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INSTRUCTION AND OPERATING MANUAL

FOR

MODEL 400A

VACUUM TUBE VOLTMETER

Serial 8504 and Above

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

General Description

The Model 400A Vacuum Tube Voltmeter is an accurate voltmeter with high sensitivity and high input impedance. Alternating current voltages as small as .005 volts and up to 300 volts at frequencies from 10 cycles/sec. to 1 megacycle/sec. may be measured with the voltmeter. The input impedance is high enough so as not to disturb the majority of circuits being measured.

The Model 400A is useful for laboratory work where quick and accurate measurements of amplifier gain, network response hum level, and output level are to be made.

The higher voltage ranges are useful for measuring power circuit voltages and high frequency voltages in broadcast and television equipment.

CAUTION

THE MAXIMUM VOLTAGE APPLIED TO THE INPUT TERMINALS OF THE MODEL 400A VACUUM TUBE VOLTMETER MUST NOT EXCEED 600 VOLTS, THE SUM OF THE DC VOLTAGE AND THE AC PEAK VOLTAGE. HIGHER VOLTAGES WILL BREAK DOWN THE CAPACITORS IN THE INPUT SYSTEM OF THE INSTRUMENT.

CAUTION

Replacement of Electrolytic Capacitors

The electrolytic capacitors (except C8, C12) 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.

.6
.3

20
.03
.60

INSTRUCTIONS

MODEL 400A

VACUUM TUBE VOLTMETER

20
.03
.60

Specifications

Voltage Ranges --

Volts Full Scale (RMS) -

.03 .1 .3 1 3 10 30 100 300

DB -

-30 -20 -10 0 +10 +20 +30 +40 +50

Frequency Range --

10 cycles/sec. to 1 MC.

Accuracy --

±3% of full scale indication on all ranges, from 10 cycles/sec. to 100 Kc.
±5% of full scale indication on all ranges, from 100 Kc to 1 Mc.

Meter Calibration --

Meter calibrated to RMS value of a sine wave.
Linear voltage scales 0-1V and 0-3V.
Voltage ranges related by 10 db steps
Zero Level - 1 milliwatt into 600 ohms

Voltmeter Stability --

Line voltage variations from 105 to 125 volts will cause less than ±2% variation in reading on all frequencies below 100 Kc and less than ±3% on all frequencies between 100 Kc and 1 Mc.

Input Impedance --

Input shunt capacity approximately 25 μμf.

Input shunt resistance:
.03 to 30 volts range - 1 megohm
100 volts range - 3 megohms
300 volts range - 2.4 megohms

Overload Capacity --

Meter will not be damaged by occasional overloads of 100 times normal.

400A 10/8/53 Serial 8456 to

Power Supply Rating --

Voltage - 115 volts
Frequency - 50/60 cycles
Wattage - 40 watts

Overall Dimensions --

7-9/16" wide x 9-1/2" high x 10-1/4" deep

Weight --

15 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, it 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 --

ON - This toggle switch controls the power supplied to the instrument from the power line. When the switch is in the ON position, the red indicator will glow.

DB-R.M.S. VOLTS - This rotary switch connects the proper multiplier resistors into the circuit for the desired voltage range. The position of the switch indicates the meter scale and the full scale voltage of the range in use. The switch position also indicates the DB level (instrument connected across 600 ohms) when the meter pointer indicates zero on the DB scale.

Input Terminals - The two binding posts, located in the lower left corner of the control panel, are connected to the input circuit of the instrument. The lower binding post is connected to the chassis.

CAUTION

THE MAXIMUM VOLTAGE APPLIED TO THE INPUT TERMINALS OF THE MODEL 400A VACUUM TUBE VOLTMETER MUST NOT EXCEED 600 VOLTS, THE SUM OF THE DC VOLTAGE AND THE AC PEAK VOLTAGE. HIGHER VOLTAGES WILL BREAK DOWN THE CAPACITORS IN THE INPUT SYSTEM OF THE INSTRUMENT.

FUSE - The fuseholder, located on the back of the chassis, contains a 1 ampere cartridge fuse. The fuse may be replaced by unscrewing the fuseholder and inserting a new fuse.

Power Cable - The power cable consists of three conductors. Two of these conductors carry power to the instrument while the third conductor (green wire) is connected to the instrument chassis. The third wire projects from the cable near the plug end of the cable and may be connected to a ground when it is desirable to have a grounded chassis.

Operation --

Zero Meter Indication - The meter pointer may not coincide with the zero scale mark when the instrument is turned off. This condition is normal.

The zero adjustment screw is set for optimum meter tracking accuracy and then the screw is sealed.

Voltage Measurements - Plug the power cable into a 115 volt power line and turn the toggle switch to ON. Allow the instrument about five minutes to reach a state of stable operation. Set the DB-R.M.S. VOLTS range switch to the desired voltage range and connect the input terminals to the voltage being measured. The meter scale multiplying factor (DB-R.M.S. VOLTS switch position divided by the full scale value of the meter scale in use) times the meter indication equals the voltage being measured.

Examples:

A. 100 (DB-RMS VOLTS switch position) ÷ 1 (full scale value of meter scale in use) = 100 (Meter scale multiplying factor)

100 (Meter scale multiplying factor) x .83 (meter scale indication) = 83 volts (measured voltage)

B. 30 (DB-RMS VOLTS switch position) ÷ 3 (full scale value of meter scale in use) = 10 (meter scale multiplying factor)

10 (meter scale multiplying factor) x 2.3 (meter scale indication) = 23 volts (measured voltage)

As a precaution in maintaining accuracy of measurement, it must be kept in mind that the instrument is an average-reading device. Although the calibration on the face of the instrument is marked RMS VOLTS, this simply means that the meter will read the rms value of a true sine wave. If the waveform of the voltage being measured contains appreciable harmonic voltages or other spurious voltages, errors in measurement will be encountered of a magnitude indicated by the following table.

% Harmonic	True RMS Value	Model 400A Indication	Peak Meter Indication
0	100	100	100
10% 2nd	100.5	100	90 to 100
20% 2nd	102	100 - 102	80 to 120
50% 2nd	112	100 - 110	75 to 150
10% 3rd	100.5	96 - 104	90 to 110
20% 3rd	102	94 - 108	80 to 120
50% 3rd	112	90 - 116	108 to 150

DB Measurement - Decibel measurements are made in the same way as voltage measurements except that the DB scale is used and the measurements must be made across 600 ohms, if the 1 milliwatt across 600 ohms reference level is to be used. The difference between two or more voltages, measured in decibles, may be read directly from the Model 400A provided each measurement is made across the same value of impedance. The decibel level being measured is determined by sum of difference of the meter scale indication and the range switch indication. The plus or minus signs before the meter scale figures, determine whether the meter scale indication is to be added or subtracted from the decibel level shown by the range switch.

Examples:

C. Interpreting the range switch position and meter scale indication for a level of +12 db. Measured across 600 ohms with one milliwatt across 600 ohms as the reference level.

+10 db (DB-RMS VOLTS switch position) plus +2 db (db meter scale indication) = +12 db or
+20 db (DB-RMS VOLTS switch position) plus -8 db (db meter scale indication) = +12 db

D. Interpreting the range switch position and meter scale indication for the difference between two voltages, measured in decibels, across the same value of impedance.

Voltages equal -37 db and +12 db.
-30 db (DB-RMS VOLTS switch position) plus -7 db (db meter scale indication) = -37 db
+10 db plus +2 db (from Example C) = (-) +12 db
49 db (total decibel difference between the two voltages)

Zero Meter Indication - The meter pointer may not coincide with the zero scale mark when the instrument is turned off. This condition is normal.

The zero adjustment screw is set for optimum meter tracking accuracy and then the screw is sealed.

Accessories

Several accessories are available which may be used to extend the voltage range of the Model 400A or adapt the instrument to measure small alternating currents. These accessories are not supplied with the instrument but may be purchased from the Hewlett-Packard Co. The accessories and their specifications are listed below.

Model 452 Capacitive Voltage Divider --

Extends the voltage range of the Model 400A to 25,000 volts.
Maximum voltage - 25,000 volts
Frequency Range - 25 cycles/sec. to 20 megacycles/sec.
Accuracy - ±3%
Division Ratio - 1000:1
Input Capacity - 15 μμf

Model 470A - 470F Shunt Resistors --

These shunt resistors adapt the Model 400A for current measurements.
Accuracy - ±1% of 100,000 cycles/sec.
±5% of 2 megacycles/sec.
Maximum Power Dissipation - 1 watt

Model	Shunt Resistance	Model	Shunt Resistance
470A	.1 ohm	470D	100 ohms
470B	1 ohm	470E	600 ohms
470C	10 ohms	470F	1000 ohms

Circuit Description

The circuit of the Model 400A Vacuum Tube Voltmeter consists of a cathode follower input stage, a stabilized amplifier, a rectifier and meter section, and a regulated power supply.

The voltage applied to the input terminals is passed through a blocking capacitor to the grid of the 6J5 cathode-follower input stage. The cathode resistor is a tapped precision wirewound resistor which serves as the voltmeter multiplier on all but the two highest ranges. On the latter two ranges a high-resistance frequency-compensated voltage divider is switched across the input terminals and ahead of the grid of the first tube.

The cathode follower feeds into a broad-band resistance-coupled amplifier using 6AC7 tubes. Negative feedback is used in this amplifier in order to

obtain high stability and uniform response over a wide frequency range, and to make the amplifier more independent of variations in tube characteristics.

From the amplifier the voltage is passed to a full wave rectifier using a 6H6 duo-diode tube. The indicating meter is connected from one plate to the opposite cathode of the tube and therefore is actuated by a portion of the plate current of the two diodes.

Direct current for the plate supply of the tubes in the instrument is obtained from a conventional full-wave rectifier feeding into a resistance-capacity filter. A voltage-regulating circuit across the output of the rectifier keeps the plate supply voltage constant over a wide range of line voltages.

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 away from the panel.

The bottom plate is fastened to the instrument with four screws, one in each corner of the plate.

Tube Replacement --

The replacement of tubes will have a slight effect upon the calibration of this instrument, especially at frequencies below 100 Kc. Tubes which differ widely from the average type characteristics can however, affect calibration at frequencies above 100 Kc, and for this reason it is desirable that the calibration be checked if possible when 6AC7 and 6H6 tubes are replaced.

Now and then, when replacing 6AC7 tubes, a permanent defflection of the meter pointer will be observed with the input terminals shorted and when the new tube has heated. This condition is usually caused by cathode-heater leakage and the tube should be rejected in favor of another.

When replacing 6H6 and/or 6AC7 tubes, it is desirable to check the voltage response of the new tube if the voltmeter is being operated from an unregulated line voltage. This check can be made by applying a constant voltage to the input terminals and varying the line voltage ±10 volts from 115 volts. The voltmeter reading should not change by more than 3% at frequencies below 100 kc nor by more than 5% at frequencies below one megacycle. Try another tube if necessary.

Checking Calibration --

Probably the most accurate method which can be used in the field to check the calibration of the Model 400A is a test using a cathode-ray oscilloscope and a freshly calibrated dynamometer type voltmeter.

After the new tube has heated in the Model 400A, apply a low-frequency (50-60 cps) voltage simultaneously to both the Model 400A and the dynamometer type voltmeters. Readings to the two instruments should agree closely. Try another tube if necessary.

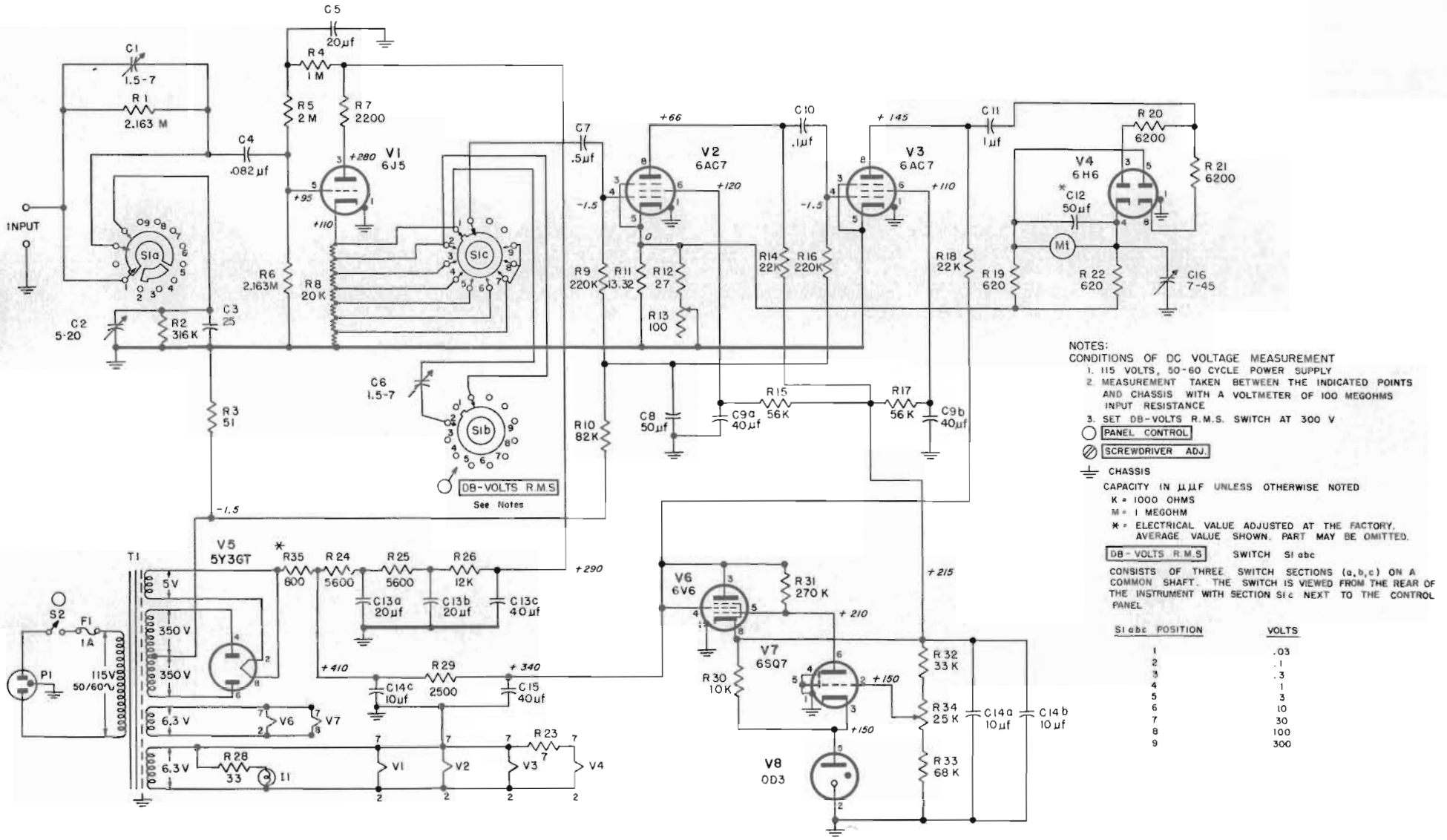
Next, calibrate the cathode-ray tube of the oscilloscope by applying a low-frequency sinusoidal voltage simultaneously to the dynamometer voltmeter and to the vertical-deflecting electrodes of the c-r tube. No horizontal sweep voltage should be used. Directions for connecting to the deflecting electrodes of the tube are usually given by the manufacturer of the oscilloscope. By measuring the peak-to-peak deflection of the c-r tube trace with a graph screen and by noting the reading of the voltmeter, the deflection voltage of the c-r tube can be quickly determined. It is important that the voltage used to calibrate the c-r tube be essentially sinusoidal and free from harmonics.

Now connect the Model 400A in parallel with the vertical-deflecting plates of the c-r tube and apply sinusoidal voltages of frequencies up to one megacycle to the combination of the two instruments. The voltage shown by the Model 400A should agree closely with that indicated by the magnitude of deflection of the c-r tube trace. If such is not the case, try another new tube in the Model 400A and repeat the process.

The above procedure will give a reasonable check at all frequencies within the range of the Model 400A, although a check cannot be made of small voltages. Low voltage ranges can be checked by starting with a voltage within one of the ranges checked on the oscilloscope and working downward. For example, if the accuracy and frequency response of the 100 volt range of the Model 400A have been checked on the oscilloscope, apply a 25-volt wave to the Model 400A and note the reading on the 100-volt range. Then switch to the 30-volt range and note that the reading is correct. By extending this procedure, all ranges of the instrument can be checked.

Although the above methods will not give precision results, they will often prove helpful in determining whether or not old tubes have exceeded their service life or new tubes are satisfactory to use.

Beyond changing tubes, it is not recommended that repair or calibration of this instrument be attempted in the field, because of the elaborate equipment required. The Hewlett-Packard Company will recalibrate the instrument quickly and at nominal charge. Use of this service will usually save a great deal of time.



NOTES:
CONDITIONS OF DC VOLTAGE MEASUREMENT

1. 115 VOLTS, 50-60 CYCLE POWER SUPPLY
2. MEASUREMENT TAKEN BETWEEN THE INDICATED POINTS AND CHASSIS WITH A VOLTMETER OF 100 MEGOHMS INPUT RESISTANCE
3. SET DB-VOLTS R.M.S. SWITCH AT 300 V

○ PANEL CONTROL

⊘ SCREWDRIVER ADJ.

⏚ CHASSIS

CAPACITY IN µµF UNLESS OTHERWISE NOTED
K = 1000 OHMS
M = 1 MEGOHM
* = ELECTRICAL VALUE ADJUSTED AT THE FACTORY. AVERAGE VALUE SHOWN. PART MAY BE OMITTED.

DB-VOLTS R.M.S. SWITCH S1 abc

CONSISTS OF THREE SWITCH SECTIONS (a,b,c) ON A COMMON SHAFT. THE SWITCH IS VIEWED FROM THE REAR OF THE INSTRUMENT WITH SECTION S1c NEXT TO THE CONTROL PANEL.

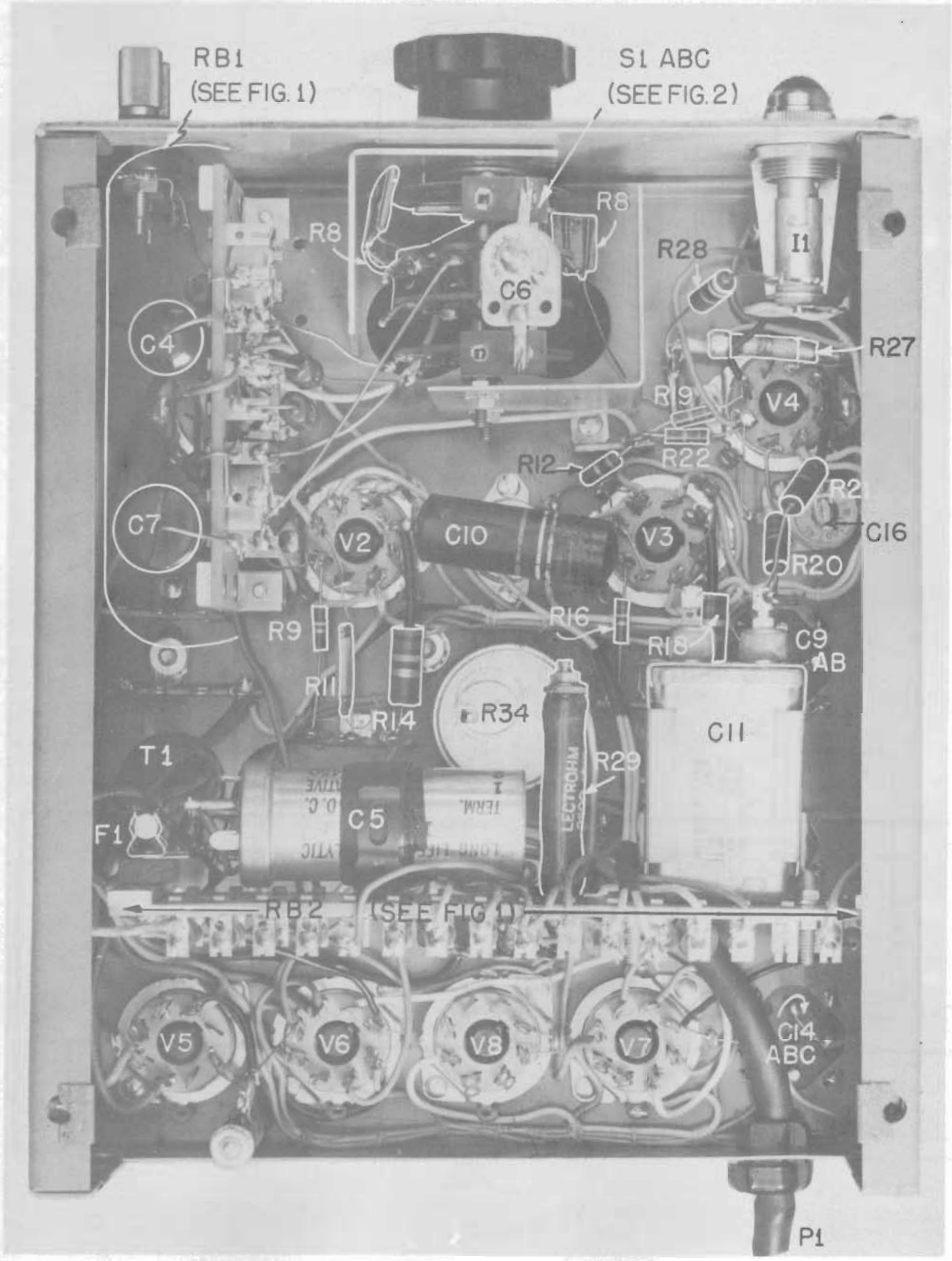
S1 abc POSITION	VOLTS
1	.03
2	.1
3	.3
4	1
5	3
6	10
7	30
8	100
9	300

SCHEMATIC DIAGRAM OF MODEL 400A

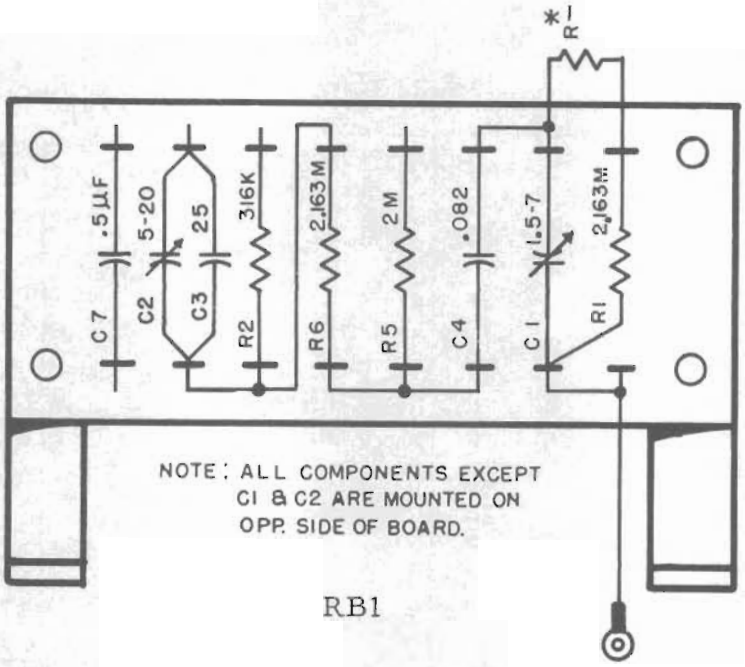
SERIAL 85048 ABOVE


R.M.S. VOLTS
DECIBELS - 1 MW. 600 Ω
MODEL 400 A
ON
R.M.S. VOLTS
DB

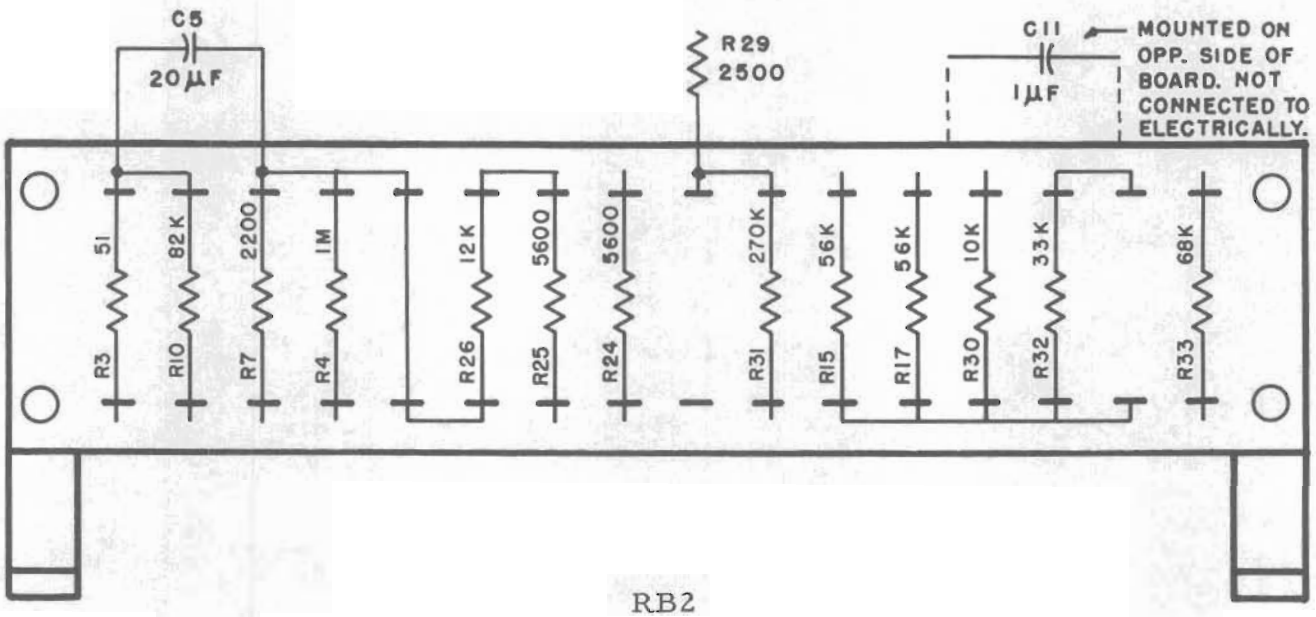
Model 400A. Top View Cover Removed



Model 400A Bottom View Bottom Plate Removed



RB1



RB2

Fig. 1. Model 400A Resistor Board Details

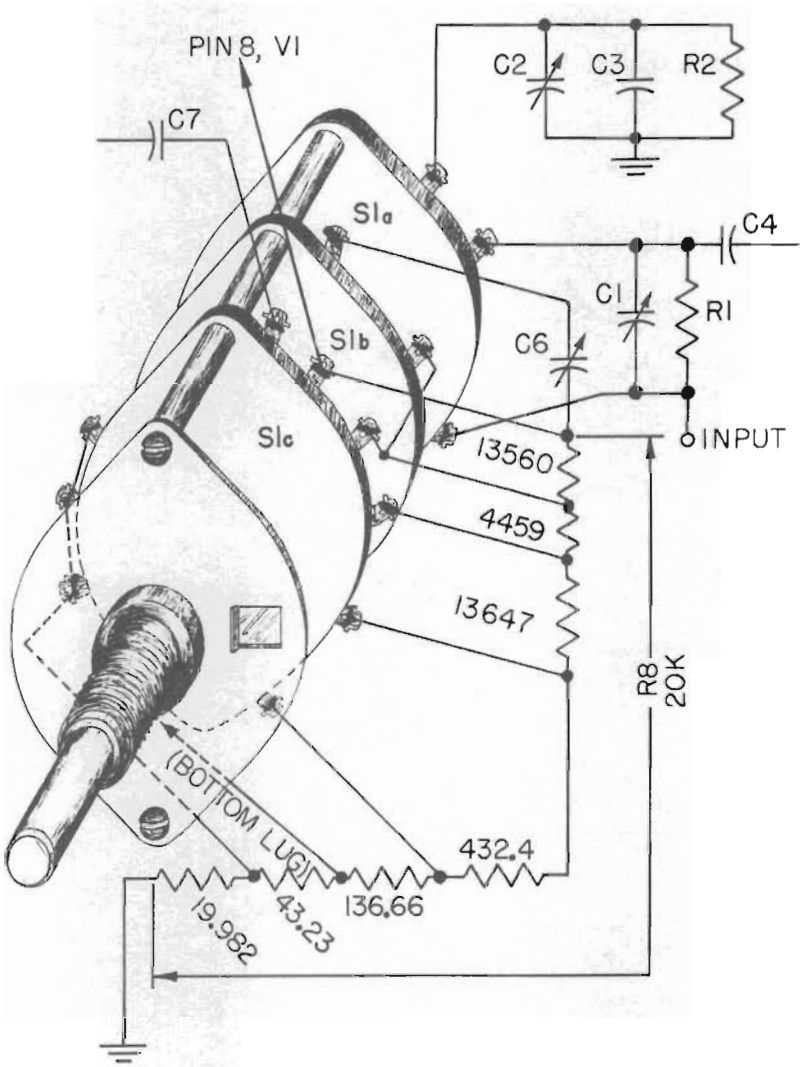


Fig. 2. S1 abc Switch Details

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
R1	Resistor: fixed, composition, 2.163 megohms, ±1%, 1 W	31-2.163M	GG Type CP-1
R2	Resistor: fixed, composition, 316,000 ohms, ±1%, 1 W	31-316K	GG Type CP-1
R3	Resistor: fixed, composition, 51 ohms, ±5%, 1 W	24-75	B GB 5105
R4	Resistor: fixed, composition, 1 megohm, ±10%, 1 W	24-1M	B GB 1051
R5	Resistor: fixed, composition, 2 megohms, ±1%, 1 W	31-2M	GG Type CP-1
R6	Resistor: fixed, composition, 2.163 megohms, ±1%, 1 W	31-2.163M	GG Type CP-1
R7	Resistor: fixed, composition, 2200 ohms, ±10%, 1/2 W	23-2200	B EB 2221
R8	Resistor: fixed, wirewound, 20,000 ohms, this resistor is part of the Range Switch Assembly. Resistor may be ordered separately under the stock number 4A-71.	4A-71	HP
R9	Resistor: fixed, composition, 220,000 ohms, ±10%, 1/2 W	23-220K	B EB 2241
R10	Resistor: fixed, composition, 82,000 ohms, ±10%, 1 W	24-82K	B GB 8231
R11	Resistor: fixed, wirewound, 13,32 ohms	4A-90	HP
R12	Resistor: fixed, composition, 27 ohms, ±10%, 1/2 W	23-27	B EB 2701
R13	Resistor: variable, wirewound, 100 ohms, linear taper	210-28	Muter Co. #10516
R14	Resistor: fixed, composition, 22,000 ohms, ±10%, 2 W	25-22K	B GB 2231
R15	Resistor: fixed, composition, 56,000 ohms, ±10%, 1 W	24-56K	B GB 5631

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

400A 10/9/53 Serial 8504 to -

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
R16	Resistor: fixed, composition, 220,000 ohms, ±10%, 1/2 W	23-220K	B EB 2241
R17	Resistor: fixed, composition, 56,000 ohms, ±10%, 1 W	24-56K	B GB 5631
R18	Resistor: fixed, composition, 22,000 ohms, ±10%, 2 W	25-22K	B GB 2231
R19	Resistor: fixed, composition, 620 ohms, ±5%, 1/2 W	23-77	B EB 6215
R20	Resistor: fixed, composition, 6200 ohms, ±5%, 1 W	24-86	B GB 6225
R21	Resistor: fixed, composition, 6200 ohms, ±5%, 1 W	24-86	B GB 6225
R22	Resistor: fixed, composition, 620 ohms, ±5%, 1/2 W	23-77	B EB 6215
R23	Resistor: fixed, wirewound, 7 ohms	26-18	I, CM 8027
R24	Resistor: fixed, composition, 5600 ohms, ±10%, 1 W	24-5600	B GB 5621
R25	Resistor: fixed, composition, 5600 ohms, ±10%, 1 W	24-5600	B GB 5621
R26	Resistor: fixed, composition, 12,000 ohms, ±10%, 1 W	24-12K	B GB 1231
R27	This circuit reference not assigned		
R28	Resistor: fixed, composition, 33 ohms, ±10%, 1 W	24-33	B GB 3301
R29	Resistor: fixed, wirewound, 2500 ohms, ±10%, 10 W	26-7	S Type 1-3/4
R30	Resistor: fixed, composition, 10,000 ohms, ±10%, 2 W	25-10K	B HB 1031
R31	Resistor: fixed, composition, 270,000 ohms, ±10%, 1 W	24-270K	B GB 2741
R32	Resistor: fixed, composition, 33,000 ohms, ±10%, 1 W	24-33K	B GB 3331

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

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
R33	Resistor: fixed, composition, 68,000 ohms, ±10%, 1 W	24-68K	B GB 6831
R34	Resistor: variable, composition, 25,000 ohms, linear taper	210-11	G BAI-010-1990
C1	Capacitor: variable, ceramic, 1.5 - 7 μμf, 500 vdcw	13-7	L TS2A-NPO
C2	Capacitor: fixed, mica, 25 μμf, ±10%, 500 vdcw	14-25	V Type OXM
C3	Capacitor: fixed, mica, 40 μμf, ±10%, 500 vdcw	14-40	V Type OXM
C4	Capacitor: fixed, oil filled paper, .082 μf, ±10%, 600 vdcw	16-70	CC #73P82396
C5	Capacitor: fixed, electrolytic, 20 μf, 450 vdcw	18-20S	CC D 16649
C6	Capacitor: variable, ceramic, 1.5 - 7 μμf, 500 vdcw	13-7	L TS2A-NPO
C7	Capacitor: fixed, paper, .5 μf, -10%, +20%, 600 vdcw	16-5	A Type 684
C8	Capacitor: fixed, electrolytic, 50 μf, 50 vdcw	18-50	X TC-39
C9 ab	Capacitor: fixed, electrolytic, 40, 40 μf, 450 vdcw	18-42S	CC D 16651
C10	Capacitor: fixed, paper, .1 μf, ±10%, 600 vdcw	16-1	A Type P688
C11	Capacitor: fixed, paper, 1 μf, ±10%, 600 vdcw	17-12	N 23F467G103
C12	Capacitor: fixed, electrolytic, 50 μf, -10%, +200%, 50 vdcw	18-50	X TC-39
C13 abc	Capacitor: fixed, electrolytic, 20, 20, 20, 20 μf, 450 vdcw	18-42S	CC D 16651
C14 abc	Capacitor: fixed, electrolytic, 10, 10, 10 μf, 450 vdcw	18-31S	CC D 16650
C15	Capacitor: fixed, electrolytic, 40 μf, 450 vdcw	18-40S	CC D 16653

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

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
C16	Capacitor: variable, ceramic, 7 - 45 μμf, 500 vdcw	13-1	L TS2A
	Binding Post:	312-3	HP
	Binding Post Insulator:	G-83A	HP
	Knob: 2" diam.	37-13	HP
F1	Fuse: 1A, 3AG type	211-1	T, 312001
	Fuseholder:	312-8	T, 342001
	Indicator Light Assembly:	312-10	BB, 807BS
I1	Lamp:	211-47	O, #47
M1	Meter:	112-6	HP
S1 abc	Range Switch Assembly: This assembly includes resistor R8	4A-19	HP
S2	Toggle Switch SPST	310-11	D, 20994-HW
	Power Transformer:	910-20	HP
	Power Cable:	812-56	HP
V1	Tube: 6J5	212-6J5	ZZ
V2	Tube: 6AC7	212-6AC7	ZZ
V3	Tube: 6AC7	212-6AC7	ZZ
V4	Tube: 6H6	212-6H6	ZZ
V5	Tube: 5Y3GT	212-5Y3GT	ZZ
V6	Tube: 6V6	212-6V6	ZZ
V7	Tube: 6SQ7	212-6SQ7	ZZ
V8	Tube: VR150	212-VR150	ZZ

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

LIST OF MANUFACTURERS CODE LETTERS FOR REPLACEABLE PARTS TABLE

Code Letter	Manufacturer
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