SERVICE NOTE

400D-4B

℗ MODEL 400D/H VACUUM TUBE VOLTMETERS
400D serial 17970 and below, 400H serial 2237 and below

REDUCTION OF RESIDUAL NOISE MODIFICATION KIT
℗ STOCK NO. 400D-95B

Residual noise indicated by the meters in the above instruments can be reduced by a modification of the input attenuator. A higher degree of residual noise reduction is obtained on the upper voltmeter ranges by this modification.

The input attenuator is changed from a capacity divider to a resistive divider system by the addition of a kit of parts available under ℗ Stock No. 400D-95B. All circuit changes are made on the Input Attenuator Resistor Board that is mounted directly behind the front panel INPUT terminals.

A frequency response adjustment outlined in these Service Notes will be required after this modification has been completed.

PARTS FURNISHED IN THE 400D-95B KIT

Quantity	Description	℗ Stock No.
1	Matched set of three resistors	400D-67
1	Capacitor, fixed, molded tubular, paper, 0.047 μf, ±10%, 600 vdcw	0160-0005
2	Resistor, fixed, composition, 10 ohms, ±10%, 1/2 watt	0687-1001
1	Resistor, fixed, composition, 27 ohms, ±10%, 1/2 watt	0687-2701
1	Resistor, fixed, composition, 100 ohms, ±10%, 1/2 watt	0687-1011
1	Resistor, fixed, composition, 47 ohms, ±10%, 1/2 watt	0687-4701
1	Label for input board shield	7124-0013
1	Service Notes (modification instructions).	400D-4B

MODIFICATION PROCEDURE

1) Remove the input attenuator resistor board shield. In 400H instruments, a small shield mounted below the power switch must also be removed.

2) Disconnect and save the variable ceramic trimmer (C4) connected between terminals A and C of the resistor board. Refer to figure 1. This variable capacitor for C4 will be replaced before the modification is completed.

3) Disconnect the end of the 0.01 μf disc capacitor for C3 to gain access to the resistors under C3.

4) Remove and discard resistors R3, R4, and R5.

5) Replace resistor R2 with a 100 ohm, ±10%, 1/2 watt resistor. Keep resistor lead lengths the same and reuse the sleeving and rubber grommet from the old resistor.

6) Mount the resistors supplied in the ℗ Stock No. 400D-67 Matched Resistor Set in the 400D-95B Modification Kit. The resistors in this matched set must not be overheated or scratched during installation.

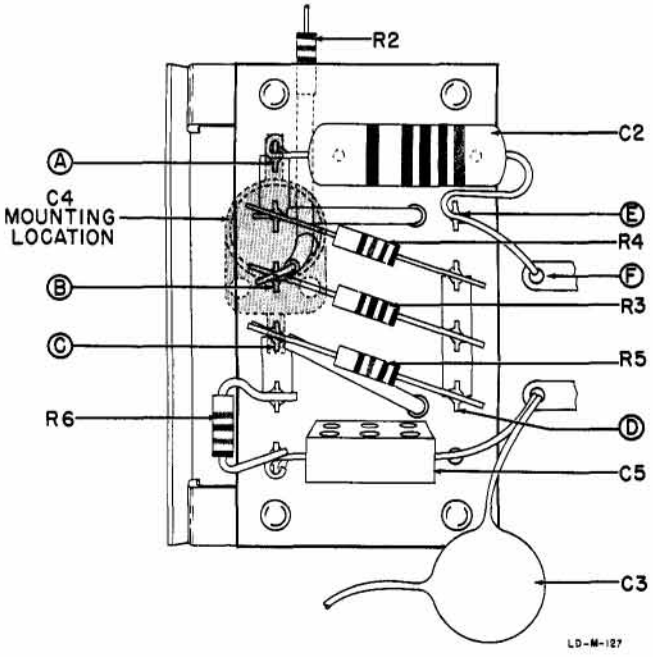

Figure 1. Input Resistor Board Before Modification

distribution abcefg$_4$p
00668-2

HEWLETT-PACKARD COMPANY
1501 PAGE MILL ROAD
PALO ALTO, CALIFORNIA, U.S.A.
CABLE: "HEWPACK" DAVENPORT 6-7000
RUE DU VIEUX BILLARD NO. 1
GENEVA, SWITZERLAND
CABLE: "HEWPACKSA" TEL. NO. (022) 26.43.66

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a. Install a 10.31 megohm, ±1%, 1 watt deposited carbon resistor for R4.

b. Install a 10,310 ohm, ±1%, 1 watt deposited carbon resistor for R3.

c. Install the remaining ±5% or ±10%, 1/2 watt composition resistor, if present, from the matched resistor set between resistor board terminals B and D. Keep this resistor close to the resistor board without touching R3. This is a padding resistor for R3 and will not be required or supplied in some matched resistor sets.

7) Install a short piece of solid bare wire between resistor board terminals C and D.

8) Reconnect capacitor C3 (disconnected in step 3) to resistor board terminal B.

9) Resistor R6 is composed of three 10%, 1/2 watt, composition resistors connected in parallel and mounted as shown in figure 1. There should be two 10 ohm resistors and one 27 ohm resistor. Use the resistors supplied in the modification kit to replace any or all resistors for R6 that do not have this value.

10) Replace the 0.01 μf tubular capacitor for C2 with the 0.047 μf, molded tubular capacitor supplied in the modification kit. Eliminate the wire jumper between resistor board terminal E and input terminal F when you make this capacitor change.

11) Install a 47 ohm, ± 10%. 1/2 watt, composition resistor for R86 between resistor board terminal E and input terminal F. This resistor replaces the wire jumper you omitted in step 10.

12) Resolder the variable ceramic trimmer capacitor for C4 between resistor board terminals A and C. This capacitor was removed from these two terminals in step 2.

13) Replace all shields removed in step 1.

14) Install the pressure sensitivity gummed label, describing C4 adjustment, on the input board shield adjacent to the access hold for C4.

FREQUENCY ADJUSTMENT PROCEDURE

Either one of two procedures can be used for the adjustment of C4. The method used will depend upon the test instruments that are available. One procedure requires an Ⓗ Model 650A Test Oscillator and a reference voltmeter having a flat frequency response from 400 cycles to 20 kilocycles. The other procedure requires a square wave signal source and a high frequency oscilloscope. The Ⓗ Model 211A Square Wave Generator and a 150A Oscilloscope with either a 151A or 152A/B Vertical Amplifier plug-in unit are recommended. The square wave can also be obtained from the internal Calibrator of the 150A Oscilloscope.

With either frequency response adjustment procedure the instrument cabinet must be in place when checking the final adjustment. Slide instrument slightly out of cabinet to adjust C4 and replace cabinet to check. The cabinet retaining screws are replaced only after adjustment is completed.

METHOD ONE

1) Temporarily replace cabinet on modified voltmeter.

2) Connect the output of an Ⓗ Model 650A Test Oscillator to the INPUT terminals of the modified voltmeter.

3) Connect the same output from the 650A to an accurate rms voltmeter. This reference voltmeter must have a flat frequency response from 400 cycles to 20 kilocycles. A second 400D or 400H can be used.

4) Set the voltmeter to be tested on the "1 VOLTS" range, turn the instrument on, and allow at least 5 minutes warm-up period.

5) Set the 650A oscillator to 400 cps and adjust amplitube to obtain nearly a full scale deflection on the voltmeter under test. Note the reading obtained on the reference voltmeter.

6) Change the input signal frequency to 20 kc and reset signal amplitude to obtain the same reference voltmeter reading.

7) Adjust C4 to obtain the same reading obtained in step 5 on the voltmeter under test.

8) Repeat steps 5, 6 and 7 until no further adjustment is required.

9) Disconnect the test equipment and install the cabinet retaining screws.

METHOD TWO

1) Temporarily replace cabinet on modified voltmeter.

2) Connect a 1 kc square wave signal to the input of the voltmeter under test.

3) Set the square wave signal source to provide a 2 volt peak-to-peak signal.

4) Connect the Ⓗ Model 150A Oscilloscope to the OUTPUT terminals of the modified voltmeter. An Ⓗ Model AC-21A Low Capacity probe must not be used for this connection.

5) Set the voltmeter to be tested on the "1 VOLTS" range, turn the instrument on, and allow at least a 5 minute warm-up period.

6) Adjust C4 for the best square wave on the oscilloscope.

7) Disconnect the test equipment and install the cabinet retaining screws.

Modification and adjustment of the 400D/H voltmeter is now complete. However, to assist during future maintenance, the data given on the following yellow page should be included in the Operating and Servicing Manual originally supplied with the instrument. Insert this page at any convenient point in the manual.

CHANGES IN OPERATING AND SERVICING MANUAL AFTER INSTALLATION OF 400D-95B MODIFICATION KIT IN AN ℗ MODEL 400D OR 400H VACUUM TUBE VOLTMETER

Make the following changes in the parts list

Change C2 from .01 μf to:
capacitor, fixed, paper dielectric, .047 μf, ±10%, 600 vdcw; ℗ Stock No. 0160-0005.

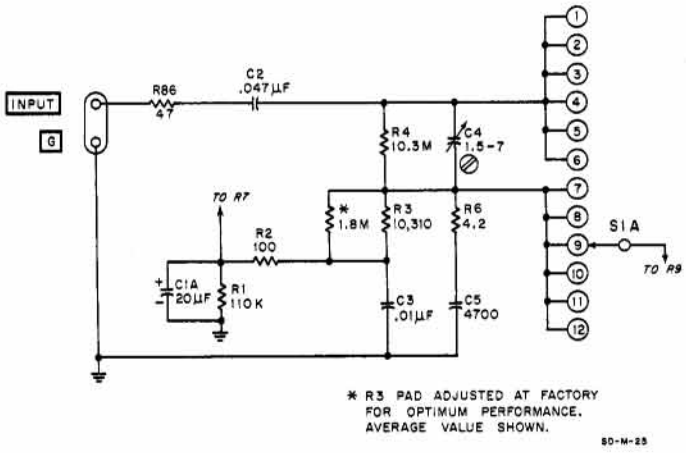
Change R2 from 1000 ohms to:
resistor, fixed, composition, 100 ohms, ±10%, 1/2 watt; ℗ Stock No. 0687-1011.

Change R3 from 9100 ohms to 10.31K and R4 from 10 megohms to 10.3M:
Matched resistor set; ℗ Stock No. 400D-67.

Delete resistor R5. This resistor is replaced by a wire jumper during the installation of the modification kit.

Add resistor R86
resistor, fixed, composition, 47 ohms, ±10%, 1/2 watt; ℗ Stock No. 0687-4701.

MAKE VOLTMETER SCHEMATIC DIAGRAM AGREE WITH THE FOLLOWING PARTIAL DIAGRAM



The 1000:1 input voltage divider which is switched into the input circuit for the one-volt range and above, has been changed from a capacitive to a resistive type divider. The 1000:1 voltage division is now determined at audio frequencies mainly by factory matched resistors R3 and R4 and very slightly by C4 which flattens the response of the 1000:1 divider at higher frequencies.

C4 also affects the calibration of the one-volt range and above even at low audio frequencies i.e.: 400 cps. The calibration process now becomes a part of the frequency-compensation adjustment process. Trimmer C4 has been properly set at the factory and should never need adjustment. If C4 is accidently disturbed the accuracy of the meter will be destroyed except at very low audio frequencies.

The procedures given in the manual for calibration and frequency response adjustment should be disregarded and any adjustments should be made as given below. The data in the manual is still valid regarding equipment required and accuracies necessary.

CALIBRATION PROCEDURE

CAUTION: If the setting of C4 has been disturbed, an approximate rough setting can be made by adjusting it so that the solder globule is at 3 o'clock, which is approximately 1/2 capacity.

1) Feed a 400 cps 0.300 volt signal into the meter. Adjust R29A so that the meter reads exactly 0.300 volt. If the adjustment of C4 has not been disturbed, the instrument should now be calibrated properly on all ranges. A check on the calibration can be made by proceeding as follows.

2) Feed 400 cps at 1.000 volt into the meter with a monitoring device connected in parallel with the meter input that has a flat frequency response preferably from 10 cps to 6.5 mc. Note the reading on the monitor.

3) Increase the input frequency to 20 kc. Adjust the signal level until the monitor indicates the same value of signal as before (1.000 volt).

4) The instrument should still read 1.000 volt. If it does not, the setting of C4 is not correct and should be adjusted slightly to bring the meter pointer onto the exact reading.

5) Check the calibration of the 1000:1 division by feeding in 400 cps signals of exactly 0.300 volt and 1.000 volt. Both voltages should give exactly full scale deflections on their respective ranges. If they do not, the precision 1000:1 resistive divider is off. If 0.3 volt is correct and 1.0 volt is reading high, decrease the value of the pad in parallel with R3. If 1.0 volt reads low, increase the value of the pad in parallel with R3.

FREQUENCY RESPONSE ADJUSTMENTS

The adjustments for frequency response are somewhat similar to the manual but should be adjusted in the following sequence and at the frequencies specified.

1) Set the frequency response on the 0.1 volt range at 4 mc with C21.

2) Set the frequency response on the 0.01 volt range at 4 mc with C16.

3) Set the frequency response on the 1.0 volt range at 20 kc with C4.

4) Set the frequency response on the 1.0 volt range at 4 mc by adjusting the value of R6.

5) Set the frequency response on the 3.0 volt range at 4 mc with C14.

6) The instrument should now be calibrated correctly for any frequency on any range.