

HEWLETT-PACKARD
CORP.

207A

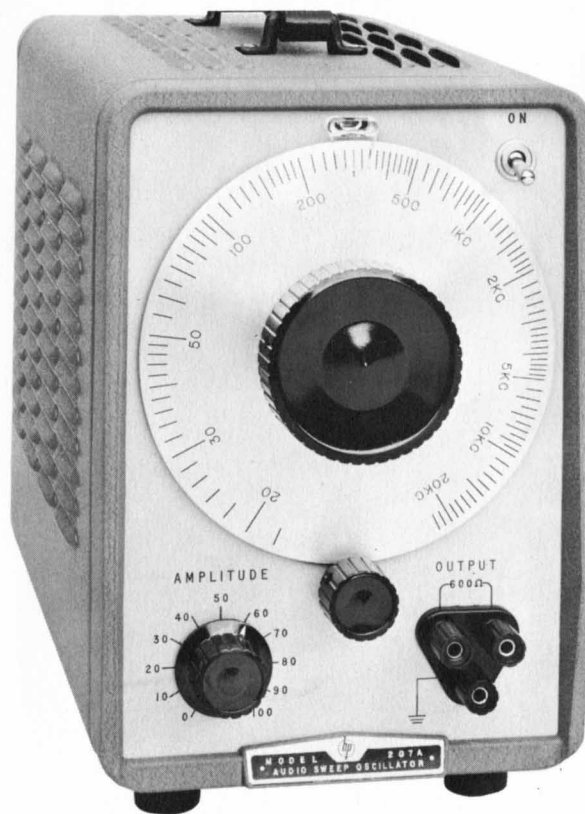
AUDIO SWEEP OSCILLATOR

OPERATING AND SERVICING MANUAL



OPERATING AND SERVICING INSTRUCTIONS
FOR

MODEL 207A
AUDIO SWEEP OSCILLATOR
Serial 11 and above



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HEWLETT-PACKARD COMPANY
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207A002

SPECIFICATIONS

FREQUENCY RANGE:	20 cps to 20,000 cps, covered in one band.
ACCURACY:	$\pm 4\%$ including warm-up, changes due to aging components, tubes, etc.
DIAL:	Six-inch diameter dial calibrated over 300° of arc.
FREQUENCY RESPONSE:	± 1 db over entire frequency range.
EXTERNAL FREQUENCY CONTROL:	1/4-inch shaft, extending from rear of instrument, rotation approximately 150° for full frequency coverage.
SWEEP TIME:	Recommended minimum time of sweep from one band edge to the other is approximately 20 seconds.
TORQUE REQUIRED:	Maximum torque required to drive rear shaft is approximately 12 ounce-inches with the front panel vernier removed.
OUTPUT:	10 volts into 600 ohms rated load, balanced or 1 terminal at ground.
OUTPUT CONTROL:	Decreases level continuously by more than 40 db.
DISTORTION:	Less than 1% over entire frequency range.
HUM VOLTAGE:	Less than 0.1% of rated output. Decreases as output is attenuated.
POWER:	115/230 volts, $\pm 10\%$, 75 watts.
DIMENSIONS:	Cabinet Mount: 7-1/2" wide, 11-1/2" high, 14-1/4" deep. Rack Mount: 19" wide, 7" high, 12-1/2" deep.
WEIGHT:	Cabinet Mount: 23 lbs. approximately, shipping 29 lbs. Rack Mount: 27 lbs. approximately, shipping 42 lbs.
OPTION AVAILABLE:	Modified to supply an output voltage (from an external dc voltage source) proportional to frequency for true logarithmic presentation.

Specify: H01 207A (Cabinet Mount)
H01 207AR (Rack Mount)

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SECTION I

GENERAL DESCRIPTION

1-1 INTRODUCTION

The Model 207A Audio Sweep Oscillator covers the entire 20-cps to 20-kc frequency range in a single dial sweep. A synthesized RC network enables the oscillator to be tuned over a 1000:1 frequency range without bandswitching, thus the entire audio range may be swept by a single dial twist. This feature makes the 207A a very useful test instrument in applications involving response measurements of amplifiers, transformers, speakers, and many other audio devices.

The dial calibration of the Model 207A is essentially logarithmic. This characteristic permits accurate presentation of waveforms on an oscilloscope or recorder when making response measurements. To facilitate such measurements, the 207A is arranged so that an extension of the tuning dial shaft is available at the rear of the instrument. The shaft extension may be equipped with an accessory potentiometer which, when used with a suitable d-c supply, provides a linear sweep voltage for use in observing response characteristics of audio devices. The shaft extension may also be equipped with a reversing-motor drive which permits automatic response measurements to be made.

In addition to the above features the Model 207A retains all the basic advantages common to the -hp- line of RC-oscillators, such

as wave-form purity, constant output over a wide range, stability, calibration accuracy, and other important features shown in the TABLE OF SPECIFICATIONS.

The Model 207A is easy to operate: frequency and amplitude of the output signal are set merely by operating dials on the control panel. The easily read, six-inch diameter frequency dial is calibrated over 300° of arc.

Usefulness of the oscillator has been extended by designing the 207A output circuit so that it can be operated balanced as well as unbalanced. The oscillator output provides a maximum of 20 volts open circuit or 10 volts into a 600-ohm load at any frequency between 20 cps and 20 kc. A bridged-T variable attenuator in the output circuit controls the output voltage level over a 40-db range.

1-2 INSPECTION

This instrument was thoroughly tested and inspected before being shipped, and is ready to use when received.

After the instrument is unpacked, it should be inspected carefully for any damage it may have received in transit. If any shipping damage is found, follow the procedure outlined in the "Claim for Damage in Shipment" section at the back of this instruction book.

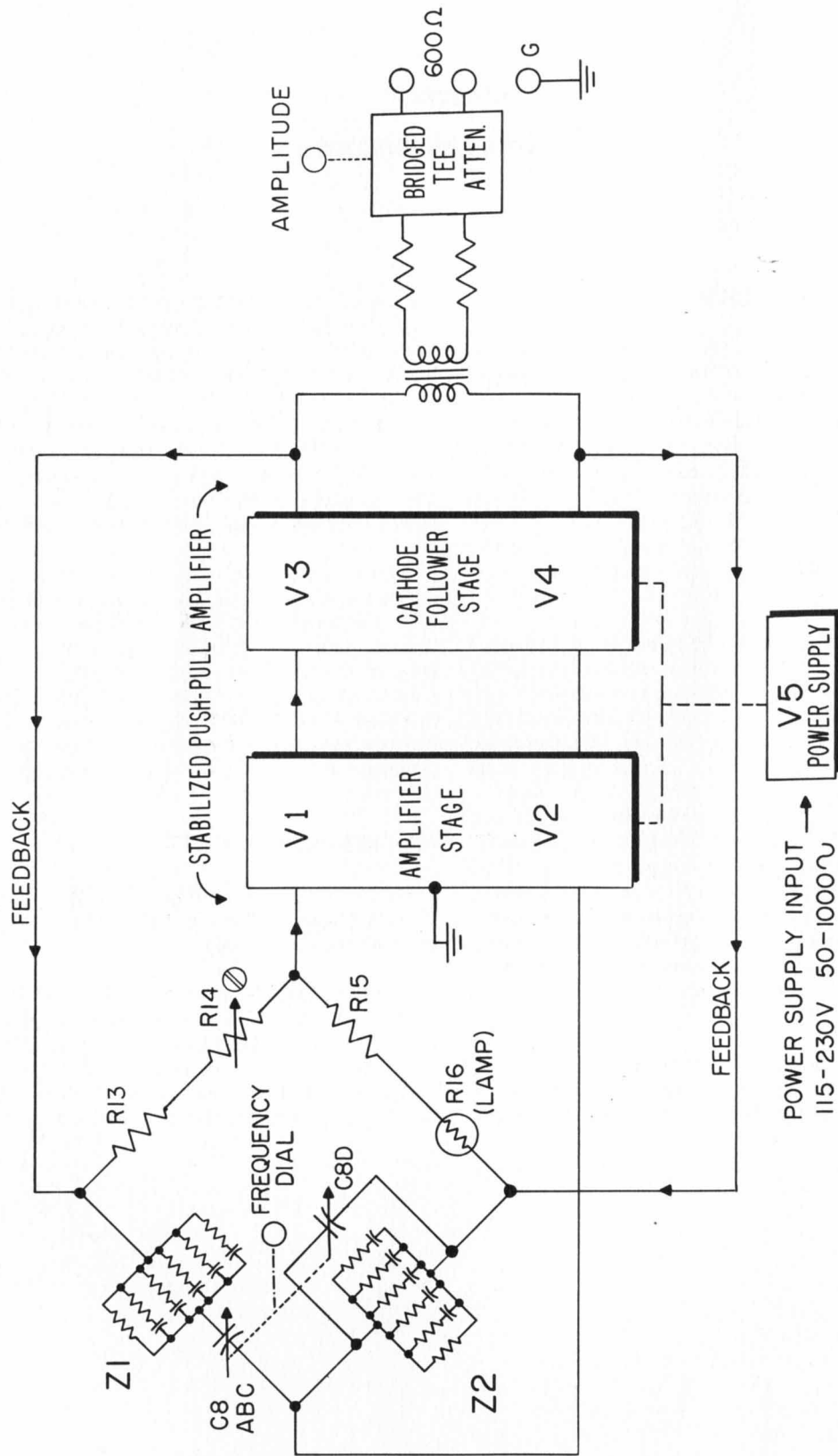


Figure 2-1 Model -hp- 207A Block Diagram

SECTION II

OPERATING INSTRUCTIONS

2-1 CONTROLS AND TERMINALS

On

This toggle switch is in the power-supply input circuit, and in the ON position closes the line voltage to the power-supply transformer. With the transformer energized, an indicator lamp lights, and the glow visible through the index window on the frequency dial indicates the instrument is turned on.

FREQUENCY DIAL

This control varies the capacity in the frequency-determining network of the instrument and thus varies the output frequency. The dial is calibrated from 20 cps to 20 kc over a 300° arc. The small knob (just below the frequency dial on cabinet models and to the right of the dial on rack models) is a vernier control for the frequency dial.

AMPLITUDE

This control varies the setting of the bridged-T-attenuator in the output circuit. The calibration marks are in arbitrary units, with maximum attenuation (and no output) at the zero setting, and minimum attenuation (and maximum output) at the maximum clockwise setting.

600 Ω $\frac{\pm}{\equiv}$ (OUTPUT)

The output voltage of the instrument appears at these terminals. The two terminals designated 600 Ω connect directly to the output of the AMPLITUDE control and are used for a balanced output. The other terminal designated $\frac{\pm}{\equiv}$ is connected to the instrument chassis. This terminal, in conjunction with one of the other terminals is used for an unbalanced output.

FUSE

The fuseholder, which is located on the back of the instrument, contains a cartridge fuse of the Slo-Blo type. For 115-volt operation, a 1-ampere fuse is used, and for 230-volt operation, a 1/2-ampere fuse of the same type is used.

POWER CABLE

The three-conductor power cable is terminated in a polarized three-prong male connector recommended by the National Electrical Manufacturer's Association. The third

contact is an offset round pin, added to a standard two-blade a-c plug, which grounds the instrument chassis when used with the appropriate receptacle. To use this NEMA plug in a standard two-contact outlet, it is recommended that instead of breaking off the ground terminal, a 2-prong to 3-prong adapter be used. The ground connection emerges from the adapter as a short lead which should be connected to ground for the protection of operating personnel.

2-2 OPERATING PROCEDURE

- a. With the instrument plugged into a power source of specified voltage and frequency, and the power switch at ON, allow a warm-up period of approximately ten minutes. Where maximum accuracy is desired, this warm-up period should be extended at least to one hour. If a 230-volt power source is used, check (1) that power transformer T1 is strapped for 230-volt operation (strapping options are shown on the schematic diagram), and (2) that fuse F1 is a 1/2-ampere Slo-Blo fuse. See paragraph 4-12.
- b. The frequency of the output voltage is determined by the setting of the frequency dial.
- c. Set the AMPLITUDE control at the zero position. Make the connection between the Model 207A and the equipment to be driven. (The Model 207A may be operated into any load of 600 ohms or greater without effect on the output waveform. Loads of less than 600 ohms will affect the waveform and are not recommended. The Model 207A may be considered as a 20-volt generator with a 600-ohm internal impedance.)
- d. Adjust the AMPLITUDE control to obtain the desired level of output voltage.

2-3 OUTPUT CIRCUIT OPTIONS

The output circuit of the Model 207A may be arranged for balanced or unbalanced operation. Typical connections for each are indicated in Figure 2-1, if a generator with an internal impedance of 600 ohms is desired.

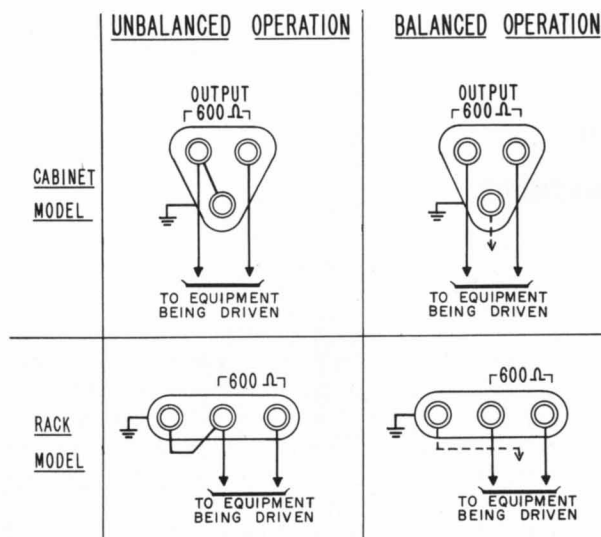


Figure 2-2 Typical Output Connections

Unbalanced Operation

To operate with one side grounded, a strap is placed between the \perp terminal and the lefthand 600 Ω terminal, as indicated in Figure 2-1. (The \perp terminal is connected to the chassis; with the Model 207A power cable plugged into a grounded female connector, the instrument chassis is connected to ground.)

NOTE

If the Model 207A is being used to supply an unbalanced output, always connect the left hand 600 ohm terminal to ground.

Balanced Operation

Connections for balanced operation are indicated in Figure 2-1. (The broken line from

the ground terminal indicates the output circuit is balanced to ground.)

The AMPLITUDE control in the output circuit is a bridged-T-attenuator and any setting except minimum attenuation unbalances the circuit. Therefore for balanced operation the AMPLITUDE control must be set for maximum output (full cw).

If smaller outputs are desired, with minimum noise turn the AMPLITUDE control maximum cw, and connect an external attenuator, designed for the frequencies involved, between the Model 207A and the load.

2-4 ADDITION OF SWEEP VOLTAGE POTENTIOMETER

A sweep voltage potentiometer is available, at extra cost, for factory installation on the Model 207A. Instruments with this modification are known as the hp Specification H01 207A/AR

This potentiometer, when attached to an external DC voltage source, will produce a voltage proportional to the logarithm of the frequency generated by plus or minus 5%. This voltage may be used to drive a recorder or may be attached to the horizontal input of an oscilloscope for direct display of the frequency characteristics of a unit under test. The potentiometer assembly is coupled to the frequency dial shaft which extends beyond the rear of the cabinet.

SECTION III

CIRCUIT DESCRIPTION

3-1 GENERAL

The Model 207A Audio Sweep Oscillator is basically similar to other -hp- RC oscillators, however the 207A sweeps the entire audio spectrum in a single frequency band. The manner in which the 207A accomplishes this broad single sweep is by means of a synthesized RC network in the frequency controlling bridge which controls the operating frequency over a 1000:1 range.

The 207A oscillator includes a frequency controlling bridge and a balanced push-pull amplifier circuit which constitute the oscillator, an output circuit which may be arranged either for balanced or unbalanced operation, and a power supply circuit. These are shown in block-diagram form in Figure 3-1 and in detail in the schematic diagram.

3-2 FREQUENCY CONTROLLING BRIDGE

The frequency-controlling network in the 207A is arranged as a floating bridge, symmetrical with respect to ground. With no connection to ground on any terminal of the bridge, stability of calibration is assured, since any stray capacity and leakage to ground present at the bridge output terminals do not shunt either the frequency or amplitude-controlling arms of the bridge. The frequency-controlling components comprise two arms of the bridge (Fig. 3-1) and consist of special two-terminal impedance elements (Z1 and Z2) and a variable condenser C8. The network consisting of Z1 and Z2 differs from the conventional RC network in that the resistance element of the RC pairs has been changed to an impedance element to effect a 1000:1 frequency range in a single band. A comparison of the conventional RC network with the 207A synthesized RC network is described below in order to show how this 1000:1 frequency range is effected.

10:1 Range Network

In the conventional -hp- resistance-capacity oscillator the frequency of oscillation is controlled by the combination of series and parallel RC networks as shown in basic form in Figure 3-2. The ratios of R_1 to R_2 and C_1 to C_2 are such that the frequency of oscillation is

expressed by $f_0 = \frac{1}{2\pi R_1 C_1}$. Normally a 10:1 range-tuning capacitor is used for C_1 and C_2 , thus the oscillators cover a 10:1 frequency range in a single band.

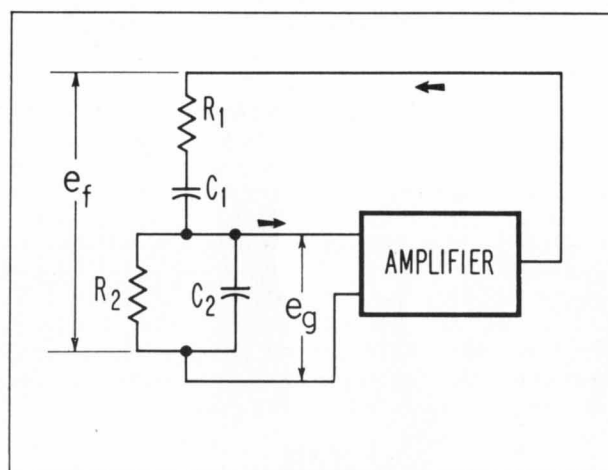


Figure 3-2 Basic arrangement of RC network used in -hp- oscillators.

When the frequency characteristic of one of the RC pairs of the frequency-determining network is plotted on a reactance chart, the plot will appear as shown in Figure 3-3. At the

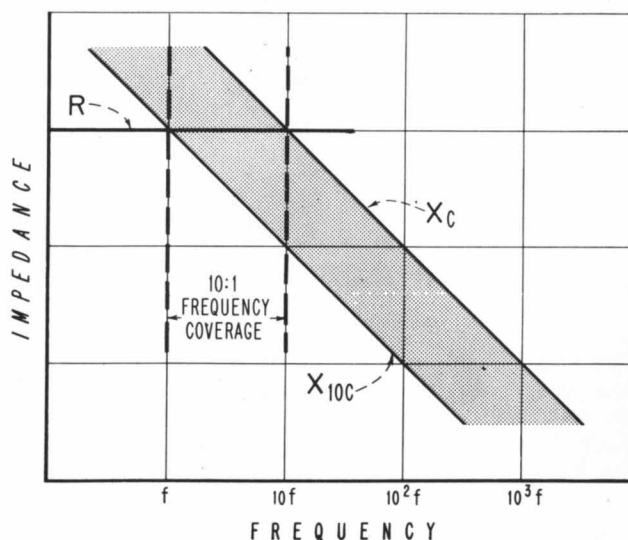


Figure 3-3 Reactance plot of one RC pair in basic RC oscillator.

frequency where the resistance curve R intersects the reactance curve of the capacitor, the voltage e_g out of the network (Figure 3-2) is in phase with the voltage e_f applied to the network, and the overall circuit oscillates. As the capacitor is tuned through its 10:1 range, the reactance moves through a 10:1 range (indicated by shaded area in Figure 3-3), consequently the frequency of oscillation moves through a 10:1 range.

1000:1 Range Network

The frequency-determining network of the 207A retains the same 10:1 range-tuning capacitor, but the resistance element R is replaced with a synthesized impedance element which has a slope between 0 and -1, i.e., between that of a resistance and that of a capacitive reactance. By doing this, the limits of the frequency range over which the circuit can be tuned occur where the impedance curve of the new network intersects the reactance limit lines of the tuning capacitor, as shown in Figure 3-4. Each of the two impedance elements used in the 207A has an impedance line whose slope approximates $-2/3$ as shown in Figure 3-4, thus the frequency coverage of the oscillator has been expanded to cover a 1000:1 range in a single band.

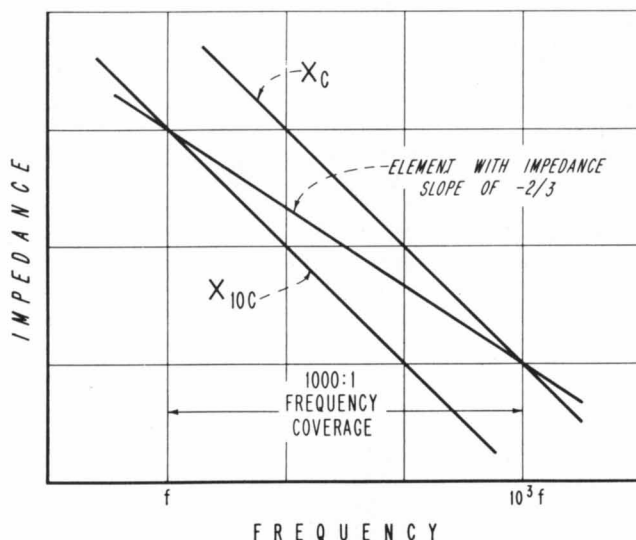


Figure 3-4 Reactance plot of impedance network

The impedance elements approach a straight line characteristic of slope $-2/3$ by using a series of RC networks as shown in Figure 3-1. Each impedance element contains 6 resistors and 5 capacitors to achieve the required im-

pedance characteristics. Figure 3-1 shows how the complete circuit appears when the two impedance elements are used.

Amplitude Stabilizing Arms

A voltage divider which includes a thermally-sensitive resistance comprises the other two arms of the frequency-controlling bridge. The amplitude is stabilized at such a level that the amplifier tubes are operated in the substantially linear portion of their characteristics. This results in a very pure sine wave oscillation.

The bridge is fed by the balanced voltage developed at the cathode of $V3$ and $V4$ in the output of the balanced amplifier. The output of the frequency-controlling branch of the bridge is applied to the control grid of $V2$ while the output of the amplitude-stabilizing branch is applied to the control grid of $V1$.

3-3 BALANCED PUSH-PULL OSCILLATOR

The oscillator is a balanced push-pull circuit which includes an amplifier stage ($V1$, $V2$) and a cathode-follower stage ($V3$, $V4$). The balanced output from the cathodes of $V3$ and $V4$ is fed back to the frequency controlling bridge and also to the primary of the output transformer. Criss-cross positive feedback is used in the cathode-follower stage to provide an essentially zero output impedance as seen by the cathode-to-cathode load. Thus the oscillator can be operated into any finite load impedance with little reaction on the oscillator.

The feedback paths are from the plate of $V3$ to the screen and control grid of $V4$, and from the plate of $V4$ to the screen and control grid of $V3$. The degree of positive feedback is a function of the load and increases as the load decreases, thus tending to maintain the output constant regardless of load conditions.

3-4 OUTPUT CIRCUIT

Transformer coupling provides isolation between the oscillator circuit and the output circuit, and allows the output to be obtained either balanced or unbalanced. The secondary winding of coupling transformer $T2$ supplies a conventional bridged "T" attenuator, the setting of which is adjusted by operation of the AMP-LITUDE control on the front panel. As the control is turned counterclockwise, the loss inserted by the attenuator is increased. The

source impedance at the output terminals is 600 ohms.

With the attenuator set for minimum loss, the output circuit is arranged for balanced operation. When it is desired to operate unbalanced,

ground should be connected to the center output terminal, which is the termination for the connection brought out from terminal 6 of the output transformer secondary winding. Proper operation cannot be obtained if the ground is connected to the side of the circuit which includes the attenuator.

SECTION IV MAINTENANCE

4-1 GENERAL

The Model -hp- 207A Sweep Oscillator is a precision instrument designed conservatively for long component life, and it is probable that tube replacement will correct a majority of the difficulties which may develop. Tube replacement instructions are given in paragraph 4-3.

The maintenance data provided in this section assumes that maintenance personnel are thoroughly familiar with the operating procedures and circuit theory given in Section II and III, respectively.

As a guide in tracing the cause of substandard operation, a trouble-shooting chart is provided in paragraph 4-13. The chart indicates causes and remedies for certain specific troubles. Where the cause of trouble is of a more obscure nature than the possibilities covered by the chart, the failure should be traced to the section in trouble, and then localized within the section.

After locating the source and eliminating the cause of the trouble, the instrument should be tested and adjusted. Rated performance specifications are given at the front of this instruction book.

4-2 COVER REMOVAL

On both cabinet and rack models, the cover is fastened to the chassis at the rear with two screws. To remove the cover, remove the screws and slide the cover to the rear and off the instrument.

NOTE

When replacing the cover, pull the power cable through the opening in the rear of the cover. Be sure the cable is free of the cover along the entire length of the cable so that it cannot get caught between chassis and cover as the cover is slid onto the instrument.

4-3 TUBE REPLACEMENT

Oscillator

If V1, V2, V3 or V4 is replaced, distortion measurements should be made to determine that distortion in the Model -hp- 207A output voltage does not exceed the rated 1%. Distortion may be measured with an instrument which directly indicates percent of distortion, such as Hewlett-Packard Model 330B Noise and Distortion Analyzer.

a. If distortion is outside rated limits, another tube of the same type should be substituted for the replacement tube, and distortion again measured.

b. If excessive distortion persists, the cause may be:

1. Excessive grid current in V1, or
2. The replacement tube does not have the proper characteristics for the oscillator circuit.

c. To determine the probable cause of the distortion, the d-c voltage between the cathodes of V3 and V4 should be measured (paragraph 4-9, below).

Power Supply

Rectifier tube V5 may be replaced with any tube which has corresponding RETMA standard characteristics.

4-4 REPLACEMENT OF LAMP R-16

Since lamp R-16 is operated well below rating, it should have an infinite life. However, severe mechanical vibration can damage the lamp.

To check lamp operation, measure the level of the output voltage. It should be 22 volts open circuit or 11 volts into 600 ohms. A vacuum tube voltmeter, such as a Hewlett-Packard Model 410B High Frequency Vacuum Tube Voltmeter, is suitable for making the measurement. Proceed as follows:

a. Set the Model -hp- 207A to 100 cps; permit a warm-up period of about five minutes.

- b. Turn the AMPLITUDE control maximum clockwise.
- c. Connect the voltmeter to the 600 Ω terminals. The voltmeter indication should be 22 volts open circuit.

If the output voltage is not at the correct level:

- a. Adjust variable resistor R14 (Figure 4-3) to obtain 22 volts.

The screwdriver adjustment for R14 is brought out to the upper side of the deck, and is accessible through the top of the instrument when the cover is off.

- b. If a 22-volt output cannot be obtained by adjustment of R-14, replace lamp R16.

After replacement of the lamps, adjust R14 to obtain 22 volts open circuit.

4-5 REPLACEMENT OF ELECTROLYTIC CAPACITORS

The electrolytic capacitors in this instrument are very high quality "long life" units which have a useful life of from five to ten years. Do not replace these capacitors unless they are proved defective by accurate tests.

4-6 REPLACEMENT OF VARIABLE RESISTORS AND CAPACITORS

Variable Resistor R14

Connections to variable resistor R14 are indicated in the schematic diagram (Figure 4-6).

After replacement of R14, the level of the output voltage should be measured (see paragraph 4-4, above), and R14 should be adjusted to obtain an output of 22 volts open circuit or 11 volts across 600 ohms.

Variable Resistor R36

Connections to variable resistor R36 (AMPLITUDE control) are indicated in the schematic diagram.

Use a No. 8 allen wrench to remove the two screws which fasten the AMPLITUDE control knob to the shaft, and a 1/2-inch socket wrench to loosen the nut which secures the shaft to the control panel.

After replacement of R36, position the control knob so that the marker will be at the "50" designation at the midpoint of shaft travel.

Variable Capacitors

Variable capacitors C6 and C14 are located on the top of tuning capacitor C8. After replacement of either one of the variable capacitors, check the calibration, paragraph 4-10, below.

4-7 REPLACEMENT OF COMPONENTS IN THE TWO TERMINAL COMPLEX NETWORK

Components R1 + R1A through R12 + R12A, C1 through C5 and C9 through C13 make up the two special two terminal networks described in paragraph 3-2. These networks are located on the two resistor boards which are mounted directly over the main tuning condenser (C8). These networks affect dial calibration and frequency response, and extreme care should be taken in replacing any of their components. The following steps should be followed when making replacements.

1. Resistors R1, R1A, R2, R2A, R3, R3A, R4, R4A, R5, and R6, should be replaced in such a manner that the total resistances R1 + R1A, R2 + R2A, etc. are within 1% of the values shown on the schematic drawing.
2. R1, R2, R3, R4, R5, R6, R7, and R7A are precision 1% resistors and should be replaced if possible with components of similar accuracy and with the same value as printed on the resistor replaced. The padding resistors, R1A, R2A, R3A, and R4A may be replaced with any resistors that produce a total resistance that is within 1% of the value shown on the schematic drawing.
3. Resistors R8, R9, R10, R11, and R12 should be replaced with precision 1% resistors of the same value as printed on the resistor replaced. Resistors R8A, R9A, and R10A, R11A, and R12A should be replaced with resistors that have the same value as indicated by the color code on the resistor replaced. Do not attempt to adjust R7 + R7A through R12 + R12A to the values shown on the schematic drawing as these resistances are factory adjusted for optimum operation of the instrument.
4. Whenever any component is replaced in the network, the frequency response of the instrument should be checked over its complete operating range. If the response is not

within the ± 1 db specifications for the instrument, a slight adjustment of the component replaced may bring the response back within tolerances. If it is impossible to adjust the network for satisfactory operation, return the complete instrument to the factory for adjustment.

4-8 LUBRICATION, TUNING-CAPACITOR DRIVE MECHANISM AND SWEEP POTENTIOMETER

Lubrication is recommended once or twice a year, depending upon instrument useage. Oil the frequency vernier knob shaft with light machine oil. The sweep potentiometer gears may be lubricated with a light moly-grease such as MOLUB-ALLOY #1 available from the Imperial Oil and Grease Co., Los Angeles 48, California.

4-9 CHECK FOR CAUSE OF DISTORTION

General

To check for the cause of distortion, the d-c voltage between the cathodes of V3 and V4 should be measured. There should be less than 1 volt between the V3 - V4 cathodes. A 20,000 ohms-per-volt, or better voltmeter (such as a Hewlett-Packard Model 410B), may be used for making the measurements. Allow a five minute warm-up period before making the voltage measurements. Connect one terminal of the voltmeter to pin 3 of V3 and the other to pin 3 of V4.

Bad Tube in Oscillator

If more than 1 volt is measured between the V3 - V4 cathodes, a bad tube in the oscillator is indicated.

To determine which tube is not operating properly; substitute another tube of corresponding RETMA standard characteristics for each tube in turn. After each tube substitution, measure the distortion. Continue tube substitution until distortion in the output voltage is within the rated 1%.

It is recommended that substitution be made first for V1 or V2 since the characteristics of these tubes more greatly affect the purity of the output voltage than do the characteristics of V3 and V4.

4-10 CALIBRATION

The Model -hp- 207A is capable of generating frequencies with an accuracy of $\pm 4\%$. The

instrument will function within this accuracy when properly calibrated. Special equipment and skill in using it are required for the calibration procedure. Unless both are available it is recommended that the Model -hp- 207A be sent to an authorized repair station for this work.

Equipment Required

1. Average-reading vacuum tube voltmeter capable of reading accurately down to at least 20 cps such as a Hewlett-Packard Model 400D/H/L.
 2. Alignment tool (insulated screwdriver).
 3. A frequency-measuring device:
 - a. Secondary frequency standard with comparison facilities, such as a Hewlett-Packard Model 100D Secondary Frequency Standard. (If a larger scope pattern than provided by the Model 100D is desired, an external oscilloscope may be used with the Model 100D.)
- or
- b. Frequency counter such as a Hewlett Packard Model 522B or 524B Electronic Counter.

Terminology

When the following expressions are used in this text, they have the meaning here specified.

- Slip the dial:
- a. Remove center knob on frequency dial.
 - b. Loosen four screws which secure dial plate to drive shaft.
 - c. Reset dial to position indicated in text.
 - d. Tighten four securing screws. (Center knob may be replaced at end of procedure.)
- On Calibration: Frequency indication centered beneath dial indicator index is the same as output frequency.

Connections

Connection arrangements are indicated in Figure 4-1. Connect as follows:

1. 600 -ohm load across Model -hp- 207A output.
2. Output of Model -hp- 207A to input of measuring equipment.
5. Check and adjust the output voltage as in section 4-4.
6. Check tracking across range; if not within specifications, proceed as explained in paragraph 4-11.

IMPORTANT

For adjustments of frequency, it is necessary to remove the instrument from its case for each adjustment and then to check the frequency adjustment with the instrument replaced in the case. This is necessary as the instrument oscillates at a different frequency when removed from its cabinet. Use non-metallic aligning tools to adjust trimmer capacitors.

Calibration Procedure

1. Turn on Model -hp- 207A and allow at least 2 hours for the instrument to warm up with the case on the instrument.
2. Turn dial to "20" -
 - a. If Model -hp- 207A is not on calibration at "20", slip dial, and put "20" on calibration.
3. Turn frequency dial toward high end to find where 20 kc falls at the top of the range. If 20 kc does not fall at "20 KC" on the dial:
 - a. Turn dial to "20 KC".
 - b. With alignment tool, adjust either trimmer (C6 or C14) to bring "20 KC" on calibration. (Seldom necessary to adjust both trimmers.)
 - c. Set dial to "100".
 - d. Adjust AMPLITUDE control until output voltage is 9 volts.
 - e. Set dial to "10 KC".
 - f. Note output voltage. If not 9 volts:
 - (1) Correct for half of voltage error with trimmer adjusted in b above.
 - (2) Adjust the other trimmer to correct frequency error at 20 KC.
4. Repeat steps 2 and 3 until calibration is on at 20 cycles and 20 KC and output is 9 volts at both "100" and "10 KC".
5. Repeat step 2 until calibration is on at "20 KC" and output is 9 volts at both "100" and "10 KC".

4-11 OSCILLATOR TRACKING ADJUSTMENTS

Oscillator tracking problems may be due to aging of one or more components in the two terminal complex network. Refer to paragraph 4-7 before attempting any of the adjustments in this paragraph.

High End of Range

1. Slip the dial and set "500" right on calibration.
2. Turn frequency dial to "20 KC".
 - a. If "20 KC" is not on calibration, adjust either trimmer (C14 or C6) until "20 KC" is on calibration.
 - b. Turn frequency dial to "100".
 - c. Adjust the AMPLITUDE control until the output voltage is 9 volts.
 - d. Turn frequency dial to "10 KC".
 - e. Check the output voltage. If not 9 volts:
 - (1) Correct for half of voltage error with trimmer adjusted in step a.
 - (2) Correct frequency error with other trimmer for "20 KC".

3. Repeat step 2 until calibration is on at "20 KC" and output is 9 volts at both "100" and "10 KC".

High end of dial will now track within specifications.

4. Check and adjust output voltage as in section 4-4.

Low End of Range

1. Check rest of dial, and find which cardinal points are off calibration.
2. For each point outside of specifications, bend associated tuning-capacitor plates as described below to bring point within specifications.

Bending plates for points above "500" on dial usually is unnecessary and impractical.

Bending Tuning-Capacitor Plates

1. Bend only plate segments associated with dial point off calibration.
 - a. In each section of tuning-capacitor rotor, border on outside plates is split into segments.
 - b. Segments associated with each dial point are those engaging stator when dial point is under indicator index. Plate segments are referred to as plates.
2. Bend plates carefully, with screwdriver or fingers. Each of the eight plates associated with dial point should be bent by same amount.
 - a. To raise the frequency of oscillation, spread plates.
 - b. To lower the frequency, squeeze plates.
 - c. The bending operation must always start with highest-frequency point involved. For example, if calibration is off at "50", "30", and "20", start bending at plates associated with "50".

4-12 POWER TRANSFORMER PRIMARY CONNECTIONS

Connections to the primary winding of power transformer T1 are brought out to a terminal strip mounted on the right side of the instrument.

The power transformer primaries of the Model -hp- 207A are connected for 115-volt operation at the factory. If the instrument is to be operated from a 230-volt power source:

- a. Reconnect the T1 primaries for 230-volt operation, as indicated on the schematic diagram.
- b. Replace 1-ampere fuse F1 with a 1/2-ampere fuse of the SLO-BLO type.

4-13 TROUBLE SHOOTING CHART

The following chart lists various symptoms of trouble and for each indicates the part or parts of the circuit which should be checked. In the main, for purposes of simplification, only the tubes are referenced, but it should be remembered that components associated with referenced tubes also are failure possibilities. Within each section of the chart, checking should be performed in the order given since it is assumed throughout a procedure that the

parts checked previously are functioning correctly.

When testing the Model -hp- 207A, it is recommended that line voltage be applied to the instrument through a variable transformer, and that the transformer be adjusted to deliver a voltage at the low end of the rated 105- to 125-volt range. An instrument in good condition operates satisfactorily from any line voltage within rated range, but where there is marginal operation (from weak tubes, etc), weaknesses become easier to trace at low line voltages.

4-14 SWEEP POTENTIOMETER TRACKING CHECK

No adjustment should normally be needed to maintain sweep potentiometer tracking. If the tracking of the output voltage is doubtful, a test can easily be made as follows:

1. Secure the chassis of the Φ 207A in its case by the two screws provided, in order to obtain a good contact between chassis and case.
 2. Turn on instrument and allow it to warm up for 10 minutes.
 3. Connect a battery to the outside terminals of the binding post strip marked (+) and (-). A 90 volt battery is suggested, as this will give readings greater than 1 volt even at the low end.
- CAUTION: NEVER USE A POTENTIOMETER VOLTAGE GREATER THAN 200-VOLTS. DAMAGE TO THE RESISTORS WILL RESULT.**
4. Connect a very high impedance DC Vacuum Tube Voltmeter from ground terminal marked (-) to center-tap terminal marked (CT). (An Φ Model 410B voltmeter which has 122 megohms input impedance, is suitable.)
 5. Measure and record the voltages when the Φ 207A is set for the following frequencies: 20 cps, 30 cps, 53 cps, 110 cps, 272 cps, 2560 cps, and 20,000 cps.

6. Plot these voltages against frequencies, on semi-log graph paper.

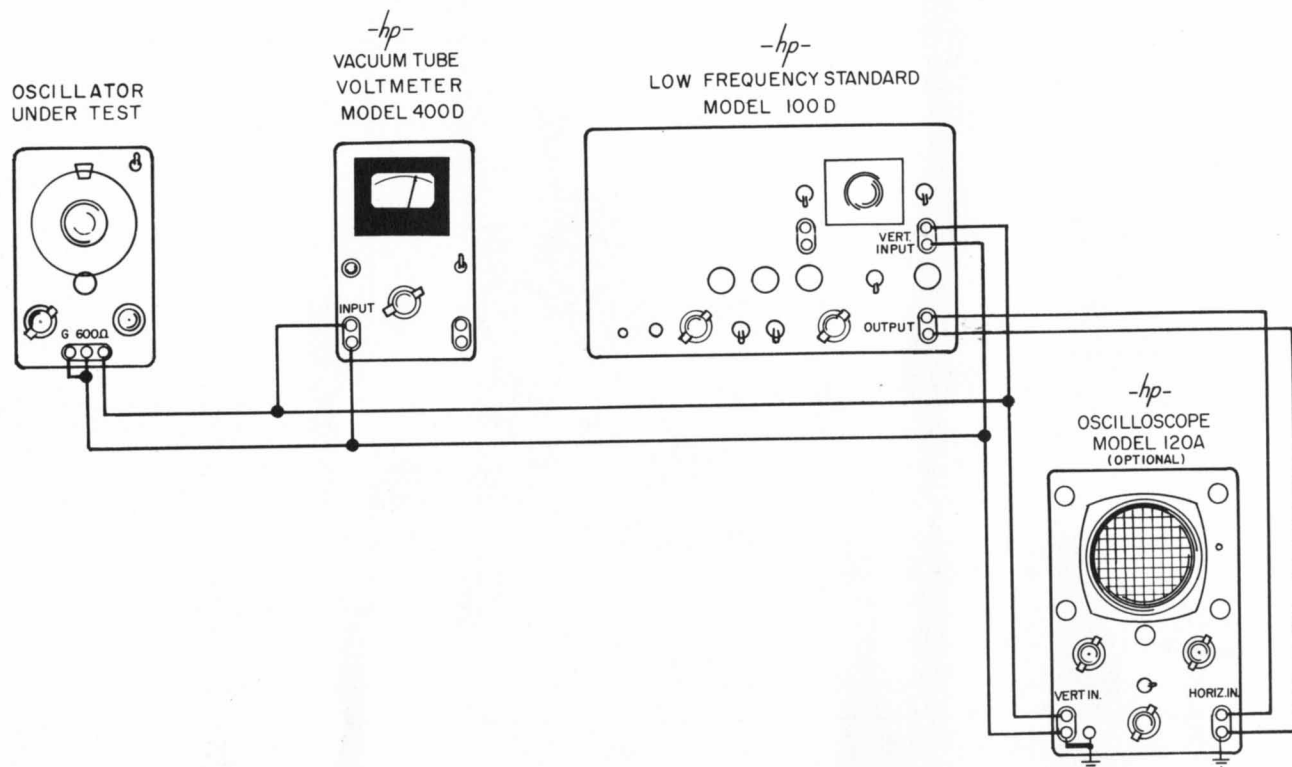
7. Draw a straight line through the 20 cycle and the 20,000 cycle voltage points. If the plotted points deviate from this straight line more than $\pm 5\%$, the loading resistors may be adjusted slightly to bring the curve into tolerance.

TROUBLE SHOOTING CHART

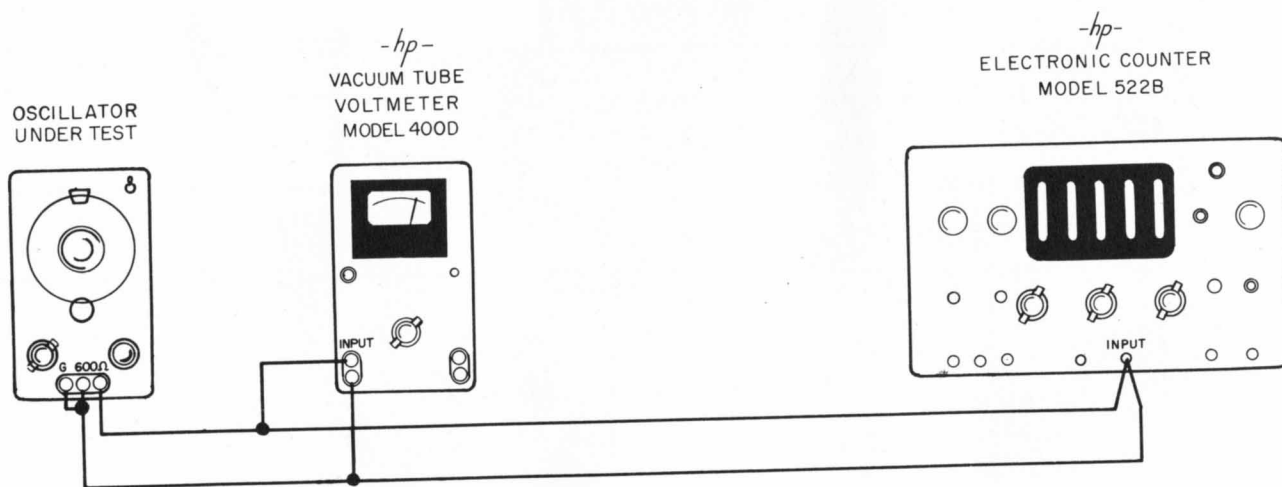
SYMPTOM AND POSSIBLE CAUSE	TEST PROCEDURE	REMEDY
<p>1. Instrument NOT operating, index window NOT lighted.</p> <p>a. Fuse open due to defective fuse or overload in power supply.</p> <p>b. Poor connection to line voltage.</p>	<p>a. Replace fuse. If new fuse blows, remove V5, and replace fuse.</p> <p>(1) Blowing of 2nd fuse indicates:</p> <p>A. Short circuit in wiring associated with T1.</p> <p>B. Short circuit in filament wiring.</p> <p>C. Defective transformer T1.</p> <p>(2) No opening of 2nd fuse with V5 removed indicates:</p> <p>A. Defective rectifier V5.</p> <p>B. Internal short circuit in V1, V2, V3, or V4.</p> <p>C. Short circuit in d-c wiring.</p> <p>D. Defective C21ABC. D-c resistance from pin 8 of V5 to ground normally is approximately 8 megohms, disconnect line voltage before measuring.</p> <p>b. Check power cable, and connections at both ends of cable.</p>	<p>1. a</p> <p>(1)</p> <p>A. Locate and clear short.</p> <p>B. Locate and clear short.</p> <p>C. Replace transformer.</p> <p>(2)</p> <p>A. Replace V5.</p> <p>B. Locate and replace defective tube.</p> <p>C. Locate and clear short.</p> <p>D. If defective, replace C21.</p>
<p>2. Instrument NOT operating; index window lighted.</p> <p>a. Power supply not operating properly.</p> <p>b. Defective tube in oscillator circuit.</p> <p>c. D-c potential applied to tube pins not of proper value.</p>	<p>a. Check level of d-c voltage at power supply output; should be $\pm 215V \pm 10\%$. Use d-c voltmeter, such as Model 410B; connect voltmeter + terminal to terminal 3 or 4 on capacitor C21, and voltmeter - terminal to chassis.</p> <p>If voltmeter indication not $215V \pm 10\%$, check rectifier tube V5, and then other components of power supply.</p> <p>b. Check for bad V1, V2, V3, or V4 by substituting tube of same type known to be good.</p> <p>c. Check d-c voltages on pins of all tube sockets; voltages should be within $\pm 10\%$ of values shown in voltage and resistance diagram and schematic.</p>	<p>a. Replace defective component.</p> <p>b. Replace defective tube. See paragraph 4-3.</p> <p>c. If potential on any pin not correct value, check resistors in power-supply network associated with incorrect potential.</p>
<p>d. Short circuit in fixed capacitor C7, variable capacitor C6, C8 or C14.</p>	<p>d. (1) To check capacitors C8A, C8B, C8C, C6 and C7:</p> <p>A. Disconnect Model -hp- 207A from line.</p> <p>B. Connect one ohmmeter terminal to C8B stator and other to C8 rotor.</p> <p>C. Ohmmeter should indicate > 100 megohms.</p>	<p>d. If resistance measurements indicate short, before making further checks, visually examine C8. If C8, is dirty, gently blow dust from plates with air hose, and then again make resistance measurements.</p>

TROUBLE SHOOTING CHART

SYMPTOM AND POSSIBLE CAUSE	TEST PROCEDURE	REMEDY
e. Capacitor C8 shorted to ground.	<p>(2) To check capacitors C8D and C14:</p> <p>A. Connect one ohmmeter terminal to C8D rotor and other to C7 stator.</p> <p>B. With -hp-207A disconnected from line ohmmeter should indicate > 80 meg-ohms.</p>	e. If resistance measurement indicates short, check for defect in insulation between C8 and instrument chassis.
f. Defective lamp (R16).	<p>e. (1) Connect ohmmeter common to instrument chassis and the other lead to C8D stator, C8ABCD rotors, or C8ABC stators.</p> <p>(2) Resistance to ground is normally: 18K from C8D stator. 80M from C8ABCD rotors. 20M from C8ABC stators.</p> <p>f. See paragraph 4-4.</p>	
3. Distortion in output.		
a. Bad tube in oscillator circuits.	a. See paragraphs 4-3 and 4-8.	
b. Incorrect potentials on tube pins.	b. Check as described in 2a, c above.	
c. Dust on plates of tuning capacitor C8.	c. Inspect visually.	c. With air hose, gently blow out dust.
d. Defective lamp (R16).	d. See paragraph 4-4.	
4. Noise present in output waveform when AMPLITUDE control is rotated; output voltage unstable when AMPLITUDE control is rotated.		
a. Defective AMPLITUDE control (R36).		a. Replace R36 (see paragraph 4-6).



METHOD OF CALIBRATION USING FREQUENCY STANDARD



METHOD OF CALIBRATION USING ELECTRONIC COUNTER

8D-L-988

Figure 4-1 Equipment Arrangement for Calibrating Model 207A.

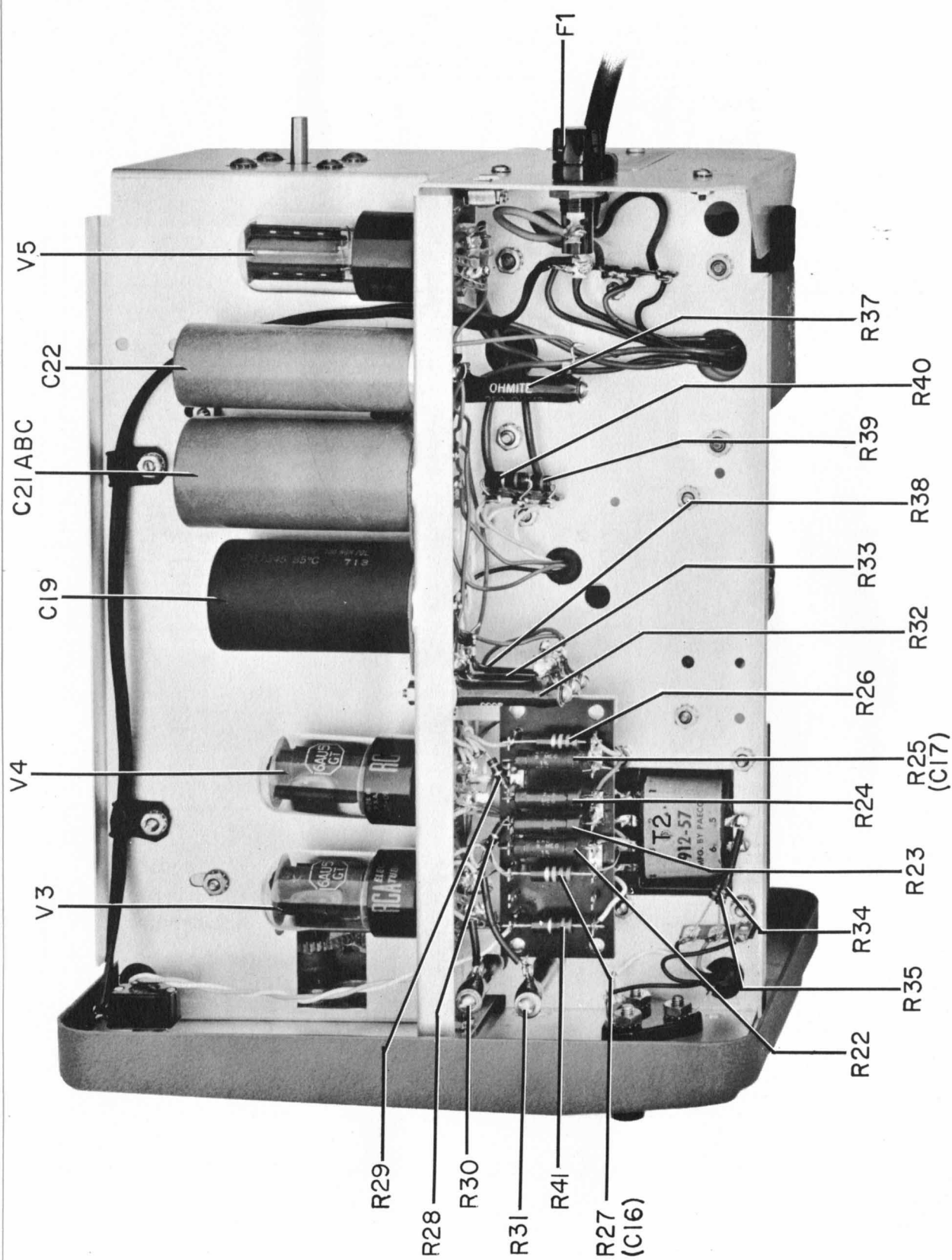


Figure 4-2 Model 207A Right Side View

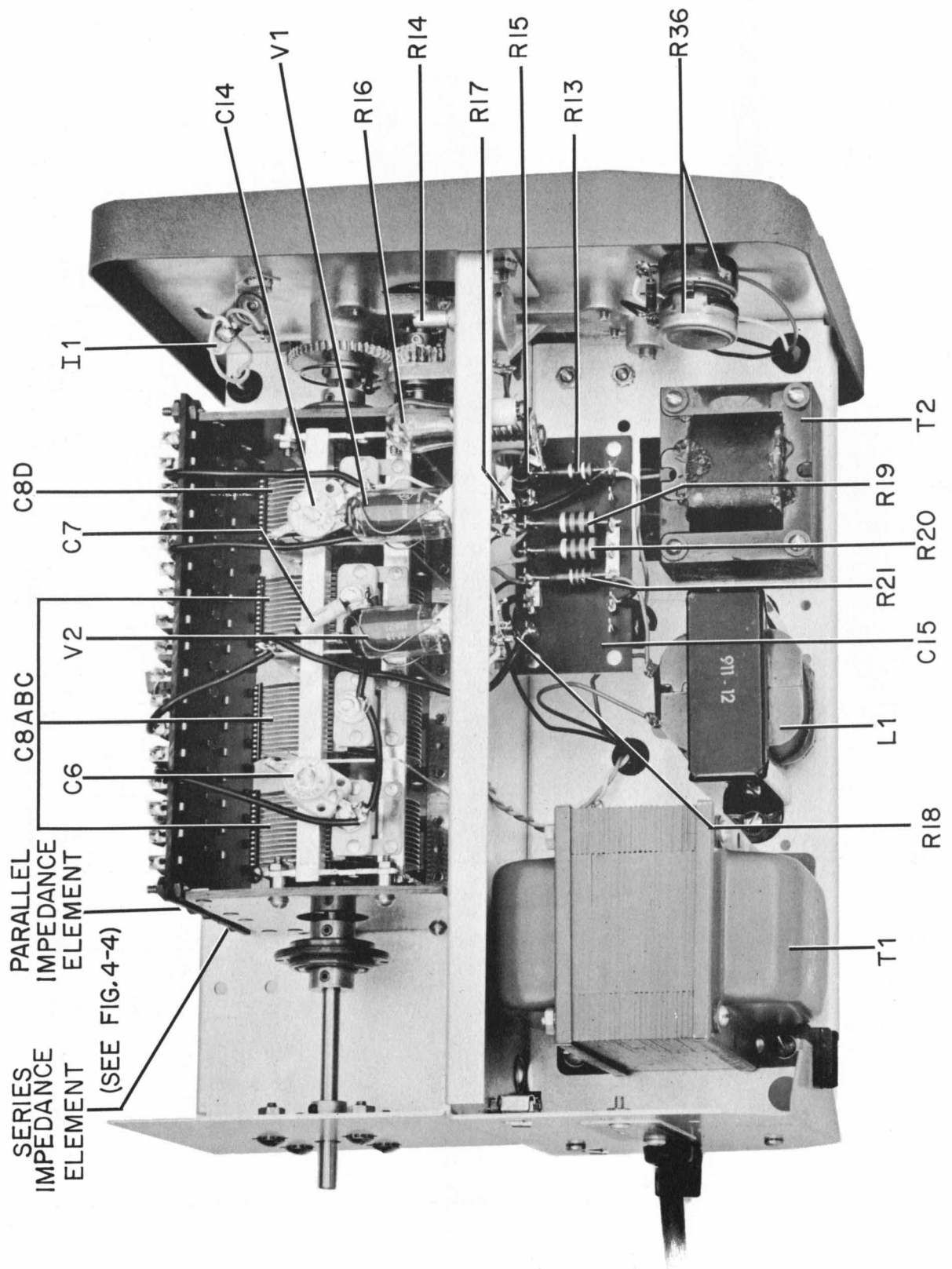


Figure 4-3 Model 207A Left Side View

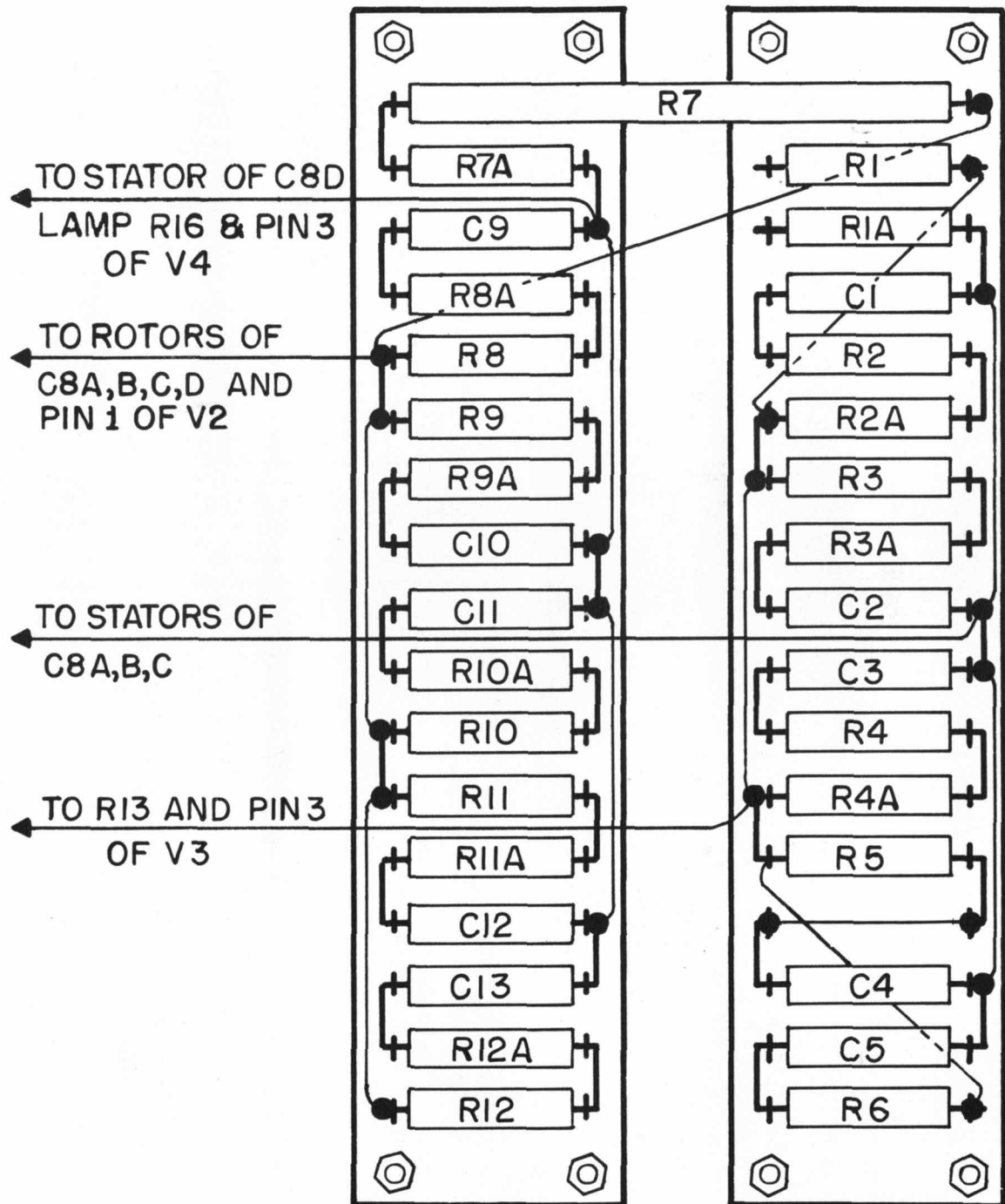


Figure 4-4 Complex Network Resistor Board

207A AUDIO SWEEP OSCILLATOR VOLTAGE-RESISTANCE DIAGRAM (VIEWED FROM BOTTOM OF CHASSIS)

NOTES:

CONDITIONS OF DC VOLTAGE MEASUREMENTS.

1. USE A VACUUM TUBE VOLTMETER TO MAKE MEASUREMENTS.
2. LINE VOLTAGE SHOULD BE 115 VOLTS.
3. SET AMPLITUDE TO ZERO. SET FREQUENCY TO 1KC. MAKE ALL MEASUREMENTS TO CHASSIS UNLESS OTHERWISE NOTED.

CONDITIONS OF RESISTANCE MEASUREMENTS.

1. TURN OFF POWER BEFORE MAKING MEASUREMENTS.
2. MAKE MEASUREMENTS TO GROUND UNLESS OTHERWISE NOTED.
3. DNA INDICATES THAT THIS MEASUREMENT IS IMPRACTICAL DUE TO HIGH CAPACITANCE IN PARALLEL WITH HIGH RESISTANCE TO GROUND.
4. # SHOWN FOLLOWING A RESISTANCE VALUE INDICATES THAT THIS MEASUREMENT SHOULD BE MADE TO PIN 8 OF V5.

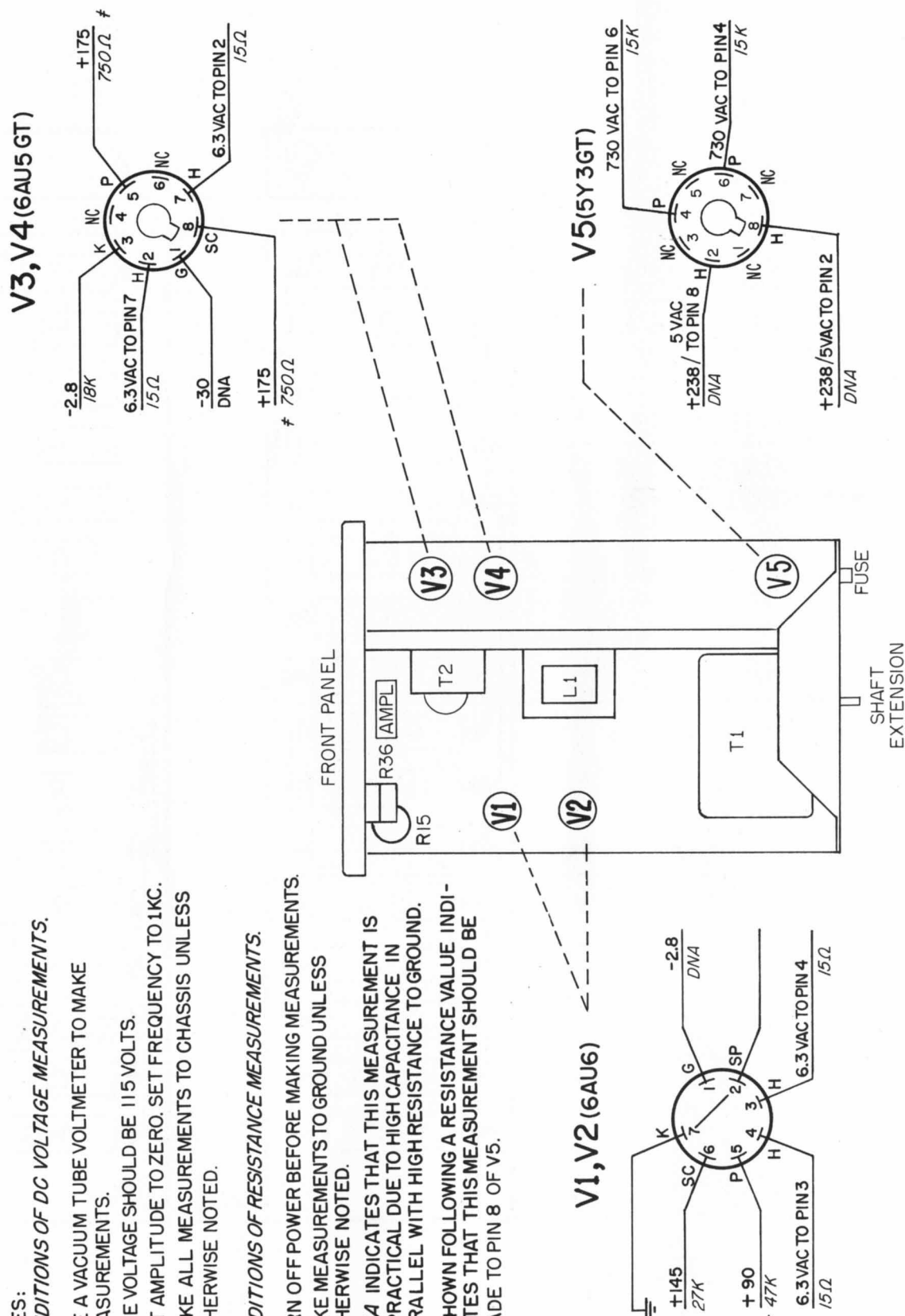
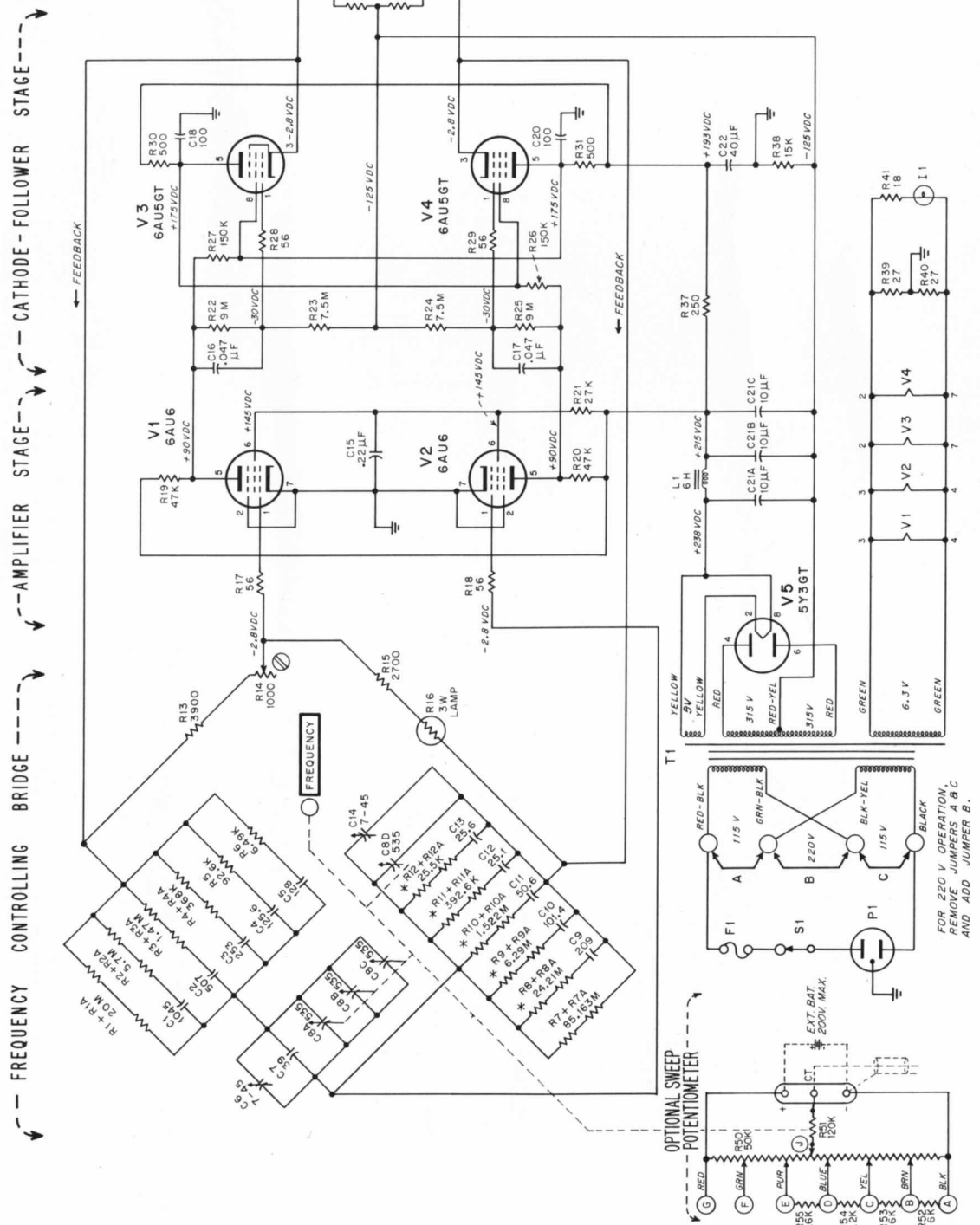


Figure 4-5 207A Voltage and Resistance Diagram



MODEL 207A AUDIO SWEEP OSCILLATOR

SECTION V

TABLE OF REPLACEABLE PARTS

NOTE

Any changes in the Table of Replaceable Parts will be listed on a Production Change sheet at the front of this manual.

When ordering parts from the factory always include the following information:

Instrument Model Number

Serial Number

Ⓢ Stock Number of Part

Description of Part

TABLE OF REPLACEABLE PARTS

CIRCUIT REF.	DESCRIPTION, MFR. * & MFR. DESIGNATION	STOCK NO.	#			
C1 thru 5	Part of special two-terminal network (see paragraph 4-7 for replacement of these components).					
C6	Capacitor: variable, ceramic, 7-45 $\mu\mu\text{f}$, 500 vdcw L*	13-1	2			
C7	Capacitor: fixed, ceramic, 39 $\mu\mu\text{f}$ $\pm 5\%$, 500 vdcw K*	15-4	1			
C8	Capacitor: variable, air, 4 sections, 12.4 $\mu\mu\text{f}$ to 535 $\mu\mu\text{f}$ /sect. HP*	12-38	1			
C9 thru 13	Same as C1					
C14	Same as C6					
C15	Capacitor: fixed, paper, .22 μf $\pm 10\%$, 400 vdcw CC*	16-48	1			
C16, 17	Capacitor: fixed, paper, .047 μf , $\pm 10\%$, 600 vdcw CC*	16-15	2			
C18	Capacitor: fixed, mica, 100 $\mu\mu\text{f}$ $\pm 10\%$, 300 vdcw V*	14-73	2			
C19	Capacitor: fixed, electrolytic, 100 μf , 100 vdcw CC*	18-25HP	1			
C20	Same as C18					
C21	Capacitor: fixed, electrolytic, 3 sections, 10 μf /sect. 450 vdcw CC*	18-31HP	1			
C22	Capacitor: fixed, electrolytic, 40 μf , 450 vdcw CC*	18-40HP	1			
F1	Fuse, cartridge: 1 amp, slow-blow for 115V operation E*	211-18	1			
	Fuse, cartridge: 1/2 amp, slow blow for 230V operation E*	211-20				
I1	Lamp, Incandescent: 6-8V, .15 amp, #47 N*	211-47	1			
L1	Reactor, filter: 6H HP	911-12	1			
P1	Cable, power Elec. Cords Co.	812-56	1			
R1+R1A thru R12+R12A	Part of special two-terminal network (see paragraph 4-7 for replacement of these components).					
R13	Resistor: fixed, composition, 3900 ohms, $\pm 10\%$, 1 W B*	24-3900	1			

* See "List of Manufacturers Code Letters For Replaceable Parts Table".

Total quantity used in the instrument.

TABLE OF REPLACEABLE PARTS

CIRCUIT REF.	DESCRIPTION, MFR. * & MFR. DESIGNATION	STOCK NO.	#			
R14	Resistor: variable, composition, linear taper, 1000 ohms G*	210-51	1			
R15	Resistor: fixed, composition, 2700 ohms $\pm 10\%$, 1 W B*	24-2700	1			
R16	Lamp, incandescent: candelabra base, 3 W, 120V N*	211-4	1			
R17, 18	Resistor: fixed, composition, 56 ohms $\pm 10\%$, 1/2 W B*	23-56	4			
R19, 20	Resistor: fixed, composition, 47,000 ohms $\pm 10\%$, 2 W B*	25-47K	2			
R21	Resistor: fixed, composition, 27,000 ohms $\pm 10\%$, 1 W B*	24-27K	1			
R22	Resistor: fixed, deposited carbon, 9 megohms $\pm 1\%$, 1 W NN*	31-9M	2			
R23, 24	Resistor: fixed, deposited carbon, 7.5 megohms $\pm 1\%$, 1 W NN*	31-7.5M	2			
R25	Same as R22					
R26, 27	Resistor: fixed, composition, 150,000 ohms $\pm 10\%$, 1 W B*	24-150K	2			
R28, 29	Same as R17					
R30, 31	Resistor: fixed, wirewound, 500 ohms $\pm 10\%$, 10 W S*	26-5	2			
R32, 33	Resistor: fixed, wirewound, 3000 ohms $\pm 10\%$, 10 W S*	26-3	2			
R34, 35	Resistor: fixed, composition, 240 ohms $\pm 5\%$, 1/2 W B*	23-240-5	2			
R36	Output Attenuator HP*	200CD-4	1			
R36C, D	Resistor: fixed, composition, 620 ohms $\pm 5\%$, 1/2 W, part of R36 B*	23-620-5	2			
R37	Resistor: fixed, wirewound, 250 ohms $\pm 10\%$, 10 W I*	26-1	1			
R38	Resistor: fixed, wirewound, 15,000 ohms $\pm 10\%$, 10 W S*	26-25	1			
R39, 40	Resistor: fixed, composition, 27 ohms $\pm 10\%$, 1 W B*	24-27	2			
R41	Resistor: fixed, composition, 18 ohms $\pm 10\%$, 1 W B*	24-18	1			
R42 thru R49	These circuit references not assigned					

* See "List of Manufacturers Code Letters For Replaceable Parts Table".

Total quantity used in the instrument.

TABLE OF REPLACEABLE PARTS

CIRCUIT REF.	DESCRIPTION, MFR. * & MFR. DESIGNATION	STOCK NO.	#			
R50	Resistor: variable, wirewound, 50,000 ohms, 4 W HP*	210-201	1			
R51	Resistor: fixed, composition, 120,000 ohms $\pm 10\%$, 1/2 W B*	23-120K	1			
R52, 53	Resistor: fixed, deposited carbon, 6000 ohms $\pm 1\%$, 1/2 W NN*	33-6K	2			
R54	Resistor: fixed, deposited carbon, 13,200 ohms $\pm 1\%$, 1/2 W NN*	33-13.2K	1			
R55	Resistor: fixed, deposited carbon, 31,600 ohms $\pm 1\%$, 1 W NN*	31-31.6K	1			
S1	Switch, toggle: SPST D*	310-11	1			
T1	Transformer, power HP*	910-94	1			
T2	Transformer, audio: output HP*	912-57	1			
V1, 2	Tube, electron: 6AU6 ZZ*	212-6AU6	2			
V3, 4	Tube, electron: 6AU5GT ZZ*	212-6AU5 GT	2			
V5	Tube, electron: 5Y3GT ZZ*	212-5Y3GT	1			
<u>MISCELLANEOUS</u>						
	Binding Post, insulated, black HP*	AC-10C	1			
	Binding Post, insulated, red HP*	AC-10D	2			
	Binding Post Insulator, triple black HP*	AC-54B	1			
	Binding Post Insulator, triple, triangular, black HP*	AC-54C	2			
	Holder, fuse T*	140-16	1			
	Handle, carrying: (cabinet model only) Specialty Lthr Prod	144-5				
	Knob: vernier control HP*	G-74F	1			
	Knob: AMPLITUDE HP*	G-74K	1			
	Knob: frequency dial HP*	G-74Z	1			
	Lampholder: miniature bayonet base AD*	145-9	1			
	Lampholder: for R16 AD*	145-15	1			
	Spring, for vernier drive HP*	146-23	1			
	Vernier drive disc, on shaft HP*	G-14A	1			
	Vernier drive disc HP*	G-14B	1			
	Window: dial index HP*	G-99K	1			

* See "List of Manufacturers Code Letters For Replaceable Parts Table".

Total quantity used in the instrument.

LIST OF CODE LETTERS USED IN TABLE OF REPLACEABLE PARTS TO DESIGNATE THE MANUFACTURERS

CODE LETTER	MANUFACTURER	ADDRESS	CODE LETTER	MANUFACTURER	ADDRESS
A	Aerovox Corp.	New Bedford, Mass.	AK	Hammerlund Mfg. Co., Inc.	New York 1, N. Y.
B	Allen-Bradley Co.	Milwaukee 4, Wis.	AL	Industrial Condenser Corp.	Chicago 18, Ill.
C	Amperite Co.	New York, N. Y.	AM	Insuline Corp. of America	Manchester, N. H.
D	Arrow, Hart & Hegeman	Hartford, Conn.	AN	Jennings Radio Mfg. Corp.	San Jose, Calif.
E	Bussman Manufacturing Co.	St. Louis, Mo.	AO	E. F. Johnson Co.	Waseca, Minn.
F	Carborundum Co.	Niagara Falls, N. Y.	AP	Lenz Electric Mfg. Co.	Chicago 47, Ill.
G	Centralab	Milwaukee 1, Wis.	AQ	Micro-Switch	Freeport, Ill.
H	Cinch-Jones Mfg. Co.	Chicago 24, Ill.	AR	Mechanical Industries Prod. Co.	Akron 8, Ohio
HP	Hewlett-Packard Co.	Palo Alto, Calif.	AS	Model Eng. & Mfg., Inc.	Huntington, Ind.
I	Clarostat Mfg. Co.	Dover, N. H.	AT	The Muter Co.	Chicago 5, Ill.
J	Cornell Dubilier Elec. Co.	South Plainfield, N. J.	AU	Ohmite Mfg. Co.	Skokie, Ill.
K	Hi-Q Division of Aerovox	Olean, N. Y.	AV	Resistance Products Co.	Harrisburg, Pa.
L	Erie Resistor Corp.	Erie 6, Pa.	AW	Radio Condenser Co.	Camden 3, N. J.
M	Fed. Telephone & Radio Corp.	Clifton, N. J.	AX	Shallcross Manufacturing Co.	Collingdale, Pa.
N	General Electric Co.	Schenectady 5, N. Y.	AY	Solar Manufacturing Co.	Los Angeles 58, Calif.
O	General Electric Supply Corp.	San Francisco, Calif.	AZ	Sealectro Corp.	New Rochelle, N. Y.
P	Girard-Hopkins	Oakland, Calif.	BA	Spencer Thermostat	Attleboro, Mass.
Q	Industrial Products Co.	Danbury, Conn.	BC	Stevens Manufacturing Co.	Mansfield, Ohio
R	International Resistance Co.	Philadelphia 8, Pa.	BD	Torrington Manufacturing Co.	Van Nuys, Calif.
S	Lectrohm Inc.	Chicago 20, Ill.	BE	Vector Electronic Co.	Los Angeles 65, Calif.
T	Littlefuse Inc.	Des Plaines, Ill.	BF	Weston Electrical Inst. Corp.	Newark 5, N. J.
U	Maguire Industries Inc.	Greenwich, Conn.	BG	Advance Electric & Relay Co.	Burbank, Calif.
V	Micamold Radio Corp.	Brooklyn 37, N. Y.	BH	E. I. DuPont	San Francisco, Calif.
W	Oak Manufacturing Co.	Chicago 10, Ill.	BI	Electronics Tube Corp.	Philadelphia 18, Pa.
X	P. R. Mallory Co., Inc.	Indianapolis, Ind.	BJ	Aircraft Radio Corp.	Boonton, N. J.
Y	Radio Corp. of America	Harrison, N. J.	BK	Allied Control Co., Inc.	New York 21, N. Y.
Z	Sangamo Electric Co.	Marion, Ill.	BL	Augat Brothers, Inc.	Attleboro, Mass.
AA	Sarkes Tarzian	Bloomington, Ind.	BM	Carter Radio Division	Chicago, Ill.
BB	Signal Indicator Co.	Brooklyn 37, N. Y.	BN	CBS Hytron Radio & Electric	Danvers, Mass.
CC	Sprague Electric Co.	North Adams, Mass.	BO	Chicago Telephone Supply	Elkhart, Ind.
DD	Stackpole Carbon Co.	St. Marys, Pa.	BP	Henry L. Crowley Co., Inc.	West Orange, N. J.
EE	Sylvania Electric Products Co.	Warren, Pa.	BQ	Curtiss-Wright Corp.	Carlstadt, N. J.
FF	Western Electric Co.	New York 5, N. Y.	BR	Allen B. DuMont Labs	Clifton, N. J.
GG	Wilcor Products, Inc.	Cleveland, Ohio	BS	Excel Transformer Co.	Oakland, Calif.
HH	Amphenol	Chicago 50, Ill.	BT	General Radio Co.	Cambridge 39, Mass.
II	Dial Light Co. of America	Brooklyn 37, N. Y.	BU	Hughes Aircraft Co.	Culver City, Calif.
JJ	Leecraft Manufacturing Co.	New York, N. Y.	BV	International Rectifier Corp.	El Segundo, Calif.
KK	Switchcraft, Inc.	Chicago 22, Ill.	BW	James Knights Co.	Sandwich, Ill.
LL	Gremar Manufacturing Co.	Wakefield, Mass.	BX	Mueller Electric Co.	Cleveland, Ohio
MM	Carad Corp.	Redwood City, Calif.	BY	Precision Thermometer & Inst. Co.	Philadelphia 30, Pa.
NN	Electra Manufacturing Co.	Kansas City, Mo.	BZ	Radio Essentials Inc.	Mt. Vernon, N. Y.
OO	Acro Manufacturing Co.	Columbus 16, Ohio	CA	Raytheon Manufacturing Co.	Newton, Mass.
PP	Alliance Manufacturing Co.	Alliance, Ohio	CB	Tung-Sol Lamp Works, Inc.	Newark 4, N. J.
QQ	Arco Electronics, Inc.	New York 13, N. Y.	CD	Varian Associates	Palo Alto, Calif.
RR	Astron Corp.	East Newark, N. J.	CE	Victory Engineering Corp.	Union, N. J.
SS	Axel Brothers Inc.	Long Island City, N. Y.	CF	Weckesser Co.	Chicago 30, Ill.
TT	Belden Manufacturing Co.	Chicago 44, Ill.	CG	Wilco Corporation	Indianapolis, Ind.
UU	Bird Electronics Corp.	Cleveland 14, Ohio	CH	Winchester Electronics, Inc.	Santa Monica, Calif.
VV	Barber Colman Co.	Rockford, Ill.	CI	Malco Tool & Die	Los Angeles 42, Calif.
WW	Bud Radio Inc.	Cleveland 3, Ohio	CJ	Oxford Electric Corp.	Chicago 15, Ill.
XX	Allen D. Cardwell Mfg. Co.	Plainville, Conn.	CK	Camloc-Fastener Corp.	Paramus, N. J.
YY	Cinema Engineering Co.	Burbank, Calif.	CL	George K. Garrett	Philadelphia 34, Pa.
ZZ	Any brand tube meeting RETMA standards.		CM	Union Switch & Signal	Swissvale, Pa.
AB	Corning Glass Works	Corning, N. Y.	CN	Radio Receptor	New York 11, N. Y.
AC	Dale Products, Inc.	Columbus, Neb.	CO	Automatic & Precision Mfg. Co.	Yonkers, N. Y.
AD	The Drake Mfg. Co.	Chicago 22, Ill.	CP	Bassick Co.	Bridgeport 2, Conn.
AE	Elco Corp.	Philadelphia 24, Pa.	CQ	Birnbach Radio Co.	New York 13, N. Y.
AF	Hugh H. Eby Co.	Philadelphia 44, Pa.	CR	Fischer Specialties	Cincinnati 6, Ohio
AG	Thomas A. Edison, Inc.	West Orange, N. J.	CS	Telefunken (c/o MYM, Inc.)	New York, N. Y.
AH	Fansteel Metallurgical Corp.	North Chicago, Ill.	CT	Potter-Brumfield Co.	Princeton, Ind.
AI	General Ceramics & Steatite Corp.	Keasbey, N. J.	CU	Cannon Electric Co.	Los Angeles, Calif.
AJ	The Gudeman Co.	Sunnyvale, Calif.	CV	Dynac, Inc.	Palo Alto, Calif.
			CW	Good-All Electric Mfg. Co.	Ogallala, Nebr.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY

Hewlett-Packard Company warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Klystron tubes as well as other electron tubes, fuses and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.
2. On receipt of shipping instructions, forward the instrument prepaid, to the factory or to the authorized repair station indicated on the instructions. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

SHIPPING

All shipments of Hewlett-Packard instruments should be made via Truck or Railway Express. The instruments should be packed in a strong exterior container and surrounded by two or three inches of excelsior or similar shock-absorbing material.

DO NOT HESITATE TO CALL ON US

HEWLETT-PACKARD COMPANY

Laboratory Instruments / *for Speed and Accuracy*

275 PAGE MILL ROAD

CABLE



PALO ALTO, CALIF. U.S.A.

"HEWPACK"



MANUAL CHANGES

MODEL 207A

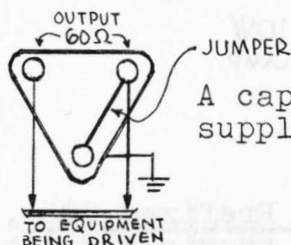
AUDIO SWEEP OSCILLATOR

ERRATA:

In Section II page 2, Unbalanced Operation should read:

To operate a cabinet type instrument with one side grounded, the captive jumper strap should be placed between the \equiv (black) terminal and the right hand 600-ohm terminal as shown below:

CABINET MODEL
ONLY



A captive jumper strap is supplied with each instrument.

-NOTE-

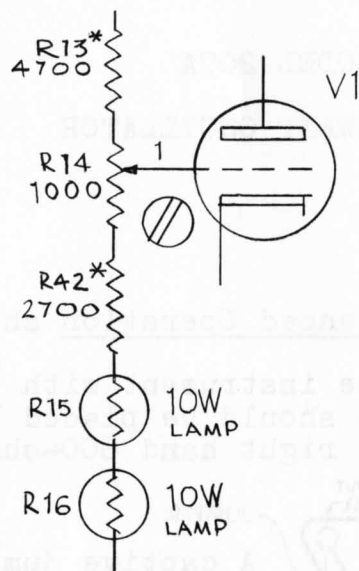
If the cabinet Model 207A is being used to supply an unbalanced output, always connect the right hand 600-ohm terminal to ground. The right hand terminal is connected to the common side of the bridged "T" attenuator. Proper operation cannot be obtained if the ground is connected at the other terminal.

Rack mounted instruments have three terminals in line. The ground strapping for this type is correct in the manual.

Serial 237 and above:

- R13: change to resistor, fixed, composition, 4700 ohms $\pm 10\%$, 1 W; -hp- Stock No. 24-4700, Mfr., B, "Electrical value adjusted at the factory."
- R15, change to lamp, incandescent, 10 W, 250 V, candelabra
- 16: base; -hp- Stock No. 211-29, Mfr., N
- R17: delete
- R42: Add resistor, fixed, composition, 2700 ohms $\pm 10\%$, 1 W; -hp- Stock No. 24-2700, Mfr., B "Electrical value adjusted at the factory."

(over)



ADDENDUM:

For instruments with Serials Prefixed 006-, include the following changes in addition to those previously listed.

- MISC.: Gear, frequency drive, large driving; -hp- Stock No. G-36H, Mfr., HP
- Gear, frequency drive, large spring loading; -hp- Stock No. G-249, Mfr., HP
- Gear, frequency drive, spur; -hp- Stock No. G-24E, Mfr., HP