

INSTRUCTION AND OPERATING MANUAL

MODEL 200CD
WIDE RANGE OSCILLATOR
Serial 2251 and Above



HEWLETT-PACKARD COMPANY

395 Page Mill Road • Palo Alto, California, U.S.A.

INSTRUCTION AND OPERATING MANUAL

FOR

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General Description

The Model 200CD Wide Range Oscillator is a laboratory oscillator which spans the range from sub-sonic to radio frequencies. The instrument uses an improved resistance-capacity oscillator circuit which cover the 5 cycles/sec. to 600 Kc range in five overlapping decade bands. A maximum voltage of at least 20 volts open circuit and 10 volts across its rated load of 600 ohms is provided by the Model 200CD. The output circuit has a nominal source impedance of 600 ohms. A simple bridged T attenuator is provided to control the output power.

The Model 200CD provides an ideal signal source for testing servo and vibrating systems; medical and geophysical equipment; audio amplifier, circuits and transducers; sonar and super-sonic apparatus; carrier telephone systems; video frequency circuits, and low radio frequency equipment.

CAUTION

Replacement of Electrolytic Capacitors

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

Parts Substitutions

Difficulties in procuring some of the parts used in this instrument may cause the electrical or physical values to deviate from those shown in this instruction manual. These substitutions have been made so as not to impair the performance of this instrument. Whenever replacement of any of these parts is necessary, either the substitute value or the original value may be used.

200CD, 5/3/54 SERIAL 2211 and ABOVE

INSTRUCTIONS

MODEL 200CD

WIDE RANGE OSCILLATOR

Specifications

Frequency Rating --

Frequency Range - 5 to 600,000 cycles/sec.

Frequency Dial Calibration - 5 to 60

Ranges -

X1	5 to 60 cycles/sec.
X10	50 to 600 cycles/sec.
X100	500 to 6,000 cycles/sec.
X1K	5,000 to 60,000 cycles/sec.
X10K	50,000 to 600,000 cycles/sec.

Calibration Accuracy - $\pm 2\%$ including calibration error, warm-up, and changes due to aging of tubes and components.

Frequency Response - ± 1 DB over entire frequency range from a reference of 1000 cycles/sec.

Frequency Stability - Line voltage variations of $\pm 10\%$ will cause negligible shift in output frequency.

Power Output Rating --

Power Output - 160 milliwatts (10 volts) into 600 ohms, 20 volts open circuit.

Distortion - Less than .5% over entire frequency range independent of load impedance.

Hum and Noise - Less than .1% of output voltage.

Output Balance - Better than .1% at lower frequencies and approximately 1% at higher frequencies.

Load Impedance - Any load impedance may be used without affecting the distortion of the output waveform.

Internal Impedance - 600 ohms. Output is balanced to ground at maximum output position of AMPLITUDE control. Instrument may be used with one side grounded.

Power Supply Rating --

Voltage - 115 or 230 volts $\pm 10\%$.

Frequency - 50/1000 cycles/sec.

Wattage - 75 watts

Overall Dimensions --

Cabinet Model - 7" wide x 10-3/4" high x 12-1/2" deep

Rack Model - 19" wide x 7" high x 14" deep

Panel - 19" wide x 7" high

Depth behind Panel - 13"

Operating Instructions

Inspection --

This instrument has been thoroughly tested and inspected before being shipped from the factory. 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.

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.

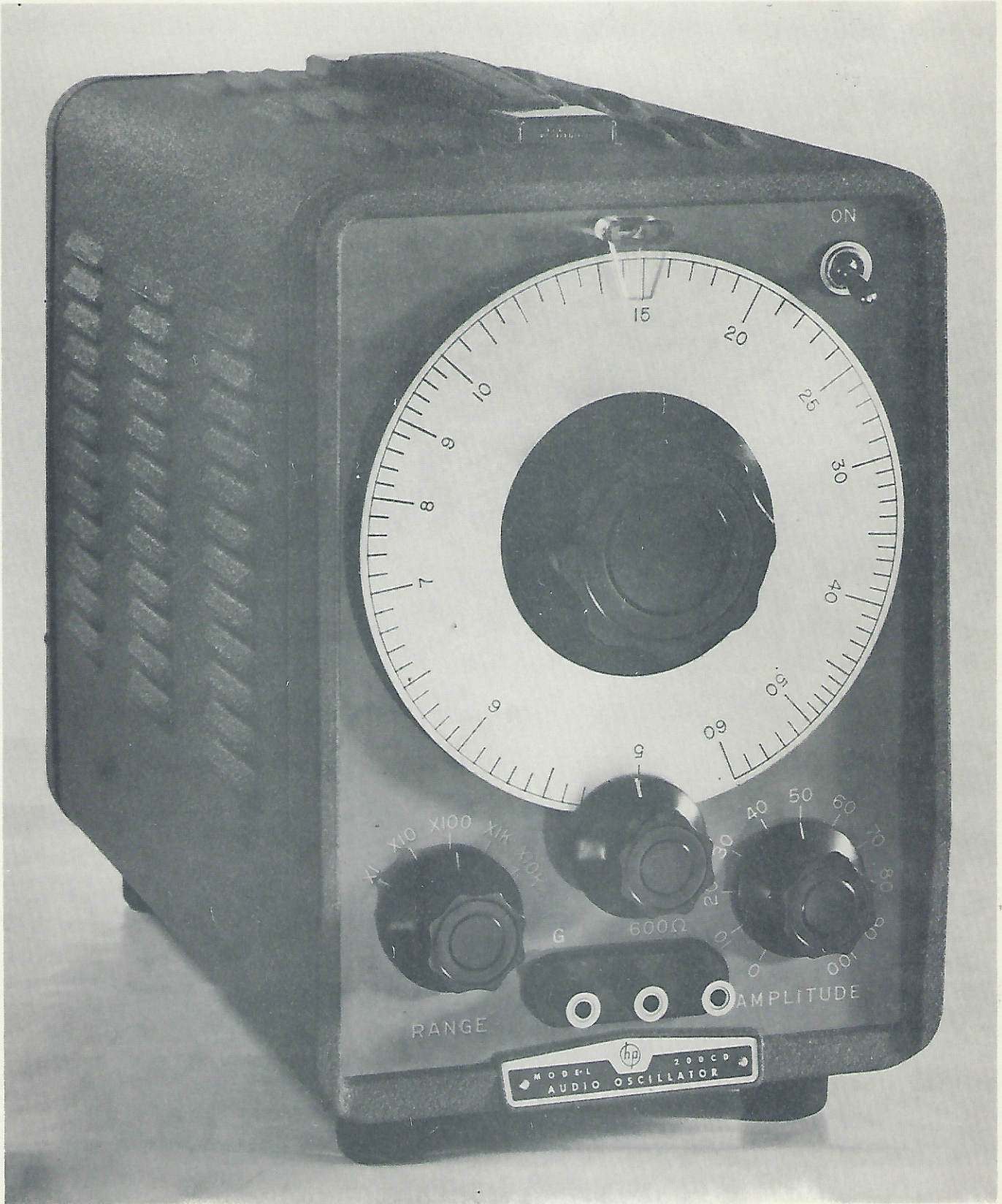


Fig. 1. Model 200CD Audio Oscillator

AMPLITUDE - This control is a bridged T attenuator which controls the magnitude of the voltage applied to the output terminals of the instrument.

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 5 to 60 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 of the AMPLITUDE control and 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 1 ampere cartridge fuse. To replace the fuse, unscrew the fuseholder cap and remove the blown fuse and replace with a new one of the same type. For 230 volt operation this fuse should have a 1/2 ampere rating.

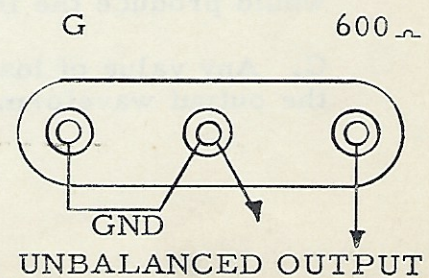
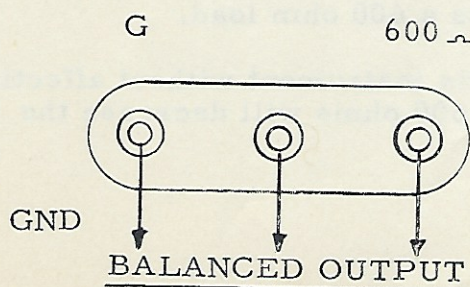
Power Cable - This is a special three conductor power cable with a standard two prong male plug molded on one end. The third conductor (green) protrudes from the power cable near the plug and may be used to connect the instrument chassis to an external ground.

Operation of the Instrument --

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

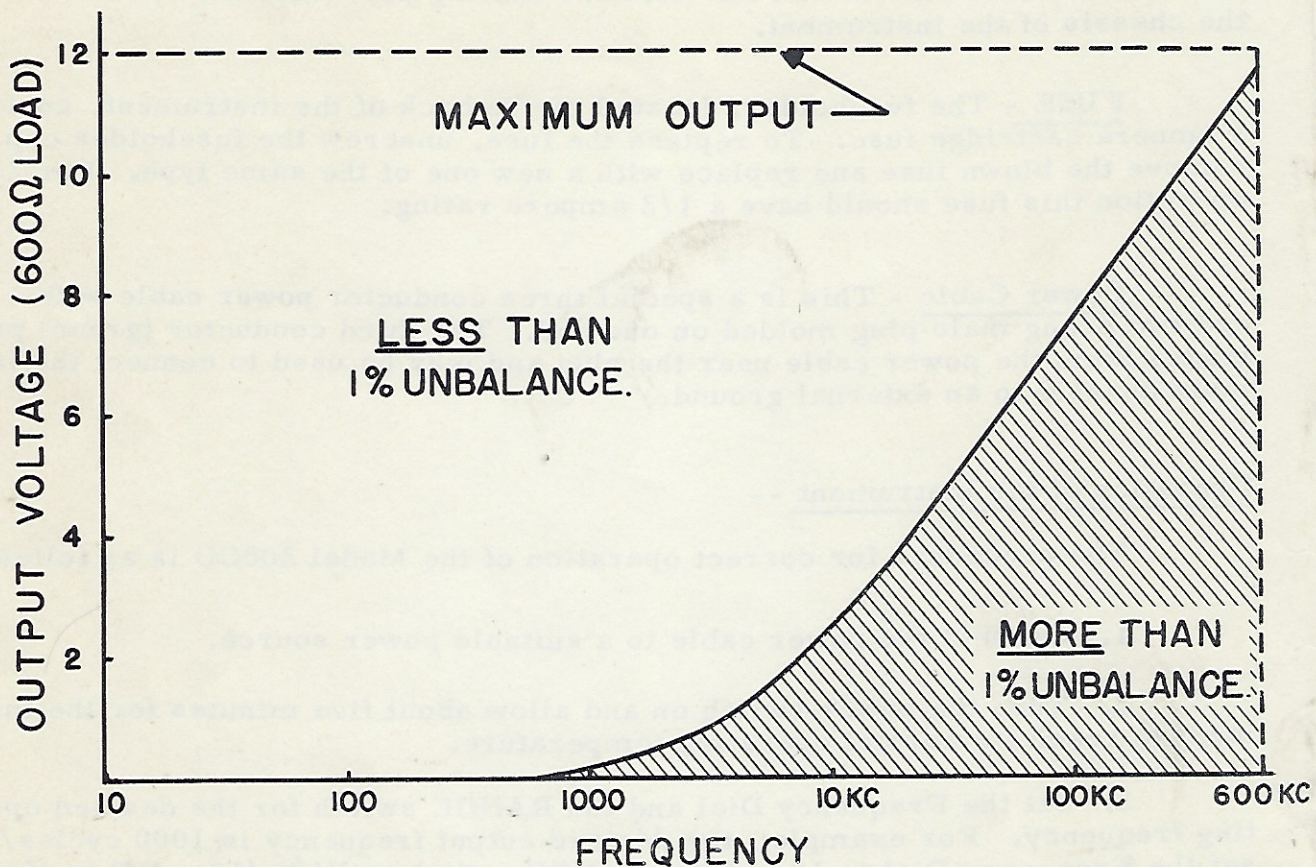
1. Connect the power cable to a suitable power source.
2. Turn the power switch on and allow about five minutes for the instrument to reach its normal operating temperature.
3. Set the Frequency Dial and the RANGE switch for the desired operating frequency. For example: the desired output frequency is 1000 cycles/sec., set the Frequency Dial to 10 and the RANGE switch to X100 (10 x 100 is 1000).
4. Connect the instrument to the equipment under test. A description of the various types of output available from the instrument follows:

A. 600 ohm balanced or unbalanced output may be obtained as follows:



If the instrument is being used to supply an unbalanced output, always connect the center output terminal to ground as indicated in the diagram.

B. Since an unbalanced attenuator is used in the instrument, the output balance will be a function of frequency and output voltage (setting of the AMPLITUDE control). The following chart indicates the area where a balanced output may be obtained from the instrument. If a balanced output is desired in the shaded area of the chart, it will be necessary to use an external balanced attenuator and set the AMPLITUDE control on the instrument to maximum.



This chart indicates output voltages across a 600 ohm resistive load. Where other values of load are used, the chart does not apply directly; but it does apply for settings of the AMPLITUDE control that would produce the indicated voltage across a 600 ohm load.

C. Any value of load may be used with this instrument without affecting the output waveform. Loads of less than 600 ohms will decrease the

maximum available output voltage and loads of more than 600 ohms will increase the available output voltage. The instrument may be considered as a 20 volt generator with a 600 ohm internal impedance.

5. Set the AMPLITUDE control for the desired output voltage. If the instrument is used to supply an unbalanced output of more than 1/2 volt, the internal attenuator is useful over the whole range of the instrument. If smaller outputs at frequencies over 50 Kc are desired, it will be necessary to use an external attenuator designed for the frequencies involved. The limitations that apply to balanced output voltages are covered in paragraph 4.

Circuit Description

The circuit of the Model 200CD oscillator consists of a single stage, push-pull, balanced amplifier (V1 and V3), and a balanced cathode follower output stage (V2 and V4). The amplifier grids receive positive feedback from the cathode follower associated with the opposite amplifier and thus oscillations occur. The frequency of oscillations is controlled by a resistance-capacity network in the grid circuit of V3. This circuit applies positive feedback to the grid of V3 at only one frequency, (determined by the setting of the RANGE switch and the frequency dial) and thus controls the operating frequency of the instrument. The amplitude of oscillations is stabilized by two lamps (R13 and R14) in the grid circuit of V1. The characteristics of these lamps are such that their resistance increases with the voltage applied to them. If the oscillator voltage tends to vary, the characteristics of the lamps will vary the positive feedback on the grid of V1 and tend to restore the voltage to its original value.

The cathode followers (V2 and V4) have an extremely low output impedance so that a balanced load on the oscillator at this point has negligible affect on its operation. The output transformers provide this balanced loading and a balanced output for the instrument. The range switch selects the correct output transformer for the frequencies involved.

The AMPLITUDE control is a bridged-T attenuator located between the output transformers and the output terminals. The instrument has a rated output of 20 volts open circuit and an internal impedance of 600 ohms. Any value of load resistance may be used with the instrument without affecting the output waveform.

Maintenance

CAUTION

The trimmers on the main tuning capacitor (C3 and C6) and the trimmer across feedback resistors R11 and R12 (C7) have been accurately adjusted at the factory and should NOT be adjusted in the field. These trimmers affect both calibration and frequency response; and if there is evidence that the instrument needs recalibration, consult the factory regarding this service.

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.

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. One cause of excessive distortion is grid current in tube V3. This can be checked by measuring the DC voltage between the cathodes of tube V2 and tube V4; if this voltage varies when the RANGE switch is changed from the X1 to X10 positions, it indicates excessive grid current in tube V3. Interchanging tubes V1 and V3 may correct the trouble, if it doesn't, it will be necessary to try another 6SH7 tube. The DC voltage between cathodes (pin 3) of the 6AU5 tubes should be 1 volt or less. If this voltage is excessive, it indicates a bad tube in the oscillator (V1-V4) which must be replaced to insure low distortion in the output waveform.

Replacement of Lamps R13 and R14 --

These lamps operate well below their rating and should have an infinite life. The lamps may be damaged by severe mechanical vibration. To check for proper operation of the lamps, set the AMPLITUDE control to its maximum clockwise position and measure the output voltage of the instrument. This voltage should be 24 volts with no external load or 12 volts across a 600 ohm load. If the output voltage is not correct, it will be necessary to adjust R11 until this output voltage is obtained. It will be necessary to replace the lamps if adjustment of R11 will not bring the output voltage of the instrument to its proper level.

Power Transformer Primary Connections --

The power transformer primaries of this instrument are connected for 115 volt operation when it leaves the factory. If 230 volt operation is desired, reconnect the power transformer primaries as indicated in the Power Transformer Detail on the schematic diagram. For 230 volt operation the line fuse must be changed as indicated in the Replaceable Parts list under F1 (For 230 Volt Operation).

Lubrication of the Tuning Capacitor Drive Mechanism --

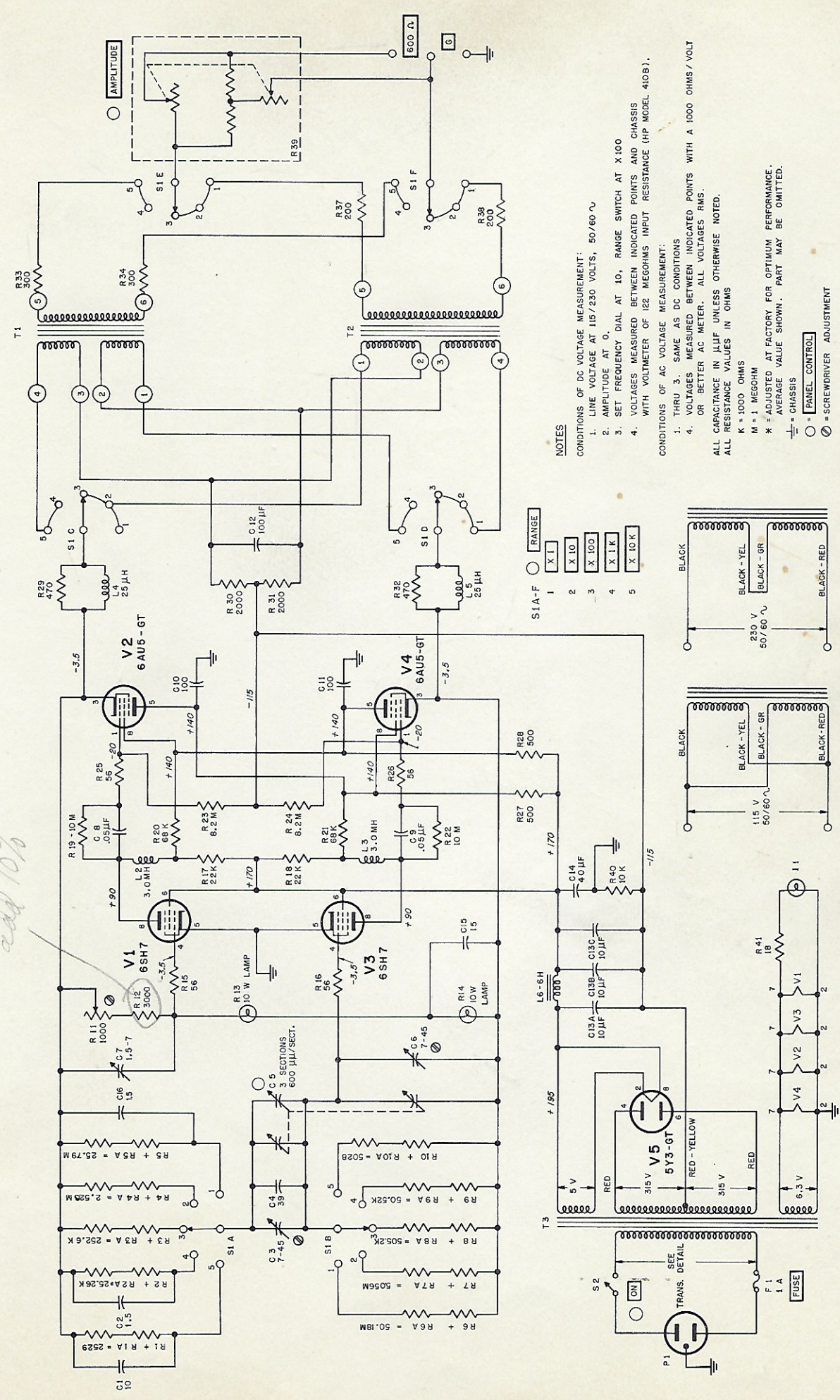
The tuning capacitor drive mechanism should be lubricated once or twice a year, depending on the amount of use. One drop of light machine oil in each of the three oil holes is sufficient. The oil holes are located in the three bearing projections on the back of the casting.

Trouble Shooting --

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

<u>Symptoms</u>	<u>Possible Cause</u>	<u>Test Procedure</u>	<u>Remedies</u>
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 V5 (5Y3GT) and again replace the fuse. If this fuse blows it indicates: 1. Short circuit in wiring associated with power transformer. 2. Short circuit in filament wiring. 3. Tube with an internal short circuit. 4. Defective power transformer.	1. Locate and clear short circuit. 2. Locate and clear short circuit. 3. Replace defective tube. 4. Replace power transformer.
Instrument NOT operating, pilot light ON.	Defective tube or component causing improper operating. Short circuit in tuning capacitor C5 or associated components.	If the fuse does not blow with V5 removed, it indicates: 1. Defective filter capacitor C13ABC. DC resistance between pin 8 on V5 socket and ground is normally 200,000 ohms (approximate) and should be measured with the instrument disconnected from the power line. 2. Short in direct current wiring. Check DC voltages against those indicated on schematic diagram (should agree within $\pm 10\%$). With RANGE switch on X1 the resistance of the front two sections of the tuning capacitor should be 75 megohms, the rear section should be 50 megohms (due to range resistors).	1. Replace C13ABC if proven defective. 2. Locate and clear short circuit. Replace tube or component that is causing incorrect DC voltage. Clear short circuit being careful not to bend the plates of the tuning capacitor as this will destroy the accuracy of the frequency dial.

add 10%



NOTES

CONDITIONS OF DC VOLTAGE MEASUREMENT:

1. LINE VOLTAGE AT 115/230 VOLTS, 50/60 \sim
2. AMPLITUDE AT 0.
3. SET FREQUENCY DIAL AT 10, RANGE SWITCH AT X100
4. VOLTAGES MEASURED BETWEEN INDICATED POINTS AND CHASSIS WITH VOLTMETER OF 122 MEGOHMS INPUT RESISTANCE (HP MODEL 410B).

CONDITIONS OF AC VOLTAGE MEASUREMENT:

1. THRU 3. SAME AS DC CONDITIONS
4. VOLTAGES MEASURED BETWEEN INDICATED POINTS WITH A 1000 OHMS / VOLT OR BETTER AC METER. ALL VOLTAGES RMS.

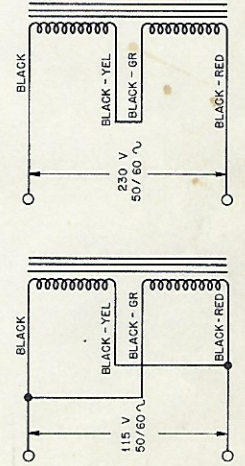
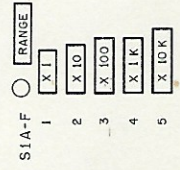
ALL CAPACITANCE IN μ F UNLESS OTHERWISE NOTED.

ALL RESISTANCE VALUES IN OHMS

K = 1000 OHMS
M = 1 MEGOHM

* = ADJUSTED AT FACTORY FOR OPTIMUM PERFORMANCE.
AVERAGE VALUE SHOWN. PART MAY BE OMITTED.

--- = CHASSIS
 --- = PANEL CONTROL
 --- = SCREWDRIVER ADJUSTMENT



TRANSFORMER DETAIL

**SCHEMATIC DIAGRAM OF MODEL 200 CD
SERIAL 2251 & ABOVE**

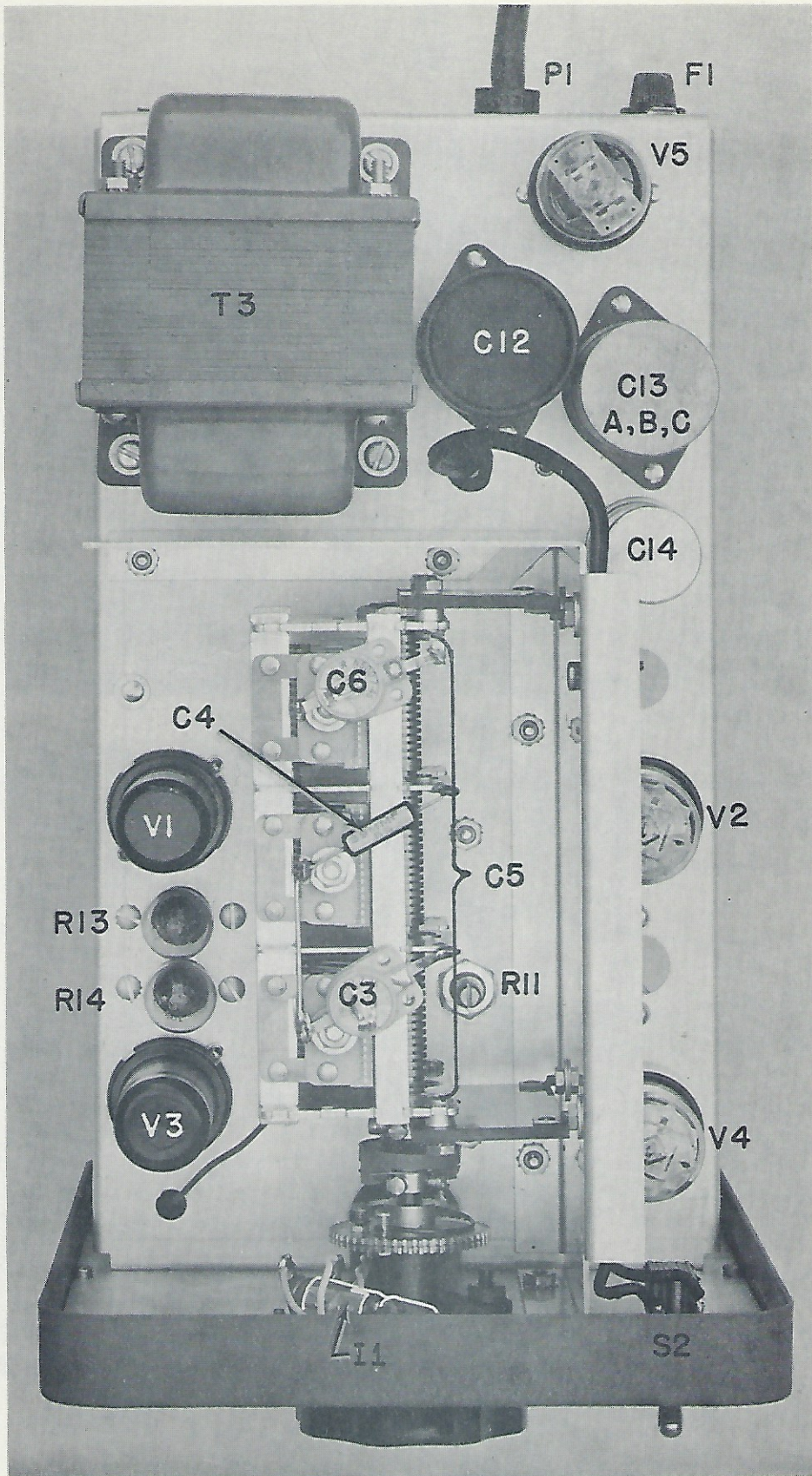


Fig. 2. Model 200CD Top View with Case Removed

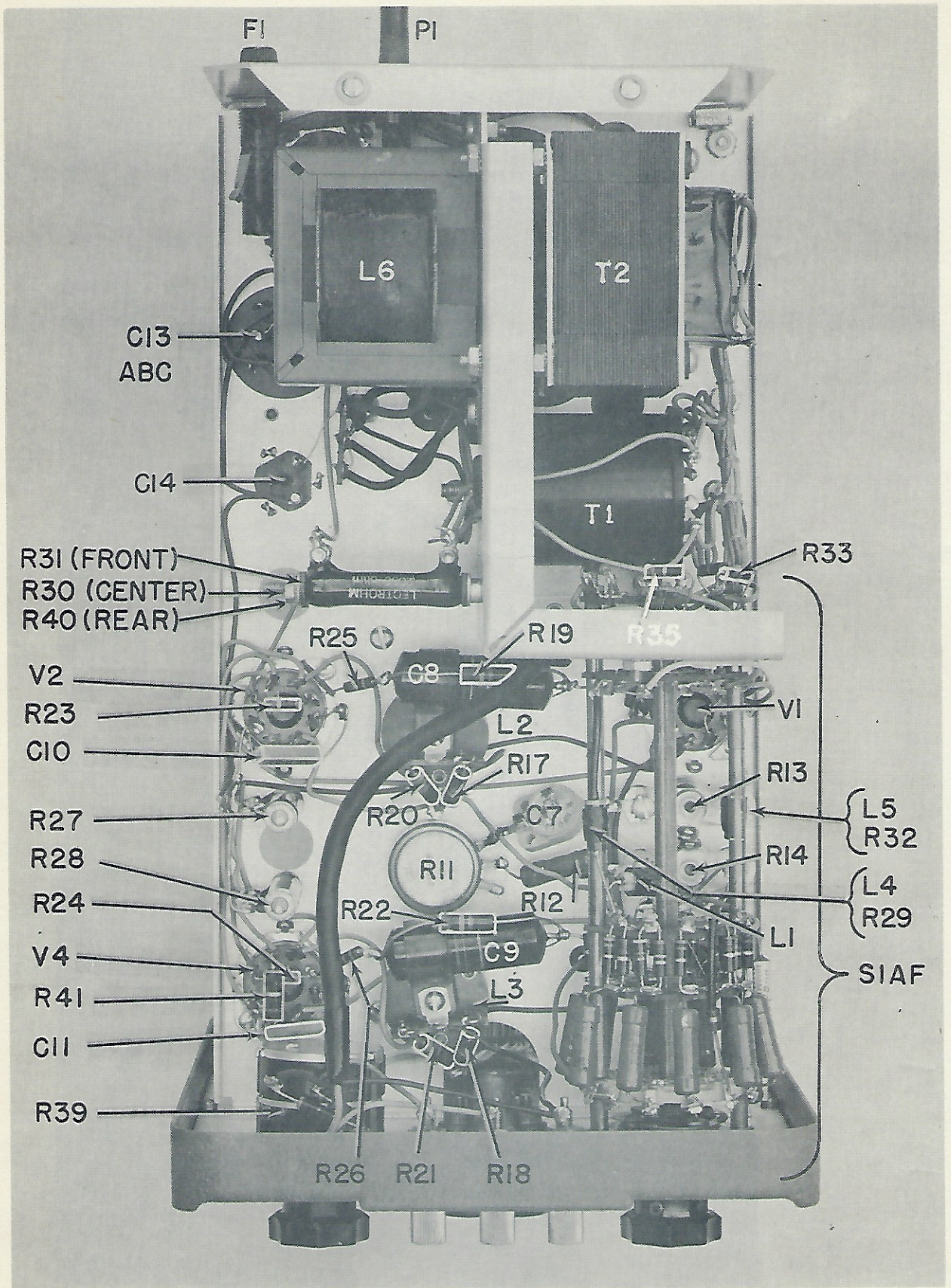


Fig. 3. Model 200CD Bottom View with Case Removed

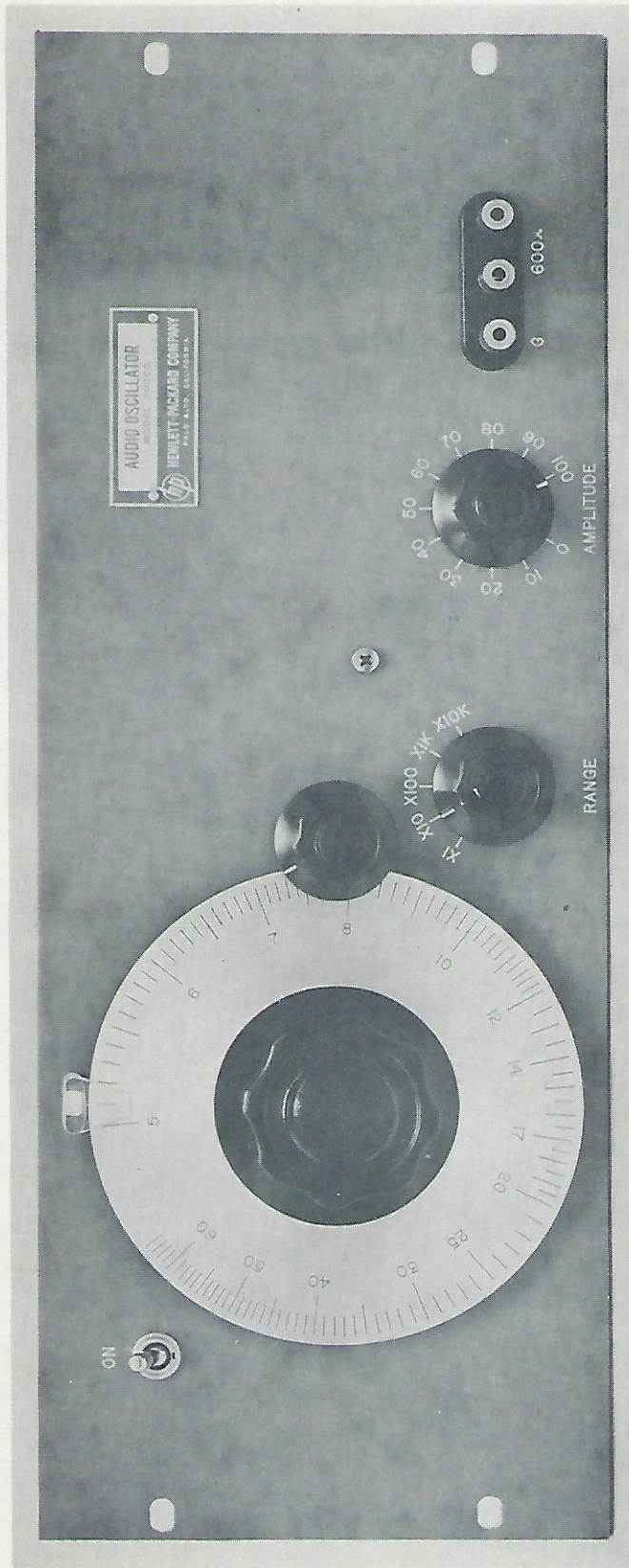


Fig. 4. Model 200CD Audio Oscillator (Rack Model)

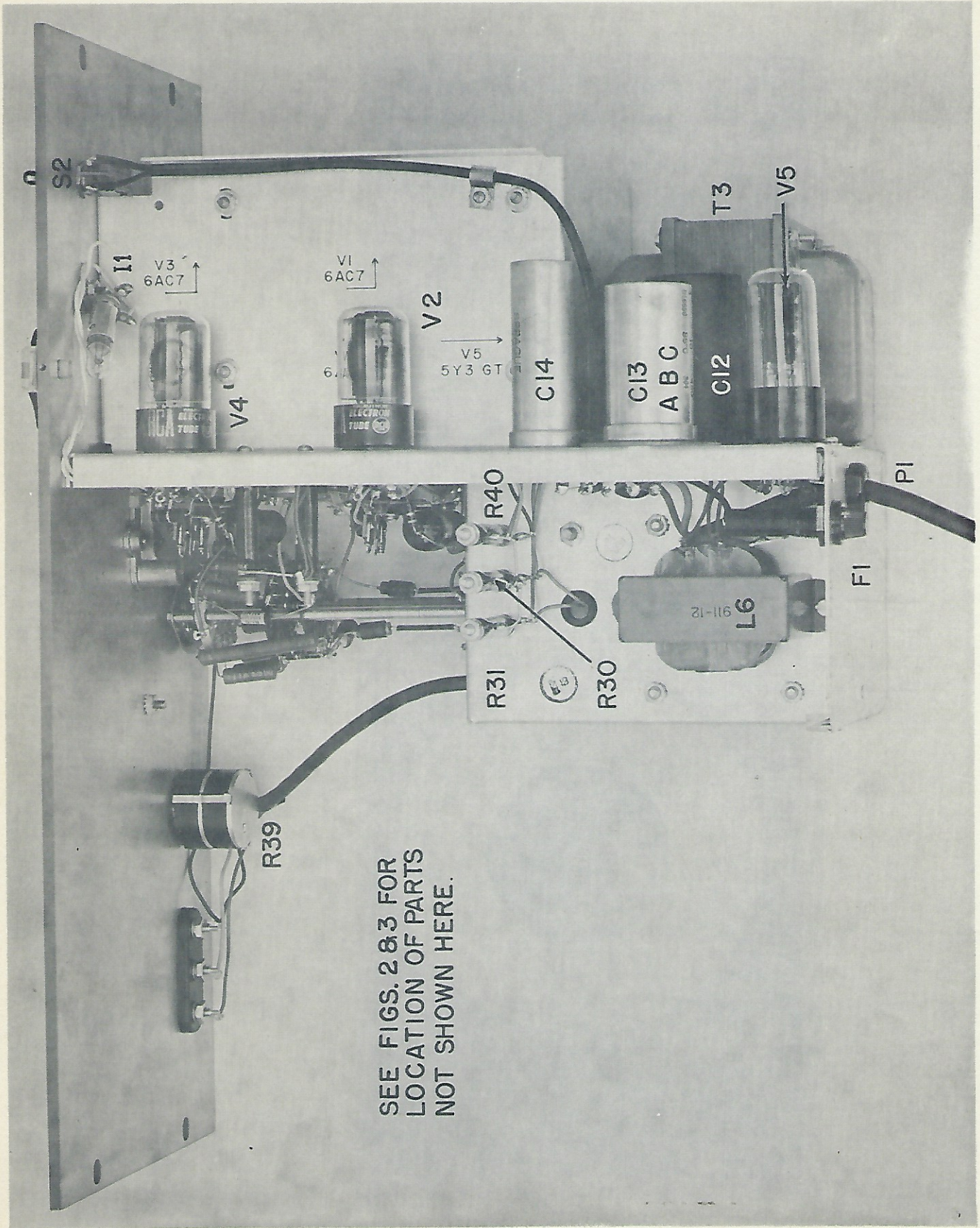


Fig. 5. Model 200CD Interior View of Rack Model

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
C1	Part of Range Switch Assembly		
C2	Part of Range Switch Assembly		
C3	Capacitor: variable, ceramic, 7 - 45 μ f, 500 vdcw	13-1	L TS2A
C4	Capacitor: fixed, ceramic, 39 μ f, \pm 5%, 500 vdcw	15-4	A, Hi-Q Div. CI-2
C5	Capacitor: variable, air, 3 section, 600 μ f per section	12-28	HP
C6	Capacitor: variable, ceramic, 7 - 45 μ f, 500 vdcw	13-1	L TS2A
C7	Capacitor: variable, ceramic, 1.5 - 7 μ f, 500 vdcw	13-7	L TS2A NPO
C8, C9	Capacitor: fixed, paper, .05 μ f, \pm 10%, 600 vdcw	16-15	CC 73P47396
C10, C11	Capacitor: fixed, mica, 100 μ f, \pm 10%, 500 vdcw	14-100	V Type OXM
C12	Capacitor: fixed, electrolytic, 100 μ f, 100 vdcw, non-polarized	18-25S	CC #D17345
C13	Capacitor: fixed, electrolytic, 10, 10, 10 μ f, 450 vdcw	18-31S	CC D16650
C14	Capacitor: fixed, electrolytic, 40 μ f, 450 vdcw	18-40S	CC D16653
C15	Capacitor: fixed, mica, 15 μ f, \pm 20%, 500 vdcw	14-15	V Type OXM
C16	Capacitor: fixed, titanium dioxide dielectric, 1.5 μ f, \pm 20%, 500 vdcw	15-38	DD GA-3
R1-R10	Part of Range Switch Assembly		
R11	Resistor: variable, composition, 1000 ohms, \pm 10%, linear taper	210-51	HP
R12	Resistor: fixed, composition, 3,000 ohms, \pm 1%, 1 W	24-3000-5	B GB 3025
R13, R14	Lamp: 10W, 250 volt, candelabra base	211-29	O, 10 S 6/10
R15, R16	Resistor: fixed, composition, 56 ohms, \pm 10%, 1/2 W	23-56	B EB 5601

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

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
R17, R18	Resistors: fixed, composition, 22,000 ohms, 10 W, ±10%	24-22K	B GB 2231
R19	Resistor: fixed, composition, 10 megohms, ±5%, 1/2 W	23-10M-5	B EB 1065
R20, R21	Resistor: fixed, composition, 68,000 ohms, ±10%, 1 W	24-68K	B GB 6831
R22	Resistor: fixed, composition, 10 megohms, ±5%, 1/2 W	23-10M-5	B EB 1065
R23, R24	Resistors: fixed, composition, 8.2 megohms, 1/2 W These resistors are a matched pair	200CD-67	HP
R25, R26	Resistor: fixed, composition, 56 ohms, ±10%, 1/2 W	23-56	B EB 5601
R27, R28	Resistor: fixed, wirewound, 500 ohms, ±10%, 10 W	26-5	S Type 1-3/4E
R29	Resistor: 470 ohms, Part of L4		
R30, R31	Resistors: fixed, wirewound, 2000 ohms, 10 W These resistors are a matched pair	200CD-26	HP
R32	Resistor: 470 ohms, Part of L5		
R33, R34	Resistors: fixed, composition, 300 ohms, ±5%, 1/2 W	23-300	B EB 3015
R35, R36	These circuit references not assigned		
R37, R38	Resistor: fixed, composition, 200 ohms, ±5%, 1/2 W	23-200	B EB 2015
R39	Delta Tee Variable Attenuator, 600 ohms	210-87	G #MX-149
R40	Resistor: fixed, wirewound, 10,000 ohms, 10 W	26-10	S Type 1-3/4E
R41	Resistor: fixed, composition, 18 ohms, ±10%, 1 W	24-18	B GB 1801
R42	This circuit reference not assigned		

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

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
	Binding Post:	312-3	HP
F1	Fuse: 1A, for 115V operation withstands 200% overload for 25 sec.	211-18	E, MDL-1
F1	Fuse: 1/2A, for 230 V operation withstands 200% overload for 25 sec.	211-20	E, MDL-1/2
	Knob: 1-1/2" diam.	37-11	HP
	Knob: 3" diam.	37-11	HP
I1	Lamp: Pilot	211-47	O, Mazda #47
	Pilot Lamp Socket:	38-65	JJ, #708-1
	Lampholder: (R13, R14)	38-89	JJ, #659-1
P1	Power Cable:	812-56	HP
L1	This circuit reference not assigned		
L2, L3	Reactor: RF, 3 millihenries	200CD-60C	HP
L4, L5	R. F. Filter: 25 μ H (wound on a 470 ohm 1 watt resistor)	200CD-60B	HP
L6	Reactor: 6 H @ 125 MA, 240 ohms	911-12	HP
S1	Range Switch Assembly:	200CD-19WA	HP
S2	Toggle Switch:	310-11	D, #20994-NV
T1	Output Transformer: High Frequency	912-37	HP
T2	Output Transformer: Low Frequency	912-38	HP
T3	Power Transformer:	910-94	HP
V1	Tube: 6SH7	212-6SH7	ZZ
V2	Tube: 6AU5GT or 6AV5GT	212-6AU5GT	ZZ
V3	Tube: 6SH7	212-6SH7	ZZ
V4	Tube: 6AU5GT or 6AV5GT	212-6AU5GT	ZZ
V5	Tube: 5Y3GT	212-5Y3GT	ZZ

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

200CD 3/5/54 Serial 2251 and above

LIST OF MANUFACTURERS CODE LETTERS
FOR REPLACEABLE PARTS TABLE

<u>Code Letter</u>	<u>Manufacturer</u>
A	Aerovox Corp.
B	Allen-Bradley Co.
C	Amperite Co.
D	Arrow, Hart and Hegeman
E	Bussman Manufacturing Co.
F	Carborundum Co.
G	Centralab
H	Cinch Manufacturing Co.
HP	Hewlett-Packard
I	Clarostat Manufacturing Co.
J	Cornell Dubilier Electric Co.
K	Hi-Q Division of Aerovox Corp.
L	Erie Resistor Corp.
M	Federal Telephone and Radio Corp.
N	General Electric Co.
O	General Electric Supply Corp.
P	Girard-Hopkins
R	International Resistance Co.
S	Lectrohm, Inc.
T	Littelfuse, Inc.
V	Micamold Radio Corp.
X	P. R. Mallory Co., Inc.
Z	Sangamo Electric Co.
AA	Sarkes Tarzian
CC	Sprague Electric Co.
DD	Stackpole Carbon Co.
EE	Sylvania Electric Products, Inc.
FF	Western Electric Co.
HH	Amphenol
II	Dial Light Co. of America
KK	Switchcraft, Inc.
LL	Greomar Mfg. Co.
MM	Carad Corp.
ZZ	Any tube having RETMA standard characteristics

12-1-53

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, type 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 (except tubes, fuses and batteries). 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 which upon our examination 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, type number and serial number. On receipt of this information, we will give you service instruction or shipping data.
2. On receipt of shipping instruction, forward the instrument prepaid, and repairs will be made at the factory. 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 Railway Express. The instruments should be packed in a wooden box and surrounded by two to 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*

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