. Refinishing Procedures

After sanding or scratch-brushing, refinish affected surfaces to match the original finish. Apply one coat of lacquer to parts which have a bright metal finish. Apply one coat of matching enamel or paint to painted surfaces. Do not apply lacquer to contact parts of jacks, switches, or potentiometers or to other surfaces which might affect the mechanical or electrical functioning of the equipment.

7-24. Preservative Application

After the equipment has been refinished completely, moisture proof and fungi proof according to instructions in paragraph 4-8*b*.

CHAPTER 8
GENERAL SUPPORT TESTING PROCEDURES

8-1. General

a. Testing procedures are prepared for use by Army Field Maintenance Shops and Army Service Organizations responsible for General Support maintenance of Army Equipment to determine the acceptability of repaired equipment. These procedures set forth specific requirements that repaired equipment must meet before it is returned to the using organization. These procedures may also be used as a guide for testing equipment that has been repaired at the direct support level if the proper tools and test equipments are available. A summary of the performance standards is given in l)paragraph 8-14.

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

8-2. Test Equipment and Materials Required

All test equipment and materials required to perform the testing procedures given in this chapter are listed in the following charts and are authorized under TA 11-17, Signal Field Maintenance Shops, and TA 11-100 (11-17), Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shop, Continental United States.

a. Test Equipment.

Nomenclature	Federal stock No.	Technical manual
Voltmeter ME-30(*)/U........................	6625-669-0742	TM 11-6625-320-12.
Frequency Meter AN/TSM-16............	6625-542-1666	TM 11-6625-218-12.
Meter, Audio Level ME-71/FCC..........		TM 11-2151.
Multimeter TS-352(*)/U		TM 11-5527.
Resistor, Decade ZM-16(*)/U		TM 11-5102.
Signal Generator SG-15(*)/PCM		This manual.

b. Materials.

Amount	Material	Federal stock No.
5 ea....................................	-600-ohm, noninductive, fixed resistor with a tolerance of ±0.1%.	5950-569-0200
1 ea....................................	Audio transformer	

8-3. Modification Work Orders

The performance standards listed in the tests (para 8-4 through 8-13) are based on the assumption that all the applicable modification work orders pertaining to this equipment have been performed. A listing of current modification work orders will be found in DA Pam 310-4.

8-4. Physical Tests and Inspections

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

b. Test Connections and Conditions.
(1) No connections necessary.
(2) Remove the signal generator and decibel meter chassis from their cases.

c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	None	Controls may be in any position.	*a.* Inspect the cases and chassis of both the signal generator and decibel meter for damage, missing parts, and condition of paint. **Note** **Touchup painting is recommended in lieu of refinishing whenever practical; screwheads. binding posts, receptacles., and other plated parts will not be painted or polished with abrasives.** *b.* Inspect all controls and mechanical assemblies for loose or missing screws, bolts, and nuts. *c.* Inspect all connectors, sockets, and receptacles, fuseholders, and meters for looseness, damage, or missing parts.	*a.* No damage evident or parts missing. External surfaces intended to be painted will not show bare metal. Panel lettering will be legible. *b.* Screws, bolts, and nuts will be tight. None will be missing. c. No loose parts or damage. No missing parts.
2	None	Controls may be in any position.	*a.* Rotate all panel controls throughout their limits of travel. *b.* Inspect dial stops for damage without evidence of damage. *c.* Operate all switches	*a.* Controls will rotate freely without binding or excessive looseness. b. Stops will operate properly and for proper operation. *c.* Switches will operate properly.
3	*MX-1292/PAQ* Connect mercury vapor lamp.	Controls may be in any position.	Turn on the mercury vapor lamp and expose the repaired or disturbed portion of the equipment to the direct rays of the lamp.	All repaired or disturbed electrical components and chassis surfaces will be covered. There must be no varnish on switch contacts or moving parts of mechanical assemblies. **Note** **Moisture-fungi proofing varnish glows gray-green under the rays of a mercury vapor lamp.**

85. Electrical Requirements of SG-15(*)/PCM

a. Test Equipment and Materials. None.

b. Test Connections and Conditions.

(1) No connections necessary.

(2) Turn on equipment and let it warm up for 15 minutes.

c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	None	SG-15(*)/PCM FREQUENCY control: Adjust so KILOCYCLES dial reads 0. COARSE DBM control: 0.	Adjust the ZERO BEAT ADJ control until the OUTPUT LEVEL meter reads 0.	The ZERO BEAT ADJ control will not be at either end of its range.
2	None		Adjust the FREQUENCY control until the KILOCYCLES control indicates 100 cps. Vary the FINE DBM control from the maximum counterclockwise position to the maximum clock-wise position.	The FINE DBM control will be capable of producing full-scale deflection (+6DB) on the OUT-PUT LEVEL meter before reaching the maximum clock wise position.

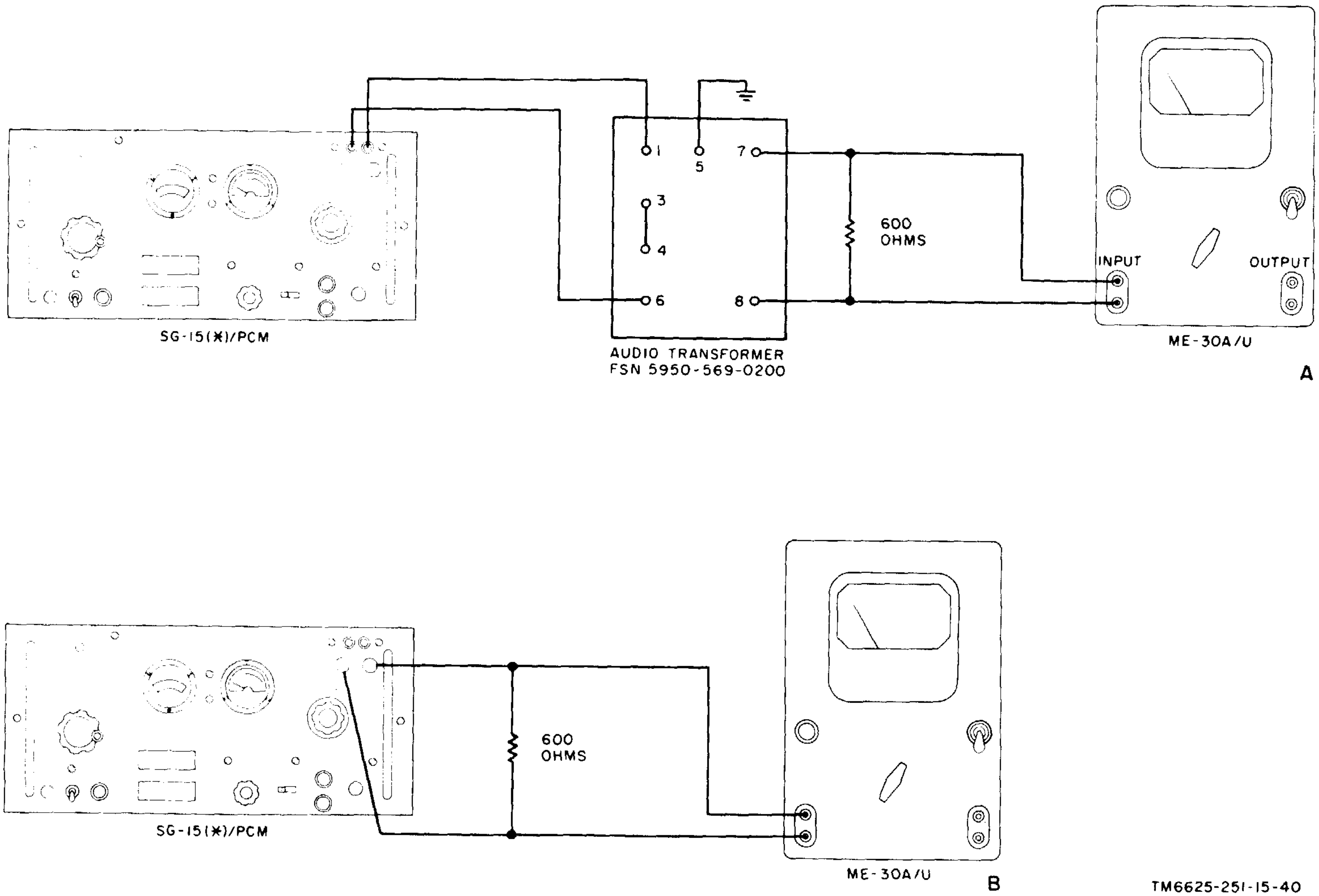


Figure 8-1. Power output test connections.

a. Test Equipment and Materials.
(1) Voltmeter, Meter ME-30A/U.
(2) Audio transformer.
(3) 600-ohm resistor.

b. Test Connections and Conditions. Connect the equipment as shown in A, figure 8-1.

c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*ME-30A* Range selector switch: -50DB.	COARSE DBM control: -50	*a.* Adjust FREQUENCY control knob on SG-15(*)/PCM until the KILOCYCLES dial reads 1 KC. Adjust the FINE DBM control until the OUTPUT LEVEL meter reads -4. *b.* Adjust the FINE DBM control until the OUTPUT LEVEL meter reads 0.	*a.* ME-30A/U meter reads between -4 and -3.5 on the DECIBEL scale. *b.* ME-30A/U meter reads between -.5 and +.5 on the DECIBEL scale.
2	*ME-30A* Range selector switch: -40DB.	COARSE DBM control: -40	Same as step 1*b*.........................	Same as step 1*b*.
3	*ME-30A* Range selector switch: -30DB.	COARSE DBM control: -30	Same as 1*b*.	Same as 1*b*.
4	*ME-30A* Range selector switch: -20DB.	COARSE DBM control: -20	Same as 1*b*.	Same as 1*b*.
5	*ME-30A* Range selector switch: -10DB.	COARSE DBM control: -10	Same as 1*b*.	Same as 1*b*.
6	*ME-30A* Range selector switch: 0DB.	COARSE DBM control: 0	Same as 1*b*.	Same as 1*b*.
7	*ME-30A* Range selector switch: +10DB.	COARSE DBM control: +10	Same as 1*b*.	Same as 1*b*.
8	*ME-30A* Range selector switch: +20DB.	COARSE DBM control: +20	*a.* Same as 1*b*........................... *b.* If testing the SG-15A/PCM, repeat tests 1*b* through 8*a* above, except set the FREQUENCY control knob so that the KILOCYCLES dial reads 35; and connect the equipment as shown in figure 8-1B.	*a.* Same as 1*b*. *b.* Same as 1*b*.

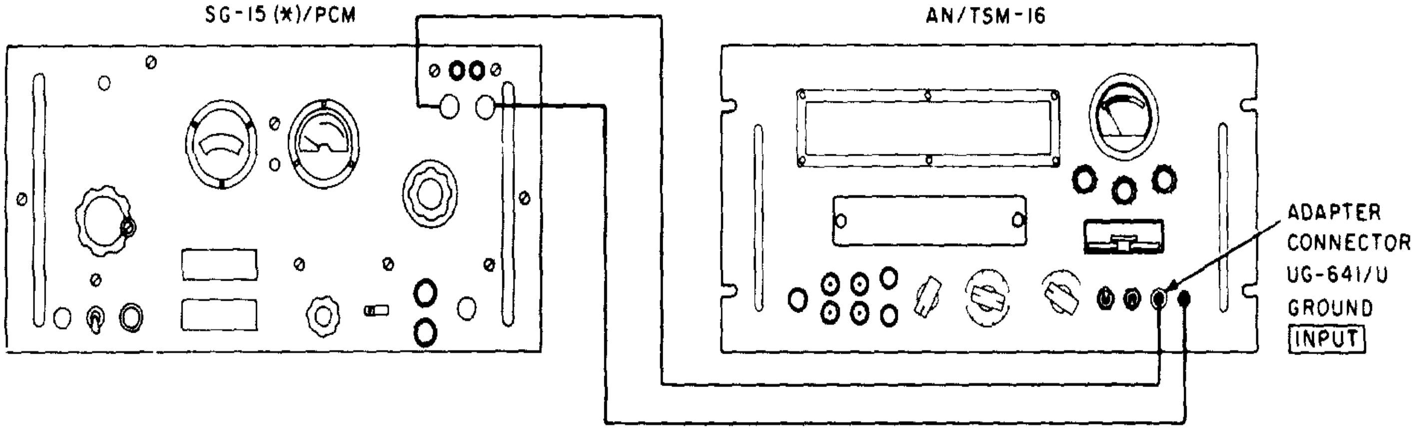


Figure 8-2. Frequency range of SG-15(*)/PCM test setup.

8-7. Frequency Range of SG-1 5(*)/U

a. Test Equipment and Materials. Frequency Meter AN/TSM-16.
b. Test Connections and Conditions. Connect the equipment as shown in figure 8-2.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*AN/TSM-16* FUNCTION: Test. DISPLAY TIME control: Near fully clockwise. TRIGGER VOLTAGE control: Fully counterclockwise. SENSITIVITY control: Fully counterclockwise. AUTO-MANUAL switch: AUDO TIME-SECONDS switch: 1. INT-EXT switch: INT.	None	Wait until the XTAL OVEN ON indicator lamp cycles on and off. Slowly turn the TRIGGER VOLTAGE control clockwise until the numerical indicators begin to count. Observe the position of the TRIGGER VOLTAGE control. Continue to advance the control until the counting stops. Back off the control to a position halfway between the one where the counting started and where it stopped. Wait until the counter counts one or more time. The counter should indicate either 100000 or 099999.	None
2	None	COURSE DBM: ZERO OUTPUT	Adjust the FREQUENCY control knob until the KILOCYCLES dial read 0. Adjust the ZERO BEAT ADJ control until the OUTPUT LEVEL meter reads 0.	None
3	*AN/TSM-16* MULTIPLY FREQUENCY BY: 1 FUNCTION: SCAN COUNT. AUTO-MANUAL: AUTO.	COURSE DEB: +20	Adjust the FINE DBM control until the OUTPUT LEVEL meter reads +6. Adjust the FREQUENCY control knob until the KILOCYCLES dial reads 200 cps. Adjust the SENSITIVITY control on the AN/TSM-16 until the INPUT LEVEL meter reads in the middle of the green area.	When the AN/TSM-16 stops counting, it reads between 190 and 210 for the SG-15/PCM or between 180 and 220 for the SG-15A/PCM.
4	Same as step 3	Same as step 3	Same as step 3 except that the FREQUENCY control knob on the SG15/PCM should be adjusted to read 1,500 cps.	When the AN/TSM-16 stops counting, it reads between 1,480 and 1,520 for the SG-15/PCM and 1,465 and 1,535 for the SG-16A/PCM.
5	Same as step 3	Same as step 3	Same as step 3 except the FREQUENCY control knob on the SG-15/PCM should be adjusted to read 5,000 cps.	When the AN/TSM-16 stops counting, it reads between 4,950 and 5,050 on both the SG-15/PCM and the SG-15A/PCM.
6	Same as step 3	Same as step 3	Same as step 3 except the FREQUENCY control knob on the SG-15/PCM should be adjusted to read 35,000 cps.	When the AN/TSM-16 stops counting, it reads between34,950 and 35,050 for the SB-15/PCM and 34,850 and 35,150 for the SG15A/PCM.

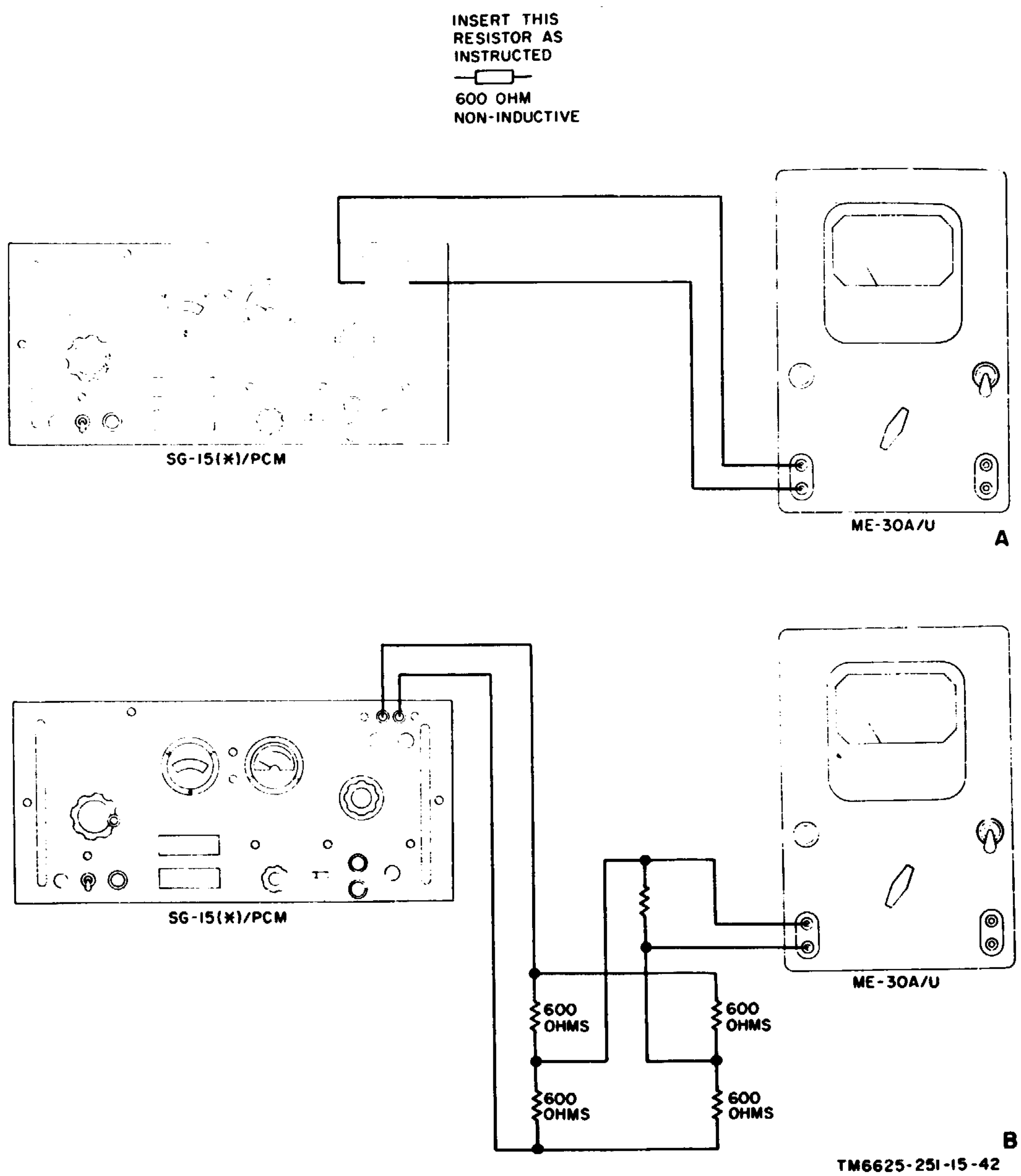


Figure 8-3. Output impedance of SG-15(*)/PCM, test setup.

8-8. Output Impedance Test for SG-15(*)/U

a. Test Equipment and Materials.
(1) Voltmeter, Meter ME-30A/U.
(2) Five 600-ohm, noninductive resistors.
b. Test Connections and Conditions. Connect the equipment as shown in figure 83.
c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*ME-30A/U* Range selector switch: 10 VOLTS.	COARSE DBM: ZERO output FINE DBM: Adjust to approximate middle of its range.	*a.* Adjust the FREQUENCY control until the KILOCYCLES dial indicates 1 KC. With the 600-ohm resistor not connected to the OUTPUT terminals, adjust the COARSE DBM control until the ME-30A indicates approximately 8 volts. Adjust the FINE DBM control until the ME-30A indicates exactly 8 volts *b.* Connect one 600-ohm resistor directly across the OUTPUT terminals of the SG15(*)/U.	*a.* None. *b.* The ME-30A/U indicates between 3.9 and 4.1 volts.
2	*ME-30A/U* Range selector switch: 10 VOLTS.	Same as step 1..........................	*a.* Same as step 1*a* except adjust the FREQUENCY control until the KILOCYCLES dial indicates 200 cps. *b.* Same as step 1*b.*	a. None. *b.* The ME-30A/U indicates between 3.8 and 4.2 volts.
3	*ME-30A/U* Range selector switch: 10 VOLTS.	Same as step 1..........................	*a.* Same as step 1a except adjust the FREQUENCY control until the KILOCYCLES dial indicates 35,000 cps. *b.* Same as step 1*b.*	*a.* None. *b.* Same as step 2*b*.
4	*ME-30A/U* Range selector switch: .03 VOLTS.	COURSE DBM: +20	Connect the equipment as shown in figure 8-3B. Adjust FREQUENCY control until the KILOCYCLES dial indicates 200 cps. Adjust the FINE DBM control until the OUTPUT LEVEL on the SG-15(*)/PCM indicates +20 dbm.	The ME-30A/U meter indicates less than 0.0245 volt.
5	*ME-30A/U* Range selector switch: .03 VOLTS.	COURSE DBM control: +20.......	Same as step 4 except adjust the FREQUENCY control until the KILOCYCLES dial indicates 1,000 cps.	Same as step 4
6	Same as step 5	Same as step 5..........................	Same as step 4 except adjust the FREQUENCY control until the KILOCYCLES dial indicates 35,000 cps.	Same as step 4

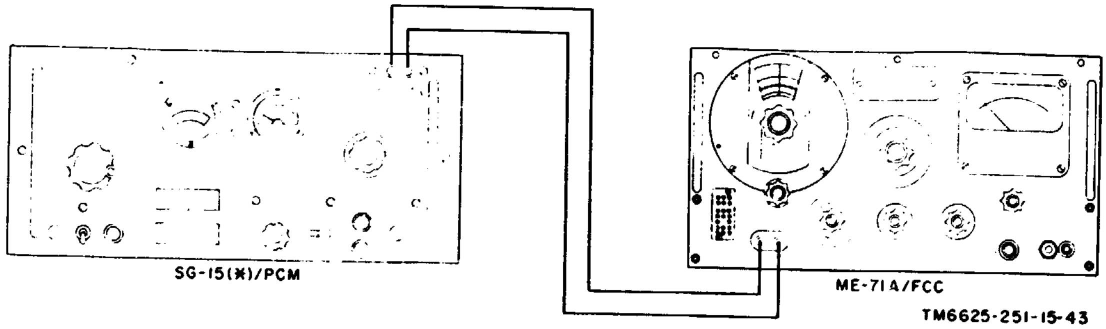


Figure 8-4. Harmonic content of output of SG-15(*)/PCM, test setup.

8-9. Harmonic Content of Output of SG-15(*)/U

a. Test Equipment and Materials. Audio Level Meter ME-71A/FCC.
b. Test Connections and Conditions. Connect the equipment as shown in figure 8-4.
c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*ME-71A/FCC* METER switch: CAL 1. ATTENUATOR DB switch: +20. SELECTOR switch: VM-UNBAL 600 BRG. AUDIO GAIN: Extreme counterclockwise position but not OFF.	None	The panel meter of the ME-71/FCC should read O DB. Place the METER switch in the CAL 2 (100KC), position and adjust the tuning dial for maximum indication on the DECIBEL meter at 100KC. Adjust the CAL 2 (IF GAIN) control for exactly 0 DB indication.	None.
2	Same as step 1 except: METER switch: MEAS.	COURSE DBM: +20	Adjust the FREQUENCY control knob on the S-15(*)/U until the KIILOCYCLES dial reads 35,000 cps. Adjust the tuning control on the ME-71A/FCC until the ME-71A/ FCC is tuned to approximately 35 KC. Continue adjusting this control for MAXIMUM indication on the DECIBEL meter. Adjust the FINE DBM control on the SG-15(*)/U for a reading of 0 DB on the DECIBEL meter on the ME-71A/FCC.	None.
3	Same as step 2 except: ATTENUATOR DB switch: -30.	Same as step 2	Adjust the tuning control on the ME-71A/FCC until the ME-71A/FCC is tuned to approximately 70,000 cps. Continue to adjust the ME71A/FCC tuning control for maximum indication Do not vary the controls on the SG15 (*) /PCM.	DECIBEL meter on the ME-71A/FCC reads 0 or below.

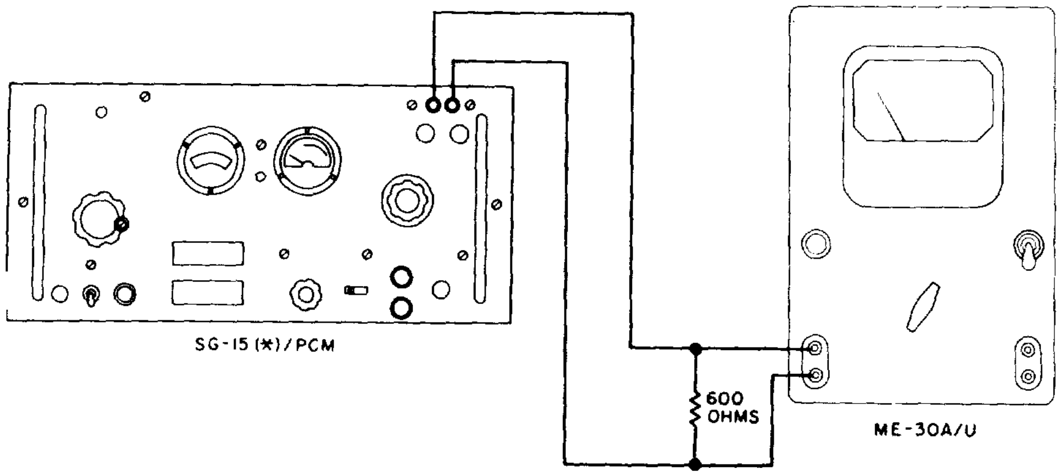


Figure 8-5. Noise test for SG-15(*)/PCM, test setup.

8-10. Noise Test for SG-15(*)/PCM

a. Test Equipment and Materials.
(1) Voltmeter, Meter ME30A/U.
(2) One 600-ohm ±.5% noninductive resistor.
b. Test Conditions and Connections. Connect the equipment as shown in figure 8-5.
c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*ME-30A/U* Range selector switch: +10 VOLTS	COARSE DBM: ZERO OUTPUT.	*a*. Adjust the FREQUENCY control knob for a KILOCYCLES dial reading of 200 cps. Turn the COARSE DBM control until the ME-30A/U meter indicates approximately 8 volts. Adjust the FINE DBM control until the ME-30A/U indicates exactly 8 volts. *b*. Adjust the FREQUENCY control knob for a KILOCYCLES dial reading of zero beat. Adjust the ZERO BEAT ADJ control for a null indication on the OUTPUT LEVEL METER on the SG-15(*)/U. Turn the range selector switch on the ME-30A/U to .03 VOLTS.	*a*. None *b*. ME-30A/U meter indicates.0253 volt or less.

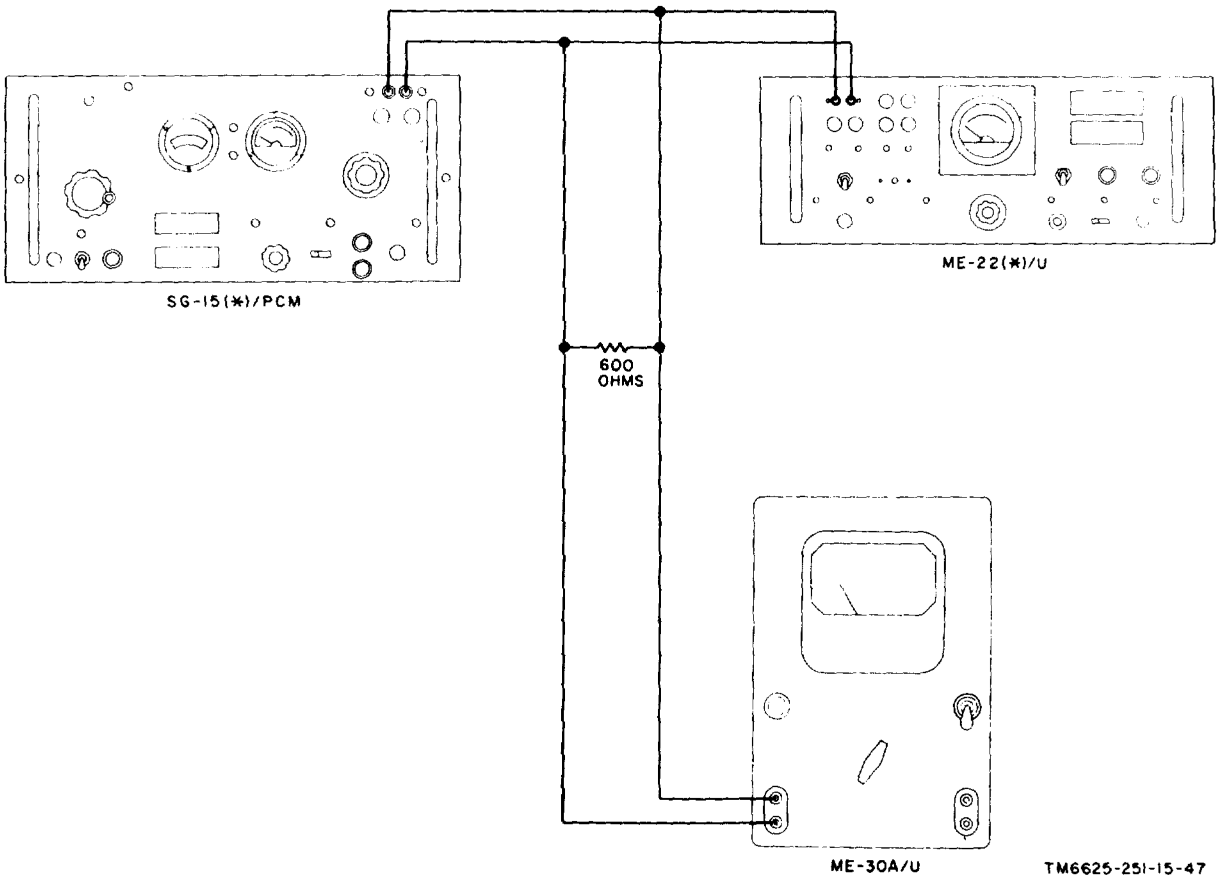


Figure 8-6. Calibration of ME-22(*)/PCM, test setup.

8-11. Calibration of Decibel Meter ME-22(*)/PCM

a. Test Equipment and Materials.

(1) Signal Generator SG-15(*)/PCM.

(2) Voltmeter, Meter ME30A/U.

(3) One 600-ohm ±.5% noninduotive resistor.

b. Test Connections and Conditions. Turn on the equipment and let it warm up for 10 minutes. Connect the equipment as shown in figure 8-6.

c. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*SG-15(*)/PCM* COARSE DBM control: 0 ME-30A/U Range selector switch: 0 DB	DBM range switch: 0 INPUT IMPEDANCE switch: 600	Turn the FREQUENCY control knob of the SG-15(*)/PCM until the KILOCYCLES dial reads 1,000 cps Adjust the FINE DBM control of the SG-15(*)/PCM until the ME-22(*)/PCM meter reads 0 on the B scale.	The ME-30A/U meter reads between -.5 and +.6 db.
2	*SG-15(*)/PCM* COARSE DBM control: -10 MS-30A/U Range selector switch: -10 DB	DBM range switch: -10 INPUT IMPEDANCE switch: 600	Same as step 1..	Same as step 1.
3	*SG-15(*)/PCM* COARSE DBM control -20 MS-30A/U Range selector switch: -20 DB	DBM range switch: -20 INPUT IMPEDANCE switch: 600	Same as step 1..	Same as step 1.
4	*SG-15(*)/PCM* COARSE DBM control -30 MS-30A/U Range selector switch: -30 DB	DBM range switch: -30 INPUT IMPEDANCE switch: 600	Same as step 1..	Same as step 1.
5	*SG-15(*)/PCM* COARSE DBM control -40 MS-30A/U Range selector switch: -40 DB	DBM range switch: -30 INPUT IMPEDANCE switch: 600	Turn the FREQUENCY control knob of the SC 15(*)/PCM until the KILOCYCLES dial reads 20 cps. Adjust the FINE DBM control until the ME-22(*)/PCM meter reads -15 on the B scale.	The ME-30A/U meter reads between -4.5 and-5.5 db.
6	Same as step 4....................	Same as step 4 INPUT IMPEDANCE switch: 600	Same as step 5 except adjust the FINE DBM control until the ME-22(*)/PCM meter reads 0 on the B scale.	Same as step 1.
7	*SG-15(*)/PCM* COARSE DBM control -40 MS-30A/U Range selector switch: -40 DB	DBM range switch: +10 INPUT IMPEDANCE switch: 600	Adjust the FINE DBM control of the SG-15(*)/U until the ME-22(*)/PCM meter reads 0 on the A scale	Same as step 1.
8	Same as step 7....................	Same as step 7....................	Same as step 5 except adjust the turn the FINE DBM control until the ME-22(*)/PCM meter reads 15 on the A scale.	Same as step 5.
9	Same as step 5....................	Same as step 5....................	Same as step 5 except turn the FREQUENCY control knob of the SG-15(*)/PCM until the KILOCYCLES dial reads 35,000 cps	Same as step 5.
10	Same as step 4....................	Same as step 4....................	Same as step 7..	Same as step 1.
11	Same as step 7....................	Same as step 7....................	Same as step 7..	Same as step 1.
12	Same as step 8....................	Same as step 8....................	Same as step 9..	Same as step 5.

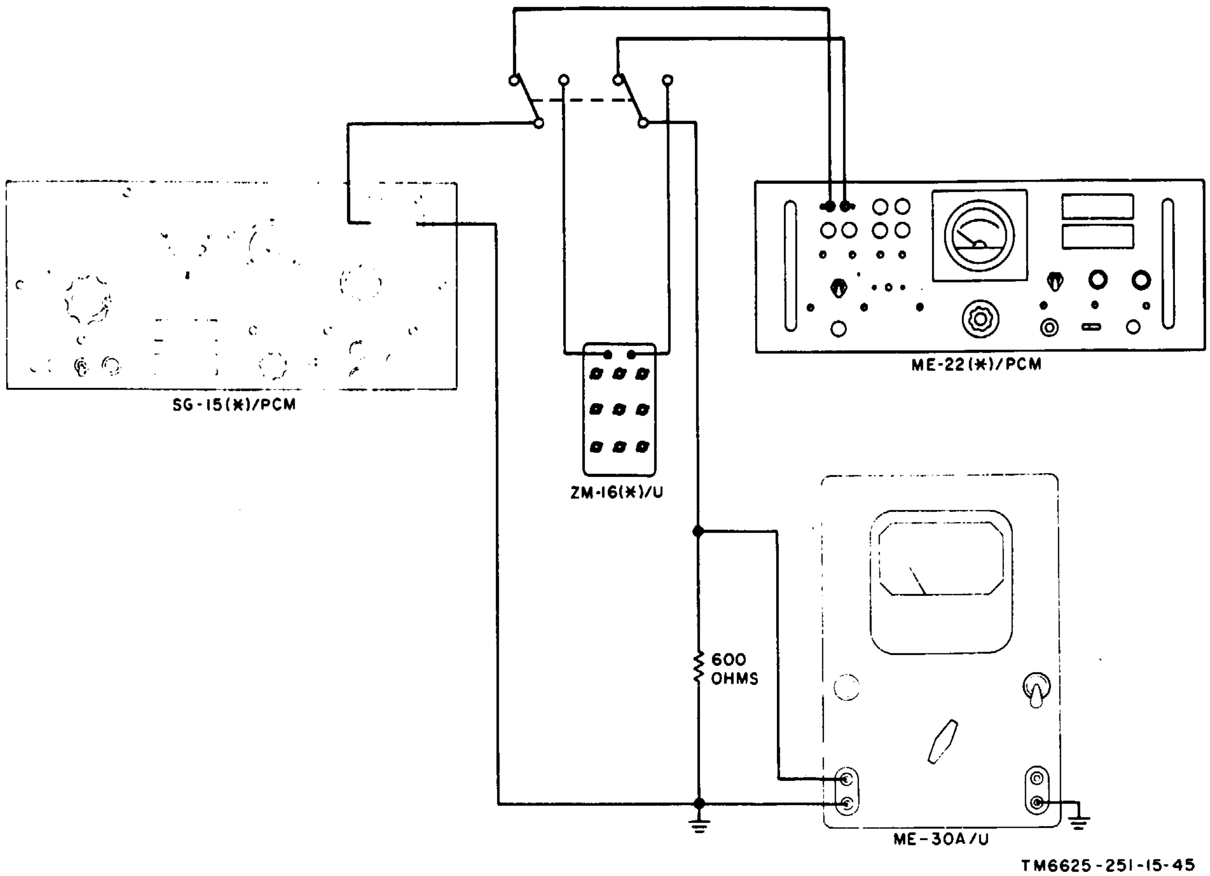


Figure 8-7. Input impedance of ME-22(*)/PCM, test setup.

8-12. Input Impedance of Decibel Meter ME-22(*)/PCM

a. Test Equipment and Materials.
(1) Signal Generator SG-15(*)/PCM.
(2) Decade Resistor ZM-16/U.
(3) Voltmeter, Meter ME-30A/U.
(4) Double-pole, double-throw switch.
(5) Resistor 600Ω ±.5%

b. Test Connections and Conditions. Connect the equipment as shown in figure 8-7.

c. Procedure.

Step	Control settings			
No.	Test equipment	Equipment under tat	Test procedure	Performance standard
1	*ME-30A/U* Range selector switch: .3 VOLTS	INPUT IMPEDANCE: BRIDGING	Set the double-pole, double throw switch so that Decibel Meter ME-22(*)/PCM is connected in the circuit. Adjust the FREQUENCY control knob of the SG-15(*/PCM so that the KILOCYCLES dial indicates 200 cps. Adjust the COARSE and FINE DBM control so that the ME-30A/U meter reads .254 volt. Place the double-throw, double-pole switch in position so that the ZM-16(*)/U is connected in the circuit. Adjust the ZM-16(*)/U controls so that the ME-30A/U meter reads exactly .254 volt.	The ZM-1 6/U indicates between 7,200 and 8,800 ohms.
2	Same as step 1	Same as step 1	Same as step 1 except adjust the FREQUENCY control knob the KILOCYCLES dial of the SG-15(*)/U so that indicates 35,000 cps.	Same as step 1.
3	Same as step 1	INPUT IMPEDANCE: 600 OHMS	Same as step 1	The ZM-16/U indicates between 540 and 660 ohms.
4	Same as step 1	Same as step 3	Same as step 2	Same as step 3.
5	Same as step 1	Same as step 1	Same as step 1 except adjust the FREQUENCY control knob of the SG-15(*)/U so that the KILOCYCLES dial indicates 1,000 cps.	The ZM-16/U indicates between 7,600 and 8,400 ohms.
6	Same as step 1	Same as step 3	Same as step 5	The ZM-16/U indicates between 570 and 630 ohms.

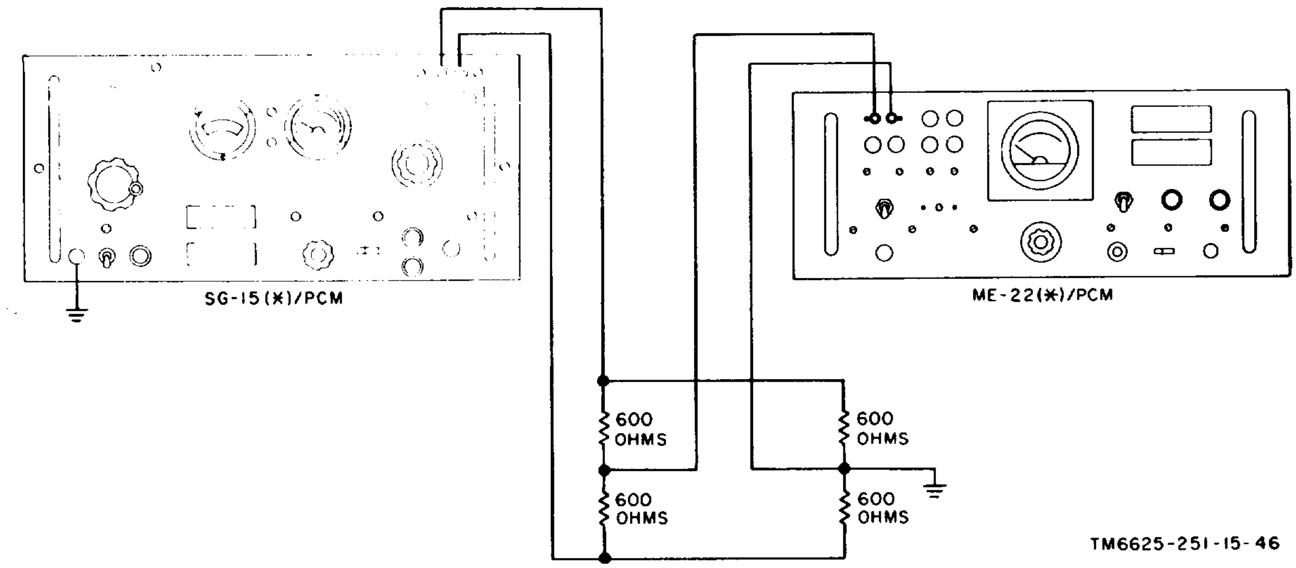


Figure 8-8. Longitudinal input test of ME-22(*)/PCM, test setup.

8-13. Longitudinal Input Test for Decibel Meter ME-22(*)/U

a. Test Equipment and Materials.

(1) Signal Generator SG-15(*)/PCM.

(2) Four 600-ohm resistors.

b. Test Connections and Conditions. Connect the equipment as shown in figure 8-8. Remove Decibel Meter ME-22(*)/ PCM from its case.

c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under tat		
1	*SG-15(*)/U* COARSE DBM: -30	DBM switch: -30	*a.* Adjust the FREQUENCY knob of the SG-15(*)/PCM until the KILOCYCLE-dial indicates 35,000 cps. Adjust the FINE DBM control of the SG15(*) /PCM for a midscale reading on the db meter of the ME-22(*)/ PCM. Adjust capacitor C1 for a minimum reading on the db meter. Note the minimum reading obtained. *b.* Adjust the FINE DBM control on the SG15 (*)/PCM for a reading of -15 on the B scale of the db mete on the ME-22(*)/PCM.	*a. None.* *b.* Disregarding the algebraic signs, the sum of the reading in a above and the-15 obtained in this step shall be greater than 50.

8-14. Summary of Test Data

Personnel may find it convenient to arrange the checklist in a manner similar to that shown below:

Signs Generator -SG-15/PCM or SG-15A/PCM

Electrical requirements-- The zero beat adj control shall not be at either end of its range when the variable frequency oscillator is zero-beat with the fixed frequency oscillator.

The FINE DBM control will be capable of producing full-scale deflection (+6 db) on the OUTPUT LEVEL meter before reaching the upper end of its range.

Power output-- At each setting of the COARSE DBM control, using a frequency of 1,000 cps for the SG-15/PCM and using frequencies of 1,000 cps and 35,000 cps for the SG-15A/PCM, the power output will be accurate within ±0.5 db.

Frequency range--- The frequency of the output, when measured at +26 dbm, will be as indicated below for the following settings of the KILOCYCLES dial:

Freq	SG-15/PCM	8-15A/PCM
200 cps	±10 cps	±20 cps
1,500 cps	±20 cps	±35 cps
5,000 cps	±50 cps	±50 cps
85,000 cps	±50 cps	+150 cps

Output impedance--- With the output of the SG-15(*)/PCM tuned to 1,000 cps and the voltage output set for 8 volts, the output voltage will drop to 3.9 to 4.1 volts when a 600-ohm load is placed across the output of the SG-15(*)/PCM. When using frequencies of 200 and 35,000 cps the voltage will drop to between 3.8 and 4.2 volts

Longitudinal output-- Using the circuit illustrated (fig. 8-3B) and with the SG-15(*)/PCM output set at +20 dbm, Voltmeter, Meter ME30A/U will indicate not more than 0.0245 volt at test frequencies of 200, 1,000, and 35,000 cps.

Harmonic output --- Using a test frequency of 35,000 cps and with the output adjusted to 8 volts, the second and third harmonic output will not exceed 0.253 volt.

Noise output -- With the output set at 8 volts at any frequency, the SG-15(*)/PCM is set at zero-beat frequency and the output voltage will not exceed 0.0253 volt.

Decibel Meters ME-22/PCM and MFE22A/PCM

Calibration--- The ME-22(*)/PCM will be accurate to within ±0.5 db at the following test points, using a frequency of 1,000 cps: 0, -10, -20, and -30 dbm and at frequencies of 200 and 35,000 cps, at the following check points: -45, -0, +10, and +25 dbm.

Input impedance --- The input impedance, when measured at 200 cps and 35,000 cps, will be 600 ohm ±60 in the 600 OHM position, and 8,000 ohms ±800 in the BRIDGING position.

The input impedance, when measured at 1,000 cps, will be 600 ohms ±30 in the 600 OHM position, and 8,000 ohms ±400 in the BRIDGING position.

Longitudinal input-- Using the test setup in figure 8-8, the response to longitudinal input power will be down at least 50 db at frequencies of 200, 1,000, 10,000, and 35,000 cps when the signal generator is adjusted for a +20-dbm output.

CHAPTER 9

DEPOT OVERHAUL STANDARDS

9-1. Applicability of Depot Overhaul Standards

The tests outlined in this chapter are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

9-2. Applicable References

a. Repair Standards. Applicable procedures of the depots performing these tests and the general standard for repaired electronic equipment given in TB SIG 355-1, TB SIG 355-2, and TB SIG 355-3 form a part of the requirements for testing this equipment.

b. Modification Work Orders. Perform all equipment before making the tests specified. DA Pam 310-4 lists all available MWO's.

9-3. Test Facilities Required

The following items are required for depot testing:

Item	Technical manual	Common name
Voltmeter, Meter ME-30A/U	TM 11-6625320-12	Voltmeter
Frequency Meter AN/TSM-16	TM 116625-218-12	Frequency meter
Meter, Audio Level ME-71/FCC	TM 1'1-2151	Audio level meter
Resistor, Decade ZM-16/U	TM 11-5102	Decade resistor

9-4. Testing of Test Set TS-140/PCM

To perform the Depot Overhaul Standards on Test Set TS-140/PCM, perform the tests in paragraphs 8-4 through 8-13.

CHAPTER 10

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

Note:

The circumstances involved in shipment and storage vary and, therefore, no definite procedure for repacking can be given. The following instructions are recommended as a guide for preparing Signal Generator SG- 15/PCM and Decibel Meter ME-22/PCM for transportation and storage.

10-1. Removing from Service

a. Set the power ON-OFF switch to the OFF position.

b. Disconnect the power cable from the power source.

c. Disconnect the output of the signal generator, either at the OUTPUT terminals or the OUTPUT jack, whichever is used. Disconnect the INPUT jack or terminals of the decibel meter from the equipment under test.

d. Disconnect the ground lead from the GND terminal.

10-2. Disassembly

Both Signal Generator SG-15(*)/PCM and Decibel Meter ME-22(*)/PCM are portable and, ordinarily, no special disassembly is required. If the equipment is rack mounted, however, remove the mounting screws from the slots at the sides of the front panel and dismount the equipment.

10-3. Repackaging

Note

As far as possible, use the original packaging materials which were saved at the time the equipment was unpacked.

a. Place the switchboard patching cord in the cover of the carrying case.

b. Block and brace in place all delicate components mounted on the chassis with cells or pads of flexible corrugated paper. This will help to reduce shearing stress on mountings and prevent movement or shearing of parts.

c. Place and secure the chassis on the shock-mounted rack in the carrying case. Close the lid of the case and secure the fastenings.

d. Cushion the cased equipment on all surfaces with cells and/or pads of corrugated fiberboard. This will absorb the shock of impact normally encountered in handling and during transit.

e. Place the cushioned equipment in a close-fitting, regular slotted style, corrugated fiberboard box. Whenever possible, place a dehydrating agent, such as silica gel, inside the box. Seal the entire closure with gummed paper tape. Blunt all corners of the box.

f. Place the boxed equipment in a water-vaporproof barrier. Extract all air and heat-seal the barrier.

g. Place the water-vapor-proofed equipment in a second close-fitting corrugated fiberboard box. Seal the entire closure with water-resistant tape or adhesive.

10-4. Packing

Place the equipment, packaged as described in paragraph 10-3, in a nailed wooden box which is lined on all interior surfaces with a 2-inch thickness of excelsior. If excelsior is not available, use pads of corrugated fiber-board. Fill all voids in the box to prevent shifting of the contents.

Section II. DEMOLITION OF MATERIAL TO PREVENT ENEMY USE

10-5. Authority for Demolition

The demolition procedures given in paragraph 10-6 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon the order of the commander.

10-6. Methods of Demolition

a. Smash. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Use axes, handaxes, or machetes.

c. Burn. Use gasoline, kerosene, oil, Flame throwers, or incendiary grenades.

d. Explode. Use firearms, grenades, or TNT.

e. Dispose. Burn in slit trenches, fox holes, or other holes. Throw in streams. Scatter.

Note

Use anything immediately available for destruction of this equipment.

10-7. Destruction of Components

When ordered by your commander, destroy all equipment to prevent its being used or salvated by the enemy.

a. Smash (para 10-6a) switches, controls, tubes jacks, binding posts, resistors, capacitors, transformers, tube sockets, meters, oscillator assembly, cord plugs, chassis, and cases.

b. Cut (para 10-6b) power cords, switch-board patching cords, and wiring.

Warning

Be extremely careful with explosives and incendiary devices. Use these items only when the need is urgent.

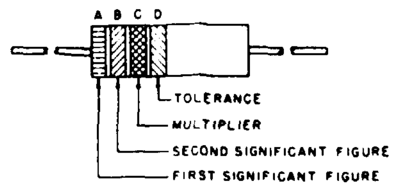
c. Burn (para 10-6c) Signal Corps forms, office records, and technical manuals.

d. Burn or scatter (para 10-6e) all of the above parts after they have been rendered useless.

e. Destroy everything.

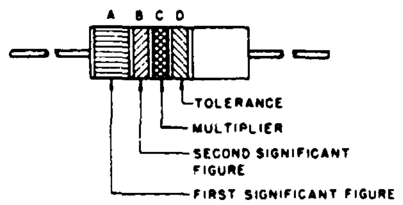
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS



BAND A— Double Width Signifies Wire-wound Resistor

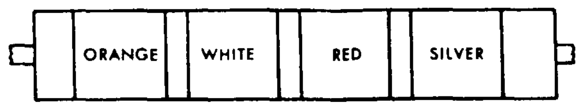
COLOR CODE TABLE

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

EXAMPLES OF COLOR CODING

BAND

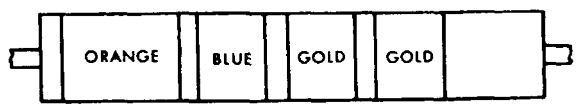
A B C D*



3 9 X100 ± 10%

BAND

A B C D*



3 6 X0.1 ± 5%

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

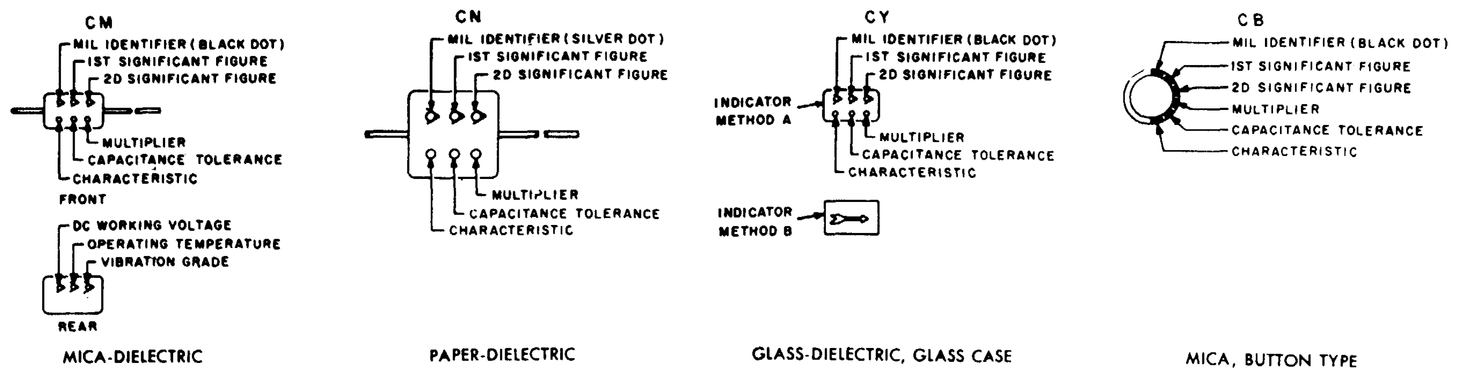
STD-R2

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

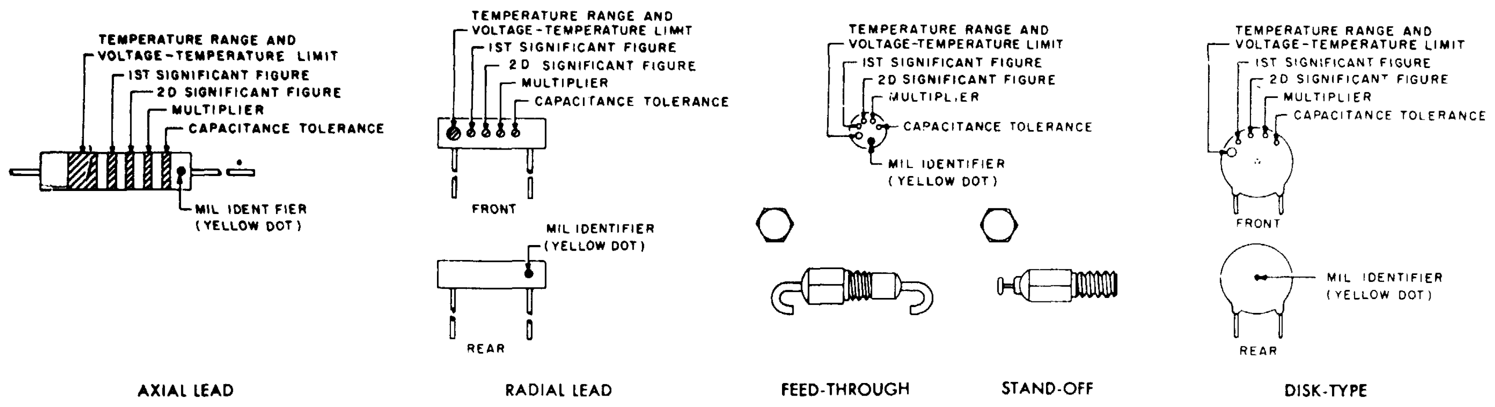
Figure 10-1. Resistor color codes.

COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

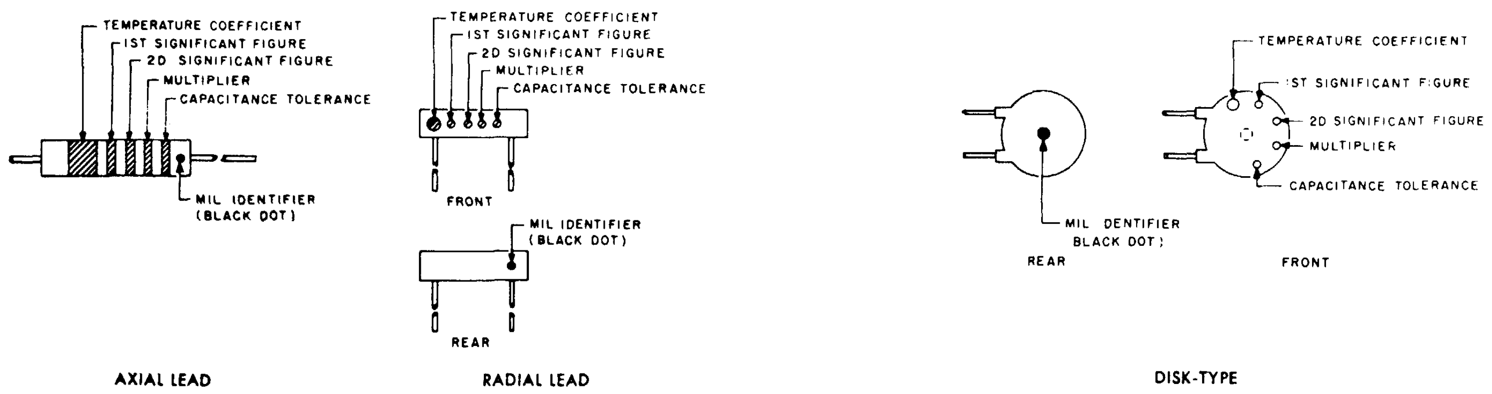
GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



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



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



COLOR CODE TABLES

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

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

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

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

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

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

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

Figure 10-2. Capacitor color codes.

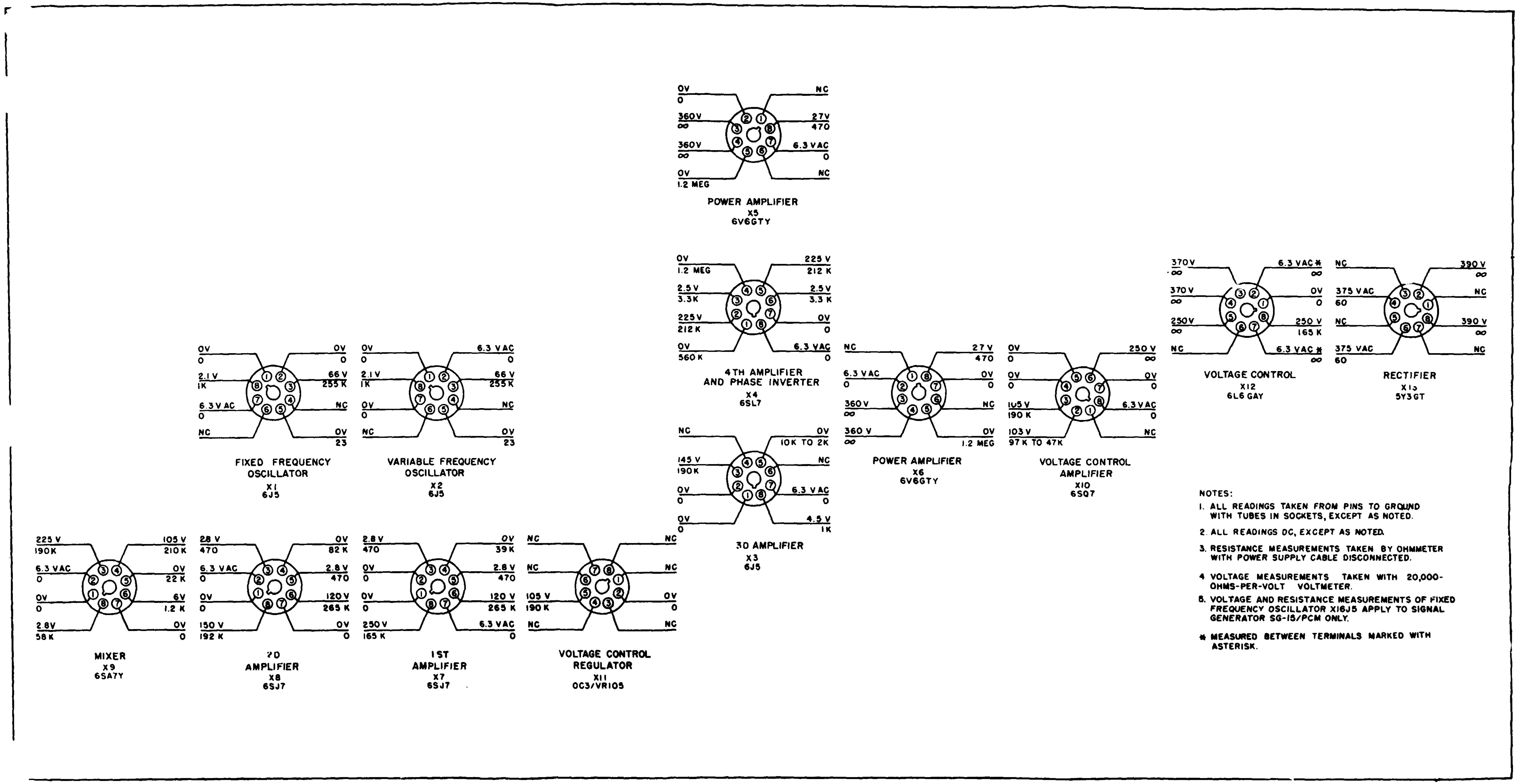


Figure 10-3. Signal Generator SG-15(*)/PCM tube socket voltage and resistance diagram.

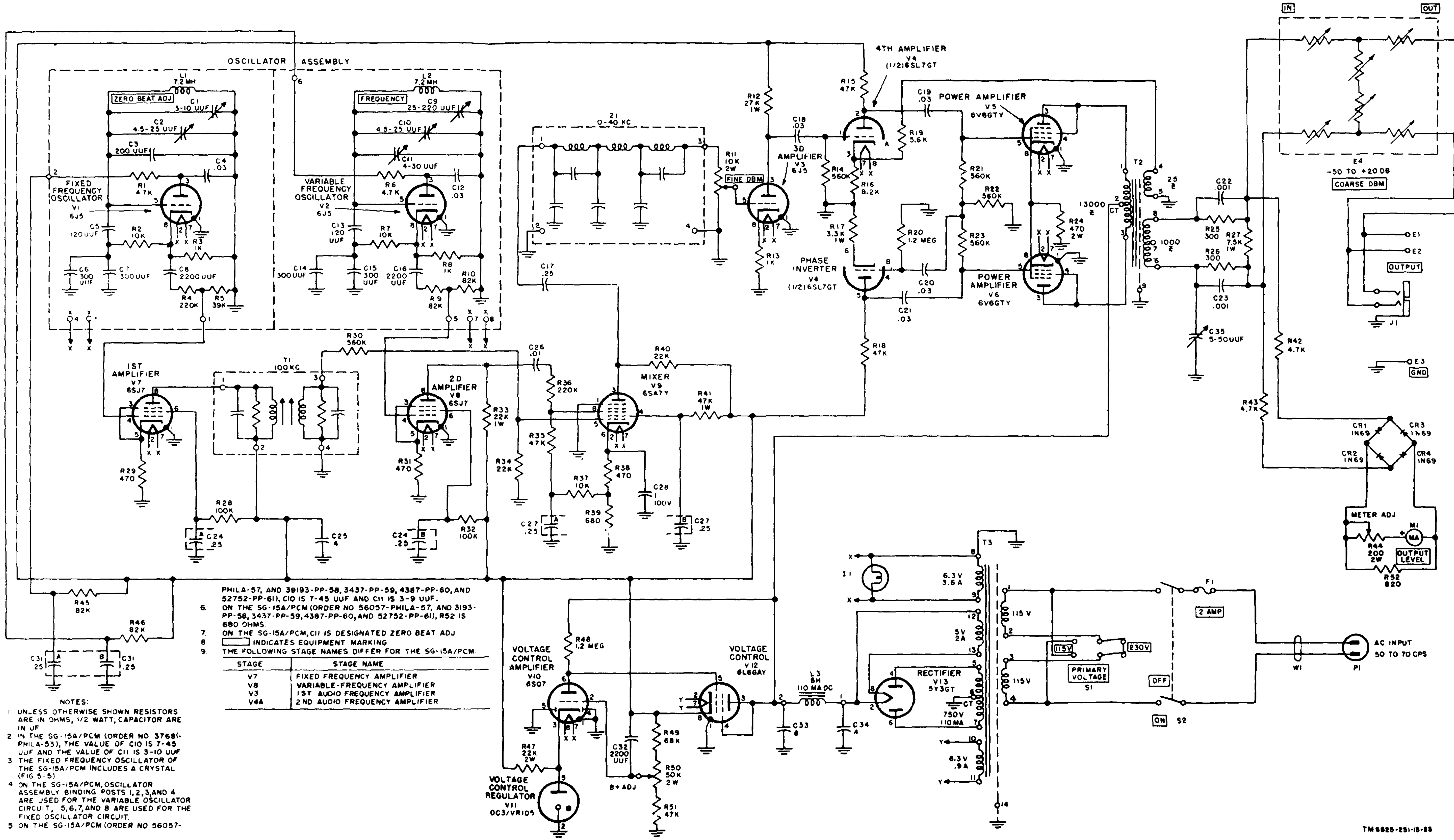
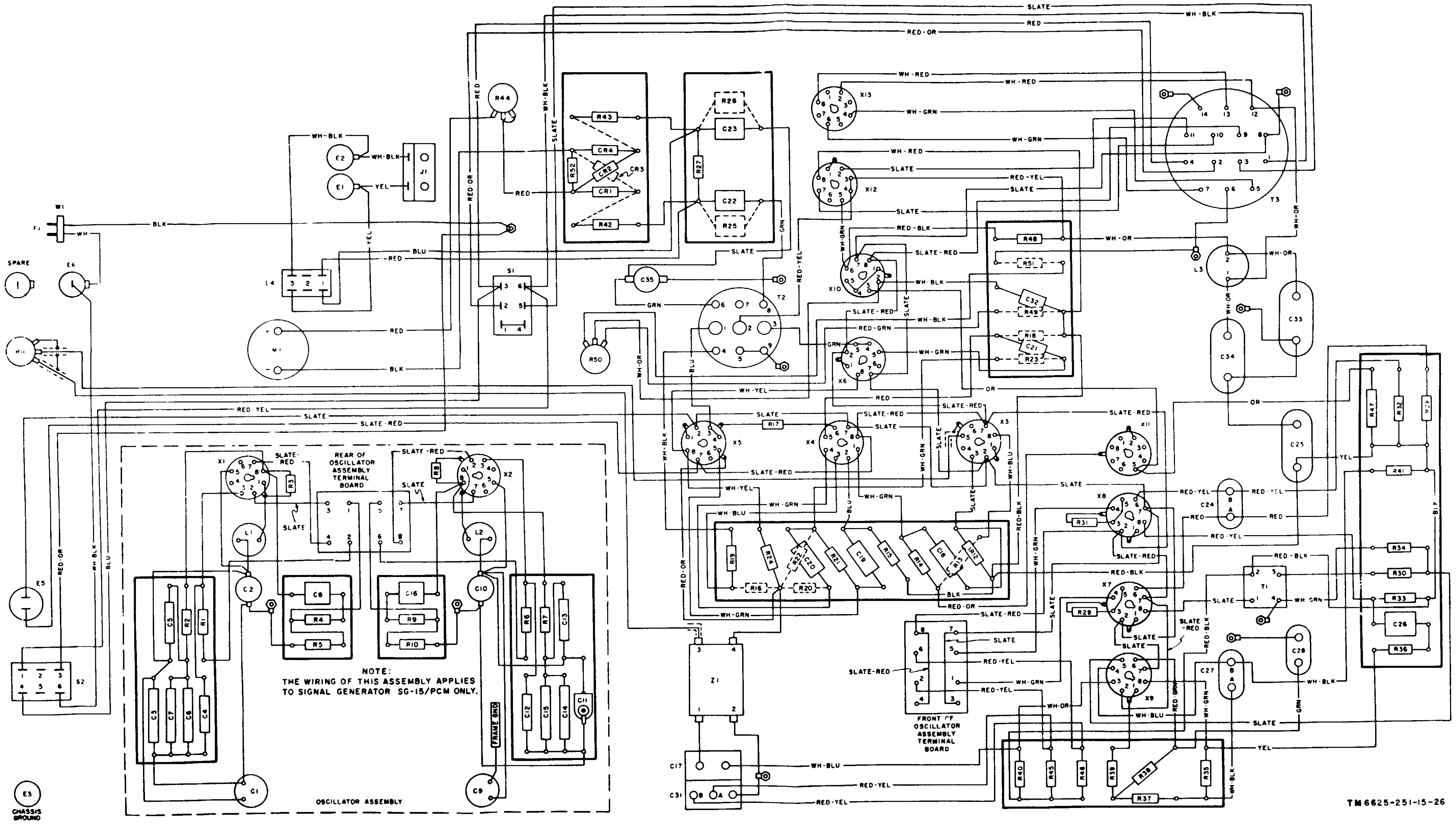


Figure 10-4. Signal Generator SG-15(*)/PCM, schematic diagram.



10–7

Figure 10-5. Signal Generator SG-15/PCM, wiring diagram.

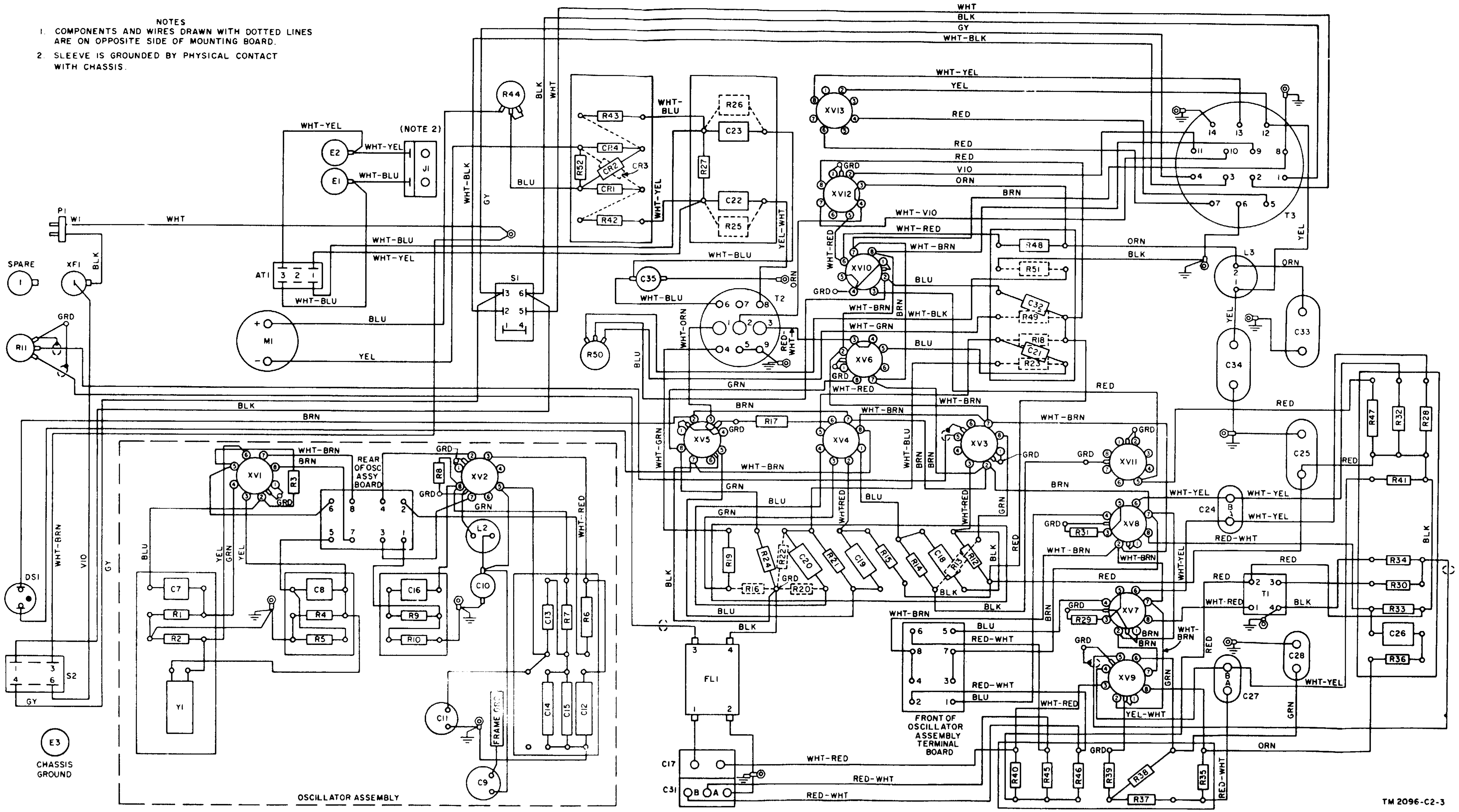


Figure 10-6. Signal Generator SG-15A/PCM, wiring diagram.

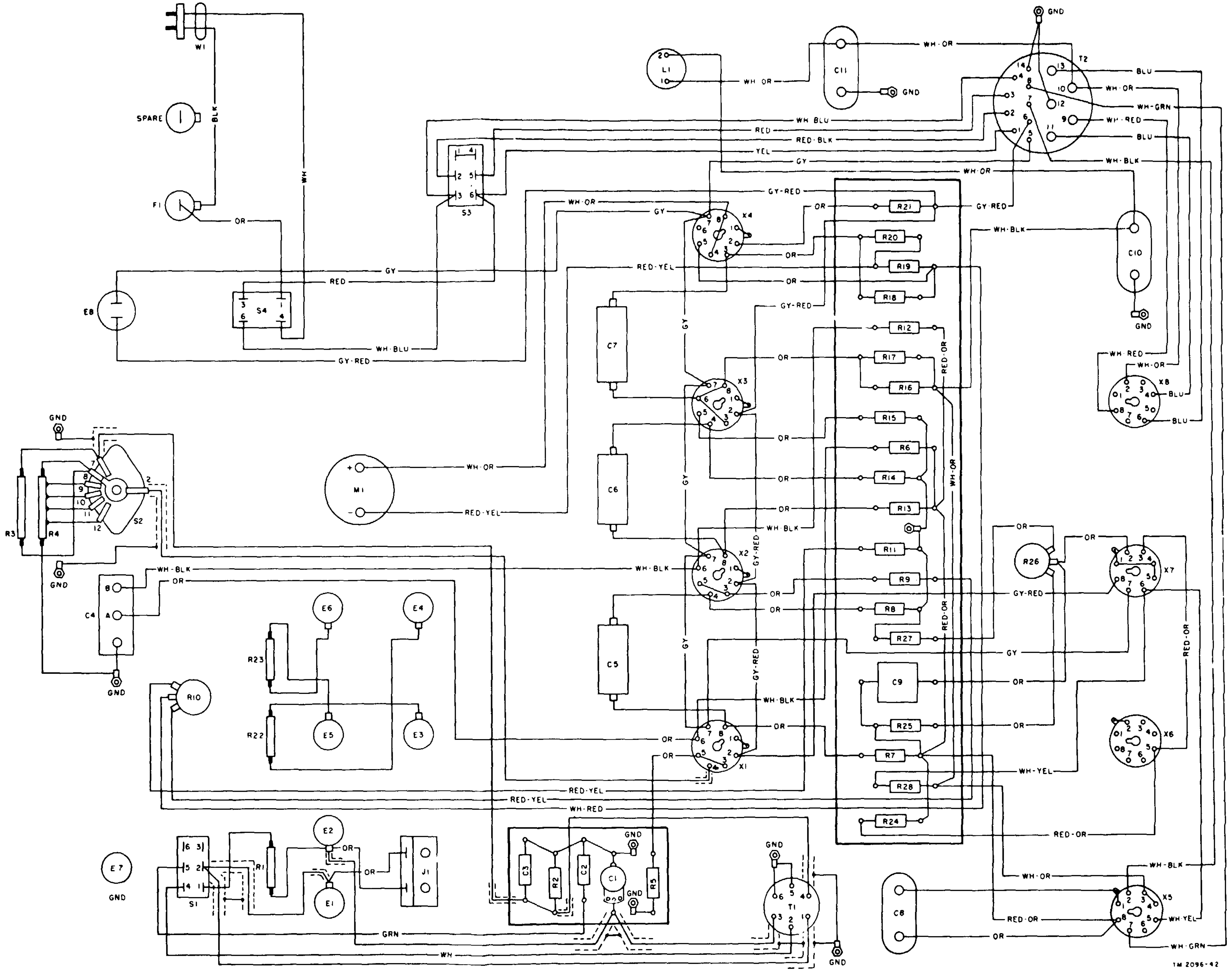


Figure 10-7. Decibel Meter ME-22/PCM, wiring diagram.

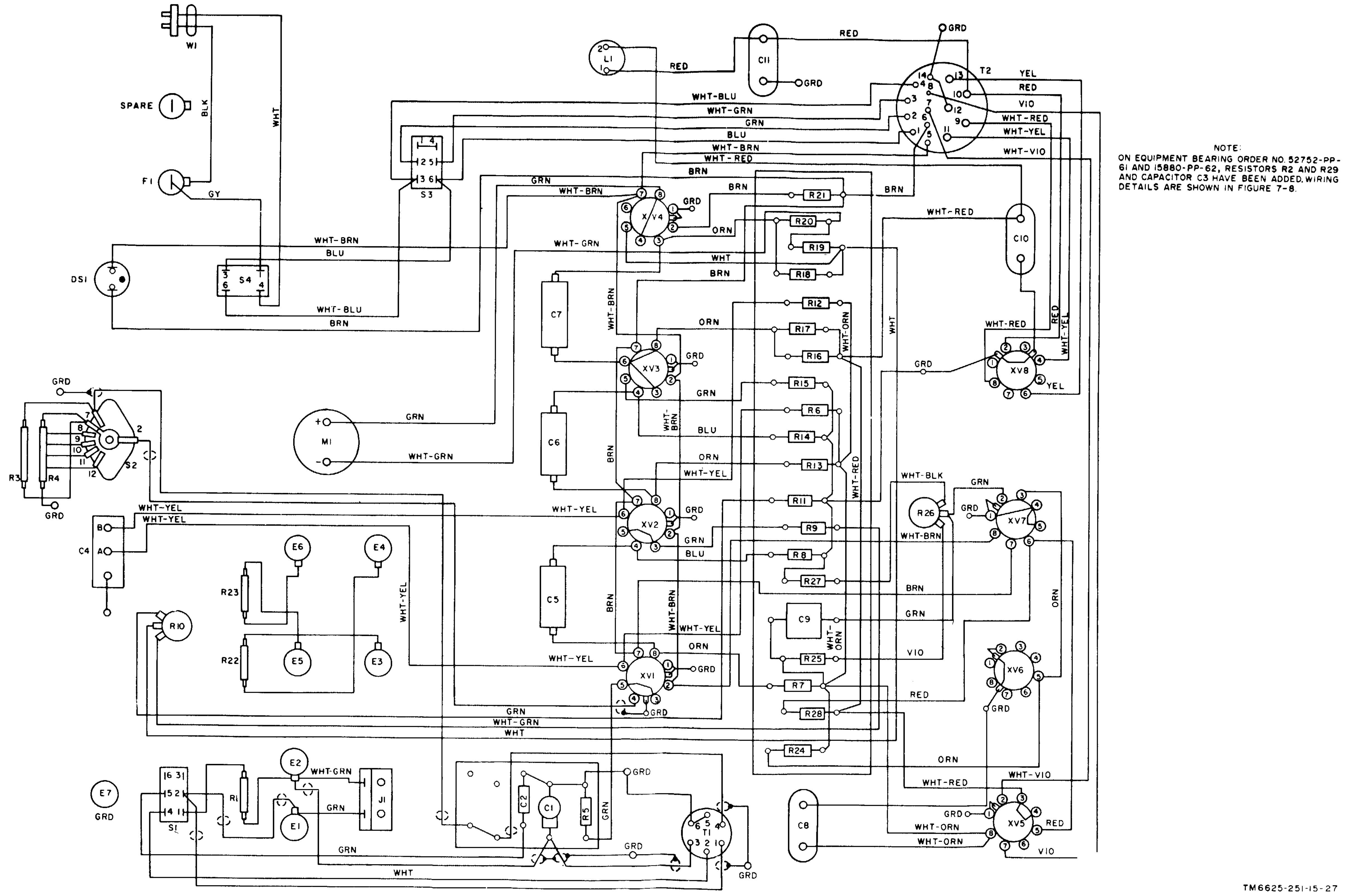


Figure 10-8. Decibel Meter ME-22A/PCM, wiring diagram.

APPENDIX I
REFERENCES

Following is a list of references available to the operator and organizational repairman and the general support and depot maintenance personnel of Test Set TS-140/PCM.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders.
SB 38-100	Preservation, Packaging, and Packing Materials, Supplies and Equipment Used by the Army.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TB SIG 364	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 11-2151	Audio Level Meters ME-71A/FCC and ME-71B/FCC.
TM 11-5102	Resistors, Decade ZM-16/U, ZM-16A/U, and ZM-16B/U.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-6625-218-12	Organizational Maintenance Manual: Frequency Meter AN/TSM-16.
TM 11-6625-320-12	Organizational Maintenance Manual: Voltmeter, Meter ME-OA/U and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-SOE/U.
TM 38-750	Army Equipment Record Procedures.

APPENDIX II
BASIC ISSUE ITEMS LIST (BIIL) AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST (ITIAL)

Section I. INTRODUCTION

AII-1. Scope.

This appendix lists only items troop installed or authorized required by the crew/operator for installation, operation, and maintenance of Test Set, TS-140/PCM, Signal Generators SG-15/PCM and SG-15A/PCM and Decibel Meters ME-22/PCM and ME-22A/PCM.

AII-2. General.

This Basic Issue Items and Items Troop Installed or Authorized List is divided into the following sections:

a. Basic Issue Items List -Section II. A list in alphabetical sequence, of items which are furnished with, and which must be turned in with the end item.

b. Items Troop Installed or Authorized List - Section III. Not applicable.

AII-3. Explanation of Columns.

The following provides an explanation of columns found in the tabular listings:

a. Illustration. This column is divided as follows:

(1) *Figure.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item Number.* Not applicable.

b. Federal Stock Number. Indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specification standards, and inspection requirements, to identify an item or range of items.

d. Federal Supply Code for Manufacturer) (FSCM). The FSCM is a 5-digit numeric code used to identify the manufacturer, distributor, or Government agency, etc., and is identified in SB 70842.

e. Description. Indicates the Federal item name and a minimum description required to identify the item.

f. Unit of Measure (U/M). Indicates the standard of basic quantity of the listed item as used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation, (e.g., ea, in., pr, etc.). When the unit of measure differs from the unit of issue, the lowest unit of issue that will satisfy the required units of measure will be requisitioned.

g. Quantity Furnished with Equipment (Basic Issue Items Only). Indicates the quantity of the basic issue item furnished with the equipment.

AII-4. Special Information.

Usable on code are included in the description column.

Code	*Used On*
1	SG-15/PCM; SC-15A/PCM
2	ME-22/PCM; ME-22A/PCM

Section II. BASIC ISSUE ITEMS LIST

(1) ILLUSTRATION		(2)	(3)	(4)	(5)		(6)	(7)
(A) FIG. NO.	(B) ITEM NO.	FEDERAL STOCK NUMBER	PART NUMBER	FSCM	DESCRIPTION	USABLE ON CODE	UNIT OF MEAS	QTY FURN WITH EQUIP
1-1		6625-669-0331			CASE, SIGNAL GENERATOR CY-712/PCM	1	EA	1
1-1		6625-498-8268			CASE, TEST CY-711/PCM	2	EA	

APPENDIX III
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

AIII-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Test Set TS-140/PCM. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

AIII-2. Explanation of Format for Maintenance Allocation Chart

a. Group Number. Group numbers correspond to the reference designation prefix assigned in accordance with ASA Y32.16, Electrical and Electronics Reference Designations. They indicate the relation of listed items to the next higher assembly.

b. Component Assembly Nomenclature. This column lists the item names of component units, assemblies, subassemblies. and modules on which maintenance is authorized.

c. Maintenance Function. This column indicates the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The numbers used represent the various maintenance, categories as follows:

Number	Maintenance Category (or categories)
1	Operator's
2	Organizational
3	Direct support
4	General support
5	Depot

d. Tools and Equipment. The numbers appearing in this column refer to specific tools and equipment which are identified by these numbers in section III.

e. Remarks. Self-explanatory.

AIII-3. Explanation of Format for Tool and Test Equipment Requirements

The columns in the tool and test equipment requirements chart are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The numbers in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number.

e. Tool Number. Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	Maintenance functions															Tools and equipment	Remarks
				SERVICE														
		INSPECT	TEST	UNPACK	REPACK	CLEAN	TOUCH UP	MARK	ADJUST	ALINE	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	TEST SET TS-140/PCM																	See separate sections for ME-22/PCM AND SG-15/PCM
	DECIBEL METER ME-22/PCM; ME-22A/CM	1																
			4														1, 2, 3, 5, 7	
			5														1, 2, 3, 5, 7	
				1														
														2			8	Replace caps, tubes, knobs, fuses, lamps, only
														4			6	
														5			1, 2, 3, 4, 6, 7	
1A	CASE, TEST SET CY-711/PCM													5			6	Obtain parts from salvage or fabricate parts as required
1B	CORD ASSEMBLY, ELECTRICAL													4			6	

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS
TOOL AND TEST EQUIPMENT REQUIREMENTS

Tools and Equip	Maint. Category	Nomenclature	Federal Stock Number	Tool Number
		TS-140/PCM (continued)		
1	4,5	MULTIMETER TS-352/U	6625-242-5023	
2	4,5	RESISTOR, DECADE 7M4-16/U	6625-669-0266	
3	4 ,5	SIGNAL GENERATOR SG-15/PCM	6625-229-1087	
4	5	TEST SET, ELECTRON TUBE TV-2/U	6625-699-0263	
5	4	TEST SET, ELECTRON TUBE TV-7/U	6625-376-4939	
6	4 ,5	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-605-0079	
7	4, 5	VOLTMETER, ELECTRONIC ME-30E/U	6625-643-1670	
8	2	TOOLS AND TEST EQUIPMENT AVAILABLE TO THE REPAIRMAN USER BECAUSE OF THIS ASSIGNED MISSION		

SECTION IV. MAINTENANCE ALLOCATION CART (SG-15/PCM; SC-15A/PCM)

SECTION II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	Maintenance functions															Tools and equipment	Remarks
				SERVICE														
		INSPECT	TEST	UNPACK	REPACK	CLEAN	TOUCH UP	MARK	ADJUST	ALINE	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	SIGNAL GENERATOR SG-15/PM; SG-15A/PCM	1																
			4														1, 2, 3, 5, 7	
			5														1,2,3,4,7	
				1														
														2			8	Replace caps, tubes, knobs, fuses, lamps, only
														4			6	
																5	1, 2, 3, 4, 6, 7	
1A	CASE, SIGNAL GENERATOR CY-712/PCM													5			6	Obtain parts from salvage or fabricate parts as required
1B	CORD ASSEMBLY, ELECTRICAL													4			6	

SECTION V. TOOL AND TEST EQUIPMENT REQUIREMENTS
TOOL AND TEST EQUIPMENT REQUIREMENTS(SG-15/PCM; SG-15A/PCM)

Tools and Equip	Maint. Category	Nomenclature	Federal Stock Number	Tool Number
1	4,5	FREQUENCY METER AN/TSM-16	6625-542-1666	
2	4,5	METER, AUDIO LEVEL MF-71/FCC	6625-545-7949	
3	4.,5	MULTIMETER TS-352/U	6625-242-5023	
4	5	TEST SET, ELECTRON TUBE TV-2/U	6625-699-0263	
5	4	TEST SET, ELECTRON TUBE TV-7/U	6625-376-4939	
6	4,5	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-605-0079	
7	4.5	VOLTMETER, ELECTRONIC ME-30E/U	6625-643-1670	
8	2	TOOL AND TEST EQUIPMENT AVAILABLE TO THE REPAIRMAN USER BECAUSE OF HIS ASSIGNED MISSION		

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By Order of the Secretary of the Army:

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USACDCEA (1)
USACDCCBRA (1)
USACDCCEA (1)
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NG: State AG (3).
USAR: None.
For explanation of abbreviations used, see AR 320-50.

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

The Metric System and Equivalents

Linear Measure

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

Weights

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

Liquid Measure

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

Square Measure

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

Cubic Measure

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

Approximate Conversion Factors

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

Temperature (Exact)

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

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