



TEST OSCILLATOR

A-C OPERATED

STOCK No. 167-A

Manufactured by

RCA Manufacturing Company, Inc.

Camden, N. J., U. S. A.



Figure 1—Test Oscillator

Stock No. 167-A Test Oscillator

ELECTRICAL CHARACTERISTICS

Frequency Range: 100 to 30,000 kc.

Calibration Accuracy: $\pm 2\%$.

R-F Output:

Terminal	Voltage Range	Impedance
Low	0.000004 to 0.01 volt	10 ohms
Medium	0.01 to 0.25 volt	750 ohms
High	1.00 volt (fixed)	4,000 ohms

Modulation Frequency (internal): Approx. 400 cycles.

A-F Output: 8 volts across 50,000 ohms impedance at no load; correspondingly less as loaded.

A-F Input: 1.5 volts for 30% modulation.

Tube Complement:

Function	Type
R-F Oscillator	1 RCA-6J7
A-F Oscillator	1 RCA-6C5
Rectifier	1 RCA-5W4

Power Supply Requirements: 110-120 volts, 50-60 cycles, 30 watts, as specified on license notice inside the case.

MECHANICAL SPECIFICATIONS

Dial: Full-vision type, 6 $\frac{1}{2}$ inches diameter (over 50 inches calibration).

Dimensions: 13 $\frac{3}{4}$ " length x 9 $\frac{1}{4}$ " height x 6 $\frac{1}{2}$ " depth.

Weight: 12 $\frac{1}{2}$ lbs.

Finish: Baked lacquer, fine blue-gray wrinkle.

IMPORTANT

Upon unpacking this instrument, remove the chassis from the case and inspect the tubes, grid-cap connections and fuse. The chassis may be with-

drawn upon removing the three screws in the back of the case. Replace the chassis and tighten the three screws before operating.

APPLICATION

The Stock No. 167 Test Oscillator, although useful in a wide variety of applications, is adapted primarily to servicing of radio receivers. Its output may be adjusted to any frequency within the overall range of 100 to 30,000 kilocycles (0.1 to 30 megacycles) and may be regulated in strength between the limits of four microvolts and one volt. To facilitate

alignment operations, a source of modulation at approximately 400 cycles is provided internally. This audio-frequency energy may be utilized independently if desired, eight volts appearing across 50,000 ohms impedance at no load. For measurements, such as overall fidelity, modulation from an external source may be applied.

INSTALLATION

The test oscillator is ready for immediate use upon inserting the power cord plug into an electrical outlet supplying power at the proper voltage and frequency (110-120 volts, 50-60 cycles). Connections to the apparatus under test and to other pieces of test equipment obviously will depend upon the type of service intended. For receiver alignment work, use of a cathode-ray oscillograph is definitely advantageous and this method is rapidly displacing the output meter test in modern service shops. RCA offers a choice of four cathode ray oscillographs especially de-

signed for this purpose—Stock No. 151 Oscillograph uses a one-inch Cathode Ray Tube—Stock No. 151-2, a two-inch tube—Stock No. 155-A, a three-inch tube and Stock No. 160 a five-inch tube. The use of a Frequency Modulator, Stock No. 9558, is also recommended. For overall fidelity measurements, it will be necessary to employ an external source of modulation which may be varied over the audible range. The RCA Stock No. 154A Beat-Frequency Oscillator is recommended for such applications.

RECEIVER ALIGNMENT

CONNECTIONS

Three output pin jacks are provided in the high-side of the test oscillator for controlling the oscillator output (input to the receiver), the markings "HIGH,"

"MED." and "LOW" being self-explanatory. Use the "HIGH" jack initially to insure ample signal but shift to one of the others as soon as a partial alignment is achieved. It is always advisable to use the lowest possible value of input signal to the receiver.

In superheterodyne receivers, the intermediate-frequency stages should be aligned first and preferably in their reverse order, starting at the stage immediately preceding the second detector. Connect the input lead through a fixed capacitor of from 0.001 mfd. to 0.01 mfd. to the grid of the tube preceding the circuit under alignment. Since it is essential that the operating characteristics of the stage shall not be altered, this connection should be made leaving the grid lead in place. The low side of the oscillator (from the "GND." tip jack) should be connected to receiver ground—usually the chassis.

To align the radio-frequency stages of a superheterodyne or tuned-radio-frequency receiver, connect the high-side of the test oscillator to the receiver antenna lead (or terminal) and the low-side to receiver ground. The former connection should be made through a dummy antenna, comprising a resistor or capacitor or both, as advised by the manufacturer of the receiver; a 300-ohm resistor will generally afford satisfactory results. With highly-sensitive receivers, the input lead should be shielded and kept as short as possible in order to reduce stray pickup.

Although an approximate alignment can be made by ear, precision adjustment is possible only through use of a visual indicating device, such as an output meter or, preferably, a cathode-ray oscillograph. Connections to an output meter obviously will depend upon the type of meter employed, whether it be a milliammeter for use in the detector plate circuit, voltmeter across the plate load of the output stage or receiver voice coil, or some other variety. Such connections, therefore, are best left to the discretion of the user. If a cathode-ray oscillograph is to be employed, refer to Figure 2. for the essential arrangement of component units. The frequency modulator shown is used to sweep the test-oscillator frequency over a narrow band, this action being obtained by plugging the output cable of the former into the "FREQ." jack of the test oscillator.

Using the oscillographic method, the audio output of the detector is brought to the binding posts connected to the *vertical* deflection plates—marked "VERT." or "VERTICAL" in the RCA oscillographs. In the case of a diode detector, this connection generally may be made across the volume control or diode load resistor. Where the detector is a triode, tetrode, or pentode, the "HIGH" binding post should be connected to the plate, and the "O" post to ground. It will be necessary to insert a resistor of approximately 20,000 ohms in series with the plate circuit in receivers which employ transformer or impedance coupling to the first audio stage, in order to make the load resistive. The load inductance should be bypassed with a capacitor of not less than 1 mfd.

PROCEDURE

As noted under "Connections," it is essential that the intermediate-frequency stages of a superheterodyne type receiver shall be aligned before the radio-frequency stages and this sequence, therefore, is observed in the following discussion. The section entitled "R-F Alignment" also covers the alignment of tuned-radio-frequency type receivers.

I-F Alignment.—The i-f stages should be aligned in their reverse order, starting at the last stage and proceeding toward the first detector (converter). With all connections made as outlined above, apply power to the test oscillator by turning the "POWER MODULATION" switch to the "INT." position. The 400-cycle modulation tone will be heard as the stage is brought into resonance by adjustment of the associated trimmers.

Set the "RANGE" switch and dial to produce the nominal intermediate frequency and adjust the output level as desired by selecting the most suitable of the pin jacks marked "HIGH," "MED." and "LOW." The "OUTPUT" control enables fine adjustment on the "LOW" and "MED." pin-jack positions.

Peak the trimmers associated with the stage involved as described in the manufacturer's service notes. It is preferable to adjust first the primary and then the secondary of the coupling transformer.

The foregoing procedure should be followed whether using an output meter or a cathode-ray oscillograph. In the latter case, however, this constitutes merely an initial check with the frequency modulator cable disengaged from the test oscillator. A vertical trace only will be observed on the oscillograph screen, the length of which is indicative of receiver output.

To complete the cathode-ray test, plug the frequency modulator cable into the "FREQ." jack of the oscillator and throw the "POWER MODULATION" switch to "EXT.," thus removing the amplitude modulation. Now apply power to the frequency modulator and adjust the test oscillator frequency until the forward and reverse images of the selectivity curve are visible on the oscillograph screen. To obtain this double-image pattern, the timing axis of the oscillograph must be set and locked with the external synchronizing control at the proper frequency (approximately 52 cycles per second).

Increase the test oscillator frequency until the highest point of the two images coincide and record the final setting of the test oscillator dial for future reference. Such readjustment of the test oscillator setting during this test is necessary to compensate for the capacitance of the frequency modulator cable plus one-half of the sweep capacitance employed. The following tabulation shows the approximate dial settings for several common test frequencies, using the RCA Stock No. 9558 Frequency Modulator. Such values are approximate, due to production variations in cable capacitance and the exact values should be recorded by the owner in the columns provided.

Test Frequency (KC)	Range (KC)	Dial Setting (KC)			
		"HI" Sweep Cap.		"LO" Sweep Cap.	
		Approx.	Exact	Approx.	Exact
175	100-260	264.5	.....	232.5	.....
180	100-260	—	.....	243.0	.....
260	260-625	291.0	.....	283.5	.....
445	260-625	—	.....	596.0	.....
455	260-625	—	.....	619.0	.....
460	260-625	—	.....	629.0	.....
465	260-625	—	.....	650.0	.....
600	625-1,550	667.5	.....	650.0	.....
1,000	625-1,550	1,475.0	.....	1,307.0	.....
1,400	625-1,550	1,533.0	.....	1,500.0	.....

The i-f trimmers should now be adjusted for maximum amplitude and complete symmetry of the two traces upon the oscillograph screen, such appearance indicating that the stage is symmetrically aligned with respect to the intermediate frequency supplied by the test oscillator. In cases where complete symmetry cannot be obtained and the amplitude increases rapidly upon approaching resonance, the trouble is apt to be due to regeneration in the i-f stages. Regeneration may be produced through coupling in the common power supply because of failure of a bypass capacitor, capacitance coupling between stages, absence of tube shields, improper placement of the input lead and in many other ways. Behavior of the oscillographic pattern in this manner is at least definitely indicative of trouble which must be corrected before a symmetrical alignment is possible. During the i-f alignment, the tuning dial of the receiver should be set at some point preferably near the low-frequency end of the scale where no interference is encountered either from broadcast stations or from the local heterodyne oscillator. For the cathode-ray test, a setting should be selected where variation of its position will have no effect on the oscillographic curves. In multi-range receivers, the range switch should be set for the standard-broadcast band.

R-F Alignment.—The r-f circuits of a superheterodyne type receiver or the cascade r-f stages of a tuned-radio-frequency type receiver are aligned in a manner similar to that described for i-f alignment. Suitable alignment points are usually recommended in the manufacturer's service notes.

In the case of the superheterodyne, the test oscillator and receiver dial first should be set at the low-frequency alignment point and the local oscillator in

the receiver adjusted by means of the series trimmer capacitor. This trimmer should be set for maximum amplitude only, whether using an output meter or cathode-ray oscillograph. Using the visual method, no attempt should be made to obtain symmetry of the two curves on the screen.

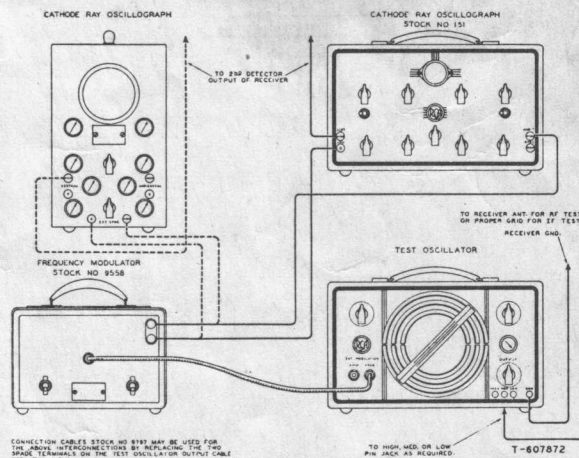


Figure 2—Connections for Oscillograph Test

The test oscillator and receiver dial should then be shifted to the high-frequency alignment point and the parallel trimmer capacitor on the local oscillator adjusted until the output frequency of the latter is correct. This condition will be evidenced by maximum amplitude when using an output meter, or by approximate coincidence of the forward and reverse images on the screen of the cathode-ray oscillograph. The first detector (converter) and antenna trimmers now should be adjusted for maximum output or, using the visual method, for maximum amplitude and

complete symmetry of the two oscillographic curves. If the latter trimmers are found to shift the output frequency (as indicated in the oscillograph test by separation of the two curves), the local oscillator parallel trimmer should be re-adjusted to compensate for this deviation.

Next, re-tune the receiver and test oscillator to the low-frequency alignment point and re-adjust the series trimmer on the local oscillator. During this adjustment, the variable tuning capacitor should be rocked slowly back and forth through the signal unless the visual method is being used. In the cathode-ray test, it is merely necessary to adjust the trimmer for maximum amplitude of the two curves, irrespective of their positions on the screen.

A final check of trimmer adjustments always should be made at the high-frequency alignment point. The sequence of operations as described above is important because of the greater effect exerted upon the high-frequency alignment settings by

the local oscillator series trimmer than upon the low-frequency setting by the parallel trimmer.

Tuned-radio-frequency type receivers likewise should be aligned at two or more points through the band as recommended by the manufacturer, starting at the high-frequency end. As for the i-f stages of a superheterodyne, the cascade r-f stages in this type receiver are best aligned in their reverse order.

Oscillograph Test.—In order to interpret the results properly when using a cathode-ray oscillograph for receiver alignment, it is necessary to know the frequency range through which the circuit under adjustment is being swept. This range may be determined readily by reference to Figure 3 which shows the percentage of sweep for any dial setting. Since this information is presented as a single curve for each value of sweep capacitance, any dial setting referred to Figure 3 should be read upon the reference band (625-1,550 KC), irrespective of the band being used.

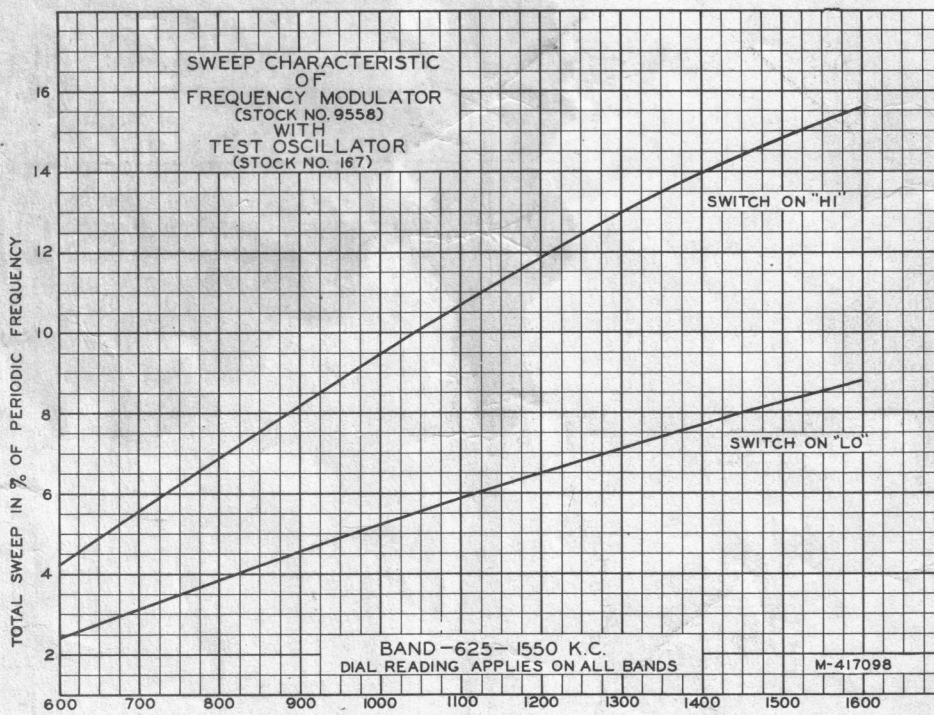


Figure 3—Sweep Characteristics, Using Stock No. 9558 Frequency Modulator

RECEIVER FIDELITY MEASUREMENTS

CONNECTIONS

To measure the overall response (fidelity) characteristics of a receiver, connect the output of the test oscillator across the antenna circuit and plug a beat-frequency oscillator (such as the RCA Stock No. 154-A) into the "AMP." jack of the test oscillator. The beat-frequency oscillator employed should be capable of delivering an r-m-s output of 1.5 volts into a 30,000-ohm load for 30% modulation of the r-f signal. A suitable output meter or cathode-

ray oscillograph should be connected to the output of the receiver.

PROCEDURE

Apply power to both oscillators, turning the "POWER-MODULATION" switch of the test oscillator to the "EXT." position.

Set the "RANGE" switch and dial of the test oscillator to 1,000 kc and tune the receiver to resonance with this signal. The r-f output should be adjusted to the desired level by selecting the most suitable output pin-jack and using the "OUTPUT" control.

Adjust the voltage output of the beat-frequency oscillator for the desired percentage of modulation. As noted under "Connections," a potential of 1.5 volts will modulate the r-f signal approximately 30%. Approximately 1.8 volts will be required for 50% modulation.

Readings of output voltage from the receiver may

now be taken, or observed on the cathode-ray oscillograph when employed, as the modulation frequency is varied in steps throughout the audible range. Since the modulation characteristic of the test oscillator is essentially flat up to 17,000 cycles, an accurate response curve may be plotted from such data.

CW AND AUDIO TESTS

CW TESTS

In tests where an r-f output without modulation is required, set the "POWER-MODULATION" switch to the position marked "EXT." and leave the "AMP." jack open.

AUDIO TESTS

The 400-cycle modulation voltage may be used externally for audio tests if desired by plugging into

the "AMP." jack and setting the "POWER-MODULATION" switch at "INT." As noted heretofore, this potential appears across a high impedance (50,000 ohms), reaching a value of approximately 8 volts at no load. The output voltage under load obviously will depend upon the ratio of the load and output impedances.

CALIBRATION

The dial calibration is accurate to within 2%, which should be satisfactory in the majority of applications. Where greater accuracy is desired, the correction chart supplied loosely in this instruction

book may be utilized to record the exact calibration. An exact calibration may be obtained, using the RCA Stock No. 9572 Piezo-Electric Calibrator.

CIRCUITS

Schematic circuit diagram for the Stock No. 167-A Test Oscillator is shown on Figure 6. The circuit consists essentially of an electron-coupled r-f oscillator using an RCA-6J7 tube which is suppressor modulated at 400 cycles by an audio oscillator using an RCA-6C5 tube. An RCA-5W4 rectifier affords complete a-c operation, suppressor bias as well as the plate and screen voltages being procured from the power supply.

The r-f oscillator is of the Hartley type with compensation added to maintain a maximum output of

approximately one volt over the entire frequency range. When using external modulation, the audio oscillator is converted to an audio amplifier which feature is highly advantageous for several reasons. Comprising these advantages are: (a) Lower audio input requirements for modulation; (b) isolation of the r-f amplifier from the external modulating source; (c) less r-f radiation; and (d) constant impedance load on the external modulating source.

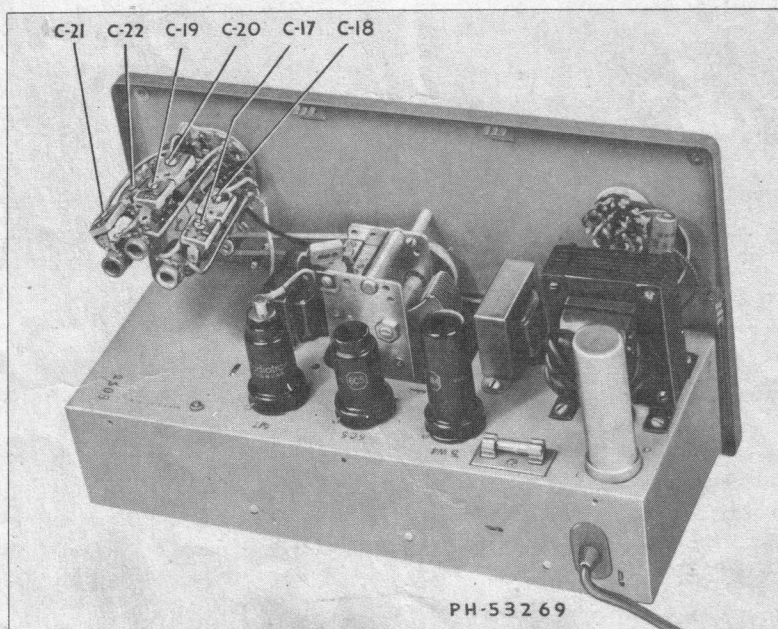


Figure 4—Panel and Chassis Assembly

MAINTENANCE

Caution: Disconnect the Power Supply Before Removing the Instrument Case to Replace Tubes or Make Service Adjustments

TUBE		Plate	Screen Grid	Suppressor Grid	Cathode	Filament or Heater
Type	Function					
RCA-6J7	R-F Osc.	+170 V. DC (pin 3)	+165 V. DC (pin 4)	-16.5 V. DC* (pin 5)	0 (pin 8)	6.3 V. AC (pin 2)
RCA-6C5	A-F Osc.	+100 V. DC (pin 3)	—	—	+8 V. DC (pin 8)	6.3 V. AC (pin 2)
RCA-5W4	Rectifier	330 V. AC +100 V. DC (pins 4, 6)	—	—	—	5.0 V. AC† +195 V. DC (pins 2, 8)

* Cannot be measured with ordinary meter.

† Heater to Heater.

TUBE SOCKET VOLTAGES

The normal voltages appearing at the respective tube-socket terminals with respect to chassis ground, using a 115-volt line supply, are shown in the foregoing tabulation. Pin numbers progress in a clockwise direction, starting from the key and viewing the bottom.

The above voltages are indicative of the proper operating conditions of the basic circuits and should not vary in excess of $\pm 20\%$. Circuit defects ordinarily will be found in cases of greater variation. Such measurements should be made with an a-c/d-c voltmeter of high internal resistance (1,000 ohms per volt) having full-scale ranges of 30, 300 and 600 volts. The nearest range above the voltage to be measured should be employed.

FUSE

A small 1-ampere cartridge fuse provides protection of the power-supply system, and should not be replaced with one of higher rating or short-circuited. Fuse failures should be carefully investigated before replacement since a fuse of good quality fails only under conditions of overload. The fuse clips should be kept clean and in secure contact with the fuse at all times.

RESISTANCE AND CONTINUITY

The various photographs and diagrams contain such information as will be needed to locate causes for defective operation if such develops. The values of the various resistors, capacitors, and inductances are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles, such as R-3, L-2 and C-1, etc., are provided for reference

between the illustrations and the Replacement Parts list.

The coils, reactors, and transformer windings are rated in terms of their d-c resistances. This method of rating provides a ready means for checking the continuity of circuits. Suspected faulty circuits or parts may be checked and their resistances compared with the value given on the schematic diagram. Failure of operation may result from:

1. Power supply being "OFF."
2. Open fuse within the instrument.
3. Defective tubes.
4. Defects within the instrument itself.

Low power or improper calibration may result from:

1. Improper alignment of the various circuits.
2. Defective tubes.
3. Improper setting of control knobs on shafts.
4. Defects within the instrument itself.

R-F ALIGNMENT

Pointer Adjustment—At the maximum capacity position of the main tuning capacitor, the dial pointer should be exactly horizontal. The pointer setting may be adjusted upon loosening its mounting screws at the center

Individual trimmer capacitors are provided for each of the six oscillator coils and each trimmer is physically mounted adjacent to the coil across which it is connected. In the event of replacement of tubes or other parts the calibration of each band can be returned to normal by readjusting these trimmers. Best results will be obtained by making these readjustments at frequencies near the high frequency end of each band. Figures 4 and 6 show location and identification of these trimmers.

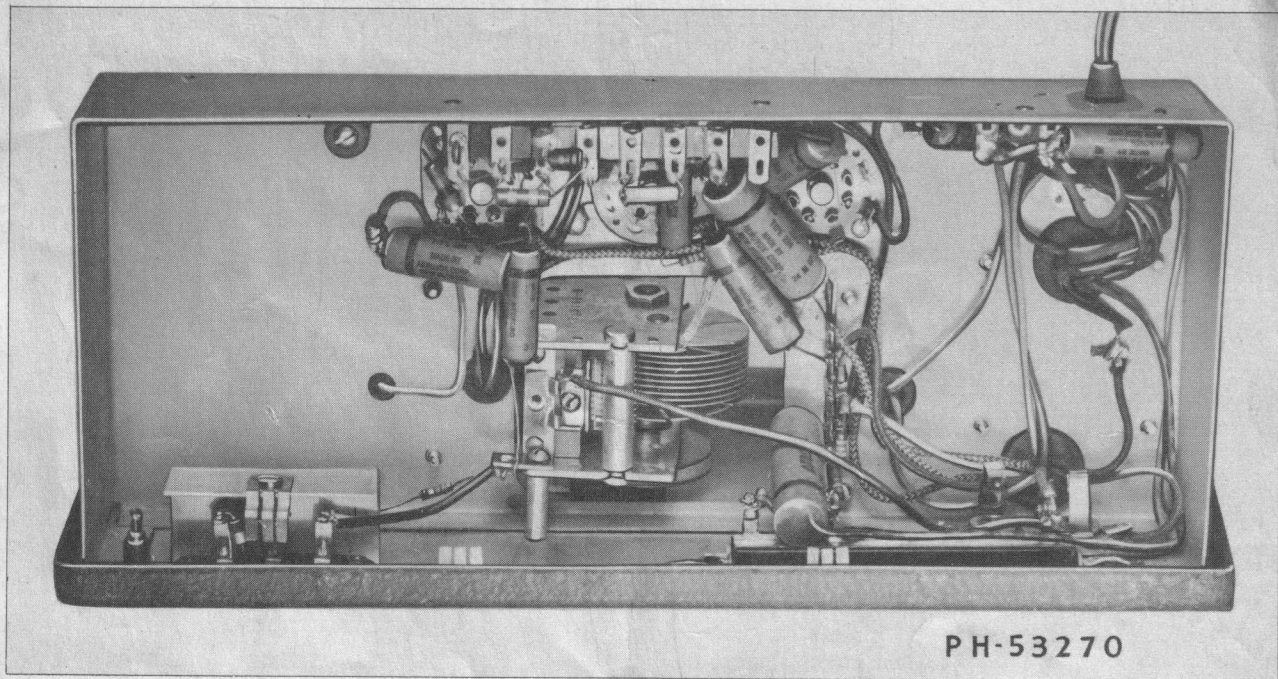


Figure 5—Bottom View of Chassis

REPLACEMENT PARTS

Insist on genuine factory-tested parts, which are readily identified and may be purchased from authorized dealers.

STOCK No.	DESCRIPTION	STOCK No.	DESCRIPTION
14384	Belt—Tuning capacitor drive belt	14636	Pulley—Idler pulley
37105	Button—Plug button for pointer	13111	Reactor—Filter reactor (L-8)
34585	Cable—Low capacity test with pin tips and test clips	13988	Resistor—10 ohms, 1/4 watt (R-14)
35924	Capacitor—9 to 411 mmfd. variable capacitor, complete with 2.5 to 27.5 mmfd. trimmer capacitor (C-7, C-8)	30929	Resistor—270 ohms, 1/4 watt (R-15)
12725	Capacitor—150 mmfd. (C-6)	12267	Resistor—1,200 ohms, 1/4 watt (R-13)
30057	Capacitor—2,700 mmfd. (C-15)	12194	Resistor—1,800 ohms, 1/4 watt (R-6)
4838	Capacitor—0.005 mfd. (C-9)	14024	Resistor—2,700 ohms, 1/4 watt (R-16)
4858	Capacitor—0.01 mfd. (C-3)	12312	Resistor—3,300 ohms, 1/4 watt (R-11)
4886	Capacitor—0.05 mfd. (C-13, C-14)	14559	Resistor—10,000 ohms, 1/4 watt (R-9)
4839	Capacitor—0.1 mfd. (C-2, C-5, C-10, C-16)	30128	Resistor—12,000 ohms, 1/4 watt (R-7)
12484	Capacitor—0.25 mfd. (C-1, C-4)	12695	Resistor—15,000 ohms, 1/4 watt (R-8)
32342	Capacitor—Comprising two sections each 10 mfd. (C-11, C-12)	30912	Resistor—Comprising one section of 15,000 ohms and one section of 4,700 ohms (R-17, R-20)
30914	Coil—Oscillator coil (L-1, L-2)	12738	Resistor—27,000 ohms, 1/4 watt (R-4)
30915	Coil—Oscillator coil (L-3, L-4)	12454	Resistor—33,000 ohms, 1/4 watt (R-5)
30916	Coil—Oscillator coil (L-5, L-6)	12412	Resistor—47,000 ohms, 1/4 watt (R-3, R-10)
30917	Coil—Peaking coil (L-7)	12286	Resistor—56,000 ohms, 1/4 watt (R-2)
30926	Foot	13715	Resistor—68,000 ohms, 1/4 watt (R-18)
14133	Fuse—1 ampere (F-1)	14020	Resistor—150,000 ohms, 1/4 watt (R-1)
30925	Handle—Carrying handle	14983	Resistor—330,000 ohms, 1/4 watt (R-19)
35923	Indicator—Dial pointer	30648	Resistor—470,000 ohms, 1/4 watt (R-21)
11780	Jack—"E X T. MODULATION" jacks (J-1, J-2)—Phone jack	4119	Screw—Set screw for pointer
30920	Jack—"HIGH," "MED." and "LOW" jacks (J-3, J-4, J-5)—Output jack	31251	Socket—(Octal base) tube socket
30921	Jack—"GND." pin jack, complete with one hex nut (J-6)	14637	Spring—Idler take-up spring
7960	Knob—Bar pointer knob	30927	Spring—Panel-to-case contact spring
30923	Knob—Tuning knob	30919	Switch—"P O W E R M O D U L A T I O N" switch (S-2)
13210	Mounting—Fuse mounting	30918	Switch—"RANGE" switch (S-1)
35922	Panel—Control Panel and scale	3979	Transformer—Oscillator transformer (T-2)
13985	Potentiometer—"OUTPUT" control, 2,000 ohms (R-12)	9556	Transformer—P o w e r transformer (T-1)
		46292	Trimmer—(C-17, C-18, C-19, C-20, C-21, C-22)

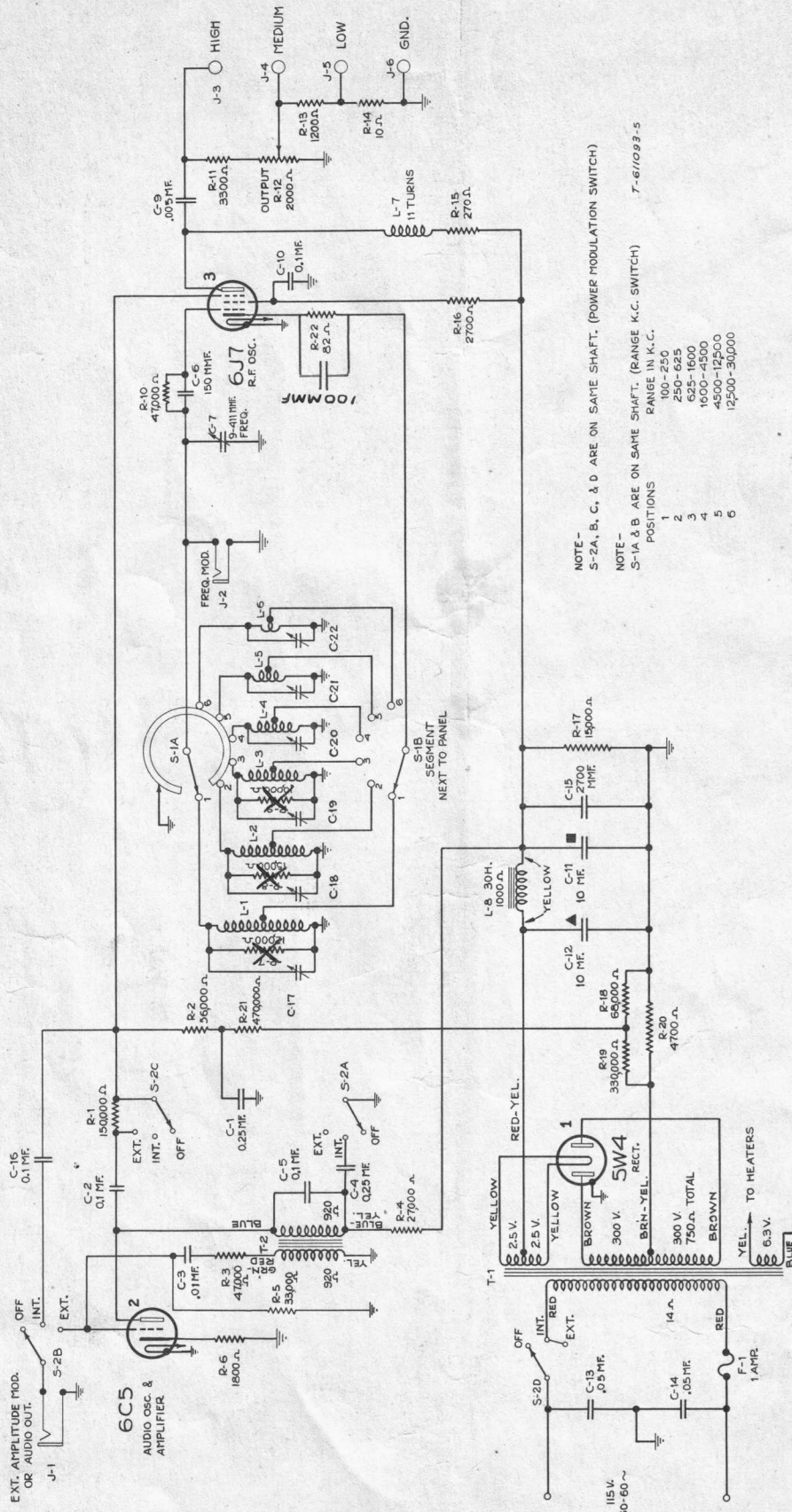


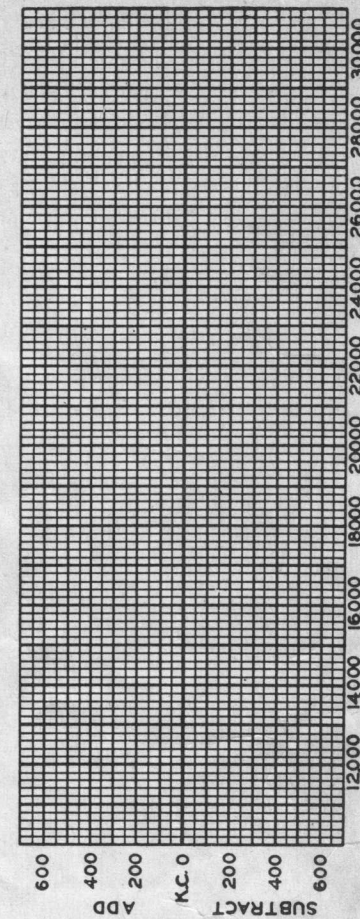
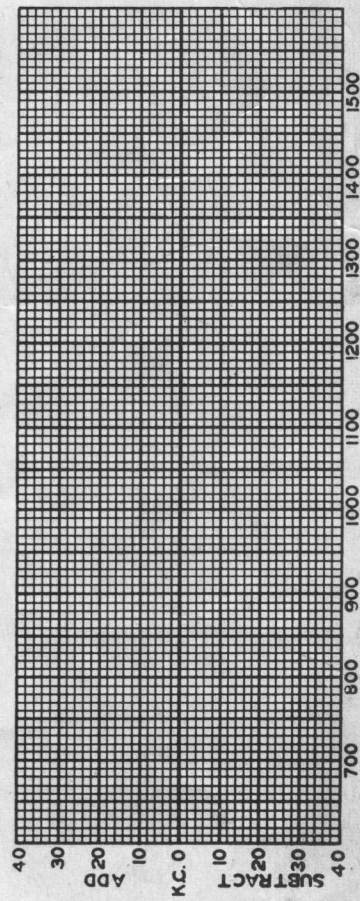
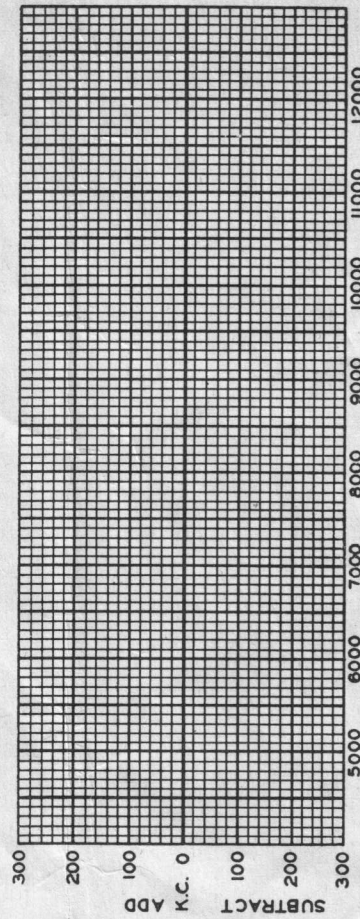
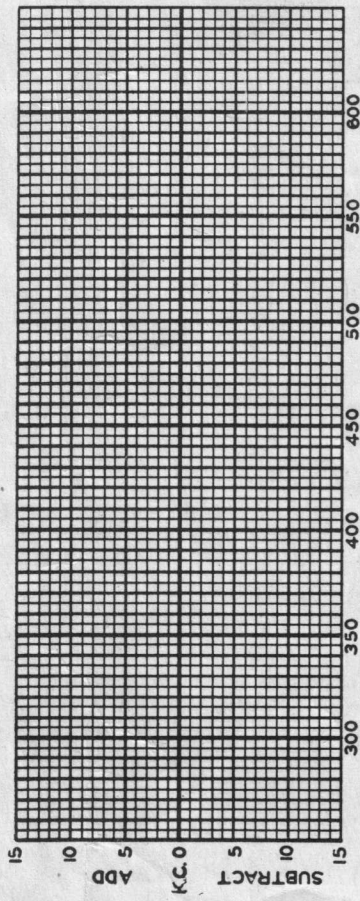
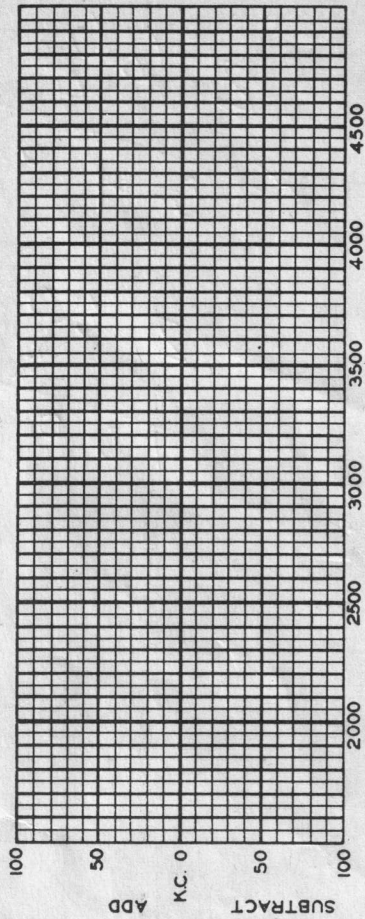
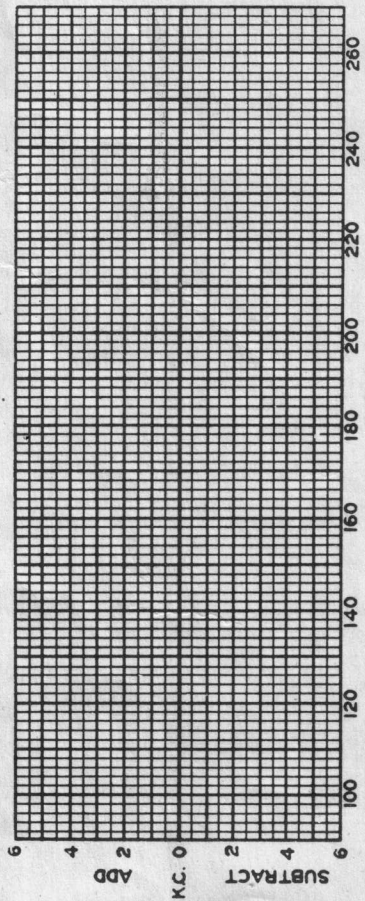
Figure 6—Schematic Circuit Diagram

Serial No.

Date

CORRECTION CHART

The correction curves shown indicate the error for any particular dial reading. For example, if a frequency of 1000 K. C. is desired, the dial should be set at 1000 + or - the correction as shown on the chart for 1000 K. C. Conversely, if it is desired to interpret the dial setting in terms of frequency, the correction if *additive* should be *subtracted from* and if *subtractive* should be *added to* the dial reading.



$$\begin{array}{r} 260 \\ 4 \\ \hline 1040 \end{array}$$

$$\begin{array}{r} 250 \\ 4 \\ \hline 1000 \end{array}$$