

INSTRUCTION AND OPERATING MANUAL  
FOR

MODEL 210A  
SQUARE WAVE GENERATOR  
Serial 1112 and Above

HEWLETT-PACKARD COMPANY  
395 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

## General Description

The Model 210A Square Wave Generator is an excellent source of square waves having a fundamental frequency range of 20 to 10,000 cycles/sec. The instrument will operate with an input voltage of 2 to 200 volts and produce a maximum output voltage of 50 volts peak to peak, open circuit. An output attenuator is provided which will alternate the output voltage up to 70 DB. The output voltage is balanced to ground.

This square wave generator is useful for production and experimental tests of receivers, video amplifiers, networks, and transmitters.

## 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.

INSTRUCTIONS  
MODEL 210A  
SQUARE WAVE GENERATOR

Specifications

Frequency Range --

20 to 10,000 cycles/sec.

Input Voltage --

2 to 200 volts

Input Impedance --

25,000 ohms

Output Voltage --

50 volts peak to peak, open circuit

Output Voltage Wave Shape --

Voltage rises to 90% of maximum in 1 microsecond. Flat top of wave decays less than 1%.

Internal Impedance --

1000 ohms balanced to ground

Output Attenuator --

Total attenuator 70 db in 5 db steps. Attenuator does not affect the wave shape of the output voltage at frequencies below 10,000 cycles/sec.

Power Supply Rating --

Voltage - 115 volts  
Frequency - 50/60 cycles  
Wattage - 100 watts

### Overall Dimensions --

#### Cabinet Model -

15-1/4" wide x 7-1/4" high x 10-5/8" deep

#### Rack Model -

19" wide x 7" high x 10-3/4" deep

Panel - 19" wide x 7" high

Depth behind panel - 9-1/4"

### Weight --

Cabinet - 37 pounds

Rack - 38 pounds

### Operating Instructions

#### Inspection --

This instrument has been thoroughly tested and inspected before being shipped and is ready for use when received.

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

#### Controls and Terminals - -

INPUT - The binding posts marked INPUT and G are input terminals of the instrument. An external sine wave which is to be square is fed into the instrument through these terminals. The control marked INPUT is used to control the amplitude of the input voltage. This control is calibrated from 0 to 100 in arbitrary units.

OSC., 60 $\wedge$  - This toggle switch is provided so that an external voltage or a 60 cycles voltage from a secondary of the power transformer, may be supplied to the input of the instrument. When the switch is in the OSC. position the external voltage is used. In the 60 $\wedge$  position the voltage taken from the power transformer is used. The INPUT control does not control the amplitude of the internal voltage.

OFF, ON - This toggle switch controls the power supplied to the instrument from the power line. When the switch is in the ON position, the indicator in the center of the control panel is lighted.

DB - The attenuator is used to reduce an established output voltage by any number of decibels up to 70 db. The internal impedance remains constant regardless of the setting of the attenuator.

Output - This group of three binding posts are the output terminals of the instrument. The binding post marked G is connected to the chassis while the other two binding posts are connected to the attenuator.

Fuse - The fuse is located in a fuse block next to the power cable on the underside of the chassis. Remove the bottom plate to gain access to the fuse.

#### Operation --

The procedure for operating this instrument is as follows:

1. Turn the power switch to ON. Connect the OUTPUT terminals to the equipment under test.
2. If a 60 $\wedge$  square wave is desired, set the OSC. -60 $\wedge$  toggle switch to the 60 $\wedge$  position.
3. Set the toggle switch to the OSC. position and apply a sine wave voltage of the desired frequency to the INPUT terminals if a square wave other than the frequency of the power line is desired.

#### CAUTION

The maximum voltage applied to the INPUT terminals must not exceed 200 volts RMS.

4. If the input voltage does not exceed approximately 25 volts, the INPUT control should be set at 100. This control may be used to reduce the input voltage when voltages above 25 volts are encountered.
5. Adjust the attenuator (DB) for desired output voltage. The internal impedance of the output circuit is 1000 ohms balanced to ground. This impedance is not affected by the setting of the attenuator.

The output circuit may be used for single ended operation by connecting the equipment being driven between the ground (G) terminal and either of the other OUTPUT terminals. It is necessary to use a coupling capacitor and grid resistor between the output of the Model 210A and the grid of the tube being driven when the output circuit is connected for single ended operation.

When balanced output is desired, the balance between the two sides of the output circuit can be measured with a voltmeter. Connect a DC voltmeter between the two OUTPUT terminals and measure the voltage. A voltage between the terminals of not more than 3 volts represents a satisfactory balance.

## Circuit Description

The Model 210A Square Wave Generator is designed to change a sine wave into a square wave.

Tubes V1 and V2 amplify and clip the peaks of the sine wave applied to the input terminals of the instrument. Tube V3 serves as a phase inverter which feeds the partially squared wave to the two sections of the direct coupled amplifier consisting of tubes V4, V5, V6, V7. The two output tubes V5 and V7 feed into the output attenuator which controls the amplitude of the square wave obtained at the output terminals.

Two power supplies are provided to meet the requirements of the direct coupled amplifier.

## Maintenance

### Cover and Bottom Plate Removal --

The cover is removed by unscrewing the four screws which fasten the cover to the back of the instrument and sliding the cover toward the rear of the instrument.

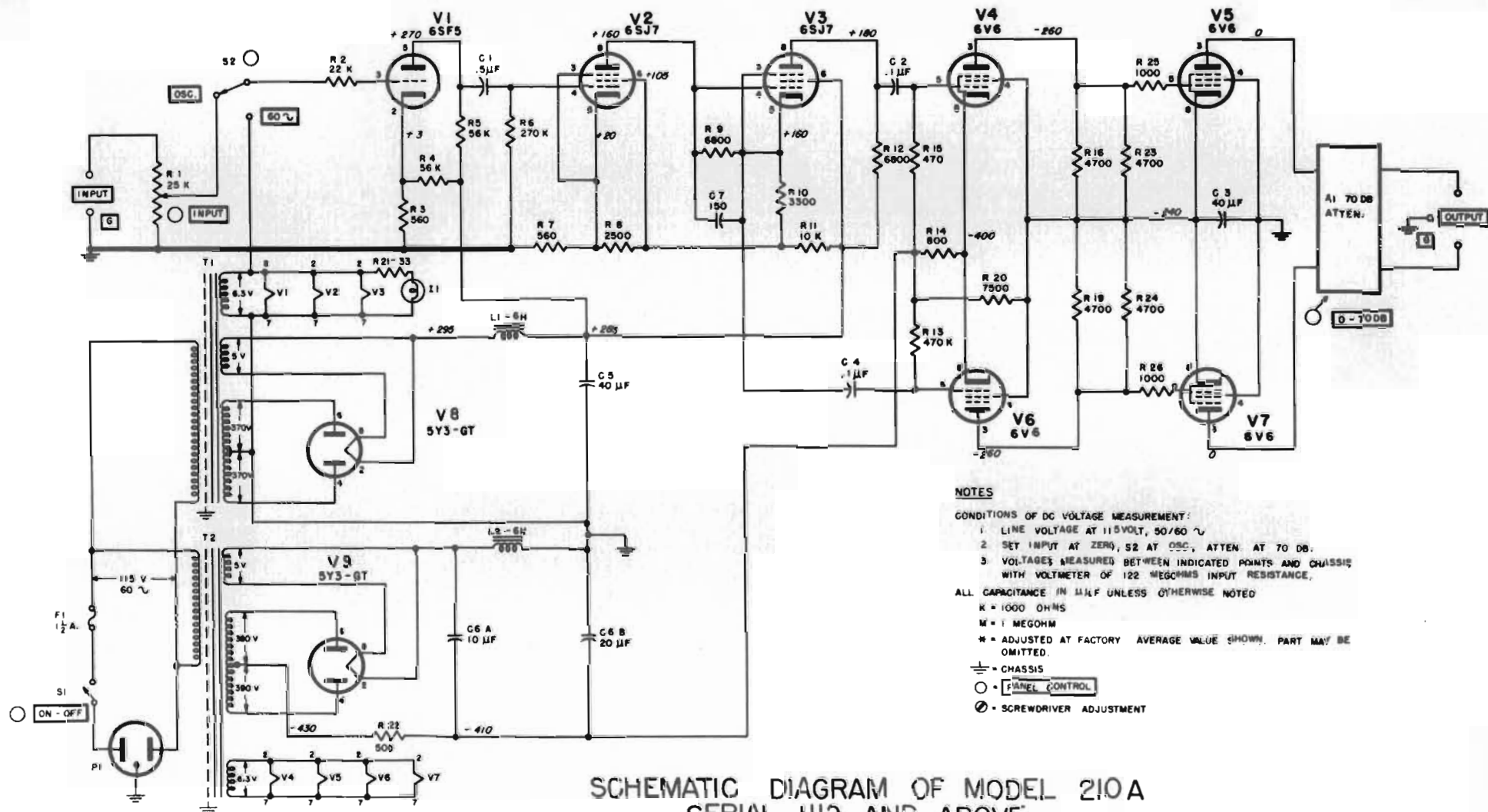
The bottom plate is removed by unscrewing the four screws, one in each corner of the bottom plate, which fasten the plate to the chassis.

### Tube Replacement --

When replacing tube V5 and/or V7, the output should be checked to see that the replacement tube has not caused excessive unbalance. It may be necessary to try several tubes before a satisfactory tube is found.

### Trouble Shooting --

<u>Symptoms</u>	<u>Causes</u>	<u>Remedies</u>
Instrument inoperative (indicator lamp won't light, no square wave output)	Blown fuse	Clear short circuit and replace fuse
Instrument inoperative (Indicator lamp lights)	Defective tube; Check both 5Y3GT tubes first	Replace defective tube
	Short circuit in capacitor C5, C6AB, or C3.	Replace defective capacitor
	The resistance across C5 should be at least 11,000 ohms and the resistance across C6A should be at least 300,000 ohms.	



SCHEMATIC DIAGRAM OF MODEL 210 A  
SERIAL 1112 AND ABOVE



SQUARE WAVE GENERATOR  
HEWLETT-PACKARD

100  
80  
60  
40  
20  
0  
10  
20  
30  
40  
50  
60  
70  
80  
90  
100

100  
80  
60  
40  
20  
0  
10  
20  
30  
40  
50  
60  
70  
80  
90  
100

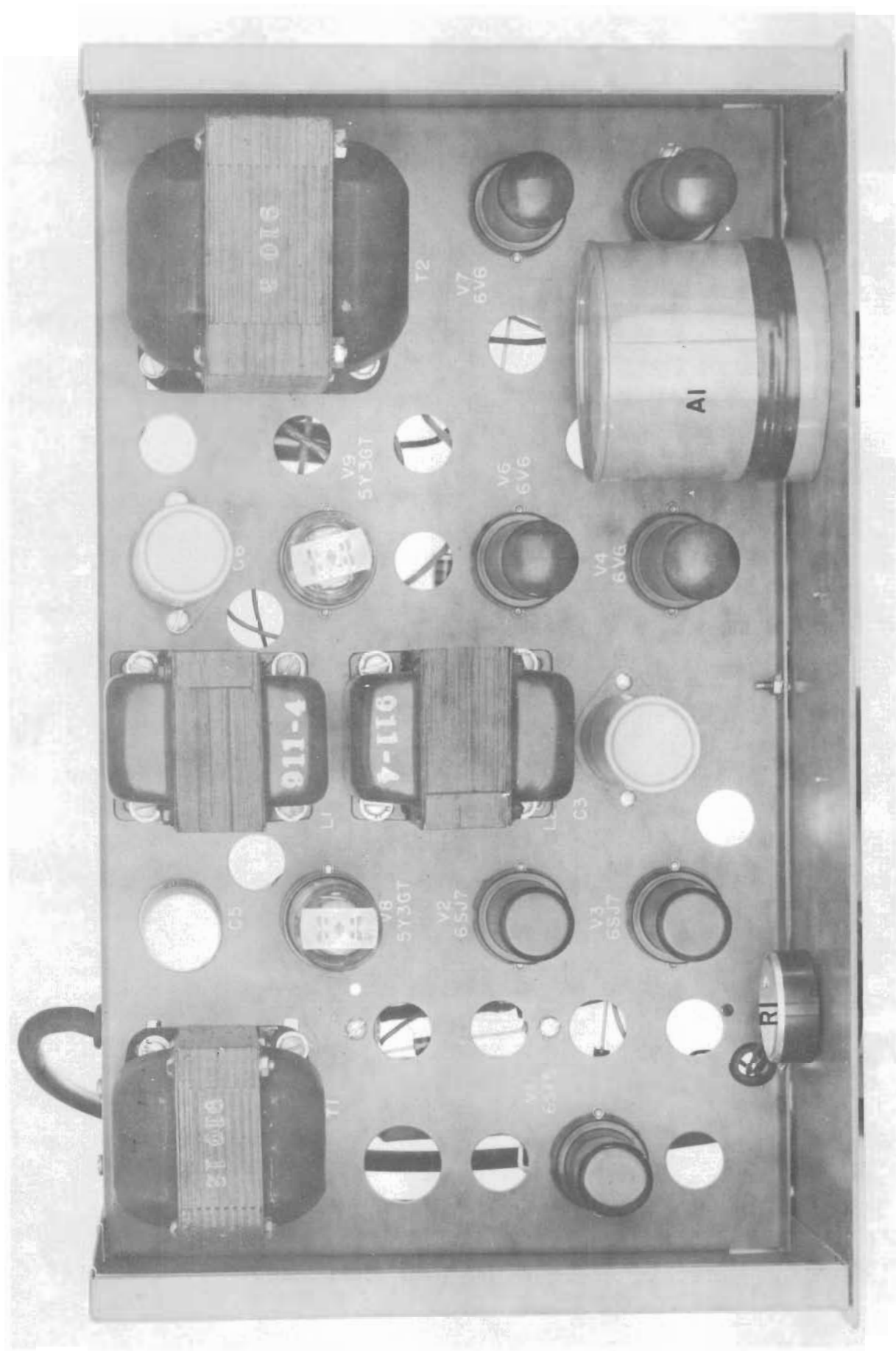
OUTPUT

ON  
OFF

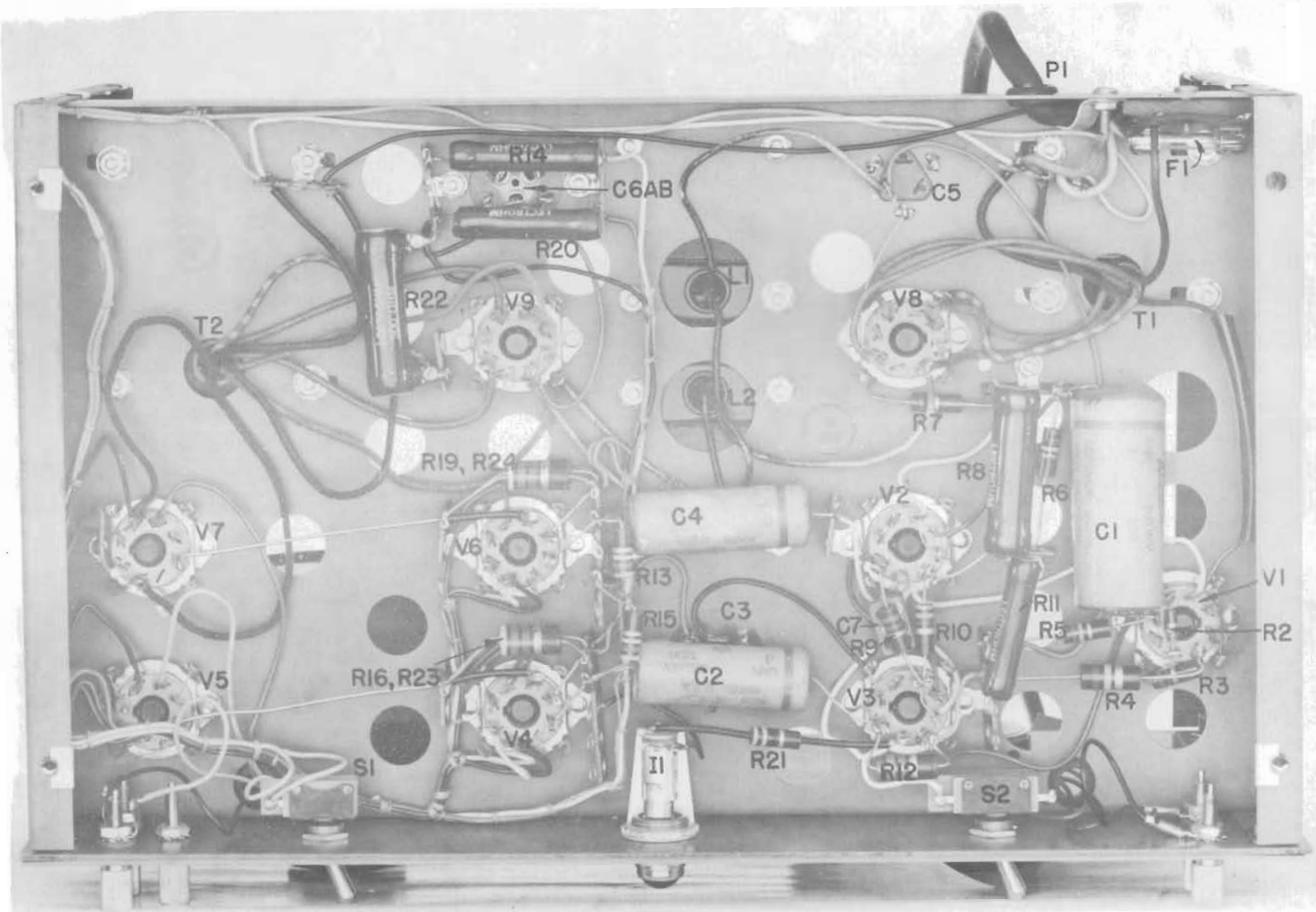
60~

INPUT





Model 210A Top View. Cover Removed



Model 210A Bottom View. Bottom Plate Removed

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. & Mfrs. Designation
C1	Capacitor: fixed, paper, .5 mf, - 10% - 20%, 600 vdcw	16-5	A Type 684
C2	Capacitor: fixed, paper, .1 mf; - 10% - 20%, 1000 vdcw	16-6	A Type 1084
C3	Capacitor: fixed, electrolytic, 40 mf, 450 vdcw	18-40	X FPS-146
C4	Capacitor: fixed, paper, .1 mf; - 10% - 20%, 1000 vdcw	16-6	A Type 1084
C5	Capacitor: fixed, electrolytic, 40 mf; 450 vdcw	18-40	X FPS-146
C6, A,B	Capacitor: fixed, electrolytic, 10, 10, 10 mf; 450 vdcw	18-31	X FPT-389
C7	Capacitor: fixed, mica, 150 mf; $\pm 10\%$ , 500 vdcw	14-150	V Type OXM
R1	Resistor: variable, composition, 25,000 ohms; linear taper	210-54	B JU 2531
R2	Resistor: fixed, composition, 22,000 ohms; $\pm 10\%$ 1/2W	23-22K	B EB 2231
R3	Resistor: fixed, composition, 560 ohms; $\pm 10\%$ 1 W	24-560	B GB 5611
R4	Resistor: fixed, composition, 56,000 ohms; $\pm 10\%$ 2 W	25-56K	B HB 5631
R5	Resistor: fixed, composition, 56,000 ohms; $\pm 10\%$ 1 W	24-56K	B GB 5631
R6	Resistor: fixed, composition, 270,000 ohms; $\pm 10\%$ 1 W	24-270K	B GB 2741
R7	Resistor: fixed, composition, 560 ohms; $\pm 10\%$ 1 W	24-56	B GB 5611
R8	Resistor: fixed, wirewound, 2500 ohms; $\pm 10\%$ 20 W	27-2	S Type 2R

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. & Mfrs. Designation
R9	Resistor: fixed, composition, 6800 ohms $\pm 10\%$ 1 W	24-6800	B GB 6821
R10	Resistor: fixed, composition, 3300 ohms; $\pm 10\%$ 1 W	24-3300	B GB 3321
R11	Resistor: fixed, wirewound, 10,000 ohms; $\pm 10\%$ 10 W	26-10	S Type 1 3/4 E
R12	Resistor: fixed, composition, 6800 ohms; $\pm 10\%$ 2 W	25-6800	B HB 6821
R13	Resistor: fixed, composition, 470,000 ohms; $\pm 10\%$ 1 W	24-470K	B GB 4741
R14	Resistor: fixed, wirewound, 800 ohms; $\pm 10\%$ 10 W	26-6	S Type 1 3/4 E
R15	Resistor: fixed, composition, 470,000 ohms; $\pm 10\%$ 1 W	24-470K	B GB 4741
R16	Resistor: fixed, composition, 4700 ohms; $\pm 10\%$ 1 W	24-4700	B GB 4721
R17	This circuit reference not assigned:		
R18	This circuit reference not assigned:		
R19	Resistor: fixed, composition, 4700 ohms; $\pm 10\%$ 1 W	24-4700	B GB 4721
R20	Resistor: fixed, wirewound, 7500 ohms; $\pm 10\%$ 10 W	26-9	S Type 1 3/4 E
R21	Resistor: fixed, composition, 33 ohms $\pm 10\%$ 1 W	24-33	B GB 3301
R22	Resistor: fixed, wirewound, 500 ohms; $\pm 10\%$ 20 W	27-5	S Type 1 3/4 E
R23	Resistor: fixed, composition, 4700 ohms; $\pm 10\%$ 1 W	24-4700	B GB 4721
R24	Resistor: fixed, composition, 4700 ohms; $\pm 10\%$ 1 W	24-4700	B GB 4721

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
R25, R26	Resistor: fixed, composition 1000 ohms, $\pm 10\%$ , 1/2W	23-1000	B EB 1021
	Attenuator:	21A-34	HP
	Attenuator Dial:	21A-41	HP
	Binding Post:	312-3	HP
	Input Dial:	21A-9	HP
F1	Fuse: 1.5 A, 3 AG type	211-8	T, 31201.5
	Fuseholder:	312-7	T, 351011
	Indicator Lamp Assembly:	312-10	BB, #807BS
	Knob 2" diam.	37-13	HP
I1	Lamp:	211-47	O, Mazda #47
	Panel Plate:	21A-43A	HP
P1	Power Cable:	812-56	HP
L1, L2	Reactor: 6 H @ 125 MA, 240 ohms:	911-4	HP
S1	Switch: Toggle SPST	310-11	D
S2	Switch: SPDT	310-12	D
T1	Transformer: Power	910-12	HP
T2	Transformer: Power	910-3	HP
V1	Tube: 6SF5	212-6SF5	ZZ
V2	Tube: 6SJ7	212-6SJ7	ZZ
V3	Tube: 6SJ7	212-6SJ7	ZZ
V4	Tube: 6V6	212-6V6	ZZ
V5	Tube: 6V6	212-6V6	ZZ
V6	Tube: 6V6	212-6V6	ZZ
V7	Tube: 6V6	212-6V6	ZZ
V8	Tube: 5Y3GT	212-5Y3GT	ZZ
V9	Tube: 5Y3GT	212-5Y3GT	ZZ

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

# 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.
I	Clarostat Manufacturing Co.
J	Cornell Dubilier Electric Co.
K	Electrical Reactance Co.
L	Erie Resistor Corp.
M	Federal Telephone and Radio Corp.
N	General Electric Co.
O	General Electric Supply Corp.
P	Girard-Hopkins
HP	Hewlett-Packard
Q	Industrial Products Co.
R	International Resistance Co.
S	Lectrohm, Inc.
T	Littelfuse, Inc.
U	Maguire Industries, Inc.
V	Micamold Radio Corp.
W	Oak Mfg. Co.
X	P.R. Mallory Co., Inc.
Y	Radio Corp. of America
Z	Sangamo Electric Co.
AA	Sarkes Tarzian
BB	Signal Indicator Co.
CC	Sprague Electric Co.
DD	Stackpole Carbon Co.
EE	Sylvania Electric Products, Inc.
FF	Western Electric Co.
GG	Wilkor Products, Inc.
HH	Amphenol
II	Dial Light Co. of America
JJ	Leecraft Manufacturing Co.
ZZ	Any tube having RMA standard characteristics



## 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*

395 PAGE MILL ROAD



PALO ALTO, CALIFORNIA