

Connection of meters

It is often necessary to know how much voltage, current or energy is being used in any particular circuit. In order to do this, we use meters.

Since current flows in a cable, we must connect the **ammeter** in series with the circuit to measure this flow.

The ammeter, when connected, must not affect the current flow in any way. Because of this, the ammeter must have a very low resistance.

As voltage is the pressure in the system, in order to measure voltage we must connect the **voltmeter** in parallel with the system or load.

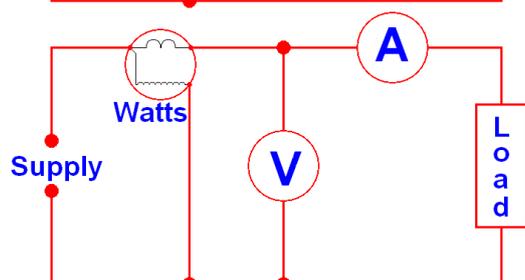
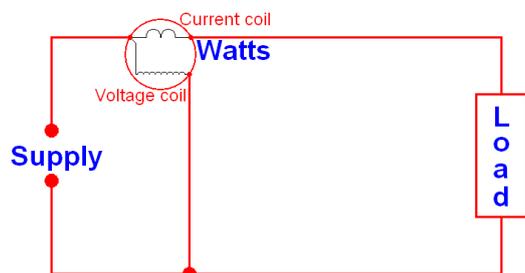
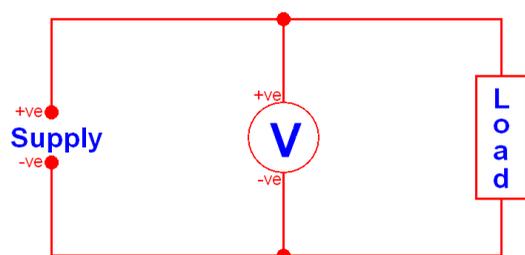
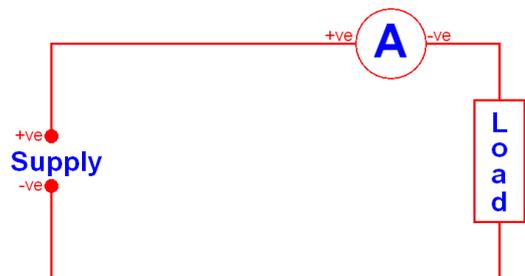
The voltmeter must also not affect the circuit in any way, when connected. Because of this, the voltmeter must have a very high resistance.

NB: +ve (pos) and -ve (neg) signs apply for DC instruments.

A **wattmeter** is an instrument which measures the amount of power being supplied to a circuit. A wattmeter measures DC and AC power.

The wattmeter is a combination of a voltmeter and an ammeter, and is connected into a circuit as shown.

It is sometimes required to take all three readings at the same time, for example to measure the power factor in a circuit. When this is the case, the instruments are connected as shown on the right.



Ohmmeters

When measuring resistance, we use an ohmmeter, which is simply connected across the circuit or piece of equipment to be tested. The ohmmeter requires its own internal supply, normally a battery. For this reason, the ohmmeter must **never** be connected across a circuit or piece of equipment that has a power supply connected to it, as this could cause damage to the meter and possibly the circuit or piece of equipment being tested.

When reading low values, a low reading ohmmeter should be used; for higher readings (thousands of ohms and above) a high reading ohmmeter (normally an insulation resistance tester) should be used.

Energy meter

Electricity measurement in premises is carried out using an energy meter. The unit for energy is the joule, though for regular use the joule is too small a unit. An alternative means of measuring electrical energy is the watt-hour or, more commonly, the kilowatt-hour (kWh). One kWh refers to a unit of electricity and is used to charge the consumer for their electricity consumption.

If a 1kW appliance is operated for one hour it will use 1kWh of energy, which is one unit. To calculate the energy used by an appliance multiply its power rating by the duration of operation in hours.

For example, a 3kW appliance is operated for 6.5 hours continuously and the electricity cost 16p per unit. Calculate the cost of running this appliance for this duration.

$$\begin{aligned} \text{kWh} &= \text{kW} \times t \text{ (in hours)} \\ &= 3 \times 6.5 \\ &= 19.5 \text{ units} \\ \text{Cost} &= \text{units} \times \text{unit cost} \\ &= 19.5 \times 16 \\ &= \mathbf{312p \text{ or } \pounds 3.12} \end{aligned}$$

