

Using the Multimeter

Multimeters are indispensable measurement tools that allow you to accurately measure currents, voltages, both AC and DC, and resistance.

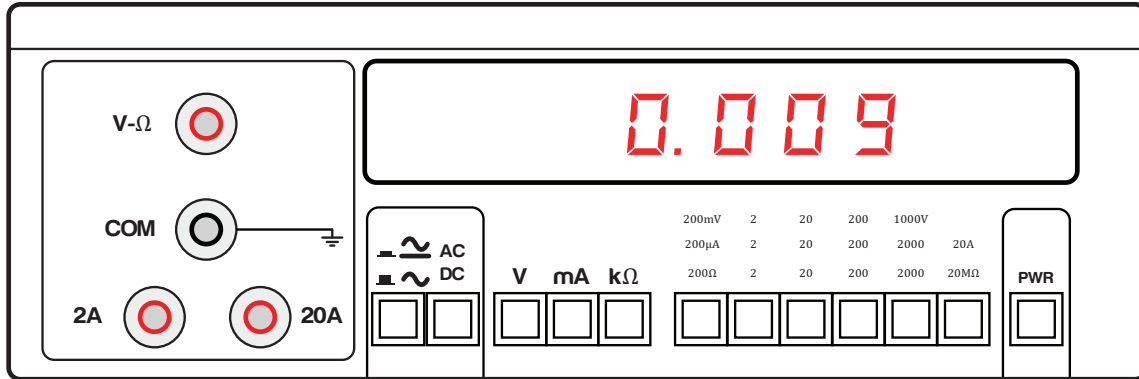


Figure 1: The front panel of the benchtop multimeter.

Using the multimeter is simple, the multimeter connects to your circuit via banana cables, using the ports on the left side of the front panel. When measuring voltages and resistances, connect the multimeter across the circuit or device, using the "Voltage and Ohms" port indicated in Figure 2 and the black COM port.

To measure series current, make a break in your circuit, and bridge the gap through the multimeter. Current is measured using the current ports and the black COM port. You will not often be measuring any significant amount of current, hence you should use the leftmost current port marked "2A".

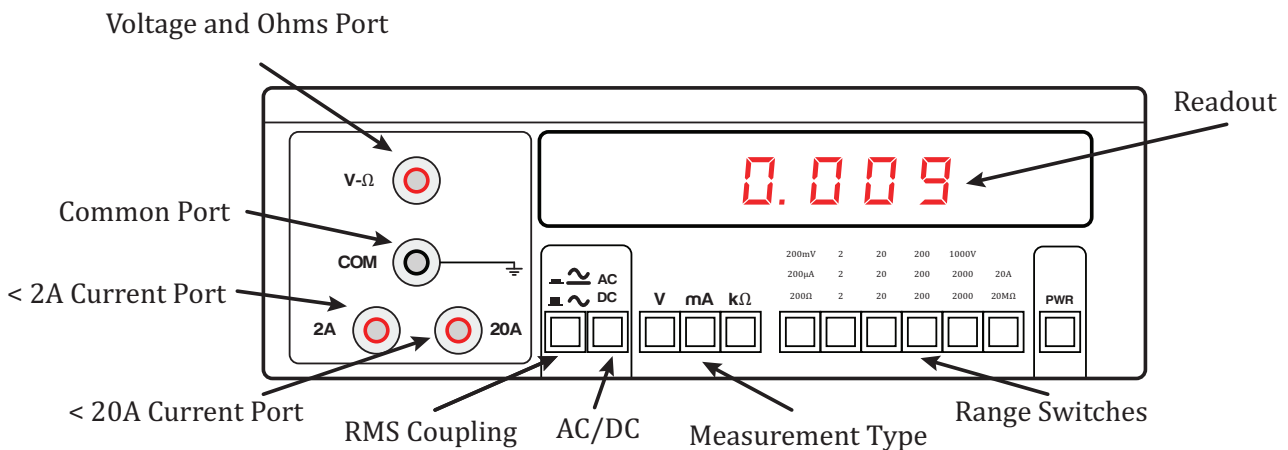


Figure 2: The front panel of the benchtop multimeter with functionality labelled.

The range switches are used to set the multimeter's measurement range, you should decide what range is suitable for your measurement *before connecting* your circuit to the multimeter. Treat the ranges indicated on the front of the multimeter as the maximum allowed values for that range setting. For example, if you are expecting to measure around 5 volts, select the 20V measurement range. This is particularly important for current measurements, **applying a higher current than the selected range**

allows will blow the protection fuses in the device. The ranges are specified in volts [V], milliamps [mA], and kilo-ohms [$k\Omega$]. If you are not sure, choose the higher measurement range first and confirm that the current or voltage can indeed be measured safely on the smaller range.

Applying an input signal that exceeds the limits of the range selected will cause all the digits on the display to flash. If you have the multimeter configured in a way that doesn't make sense, the decimal places on the display will flash. For example, selecting the $20M\Omega$ range while measuring voltage will cause the decimal places to flash as there is range setting above 1000 V.

RMS Measurements

When you measure AC signals with the multimeter, the reading you get is the RMS value of the signal. In fact, the benchtop multimeters in the laboratories are *true RMS* meters, which means that the RMS value of the signal is calculated accurately from digitally sampled readings. In cheaper or older multimeters, the signal is assumed to be purely sinusoidal, and hence the RMS value is computed by multiplying the average value by a correction factor. This method works well if the signals you are measuring are sinusoidal, but produces incorrect readings for other kinds of signals, or if there is a significant amount of noise present in the signal.

The switch to the left of the AC/DC switch is used to set the AC/DC coupling of the RMS measurements. If any DC is present in the input signal, it will be included in the RMS measurement given by the multimeter. If this is important for your measurement, push the coupling switch in as the diagram above the switch indicates. Alternately, leaving the switch out AC couples the RMS measurement, giving you the RMS value of the AC component of the signal only.

Summary

The procedure for taking a voltage measurement is as follows:

1. Plug a red banana cable into the red topmost port marked $V - \Omega$.
2. Plug a black banana cable into the black port marked COM. Reserving black for ground connections is good practice.
3. Push the AC/DC switch if you want to take an AC measurement. Depress the switch for a DC measurement.
4. Push the voltage switch "V", and select the measurement range.
5. Connect the red cable to the positive measurement point in your circuit, and the black cable to the negative measurement point in your circuit.

To measure current:

1. Plug a red banana cable into the bottom left red port marked "mA".
2. Plug a black banana cable into the black port marked COM. Reserving black for ground connections is good practice.
3. Push the AC/DC switch if you want to take an AC measurement. Depress the switch for a DC measurement.
4. Push the current switch "mA", and select the measurement range.
5. Connect the multimeter in series with the current you need to measure. Current flowing into the multimeter through the red cable will be measured as positive.

Finally, to measure resistance:

1. Plug a red banana cable into the red topmost port marked $V - \Omega$.

2. Plug a black banana cable into the black port marked COM.
3. If the element you are measuring is in a circuit, take the element out.
4. Connect the cables across the element and choose an appropriate measurement range.