Technical Reference

Tektronix

Handheld Instruments
Basic Service

061-4123-00

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

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Service Reference

This manual contains the Performance Verification and Adjustment procedures for many handheld products. Table i lists the products supported by this manual.

Table i: Handheld products supported by this manual

Products	
CMM150 AC Current Probe	DMM249 Digital Multimeter
DCM300 and 320 Digital Clamp Multimeters	DMM254 Digital Multimeter
DCM330 Digital Clamp Meter	DMM800 Series Digital Multimeters
DCM910 Digital Clamp Meter	DMM912, 914, and 916 Digital Multimeters
DMM150 Digital Multimeter	DTM510 and DTM520 Digital Thermometers
DMM157 Digital Multimeter (serial numbers above TW80000)	DTM900 and DTM920 Digital Thermometers

Service information of products not provided in this manual may be available under separate cover. Table ii provides a list of many handheld and benchtop instruments and their service documentation.

Table ii: Handheld and benchtop instruments service manuals

Product	Tektronix part number
212 Oscilloscope	070-5053-00
214 Oscilloscope	070-5055-00
214 Storage Oscilloscope	070-1483-00
221 Oscilloscope	070-1573-01
222 Digital Storage Oscilloscope	070-7459-00
222A DSO: B010100 thru B039999 B040000 and above	 070-8330-00 070-8330-02
222PS Power Scout	070-8098-02
224 Digital Storage Oscilloscope	070-8405-02
305 DMM Oscilloscope	070-2423-01
314 Storage Oscilloscope	070-1824-00
335 Oscilloscope	070-1943-01
336 Digital Storage Oscilloscope	070-4421-00

Table ii: Handheld and benchtop instruments service manuals (cont.)

Product	Tektronix part number
2201 Portable Oscilloscope	070-7189-00
2205 Oscilloscope	070-6716-00
2211 Oscilloscope	070-7234-00
2214 Digital Storage Oscilloscope	070-7783-00
2220 Digital Storage Oscilloscope	070-5302-00
2221A Oscilloscope: B010100 to B019999 B020000 and above	 070-8157-01 070-8549-00
2225 Oscilloscope	070-6299-00
2230 Digital Storage Oscilloscope	070-4999-00
2232 Digital Storage Oscilloscope: B010100 to B029999 B030000 and above	 070-7067-01 070-8548-00
2235 AN/USM-488 Oscilloscope	070-4977-00
2245 Portable Oscilloscope	070-6276-00
2245A Portable Oscilloscope: B010100 to B015999 B016000 and above	 070-6557-00 070-7672-00
2246A Portable Oscilloscope	070-6555-00
2246/1Y/2R/2246 Mod A	070-7062-00
2247A Portable Oscilloscope	070-6367-00
2252 Portable Oscilloscope	070-7838-01
2335 Oscilloscope	070-4116-00
2336 Oscilloscope	070-4118-00
2336YA Oscilloscope	070-5011-00
2337 Oscilloscope	070-4120-00
TAS 455/465 Oscilloscope	070-8524-02
TAS 465 Oscilloscope	070-9403-00
TAS 475/485 Oscilloscope: B010100 to B020099 B020100 and above	 070-8878-01 070-9404-00
TDS 210/220 Oscilloscope	070-9693-01
TDS 310/320/350 Oscilloscope	070-8570-05
TDS 340/340A/360/380 Oscilloscope	070-9435-02
THS 710/720/730 Oscilloscope	070-9246-03

General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to the products in this manual or any products connected to them. To avoid potential hazards, use these products only as specified.

Only qualified personnel should perform service procedures.

While using these products, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Use Proper Power Cord. To avoid fire hazard, use only the power cord specified for the product you are using.

Use Proper Voltage Setting. Before applying power, ensure that the line selector is in the proper position for the power source being used.

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. Some of these products are grounded through the grounding conductor or the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product you are using, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product you are using. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

Recharge Batteries Properly. Recharge batteries for the recommended charge cycle only.

Use Proper AC Adapter. Use only the AC adapter specified for the product you are using.

Do Not Operate Without Covers. Do not operate these products with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for the product you are using.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate in Wet/Damp Conditions. To avoid electric shock, do not operate these products in wet or damp conditions.

Do Not Operate in Explosive Conditions. To avoid injury or fire hazard, do not operate these products in an explosive atmosphere.

Keep Product Surfaces Clean and Dry. To avoid electric shock and erroneous readings, keep probe surfaces clean and dry.

Provide Proper Ventilation. Refer to the product installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual.

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Products. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

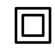
CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:

DANGER
High Voltage

Protective Ground
(Earth) Terminal

ATTENTION
Refer to Manual



Double
Insulated

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, disconnect the main power by means of the power cord or, if provided, the power switch.

Use Caution When Servicing the CRT. To avoid electric shock or injury, use extreme caution when handling the CRT. Only qualified personnel familiar with CRT servicing procedures and precautions should remove or install the CRT.

CRTs retain hazardous voltages for long periods of time after power is turned off. Before attempting any servicing, discharge the CRT by shorting the anode to chassis ground. When discharging the CRT, connect the discharge path to ground and then the anode. Rough handling may cause the CRT to implode. Do not nick or scratch the glass or subject it to undue pressure when removing or installing it. When handling the CRT, wear safety goggles and heavy gloves for protection.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

X-Radiation. To avoid x-radiation exposure, do not modify or otherwise alter the high-voltage circuitry or the CRT enclosure. X-ray emissions generated within this product have been sufficiently shielded.

Preventing Electrostatic Discharge

CAUTION. *Static discharge can damage internal semiconductor components. Follow the guidelines listed below to avoid product damage.*

When performing service that requires internal access to an instrument, adhere to the following precautions to avoid damaging internal modules or their components:

- Avoid handling modules or components in areas that have floors or work surfaces capable of generating a static charge.
- Spray carpeted work areas with a solution of equal parts of water and fabric softener.
- Wear clothing made from materials that do not accumulate static charges. Avoid Wool (and some artificial fibers) which build up static charges readily; wear cotton which conducts electricity and resists static accumulation.
- Minimize the handling of static-sensitive devices.
- Transport and store static-sensitive devices in their protected containers or on a metal rail. Label any package that contains static-sensitive parts.
- Service instruments and modules at grounded, static-free work stations.
- Do not allow devices capable of generating a static charge on a work station surface.
- Wear a grounding strap while working with static-sensitive devices.
- Handle circuit boards by their edges, if possible.
- Do not slide static-sensitive components over any surface.
- Do not use high-velocity compressed air to clean or dry components or modules.

Preface

This manual contains service information for a wide range of handheld products. Each section covers a product or related series of products and includes the following information:

- A product description that details instrument functions, capabilities, and recommended uses
- A front panel illustration
- A set of electrical, mechanical, environmental, and physical specifications
- A performance verification procedure to ensure the instrument meets specifications
- An adjustment procedure to return the instrument to factory calibration (not included for all instruments)

The information contained in this manual is current at the date of publication and is typical or suggested, not guaranteed.

Some instruments have optional service information available under separate cover. This manual does not duplicate information from optional service manuals. Refer to the optional accessories list in your user manual for Tektronix part numbers of optional service manuals. A list of many handheld and benchtop instruments manuals are listed in Table ii on Page i.

NOTE*. This manual provides the necessary service information to verify that your instrument is working properly. Should you have service-related questions not covered in either this manual or in an optional service manual, please contact your Tektronix Service Center for additional information.*

For product warranty information, refer to the user manual supplied with your instrument.

Contacting Tektronix

Product Support	For application-oriented questions about a Tektronix measurement product, call toll free in North America: 1-800-TEK-WIDE (1-800-835-9433 ext. 2400) 6:00 a.m. – 5:00 p.m. Pacific time Or contact us by e-mail: tm_app_supp@tek.com For product support outside of North America, contact your local Tektronix distributor or sales office.
Service Support	Contact your local Tektronix distributor or sales office. Or visit our web site for a listing of worldwide service locations. http://www.tek.com
For other information	In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call.
To write us	Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000

Instructions Manual

Tektronix

CMM150
AC Current Probe

070-9937-00

Table of Contents

CMM150 AC Current Probe

The CMM150 measures AC current (up to 300 A) when used with the DMM150 Digital Multimeter.

The current probe acts as a current to voltage transformer. The probe captures the current induced magnetic fields around a conductor (wire) and converts the fields to a proportional voltage that is displayed on the DMM150.

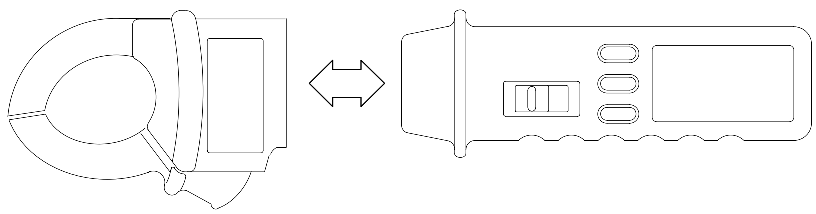


Figure 1: CMM150 AC Current Probe with DMM150 Digital Multimeter

CMM150 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
Operating temperature	0 °C to 45 °C <75% R.H.
Storage temperature	–20 °C to +60 °C <75% R.H.
Temperature coefficient	0.15 × (specified accuracy) /°C (<18 °C or >28 °C)
Dimensions (W × L × D) with holster	72 mm × 102 mm × 36 mm (2.83 in. × 4.02 in. × 1.42 in.)
Weight	130.1 g (0.29 lbs)
Maximum altitude	2000 m
Maximum jaw opening	30 mm (1.18 in)
Maximum conductor size	29 mm dia. (1.14 in.)

Table 2: Measurement characteristics

Characteristics	Description
Current range	0.1 A to 300 A AC_{RMS}
Output voltage	10 mV/A
Accuracy	±(1.9% + 0.5 A) 50～60 Hz ±(3.9% + 1 A) 40～400 Hz
Maximum bare wire voltage	600 VAC_{RMS} CAT II
Sensor type	Induction coil
Maximum output impedance	120 Ω

Table 3: Certifications and compliances

EC Declaration of Conformity	Meets intent of 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 Low Voltage Directive 73/23/EEC: EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use
Certifications	Certified by CSA to CAN/CSA–C22.22 No. 231 and UL1244

Table 3: Certifications and compliances (cont.)

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	As defined in EN 61010-1. Do not operate in environments where conductive pollutants may be present.	

CMM150 Performance Verification

This section contains the procedure to verify that the CMM150 AC Current Probe performs as warranted when installed on a DMM150 Digital Multimeter. If an instrument fails any of these checks, it needs adjustment and or repair.

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

- The CMM150 and DMM150 operate in an 18° to 28° C (64° to 82° F) ambient environment with a relative humidity of less than 75%.
- The DMM150 stabilizes at the stated ambient temperature for one hour.
- The DMM150 warms up for five minutes.
- The DMM150 is set to the 3 V AC mode.
- Allow the DMM150 to settle to its final value before taking the measurement.

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

Test Equipment

The performance verification procedure uses external traceable test equipment to directly check warranted characteristics.

Alternative test equipment must meet or exceed the intended minimum requirements specified in Table 4. If you substitute equipment, you may need to modify the procedures.

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

Table 4: Test equipment

Description	Minimum requirements	Example product
Universal Calibration System	Resolution & accuracy 4 times greater than the multimeter display reading	Wavetek 9100 with option 200 current coil set

Set Up

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

1. Attach the CMM150 to the DMM150 and allow them to stabilize at the ambient temperature for one hour before testing.
2. Turn the DMM150 on by pushing the slide switch to V~V⎓.

***NOTE**. You need to keep the DMM150 powered on throughout the warm-up period and throughout the entire verification procedure.*

3. Warm up the DMM150 for five minutes.
4. Photocopy the test record on page 7 to record your test results.

Verification Procedure

Implement the following checks to verify the performance of your CMM150 AC Current Probe.

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

AC Ampere Check

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

1. Set the DMM150 slide switch to V~V⎓.
2. Push the Blue function button to select AC volts.
3. Press the RANGE button to select the 3 V range.
4. Select the appropriate coils as necessary to multiply the AC current calibrator output to each of the values given in the Test Record. For more information, refer to the user manual of your calibrator.
5. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
6. Verify that the multimeter reads within the specified Display minimum and maximum limits.
7. Turn the calibrator output off.
8. Remove the clamp from the current loop.

CMM150 Test Record

Serial number	Procedure performed by	Date

CMM150 test record

Test input	Tolerance	Display minimum	Reading	Display maximum
AC ampere test (50 Hz or 60 Hz)				
0.1 A	±1.9% + 0.5 A	–.005		.007
10.0 A	±1.9% + 0.5 A	.094		.106
100.0 A	±1.9% + 0.5 A	.976		1.024
300.0 A	±1.9% + 0.5 A	2.938		3.062

CMM150 Adjustment Procedures

This section contains procedures to adjust the CMM150 AC Current Probe. Perform these procedures once a year or if the *CMM150 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 *CMM150 Performance Verification* section.

Test Equipment

The test equipment listed in Table 4 on page 5 is a complete list of equipment needed for the adjustment procedures. This procedure assumes that the test equipment is operating within tolerance.

Alternative test equipment must meet or exceed the intended minimum requirements specified in Table 4. If you substitute equipment, you may need to modify the procedures.

Test Accessories

In addition to the test equipment, some additional test accessories are required to perform the adjustment procedure.

Table 5: Test accessories

Description	Qty	Example product
Couplers	2	ITT Pomona 5635
Patch cords	2	ITT Pomona B8

Preparation for Adjustment

The following guidelines apply to all CMM150 adjustments:

- Perform all adjustments in a 21° to 25° C ambient environment with a relative humidity of 75% or less.
- Warm up the DMM150 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.

Adjustment

1. Connect the CMM150 to the DMM150 as shown in Figure 2.

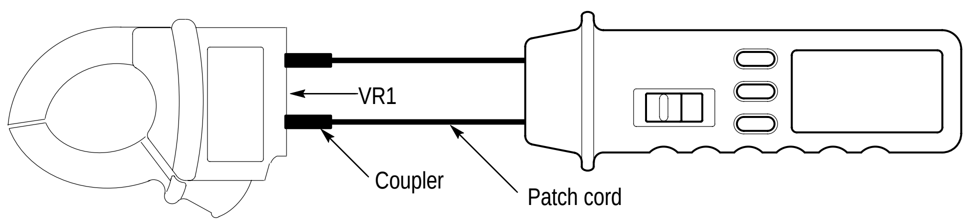


Figure 2: Adjustment location

2. Set the DMM150 to measure AC volts.

3. Select the appropriate coil to multiply the AC current calibrator output to 100.0 Amps at 60 Hz.

4. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.

5. Adjust VR1 for a reading of 1.000.

6. Turn the calibrator output off.

7. Remove the clamp from the current loop.

Instructions Manual

Tektronix

DCM300 and DCM320
Digital Clamp Multimeters

070-9847-01

Table of Contents

DCM300 and DCM320 Digital Clamp Multimeters

The DCM300 and DCM320 Digital Clamp multimeters measure AC current, AC voltage, and resistance/continuity. The meters use a current transformer to measure current without opening the circuit.

The meters automatically select the correct measurement range and have a 4000 count resolution. (The maximum reading is 3999.)

The DCM320 meter provides true RMS readings for both AC volts and AC current.

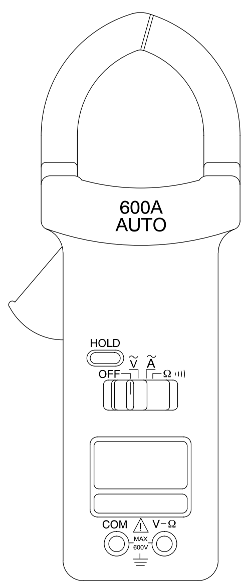


Figure 1: DCM300 Digital Clamp Multimeter

DCM300 and DCM320 Specifications

The characteristics listed in this section apply under the following conditions:

- The instrument operates in a 0° to 45° C ambient environment unless otherwise noted.
- The instrument warms up for at least 20 minutes.

***NOTE**. All specifications are warranted unless marked "typical." Typical characteristics are not guaranteed but are provided for the convenience of the user.*

Table 1: Electrical characteristics

Characteristic	Description
AC Voltage, Auto Ranging (nominal Input Impedance: 10 MΩ, <100 pF)	
Ranges	600 V and 400 V
Voltage Rating	600 V_{RMS} CAT II
Resolution	
400 V Range	0.1 V
600 V Range	1 V
Accuracy	40 to 500 Hz: ±(1.2% of reading + 5 digits)
Crest Factor (DCM 320 only)	1.4 to 2.0, add 0.6% to accuracy 2.0 to 2.5, add 2.0% to accuracy
AC Current, Auto Ranging	
Ranges	600 A and 400 A
Overload Protection	800 A
Uninsulated Wire Voltage Rating	600 V_{RMS} CAT II
Resolution	
400 A Range	0.1 A
600 A Range	1 A
Accuracy	50 to 60 Hz
400 A Range	±(1.9% of reading + 5 digits)
600 A Range	±(2.9% of reading + 5 digits)
Crest Factor (DCM 320 only)	1.4 to 2.0, add 1.0% to accuracy 2.0 to 2.5, add 2.5% to accuracy

Table 1: Electrical characteristics (cont.)

Characteristic	Description
Resistance, Auto ranging (meter beeps if resistance is <100 Ω.)	
Ranges	4 kΩ and 40 kΩ
Overload Protection	600 V_{RMS}
Resolution	
4 kΩ Range	1 Ω
40 kΩ Range	10 Ω
Accuracy	±(2.0% of reading + 9 digits)
Maximum Open Circuit Voltage	1 V

Table 2: General specifications

Characteristic	Description
Auto Power Off	Approximately 30 minutes
Battery	9 V, ANSI/NEDA1604A, IEC 6F22
Battery Life	200 hours (alkaline)
Maximum Conductor Size	40 mm

Table 3: Certifications and compliances

Certifications	Canadian Standards Association certified to Standard CSA 1010.1, Standard UL3111-1 for Electrical and Electronic Measuring and Testing Equipment, and IEC1010-2-032 particular requirements for hand-held current clamps for electrical measurement and test.	
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.	

Table 4: Environmental characteristics

Characteristic	Description
Temperature	
Operating	0° to 45° C (32° to 113° F), <75% relative humidity
Nonoperating	–20° to +60° C (–4° to 140° F), <80% relative humidity
Temperature Coefficient	0.2% (specified accuracy) per °C at <18° C (64° F) or >28° C (82° F)
Maximum Altitude (Operating)	2,200 m (7,218 ft.)

DCM300 and DCM320 Performance Verification

This section contains procedures to verify that the DCM300 and DCM320 Digital Clamp Multimeters perform as warranted. If an instrument fails any of the 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 instrument operates in an 18° to 28° C ambient environment with a relative humidity of less than 75%.
- The instrument warms up for 20 minutes.
- The instrument remains fully assembled (do not remove the bottom cover).

The DCM300 and DCM320 performance verification consists of the checks listed in Table 5.

Table 5: Performance verification checks

AC Current Check
AC Voltage Check
Resistance and 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 6. 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 6: Test equipment

Description	Minimum requirements	Example product
AC Current Calibrator	>0.5% accuracy, 0 to 400 A	Wavetek 9100 with option 200 current multiplier coils or Fluke 5500A with Wavetek X10 and X50 Current multiplier Coils
	>0.7% accuracy, 400 to 600 A	
AC Voltage Calibrator	>0.2% accuracy	
Resistance Calibrator	>0.3% accuracy	

Set Up

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

1. Turn the DCM300/DCM320 Digital Clamp Multimeter on by sliding the function switch to any position other than OFF.
2. Warm up the instrument for 20 minutes.
3. Photocopy the test record on pages 11 and 12 to record your test results.

Verification Procedure

The following checks verify the performance of your DCM300 or DCM320 multimeter.

WARNING. *The following procedures produce magnetic fields that may cause a malfunction in heart pacemakers or damage to sensitive equipment.*

AC Current Check

To check the AC current accuracy, perform the following steps.

1. Set the multimeter function switch to the $\tilde{\mathrm{A}}$ position.
2. Set up the AC current calibrator to output the values in the AC current test record.

***NOTE**. Select the appropriate coils to multiply the AC Current calibrator output for each of the values listed in the AC current test record.*

3. For each of the conditions listed in the AC current test record, position the clamp around the current loop of the AC current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.

4. Verify that the multimeter display reads within the specified Display minimum and maximum limits for each of the specified conditions.
5. Turn the calibrator output off.
6. Remove the clamp from the current loop.

AC Voltage Check

To check the AC voltage accuracy, perform the following steps.

WARNING. *To avoid electric shock, avoid touching the exposed connections on the multimeter circuit board.*

1. Set the multimeter function switch to the $\tilde{V}$ position.
2. Connect the AC voltage calibrator output to the multimeter **V–Ω** and **COM** input terminals.
3. Set the calibrator to each of the values listed in the AC voltage test record and verify that the multimeter display reads within the specified Display minimum and maximum limits.
4. Turn the calibrator output off.
5. Disconnect the calibrator.

Resistance and Continuity Check

To check the resistance accuracy and verify the continuity function, perform the following steps.

1. Set the multimeter function switch to the **Ω**))) position.
2. Connect the resistance calibrator output to the multimeter **V–Ω** and **COM** input terminals.
3. Set the calibrator to each of the values listed in the Resistance and continuity test record and verify that the display reads within the specified Display minimum and maximum limits.
4. Turn the calibrator output off.
5. Disconnect the calibrator.

DCM300 and DCM320 Test Record

Serial number	Procedure performed by	Date

DCM300 and DCM320 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC current test					
0 A		±0.5 A	00.0		00.5
10.0 A	50 Hz	±0.7 A	09.3		10.7
	60 Hz	±0.7 A	09.3		10.7
100.0 A	50 Hz	±2.4 A	97.6		102.4
	60 Hz	±2.4 A	97.6		102.4
300.0 A	50 Hz	±6.2 A	293.8		306.2
	60 Hz	±6.2 A	293.8		306.2
380.0 A	50 Hz	±8 A	372.0		388.0
	60 Hz	±8 A	372.0		388.0
600 A	50 Hz	±22 A	578		622
	60 Hz	±22 A	578		622
AC voltage test					
0 V		±0.5 V	00.0		00.5
10.0 V	500 Hz	±0.6 V	09.4		10.6
100.0 V	500 Hz	±1.7 V	98.3		101.7
380.0 V	500 Hz	±5.1 V	374.9		385.1
600 V	50 Hz	±12 V	588		612
	500 Hz	±12 V	588		612

DCM300 and DCM320 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
Resistance and continuity test					
0 Ω		±9 Ω	000 Ω		009 Ω
			Buzzer must sound		
120 Ω		±11 Ω	109 Ω		131 Ω
			Buzzer must sound		
1.000 kΩ		±0.029 kΩ	971 Ω		1.029 kΩ
3.700 kΩ		±0.083 kΩ	3.617 kΩ		3.783 kΩ
39.00 kΩ		±0.87 kΩ	38.13 kΩ		39.87 kΩ

DCM300 and DCM320 Adjustment Procedures

This section contains procedures to adjust DCM300 and DCM320 Digital Clamp multimeters. If your instrument fails a performance requirement, use these procedures to return it to factory specifications.

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, implement the procedures in the *DCM300 and DCM320 Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 7 to return DCM300 and DCM320 multimeters to factory calibration.

Table 7: DCM300 and DCM320 adjustments

AC Current
AC Voltage
Resistance
Continuity

Test Equipment

The test equipment listed in Table 6 on page 8 is a complete list of equipment needed for the adjustment procedures. These procedures assume that all test equipment is operating within tolerance. Detailed operating instructions for test equipment are not given in this procedure. If you need operating information, refer to the instruction manual of the test equipment.

Alternative test equipment must meet or exceed the intended minimum requirements specified in Table 6. If you substitute equipment, you may need to modify the procedures.

Preparation for Adjustment

The following guidelines apply to all DCM300 & DCM320 adjustments.

- Perform all adjustments in a 21° to 25° C ambient environment with a relative humidity of 75% or less.
- Before making any adjustment, warm up the multimeter for 20 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 meter case to gain access to the internal adjustments.

1. Lay the meter face down on a flat work surface.
2. Remove the two screws from the meter bottom with a Phillips-head screwdriver.
3. Gently lift the end of the bottom cover until it unsnaps from the top cover. Do not remove the circuit board mounting screws.

To reassemble the meter following the adjustments, perform steps 2 and 3 above in reverse order.

Adjustment Procedure

To return your instrument to factory calibration, perform the following procedures.

WARNING. *The following procedures produce magnetic fields that may cause a malfunction in heart pacemakers or damage to sensitive equipment.*

AC Current

To adjust the AC current calibration, perform the following steps.

1. Set the AC current calibrator to output 100 A at 50 Hz.
2. Set the multimeter function switch to the $\tilde{\mathrm{A}}$ position.
3. Select the appropriate coil to multiply the AC current calibrator output to 100 A at 50 Hz.

4. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
5. Adjust VR2 with a small flat-tipped screwdriver; set the multimeter reading to 100.0.
6. Turn the calibrator output off.
7. Remove the clamp from the current loop.

AC Voltage

To adjust the AC voltage calibration, perform the following steps.

WARNING. *To avoid electrical shock, avoid touching the exposed connections on the multimeter circuit board.*

1. Set the multimeter function switch to the $\tilde{\mathrm{V}}$ position.
2. Connect the AC voltage calibrator output to the multimeter **V–Ω** and **COM** input terminals.
3. Set the AC voltage calibrator to output 300 V at 500 Hz (DCM300) or 300 V at 50 Hz (DCM320).
4. Adjust VR1 with a small flat-tipped screwdriver; set the multimeter reading to 300.0.
5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

Resistance

To adjust the resistance calibration, perform the following steps.

1. Set the multimeter function switch to the **Ω**·))) position.
2. Connect the resistance calibrator output to the multimeter **V–Ω** and **COM** input terminals.
3. Set the resistance calibrator to simulate a 1 kΩ resistance load.
4. Adjust VR3 with a small flat-tipped screwdriver; set the multimeter reading to 1.000.
5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

Continuity

To adjust the continuity calibration, perform the following steps.

1. Connect the resistance calibrator output to the multimeter **V–Ω** and **COM** input terminals.
2. Set the resistance calibrator to simulate a 150 Ω resistance load.
3. Place the bottom cover back on the meter and hold it in place. (The continuity buzzer will not sound during the following adjustments without the cover in place.)
4. If the buzzer does not sound, use a small flat-tipped screwdriver to adjust VR4 until the buzzer sounds. You will have to remove the bottom cover to make the adjustment and then replace the cover to make the test.
5. If the buzzer does sound, use a small flat-tipped screwdriver to adjust VR4 until the buzzer does not sound. After that, use the screwdriver to adjust VR4 until the buzzer sounds again. (Remove the cover to adjust; replace the cover to test.)
6. When you complete all adjustments, turn the multimeter off and replace the bottom cover. Do not pinch the battery leads between the case halves during reassembly.

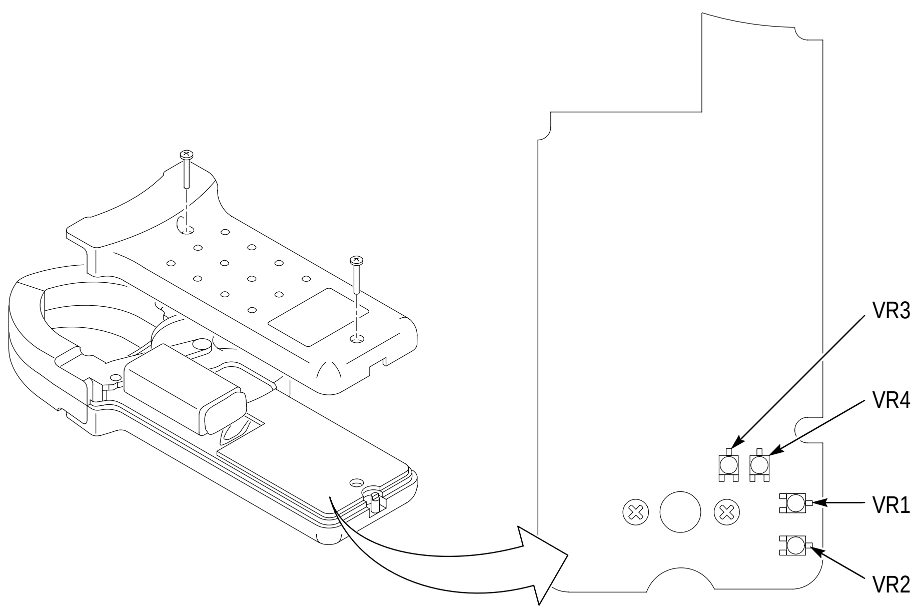


Figure 2: Adjustment locations

Table 8: Summary of adjustments

Adjustment name	Test value	Range setting	Circuit location	Tolerance	Display minimum	Display maximum
AC Current	100.0 A	50 Hz	VR2	±1.0 A	99.0	101.0
AC Volts	300.0 V	500 Hz (DCM300) 50 Hz (DCM320)	VR1	±0.3 V	299.7	300.3
Ohm	1.000 kΩ		VR3	±1 Ω	999 Ω	1.001 kΩ
	150 Ω		VR4	Adjust VR4 until the buzzer just sounds		

Instructions Manual

Tektronix

DCM330
Digital Clamp Meter

070-9848-01

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DCM330 Digital Clamp Meter

The DCM330 Digital Clamp Meter measures DC current, AC current, and frequency. The meter uses a Hall-effect device to measure current without opening the circuit.

The meter automatically selects the correct measurement range and has a 4000 count resolution. (The maximum reading is 3999.)

The DCM330 meter provides true RMS readings for AC current.

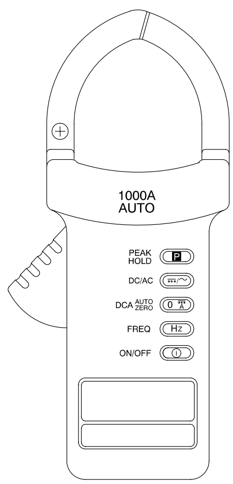

Figure 1: DCM330 Digital Clamp Meter

DCM330 Specifications

The characteristics listed in this section apply under the following conditions:

- The instrument operates in a 0° to 50° C (32° to 122° F) ambient environment unless otherwise noted.
- The instrument warms up for at least 20 minutes.

***NOTE**. All specifications are warranted unless marked "typical." Typical characteristics are not guaranteed but are provided for the convenience of the user.*

Table 1: Electrical characteristics

Characteristic	Description
Overload Protection	2000 A for one minute
Uninsulated Wire Voltage	600 V_{RMS} CAT II
Measuring Rate	2 times per second nominal
AC Current, Auto Ranging	
Ranges	400 A and 1000 A
Uninsulated Wire Voltage Rating	600 V_{RMS} CAT II
Resolution	
400 A Range	0.1 A
1000 A Range	1 A
Accuracy	40 Hz to 400 Hz
0 A to 400 A	±(1.9% of reading + 8 counts)
401 A to 1000 A	±(2.9% of reading + 5 counts)
Crest Factor	1.4 to 2.0, add 1.0% to accuracy 2.0 to 2.5, add 2.5% to accuracy
DC Current, Auto Ranging	
Ranges	400 A and 1000 A
Resolution	
400 A Range	0.1 A
1000 A Range	1 A

Table 1: Electrical characteristics (cont.)

Characteristic	Description
Accuracy	
0 A to 20 A	±(1.9% of reading + 10 counts)
20.1 A to 400 A	±(1.9% of reading + 40 counts)
401 A to 1000 A	±(2.9% of reading + 5 counts)
Frequency, Auto Ranging	
Ranges	4 kHz and 10 kHz
Sensitivity	6 A_{RMS} (10 A_{RMS}, 1kHz to 10 kHz)
Resolution	
4 kHz Range	1 Hz
10 kHz Range	10 Hz
Accuracy	±(0.5% of reading + 3 counts)
Peak Hold	
Range	Low, High
Resolution	
Low	0.1 A
High	1.0 A
Accuracy	±(3% of reading + 10 counts)

Table 2: General specifications

Characteristic	Description
Auto Power Off	Approximately 30 minutes
Battery	9 V, ANSI/NEDA1604A, IEC 6F22
Battery Life	40 hours (alkaline)
Maximum Conductor Size	51 mm (2 inch) diameter or 24 × 60 mm (.95 × 2.36 inch) bus bar

Table 3: Certifications and compliances

Certifications	Canadian Standards Association certified to Standard CSA 1010.1, Standard UL3111-1 for Electrical and Electronic Measuring and Testing Equipment, and IEC1010-2-032 particular requirements for hand-held current clamps for electrical measurement and test.	
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.	

Table 4: Environmental characteristics

Characteristic	Description
Temperature	
Operating	0° to 50° C (32° to 122° F), <75% relative humidity
Nonoperating	–20° C to +60° C (21° to 140° F), <80% relative humidity
Temperature Coefficient	0.2 × (specified accuracy) per °C at <18° C or >28° C
Maximum Altitude (Operating)	2,000 m (6,562 ft)

DCM330 Performance Verification

This section contains procedures to verify that the DCM330 Digital Clamp Meter performs as warranted. If an instrument fails any of the 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 instrument operates in an 18° to 28° C (64° to 82° F) ambient environment with a relative humidity of less than 75%.
- The instrument warms up in the ambient environment for at least one hour.
- The instrument remains fully assembled (do not remove the bottom cover).

The DCM330 performance verification consists of the checks listed in Table 5.

Table 5: Performance verification checks

AC Current Check
DC Current Check
Frequency 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 specfied in Table 6. 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 6: Test equipment

Description	Minimum requirements	Example product
AC/DC Current Calibrator	>0.5 % accuracy 0 to 400 A	Wavetek 9100 with Option 200 current multiplier coils
	>0.7 % accuracy 400 to 1000 A	

Set Up

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

1. Turn the DCM330 Digital Clamp Meter on.
2. Warm up the meter for 20 minutes.
3. Photocopy the test record on pages 11 and 12 to record your test results.

Verification Procedure

The following checks verify the performance of your DCM330 meter.

WARNING. *The following procedures produce magnetic fields that may cause a malfunction in heart pacemakers or damage to sensitive equipment.*

AC Current Check

To check the AC current accuracy, perform the following steps.

1. Set the meter function to **AC**.
2. Select the appropriate coils as necessary to multiply the AC current calibrator output to each of the test values in the AC current test record. For more information, refer to the user manual of your calibrator.
3. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Verify that the display reads within the specified Display minimum and maximum limits.
5. Turn the calibrator output off.
6. Remove the clamp from the current loop.

DC Current Check

To check the DC current accuracy, perform the following steps.

1. Set the meter function to **DC**.
2. In the absence of any magnetic fields, press the **DCA AUTO ZERO** button to zero the meter.
3. Select the appropriate coil(s) as necessary to multiply the DC current calibrator output to each of the test values in the DC current test record. For more information, refer to the user manual of your calibrator.
4. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
5. Verify that the display reads within the specified Display minimum and maximum limits.
6. Before each measurement, set the calibrator output to off and press the **DCA AUTO ZERO** button to zero the meter.

***NOTE**. Any time a measurement appears to be out of tolerance, turn the calibrator output off, rezero the meter, and try again.*

7. Turn the calibrator output off.
8. Disconnect the calibrator.

Frequency Check

To check the frequency accuracy, perform the following steps.

1. Set the meter function to **Hz**.
2. Select the appropriate coil as necessary to multiply the AC current calibrator output to 20 A.
3. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Verify that the display reads within the specified Display minimum and maximum limits for each of the frequencies listed in the Frequency test record.
5. Turn the calibrator output off.
6. Disconnect the calibrator.

DCM330 Test Record

Serial number	Procedure performed by	Date

DCM330 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC current test					
0.0 A		±0.8 A	–00.8		00.8
10.0 A	50 Hz	±1.0 A	0.90		11.0
	400 Hz	±1.0 A	0.90		11.0
100.0 A	50 Hz	±2.7 A	97.3		102.7
	400 Hz	±2.7 A	97.3		102.7
300.0 A	50 Hz	±6.5 A	293.5		306.5
	60 Hz	±6.5 A	293.5		306.5
380.0 A	50 Hz	±8 A	372.0		388.0
	60 Hz	±8 A	372.0		388.0
600 A	50 Hz	±22 A	578		622
	60 Hz	±22 A	578		622
1000 A	50 Hz[1]	±34 A	966		1034
	60 Hz[1]	±34 A	966		1034

1 **At these frequencies, the inductance of the DCM330 may shut down the output of some calibrators. If this happens, decrease the calibrator output frequency until the output remains on for the duration of the test.**

DCM330 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
DC current test					
0.0 A		±1.0 A	–1.0		01.0
10.0 A		±1.2 A	08.8		11.2
100.0 A		±5.9 A	94.1		105.9
300.0 A		±9.7 A	290.3		309.7
600 A		±22 A	578		622
1000 A		±34 A	966		1034
–10.0 A		±1.2 A	–11.2		–8.8
–100.0 A		±5.9 A	–105.9		–94.1
–300.0 A		±9.7 A	–309.7		–290.3
–600 A		±22 A	–622		–578
–1000 A		±34 A	–1034		–966
Frequency test					
20 A	20 Hz	±3 Hz	0.017 kHz		0.023 kHz
20 A	50 Hz	±3 Hz	0.047 kHz		0.053 kHz
20 A	60 Hz	±3 Hz	0.057 kHz		0.063 kHz
20 A	100 Hz	±4 Hz	0.096 kHz		0.104 kHz
20 A	1 kHz	±8 Hz	0.992 kHz		1.008 kHz
20 A	3 kHz	±18 Hz	2.982 kHz		3.018 kHz
20 A	5 kHz	±60 Hz	4.94 kHz		5.06 kHz
20 A	7 kHz	±70 Hz	6.93 kHz		7.07 kHz
20 A	10 kHz	±80 Hz	9.92 kHz		10.08 kHz

DCM330 Adjustment Procedures

This section contains procedures to adjust the DCM330 Digital Clamp Meter. If your instrument fails a performance requirement, use these procedures to return it to factory specifications.

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 *DCM330 Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 7 to return the DCM330 clamp meter to factory calibration.

Table 7: DCM330 adjustments

Position Error
AC Current
DC Current
Peak Hold

Test Equipment

The test equipment listed in Table 6 on page 8 is a complete list of equipment needed for the adjustment procedures. These procedures assume that all test equipment is operating within tolerance. Detailed operating instructions for test equipment are not given in this procedure. If you need operating information, refer to the instruction manual of the test equipment.

Alternative test equipment must meet or exceed the intended minimum requirements specfied in Table 6. If you substitute equipment, you may need to modify the procedures.

Preparation for Adjustment

The following guidelines apply to all DCM330 adjustments.

- Perform all adjustments in a 21° to 25° C ambient environment with a relative humidity of 75% or less.
- Before making any adjustment, warm up the current meter for at least 30 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 meter case to gain access to the internal adjustments.

1. Lay the meter face down on a flat work surface.

2. Remove the two screws from the case bottom with a Phillips-head screwdriver.

3. Gently lift the end of the case bottom until it unsnaps from the case top.

4. Remove the three screws that secure the circuit board assembly to the case top. Do not remove the screws that secure the circuit boards to each other.

5. To access the adjustments, lift the circuit board assembly far enough out of the top case to expose the adjustments. See Figure 2 and the procedure that follows.

To reassemble the meter following the adjustments, perform steps 2 through 4 above in reverse order.

Adjustment Procedure

To return your instrument to factory calibration, implement the following procedures.

Use a small flat-tipped screwdriver to make the adjustments. Refer to Figure 2 for adjustment locations.

WARNING. *Magnetic fields are produced that may cause a malfunction in heart pacemakers, or damage to sensitive equipment.*

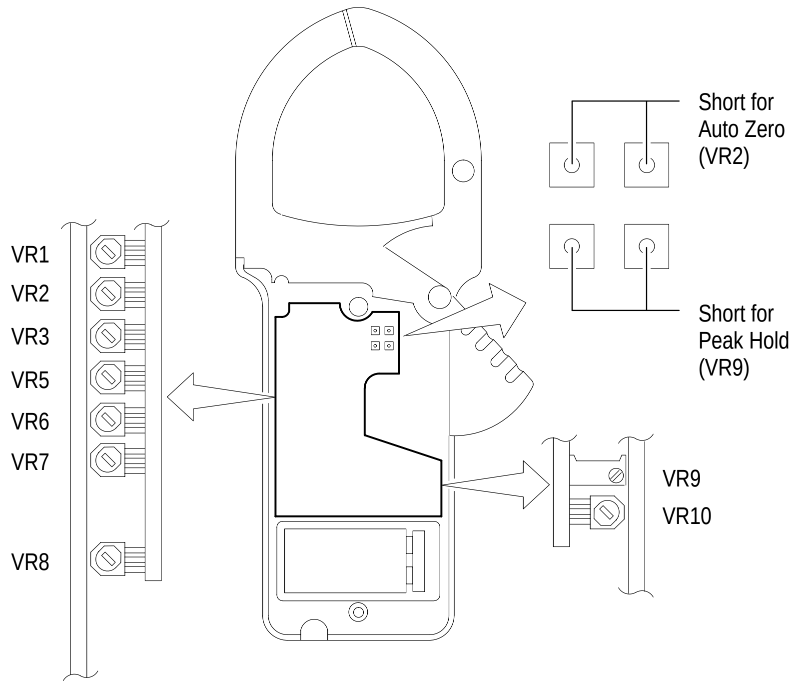

Figure 2: Adjustment locations

Position Error

To adjust the position error calibration, perform the following steps.

1. Set the clamp meter to the **AC** position.
2. Select the appropriate coil to multiply the AC current calibrator output to 380 A at 50 Hz.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Adjust VR1 to maintain the measurement error to less than 1% total while positioning the coil in the clamp.
5. Turn the calibrator output off.
6. Remove the clamp meter from the coil.

DC Auto Zero

To adjust the DC zero calibration, perform the following steps.

1. Set the clamp meter to the **DC** position.
2. Short the Auto Zero points indicated in Figure 2.

3. Adjust VR2 until the display reads 00.0 ± 5 counts.
4. Remove the short.
5. Press the clamp meter **DCA AUTO ZERO** button to zero the display.
6. Adjust VR3 until the display reads 00.0.

DC 400 A Range

To adjust the DC 400 A range calibration, perform the following steps.

1. Set the clamp meter to the **DC** position.
2. Select the appropriate coil to multiply the DC current calibrator output to 200 A.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Position the clamp to the center of the coil.
5. Adjust VR5 until the display reads 201.5.
6. Turn the calibrator output off.
7. Remove the clamp meter from the coil.

DC 1000 A Range

To adjust the DC 1000 A range calibration, perform the following steps.

1. Set the clamp meter to the **DC** position.
2. Select the appropriate coil to multiply the DC current calibrator output to 400 A.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Press the clamp meter **DCA AUTO ZERO** button to zero the display.
5. Position the clamp to the center of the coil.
6. Adjust VR6 until the display reads 400.
7. Turn the calibrator output off.
8. Remove the clamp meter from the coil.

AC 400 A Range

To adjust the AC 400 A range calibration, perform the following steps.

1. Set the clamp meter to the **AC** position.
2. Select the appropriate coil to multiply the AC current calibrator output to 390 A at 400 Hz.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Position the clamp to the center of the coil.
5. Adjust VR8 until the display reads 396.0. To keep the meter on the lower range, it may be necessary to cycle the calibrator output off and on.
6. Turn the calibrator output off.
7. Remove the clamp meter from the coil.

AC 1000 A Range

To adjust the AC 1000 A range calibration, perform the following steps.

1. Set the clamp meter to the **AC** position.
2. Select the appropriate coil to multiply the AC current calibrator output to 400 A at 400 Hz.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Position the clamp to the center of the coil.
5. Adjust VR7 until the display reads 400.
6. Turn the calibrator output off.
7. Remove the clamp meter from the coil.

Peak Hold

To adjust the peak hold calibration, perform the following steps.

1. Set the clamp meter to the **AC** position.
2. Short the Peak Hold points indicated in Figure 2.
3. Press **PEAK HOLD** to activate the function.
4. Adjust VR9 until the display reads 00.0.
5. Remove the short.
6. Press **PEAK HOLD** to cancel the function.
7. Press **PEAK HOLD** again to verify that the display reads 00.0.

8. Press **PEAK HOLD** to cancel the function.
9. Repeat steps 2 through 8 above until the display reads 00.0.
10. Select the appropriate coil to multiply the AC current calibrator output to 200 A at 400 Hz.
11. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
12. Position the clamp to the center of the coil.
13. Adjust VR10 until the display reads 200.0.
14. Turn the calibrator output off.
15. Remove the clamp meter from the coil.
16. Reassemble the meter.

Table 8: Summary of adjustments

Adjustment name	Mode	Test value	Frequency	Circuit location	Tolerance	Display minimum	Display maximum
Position Error	AC	380 A	50 Hz	VR1	<5 counts	0 count	5 counts
DC Zero	DC			VR2[1]	±0.5	–00.5	00.5
	DC			VR3	±0.1	–00.1	+00.1
DC 400 A Range	DC	200.0 A		VR5	±0.5	201.2	201.8
DC 1000 A Range	DC	400 A		VR6	±1	399	401
AC 400 A Range	AC	390.0 A	400 Hz	VR8	±0.1	395.5	396.5
AC 1000 A Range	AC	400 A	400 Hz	VR7	±1	399	401
Peak Hold	AC			VR9[2]		00.0	00.0
	AC	200.0 A	120 Hz	VR10[2]	±0.1	199.9	200.1

1 **Auto Zero points shorted.**

2 **Peak Hold points shorted.**

Instructions Manual

Tektronix

DCM910
Digital Clamp Meter

070-9849-01

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DCM910 Digital Clamp Meter

The DCM910 Digital Clamp Meter measures DC current, AC current, and frequency. The meter uses a Hall-effect device to measure current without opening the circuit.

The meter automatically selects the correct measurement range and has a 4000 count resolution. (The maximum reading is 3999.)

The DCM910 meter provides true RMS readings for AC current.

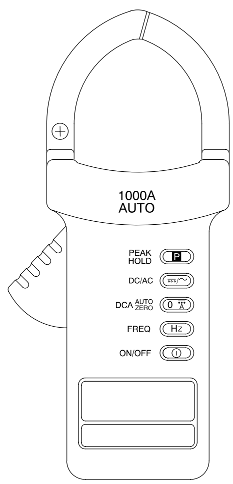

Figure 1: DCM910 Digital Clamp Meter

DCM910 Specifications

The characteristics listed in this section apply under the following conditions:

- The instrument operates in a 0° to 50° C (32° to 122° F) ambient environment unless otherwise noted.
- The instrument warms up for at least 20 minutes.

***NOTE**. All specifications are warranted unless marked "typical." Typical characteristics are not guaranteed but are provided for the convenience of the user.*

Table 1: Electrical characteristics

Characteristic	Description
Overload Protection	2000 A for one minute
Uninsulated Wire Voltage	600 V_{RMS} CAT II
Measuring Rate	2 times per second nominal
AC Current, Auto Ranging	
Ranges	400 A and 1000 A
Uninsulated Wire Voltage Rating	600 V_{RMS} CAT II
Resolution	
400 A Range	0.1 A
1000 A Range	1 A
Accuracy	40 Hz to 400 Hz
0 A to 400 A	±(1.9% of reading + 8 counts)
401 A to 1000 A	±(2.9% of reading + 5 counts)
Crest Factor	1.4 to 2.0, add 1.0% to accuracy 2.0 to 2.5, add 2.5% to accuracy
DC Current, Auto Ranging	
Ranges	400 A and 1000 A
Resolution	
400 A Range	0.1 A
1000 A Range	1 A

Table 1: Electrical characteristics (cont.)

Characteristic	Description
Accuracy	
0 A to 20 A	±(1.9% of reading + 10 counts)
20.1 A to 400 A	±(1.9% of reading + 40 counts)
401 A to 1000 A	±(2.9% of reading + 5 counts)
Frequency, Auto Ranging	
Ranges	4 kHz and 10 kHz
Sensitivity	6 A_{RMS} (10 A_{RMS}, 1kHz to 10 kHz)
Resolution	
4 kHz Range	1 Hz
10 kHz Range	10 Hz
Accuracy	±(0.5% of reading + 3 counts)
Peak Hold	
Range	Low, High
Resolution	
Low	0.1 A
High	1.0 A
Accuracy	±(3% of reading + 10 counts)

Table 2: General specifications

Characteristic	Description
Auto Power Off	Approximately 30 minutes
Battery	9 V, ANSI/NEDA1604A, IEC 6F22
Battery Life	40 hours (alkaline)
Maximum Conductor Size	51 mm (2 inch) diameter or 24 × 60 mm (.95 × 2.36 inch) bus bar

Table 3: Certifications and compliances

Certifications	Canadian Standards Association certified to Standard CSA 1010.1, Standard UL3111-1 for Electrical and Electronic Measuring and Testing Equipment, and IEC1010-2-032 particular requirements for hand-held current clamps for electrical measurement and test.	
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.	

Table 4: Environmental characteristics

Characteristic	Description
Temperature	
Operating	0° to 50° C (32° to 122° F), <75% relative humidity
Nonoperating	–20° C to +60° C (21° to 140° F), <80% relative humidity
Temperature Coefficient	0.2 × (specified accuracy) per °C at <18° C or >28° C
Maximum Altitude (Operating)	2,000 m (6,562 ft)

DCM910 Performance Verification

This section contains procedures to verify that the DCM910 Digital Clamp Meter performs as warranted. If an instrument fails any of the 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 instrument operates in an 18° to 28° C (64° to 82° F) ambient environment with a relative humidity of less than 75%.
- The instrument warms up in the ambient environment for at least one hour.
- The instrument remains fully assembled (do not remove the bottom cover).

The DCM910 performance verification consists of the checks listed in Table 5.

Table 5: Performance verification checks

AC Current Check
DC Current Check
Frequency 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 6. 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 6: Test equipment

Description	Minimum requirements	Example product
AC/DC Current Calibrator	>0.5 % accuracy 0 to 400 A	Wavetek 9100 with Option 200 current multiplier coils
	>0.7 % accuracy 400 to 1000 A	

Set Up

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

1. Turn the DCM910 Digital Clamp Meter on.

2. Warm up the meter for 20 minutes.

3. Photocopy the test record on pages 11 and 12 to record your test results.

Verification Procedure

The following checks verify the performance of your DCM910 meter.

WARNING. *The following procedures produce magnetic fields that may cause a malfunction in heart pacemakers or damage to sensitive equipment.*

AC Current Check

To check the AC current accuracy, perform the following steps.

1. Set the meter function to **AC**.

2. Select the appropriate coils as necessary to multiply the AC current calibrator output to each of the test values in the AC current test record. For more information, refer to the user manual of your calibrator.

3. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.

4. Verify that the display reads within the specified Display minimum and maximum limits.

5. Turn the calibrator output off.

6. Remove the clamp from the current loop.

DC Current Check

To check the DC current accuracy, perform the following steps.

1. Set the meter function to **DC**.
2. In the absence of any magnetic fields, press the **DCA AUTO ZERO** button to zero the meter.
3. Select the appropriate coil(s) as necessary to multiply the DC current calibrator output to each of the test values in the DC current test record. For more information, refer to the user manual of your calibrator.
4. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
5. Verify that the display reads within the specified Display minimum and maximum limits.
6. Before each measurement, set the calibrator output to off and press the **DCA AUTO ZERO** button to zero the meter.

***NOTE**. Any time a measurement appears to be out of tolerance, turn the calibrator output off, rezero the meter, and try again.*

7. Turn the calibrator output off.
8. Remove the clamp from the current loop.

Frequency Check

To check the frequency accuracy, perform the following steps.

1. Set the meter function to **Hz**.
2. Select the appropriate coil as necessary to multiply the AC current calibrator output to 20 A.
3. Position the clamp around the current loop of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Verify that the display reads within the specified Display minimum and maximum limits for each of the frequencies listed in the Frequency test record.
5. Turn the calibrator output off.
6. Remove the clamp from the current loop.

DCM910 Test Record

Serial number	Procedure performed by	Date

DCM910 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC current test					
0.0 A		±0.8 A	–00.8		00.8
10.0 A	50 Hz	±1.0 A	09.0		11.0
	400 Hz	±1.0 A	09.0		11.0
100.0 A	50 Hz	±2.7 A	97.3		102.7
	400 Hz	±2.7 A	97.3		102.7
300.0 A	50 Hz	±6.5 A	293.5		306.5
	60 Hz	±6.5 A	293.5		306.5
380.0 A	50 Hz	±8.0 A	372.0		388.0
	60 Hz	±8.0 A	372.0		388.0
600 A	50 Hz	±22 A	578		622
	60 Hz	±22 A	578		622
1000 A	50 Hz [1]	±34 A	966		1034
	60 Hz [1]	±34 A	966		1034

[1] **At these frequencies, the inductance of the DCM910 may shut down the output of some calibrators. If this happens, decrease the calibrator output frequency until the output remains on for the duration of the test.**

DCM910 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
DC current test					
0.0 A		±1.0 A	–01.0		01.0
10.0 A		±1.2 A	08.8		11.2
100.0 A		±5.9 A	94.1		105.9
300.0 A		±9.7 A	290.3		309.7
600 A		±22 A	578		622
1000 A		±34 A	966		1034
–10.0 A		±1.2 A	–11.2		–8.8
–100.0 A		±5.9 A	–105.9		–94.1
–300.0 A		±9.7 A	–309.7		–290.3
–600 A		±22 A	–622		–578
–1000 A		±34 A	–1034		–966
Frequency test					
20 A	20 Hz	±3 Hz	0.017 kHz		0.023 kHz
20 A	50 Hz	±3 Hz	0.047 kHz		0.053 kHz
20 A	60 Hz	±3 Hz	0.057 kHz		0.063 kHz
20 A	100 Hz	±4 Hz	0.096 kHz		0.104 kHz
20 A	1 kHz	±8 Hz	0.992 kHz		1.008 kHz
20 A	3 kHz	±18 Hz	2.982 kHz		3.018 kHz
20 A	5 kHz	±60 Hz	4.94 kHz		5.06 kHz
20 A	7 kHz	±70 Hz	6.93 kHz		7.07 kHz
20 A	10 kHz	±80 Hz	9.92 kHz		10.08 kHz

DCM910 Adjustment Procedures

This section contains procedures to adjust the DCM910 Digital Clamp Meter. If your instrument fails a performance requirement, use these procedures to return it to factory specifications.

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 *DCM910 Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 7 to return the DCM910 clamp meter to factory calibration.

Table 7: DCM910 adjustments

Position Error
AC Current
DC Current
Peak Hold

Test Equipment

The test equipment listed in Table 6 on page 8 is a complete list of equipment needed for the adjustment procedures. These procedures assume that all test equipment is operating within tolerance. Detailed operating instructions for test equipment are not given in this procedure. If you need operating information, refer to the instruction manual of the test equipment.

Alternative test equipment must meet or exceed the intended minimum requirements specified in Table 6. If you substitute equipment, you may need to modify the procedures.

Preparation for Adjustment

The following guidelines apply to all DCM910 adjustments.

- Perform all adjustments in a 21° to 25° C ambient environment with a relative humidity of 75% or less.
- Before making any adjustment, warm up the current meter for at least 30 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 meter case to gain access to the internal adjustments.

1. Lay the meter face down on a flat work surface.
2. Remove the two screws from the case bottom with a Phillips-head screwdriver.
3. Gently lift the end of the case bottom until it unsnaps from the case top.
4. Remove the three screws that secure the circuit board assembly to the case top. Do not remove the screws that secure the circuit boards to each other.
5. To access the adjustments, lift the circuit board assembly far enough out of the top case to expose the adjustments. See Figure 2 and the procedure that follows.

To reassemble the meter following the adjustments, perform steps 2 through 4 above in reverse order.

Adjustment Procedure

To return your instrument to factory calibration, implement the following procedures.

Use a small flat-tipped screwdriver to make the adjustments. Refer to Figure 2 for adjustment locations.

WARNING. *Magnetic fields are produced that may cause a malfunction in heart pacemakers, or damage to sensitive equipment.*

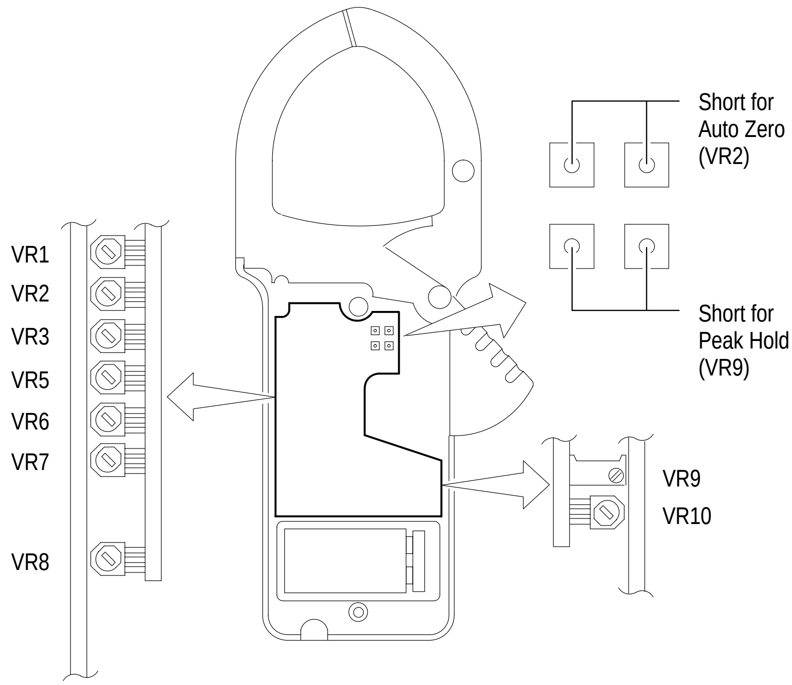

Figure 2: Adjustment locations

Position Error

The adjust the position error calibration, perform the following steps.

1. Set the clamp meter to the **AC** position.
2. Select the appropriate coil to multiply the AC current calibrator output to 380 A at 50 Hz.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Adjust VR1 to maintain the measurement error to less than 1% total while positioning the coil in the clamp.
5. Turn the calibrator output off.
6. Remove the clamp from the coil.

DC Auto Zero

To adjust the DC zero calibration, perform the following steps.

1. Set the clamp meter to the **DC** position.
2. Short the Auto Zero points indicated in Figure 2.

3. Adjust VR2 until the display reads 00.0 ± 5 counts.
4. Remove the short.
5. Press the clamp meter **DCA AUTO ZERO** button to zero the display.
6. Adjust VR3 until the display reads 00.0.

DC 400 A Range

To adjust the DC 400 A range calibration, perform the following steps.

1. Set the clamp meter to the **DC** position.
2. Select the appropriate coil to multiply the DC current calibrator output to 200 A.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Position the clamp to the center of the coil.
5. Adjust VR5 until the display reads 201.5.
6. Turn the calibrator output off.
7. Remove the clamp from the coil.

DC 1000 A Range

To adjust the DC 1000 A range calibration, perform the following steps.

1. Set the clamp meter to the **DC** position.
2. Select the appropriate coil to multiply the DC current calibrator output to 400 A.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Press the clamp meter **DCA AUTO ZERO** button to zero the display.
5. Position the clamp to the center of the coil.
6. Adjust VR6 until the display reads 400.
7. Turn the calibrator output off.
8. Remove the clamp from the coil.

AC 400 A Range

To adjust the AC 400 A range calibration, perform the following steps.

1. Set the clamp meter to the **AC** position.
2. Select the appropriate coil to multiply the AC current calibrator output to 390 A at 400 Hz.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Position the clamp to the center of the coil.
5. Adjust VR8 until the display reads 396.0. To keep the meter on the lower range, it may be necessary to cycle the calibrator output off and on.
6. Turn the calibrator output off.
7. Remove the clamp from the coil.

AC 1000 A Range

To adjust the AC 1000 A range calibration, perform the following steps.

1. Set the clamp meter to the **AC** position.
2. Select the appropriate coil to multiply the AC current calibrator output to 400 A at 400 Hz.
3. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Position the clamp to the center of the coil.
5. Adjust VR7 until the display reads 400.
6. Turn the calibrator output off.
7. Remove the clamp from the coil.

Peak Hold

To adjust the peak hold calibration, perform the following steps.

1. Set the clamp meter to the **AC** position.
2. Short the Peak Hold points indicated in Figure 2.
3. Press **PEAK HOLD** to activate the function.
4. Adjust VR9 until the display reads 00.0.
5. Remove the short.
6. Press **PEAK HOLD** to cancel the function.
7. Press **PEAK HOLD** again to verify that the display reads 00.0.

8. Press **PEAK HOLD** to cancel the function.
9. Repeat steps 2 through 8 above until the display reads 00.0.
10. Select the appropriate coil to multiply the AC current calibrator output to 200 A at 400 Hz.
11. Position the clamp around the coil of the current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
12. Position the clamp to the center of the coil.
13. Adjust VR10 until the display reads 200.0.
14. Turn the calibrator output off.
15. Remove the clamp from the coil.
16. Reassemble the meter.

Table 8: Summary of adjustments

Adjustment name	Mode	Test value	Frequency	Circuit location	Tolerance	Display minimum	Display maximum
Position Error	AC	380 A	50 Hz	VR1	<5 counts	0 count	5 counts
DC Zero	DC			VR2[1]	±0.5	–00.5	00.5
	DC			VR3	±0.1	–00.1	+00.1
DC 400 A Range	DC	200.0 A		VR5	±0.5	201.2	201.8
DC 1000 A Range	DC	400 A		VR6	±1	399	401
AC 400 A Range	AC	390.0 A	400 Hz	VR8	±0.1	395.5	396.5
AC 1000 A Range	AC	400 A	400 Hz	VR7	±1	399	401
Peak Hold	AC			VR9[2]		00.0	00.0
	AC	200.0 A	120 Hz	VR10[2]	±0.1	199.9	200.1

[1] **Auto Zero points shorted.**

[2] **Peak Hold points shorted.**

Instructions Manual

Tektronix

DMM150
Digital Multimeter

070-9938-00

Table of Contents

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

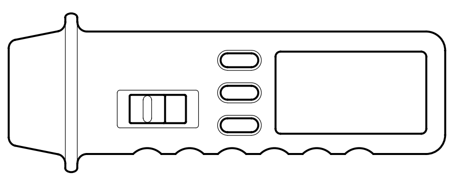

Figure 1: DMM150 Digital Multimeter

DMM150 Specifications

All specifications are warranted unless noted typical.

Stated accuracies are ±(% reading + number of counts) at 23° C ± 5° 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 × (specified accuracy)/°C at <18°C or >28°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	±(0.7% + 2 counts)
Input impedance (typical)	
300 mV	Near infinite resistance
3 V, 30 V, 300 V, 600 V	10 MΩ
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	±(1.7% reading + 5 counts) at 40 Hz to 300 Hz
30 V, 300 V, 600 V	±(1.7% reading + 5 counts) at 40 Hz to 500 Hz
Input impedance (typical)	10 MΩ 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 kΩ, 30 kΩ, 300 kΩ, 3 MΩ, 30 MΩ
Accuracy (by range)	
300 Ω	±(1.2% reading + 4 counts)
3 MΩ	±(1.5% reading + 3 counts)
30 MΩ	±(1.3% reading + 5 counts)
Other ranges	±(1.0% reading + 2 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 kΩ	1 Ω
30 kΩ	10 Ω
300 kΩ	100 Ω
3 MΩ	1 kΩ
30 MΩ	10 kΩ
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	±(1.5% + 5 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~V⎓.
2. Push the BLUE button to select the AC volts 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 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~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 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·))) ➔⊢.
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·))) ➔⊢.
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
AC volts test					
2.900 V	50 Hz	±1.7% + 5 counts	2.846 V		2.954 V
	300 Hz	±1.7% + 5 counts	2.846 V		2.954 V
29.00 V	50 Hz	±1.7% + 5 counts	28.46 V		29.54 V
	400 Hz	±1.7% + 5 counts	28.46 V		29.54 V
290.0 V	50 Hz	±1.7% + 5 counts	284.6 V		295.4 V
	400 Hz	±1.7% + 5 counts	284.6 V		295.4 V
600.0 V	50 Hz	±1.7% + 5 counts	585 V		615 V
	400 Hz	±1.7% + 5 counts	585 V		615 V
DC volts test					
–2.900 mV		±0.7% + 2 counts	–03.1 mV		–02.7 mV
290.0 mV		±0.7% + 2 counts	287.8 mV		292.2 mV
2.900 V		±0.7% + 2 counts	2.878 V		2.922 V
29.00 V		±0.7% + 2 counts	28.78 V		29.22 V
290.0 V		±0.7% + 2 counts	287.8 V		292.2 V
600.0 V		±0.7% + 2 counts	594 V		606 V
Ω test					
0.00 Ω		±1.2% + 4 counts	–0.4 Ω		0.4 Ω
300.0 Ω		±1.2% + 4 counts	296.0 Ω		304.0 Ω
3.000 kΩ		±1.0% + 2 counts	2.968 kΩ		3.032 kΩ
30.00 kΩ		±1.0% + 2 counts	29.68 kΩ		30.32 kΩ
300.0 kΩ		±1.0% + 2 counts	296.8 kΩ		303.2 kΩ
3.000 MΩ		±1.5% + 3 counts	2.952 MΩ		3.048 MΩ
30.00 MΩ		±1.3% + 5 counts	29.56 MΩ		30.44 MΩ

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.

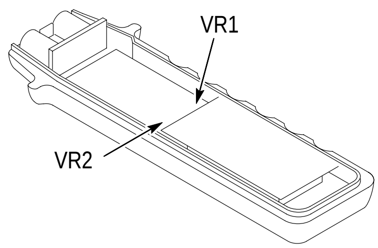

Figure 2: Adjustment location

DC Volts

Perform the following steps to adjust the DC voltage calibration.

1. Set the multimeter slide switch to V⎓.
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～.
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.*

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2. Close the case, snapping the case halves together.

3. Reinstall the screw.

Instructions Manual

Tektronix

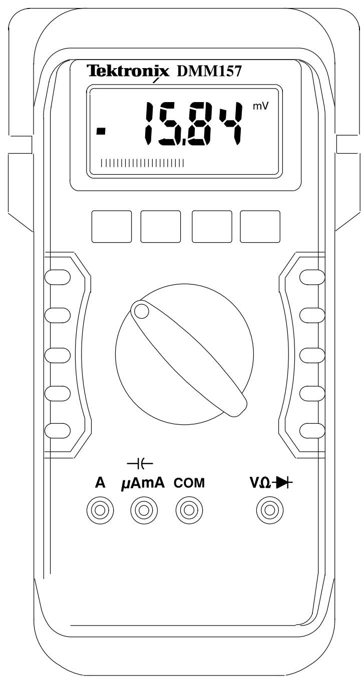
DMM157
Digital Multimeter
Serial Numbers Above TW80000

070-9933-00

Table of Contents

DMM157 Digital Multimeter

The DMM157 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.



- Shock-absorbing holster
- Tilt stand, holster hook, and probe holders
- 3200 count LCD display
- Autorange (volts, ohms) and manual range selection
- Measurement hold
- Measures DC and AC voltage, DC and AC current, resistance, and capacitance
- Diode and continuity tester with audible signal
- Overvoltage and overload protection
- Alarm that warns of improper connections to the current inputs
- Recessed input jacks for safety
- Automatic power off after ten minutes prolongs battery life
- Low-battery indicator
- Uses two standard AAA 1.5 V batteries

Figure 1: DMM157 Digital Multimeter

DMM157 Specifications

All specifications are warranted unless noted typical.

Stated accuracies are ±(% reading + number of counts) at 23° C ±5° C, at less than 75% R.H. (relative humidity).

Table 1: General specifications

Characteristics	Description
Display	3200 count Liquid Crystal Display (LCD) with a 65 segment analog bargraph
Polarity indication	Automatic; positive implied, negative indicated
Overrange indication	“OL” or “–OL” displayed
Low battery indication	The battery symbol displays when the battery voltage drops below the operating voltage level
Sampling rate	2 times/second
Power supply	Two standard AAA, IEC LR03, or ANSI/NEDA 24A 1.5 V batteries
Battery life (typical)	600 hours (alkaline batteries)
Maximum input voltage	600 VDC or 600 VAC_{RMS} CAT II between V and COM terminals
Maximum floating voltage	600 VDC or 600 VAC_{RMS} CAT II between any terminal and earth GND
Maximum open circuit voltage (current/capacitance inputs)	240 VDC or 240 VAC_{RMS} between current inputs and COM terminals
Overload protection	
V connector	600 VDC or 600 VAC_{RMS}
A connector	13 A (240 V) fast blow fuse (type AGX or 8AG) Tektronix part number 159-0357-00
µA/mA connector	1 A (240 V) fast blow fuse (type AGX or 8AG) Tektronix part number 159-0355-00
TL60 test lead set	Rated 1000 V ANSI/ISA S82.02-1988 CSA 22.2 No 231.1 M89 C/NRTL LR100328
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
Dimension (H × W × D) with holster	165 mm × 85 mm × 40 mm (6.5 in. × 3.3 in. × 1.5 in.)

Table 2: Measurement characteristics

Characteristics	Description
DC Volts	
Ranges	300 mV, 3 V, 30 V, 300 V, 600 V
Accuracy	±(0.5% reading + 2 counts)
Input impedance (typical)	
300 mV	Near infinite resistance paralleled by less than 100 pF
3 V, 30 V, 300 V, 600 V	10 MΩ to 11 MΩ paralleled by less than 100 pF
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	±(1.5% reading + 5 counts)
Frequency response	40 Hz to 500 Hz (3 V range is 40 Hz to 300 Hz)
Input impedance (typical)	10 MΩ to 11 MΩ 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
AC conversion type	Average sensing RMS indication
DC current	
Ranges	300 μA, 3 mA, 30 mA, 300 mA, 10 A (10 A range: 30 seconds maximum above 10 A input up to 20 A)
Accuracy (by range)	
300 μA, 30 mA	±(0.9% reading + 2 counts)
3 mA, 300 mA	±(1.2% reading + 2 counts)
10 A	±(2.5% reading + 5 counts)
Resolution (by range)	
300 μA	0.1 μA
3 mA	1 μA
30 mA	10 μA
300 mA	100 μA
10 A	10 mA

Table 2: Measurement characteristics (cont.)

Characteristics	Description
AC current	
Ranges	300 μA, 3 mA, 30 mA, 300 mA, 10 A (10 A range: 30 seconds maximum above 10 A input up to 20 A)
Accuracy (by range)	
300 μA, 3 mA, 30 mA	±(1.5% reading + 4 counts)
300 mA	±(2% reading + 4 counts)
10 A	±(2.9% reading + 5 counts)
Frequency response	40 Hz to 500 Hz
Resolution (by range)	
300 μA	0.1 μA
3 mA	1 μA
30 mA	10 μA
300 mA	100 μA
10 A	10 mA
AC conversion type	Average sensing RMS indication
Resistance	
Ranges	300 Ω, 3 kΩ, 30 kΩ, 300 kΩ, 3 MΩ, 30 MΩ
Accuracy (by range)	
300 Ω, 3 MΩ	±(1% reading + 4 counts)
30 MΩ	±(2% reading + 5 counts)
Other ranges	±(0.8% reading + 2 counts)
Test voltage	Approximately 1.3 V open-circuit
Resolution (by range)	
300 Ω	0.1 Ω
3 kΩ	1 Ω
30 kΩ	10 Ω
300 kΩ	100 Ω
3 MΩ	1 kΩ
30 MΩ	10 kΩ
Capacitance	
Ranges	3 μF, 30 μF, 300 μF, 3000 μF
Accuracy (by range)	
3 μF, 30 μF	±(1.9% reading + 5 counts)
300 μF	±(1.9% reading + 10 counts)
3000 μF	±(2.9% reading + 20 counts)

Table 2: Measurement characteristics (cont.)

Characteristics	Description
Resolution (by range)	
3 μF	1 nF
30 μF	10 nF
300 μF	100 nF
3000 μF	1 μF
Test frequency	
3 μF, 30 μF	82 Hz
300 μF, 3000 μF	8.2 Hz
Test voltage	3.3 V peak
Continuity check	
Threshold	The beeper sounds if the resistance of the circuit measured is < 100 Ω
Beeper frequency (typical)	2 kHz
Diode test	
Test current	1.5 mA maximum
Test voltage	3.3 V maximum open circuit
Auto power off	The meter automatically shuts off in about ten minutes from the last function or mode change. The meter turns on again when 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.

DMM157 Performance Verification

This section contains procedures to verify that the DMM157 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 DMM157 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
Capacitance Check
DC Microampere Check
DC Milliampere Check
AC Microampere 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.*

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3. Warm up the multimeter for five minutes.
4. Photocopy the test record on pages 15 through 17 to record your test results.

Verification Procedure

Implement the following checks to verify the performance of your DMM157 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. Push the BLUE button to select AC volts.
3. Connect the calibrator outputs to the multimeter VΩ⊣▶⊢ 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 dial to V≂.
2. Connect the calibrator outputs to the multimeter VΩ⊣▶⊢ 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 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. 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 dial to ·))) ⯈|.
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 Continuity test record and verify proper operation.
4. Set the calibrator output to OFF.
5. Disconnect the calibrator from the multimeter.
6. Insert the multimeter test leads into the V Ω ⯈| and COM input connectors of the multimeter.
7. 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 to the capacitance ranges indicated in the test record.
2. Set the calibrator to each of the values in the Capacitance test record for each multimeter range and verify that the multimeter reads within the specified Display minimum and maximum limits.
3. Set the calibrator output to OFF.
4. Disconnect the calibrator from the multimeter.

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 mA ⊣⊢ 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. Set the calibrator output to OFF.

DC Milliampere Check

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

1. Set the multimeter dial to mA≂.
2. Connect the calibrator outputs to the multimeter µA 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. Set the calibrator output to OFF.
5. Disconnect the calibrator from the multimeter.

AC Microampere Check

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

1. Set the multimeter dial to µA≂.
2. Push the BLUE button to select AC mode.
3. Connect the calibrator outputs to the multimeter µA 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. Set the calibrator output to OFF.
6. 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≂.
2. Push the BLUE button to select AC mode.
3. Connect the calibrator outputs to the multimeter µA 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. Set the calibrator output to 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. Set the calibrator output to 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 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. Set the calibrator output to OFF.
6. Disconnect the calibrator from the multimeter.

DMM157 Test Record

Serial number	Procedure performed by	Date

DMM157 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC volts test					
2.900 V	50 Hz	±1.5% + 5 counts	2.852 V		2.948 V
	300 Hz	±1.5% + 5 counts	2.852 V		2.948 V
29.00 V	50 Hz	±1.5% + 5 counts	28.52 V		29.48 V
	400 Hz	±1.5% + 5 counts	28.52 V		29.48 V
290.0 V	50 Hz	±1.5% + 5 counts	285.2 V		294.8 V
	400 Hz	±1.5% + 5 counts	285.2 V		294.8 V
600.0 V	50 Hz	±1.5% + 5 counts	586 V		614 V
	400 Hz	±1.5% + 5 counts	586 V		614 V
DC volts test					
290.0 mV		±0.5% + 2 counts	288.4 mV		291.6 mV
2.900 V		±0.5% + 2 counts	2.884 V		2.916 V
29.00 V		±0.5% + 2 counts	28.84 V		29.16 V
290.0 V		±0.5% + 2 counts	286.4 V		291.6 V
600.0 V		±0.5% + 2 counts	595 V		605 V
Ω test					
0.00 Ω		±1.0% + 4 counts	–0.4 Ω		0.4 Ω
300.0 Ω		±1.0% + 4 counts	296.6 Ω		303.4 Ω
3.000 kΩ		±0.8% + 2 counts	2.974 kΩ		3.026 kΩ
30.00 kΩ		±0.8% + 2 counts	29.74 kΩ		30.26 kΩ
300.0 kΩ		±0.8% + 2 counts	297.4 kΩ		302.6 kΩ
3.000 MΩ		±1.0% + 4 counts	2.966 MΩ		3.034 MΩ
30.00 MΩ		±2.0% + 5 counts	29.35 MΩ		30.65 MΩ

DMM157 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Continuity test				
0.0 Ω		Beeper sounds		
200 Ω		Beeper does not sound		
Multimeter leads shorted		Beeper sounds		
Capacitance test[1]				
3.000 μF	±1.9% + 5 counts	2.938 μF		3.062 μF
30.00 μF	±1.9% + 5 counts	29.38 μF		30.62 μF
300.00 μF	±1.9% + 10 counts	293.3 μF		306.7 μF
DC microampere test				
0.0 μA	±2 counts	–0.2 μA		0.2 μA
290.0 μA	±0.9% + 2 counts	287.2 μA		292.8 μA
DC milliampere test				
2.900 mA	±1.2% + 2 counts	2.863 mA		2.936 mA
29.00 mA	±0.9% + 2 counts	28.72 mA		29.28 mA
290.0 mA	±1.2% + 2 counts	286.3 mA		293.6 mA
AC microampere test (50 Hz)				
0.0 μA	±4 counts	–0.4 μA		0.4 μA
290.0 μA	±1.5% + 4 counts	285.3 μA		294.7 μA
AC milliampere test (50 Hz)				
2.900 mA	±1.5% + 4 counts	2.853 mA		2.947 mA
29.00 mA	±1.5% + 4 counts	28.53 mA		29.47 mA
290.0 mA	±2.0% + 4 counts	283.8 mA		296.2 mA

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

DMM157 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
DC ampere test				
10.000 A	2.5% + 5 counts	9.70 A		10.30 A
AC ampere test (60 Hz)				
10.000 A	±2.9% + 5 counts	9.66 A		10.34 A

DMM157 Adjustment Procedure

This section contains the procedure to adjust the DMM157 Digital Multimeter. Perform this procedure once a year or if the *DMM157 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
- Adjustment procedure

The procedure in this section does not verify performance. To confirm that your multimeter meets factory specifications, perform the procedures in the *DMM157 Performance Verification* section.

Test Equipment

The test equipment listed in Table 5 on page 8 is a complete list of equipment needed for the adjustment procedure. This procedure 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 DMM157 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 adjustment. 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 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 22.

Adjustment

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 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.

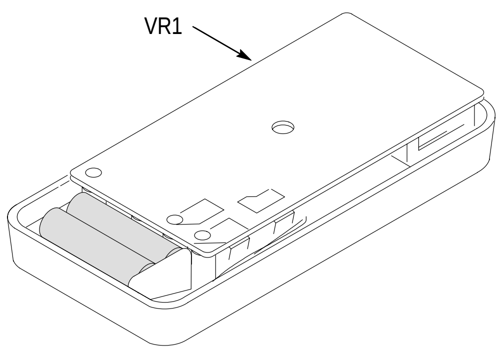

Figure 2: Adjustment location

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 screw.

Instructions Manual

Tektronix

DMM249
Digital Multimeter

070-9934-00

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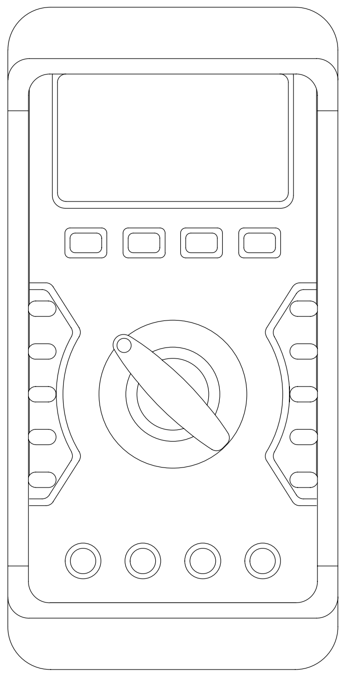
DMM249 Digital Multimeter

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 ±(% reading + number of digits) at 23° C ±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 750 VAC$_{RMS}$ V~ V⎓ 600 VDC/AC$_{RMS}$ Ω))) →|
A connector	15 A (600 V) fast blow fuse (type KTK or KLK) Tektronix part number 159-0287-00
µA/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 ANSI/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	±(0.3% reading + 2 digits)
Input impedance	10 MΩ
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	±(1.3% reading + 3 digits)
Input impedance	10 MΩ (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	±(1% reading + 2 digits)
3 mA	±(1.2% reading + 2 digits)
30 mA	±(1% reading + 2 digits)
300 mA	±(1.2% reading + 2 digits)
20 A	±(2% reading + 3 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 µA	0.1 µA
3 mA	1 µA
30 mA	10 µA
300 mA	0.1 mA
20 A	10 mA
AC 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 to 30 mA	±(1.5% reading + 3 digits)
300 mA	±(2% reading + 3 digits)
20 A	±(2.5% reading + 5 digits)
Burden voltage	
300 µA, 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 µA	0.1 µA
3 mA	1 µA
30 mA	10 µA
300 mA	100 µA
20 A	10 mA
Resistance	
Ranges	300 Ω, 3 kΩ, 30 kΩ, 300 kΩ, 3 MΩ, 30 MΩ
Accuracy	
300 Ω	±(1.2% reading + 4 digits)
3 kΩ to 300 kΩ	±(1.0% reading + 2 digits)
3 MΩ	±(1.5% reading + 3 digits)
30 MΩ	±(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 kΩ	1 Ω
30 kΩ	10 Ω
300 kΩ	100 Ω
3 MΩ	1 kΩ
30 MΩ	10 kΩ
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 ~.
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 •))) ⏵|.
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 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-⏵| 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 μAmA 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≂.
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≂.
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≂.
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≂.
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 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
AC volts test					
2.900 V	50 Hz	±1.3% + 3 counts	2.859 V		2.940 V
	300 Hz	±1.3% + 3 counts	2.859 V		2.940 V
29.00 V	50 Hz	±1.3% + 3 counts	28.59 V		29.40 V
	400 Hz	±1.3% + 3 counts	28.59 V		29.40 V
290.0 V	50 Hz	±1.3% + 3 counts	285.9 V		294.0 V
	400 Hz	±1.3% + 3 counts	285.9 V		294.0 V
600.0 V	50 Hz	±1.3% + 3 counts	589 V		611 V
	400 Hz	±1.3% + 3 counts	589 V		611 V
DC volts test					
290.0 mV		±0.3% + 2 counts	288.9 mV		291.1 mV
2.900 V		±0.3% + 2 counts	2.889 V		2.911 V
29.00 V		±0.3% + 2 counts	28.89 V		29.11 V
290.0 V		±0.3% + 2 counts	288.9 V		291.1 V
600.0 V		±0.3% + 2 counts	596 V		604 V
Ω test					
0.00 Ω		±1.2% + 4 counts	–0.4 Ω		0.4 Ω
300.0 Ω		±1.2% + 4 counts	296.0 Ω		304.0 Ω
3.000 kΩ		±1.0% + 2 counts	2.968 kΩ		3.032 kΩ
30.00 kΩ		±1.0% + 2 counts	29.68 kΩ		30.32 kΩ
300.0 kΩ		±1.0% + 2 counts	296.8 kΩ		303.2 kΩ
3.000 MΩ		±1.5% + 3 counts	2.952 MΩ		3.048 MΩ
30.00 MΩ		±2.5% + 5 counts	29.20 MΩ		30.80 MΩ

DMM249 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		
DC microampere test				
0.0 µA	±2 counts	–00.2 µA		00.2 µA
290.0 µA	±1.0% + 2 counts	286.9 µA		293.1 µA
DC milliampere test				
2.900 mA	±1.2% + 2 counts	2.863 mA		2.936 mA
29.00 mA	±1.0% + 2 counts	28.69 mA		29.31 mA
290.0 mA	±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	±1.5% + 3 counts	285.4 µA		294.6 µA
AC milliampere test (50 Hz)				
2.900 mA	±1.5% + 3 counts	2.854 mA		2.946 mA
29.00 mA	±1.5% + 3 counts	28.54 mA		29.46 mA
290.0 mA	±2.0% + 3 counts	283.9 mA		296.1 mA
DC ampere test				
10.000 A	±2.0% + 3 counts	9.77 A		10.23 A
AC ampere test (50 Hz)				
10.000 A	±2.5% + 5 counts	9.70 A		10.30 A

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.

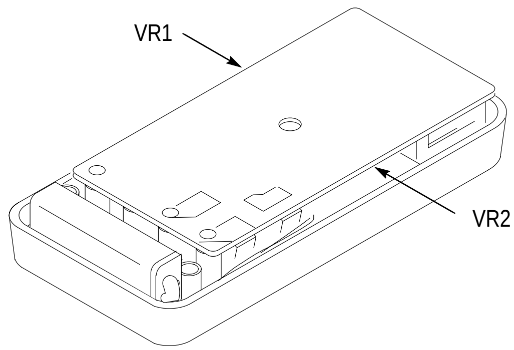


Figure 2: Adjustment locations

DC Volts

Perform the following steps to adjust the DC voltage calibration.

1. Set the multimeter dial to V⎓.
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.

Instructions Manual

Tektronix

DMM254
Digital Multimeter

070-9935-00

Table of Contents

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

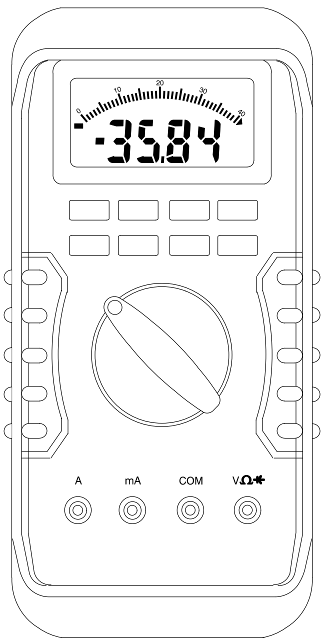


Figure 1: DMM254 Digital Multimeter

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 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

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.**

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

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.

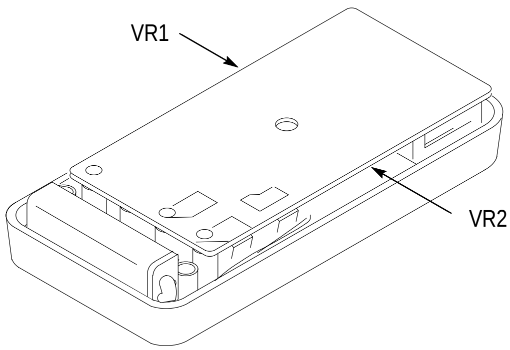


Figure 2: Adjustment locations

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.

Instructions Manual

Tektronix

DMM800 Series
Digital Multimeters

070-9850-01

Table of Contents

DMM800 Series Digital Multimeters

The Tektronix DMM800 Series digital multimeters provide many features. Table 1 lists the features of each meter for easy comparison.

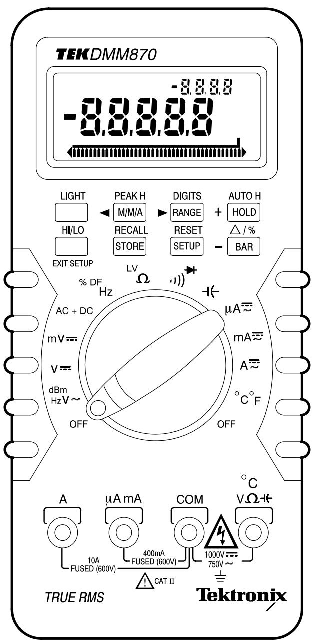


Figure 1: DMM870 Digital Multimeter

Table 1: DMM800 series digital multimeter features

Feature	DMM830	DMM850	DMM870
40,000 display count	●	●	●
Bargraph	●	●	●
Centering and zooming		●	●
True RMS or average AC measurements	●	●	●
Autorange	●	●	●
Measurements			
DC/AC voltage	●	●	●
AC + DC voltage	●	●	●
DC/AC current	●	●	●

Table 1: DMM800 series digital multimeter features (cont.)

Feature	DMM830	DMM850	DMM870
Resistance	●	●	●
Frequency	●	●	●
Diodes and capacitors	●	●	●
Continuity	●	●	●
Duty factor		●	●
Temperature		●	●
Decibel			●
AC volts and amps with Hz display		●	●
Measurement hold	●	●	●
Peak hold			●
Minimum, maximum, and average values	●	●	●
M/M/A time stamp		●	●
Delta mode	●	●	●
HI/LO limits		●	●
Memory store and recall	●	●	●
Backlight			●
Automatic fuse verification	●	●	●
Improper input connection warning	●	●	●

DMM800 Series Specifications

The characteristics listed in this section apply under the following conditions:

- The instrument operates in an 18° to 28° C ambient environment at less than 75% relative humidity.
- The batteries are adequately charged (the battery indicator does not display).

***NOTE**. All specifications are warranted unless marked "typical." Typical characteristics are not guaranteed but are provided for the convenience of the user.*

Table 2: General specifications

Characteristic	Description
LCD display digits	$4^3/_4$ or $3^3/_4$
Bargraph segments	40
Display count	40,000 or 4,000
Numeric update rate	1 time/sec (40,000 count) 4 times/sec (4,000 count)
Bargraph	20 times/sec
Polarity display	Automatic
Overrange display	OL is displayed
Low voltage indicator	Battery indicator
Automatic power-off time	User selectable (default = 15 minutes)
Power source	One standard 9 V battery, ANSI/NEDA 1604A, IEC 6F22
Maximum input voltage	1000 V (750 V AC) CAT II between V and COM
Maximum floating voltage	1000 V (750 V AC) CAT II between any terminal and earth ground
Maximum input current	400 mA between µA mA and COM 10 A continuous between A and COM (20 A for 30 seconds)
Maximum open circuit voltage	Current inputs: 600 V between A and COM and between µA mA and COM
Overload protection	
µA mA connector	1 A (600 V) fast blow fuse (type BLS or BBS) Tektronix part number 159-0337-00
A connector	15 A (600 V) fast blow fuse (type KTK or KLK) Tektronix part number 159-0287-00
V connector	$1100\ V_{pk}$ V~ V⎓ AC + DC $850\ V_{pk}$ mV⎓ Hz Ω ·))) °C ⊣(–

Table 3: Measurement characteristics

Characteristic	Description		
DC voltage			
V ranges	4 V, 40 V, 400 V, 1000 V		
mV range	400 mV		
Accuracy (% + 10 counts)[1]	*DMM830*	*DMM850*	*DMM870*
	±0.2%	±0.1%	±0.06%
AC voltage			
Ranges	4 V, 40 V, 400 V, 750 V		
Accuracy[5] (% + 40 counts)[1]	*DMM830*	*DMM850*	*DMM870*
50 to 100 Hz	±1.0%	±0.8%	±0.7%
>100 to 1 kHz[2]	±2.5%	±2.0%	±1.5%
>1 kHz to 10 kHz[2]	– – –	±3.5%	±2.5%
>10 kHz to 20 kHz[2]	– – –	– – –	±3.5%
Bandwidth	*DMM830*	*DMM850*	*DMM870*
	1 kHz	10 kHz	20 kHz
Crest factor	≤3		
Input impedance	10 MΩ paralleled by 100 pF		
AC + DC volts	Same as AC (RMS) + 1.2% + 10 counts[3]		
dBm/dB	dBm reference = 1 mV into 600 Ω dB reference = 1 V		
Current			
AC and DC ranges	4,000 µA, 400 mA, 10 A: 20 A maximum for < 30 seconds		
DC accuracy (% + 10 counts)[1]	*DMM830*	*DMM850*	*DMM870*
	±0.5%	±0.4%	±0.3%
AC accuracy (% + 80 counts)[1]	±1.2%	±0.9%	±0.9%
Bandwidth (typical)	≤1 kHz		
Resistance			
Ranges			
Ω ranges	400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ		
LV ranges	4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ		
Accuracy	*DMM830*	*DMM850*	*DMM870*
Ω (% + 10 counts)[1]	±0.5%	±0.4%	±0.3%
LV (% + 1 count)[2,3]	±1%	±0.8%	±0.6%
4 MΩ/400 Ω range	±1%	±0.8%	±0.6%
40 MΩ range[3]	±5%	±5%	±5%

Table 3: Measurement characteristics (cont.)

Characteristic	Description
Compliance voltages (typical)	1 V (Ω setting) 0.4 V (LV setting)
Continuity threshold[3]	Beeper sounds when resistance is approximately 75 Ω or less
Diode test[3]	
Test current (typical)	0.6 mA
Test voltage (typical)	≤3 V
Capacitance	
Ranges	4 nF, 40 nF, 400 nF, 4 µF, 40 µF, 400 µF, 4 mF, 40 mF
Accuracy[3] (% + 10 count)	
4 nF to 4 µF	±1% (delta mode)
40 µF to 40 mF	±3%
Frequency[4]	
Ranges	400 Hz, 4 kHz, 40 kHz, 400 kHz, 2 MHz
Accuracy[6] (% + 10 count)	
400 Hz to 400 kHz	±0.01%
2 MHz	±0.15%
Sensitivity	0.5 V_{p-p}
Duty factor	
Accuracy	±(0.1% + 0.05% per kHz) for 5 V input
Range	15 Hz to 10 kHz (10% to 90% duty factor)
Temperature	
Range	–50° to +980° C
Accuracy	2° C
Thermocouple type	K
Peak measurements[3]	
Accuracy	DC volts: ±5% + 40 counts of the peak value of a single 1 ms pulse

1 **Divide counts by 10 in 4000 count mode.**

2 **750 V, 40 MΩ–LV range unspecified.**

3 **4000 count mode only.**

4 **Upper display readout is limited to 10 kHz with reduced accuracy.**

5 **>10% range, 4 V range > 1 V.**

6 **>5% range.**

Table 4: Physical characteristics

Characteristic	Description
Dimensions	
Without holster	32 mm × 86 mm × 185 mm (H × W × D)
Weight	
With battery	370 g (13 oz.)
With battery and holster	600 g (21.2 oz.)

Table 5: Environmental characteristic

Characteristic	Description
Temperature	
Operating	0° to +50° C
Nonoperating (storage)	–20° to +60° C
Humidity	
Operating	<80%
Altitude	
Operating	2,222 m (7290 ft.)
Nonoperating	12,300 m (40354 ft.)
Vibration	
Operating	2.66 g_{RMS}, 5 to 500 Hz, 3 axes (10 minutes each)
Nonoperating	3.48 g_{RMS}, 5 to 500 Hz, 3 axes (10 minutes each)

Table 6: Certifications and compliance

Characteristic	Description
EC Declaration of Conformity	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/ECC for Product Safety. Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities: EN 55011 Class A: Radiated and Conducted Emissions EN 50082–1 Immunity: IEC 801–2 Electrostatic Discharge IEC 801–3 RF Radiated EN 61010-1: Electrical equipment safety requirements for measurement,control, and laboratory use
Certifications	Certified UL3111-1 and CAN/CSA C22.2 No. 1010.1-92

Table 6: Certifications and compliance (cont.)

Characteristic	Description
Overvoltage category	CAT III: Distribution level mains, fixed installation
	CAT II: Local level mains, appliances, portable equipment
	CAT I: Signal level, special equipment or parts of equipment, telecommunication, electronics
Pollution Degree 2	Do not operate in environments where conductive pollutants may be present.

DMM800 Series Performance Verification

This section contains procedures to verify that the DMM830, DMM850, and DMM870 Digital Multimeters perform 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 DMM800 Series performance verification consists of the checks listed in Table 7.

Table 7: Performance verification checks

AC Volts Check
DC Volts Check
DC Millivolts Check
AC+DC Volts Check
Frequency Check
Duty Factor Check (DMM850 and DMM870)
Ω Check
Low Voltage Ω Check
Continuity Check
Diode Check
Capacitance Check
Temperature Check (DMM850 and DMM870)
Volts Peak Hold Check (DMM870)
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 8. 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 8: 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	
Thermocouple adapter	K Type	Tektronix ATK01
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.*

Set the auto power off time to a large value or disable the auto power off by pushing the Blue button when turning the dial from the OFF position.

3. Warm up the multimeter for five minutes.
4. Set the Digits to the 40,000 counts display.
5. Pages 19 through 33 contain test records for the DMM800 series multimeters. Each model has its own test record. Photocopy the test record pages for your model to record your test results.

***NOTE**. If stability of the display reading causes questionable accuracy of a test, set the multimeter to Average mode.*

Verification Procedure

Implement the following checks to verify the performance of your DMM800 Series 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 °C 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⎓.
2. Connect the calibrator outputs to the multimeter °C 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.

DC Millivolts Check

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

1. Set the multimeter dial to mV⎓.
2. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
3. Set the calibrator to each of the values in the DC millivolt 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+DC Volts Check

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

1. Set the multimeter dial to AC+DC.
2. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
3. Set the calibrator to each of the values in the AC+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.

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 °C 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.

Duty Factor Check (DMM850 and DMM870)

Perform the following steps to verify the duty factor measurement accuracy.

1. Set the multimeter dial to Hz.
2. Push the BLUE button to select duty factor (% DF).
3. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
4. Set the calibrator to each of the values in the Duty factor 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.

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 °C 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.

Low Voltage Ω Check

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

1. Set the multimeter dial to Ω.
2. Push the BLUE button to select the LV mode.
3. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
4. Set the calibrator to each of the values in the Low voltage Ω 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.

Continuity Check

Perform the following steps to verify the continuity check accuracy.

1. Set the multimeter dial to ·))).
2. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ 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 °C V Ω ⊣⊢ and COM input connectors of the multimeter.
7. Short the test leads together and check for proper operation.

Diode Check

Perform the following steps to verify the diode check accuracy.

1. Set the multimeter dial to ·))).
2. Push the BLUE button to select the diode test mode.
3. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
4. Set the calibrator to each of the values in the Diode 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.

Capacitance Check

Perform the following steps to verify the capacitance measurement accuracy.

1. Set the multimeter dial to ⊣⊢.
2. Set the noise suppression to 60 Hz:
   a. Press the DMM SETUP key (repeatedly) until the upper display reads 5060.
   b. Set the main display to 60 Hz with the + and – keys.
3. Null the residual DMM and lead capacitance offset.
   a. Using Fluke 5500A or Wavetek 9100 minus the 9105 front porch:
      - Turn the calibrator output off.
      - Connect the test leads to the multimeter °C V Ω ⊣⊢ and COM inputs.
      - Connect the multimeter COM lead to the calibrator common output.
      - Press the multimeter gold key followed by the Δ/% key.
      - Connect the multimeter °C V Ω ⊣⊢ lead to the remaining calibrator output.
      - Turn the calibrator output on.

b. Using Wavetek 9100 with 9105 front porch:

- Turn the calibrator output off.
- Connect the multimeter test leads to the calibrator outputs.
- Connect the calibrator common lead to the multimeter COM input.
- Press the multimeter gold key followed by the Δ/% key.
- Connect the remaining calibrator output lead to the multimeter °C V Ω ⊣⊢ input.
- Turn the calibrator output on.

4. 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.

5. Turn the calibrator output off.

6. Disconnect the calibrator from the multimeter.

Temperature Check (DMM850 and DMM870)

Perform the following steps to verify the temperature measurement accuracy.

1. Set the multimeter dial to °C / °F.

2. Connect the ATK01 thermocouple adapter to the multimeter °C V Ω ⊣⊢ and COM input connectors.

3. Connect the Standard thermocouple (K type) of the calibrator to the ATK01 thermocouple adapter.

4. Allow five minutes for the connector temperature to stabilize.

5. Set the calibrator to each of the values in the Temperature test record and verify that the multimeter reads within the specified Display minimum and maximum limits.

6. Turn the calibrator output off.

7. Disconnect the calibrator from the multimeter.

Volts Peak Hold Check (DMM870)

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

1. Set the multimeter dial to V⎓.

2. Push the GOLD button and then the M/M/A button to select PEAK H.

3. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.

4. Set the calibrator to each of the values in the Volts peak hold 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 µA ≂ or mA ≂ as needed.
2. Connect the calibrator outputs to the multimeter µA 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 µA ≂ or mA ≂ as needed.
2. Push the BLUE button to select AC mode.
3. Connect the calibrator outputs to the multimeter µA 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 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.

DMM830 Test Records

Serial number	Procedure performed by	Date

DMM830 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC volts test[1,2]					
3.6000 V	60 Hz	±1.0% + 40 counts	3.5600 V		3.6400 V
	1 kHz	±2.5% + 40 counts	3.5060 V		3.6940 V
36.000 V	60 Hz	±1.0% + 40 counts	35.600 V		36.400 V
	1 kHz	±2.5% + 40 counts	35.060 V		36.940 V
360.00 V	60 Hz	±1.0% + 40 counts	356.00 V		364.00 V
	1 kHz	±2.5% + 40 counts	350.60 V		369.40 V
750.0 V[3]	60 Hz	±1.0% + 40 counts	738.5 V		761.5 V

1 **Verify proper DMM range (5 display digits); use manual range if necessary. The 750 V range displays 4 digits.**

2 **The upper display readout is ±2 counts corresponding to the input frequency.**

3 **750 V range not specified above 100 Hz.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC volts test				
0.0000 V	±0.2% + 10 counts	–0.0010 V		0.0010 V
3.6000 V	±0.2% + 10 counts	3.5918 V		3.6082 V
–3.6000 V	±0.2% + 10 counts	–3.6082 V		–3.5918 V
36.000 V	±0.2% + 10 counts	35.918 V		36.082 V
360.00 V	±0.2% + 10 counts	359.18 V		360.82 V
1000.0 V	±0.2% + 10 counts	997.0 V		1003.0 V
–1000.0 V	±0.2% + 10 counts	–1003.0 V		–997.0 V
DC millivolts test				
0.00 mV	±0.2% + 10 counts	–0.10 mV		0.10 mV
40.00 mV	±0.2% + 10 counts	39.82 mV		40.18 mV
360.00 mV	±0.2% + 10 counts	359.18 mV		360.82 mV
–360.00 mV	±0.2% + 10 counts	–360.82 mV		–359.18 mV

DMM830 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
AC+DC volts test[1]					
–1.000 V	DC	±2.2% +14 counts	0.964 V		1.036 V
1.000 V	DC	±2.2% +14 counts	0.964 V		1.036 V
1.000 V	60 Hz	±2.2% +14 counts	0.964 V		1.036 V

[1] **4000 count mode only.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Frequency test					
20.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	19.90 Hz		20.10 Hz
100.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 Hz		100.11 Hz
1.0000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	.9989 kHz		1.0011 kHz
10.000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	9.989 kHz		10.011 kHz
100.00 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 kHz		100.11 kHz
1.0000 MHz[1,2]	1 V_{p-p}	±0.15% + 10 counts	0.9975 MHz		1.0025 MHz

[1] **Select Frequency mode if using the Wavetek 9100; set the amplitude to 1 V. Select the square wave AC mode if using the Fluke 5500A; set the amplitude to 1.000 V.**

[2] **Select the sine wave AC mode if using the Fluke 5500A; set the amplitude to 0.354 V.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Ω test				
0.00 Ω[1]	±0.5% + 10 counts	–0.10 Ω		0.10 Ω
360.00 Ω[1]	±1% + 10 counts	356.30 Ω		363.70 Ω
3.6000 kΩ	±0.5% + 10 counts	3.5810 kΩ		3.6190 kΩ
36.000 kΩ	±0.5% + 10 counts	35.810 kΩ		36.190 kΩ
360.00 kΩ	±0.5% + 10 counts	358.10 kΩ		361.90 kΩ
3.6000 MΩ	±1% + 10 counts	3.5630 MΩ		3.6370 MΩ
20.00 MΩ[2]	±5% + 10 counts	18.90 MΩ		21.10 MΩ

[1] **To test these values with the Fluke 5500A, apply 0.0 Ω and set the DMM to Delta mode.**

[2] **4,000 count mode only.**

DMM830 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Low voltage Ω test[1]				
3.600 kΩ[2]	±1% + 1 count	3.563 kΩ		3.637 kΩ
36.00 kΩ	±1% + 1 count	35.63 kΩ		36.37 kΩ
360.0 kΩ	±1% + 1 count	356.3 kΩ		363.7 kΩ
3.600 MΩ	±1% + 1 count	3.563 MΩ		3.637 MΩ

1 **4000 count mode only.**

2 **Use DMM manual ranging or set calibrator to 3.0 kΩ before selecting 3.6kΩ.**

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

Test input	Tolerance	Display minimum	Reading	Display maximum
Diode test				
0.5 V	–	0.400 V		0.600 V

Test input	Tolerance	Display minimum	Reading	Display maximum
Capacitance test[1,2]				
3.600 nF	±1% + 10 counts	3.554 nF		3.646 nF
36.00 nF	±1% + 10 counts	35.54 nF		36.46 nF
360.0 nF	±1% + 10 counts	355.4 nF		364.6 nF
3.600 µF	±1% + 10 counts	3.554 µF		3.646 µF
36.00 µF	±3% + 10 counts	34.82 µF		37.18 µF
360.00 µF[3]	±3% + 10 counts	348.2 µF		371.8 µF
3.600 mF[3]	±3% + 10 counts	3.482 mF		3.718 mF
36.00 mF[3]	±3% + 10 counts	34.82 mF		37.18 mF

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

2 **Set the DMM to Delta mode. Delta mode removes stray capacitance for low capacitance measurements.**

3 **Set the DMM noise suppression to 60 Hz with the SETUP mode. See Page 15 for detailed instructions.**

DMM830 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
DC milliampere test				
0.0 µA	±10 counts	–1.0 µA		1.0 µA
360.0 µA	±0.5% + 10 counts	357.2 µA		362.8 µA
–360.0 µA	±0.5% + 10 counts	–362.8 µA		–357.2 µA
3600.0 µA	±0.5% + 10 counts	3581.0 µA		3619.0 µA
36.00 mA	±0.5% + 10 counts	35.72 mA		36.28 mA
360.00 mA	±0.5% + 10 counts	358.10 mA		361.90 mA
AC milliampere test (60 Hz)				
3600.0 µA	±1.2% + 80 counts	3548.8 µA		3651.2 µA
360.00 mA	±1.2% + 80 counts	354.88 mA		365.12 mA
DC ampere test				
10.000 A	0.5% + 10 counts	9.940 A		10.060 A
AC ampere test (60 Hz)				
10.000 A	±1.2% + 80 counts	9.800 A		10.200 A

DMM850 Test Records

Serial number	Procedure performed by	Date

DMM850 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC volts test[1,2]					
3.6000 V	60 Hz	±0.8% + 40 counts	3.5672 V		3.6328 V
	500 Hz	±2.0% + 40 counts	3.5240 V		3.6760 V
	10 kHz	±3.5% + 40 counts	3.4700 V		3.7300 V
36.000 V	500 Hz	±2.0% + 40 counts	35.240 V		36.760 V
	10 kHz	±3.5% + 40 counts	34.700 V		37.300 V
360.00 V	500 Hz	±2.0% + 40 counts	352.40 V		367.60 V
	10 kHz	±3.5% + 40 counts	347.00 V		373.00 V
750.0 V[3]	60 Hz	±0.8% + 40 counts	740.0 V		760.0 V

1 **Verify the proper DMM range (5 display digits); use the manual range if necessary. The 750 V range displays 4 digits.**

2 **The upper display readout is ±2 counts corresponding to the input frequency.**

3 **750 V range not specified above 100 Hz.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC volts test				
0.0000 V	±0.1% + 10 counts	–0.0010 V		0.0010 V
3.6000 V	±0.1% + 10 counts	3.5954 V		3.6046 V
–3.6000 V	±0.1% + 10 counts	–3.6046 V		–3.5954 V
36.000 V	±0.1% + 10 counts	35.954 V		36.046 V
360.00 V	±0.1% + 10 counts	359.54 V		360.46 V
1000.0 V	±0.1% + 10 counts	998.0 V		1002.0 V
–1000.0 V	±0.1% + 10 counts	–1002.0 V		–998.0 V

DMM850 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
DC millivolts test					
0.00 mV		±0.1% + 10 counts	–0.10 mV		0.10 mV
40.00 mV		±0.1% + 10 counts	39.86 mV		40.14 mV
360.00 mV		±0.1% + 10 counts	359.54 mV		360.46 mV
–360.00 mV		±0.1% + 10 counts	–360.46 mV		–359.54 mV
AC+DC volts test[1]					
–1.000 V	DC	±2.0% +14 counts	0.966 V		1.034 V
1.000 V	DC	±2.0% +14 counts	0.966 V		1.034 V
1.000 V	60 Hz	±2.0% +14 counts	0.966 V		1.034 V

1 **4000 count mode only.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Frequency test					
20.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	19.90 Hz		20.10 Hz
100.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 Hz		100.11 Hz
1.0000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	.9989 kHz		1.0011 kHz
10.000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	9.989 kHz		10.011 kHz
100.00 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 kHz		100.11 kHz
1.0000 MHz[1,2]	1 V_{p-p}	±0.15% + 10 counts	0.9975 MHz		1.0025 MHz

1 **Select Frequency mode if using the Wavetek 9100; set the amplitude to 1 V. Select the square wave AC mode if using the Fluke 5500A; set the amplitude to 1.000 V.**

2 **Select the sine wave AC mode if using the Fluke 5500A; set the amplitude to 0.354 V.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Duty factor test					
50.0	5 V, 1 kHz squarewave	±0.15%	49.9		50.1
90.0	5 V, 1 kHz squarewave	±0.15%	89.9		90.1
10.0	5 V, 1 kHz squarewave	±0.15%	9.9		10.1

DMM850 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Ω test				
0.0000 Ω[1]	±0.4% + 10 counts	–0.1000 Ω		0.1000 Ω
360.00 Ω[1]	±0.8% + 10 counts	357.02 Ω		362.98 Ω
3.6000 kΩ	±0.4% + 10 counts	3.5846 kΩ		3.6154 kΩ
36.000 kΩ	±0.4% + 10 counts	35.846 kΩ		36.154 kΩ
360.00 kΩ	±0.4% + 10 counts	358.46 kΩ		361.54 kΩ
3.6000 MΩ	±0.8% + 10 counts	3.5702 MΩ		3.6298 MΩ
20.00 MΩ[2]	±5% + 10 counts	18.90 MΩ		21.10 MΩ

[1] **To test these values with the Fluke 5500A, apply 0.0 Ω and set the DMM to Delta mode.**

[2] **4,000 count mode only.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Low voltage Ω test[1]				
3.600 kΩ[2]	±0.8% + 1 count	3.570 kΩ		3.630 kΩ
36.00 kΩ	±0.8% + 1 count	35.70 kΩ		36.30 kΩ
360.0 kΩ	±0.8% + 1 count	357.0 kΩ		363.0 kΩ
3.600 MΩ	±0.8% + 1 count	3.570 MΩ		3.630 MΩ

[1] **4000 count mode only.**

[2] **Use DMM manual ranging or set calibrator to 3.0 kΩ before selecting 3.6kΩ.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Continuity test				
0.0 Ω	–	Beeper sounds		
150 Ω	–	Beeper does not sound		
Multimeter leads shorted	–	Beeper sounds		
Diode test				
0.5 V	–	0.400 V		0.600 V

DMM850 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Capacitance test[1,2]				
3.600 nF	±1% + 10 counts	3.554 nF		3.646 nF
36.00 nF	±1% + 10 counts	35.54 nF		36.46 nF
360.0 nF	±1% + 10 counts	355.4 nF		364.6 nF
3.600 μF	±1% + 10 counts	3.554 μF		3.646 μF
36.00 μF	±3% + 10 counts	34.82 μF		37.18 μF
360.00 μF[3]	±3% + 10 counts	348.2 μF		371.8 μF
3.600 mF[3]	±3% + 10 counts	3.482 mF		3.718 mF
36.00 mF[3]	±3% + 10 counts	34.82 mF		37.18 mF

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

2 **Set the DMM to Delta mode. Delta mode removes stray capacitance for low capacitance measurements.**

3 **Set the DMM noise suppression to 60 Hz with the SETUP mode. See Page 15 for detailed instructions.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Temperature test				
0.0° C	±2° C	–2.0		2.0
–40.0° C	±2° C	–42.0		–38.0
100.0° C	±2° C	98.0		102.0
950.0° C	±2° C	948.0		952.0
DC milliampere test				
0.0 μA	±10 counts	–1.0 μA		1.0 μA
360.0 μA	±0.4% + 10 counts	357.6 μA		362.4 μA
–360.0 μA	±0.4% + 10 counts	–362.4 μA		–357.6 μA
3600.0 μA	±0.4% + 10 counts	3584.6 μA		3615.4 μA
36.00 mA	±0.4% + 10 counts	35.76 mA		36.24 mA
360.00 mA	±0.4% + 10 counts	358.46 mA		361.54 mA

DMM850 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
AC milliampere test (60 Hz)[1]				
3600.0 µA	±0.9% + 80 counts	3559.6 µA		3640.4 µA
360.00 mA	±0.9% + 80 counts	355.96 mA		364.04 mA

[1] **The upper display readout is 60 Hz ±2 counts corresponding to the input frequency.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC ampere test				
10.000 A	±0.4% + 10 counts	9.950 A		10.050 A
AC ampere test (60 Hz)[1]				
10.000 A	±0.9% + 80 counts	9.830 A		10.170 A

[1] **The upper display readout is 60 Hz ±2 counts corresponding to the input frequency.**

DMM870 Test Records

Serial number	Procedure performed by	Date

DMM870 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC volts test[1,2]					
3.6000 V	60 Hz	±0.7% + 40 counts	3.5708 V		3.6292 V
	500 Hz	±1.5% + 40 counts	3.5420 V		3.6580 V
	10 kHz	±2.5% + 40 counts	3.5060 V		3.6940 V
36.000 V	500 Hz	±1.5% + 40 counts	35.420 V		36.580 V
	10 kHz	±2.5% + 40 counts	35.060 V		36.940 V
360.00 V	500 Hz	±1.5% + 40 counts	354.20 V		365.80 V
	10 kHz	±2.5% + 40 counts	350.60 V		369.40 V
750.0 V[3]	60 Hz	±0.7% + 40 counts	740.7 V		759.3V

1 **Verify the proper DMM range (5 display digits); use the manual range if necessary. The 750 V range displays 4 digits.**

2 **The upper display readout is ±2 counts corresponding to the input frequency.**

3 **750 V range not specified above 100 Hz.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC volts test				
0.0000 V	±0.06% + 10 counts	–0.0010 V		0.0010 V
3.6000 V	±0.06% + 10 counts	3.5969 V		3.6031 V
–3.6000 V	±0.06% + 10 counts	–3.6031 V		–3.5969 V
36.000 V	±0.06% + 10 counts	35.969 V		36.031 V
360.00 V	±0.06% + 10 counts	359.69 V		360.31 V
1000.0 V	±0.06% + 10 counts	998.4 V		1001.6 V
–1000.0 V	±0.06% + 10 counts	–1001.6 V		–998.4 V

DMM870 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
DC millivolts test					
0.00 mV		±0.06% + 10 counts	–0.10 mV		0.10 mV
40.00 mV		±0.06% + 10 counts	39.88 mV		40.12 mV
360.00 mV		±0.06% + 10 counts	359.69 mV		360.31 mV
–360.00 mV		±0.06% + 10 counts	–360.31 mV		–359.69 mV
AC+DC volts test[1]					
–1.000 V	DC	±1.9% +14 counts	0.967 V		1.033 V
1.000 V	DC	±1.9% +14 counts	0.967 V		1.033 V
1.000 V	60 Hz	±1.9% +14 counts	0.967 V		1.033 V

[1] **4000 count mode only.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Frequency test					
20.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	19.90 Hz		20.10 Hz
100.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 Hz		100.11 Hz
1.0000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	.9989 kHz		1.0011 kHz
10.000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	9.989 kHz		10.011 kHz
100.00 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 kHz		100.11 kHz
1.0000 MHz[1,2]	1 V_{p-p}	±0.15% + 10 counts	0.9975 MHz		1.0025 MHz

[1] **Select Frequency mode if using the Wavetek 9100; set the amplitude to 1 V. Select the square wave AC mode if using the Fluke 5500A; set the amplitude to 1.000 V.**

[2] **Select the sine wave AC mode if using the Fluke 5500A; set the amplitude to 0.354 V.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Duty factor test					
50.0	5 V, 1 kHz squarewave	±0.15%	49.9		50.1
90.0	5 V, 1 kHz squarewave	±0.15%	89.9		90.1
10.0	5 V, 1 kHz squarewave	±0.15%	9.9		10.1

DMM870 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Ω test				
0.0000 Ω[1]	±0.3% + 10 counts	–0.1000 Ω		0.1000 Ω
360.00 Ω[1]	±0.6% + 10 counts	357.74 Ω		362.26 Ω
3.6000 kΩ	±0.3% + 10 counts	3.5882 kΩ		3.6118 kΩ
36.000 kΩ	±0.3% + 10 counts	35.882 kΩ		36.118 kΩ
360.00 kΩ	±0.3% + 10 counts	358.82 kΩ		361.18 kΩ
3.6000 MΩ	±0.6% + 10 counts	3.5774 MΩ		3.6226 MΩ
20.00 MΩ[2]	±5% + 10 counts	18.90 MΩ		21.10 MΩ

1 **To test these values with the Fluke 5500A, apply 0.0 Ω and set the DMM to Delta mode.**

2 **Verify the DMM is in the 4,000 count mode for this test.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Low voltage Ω test[1]				
3.600 kΩ[2]	±0.6% + 1 count	3.577 kΩ		3.623 kΩ
36.00 kΩ	±0.6% + 1 count	35.77 kΩ		36.23 kΩ
360.0 kΩ	±0.6% + 1 count	357.7 kΩ		362.3 kΩ
3.600 MΩ	±0.6% + 1 count	3.577 MΩ		3.623 MΩ

1 **4000 count mode only.**

2 **Use DMM manual ranging or set calibrator to 3.0 kΩ before selecting 3.6kΩ.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Continuity test				
0.0 Ω	–	Beeper sounds		
150 Ω	–	Beeper does not sound		
Multimeter leads shorted	–	Beeper sounds		
Diode test				
0.5 V	–	0.400 V		0.600 V

DMM870 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Capacitance test[1,2]				
3.600 nF	±1% + 10 counts	3.554 nF		3.646 nF
36.00 nF	±1% + 10 counts	35.54 nF		36.46 nF
360.0 nF	±1% + 10 counts	355.4 nF		364.6 nF
3.600 µF	±1% + 10 counts	3.554 µF		3.646 µF
36.00 µF	±3% + 10 counts	34.82 µF		37.18 µF
360.00 µF[3]	±3% + 10 counts	348.2 µF		371.8 µF
3.600 mF[3]	±3% + 10 counts	3.482 mF		3.718 mF
36.00 mF[3]	±3% + 10 counts	34.82 mF		37.18 mF

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

2 **Set the DMM to Delta mode. Delta mode removes stray capacitance for low capacitance measurements.**

3 **Set the DMM noise suppression to 60 Hz with the SETUP mode. See Page 15 for detailed instructions.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Temperature test				
0.0° C	±2° C	–2.0		2.0
–40.0° C	±2° C	–42.0		–38.0
100.0° C	±2° C	98.0		102.0
950.0° C	±2° C	948.0		952.0

Test input		Tolerance	Display minimum	Reading	Display maximum
Volts peak hold test					
1 V_{RMS} (60 Hz, 1.414 V_p)	MAX	±5% + 40 counts	1.303 V		1.524 V
1 V_{RMS} (60 Hz, 1.414 V_p)	MIN	±5% + 40 counts	–1.524 V		–1.303 V

Test input	Tolerance	Display minimum	Reading	Display maximum
DC milliampere test				
0.0 µA	±10 counts	–1.0 µA		1.0 µA
360.0 µA	±0.3% + 10 counts	358.0 µA		362.0 µA
–360.0 µA	±0.3% + 10 counts	–362.0 µA		–358.0 µA
3600.0 µA	±0.3% + 10 counts	3588.2 µA		3611.8 µA
36.00 mA	±0.3% + 10 counts	35.80 mA		36.20 mA
360.00 mA	±0.3% + 10 counts	358.82 mA		361.18 mA

DMM870 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
AC milliampere test (60 Hz)[1]				
3600.0 µA	±0.9% + 80 counts	3559.6 µA		3640.4 µA
360.00 mA	±0.9% + 80 counts	355.96 mA		364.04 mA

1 **The upper display readout is 60 Hz ±2 counts corresponding to the input frequency.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC ampere test				
10.000 A	±0.3% + 10 counts	9.960 A		10.040 A
AC ampere test (60 Hz)[1]				
10.000 A	±0.9% + 80 counts	9.830 A		10.170 A

1 **The upper display readout is 60 Hz ±2 counts corresponding to the input frequency.**

DMM800 Series Adjustment Procedures

This section contains procedures to adjust DMM830, DMM850, and DMM870 multimeters. Perform these procedures once a year or if the *DMM800 Series 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 *DMM800 Series Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 9 to return DMM800 Series multimeters to factory calibration.

Table 9: DMM800 series adjustments

Adjustments Part 1	
	DC Volts
	AC Volts
	Capacitance
	Temperature (DMM850 and DMM870)
	DC Milliamperes
	DC Amperes
Adjustments Part 2	
	AC Response

Test Equipment

The test equipment listed in Table 8 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 8. If you substitute equipment, you may need to modify the procedures.

Preparation for Adjustment

The following guidelines apply to all DMM800 Series 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. See Figure 2 for details.

To reassemble the multimeter following the adjustments, see page 42.

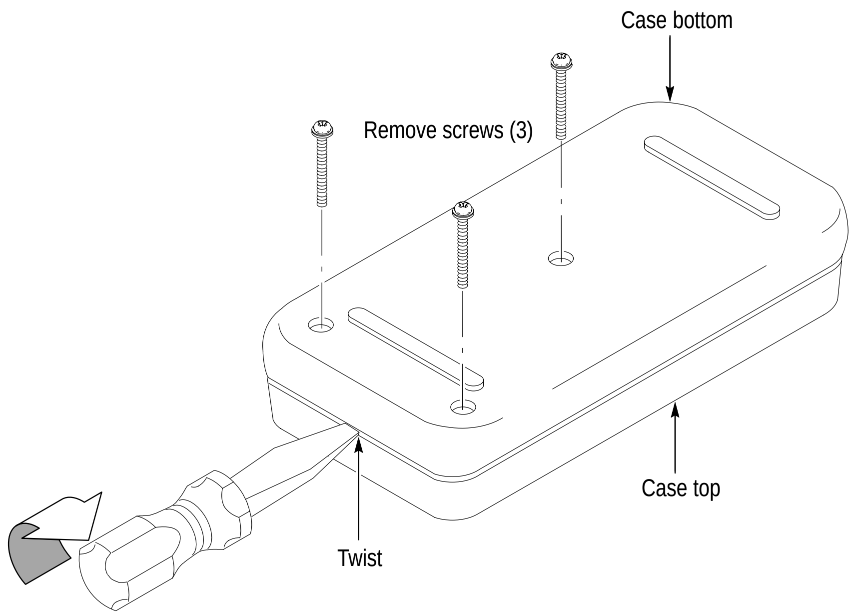


Figure 2: Opening the meter case

Adjustments Part 1

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

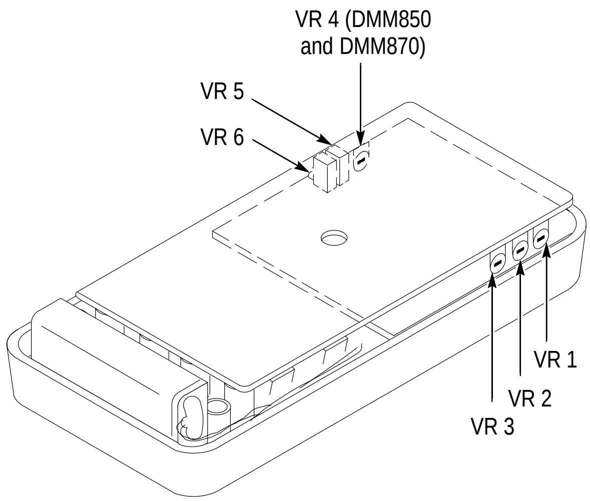


Figure 3: Adjustment locations 1

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 °C V Ω ⊣⊢ and COM input connectors of the multimeter.
3. Set the calibrator to output 3.0000 VDC.
4. Adjust VR5 until the display shows 2.9999 to 3.0001 VDC.
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 at 60 Hz.

1. Set the multimeter dial to V~.
2. Connect the outputs of the calibrator to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
3. Set the calibrator to output 2.0000 VAC at 60 Hz.
4. Adjust VR6 until the display shows 1.9999 to 2.0001 VAC.

5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

Capacitance

Perform the following steps to adjust the capacitance calibration.

1. Set the multimeter dial to ⊣⊢.
2. Null the residual DMM and lead capacitance offset.
   a. Using Fluke 5500A or Wavetek 9100 minus the 9105 front porch:
      - Turn the calibrator output off.
      - Connect the test leads to the multimeter °C V Ω ⊣⊢ and COM inputs.
      - Connect the multimeter COM lead to the calibrator common output.
      - Press the multimeter gold key followed by the Δ/% key.
      - Connect the multimeter °C V Ω ⊣⊢ lead to the remaining calibrator output.
      - Turn the calibrator output on.
   b. Using Wavetek 9100 with 9105 front porch:
      - Turn the calibrator output off.
      - Connect the multimeter test leads to the calibrator outputs.
      - Connect the calibrator common lead to the multimeter COM input.
      - Press the multimeter gold key followed by the Δ/% key.
      - Connect the remaining calibrator output lead to the multimeter °C V Ω ⊣⊢ input.
      - Turn the calibrator output on.
3. Set the calibrator to output 300 nF.
4. Adjust VR2 until the display shows 299.9 to 300.1 nF.
5. Set the calibrator to output 1.000 μF.
6. Adjust VR3 until the display shows 0.999 to 1.001 μF.
7. Set the calibrator to output 100.0 μF.
8. Adjust VR1 until the display shows 99.9 to 100.1 μF.
9. Turn the calibrator output off.

10. Disconnect the calibrator from the multimeter.

Temperature (DMM850 and DMM870)

Perform the following steps to adjust the temperature calibration.

1. Set the multimeter dial to °C / °F.
2. Connect the thermocouple adapter ATK01 to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
3. Set the calibrator to output 18.6° C.
4. Connect a K-type thermocouple from the calibrator output to the ATK01 thermocouple adapter.
5. Allow five minutes of settling time for a stable reading.
6. Adjust VR4 until the display shows 18.5° to 18.7 °C.
7. Turn the calibrator output off.
8. Disconnect the calibrator from the multimeter.

DC Milliamperes

Perform the following steps to adjust the DC milliamperes calibration.

1. Set the multimeter dial to mA ≂.
2. Connect the outputs of the calibrator to the µA mA and COM input connectors of the multimeter.
3. Set calibrator to output 100.0 mA.
4. Press and hold the gold button for five seconds. (The multimeter beeps twice when the gold button is first pressed and then two more beeps follow after five seconds.)
5. Press the SETUP button and wait for the calibration to finish (CAL is displayed during the calibration). After the calibration is completed, press EXIT SETUP (blue button).
6. Turn the calibrator output off.
7. Disconnect the calibrator from the multimeter.

DC Amperes

Perform the following steps to adjust the DC amperes calibration.

1. Set the multimeter dial to A ≂.
2. Connect the calibrator outputs to the multimeter A and COM inputs.
3. Set calibrator to output 10.00 A.

4. Press and hold the gold button for five seconds. (The multimeter beeps twice when the gold button is first pressed and then two more beeps follow after five seconds.)

5. Press the SETUP button and wait for the calibration to finish (CAL is displayed during the calibration). After the calibration is completed, press EXIT SETUP (blue button).

6. Turn the calibrator output off.

7. Disconnect the calibrator from the multimeter.

Adjustments Part 2

To perform the following procedure, you must lift out the entire circuit board assembly from the top case half to access the adjustments. Perform this procedure only if the *Performance Verification* procedure indicates that the AC voltage accuracy checks above 60 Hz is out of specification.

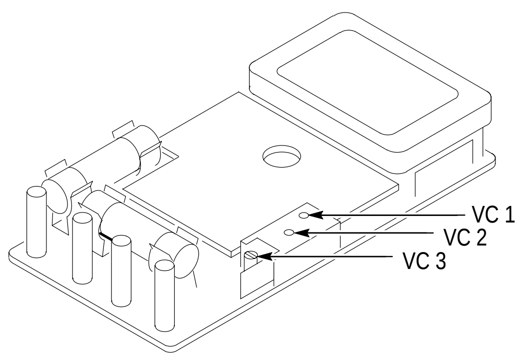


Figure 4: Adjustment locations 2

AC Response

Perform the following steps to adjust the AC voltage calibration above 60 Hz.

1. Set the multimeter dial to V~.

2. Lift the circuit board assembly out of the top case half.

3. Connect the outputs of the calibrator to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.

4. Set calibrator to output 100 VAC at 10 kHz (sinewave).

5. Adjust VC3 until the display shows +98.60 V.

6. Set the calibrator frequency to 500 Hz (sinewave).

7. Confirm that the reading is less than 100.60 V. Repeat step 5 if necessary.
8. Set the calibrator frequency to 1 kHz (sinewave).
9. Confirm that the reading is less than 104.0 V. Repeat step 5 if necessary.

NOTE. *Steps 10 through 17 do not apply to the DMM830.*

10. Set the calibrator to output 20 VAC at 10 kHz (sinewave).
11. Adjust VC1 until the display shows 19.700 V.
12. Set the calibrator frequency to 500 Hz (sinewave).
13. Confirm that the reading is less than 20.110 V. Repeat step 11 if necessary.
14. Set the calibrator to output 2 VAC at 10 kHz (sinewave).
15. Adjust VC2 until the display shows 1.9700 V.
16. Set the calibrator frequency to 500 Hz (sinewave).
17. Confirm that the reading is less than 2.011 V. Repeat step 15 if necessary.
18. Turn the calibrator output off.
19. 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.

Instructions Manual

Tektronix

DMM912, 914, and 916
Digital Multimeters

070-9851-01

Table of Contents

DMM912, 914, and 916 Digital Multimeters

The Tektronix DMM912, DMM914, and DMM916 digital multimeters provide many features. Table 1 lists the features of each meter for easy comparison.

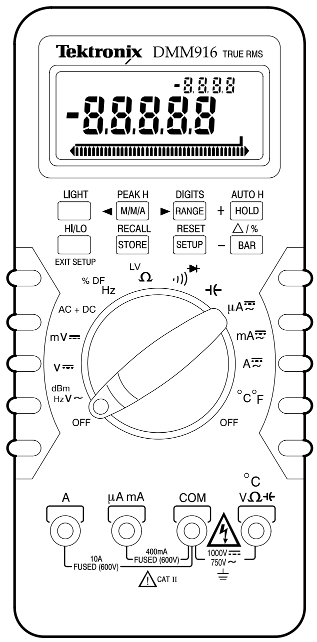


Figure 1: DMM916 Digital Multimeter

Table 1: DMM91X series digital multimeter features

Feature	DMM912	DMM914	DMM916
40,000 display count	●	●	●
Bargraph	●	●	●
Centering and zooming		●	●
True RMS or average AC measurements	●	●	●
Autorange	●	●	●
Measurements			
DC/AC voltage	●	●	●
AC + DC voltage	●	●	●
DC/AC current	●	●	●

Table 1: DMM91X series digital multimeter features (cont.)

Feature	DMM912	DMM914	DMM916
Resistance	●	●	●
Frequency	●	●	●
Diodes and capacitors	●	●	●
Continuity	●	●	●
Duty factor		●	●
Temperature		●	●
Decibel			●
AC volts and amps with Hz display		●	●
Measurement hold	●	●	●
Peak hold			●
Minimum, maximum, and average values	●	●	●
M/M/A time stamp		●	●
Delta mode	●	●	●
HI/LO limits		●	●
Memory store and recall	●	●	●
Backlight			●
Automatic fuse verification	●	●	●
Improper input connection warning	●	●	●

DMM912, 914, and 916 Specifications

The characteristics listed in this section apply under the following conditions:

- The instrument operates in an 18° to 28° C ambient environment at less than 75% relative humidity.
- The batteries are adequately charged (the battery indicator does not display).

***NOTE**. All specifications are warranted unless marked "typical." Typical characteristics are not guaranteed but are provided for the convenience of the user.*

Table 2: General specifications

Characteristic	Description
LCD display digits	$4^3/_4$ or $3^3/_4$
Bargraph segments	40
Display count	40,000 or 4,000
Numeric update rate	1 time/sec (40,000 count) 4 times/sec (4,000 count)
Bargraph	20 times/sec
Polarity display	Automatic
Overrange display	OL is displayed
Low voltage indicator	Battery indicator
Automatic power-off time	User selectable (default = 15 minutes)
Power source	One 9 V battery, ANSI/NEDA 1604A, IEC 6F22
Maximum input voltage	1000 V (750 V AC) CAT II between V and COM
Maximum floating voltage	1000 V (750 V AC) CAT II between any terminal and earth ground
Maximum input current	400 mA between µA mA and COM 10 A continuous between A and COM (20 A for 30 seconds)
Maximum open circuit voltage	Current inputs: 600 V between A and COM and between µA mA and COM
Overload protection	
µA mA connector	1 A (600 V) fast blow fuse (type BLS or BBS) Tektronix part number 159-0337-00
A connector	15 A (600 V) fast blow fuse (type KTK or KLK) Tektronix part number 159-0287-00
V connector	1100 V_{pk} V~ V⎓ AC + DC 850 V_{pk} mV⎓ Hz Ω ·))) °C ⊣⊢

Table 3: Measurement characteristics

Characteristic	Description		
DC voltage			
V ranges	4 V, 40 V, 400 V, 1000 V		
mV range	400 mV		
Accuracy (% + 10 counts)[1]	*DMM912*	*DMM914*	*DMM916*
	±0.2%	±0.1%	±0.06%
AC voltage			
Ranges	4 V, 40 V, 400 V, 750 V		
Accuracy[5] (% + 40 counts)[1]	*DMM912*	*DMM914*	*DMM916*
50 to 100 Hz	±1.0%	±0.8%	±0.7%
>100 to 1 kHz[2]	±2.5%	±2.0%	±1.5%
>1 kHz to 10 kHz[2]	– – –	±3.5%	±2.5%
>10 kHz to 20 kHz[2]	– – –	– – –	±3.5%
Bandwidth	*DMM912*	*DMM914*	*DMM916*
	1 kHz	10 kHz	20 kHz
Crest factor	≤3		
Input impedance	10 MΩ paralleled by 100 pF		
AC + DC volts	Same as AC (RMS) + 1.2% + 10 counts[3]		
dBm/dB	dBm reference = 1 mV into 600 Ω dB reference = 1 V		
Current			
AC and DC ranges	4,000 µA, 400 mA, 10 A: 20 A maximum for < 30 seconds		
DC accuracy (% + 10 counts)[1]	*DMM912*	*DMM914*	*DMM916*
	±0.5%	±0.4%	±0.3%
AC accuracy (% + 80 counts)[1]	±1.2%	±0.9%	±0.9%
Bandwidth (typical)	≤1 kHz		
Resistance			
Ranges			
Ω ranges	400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ		
LV ranges	4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ		
Accuracy	*DMM912*	*DMM914*	*DMM916*
Ω (% + 10 counts)[1]	±0.5%	±0.4%	±0.3%
LV (% + 1 count)[2,3]	±1%	±0.8%	±0.6%
4 MΩ/400 Ω range	±1%	±0.8%	±0.6%
40 MΩ range[3]	±5%	±5%	±5%

Table 3: Measurement characteristics (cont.)

Characteristic	Description
Compliance voltages (typical)	1 V (Ω setting) 0.4 V (LV setting)
Continuity threshold[3]	Beeper sounds when resistance is approximately 75 Ω or less
Diode test[3]	
Test current (typical)	0.6 mA
Test voltage (typical)	≤3 V
Capacitance	
Ranges	4 nF, 40 nF, 400 nF, 4 μF, 40 μF, 400 μF, 4 mF, 40 mF
Accuracy[3] (% + 10 count)	
4 nF to 4 μF	±1% (delta mode)
40 μF to 40 mF	±3%
Frequency[4]	
Ranges	400 Hz, 4 kHz, 40 kHz, 400 kHz, 2 MHz
Accuracy[6] (% + 10 count)	
400 Hz to 400 kHz	±0.01%
2 MHz	±0.15%
Sensitivity	0.5 V_{p-p}
Duty factor	
Accuracy	±(0.1% + 0.05% per kHz) for 5 V input
Range	15 Hz to 10 kHz (10% to 90% duty factor)
Temperature	
Range	–50° to +980° C
Accuracy	2° C
Thermocouple type	K
Peak measurements[3]	
Accuracy	DC volts: ±5% + 40 counts of the peak value of a single 1 ms pulse

1 **Divide counts by 10 in 4000 count mode.**

2 **750 V, 40 MΩ–LV range unspecified.**

3 **4000 count mode only.**

4 **Upper display readout is limited to 10 kHz with reduced accuracy.**

5 **>10% range, 4 V range > 1 V.**

6 **>5% range.**

Table 4: Physical characteristics

Characteristic	Description
Dimensions	
Without holster	32 mm × 86 mm × 185 mm (H × W × D)
Weight	
With battery	370 g (13 oz.)
With battery and holster	600 g (21.2 oz.)

Table 5: Environmental characteristic

Characteristic	Description
Temperature	
Operating	0° to +50° C
Nonoperating (storage)	–20° to +60° C
Humidity	
Operating	<80%
Altitude	
Operating	2,000 m (6,562 ft.)
Nonoperating	12,300 m (40354 ft.)
Vibration	
Operating	2.66 g_{RMS}, 5 to 500 Hz, 3 axes (10 minutes each)
Nonoperating	3.48 g_{RMS}, 5 to 500 Hz, 3 axes (10 minutes each)

Table 6: Certifications and compliances

Characteristic	Description
EC Declaration of Conformity	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/ECC for Product Safety. Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities: EN 55011 Class A: Radiated and Conducted Emissions EN 50082–1 Immunity: IEC 801–2 Electrostatic Discharge IEC 801–3 RF Radiated EN 61010-1: Electrical equipment safety requirements for measurement,control, and laboratory use
Certifications	Certified UL3111-1 and CAN/CSA C22.2 No. 1010.1-92

Table 6: Certifications and compliances (cont.)

Characteristic	Description
Overvoltage category	CAT III: Distribution level mains, fixed installation
	CAT II: Local level mains, appliances, portable equipment
	CAT I: Signal level, special equipment or parts of equipment, telecommunication, electronics
Pollution Degree 2	Do not operate in environments where conductive pollutants may be present.

DMM912, 914, and 916 Performance Verification

This section contains procedures to verify that the DMM912, DMM914, and DMM916 Digital Multimeters perform 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 DMM91X Series performance verification consists of the checks listed in Table 7.

Table 7: Performance verification checks

AC Volts Check
DC Volts Check
DC Millivolts Check
AC+DC Volts Check
Frequency Check
Duty Factor Check (DMM914 and DMM916)
Ω Check
Low Voltage Ω Check
Continuity Check
Diode Check
Capacitance Check
Temperature Check (DMM914 and DMM916)
Volts Peak Hold Check (DMM916)
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 listed in Table 8. 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 8: 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	
Thermocouple adapter	K Type	Tektronix ATK01
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.*

Set the auto power off time to a large value or disable the auto power off by pushing the Blue button when turning the dial from the OFF position.

---

3. Warm up the multimeter for five minutes.
4. Set the Digits to the 40,000 counts display.
5. Pages 19 through 33 contain test records for the DMM91X series multimeters. Each model has its own test record. Photocopy the test record pages for your model to record your test results.

***NOTE**. If stability of the display reading causes questionable accuracy of a test, set the multimeter to Average mode.*

Verification Procedure

Implement the following checks to verify the performance of your DMM91X Series 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 °C 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⎓.
2. Connect the calibrator outputs to the multimeter °C 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.

DC Millivolts Check

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

1. Set the multimeter dial to mV⎓.
2. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
3. Set the calibrator to each of the values in the DC millivolt 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+DC Volts Check

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

1. Set the multimeter dial to AC+DC.
2. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
3. Set the calibrator to each of the values in the AC+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.

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 °C 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.

Duty Factor Check (DMM914 and DMM916)

Perform the following steps to verify the duty factor measurement accuracy.

1. Set the multimeter dial to Hz.
2. Push the BLUE button to select duty factor.
3. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
4. Set the calibrator to each of the values in the Duty factor 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.

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 °C 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.

Low Voltage Ω Check

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

1. Set the multimeter dial to Ω.
2. Push the BLUE button to select the LV mode.
3. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.
4. Set the calibrator to each of the values in the Low voltage Ω 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.

Continuity Check

Perform the following steps to verify the continuity check accuracy.

1. Set the multimeter dial to ·))).
2. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ 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 °C V Ω ⊣⊢ and COM input connectors of the multimeter.

7. Short the test leads together and check for proper operation.

Diode Check

Perform the following steps to verify the diode check accuracy.

1. Set the multimeter dial to ·))).

2. Push the BLUE button to select the diode test mode.

3. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.

4. Set the calibrator to each of the values in the Diode 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.

Capacitance Check

Perform the following steps to verify the capacitance measurement accuracy.

1. Set the multimeter dial to ⊣⊢.

2. Set the noise suppression to 60 Hz:

   a. Press the DMM SETUP key (repeatedly) until the upper display reads 5060.

   b. Set the main display to 60 Hz with the + and – keys.

3. Null the residual DMM and lead capacitance offset.

   a. Using Fluke 5500A or Wavetek 9100 minus the 9105 front porch:

      - Turn the calibrator output off.
      - Connect the test leads to the multimeter °C V Ω ⊣⊢ and COM inputs.
      - Connect the multimeter COM lead to the calibrator common output.
      - Press the multimeter gold key followed by the Δ/% key.
      - Connect the multimeter °C V Ω ⊣⊢ lead to the remaining calibrator output.
      - Turn the calibrator output on.

b. Using Wavetek 9100 with 9105 front porch:

- Turn the calibrator output off.
- Connect the multimeter test leads to the calibrator outputs.
- Connect the calibrator common lead to the multimeter COM input.
- Press the multimeter gold key followed by the Δ/% key.
- Connect the remaining calibrator output lead to the multimeter °C V Ω ⊣⊢ input.
- Turn the calibrator output on.

4. 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.

5. Turn the calibrator output off.

6. Disconnect the calibrator from the multimeter.

Temperature Check (DMM914 and DMM916)

Perform the following steps to verify the temperature measurement accuracy.

1. Set the multimeter dial to °C / °F.

2. Connect the ATK01 thermocouple adapter to the multimeter °C V Ω ⊣⊢ and COM input connectors.

3. Connect the Standard thermocouple (K type) of the calibrator to the ATK01 thermocouple adapter.

4. Allow five minutes for the connector temperature to stabilize.

5. Set the calibrator to each of the values in the Temperature test record and verify that the multimeter reads within the specified Display minimum and maximum limits.

6. Turn the calibrator output off.

7. Disconnect the calibrator from the multimeter.

Volts Peak Hold Check (DMM916)

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

1. Set the multimeter dial to V⎓.

2. Push the GOLD button and then the M/M/A button to select PEAK H.

3. Connect the calibrator outputs to the multimeter °C V Ω ⊣⊢ and COM input connectors.

4. Set the calibrator to each of the values in the Volts peak hold 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 µA≂ or mA≂ as needed.

2. Connect the calibrator outputs to the multimeter µA 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 µA≂ or mA≂ as needed.

2. Push the BLUE button to select AC mode.

3. Connect the calibrator outputs to the multimeter µA 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 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.

DMM912 Test Record

Serial number	Procedure performed by	Date

DMM912 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC volts test[1,2]					
3.6000 V	60 Hz	±1.0% + 40 counts	3.5600 V		3.6400 V
	1 kHz	±2.5% + 40 counts	3.5060 V		3.6940 V
36.000 V	60 Hz	±1.0% + 40 counts	35.600 V		36.400 V
	1 kHz	±2.5% + 40 counts	35.060 V		36.940 V
360.00 V	60 Hz	±1.0% + 40 counts	356.00 V		364.00 V
	1 kHz	±2.5% + 40 counts	350.60 V		369.40 V
750.0 V[3]	60 Hz	±1.0% + 40 counts	738.5 V		761.5 V

[1] **Verify proper DMM range (5 display digits); use manual range if necessary. The 750 V range displays 4 digits.**

[2] **The upper display readout is ±2 counts corresponding to the input frequency.**

[3] **750 V range not specified above 100 Hz.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC volts test				
0.0000 V	±0.2% + 10 counts	–0.0010 V		0.0010 V
3.6000 V	±0.2% + 10 counts	3.5918 V		3.6082 V
–3.6000 V	±0.2% + 10 counts	–3.6082 V		–3.5918 V
36.000 V	±0.2% + 10 counts	35.918 V		36.082 V
360.00 V	±0.2% + 10 counts	359.18 V		360.82 V
1000.0 V	±0.2% + 10 counts	997.0 V		1003.0 V
–1000.0 V	±0.2% + 10 counts	–1003.0 V		–997.0 V
DC millivolts test				
0.00 mV	±0.2% + 10 counts	–0.10 mV		0.10 mV
40.00 mV	±0.2% + 10 counts	39.82 mV		40.18 mV
360.00 mV	±0.2% + 10 counts	359.18 mV		360.82 mV
–360.00 mV	±0.2% + 10 counts	–360.82 mV		–359.18 mV

DMM912 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
AC+DC volts test[1]					
–1.000 V	DC	±2.2% +14 counts	0.964 V		1.036 V
1.000 V	DC	±2.2% +14 counts	0.964 V		1.036 V
1.000 V	60 Hz	±2.2% +14 counts	0.964 V		1.036 V

[1] **4000 count mode only.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Frequency test					
20.00 Hz[1]	1 $V_{p\text{-}p}$	±0.01% + 10 counts	19.90 Hz		20.10 Hz
100.00 Hz[1]	1 $V_{p\text{-}p}$	±0.01% + 10 counts	99.89 Hz		100.11 Hz
1.0000 kHz[1]	1 $V_{p\text{-}p}$	±0.01% + 10 counts	.9989 kHz		1.0011 kHz
10.000 kHz[1]	1 $V_{p\text{-}p}$	±0.01% + 10 counts	9.989 kHz		10.011 kHz
100.00 kHz[1]	1 $V_{p\text{-}p}$	±0.01% + 10 counts	99.89 kHz		100.11 kHz
1.0000 MHz[1,2]	1 $V_{p\text{-}p}$	±0.15% + 10 counts	0.9975 MHz		1.0025 MHz

[1] **Select Frequency mode if using the Wavetek 9100; set the amplitude to 1 V. Select the square wave AC mode if using the Fluke 5500A; set the amplitude to 1.000 V.**

[2] **Select the sine wave AC mode if using the Fluke 5500A; set the amplitude to 0.354 V.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Ω test				
0.00 Ω[1]	±0.5% + 10 counts	–0.10 Ω		0.10 Ω
360.00 Ω[1]	±1% + 10 counts	356.30 Ω		363.70 Ω
3.6000 kΩ	±0.5% + 10 counts	3.5810 kΩ		3.6190 kΩ
36.000 kΩ	±0.5% + 10 counts	35.810 kΩ		36.190 kΩ
360.00 kΩ	±0.5% + 10 counts	358.10 kΩ		361.90 kΩ
3.6000 MΩ	±1% + 10 counts	3.5630 MΩ		3.6370 MΩ
20.00 MΩ[2]	±5% + 10 counts	18.90 MΩ		21.10 MΩ

[1] **To test these values with the Fluke 5500A, apply 0.0 Ω and set the DMM to Delta mode.**

[2] **4,000 count mode only.**

DMM912 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Low voltage Ω test[1]				
3.600 kΩ[2]	±1% + 1 count	3.563 kΩ		3.637 kΩ
36.00 kΩ	±1% + 1 count	35.63 kΩ		36.37 kΩ
360.0 kΩ	±1% + 1 count	356.3 kΩ		363.7 kΩ
3.600 MΩ	±1% + 1 count	3.563 MΩ		3.637 MΩ

[1] **4000 count mode only.**

[2] **Use DMM manual ranging or set calibrator to 3.0 kΩ before selecting 3.6kΩ.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Continuity test				
0.0 Ω	–	Beeper sounds		
150 Ω	–	Beeper does not sound		
Multimeter leads shorted	–	Beeper sounds		
Diode test				
0.5 V	–	0.400 V		0.600 V
Capacitance test[1,2]				
3.600 nF	±1% + 10 counts	3.554 nF		3.646 nF
36.00 nF	±1% + 10 counts	35.54 nF		36.46 nF
360.0 nF	±1% + 10 counts	355.4 nF		364.6 nF
3.600 µF	±1% + 10 counts	3.554 µF		3.646 µF
36.00 µF	±3% + 10 counts	34.82 µF		37.18 µF
360.00 µF[3]	±3% + 10 counts	348.2 µF		371.8 µF
3.600 mF[3]	±3% + 10 counts	3.482 mF		3.718 mF
36.00 mF[3]	±3% + 10 counts	34.82 mF		37.18 mF

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

[2] **Set the DMM to Delta mode. Delta mode removes stray capacitance for low capacitance measurements.**

[3] **Set the DMM noise suppression to 60 Hz with the SETUP mode. See Page 15 for detailed instructions.**

DMM912 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
DC milliampere test				
0.0 μA	±10 counts	–1.0 μA		1.0 μA
360.0 μA	±0.5% + 10 counts	357.2 μA		362.8 μA
–360.0 μA	±0.5% + 10 counts	–362.8 μA		–357.2 μA
3600.0 μA	±0.5% + 10 counts	3581.0 μA		3619.0 μA
36.00 mA	±0.5% + 10 counts	35.72 mA		36.28 mA
360.00 mA	±0.5% + 10 counts	358.10 mA		361.90 mA
AC milliampere test (60 Hz)				
3600.0 μA	±1.2% + 80 counts	3548.8 μA		3651.2 μA
360.00 mA	±1.2% + 80 counts	354.88 mA		365.12 mA
DC ampere test				
10.000 A	0.5% + 10 counts	9.940 A		10.060 A
AC ampere test (60 Hz)				
10.000 A	±1.2% + 80 counts	9.800 A		10.200 A

DMM914 Test Record

Serial number	Procedure performed by	Date

DMM914 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC volts test[1,2]					
3.6000 V	60 Hz	±0.8% + 40 counts	3.5672 V		3.6328 V
	500 Hz	±2.0% + 40 counts	3.5240 V		3.6760 V
	10 kHz	±3.5% + 40 counts	3.4700 V		3.7300 V
36.000 V	500 Hz	±2.0% + 40 counts	35.240 V		36.760 V
	10 kHz	±3.5% + 40 counts	34.700 V		37.300 V
360.00 V	500 Hz	±2.0% + 40 counts	352.40 V		367.60 V
	10 kHz	±3.5% + 40 counts	347.00 V		373.00 V
750.0 V[3]	60 Hz	±0.8% + 40 counts	740.0 V		760.0 V

1 **Verify the proper DMM range (5 display digits); use the manual range if necessary. The 750 V range displays 4 digits.**

2 **The upper display readout is ±2 counts corresponding to the input frequency.**

3 **750 V range not specified above 100 Hz.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC volts test				
0.0000 V	±0.1% + 10 counts	–0.0010 V		0.0010 V
3.6000 V	±0.1% + 10 counts	3.5954 V		3.6046 V
–3.6000 V	±0.1% + 10 counts	–3.6046 V		–3.5954 V
36.000 V	±0.1% + 10 counts	35.954 V		36.046 V
360.00 V	±0.1% + 10 counts	359.54 V		360.46 V
1000.0 V	±0.1% + 10 counts	998.0 V		1002.0 V
–1000.0 V	±0.1% + 10 counts	–1002.0 V		–998.0 V

DMM914 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
DC millivolts test					
0.00 mV		±0.1% + 10 counts	–0.10 mV		0.10 mV
40.00 mV		±0.1% + 10 counts	39.86 mV		40.14 mV
360.00 mV		±0.1% + 10 counts	359.54 mV		360.46 mV
–360.00 mV		±0.1% + 10 counts	–360.46 mV		–359.54 mV
AC+DC volts test[1]					
–1.000 V	DC	±2.0% +14 counts	0.966 V		1.034 V
1.000 V	DC	±2.0% +14 counts	0.966 V		1.034 V
1.000 V	60 Hz	±2.0% +14 counts	0.966 V		1.034 V

[1] **4000 count mode only.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Frequency test					
20.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	19.90 Hz		20.10 Hz
100.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 Hz		100.11 Hz
1.0000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	.9989 kHz		1.0011 kHz
10.000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	9.989 kHz		10.011 kHz
100.00 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 kHz		100.11 kHz
1.0000 MHz[1,2]	1 V_{p-p}	±0.15% + 10 counts	0.9975 MHz		1.0025 MHz

[1] **Select Frequency mode if using the Wavetek 9100; set the amplitude to 1 V. Select the square wave AC mode if using the Fluke 5500A; set the amplitude to 1.000 V.**

[2] **Select the sine wave AC mode if using the Fluke 5500A; set the amplitude to 0.354 V.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Duty factor test					
50.0	5 V, 1 kHz squarewave	±0.15%	49.9		50.1
90.0	5 V, 1 kHz squarewave	±0.15%	89.9		90.1
10.0	5 V, 1 kHz squarewave	±0.15%	9.9		10.1

DMM914 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Ω test				
0.0000 Ω[1]	±0.4% + 10 counts	–0.1000 Ω		0.1000 Ω
360.00 Ω[1]	±0.8% + 10 counts	357.02 Ω		362.98 Ω
3.6000 kΩ	±0.4% + 10 counts	3.5846 kΩ		3.6154 kΩ
36.000 kΩ	±0.4% + 10 counts	35.846 kΩ		36.154 kΩ
360.00 kΩ	±0.4% + 10 counts	358.46 kΩ		361.54 kΩ
3.6000 MΩ	±0.8% + 10 counts	3.5702 MΩ		3.6298 MΩ
20.00 MΩ[2]	±5% + 10 counts	18.90 MΩ		21.10 MΩ

1 **To test these values with the Fluke 5500A, apply 0.0 Ω and set the DMM to Delta mode.**

2 **4,000 count mode only.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Low voltage Ω test[1]				
3.600 kΩ[2]	±0.8% + 1 count	3.570 kΩ		3.630 kΩ
36.00 kΩ	±0.8% + 1 count	35.70 kΩ		36.30 kΩ
360.0 kΩ	±0.8% + 1 count	357.0 kΩ		363.0 kΩ
3.600 MΩ	±0.8% + 1 count	3.570 MΩ		3.630 MΩ

1 **4000 count mode only.**

2 **Use DMM manual ranging or set calibrator to 3.0 kΩ before selecting 3.6k Ω.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Continuity test				
0.0 Ω	–	Beeper sounds		
150 Ω	–	Beeper does not sound		
Multimeter leads shorted	–	Beeper sounds		
Diode test				
0.5 V	–	0.400 V		0.600 V

DMM914 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Capacitance test[1,2]				
3.600 nF	±1% + 10 counts	3.554 nF		3.646 nF
36.00 nF	±1% + 10 counts	35.54 nF		36.46 nF
360.0 nF	±1% + 10 counts	355.4 nF		364.6 nF
3.600 µF	±1% + 10 counts	3.554 µF		3.646 µF
36.00 µF	±3% + 10 counts	34.82 µF		37.18 µF
360.00 µF[3]	±3% + 10 counts	348.2 µF		371.8 µF
3.600 mF[3]	±3% + 10 counts	3.482 mF		3.718 mF
36.00 mF[3]	±3% + 10 counts	34.82 mF		37.18 mF

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

2 **Set the DMM to Delta mode. Delta mode removes stray capacitance for low capacitance measurements.**

3 **Set the DMM noise suppression to 60 Hz with the SETUP mode. See Page 15 for detailed instructions.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Temperature test				
0.0° C	±2° C	–2.0		2.0
–40.0° C	±2° C	–42.0		–38.0
100.0° C	±2° C	98.0		102.0
950.0° C	±2° C	948.0		952.0
DC milliampere test				
0.0 µA	±10 counts	–1.0 µA		1.0 µA
360.0 µA	±0.4% + 10 counts	357.6 µA		362.4 µA
–360.0 µA	±0.4% + 10 counts	–362.4 µA		–357.6 µA
3600.0 µA	±0.4% + 10 counts	3584.6 µA		3615.4 µA
36.00 mA	±0.4% + 10 counts	35.76 mA		36.24 mA
360.00 mA	±0.4% + 10 counts	358.46 mA		361.54 mA

DMM914 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
AC milliampere test (60 Hz)[1]				
3600.0 μA	±0.9% + 80 counts	3559.6 μA		3640.4 μA
360.00 mA	±0.9% + 80 counts	355.96 mA		364.04 mA

1 **The upper display readout is 60 Hz ±2 counts corresponding to the input frequency.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC ampere test				
10.000 A	±0.4% + 10 counts	9.950 A		10.050 A
AC ampere test (60 Hz)[1]				
10.000 A	±0.9% + 80 counts	9.830 A		10.170 A

1 **The upper display readout is 60 Hz ±2 counts corresponding to the input frequency.**

DMM916 Test Record

Serial number	Procedure performed by	Date

DMM916 test record

Test input		Tolerance	Display minimum	Reading	Display maximum
AC volts test[1,2]					
3.6000 V	60 Hz	±0.7% + 40 counts	3.5708 V		3.6292 V
	500 Hz	±1.5% + 40 counts	3.5420 V		3.6580 V
	10 kHz	±2.5% + 40 counts	3.5060 V		3.6940 V
36.000 V	500 Hz	±1.5% + 40 counts	35.420 V		36.580 V
	10 kHz	±2.5% + 40 counts	35.060 V		36.940 V
360.00 V	500 Hz	±1.5% + 40 counts	354.20 V		365.80 V
	10 kHz	±2.5% + 40 counts	350.60 V		369.40 V
750.0 V[3]	60 Hz	±0.7% + 40 counts	740.7 V		759.3V

1 **Verify the proper DMM range (5 display digits); use the manual range if necessary. The 750 V range displays 4 digits.**

2 **The upper display readout is ±2 counts corresponding to the input frequency.**

3 **750 V range not specified above 100 Hz.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC volts test				
0.0000 V	±0.06% + 10 counts	–0.0010 V		0.0010 V
3.6000 V	±0.06% + 10 counts	3.5969 V		3.6031 V
–3.6000 V	±0.06% + 10 counts	–3.6031 V		–3.5969 V
36.000 V	±0.06% + 10 counts	35.969 V		36.031 V
360.00 V	±0.06% + 10 counts	359.69 V		360.31 V
1000.0 V	±0.06% + 10 counts	998.4 V		1001.6 V
–1000.0 V	±0.06% + 10 counts	–1001.6 V		–998.4 V

DMM916 test record (cont.)

Test input		Tolerance	Display minimum	Reading	Display maximum
DC millivolts test					
0.00 mV		±0.06% + 10 counts	–0.10 mV		0.10 mV
40.00 mV		±0.06% + 10 counts	39.88 mV		40.12 mV
360.00 mV		±0.06% + 10 counts	359.69 mV		360.31 mV
–360.00 mV		±0.06% + 10 counts	–360.31 mV		–359.69 mV

Test input		Tolerance	Display minimum	Reading	Display maximum
AC+DC volts test[1]					
–1.000 V	DC	±1.9% +14 counts	0.967 V		1.033 V
1.000 V	DC	±1.9% +14 counts	0.967 V		1.033 V
1.000 V	60 Hz	±1.9% +14 counts	0.967 V		1.033 V

1 **4000 count mode only.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Frequency test					
20.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	19.90 Hz		20.10 Hz
100.00 Hz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 Hz		100.11 Hz
1.0000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	.9989 kHz		1.0011 kHz
10.000 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	9.989 kHz		10.011 kHz
100.00 kHz[1]	1 V_{p-p}	±0.01% + 10 counts	99.89 kHz		100.11 kHz
1.0000 MHz[1,2]	1 V_{p-p}	±0.15% + 10 counts	0.9975 MHz		1.0025 MHz

1 **Select Frequency mode if using the Wavetek 9100; set the amplitude to 1 V. Select the square wave AC mode if using the Fluke 5500A; set the amplitude to 1.000 V.**

2 **Select the sine wave AC mode if using the Fluke 5500A; set the amplitude to 0.354 V.**

Test input		Tolerance	Display minimum	Reading	Display maximum
Duty factor test					
50.0	5 V, 1 kHz squarewave	±0.15%	49.9		50.1
90.0	5 V, 1 kHz squarewave	±0.15%	89.9		90.1
10.0	5 V, 1 kHz squarewave	±0.15%	9.9		10.1

DMM916 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Ω test				
0.0000 Ω[1]	±0.3% + 10 counts	–0.1000 Ω		0.1000 Ω
360.00 Ω[1]	±0.6% + 10 counts	357.74 Ω		362.26 Ω
3.6000 kΩ	±0.3% + 10 counts	3.5882 kΩ		3.6118 kΩ
36.000 kΩ	±0.3% + 10 counts	35.882 kΩ		36.118 kΩ
360.00 kΩ	±0.3% + 10 counts	358.82 kΩ		361.18 kΩ
3.6000 MΩ	±0.6% + 10 counts	3.5774 MΩ		3.6226 MΩ
20.00 MΩ[2]	±5% + 10 counts	18.90 MΩ		21.10 MΩ

[1] **To test these values with the Fluke 5500A, apply 0.0 Ω and set the DMM to Delta mode.**

[2] **Verify the DMM is in the 4,000 count mode for this test.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Low voltage Ω test[1]				
3.600 kΩ[2]	±0.6% + 1 count	3.577 kΩ		3.623 kΩ
36.00 kΩ	±0.6% + 1 count	35.77 kΩ		36.23 kΩ
360.0 kΩ	±0.6% + 1 count	357.7 kΩ		362.3 kΩ
3.600 MΩ	±0.6% + 1 count	3.577 MΩ		3.623 MΩ

[1] **4000 count mode only.**

[2] **Use DMM manual ranging or set calibrator to 3.0 kΩ before selecting 3.6kΩ.**

Test input	Tolerance	Display minimum	Reading	Display maximum
Continuity test				
0.0 Ω	–	Beeper sounds		
150 Ω	–	Beeper does not sound		
Multimeter leads shorted	–	Beeper sounds		
Diode test				
0.5 V	–	0.400 V		0.600 V

DMM916 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
Capacitance test[1,2]				
3.600 nF	±1% + 10 counts	3.554 nF		3.646 nF
36.00 nF	±1% + 10 counts	35.54 nF		36.46 nF
360.0 nF	±1% + 10 counts	355.4 nF		364.6 nF
3.600 μF	±1% + 10 counts	3.554 μF		3.646 μF
36.00 μF	±3% + 10 counts	34.82 μF		37.18 μF
360.00 μF[3]	±3% + 10 counts	348.2 μF		371.8 μF
3.600 mF[3]	±3% + 10 counts	3.482 mF		3.718 mF
36.00 mF[3]	±3% + 10 counts	34.82 mF		37.18 mF

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

2 Set the DMM to Delta mode. Delta mode removes stray capacitance for low capacitance measurements.

3 Set the DMM noise suppression to 60 Hz with the SETUP mode. See Page 15 for detailed instructions.

Test input	Tolerance	Display minimum	Reading	Display maximum
Temperature test				
0.0° C	±2° C	–2.0		2.0
–40.0° C	±2° C	–42.0		–38.0
100.0° C	±2° C	98.0		102.0
950.0° C	±2° C	948.0		952.0

Test input		Tolerance	Display minimum	Reading	Display maximum
Volts peak hold test					
1 V_{RMS} (60 Hz, 1.414 V_p)	MAX	±5% + 40 counts	1.303 V		1.524 V
1 V_{RMS} (60 Hz, 1.414 V_p)	MIN	±5% + 40 counts	–1.524 V		–1.303 V

Test input	Tolerance	Display minimum	Reading	Display maximum
DC milliampere test				
0.0 μA	±10 counts	–1.0 μA		1.0 μA
360.0 μA	±0.3% + 10 counts	358.0 μA		362.0 μA
–360.0 μA	±0.3% + 10 counts	–362.0 μA		–358.0 μA
3600.0 μA	±0.3% + 10 counts	3588.2 μA		3611.8 μA
36.00 mA	±0.3% + 10 counts	35.80 mA		36.20 mA
360.00 mA	±0.3% + 10 counts	358.82 mA		361.18 mA

DMM916 test record (cont.)

Test input	Tolerance	Display minimum	Reading	Display maximum
AC milliampere test (60 Hz)[1]				
3600.0 μA	±0.9% + 80 counts	3559.6 μA		3640.4 μA
360.00 mA	±0.9% + 80 counts	355.96 mA		364.04 mA

1 **The upper display readout is 60 Hz ±2 counts corresponding to the input frequency.**

Test input	Tolerance	Display minimum	Reading	Display maximum
DC ampere test				
10.000 A	±0.3% + 10 counts	9.960 A		10.040 A
AC ampere test (60 Hz)[1]				
10.000 A	±0.9% + 80 counts	9.830 A		10.170 A

1 **The upper display readout is 60 Hz ±2 counts corresponding to the input frequency.**

DMM912, 914, and 916 Adjustment Procedures

This section contains procedures to adjust DMM912, DMM914, and DMM916 multimeters. Perform these procedures once a year or if the *DMM912*, DMM914, and DMM916 *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 *DMM912*, DMM914, and DMM916 *Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 9 to return DMM91X Series multimeters to factory calibration.

Table 9: DMM91X series adjustments

Adjustments Part 1	
	DC Volts
	AC Volts
	Capacitance
	Temperature (DMM914 and DMM916)
	DC Milliamperes
	DC Amperes
Adjustments Part 2	
	AC Response

Test Equipment

The test equipment listed in Table 8 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 8. If you substitute equipment, you may need to modify the procedures.

Preparation for Adjustment

The following guidelines apply to all DMM91X Series 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. See Figure 2 for details.

To reassemble the multimeter following the adjustments, see page 42.

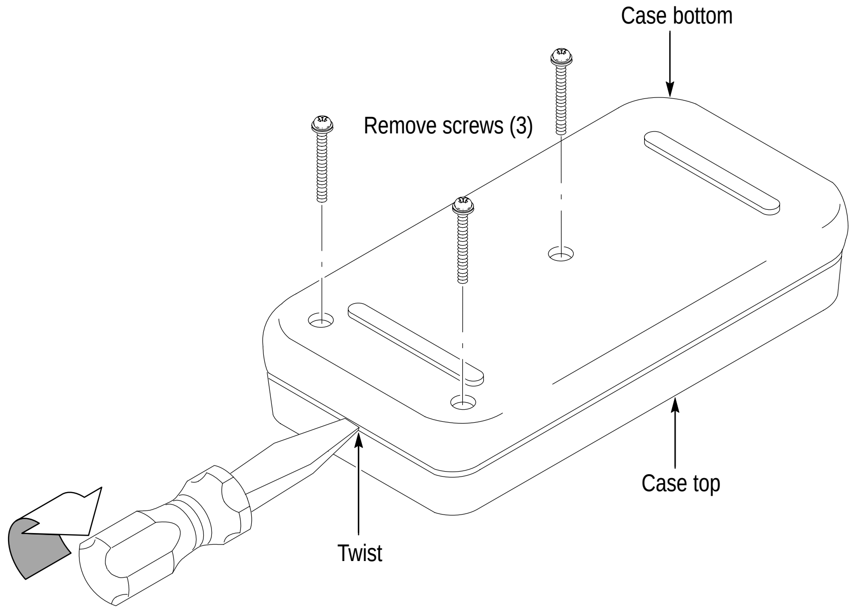


Figure 2: Opening the meter case

Adjustments Part 1

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

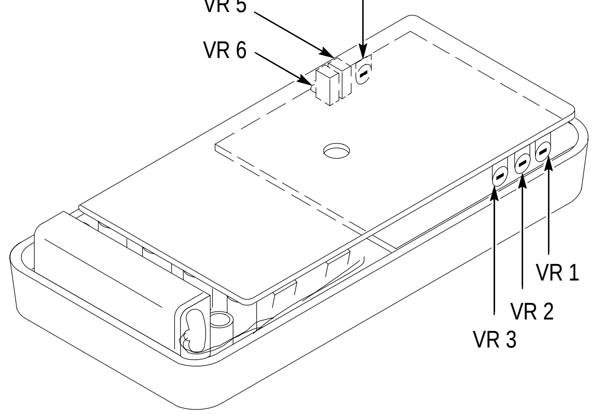


Figure 3: Adjustment locations 1

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 °C V Ω ⊣⊢ and COM input connectors of the multimeter.
3. Set the calibrator to output 3.0000 VDC.
4. Adjust VR5 until the display shows 2.9999 to 3.0001 VDC.
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 at 60 Hz.

1. Set the multimeter dial to V~.
2. Connect the outputs of the calibrator to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
3. Set the calibrator to output 2.0000 VAC at 60 Hz.
4. Adjust VR6 until the display shows 1.9999 to 2.0001 VAC.

5. Turn the calibrator output off.
6. Disconnect the calibrator from the multimeter.

Capacitance

Perform the following steps to adjust the capacitance calibration.

1. Set the multimeter dial to ⊣⊢.
2. Null the residual DMM and lead capacitance offset.
   a. Using Fluke 5500A or Wavetek 9100 minus the 9105 front porch:
      - Turn the calibrator output off.
      - Connect the test leads to the multimeter °C V Ω ⊣⊢ and COM inputs.
      - Connect the multimeter COM lead to the calibrator common output.
      - Press the multimeter gold key followed by the Δ/% key.
      - Connect the multimeter °C V Ω ⊣⊢ lead to the remaining calibrator output.
      - Turn the calibrator output on.
   b. Using Wavetek 9100 with 9105 front porch:
      - Turn the calibrator output off.
      - Connect the multimeter test leads to the calibrator outputs.
      - Connect the calibrator common lead to the multimeter COM input.
      - Press the multimeter gold key followed by the Δ/% key.
      - Connect the remaining calibrator output lead to the multimeter °C V Ω ⊣⊢ input.
      - Turn the calibrator output on.
3. Set the calibrator to output 300 nF.
4. Adjust VR2 until the display shows 299.9 to 300.1 nF.
5. Set the calibrator to output 1.000 μF.
6. Adjust VR3 until the display shows 0.999 to 1.001 μF.
7. Set the calibrator to output 100.0 μF.
8. Adjust VR1 until the display shows 99.9 to 100.1 μF.

9. Turn the calibrator output off.
10. Disconnect the calibrator from the multimeter.

Temperature (DMM914 and DMM916)

Perform the following steps to adjust the temperature calibration.

1. Set the multimeter dial to °C / °F.
2. Connect the thermocouple adapter ATK01 to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
3. Set the calibrator to output 18.6° C.
4. Connect a K-type thermocouple from the calibrator output to the ATK01 thermocouple adapter.
5. Allow five minutes of settling time for a stable reading.
6. Adjust VR4 until the display shows 18.5° to 18.7 °C.
7. Turn the calibrator output off.
8. Disconnect the calibrator from the multimeter.

DC Milliamperes

Perform the following steps to adjust the DC milliamperes calibration.

1. Set the multimeter dial to mA≂.
2. Connect the outputs of the calibrator to the μA mA and COM input connectors of the multimeter.
3. Set calibrator to output 100.0 mA.
4. Press and hold the gold button for five seconds. (The multimeter beeps twice when the gold button is first pressed and then two more beeps follow after five seconds.)
5. Press the SETUP button and wait for the calibration to finish (CAL is displayed during the calibration). After the calibration is completed, press EXIT SETUP (blue button).
6. Turn the calibrator output off.
7. Disconnect the calibrator from the multimeter.

DC Amperes

Perform the following steps to adjust the DC amperes calibration.

1. Set the multimeter dial to A≂.
2. Connect the calibrator outputs to the multimeter A and COM inputs.

3. Set calibrator to output 10.00 A.
4. Press and hold the gold button for five seconds. (The multimeter beeps twice when the gold button is first pressed and then two more beeps follow after five seconds.)
5. Press the SETUP button and wait for the calibration to finish (CAL is displayed during the calibration). After the calibration is completed, press EXIT SETUP (blue button).
6. Turn the calibrator output off.
7. Disconnect the calibrator from the multimeter.

Adjustments Part 2

To perform the following procedure, you must lift out the entire circuit board assembly from the top case half to access the adjustments. Perform this procedure only if the *Performance Verification* procedure indicates that the AC voltage accuracy checks above 60 Hz is out of specification.

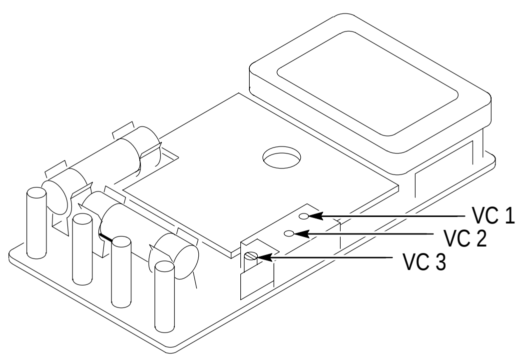


Figure 4: Adjustment locations 2

AC Response

Perform the following steps to adjust the AC voltage calibration above 60 Hz.

1. Set the multimeter dial to V~.
2. Lift the circuit board assembly out of the top case half.
3. Connect the outputs of the calibrator to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
4. Set calibrator to output 100 VAC at 10 kHz (sinewave).
5. Adjust VC3 until the display shows +98.60 V.

6. Set the calibrator frequency to 500 Hz (sinewave).
7. Confirm that the reading is less than 100.60 V. Repeat step 5 if necessary.
8. Set the calibrator frequency to 1 kHz (sinewave).
9. Confirm that the reading is less than 104.0 V. Repeat step 5 if necessary.

NOTE. *Steps 10 through 17 do not apply to the DMM912.*

10. Set the calibrator to output 20 VAC at 10 kHz (sinewave).
11. Adjust VC1 until the display shows 19.700 V.
12. Set the calibrator frequency to 500 Hz (sinewave).
13. Confirm that the reading is less than 20.110 V. Repeat step 11 if necessary.
14. Set the calibrator to output 2 VAC at 10 kHz (sinewave).
15. Adjust VC2 until the display shows 1.9700 V.
16. Set the calibrator frequency to 500 Hz (sinewave).
17. Confirm that the reading is less than 2.011 V. Repeat step 15 if necessary.
18. Turn the calibrator output off.
19. 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.

Instructions Manual

Tektronix

DTM500 Series
Digital Thermometers

070-9852-01

Table of Contents

DTM500 Series Digital Thermometers

The Tektronix DTM510 and DTM520 are hand-held digital thermometers that can measure temperature using a variety of thermocouple probes. A K-type surface measurement bead probe comes standard with both instruments.

The DTM510 thermometer uses a single K-type probe; the DTM520 uses K- or J-type probes. The DTM520 thermometer has inputs for two probes and can perform differential measurements.

In addition, the thermometers include the following features:

- Temperature display in °C or °F
- A hold feature to freeze the display
- MIN and MAX readouts (DTM510 thermometer includes MAX only)
- A stopwatch (DTM520 only)

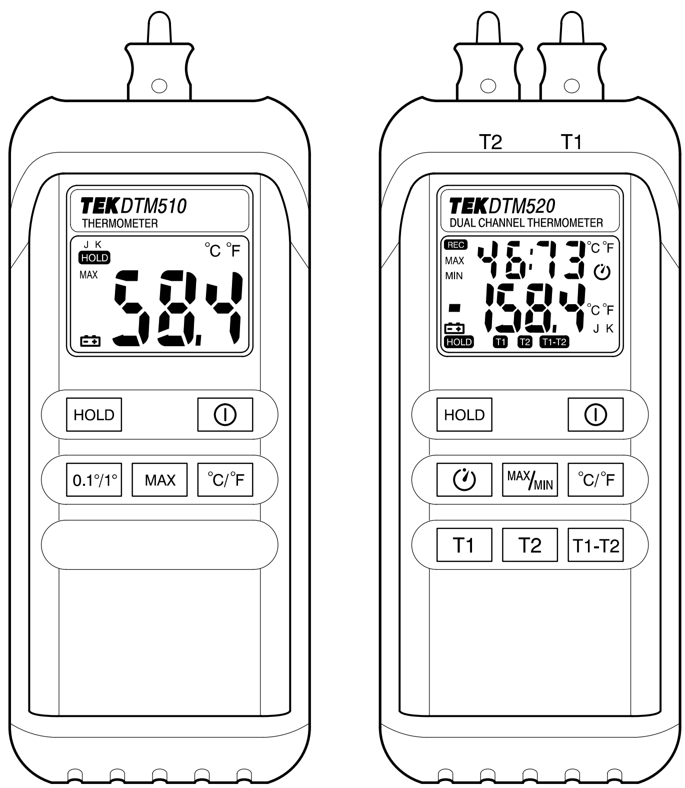


Figure 1: DTM510 & DTM520 digital thermometers

DTM500 Series Specifications

The characteristics listed in this section apply under the following conditions:

- The instrument operates in an 18° to 28° C ambient environment unless otherwise noted.
- The instrument warms up for 60 minutes.

***NOTE**. All specifications are warranted unless marked "typical." Typical characteristics are not guaranteed but are provided for the convenience of the user.*

Specifications marked with the ✓ symbol are checked in the performance verification procedures.

Table 1: General characteristics

Characteristic	Description		
Product	Measurement Range		
DTM510	–50° to 1300° C (–58° to 1999° F)		
DTM520 (K-type probe)	–200° to 1370° C (–328° to 2498° F)		
DTM520 (J-type probe)	–200° to 760° C (–328° to 1400° F)		
✓Accuracy	Temperature Range	Resolution	% of Reading
DTM510	–50° to 199.9° C	0.1° C	±(0.2% + 1° C)
	–58° to 391° F	0.1° F	±(0.2% + 2° F)
	–50° to 199.9° C	1° C	±(0.3% + 2° C)
	–58° to 391° F	1° F	±(0.3% + 4° F)
	200° to 999.9° C	1° C	±(0.4% + 2° C)
	392° to 1831° F	1° F	±(0.4% + 4° F)
	1000° to 1300° C	1° C	±(0.6% + 2° C)
	1832° to 1999° F	1° F	±(0.6% + 4° F)

Table 1: General characteristics (cont.)

Characteristic	Description		
✓ Accuracy	Temperature range	Resolution	% of reading
DTM520 (K-type probe)	–200° to –100° C	0.1° C	±(0.3% + 1° C)
	–328° to –148° F	0.2° F	±(0.3% + 2° F)
	–99.9° to 999.9° C	0.1° C	±(0.1% + 0.7° C)
	–147.9° to 999.9° F	0.2° F	±(0.1% + 1.4° F)
	1000° to 1370° C	1° C	±(0.3% + 1° C)
	1000° to 2498° F	2° F	±(0.3% + 2° F)
	T1 – T2 reading	—	±(0.3% + 2.2° C)
✓ Accuracy	Temperature range	Resolution	% of reading
DTM520 (J-type probe)	–200° to –100° C	0.1° C	±(0.3% + 1.1° C)
	–328° to –148° F	0.2° F	±(0.3% + 2.2° F)
	–99.9° to 760° C	0.1° C	±(0.1% + 0.8° C)
	–147.9° to 999.9° F	0.2° F	±(0.1% + 1.6° F)
	1000° to 1400° F	2° F	±(0.3% + 2° F)

Table 2: General characteristics

Characteristic	Description
Temperature Range	ATP01 bead probe: –40° to 204° C
Probe Tolerance	ATP01 bead probe: ±2.2° C
Measurement Rate (Readings/second)	
DTM510	2.5
DTM520 (T2 or T1)	1
DTM520 (T1 – T2)	0.5
Input Protection	24 V maximum. Class III as defined in IEC 1010, Safety Requirements for Electrical equipment for measurement, control, and laboratory use. Class III equipment is equipment for connection to SELV or SELV-E circuits only.
Electrical Isolation T1 to T2	20 kΩ minimum

Table 3: Environmental characteristics

Characteristic	Description
Temperature coefficient <18° C or >28° C	
DTM510	0.15 × (specified accuracy) per °C
DTM520	0.1 × (specified accuracy) per °C
Operating temperature	0° to 50° C (32° to 122° F) at 0% to 75% RH
Storage temperature	–20° to 60° C (–4° to 140° F) at 0% to 80% RH
Power requirements	Single standard 9 V battery (ANSI/NEDA 1604A, IEC 6F22)
Battery life (Alkaline)	
DTM510	250 hours
DTM520	90 hours

DTM500 Series Performance Verification

This section contains procedures to verify that the DTM510 and DTM520 thermometers perform as warranted. If an instrument fails any of the checks, it needs adjustment and or repair. Verify the performance of your thermometer annually or whenever its accuracy or function is in question.

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

- The instrument operates in an 18° to 28° C ambient environment with a relative humidity of less than 80%.
- The instrument warms up for 60 minutes.
- The instrument remains fully assembled (do not remove the bottom cover).

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 4. 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 4: Performance verification test equipment

Description	Minimum requirements	Example product
Thermocouple Simulator	–200° to1370° C ±0.01% (–328° to 2498° F ±0.01%)	Wavetek 9100 Universal Calibration System or Fluke 5500A Calibrator

Set Up

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

1. Warm up the thermometer for 60 minutes.
2. Photocopy the test record for your model on pages 9 through 12 to record your test results.

Verification Procedure

Implement the following tests to verify the temperature measurement accuracy of your DTM510 or DTM520 thermometer.

1. Connect the thermocouple simulator output to the temperature probe input. For the DTM520, connect the simulator to the T1 input connector; then repeat the test using the T2 input connector.

***NOTE**. Thermocouple connectors are temperature sensitive. For best measurement accuracy, do not touch the connector contacts and minimize handling of the connector housings.*

2. Set the simulator to the correct probe type. The DTM510 thermometer uses a K-type probe. The DTM520 thermometer can use either a K- or J-type probe.
3. For each of the conditions specified in the test records, do the following:
   - **a.** Set the thermometer Resolution to 0.1° or 1° (DTM510 only).
   - **b.** Set the thermometer to measure °C or °F.
   - **c.** Set the calibrator to each of the temperature values shown in the test record; then verify that the thermometer display reads within the specified Display minimum and maximum limits.

DTM510 Test Record

Serial number	Procedure performed by	Date

DTM510 test record

Resolution	Temperature	Display minimum	Reading	Display maximum
0.1°	–48.0° C	–49.1°		–46.9°
	–30.0° C	–31.1°		–28.9°
	0.0° C	–01.0°		01.0°
	30.0° C	28.9°		31.1°
	50.0° C	48.9°		51.1°
	100.0° C	98.8°		101.2°
	–50.0° F	–52.1°		–47.9°
	–22.0° F	–24.0°		–20.0°
	0.0° F	–02.0°		02.0°
	190.0° F	187.6°		192.4°
1.0°	–48° C	–050°		–046°
	0° C	–002°		002°
	50° C	048°		052°
	200° C	197°		203°
	310° C	307°		313°
	700° C	695°		705°
	810° C	805°		815°
	945° C	939°		951°
	1280° C	1270°		1290°
	–50° F	–054°		–046°
	0° F	–004°		004°
	590° F	584°		596°
	1292° F	1283°		1301°
	1733° F	1722°		1744°
	1980° F	1964°		1996°

DTM520 Test Record

Serial number	Procedure performed by	Date

DTM520 test record

Probe type	Temperature	Display minimum	Reading	Display maximum
K	–198.0° C	–199.6°		–196.4°
	–99.0° C	–99.8°		–98.2°
	0.0° C	–0.7°		0.7°
	50.0° C	49.2°		50.8°
	500.0° C	498.8°		501.2°
	998.0° C	996.3°		999.7°
	1360° C	1355°		1365°
	–320° F	–323°		–317°
	–146° F	–147.5°		–144.5°
	0.0° F	–1.4°		1.4°
	100° F	98.5°		101.5°
	500° F	498.1°		501.9°
	990° F	987.6°		992.4°
	1980° F	1972°		1988°
	2480° F	2471°		2489°

DTM520 test record (cont.)

Probe type	Temperature	Display minimum	Reading	Display maximum
J	–198.0° C	–199.7°		–196.3°
	–99.0° C	–99.9°		–98.1°
	0.0° C	–0.8°		0.8°
	50.0° C	49.1°		50.9°
	100.0° C	99.1°		100.9°
	500.0° C	498.7°		501.3°
	755.0° C	753.4°		756.6°
	–320.0° F	–323.2°		–316.8°
	–146.0° F	–147.7°		–144.3°
	0.0° F	–1.6°		1.6°
	100.0° F	98.3°		101.7°
	500.0° F	497.9°		502.1°
	990.0° F	987.4°		992.6°
	1390° F	1384°		1396°

DTM500 Series Adjustment Procedures

This section contains procedures to adjust DTM510 and DTM520 thermometers. If your thermometer fails a performance requirement, use these procedures to return it to factory specifications.

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 thermometer meets factory specifications, implement the procedures in the *DTM500 Series Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 5 to return DTM510 and DTM520 thermometers to factory calibration.

Table 5: DTM510 and DTM520 adjustments

DTM510 Adjustment Procedure	
DTM520 Adjustment Procedure	
	2000 mV Calibration
	Gain Calibration
	0° C Calibration

Test Equipment

To ensure accurate adjustments, use the following or equivalent test equipment. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 6.

***NOTE**. Before making any adjustment, warm up the test equipment according to the manufacturer's recommendations.*

Table 6: Adjustment test equipment

Description	Minimum requirements	Examples
Thermocouple Simulator	–200 to1370° C ±0.01% (–328 to 2498° F ±0.01%)	Wavetek 9100 Universal Calibration System or Fluke 5500A Calibrator
DC Voltage Source (DTM520)	10 mV to 2 V, 0.01% accuracy	
Thermocouple Extension Cable	K-type thermocouple wire with SMP male end connectors	Omega TECK-10-10
Transition Adapter (DTM520)	SMP female-to-male banana	Omega TAS-U-5

Preparation for Adjustment

The following guidelines apply to all DTM510 and DTM520 adjustments:

- Perform all adjustments in a 21° to 25° C ambient environment with a relative humidity of 75% or less.
- Warm up the thermometer for at least 30 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.

***NOTE**. Thermocouple connectors are temperature sensitive. For best measurement accuracy, do not touch the connector contacts and minimize handling of the connector housings.*

Open the Thermometer

To make internal adjustments, you must open the thermometer case and remove the circuit board (see Figure 2 or Figure 3).

1. Unplug the thermocouple(s).
2. Lay the thermometer face down on a flat work surface.
3. Remove the single screw from the battery compartment cover with a Phillips-head screwdriver and remove the battery compartment cover.
4. Remove the four screws from the corners of the thermometer.
5. Lift the top end of the cover and remove both the cover and the cap.
6. Remove the screws from the corners of the circuit board (the DTM510 thermometer has three screws; the DTM520 thermometer has four) and gently lift the circuit board out of the case.
7. Remove the rubber keypad from the case.
8. Lay the circuit board face up.
9. Place the rubber keypad on the circuit board so it can be used to operate the thermometer.

To reassemble the thermometer following the adjustments, perform steps 3 through 7 above in reverse order.

DTM510 Adjustment Procedure

This section describes how to adjust the DTM510 thermometer. To properly adjust the thermometer, perform the following steps in sequential order.

1. Open the thermometer as described in the previous section.
2. Turn on the thermometer and allow it to warm up for at least 30 minutes.
3. Connect the thermocouple simulator to the probe connector.
4. Set the simulator probe type to K.
5. For each row in Table 7, set the thermometer and simulator as shown; then adjust the specified test point until the displayed temperature is within the proper limits. Figure 2 shows the location of the adjustment points.

Table 7: DTM510 adjustment procedures

Thermometer setting		Simulator setting		
C/F	**Resolution**	**Temperature**	**Test point**	**Temperature limits**
C	0.1°	0° C	VR1	–00.1° and 00.1°
F	1°	1000° C	VR3	1831° and 1833°
C	1°	1000° C	VR5	999° and 1001°
C	0.1°	190° C	VR2	189.9° and 190.1°
F	0.1°	0° C	VR4	31.9° and 32.1°
C	1°	1000° C	VR3	999° and 1001°

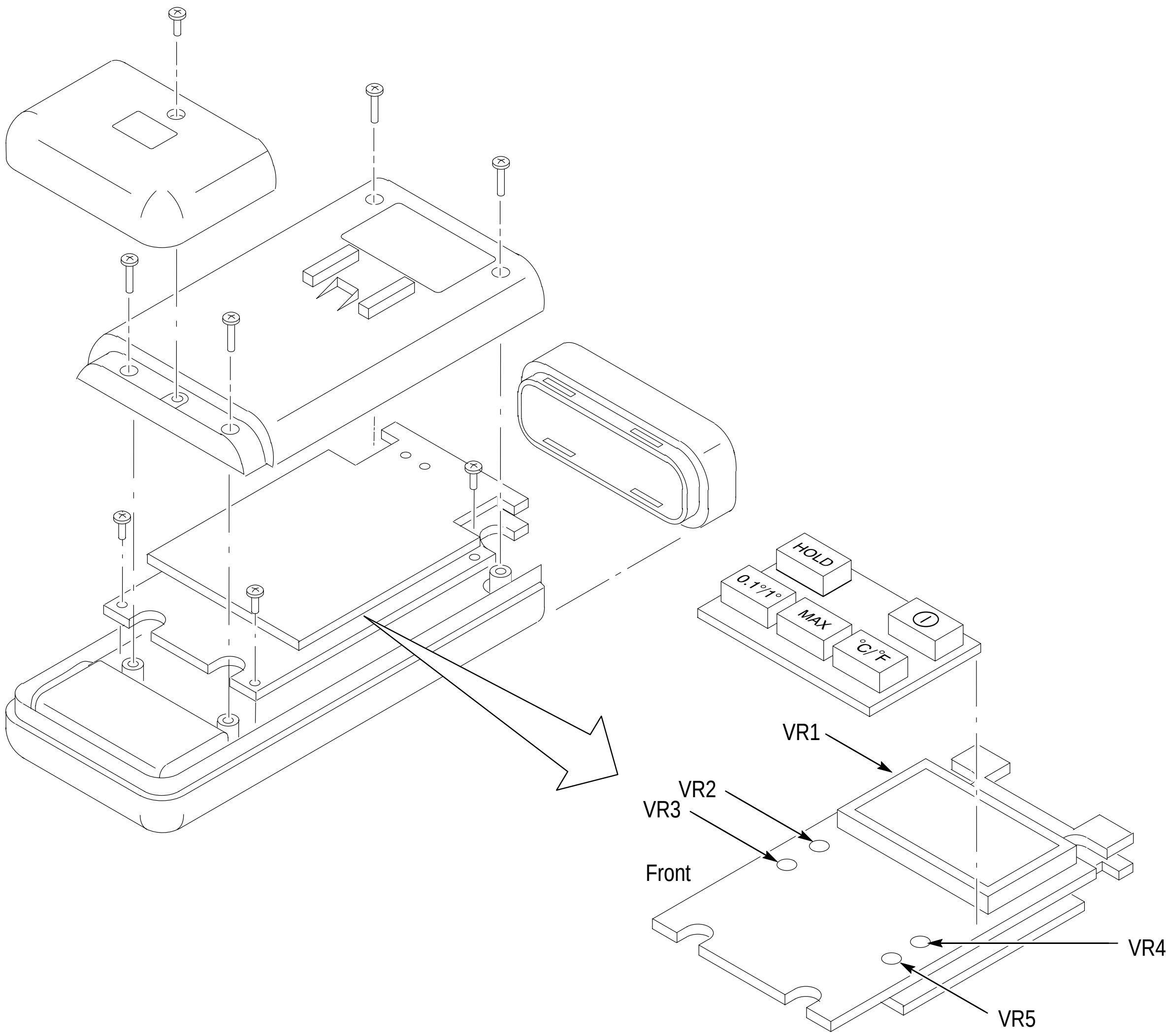


Figure 2: DTM510 Thermometer disassembly and adjustment locations

DTM520 Adjustment Procedure

This section describes how to adjust the DTM520 thermometer. To properly adjust the thermometer, perform the following steps in sequential order. Figure 3 shows the location of the test and adjustment points.

1. Open the thermometer. (See page 15 for instructions.)
2. Solder a jumper across R25.
3. Turn on the thermometer and allow it to warm up for at least 30 minutes.

2000 mV Calibration

Use the following procedure to perform a 2000 mV calibration.

1. Press T2 once to access the T2 mode.
2. Install a jumper across the test points marked JP1.
3. Connect the DC voltage source to the T1 probe connector. The composition of both lead wires should be identical.
4. Set the DC voltage source output to +2000.0 mV ±0.01%.
5. Adjust VR2 until the display shows 2000.0°. (The first digit of the temperature appears at the upper right-hand corner of the display.)
6. Disconnect the DC voltage source.
7. Remove the R25 jumper. (Do not remove the JP1 jumper.)

Gain Calibration

Use the following procedure to perform a gain calibration.

1. Press °C/°F until "1L" appears in the upper left-hand corner of the display.
2. Set the DC voltage source output to +50.000 mV ±0.01%.
3. Reconnect the DC voltage source to the T1 probe connector.
4. Adjust VR3 until the display shows 000.0°. (The first digit of the temperature appears at the upper right-hand corner of the display.)
5. Disconnect the DC voltage source.
6. Remove the JP1 jumper.

0° C Calibration

Use the following procedure to perform a 0° calibration.

1. Connect the thermocouple simulator to the T1 probe connector.
2. Set the thermocouple simulator and thermometer probe types to K.
3. Set the thermocouple simulator to 0° C.
4. Adjust VR1 until displayed temperature is between –00.1° and 00.1°.
5. Disconnect the thermocouple simulator.

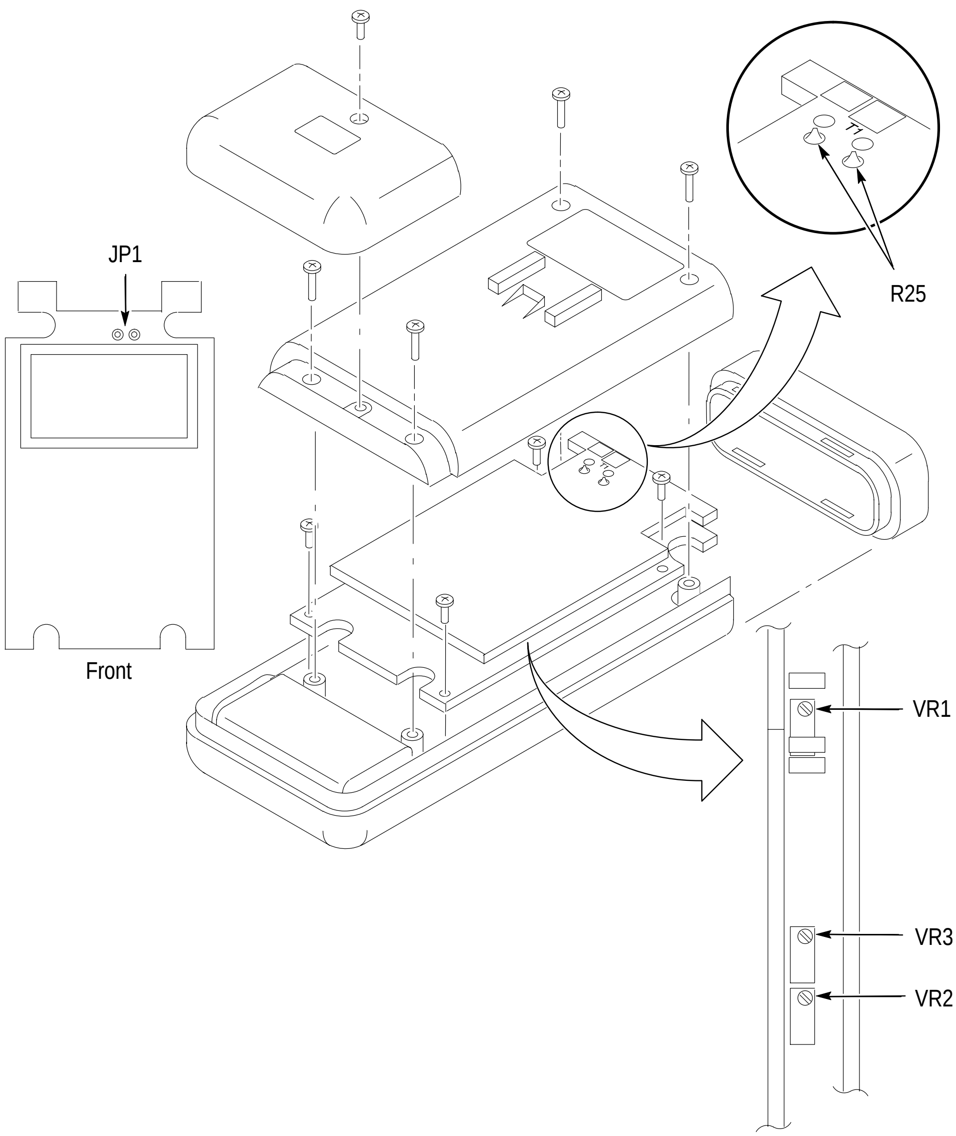


Figure 3: DTM520 Thermometer disassembly, test points, and adjustment locations

Instructions Manual

Tektronix

DTM900 and DTM920
Digital Thermometers

070-9853-01

Table of Contents

DTM900 and DTM920 Digital Thermometers

The Tektronix DTM900 and DTM920 are hand-held digital thermometers that can measure temperature using a variety of thermocouple probes. A K-type surface measurement bead probe comes standard with both instruments.

The DTM900 thermometer uses a single K-type probe; the DTM920 uses K- or J-type probes. The DTM920 thermometer has inputs for two probes and can perform differential measurements.

In addition, the thermometers include the following features:

- Temperature display in °C or °F
- A hold feature to freeze the display
- MIN and MAX readouts (DTM900 thermometer includes MAX only)
- A stopwatch (DTM920 only)

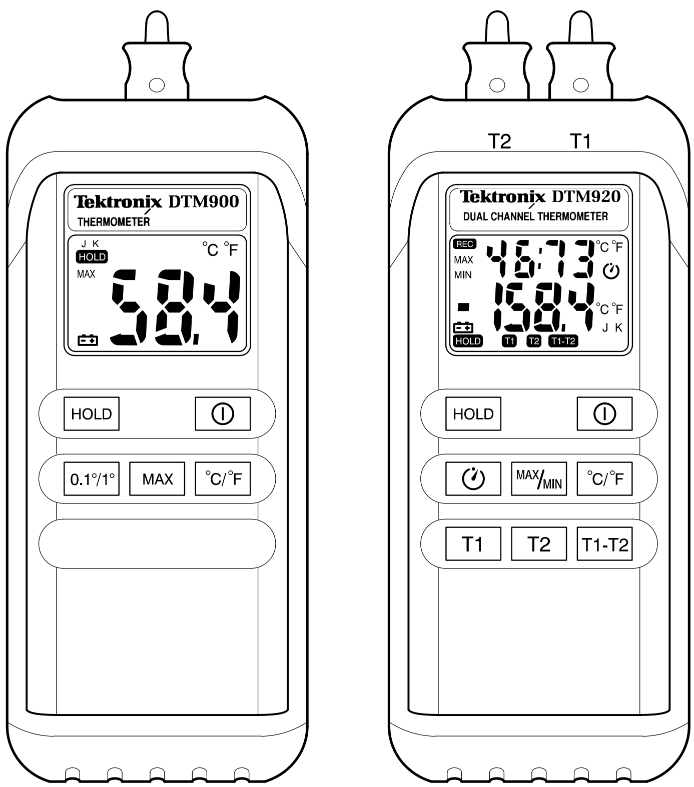


Figure 1: DTM900 & DTM920 digital thermometers

DTM900 and DTM920 Specifications

The characteristics listed in this section apply under the following conditions:

- The instrument operates in an 18° to 28° C ambient environment unless otherwise noted.
- The instrument warms up for 60 minutes.

***NOTE**. All specifications are warranted unless marked "typical." Typical characteristics are not guaranteed but are provided for the convenience of the user.*

Specifications marked with the ✓ symbol are checked in the performance verification procedures.

Table 1: General characteristics

Characteristic	Description		
Product	Measurement Range		
DTM900	–50° to 1300° C (–58° to 1999° F)		
DTM920 (K-type probe)	–200° to 1370° C (–328° to 2498° F)		
DTM920 (J-type probe)	–200° to 760° C (–328° to 1400° F)		
✓ Accuracy	Temperature Range	Resolution	% of Reading
DTM900	–50° to 199.9° C	0.1° C	±(0.2% + 1° C)
	–58° to 391° F	0.1° F	±(0.2% + 2° F)
	–50° to 199.9° C	1° C	±(0.3% + 2° C)
	–58° to 391° F	1° F	±(0.3% + 4° F)
	200° to 999.9° C	1° C	±(0.4% + 2° C)
	392° to 1831° F	1° F	±(0.4% + 4° F)
	1000° to 1300° C	1° C	±(0.6% + 2° C)
	1832° to 1999° F	1° F	±(0.6% + 4° F)

Table 1: General characteristics (cont.)

Characteristic	Description		
✓ Accuracy	Temperature Range	Resolution	% of Reading
DTM920 (K-type probe)	–200° to –100° C	0.1° C	±(0.3% + 1° C)
	–328° to –148° F	0.2° F	±(0.3% + 2° F)
	–99.9° to 999.9° C	0.1° C	±(0.1% + 0.7° C)
	–147.9° to 999.9° F	0.2° F	±(0.1% + 1.4° F)
	1000° to 1370° C	1° C	±(0.3% + 1° C)
	1000° to 2498° F	2° F	±(0.3% + 2° F)
	T1 – T2 reading	—	±(0.3% + 2.2° C)
✓ Accuracy	Temperature Range	Resolution	% of Reading
DTM920 (J-type probe)	–200° to –100° C	0.1° C	±(0.3% + 1.1° C)
	–328° to –148° F	0.2° F	±(0.3% + 2.2° F)
	–99.9° to 760° C	0.1° C	±(0.1% + 0.8° C)
	–147.9° to 999.9° F	0.2° F	±(0.1% + 1.6° F)
	1000° to 1400° F	2° F	±(0.3% + 2° F)

Table 2: General characteristics

Characteristic	Description
Temperature Range	ATP01 bead probe: –40° to 204° C
Probe Tolerance	ATP01 bead probe: ±2.2° C
Measurement Rate (Readings/second)	
DTM900	2.5
DTM920 (T2 or T1)	1
DTM920 (T1 – T2)	0.5
Input Protection	24 V maximum. Class III as defined in IEC 1010, Safety Requirements for Electrical equipment for measurement, control, and laboratory use. Class III equipment is equipment for connection to SELV or SELV-E circuits only.
Electrical Isolation T1 to T2	20 kΩ minimum

Table 3: Environmental characteristics

Characteristic	Description
Temperature coefficient <18° C or >28° C	
DTM900	0.15 × (specified accuracy) per °C
DTM920	0.1 × (specified accuracy) per °C
Operating temperature	0° to 50° C (32° to 122° F) at 0% to 75% RH
Storage temperature	–20° to 60° C (–4° to 140° F) at 0% to 80% RH
Power requirements	Single standard 9 V battery (ANSI/NEDA 1604A, IEC 6F22)
Battery life (Alkaline)	
DTM900	250 hours
DTM920	90 hours

DTM900 and DTM920 Performance Verification

This section contains procedures to verify that the DTM900 and DTM920 thermometers perform as warranted. If an instrument fails any of the checks, it needs adjustment and or repair. Verify the performance of your thermometer annually or whenever its accuracy or function is in question.

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

- The instrument operates in an 18° to 28° C ambient environment with a relative humidity of less than 80%.
- The instrument warms up for 60 minutes.
- The instrument remains fully assembled (do not remove the bottom cover).

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 4. 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 4: Performance verification test equipment

Description	Minimum requirements	Example product
Thermocouple Simulator	–200° to1370° C ±0.01% (–328° to 2498° F ±0.01%)	Wavetek 9100 Universal Calibration System or Fluke 5500A Calibrator

Set Up

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

1. Warm up the thermometer for 60 minutes.
2. Photocopy the test record for your model on pages 9 through 12 to record your test results.

Verification Procedure

Implement the following tests to verify the temperature measurement accuracy of your DTM900 or DTM920 thermometer.

1. Connect the thermocouple simulator output to the temperature probe input. For the DTM920, connect the simulator to the T1 input connector; then repeat the test using the T2 input connector.

***NOTE**. Thermocouple connectors are temperature sensitive. For best measurement accuracy, do not touch the connector contacts and minimize handling of the connector housings.*

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2. Set the simulator to the correct probe type. The DTM900 thermometer uses a K-type probe. The DTM920 thermometer can use either a K- or J-type probe.
3. For each of the conditions specified in the test records, do the following:
   - **a.** Set the thermometer Resolution to 0.1° or 1° (DTM900 only).
   - **b.** Set the thermometer to measure °C or °F.
   - **c.** Set the calibrator to each of the temperature values shown in the test records; then verify that the thermometer display reads within the specified Display minimum and mximum limits.

DTM900 Test Record

Serial number	Procedure performed by	Date

DTM900 test record

Resolution	Temperature	Display minimum	Reading	Display maximum
0.1°	–48.0° C	–49.1°		–46.9°
	–30.0° C	–31.1°		–28.9°
	0.0° C	–01.0°		01.0°
	30.0° C	28.9°		31.1°
	50.0° C	48.9°		51.1°
	100.0° C	98.8°		101.2°
	–50.0° F	–52.1°		–47.9°
	–22.0° F	–24.0°		–20.0°
	0.0° F	–02.0°		02.0°
	190.0° F	187.6°		192.4°
1.0°	–48° C	–050°		–046°
	0° C	–002°		002°
	50° C	048°		052°
	200° C	197°		203°
	310° C	307°		313°
	700° C	695°		705°
	810° C	805°		815°
	945° C	939°		951°
	1280° C	1270°		1290°
	–50° F	–054°		–046°
	0° F	–004°		004°
	590° F	584°		596°
	1292° F	1283°		1301°
	1733° F	1722°		1744°
	1980° F	1964°		1996°

DTM920 Test Record

Serial number	Procedure performed by	Date

DTM920 test record

Probe Type	Temperature	Display minimum	Reading	Display maximum
K	–198.0° C	–199.6°		–196.4°
	–99.0° C	–99.8°		–98.2°
	0.0° C	–0.7°		0.7°
	50.0° C	49.2°		50.8°
	500.0° C	498.8°		501.2°
	998.0° C	996.3°		999.7°
	1360° C	1355°		1365°
	–320° F	–323°		–317°
	–146° F	–147.5°		–144.5°
	0.0° F	–1.4°		1.4°
	100° F	98.5°		101.5°
	500° F	498.1°		501.9°
	990° F	987.6°		992.4°
	1980° F	1972°		1988°
	2480° F	2471°		2489°

DTM920 test record (cont.)

Probe Type	Temperature	Display minimum	Reading	Display maximum
J	–198.0° C	–199.7°		–196.3°
	–99.0° C	–99.9°		–98.1°
	0.0° C	–0.8°		0.8°
	50.0° C	49.1°		50.9°
	100.0° C	99.1°		100.9°
	500.0° C	498.7°		501.3°
	755.0° C	753.4°		756.6°
	–320.0° F	–323.2°		–316.8°
	–146.0° F	–147.7°		–144.3°
	0.0° F	–1.6°		1.6°
	100.0° F	98.3°		101.7°
	500.0° F	497.9°		502.1°
	990.0° F	987.4°		992.6°
	1390° F	1384°		1396°

DTM900 and DTM920 Adjustment Procedures

This section contains procedures to adjust DTM900 and DTM920 thermometers. If your thermometer fails a performance requirement, use these procedures to return it to factory specifications.

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 thermometer meets factory specifications, implement the procedures in the *DTM900 and DTM920 Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 5 to return DTM900 and DTM920 thermometers to factory calibration.

Table 5: DTM900 and DTM920 adjustments

DTM900 Adjustment Procedure	
DTM920 Adjustment Procedure	
	2000 mV Calibration
	Gain Calibration
	0° C Calibration

Test Equipment

To ensure accurate adjustments, use the following or equivalent test equipment.

Alternative test equipment must meet or exceed the intended minimum requirementsspecified in Table 6. If you substitute equipment, you may need to modify the procedures.

***NOTE**. Before making any adjustment, warm up the test equipment according to the manufacturer's recommendations.*

Table 6: Adjustment test equipment

Description	Minimum requirements	Examples
Thermocouple Simulator	–200 to1370° C ±0.01% (–328 to 2498° F ±0.01%)	Wavetek 9100 Universal Calibration System or Fluke 5500A Calibrator
DC Voltage Source (DTM920)	10 mV to 2 V, 0.01% accuracy	
Thermocouple Extension Cable	K-type thermocouple wire with SMP male end connectors	Omega TECK-10-10
Transition Adapter (DTM920)	SMP female-to-male banana	Omega TAS-U-5

Preparation for Adjustment

The following guidelines apply to all DTM900 and DTM920 adjustments:

- Perform all adjustments in a 21° to 25° C ambient environment with a relative humidity of 75% or less.
- Warm up the thermometer for at least 30 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.

***NOTE**. Thermocouple connectors are temperature sensitive. For best measurement accuracy, do not touch the connector contacts and minimize handling of the connector housings.*

Open the Thermometer

To make internal adjustments, you must open the thermometer case and remove the circuit board (see Figure 2 or Figure 3).

1. Unplug the thermocouple(s).
2. Lay the thermometer face down on a flat work surface.
3. Remove the single screw from the battery compartment cover with a Phillips-head screwdriver and remove the battery compartment cover.
4. Remove the four screws from the corners of the thermometer.
5. Lift the top end of the cover and remove both the cover and the cap.
6. Remove the screws from the corners of the circuit board (the DTM900 thermometer has three screws; the DTM920 thermometer has four) and gently lift the circuit board out of the case.
7. Remove the rubber keypad from the case.
8. Lay the circuit board face up.
9. Place the rubber keypad on the circuit board so it can be used to operate the thermometer.

To reassemble the thermometer following the adjustments, perform steps 3 through 7 above in reverse order.

DTM900 Adjustment Procedure

This section describes how to adjust the DTM900 thermometer. To properly adjust the thermometer, perform the following steps in sequential order.

1. Open the thermometer as described in the previous section.
2. Turn on the thermometer and allow it to warm up for at least 30 minutes.
3. Connect the thermocouple simulator to the probe connector.
4. Set the simulator probe type to K.
5. For each row in Table 7, set the thermometer and simulator as shown; then adjust the specified test point until the displayed temperature is within the proper limits. Figure 2 shows the location of the adjustment points.

Table 7: DTM900 adjustment procedures

Thermometer setting		Simulator setting		
C/F	**Resolution**	**Temperature**	**Test point**	**Temperature limits**
C	0.1°	0° C	VR1	–00.1° and 00.1°
F	1°	1000° C	VR3	1831° and 1833°
C	1°	1000° C	VR5	999° and 1001°
C	0.1°	190° C	VR2	189.9° and 190.1°
F	0.1°	0° C	VR4	31.9° and 32.1°
C	1°	1000° C	VR3	999° and 1001°

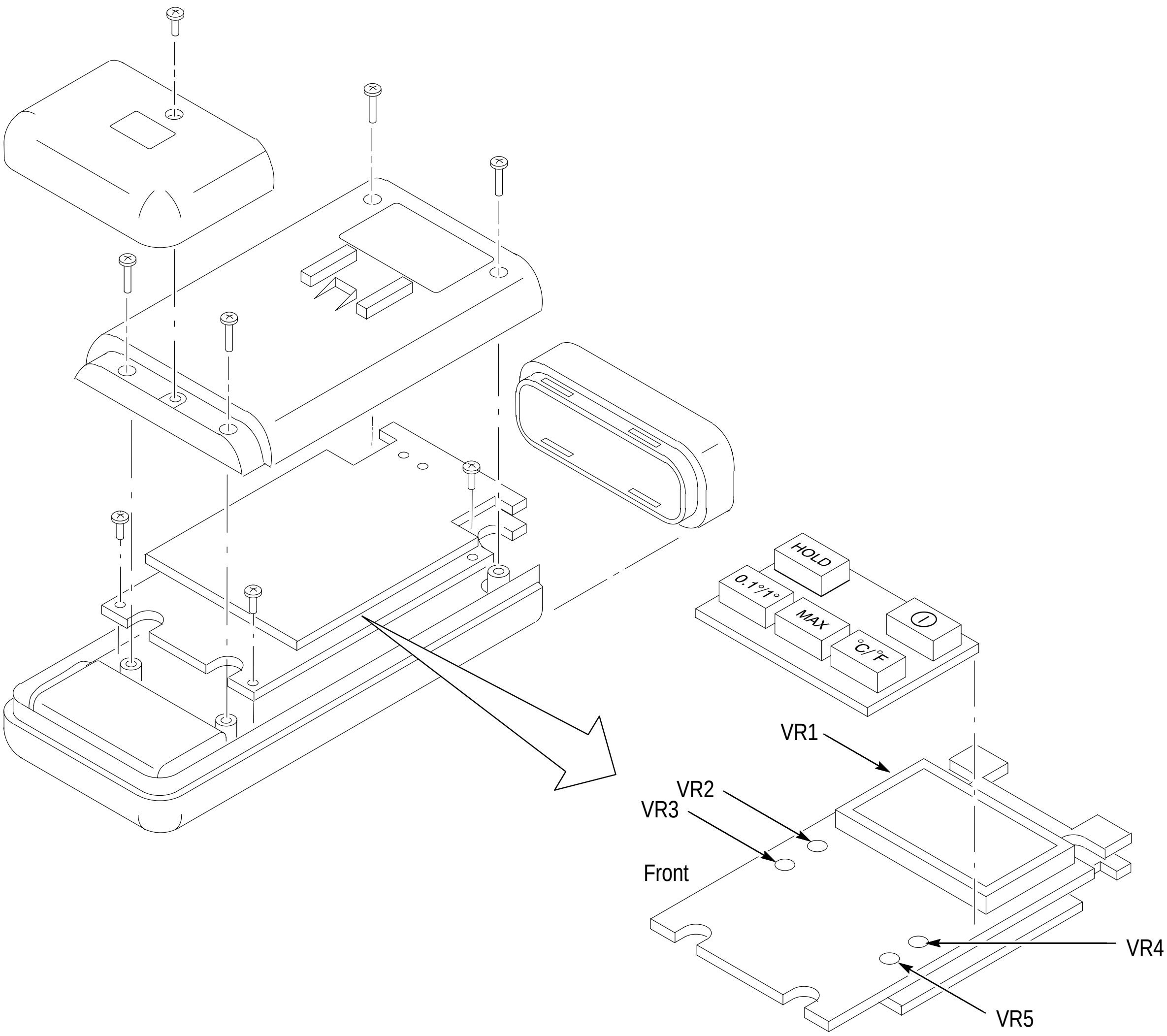

Figure 2: DTM900 Thermometer disassembly and adjustment locations

DTM920 Adjustment Procedure

This section describes how to adjust the DTM920 thermometer. To properly adjust the thermometer, perform the following steps in sequential order. Figure 3 shows the location of the test and adjustment points.

1. Open the thermometer. (See page 15 for instructions.)

2. Solder a jumper across R25.

3. Turn on the thermometer and allow it to warm up for at least 30 minutes.

2000 mV Calibration

Use the following procedure to perform a 2000 mV calibration.

1. Press T2 once to access the T2 mode.

2. Install a jumper across the test points marked JP1.

3. Connect the DC voltage source to the T1 probe connector. The composition of both lead wires should be identical.

4. Set the DC voltage source output to +2000.0 mV ±0.01%.

5. Adjust VR2 until the display shows 2000.0°. (The first digit of the temperature appears at the upper right-hand corner of the display.)

6. Disconnect the DC voltage source.

7. Remove the R25 jumper. (Do not remove the JP1 jumper.)

Gain Calibration

Use the following procedure to perform a gain calibration.

1. Press °C/°F until “1L” appears in the upper left-hand corner of the display.

2. Set the DC voltage source output to +50.000 mV ±0.01%.

3. Reconnect the DC voltage source to the T1 probe connector.

4. Adjust VR3 until the display shows 000.0°. (The first digit of the temperature appears at the upper right-hand corner of the display.)

5. Disconnect the DC voltage source.

6. Remove the JP1 jumper.

0° C Calibration

Use the following procedure to perform a 0° calibration.

1. Connect the thermocouple simulator to the T1 probe connector.
2. Set the thermocouple simulator and thermometer probe types to K.
3. Set the thermocouple simulator to 0° C.
4. Adjust VR1 until displayed temperature is between –00.1° and 00.1°.
5. Disconnect the thermocouple simulator.

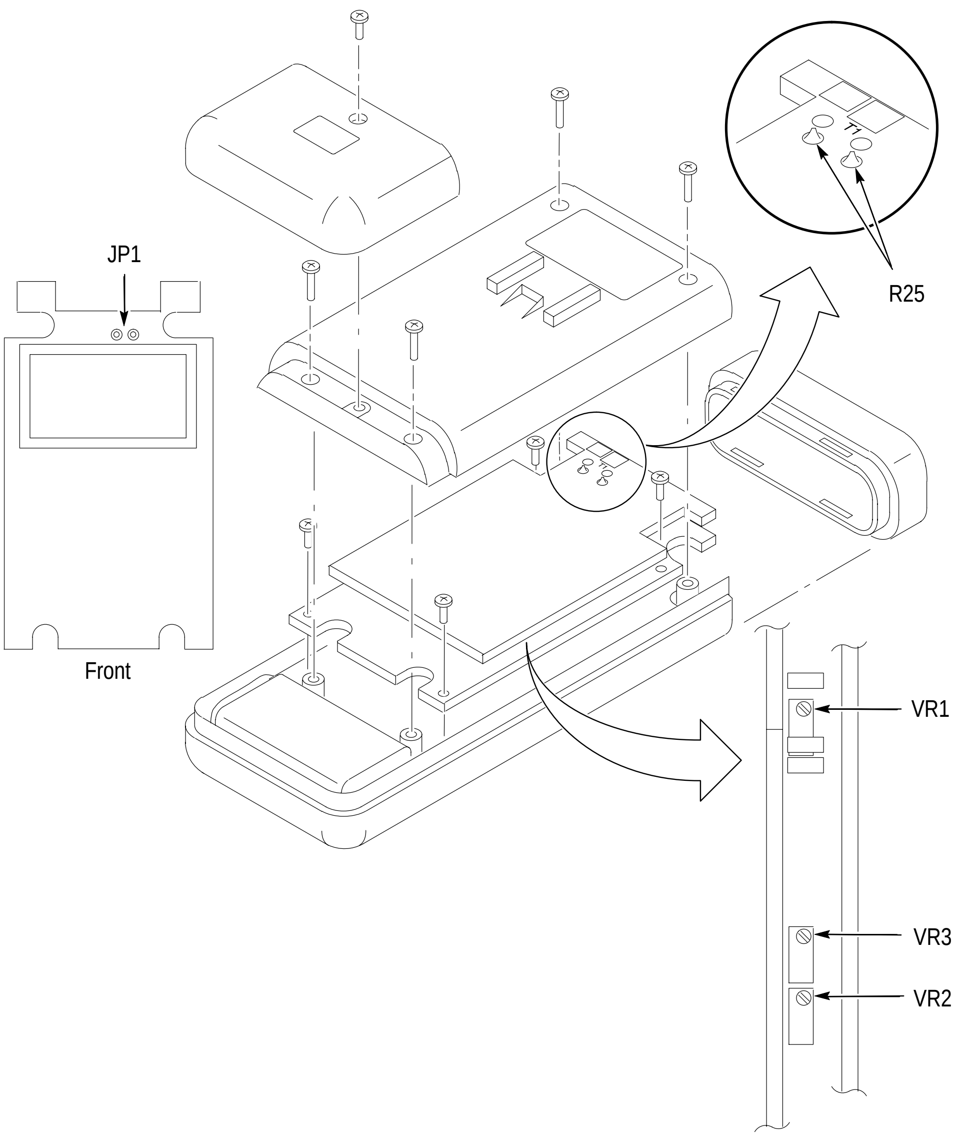

Figure 3: DTM920 Thermometer disassembly, test points, and adjustment locations