Technical Reference

Tektronix

Handheld and Benchtop Instruments Basic Service

061-4108-00

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.

Printed in the U.S.A.

Tektronix, Inc., P.O. Box 1000, Wilsonville, OR 97070–1000

Handheld and Benchtop Instruments Service Reference

Service information not provided in this manual may be available under separate cover. See Table i for a complete list of Handheld and Benchtop Instruments service documentation.

Table i: 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
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

Table i: Handheld and Benchtop Instruments Service Manuals (Cont.)

Product	Tektronix Part Number
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 Oscilloscope TDS 220	070-9693-00
TDS 310 Oscilloscope TDS 320 TDS 350	070-8570-05
TDS 340 Oscilloscope TDS 340A TDS 360 TDS 380	070-9435-02
THS 710 Oscilloscope THS 720 THS 730	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.*

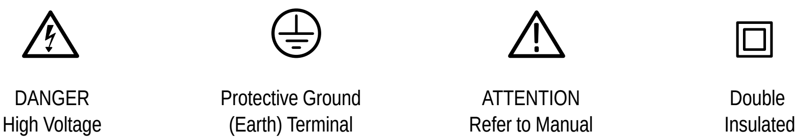
Terms on the Products. These terms may appear on the product:

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:



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 and benchtop 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. Since manual updates occur at approximately six month intervals, information may be incomplete or missing in some versions.

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 Handheld and Benchtop instruments manuals can also be found 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

DCM300 and DCM320
Digital Clamp Multimeters

070-9847-00

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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.

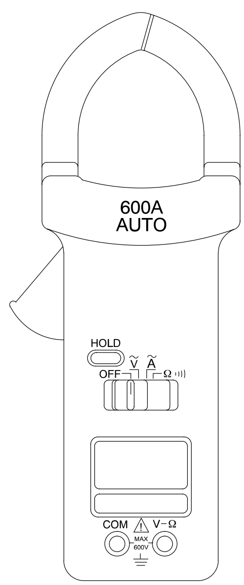

Figure 1: DCM300 Digital Clamp Multimeter

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, NEDA1604, IEC6F22, JIS 006P
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.)

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

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 6.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification 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 Records* on pages 8 and 9. Use them 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 $\tilde{A}$ position.
2. Set up the AC Current calibrator to output the values specified in Table 7 on page 8.
3. Select the appropriate coils to multiply the AC Current calibrator output for each of the values listed in Table 7.
4. For each of the conditions listed in Table 7, position the clamp around the current loop of the AC current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.

5. Verify that the multimeter display reads within the specified Low and High Limits for each of the specified conditions.

6. Disconnect the calibrator.

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 $\tilde{\mathrm{V}}$ 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 Table 8 on page 8 and verify that the multimeter display reads within the specified Low and High limits.

4. Disconnect the current 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 Table 9 on page 9 and verify that the display reads within the specified Low and High limits.

4. Disconnect the calibrator.

Test Records

Serial Number	Procedure performed by	Date

Table 7: AC Current Checks

AC Current Calibrator Output	Test Frequency	Tolerance	Low Limit	Test Result	High Limit
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
400 A	50 Hz	±17 A	383		417
	60 Hz	±17 A	383		417
600 A	50 Hz	±22 A	578		622
	60 Hz	±22 A	578		622

Table 8: AC Voltage Checks

AC Voltage Calibrator Output	Test Frequency	Tolerance	Low Limit	Test Result	High Limit
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
400 V	500 Hz	±10 V	390		410
600 V	50 Hz	±12 V	588		612
	500 Hz	±12 V	588		612

Table 9: Resistance Checks

Resistance Calibrator Output	Tolerance	Low Limit	Test Result	High Limit
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

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 *Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 10 to return DCM300 and DCM320 multimeters to factory calibration.

Table 10: DCM300 and DCM320 Adjustments

AC Current
AC Voltage
Resistance
Continuity

Test Equipment

The test equipment listed in Table 6 on page 6 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.

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

4. Position the clamp around the current loop of the AC 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. Remove the clamp meter from the calibrator 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 up the AC voltage calibrator to output 300 V at 500 Hz (DCM300) or 300 V at 50 Hz (DCM320).
2. Set the multimeter function switch to the **Ṽ** position.
3. Connect the AC voltage calibrator output to the multimeter **V–Ω** and **COM** input terminals.
4. Adjust VR1 with a small flat-tipped screwdriver; set the multimeter reading to 300.0.
5. Disconnect the voltage calibrator.

Resistance

To adjust the resistance calibration, perform the following steps.

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

Continuity

To adjust the continuity calibration, perform the following steps.

1. Set up the resistance calibrator to simulate a 150 Ω resistance load.
2. Connect the resistance calibrator output to the multimeter **V–Ω** and **COM** input terminals.

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.

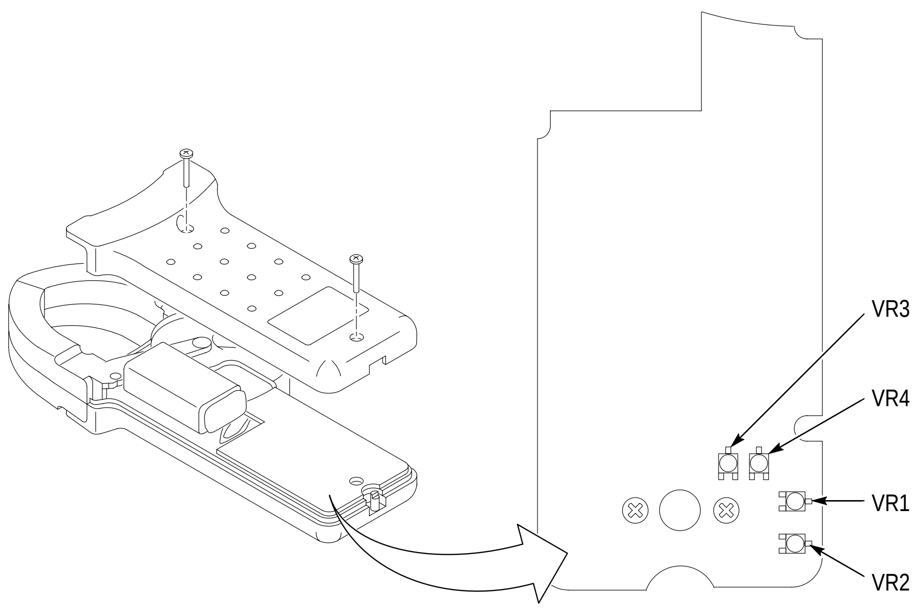

Figure 2: Adjustment Locations

Table 11: Summary of Adjustments

Adjustment Name	Test Value	Range Setting	Circuit Location	Tolerance	Display Min	Display Max
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

070-9848-00

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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.

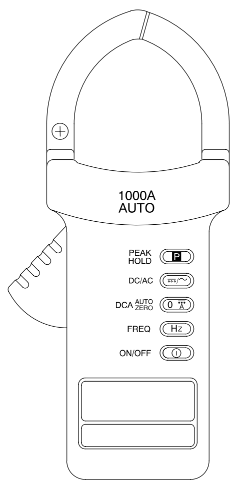

Figure 1: DCM330 Digital Clamp Meter

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, NEDA1604, IEC6F22, JIS 006P
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)

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

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 6.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification 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 Records* on pages 9 and 10. Use them 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 given in Table 7 on page 9. For more information, refer to the user manual of your calibrator.
3. 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 display reads within the specified Low and High Limits and record the reading.
5. Disconnect the calibrator.

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 given in Table 8 on page 10. For more information, refer to the user manual of your calibrator.
4. Position the clamp around the current loop of the DC current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
5. Verify that the display reads within the specified Low and High Limits and record the reading.
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. 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 AC current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Verify that the display reads within the specified Low and High Limits for each of the frequencies listed in Table 9 on page 10 and record the reading.
5. Disconnect the calibrator.

Test Records

Serial Number	Procedure performed by	Date

Table 7: AC Current Checks

AC Current	Test Frequency	Tolerance	Low Limit	Test Result	High Limit
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
400 A	50 Hz	±17 A	383		417
	60 Hz	±17 A	383		417
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.**

Table 8: DC Current Checks

DC Current	Tolerance	Low Limit	Test Result	High Limit
0.0 A	±1.0 A	–1.0		01.0
10.0 A	±1.2 A	08.8		11.2
100.0 A	±4.9 A	95.1		104.9
300.0 A	±9.7 A	290.3		309.7
400 A	±12 A	388		412
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	±4.9 A	–104.9		–95.1
–300.0 A	±9.7 A	–309.7		–290.3
–400 A	±12 A	–412		–388
–600 A	±22 A	–622		–578
–1000 A	±34 A	–1034		–966

Table 9: Frequency Checks

AC Current	Frequency	Tolerance	Low Limit	Test Result	High Limit
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

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 *Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 10 to return the DCM330 clamp meter to factory calibration.

Table 10: DCM330 Adjustments

Position Error
AC Current
DC Current
Peak Hold

Test Equipment

The test equipment listed in Table 6 on page 6 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.

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.*

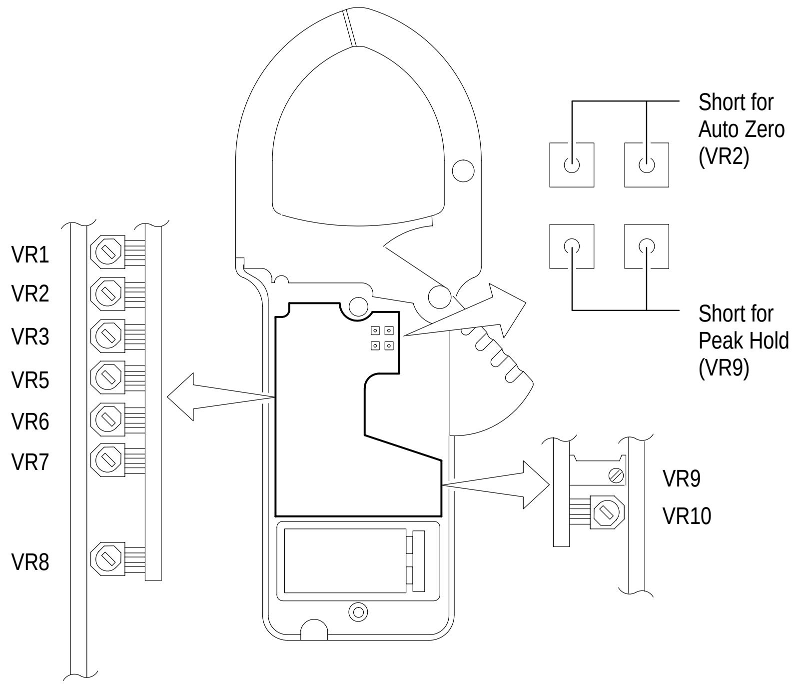

Figure 2: Adjustment Locations

Position Error

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 output of the AC current calibrator to 380 A at 50 Hz.
3. Position the clamp around the coil of the AC 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. 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 output of DC current calibrator to 200 A.
3. Position the clamp around the coil of the DC 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. 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 output of the DC current calibrator to 400 A.
3. Position the clamp around the coil of the DC 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. 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 output of the AC current calibrator to 390 A at 400 Hz.
3. Position the clamp around the coil of the DC 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. 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 output of AC current calibrator to 400 A at 400 Hz.
3. Position the clamp around the coil of the DC 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. 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 output of the AC current calibrator to 200 A at 400 Hz.
11. Position the clamp around the coil of the DC 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. Remove the clamp meter from the coil.

15. Reassemble the meter.

Table 11: Summary of Adjustments

Adjustment Name	Mode	Test Value	Frequency	Circuit Location	Tolerance	Display Min.	Display Max.
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

070-9849-00

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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.

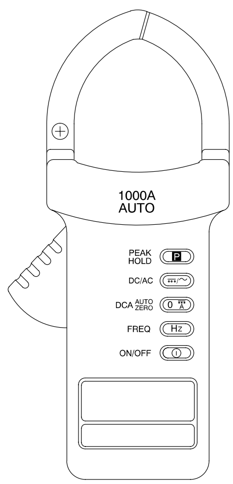

Figure 1: DCM910 Digital Clamp Meter

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, NEDA1604, IEC6F22, JIS 006P
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)

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

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 6.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification 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 Records* on pages 9 and 10. Use them 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 given in Table 7 on page 9. For more information, refer to the user manual of your calibrator.
3. 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 display reads within the specified Low and High Limits and record the reading.
5. Disconnect the calibrator.

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 given in Table 8 on page 10. For more information, refer to the user manual of your calibrator.
4. Position the clamp around the current loop of the DC current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
5. Verify that the display reads within the specified Low and High Limits and record the reading.
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.*

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7. 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 AC current calibrator and release the clamp trigger. Ensure that the clamp is entirely closed.
4. Verify that the display reads within the specified Low and High Limits for each of the frequencies listed in Table 9 on page 10 and record the reading.
5. Disconnect the calibrator.

Test Records

Serial Number	Procedure performed by	Date

Table 7: AC Current Checks

AC Current	Test Frequency	Tolerance	Low Limit	Test Result	High Limit
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
400 A	50 Hz	±17 A	383		417
	60 Hz	±17 A	383		417
600 A	50 Hz	±22 A	578		622
	60 Hz	±22 A	578		622
1000 A	50 Hz[3]	±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.

Table 8: DC Current Checks

DC Current	Tolerance	Low Limit	Test Result	High Limit
0.0 A	±1.0 A	–01.0		01.0
10.0 A	±1.2 A	08.8		11.2
100.0 A	±4.9 A	95.1		104.9
300.0 A	±9.7 A	290.3		309.7
400 A	±12 A	388		412
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	±4.9 A	–104.9		–95.1
–300.0 A	±9.7 A	–309.7		–290.3
–400 A	±12 A	–412		–388
–600 A	±22 A	–622		–578
–1000 A	±34 A	–1034		–966

Table 9: Frequency Checks

AC Current	Frequency	Tolerance	Low Limit	Test Result	High Limit
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

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 *Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 10 to return the DCM910 clamp meter to factory calibration.

Table 10: DCM910 Adjustments

Position Error
AC Current
DC Current
Peak Hold

Test Equipment

The test equipment listed in Table 6 on page 6 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.

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.*

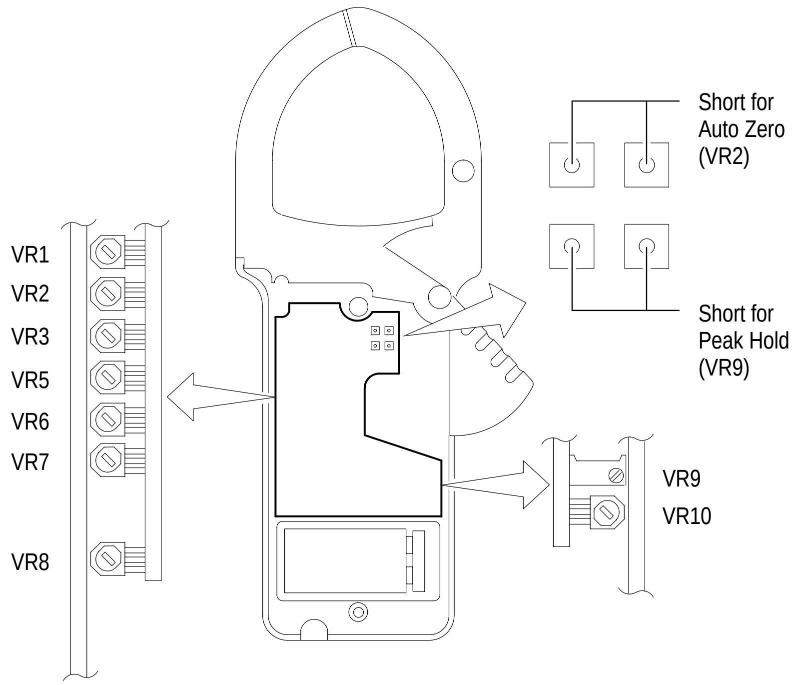

Figure 2: Adjustment Locations

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 output of the AC current calibrator to 380 A at 50 Hz.
3. Position the clamp around the coil of the AC 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. 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 output of DC current calibrator to 200 A.
3. Position the clamp around the coil of the DC 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. 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 output of the DC current calibrator to 400 A.
3. Position the clamp around the coil of the DC 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. 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 output of the AC current calibrator to 390 A at 400 Hz.
3. Position the clamp around the coil of the DC 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. 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 output of AC current calibrator to 400 A at 400 Hz.
3. Position the clamp around the coil of the DC 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. 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 output of the AC current calibrator to 200 A at 400 Hz.
11. Position the clamp around the coil of the DC 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. Remove the clamp meter from the coil.

15. Reassemble the meter.

Table 11: Summary of Adjustments

Adjustment Name	Mode	Test Value	Frequency	Circuit Location	Tolerance	Display Min.	Display Max.
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

DMM800
Series Digital Multimeters

070-9850-00

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DMM800 Series Digital Multimeters

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

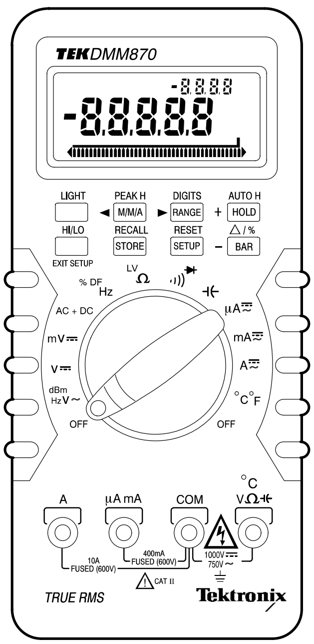

Figure 1: DMM870 Digital Multimeter

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	●	●	●

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 dry cell battery
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
A connector	15 A (600 V) fast blow fuse
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.

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

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements listed in Table 8.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification 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 18 through 31 contain *Test Records* for the DMM800 series multimeters. Each model has its own test record. Photocopy the *Test Records* pages for your model and use them 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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.
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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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:

      - Set the calibrator output to 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.
      - Set the calibrator output to ON.

   b. Using Wavetek 9100 with 9105 front porch:

- Set the calibrator output to 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.
- Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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 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 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.

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.**

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 14 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 14 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
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.**

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.**

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 14 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
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
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.**

Adjustment Procedures

This section contains procedures to adjust DMM830, DMM850, and DMM870 multimeters. Perform these procedures once a year or if the *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 *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 9 is a complete list of equipment needed for the adjustment procedures. These procedures assume that the test equipment is operating within tolerance.

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 39.

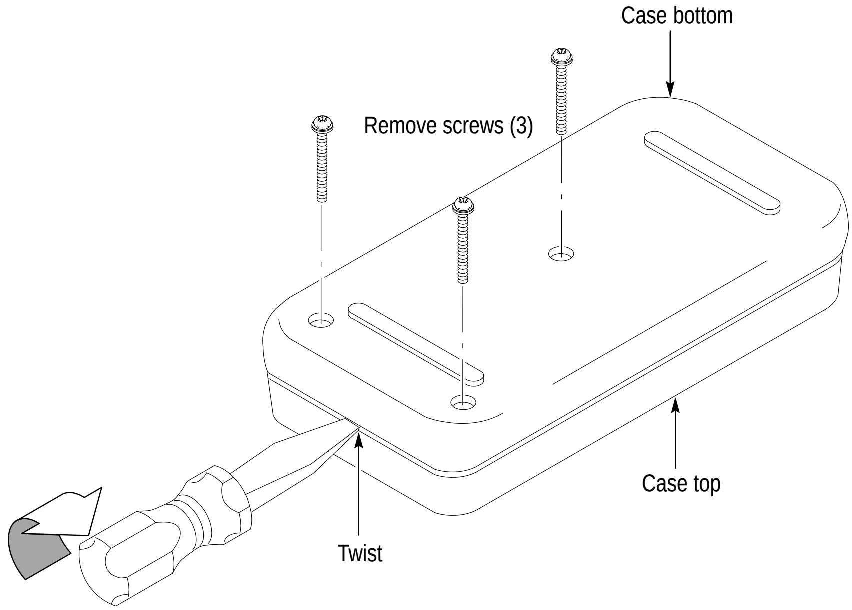

Figure 2: Opening the Meter Case

Adjustments Part 1

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

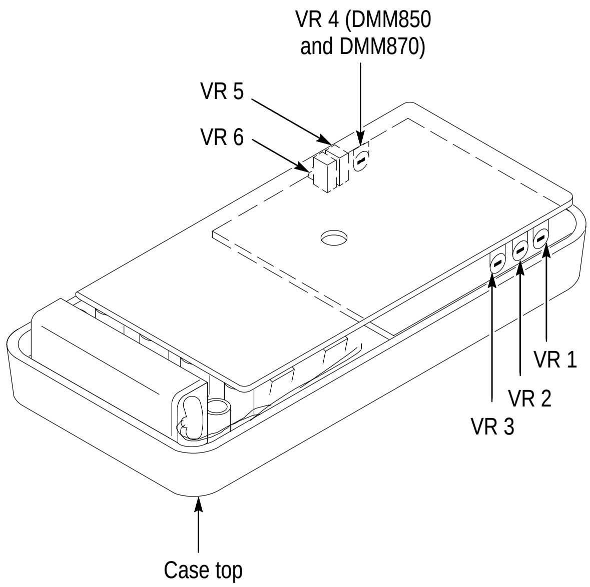

Figure 3: Adjustment locations 1

DC Volts

Perform the following steps to adjust the DC voltage calibration.

1. Set the multimeter dial to V⎓.
2. Set the calibrator to output 3.0000 VDC.
3. Connect the outputs of the calibrator to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
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. Set the calibrator to output 2.0000 VAC at 60 Hz.
3. Connect the outputs of the calibrator to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
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:
      - Set the calibrator output to 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.
      - Set the calibrator output to ON.
   b. Using Wavetek 9100 with 9105 front porch:
      - Set the calibrator output to 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.
      - Set the calibrator output to 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.

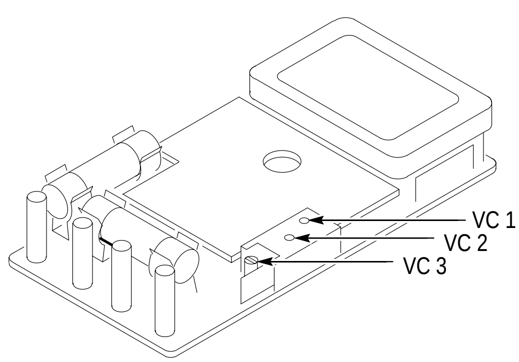

Figure 4: Adjustment locations 2

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. Set calibrator to output 100 VAC at 10 kHz (sinewave).
4. Connect the outputs of the calibrator to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
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.

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

070-9851-00

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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.

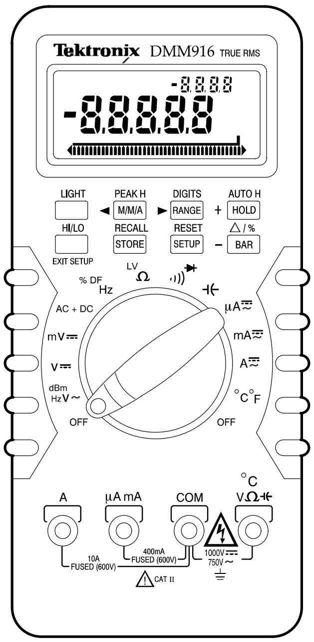

Figure 1: DMM916 Digital Multimeter

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	●	●	●

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 dry cell battery
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
A connector	15 A (600 V) fast blow fuse
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.

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

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements listed in Table 8.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification 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 18 through 31 contain *Test Records* for the DMM91X series multimeters. Each model has its own test record. Photocopy the *Test Records* pages for your model and use them 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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:

- Set the calibrator output to 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.
- Set the calibrator output to ON.

b. Using Wavetek 9100 with 9105 front porch:

- Set the calibrator output to 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.
- Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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. Set the calibrator output to 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 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 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.

DMM912 Test Records

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-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.**

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 14 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 Records

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.**

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.**

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.**

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 14 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 Records

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.**

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

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.**

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.**

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 14 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
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
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.**

Adjustment Procedures

This section contains procedures to adjust DMM912, DMM914, and DMM916 multimeters. Perform these procedures once a year or if the *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 *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 9 is a complete list of equipment needed for the adjustment procedures. These procedures assume that the test equipment is operating within tolerance.

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 39.

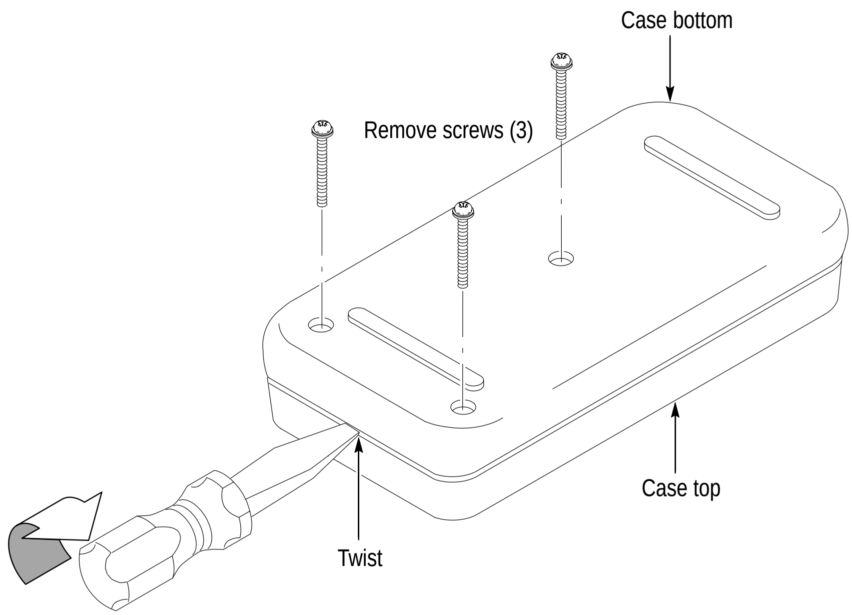

Figure 2: Opening the Meter Case

Adjustments Part 1

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

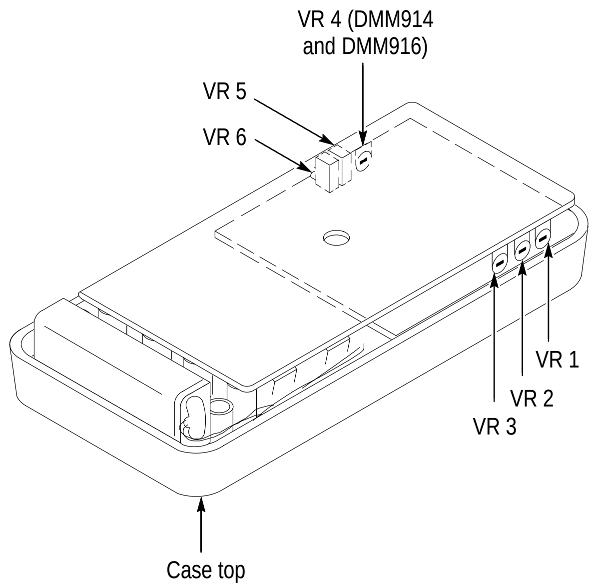

Figure 3: Adjustment locations 1

DC Volts

Perform the following steps to adjust the DC voltage calibration.

1. Set the multimeter dial to V⎓.
2. Set the calibrator to output 3.0000 VDC.
3. Connect the outputs of the calibrator to the °C V Ω ⊣⊢ and COM input connectors of the multimeter.
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. Set the calibrator to output 2.0000 VAC at 60 Hz.

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

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:

- Set the calibrator output to 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.
- Set the calibrator output to ON.

b. Using Wavetek 9100 with 9105 front porch:

- Set the calibrator output to 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.
- Set the calibrator output to 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.

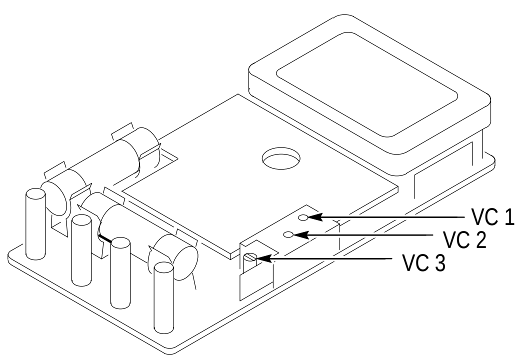

Figure 4: Adjustment locations 2

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

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

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.

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

070-9852-00

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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)

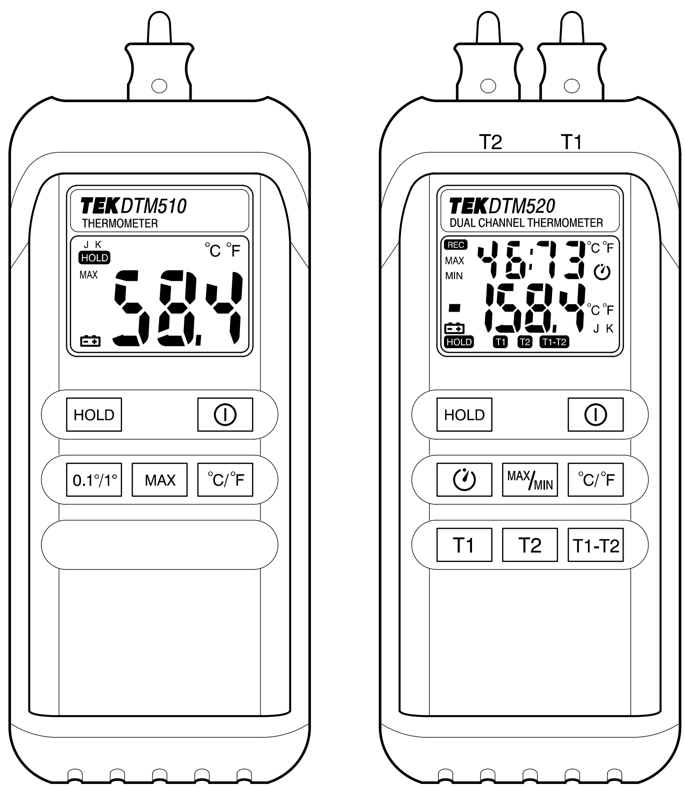

Figure 1: DTM510 & DTM520 Digital Thermometers

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 (NEDA 1604, JIS 006P, IEC 6F22 size)
Battery life (Alkaline)	
DTM510	250 hours
DTM520	90 hours

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).

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 4.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification 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 records on pages 7 through 9. Use them 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.*

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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 records; then verify that the thermometer display reads within the specified Low and High limits.

DTM510 Test Record

Serial Number	Procedure Performed By	Date

Resolution	Temperature	Low Limit	Test Result	High Limit
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

Probe Type	Temperature	Low Limit	Test Result	High Limit
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	Low limit	Test result	High limit
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°

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 *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.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the adjustment 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 (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°

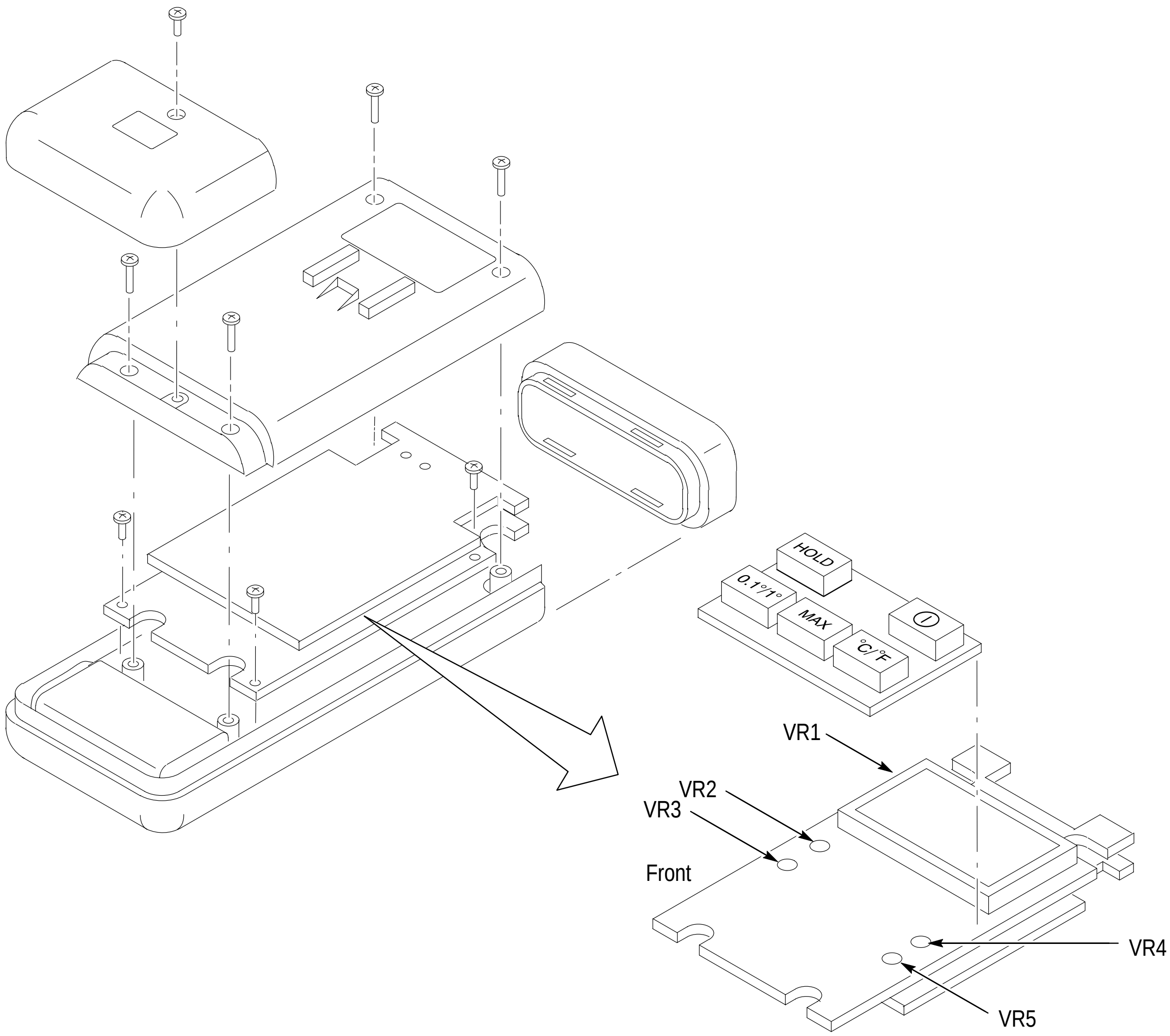

Figure 2: DTM510 Thermometer Disassembly and Adjustment Locations

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 12 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.

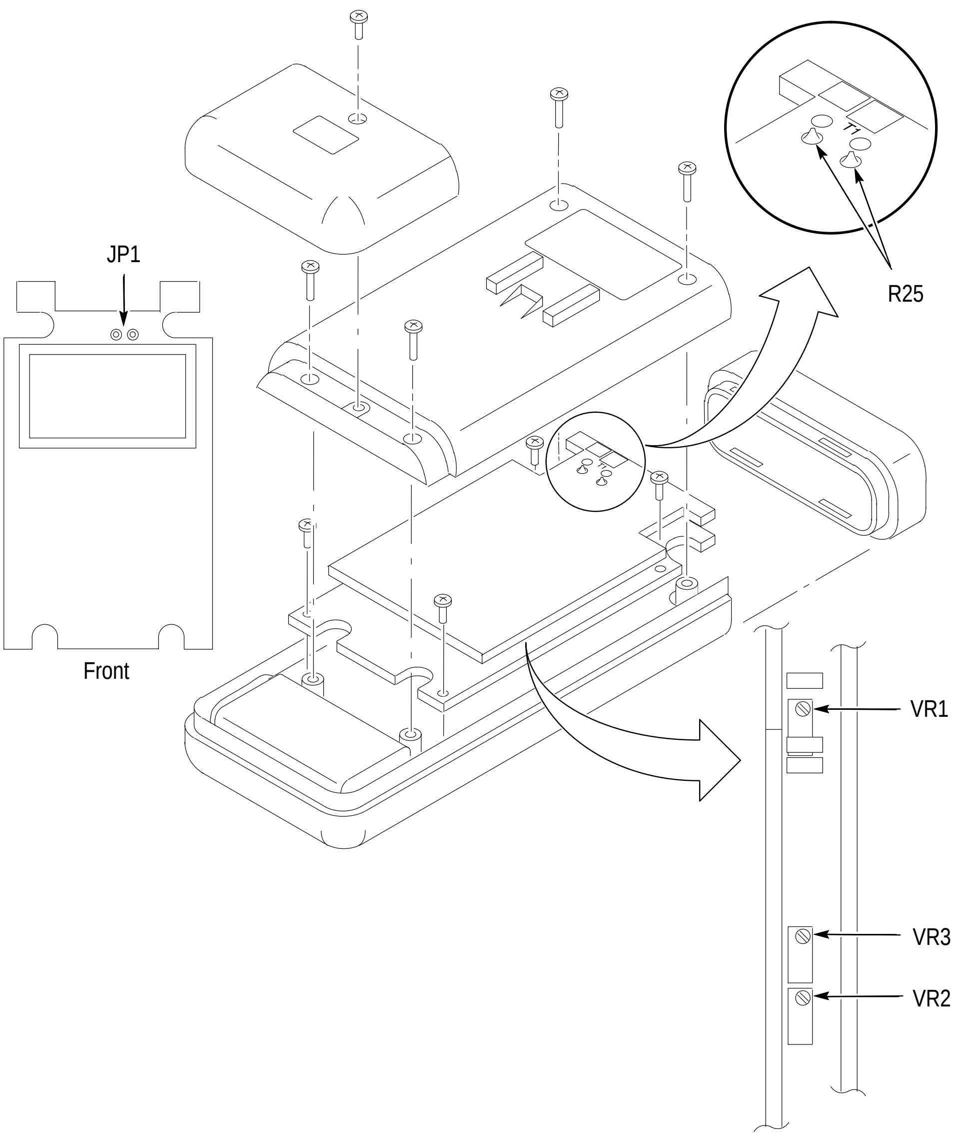

Figure 3: DTM520 Thermometer Disassembly, Test Points, and Adjustment Locations

Instructions Manual

Tektronix

DTM900 and DTM920
Digital Thermometers

070-9853-00

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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)

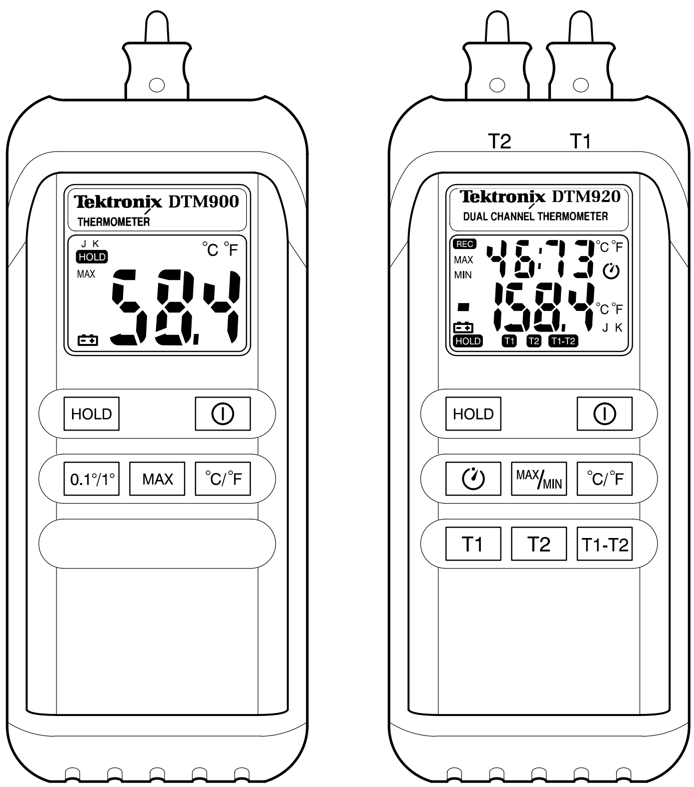

Figure 1: DTM900 & DTM920 Digital Thermometers

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 (NEDA 1604, JIS 006P, IEC 6F22 size)
Battery life (Alkaline)	
DTM900	250 hours
DTM920	90 hours

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).

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 4.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification 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 records on pages 7 through 9. Use them 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 Low and High limits.

DTM900 Test Record

Serial Number	Procedure Performed By	Date

Resolution	Temperature	Low Limit	Test Result	High Limit
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

Probe Type	Temperature	Low Limit	Test Result	High Limit
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	Low limit	Test result	High limit
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°

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 *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. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 6.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the adjustment 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°

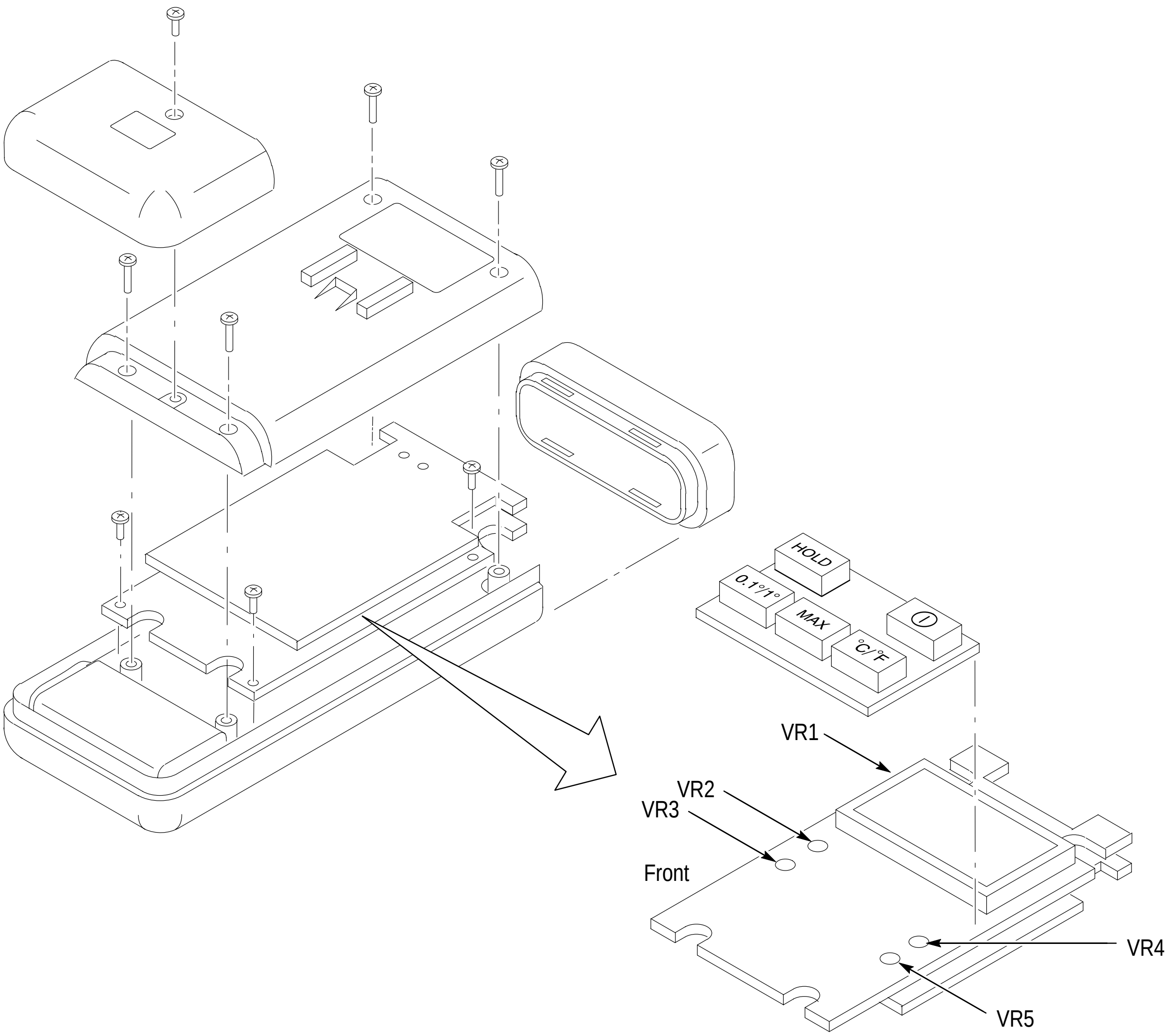

Figure 2: DTM900 Thermometer Disassembly and Adjustment Locations

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 12 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.

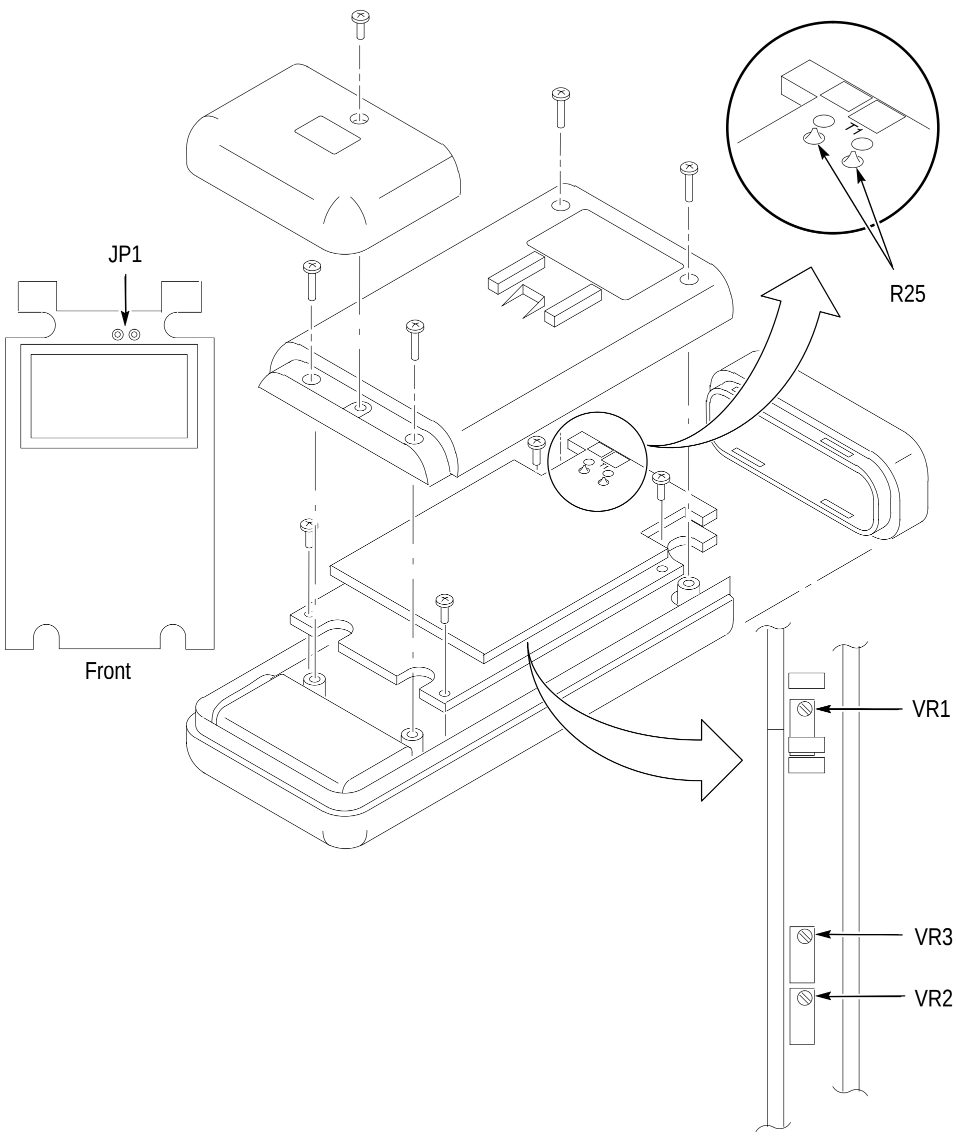

Figure 3: DTM920 Thermometer Disassembly, Test Points, and Adjustment Locations

Instructions Manual

Tektronix

PS280 and PS283
Power Supplies

070-9894-00

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PS280 and PS283 Power Supplies

The Tektronix PS280 and PS283 Laboratory DC Power Supplies are multifunction benchtop or portable instruments. These regulated triple output power supplies provide one fixed 5 V, 3 A output suitable for powering logic circuits and two variable 0 to 30 V outputs useful in a wide variety of test and experimental uses.

The current output of the PS280 varies from 0 to 2 A. The current output of the PS283 varies from 0 to 1 A. In all other respects, the instruments are identical. Unless otherwise noted, descriptions and procedures in this manual apply to both instruments.

The front panel switches provide three modes of operation for the PS280 and PS283 power supplies:

- Independent mode: the output voltage and current of each supply is controlled independently.
- Series mode: the variable outputs are connected in series and the controls of the MASTER power supply adjust the voltages or currents of both supplies. Series mode allows the supplies to vary from 0 to 60 V at 0 to 2 A for the PS280 and 0 to 60 V at 0 to 1 A for the PS283.
- Parallel mode: the variable outputs are connected in parallel and the controls of the MASTER power supply adjust the voltages or currents of both supplies. Parallel mode allows the supplies to vary from 0 to 4 A at 0 to 30 V for the PS280 and 0 to 2 A at 0 to 30 V for the PS283.

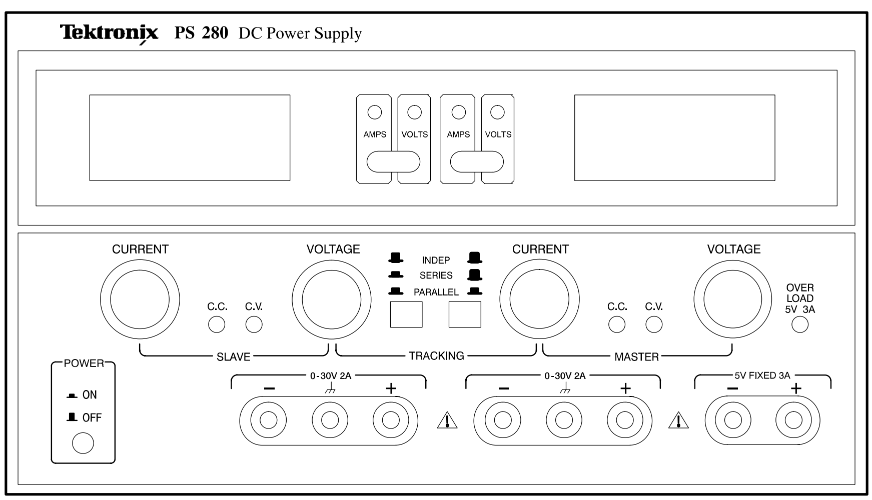

Figure 1: PS280 DC Power Supply

Specifications

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

- The instrument operates in a 0° to 40° C (32° to 104° F) ambient environment, unless otherwise noted.
- The instrument warms up for at least twenty minutes.

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

Table 1: Operational Characteristics

Characteristic	Description
Outputs	One fixed 5 VDC, two variable 0 to 30 VDC
Voltage (5 V Fixed Supply)	5.0 VDC ±0.25 VDC at 3.0 A maximum, foldback current limited
Voltage (0 to 30 V Supplies)	PS280: 0 to 30 VDC constant at 2.0 A constant, maximum PS283: 0 to 30 VDC constant at 1.0 A constant, maximum
Line regulation	
5 V	< 5 mV
CV	PS280: ≤ 0.01% + 3 mV PS283: ≤ 0.01% + 5 mV
CC	≤ 0.2% + 3 mA
Load regulation	
5 V	≤ 0.2%
CV	≤ 0.01% + 3 mV (rating current ≤ 3 A) ≤ 0.01% + 5 mV (rating current > 3 A PS280) ≤ 300 mV (0 to 60 VDC single series tracking supply)
CC	≤ 0.2% + 3 mA

Table 1: Operational Characteristics (Cont.)

Characteristic	Description
Ripple and Noise	
5 V	$\leq$ 2 mV_{RMS}
CV	5 Hz to 1 MHz: $\leq$ 1 mV_{RMS}
CC	$\leq$ 3 mA_{RMS}
Temperature coefficient (CV)	$\leq$ 300 ppm/°C
Recovery time (CV)	$\leq$ 100 µs (time to recover after a 50% load change with 0.5 A minimum)
Tracking error (SLAVE)	$\leq$ 0.5% + 10 mV of the MASTER supply
Indicator	Two 3½ digit, 0.5 inch LED panel displays
Meter indicators	0 to 30 VDC ±(0.5% of RDG + 2 digits) 0 to 2 A ±(0.5% of RDG + 2 digits)
Insulation	
Chassis to terminals	$\geq$ 20 MΩ at 500 VDC
Chassis to AC cord	$\geq$ 30 MΩ at 500 VDC

Table 2: Electrical Characteristics

Characteristic	Description
Line Voltage	90 to 110, 108 to 132, 198 to 242, and 216 to 250 VAC
Line Frequency	50 to 60 Hz
Power Consumption	PS280: 348 VA, 250 W maximum PS282: 254 VA, 172 W maximum

Table 3: Environmental Characteristics

Characteristic	Description
Operating Temperature	0° to 40° C (32° to 104° F), $\leq$ 70% relative humidity
Nonoperating Temperature	–10° to +70° C (14° to 158° F), $\leq$ 80% relative humidity

Table 4: Physical Characteristics

Characteristic	Description
Width	255 mm (10.04 inch)
Height	145 mm (5.71 inch)
Depth	335 mm (13.19 inch)
Weight	PS280: 11.5 kg (25.3 lb) PS283: 9.0 kg (19.8 lb)

Performance Verification

This section contains procedures to verify that PS280 or PS283 power supplies perform as warranted. Implement the performance verification procedures whenever the accuracy or function of your instrument 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 a 20° to 30° C (68° to 104° F) ambient environment.
- The instrument warms up for at least 20 minutes before the verification begins.
- The cabinet remains installed on the instrument.

The PS280 and PS283 performance verification consists of the checks listed in Table 5.

Table 5: Performance Verification Checks

Constant Current Load Regulation Check	
	MASTER Current Regulation (INDEP mode)
	SLAVE Current Regulation (INDEP mode)
	MASTER Current Regulation (PARALLEL mode)
Constant Current Ripple and Noise Check	
	MASTER Current Ripple
	SLAVE Current Ripple
Constant Voltage Regulation Check	
	MASTER Voltage Regulation
	SLAVE Voltage Regulation
	5 V Fixed Voltage Regulation

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 6.

Alternate test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification procedures.

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

Table 6: Performance Verification and Adjustment Test Equipment

Description	Minimum Requirements	Example Product
Oscilloscope	50 MHz, 3% vertical deflection accuracy	Tektronix TDS300 Series Oscilloscope
Digital Multimeter	35 V, 4 A, ±0.1% Accuracy	Tektronix DMM914 Digital Multimeter
Fixed Resistive Loads	20 Ω 30 W 10 Ω 30 W 2 Ω 5 W 1 Ω 30 W 7 Ω 140 W 0.5 Ω 5 W 15 Ω 70 W 30 Ω 140 W 7.5 Ω 140 W 30 Ω 40 W 60 Ω 70 W	
Variable Resistive Load	0 to 2 Ω 30 W	
Shorting Strap with Alligator Clips	Insulated	

Constant Current Load Regulation Check

To check the constant current load regulation of your power supply, perform the following tests.

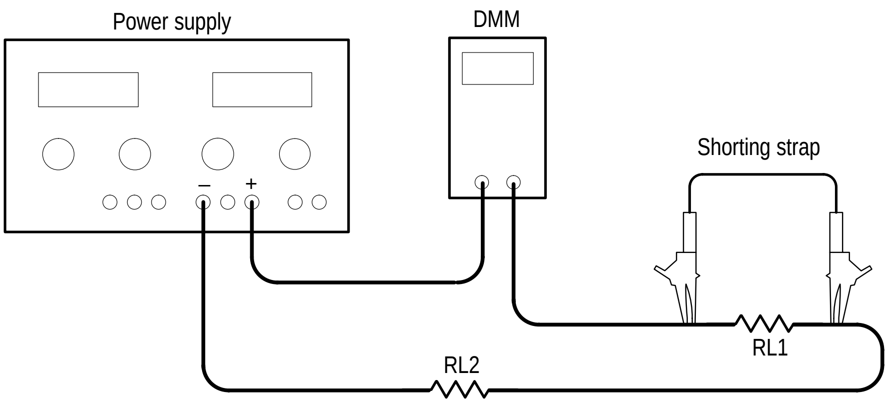

Figure 2: Constant Current Test Setup

MASTER Current Regulation (INDEP mode)

The following check verifies the INDEP mode MASTER current regulation performance.

1. Set the power supply to the INDEP operating mode by disengaging both TRACKING mode switches (both switches out).
2. Set the power supply MASTER AMPS/VOLTS selection switch to AMPS.
3. Set up the digital multimeter to measure 25 VDC.
4. Connect the digital multimeter to the + and – terminals of the power supply MASTER output.
5. Adjust the power supply MASTER VOLTAGE control until the multimeter reads 25 VDC.
6. Disconnect the digital multimeter from the power supply.
7. Set the digital multimeter to measure a DC current of at least 1 A (PS280) or 0.5 A (PS283).
8. Connect the digital multimeter and load resistors to the + and – terminals of the power supply MASTER output as shown in Figure 2. See Table 7 for the appropriate load resistor values.
9. Verify that the power supply output current varies less than 0.2% ±3 mA while shunting load resistor RL1 with the shorting strap. See Figure 2 above.

Table 7: Load Resistor Values for Current Checks

Mode	PS280		PS283	
	RL1	RL2	RL1	RL2
INDEP	20 Ω, 30 W	2 Ω, 5 W	20 Ω, 30 W	2 Ω, 5 W
PARALLEL	10 Ω, 30 W	1 Ω, 30 W	10 Ω, 30 W	1 Ω, 30 W

SLAVE Current Regulation (INDEP Mode)

The following check verifies the INDEP mode SLAVE current regulation performance.

1. Set the power supply SLAVE AMPS/VOLTS meter selection switch to AMPS.
2. Set up the digital multimeter to measure 25 VDC.
3. Connect the digital multimeter to the + and – terminals of the power supply SLAVE output.
4. Adjust the power supply SLAVE VOLTAGE control until the multimeter reads 25 VDC.
5. Disconnect the digital multimeter from the power supply.
6. Set the digital multimeter to measure a DC current of at least 1 A (PS280) or 0.5 A (PS283).
7. Connect the digital multimeter and load resistors to the + and – terminals of the power supply SLAVE output as shown in Figure 2. See Table 7 for the appropriate load resistor values.
8. Verify that the power supply output current varies less than 0.2% ±3 mA while shunting load resistor RL1 with the shorting strap. See Figure 2 above.

MASTER Current Regulation (PARALLEL Mode)

The following check verifies the PARALLEL mode MASTER current regulation performance.

1. Set the power supply to the PARALLEL operating mode by engaging both TRACKING mode switches (both switches in).
2. Set up the digital multimeter to measure 25 VDC.
3. Connect the digital multimeter to the + and – terminals of the power supply MASTER output.
4. Adjust the power supply MASTER VOLTAGE control until the digital multimeter reads 25 VDC.
5. Disconnect the digital multimeter from the power supply.

6. Set the digital multimeter to measure a DC current of at least 1 A (PS280) or 0.5 A (PS283).

7. Connect the digital multimeter and load resistors to the + and – terminals of the power supply MASTER output as shown in Figure 2. See Table 7 for the appropriate load resistor values.

8. Verify that the power supply output current varies less than 0.2% ±5 mA while shunting load resistor RL1 with the shorting strap. See Figure 2 above.

Constant Current Ripple and Noise Check

To check the constant current ripple and noise performance of your power supply, perform the following tests.

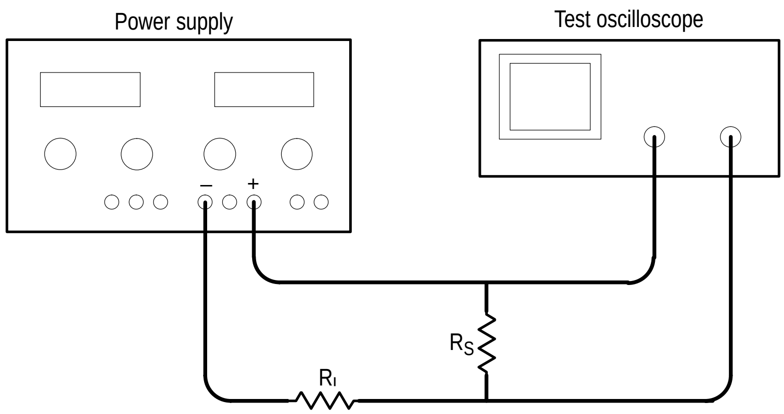

Figure 3: Constant Current Ripple and Noise Test Setup

MASTER Current Ripple

The following check verifies the MASTER current ripple.

1. Set the power supply to the INDEP operating mode by disengaging both TRACKING switches (both switches out).

2. Set the power supply MASTER AMPS/VOLTS meter selection switch to VOLTS.

3. Set the power supply to 25 VDC using the digital display.

4. Connect the test oscilloscope and load resistors to the + and – terminals of the MASTER output as shown in Figure 3. See Table 8 for the appropriate load resistor values.

5. Verify that the peak-to-peak ripple viewed on the oscilloscope is less than 3 mV.

6. Set the power supply to the PARALLEL operating mode by engaging both TRACKING mode switches (both switches in).
7. Verify that the peak-to-peak ripple viewed on the oscilloscope is less than 2.5 mV.
8. Set the power supply to the SERIES operating mode by disengaging the right TRACKING mode switch (switch out).
9. Verify that the peak-to-peak ripple viewed on the oscilloscope is less than 5 mV.

Table 8: Load Resistor Values for Ripple Checks

	PS280		PS283	
Mode	R_L	R_S	R_L	R_S
INDEP	15 Ω, 70 W	0.5 Ω, 5 W	30 Ω, 40 W	0.5 Ω, 5 W
PARALLEL	7 Ω, 140 W	10 Ω, 30 W	15 Ω, 70 W	0.5 Ω, 5 W

SLAVE Current Ripple

The following check verifies the SLAVE current ripple.

1. Set the power supply to INDEP operating mode by disengaging both TRACKING switches (both switches out).
2. Set the power supply SLAVE AMPS/VOLTS meter switch to VOLTS.
3. Set the power supply to 25 VDC using the digital display.
4. Connect the test oscilloscope and load resistors to the + and – terminals of the SLAVE output as shown in Figure 3. See Table 8 for the appropriate load resistor values.
5. Verify that the peak-to-peak ripple viewed on the oscilloscope is less than 3 mV.

Constant Voltage Regulation Check

To check the constant voltage regulation of your power supply, perform the following tests.

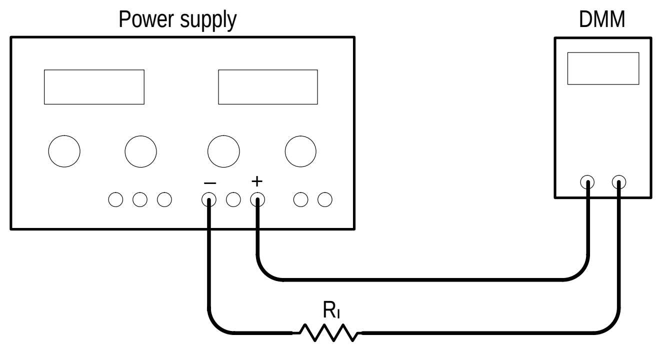

Figure 4: Constant Voltage Test Setup

MASTER Voltage Regulation

The following check verifies the MASTER voltage regulation performance.

1. Set the power supply to the INDEP operating mode by disengaging both TRACKING mode switches (both switches out).
2. Set up the digital multimeter to measure 60 VDC.
3. Connect the digital multimeter and load resistors to the + and – terminals of the power supply MASTER output as shown in Figure 4. See Table 9 for the appropriate load resistor values.
4. Verify that you can adjust the power supply from 0 to 30 V.
5. Set the power supply to the SERIES operating mode by engaging the left TRACKING mode switch (switch in) and disengaging the right TRACKING mode switch (switch out).
6. Verify that you can adjust the power supply from 0 to 60 V.
7. Set the power supply to the PARALLEL operating mode by engaging both TRACKING mode switches (both switches in).
8. Verify that you can adjust the power supply from 0 to 30 V.

Table 9: Load Resistor Values for Voltage Checks

Mode	PS280 R_L	PS283 R_L
INDEP	15 Ω, 70 W	30 Ω, 40 W
SERIES	30 Ω, 140 W	60 Ω, 70 W
PARALLEL	7.5 Ω, 140 W	15 Ω, 70 W
5V FIXED	1.7 Ω, 20 W	1.7 Ω, 20 W

SLAVE Voltage Regulation

The following check verifies the SLAVE voltage regulation performance.

1. Set the power supply to the INDEP operating mode by disengaging both TRACKING mode switches (both switches out).
2. Set up the digital multimeter to measure 30 VDC.
3. Connect the digital multimeter and load resistors to the + and – terminals of the SLAVE output as shown in Figure 4. See Table 9 for the appropriate load resistor values.
4. Verify that you can adjust the power supply from 0 to 30 V.

5 V Fixed Voltage Regulation

The following check verifies the 5 V fixed voltage regulation performance.

1. Set up the digital multimeter to measure 5 VDC.
2. Connect the digital multimeter and load resistors to the 5V FIXED 3A terminals. Use the test setup illustrated in Figure 4. See Table 9 for the appropriate load resistor values.
3. Verify that the power supply maintains an output of 5 V, ±0.25 V

Adjustment Procedures

This section contains procedures to adjust PS280 and PS283 power supplies. 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 instruments for adjustment
- Step-by-step adjustment procedures

The procedures in this section do not verify performance. To confirm that your power supply meets factory specifications, implement the procedures in the *Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 10 to return PS280 and PS283 power supplies to factory calibration.

Table 10: PS280 and PS283 Adjustments

Independent Mode Adjustments	
	MASTER Voltage Output
	SLAVE Voltage Output
	MASTER Current Output
SERIES Tracking Mode Adjustments	
	Series Tracking
PARALLEL Tracking Mode Adjustments	
	Parallel Tracking
5 V Fixed Output Adjustments	
	5 V Output
	Current Limit
	Overload Indicator

Test Equipment

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

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

Preparation for Adjustment

The following guidelines apply to all PS280 and PS283 power supply adjustments:

- Perform the adjustments in a 20° to 30° C (68° to 104° F) ambient environment with a relative humidity of 75% or less.
- Before making any adjustment, warm up the instrument for at least 20 minutes.
- Read the *Safety Summary* at the beginning of this manual.
- Do not alter any setting without reading the entire adjustment procedure first.
- Do not alter any setting unless a performance characteristic cannot be met at the current setting.

Remove Instrument Cover

You must remove the instrument cover to make internal adjustments.

***WARNING.** To avoid electrical shock, disconnect the power cord from its source while removing the instrument cover. Following the adjustment procedure, replace the instrument cover before using the power supply.*

To remove the instrument cover, refer to Figure 5 while performing the following steps.

1. Remove the two handle mounting screws and remove the handle.
2. Remove the three screws on the left side and the three screws on the right side of the instrument.
3. Slide the cover toward the rear of the instrument and lift.

To reinstall the cover, perform steps 1 through 3 above in reverse order.

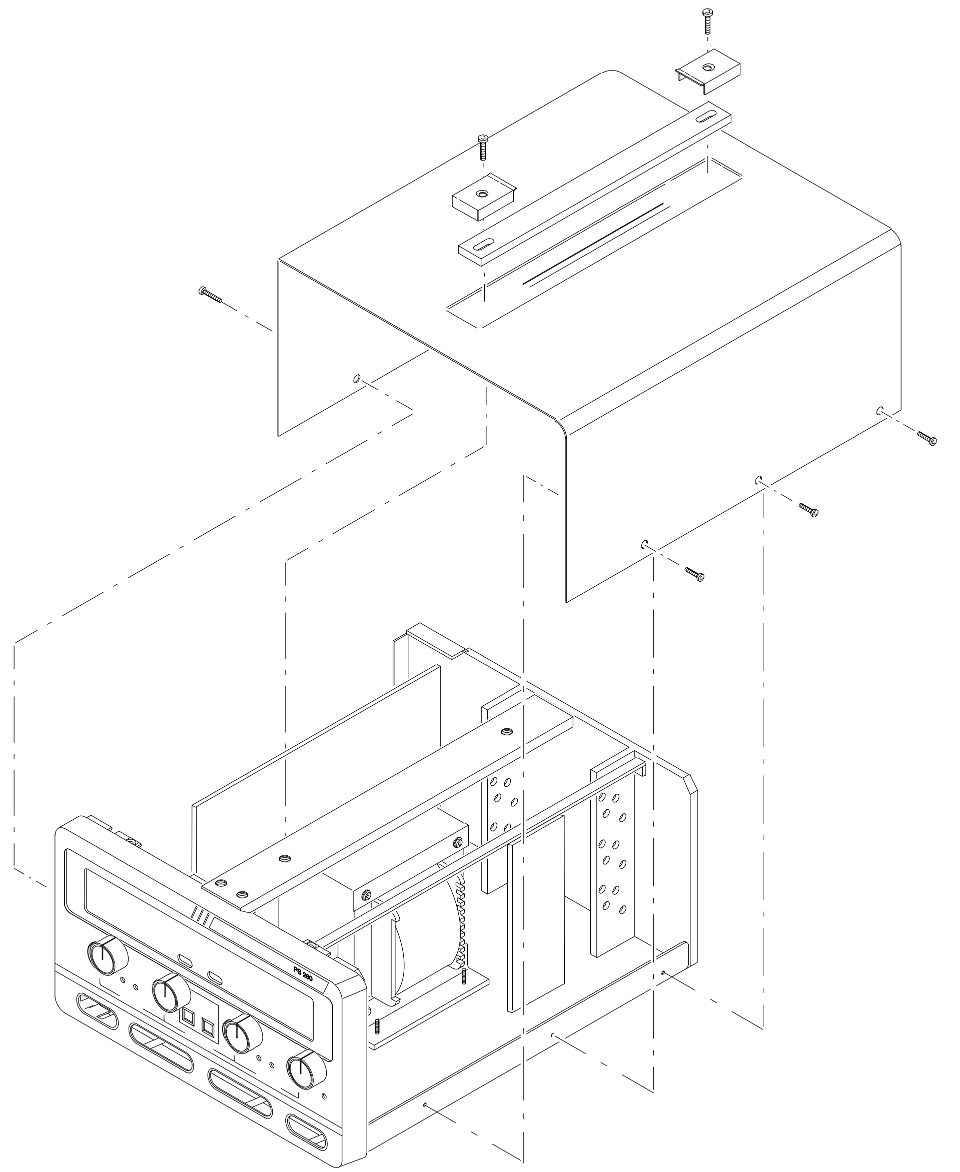

Figure 5: PS280/PS283 Instrument Cover Removal

Circuit Board Locations

Refer to Figure 6 to locate PS280/PS283 internal circuit boards.

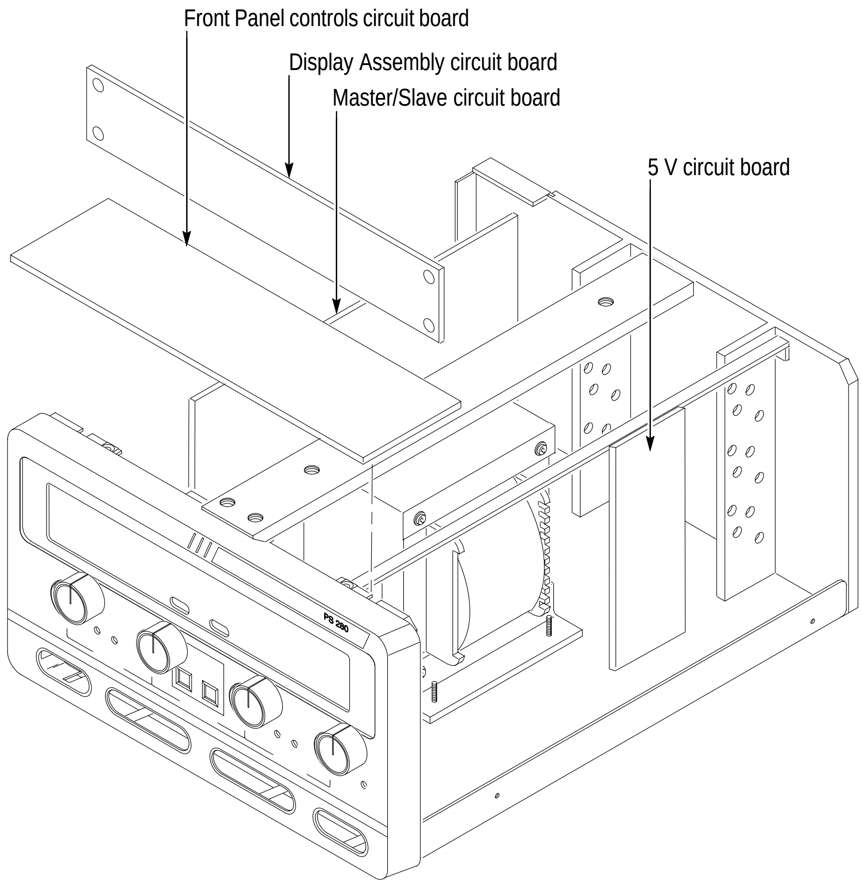

Figure 6: PS280/PS283 Internal Circuit Board Locations

Independent Mode Adjustments

Refer to Figures 6, 7, and 8 for the circuit board and adjustment locations used in this procedure.

MASTER Voltage Output

To adjust the MASTER voltage output, perform the following steps.

1. Disengage both TRACKING mode switches (both switches out) so that the power supply is in the INDEPendent operating mode.
2. Set the MASTER AMPS/VOLTS meter selection switch to VOLTS.
3. Set the digital multimeter to measure a DC voltage of ±16 mV.
4. Set the PS280/PS283 MASTER VOLTAGE control to minimum (fully counterclockwise).
5. Connect the digital multimeter to the + and – terminals of the MASTER output.
6. Adjust VR102 (Master/Slave circuit board) for a reading of –15 mV, within ±15 mV on the multimeter.
7. Set the digital multimeter to measure a DC voltage of ±35 V.
8. Set the MASTER VOLTAGE control to maximum (fully clockwise).
9. Adjust VR101 (Master/Slave circuit board) for a reading of 31.5 V on the multimeter.
10. Adjust VR201 (Display Assembly circuit board) until the PS280/PS283 front panel display reads 31.5 V.
11. Disconnect the digital multimeter from the power supply.

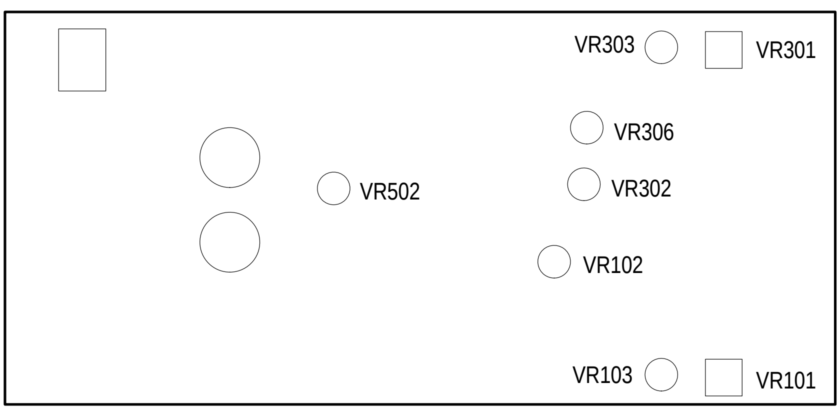

Figure 7: Master/Slave Circuit Board Adjustments

SLAVE Voltage Output

To adjust the SLAVE voltage output, perform the following steps.

1. Disengage both TRACKING mode switches (both switches out) so that the power supply is in the INDEPendent operating mode.
2. Set the SLAVE AMPS/VOLTS meter selection switch to VOLTS.
3. Set the digital multimeter to measure a DC voltage of ±16 mV.
4. Set the power supply SLAVE VOLTAGE control to minimum (fully counterclockwise).
5. Connect the digital multimeter to the + and – terminals of the SLAVE output.
6. Adjust VR302 (Master/Slave circuit board) for a reading of –15 mV, within ±15 mV on the multimeter.
7. Set the digital multimeter to measure a DC voltage of ±35 V.
8. Set the SLAVE VOLTAGE control to maximum (fully clockwise).
9. Adjust VR301 (Master/Slave circuit board) for a reading of 31.5 V on the multimeter.
10. Adjust VR601 (Display Assembly circuit board) until the PS280/PS283 front panel display reads 31.5 V.
11. Disconnect the digital multimeter from the power supply.

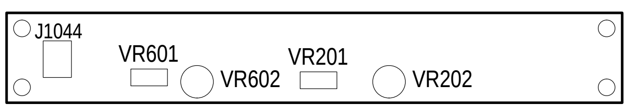

Figure 8: Display Assembly Circuit Board Adjustments

MASTER Current Output

To adjust the MASTER current output, perform the following steps.

1. Disengage both TRACKING mode switches (both switches out) so the power supply is in the INDEPendent operating mode.
2. Set the MASTER AMPS/VOLTS meter selection switch to AMPS.
3. Set the digital multimeter to measure a DC current of 2 A.
4. Connect the digital multimeter to the + and – terminals of the MASTER output.
5. Set the MASTER CURRENT control to maximum (fully clockwise).

6. Adjust VR103 (Master/Slave circuit board) for a reading of 1.05 A (PS283) or 2.1 A (PS280) on the multimeter.
7. Adjust VR202 (Display Assembly circuit board) until the PS280/PS283 front panel display reads 1.05 A (PS283) or 2.1 A (PS280).
8. Disengage both TRACKING mode switches (both switches out) so that the power supply is in the INDEPendent operating mode.
9. Set the SLAVE AMPS/VOLTS meter selection switch to AMPS.
10. Set the digital multimeter to measure a DC current of 2 A.
11. Connect the digital multimeter to the + and – terminals of the SLAVE output.
12. Set the SLAVE CURRENT control to maximum (fully clockwise).
13. Disconnect the digital multimeter from the power supply.

Series Tracking Mode Adjustments

Refer to Figures 6, 7, and 9 for the circuit board and adjustment locations used in this procedure.

SERIES Tracking

To adjust the series tracking mode, perform the following steps.

1. Engage the left TRACKING mode switch (switch in) and disengage the right TRACKING mode switch (switch out) so that the power supply is in the SERIES operating mode.
2. Set the SLAVE CURRENT control to midrange.
3. Set the MASTER VOLTAGE control to minimum (fully counterclockwise).
4. Set the digital multimeter to measure a DC voltage of ±16 mV.
5. Connect the digital multimeter to the + and – terminals of the MASTER output and note the reading obtained.
6. Connect the digital multimeter to the + and – terminals of the SLAVE output.
7. Adjust VR306 (Master/Slave circuit board) until the voltage output of the SLAVE output matches the reading obtained from the MASTER output.
8. Set the MASTER VOLTAGE control to maximum (fully clockwise).
9. Set the digital multimeter to measure a DC voltage of ±35 V.

10. Connect the digital multimeter to the + and – terminals of the MASTER output and note the reading obtained.

11. Connect the digital multimeter to the + and – terminals of the SLAVE output.

12. Adjust VR501 (Front Panel Controls circuit board) until the voltage of the SLAVE output matches the reading obtained from the MASTER output in step 10 above.

13. Recheck the value of the MASTER output compared to the value of the SLAVE output. Readjust VR501 if the outputs do not match.

14. Disconnect the test setup.

Figure 9: Front Panel Controls Circuit Board Adjustments

Parallel Tracking Mode Adjustments

Refer to Figures 6 and 7 for the circuit board and adjustment locations used in this procedure.

PARALLEL Tracking

To adjust the PARALLEL tracking Mode, perform the following steps.

1. Disengage both TRACKING mode switches (both switches out) so that the power supply is in the INDEPendent operating mode.

2. Set the MASTER VOLTAGE and CURRENT controls to minimum (fully counterclockwise).

3. Set the digital multimeter to measure a DC current of 4 A.

4. Connect the digital multimeter to the + and – terminals of the MASTER output.

5. Set the MASTER VOLTAGE control to midrange and adjust the MASTER CURRENT control until a reading of 1 A (PS283) or 2 A (PS280) is displayed on the multimeter.

***NOTE**. Do not readjust the CURRENT control setting through the remainder of this procedure.*

6. Engage both TRACKING switches (both switches in) so that the power supply is in the PARALLEL operating mode.
7. Set the SLAVE CURRENT control to maximum (fully clockwise) and set the SLAVE VOLTAGE control to midrange.
8. Adjust VR502 (Master/Slave circuit board) until a reading of 2 A (PS283) or 4 A (PS280) is displayed on the multimeter.
9. Disconnect the test setup.

5 V Fixed Output Adjustments

Refer to Figures 6 and 10 for the circuit board and adjustment locations used in this procedure.

5 V Output

To adjust the 5 V fixed output, perform the following steps.

1. Set the digital multimeter to measure a DC voltage of +5.25 V.
2. Connect the digital multimeter to the terminals of the 5 V FIXED 3A output.
3. Adjust VR401 (5 V circuit board) until the multimeter displays 5.00 V ±0.25 V.
4. Disconnect the multimeter from the power supply.

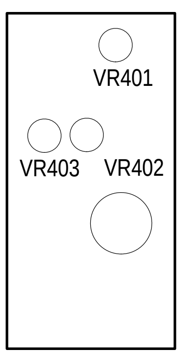

Figure 10: 5 V Circuit Board Adjustments

Current Limit

To adjust the current limit, perform the following steps.

1. Set the digital multimeter to measure a DC current of 3.25 A.
2. Adjust VR403 (5 V circuit board) fully counterclockwise.
3. Connect a variable load and the multimeter in series to the terminals of the 5 V FIXED 3A output.
4. Adjust the variable load until the multimeter displays 3.25 A.
5. Disconnect the multimeter from the power supply and reconnect the variable load (without changing the setting) to the terminals of the 5 V FIXED 3A output.
6. Set the digital multimeter to measure a DC voltage of +5.25 V.
7. Connect the digital multimeter to the terminals of the 5 V FIXED 3A output.
8. Slowly adjust VR403 (5 V circuit board) clockwise until the multimeter display shows a voltage drop of 5 to 6 mV.
9. Disconnect the test setup.

Overload Indicator

To adjust the current limit overload indicator, perform the following steps.

1. Set the digital multimeter to measure a DC current of 3.25 A.
2. Connect a variable load and the multimeter in series to the terminals of the 5 V FIXED 3A output.
3. Adjust the variable load until the multimeter displays 3.10 A.
4. Adjust VR402 (5 V circuit board) until the OVERLOAD 5V3A indicator starts to light on the power supply.
5. Disconnect the test setup.

Instructions Manual

Tektronix

PS2520 Series
Power Supplies

070-9854-00

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PS2520 Series Power Supplies

The Tektronix PS2520, PS2520G, PS2521, and PS2521G power supplies are multifunction benchtop or portable instruments. All PS2520 series power supplies include the following standard features:

- Three high stability low drift outputs (outputs may be configured for independent, series, or parallel operation)
- Automatic series or parallel tracking
- Push-button controls
- Keypad and up-down key data entry
- Four-digit display of voltage and current
- High resolution digital-to-analog converter
- Memory storage and recall
- Display readout of output, memory, and error codes
- Automatic sequencing with timer
- Self-test diagnostic at power up
- Overvoltage protection (OVP) and overcurrent protection (OCP)

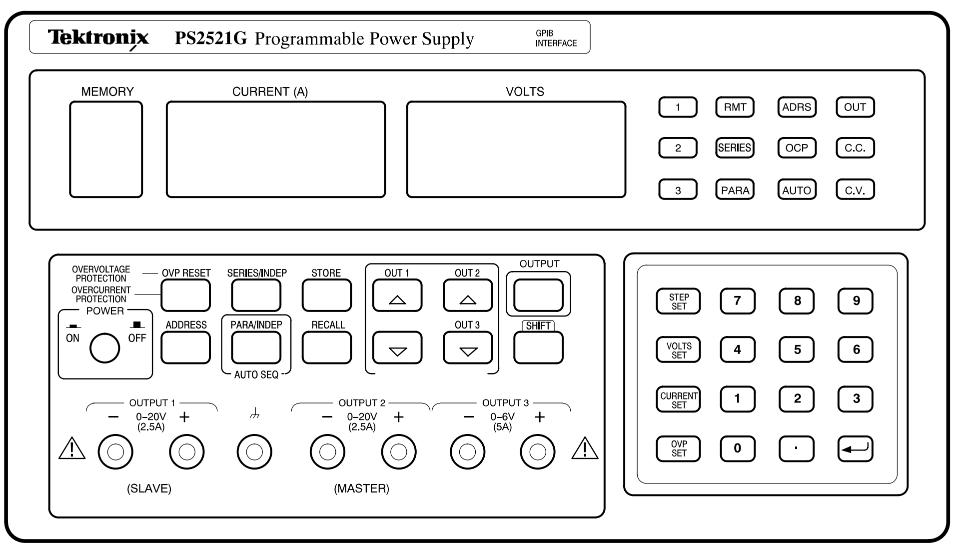

Figure 1: PS2520 and PS2521G Power Supply

The descriptions and procedures in the following sections apply to all PS2520 series power supplies (unless specifically noted), with the following exceptions:

- The PS2520 and PS2520G power supplies have two variable outputs providing 0 to 36 V at 0 to 1.5 A and one variable output providing 0 to 6 V at 0 to 3A.
- The PS2521 and PS2521G power supplies have two variable outputs providing 0 to 20 V at 0 to 2.5 A and one variable output providing 0 to 6 V at 0 to 5 A.
- The PS2520G and PS2521G include General Purpose Interface Bus (GPIB) operation.

Specifications

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

- The power supply operates in a 20° to 30° C (68° to 86° 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: Operational Characteristics

Characteristic	Description
Independent Output Ratings	
PS2520 and PS2520G	Two outputs: 0 to 36 V at 0 to 1.5 A One output: 0 to 6 V at 3 A
PS2521 and PS2521G	Two outputs: 0 to 20 V at 0 to 2.5 A One output: 0 to 6 V at 0 to 5 A
Series Tracking Output Rating	
PS2520 and PS2520G	0 to 72 V at 0 to 1.5 A
PS2521 and PS2521G	0 to 40 V at 0 to 2.5 A
Parallel Tracking Output Rating	
PS2520 and PS2520G	0 to 36 V at 0 to 3 A
PS2521 and PS2521G	0 to 20 V at 0 to 5 A
Maximum Overvoltage Protection	
PS2520 and PS2520G	36 V outputs: 38.5 V 6 V output: 7.0 V
PS2521 and PS2521G	20 V outputs: 22.5 V 6 V output: 7.0 V
Load Effect	
Voltage	Rear output: ≤3 mV Front output: ≤6 mV
Current	≤3 mA (≤6 mA if rating current > 3.5 A)
Source Effect	
Voltage	≤3 mV
Current	≤3 mA

Table 1: Operational Characteristics (Cont.)

Characteristic	Description
Resolution	
Voltage	10 mV (20 mV if rating voltage > 36 V)
Current	1 mA (2 mA if rating current > 3.5 A)
Overvoltage Protection	10 mV (20 mV if rating voltage > 36 V)
Program Accuracy	
Voltage	≤0.05% + 25 mV (50 mV if rating voltage > 36 V)
Current	≤0.2% + 10 mA
Overvoltage Protection	≤2% + 0.6 V
Ripple and Noise 20 Hz to 20 MHz	
Voltage Ripple	1 mV_{RMS} (3 mV_{p-p})
Voltage Noise	2 mV_{RMS} (30 mV_{p-p})
Current	≤3 mA_{RMS} (≤5 mA_{RMS} if rating current > 3.5 A)
Temperature Coefficient 0° to 40° C (32° to 104° F)	
Voltage	≤100 ppm + 3 mV
Current	≤150 ppm + 3 mA
Readback Resolution	
Voltage	10 mV (20 mV if rating voltage > 36 V)
Current	1 mA (2 mA if rating current > 3.5 A)
Readback Accuracy	
Voltage	≤0.05% + 25 mV (50 mV if rating voltage > 36 V)
Current	≤0.2% + 10 mA
Response Time	
10 to 90% (up)	≤100 ms
90 to10% (down)	≤100 ms (≥10% rating load)
Readback Temperature Coefficient	
Voltage	≤100 ppm + 10 mV (20 mV if rating voltage > 36V)
Current	≤150 ppm + 10 mA
Drift[1]	
Voltage	≤0.03% + 6 mV
Current	≤0.1% + 6 mA
Series Tracking	
Tracking Error Voltage	≤0.1% + 50 mV
Load Effect Voltage	≤50 mV
Source Effect Voltage	≤3 mV

[1] **Change in output over an 8 hour interval with a constant line voltage, load, and ambient temperature. Requires a 30 minute warm-up.**

Table 1: Operational Characteristics (Cont.)

Characteristic	Description
Parallel Tracking	
Program Accuracy	
Voltage	≤0.05% + 25 mV (50 mV if rating voltage > 36 V)
Current	≤0.2% + 20 mA
Overvoltage Protection	≤2% + 0.6 V
Load Effect	
Voltage	≤3 mV rear output (≤6 mV front output)
Current	≤6 mA (≤12 mA if rating current > 3.5 A)
Source Effect	
Voltage	≤3 mV
Current	≤6 mA
GPIB Capability (Optional IEEE-488.2)	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E1
Memory Locations (Store and Recall)	00 to 49 (50 locations)
Timer	
Setting Time	1 to 65535 seconds
Resolution	1 second

Table 2: Electrical Characteristics

Characteristic	Description
Power Source	100, 120, and 220 VAC ±10% at 50 to 60 Hz 240 VAC –10%, +4.2%, at 50 to 60 Hz
Safety	ETL listed to UL 1244 Certified to CSA-C22.2 No 231-M89

Table 3: Environmental Characteristics

Characteristic	Description
Operating Temperature	0° to 40° C (32° to 104° F)
Nonoperating Temperature	–10° to +70° C (14° to 158° F)

Table 4: Physical Characteristics

Characteristic	Description
Width	255 mm (10.04 inch)
Height	145 mm (5.71 inch)
Depth	346 mm (13.62 inch)
Weight	10 kg (22 lbs)

Performance Verification

This section contains procedures to verify that PS2520, PS2520G, PS2521, or PS2521G power supplies perform as warranted. Implement the performance verification procedures whenever the accuracy or function of your power supply 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 a 20° to 30° C (68° to 86° F) ambient environment.
- The instrument warms up for at least 20 minutes.
- The cabinet remains installed on the instrument.

The PS2520 series performance verification consists of the checks listed in Table 5.

Table 5: Performance Verification Checks

Basic Function
Voltage Set Accuracy
Current Set Accuracy
Overvoltage Protection (OVP) Accuracy
Constant Voltage Load Accuracy
Constant Voltage Source Accuracy
Constant Voltage Ripple and Noise Accuracy
Constant Current Load and Overcurrent Protection (OCP) Accuracy
Constant Current Source Accuracy

There are two separate performance verification procedures for the PS2520/2520G and PS2521/2521G series instruments. The PS2520/2520G procedures begin on page 9; the PS2521/2521G procedures begin on page 32. Use the procedure appropriate to your instrument.

You will find the recommended test equipment and initial settings for all verification procedures listed on page 8.

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 6.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification procedures.

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

Table 6: Performance Verification Test Equipment

Description	Minimum Requirements	Example Product
Digital Multimeter (DMM)	500 V, 10 A, accuracy within ±0.01%	Fluke 8505A
Oscilloscope	20 MHz, 3% vertical deflection accuracy	Tektronix TDS300 Series
Electronic Load	40 V, 8 A CR mode	
Variac	0 to 250 V, 2 A	
Resistors	2.2 Ω 50 W, 27 Ω 100 W	

Set Up

Following a 20 minute warm-up period, preset your power supply to the settings listed in Table 7.

Table 7: Power Supply Initial Settings

Control	Setting
(SHIFT) RECALL	Enter 00 on keypad
AUTO SEQ	OFF
(SHIFT)	OUT 1
OCP	OFF
(SHIFT) SERIES/INDEP	INDEP
(SHIFT) PARA/INDEP	INDEP
OUTPUT	OFF
STEP SET (volts)	1
STEP SET (current)	0.1

PS2520 and PS2520G Checks

To verify the function and performance of the PS2520 and PS2520G power supplies, implement the following checks in sequential order. To verify the function and performance of the PS2521 and PS2521G power supplies, see page 32.

NOTE*. To clear a memory location, enter “0” as the VOLTS SET and CURRENT SET values; then save the “0” values to the desired memory location.*

For a list of error code descriptions, see your User manual.

Basic Function

Complete the following procedures to verify basic instrument function.

Outputs 1, 2, and 3. Use the following steps to verify OUTPUT 1, OUTPUT 2, and OUTPUT 3 basic function.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	10 V
CURRENT SET	1 A
OVP SET	38 V
DELAY	3 s

3. Press SHIFT → STORE → 1 ↵ to store the above values in the memory 01 location. Verify that the MEMORY, CURRENT (A), and VOLTS readouts display the values listed in step 2 for memory location 01.
4. Reset the power supply as follows:

VOLTS SET	11 V
CURRENT SET	1.1 A
OVP SET	38 V
DELAY	3 s

5. Press SHIFT → STORE → 2 ↵ to store the above values in the memory 02 location. Verify that the MEMORY, CURRENT (A), and VOLTS readouts display the values listed in step 4 for memory location 02.
6. Press SHIFT → RECALL; then enter 1.2 ↵.
7. Press RECALL LAST; verify that the readouts display the data stored in the memory 02 location.

8. Press RECALL LAST again; verify that the readouts now display the data stored in the memory 01 location.

9. Press RECALL NEXT; verify that the readouts display the data stored in the memory 02 location.

10. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

11. Press AUTO SEQ ON/OFF and verify that the “AUTO” indicator lights up on the display. Verify that the front panel readouts alternately display the memory 01 and memory 02 setups from steps 2 and 4 above, every three seconds.

12. Press AUTO SEQ ON/OFF and OUTPUT ON/OFF. Verify that the “AUTO” and “OUT” indicators turn off.

13. Press STEP SET. Set the VOLTS SET to 1.00 V.

14. Press VOLTS ▽ and verify that as you attempt to decrease the voltage below 0.00 V, “Err - 018” appears on the CURRENT (A) and VOLTS readouts. The voltage should decrease in 1 volt steps on the VOLTS readout.

15. Press VOLTS △ and verify that as you attempt to increase the voltage past 37.00 V, “Err - 016” appears on the readouts. The voltage should increase in 1 volt steps on the VOLTS readout.

16. Press STEP SET. Set the CURRENT SET to .1 A.

17. Press CURRENT ▽ and verify that as you attempt to decrease the current below 0.000 A, “Err - 019” appears on the readouts and the “C.C.” indicator lights. The current should decrease in .1 ampere steps on the CURRENT (A) readout.

18. Press CURRENT △ and verify that as you attempt to increase the current past 1.550 A, “Err - 017” appears on the readouts. The current should increase in .1 ampere steps on the CURRENT (A) readout.

To check the function of OUTPUT 2, press SHIFT → OUT 2. Verify that the “2” indicator lights up on the display; then repeat steps 2 through 18 above.

To check the function of OUTPUT 3, press SHIFT → OUT 3. Verify that the “3” indicator lights up on the display; then continue with the steps below.

19. Set up the power supply as follows:

VOLTS SET	5 V
CURRENT SET	2 A
OVP SET	7 V
DELAY	3 s

20. Press SHIFT→ STORE → 1 ↵ to store the above values in the memory 01 location. Verify that the MEMORY, CURRENT (A), and VOLTS readouts display the values listed in step 19 for memory location 01.

21. Reset the power supply as follows:

VOLTS SET	6 V
CURRENT SET	3 A
DELAY	3 s

22. Press SHIFT → STORE → 2 ↵ to store the above values in the memory 02 location. Verify that the MEMORY, CURRENT (A), and VOLTS readouts display the values set in step 21 for memory location 02.

23. Repeat steps 6 through 12 above.

24. Press STEP SET. Set the VOLTS SET to 1 V.

25. Press VOLTS ▽ and verify that as you attempt to decrease the voltage below 0.00 V, “Err - 018” appears on the CURRENT (A) and VOLTS readouts. The voltage should decrease in 1 volt steps on the VOLTS readout.

26. Press VOLTS △ and verify that as you attempt to increase the voltage past 6.50 V, “Err - 016” appears on readouts. The voltage should increase in 1 volt steps on the VOLTS readout.

27. Press STEP SET. Set the CURRENT SET to .1 A.

28. Press CURRENT ▽ and verify that as you attempt to decrease the current below 0.000 A, “Err - 019” appears on the readouts and the “C.C.” indicator lights. The current should decrease in .1 ampere steps on the CURRENT (A) readout.

29. Press CURRENT △ and verify that as you attempt to increase the current past 3.100 A, “Err - 017” appears on the readouts. The current should increase in .1 ampere steps on the CURRENT (A) readout.

OCP, Series, and Parallel Mode Indicators. Use the following steps to verify OCP, series, and parallel output indicator function.

1. On the power supply front panel, press OCP ON/OFF to enable the OCP. Verify that the “OCP” indicator lights up on the display.

2. Press OCP ON/OFF. Verify that the “OCP” indicator turns off.

3. Press SHIFT → SERIES/INDEP to configure the power supply outputs for series operation. Verify that the “SERIES” indicator lights up on the display.

4. Press SHIFT → PARA/INDEP to configure the power supply outputs for parallel operation. Verify that the “PARA” indicator lights up on the display.

5. Press SHIFT → PARA/INDEP again to reconfigure the outputs for independent operation. Verify that the “PARA” and “SERIES” indicators turn off.

Set GPIB. Use the following steps to check the GPIB address.

1. Press LOCAL.
2. Enter a GPIB address <0 to 30> and press ↵.
3. Press SHIFT → ADDRESS. Verify that the address entered in step 2 above appears on the readout for about one second.

Voltage Set Accuracy

Complete the following procedures to verify voltage setting and readout accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	36 V
OVP SET	37 V

3. Press STEP SET. Set the VOLTS SET to 0.05 V.
4. Ensure that the power supply output is disabled. Configure the DMM to measure 40 VDC across the front panel OUTPUT 1 (2) terminals.
5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Verify that the DMM reads between 35.950 and 36.050 VDC.
7. Press VOLTS △ or VOLTS ▽ to adjust the power supply output voltage until the DMM reads 36.00 VDC.
8. Verify that the power supply VOLTS readout indicates between 35.950 and 36.050 V.
9. Press VOLTS SET. Set the power supply output voltage to 0.1 V.
10. Set the DMM to measure 1 VDC across the power supply OUTPUT 1 (2) terminals.
11. Verify that the DMM reads between 0.0749 and 0.1250 VDC.
12. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

13. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.

14. Repeat steps 2 through 12 above to measure the OUTPUT 2 voltage setting and readout accuracy.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.

2. Set up the power supply as follows:

VOLTS SET	6 V
OVP SET	7 V

3. Press STEP SET. Set the VOLTS SET to 0.05 V.

4. Ensure that the power supply output is disabled. Configure the DMM to measure 10 VDC across the power supply front panel OUTPUT 3 terminals.

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

6. Verify that the DMM reads between 5.972 and 6.028 VDC.

7. Press VOLTS △ or VOLTS ▽ to adjust the power supply output voltage until the DMM reads 6.00 VDC.

8. Verify that the power supply VOLTS readout indicates between 5.950 and 6.050 V.

9. Press VOLTS SET. Set the power supply output voltage to 0.1 V.

10. Set the DMM to measure 1 VDC across the power supply OUTPUT 3 terminals.

11. Verify that the DMM reads between 0.0749 and 0.1250 VDC.

12. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

Series Operation. Use the following steps to check the series mode accuracy.

1. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.

2. Set up the power supply as follows:

VOLTS SET	36 V
OVP SET	37 V

3. Press STEP SET. Set the VOLTS SET to 0.05 V.

4. Ensure that the power supply output is disabled. Configure the DMM to measure 100 VDC across the front panel OUTPUT 2 (+) and OUTPUT 1 (–) terminals.
5. Press SHIFT → SERIES/INDEP to configure OUTPUT 1 and OUTPUT 2 for series operation. Verify that the “SERIES” indicator lights up on the display.
6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
7. Verify that the DMM reads between 71.900 and 72.100 VDC.
8. Press VOLTS △ or VOLTS ▽ to adjust the power supply output voltage until the DMM reads 72.000 VDC.
9. Verify that the power supply VOLTS readout indicates between 35.950 and 36.050 V.
10. Press VOLTS SET. Set the power supply output voltage to 0.1 V.
11. Set the DMM to measure 1 VDC across the power supply OUTPUT 2 (+) and OUTPUT 1 (–) terminals.
12. Verify that the DMM reads between 0.1498 and 0.2500 VDC.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

Parallel Operation. Use the following steps to check the parallel mode accuracy.

1. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	36 V
OVP SET	37 V

3. Press STEP SET. Set the VOLTS SET to 0.05 V.
4. Ensure that the power supply output is disabled. Configure the DMM to measure 40 VDC across the power supply front panel OUTPUT 2 terminals.
5. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.
6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
7. Verify that the DMM reads between 35.950 and 36.050 VDC.
8. Press VOLTS △ or VOLTS ▽ to adjust the power supply output voltage until the DMM reads 36.00 VDC.

9. Verify that the power supply VOLTS readout indicates between 35.950 and 36.050 V.
10. Press VOLTS SET. Set the power supply output voltage to 0.1 V.
11. Set the DMM to measure 1 VDC across the power supply OUTPUT 2 terminals.
12. Verify that the DMM reads between 0.0749 and 0.1250 VDC.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
14. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.

Current Set Accuracy

Complete the following procedures to verify current setting and readout accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	10 V
CURRENT SET	1.5 A
OVP SET	11 V

3. Press STEP SET. Set the CURRENT SET to 0.002 A.
4. Ensure that the power supply output is disabled. Configure the DMM to measure 2 amperes DC across the front panel OUTPUT 1 (2) terminals.
5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Verify that the DMM reads between 1.487 and 1.513 A.
7. Press CURRENT △ or CURRENT ▽ to adjust the power supply output current until the DMM reads 1.500 A.
8. Verify that the power supply CURRENT (A) readout indicates between 1.487 and 1.513 A.
9. Press CURRENT SET. Set the power supply output current to 0.1 A.
10. Verify that the DMM reads between 0.089 and 0.111 A.
11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

12. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.

13. Repeat steps 2 through 11 above to measure the OUTPUT 2 current setting and readout accuracy.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the "3" indicator lights up on the display.

2. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	3 A
OVP SET	7 V

3. Press STEP SET. Set the CURRENT SET to 0.002 A.

4. Ensure that the power supply output is disabled. Configure the DMM to measure 10 amperes DC across the front panel OUTPUT 3 terminals.

5. Press OUTPUT ON/OFF. Verify that the "OUT" indicator lights up on the display.

6. Verify that the DMM reads between 2.984 and 3.016 A.

7. Press CURRENT △ or CURRENT ▽ to adjust the power supply output current until the DMM reads 3.000 A.

8. Verify that the power supply CURRENT (A) readout indicates between 2.984 and 3.016 A.

9. Press CURRENT SET. Set the power supply output current to 0.1 A

10. Verify that the DMM reads between 0.089 and 0.111 A.

11. Press OUTPUT ON/OFF. Verify that the "OUT" indicator turns off.

Parallel Operation. Use the following steps to the check parallel mode accuracy.

1. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.

2. Set up the power supply as follows:

VOLTS SET	10 V
CURRENT SET	1.5 A
OVP SET	11 V

3. Press STEP SET. Set the CURRENT SET to 0.002 A.

4. Ensure that the power supply output is disabled. Configure the DMM to measure 10 amperes DC across the power supply front panel OUTPUT 2 terminals.

5. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.

6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

7. Verify that the DMM reads between 2.974 and 3.026 A.

8. Press CURRENT △ or CURRENT ▽ to adjust the power supply output current until the DMM reads 3.000 A.

9. Verify that the power supply CURRENT (A) readout indicates between 2.974 and 3.026 A.

10. Press CURRENT SET. Set the power supply output current to 0.1 A

11. Verify that the DMM reads between 0.089 and 0.111 A.

12. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

13. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.

14. Disconnect the DMM from the power supply output terminals.

Overvoltage Protection Accuracy

Complete the following procedures to verify OVP (overvoltage protection) accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.

2. Press OVP SET; set the OVP to 38.6 V. Verify that the power supply readouts display the error message “Err - 065”.

3. Press OVP SET again; set the OVP to 38.5 V. Verify that the power supply readouts display no error message.

4. Set up the power supply as follows:

VOLTS SET	34.5 V
CURRENT SET	.1 A
OVP SET	36 V

5. Press STEP SET. Set the VOLTS SET to 0.02 V.

6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
7. Press VOLTS △ to increase the power supply output voltage until the error message “Err - 013” appears on the readouts. Verify that this event occurs between 34.68 and 37.32 V.
8. Press SHIFT → OVP RESET.
9. Reset the output voltage to 34.5 V.
10. Repeat steps 6 through 9 above as necessary to determine the exact voltage.
11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
12. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
13. Repeat steps 2 through 11 above.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. With the power supply still set to OUT 2, press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.
2. Repeat steps 2 through 11 of the *Outputs 1 and 2* procedure above.
3. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.
2. Press OVP SET; set the OVP to 7.1 V. Verify that the power supply readouts display the error message “Err - 065”.
3. Press OVP SET again; set the OVP to 7 V. Verify that power supply readouts display no error message.
4. Set up the power supply as follows:

VOLTS SET	4 V
CURRENT SET	.1 A
OVP SET	5 V

5. Press STEP SET. Set the VOLTS SET to 0.02 V.
6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

7. Press VOLTS △ to increase the power supply output voltage until the error message “Err - 013” appears on the readouts. Verify that the readouts indicate between 4.3 and 5.7 V prior to error message activation.
8. Press SHIFT → OVP RESET.
9. Reset the output voltage to 4 V.
10. Repeat steps 6 through 9 above as necessary to determine the exact voltage.
11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

Constant Voltage Load Accuracy

Complete the following procedures to verify constant voltage load accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 1 terminals. See Figure 2 for details.

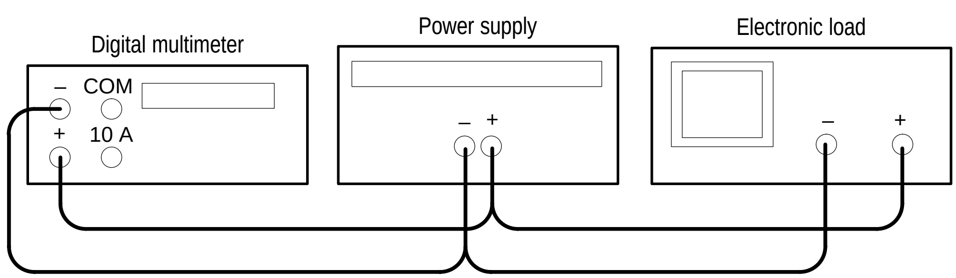

Figure 2: Constant Voltage Load Test Setup

3. Set the DMM to measure 40 VDC.
4. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	1.55 A
OVP SET	38.5 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Enable the electronic load. Adjust the load until the power supply CURRENT (A) readout indicates 1.500 A.

7. Record the DMM voltage (V1).
8. Turn off the electronic load and record the DMM voltage again (V2).
9. Verify that the difference between V1 and V2 is ≤6 mV.
10. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
11. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 1 terminals and connect them to the OUTPUT 1 terminals on the rear of the instrument. Maintain the equipment configuration and polarities shown in Figure 2.
12. Repeat steps 5 through 8 above and verify that the difference between V1 and V2 is ≤3 mV.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
14. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
15. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 2.
16. Repeat steps 4 through 10 above.
17. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 2 terminals and connect them to the OUTPUT 2 terminals on the rear of the instrument. Maintain the equipment configuration and polarities shown in Figure 2.
18. Repeat steps 5 through 8 above and verify that the difference between V1 and V2 is ≤3 mV.
19. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
20. Disconnect the DMM and electronic load from the instrument.

Series Operation. Use the following steps to check the series mode output accuracy.

1. With the power supply set to OUT 2, press SHIFT → SERIES/INDEP to configure OUTPUT 1 and OUTPUT 2 for series operation. Verify that the “SERIES” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 (+) and OUTPUT 1 (–) terminals. Maintain the equipment configuration and polarities shown in Figure 2.
3. Perform steps 5 through 8 of the *Outputs 1 and 2* procedure above.

4. Verify that the difference between V1 and V2 is ≤50 mV.
5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
6. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 2 and OUTPUT 1 terminals and connect them to the OUTPUT 2 (+) and OUTPUT 1 (–) terminals on the rear of the instrument. Maintain the equipment configuration and polarities shown in Figure 2.
7. Repeat steps 5 through 8 of the *Outputs 1 and 2* procedure above and verify that the difference between V1 and V2 is ≤50 mV.
8. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
9. Disconnect the DMM and electronic load from the instrument.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 2.
3. Set the DMM to measure 40 VDC.
4. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	3.1 A
OVP SET	38.5 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Enable the electronic load. Adjust the load until the power supply CURRENT (A) readout indicates 3.000 A.
7. Record the DMM voltage (V1).
8. Turn off the electronic load and record the DMM voltage again (V2).
9. Verify that the difference between V1 and V2 is ≤6 mV.
10. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
11. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 2 terminals and connect them to the OUTPUT 2 terminals on the rear of the instrument. Maintain the equipment configuration and polarities shown in Figure 2.

12. Repeat steps 5 through 8 above and verify that the difference between V1 and V2 is ≤3 mV.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
14. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.
15. Disconnect the DMM and electronic load from the instrument.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 3 terminals. Maintain the equipment configuration and polarities shown in Figure 2.
3. Set the DMM to measure 10 VDC.
4. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	3.1 A
OVP SET	7 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Enable the electronic load. Adjust the load until the power supply CURRENT (A) readout indicates 3.000 A.
7. Record the DMM voltage (V1).
8. Turn off the electronic load and record the DMM voltage again (V2).
9. Verify that the difference between V1 and V2 is ≤6 mV.
10. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
11. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 3 terminals and connect them to OUTPUT 3 on the rear of the instrument. Maintain the equipment configuration and polarities shown in Figure 2.
12. Repeat steps 5 through 8 above and verify that the difference between V1 and V2 is ≤3 mV.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
14. Disconnect the DMM and electronic load from the instrument.

Constant Voltage Source Accuracy

Complete the following procedures to verify constant voltage source accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Set up the Variac. Connect the power supply AC input to the Variac variable output. Allow 20 minutes for the power supply to warm-up and stabilize.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 1 terminals. See Figure 3 for details.

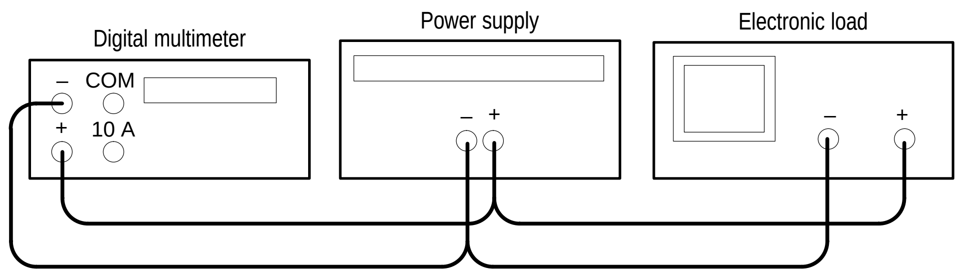

Figure 3: Constant Voltage Source Test Setup

3. Set the DMM to measure 2 amperes DC.
4. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.
5. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	1.55 A
OVP SET	38.5 V

6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
7. Enable the electronic load. Adjust the load until the DMM current reads 1.500 A.
8. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the power supply VOLTS readout changes ≤0.003 V over the adjustment range.
9. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off; then disable the electronic load.
10. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.

11. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 1 terminals and connect them to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 3.

12. Repeat steps 5 through 9 above.

Series Operation. Use the following steps to check the series mode output accuracy.

1. Press SHIFT → SERIES/INDEP to configure OUTPUT 1 and OUTPUT 2 for series operation. Verify that the “SERIES” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 (+) and OUTPUT 1 (–) terminals. Maintain the equipment configuration and polarities shown in Figure 3.

3. Repeat steps 5 through 9 of the *Outputs 1 and 2* procedure above.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. Keep the power supply set to OUT 2. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 3.

3. Set the DMM to measure 5 amperes DC.

4. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	3.1 A
OVP SET	38.5 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

6. Enable the electronic load. Adjust the load until the DMM current reads 3.000 A.

7. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the power supply VOLTS readout changes ≤0.003 volts over the adjustment range.

8. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off; then disable the electronic load.

9. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 3 terminals. Maintain the equipment configuration and polarities shown in Figure 3.

3. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	3.1 A
OVP SET	7 V

4. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

5. Enable the electronic load. Adjust the load until the DMM current reads 3.000 A.

6. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the power supply VOLTS readout changes ≤0.003 V over the adjustment range.

7. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns of; then disable the electronic load.

8. Disconnect the DMM and electronic load from the instrument.

Constant Voltage Ripple and Noise Accuracy

Complete the following procedures to verify constant voltage ripple and noise accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the oscilloscope and 27 Ω 100 W resistor to the front panel OUTPUT 1 terminals. See Figure 4 for details.

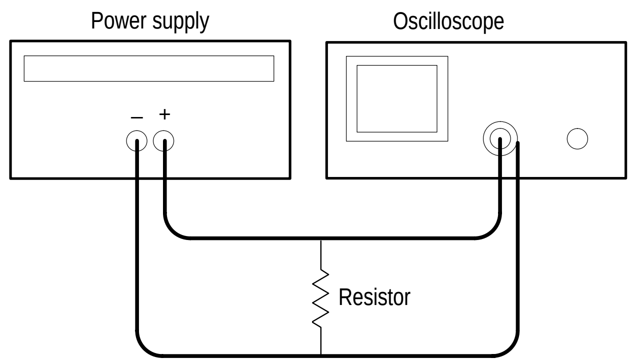

Figure 4: Constant Voltage Ripple and Noise Test Setup

3. Set up the oscilloscope to measure 100 mV_{p-p} (AC coupled).

4. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	1.55 A
OVP SET	38.5 V

5. Press OUTPUT ON/OFF. Verify that the "C.V." indicator lights up on the display.

6. Using a 0.1 μF ceramic capacitor to decouple the test points, adjust the oscilloscope and verify that the noise is ≤30 mV_{p-p}.

7. Set the oscilloscope to LINE trigger source. Adjust the output of the Variac from 108 to 132 VAC (120V range) or 198 to 242 VAC (220V range). Verify that the ripple changes ≤3 mV_{p-p} over the adjustment range.

8. Press OUTPUT ON/OFF. Verify that the "OUT" indicator turns off.

9. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.

10. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 1 terminals and connect them to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 4.

11. Repeat steps 4 through 8 above.

Outputs 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the "3" indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the oscilloscope and 2.2 Ω 50 W resistor to the front panel OUTPUT 3 terminals. See Figure 4 for details.

3. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	3.1 A
OVP SET	7 V

4. Repeat steps 5 through 8 of the *Outputs 1 and 2* procedure above.

5. Remove the Variac from the test setup and repower the instrument. Allow 20 minutes for the power supply to warm-up and stabilize before the next check.

Constant Current Load and Overcurrent Protection Accuracy

Complete the following procedures to verify constant current load and overcurrent protection accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the "1" indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 1 terminals. See Figure 5 for details.

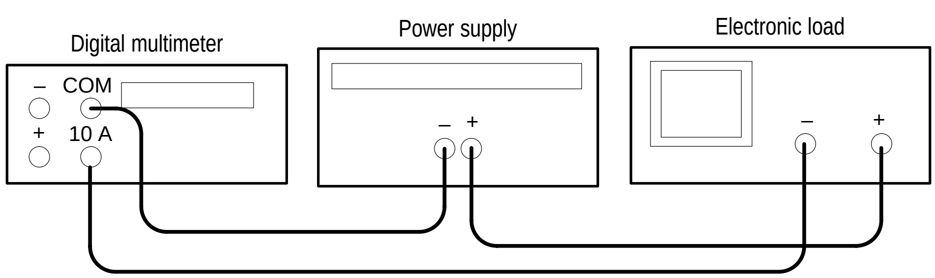

Figure 5: Constant Current Load Test Setup

3. Set the DMM to measure 2 amperes DC.

4. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	1.5 A
OVP SET	38.5 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Enable the electronic load. Adjust the load until the “C.C.” indicator lights up on the power supply display.
7. Record the DMM current reading (I1).
8. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
9. Ensure that the power supply output is disabled. Remove the wire connecting the power supply OUTPUT (+) terminal to the electronic load (+) terminal.
10. Move the electronic load (–) connection, to the power supply OUTPUT (+) terminal.
11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
12. Record the DMM current reading again (I2).
13. Verify that the difference between (I1) and (I2) is ≤0.003 A.
14. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
15. Press OCP ON/OFF. Verify that the “OCP” indicator lights up on the display.
16. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
17. Verify that the power supply readouts display the error message “Err - 012”.
18. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
19. Press OCP ON/OFF to return the power supply to normal operation. Verify that the “OCP” indicator turns off.
20. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
21. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 5.
22. Repeat steps 4 through 18 above.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. Keep the power supply set to OUT 2. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the "PARA" indicator lights up on the display.
2. Set the DMM to measure 5 amperes DC.
3. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	3.0 A
OVP SET	38.5 V

4. Repeat steps 5 through 14 of the *Outputs 1 and 2* procedure above but verify that the difference between (I1) and (I2) is ≤0.006 A.
5. Repeat steps 15 through 18 of the *Outputs 1 and 2* procedure above.
6. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the "PARA" indicator turns off.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the "3" indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 3 terminals. Maintain the equipment configuration and polarities shown in Figure 5.
3. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	3.0 A
OVP SET	7 V

4. Repeat steps 5 through 18 of the *Outputs 1 and 2* procedure above.
5. Disconnect the DMM and electronic load from the instrument.

Constant Current Source Accuracy

Complete the following procedures to verify constant current source accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Set up the Variac. Connect the power supply AC input to the Variac variable output. Allow 20 minutes for the power supply to warm up and stabilize.

2. Ensure that the power supply output is disabled. Connect the DMM and 27 Ω 100 W resistor to the front panel OUTPUT 1 terminals. See Figure 6 for details.

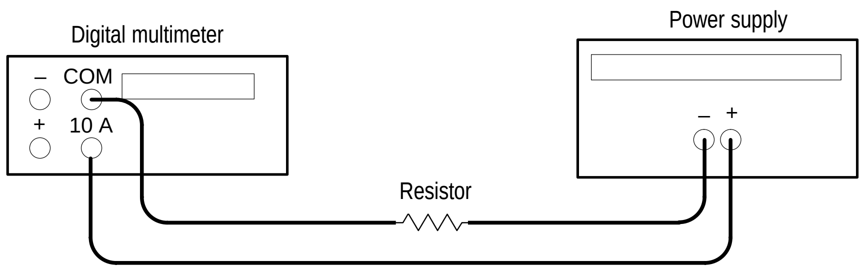

Figure 6: Constant Current Source Test Setup

3. Set the DMM to measure 2 amperes DC.

4. Press SHIFT → OUT 1; verify that the "1" indicator lights up on the display.

5. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	1.5 A
OVP SET	38.5 V

6. Press OUTPUT ON/OFF. Verify that the "OUT" indicator lights up on the display.

7. Adjust the output of the Variac from 108 to 132 VAC (120V range) or 198 to 242 VAC (220V range). Verify that the DMM current variation is ≤0.003 A over the adjustment range.

8. Press OUTPUT ON/OFF. Verify that the "OUT" indicator turns off.

9. Press (SHIFT) OUT 2; verify that the "2" indicator lights up on the display.

10. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 1 terminals and connect them to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 6.

11. Repeat steps 5 to 8 above.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.

2. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.

3. Set the DMM to measure 5 amperes DC.

4. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	3.0 A
OVP SET	38.5 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

6. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the DMM current variation is ≤0.006 A over the adjustment range.

7. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

8. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA ”indicator turns off.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and 2.2 Ω 50 W resistor to the front panel OUTPUT 3 terminals. See Figure 6 for details.

3. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	3.0 A
OVP SET	7 V

4. Repeat steps 6 through 8 of the *Outputs 1 and 2* procedure above.

This concludes the PS2520 and PS2520G performance verification procedures.

PS2521 and PS2521G Checks

To verify the performance and function of the PS2521 and PS2521G power supplies, implement the following checks in sequential order. To verify the performance and function of the PS2520 and PS2520G power supplies, see page 9. The test equipment for all verification procedures is listed on page 8.

***NOTE**. To clear a memory location, enter "0" as the VOLTS SET and CURRENT SET values; then save the "0" values to the desired memory location.*

For a list of error code descriptions, see your User manual.

Basic Function

Complete the following procedures to verify basic instrument function.

Outputs 1, 2, and 3. Use the following steps to verify OUTPUT 1, OUTPUT 2, and OUTPUT 3 basic function.

1. Press SHIFT → OUT 1; verify that the "1" indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	10 V
CURRENT SET	1 A
OVP SET	22 V
DELAY	3 s

3. Press SHIFT → STORE → 1 ↵ to store the above values in the memory 01 location. Verify that the MEMORY, CURRENT (A), and VOLTS readouts display the values listed in step 2 for memory location 01.
4. Reset the power supply as follows:

VOLTS SET	11 V
CURRENT SET	1.1 A
OVP SET	22 V
DELAY	3 s

5. Press SHIFT → STORE → 2 ↵ to store the above values in the memory 02 location. Verify that the MEMORY, CURRENT (A), and VOLTS readouts display the values listed in step 4 for memory location 02.
6. Press SHIFT → RECALL; then enter 1.2 ↵.
7. Press RECALL LAST; verify that the readouts display the data stored in the memory 02 location.

8. Press RECALL LAST again; verify that the readouts now display the data stored in the memory 01 location.

9. Press RECALL NEXT; verify that the readouts display the data stored in the memory 02 location.

10. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

11. Press AUTO SEQ ON/OFF and verify that the “AUTO” indicator lights up on the display. Verify that the front panel readouts alternately display the memory 01 and memory 02 setups from steps 2 and 4 above, every three seconds.

12. Press AUTO SEQ ON/OFF and OUTPUT ON/OFF. Verify that the “AUTO” and “OUT” indicators turn off.

13. Press STEP SET. Set the VOLTS SET to 1.00 V.

14. Press VOLTS ▽ and verify that as you attempt to decrease the voltage below 0.00 V, “Err - 018” appears on the CURRENT (A) and VOLTS readouts. The voltage should decrease in 1 volt steps on the VOLTS readout.

15. Press VOLTS △ and verify that as you attempt to increase the voltage past 21.00 V, “Err - 016” appears on the readouts. The voltage should increase in 1 volt steps on the VOLTS readout.

16. Press STEP SET. Set the CURRENT SET to .1 A.

17. Press CURRENT ▽ and verify that as you attempt to decrease the current below 0.000 A, “Err - 019” appears on the readouts and the “C.C.” indicator lights up on the display. The current should decrease in .1 ampere steps on the CURRENT (A) readout.

18. Press CURRENT △ and verify that as you attempt to increase the current past 2.500 A, “Err - 017” appears on the readouts. The current should increase in .1 ampere steps on the CURRENT (A) readout.

To check the function of OUTPUT 2, press SHIFT → OUT 2. Verify that the “2” indicator lights up on the display; then repeat steps 2 through 18 above.

To check the function of OUTPUT 3, press SHIFT → OUT 3. Verify that the “3” indicator lights up on the display; then continue with the steps below.

19. Set up the power supply as follows:

VOLTS SET	5 V
CURRENT SET	4 A
OVP SET	7 V
DELAY	3 s

20. Press SHIFT → STORE → 1 ↵ to store the above values in the memory 01 location. Verify that the MEMORY, CURRENT (A), and VOLTS readouts display the values listed in step 19 for memory location 01.

21. Reset the power supply as follows:

VOLTS SET	6 V
CURRENT SET	5 A
DELAY	3 s

22. Press SHIFT → STORE → 2 ↵ to store the above values in the memory 02 location. Verify that the MEMORY, CURRENT (A), and VOLTS readouts display the values set in step 21 for memory location 02.

23. Repeat steps 6 through 12 above.

24. Press STEP SET. Set the VOLTS SET to 1 V.

25. Press VOLTS ▽ and verify that as you attempt to decrease the voltage below 0.00 V, "Err - 018" appears on the CURRENT (A) and VOLTS readouts. The voltage should decrease in 1 volt steps on the VOLTS readout.

26. Press VOLTS △ and verify that as you attempt to increase the voltage past 6.00 V, "Err - 016" appears on readouts. The voltage should increase in 1 volt steps on the VOLTS readout.

27. Press STEP SET. Set the CURRENT SET to .1 A.

28. Press CURRENT ▽ and verify that as you attempt to decrease the current below 0.000 A, "Err - 019" appears on the readouts and the "C.C." indicator lights. The current should decrease in .1 ampere steps on the CURRENT (A) readout.

29. Press CURRENT △ and verify that as you attempt to increase the current past 5.100 A, "Err - 017" appears on the readouts. The current should increase in .1 ampere steps on the CURRENT (A) readout.

OCP, Series, and Parallel Mode Indicators. Use the following steps to verify OCP, series, and parallel output indicator function.

1. On the power supply front panel, press OCP ON/OFF to enable the OCP. Verify that the "OCP" indicator lights up on the display.

2. Press OCP ON/OFF. Verify that the "OCP" indicator turns off.

3. Press SHIFT → SERIES/INDEP to configure the power supply outputs for series operation. Verify that the "SERIES" indicator lights up on the display.

4. Press SHIFT → PARA/INDEP to configure the power supply outputs for parallel operation. Verify that the "PARA" indicator lights up on the display.

5. Press SHIFT → PARA/INDEP again to reconfigure the outputs for independent operation. Verify that the "PARA" and "SERIES" indicators turn off.

Set GPIB. Use the following steps to check the GPIB address.

1. Press LOCAL.
2. Enter a GPIB address <0 to 30> and press ↵.
3. Press SHIFT → ADDRESS. Verify that the address entered in step 2 above appears on the readout for about one second.

Voltage Set Accuracy

Complete the following procedures to verify voltage setting and readout accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the "1" indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	20 V
OVP SET	22 V

3. Press STEP SET. Set the VOLTS SET to 0.05 V.
4. Ensure that the power supply output is disabled. Configure the DMM to measure 25 VDC across the front panel OUTPUT 1 (2) terminals.
5. Press OUTPUT ON/OFF. Verify that the "OUT" indicator lights up on the display.
6. Verify that the DMM reads between 19.965 and 20.035 VDC.
7. Press VOLTS △ or VOLTS ▽ to adjust the power supply output voltage until the DMM reads 20.00 VDC.
8. Verify that the power supply VOLTS readout indicates between 19.965 and 20.035 V.
9. Press VOLTS SET. Set the power supply output voltage to 0.1 V.
10. Set the DMM to measure 1 VDC across the power supply OUTPUT 1 (2) terminals.
11. Verify that the DMM reads between 0.0749 and 0.1250 VDC.
12. Press OUTPUT ON/OFF. Verify that the "OUT" indicator turns off.

13. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.
14. Repeat steps 2 through 12 above to measure the OUTPUT 2 voltage setting and readout accuracy.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the "3" indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	6 V
OVP SET	7 V

3. Press STEP SET. Set the VOLTS SET to 0.05 V.
4. Ensure that the power supply output is disabled. Configure the DMM to measure 10 VDC across the power supply front panel OUTPUT 3 terminals.
5. Press OUTPUT ON/OFF. Verify that the "OUT" indicator lights up on the display.
6. Verify that the DMM reads between 5.972 and 6.028 VDC.
7. Press VOLTS △ or VOLTS ▽ to adjust the power supply output voltage until the DMM reads 6.00 VDC.
8. Verify that the power supply VOLTS readout reads between 5.950 and 6.050 V.
9. Press VOLTS SET. Set the power supply output voltage to 0.1 V.
10. Set the DMM to measure 1 VDC across the power supply OUTPUT 3 terminals.
11. Verify that the DMM reads between 0.0749 and 0.1250 VDC.
12. Press OUTPUT ON/OFF. Verify that the "OUT" indicator turns off.

Series Operation. Use the following steps to check the series mode accuracy.

1. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	20 V
OVP SET	22 V

3. Press STEP SET. Set the VOLTS SET to 0.05 V.

4. Ensure that the power supply output is disabled. Configure the DMM to measure 50 VDC across the front panel OUTPUT 2 (+) and OUTPUT 1 (–) terminals.

5. Press SHIFT → SERIES/INDEP to configure OUTPUT 1 and OUTPUT 2 for series operation. Verify that the “SERIES” indicator lights up on the display.

6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

7. Verify that the DMM reads between 39.930 and 40.070 VDC.

8. Press VOLTS △ or VOLTS ▽ to adjust the power supply output voltage until the DMM reads 40.000 VDC.

9. Verify that the power supply VOLTS readout indicates between 19.965 and 20.035 V.

10. Press VOLTS SET. Set the power supply output voltage to 0.1 V.

11. Set the DMM to measure 1 VDC across the power supply OUTPUT 2 (+) and OUTPUT 1 (–) terminals.

12. Verify that the DMM reads between 0.1498 and 0.2500 VDC.

13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

Parallel Operation. Use the following steps to check the parallel mode accuracy.

1. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.

2. Set up the power supply as follows:

VOLTS SET	20 V
OVP SET	22 V

3. Press STEP SET. Set the VOLTS SET to 0.05 V.

4. Ensure that the power supply output is disabled. Configure the DMM to measure 25 VDC across the power supply front panel OUTPUT 2 terminals.

5. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.

6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

7. Verify that the DMM reads between 19.965 and 20.035 VDC.

8. Press VOLTS △ or VOLTS ▽ to adjust the power supply output voltage until the DMM reads 20.00 VDC.

9. Verify that the power supply VOLTS readout indicates between 19.965 and 20.035 V.
10. Press VOLTS SET. Set the power supply output voltage to 0.1 V.
11. Set the DMM to measure 1 VDC across the power supply OUTPUT 2 terminals.
12. Verify that the DMM reads between 0.0749 and 0.1250 VDC.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
14. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.

Current Set Accuracy

Complete the following procedures to verify current setting and readout accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	10 V
CURRENT SET	2.5 A
OVP SET	11 V

3. Press STEP SET. Set the CURRENT SET to 0.002 A.
4. Ensure that the power supply output is disabled. Configure the DMM to measure 10 amperes DC across the front panel OUTPUT 1 (2) terminals.
5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Verify that the DMM reads between 2.485 and 2.515 A.
7. Press CURRENT △ or CURRENT ▽ to adjust the power supply output current until the DMM reads 2.500 A.
8. Verify that the power supply CURRENT (A) readout indicates between 2.485 and 2.515 A.
9. Press CURRENT SET. Set the power supply output current to 0.1 A.
10. Verify that the DMM reads between 0.089 and 0.111 A.
11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

12. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
13. Repeat steps 2 through 11 above to measure the OUTPUT 2 current setting and readout accuracy.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	5 A
OVP SET	7 V

3. Press STEP SET. Set the CURRENT SET to 0.002 A.
4. Ensure that the power supply output is disabled. Configure the DMM to measure 10 amperes DC across the front panel OUTPUT 3 terminals.
5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Verify that the DMM reads between 4.980 and 5.020 A.
7. Press CURRENT △ or CURRENT ▽ to adjust the power supply output current until the DMM reads 5.000 A.
8. Verify that the power supply CURRENT (A) readout indicates between 4.980 and 5.020 A.
9. Press CURRENT SET. Set the power supply output current to 0.1 A
10. Verify that the DMM reads between 0.089 and 0.111 A.
11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

Parallel Operation. Use the following steps to the check parallel mode accuracy.

1. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
2. Set up the power supply as follows:

VOLTS SET	10 V
CURRENT SET	2.5 A
OVP SET	11 V

3. Press STEP SET. Set the CURRENT SET to 0.002 A.

4. Ensure that the power supply output is disabled. Configure the DMM to measure 10 amperes DC across the power supply front panel OUTPUT 2 terminals.
5. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.
6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
7. Verify that the DMM reads between 4.970 and 5.030 A.
8. Press CURRENT △ or CURRENT ▽ to adjust the power supply output current until the DMM reads 3.000 A.
9. Verify that the power supply CURRENT (A) readout indicates between 4.970 and 5.030 A.
10. Press CURRENT SET. Set the power supply output current to 0.1 A
11. Verify that the DMM reads between 0.089 and 0.111 A.
12. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
13. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.
14. Disconnect the DMM from the power supply output terminals.

Overvoltage Protection Accuracy

Complete the following procedures to verify OVP (overvoltage protection) accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.
2. Press OVP SET and set the OVP to 22.6 V. Verify that the power supply readouts display the error message “Err - 065”.
3. Press OVP SET again and set the OVP to 22.5 V. Verify that the power supply readouts display no error message.
4. Set up the power supply as follows:

VOLTS SET	18 V
CURRENT SET	.1 A
OVP SET	20 V

5. Press STEP SET. Set the VOLTS SET to 0.02 V.

6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
7. Press VOLTS △ to increase the power supply output voltage until the error message “Err - 013” appears on the readouts. Verify that this event occurs between 19.00 and 21.00 V.
8. Press SHIFT → OVP RESET.
9. Reset the output voltage to 18 V.
10. Repeat steps 6 through 9 above as necessary to determine the exact voltage.
11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
12. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
13. Repeat steps 2 through 11 above.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. With the power supply still set to OUT 2, press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.
2. Repeat steps 2 through 11 of the *Outputs 1 and 2* procedure above.
3. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.
2. Press OVP SET; set the OVP to 7.1 V. Verify that the power supply readouts display the error message “Err - 065”.
3. Press OVP SET again; set the OVP to 7 V. Verify that power supply readouts display no error message.
4. Set up the power supply as follows:

VOLTS SET	4 V
CURRENT SET	.1 A
OVP SET	5 V

5. Press STEP SET. Set the VOLTS SET to 0.02 V.
6. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

7. Press VOLTS △ to increase the power supply output voltage until the error message “Err - 013” appears on the readouts. Verify that this event occurs between 4.3 and 5.7 V.

8. Press SHIFT → OVP RESET.

9. Reset the output voltage to 4 V.

10. Repeat steps 6 through 9 above as necessary to determine the exact voltage.

11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

Constant Voltage Load Accuracy

Complete the following procedures to verify constant voltage load accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 1 terminals. See Figure 2 for details.

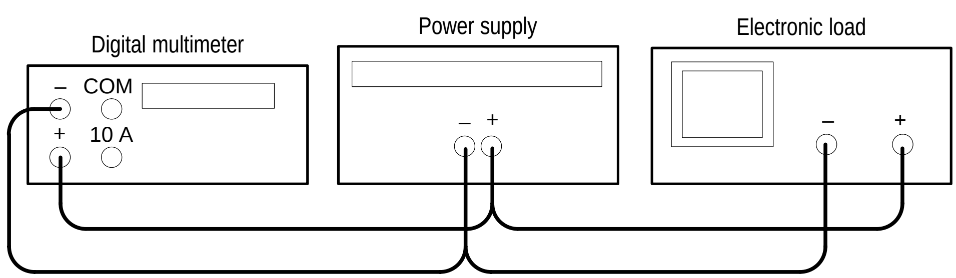

Figure 7: Constant Voltage Load Test Setup

3. Set the DMM to measure 25 VDC.

4. Set up the power supply as follows:

VOLTS SET	20 V
CURRENT SET	2.55 A
OVP SET	22 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

6. Enable the electronic load. Adjust the load until the power supply CURRENT (A) readout indicates 2.500 A.

7. Record the DMM voltage (V1).
8. Turn off the electronic load and record the DMM voltage again (V2).
9. Verify that the difference between V1 and V2 is ≤6 mV.
10. Press OUTPUT OFF. Verify that the “OUT” indicator turns off.
11. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 1 terminals and connect them to the OUTPUT 1 terminals on the rear of the instrument. Maintain the equipment configuration and polarities shown in Figure 2.
12. Repeat steps 5 through 8 above and verify that the difference between V1 and V2 is ≤3 mV.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
14. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
15. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 2.
16. Repeat steps 4 through 10 above.
17. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 2 terminals and connect them to the rear panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 2.
18. Repeat steps 5 through 8 above and verify that the difference between V1 and V2 is ≤3 mV.
19. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
20. Disconnect the DMM and electronic load from the instrument.

Series Operation. Use the following steps to check the series mode output accuracy.

1. With the power supply set to OUT 2, press SHIFT → SERIES/INDEP to configure OUTPUT 1 and OUTPUT 2 for series operation. Verify that the “SERIES” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 (+) and OUTPUT 1 (–) terminals. Maintain the equipment configuration and polarities shown in Figure 2.
3. Perform steps 5 through 8 of the *Outputs 1 and 2* procedure above.

4. Verify that the difference between V1 and V2 is ≤50 mV.
5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
6. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 2 and OUTPUT 1 terminals and connect them to the rear panel OUTPUT 2 (+) and OUTPUT 1 (–) terminals. Maintain the equipment configuration and polarities shown in Figure 2.
7. Repeat steps 5 through 8 of the *Outputs 1 and 2* procedure above and verify that the difference between V1 and V2 is ≤50 mV.
8. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
9. Disconnect the DMM and electronic load from the instrument.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 2.
3. Set the DMM to measure 25 VDC.
4. Set up the power supply as follows:

VOLTS SET	20 V
CURRENT SET	5.1 A
OVP SET	22 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Enable the electronic load. Adjust the load until the power supply CURRENT (A) readout indicates 5.000 A.
7. Record the DMM voltage (V1).
8. Turn off the electronic load and record the DMM voltage again (V2).
9. Verify that the difference between V1 and V2 is ≤6 mV.
10. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
11. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 2 terminals and connect them to the OUTPUT 2 terminals on the rear of the instrument. Maintain the equipment configuration and polarities shown in Figure 2.

12. Repeat steps 5 through 8 above and verify that the difference between V1 and V2 is ≤3 mV.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
14. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.
15. Disconnect the DMM and electronic load from the instrument.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 3 terminals. Maintain the equipment configuration and polarities shown in Figure 2.
3. Set the DMM to measure 10 VDC.
4. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	5.1 A
OVP SET	7 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Enable the electronic load. Adjust the load until the power supply CURRENT (A) readout indicates 5.000 A.
7. Record the DMM voltage (V1).
8. Turn off the electronic load and record the DMM voltage again (V2).
9. Verify that the difference between V1 and V2 is ≤6 mV.
10. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
11. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 3 terminals and connect them to rear panel OUTPUT 3 terminals. Maintain the equipment configuration and polarities shown in Figure 2.
12. Repeat steps 5 through 8 above and verify that the difference between V1 and V2 is ≤3 mV.
13. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
14. Disconnect the DMM and electronic load from the instrument.

Constant Voltage Source Accuracy

Complete the following procedures to verify constant voltage source accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Set up the Variac. Connect the power supply AC input to the Variac variable output. Allow 20 minutes for the power supply to warm up and stabilize.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 1 terminals. See Figure 3 for details.

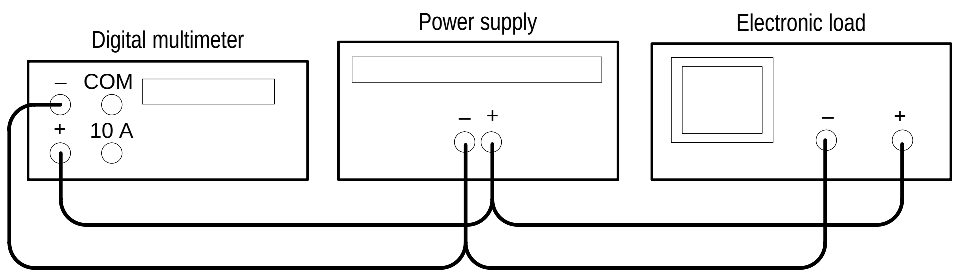

Figure 8: Constant Voltage Source Test Setup

3. Set the DMM to measure 5 amperes DC.
4. Press SHIFT → OUT 1; verify that the "1" indicator lights up on the display.
5. Set up the power supply as follows:

VOLTS SET	20 V
CURRENT SET	2.55 A
OVP SET	22 V

6. Press OUTPUT ON/OFF. Verify that the "OUT" indicator lights up on the display.
7. Enable the electronic load. Adjust the load until the DMM current reads 2.500 A.
8. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the power supply VOLTS readout changes ≤0.003 volts over the adjustment range.
9. Press OUTPUT ON/OFF and disable the electronic load.
10. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.

11. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 1 terminals and connect them to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 3.

12. Repeat steps 5 through 9 above.

Series Operation. Use the following steps to check the series mode output accuracy.

1. Press SHIFT → SERIES/INDEP to configure OUTPUT 1 and OUTPUT 2 for series operation. Verify that the “SERIES” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 (+) and OUTPUT 1 (–) terminals. Maintain the equipment configuration and polarities shown in Figure 3.

3. Repeat steps 5 through 9 of the *Outputs 1 and 2* procedure above.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 3.

3. Set the DMM to measure 10 amperes DC.

4. Set up the power supply as follows:

VOLTS SET	20 V
CURRENT SET	5.1 A
OVP SET	22 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

6. Enable the electronic load. Adjust the load until the DMM current reads 5.000 A.

7. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the power supply VOLTS readout changes ≤0.003 volts over the adjustment range.

8. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off; then disable the electronic load.
9. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 3 terminals. Maintain the equipment configuration and polarities shown in Figure 3.
3. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	5.1 A
OVP SET	7 V

4. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
5. Enable the electronic load. Adjust the load until the DMM current reads 5.000 A.
6. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the power supply VOLTS readout changes ≤0.003 volts over the adjustment range.
7. Press OUTPUT ON/OFF; then disable the electronic load.
8. Disconnect the DMM and electronic load from the instrument.

Constant Voltage Ripple and Noise Accuracy

Complete the following procedures to verify constant voltage ripple and noise accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the “1” indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the oscilloscope and 27 Ω 75 W resistor to the front panel OUTPUT 1 terminals. See Figure 4 for details.

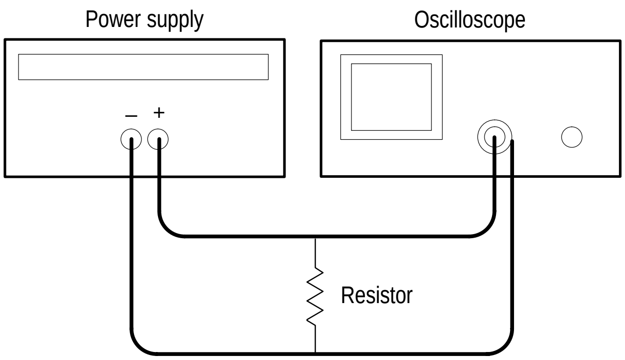

Figure 9: Constant Voltage Ripple and Noise Test Setup

3. Set up the oscilloscope to measure 100 mV_{p-p} (AC coupled).
4. Set up the power supply as follows:

VOLTS SET	36 V
CURRENT SET	2.55 A
OVP SET	38 V

5. Press OUTPUT ON/OFF. Verify that the "C.V." indicator lights up on the display.
6. Using a 0.1 μF ceramic capacitor to decouple the test points, adjust the oscilloscope and verify that the noise is ≤30 mV_{p-p}.
7. Set up the oscilloscope to LINE trigger source. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the ripple changes ≤3 mV_{p-p} over the adjustment range.
8. Press OUTPUT ON/OFF. Verify that the "OUT" indicator turns off.
9. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.
10. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 1 terminals and connect them to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 4.
11. Repeat steps 4 through 8 above.

Outputs 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the "3" indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the oscilloscope and 2.2 Ω 50 W resistor to the front panel OUTPUT 3 terminals. See Figure 4 for details.

3. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	5.1 A
OVP SET	7 V

4. Repeat steps 5 through 8 of the *Outputs 1 and 2* procedure above.

5. Remove the Variac from the test setup and repower the instrument. Allow 20 minutes for the power supply to warm-up and stabilize before the next check.

Constant Current Load and Overcurrent Protection Accuracy

Complete the following procedures to verify constant current load and overcurrent protection accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Press SHIFT → OUT 1; verify that the "1" indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 1 terminals. See Figure 5 for details.

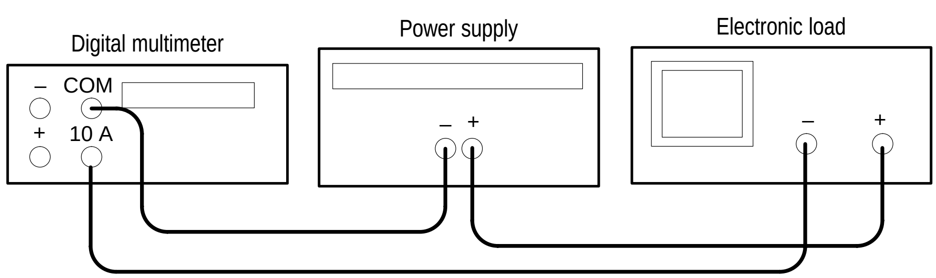

Figure 10: Constant Current Load Test Setup

3. Set the DMM to measure 5 amperes DC.

4. Set up the power supply as follows:

VOLTS SET	20 V
CURRENT SET	2.5 A
OVP SET	22 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
6. Enable the electronic load. Adjust the load until the “C.C.” indicator lights up on the power supply display.
7. Record the DMM current reading (I1).
8. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
9. Ensure that the power supply output is disabled. Remove the wire connecting the power supply OUTPUT (+) terminal to the electronic load (+) terminal.
10. Move the electronic load (–) connection to the power supply OUTPUT (+) terminal.
11. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
12. Record the DMM current reading again (I2).
13. Verify that the difference between (I1) and (I2) is ≤0.003 A.
14. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
15. Press OCP ON/OFF; verify that the “OCP” indicator lights up on the display.
16. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.
17. Verify that the power supply readouts display the error message “Err - 012”.
18. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.
19. Press OCP ON/OFF to return the power supply to normal operation. Verify that the “OCP” indicator turns off.
20. Press SHIFT → OUT 2; verify that the “2” indicator lights up on the display.
21. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 5.
22. Repeat steps 4 through 18 above.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. With the power supply set to OUT 2, press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the "PARA" indicator lights up on the display.
2. Set the DMM to measure 10 amperes DC.
3. Set up the power supply as follows:

VOLTS SET	20 V
CURRENT SET	5.0 A
OVP SET	22 V

4. Repeat steps 5 through 14 of the *Outputs 1 and 2* procedure above but verify that the difference between (I1) and (I2) is ≤0.006 A.
5. Repeat steps 15 through 18 of the *Outputs 1 and 2* procedure above.
6. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the "PARA" indicator turns off.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the "3" indicator lights up on the display.
2. Ensure that the power supply output is disabled. Connect the DMM and electronic load to the front panel OUTPUT 3 terminals. Maintain the equipment configuration and polarities shown in Figure 5.
3. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	5.0 A
OVP SET	7 V

4. Repeat steps 5 through 18 of the *Outputs 1 and 2* procedure above.
5. Disconnect the DMM and electronic load from the instrument.

Constant Current Source Accuracy

Complete the following procedures to verify constant current source accuracy.

Outputs 1 and 2. Use the following steps to check the OUTPUT 1 and OUTPUT 2 accuracy.

1. Set up the Variac. Connect the power supply AC input to the Variac variable output. Allow 20 minutes for the power supply to warm up and stabilize.

2. Ensure that the power supply output is disabled. Connect the DMM and 27 Ω 75 W resistor to the front panel OUTPUT 1 terminals. See Figure 6 for details.

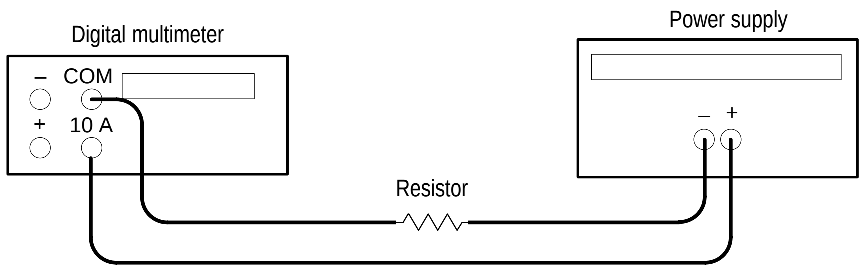

Figure 11: Constant Current Source Test Setup

3. Set the DMM to measure 5 amperes DC.

4. Press SHIFT → OUT 1; verify that the "1" indicator lights up on the display.

5. Set up the power supply as follows:

VOLTS SET	20 V
CURRENT SET	2.5 A
OVP SET	22 V

6. Press OUTPUT ON/OFF. Verify that the "OUT" indicator lights up on the display.

7. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the DMM current variation is ≤0.003 A over the adjustment range.

8. Press OUTPUT ON/OFF. Verify that the "OUT" indicator turns off.

9. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.

10. Ensure that the power supply output is disabled. Remove the leads from the front panel OUTPUT 1 terminals and connect them to the front panel OUTPUT 2 terminals. Maintain the equipment configuration and polarities shown in Figure 6.

11. Repeat steps 5 to 8 above.

Parallel Operation. Use the following steps to check the parallel mode output accuracy.

1. Press SHIFT → OUT 2; verify that the "2" indicator lights up on the display.

2. Press SHIFT → PARA/INDEP to configure OUTPUT 1 and OUTPUT 2 for parallel operation. Verify that the “PARA” indicators light up on the display.

3. Set the DMM to measure 5 amperes DC.

4. Set up the power supply as follows:

VOLTS SET	20 V
CURRENT SET	5.0 A
OVP SET	22 V

5. Press OUTPUT ON/OFF. Verify that the “OUT” indicator lights up on the display.

6. Adjust the output of the Variac from 108 to 132 VAC (120 V range) or 198 to 242 VAC (220 V range). Verify that the DMM current variation is ≤0.006 A over the adjustment range.

7. Press OUTPUT ON/OFF. Verify that the “OUT” indicator turns off.

8. Press SHIFT → PARA/INDEP to reconfigure the outputs for independent operation. Verify that the “PARA” indicator turns off.

Output 3. Use the following steps to check the OUTPUT 3 accuracy.

1. Press SHIFT → OUT 3; verify that the “3” indicator lights up on the display.

2. Ensure that the power supply output is disabled. Connect the DMM and 2.2 Ω 50 W resistor to the front panel OUTPUT 3 terminals. See Figure 6 for details.

3. Set up the power supply as follows:

VOLTS SET	6 V
CURRENT SET	5.0 A
OVP SET	7 V

4. Repeat steps 6 through 8 of the *Outputs 1 and 2* procedure above.

This concludes the PS2521 and PS2521G performance verification procedures.

Adjustment Procedures

This section contains procedures to adjust PS2520 Series power supplies. 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 the adjustments
- A list of test equipment needed to make the adjustments
- Instructions on how to prepare instruments for adjustment
- Step-by-step adjustment procedures

The procedures in this section do not verify performance. To confirm that your power supply meets factory specifications, implement the procedures in the *Performance Verification* section.

List of Adjustments

Use the adjustments listed in Table 10 to return PS2520 Series power supplies to factory calibration.

Table 8: PS2520 Series Adjustments

Full Calibration	
	Output 1
	Output 2
	Parallel Output: Current Offset
	Parallel Output: Current Full Scale
	Output 3
Partial Calibration	
	Voltage Offset
	Voltage Full Scale
	Current Offset
	Current Full Scale
	Overvoltage Protection: Offset
	Overvoltage Protection: Full Scale

Table 8: PS2520 Series Adjustments (Cont.)

Parallel Output: Current Offset
Parallel Output: Current Full Scale

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 9.

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

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

Table 9: Adjustment Test Equipment

Description	Minimum Requirements	Example Product
Digital Multimeter	4½-digit	Tektronix DM2510 or DM25210G
	DC volts accuracy: 0.05%	
	DC ampere accuracy: 0.8%	

Preparation for Adjustment

Perform the adjustment procedures on an as-needed basis. If a power supply section fails a performance requirement, or if a section is replaced or repaired, adjust only that section. Adjusting individual sections of the instrument rarely affects its total performance.

The following guidelines apply to all adjustments:

- Verify that the line voltage selector (instrument rear) is set to the correct voltage. If you must change the selector setting, disconnect the AC power before altering the setting.
- Remove the instrument cover for the voltage full-scale calibrations only.
- Plug in and warm up the instrument for at least ten minutes. A thirty minute warm-up period is required if the instrument has been exposed to a high-humidity or high-condensing environment.

- Perform the adjustments in a 22° to 24° C (71° to 75° F) ambient environment with a relative humidity of 75% or less.
- Do not alter any setting unless a performance characteristic cannot be met at the current setting.
- Do not alter any setting without reading the entire adjustment procedure first.
- Read the *Safety Summary* at the beginning of this manual before proceeding.

Remove Instrument Cover

You must remove the instrument cover to make internal adjustments.

WARNING. *To avoid electrical shock, disconnect the power cord from its source while removing the instrument cover. Following the adjustment procedure, replace the instrument cover before using the power supply.*

To remove the instrument cover, refer to Figure 12 while performing the following steps.

1. Remove the two handle mounting screws with a Phillips-head screwdriver.
2. Remove the six side panel mounting screws.
3. Slide the cover toward the rear of the instrument and lift.

To reinstall the cover, perform steps 1 through 3 above in reverse order.

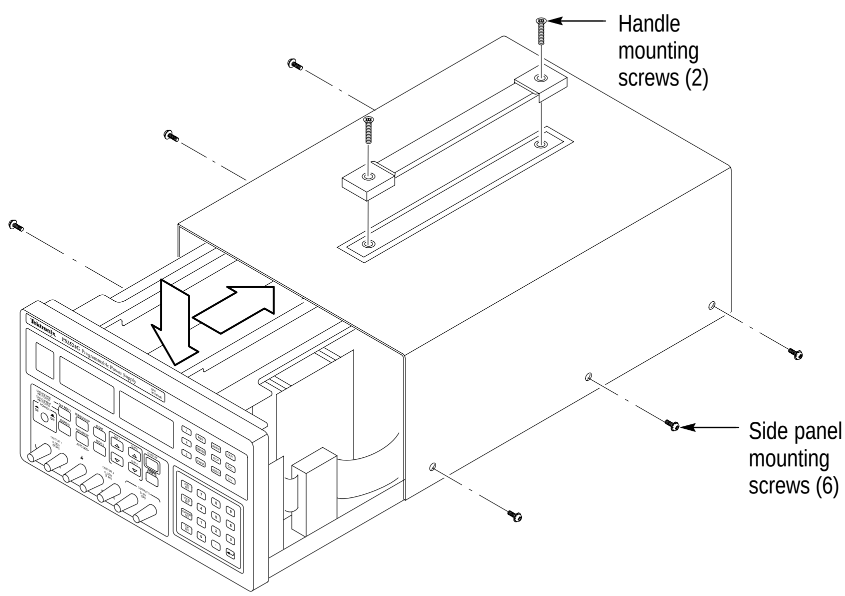

Figure 12: PS2520 Series Instrument Cover Removal

Adjustment Procedure

To calibrate PS2520 series power supplies, you must create voltage and current constants and store them in nonvolatile RAM. Each set of constants consist of an offset and full-scale value.

You can perform either partial or full calibrations. To perform a full calibration, the power supply follows a preset procedure that allows you to set the voltage, current, and overvoltage protection values. You can also make individual calibrations as identified in Table 10. Each calibration procedure is identified by a display code.

Table 10: Calibration Display Codes

Display Code	Calibration Description
cL00	Password accepted (initiate calibration)
cL10	Voltage offset
cL11	Voltage full scale
cL20	Current offset
cL21	Current full scale
cL2F	Current offset or current full-scale calibration complete
cL30	Overvoltage protection offset
cL31	Overvoltage protection full scale
cL40	Parallel output: current offset
cL41	Parallel output: current full scale

***NOTE**. If the calibration procedure detects an error, the readout will display an error code. See your User manual for a list of error code descriptions.*

Full Calibration

To perform a full calibration, perform the following procedures in sequential order.

Output 1. Use the following steps to calibrate OUTPUT 1.

1. Press (SHIFT) OUT 1; verify that the “1” indicator lights up on the display.
2. Press (SHIFT) CURRENT ▽.

3. Enter the calibration password on the keypad:

PS2520 & PS2520G: enter **2520** (↵)
PS2521 & PS2521G: enter **2521** (↵)

4. Verify that the power supply readout displays **cL00**, indicating calibration mode.

5. Configure the DMM to measure DC volts autorange.

6. Connect the DMM positive and negative leads to the corresponding front panel OUTPUT 1 (+) and (–) terminals.

7. Press (↵) on the power supply keypad. Verify that the power supply readout displays **cL10**, indicating voltage offset calibration.

8. Enter the DMM reading on the power supply keypad and press (↵).

9. Verify that the power supply readout displays **cL11,** indicating voltage full-scale calibration.

10. Adjust VR501 and VR601 to the settings listed in Table 11. (See Figure 13 for the adjustment locations.) Following the adjustment, enter the DMM reading on the power supply keypad and press (↵).

Table 11: Voltage Full-scale Adjustment (Full Calibration)

Instrument Model	To Cal. OUTPUT 1	To Cal. OUTPUT 2
PS2520/PS2520G	Adjust VR601 for a DMM reading of 37.00 V	Adjust VR501 for a DMM reading of 37.00 V
PS2521/PS2521G	Adjust VR601 for a DMM reading of 21.00 V	Adjust VR601 for a DMM reading of 21.00 V

11. Verify that the power supply readout displays **cL20**, indicating current offset calibration.

12. Configure the DMM to measure 2 amperes DC.

NOTE. *For proper current calibration, use quality test leads with good low temperature thermal characteristics. Also ensure that good connections exist between the DMM and the Power Supply.*

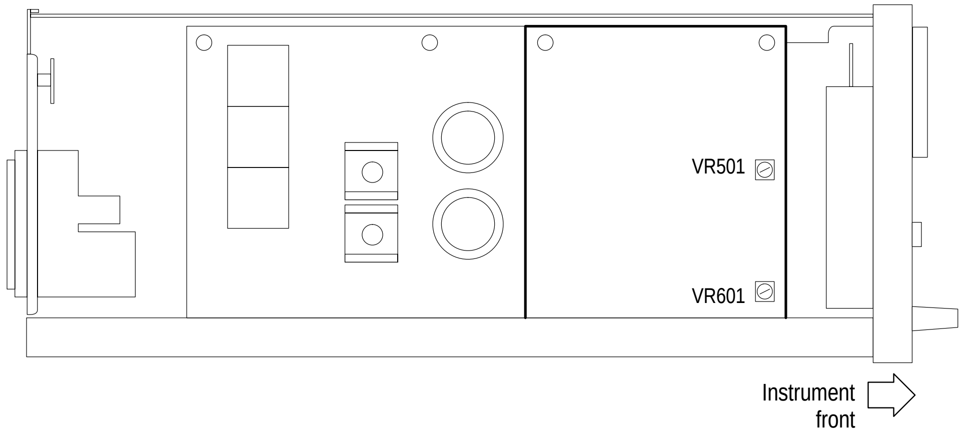

Figure 13: VR501, VR601 Adjustment Location

13. Enter the DMM reading on the keypad (in amperes); then press (↵). Verify that the power supply readout displays **cL2F**, indicating that the current offset calibration is complete.

14. Set the DMM to the 10 A range and press (↵) on the power supply. Verify that the power supply readout displays **cL21**, indicating current full-scale calibration.

15. Enter the DMM reading on the power supply keypad and press (↵). Verify that the power supply readout displays **cL2F**, indicating that the current full-scale calibration is complete.

16. Disconnect the DMM from the power supply.

17. Press (↵) on the power supply and verify that the readout displays **cL30**, indicating overvoltage protection offset calibration. Wait 10 seconds and verify that the readout displays **cL31**, indicating that the overvoltage protection full-scale calibration is running.

18. Wait another 10 seconds for the readout to return to normal. The calibration is complete.

Output 2. Use the following steps to calibrate OUTPUT 2.

1. Press (SHIFT) OUT 2; verify that the “2” indicator lights up on the display.

2. Perform steps 2 through 5 of the *Output 1* procedure above.

3. Connect the DMM positive and negative leads to the corresponding front panel OUTPUT 2 (+) and (–) terminals.

4. Perform steps 7 through 18 of the *Output 1* procedure above.

Parallel Output: Current Offset. Use the following steps to calibrate the parallel output offset current.

1. Press (SHIFT) OUT 2; verify that the “2” indicator lights up on the display.
2. Press (SHIFT) CURRENT ▽.
3. Enter the calibration password on the keypad:

   PS2520 & PS2520G: enter **2520** (↵)
   PS2521 & PS2521G: enter **2521** (↵)

4. Verify that the power supply readout displays **cL00**, indicating calibration mode.
5. Configure the DMM to measure 2 amperes DC.
6. Enter **4** on the power supply keypad and press (↵).Verify that the “PARA” indicator lights up on the display and the readout displays **cL40**, indicating parallel output current offset calibration.
7. Enter the DMM reading on the power supply keypad and press (↵). The power supply readout will return to normal in approximately 10 seconds. The calibration is complete.

Parallel Output: Current Full Scale. Use the following steps to calibrate the parallel output full-scale current.

1. Press (SHIFT) OUT 2; verify that the “2” indicator lights up on the display.
2. Press (SHIFT) CURRENT ▽.
3. Enter the calibration password on the keypad:

   PS2520 & PS2520G: enter **2520** (↵)
   PS2521 & PS2521G: enter **2521** (↵)

4. Verify that the power supply readout displays **cL00**, indicating calibration mode.
5. Configure the DMM to measure 10 amperes DC.
6. Enter **4** on the power supply keypad.
7. Press VOLTS △ to select the parallel output full-scale current calibration; verify that the the readout displays **cL41**, indicating parallel output full-scale calibration.
8. Press (↵) on the power supply. Verify that the “PARA” indicator lights up on the display.

9. Enter the DMM reading on the power supply keypad and press (↵). The power supply readout will return to normal in approximately 5 seconds. The calibration is complete.

Output 3. Use the following steps to calibrate OUTPUT 3.

1. Press (SHIFT) OUT 3; verify that the “3” indicator lights up on the display.
2. Press (SHIFT) CURRENT ▽.
3. Enter the calibration password on the keypad:

   PS2520 & PS2520G: enter **2520** (↵)
   PS2521 & PS2521G: enter **2521** (↵)

4. Verify that the power supply readout displays **cL00**, indicating calibration mode.
5. Configure the DMM to measure DC volts autorange.
6. Connect the DMM positive and negative leads to the corresponding OUTPUT 3 (+) and (–) terminals.
7. Press (↵) on the power supply keypad. Verify that the power supply readout displays **cL10** (voltage offset calibration).
8. Enter the DMM reading on the power supply keypad and press (↵).
9. Verify that the power supply readout displays **cL11,** indicating voltage full-scale calibration.
10. Adjust VR401 for a DMM reading of 6.5 V. See Figure 14 for the adjustment location.

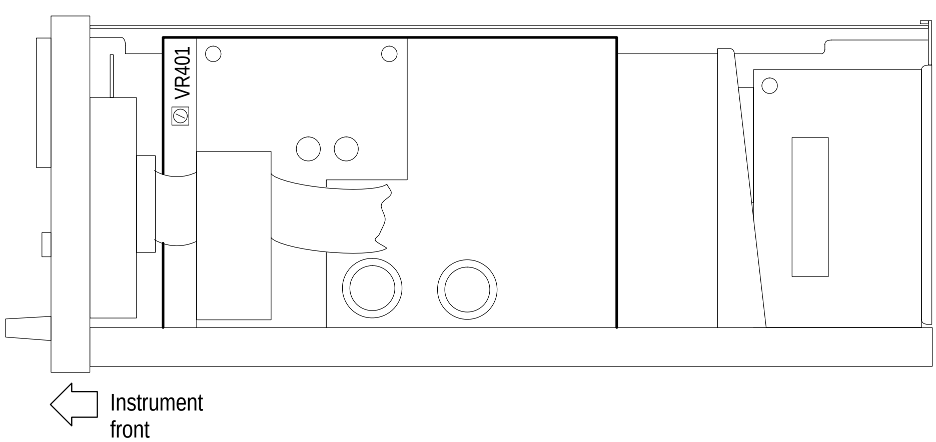

Figure 14: VR401 Adjustment Location

11. Enter the DMM reading on the power supply keypad and press (↵).

12. Verify that the power supply readout displays **cL20**, indicating current offset calibration.

13. Configure the DMM to measure 2 amperes DC.

14. Enter the DMM reading on the power supply keypad and press (↵). Verify that the power supply readout displays **cL2F**, indicating that the current offset calibration is complete.

15. Set the DMM to the 10 A range and press (↵) on the power supply. Verify that the power supply readout displays **cL21** indicating current full-scale calibration.

16. Enter the DMM reading on the power supply keypad and press (↵). Verify that the power supply readout displays **cL2F**, indicating that the current full-scale calibration is complete.

17. Disconnect the DMM from the power supply.

18. Press (↵) on the power supply and verify that the readout displays **cL30**, indicating overvoltage protection offset calibration.

19. Wait 10 seconds and verify that the readout displays **cL31,** indicating that the overvoltage protection full-scale calibration is running. Wait another 10 seconds for the readout to return to normal. The calibration is complete.

Partial Calibration

See Table 10 for a list of partial calibrations; then proceed with the following steps.

NOTE. *Do not remove the instrument cover unless you intend to perform a voltage full-scale calibration.*

---

1. Select the power supply output to calibrate: press (SHIFT) <OUT 1, OUT 2, or OUT 3>. For a Parallel Output calibration, select OUT 2.

2. Press (SHIFT) CURRENT ▽.

3. Enter a calibration password on the keypad:

   PS2520 & PS2520G: enter **2520** (↵)
   PS2521 & PS2521G: enter **2521** (↵)

4. Verify that the power supply readout displays **cL00**, indicating calibration mode.

5. Configure the DMM function and range as outlined in table 12.

Table 12: Set DMM Function and Range

Calibration Type	DMM Function	DMM Range
All voltage calibrations	DC Volts	Autorange
Current offset	DC Amperes	2 A
Current full scale	DC Amperes	10 A

6. Connect the DMM to the power supply as outlined in table 13.

Table 13: DMM to Power Supply Connections

Calibration Type	Display Code	Connection Instructions
Voltage	cL10, cL11	Connect DMM positive and negative leads to the corresponding power supply (+) and (–) OUTPUT terminals.
Current	cL20, cL21	Connect DMM positive and negative leads to the corresponding power supply (+) and (–) OUTPUT terminals.
Overvoltage Protection	cL30, cL31	No connection from DMM to power supply.
Parallel Output Current	cL40, cL41	Connect DMM positive and negative leads to the corresponding power supply (+) and (–) OUTPUT terminals.

NOTE. *The DMM range and function must be properly selected before proceeding to the next step. Ensure that good connections exist between the DMM and the power supply.*

7. Enter the calibration mode on the keypad:

   a. Press **1** for voltage calibrations.

   b. Press **2** for current calibrations.

   c. Press **3** for overvoltage protection calibrations.

   d. Press **4** for parallel output calibrations.

8. Press VOLTS △ for offset calibration, or press VOLTS ▽ for full-scale calibration.

9. Verify that the readout displays the correct code for the desired calibration. See Table 10.

10. Press (↵) on the power supply keypad to initiate the calibration. Refer to the instructions below to complete each calibration.

cL10 Voltage Offset Calibration. To calibrate the voltage offset, enter the DMM reading on the power supply keypad and press (↵). The readout will return to normal when the calibration is complete.

cL11 Voltage Full Scale Calibration. To calibrate the full-scale voltage, adjust VR601, VR501, or VR401 using the instructions in Table 14. Refer to Figures 13 and 14 for the adjustment locations.

Enter the DMM reading on the power supply keypad and press (↵). The readout will return to normal when the calibration is complete.

Table 14: Voltage Full-scale Adjustment (Partial Calibration)

Instrument Model	To Cal. OUTPUT 1	To Cal. OUTPUT 2	To Cal. OUTPUT 3
PS2520/PS2520G	Adjust VR601 for a DMM reading of 37.00 V	Adjust VR501 for a DMM reading of 37.00 V	Adjust VR401 for a DMM reading of 6.5 V
PS2521/PS2521G	Adjust VR601 for a DMM reading of 21.00 V	Adjust VR601 for a DMM reading of 21.00 V	Adjust VR601 for a DMM reading of 6.5 V

cL20 Current Offset Calibration. To calibrate the current offset, enter the DMM reading (in amperes) on the power supply keypad and press (↵). The readout will return to normal when the calibration is complete.

cL21 Current Full Scale Calibration. To calibrate the full-scale current, enter the DMM reading on the power supply keypad and press (↵). The readout will return to normal when the calibration is complete.

cL30 Overvoltage Protection: Offset Calibration. Wait 10 seconds for the calibration to complete.

cL31 Overvoltage Protection: Full Scale Calibration. Wait 10 seconds for the calibration to complete.

cL40 Parallel Output: Current Offset Calibration. To calibrate the parallel output current offset, perform the following steps.

1. Verify that the “PARA” indicator lights up on the display.
2. Enter the DMM current reading on the power supply keypad and press (↵).

The readout will return to normal when the calibration is complete.

cL41 Parallel Output: Current Full Scale Calibration. To calibrate the parallel output full-scale current, perform the following steps.

1. Verify that the “PARA” indicator lights up on the display.
2. Enter the DMM current reading on the power supply keypad and press (↵).

The readout will return to normal when the calibration is complete.

Instructions Manual

Tektronix

TAS 200 Series Oscilloscopes

070-9855-00

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TAS 200 Series Oscilloscopes

The Tektronix TAS 220 and TAS 250 oscilloscopes are dual-channel products with frequency bandwidths of DC to 20 MHz and DC to 50 MHz respectively. Both oscilloscopes feature a maximum sensitivity of 1 mV/division and a maximum sweep speed of 10 ns/division.

In addition, the TAS 200 series oscilloscopes offer the following features:

- High beam transmission and high intensity CRT displays for clear waveforms at high sweep speeds.
- High stability low-drift temperature compensation circuits to reduce baseline and DC balance drift.
- Trigger feature, Set to 50% that eliminates triggering adjustments when displaying regular, video, and large duty-cycle-ratio signals.
- Synchronization separator and trigger circuitry that permits the display of TV signals. (You can automatically select vertical and horizontal signals with the SEC/DIV control.)
- Automatic focus (following an initial intensity adjustment).

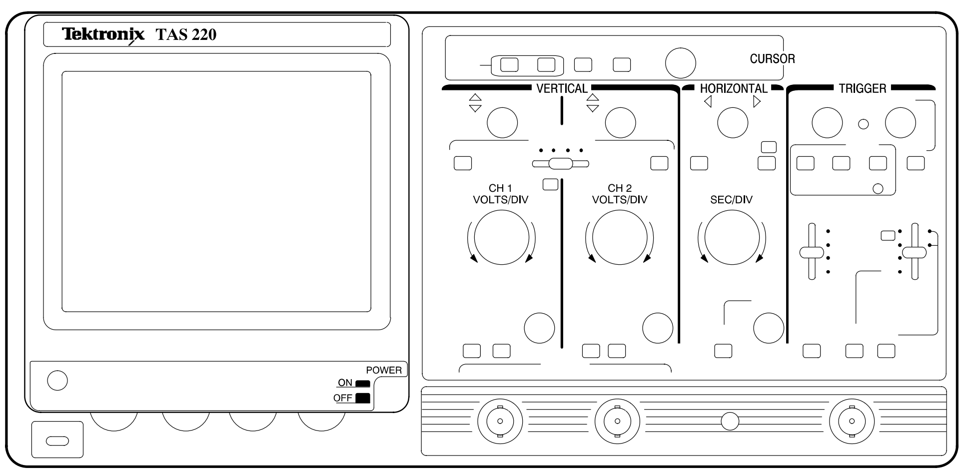

Figure 1: TAS 220 Oscilloscope

Specifications

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

- The instrument operates in a 0° to 40° C ambient environment unless otherwise noted.
- The instrument warms up for at least 20 minutes.
- The instrument is adjusted at an ambient temperature between 20° and 30° C.

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

NOTE. *Input limits apply to signals with frequencies less than 1 kHz.*

Table 1: Vertical Deflection Characteristics

Characteristic	TAS 220 Description	TAS 250 Description
Frequency Bandwidth (–3 dB)	DC to 20 MHz (5 mV/div to 5 V/div at 5° to 35° C)	DC to 50 MHz (at 0° to 10° C and 35 to 40° C)
	DC to 15 MHz	DC to 40 MHz (at 0° to 5° C and 35° to 40° C)
	DC to 10 MHz (1mV/div to 2 mV/div)	DC to 15 MHz
Vertical Gain (15° to 35° C)	5 mV/div to 5 V/div: ±3%	
	1 mV/div to 2 mV/div: ±5%	
Variable Gain (Typical)	To 1/2.5 or less of the readout indicated value.	
Common Mode Rejection Ratio (Typical)	50 kHz: >50:1 10 MHz: >10:1	
Input Impedance (Typical)	1 MΩ, 30 pF	
Vertical Linearity (Typical)	±0.1 division or less of amplitude change when a waveform of two divisions at graticule center is moved vertically.	
DC Balance Shift (Typical)	5 mV/div to 5 V/div: ±0.5 divisions	
	1 mV/div to 2 mV/div: ±2.0 divisions	

Table 1: Vertical Deflection Characteristics (Cont.)

Characteristic	TAS 220 Description	TAS 250 Description
Chopping Repetition Frequency (Typical)	250 kHz	
Maximum Input Voltage	400 V (DC + peak AC)	
Channel Isolation (Typical)	50 kHz: 1000:1	
	10 MHz: 100:1	
	20 MHz: 30:1	50 MHz: 30:1
CH 1 Signal Output (Typical)	100 mV/div open circuit	
	50 mV/div into 50 Ω	
CH 2 INV Balance (Typical)	≤1 division balanced point variation	

Table 2: Horizontal Characteristics TAS 200 Series

Characteristic	Description	
Standard Sweep Time Accuracy	15° to 35° C:	±3%
	0° to 15° C and 35° to 40° C:	±4%
Magnified Sweep Time Accuracy	1 µs/div to 0.5 sec/div:	±5%
	0.1 to 0.5 µs/div:	±8%
Sweep Linearity		
Standard	±3%	
X10 MAG	±5%	
X10 MAG	0.1 to 0.5 µs/div:	±8%

Table 3: Readout Characteristics TAS 200 Series

Characteristic	Description
Readout Resolution	1/25 div
Readout Accuracy	±3% + 1/25 div
Readout Modes	ΔV, ΔT, 1/ΔT

Table 4: Trigger Characteristics

Characteristic	TAS 220 Description	TAS 250 Performance Description
Sensitivity		
0.5 divisions (internal), 0.1 V (external)	DC to 5 MHz	DC to 10 MHz
1.5 divisions (internal), 0.2 V (external)	5 to 20 MHz	10 to 50 MHz
2.0 divisions (internal), 0.2 V (external)	Video	Video
Input Impedance (Typical)	1 MΩ, 30 pF	
Maximum Input Signal	100 V (DC + peak AC)	

Table 5: Typical Z-Axis Characteristics TAS 200 Series

Characteristic	Description
Maximum Input Voltage	50 V (DC + peak AC)
Sensitivity	3 V_{p-p} (Trace becomes brighter with negative input.)
Frequency Bandwidth	DC to 5 MHz
Input Resistance	5 kΩ

Table 6: Typical X-Y Mode Operation

Characteristic	TAS 220 Description	TAS 250 Description
Sensitivity	Same as CH 1 vertical axis	
Sensitivity Accuracy	5 mV to 5 V/div: ±4% 1 to 2 mV/div: ±6%	
Frequency Bandwidth	DC to 1 MHz	DC to 2 MHz
X-Y Phase Difference	≤3° from DC to 50 kHz	≤3° from DC to 100 kHz
EXT HOR Sensitivity	0.1 V/div	

Table 7: Typical Probe Compensation Signal Characteristics TAS 200 Series

Characteristic	Description
Waveform	Positive going square wave
Frequency	1 kHz
Duty Ratio	50:50
Output Level	2 V_{p-p}
Output Resistance	2 kΩ

Table 8: Environmental Characteristics

Characteristic	Description
Temperature	
Operating	0° to 40° C
Nonoperating	–40° to +70° C Tested to MIL-T-28800D, paragraphs 4.5.5.1.3 and 4.5.5.1.4, except in 4.5.5.1.3 steps 4 and 5 (0° C operating test) are performed ahead of step 2 (–40° C nonoperating test). Equipment shall remain off upon return to room ambient during step 6. Excessive condensation shall be removed before operating during step 7.
Altitude	
Operating	≤4,570 meters (15,000 feet). Maximum operating temperature decreases 1° C per 300 m (1,000 feet) above 1,500 m (5,000 feet).
Nonoperating	≤15,250 meters (50,000 feet)
Relative Humidity	
Operating	30° to 40° C, 90% relative humidity +0%, –5%
Nonoperating	30° to 60° C, 90% relative humidity +0%, –5% Five cycles (120 hours) referenced to MIL-T-28800D paragraph 4.5.1.2.2 for type III, class 5 instruments. Operating and nonoperating at 90%, +0%, –5% relative humidity.
Vibration (Operating)	15 minutes along each of three major axes at a total displacement of 0.015 inch peak-to-peak (2.4 g at 55 Hz) with frequency varied from 10 Hz to 55 Hz to 10 Hz in one minute sweeps. Hold for 10 minutes at 55 Hz in each of three major axes. All major resonances must be above 55 Hz.
Shock (Operating and Nonoperating)	30 g, half-sine, 11 ms duration, three shocks per axis each direction, for a total of 18 shocks.
Radiated and Conducted Emissions	Meets EN55011, class A.
Safety	Listed CSA C22.2 No. 231 and UL1244

Table 9: Typical Mechanical Characteristics TAS 200 Series

Characteristic	Description
Dimensions	32.7 cm × 16.2 cm × 46.3 cm (12.9 inch × 6.38 inch × 18.2 inch)
Weight	7.0 kg (15.4 lbs)
Operating Voltages	100 V, 120 V, 220 V, 240 V, 10% variation from selector range permitted.
Line Frequency	50 or 60 Hz
Power Consumption	70 VA

Performance Verification

This section contains procedures to verify that the TAS 220 and TAS 250 oscilloscopes perform as warranted. Verify instrument performance whenever the accuracy or function of your instrument is in question. The procedures are organized into four sections: Vertical Check, Horizontal Check, Trigger Check, and Cursor Check.

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

- The instrument operates in a 20° to 30° C ambient environment.
- The oscilloscope warms up for at least 20 minutes.
- The cabinet remains installed on the oscilloscope.

Table 11 lists the equipment needed to do the performance verification procedures.

The TAS 200 series performance verification consists of the checks listed in Table 10.

Table 10: Performance Verification Checks

Vertical Check	
	DC Gain Accuracy
	DC Coupled Bandwidth
	DC Balance
	Variable DC Balance
	CH 2 Inverted Balance
Horizontal Check	
	Time Base Accuracy
Trigger Check (Trigger Sensitivity)	
Cursor Check	
	ΔT Measurement Accuracy
	ΔV Measurement Accuracy

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 11.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification procedures.

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

Table 11: Performance Verification Test Equipment

Description	Minimum Requirements	Example Product
Leveled Sine Wave Generator	200 kHz to 250 MHz; variable amplitude from 5 mV to 4 V_{p-p} into 50 Ω	Wavetek 9100 Universal Calibration System with Oscilloscope Calibration Module (Option 250) Fluke 5500A Multi-product Calibrator with Oscilloscope Calibration Option 5500A-SC
Time Mark Generator	Variable marker frequency from 10 ms to 10 ns; accuracy within 2 ppm	
DC Calibration Generator	DC voltage levels from 100 mV to 10 V	
Digital Multimeter	35 V, 4 A, ±0.1% Accuracy	Tektronix DMM252 Digital Multimeter
Termination (two required)	50 Ω, female BNC input, male BNC output	Tektronix 011-0049-01
Cable, Coaxial	75 Ω, male-to-male BNC connectors, 36 inch length	Tektronix 012-1338-00
Cable, Precision Coaxial	50 Ω, male-to-male BNC connectors, 36 inch length	Tektronix 012-0482-00

Set Up

Following a 20 minute warm-up period, preset the oscilloscope to the settings listed below.

Table 12: Oscilloscope Initial Settings

Control	Setting
INTENSITY	Visible Display
CURSOR ON/OFF	Off
VERTICAL	
POSITION	Midrange
MODE	CH1
VOLTS/DIV	10 mV
VARIABLE	CAL
GND	In
HORIZONTAL	
SEC/DIV	10 ms
POSITION	Midrange
MAG	Off (Out)
X-Y	Off (Out)
SWEEP VARIABLE	CAL
TRIGGER	
SLOPE	Positive (push switch out)
LEVEL	Midrange
MODE	AUTO
SOURCE	CH 1
COUPLING	DC

Vertical Check

The following checks verify the vertical accuracy of your oscilloscope.

DC Gain Accuracy

To check DC gain accuracy, perform the following steps.

1. Use the 50 Ω precision coaxial cable to connect the standard amplitude output of the DC calibration generator to the TAS 200 series oscilloscope CH 1 (CH 2) input. See Figure 2 below.

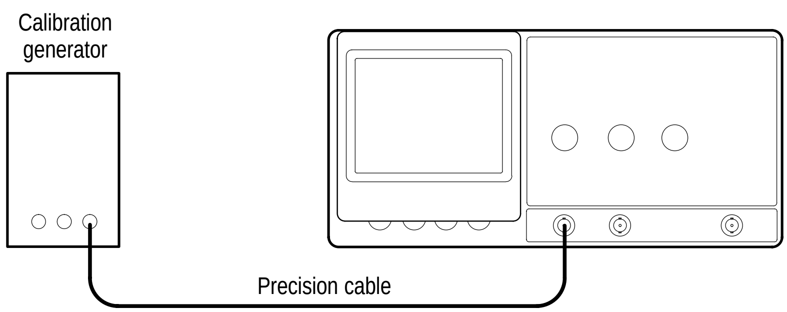

Figure 2: Gain and Voltage Check Setup

2. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) AC-DC	DC
CH 1 (CH 2) VOLTS/DIV	1 mV
TRIGGER MODE	AUTO
HORIZONTAL SEC/DIV	0.5 ms
CH 1 (CH 2) GND	Out (release)

3. Set the oscilloscope CH 1 VOLTS/DIV Scale and calibration generator output to each of the values listed in Table 13; then verify that the readings on the oscilloscope remain within the limits of the Displayed Signal Accuracy.

Table 13: DC Gain and Displayed Signal Accuracy

TAS 200 Volts/Div Scale	Generator Output	Displayed Signal Accuracy
1 mV	5 mV	4.75 to 5.25 div
2 mV	10 mV	4.75 to 5.25 div
5 mV	20 mV	3.88 to 4.12 div
10 mV	50 mV	4.85 to 5.15 div
20 mV	0.1 V	4.85 to 5.15 div
50 mV	0.2 V	3.88 to 4.12 div
100 mV	0.5 V	4.85 to 5.15 div
200 mV	1 V	4.85 to 5.15 div
500 mV	2 V	3.88 to 4.12 div
1 V	5 V	4.85 to 5.15 div
2 V	10 V	4.85 to 5.15 div
5 V	20 V	3.88 to 4.12 div

4. Set the calibration generator output to 5 mV.

5. Return the oscilloscope CH 1 (CH 2) VOLTS/DIV control to 1 mV.

6. Rotate the oscilloscope CH 1 (CH 2) VERTICAL VARIABLE control counterclockwise off of the CAL position until the amplitude of the displayed waveform is reduced to two divisions or less.

7. Set the oscilloscope CH 1 (CH 2) VERTICAL VARIABLE control to the CAL position.

8. Disconnect the test setup from the oscilloscope.

9. Repeat steps 1 through 8 for CH 2.

DC Coupled Bandwidth

To check DC coupled bandwidth accuracy, perform the following steps.

1. Use the 50 Ω precision coaxial cable to connect the output of the leveled sine wave generator to the 50 Ω termination; then connect the 50 Ω termination to the TAS 200 series oscilloscope CH 1 (CH 2) input. See Figure 3 below.

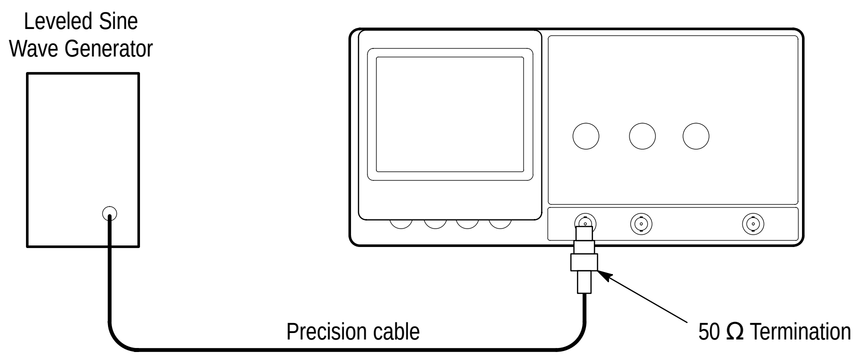

Figure 3: Bandwidth Check Setup

2. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) AC-DC	DC
CH 1 (CH 2) VOLTS/DIV	1 mV
HORIZONTAL SEC/DIV	10 μs
TRIGGER MODE	AUTO
TRIGGER COUPLING	DC
TRIGGER SOURCE	CH 1 (CH 2)
CH 1 (CH 2) GND	Out (release)

3. To confirm the bandwidth of the input channel, perform the following substeps (a. through c.) at the settings and limits noted in Table 14.

   a. Set the oscilloscope CH 1 (CH 2) VOLTS/DIV control as indicated.

   b. Set the leveled sine wave generator to the specified 50 kHz reference amplitude.

   c. Verify that the oscilloscope display amplitude remains greater than the bandwidth minimum amplitude (minimum number of divisions), while increasing the leveled sine wave generator frequency to the specified value for the CH 1 (CH 2) VOLTS/DIV setting and oscilloscope model.

NOTE. *At lower VOLTS/DIV settings, you might need to set TRIGGER COUPLING to HF REJ to minimize noise or double triggering.*

Table 14: DC Coupled Bandwidth

Volts/Div	50 kHz Reference Amplitude	Bandwidth Minimum Amplitude	TAS 220 Bandwidth	TAS 250 Bandwidth
1 mV	6 divisions	4.2 divisions	10 MHz	15 MHz
2 mV	6 divisions	4.2 divisions	10 MHz	15 MHz
5 mV	6 divisions	4.2 divisions	20 MHz	50 MHz
10 mV	6 divisions	4.2 divisions	20 MHz	50 MHz
20 mV	6 divisions	4.2 divisions	20 MHz	50 MHz
50 mV	6 divisions	4.2 divisions	20 MHz	50 MHz
100 mV	6 divisions	4.2 divisions	20 MHz	50 MHz
200 mV	6 divisions	4.2 divisions	20 MHz	50 MHz
500 mV	6 divisions	4.2 divisions	20 MHz	50 MHz
1 V	4 divisions	2.8 divisions	20 MHz	50 MHz

4. Repeat steps 1 through 3 for CH 2.

DC Balance

To check DC balance accuracy, perform the following steps.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) GND	In
CH 1 (CH 2) VARIABLE	CAL

2. Verify that the oscilloscope trace shift is less than ±0.5 divisions when rotating the CH 1 (CH 2) VOLTS/DIV control between the 5 mV and 5 V settings.

3. Verify that the oscilloscope trace shift is less than two divisions when the CH 1 (CH 2) VOLTS/DIV control is changed from the 1 mV to the 2 mV setting.

4. Repeat steps 1 through 3 above for CH 2.

Variable DC Balance

To check Variable DC balance accuracy, perform the following steps.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) AC-DC	DC
CH 1 (CH 2) GND	In
CH 1 (CH 2) VOLTS/DIV	10 mV

2. Verify that the oscilloscope trace shift is less than one division between the fully clockwise and the fully counterclockwise positions of the CH 1 VARIABLE control.

3. Repeat steps 1 and 2 above for CH 2.

CH 2 Inverted Balance

To check CH 2 Inverted balance accuracy, perform the following steps.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH2
CH 2 GND	In

2. Position the oscilloscope trace on the center horizontal graticule line using the CH 2 POSITION control.

3. Verify that there is minimal trace shift (<±1 divisions) on the TAS 200 series instrument when switching the CH 2 INVERT button in and out.

4. Set the oscilloscope CH 2 INVERT button to the out position.

Horizontal Check

The following checks verify the horizontal accuracy of your oscilloscope.

Time Base Accuracy

To check time base accuracy, perform the following steps.

1. Use the 50 Ω precision coaxial cable to connect the output of the time mark generator to the 50 Ω termination; then connect the 50 Ω termination to the TAS 200 series instrument CH 1 input. See Figure 4 below.

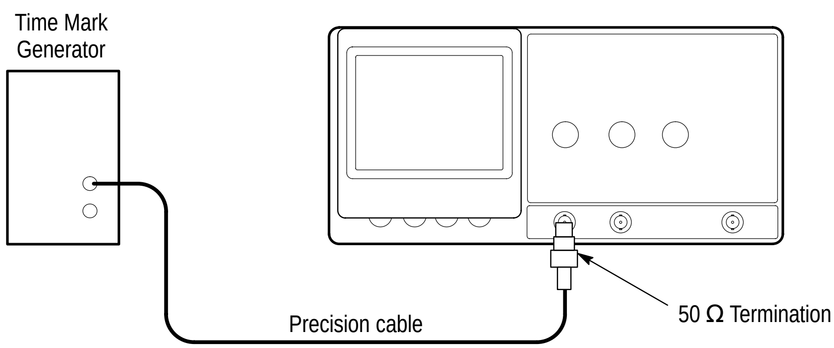

Figure 4: Timing Check Setup

2. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 AC-DC	DC
CH 1 VOLTS/DIV	0.5 V
CH 1 GND	Out (release)
HORIZONTAL SEC/DIV	.1 μs
TRIGGER MODE	AUTO
TRIGGER COUPLING	DC

3. Set up the time mark generator to produce 0.1 μs markers.

4. Center the time marks vertically on the oscilloscope display.

5. Position the rising edge of the second time mark to the second vertical graticule line of the oscilloscope display.

6. Verify that the time mark to graticule accuracy over the center eight divisions is within the limits shown for each HORIZONTAL SEC/DIV setting listed in Table 15.

Table 15: Standard Time Base Accuracies

HORIZONTAL SEC/DIV	Time Marker Setting	Time Mark to Graticule Accuracy Over Center 8 Divisions
.1 µs	0.1 µs	±0.24 division
.2 µs	0.2 µs	±0.24 division
.5 µs	0.5 µs	±0.24 division
1 µs	1 µs	±0.24 division
2 µs	2 µs	±0.24 division
5 µs	5 µs	±0.24 division
10 µs	10 µs	±0.24 division
20 µs	20 µs	±0.24 division
50 µs	50 µs	±0.24 division
.1 ms	0.1 ms	±0.24 division
.2 ms	0.2 ms	±0.24 division
.5 ms	0.5 ms	±0.24 division
1 ms	1 ms	±0.24 division
2 ms	2 ms	±0.24 division
5 ms	5 ms	±0.24 division

7. Set the oscilloscope HORIZONTAL SEC/DIV control to either .5 µs (TAS 220) or .1 µs (TAS 250).
8. Set the oscilloscope HORIZONTAL X10 MAG push switch to the on position (in).
9. Set the time mark generator to 20 ns.
10. Position the edge of the second time mark to the second vertical graticule line of the oscilloscope display.
11. Verify that the time mark to graticule accuracy over the center eight divisions is within the limits shown for each HORIZONTAL SEC/DIV setting listed in Table 16.

Table 16: X10 MAG Time Base Accuracy

HORIZONTAL SEC/DIV	Time Marker Setting	Time Mark to Graticule Over Center 8 Divisions
10 ns	10 ns	±0.64 division
20 ns	20 ns	±0.64 division
50 ns	50 ns	±0.64 division

12. Set the oscilloscope HORIZONTAL X10 MAG push switch to the off position (out).

Trigger Check

The following check verifies the trigger accuracy of your oscilloscope.

1. Use the 50 Ω precision coaxial cable to connect the output of the leveled sine wave generator to the 50 Ω termination; then connect the 50 Ω termination to the TAS 200 series instrument CH 1 input. See Figure 5 below.

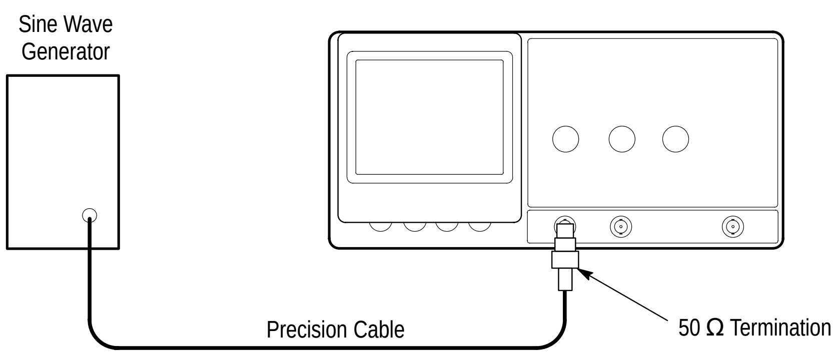

Figure 5: Trigger Level Check Setup

2. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 VOLTS/DIV	1 V
CH 1 AC-DC	DC
CH 1 GND	Out (release)
HORIZONTAL SEC/DIV	.5 µs
TRIGGER MODE	AUTO
TRIGGER LEVEL	Midway

TRIGGER COUPLING	DC
TRIGGER SET TO 50%	Out (release)

3. Set the leveled sine wave generator to produce a five-division output at the low-frequency trigger level listed for your instrument. See Table 17.

Table 17: DC Coupled Triggering Sensitivity

	Minimum Trigger Waveform Amplitude	TAS 220	TAS 250
Low Frequency Trigger	0.5 divisions	5 MHz	10 MHz
High Frequency Trigger	1.5 divisions	20 MHz	50 MHz

4. Reduce the leveled sine wave generator output until the minimum trigger waveform amplitude is equal to the value listed in Table 17. If necessary, adjust the oscilloscope TRIGGER LEVEL to maintain a stable waveform during the operation.

5. Set the leveled sine wave generator for a four division output at the high frequency trigger level listed in Table 17.

6. Reduce the leveled sine wave generator output until the minimum trigger waveform amplitude is equal to the value listed in Table 17. If necessary, adjust the oscilloscope TRIGGER LEVEL to maintain a stable waveform during the operation.

Cursor Check

The following checks verify the cursor accuracy of your oscilloscope.

ΔT Measurement Accuracy

To check cursor ΔT measurement accuracy, implement the following steps.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
HORIZONTAL SEC/DIV	1 ms

2. Press and hold the oscilloscope CURSOR ON/OFF push switch to activate the cursors.
3. If not already displayed, press and hold the ΔV/ΔT 1/ΔT push switch until two vertical cursors appear on the display.
4. Toggle the TRACKING ◊ – O(REF) switch to select only the ◊ cursor.
5. Position the ◊ cursor 4 divisions to the left of the display vertical center with the CURSOR POSITION switch.
6. Toggle the TRACKING ◊ – O(REF) push switch to select only the O cursor.
7. Position the O cursor 4 divisions to the right of the display vertical center with the CURSOR POSITION switch.
8. Verify that the ΔT readout at the top-left corner of the display reads between 7.72 and 8.28 ms.
9. Set the VERTICAL MODE switch to CH2 and repeat steps 4 through 8 for CH 2.

ΔV Measurement Accuracy

To check cursor ΔV measurement accuracy, implement the following steps.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
VERTICAL VOLTS/DIV	1 V

2. Press and hold the oscilloscope ΔV/ΔT 1/ΔT push switch until two horizontal cursors appear on the display.
3. Toggle the TRACKING ◊ – O(REF) switch to select only the ◊ cursor.
4. Position the ◊ cursor 3 divisions above the display horizontal center with the CURSOR POSITION switch.
5. Toggle the TRACKING ◊ – O(REF) push switch to select only the O cursor.

6. Position the O cursor 3 divisions below the display horizontal center with the CURSOR POSITION switch.
7. Verify that the $\Delta V_{1\ (2)}$ readout at the top-left corner of the display, reads between 5.78 and 6.22 V.
8. Set the VERTICAL MODE switch to CH2 and repeat steps 3 through 7 for CH 2.

Adjustment Procedures

This section contains procedures to adjust TAS 220 and TAS 250 oscilloscopes. 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 instruments for adjustment
- Step-by-step adjustment procedures

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

List of Adjustments

Use the adjustments listed in Table 18 to return TAS 220 and TAS 250 oscilloscopes to factory calibration.

Table 18: TAS 220 and TAS 250 Adjustments

Power Supply Adjustments	
	+12 V Supply
	Intensity
	Focus and Astigmatism
Vertical Adjustments	
	DC Balance
	Variable DC Balance
	Channel 2 Inverted Balance and Position Center
	ADD Mode Balance
	Vertical Gain
	MAG Sensitivity
	High Frequency Compensation
	Attenuator Compensation
	Channel 1 Output DC Offset

Table 18: TAS 220 and TAS 250 Adjustments (Cont.)

Horizontal Adjustments	
	X10 Magnification Registration
	Horizontal Position
	1 ms Timing
	1 µs and .1 µs Timing
	X-Gain Accuracy
	X-Axis Offset
Trigger Adjustments	
	Trigger DC Offset
	Trigger Slope Balance
	Trigger Center
Probe Compensation	
Cursors and Readout Adjustments	
	Cursor Accuracy
	Drift

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 19.

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

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

Table 19: Adjustment Test Equipment

Description	Minimum Requirements	Example Product
Leveled Sine Wave Generator	1 kHz to 250 MHz; variable amplitude from 5 mV to 4 V_{p-p} into 50 Ω	Wavetek 9100 Universal Calibration System with Oscilloscope Calibration Module (Option 250) Fluke 5500A Multi-product Calibrator with Oscilloscope Calibration Option 5500A-SC
Time Mark Generator	Variable marker frequency from 1 ms to 10 ns; accuracy within 2 ppm	
DC Calibration Generator	DC voltage levels from 100 mV to 10 V	
Digital Multimeter	35 V, 4 A, ±0.1% Accuracy	Tektronix DMM252 Digital Multimeter
Termination (two required)	50 Ω, female BNC input, male BNC output	Tektronix 011-0049-01
Cable, Coaxial	75 Ω, male-to-male BNC connectors, 36 inch length	Tektronix 012-1338-00
Cable, Precision Coaxial	50 Ω, male-to-male BNC connectors, 36 inch length	Tektronix 012-0482-00
Coupler	Female-BNC-to-dual-male-BNC, dual-input	Tektronix 067-0525-02
Probe	Standard accessory probe	Tektronix P6109B

Preparation for Adjustment

Perform the adjustment procedures on an as-needed basis. If an oscilloscope section fails a performance requirement, or if a section is replaced or repaired, adjust only that section. Adjusting individual sections of the oscilloscope rarely affects its overall performance.

In general, accurate adjustments require a stable, well-focused, low intensity display. Unless otherwise noted, adjust the INTENSITY, FOCUS, and TRIGGER LEVEL controls as needed to view the display.

In addition to the above, the following guidelines apply to all instrument adjustments:

- Perform the adjustments in a 20° to 30° C (68° to 86° F) ambient environment.
- Before making any adjustments, warm up the instrument for at least 20 minutes.
- Do not alter a setting unless a performance characteristic cannot be met at the current setting.
- Do not alter any setting without reading the entire adjustment procedure first.
- Read the *Safety Summary* at the beginning of this manual.

NOTE*. Altering the +12 V ADJ setting may require a complete readjustment of the instrument.*

Remove the Instrument Cover

You must remove the instrument cover to make internal adjustments.

WARNING. *To avoid electrical shock, always disconnect the power cord from its source before removing the instrument cover. After the adjustment procedures, replace the instrument cover before using the oscilloscope.*

To remove the cover, refer to Figure 12 while performing the following steps:

1. Remove the two cover screws on the instrument bottom.
2. Remove the four rear panel mounting screws.
3. Remove the rear panel.
4. Slide the cover off the rear of the instrument.

To reinstall the cover, perform steps 1 through 4 above in reverse order.

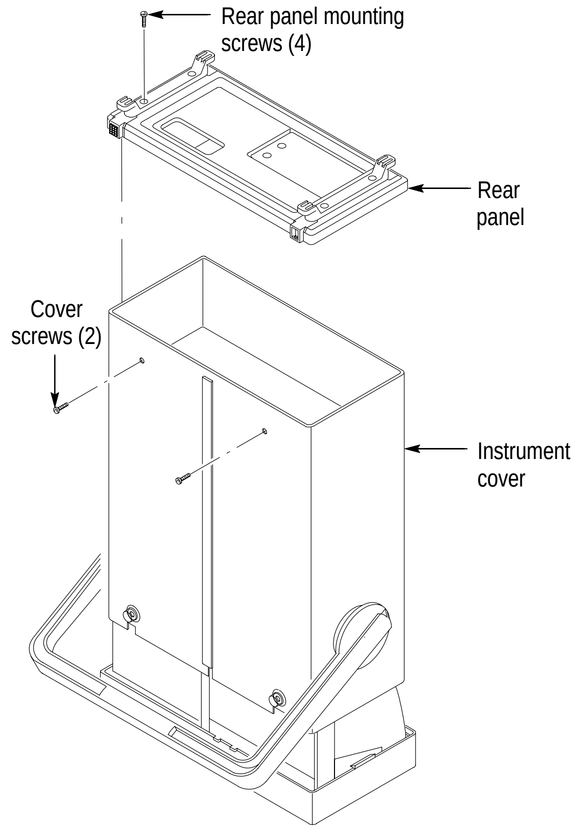

Figure 6: TAS 220 and TAS 250 Instrument Cover Removal

Initial Settings

Following the warm-up period, preset the oscilloscope to the settings listed below.

Table 20: Oscilloscope Initial Settings

Control	Setting
INTENSITY	Visible display
CURSOR ON/OFF	Off
VERTICAL	
CH 1 (CH 2) POSITION	Midrange
MODE	CH1 (CH2)
CH 1 (CH 2) VOLTS/DIV	10 mV
CH 1 (CH 2) VOLTS/DIV VARIABLE	CAL
CH 1 (CH 2) GND	In
HORIZONTAL	
POSITION	Midrange
X10 MAG	Out
X-Y	Out
SWP UNCAL	Out
TRIGGER	
LEVEL	Midrange
MODE	AUTO
COUPLING	AC
SOURCE	CH 1 (CH 2)
SLOPE	Rising (push switch out)

Power Supply Adjustments

To locate the adjustments and test points for the following procedures, refer to Figure 7. The Power and High Voltage board occupies the bottom-left side of the instrument below the CRT.

NOTE. *The power supply section affects all other sections of the instrument. If you make repairs or adjustments that change the absolute value of any power supply voltage, you must complete the entire adjustment procedure.*

WARNING. *Use extreme caution when adjusting the power supply. The high voltages present can cause a fatal injury.*

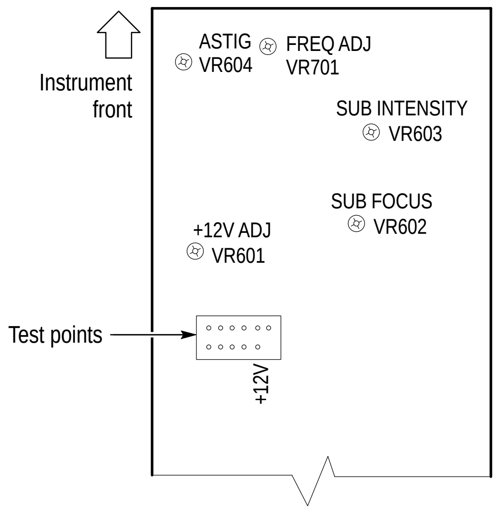

Figure 7: Power and High Voltage Board (Viewed from the Instrument Bottom)

+12 V Supply

Use the following procedure to adjust the +12 V power supply.

1. On the Power and High Voltage board, connect the voltmeter common lead to the oscilloscope chassis ground and the measurement lead to the +12 V test point. See Figure 7 for the test point location.
2. Verify that the voltmeter reads between +11.95 and +12.05 V. If the reading is within these limits, go to step 4.
3. Adjust VR601 for a voltmeter reading of +12 V. See Figure 7 for the adjustment location.

4. Verify that the voltage levels in Table 21 are within the specified limits. See Figure 7 for the test point locations.

Table 21: Power Supply Limits

Power Supply	Test Point	Limits (Volts)
+12	+12	+11.95 to +12.05
–12	–12	–11.80 to –12.20
+5	+5	+4.75 to +5.25
+185 (TAS 220)	+185	+180 to +190
+145 (TAS 250)	+145	+140 to +150

NOTE*. If a power supply measurement exceeds the limits specified in Table 21, discontinue the adjustment procedures. Contact a Tektronix service center for instrument repair.*

5. Disconnect the voltmeter from the instrument.

Intensity

Use the following procedure to adjust the display intensity.

1. Set up the oscilloscope as follows:

   HORIZONTAL SEC/DIV 1 ms
   TRIGGER HOLDOFF NORM

2. Rotate the front panel INTENSITY control to the fully counterclockwise position; then rotate the control clockwise to the 90° (nine o'clock) position.

3. Locate VR603 on the Power and High Voltage board (see Figure 7 for the adjustment location). Adjust VR603 until the trace is barely visible.

4. Rotate the INTENSITY control clockwise. Verify that the trace becomes brighter. Rotate the INTENSITY control fully counterclockwise; the trace should disappear.

Focus and Astigmatism

Use the following procedure to adjust the display focus and astigmatism.

1. Set the front panel FOCUS control to midrange; then adjust VR602 on the Power and High Voltage board to obtain the best focus. See Figure 7 for the adjustment location.

2. Set the front panel HORIZONTAL X-Y push switch to the in position.

3. Rotate the front panel HORIZONTAL POSITION control to move the dot to the display center. Rotate the INTENSITY control to give the dot a sharp edge.
4. Adjust VR604 on the Power and High Voltage board and the oscilloscope front panel FOCUS control until the dot becomes circular. See Figure 7 for the adjustment location.
5. Set the front panel HORIZONTAL X-Y push switch to the out position.
6. Repeat steps 1 through 5 for best performance.

Vertical Adjustments

To locate the adjustments for the following procedures, refer to Figures 8, 9, and 10. The Main board occupies the bottom-right side of the instrument.

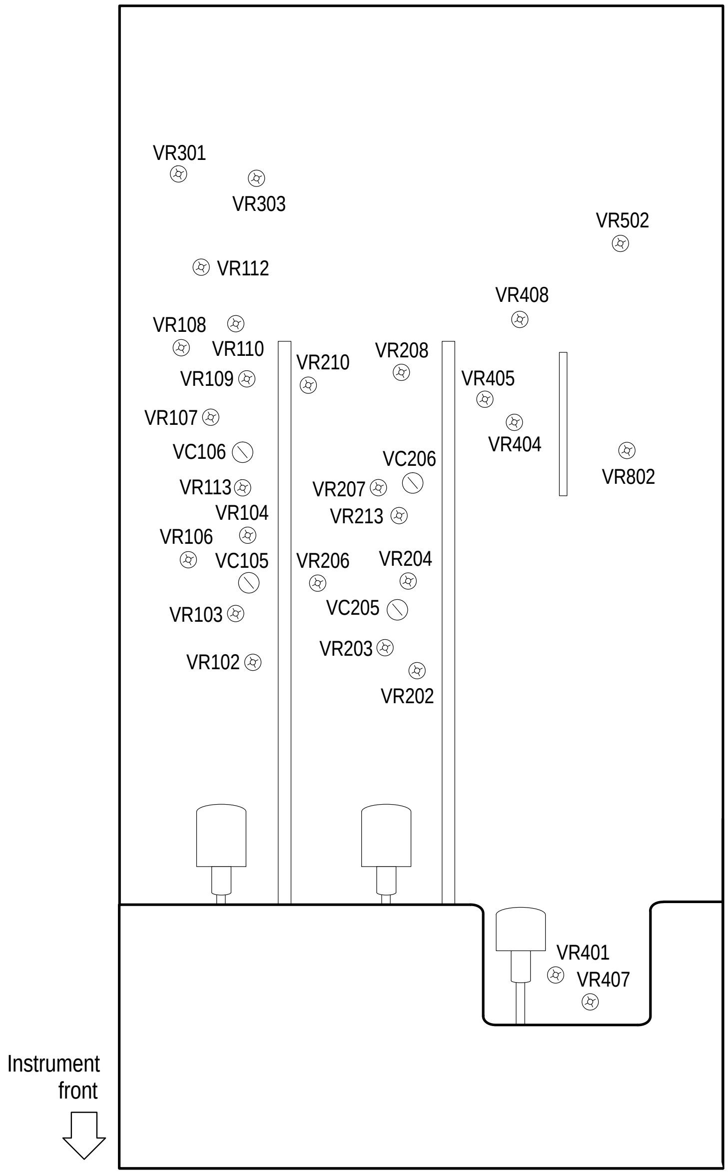

Figure 8: Main Board (Viewed from the Instrument Top)

DC Balance

Use the following procedure to adjust the DC balance.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) VERTICAL VARIABLE	CAL
CH 1 (CH 2) GND	In

2. On the oscilloscope Main board, adjust VR101 (VR201) for a minimal trace shift when switching the front panel CH 1 (CH 2) VOLTS/DIV control between 5 mV and 10 mV. See Figure 10 for the adjustment locations.
3. Verify that the trace shift is less than ±0.5 divisions for each CH 1 (CH 2) VOLTS/DIV step between 5 mV and 5 V.
4. On the Main board, adjust VR104 (VR204) for minimal trace shift when switching the CH 1 (CH 2) VOLTS/DIV control between 2 mV and 10 mV. See Figure 8 for the adjustment locations.
5. Verify that the trace shift is less than two divisions when switching the VOLTS/DIV control between 1 mV and 2 mV.
6. Set the VERTICAL MODE to CH2 and repeat steps 2 through 5 for CH 2.

Variable DC Balance

Use the following procedure to adjust the variable DC balance.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) VOLTS/DIV	10 mV
CH 1 (CH 2) VARIABLE	CAL
CH 1 (CH 2) GND	In

2. On the Main board, adjust VR106 (VR206) for a minimal trace shift while rotating the front panel CH 1 (CH 2) VARIABLE control between the fully clockwise and the fully counterclockwise positions. See Figure 8 for the adjustment locations.
3. Set the VERTICAL MODE to CH2 and repeat step 2 for CH 2.

Channel 2 Inverted Balance and Position Center

Use the following procedure to adjust the channel 2 inverted balance and position center.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH2
CH 2 GND	In

2. Position the trace on the center horizontal graticule line using the CH 2 VERTICAL POSITION control.

3. Set the CH 2 VERTICAL INVERT push switch to the in position and note the new trace location.

4. On the Main board, adjust VR213 to position the trace half way back to the center horizontal graticule line. See Figure 8 for the adjustment location.

5. Set the channel 2 VERTICAL INVERT push switch to the out position.

6. If the trace shifts, adjust VR303 to return the trace to the center horizontal graticule line.

7. Repeat steps 3 through 6 to obtain a minimal trace shift (<±1 division) when you toggle the CH 2 VERTICAL INVERT push switch in and out.

ADD Mode Balance

Use the following procedure to adjust the ADD mode balance.

1. Set up the oscilloscope as follows:

VERTICAL MODE	BOTH
CH 1 (CH 2) VOLTS/DIV	10 mV
CH 1 (CH 2) VARIABLE	CAL
CH 1 (CH 2) GND	In

2. Position both traces on the center horizontal graticule line using the CH 1 and CH 2 VERTICAL POSITION controls.

3. Set the VERTICAL MODE control to the ADD position.

4. On the Main board, adjust VR301 to position the trace on the center horizontal graticule line. See Figure 8 for the adjustment location.

5. Set the VERTICAL MODE switch to BOTH, CH2, and then CH1; verify that the trace shifts less than ±1 division from the center of the display. If necessary, repeat steps 2 through 4 to obtain the best performance.

Vertical Gain

Use the following procedure to adjust the vertical gain.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 (CH 2) VOLTS/DIV	10 mV
CH 1 (CH 2) VARIABLE	CAL
CH 1 (CH 2) AC-DC	DC

2. Connect a 50 mV_{p-p} 50 kHz square wave to the CH 1 and CH 2 inputs with a dual input coupler.

3. On the Main board, adjust VR108 to obtain a waveform five divisions in amplitude. See Figure 8 for the adjustment location.

4. Set the CH 2 VERTICAL INVERT push switch to the in position.
5. Set the VERTICAL MODE control to the ADD position.
6. Position the trace to the center horizontal graticule.
7. Adjust VR208 to obtain a flat line. See Figure 8 for the adjustment location.

MAG Sensitivity

Use the following procedure to adjust the MAG Sensitivity.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) VOLTS/DIV	2 mV
CH 1 (CH 2) VARIABLE	CAL
CH 2 INVERT	Out
CH 1 (CH 2) AC-DC	DC

2. Connect a 10 mV_{p-p} 50 kHz square wave to the CH 1 (CH 2) input.
3. Adjust VR102 (VR202) to obtain a waveform five divisions in amplitude. See Figure 8 for the adjustment locations.
4. Set the VERTICAL MODE to CH2 and repeat steps 2 and 3 for CH 2.

High Frequency Compensation

Use the following procedure to adjust the high frequency compensation.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) VOLTS/DIV	10 mV
CH 1 (CH 2) VARIABLE	CAL
CH 1, CH 2 AC-DC	AC
HORIZONTAL SEC/DIV	0.2 μs

2. Connect a 20 MHz sine wave to the CH 1 (CH 2) input. Adjust the generator output to produce a waveform four divisions in amplitude on the display.
3. Adjust VC105 and VC106 (VC205, VC206) for maximum waveform amplitude. See Figure 8 for the adjustment locations.
4. Adjust VR103 (VR203) to obtain a maximum waveform amplitude. See Figure 8 for the adjustment locations.
5. Connect a 1 MHz square wave to the CH 1 (CH 2) input. Adjust the generator output to produce a waveform six divisions in amplitude on the display.
6. Adjust VR302 and VC301 to optimize the waveform flatness. See Figure 9 for the adjustment location.

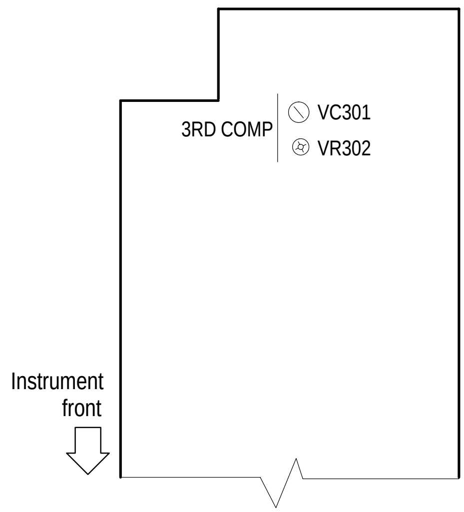

Figure 9: Power and High Voltage Board (Viewed from the Instrument Bottom)

7. Adjust VR107 (VR207) to optimize the waveform flatness. See Figure 8 for the adjustment locations.

8. Readjust VR103 (VR203) to reduce peak aberrations to less than 0.24 divisions while maintaining peak-to-peak aberrations less than 0.36 divisions. See Figure 8 for the adjustment locations.

9. Connect a 50 kHz sine wave to the CH 1 (CH 2) input. Adjust the generator output to produce a waveform six divisions in amplitude on the display.

10. Increase the frequency to 20 MHz for the TAS 220 or 50 MHz for the TAS 250. Verify that the waveform amplitude exceeds 4.2 divisions at these frequencies.

11. Set the oscilloscope CH 1 (CH 2) VOLTS/DIV to 1 mV and the sine wave generator to 50 kHz. Adjust the generator output to produce a waveform eight divisions in amplitude on the display.

12. Increase the frequency to 10 MHz for the TAS 220 or 15 MHz for the TAS 250. Verify that the waveform amplitude exceeds 5.6 divisions at these frequencies.

13. If steps 10 or 12 fail the specified criteria, repeat steps 7, 8, and 9.

14. Set the VERTICAL MODE to CH2 and repeat steps 2 through 13 for CH 2.

Attenuator Compensation

Use the following procedure to adjust the vertical input attenuator compensation.

1. Set up the oscilloscope as follows:

VERTICAL MODE	BOTH
CH 1 (CH 2) VOLTS/DIV	0.1 V
CH 1 (CH 2) VARIABLE	CAL
CH 1 (CH 2) AC-DC	DC

2. Connect a 1 kHz square wave to the CH 1 (CH 2) input. Adjust the generator output to produce a waveform five divisions in amplitude on the display.

3. Adjust VC102 (VC202) to obtain an optimum waveform symmetry with minimal overshoot. See Figure 10 for the adjustment locations.

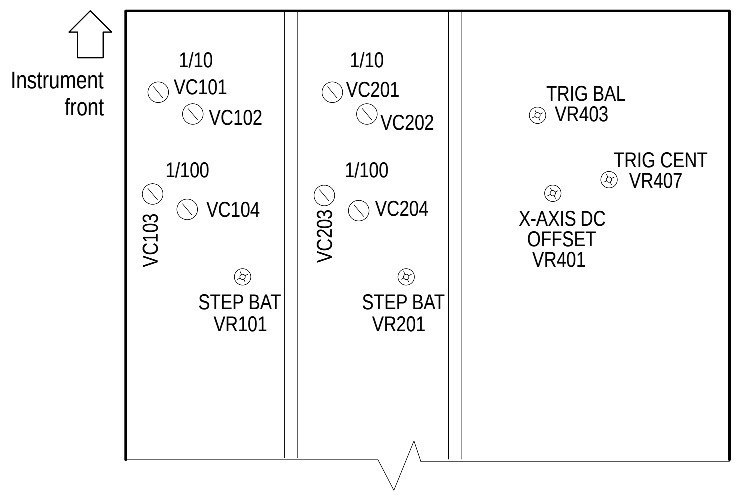

Figure 10: Main Board (Viewed from the Instrument Bottom)

4. Set the CH 1 (CH 2) VOLTS/DIV control to 1 V.

5. Readjust the generator output to produce a waveform five divisions in amplitude. Adjust VC104 (VC204) to obtain an optimum waveform symmetry with minimal overshoot. See Figure 10 for the adjustment locations.

6. Disconnect the square wave generator from the instrument.

7. Connect a 10X probe to the CH1 (CH 2) input

8. Set the CH 1 (CH 2) VOLTS/DIV control to 10 mV/division.

9. Connect the probe to the square wave generator and confirm that the output is a 1 kHz square wave. Adjust the generator output to produce a waveform five divisions in amplitude on the display. Adjust the probe compensation to flatten and optimize the waveform.

10. Set the CH 1 (CH 2) VOLTS/DIV control to 0.1 V.

11. Readjust the generator output to produce a waveform five divisions in amplitude.

12. Adjust VC101 (VC201) to flatten the waveform. See Figure 10 for the adjustment locations.

13. Set the CH 1 (CH 2) VOLTS/DIV control to 1 V.

14. Readjust the generator output to produce a waveform five divisions in amplitude.

15. Adjust VC103 (VC203) to flatten the waveform. See Figure 10 for the adjustment locations.

16. For each setting of the CH 1 (CH 2) VOLTS/DIV control, adjust the generator output to produce a waveform five divisions in amplitude. Evaluate the waveform for optimum symmetry and flatness at each setting.

17. Set the VERTICAL MODE to CH2 and repeat steps 2 through 16 for CH 2.

Channel 1 Output DC Offset

Use the following procedure to adjust the channel 1 output DC offset.

1. Set up the oscilloscope as follows:

VERTICAL MODE	BOTH
CH 1 (CH 2) VOLTS/DIV	10 mV
CH 1 (CH 2) VARIABLE	CAL
CH 1 (CH 2) GND	In
TRIGGER SOURCE	CH 1

2. Position the CH 1 and CH 2 traces to the center horizontal graticule line with the VERTICAL POSITION controls.

3. Connect the rear panel CH 1 OUTPUT to the front panel CH 2 input with a 50 Ω coaxial cable.

4. Set the CH 2 GND push switch to the out position.

5. On the Main board, adjust VR112 to position the CH 2 trace to the center horizontal graticule line. See Figure 8 for the adjustment location.

Horizontal Adjustments

To locate the adjustments for the following procedures, refer to Figures 8 and 10. The Main board occupies the bottom-right side of the instrument.

X10 MAG Registration

Use the following procedure to adjust the X10 MAG registration.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 VERTICAL POSITION	Midrange
HORIZONTAL SEC/DIV	1 ms

2. Rotate the HORIZONTAL POSITION control to move the left edge of the trace to the display center (center vertical graticule line).

3. Set the HORIZONTAL X10 MAG push switch to the in position. Verify that the trace is located within ±1 division of the display vertical center. If the trace does not line up, use the HORIZONTAL POSITION control to reposition the trace to the display center.

4. Set the HORIZONTAL X10 MAG push switch to the out position. Adjust VR502 to position the trace edge to the display vertical center. See Figure 8 for the adjustment location.

5. Repeat steps 3 and 4 until the trace edge remains within ±1 division of the display center when pressing the HORIZONTAL X10 MAG push switch in and out.

Horizontal Position

Use the following procedure to adjust the horizontal position.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 VERTICAL POSITION	Midrange
HORIZONTAL SEC/DIV	1 ms

2. Center the HORIZONTAL POSITION control.

3. Adjust VR408 to align the left edge of the trace to the left-most graticule of the display. See Figure 8 for the adjustment location.

1 ms Timing

Use the following procedure to adjust the 1 ms timing.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 VERTICAL POSITION	Midrange

HORIZONTAL SEC/DIV	1 ms
SWEEP UNCAL	Out

2. Connect the time mark generator to the CH 1 input with a 50 Ω coaxial cable and 50 Ω termination.
3. Set up the generator to produce a 1 ms output.
4. Adjust the generator output to produce a waveform two divisions in amplitude on the display.
5. Adjust VR405 for a one marker per division display over the center eight divisions. See Figure 8 for the adjustment location.

1 μs and .1 μs Timing

Use the following procedure to adjust the 1 μs and .1 μs timing.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 VERTICAL POSITION	Midrange
HORIZONTAL SEC/DIV	1 μs
HORIZONTAL SWP UNCAL	Out

2. Connect the time mark generator to the CH 1 input with a 50 Ω coaxial cable and 50 Ω termination.
3. Set up the generator to produce a 1 μs output.
4. Adjust the generator output to produce a waveform one division in amplitude on the display.
5. Adjust VR404 for a one marker per division display. See Figure 8 for the adjustment location.
6. Set the generator to produce a .1 μs output.
7. Set the HORIZONTAL SEC/DIV control to .1 μs.
8. Adjust VR802 for a one marker per division display. See Figure 8 for the adjustment location.

X-Gain Accuracy

Use the following procedure to adjust the X-gain accuracy.

1. Set up the oscilloscope as follows:

VERTICAL MODE	X-Y
CH 1 VOLTS/DIV	10 mV
CH 1 VARIABLE	CAL
HORIZONTAL X-Y	In

TRIGGER COUPLING	AC
TRIGGER SOURCE	X-Y

2. Use a 50 Ω coaxial cable to connect the square wave generator to the CH 1 input. Set up the generator for a 1 kHz 50 mV output.

3. Adjust VR109 for exactly five divisions of horizontal deflection on the display. See Figure 8 for the adjustment location.

X-Axis Offset

Use the following procedure to adjust the X-axis DC offset.

1. Set up the oscilloscope as follows:

CH 1 VERTICAL POSITION	Midrange
VERTICAL MODE	CH1
CH 1 VOLTS/DIV	50 mV
CH 1 GND	In
HORIZONTAL SEC/DIV	1 ms
HORIZONTAL X-Y	Out
TRIGGER MODE	AUTO

2. Position the trace vertically to the horizontal center graticule line.

3. Position the left edge of the trace horizontally to the first vertical graticule line (extreme left).

4. Set the HORIZONTAL X-Y push switch to the in position.

5. Adjust VR401 to position the spot to the center vertical graticule line. See Figure 10 for the adjustment location.

Trigger Adjustments

To locate the adjustments for the following procedures, refer to Figures 8 and 10. The Main board occupies the bottom-right side of the instrument.

Trigger DC Offset

Use the following procedure to adjust the trigger DC offset.

1. Set up the oscilloscope as follows:

CH 1 (CH 2) VERTICAL POSITION	Midrange
VERTICAL MODE	CH1 (CH2)
CH 1 (CH 2) VOLTS/DIV	10 mV
CH 1 (CH 2) VARIABLE	CAL
CH 1 (CH 2) AC-DC	AC
HORIZONTAL SEC/DIV	1 ms
TRIGGER COUPLING	AC
TRIGGER SOURCE	CH 1 (CH 2)

2. Connect a 50 kHz sine wave to the CH 1 (CH 2) input. Adjust the generator output to produce a waveform eight divisions in amplitude on the display.

3. Rotate the TRIGGER LEVEL control to set the trigger point at the center of the signal swing.

4. Alternate the TRIGGER COUPLING control between the AC and DC positions. Adjust VR110 (VR210) until the oscilloscope triggers at the same amplitude for both switch positions. See Figure 8 for the adjustment location.

5. Set the VERTICAL MODE and TRIGGER SOURCE to CH2 and repeat steps 2 through 4 for channel 2.

Trigger Slope Balance

Use the following procedure to adjust the trigger slope balance.

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 AC-DC	AC
CH 1 GND	In
HORIZONTAL SEC/DIV	1 ms

TRIGGER SET TO 50%	In
TRIGGER SLOPE	Falling (push switch in)

2. Use a DMM to measure the collector voltage of Q414. Adjust VR403 for a reading of 1.40 V ±0.02 V. See Figure 10 for the adjustment location.

3. Set the CH 1 GND push switch to the out position.

4. Connect a 50 kHz sine wave to the CH 1 input. Adjust the generator output to produce a waveform four divisions in amplitude on the display.

5. Alternate the TRIGGER SLOPE push switch between the rising (in) and falling (out) slope settings. Adjust VR403 for a 0.4 division downward vertical shift at the beginning of the sweep. See Figure 10 for the adjustment location.

Trigger Center

Use the following procedure to adjust the trigger center.

1. Set up the oscilloscope as follows:

HORIZONTAL SEC/DIV	1 ms
TRIGGER SOURCE	CH 1
TRIGGER SET TO 50%	In
CH 1 AC-DC	AC

2. Connect a 50 kHz sine wave to the CH 1 input. Adjust the generator output to produce a waveform eight divisions in amplitude on the display.

3. Verify that the trigger point is within ±1.5 divisions of the signal swing center.

4. Readjust the oscilloscope controls as follows:

TRIGGER SET TO 50%	Out
TRIGGER LEVEL	Midway

5. Adjust VR407 to position the trigger points equidistant from the center horizontal graticule line. See Figure 10 for the adjustment location.

Probe Compensation

To locate the adjustment for the following procedure, refer to Figure 11. The Power and High Voltage board occupies the bottom-left side of the instrument below the CRT.

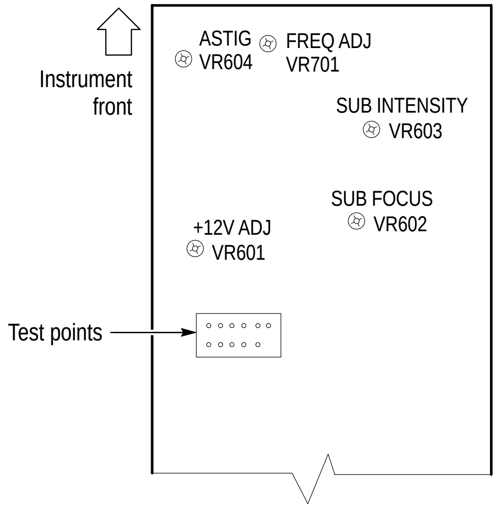

Figure 11: Power and High Voltage Board (Viewed from the Instrument Bottom)

1. Set up the oscilloscope as follows:

VERTICAL MODE	CH1
CH 1 VOLTS/DIV	0.5 V
CH 1 AC-DC	DC
HORIZONTAL SEC/DIV	0.2 ms
TRIGGER COUPLING	DC
TRIGGER SOURCE	CH 1

2. Connect the probe to the CH 1 input connector

3. Touch the probe tip to the PROBE COMP tab on the left side of the front panel.

4. Adjust the probe (compensation) for a flat-topped square wave on the display.

5. Adjust VR701 on the Power and High Voltage board until one cycle spans five divisions. See Figure 11 for the adjustment location.

6. Verify that the display amplitude is 2 $V_{p\text{-}p}$ ±2% and the duty-cycle ratio is approximately 1 to 1.

Cursors and Readout Adjustments

To locate the adjustments for the following procedures, refer to Figure 13. The Control and I/O board occupies the top left-hand corner of the instrument.

Cursor Accuracy

Use the following procedure to adjust the cursor accuracy.

1. Simultaneously press the front panel PROBE X1/X10 and the ΔV/ΔT 1/ΔT push switches to display the cursor calibration square.

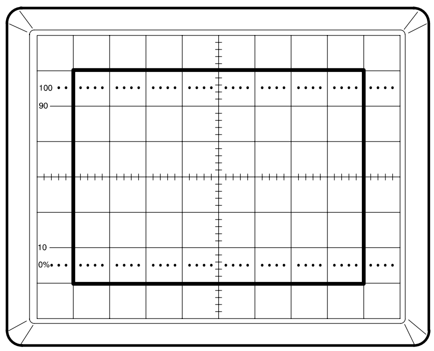

Figure 12: Cursor Calibration Display

2. On the Control and I/O board, adjust the following potentiometers to position the alignment square as shown in Figure 12. See Figure 13 for the adjustment locations.

   X-Gain: VRA01
   X-Position: VRA02
   Y-Gain: VRA03
   Y-Position: VRA04

3. Simultaneously press the PROBE X1/X10 and the ΔV/ΔT 1/ΔT push switches again to exit the adjustment mode.

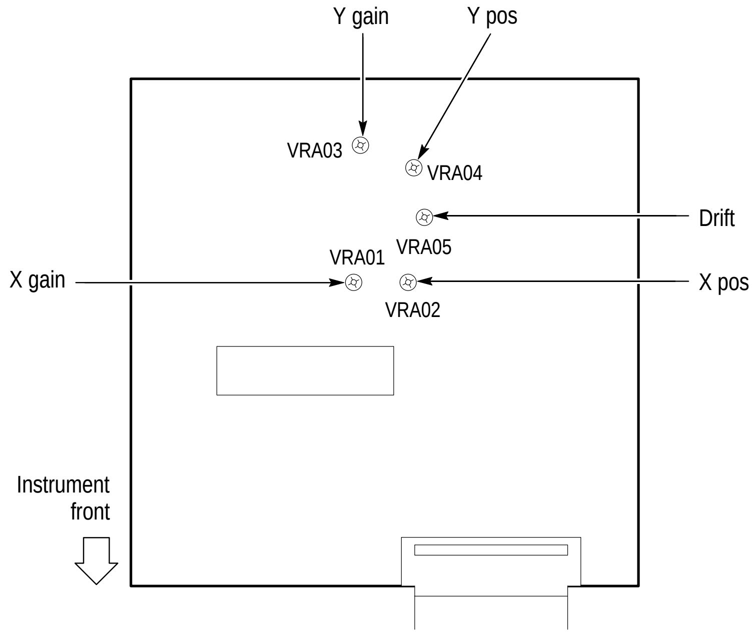

Figure 13: Control and I/O Board (Viewed from the Instrument Top)

Drift

Use the following procedure to minimize the readout drift.

1. If the display readouts are not visible, simultaneously press the front panel PROBE X1/X10 and the CURSOR ON/OFF push switches.
2. While toggling the VERTICAL MODE switch between BOTH and ADD positions, adjust VRA05 on the Control and I/O board to minimize the character drift.
3. Simultaneously press the PROBE X1/X10 and the ΔV/ΔT 1/ΔT push switches to turn off the display readouts, if desired.

Instructions Manual

Tektronix

THM420
Digital Multimeter

070-9856-00

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THM420 Digital Multimeter

The Tektronix THM420 multipurpose instrument combines the functions of a digital multimeter with the ability to display waveforms. The THM420 includes the following features:

- 3¾ digits (4000 count) LCD display with bargraph
- Waveform display with the press of a button
- A variety of measurement functions: DC/AC voltage, DC/AC current, resistance, frequency, diode testing, continuity checking
- True RMS measurements
- Autoranging for DMM and waveform display
- Measurement hold
- Input overvoltage and overcurrent warning beeper

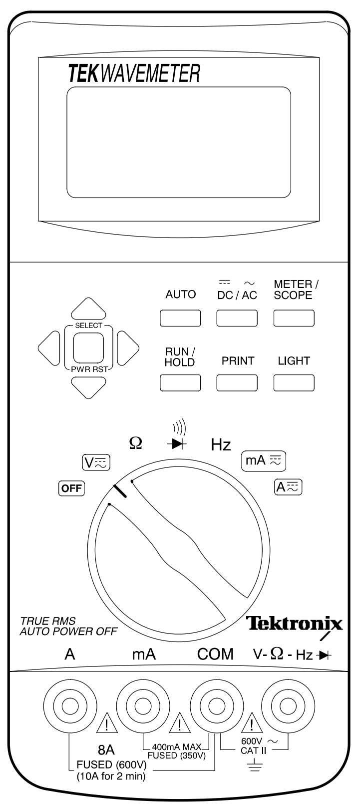

Figure 1: THM420 Instrument

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.

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

Table 1: General Specifications

Characteristic	Description
Display	3¾ digit (4000 count) LCD
Polarity Display	Automatic
Overrange Display	OVER is displayed
Low Voltage Indicator	Battery indicator is displayed
Measurement Rate	50 ms
Automatic power-off time	Approximately 30 minutes
Power	Six AA UM-3, R6, dry cell batteries
Battery Life	Back light Off: typically greater than 10 hours using six alkaline batteries
Maximum Floating Voltage	600 VAC_{RMS} CAT II (or 850 VDC) between any terminal to earth and ground
Maximum Input Voltage	600 VAC_{RMS} CAT II (or 850 VDC) between V and COM
Maximum Input Current	
Between mA and COM	400 mA
Between A and COM (10 A for 2 minutes)	8 A
Maximum Open Circuit Input Voltage	
Between A and COM	600 V
Between mA and COM	350 V

Table 2: Measurement Characteristics

Characteristic	Description
Volts	
DC Ranges	400 mV, 4 V, 40 V, 400 V, 850 V
AC Ranges	400 mV, 4 V, 40 V, 400 V, 600 V
DC Accuracy	±(0.3% of reading + 2 counts)
AC Accuracy	
40 to 50 Hz	±(1.5% of reading + 5 counts)
50 to 60 Hz	±(1.0% of reading + 5 counts)
60 Hz to 1 kHz	±(1.5% of reading + 5 counts)
Input Impedance	Maximum: 1 MΩ paralleled by 100 pF
Current	
DC Ranges	400 mA, 8 A
AC Ranges	400 mA, 8 A
DC Accuracy	
400 mA Range	±(0.6% of reading + 3 counts)
8 A Range	±(0.8% of reading + 4 counts)
AC Accuracy (40 to 1 kHz)	
400 mA Range	±(1.8% of reading + 5 counts)
8 A Range	±(1.8% of reading + 5 counts)
Overload protection	
⚠ mA Connector	500 mA (350 V) fast blow fuse
A Connector	15 A (600 V) fast blow fuse
Resistance	
Ranges	400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ
Accuracy (By range)	
400 Ω	±(0.4% of reading + 4 counts)
4 kΩ, 40 kΩ, 400 kΩ	±(0.4% of reading + 2 counts)
4 MΩ	±(0.6% of reading + 3 counts)
40 MΩ	±(1.5% of reading + 5 counts)
Frequency	
Ranges	100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz

Table 2: Measurement Characteristics (Cont.)

Characteristic	Description
Accuracy (By range)	
100 Hz, 1 kHz, 10 kHz, 100 kHz	±(0.1% of reading + 4 counts)
1 MHz	±(0.5% of reading + 4 counts)
Sensitivity	
100 Hz, 1 kHz, 10 kHz	40 mV_{RMS}
100 kHz, 1 MHz	400 mV_{RMS}
Lowest Measurable Frequency	10 Hz
Continuity	
Threshold	Beeper sounds when resistance is approximately 30 Ω or less
Diode Test	
Test Current	1.0 mA
Test Voltage	5 V maximum

Table 3: Waveform Display Characteristics

Characteristic	Description
Display Region	8 Horizontal divisions and 4 vertical divisions (16 dots/division)
Vertical	
Voltage Input Bandwidth	
20 mV to 1 V/div	DC to 5 MHz
2 V to 200 V/div	DC to 3 MHz
Current Inputs Rise Time Limits	
400 mA Connector	>500 ns
8 A Connector	>5 µs
Voltage Ranges	20 mV/div to 200 V/div
Current Ranges	
mA	2 to 500 mA/div
A	200 mA/div to 10 A/div
Sample Rate	16 MS/s
Resolution	6 bits
Coupling	DC and AC (–3 dB at 15 Hz)
Input Impedance	1 MΩ

Table 3: Waveform Display Characteristics (Cont.)

Characteristic	Description
DC Accuracy	±(3.5% + 2 pixels)
Horizontal	
Sweep Time	100 ns/div to 10 s/div Using roll mode: 0.2 s/div to 10 s/div
Position Settings	Left edge: 8 divisions shown after the trigger point Center screen: 4 divisions shown before and after trigger point Right edge: 8 divisions shown after the trigger point
Trigger	
Trigger Mode	Auto
Coupling	DC
Slope	Positive or negative

Table 4: Physical Characteristics

Characteristic	Description
Height	6.5 cm (2.56 inch)
Width	9 cm (3.54 inch)
Depth	20.8 cm (8.19 inch)
Weight	With batteries: approximately 640 g (22.6 oz.)

Table 5: Environmental Characteristics

Characteristic	Description
Temperature	
Operating	0° to 50° C
Nonoperating (Storage)	–20° to +70° C
Humidity (Operating)	0° to 40° C: ≤80% 41° to 50° C: ≤60%
Altitude	
Operating	2,222 m (7290 ft)
Nonoperating	12,300 m (40354 ft)

Table 5: Environmental Characteristics (Cont.)

Characteristic	Description
Vibration	
Operating	5 to 500 Hz, 3 axes (10 minutes each): 2.66 g_{RMS}
Nonoperating	5 to 500 Hz, 3 axes (10 minutes each): 3.48 g_{RMs}

Table 6: Optical Interface Characteristics

Characteristic	Description
Infrared Wavelength	945 nm
Carrier Wavelength	38 kHz
Reception Range	Approximately 1 meter

Table 7: Certifications

Characteristic	Description
Certifications	Listed UL3111-1 and CSA C22.2 No. 1010.1

Performance Verification

This section contains procedures to verify that the THM420 performs as warranted. If your 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 environment with a relative humidity of less than 80%.
- The instrument remains fully assembled (do not remove the bottom cover).

The THM420 performance verification consists of the checks listed in Table 8.

Table 8: Performance Verification Checks

DC Voltage
AC Voltage
Resistance
Diode and Continuity
Frequency
DC Amperes
AC Amperes
Trace Shift
Trace Slope
Printer
Back Light

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. The following procedures use either the Wavetek 9100 Universal Calibration System with Oscilloscope Calibration Module (Option 250) or the Fluke 5500A Multi-product Calibrator with Oscilloscope Calibration Option 5500A-SC.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification procedures.

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

Verification Procedure

***WARNING.** The following tests use hazardous voltages. If you use standard banana plugs to apply test signals to the THM420 instrument, do not touch the exposed conductors.*

***NOTE**. For the following series of tests, set the METER/SCOPE button to the METER mode.*

To verify the performance of your THM420 instrument, perform the following checks in sequential order.

DC Voltage

The following check verifies DC voltage measurement accuracy.

1. Turn the THM420 rotary switch to V≂.
2. Set the DC/AC button to **DCV**.
3. Connect the voltage source output to the THM420 COM and the V Ω Hz ⏩| inputs.
4. Configure the voltage source to output **DC**.
5. Set the controls of the THM420 and the voltage source to each of the values listed in Table 9; then verify that the THM420 readout remains within the readout limits.

Table 9: DC Voltage Accuracy

THM420 Range	DC Voltage Source	Readout Limits	
		Minimum	Maximum
400m V	300.0 mV	298.9 mV	301.1 mV
4 V	3.000 V	2.989 V	3.011 V
40 V	30.00 V	29.89 V	30.11 V
400 V	300.0 V	298.9 V	301.1 V
850 V	450 V	447 V	453 V

6. Disable the voltage source output.
7. Do not disconnect the test setup.

AC Voltage

The following check verifies AC voltage measurement accuracy.

1. Set the THM420 DC/AC button to **ACV**.
2. Configure the voltage source to output **AC**.
3. Set the controls of the THM420 and the voltage source to each of the values listed in Table 10; then verify that the THM420 readout remains within the readout limits.

Table 10: AC Voltage Accuracy

THM420 Range	AC Voltage Source		Readout Limits	
	Voltage	Frequency	Minimum	Maximum
400 mV	300.0 mV	1 kHz	295.0 mV	305.0 mV
4 V	3.000 V	50 Hz	2.965 V	3.035 V
40 V	30.00 V	1 kHz	29.50 V	30.50 V
400 V	300.0 V	1 kHz	295.0 V	305.0 V
600 V	450 V	1 kHz	438 V	462 V

4. Disable the voltage source output.
5. Disconnect the test setup.

Resistance

The following check verifies resistance measurement accuracy.

1. Turn the THM420 rotary switch to **Ω**.
2. Connect the resistance source output to the THM420 COM and the V Ω Hz ▶| input connectors.
3. Set the controls of the THM420 and the resistance source to each of the values listed in Table 11; then verify that the THM420 readout remains within the readout limits.

Table 11: Ohms Accuracy

THM420 Range	Resistance Source	Readout Limits	
		Minimum	**Maximum**
400 Ω	100.0 Ω	99.2 Ω	100.8 Ω
400 kΩ	100.0 kΩ	99.4 kΩ	100.6 kΩ
40 MΩ	10.00 MΩ	9.80 MΩ	10.20 MΩ

4. Disconnect the test setup.

Diode and Continuity

The following check verifies diode and continuity measurement accuracy.

1. Turn the THM420 rotary switch to ▶| and ·))).
2. Connect the THM420 COM input to the V Ω Hz ▶| input with a shorting strap.
3. Verify that the THM420 readout indicates approximately **0.000V** and the beeper sounds.
4. Disconnect the test setup.

Frequency

The following check verifies frequency measurement accuracy.

1. Turn the THM420 rotary switch to **Hz**.
2. Connect the frequency source output to the THM420 COM and the V Ω Hz ▶| input connectors.
3. Set the controls of the THM420 and the frequency source to each of the values listed in Table 12; then verify that the THM420 readout remains within the readout limits.

Table 12: Frequency Accuracy

THM420 Range	Frequency Source		Readout Limits	
	Voltage	Frequency	Minimum	Maximum
100 kHz	1.000 V	50 kHz	49.91 kHz	50.09 kHz

4. Disconnect the test setup.

DC Amperes

The following check verifies DC ampere measurement accuracy.

1. Turn the THM420 rotary switch to mA≂ for the first verification; turn the THM420 rotary switch to A≂ for the second verification.
2. Set the THM420 DC/AC button to **DCA**.
3. Set the current source to output **DC**.
4. Connect the current source output to the THM420 COM and the V Ω Hz ⊣▶⊢ input connectors.
5. Set the controls of the THM420 and the current source to each of the values listed in Table 13; then verify that the THM420 readout remains within the readout limits.

Table 13: DC Amperes Accuracy

THM420 Rotary Switch	DC Current Source	Readout Limits	
		Minimum	Maximum
mA	200.0 mA	198.5 mA	201.5 mA
A	2.000 A	1.94 A	2.06 A

6. Do not disconnect the test setup.

AC Amperes

The following check verifies AC ampere measurement accuracy.

1. Turn the THM420 rotary switch to mA≂
2. Set the THM420 DC/AC button to **ACA**.
3. Reconfigure the current source to output **AC**.
4. Set the controls of the THM420 and the current source to each of the values listed in Table 14; then verify that the THM420 readout remains within the readout limits.

Table 14: AC Amperes Accuracy

THM420 Rotary Switch	AC Current Source		Readout Limits	
	Current	Frequency	Minimum	Maximum
mA	200.0 mA	50 Hz	195.9 mA	204.1 mA

5. Set the METER/SCOPE button to **SCOPE** mode.
6. Verify that the current measurement is displayed.
7. Disconnect the test setup.

***NOTE**. For the following series of tests, the METER/SCOPE button must remain in the SCOPE mode.*

Trace Shift

The following check verifies trace shift accuracy.

1. Turn the THM420 rotary switch to V≂.
2. Connect the THM420 COM input to the V Ω Hz ⇥ input with a shorting strap.
3. Verify that there is no trace shift while using the ▲▼ buttons to switch between SCALE settings (vertical volts/division).
4. Disconnect the test setup.

Trace Slope

The following check verifies trace slope accuracy.

1. Turn the THM420 rotary switch to V≂.
2. Set the DC/AC button to **AC(V)**.
3. Set the SCALE to **200 V** with the ▲▼ buttons.
4. Set the horizontal time-per-division to **100 μs** with the ◀▶ buttons.
5. Connect the voltage source to the THM420 COM and the V Ω Hz ⇥ input connectors.
6. Set up the voltage source to output an AC voltage of **200 V** at **1 kHz**.
7. Set the THM420 trigger slope to ⎍ and verify that the waveform display starts on the rising edge.

8. Set the THM420 trigger slope to ⌊ and verify that the waveform display starts on the falling edge.

9. Disable the voltage source output.

10. Disconnect the test setup.

Printer

The following check verifies printer operation.

1. Press and hold the THM420 **PRINT** button for two seconds. Verify that the P icon appears in the upper-right corner of the display.

Back Light

The following check verifies that the display back light operates properly.

1. Press the THM420 **LIGHT** button and verify that the back light is on.

Adjustment Procedures

This section contains procedures to adjust the THM420. 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:

- 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 instrument meets factory specifications, perform the procedures in the *Performance Verification* section.

Preparation for Adjustment

The following guidelines apply to all instrument adjustments:

- Perform all adjustments in a 20° to 30° C (68° to 86° F) ambient environment.
- Before making any adjustment, warm up the instrument for at least 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.

Remove the Bottom Cover

You must remove the bottom cover to gain access to the internal adjustments. To remove the cover, refer to Figure 2 while performing the following steps.

1. Remove the battery pack.
2. Lay the instrument face down on a flat work surface.
3. Remove the four cover screws with a Phillips-head screwdriver.
4. Carefully lift the bottom cover off of the instrument.
5. Replace the battery pack (the instrument must be powered for the adjustment procedures that follow).

To reinstall the bottom cover following the adjustments, perform steps 1 and 4 above in reverse order.

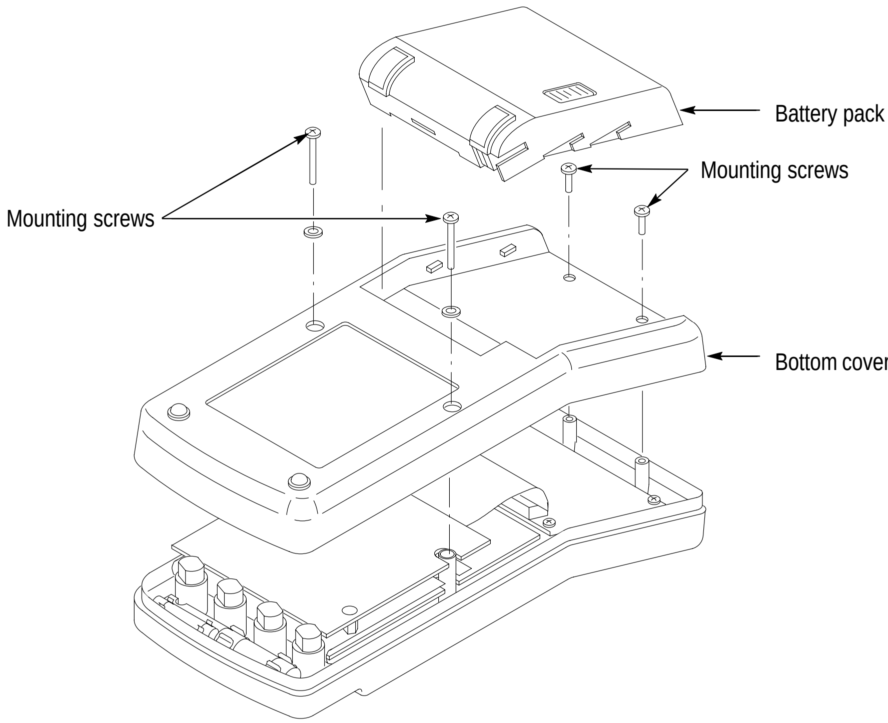

Figure 2: Removing the Bottom Cover

Access the Main Circuit Board

You must access the main circuit board to make adjustments. To expose the board, refer to Figure 3 while performing the following steps.

1. Remove the two circuit board mounting screws with a Phillips-head screwdriver.
2. Lift the top circuit board up and position it to the side. Do not disconnect any cables.
3. Fold back the insulating shield that separates the top circuit board from the bottom circuit board.

To reinstall the top circuit board following the adjustments, perform steps 1 through 3 above in reverse order.

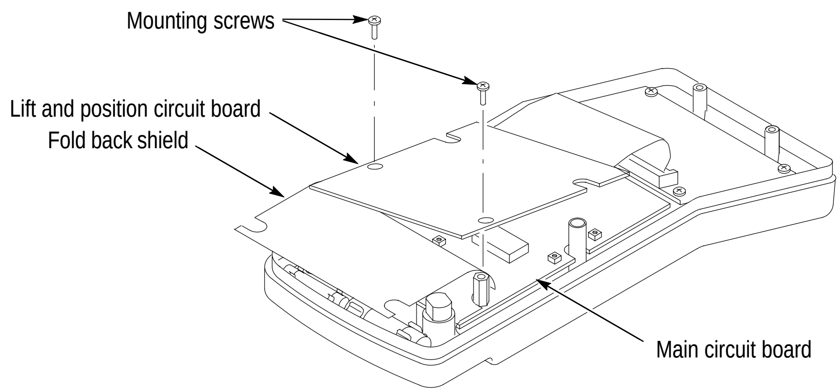

Figure 3: Exposing the Main Circuit Board

Adjustment Procedure

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

1. Turn the THM420 rotary switch to V≂.
2. Press the METER/SCOPE button to select **SCOPE** mode.
3. Set the AC/DC button to **DC**.
4. Connect the COM input to the V Ω Hz ⯈| input with a shorting strap.
5. Set the vertical offset (POS) to **0 mV**.
6. Set the vertical SCALE to **200 V**.
7. Adjust R80 to align the trace to the display center line. See Figure 4 for the adjustment location.
8. Set the vertical scale to **20 mV**.
9. Adjust R84 to align the trace to the display center.
10. If necessary, repeat steps 5 through 9 above to achieve a fine adjustment.

11. Turn the rotary switch to mA≂.

12. Press the METER/SCOPE button to select **SCOPE** mode.

13. Set the AC/DC button to **DC**.

14. Set the vertical offset (POS) to **0 mA**.

15. Set the vertical SCALE to **2 mA**.

16. Adjust R86 to align the trace to the display center.

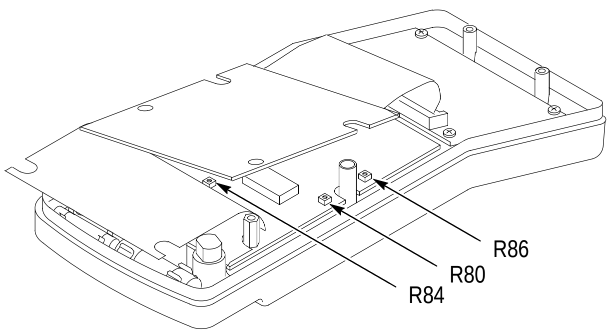

Figure 4: Adjustment Locations

Instructions Manual

Tektronix

THM500 Series Instruments

070-9857-00

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THM500 Series Instruments

The Tektronix THM500 Series instruments combine the features of a complete digital multimeter (DMM) with the power of an oscilloscope, all in a single package.

The DMM portion of these instruments measure true RMS AC and DC voltage, resistance, continuity with audible mode, and a diode test.

The DMM portion also includes the following features:

- A hold feature to freeze the display
- MIN and MAX readouts to track instantaneous signal variations from the last held value (Δ Hold)
- AC and DC current measurement with optional current probe

The oscilloscope portion of the instruments feature an autoranging mode that completely automates operation. In this mode, a usable signal is always displayed without operator intervention. If desired, you can switch to manual mode by selecting any control. In manual mode, you can specify general oscilloscope operations such as coupling, triggering, and acquisition modes.

THM550, THM560, and THM565 models include preconfigured modes to set up the oscilloscope for motor testing, transformer THDF measurement, power line monitoring, and power measurement. The THM57x series instruments include preconfigured automotive test setups.

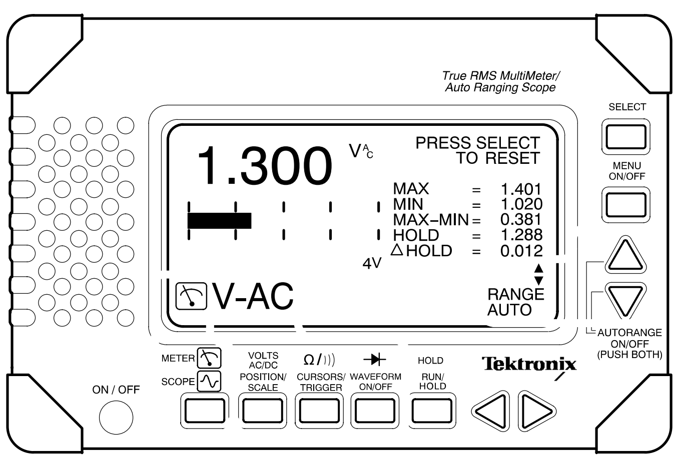

Figure 1: THM500 Series Instrument

THM500 series instruments will also store waveforms, settings, and displays. With these features, you can do the following:

- Recall settings
- Automate test procedures
- Save waveforms and screens in the field for later analysis
- Transfer waveforms and screens to a personal computer (requires optional communications adapter)

Specifications

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

- The instrument operates within the environmental conditions specified in Table 4 on page 8, unless otherwise noted.
- The instrument warms up for at least 5 minutes.

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

The specifications listed for the THM565 also apply to the THM57x series except as noted in Table 1.

Table 1: How THM565 and THM57x Series Products Differ

	57x	565
Modes		
Line Test		●
Motor Test		●
Automotive preconfigured test setups	●	
Vertical		
Mathematics capability		●
Invert capability		●
Measurements		
Voltage Measurement		●
Timing Measurement		●
Power Measurement		●
THDF Measurement		●
Automotive Measurements (preconfigured test setups)	●	

Table 2: DMM Specifications

		550	560	565
General				
Resolution	3¾ digit (4000 count) full-scale reading except as noted	●	●	●
Input Impedance (Typical)	VDC or VAC: 10 MΩ (<10 pF; <70 pF at 400 mV range)	●	●	●

Table 2: DMM Specifications (Cont.)

		550	560	565
General				
Additional Readouts	MIN: Minimum voltage or resistance MAX: Maximum voltage or resistance MAX–MIN: Difference between MAX and MIN HOLD: Value of the main reading when the HOLD button is pressed ΔHOLD: Difference between HOLD reading and active reading	•	•	•
DC Voltage				
Range and Resolution	**Range** / **Resolution** 400 mV / 0.1 mV 4 V / 1 mV 40 V / 10 mV 400 V / 100 mV 850 V / 1 V Autorange available; selects from all ranges except 400 mV.	•	•	•
Accuracy	±(0.5% of reading + 5 counts)	•	•	•
Normal Mode Rejection	>60 dB typical at user selectable 50 or 60 Hz	•	•	•
Common Mode Rejection	>100 dB typical at user selectable 50 or 60 Hz	•	•	•
AC Voltage				
Range and Resolution (True RMS)	**Range** / **Resolution** 400 mV / 0.1 mV 4 V / 1 mV 40 V / 10 mV 400 V / 100 mV 600 V / 1 V Autorange not available on 400.0 mV range	•	•	•
Accuracy	±(2% of reading + 5 counts) for 50 or 60 Hz sine wave. Add 2% of reading plus 5 counts for nonsinusoidal signal with crest factor <3.	•	•	•
Ω/Resistance				
Range and Resolution	**Range** / **Resolution** 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 Autorange available	•	•	•
Accuracy	±(0.5% of reading + 2 counts). 40 MΩ range is ±(2% of reading +5 counts) at ≤60% relative humidity. Derate 4 MΩ range to ±(1% of reading + 2 counts) from 60% to 90% relative humidity	•	•	•

Table 2: DMM Specifications (Cont.)		550	560	565
Diode Test				
Range	0 to 2 V. Red input connector is positive.	●	●	●
Continuity Check				
Indication	Audible tone and graphic of a closed switch displayed when resistance is <50 Ω (typical). Indicators optionally disabled.	●	●	●

Table 3: Scope Specifications		550	560	565
Modes				
Autorange (Typical)	Autorange mode positions and sets the vertical and horizontal scales to between 30% and 60% of full screen. After 500 ms, the process repeats if the signal amplitude or period changes. The lower limits of Autorange are 50 mV/div and 100 ms/div. Autorange is the default mode.	●	●	●
Manual	The scope switches to manual operation when any control alters the waveform display.	●	●	●
Line Test	■ Will monitor a 45 to 65 Hz power waveform on CH 1 and check for variations in amplitude and frequency. Abnormal events, such as spikes, drop-outs, and substantial frequency variations, will be captured and counted.		●	●
	■ Automatic print of failures		●	●
	■ Automatic screen save on failures		1	8
	■ Time and date stamp on failure			●
Motor Test	Will stabilize (trigger) on pulse-width modulated signals generated by variable-speed AC motor drives.			●
Vertical				
Channels	Each channel is identical.	1	2	2
Probe Interface	Shrouded banana jack. Accepts 4 mm caged-spring safety style banana plug. Use probes incorporating 9 leaf-spring contacts only.	●	●	●
Digitizers	8 bits, 25 Msamples/s	1	2	2
Volts/Division Range	5 mV/div to 500 V/div in a 1-2-5 sequence	●	●	●
Modes	Normal and Invert	●	●	●
Coupling	DC, AC, COM (COM simulated)	●	●	●
Input Impedance	DC Coupled ≤10 pF: ≥975 kΩ	●	●	●
Analog Bandwidth	5 mV/div: DC to 1 MHz 10 mV/div to 2 V/div: DC to 5 MHz 5 to 500 V/div: DC to 1 MHz	●	●	●
Maximum Input Voltage	600 V_{RMS}	●	●	●
DC Accuracy (ΔV)	±(3.5% + 2 pixels) 19° to 27° C; derate by 0.25% per °C outside the range. Derate additional 0.5% at 5 mV/div. Linear range is ±8 divisions from COM (common).	●	●	●
Crosstalk Between Channels	≥100:1 at 5 MHz, with other channel connected to COM (common)		●	●

Table 3: Scope Specifications (Cont.)

		550	560	565
Vertical				
Mathematics	Subtract: (CH 1 – CH 2) Add: (CH 1 + CH 2)		●	●
Acquisition				
Modes	Sample (Normal), Spike Detect, Roll, Run/Hold, Smooth, Dynamic DSP	●	●	●
Acquisition Rate	All modes except Dynamic DSP: Up to five waveforms per second Dynamic DSP Mode: Up to 750 waveforms per second (redisplayed at a slower rate.)	●	●	●
Horizontal				
Time/Division Range	60 s/div to 200 ns/div in a 1-2-5 sequence	●	●	●
Time Base Accuracy	±(0.1% + 1 pixel)	●	●	●
Record Length	256 points	●	●	●
Spike Detect	Captures spikes down to 40 ns at all sweep speeds	●	●	●
Single Shot	Single shot on two channels simultaneously	●	●	●
Roll	200 ms/div to 60 s/div	●	●	●
Measurements				
Cursors	Voltage difference between cursors (ΔV) Time difference between cursors (ΔT) Reciprocal of ΔT in Hertz (1/ΔT)	●	●	●
Voltage and Amperes	For voltage or current probes: Maximum (MAX), Minimum (MIN), Peak-Peak (P–P)	●	●	●
Timing	Frequency (FREQ), Period (PER)	●	●	●
Power	Calculates true RMS current, voltage, true power, and power factor from CH 1 current (using current probe) and CH 2 voltage.		●	●
THDF	(Transformer Harmonic Derating Factor) calculated as [(RMS Current × 1.41414) ÷ Peak Current], read from a current probe on CH 1.		●	●
Trigger				
Source	CH 1 (Default)	●	●	●
	CH 2		●	●
Modes	Auto-Level: Default when in AutoRange mode Auto: Default in manual operation Normal: User selectable Single-Shot: User selectable	●	●	●
Slope	Positive or Negative slope	●	●	●
Sensitivity, Edge-type DC Coupled	0.5 division: 200 to 500 V/div 1 division: 10 to 100 mV/div 2 divisions: 5 mV/div	●	●	●

Table 3: Scope Specifications (Cont.)

		550	560	565
Waveform Display				
Display Update Rate	Dynamic Display Digital Signal Processing maps up to 750 waveforms/s on screen, simulating an analog-like display.	●	●	●
Memories				
Setups	Each setup memory stores the complete state of the instrument, including the multimeter state.	4	4	8
Waveforms	Each waveform memory stores all waveform points and the scale of the selected waveform.	4	4	8
Screens	Each screen memory stores the exact information displayed on screen (snapshot).	1	1	8

Table 4: General Specifications

		550	560	565
Clock				●
Real Time	Provides date and time stamp capability for line test events and saved waveforms.	●	●	●
Display System				
Display Type	Super Twisted Liquid Crystal Display	●	●	●
Size	Width: 120 mm (4.72 inch) Height: 60 mm (2.36 inch)	●	●	●
Display Resolution	256 pixels horizontal × 128 pixels vertical	●	●	●
Contrast	User adjustable	●	●	●
Backlight	Electroluminescent			●
Waveform Graticule	8 divisions vertical × 10 divisions horizontal Default = crosshair, grid, or none 1 vertical division = 15 pixels 1 horizontal division = 25 pixels	●	●	●
Power Source				
Batteries	Six AA cells (9 V nominal)	●	●	●
Battery Life (Typical)	4.5 hours continuous operation with alkaline cells (backlight off). Tested using RAYOVAC® Alkaline MAXIMUM™ batteries. Battery life extended when used intermittently.	●	●	●
Battery Saver	User adjusted battery saver feature turns the instrument off after five minutes and the backlight off after one minute.	●	●	●
Memory Retention Time	Memory hold-up time following battery removal: eight minutes minimum, three hours typical. Memory retention extended (weeks or months) if discharged batteries remain installed.	●	●	●

Table 4: General Specifications (Cont.)

		550	560	565
Environmental				
Temperature	Operating: 0° to 50° C (32° to 122° F) Storage: –20° to +70° C (–4° to 158° F)	●	●	●
Humidity, Operating	0° to 40° C (32° to 104° F): Up to 90% relative humidity noncondensing (60% for 4 and 40 MΩ measurements) 41° to 50° C (106° to 122° F): 60% relative humidity noncondensing.	●	●	●
Altitude	Operating:: 2,200 m (7,221 ft) Storage:: 12,192 m (40,000 ft)	●	●	●
Random Vibration	5 to 500 Hz, 10 min/axis, operating: 2.66 g_{RMS} 5 to 500 Hz, 10 min/axis, nonoperating: 3.48 g_{RMS}	●	●	●
Sine Vibration	Operating: 0.06 inch displacement from 5 to 15 Hz 0.04 inch displacement from 15 to 25 Hz 0.02 inch displacement from 25 to 55 Hz Test Duration: 10 minutes at the peak resonance condition (33 Hz if no resonance found). Test performed on each of three axes.	●	●	●
Half-sine Shock	Operating: 30 g with pulse duration of 11 ms. Three shocks per axis. Test Duration: 10 minutes at the peak resonance condition (33 Hz if no resonance found). Test performed on each of three axes.	●	●	●
EMC				
Emissions	EN 55011 radiated, class A	●	●	●
Immunity	IEC 801-2 electrostatic discharge: Up to 8 kV IEC 801-3 radiated immunity: 3 V/meter, 27 to 500 MHz	●	●	●
Mechanical				
Size	140 mm (5.5 inch) high × 210 mm (8.3 inch) wide × 43 mm (1.7 inch) deep	●	●	●
Weight	1 kg (2.2 lb) with Alkaline batteries installed	●	●	●
Tripod Socket	0.25 inch × 20 thread × 6.3 mm (0.25 inch) deep	●	●	●
Safety				
Certifications	Listed UL 3111-1 for 600 V CAT II measurements; CSA-C22.2 No 1010.1-92	●	●	●
Surge Protection	Withstands incidental line surges up to 6 kV (comprised of a minimum rise time of 1.2 µs and a maximum 50 µs duration, minimum of 2 minutes between pulses). Maximum volt-hertz product: 50 V·MHz.	●	●	●
Fuse	The instrument has no user-replaceable fuses	●	●	●
General	Safety Class 2	●	●	●

Performance Verification

This section contains procedures to verify that the THM500 Series instruments perform as warranted. Verify instrument performance whenever the accuracy or function of your instrument is in question.

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

- The instrument operates within the environmental conditions specified in Table 4 on page 8 during the verification process.
- The instrument operates continuously for a 5 minute period before the verification begins.

Table 6 lists the equipment needed to complete the performance verification procedures.

The THM500 Series performance verification consists of the checks listed in Table 5.

Table 5: Performance Verification Checks

Functional Test	
DMM Verification	
	DC Voltage Accuracy
	AC Voltage Accuracy
	Resistance Accuracy
Oscilloscope Verification	
	Noise
	Input Leakage Trace Shift
	Time Base Accuracy
	Vertical Accuracy
	Analog Bandwidth
	Crosstalk from DMM to Oscilloscope
	Crosstalk Between Oscilloscope Channels
	DC Offset

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. If you substitute equipment, always choose instruments that meet or exceed the minimum requirements specified in Table 6.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification 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
Leveled Sine Wave Generator	Output must provide 5 V into 50 Ω with 3% amplitude regulation at 50 kHz to 5 MHz	Wavetek 9100 Universal Calibration System with Oscilloscope Calibration Module (Option 250) Fluke 5500A Multi-product Calibrator with Oscilloscope Calibration Option 5500-SC
Time Mark Generator	Output must provide 1 µs markers, ±0.5%, at 1 V amplitude	
Calibrator		
DC Voltages	300 mV, 3 V, 30 V, 300 V, 500 V, with accuracy of ±0.125% or better	
AC Voltages	300 mV, 3 V, 30 V, 300 V, 500 V, with accuracy of ±0.5% or better	
Resistances	10 Ω, 100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ, with accuracy of ±0.125% or better	
Termination	50 Ω ±2%, 2 W	Tektronix 011-0049-xx
BNC Cable	50 Ω, 1.04 m (42 inch) long	Tektronix 012-0057-xx
Safety Banana Lead Patch Cord		Tektronix 012-1413-xx
BNC Female-to-Dual-Banana Cable	Stacking banana connector	Tektronix 012-1450-xx
BNC Female-to-Dual-Banana Adapter		Tektronix 103-0090-xx

Functional Test

The following steps verify basic instrument operation and reset the THM500 series instruments to factory default settings.

1. Install fully charged batteries or use the THMCOM1 Communications Adapter or the THM5AC Power Adapter optional accessories to provide power.
2. Press the **ON/OFF** button to turn the THM500 series instrument on.
3. Press the **MENU ON/OFF** button to display the menus.

NOTE. *The THM575 can display the menus in more than one language. The language selections are located in the Utility menu.*

4. Select **UTILITY▸STATUS▸DISPLAY** from the menus.
5. Press the **SELECT** button. Verify that the correct THM500 series instrument model number is displayed.
6. Use the menus to select **RESET ALL**. It will appear underlined.
7. Press the **SELECT** button and wait for the confirmation message; then press the **SELECT** button again.
8. Verify that the instrument returns to its power-on mode:
   - THM550, THM560, THM565, THM570, or THM570U instruments return to METER mode.
   - THM571, THM575, or THM570U Option 3K instruments return to a banner screen.

DMM Verification

The following checks verify the performance of the DMM functions. The oscilloscope verification begins on page 15.

***NOTE**. The THM575 can display menus in more than one language. The language selections are located in the Utility menu.*

DC Voltage Accuracy

The following check verifies DC voltage accuracy.

***WARNING.** This test uses hazardous voltages. If you use standard banana plugs to apply test signals to the THM500 series instrument, do not touch the exposed conductors.*

1. Set the THM500 series instrument to **METER** mode displaying **V-DC**. If the range display at the lower-right does not indicate AUTO, press the ▲ and ▼ buttons simultaneously to set the RANGE to **AUTO**.
2. Connect the voltage source output to the THM500 series instrument DMM and COM inputs as shown in Figure 2. Assure that the ground connection for each adapter connects to the common (or ground) connector of its associated instrument.
3. Set the voltage source for **DC** output.

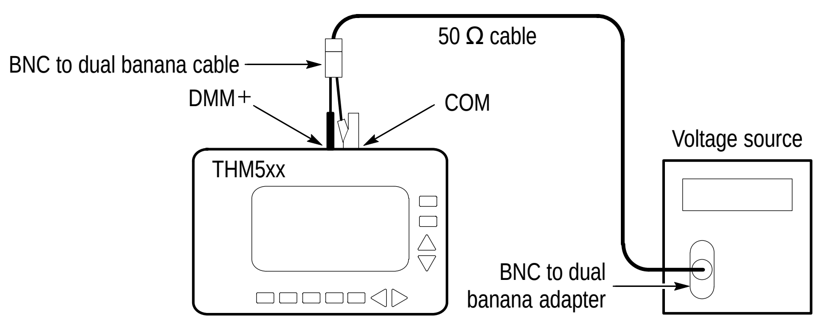

Figure 2: DC and AC Voltage Accuracy Test Setups

4. For each row of Table 7, use the ▲ and ▼ buttons to set the THM500 series instrument to the range specified in the first column; then set the voltage source to the output voltage specified in the second column. Verify that the THM500 series instrument readout is within the range listed in the third column.

Table 7: DC Voltage Accuracy Test Limits

Instrument Range	DC Voltage Source	Instrument Readout
400 mV	300 mV	298.0 to 302.0
4 V	3 V	2.980 to 3.020
40 V	30 V	29.80 to 30.20
400 V	300 V	298.0 to 302.0
850 V	500 V	492 to 508

AC Voltage Accuracy

The following check verifies AC voltage accuracy.

WARNING. *This test uses hazardous voltages. If you use standard banana plugs to apply test signals to the THM500 series instrument, do not touch the exposed conductors.*

1. Set the THM500 series instrument to **METER** mode displaying **V-AC**. If the range display at the lower-right corner does not indicate AUTO, press the ▲ and ▼ buttons simultaneously to set the RANGE to **AUTO**.
2. Set the voltage source to **60 Hz AC** output.
3. For each row of Table 8, use the ▲ and ▼ buttons to set the THM500 series instrument to the range specified in the first column; then set the voltage source to the output voltage specified in the second column. Verify that the THM500 series instrument readout is within the range listed in the third column.

Table 8: AC Voltage Accuracy Test Limits

Instrument Range	Voltage Source at 60 Hz	Instrument Readout
400 mV	300 mV	293.5 to 306.5
4 V	3 V	2.935 to 3.065
40 V	30 V	29.35 to 30.65
400 V	300 V	293.5 to 306.5
600 V	500 V	485 to 515

4. Set the calibrator output to a safe voltage (less than 20 V) and disconnect the THM500 series instrument from the calibrator.
5. Disconnect the test setup.

Resistance Accuracy

The following check verifies resistance accuracy.

1. Set the THM500 series instrument to **METER** mode displaying **Ω**. Connect the THM500 series instrument to the resistance source as shown in Figure 3.

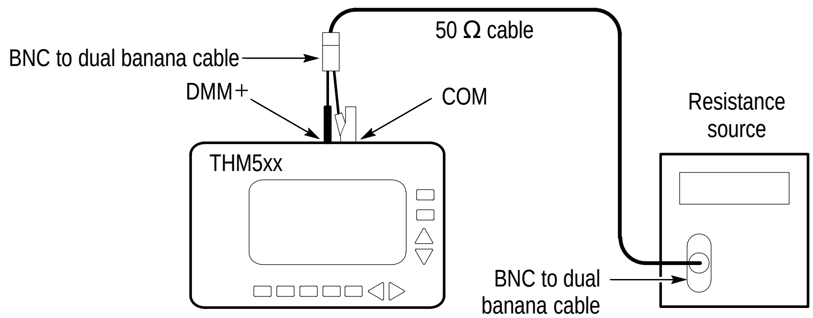

Figure 3: Resistance Accuracy Test Setup

2. For each row of Table 9, use the ▲ and ▼ buttons to set the THM500 series instrument to the range specified in the first column; then set the resistance source to the resistance specified in the second column. Verify that the THM500 series instrument readout is within the range listed in the third column.

Table 9: Resistance Accuracy Test Limits

Instrument Range	Resistance Source	Instrument Readout
400 Ω	100 Ω	99.3 to 100.7
4 kΩ	1 kΩ	0.993 to 1.007
40 kΩ	10 kΩ	9.93 to 10.07
400 kΩ	100 kΩ	99.3 to 100.7
4 MΩ	1 MΩ	0.993 to 1.007

3. Disconnect the test setup.

4. If you will not be performing the Oscilloscope Verification procedures, use the menus to return the THM500 series instrument to factory default settings by selecting **RESET ALL**.

Oscilloscope Verification

The following checks verify the performance of the oscilloscope functions. The DMM checks begin on page 12.

***NOTE**. The THM575 can display the menus in more than one language. The language selections are located in the Utility menu.*

Noise

The following check verifies an acceptable noise level.

1. Set the THM500 series instrument to **SCOPE** mode. If necessary, press the **SELECT** button to point to **CH 1**.
2. Use a patch cord to short the THM500 series instrument COM and CH 1 inputs as shown in Figure 4.

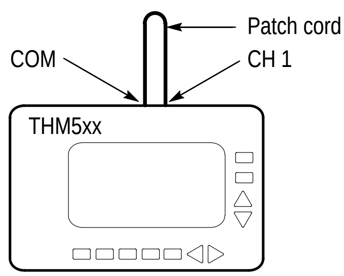

Figure 4: Noise Test Setup

3. Press the **SCALE** button until the readout in the lower-right corner indicates **SCALE**; then use the ▲ and ▼ buttons to set the vertical scale to **10 mV/div**.
4. Use the menus to set the sampling mode to **SPIKE DETECT**; then turn off the menus.
5. Verify that the displayed peak-to-peak signal is less than 0.5 divisions (5 mV_{p-p}).
6. If your THM500 series instrument is equipped with two channels, repeat steps 2 through 5 above for CH 2.
7. Disconnect the test setup.

Input Leakage Trace Shift

The following check verifies an acceptable input leakage trace shift.

1. Use the THM500 series instrument menus to set the sampling mode to **SAMPLE** (NORMAL for the THM571); then turn the menus off.
2. Use a patch cord to short the COM and CH 1 inputs as shown in Figure 5.

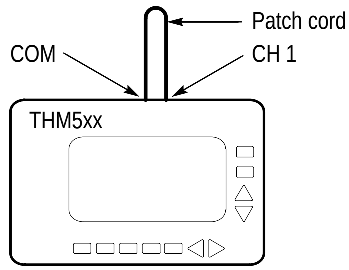

Figure 5: Trace Shift Test Setup

3. Press the THM500 series instrument **POSITION/SCALE** button until the readout in the lower-right corner shows **SCALE**; then use the ▲ and ▼ buttons to set the vertical scale to **5 mV/div**.
4. Press the THM500 series instrument **POSITION/SCALE** button until the readout in the lower-right corner shows **POS**; then use the ▲ and ▼ buttons to position the trace vertically at the center of the display.
5. Verify that as you remove the shorting patch cord, the waveform does not move more than three pixels vertically.
6. If your THM500 series instrument is equipped with two channels, repeat steps 2 through 5 above for CH 2.
7. Disconnect the test setup.

Time Base Accuracy

The following check verifies the time base accuracy.

1. Connect the time mark generator marker output to the THM500 series instrument CH 1 and COM inputs using a 50 Ω termination as shown in Figure 6. Assure that the ground connection for each adapter connects to the common (or ground) connector of its associated instrument.
2. If necessary, press the THM500 series instrument **SELECT** button to point to **CH 1**.

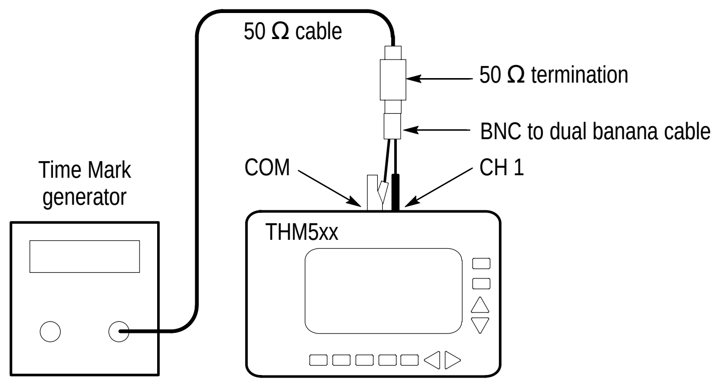

Figure 6: Time Base Accuracy Test Setup

3. Set the time mark generator for **1 µs** markers.
4. On the THM500 series instrument, press the **POSITION/SCALE** button until the readout shows **SCALE** in the lower-right corner. Use the ▲ and ▼ buttons to set the vertical scale to **200 mV/div**. Use the ◄ and ► buttons to set the time base to **1 µs/div**.
5. Use the THM500 series instrument menus to set **CH 1 CPLG** to **DC**; then turn the menus off.
6. Press the THM500 series instrument **CURSORS/TRIGGER** button until the readout shows **TRIG** in the lower-right corner; then use the ▲ and ▼ buttons to set the trigger level to one division above the bottom of the displayed signal. Use the ◄ or ► button to set the trigger to rising edge (/).
7. Press the THM500 series instrument **POSITION/SCALE** button until the readout shows **POS** in the lower-right corner; then use the ◄ button to set the trigger position to **10%**.
8. Verify that the THM500 series instrument rising edge of the fifth time mark is within one pixel of the center vertical graticule line, measured at one division above the bottom of the displayed signal.
9. Disconnect the test setup.

Vertical Accuracy

The following check verifies vertical accuracy.

1. Connect the voltage source output to the THM500 series instrument CH 1 and COM inputs as shown in Figure 7. Assure that the ground connection for each adapter connects to the common (or ground) connector of its associated instrument.

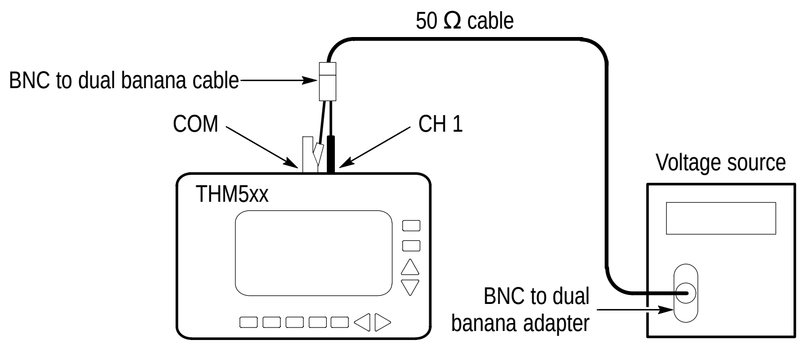

Figure 7: Vertical Accuracy Test Setup

2. Use the menus to set the THM500 series instrument **CH 1 CPLG** to **DC**; then turn the menus off.

WARNING. *This test uses hazardous voltages. If you use standard banana plugs to apply test signals to the THM500 series instrument, do not touch the exposed conductors.*

3. For each row of Table 10, perform the following steps:

   a. Use the THM500 series instrument ▲ and ▼ buttons to set the vertical scale to the setting listed in the first column.

   b. Set the voltage source output to the value in the second column.

   c. Press the THM500 series instrument **POSITION/SCALE** button to show **POS**; then use the ▲ and ▼ buttons to move the waveform three divisions below the center of the graticule.

   d. Press the THM500 series instrument **CURSORS/TRIGGER** button to show the cursors; then use the ▲ and ▼ buttons to move one cursor over the waveform.

   e. Set the voltage source output to the value in the third column, press the THM500 series instrument **SELECT** button to select the second cursor, and position the second cursor over the new waveform position.

f. Observe the ΔV readout on the THM500 series instrument display and verify that its absolute value falls within the range listed in the fourth column.

Table 10: Vertical Accuracy Test Settings

THM500 Series Vertical Scale	DC Voltage Source (First Cursor)	DC Voltage Source (Second Cursor)	Instrument ΔV Readout (Ignore Polarity)
5 mV/div	–15mV	+15 mV	27.5mV to 32.5 mV
100mV/div	–300 mV	+300 mV	552 mV to 648 mV
1 V/div	–3 V	+3 V	5.52 V to 6.48 V
10V/div	–30 V	+30 V	55.2 V to 64.8 V
100V/div	–300 V	+300 V	552 V to 648 V

4. If your THM500 series instrument is equipped with two channels, repeat Step 3 (all tests) above on CH 2.

5. Disconnect the test setup.

Analog Bandwidth

The following check assesses the analog bandwidth.

1. Connect the leveled sine wave generator output to the THM500 series instrument CH 1 and COM inputs. Use a 50 Ω termination as shown in Figure 8. Assure that the ground connection for each adapter connects to the common (or ground) connector of its associated instrument.

2. Press the THM500 series instrument **CURSORS/TRIGGER** button until the readout shows **TRIG** in the lower-right corner; then use the ▲ and ▼ buttons to set the trigger level to center screen.

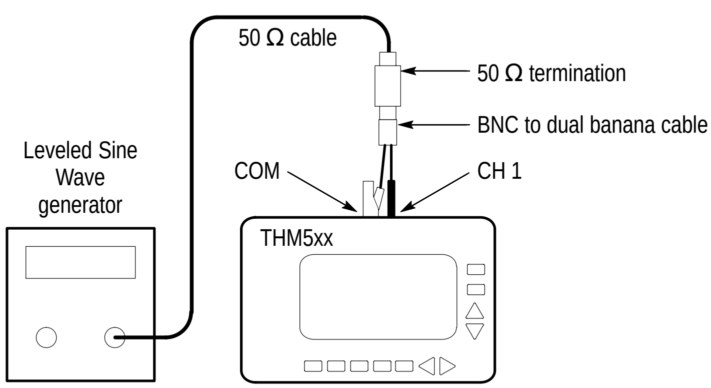

Figure 8: Analog Bandwidth Test Setup

3. On the THM500 series instrument, press the **POSITION/SCALE** button until the readout shows **SCALE** in the lower-right corner.

4. For each row of Table 11, perform the following steps:

   a. Use the THM500 series instrument ▲ and ▼ buttons to set the vertical scale to the setting listed in the first column.

   b. Set the horizontal scale of the THM500 series instrument to **10 µs/div** and the frequency of the leveled sine wave generator to **50 kHz**.

   c. Adjust the leveled sine wave generator amplitude to show the waveform height and cursor readout listed in the second column.

   d. Set the horizontal scale of the THM500 series instrument to **200 µs/div** and the leveled sine wave generator to the test frequency listed in the third column.

   e. Verify that the amplitude of the waveform displayed on the THM500 series instrument is greater than or equal to the value listed in the third column. Use the cursors for greater accuracy.

Table 11: Bandwidth Test Settings

THM500 Series Vertical Scale	Leveled Sine Wave Generator Amplitude	Leveled Sine Wave Generator Test Frequency	Instrument Waveform Amplitude
100 mV/div	6 divisions ($600\ mV_{p-p}$ readout)	5 MHz	4.2 divisions[1] (420 mV cursor readout)
500 mV/div	6 divisions ($3.00\ V_{p-p}$ readout)	5 MHz	4.2 divisions[1] (2.1 V cursor readout)
5 V/div	1 division ($5.00\ V_{p-p}$ readout)	1 MHz	0.7 divisions[1] (3.5 V cursor readout)

1 **The waveform is aliased and appears untriggered.**

5. If your THM500 series instrument is equipped with two channels, repeat Step 4 above on CH 2 (all tests).

6. Disconnect the test setup.

Crosstalk from DMM to Oscilloscope

The following check assesses the crosstalk between the DMM and the oscilloscope.

1. Connect the leveled sine wave generator output to the THM500 series instrument DMM and COM inputs. Use a 50 Ω termination as shown in Figure 9. Assure that the ground connection for each adapter connects to the common (or ground) connector of its associated instrument.

2. Connect the THM500 series instrument CH 1 input to the COM input using a patch cord as shown in Figure 9.

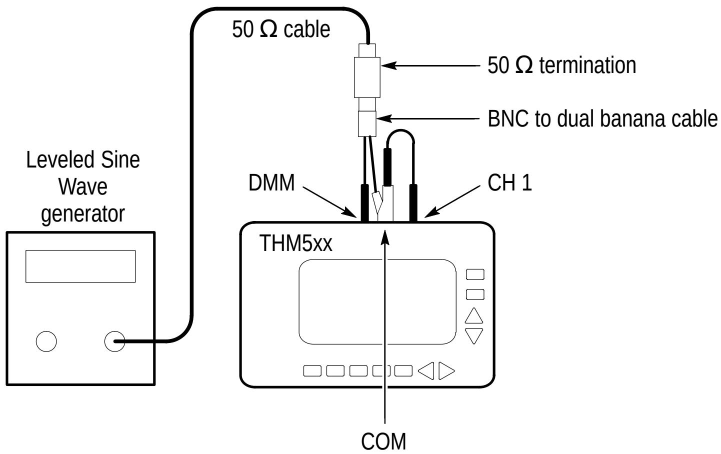

Figure 9: Crosstalk Between DMM And Scope Test Setup

3. Set the leveled sine wave generator for a **2.5 V_{p-p}** signal at **5 MHz**.

4. On the THM500 series instrument, press the **POSITION/SCALE** button until the readout shows **SCALE** in the lower-right corner. Use the ▲ and ▼ buttons to set the vertical scale to **50 mV/div** and the ◄ and ► buttons to set the time base to **2000 μs/div**.

5. Use the THM500 series instrument menus to set the sampling mode to **SPIKE DETECT**; then remove the menus from the display.

6. Verify that the peak-to-peak amplitude is less than 0.5 divisions (25 mV_{p-p}).

Crosstalk Between Oscilloscope Channels

The following check assesses the crosstalk between oscilloscope channels. If your instrument has only one channel (THM550), do not perform this test.

1. Connect the leveled sine wave generator output to the THM500 series instrument CH 1 and COM inputs. Use a 50 Ω termination as shown in Figure 10. Assure that the ground connection for each adapter connects to the common (or ground) connector of its associated instrument.

2. Connect the THM500 series instrument CH 2 input to the COM input using a patch cord as shown in Figure 10.

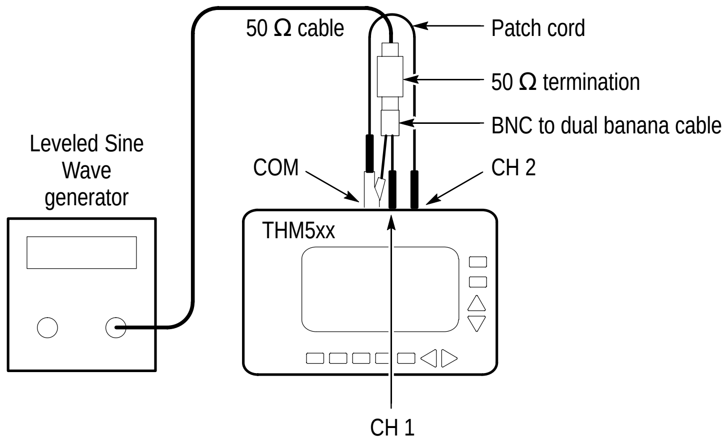

Figure 10: Crosstalk Between Scope Channels Test Setup

3. On the THM500 series instrument, press the **POSITION/SCALE** button until the readout shows **SCALE** in the lower-right corner. Use the ▲ and ▼ buttons to set the CH 1 vertical scale to **500 mV/div** and the ◄ and ► buttons to set the time base to **200 µs/div**.

4. Use the THM500 series instrument menus to set the sampling mode to **SPIKE DETECT**; then remove the menus from the display.

5. Adjust the leveled sine wave generator to display five divisions peak-to-peak at **5 MHz**.

***NOTE**. The 5 MHz waveform is aliased and appears untriggered.*

6. Press the THM500 series instrument **WAVEFORM ON/OFF** button to turn the CH 1 waveform display off.

7. Press the THM500 series instrument **SELECT** button to select **CH 2**. Press the **WAVEFORM ON/OFF** button to turn on channel 2. Press the **POSITION/SCALE** button to show **SCALE**; then use the ▲ and ▼ buttons to set the vertical scale to **50 mV/div**.

8. Verify that the peak-to-peak signal displayed on the THM500 series instrument channel 2 is less than 0.5 divisions (25 $mV_{p\text{-}p}$).

9. Disconnect the test setup.

DC Offset

The following check assesses the DC offset.

1. Use the THM500 series instrument menus to select **RESET ALL**. This sets the vertical position to zero.
2. Return the THM500 series instrument to **SCOPE** mode.
3. Use the THM500 series instrument **UTILITY** menu to select **CH 1 OFFSET**. This automatically adjusts the channel offset.
4. Use a patch cord to short the THM500 series instrument COM and CH 1 inputs as shown in Figure 11.

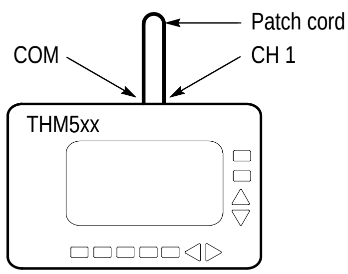

Figure 11: DC Offset Test Setup

5. Press the THM500 series instrument **POSITION/SCALE** button until the readout shows **SCALE** in the lower-right corner; then use the ▲ and ▼ buttons to set the CH 1 vertical scale to **5 mV/div**.
6. Verify that the offset is less than four pixels from the center graticule line.
7. Use the ▲ and ▼ buttons to set the vertical scale to the next range.
8. Repeat steps 6 through 7 above until you have checked all ranges (10 mV/div through 500 V/div).
9. If your THM500 series instrument is equipped with two channels, repeat steps 3 through 8 above for CH 2.
10. Disconnect the test setup.
11. Use the menus to return the THM500 series instrument to the factory default settings; select **RESET ALL**.

***NOTE**. Return THM575 products to the initial language selection (if you changed the language selection). You will find these selections in the Utility menu.*
