



**DM 501
DIGITAL
MULTIMETER**

INSTRUCTION MANUAL

**Tektronix, Inc.
P.O. Box 500
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Serial Number B154057

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This Tektronix product is warranted against defective materials and workmanship, under normal use, for a period of one year from date of initial shipment. Tektronix will repair or replace, at its option, those products determined to be defective within the warranty period and returned, freight prepaid, to a Tektronix Service Center. There is no implied warranty for fitness of purpose.

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OPERATING INSTRUCTIONS

INTRODUCTION

Description

The DM 501 Digital Multimeter measures dc and ac voltage and current, resistance and temperature. The ac functions respond to average values, and display rms values. A single front-panel control selects all functions and ranges. A push-button selects front panel input or rear interface connector input. Temperature measurements are made using a TEKTRONIX P6058 Probe, or other suitable sensing devices. Option 1 instruments are shipped without the P6058 probe. Front-panel pin jacks provide external temperature readout, independent of the function being displayed. An internal switch selects degrees calibration in either Celsius or Fahrenheit. Option 2 instruments delete the temperature measuring capability.

The readout is a 4 1/2-digit stored display using seven-segment LED. The decimal point is automatically positioned by the RANGE/FUNCTION switch and leading zeros (those to the left of the decimal point or most significant digit) are blanked. Polarity indication is automatic. A blinking display indicates over-range. Serial bcd output is available at the rear interface connector.

Installation and Removal

CAUTION

Turn the power module off before inserting the plug-in; otherwise, damage may occur to the plug-in circuitry. It is also recommended that the power module be turned off before removing the DM 501. Refer to Fig. 1-1. Check to see that the plastic barriers on the interconnecting jack of the selected power module compartment match the cut-outs in the DM 501 circuit board edge connector.

Align the DM 501 chassis with the upper and lower guides of the selected compartment. Push the module in and press firmly to seat the circuit board in the interconnecting jack.

To remove the DM 501, pull on the release latch located in the lower left corner until the interconnecting jack disengages and the DM 501 will slide out.

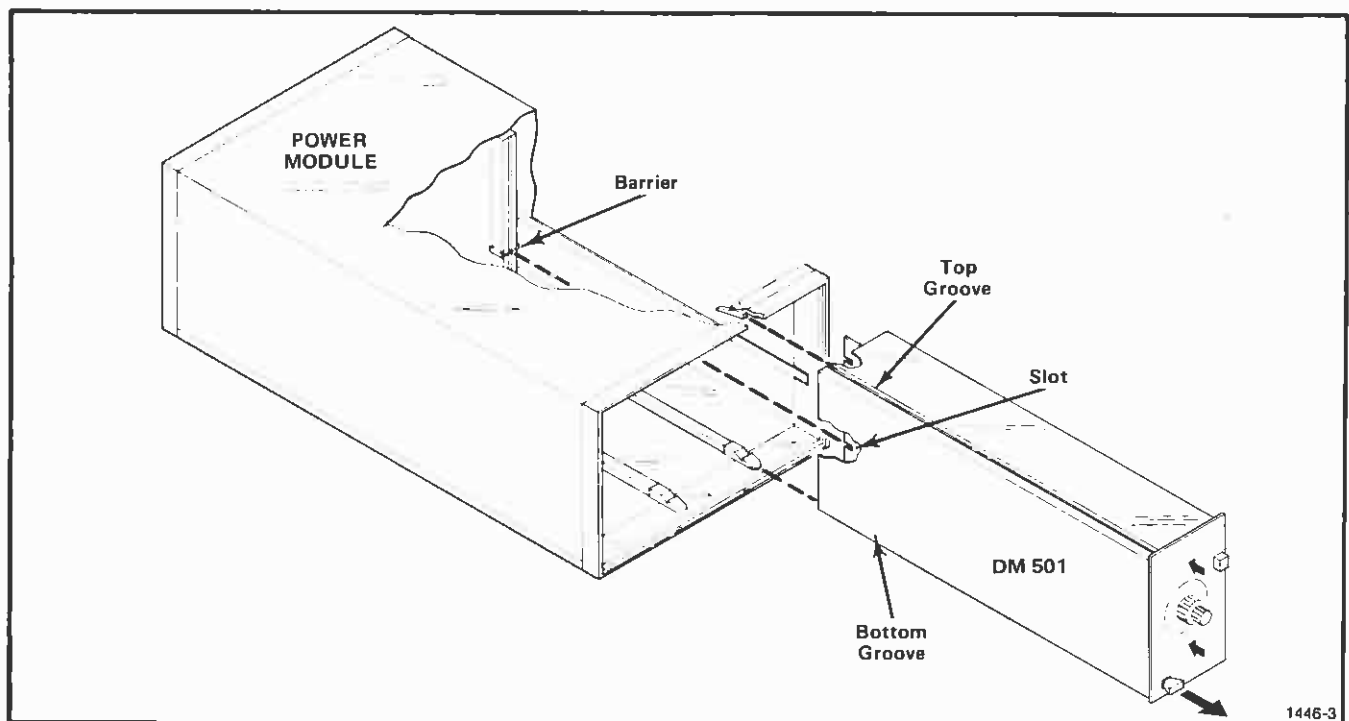


Fig. 1-1. Plug-In Installation and removal.

Controls and Connectors

Refer to Fig. 1-2. Even though the DM 501 is fully calibrated and ready to use, the functions and actions of the controls and connectors should be reviewed before attempting to use it. Pull the power switch on the power module to apply power to the DM 501. One or more characters in the LED display should now be visible. Rotate the RANGE/FUNCTION switch from the 2000 DC mA position to the 2 DC mA position. The decimal point must be visible in the right character position and move one position left as the switch is rotated through each step. No characters are visible to the left of the decimal point, except the polarity sign.

Three binding posts provide measurement connections. The HI and LO posts are normally used for all measurements except temperature. Normal measurement conditions will be with the LO terminal ungrounded. A connection between the LO and GND post may be made to reference the input against DM 501 chassis ground. Use caution, as the LO terminal is then connected to earth ground through the three-wire power cord, and false readings may be obtained due to ground loops.

If the INPUT button is pushed in, signal inputs are made via the rear interface connector; if the button is out, signal inputs are made via the front panel HI and LO terminals. The TEMP PROBE connector mates with the P6058 probe. It is also used with other temperature sensing devices.

Two front-panel pin jacks labeled TEMP OUT provide an output at 10 mV per degree, into loads of more than two kilohms, for external recorders or other readout devices.

OPERATING CONSIDERATIONS

Introduction

With the DM 501 properly installed in the power module, allow twenty minutes warmup time for operation to specified accuracy. When the value of the quantity being measured is unknown, select the highest range first. Decrease the range setting until the display blinks indicating over-range. Increase the range switch to the next higher position. This method obtains maximum resolution. Resolution of the DM 501 is 0.005 percent of full scale setting, except temperature, which is 0.1 degree. Do not exceed the maximum voltage ratings. With the RANGE/FUNCTION switch in the 1 K DC VOLTS or 500 AC VOLTS positions, internal damage may result before overrange is indicated.

Overheating

The DM 501 is designed to operate at an ambient temperature from 0 degrees Celsius to +50 degrees Celsius. However, when operating several power supplies in a multi-plug-in power module, especially at low output voltages, or when operating close to other heat-producing equipment, internal temperature may exceed safe limits and actuate a thermal cutout in the power module. Refer to the power module instruction manual for more complete information.

Using a Transistor as a Temperature-Sensing Device

Certain NPN transistors such as a 2N2484 can be used as separate sensors in place of the probe with little or no selection of the transistor. Connect the temperature-sensing transistor to the DM 501 through the TEMP PROBE connector as illustrated in Fig. 1-3. Accuracy without recalibration of the DM 501 is within ± 5 degrees Celsius for measurements from -55 degrees Celsius to $+125$ degrees Celsius. If the measurement to be made requires greater accuracy, check the calibration of the DM 501. Place the sensing device in an environment having a known ambient temperature. Use any difference between the known temperature and the DM 501 readout as a correction factor throughout the entire measurement range.

Using the P6058 as a Voltage Measuring Probe

The P6058 probe can be used as a 1X voltage measuring probe. See the probe instruction manual for required accessories and probe use. Internal connections must be made in the DM 501 as shown in Fig. 1-4. When the INPUT button is depressed, the P6058 is connected to the DM 501 input for voltage measurements. Connect the probe ground strap to the circuit common and the probe tip to the voltage being measured.

To make these connections, unsolder the white-with-red striped wire and the white-with-brown striped wire from the holes in the circuit board in the illustration. Tape the ends of these wires. Cut and strip two wires about 1.5 inches in length. Connect these wires as shown in the illustration.

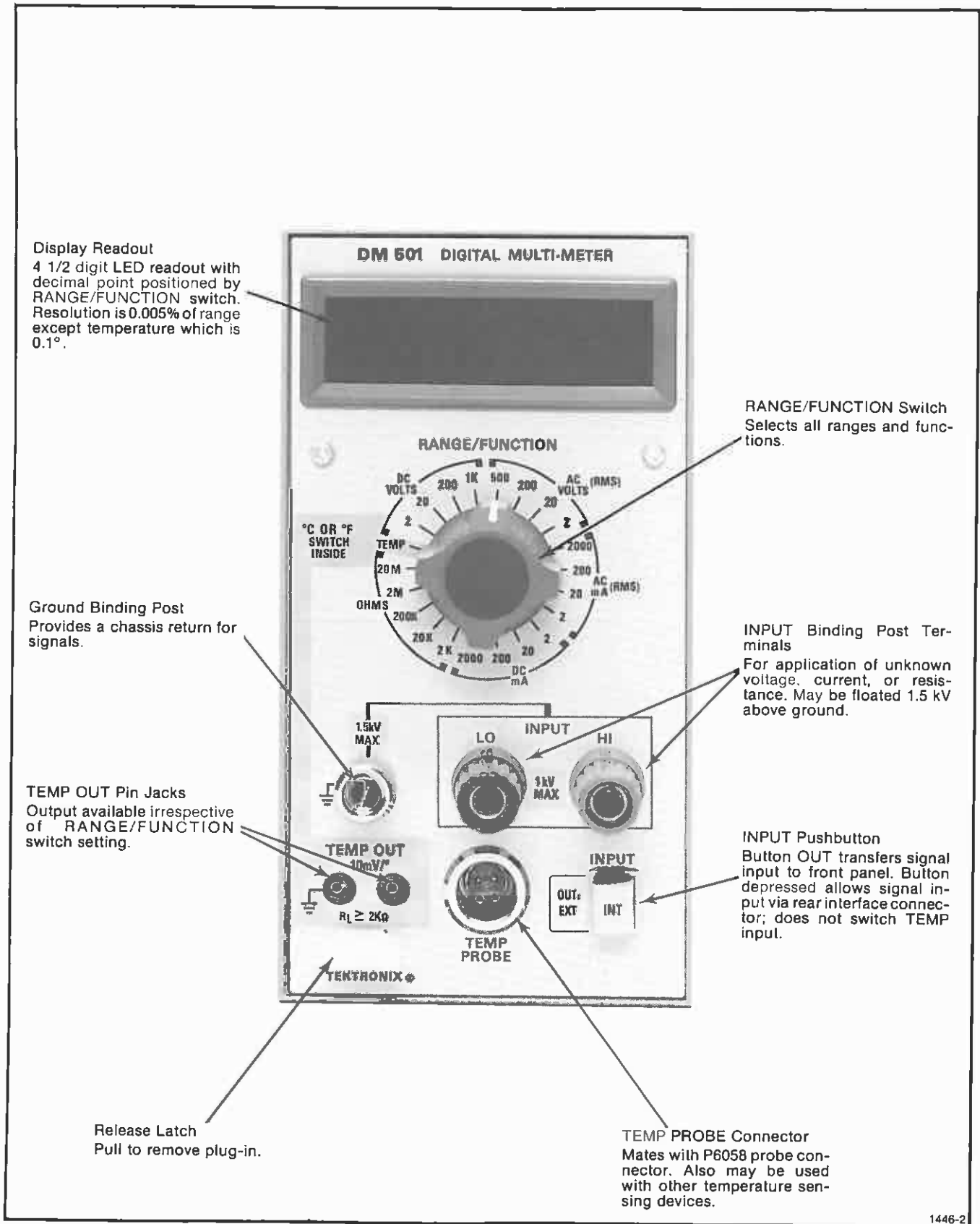


Fig. 1-2. DM 501 controls and connectors.

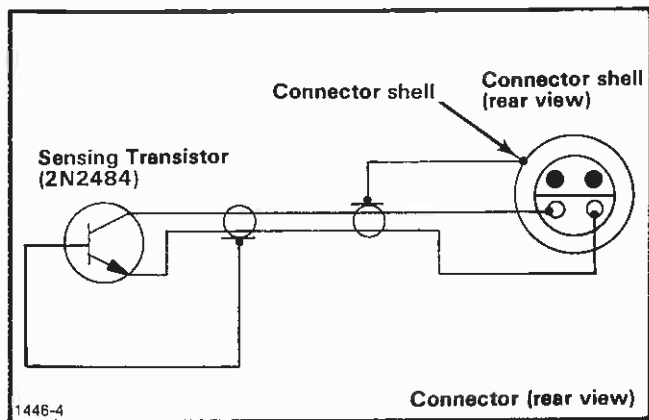


Fig. 1-3. Illustration of temperature-sensing transistor connected to probe connector.

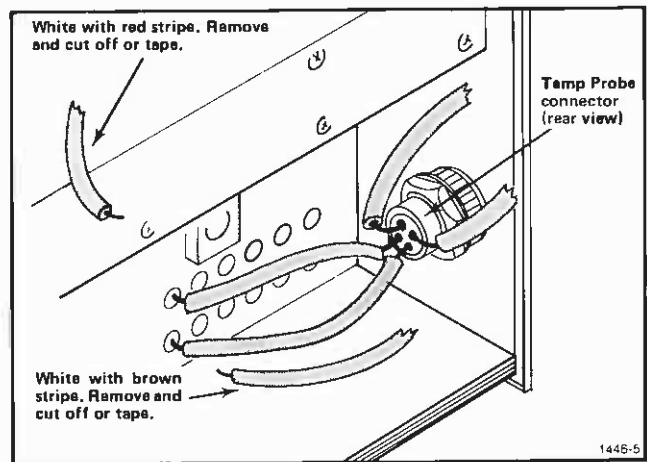


Fig. 1-4. Illustration of Temp Probe connector and circuit board connections when using the P6058 probe as a voltage-measuring probe.

SPECIFICATION AND PERFORMANCE CHECK

SPECIFICATION

Performance Conditions

The electrical characteristics are valid only if the DM 501 has been calibrated at an ambient temperature between the +20-degrees Celsius and +30-degrees Celsius and is operating at an ambient temperature between +15-degrees Celsius and +35-degrees Celsius unless otherwise noted.

Sine-Wave Response

The DM 501 responds to the average value of a sinusoidal current or voltage. The readout indicates the equivalent rms value. The effective or rms value of a sine wave is 0.707 times the peak voltage or current. The average value (equivalent dc output of a full wave rectifier) is 0.636 of the peak value. The scale factor of the DM 501 is 0.636/0.707 or 0.9. Multiply the DM 501 readout by 0.9 to obtain the average value of a sinusoidal input voltage or current.

DC Voltage Measurements

Select an appropriate full range DC VOLTS position on the RANGE/FUNCTION switch. Apply the voltage to be measured to the INPUT binding posts. Observe the maximum voltage ratings as indicated on the front panel. The readout displays a + if the HI input is positive with respect to the LO input. A - is displayed if the LO input is more positive. With the input shorted, the display reads zero, plus or minus one count.

DC Current Measurements

Select an appropriate full scale DC mA position on the RANGE/FUNCTION switch. Apply the dc current to be measured to the INPUT binding posts. A current (electron flow) into the LO connector and out of the HI connector indicates + on the display. For opposite current flow, a - will be displayed.

AC Voltage, Current, and Resistance Measurements

Select an appropriate full scale AC VOLTS, AC mA, or OHMS position on the RANGE/FUNCTION switch. Connect the unknown voltage, current, or resistance to the INPUT binding posts.

Temperature Measurements

With the P6058 Probe connected to the front panel connector labeled TEMP PROBE, set the RANGE/FUNCTION switch to the TEMP position. Apply the probe sensor tip to the device being measured. For optimum temperature transfer, coat the surface of the device being measured with silicon grease and apply the probe tip squarely to the surface. Allow sufficient time for the probe tip to stabilize before taking a reading. The time required depends upon several factors. Generally, when the tip is first applied to the device under test, the readings change rapidly. As the probe tip temperature approaches the temperature of the device under test, the readings change less rapidly, and finally stabilize. The readings are in degree Celsius or degree Fahrenheit, depending on the position of the internal TEMP SCALE switch S125. See the P6058 Probe manual for more information on temperature measurements and probe use.

Items listed in the Performance Requirements column of the Electrical Characteristics are verified by completing the Performance Check in this manual. Items listed in the Supplemental Information column are not verified in this manual; they are either explanatory notes or performance characteristics for which no limits are specified.

Table 2-1
ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
DC VOLTMETER		
Range 2 V, 20 V, 200 V, 1000 V Accuracy	$\pm 0.1\%$ of reading, ± 2 counts	
Common Mode Rejection	≥ 100 dB at dc, 80 dB at 60 Hz with a 1 k Ω unbalance.	
Normal Mode Rejection	≥ 30 dB at 60 Hz increasing 20 dB per decade	
Step Response Time	<1 s.	
Input Resistance		10 M Ω
AC VOLTMETER		
Range 2 V, 20 V, 200 V, 500 V Accuracy	$\pm 0.7\%$ of reading, ± 2 counts 40 Hz to 10 kHz. $\pm 1.2\%$ of reading, ± 2 counts, 20 Hz to 20 kHz.	Usable to 100 kHz. Typically <5% down between 0.4 V and 500 V at 100 kHz.
Response Time	10 s.	
Input Impedance		10 M Ω paralleled by <70 pF.
OHMMETER		
Range 2 k Ω , 20 k Ω , 200 k Ω , 2 M Ω , 20 M Ω Accuracy		
2 k Ω through 2 M Ω range	0.3% ± 2 counts.	
20 M Ω range	0.5% ± 2 counts.	
Response Time		
2 k Ω through 2 M Ω range	≤ 1 s.	
20 M Ω range	≤ 5 s.	
Measurement Current		2 V Range Setting

Table 2-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
DC AMMETER		
Range 2 mA, 20 mA, 200 mA,	2000 mA	
Accuracy	+0.2% of reading, ±10 counts.	
Response Time	≤1 s.	
Input Impedance		0.2 V + 0.1 ohm Range Setting
AC AMMETER		
Range 2 mA, 20 mA, 200 mA, 2000 mA		
Accuracy 40 Hz to 1 kHz	±0.6% of reading, ±2 counts.	
1 kHz to 10 kHz	±0.6% of reading, ±10 counts.	
Response Time	≤ 10 s.	
Input Impedance		0.2 V + 0.1 ohm Range Setting
THERMOMETER		
Range, -55°C to +150°C or -67°F to +302°F.		
Accuracy (with P6058 probe) -55°C (-67°F) to +125°C (+257°F)	±1.5°C (+2.7°F).	
+125°C (+257°F) to +150°C (+302°F)	±2.5°C (+4.5°F).	

Table 2-2
ENVIRONMENTAL CHARACTERISTICS

Characteristlcs	Information
Temperature	
Operating	0° C to +50° C.
Storage	-40° C to +75° C.
Altitude	
Operating	To 15,000 feet, maximum operating temperature decreased by 1° C/1000 feet from 5000 to 15,000 feet.
Storage	To 50,000 feet.
Vibration	
Operating and Non-Operating	With the instrument complete and operating, vibration frequency swept from 10 to 55 to 10 Hz at 1 minute per sweep. Vibrate 15 minutes in each of the three major axes at 0.015" total displacement. Hold 10 minutes at any major resonance, or if none, at 55 Hz. Total Time, 75 minutes.
Shock	
Operating and Non-Operating	30 g's, 1/2 sine, 11 ms duration, 3 shocks in each direction along 3 major axes, for a total of 18 shocks.
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.

Table 2-3
PHYSICAL CHARACTERISTICS

Characteristlcs	Information
Overall Dimensions (measured at maximum points)	
Height	5.0 inches 12.7 centimeters.
Width	2.6 inches 6.6 centimeters.
Length	11.75 inches 29.8 centimeters.
Net Weight (Instrument Only)	1 pound, 13 ounces. 793 grams

PERFORMANCE CHECK

Introduction

This procedure checks the electrical characteristics of the DM 501 that appear in the Specification section of this manual. If the instrument fails to meet the requirements given in this performance check, the calibration procedure should be performed. This procedure can also be used by an incoming inspection facility to determine acceptability of performance.

The electrical characteristics in Section 2 are valid only if the DM 501 is calibrated at an ambient temperature of +20 degrees Celsius to +30 degrees Celsius and operated at an ambient temperature of 0 degrees Celsius to +50 degrees Celsius. Forced air circulation is required for ambient temperature above +40 degrees Celsius.

Tolerances that are specified in this performance check procedure apply to the instrument under test and do not include test equipment error.

Test Equipment Required

The test equipment listed in Table 2-4, or equivalent, is required to perform the performance check. Test equipment characteristics listed are the minimum required to verify the performance of the equipment under test. Substitute equipment must meet or exceed the stated requirements. All test equipment is assumed to be operating within tolerance.

Special test devices are used where necessary to facilitate the procedure. Most of these are available from Tektronix, Inc. and can be ordered through your local Tektronix Field Office or representative.

Table 2-4
LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Application	Example
Digital Voltmeter	Range, 0 to 50 V; accuracy within 0.1%.	Temperature voltage measurement.	TEKTRONIX DM 501 Digital Multimeter. ^c
Power Module	Three compartments or more.	All tests.	TEKTRONIX TM 503 or TM 504.
Precision dc current source ^a	Range, 0 to 2 A; accuracy, within 0.02%.	DC ammeter function check.	Optimization, Inc. Model CS110-2066 or Fluke Model 382.
Precision dc voltage source ^a	Range, 0 to 1000 V; accuracy, within 0.01%.	DC voltmeter function check.	a. Optimization, Inc. Model AC 126 with Optimization, Inc. Model PA-226 Power Amplifier. b. Fluke Model 343A or Model 341A.
Precision ac voltage source ^a	Range, 0 to 500 V; accuracy, within 0.05%.	AC voltmeter function check.	a. Optimization, Inc. Model AC 126 with Optimization Inc. Model PA-226 Power Amplifier. b. Hewlett-Packard 745A AC Calibrator with Hewlett Packard 746A High-Voltage Amplifier.

Table 2-4 (cont)

Description	Performance Requirements	Application	Example
Precision ac current source ^a	Range, 0 to 2 A; sine wave output from 40 Hz to 10 kHz; accuracy, within 0.06%.	AC ammeter function check ^b	Optimization, Inc. Model CS110-2066.
Resistance standard ^a	Range, 0 to 20 MΩ accuracy, within 0.05%.	Ohmmeter accuracy check.	Electro Scientific Industries Model DB62 Dekabox.
Temperature Bath and Bath Cooler ^d	Range, 0°C to 125°C.	Temperature accuracy check	Neslab Instruments Model TE9/100 Stirred Bath and Model PBC-4 Bath Cooler.
Oil Testing Thermometers ^{ad} (2 required)	Range, 0°C to +125°C; accuracy, within 0.2°C.	Temperature accuracy check.	ASTM 67C; Nurnberg Catalog Number 5790.
Temperature Probe equalizing blocks ^d	Accept TEKTRONIX P6058 probe and ASTM 67C thermometer.	Temperature accuracy check	None known. See Fig. 3-2 and Fig. 3-3 for details.
Temperature Probes ^d (2 required)	Compatible with digital multimeter to be used.	Temperature accuracy check.	TEKTRONIX P6058.
Adapter	BNC female to dual male banana plug.	Used throughout procedure for signal connection.	Tektronix Part No. 103-0090-00.
Coaxial cable (2 required)	Impedance, 50 Ω; length, 42 inches; connectors, bnc.	Used throughout procedure for signal connection.	Tektronix Part No. 012-0057-01.

^aThis equipment must be traceable to NBS for certification of measurement characteristics.

^bIf all other functions check out, the ac current function is probably within specifications.

^cRequires TM 500-series power module.

^dThis equipment is not required if instrument under test is an Option 2 instrument.

Preliminary Procedure

1. Ensure that all power switches are off.
2. Ensure that all test equipment and the DM 501 under test are suitably adapted to the line voltage to be applied.
3. Install the DM 501 into the power module and, if applicable, install all other TM 500-series test equipment into the power module.

4. Connect the equipment under test and the test equipment to a suitable line voltage source. Turn all equipment on and allow at least 20 minutes for the equipment to warm up and stabilize.

Initial Control Settings

Set the following controls during warm-up time:

DM 501

RANGE FUNCTION switch 2 DC VOLTS
 INPUT EXT (pushbutton out)

PERFORMANCE CHECK PROCEDURE

WARNING

1. Check Integrator Zero

a. Short the DM 501 INPUT terminals together and check that the DM 501 display indicates ± 0.0000 , ± 2 counts.

2. Check 2 DC Volts Range Linearity

a. Set the dc voltage calibrator output for 0.000500 volt output.

b. Connect the output of the dc voltage calibrator to the DM 501 input terminals.

c. Check—that the DM 501 display reads $+0.0005$, ± 2 counts ($+0.0003$ to $+0.0007$).

d. Set the output polarity of the dc voltage calibrator to negative output.

e. Check—that the DM 501 display reads -0.0005 , ± 2 counts (-0.0003 to -0.0007).

f. Set the dc voltage calibrator output for $+1.00000$ volt.

g. Check—that the DM 501 display reads $+1.0000$, ± 12 counts ($+0.9988$ to $+1.0012$).

h. Set the output polarity of the dc voltage calibrator to negative.

i. Check—that the DM 501 display reads -1.0000 , ± 12 counts (-0.9988 to -1.0012).

j. Set the dc voltage calibrator output for $+1.99700$ volt output.

k. Check—that the DM 501 display reads $+1.9970$, ± 22 counts ($+1.9948$ to $+1.9992$).

l. Set the output polarity of the dc voltage calibrator to negative.

m. Check—that the DM 501 display reads -1.9970 , ± 22 counts (-1.9948 to -1.9992).

3. Check 20 DC VOLTS Range

a. Set the DM 501 to the 20 DC VOLTS range.

b. Set the dc voltage calibrator output for $+18.000$ volts output.

c. Check—that the DM 501 display reads $+18.000 \pm 20$ counts ($+17.980$ to $+18.020$).

Dangerous voltages may be encountered in the following steps. Caution must be exercised. Do not contact the output connectors of the voltage calibrator, the INPUT terminals of the DM 501, or the internal circuitry of the DM 501. The knob setscrews of some voltage calibrators in the list of test equipment have been known to be at a high voltage potential; check the setscrews with a voltmeter before handling the knobs.

4. Check 200 DC VOLTS Range.

a. Set the DM 501 RANGE/FUNCTION switch to 200 DC VOLTS.

b. Set the dc voltage calibrator to give $+180.000$ volts output.

c. Check—that the DM 501 display reads $+180.00 \pm 20$ counts ($+179.80$ to $+180.20$).

5. Check 1K DC VOLTS Range.

a. Set the DM 501 RANGE/FUNCTION switch to 1K DC VOLTS.

b. Set the dc voltage calibrator to 1000 volts.

c. Check—that the DM 501 display reads $+1000.0 \pm 12$ counts ($+998.8$ to $+1001.2$).

d. Turn the dc voltage calibrator output back to zero volt.

6. Check 2 AC VOLTS Range.

a. Set the DM 501 RANGE/FUNCTION switch to 2 AC VOLTS.

b. Set the output of the ac voltage calibrator to 1.00000 volt. Connect the output of the ac voltage calibrator to the DM 501 INPUT terminals (∇ to LO, ⚡ to HI).

NOTE

∇ and ⚡ are the symbols used by some manufacturers to denote the Low and High terminals of their AC Calibrators. These symbols are not universally used.

c. Step the ac voltage calibrator through the frequencies and note the DM 501 display, using Table 2-5 as a reference.

Table 2-5
2 AC VOLTS RANGE ACCURACY

AC Voltage Calibrator output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
20	1.8000	±218
40	1.8000	±128
100	1.8000	±128
200	1.8000	±128
400	1.8000	±128
1k	1.8000	±128
2k	1.8000	±128
4k	1.8000	±128
10k	1.8000	±128
20k	1.8000	±218

7. Check 20 AC VOLTS Range

a. Set the DM 501 RANGE/FUNCTION switch to 20 AC VOLTS.

b. With the output of the ac voltage calibrator still connected to the DM 501 as in the preceding step, set the ac voltage calibrator output for 18.0000 volts.

c. Step the ac voltage calibrator through the frequencies and note the DM 501 display, using Table 2-6 as a reference.

Table 2-6
20 AC VOLTS RANGE ACCURACY

AC Voltage Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
20	18.000	±218
40	18.000	±128
100	18.000	±128
200	18.000	±128
400	18.000	±128
1k	18.000	±128
2k	18.000	±128
4k	18.000	±128
10k	18.000	±128
20k	18.000	±218

WARNING

Dangerous voltages may be encountered in the following steps. Do not contact the output connectors of the voltage calibrator, the INPUT terminals of the DM 501, or the internal circuitry of the DM 501. The knob setscrews of some voltage calibrators in the list of test equipment have been known to be at a high voltage potential; check the setscrews with a voltmeter before handling the knobs.

8. Check 200 AC VOLTS Range

a. Set the DM 501 RANGE/FUNCTION switch to 200 AC VOLTS.

b. Connect the output of the ac voltage calibrator to the DM 501 INPUT terminals (↓ to LO, ⚡ to HI).

c. Set the ac calibrator output voltage to 180.000 volts ac. Step the ac voltage calibrator through the frequencies and note the DM 501 display, using Table 2-7 as a reference.

Table 2-7
200 AC VOLTS RANGE ACCURACY

AC Voltage Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
20	180.00	±218
40	180.00	±128
100	180.00	±128
200	180.00	±128
400	180.00	±128
1k	180.00	±128
2k	180.00	±128
4k	180.00	±128
10k	180.00	±128
20k	180.00	±218

9. Check 500 AC VOLTS Range

a. Set the DM 501 RANGE/FUNCTION switch to 500 AC VOLTS.

b. Set the ac calibrator output voltage to 500 volts ac.

c. Step the ac voltage calibrator through the frequencies and note the DM 501 display, using Table 2-8 as a reference.

Table 2-8
500 AC VOLTS RANGE ACCURACY

AC Voltage Callibrator Output Frequency (In Hz)	DM 501 Display	Tolerance (counts)
20	500.0	±62
40	500.0	±37
100	500.0	±37
200	500.0	±37
400	500.0	±37
1k	500.0	±37
2k	500.0	±37
4k	500.0	±37
10k	500.0	±37
20k	500.0	±62

Check 2 DC mA Range

a. Set the DM 501 RANGE/FUNCTION switch to the 2 DC mA position. With nothing connected to the DM 501 INPUT terminals, check that the display reads ±.0000, ±10 counts.

b. Set the dc current calibrator to deliver +1.8 mA; connect the output to the DM 501 INPUT terminals (use 50-ohm cable with bnc connectors and a bnc-to-banana adapter if appropriate).

c. Check—that the DM 501 readout displays +1.8000, ±54 counts.

d. Reverse the input connections to the DM 501. Check that the DM 501 readout displays -1.8000 ±54 counts.

11. Check the 20 DC mA Range

a. Set the DM 501 RANGE/FUNCTION switch to 20 DC mA. Set the dc current calibrator to a range that will deliver +18.00 mA output.

b. Check—that the DM 501 readout displays +18.000, ±54 counts.

12. Check the 200 DC mA Position of the DM 501 RANGE/FUNCTION switch

a. Set the DM 501 RANGE/FUNCTION switch to 200 DC mA. Set the dc current calibrator to deliver 180 mA output.

b. Check—that the DM 501 readout displays 180.00, ±54 counts.

13. Check the 2000 DC mA Range

a. Set the DM 501 RANGE/FUNCTION switch to 2000 DC mA. Set the dc current calibrator to deliver 1800 mA.

b. Check—that the DM 501 readout displays 1800.0, ±54 counts.

c. Set the dc calibrator output to zero and disconnect it from the DM 501.

14. Check the 2 mA AC Range

a. Set the DM 501 RANGE/FUNCTION switch to 2 mA AC.

b. Set the ac current calibrator to 1.800 mA ac and connect it to the input of the DM 501 (make the connection with a 50-ohm cable with bnc connectors and with a bnc-to-banana adapter).

c. Step the ac current calibrator through the frequencies and note the DM 501 display, using Table 2-9 as a reference.

Table 2-9
2 mA AC RANGE ACCURACY

AC Current Calibrator Output Frequency (In Hz)	DM 501 Display	Tolerance (counts)
40	1.8000	±110
100	1.8000	±110
400	1.8000	±110
1k	1.8000	±110
4k	1.8000	±118
10k	1.8000	±118

15. Check the 20 mA AC Range

a. Set the DM 501 RANGE/FUNCTION switch to 20 mA ac.

b. Set the ac current calibrator to deliver 18 mA ac.

c. Step the ac current calibrator through the frequencies and note the DM 501 display, using Table 2-10 as a reference.

Table 2-10
20 mA AC RANGE ACCURACY

AC Current Calibrator Output Frequency (In Hz)	DM 501 Display	Tolerance (counts)
40	18.000	±110
100	18.000	±110
400	18.000	±110
1k	18.000	±110
4k	18.000	±118
10k	18.000	±118

Specification And Performance Check—DM 501

16. Check the 200 mA AC Range

- a. Set the DM 501 RANGE/FUNCTION switch to 200 mA AC.
- b. Set the ac current calibrator to deliver 180 mA ac.
- c. Step the ac current calibrator through the frequencies and note the DM 501 display, using Table 2-11 as a reference.

**Table 2-11
200 mA AC RANGE ACCURACY**

AC Current Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
40	180.00	±110
100	180.00	±110
400	180.00	±110
1k	180.00	±110
4k	180.00	±118
10k	180.00	±118

17. Check the 2000 mA AC Range

- a. Set the DM 501 RANGE/FUNCTION switch to 2000 mA ac.
- b. Set the current calibrator to deliver 1800 mA ac.
- c. Step the ac current calibrator through the frequencies and note the DM 501 display, using Table 2-12 as a reference.

**Table 2-12
2000 mA AC RANGE ACCURACY**

AC Current Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
40	1800.0	±110
100	1800.0	±110
400	1800.0	±110
1k	1800.0	±110
4k	1800.0	±118
10k	1800.0	±118

18. Check Ohms Range

- a. Connect the DM 501 INPUT terminals to the resistance standard.

- b. Check—the ohms range accuracy, using Table 2-13 as a reference.

**Table 2-13
OHMS RANGE ACCURACY**

Resistance Standard Setting	DM 501 RANGE/FUNCTION Switch Setting	DM 501 Display	Tolerance (counts)
1.8 kilohms	2K	1.8000	±56
18 kilohms	20K	18.000	±56
180 kilohms	200K	180.00	±56
1.8 Megohm	2M	1.8000	±56
11 Megohm	20M	11.000	±77

- c. Disconnect the resistance standard from the DM 501 INPUT terminals. Check that the DM 501 display blinks, indicating overrange.

NOTE

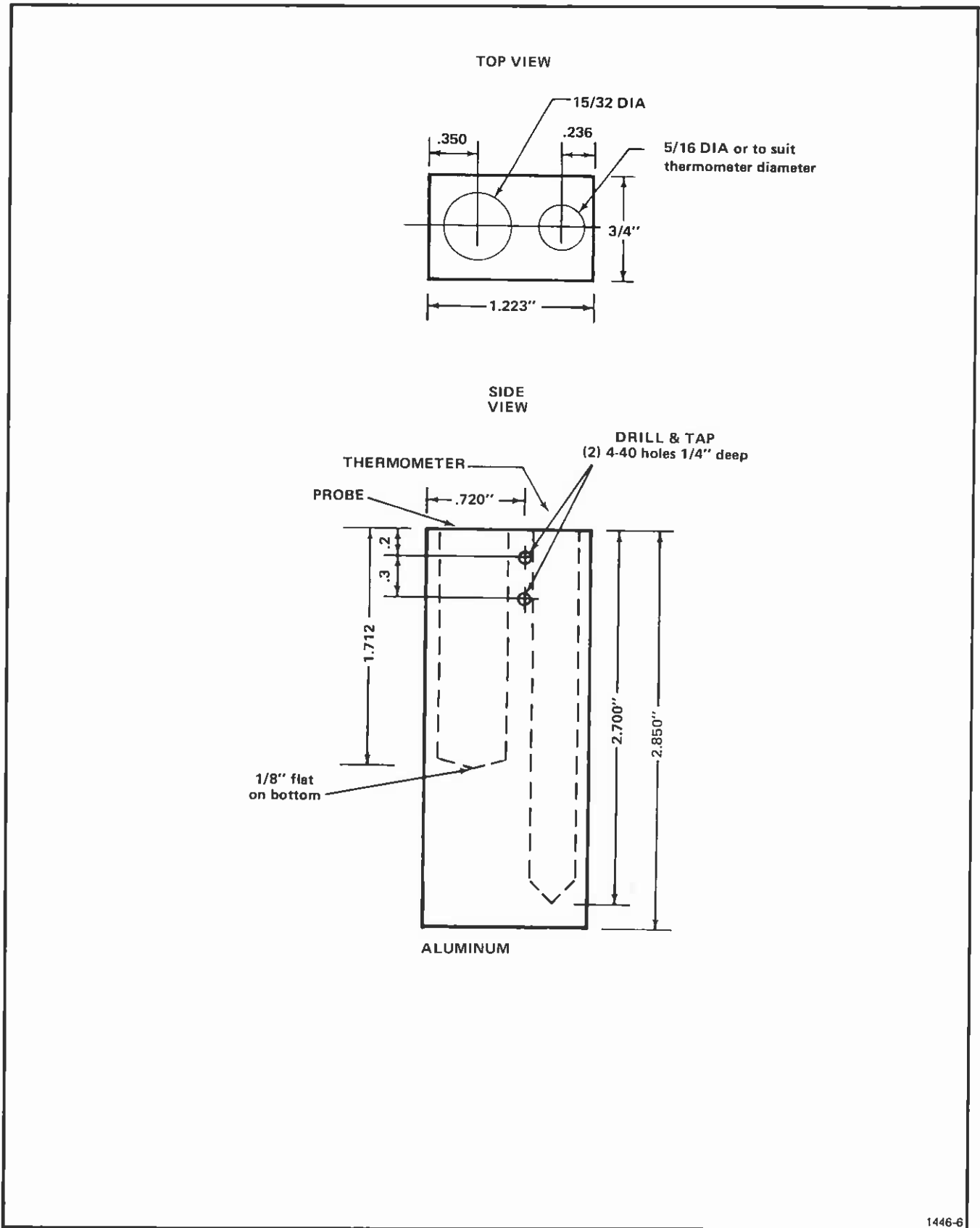
Option 2 deletes the Temperature Measurement capability from the instrument. If the instrument under test is an Option 2 instrument, omit Steps 19, 20, and 21.

19. Check Celsius Temperature Scale

- a. Turn off the power to the power module and remove the DM 501. Set internal switch S125 to the C position; reinstall the DM 501 and turn on the power to the power module. See Fig. 3-1 for switch location.
- b. Set the DM 501 RANGE/FUNCTION switch to the TEMP position.
- c. Insert the probe and thermometer intended for checking the 0°C reading, into a temperature equalizing block and place the equalizing block into the cooling bath.
- d. Insert the probe and thermometer intended for checking the 100°C reading, into a temperature equalizing block and place the equalizing block into the temperature bath.

NOTE

Use Fig. 2-1 and Fig. 2-2 for reference when constructing equalizing blocks for use in Steps 19 and 20.



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Fig. 2-1. Temperature probe equalizing block dimensions.

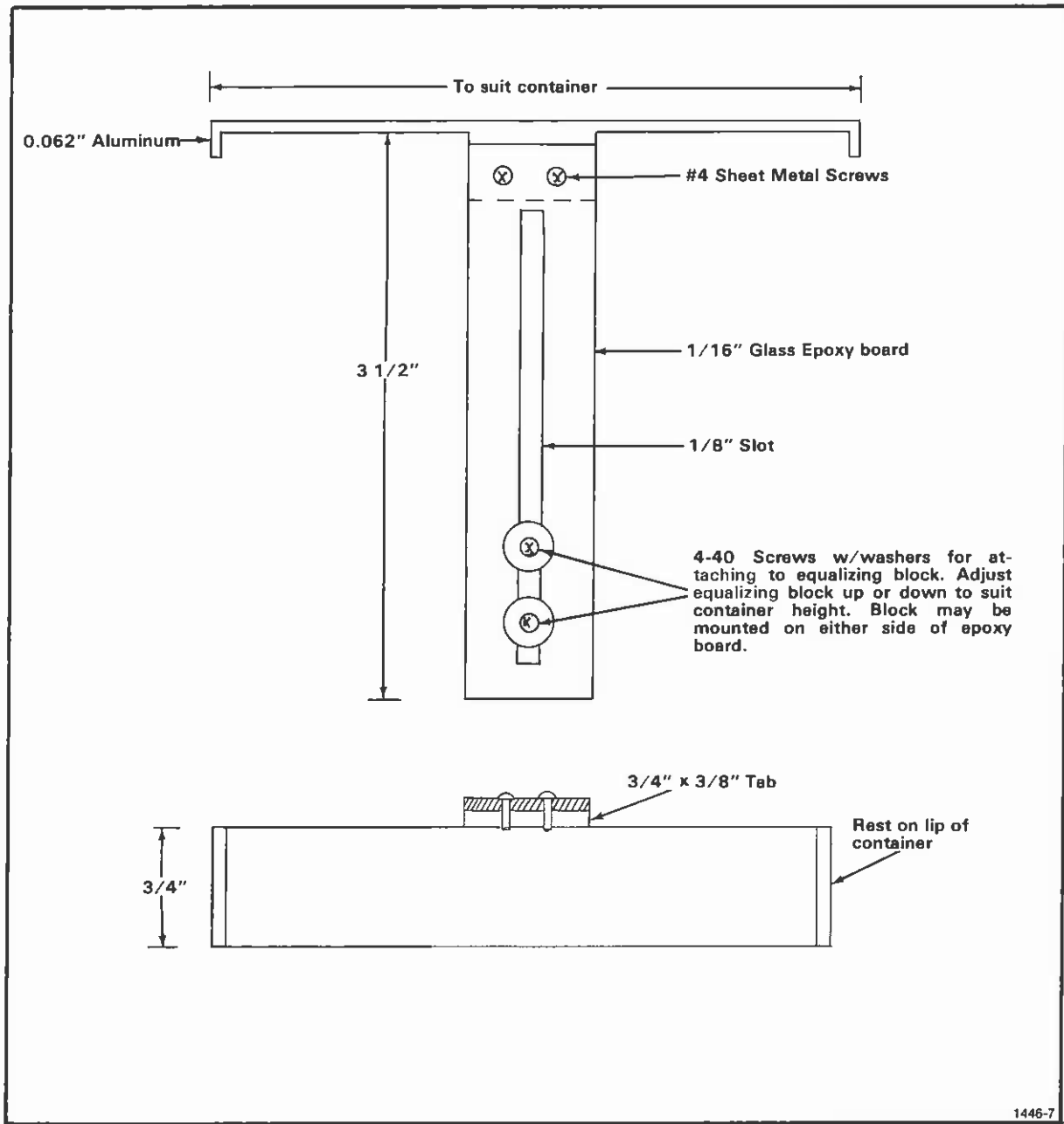


Fig. 2-2. Suspension bracket for temperature probe equalizing block.

NOTE

If the specified Temperature Bath and Bath Cooler are not available, place the probe and thermometer into an equalizing block and place the equalizing block in either ice water or boiling water, as appropriate for the temperature reading desired. Do not immerse the equalizing block so far that water contacts the probe.

e. After the thermometers have stabilized at the temperature of the equalizing blocks, connect the 0°C to the DM 501 TEMP PROBE connector and check that the DM 501 reads the same as the cold thermometer, ± 15 counts. Make sure the probe and thermometer have had time to stabilize.

f. Disconnect the 0°C from the DM 501 and connect the probe intended for making the 100°C reading to the DM 501 TEMP PROBE connector.

g. Check—that the DM 501 reads the same as the hot thermometer, ± 15 counts. Be sure the probe and thermometer have had time to stabilize. The reading obtained may not be exactly 100°C because of altitude or other factors, but the reading of the DM 501 and thermometer should agree within ± 15 counts.

20. Check Fahrenheit Temperature Scale

a. Turn off the power to the power module, and remove the DM 501. Set internal Temp Scale switch S125 to the F position; re-install the DM 501. Turn on power to the power module. See Fig. 3-1 for switch location.

b. Check—that the DM 501 readout agrees with the reading of the hot thermometer, within ± 27 counts.

c. Disconnect the probe from the DM 501 and connect the probe for measuring cold temperature. Check that the DM 501 readout is within ± 27 counts of the thermometer in the cooling bath.

21. Check Temp Out Output Voltage

a. Turn off the power to the power module, and remove the DM 501. Set internal Temp Scale switch S125 to the C position; re-install the DM 501. Turn on power to the power module.

b. Connect the probe for reading 100°C to the DM 501 TEMP PROBE connector.

c. Connect another digital multimeter whose Range/Function switch is set to 20 dc volts, to the TEMP OUT pin jacks of the DM 501 being checked.

d. Check—that the test multimeter reads the same as the hot thermometer at 10 mV per degree (100°C equals 1 volt output). The tolerance is ± 15 mV from 0°C to 100°C.

e. Disconnect all cables and equipment.

This completes the Performance procedure of the DM 501.



WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.



ADJUSTMENT

Introduction

This adjustment procedure is to be used to restore the DM 501 to original performance specifications. Adjustment need not be performed unless the instrument fails to meet the Performance Requirements of the Electrical Characteristics listed in the Specification section, or the Performance Check cannot be completed satisfactorily.

Completion of all adjustment steps in this procedure ensures that the instrument will meet the performance requirements listed in the Specification section. However, to fully ensure satisfactory performance, it is recommended that the Performance Check be performed after any adjustment is made.

Services Available

Tektronix, Inc. provides complete instrument repair and adjustment at local Field Service Centers and at the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

Test Equipment Required

The test equipment listed in Table 3-1, or equivalent, is required for adjustment of the DM 501. Specifications given for the test equipment are the minimum necessary for accurate adjustment and measurement. All test equipment is assumed to be correctly calibrated and operating within specification.

If other test equipment is substituted, control settings or calibration setup may need to be altered to meet the requirements of the equipment used.

A flexible plug-in extender, Tektronix Part No. 067-0645-03, is useful for troubleshooting or adjusting the DM 501; however, the complete Adjustment Procedure can be performed without use of the extender. Remove the power module cabinet to make adjustments to the DM 501 inside the power module.

Table 3-1

LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Application	Example
Digital Voltmeter	Range, 0 to 50 V; accuracy, within 0.1%	Voltage measurements. Temperature voltage measurement.	TEKTRONIX DM 501 Digital Multimeter ^c
Power Module	Three compartments or more	All Tests	TEKTRONIX TM 503 or TM 504.
Precision dc current source ^a	Range, 0 to 2 A; accuracy, within 0.02%.	DC ammeter function check	Optimization, Inc. Model CS110-2066 or Fluke Model 382.
Precision dc voltage source ^a	Range, 0 to 1000 V; accuracy, within 0.01%.	DC voltmeter function check	a. Optimization, Inc. Model AC 126 with Optimization, Inc. Model PA-226 Power Amplifier. b. Fluke Model 343A or Model 341A.
Precision ac voltage source ^a	Range, 0 to 500 V; accuracy, within 0.05%.	AC voltmeter function check	a. Optimization, Inc. Model AC 126 with Optimization, Inc. Model PA-226 Power Amplifier. b. Hewlett-Packard 745A AC Calibrator with Hewlett Packard 746A High-Voltage Amplifier.

Table 3-1 (cont)

Description	Performance Requirements	Application	Example
Precision ac current source ^a	Range, 0 to 2 A; sine wave output from 40 Hz to 10 kHz; accuracy, within 0.06%.	AC ammeter function check. ^b	Optimation, Inc. Model CS 110-2066.
Resistance standard ^a	Range, 0 to 20 M Ω accuracy, within 0.05%.	Ohmmeter accuracy check.	Electro Scientific Industries Model DB62 Dekabox.
Temperature Bath and Bath Cooler ^a	Range, 0°C to +125°C.	Temperature accuracy check.	Neslab Instruments Model TE9/100 Stirred Bath and Model PBC-4 Bath Cooler.
Oil Testing Thermometers ^d	Range, 0°C to +125°C; accuracy, within 0.2°C.	Temperature accuracy check.	ASTM 67C; Nurnberg Catalog Number 5790.
Temperature Probe equalizing blocks ^d	Accept TEKTRONIX P6058 probe and ASTM 67C thermometer.	Temperature accuracy check.	None known. See Fig. 3-2 and Fig. 3-3 for details.
Temperature Probes ^d (2 required)	Compatible with digital multimeter to be used.	Temperature accuracy check.	TEKTRONIX P6058.
Adapter	BNC female to dual male banana plug.	Used throughout procedure for signal connection.	Tektronix Part No. 103-0090-00.
Coaxial cable (2 required)	Impedance, 50 Ω ; length, 42 inches; connectors, bnc.	Used throughout procedure for signal connection.	Tektronix Part No. 012-0057-01.

^aThis equipment must be traceable to NBS for certification of measurement characteristics.

^bIf all other functions check out, the ac current function is probably within specifications.

^cRequires TM 500-series power module.

^dThis equipment is not required if instrument under test is an Option 2 instrument.

Preparation

a. Remove the left side cover of the DM 501 to gain access to the component side of the circuit boards. Pull the rear end of the side cover outward from the side of the instrument (the cover snaps into place).

b. Install the DM 501 into the left power module compartment, or if appropriate, connect the DM501 to the power module by means of the flexible plug-in extender.

c. Set the power module for the line voltage to be applied (see power module manual) and connect it to the variable autotransformer; connect the autotransformer to the line voltage source. Be sure that the power switch is off.

d. Install the TM 500-series equipment, including the DM 501 into the power module.

e. Connect all test equipment to a suitable line voltage source.

f. Turn on all test equipment and allow at least 20 minutes for the equipment to warm up and stabilize.

Initial Control Settings

Set the following controls during warm-up time:

DM 501

RANGE FUNCTION switch 20 DC VOLTS
INPUT EXT (pushbutton out)

ADJUSTMENT PROCEDURE

1. Adjust +5 Volt Power Supply

- Connect the digital voltmeter between the +5 V test point (U330, pin 24) on the Digital Multimeter circuit board, and chassis ground. See Fig. 3-1 for voltage test point location.
- Adjust the autotransformer output voltage to 120 V.
- Check—for a meter reading of +4.95 to +5.05 V.
- Adjust—+5 V Adj, R420, for a meter reading of +5.00 V within ± 0.02 V. See Fig. 3-1 for adjustment location.
- Disconnect the digital voltmeter lead from the +5 V test point.
- Set the DM 501 RANGE/FUNCTION switch to 2000 DC mA.
- Reconnect the digital voltmeter lead to the +5 V test point (U330, pin 24).
- Check—for a meter reading of 450 mA to 550 mA.

- Disconnect the digital voltmeter.

2. Check—12 Volt Power Supply

- Set the DM 501 RANGE/FUNCTION switch to 20 DC VOLTS.
- Connect the digital voltmeter between the -12 V test point (U330, pin 15) on the Digital Multimeter circuit board, and chassis ground. See Fig. 3-1 for voltage test point location.
- Check—for a meter reading of -11.200 to -12.800 V.
- Disconnect the digital voltmeter lead from the -12 V test point.
- Set the DM 501 RANGE/FUNCTION switch to 2000 DC mA.
- Reconnect the digital voltmeter lead to the -12 V test point (U330, pin 15).
- Check—for a meter reading of 400 mA to 600 mA.
- Disconnect the digital voltmeter.

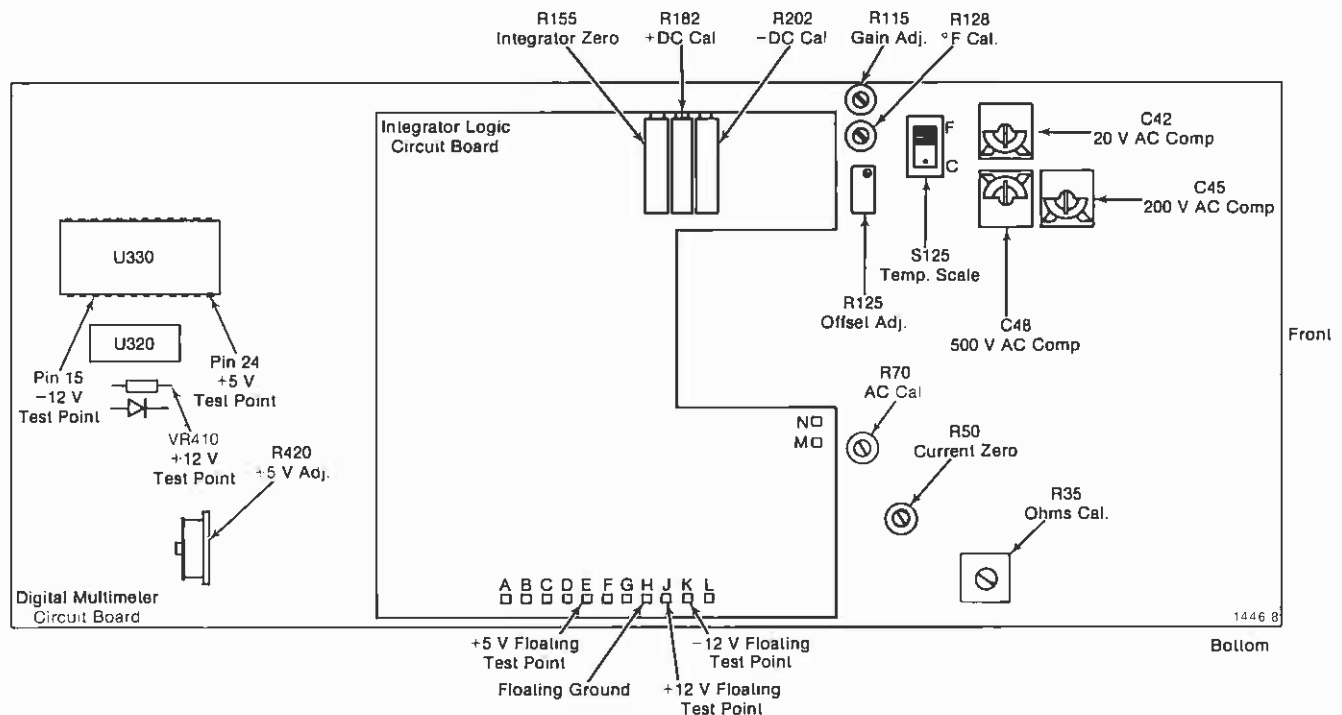
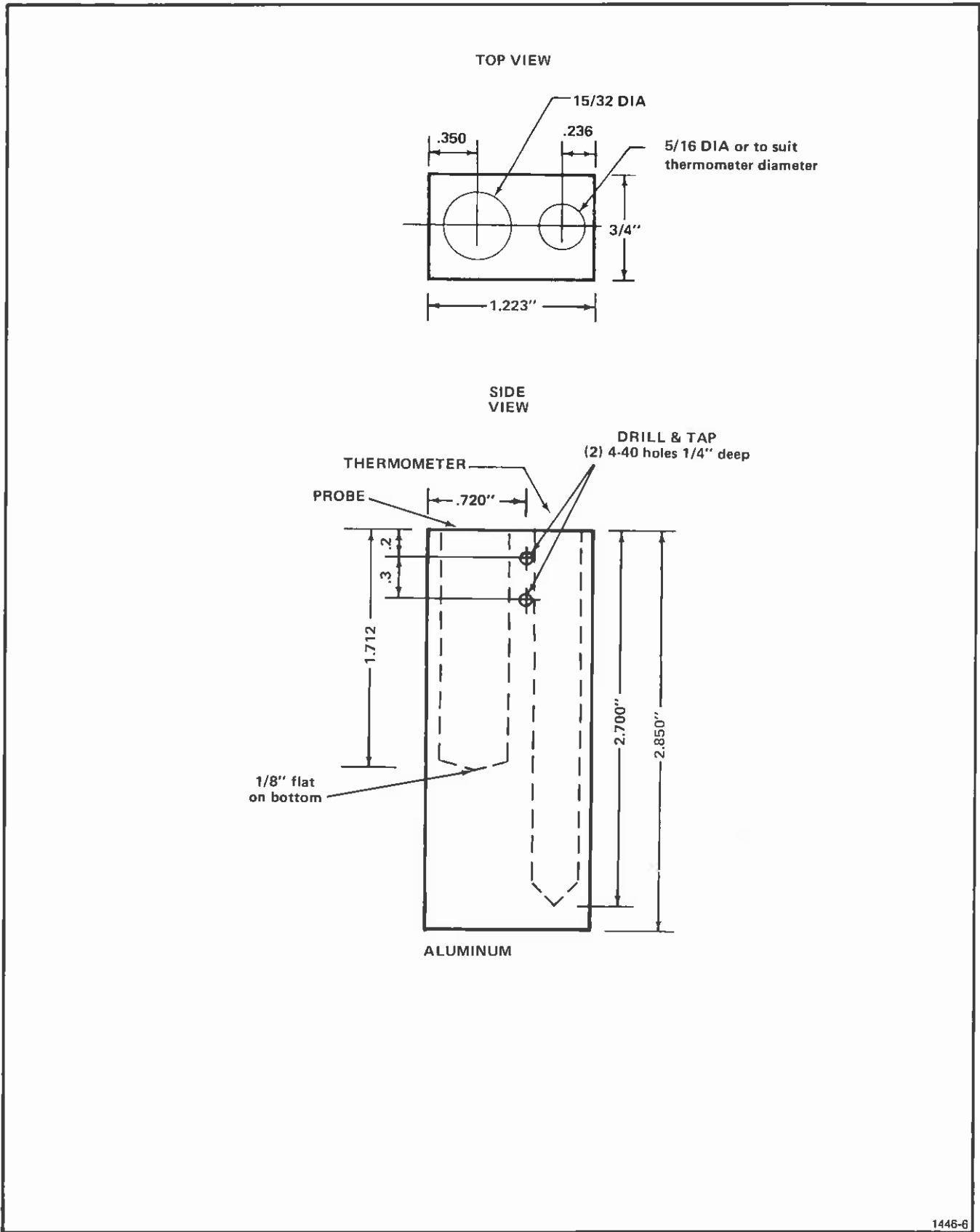


Fig. 3-1. Adjustment, test point locations, and temperature scale switch location.



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Fig. 3-2. Temperature probe equalizing block dimensions.

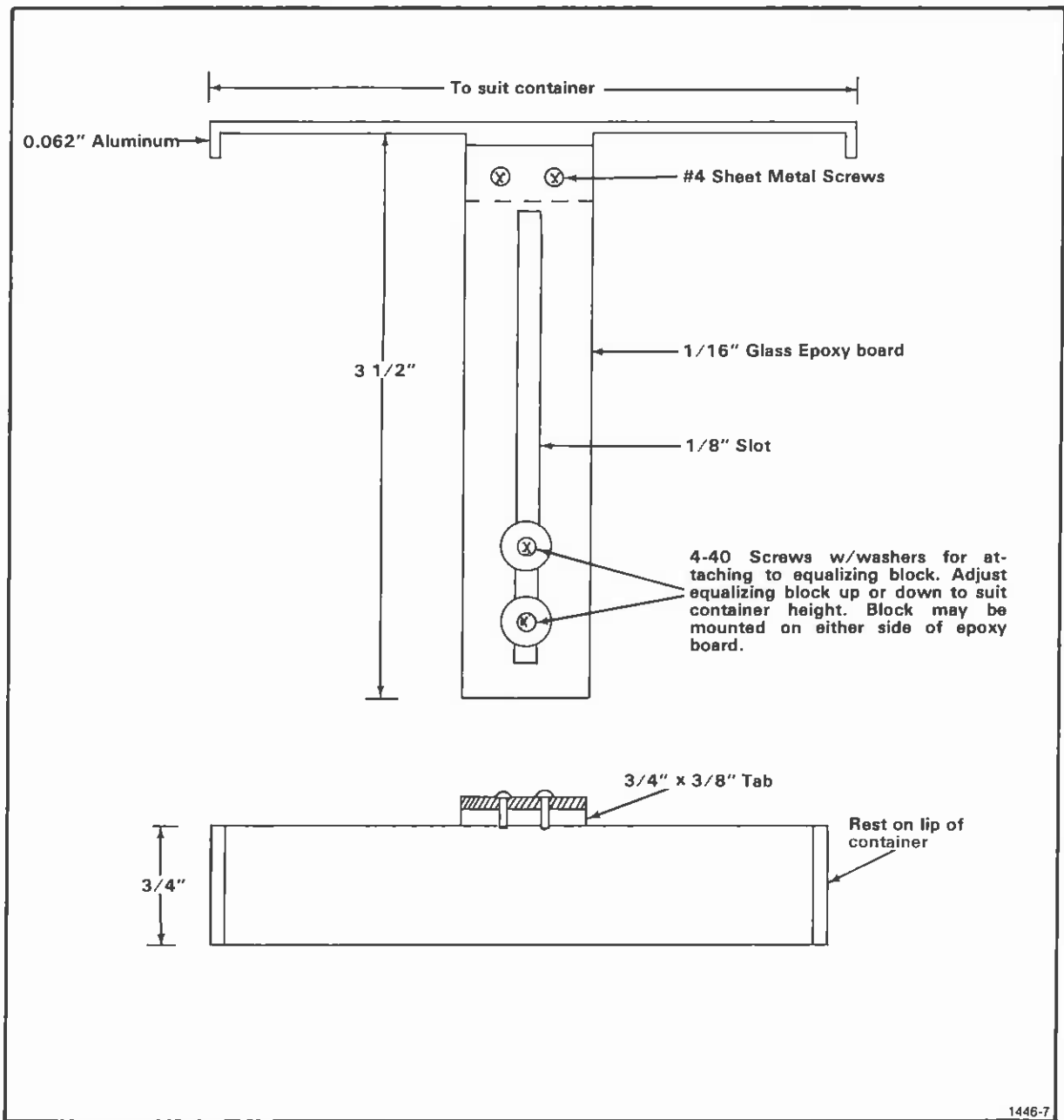


Fig. 3-3. Suspension bracket for temperature probe equalizing block.

3. Check +12 Volt Power Supply

a. Connect the digital voltmeter between the +12 V test point (cathode of VR410) on the Digital Multimeter circuit board, and chassis ground. See Fig. 3-1 for voltage test point location.

b. Check—for a meter reading of +11.000 to +13.000 V.

c. Disconnect the digital voltmeter.

4. Check -12 Volt (Floating) Power Supply

a. Connect the positive digital voltmeter lead to the -12 V Floating test point (pin k) and the negative lead to the Floating Ground test point (pin h) on the Integrator Logic circuit board. See Fig. 3-1 for test point location.

b. Check—for a meter reading of -11.500 to -12.500 V.

c. Disconnect the positive digital voltmeter lead from the -12 V Floating test point.

Adjustment—DM 501

5. Check +12 Volt (Floating) Power Supply

a. Connect the positive digital voltmeter lead to the +12 V Floating test point (pin j) on the Integrator Logic circuit board. See Fig. 3-1 for test point location.

b. Check—for a meter reading of +11.500 to +12.500 V.

c. Disconnect the positive digital voltmeter lead from the +12 V Floating test point.

6. Check +5 Volt (Floating) Power Supply

a. Connect the positive digital voltmeter lead to the +5 V Floating test point (pin e) on the Integrator Logic circuit board. See Fig. 3-1 for test point location.

b. Check—for a meter reading of +4.500 to +5.500 V.

c. Disconnect the digital voltmeter.

7. Check -12 Volt Power Supply Regulation

a. Connect the digital voltmeter between the -12 V test point (U330, pin 15) on the Digital Multimeter circuit board, and chassis ground. See Fig. 3-1 for voltage test point location.

b. Adjust the autotransformer output voltage to 108 V.

c. Note and record the DM 501 display reading.

d. Adjust the autotransformer output voltage to 132 V.

e. Note and record the DM 501 display reading.

f. Check—the difference between the record voltage obtained in part c of this step and the last reading; difference must be within 0.100 V.

g. Adjust the autotransformer output voltage to 120 V.

h. Disconnect the digital voltmeter.

i. Set the DM 501 RANGE/FUNCTION switch to 2 DC VOLTS.

8. Adjust Integrator Zero

a. Short the input terminals of the DM 501 together and check that the DM 501 display indicates ± 0.0000 , ± 2 counts.

b. Adjust—Integrator Zero, R155, for a display readout of $.0000 \pm 1$ count. See Fig. 3-1 for adjustment location.

9. Adjust DC Calibration

a. Set the dc voltage calibrator output for 1.000000 V output.

b. Connect the output of the dc voltage calibrator to the DM 501 input terminals.

c. Check—that the DM 501 display reads +1.0000, ± 5 counts (+.9995 to +1.0005).

d. Adjust— +DC Cal, R182, for a display reading of +1.0000, ± 1 count. See Fig. 3-1 for adjustment location.

e. Set the output polarity of the dc voltage calibrator to negative output.

f. Check—that the DM 501 display reads -1.0000, ± 5 counts (-.9995 to -1.0005).

g. Adjust— -DC Cal, R202, for a display reading of -1.0000, ± 1 count. See Fig. 3-1 for adjustment location.

h. Interaction—repeat parts c through g of this step to obtain optimum readings.

10. Check 2 DC Volts Range Linearity

a. Set the dc voltage calibrator output for 1.999000 V output.

b. Check—that the DM 501 display reads -1.9970, ± 22 counts (-1.9948 to -1.9992).

c. Set the output polarity of the dc voltage calibrator to positive output.

d. Check—that the DM 501 display reads +1.9970, ± 22 counts (+1.9948 to +1.9992).

11. Check 20 DC VOLTS Range

a. Set the DM 501 to the 20 DC VOLTS range.

b. Set the dc voltage calibrator output for +18.000 V output.

c. Check—that the DM 501 display reads +18.000 ± 20 counts (+17.980 to +18.020).

WARNING

Dangerous voltages may be encountered in the following steps. Caution must be exercised. Do not contact the output connectors of the voltage calibrator, the INPUT terminals of the DM 501, or the internal circuitry of the DM 501. The knob setscrews of some voltage calibrators in the list of test equipment have been known to be at a high voltage potential; check the setscrews with a voltmeter before handling the knob.

12. Check 200 DC VOLTS Range

a. Set the DM 501 RANGE/FUNCTION switch to 200 DC VOLTS.

b. Set the dc voltage calibrator to give +180.000 V output.

c. Check—that the DM 501 display reads +180.00 \pm 20 counts (+179.80 to +180.20).

13. Check 1K DC VOLTS Range

a. Set the DM 501 RANGE/FUNCTION switch to 1K DC VOLTS.

b. Set the dc voltage calibrator to 1000 V.

c. Check—that the DM 501 display reads +1000.0 \pm 12 counts (+998.8 to +1001.2).

d. Turn the dc voltage calibrator output back to 0 V.

14. Adjust 2 AC Volts Range

a. Set the DM 501 RANGE/FUNCTION switch to the 2 AC VOLTS position.

b. Set the output of the ac voltage calibrator to 1.8000 V, at 1 kHz. Connect the output of the ac voltage calibrator to the INPUT terminals of the DM 501 (\downarrow to LO, \uparrow to HI).

NOTE

\downarrow and \uparrow are the symbols used by some manufacturers to denote the Low and High terminals of their AC Calibrators. These symbols are not universally used.

c. Check—that the DM 501 display reads 1.8000, \pm 20 counts (1.7980 to 1.8020).

d. Adjust—AC Cal, R70, for a display reading of 1.8000, \pm 1 count. See Fig. 3-1 for adjustment location.

e. Step the ac voltage calibrator through the frequencies and note the DM 501 display, using Table 3-2 as a reference.

Table 3-2

2 AC VOLTS RANGE ACCURACY

AC Voltage Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
20	1.8000	\pm 218
40	1.8000	\pm 128
100	1.8000	\pm 128
200	1.8000	\pm 128
400	1.8000	\pm 128
1k	1.8000	\pm 128
2k	1.8000	\pm 128
4k	1.8000	\pm 128
10k	1.8000	\pm 128
20k	1.8000	\pm 218

15. Adjust 20 AC Volt Compensation

a. Set the DM 501 RANGE/FUNCTION switch to the 20 AC VOLTS position.

b. Set the output of the ac voltage calibrator to 18.0000 V, at 10 kHz.

c. Check—that the DM 501 display reads 18.0000, \pm 20 counts (17.9980 to 18.0020).

d. Adjust—20 V AC Comp, C42, for a display reading of 18.0000, \pm 1 count. See Fig. 3-1 for adjustment location.

e. Step the ac voltage calibrator through the frequencies and note the DM 501 display, using Table 3-3 as a reference.

Table 3-3

20 AC VOLT COMPENSATION ACCURACY

AC Voltage Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
20	18.000	\pm 218
40	18.000	\pm 128
100	18.000	\pm 128
200	18.000	\pm 128
400	18.000	\pm 128
1k	18.000	\pm 128
2k	18.000	\pm 128
4k	18.000	\pm 128
10k	18.000	\pm 128
20k	18.000	\pm 218

WARNING

Dangerous voltages may be encountered in the following steps. Do not contact the output connectors of the voltage calibrator, the INPUT terminals of the DM 501, or the internal circuitry of the DM 501. The knob setscrews of some voltage calibrators in the list of test equipment have been known to be at a high voltage potential; check the setscrews with a voltmeter before handling the knobs.

16. Adjust 200 AC Volt Compensation

- a. Set the DM 501 RANGE/FUNCTION switch to the 200 AC VOLTS position.
- b. Set the output of the ac voltage calibrator to 180.000 V, at 10 kHz.
- c. Check—that the DM 501 display reads 180.000, ± 20 counts (179.980 to 180.020).
- d. Adjust—200 V AC Comp, C45, for a display reading of 180.000, ± 1 count. See Fig. 3-1 for adjustment location.
- e. Step the ac voltage calibrator through the frequencies and note the DM 501 display, using Table 3-4 as a reference.

Table 3-4

200 AC VOLT COMPENSATION ACCURACY

AC Voltage Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
20	180.00	± 218
40	180.00	± 128
100	180.00	± 128
200	180.00	± 128
400	180.00	± 128
1k	180.00	± 128
2k	180.00	± 128
4k	180.00	± 128
10k	180.00	± 128
20k	180.00	± 218

17. Adjust 500 AC Volt Compensation

- a. Set the DM 501 RANGE/FUNCTION switch to the 500 AC VOLTS position.
- b. Set the output of the ac voltage calibrator to 500.0 V, at 10 kHz.
- c. Check—that the DM 501 display reads 500.0, ± 50 counts (499.5 to 500.5).

d. Adjust—500 V Comp, C48, for a display reading of 500.0, ± 1 count. See Fig. 3-1 for adjustment location.

e. Step the ac voltage calibrator through the frequencies and note the DM 501 display, using Table 3-5 as a reference.

Table 3-5

500 AC VOLT COMPENSATION ACCURACY

AC Voltage Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
20	500.0	± 62
40	500.0	± 37
100	500.0	± 37
200	500.0	± 37
400	500.0	± 37
1k	500.0	± 37
2k	500.0	± 37
4k	500.0	± 37
10k	500.0	± 37
20k	500.0	± 62

f. Disconnect the ac voltage calibrator.

18. Adjust Current Zero

- a. Set the DM 501 RANGE/FUNCTION switch to the 2 DC mA position.
- b. Check—that the DM 501 display reads $\pm .0000$, within 10 counts.
- c. Adjust—Current Zero, R50, for a display reading of $\pm .000$ with no error.
- d. Connect a dc current calibrator to the DM 501 INPUT terminals, using a 50 Ω cable and bnc-to-banana adapter, if appropriate; set the dc current calibrator to deliver +1.8 mA.
- e. Check—that the DM 501 display reads +1.8000, ± 54 counts.
- f. Reverse the input connections to the DM 501. Check that the DM 501 display reads -1.8000, ± 54 counts. Reverse the input connection to the DM 501.

19. Check 20 DC mA Range

- a. Set the DM 501 RANGE/FUNCTION switch to the 20 DC mA position.
- b. Set the dc current calibrator to deliver +18.00 mA output.

c. Check—that the DM 501 display reads +18.000, ± 54 counts.

20. Check 200 DC mA Range

a. Set the DM 501 RANGE/FUNCTION switch to the 200 DC mA position.

b. Set the dc current calibrator to deliver +180 mA output.

c. Check—that the DM 501 display reads +180.00, ± 54 counts.

21. Check 2000 DC mA Range

a. Set the DM 501 RANGE/FUNCTION switch to the 2000 DC mA position.

b. Set the dc current calibrator to deliver +1800 mA output.

c. Check—that the DM 501 display reads +1800.0, ± 54 counts.

d. Set the dc calibrator output to zero and disconnect it from the DM 501.

22. Check 2 AC mA Range

a. Set the DM 501 RANGE/FUNCTION switch to the 2 AC mA position.

b. Set the output of the current calibrator to 1.800 mA, at 40 Hz. Connect the output of the current calibrator to the INPUT terminals of the DM 501, using a 50 Ω cable and bnc-to-banana adapter.

c. Step the ac current calibrator through the frequencies and note the DM 501 display, using Table 3-6 as a reference.

Table 3-6

2 mA AC RANGE ACCURACY

AC Current Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
40	1.8000	± 110
100	1.8000	± 110
400	1.8000	± 110
1k	1.8000	± 110
4k	1.8000	± 118
10k	1.8000	± 118

23. Check 20 mA AC Range

a. Set the DM 501 RANGE/FUNCTION switch to the 20 mA AC position.

b. Set the ac current calibrator to deliver 18.000 mA output.

c. Step the ac current calibrator through the frequencies and note the DM 501 display, using Table 3-7 as a reference.

Table 3-7

20 mA AC RANGE ACCURACY

AC Current Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
40	18.000	± 110
100	18.000	± 110
400	18.000	± 110
1k	18.000	± 110
4k	18.000	± 118
10k	18.000	± 118

24. Check 200 mA AC Range

a. Set the DM 501 RANGE/FUNCTION switch to the 200 mA AC position.

b. Set the ac current calibrator to deliver 180.00 mA output.

c. Step the ac current calibrator through the frequencies and note the DM 501 display, using Table 3-8 as a reference.

Table 3-8

200 mA AC RANGE ACCURACY

AC Current Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
40	180.00	± 110
100	180.00	± 110
400	180.00	± 110
1k	180.00	± 110
4k	180.00	± 118
10k	180.00	± 118

25. Check 2000 mA AC Range

a. Set the DM 501 RANGE/FUNCTION switch to the 2000 mA AC position.

b. Set the ac current calibrator to deliver 1800.0 mA output.

c. Step the ac current calibrator through the frequencies and note the DM 501 display, using Table 3-9 as a reference.

Adjustment—DM 501

Table 3-9

2000 mA AC RANGE ACCURACY

AC Current Calibrator Output Frequency (in Hz)	DM 501 Display	Tolerance (counts)
40	1800.0	±110
100	1800.0	±110
400	1800.0	±110
1k	1800.0	±110
4k	1800.0	±118
10k	1800.0	±118

d. Disconnect the ac current calibrator.

26. Adjust Ohms Calibration

a. Connect the resistance standard to the DM 501 INPUT terminals, using a 50 Ω cable and a bnc-to-banana adapter.

b. Set the resistance standard range switch to 1 kΩ.

c. Check—that the DM 501 display reads 1.0000, ±5 counts (.9995 to 1.0005).

d. Adjust—Ohms Cal, R35, for a display reading of 1.0000, ±1 count. See Fig. 3-1 for adjustment location.

e. Check the ohms range accuracy, using Table 3-10 as a reference.

Table 3-10

OHMS RANGE ACCURACY

Resistance Standard Setting	DM 501 RANGE/FUNCTION Switch Setting	DM 501 Display	Tolerance (counts)
1.8 kilohms	2K	1.8000	±56
18 kilohms	20K	18.000	±56
180 kilohms	200K	180.00	±56
1.8 Megohms	2M	1.8000	±56
11 Megohms	20M	11.000	±77

f. Disconnect the resistance standard from the DM 501 INPUT terminals. Check that the DM 501 display blinks, indicating overrange.

NOTE

Option 2 deletes the Temperature Measurement capability from the instrument. If the instrument under test is an Option 2 instrument, omit Steps 27, 28, and 29.

27. Adjust Celsius Temperature Scale

a. Turn off the power to the power module. Set internal Temp Scale switch S125 to the C position; turn on the power to the power module. See Fig. 3-1 for switch location.

b. Set the DM 501 RANGE/FUNCTION switch to the TEMP position.

c. Insert the probe and thermometer intended for checking the 0°C reading, into a temperature equalizing block and place the equalizing block into the cooling bath.

d. Insert the probe and thermometer intended for checking the 100°C reading, into a temperature equalizing block and place the equalizing block into the temperature bath.

NOTE

Use Fig. 2-1 and Fig. 2-2 for reference when constructing equalizing blocks for use in Step 27 and 28.

NOTE

If the specified Temperature Bath and Bath Cooler are not available, place the probe and thermometer into an equalizing block and place the equalizing block in either ice water or boiling water, as appropriate for the temperature reading desired. Do not immerse the equalizing block so far that water contacts the probe.

e. After the thermometer has stabilized at the temperature of the equalizing blocks, connect the 0°C probe to the DM 501 TEMP PROBE connector and check that the DM 501 reads the same as the cold thermometer, ±1 count. Make sure the probe and thermometer have had time to stabilize.

f. Adjust—Offset Adj, R125, for a display reading of ±.0. See Fig. 3-1 for adjustment location.

g. Disconnect the 0°C probe from the DM 501 and connect the probe intended for making the 100°C reading to the DM 501 TEMP PROBE connector.

h. Adjust—Gain Adj, R115, for a display reading that agrees with the reading of the hot thermometer, ±1 count.

i. Interaction—repeat parts e through h of this step until optimum readings are obtained.

28. Adjust Fahrenheit Temperature Scale

a. Turn off the power to the power module. Set internal Temp Scale switch S125 to the F position; turn on the power to the power module. See Fig. 3-1 for switch location.

b. Connect the 0°C probe to the DM 501 TEMP PROBE connector and check that the DM 501 reads the same as the cold thermometer, ± 1 count. Make sure the probe and thermometer have had time to stabilize.

c. Adjust—F Adj, R128, for a display reading of +32.0, ± 1 count.

29. Check Temp Out Output Voltage

a. Turn off the power to the power module. Set internal Temp Scale switch S125 to the C position; turn on the power to the power module. See Fig. 3-1 for switch location.

b. Disconnect the 0°C probe from the DM 501 and connect the probe intended for making the 100°C reading to the DM 501 TEMP PROBE connector.

c. Connect another digital multimeter whose Range/Function switch is set to 20 dc volts, to the TEMP OUT pin jacks of the DM 501 being checked.

d. Check—that the test multimeter reads the same as the hot thermometer at 10 mV per degree (100°C equals 1 volt output). The tolerance is ± 15 mV from 0°C to 100°C.

e. Disconnect all cables and equipment.

This completes the Adjustment procedure of the DM 501.

