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US

WAR DEPARTMENT

TECHNICAL MANUAL

SIGNAL GENERATORS I-72-G AND I-72-H

March 16, 1943

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TECHNICAL MANUAL
No. 11–307

WAR DEPARTMENT,
WASHINGTON, March 16, 1943.

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SIGNAL GENERATORS I–72–G AND I–72–H

DESTRUCTION NOTICE

Depending upon the time and materials available, when the capture of this equipment by the enemy is certain, completely destroy it by one or more of the following means:

1. Explosives, such as grenades or TNT.

2. Incendiaries, such as wood, oil, and gasoline.

3. Axes, hammers, large rocks, or hard heavy instruments such as hand generators, dynamotors, etc.

4. Removal of the chassis from the cabinet and covers from generators will facilitate the above means of destruction. When this is done, be sure to smash all variable capacitors, tubes, and tuning coils.

SAFETY NOTICE

The maximum voltage available in this equipment is less than 300 volts. Such voltages are not usually regarded as dangerous to human life, but may be the source of considerable discomfort or even injury to a person coming in contact with them. Care should be taken not to touch those components carrying plate potentials. It is to be noted that no interlocks are provided, as no high-potential parts are exposed or accessible during operation.

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SECTION I

DESCRIPTION

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Use	1

1. Use.—Signal generator I–72–H* is a radio-frequency oscillator for use in alining Signal Corps radio sets. It has a range of 100

*Signal generator I–72–G is identical to I–72–H. In this manual, wherever signal generator I–72–H is mentioned, it will be understood also to include signal generator I–72–G.

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kc to 32 mc (32,000 kc) with 400-cycle modulation. The r. f. output voltage with the attenuator set for maximum is over 30,000 microvolts on all bands except in the region of 10,000 kc to 20,000 kc where the maximum obtainable output may exceed only 10,000 microvolts. It operates on 110- to 125-volt, 60-cycle alternating current and is contained in a metal cabinet which is provided with a removable cover held in place by four drawbolts. A leather handle is provided for convenience in carrying. The shielded output lead and a spare fuse are mounted in clips attached to the inside of the cover. The generator consists of a tuned plate oscillator, modulator, attenuators, and filament and plate supply. The complete unit weighs 22.2 pounds and the overall dimensions are 15⅛ inches long, 6¾ inches deep, and 9$^{7}/_{16}$ inches high.

Section II

EMPLOYMENT

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Installation	2
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2. Installation.—Because signal generator I–72–H is a portable test equipment, no special instructions are required for its installation other than to make certain that the a-c power source to which it is attached is 110- to 125-volt, 60-cycle current.

3. Preparation for use.—In alining the r. f. circuits of a receiver, some form of dummy antenna must be used to prevent undue reaction between the low output impedance of the signal generator and the input circuits of the receiver. Unless other instructions are contained in the maintenance instructions for the receiver being alined, the I. R. E. dummy antenna as shown in figure 2 may be used. This antenna may be built up by using 45 turns of No. 34 DSC wire, close-wound on a ½-inch form. This should give an inductance of 20μh. One capacitor of 200μf, one capacitor of 400μf, and a 400-ohm noninductive resistor will also be required. The dummy antenna should be connected between the signal generator and the receiver as shown in figure 2.

4. Operation.—*a. Starting*—To start signal generator I–72–H, throw the POWER switch up to ON. Set the OUTPUT control to MOD. (modulated), UN-MOD., (unmodulated), or 400 ~ position, depending on the type of output desired. With OUTPUT control set at MOD., the signal generator gives an r. f. output with

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400-cycle audio modulation. With OUTPUT control set at UNMOD., the output of the signal generator is an unmodulated r. f. carrier. With OUTPUT control set at 400 ~, the signal generator output is a 400-cycle a. f. signal *without* r. f. carrier.

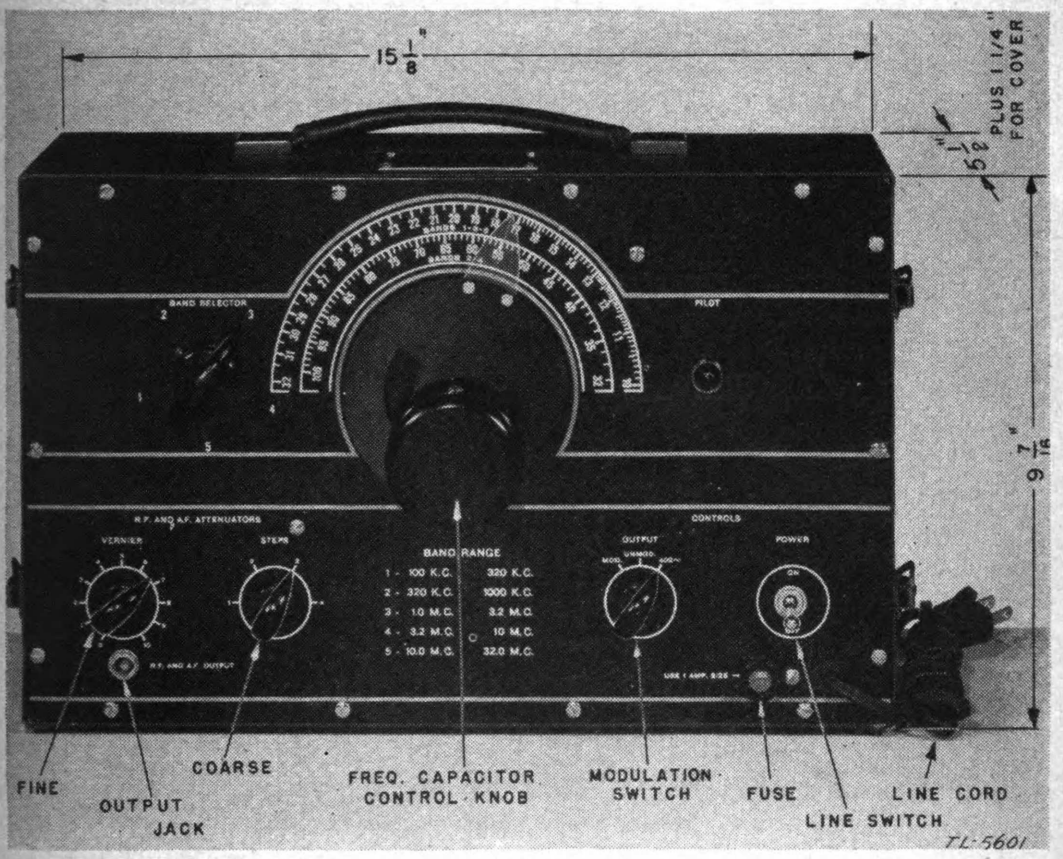


FIGURE 1.—Signal generator I–72–H—front view, cover removed.

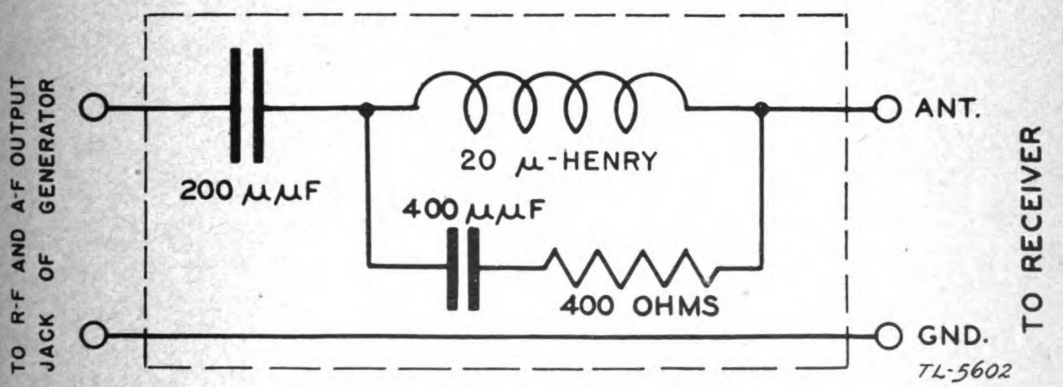


FIGURE 2.—I. R. E. standard dummy antenna—schematic diagram.

b. Tuning.—To set the signal generator to any desired frequency within its range, ascertain the band in which the desired frequency occurs and adjust the BAND SELECTOR switch and frequency dial pointer for the frequency desired. As an example, assume that

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the desired frequency is 7.0 megacycles. From the legend is seen that this frequency occurs in band No. 4 (3.2 to 10.0 mc) and, therefore, is read on the lower scale at 70. Adjust the STEPS control and the VERNIER control of the r. f. and a. f. attenuators, marked R. F. AND A. F. ATTENUATORS. These controls vary the voltage available at the output jack. More detailed description of the attenuator will be found in paragraph 10. To turn the signal generator off, throw the POWER switch to OFF.

5. Use with output meter.—Most alinement work is done with a copper-oxide rectifier type a-c meter (output meter) across the audio output of the receiver. The effect of various adjustments can also be observed by the use of a cathode-ray oscilloscope or a meter in the second detector output. Signal generator I–72–H should be used with the r. f. output modulated by means of the internal 400-cycle oscillator (MOD. position of OUTPUT switch). It is important when adjustments are made that the output of the signal generator be reduced as the alinement progresses. If this is not done, the automatic-volume-control action of the receiver will tend to make the response seem broad and misalinement will result. When greater sensitivity is required, connect the output meter from the plate of one of the output tubes through a .5μf capacitor, in series, to the chassis. *Modulated output from the signal generator must be used when using an a-c output meter.* Some receivers will require the use of an unmodulated signal (OUTPUT switch set at UNMOD.) and a d-c meter of suitable range connected in the output of the second detector circuit. This procedure should be followed when called for in the service notes of such receivers.

6. Intermediate frequency alinement.—*a. Procedure.*—The usual procedure in alining a superheterodyne receiver is first to aline the i. f. amplifier, then the oscillator and finally the r. f. amplifier and mixer.

NOTE.—Some Signal Corps radio receivers require special alinement procedure. Consult the Technical Manual or instruction book for the receiver before alining.

b. Method of connection.—With the output meter connected across the audio output of the receiver as shown in figure 3, disconnect the lead from the control-grid terminal of the first detector tube. Place an isolating resistor of ¼ megohm in series with this lead and reconnect to the terminal from which it was removed. This resistor will minimize the effect of the tuned circuit upon the stage under test while maintaining proper bias on the grid. Connect the signal generator to the grid through a 250$\mu\mu$f capacitor in series with the output lead of the signal generator and connect the shielded braid of the signal generator output lead to the receiver chassis as shown in figure 3.

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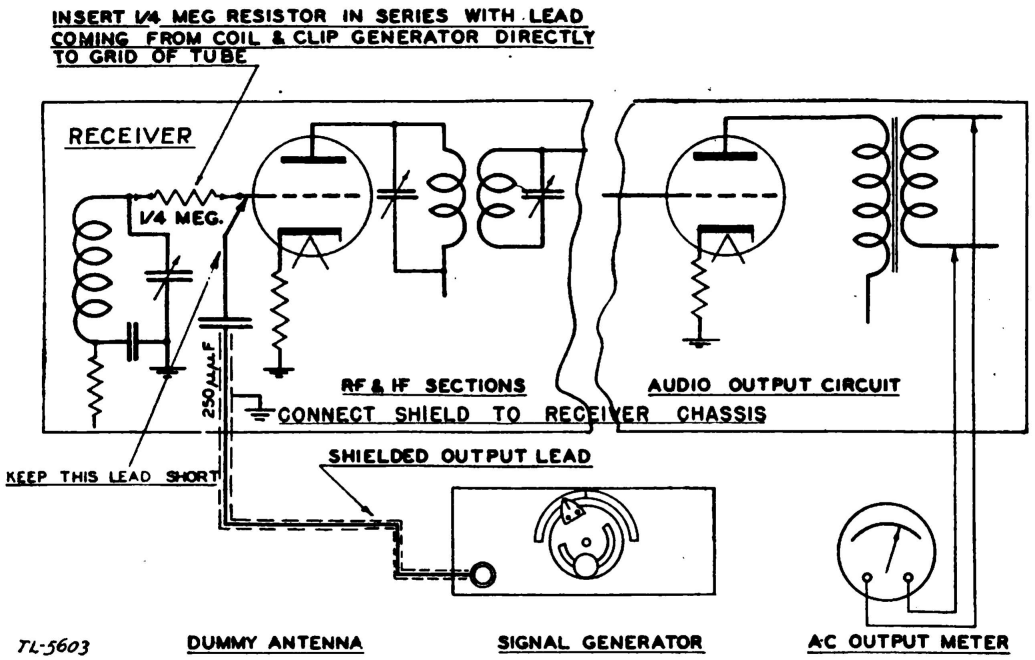


FIGURE 3.—Method of connecting signal generator to radio receiver for alinement.

c. Adjustment of generator.—Set the signal generator to the correct intermediate frequency as shown on the receiver chassis or circuit diagram. Advance the receiver volume control to its maximum-volume position. Advance the r. f. and a. f. attenuator settings of the signal generator until an indication is noted on the output meter or a signal is heard in the loudspeaker. If no indication is noted with all output controls in their maximum position, the receiver may have been previously alined at another frequency. Turn the frequency dial of the signal generator slightly to one side and then to the other until a response is noted. This will indicate the frequency to which the receiver has been adjusted. If no response is noted, it is an indication that the i. f. system is badly out of alinement and stage-by-stage alinement will be necessary. Start at the grid of the tube that precedes the second-detector and aline each stage in turn, until the entire i. f. system is in tune. Reduce the output of the signal generator as the alinement proceeds to reduce the effect of the automatic-volume-control system. Keep it low enough so that the fluctuation of the output meter is just readable. Check over all trimmers a second time to be sure of the best possible alinement.

7. R. f. and oscillator alinement.—*a. Procedure.*—Before proceeding to aline the r. f. and oscillator circuits of a superheterodyne receiver, consult the service notes and circuit diagram of the receiver for the correct frequencies at which the alinement should be made and for proper connection of the signal generator to the receiver antenna connector. In the absence of such instructions, select two

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frequencies, one slightly above the low end and the other slightly below the high end of each frequency range of the receiver. Connect a .1μf capacitor in series with the signal generator lead. If the receiver band covers the broadcast range these points will be at 1,400 and 600 kc, while the short-wave bands will be at corresponding points on the short-wave dial scale.

b. High frequency.—Set both the signal generator and receiver dial to the higher frequency alinement point first and adjust the oscillator trimmer until a response is indicated. Adjust the 1st detector and r. f. trimmers for maximum response. The output of the signal generator must be reduced as the various circuits are brought into alinement.

c. Low frequency.—Now set the signal generator at the low frequency point and tune the receiver dial until a response is indicated. This point should agree with the dial calibration. If an oscillator padder capacitor is employed in the receiver, adjust it while slowly rocking the tuning capacitor of the receiver back and forth until maximum signal is indicated. Recheck the oscillator trimmer at the high-frequency point and readjust if necessary. The low-frequency point should also be readjusted as these two oscillator adjustments are not independent.

d. Final check.—(1) The receiver dial calibration should now check with that of the signal generator. If the calibration does not check, one of the following faults is indicated:

(*a*) The i. f. amplifier was not alined to the frequency for which it was designed.

(*b*) The proper alinement procedure was not carried out.

(*c*) The inductance of one of the r. f. coils is incorrect.

(*d*) The spacing of the r. f. sections of the variable tuning capacitor is incorrect.

(2) Unless replacement of the indicated parts in (1)(*c*) and (*d*) above has been made, these two possibilities can safely be eliminated. Point (1)(*b*) should be checked by repeating the alinement operations.

Section III

FUNCTIONING OF PARTS

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Attenuator	10
Radio frequency filters	11
Power supply	12

8. Tuned-plate oscillator.—This consists of tube VT–94–D, mounted on a bracket in close association with the variable capacitor

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C–1 and the roto-inductor coil system, operating as a tuned-plate oscillator. The shaft of capacitor C–1 extends through the front panel and carries the pointer for the frequency calibrated dial. The turntable of the roto-inductor coil system is rotated by a knob attached to a shaft extending through the panel. This control has band indications numbered 1 to 5 indicating the frequency range as follows:

Band number	*Frequency range*
1	100 kc to 320 kc
2	320 kc to 1000 kc
3	1.0 mc to 3.2 mc
4	3.2 mc to 10.0 mc
5	10.0 mc to 32.0 mc

Bands 1, 3, and 5 are read on the upper part of the frequency calibrated dial and bands 2 and 4 are read on the lower part of the dial.

9. Modulator.—Tube VT–76 mounted on the vertical partition, together with the modulation transformer T–2 and the .5μf capacitor C–7, constitute the 400-cycle internal oscillator and provide the necessary energy to modulate the radio frequency oscillator approximately 30 percent. The output of this audio oscillator is also available through the attenuators and output jack.

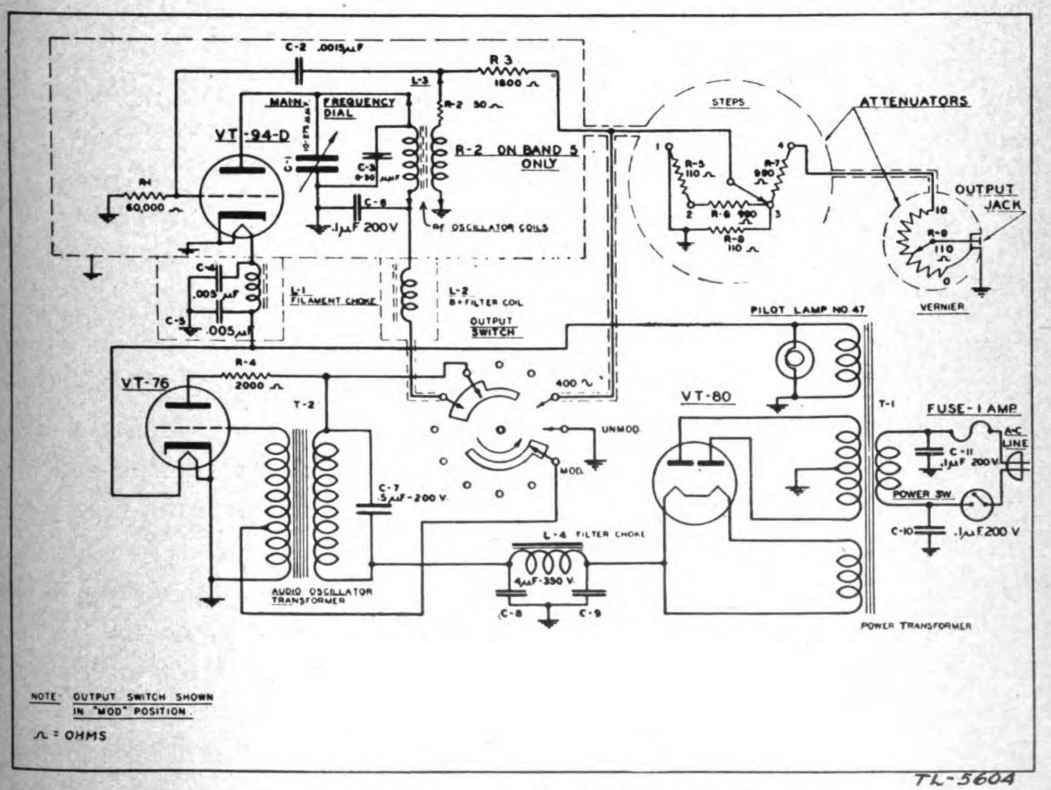


FIG. 4.—Signal generator I–72–H—schematic diagram.

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10. Attenuator.—The attenuator is built in two sections in the round shielded compartments at the lower right of the chassis as shown in figure 6. The first section R–5, R–6, R–7, and R–8 consists of four steps, each giving increases of approximately 10 to 1 per step as the control is advanced from 1 to 4. The second section R–9 is a vernier to permit closer adjustment of the output levels between adjustment obtainable with the STEPS control. Maximum output is obtained when the STEPS control is set at 4 and the VERNIER control is set at the extreme right or clockwise position. When using the 400-cycle oscillator output through the attenuator, a maximum of approximately 1.2 volts is available. With the step attenuator in position 1, audio output will be zero.

11. Radio frequency filters.—Frequency traps L–1 and L–2 are provided to keep r. f. strays at a minimum. The r. f. choke L–2 prevents the outward flow of r. f. currents from the plate circuit while r. f. choke L–1, in combination with the two .005μf capacitors C–4 and C–5, performs the same function for the filament circuit.

12. Power supply.—The power supply consists of tube VT–80, power transformer T–1, filter choke L–4 and two 4μf capacitors, C–8 and C–9. In addition, two .1μf capacitors, C–10 and C–11 are employed across the power transformer primary to block r. f. currents from the power line. The attachment plug, attached to the power cord, may be plugged into any 110- to 125-volt, 60-cycle, a-c source.

Section IV

MAINTENANCE

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Care of coil contacts	16
Voltage and resistance readings	17
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13. Parts replacement.—In the event that replacement of any of the fixed capacitors of signal generator I–72–H should become necessary, this work should be done only by qualified personnel. Careful attention should be paid to the manner of installation and the heavy short leads and well sweated joints should be duplicated carefully. To install a new fuse, turn the fuse retainer marked FUSE, at the lower right of the panel, in a counterclockwise direction and screw it all the way out. If the fuse is defective, replace it with the spare fuse secured by a clip to the inside of the cover of the signal generator. *Do not replace the fuse until the cause of its having burned out is located and remedied.* Replace the spare fuse as soon as possible.

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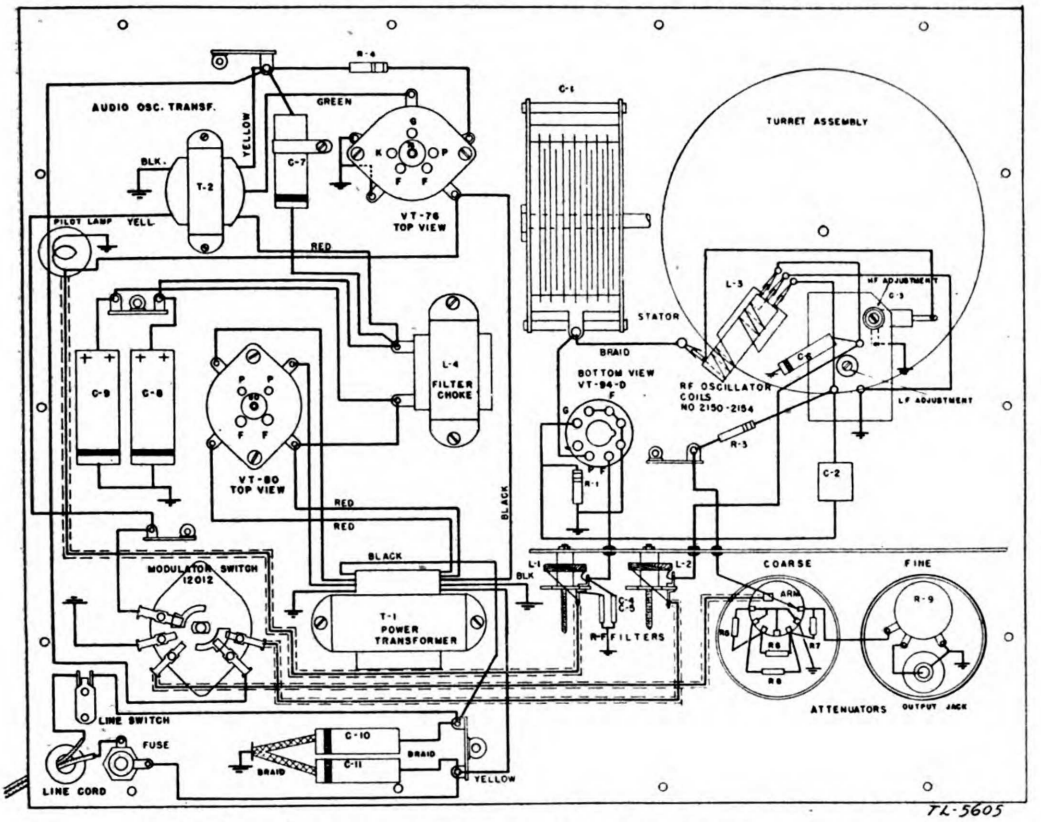


FIGURE 5.—Signal generator I–72–H—practical wiring diagram.

14. Tube replacement.—Either tube VT–80 or tube VT–76 may be replaced without affecting the calibration of the instrument. Ordinarily, this is also true of tube VT–94–D although the frequency calibration should be checked after changing this tube before further use is attempted. If the calibration of the signal generator is thrown off by the replacement of tube VT–94–D, normal operation of the signal generator for a period of 24 to 48 hours will age the tube and usually restore the instrument to calibration. Calibration change will be most noticeable at the high-frequency end of band 5. Small changes in calibration can be corrected by means of the trimmer capacitor adjacent to each coil and accessible through the upper adjustment port in the oscillator shield can (see fig. 6). The chassis may be withdrawn by removing the fourteen binding-head screws which are at the edge of the front panel. The chassis is then removed by tilting the case forward.

15. Recalibration.—Under no circumstances should recalibration be attempted unless frequency standards of known accuracy are available. Do not conclude that the generator frequency is incorrect unless it has been checked against more than one standard,

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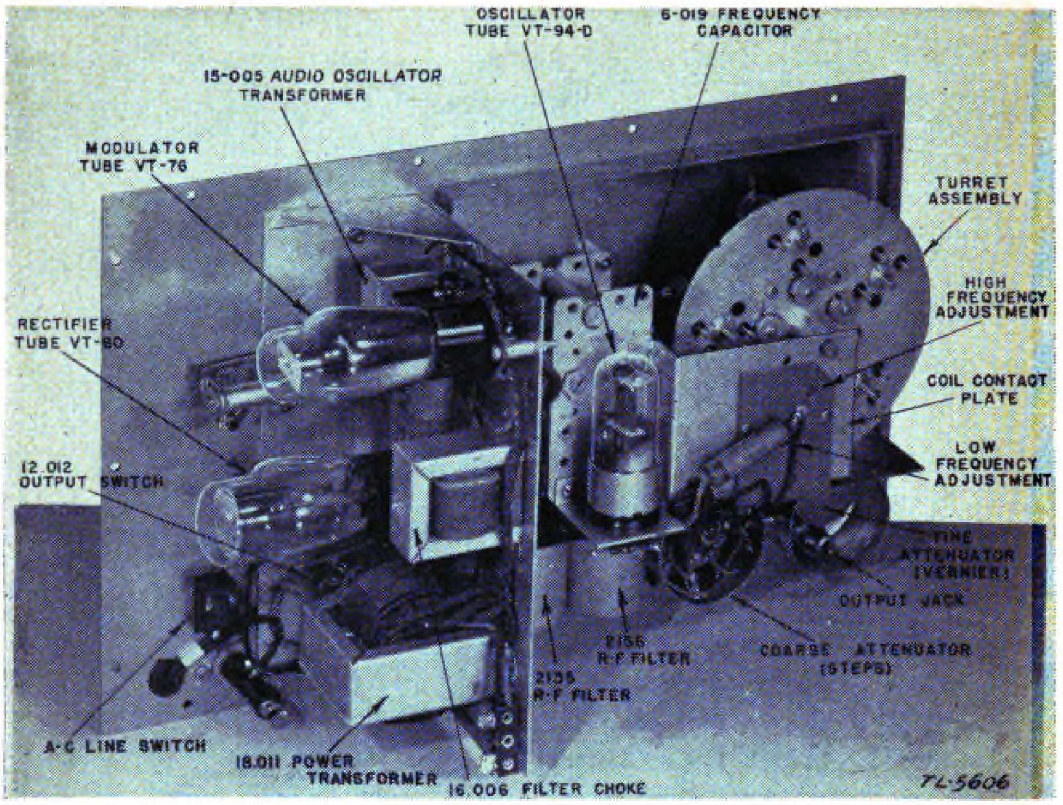


FIGURE 6.—Signal generator I–72–H—rear view of chassis with oscillator and attenuator covers removed.

as it is possible that the standard may be at fault. Only qualified personnel should attempt to recalibrate this instrument. Attention is directed to the adjustable iron core in each coil for the control of its inductance and to the five trimmers on the turntable assembly for control of the capacities of the individual bands. Adjustment should be made preferably through the two access ports provided in the rear of the oscillator shield can, with the shield in place (see fig. 6). Although the two adjustments for each band are not completely independent, it may be said that the iron slug has the greater control over the low-frequency end of each band and the trimmer over the high-frequency end. After the iron slug has been adjusted, the jam nut should be reseated to prevent shifting of the adjustment.

16. Care of coil contacts.—The coil contacts are silver plated and should not be cleaned with sandpaper or other abrasives. These contacts may be cleaned with carbon tetrachloride or alcohol. After cleaning, the contacts should be coated with a light coating of petroleum jelly.

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17. Voltage and resistance readings.—See figure 7.

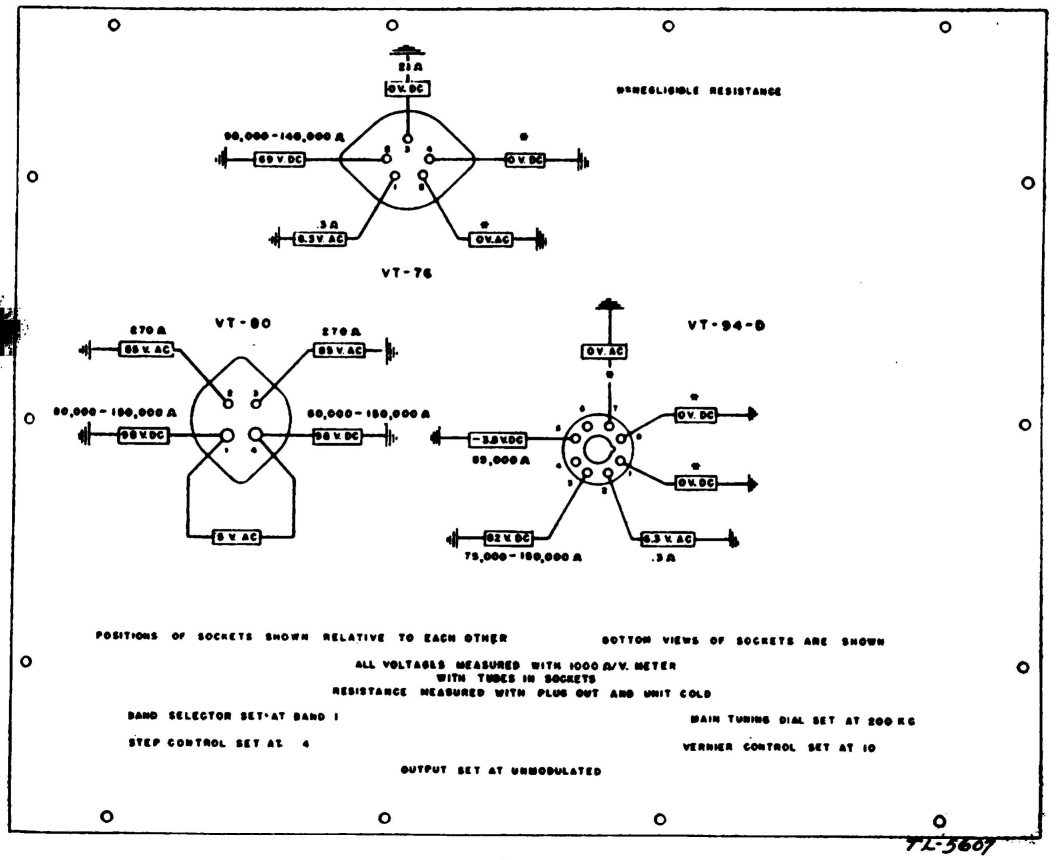


FIGURE 7.—Resistance and voltage measurements from tube sockets to chassis.

18. Commercial equivalents of VT tubes.

Signal Corps types	*Commercial equivalents*
VT–76	76
VT–80	80
VT–94–D	6J5–GT

SECTION V

SUPPLEMENTARY DATA

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19. Table of replaceable parts.

Reference No.	Signal Corps stock No.	Name of part	Description	Function	Manufacturer's No.	Drawing No.	
						Contractor	Signal Corps
C–1	3D9010V–7	Capacitor	Var. capacitor, min. cap. 10 μμf, max. 275μμf.	Frequency control	1	6. 019	
C–2	3DA1.50–4	do	.0015μf, mica ±5% or .0015μf, 400v, tubular, paper, type W.	Grid coupling capacitor	2		
C–3	3D9001V–1	do	Air dielectric, 0–30μμf, type 22–5230.	High frequency adjustment.	3		
C–4	3DA5–49	do	.005μf, bakelite, paper, ±5%, type W.	Part of filament filter	2		
C–5	3DA5–49	do	do	do	2		
C–6	3DA100–109	do	.1μf-200v, ¼″ braid leads, tubular, paper.	R. F. plate supply bypass	1	25. 005	
C–7	3DA500–67	do	.5μf-200v, with clamp, tubular, paper, type W2B.	Audio tuning capacitor	4		
C–8	3DB4–41	do	4μf-450v, electrolytic, type W2B.	Power supply filter capacitor.	4		
C–9	3DB4–41	do	do	do	4		
C–10	3DA100–109	do	.1μf-200v, tubular, paper, type W2B.	R. F. line filter	4		
C–11	3DA100–109	do	do	do	4		
L–1	3F3852H/C1	Coil	Iron core choke coil	Filament filter choke	1	2. 155	
L–2	3F3852H/C2	do	do	R. F. osc. plate supply filter.	1	2. 156	
L–3–1	3F3852H/C	do	Set of inductors, one for each band.	R. f. oscillator coil	1	2. 150	
–2						2. 151	
–3						2. 152	
–4						2. 153	
–5						2. 154	

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L–4	3C321	do	Iron core reactor	Plate power supply filter choke.	1	16. 006	
R–1	3Z6660–7	Resistor	60,000 ohm, ½w, ± 10%, type EB.	Oscillator grid bias	7		
R–2	3Z6005–31	do	50 ohm, ½w, ± 10%, type EB.	Use in series with r. f. oscillator coil on band 5.	7		
R–3	3Z6180–3	do	1,800 ohm, ½w, ± 10%, type EB.	Limiting resistor	7		
R–4	3Z6200–40	do	2,000 ohm, ½w, ± 10%, type EB.	Modulation % adjustment resistor.	7		
R–5	3Z6011–2	do	110 ohm, ½w, ± 1%, type BT½.	Part of attenuator assembly output voltage control.	5		
R–6	3Z6099–1	do	990 ohm, ½w, ± 1%, type BTS.	do	5		
R–7	3Z6099–1	do	do	do	5		
R–8	3Z6011–2	do	110-ohm, ½w, ± 1%, type BT½.	do	5		
R–9	2Z7283.7	do	110-ohm potentiometer	Fine adjustment of attenuator output voltage control.	1	9. 046	
T–1	2Z9955.1	Transformer	Primary: 117v Sec: 1: 100–0–100v, 12ma. Sec. 2: 5.0v, 2.0 amp. Sec. 3: 6.3v, 1.0 amp.	Power transformer	1	18. 011	
T–2	2Z9943–6	do	Audio oscillator transformer, 400 cycle.	Modulation transformer	1	15. 005	
	3F3852H/C3	Cable	2′6″ shielded braided lead with male connector, braid to protrude.	Output cable	1	10. 007	
	3F3852H/L	Contact lug	4 sets "Plate", "Grid", "Plate Supply", "Ground."	Coil turret contacts	1	27. 021	
	3F3852H/C4	Cord	6-foot black rubber line cord with plug.	A-c line cord	1	13. 011	
	3Z1926	Fuse	1 amp, type 1040	Protect power transformer	6		
	3Z3275	Fuseholder	Type 1075	Holder for fuse	6		
	6Z4996	Handle	Black cowhide	Carrying handle	1	27. 127	

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Reference No.	Signal Corps stock No.	Name of part	Description	Function	Manufacturer's No.	Drawing No.	
						Contractor	Signal Corps
T–2	2Z5748.4	Knob	Round knob	Part of VERNIER control Part of STEPS control Part of OUTPUT control	1	7. 011	
	2Z5748.6	do	Pointer knob	Part of BAND SELECTOR.	1	7. 012	
	2Z5748.5	do	Large round knob	Part of main tuning control	1	7. 013	
	2Z5573.1	Output jack	Bayonet type, female connector (modified).	Output jack	1	27. 128	
	3F3852H/P3	Panel	Front, 15″ x 9⅜″	Front panel	1	23. 026	
	2Z5952	Pilot lamp	General Electric, type 44 or 47.	Pilot light	7		
	3F3852H/P	Pointer	Plastic pointer	Part of main tuning control	1	7. 004	
	3F3852H/P1	Pointer disk	Bakelite dial disk	do	1	7. 003	
	2Z8665.2	Socket	Marked "VT–76", 5-prong 1½″ mtg. ctrs.	Modulator	8		
	2Z8761.5	do	Marked "VT–94–D" or "Type A," octal socket, black bakelite, type S–8.	R. f. oscillator	9		
	3Z9825–20	Switch	1 circuit 7-position	Attenuator stop switch	1	12. 013	
	3Z9825–19	do	2 circuit 3-position	Modulator switch	1	12. 012	
	3Z9843–1	do	SPST toggle, ½ x ¼ hub, bat handle.	A-c line switch	10		
	2V76	Vacuum tube	Triode, VT–76, RMA #76	Audio osc. mod	11		
	2V80	do	Duo-diode, VT–80, RMA #80.	Power rectifier	11		
	2V6J5GT	do	VT–94–D, RMA #6J5–GT	R. f. osc	11		

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20. List of manufacturers.

Manufacturer	*Address*	*Number*
Espey Mfg. Co. Inc	305 East 63rd Street, N.Y.C	1
Micamold Radio Co	1087 Flushing Avenue, Brooklyn, N.Y	2
Meissner Co	Mount Carmel, Illinois	3
Sprague Specialties Co	North Adams, Mass	4
International Resistance Co	401 N. Broad Street, Philadelphia, Pa	5
Littelfuse Inc	4757 Ravenswood Avenue, Chicago, Ill	6
General Electric Co	570 Lexington Avenue, N.Y.C	7
A. W. Franklin Co	175 Varick Street, N.Y.C	8
American Phenolic Corp. (Amphenol).	1830 S. 54th Avenue, Chicago, Ill.	9
Carling Tool Co	626 Capitol Avenue, Hartford, Conn.	10
Sylvania Elect. Products	Emporium, Pa	11

[A. G. 062.11 (2–4–43).]

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