FULL THREE (3) YEAR WARRANTY

Actron Manufacturing Company, 9999 Walford Avenue, Cleveland, Ohio 44102, warrants to the user that this unit will be free from defects in materials and workmanship for a period of three (3) years from the date of original purchase. Any unit that fails within this period will be repaired or replaced at Actron's option and without charge when returned to the Factory. Actron requests that a copy of the original, dated sales receipt be returned with the unit to determine if the warranty period is still in effect. This warranty does not apply to damages caused by accident, alterations, or improper or unreasonable use. Expendable items, such as batteries, fuses, lamp bulbs, flash tubes are also excluded from this warranty.

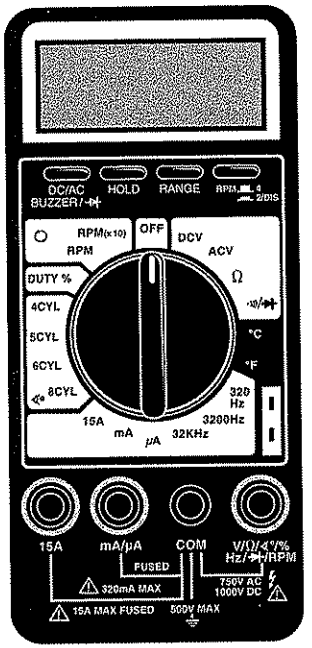
ACTRON MANUFACTURING COMPANY DISCLAIMS ANY LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR BREACH OF ANY WRITTEN WARRANTY ON THE UNIT. Some states do not allow the disclaimer of liability for incidental or consequential damages, so the above disclaimer may or may not apply to you. This warranty gives specific legal rights, and you may also have rights which vary from state to state.

ACTRON MANUFACTURING CO.
9999 Walford Avenue
Cleveland, Ohio 44102

2-2210

actron®

INSTRUCTIONS



2-2210

DIGITAL MULTIMETER

Instrucciónnes en español, página 17

Contents

Safety!

- **Do not use this product to measure voltages that are over 1000 VDC or 750 VAC between any terminal and ground.**
- **Internal combustion engines produce carbon monoxide which can slow reaction time and can lead to serious injury. Keep the service area well ventilated or attach an exhaust extraction system.**
- **Set the parking brake and block the wheels when doing testing.**
- **Do not operate the vehicle while taking measurements with the multimeter. Use two people for testing that requires vehicle operation.**
- **Use eye protection when working on vehicles. Always check the condition of belts and hoses that can cause injury to technicians working near rotating or hot components.**
- **Do not use damaged or frayed test leads that have poor insulation.**
- **Automotive service areas have safety hazards that technicians must understand and observe while using this product. This list of safety items cannot be complete because of the number of possibilities and should not be considered as a complete list.**

Introduction

The meter is an advanced electronic tester that has all the functions of an advanced multimeter and automotive tester in one compact unit. The automotive features include frequency, temperature, RPM and dwell measurement.

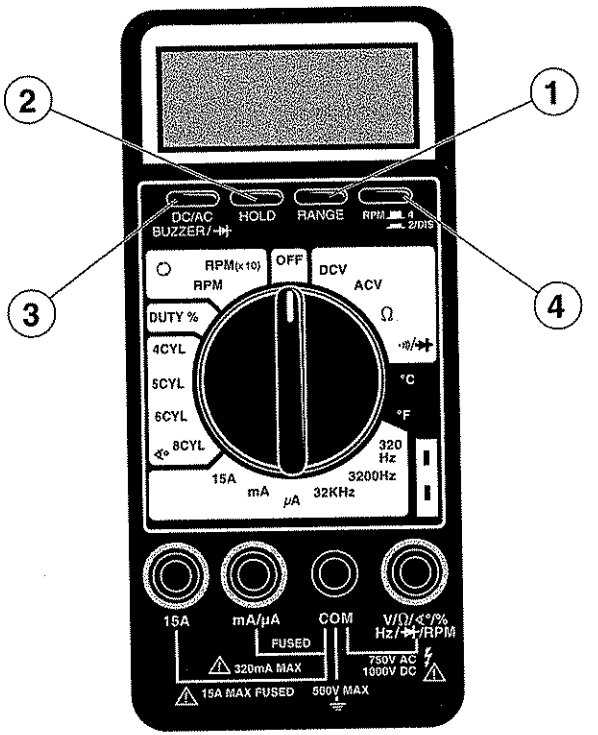
The meter has a 3-3/4 digit display with a range of 0 to 3260 for standard measurements. It also has a 32 segment graphic bargraph which updates 12 times per second for a faster response than the digital display. This manual will help technicians understand the uses and capabilities of the meter.

How to use this manual

The layout is by meter functions. Included in each chapter are specifications, ranges, special measurement options, and typical applications for each function on the rotary switch. Use the chapter for the function you are using in order to learn the complete capability of this product. Meter controls and the display layout are in the first section with meter functions following.

Getting Started

The meter is an advanced design incorporating a wide range of automotive and multimeter functions. This section will help you get started but is not intended to explain every function in detail.



Special Measurement Features

These buttons are used to select operating modes. When the button is pushed the beeper sounds. An annunciator is displayed to indicate that a mode or option was selected.

(1) MANUAL RANGING

Press RANGE button to select the manual range mode. In the manual range mode, each time you press the RANGE button, the range changes, and a new value is displayed. To exit the manual range mode and turn to autoranging, press and hold down RANGE button for 2 seconds.

(2) HOLD

Press HOLD button to toggle in and out of the hold mode. In the hold mode, the "DH" annunciator is displayed.

(3) DC/AC BUZZER / →+

Press push button to select between DC/AC when measuring current. Also for measuring audible continuity or diode test.

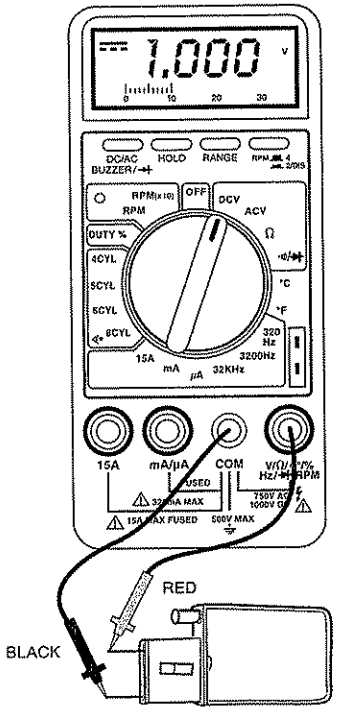
(4) RPM 4/2(DIS)

Press the button to toggle between RPM for 2-cycle/distributorless ignition systems or RPM for 4-cycle engines.

1 – Voltage Measurements

1. Set up the meter as shown in the diagram.
2. Plug the meter leads in as shown.
3. Connect the meter to the circuit to be measured.
4. Observe voltage readings.

Special measurement options are included in this section. Examples of automotive applications are shown in section 11.



Voltage Range Selection

Voltage ranges are provided on the rotary selector.

• 0V to 1000V auto/manual range

The 0 to 1000V range starts with a 320mV range on DCV.

The 0 to 750V range starts with a 3.2V range on ACV.

Two types of voltage measurements are possible.

1. DC voltage always has the same polarity. Batteries, solar cells, and computer power supplies are examples of DC voltage sources.
2. AC voltage continuously changes polarity at regular intervals. Rotating generators, alternators, and signal generators such as magnetic pick ups and speed sensors are examples.

Selector Switch Position

Set the rotary selector switch to the DCV, or ACV position on the rotary dial. The meter will automatically select the best range.

Range Selection:

There are two modes of range selection when measuring voltage.

1. Autoranging is the default mode when the voltage function is selected or when the meter is powered on. Auto ranging automatically selects the best measurement range.
2. Manual ranging is selected when the RANGE button is pressed. Each time the RANGE button is pressed, the next higher range is selected. Manual ranging allows the operator to choose the desired measurement range.

Note: Pressing the RANGE button for 2 seconds or longer will release the manual range mode and restore the autorange mode.

Manual Range:

The voltage ranges that can be selected with the front panel buttons in manual range are:

0.000V to 3.200V

00.00V to 32.00V

000.0V to 320.0V

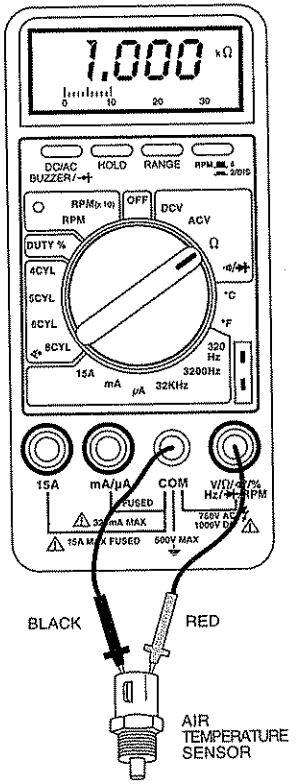
0000V to 1000VDC or 750VAC

2 – Ohms Measurements

1. Set up the meter as shown in the diagram.
2. Plug the meter leads in as shown.
3. Connect the meter to the circuit to be measured.
4. Observe resistance readings.

The example shown here is for testing a resistive type temperature sensor.

Special measurement options are included in this section. Examples of automotive applications are shown in section 11.



Test Lead Connection

The red lead plugs into the V ohms receptacle on the lower right of the front panel. The black lead plugs into the COM receptacle on the lower right of the front panel.

Selector Switch Position

Set the selector switch to the ohms position on the rotary switch. The meter will automatically select the best range for the circuit being measured.

Range Selection

There are two modes of range selection when measuring resistance.

1. Autoranging is the default mode when the ohms function is selected or when the meter is powered on. Autoranging automatically selects the best measurement range.
2. Manual ranging is selected when the RANGE button is pressed. Each time the RANGE button is pressed, the next higher range is selected. Manual ranging allows the operator to choose the appropriate measurement range.

Manual Ranges

The resistance ranges that may be selected with the range button are:

000.0 Ω to 320.0 Ω

0.000K Ω to 3.200K Ω

00.00K Ω to 32.00K Ω

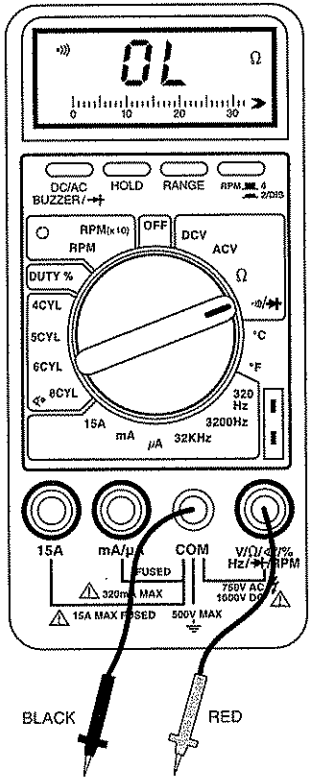
000.0K Ω to 320.0K Ω

0.000M Ω to 3.200M Ω

00.00M Ω to 32.00M Ω

3 – Audible Continuity Test

It is difficult to watch the meter when testing for an open or a short in a complex wiring harness especially when it is in a tight place or under the dash. The audible continuity feature produces an audible tone when the resistance being measured is under 20 ohms. If the resistance is greater than 20 ohms, the tone will not be produced. Finding opens and shorts is made easy by listening for the tone instead of looking at the meter.



Typical Uses For Audible Continuity

Test for open circuit

1. Disconnect both ends of the circuit.
2. Connect a jumper wire to ground at one end of the circuit. This allows testing with the meter connected to ground and one end at the circuit, since it may not be easy to connect the meter to both ends of the circuit.
3. Connect the red lead to the circuit to be tested and the black lead to ground.

If the tone does not sound, the circuit is open. Remove the jumper wire from the circuit (do not disconnect it from ground) and connect it to an easy access point closer to the meter. The tone will sound when the jumper wire completes the circuit. The open will be between the point when the tone sounds and the last point tested.

Short Circuit Testing

1.Disconnect both ends of the circuit.

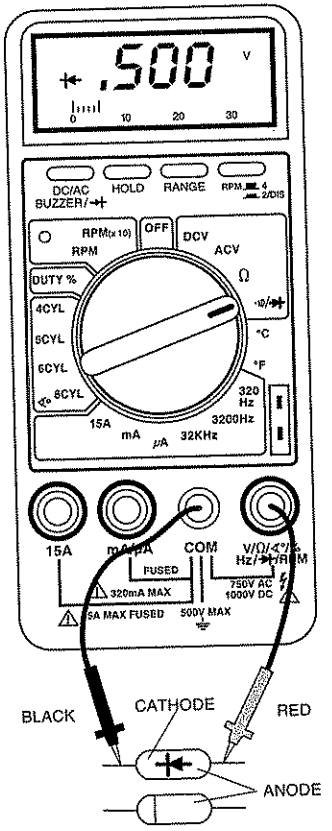
2.The meter should show an open circuit when connected to ground and one end of the circuit. If not, disconnect the connectors until the short disappears. The short is in wiring that was disconnected when the tone stopped sounding.

4 – Diode Test

The diode test applies a 3 volt signal to the diode under test and tests the ability of the diode to pass and block the signal.

Note : Be sure that no power is applied to the diode under test. Preferably remove the diode from the circuit.

1. Set up the meter as shown in the diagram.
2. Plug the meter leads in as shown in the diagram.
3. Connect the meter to the diode for conduction and blocking action.



Conduction test- The red lead connects to the anode and the black lead connects to the cathode for forward conduction, which results in a low voltage reading.

Blocking test- Reversing the leads will cause a good diode to block current flow, which results in a higher voltage reading.

Normal test results:

Connect red lead to anode, black lead to cathode, when measuring the forward voltage across diode. A good diode will indicate 0.4 to 0.7V.

Shorted diodes will have a low voltage reading for conduction and blocking tests.

Open diodes will read "OL" for the blocking and conduction test.

Test Lead Connection

The red lead plugs into the V ohms receptacle on the lower right of the front panel. The black lead plugs into the COM receptacle on the lower right of the front panel.

Selector Switch Position

Set the selector switch to the ·))/→+ position. Press the **BUZZER/→+** mode button and the →+ mark is indicated on the left side of the display.

5 – Frequency Measurements

1. Set up meter as shown in the diagram.
2. Plug the meter leads in as shown.
3. Connect the meter to the circuit to be measured.
4. Observe frequency readings.

Examples of automotive applications are shown in section 11.

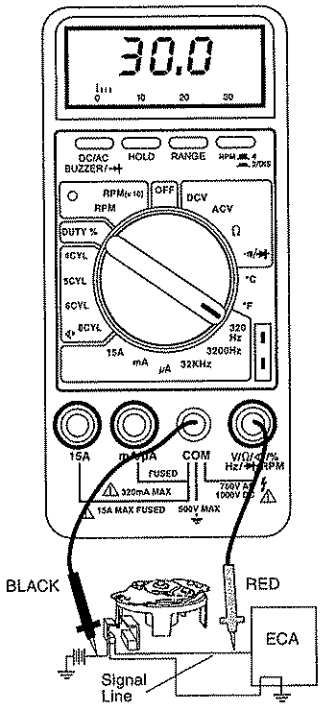
Frequency measurement of the output signal from a hall effect pick up in a distributor.

Test Lead Connection

The red lead plugs into the V ohms receptacle on the lower right of the front panel. The black lead plugs into the COM receptacle on the lower front panel.

Selector Switch Position

Set the selector switch to the 320, 3200 or 32KHz position on the rotary dial.



6 – Temperature Measurements

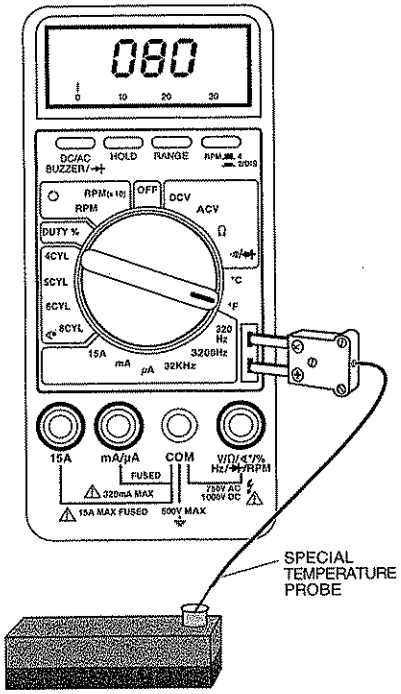
1. Set selector switch to temperature (°C or °F).
2. Insert the special temperature probe into yellow receptacle.
3. Place the probe tip on the surface where temperature is being measured.
4. Allow temperature readings to stabilize and read temperature.

Examples of automotive applications are shown in section 11.

Selector Switch Position:

Set the selector switch to the °C or °F position on the rotary dial and connect the special temperature probe.

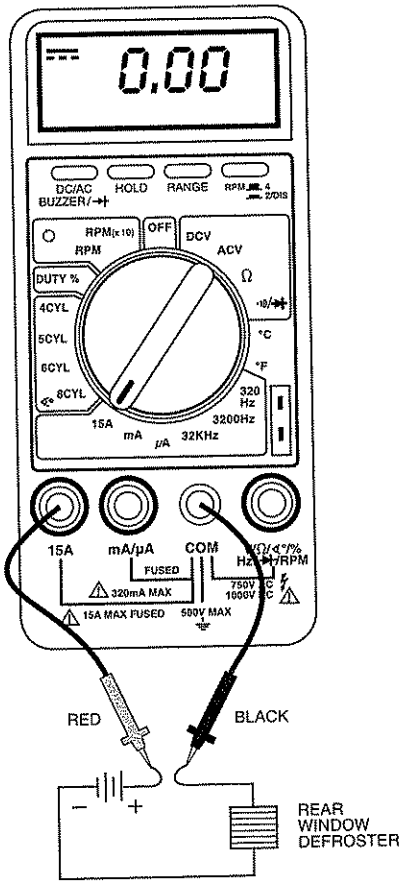
RANGE Centigrade: -20° to 1370°
Fahrenheit: 0° to 2000°



7 – Amps Measurements

1. Set up the meter as shown in the diagram.
2. Open the circuit so that the meter can be placed in series with the circuit being tested.
3. Plug the leads into the 15A or mA/µA receptacle.

Note : Always start with the 15A scale if there is any doubt about the expected current. The circuits are protected by fuses to prevent damage to the meter If the meter does not appear to work even when testing a good circuit, it is likely the fuse is blown.



4. Select AC or DC amps. DC is the default value and is the most commonly used setting.
5. Observe amp reading.

Examples of automotive applications are shown in section 11.

Test Lead Connection

Plug the red lead into the 15A or mA/µA receptacle on the lower left of the front panel. Plug the black lead into the COM receptacle on the lower front panel.

Note : An amp meter is a short circuit to other circuits. Never connect it across a power source even if the selector switch is set to a different function. The function switch does not disconnect the internal amp circuits.

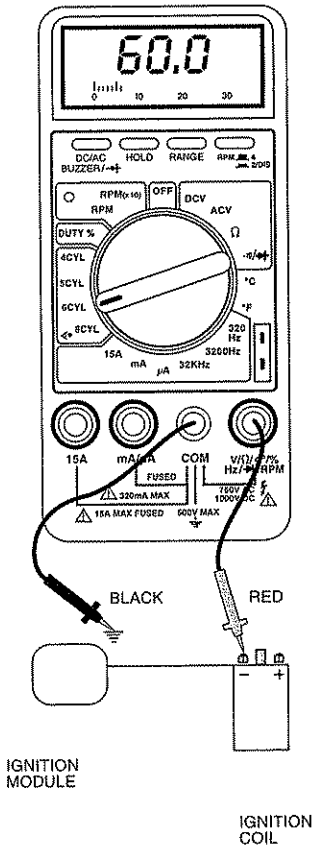
Range Selection

Set the selector switch to the 15A, mA or µA position of the rotary dial.

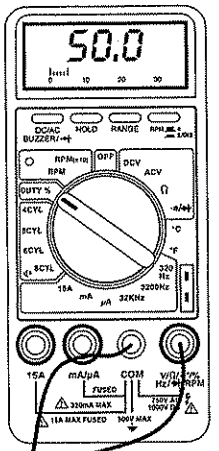
Note : To select AC current, press the DC/AC front panel button and use the same procedure as used for DC current.

8 – Dwell Measurements

1. Set selector switch to dwell (4CYL, 5CYL, 6CYL, 8CYL).
2. Plug the leads into the panel receptacles.
3. Connect the leads to the circuit to be measured.
4. Take dwell readings.

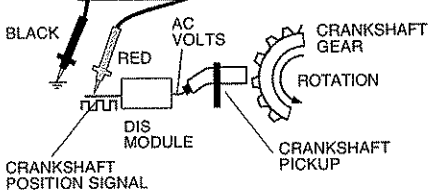


9 – Duty Cycle Measurements



1. Set selector switch to duty cycle.
2. Plug the leads into the panel receptacles.
3. Connect the leads to the circuit to be measured.
4. Take duty cycle readings.

Examples of automotive applications are shown in section 11.



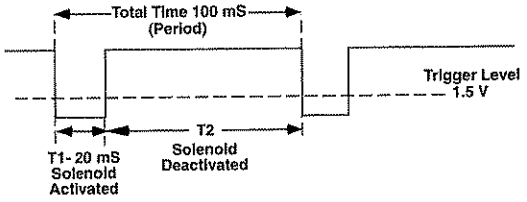
Selector Switch Position

Set the selector switch to the duty cycle position on the rotary dial.

Duty Cycle Defined

Duty cycle is the ratio of the amount of time a signal is doing work to the total time period expressed as a percentage.

Example: Total time of one cycle is 100mS. The solenoid is activated for 20mS.

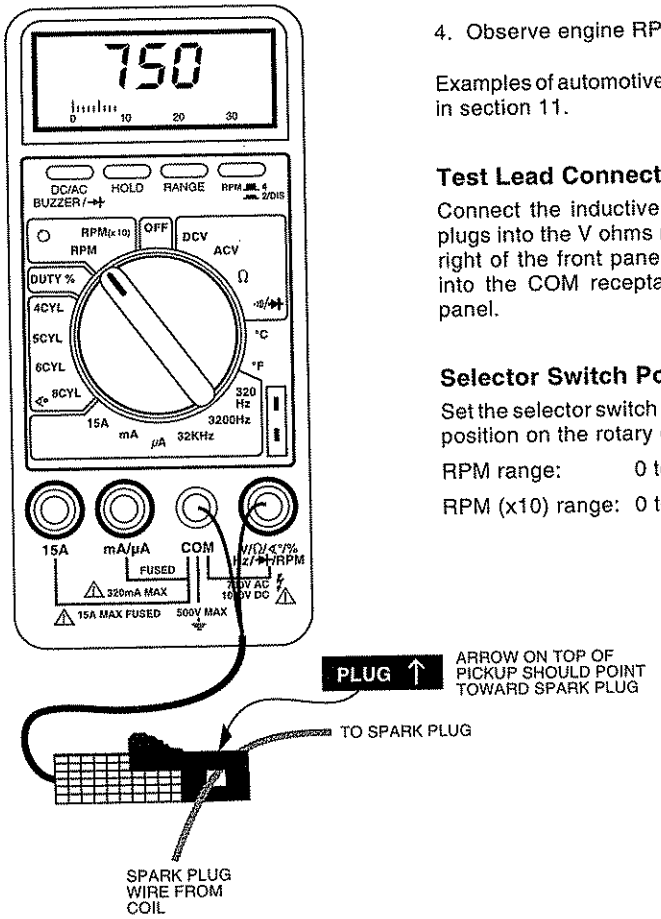


Duty Cycle = 20ms divided by 100 ms X 100% = 20% in this example

% Duty Cycle = Activated time divided by Total cycle time x 100%.

10 – Engine RPM Measurements

1. Set up the meter as shown in the diagram.
2. Connect the inductive pick up, being sure to have the arrow on the pick up pointing toward the spark plug.
3. Use button to select 2 or 4 cycle mode.



Note: Most distributor-equipped systems are of a 4 stroke cycle type (4 cycle for short). A few car engines, some motorcycle engines and small industrial motors are of a 2 stroke cycle type (2 cycle for short). DIS equipped vehicles use 4 stroke cycle engines, however, since the DIS ignition system fires spark plugs at twice the rate, the ignition pattern looks like a pattern for a 2 stroke cycle engine. ***Follow this simple rule when selecting the RPM mode: for distributor-equipped 4 cycle engines: set the mode to RPM4, for 2 cycle and DIS engines set the mode to RPM2.***

4. Observe engine RPM readings.

Examples of automotive applications are shown in section 11.

Test Lead Connection

Connect the inductive pick up. The red lead plugs into the V ohms receptacle on the lower right of the front panel. The black lead plugs into the COM receptacle on the lower front panel.

Selector Switch Position

Set the selector switch to the RPM or RPM(x10) position on the rotary dial.

RPM range: 0 to 3000 RPM

RPM (x10) range: 0 to 9000 RPM

11 – Component Testing

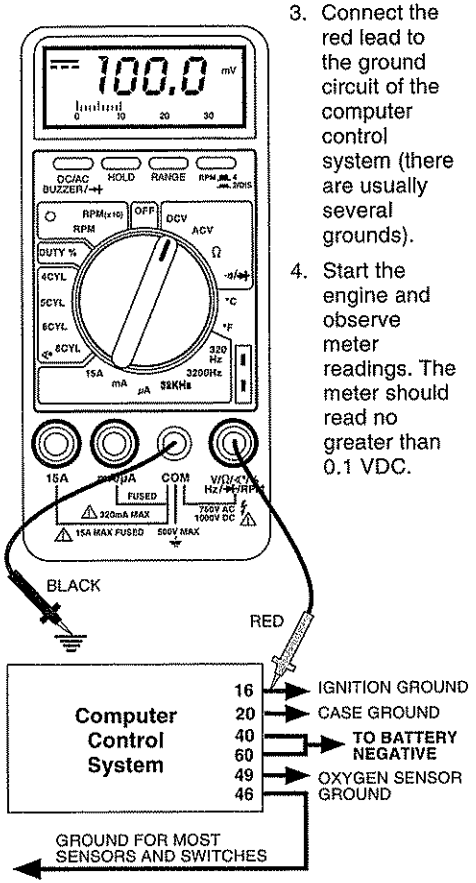
This section deals with the use of the meter on component circuits including distributorless ignition systems and computer control systems.

The test procedures will show the best use of the advanced functions provided by the meter. If more information is needed about a test function, see the details in the function section.

Computer Ground Noise Testing

Test Set Up

1. Set meter rotary selector switch to the DCV position.
2. Connect black meter lead to chassis or battery ground.
3. Connect the red lead to the ground circuit of the computer control system (there are usually several grounds).
4. Start the engine and observe meter readings. The meter should read no greater than 0.1 VDC.

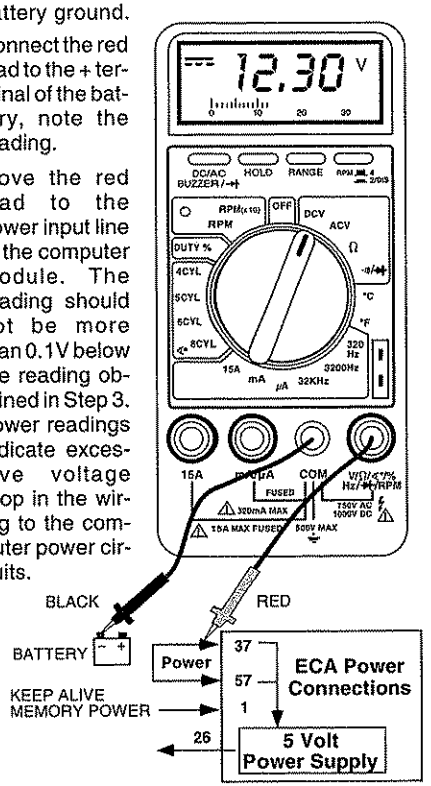


Computer Battery Power Testing

To check for voltage drop and noise on the computer input power line the following procedure is given.

Test Set Up

1. Set meter rotary selector switch to the DCV position.
2. Connect black meter lead to chassis or battery ground.
3. Connect the red lead to the + terminal of the battery, note the reading.
4. Move the red lead to the power input line of the computer module. The reading should not be more than 0.1V below the reading obtained in Step 3. Lower readings indicate excessive voltage drop in the wiring to the computer power circuits.

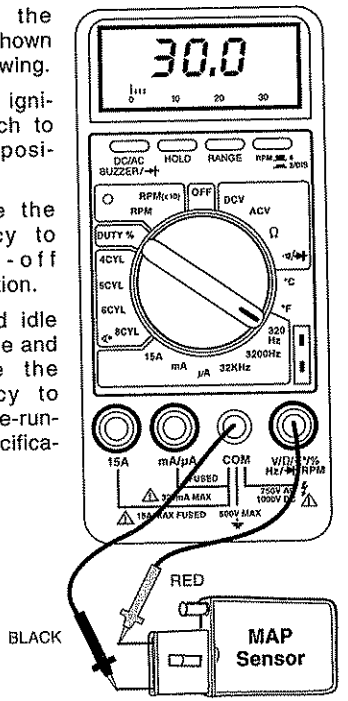


MAP Sensor Testing

Some MAP sensors produce a frequency that is proportional to manifold vacuum. The example shown is for a Ford MAP sensor, but the procedure will also work for all sensors that have a frequency output signal.

Test Procedure

1. Set meter to one of the frequency ranges.
2. Connect the meter as shown in the drawing.
3. Turn the ignition switch to the ON position.
4. Compare the frequency to engine-off specification.
5. Start and idle the engine and compare the frequency to the engine-running specification.



Duty Cycle Testing

MAP sensor signals have duty cycle as well as frequency characteristics that should be measured.

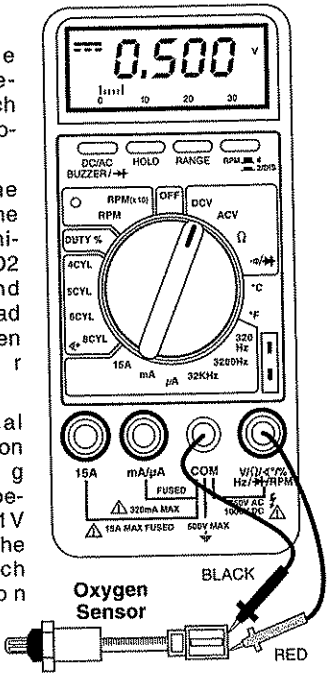
Diagnostic Note: Erratic signals may show a greater change in duty cycle than in the frequency reading. Both tests should be run on frequency generating sensors to do a complete test of the sensor.

Oxygen Sensor Testing

The oxygen sensor monitors the oxygen content in the exhaust stream and generates a voltage proportional to the amount of oxygen in the exhaust stream. The following test will check the oxygen sensor output voltage level. This test is performed with the oxygen sensor in the car and the sensor harness connected. Use a back-probe adapter or other means to obtain the signal.

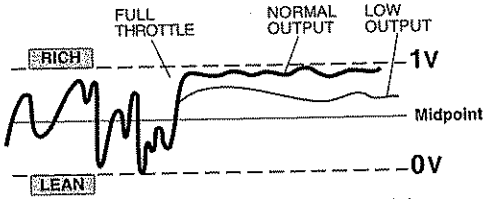
Test Set Up

1. Rotate the function selector switch to the DCV position.
2. Connect the red lead to the output terminal of the O2 sensor and the black lead to the oxygen sensor ground.
3. The normal lean condition reading should be between 0.1V and 0.3V. The normal rich condition reading should be between 0.7V and 0.9V.



Dynamic Oxygen Sensor Testing

The oxygen sensor must respond quickly and cover the voltage range from 0.1 V to 0.9V. The chart below shows the results of a typical wide open throttle test drive.



Full Throttle Oxygen Sensor Activity

Note: The oxygen sensor signal may not reach the full 0.9V level because of a fuel delivery problem such as dirty injectors or low fuel pressure. The oxygen sensor is working if it can reach the full enrichment point of 0.9V. Check the fuel delivery system on the vehicle

that failed the test drive but has an oxygen sensor that can cover the complete range.

Oxygen sensor response time should also be tested. Slow oxygen sensors can cover the entire operating range but have a delayed response to changes. Test this by measuring how quickly the sensor responds to a sudden enrichment. Use the bargraph to watch for an instant (0.1 sec) rich response to a quick burst of propane into the intake.

12 – General Specifications

Display
3-3/4 digit (3260 count). 32 Segment analog bargraph and units sign annunciators.

Low battery indication
Battery symbol on display blinks when battery voltage is 6.5 to 7.0 volts

Display test
All symbols are displayed at power up.

Display update rate
Digital display: 2 times per second
Bar graph: 12 times per second

Operating Environment
0°C to 40°C (32°F to 104°F) at <75% R.H

Storage Environment
-10°C to 500°C (14°F to 122°F) at <75% R.H with battery removed.

Temperature Coefficient
0.1 x (Specified accuracy)/°C (<18°C or 28°C to 50°C)

Auto power off
10 minutes after rotary switch or mode change (Meter turns back on if HOLD or RANGE button is pushed.)

Power
Single 9V battery. (NEDA 1604A, JIS006P, EES 6F22)

Battery Life
500 hours typical with alkaline battery

Fuse
15A/250V, 5.0 x 20mm ceramic type
0.5A/250V, 5.0 x 20mm fast acting type

Size (H x W x L): 33mm x 84mm x 184mm

Weight: Approx. 350g

13 – Electrical Specifications

Accuracy is listed as ±% of reading and the number of least significant digits the measurement is allowed to vary from the calibration standard.

AC Voltage
Range: 3V, 30V, 300V, 750V
Resolution: 1 mV to 1V
Accuracy: ±(1.5% + 10 dgt) 50 to 500Hz.
(3V Range: 50 to 200Hz)
Input Impedance: Greater than 10MΩ
Overload Protection: 750V rms

DC Voltage
Ranges: 300mV, 3V, 30V, 300V, 1000V
Resolution: 0.1mV to 1V
Accuracy : ±(1.0% + 5 dgt)
Input Impedance: Greater than 10MΩ
Overload Protection: 1000V DC

DC Current
Ranges: 300µA, 3000µA, 30mA, 300mA, 15A
Resolution: 0.1µA to 0.01A
Accuracy: ±(1.5% + 5 dgt) 300µA to 300mA
±(2.0% + 5 dgt) 15A range
Overload Protection:
300µA to 300mA range – 0.5A 250V fuse
15A range – 15A 250V fuse

AC Current
Ranges: 300µA, 3000µA, 30mA, 300mA, 15A
Resolution: 0.lµA to 0.01A
Accuracy: ±(2.0% + 5 dgt) 300µA to 300mA
±(2.5% + 5 dgt) 15A range
Overload Protection:
300µA to 300mA range – 0.5A 250V fuse
15A range – 15A 250V fuse

Resistance
Ranges: 300Ω, 3KΩ, 30KΩ, 300KΩ, 3MΩ, 30MΩ
Accuracy:
±(l.5% + 5 dgt) 300Ω, 3KΩ, 30KΩ, 300KΩ ranges
±(2.0% + 5 dgt) 3MΩ, 30MΩ ranges
Overload Protection: 250V DC/AC Peak

Frequency
Ranges: 320Hz, 3200Hz, 32KHz
Resolution: 0.1Hz to 10Hz
Accuracy: ±(1.0% + 5 dgt)
Overload Protection: 250V DC/AC Peak
Sensitivity: 2.5Vrms

Diode Test
Resolution: 0.lV
Accuracy: ±(10% + 2 dgt)
Open Circuit Voltage: 3.0V typical
Overload Protection: 250V DC/AC Peak

RPM
Ranges: RPM, RPM(x10)
Resolution: 1 RPM to 10 RPM
Accuracy: ±(2% + 10 dgt)
Overload Protection: 250V DC/AC Peak

Audible Continuity
Buzzer sounds at approximately less than 20 Ohms

Duty Cycle
Resolution: 0.1%
Accuracy: ±(2% + 5 dgt)
Overload Protection: 250V DC/AC Peak

Dwell Angle
Ranges: 4CYL, 5CYL, 6CYL, 8CYL
Resolution: 0.1°
Accuracy: ±(2% + 5 dgt)
Overload Protection: 250V DC/AC Peak

Temperature
Ranges: Centigrade: -20°C to 1370°C
Fahrenheit: 0°F to 2000°F
Resolution: 1°F, 1°C
Accuracy: ±(3° + 1 dgt) up to l50°C
±3% rdg over 150°C
±(5° + 2 dgt) up to 225°F
±3% rdg over 225°F

14 – Maintenance

To avoid electrical shock:

- **Remove the test leads before opening the meter case.**
- **Do not operate the meter while the back cover is removed.**

Battery Replacement

Replace the battery according to the following steps:

1. Turn off the power to the meter.
2. Loosen the four screws located on the back of the meter.
3. Gently lift the bottom case half up and away from the top case half.
4. Remove the old battery.
5. Gently unsnap the battery connector from the battery.
6. Snap the new battery into the battery connector.
7. Reinsert the battery into the battery compartment. Position the battery wires so they will not be pinched between the bottom and top case halves.
8. Reinstall the bottom case half by snapping it into the top case half.
9. Tighten the four screws located on the back of the meter.

Fuse Replacement

1. Turn off the power to the meter.
2. Loosen the four screws located on the back of the meter.
3. Gently lift the bottom case half up and away from the top case half.
4. Remove the open fuse by gently prying loose one end and sliding the fuse from the fuse holder.
5. Install a new fuse with the same size and rating.
6. Reinstall the bottom case half by snapping it into the top case half.
7. Tighten the four screws located on the back of the meter.

Fuses
1. µA/mA Range: 0.5A 250V Fuse – 5.0X20mm Fast Acting Type
2. 15A Range: 15A 250V Fuse – 5.0X20mm Ceramic Type

Applications Guide

	15A	Bar Graph	•)))	✱	Duty %	Dwell	Hz	Ω	RPM	Temp	V/AC	V/DC	µA/mA
IGNITION/ENGINE													
AFS							•			•		•	
Coils								•				•	
Computer Temp Sensors								•		•		•	
Condensers (capacitors)		•						•				•	
Connectors			•					•				•	
Distributor Cap								•					
Engine Speed									•				
Feedback Carburetors					•	•	•	•			•	•	
Fuel Injectors (Electronic)		•			•		•	•				•	
Hall-Type Sensors		•					•	•	•		•	•	
Idle Air Motors		•			•		•	•				•	•
Ignition Modules		•			•			•				•	
Magnetic Pickups		•	•			•	•	•			•	•	
MAP & BP Sensors		•					•					•	
O_2 Sensors		•					•					•	
Points			•			•		•				•	
Throttle Position Sensors		•						•				•	
STARTING SYSTEM													
Battery									•	•		•	
Connectors			•					•				•	
Interlocks(neutral safety switch)			•					•				•	
Solenoids			•					•				•	
Starters								•	•			•	
COOLING SYSTEM													
Connectors			•					•				•	
Fan Motor	•		•					•				•	
Relays	•		•					•				•	
Temperature Sensors								•		•		•	
Temperature Switches			•					•		•		•	
CHARGING SYSTEM													
Alternators				•				•	•		•	•	
Computerized Regulators					•	•	•		•			•	
Connectors			•					•				•	
Diodes, (AC Ripple)				•							•	•	
Diode Rectifier			•	•							•	•	
Regulators								•				•	
BODY ELECTRIC													
Compressor Clutch				•				•				•	
Lighting Circuits				•				•				•	
Relay and Motor Diodes	•			•	•								