DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

SIGNAL GENERATORS

SG-71/FCC, SG-71A/FCC, SG-71B/FCC,

AND SG-71C/FCC

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

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1968

WARNING

Be careful when working on the 115-volt or 230-volt ac line connections and the +420-volt dc circuits. Serious injury or death may occur from contact with these terminals. Discharge all filter capacitors before handling.

DON'T TAKE CHANCES

TECHNICAL MANUAL No. 11-6625-358-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *6 June 1968*

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT, GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL

SIGNAL GENERATORS

SG-71/FCC, SG-71A/FCC, SG-71B/FCC AND SG-71C/FCC

*This manual supersedes TM 11 5088, 13 December 1954, including all changes.

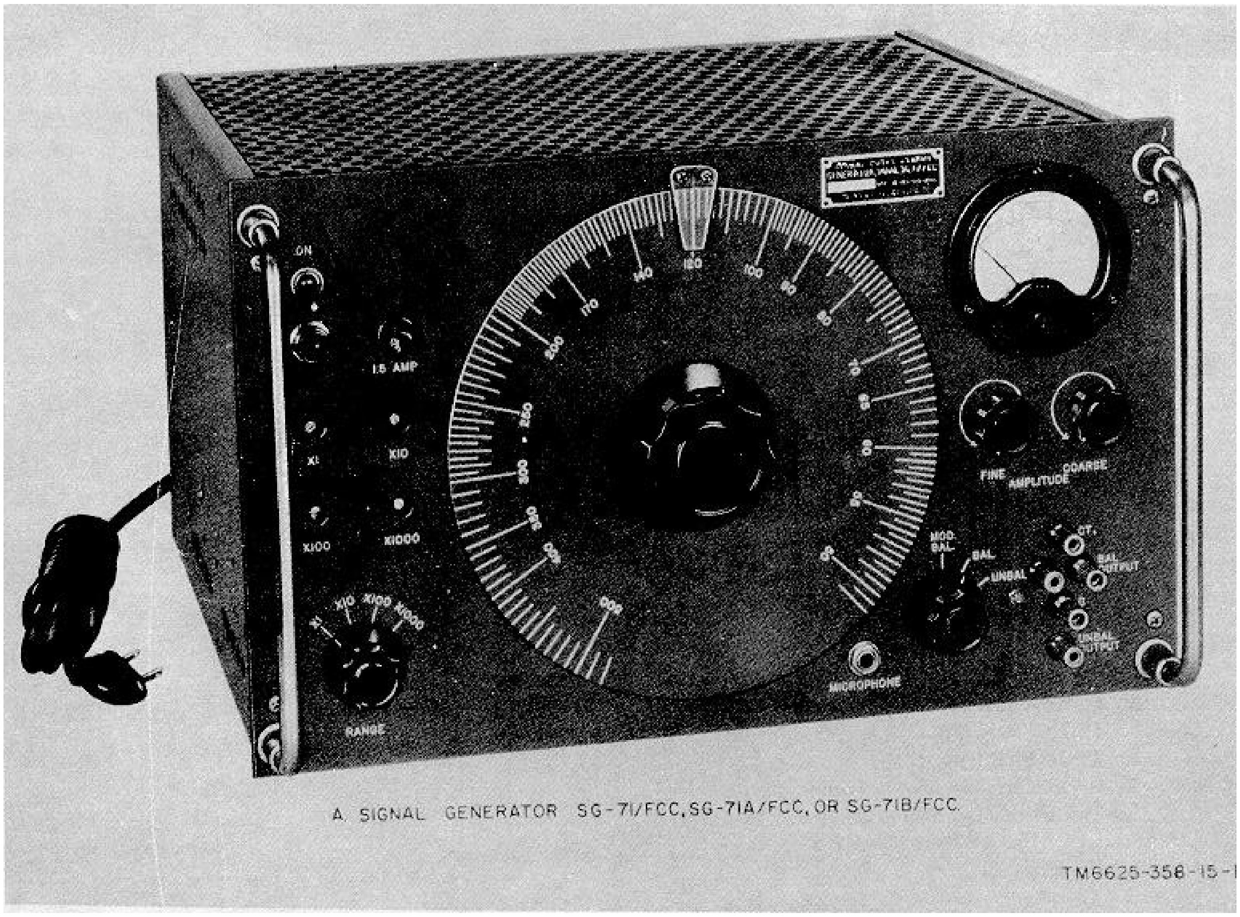


Figure 1-1. Signal Generators SG-71/FCC, SG-71A/FCC, and SG-71B/FCC.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual describes Signal Generators SG-71/FCC, SG-71A/FCC, and 1-2) and covers their installation, operation, operator, organizational, General support, and depot maintenance. It includes operation under usual and unusual conditions, cleaning and inspection of the equipment, replacement of parts available to the operator and organizational repairman, and instructions appropriate to General support and depot maintenance categories for troubleshooting, testing, aligning, and repairing the equipment

b. Official nomenclature followed by (*) is used to indicate all models of the equipment item covered in this manual. Therefore, Signal Generator SG-71(*)/FCC represents Signal Generators SG-71/FCC, SG-71A/FCC, SG-71B/FCC, and SG-71C/FCC.

1-2. Indexes of Publications

a. DA Pam 310-4. 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 714/MCO P4030.29, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward discrepancy in Shipment Report (DISREP) (SF361) 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 077()3.

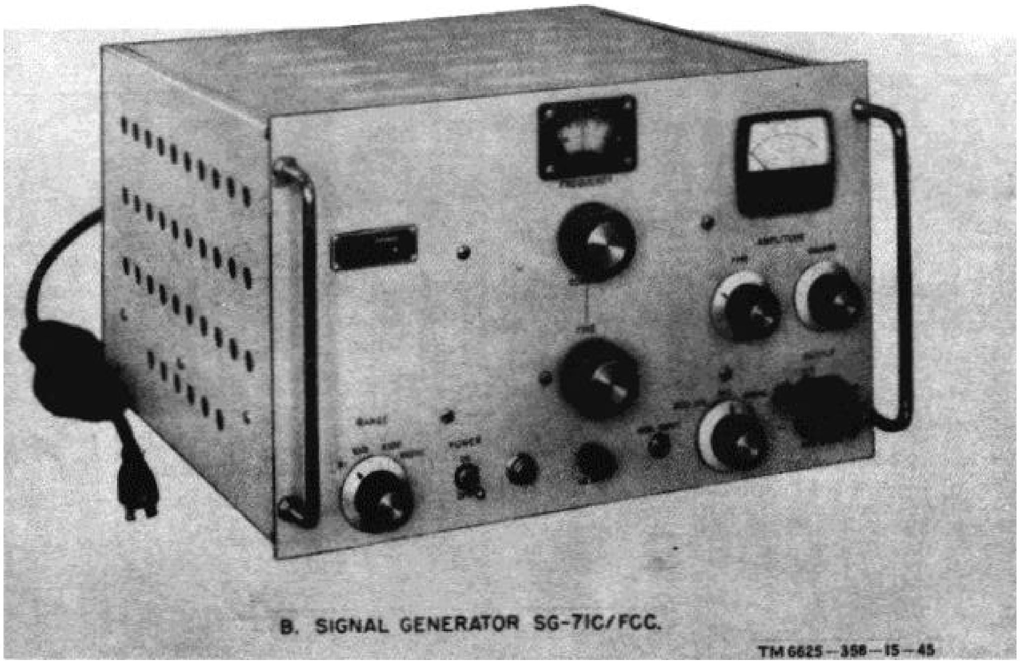


Figure 1-2. Signal Generator SG-71C/FCC.

Section II. DESCRIPTION AND DATA

1-4. Purpose and Use

Signal Generator SG-71(*)/FCC, (fig. 1-1 and 1-2 is a portable test instrument which generates sine wave signals of medium power over the frequency range from 50 cycles per second (cps) to 500 kilocycles (kc) per second It is used as a generator of test signals in measuring the bandwidth, attenuation, or amplification of telephone carrier systems It is also used for service and development work, such as signal tracing, waveform analysis, distortion measurement, and acoustical tests, as well as for any other purpose served by oscillators operating in the audio, supersonic, and low radiofrequency ranges.

1-5. Technical Characteristics

Frequency range ....50 cps to 500 kc, covered in four decade bands, X1, X10, X100, and X1000. Frequency dial calibrated on one scale from 5 to 500

Frequency stability ....±2 percent under normal room temperature variation warmup. Negligible frequency change with 10 percent line voltage variation.

Power output and rated load:
- Balanced output ....3 watts max(43 volts) into 600-ohm load from 5 to 500 kc. (Output is center-tapped and not grounded.)
- Unbalanced output ....6 volts max into 600-ohm load from 50 cps to 500 kc. (One side of output grounded.)

Frequency response:
- Balanced output ....±1 db from 5 to 500 kc
- Unbalanced output ....±1 db from 50 to 500 kc

Noise level ....Noise level in ea output channel is less than 0.1 percent of full output level

Distortion:
- Balanced output ....Less than 1 percent at 1 watt into 600-ohm load from 10 to 100 kc; less than 3 percent at 3 watts

	into 600-ohm load from 10 to 100 kc; less than 4 percent at 3 watts 600-ohm load from 5 to 500 kc
Unbalanced output	Less than 1 percent at 6 volts into 600-ohm load from 50 cps to 100 kc.
Internal impedance:	
Balanced output	135 ohms from 5 to 100 kc to approximately 350 ohms at 500 kc.
Unbalanced output	Approximately 6 ohms at middle frequencies with rated load.
Output level meter (for balance output only)	Calibrated in volts and dbm. Dbm calibration for 600-ohm load.
Voice modulation (for balanced output only)	By means of field-type telephone test set having 600-ohm output (not supplied). Modulation frequency range 150 to 2,500 cps. Carrier frequency range 10 to 500 kc.
Power requirements	115 or 230 volts, 50 to 60 cycles, 100 watts.

1.6. Components Comprising the Operable End Item

Signal Generators SG-71/FCC, SG-71A/FCC, SG-71B/FCC and SG-71C/FCC (FSN 6625-669-0255) each comprise an operable end item.

1-7. Description of Signal Generator SG-71(*)/FCC

a. This equipment consists of Signal Generator SG-71 (*)/FCC (signal generator) and running spares. The dimensions are: height, 10-1/2 inches; depth, 11 inches; and length, 18 inches. The weight is 39 pounds. Signal Generator SG-71(*)/FCC is used together with appropriate indicating equipment for determining the frequency response, gain, distortion characteristics, and efficiency of audio, supersonic, and low radiofrequency devices. It is equipped with large rubber feet for test bench use. Guardrail handles protect the front panel in field use.

b. To make the signal generator particularly usable in carrier communications work, which deals with relatively narrow bandwidths, the SG-71(*)/FCC has a high-definition frequency control dial operated by a 3-to-1 reduction drive mechanism. To allow accurate reading of incremental frequencies, the frequency control dial is large and calibrated with approximately 155 calibration points.

c. The 50- to 500,000-cps tuning range of the instrument is covered in four decade bands. The frequency dial has a single scale calibrated from 50 to 500. A frequency range switch multiplies the dial calibration by factors of 1, 10, 100, and 1,000.

d. To obtain high accuracy frequency calibration, the instrument contains frequency adjustments located on the front panel. Frequency calibration is nominally accurate to within approximately 2 percent; however, when higher accuracy is desired, the calibration of each range can be adjusted against an external standard by screwdriver operated potentiometers.

NOTE

In Signal Generator SG-71C/FCC, the standardization potentiometers are located behind the front panel.

e. Signal Generator SG-71(*)FCC contains two separate output systems, one balanced and one unbalanced, which are available from separate sets of output terminals. The balanced output operates from 5 to 500 kc and provides up to 3 watts of power to 600-ohm resistive loads. The unbalanced output operates from 50 to 500 kc and provides 6 volts into loads of 600 or more ohms. One terminal of the unbalanced output is grounded. The balanced output is continuously monitored by the self-contained output level meter. Also, this output may be voice-modulated at carrier frequencies above 10 kc from a field-type telephone test set connected to a standard two-circuit telephone jack located on the front panel.

f. All controls and terminals, except the power cord, are located on the front panel. The power cord, which is not removable, is connected at the rear of the chassis. All output terminals are special binding posts spaced 3/4 inch center-to-center to receive standard two-conductor, banana-type plugs as well as plain wire. They are located in the lower right-hand corner of the front panel.

g. Signal Generator SG-71(*)/FCC is factory-connected for use on a 115-volt, 50- to 60-cycle, single-phase alternating current (ac) power source. The power transformer is arranged so that it may also be connected for use on a nominal 230-volt (para 2-5), ac powerline. The signal generator uses approximately 160-watt power. The power fuse for the equipment is replaceable from the front panel.

1-8. Additional Equipment Required

a. Because Signal Generator SG-71(*)/FCC is a General purpose test set used to provide a test signal, it will be used in combination with other test equipments. For example, if the signal generator is used to generate sine wave voltages for distortion measurements of an amplifier, use a suitable distortion measuring device (Spectrum Analyzer TS-723A/U) at the output of the amplifier. If the signal generator is used as a signal source on a transmission line, use a suitable signal-measuring device, covering the test frequencies in use, at the receiving end of the line.

b. Test leads, patch cords, or a similar means of connecting the signal generator to the equipment under test also will be required; however, they are not supplied with the signal generator.

c. The signal generator can be voice-modulated under certain circumstances If this feature is to be used, Telephone Set TA-312/PT, or equivalent, which contains a carbon microphone, a battery, and a 600-ohm matching transformer is required.

1-9. Differences In Models

Item	*SG-71/FCC*	*SG-71A/FCC*	*SG-71B/FCC*	*SG-71C/FCC*
Physical appearance	Fig. 1-1	Fig. 1-1	Fig. 1-1	Fig. 1-2
Front panel	Fig. 31	Fig. 3-1	Fig. 3-1	Fig. 3.2
Tube V3	6SA7	6SA7	6SA7	6SA7GT
Tube V6	5R4GY	5R4GY	5U4GB	5R4GYA
Tube 7	6Y6G	6Y6G	6Y6G	6Y6G
Tubes V12 and V13	6L6GA	6L6	6L6AGA	6L6GC
Connector W1...........................	2 terminals	2 terminals	Also has third, grounded terminal	Also has third, grounded terminal

CHAPTER 2

INSTALLATION

2-1. Unpacking

a. Packaging Data. When packaged for shipment, the SG-71(*)/GCC is placed in a corrugated cardboard container, which is then wrapped in moistureproof cloth. This package is packed in excelsior inside a wooden crate (fig. 21). The running spares included with the equipment are also packaged in a cardboard container, which is then wrapped in moistureproof cloth. This package is included in the wooden crate for the equipment. The outside dimensions of the crate are 31 inches wide by 21 inches high by 21 inches deep. The volume of the crate is 7.2 cubic feet, and the shipping weight is 100 pounds.

b. Removing Contents.

(1) Place the packing case as near the place of operation or installation as is convenient.

(2) Remove the nails that hold the top boards on the packing box. Use a nailpuller; the instrument may be damaged if the top is removed by pounding or prying. If the box is strapped, remove the strapping before removing the nails.

(3) Remove the top of the packing case. Do not attempt to pry off the sides and top; the equipment may be damaged.

(4) Remove the excelsior or corrugated paper that covers the equipment inside the packing case.

(5) Remove the equipment from its inner case or wrapping and place it on a workbench near its final' location.

Note. Save the original packing eases and containers, export or domestic type; they can be used again when the equipment is repacked for storage or shipment.

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 13).

b. Check to see that the equipment is complete as listed on the packing slip. If a packing slip is not available, check the equipment against the basic issue items list (app. B). Report all discrepancies in accordance with TM 38-750. Shortage of a minor assembly or part that does not affect proper functioning of tile equipment should not prevent use of the equipment.

c. If the equipment has been used or reconditioned, check to see whether it has been changed by a modification work order (MWO). If the equipment has been modified, the MWO) will appear 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 81107.

23. Installation of Signal Generator SG-71 (*)/FCC

The signal generator is a one-piece, portable instrument of moderate weight. The installment is fully assembled and ready for use as received. Installation consists of providing the necessary space on a test bench close to the equipment to be tested and convenient to a 115-volt or a 230-volt, ac single-phase power source.

2-4. Seating of Tubes and Fuses

The SG-71(*)/FCC is shipped with tubes and fuses installed.

a. Check for breakage and proper seating of the tubes (figs. 2-2 or 6-1). To reach the tubes, remove the screws that attach the dust cover of the equipment, and slide off the dust cover.

b. Check to see that a fuse of the correct rating is installed in the front panel fuse holder (figs. 3-1 or 3-2). For operation using a 115-volt source, a 2-ampere fuse is required for all models. Models procured

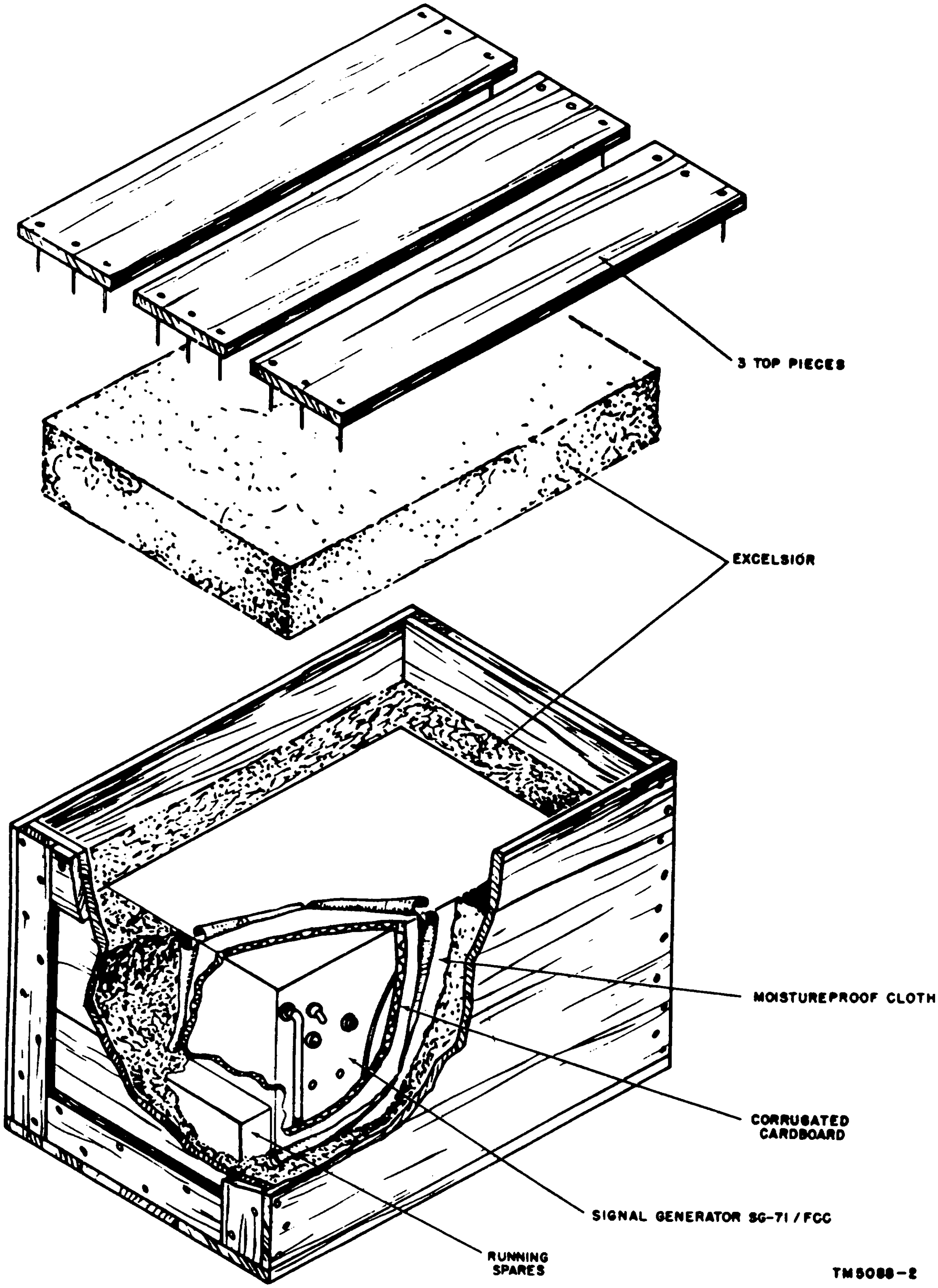


Figure 2-1. Signal Generators SG-71/FCC and SG-71A/FCC, packaging diagram.

prior to May 1968 have fuse markings of 1.5 and 1.6 AMP on the front panel. These models should have the panel markings changed to read 2 AMP. If the equipment is wired for operation with a 230-volt ac source, a 0.8-ampere. fuse is required on all models of the equipment.

2-5. Connections

a. Test leads required for connection of the signal generator to the equipment under test must be made by the operator. For moderate signal levels and short lead lengths (3 feet or less), a pair of insulated wires terminated in alligator clips is usually adequate and most convenient.

b. The power cord, which is the only cable supplied with the equipment, has three conductors. The third conductor is attached to the chassis of the instrument. In the SG-71/FCC and the SG-71A/FCC. the third conductor branches from the cord at the power connector and forms a pigtail termination. To ground tile chassis externally, fasten the pigtail to the ac outlet mounting box. One end of the power cord of the SG-71B/FCC and the SG-71C/FCC is terminated in a three-terminal plug. If this plug is to be connected to a standard two-terminal receptacle, an adapter must be used.

c. The power cord should be plugged into a 115-volt, 50- to 60-cycle powerline. To operate the signal generator from a 230-volt source, the power transformer primary windings must be reconnected as indicated in the notes on the schematic diagram (figs. 10-3 and 10-5). The leads from the power transformer are color-coded so that following these directions will insure proper phasing of the primary windings. After connecting the power transformer for 230-volt operation, change the instrument fuse to one with a 0.8-ampere rating.

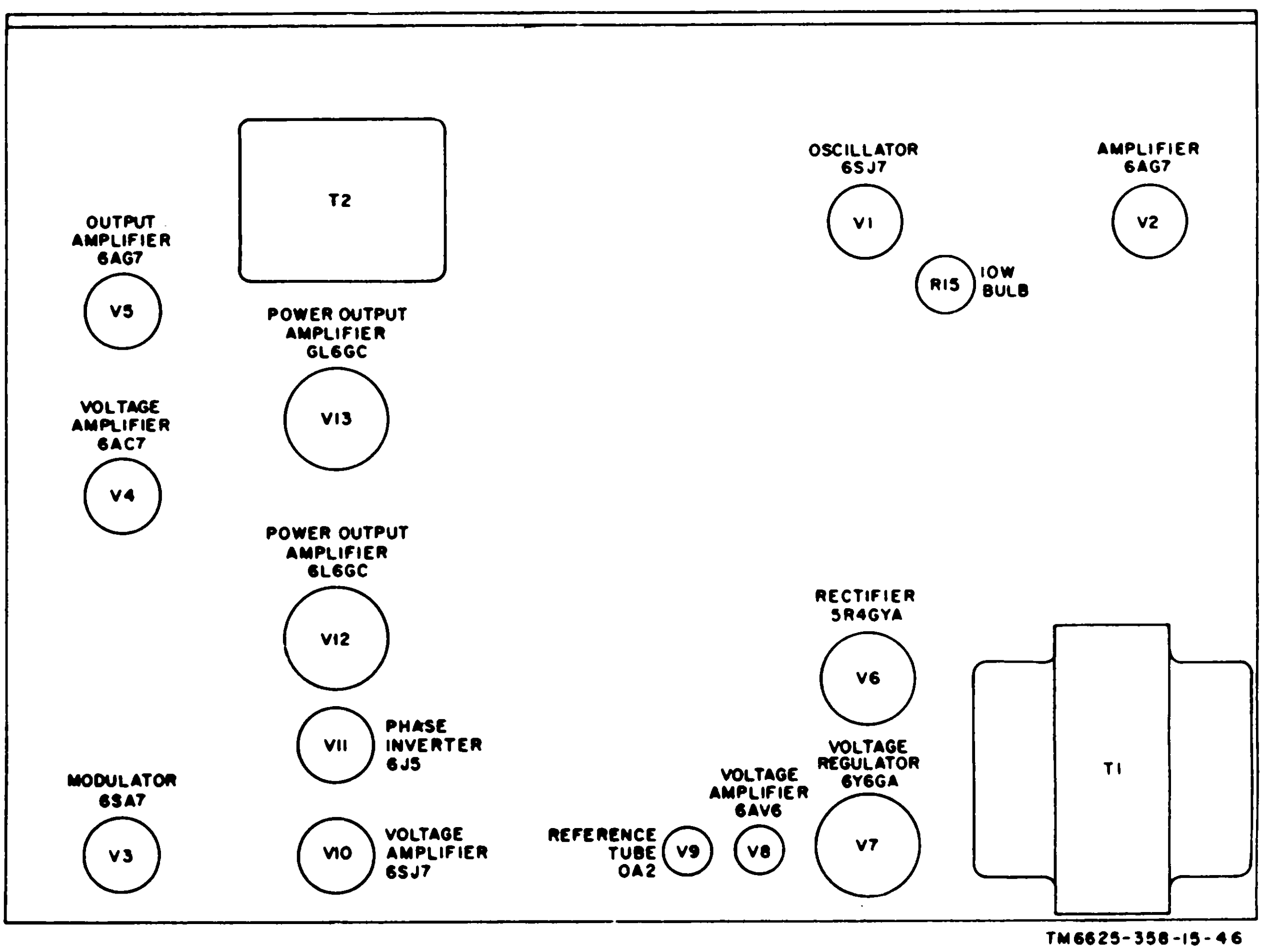


Figure A. Signal Generator SG-71C/FCC, tube location diagram.

CHAPTER 3

OPERATION

Section I. OPERATOR'S CONTROLS AND INDICATORS

Note. This section covers only the items used by the operator; items used by maintenance personnel are covered, in the instructions for the appropriate maintenance category.

3-1. General

To properly operate this equipment, it is important to know the function of every control. This section locates, illustrates, and describes the various controls)provided for the operation of the signal generator. The controls are listed, with their functions, in paragraph 3-2. The actual operating instructions are described in sections II and III.

3-2. Signal Generator SG-71 (*)/FCC Operating Controls and Indicators

(figs. 3-1 and 3-2)

Control or terminal	Function
ON switch, or POWER switch (SG-71C/FCC).	Power switch.
2 amp fuse F1	Contains a 2-ampere fuse which may be replaced by unscrewing cap and inserting new fuse. 0.8-ampere fuse is used when power transformer is connected for 230-volt operation.
RANGE selector switch S1	Sets signal generator output to desired frequency band; multiplies calibration of tuning dial by factor of X1, X10, X100, or X1000.
Tuning dial or FREQUENCY dial (SG-71C/FCC).	Selects frequency of generated signal. Is graduated in cps with markings from 49 to 520. Graduations are multiplied by appropriate factor from setting of RANGE switch.
AMPLITUDE FINE control R24.	Provide fine adjust ment of output voltage.
AMPLITUDE COARSE control R25.	Provides coarse adjustment of output voltage.
MOD. BAL.-BAL.-UN BAL. selector switch S2.	Switches output of instrument to desired type of operation; i.e., modulated balanced, or unbalanced.
BAL. OUTPUT	Terminals for balanced output of instrument
UNBAL. OUTPUT	Terminals for unbalanced output section of equipment
Output level meter	Connected to indicate voltage delivered by balanced output amplifier. Scale calibrated in rms volts and dbm (one milliwatt into 600 ohms reference).
MICROPHONE jack J1 or MOD. INPUT jack SG-71C/FCC).	Used to connect field telephone set into modulator circuit.
X1 (R9)	Screwdriver control that adjusts calibration of X1 frequency range (60 to 500 cps) to external frequency standard.
X10 (R10)	Screwdriver control that adjusts calibration of X frequency range (500 cps to 5 kc) to external frequency standard.

Control or terminal	Function
X100 (R11)	Screwdriver control that adjusts calibration of X100 frequency range (5 to 50 kc) to external frequency standard.
X1000 (R2)	Screwdriver control that adjusts calibration of X1000 frequency range (50 to 5600 kc) to external frequency standard. **Caution: Adjustments R9, R10, R11, and R12 used for calibration only.**

Control or terminal	Function
Power cable	Consists of three conductors; carry power to instrument while the third conductor (green wire) is connected to instrument chassis for ground.
FREQUENCY COARSE control (SG-71C/FCC only.	Provides coarse adjust ment of FREQUENCY dial
FREQUENCY FINE control (SG-71C/FCC only).	Provides fine adjust ment of FREQUENCY dial

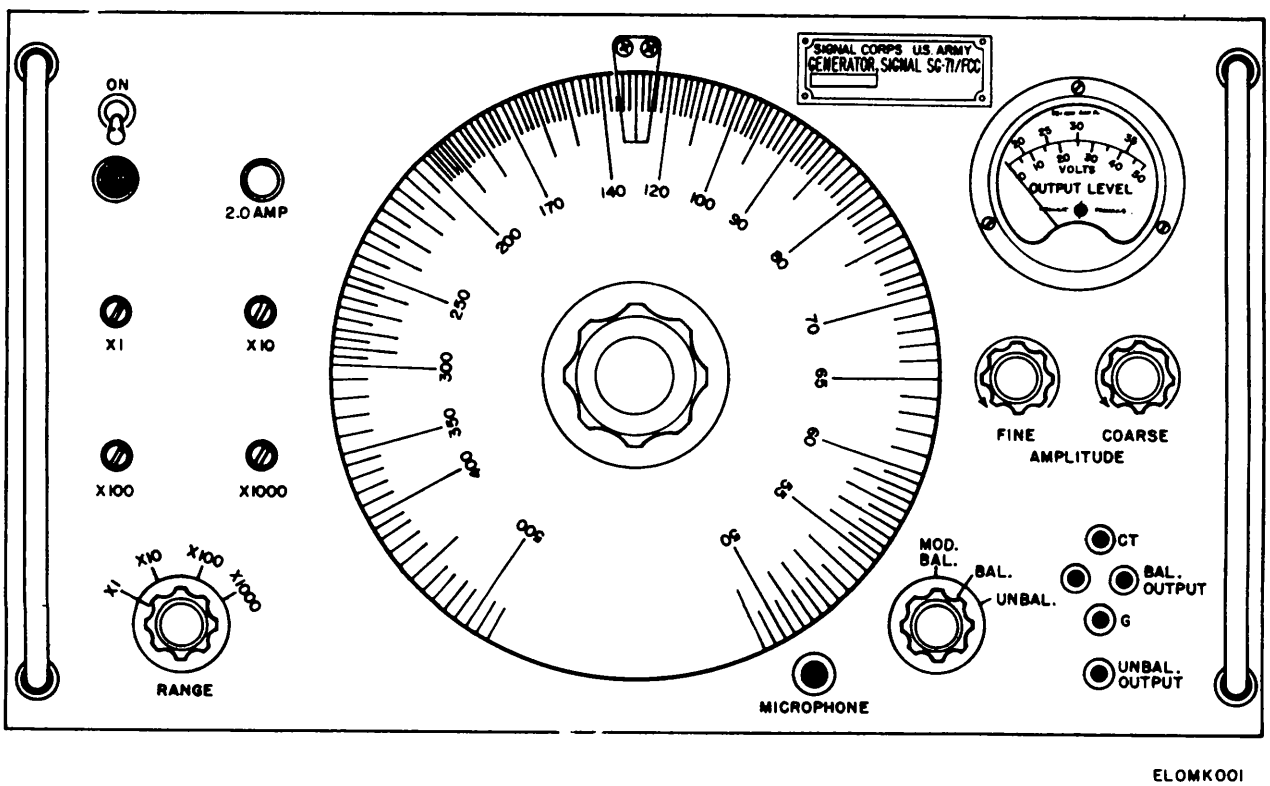


Figure 3-1. Signal Generators SG-71/FCC, SG-71A/FCC, and SG-71B/FCC, front panel controls.

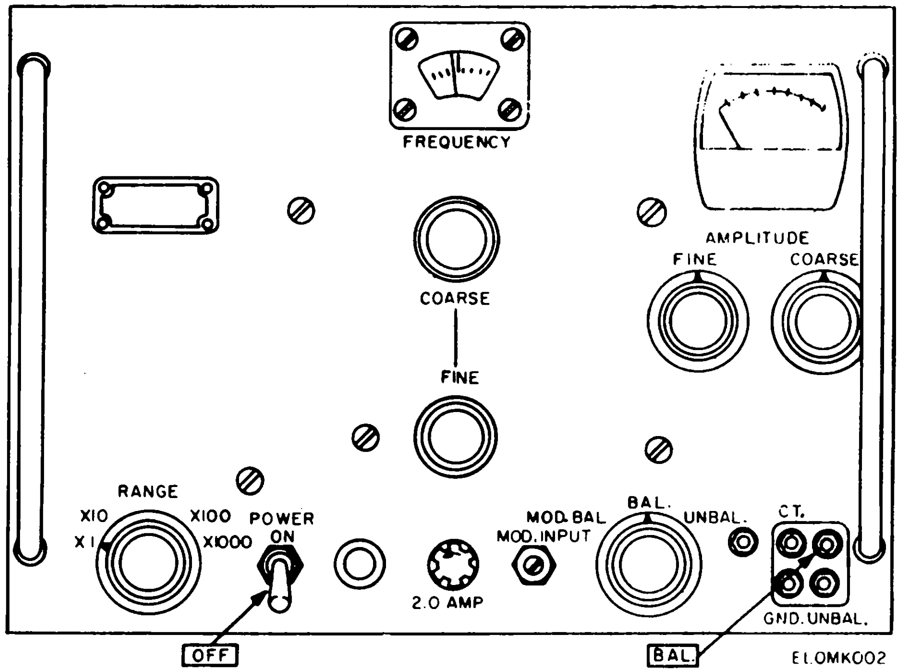


Figure 3-2. Signal Generator, SG-71C/FCC, front panel controls.

Section II. OPERATION UNDER USUAL CONDITIONS

3-3. Types of Operation

a. Signal Generator SG-71(*)/FCC provides three different types of operation: grounded or ungrounded balanced output, balanced output which may be voice-modulated, and unbalanced single-ended output.

b. For any type of operation, perform the following procedure:

(1) Starting procedure (para 3-4).

(2) Procedure for the desired type of operation (paras 3-6, 3-7, and 3-8).

(3) Stopping procedure (para 3-10).

3-4. Starting Procedure

a. Before connecting the output of the signal generator to the equipment under test, determine the type of connections most suitable, the exact points in the circuits where connection is to be made, and the signal amplitude required. Refer to figure 3-3 regarding connection of the output terminals of the signal generator to a point within a circuit where a direct current (dc) potential already exists.

b. The controls of Signal Generator SG-71(*)/FCC may be set to any position before starting. Start the signal generator as follows:

(1) Plug the power cord into a 115- or 230-volt operation (para 2-5) and that the fuse is of the correct rating.

(2) Turn on the power switch and allow the equipment to warm up for a minimum of 5 minutes before use. Allow a longer warmup period when the most stable operation is required.

(3) Set the MOD. BAL.-BAL.-UNBAL. switch to BAL.

(4) Set the frequency RANGE switch to X100.

(5) Turn the AMPLITUDE COARSE control fully clockwise.

(6) Approximately 30 seconds after the power switch is set to ON, the output level meter will indicate the presence of output voltage and after a 5- to 10-minute warmup period, the equipment will be ready for use. When maximum frequency stability is required, allow the instrument to warm up for approximately 30 minutes in average room temperature, and longer at lower temperatures.

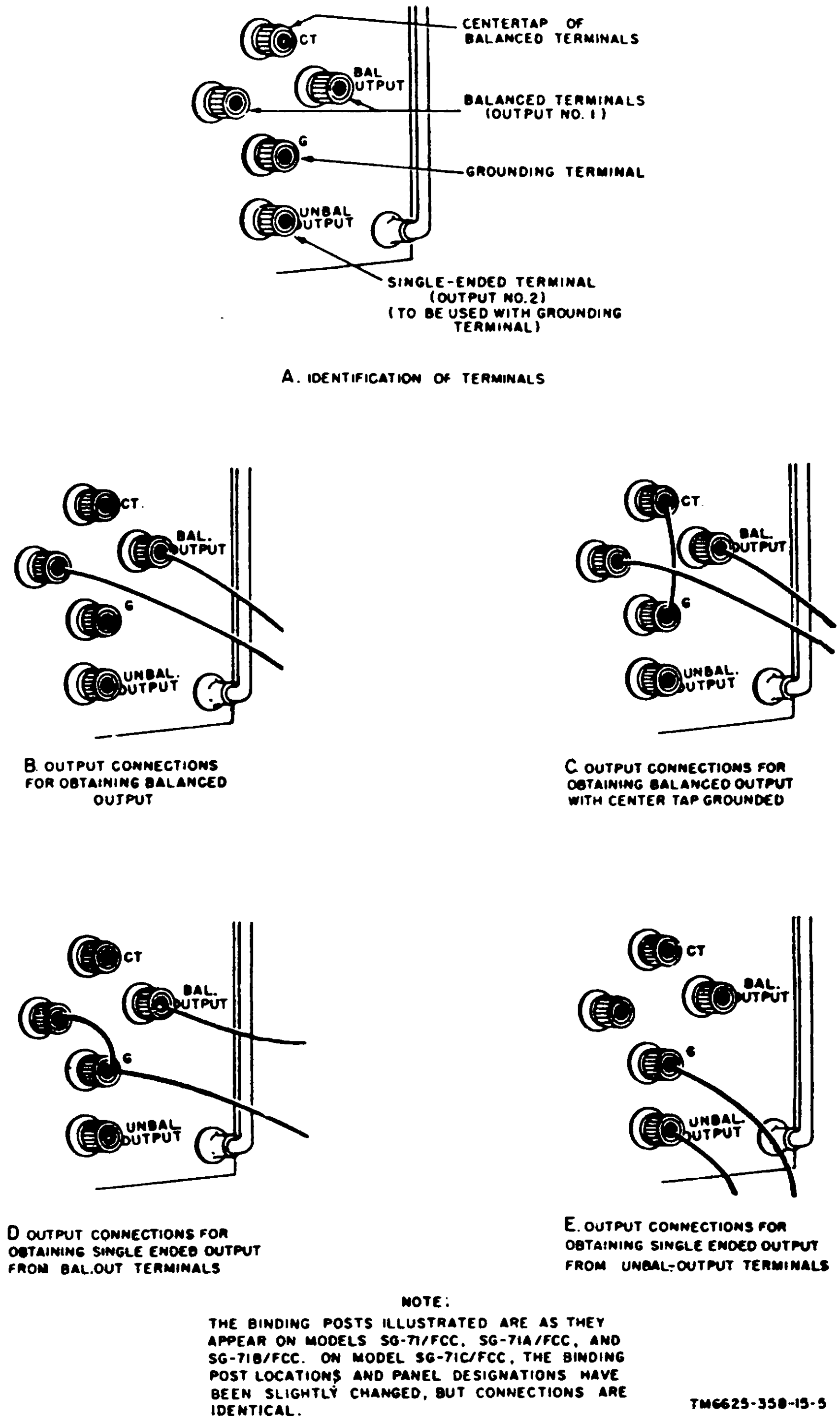


Figure -3. Connection for different types of output.

35. Operating Precautions

Observe the following precaution to obtain best results from the signal generator.

a. For the most dependable overall performance, operate the signal generator into its rated load, 600-ohm resistance. For maximum signal-to-noise ratio, use the highest possible signal output within the limits of the device under test. The noise level in the balanced amplifier is less than 25 millivolts, and in the unbalanced amplifier less than 5 millivolts. When used at maximum output level, the amplitude of the signal will give a 60-decibel (db) or better signal-to-noise ratio. If the signal level is then reduced by the AMPLITUDE FINE COARSE controls, the signal-to-noise ratio is also reduced. To get very low signal levels without sacrifice of the high signal-bo-noise ratio, operate the signal generator at its rated output, and then reduce the output voltage by an external attenuator or voltage divider.

b. To obtain an output signal containing minimum distortion (significantly less than 1 percent) for use in waveform analysis and distortion measurements, operate the signal generator at a slightly reduced output and, if possible, into load resistances greater than 600 ohms.

c. For information regarding connection of the signal generator output into circuits where a dc potential exists, refer to figure 3-3.

d. For information regarding impedance matching between the signal generator and external circuits, refer to paragraph 3-6.

3-6. Operation Using Balanced Output

a. The balanced output provides sine -waves over the frequency range from 5,000 to 500,000 cps at power levels up to 3 watts and is continuously monitored by the self-contained output meter. Although primarily - intended as a signal source for measurements on telephone carrier systems, the balanced output can often be used wherever a signal in the 5,000- to 500,1000-cps range is required. The output level meter indicates the signal voltage directly in volts. When the load is 600 ohms, the output meter. also indicates the output power level in decibels (referred to 1 milliwatt in 600 ohms) (dbm). The dbm calibration is not correct for any load resistance other than 600 ohms; however, the voltage calibration of the output level meter is accurate for any load connected to the output terminals.

b. The balanced output operates as an unmatched source (where impedance matching of the signal generator to the circuit is not required) with a load of 600 ohms or higher resistance. For such use, the signal generator may be connected directly to the circuit under test. If the impedance of the circuit is greater than 600 ohms, the dbm reading of the output level meter must be corrected by subtracting from it the appropriate dbm quantity given in the graph in figure 3-4.

c. Although the balanced amplifier is not designed to operate into loads less than 600 ohms, this action can be accomplished by adding resistance in series with the load so that the total resistance presented to the signal generator is 600 ohms. If the load is balanced, the load-matching resistance should be divided in half. The two halves should then be connected on different sides of the load (fig. 3-5). *For example*, to drive a balanced load of 130 ohms with the signal generator, an additional resistance of 470 ohms must be connected in series with the load to increase it to 600 ohms. This additional resistance can be made up of two 240-ohm resistors connected as shown in figure 3-5. Some of the power from the signal generator is sacrificed in the load-matching resistor, so that the full 3-watt output is not available to the actual load. The output level meter can no longer be directly used to determine the voltage across the load. This voltage can be found by using the following equation:

$$^{E}\text{ load} = \text{Voltage reading of output meter X } \frac{\text{resistance of load}}{\text{600 ohms}}$$

The power in the load is equal to:

$$^{P}\text{ load} = \frac{E^{3}\text{ load}}{\text{Resistance of load}}$$

where E load is the value obtained in the equation. The second equation gives the power level in the load in watts. This can be converted to dbm by referring to figure 3-6.

d. The balanced output may also be operated as a matched source (where the impedance of the signal generator must equal the impedance of the load). To do this, connect appropriate resistors or pads between the output terminals and the load; Two common situations arise: when the signal generator must match a load of 600 or more ohms, and when the signal generator must match a low value of much less than 600 ohms. The solutions to both situations depend partly on the frequency being used, because the internal impedance of the SG-71(*)/ FCC varies with frequency.

e. If the load is 600 ohms or more, load-matching resistors must be added between the signal generator terminals and the load (fig. 3-7). To determine the necessary value for these resistors, the internal impedance of the signal generator at the frequency to be used should be obtained from figure 3-8. Internal impedance varies from instrument to instrument, so figure 3-8 can only be considered to be an approximation. To determine the required value for the load-matching resistance, subtract the internal impedance of the signal generator at the intended frequency from the resistance of the load. Then halve this difference value of resistance if the load is balanced, and connect each half on the opposite sides of the load (fig. 3-7). *For example*, assume that a balanced load of 1,000 ohms is to be used at a frequency of 100 kc. Figure 3-8 shows that at 100 kc the internal impedance of the signal generator is 130 ohms; therefore, a total load matching resistance of 870 ohms is required (1,000-130 ohms). This load-matching resistance can be made up of two 430-ohm resistors.

When the load-matching resistors are used in this case, neither the voltage nor the dbm readings of the output level meter will apply to the signal level across the actual load; however, the voltage across the load can be obtained from the following:

$$E_{load} = \text{Voltage reading of output meter} \times \frac{\text{Resistance of load}}{\text{Resistance of load + total resistance of load-matching resistors}}$$

f. When the impedance of the input load under test is less than 600 ohms and a matched source is required, the following steps are necessary:

(1) The load-matching resistors must be connected in series to the output terminals of the signal generator (figs. 3-9 and 3-5). This connection is necessary for 600-ohms impedance at the frequency to be used.

(2) A *minimum loss* pad (fig. 3-9) is connected in series-parallel in the circuit from the output load-matching resistors to the low impedance load under test.

(3) A matching system, including formulas that can be used for determining the pad resistance, is shown. in figure 3-9.

(4) To determine the input dc voltage to the load under test, connect Voltmeter, Electronic ME-39(*)/U in the circuit under test.

g. Obtain signal voltage from the balanced output as follows:

(1) Connect the circuit or equipment to be tested to the terminals marked BAL. OUTPUT (B or C, fig. 3-3). Refer to a through *f* above if the load is other than 600 ohms.

(2) Set the RANGE switch to X100 or X1000. Do not use the X1 or X10 range for balanced output.

(3) Set the tuning dial and the RANGE switch so that their readings, when multiplied together, give the desired frequency.

(4) Set the MOD. BAL.-BAL.-UNBAL. switch h to BAL.

(5) Adjust the AMPLITUDE FINE-COARSE controls to give the output level as indicated on the output level meter.

3-7. Operation Using Modulated Balanced Output

a. In carrier system testing, it is at time advantageous to communicate with another operator at a distant point. For this operation, the balanced output may be voice-modulated by connecting a field-type telephone to the MICROPHONE or MOD. INPUT jack located on the front panel and by setting the MOD. BAL.-BAL.-UNBAL. selector switch to MOD. BAL. Only one-way transmission by voice modulation to another carrier system can be accomplished with the signal generator. No means of receiving is provided in the signal generator for a two-way communication. To

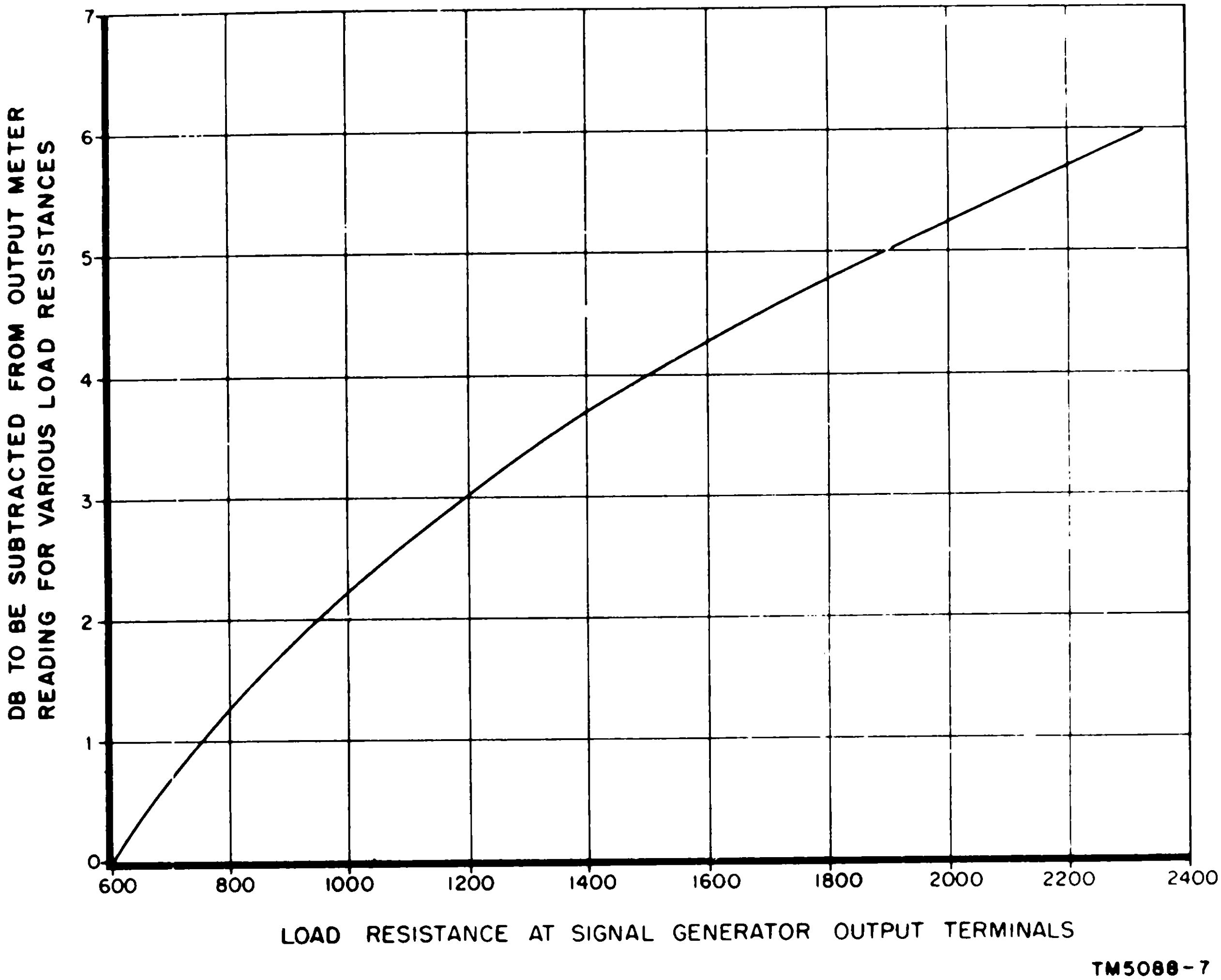


Figure 3-5. Connection of signal generator to load resistance of less than 600 ohms.

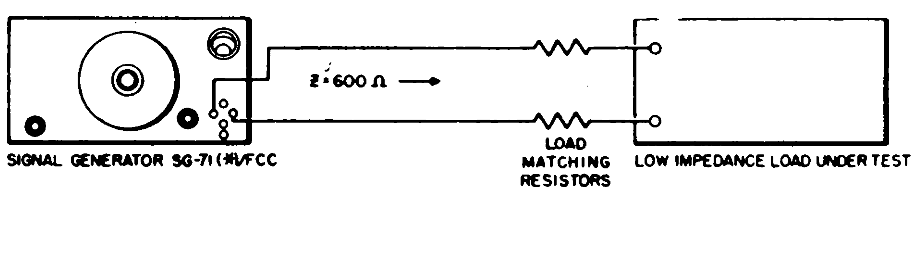


Figure 3-5. Connection of signal generator to load resistance of less than 600 ohms.

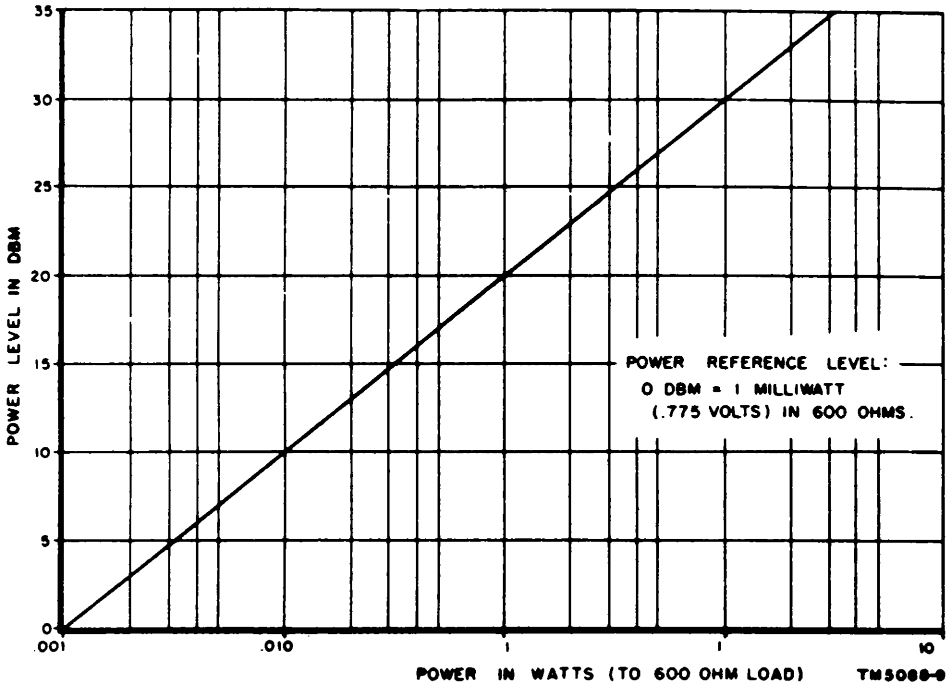


Figure 3-6. Actual power in watts vs db power level to +35 dbm.

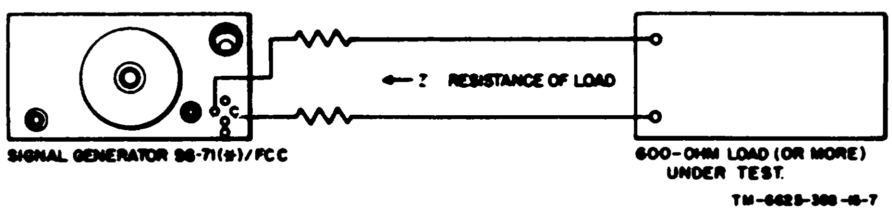


Figure 3-7. Connection of signal generator to load resistance of 600 ohms or more.

receive from a carrier system at a distant point, connect a suitable receiver covering test frequencies under operation. If a very low signal level has been used for the tests, it may be necessary to increase the output signal level for modulation and then return to the former level to resume the tests. No provision is made in tee signal generator for ringing another terminal, nor for receiving. It is assumed that only one-way communication will be held, or that the operator has, as part of the equipment at his disposal, a means of receiving a modulated signal from another terminal.

b. The balanced output may be modulated over the frequency range from 10 to 500 kc with a maximum output power approximating that of the unmodulated balanced output; however, because of the audio rejection filter, which follows the modulator circuit, the maximum available modulated signal output decreases for frequencies below 40 kc to a maximum of 25 volts at 10 kc. Carrier frequencies below 10 kc are not expected to be modulated.

c. The audiofrequency response of the modulator circuit is broad enough so that essential voice frequencies are not attenuated. The terminations and the internal impedance of the balanced output remain unchanged for

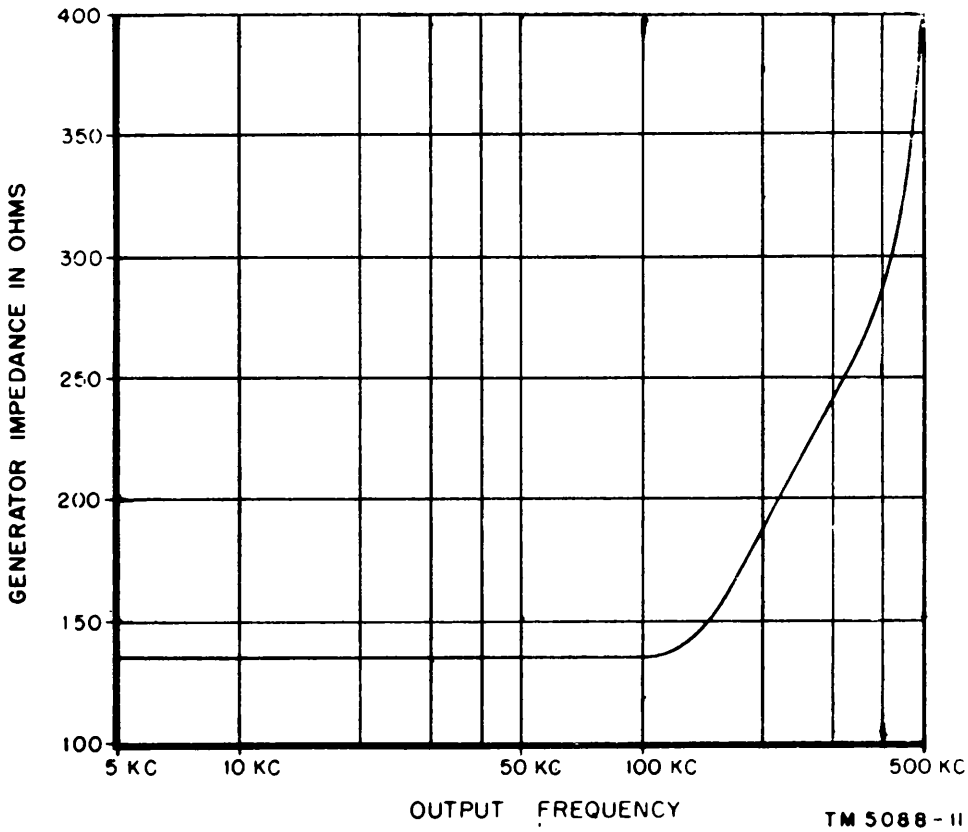
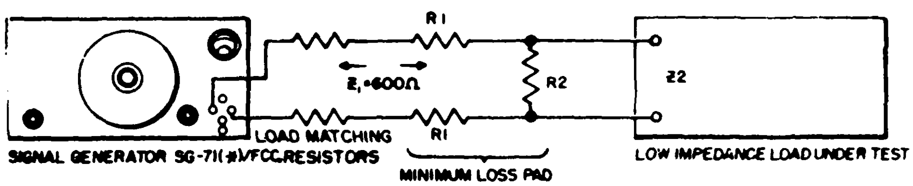


Figure 3-8. Signal Generator SG-71 (*)/FCC, internal impedance vs operating frequency.



$$R1 = \frac{Z_1\sqrt{1-\frac{Z2}{Z1}}}{2} \qquad R2 = \frac{Z2}{\sqrt{1-\frac{Z2}{Z1}}}$$

Figure 3-9. Connection of load-matching resistors and minimum loss pad to signal generator when operated into loads of less than 600 ohms.

modulated output, because modulation is done by a mixer tube operating ahead of the balanced output amplifier while the amplifier itself remains unchanged.

d. Modulate the balanced output signal as follows:

(1) With the signal generator and the equipment under test being operated as

instructed for balanced output signals, connect a field-type telephone test set to the MICROPHONE or MOD. INPUT jack on the front panel.

(2) Set the MOD. BAL.-BAL.-UNBAL. switch to MOD. BAL.

(3) Set the AMPLITUDE COARSE control for approximately a 30-volt output or for a maximum output at the frequencies which will supply a power output level approximate to that of an unmodulated balanced output. The maximum available modulation signal output decreases to a lower level for frequencies below 40 kc, to a maximum of 25 volts dc at 10 kc. Carrier frequencies from 10 kc and below will not be modulated.

3-8. Operation Using Unbalanced Output

a. The unbalanced output is for General purpose use and provides up to 6 volts over the full frequency range from 50 to 500,000 cps. The unbalanced output is used for resistive loads of 600 ohms or greater.

b. Obtain an unbalanced output signal as follows:

(1) Connect the circuit or the equipment to be tested to the terminals marked UNBAL. OUTPUT and G or GND (E, fig. 8-3).

(2) Set the RANGE switch to the desired frequency range.

(3) Set the tuning dial to the desired frequency; take into account the RANGE switch multiplying factor.

(4) Set the MOD. BAL.-BAL.-UNBAL. switch to UNBAL.

(5) Adjust the AMPLITUDE FINE COARSE controls for the desired signal level. The output meter in the signal generator is not connected to the unbalanced output. The output level must be measured by an external ac voltmeter.

3-9. Frequency Standardization

a. For frequency calibration of each frequency range, four screwdriver adjusting potentiometers are provided on the front panel of Signal Generators SG-71/FCC, SG-71A/ FCC, and SG-71B/FCC, and directly behind the front panel of Signal Generator SG-71C/ FCC. These adjustments may easily be set to give a frequency calibration accuracy of better than 1 percent overall, or better than 1/2 percent over portions of the frequency dial. Each potentiometer affects only one frequency range and shifts the entire range an equal number of cycles.

b. Frequency standardization may be performed by experienced operating personnel who are familiar with the use of either a frequency meter or an oscilloscope and frequency standard. Refer to paragraph 7-5a for instructions on frequency standardization.

3-10. Stopping Procedure

To stop the signal generator, set the POWER switch to the off position. The signal generator controls may be set in any position before stopping. Disconnect the leads from the equipment under test.

CHAPTER 4

OPERATOR AND ORGANIZATIONAL MAINTENANCE

4-1. Scope of Operator and Organizational Maintenance

The maintenance duties assigned to the operator and organizational repairman of Signal Generator SG-71(*)/FCC are listed below together with a reference to the paragraphs covering the specific maintenance functions.

a. Operator's daily preventive maintenance checks and services chart (para 4-4).

b. Operator's weekly preventive maintenance checks and services chart (para P-5).

c. Organizational monthly preventive maintenance checks and services chart (para 4-6).

d. Organizational quarterly preventive maintenance checks and services chart (para 4-7).

e. Cleaning (part 4-8).

f. Touchup painting (para 4-9).

g. Troubleshooting (paras 4-10 and 4-11).

h. Repairs.

(1) Replacement of fuse (para 4-13a).

(2) Replacement of dial lamp (para 4-13b).

4-2. Preventive Maintenance

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

a. Systematic Care. The procedures given in paragraphs 4-4 through 4-9 cover routine systematic care anti cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services chart (paras 4-4 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 performing the corrective actions listed, higher category 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.

4-3. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of the signal-generator are required daily, weekly, monthly, and quarterly.

a. Paragraph 4-4 specifies the checks and services that must be accomplished daily (or at least once each week if the equipment is maintained in standby condition).

b. Paragraphs 4-5, 4-6, and 4-7 specify *additional* checks and services that must be performed on a weekly, monthly, and quarterly basis, respectively.

4-4. Operator's Daily Preventive Maintenance Checks and Services Chart

Sequence No .	Item to be inspected	Procedures	References
1	Completeness	Check to see that equipment is complete.	App. B.
2	Exterior surfaces	Clean exterior surfaces, including panel and meter glass. Check meter glass and indicator lenses for cracks.	Para 4-8.
3	Connectors	Check tightness of all connectors.	
4	Controls and indicators	While making operating checks (item 5 through 18), observe that mechanical action of each knob, dial, and switch is smooth and free of external or internal binding, and that there is not excessive looseness. Also, check meter for sticking or bent pointer.	
5	Preliminary starting procedures	Connect 600-ohm, 5 watt, noninductive resistors to UNBAL. OUT-PUT and BAL. OUTPUT terminals. Set controls as follows: *a.* AMPLITUDE FINE-COARSE controls to midscale. *b.* MOD.-BAL.-UNBAL selector switch to BAL *c.* Tuning or FREQUENCY dial to 100.	None.
6	ON or POWER switch	Set to ON. Note that- *a.* Dial lamp lights *b.* Output level meter indicates some value of output voltage.	 *a.* Para 4-12. *b.* Para 4-12.
7	RANGE selector switch.	Set to X100 -	None
8	AMPLITUDE COARSE control.	Adjust for 42.5-volt indication in output level meter.	Para 4-12.
9	Tuning or FREQUENCY dial.	Vary from 50 to 500. Check to see that output level meter indication remaining at approximately 42.5 volts (a variation of several volts is acceptable).	Para 4-12.
10	RANGE switch	Set to X1000, and repeat sequences No. 8 and 9 above. Indications should be same as those in sequence No. 8 and 9 above.	Para 4-12.
11	MICROPHONE or MOD INPUT jack.	Connect external telephone test set	None.
12	RANGE selector switch	Set to X1000	None.
13	MOD. BAL.-BAL.-UNBAL. switch	Set to MOD. BAL. Check to m that output level meter indicates approximately 40 volts	Para 4-12
14	Tuning or Frequency dial.	Vary from 50 to 600. Check to me that output level meter indication remains at approximately 40 volts.	Para 4-12.
15	RANGE selector switch	Set to X100	None.

Sequence No .	Item to be inspected	Procedures	References
16	Tuning or FREQUENCY dial.	Vary from 50 to 500. Check to see that output level meter indication is approximately 20 volts at 6 kc, and approximately 40 volts at 50 kc.	Para 4-12.
17	Microphone	Speak loudly into microphone or tap to obtain high output from telephone test set. Check for slight deflection in output level meter indication, indicating presence of modulation in output signal.	Para 4-12.
18	ON or POWER switch	Set to off (down) position; dial lamp extinguishes.	None

4-5. Operator's Weekly Preventive Maintenance Checks and Services Chart

Sequence No .	Item to be inspected	Procedures References	
1	Cables	Inspect cords, cables, and wires for chafed, cracked, or frayed insulation. Replace connectors that are broken, arced, stripped, or excessively worn.	None.
2	Handles	Inspect handles for looseness; replace or tighten as necessary.	None.
3	Metal surfaces.	Inspect exposed metal surfaces for None. rust and corrosion; touchup paint as required (para 4-9).	

4-6. Organizational Monthly Preventive Maintenance Checks and Services Chart

Sequence No .	Item to be inspected	Procedures References	
1	Pluckout items	Inspect seating of pluckout items Make sure that tube clamps grip tube babes tightly.	None.
2	Jacks	Inspect jacks for snug fit and good contact.	None
3	Transformer terminals	Inspect terminals on power transformer. All nuts must be tight. There should be no evidence of dirt or corrosion.	None.
4	Terminal blocks	Inspect terminal for loose connections and cracked or broken insulation.	None
6	Resistors and capacitors	Inspect resistors and capacitors for cracks, blistering, or other detrimental defects.	None
6	Gaskets and insulator	Inspect gaskets, insulators, bushings, and sleeves for cracks, chipping, and excessive wear.	None.
7	Variable capacitor	Inspect variable capacitors for dirt, corrosion, and deformed plates.	None
8	Interior .	Clean interior of chassis and cabinet	None

4-7. Organizational Quarterly Preventive Maintenance Checks and Services Chart

Sequence No .	Item to be inspected	Procedures	References
1	Publications	Check to see that all publications are complete, serviceable, and current.	DA Pam 310-4.
2	Modifications	Check DA Pam 310 to determine if new applicable MWO's have been published. All urgent MWO's must be applied immediately. All normal MWO's must be scheduled.	TM 38-750 and DA Pam 310-7.
3	Spare parts	Check all spare parts (operator and organizational) for General condition and method of storage. There should be no evidence of overstock, and all shortages must be on valid requisitions.	App. B.

4-8. Cleaning

The exterior surfaces of the signal generator should be free of dust, dirt, grease, and fungus.

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

Warning: Prolonged breathing of cleaning compound fumes is dangerous; make sure adequate ventilation is provided. Cleaning compound is flammable; do not use near a flame.

b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with cleaning compound (Federal stock No. 7930-395-9542).

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

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

d. Clean the front panel, the meter, and the control knobs; use a soft, clean cloth. If dirt is difficult to remove, dampen the cloth with water. Mild soap may be used.

4-9. Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them-with fine sand paper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TM 9-213.

4-10. General Troubleshooting Information

Troubleshooting the equipment is based upon the operational checks contained in the operator's daily preventive maintenance checks and services chart. To troubleshoot the equipment, perform all the functions starting with sequence No. 5 in the operator's daily preventive maintenance checks and services chart (para 4-4) and proceed through the sequence numbers until an abnormal condition or result is observed. When an abnormal condition or result is observed, turn to the corresponding trouble in the troubleshooting chart (para 4-11). Perform the checks and corrective actions indicated in the troubleshooting chart. If the corrective measures indicated do not result in the correction of the trouble, maintenance at a higher maintenance category is required. Paragraphs 4-12 and 4-13 (referenced in the chart) contain additional information and step-by-step instructions for performing procedures to be used during the troubleshooting procedure.

4-11. Organizational Troubleshooting Chart

Sequence No.	Trouble symptom	Probable trouble	Checks and connective measures
1	*a.* Dial light does not illuminate.	a. Power cable loose, fuse F1 defective, or dial lamp I1 defective.	a. Check and tighten power cable connection. Replace fuse F1 (para 4-13) or dial lamp I1 (para 4-13).
	b. Output level meter indicates zero.	b. Defective tube V1, V2, V10, V11, V12, V13, V6, or V7.	b. Check tubes and replace defective tube (para 4-12).
2	Output level meter indication less than 42.5 volts.	Defective tube V1, V2, V6, V7, V8, V9, V10, V11, V12, or V13.	Check tubes and replace defective tube (para 4-12).
3	Large variation in output level meter indication noted as tuning or FREQUENCY dial is varied.	Defective tube V1 or V2	Check tubes V1 and V2. Replace defective tube (para 4-12).
4	Abnormal operation noted on one or more, but not all RANGE settings.	Defective tube V1 or V2-	Check tubes V1 and V2; re place if defective (para 4-12).
5	Output level meter indication is zero or low.	Defective tube V3	Check tube V3 and replace if defective (para 4-12).
6	Wide variation in output level meter indication noted as tuning or FREQUENCY dial is varied.	Defective tube V3	Check tube V3 and replace if defective (para 4-12).
7	Output level meter indication not within specified limits.	Defective tube V3	Check tube V3 and replace if defective (para 4-12).
8	No indication of modulation noted in output level meter indication.	Defective tube V3	Check tube V3 and replace if defective (par 4-12).

4-12. Tube Testing and Replacement

When trouble occurs, check the line cord and the power fuse before removing any of the tubes. Try to isolate the trouble to an assembly or stage. If tube failure is suspected, use the applicable procedure given below to check the tubes.

Caution: Do not rock or rotate a tube when removing it from a socket; pull it straight out with a tube puller.

Note. Variations in the characteristics of tubes V1 and V2 may alter frequency calibration and distortion; therefore, after the replacement of either of these tubes, the signal generator should be tested. Replace ment of tubes V8 and V9 may affect the voltage level of the power supply. A higher category of maintenance is required for testing the signal generator and for adjusting the voltage level of the power supply.

a. Use of Tube Tester. Remove and test one tube at a time. Discard a tube only if its defect is obvious, or if the tube tester shows it to be defective. Do not discard a tube that tests at or near its minimum test limit on the tube tester.

b. Tube 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 original tube. Repeat this procedure with each suspected tube until the defective tube is located.

4-13. Repairs and Adjustments

a. Replacement of Fuse. The fuse can be replaced from the front panel of the signal generator as follows:

(1) Press in on the fuse holder cap and turn it counterclockwise to unlock it.

(2) Pull out the fuse holder cap and the fuse, and discard the defective fuse.

(3) Insert the replacement fuse in the fuse holder cap and insert them in the fuse holder; press in on the cap and turn it clockwise to lock it in place.

b. Replacement of Dial Lamp. Replace the dial lamp from the front panel of the signal generator as follows:

(1) Remove the dial lamp lens by unscrewing it.

(2) Press in on the dial lamp and turn it counterclockwise a fraction of a turn to release ft from its socket. Then, remove the dial lamp.

(3) Insert the replacement dial lamp in the lamp socket; press in and turn the dial lamp clockwise to lock it in place.

(4) Screw on the dial lamp lens.

CHAPTER 5

FUNCTIONING

Note. The functioning presented in this chapter is based on the Quits of Signal Generator SG-71/FCC, Except for variation; which result from parts value and tube type differences noted in the simplified schematic diagrams, the functioning is also applicable to all other models of the SG-71(*)/FCC.

5-1. Block Diagram

a. General. Signal Generator SG-71/FCC supplies sine wave voltage at frequencies from 50 cps to 500 kc per second. These voltages are available from two separate amplifiers: one balanced and ungrounded, the other single-ended and grounded. The balanced amplifier supplies a continuously variable voltage from 0 to 45 volts across an external load of 600 ohms. This voltage is used over the frequency range from 5 to 500 kc. The output from the unbalanced amplifier is continuously variable from 0 to 6 volts root mean square (rms) across loads of 600 or more ohms and is useful over the full 50- to 500,000-cps frequency range of the equipment. The signal generator also provides for voice modulation of the balanced output over the frequency range from 10 to 500 kc.

b. Functional Sections. The electrical circuit of the complete signal generator is shown in block form in figure 5-1. The overall circuit is divided into five sections which are shown in large dashed blocks (fig. 5-1). The tubes and certain major networks are shown as solid blocks within the sections. The following paragraphs contain a brief discussion of the function of each section, then a detailed discussion of the operation of each stage. Reference symbols used in the text and partial schematic diagrams for each section are the same as those found in the schematic diagrams (figs. 10-3 and 10-5) for the complete equipment.

c. Oscillator Section. The oscillator section generates the variable frequency, sine wave voltage which is applied to any one of three sections: the unbalanced amplifier, the balanced amplifier, or through the modulator to the balanced amplifier, depending on the setting of the MOD. BAL.-BAL.-UNBAL. selector switch. The oscillator consists of two resistance-coupled amplifiers V1 and V2, and a frequency-determining network which consists of the frequency RANGE switch assembly and the main tuning capacitor.

d. Unbalanced Amplifier. When the MOD BAL.-BAL.-UNBAL. selector switch is set to UNBAL., the oscillator drives the unbalanced amplifier. The unbalanced amplifier operates over the full frequency range of 60 cps to 500 kc. The amplifier consists of two resistance-coupled amplifiers V4 and V5. To stabilize the operation of the amplifier, a high order of negative feedback is used.

e. *Balanced Amplifier*. When the MOD. BAL.-BAL.-UNBAL. switch is set to BAL., the oscillator drives the balanced amplifier. This amplifier operates over the frequency range from 5 to 500 kc. The amplifier consists of voltage amplifier tube V10, phase inverter tube V11, push-pull power amplifier tube V12 and V13, output transformer T2, and output level meter MI. The amplifier provides at least 3 watts to loads of 600 ohms. Negative feedback is used around the complete amplifier for stabilization purposes.

f. Modulator Section. When the MOD. BAL.-BAL.-UNBAL. selector switch is set to MOD. BAL., the modulator section mixes the voice signals from the front panel MICROPHONE jack with the signal received from the oscillator section and supplies a modulated carrier to the balanced amplifier. The modulator includes mixer tube V3 and an audio-rejection filter which prevents the audio components of the mixing process from being passed to the balanced amplifier.

g. Power Supply. The power supply provides three separate ac heater voltages, two unregulated B + voltages, and one regulated B + voltage. The power supply consists of power transformer T1; rectifier tube V6; a smoothing filter; and a voltage regulator composed of reference tube V9, voltage amplifier V8, and series voltage regulator V7. The power supply remains connected to all the section of the signal generator regardless of the setting of the MOD. BAL.-BAL.-UNBAL. selector switch.

5-2. Stage Analysis

a. Oscillator Section.

(1) *General.* The oscillator in Signal Generator SG-71(*)/FCC is a resistance-capacitance-type, sine wave generator. It is also known as a Wein bridge oscillator. Figure 5-2 shows the oscillator circuit in basic form. The circuit consists of a two-stage, resistance-coupled amplifier which oscillates by using a positive feedback circuit. Because two resistance-coupled stages are used, the output voltage of the second tube is in phase with the grid voltage of the first tube. At resonant frequency f_O, there is no phase shift in the positive feedback circuit, so that a voltage of the resonant frequency at the output of the second tube reinforces the voltage at the input to the first tube, and oscillation occurs.

(2) *Frequency selective feedback circuit*. Figure 5-2 shows the oscillator circuit in basic form. Resistors R_a and R_b and capacitors C_a and C_b in the positive feedback circuit constitute the frequency-determining network shown in block form in figure 5-1. This network controls the frequency of oscillation of the system. The frequency and phase characteristics of the frequency determining network are shown in figure 5-3. The ordinate at the left in figure 5-3 pertains to curve *a* and shows how voltage e_g out of the network varies with a constant amplitude input voltage e applied to the network over a range of frequencies. The ordinate at the right in figure 5-3 pertains to curve *b* and shows the phase shift that occurs between e_g and e_f for various frequencies. At one frequency, f_O, the ratio of the grid voltage e_g to the voltage e_f applied to the network (curve *a*) is greater than at any other frequency. Also, at frequency f_0, the phase shift (curve *b*), between e_g, and e_f is zero; that is, the two voltages are in phase. Thus, the frequency of oscillation is limited to f_0, since phase shift through the system does not permit oscillation at any other frequency. By using variable capacitors for C_a and C_b, the oscillator is made variable. The frequency of oscillation is given by the formula:

$$f_O = \frac{1}{2\pi\sqrt{R_a \times R_b \times C_a \times C_b}}$$

However, since R_a and R_b are equal, and C_a and C_b are equal, the above formula may be reduced to:

$$f_O = \frac{1}{2\pi R_a C_a}$$

The values of the two capacitors are equally and simultaneously varied by the tuning dial on the front panel. The values of the resistors are switched by factors of 10 so that the basic dial calibration may be multiplied by 10, or a multiple thereof for each frequency range

(3) Negative feedback and automatic amplitude limiter. In addition to the frequency-determining feedback circuit used in the oscillator, a negative feedback circuit is also used for stabilizing the oscillator, minimizing distortion, and keeping the oscillator output voltage constant over a wide range of frequencies. Basically, this circuit consists of resistor R18 and lamp R15 (fig. 5-2). R15 is a 10-watt incandescent lamp which has a positive temperature coefficient; that is, the resistance of the lamp increases when the temperature of the lamp filament increases. This action allows the lamp to operate as an automatic amplitude limiter. If the amplitude of oscillation tends to rise, the current through the lamp also tends to rise, thus increasing the resistance of the lamp; therefore, the negative feedback tends to increase so that the amplitude of oscillation is maintained constant. If the amplitude of oscillation tends to decrease, the reverse of the above action occurs, and the amplitude is also maintained constant; thus, the lamp acts as an automatic amplitude limiter. Negative feedback also gives a more constant phase characteristic

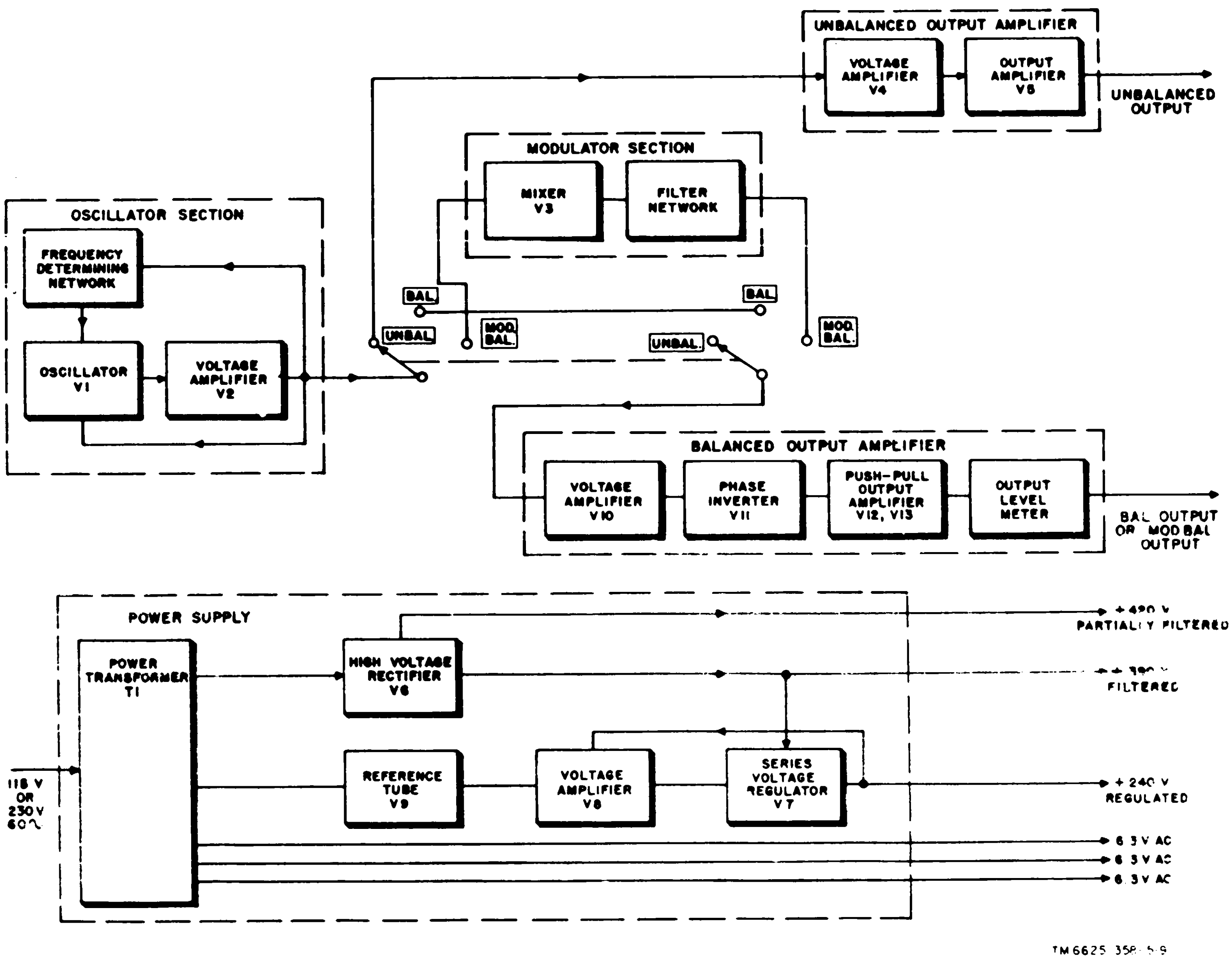


Figure 5-1. Signal Generator SG-71(*)/FCC, block diagram.

to the two-stage amplifier, stabilizing the frequency of oscillation of the system and reducing its sensitivity to supply voltage variations.

(4) *Function of components*.

(a) Figure 5-4 shows the complete oscillator circuit used in the instrument. Resistors R1 through R12 are frequency-determining resistors. These resistors are precision 1-percent resistors. Resistors R1 through R4 are padded with low-value, 1/2-watt resistors to obtain the desired precision. The padder resistors are shown as R1A through R4A. Potentiometers R9 through R12 are used for standardization purposes. The main tuning capacitor is composed of four identical ganged sections with each pair of sections connected in parallel to obtain the required capacitance. Two parallel sections of the main tuning capacitor constitute C1A and are in series with resistors R1 through R4 in the frequency-determining feedback network. The remaining two parallel sections of the main tuning capacitor constitute C1B and are connected in parallel with resistors R5 through R8 from the grid of V1 to ground.

(b) Capacitors C2 and C3 are trimmers which adjust the tracking of the oscillator circuit. These capacitors are basic adjustments which establish the point of optimum operation of the oscillator. Capacitors C4, C29, and C31 compensate for the effect of stray capacities that make the total phase shift through tubes V1 and V2 less than 3600 at high frequencies. These capacitors are factory-adjusted to set the tuning dial calibration of frequencies above 300,000 cps. Capacitor C29 is placed across capacitor C4 to increase the range of adjustment. Capacitor C29 is not included when the range of capacitor C4 is sufficient for accurate dial calibration at these frequencies. Increasing the capacity of capacitor C4 or C29 increases the frequency of oscillation. Increasing the capacity of capacitor C31 decreases the frequency of oscillation. Capacitor C31 is not included when the range of capacitor C4 is sufficient for accurate calibration. Resistors R13 and R14 and lamp R15 constitute a voltage-divider network which determines the magnitude of negative feedback voltage and, therefore, the voltage output of the oscillator. The resistance value of lamp R15 varies noticeably from one bulb to another. Variable resistor R13 compensates for variations in lamp resistance and is used to adjust the oscillator output voltage to the required value.

(c) A high-gain voltage amplifier (type 6SJ7) is used for tube V1. Because low value resistors and low plate load resistors are used in the frequency-determining network on the higher frequency ranges, a high G_m power pentode (type 6AG7) is used for V2. Screen voltage for tube V1 is obtained from a voltage divider composed of resistors R16 and R17; resistor R18 is the plate load resistor. Capacitor C5 is a dc blocking capacitor which couples the output of tube V1 to the input of tube V2. Resistor R19 is the grid return for tube V2, and series grid resistor R20 suppresses parasitic oscillations. Resistor R22 is the plate load resistor for tube V2. An electrolytic dc blocking capacitor C7 couples the output of tube V2 to the two feedback networks and to the input circuits of the other sections of the equipment. Resistors R23, R24, and R25 make up a signal-attenuating network to control the output amplitude. The value of resistor R23 is selected to limit the maximum output voltage; across R23 a small capacitor (C32) may be placed to vary the frequency response of the signal generator output at the higher frequencies. Potentiometers R24 and R25 are the AMPLITUDE FINE-COARSE controls on the front panel.

b. Modulator Section.

(1) *General.* Figure 55 shows the complete modulator section. A 6SA7 pentagrid converter is used as the modulator tube. The output of the oscillator section is introduced into the first grid of the converter tube, and the modulating signal from an external microphone is introduced into the third grid. The two voltages affect the plate current of the tube to produce an amplitude-modulated wave in the plate circuit. To remove unwanted modulation products from the output of the modulator, the output of the mixer tube is passed through a high-pass filter which has a cutoff frequency of approximately 3,500 cps. Because of some remaining attenuation in the filter of frequencies between 3,500 cps and 1.5 kc, the maximum available modulated power is limited in this

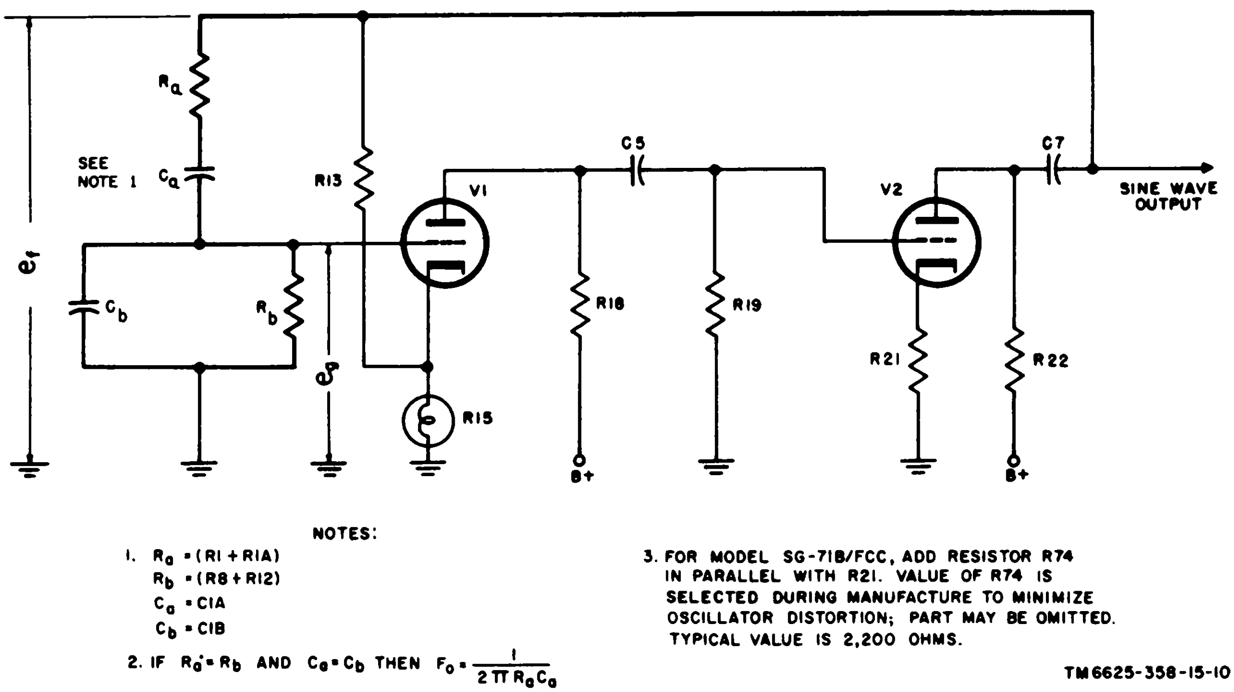


Figure 5-2. Oscillator circuit, simplified functional diagram.

range. The circuit is modulated from a field-type telephone test set which consists of a carbon microphone, battery, and transformer to match a 600-ohm line. Approximately 1.50 volt rms are required for 50-percent modulation of 1 watt of carrier power.

(2) *Functioning of components*. When MOD BAL.-BAL.-UNBAL. selector switch S2 is set to MOD. BAL., the signal from the oscillator is passed to No. 1 of tube V3 through a divider which consists of series-dropping resistor R26 and grid return resistor R27. Resistor R28 is a cathode-biasing resistor and capacitor C8 its bypass capacitor. The screen voltage for tube V3 is obtained through resistor R31 and is bypassed by capacitor C10A. Resistor R29 is the grid return for No. 83 grid; load resistor R30 for the telephone test set is used for modulation. Blocking capacitor C9 couples the signal from the MICROPHONE jack to grid No. 3 of tube V3. Resistor R32 is the plate load resistor. Resistor R33 is a decoupling resistor for the plate supply voltage to tube V3 and capacitor C10B is its bypass capacitor. Capacitors C11 through C14 audio chokes L1, L2, and L3, and resistor R34 comprise the highpass filter following mixer tube V3. This filter removes audio components below approximately 5 kc from the modulated signal.

c. Balanced Output Amplifier.

(1) *General.* The balanced amplifier (fig. 5-6) supplies 3 watts of power into a 600-ohm load over the frequency range from 5 to 500 kc per second. This section consists of three stages: voltage amplifier V10 (type 6SJ7), phase inverter V11 (type 6J5), and push-pull power amplifier, V12 and V13 (two type 6L6GA). A third winding on output transformer terminals 5 and 6 provides negative feedback voltage which is applied to the cathode of tube V10. Tube V10 is a voltage amplifier; tube V11 is a plate- and cathode-loaded-type phase inverter or paraphase amplifier in which two out-of-phase voltages are derived from one tube. In this inverter, a load is placed in the cathode of the tube equal to the load in the plate circuit; therefore, essentially equal, but out-of-phase voltages are then applied to the grids of the push-pull output amplifier tubes. A 6J5 triode is used for tube V11. The output

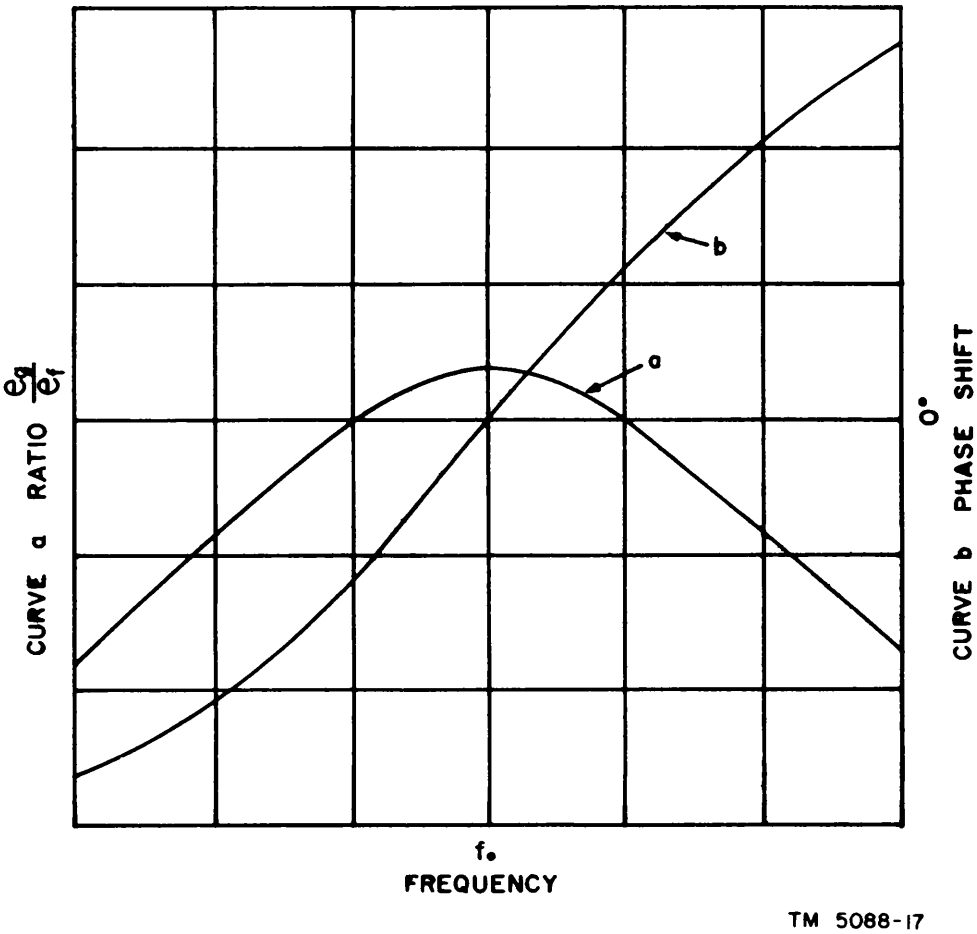
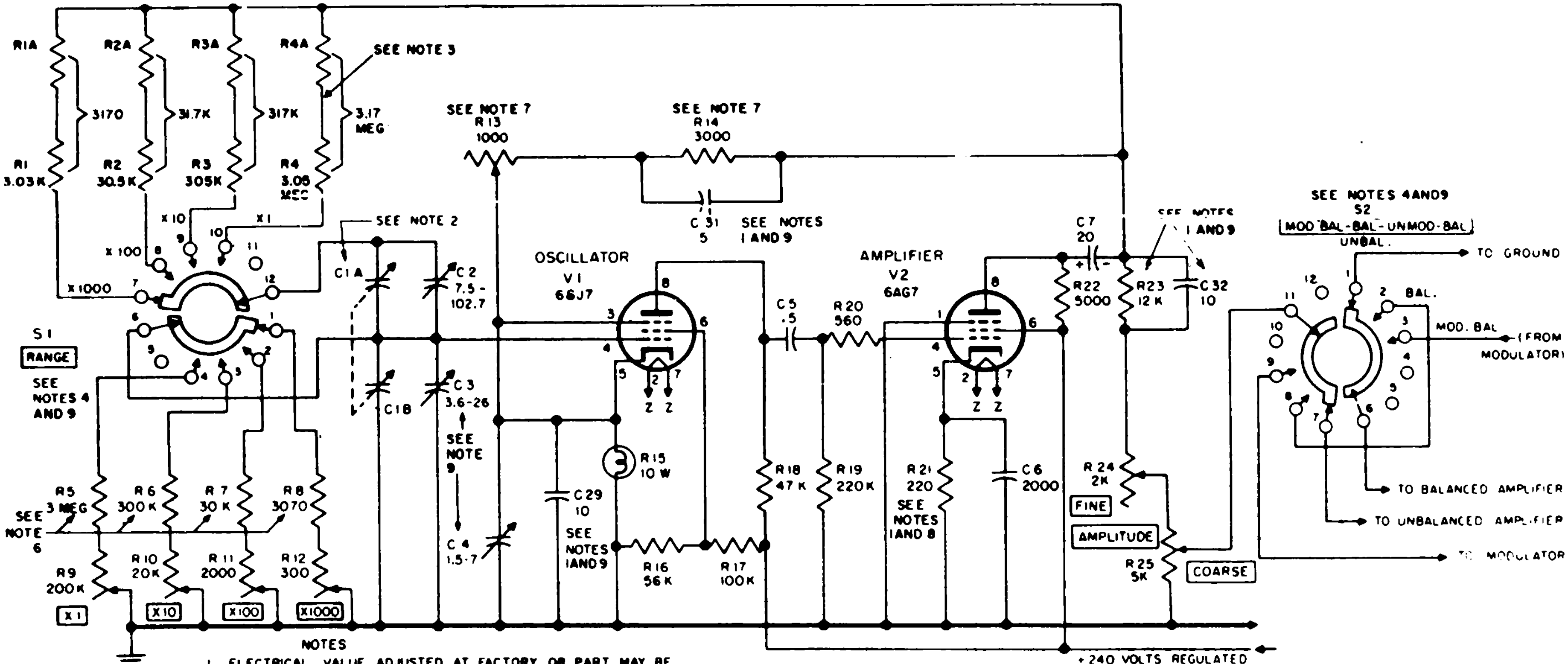


Figure 5-3. Frequency determining network characteristics.

stage is a push-pull power stage, using 6L6GA beam tetrodes coupled to the BAL. OUTPUT terminals through a special output transformer for wide bandwidth. The low frequency cutoff point is 5 kc. Included in the output system is an output level meter connected across the secondary of the output transformer. The output level meter uses a full-wave rectifier circuit which consists of four germanium-type crystals and current-,limiting resistors R67, R68 and R69. Potentiometer R69 is used to adjust .the calibration of the output level meter scale.

(2) *Functioning of components*. When switch S2 is set to BAL., the signal generated by the oscillator is coupled to the control grid of tube V10. Resistor R56 is the grid return resistor for tube V10. Cathode-biasing resistor R57 is placed in series with third winding terminals 5 and 6 on the output transformer T2. Resistor R58 is a screen voltage-dropping resistor for tube V10, and capacitor C24 is the screen bypass capacitor. Capacitor C30 and resistor R72 attenuate frequencies above the range of the signal generator to prevent high frequency oscillation caused by phase shift in the output transformer. Plate load resistor R59 and dc blocking capacitor C25 couple the signal from the plate of tube V10 to the grid of tube V11. Resistors R55A, R55B, R55C and capacitor C18C form a voltage-dropping resistance-capacitance filter in the plate supply lead from the 390-volt dc supply. Resistor R61 is the grid return for tube V11, and grid resistor R60, returned to the high voltage supply, establishes



NOTES

1. ELECTRICAL VALUE ADJUSTED AT FACTORY, OR PART MAY BE OMITTED. VALUE GIVEN IN TYPICAL
2. C1A AND C1B EACH COMPOSED OF TWO SECTIONS OF FOUR SECTION TUNING CAPACITOR. EACH SECTION IS 12.4 TO 535 UUF
3. RESISTORS R1, R2, R3, AND R4 PADDED TO TOTAL VALUES AS SHOWN. IN SIGNAL GENERATOR SG-71C/FCC VALUES OF R1 THROUGH R4 ARE 2.87K, 30.1K, 301K, AND 3.01 MEG, RESPECTIVELY, AND TOTAL VALUES ARE 3.02K, 31.6K, 316K, AND 3.16 MEG, RESPECTIVELY
4. WAFER SWITCHES VIEWED FROM REAR
5. UNLESS OTHERWISE INDICATED RESISTORS ARE IN OHMS, AND CAPACITORS ARE IN UF.
6. IN SIGNAL GENERATOR SG-71A/FCC R5 THROUGH R8 ARE 3.05 MEG, 305K, 30.5K, AND 3050 OHMS RESPECTIVELY, AND IN SIGNAL GENERATOR SG-71C/FCC, 3.01 MEG, 301K, 30.1K, AND 3010 OHMS, RESPECTIVELY.
7. IN SIGNAL GENERATORS SG-71B/FCC AND SG-71C/FCC VALUE OF R13 IS 2K, AND VALUE OF R14 IS 1600 OHMS.
8. IN SIGNAL GENERATOR SG-71B/FCC RESISTOR R74, A FACTORY SELECTED RESISTOR, TYPICAL VALUE OF 2.2K, IS ADDED IN PARALLEL WITH R21
9. IN SIGNAL GENERATOR SG-71C/FCC
   TERMINAL NUMBERING OF WAFER SWITCHES DIFFER, THOUGH SWITCHES FUNCTION IN SIMILAR MANNER
   CAPACITORS C2 AND C3 ARE 7 TO 100 UUF
   CAPACITOR C4 IS 7 TO 45 UUF
   CAPACITOR C29 IS 33 UUF
   CAPACITOR C31 IS 56 UUF
   CAPACITOR C32 IS 18 UUF
   RESISTOR R23 IS 4700 OHMS

Figure 5-4. Oscillator circuit, simplified schematic diagram.

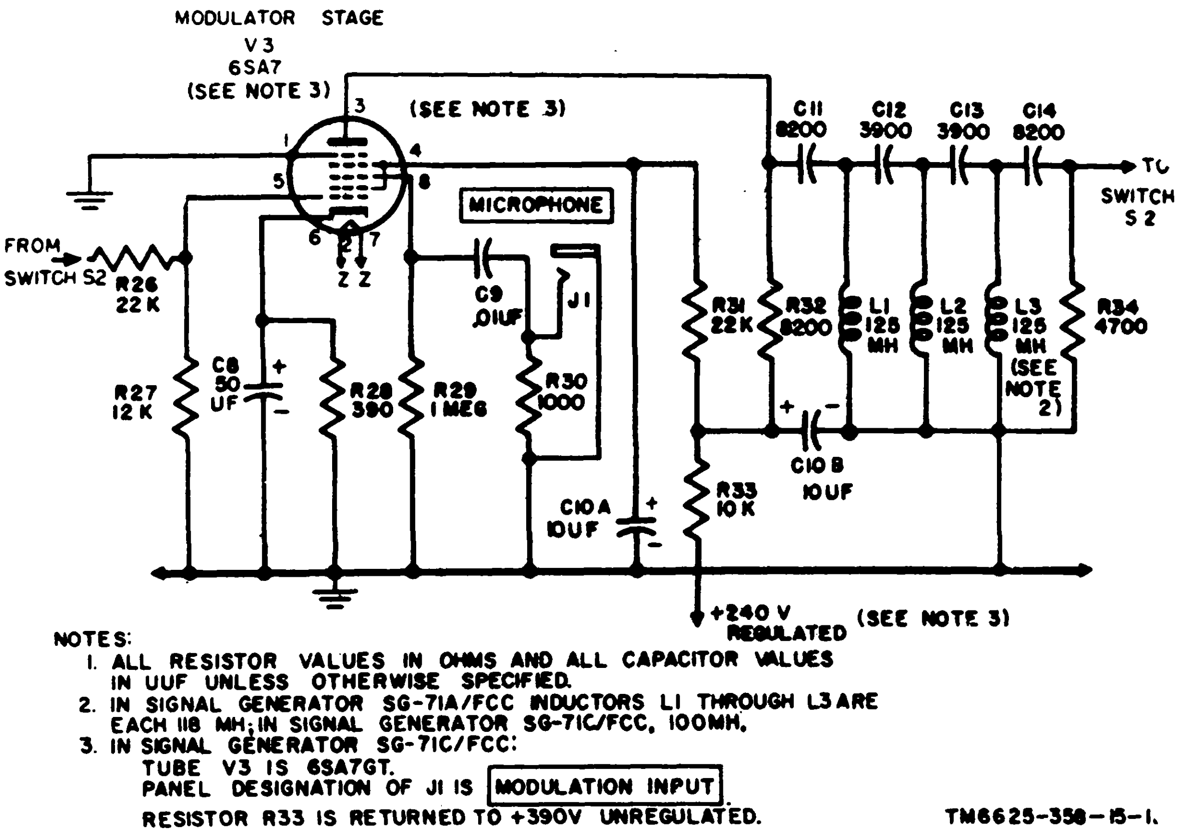


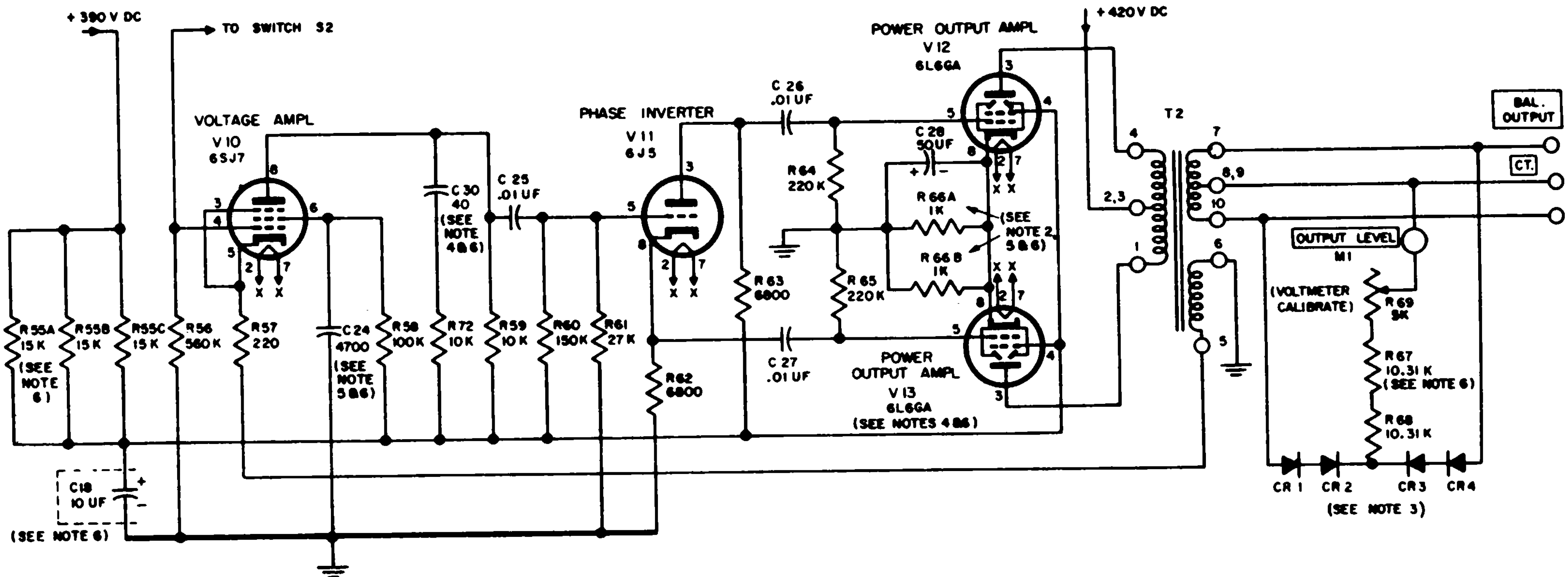
Figure 5-5. Modulator circuit, simplified schematic diagram.

correct bias. Resistor R63 is the plate load resistor for tube VII. Dc blocking capacitors C26 and C27 couple the out-of-phase signal voltages to the push-pull stage. Resistors R64 and R65 are grid return resistors for tubes V12 and V13. Resistors R66A and R66B are common cathode-biasing resistors, and capacitor C28 is the cathode bypass capacitor for the push-pull stage. The total value of resistance between cathode and ground is factory-selected to give minimum distortion from the balanced output when operating at 8 watts into 600 ohms at a frequency of 5,000 cps. T2 is the output impedance-matching transformer. Output level meter M1 is a dc milliammeter with 1 milliampere (ma) sensitivity. Crystal diodes CR1 through CR4 comprise the full-wave rectifier for the output level meter. Resistors R67 through R69 are current-limiting resistors for correct calibration of M1.

d. Unbalanced Output Amplifier.

(1) *General.* The unbalanced amplifier (fig. 5-7) is a two-stage, resistance-coupled amplifier which consists of high-gain voltage-amplifier tube V4 (type 6AC7) and high G_m power amplifier tube V5 (type 6AG7). To make the circuit suitable for use over a wide range of frequencies, a high degree of negative feedback is used.

(2) *Functioning of components*. When switch S2 is set to UNBAL., the signal from the oscillator is passed directly to the grid of tube V4, through dc blocking capacitor C165 and parasitic suppression resistor R70. Resistor R85 is the grid return for tube V4 and resistor R36 is the cathode-biasing resistor. Resistor R37 increases the resistance in the cathode circuit of tube V4 and determines the degree of negative feedback voltage used. Screen voltage for tube V4 is



NOTES:

1. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN UUF UNLESS OTHERWISE SPECIFIED.
2. ELECTRICAL VALUE SELECTED DURING MANUFACTURE OR PART MAY BE OMITTED. VALUE GIVEN IS TYPICAL.
3. CATHODE OF DIODE INDICATED BY LINE. ELECTRON FLOW IS OPPOSITE TO DIRECTION OF ARROW.
4. IN SIGNAL GENERATOR SG-71A/FCC: CAPACITOR C30 IS 39 UUF, AND TUBES V12 AND V13 ARE 6L6.
5. IN SIGNAL GENERATOR SG-71B/FCC: CAPACITOR C24 IS 0.047 UF, AND RESISTOR R66C, 1.5K, IS ADDED IN PARALLEL WITH R66B.
6. IN SIGNAL GENERATOR SG-71C/FCC:
   RESISTORS R55A, R55B AND R55C ARE REPLACED BY RESISTOR R55, 5K.
   CAPACITOR C18 IS REPLACED BY CAPACITOR C33, SAME VALUE.
   CAPACITOR C24 IS 0.047 UF.
   CAPACITOR C30 IS 39 UUF.
   RESISTORS R66A AND R66B ARE REPLACED BY RESISTOR R66, 350 OHMS.
   RESISTOR R67 IS OMITTED. RESISTOR R68 IS 24K.
   DIODE CR2 IS DESIGNATED CR3, DIODE CR3 IS DESIGNATED CR4, DIODE CR4 IS DESIGNATED CR2.
   TUBES V12 AND V13 ARE 6L6GC.

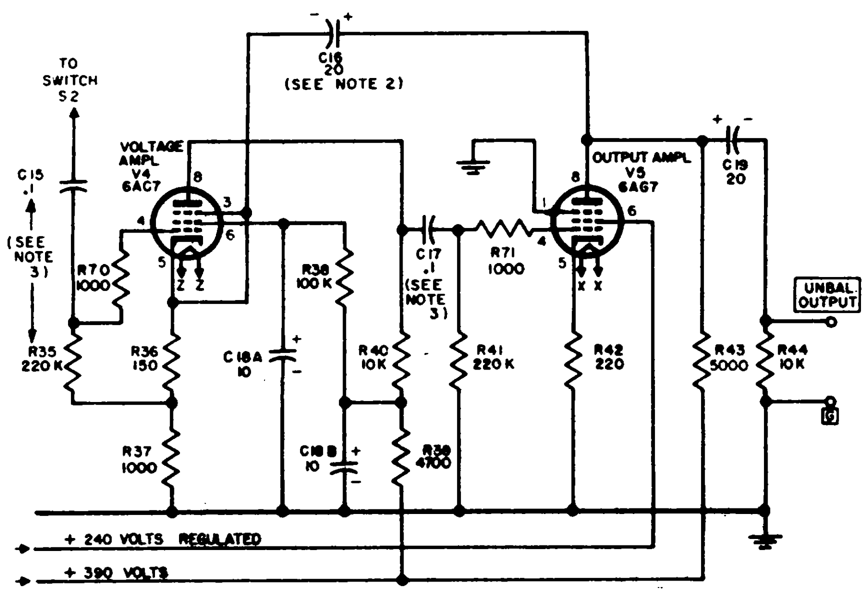
TM6625-358-15-13

Figure 5-6. Balanced output amplifier, simplified schematic diagram.

supplied through resistor R38, which is bypassed by electrolytic capacitor C18A. Resistor R40 is the plate load resistor. The 390-volt plate supply is decoupled by resistor R39 and capacitor C18B. The signal is coupled from tile plate of tube V4 to the grid of tube V5 through de blocking capacitor C17 and parasitic suppression resistor R71. Resistor R41, is the grid return resistor for tube V5, and resistor R42 is the cathode-biasing resistor. Resistor R43 is the plate load resistor. Electrolytic capacitor C19 couples the signal to the output terminals. Resistor R44 bleeds blocking capacitor C19. Electrolytic capacitor C16 provides 'the negative feedback path from the plate of tube V5 to the cathode of tube V4. Screen voltage for tube V5 is obtained directly from the 240-volt regulated power supply.

e. Power Supply.

(1) *General.* The power supply (fig. 58) operates from a nominal 115- or 230-volt, 50- to 60-cps, single-phase, ac source and consists of a power transformer, a full-wave rectifier, a two-section pi-filter, and a dc voltage regulator circuit. For best stability and minimum hum, regulated dc voltage is applied to the oscillator section and to the screen grid of power amplifier tube V5 and V3. Unregulated voltage is supplied to all other tube elements in the signal generator. The dc voltage-regulator circuit maintains its output voltage essentially constant, whether the rectifier voltage output increases or decreases, or whether the load current increases or decreases. Voltage regulators also reduce ripple, etc that appear in the rectifier output. Tube V9 is a voltage regulator tube which maintains the cathode of tube V8 at a uniform potential. Tube V7 operates as a variable resistor, and tube V8 controls the grid voltage, and, therefore, the resistance of tube V7. If the regulated B + voltage at the cathode of tube V7 tends to increase, the grid voltage of tube V8 tends to increase, causing tube V8 to draw more current. This action lowers the plate voltage of tube V8 and, therefore, the grid voltage (increase the grid bias) of tube V7, resulting in a greater



NOTES:
1. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN UF UNLESS OTHERWISE SPECIFIED.
2. IN SIGNAL GENERATORS SG-71A/FCC AND SG-71C/FCC RESISTOR R73, 150 OHMS, IS ADDED BETWEEN CAPACTOR C16 PIN 3 OF TUBE V4.
3. IN SIGNAL GENERATOR SG-71C/FCC. CAPACITOR C15 IS 2 UF. CAPACITOR C17 IS 2UF. RESISTOR R35 IS 22K. RESISTOR R41 IS 22K.

TM 6625-358-15-14

Figure 5-7. Unbalanced output amplifier, simplified schematic diagram.

plate resistance for tube V7. This greater plate resistance causes a greater voltage drop across tube V7, compensating for the increased voltage at its cathode and resulting in a substantially constant voltage. If the regulated B + voltage tends to decrease, the reverse of the above action occurs, which also tends to maintain the cathode voltage substantially constant.

(2) *Functioning of components*. The high-voltage output of transformer T1 is rectified by tube V6 and smoothed by a two-section pifilter which consists of capacitors C20, C21, C22 and chokes L4 and L5. Resistor R46 provides operating current for voltage-regulator tube V9. Resistor R49 is the plate load resistor for tube V8. Resistor R48 is a parasitic suppressor in series with the grid of tube V7. Resistor R51 is a parasitic suppressor in series with the screen of tube V7. Dc blocking capacitor C23 couples the ac component on the regulator output to the grid of tube V8. Resistor R50 is the grid return for, tube V8. Resistors R52, R53, and R54 comprise a voltage divider to provide the correct bias and voltage compensation for tube V8. Potentiometer R53 adjusts the amplitude of the regulated voltage. Capacitor C10C is a bypass capacitor on the regulated 240-volt supply.

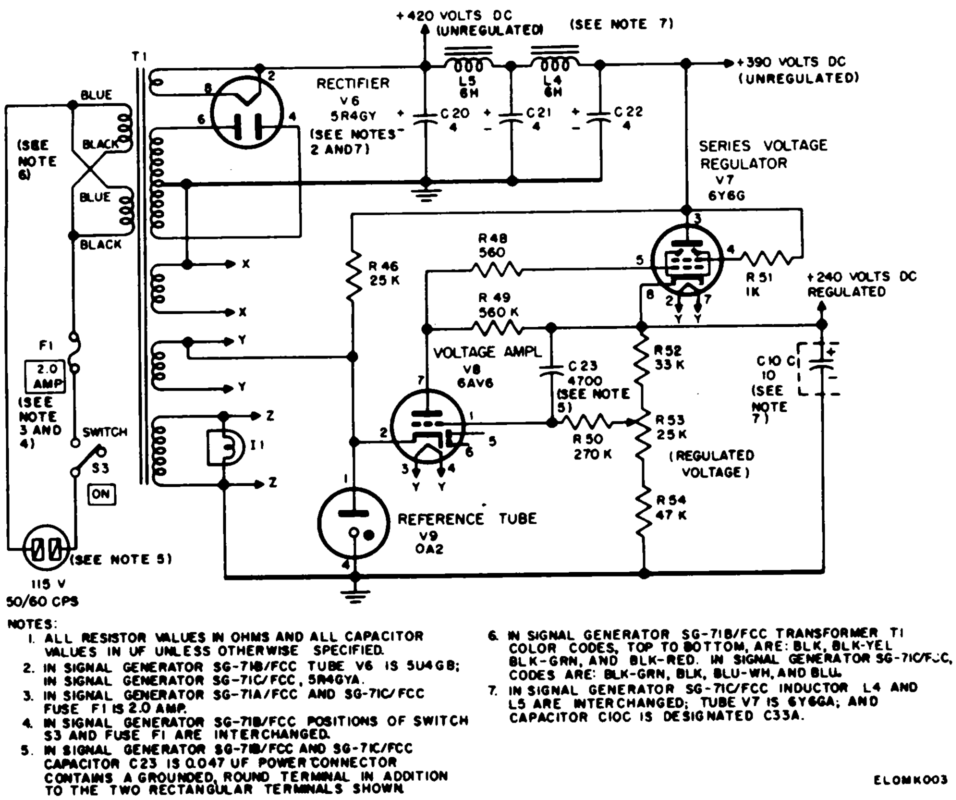


Figure 58. Power supply, simplified schematic diagram.

CHAPTER 6

TROUBLESHOOTING

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

Warning

Voltages as high as 420 volts exist at various points in Signal Generator SG-71(*)/FCC. Be careful when servicing the signal generator, even when the equipment has been turned off. Voltages will be retained by filter capacitors if the bleeder circuit is inoperative. Always discharge all filter capacitors by shorting their terminals together before handling.

6-1. General Instructions

Troubleshooting at general support and depot maintenance categories includes all the techniques given for organizational maintenance and any special or additional techniques required to isolate a defective part. Section II describes localizing and isolating techniques to be used at the general support maintenance level.

6-2. Organization of Troubleshooting Procedures

a. General. The first step in servicing & defective signal generator is to localize the fault. Localization means tracing the fault to a defective stage or circuit responsible for the abnormal condition. The second step is isolation. Isolation means locating the defective part or parts. Some defective parts, such as burned-out resistors, and arcing or shorted transformers, can often be located by sight, smell, and hearing; however, most defective parts, must be isolated by checking voltages and resistances.

b. Localization. The localization procedures applicable to this equipment are listed in (1), (2), and (8) below, and should be used in localizing the trouble to a stage in the suspected unit.

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without testing or measuring the circuits. All output level meter readings and other visual signs should be observed and an attempt made to localize the fault to a particular stage.

(2) *Operational test.* The operational test will frequently indicate the general location of trouble and, in many instances, will help in determining the exact nature of the fault. The operator's daily preventive maintenance checks and services chart (para 4-5) contains a good operational test.

(3) *Troubleshooting Chart.* The troubleshooting chart (para 6-7) lists symptoms of common troubles and gives (or references) corrective measures. Such a chart obviously cannot include all the trouble symptoms that may occur. The repairman should use this chart as a guide in analyzing symptoms that may not be listed.

c. Isolation. Procedures for isolating troubles are given in paragraph 6-8.

d. Techniques. In performing the localization and isolation procedures, one or more of the techniques below may be applied. Apply these techniques only as indicated, and observe all cautions.

(1) *Voltage and resistance measurements.* Make voltage and resistance measurements as directed on the voltage and resistance diagrams (figs. 6-6, 6-7, and 6-8).

(2) *Signal substitution and stage gain measurements.* Because of the large amount of degeneratice feedback around all amplifier tubes, measurements of gain through single

stages are misleading. Stage-by-stage gain and signal-tracing measurements are not recommended or deemed necessary for efficient troubleshooting. Localization, followed by a visual check, a tube check, and voltage and resistance measurements, will usually lead to any trouble likely to occur.

(3) *Intermittent troubles.* In all tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the equipment. Make a visual inspection of the wiring of the signal generator. Minute cracks in printed-circuit boards can cause intermittent operation. A magnifying glass is often helpful in locating defects in printed-circuit boards. Continuity measurements of printed conductors may be made by using the same techniques ordinarily used on hidden conventional wiring.

(4) *Resistor and capacitor color code diagrams.* Color code diagrams for resistors and capacitors (figs. 10-1 and 10-2) provide pertinent resistance, capacitance, voltage rating, and tolerance information.

6-3. Equipment Required

The chart below lists the test equipment required for troubleshooting Signal Generator SG-71 (*)/FCC. The associated technical manuals are also listed.

Test equipment	Technical manual
Multimeter TS-352B/U...........	TM 11-6625-366-15
Frequency Meter AN/ TSM-16	TM 11-6625-218-12
Spectrurh analyzer TS-723A/U	TM 11-5097
Voltmeter Electronic ME-30(*)/U[a]......................	TM 11-6625-320-12
Test Set, Electron Tube TV-7(*)/U[b].........................	TM 11-6625-274-12

[a] Voltmeter, Electronic ME-30(*)/U represents Voltmeter, Meter ME-30A/U and Voltmeter, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.
[b] Test Set, Electron Tube TV-7(*)/U represents Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.

6-4. Internal Differences in Models

Item	SG-71/FCC	SG-71A/FCC	SG-71B/FCC	SG-71C/FCC
Resistor R1	3.03K	3.03K	3.03K	2.87K
Resistor R2	30.5K	30.5K	30.5K	30.1K
Resistor R3	305K	305K	305K	301K
Resistor R4	3.05 Meg	3.05 Meg	3.05 Meg	3.01 Meg
Resistor R5	3 Meg	3.05 Meg	3 Meg	3.01 Meg
Resistor R6	300K	305K	300K	301K
Resistor R7	30K	30.5K	30K	30.1K
Resistor R8	3.07K	3.05K	3.07K	3.01K
Resistor R13	1K	1K	2K	2K
Resistor R14	3K	3K	1.6K	1.6K
Resistor R23	12K (typical)	12K (typical)	12K (typical)	4.7K (typical)
Resistor R33	Return to +240 vdc	Return to +240 vdc	Return to +240 vdc	Return to +390 vdc
Resistor R35	220K	220K	220K	22K
Resistor R41	220K	220K	220K	22K
Resistors R55A, R55B, and.. R55C	15K each	15K each	15K each	Replaced by R55, 5K
Resistors R66A and R66B....	1K each	1K each	1K each; R66C, 1:5K, added in parallel	Replaced by R66, 360 ohms
Resistor R67	10.31K	10.31K	10.31K	Not used
Resistor R68	10.31K	10.31K	10.31K	24K
Resistor R73	Not used	150 ohms	Not used	150 ohms
Resistor R74	Not used	Not used	2.2K	Not used
Capacitor C2........................	7.5 to 102.7µµf	7.5 to 102.7µµf	7.5 to 102.7µµf	7-100µµf
Capacitor C3........................	7.5 to 102.7µµf	7.6 to 102.7µµf	7.5 to 102.7µµf	7 to 100µµf

Item	SG-71/FCC	SG-71A/FCC	SG-71B/FCC	SG-71C/FCC
Capacitor C4	1.5 to 7 µµf	1.5 to 7 µµf	1.5 to 7 µµf	7 to 45 µµf
Capacitor C10C	10 µf	10 µf	10 µf	Replaced by C33A, 10 µf
Capacitor C15	0.1 µf	0.1 µf	0.1 µf	2 µf
Capacitor C17	0.1 µf	0.1 µf	0.1 µf	2 µf
Capacitor C18	10 µf	10 µf	10 µf	Replaced by C33B, 10 µf
Capacitor C23	4700 µµf	4700 µµf	0.047 µf	0.047 µf
Capacitor C24	4700 µµf	4700 µµf	0.047 µf	0.047 µf
Capacitor C29	10 µµf (typical)	10 µµf (typical)	10 µµf (typical)	33 µµf (typical)
Capacitor C30	40 µµf	39 µµf	40 µµf	39 µµf
Capacitor C31	5 µµf (typical)	5 µµf (typical)	5 µµf (typical)	56 µµf (typical)
Capacitor C32	10 µµf (typical)	10 µµf (typical)	10 µµf (typical)	18 µµf (typical)
Inductors L1 through L3	125 mh each	118 mh each	125 mh each	100 mh each
Fuse- F1	2.0 amp	2.0 amp	2.0 amp	2.0 amp
Connector W1	2 terminals	2 terminals	Also has third grounded terminal.	Also has third grounded terminal.
Tube V3	6SA7	6SA7	6SA7	6SA7GT
Tube V6	5R4GY	5R4GY	5U4GB	5R4GYA
Tube V7	6Y6G	6Y6G	6Y6G	6Y6GA
Tubes V12 and V13	6L6GA	6L6	6L6GA	6L6GC
Front panel controls	Fig. 3-1	Fig. 3-1	Fig. 3-1	Fig. 3-2

Section II. TROUBLESHOOTING SIGNAL GENERATOR SG-71(*)/FCC

Caution:

Do not attempt removal or replacement of parts before reading the instructions given in paragraph 7-1.

6-5. Checking B+ Circuits for Shorts

a. When to Check. When either of the following conditions exist, check for short circuits and clear the trouble before applying power:

(1) When the signal generator is being serviced and the nature of the abnormal symptom is not known.

(2) When abnormal symptoms reported from operational tests indicate possible power.

supply troubles.

b. Conditions for. Tests. Short circuit test should be conducted with the power cord disconnected from the ac power source.

c. Procedure. Proceed as follows:

(1) Measure the resistance between pin 2 of tube V6 and ground. If the resistance is less than approximately 150,000 ohms, check capacitors C20, C21, and C22 for shorts. Shorted coupling and decoupling capacitors in the various stages of the equipment will also cause a low resistance reading at this point. Also, check for a shorted rectifier filament winding in the power transformer.

(2) Measure the resistance between pin 8 of tube V7 and ground. If the resistance is less than approximately 62,000 ohms, check capacitor C10 in the SG-71/FCC, the SG-71A/FCC, and the SG-71B/FCC, or C33 in the SG-71C/FCC, potentiometer R53, or components in the plate circuits of the oscillator.

6-6. Test Setup

Connect a 600-ohm, 1-watt, composition resistor to the UNBAL. OUTPUT terminals, and a 600-ohm, 5-watt composition resistor to the BAL. OUTPUT terminals. Connect the signal generator power cord to a 115-volt, 60-cps, ac power source.

6-7. Localizing Troubles

a. General. In the troubleshooting chart (d below), procedures are given for localizing troubles to a stage within the signal generator. Parts locations are shown in figures 6-1 through 6-5. Voltage and resistance measurements are shown in figures 6-6, 6-7, and 6-8.

Depending on the nature of the operational symptom, one or more of the localizing procedures will be necessary. When trouble has been localized to a particular stage, use voltage and resistance measurements to isolate the trouble to a particular part.

b. Use of Chart. When an abnormal symptom has been observed in the equipment, look for a description of this symptom in the Trouble symptom column and perform the corrective measures shown in the Checks and corrective measures column. If no operational symptoms are known, begin with sequence No. 6 in the operator's daily preventive maintenance checks and services chart (para 45) and proceed until a trouble symptom appears.

Caution:

If operational symptoms are not known, or if they indicate the possibility of short circuits within the signal generator, make the short circuit checks described In paragraph 6-5 before applying power to the signal generator.

c. Conditions to Tests. All checks described in the troubleshooting chart are to be conducted with the signal generator connected to a power source as described in paragraph 6-6.

d. Troubleshooting Chart.

Item No.	Trouble System	Probable cause	Checks and corrective measures
1	ON and POWER switches set to ON, but indicator lamp fails to illuminate and no output is observed.	*a.* No power from source .... *b. Defective power cord..........................* *c. Open fuse F1 ....* *d. Defective POWER switch...................* *e. Power transformer primary open.*	*a.* Check power source. *b.* Check cord. *c.* Replace fuse. If replaced fuse blows, check filter capacitors and high voltage rectifier tube V6. *d.* Check switch. *e.* Check continuity; if necessary, replace power transformer.
2	Excessive distortion in oscillator output, or Excessive frequency modulation at high frequencies.	*Defective oscillator tube V1 or V2.*	Replace V1 and V2; recheck distortion and frequency modulation.
3	No output from oscillator tube V2.	*a. Lamp R15 loose in sock.* *b. Defective oscillator tube V2 or V2.* *c.* Poor contact in frequency RANGE switch S1. *d.* Short in main tuning capacitor.	*a.* Tighten lamp *b.* Test V1 and V2 and their tube socket resistances and voltages. *c.* Check switch contacts; clean if necessary. *d.* Inspect plates without bending; clean if necessary.
4	No modulation possible, but carrier power output normal.	*a. Defective mixer tube V3 ....* *b.* Defective MICROPHONE Jack J1. *c.* Defective component in audio filter. *d.* Defective telephone test set.	*a.* Test V3 and its tube socket resistances and voltages. *b.* Check jack. Check C11 through C14, and L1, L2, and L3. Replace any defective component. *d.* Check telephone test set.
5	Dip in MOD. BAL selector switch output over short range of Carrier frequencies when using modulator.	Open audio filter choke L1, L2, or L3.	Test chokes for continuity. Replace any choke not having normal dc resistance.

Item No.	Trouble System	Probable cause	Checks and corrective measures
6	Very high and distorted balanced output.	Open negative feedback loop around balanced amplifier.	Check feedback circuit from pin 5 of V10 through output transformer T2 to ground.
7	Very high and distorted unbalanced output.	Open negative feedback loop around single-ended amplifier.	Check feedback coupling capacitor C16.
8	Excessive distortion in unbalanced output at rate output.	*a.* Faulty power amplifier tubes V12 or V13.	*a.* Check V12 and V13 replacement, and recheck distortion. Check resistances and voltages at tube sockets in balanced amplifier.
		b. Improper bias in power amplifier.	*b.* Check for open R66A, R66B, R66C, or R66.
9	Excessive distortion in unbalanced output at rated output.	Defective tube V4 or V5	Check V4 and V5 by replacement, and recheck distortion. Check tube socket resistances and voltages in unbalanced amplifier.
10	No balanced output. Power supply voltage normal.	Defective V10, V11, T2, C25, or S2.	Check V10, V11, T2, C25, and S2. Replace any defective component. Check tube socket voltages and resistances.
11	No balanced output. Power supply voltage normal.	Defective V4, V5, C15, C17, C19, or S2.	Check V4, V5, C15, C17, C19, and S2. Replace any defective component. Check tube socket voltages and resistance.
12	Spurious high frequency oscillations in balanced output.	*a.* Capacitor C30 or resistor R72 open.	*a.* Check C30 and R72; replace if necessary.
		b. Uncompensated output transformer T2.	*b.* Connect 40 µf capacitor across primary of output transformer T2 or from either side of primary to ground. Use minimum capacity necessary to stop spurious oscillations. If capacity required to stop spurious oscillations causes high frequency distortion; replace transformer.
13	Hum in output with amplitude control set for zero output.	*a.* Open filter capacitor C18, C20, C21, C22, or C33B.	*a.* Check each capacitor by replacing with new equivalent capacitor for comparison, and check with ohmmeter for short.
		b. Shorted choke L4 or L15	*b.* Check dc resistance of chokes; replace if necessary.
14	Hum modulation of output signal and general instability; voltage regulator output not constant during line voltage changes.	Voltage regulator does not regulate.	Check and, if necessary, replace V6, V7, V8, or V9.
15	Bouncing pattern of unbalanced output viewed on oscilloscope.	Defective gaseous regulator tube V9.	Check V9 by a replacement.

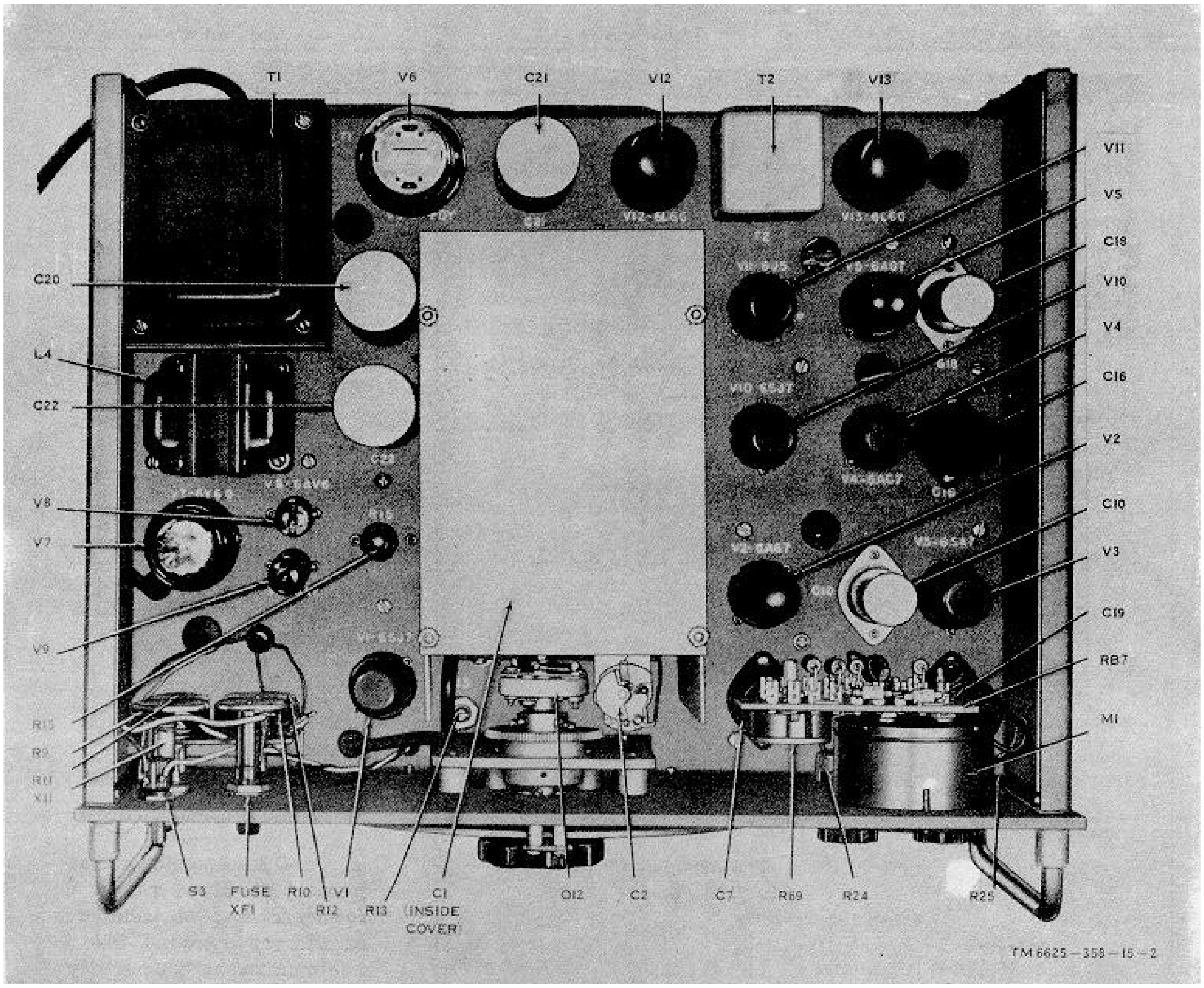


Figure 6-1. Signal Generator SG-71/FCC, SG-71A/FCC, or SG-71B/FCC, top view, cover removed.

6-8. Localizing Cause of Distortion

a. To measure the distortion in the output signal of the signal generator, use Spectrum Analyzer TS-732A/U. If the measured values of distortion significantly differ, check the tubes involved and .then consult the voltage and resistance diagrams (figs. 6-6, 6-7, and 6-8).

b. Localize a source of distortion as follows:

(1) Connect a 600-ohm, 1-watt composition resistor to the unbalanced output terminal, and ground the terminal.

(2) Connect Spectrum Analyzer TS-723A/U to the unbalanced output terminals in parallel with the 600-ohm resistor. Adjust the output voltage from the signal generator to 6 volts.

(3) Measure the distortion in the output signal at frequencies of 50 cycles and 20 kc. The distortion content should be 1 percent or less of rated output.

(4) Connect a 600-ohm, 5-watt, non-inductive resistor across the balanced output terminals.

(5) Connect Spectrum Analyzer TS-723A/U to the balanced output terminals in parallel with the load resistor. Adjust the output voltage to 42.5 volts.

(6) Measure the distortion in the output signal at 5 and 10 kc. The distortion should

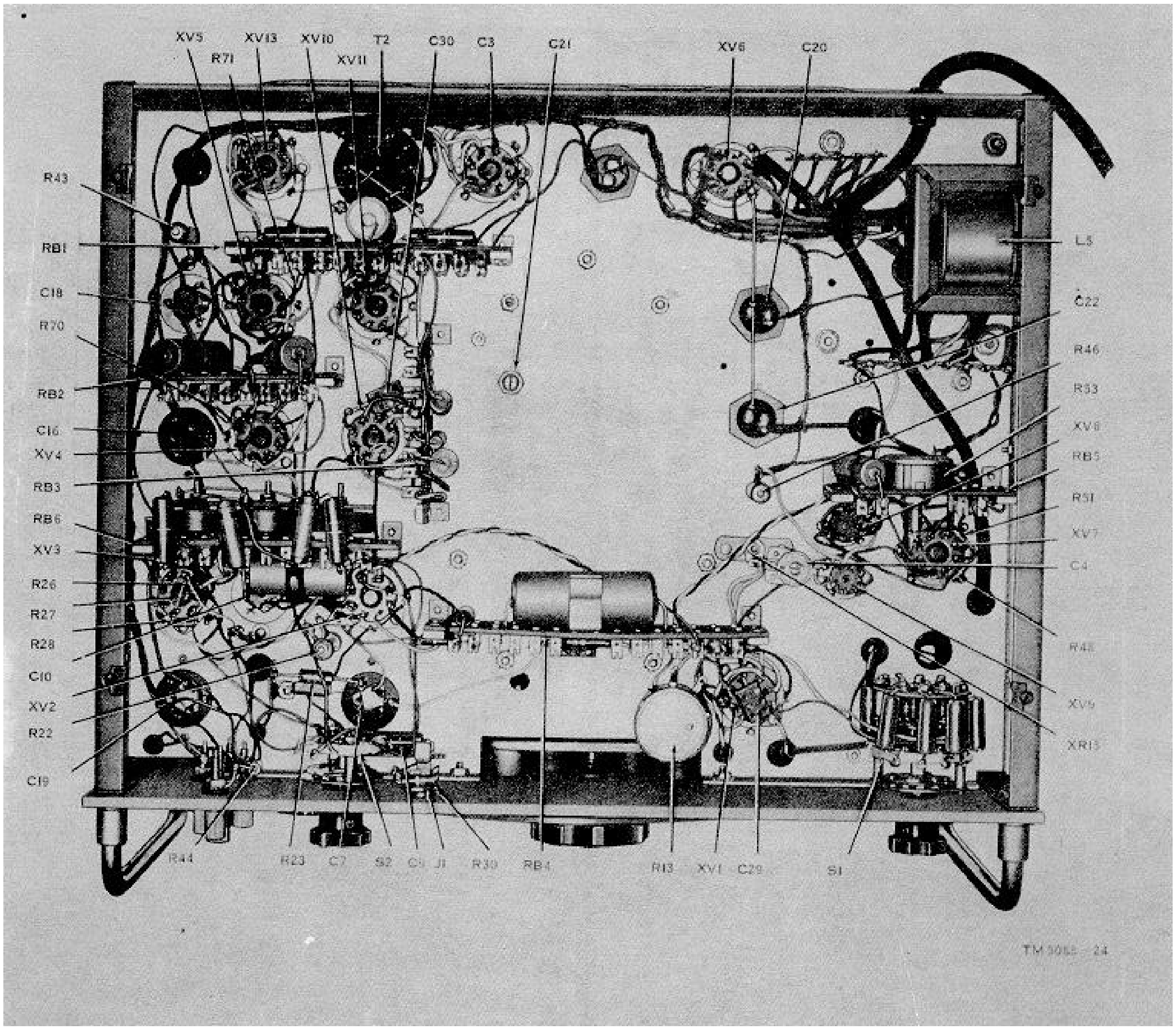


Figure 6-2. Signal Generator SG-71/FCC, SG-71A/FCC, or SG-71B/FCC, bottom view, bottom plate removed.

be 3 percent or less of rated output at 10 kc, and 4 percent at 5 kc.

c. Excessive distortion in only one of the outputs indicates *that the amplifier only* is the source of trouble. Excessive and nearly equal distortion in both amplifiers indicates that the oscillator is the source of trouble. The signal from the oscillator may be directly checked at the output of capacitor C7. To prevent excessive loading of the oscillator circuit, this point must not be shunted with a resistor less than 100,000 ohms. The distortion value measured at the output of the oscillator should be 50 decibels or more below the signal level from the oscillator (approximately 22 volts). Distortion noticeable only in the balanced output is often due to weak or unbalanced power amplifier tubes V12 and V13. Reversing these tubes will sometimes aid in obtaining the lowest distortion.

6-9. Isolating Trouble Within a Stage

When trouble has been localized to a stage, use the techniques given below to isolate the defective part.

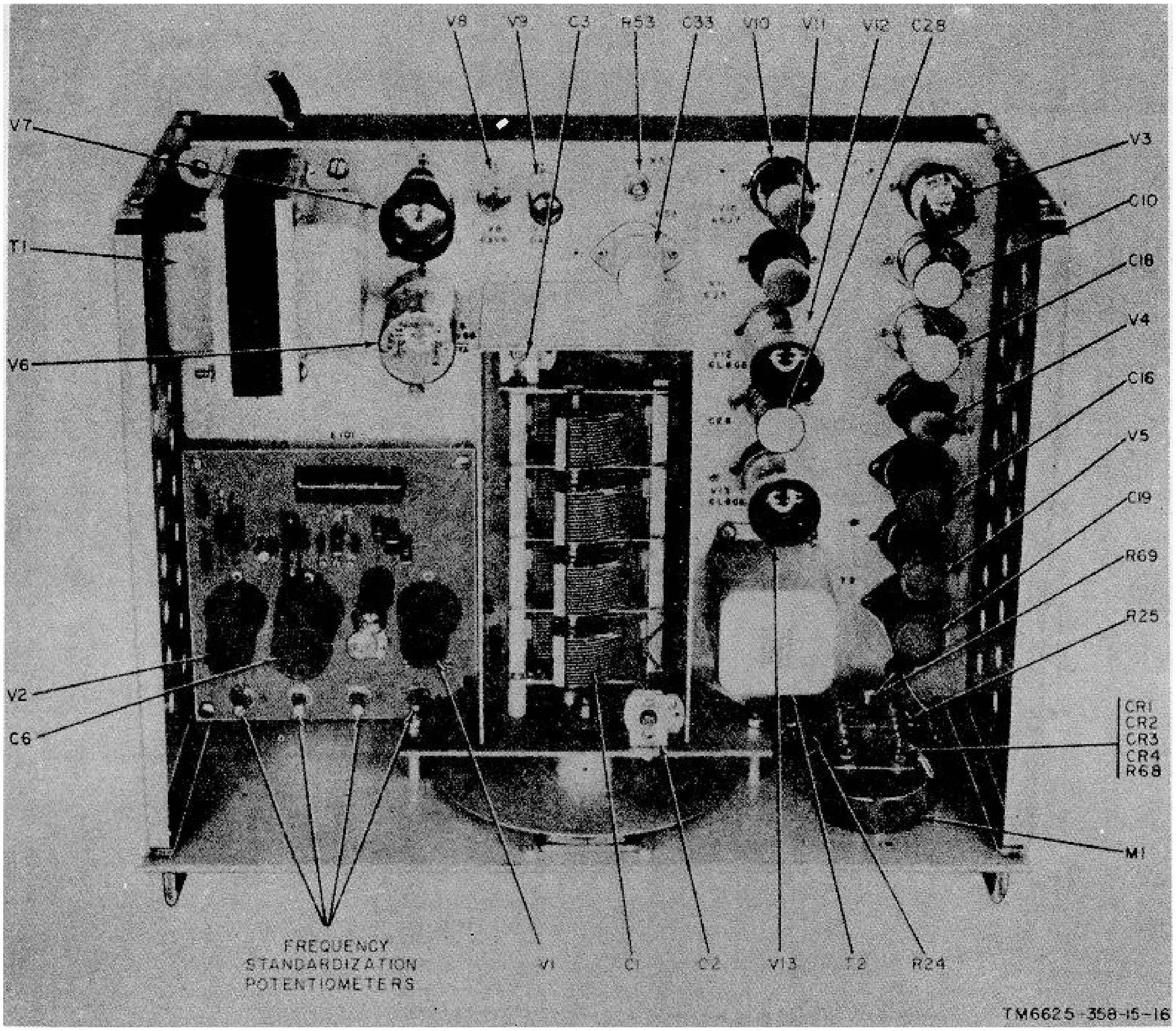


Figure 6-3. Signal Generator SG-71C/FCC, top view, cover removed.

a. Test the tube involved, either in Test Set, Electron Tube TV-7(*)/U, or by substituting a similar type of tube which is known to be good.

b. Take voltage measurements at the tube sockets (figs. 6-6 and 6-8) and other points related to the stage in question (fig. 6-7).

c. If voltage readings are abnormal, take resistance readings (figs. 6-6, 6-7, and 6-8). Refer also to the dc resistances of transformers and coils given in paragraph 6-10.

d. Use the schematic and wiring diagrams (figs. 10-3, 10-4, and 10-5) to trace circuits and to isolate the faulty part.

6-10. Dc Resistances of Transformers and Coils

a. The dc resistance data (b below) is provided as an aid in troubleshooting. When using the data, observe the following:

(1) Before making resistance measurements of the windings, determine that faulty operation is very likely due to a faulty transformer or coil; follow the troubleshooting procedures (paras 6-5, 6-6, and 6-7) and make voltage and resistance checks (para 6-9).

(2) Do not use resistance measurements as the sole basis for discarding a transformer

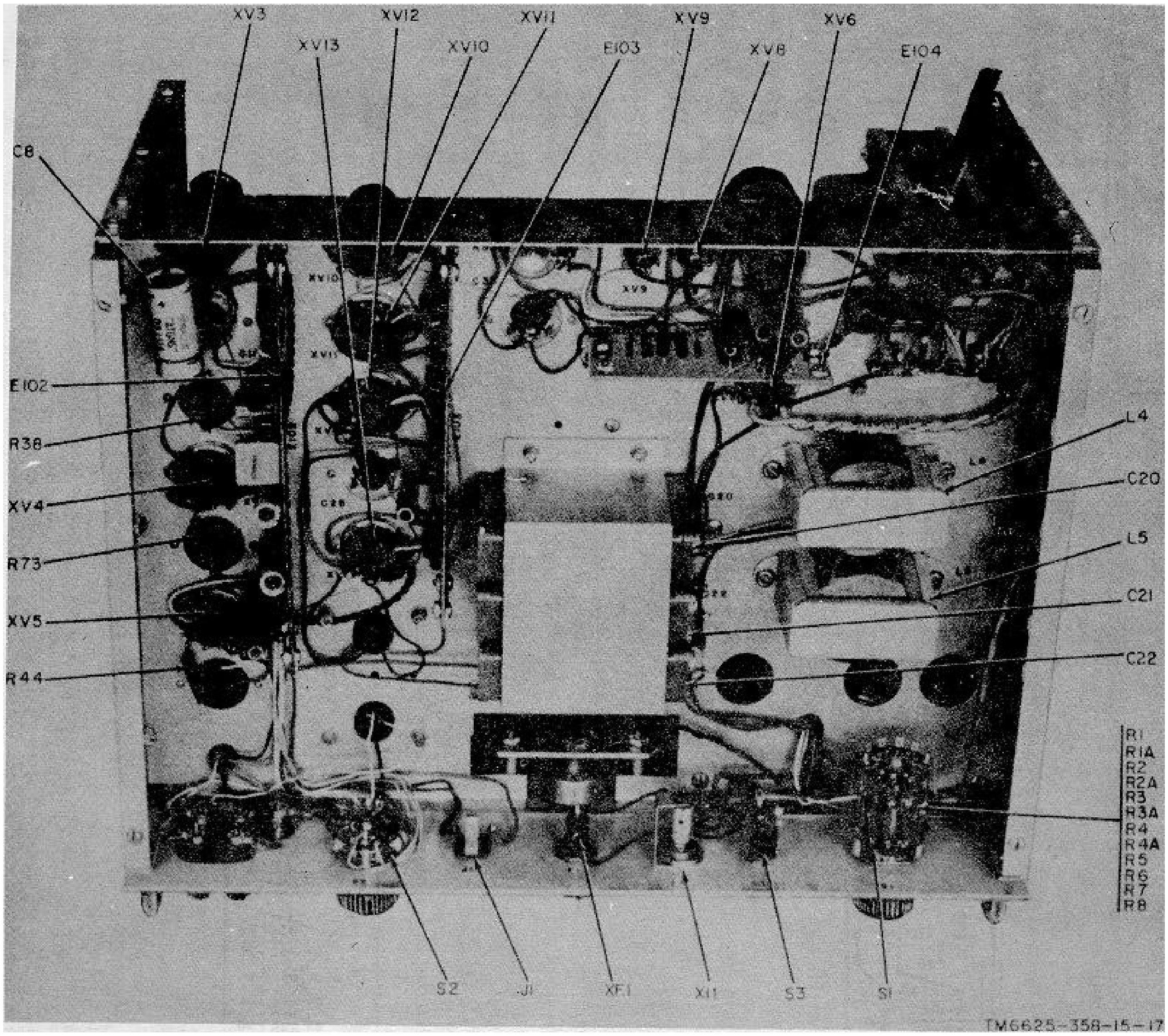


Figure 6-4. Signal Generator SG-71C/FCC, bottom view, bottom cover removed.

or coil as defective. Due to rather broad winding tolerances during manufacture, resistances may vary from one transformer or coil to another; the chart values are typical average values.

(3) The normal resistance of replacement transformers and coils may differ greatly from the values given in the chart.

b. The dc resistances of the transformer windings and the coils in the signal generator are listed below:

(1) The dc resistance of the primary windings of transformer T1, connected for 115-volt operation, .is approximately 1 ohm.

(2) The dc resistance of the high-voltage secondary windings of transformer T1 is approximately 60 ohms each side of the center tap.

(3) The dc resistance of the filament windings of transformer T1 is less than 1 ohm for each winding.

(4) The dc resistance of inductors L4A and L5 is approximately 100 ohms.

(5) The dc resistance of the primary winding of transformer T2 is approximately 5 ohms each side of the center tap.

(6) The dc resistance of the feedback winding of transformer T2 is less than 1 ohm.

(7) The dc resistance of the secondary output winding of transformer T2 is 6 ohms each side of the center tap.

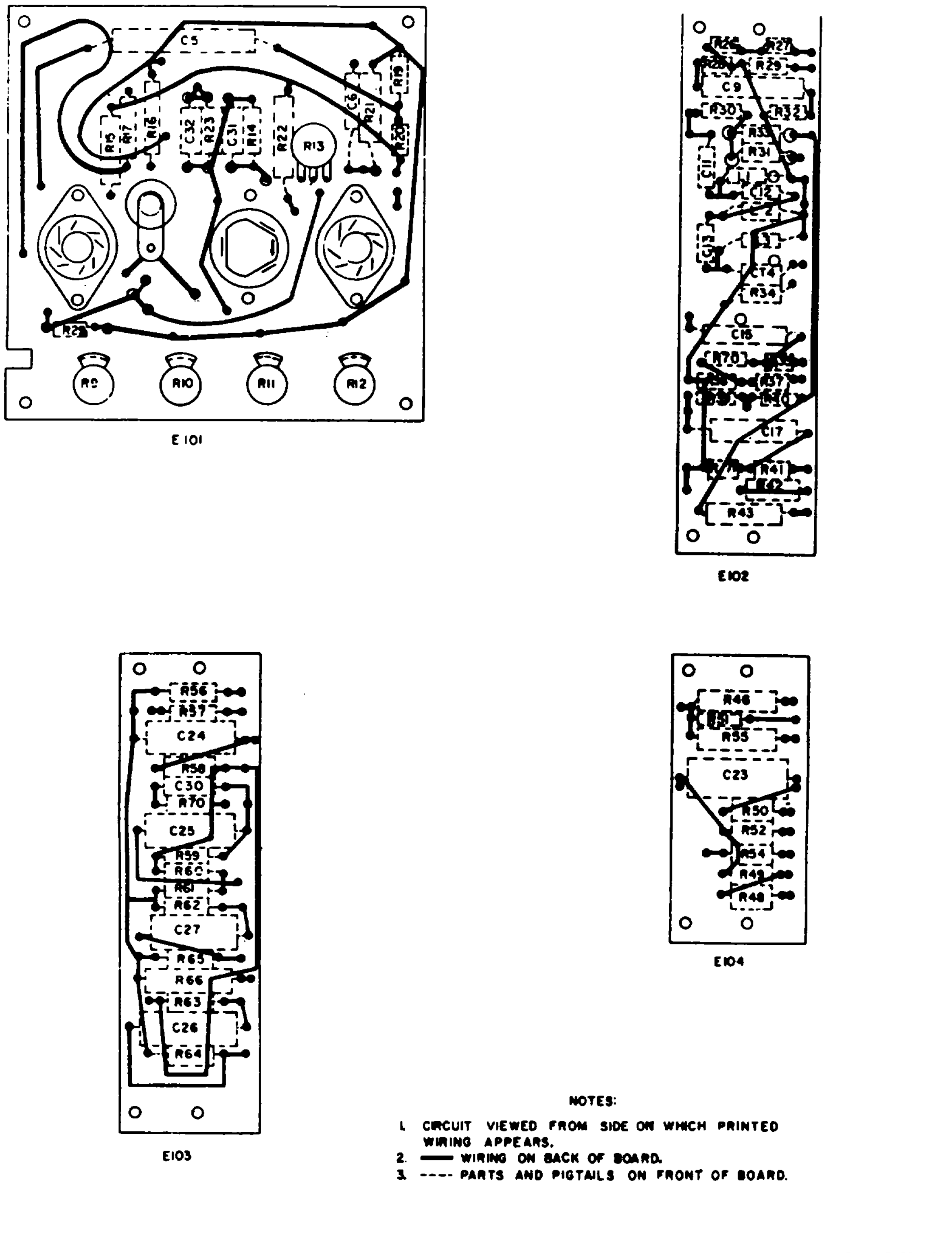
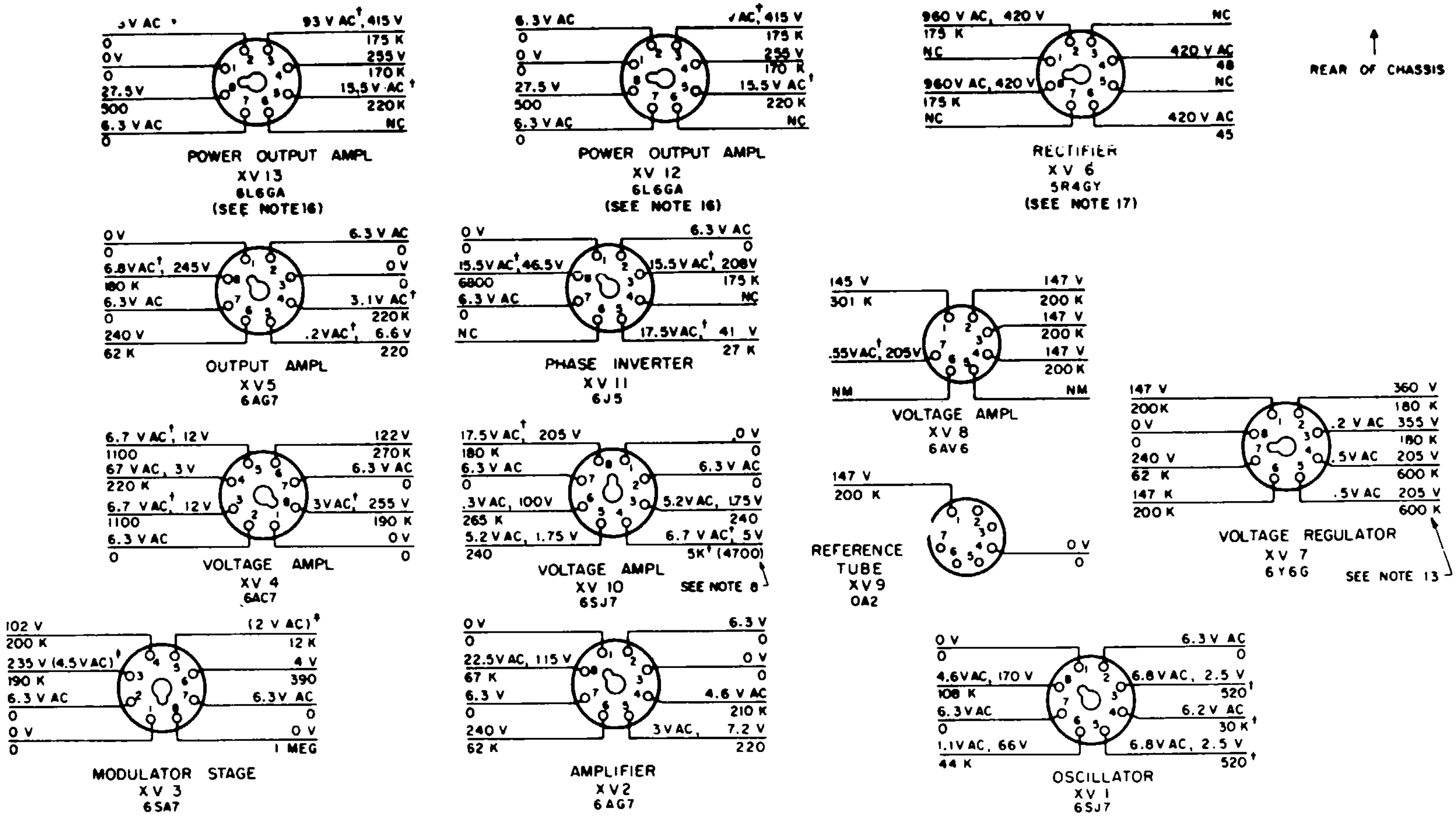


Figure 6-5. Signal Generator SG-71C/FCC, printed circuit boards.



NOTES

1. 115 V AC, 60 CYCLE INPUT.
2. FREQUENCY DIAL SET TO 10 KC.
3. AMPLITUDE SET FOR MAXIMUM INTO 600 OHM LOAD.
4. S2 IN [BAL] POSITION FOR ALL MEASUREMENTS EXCEPT AS INDICATED (*) OR (‡).
5. (*) INDICATES S2 IN [UNBAL] POSITION WHEN MEASURED.
6. (‡) INDICATES S2 IN [MOD BAL] POSITION WHEN MEASURED.
7. (†) INDICATES MEASUREMENTS MAY VARY FROM VALUE SHOWN DUE TO VARIATION IN CONTROL SETTINGS AND/OR TUBE CHARACTERISTICS.
8. RESISTANCE MEASURES 5000 OHMS ON [MOD BAL][BAL][UNBAL] SWITCH IN [MOD BAL] POSITION, AND 4700 OHMS IN [BAL] POSITION
9. RESISTANCES IN OHMS UNLESS OTHERWISE SPECIFIED K = 1000 MEG = 1,000,000.
10. ALL RESISTANCES AND DC VOLTAGES MEASURED TO GROUND WITH TS-352/U MULTIMETER.
11. ALL AC VOLTAGES MEASURED TO GROUND WITH ME-6U AC MULTIMETER
12. VOLTAGE READINGS ABOVE LINE. RESISTANCE READINGS BELOW.
13. TIE POINT ONLY. NO CONNECTION TO TUBE ELEMENTS.
14. NC INDICATES NO CONNECTION.
15. NM INDICATES NO MEASUREMENT.
16. IN SIGNAL GENERATOR SG-71A/FCC, POWER OUTPUT AMPL XV12 AND XV13 ARE 6L6
17. IN SIGNAL GENERATOR SG-71B/FCC, ELECTRON TUBE TYPE 5U4B IS USED INSTEAD OF 5R4GY.

TM6625-358-15-19

Figure 6-6. Signal Generators SG-71/FCC, SC-71A/FCC, and SG-71B/FCC, tube socket voltage and resistance diagram.

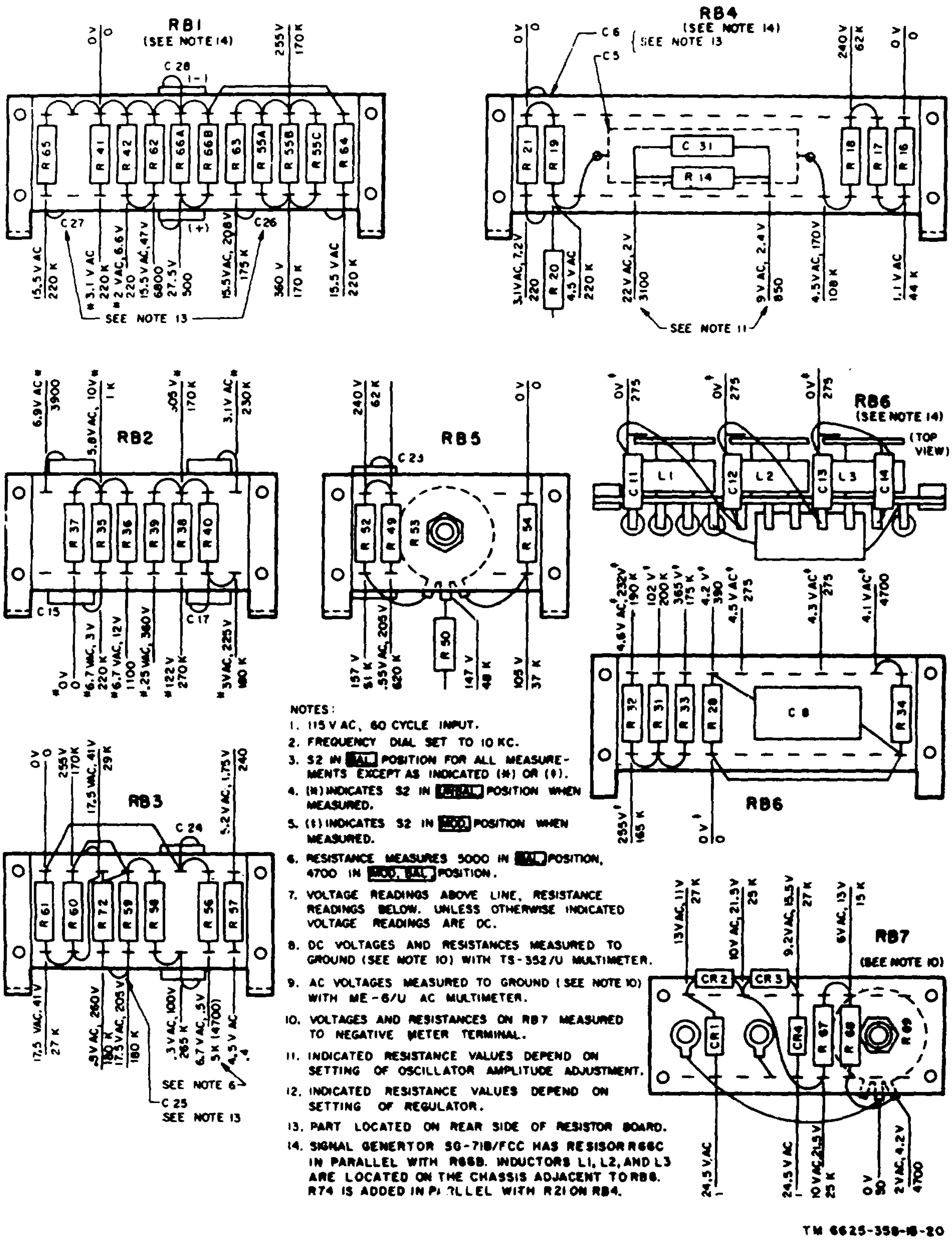


Figure 6-7. Signal Generators SG-71/FCC, SG-71A/FCC, and SG-71B/FCC, terminal-board voltage and resistance diagram.

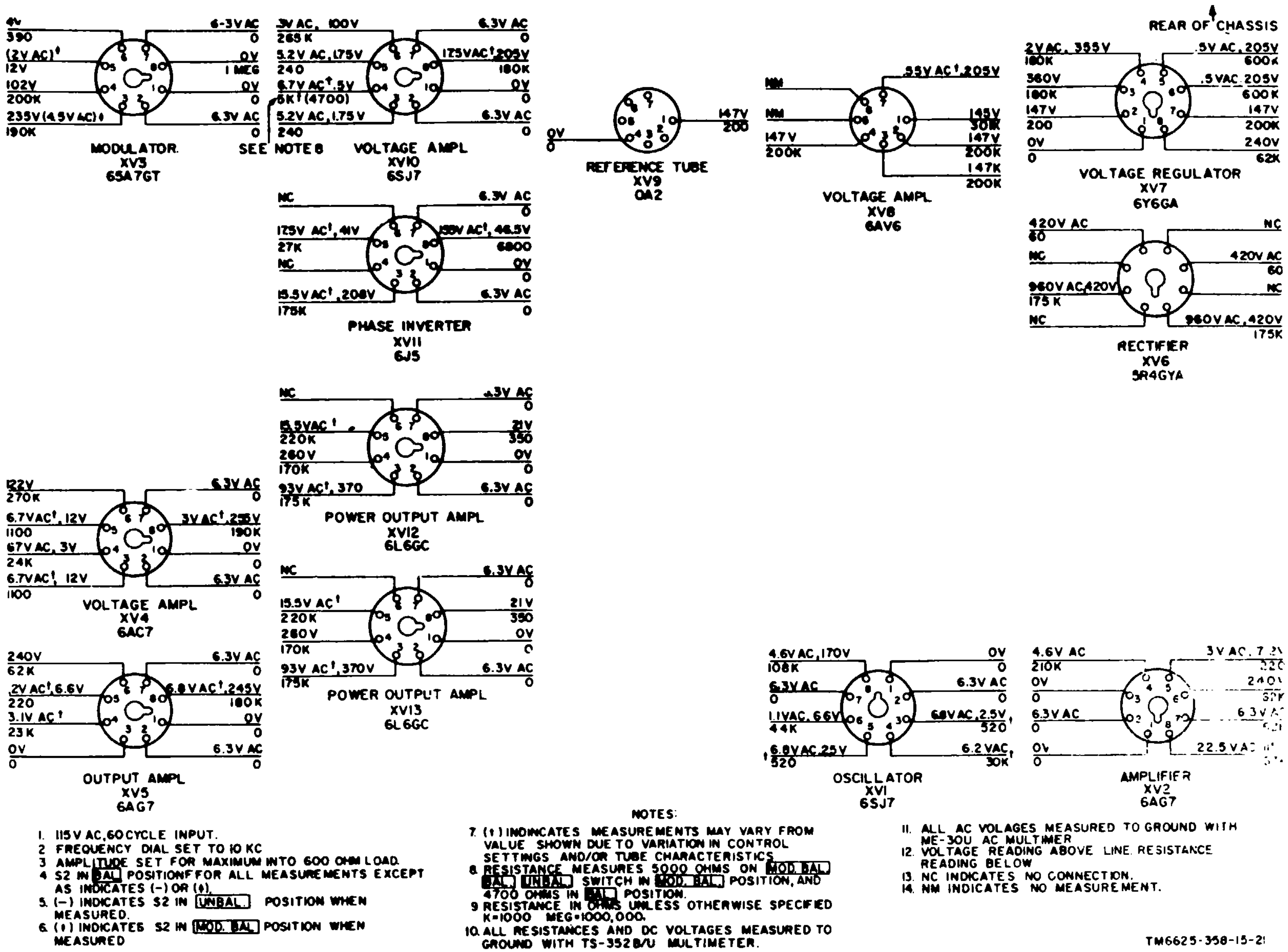


Figure 6-8. Signal Generator SG-71C/FCC, tube socket voltage and resistance diagram.

CHAPTER 7

REPAIRS AND ALIGNMENT

Section I. REPAIRS

7-1. General Parts Replacement Techniques

Careless replacement of parts often creates new faults. When replacing parts in Signal Generator SG-71(*)/FCC, follow the precautions given below.

a. Do not disturb the settings of potentiometers R9, R10, R11, R12, R53, and R69 and capacitors C2, C3, and C4.

b. Before a part is unsoldered, note the position of the leads. If the part to be replaced has a number of connections, such as a transformer, tag each of the leads.

c. Be careful not to damage other leads by pulling or pushing them out of the way.

d. Do not allow drops of solder to fall into the equipment; they may cause short circuits.

e. Make well-soldered joints; a carelessly soldered joint may create a new fault, and a poorly soldered joint is one of the most difficult faults to find.

f. When a part is replaced, it must be positioned exactly as the original part. A defective part may be replaced with one which has the same electrical value but a different physical size, if space permits. Pay particular attention to proper grounding when replacing a part.. Use the same ground as in the original wiring. Failure to observe these precautions may result in unwanted oscillations or instability.

7-2. Replacement of Parts In Signal Generator SG-71(*)/FCC

a. Most of the parts in Signal Generator SG71(*)/FCC can be easily reached and replaced; however, in all cases involving multiple connections, tage each wire as it is removed so that it may be replaced correctly.

b. In replacing parts having factory-selected values, use replacement parts which have a value equal to the part removed. The selection is originally made by slightly varying the value of the part until the desired operation is obtained. Factory-selected parts are indicated on the schematic diagrams (figs. 10-3 and 10-5).

c. If lamp R15 is replaced, the output level of the oscillator section must be readjusted. To adjust this output level, set the signal generator controls for an output frequency of 10 kc. Connect Voltmeter, Electronic ME-30(*)/U between the junction of capacitor C7 and restore R28, and ground. Adjust potentiometer RI3 for a 22-volt meter indication. If the output amplitude is unstable, or 22 volts cannot be obtained, select another lamp and repeat the adjustment.

d. If tube V7, V8, or V9 is replaced, check the dc voltage between pin 8 of tube V7 and ground with Multimeter TS-352B/U. If necessary, adjust potentiometer R53 for a 240-volt indication.

e. After replacement of tubes V1 and V2, check the frequency calibration of the tuning or FREQUENCY dial (para 7-5b) and check the distortion from the unbalanced output (para 6-7).

Section II. ALIGNMENT

7-3. General

The alignment of Signal Generator SG-71(*)/ FCC is not required during normal operation. The adjustments on or behind the front panel are for convenient frequency standardization when greater calibration accuracy is desired; however, oscillator tube replacement, repairs, or mechanical shock may result in the shift of the frequency determining elements in the oscillator and inaccuracy of dial calibrations. Five different instances which necessitate the alignment of the main tuning or FREQUENCY dial are listed in *a* through *e* below. Refer to paragraph 7-4 for a list of the equipment required for alignment.

a. Normal frequency standardization, accomplished at or behind the front panel.

b. Alignment following replacement of tube VI or V2, or frequency RANGE switch S1.

c. Alignment following replacement or movement of either (but not both) capacitor C2 or C3.

d. Complete alignment and output level flattening for use when adjustment at front panel is not sufficient.

e. Alignment following replacement of main tuning capacitor C1.

Note:

Complete alignment (*d* and *e* above) should be performed only by trained technicians.

7-4. Test Equipment Required

The chart below lists test equipment required for aligning Signal Generator SG-71(*)/FCC, the associated technical manuals, and the common names.

Test equipment	Technical manual	Common name
Frequency Meter AN/TSM-16	TM 11-6625-218-12	Frequency meter
Voltmeter, Electronic ME-30(*)/U	TM 11-6625-320-12	Voltmeter

[a] Voltmeter, Electronic ME-30(*)/U represents Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.

7-5. Alignment Procedures

a. Frequency Standardization (figs. 3-1 and 6-3). Frequency standardization listed in paragraph 7-3a is for standardizing the tuning dial calibration of each of the four ranges to obtain highest accuracy. This standardization can be performed at any time to insure the highest frequency calibration accuracy for the equipment. Any one point on the tuning dial can be placed exactly on the frequency meter. Adjustment may be made for best overall calibration. Study all of the procedures below before attempting any operation. Do not adjust any control until it becomes part of one of the procedures.

(1) Connect the power cord of the signal generator to the power source and allow the signal generator to warm up for at least 20 minutes.

(2) Set the RANGE switch to X10.

(3) Set the MOD. BAL.-BAL.-UNBAL. switch to UNBAL.

(4) Connect the UNBAL. OUTPUT terminals to a frequency meter.

(5) Set the tuning or FREQUENCY-dial to exactly 50. Adjust potentiometer R10 for a reading of 500 cycles on the frequency meter.

(6) Set the tuning or FREQUENCY dial in the vicinity of 500 for a reading of 5,000 cycles on the frequency meter.

(7) When an indication of 5,000 cps is obtained, the tuning or FREQUENCY dial should read within 1 percent of 500 (between 495 and 505). If it does not, readjust R10 until the 6,000 cps falls halfway between its present point and 500 on the tuning or FREQUENCY dial.

(8) Check all even-numbered calibration point across the dial

(9) If necessary, readjust R10 for best overall accuracy.

(10) Repeat the steps given in (5) through (8) above in aligning each of the other ranges. For the X1, X100, and X1000 ranges, adjust R9, R11, and R12, respectively. If the range of adjustment for one or more of the frequency ranges is not sufficient to being the tuning or FREQUENCY dial calibration *on frequency*, replace the entire RANGE switch S1 assembly. Following replacement of RANGE switch S1, repeat the calibration procedures given in (1) through (9) above. No further adjustment should be necessary.

b. Alignment Following Replacement of Tube V1 or V2. When tube V1 or V2 is replaced, the calibration accuracy in the vicinity of 300 to 500 kc may be slightly reduced. To correct this variation in tracking at the high frequency end of the X1000 range, adjustable capacitor C4 is provided as an additional adjustment. Proceed as follows:

(1) Follow the alignment procedure given in a above for all ranges but the X1000 range.

(2) Set the RANGE switch to X1000.

(3) Set the tuning or FREQUENCY dial to 50.

(4) Adjust R12 until a frequency of 60,000 cps it obtained, as determined by the reading on the frequency meter.

(5) Set the tuning or FREQUENCY dial to 500.

(6) Adjust C4 (figs. 6-2 or 6-5) until a frequency of 600,000 cps is obtained.

(7) Check even-numbered calibration' points across the tuning or FREQUENCY dial.

(8) If necessary, readjust R12 (fig. 6-1) and C4 (fig. 6-2) for best overall calibration.

c. Alignment and Output Level Reflattening Following Replacement of Capacitor C2 or C3. If capacitor C2 or C3 has been replaced or shifted in position, the tuning or FREQUENCY dial calibration will be inaccurate on all ranges, particularly or the high frequency end of the band. Also, a continuous rise or fall in output voltage will be observed when tuning across the band. All ranges will act similarly in this respect. Adjustment of either C2 or C3 affects both frequency calibration and flatness of frequency response over each range; however, adjustment is necessary on the X100 range only. TM 11-6625-358-15 The remaining ranges will automatically be correct when the X100 range is in adjustment. The procedures given in (1) through (10) below are used when the position of only one of these capacitors (C2 and C3) has been altered. If the positions of both capacitors have been disturbed, the process described in d below must be used. In addition to Frequency Meter AN/TSM-16, the procedures given in (1) through (10) below also require an electronic voltmeter such as Voltmeter, Electronic ME-30(*)/U and an aligning tool for adjustment of C2.

(1) Connect a 600-ohm, 1-watt, carbon resistor across the UNBAL. OUTPUT terminals.

(2) Connect the voltmeter and the frequency meter to the UNBAL. OUTPUT terminals.

(3) Set the MOD. BAL.-BAL.-UNBAL. switch to UNBAL.

(4) Set the RANGE switch to X100.

(5) Set the main tuning or FREQUENCY dial to 50.

(6) Set the AMPLITUDE FINE-COARSE controls to obtain a reading of exactly 5 volts on the external ac voltmeter.

(7) Set the main tuning or FREQUENCY dial to 500. Note the output voltage and frequency.

(8) Adjust the capacitor which has been altered to bring the output signal voltage to 5 volts. Note the frequency; If only one capacitor is out of adjustment, the output frequency should be 50,000 cps, and the output voltage 5 volts. If not, both capacitors C2 and CS are out of adjustment and further alignment (d below) is necessary.

(9) If, in (8) above, the frequency was close to 50,000 cps, set the tuning or FREQUENCY dial to 50. If necessary, adjust R11 to obtain exactly 5,000 cps and reset the amplitude control to obtain exactly 5 volts.

(10) Set the tuning or FREQUENCY dial to 500 and repeat the procedures given in (8) above.

d. Complete Alignment and Output Level Flattening. This procedure is used when the frequency dial calibration and frequency response of the signal generator are completely out of adjustment, and cannot be brought into adjustment by one of the first three alignment procedures.

(1) Connect a 600-ohm, 1-watt, carbon resistor across the UNBAL. output terminals.

(2) Connect the voltmeter and the frequency meter to the UNBAL. OUTPUT terminals.

(3) Set the MOD. BAL.-BAL.-UNBAL. switch to UNBAL.

(4) Set the RANGE switch to X100.

(5) Set capacitors C2 and C3 so that their plates are meshed approximately halfway. At certain setting combinations of these two capacitors, the equipment may go out of oscillation. This action is normal when the balance of C2 and C3 is sufficiently upset. To regain oscillation, simply adjust one or both capacitors until oscillation is regained.

(6) With the tuning or FREQUENCY dial set to 50, adjust the output voltage to exactly 5 volts, as indicated on the voltmeter. This action establishes a reference point.

(7) Set the tuning or FREQUENCY dial to 500. Adjust capacitor C2 to obtain 50,000 cps regardless of output voltage. At this frequency, note the value of the output voltage.

(8) Regardless of the change in frequency, readjust capacitor C2 to obtain an output voltage that is halfway between the present voltage and 5 volts. This action will shift the output frequency. The instructions given in (9) below will bring the output frequency back to 50,000 cps.

(9) Adjust capacitor C8 until an output frequency of 50,000 cycles is obtained. The output voltage should simultaneously move closer to the desired 5 volts.

(10) Set the tuning or FREQUENCY dial to 50. If necessary, adjust potentiometer R10 to obtain a frequency of 5,000 cps and readjust the output AMPLITUDE FINE-COARSE controls to give exactly 5 volts.

(11) Repeat the steps given in (6), (7), and (8) above to simultaneously obtain a 5-volt output and 50,000 cps ±1 percent. Several repetitions of these steps may be required. This procedure establishes the correct operation conditions of all ranges; however, if' the other ranges are off calibration, adjust the individual 7-4 range adjusting potentiometers and capacitor C4 for high frequency tracking (*b* above).

e. Alignment Following Replacement of Capacitor C1. Following the replacement of, or damage to, main tuning capacitor C1, the dial calibration may be found to be inaccurate, and, the frequency response may no longer be fµ over each range. This procedure is used to adjust the tracking of the new tuning capacitor to the original frequency dial. The overall tracking of a replacement capacitor will closely follow the dial calibration; however, the new capacitor must be properly positioned. When replacing main tuning capacitor C1, capacitor C2 must be removed from the frame and installed on the new tuning capacitor. If possible, do this without disturbing the setting of C2. If the setting of C2 must be disturbed before removal, lightly draw a line on the rear stator plate at the present position of the rotor plate, so that after reassembly the setting may be returned to its original position.

(1) Following installation of a new tuning capacitor (C1), connect the voltmeter and the frequency meter to the UNBAL. OUTPUT terminals.

(2) Set the MOD. BAL.-BAL.-UNBAL. switch to UNBAL.

(8) Set the tuning or FREQUENCY dial to 50.

(4) Set the RANGE selector switch to X100.

(5) Set the AMPLITUDE FINE-COARSE controls to obtain exactly 5 volts on the voltmeter.

(6) Loosen the setscrews in one side of flexible coupler 0 12 (fig. 6-1). Set tuning capacitor C1 to obtain exactly 5,000 cps with the tuning capacitor cover installed. The cover will affect frequency calibration, and must be in place for correct positioning of the tuning capacitor.

Note.

In Signal Generator SG-71C/FCC, loosen the setscrew in the spur gear that drives tuning capacitor C1 instead of flexible coupler 0.12.

(7) Tighten the previously loosened setscrews in flexible coupler 0.12, while maintaining the angular relation between the tunin capacitor shaft and the tuning or FREQUENCY dial. This relation must be maintained as accurately as possible.

(8) Set the tuning or FREQUENCY dial to 500. Note the output frequency and voltage.

If the output frequency and voltage are not 50,000 cps and 5 volts, respectively, proceed as instructed in d above to flatten the frequency response and frequency calibration.

(9) Following alignment (d above) check all numbered calibrations across the tuning dial with the RANGE selector switch set to X100.

If the center portion of the tuning or FREQUENCY dial is found to be inaccurate, reset the tuning capacitor.

(10) Slightly readjust the angular relation of the tuning capacitor ((7) above) to bring the dial calibration within the frequency ranges.

(11) With the tuning or FREQUENCY dial set to 500, adjust C2 to obtain 50,000 cps regardless of the output voltage. At this frequency, note the value of the output voltage.

(12) Regardless of change in frequency, readjust C2 to obtain an output voltage that is halfway between the present voltage and 5 volts. This action will shift the output frequency. Step (18) below will bring the output frequency back to 50,000 cps.

(13) Adjust capacitor C3 until an output frequency of 50,000 cycles is obtained. The out TM 116625-358-15 put voltage should simultaneously move closer to the desired 5 volts.

(14) Repeat procedures given in (11), (12), and (13) above as necessary to obtain 50,000 cps at a voltmeter indication of 5 volts.

(15) Check the 500, the 400, and the 300 points on the tuning or FREQUENCY dial for accuracy, which should be within 1 percent.

(16) Check the 200, the 100, and the 50 points on the tuning or FREQUENCY dial for the same accuracy. To correct calibration between 200 and 50, start at 200 and work down to 50.

7-6. Standardization of Output Level Meter

Connect Voltmeter, Electronic ME-30(*)/U across the balanced output terminals. Adjust the output level of the signal generator to obtain 40 volts on the multimeter. Adjust potentiometer R69 in the signal generator until the readings on the self-contained output level meter and the multimeter agree. Check meter calibration at other points on the scale and readjust potentiometer R53 for best overall accuracy.

CHAPTER 8

GENERAL SUPPORT TESTING PROCEDURES

8-1. General

a. Testing procedures are prepared for use by electronics field maintenance shops and service organizations responsible for general support maintenance to determine the acceptability of repaired electronic equipment. These procedures set forth specific requirements that repaired equipment *must* meet before it is returned to the using organization. The testing procedures may also be used as a guide for testing equipment that has been repaired at direct support maintenance if the proper tools and test equipments are available.

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

8-2. Test Equipment Required

All the test equipment required to perform the testing procedures given in this chapter are listed in the chart given in a below.

a. Test Equipment. Use the following equipment, or suitable equivalents.

Nomenclature	Technical manual
Multimeter TS-352B/U	TM 11-6625-366-15
Frequency Meter AN/ TSM-16	TM 11-6625-218-12
Voltmeter, Electronic ME30(*)/U*	TM 11-6625-320-12
Spectrum Analyzer TS 723A/U	TM 11-5097
Telephone Set TA-212/PT	TM 11-5805-201-12
Oscilloscope AN/USM-281A	TM 11-6625-1703-15

*Voltmeter, Electronic ME-30(*)/U represents Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME30B/U, ME-3C/U, and ME-30E/U.

b. Materials. The only materials required are two noninductive 600-ohm resistors: one 5 watts, and the other 1 watt.

8-3. Modification Work Orders

The performance standards listed in the tests (paras 8-5 through 8-9) are based on the assumption that all modifications have been performed. A listing of current modification work orders will be found in DA Pam 310-7.

8-4. Physical Tests and Inspection

a. Test Equipment and Materials. None required.

b. Test Connections and Conditions.

(1) No connections necessary.

(2) Remove the signal generator from its case.

c. Procedure.

Step No.	Control Settings: Test equipment	Control Settings: Equipment under test	Test procedure	Performance standard
1	None	Controls may be in any position.	*a*. Inspect case and chassis for damage, missing parts, and condition of paint. *Note*. Touchup painting is recommended in lieu of refinishing whenever practical; screwheads, binding posts, receptacles, and other plated parts should not be painted or polished with abrasives.	*a*. No damage evident or parts missing. External surfaces intended to be painted will not show bare metal. Panel lettering will be legible.
			b. Inspect all controls and mechanical assemblies for loose or missing screws, bolts, and nuts.	*b*. Screws, bolts, and nuts will be tight. None missing.
			c. Inspect all connectors sockets, fuseholders, and meter for looseness, damage, or missing parts.	*c*. No looseness or damage evident. No missing parts
2	None	Controls may be in any position.	*a*. Rotate all panel controls throughout their limits of travel.	*a*. Controls will rotate freely without binding or excessive looseness.
			b. Operate all switches	*b*. Switches will operate properly.

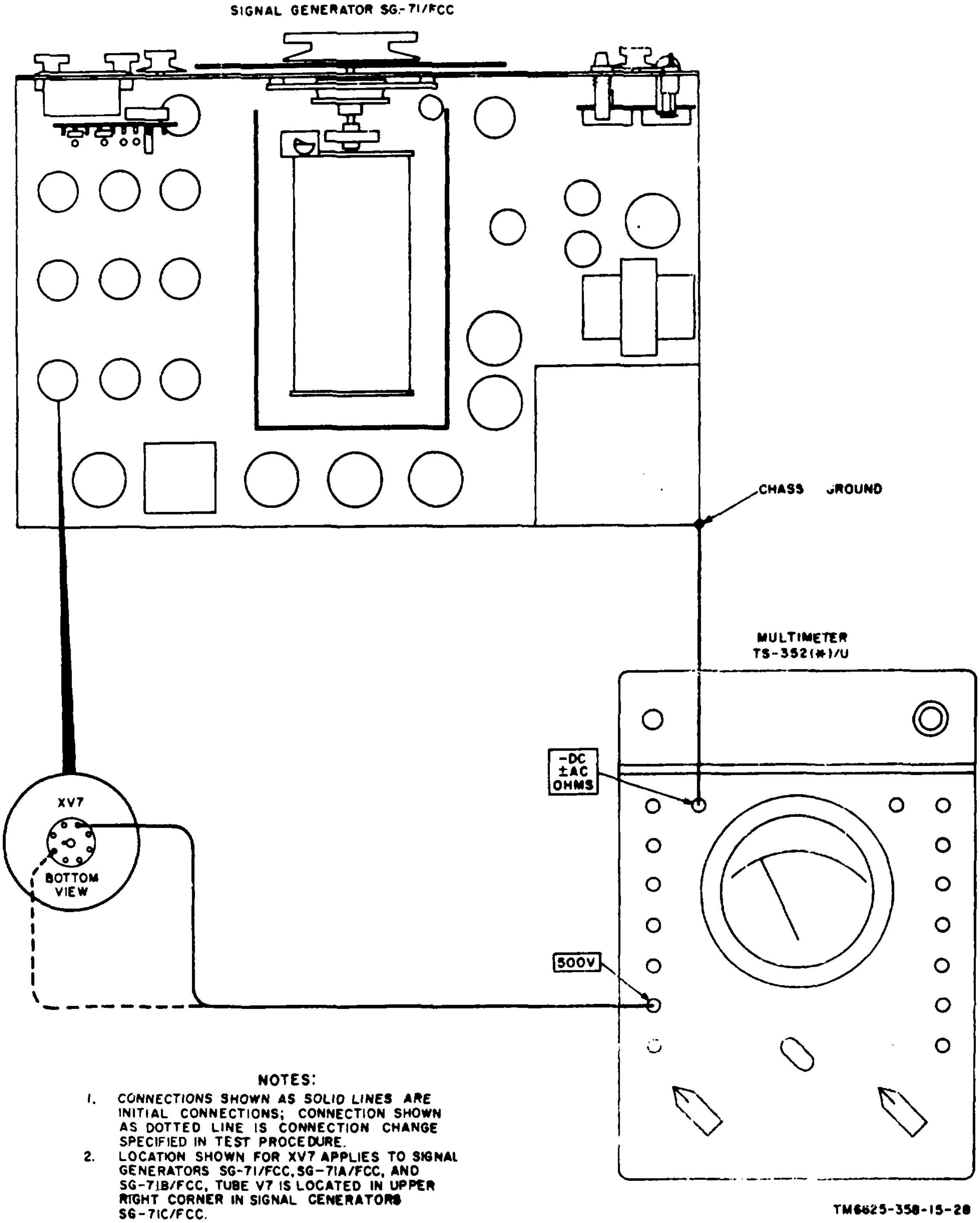


Figure 8-1. Dc power supply voltage, test setup.

8-5. Dc Power Supply Voltage Test

a. *Test Equipment and materials*. Multimeter TS-352B/U.

b. *Test Connections and conditions*.

(1) Connect the equipment as shown in figure 8-1.

(2) Allow the equipment to warm up at least 20 minutes before the test procedure is started.

c. *Procedure*.

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	TS-352B/U: FUNCTION: DIRECT	ON and POWER switches: ON	*a.* Remove bottom plate of signal generator. *b.* Measure dc voltage between Pin 8 of V7 and chassis ground.	*a.* None. *b.* +355 ±10 volts dc.
2	Same as step 1	Same as step 1	Measure dc voltage between pin 8 of V7 and chassis ground.	+240 ± 10 volts dc.

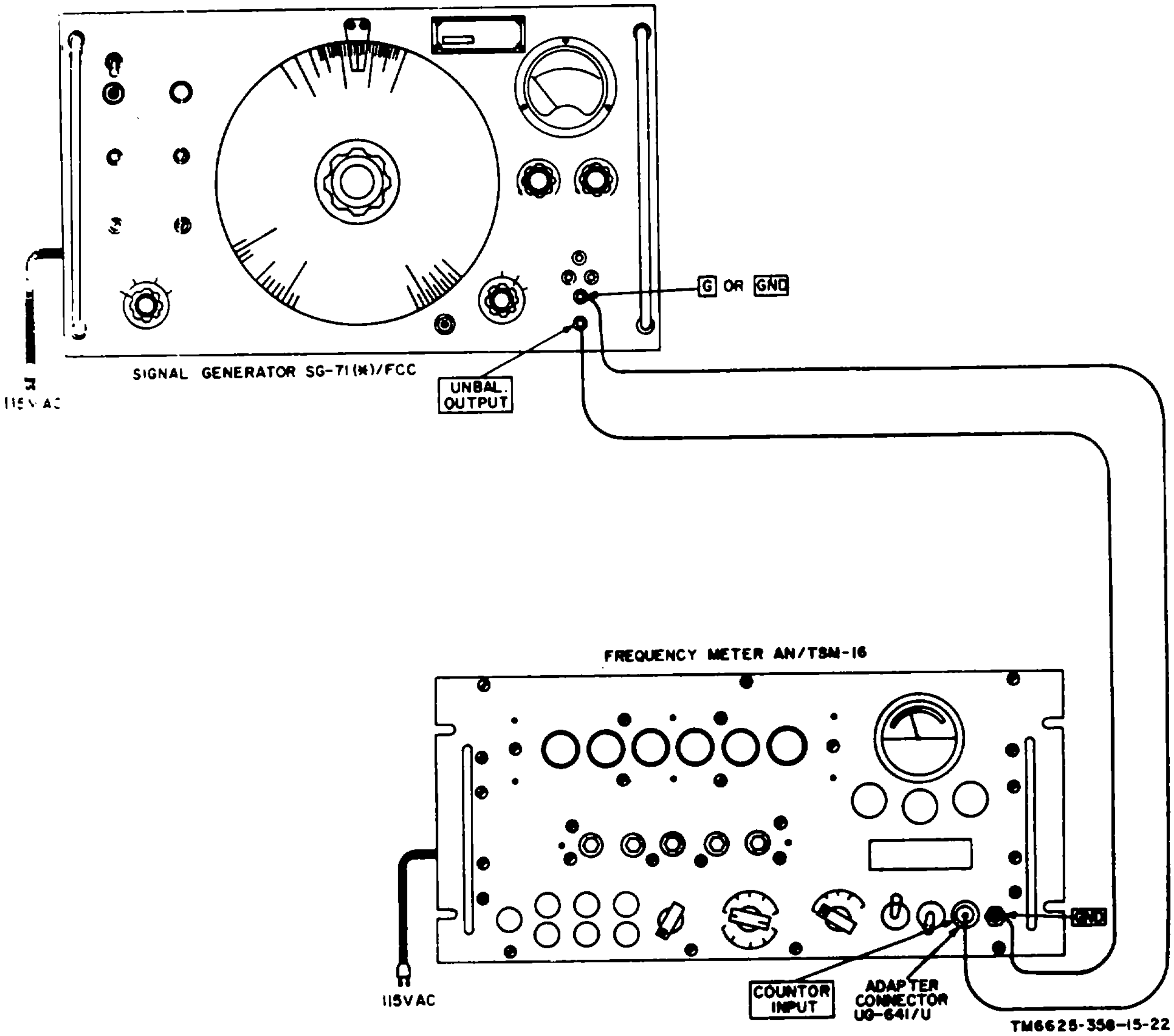


Figure 8-2. Frequency calibration, test setup.

8-6. Frequency Calibration Test.

a. Test Equipment and Materials. Frequency Meter AN/TSM-16.

b. Test Connections and Conditions.

(1) Connect the equipment as shown in figure 8-2.

(2) Allow the equipment to warm up for at least 20 minutes before the test procedure is started.

c. Procedure.

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	AN/TSM-16: INT.-EXT.: INT. (on rear panel) AUTO-MANUAL: AUTO FUNCTION: SCAN COUNT. POWER-STANDBY-OFF: POWER	MOD. BAL-BAL-UNBAL: UNBAL RANGE: X1 AMPLITUDE COARSE: fully clockwise Tuning or FREQUENCY dial: 50. ON or POWER switches: ON.	*a.* Adjust; AN/TSM-16 SENIVITY control for indication at lower end of INPUT LEVEL meter scale. *b.* Slowly turn AN/TSM-16 TRIGGER VOLTAGE control until numerical indicators begin to count. Note this setting. *c.* Continue to turn TRIGGER VOLTAGE control clockwise until counting stops. Set TRIGGER VOLTAGE control midway between this setting and that noted in b above.	*a.* None. *b*. None. *c* None.
2	AN/TSM-16: TRIGGER VOLTAGE: Leave at final setting of step 1. FUNCTION: FREQ. COUNT TIME SECONDS: 1 DISPLAY TIME: Adjust for suitable display time between counts.	Leave all controls in positions indicated in step 1.	Note AN/TSM-16 frequency Indication.	Frequency indication should be between 49 and 51 cps
8	Leave all controls in positions indicated in step 2.	Tuning or FREQUENCY dial: Set successively to each numbered Division.	Note frequency indication on AN/TSM-16 for each setting of tuning or FREQUENCY dial	Frequency indications on AN/TSM-16 and tuning or FRE-QUENCY dial agree within 2 percent

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
4	Leave all controls in positions indicated in step 2.	RANGE: X10 Tuning or FREQUENCY dial: Set successively to each numbered division.	Note frequency indications on AN/TSM-16 for each setting of tuning or FREQUENCY dial	Frequency indications on AN/TSM-16 and tuning or FREQUENCY dial agree within 2 percent.
5	Leave all controls in positions indicated in step 2.	RANGE: X100 Tuning or FREQUENCY dial: Set successively to each numbered division.	Note frequency indication on AN/TSM-16 for each setting of tuning or FREQUENCY Dial	Frequency indications on AN/TSM-16 and tuning or FREQUENCY dial agree within 2 percent.
6	Leave all controls in positions indicated in step 2.	RANGE: X1000 Tuning or FREQUENCY dial: Set successively to each numbered division.	Note frequency indication on AN/TSM-16 for each setting of tuning or FREQUENCY dial.	frequency indications on AN/TSM-16 and tuning or FREQUENCY dial agree within 2 Percent

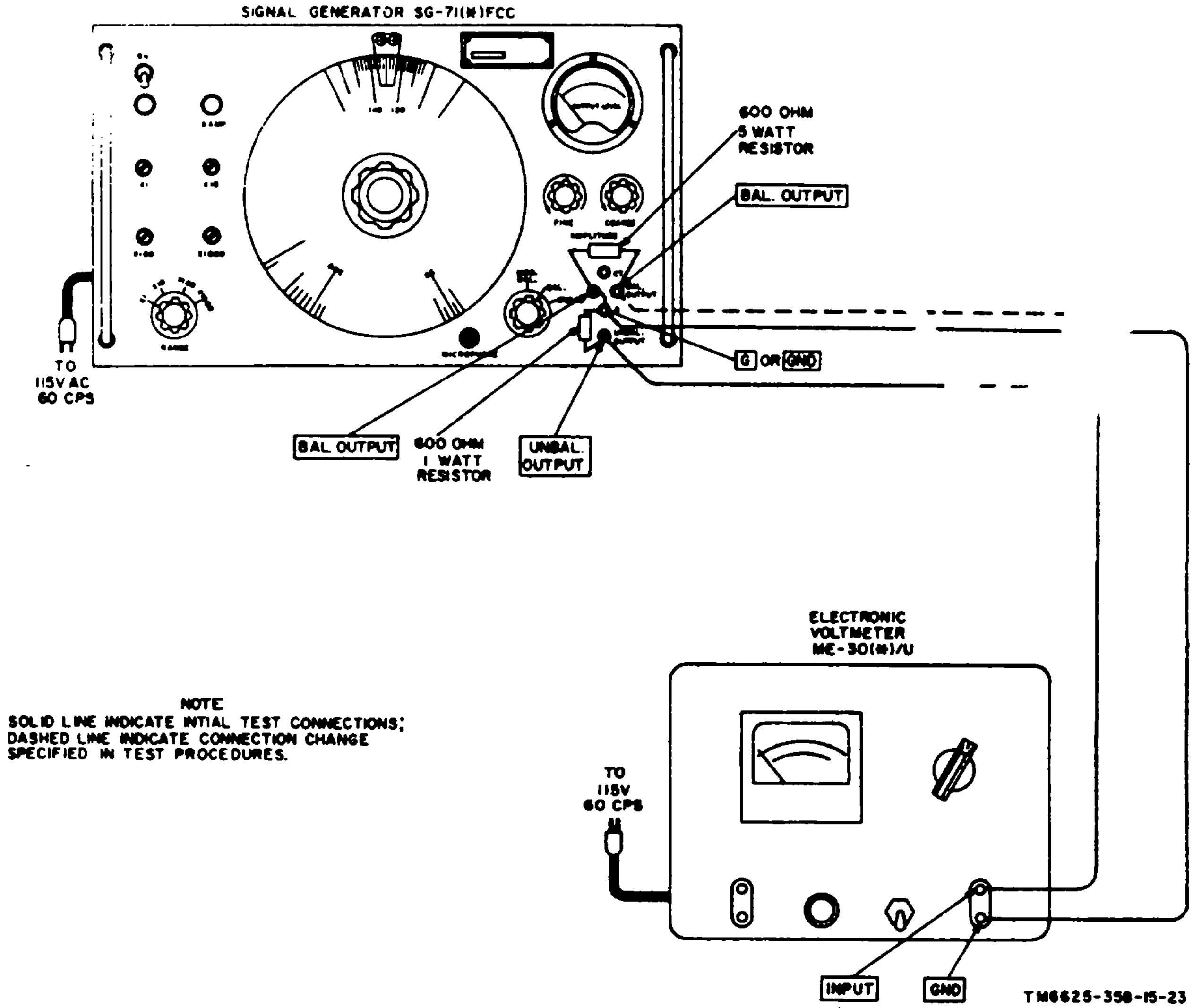


Figure 8-3. Hum measurement, output level meter calibration, frequency response, and power output, test setup.

8-7. Hum Measurement, Output Level Meter Calibration, Frequency Response, and Output Tests

a. Test Equipment and Materials.

(1) Voltmeter, Electronic ME-30(*)/U.

(2) 600-ohm, 1-watt, noninductive resistor.

(3) 600-ohm, 5-watt, noninductive resistor.

b. Test Connections and Conditions.

(1) Connect the equipment as shown in figure 8-3.

(2) Allow the equipment to warm up for at least 20 minutes before the test procedure is started.

c. Procedure.

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	ME-30(*)/U: *a*. Range selector switch: .01. *b*. POWER: ON	ON and POWER switches : ON MOD. BAL-BAL.-UNBAL.: UNBAL AMPLITUDE FINE and COARSE: fully clockwise	*a*. Remove dust cover from signal generator and loosen lamp R15 *b*. Check hum voltage on ME-30(*)/U.	*a*. None *b*. Less than 0.006 volt
2	ME-30(*)/U: RANGE selector switch: 1.	Leave all controls in positions indicated in step 1.	*a*. Connect ME-O(*)/U to signal generator BAL OUTPUT Terminals. *b*. Check hum voltage on ME-30(*)/U. *c*. Tighten lamp R15, and replace dust cover.	*a*. None. *b*. Less than 0.04 volt. *c*. None
3	ME-30(*)/U Range selector switch: 100.	MOD. BAL-BAL.-UNBAL.: BAL. RANGE: X100. Tuning or FREQUENCY dial: 100. AMPLITUDE: FINE COARSE: 40-volt indication on output level meter.	Connect ME-30(*)/U to generator BAL OUTPUT terminals Compare indications on output level meter and ME-30(*)/U.	Meter indications agree within 5 percent
4	ME-3(*)/U: Range selector switch: 10.	MOD. BAL-BAL-UNBAL: UNBAL. RANGE: X100. Tuning or FREQUENCY dial: 100.	*a*. Connect ME-30(*)/U to signal generator UNBAL OUTPUT Terminals. Set signal generator AMPLITUDE COARSE and FINE controls for exact 6-volt indication on ME-30(*)/U.	*a*. None

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
			b. Rotate tuning or FREQUENCY dial over entire range, and note ME-30(*)/U indication.	*b*. ME-30(*)/U indication should not vary more than ±1 dbm (12 percent) from 6 volts.
5	Leave controls as indicated in step 4.	RANGE: X1..	Rotate tuning or FREQUENCY dial over entire range, and note ME-30(*)/U indication.	ME-30(*)/U indication should not vary more than ±1 dbm (12 percent) from 6 volts.
6	Leave controls as indicated in step 4.	RANGE: X10......................................	Rotate tuning or FREQUENCY dial over entire range, and note ME-30(*)/U indication.	ME-30(*)/U indication should not vary more than ±1 dbm (12 percent) from 6 volts.
7	Leave controls as indicated in step 4.	RANGE: X1000..................................	Rotate tuning or FREQUENCY dial over entire range, and note ME-30(*)/U indication.	ME-30(*)/U indication should not vary more than ±1 dbm (12 percent) from 6 volts.
8	ME-30(*)/U: Range selector switch: 100.	MOD. BAL.-BAL.-UNBAL.: BAL. RANGE: X100 Tuning of FREQUENCY dial: 100.	*a*. Connect ME-30(*)/U to signal generator BAL. OUTPUT terminals. Adjust signal generator AMPLITUDE COARSE and FINE controls for 42.5-volt indication on ME-30(*)/U.	*a*. None.
			b. Rotate tuning or FREQUENCY dial over entire range, while observing indications on ME-30(*)/U and output level meter.	*b*. Meter indications should agree within 1 dbm (12 percent).
9	Leave controls as indicated in step 8.	RANGE: X1000..................................	Rotate tuning or FREQUENCY dial over entire range, while observing indications on ME-30(*)/U and output level meter.	Meter indications should agree within 1 dbm (12 percent).

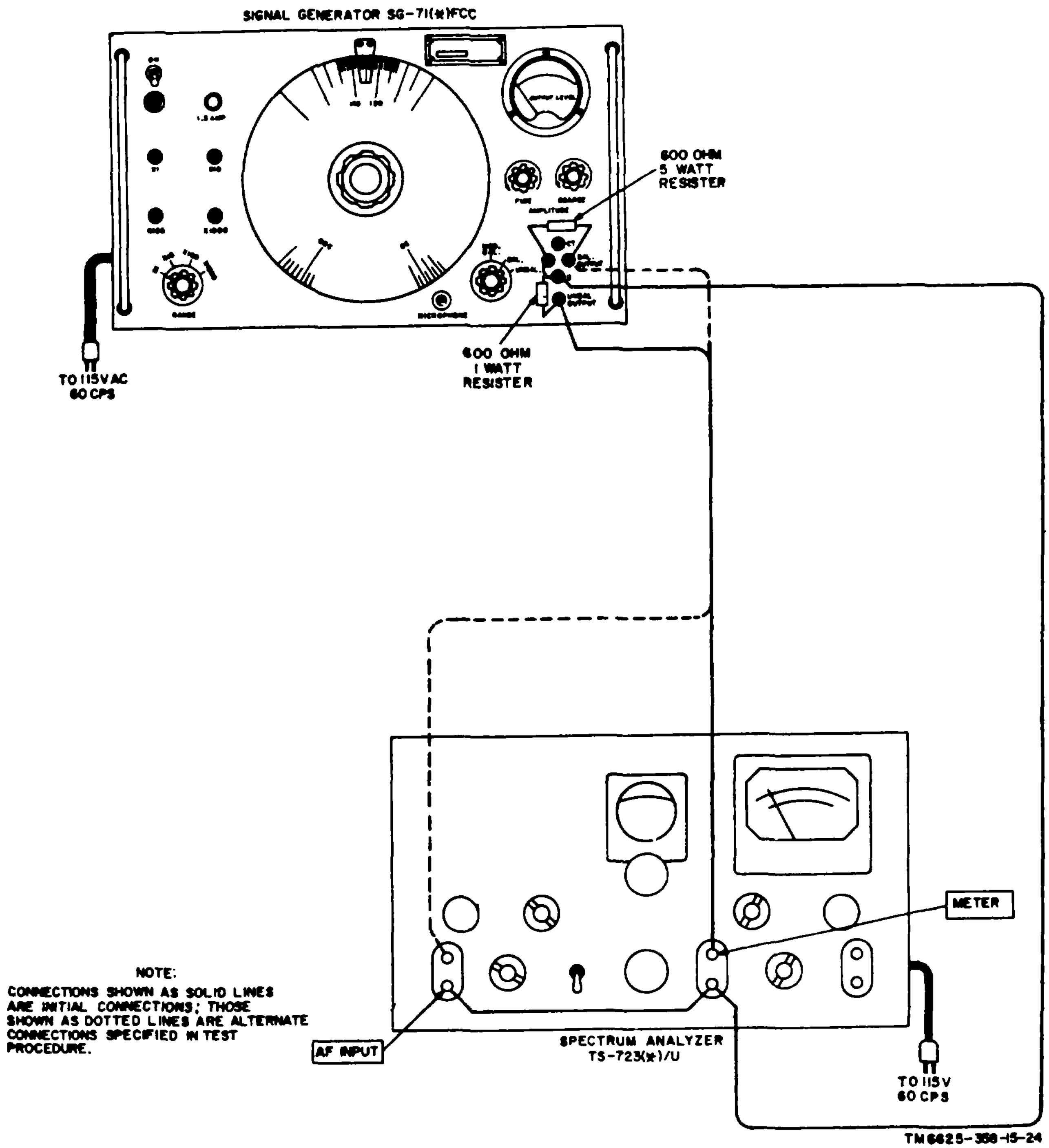


Figure 8-4. Distortion, test setup.

8-8. Distortion Test

a. Teat Equipment and Material

(1) Spectrum Analyzer TS-723A/U.

(2) 600-ohm, 1-watt, noninductive resistor.

(3) 600-ohm, 5-watt, noninductive resistor.

b. Test Connections and Conditions.

(1) Connect the equipment as shown in figure 8-4.

(2) Allow the equipment to warm up for at least 20 minutes before the test procedures is started.

c. Procedure.

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	TS-723A/U AF-RF: AF Meter range switch: 10 volts. Function switch: METER. RANGE X1 ON-OFF: ON	MOD. BAL-BAL.-UNBAL.: UNBAL. RANGE: X1 Tuning of FREQUENCY dial: 100. POWER switches: ON	*a*. Adjust signal generator AMPLITUDE COARSE and FINE controls for 6volt indication on TS-723A/U. *b*. Switch test leads from METER to AF input terminal on TS-723A/U. Set TS-723A/U function switch to SET LEVEL. Slowly rotate TS-723A/U INPUT control until meter pointer reaches full-scale deflection. *c*. Set TS-723A/U function switch to DISTORTION, and range switch to 100%. Adjust TS-723A/U coarse FREQUENCY control on until meter pointer dips sharply. Adjust fine FREQUENCY control for maximum dip in meter indication. Adjust BALANCE control for minimum meter indication. *d*. Readjust coarse and fine FREQUENCY controls and BALANCE control until no further reduction in TS-723A/U meter indication can be Obtained. Set meter range switch to 12% or 1%, applicable,	*a*. None. *b*. None. *c*. None *d*. Distortion is less than 1 percent.

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
			to maintain midscale meter deflection. Read distortion in percent on meter.	
2	TS-723A/U RANGE X100	RANGE: X100 Tuning of FREQUENCY dial: 200.	Measure distortion in steps 1*c* and 1*d* above.	Distortion is less than 1 percent.
3	TS-723A/U Function switch: METER. Meter range switch: 100 volts. RANGE X100	*a*. MOD. BAL-BAL.-UNBAL.: BAL. *b*. RANGE: X100 *c*. Tuning of FREQUENCY dial: 50.	*a*. Connect TS-723A/U METER terminals to BAL. OUTPUT terminals. Adjust signal generator AMPLITUDE COARSE and FINE controls foe 42.5-volt indication on TS-723A/U. *b*. Measure distortion by repeating procedures given in 1*b*, *c*, and *d*, above.	*a*. None. *b*. Distortion is less than 4 percent.
4	Leave controls in same positions as indicated in step 3.	Tuning of FREQUENCY dial: 100.	Measure distortion by repeating procedures given in steps 1*b*, *c*, and *d*, above.	Distortion is less than 3 percent.

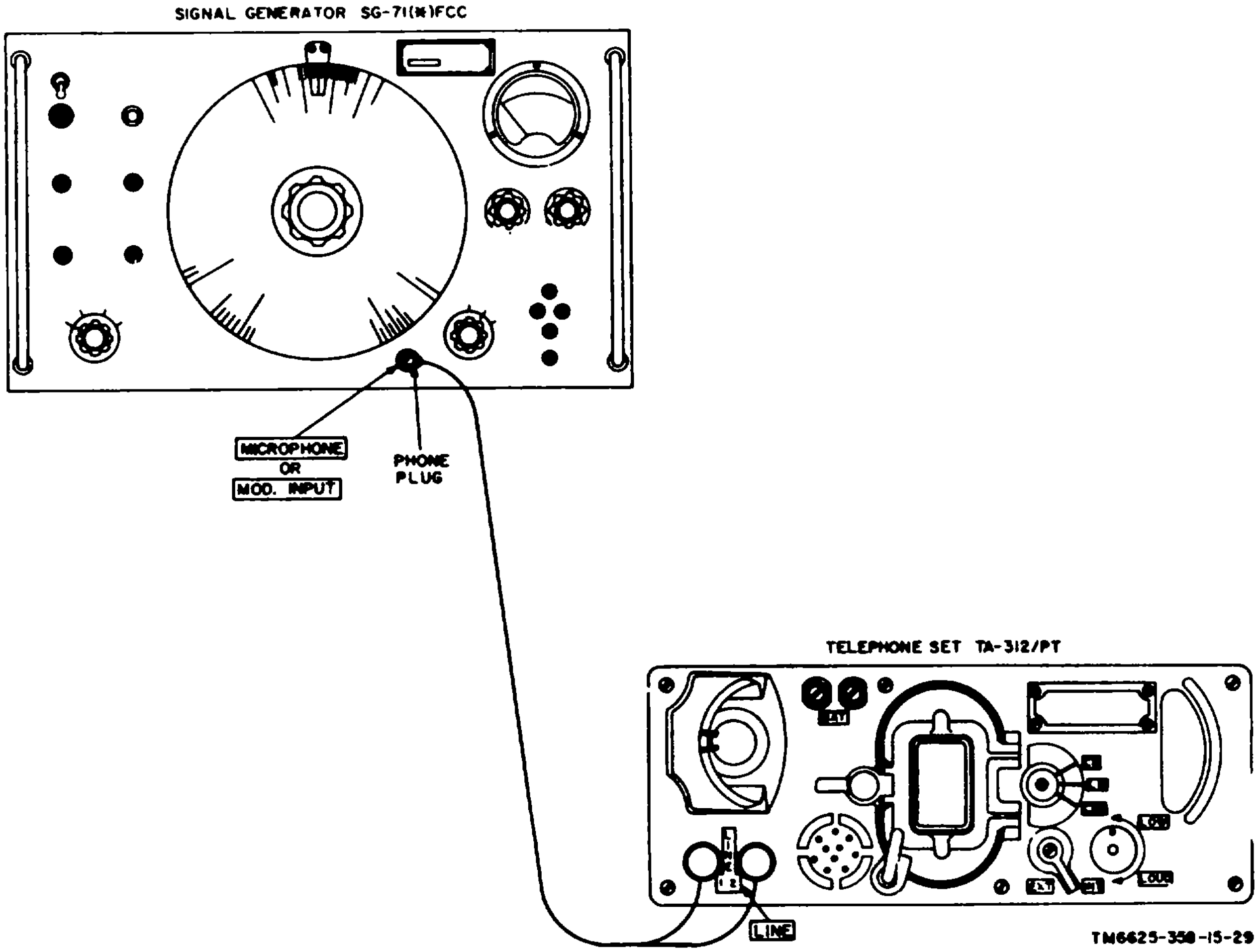


Figure 8-5. Voice modulation, test setup.

8-9. Voice Modulation Test

a. Test Equipment and Material. Telephone Set TA-312/PT and Oscilloscope AN/USM-281A.

b. Test Connection and Conditions. Connect the equipment as shown in figure 8-5. Also connect the APN/USM-281A vertical input terminals to the SG-71( )/FCC BAL OUTPUT terminals.

c. Procedure.

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	TA-312/PT INT EXT switch: INT. Circuit selector switch: LB.	MOD. BAL.-BAL-UNBAL: MOD, BAL. RANGE: X1000 Tuning or FREQUENCY dial: 100. ON and POWER switches: ON. AMPLITUDE COARSE and FINE controls: Set for upscale reading on output level meter.	Speak loudly into, or tap microphone to obtain strong modulation: note output level as presented on Oscilloscope AN/USM-281A (with controls adjusted to receive signal).	Voice modulation should be present on the screen.

8-10. Test Data Summary

1. DC POWER SUPPLY VOLTAGE TESTS
   a. Pin 8 of tube V7 .... +355 ±10 volts dc.
   b. Pin 8 of tube V7 .... +240 ±10 volts dc.
2. FREQUENCY CALIBRATION .... ±2 percent.
3. HUM MEASUREMENT TEST
   a. UNBAL. OUTPUT .... Less than 0.006 volt ac
   b. BAL OUTPUT .... Less than 0.04 volt ac
4. OUTPUT LEVEL METER CALIBRATION.................. ±5 percent.
5. FREQUENCY RESPONSE TEST .... ±1 dbm from output at 10 kc.
6. POWER OUTPUT TEST
   a. UNBAL. OUTPUT .... 6 ±0.72 volts.
   b. BAL OUTPUT .... 42.5 ±5.1 volts.
7. DISTORTION TEST
   a. UNBAL OUTPUT .... Less than 1 percent.
   b. BAL. OUTPUT .... Less than 4 percent at 5 kc; less than 3 percent at 10 kc
8. VOICE MODULATION TEST .... Modulation present on oscilloscope screen.

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 depot 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 standards for repaired electronic equipment given in TB SIG 855-1, TB SIG 855-2, and TB SIG 855-3 form a part of the requirements for testing this equipment.

b. Modification Work Orders. Perform all modification work orders applicable to this equipment before making the tests specified. DA Pam 310-7 lists all available MWO's.

9-3. Test Equipment Required

Item	Technical manual	Common name
Multimeter TS-352B/U	TM 11-6625-366-15	Multimeter.
Frequency Meter AN/TSM-16.	TM 11-6625-218-12	Frequency meter.
Voltmeter, Electronic ME-30(*)/U [a].	TM 11-6625-320-12	Voltmeter.
Spectrum Analyzer TS-723A/U.	TM 11-5097	Spectrum analyzer.
Telephone Set TA-312/PT.	TM 11-5805-201-12	Telephone set.

[a] Voltmeter. Electronic ME-30(*)/U represents Voltmeter, Meter ME-30A/U and Voltmeter, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.

9-4. Depot Overhaul Test

To perform the depot overhaul standard tests, perform the tests given in paragraphs 8-4 through 8-9.

CHAPTER 10

SHIPMENT, LIMITED STORAGE, AND DEMOLITION TO PREVENT ENEMY USE

10-1. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Reverse the instructions given in paragraph 2-1 for repacking.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the inner wrappings of the packing case. Protect the equipment by moisture-proofing the inner wrapper and sealing the seam with waterproof sealing compound or tape. Pack the wrapped equipment in a padded wooden case; provide at least 8 inches of excelsior padding, or some similar material, between the paper barrier and the packing case.

10-2. Demolition of Materiel

The demolition methods given in paragraph 10-3 will be used to prevent the enemy from using or salvaging the equipment. Demolition of the equipment will be accomplished only upon the order of the commander.

10-3. Methods of Destruction

a. Smash. Smash the controls, capacitors, coils, tubes, switches, transformers, and other interior parts; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cords and wiring; use axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical .manuals; use gasoline, kerosene, oil, flamethrowers, or incendiary grenades.

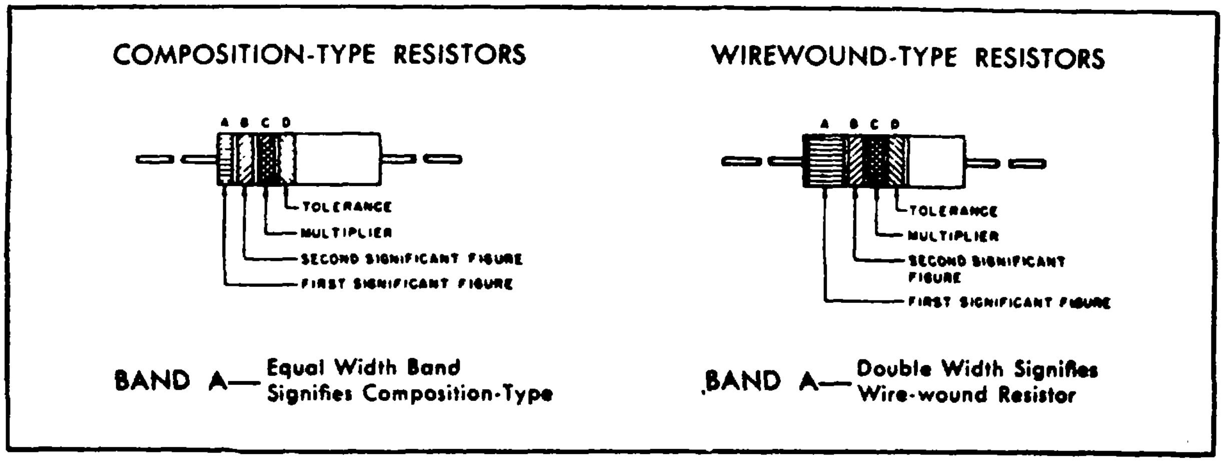
d. Bend. Bend panels, cabinet, and chassis.

e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, foxholes, or other holes, or throw them into streams.

g. Destroy. Destroy all the equipment.

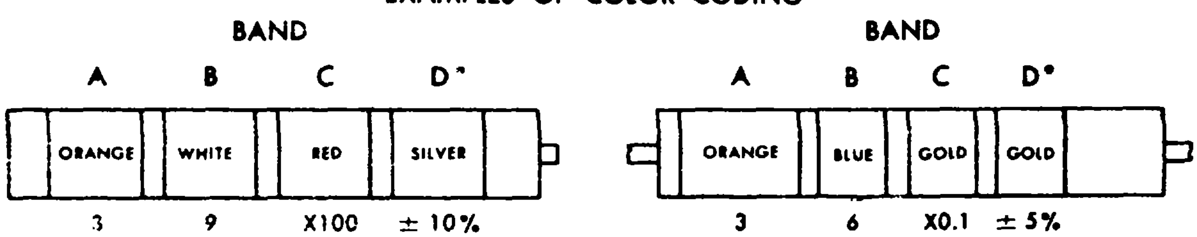
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS



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



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. Color code marking for MIL-STD resistors.

APPENDIX A
REFERENCES

The following publications contain information applicable to the maintenance of Signal Generator SG-71( )FCC.

AR 746-1	Color, Marking, and Preparation of Equipment for Shipment.
DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	US Army Equipment Index of Modification Work Orders.
SB 11-573	Painting and Preservation Supplies Available for Field Use of Electronics Command Equipment.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies, and Equipment Used by the Army.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, TS723C/U, and TS723D/U.
TM 11-5805-201-12	Operator and Organizational Maintenance Manual Including Repair Parts and Special Tool Lists: Telephone Set TA-312/PT.
TM 11-6625-218-12	Organizational Maintenance Manual: Frequency Meter AN/TSM-16.
TM 11-6625-261-12	Operator's and Organizational Maintenance Manual: Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Tests Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.
TM 11-6625-316-12	Operator and Organizational Maintenance Manual: Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.
TM 11-6625-320-12	Operator and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U, and Voltmeters, Electronic ME30B/U, ME-30C/U, and ME-30E/U.
TM 11-462-366-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS-352B/U.
TM 11-6625-1703-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Oscilloscope AN/USM-281A.
TM 38-750	The Army Maintenance Management Systems (TAMMS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Generator Signal SG-71/FCC, SG-71A/FCC SG-71B/FCC, and SG-71C/FCC. 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.

C-2. Explanation of Format for Maintenance Allocation Chart

a. Group Number. Not used.

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 codes used represent the various maintenance categories as follows:

Code	Maintenance category
C	Operator/crew
O	Organizational maintenance
F	Direct support maintenance
H	General support maintenance
D	Depot maintenance

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.

C-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 codes 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
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	GENERATIONS, SIGNAL SG-71/FCC,	O												
	SG-71A/FCC, SG-71B/FCC, AND		H										1 thru 5,7,8,9,10	Inspect visually
	SG-71C/FCC		D										1 thru 6,8,9,10	
				O										
					H	H							1 thru 5,7,8,9	
							H						1 thru 4,7,8,9	
								O						
									H					
										H			1 thru 5,7,8,9	
											D		1 thru 6,8,9	
												D		

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENT

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
		SB-71. A, B, C/FCC (continued)		
1	H,D	ANLAYZER SPECTRUM TS-723/U	6625-668-9418	
2	H,D	FREQUENCY METER AN/TSM-16	6625-542-1666	
3	H,D	MULTIMETER TS-352B/U	6625-553-0142	
4	H.D	VOLTMETER ME-30/U	6625-669-0742	
5	H,D	TELEPHONE SET TA-312/PT	5805-543-0012	
6	D	TEST SET, ELECTRON TUBE TV-2/U	6625-699-0263	
7	H	TEST SET, ELECTRON TUBE TV-7/U	6625-820-0064	
8	H,D	TOOL KIT, ELECTRON EQUIP TK-100/G	5180-605-0079	
9	H,D	TOOL KIT, ELECTRON EQUIP TK-105/G	5180-610-8177	
10	H,D	OSCILLOSCOPE AN/USM-281A	6625-228-2201	

INDEX

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CNGB (1)
ACSC-E (7)
Dir of Trans (1)
CofEngrs (1)
TSG (1)
Cof SptS (1)
USAARENBD (2)
USAAVNTBD (6)
USACDCEC (10)
USACDC Agcy (1)
USAMC (5)
USCONARC (5)
ARADCOM (6)
ARADCOM Rgn (2)
OS Maj Comd (4)
USARYIS (5)
USASETAF (5)
LOGCOMD (2)
USAMICOM (4)
USASTRATCOM (4)
USAESC (70)
MDW (1)
Armies (2)
Corps (2)
USAC (3)
Instl (2) except
Ft Hancock (4)
Ft Gordon (10)
Ft Huachuca (10)
WSMR (5)
Ft Carson (25)
Ft Knox (12)
Svc Colleges (2)
USAADS (2)
USAAMS (2)
USAARMS (2)
USAIS (2)
USAES (2)
USATC Armor (2)
USATCFLW (2)
USATC Inf (2)
USASTC (2)
Army Dep (2) except

LBAD (14)
SAAD (30)
TOAD (14)
LEAD (7)
SHAD (8)
NAAD (6)
SVAD (6)
CHAD (8)
ATAD (10)
Gen Dep (2)
Sig Sec, Gen Dep (2)
Sig Dep (12)
AMS (1)
MAAG (2)
USARMIS (S)
WRAMC (1)
USAATC (6)
Army Pic Cen (2)
USAERDAA (3)
USAERDAW (13)
USACRREL (2)
USABIOLABS (5)
Sig FLDMS (2)
Units org under fol TOE:--2 e*a.*
6-615
6-616
7
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11-56
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11-157
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11-216
11-247
11-327
11-347
11-357
11-377
11-500(AA-AC), (GL, GR, KA, RT, RU, RV)
11-587
11-592
11-597
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29-11
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29-17
29-21
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29-41
29-51
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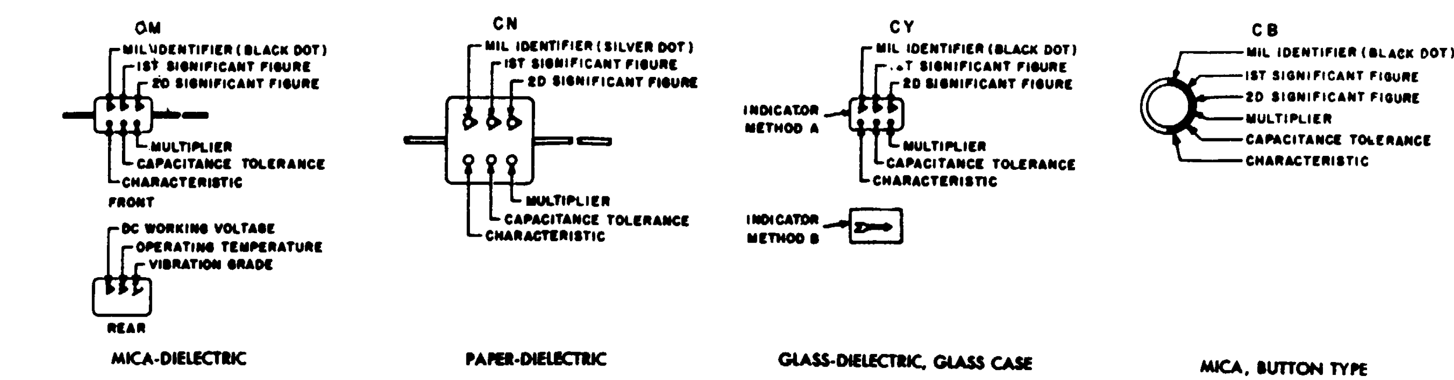
29-57
29-85
29-86
29-87
29-105
29-109
29-134
29-138
29 205
29-206
29-207
29-245
29-247
29-500
31-105
37
44-568
57
77-100

NG: State AG (3); Units-same as active Army except allowance is one (1) copy ea.
USAR: None.
For explanation of abbreviation used, see AR 320-60.

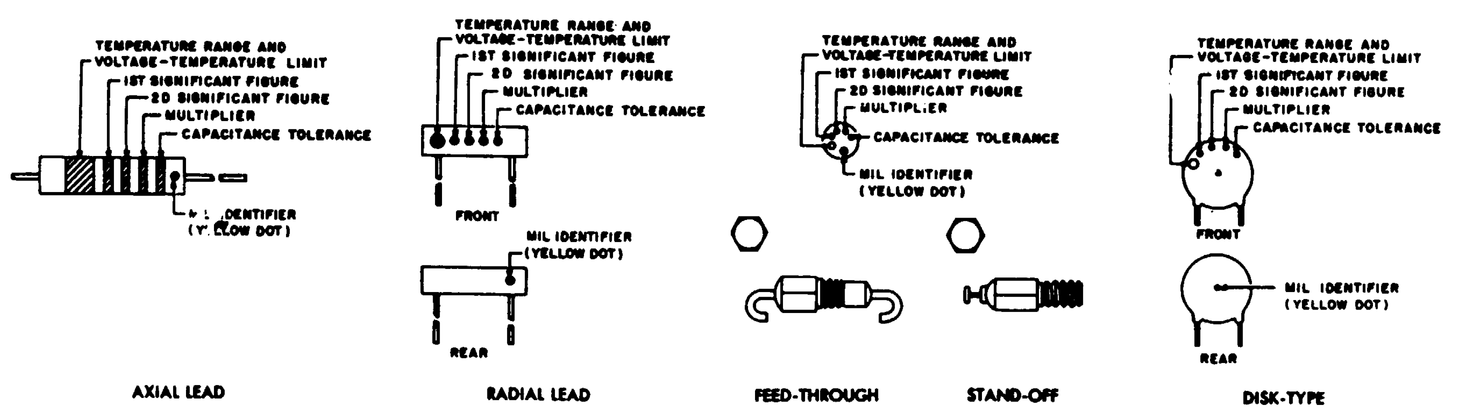
☆U.S. GOVERNMENT PRINTING OFFICE: 1990 - 262-912/30204

COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

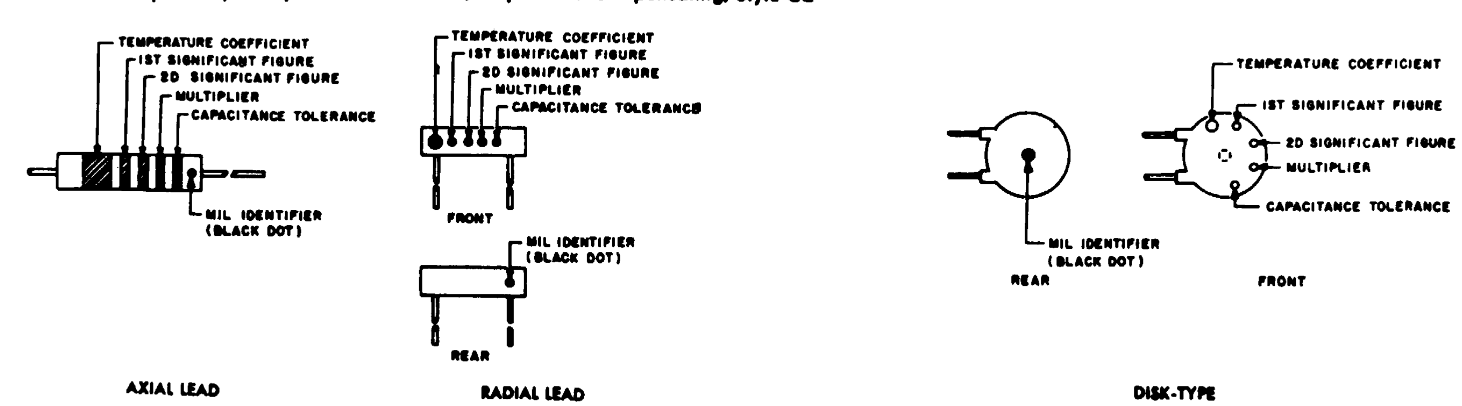
GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



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



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



COLOR CODE TABLES

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

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

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

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

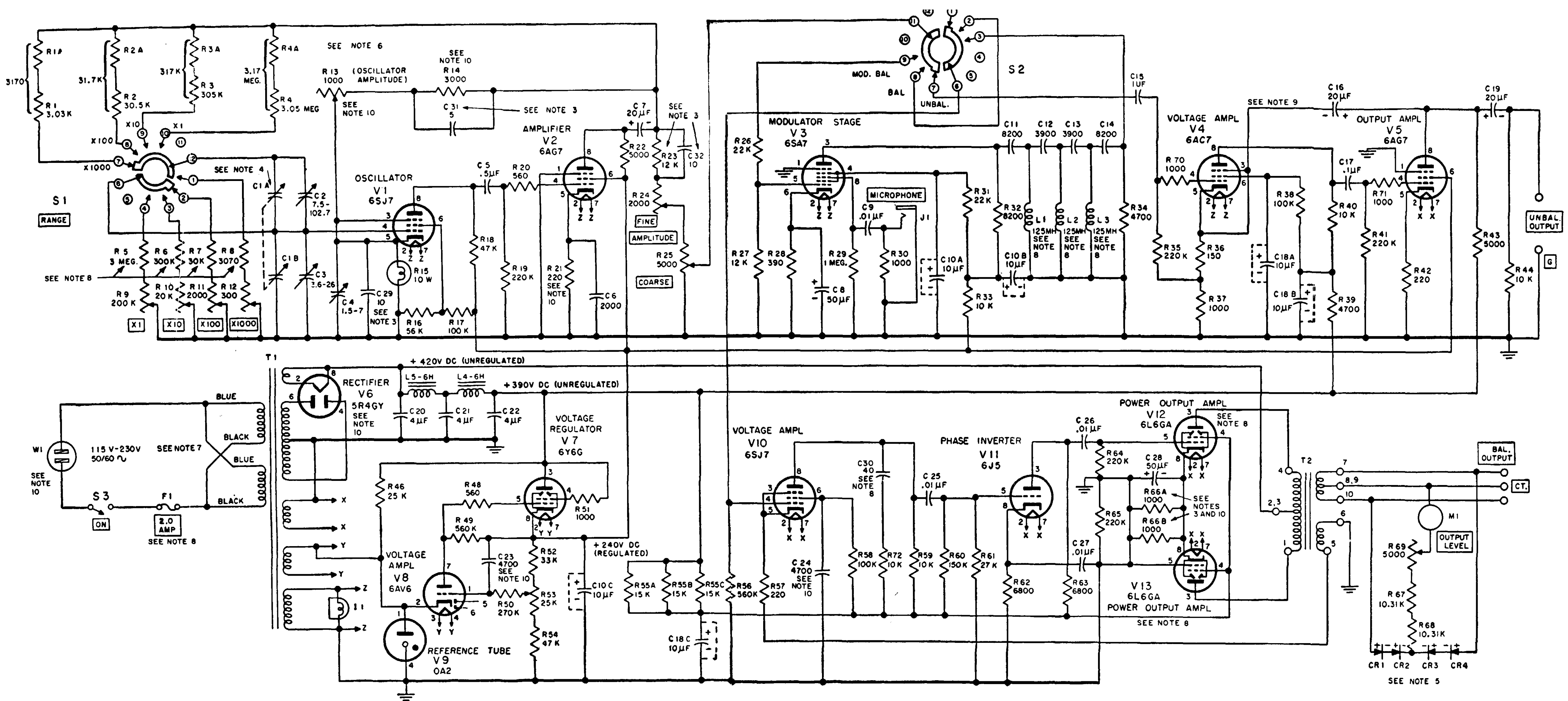
TABLE III – For use with Group III, Temperature Compensating, Style CC

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

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

STD–CE

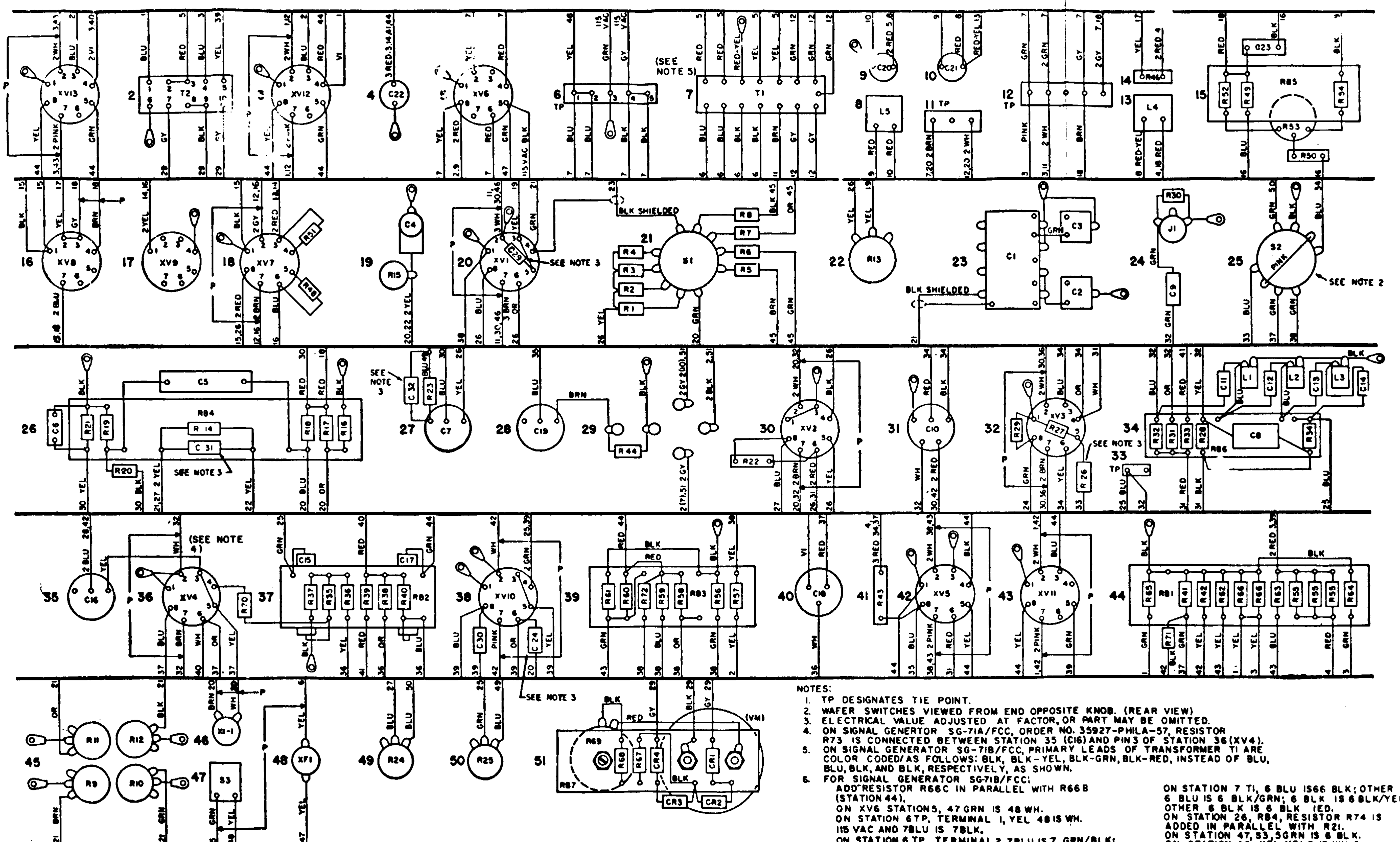
Figure 10-2. Color cods marking for MIL-STD capacitors.



NOTES

1. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN UUF UNLESS OTHERWISE SPECIFIED, K=1,000 MEG=1,000,000
2. WAFER SWITCHES VIEWED FROM END OPPOSITE KNOB. (REAR VIEW)
3. ELECTRICAL VALUE ADJUSTED AT FACTORY OR PART MAY BE OMITTED. VALUE SHOWN IS TYPICAL.
4. C1A AND C1B EACH COMPOSED OF TWO SECTIONS OF A FOUR SECTION TUNING CAPACITOR. EACH SECTION 12.4 TO 535 UUF.
5. CATHODE OF DIODE INDICATED BY LINE. ELECTRON FLOW IS OPPOSITE TO DIRECTION OF ARROW.
6. *RESISTORS R1, R2, R3, AND R4 PADDED TO TOTAL VALUES AS SHOWN*
7. TRANSFORMER T1 SHOWN CONNECTED FOR 115 VOLT OPERATION. FOR 230 VOLT OPERATION, DISCONNECT BLUE WIRE OF ONE WINDING AND BLACK WIRE OF OTHER WINDING, AND CONNECT TOGETHER AT POINT OF CROSSING IN DIAGRAM. IN SIGNAL GENERATOR SG-71B/FCC, PRIMARY LEADS OF TRANSFORMER T1 ARE COLOR CODED AS FOLLOWS, READING FROM TOP DOWN: BLACK, BLACK-YELLOW, BLACK-GREEN, AND BLACK-RED. TO CONNECT SG-71B/FCC FOR 230 VOLT OPERATION, DISCONNECT BLACK-YELLOW AND BLACK-GREEN LEADS AND SOLDER THEM TOGETHER.
8. IN SIGNAL GENERATOR SG-71A/FCC THE FOLLOWING COMPONENTS HAVE BEEN CHANGED:
   - RESISTOR R5 IS 3.05 MEG.
   - RESISTOR R6 IS 305K.
   - RESISTOR R7 IS 30.5K
   - RESISTOR R8 IS 3,030.
   - FUSE F1 IS 2.0 AMP.
   - CAPACITOR C30 IS 39.
   - TUBES V12 AND V13 ARE 616.
   - INDUCTORS L1, L2, AND L3 ARE EACH 118 MH.
9. IN SIGNAL GENERATOR SG-71A/FCC, ORDER NO. 35927-PHILA-57, 150-OHM RESISTOR R73 IS ADDED BETWEEN CAPACITOR C16 AND PIN 3 OF TUBE V4.
10. IN SIGNAL GENERATOR SG-71B/FCC, TUBE V6 IS 5U4GB: VALUE OF C23 AND C24 IS CHANGED TO 0.047 UF; VALUE OF R13 IS CHANGED TO 2,000 OHMS: VALUE OF R14 IS CHANGED TO 1,600 OHMS: NEW RESISTOR R66C, 1,500 OHMS, IS ADDED IN PARALLEL WITH R66B: RESISTOR R74 IS ADDED IN PARALLEL WITH R21. VALUE OF R74 IS FACTORY SELECTED TO MINIMIZE DISTORTION. AVERAGE VALUE IS 2,200 OHMS; PART MAY BE OMITTED. POWER CONNECTOR CONTAINS AN ADDITIONAL ROUND TERMINAL, WHICH IS GROUNDED. POSITIONS OF S1 AND F1 ARE INTERCHANGED.

Figure 10-3. Signal Generators SG-71/FCC, SG-71A/FCC, and SG-71B/FCC, schematic diagram.



NOTES:

1. TP DESIGNATES TIE POINT.
2. WAFER SWITCHES VIEWED FROM END OPPOSITE KNOB. (REAR VIEW)
3. ELECTRICAL VALUE ADJUSTED AT FACTOR, OR PART MAY BE OMITTED.
4. ON SIGNAL GENERTOR SG-71A/FCC, ORDER NO. 35927-PHILA-57, RESISTOR R73 IS CONNECTED BETWEEN STATION 35 (C16) AND PIN 3 OF STATION 36 (XV4).
5. ON SIGNAL GENERATOR SG-71B/FCC, PRIMARY LEADS OF TRANSFORMER T1 ARE COLOR CODED/AS FOLLOWS: BLK, BLK-YEL, BLK-GRN, BLK-RED, INSTEAD OF BLU, BLU, BLK, AND BLK, RESPECTIVELY, AS SHOWN.
6. FOR SIGNAL GENERATOR SG-71B/FCC:
   ADD RESISTOR R66C IN PARALLEL WITH R66B (STATION 44).
   ON XV6 STATION 5, 47 GRN IS 48 WH.
   ON STATION 6 TP, TERMINAL 1, YEL 48 IS WH.
   115 VAC AND 7BLU IS 7BLK.
   ON STATION 6 TP, TERMINAL 2, 7BLU IS 7 GRN/BLK; TERMINAL 4, GY115 VAC IS BLK 47; 7 BLK IS 7 YEL/BLK; TERMINAL 5, 7 BLK IS 7 RED/BLK.
   ON STATION 7 T1, 6 BLU IS 6 BLK; OTHER 6 BLU IS 6 BLK/GRN; 6 BLK IS 6 BLK/YEL; OTHER 6 BLK IS 6 BLK IED.
   ON STATION 26, RB4, RESISTOR R74 IS ADDED IN PARALLEL WITH R21.
   ON STATION 47, S3, 5GRN IS 6 BLK.
   ON STATION 48, XF1, YEL6 IS WH 5.

TM 6625-358-15-26

Figure 10-4. Signal SG-71/FCC, SG-71A/FCC, and SG-71B/FCC, wiring diagram.

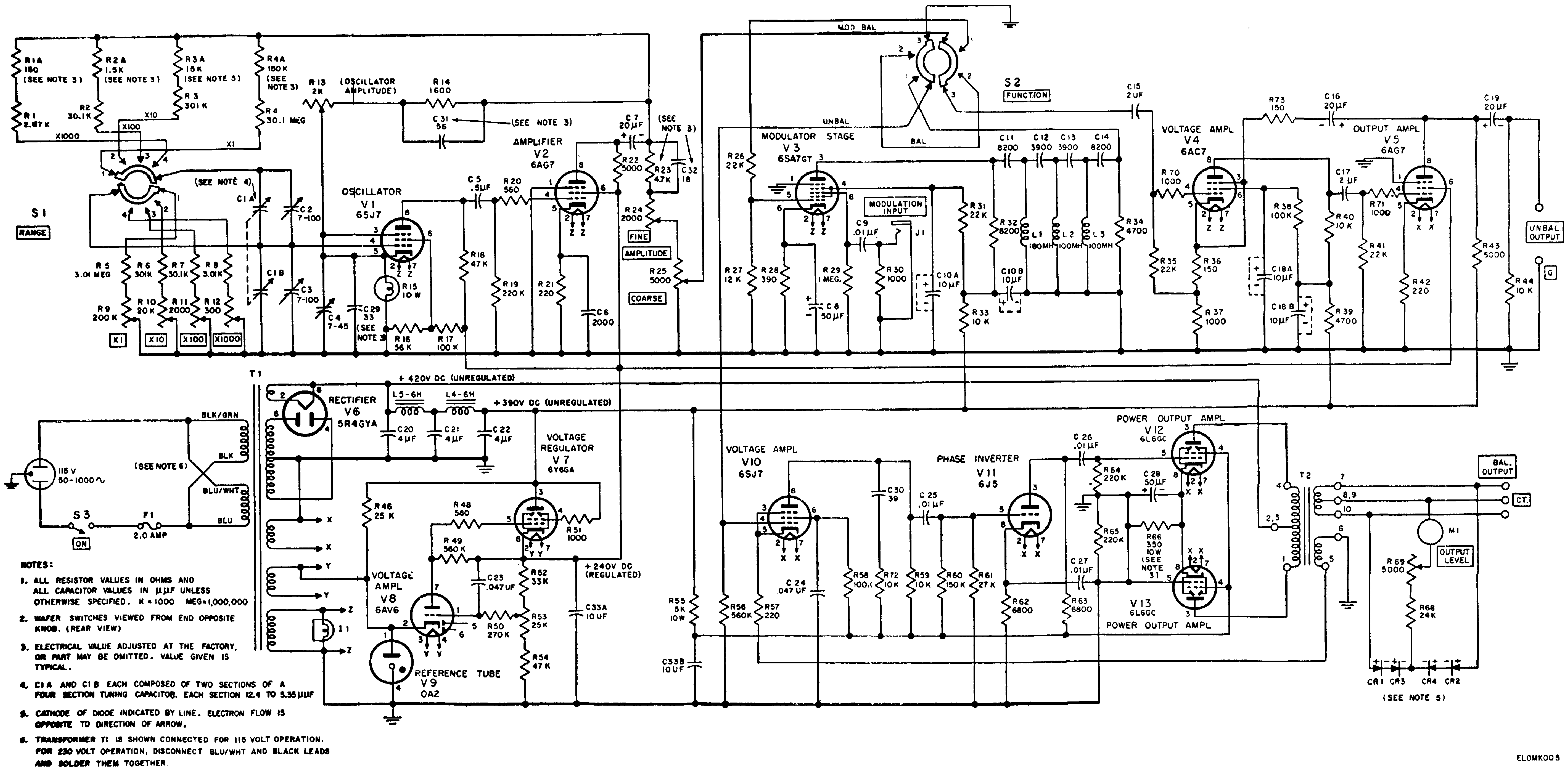


Figure 10-5. Signal Generator SG-71C/FCC, schematic diagram.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.	IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

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

The Metric System and Equivalents

Linear Measure

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

Weights

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

Liquid Measure

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

Square Measure

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

Cubic Measure

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

Approximate Conversion Factors

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

Temperature (Exact)

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

PIN: 017167-000