DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-5018

TO 16-35TS588-5

SIGNAL GENERATOR TS-588A/U

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

OCTOBER 1952

DEPARTMENT OF THE ARMY TECHNICAL MANUAL
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C1, TM 11-5018
TO 16-35TS588-5

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
WASHINGTON 25, D. C., *21 September 1953*

TM 11-5018/TO 16-35TS588-5, 6 October 1952, is changed as follows:

70. Output Voltage Calibration

* * * * *

b. (Superseded) To check and recalibrate the output voltage, use Electronic Multimeter TS-505/U (or equal). Remove the signal generator from its case (par. 66). Turn the signal generator on and *allow a warm-up period of not less than 30 minutes before recalibrating.* Follow the preliminary starting procedure (par. 18*b*) and then adjust the ZERO ADJ. CARRIER METER control to bring the signal generator meter reading to zero (par. 18*c*). Set the bandswitch and the FREQUENCY control to obtain a 50-kc, unmodulated carrier output. Set the OUTPUT switch to the 2 VOLT OUTPUT position. Set the METER TO switch to CARRIER. Adjust the electronic voltmeter to obtain a reading on the 0- to 4-volt a-c range. Use the a-c probe to measure the output voltgage at the 2 VOLT OUTPUT jack and adjust the signal generator ADJUST CARRIER control to obtain a 2-volt reading on the *electronic multimeter.* Adjust the signal generator CALIBRATE CARRIER control (fig. 16) so that the signal generator meter reads on the SET CARRIER mark on the carrier voltage scale. This procedure should provide adequate calibration for the ATTEN OUTPUT voltage, as well as for the 2 VOLT OUTPUT jack. If correct calibration cannot be obtained, trouble shooting is required.

Caution: Do not attempt to modify the L-pad multiplier; any modification will result in damage that cannot be repaired.

[AG 413.44 (11 Aug 53)]

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SIGNAL GENERATOR TS-588A/U





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WARNING

HIGH VOLTAGE

is used in the operation of

this equipment.

DEATH ON CONTACT

may result if operating personnel

fail to observe safety precautions.



First Aid for Electric Shock

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only,* remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

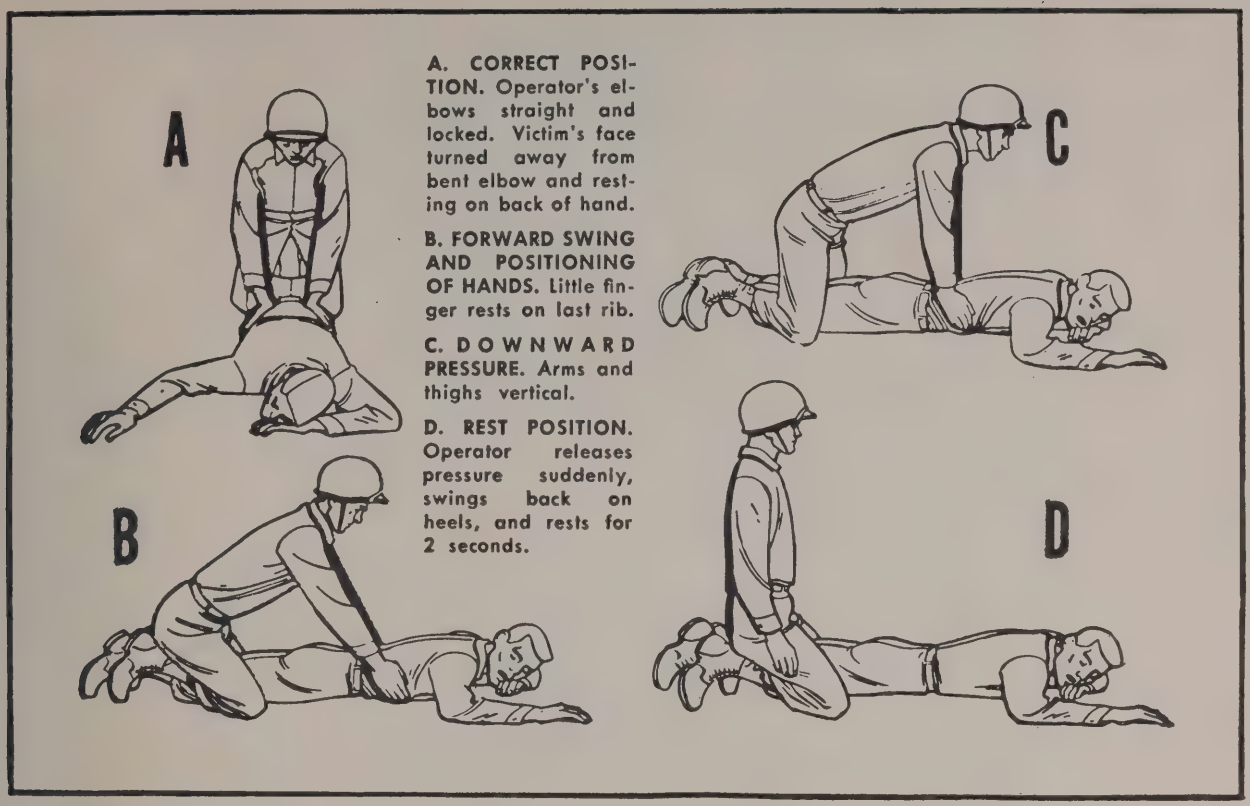
f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit up on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4



A. CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.

B. FORWARD SWING AND POSITIONING OF HANDS. Little finger rests on last rib.

C. DOWNWARD PRESSURE. Arms and thighs vertical.

D. REST POSITION. Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

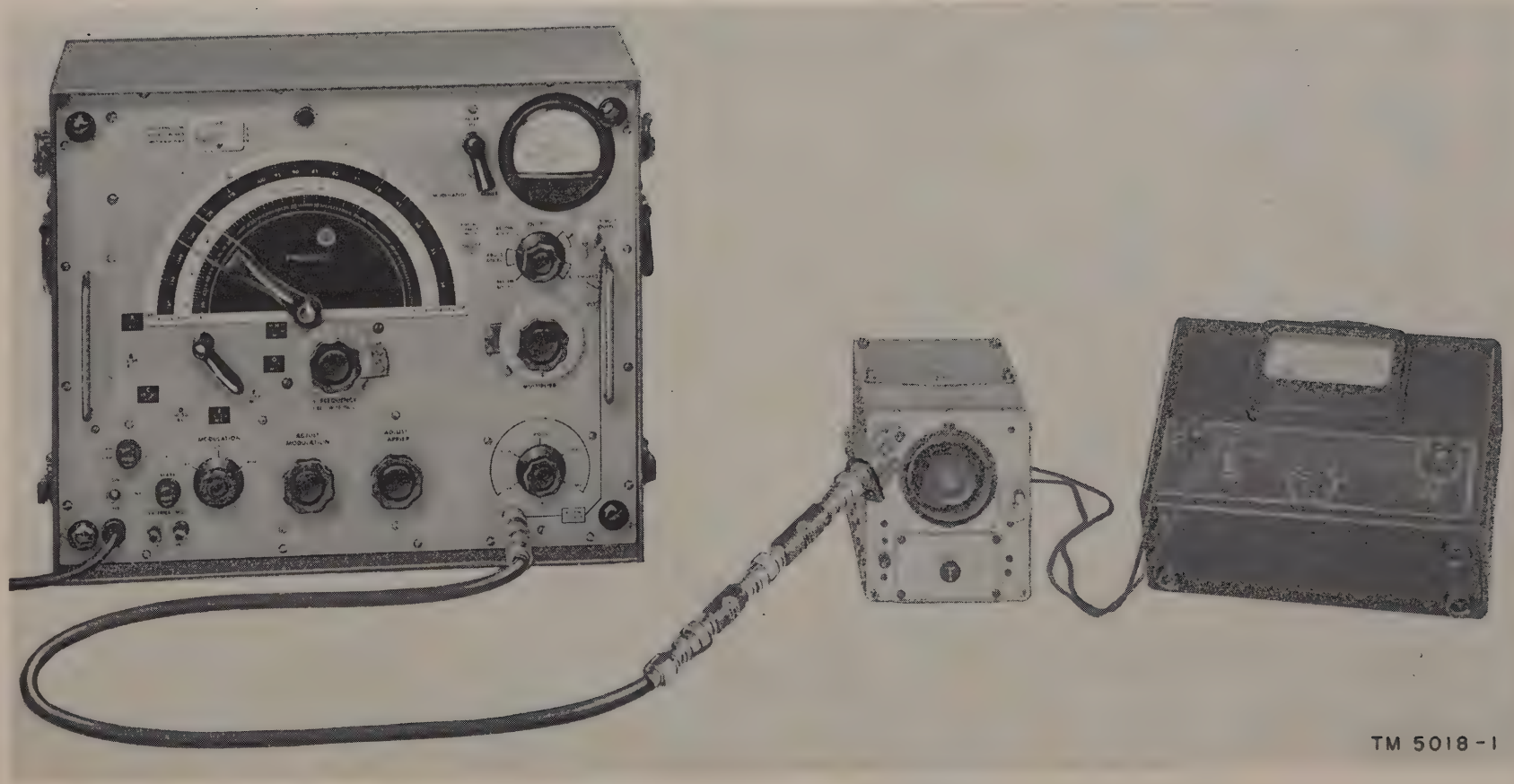


Figure 1. Signal Generator TS–588A/U.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, maintenance, and repair of Signal Generator TS–588A/U (fig. 1). It also contains a functional description of the component parts and a discussion of the theory of operation.

b. Supplementing these instructions are an index and two appendixes, which contain references and an identification table of parts.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army matériel and equipment.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5.

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. DA AGO Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form.

d. DA AGO Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form.

e. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Signal Generator TS–588A/U (fig. 1) is a portable, self-contained test equipment that provides accurately calibrated a-m (amplitude-modulated) or c-w (continuous-wave) test signals in the carrier frequency range of 5 kc (kilocycles) to 50 mc (megacycles). The amplitude of the carrier input to a calibrated output attenuator is measured by a built-in VTVM (vacuum-tube voltmeter). Thus, by first adjusting the input to the attenuator and then adjusting the attenuator, accurately measured carrier output voltages from .1 μv (microvolt) to .2 volt may be obtained from ATTEN. OUTPUT jack. Output voltages up to 2 volts may be obtained from a separate 2 VOLT OUTPUT jack. The signal generator operates from either a 105- to 125-volt or a 210- to 250-volt, 40- to 60-cycle a-c (alternating-current) power source.

b. The output signal may be amplitude-modulated up to 80 percent by an internal 400-cycle oscillator. An external a-f (audio-frequency) oscillator may be connected to the front panel EXTERNAL MOD. terminals to obtain up to 80 percent modulation at frequencies from 20 cycles to 15 kc.

c. A coaxial output cable and suitable terminating units are furnished for connecting the signal generator to the unit to be tested.

4. Application of Equipment

a. Signal Generator TS–588A/U is used primarily to aline and test the r-f (radio-frequency) and i-f (intermediate-frequency) circuits of radio receivers. Because of its accurately calibrated output, the signal generator may be used for measuring the sensitivity and selectivity of receivers, as well as for making

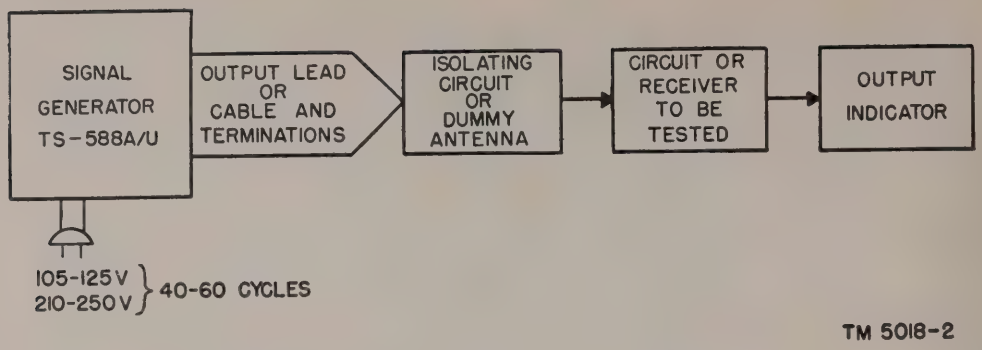


Figure 2. Typical test set-up, block diagram.

routine alinement adjustments. With an external audio oscillator to amplitude-modulate its carrier frequency, the signal generator also may be used to measure the a-f response of a receiver. *Always use the test procedures given in the technical manual for the equipment being tested.* The block diagram in figure 2 shows a typical test set-up.

b. The signal generator is also useful as a secondary r-f voltage standard for field intensity measurements, as a voltage source for many bridge measurements, and as a source of test signals for testing supersonic equipment.

5. Technical Characteristics

Frequency ranges:

Band	*Dial*	*Range*
A	Black	5–15 kc.
B	White	15–50 kc.
C	Black	50–150 kc.
D	White	150–500 kc.
E	Black	.5–1.5 mc.
F	White	1.5–5.0 mc.
G	Black	5.0–15.0 mc.
H	Black	15.0–50.0 mc.

Frequency calibration ..... Accurate to 1 percent

Output voltage ranges:

ATTEN. OUTPUT jack. Open-circuit voltage, adjustable from .1 μv. to .2 v; with output cable and terminating units, adjustable from .05 μv. to .1 v.

2 VOLT OUTPUT jack. Up to 2 v at frequencies up to 15 mc.

Output impedances:

ATTEN. OUTPUT ..... Approximately 15 ohms, except with attenuator in .1V. 50 OHMS position.

Terminated cable ..... 25 ohms; 1 ohm with 100:1 VOLTAGE DIVIDER.

2 VOLT OUTPUT ..... Approximately 300 ohms.

Amplitude modulation:

Percentage ..... Adjustable from 0 to 80 percent.

Frequency (internal) ..... 400 cyc.

Frequencies (external). 20 cps to 15 kc; 12-v input to EXTERNAL MOD. 4000 OHMS terminals for 80 percent modulation.

Noise level ..... Carrier noise less than .1 percent modulation.

Frequency modulation (spurious). Less than 100 cps/mc at 80 percent am; up to 300 cps/mc on band H.

Envelope distortion ..... Less than 6 percent at 80 percent am.

Modulation meter ..... SET CARRIER scale and percent MODULATION scale.

Radiation ..... Stray fields less than 1 μv/meter 2 ft. from case.

Number of tubes ..... 8.

Types of tubes:

V1, power rectifier ..... 5Y3GT.

V2, voltage regulator ..... OD3.

V3, voltage regulator ..... OC3.

V4, carrier oscillator ..... 6C4.

V5, amplifier-modulator ..... 6AQ5.

V6, audio oscillator ..... 6AK6.

V7, VTVM ..... 6AL5.

V8, cathode follower ..... 6C4.

Power supply ..... 105–125 v, or 210–250 v, 40–60 cyc, ac.

Accessories ..... Output cable, 3-ft coaxial; 50 OHM TERMINATION; 40 OHM SERIES UNIT; 100:1 DIVIDER; DUMMY ANTENNA; B.P. adapter; BNC adapter unit; and 1 wrench, 3/32, for Allen-head screws.

Dimensions ..... 14½ in. high, 17½ in. long, and 9 in. deep.

Weight ..... 55 lb.

6. Packaging Data

a. When packaged for export shipment, Signal Generator TS–588A/U with its accessories and spare tubes is placed in a moisture-vapor-

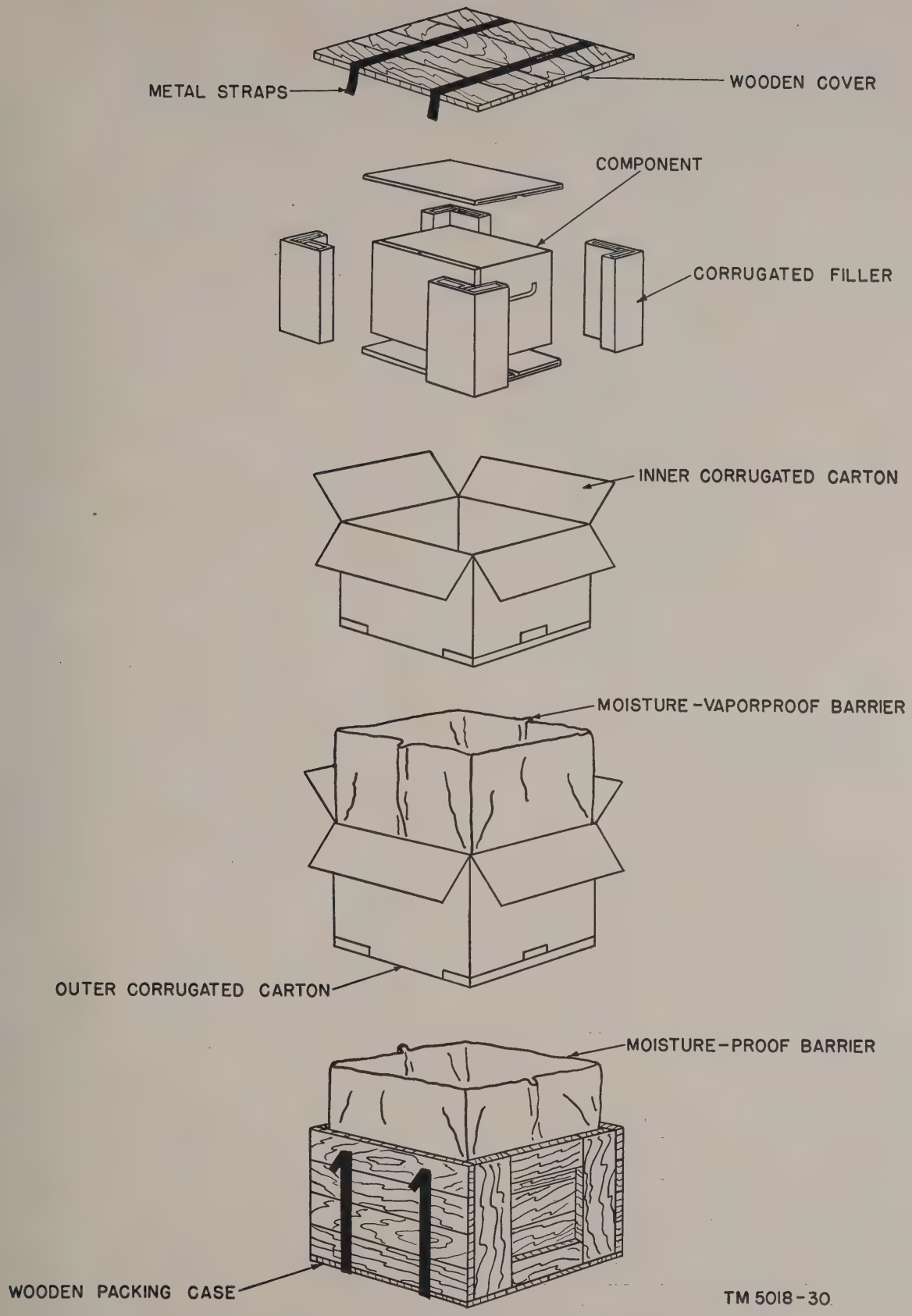


Figure 3. Signal Generator TS-588A/U, packing and packaging.

proof container and is packed in one wooden export box. When packed for export shipment (fig. 3), the unit is 17½ inches by 20½ inches by 12 inches. The package weighs 75 pounds and its volume is 2.5 cubic feet. When packed for domestic shipment, the unit dimensions are the same as for export shipment, except that the weight is only 74 pounds.

b. The following list indicates the contents of the case. See the packing list attached to each case for exact contents.

Case dimensions (in.)	Contents	Remarks
Export package: 17½" x 20½" x 12".	1 Signal Generator TS–588A/U	Operating tubes in place in sockets.
Domestic package: 17½" x 20½" x 12".	1 coaxial output cable with plug and receptacle	Clipped inside cover.
	1 50-ohm termination unit	In clips in cover.
	1 40-ohm series unit	Do.
	1 100:1 voltage divider	Do.
	1 dummy antenna	Do.
	1 cable to binding post adapter unit	Do.
	1 cable to BNC adapter unit	Do.
	1 power cord with plug	Attached, stowed around posts on panel.
	1 wrench, 3/32" Allen	In clip in cover.
	2 technical manuals	Do.
	4 spare fuses, 1 amp	In clips in back of case.
	4 spare fuses, ½ amp	Do.
	1 spare tube 5Y3GT	In mount in back of case.
	1 spare tube OC3	Do.
	1 spare tube OD3	Do.
	1 spare tube 6C4	In socket in back of case.
	1 spare tube 6AQ5	Do.
	1 spare tube 6AK6	Do.
	1 spare tube 6AL5	Do.

7. Table of Components
(figs. 4 and 16)

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu ft)	Unit weight (lb)
Signal Generator TS–588A/U with tubes, spare tubes, and fuses but less cover.	1	14½	9	17½	1.32	50.67
Cover (less accessories)	1	14½	¾	17½		4.33
Coaxial output cable	1	¾	¾	36		
50-ohm termination unit	1	¾	¾	3½		
40-ohm series unit	1	¾	¾	2⅞		
100:1 voltage divider	1	¾	¾	4		
Dummy antenna	1	¾	¾	4⅛		
Binding post adapter	1	⅞	1½	2⅝		
BNC adapter	1	¾	¾	3		
Wrench	1	5/32	⅝	3½		
Technical manual, TM 11–5018	2	10¼	¼	7⅞		
Spare fuse, 1 amp	4	9/32	9/32	1¼		
Spare fuse, ½ amp	4	9/32	9/32	1¼		
Spare tube 5Y3GT	1	1½	1½	3⅜		
Spare tube OC3	1	1⅝	1⅝	4⅛		
Spare tube OD3	1	1⅝	1⅝	4⅛		
Spare tube 6C4	1	¾	¾	2⅛		
Spare tube 6AQ5	1	¾	¾	2⅝		
Spare tube 6AK6	1	¾	¾	2⅛		
Spare tube 6AL5	1	¾	¾	1¾		
Total					1.32	55.

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

8. Description of Signal Generator TS–588A/U

a. Signal Generator TS–588A/U (fig. 4) generates c-w or a-m test signals within the range of 5 kc to 50 mc. The frequency calibration dial has three strips—the outer black strip with the basic numerals 50–160 is for bands A, C, E, and G; the middle white strip with the basic numerals 15–50 is for bands B, D, and F; and the inner black strip with annular lines and the numerals 15–50 is for band H. The transparent tip the frequency pointer has two hairlines, one on the front and the other directly beneath it on the back. When viewed from directly above, these lines appear as one line and the FREQUENCY dial is being read from the same position as in calibration.

b. The FREQUENCY pointer is turned through a reduction gear by the knob marked % FREQUENCY. Since the tuning curve is logarithmic for bands A through G, the dial on this knob is calibrated from 0 to 15 percent with the divisions of .1 percent. This percentage dial is read through the transparent pointer to the right. It sometimes is called an incremental frequency dial, because it permits evaluation of small detunings from any *initial setting* as a percentage above or below the frequency at the initial setting. The capacitance ratio for band H differs from that of the other bands and, therefore, the % FREQUENCY dial is not used for band H.

c. The desired frequency band is selected by a frequency range or band switch with a lever-type knob, and the eight band designations are keyed to the annular rings of the FREQUENCY dial by suitable reversals of color.

d. There are two calibrated scales on the panel meter, one for the carrier voltage and the other for percentage of modulation. The carrier voltage scale has a prominent SET CARRIER graduation at midscale. With the carrier voltage set to this mark, the signal generator output voltage is read directly from the settings of the attenuator controls. With the carrier voltage set to a graduation above or below the SET CARRIER mark, the amplitude indicated by the attenuator controls must be multiplied by the meter reading (.4 to 1.6) to obtain the correct output voltage. The % MODULATION scale is calibrated to read percentage of modulation directly, regardless of the source of modulating voltage.

e. The METER TO switch beside the meter connects the meter to measure the CARRIER voltage or the MODULATION percentage.

f. A small port below the METER TO switch is marked ZERO ADJ. CARRIER METER. This port permits access to a screw-driver adjustment to zero the VTVM-type carrier meter.

g. The switch marked OUTPUT has four positions and two white line indicators. The right-hand line refers to the 2 VOLT OUTPUT jack in the first two counterclockwise positions of the switch and to the attenuator (ATTEN. OUTPUT) in the two clockwise positions. The left-hand line refers to BELOW 400 KC. in the extreme positions and to ABOVE 400 KC. in the two central positions. In this way, either the attenuated or high output is selected and the proper R-C (resistance-capacitance) output circuit is chosen to separate the modulating and carrier frequencies, according to the frequency of the latter.

h. With the carrier voltage adjusted to the scale line, SET CARRIER, the carrier output voltage from the attenuator is the product of the reading of the MULTIPLIER dial and the step attenuator setting. The continuously variable MULTIPLIER dial is calibrated from zero to 2.0, and it is read through an indicator at the left. The attenuator has six steps marked 1 μV., 10μV, 100 μV., 1 MV., 10 MV., and .IV. 50 OHMS. The output impedance of each of the 5 steps from 1 μV. to 10 MV. is approximately 10 ohms, as indicated by the panel marking.

i. A three-position switch marked MODULATION selects an unmodulated signal in the central OFF position, 400 $\sim$ at the right, and EXT. at the left. For the latter to be effective an external a-f oscillator must be connected to the two binding posts marked EXTERNAL MOD.

j. The power cord enters the panel at the lower left, and line power is controlled by the toggle-type LINE switch. Power ON is indicated by the marking of the switch and the pilot light above the FREQUENCY dial. A small plate to the left of the pilot light covers a transformer switch that permits selection of 115- or 230-volt line operation. Whenever this switch is reversed, the cover also must be reversed,

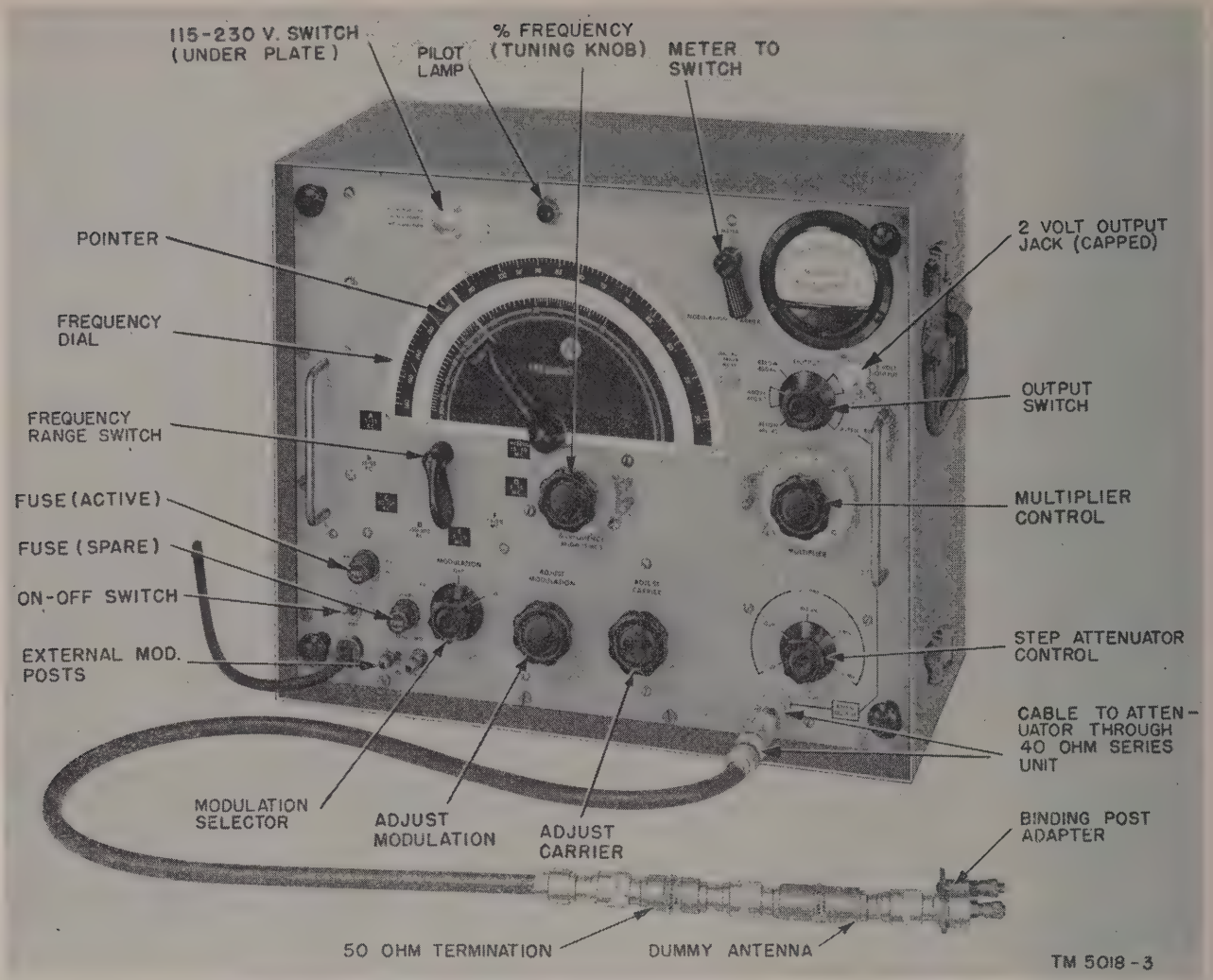


Figure 4. Signal Generator TS–588A/U, front view, cover removed.

and the line voltage for which the set is adapted is indicated on the panel.

k. The line fuseholder is designated 1 AMP 115V and ½ AMP 230 V; the spare fuseholder is marked SPARE. Fuses of both sizes are clipped in the back of the case.

9. Coaxial Output Cable, Terminations, and Adapters

These units are clipped into the cover and the output cable ends are screwed together for stowage only. One end of the cable can be attached either to the ATTEN. OUTPUT jack (fig. 1) or to the 2 VOLT OUTPUT jack. The other end of the output cable is fitted for attachment of the terminations and adapters (fig. 4). Circuit details of the terminations (Z1, Z2, Z3, and Z4) and the adapters (Z5 and Z6) are shown in the schematic diagram (fig. 31). Each has the proper type of N series fitting to prevent its being placed in the wrong direction in the cable sequence. A better understanding of the terminations and adapters is obtained from a review of their application (par. 20).

10. Running Spares

A group of running spares is supplied with each Signal Generator TS–588A/U and is stored on the shelf in the back of the case. The following is a list of running spares:

4 Fuses MDM–1, 1 ampere.
4 Fuses MDM–½, ½ ampere.
1 Tube 5Y3GT.
1 Tube OD3.

1 Tube OC3.
1 Tube 6C4.
1 Tube 6AQ5.
1 Tube 6AK6.
1 Tube 6AL5.

11. Additional Equipment Required

When Signal Generator TS–588A/U is used to aline and test radio receivers, some form of output indicator is required. In general, one of the following three types of output meter may be used:

a. Copper-Oxide Rectifier Output Meter. A typical output meter of this type is Multimeter TS–352/U. When used in receiver alinement, this type of meter is connected to the audio output of the receiver under test.

b. Cathode-Ray Oscilloscope. A cathode-ray oscilloscope is a more sensitive type of output indicator than a copper-oxide rectifier meter, and it is not so likely to be damaged by excessive input signals. It may be connected to any point in the audio circuit of the receiver. It also can be used to compare the waveform of the audio voltage, as it is detected by the receiver, with the waveform of the modulated signal output from the signal generator. A typical oscilloscope is Oscilloscope BC–1060–A.

c. Sensitive D-C Voltmeter. A sensitive d-c (direct-current) voltmeter is connected directly into the detector circuit as an output indicator when the selectivity of the receiver to be alined is so great that it will not pass a 400-cycle modulated signal.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF SIGNAL GENERATOR TS–588A/U

12. Siting

a. Signal Generator TS–588A/U should be placed upon a substantial bench, preferably to the left and within output cable length of the receiver to be tested. Release the signal generator cover by means of the four snap catches and place it where the cables and fittings will be within easy reach. If an audio oscillator is to be used for external modulation, place it to the left of the signal generator, *not* on top of it. The power transformer of the audio oscillator may induce a power line hum into the signal generator carrier output, particularly when a low-frequency carrier is in use.

b. Vibrations from the loudspeaker of the receiver under test may be transmitted through a thin or flimsy bench top to parts of the signal generator oscillator circuit. This feedback may produce from the speaker a sustained howl which is independent of the degree and frequency of the modulation applied to the signal generator. To remedy this, reduce the audio gain control setting of the receiver to well below the howl point, or substitute a resistance load for the speaker. If test conditions do not permit either remedy, place the signal generator and receiver on separate substantial benches or stands.

13. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, see paragraph 15.

a. General. Equipment may be shipped in export packing cases, in domestic packing cases, or in carrying cases. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and which is convenient to the permanent or semipermanent installation of the equipment. The instructions in *b* below apply to equipment shipped in export packing cases, and the instructions in *e* below apply to equipment in domestic packing cases. Aside from checking to make sure that all carrying cases are present and that the equipment is undamaged, no special unpacking and uncrating procedures are necessary for equipment shipped in carrying cases.

Caution: Be careful in uncrating, unpacking, and handling the equipment; it is damaged easily. If it becomes damaged or exposed, a complete overhaul might be required or the equipment might be rendered useless.

b. Instructions for Uncrating and Unpacking Export Shipments. Figure 3 shows the details of the export packaging.

c. Opening Cardboard Carton and Waterproof Barrier. No special instructions are needed for opening the waterproof paper barrier and removing the equipment from the cardboard carton.

d. Checking. Check the contents against the master packing slip.

e. Unpacking Domestic Packing Cases. The equipment may be received in domestic packing cases. The instructions in *b* above apply also to unpacking domestic shipments. Open the cartons that protect the equipment or, if heavy wrapping paper has been used, open it carefully and take out the components. Check the contents of the packing case against the master packing slip.

Note. Save the original packing cases and containers for both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

14. Installation of Signal Generator TS–588A/U

a. All operating tubes are in place when the

signal generator is shipped.

b. Transformer switch S7 is in the 115 V. position (this designation appears on the panel to the right of the cover plate), and 1-ampere fuses are installed in the fuseholders. Before plugging the line cord into the power source, make certain that the supply is 105- to 125-volt, 40- to 60-cycle ac and that a voltage of at least 105 volts can be maintained under load.

c. If the power supply is 210- to 250-volt, 40- to 60-cycle ac, remove the 17 hexagon-headed screws around the edge of the panel and pull the unit from the case to gain access to the spare fuses in the back of the case. Replace the two 1-ampere fuses with two ½-ampere fuses. After replacing the unit in the case, remove the two screws in the plate over the transformer switch and flip the toggle to the right. The plate now must be reversed to fit and this reversal exposes the 230 V designation on the panel.

d. Because of the line filter capacitors in the generator, there is between the case and ground a potential difference equal to one-half the line voltage. This potential difference may give the operator an unpleasant shock whenever he touches the panel. To avoid this condition, connect the left-hand EXTERNAL MOD. post to a good ground, such as a grounded conduit or a stake driven into the earth. The power cord now may be plugged into the most convenient outlet.

15. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 13 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note the changes in this manual, preferably on the schematic diagram.

c. Check the operating controls for ease of rotation.

d. Perform the siting and installation procedure given in paragraphs 12 and 14.

Section II. CONTROLS AND INSTRUMENTS

16. General

Haphazard operation or improper setting of the controls can cause damage to electronic equipment. For this reason, it is important to know the function of every control. The actual operation of the equipment is discussed in paragraphs 18 through 26.

17. Signal Generator TS–588A/U Controls (fig. 5)

The following table lists the signal generator controls and indicates the function of each:

Control	Function
LINE ON-OFF switch (S6)	In ON position, connects generator to a-c power source.
FREQUENCY dial (I4)	Indicates, in conjunction with band switch, the carrier frequency to which generator is set.
% FREQUENCY (BELOW 15 MC.) control knob (I3).	Tuning knob, controls pointer of FREQUENCY control dial. Incremental frequency dial indicates small percentages of detuning from original frequency setting.
Band switch knob (S2)	Selects band of frequencies within which the desired carrier frequency lies.
METER TO switch (S3)	Two-position switch shifts meter M1 to indicate either the carrier output or the percentage of am of the carrier.
OUTPUT switch (S4)	Four-position switch; two positions connect carrier output to 2 VOLT OUTPUT jack; two positions connect carrier output to the attenuator. One pair of positions is used for modulating frequencies ABOVE 400 KC.; the other positions are used for modulating frequencies BELOW 400 KC.
MULTIPLIER (R14)	Continuously variable carrier output control; dial calibrated 0–2.0. Product of dial reading and the attenuator setting is the open-circuit output voltage.
Step attenuator control (S5)	A six-position selector switch in decimal steps of 1 μv to .1 v. Selects range of output voltage.

Control	Function
ADJUST CARRIER control (R24)	A potentiometer controlling the plate voltage to the carrier oscillator tube. Resultant carrier voltage is indicated on meter when METER TO switch is in CARRIER position.
ADJUST MODULATION control (R25)	A potentiometer controlling the modulating voltage at the grid of the carrier modulating tube. Resultant percentage of modulation is indicated by meter when METER TO switch is in MODULATION position.
MODULATION switch (S1)	A three-position switch, EXT., OFF, 400 ~; selects modulation from either the 400-cycle self-contained oscillator or from an external source of 20 cps to 15 kc; in OFF position, modulation is zero irrespective of settings of the ADJUST MODULATION control or the external oscillator controls.
EXTERNAL MOD. binding posts (E5 and E6).	For connecting external audio oscillator. Impedance is 4,000 OHMS; 12 v are required for 80 percent modulation.
2 VOLT OUTPUT jack (J2)	For high carrier voltage output; amplitude of output controlled only by ADJUST CARRIER control and meter; 300-ohm output impedance. *Jack must be capped when not in use.*
ATTEN. OUTPUT jack (J1)	Output cable connection for carrier voltage range indicated by MULTIPLIER control and attenuator setting.
Pilot lamp (E4)	Indicates that line power is ON and power circuit is complete to primary of power transformer.
Transformer switch (S7)	Changes power transformer primary connections from 115-v operation. Change of fuse also required.
FUSE: 1 AMP 115 V. or ½ AMP 230 V.	Main fuse in primary of power transformer.
FUSE: SPARE	Spare fuse. Additional spares inside case.
ZERO ADJ. CARRIER METER (R17)	Potentiometer with screwdriver slot under cap. Used to bring carrier meter reading to zero, when required.

Section III. OPERATION UNDER USUAL CONDITIONS

18. Preliminary Starting Procedure

a. Make certain that the instructions in paragraphs 12 and 14 have been carried out correctly.

b. Turn the METER TO switch to CARRIER, and turn the ADJUST MODULATION and ADJUST CARRIER controls to their extreme counterclockwise positions. Turn the LINE switch to the ON position and note the pilot light indication. If all is in order, the meter pointer will swing below zero and then return to zero.

c. If the meter pointer does not return to zero after 3 or 4 minutes, remove the plug button marked ZERO ADJ. CARRIER METER. Insert a screw driver and adjust the control slowly right or left as required to bring the meter pointer to zero.

d. Select any frequency and the corresponding position of the OUTPUT switch. Turn the ADJUST CARRIER control clockwise to obtain a SET CARRIER indication on the meter. Return the ADJUST CARRIER control to zero.

e. Turn the MODULATION switch to 400 ~ and the METER TO switch to MODULATION. Advance the ADJUST MODULATION control clockwise to obtain an increased reading on the meter scale. This indicates that the internal audio oscillator and modulating circuits are in good running order. Return the ADJUST MODULATION control to its extreme counterclockwise position.

19. External Modulation

a. If tests are to be made with modulation frequencies other than 400 cycles, an external audio oscillator must be used. This external oscillator should have a frequency range of 20 cps (cycle per second) to 15 kc, and it must be able to supply at least 12 volts to a 4,000-ohm load. Audio Oscillator TS–382A/U is suggested for this purpose.

b. Connect the output cable of the audio oscillator to the EXTERNAL MOD. posts. The chassis side of the audio oscillator output connector must be connected to the chassis side of the signal generator (the left-hand EXTERNAL MOD. post). Turn the MODULATION switch to EXT.

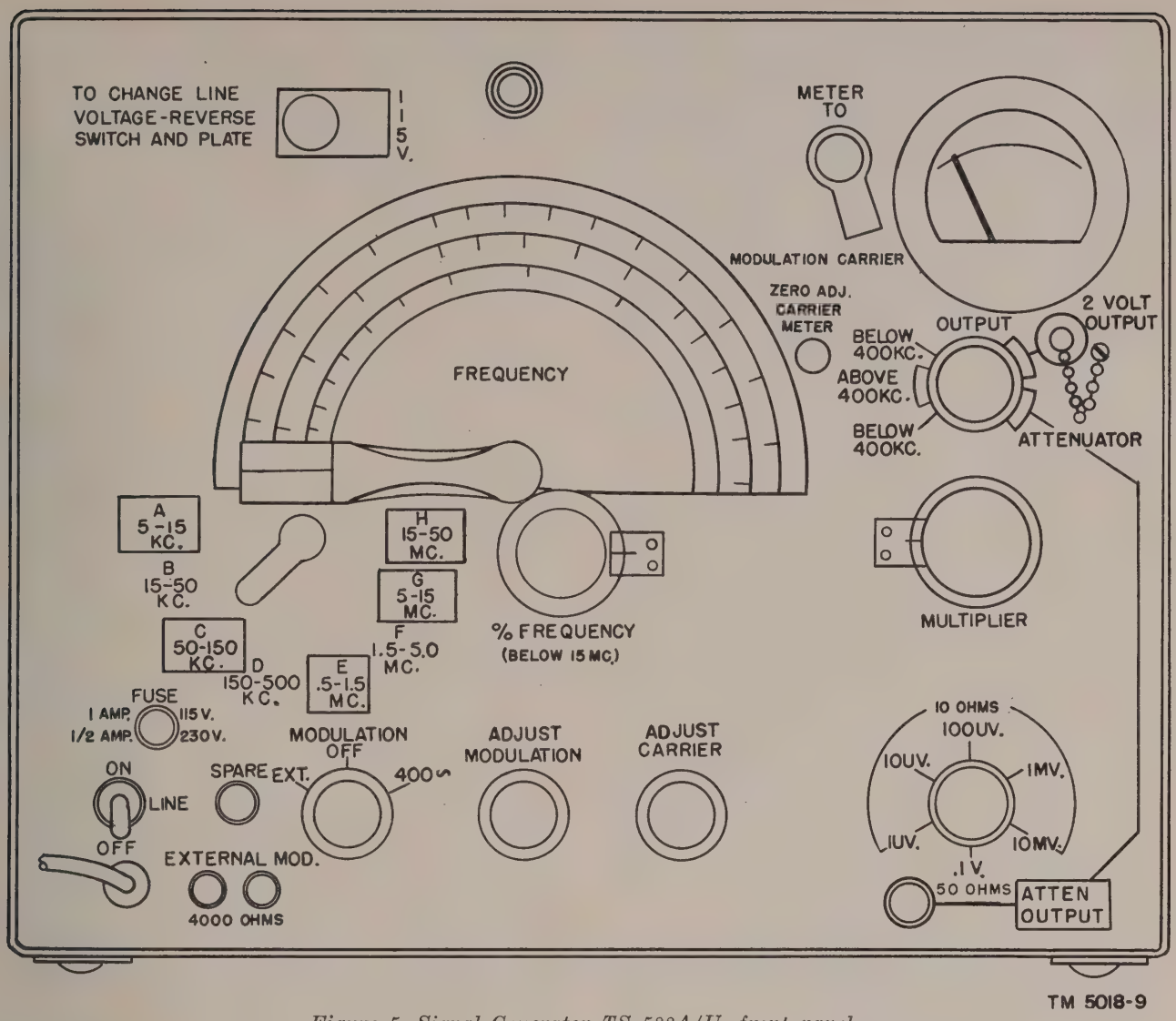


Figure 5. Signal Generator TS–588A/U, front panel.

c. Set the *audio oscillator* output control to zero and turn the signal generator METER TO switch to MODULATION. Turn the ADJUST MODULATION control to its extreme *clockwise* position and then adjust the *audio oscillator* output, so that the signal generator meter indicates modulation slightly greater than 80 percent. Leave the *audio oscillator* output control at this setting and use the signal generator ADJUST MODULATION control to make subsequent modulation adjustments. (If the audio oscillator output is not constant over the a-f range, it may be necessary to readjust the audio oscillator output control.)

20. Output Cable Termination

a. At carrier frequencies below 1.5 mc, use the unterminated output cable from either the ATTEN. OUTPUT jack or the 2 VOLT OUTPUT jack, according to the carrier voltage required. Use the B.P. adapter (Z5, fig. 31) on the output end of the cable with short wires for connections into the circuit being tested. If the input of the receiver, or other equipment under test, is equipped with a type BNC fitting, use the BNC adapter (Z6, fig. 31) between the output of the cable and the receiver.

b. At frequencies below 100 kc, it is generally unnecessary to use the output cable, unless de-

sired. Connections may be made between the test circuit and B.P. adapter (Z5) with open wires, and the adapter may be plugged directly into the desired output jack. At frequencies above 2 mc, it is generally necessary to use this arrangement on the 2 VOLT OUTPUT jack; otherwise, the available output is reduced by the capacitance of the unterminated low-impedance cable across the relatively high impedance (300 ohms) at this jack. When using the B.P. adapter, note that the central post is the *hot* side; the offset post always is connected to the frame or chassis side of the test circuit.

c. When carrier frequencies above 1.5 mc are taken from the ATTEN. OUTPUT jack, proper termination of the 50-ohm output cable becomes important to avoid reflection errors. The signal generator panel marking (figs. 4 and 5) shows that the 50-ohm cable is terminated properly at the generator end only when the step attenuator is in its .1V. position. At lower voltage steps of the attenuator, the output impedance of the signal generator is about 10 ohms; therefore, the 40 OHM SERIES UNIT (Z3) must be inserted between the ATTEN. OUTPUT jack and the cable. The open-circuit output voltage at the output end of the cable is still as indicated by the panel controls, but the output impedance of the signal generator is increased to 50 ohms to match the cable impedance.

d. At frequencies above 1.5 mc, the cable should be terminated at its output end by attachment of the 50 OHM TERMINATION (Z4). The effective voltage at the output of the cable is then *one-half* the value indicated by the panel controls. This termination may be used at any carrier frequency if the lower impedance and output voltage is adequate for the tests to be made.

e. At any carrier frequency and with the cable terminated at both ends as described in *d* above, the 50 OHM TERMINATION may be removed and replaced with the 100:1 DIVIDER (Z2, fig. 33). The 50-ohm cable then is terminated correctly, but the effective output impedance is 1.0 ohm and the output voltage is 1/100 of the voltage indicated by the panel controls; for example, 5 μv, as read on the panel controls, is actually a .05-μv output.

f. With any of the output combinations of *b*, *c*, *d*, or *e* above, the DUMMY ANTENNA (Z1, fig. 33) may be added between the output termination and the receiver input. The DUMMY ANTENNA impedance in the 540- to 1600-kc range approximates that of an open-wire antenna which is resonant at about 2,500 kc and has a capacity of about 200$\mu\mu$f (micromicrofarads). At higher frequencies, the impedance of the DUMMY ANTENNA is 400 ohms, resistive. If a dummy antenna of different impedance is recommended in the receiver manual, use the recommended dummy antenna between the B.P. adapter and the receiver antenna posts.

g. To any of the cable set-ups described, the B.P. adapter (Z5) or the BNC adapter (Z6) may be added to the output end of the string to facilitate connection to the receiver or device to be tested. Ordinarily, there is no applicable correction for voltage or impedance because of the use of either adapter.

h. For an example of cable set-up, refer to figure 4. The attenuator switch is in the 10 μV. position and the output impedance is approximately 10 ohms. This requires that the 40 OHM SERIES UNIT (Z3) be used between the ATTEN. OUTPUT jack and the 50-ohm output cable. The 50 OHM TERMINATION (Z4) is shown on the output end of the cable, followed by the DUMMY ANTENNA (Z1) and the B.P. adapter (Z5). Be sure that the fittings in such a string are screwed firmly to one another to assure correct output and to avoid circuit noise.

21. Connections to Radio Receiver

Note 1. The details of alinement and test procedures for various receivers are different. The appropriate technical manual should be consulted when preparing to aline or measure a receiver. *The steps and connections given in this section are general and should be used only when specific information is not available.*

Note 2. The following assumes that the signal generator output cabling has been arranged in accordance with paragraph 20 and in accordance with the carrier frequency to be used.

a. For over-all sensitivity, selectivity, and fidelity tests, use a dummy antenna between the signal generator cable output and the antenna-ground connection to the receiver. (If the receiver technical manual does not recommend the standard dummy antenna, follow the manual instructions explicity; otherwise add the standard DUMMY ANTENNA (Z1) to the cable output and use the B.P. (Z5) or BNC (Z6) adapter to make connections to the receiver.)

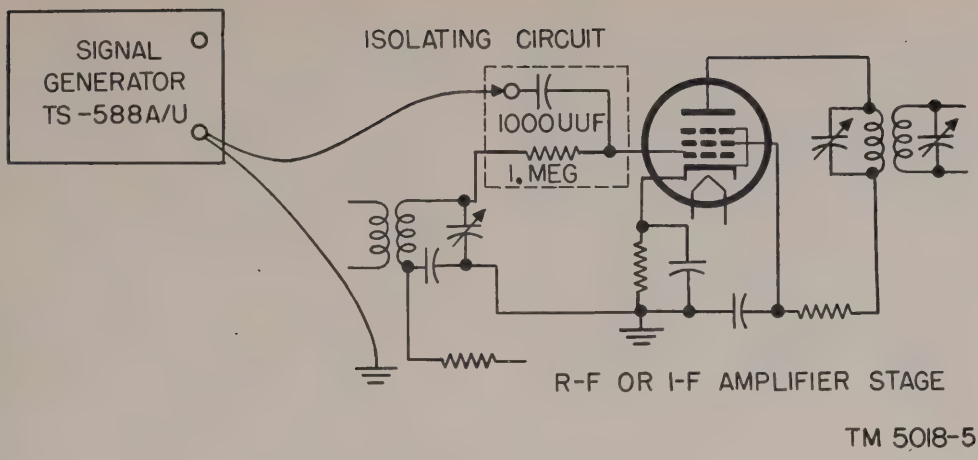


Figure 6. Typical isolating circuit.

b. For alining receivers or measuring their characteristics at intermediate and radio frequencies, it is usually necessary to connect the signal generator so that the receiver avc (automatic volume control) or other bias circuits in the receiver are not short-circuited. A typical isolating circuit is shown in figure 6; the values shown for the capacitor and resistor are not critical.

22. Output Connections, Indicator to Receiver

a. The available output indicator (figs. 1 and 2) will determine to some extent the manner in which to operate Signal Generator TS–588A/U.

b. If a copper-oxide, rectifier-type, a-c instrument is used, connect it across the audio output circuit of the receiver. The receiver speaker may be left in the circuit, and an instrument with an arbitrary calibration may be used for ordinary alinement purposes. *Standard sensitivity measurements must be made in accordance with the receiver technical manual instructions.*

c. The receiver technical manual instructions must also be used for making fidelity tests. Note that fidelity curves (fig. 7) should include a complete notation of the conditions under which they are made.

d. For standard selectivity tests, the receiver technical manual instructions must be available. Figure 8 shows the selectivity curve for a typical receiver.

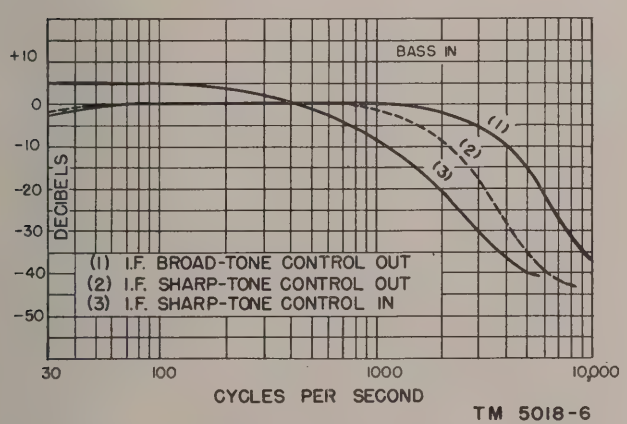


Figure 7. Fidelity curve for radio receiver.

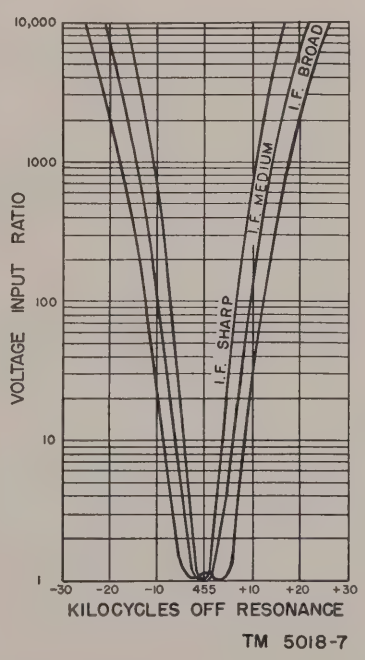


Figure 8. Selectivity curve for radio receiver.

e. A cathode-ray oscilloscope may be used as an output indicator for alinement of a receiver; connect it to any point in the audio circuits of the receiver.

f. On very selective receivers, where the selectivity is of the order of a few hundred cycles, it may be necessary to use a sensitive d-c voltmeter (preferably a VTVM) as the output indicator. The meter may be connected into the detector circuit as shown in figure 9. Refer to the receiver technical manual for detailed instructions.

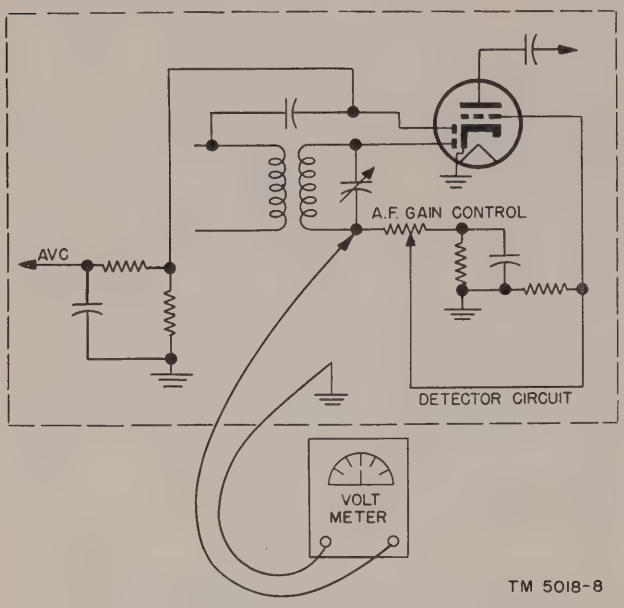


Figure 9. Connection of d-c VTVM to detector.

23. Setting Generator Controls

a. Select the desired carrier frequency as indicated by the selector switch and the FREQUENCY dial. Always use the % FREQUENCY knob; do not attempt to adjust by forcing the pointer. The outermost and center calibration strips of the FREQUENCY dial have basic numerals only. Consequently, the numerical reading must be pointed off (divided or multiplied) according to the band in use. For example, in figure 4, the range selector is on band E .5–1.5 MC. and the FREQUENCY pointer reads 120 on the outer calibration (light figures). Accordingly, point off the 120 to read 1.20 mc. The innermost scale is calibrated to read frequency in mc directly.

b. The % FREQUENCY dial is used to obtain accurate small percentage *changes* in frequency, such as those required for plotting selectivity curves. Assume that it is desired to plot the selectivity curve of a 455-kc i-f amplifier. After adjusting the signal generator for the desired output voltage, vary the signal generator frequency slowly about the 455-kc point to find the exact resonant frequency of the i-f amplifier, as indicated by the output meter. To change the signal generator frequency to a frequency 1.0 percent above this resonant frequency, rotate the % FREQUENCY dial to read 1.0 percent higher than at the resonant frequency. For example, if the % FREQUENCY dial is at 12.2 at the resonant frequency, rotating the dial to 13.2 will increase the signal generator frequency 1.0 percent, that is, from 455 kc to 459.55 kc. Similarly, a 2-percent increase is obtained by rotating the % FREQUENCY dial to 14.2, and a 2-percent decrease is obtained by rotating the % FREQUENCY dial to 10.2. When used in this manner, the % FREQUENCY dial is accurate for 5-percent changes in frequency. For changes greater than 5 percent (fig. 10), the actual percentage change (solid line) deviates from the dial indicated change (dashed line).

c. Output voltage is obtained at either the 2 VOLT OUTPUT jack or the ATTEN. OUTPUT jack. To prevent carrier leakage, cover

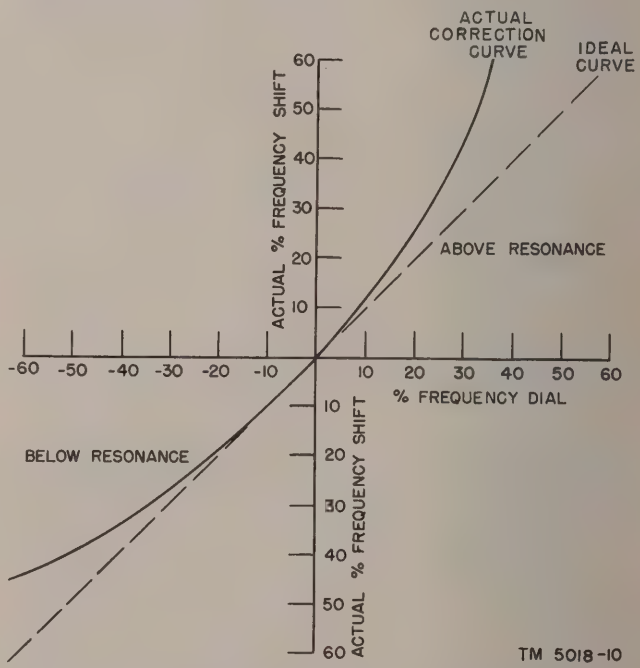


Figure 10. Curve showing actual percentage change as % FREQUENCY dial is varied.

the 2 VOLT OUTPUT jack with its cap when the ATTEN. OUTPUT jack is used. The OUTPUT switch has two positions for each jack. After the desired jack is selected, as shown by the right-hand white indicator line, set the left-hand indicator according to whether the *carrier* frequency is ABOVE 400 KC. or BELOW 400 KC.

d. To obtain carrier voltage at the ATTEN. OUTPUT jack, establish a fixed voltage at the input of the attenuator system by setting the METER TO switch to CARRIER and adjusting the ADJUST CARRIER control to bring the meter pointer to the midscale line marked SET CARRIER. Adjust the open-circuit voltage at the ATTEN. OUTPUT jack by selecting the proper step on the attenuator and setting the MULTIPLIER dial, so that the product of the two readings is equal to the desired output voltage (par. 8*h*).

Note. When using output cable terminations, refer to paragraph 20 for information on their effects on output voltage.

e. The output impedance at the ATTEN. OUTPUT jack is about 10 ohms on all but the .1V. 50 OHMS step of the attenuator. It is 50 ohms when the attenuator is at .1V. 50 OHMS and the MULTIPLIER dial is set at zero. At other settings of the MULTIPLIER dial, the output impedance of the .1V. 50 OHMS position is somewhat less than 50 ohms, and it reaches a minimum of 43.7 ohms at the full-scale setting of 2.0. This change in output impedance has no effect on the open-circuit voltage. However, when a terminated cable (par. 20*d*) is used, the impedance variation must be considered if the best accuracy is necessary. Errors due to this variation of impedance may be eliminated by adjusting the output to SET CARRIER with the attenuator at any setting except .1V. 50 OHMS. Reset the attenuator to the .1V. 50 OHMS step. The meter reading will decrease somewhat at high settings of the MULTIPLIER dial. However, the output voltage will be correct if the ADJUST CARRIER control is *not* reset.

f. If the 2 VOLT OUTPUT jack is selected by the OUTPUT switch, the output voltage is 2.0 volts when the meter is adjusted to SET CARRIER. If this meter setting cannot be obtained with the ADJUST CARRIER control at maximum, the load impedance connected to the 2 VOLT OUTPUT jack is too *low* for the available power. The voltage at the 2 VOLT OUTPUT jack may be adjusted to various multiplying factors below and above the SET CARRIER point when the load and available power permit. There may be a small shift in frequency and an increase in distortion for multiplying factors above 1.0.

g. To amplitude-modulate the carrier, set the MODULATION switch to 400 ~, or to EXT. (par. 19). Set the METER TO switch to MODULATION and vary the ADJUST MODULATION control to obtain any desired degree of modulation up to 80 percent, as indicated on the meter. With high percentage modulation at 400 cycles and below, the carrier level is reduced a small amount, and it must be readjusted to SET CARRIER on the meter. At higher modulating frequencies, the modulating voltage will affect the carrier meter reading, particularly when the OUTPUT switch is set to BELOW 400 KC. Reset the carrier level at a modulating frequency of 400 cycles, or lower; then apply the required higher modulating frequency. The actual carrier level now will be correct, *even though the carrier meter does not indicate the correct level.*

h. When the OUTPUT switch is set to 2 VOLT OUTPUT, the carrier meter is, in effect, directly across the 2 VOLT OUTPUT jack and the effective output impedance is, therefore, zero.

24. Receiver Alinement, I-f Stages

Note. Consult the receiver technical manual for the procedure. When making measurements of over-all performance against representative data, be sure to duplicate *all* the conditions under which such data was taken. The following information is general; *use it only when specific instructions are not available.*

a. Aline the i-f stages of a receiver in order. Begin with the stage just preceding the detector and progress toward the mixer or converter stage. If the i-f stages are fairly close to correct alinement, connect the signal generator to the grid of the converter or mixer and aline the various stages in order without reconnection.

b. Connect the signal generator output to the grid of the desired stage and use an isolating circuit such as that shown in figure 6. Set the signal generator to the frequency at which it is desired to aline the i-f amplifier. Increase the generator output to obtain a *small* indication on the output indicator and attempt to increase this by trimming the stage.

Note. Never use a higher carrier voltage than is necessary to get a readable indication on the output indicator. Too high a voltage will actuate the avc circuit of the receiver and broaden the trimmer adjustments. This causes misalinement. It may be necessary to disable the avc circuit. Refer to the receiver technical manual.

c. If no output indication is obtained with the highest output voltage from the signal generator, the receiver may be alined on a different frequency. To see if output can be obtained, rotate the % FREQUENCY knob to rock the FREQUENCY dial pointer back and forth. (Ascertain the correct alinement frequency; do not assume that there is trouble in the receiver circuits.)

d. With an initial small output indication, adjust the trimmers to get maximum indication on the output indicator. If the output indicator tends to go off scale, *reduce the carrier voltage output from the signal generator.* This protects the output indicator and assures against misalinement due to overloading or avc action.

e. After securing the best alinement of a stage, adjust the carrier voltage so that the output indicator shows some arbitrary lower value. Connect the generator to the next preceding grid, aline the stage, and adjust the carrier voltage until the output indication is the same value as before. The ratio of the two carrier voltages is the gain of the stage in question. Record the data for the various stages of a receiver; it will be helpful when testing receivers of the same or similar type.

25. Receiver Alinement, R-f and Oscillator

Consult the receiver technical manual for the correct alinement frequencies and procedures. If the technical manual is not available, the following procedure may be used.

a. Use the DUMMY ANTENNA (Z1) between the signal generator and receiver. Select two alinement frequencies, one about 90 percent of the highest frequency in the receiver band and the other about 120 percent of the lowest frequency in the band.

b. Set both the signal generator and the receiver to the *higher* alinement frequency, and adjust the high-frequency trimmer of the oscillator for maximum response on the output indicator. Then adjust the mixer and r-f trimmers for maximum response. Always reduce the carrier output from the signal generator as the receiver output increases.

c. Set the signal generator at the lower alinement frequency of the band, and *tune the receiver* for maximum response. (The receiver dial reading should very nearly agree with the frequency of the signal generator.) If there is a low-frequency trimmer on the receiver oscillator, slowly rock the tuning dial of the receiver back and forth while adjusting the trimmer for maximum output.

d. Recheck the high-frequency oscillator trimmer at the high alinement frequency, and readjust it if necessary. Also recheck the low-frequency adjustment, since these two oscillator adjustments are not completely independent.

e. The receiver dial calibration now should check closely with the signal generator frequencies. If not, one of the following faults may be indicated:

(1) The i-f amplifier is not alined on the frequency for which it was designed.
(2) The oscillator is alined on the image of the signal generator signal; that is, the oscillator is set at a frequency lower than the signal frequency, whereas it should be higher, or vice versa.
(3) Components in the receiver are incorrect or defective.

f. If the signal generator carrier frequency and voltage required to obtain best response is recorded, the data will be useful for working on another receiver of the same type.

26. Stopping Procedure

a. Return the ADJUST MODULATION and ADJUST CARRIER controls to their minimum positions; that is, turn them as far as they will go in the counterclockwise direction.

b. Remove the output cable and all terminations and adapters in use; disjoint them; and stow each in its proper position in the cover.

c. Turn the LINE switch to OFF. Remove the line cord from the power receptacle and wrap it around the four panel buttons. The cover now may be replaced on the case and secured by the four catches.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

27. General

The operation of Signal Generator TS–588A/U may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In paragraphs 28–30, procedures are given for minimizing the effect of these unusual operating conditions. Alinement work should be done at approximately the temperature at which the receiver is to be operated.

28. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry and, if necessary, construct an insulated box for the generator. Keep the filaments of the vacuum tubes lighted constantly. To do this, turn the LINE switch to ON and turn the ADJUST MODULATION and ADJUST CARRIER controls to their extreme counterclockwise positions. Place a blanket over the generator to conserve the heat.

c. The generator should be removed from its case in a heated inclosure, so that there is no danger of a cold draft striking the glass tubes. A sudden draft of cold air is often sufficient to shatter the glass envelope of a heated tube. If the inclosure is constructed so that this is impossible, place a blanket or some barrier between the source of the draft and the equipment.

d. When equipment has been exposed to the cold, it will sweat when it is brought into a warm room. Dry the equipment thoroughly when it reaches room temperature. This condition also arises when equipment warms up during the day after exposure during a cold night.

29. Operation in Tropical Climates

When operated in tropical climates, radio equipment may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground and when it is set up in swampy areas, moist conditions are more acute than normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than that of the ambient air. To minimize this condition, place lighted electric bulbs under the equipment.

30. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures to insure proper operation of the equipment.

b. The main problem that arises with equipment operation in desert areas is the large amount of sand and dust which enters the moving parts of radio equipment. The ideal preventive precaution is to house the equipment in a dustproof shelter. However, since such a building is seldom available and would require air conditioning, the next best possible precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors and cover the inside walls with heavy paper. Use sand to secure the side walls of tents to prevent their flapping in the wind.

c. Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

d. Be careful to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks. Excessive amounts of dust, sand, or dirt that come into contact with the moving parts of the equipment will damage it.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

31. Tools and Materials Required for Preventive Maintenance

Necessary tools, instruments, and materials to be used with the signal generator are listed in *a* through *c* below. The tools and materials contained in Tool Equipment TE–41 are listed in Department of the Army Supply Catalog SIG 6–TE–41.

a. Tools.

1—Wrench (H1), $^{3}/_{32}$-inch hexagon for Allen-head screws (in cover of Signal Generator TS–588A/U).

1—Tool Equipment TE–41.

b. Instruments.

1—Multimeter TS–352/U.

1—Electronic Multimeter TS–505/U.

c. Materials.

Orangestick.

Cheesecloth, bleached, lint-free.*

Carbon tetrachloride.*

Paper, sand, flint No. 0000.*

Solvent, dry-cleaning (SD) (Fed. spec. No. P–S–661A).

32. Use of Wrench

The wrench (par. 31*a*) fits the Allen-head screws used to secure knobs on the panel controls. Always insert the long shank of the wrench in the screw head. Do not force this wrench with pliers; several of the setscrews seat on bakelite thimbles over the metal shaft, and these thimbles may be pierced by the screw.

Section II. PREVENTIVE MAINTENANCE SERVICES

33. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order, so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring. See AR 750–5.

34. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or dry, soft brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with solvent, dry-cleaning (SD); wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; wipe them dry with a dry cloth.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

*Part of Tool Equipment TE–41.

35. Use of Preventive Maintenance Forms

a. The information in paragraph 36 is presented as a guide to the individual making an inspection of equipment in accordance with instructions on DA AGO Forms 11–238 and 11–239. The decision as to which items on the forms are applicable to this equipment is a tactical decision to be made, in the case of first echelon maintenance, by the communication officer/chief or his designated representative and, in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. The first two columns in the table in paragraph 36 serve as a cross reference between the item numbers of DA AGO Forms 11–238 and 11–239 and the preventive maintenance information in this manual.

36. Performing Preventive Maintenance

The following preventive maintenance operations should be performed at the intervals indicated, unless these intervals are reduced by the local commander.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

DA AGO Form 11–238 item No.	DA AGO Form 11–239 item No.	
		DAILY
1	1	Check for completeness and satisfactory condition of the signal generator. The components are listed in paragraph 7 and illustrated in figures 1, 4, and 16.
2	2	Check suitability of location and installation for normal operation.
3	3	Clean dirt and moisture from cabinet, panel, and cable fittings; be careful not to damage pointers on the FREQUENCY, % FREQUENCY, and MULTIPLIER dials.
4	4	Inspect the seating of panel fuses and all plugs and connectors.
5	5	Inspect all controls for binding, scraping, excessive looseness, worn or chipped parts, misalinement, and positive action.
6	6	Check for normal operation (par. 43).
		WEEKLY
		Caution: Disconnect all power before performing the following operations. Upon completion, reconnect power and check for satisfactory operation.
7	7	Clean and tighten panel mountings.
8	8	Inspect exposed surfaces for rust, corrosion, and moisture.
9	9	Inspect cables, accessories, and power cord for cuts, breaks, fraying, deterioration, kinks, and strain.
		MONTHLY
	19	Inspect electron tubes for loose envelopes, cracked bases, and poor pin connections; clean carefully; check emission of tubes.
	21	Inspect fixed capacitors for leaks, bulges, and discoloration.
	23	Inspect variable capacitors for dirt, moisture, misalinement of plates, and loose mountings.
	24	Inspect resistors, bushings, and insulators for cracks, chipping, blistering, discoloration, and moisture.
	26	Clean and tighten switches and terminal blocks, clean interior of chassis.
	31	Clean and tighten connections and mountings for transformers, chokes, potentiometers, and rheostats.
	37	Check adequacy of moistureproofing and fungiproofing treatments.
	38	If deficiencies noted are not corrected during inspection, indicate what action was taken to correct the deficiencies.

Section III. LUBRICATION AND WEATHERPROOFING

37. Lubrication

Lubrication of this equipment is not required.

38. Weatherproofing

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

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

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

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

39. Rustproofing and Painting

a. When the finish on the case has been scarred or damaged badly, touch up the bared surface to prevent rust and corrosion. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section IV. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

40. Scope

a. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is limited necessarily in scope by the tools, test equipment, and replaceable parts issued and by the existing tactical situation. Accordingly, trouble shooting is based on the performance of the equipment (par. 43) and the use of the senses in determining such troubles as burned-out tubes, broken connections, etc.

b. Paragraphs 41–43 help in determining which of the components, such as the r-f oscillator or modulator system, are at fault and in localizing the fault in that component to the defective function or item, such as a tube or a fuse.

41. Inspection

a. Failure of this equipment to operate properly usually will be caused by one or more of the following faults:

(1) Improperly connected power cord.
(2) Worn, broken, or disconnected power cord or plug.
(3) 230-volt a-c line connection with 115-volt power supply.
(4) Burned-out line fuse.
(5) Wires broken because of excessive vibration.
(6) Defective tubes.
(7) Damaged output jack.
(8) Open or shorted output cable.
(9) Damaged termination or adapter units.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed examination of the component parts of the signal generator. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

42. Trouble Shooting by Using Equipment Performance Checklist

a. General. Experience has shown that many reported difficulties are caused by missetting the instrument controls or by incorrect connections to the circuit to be tested. The equipment performance checklist (par. 43) will help the operator to locate troubles of this character. The list gives the item to be checked, the conditions under which the item is to be checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. *When using this list, follow the items in numerical sequence.*

b. Action or condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the *Normal indications* column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the generator for repairs. If the corrective measures do not correct the trouble, the generator and a memorandum of the troublesome conditions should be turned over to an experienced repairman. Trouble shooting and repairs will be done in accordance with paragraphs 54 through 69.

e. Emergency Tube Replacements. A spare tube of each type used in the generator is mounted in the rear of the case (fig. 14). It is not recommended, generally, that tube replacements be made in the field where recalibration is not ordinarily possible. However, if the situation requires that the signal generator be kept in operation, even though accuracy is sacrificed, the following information will be of value:

(1) In general, power rectifier V1, regulator tubes V2 and V3, and cathode-follower tube V8 may be replaced with standard tubes without appreciable effect on the calibration of the signal generator.

(2) Oscillator tube V4 usually can be replaced without appreciable shift in the percentage (1 percent) of accuracy of the FREQUENCY calibration. However, try to find one frequency which is accurate to within .1 percent (preferably near the high-frequency end of one of the bands). From this, determine how great a shift has been caused by the new tube. If the shift is appreciable, it may be reduced by allowing the tube to operate at normal output for a day. In any event, tag the generator V4 REPLACED, BUT FREQUENCY NOT CALIBRATED, so that the repairman will make a complete recheck of the calibration.

(3) Amplifier-modulator tube V5 can be replaced without affecting the frequency, but the percentage modulation may be somewhat in error. If emergency replacement is made, tag the instrument V5 REPLACED, BUT MODULATION NOT RECALIBRATED.

(4) Replacement of VTVM tube V7 is likely to cause *large* errors in output voltage readings. Tag the instrument V7 REPLACED, BUT OUTPUT NOT RECALIBRATED.

Note. If a defective tube is replaced in the rack in the case, tag it as the original and indicate the reason for replacement.

43. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	LINE voltage switch (S7). Fuse (F1).	Proper voltage shown beside cover plate. Correct fuse size for line voltage.	Paragraph 14*b* and *c*. Paragraph 14*c*.	
	2	Left-hand EXTERNAL MOD. post (E6).	Ground wire connected. Ground inspected.	Paragraph 14*d*.	
	3	EXTERNAL MOD. posts (E5 and E6).	External a-f oscillator connected.	Paragraph 19.	
	4	Output jack; 2 VOLT OUTPUT, or ATTEN. OUTPUT.	Connections to desired jack and receiver.	Paragraphs 9, 17, and 21.	
	5	OUTPUT switch (S4)----	Set to output jack used---- Set to frequency used.	Paragraph 23*c*.	
	6	Band switch (S2)--------	Set to desired band----	Paragraphs 17 and 23.	
	7	FREQUENCY dial------	Set to desired frequency----	Paragraphs 17 and 23.	
	8	METER TO switch (S3)-	Set to CARRIER--------	Paragraphs 17 and 23.	
	9	ADJUST CARRIER control (R24).	Turn to extreme counterclockwise position.	Paragraph 18.	
	10	ADJUST MODULATION control (R25).	Turn to extreme counterclockwise position.		
	11	MODULATION switch (S1).	Turn to OFF position.		
	12	Attenuator and MULTIPLIER.	If ATTEN. OUTPUT jack is used, select a product consistent with receiver sensitivity.	Paragraph 23.	
	13	Line cord (W1)----------	Plug into proper power receptacle.		
START	14	LINE switch (S6)----	Turn to ON	Pilot lamp (E4) lights--	Check fuse F1 in panel receptacle. Check line cord and plug. Check 115- or 230-volt switch. Replace panel lamp. See chapter 5.
				Meter swings below zero and zeros after warm-up.	If no activity, check setting of METER TO switch. If off zero, reset ZERO ADJ. CARRIER METER control through panel port. If meter cannot be adjusted, see chapter 5.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	15	ADJUST CARRIER control (R24) with METER TO switch set to CARRIER.	Advance clockwise	Meter reads SET CARRIER.	If low, OUTPUT switch may be ABOVE 400 KC. for low carrier frequency, or vice versa. If still low or zero, see chapter 5.
	16	METER TO switch (S3)	Turn to MODULATION.		
	17	MODULATION switch (S1).	Turn to 400 ~ position.		
	18	ADJUST MODULATION control (R25).	Turn clockwise	Meter reading increases to at least 80 percent.	Check switch settings. If reading is zero, try EXT. MODULATION to see if fault is in internal oscillator or modulator. See chapter 5
	19	MODULATION switch (S1).	Turn to EXT.		
	20	ADJUST MODULATION control (R25), with external oscillator connected to EXTERNAL MOD. posts.	Turn clockwise	METER reading increases to at least 80 percent.	Turn up output on external a-f oscillator. Its output may be inadequate or of wrong impedance. Check connections to EXTERNAL MOD. binding posts.
	21	Signal generator	Connect signal generator to receiver (par. 21) which is in good operating condition.	Modulation heard or indicated on output indicator.	Receiver sensitivity may not be adequate; increase attenuator and MULTIPLIER settings, if using the ATTEN. OUTPUT jack. OUTPUT switch may be in wrong position for jack used. Output cable and terminations may not be screwed on tightly. Cable or terminations may be defective; substitute open wires from B. P. adapter to receiver.
STOP	22	ADJUST MODULATION control.	Turn to extreme counterclockwise setting.	Modulation indication will fall to zero.	
	23	ADJUST CARRIER control.	Turn to extreme counterclockwise position.	Carrier indication will fall to zero.	
	24	MODULATION switch	Turn to OFF.		
	25	LINE switch	Turn to OFF	Pilot light will go out.	

CHAPTER 4

THEORY OF SIGNAL GENERATOR TS-588A/U

44. Block Diagram
(fig. 11)

Signal Generator TS–588A/U is of the a-m type and has a carrier frequency range of 5 kc to 50 mc, divided into eight frequency bands. The signal path is shown in figure 11. A complete schematic diagram is shown in figure 31.

a. Carrier Oscillator (V4). The carrier frequency is selected by an eight-position band switch and a calibrated dial. The output of the carrier oscillator is adjustable so that it always operates at the lowest possible level consistent with the required output.

b. Amplifier-Modulator (V5). This is an aperiodic or untuned stage; its gain is essentially unity. The tube is biased to the square-law portion of its characteristic, so that modulation may be accomplished by application of an a-f voltage to its grid.

c. Output Switch and Filters. The OUTPUT switch selects the 2 VOLT OUTPUT or the ATTEN. OUTPUT and connects into the circuit the proper R-C filter for the carrier frequency being used.

d. Meter. The single panel meter is used to indicate either the carrier voltage (to the 2 VOLT OUTPUT jack or to the attenuator input) or the a-f modulating voltage applied to the amplifier-modulator (V5). The required changes in the meter circuits are accomplished by a METER TO switch.

e. Attenuator Circuits. When the METER TO switch is on CARRIER, the meter indicates the r-f *input* to the attenuator. The attenuator network consists of a calibrated L-pad MULTIPLIER (range 0 to 2) and a five-decade, ladder-type attenuator with section junctions connected to a six-point switch. This network divides the r-f input to the attenuator, so that the actual output voltage may be adjusted to any value from .1 μv to .2 volt.

f. Cathode Follower (V8). The cathode follower couples the a-f modulating voltage to the meter and to the amplifier-modulator circuits. It presents a low-source impedance for easy passage of the higher a-f modulating frequencies through r-f filters to the amplifier-modulator.

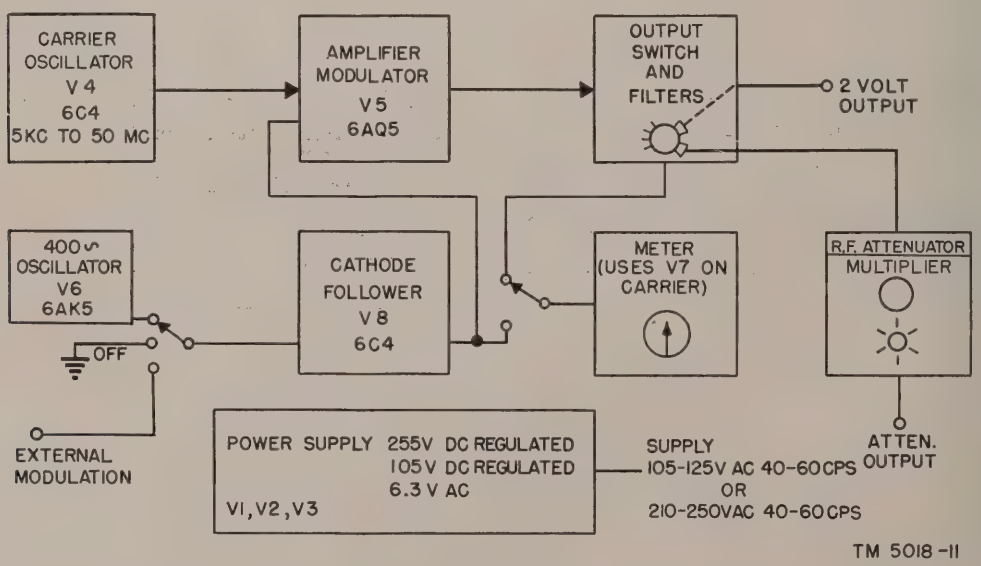


Figure 11. Signal Generator TS–588A/U, block diagram.

g. 400-Cycle Oscillator (V6). The 400-cycle oscillator is a simple self-contained unit of the phase shift type. Its inclusion permits use of the generator in making all types of standard alinement and performance tests, except fidelity, without the attachment of an external audio oscillator.

h. External Modulation. The external modulation circuit is for connecting a variable frequency audio oscillator to modulate the carrier output at frequencies within the range of 20 cycles to 15 kc.

i. Power Supply. The power supply furnishes 6.3 volts ac for general filament supply throughout the generator; 5 volts ac for the power rectifier; and two well-filtered d-c potentials, +105 volts dc (B1) and +255 volts dc (B2), which are distributed to the various tube circuits.

45. Carrier Oscillator V4
(fig. 14)

a. The carrier oscillator tube is connected in a Hartley circuit on all eight frequency bands, A through H. In figure 31 the basic relationship of parts is obscured by the band switch connections. Figure 12 shows the circuit in simplified form.

b. Each of the eight oscillator tank coils, L1 through L8, is center-tapped, and each has its independent high-frequency trimmer capacitor, C41 through C48. Each of the coils L1 through L5 has an adjustable iron core for adjustment of the low-frequency end of its band. The plate and grid ends of the coils are picked up by section 3 (rear) and section 2 (front) decks of range switch S2 and are connected to the main tuning (FREQUENCY) capacitor C5. Because of the wide range of frequencies covered by the eight coils, a new value of grid capacitor is used for each; these are represented in figure 14 by a single capacitor, C49–C56, and are selected for the band in use by section 1 (front) of range switch S2. Resistor R1 is the grid leak for bands A through E. On bands F, G, and H, a second resistor (R45, R46, *or* R47) is placed in parallel with R1 to give a lower effective value.

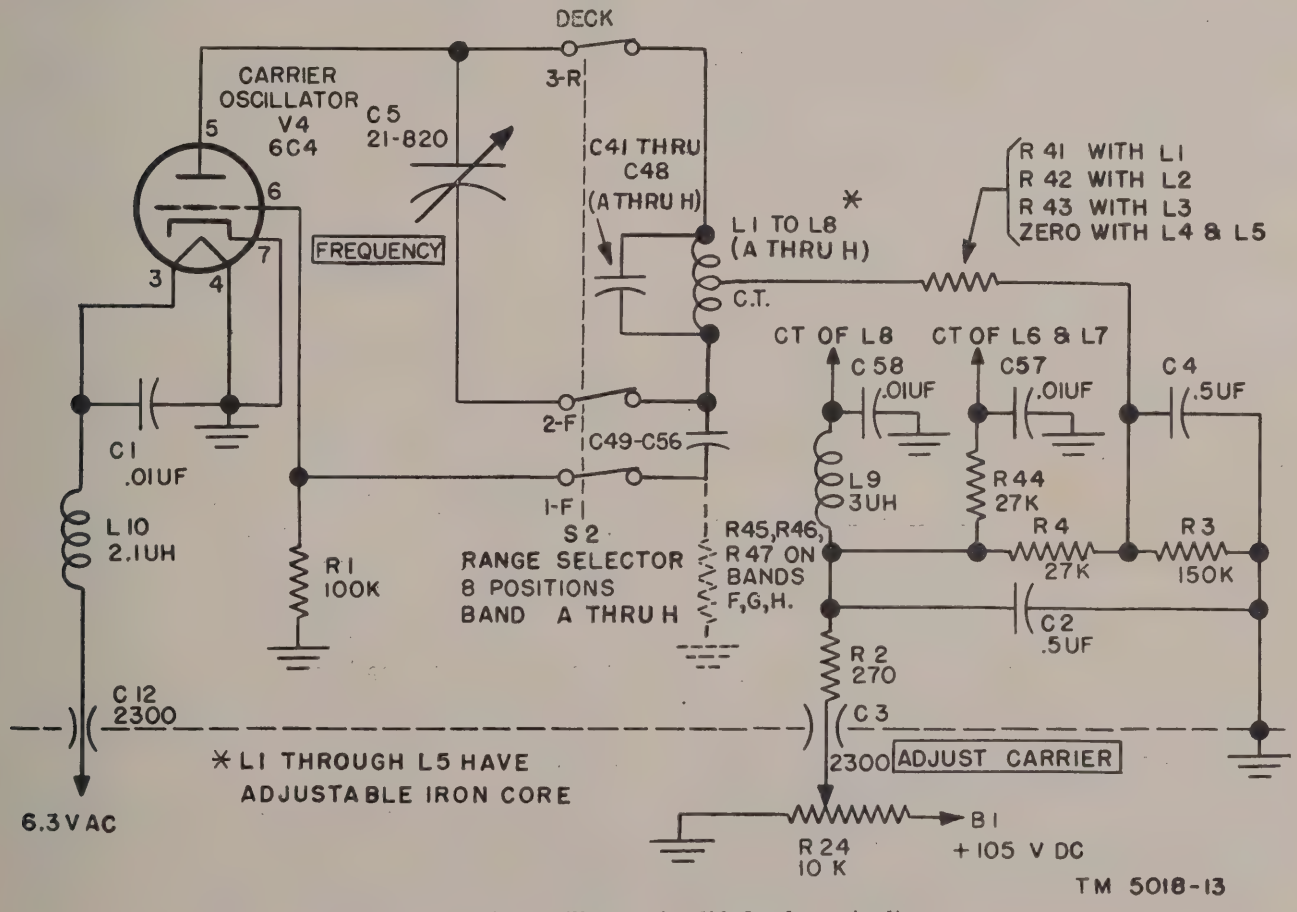


Figure 12. Carrier oscillator, simplified schematic diagram.

c. In figure 31 comparison of band H coil L8 with the other coils shows a variation in construction that is not apparent in the simplified diagram. A second coil is inductively coupled to the center-tapped tank and tuned by capacitor C59 to a frequency slightly *lower* than the lowest frequency (15 mc) at which coil L8 is used. This second coil is used because the low value of L/C (inductance to capacitance ratio) makes it difficult to secure a satisfactory value of resonant impedance in this frequency range. The auxiliary circuit increases the grid excitation to offset the low value of tuned impedance. Note also that the auxiliary circuit is connected adjacent to the grid of oscillator tube V4 so that grid capacitor C56 and grid leak resistor R47 may not impair operation.

d. Plate (B) voltage is controlled by panel-mounted ADJUST CARRIER potentiometer R24, and is fed to the C.T. (center tap) of each coil as indicated by notations in figure 14. The lower carrier frequency coils have extraordinarily high resonant impedances and are fed reduced voltage from voltage divider R3 and R4. To improve the output waveform, this voltage is further reduced by a series resistor (R41, R42, or R43) according to the band in use. Plate voltage through coils L4 and L5 is fed from the divider without a series resistance. Coils L6 and L7 require the highest plate voltage and are supplied from the high-voltage end of the divider circuit through an r-f filter (R44 and C57). Coil L8 requires additional filtering and, therefore, plate voltage is fed through an inductance-capacitance filter (L9 and C58 in figure 31). The plate supply to all bands is filtered by capacitor C2 and resistor R2. Feed-through capacitor C3 reduces r-f feedback through the power supply leads.

e. In the higher frequency bands, capacitor C1 across the filament of V4 keeps this filament at the same r-f potential as the cathode and, together with choke L10, also keeps r-f currents out of the filament and general power supply circuit.

f. In the section 3 (front) and section 2 (rear) decks of band switch S2, there are contacts which are not shown on the simplified diagram. These contacts are called *follower* contacts, because they follow the coil selecting contacts and short-circuit the first two coils of lower frequency than the coil in use. For example, in figure 31 the band switch is set to band H (coil L8) and circuit tracing will show that coils L7 and L6 are shorted. This prevents the resonant frequency of either coil L7 or L6, considered with its trimmer and wiring capacitances, from falling within the frequency band of the operating coil. Such resonance would cause absorption of energy from the operating coil and would stop oscillations at the resonant frequencies.

46. Amplifier-Modulator V5
(fig. 31)

a. The grid of tube V5 receives carrier frequency from the plate side of carrier oscillator V4 through two paths. For low carrier frequencies, the path is through resistors R8 and R9 and capacitor C8, for high carrier frequencies the path is primarily through capacitor C7.

b. The modulating a-f voltage is applied to the grid through an r-f filter composed of resistors R5, R6, and R7 and capacitors C9, C10, and C11. This r-f filter prevents r-f feedback to the audio oscillator.

c. Cathode bias for V5 is developed across cathode resistor R11. The cathode is bypassed for r-f currents by capacitor C13. Capacitor C14 bypasses the cathode for a-f currents.

d. Regulated +255 volts dc (B2) is fed into the shielded compartment through an R-C r-f filter consisting of C18, R15, C17, and C15. The +255 volts is applied to the screen of tube V5 directly and to the plate through resistor R10. A-f currents in this lead are bypassed to the cathode by capacitor C16.

e. The amplifier-modulator operates into a load composed of the input to the attenuator system, together with the effective impedance of the carrier voltmeter. The gain of the stage is essentially one. Distributed capacitances, such as the capacitances of the various circuit elements to ground and the contact capacitances of switch S4, normally would cause the gain to fall at the higher carrier frequencies. However, inductor L11 sustains the gain at higher frequencies.

f. In figure 31, the arc concentric to the outline of tube V5 (between pins 3 and 7) represents a capacitor flap; it reduces incidental frequency modulation of the generator to a mini-

mum. The flap is seen to be similarly concentric to the unshielded tube V5 in figure 17. To understand this connection, consider that every amplifying tube has, in addition to its cold capacitance between grid and cathode, a dynamic capacitance which is proportional to the signal voltage on its plate and to its grid-plate capacitance (often referred to as the Miller effect). Screen-grid tubes are designed to have a very small grid-plate capacitance (.35 $\mu\mu$f for tube 6AQ5), but the Miller effect is not negligible for every purpose. During 80 percent amplitude modulation, the plate voltage of V5 necessarily swings upward to 180 percent of its unmodulated value on positive modulation peaks and downward to 20 percent on negative peaks. The dynamic input capacitance swings similarly and is effectively connected through capacitor C7, across one-half of the oscillator coil in use. This varying capacitance would cause a similar swing of the oscillator *frequency* (incidental frequency modulation), greatest at the high-frequency end of any band where the circuit capacitance is minimum. The flap has a capacitance to the plate of V5 comparable to the grid-to-plate capacitance of the tube, and, since it is connected to the opposite end of the coil in use, it neutralizes the effects of the variable Miller capacitance. The flap is adjusted to balance out the incidental frequency modulation as closely as practical.

47. Output Switch and Filters

a. With OUTPUT switch S4 (fig. 31) turned to either of the two ATTEN. OUTPUT positions, a load impedance of 328 ohms is connected to the output of amplifier-modulator tube V5. This impedance is formed by the 400-ohm impedance of multiplier pad R14 in parallel with the 1,820-ohm input impedance of VTVM tube V7. In the ABOVE 400 KC. position, connection to the load is through the 510-$\mu\mu$f capacitor, C20; in the BELOW 400 KC. position, the .01-μf (microfarad) capacitor, C19, is added to capacitor C20. The connecting capacity together with the 328-ohm load impedance provides discrimination with respect to frequency as shown in figure 13. Thus, when the operating procedure is carried out correctly, the modulated carrier may be measured correctly and utilized without interference from the modulating voltages

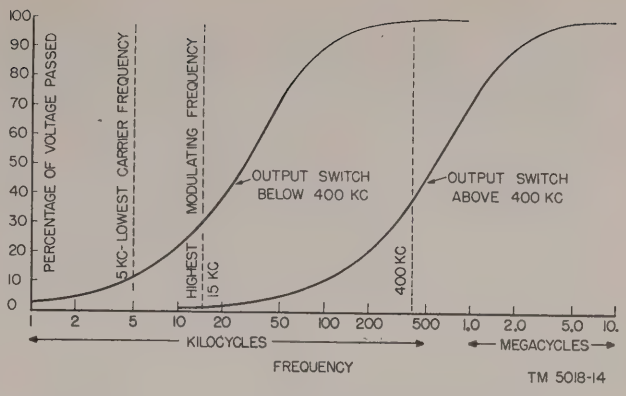


Figure 13. Output filter pass characteristics.

which are necessarily present in the output of amplifier-modulator V5.

b. The same frequency discrimination is obtained when the OUTPUT switch is turned to the respective positions for the 2 VOLT OUTPUT jack, J2. With the OUTPUT switch in these positions, the 82-ohm resistor R13 is added to the normal load impedance to secure 2 VOLT OUTPUT against the SET CARRIER VTVM reading of 1.6 volts rms (root mean square). The output impedance (as viewed from jack J2) is nominally about 285 ohms (328 plus 82 ohms in parallel with 1,000-ohm resistor R10). Within the power output capabilities of the amplifier-modulator, the normal carrier reading will be maintained *manually* by means of the ADJUST CARRIER control.

48. Meter and Associated Circuits

a. Panel-mounted meter M1 is backed by a metal subpanel (figs. 14, 15, and 16) which carries terminal r-f bypass capacitors C33 and C34. These capacitors, together with r-f resistors R37 and R38, are in the meter circuit at all times and prevent r-f radiation from the face of the meter.

b. The switch marked METER TO (S3) connects the instrument to a VTVM circuit (V7, fig. 31) in the CARRIER position or to a full-wave copper-oxide rectifier circuit in the MODULATION position. With the switch in either position, resistor R34 replaces the resistance of the meter and its isolating resistors in the unused measuring circuit.

c. VTVM tube V7 and its circuit are contained in the r-f shield; therefore, the d-c output is shielded and filtered carefully to prevent leak-

age of r-f currents. In figure 31, the plate (pin 7) and cathode (pin 1) of V7 are the signal rectifying elements. The cathode is bypassed by capacitor C21 for high-frequency carrier currents and by capacitor C22 for the moderate and low carrier frequencies. Resistor R12 acts as an r-f isolation unit and, with the meter resistance, is the d-c load for the diode. Even with zero signal input, vacuum-tube diodes show some d-c output. This zero signal output is bucked out as follows: The second diode of V7 (plate, pin 2; cathode, pin 5) is used to rectify 6.3-volt a-c filament voltage, so that dc appears across potentiometer R17. Capacitor C6 acts as a filter in this rectifier circuit. The ZERO ADJ. CARRIER METER control applies the correct portion of the rectified dc through resistor R16 to buck out the dc of opposite polarity from the signal diode at bypass capacitor C23. Proper adjustment, then, makes meter current zero in the absence of input signal. Variable resistor R36 and limiting resistor R35 permit adjustment of the meter sensitivity for calibration purposes. The slotted shaft marked CALIBRATE CARRIER may be seen in figure 16.

d. The modulation measuring circuit is built around copper-oxide rectifier CR1 which, with signal splitting resistors R30 and R31, forms a full-wave rectifier circuit. Resistor R29 provides a meter sensitivity of about 10 volts rms, and is connected to the output of the cathode follower. The filter (C9, C10, C11, R5, R6, and R7) in the grid of amplifier-modulator V5 shows a small but measurable frequency discrimination at the higher modulating frequencies. Capacitor C32 acts to offset this by decreasing the rectifier meter sensitivity at higher frequencies. Resistors R33 and variable resistor R32 permit adjustment of the meter sensitivity for correct readings of modulation. R32 is marked CALIBRATE MODULATION as shown in figure 16. The various elements of the rectifier circuit are shown on the back of the meter subpanel in figures 14, 15, and 21.

49. R-f Attenuator System

a. The r-f attenuator system consists of an r-f L-pad R14 and a five-section ladder attenuator assembly E1 (fig. 31). With the OUTPUT switch set to either of the ATTEN. OUTPUT positions and with the carrier meter set so SET CARRIER, the input voltage to the system is 1.6 volts rms.

b. The linear element of L-pad R14 (figs. 23 and 31) is 95 ohms, and the input resistance of ladder E1 is 105.5 ohms. Since the linear element and the ladder are in parallel, the resultant resistance between the .1-volt tap of the ladder and ground is approximately 50 ohms. With the MULTIPLIER set at 2, the 350-ohm resistance between the L-pad contacts and this 50-ohm resistance are in series, so that the total resistance between the input stud of the L-pad and ground is 400 ohms. Since the output is taken from across the 50 ohms between the .1-volt connection and ground, only one-eighth of the 1.6-volt carrier input appears across the ATTEN. OUTPUT connector. Therefore, the output voltage is equal to the product of the multiplier and attenuator settings: 2 x .1 = .2 volt. When the MULTIPLIER is turned to settings lower than 2, the contact arm on the linear element approaches ground to reduce the output voltage across the ATTEN. OUTPUT connector. If only the linear element were used in the L-pad, the resistance between the input stud and ground would change with reduced settings of the MULTIPLIER control, and the output voltage would not be equal to the product of the MULTIPLIER and attenuator settings. This effect is eliminated by the tapered element which is ganged with the linear element as shown in figure 23. As the MULTIPLIER control is turned to lower settings, the contact arm of the tapered element moves to *add* the correct amount of series resistance to maintain at 400 ohms the resistance between the input stud and ground. The variable elements of the L-pad are wire-wound to stand wear, and the windings are of a special form to reduce the residual inductance to a minimum. However, the inductance effect is not negligible at the higher carrier frequencies. The R-C combinations, RaCa and RbCb, in figure 23 are neutralizing impedances. These R-C combinations are not replaceable in the field, because the R and C values must be determined in a special test set.

c. The five pairs of resistance elements comprising the ladder attenuator (E1, fig. 31) are housed with ATTEN. OUTPUT switch S5 in a massive cylindrical aluminum casting (fig. 22). The casting is sectionalized so that each pair of

elements and the adjacent switch contacts are housed in a separate pocket. This construction minimizes the self-inductance of each shunt element and the mutual inductance between elements of different sections. The necessity for this is appreciated when it is realized that the difference in level between the input and output sctions is 100,000 times or 100 db (decibels).

d. The resistor elements of the ladder attenuator, R49 through R58 (fig. 31), are adjusted to exact resistance in manufacture by cutting a spiral into a metallic film previously deposited on a ceramic form. This gives the elements a slight inductive effect which is not appreciable in the series elements (odd numbered), but could cause appreciable error at 50 mc in the shunt elements (even numbered) because of their low value. The possible error is reduced by coiling the lead of each series element to give it the same phase angle as the shunt element with which it is associated (R49 and R50, R51 and R52, and so on). In this way, the inductive effect is eliminated from the final attenuator calibration.

e. ATTEN. OUTPUT jack J1 is mounted directly on the ladder attenuator casting to secure complete shielding, and it projects through the panel when the casting is mounted. The input of ladder attenuator E1 connects to the L-pad MULTIPLIER through a short concentric cable of 100-ohms impedance, corresponding to the junction impedance.

50. Cathode Follower V8
(fig. 31)

a. This is a triode, connected as a cathode follower, with a gain slightly less than unity and a low effective output impedance of about 400 ohms.

b. Plate supply is from +255 volts dc (tap B2), additionally filtered by an R-C combination (R48 and C60). Plate current through resistors R27 and R28 biases the cathode to operating potential with respect to ground. The voltage drop across resistor R28 is applied as grid bias through resistor R26.

c. A-f voltage is applied across ADJUST MODULATION control R25 when MODULATION switch S1 is in the 400 ~ or EXT. position. The desired portion of the a-f voltage across R25 is applied to the cathode follower grid through capacitor C30. The a-f signal, slightly reduced, appears across the cathode resistance which is the sum of resistors R27 and R28. Capacitor C31 blocks off the cathode dc and couples the signal to the modulation meter circuit and through the modulation filter to the grid of the amplifier-modulator, V5.

d. With MODULATION switch S1 at OFF, the output of the cathode follower is grounded and modulation is zero regardless of the panel control settings. Additional contacts on switch S1 control the d-c potential on capacitor C31 to avoid charge through the meter circuit during rapid switching.

51. 400-Cycle Oscillator (V6)

a. Tube V6 operates as a phase-shift oscillator (fig. 31). With the MODULATION switch in the 400 ~ position, the plate supply is from the +255-volt d-c supply, B2, through the ADJUST MODULATION potentiometer R25 and resistor R19. The cathode is biased by the drop across cathode resistor R18 and bypassed by capacitor C24.

b. The plate of V8 is connected to a phase-shifting network consisting of three pairs of capacitor-resistor sections, C25 and R20, C26 and R21, and C27 and R22. Any random disturbance at the plate is shifted in phase by each pair of elements and appears across resistor R22, reduced in amplitude but considerably changed in phase. The network is proportioned so that a 400-cycle component is shifted exactly 180°, and since this is applied to the grid of V8, the conditions for self-oscillation are complete.

c. Oscillations tend to increase until a large, but highly distorted, output wave is produced. A slight grid current in the high effective output impedance of the network limits the amplitude of oscillation, and the tube operates entirely within its linear capabilities, producing a 400-cycle note of good waveform. The amplitude of the 400-cycle voltage applied to the modulating circuit is determined by the setting of ADJUST MODULATION control R25.

52. External Modulation

An external audio oscillator may be connected to EXTERNAL MOD. binding posts E5 and E6 for modulating the signal generator in the range

of 20 cycles to 15 kc. Capacitors C28 and C29 and inductance L12 (fig. 31) form a low-pass filter which passes the a-f currents to the generator, but prevents internal r-f currents from reaching the binding posts and the external audio oscillator. Resistor R23 properly terminates the filter. The load for the external oscillator is 4,000 ohms (the parallel value of R29, R25, and R23 when MODULATION switch S1 is in the EXT. position).

53. Power Supply

a. Power transformer T1 has two equal primary windings. For 115-volt operation, switch S7 (fig. 31) puts these primaries in parallel; for 230-volt lines the windings are in series. Capacitors C35 and C36 are placed as close as possible to the primary connections to bypass any r-f currents that may have found their way into the supply. Additional filtering is provided by capacitors C39 and C40 which are installed on the back of the main signal generator panel adjacent to LINE ON-OFF switch S6. The primary circuit is protected by fuse F1.

b. A high-voltage secondary supplies the plates of power rectifier tube V1, a 5-volt secondary supplies filament voltage to V1, and a 6.3-volt secondary supplies filament voltage to the other tubes in the signal generator.

c. The rectified d-c output of the rectifier is wired through contacts on the regulator tubes (pins 3 and 7) to disconnect the d-c output when regulator tubes V2 and V3 are removed from their sockets. This protects filter capacitors C37 and C38 and also prevents erratic operation of the filter on an unregulated supply.

d. The rectifier output is filtered by choke L13, capacitor C37, and capacitor C38. The d-c resistance of choke L13 is of the correct value to permit proper operation of the regulator tubes without a separate voltage-regulating resistor. Parallel resistors R39 and R40 equalize the loads on the two regulator tubes V2 and V3 by causing equal currents despite the unequal external tube loads.

e. Pilot lamp E4, connected across the 6.3-volt filament winding, is mounted on the panel and indicates that power is on.

CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing the signal generator, be extremely careful because of the high voltages exposed. Always pull the line power plug. Discharge the filter capacitors by inserting a screw driver with an insulated handle through the hole (marked TEST +290V DC) in the upper edge of the power chassis to short the lug of the power choke to the chassis. Before touching any part with the line power off, short the part to ground.

54. Trouble Shooting Procedures

The first step in servicing a defective signal generator is to sectionalize the fault. Sectionalization means tracing the fault to the major *component or circuit* responsible for the abnormal operation of the generator. The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition. Some faults such as burned-out resistors, r-f arcing, and shorted transformers often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by *checking voltage and resistance.*

a. System Sectionalization. System sectionalization is discussed in paragraphs 42 and 43.

b. Component Sectionalization and Localization. The tests listed below aid in isolating the source of trouble. To be effective, the procedure should be followed in the order given. Remember that servicing procedure should cause no further damage to the signal generator nor alter the calibration of circuit features not involved in the vault. Trouble should be localized to a single function or circuit. Then the trouble may be isolated within that function or circuit by appropriate voltage, resistance, and continuity measurements. The service procedure is summarized as follows:

(1) *Inspection.* The purpose of inspection (par. 41) is to locate any visible trouble. Through this inspection alone, the repairman frequently may discover the trouble, or may determine the circuit function in which the trouble exists. This inspection is valuable in avoiding additional damage to the signal generator which might occur through improper servicing methods.

(2) *Input resistance measurements.* These measurements (par. 58) prevent further damage to the signal generator from possible short circuits. Since this test gives an indication of the condition of the filter circuits, its function is more than preventive.

(3) *Operational test.* The operational test (par. 59) is important because it frequently indicates the general location of trouble. In many instances, the information gained will determine the exact nature of the fault. In order to utilize this information fully, all symptoms must be interpreted in relation to one another.

(4) *Trouble-shooting chart.* The trouble symptoms listed in this chart (par. 60) will aid greatly in localizing trouble.

(5) *Gain data.* This data (par. 65) can be used to localize obscure, hard-to-find troubles in the amplifier-modulator and output circuits.

(6) *Intermittents.* In all these tests, the possibility of intermittents should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the set. The trouble may not be in the signal generator, but in the installation or accessories (output cable, terminations, or adapters). Test the installation, if possible.

55. Trouble Shooting Data

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the following trouble shooting data:

Fig. No.	Description
31	Signal Generator TS–588A/U, schematic diagram.
14	Rear view, removed from case.
15	Rear view, r-f shield removed.
16	Top view, power chassis removed and inverted.
17	Bottom view, modulator chassis removed and inverted.
18	Signal Generator TS–588A/U, tube socket and test point voltage and resistance diagram.
19	B+ voltage distribution.
20	400 ~ oscillator terminal board, resistance values.
21	Meter panel, wiring detail and parts.
22	Attenuator, details of construction.
23	L-pad R14, details.
24	Amplifier-modulator gain data.

56. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting Signal Generator TS–588A/U is listed below. The technical manuals associated with the test equipment also are listed.

Test equipment	Technical manual
Multimeter TS–352/U	TM 11–5527
Test Set I–49 (Portable Wheatstone bridge).	TM 11–2019
Tube Tester TV–2/U, or alternate Tube Tester I–177 with Tube Socket Adapter Kit MX–949/U.	TM 11–2627
Frequency Calibrator-Meter Set AN/URM–18.	Instruction book (manufacturer).
Oscilloscope BC–1060–A	TM 11–2526
Electronic Multimeter TS–505/U	TM 11–5511

57. General Precautions

Whenever the signal generator is serviced, observe the following precautions very carefully.

a. Do not use settings of the ADJUST CARRIER or ADJUST MODULATION controls that allow the panel meter to deflect off scale continuously. Do not switch frequency bands without having first returned the ADJUST CARRIER control to its zero (extreme counterclockwise) position.

b. Be careful when the generator is removed from its case (fig. 14); dangerous voltages are present. A shock may cause you to rake a tool across the r-f wiring and preset adjustments, or to upset the instrument completely.

c. Careless replacement of parts makes new faults.

(1) Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections, tag each of the leads or make a notation of the lead colors. If removing a capacitor whose construction permits reversal when replaced, mark it so that it can be replaced in the original manner. When disconnecting or connecting a resistor or a capacitor that has a short lead, use pliers to grasp the lead between the component and the point at which a soldering iron is to be applied. The pliers will draw heat and prevent it from affecting the component. Always use a freshly cleaned, properly tinned soldering iron.

(2) Be careful not to damage other leads

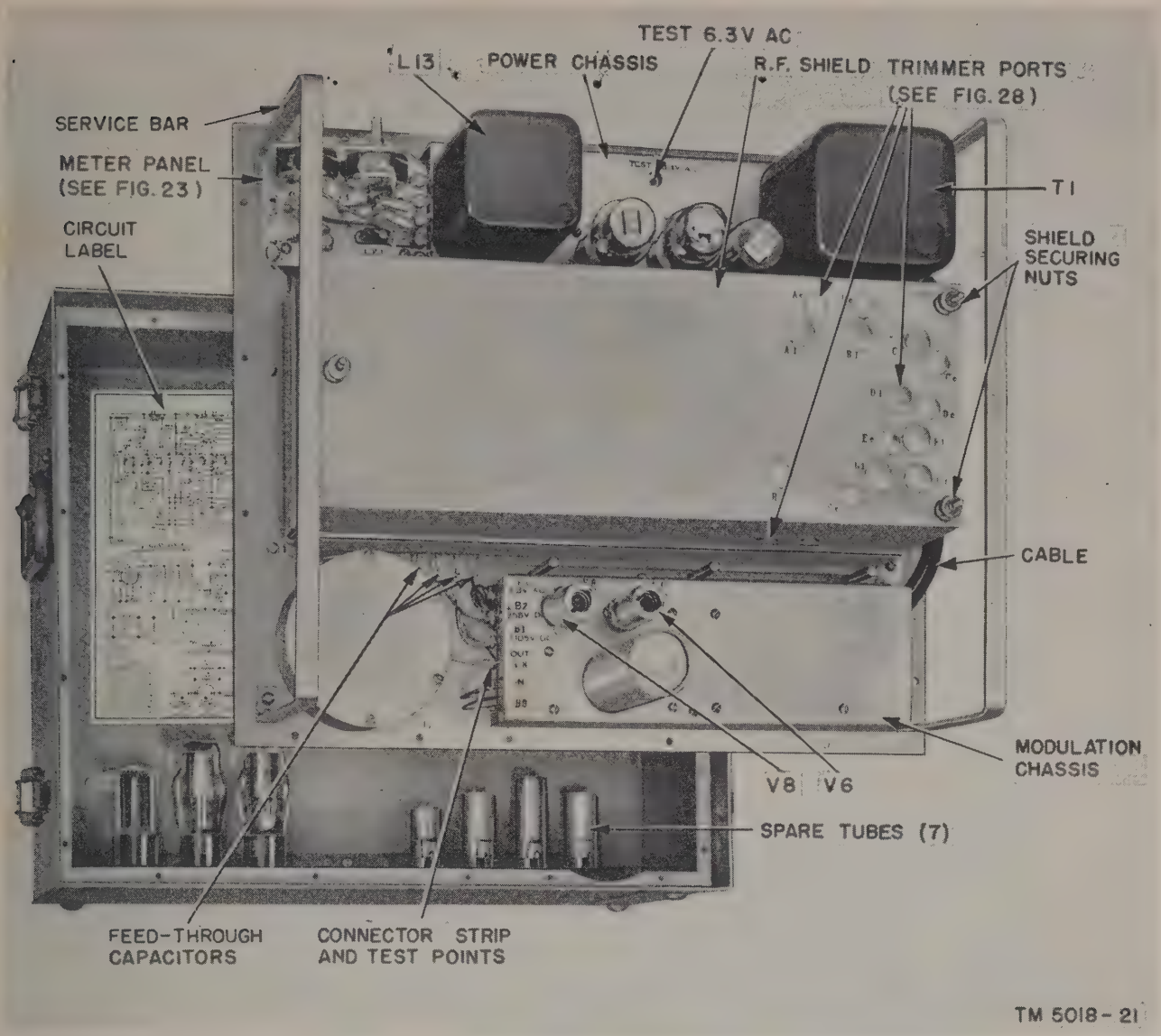


Figure 14. Signal Generator TS-588A/U, removed from case, rear view.

by pulling or pushing them out of the way. This may necessitate a time consuming recalibration when only a simple replacement is required.

(3) Do not allow drops of solder to fall into the generator, since they may cause short circuits. For the same reason never use steel wool within the instrument for any purpose.

(4) A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

(5) When a part is replaced in the carrier oscillator, amplifier-modulator, output switch, or r-f attenuator system, it must be placed exactly as the original one. A part which has the same electrical value but different physical size may cause trouble in high-frequency circuits. Give particular attention to proper grounding when replacing a part. Use the same ground point as in the original grounding; use the same lead length as the original between the part and ground point. Failure to observe these precautions may

result in altered performance and calibration of the circuit.

(6) Do not disturb the adjustment of meter calibration controls R32 and R36 (CALIBRATE CARRIER and CALIBRATE MODULATION in figure 16), the oscillator trimmers (C41 through C48 in figure 31, Ac through Gc in figures 14, 15, and 26, or the coil trimmer slugs (L1 through L5 in figure 31), A1 through G1 in figures 14, 15, and 26).

(7) Avoid pointless tampering at all times. Never release the dial screws on panel controls before the service data in this chapter has been considered thoroughly. Before releasing the FREQUENCY dial pointer and MULTIPLIER dial screws, make sure that equipment is available for resetting them properly. Never release the four screws holding the FREQUENCY dial to the panel, unless the dial must be replaced. Components in back of the dial can be released from behind the panel.

58. Checking Power, Filament, and B+ Circuits for Shorts

Trouble within the generator often may be detected by checking the resistance of the power, filament, and high-voltage circuits before applying power to the equipment. These checks also may prevent damage to the power supply. Make the following checks before attempting to put the signal generator in operation. Leave the line cord disconnected while making these checks.

a. With LINE switch S6 at ON, measure the resistance between the blades of power plug P1. The correct resistance is 4.3 ohms (± 10 percent) with switch S7 in the 115-volt position, and 17.4 ohms (± 10 percent) with S7 in the 230-volt position.

(1) About twice the normal resistance for the 115-volt connection probably will be accompanied by an open indication when switch S7 is set to the 230-volt position. This indicates an open transformer T1 primary (lugs 1–2 or 3–4),

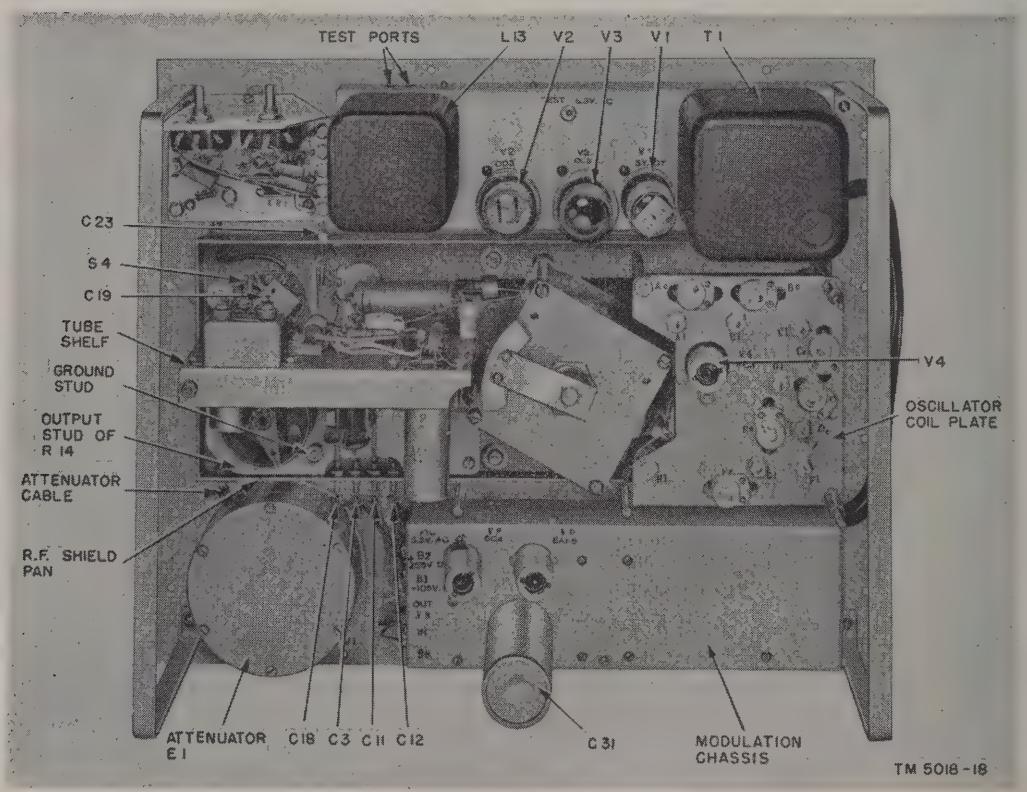


Figure 15. Signal Generator TS-588A/U, r-f shield removed.

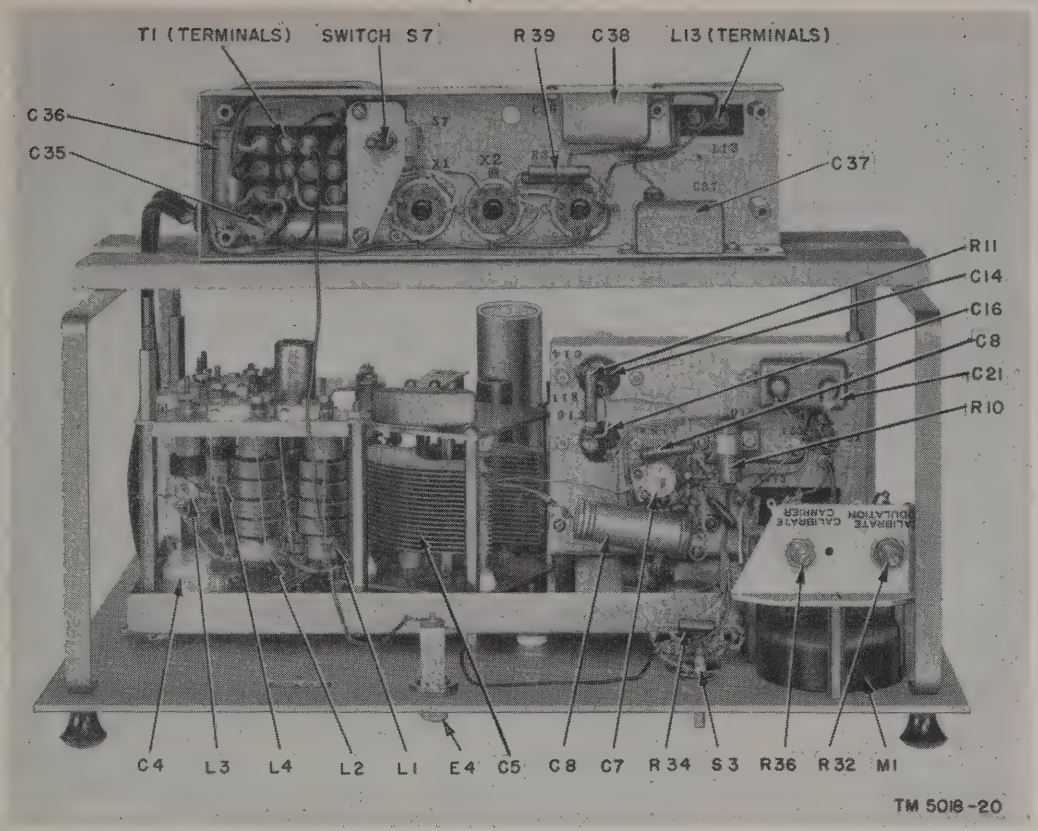


Figure 16. Signal Generator TS–588A/U, power chassis removed and inverted.

or an open in associated connections to switch S7, or a completely defective switch.

(2) If an open circuit is found in *both* the 115- and 230-volt positions of switch S7, check the condition of fuse F1 and its holder; also check the condition of switch S6. If these parts are not defective, the open is probably in the power cord or in its connection to the plug, or in the cable connecting the power supply chassis to the LINE switch.

(3) If a short circuit is indicated between the blades of plug P1, test with the LINE switch at OFF to determine whether the short is in the line cord or plug, or if it is internal. If the short is internal, check the connecting leads, keeping in mind the *remote* possibility that *two* of the line capacitors (C39, C40, C35, or C36) are shorted.

(4) Short the blades of the attachment plug and measure the resistance *to chassis* with LINE switch S6 open (OFF). The resistance should be infinite and should remain so when the LINE switch is closed (ON). If the resistance reading is zero, disconnect line capacitors C39 and C40 to see if they are shorted. These capacitors are adjacent to the LINE switch (fig. 17). If C39 and C40 are not shorted, remove the power supply from the panel (fig. 16) and make a general inspection of the primary wiring; test the primaries of transformer T1 and the line capacitors (C35 and C36) for shorts.

b. Pass an insulated test prod through the test port marked TEST +290 V.DC on the upper edge of the power chassis (fig. 15) and contact the lug of power choke L13 firmly. Connect the *positive* lead from the ohmmeter or bridge to this prod, because of the electrolytic capacitors in the circuit, and connect the negative lead to

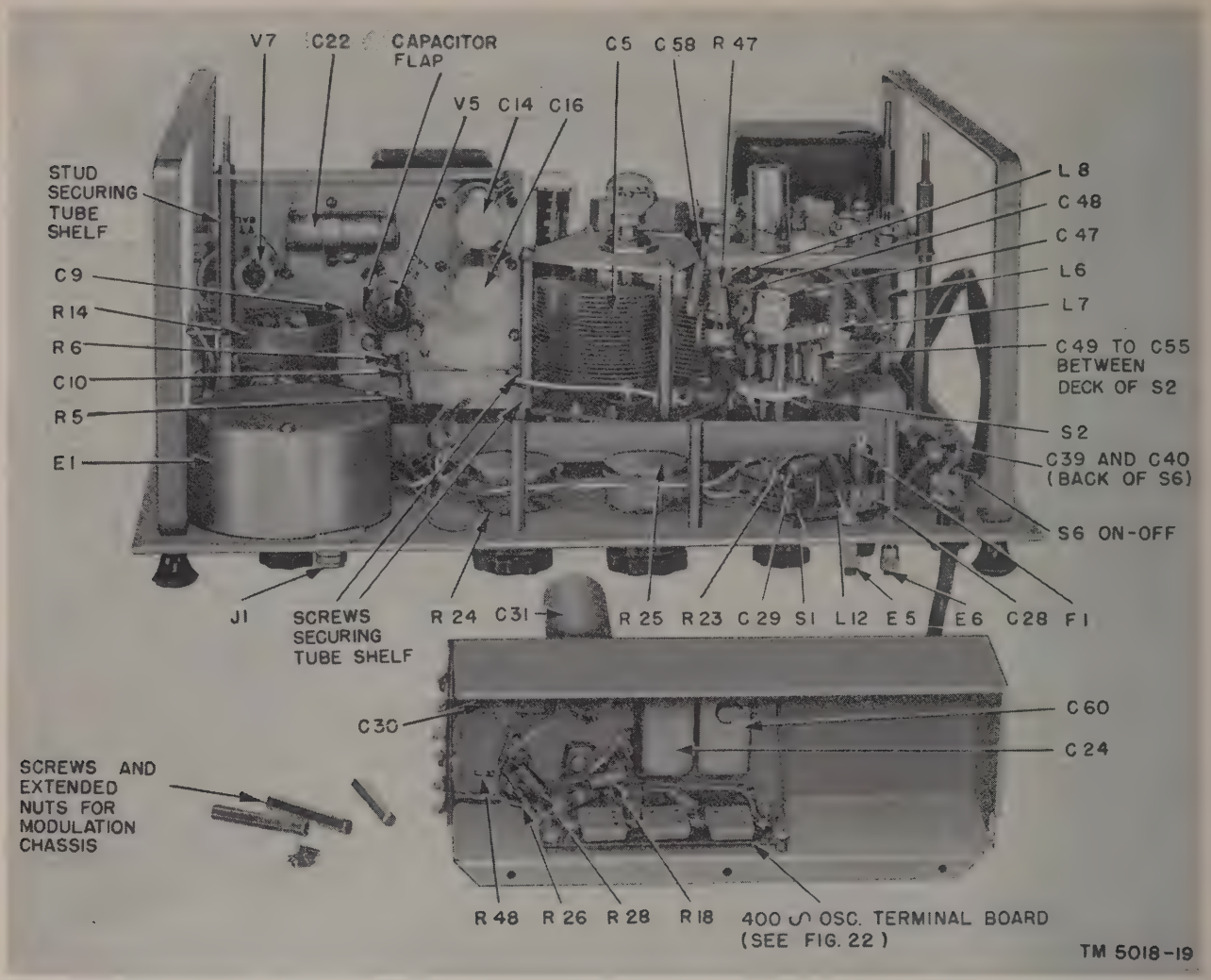


Figure 17. Signal Generator TS–588A/U, bottom view with modulation chassis removed and inverted.

the chassis. There will be some effect of the charging current to these capacitors, after which the final resistance reading should be at least 17,000 ohms with the ADJUST CARRIER control at its extreme counterclockwise position.

(1) If a substantially lower resistance is measured, pull power rectifier tube V1 to eliminate the possibility of a plate-to-filament short. Then remove *both* voltage-regulator tubes (V2 and V3); this will break the pin 3 to pin 7 connections and will determine if there is a ground in the 5-volt secondary of transformer T1 or in the connections thereto (lugs 10, 11, and 12).

(2) If the resistance is still below normal, open the connection between the +B2 lug on the modulation chassis and the feed-through capacitor C18 in the lower edge of the oscillator pan (fig. 15). If the resistance remains low, remove the power chassis, test filter capacitors C37 and C38 separately, and check the insulation resistance of power choke L13. Inspect the associated wiring and connections as well as the cable passing down the right-hand side to the modulation chassis.

(3) If the resistance rises to normal when the +B2 connection at C18 is removed, the trouble must be in the feed-through capacitor or in one of the numerous elements connecting to it within the r-f shield (fig. 31). Remove the shield

and then remove amplifier-modulator tube V5 to eliminate the possibility of a screen-to-cathode or plate-to-suppressor short. If necessary, check the components group, C18, R15, C17, C15, C16, R10, L11, C19, and C20, and all associated wiring and connections.

c. Measure the resistance from the +B1 lug at the left end of the modulation chassis (fig. 15) to ground. This should be 10,000 ohms, the resistance of control R24, with the ADJUST CARRIER knob turned to its extreme counterclockwise (zero) position. Advance the ADJUST CARRIER setting, and the resistance should drop about 5 percent, indicating the shunting action of the voltage dividers R3 and R4 (fig. 12).

(1) If the resistance is low with the ADJUST CARRIER control at zero, remove tube V6 to ascertain that it has no screen short. If the resistance is still low, remove the modulation chassis and inspect the cable passing beside controls R24 and R25 and all connections thereto.

(2) If the resistance is normal with the ADJUST CARRIER control at zero, but drops sharply as the control is advanced, disconnect the center connection from R24 (just under the left-hand edge of the modulation chassis) leading to feed-through capacitor C3 (fig. 15) on the under side of the r-f shield pan. Measure resistance from capacitor C3 to chassis; this should be 177,000 ohms, the resistance of R3 and R4 in series. If the resistance is lower, pass the frequency band switch through all positions from A through H to determine if these is a shorted condition identified with only one band. Remove oscillator tube V4 (tag it to avoid possible confusion with V8) to eliminate the possibility of a plate-to-cathode ground. Refer to figures 12 and 31 and proceed with the analysis of all wiring and components of the oscillator group (excluding the outer ends of the oscillator coils and elements connected thereto, because it already has been determined that the fault is not associated with an individual band).

d. Remove all tubes V1 through V8 (*mark V4*) and pilot lamp E4 from the signal generator, and remove two leads from the FIL. (filament) lug on the modulation chassis. Measure the resistance to ground of the filament lead passing under the modulation chassis. This should be .18 ohm, the resistance of the 6.3-volt secondary of power transformer T1. Measure the resistance to ground of the filament lead to capacitor C12 (fig. 15) in the lower flange of the r-f shield pan. This should be infinite, indicating that the feed-through capacitor and filament capacitor C1 are not shorted and that there are no shorts to ground at choke L10 or other filament wiring within the compartment. Check resistance to ground of the FIL. lug. This should be infinite, indicating that the filament circuit is clear within the modulator chassis. Resolder the leads at the FIL. lug.

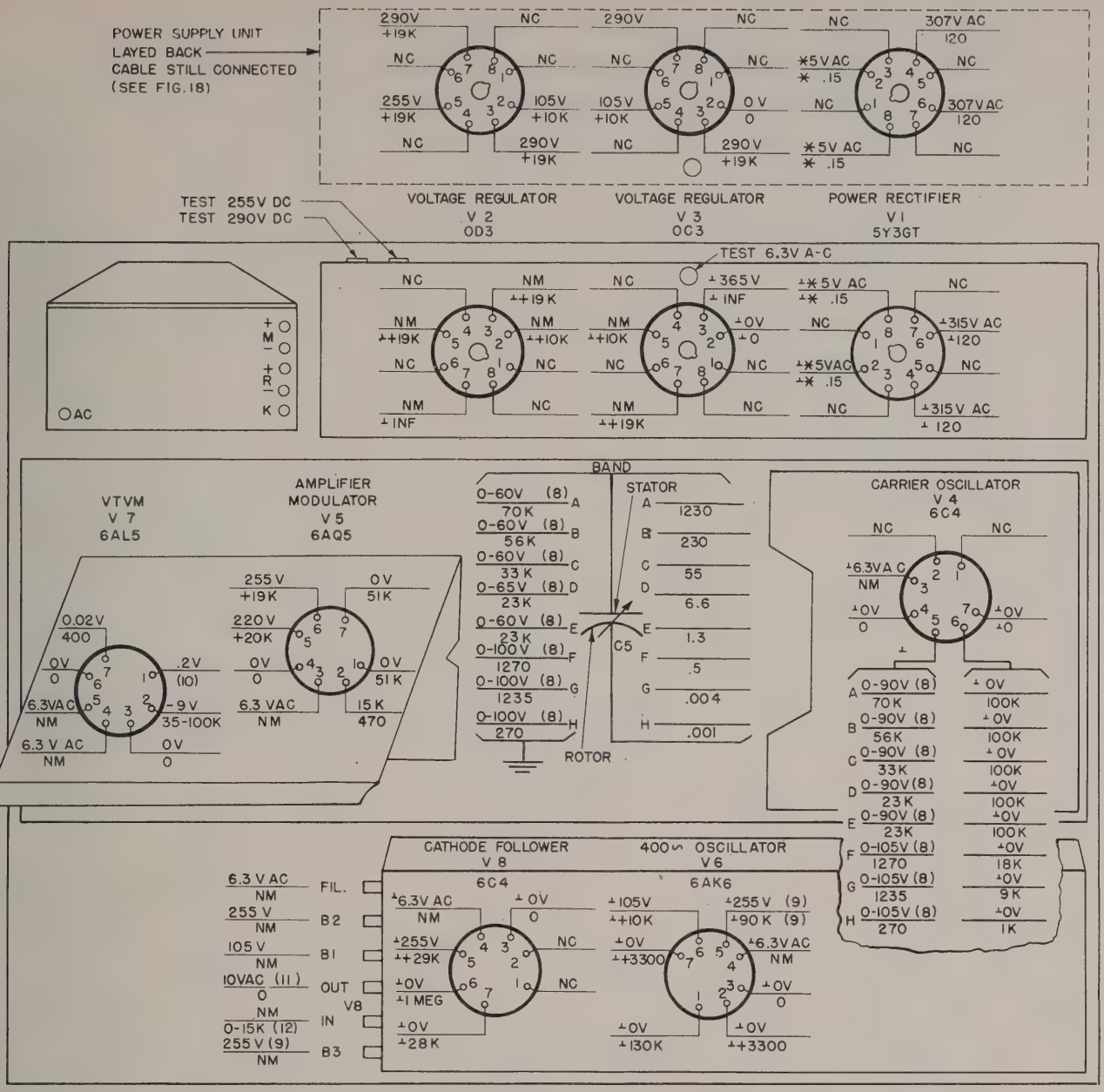
59. Operational Test

Connect the signal generator to a radio receiver and operate the equipment as described in the equipment performance checklist (par. 43). This checklist is important because it frequently indicates the general location of the trouble. Also listen for crackling or buzzing noises which indicate high-voltage arcing. Check the signal generator for smoke and the odor of burned or overheated parts.

60. Trouble Shooting Chart

a. The following chart is supplied as an aid in locating trouble in the signal generator. This chart lists the symptoms which the repairman observes, either visually or audibly, while making a few simple tests. *The chart also indicates how to localize trouble quickly to the carrier-oscillator, amplifier-modulator, output, 400 cycle, or external modulation circuits of the generator.* Once the trouble has been localized to a single circuit function, a tube check and voltage and resistance measurements ordinarily should be sufficient to isolate the defective part. Normal voltage and resistance measurements are given in figure 18 and a B+ voltage distribution diagram is given in figure 19.

Symptom	Probable trouble	Correction
LINE switch in ON position. Generator fails to operate and panel lamp does not light.	Open fuse F1 in panel receptacle.	Replace fuse. If replaced fuse blows on 230 V. line, check 115 V.–230 V. switch position (par. 58).
	Switch S7 in 230 V. position with 115 V. line.	Check 115 V.–230 V. switch position. Set to 115 V.
No carrier meter reading on one frequency band.	Defective oscillating circuit in that band.	Leave switch on defective band and make resistance and voltage analysis at C5 and socket of V4.
Low carrier meter reading, bands A, B, C, and D only.	Output switch set incorrectly	Set OUTPUT switch to BELOW 400 KC. position.
Low carrier meter reading in h-f bands only.	Cable on 2 VOLT OUTPUT jack.	Remove cable.
	C20 open, or C7 set too low	Inspect connections. Reset C7.
No output from 2 VOLT OUTPUT jack.	Shorted cable or adapter on 2 VOLT OUTPUT jack.	Remove fittings from jack. If output is now correct, test fittings.
Lower carrier meter reading on all bands.	Defective panel meter	Try meter on modulation.
	VTVM circuit defective or defect in amplifier-modulator.	Connect external VTVM to 2 VOLT OUTPUT jack; if 2 volts can be set, check V7 and make resistance and voltage analysis at its socket. If less than 2 volts, but accurate, connect external VTVM to grid of V5. If voltages of figure 24 can be set, amplifier-modulator is defective. Test V5 and its socket voltages and resistances.
	Carrier oscillator defective, probably in d-c side.	If the voltages cannot be set, defect is ahead of grid of V5.
Carrier meter indicates on ATTEN. OUTPUT, but not on 2 VOLT OUTPUT.	Open R13 or associated switch contacts (S4).	Make resistance analysis and correct fault.
Carrier meter below zero at all settings of ZERO ADJ.	Input of R14 open	Check connections to R14 and measure input resistance (par. 63).
Carrier meter can be set, but low or no response in test receiver.	Defective cable or terminations	Replace cable with wires and B. P. adapter, irrespective of frequency. Make resistance analysis of cable and fittings. ***Caution:*** Fault may be in receiver.
Approximately equal test receiver responses from two adjacent attenuator steps.	An open shunt element in attenuator E1.	Test and repair (par. 62).
	Avc action in receiver	Disable avc or reduce signal generator output.
Excessive change in test receiver response between two adjacent attenuator steps. (Compare with .2 and 2.0 on MULTIPLIER dial.)	Open series element or shorted shunt element in attenuator E1.	Test and repair (par. 62).
No modulation meter reading on 400 ~ or EXT.	Defect in cathode follower or modulation meter circuit.	Tune signal in receiver. If modulation is heard, fault is probably in meter circuit or switch S3. If carrier noise is heard without modulation, test V8 and analyze voltages and resistances at socket.
Modulation can be set, but zero or weak modulation in test receiver.	Modulating voltage not reaching grid of V5.	Test with VTVM or headphones at grid of V5. If no a-f signal, check filters C9, C10, C11, R5, R6, and R7.
Modulation can be set on EXT. but not on 400 ~.	Defective 400 ~ oscillator circuit.	Test tube V6 and make resistance and voltage analysis from its socket. Remove modulator chassis and analyze 400 ~ oscillator panel board.
Can set modulation on 400 ~ but not on EXT.	Defective external a-f generator.	Test external generator output. Must be 12 volts with 4,000-ohm load. Check connections and leads. Observe ground side.
	Faulty connections, a-f generator to posts E5 and E6.	
	Fault in filter C28, C29, and L12.	Test resistance between posts; 6,800 ohms is normal.



NOTES:

1. 115 OR 230 V AC INPUT.
2. VOLTAGES MEASURED TO GROUND WITH A 20,000 OHM-PER VOLT METER. USE HIGHER METER RANGES TO PREVENT CIRCUIT LOADING.
3. UNLESS OTHERWISE SPECIFIED; MODULATION SWITCH OFF, ADJUST CARRIER AND MODULATION CONTROLS AT EXTREME CCW (OFF).
4. * INDICATES MEASURED ACROSS FILAMENTS.
5. ⊥ INDICATES THIS TUBE ONLY REMOVED FROM SOCKET TO CONTACT CLIPS FROM FACE.
6. + ON RESISTANCE VALUE MEANS APPLY POSITIVE OHMMETER TERMINAL TO PIN. (RESISTANCE VALUE MAY RUN LOWER THAN STATED DUE TO ELECTROLYTIC CAPACITOR).
7. INF. MEANS INFINITE OR ABOVE 30 MEGOHMS.
8. AS ADJUST CARRIER CONTROL IS VARIED.
9. WITH MODULATION SWITCH AT 400∿, OTHERWISE 0V AND INF.
10. TURN METER SWITCH TO MODULATION. THEN APPLY PROD AND CHECK 4900 OHMS.
11. WITH 80% MODULATION SET.
12. AS ADJUST MODULATION CONTROL IS VARIED.
13. NC MEANS NO CONNECTION.
14. NM MEANS NOT MEASURED.

TM 5018-15

Figure 18. Tube socket and test point voltage and resistance diagram.

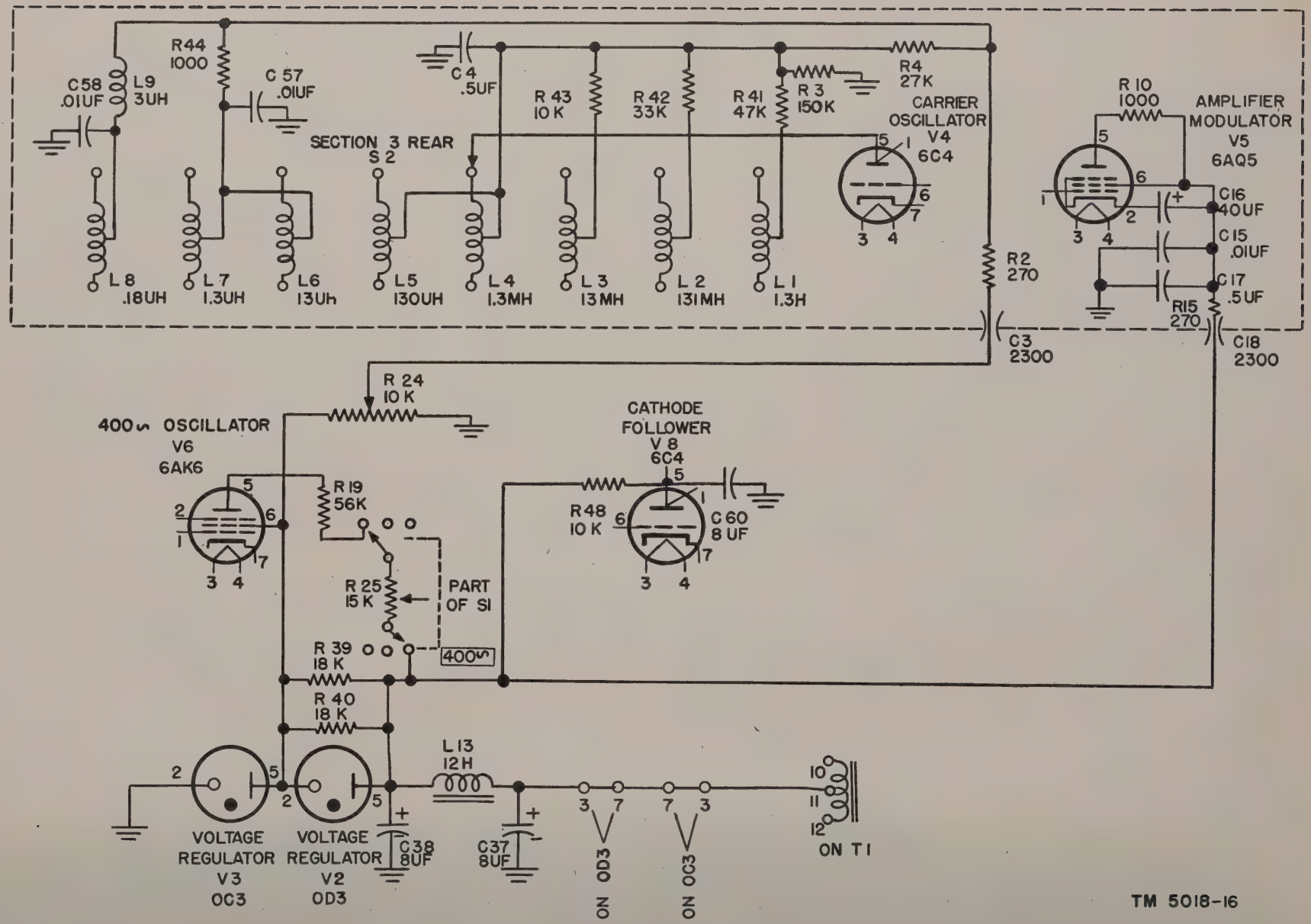


Figure 19. B+ distribution diagram.

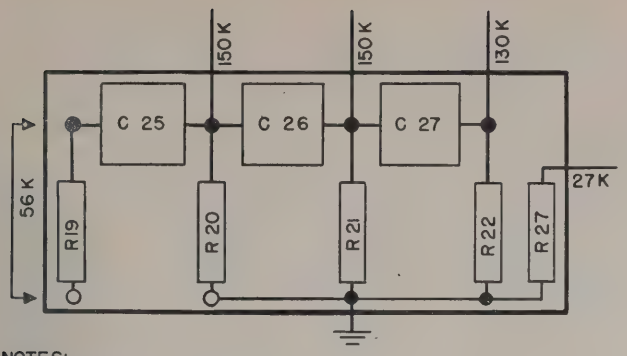


Figure 20. 400-cycle oscillator terminal board, resistance values.

b. The 400 ~ oscillator terminal board is mounted on the inside of the modulator chassis (fig. 17), and all its elements are not accessible for test from the pins of the socket of V6. Figure 20 shows its appearance and resistance values after removal of the modulator chassis.

c. Data for over-all resistance analysis of the meter subpanel have been omitted from the various charts and illustrations, because of the danger of passing excessive currents from the bridge or ohmmeter through the meter and/or copper-oxide rectifier. Figure 21 shows the general appearance and placement of parts in the meter subpanel. The resistors may be checked individually until the fault is found. *The meter should be protected by a jumper across the protruding ends of feed-through capacitors C33 and C34.*

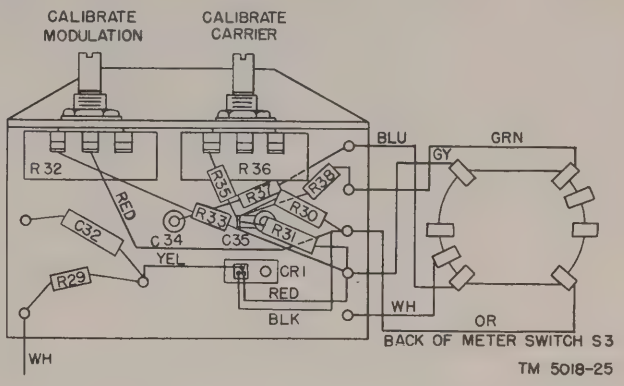


Figure 21. Meter panel, wiring detail and parts layout.

61. D-C Resistances of Transformers and Coils

The d-c resistances of the transformer windings and the coils in the signal generator are listed below:

Transformer or coil	Terminals	Ohms
T1	1–2	8.3
	3–4	9.1
	5–6	119.
	6–7	125.
	8–9	.18
	10-12	.15
L1	End-end	1230.
L2	End-end	230.
L3	End-end	55.
L4	End-end	6.6
L5	End-end	1.3
L6	End-end	.5
L7	End-end	.004
L8	End-end	.001
L8 (aux)	End-end	.16
L9	Leads	.26
L10	Leads	.14
L11	Leads	.21
L12	Leads	1.2
L13	1–2	238.

62. Tests and Repairs on Attenuator

a. Signal generator attenuators sometimes are damaged by connecting the output cable to an external circuit which already has a high potential on it. Usually, the *shunt* element on which the attenuator switch is standing at the time of contact is opened or drastically altered in value. Occasionally, if the potential is very great, the series element at either side will be altered. This condition is indicated by a similarity in output when comparing the damaged step with the next higher step. Since the attenuator El contains delicately adjusted elements, do not open the casting until resistance measurements are made to determine definitely that damage has occurred. The following chart gives the resistance values and tolerances of a normal attenuator. The tolerances call for a better order of accuracy than can be had in an ordinary ohmmeter. A bridge should be used, but an ohmmeter may be used, to determine that no drastic damage has been sustained. Make certain that the instrument will not apply more than 1 volt to a 10-ohm circuit before using it to make measurements in the attenuator circuits. Connection is made conveniently with the B.P. adapter on the ATTEN. OUTPUT jack.

Attenuator switch position	Nominal resistance (ohms)	Tolerance (ohms)	
		High	Low
1 μV	10	10.15	9.85
10 μV	10	10.15	9.85
100 μV	10	10.15	9.85
1 MV	10	10.15	9.85
10 MV	10	10.15	9.85
.1V., MULTIPLIER at 0	50	50.5	49.4
.1V., MULTIPLIER disconnected.*	105.5	107.1	103.9

*Omit test unless previous value indicates trouble.

b. If extensive work is to be done on the attenuator, remove it from the signal generator. Figure 22 shows an exploded view of the attenuator, as well as a full view into the body from the rear.

c. To replace an element, note carefully the lead length and position of the original and make an identical replacement; follow the soldering technique described in paragraph 57*c*(1) to draw the heat away from the resistor. Allow approximately 5 minutes for the joint to cool to room temperature and then measure the resistance (*a* above).

d. If a series element has a coiled lead or lead extension, snip off the element to leave the coil in place; then solder the new element to it.

e. Record the repairs on a tag and secure the tag under one of the cover screws. It is not recommended that more than two element pairs (R49 and R50, R51 and R52, etc.) be repaired (except in emergency) without complete recalibration. If recalibration is not done, the calibration above 15 mc may not be reliable.

63. Tests and Repairs on L-Pad Multiplier

a. Troubles in L-pad R14 are shown by excessive change in the carrier meter indication as the MULTIPLIER dial is turned from .0 to 2.0, failure of the .2 and 2.0 points to check with adjacent attenuator steps (as indicated by a test receiver with an output indicator), and/or generally erratic performance of the MULTIPLIER control. Since the rotational stops are on the dial rather than on the L-pad, the dial setscrews are not likely to be forced. Make all possible tests without removal of the L-pad, because removal of the pad necessitates subsequent resetting of the panel dial with respect to the contact arm position. Figure 23 shows the construction of L-pad R14 and the names of its parts. Each of the strips actually is made with two wires, each of twice the required resistance, wound in opposite directions and connected in parallel.

b. Make resistance measurements with an accurate d-c bridge to find the probable cause

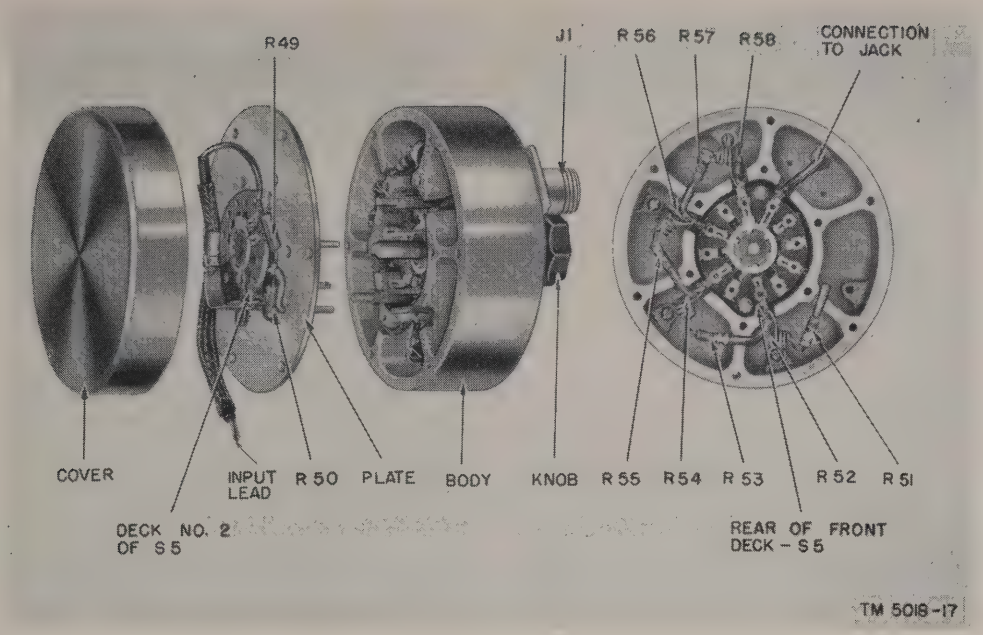


Figure 22. Attenuator, construction details.

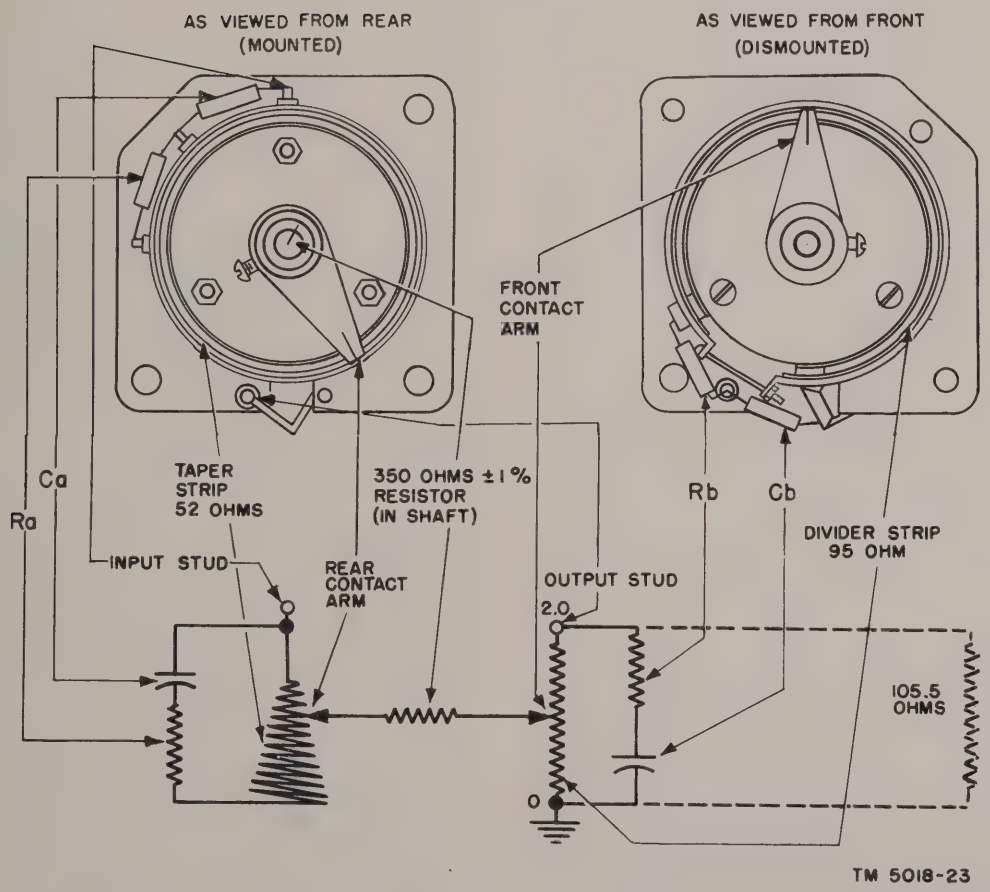


Figure 23. L-pad R14, details.

of difficulty. In the following table, it is assumed that the attenuator or an equivalent 105.5-ohm resistance is connected from the output stud to frame, as indicated by the broken-line 105.5-ohm resistor in figure 23.

Step No.	Measure resistance from	MULTIPLIER dial at	Correct d-c resistance	Resistance readings and likely faults
1	Input stud to chassis	2.0	400	Infinite: Open 350-ohm resistor in shaft, or either contact arm may have run off strip. 445 ohms: L-pad is correct, but attenuator input or divider strip is open.* 418 ohms: One wire of divider strip is open.* 383 ohms: Capacitor Cb is shorted.* 350 ohms: Divider strip or attenuator connection is shorted.
2	Input stud to chassis	.0	400	Infinite: Taper strip is open, or contact arm may have run off strip. 450 ohms: One wire or taper strip is open.* 375 ohms: Capacitor Ca is shorted.*
3	Input stud to chassis	Vary slowly .0 to 2.0.	400 ±4 ohms	Generally correct, but always jumps at one dial reading; look for foreign matter on strips; clean strips. Generally correct, but jumpy throughout; worn contact arm or arms. Correct at 2.0, but increases steadily as control is turned to .0; taper contact arm leads the divider arm too much. (Reverse also true.)
4	Output stud	2.0 (exact)	0 to .2 ohm	This step-off from end-slug of winding is correct setting of MULTIPLIER dial with respect to divider contact arm.

*This trouble ordinarily cannot be repaired in the field, unless the cause is superficial; for example, a resistance element unsoldered at the end or a capacitor open at the lead. Unless inspection shows a simple trouble, replacement of the entire L-pad is required.

64. R-f Shield Pan Insulation

a. Close inspection of figures 15 and 16 shows that the r-f shield pan is supported about ¼-inch behind the main panel on five ceramic *insulators* and one *metal* stud. This metal stud is secured to the panel with a massive nut, and it continues back to secure the tube shelf. A second nut locks the mounting plate of L-pad R14 as indicated in figure 15. The purpose of this construction is to provide *only one* path to the panel for r-f currents to keep radiation from the generator at a minimum.

b. Because of the low resistance involved, there is no practical test other than inspection to determine that proper conditions are maintained. When any parts involving this stud are removed, always make certain that the various nuts and collars are installed in their original positions and that nuts are secured firmly. When replacing parts, make sure that no tag ends of wires or shields are left to form a second ground path from shield pan to panel; determine by inspection that the stud is the *only* path.

65. Amplifier-Modulator Gain

a. Figure 24 shows the gain characteristic of the amplifier-modulator circuit in terms of the voltage applied to the grid of tube V5 to get a carrier meter deflection of SET CARRIER (1.6 volts rms) at the output. It is not important that a particular signal generator have *exactly* this gain curve, but it should be of the same general order, so that tube V5 is not overloaded to bring about standard carrier output.

b. To make this test, connect the probe of the external VTVM as close as possible to pin 1 of tube V5. Connect the ground side of the probe to the chassis with a heavy strap or braid as short as practicable. For various frequencies, turn up the ADJUST CARRIER control until the meter reads SET CARRIER and note the corresponding reading of the VTVM. In comparing these readings with data from figure 26, allow about 10 percent, *plus* the stated calibration accuracy of the external VTVM.

c. If the required input is generally excessive at all frequencies, look for general faults such

as a weak tube V5, incorrect cathode bias, low value of plate resistor R10, and so on. If the required input is high at low carrier frequencies only, look for low valued or disconnected capacitor C19. Excessive input at high carrier frequencies indicates a defective choke L11, that any one of the elements in the plate circuit of V5 is pushed against the chassis, or some other cause of excessive plate-to-ground capacitance.

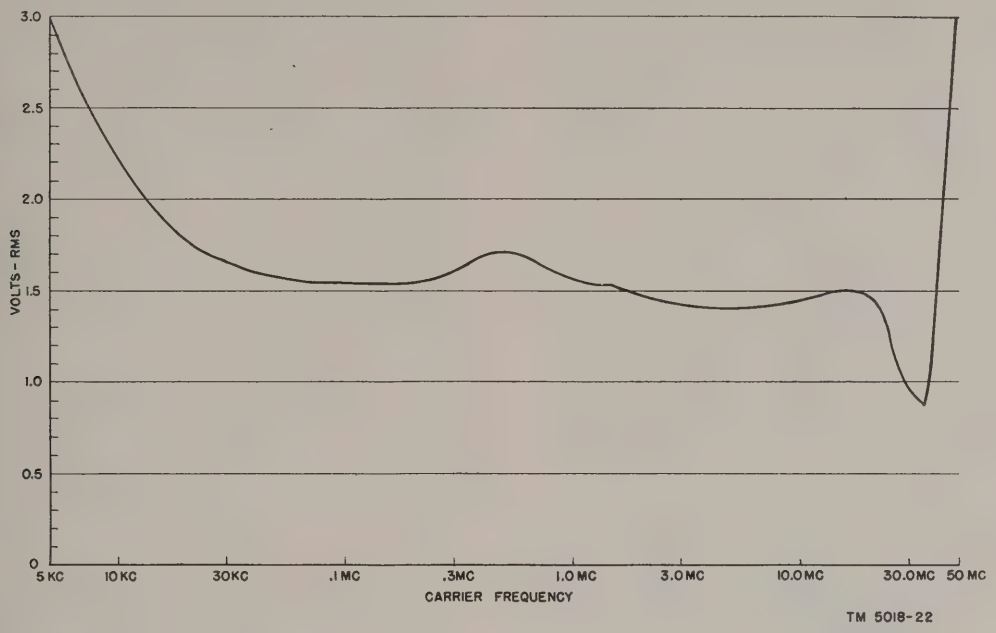


Figure 24. Amplifier-modulator, grid voltage required to obtain SET CARRIER reading.

Section II. REPAIRS

66. Replacement of Parts

Most of the parts in Signal Generator TS–588A/U are readily accessible and easily replaced. This paragraph covers certain removal procedures which are not obvious by inspection.

a. To remove the generator from the case, remove the 17 hexagonal-headed screws around the outer edge of the panel. Grasp the panel handles and pull straight forward and out, allowing the service bars to ride the lower flange of the case. When replacing, wipe the case flange free of foreign matter and make certain each panel screw has a lockwasher; use sufficient torque to force the washer through any panel paint.

b. To remove the power supply chassis, remove the lower knob from the METER TO switch and slip the cable out of the clip on the end of the r-f shield. Remove the screws just above and below the METER TO switch shaft and then remove the two screws at the left of the 115-and 230-volt switch. The chassis now can be laid back. In replacing the chassis, dress the lead from the chassis to the pilot lamp to avoid a squeeze when the panel screws are drawn up.

c. To remove the modulation chassis, remove all leads from the terminal strip at the left-hand end and make a note of the colors. Remove the three extended nuts along the upper edge and the three binder-head screws along the lower edge of the chassis.

d. To remove the r-f shield, remove the cable from the clip on the right-hand end, and remove the three thumbnuts and plain washers. Pull back on the shield and jiggle it a little; it is held tightly by the spring tension on the double flanges of the r-f shield pan.

e. To remove attenuator E1, remove the r-f shield and release the connection of the attenuator cable at the output stud of L-pad R14 (fig. 15). Remove the attenuator knob, the plain and spring washers, and the bakelite thimble. Re-

move the three screws adjacent to the 10 μV., 1MV., and .1V. panel markings and pull the casting back, while snaking the little cable through its grommet. In replacing the attenuator, check the screws holding jack J1 for tightness and wipe the face of the casting and panel area before seating. Turn the switch to its extreme clockwise position. If the thimble is burred, sand it lightly to remove the burr. Place the thimble on the shaft so that the knob setscrews will fall at new spots. The knob should be installed toward the .1V. designation.

f. To remove L-pad multiplier R14, unsolder the connections to the input and output studs (fig. 23). Remove the two screws holding the transparent marker, dial stop, and spacers. Remove the dial and the plain and spring washers. From the back, remove the nut and washer at the lower right hand of the mounting plate and the three screws at the other corners. Remove VTVM tube V7 and its shield and pull the attenuator straight back to the socket of V7; then jiggle the attenuator slightly to get it clear and out. Be especially careful not to rake the windings against sharp corners. When replacing the attenuator, make sure that the dial stop is adjusted to permit a slight overrun at .0 and 2.0. Also check for correct resistance readings (pars. 60 and 61).

g. If frequency tuning capacitor C5 is to be removed, consider whether the same capacitor is likely to be replaced. If the capacitor is to be replaced the rotor should be keyed to the frequency pointer so that the work of frequency recalibration will be a minimum. Turn the frequency pointer toward the low end of the dial and reach under the long end of the stator blades with a straight hard object, such as the end of a metal rule. Then turn the % FREQUENCY control to click the rotor blades against the object, indicating that the rotor and stator blades are intermeshed completely and exactly. Note the *exact* frequency reading or make a small mark on the FREQUENCY dial. Now remove the capacitor by removing all connections, the pointer and % FREQUENCY dial with its washers and thimble, and the flat headscrew appearing through the upper right and lower left of the % FREQUENCY dial shaft. With the capacitor plates at full mesh, unsolder the copper tape from the second deck of the band switch at the rotor lug of the capacitor; also unsolder the wire leading to the capacitor flap. Unsolder the copper tape from the stator lug of C5 at the rear deck of the band switch. From the upper stator lug, disconnect resistor R9 and the lead to capacitor C7. Before replacing the capacitor, put the panel screws in place and drop the three spacers onto them. Treat the shaft thimbles as described in *e* above and lock the pointer at the full-mesh position determined before removal. Recalibration of the FREQUENCY dial will be necessary.

h. The oscillator coil plate and the frequency band switch may be removed as an assembly without removal of the oscillator shield pan, frequency tuning capacitor, or other major parts. Unsolder the copper tape leads as for removal of capacitor C5 (*g* above). Open the lead from oscillator coil L5 to capacitor C5. Remove the lever knob from the band switch, together with its thimble and washers. Remove the two short hexagonal studs at the right of the plate and the hexagonal nut at the upper left (fig. 15). The plate now can be lifted clear for inspection. If work on it is required, remove the shielded lead to pin 3 of oscillator tube V4. Also remove the shielded lead to the tie lug on the front deck of the band switch. Always mark the leads so that they can be replaced properly.

i. To remove the panel meter, reach between the main panel and the meter subpanel with a soldering iron and disconnect the meter studs from feed-through capacitors C34 and C35. Be careful not to break the hermetically sealed meter terminals or the ceramic posts of the capacitors. Remove the three screws in the flange of the meter. Now pull the meter outward from the front panel.

j. To remove the meter subpanel, remove the meter (*i* above). Remove the six wires from the subpanel terminals (fig. 21), and make a record of the lead colors and connections. The subpanel now will be free.

k. The tube shelf can be removed independently of other assemblies, except the L-pad. This L-pad may be left on the shelf, or it may be removed prior to removal of the shelf. In either event, the hexagonal nut must be removed from the L-pad mounting plate. Remove

the necessary leads connecting the shelf parts to the shield pan parts. Remove the two round headscrews at the right of the shelf and the long stud at the left (fig. 17) to free the shelf.

l. The basic construction is such that the r-f shield pan may be removed without prior removal of the subassemblies. The knobs must be removed from the OUTPUT switch, MULTIPLIER dial % FREQUENCY control, and range switch. The FREQUENCY dial pointer also must be removed. The mounting screws of capacitor C5 must be removed, although the capacitor itself need not be disconnected unless desired. Observe all the techniques and precautions of the preceding subparagraphs. Remove the attenuator connection to the output stud of the L-pad, the connection to 2 VOLT OUTPUT jack J2, and the external leads to the five feedthrough capacitors around the edge of the pan. Remove the hexagonal nut on the L-pad mounting plate and the five nuts that secure the ceramic insulators against the pan. The entire pan is now free with the oscillator coil plate, the band switch, the tube shelf, and the L-pad attached. The frequency tuning capacitor remains in place, secured by its leads.

67. Refinishing

Instructions for refinishing badly marred panels on exterior cabinets are given in TM 9–2851.

68. Dial Gearing, Capacitor C5

a. Details of the gear drive of the frequency capacitor are shown in figure 25. After extensive wear, the pinion gear or the driven gears, or both, may have to be replaced.

b. Remove the jam nuts on the under side of the front plate. If the pinion is to be replaced, remove both screens securing the pinion plate. If the pinion is not to be replaced, remove only one screw and loosen the other sufficiently to let the pinion plate swing aside. The captive gear is secured to the capacitor shaft by two setscrews. Remove these screws and lift off the two gears.

c. After replacing the driven gears, replace the springs. Secure the pinion plate by one screw and swing it so that it does not mesh with the driven gears. Note the position where the spring apertures are in coincidence and then skew the driven and idler gears in the direction that compresses the spring in the amount of two teeth. Swing the pinion into mesh and secure the other side of the pinion plate lightly. Place the knob on the pinion shaft and adjust the depth of mesh until the action is smooth. Then securely lock the pinion plate and replace the jam nuts under the front plate.

d. Place a small amount of vaseline on the pinion gear to secure smooth action.

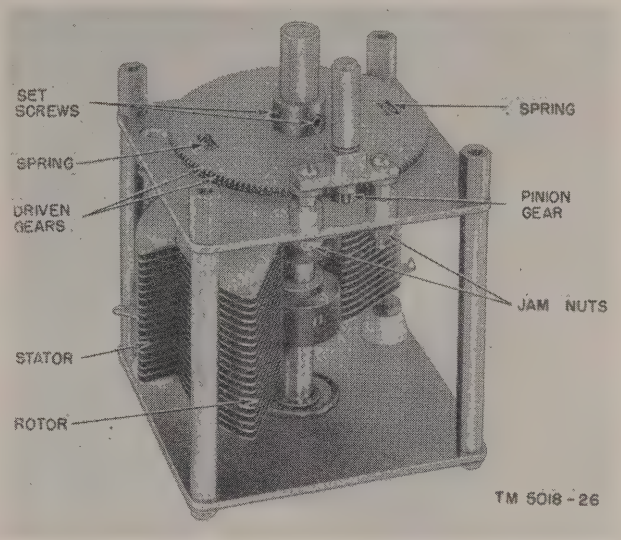


Figure 25. Gear drive of capacitor C5.

69. Repairs to Accessories

a. The output cable may become broken or frayed at the fittings. A broken cable will have to be replaced, but a frayed cable may be trimmed back once or twice before becoming too short. Always test the replaced or repaired cable for opens and shorts before placing it in service.

b. The terminations are well protected mechanically and connecting them to points of excessive potential is the usual cause of damage. Such damage will be disclosed by a resistance check. Always replace elements with exact duplicates in the same position as the original. Check by careful resistance measurement after replacement.

c. If the adapters are damaged, complete replacement will be necessary.

70. Output Voltage Calibration

a. Whenever the vacuum-tube voltmeter tube V7 is replaced, a recalibration of the output voltage should be made. If resistor R13, other parts, or wiring associated with the OUTPUT switch S4 are replaced, the accuracy of the output from the 2 VOLT OUTPUT jack should be checked.

b. To check and recalibrate the output voltage, use Electronic Multimeter TS–505/U (or equal). Apply the test point to the input stud of L-pad R14. Turn the MULTIPLIER dial to 2.0. Adjust the signal generator for an unmodulated carrier of 1 mc and turn the ADJUST CARRIER control to obtain a voltmeter reading of 1.6 volts. The carrier meter should read exactly on the SET CARRIER mark. If necessary, adjust the CALIBRATE CARRIER control (fig. 16), so that the carrier meter reads exactly on the SET CARRIER mark. Now adjust the signal generator for unmodulated output at other frequencies and note the deflections on the *voltmeter* for each adjustment of the signal generator output to the SET CARRIER mark. The voltmeter readings should not show an error in excess of 3 percent at any frequency in the range of the signal generator. If greater errors exist, there is a fault in the vacuum-tube voltmeter circuit of the signal generator: for example, an open bypass capacitor C21 or C22.

71. Frequency Calibration

a. Before attempting to calibrate the FREQUENCY dial, make certain that all troubles have been cleared correctly and that the general performance of the signal generator checks according to the tests of paragraph 43. The signal generator will be removed from its case, but the r-f shield should be in place as shown in figure 14.

b. The standard of frequency used should have an accuracy of at least .01 per cent. Frequency Calibrator Meter Set AN/URM–18 is suitable.

c. To avoid expending much time and labor, make a survey of the existing frequency calibration before making any adjustments. Select convenient test frequencies near the ends and center of each band of the generator. Make a complete determination at each point and record the results. Compute the error for each point and study the data with respect to the following:

(1) *If all errors are within 1 percent,* the frequency calibration is within original factory limits and the generator does not require recalibration.

(2) *Calibration may be within 1 percent at the low-frequency ends of each band, but a greater error, in the same amount and direction, will be found at the high-frequency end of each band.* This type of error is caused by a new oscillator tube with constants that differ somewhat from those of the original tube. If possible, let the new tube age for 24 hours at normal operating potentials and the calibration may correct itself. Try other tubes of the same type from stock; one may be found to give the correct frequencies.

(3) *Calibration at all points may be in error by an amount corresponding to a constant physical distance along the FREQUENCY dial.* This condition suggests the possibility that the frequency pointer has been forced, or replaced, in the wrong angular setting with respect to the capacitor shaft. If so, the obvious mechanical correction (resetting the pointer) should correct the calibration.

(4) *If the errors are generally in excess of 1 percent and do not fit into any of the above patterns, recalibration is necessary.*

d. For any band, select two calibration frequencies: a low-frequency point about 120 percent of the minimum band frequency, and a high-frequency point about 90 percent of the maximum band frequency. For any band, the low-frequency point is adjusted by an iron slug in the coil (A1, B1, C1, etc.) indicated in figures 14 and 26. The high-frequency end is adjusted by a trimmer capacitor (Ac, Bc, Cc, etc.). The iron slugs are locked with a $\frac{5}{16}$-hexagonal nut which must be released before the

slug stem can be turned with a small screw driver. The trimmer capacitors must be turned with a screw driver made of *insulating* material.

e. Unless frequency tuning capacitor C5 has been physically damaged or replaced, excessive midrange errors usually are caused by failure to carry out the end point adjustments with sufficient care, or by a shifting of the frequency pointer (*c*(3) above). *Do not adjust the capacitor blade spacing. Find the basic cause of poor calibration and adjust calibration trimmers only.*

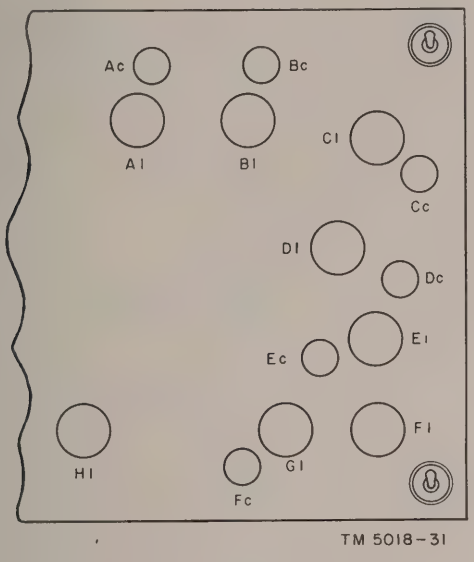


Figure 26. Calibration trimmers.

72. Modulation Calibration

a. A cathode-ray oscillograph is required and it should produce a full screen vertical (y) deflection with a vertical input of 2 volts or less, without overloading or distortion at frequencies up to 50 kc. The horizontal (x) side should have a linear sweep together with facilities for synchronizing the sweep to an external source. Oscilloscope BC–1060A is suitable for this purpose. If a nonparallax reading device with micrometer adjustment is available for evaluating the vertical amplitude, the accuracy of the determination will be improved. If not, the deflections can be determined on a carefully ruled screen placed close to the face of the tube.

b. The signal generator should be set up for external modulation (par. 19) as shown in figure 27. The vertical input (y) side of the oscillograph connects to the 2 VOLT OUTPUT jack

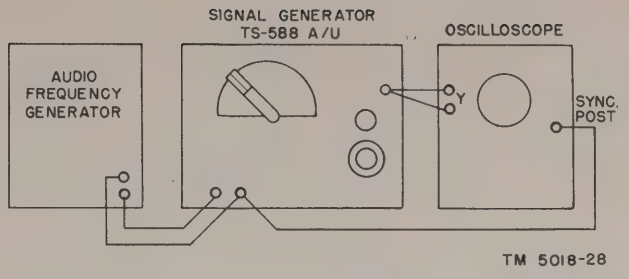


Figure 27. Test setup for calibration of modulation.

or, optionally, to the ATTEN. OUTPUT jack if the vertical sensitivity permits.

c. During calibration the modulating frequency must be low with respect to the carrier

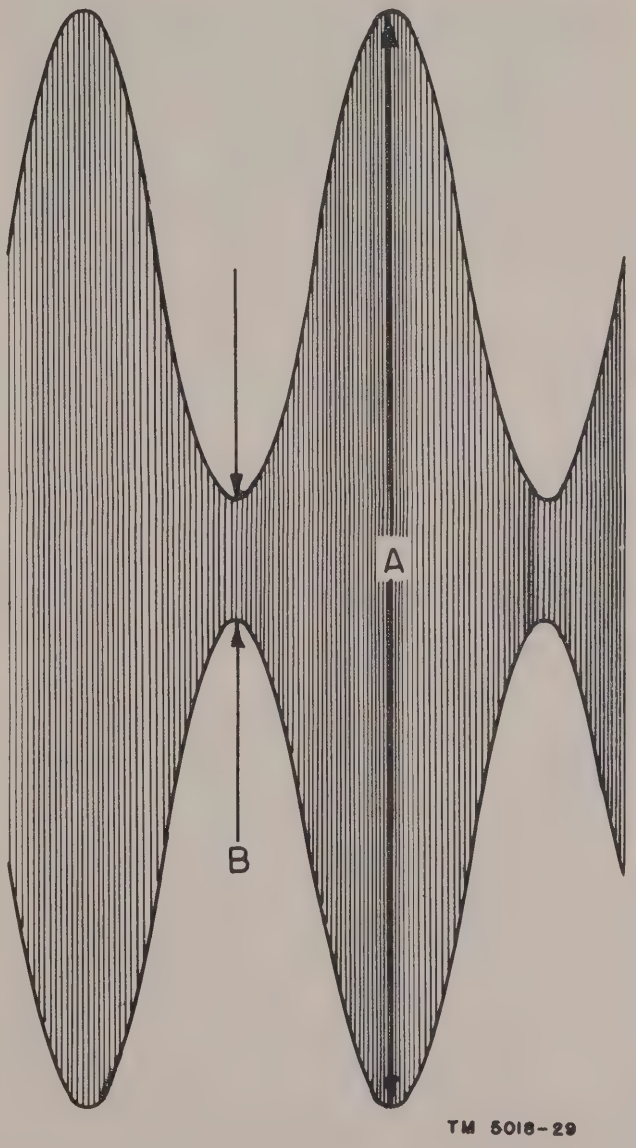


Figure 28. Typical modulation pattern.

frequency, so that a-f fire-through of the modulating voltage (fig. 13) will not distort the modulation pattern. During receiver testing this fire-through is eliminated by the tuned circuits of the receiver, but tuned circuits produce inaccuracies when employed for calibration purposes. Convenient test values are carrier, 50 kc, and modulation at 100 cycles. Set the modulation depth to 30 percent as indicated by the panel meter (whether correct or not). Set the linear sweep for 50 per second and synchronize it to the a-f oscillator. A pattern such as that shown in figure 28 should be seen on the screen. In this pattern the peaks of modulation, distance A, are 1.86 times the distance B at the trough of modulation. Check your pattern for these distances and compute their ratio. If the ratio is not 1.86, the actual modulation is greater or less than 30 percent. Readjust the MODULATION control as necessary to secure a ratio of exactly 1.86. The panel meter will now read high or low and should be corrected by turning the internal control, CALIBRATE MODULATION (fig. 16), as required. With the MODULATION switch at OFF, measure the amplitude of the unmodulated carrier on the scope. For symmetrical modulation, the value should fall halfway between the values of A and B (fig. 28).

d. Now, set other values of modulation on the panel meter and check the results against the following table:

Modulation percent	A/B
80	9.0
70	5.65
60	4.00
50	3.00
40	2.34
30	1.86
20	1.50
10	1.22
0	1.00

Note. Owing to the difficulty of measuring A and B accurately, ratios within 10 to 20 percent of those in the A/B column should be considered satisfactory.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

73. Disassembly

Refer to paragraph 13 for information on removing the signal generator from its cabinet. Before repacking the equipment, put all components in the positions indicated in the remarks column of the packing list in paragraph 6*b*. Also set the line switch S7 to the 115-V position and install 1-ampere fuses in the fuseholders.

74. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for limited storage depends upon the material available and the conditions under which the equipment is to be shipped or stored. Original packaging is shown in figure 3.

b. Whenever practicable, place a dehydrating agent, such as silica gel, inside the packing case. Protect the instrument with a waterproof paper barrier. Seal the seams of the paper barrier with waterproof compound or tape. Pack the protected instrument in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATÉRIEL TO PREVENT ENEMY USE

75. General

The demolition procedures outlined in paragraph 76 will be used to prevent the enemy from using or salvaging this equipment. Demolition will be accomplished *only* upon order of the commander.

76. Methods of Destruction

a. Smash. Smash the controls, tubes, coils, switches, capacitors, transformers, and meter, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut the output and power cord and slash the r-f shield, using axes, handaxes, or machetes.

c. Burn. Burn cords and technical manuals, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels and cabinets.

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

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

g. Other. Destroy everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, check SR 310–20–3, SR 310–20–4, and SR 310–20–5. Check Department of the Army Supply Catalog SIG 1 for Signal Corps supply catalogs.

1. Army Regulations

AR 380–5	Military Security (Safeguarding Military Information).
AR–750–5	Maintenance of Supplies and Equipment (Maintenance Responsibilities and Shop Operation).

2. Supply Publications

SIG 1	Introduction and Index.
SIG 3	List of Items for Troop Issue.
SIG 5	Stock List of All Items.
SIG 6	Sets of Equipment.
SIG 7 & 8	Organizational Maintenance Allowances and Field and Depot Maintenance Stockage Guide.
SB 11–76	Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–300	Frequency Meter Sets SCR–211–(*).
TM 11–2019	Test Set I–49.
TM 11–2526	Oscilloscope BC–1060–A.
TM 11–2626	Test Units I–176, I–176–A, and I–176–B.
TM 11–2627	Tube Testers I–177 and I–177–A.
TM 11–5511	Electronic Multimeter TS–505/U.
TM–11–5527	Multimeter TS–352/U.

4. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69	Lubrication of Ground Signal Equipment.
TM 9–2851	Painting Instructions for Field Use.

5. Decontamination

TM 3–220	Decontamination.

6. Demolition

FM 5–25	Explosives and Demolitions.

7. Other Publications

FM 24–18	Field Radio Techniques.
SR 310–20–3	Index of Training Publications.
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.
SR 310–20–5	Index of Administrative Publications.
SR 700–45–5	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247).
SR 745–45–5 AFR 71–4	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army) and AF–MC–U2 (Air Force)).
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 123	Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178	Preventive Maintenance Guide for Radio Communication Equipment.
TB SIG 219	Operation of Signal Equipment at Low Temperatures.
TM 11–662	Basic Theory and Application of Electron Tubes.
TM 11–663	Electronic Power Supplies.
TM 11–665	C–W and A–M Radio Transmitters and Receivers.
TM 11–668	F–M Transmitters and Receivers.

8. Abbreviations

a-c	alternating-current	h-f	high-frequency
a-m	amplitude-modulated	in.	inch
approx	approximately	i-f	intermediate-frequency
atten	attenuator	kc	kilocycles
a-f	audio-frequency	lb	pound
avc	automatic volume control	max	maximum
aux	auxiliary	mc	megacycle
B.P.	binding post, (referring to adapter unit)	meg	megohm
c-w	continuous-wave	mv	millivolt
cyc	cycle	r-f	radio-frequency
cps	cycles per second	rms	root mean square
cps/mc	cycles per second per megacycle	μf	microfarad
d-c	direct-current	$\mu\mu$f	micromicrofarad
ext	external	μv	microvolt
ft	foot, feet	VTVM	vacuum-tube voltmeter
gnd	ground	v, V	volt

APPENDIX II

IDENTIFICATION TABLE OF PARTS

1. Requisitioning Parts

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7 & 8, list of allowances of expendable material, or other authorized supply basis. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see SIG 1.

2. Identification Table of Parts for Signal Generator TS-588A/U

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	SIGNAL GENERATOR TS–588A/U: am; 5 kc to 50 mc in 8 bands.		3F3901–588A
E1	ATTENUATOR, variable: resistance type unbalanced ladder; input impedance +105.5 ohms ±4% up to 10 mc, output impedance 10 ohms ±10% up to 10 mc.	Controls carrier output in decimal steps.	2Z395.97
	BARE UNIT for Signal Generator TS–588A/U.		3F3901–588AZ
W1	CABLE, power: UL type SJ cable modified, 2 #18 AWG stranded cond; 8 ft lg o/a.	A-c line cord.	1B3018–2.28
	CAP.	Caps the 2 VOLT OUTPUT jack when not in use.	2Z1612.16
C1, C13, C15 C39, C40, C57, C58	CAPACITOR, fixed: ceramic; 10,000 μμf; 600 vdcw.	C1: R-f bypass, oscillator filament. C13: R-f bypass, modulator cathode. C15: R-f bypass, modulator screen. C39, C40: R-f bypass, line. C57: R-f plate return, band G. C58: R-f plate return, band H.	3DA10–572
C2, C4, C17	CAPACITOR, fixed: paper; 500,000 μμf +20% —10%; 600 vdcw; JAN type CP53B1EF504V.	C2: R-f bypass, all bands. C4: R-f plate return bands A, B, C, D, E. C17: R-f return, modulator plate.	3DA500–451
C3, C11, C12, C18, C21, C23	CAPACITOR, fixed: ceramic; 2,300 μμf; —20% +50%, 500 vdcw.	C3: Bypass, carrier plate. C11: Bypass, modulator grid. C12: Bypass, all filaments in r-f shield. C18: Bypass, modulator plate and screen. C21: Bypass, cathode VTVM. C23: Bypass, VTVM output.	3DA2.300–2
C5	CAPACITOR, variable: air; plate meshing type; single sect.; 21 to 820 μμf.	Frequency tuning unit.	3D9820V
C6	CAPACITOR, fixed: electrolytic; 25 μf; 500 vdcw; JAN type CE64C250G.	Smoother, rectified a-c for VTVM.	3DB25–82
C7, C48	CAPACITOR, variable: ceramic; 1.5 to 7 μμf; 500 vdcw; JAN type CV11A070.	C7: H-f coupler, carrier oscillator to modulator. C48: Trimmer, band H.	BD9007V–17
C8, C22	CAPACITOR, fixed: paper; 250,000 μμf ±10%; 200 vdcw; JAN type CP26A1EC254K.	C8: Coupling capacitor V4 to V5. C22: Cathode bypass V7.	BDA250-425

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
C9, C10, C20, C28, C29	CAPACITOR, fixed: mica; 510 μμf ±5%; 500 vdcw; JAN type CM20B511J.	C9 and C10: bypasses, modulator grid. C20: Couples modulator to output, above 400 kc. C28 and C29: Bypasses, external modulator connection.	3K2051122
C14	CAPACITOR, fixed: electrolytic; 250 μf; 25 vdcw; JAN type CE31C251F.	L-f bypass, modulator cathode.	3DB250–10
C16	CAPACITOR, fixed: electrolytic; 40 μf; 250 vdcw; JAN type CE31C400M.	Screen cathode bypass, modulator.	3DB40–87
C19, C49, C50	CAPACITOR, fixed: mica; 10,000 μμf ±10%; 300 vdcw; JAN type CM35B103K.	C19: Modulator output, below 400. C49: Grid capacitor, band A. C50: Grid capacitor blocking, band B.	3K3510321
C30, C35, C36	CAPACITOR, fixed: paper; 50,000 μμf ±10%; 600 vdcw; JAN type CP26A1EF503K.	C30: Coupling capacitor, V8. C35 and C36: Line filters.	3DA50–224
C24	CAPACITOR, fixed: electrolytic; 25 μf; 25 vdcw; JAN type CE61C250F.	Cathode bypass, 400 cps oscillator.	3DB25–130
C25, C26, C27, C32, C51	CAPACITOR, fixed: mica; 1,000 μμf ±5%; 500 vdcw; JAN type CM30B102J.	C25, C26, and C27: Elements of phase net. C32: Frequency compensator, rectifier meter circuit. C51: Grid capacitor band C.	3K3010222
C31	CAPACITOR, fixed: paper; 4 μf +20% —10%; 600 vdcw; JAN type CP41B1EF405V.	Blocker, cathode of cathode follower.	3DB4–288
C33, C34	CAPACITOR, fixed: ceramic; 1,000 μμf ±20%; 500 vdcw.	Meter stud bypasses.	3DA1–338
C37, C38, C60	CAPACITOR, fixed: electrolytic; 8 μf; 350 vdcw; JAN type CE62C080P.	C37: Input +B filter. C38: Filter. C60: Filter, cathode follower plate.	3DB8–229
C41 through C47	CAPACITOR, variable: ceramic; 7 to 45 μμf; 500 vdcw; JAN type CV11C450.	C41: Trimmer, band A. C42: Trimmer, band B. C43: Trimmer, band C. C44: Trimmer, band D. C45: Trimmer, band E. C46: Trimmer, band F. C47: Trimmer, band G.	3D9045V–15
C52	CAPACITOR, fixed: mica; 330 μμf ±10%; 500 vdcw; JAN type CM20B331K.	Grid capacitor, band D.	3K2033121
C53	CAPACITOR, fixed: mica; 120 μμf ±10%; 500 vdcw.	Grid capacitor, band E.	3D9120–41
C54	CAPACITOR, fixed: mica; 33 μμf ±10%; 500 vdcw.	Grid capacitor, band F.	3D9033–43
C55	CAPACITOR, fixed: mica; 100 μμf ±10%; 500 vdcw.	Grid capacitor, band G.	3D9100–318
C56	CAPACITOR, fixed: mica; 430 μμf ±5%; 500 vdcw.	Grid capacitor, band H.	3D9430–6
C59	CAPACITOR, fixed: ceramic; 51 μμf ±2%; 500 vdcw; JAN type CC20UJ510G.	Tunes tertiary, band H.	3D9051–55
C101	CAPACITOR, fixed: mica; 200 μμf ±5%; 500 vdcw.	Part of dummy antenna.	3D9200–113
C102	CAPACITOR, fixed: mica; 400 μμf ±5%; 500 vdcw.	Part of dummy antenna	3D9400–57
L10	COIL, RF: choke; unshielded; 2.1 μh at 8 mc.	Filament choke, carrier oscillator.	3C320E
L11	COIL, RF: choke; unshielded; 2.4 μh at 8 mc.	Equalizer, modulator plate.	3C320E–2
L12	COIL, RF: choke; unshielded; 31.5 μh at 2.5 mc.	Filter element, external modulator connection.	3C320E–3

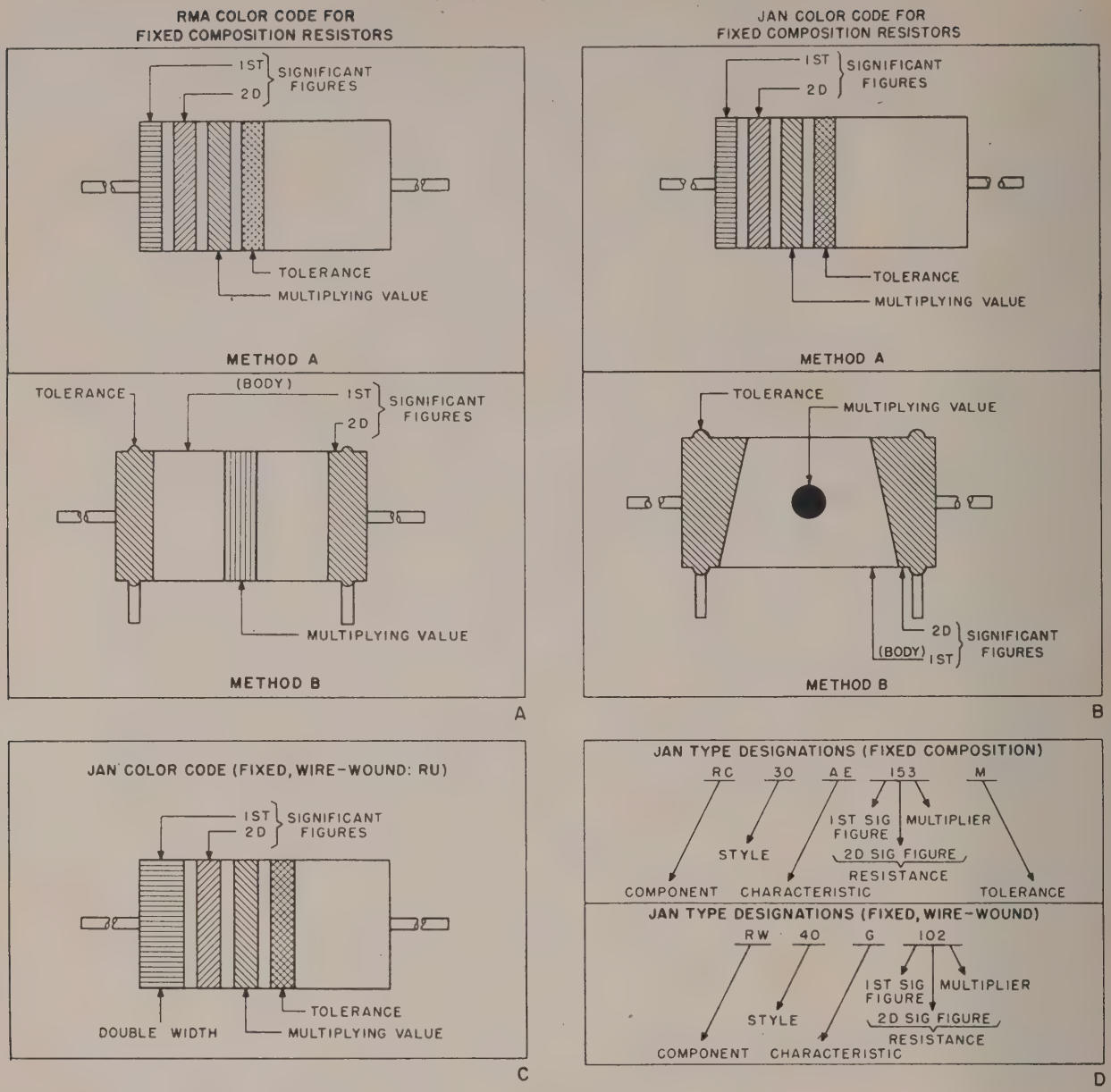
Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
L1	COIL, RF: osc; single wnd, 4 pie universal wnd; unshielded; 1⅛″ dia x 4″ lg o/a; phenolic form, adj powdered iron core; form ¾″ dia x 2¾″ lg; scdr adj at bottom; mtg by ¼″–28 dia x 5/16″ lg stud; 4 solder lug term. on top; impr for moisture-proofing and fungiproofing.	Oscillator coil, band A.	
L2	COIL, RF: osc; single wnd, 4 pie universal wnd; unshielded; 1″ dia x 4″ lg o/a; phenolic form, adj powdered iron core; form ¾″ dia x 2¾″ lg; scdr adj at bottom; mtd by ¼″–28 dia x 5/16″ lg stud; 4 solder lug term. at top; impr for moistureproofing and fungiproofing.	Oscillator coil, band B.	
L5	COIL, RF: osc; single wnd, 1 pie universal wnd; unshielded; ⅞″ dia x 2¾″ lg o/a; phenolic form, adj powdered iron core; form ½″ dia x 1⅝″ lg; scdr adj at bottom; mtd by ¼″–28 dia x 5/16″ lg stud; 3 solder lug term. on top; impr for moisture-proofing and fungiproofing.	Oscillator coil, band E.	
L7	COIL, RF: osc; unshielded; ⅝″ dia x 3⅜″ o/a	Oscillator coil, band G.	3C1081–37C
L4	COIL, RF: osc; single wnd, 1 pie universal wnd; unshielded; ⅞″ dia x 2¾″ lg o/a; phenolic form, adj powdered iron core; form ½″ dia x 1⅝″ lg; scdr adj at bottom; mtd by ¼″–28 dia x 5/16″ lg stud; 3 solder lug term. on top; impr for moisture-proofing and fungiproofing.	Oscillator coil, band D.	
L3	COIL, RF: osc; single wnd, 1 pie universal wnd; unshielded; ⅞″ dia x 2¾″ lg o/a; phenolic form, adj powdered iron core; form ½″ dia x 1⅝″ lg; scdr adj at bottom; mtd by ¼″–28 dia x 5/16″ lg stud; 4 solder lug term. on top; impr for moisture-proofing and fungiproofing.	Oscillator coil, band C.	
L8	COIL, RF: osc; 7/16″ dia x 2″ lg.	Oscillator coil, band H.	2Z9629–389
L9	COIL, RF: choke; unshielded; 3 μh at 8 mc.	R-f choke, band H.	3C320E–1
L6	COIL, RF: osc; unshielded; ⅝″ dia x 2¾″ o/a.	Oscillator coil, band F.	3C1081–37B
L101	COIL, RF: choke; single layer wnd, unshielded; 20 μh at 2.5 mc, .015 amp continuous dc, 4 ohm dc; ¼″ dia x ¾″ lg body; phenolic form, air core; 2 axial wire leads, 1½″ lg; mts on leads; impr for moistureproofing and fungiproofing.	Part of dummy antenna.	
	CLAMP: power cord; molded phenolic; snaps into ⅝″ dia panel hole; ¾″ dia x ⅝″ h o/a; holds in 5/16″ material.	Used where cord passes through front panel.	
	CONNECTOR, plug: 2 flat parallel male cont.		6Z1727
J1, J2	CONNECTOR, RF: Radio Frequency Receptacle UG–58A/U; 1 round female coax cont; straight type.	J1: ATTEN OUTPUT. J2: 2 VOLT OUTPUT.	2Z7390–58A
I2	DIAL: multiplier.	Dial for MULTIPLIER control.	2Z3723–320
I3	DIAL: incremental freq; etched aluminum, bright numerals, graduations; reads 0 to 15″ .1 increments in 360° ccw; 2¼″ dia x ⅞″ h; shaft hole 9/16″ dia x 9/16″ d.	% FREQUENCY dial.	2Z3723–321
I4	DIAL: frequency.	Main FREQUENCY dial.	2Z3723–322
F1, F2	FUSE, cartridge: 1 amp 25v.	Line fuses.	3Z2601.35
E2, E3	FUSEHOLDER: Fuse Post FU–39; 9/32″ dia x 1¼″ lg eye fuse.	Line fuseholders.	3Z1939
	INSULATOR, standoff: cylindrical; .75″ lg x ⅜″ dia; JAN type NS5W0106.	Two used to support C8. One for capacitor flap.	3G3501–06.2
	KNOB: round; black bakelite; for ¼″ dia shaft; 1½″ dia x 13/16″ h o/a.	For MODULATION switch.	2Z5822–68

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	KNOB: round; black bakelite; for ¼″ dia shaft.	For ADJUST CARRIER and ADJUST MODULATION controls.	2Z5788–65
	KNOB: lever type; black aluminum; for 5/16″ dia shaft.	For range switch.	2Z5822–618
	KNOB: bar pointer; black bakelite; for ¼″ dia shaft.	For METER TO switch.	2ZK5822–36
	KNOB: round; black bakelite; for 5/16″ dia round shaft; 1½″ dia x 1 13/16″ h o/a; brass insert; shaft hole 41/64″ d.	For OUTPUT switch.	
	KNOB: round; black bakelite; for 5/16″ dia shaft.	For attenuator, E1.	2Z5822–617
	KNOB: round; black bakelite; for 8–32 shaft.	Used at corners for stowage of a-c line cord.	2Z5822–354
E4	LAMP LM–27: 6–8 v, .25 amp; miniature bayonet base.	Line supervisory.	2Z5927
I1	LIGHT, indicator: w/lens; for miniature bayonet base, T–3¼ bulb.	Indicator light.	2Z5991
W2	CABLE ASSEMBLY, RF: uses Radio Frequency Cable RG–9A/U; 40″ lg o/a.	Connects generator to the work circuit.	3E7350–2.36.5
M1	METER, arbitrary scale: dc; 0–2 v rf and 0 to 80 percent modulation.	Reads carrier-modulation.	3F8002–13
	POINTER, indicator.	For FREQUENCY dial indication.	3F33440–5
E5, E6	POST, binding: screw type.	Connects external modulating oscillator.	3Z741–40
L13	REACTOR: 12 hy at 105 ma; 170 ohm dc resistance.	Main +B power filter choke.	3C547–41
CR1	RECTIFIER, metallic; copper oxide; input 5 v ac single phse; output 5 ma continuous.	For percent modulation indication.	3H4702–4
R14	RESISTOR ASSEMBLY: c/o 2 ganged variable resistors 1 fixed resistor; 4 mtg holes irregularly located in plate, 2 5/8″ x 2 5/8″ x 3 7/8″ lg incl shaft.	Interpolating control, r-f output system.	3Z6960–63
R1, R8, R9	RESISTOR, fixed: comp; 100,000 ohms ±10%; ½ w; JAN type RC20BF104K.	R1: Grid leak. R8 and R9: Part of oscillator-modulator feed, 1–f.	3RC20BF104K
R2, R15	RESISTOR, fixed: comp; 270 ohms ±10%; 2 w; JAN type RC42BE271K.	R2: Part of r-f filter, oscillator plate. R15: Part of r-f filter, modulator plate.	3RC42BE271K
R3, R20, R21	RESISTOR, fixed: comp; 150,000 ohms ±5%; 1 w; JAN type RC30BF154J.	R3: Part of plate divider, carrier oscillator. R20 and R21: Elements of 400 cps phase shift net.	3RC30BF154J
R4, R27, R44	RESISTOR, fixed: comp; 27,000 ohms ±10%; 1 w; JAN type RC30BF273K.	R4: Part of plate divider, carrier oscillator. R27: Cathode load, c-f tube. R44: Plate dropping resistor, band G.	3RC30BF273K
R5, R6	RESISTOR, fixed: comp; 2,000 ohms ±5%; ½ w; JAN type RC20BF202J.	Parts of modulator grid filter.	3RC20BF202J
R7, R41	RESISTOR, fixed: comp; 47,000 ohms ±10%; ½ w; JAN type RC20BF473K.	R7: Grid resistor, modulator. R41: Plate dropping resistor, band A.	3RC20BF473K
R11	RESISTOR, fixed: comp; 470 ohms ±5%; 2 w; JAN type RC42BE471J.	Cathode resistor, modulator.	3RC42BE471J
R16, R42	RESISTOR, fixed: comp; 33,000 ohms ±10%; ½ w; JAN type RC20BF333K.	R16: Load resistor, a-c side of diode. R42: Plate dropping resistor, band B.	3RC20BF333K
R18, R30, R31	RESISTOR, fixed: comp; 3,300 ohms ±5%; 1 w; JAN type RC30BF332J.	R18: Cathode bias V6. R30 and R31: Voltage splitter; rectifier meter.	3RC30BF332J

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
R19	RESISTOR, fixed: comp; 56,000 ohms ±10%; 1 w; JAN type RC30BF563K.	Plate feed for V6.	3RC30BF563K
R22	RESISTOR, fixed: comp; 130,000 ohms ±5%; 1 w; JAN type RC30BF134J.	Element of 400 cps phase net.	3RC30BF134J
R23	RESISTOR, fixed: comp; 6,800 ohms ±10%; ½ w; JAN type RC20BF682K.	Filter termination, external modulator connection.	3RC20BF682K
R26	RESISTOR, fixed: comp; 1 meg ±10%; ½ w; JAN type RC20BF105K.	Grid leak, cathode follower tube V8.	3RC20BF105K
R28, R34	RESISTOR, fixed: comp; 1,200 ohms ±5%; 1 w; JAN type RC30BF122J.	R28: Bias resistor, cathode follower tube V8. R34: Dummy, replaces meter, etc., on unused side.	3RC30BF122J
R33, R35	RESISTOR, fixed: comp; 4,700 ohms ±10%; ½ w; JAN type RC20BF472K.	Adjustment limiters.	3RC20BF472K
R37, R38	RESISTOR, fixed: comp; 470 ohms ±10%; ½ w; JAN type RC20BF471K.	R-f isolations for meter studs.	3RC20BF471K
R39, R40	RESISTOR, fixed: comp; 18,000 ohms ±10%; 2 w; JAN type RC42BE183K.	Equalize currents in regulators.	3RC42BE183K
R43, R46, R48	RESISTOR, fixed: comp; 10,000 ohms ±10%; ½ w; JAN type RC20BF103K.	R43: Plate dropper, band C. R46: Grid leak, band G. R48: Plate filter, V8.	3RC20BF103K
R45	RESISTOR, fixed: comp; 22,000 ohms ±10%; ½ w; JAN type RC20BF223K.	Grid leak, band F.	3RC20BF223K
R47	RESISTOR, fixed: comp; 1,000 ohms ±5%; 1 w; JAN type RC30BF102J.	Grid leak, band H.	3RC30BF102J
R101	RESISTOR, fixed: comp; 430 ohms ±5%; ½ w; JAN type RC10BF431J.	Part of dummy antenna.	3RC10BF431J
R12	RESISTOR, fixed: film; 3,080 ohms ±2%; ½ w.	Diode load, VTVM.	3Z6308–1
R13	RESISTOR, fixed: film; 82 ohms ±1%; ½ w.	Builds out VTVM range to 2 volts.	3Z6008B2–21
R29	RESISTOR, fixed: film; 4,000 ohms ±1%; ½ w.	Meter multiplier.	3Z6400–129
R49	RESISTOR, fixed: film; 94.8 ohms ±1%; ½ w.	Series element of attenuator.	3Z6009D4–2
R50	RESISTOR, fixed: film; 11.7 ohms ±1%; ½ w.	Shunt element of attenuator.	3Z6001A1–21
R51, R53, R55, R57	RESISTOR, fixed: film; 99 ohms ±1%; ½ w.	Series elements of attenuator.	3Z6009J9–3
R52, R54, R56	RESISTOR, fixed: film; 12.2 ohms ±1%; ½ w.	Attenuator shunts.	3Z6001B2–39
R58	RESISTOR, fixed: film; 11 ohms ±1%; ½ w.	Shunt element of attenuator.	3Z6001A1–19
R201	RESISTOR, fixed: film; 49 ohms ±1%; ½ w.	Part of 100:1 divider.	3Z6004J9–2
R202	RESISTOR, fixed: film; 1 ohm ±1%; ½ w.	Part of 100:1 divider.	3Z5991–114
R301	RESISTOR, fixed: film; 40 ohms ±1%; ½ w.	Part of the 40-ohm termination unit.	3Z6004–58
R401	RESISTOR, fixed: film; 50 ohms ±1%; ½ w.	Part of the 50-ohm termination unit.	3Z6005–17
R10	RESISTOR, fixed: WW; 1,000 ohms ±5%; 5 w; JAN type RW55G102.	Plate load of modulator.	3RW24355
R17	RESISTOR, variable: comp; 100,000 ohms ±10%; ¼ w; JAN type RV2ANSA104A.	Zero adjust voltage for VTVM.	3RV51039
R24	RESISTOR, variable: WW; 10,000 ohms ±10%; 4 w; JAN type RA30A1RD103AK.	ADJUST CARRIER control.	3RA7513
R25	RESISTOR, variable: WW; 15,000 ohms ±10%; 4 w; JAN type RA30A1FK153AK.	ADJUST MODULATION control.	3RA7802
R32, R36	RESISTOR, variable: WW; 15,000 ohms ±10%; 3 w; JAN type RA25A1SA153AK.	R32: CALIBRATE MODULATION. R36: CALIBRATE CARRIER.	3RA7809
	RETAINER, tube.	Tube retainer.	2Z7780–154
	SHIELD, tube: bayonet mtg; JAN type TS102U01.	Shields.	2Z8304.57
	SHIELD, tube: bayonet mtg; JAN type TS102U02.	Shields.	2Z8304.154
X1, X2, X3	SOCKET, tube: octal; 1 piece saddle mtg; JAN type TS101P02.	Tube socket.	2Z8678.326

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
X4 through X8	SOCKET, tube: 7 cont miniature; 1 piece saddle mtg; JAN type TS102P01.	Tube socket.	2Z8677.94
S1	SWITCH, rotary: 3 poles, 3 positions; 1 phenolic deck.	MODULATION switch.	3Z9825–62.648
S2	SWITCH, rotary: 3 poles, 8 positions; 3 ceramic decks.	Band selector switch.	3Z9825–62.647
S3	SWITCH, rotary: 4 poles, 2 positions; 1 phenolic deck.	METER TO switch.	3Z9825–62.646
S4	SWITCH, rotary: 2 poles, 4 positions; 1 phenolic deck.	OUTPUT switch.	3Z9825–62.645
S5	SWITCH, rotary: 1 pole, 6 positions; 2 phenolic decks.	Part of ladder attenuator assembly E1.	3Z9825–62.644
S6	SWITCH, toggle: DPST; JAN type ST52K.	LINE ON-OFF.	3Z9863–52K
S7	SWITCH, toggle: DPST; JAN type ST29N.	115–230 V change-over.	3Z9863–29N
Z4	TERMINAL BOX: 50 ohm cable termination unit.	Terminator output cable.	3Z12501–1
Z1	TERMINAL BOX: dummy ant.	Standard dummy antenna.	3Z12501–1.4
Z2	TERMINAL BOX: 100/1 voltage divider.	Output voltage divider.	3Z12501–1.3
Z3	TERMINAL BOX: 40 ohms series unit.	Increases output impedance.	3Z12501–1.1
Z5	TERMINAL BOX: binding post adapter unit.	Binding post adapter.	3Z12501–1.2
T1	TRANSFORMER, power: fil and plate type; input 115 v reconnectable to 230 v; 40–60 cyc single ph, secd #2 560 v at 100 ma CT; secd #5 v at 2 A. CT; secd #3 6.3 v at 1.8 amp.	Power transformer.	
V1	TUBE, electron: JAN type 5Y3GT.	Power rectifier.	2J5Y3GT
V2	TUBE, electron: JAN type OD3.	Voltage regulator.	2JOD3
V3	TUBE, electron: JAN type OC3W.	Voltage regulator.	2JOC3W
V4, V8	TUBE, electron: JAN type 6C4.	V4: Carrier oscillator. V8: Cathode follower.	2J6C4
V5	TUBE, electron: JAN type 6AQ5.	Amplifier-modulator.	2J6AQ5
V6	TUBE, electron: JAN type 6AK6.	400-cycle oscillator.	2J6AK6
V7	TUBE, electron: JAN type 6AL5.	VTVM.	2J6AL5W
H1	WRENCH: fits $\frac{3}{32}$ Allen head.	Knob setscrew wrench.	6R55496–1

RESISTOR COLOR AND LETTER CODE



STANDARDS				
COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)	JAN LETTER TOLERANCE
BLACK	0	1	–	–
BROWN	1	10	± 1	F
RED	2	100	± 2	G
ORANGE	3	1,000	± 3	–
YELLOW	4	10,000	± 4	–
GREEN	5	100,000	± 5	–
BLUE	6	1,000,000	± 6	–
VIOLET	7	10,000,000	± 7	–
GRAY	8	100,000,000	± 8	–
WHITE	9	1,000,000,000	± 9	–
GOLD	–	0.1	± 5	J
SILVER	–	0.01	±10	K
NO COLOR	–	–	±20	M

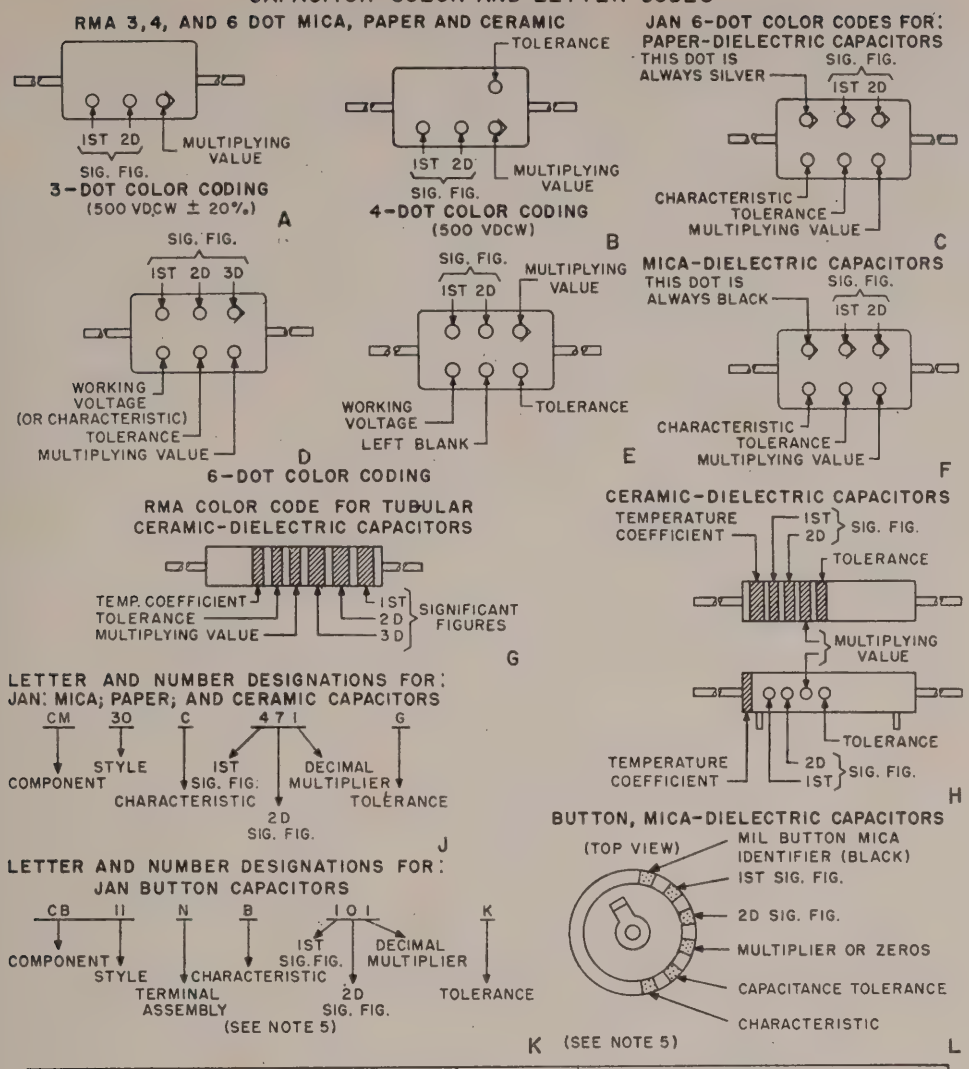
NOTES:

1. RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
2. RMA: RADIO MANUFACTURERS ASSOCIATION.
3. JAN: JOINT ARMY-NAVY.
4. THESE COLOR AND NUMBER CODES GIVE ALL RESISTANCE VALUES IN OHMS.
5. RESISTIVE COMPONENTS USED FOR LETTER TOLERANCES ARE: RC, RN, AND RU.
6. WATTAGE FOR RW TYPES IS FOUND IN THE JAN SPECIFICATIONS UNDER CHARACTERISTICS.

TM RC

Figure 29. Resistor color code.

CAPACITOR COLOR AND LETTER CODES



- STANDARDS -					JAN MICA-CM		JAN PAPER-CM		JAN CERAMIC-CC					
									CAP. TOL. FOR MORE THAN 10 UUF			CAP. TOL. FOR 10 UUF OR LESS		
COLOR	SIG. FIG.	DECIMAL MULTIPLIER	% TOL.	VDCW	LETTER TOL.	CHARAC-TERISTIC	LETTER TOL.	CHARAC-TERISTIC	DEC. MULT.	%	LETTER DESIG-NATION	UUF	LETTER DESIG-NATION	CHARAC-TERISTIC
BLACK	0	1	±20	500	M	A	M	A	1	±20	M	±2.0	G	C
BROWN	1	10	± 1	100	-	B	-	E	10	± 1	F	-	-	H
RED	2	100	± 2	200	G	C	-	H	100	± 2	G	-	-	L
ORANGE	3	1,000	± 3	300	-	D	N*	J	1,000	-	-	-	-	P
YELLOW	4	10,000	± 4	400	-	E	-	P	-	-	-	-	-	R
GREEN	5	100,000	± 5	500	-	F	-	R	-	± 5	J	±0.5	D	S
BLUE	6	1,000,000	± 6	600	-	G	-	S	-	-	-	-	-	T
VIOLET	7	10,000,000	± 7	700	-	-	-	T	-	-	-	-	-	U
GRAY	8	100,000,000	± 8	800	-	-	-	-	0.01	-	-	±0.25	C	B
WHITE	9	1,000,000,000	± 9	900	-	-	-	-	0.1	± 10	K	±1.0	F	SL
GOLD	-	0.1	± 5	1,000	J	-	-	-	-	-	-	-	-	A
SILVER	-	0.01	±10	2,000	K	-	K	-	-	-	-	-	-	-
NO COLOR	-	-	±20	500	-	-	-	-	-	-	-	-	-	-

* THE TOLERANCE OF THIS CAPACITOR IS ±30%, NOT ±3%

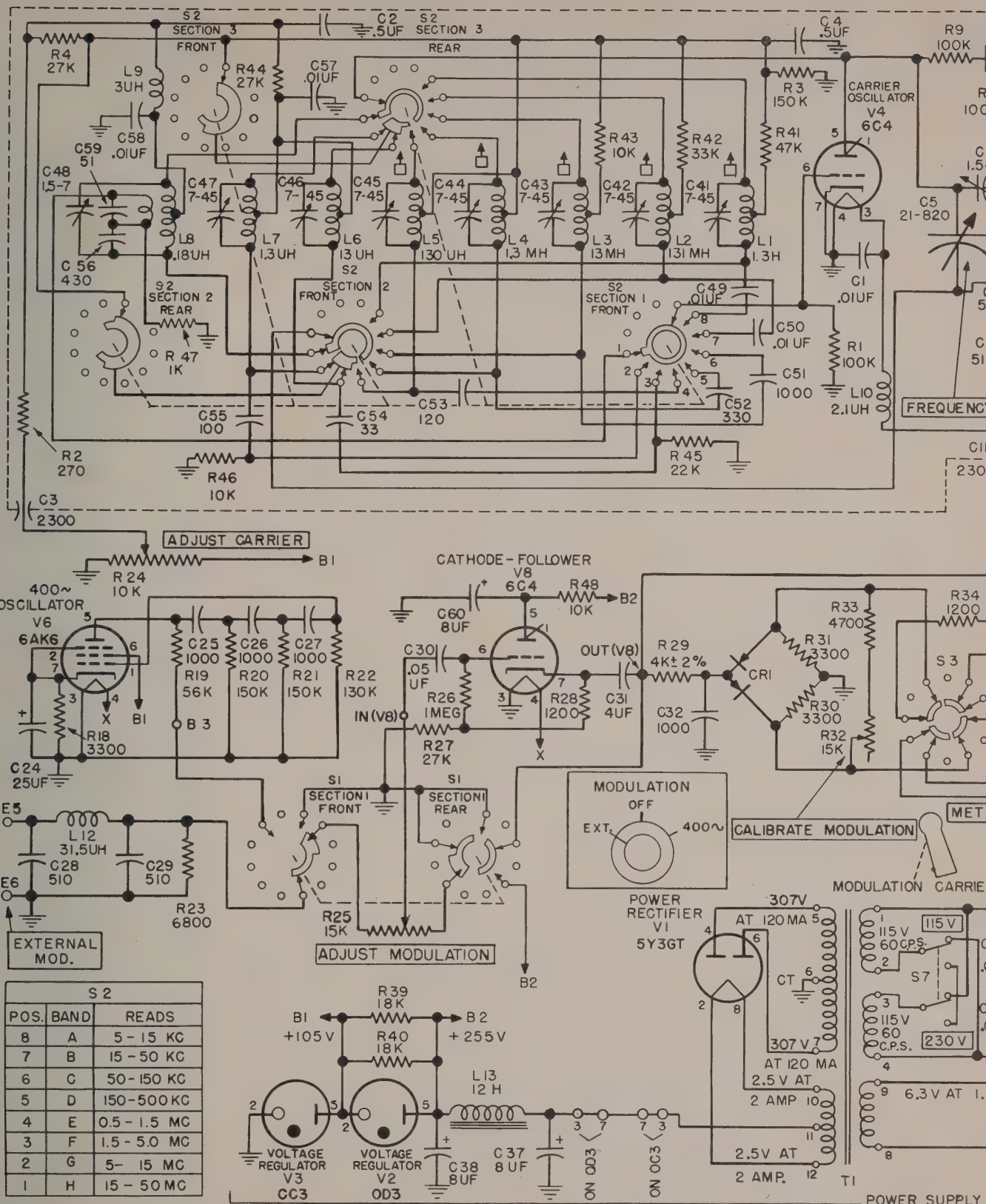
NOTES

JAN: JOINT ARMY-NAVY
RMA: RADIO MANUFACTURERS ASSOCIATION

1. THESE COLOR AND LETTER CODES GIVE CAPACITANCES IN MICROMICROFARADS
2. THIS TABLE IS ADAPTED FOR JAN AND RMA COLOR AND JAN LETTER TYPE DESIGNATIONS
3. CERAMIC AND MICA CAPACITORS, BOTH JAN AND RMA, ARE GENERALLY 500 VDCW
4. BUTTON CAPACITORS ARE GENERALLY 300 VDCW
5. READ BUTTON CAPACITOR TOLERANCE UNDER CERAMICS OF MORE THAN 10 UUF
6. CHARACTERISTICS ARE AVAILABLE IN JAN CAPACITOR SPECIFICATION MANUALS
7. THE COMPONENTS USED ABOVE FOR JAN LETTER TYPE DESIGNATIONS ARE:
   CB MICA BUTTON: *CC* CERAMIC; *CM* MICA MOULDED: *CN* PAPER MOULDED

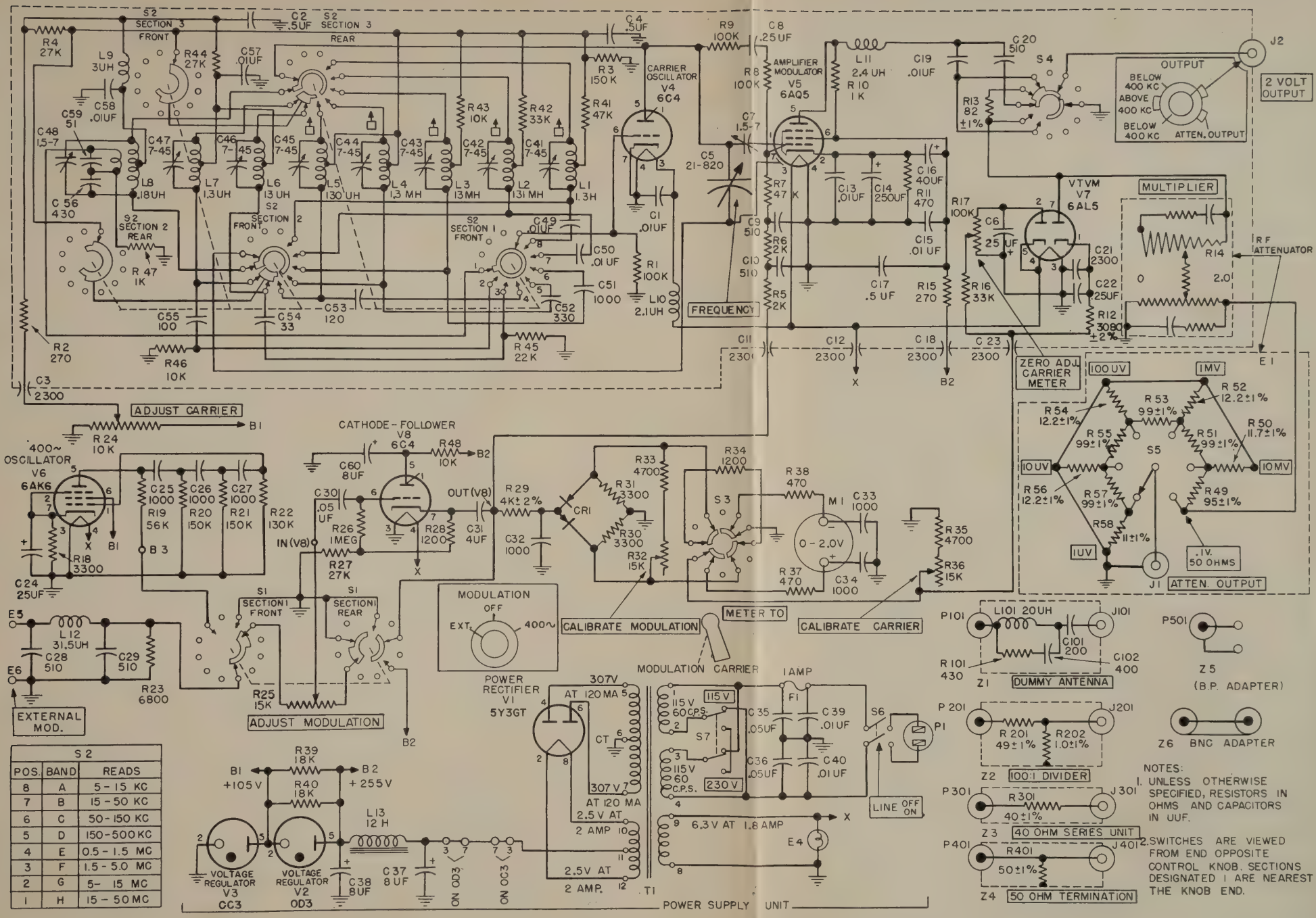
TM CC

Figure 30. Capacitor color codes.



S 2		
POS.	BAND	READS
8	A	5 - 15 KC
7	B	15 - 50 KC
6	C	50 - 150 KC
5	D	150 - 500 KC
4	E	0.5 - 1.5 MC
3	F	1.5 - 5.0 MC
2	G	5 - 15 MC
1	H	15 - 50 MC

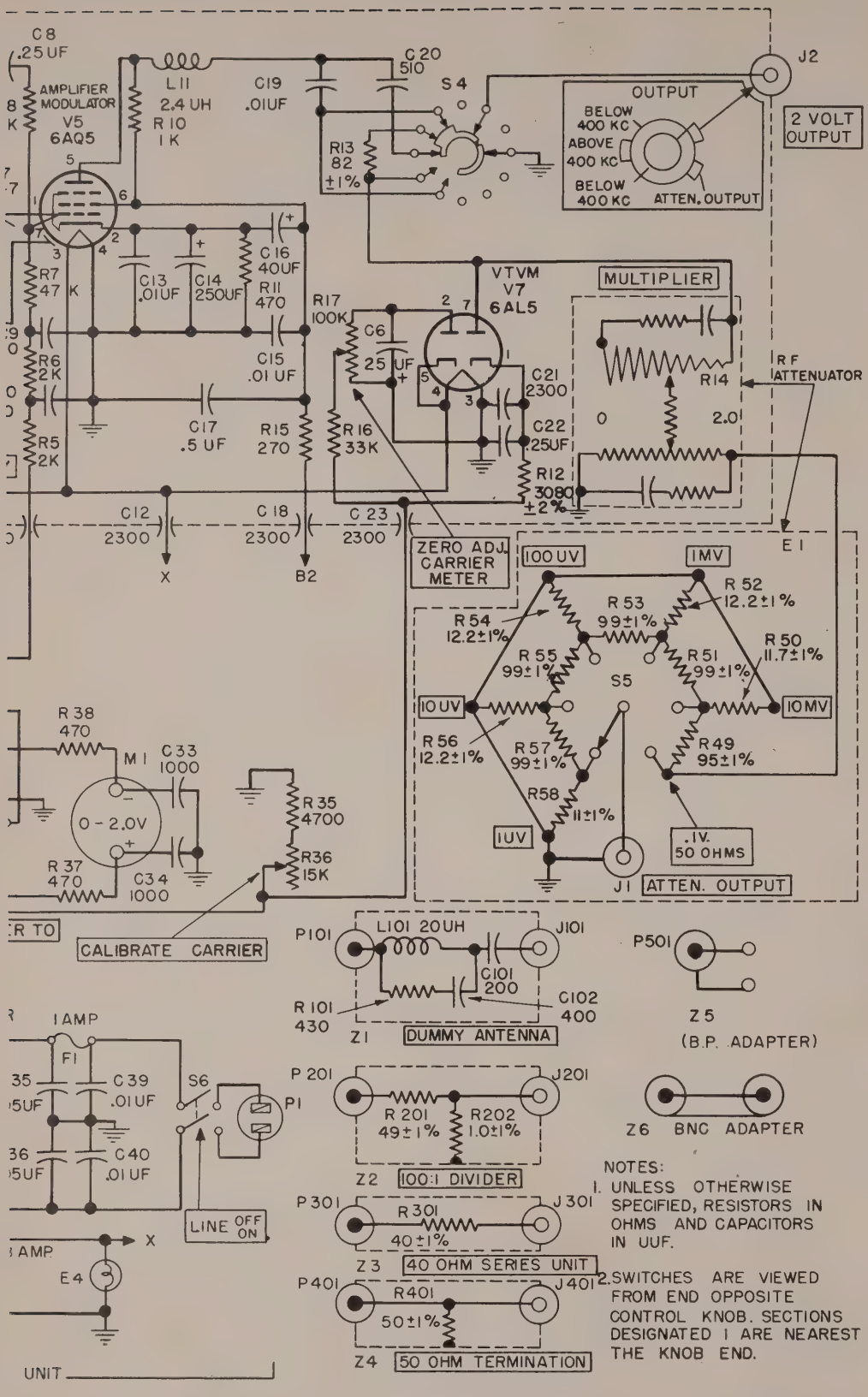
Figure 31. Signal Generator TS-588A/U, complet



S2		
POS.	BAND	READS
8	A	5 - 15 KC
7	B	15 - 50 KC
6	C	50 - 150 KC
5	D	150 - 500 KC
4	E	0.5 - 1.5 MC
3	F	1.5 - 5.0 MC
2	G	5 - 15 MC
1	H	15 - 50 MC

NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTORS IN OHMS AND CAPACITORS IN UUF.
2. SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB. SECTIONS DESIGNATED 1 ARE NEAREST THE KNOB END.

Figure 31. Signal Generator TS-588A/U, complete schematic diagram.



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTORS IN OHMS AND CAPACITORS IN UUF.
2. SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB. SECTIONS DESIGNATED 1 ARE NEAREST THE KNOB END.

TM 5018-12

schematic diagram.

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