Instructions Manual

Tektronix

DMM254
Digital Multimeter

070-9935-00

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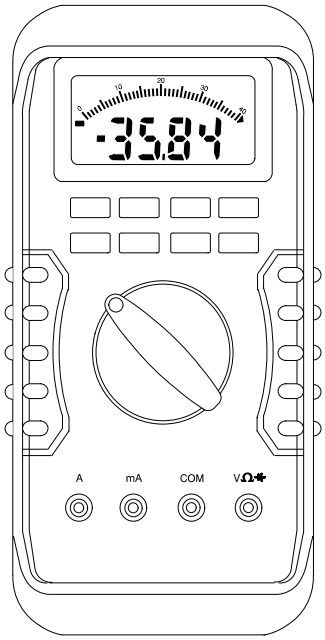
DMM254 Digital Multimeter

The DMM254 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.



- 3 ¾ digital display with bargraph
- Shock-absorbing holster
- Autorange (volts, ohms) and manual range
- Measures DC and AC voltage (true RMS measurement) and current
- Measures resistance, capacitance, and frequency
- Diode and continuity checker
- Relative measurements
- Measurement hold
- Minimum and maximum values
- Memory store and recall
- Automatic power off after 30 minutes prolongs battery life
- Low battery indicator
- Uses one 9 V battery

Figure 1: DMM254 Digital Multimeter

DMM254 Specifications

Accuracies are ±(% reading + number of digits) at 23° C ±5° C at less than 80% R.H. (relative humidity).

Table 1: General specifications

Characteristics	Description
Display	$3^3/_4$ digit Liquid Crystal Display (LCD) and a 42 segment analog bar graph
Polarity indication	Automatic; positive implied, negative indicated
Overrange indication	Most significant digit (MSD) blinks
Low battery indication	The low battery indicator is displayed when battery voltage drops below the operating level
Sampling rate	
Analog bar graph	20 times/second
Digital display	
Capacitance mode	1 time/second
Other modes	2 times/second
Power supply	One standard 9 V battery, IEC 6F22, or ANSI/NEDA 1640A
Battery life	500 hours, typical (alkaline)
Auto power off	The meter will automatically shut off approximately 30 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	1100 V_p V~ V⎓ 600 VDC/AC-RMS Ω))) ⊣⊢ Hz ADp
A connector	15 A (600 V) fast blow fuse (type KTK or KLK) Tektronix part number 159-0287-00
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 SA® ANSI/ISA S82.02-1988 CSA 22.2 No 231.1 M89 C/NRTL LR100328
Operating temperature	–10° C to +50° C
Storage temperature	–30° C to +60° C, 0 to 80% R.H. with battery removed from the meter
Operating altitude	2000 m (6561 ft.), maximum

Table 1: General specifications (cont.)

Characteristics	Description
Dimensions (H × W × D) with holster	199 mm × 98 mm × 51 mm
Weight (with battery)	13 ounces (370 grams)
With holster	21.2 ounces (600 grams)
Shock and vibration	Meets requirements of MIL-T-28800, Class 2
Dust/water protection	IP 54

Table 2: Measurement characteristics

Characteristics	Description
DC volts	
Ranges	400 mV, 4 V, 40 V, 400 V, 1000 V
Accuracy	
400 mV range	±(0.3% reading + 2 digits)
4 V to 1000 V ranges	±(0.1% reading + 2 digits)
Input impedance	10 MΩ (paralleled by less than 100 pF)
Resolution (by range)	
400 mV	100 µV
4 V	1 mV
40 V	10 mV
400 V	100 mV
1000 V	1V
AC volts	
Ranges	400 mV, 4 V, 40 V, 400 V, 750 V
Accuracy	All ranges (except 400 mV)
50 Hz to 60 Hz	±(0.5% reading + 5 digits)
40 Hz to 1 kHz	±(1% reading + 5 digits)
Input impedance	10 MΩ (paralleled by less than 100 pF)
Resolution (by range)	
400 mV	100 µV
4 V	1 mV
40 V	10 mV
400 V	100 mV
750 V	1 V

Table 2: Measurement characteristics (cont.)

Characteristics	Description
DC current	
Ranges	4 mA, 40 mA, 400 mA, A (10 A) The A range has a 30 second time limit for measuring current levels above 10 A but not to exceed 15 A.
Accuracy	
A (10 A)	±(0.8% reading + 4 digits)
Other ranges	±(0.4% reading + 2 digits)
Burden voltage	
A	1 V maximum
Other ranges	800 mV maximum
Resolution (by range)	
4 mA	1 µA
40 mA	10 µA
400 mA	100 µA
A	10 mA
AC current	
Ranges	4 mA, 40 mA, 400 mA, A (10 A) (The A range has a 30 second time limit for measuring current levels above 10 A but not to exceed 15 A.)
Accuracy (40 Hz to 1 kHz)	±(1% reading + 5 digits)
Resolution (by range)	
4 mA	1 µA
40 mA	10 µA
400 mA	100 µA
A	10 mA
Resistance	
Ranges	400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ
Accuracy	
400 Ω range	±(0.4% reading + 4 digits)
4 MΩ range	±(0.6% reading + 3 digits)
40 MΩ range	±(1.5% reading + 5 digits)
Other ranges	±(0.4% reading + 2 digits)
Test voltage	Approximately 450 mV

Table 2: Measurement characteristics (cont.)

Characteristics	Description
Resolution (by range)	
400 Ω	0.1 Ω
4 kΩ	1 Ω
40 kΩ	10 Ω
400 kΩ	100 Ω
4 MΩ	1 kΩ
40 MΩ	10 kΩ
Continuity check	
Threshold	Less than or equal to 30 Ω — tone will sound
Tone frequency	2 kHz
Diode test	
Test current	0.6 mA
Test voltage (open circuit)	3.6 V maximum
Capacitance	
Ranges	4 nF, 40 nF, 400 nF, 4 µF, 40 µF
Accuracy (in relative mode)	
4 nF range	±(1% reading + 40 digits)
Other ranges	
40 pF to 20 µF	±(1% reading + 4 digits)
>20 µF	±(5% reading + 8 digits)
Resolution (by range)	
4 nF	1 pF
40 nF	10 pF
400 nF	100 pF
4 µF	1 nF
40 µF	10 nF
Frequency	
Ranges	100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz
Accuracy	
100 Hz to 100 kHz	±(0.1% reading + 4 digits)
1 MHz	±(0.5% reading + 4 digits)
Sensitivity	
1 Hz to 20 kHz	40 mV_{RMS}
20 kHz to 1 MHz	400 mV_{RMS}

Table 2: Measurement characteristics (cont.)

Characteristics	Description
Resolution (by range)	
100 Hz	0.01 Hz
1 kHz	0.1 Hz
10 kHz	1 Hz
100 kHz	10 Hz
1 MHz	100 Hz
ADp mode	
Display	10 counts per 1 mV DC
Accuracy	±(0.3% reading + 4 digits)

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.

DMM254 Performance Verification

This section contains procedures to verify that the DMM254 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 DMM254 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 with 9105 lead set.
	AC and DC volts measurement[1] AC and DC current measurement	
	Resistance measurement[1] Capacitance measurement	
	Sinewave generation Squarewave generation	
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. Photcopy the test record on pages 17 through 19 to record your test results.

Verification Procedure

Implement the following checks to verify the performance of your DMM254 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~.
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 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⎓ and press the BLUE function button to select DC volts.
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 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-⊣⊢ 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 Ω.
2. Push the BLUE function button to select the continuity test 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. Turn the calibrator output 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.

Capacitance Check

Perform the following steps to verify the capacitance measurement accuracy.

1. Set the multimeter dial to →⊣⊢.
2. Push the BLUE function button to select the capacitance test mode.
3. Set the calibrator to each of the values in the Capacitance 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.

Frequency Check

Perform the following steps to verify the frequency measurement accuracy.

1. Set the multimeter dial to Hz.
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 Frequency 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 Milliampere Check

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

1. Set the multimeter dial to to the mA ranges indicated in the test record.
2. Connect the calibrator outputs to the multimeter mA 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 to the mA ranges indicated in the test record.
2. Push the BLUE function button to select the continuity test mode.
3. Connect the calibrator outputs to the multimeter mA 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≂.
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≂.
2. Push the BLUE function button to select the continuity test 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.

DMM254 Test Record

Serial number	Procedure performed by	Date

DMM254 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC volts test					
2.900 V	50 Hz	±0.5% + 5 counts	2.881 V		2.919 V
	300 Hz	±1.0% + 5 counts	2.866 V		2.934 V
29.00 V	50 Hz	±0.5% + 5 counts	28.81 V		29.19 V
	400 Hz	±1.0% + 5 counts	28.66 V		29.34 V
290.0 V	50 Hz	±0.5% + 5 counts	288.1 V		291.9 V
	400 Hz	±1.0% + 5 counts	286.6V		293.4 V
600.0 V	50 Hz	±0.5% + 5 counts	592 V		608 V
	400 Hz	±1.0% + 5 counts	589 V		611 V
DC volts test					
290.0 mV		±0.3% + 2 counts	288.9 mV		291.0 mV
2.900 V		±0.1% + 2 counts	2.895 V		2.905 V
29.00 V		±0.1% + 2 counts	28.95 V		29.05 V
290.0 V		±0.1% + 2 counts	289.5 V		290.5 V
600.0 V		±0.1% + 2 counts	597 V		603 V
Ω test					
0.00 Ω [1]		±0.4% + 4 counts	–0.4 Ω		0.4 Ω
300.0 Ω [1]		±0.4% + 4 counts	298.4 Ω		301.6 Ω
3.000 kΩ		±0.4% + 2 counts	2.986 kΩ		3.014 kΩ
30.00 kΩ		±0.4% + 2 counts	29.86 kΩ		30.14 kΩ
300.0 kΩ		±0.4% + 2 counts	298.6 kΩ		301.4 kΩ
3.000 MΩ		±0.6% + 3 counts	2979 kΩ		3021 kΩ
30.00 MΩ		±1.5% + 5 counts	29.50 MΩ		30.50 MΩ

1 Set the DMM to Relative mode.

DMM254 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		
Frequency test					
100.00 Hz	1 V_{p-p}	±0.1% + 4 counts	99.5 Hz		100.5 Hz
1.0000 kHz	1 V_{p-p}	±0.1% + 4 counts	0.995 kHz		1.005 kHz
10.000 kHz	1 V_{p-p}	±0.1% + 4 counts	9.95 kHz		10.05 kHz
100.00 kHz	1 V_{p-p}	±0.1% + 4 counts	99.5 kHz		100.5 kHz
1.0000 MHz	1 V_{p-p}	±0.5% + 4 counts	0.991 MHz		1.009 MHz
Capacitance test[1,2]					
3.600 nF		±1.0% + 40 counts	3.524 nF		3.676 nF
36.00 nF		±1.0% + 4 counts	35.24 nF		36.76 nF
360.0 nF		±1.0% + 4 counts	352.4 nF		367.6 nF
3.600 µF		±1.0% + 4 counts	3.524 µF		3.676 µF
36.00 µF		±5.0% + 8 counts	34.12 µF		37.88 µF
DC milliampere test					
2.900 mA		±0.4% + 2 counts	2.886 mA		2.913 mA
29.00 mA		±0.4% + 2 counts	28.86 mA		29.13 mA
290.0 mA		±0.4% + 2 counts	288.6 mA		291.3 mA
AC milliampere test (50 Hz)					
2.900 mA		±1.0% + 5 counts	2.866 mA		2.934 mA
29.00 mA		±1.0% + 5 counts	28.66 mA		29.34 mA
290.0 mA		±1.0% + 5 counts	286.6 mA		293.4 mA

1 **Variations in test equipment can cause erroneous readings. Use a fixed value capacitance standard if instability occurs.**

2 **Set the DMM to Relative mode to remove stray capacitance for low capacitance measurements.**

DMM254 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
DC ampere test				
10.000 A	±0.8% + 4 counts	9.88 A		10.12 A
AC ampere test (50 Hz)				
10.000 A	±1.0% + 5 counts	9.85 A		10.15 A

DMM254 Adjustment Procedures

This section contains procedures to adjust the DMM254 Digital Multimeter. Perform these procedures once a year or if the *DMM254 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 *DMM254 Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 6 to return DMM254 multimeter to factory calibration.

Table 6: DMM254 adjustments

DC Volts
AC Volts

Test Equipment

The test equipment listed in Table 5 on page 10 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 DMM254 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 24.

Adjustments

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

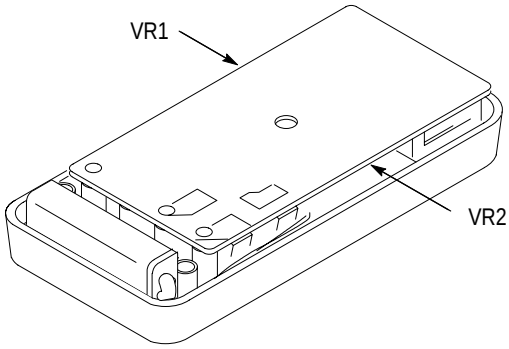


Figure 2: Adjustment locations

DC Volts

Perform the following steps to adjust the DC voltage calibration.

1. Set the multimeter dial to V⎓.
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~.
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.