

BME 3511 Laboratory 2

Digital Multimeter (DMM)

Objective:

The objective of this exercise is to further explore the usage of digital multimeters (DMM). Upon the completion of this lab, the student will:

- Distinguish the different parts of the DMM.
- Use the DMM to measure resistance.

Background:

As discussed in an earlier lab, a digital multimeter (DMM), can be used to diagnose circuits. But before we can use the DMM, we must learn its different components, specifically the Display, the Selection Knob and the Ports. The **display** shows the reading of the measured quantity and typically has three to four digits and the ability to display a negative sign:



The **selection knob** allows the user to set the multimeter to read different things such as current (A), voltage (V) and resistance (Ω):



The third component of the DMM is the probes: the two probes are plugged into two of the **ports** on the front of the unit. **COM** stands for common and is almost always connected to Ground or ‘-’ of a circuit. The **COM** probe is conventionally black but there is no difference between the red probe and black probe other than color: **10A** is the port used when measuring large currents (greater than 200mA), **mAVΩ** is the port that the red probe is conventionally plugged in to. This port allows the measurement of current (up to 200mA), voltage (V), and resistance (Ω):



Here are some key points you should know about using the DMM:

You can only test resistance when the device you're testing is not powered. Resistance testing works by applying a small amount of voltage into the circuit and seeing how much current flows. If the resistor is powered before you begin, there is already voltage in the circuit, and you will get incorrect readings.

You should only test a resistor before it has been soldered or inserted into a circuit. If you measure it in the circuit you will be measuring everything connected to it. Sometimes this is acceptable

Resistance is non-directional. You can switch probes and the reading will be the same.

If you have a ranging meter, you'll need to keep track of what range you are in. Otherwise, you will get strange readings, like **OL** or similar, or you may think you're in $K\Omega$ when really you're in $M\Omega$.

To use the meter, find the ohm (Ω) symbol. If this is a ranging meter, there will be a bunch of subdivided modes.



Figure 1. Ranges for resistance measurement.

Now, you will be shown how to measure the resistance:

- 1) Obtain a multimeter (for us it's a model DVM850BL) and plug in the red probe into the V Ω mA port and the black probe into the COM port.



- 2) Turn the selection knob to 200 Ω as shown below.



- 3) Now obtain the resistor to be measured and place the probes on the ends of the resistor.
- 4) Notice that when the resistor is set to 200 Ω then the DMM has the display shown below. This is an error message which informs us that the resistance of our component is higher than 200 Ω . Therefore we must change the selection knob from 200 Ω to 2k Ω .
- 5) Now the display gives us a reading of 0.556 k Ω or 556 Ω . (Note: Using the resistor code table from the previous lab, we could have estimated the resistance by the color bands. Looking at the colors we have: Green, Blue, Brown, and Gold. From the resistor color table we get: $56 \cdot 10^1 = [560+5\%, 560-5\%]$ or that our resistor can fall anywhere from 588 Ω to 532 Ω .)

Lab Procedure

1. Obtain 15 resistors. Estimate their value using the Resistor Color Code Chart and record it into Table 1 along with the minimum and maximum values. Now use the DMM to measure the values of the resistors and record them in the proper cell.

Nominal Value	Minimum	Maximum	DMM measured value

Table 1. Table for Resistor Values

Questions

1. Do all the DMM measured values fall within the minimum and maximum values? If not, why?
2. Why do you think the DMM values and the nominal values do not agree with each other?
3. Why do you think it is incorrect to measure the resistance after plugging the resistor into the circuit?

References:

- "How to Use a Multimeter." *How to Use a Multimeter*. N.p., n.d. Web. 18 May 2015. <<https://learn.sparkfun.com/tutorials/how-to-use-a-multimeter>>.
- Dr. Hance's Lab