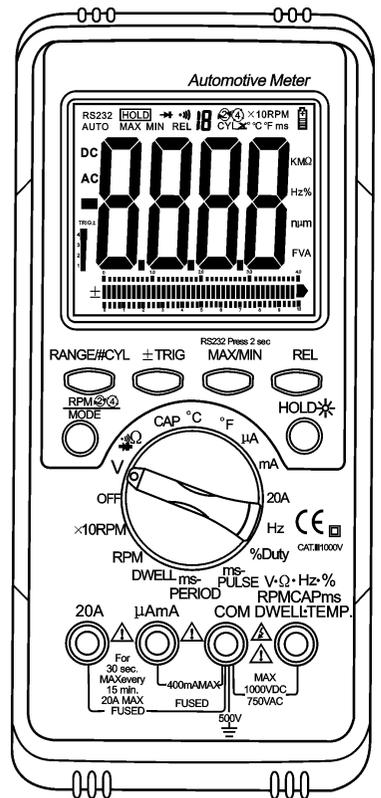


AUTOMOTIVE MULTIMETER WITH PC INTERFACE

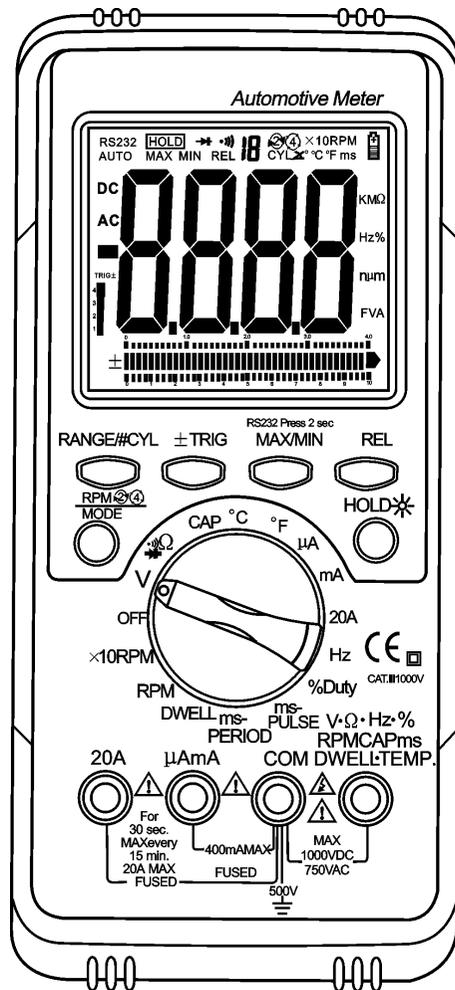


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This chapter covers the following information, You will find:

- Safety precautions



Safety

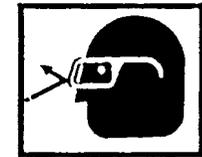


DANGER

- Engines produce carbon monoxide which is odorless, causes slower reaction time, and can lead to serious injury. When the engine is operating, keep service areas WELL VENTILATED or attach the vehicle exhaust system to the shop exhaust removal system.



- Set the parking brake and block the wheels before testing or repairing the vehicle. It is especially important to block the wheels on front-wheel drive vehicles; the parking brake does not hold the drive wheels.
- Wear an eye shield when testing or repairing vehicles.



Exceeding the limits of this meter is dangerous. This will expose you to serious or possibly fatal injury. Carefully read and understand the cautions and the specification limits of this meter.

- Voltage between any terminal and ground must not exceed 1000V DC or 750V 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.



Safety Cont'd...

Danger

- 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.



See also...

- Fuse Replacement

Safety Cont'd...

IMPORTANT

- To maintain accuracy of the meter, replace the discharged battery immediately when the battery symbol  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
AC Volts	V-Ω -RPM	750Volts AC rms
DC Volts		1000Volts DC
Frequency	V-Ω -RPM	250VoltsAC/DC
① Ohm(resistance)	V-Ω -RPM	250VoltsAC DC
Diode		
AC/DC μ A mA	μ A / mA	400mAAC/DC
AC/DC20A	20A	*20AAC/DC
RPM	V-Ω -RPM	250Volts AC/DC
Duty Cycle(%)		
Dwell angle		

* 20 Amp measurement for 30 seconds maximum.

① Ohms can not be measured if voltage is present, ohms can be measured only in a non-powered circuit. However, the meter is protected to 250 volts.

Meter Basics

1. Digital and Analog display

Display features:

- Four character digital display
- Symbols to identify function
- Analog bar graph

The digital display is best for stable input. The bar graph is best for rapidly changing input.

2. Function buttons

Press the button to select a function. A symbol will display to verify your choice.

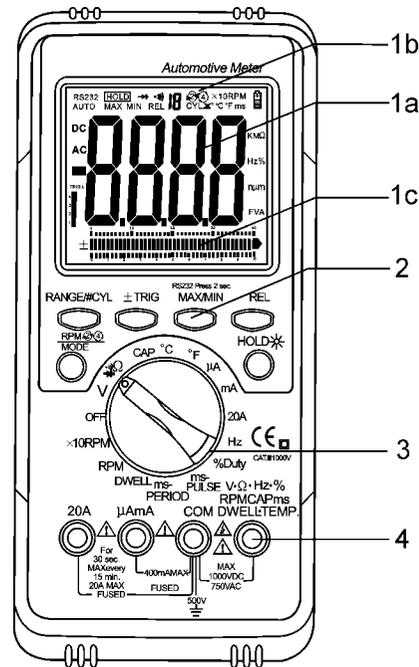
3. Rotary Selector Switch

Turn this switch to select a function or turn the meter OFF.

4. Volts Terminal

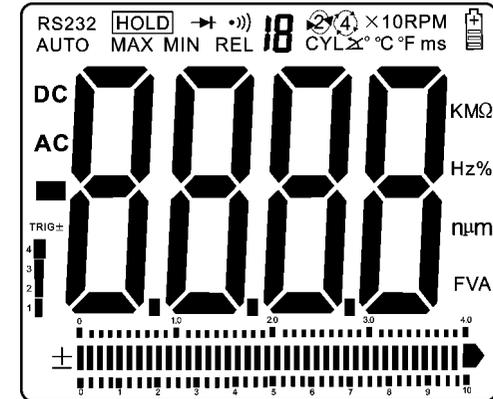
The Red test lead is used to measure Amps, Volts, Ohms, TEMP, Hz, RPM, Cap, mS and Dwell.

The Black test lead is used in the Common(COM) terminal for all tests



Meter Basics Cont'd...

Digital and Analog display



AC DC

Press the Mode button to select Alternating Current (AC) or Direct Current (DC)

HOLD

Press Hold to hold data display or resume testing.



RPM (Tach)



Negative Polarity Indicator



Continuity Test



When Dwell (# of cylinders) is selected with the rotary switch.



Low Battery Replace the master battery when this symbol displays.



Analog bar Graph display with polarity.

Units of measure:

Kilo (k=1,000)

Hertz (Hz)

Milli (M=1/1000,)

Volts (V)

mega(m=1,000,000)

ohms (Ω)

dwell degrees

duty percent (%)

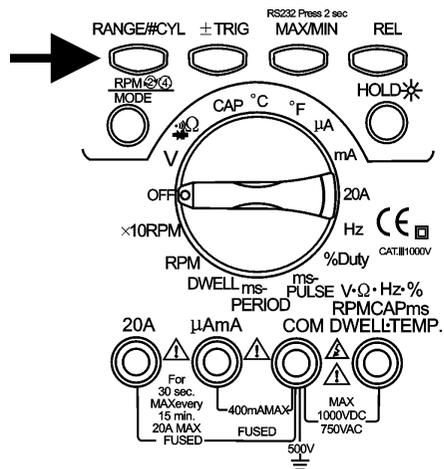
Meter Basics Cont'd ...

Function and Range Select

Turn the rotary switch in either direction to select a function.

Most functions also have ranges. Always select a range higher than you expect the current or voltage to be. Then select a lower range if better accuracy is needed.

- If the range is too high, the readings are less accurate.
- If the range is too low, the meter shows $\square L$ (over limit).



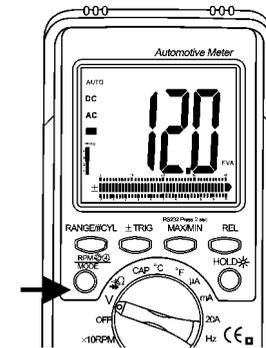
Push-button Functions

Mode Button

Press the Mode button to toggle between DC and AC in the voltage & current measurements.

Range / # CYL Select

The range is automatically selected by the meter. You can also manually select a range or DWELL (#CYL) range within a function by pressing the **RANGE** button.

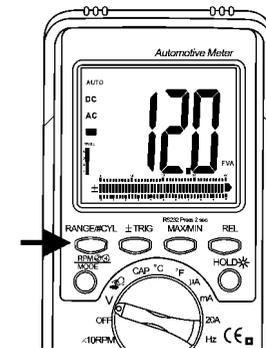


Range Exit

To exit the **RANGE** mode and return to autoranging, press and hold the **RANGE** button for 2 seconds.

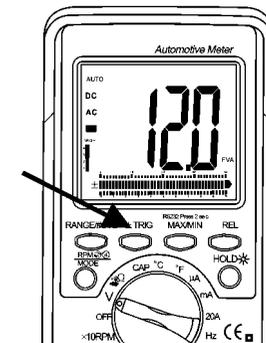
Note:

- If the range is too high, the readings are less accurate.
- If the range is too low, the meter shows OL (over limit).



± TRIG

Toggles between a Negative (-) and Positive (+) Trigger Slope when the Meter is in the ms-pulse, %duty cycle mode, press this button down for 2 seconds to toggle between a negative(-) and positive (+) trigger slope.



The change in the trigger slope is indicated by a + or – shown at the lower left corner of the display.

The Meter defaults to a – trigger slope whenever the Meter is in the Hz, %duty, ms-pulse, ms-period, dwell & RPM.

Once the trigger slope is selected, press this button repeatedly to adjust trigger level if the meter reading is too high or unstable

The Trigger Level has five steps and is different for each function combination.

Press this TRIG button to move one step at a time in order to select a suitable trigger level.

The trigger level is indicated by the number above the “trig” symbol at the lower left corner of the LCD.

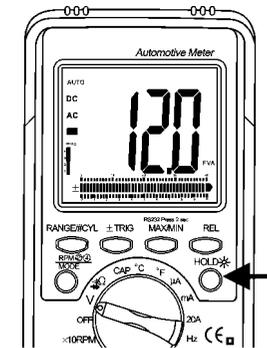
The number of steps on the LCD is also a good indication of the trigger level.

Function Step	Trigger Level
	RPM, ms-Pulse,ms-Period,Dwell, %Duty,HZ
4	+7.2v
3	+4.1V
2	+2.1 V
1	+0.8 V

Data Hold/ Backlight

The Data Hold Feature stores the last reading in memory.

- Press the **Data Hold** button once to hold the present reading.
- Press the **Data Hold** button again to exit and resume normal readings.
- Press the **Data Hold** button for one second to turn the backlight on and press the button a second time to turn the backlight off.

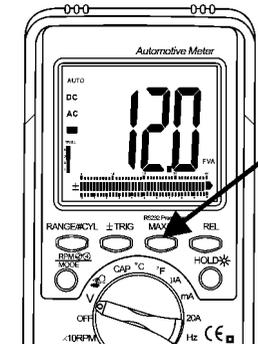


MAX/ MIN /RS232

Press MAX/MIN to enter, MAX MIN recording mode. MAX/MIN function is operative in **manual range only!**

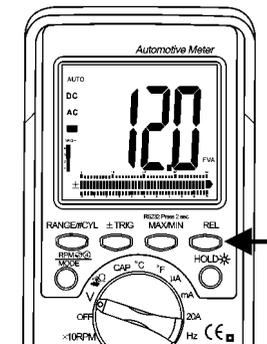
Select the proper range before activating MAX MIN to ensure that the MZX/MIN reading will not exceed the testing range. Press once to select MAX Press again to select MIN and press again release MAX/MIN recording function.

Press this button down for 2 seconds to select RS232 PC interface mode.



Relative Mode

The relative measurement feature allows you to make measurements relative to a stored reference value. A reference voltage, current, etc. can be stored and measurements made in comparison to that value.



The displayed value is the difference between the reference value and the measured value.

1. Perform the measurement as described in the operating instructions.
2. Press the REL button to store the reading in the display and the "REL" indicator will appear on the display.
3. The display will now indicate the difference between the stored value and the measured value.
4. Press the REL button to exit the relative mode.

Meter Functions - Voltage (V)

- ⇒ The meter will automatically select the best voltage (V) range.
- ⇒ Select DCV or ACV with the **MODE** button.

Insert:

- Black lead in **COM** terminal.
- Red lead in **V-Ω -PRM** terminal

Touch the Black probe to ground or to the negative (-) circuit

Touch the Red probe to the circuit coming from the power source

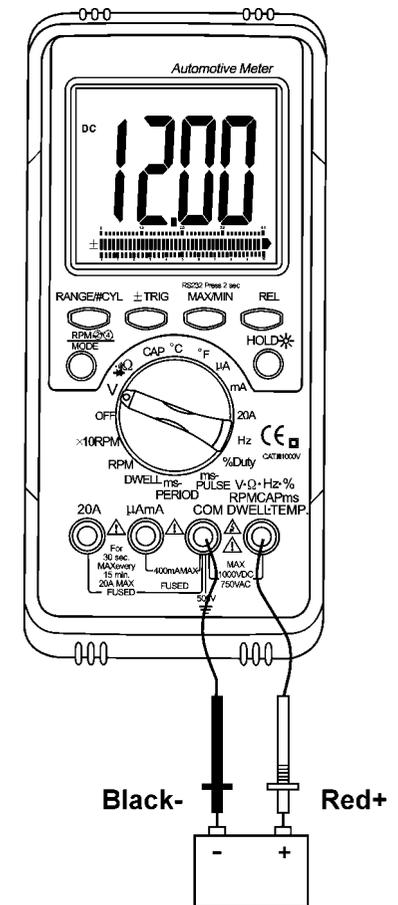
IMPORTANT: Voltage must be measured in parallel (Red probe measuring circuit from power source).

⇒ Accuracy

Selection of a lower range will move the decimal point one place and increase the accuracy. An "OL" display means the range is too low. Select the next higher range.

⇒ Analog Bar Graph

The Bar Graph is easiest to read when the data causes the digital display to rapidly change. It is also useful for trend setting or directional data.



⚠ 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 meter damaged.

Meter Functions – Resistance (Ω)

IMPORTANT: If you are testing an application that has capacitors in the circuit, be sure to turn the power OFF on the test circuit and discharge all capacitors. Accurate measurement is not possible if external or residual voltage is present.

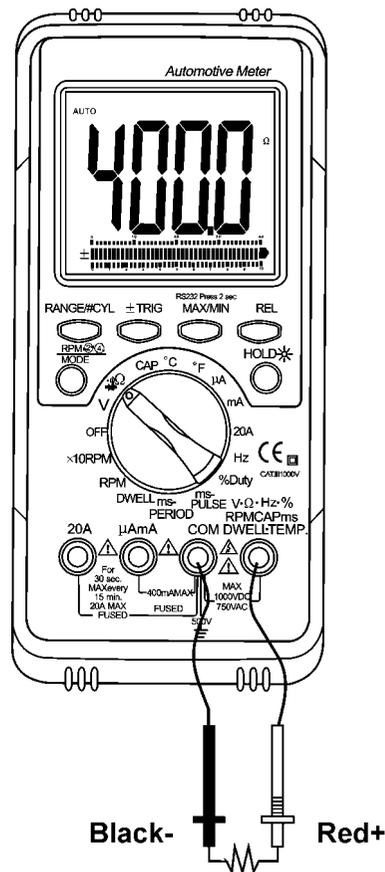
⇒ Select the **resistance (Ω)** range with the rotary switch.

⇒ Select the **resistance (Ω)** range with the button labeled “RANGE”, if more accurate measurement is desired.

Insert:

- Black lead in **COM** terminal.
- Red lead in **V- Ω -RPM** terminal.

Touch the test lead probes across the resistor to be tested.



Meter Functions – Diode Check (\blacktriangleright)

IMPORTANT: Turn the power OFF to the test circuit

Select the **Diode Check (\blacktriangleright)** function with the rotary switch.

Insert:

Black lead in **COM** terminal.
Red lead in **V- Ω -RPM** terminal.

Touch the Black test probe to the negative (-) side of the diode.

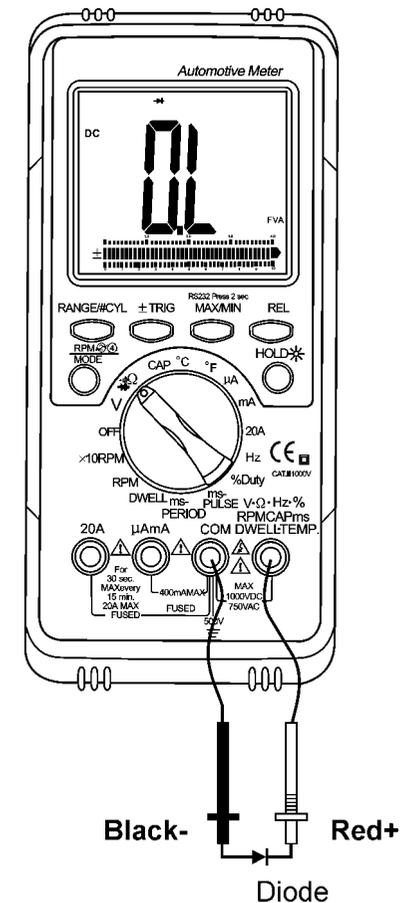
Touch the Red test probe to the positive (+) side of the diode.
Reverse the probes: Black to the positive (+) side and Red to the negative (-) side.

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 1.0 to 3.0 V. in both directions

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



Meter Functions –Audible Continuity (••••)

IMPORTANT: Turn the power OFF on the test circuit

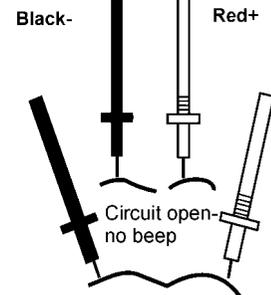
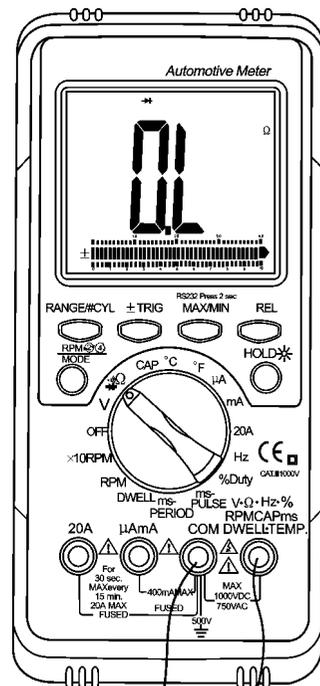
⇒ Select the **Audible Continuity** (••••) function with the rotary switch and mode button

Insert:

- Black lead in **COM** terminal.
- Red lead in **V- Ω -RPM** terminal.

Connect one test probe to each end of the circuit to be tested.

- Circuit complete, the meter will beep continuously.
- Circuit open, there is no beep and the display shows to OL (over limit).



Circuit complete - beep sounds

Meter Functions –AC or DC Current (A)

IMPORTANT: All current measured flows through the meter.

It is important that you do not:

- Measure current greater than 600 Volts AC or DC, with respect to ground.
- Do Not Exceed 30 seconds when measuring continuous current between 1A-20A. Allow five minutes for cool down before continuing.

⇒ Select the **20A., mA or μA** range with the rotary switch.

⇒ Press the **Mode** button to select **AC or DC**.

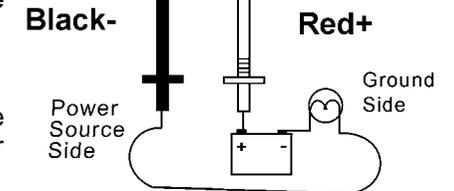
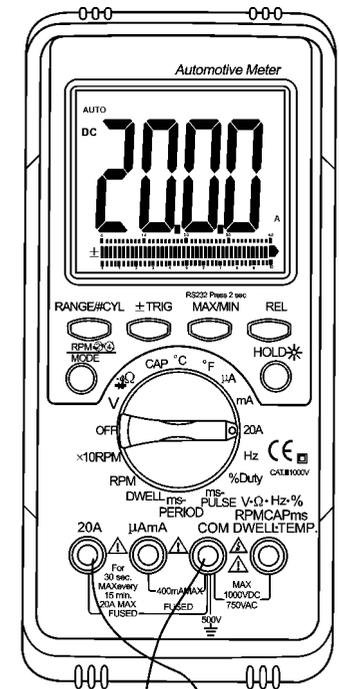
Insert:

- Black lead in **COM** terminal.
- Red lead in the **20A or mA** terminal (select 20A if you are unsure of the current draw).

IMPORTANT: Turn OFF all power to the circuit or disconnect the circuit from the power source.

Connect:

- The Red probe to the side of the circuit closest to the power source.
- The Black probe to the side of the circuit to ground.
- Turn the power ON and test.



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

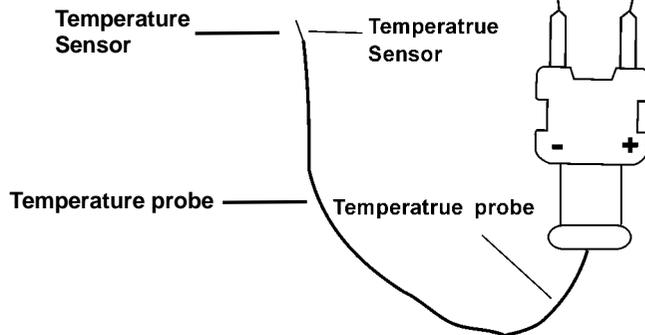
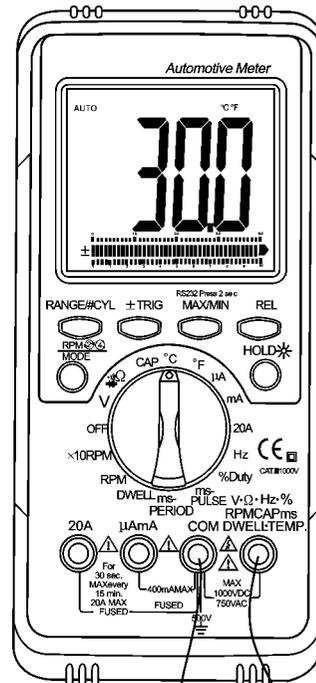
Meter Functions –Temperature (°C/ °F)

IMPORTANT: To avoid heat damage to the meter, keep it away from sources of very high temperature. The life of the Temperature Probe is also reduced when subjected to very high temperatures. Probe operating range is -4° to $1,400^{\circ}$ F.

⇒ Select the **Temperature** ($^{\circ}$ C / $^{\circ}$ F) function with the rotary switch.

⇒ Insert the temperature probe connector into the K-type thermocouple socket.

Touch the end of the temperature sensor to the area or surface of the object to be measured.



Meter Functions –Frequency(Hz)

⇒ Select the **Frequency (Freq)** setting with the rotary switch.

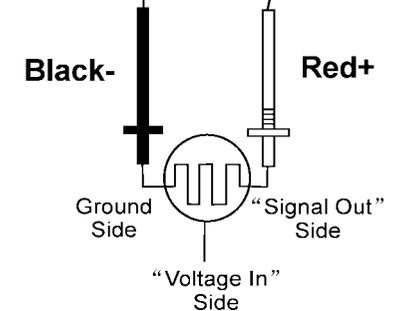
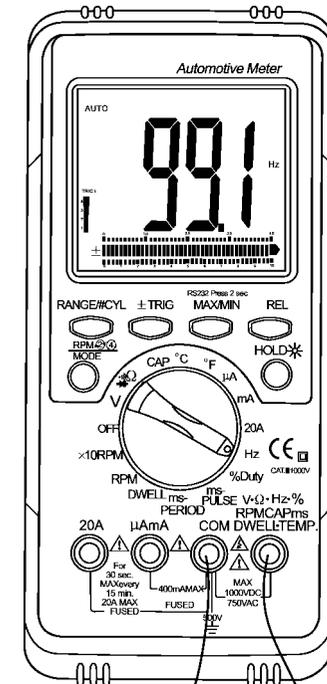
⇒ Adjust the trigger level to the setting that gives the most stable and accurate reading.

Insert:

- Black lead in **COM** terminal.
- Red lead in **V-Ω-RPM** terminal.

Connect the Black test probe to ground.

Connect the Red test probe to the “signal out” wire of the sensor to be tested.



Meter Functions-Dwell (Δ°)

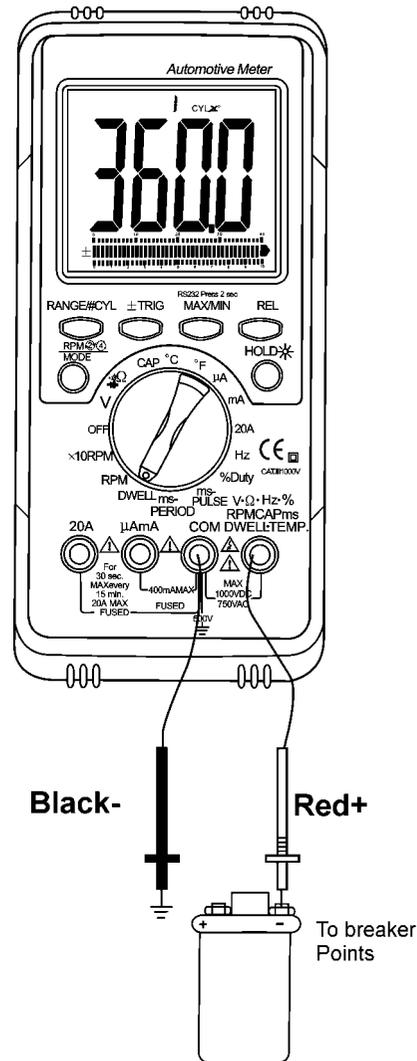
⇒ Select the proper **Dwell** range with the rotary switch.

Insert:

- Black lead in **COM** terminal.
- Red lead in **V- Ω -RPM** terminal.

Connect the Black test probe to ground.

Connect the Red test probe to the wire that connects to the breaker points (see illustration).



Meter Functions-Duty Cycle (%)

⇒ Select the % **Duty Cycle** range with the rotary switch.

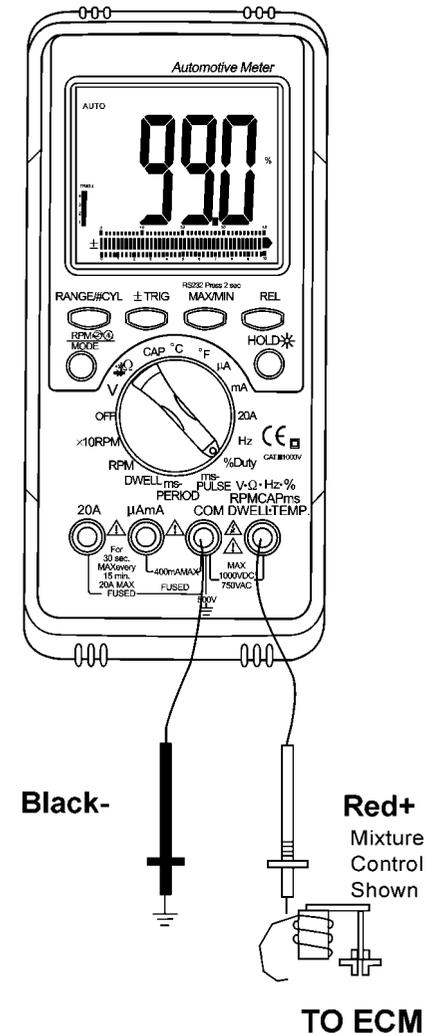
Insert:

- Black lead in **COM** terminal.
- Red lead in **V- Ω -RPM** terminal.

Connect the Black test probe to ground.

Connect the Red test probe to the signal wire circuit.

The illustration for a mixture control solenoid is shown with the metering rod in the closed position. The meter will display the percentage of time the plunger is in the closed position. (low duty cycle) during one duty cycle.

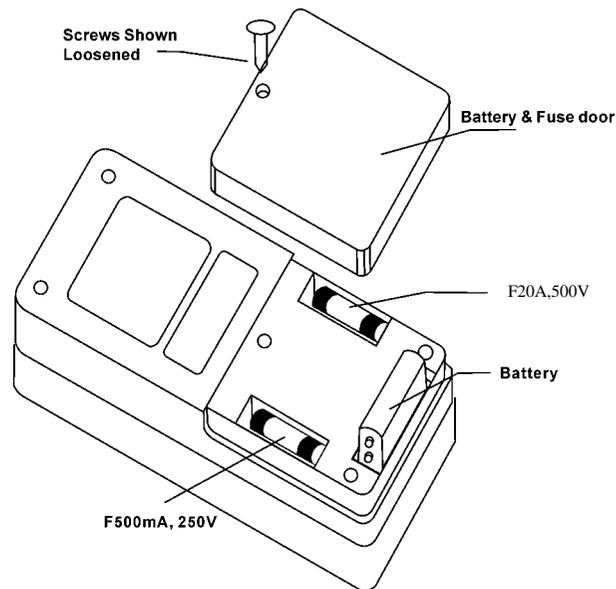


Replacing The Fuses

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

1. Disconnect the test leads from the meter and any item under test.
2. Open the fuse door by loosening the screw on the door 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 fast blow for the 400mA range, 20A/500V 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, do not operate your meter until the fuse door is in place and fastened securely



Trouble Shooting

1. Meter will not turn ON.

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

2. Ampere reading is erratic or there is no reading at all.

- Disassemble the meter back cover and test the fuses for continuity.

3. Meter reading is erratic.

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

4. Meter readings do not change.

- "Hold" feature is still toggled ON.

General Specifications

General Specifications

- **Safety:** Designed to Protection Class III requirement of EN61010-1 over-voltage Category III (CATIII).
- **Maximum Voltage:** 500V rms. (Between any terminal and earth ground)
- **RS232:** Optically isolated PC interface-optional RS-232 cable windows® 95/98/2000/XP compatible software allows user to collect, display, plot and save data.
- **Display:** 4 3/4 digit (4000 counts) liquid crystal display (LCD), with function and units sign annunciators.
- **Analog Bar Graph:** 40 segments with measurements 15 times per second.
- **Polarity:** Automatic, (-) negative polarity indication.
- **Ovrange Indication:** "OL" mark indication.
- **Low Battery Indication:** The  is displayed when the battery voltage drops below the operating level.
- **Auto power off:** Meter automatically shuts down after approx. 30 minutes of inactivity.
- **Measurement Rate:** 2 times per second, nominal.
- **Operating Environment:** 0°C to 50°C (32 °F to 122 °F) at<70% R.H.
- **Storage Environment:** -20°C to 60°C (-4° F to 140°) at<80% R.H.
- **Temperature Coefficient:** 0.2×(specified accuracy)/ °C (< 18°C or > 28°C) .
- **Power:** Single standard 9 Volt battery (NEDA 1604 or IEC 6F22).
- **Battery Life:** 200 hours typical with alkaline battery.
- **Fuse:** 20A/500V, φ 10.3×38mm fast acting ceramic type. 0.5A/250V,φ 5×20mm fast acting ceramic type.
- **Dimensions:** 197 (H) x 88.4 (W) x 41.2 (D) mm
- **Weight: Approx.:** 635g including holster.

Electrical Specifications

Electrical Specifications

*Accuracy is given as±[(% of reading)+[number of least significant digits]] at 18°C to 28°C(65° F to 83° F), with relative humidity up to 70%.

RPM (Tach)

Range		Resolution	Accuracy
RPM 4	600~4000 RPM	1 RPM	±2 % of rdg ± 4 dgts
	600~12000 RPM (X10 RPM)	10 RPM	
RPM2/DIS	300~4000 RPM	1 RPM	
	300~6000 RPM (X10 RPM)	10 RPM	

Effect Reading: >600 RPM

Overload protection: 250V dc or ac rms.

Dwell Angle

Cylinder	Range	Resolution	Accuracy
1CYL	0~360.0°	0.1°	±2.0% of rdg ± 4 dgts
2CYL	0~180.0°		
3CYL	0~120.0°		
4CYL	0~90.0°		
5CYL	0~72.0°		
6CYL	0~60.0°		
8CYL	0~45.0°		
10CYL	0~36.0°		
12CYL	0~30.0°		

Overload protection: 250V dc or ac rms.

DC Voltage (Auto-ranging for uA and mA)

Range	Resolution	Accuracy
400.0mV	0.1mV	$\pm 0.5\%$ of rdg ± 2 dgts
4.000V	1mV	$\pm 1.5\%$ of rdg ± 2 dgts
40.00V	10mV	
400.0V	100mV	
1000V	1V	$\pm 1.8\%$ of rdg ± 2 dgts

Input Impedance: 10M Ω .

Maximum Input: 1000V dc or 750V ac rms.

AC Voltage (Auto-ranging except 400mV)

Range	Resolution	Accuracy
400.0mV	0.1mV	$\pm 1.5\%$ of rdg ± 60 dgts
4.000V	1mV	$\pm 1.0\%$ of rdg ± 3 dgts
40.00V	10mV	$\pm 1.5\%$ of rdg ± 3 dgts
400.0V	100mV	
750V	1V	$\pm 2.0\%$ of rdg ± 4 dgts

Input Impedance: 10M Ω

Frequency Range: 50 to 400Hz

Maximum Input: 1000V dc or 750V ac rms.

DC Current (Auto-ranging for uA and mA)

Range	Resolution	Accuracy
400.0uA	0.1uA	$\pm 1.0\%$ of rdg ± 3 dgts
4000uA	1uA	$\pm 1.5\%$ of rdg ± 3 dgts
40.00mA	10uA	
400.0mA	100uA	

4A	1mA	$\pm 2.5\%$ of rdg ± 5 dgts
20A	10mA	

Overload Protection: 0.5A / 250V and 20A / 500V Fuse.

Maximum Input: 400mA dc or 400mA ac rms on uA / mA ranges,
20A dc or ac rms on 20A range.

AC Current (Auto-ranging)

Range	Resolution	Accuracy
400.0uA	0.1uA	$\pm 1.5\%$ of rdg ± 5 dgts
4000uA	1uA	$\pm 1.8\%$ of rdg ± 5 dgts
40.00mA	10uA	
400.0mA	100uA	
4A	1mA	$\pm 3.0\%$ of rdg ± 7 dgts
20A	10mA	

Overload Protection: 0.5A / 250V and 20A / 500V Fuse.

Frequency Range: 50 to 400 Hz

Maximum Input: 400mA dc or 400mA ac rms on uA / mA ranges,
20A dc or ac rms on 20A range.

Resistance (Auto-ranging)-

Range	Resolution	Accuracy
400.0 Ω	0.1 Ω	$\pm 1.2\%$ of rdg ± 4 dgts
4.000k Ω	1 Ω	$\pm 1.0\%$ of rdg ± 2 dgts
40.00k Ω	10 Ω	$\pm 1.2\%$ of rdg ± 2 dgts
400.0k Ω	100 Ω	
4.000M Ω	1k Ω	$\pm 2.0\%$ of rdg ± 3 dgts
40.00M Ω	10k Ω	

Input Protection: 250V dc or 250V ac rms.

Capacitance (Auto-ranging)

Range	Resolution	Accuracy
40.00nF	10pF	$\pm 5.0\%$ of rdg ± 7 dgts
400.0nF	0.1nF	

4.000uF	1nF	±3.0% of rdg ± 5 dgts
40.00uF	10nF	
100.0uF	0.1uF	±5.0% of rdg ± 5 dgts

Input Protection: 250V dc or 250V ac rms.

Frequency (Auto-ranging)

Range	Resolution	Accuracy
5Hz	0.001Hz	±1.5% of rdg ± 5 dgts
50Hz	0.01Hz	
500Hz	0.1Hz	±1.2% of rdg ± 3 dgts
5kHz	1Hz	
30.00kHz	10Hz	

Sensitivity: >5V RMS MIN.

Overload protection: 250V dc or ac rms.

Duty Cycle

Range	Resolution	Accuracy
0.1%~99.9%	0.1%	±1.2% of rdg ± 4 dgts

Pulse width: >100us, <100ms; (Continued next page)

Sensitivity: <0.5V RMS

Overload protection: 250V dc or ac rms.

Period

Range	Resolution	Accuracy
2.0~ 20.0ms	0.1ms	±3% of rdg ± 10 dgts

Overload protection: 250V dc or ac rms.

Pulse Width

Range	Resolution	Accuracy
2.0~ 10.0ms	0.1ms	±3% of rdg ±10 dgts

Overload protection: 250V dc or ac rms

Temperature

Range	Resolution	Accuracy
-20°C~+760°C	1 °C	±3% of rdg ±5dgts(Meter only, probe accuracy not included)
-4 °F~+1400 °F	1°F	

Sensor: Type K Thermocouple

Diode Test

Test current	Resolution	Accuracy
0.3mA typical	1 mV	±10% of rdg ± 5 dgts

Open circuit voltage: 1.5V dc typical

Overload protection: 250V dc or ac rms.

Audible continuity

Audible threshold: Less than 150Ω Test current: <0.3mA

Overload protection: 250V dc or ac rms.

Ready – to – Use Windows® Application Program

Hardware and Software Requirements

386/25 personal computer, 4 Megabytes of memory or better. windows® 95 or above.

RS232: Optically isolated PC interface-optional RS-232 cable windows® 95/98/2000/XP compatible software allows user to collect, display, plot and save data.

Printing Data and Graph tester report

- Print data tester report
- Please press off line
- Move the cursor to the number of data that you want to print out. (e.g.: If you want to print the data area from number 0 to 100, move the cursor to number 0 and click. If you want to print the data area from number 50 to 100, move the cursor to number 50 and click).
- Please press printer icon.
- A information show: List "Y" or "N" - press "Y".
- The data tester report will print out the selected data sets.

Print graph tester report

- Please press off line
- Move the cursor to the number of data that you want to print out. (e.g.: If you want to print the graph area from number 0 to 100, move the cursor to number 0 and click. If you want to print the graph area from number 50 to 100, move the cursor to number 50 and click).
- Please press printer icon.
- A information show: List "Y" or "N" - press "N". A information show Graph "Y" or "N" press "Y".
- The graph tester report will print out the selected graph sets.

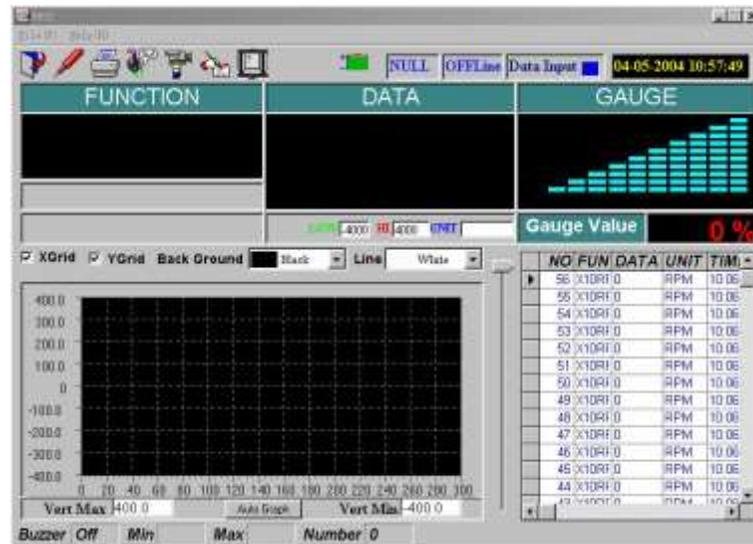
Installation of the Windows Application program

- A. Start Microsoft ® Windows®
- B. Insert disk in drive CD
- C. From the program Manager, select file menu and choose Run
- D. For Win98 from the start, select Execute.
- E. Type E :\setup and press Enter Key

Note: If you are using 386 PC, it might takes more than 3 minutes.

Description of Windows® Application Program

When the ICON “Panel” is selected and executed,the program automatically search for connected DMM/Data Logger or available serial port. If no serial port is available, then a message of “:No Com:” shall be displayed, and the program exits itself. Once communication port is setup, a main window will be displayed on the screen. The Layout of the window is as Figure:



Note: Please click “Help” on the PC interface for detailed instruction.