

**WEEK 15 WORKSHEET**

**Subject:** Applied Technology

**Year/Level:** 13

<b>Strand: 4</b>	<b>Basic Home Improvement</b>
<b>Sub Strand</b>	<b>General Trade Skills</b>
<b>Content Learning Outcome</b>	<b>Demonstrate Knowledge of general trade skills.</b>

**LESSON NOTES**

**Chapter 4: Basic Home improvement.**

**Electricity**

Continued from week 14 Lesson notes....

**Connection of capacitors**

**Series** - Capacitors, when connected in a series, work the opposite to resistors and the overall value of the capacitance will reduce.

**Parallel** - When capacitors are connected in parallel, the result is the sum of all the capacitors.

**Time constants**

When voltage is applied to a capacitor it does not charge instantly. The capacitor is charged up over five time periods. These periods are called time constants. In the first time constant, a capacitor will always achieve 63.2% of total charge. The actual time that it will take can range from milliseconds to hours.

Select the switch to see the capacitor charge. The time it takes to charge up, depends on the size of the capacitor and the resistance in the circuit.

Now select the switch to see the capacitor discharge.

**Calculations**

The time constant depends on the resistance and capacitance (RC) in a circuit. The time constant can be calculated using the equation:

$$t = RC$$

Where:

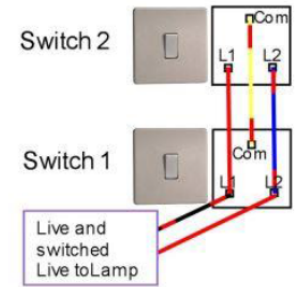
t = time in seconds R = resistance in ohms C = capacitance in farads.

After five time constants a capacitor will be fully charged, therefore the charging time of a capacitor equals five times the time constant.

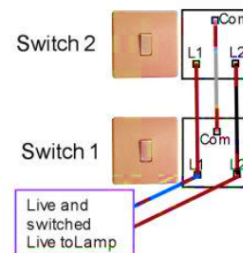
**Two Way Switch.**

Two way switching with the old wiring colours-

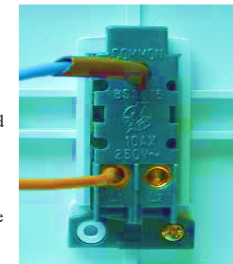
This diagram represents a two way switching arrangement. There are other ways of wiring a two way lighting circuit, but this is by far the most common and easiest method. The old wiring colours that are present in the majority of homes in the UK have been used for this diagram. Three core and earth cable is required to install two or three way switching and this should be run from the first light switch to the second and then wired as shown in this diagram. Switch one is the switch that contains the live wire and switched live wire. The diagram shows single colours only. In real life these wires would be covered by an outer protective sheath and would include a bare earth wire and would be called a cable. Red sleeving or tape would be placed on the wires as shown to show that they would be live at some point. Now this sleeving would be brown. The connections are very simple and there is another guide further down this page.



Two way switching with the new harmonised colours-



This is the same diagram as above, but using the new harmonised colours. Three core and earth cable is required to install two or three way switching and this should be run from the first light switch to the second and then wired as shown in this diagram. Switch one is the switch that contains the live wire and switched live wire. The diagram shows single colours only. In real life these wires would be covered by an outer protective sheath and would include a bare earth wire and would be called a cable. Brown sleeving or tape would be placed on the wires as shown to show that they would be live at some point.



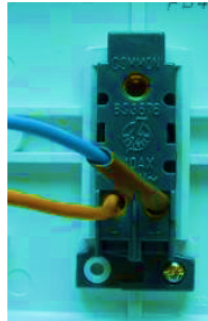
## How to convert a single switch to a two way system

Here you can see the back of a light switch, in this instance it is a two way switch being used for a one way light. A one way switch has only a common and L1 terminal and a two way switch has a common, L1 and L2 terminal, like this one in the picture.

Note that new harmonised cable is being used (Brown and Blue) and note that Brown sleeving has been placed over the Blue wire, This signifies that it will be live at some point! The earth wire should always be connected to the earthing terminals, it has been removed for clarity here but must be connected, even on plastic light switches, unless there is no earthing terminal. The back box will need earthing unless it is plastic and there is no earthing point.



For two way switching you need a length of three core and earth cable long enough to reach from the existing light switch to the place where you intend placing the second light switch.



This cable needs routing via the easiest route, here are the guidelines and permissible zones permitted wiring zones

This is not the new harmonised cable so the colours may need changing, the earth sleeving still needs using before connection as with all cable.

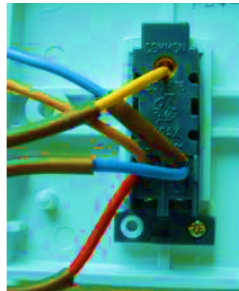
There are no set rules for which wire does what in three way lighting, but I am going to use the most sensible option.

Remove the wire which is in the common terminal and place it in the L2 terminal.

These two wires are the permanent live and switched live wires.

There are no fixed regulations for which wire goes where but if you follow the colours that I have used here, they seem to make sense!

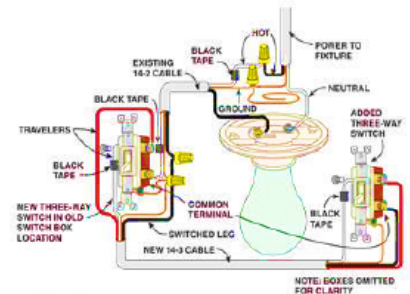
Note how all of the wires have brown sleeving on them! I have slid this back a little then you can see the actual colours of the wires. The brown wire and the blue wire that is sheathed brown are already in terminals L1 and L2, this is described above. These two wires are the Permanent live and switched live.



## Wiring a three-way switch

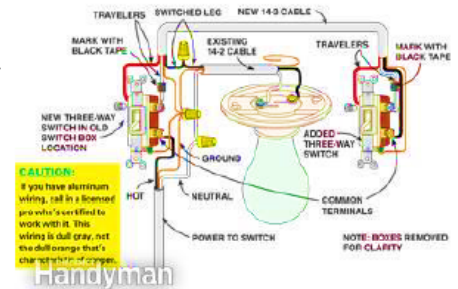
The wiring of three-way switches is certainly more complicated than that of the more common single-pole switch, but you can figure it out if you follow our diagrams. With a pair of three-way switches, either switch can make or break the connection that completes the circuit to the light. The whole project can be completed in a few hours if you don't have to do any drywall removal and repair.

To add the switch, you'll use one of two wiring diagrams, depending on whether the power comes to your light switch first (the most common situation) or to the light fixture first. Either way, complete these five steps:



1. Turn off the correct circuit at your electrical panel.
2. Add an electrical box for the second three-way switch in the basement. It's likely you'll also need to replace the existing switch box with a larger one to accommodate the extra wires for the three-way switch.
3. Feed a length of 14-3 type NM cable (or 12-3, if you're connecting to 12-gauge wire) between the two boxes. The 14-3 cable has three insulated conductors: white, black and red (plus a bare ground wire).
4. Connect the wires to the new three-way switches with ground screws using one of the two wiring diagrams (Fig. A or B). On the switches, the common terminal will be identified by a label and/or the terminal screw will be a different color than the other two.
5. Make sure to wrap black electrical tape around the ends of all white wires that are used as travelers between the three-way switches. If you have the setup shown in Fig. A, also wrap black tape around the white wire from the switch to the light. This way, both you and others will know these wires are "hot" and not neutral like most white wires.

Handyman



**Caution:** If you have aluminum wiring, call in a licensed pro who's certified to work with it. This

Handyman

## STUDENT ACTIVITY

1. Explain the following terms?
  - Electrolytic capacitor

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  - Ceramic capacitor

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2. List down the five steps in completing a wiring in a three way switch?

**THE END**