



OPERATING AND SERVICE MANUAL

**MODELS  
200A AND 200B**

ALL SERIAL NUMBERS

**AUDIO OSCILLATORS**

Copyright HEWLETT-PACKARD COMPANY 1961  
1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.



Printed: FEB

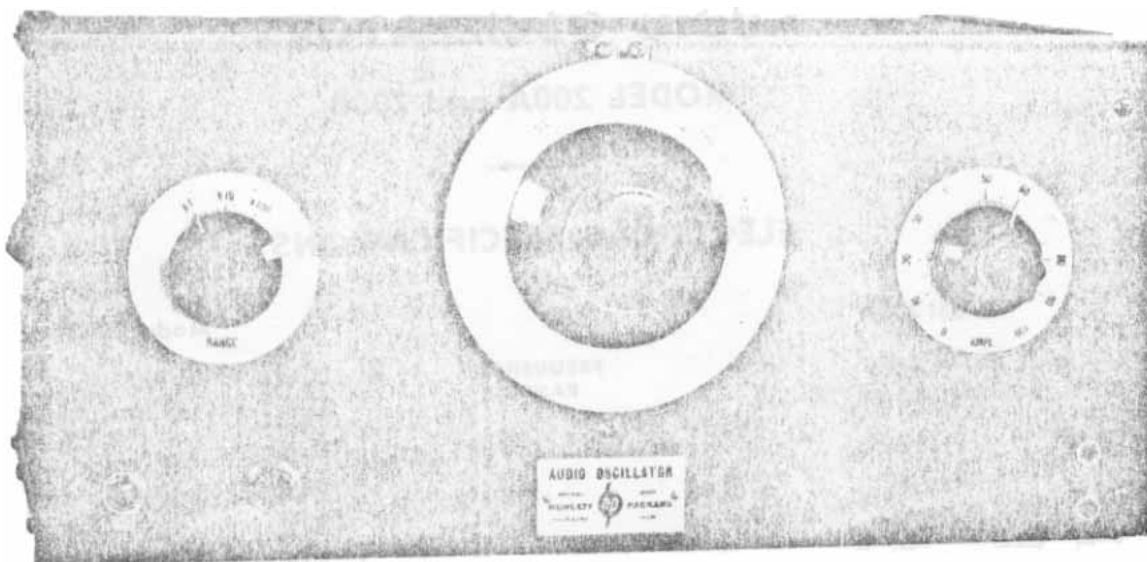
This manual is supplied for use with both the 200A and 200B Audio Oscillators having any serial number below about 41,000. In oscillators with very low serial numbers the values of a few of the parts differ from the values given in the parts list and schematic diagram, for example:

In oscillators with very low serial numbers, C16, R29 and R30 were omitted; C11 was connected directly across B+. The newer arrangement is recommended to reduce the peak voltage across electrolytic capacitors during turn-on.

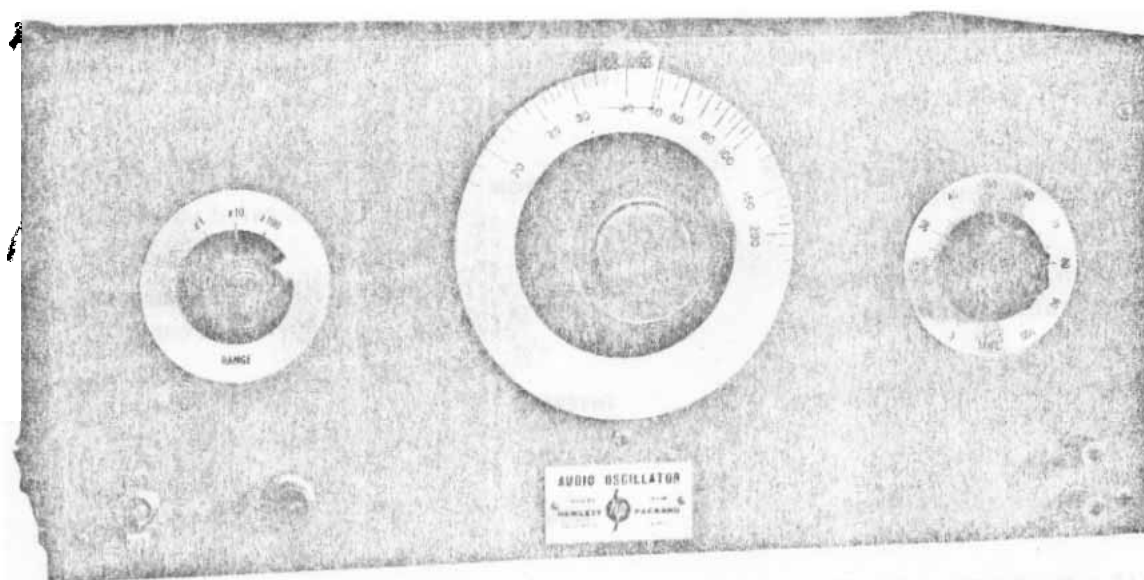
Types 5V4, 5Z4 and 5Y3 rectifier tubes have been used for V5. The 5Y3 supplies about 50 vdc less B+ than the 5V4 and 5Z4. The frequency dial should be calibrated with the rectifier tube that is to be used to prevent any small error due to a change in B+ volts.

The values of R14, R17, R19 and R24 have been adjusted over small ranges to accommodate component part characteristics at various times. R17 and R19 were often 15 k, and R14 and R24 were sometimes up to 250 ohms below the value shown on the schematic diagram. When replacing parts try to use exactly the same value. If the value must be changed check the distortion in the output waveform at maximum output voltage into rated load, over as wide a frequency range as possible.

The appearance of the bottom of the chassis may differ from the views in this manual due to minor relocation of a few parts. Two different versions are shown which represent almost all models of the 200A and 200B.



Panel View of Model 200A



Panel View Model 200B

—hp—  
**AUDIO OSCILLATORS**

**MODEL 200A and 200B**

**ELECTRICAL SPECIFICATIONS**

Model 200A		Model 200B
35 cps — 35,000 cps. Main dial calibration, 35-350. Range X1 35-350 cps. X10 350-3500 cps. X100 3500-35,000 cps.	<b>FREQUENCY RANGE</b>	20 cps — 20,000 cps. Main dial calibration, 20-200. Range X1 20-200 cps. X10 200-2000 cps. X100 2000-20,000 cps.
Within 2%.	<b>CALIBRATION ACCURACY</b>	Within 2%
1 watt into 500 ohms.	<b>POWER OUTPUT</b>	1 watt into 500 ohms.
500 ohms.	<b>RATED LOAD</b>	500 ohms.
Within $\pm 1$ db from 35 cps to 15 kc.	<b>FREQUENCY RESPONSE</b>	Within $\pm 1$ db from 20 cps to 15 kc.
Less than 1% from 35 cps to 15 kc at rated output.	<b>DISTORTION</b>	Less than 1% from 35 cps to 15 kc at rated output.
Within $\pm 2\%$ under normal temperature conditions.	<b>FREQUENCY STABILITY</b>	Within $\pm 2\%$ under normal temperature conditions.
Approximately 75 ohms below 15 kc.	<b>INTERNAL IMPEDANCE</b>	Approximately 75 ohms below 15 kc.
60 db below rated output.	<b>HUM</b>	60 db below rated output
115 volts, 50-60 cycles, 60 watts.	<b>POWER SUPPLY</b>	115 volts, 50-60 cycles, 60 watts.

# **-hp- MODEL 200A and 200B**

## **AUDIO OSCILLATORS**

### **OPERATING INSTRUCTIONS**

#### **General**

-hp- Model 200A and 200B Audio Oscillators differ only in their frequency range and in the values of some of the circuit components. Physically and in appearance the two instruments are the same. This instruction manual therefore covers the operation and maintenance of both instruments. In this manual the term "Model 200" is used collectively, referring to both the Model 200A and 200B.

When this instrument is first received from the factory, it is desirable to make a thorough inspection for possible damage in transit. If any such damage is found, the procedure at the back of this manual should be followed.

#### **Circuit Description**

The circuit of the Models 200A and 200B, shown on page 8, can be divided into the oscillator, amplifier, and power supply sections.

The oscillator section includes T1 and T2 and is known as a resistance-tuned oscillator. Basically, this oscillator is a two-stage resistance-coupled amplifier which is caused to oscillate by the use of a positive-feedback network. This network is a frequency-selective resistance-capacity combination which controls the frequency of oscillation. By using a variable tuning condenser for the capacity of the network it is possible to tune the oscillator over a wide range; and by using a switching arrangement to select different values of resistance for the network several ranges are given to the oscillator.

Negative feedback is also used in the oscillator section in order to minimize distortion and to obtain highest stability. The amount of negative feedback is determined by a resistance network, one element of which is non-linear (the 3-watt lamp R7). This element controls the amount of feedback in accordance with the amplitude of oscillation and consequently maintains the proper operating point for the system. It is noteworthy that this element

has sufficient thermal inertia so that it functions well even at low audio frequencies.

Following the oscillator section is the amplifier, a conventional audio power amplifier with transformer-coupled output. Negative feedback is used in this amplifier to minimize distortion and to provide good frequency response. The amplifier is designed to deliver one watt of power into a 500-ohm resistive load over the major portion of the frequency range.

The internal impedance of the output system is quite low, approximately 75 ohms, and for this reason the output voltage is not critical with load resistance. Although rated load for the instrument is 500 ohms, loads of 600 ohms can be used with only a small loss in available power.

The power supply section includes a conventional full-wave rectifier with a low-pass pi filter for removing the ac components from the rectified wave.

#### **Operation**

Plug the instrument into a nominal 115-volt, 50/60 cycle power supply and turn on the power switch. The instrument will begin to operate in a minute or two, but for maximum accuracy a warm-up period of 20 to 30 minutes is desirable.

Only three controls are necessary for the operation of the Model 200A or 200B. These are the RANGE switch at the left of the front panel, the frequency control dial in the center of the panel, and the AMPL control at the right of the panel.

Selection of a desired frequency is made by the frequency control dial in conjunction with the RANGE switch. The frequency control dial is calibrated directly in cycles per second for the lowest range, the x1 range of the RANGE switch. The other two positions of the RANGE switch multiply the frequency dial calibration by the indicated factors of "10" and "100", respectively. Thus, to select a desired frequency, set the frequency dial and RANGE switch so that the product of their read-

ings equals the desired frequency. For example, if it is desired to select 400 cps, set the frequency dial to "40" and the RANGE switch to "x10".

The magnitude of the output voltage is determined by the setting of the AMPL control. By means of this control voltages up to approximately 25 volts can be selected when the instrument is working into its rated load.

Rated load for both the Model 200A and 200B is 500 ohms resistive. Higher loads can be used but result in a corresponding loss of power. Lower loads are not recommended because they cause an increase in distortion and a reduction in the output voltage. However, no damage to the instrument will occur through the use of loads of less than 500 ohms.

## MAINTENANCE

### Tube Replacement

When replacing any of the tubes except the power rectifier, it is desirable to measure the distortion in the output of the instrument because a poor tube can cause excessive distortion without otherwise affecting the operation. Distortion should be less than 1% at frequencies between 35 cps and 15 kc.

### Replacement of Lamp R7

If the 3-watt lamp (R7) should require replacement, it is necessary for proper operation to check the ac voltage between the junction of C4-R19 and ground with the new lamp in the circuit. As measured with a high-impedance (1 megohm or more) ac vacuum tube voltmeter, this voltage should be within the range of approximately 20-22 volts. If the voltage is not within this range, it may be corrected by changing the value of R11. Increasing the value of this resistor will cause an increase in the subject voltage, while decreasing the value will decrease the voltage. A change of 50 ohms will change the voltage about 1 volt. If it is necessary to use a resistor of more than 820 ohms, reject the lamp in favor of another. The design of the circuit is such that not more than an 820-ohm composition resistor should be used.

### Frequency Calibration

If a change occurs in the frequency calibration after a long period of use, the cause of this change probably lies in the aging of the frequency-determining resistors in the oscillator positive feedback network. These resistors each consist of a precision resistor in series with a small one-half watt resistor which is selected to give a very accurate frequency calibration. Therefore, adjusting the frequency calibration requires that the value of these small resistors be changed as necessary to obtain proper calibration.

An oscilloscope, an ac vacuum tube voltmeter, and a secondary frequency standard are needed to adjust the calibration of the Model 200. The secondary standard preferably should supply a frequency of 1 kc. Allow the Model 200 to heat for thirty minutes or more. Connect the Model 200 to the vertical deflecting plate input of the oscilloscope and the secondary frequency standard to the horizontal deflecting plate input.

Next check the calibration of the Model 200 by means of Lissajous figures on the oscilloscope; determine whether the frequencies generated by the Model 200 are higher or lower than the dial calibration. If the instrument is in need of recalibration, the dial calibration will show a definite trend either higher or lower than the true output frequency for each range. The various ranges of the Model 200 do not necessarily change in the same "direction".

If the x1 range requires readjusting, change the small resistors in series with R1 and R4. If the output frequency is higher than the dial calibration, increase the value of the small resistor; if the output frequency is lower than the dial calibration, decrease the value of the small resistor. A change of about 100,000 ohms will change the calibration about 1%. Do not change the value of R1 more than 100,000 ohms without making a corresponding change in R4. It is desirable to keep the value of R1 and R4 as equal as possible, because the oscillator tends to become unstable if the resistors are too unbalanced. After each change it is necessary to replace the dust cover before checking the output frequency.

The same procedure should be used if necessary to adjust the calibration of the x10 and x100 ranges. On the x10 range a change greater than 10,000 ohms should not be made in R2 without also changing R5. On the x100 range a change greater than 1000 ohms should not be made in R3 without also changing R6.

It is important that the dust cover be tightly in place after each adjustment, because the frequency calibration is affected by the dust cover.

The vacuum tube voltmeter should be used to check the output of the instrument after the calibration has been adjusted. Set the dial to "100" and the AMPL control to about "80". Connect the VTVM and measure the output of each range. If the range switch has been properly adjusted, the difference between the output of the three ranges with the dial set at "100" should be within 1 db, preferably less.

#### **Trimmer Condensers**

Two trimmer condensers are provided for the main tuning condenser. These trimmers are adjusted at the factory and do not require further adjustment for the life of the equipment. If the trimmers inadvertently become misadjusted directions for resetting should be requested of -hp-.

#### **Intermittent Output**

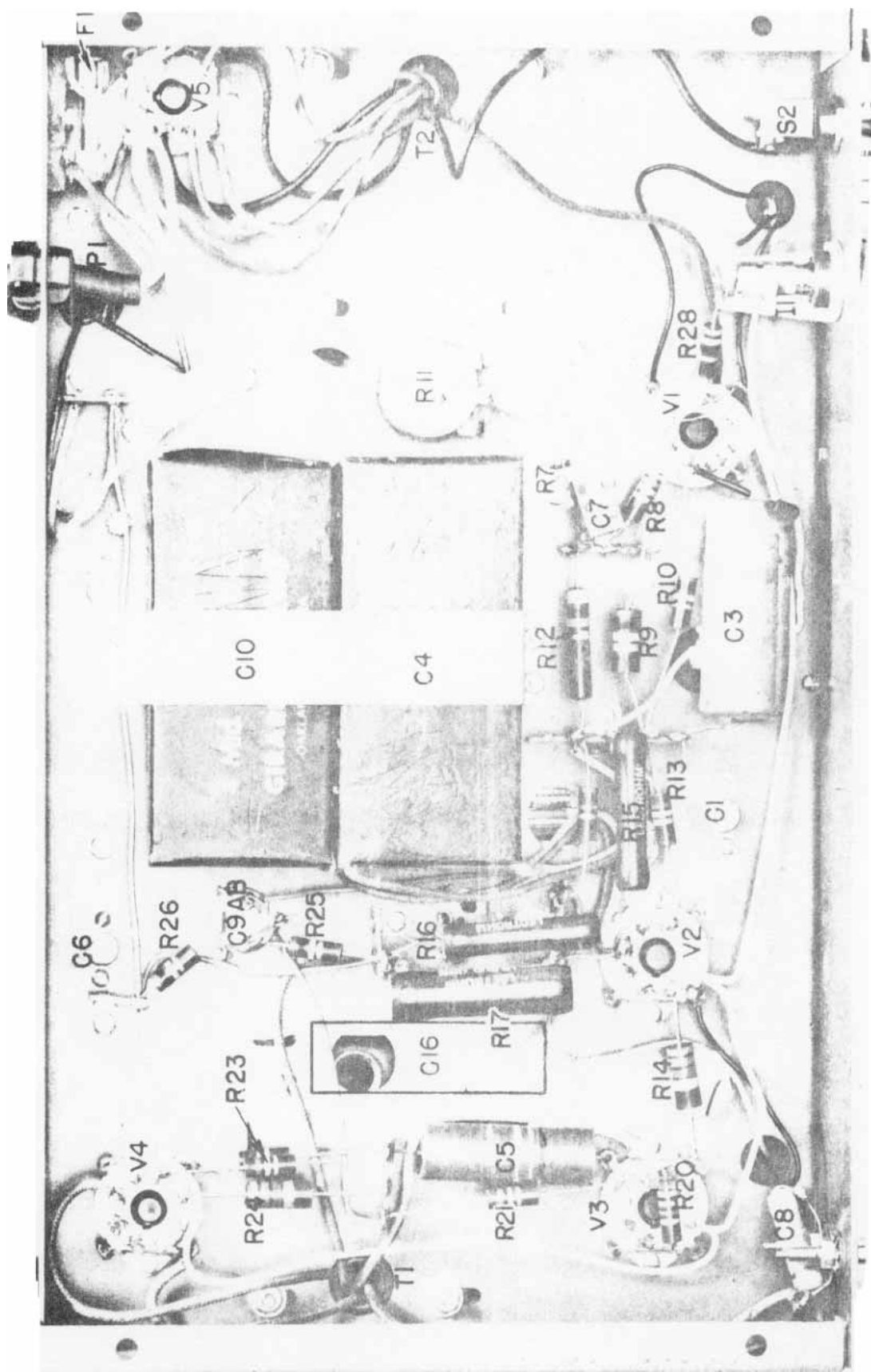
Jumpy or intermittent output accompanied by flashing of the 3-watt oscillator lamp is a reliable

indication of a short in trimmer condenser C1 or in the first two sections of the main tuning condenser. If these symptoms occur, search out and clear the short with a weak air jet or other means. Do not bend the condenser plates as this affects frequency calibration.

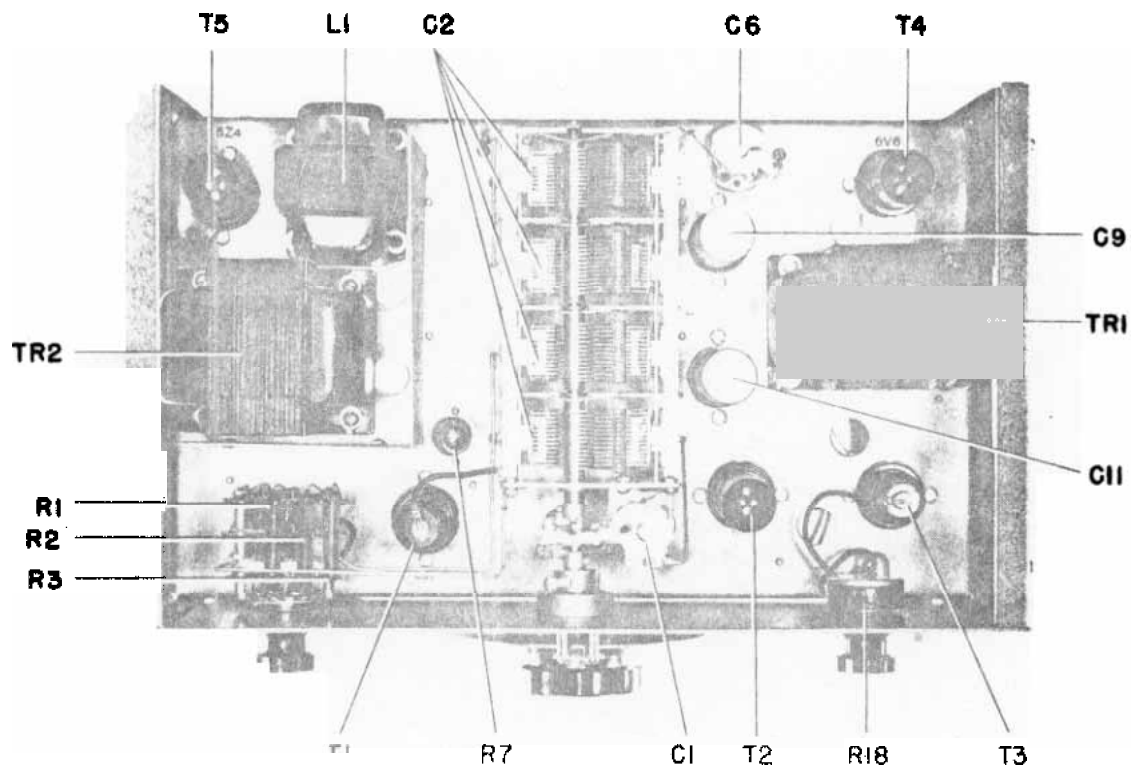
#### **Dial Coupler**

An insulated coupler connects the main tuning dial to the shaft of the main tuning condenser. If the coupler becomes loosened, rotate the condenser completely clockwise. To do this it will be necessary to loosen the collar of the stop on the rear of the panel bearing. When the condenser is completely closed, set the main tuning dial so that the dot to the left of "20" on the main tuning dial is exactly under the hairline. Tighten the coupler with the tuning dial and tuning condenser in these relative positions. Then tighten the collar of the stop so that the tuning condenser rotor cannot strike the frame or stator.

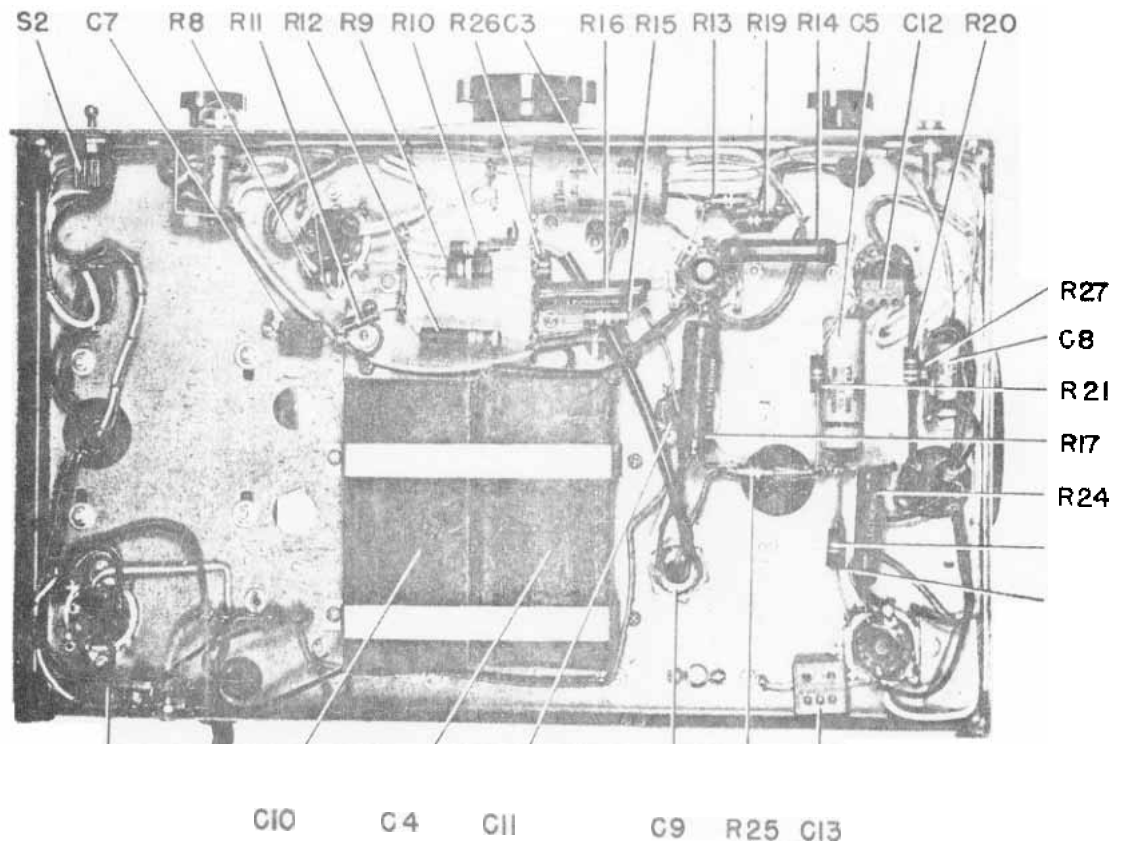
After the coupler has been tightened and the dust cover replaced, it is desirable to check the calibration of the instrument.



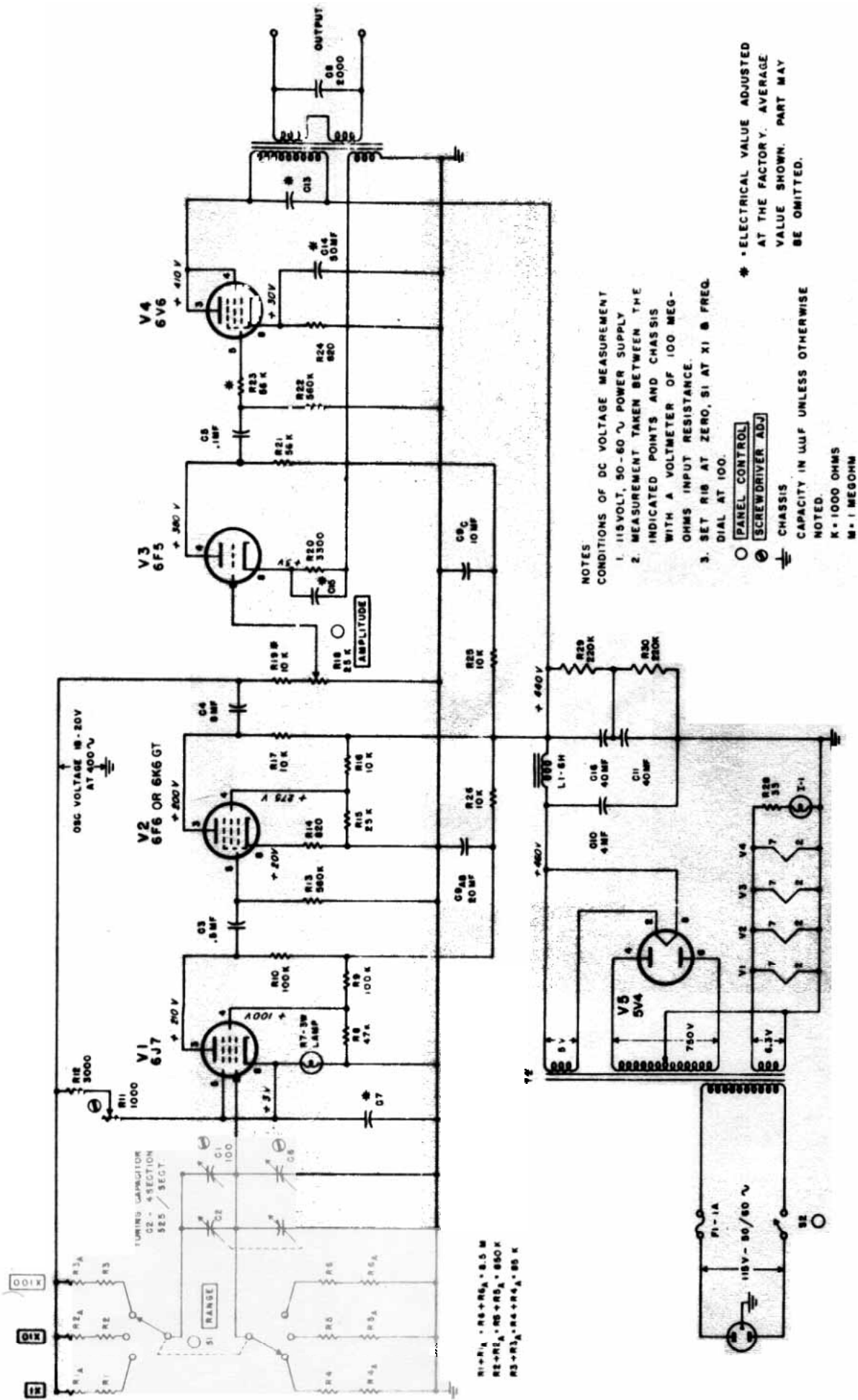
Model 200A Bottom View



**Top View of Deckplate— Models 200A and 200B**



**Bottom View of Deckplate—Models 200A and 200B**



SCHEMATIC DIAGRAM OF MODEL 200 B  
AUDIO OSCILLATOR

# TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	hp Stock No.	Mfr. & Type
C1	CAPACITOR: air trimmer; 100 mmf max	13-100A	Sarkes-Tarzian: A-103L
C2	CAPACITOR: variable; 4 sections each 530 mmf max	12-1500	Oak Mfg. Co.: 890C-4-60
C3	CAPACITOR: paper; 0.5 mf, 600 vdcw	16-5	Aerovox: 684
C4	CAPACITOR: paper; 2 sections each 4 mf, 600 vdcw	17-44	Girard-Hopkins: P-8-8
C5	CAPACITOR: paper; 0.1 mf, 600 vdcw	16-1	Aerovox: 684
C6	CAPACITOR: air trimmer; 100 mmf max (200A only)	13-100A	Sarkes-Tarzian: A-103L
C6	CAPACITOR: air trimmer; 25 mmf max (200B only)	13-25AS	Sarkes-Tarzian: 0-25L
C7	CAPACITOR: mica; 500 vdcw; value selected during factory adjustment		
C8	CAPACITOR: paper; 600 vdcw; value selected during factory adjustment; sometimes omitted		
C9	CAPACITOR: electrolytic; 3 sections, each 10 mf, 450 vdcw	18-310	Mallory: FPT-389
C10	CAPACITOR: paper; 4 mf, 800 vdcw	17-4-800	Girard-Hopkins: P-8-4
C11	CAPACITOR: electrolytic; 40 mf, 450 vdcw	18-40	Mallory: FPS-146
C12 & C13	CAPACITOR: mica; 500 vdcw; value selected during factory adjustment; sometimes omitted		
F1	FUSE: cartridge type, size 3AG; 1 amp	211-1	Littelfuse: 1040
I1	PILOT LAMP: 6-8v; min bay base	211-47	General Elec.: 47
L1	FILTER CHOKE: 6 henries at 125 ma dc	911-12A	Hadley: 8169A
R1-6 & S1	RANGE SWITCH ASSEMBLY	200A: A-19W 200B: B-19W	Hewlett-Packard
R7	LAMP: 3-W, 120v	211-3W	General Elec.: S6-3 watt
R8	RESISTOR: composition; 47,000 ohms; 1 watt	24-47K	Allen-Bradley: GB-4731
R9	RESISTOR: composition; 0.1 megohm; 2 watts	25-100K	Allen-Bradley: HB-1011
R10	RESISTOR: composition; 0.1 megohm; 1 watt	24-100K	Allen-Bradley: GB-1011
R11	RESISTOR: composition; 1 watt; value selected during factory adjustment; value does not exceed 820 ohms		
R12	RESISTOR: wirewound; 3,000 ohms; 1 watt	26-3K	IRC: BW-1
R13	RESISTOR: composition; 0.56 megohm; 1 watt	24-560K	Allen-Bradley: GB-5641
R14	RESISTOR: wirewound; 800 ohms; 10 watts	26-800	Lectrohm: 1½ E
R15	RESISTOR: composition; 27,000 ohms; 2 watts	25-27K	Allen-Bradley: HB-2731
R16	RESISTOR: wirewound; 10,000 ohms; 10 watts	26-10K	Lectrohm: 1½ E
R17	RESISTOR: wirewound; 10,000 ohms; 20 watts	27-10K	Lectrohm: 2R
R18	POTENTIOMETER: composition; 25,000 ohms	210-25K	Centralab: 1-010-1670
R19	RESISTOR: composition; 10,000 ohms; 1 watt	24-10K	Allen-Bradley: GB-1031
R20	RESISTOR: composition; 3,300 ohms; 1 watt	24-3300	Allen-Bradley: GB-3321

# TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	hp Stock No.	Mfr. & Type
R21	RESISTOR: composition; 56,000 ohms; 1 watt	24-56K	Allen-Bradley: GB-5631
R22	RESISTOR: composition; 0.56 megohm; 1 watt	24-560K	Allen-Bradley: GB-5641
R23	RESISTOR: composition; 56,000 ohms; 1 watt	24-56K	Allen-Bradley: GB-5631
R24	RESISTOR: wirewound; 800 ohms; 10 watts	26-800	Lectrohm: 1 1/4 E
R25	RESISTOR: composition; 10,000 ohms; 1 watt	24-10K	Allen-Bradley: GB-1031
R26	RESISTOR: composition; 10,000 ohms; 1 watt	24-10K	Allen-Bradley: GB-1031
R27	RESISTOR: composition; 1/2 watt; value selected during factory adjustment; sometimes omitted		
S2	SWITCH: toggle; SPST	310-11	Arrow-H & H: 20994
T1	TUBE: RMA type 6J7	212-6J7	
T2	TUBE: RMA type 6F6	212-6F6	
T3	TUBE: RMA type 6F5	212-6F5	
T4	TUBE: RMA type 6V6	212-6V6	
T5	TUBE: RMA type 5Z4	212-5Z4	
TR1	OUTPUT TRANSFORMER (for Model 200A only)	A-9	Peerless: 0021A
TR1	OUTPUT TRANSFORMER (for Model 200B only)	B-9	Peerless: 0021A
TR2	POWER TRANSFORMER	910-200	Hadley: 8158A
	KNOB: molded black phenolic; 1 1/2" diam.	37-112	Kurz-Kasch: S-380-64-L
	KNOB: molded black phenolic; 3" diam.	37-3	Kurz-Kasch: S-312-64
	TUBE SOCKET: standard oct: 1	38-8	Cinch: 9950
	LAMPHOLDER: for 3-watt lamp	M-1	Hewlett-Packard: M-1