

AUTOMOTIVE DIGITAL MULTIMETER



IMPORTANT SAFETY INFORMATION

Please read this manual thoroughly before use and store in a safe place for future reference

WARNING

WARNINGS:

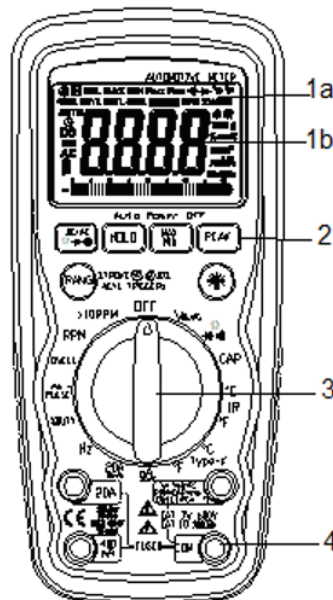
- Voltage between any terminal and ground must not exceed 600V DC or 600V AC.
- Use caution when measuring voltage above 25V DC or 25V AC.
- Circuit tested must be protected by a 20A fuse or circuit breaker.
- Do not use the meter if it has been damaged.
- Do not use the test leads if the insulation is damaged or if metal is exposed.
- Avoid electrical shock: do not touch the test leads, tips or the circuit being tested.
- Do not try a voltage measurement with the test leads in the 20A or the mA terminal.
- When testing for the presence of voltage or current, make sure the meter is functioning correctly. Take a reading of a known voltage or current before accepting a zero reading.
- Choose the proper range and function for the measurement. Do not try voltage or current measurements that may exceed the ratings marked on the Function/Range switch or terminal.
- When measuring current, connect the meter in series with the load.
- Never connect more than one set of test leads to the meter.
- Disconnect the live test lead before disconnecting the common test lead.
- The mA and the 20A terminals are protected by fuses. To avoid possible injury or damage, use only in circuits limited to 400mA or 20A for 30 seconds.
- To maintain accuracy of the meter, replace the discharged battery immediately when the battery symbol "BAT" appears on the meter display.
- Avoid measuring error from outside interference. Keep the meter away from spark plug or coil wires.
- Avoid damaging the meter when testing voltage. Disconnect the test leads from the test points before changing functions.
- Do not exceed the limits shown in the table below:



Function	Terminal	Input Limit
DC/AC Volts, Ohm/Continuity/Diode, CAP., IR- TEMP Adaptor, Type-K TEMP., Hz, %Duty, Ms Dwell, RPM	V-Ω-RPM	600V AC DC
AC/DC μA mA	μA / mA	400ma DC/AC
AC/DC 20A	20A	*20A DC/AC

Product Overview

1. LCD Display
 - a. Symbols to identify function
 - b. Four-character digital display
2. Function Buttons
3. Rotary Selector Switch
4. Volts Terminal



SYMBOLS USED ON LCD DISPLAY

-8.8.8.8	LCD Display Reading	A	Amps
	Continuity	k	kilo (10 ³) (ohms)
BAT	Low Battery	F	Farads (capacitance)
	Diode	M	mega (10 ⁶) (ohms)
DATA HOLD	Data Hold	Ω	Ohms
AUTO	Auto Ranging	Hz	Hertz (frequency)
AC	Alternating Current or Voltage	V	Volts
DC	Direct Current or Voltage	%	Percent (duty ratio)
n	nano (10 ⁻⁹) (capacitance)	oF	Degrees Fahrenheit
μ	micro (10 ⁻⁶) (amps, cap)	oC	Degrees Centigrade
m	milli (10 ⁻³) (volts, amps)	IR TEMP	Infrared Temperature

BUTTON FUNCTIONS

MODE BUTTON (DC/AC Ω →)

- Press the MODE button to select DC/AC Voltage, DC/AC Current, Resistance, Diode, Continuity or Capacitance.

MANUAL RANGE & STROKE (4) (2) DIS #CYL TRIGGER ± BUTTON

- Press this RANGE button to select STROKE 4, 2DIS, Hz, %, ms±, CYL range & V/A Resistance Manual Range.
- Press the RANGE button to turn on manual ranging.
- "○" Will appear when the multi meter has changed modes.
- Continue to press the RANGE button to cycle through the ranges until you select the range you want.
 - Range will be indicated by the units and decimal points location.
- Press and hold the RANGE button for 2 seconds to return to auto ranging.

HOLD BUTTON

- Press HOLD button to “freeze” the reading on the indicator.
- “HOLD” will appear when the reading has been “frozen”
- Press HOLD button again to return to normal operation.

PEAK BUTTON

- Turn the function switch to the A or V position.
- Press and hold the PEAK button until “CAL” appears.
This will zero the range selected and the multi meter will go to manual ranging.
- Press the PEAK button, Pmax will display.
This display will update each time a higher positive peak occurs.
- Press the PEAK button again, Pmin will display.
The display will now update and indicate the lowest negative peak.
- Press and hold the PEAK button until the Pmax or Pmin indicator switches off to return to normal operation.

NOTE: If the function switch position is changed after a calibration the Peak Hold calibration must be repeated for the new function selected.

HOLD BUTTON

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- Press HOLD button again to return to normal operation.

PEAK BUTTON

- Turn the function switch to the A or V position.
- Press and hold the PEAK button until “CAL” appears. This will zero the range selected and the multi meter will go to manual ranging.
- Press the PEAK button, Pmax will display. This display will update each time a higher positive peak occurs.
- Press the PEAK button again, Pmin will display. The display will now update and indicate the lowest negative peak.
- Press and hold the PEAK button until the Pmax or Pmin indicator switches off to return to normal operation.

NOTE: If the function switch position is changed after a calibration the Peak Hold calibration must be repeated for the new function selected.

MAX/MIN BUTTON

- Press the MAX/MIN button to activate the MAX/MIN recording mode.
- “MAX” or “MIN” will appear, and the multimeter will go to manual ranging.
- The multimeter will display and hold either the maximum or minimum reading and will only update when a new “MAX” or “MIN” occurs.
- Press the MAX/MIN button and a blinking “MAX MIN” will appear and the multimeter will display the present reading, but will continue to update and store the max and min readings.
- Press and hold the MAX/MIN button for 2 seconds to return to normal operation.

BACKLIGHT BUTTON

- Press the BACKLIGHT button to turn the backlight on.
- Press the BACKLIGHT button again to turn the backlight off.

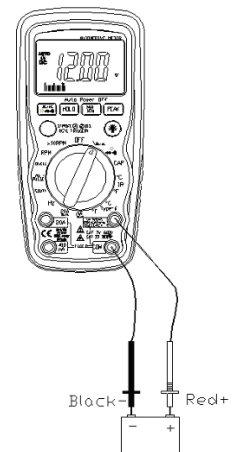
METER FUNCTIONS

VOLTAGE (V)

1. Select the Volts "V" range with the rotary switch.
 - a. The multimeter will automatically select the best voltage (V) range.
2. Select DCV or ACV with the MODE button.
3. Insert the black lead into the COM terminal and the red lead into the V- Ω -RPM terminal.
4. Touch the black probe to the ground or to the negative (-) circuit.
5. Touch the red probe to the circuit coming from the power source.

NOTE: Voltage must be measuring parallel (red probe measuring circuit from power source)

WARNING: When measuring voltage, be sure the red test lead is in the terminal marked "V". If the test lead is in an Amp (A) or Milliampere (mA) terminal, you may be injured or the multi meter may be damaged.

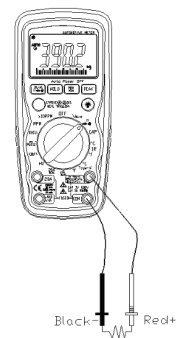


RESISTANCE (Ω)

1. Select the Resistance " Ω " range with the rotary switch.
2. Select Resistance " Ω " function with the MODE button.
3. Insert the black lead into the COM terminal and the red lead into the V- Ω -RPM terminal.
4. Touch the test lead probes across the resistor to be tested.

NOTE: Accurate measurement is not possible if external or residual voltage is present.

WARNING: Be sure to turn the power off on the test circuit and discharge all capacitors before testing an application that has capacitors in the circuit.

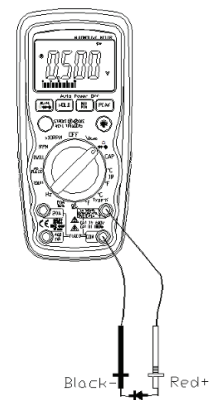


DIODE CHECK ($\rightarrow$)

1. Select the Diode Check " $\rightarrow$ " function with the rotary switch and the MODE button.
2. Insert the black lead into the COM terminal and the red lead into the V- Ω -RPM terminal.
3. Touch the black probe to the negative (-) side of the diode.
4. Touch the red probe to the positive (+) side of the diode.
5. Reverse the probes: Black to positive (+) and Red to the negative (-) side.

NOTE: A "good" diode will read low in one direction and high in the other direction when the probes are reversed (or vice versa). A defective diode will have the same reading in both directions or read between 100 to 3.0V in both directions.

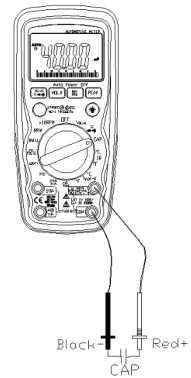
WARNING: Be sure to turn the power off on the test circuit.



Diode	- to +	Reverse Probes + to -
Good	.4 to .9V	OL
	OL	.4 to .9V
Bad	OL	1.0 to 3.0V
	1.0 to 3.0V	OL
	.4 to .9V	.4 to .9V
	OL	OL
	.000V	.000V

CAPACITANCE (CAP)

1. Select the Capacitance "CAP" function with the rotary switch and the MODE button.
2. Insert the black lead into the COM terminal and the red lead into the V-Ω-RPM terminal.
3. Touch the test lead probes across the capacitance circuit to be tested.
4. Read the measured value from the LCD display.



NOTE: When checking in-circuit capacitance, be sure that the circuit has all power removed and all capacitors are fully discharged.

NOTE: The bar graph is disabled in capacitance measurement mode. However, since the measurement time of 4mF and 40mF modes is quite long (3.75s and 7.5s respectively, to be precise) the bar graph is used to display the time rest to accomplish the measurement.

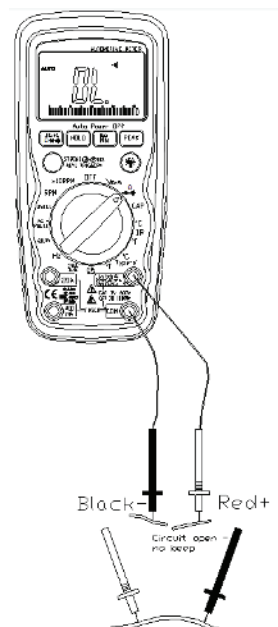
NOTE: To obtain an accurate reading, a capacitor must be discharged before measurement begins. The multimeter has a built-in discharge mode to automatically discharge the capacitor. In discharge mode, the LCD displays "DIS.C"

NOTE: Discharging through the chip is quite slow. It is recommended you discharge the capacitor with some other apparatus.

WARNING: Be sure to turn the power off on the test circuit.

AUDIBLE CONTINUITY (🔊)

1. Select the Audible Continuity "🔊" function with the rotary switch and the MODE button.
2. Insert the black lead into the COM terminal and the red lead into the V-Ω-RPM terminal.
3. Connect one test probe to each end of the circuit to be tested.
 - a. Circuit complete, the multimeter will beep continuously.
 - b. Circuit open, there will be no beep and the display shows to OL (over limit).



WARNING: Be sure to turn the power off on the test circuit.

AC OR DC CURRENT (A)

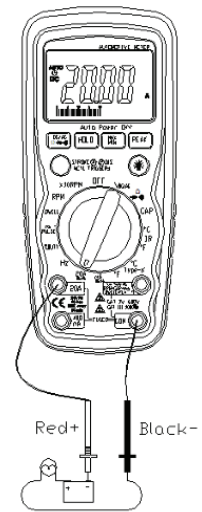
1. Select the "20A" or "mA" range with the rotary switch.
2. Press the MODE button to select AC or DC.
3. Insert the black lead into the COM terminal and the red lead into the 20A or mA terminal (select 20A if you are unsure of the current draw).
4. Connect the red probe to the side of the circuit closest to the power source and the black probe to the side of the circuit to ground.
5. Turn on the power on and test

NOTE: All current measured flows through the multimeter. It is important that you do not measure current greater than 600V AC or DC, with respect to ground.

NOTE: Do not exceed 30 seconds when measuring continuous current between 1A-20A. Allow 5 minutes for cool down before continuing.

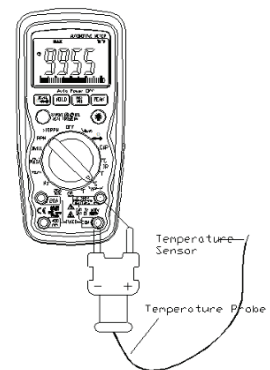
NOTE: Current must always be measured with the multimeter test probes connected in series, as described.

WARNING: Be sure to turn the power off on the circuit or disconnect the circuit from the power source.



TEMPERATURE (°C/°F)

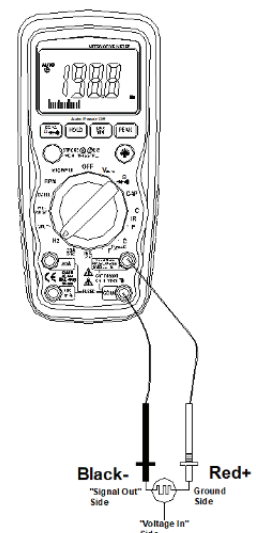
1. Select the Temperature "°C or °F" function with the rotary switch.
2. Insert the temperature probe connector into the K-type thermocouple adapter.
3. Insert the adaptor into the front of the meter as shown.
4. Touch the end of the temperature sensor to the area or surface of the object to be measured.



WARNING: To avoid heat damage to the multimeter, keep it away from sources of very high temperature. The life of the Temperature Probe is also reduced when subjected to the very high temperatures. Probe operating range is -58° to 482°F.

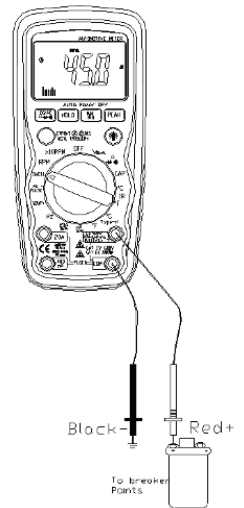
FREQUENCY (Hz)

1. Select the Frequency "Hz" function with the rotary switch.
2. Insert the black lead into the COM terminal and the red lead into the V-Ω-RPM terminal.
3. Connect the black test probe to ground and the red test probe to the "signal out" wire of the sensor to be tested.



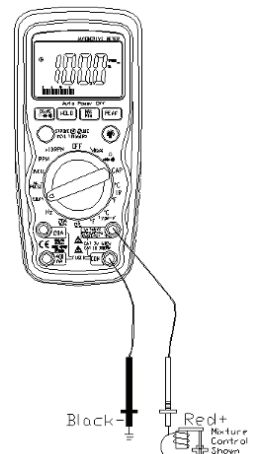
DWELL ()

1. Select the "DWELL" function with the rotary switch.
2. Insert the black lead into the COM terminal and the red lead into the V-Ω-RPM terminal.
3. Connect the black test probe to ground and the red test probe to the wire that connects to the breaker points.



DUTY CYCLE (%)

1. Select the "% Duty" function with the rotary switch.
2. Insert the black lead into the COM terminal and the red lead into the V-Ω-RPM terminal.
3. Connect the black test probe to ground and the red test probe to the signal wire circuit.



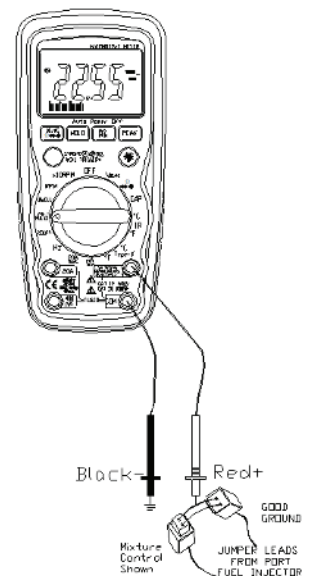
mS-PULSE (PULSE WIDTH) & mS-PERIOD (PERIOD)

Pulse Width is the length of time an actuator is energized. For example, fuel injectors are activated by an electronic pulse from the Engine Control Module (ECM). This pulse generates a magnetic field that pulls the injector nozzle valve open. This pulse ends and the injector nozzle is closed. This open to close time is the Pulse Width and is measured in milliseconds(ms). The most common automotive application for measuring pulse width is on fuel injectors.

You can also measure the pulse width of the fuel mixture control solenoid and the idle air control motor.

This exercise shows how to measure Pulse Width on Port Fuel Injectors.

1. Select the "mS-Pulse" function with the rotary switch.
2. Press the $\pm$ TRIG button for 2 seconds until the negative (-) trigger slope is displayed on the upper left side of the display.
3. Insert the black lead into the COM terminal and the red lead into the V-Ω-RPM terminal.
4. Connect the jumper wires between the fuel injector and the harness connector.
5. Connect the black test probe to a good ground at the fuel injector or the negative (-) vehicle battery post and the red test probe to the fuel injector solenoid driver input on the jumper cable.
6. Start the engine.
7. The multimeter will display a pulse width in milliseconds.



NOTE: The applied time for most fuel injectors is displayed on the negative (-) slope.

NOTE: Initially, the unit will read "OL", then readings will descend and stabilize to the actual pulse width. If "OL" remains, re-check your connections.

RPM/ X 10RPM

1. Select the RPM function with the rotary switch.

OR

2. Select the X10RPM range with the rotary switch (1,000 to 12,000 RPM).

Multiply the displayed reading by 10 to get the actual RPM.

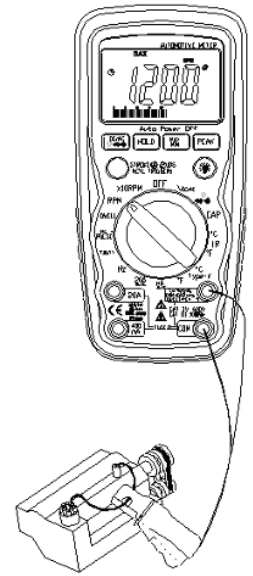
3. Press STROKE (4) (2) DIS button to select through RPM (4) for 4-stroke, RPM (2) for 2-stroke and DIS (Distributorless Ignitions Systems).

4. Insert the inductive pickup connecting terminal into the multimeter.

5. Insert the black lead into the COM terminal and the red lead into the V-Ω-RPM terminal.

6. Connect the inductive pickup to a spark plug wire.

7. If no reading is received, unhook the clamp, turn it over and connect again.



NOTE: Position the inductive pickup as far away from the distributor and the exhaust manifold as possible.

NOTE: Position the inductive pickup to within 6" of the spark plug or move it to another plug wire if no reading or an erratic reading is received.

NOTE: The RPM pickup has an adjustable sensitivity switch that can also be used to correct an unstable reading.

GENERAL SPECIFICATIONS

The instrument Complies with	IEC 1010-1 EN61010-1
Insulation	Class 2, Double Insulation
Overvoltage Category	CATIII1000V/CATIV600V
Display	4000 counts LCD display with function indication
Polarity	Automatic, (-) negative polarity indication
Over Range Indication	"OL" mark indication
Low Battery Indication	The "BAT" is displayed when the battery voltage drops below the operating level
Measurement Rate	2 times per second, nominal
Auto Power Off	Multimeter automatically shuts down after approx. 30 minutes of inactivity
Operating Environment	0oC to 50oC (32oF to 122oF)
at < 70% relative humidity	
Storage Environment	-20oC to 60oC (-4oF to 140oF) at < 80 % relative humidity
For Inside Use, Max Height	2000m
Pollution Degree	2
Power	1x "9V" Battery, NEDA 1604, IEC 6F22
Dimensions	182 (H) x 82 (W) x55 (D) mm
Weight	Approx. 375g

ELECTRICAL SPECIFICATIONS

Electrical Specifications

*Accuracy is given as $\pm$ [(% of reading)+[number of least significant digits]] at 18oC to 28oC (65oF to 83oF), with relative humidity up to 70%.

RPM (Tach)

Range		Resolution	Accuracy
RPM 4	600~4000 RPM	1 RPM	$\pm 2.0\%$ of rdg ± 4 dgts
	1000~12000 RPM (X10 RPM)	10 RPM	
RPM 2/DIS	300~4000 RPM	1 RPM	
	1000~6000 RPM (X10 RPM)	10 RPM	

Effective Reading: >600RPM

DWELL ANGLE

Cylinder	Range	Resolution	Accuracy
4CYL	0~90.0o	0.1°	$\pm 2.0\%$ of rdg ± 4 dgts
5CYL	0~72.0o		
6CYL	0~60.0o		
8CYL	0~45.0o		

DC VOLTAGE

Range	Resolution	Accuracy
400.0mV	0.1mV	$\pm 0.5\%$ of rdg ± 3 dgts
4.000V	1mV	$\pm 1.5\%$ of rdg ± 2 dgts
40.00V	10mV	
400.0V	100mV	
600V	1V	$\pm 1.8\%$ of rdg ± 2 dgts

Input Impedance: 10M Ω

AC VOLTAGE

Range	Resolution	Accuracy
400.0mV	0.1mV	$\pm 1.5\%$ of rdg ± 5 dgts
4.000V	1mV	$\pm 1.0\%$ of rdg ± 3 dgts
40.00V	10mV	$\pm 1.5\%$ of rdg ± 3 dgts
400.0V	100mV	
600V	1V	$\pm 2.0\%$ of rdg ± 4 dgts

Input Impedance: 10M Ω

Frequency Range: 50 to 60Hz

DC CURRENT

Range	Resolution	Accuracy
40.00mA	10μA	±1.5% of rdg ± 3 dgts
400.0mA	100μA	
20A	10ma	±2.5% of rdg ± 5 dgts

Overload Protection: 0.5A / 250V and 20A / 250V Fuse.

Maximum Input: 400mA DC or 400mA AC RMS on μA/mA ranges, 20A DC or AC RMS on 20A range.

AC CURRENT

Range	Resolution	Accuracy
40.00mA	10μA	±1.8% of rdg ± 5 dgts
400.0mA	100μA	
20A	10ma	±3.0% of rdg ± 7 dgts

Overload Protection: 0.5A / 250V and 20A / 250V Fuse.

Frequency Range: 50 to 60Hz

Maximum Input: 400mA DC or 400mA AC RMS on μA/mA ranges, 20A DC or AC RMS on 20A range.

RESISTANCE

Range	Resolution	Accuracy
400.0Ω	0.1Ω	±1.2% of rdg ± 4 dgts
4.000kΩ	1Ω	±1.0% of rdg ± 2 dgts
40.00kΩ	10Ω	±1.2% of rdg ± 2 dgts
400.0kΩ	100Ω	
4.000MΩ	1kΩ	
40.00MΩ	10kΩ	±2.0% of rdg ± 3 dgts

CAPACITANCE

Range	Resolution	Accuracy
4.000nF	1pF	±5.0% of rdg ± 50 dgts
40.00nF	10pF	±5.0% of rdg ± 7 dgts
400.0nF	0.1nF	±3.0% of rdg ± 5 dgts
4.000μF	1nF	
40.00μF	10nF	
400.00μF	0.1μF	±10% of rdg ± 10 dgts
4.000mF	0.001mF	

FREQUENCY

Range	Resolution	Sensitivity	Accuracy
4.000kHz	1Hz	>5V RMS	±1.5% of rdg ± 3 dgts
40.00kHz	10Hz		
400.0kHz	100Hz		
4.000MHz	1000Hz		
40.00MHz	1kHz	>15 RMS	±2.0% of rdg ± 4 dgts

DUTY CYCLE

Range	Resolution	Accuracy
0.5%~99.0%	0.1%	±2.0% of rdg ± 5 dgts

Pulse Width: >100µs, <100ms

Frequency Width: 5Hz – 100Hz

Sensitivity: >5V RMS

PULSE WIDTH

Range	Resolution	Accuracy
1.0~20.0ms	0.1ms	±2.0% of rdg ± 20 dgts

TYPE-K TEMPERATURE

Range	Resolution	Accuracy
-30oC~1000oC	1oF	±3.0% of rdg ± 5oC/8oF (Meter only, probe accuracy not included)
-22oF~1832oF	1oF	

Sensor: Type K Thermocouple

DIODE TEST

Test Current	Resolution	Accuracy
1.0mA typical	1mV	±5.0% of rdg ± 15 dgts

Open Circuit Voltage: 3.0V DC typical

AUDIBLE CONTINUITY

Audible Threshold: Less than 35Ω Test Current: <1mA DC typical

BATTERY INSTALLATION

1. Disconnect the test leads from the multimeter.
2. Open the battery door by loosening the screw using a Phillips head screwdriver.
3. Insert the battery into battery holder, observing the correct polarity.
4. Put the battery door back in place. Secure with the two screws.

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

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

REPLACING THE BATTERY

1. When the batteries become exhausted or drop below the operating voltage, "BAT" will appear in the right-hand side of the LCD display. The battery should be replaced.
2. Follow instructions for installing battery.
3. Dispose of the old battery properly.

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

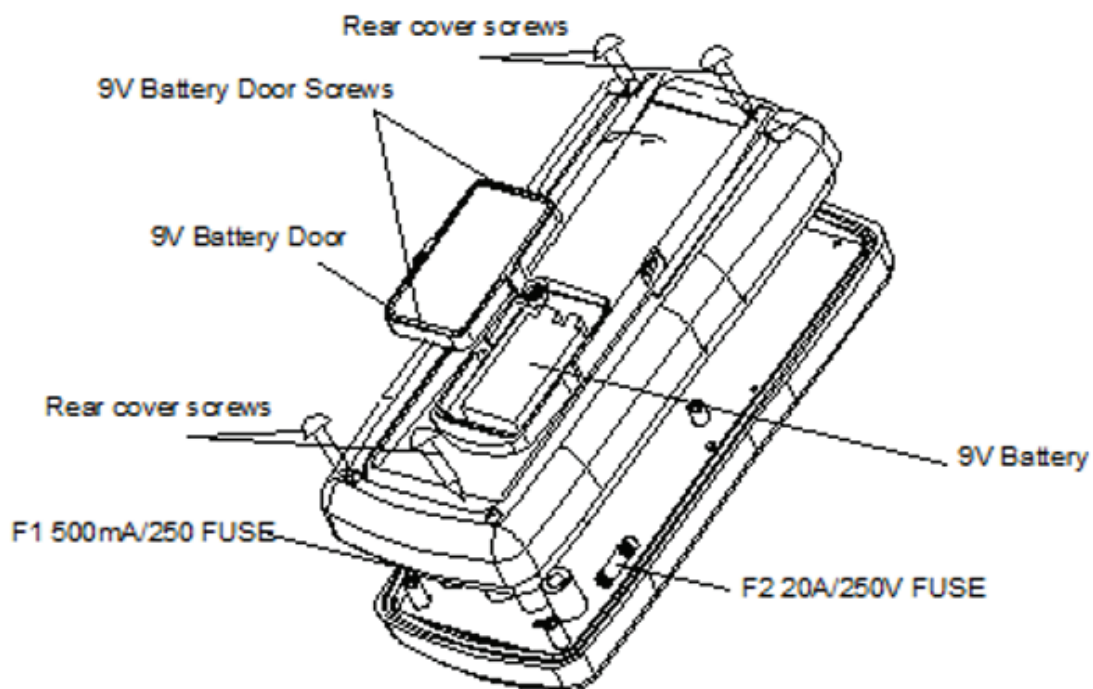
WARNING: To avoid electric shock, do not operate the multi meter until the battery door is in place and fastened securely.

REPLACING THE FUSES

1. Disconnect the test leads from the multimeter and any item under test.
2. Open the fuse door by loosening the screws on the rear cover using a Phillips head screwdriver.
3. Remove the old fuse from its holder by gently pulling it out.
4. Install the new fuse into the holder.
5. Always use a fuse of the proper size and value (0.5A/250V – $\Phi 5 \times 20$, fast blow for the 40mA range, 20A/250V – $\Phi 6.3 \times 32$ fast blow for the 20A range).
6. Put the fuse door back in place. Insert the screw and tighten it securely.

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

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



TROUBLE SHOOTING

METER WILL NOT TURN ON:

- Check the battery contacts for a tight fit.
- Check for a minimum battery voltage of 8.0V.

AMPERE READING IS ERRATIC OR THERE IS NO READING AT ALL:

- Disassemble the multimeter back cover as per the fuse replacement instructions and test the fuses for continuity with another meter.

MULTIMETER READING IS ERRATIC:

- Printed circuit board damaged from handling with hands.
- Low battery.
- "Blown" fuse.
- Open circuit in a test lead (frayed or broken wire)

MULTIMETER READINGS DO NOT CHANGE:

- "HOLD" feature is still toggled ON.

WARRANTY STATEMENT

Brown & Watson International Pty Ltd ("BWI") of 1500 Ferntree Gully Road, Knoxfield, Vic., telephone (03) 9730 6000, fax (03) 9730 6050, warrants that all products described in its current catalogue will under normal use and service be free of failures in material and workmanship for a period of three (3) years from the date of the original purchase by the customer as marked on the invoice. This warranty does not cover ordinary wear and tear, abuse, alteration of products or damage caused by the purchaser.

To make a warranty claim the consumer must deliver the product at their cost to the original place of purchase or to any other place which may be nominated by either BWI or the retailer from where the product was bought in order that the warranty assessment may be performed. The consumer must also deliver the original invoice evidencing the date and place of purchase together with an explanation in writing as to the nature of the claim. In the event that the claim is determined to be for a minor failure of the product then BWI reserves the right to repair or replace it at its discretion. In the event that a major failure is determined the consumer will be entitled to a replacement or a refund as well as compensation for any other reasonably foreseeable loss or damage.

This warranty is in addition to any other rights or remedies that the consumer may have under State or Federal legislation.

IMPORTANT NOTE

Our goods come with guarantees that cannot be excluded under the Australian Consumer Law. You are entitled to a replacement or refund for a major failure and compensation for any other reasonably foreseeable loss or damage. You are also entitled to have the goods repaired or replaced if the goods fail to be of acceptable quality and the failure does not amount to a major failure.

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Brown & Watson International Pty. Ltd.
Knoxfield Victoria 3180
Phone: (03) 9730 6000
Fax: (03) 9730 6050
National Toll Free: 1800 113 443

NEW ZEALAND OFFICE Griffiths Equipment Ltd.

19 Bell Avenue,
Mount Wellington,
Auckland 1060, New Zealand
Phone: (09) 525 4575
Fax: (09) 579 1192