The 50plus

50plus technical support – lighting circuits

Scroll down to look at the information put together by our technical team on lighting circuits, fault-finding and adding lights.

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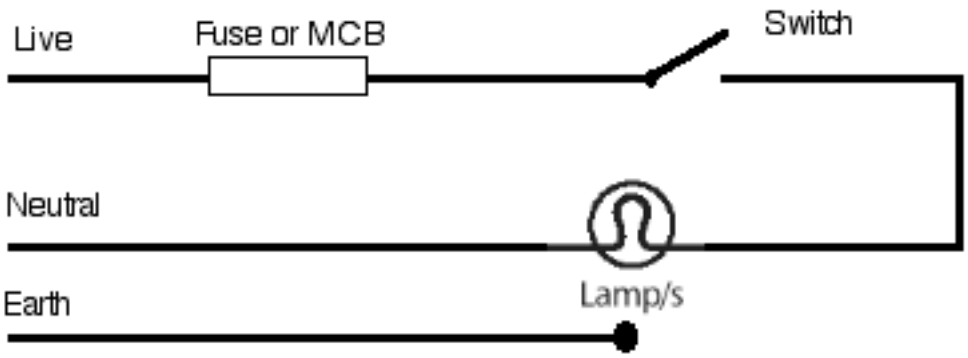
1 Lighting circuits

1.1 The basic circuit

Lighting circuits are very simple. It is the physical presentation, which can cause confusion. A basic lighting circuit is shown in Figure 1.

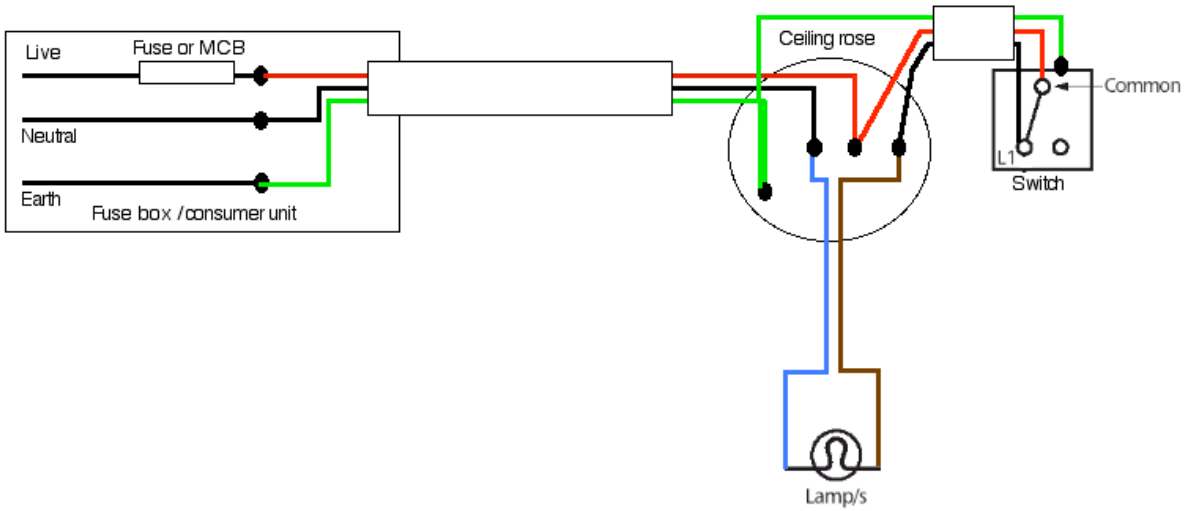
Figure 1 – a basic lighting circuit



1.2 How the wiring is physically connected

Physically the wiring requires a feed from the fuse box (or consumer unit) and a connection to the switch, both via cables as shown in Figure 2.

Figure 2 - a simple lighting circuit



1.3 Add more lights

In reality we often have a number of lights running on the same circuit. So in a typical house we will find something like Figure 3.

Figure 3 – a typical lighting circuit

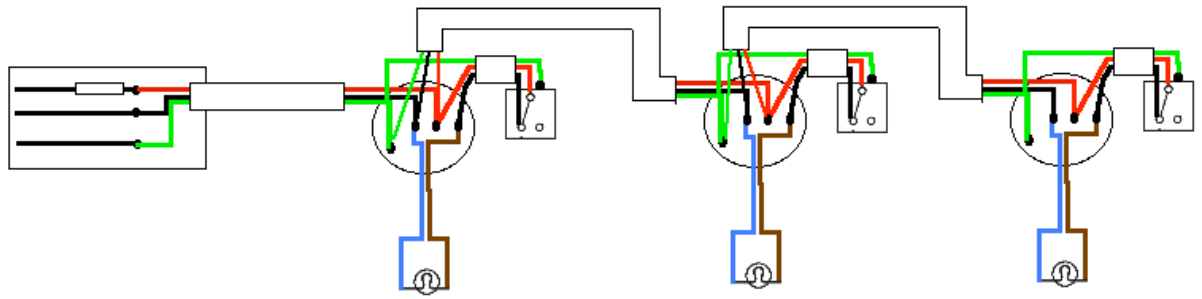
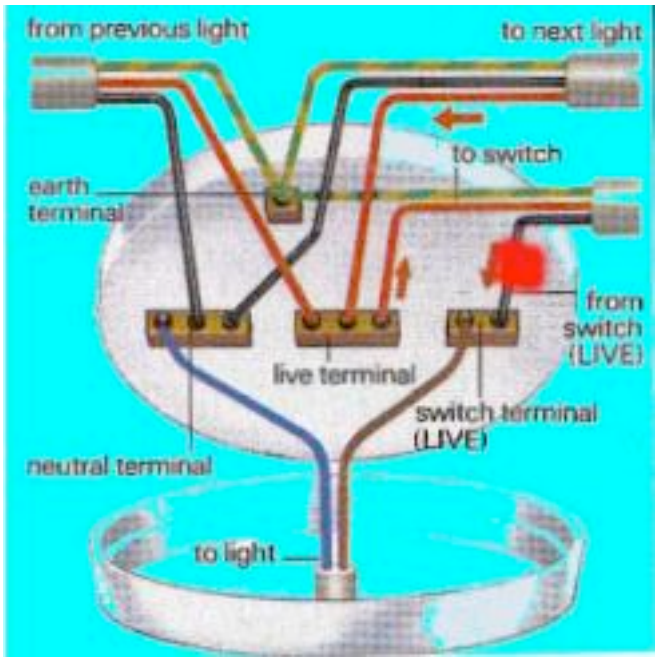


Figure 3 shows a 'daisy chain' arrangement where each light is connected to the other in turn until we reach the end of the run. In some instances we will find a 'star' distribution where a single ceiling rose acts as the distribution point to a number of lights. 'Star' distribution is particularly prone to problems with mechanical disconnection of wires at the 'star' (too many wires into one point) resulting in faults such as a 'missing neutral'. When this happens both the live and neutral wires at a particular light will appear live as the neutral connection has been lost and the neutral wire is getting a live feed via the light bulb.

A closer look at a ceiling rose should show something like Figure 4.

Figure 4 - a typical ceiling rose



1.4 A note about language

A CABLE is a grouping of two or more wires, usually in a PVC sheath. A lighting cable typically has 3 WIRES. Most lighting cables are 'twin and earth' (T&E) meaning there is a live (red or brown) wire, a neutral (black or blue) wire and an earth wire which is bare copper until it is sleeved at the point of connection (in green or green/yellow).

The majority lighting circuits are wired in T&E. In older properties (pre mid 1960's) there may be no earth so cables with just a live and neutral may have been used. In these properties metallic light fittings or metallic switches should not be installed unless a separate earth cable is run.

There are some properties using conduit where each wire is run separately in a metal conduit, which forms the earth circuit. Always check the earth continuity of the conduit, as it is sometimes the case that the conduit has been removed at some point so the earth circuit no longer exists.

2 How to fault find at a ceiling rose

We are sometimes presented with cabling that has been disconnected or connected incorrectly at a ceiling rose. Resolving doubt about which cable is which is a simple process. The following steps show how to identify the wires and reconnect them correctly.

Step 1 - turn the power to the lighting circuit OFF and using a neon screwdriver make sure none of the cables in the ceiling rose are live.

Step 2 - disconnect all of the wires from the ceiling rose except the brown and blue, which go to the light bulb and the earth wires. (The normally brown and blue wires to the bulb may be red and black or even not colour coded in older properties).

Step 3 - make sure you can see which cable each wire comes from (you may need to remove the ceiling rose to do this). If there is a black (or blue) wire, which has a piece of red (or brown) sleeving on it then this should be return wire from the switch and the cable it is in is the cable going to the switch (see Step 5 below). Make sure none of the bare ends of the wires are touching each other.

Step 4 - with the power ON (and taking care not to touch any wires yourself) identify the incoming 'live' feed using a neon screwdriver. It will be a red (or brown) wire. The cable 'pair' of this live feed (a black or blue) will be the incoming neutral. Carefully pull this pair of wires to one side and remember which they are or write 'i/c' on the cable using a biro after turning the power OFF.

Step 5 - with the power OFF identify the switch cable using a test meter on the 'Ohm' range (see paragraph 6 – Notes on using an Ohm meter). Mark the black (or blue) wire from the switch with a piece of red or brown sleeving (or suitably coloured insulating tape if no sleeving is available).

Step 6 - connect the incoming live to the central terminal block in the ceiling rose.

Step 7 - connect the incoming neutral to the left hand terminal block in the ceiling rose. This is where the blue wire going to the light fitting is connected.

Step 8 - connect the red (or brown) switch wire to the centre terminal block in the ceiling rose (the same as the incoming live).

Step 9 - connect the black (or blue) switch wire (sleeved red or brown) to the right hand terminal block in the ceiling rose. This is where the brown wire going to the light fitting is connected.

Step 10 - any cables left will be outgoing live/neutral pairs. Connect the red (or brown) wires of these cables to the central terminal block in the ceiling rose and connect the black (or blue) wires of these cables to the left hand terminal block in the ceiling rose.

Step 11 - Sleeve all the earth cables green/yellow and connect these to the single earth terminal in the ceiling rose.

The ceiling rose should now look like should now look like Figure 4.

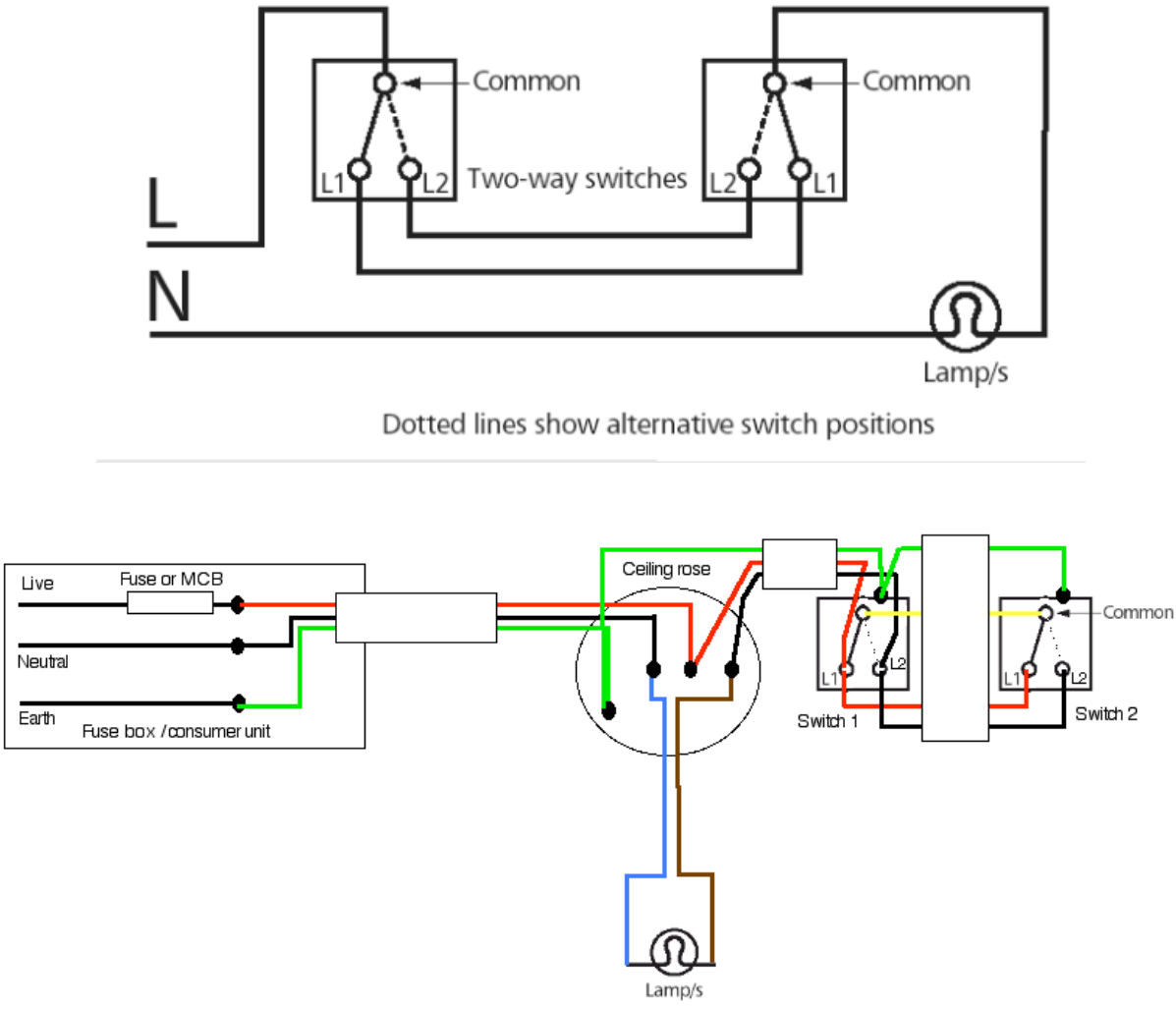
Step 12 – Double check your wiring then turn the power back on and test that the light is working and switches on and off.

Step 13 - test all other lights on the same floor of the property (or if it's a small property all other lights).

3 Two way switched lighting

Two way switching of a single light is commonly employed. It is usually achieved by running a '3 core and earth' (3 wires and an earth wire) between the two light switches. Figure 5 shows the circuit and typical physical arrangements.

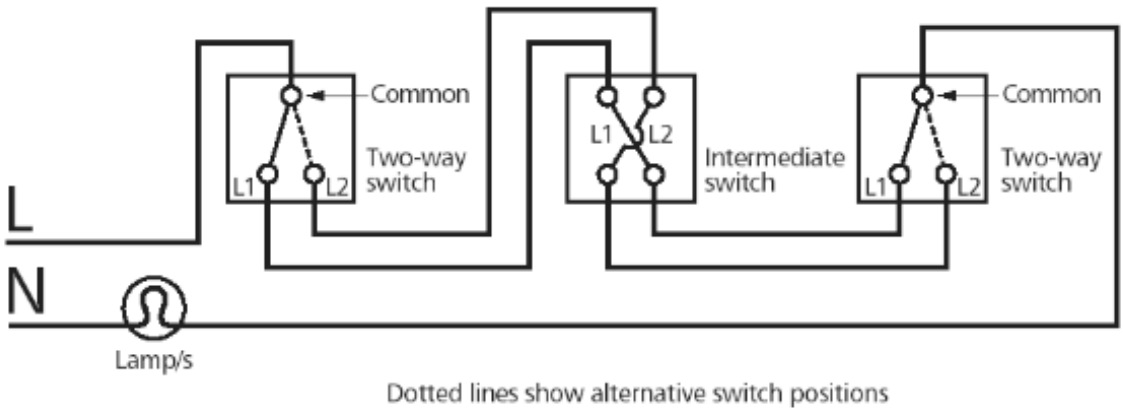
Figure 5 - two way switching



4 Three way switched lighting

Occasionally three way switched lighting is employed. This requires the use of an intermediate switch, which is physically different to 'standard' switches. The physical presentation of three way switching varies and should be investigated on a case-by-case basis.

Figure 6 - three way switching



5 Installing 'feature lights'

When replacing ceiling roses with 'feature' lights of some description it is usually necessary to replace the ceiling rose with a 4 way terminal block which can be located in the ceiling void as:

- most feature lights do not have an adequate sized 'fitted' terminal block
- cables that were previously terminated in the ceiling rose are often not long enough to reach the terminal block in the feature light.

If this is the case run a 1.5mm^2 two core and earth cable from the new terminal block to the light fitting - this often makes installing the light fitting a lot easier. Remember to put green/yellow sleeving over the earth wires.

6 Notes on using an Ohm meter

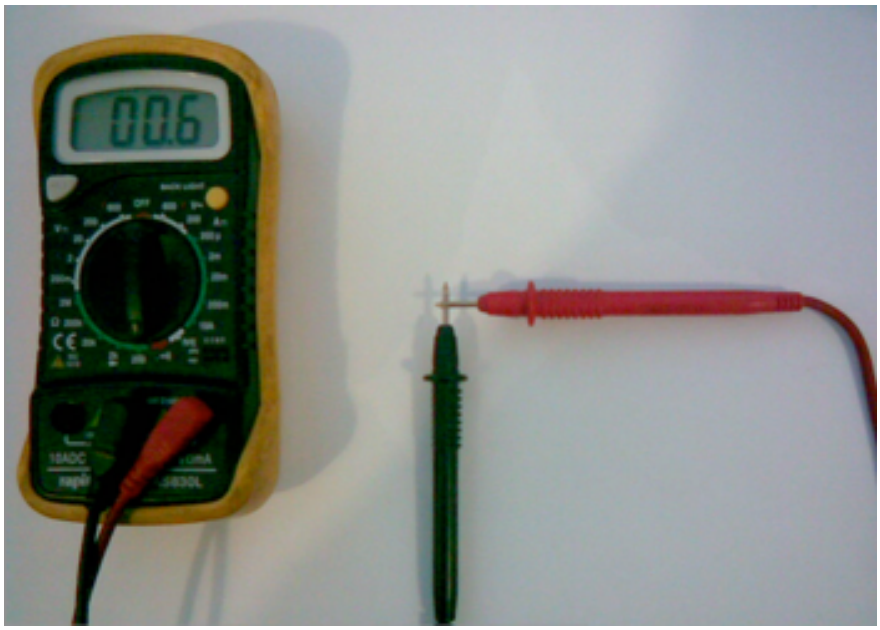
Ohms law states that V = I x R where

- V = volts
- I = current measured in Amps and
- R = resistance, measure in Ohms (Ω).

If plumbing is more of your thing, think of the volts as the water pressure, the currents as the flow of the water and the resistance as something stuck in the pipe.

An electrical 'short circuit', for example a piece of wire will measure something near zero Ohms as shown in Figure 7.

Figure 7 - a near short circuit on an Ohm meter



An open circuit will measure infinity. Meters can show an open circuit in a number of different ways. This meter shows it a '1' well to the left of the decimal point as shown in Figure 8.

Figure 8 - an Ohm meter measuring an open circuit

There are two ways to use an Ohm meter to find the switch cable at a ceiling rose. Both can only be employed with the power to the circuit turned OFF. The meter should be in a low Ohms (Ω) position e.g. 200 Ω. The actual number of Ohms will depend on the model of meter being used. Some meters are self-ranging and have only a single Ohms range.

Method 1 – easier if there are two people

Step 1 – check the power to the circuit is turned off at the fuse board (consumer unit).

Step 2 – At the ceiling rose select a pair of wires from the same cable and connect the Ohm meter across them to obtain a measurement.

Step 3 - Change the position of the light switch. Has the reading changed? It should change between open circuit and a reading of typically less than one Ohm. If not then that cable does not go to the switch. Pick another cable and go back to step 2. Repeat until a pair of wires for which the switch changes the meter reading between open circuit to near zero is found. You will then have identified the switch cable. Double-check your finding by changing the switch position from on to off a couple of times.

Method 2 – simpler if you are on your own

Step 1 – check the power to the circuit is turned off at the fuse board (consumer unit).

Step 2 – disconnect red (or brown) wire at the light switch.

Step 3 - obtain a piece of wire long enough to run from the light switch to the ceiling rose position. Connect one end to the red (or brown) wire at the light switch and the other end to one of the meter probes (it doesn't matter which one).

Step 4 – Select a red (or brown) wire at the ceiling rose and connect the other meter probe to it. If you have a near zero reading then that is the wire, which goes to the switch and its black (or blue) pair in the cable is the return from the switch. If the reading is open circuit then pick another red (or brown) wire until a near zero reading is found.

Finally

Remember that electricity is dangerous. If you have any doubts about what you are doing then STOP and consult the 50plus Handyman office.