كلية الهندسة

Faculty of Engineering

جامعة الأهرام الكندية

Ahram Canadian University

Electric Circuits I – Laboratory 01

1.1 DC Sources and Metering

1.2 Resistor Color Code

#	Student ID	Student Name	Grade (10)	Instructor signature
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Delivery Date	

1.1 DC Sources and Metering

Objective

The objective of this exercise is to become familiar with the operation and usage of basic DC electrical laboratory devices, namely DC power supplies and digital multimeters.

Theory Overview

The adjustable DC power supply is mandatory in the prototyping of electronic circuits.
Handheld digital multimeter or DMM is designed to measure voltage, current, and resistance at a minimum.

It is very important to keep in mind that no measurement device is perfect;
Their relative accuracy, precision, and resolution must be taken into account.
<u>Accuracy</u> refers to how far a measurement is from that parameter's true value.
<u>Precision</u> refers to the repeatability of the measurement, that is, the sort of variance (if any) that occurs when a parameter is measured several times.
<u>Resolution</u> refers to the smallest change in measurement that may be discerned, which is limited by the number of significant digits available to display.
<u>Valid measurement</u> must be both accurate and repeatable.

DMM offers 3 ½ digits of resolution, the half-digit referring to a leading digit that is limited to zero or one. This is also known as a "2000 count display", meaning that it can show a minimum of 0000 and a maximum of 1999, decimal point is "floating" in that it could appear anywhere in the sequence.

Thus, these 2000 counts could range from 0.000 volts up to 1.999 volts, or 00.00 volts to 19.99 volts, or 000.0 volts to 199.9 volts.

A typical accuracy specification would be 1% of full scale plus two counts. “Full scale” refers to the selected range. If the 2 volt range was selected (0.000 to 1.999 for a 3 ½ digit meter), 1% would be approximately 20 millivolts (0.02 volts).
To this a further uncertainty of two counts (i.e., the finest digit) must be included. In this example, the finest digit is a millivolt (0.001 volts) so this adds another 2 millivolts for a total of 22 millivolts of potential inaccuracy
So; the value displayed by the meter could be as much as 22 millivolts higher or lower than the true value

Example: the value displayed by the meter could be as much as 22 millivolts higher or lower than the true value. For the 20 volt range the inaccuracy would be computed in like manner for a total of 220 millivolts.

Conclusion: if a signal in the vicinity of, say, 1.3 volts was to be measured, greater accuracy will be obtained on the 2 volt scale than on either the 20 or 200 volt scales. In contrast, the 200 millivolt scale would produce an overload situation and cannot be used.

Procedure

1. Assume a general purpose 3 ½ digit DMM is being used. Its base accuracy is listed as 2% of full scale plus 5 counts. Compute the inaccuracy caused by the scale and count factors and determine the total. Record these values in Table 1.

2. Repeat step one for a precision 4 ½ digit DMM spec’d at .5% full scale plus 3 counts. Record results in Table 2.

3. Set the adjustable power supply to 2.2 volts via its display. Use both the Coarse and Fine controls to get as close to 2.2 volts as possible. Record the displayed voltage in the first column of next table 3. Using the general purpose DMM set to the DC voltage function, set the range to 20 volts full scale. Measure the voltage at the ouput jacks of the power supply. Be sure to connect the DMM and power supply red lead to red lead, and black lead to black lead. Record the voltage registered by the DMM in the middle column of next table 3. Reset the DMM to the 200 volt scale, re-measure the voltage, and record in the final column

4. Repeat step three for the remaining voltages of next table 3.

Results

Table 1, 3 ½ digit DMM

Scale	2% FS	5 Counts	Total
200 mV			
20 V			

Table 2, 4 ½ digit DMM

Scale	0.5% FS	3 Counts	Total
200 mV			
20 V			

Table 2, 3 ½ digit DMM measurements

Voltage	Power Supply	DMM 20V Scale	DMM 200V Scale
2.2			
5.0			
9.65			
15.0			

Questions and Conclusions

1. For the general purpose DMM of Table 2.1, which contributes the larger share of inaccuracy; the full scale percentage or the count spec?

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2. For the general purpose DMM of Table 2.1, which contributes the larger share of inaccuracy; the full scale percentage or the count spec?

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1.2 Resistor Color Code

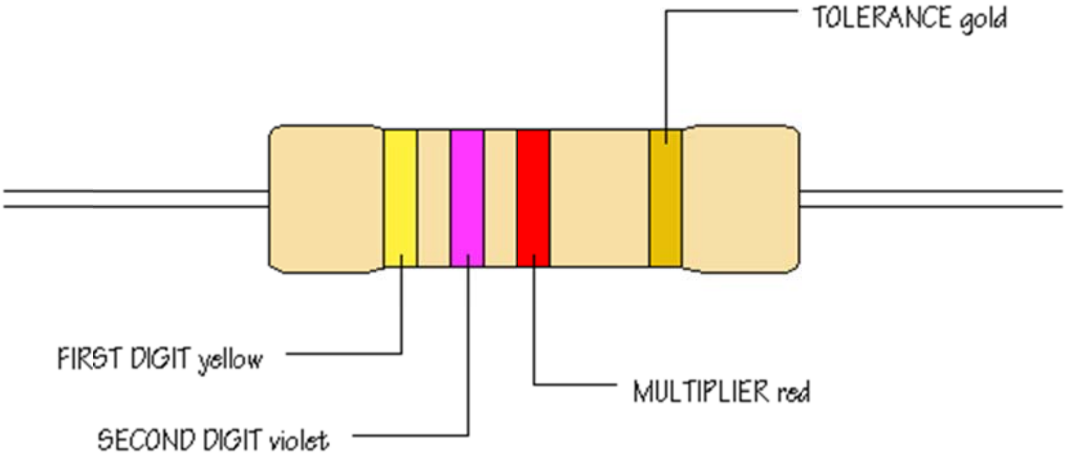
Objective

The objective of this exercise is to become familiar with the measurement of resistance values using a digital multimeter (DMM). A second objective is to learn the resistor color code.

Theory Overview

The resistor is the most fundamental of all electrical devices. For precision resistors, typically 1% tolerance or better, the nominal value is usually printed directly on the component. Normally, general purpose components, i.e. those worse than 1%, usually use a color code to indicate their value.

The resistor color code typically uses 4 color bands. The first two bands indicate the precision values, while the third band indicates the power of ten applied (i.e. the number of zeroes to add). The fourth band indicates the tolerance.



It is important to note that the physical size of the resistor indicates its power dissipation rating, not its ohmic value.

digit	color
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet

8	Gray
9	White

For tolerance

percentage	color
5%	gold
10%	Silver
20%	No

Procedure

1. Given the nominal values and tolerances in Table 1, determine and record the corresponding color code bands.

2. Given the color codes in Table 2, determine and record the nominal value, tolerance and the minimum and maximum acceptable values.

3. Obtain a resistor equal to the first value listed in Table 3. Determine the minimum and maximum acceptable values based on the nominal value and tolerance.
Record these values in Table 3.
Using the DMM, measured the actual value of the resistor and record it in Table 3.
Determine the deviation percentage of this component and record it in Table 3.
The deviation percentage may be found via:

*Deviation = 100 * (measured-nominal)/nominal.*

Circle the deviation if the resistor is out of tolerance.

4. Repeat Step 3 for the remaining resistor in Table 3.

Results

Table 1 converting color to code

#	Band 1 color	Band 2 color	Band 3 color	Band 4 color	Resistor Nominal Value (ohm)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Table 2, calculating resistor value, tolerance, acceptable reading for resistor

#	Resistor Nominal value	Tolerance	Minimum accepted value	Maximum accepted value
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Table 3, measured value and deviation

#	Resistor Nominal value	Resistor Measured value	*Deviation*
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Questions and Conclusions

1. What is the largest deviation in Table 3? Would it ever be possible to find a value that is outside the stated tolerance? Why or why not?

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2. If Steps 3 and 4 were to be repeated with another batch of resistors, would the final two columns be identical to the original Table 3? Why or why not?

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3. Do the measured values of Table 3 represent the exact values of the resistors tested? Why or why not?

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