

True RMS Digital Multimeter

400002



SPER
SCIENTIFIC

Environmental Measurement

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1. Introduction

This meter measures AC/DC Voltage, AC/DC Current, Resistance, Capacitance, Frequency (electrical), Diode Test, and Continuity. It features a waterproof, rugged design for heavy duty use. Proper use and care of this meter will provide many years of reliable service.

Safety

This symbol adjacent to another symbol, terminal or operating device indicates that the operator must refer to an explanation in the Operating Instructions to avoid personal injury or damage to the meter.

WARNING

This WARNING symbol indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.

CAUTION

This CAUTION symbol indicates a potentially hazardous situation, which if not avoided, may result damage to the product.



This symbol advises the user that the terminal(s) so marked must not be connected to a circuit point at which the voltage with respect to earth ground exceeds (in this case) 600VAC or VDC.



This symbol adjacent to one or more terminals identifies them as being associated with ranges that may, in normal use, be subjected to particularly hazardous voltages. For maximum safety, the meter and its test leads should not be handled when these terminals are energized.



This symbol indicates that a device is protected throughout by double insulation or reinforced insulation.

2. PER IEC1010 OVERVOLTAGE INSTALLATION CATEGORY

OVERVOLTAGE CATEGORY I

Equipment of OVERVOLTAGE CATEGORY I is equipment for connection to circuits in which measures are taken to limit the transient overvoltages to an appropriate low level.

Note – Examples include protected electronic circuits.

OVERVOLTAGE CATEGORY II

Equipment of OVERVOLTAGE CATEGORY II is energy-consuming equipment to be supplied from the fixed installation.

Note – Examples include household, office, and laboratory appliances.

OVERVOLTAGE CATEGORY III

Equipment of OVERVOLTAGE CATEGORY III is equipment in fixed installations.

Note – Examples include switches in the fixed installation and some equipment for industrial use with permanent connection to the fixed installation.

OVERVOLTAGE CATEGORY IV

Equipment of OVERVOLTAGE CATEGORY IV is for use at the origin of the installation.

Note – Examples include electricity meters and primary over-current protection equipment

3. SAFETY INSTRUCTIONS

This meter has been designed for safe use, but must be operated with caution. The rules listed below must be carefully followed for safe operation.

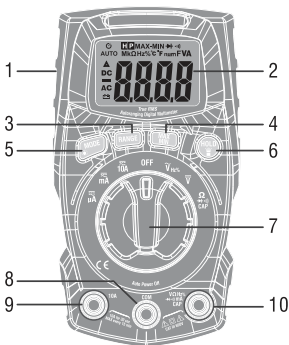
3.1. **NEVER** apply voltage or current to the meter that exceeds the specified maximum:

Input Protection Limits	
Function	Maximum Input
VDC or VAC	600V DC/AC rms
mA AC/DC	500mA 600V fast acting fuse
A AC/DC	10A 600V fast acting fuse
Frequency, Resistance, Capacitance, Diode Test, Continuity	300V DC/AC rms
Surge Protection: 6kV peak per IEC 61010	

- 3.2. **USE EXTREME CAUTION** when working with high voltages.
- 3.3. **DO NOT** measure voltage if the voltage on the "COM" input jack exceeds 600V above earth ground.
- 3.4. **NEVER** connect the meter leads across a voltage source while the function switch is in the current, resistance, or diode mode. Doing so can damage the meter.
- 3.5. **ALWAYS** discharge filter capacitors in power supplies and disconnect the power when making resistance or diode tests.
- 3.6. **ALWAYS** turn off the power and disconnect the test leads before opening the covers to replace the fuse or batteries.
- 3.7. **NEVER** operate the meter unless the back cover and the battery and fuse covers are in place and fastened securely.
- 3.8. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.





4. Controls and Jacks

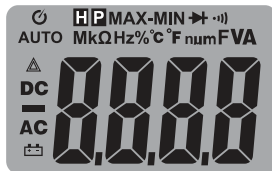
1. Battery Cover
2. 4,000 counts LCD Negativity display
3. RANGE button
4. MAX/MIN button
5. Mode button
6. HOLD and Flashlight button
7. Function switch
8. COM input jack
9. 10A input jacks
10. Positive, mA, μ A input jack



Note: Tilt stand and battery compartment are on rear of unit.

5. Symbols and Annunciators

	Auto power off
	Continuity
	Diode test
	Battery status
n	nano (10 ⁻⁹) (capacitance)
μ	micro (10 ⁻⁶) (amps, cap)
m	milli (10 ⁻³) (volts, amps)
A	Amps
k	kilo (10 ³) (ohms)
F	Farads (capacitance)
M	mega (10 ⁶) (ohms)
Ω	Ohms
Hz	Hertz (frequency)
V	Volts
%	Percent (duty ratio)
AC	Alternating current
AUTO	Autoranging
DC	Direct current
HOLD	Display hold
MAX	Maximum
MIN	Minimum



Operating Instructions

WARNING: Risk of electrocution. High-voltage circuits, both AC and DC, are very dangerous and should be measured with great care.

1. ALWAYS turn the function switch to the OFF position when the meter is not in use.
2. If “OL” appears in the display during a measurement, the value exceeds the range you have selected. Change to a higher range.

DC VOLTAGE MEASUREMENTS

CAUTION: Do not measure DC voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.

1. Set the function switch to the green VDC position.
2. Insert the black test lead banana plug into the negative COM jack. Insert the red test lead banana plug into the positive V jack.
3. Touch the black test probe tip to the negative side of the circuit. Touch the red test probe tip to the positive side of the circuit.
4. Read the voltage in the display.

AC VOLTAGE (FREQUENCY, DUTY CYCLE) MEASUREMENTS

WARNING: Risk of Electrocutation. The probe tips may not be long enough to contact the live parts inside some 240V outlets for appliances because the contacts are recessed deep in the outlets. As a result, the reading may show 0 volts when the outlet actually has voltage on it. Make sure the probe tips are touching the metal contacts inside the outlet before assuming that no voltage is present.

CAUTION: Do not measure AC voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.

1. Set the function switch to the green VAC/Hz/% position.
2. Insert the black test lead banana plug into the negative COM jack. Insert red test lead banana plug into the positive V jack.
3. Touch the black test probe tip to the neutral side of the circuit. Touch the red test probe tip to the “hot” side of the circuit.
4. Read the voltage in the display.
5. Press the HZ/% button to indicate “Hz”.
6. Read the frequency in the display.
7. Press the Hz/% button again to indicate “%”.
8. Read the % of duty cycle in the display.

DC CURRENT MEASUREMENTS

CAUTION: Do not make 20A current measurements for longer than 30 seconds. Exceeding 30 seconds may cause damage to the meter and/or the test leads.

1. Insert the black test lead banana plug into the negative COM jack.
2. For current measurements up to $6000\mu\text{A}$ DC, set the function switch to the yellow μA position and insert the red test lead banana plug into the $\mu\text{A}/\text{mA}$ jack.
3. For current measurements up to 600mA DC, set the function switch to the yellow mA position and insert the red test lead banana plug into the $\mu\text{A}/\text{mA}$ jack.
4. For current measurements up to 20A DC, set the function switch to the yellow 10A/HZ/% position and insert the red test lead banana plug into the 10A jack.
5. Press the MODE button to indicate "DC" on the display.
6. Remove power from the circuit under test, then open up the circuit at the point where you wish to measure current.
7. Touch the black test probe tip to the negative side of the circuit.
Touch the red test probe tip to the positive side of the circuit.
8. Apply power to the circuit.
9. Read the current in the display.

AC CURRENT (FREQUENCY, DUTY CYCLE) MEASUREMENTS

CAUTION: Do not make 20A current measurements for longer than 30 seconds. Exceeding 30 seconds may cause damage to the meter and/or the test leads.

1. Insert the black test lead banana plug into the negative COM jack.
2. For current measurements up to $6000\mu\text{A}$ AC, set the function switch to the yellow μA position and insert the red test lead banana plug into the $\mu\text{A}/\text{mA}$ jack.
3. For current measurements up to 600mA AC, set the function switch to the yellow mA position and insert the red test lead banana plug into the $\mu\text{A}/\text{mA}$ jack.
4. For current measurements up to 20A AC, set the function switch to the yellow 10A/HZ/% position and insert the red test lead banana plug into the 10A jack.
5. Press the MODE button to indicate "AC" on the display.
6. Remove power from the circuit under test, then open up the circuit at the point where you wish to measure current.
7. Touch the black test probe tip to the neutral side of the circuit.
Touch the red test probe tip to the "hot" side of the circuit.
8. Apply power to the circuit.
9. Read the current in the display.

RESISTANCE MEASUREMENTS

WARNING: To avoid electric shock, disconnect power to the unit under test and discharge all capacitors before taking any resistance measurements. Remove the batteries and unplug the line cords.

1. Set the function switch to the green $\rightarrow \vdash \rightarrow \Omega$ **CAP** position. Insert the black test lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive Ω jack.
2. Press the **MODE** button to indicate " Ω " on the display.
3. Touch the test probe tips across the circuit or part under test. It is best to disconnect one side of the part under test so the rest of the circuit will not interfere with the resistance reading.
4. Read the resistance in the display.

CONTINUITY CHECK

WARNING: To avoid electric shock, never measure continuity on circuits or wires that have voltage on them.

1. Set the function switch to the green $\rightarrow \vdash \rightarrow \Omega$ **CAP** position.
2. Insert the black lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive Ω jack.
3. Press the **MODE** button to indicate " $\rightarrow \vdash$ " and " Ω " on the display
4. Touch the test probe tips to the circuit or wire you wish to check.
5. If the resistance is less than approximately 50 Ω , the audible signal will sound. If the circuit is open, the display will indicate "**OL**".

DIODE TEST

1. Set the function switch to the green $\rightarrow \vdash \rightarrow \Omega$ **CAP** position.
2. Insert the black test lead banana plug into the negative **COM** jack and the red test lead banana plug into the positive V jack.
3. Press the **MODE** button to indicate $\rightarrow \vdash$ and **V** on the display.
4. Touch the test probes to the diode under test. Forward voltage will typically indicate 0.400 to 0.700V. Reverse voltage will indicate "**OL**". Shorted devices will indicate near 0V and an open device will indicate "**OL**" in both polarities.

CAPACITANCE MEASUREMENTS

WARNING: To avoid electric shock, disconnect power to the unit under test and discharge all capacitors before taking any capacitance measurements. Remove the batteries and unplug the line cords.

1. Set the rotary function switch to the green $\rightarrow + \rightarrow \Omega$ **CAP** position.
2. Insert the black test lead banana plug into the negative **COM** jack. Insert the red test lead banana plug into the positive **V** jack.
3. Press the **MODE** button to indicate “**nF**” on the display.
4. Touch the test leads to the capacitor to be tested.
5. The test may take up to 3 minutes or more for large capacitors to charge. Wait until the readings settle before ending the test.
6. Read the capacitance value in the display

6. AUTORANGING/MANUAL RANGE SELECTION

When the meter is first turned on, it automatically goes into Autoranging. This automatically selects the best range for the measurements being made and is generally the best mode for most measurements. For measurement situations requiring that a range be manually selected, perform the following:

1. Press the **RANGE** key. The “**AUTO**” display indicator will turn off.
2. Press the **RANGE** key to step through the available ranges until you select the range you want.
3. To exit the Manual Ranging mode and return to Autoranging, press and hold the **RANGE** key for 2 seconds.

Note: Manual ranging does not apply for the Capacitance and Frequency functions.
MAX/MIN

Note: When using the MAX/MIN function in Autoranging mode, the meter will “**lock**” into the range that is displayed on the LCD when MAX/MIN is activated. If a MAX/Min reading exceeds that range, an “**OL**” will be displayed. Select the desired range BEFORE entering MAX/MIN mode.

1. Press the MAX/MIN key to activate the MAX/MIN recording mode. The display icon “**MAX**” will appear. The meter will display and hold the maximum reading and will update only when a new “**max**” occurs.

2. Press the MAX/MIN key again and the display icon "MIN" will appear. The meter will display and hold the minimum reading and will update only when a new "min" occurs.
3. To exit MAX/MIN mode press and hold the MAX/MIN key for 2 seconds.

DISPLAY BACKLIGHT

Positive Display and Backlight on when unit is turned on

MODE

Press MODE key the selection of double measured functions which are present at display is possible. In particular this key is active in $V \bullet \rightarrow \bullet CAP \bullet \Omega$ position to select among resistance test, diode test, continuity test and capacitance test, and in current position to select between AC or DC current measurements.

HOLD/ FLASH LIGHT


The hold function freezes the reading in the display. Press the HOLD key momentarily to activate or to exit the HOLD function.

Press the HOLD key for >1 second to turn on or off the FLASH light function. The flash light and will automatically power OFF after 5 minutes of inactivity.

AUTO POWER OFF

The auto off feature will turn the meter off after 15 minutes. To disable the auto power off feature, hold down the MODE button and turn the meter on.

LOW BATTERY INDICATION

The  icon will appear in the lower left corner of the display when the battery voltage becomes low. Replace the battery when this appears.

7. Maintenance

WARNING: To avoid electric shock, disconnect the test leads from any source of voltage before removing the back cover or the battery or fuse covers.

WARNING: To avoid electric shock, do not operate your meter until the battery and fuse covers are in place and fastened securely.

This MultiMeter is designed to provide years of dependable service, if the following care instructions are performed:

1. KEEP THE METER DRY. If it gets wet, wipe it off.
2. USE AND STORE THE METER IN NORMAL TEMPERATURES. Temperature extremes can shorten the life of the electronic parts and distort or melt plastic parts.
3. HANDLE THE METER GENTLY AND CAREFULLY. Dropping it can damage the electronic parts or the case.
4. KEEP THE METER CLEAN. Wipe the case occasionally with a damp cloth. DO NOT use chemicals, cleaning solvents, or detergents.
5. USE ONLY FRESH BATTERIES OF THE RECOMMENDED SIZE AND TYPE. Remove old or weak batteries so they do not leak and damage the unit.
6. IF THE METER IS TO BE STORED FOR A LONG PERIOD OF TIME, the batteries should be removed to prevent damage to the unit.

BATTERY INSTALLATION

WARNING: To avoid electric shock, disconnect the test leads from any source of voltage before removing the battery cover.

1. Turn power off and disconnect the test leads from the meter.
2. Open the rear battery cover by removing the screw using a Phillips head screwdriver.
3. Insert the battery into battery holder, observing the correct polarity.
4. Put the battery cover back in place. Secure with the screw.

WARNING: To avoid electric shock, do not operate the meter until the battery cover is in place and fastened securely.

NOTE: If your meter does not work properly, check the fuses and batteries to make sure that they are still good and that they are properly inserted.

REPLACING THE FUSES

WARNING: To avoid electric shock, disconnect the test leads from any source of voltage before removing the fuse cover.

1. Disconnect the test leads from the meter.
2. Remove the battery cover.
3. Gently remove the old fuse and install the new fuse into the holder.
4. Always use a fuse of the proper size and value (0.5A/600V fast blow for the 600mA range, 10A/600V fast blow for the 20A range).
5. Replace and secure the rear cover, battery and battery cover.

WARNING: To avoid electric shock, do not operate your meter until the fuse cover is in place and fastened securely.

8. Specifications

Function	Range	Resolution	Accuracy
DC Voltage	400mV	0.1mV	$\pm(1.0\% \text{reading} + 5 \text{digits})$
	4V	0.001V	$\pm(1.0\% \text{reading} + 3 \text{digits})$
	40V	0.01V	
	400V	0.1V	
	600V	1V	
AC Voltage			50Hz to 60Hz
	4V	0.001V	$\pm(1.2\% \text{reading} + 3 \text{digits})$
	40V	0.01V	
	400V	0.1V	
	600V	1V	
All AC voltage ranges are specified from 5% of range to 100% of range			
DC Current	400 μ A	0.1 μ A	$\pm(1.0\% \text{reading} + 3 \text{digits})$
	4000 μ A	1 μ A	
	40mA	0.01mA	
	400mA	0.1mA	
	4A	0.001A	$\pm(1.2\% \text{reading} + 3 \text{digits})$
	10A	0.01A	
	(20A: 30 sec max with reduced accuracy)		
AC Current			50Hz to 60Hz
	400 μ A	0.1 μ A	$\pm(1.2\% \text{reading} + 3 \text{digits})$
	4000 μ A	1 μ A	
	40mA	0.01mA	
	400mA	0.1mA	
	4A	0.001A	$\pm(1.8\% \text{reading} + 5 \text{digits})$
	10A	0.01A	
	(20A: 30 sec max with reduced accuracy)		
All AC voltage ranges are specified from 5% of range to 100% of range			


NOTE: Accuracy is stated at 65°F to 83°F (18°C to 28°C) and less than 75% RH.

Function	Range	Resolution	Accuracy
Resistance	400Ω	0.1kΩ	±(1.5%reading + 5 digits)
	4kΩ	0.001kΩ	
	40kΩ	0.01kΩ	
	400kΩ	0.1kΩ	
	4MΩ	0.001MΩ	
		40MΩ	0.01MΩ
Capacitance	40nF	0.01nF	±(4.5%reading + 10 digits)
	400nF	0.1nF	
	4μF	0.001μF	±(3.0%reading + 5 digits)
	40μF	0.01μF	
	400μF	0.1μF	
		4000μF	1μF
Frequency (electrical)	10.00-10KHz	0.01Hz	±(1.2% reading)
	Sensitivity: 15Vrms		
Duty Cycle	0.1 to 99.9%	0.1%	±(1.2% reading + 2 digits)
	Pulse width: 100μs - 100ms, Frequency: 5Hz to 150kHz		

Note: Accuracy specifications consist of two elements:

- (% reading) – This is the accuracy of the measurement circuit.
- (+ digits) – This is the accuracy of the analog to digital converter.

Enclosure	Double molded
Shock (Drop Test)	6.5 feet (2 meters)
Diode Test	Test current of 1.5 mA maximum, open circuit voltage 3V DC typical
Continuity Check	Audible signal will sound if the resistance is less than 50Ω (approx.), test current <0.35mA
Temperature Sensor	Requires type K thermocouple
Input Impedance	> 10MΩ VDC & > 10MΩ VAC
AC Response	TRMS
ACV Bandwidth	50/60HZ(ALL WAVE) 45Hz to 1000Hz(SINE WAVE)
Crest Factor	≤3 at full scale up to 300V, decreasing linearly to ≤1.5 at 600V

Display	4,000 counts Positive Display
Overrange indication	"OL" is displayed
Auto Power Off	15 minutes (approximately) with disable feature
Polarity	Automatic (no indication for positive); Minus (-) sign for negative
Measurement Rate	3 times per second, nominal
Low Battery Indication	"  " is displayed if battery voltage drops below operating voltage
Battery	1.5V AAA * 2 battery
Fuses	mA, μ A ranges; 0.5A 600V ceramic fast blow A range; 10A/600V ceramic fast blow
Operating Temperature	41°F to 104°F (5°C to 40°C)
Storage Temperature	-4°F to 140°F (-20°C to 60°C)
Operating Humidity	Max 80% up to 87°F (31°C) decreasing linearly to 50% at 104°F (40°C)
Storage Humidity	<80%
Operating Altitude	7000ft. (2000meters) maximum.
Weight	0.753lb (342g) (includes holster).
Size	(182 x 82 x 59mm) (includes holster)
Safety	This meter is intended for origin of installation use and protected, against the users, by double insulation per EN61010-1 and IEC61010-1 2nd Edition (2001) to Category III 600V and Category II 1000V; Pollution Degree 2. The meter also meets UL 61010-1, 2nd Edition (2004), CAN/CSA C22.2 No. 61010-1 2nd Edition (2004), and UL 61010B-2-031, 1st Edition (2003)

WARRANTY

Sper Scientific warrants this product against defects in materials and workmanship for a period of **one (1) year** from the date of purchase, and agrees to repair or replace any defective unit without charge. If your model has since been discontinued, an equivalent Sper Scientific product will be substituted if available. This warranty does not cover probes, batteries, battery leakage, or damage resulting from accident, tampering, misuse, or abuse of the product. Opening the meter to expose its electronics will break the waterproof seal and void the warranty.

To obtain warranty service, ship the unit postage prepaid to:

SPER SCIENTIFIC LTD.

8281 East Evans Road, Suite #103
Scottsdale, AZ 85260

The defective unit must be accompanied by a description of the problem and your return address. Register your product online at www.sperwarranty.com within 10 days of purchase.

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