Lab 2- Acquaintance with measurement devices

Objective:

The objective of this lab is that students get acquainted with analog and digital devices. Although at this time a student is not familiar with electric current and other electrical parameters this lab serves as a preliminary step for using the measurement devices that later on must be widely used.

Materials needed:

Analog multimeter, digital multimeter, two of each of the following ½ W resistors: 4.7 ohm, 47 ohm, 470 ohm, 1000 ohm, 2.2k.

Description:

Almost all electrical parameters can be measured with one instrument called multimeter; this is why the term multi is employed. There are also meters for each individual parameter, but most of them are for more specialized applications. There exist two main types of multimeters, analog meters, which have a needle that moves and shows values, and digital meter (also called DMM), which shows a value by numbers. A digital multimeter is easier to use since it is easier to read the measured values; it is not necessarily more precise (as some people may think).

The precision of a measurement device depends on two factors, how sensitive the device is and what the range of values to measure is. The sensitivity of a device is governed by its design and the way it works. As for the range of values, consider a scale for measuring weight. If the range of values to measure is between zero and 10 (pounds, for instance) and there are 20 graduations for the needle position, then each graduation can represent 0.5 (10 ÷ 20). Since you can also read a fraction when the needle is in between two graduations, the smallest number that the device can measure (which defines the precision of the device) is less than 0.5. If the device is to measure between 0 and 200, and again it has 20 graduations, this time the difference between each two neighboring numbers is 10 (200 ÷ 20). With this device it is impossible to measure a weight to 1 lb precision if reading the needle position is done correctly (the last digit of a reading, say whether 42 or 43, depends on the judgment of a user).

For a digital measurement device the precision cannot be more than what the instrument can offer before the number is converted to show on a digital display. Nevertheless, the display can have (as is the case for most DMM's) 3 or 4 digits. The more the number of digits, the higher is the precision of the device. Suppose that a digital reading is 34.56 in a four-digit multimeter. On a device with only 3 digits this number is rounded to 34.6, which has less precision.

Usually digital multimeters have an automatic range selection. So, with a 4 digit display always four digits are shown, but the precision changes. For instance, suppose that a measured value in

the range between 3 and 4 is shown as 3.456. If the measured value is between 30 and 40 the reading can be 34.56. The same four digit number for a value in the range of 300 to 400 is 345.6; and so on.

Exercises:

For this exercise you read the values of resistors. Resistors are used in many electric and electronic devices. At this time you consider them as components that have a value and you want to measure the values for some of them, in the same way that you may have a number of pebbles that you want to find their weights.

Identify the resistors by the color bands on them. Each one should have four color bands. Use only three of them. Find and separate in groups the resistors having the following colors in order from one end, respectively:

Yellow, violet, gold (group 1)

Yellow, violet, black (group 2)

Yellow, violet, brown (group 3)

Brown, black, red (group 4)

Red, red, red (group 5)

If there are no color bands on the resistors, ask your instructor to group them for you.

(a) Exercise with analog multimeter

When reading a meter with a needle you must look perpendicular to the needle and the face of the instrument in order to have less error in reading a value. The meter has a rotary selector switch. You are going to use those selections identified by an X (like X, 10X, 100X, or R1X, R100X, R1000X).

1- If the meter has an on-off switch, turn it on. Put the range on X or R1X.

2- Connect the two leads of the meter together. The needle moves to right. With a knob that you find on the meter adjust the position of the needle to zero. Every time you change the range, for instance from X to 10X) you need to check for zero and adjust the meter if necessary.

3- The meter has various scales for reading. Identify the one that has a symbol Ω near it or at its end.

4- Depending of the range that you have selected with the rotary switch the numbers that you read must be multiplied by the number shown by the rotary switch. For example, if the rotary switch is set on 10X and you read 3 on the meter your reading is 30, or when the scale is R100X and you read 2.2 the reading is 220 and if you read 22 the reading is 2200.

5- Try to select a range that the needle is not too far on the right or on the left when you make a measurement. Change the range, as far as possible, so that the needle is in the middle area.

6- When doing a measurement the contacts between the meter leads and the points you connect to must be firm. Loose connections can give you a wrong reading.

7- When the needle is not exactly on a graduation line, try to read the fraction for a number as best as you can.

8- Measure the values for each of the two resistors in each group. Try the measurement with all available ranges, then select the best (more precise value in your judgment) and write the two values down in the lab report.

(b) Exercise with digital multimeter

Digital multimeters are usually capable of automatically adjust the range for a measured value and show the result with 3 or 4 digits (they come with 3 or 4 digits). Also, they may have a button for switching from automatic to manual. With manual selection the precision can be changed. The number of display digits, however, cannot be more than what a meter comes with.

Similar to analog multimeters digital meters have a rotary switch with which measurement for various electric entities may be selected.

1- Put the rotary select switch where you can see a symbol Ω.

2- There is no need to adjust for zero position or value.

3- Measure the values for the same groups of resistors in the same order that you did with the analog meter.

4- Record your measurements on the lab sheet in the same order as before.

(c) Compare the results for each measurement that you have made. If you see any major difference or discrepancy between each pair of results, repeat those measurements.

(d) Write a few paragraphs about your findings and all what you learned from this experiment. Type your write-up and print on a separate sheet. Staple it to the lab sheet.

Lab Report page

Name ---------- Date ---------- Lab # ----------

Analog reading:

Group	Resistor 1	Resistor 2

Digital reading:

Group	Resistor 1	Resistor 2