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Electrical Measuring Equipment and Procedures

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Electrical Measuring Equipment and Procedures

Model: All

Production: All

OBJECTIVES

After completion of this module you will be able to:

- Understand DVOM/IMIB settings.
- Correctly install the DVOM/IMIB to test different circuits.
- Understand the use of the DVOM/IMIB for the different type of electrical measurements.
- Correctly utilize IMIB to test circuits on a vehicle.

Introducing the DVOM

The ability to measure voltage, current flow, and resistance is important in the diagnosing of electrical problems. Without the results of these measurements troubleshooting in an electrical system is a futile process.

The instrument most commonly used to make electrical measurements is called the Digital Voltage-Ohm Meter (DVOM).

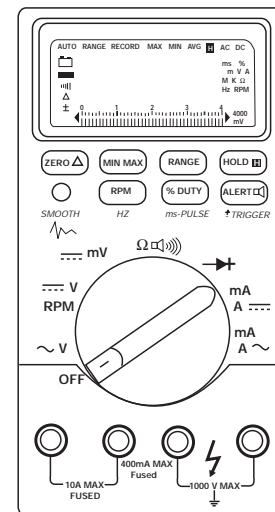
Basic DVOM's are capable of measuring:

- AC Voltage
- DC Voltage
- Millivolts
- Resistance
- Conductance
- Capacitance
- Continuity
- Diode Test
- Amps/Milliamps
- Microamps

Advanced DVOM's add:

- Frequency
- RPM
- Duty Cycle
- Pulse Width

The DVOM provides for a method of accurate measurements.



Even though accurate measurements are the key to electrical diagnosis, the following four factors determine the effectiveness of the measurements:

- Accuracy of the measuring instrument.
- Correct installation in the circuit of the measuring instrument.
- Ability of the Technician to read the instrument.
- Skill of the Technician in interpreting the results.

As it is clearly seen, only one of the factors depends on the DVOM (e.g. accuracy), the rest will always depend the ability of the technician to read and interpret the results.

Choosing a DVOM

A good choice of a DVOM is the IMIB, as the measuring system of each contains a highly accurate DVOM.

Choosing a handheld DVOM from a reputable manufacturer, however, leaves the shop IMIB free to perform other tasks that a DVOM can not do (e.g. Retrieval of fault codes).

In choosing a DVOM several factors need to be considered, one of which is Impedance. Impedance is the combined resistance to current created by the resistance, capacitance and inductance of the meter. Impedance is measured in 'Ohms per Volt'.

Meters with the highest 'Ohms per Volt' impedance are the most accurate. More importantly using a meter with high impedance will not cause damage to sensitive electronic circuitry.

When a Meter is connected across a circuit to measure voltage, it must be connected in parallel. This adds parallel resistance. The total resistance in a parallel circuit is less than the lowest resistance in that circuit (Ohms Law). Using a Meter with low impedance will reduce the total resistance of the circuit and allow more current to flow.

A meter with low impedance can draw enough current to cause inaccurate measurement, voltage drops or damage sensitive electronic circuit boards. A high impedance meter will draw little current and insure accurate readings.

Using older type meters with low impedance values (20,000 to 30,000 ohms-per-volt) can damage modern electronic circuits and components or give inaccurate readings.

Test lights should be avoided for the same reason. They lower the total resistance of the circuit and cause increased current flow.

Other factors in choosing the proper DVOM are:

- Cost
- Features

Basic DVOM's are available reasonably priced. These basic models may be more than sufficient for use in BMW Centers, given the availability of the IMIB for advanced measurement and scope functions.

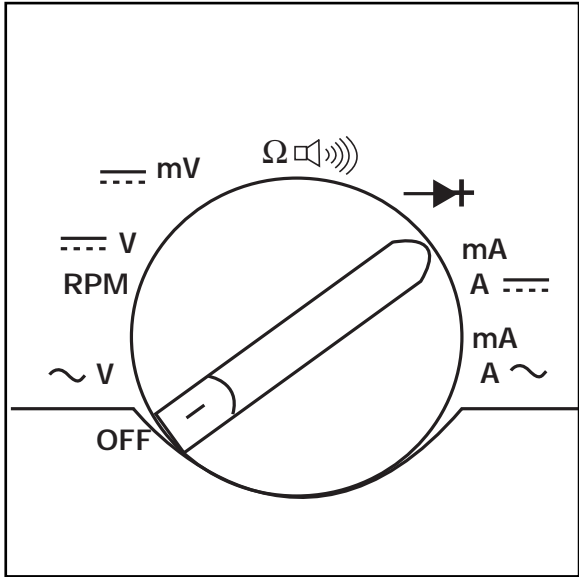
Advanced features and price go hand in hand. The more features added the higher the cost. Some of those features may be worth the increase in cost (e.g. frequency, duty cycle and pulse width). Other features may not (e.g. oscilloscope, graphing).

Choose a DVOM wisely based on personal preference and cost. Like many other tools it is valuable in the diagnosis and repair of BMW's. Experience has shown if the technician is not comfortable with the DVOM or confident in the results of the measurements, the DVOM will not be used.

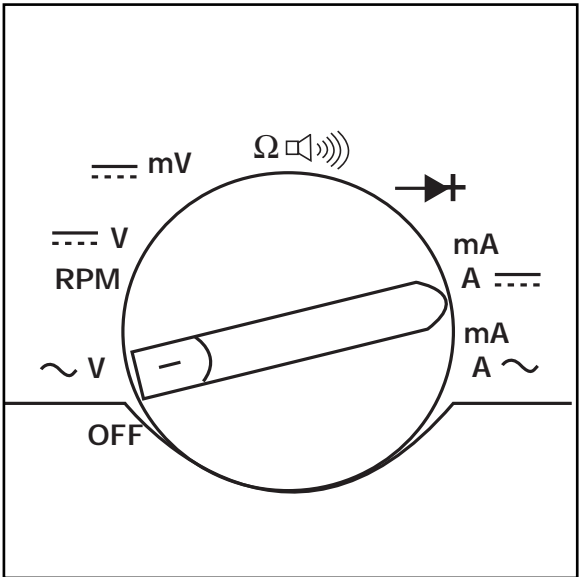
Considering the technology in BMW automobiles, diagnosing with a quality DVOM certainly makes repairing the problem correctly and expediently a more manageable task.

The Functions

Function Selector Rotary Switch

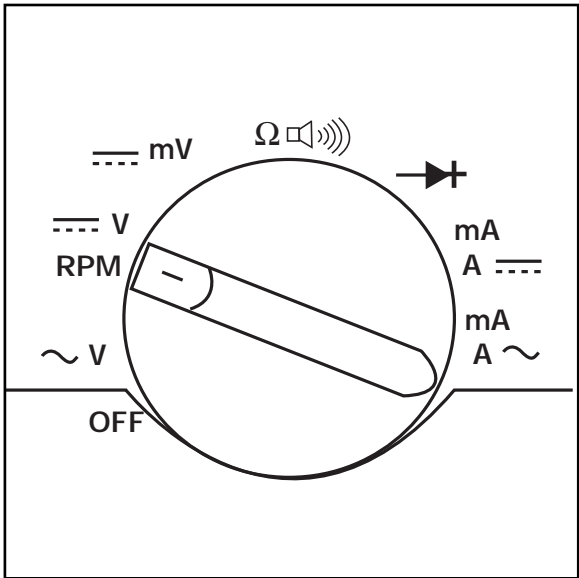


Power to the meter is turned off.



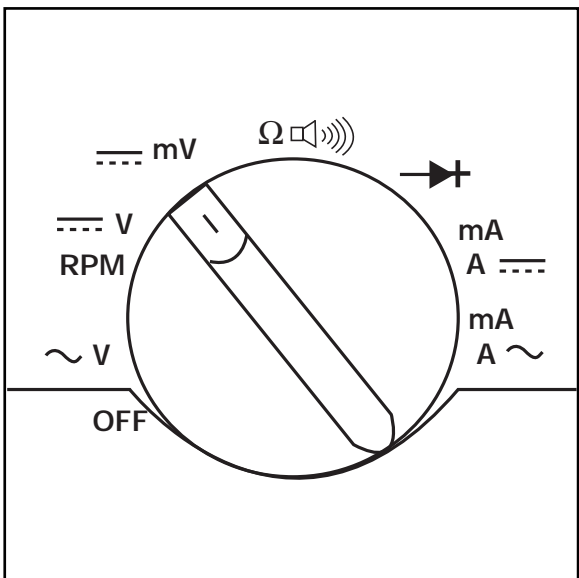
Volts AC

Measures AC Voltage
 Ranges: 400mV, 4V, 400V, 1000V



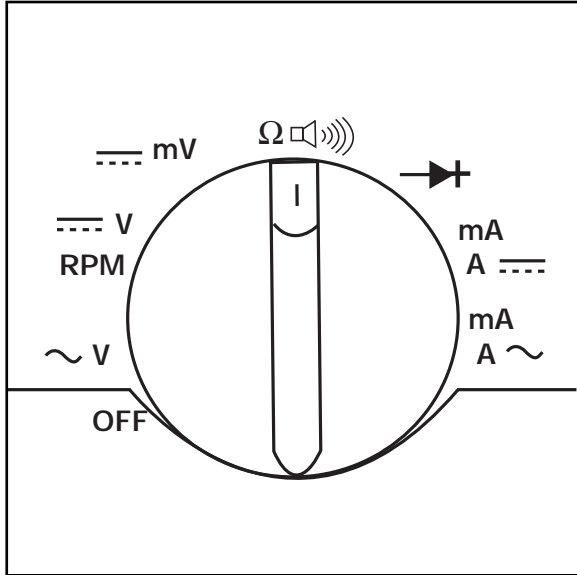
Volts DC, RPM

Measures DC Voltage
 Ranges: 4V, 40V, 400V, 1000V



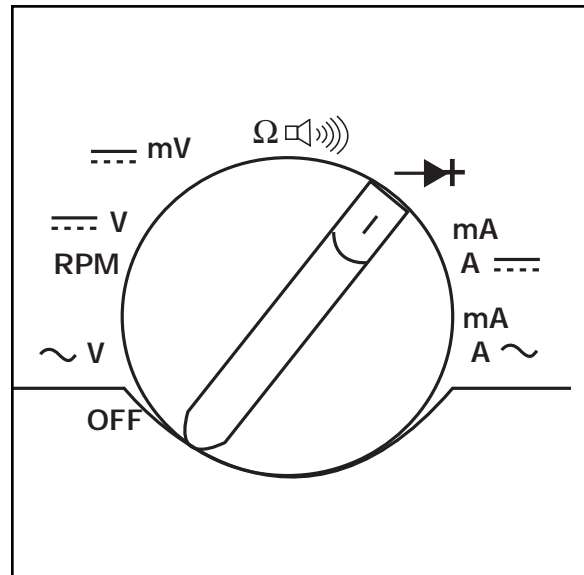
mV

Measures DC Millivolts
 Range: 400mV



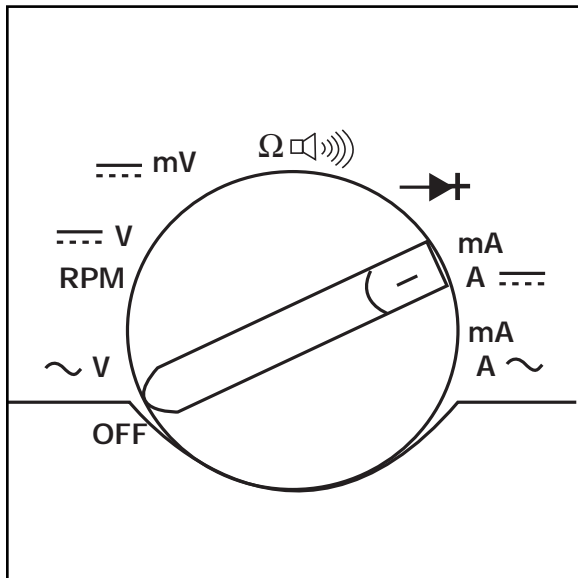
Continuity / Ohms

Measures Continuity and Ohms.
 Ranges: 400Ω ,4kΩ , 400kΩ , 4MΩ,
 40MΩ



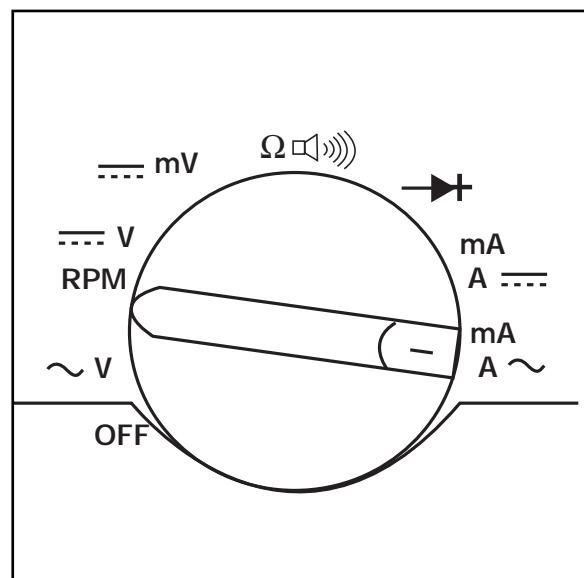
Diode Test

Test diode operation.
 Range: 3.000V



Milliamp or Amps DC

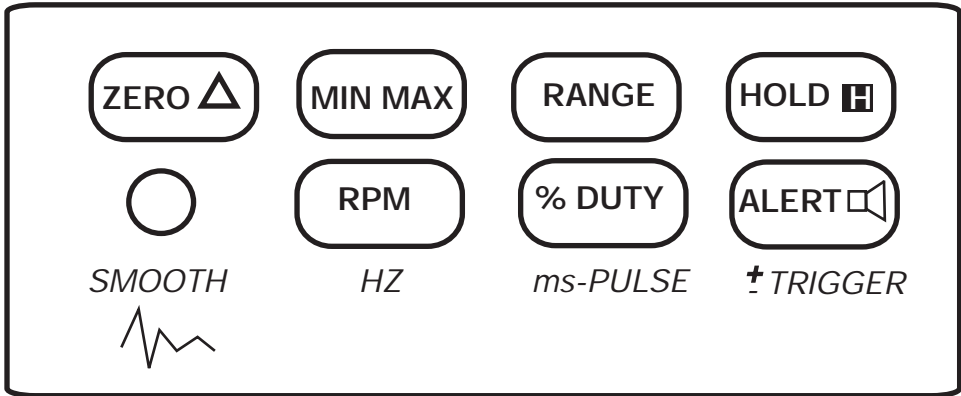
Measures DC Milliamps or amps.
 Ranges: 40mA or 400mA for mA input
 4000mA or 10 A for A input



Milliamps or Amps AC

Measures AC Milliamp or amps
 Ranges: 40mA or 400mA for mA input
 4000mA or 10 A for A input

Push Button Functions



Zero (Relative Reading) Function

Displays difference between the measured value and the stored value.



Minimum (Min), Maximum (Max), Average (AVG) Recording

Records minimum, maximum and calculates the true average.



Manual Range or Auto Range

In Manual Range user selects fixed range. Meter stays in that range until user changes it, selects Auto Range or turns meter off. In Auto Range meter selects range automatically.



Touch Hold

Touch Hold holds last stable reading on display. A new stable reading causes beeper to sound and display to update.

If meter is in MIN MAX Recording, RPM, Duty Cycle, Pulse Width or Hz, Touch Hold interrupts the function. The display is frozen, but recorded readings are not erased.



HZ

RPM / HZ

RPM 2, RPM 1, or frequency
RPM 2, 4-cycle engines
RPM 1, 2-cycle engines
Hz. counts frequency between 0.5 Hz and 200 kHz.



ms-PULSE

Duty Cycle or Pulse Width

Duty Cycle between 0.0 and 99.9% displayed.
Pulse Width between 0.002 and 1999.9 ms displayed.



± TRIGGER

Change Alert, Continuity Beeper or +/- Trigger.

In voltage or current functions selects Change Alert.
In W function selects Continuity Tests.
In Duty Cycle or Pulse Width selects trigger slope.



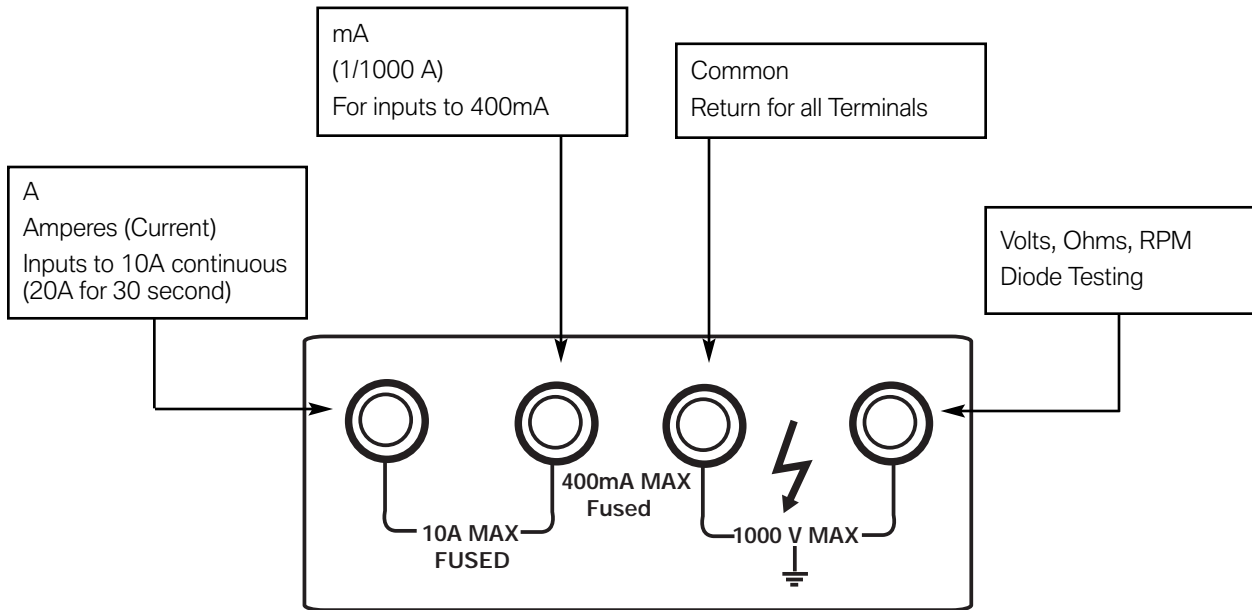
SMOOTH



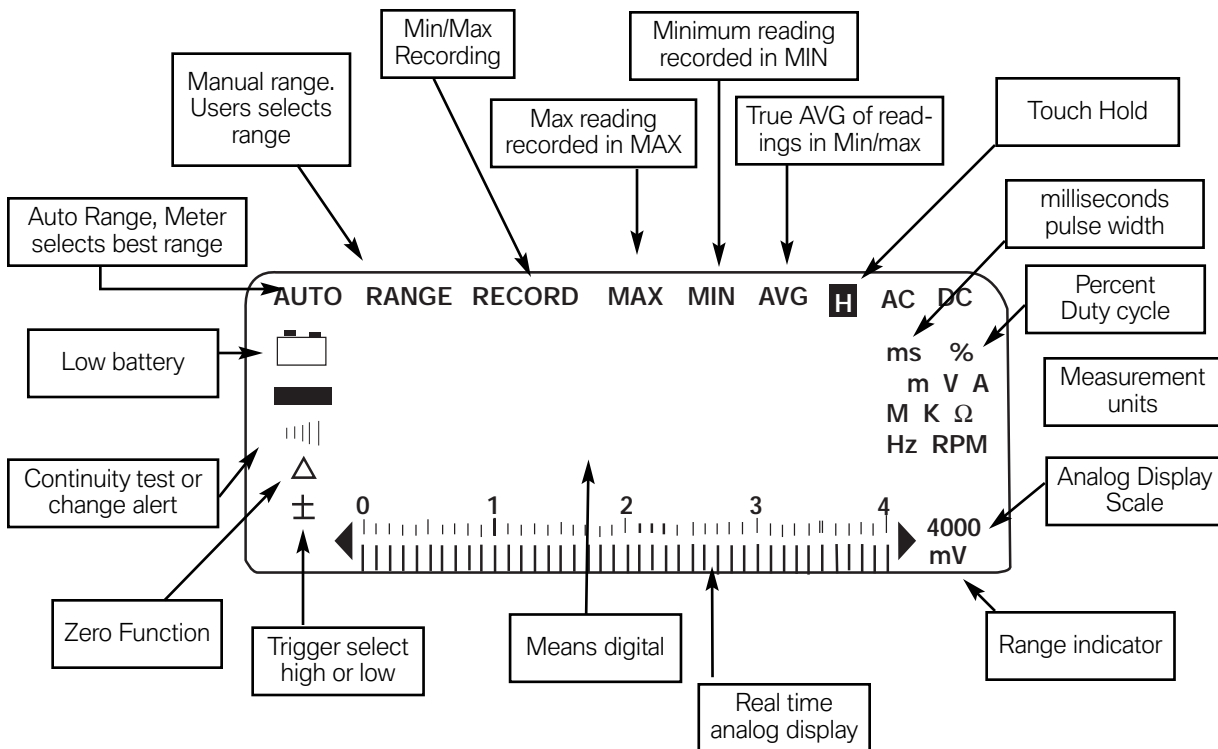
**Smoothing Function and Back-light display
(advance model only).**

Smooth displays average of last eight readings.
Press Yellow button to turn on or off back-light.

Input Terminals

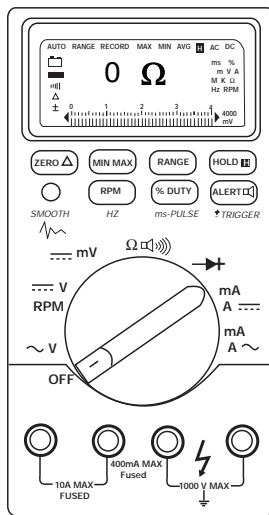


Display

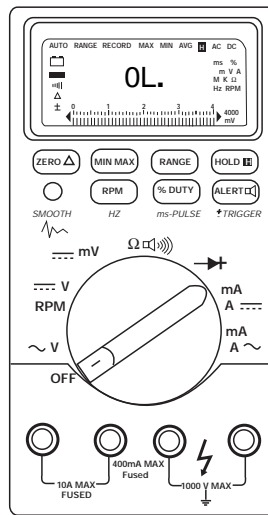


■ Infinity Display

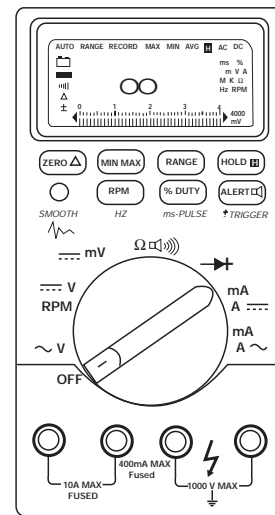
While most displays of DVOMs are standard (i.e. mV means millivolt, mA means milliamp) the display or symbol for infinity or open circuit can be confusing. A display of 0Ω indicates no or little resistance. It means the circuit or portion of the circuit being measured has continuity or is complete. A reading of OL means the circuit is open or not complete, the resistance is said to be “INFINITY”. Some meters may use the symbol ∞ for Infinity. Be aware of which reading the meter being used will give for infinity or open circuit.



Meter 1



Meter 2



Meter 3

Using the DVOM

Voltage Testing

The voltmeter (DVOM) must be connected in parallel with the load or circuit.

The DVOM has a high resistance and taps off a small amount of current.

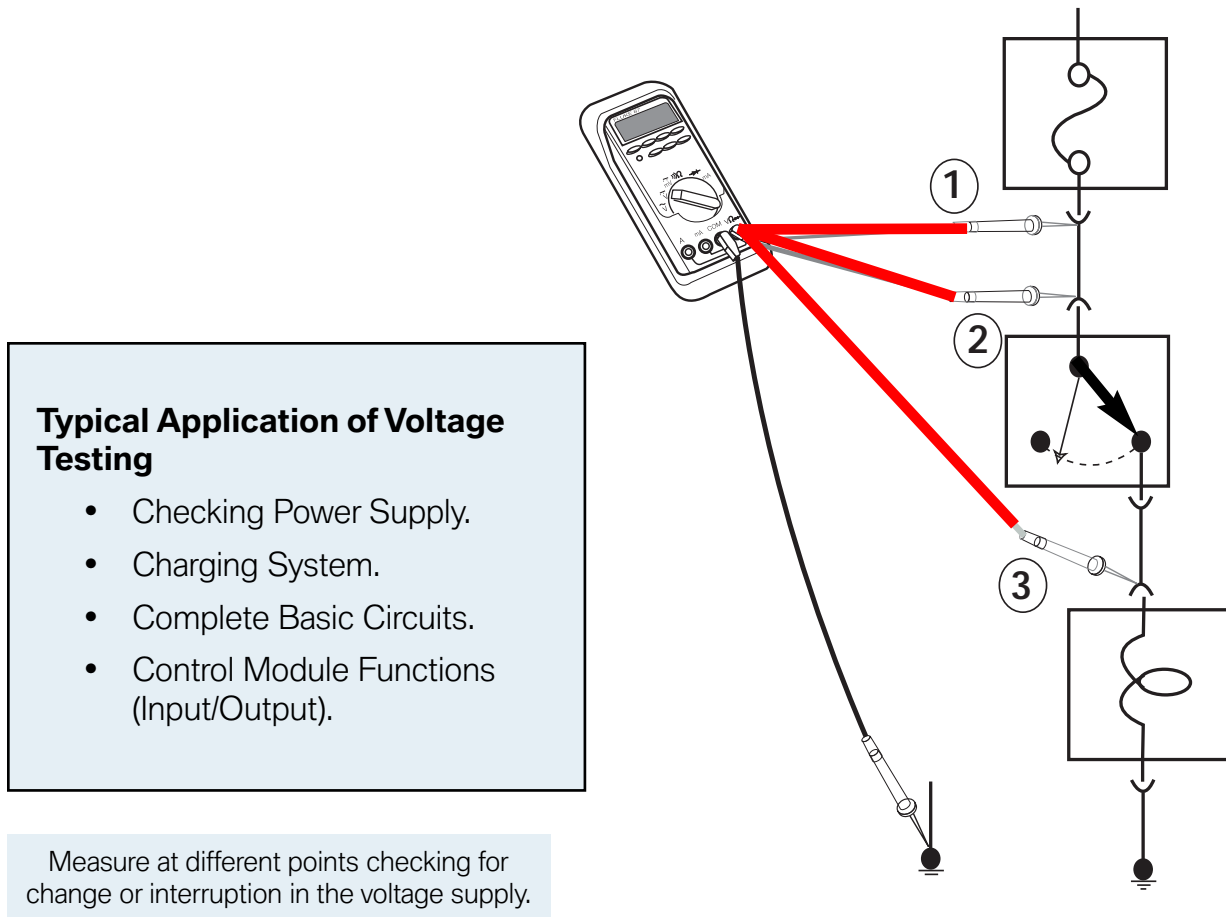
A voltmeter must be used with the current on and with the correct polarity.

The red lead should be connected to the B+ side of the circuit and the black lead to the B- side of the circuit.

If the leads are reversed the reading will be a negative number.

- Select proper function and range of DVOM.
- Connect (-) lead of meter to battery B- or known good ground.
- Connect (+) lead of meter to test circuit.

DVOM will indicate supply or available voltage at that point.



Amperage Testing

To measure amperage the meter must be installed in series in the circuit. The current flow of the circuit must flow through the meter itself.

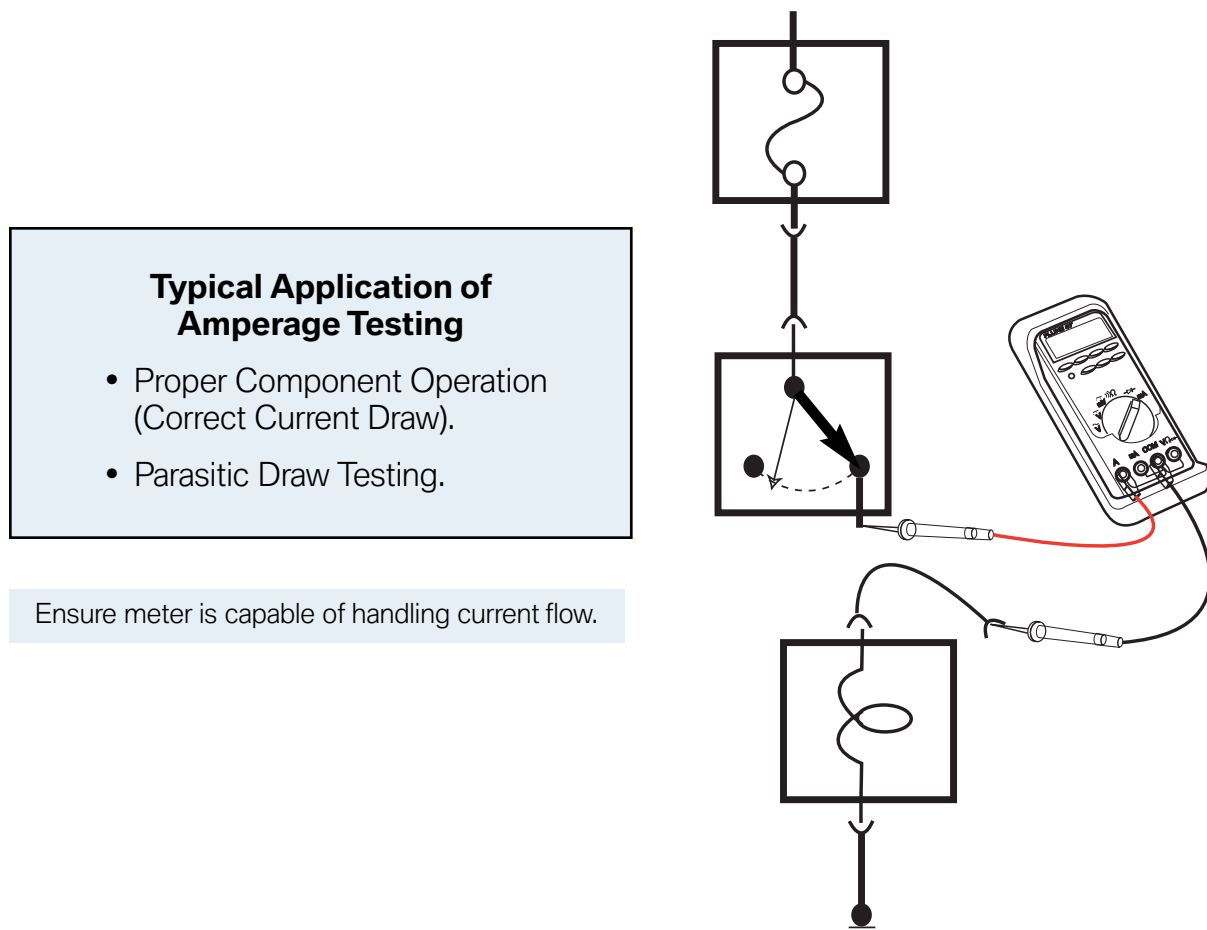
Current must be flowing in the circuit.

Installing the meter in parallel with the circuit may cause damage to the meter, because of the increased current flow in the circuit, due to the low resistance in the meter.

Caution: Most ampere meters or DVOMs are rated for no more than 10 amps. Current flow above 10 amps will damage the internal fuse of the DVOM and render it unable to measure amperage.

- Select proper function of DVOM and move leads to proper position.
- Connect meter in series with (+) lead on the B+ side of the circuit.
- Connect (-) lead of meter to complete circuit.

DVOM will indicate current flow (Amps) through circuit.



Resistance Testing

When set for resistance testing (Ohms) the DVOM must never be connected in a live circuit. The component or portion of a circuit being measured, must be isolated from the power source.

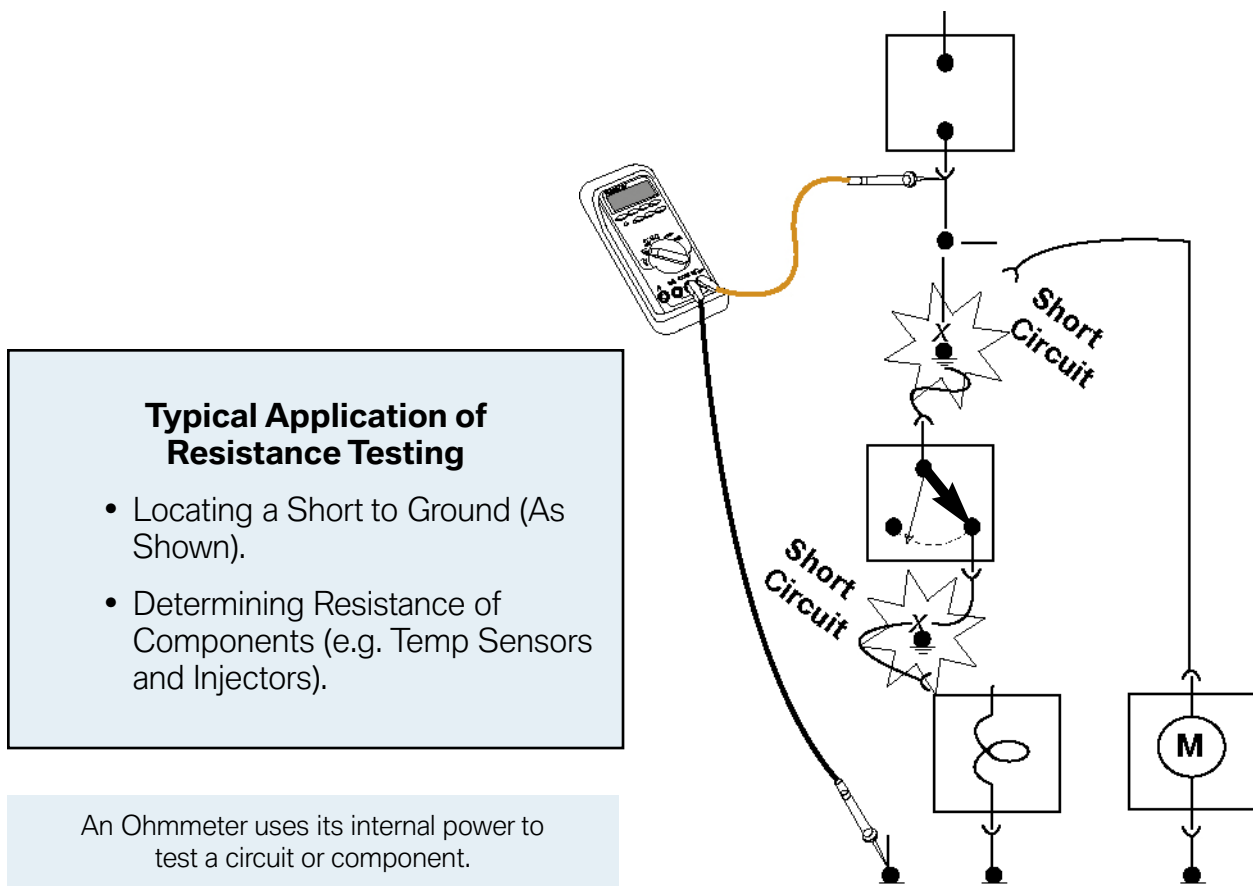
Most modern day DVOM's are self ranging when set to measure resistance, so the meter can not be damaged by out of range measurements.

The test leads may be used without regard for polarity, unless the circuit contains a diode.

The DVOM functions by placing a very small amount of current on the circuit being tested, the red lead must be placed on the anode side of the diode.

- Select correct function and range (Most meters are self ranging in this function).
- Disconnect power to circuit.
- Disconnect any circuit wired in parallel with circuit being tested.
- Connect test leads.

DVOM will indicate resistance (Ohms) of component or circuit being tested.



Continuity Testing

The DVOM uses its own internal power supply to test the continuity of the circuit. The DVOM must never be connected in a live circuit. Any circuits wired in parallel with the circuit being tested must also be disconnected.

Continuity testing verifies that circuit connections are intact. The continuity mode is extremely fast and is used to detect either shorts or opens that last as little as 1 ms.

When a change is detected the beeper tone is stretched to last at least 1/4 second so both shorts and opens can be audibly detected.

This is a valuable troubleshooting aid when diagnosing intermittent faults associated with wiring, connections, switches and other components of the circuit.

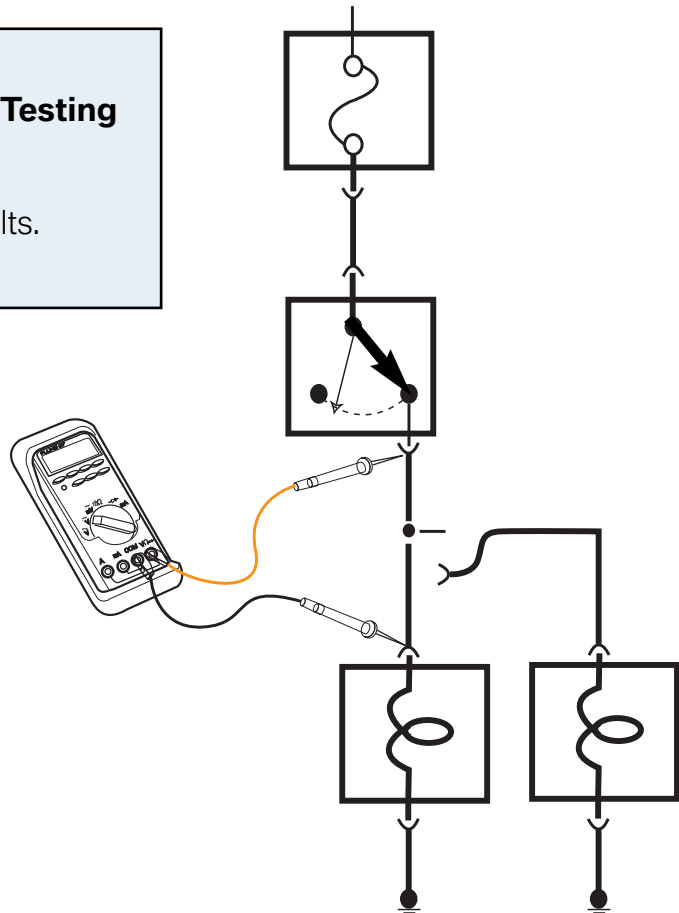
- Select correct function and range of DVOM.
- Disconnect power to the circuit.
- Disconnect any circuits wired in parallel.
- Connect DVOM leads to the circuit to be tested.

DVOM display will indicate continuity of circuit.

Typical Application of Continuity Testing

- Circuit Continuity.
- Intermittent Wiring Harness Faults.

There must be **NO** current available to the circuit during the continuity test.



Voltage Drop Testing

Voltage Drop Tests determine the resistance of an active circuit, a circuit with current flowing.

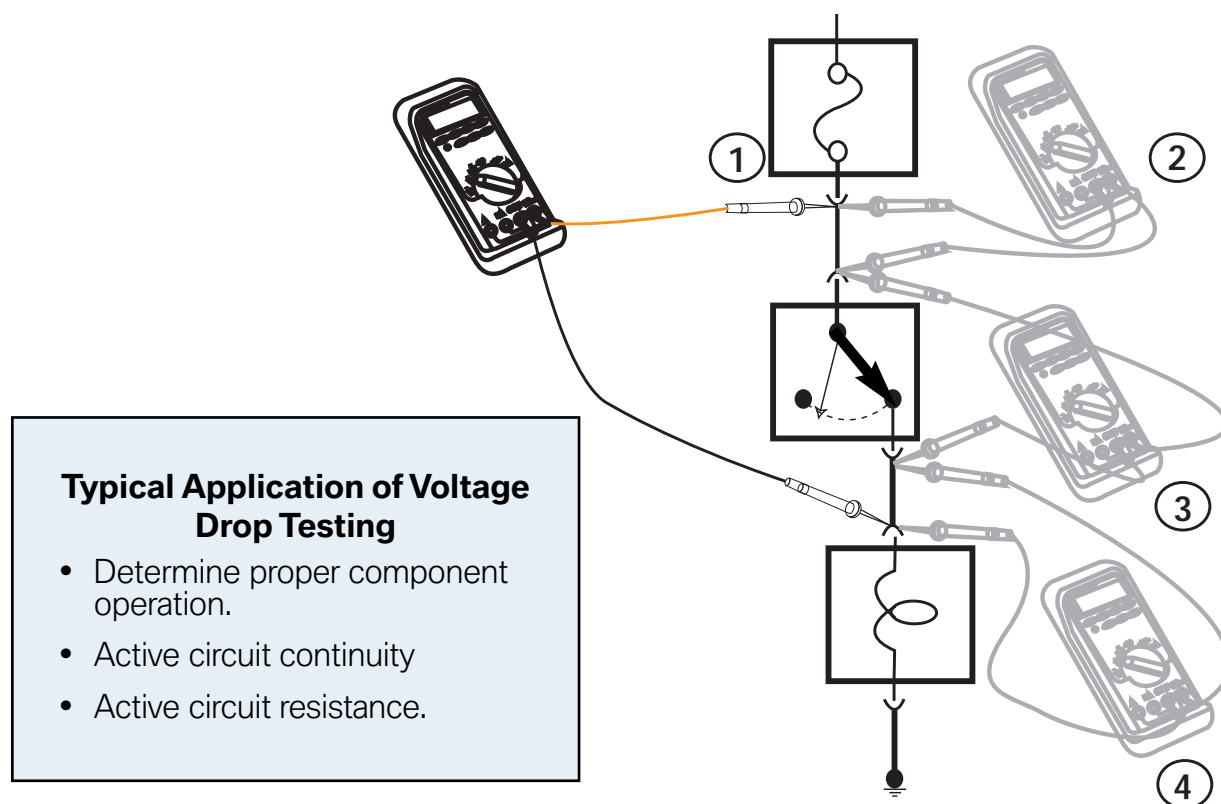
Voltage drop tests are preferred over simple resistance measurements because the power source is not removed from the circuit.

By measuring the voltage on both sides of a load, the amount of voltage consumed by the load is measured.

The voltage drops of each part of a series circuit added together must equal the power supply for that circuit while it is active.

- Select proper function and range of DVOM.
- Connect (+) lead to the B+ side of the circuit or component being tested.
- Connect (-) lead to the B- side of the circuit or component.

DVOM display will indicate the voltage drop in the circuit tested between the DVOM leads.



As a “Dynamic” test with the circuit operational, a voltage drop in any non-resistive part of the circuit indicates a fault in the circuit.

NOTES

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