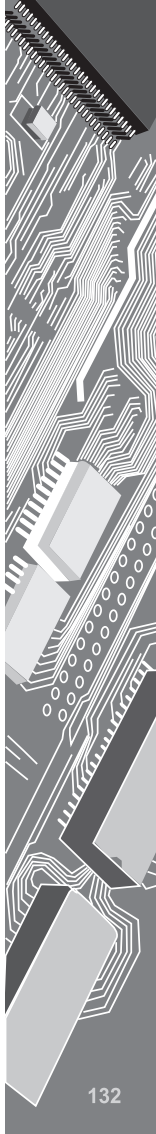


DIGITAL AUTOMOTIVE MULTIMETER

INSTRUCTION MANUAL

Read this owners manual thoroughly before use



WARRANTY

This instrument is warranted to be free from defects in material and workmanship for a period of one year. Any instrument found defective within one year from the delivery date and returned to the factory with transportation charges prepaid, will be repaired, adjusted, or replaced at no charge to the original purchaser. This warranty does not cover expandable items such as battery or fuse. If the defect has been caused by a misuse or abnormal operating conditions, the repair will be billed at a nominal cost.

INTRODUCTION

This meter is a compact 3 3/4-digit digital automotive multimeter. In addition to the features of a normal multimeter, it can also be used to measure RPM, dwell angle, duty cycle, internal resistance of vehicle battery, temperature ($^{\circ}\text{C}/^{\circ}\text{F}$), and etc. It is a useful and ideal measurement tool for automotive repair and service.

It can be used to measure :

1. RPM of engine
2. Dwell angle
3. Internal resistance of vehicle battery
4. Duty cycle
5. DC and AC voltage
6. DC and AC current
7. Resistance
8. Frequency
9. Diode
10. Continuity
11. Temperature ($^{\circ}\text{C}/^{\circ}\text{F}$)

SAFETY INFORMATION


This meter has been designed according to IEC-61010 concerning electronic measuring instruments with a measurement category (CAT II 600V) and pollution degree 2.

Warning

To avoid possible electric shock or personal injury, follow these guidelines:

- a. Do not use the meter if it is damaged. Before you use the meter, inspect the case. Pay particular attention to the insulation surrounding the connectors.
- b. Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before you use the meter.
- c. Do not use the meter if it operates abnormally. Protection may be impaired. When in doubt, have the meter serviced.
- d. Do not operate the meter around explosive gas, vapor, or dust.
- e. Do not apply more than the rated voltage, as marked on the meter, between terminals or between any terminal and earth ground.
- f. Before use, verify the meter's operation by measuring a known voltage.
- g. When measuring current, turn off circuit power before connecting the meter in the circuit. Remember to place the meter in series with the circuit.
- h. When servicing the meter, use only specified replacement parts.
- i. Use caution when working above 30V ac rms, 42V peak, or 60V dc. Such voltages pose a shock hazard.
- j. When using the probes, keep your fingers behind the finger guards on the probes.
- k. When making connections, connect the common test lead before you

connect the live test lead. When you disconnect test leads, disconnect the live test lead first.

- l. Remove the test leads from the meter before you open the battery cover or the case.
- m. Do not operate the meter with the battery cover or portions of the case removed or loosened.
- n. To avoid false readings, which could lead to possible electric shock or personal injury, replace the batteries as soon as the low battery indicator ("  ") appears.
- o. When in Relative Mode or in MIN mode, the symbol "REL" or "MIN" is displayed. Caution must be used because hazardous voltage may be present.
- p. To avoid electric shock, do not touch any naked conductor with your hand or skin, do not ground yourself while using the meter.
- q. Comply with local and national safety requirements when you work in hazardous locations.

Use correct protective equipment, as required by local or national authorities when you work in hazardous areas.

- r. Do not work alone.
- s. Do not measure a battery's internal resistance if the battery's voltage exceeds 36V.
- t. Remaining endangerment:
When an input terminal is connected to dangerous live potential it is to be noted that this potential at all other terminals can occur!
- u. CATII - Measurement Category II is for measurements performed on circuits directly connected to low voltage installation. (Examples are measurements on household appliances, portable tools and similar equipments.) Do not use the meter for measurements within Measurement Categories III and IV.

Caution

To avoid possible damage to the meter or to the equipment under test, follow these guidelines:

- a. Disconnect circuit power and discharge all capacitors before testing resistance, diode, continuity and temperature.
- b. Use the proper terminals, function and range for your measurements.
- c. Before measuring current, check the meter's fuse and turn off the power to the circuit before connecting the meter to the circuit.
- d. Before rotating the range switch to change functions, disconnect test leads from the circuit under test.
- e. Remove test leads from the meter before opening the meter case or the battery cover.

Symbols

- ~ AC (Alternating Current)
- ≡ DC (Direct Current)
- ≈ DC or AC
- ⚠ Important safety information. Refer to the manual.
- ⚡ Dangerous voltage may be present. Be cautious.
- ⊥ Earth ground
- ⊞ Fuse
- CE Conforms to European Union directives
- Double insulated
- 🔋 Low battery
- Diode

INSTRUCTION

Function/Range Switch

Turn on the meter by selecting a measurement function. The meter provides a standard display for the function (range, measurement units, etc.). Use the relevant buttons to select other functions, such as Data Hold, range selection, Relative mode and so on.

For more detailed information about the function/range switch, see Figure 1 and Table 1.

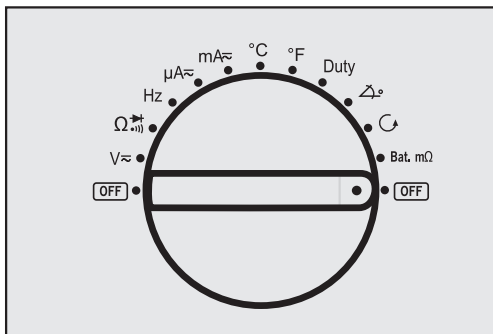


Figure 1

Function/Range Switch Instruction

Table 1

Switch Position	Measurement Function
V_{\approx}	AC voltage from 0V to 600V. DC voltage from 0V to 600V.
Ω	Ohms from 0Ω to $40M\Omega$.
$\rightarrow $	Diode test. Displays "0L" above 2V.
$\bullet)$	Continuity test. Buzzer turns on at $<30\Omega$ and turns off at $>50\Omega$.
Hz	Frequency from 1Hz to 400kHz
μA_{\approx}	AC or DC μA from $0\mu A$ to $4000\mu A$
mA_{\approx}	AC or DC mA from 0mA to 400mA.
Duty	Duty cycle from 5% to 95%
Bat. $m\Omega$	Battery internal resistance from $0m\Omega$ to $4000m\Omega$.
$^{\circ}C$	Fahrenheit temperature from $-20^{\circ}C$ to $1000^{\circ}C$.
$^{\circ}F$	Celsius degree from $-4^{\circ}F$ to $1832^{\circ}F$.
Δ°	Dwell angle
\curvearrowright	RPM measurement from 250RPM to 40kRPM
OFF	Turn off the meter

Input Terminal Instruction

The terminals are indicated in Figure 2, and explained in Table 2.

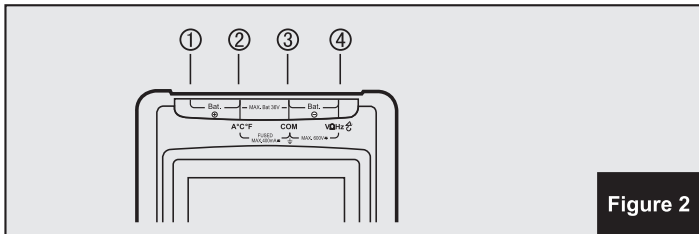


Figure 2

Table 2

Item	Description
①	Positive input terminal for the sampled voltage for battery internal resistance measurements. It must be connected to the positive terminal of the vehicle's battery to be tested.
②	Input terminal for current measurements < 400mA. Positive input terminal for K type thermocouple for temperature measurements. Output terminal of the test current for battery internal resistance measurements, it must be connected to the positive terminal of the vehicle's battery to be tested.
③	Negative input terminal for K type thermocouple for temperature measurements. Input terminal of the test current for battery internal resistance measurements, it must be connected to the negative terminal of the vehicle battery to be tested. Common (return) terminal for the other measurements.
④	Input terminal for voltage, continuity, resistance, diode, frequency RPM and dwell measurements. Negative input terminal for the sampled voltage for battery internal resistance measurements, it must be connected to the negative terminal of the vehicle battery to be tested.

Button Instruction

The meter's buttons are shown in Figure 3 and described in Table 3.

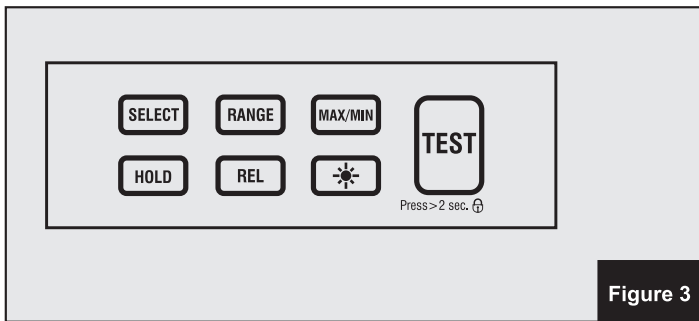


Figure 3

Table 3








Button	Description
	In voltage or current measurements, you can press this button to select ac or dc function. When the rotary switch is in Ω position, you can press this button to select resistance, diode or continuity measurement. In RPM or dwell angle measurements, you can press this button to select cylinder number of the engine.
	Changes the meter from autorange mode (default) to manual range mode. Press and hold to return to autorange mode.

Table 3 (Continued)

	<p>Press the button, the display shows the symbol "MAX" and the maximum reading. Press the button again, the display shows the symbol "MIN" and the minimum reading. Press the button once more, the display shows the flickering "MAX" and "MIN" along with the present reading. Press and hold down for more than 1 second to exit the MAX MIN mode, the display shows the present reading.</p>
	<p>Press to freeze the present reading, the meter stays in Data Hold mode. Press again to release the display. In MIN, MAX or REL mode, this button functions normally. In Data Hold mode, the "REL" and "MAX/MIN" buttons are disabled.</p>
	<p>Turns the backlight on and off. The backlight goes off automatically about 1 minute later.</p>
	<p>When the rotary switch is in Bat.mΩ position, you can press this button to start or stop measuring vehicle's battery internal resistance. Pressing this button momentarily to start the measurement causes the meter to output a test signal for about 60 seconds to measure the vehicle's battery internal resistance. Pressing and holding this button for more than 2 seconds to start the measurement causes the meter to output a continuous test signal to measure the battery internal resistance, the measurement is locked and doesn't stop until you press this button again.</p>
	<p>Press momentarily to enter the Relative mode and store the present reading as a reference for subsequent measurements, "REL" appears on the display, the display reads zero. Press this button again, "REL" flickers, and the display shows the reference. Press and hold down this button for more than 1 second to exit the Relative mode.</p>

LCD Display

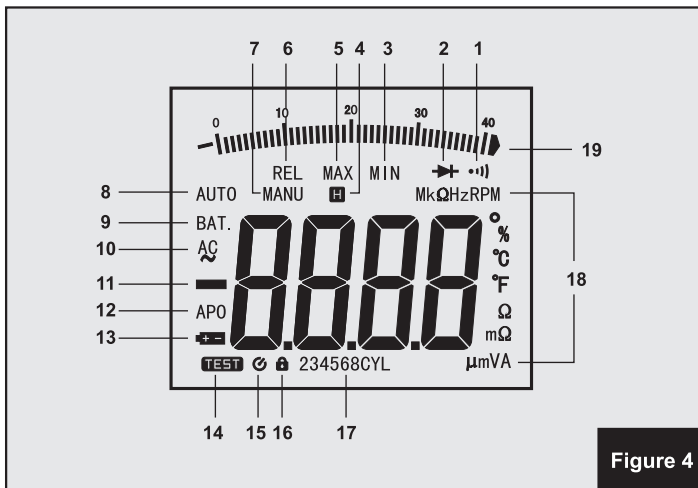








Figure 4

Table 4

Indicator	Description
1	•)
2	▶
3	MIN
4	☐
5	MAX

Table 4 (Continued)

	Indicator	Description
6	REL	Relative mode is active.
7	MANU	Manual range mode is selected.
8	AUTO	Autorange mode is selected
9	BAT.	The rotary switch is in Bat.mΩ range position.
10		AC
11		Negative sign
12	APO	Automatic power-off is enabled.
13		<p>The batteries in the battery compartment are low and should be replaced immediately.</p> <p>Warning To avoid false readings, which could lead to possible electric shock or personal injury, replace the batteries as soon as this low battery indicator appears.</p>
14		Battery internal resistance test indicator. It appears when battery internal resistance test is enabled.
15		Battery internal resistance test is in Fixed Time Test mode.
16		Battery internal resistance test is locked so that you can perform the test continuously as long as as you like.
17	234568 CYL	Number of cylinders of the engine to be tested

18. Units on the LCD

Table 5

mV、V	Voltage unit mV: Millivolt ; V: Volt; $1V=10^3mV$
μA 、mA、A	Current unit μA : Microamp; mA: Milliamp; A: Ampere; $1A=10^3mA=10^6\mu A$
m Ω 、 Ω 、k Ω 、M Ω	Resistance unit m Ω : Milliohm; Ω : Ohm; k Ω : Kilohm; M Ω : Megohm; $1M\Omega=10^3k\Omega=10^6\Omega=10^9m\Omega$
Hz、kHz、MHz	Frequency unit Hz: Hertz; kHz: Kilohertz; MHz: Megahertz; $1MHz=10^3kHz=10^6Hz$
RPM	Rotation speed unit RPM: Revolutions per minute
$^{\circ}C$ 、 $^{\circ}F$	Temperature unit $^{\circ}C$: Celsius degree; $^{\circ}F$: Fahrenheit degree;
\bullet	Unit of dwell angle \bullet : Degree
%	Unit of duty cycle %: Percent

18. Analog Bar Graph

The length of its lit segments is proportional to the present reading on the LCD. The bar graph is like the needle on an analog meter. It has an overload indicator ("OL") on its right and a negative polarity indicator ("—") on its left. Because the bar graph updates 10 times faster than the digital display, the bar graph is useful for making peak and null adjustments and for observing rapidly changing inputs.

The number of lit segments indicates the measured value and is relative to the full-scale value of the selected range. In the 400V range, for example, the major divisions on the scale represent 0V, 100V, 200V, 300V and 400V. An input of -100V lights the negative sign and the segments up to the "10" on the scale.

GENGRAL SPECIFICATION

Maximum Voltage between

any Terminal and Earth Ground: 600V DC or AC rms

Fuse Protection for "A°C°F" Jack Inputs: 500mA, 690V, FAST,
Min. Interrupt Rating 20000A

Display: 3 3/4-digit LCD, with a max. reading of 3999

Overrange Indication: " OL " shown on the LCD.

Negative Polarity Indication: " — " displayed automatically

Sampling Rate: About 2~3 times/sec

Operating Temperature: 0°C~40°C, <75%RH

Storage Temperature: -20°C~60°C, <85%RH

Operating Altitude: 0 to 2000 meters

Battery: 6 X1.5V, AA or equivalent

Low Battery Indication: "  " shown on the display

Dimensions: 199 X 100 X 54mm

Weight: about 640g (including batteries)

SPECIFICATIONS

Accuracy is specified for a period of one year after calibration and at 18°C to 28°C, with relative humidity < 75%. Accuracy specifications take the form of: \pm ([% of Reading]+[number of Least Significant Digits])

DC Voltage

Range	Resolution	Accuracy
400mV	0.1mV	\pm (1.0% + 5)
4V	0.001V	\pm (0.8% + 3)
40V	0.01V	
400V	0.1V	
600V	1V	\pm (1.0% + 5)

Input Impedance : range 400mV: >1000M Ω
the other ranges: 10M Ω

Overload Protection : 600V DC or AC rms

AC Voltage

Range	Resolution	Accuracy
4V	0.001V	\pm (1.0% + 5)
40V	0.01V	
400V	0.1V	
600V	1V	\pm (1.2% + 5)

Input Impedance : 10M Ω

Frequency Range : 40Hz ~ 400Hz

Overload Protection : 600V DC or AC rms

Response : Average, calibrated in rms of sine wave.

DC Current

Range	Resolution	Accuracy
400 μ A	0. 1 μ A	\pm (1. 2%+5)
4000 μ A	1 μ A	\pm (1. 0%+3)
40mA	0. 01mA	\pm (1. 2%+5)
400mA	0. 1mA	\pm (1. 0%+3)

Max. Permitted Input : 400mA DC/AC rms

Maximum Voltage Drop : 200mV

Overload Protection : Fuse, 500mA/690V, fast action,

AC Current

Range	Resolution	Accuracy
400 μ A	0. 1 μ A	\pm (1. 5%+5)
4000 μ A	1 μ A	\pm (1. 2%+5)
40mA	0. 01mA	\pm (1. 5%+5)
400mA	0. 1mA	\pm (1. 2%+5)

Max. Permitted Input : 400mA DC/AC rms

Frequency Range : 40Hz ~ 400Hz

Response : Average, calibrated in rms of sine wave.

Maximum Voltage Drop : 200mV

Overload Protection : Fuse, 500mA/690V, fast action,

Resistance

Range	Resolution	Accuracy
400 Ω	0.1 Ω	$\pm (1.0\%+5)$
4k Ω	0.001k Ω	$\pm (1.0\%+3)$
40k Ω	0.01k Ω	
400k Ω	0.1k Ω	
4M Ω	0.001M Ω	
40M Ω	0.01M Ω	$\pm (2.0\%+5)$

Open Circuit Voltage : range 400 Ω : about -1.2Vdc

the other ranges : about -0.45Vdc

Overload Protection : 250V DC/AC rms



Frequency

Range	Resolution	Accuracy
4kHz	0.001kHz	$\pm (0.8\%+3)$
40kHz	0.01kHz	
400kHz	0.1kHz	
>400kHz		not specified

Measurement Range: 500mV rms ~ 20V rms

Overload Protection: 250V DC/AC rms

Diode and Continuity

Range	Introduction	Test Condition
	The approx. forward voltage drop of the diode will be displayed.	Open Circuit Voltage : about 3V
	The built-in buzzer will sound if the resistance is less than about 30Ω.	Open Circuit Voltage : about -1.2V

Overload Protection: 250V DC/AC rms

Temperature

Range	Resolution	Accuracy
-20°C ~ 1000°C	1°C	-20°C ~ 0°C : $\pm (6.0\%+5)$
		0°C ~ 400°C : $\pm (1.5\%+5)$
		>400°C : $\pm (1.8\%+5)$
-4°F ~ 1832°F	1°F	-4°F ~ 32°F : $\pm (6.0\%+9)$
		32°F ~ 752°F : $\pm (1.5\%+9)$
		>752°F : $\pm (1.8\%+9)$

Overload Protection : Fuse, 500mA/690V, fast action

- Note :**
1. The above accuracy does not include error of the thermocouple probe.
 2. Accuracy specification assumes ambient temperature stable to $\pm 1^\circ\text{C}$. For ambient temperature changes of $\pm 5^\circ\text{C}$, rated accuracy applies after 1 hour.

Duty Cycle

Range	Resolution	Accuracy
5% ~ 95%	0.1%	$\pm (2.5\%+5)$

Measurement Range : 3Vp ~ 50Vp

Frequency Range : 10Hz ~ 10kHz

Overload Protection : 250V DC/AC rms

Dwell Angle

Number of Cylinders	Range	Resolution	Accuracy
2 cylinders	0 ~ 180°	0.1°	$\pm (2.0\%+5)$
3 cylinders	0 ~ 120°		
4 cylinders	0 ~ 90°		
5 cylinders	0 ~ 72°		
6 cylinders	0 ~ 60°		
8 cylinders	0 ~ 45°		

Measurement Range : 3Vp ~ 50Vp

Rotation Speed of Engine : 250RPM ~ 40kRPM

Overload Protection : 250V DC/AC rms

Tach (rotation speed)

Number of Cylinders	Range	The Highest Resolution	Accuracy
2 cylinders	250RPM ~ 40kRPM	1RPM	$\pm (2.0\%+5)$
3 cylinders			
4 cylinders			
5 cylinders			
6 cylinders			
8 cylinders			

Note: For 4-stroke engine : actual rotation speed = reading ;

For 2-stroke engine : actual rotation speed = 50% of reading ;

Measurement Range: 3Vp ~ 50Vp

Overload Protection: 250V DC/AC rms

Vehicle's Battery Internal Resistance

Range	Resolution	Accuracy	Test Signal
400m Ω	0.1m Ω	$\pm (5\%+10)$	about 1kHz, 50mA
4000m Ω	1m Ω		

Note: 1. Do not attempt to test a battery whose voltage exceeds 36V.

2. The resistance of each test lead (with clip) must be less than 5 Ω .

Overload Protection : Fuse, 500mA/690V, fast action,

OPERATION INTRODUCTION

Using Relative Mode



Selecting relative mode causes the meter to store the present reading as a reference for subsequent measurements.

1. Press the " **REL** " button, the meter enters the Relative mode and stores the present reading as a reference for subsequent measurements, and " REL " appears on the display as an indicator. The display reads zero.
2. When you perform a new measurement, the display shows the difference between the reference and the new measurement.
TIP: Press the " **REL** " button again, " REL " flickers on the display, the display shows the reference. Press the " **REL** " button once more, the meter returns to Relative mode.
3. Press and hold down the " **REL** " button for more than 1 second, the meter exits the Relative mode, " REL " disappears.

Note :

The meter enters manual range when you enter the Relative Mode.

Data Hold Mode

Press the " **HOLD** " button to hold the present reading on the display, "  " appears on the display as an indicator. To exit the Data Hold mode, press the button again, the indicator "  " disappears.

Manual Ranging and Autoranging

The meter defaults to autorange mode in measurement functions which have both autorange mode and manual range mode. When the meter is

in autorange mode, " AUTO " is displayed.

1. To enter the manual range mode, press the " **RANGE** " button, the meter enters the manual range mode, " AUTO " turns off, " MANU " turns on.

Each press of the " **RANGE** " button increases the range. When the highest range is reached, the meter wraps to the lowest range.

2. To exit the manual range mode, press and hold down the " **RANGE** " button for more than 2 seconds, the meter returns to the autorange mode.

MIN MAX Recording Mode

The MIN MAX mode captures and records the minimum and maximum values of all input values since this mode is activated.

In the MIN MAX mode, when the inputs go below the recorded minimum value or above the recorded maximum value, the meter records the new minimum or maximum value.

To use MIN MAX recording :

1. Select the desired function and manual range.
2. Press the "**MAX/MIN**" button to activate the MIN MAX mode and the display shows the maximum reading, meanwhile "MAX" appears on the display as an indicator.
Note: For MIN MAX mode, autoranging is not available.
3. Press the "**MAX/MIN**" button to step through the minimum reading ("MIN" appears), the present reading ("MAX" and "MIN" flicker), and the maximum reading ("MAX" appears), and so on.
4. To exit the MIN MAX mode and erase stored readings, press and hold

down the " **MAX/MIN** " button for more than 1 second, the display shows the present reading.

Measuring Voltage

1. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **VΩHz** $\frac{A}{C}$ " jack.
2. Set the range switch to the **V** \approx range.
Select ac voltage measurement (" \overline{AC} " appears on the display) or dc voltage measurement with the " **SELECT** " button.
3. Select autorange mode or manual range mode with the " **RANGE** " button.
If you use manual range mode and don't know the magnitude of the voltage to be measured beforehand, select the highest range and then reduce it range by range until satisfactory resolution is obtained.
4. Connect the test leads across the load to be measured.
5. Read LCD display. For dc voltage measurement, the polarity of the red lead connection will be indicated as well.

Note :

To avoid electric shock to you or damages to the meter, do not attempt to measure dc voltage higher than 600V or ac voltage higher than 600V rms although readings may be obtained.

Measuring Current

Warning

To avoid personal injury or damage to the meter :



- Never attempt to perform an in-circuit current measurement when the open circuit potential to earth is more than 600V.
- Use the proper terminals, switch position, and range for your measurement.
- Don't use the meter to measure currents exceeding 400mA.
- Never place the probes in parallel with a circuit or component when the test leads are plugged into the current terminals.
- Check the meter's fuse before measuring.

1. Set the range switch to desired " mA \approx " or " μ A \approx " position.
2. Select ac current measurement (" AC " appears on the display) or dc current measurement with the " **SELECT** " button.
3. Select autorange mode or manual range mode with the " **RANGE** " button.
4. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **A°C°F** " jack.
5. Turn off power to the circuit which you will measured.
Discharge all capacitors.
6. Break the circuit path to be measured, connect the test leads in series with the circuit.
7. Turn on power to the circuit, then read the display.
For dc current measurement, the polarity of the red test lead connection will be indicated as well.

Note:

If you don't know the magnitude of the current to be measured beforehand, select the highest range and then reduce it range by range until satisfactory resolution is obtained.




Measuring Resistance

1. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **VΩHz**  " jack. (Note:The polarity of the red lead is positive " + ".)
2. Set the range switch to Ω  range.
3. Connect the test leads across the load to be measured.
4. Read the reading on the display.

Note :

1. For resistance above $1M\Omega$, the meter may take a few seconds to stabilize reading. This is normal for high resistance measurements.
2. When the input is not connected, i.e. at open circuit, "OL" will be displayed as overrange indication.
3. Before measuring in-circuit resistance, make sure that the circuit under test has all power removed and all capacitors are fully discharged.

Continuity Test


1. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **VΩHz**  " jack. (Note:The polarity of the red lead is positive " + ".)
2. Set the range switch to Ω  position, press the " **SELECT** " button until symbol "  " appears on the display.
3. Connect the test leads to the circuit to be measured.
4. If the circuit resistance is less than about 30Ω , the built-in buzzer will sound.

Note:

Before performing in-circuit continuity test, make sure that the circuit under

test has all power removed and all capacitors are fully discharged.




Measuring Frequency

1. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **VΩHz**  " jack.
2. Set the range switch to **Hz** position.
3. Connect the test leads across the source or load to be measured.
4. Read the reading.

Note:

The voltage of the input signal should be between 500mV rms and 20V rms. If the voltage exceeds 20V rms, the accuracy of reading may be out of the specified accuracy range.

Diode

1. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **VΩHz**  " jack. (Note:The polarity of the red lead is positive " + " .)
2. Set the range switch to Ω  position, press the " **SELECT** " button until the symbol "  " appears on the display.
3. Connect the red test lead to the anode of the diode to be tested, and the black test lead to the cathode.
4. The display will show the approximate forward voltage drop of the diode. If the connection is reversed, "OL" will be shown on the display.

Measuring Duty Cycle

1. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **VΩHz** $\frac{\Delta}{\square}$ " jack.
2. Set the range switch to **Duty** position.
3. Connect the test leads across the signal source be measured.
4. Read the reading.

Note:

1. The voltage of input signal must be between 3Vp and 50Vp. If the voltage is too low, it is impossible to perform measurement. If the voltage exceeds 50Vp, the accuracy of the reading may be out of the specified accuracy range.
2. If the frequency of input signal is too low, the reading's stability will decrease.
3. The polarity of the input voltage must be correct, otherwise it will be impossible to perform measurement.

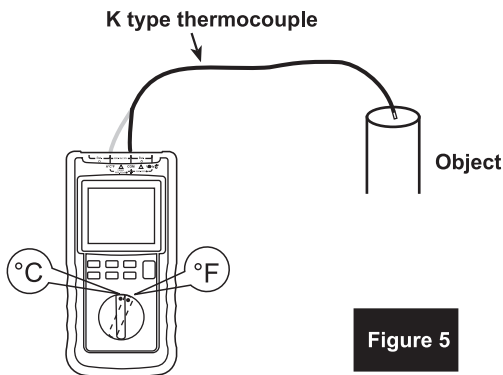
Measuring Temperature (Figure 5)

NOTE

To avoid possible damage to the meter or other equipment, remember that while the meter is rated for -20°C to $+1000^{\circ}\text{C}$ and -4°F to 1832°F , the K Type Thermocouple provided with the meter is rated to 250°C . For temperatures out of that range, use a higher rated thermocouple.

The K Type Thermocouple provided with the meter is a present, it is not professional and can only be used for non-critical reference measurements. For accurate measurements, use a professional thermocouple.

1. Connect the negative " - " plug of the K type thermocouple to the " **COM** " jack, and the positive " + " plug to the " **A°C°F** " jack.
2. Set the range switch to " °C " or " °F " position.
3. Connect the end of the thermocouple to the object to be measured.
4. Wait until the reading is stable, read the reading on the display.



Measuring Dwell Angle (Figure 6)

1. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **VΩHz Δ°** " jack. (Note: The polarity of the red lead is positive " + ".)
2. Set the range switch to Δ° position.
3. Press the " **SELECT** " button until the number of cylinders of the engine to be tested appears. (The meter displays the number of cylinders followed by " **CYL**".)

4. Connect the black test lead to ground or the negative terminal of the battery, and the red test lead to the low voltage terminal of the distributor or the negative terminal of the ignition coil.
5. Start the engine and read the reading on the display.

Note:

1. The input voltage must be between 3Vp and 50Vp. If the voltage is too low, it will be impossible to perform dwell measurement.
2. Reading's stability will decrease if the rotation speed of the engine is too low.
3. The polarity of the input voltage must be correct, otherwise it will be impossible to perform measurement.

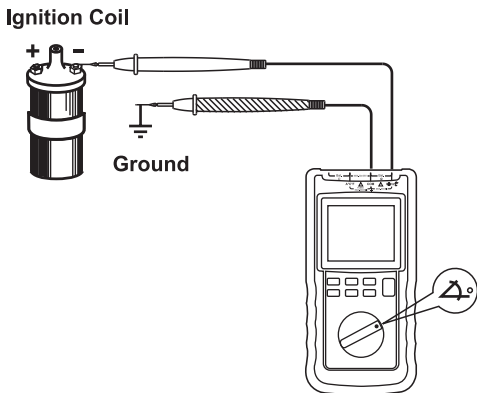




Figure 6

Measuring Engine Tach (Rotation Speed)

1. Connect the black test lead to the " **COM** " jack, and the red test lead to the " **VΩHz**  " jack. (Note:The polarity of the red lead is positive " + ".)
2. Set the range switch to  position.
3. Press the " **SELECT** " button until the number of cylinders of the engine to be tested appears.
4. Connect the black test lead to ground or the negative terminal of the battery, and the red test lead to the low voltage terminal of the distributor or the negative terminal of the ignition coil.
5. Start the engine and read the reading on the display.

Note:

1. The input voltage must be between 3Vp and 50Vp. If the voltage is too low, it will be impossible to perform measurement.
2. The meter's measurement range is from 250RPM to 40kRPM. If the engine's actual rotation speed is out of this range, measurement may be incorrect.

To measure a rotation speed which is out of this range, you can measure the ignition frequency, and then determine the rotation speed by using the formula: **$N = 120F/C$**

In this formula, **N** is rotation speed (unit : RPM), **F** is ignition frequency (unit : Hz), **C** is the number of cylinders.

3. The polarity of the input voltage must be correct, otherwise it will be impossible to perform measurement.

Ignition Coil

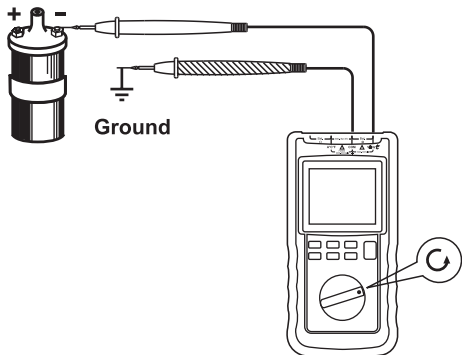


Figure 7

Measuring Vehicle's Battery Internal Resistance

Note:

Use only the 4-wire measurement method to perform the internal resistance measurement. Make sure that the connections are correct.

Caution:

1. To avoid damage to the meter, don't use the meter to measure battery's internal resistance if the battery's voltage exceeds 36V.
2. To avoid damage to the battery, don't short the battery's terminals while making connections.
3. To avoid error caused by test lead, make sure that the resistance of each test lead (with clip) is less than 5Ω . (Two test leads share a clip.)
4. Before measurement, check the meter's fuse.



Measurement Procedure:


1. Set the range switch to **Bat. $m\Omega$** range position.
2. See Figure 8, insert the plugs of the two red test leads to the two "^{Bat.} ⊕ " jacks respectively, the plugs of the two black test leads to the two "^{Bat.} ⊖ " jacks respectively.
3. Remove the oxide layer on the surface of the battery terminals.
Clip the red clip to the battery's positive terminal, clip the black clip to the battery's negative terminal (Figure 8).
Note: For accurate measurement, the two jaws of each clip must not touch each other directly (Figure 8).
4. Press the " **TEST** " button, the indicator " **TEST** " appears on the display indicating that the internal resistance is being performing. Read the reading on the display.

If the internal resistance is more than $4000m\Omega$, the built-in buzzer will

sound.

5. To stop the measurement :


In Step 4, if you press the " **TEST** " button momentarily, the indicator "  " will appear on the display indicating that the internal resistance measurement is in Fixed Time Test mode. About 60 seconds later, the indicator "  " will disappear and the internal resistance measurement will stop automatically.

In Step 4, if you press and hold down the " **TEST** " button for more than 2 seconds to start the internal resistance measurement, the indicator "  " will appear on the display indicating that you can perform the measurement as long as you like. The measurement will not stop until you press the " **TEST** " button again.

After internal resistance measurement starts, the built-in buzzer sounds a beep about every 10 seconds to remind you that the measurement is being performed.

At any time, you can press the " **TEST** " button to stop internal resistance measurement.

Note:

1. Battery's internal resistance is not constant because it is affected by temperature, state of charge, aging factor, etc.
2. Before the meter has been connected to the battery correctly and the indicator "  " appears on the display, any reading on the display is meaningless and useless.
3. During measurement, reading on the display may change lightly. It is normal because battery's internal resistance is not very stable.

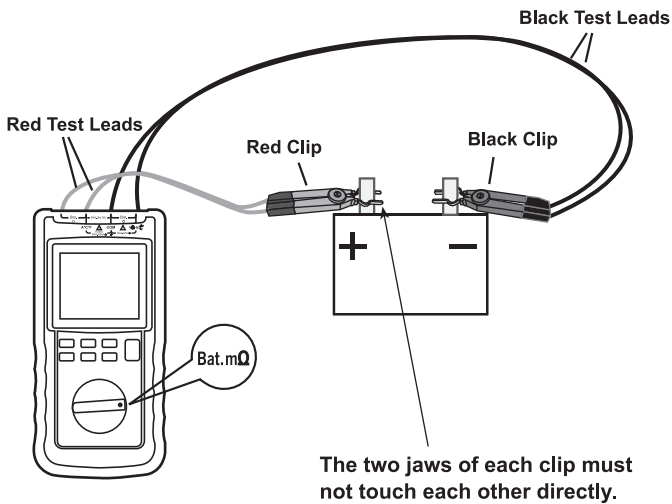


Figure 8

Auto Power Off

After the meter is turned on, it defaults to automatic power-off mode and the symbol "APO" appears as an indicator. The display will blank and the meter will go into "Sleep" mode if you do not operate the meter about 30 minutes. To turn on the meter again, set the range switch to the "OFF" position and then set it to desired range position.

To disable the automatic power-off feature, turn on the meter while pressing and holding down any button except the "**HOLD**" and "**TEST**" buttons. (Note: Do not release the button too fast.).

MAINTENANCE

Warning

Except replacing batteries and fuses, never attempt to repair or service the meter unless you are qualified to do so and have the relevant calibration, performance test, and service instructions.

The meter should be stored in dry place.

General Maintenance

Periodically wipe the case with a damp cloth and mild detergent. Do not use abrasives or solvents.


Dirt or moisture in the terminals can affect readings.

Clean the terminals as follows:

1. Set the range switch to **OFF** position and remove the test leads from the meter.
2. Shake out any dirt which may exist in the terminals.
3. Soak a new swab with alcohol.
4. Work the swab around in every terminal.

Replacing the Battery and Fuse

Warning

To avoid false readings, which could lead to possible electric shock or personal injury, replace the batteries as soon as the low battery indicator (“”) appears.

To prevent damage or injury, install only replacement fuse of the same ratings.

Remove test leads from the meter before opening the back cover or the battery cover.

To replace the batteries, remove the screws on the battery cover, remove the battery cover, replace the exhausted batteries with new batteries of the same type (AA or equivalent). Reinstall the battery cover and the screws.

This meter uses one fuse : 500mA, 690V, Fast, Min. Interrupt Rating
20000A, ϕ 10X38mm

To replace the fuse, remove the screws on the back cover, move the back cover aside gently, replace the blown fuse with a new one of the same ratings. Reinstall the back cover and all the screws.

ACCESSORIES

Owners Manual :	1 piece
Test Lead With Clip :	1 set (for battery internal measurements)
Normal Test Lead :	1 set

PRESENT

K Type Thermometer :	1 piece
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WARNING

1. This tester can only be operated by qualified personnel and according to the manual.
2. If the tester is used in a manner not specified by the manual so that electric shock or meter's damage occurs, our company will not take the responsibility.
3. Read and understand the safety information in this manual and always adhere to it.
4. Pay particular attention to the cautions in the automotive servicing manual.

NOTE

1. This users manual is subject to change without notice.
2. Our company will not take the responsibilities for any loss caused by incorrectly using the meter.
3. The content of this manual can not be used as the reason to use the meter for any other applications.

DISPOSAL OF THIS ARTICLE

Dear Customer,

If you at some point intend to dispose of this article, then please keep in mind that many of its components consist of valuable materials, which can be recycled.

Please do not discharge it in the garbage bin, but check with your local council for recycling facilities in your area.



