The Digital Multimeter (8/8/2018) (approx. 60 min)

Introduction

The Digital Multimeter is an instrument designed to measure alternating and direct voltage, currents, and resistance, typically over several ranges of value.

Equipment

Digital Multimeter
Various electronic components provided by the instructor including;
Light Bulbs/LEDs
Wires/Conductors
Batteries/Power Supply

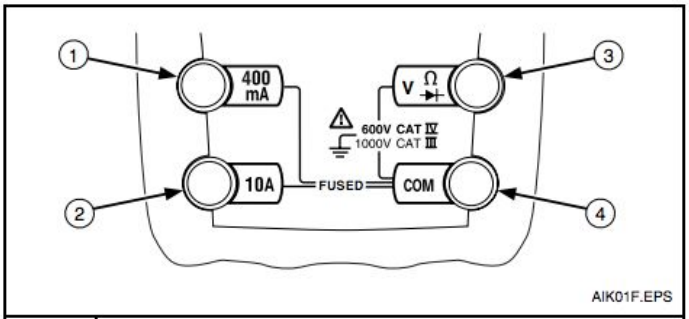
Rotary Switch Positions:

The rotary switch on the multimeter can be rotated to measure various electrical quantities. The table below provides a legend.

Switch Position	Measurement Function
Ṽ Hz	AC voltage from 0.001 to 1000 V. Frequency from 2 Hz to 99.99 kHz.
V⎓	DC voltage from 1 mV to 1000 V.
mV⎓	DC mV from 0.1 mV to 600 mV.
Ω ⊣⊢	Ohms from 0.1 Ω to 50 MΩ. Farads from 1 nF to 9999 µF.
)))) ⊣◂	Beeper turns on at <25 Ω and turns off at >250 Ω. Diode test. Displays OL above 2.4 V.
⎓~ mA	AC mA from 0.01 mA to 400 mA. DC mA from 0.01 mA to 400 mA.
⎓ ~A	AC A from 0.001 A to 10 A. DC A from 0.001 A to 10 A >10.00 display flashes. >20 A, **OL** is displayed.

Multimeter input jacks:

The black lead is always plugged into the common terminal. The red lead is plugged into the 10 A jack when measuring currents greater than 400 mA, the 400 mA jack when measuring currents less than 400 mA, and the remaining jack (V-ohms-diode) for all other measurements. (Voltage, Capacitance, Resistance, LED test, Frequency, etc.)



Item	Description
1	Input terminal for AC and DC milliamp measurements to 400 mA.
2	Input terminal for AC and DC current measurements to 10 A.
3	Input terminal for voltage, continuity, resistance, diode test, capacitance, and frequency measurements.
4	Common (return) terminal for all measurements.

Multimeter range function:

The multimeter measures quantities over a range of values with varying precision. The precision of the instrument can be adjusted by pressing the range button. Pressing the range button will vary the readout between three and zero decimal places.

RANGE

Pressing the range button will change the precision.
0.000V→0.00V→0.0V→0V

The range function dampens display fluctuations of rapidly changing inputs by filtering data.

Measuring AC and DC Voltage:

Batteries are a source of “electromotive force” (EMF) for a circuit. Chemical reactions in the battery maintain a potential difference (i.e. a voltage) between the positive and negative terminals of the battery. If the battery is connected to a circuit with conducting wires then electrons will move from the negative terminal (a region of higher potential energy for negatively charged electrons) toward the positive terminal (a region of lower potential energy). The symbol for voltage is V and its units are Joules/Coulomb or Volts (V).

The digital multimeters measure alternative and direct currents (AC and DC currents). Rotate the rotary switch to the desired voltage measurement:

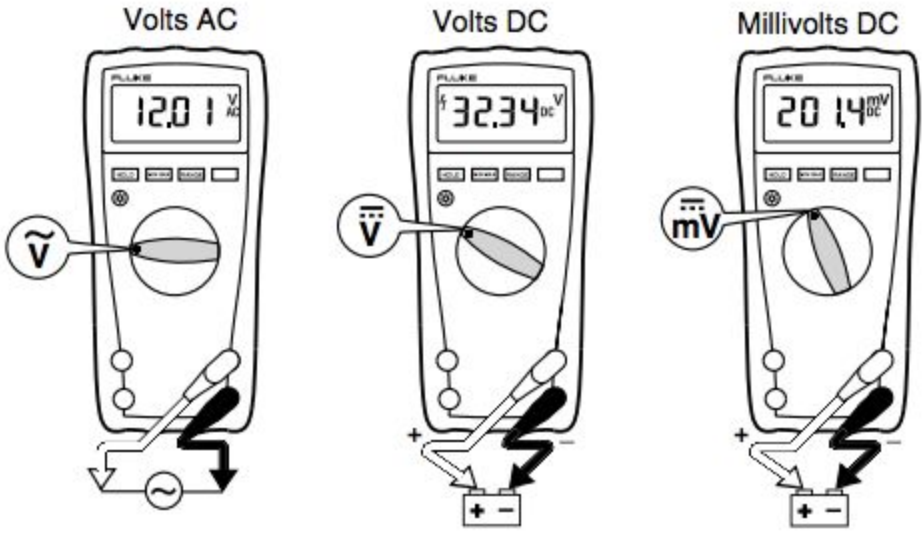


Figure I: Measuring AC and DC Voltage. Note: Lead positions.

When measuring voltage, the black lead is always plugged in the common input jack and the red lead is plugged in the input terminal for voltage, continuity, and resistance. The measure of voltage is the potential difference between terminal (3) and terminal (4), the common (return) terminal for all measurements. The common terminal is defined as zero Volts (zero electric potential) and the reading is the difference in electric potential between terminal 3 and the common terminal.

Measure the voltages of components supplied by your instructor.

Record your results in the space below:

Instructor Sign Off:_____

Resistance:

Resistance: The resistance, R, between two points of a conductor is determined by applying a voltage V between those points and measuring the current, I, that results. The multimeter will provide a current from the internal voltage supply, usually a battery. The resistance is then defined by: R ≡ V/I. The unit of resistance, 1 Ohm (Ω) is therefore defined as 1 V/A. Electrical devices which have a linear relationship between voltage and current under usual conditions are said to obey "Ohm's Law", and may be assigned a single value for resistance. Circuit elements such as capacitors, transistors, etc. have a more complex relationship between voltage and current.

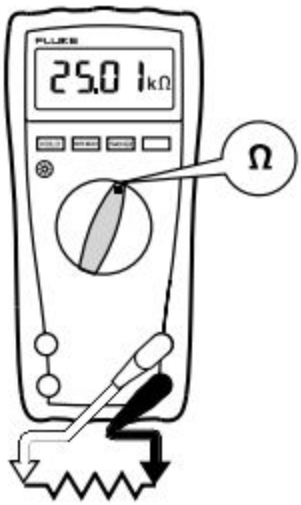


Figure II: Measuring Resistance. Note: Lead positions.

Turn off power, unplug the circuit from the power supply, and discharge any capacitors when measuring resistance. Any external voltage across a component, or attached components will cause invalid resistance readings. The OL reading on the display corresponds with a resistance that is "out of range." Out of range resistances typically occur when the resistance is very high.

Measure the resistances of components supplied by your instructor.

Record your results in the space below:

Instructor Sign Off:_____

Continuity:

In electronics, a continuity test is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a speaker) across the chosen path.

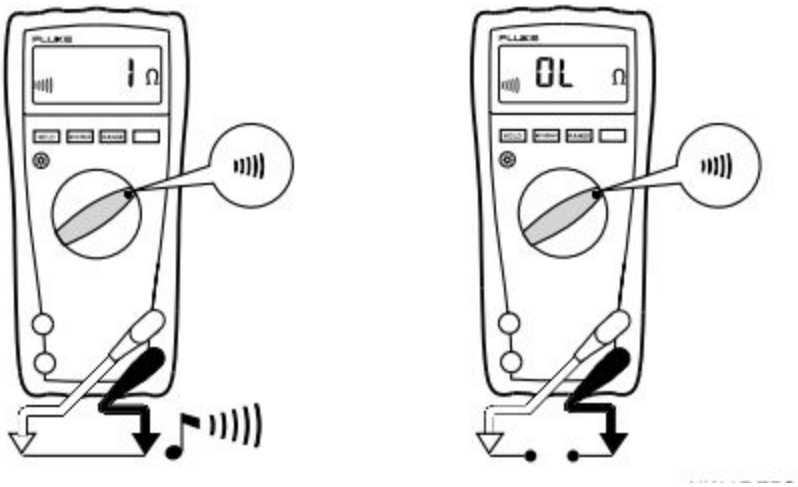


Figure III: Measuring Continuity.. Note: Lead positions.

This mode is used to check if two points are electrically connected. It is often used to verify connectors. If continuity exists (resistance is very small), the beeper sounds continuously.

Measure the electrical continuity of various components provided by the instructor.

Record your results in the space below:

Instructor Sign Off:_____

Current:

Even though we now know it is the electrons which actually move, by convention current is defined as the direction of movement of positive charge. Thus the conventional positive current is said to flow from the higher voltage (i.e. positive) terminal to the lower voltage (i.e. negative) terminal. The symbol for current is I and its units are Coulombs/Second or Amperes also known as Amps (A).

Measuring AC or DC Current.

CAUTION-

Use the proper terminals, switch position, and range for your measurement.

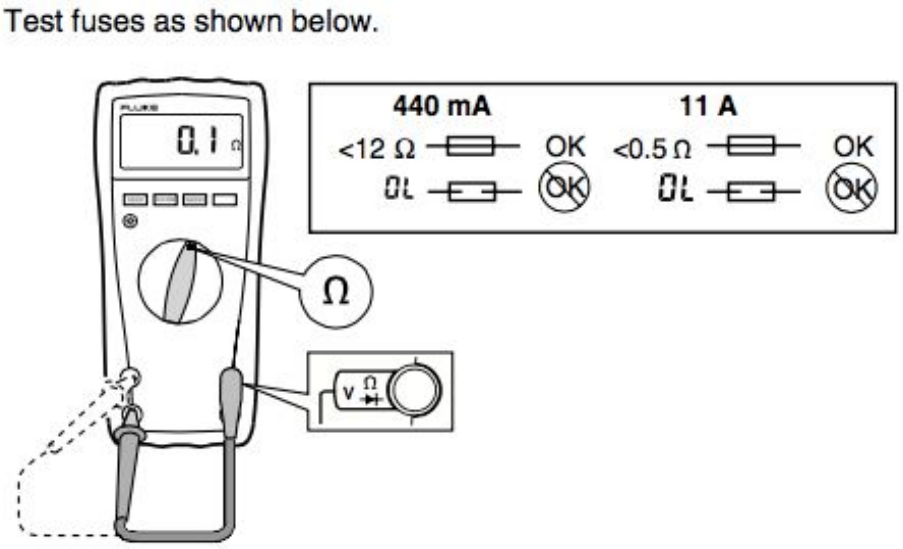
Never place the probes in parallel with a circuit or component when leads are plugged into the current terminals. The multimeter is protected with fuses within the 400 milliampere and 10 ampere terminal channels. Fuses within the multimeter protect the meter from large currents which can cause damage.

Ammeters are generally protected from excessive current by means of a small *fuse* located inside the meter housing. If the ammeter is accidently connected across a substantial voltage source, the resultant surge in current will “blow” the fuse and render the meter incapable of measuring current until the fuse is replaced.

Testing the fuses before and after use:

You may test the condition of a multimeter fuse by switching it to the resistance mode and measuring continuity through the test leads (and through the fuse). On a meter where the same test lead jacks are used for both resistance and current measurement, simply leave the test lead plugs where they are and touch the two probes together. On a meter where different jacks are used, this is how you insert the test lead plugs to check the fuse:

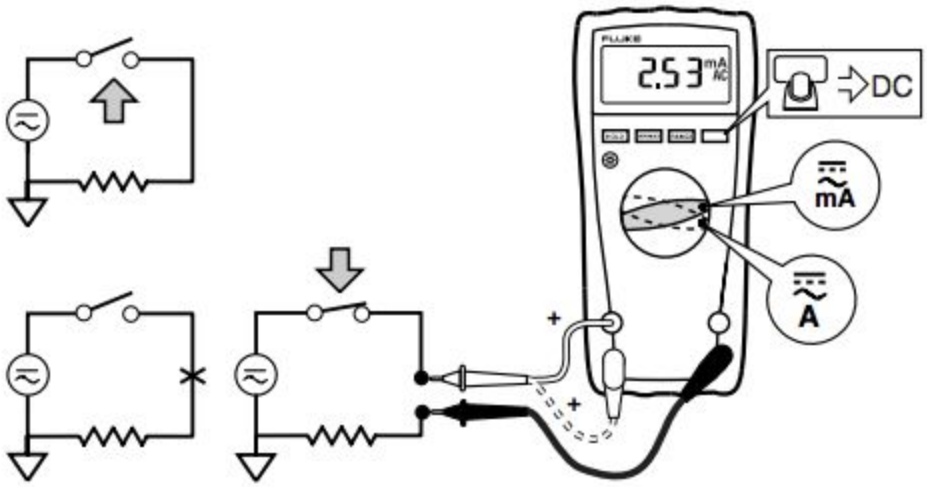
Test the fuses by placing the rotary switch on Resistance (Ω). Place connect the input terminal for voltage, continuity, and resistance to the input terminals for the 400mA or 10 A using either lead wire.



Demonstrate the testing of fuses with the digital multimeter (DMM)

Instructor Sign Off:_____

Measuring AC and DC Currents continued.



a)Disconnect the power within the circuit.
b)break the circuit.
c)insert the meter in series. (Be sure to use the 10 AMP channel first. If the current is below 400 milliAmps (0.4 Amps) you can measure with greater precision with the 400 milliAmp channel.
d)turn power on.

Given a series and or parallel circuit. Measure the current in any location.

Sketch the circuit and record current at various locations below.

Instructor Sign Off:_____