Laboratory Instruments

Electricity Laboratory Set

The basic electricity lab set consists of a DC voltage source of 15 V, an AC voltage source of 12 V, a potentiometer of 5kΩ, ammeter that can measure currents in the range of μA, a stopwatch and can be set up on circuits. Figure 1 shows the electricity lab set used in our laboratory.

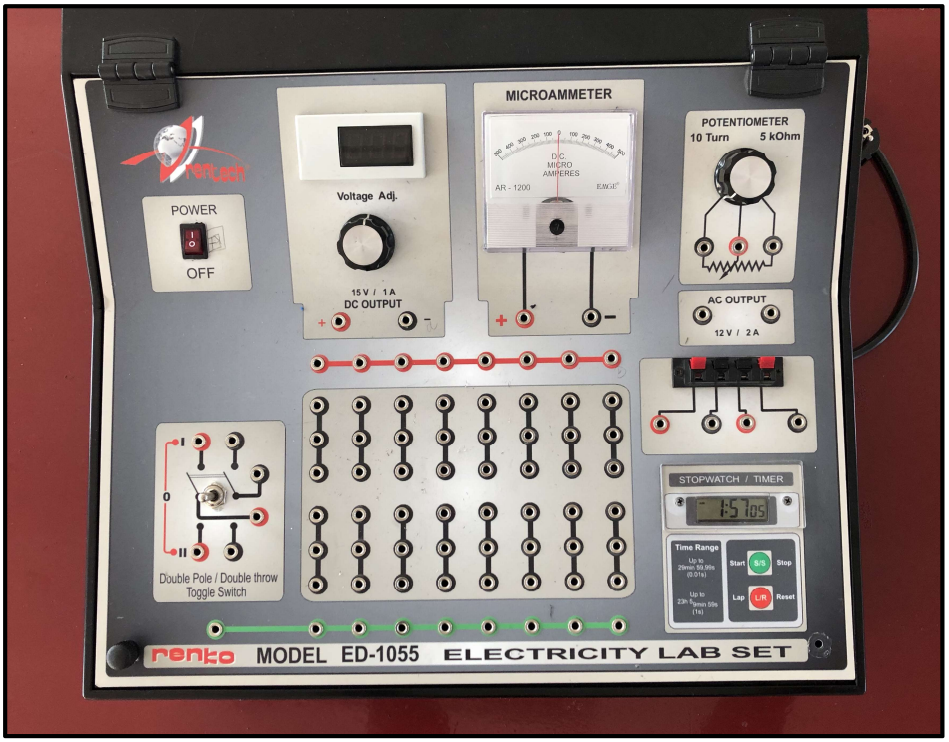

Figure 1. Electricity laboratory set

What is a Digital Multimeter? How to use it?

Digital Multimeters are used for measuring current (AC / DC), voltage (AC / DC) and resistance. These devices are also called AVOmeter, which is the first letter of the current unit Amper, the voltage unit Volt and the resistance unit Ohm.

- **Measurement of voltage**

In order to measure the voltage with an avometer, the measuring scale of the device must be set to one of the $V-$ (DC) or $V\sim$ (AC) scales. If the approximate value of the voltage value to be

measured is unknown, the measurement must be carried out starting from the largest step. Otherwise, the fuse of the avometer can become flammable and unusable.

After the measurement scale is set, the black cable is connected to the COM (common) connection and the red cable to the V connection. The other ends of the cables are connected in parallel to the circuit element to be measured as shown in Figure 2. When making the connection, the red tip must be installed on the side where the voltage is high. Otherwise, the measurement result will be the same as in magnitude but a minus sign in front.

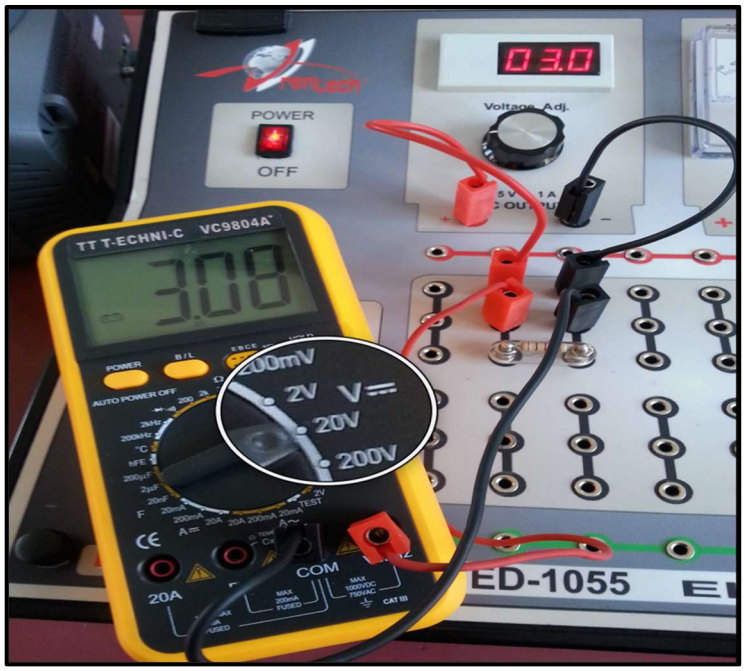

Figure 2. Measuring the voltage value between the ends of the resistance by the Avometer.

The reason for the parallel connection of the avometer when measuring voltage is that the voltages in the parallel arms are equal to each other. The voltmeter must not change the voltage of the circuit passing through the measured resistance. Therefore, the internal resistance of the voltmeter is ideally infinite, in practice it is very large.

- **Measurement of current**

In order to measure the current with an avometer, the measurement scale of the device must be set to A⎓ (DC) or A ~ (AC). The maximum current value that an avometer can measure is constant, and if a current greater than this value is to be measured, a multimeter that can measure larger currents should be used. If there is no information about the current value to be measured,

the measurement must be carried out starting from the largest step. Otherwise, the fuse of the avometer can become flammable and unusable.

Once the measurement scale is set, the black cable is connected to the COM connection and the red cable to the A connection. The other ends of the cables are connected to the circuit element in series as in Figure 3. When making the connection, the red tip must be installed on the side where the voltage is high. Otherwise, the measurement result will be the same as the magnitude but minus sign in front.

The reason for the serial connection of the avometer when measuring current is that the current flowing through each of the series-connected circuit elements is of equal magnitude. The ammeter must not change the current in the circuit to which it is connected. The internal resistance should be zero. If the ammeter current is connected in parallel to the circuit element to be measured, the internal resistance of the ammeter is too small to cause a high current to pass through and the fuse will become inoperative.

Figure 3. Measuring the current value of the resistance with the avometer.

WARNING:

Measurements have to be done along with the range specified by the range-fixing knob of the avometer.

Whenever you use the avometer, first put the range fixing knob at its maximum range and gradually decrease it to the appropriate range.

- **Measurement of resistance**

To measure the resistance of a circuit element, the black cable is first connected to the COM connection and the red cable to the Ω connection. The other ends of the cables are connected in parallel to the circuit element whose resistance is to be measured as shown in Figure 4. The circuit element must not be connected to the power supply when measuring resistance. Also, if there is no information about the resistance value to be measured, the measurement must be carried out starting from the largest range on the avometer.

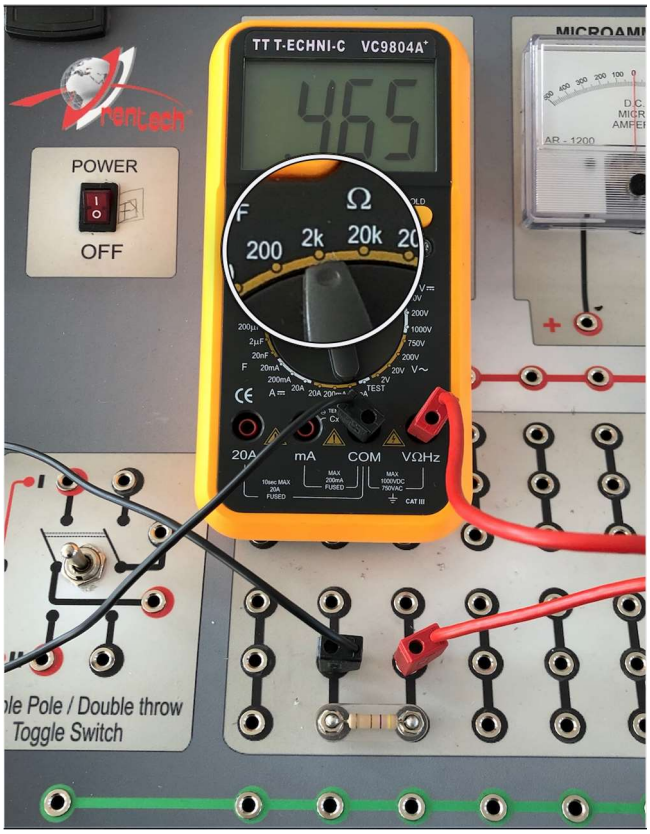

Figure 4. Measuring value of the resistance with the Avometer.

- **Determination of Resistance Value by using Color Codes**

There are usually four colored bands on one resistor. When determining the magnitude of the resistance by using these colored bands, first of all, the gold or silver part must be brought to the right side. In this case, if the colors are respectively ABCD, the magnitude of the resistance is determined by calculating the following equation.

$$\mathbf{AB} \times 10^{C} \pm \%\mathbf{D}$$

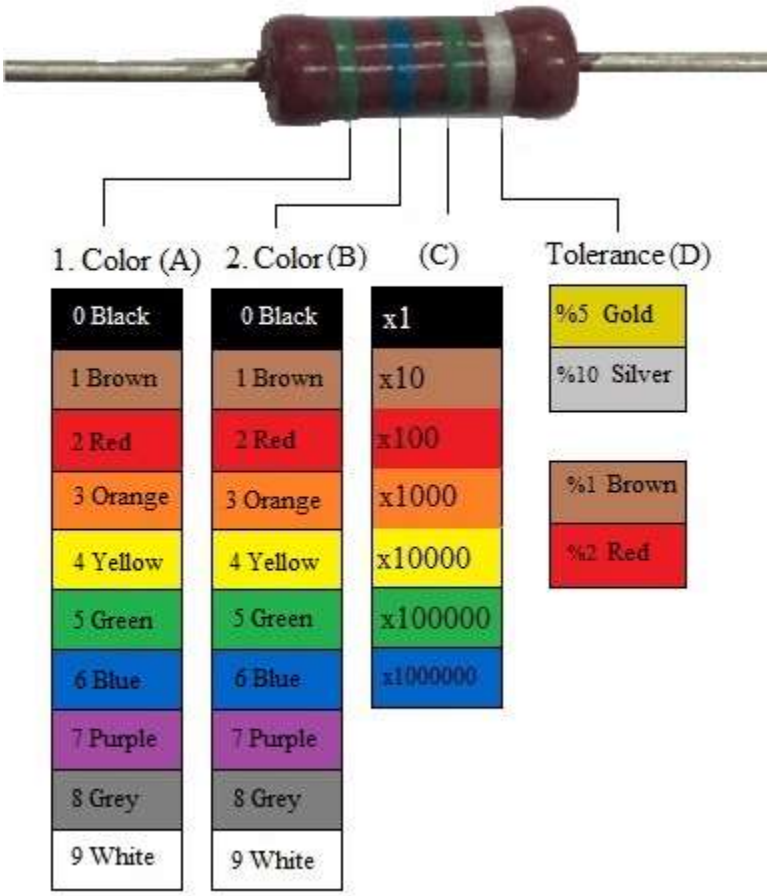

Figure 5. Color codes for four-color resistance

The color codes of the resistance in Figure 5 are "Green Blue Green Silver". In that case, A = Green = 5, B = Blue = 6, C = Green = 5 and D = Silver = 10%; $AB\times10^{C}=56\times10^{5}=5600000\ \Omega=5,6\text{M}\Omega$. In this case the tolerance of the resistance is $5600000\times\frac{10}{100}=560000\Omega$. So, the magnitude of the resistance is defined as $R=5600000\pm560000\ \Omega$ and it is in the range of $6160000-5040000\ \Omega$.