

Instructions Manual

Tektronix

DMM249
Digital Multimeter

070-9934-00

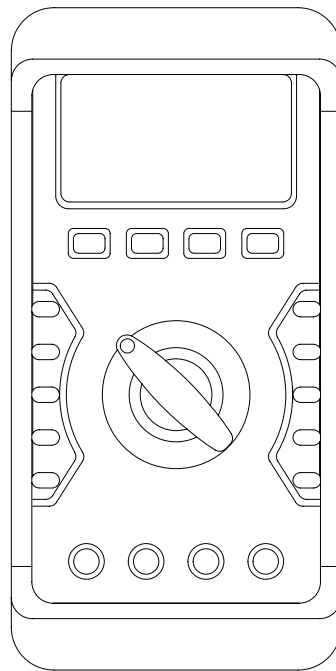


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DMM249 Digital Multimeter

The DMM249 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.



- 3200 count display with bargraph
- Shock-absorbing holster
- Autorange (volts, ohms) and manual range
- Measures DC and AC voltage (true RMS measurement), DC and AC current, and resistance
- Diode and continuity checker
- Measurement hold
- Automatic power off after 30 minutes prolongs battery life
- Low battery indicator
- Uses one 9 V battery

Figure 1: DMM249 Digital Multimeter

DMM249 Specifications

Accuracies are \pm (% reading + number of digits) at 23° C \pm 5° C at less than 75% R.H. (relative humidity).

Table 1: General specifications


Characteristics	Description
Display	3200 count Liquid Crystal Display (LCD) 65 segment analog bargraph
Polarity indication	Automatic; positive implied, negative indicated
Overrange indication	OL or -OL
Low battery indication	The low battery indicator is displayed when battery voltage drops below the operating level
Sampling rate	
Analog bar graph	12 times/second
Digital display	2 times/second
Power supply	One standard 9 V battery, IEC 6F22, or ANSI/NEDA 1640A
Battery life	350 hours, typical (alkaline)
Auto power off	The meter will automatically shut off approximately 10 minutes after the last function or mode change
Maximum input voltage	1000 VDC or 750 VAC _{RMS} CAT II between V and COM terminals
Maximum floating voltage	1000 VDC or 750 VAC _{RMS} CAT II between any terminal and earth GND
Maximum open circuit voltage (current inputs)	600 VDC or 600 VAC _{RMS} between current input and COM terminals
Overload protection	
V connector	1000 VDC or $V \sim V \equiv$ 750 VAC _{RMS} 600 VDC/AC _{RMS} $\Omega \text{))) } \rightarrow$
A connector	15 A (600 V) fast blow fuse (type KTK or KLK) Tektronix part number 159-0287-00
μ A/mA connector	1 A (600 V) fast blow fuse (type BLS or BBS) Tektronix part number 159-0337-00
TL60 test lead set	Rated 1000 V  ANS/ISA S82.02-1988 CSA 22.2 No 231.1 M89 C/NRTL LR100328
Operating temperature	0° C to +50° C, 0 to 80% R.H.
Storage temperature	-20° C to +60° C, 0 to 80% R.H. with battery removed from the meter
Temperature coefficient	(0.15 x specified accuracy)/ ° C <18° C or >28° C
Operating altitude	2000 m (6561 ft.), maximum

Table 1: General specifications (cont.)

Characteristics	Description
Dimensions (H x W x D) with holster	199 mm x 98 mm x 51 mm
Dust/water protection	IP 54

Table 2: Measurement characteristics

Characteristics	Description
DC volts	
Ranges	300 mV, 3 V, 30 V, 300 V, 1000 V
Accuracy	$\pm(0.3\% \text{ reading} + 2 \text{ digits})$
Input impedance	10 M Ω
Resolution (by range)	
300 mV	100 μV
3 V	1 mV
30 V	10 mV
300 V	100 mV
1000 V	1V
AC volts ¹	
Ranges	3 V, 30 V, 300 V, 750 V
Frequency response	40 Hz to 1 kHz (40 Hz to 300 Hz on 3V range)
Accuracy	$\pm(1.3\% \text{ reading} + 3 \text{ digits})$
Input impedance	10 M Ω (paralleled by less than 100 pF)
Resolution (by range)	
3 V	1 mV
30 V	10 mV
300 V	100 mV
750 V	1 V
DC current	
Ranges	300 μA , 3 mA, 30 mA, 300 mA, 20 A The A range has a 30 second time limit for measuring current levels above 10 A but not to exceed 20 A
Accuracy	
300 μA	$\pm(1\% \text{ reading} + 2 \text{ digits})$
3 mA	$\pm(1.2\% \text{ reading} + 2 \text{ digits})$
30 mA	$\pm(1\% \text{ reading} + 2 \text{ digits})$
300 mA	$\pm(1.2\% \text{ reading} + 2 \text{ digits})$
20 A	$\pm(2\% \text{ reading} + 3 \text{ digits})$
Burden voltage	
300 μA , 30 mA	200 mV maximum
3 mA, 300 mA, 10 A	2 V maximum

Table 2: Measurement characteristics (cont.)

Characteristics	Description
Resolution (by range)	
300 μ A	0.1 μ A
3 mA	1 μ A
30 mA	10 μ A
300 mA	0.1 mA
20 A	10 mA
AC current	
Ranges	300 μ A, 3 mA, 30 mA, 300 mA, 20 A The A range has a 30 second time limit for measuring current levels above 10 A but not to exceed 20 A
Accuracy	
300 μ A to 30 mA	$\pm(1.5\%$ reading + 3 digits)
300 mA	$\pm(2\%$ reading + 3 digits)
20 A	$\pm(2.5\%$ reading + 5 digits)
Burden voltage	
300 μ A, 30 mA	200 mV maximum
3 mA, 300 mA, 10 A	2 V maximum
Frequency response	40 Hz to 1 kHz
Resolution (by range)	
300 μ A	0.1 μ A
3 mA	1 μ A
30 mA	10 μ A
300 mA	100 μ A
20 A	10 mA
Resistance	
Ranges	300 Ω , 3 k Ω , 30 k Ω , 300 k Ω , 3 M Ω , 30 M Ω
Accuracy	
300 Ω	$\pm(1.2\%$ reading + 4 digits)
3 k Ω to 300 k Ω	$\pm(1.0\%$ reading + 2 digits)
3 M Ω	$\pm(1.5\%$ reading + 3 digits)
30 M Ω	$\pm(2.5\%$ reading + 5 digits)
Open circuit voltage	Approximately 1.3 V

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	Approximately 50 Ω — tone will sound
Diode test	
Maximum test current	1.5 mA
Test voltage (open circuit)	3.3 V maximum
Resolution	1 mV

¹ AC conversions are AC-coupled, true RMS responding, and calibrated to the RMS value of a sine wave input. The basic accuracy is for sine wave at full scale and non-sine wave below half scale (3 V range only for sine wave measurement).

For non-sine wave accuracy, refer to the following crest factor guide:

1.4 to 2.0, add 0.5% to accuracy

2.0 to 2.5, add 2% to accuracy

2.5 to 3.0, add 4% to accuracy

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.

DMM249 Performance Verification

This section contains procedures to verify that the DMM249 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 and in the holster.

The DMM249 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
DC Milliampere Check
AC Milliampere Check
DC Ampere Check
AC Ampere 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 Capacitance measurement	
Capacitance Standard		Optional

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 rotating the function 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 16 and 17 to record your test results.

Verification Procedure

Implement the following checks to verify the performance of your DMM249 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 dial to $V\sim$.
2. Connect the calibrator outputs to the multimeter $V\Omega\rightarrow$ and COM input connectors.
3. 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.
4. Turn the calibrator output off.
5. Disconnect the calibrator from the multimeter.

DC Volts Check

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

1. Set the multimeter dial to $V\equiv$ and press the Blue function button to select DC volts.
2. Connect the calibrator outputs to the multimeter $V\Omega\rightarrow$ 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. Turn the calibrator output 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 dial to Ω .
2. Connect the calibrator outputs to the multimeter V- Ω - \rightarrow 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. Turn the calibrator output off.
5. Disconnect the calibrator from the multimeter.

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

1. Set the multimeter dial to \rightarrow .
2. Connect the calibrator outputs to the multimeter V- Ω - \rightarrow and COM input connectors.
3. Set the calibrator to each of the values in the Continuity test record and verify proper operation.
4. Turn the calibrator output off.
5. Disconnect the calibrator from the multimeter.
6. Insert the multimeter test leads into the V- Ω - \rightarrow and COM input connectors of the multimeter.
7. Short the test leads together and check for proper operation.

DC Microampere Check Perform the following steps to verify the DC microampere measurement accuracy.

1. Set the multimeter dial to μA .
2. Connect the calibrator outputs to the multimeter μA and COM input connectors.
3. Set the calibrator to each of the values in the DC microampere test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
4. Turn the calibrator output off.

AC Microampere Check

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

1. Set the multimeter dial to μA \approx .
2. Push the DC/AC button to select AC mode.
3. Connect the calibrator outputs to the multimeter μAmA and COM input connectors.
4. Set the calibrator to each of the values in the AC milliampere test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

DC Milliampere Check

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

1. Set the multimeter dial to mA \approx .
2. Connect the calibrator outputs to the multimeter μAmA and COM input connectors.
3. Set the calibrator to each of the values in the DC milliampere test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
4. Turn the calibrator output off.
5. Disconnect the calibrator from the multimeter.

AC Milliampere Check

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

1. Set the multimeter dial to mA \approx .
2. Push the DC/AC button to select AC mode.
3. Connect the calibrator outputs to the multimeter μAmA and COM input connectors.
4. Set the calibrator to each of the values in the AC milliampere test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

DC Ampere Check Perform the following steps to verify the DC ampere measurement accuracy.

1. Set the multimeter dial to A \approx .
2. Connect the calibrator outputs to the multimeter A and COM input connectors.
3. Set the calibrator to each of the values in the DC ampere test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
4. Turn the calibrator output off.
5. Disconnect the calibrator from the multimeter.

AC Ampere Check Perform the following steps to verify the AC ampere measurement accuracy.

1. Set the multimeter dial to A \approx .
2. Push the DC/AC button to select AC mode.
3. Connect the calibrator outputs to the multimeter A and COM input connectors.
4. Set the calibrator to each of the values in the AC ampere test record and verify that the multimeter reads within the specified Display minimum and maximum limits.
5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

DMM249 Test Record

Serial number	Procedure performed by	Date

DMM249 test record

Test input	Tolerance	Display minimum	Reading	Display maximum
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AC volts test

2.900 V	50 Hz	$\pm 1.3\% + 3$ counts	2.859 V	2.940 V
	300 Hz	$\pm 1.3\% + 3$ counts	2.859 V	2.940 V
29.00 V	50 Hz	$\pm 1.3\% + 3$ counts	28.59 V	29.40 V
	400 Hz	$\pm 1.3\% + 3$ counts	28.59 V	29.40 V
290.0 V	50 Hz	$\pm 1.3\% + 3$ counts	285.9 V	294.0 V
	400 Hz	$\pm 1.3\% + 3$ counts	285.9 V	294.0 V
600.0 V	50 Hz	$\pm 1.3\% + 3$ counts	589 V	611 V
	400 Hz	$\pm 1.3\% + 3$ counts	589 V	611 V

DC volts test

290.0 mV	$\pm 0.3\% + 2$ counts	288.9 mV	291.1 mV
2.900 V	$\pm 0.3\% + 2$ counts	2.889 V	2.911 V
29.00 V	$\pm 0.3\% + 2$ counts	28.89 V	29.11 V
290.0 V	$\pm 0.3\% + 2$ counts	288.9 V	291.1 V
600.0 V	$\pm 0.3\% + 2$ counts	596 V	604 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	$\pm 2.5\% + 5$ counts	29.20 M Ω	30.80 M Ω

DMM249 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
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Continuity test

0.0 Ω		Beeper sounds		
100 Ω		Beeper does not sound		
Multimeter leads shorted		Beeper sounds		

DC microampere test

0.0 μA	± 2 counts	-00.2 μA		00.2 μA
290.0 μA	$\pm 1.0\% + 2$ counts	286.9 μA		293.1 μA

DC milliampere test

2.900 mA	$\pm 1.2\% + 2$ counts	2.863 mA		2.936 mA
29.00 mA	$\pm 1.0\% + 2$ counts	28.69 mA		29.31 mA
290.0 mA	$\pm 1.2\% + 2$ counts	286.3 mA		293.6 mA

AC microampere test (50 Hz)

0.0 μA	± 3 counts	-00.3 μA		00.3 μA
290.0 μA	$\pm 1.5\% + 3$ counts	285.4 μA		294.6 μA

AC milliampere test (50 Hz)

2.900 mA	$\pm 1.5\% + 3$ counts	2.854 mA		2.946 mA
29.00 mA	$\pm 1.5\% + 3$ counts	28.54 mA		29.46 mA
290.0 mA	$\pm 2.0\% + 3$ counts	283.9 mA		296.1 mA

DC ampere test

10.000 A	$\pm 2.0\% + 3$ counts	9.77 A		10.23 A
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AC ampere test (50 Hz)

10.000 A	$\pm 2.5\% + 5$ counts	9.70 A		10.30 A
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DMM249 Adjustment Procedures

This section contains procedures to adjust the DMM249 Digital Multimeter. Perform these procedures once a year or if the *DMM249 Performance Verification* procedure indicates the need for calibration.

In this section you will find the following information:

- A list of adjustments
- 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 *DMM249 Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 6 to return DMM249 multimeter to factory calibration.

Table 6: DMM249 adjustments

DC Volts
AC Volts

Test Equipment

The test equipment listed in Table 5 on page 9 is a complete list of equipment needed for the adjustment procedures. 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 DMM249 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 three screws from the case bottom using a standard Philips-head screwdriver.
3. Gently lift the end of the case bottom at the end opposite from the display. Then lift the end nearest the display until it unsnaps from the case top.

To reassemble the multimeter following the adjustments, see page 21.

Adjustments

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

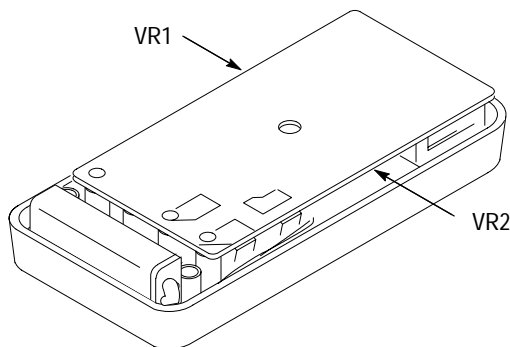


Figure 2: Adjustment locations

DC Volts Perform the following steps to adjust the DC voltage calibration.

1. Set the multimeter dial 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 190.0 mVDC.
4. Adjust VR1 until the display shows 190.0 to 190.1 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 dial 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 300.0 VAC.
4. Adjust VR2 until the display shows 300.0 VAC.
5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

Reassembling the Multimeter

1. Ensure that the rotary dial is properly aligned.
2. Align the tabs of the bottom case half with the slots in the top case half at the end of the meter near the input connectors.



CAUTION. Before closing the case, check that the rotary dial is properly aligned and that the battery wires are not pinched.

3. Close the case, snapping the case halves together.
4. Reinstall the three screws.