

Instructions Manual

Tektronix

**DMM150
Digital Multimeter**

070-9938-00



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DMM150 Digital Multimeter

The DMM150 is a rugged, handheld digital multimeter that allows you to make accurate measurements quickly and easily. Whether you are a professional or hobbyist, this instrument provides a useful range of features:

- Small, pen-style case
- 3½ digit LCD display with bar graph
- Auto range (volts, ohms)
- Measurement hold
- Measures DC and AC voltages, resistance, diode voltage, and continuity
- Diode and continuity tester with audible signal
- Overvoltage protected
- Recessed input jacks for safety
- Automatic power off after 10 minutes to prolong battery life
- Low-battery indicator
- Uses standard AAA batteries

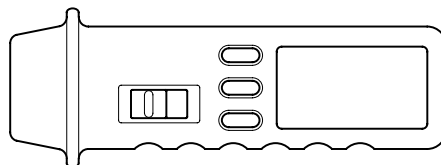


Figure 1: DMM150 Digital Multimeter

DMM150 Specifications

All specifications are warranted unless noted typical.

Stated accuracies are $\pm(\% \text{ reading} + \text{number of counts})$ at $23^\circ \text{C} \pm 5^\circ \text{C}$, at less than 75% R.H. (relative humidity).

Table 1: General specifications

Characteristics	Description
Display	3½ digit liquid crystal display (LCD) with a maximum reading of 3200 65 segment analog bar graph
Polarity indication	Automatic; positive implied, negative indicated
Overrange indication	"OL" or "-OL"
Low battery indication	The battery symbol is displayed when the battery voltage drops below the operating voltage level
Sampling rate	2 times/second for digital display 12 times/second for analog bar graph
Operating altitude	2000 m (6561 ft.), maximum
Operating temperature	0° C to +50° C, 0–80% R.H.
Storage temperature	–20° C to +60° C, 0–80% R.H. with batteries removed from the meter
Temperature coefficient	$0.15 \times (\text{specified accuracy})/^\circ \text{C}$ at $<18^\circ \text{C}$ or $>28^\circ \text{C}$
Power supply	Two standard AAA, IEC LR03, or ANSI/NEDA 24A 1.5 V batteries
Battery life (typical)	Alkaline 800 hours
Dimensions (HxWxD)	42 mm × 145 mm × 24 mm (1.7 in. × 5.7 in. × 0.9 in.)
Maximum floating voltage	600 VDC or 600 VAC _{RMS} CAT II between any terminal and earth GND
Maximum input voltage	600 VDC or 600 VAC _{RMS} CAT II between V-Ω and COM terminals

Table 2: Measurement characteristics

Characteristics	Description
DC Volts	
Ranges	300 mV, 3 V, 30 V, 300 V, 600 V
Accuracy	$\pm(0.7\% + 2 \text{ counts})$
Input impedance (typical)	
300 mV	Near infinite resistance
3 V, 30 V, 300 V, 600 V	10 M Ω
Resolution (by range)	
300 mV	100 μV
3 V	1 mV
30 V	10 mV
300 V	100 mV
600 V	1 V
AC Volts	
Ranges	3 V, 30 V, 300 V, 600 V
Accuracy (by range)	
3 V	$\pm(1.7\% \text{ reading} + 5 \text{ counts})$ at 40 Hz to 300 Hz
30 V, 300 V, 600 V	$\pm(1.7\% \text{ reading} + 5 \text{ counts})$ at 40 Hz to 500 Hz
Input impedance (typical)	10 M Ω paralleled by less than 100 pF
Resolution (by range)	
3 V	1 mV
30 V	10 mV
300 V	100 mV
600 V	1 V
Resistance	
Ranges	300 Ω , 3 k Ω , 30 k Ω , 300 k Ω , 3 M Ω , 30 M Ω
Accuracy (by range)	
300 Ω	$\pm(1.2\% \text{ reading} + 4 \text{ counts})$
3 M Ω	$\pm(1.5\% \text{ reading} + 3 \text{ counts})$
30 M Ω	$\pm(1.3\% \text{ reading} + 5 \text{ counts})$
Other ranges	$\pm(1.0\% \text{ reading} + 2 \text{ counts})$
Test voltage	Approximately 1.3 V open-circuit

Table 2: Measurement characteristics (cont.)

Characteristics	Description
Resolution (by range)	
300 Ω	0.1 Ω
3 k Ω	1 Ω
30 k Ω	10 Ω
300 k Ω	100 Ω
3 M Ω	1 k Ω
30 M Ω	10 k Ω
Continuity check threshold	The beeper sounds if the resistance of the circuit measured is < 20 Ω
Diode test	
Test current	1.5 mA maximum
Test voltage	3.3 V maximum open circuit
Resolution	1 mV
Accuracy	$\pm(1.5\% + 5 \text{ counts})$ from 0.4 V to 0.8 V
Auto power off	The meter automatically shuts off approximately ten minutes from the last function or mode change. The meter turns on again when another range is selected or any button is pressed.

Table 3: Certifications and compliances

EC Declaration of Conformity	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/EEC for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: EMC Directive 89/336/EEC: EN 55011 Class B Radiated and Conducted Emissions EN 50082-1 Immunity: IEC 801-2 Electrostatic Discharge Immunity IEC 801-3 RF Electromagnetic Field Immunity Low Voltage Directive 73/23/EEC as amended by 93/68/EEC: EN 61010-1/A2 Safety requirements for electrical equipment for measurement, control, and laboratory use
Certifications	Listed UL3111-1 and CAN/CSA C22.2 No. 1010.1.
Overvoltage Category	Category: Examples of Products in this Category: CAT III Distribution-level mains, fixed installation CAT II Local-level mains, appliances, portable equipment CAT I Signal levels in special equipment or parts of equipment, telecommunications, electronics
Pollution Degree 2	Do not operate in environments where conductive pollutants may be present.

DMM150 Performance Verification

This section contains procedures to verify that the DMM150 Digital Multimeter performs as warranted. If an instrument fails any of these checks, it needs adjustment and or repair.

The performance verification procedures provide a valid confirmation of instrument electrical characteristics and function under the following conditions:

- The multimeter operates in an 18° to 28° C (64° to 82° F) ambient environment with a relative humidity of less than 75%.
- The multimeter stabilizes in the stated ambient temperature for one hour.
- The multimeter warms up for five minutes.
- For AC measurements, allow the multimeter to settle to its final value before taking the measurement.
- The multimeter remains fully assembled.

The DMM150 performance verification consists of the checks listed in Table 4.

Table 4: Performance verification checks

AC Volts Check
DC Volts Check
Ω Check
Continuity Check

The performance verification procedure should be performed annually or after every 2000 hours of operation if used infrequently.

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics.

Alternative test equipment must meet or exceed the intended minimum requirements specified in Table 5. If you substitute equipment, you may need to modify the procedures.

NOTE. Before beginning the performance verification procedures, warm up the test equipment according to the manufacturer's recommendations.

Table 5: Test equipment

Description	Minimum requirements	Example product
Universal Calibration System	Resolution & accuracy 4 times greater than the multimeter display reading.	Wavetek 9100
	AC and DC volts measurement ¹ AC and DC current measurement	
	Resistance measurement ¹	

¹ Choose 4-wire measurement setup if available.

Set Up

To prepare for the performance verification checks, do the following steps.

1. Allow the multimeter to stabilize at the ambient temperature for one hour before testing.
2. Turn the multimeter on by pushing the slide switch to any position other than OFF.

NOTE. You need to keep the multimeter powered on throughout the warm-up period and throughout the entire verification procedure.

3. Warm up the multimeter for five minutes.
4. Photocopy the test record on pages 11 and 12 to record your test results.

Verification Procedure

Implement the following checks to verify the performance of your DMM150 multimeter.



WARNING. To avoid electric shock, avoid touching exposed connections.

AC Volts Check

Perform the following steps to verify the AC voltage measurement accuracy.

1. Set the multimeter slide switch to $V \sim V \overline{=}$.
2. Push the BLUE button to select the AC volts mode.
3. Connect the calibrator outputs to the multimeter $V-\Omega$ and COM input connectors.
4. Set the calibrator to each of the values in the AC volts test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
5. Set the calibrator output to OFF.
6. Disconnect the calibrator from the multimeter.

DC Volts Check

Perform the following steps to verify the DC volts measurement accuracy.

1. Set the multimeter slide switch to $V \sim V \overline{=}$.
2. Connect the calibrator outputs to the multimeter $V-\Omega$ and COM input connectors.
3. Set the calibrator to each of the values in the DC volts test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
4. Set the calibrator output to OFF.
5. Disconnect the calibrator from the multimeter.

Ω Check Perform the following steps to verify the resistance measurement accuracy in Ω mode.

1. Set the multimeter slide switch to Ω \rightarrow \rightarrow .
2. Connect the calibrator outputs to the multimeter V- Ω and COM input connectors.
3. Set the calibrator to each of the values in the Ω test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
4. Set the calibrator output to OFF.
5. Disconnect the calibrator from the multimeter.

Continuity Check Perform the following steps to verify the continuity check accuracy.

1. Set the multimeter slide switch to Ω \rightarrow \rightarrow .
2. Push the BLUE button to select the continuity mode.
3. Connect the calibrator outputs to the multimeter V- Ω and COM input connectors.
4. Set the calibrator to each of the values in the Continuity test record and verify proper operation.
5. Set the calibrator output to OFF.
6. Disconnect the calibrator from the multimeter.
7. Insert the multimeter test leads into the V- Ω and COM input connectors of the multimeter.
8. Short the test leads together and check for proper operation.

DMM150 Test Record

Serial number	Procedure performed by	Date

DMM150 test record

Test input	Tolerance	Display minimum	Reading	Display maximum
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AC volts test

2.900 V	50 Hz	$\pm 1.7\% + 5$ counts	2.846 V		2.954 V
	300 Hz	$\pm 1.7\% + 5$ counts	2.846 V		2.954 V
29.00 V	50 Hz	$\pm 1.7\% + 5$ counts	28.46 V		29.54 V
	400 Hz	$\pm 1.7\% + 5$ counts	28.46 V		29.54 V
290.0 V	50 Hz	$\pm 1.7\% + 5$ counts	284.6 V		295.4 V
	400 Hz	$\pm 1.7\% + 5$ counts	284.6 V		295.4 V
600.0 V	50 Hz	$\pm 1.7\% + 5$ counts	585 V		615 V
	400 Hz	$\pm 1.7\% + 5$ counts	585 V		615 V

DC volts test

-2.900 mV	$\pm 0.7\% + 2$ counts	-03.1 mV		-02.7 mV
290.0 mV	$\pm 0.7\% + 2$ counts	287.8 mV		292.2 mV
2.900 V	$\pm 0.7\% + 2$ counts	2.878 V		2.922 V
29.00 V	$\pm 0.7\% + 2$ counts	28.78 V		29.22 V
290.0 V	$\pm 0.7\% + 2$ counts	287.8 V		292.2 V
600.0 V	$\pm 0.7\% + 2$ counts	594 V		606 V

Ω test

0.00 Ω	$\pm 1.2\% + 4$ counts	-0.4 Ω		0.4 Ω
300.0 Ω	$\pm 1.2\% + 4$ counts	296.0 Ω		304.0 Ω
3.000 k Ω	$\pm 1.0\% + 2$ counts	2.968 k Ω		3.032 k Ω
30.00 k Ω	$\pm 1.0\% + 2$ counts	29.68 k Ω		30.32 k Ω
300.0 k Ω	$\pm 1.0\% + 2$ counts	296.8 k Ω		303.2 k Ω
3.000 M Ω	$\pm 1.5\% + 3$ counts	2.952 M Ω		3.048 M Ω
30.00 M Ω	$\pm 1.3\% + 5$ counts	29.56 M Ω		30.44 M Ω

DMM150 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Continuity test				
0.0 Ω		Beeper sounds		
100 Ω		Beeper does not sound		
Multimeter leads shorted		Beeper sounds		

DMM150 Adjustment Procedure

This section contains the procedures to adjust the DMM150 Digital Multimeter. Perform these procedures once a year or if the *DMM150 Performance Verification* procedure indicates the need for calibration.

In this section you will find the following information:

- A list of test equipment needed to make the adjustments
- Instructions on how to prepare the instrument for adjustment
- Step-by-step adjustment procedures

The procedures in this section do not verify performance. To confirm that your multimeter meets factory specifications, perform the procedures in the *DMM150 Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 6 to return DMM150 multimeter to factory calibration.

Table 6: DMM150 adjustments

DC Volts
AC Volts

Test Equipment

The test equipment listed in Table 5 on page 8 is a complete list of equipment needed for the adjustment procedure. These procedures assume that the test equipment is operating within tolerance.

Alternative test equipment must meet or exceed the intended minimum requirements specified in Table 5. If you substitute equipment, you may need to modify the procedures.

Preparation for Adjustment

The following guidelines apply to all DMM150 adjustments:

- Perform all adjustments in a 21° to 25° C ambient environment with a relative humidity of 75% or less.
- Warm up the multimeter for at least 15 minutes.
- Do not alter any setting without reading the entire adjustment procedure first.
- Do not alter a setting unless a performance characteristic cannot be met at the current setting.
- Read the *Safety Summary* at the beginning of this manual.

Open the Meter Case

You must open the multimeter case to access the internal adjustments. Use the following procedure to open the case.

1. Lay the meter face down on a flat work surface that cannot damage the multimeter face.
2. Remove the screw from the case back using a standard Philips-head screwdriver.
3. Gently lift the case back at the end nearest the input terminals.

To reassemble the multimeter following the adjustments, see page 16.

Adjustment

The procedures within this section use the adjustments accessible with the back case removed from the multimeter.

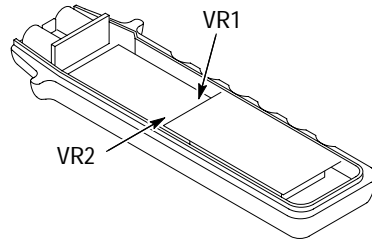


Figure 2: Adjustment location

DC Volts

Perform the following steps to adjust the DC voltage calibration.

1. Set the multimeter slide switch to V_{DC} .
2. Connect the outputs of the calibrator to the V- Ω and COM input connectors of the multimeter.
3. Set the calibrator to output 290.0 mVDC.
4. Adjust VR1 until the display shows 290.0 to 290.1 mVDC.
5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

AC Volts

Perform the following steps to adjust the AC voltage calibration.

1. Set the multimeter slide switch to V_{AC} .
2. Connect the outputs of the calibrator to the V- Ω and COM input connectors of the multimeter.
3. Set the calibrator to output 3.000 VAC.
4. Adjust VR2 until the display shows 3.000 VAC.
5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

Reassembling the Multimeter

1. Align the tabs of the bottom case half with the slots in the top case half at the end of the meter opposite the input connectors.



CAUTION. *Before closing the case, check that the battery wires are not pinched.*

2. Close the case, snapping the case halves together.
3. Reinstall the screw.