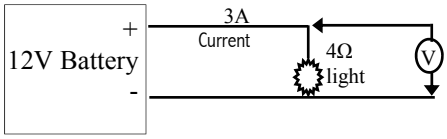
Tech Basics: Multi-Meters –Theory & Use

By Gerald Cooper & Femi G. Ibitayo

Most aircraft mechanics and IAs dealing with Aircraft Electrical Charging Systems (AECS) have three basic uses for Multi-Meters: measuring Voltage, Current, and Resistance. What are these things and how do they work together?

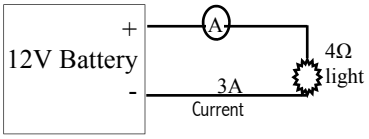
Voltage. Voltage is the electrical pressure needed to move electrons through a circuit. Voltage is like the water pressure needed to move water through a pipe.
Current. Current is the flow of electrons in a circuit. Current is like the flow of water though a pipe
Resistance. Resistance is the opposition to the flow of electrons in a circuit. Resistance is like the resistance that a valve can offer to the flow of water in a pipe.

Voltage is measured by bridging a point in a circuit in reference to another point in the circuit. Ground is the most common reference used in respect to other points in a circuit.



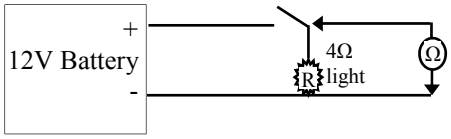
A **Volt** Meter measures voltage by bridging a point in a circuit that will allow a sample of current to be taken. The meter then measures how much resistance is required to stop the flow of current. The result of the relationship between the current flow and the resistance equals Volts. In other words voltage measurement derived came from using the principles of Ohm's Law, V= I*R.

Current is measured in a circuit by opening the current path and inserting the ammeter (current meter) in series with the current path.



The current meter (Ammeter) is a known value of shunt resistor with the measuring circuits in parallel with the shunt resistor. The measuring circuits detect the voltage drop across the shunt and converts it to units that correspond to the calibration of the meter scale. Again, the current measurement derived came from using the principles of Ohm's Law, I= V/R.

Resistance in a material or device, is anything that causes an opposition to the flow of current in a circuit. It is used to control the amount of voltage or current flow in a circuit. Everything in the circuit causes resistance, even wires and connector contacts.



An Ohmmeter measures resistance by inserting an unknown resistance in series with a known resistance and a known voltage, then by measuring the voltage across the unknown resistance, it calculates the resistance by Ohm's Law. Resistance measurement unit is in Ohms, Ω. Its relationship to Ohm's Law is R=V/I.

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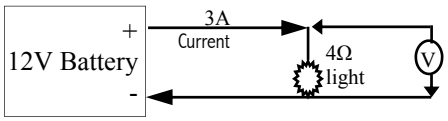
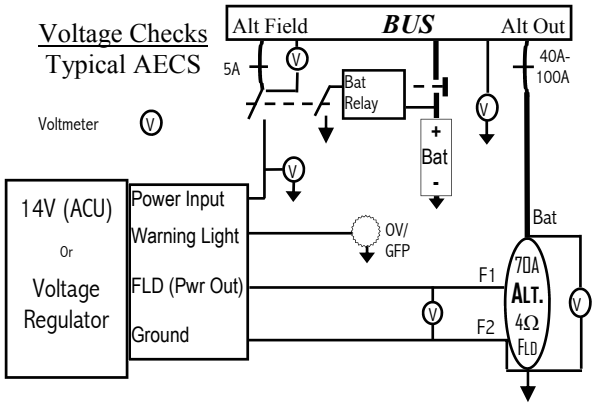
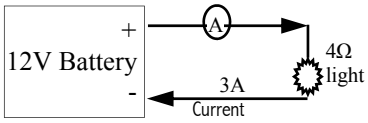
MultiMeters perform **Voltage** measurement by bridging a point in a circuit in reference to another point in the circuit. While ground is the most common reference used in respect to other points in a circuit, voltage measurement across a given component is also possible.



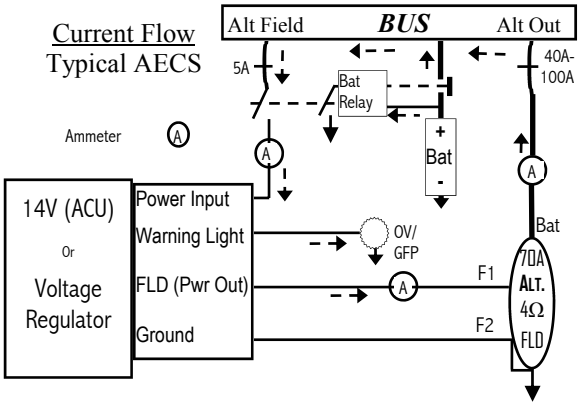
The AECS voltage measurement diagram shows a **Voltmeter** measuring voltages at different points. We can check the voltage across the Alt Switch to verify that its internal resistance is low. A voltage measurement across the ALT field might indicate the condition of the field or the ACU. We can also check the system Bus voltage.



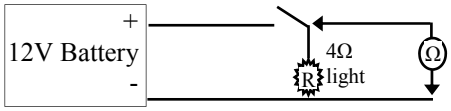
As the current flow diagram shows, we measure **Current** in a circuit by inserting the Ammeter in series with the current path.



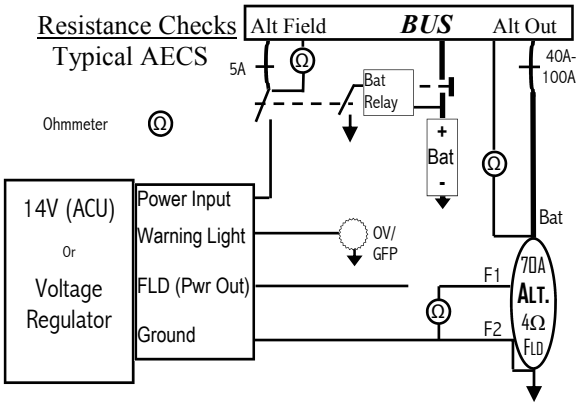
The Ammeter can measure the total current flowing from the alternator or the current flowing through just parts of the circuit. In this AECS circuit, the small field current excites the alternator's stator to produce the current required by all the system's electrical loads. Most Ammeters sense the voltage drop across shunt resistors or magnetically coupled devices. They convert the sensed voltage to corresponding units on the Ammeter's scale.



Every AECS component has **Resistance.** An Ohmmeter measures the resistances of different components to the flow of current. It can help verify that the component's resistance will not impede or allow the flow of current beyond what the component's design or operational specification allow.



For example, a 5A circuit breaker with a 2Ω resistance in a system with 3A field current will cause a 6V drop across it, and not let the alternator work right. One with a 0.02Ω resistance will drop a 0.06V and allow the alternator to work right.



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