3.1 Measuring instruments

Electronic engineering depends on the processing and transmission of signals and information in electrical (and optical) form. The electronic technician had to depend on the instruments to observe and measure the electronic circuit.

3.2 Electrical quantities to be measured

Major electrical quantities that need to measure are as follows:

- Voltage (V)
- Current (A)
- Frequency (Hz), phase shift (º) and time (s)

3.3 Instruments to measure voltage and current

There are two main types of instrument used to measure voltage and current :

- Electronic multimeter
- Electromechancial meter

Electronic multimeter

Electronic meter are based on analogue-to-digital conversion, comparing voltage to be measured against an internal reference voltage. These types of meter are usually multi-purpose and capable of measuring resistance as well as AC and DC voltage and current. They are commonly known as Digital multimeter or DMM.

Electromechancial meter

Electromechancial meter depend on the deflection of a current-carrying conductor, normally a coil, in a magnetic field to move a pointer or needle against calibrated scale. Fig 3.3 shows the typical arrangement of a moving coil DC ammeter (or current meter).

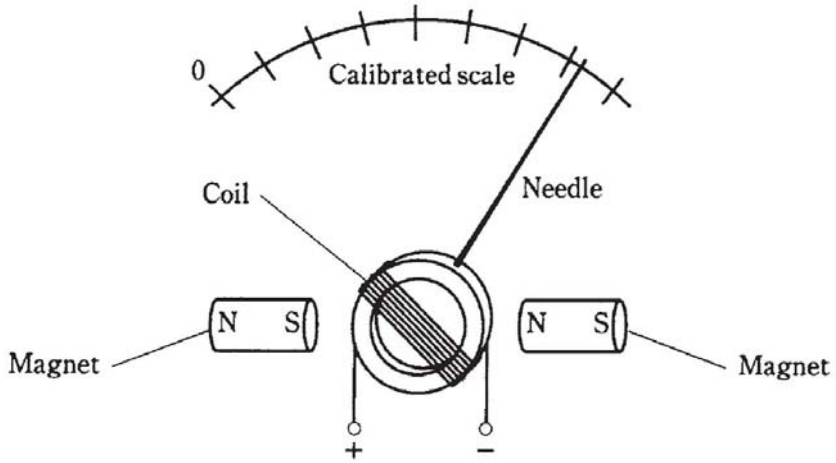


Fig 3.3 General arrangement of a moving ammeter

3.4 Instrument to measure frequency and time

Measurement of voltage, frequency, time and phase can be made with an oscilloscope. It also allows waveforms to be visualized and the operation of circuit to be observed.

Fig. 3.4 Oscilloscope

What do meters measure?

A meter is a measuring instrument.

An **ammeter** measures current.

A **voltmeter** measures the potential difference (voltage) between two points.

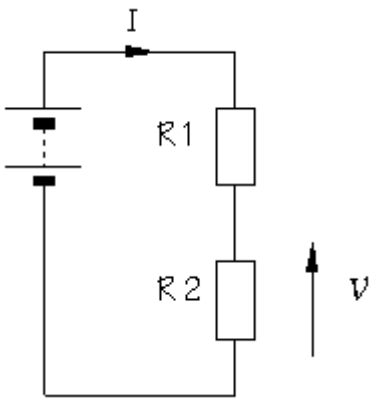
An **ohmmeter** measures resistance.

A **multimeter** combines these functions, and possibly some additional ones as well, into a single instrument.

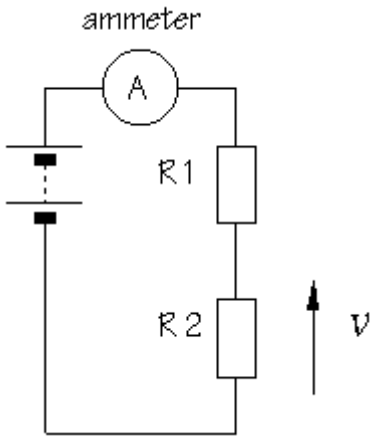
How meters are connected into circuits:

I) Diagrams *A* and *B* below show a circuit before and after connecting an ammeter:

A



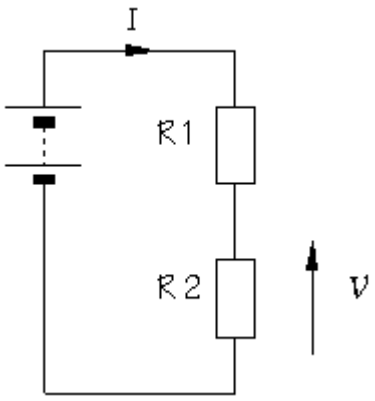
B



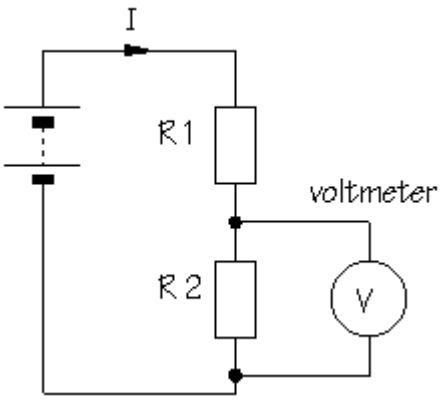
One needs to *break the circuit* so that the ammeter can be connected in series. All the current flowing in the circuit must pass through the ammeter.

II) Diagram *C* shows the same circuit after connecting a voltmeter:

A



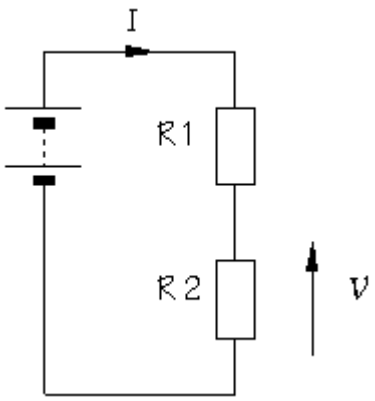
C



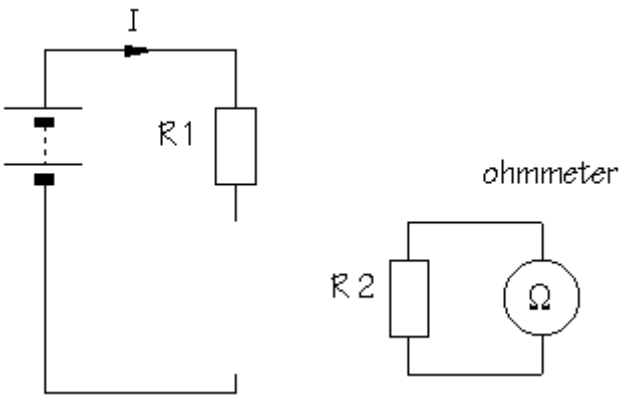
One does not need to break the circuit. The voltmeter is connected in parallel between the two points where the measurement is to be made.

III) An ohmmeter does not function with a circuit connected to a power supply. If you want to measure the resistance of a particular component, you must take it out of the circuit altogether and test it separately, as shown in diagram *D*:

A



D



Ohmmeters work by passing a small current through the component and measuring the voltage produced. If you try this with the component connected into a circuit with a power supply, the most likely result is that the meter will be damaged. Most multimeters have a fuse to help protect against misuse.