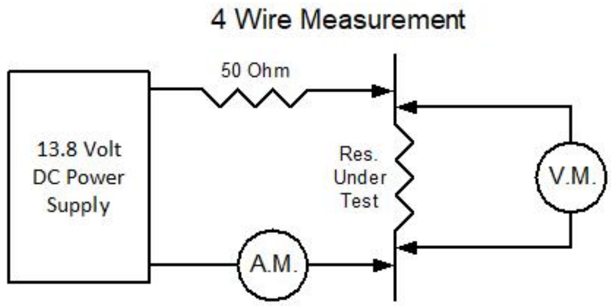
Measuring Low Value Resistors

Measuring a resistance with a typical DMM can be an issue when the resistance gets below a few Ohms. A way around this is with a 4 wire measurement. This approach is definitely not new but doesn't seem to get much attention. An example for using a 4 wire measurement is when making a shunt resistor for an analog meter. The 4 wire measurement has 4 contact points at the test resistor, 2 for a current path and 2 for voltage readings.

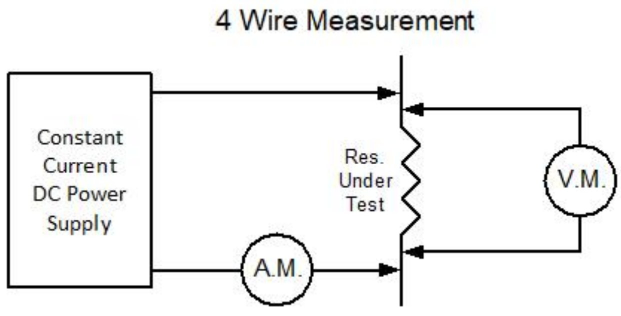


The idea is not to make a direct resistance measurement but to provide a steady current through the resistor to be tested and measure the voltage across it and then do an Ohms Law calculation. For example, if you had say 1 amp passing through the resistor and you measured 1 Volt across it the resistance would be 1Ω (V/I = 1).

For a practical example let's use a typical 13.8 Volt power supply. We will need to limit the output current to a reasonable level so we can, for example, use a 50 Ω resistor in series with the output that goes to the resistor under test. This will limit the current to less than 0.276 amps depending on the value of the resistor under test. The 50 Ω resistor needs to be 4 Watts or higher (V^2/R=W). Two good meters are required, one to measure the series current and the other to measure the voltage across the resistor under test. In our above example let's say the resistor under test is 1Ω. This will change the current from the 13.8 Volt supply slightly, closer to 0.271 amps because we are now dealing with a total series resistance of 51Ω (plus lead resistance). So now we have 0.271 amps X 1Ω = 0.271 Volts across the resistor under test, therefore, 0.271 Volts/0.271 amps = 1Ω (V/I=R). The total resistance from the power supply leads through the current limiting series resistor and the resistor under test is not to critical as long as we have an accurate current reading. Also, the shunt resistance of the voltmeter won't have an effect on the readings because it will be very high, typically 10 MΩ for a DMM.

Here is simpler example using the set up above. Your current meter reads 0.260 amps and the voltage across the resistor is 0.52 Volts so the resistance is 0.52/0.260=2Ω (V/I=R).

The accuracy of your results will of course depend on the accuracy of your meters. You could use higher currents to possibly get higher accuracy but you need to be careful not over dissipate your test or series resistors.



If you have a constant current supply the measurements can be easier. If you set the power supply to say 0.1 amps all you need to do is measure the voltage across the resistor under test. If you measure, for example, 0.06 volts the resistor will be 0.6 Ω, or 0.06/.1= 0.6 Ω (V/I =R). You can see if the current through the test resistor was 1 amp instead of the 0.1 amp shown above the new reading on the voltmeter, 0.6 volts, would correspond to the actual resistance 0.6/1 = 0.6 Ω (V/I=R).

Doing 4 wire measurements does take more time than just doing a simple resistance measurement with a DMM but the accuracy will be better at low resistance values. No special equipment is needed, just a power supply, a current limiting resistor if you are not doing a measurement with a constant current power supply, a couple of good meters and a calculator.

The equipment I used for the above was a Fluke model 75 DMM for the current measurements, a Meterman 10XL DMM for the voltage measurement and a home constructed 0 to 13.8 Volt DC power supply capable of operating in the constant current mode.

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