OPERATING AND SERVICING MANUAL

MODEL 200AB/ABR
AUDIO OSCILLATOR

SERIALS PREFIXED: 008 -

SPECIFICATIONS

FREQUENCY RANGE:	20 cps to 40 kc.
BANDS:	X1 20 cps to 200 cps X10 200 cps to 2 kc X100 2 kc to 20 kc X200 4 kc to 40 kc
CALIBRATION ACCURACY:	±2% including calibration error, warm-up, and changes due to aging of tubes and components.
FREQUENCY DIAL:	Six inch diameter, calibrated over 300° of arc. 72 divisions. Total scale length, 63 inches. Vernier control for precise setting.
FREQUENCY RESPONSE:	±1 db entire frequency range when working into rated load (reference 1 kc).
FREQUENCY STABILITY:	Line voltage variations of ±10% cause negligible shift in output frequency.
POWER OUTPUT:	1 watt or 24.5 volts into a 600 ohm load.
DISTORTION:	Less than 1%, 20 cps to 20 kc; less than 2%, 20 kc to 40 kc when working into rated load or higher impedance. 0.15% @ 400 Hz +8dbm 1/74
INTERNAL IMPEDANCE:	Approximately 75 ohms from 20 cps to 20 kc. Output is balanced to ground over entire frequency range (may be operated one side grounded, if desired).
HUM AND NOISE:	At least 66 db below rated output (less than 0.05% of rated output).
POWER SUPPLY:	115/230 volts, 50/1000 cps, 70 watts.
DIMENSIONS:	Cabinet: 7-3/8" wide, 11-1/2" high, 12" deep. Rack: 19" wide, 7" high, 11" deep behind panel.
WEIGHT:	Cabinet: 15 lbs., shipping 20 lbs. Rack: 19 lbs., shipping 30 lbs.

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FOR

MODEL 200AB AUDIO OSCILLATOR

SECTION I
GENERAL DESCRIPTION

1-1 GENERAL

The Model 200AB Audio Oscillator is designed for general purpose audio testing and measurements. The resistance-capacity oscillator used in this instrument will retain its high degree of accuracy for long periods of time with no adjustment. The push-pull output amplifier used in the Model 200AB has a large amount of overall negative feedback for maximum stability and low distortion. The output impedance of the instrument is 600 ohms balanced or unbalanced. The output voltage is adjustable from 0 to 24.5 volts (1 watt) across a 600 ohm resistive load over the full range of 20 to 40,000 cycles/second, and is sufficient for modulating signal generators or other applications that require considerable power.

1-2 INSPECTION

After the instrument is unpacked, it should be carefully checked for damage received in transit. If any shipping damage is found, follow the procedure outlined in the "Claim for Damage in Shipment" section on the last page of this instruction book.

1-3 POWER SOURCE VOLTAGE

The 200AB, like other ℌ instruments, is shipped from the factory with the power transformer dual primary windings connected for operation from a 115 volt a-c source unless otherwise specified on the order. If operation from a 230 volt a-c source is desired, the transformer primary windings can be quickly reconnected. Refer to Section IV, paragraph 4-6 for details.

1-4 POWER CABLE

The three-conductor power cable supplied with this instrument is terminated in a polarized three-prong male connector recommended by the National Electrical Manufacturers' Association. The third contact is an offset round pin added to a standard two-blade connector which grounds the instrument chassis when used with an appropriate receptacle. To use this connector with a standard two-contact receptacle, an adapter should be used to connect the NEMA connector to the two-contact system. When the adapter is used, the third contact is terminated in a short lead from the adapter which can then be connected to a suitable ground.

SECTION II
OPERATING INSTRUCTIONS

2-1 CONTROLS AND TERMINALS

ON
This toggle switch controls the power supplied to the instrument from the power line. When the instrument is turned on, a glow will be visible through the plastic frequency dial index.

RANGE
This rotary switch changes resistance values in the frequency determining sections of the instrument. The position of this switch determines the multiplying factor that must be used to convert the frequency dial indication to the actual output frequency of the instrument.

AMPLITUDE
This control is a potentiometer that is used to vary the amount of oscillator voltage that is applied to the amplifier section of the instrument, and thus determines the amplitude of the output voltage.

Frequency Dial
This control varies the capacity in the frequency determining circuits of the instrument, and thus varies the output frequency. This dial is calibrated from 20 to 200 and its indication multiplied by the factor indicated by the RANGE switch will give the actual output frequency of the oscillator. The small knob just below the frequency dial (on the right hand side on the rack model) is a vernier control for this dial.

600 Ω, G
The output voltage of the instrument appears at these terminals. The two right hand binding posts (marked 600 Ω) connect directly to the output transformer of the instrument. This 600 Ω output is balanced to ground. The left hand binding post (marked G) is connected to the chassis of the instrument.

FUSE
The fuseholder, located on the back of the instrument, contains a .8 ampere slow-blowing fuse. For 230 volt operation this fuse should have a .4 ampere rating.

2-2 OPERATION OF THE INSTRUMENT

The procedure for correct operation of the Model 200AB is as follows:

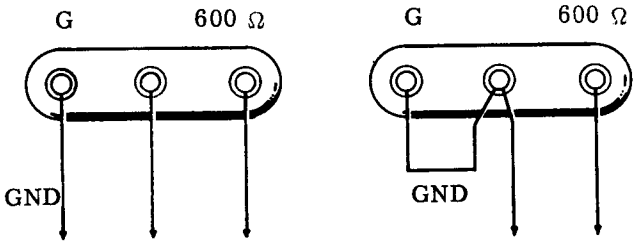
a. Connect the power cable to a suitable power source.

b. Turn the power switch on and allow about five minutes for the instrument to reach its normal operating temperature.

c. Set the Frequency Dial and the RANGE switch for the desired operating frequency. For example: the desired output frequency is 5000 cycles/sec., set the Frequency Dial to 50 and the RANGE switch to X100 (50 x 100 is 5000).

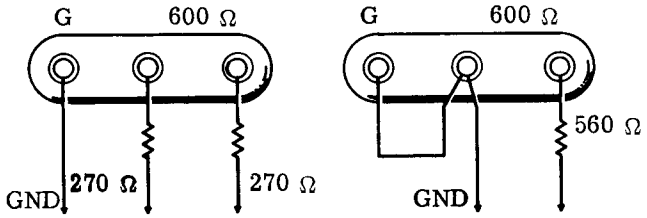
d. Connect the instrument to the equipment under test. A description of the various types of output available from the instrument follows:

1) 600 ohm balanced or unbalanced output may be obtained as follows:



BALANCED OUTPUT UNBALANCED OUTPUT

2) If a generator with an internal impedance of 600 ohms is desired, the Model 200AB may be connected as follows:

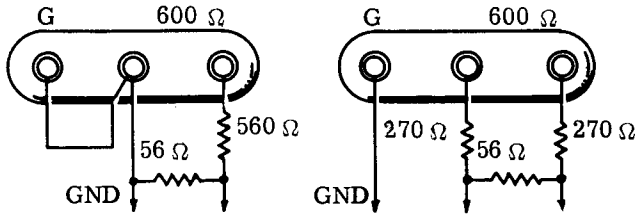


Under these conditions the output voltage available to a 600 ohm load will be reduced to approximately 12 volts and the power will be reduced to approximately 1/4 watt.

CAUTION

To minimize distortion in the output voltage, the instrument should work into a load of 600 to 6000 ohms resistive.

e. Set the AMPLITUDE controls so the Model 200AB is delivering the desired voltage to the equipment under test. If a small output voltage with minimum noise is desired, best results will be obtained by externally attenuating the instrument output rather than by decreasing the AMPLITUDE control. The input to the external attenuator should be approximately 20 volts for the best possible signal to noise ratio. The Hewlett-Packard Model 350B Attenuator may be used for this purpose if the instrument is being used to supply an unbalanced signal. A balanced attenuator should be used to attenuate a balanced signal. A simple voltage divider will also be sufficient in many cases, the total resistance of the voltage divider should be approximately 600 ohms.



This type of output attenuator is suitable when the output impedance of the instrument is not critical. When a low voltage is desired for testing low impedance circuits, it may be obtained by first attenuating the oscillator output with a 600 ohm attenuator and then changing the impedance by means of a transformer such as the Hewlett-Packard #912-17 or a suitable resistive impedance matching pad. The Hewlett-Packard line matching transformer will provide output impedances of 600, 250, 150, 62.5 or 37.5 ohms from a 600 ohm source.

SECTION III
CIRCUIT DESCRIPTION

3-1 GENERAL

The circuit of the Model 200AB consists of an oscillator section, a push-pull amplifier section, and a conventional power supply.

The oscillator section consists of a 6SJ7 (V1) and a 6K6 (V2) and is basically a two stage resistance coupled amplifier. Two feedback loops are used around this amplifier, positive feedback to set up oscillations, a negative feedback to reduce distortion and keep the amplitude of oscillation constant. The positive feedback network contains fixed resistance values and a variable capacitor (see Figure 3-1) is proportioned such that $R_1 C_1 = R_2 C_2$. The oscillator output voltage is applied to this network and the oscillator input voltage is derived from it. Since the input and output signals of a two stage amplifier are in phase, oscillations will occur when the phase shift between the voltage applied to the network and the voltage at the grid of the first stage is zero. The zero phase shift point is also the point of mini-

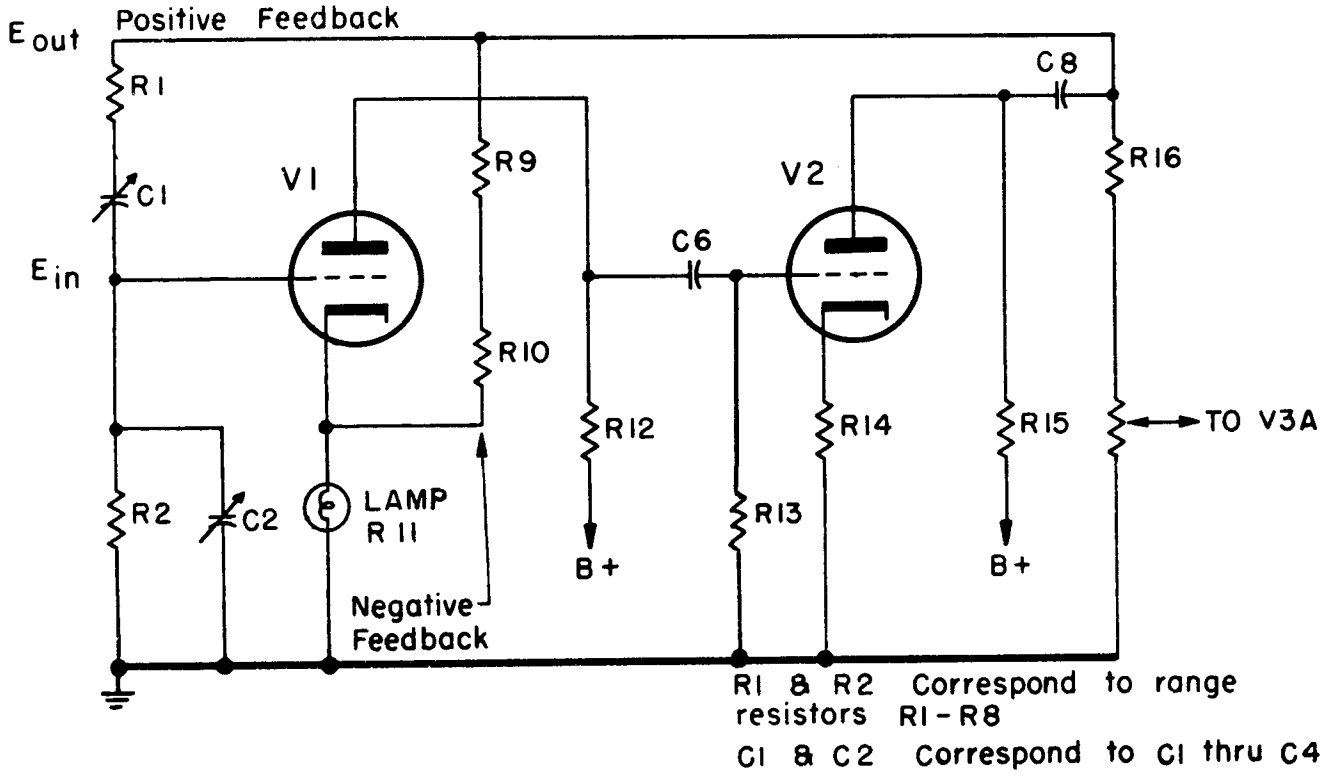


Figure 3-1. Simplified Oscillator Circuit

mum loss through the network as indicated by the curves of Figure 3-2. The frequency of oscillation, RELATIVE FREQUENCY = 1 in Figure 3-1, is equal to $1/2\ \pi\ \sqrt{R_1\ C_1\ R_2\ C_2}$ or $1/2\ \pi$ RC since $R1 = R_2$ and $C_1 = C_2$. The cathode by-pass capacitors in the oscillator section (C5, C7) are to correct phase shift at the higher operating frequencies of the instrument.

The negative feedback network in the oscillator section minimizes changes in oscillator amplitude with changes in frequency. The incandescent lamp is used as a cathode bias resistor, and is also part of the negative feedback voltage divider in the first stage of the oscillator (V1). The lamp has a temperature-resistance characteristic such that its resistance will increase in direct proportion to the voltage applied to it. Changes in the resistance of this lamp will change the percentage of negative feedback in the oscillator circuit. When the oscillator voltage rises, more voltage is applied to the lamp (R11), the increased voltage will raise the temperature and resistance of the lamp which in turn increases the percentage of negative feedback in the oscillator circuit. Increasing the percentage of negative feedback will tend to decrease the oscillator output voltage to its normal operating point. The action will be reversed if the oscillator output voltage decreases, the negative feedback voltage will decrease lowering the voltage across the lamp (R11) which will lower its resistance thus lowering the percentage of negative feedback and tending to raise the oscillator output to its normal operating point. The thermal inertia of the lamp is great enough so that its resistance will not vary in accordance with the sine wave voltage at the lowest frequencies involved.

The amplifier section of the instrument is a feedback amplifier circuit containing a push-pull output amplifier. The first amplifier tube (V3A) is directly coupled to the phase inverter tube (V3B). The phase inverter drives the output amplifier tubes (V4 and V5). The output transformer contains a tertiary winding for overall negative feedback in the amplifier section. The cathode bias resistor of the first stage (V3A) is not by-passed giving additional negative feedback. This large amount of negative feedback (over 30 db) in the amplifier section results in very little distortion being introduced by the amplifier section of the instrument.

The power supply section of the instrument consists of a conventional full wave rectifier with pi-section filter.

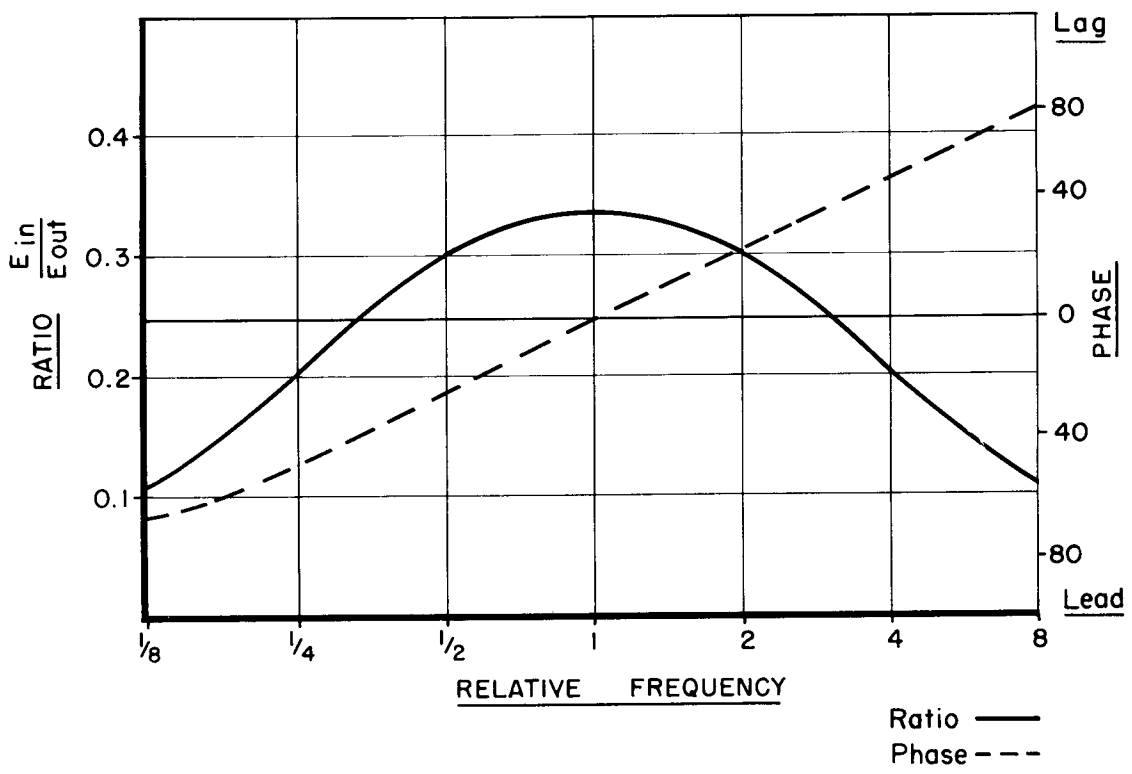


Figure 3-2. Positive Feedback Network Characteristics

SECTION IV
MAINTENANCE

CAUTION

The trimmers on the main tuning capacitor (C2 and C4) affect both calibration and frequency response. The settings of these two capacitors should not be changed unless the instrument needs recalibration.

4-1 REMOVAL OF CASE

On the rear cover of the instrument there are two screws that hold the case on the instrument. Removal of these screws will allow the instrument to slide forward out of the case.

4-2 TUBE REPLACEMENT

When replacing any of the tubes, with the exception of the rectifier, distortion measurements should be made to determine whether or not the instrument still meets the specifications set forth in the front of this instruction manual. Poor tubes can greatly increase the noise and distortion components of the output waveform.

4-3 REPLACEMENT OF ELECTROLYTIC CAPACITORS

The electrolytic capacitors in this instrument are very high quality capacitors with a life of from five to ten years.

4-4 REPLACEMENT OF LAMP R11

This lamp operates well below its rating and should have an infinite life. The lamp may be damaged by severe mechanical vibration. If the lamp is damaged, a notch may appear in the output waveform and the oscillator voltage may be excessive. If the lamp opens, the circuit will not oscillate. If it is necessary to replace the lamp, the oscillator voltage should be checked to make certain it falls within the range specified on the schematic diagram. Measure this voltage between the negative terminal of C8 and chassis (see Figure 4-3 for the location of C8). Adjust the value of R10 until the proper oscillator output is obtained.

4-5 LUBRICATION OF THE TUNING CAPACITOR DRIVE MECHANISM

The tuning capacitor drive mechanism should be lubricated once or twice a year, the interval depending upon the amount of use. One drop of light machine oil in each of the holes in the three bearing projections on the back of the casting is sufficient.

4-6 230 VOLT POWER TRANSFORMER CONVERSION

The 200AB is normally shipped from the factory with the dual 115 volt primary windings of the power transformer connected in parallel for operation from a 115-volt a-c source. The windings can easily be reconnected in series for operation from a 230-volt a-c source if desired. Refer to the schematic drawing and note the transformer primary detail.

To connect T2 for 230-volt operation, remove the jumpers from terminals 2-3 and 4-5. Connect a jumper between terminals 3-4. Replace the 0.8 ampere slow-blow fuse with one rated at 0.4 ampere.

4-7 TROUBLE SHOOTING

The following information is designed to aid in trouble shooting a defective instrument.

TROUBLE SHOOTING CHART

SYMPTOMS	POSSIBLE CAUSE	TEST PROCEDURE	REMEDIES
Instrument NOT operating, pilot light NOT on.	Line fuse blown due to defective fuse or overload in power supply section of instrument.	Replace fuse, if this fuse blows remove V6 and again replace the fuse. If this fuse blows it indicates:	
		1. Short circuit in wiring associated with power transformer.	1. Locate and clear short circuit.
		2. Short circuit in filament wiring.	2. Locate and clear short circuit.
		3. Tube with an internal short circuit.	3. Replace defective tube.
		4. Defective power transformer.	4. Replace power transformer.
		If fuse does not blow with V6 removed, it indicates:	
		1. Defective filter capacitor C12. DC resistance between pin 8 on V6 socket and ground is normally 50,000 ohms (approximate) and should be measured with the instrument disconnected from the power line.	1. Replace C12 if proven defective.
		2. Short in direct current wiring.	2. Locate and clear short circuit.
Instrument NOT operating, pilot light ON.	Oscillator section not operating properly.	Measure oscillator voltage between negative terminal of C8 and ground; should agree with the voltage specified on schematic. If oscillator voltage not present, check:	
		1. Defective tube.	1. Replace V1 and V2.
		2. DC voltage in oscillator circuit (should agree with those indicated on schematic diagram within ±10%).	2. Replace component causing incorrect d-c voltage.
		3. Short circuit in tuning capacitor or associated trimmers. Short circuit in front two sections of tuning capacitor will cause lamp (R11) to flash intermittently (lamp filament dull red) when the instrument is set at 1000 cycles/second.	3. Clear short circuit. If trimmer (C2, C3, or C4) is defective replace. If foreign material is shorting tuning capacitor (C1) remove carefully without bending plates. If plates have been damaged and are touching, straighten carefully.
		4. Range switch (S1) to make certain it is making good contact and that there are no open range resistors.	4. Clean range switch contacts or replace assembly if there are any open or damaged resistors.

TROUBLE SHOOTING CHART (CONT'D.)

SYMPTOMS	POSSIBLE CAUSE	TEST PROCEDURE	REMEDIES
	Amplifier section not operating properly, oscillator voltage correct but no output from instrument.	Check dc voltage in amplifier section (V3 thru V5) they should agree with the values indicated on the schematic diagram within ±10%. Test amplifier under conditions specified on schematic diagram for voltage measurement (except AMPLITUDE at 60) and with a 600 resistive load on the output terminals.	Replace faulty component in amplifer section.
Instrument operating, high amount of distortion in output voltage	Defective lamp (R11) in oscillator section.	Notch apparent in output waveform as viewed on oscilloscope.	Replace lamp (see paragraph 4-4).
Instrument operating but very small voltage available at output terminals, oscillator voltage normal.	Amplifier section not operating properly.	Check dc voltage in amplifer section. With proper termination on the output, the ac voltage on the grid of V3A should be 13 volts rms and the ac voltage appearing on the grid (pin 5) of V4 or V5 should be 5 volts rms. (These conditions apply for 1 watt output into a 600 Ω load.)	Replace tube or component.
Intermittent operation of instrument.	Defective coupling capacitor C6, C8, C9, C10, C11. Defective tube.	Determine portion of the circuit that is operating intermittently by signal tracing with an oscilloscope or voltmeter.	Replace component causing intermittent operation.
AMPLITUDE control rotation causes unstable output amplitude variation.	AMPLITUDE control (R17) dirty or worn, C9 defective.	1. Check dc voltage on pin 4 of V3, more than .2 volt indicates defective C9. 2. Resistance between arm (center contact) and ground of R17 does not vary smoothly with rotation of AMPLITUDE control. (CAUTION-measure resistance with instrument disconnected from power line.)	1. Replace C9. 2. Replace R17.

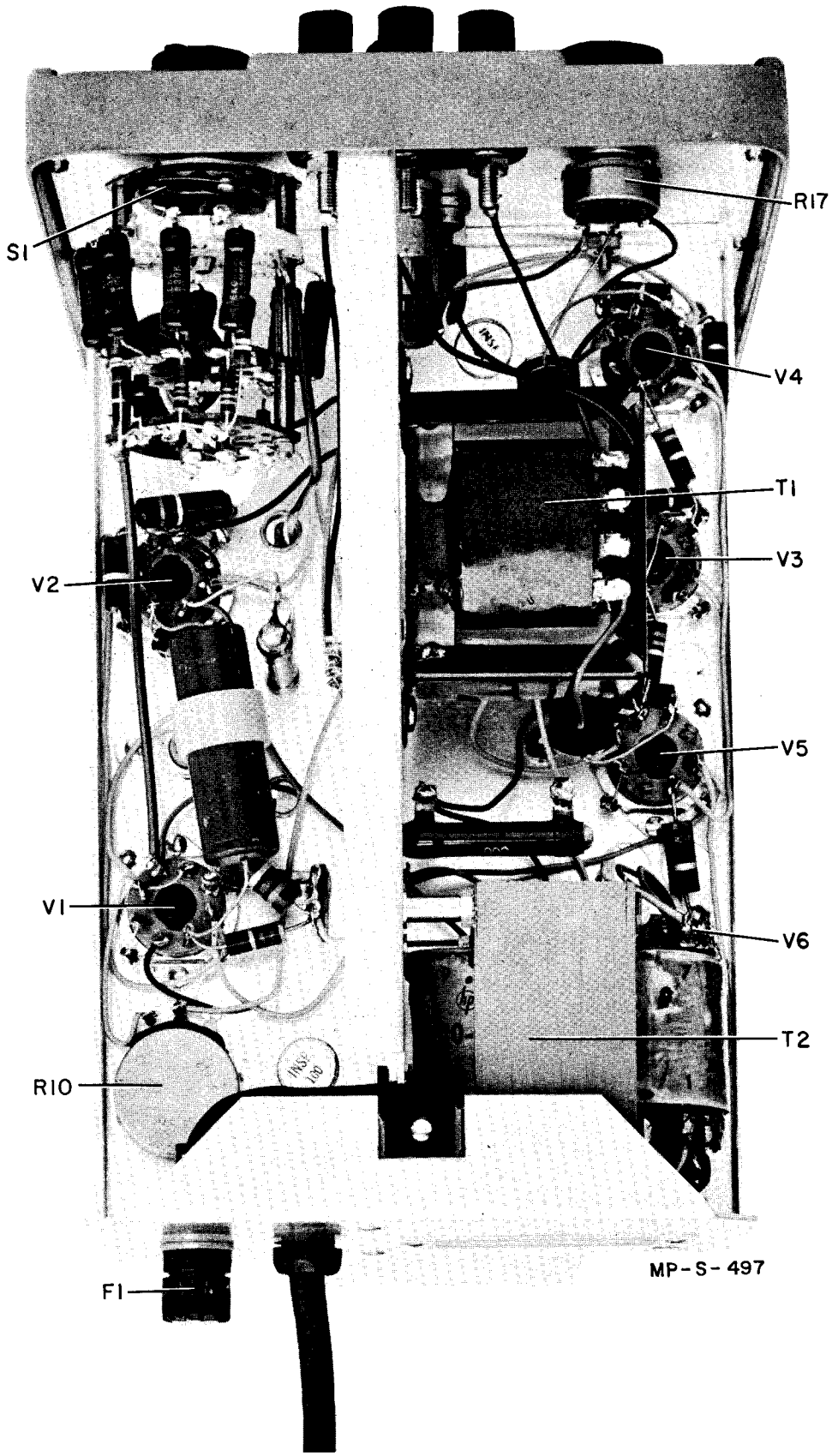


Figure 4-1. Model 200AB Top View

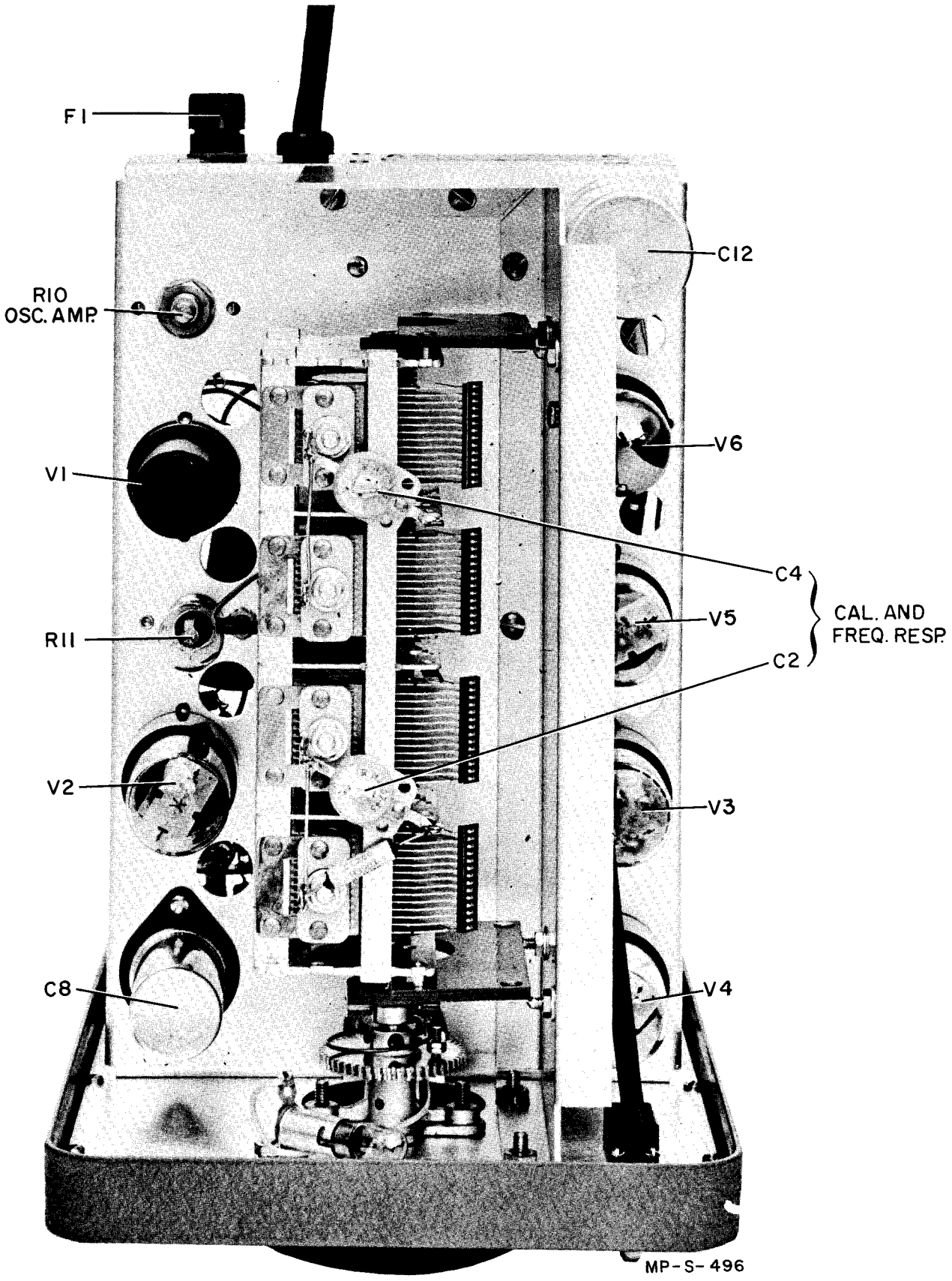


Figure 4-2. Model 200AB Bottom View

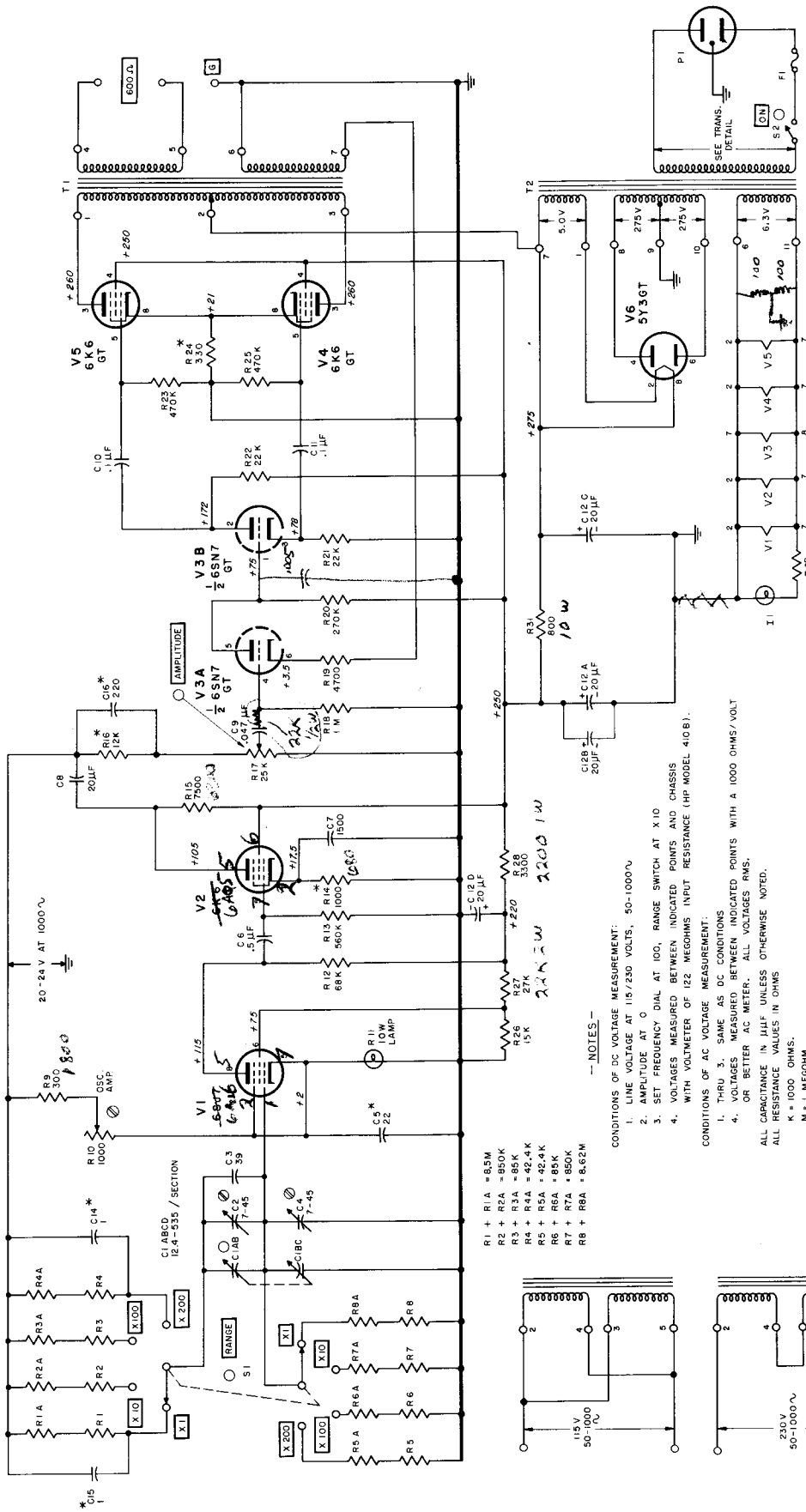


Figure 4-3. Model 200AB Audio Oscillator

SECTION V
REPLACEABLE PARTS

NOTE

Standard components have been used in this instrument, whenever possible. Special components may be obtained from your local Hewlett-Packard representative or from the factory.

When ordering parts always include:

1. ℌ Stock Number.
2. Complete description of part including circuit reference.
3. Model number and serial number of instrument.
4. If part is not listed, give complete description, function and location of part.

Corrections to the Table of Replaceable Parts are listed on an Instruction Manual Change sheet at the front of this manual.

RECOMMENDED SPARE PARTS LIST

Column RS in the Table lists the recommended spare parts quantities to maintain one instrument for one year of isolated service. Order complete spare parts kits from the Factory Parts Sales Department. ALWAYS MENTION THE MODEL AND SERIAL NUMBERS OF INSTRUMENTS INVOLVED.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
C1	Capacitor: variable, air, 4 sections, 12.4 pf to 535 pf	W	0121-0004	1	1		
C2	Capacitor: variable, ceramic, trimmer, 7-45 pf, 500 vdcw	L	0130-0001	2	1		
C3	Capacitor: fixed, ceramic, 39 pf ±5%, 500 vdcw	K	0150-0002	1	1		
C4	Same as C2						
C5	Capacitor: fixed, mica, 22 pf ±10%, 500 vdcw Optimum value selected at factory Average value shown	Z	0140-0026	1	1		
C6	Capacitor: fixed, paper, 0.5 μf ±10%, 400 vdcw	J	0160-0024	1	1		
C7	Capacitor: fixed, paper, 1500 pf ±10%, 600 vdcw	CC	0160-0012	1	1		
C8	Capacitor: fixed, electrolytic, 20 μf, 450 vdcw	CC	0180-0011	1	1		
C9	Capacitor: fixed, paper, .047 μf ±10%, 600 vdcw	CC	0160-0005	1	1		
C10, 11	Capacitor: fixed, paper, 0.1 μf ±10%, 600 vdcw	CC	0160-0001	2	1		
C12 A,B,C,D	Capacitor: fixed, electrolytic, 4 sections, 20 μf/sect., 450 vdcw	CC	0180-0025	1	1		
C13	Not assigned						
C14, 15	Capacitor: fixed, titanium dioxide, 1.0 pf ±10%, 500 vdcw Optimum value selected at factory Average value shown	DD	0150-0029	2	1		
C16	Capacitor: fixed, mica, 220 pf ±5%, 500 vdcw Optimum value selected at factory Average value shown	Z	0140-0068	1	1		
F1	Fuse, cartridge: 0.8 amp, 115 volt operation	T	2110-0020	1	10		
	Fuse, cartridge: 0.4 amp, 230 volt operation	T	2110-0019				
I1	Lamp, incandescent: 6-8V, .15 amp, #47	N	2140-0009	1	1		
P1	Power cord	Elec. Cords Co.	8120-0050	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	℗ Stock No.	TQ	RS		
R1, 1A	Resistor: fixed, part of range switch assembly						
R2, 2A	Resistor: fixed, part of range switch assembly						
R3, 3A	Resistor: fixed, part of range switch assembly						
R4, 4A R5, 5A	Resistor: fixed, deposited carbon, part of range switch assembly						
R6, 6A	Same as R3 part of range switch assembly						
R7, 7A	Same as R2 part of range switch assembly						
R8, 8A	Same as R1 part of range switch assembly						
R9	Resistor: fixed, wirewound, 3000 ohms ±5%, 1 W	IRC	0812-0010	1	1		
R10	Resistor: variable, wirewound, 1000 ohms ±10%, 2 W	BO	2100-0004	1	1		
R11	Lamp, incandescent: 10 W, 250 V	N	2140-0007	1	1		
R12	Resistor: fixed, composition, 68,000 ohms ±10%, 1 W	B	0690-6831	1	1		
R13	Resistor: fixed, composition, 560,000 ohms ±10%, 1 W	B	0690-5641	1	1		
R14	Resistor: fixed, composition, 1000 ohms ±10%, 2 W Optimum value selected at factory Average value shown	B	0693-1021	1	1		
R15	Resistor: fixed, wirewound, 7500 ohms ±10%, 10 W	S	0816-0007	1	1		
R16	Resistor: fixed, composition, 12,000 ohms ±10%, 1 W Optimum value selected at factory Average value shown	B	0690-1231	1	1		
R17	Resistor: variable, composition, 25,000 ohms ±20%, 1/3 W	BO	2100-0089 3	1	1		
R18	Resistor: fixed, composition, 1 megohm ±10%, 1 W	B	0690-1051	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
R19	Resistor: fixed, composition, 4700 ohms ±10%, 1 W	B	0690-4721	1	1		
R20	Resistor: fixed, composition, 270,000 ohms ±10%, 1 W	B	0690-2741	1	1		
R21, 22	Resistor: fixed, composition, 22,000 ohms ±5%, 1 W	B	0689-2235	2	1		
R23	Resistor: fixed, composition, 470,000 ohms ±10%, 1 W	B	0690-4741	2	1		
R24	Resistor: fixed, composition, 330 ohms ±10%, 2 W Optimum value selected at factory Average value shown	B	0693-3311	1	1		
R25	Same as R23						
R26	Resistor: fixed, composition, 15,000 ohms ±10%, 1 W Optimum value selected at factory Average value shown	B	0690-1531	1	1		
R27	Resistor: fixed, composition, 27,000 ohms ±10%, 2 W	B	0693-2731	1	1		
R28	Resistor: fixed, composition, 3300 ohms ±10%, 1 W	B	0690-3321	1	1		
R29	Resistor: fixed, composition, 18 ohms ±10%, 1 W	B	0690-1801	1	1		
R30	Not assigned						
R31	Resistor: fixed, wirewound, 800 ohms ±10%, 10 W	S	0816-0004	1	1		
S1	Range Switch Assembly	HP	200AB-19W	1	1		
S2	Switch, toggle: SPST	D	3101-0001	1	1		
T1	Transformer, output	HP	9120-0012	1	1		
T2	Transformer, power	HP	9100-0027	1	1		
V1	Tube, electron: 6SJ7	ZZ	1923-0037	1	1		
V2	Tube, electron: 6K6GT	RCA	1923-0033	3	3		
V3	Tube, electron: 6SN7GT	ZZ	1932-0025	1	1		
V4, 5	Same as V2						
V6	Tube, electron: 5Y3GT or 5AR4	ZZ ZZ	1930-0010 1930-0003	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	℗ Stock No.	TQ	RS		
	MISCELLANEOUS						
	Binding Post Assembly: red	HP	AC-10D	2	1		
	Binding Post Assembly: black with ground link	HP	G-76J	1	1		
	Coupler, insulated	HP	AC-32A	1	1		
	Disc, vernier drive: on shaft	HP	G-14A	1	0		
	Disc, vernier drive	HP	G-14B	1	0		
	Fuseholder	T	1400-0084	1	1		
	Handle, cabinet	HP	1440-0002	1	0		
	Holder, lamp: candelabra (used for R11)	AD	1450-0013	1	1		
	Holder, lamp	AD	1450-0012	1	0		
	Insulator, binding post: 3 hole, black	HP	AC-54B	1	0		
	Insulator, standoff: 3/4 in. long	AI	0340-0020	1	0		
	Knob: AMPLITUDE	HP	G-74K	1	0		
	Knob: RANGE	HP	G-74N	1	0		
	Spring,gear: tuning capacitor gear	HP	624A-36B-5	1	0		
	Spring, compression: for vernier drive	Connor Spring Co.	1460-0019	1	0		
	Window, dial: for curved frequency dial	HP	G-99K	1	0		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

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

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

MANUAL CHANGES

MODEL 200AB

AUDIO OSCILLATOR

Manual Serial Prefixed: 008-
Manual Printed 12-60

To adapt this manual to instruments with other serial prefixes check for errata below, and make changes shown in tables.

Instrument Serial Prefix	Make Manual Changes
ALL	ERRATA
130	1
224	1, 2
ALL	ERRATA

Instrument Serial Prefix	Make Manual Changes
234	1, 2, 3
310	1, 2, 3, and 4

ERRATA — Table of Replaceable Parts under Miscellaneous.
Fuseholder: Change hp Stock No. to read 1400-0084

Change #1 — C1: Change HP Stock No. to read 200AB-95B, Mfr. HP

C3: Change to Capacitor, Fixed, Mica, 39 pf ±2%
500 WVDC, hp Stock No. 0140-0116; Mfr. V.

Change #2 — F1: Fuse, Cartridge

115 Volt Operation change . 8 amp to 1. 25 amp
Slo-Blo hp Stock No. 2110-0021

230 Volt Operation change . 4 amp to . 8 amp
Slo-Blo hp Stock No. 2110-0020

ERRATA — Replaceable Parts (Section V Page 3)
Was R-17 hp Part No. 2100-0009
Now R-17 hp Part No. 2100-0039

CHANGE #3 — Table of Replaceable Parts: (MISCELLANEOUS)
Delete the following:

Disc, vernier drive	G-14A
Disc, vernier drive	G-14B
Spring, compression	1460-0019

Add the following:

Disc Ass'y Vernier Drive; hp Stock No. G-14J;
Mfr. 28480; TQ, 1.
Bearing, Capacitor Drive; hp Stock No. G-36J;
Mfr. 28480; TQ, 1.
Spring Thrust; hp Stock No. G-91A; Mfr. 28480, TQ, 1.

Instrument Serial Prefix	Make Manual Changes
ALL	ERRATA
130	1
224	1, 2
ALL	ERRATA

Instrument Serial Prefix	Make Manual Changes
234	1, 2, 3
310	1, 2, 3, and 4

CHANGE #4

R9* Change to Resistor, fixed, comp, 1800 ohms ±10%, 1W
hp Stock No. 0690-1821

R14 Change to Resistor, fixed, ww, 680 ohms ±10%, 2W
hp Stock No. 0693-6811

R15 Change to Resistor, fixed, ww, 6300 ohms ±10%, 2W
hp Stock No. 0816-0017

R27 Change to Resistor, fixed, ww, 22K ohms ±10%, 2W
hp Stock No. 0693-2231

R28 Change to Resistor, fixed, comp, 2200 ohms ±10%, 1W
hp Stock No. 0690-2221

R31 Change to Resistor, fixed, ww, 800 ohms ±10%, 10W
hp Stock No. 0816-0004

V1 Change to Tube, electron (6AU6), hp Stock No. 1923-0021
(See Figure 1)

V2 Change to Tube, electron (6AQ5), hp Stock No. 1923-0018
(See Figure 2)

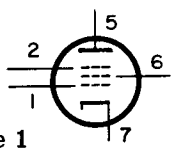


Figure 1

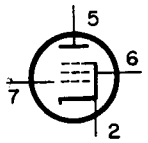


Figure 2

Change Holder, lamp to hp Stock No. 1450-0009

Add the following:

R32 and R33, Resistors, fixed, comp, 100 ohms ±10%, 1/2W
hp Stock No. 0687-1011

See Figure 3 for placement of components.

R34, Resistor, fixed, comp, 22K ±10%, 1/2W, hp Stock No. 0687-2231

See Figure 4 for placement of components.