

KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

Electrical Engineering Department

EE 208 ELECTRICAL SYSTEMS

Experiment # 10 ELECTRICAL SWITCHES AND LIGHTING CIRCUITS

OBJECTIVE:

- 1- To study the different types of switches.
- 2- To study how these switches can be utilized in designing circuits for lighting purposes in residential areas.

APPARATUS: AC Power Supply
Different types of switches: S₁, S₂, S₃ and S₄
Duplex Receptacle, Conduits, Junction Box
Connecting wires with different Colors

PROCEDURE:

Case 1: Circuit With Single-Pole Switch: Feed At Switch

A **single-pole** switch is used where it is desired to **control a light or group** of lights or other load from one switching point. This type of switch is used in series with the ungrounded "**hot**" wire feeding the load. The diagrams given in **Figure 1** show a single-pole switch controlling a light from one switching point where the 120-volt source feeds directly through the switch.

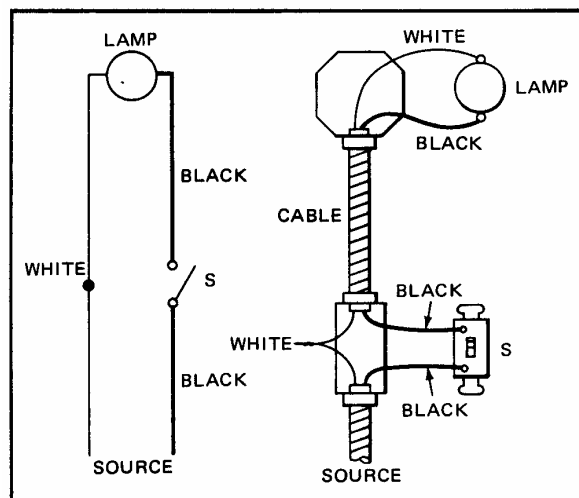


Figure 1: Single-pole switch in circuit with feed at switch.

Note that the **identified white** wire goes directly to the **load**. The **unidentified** wire or **black** wire is **broken** at the **single-pole switch**. The cable is nonmetallic with conductors and a separate wire for grounding.

Case 2: Circuit With Single-Pole Switch: Feed At Lighting

The 120-volt **source feeds directly** to the light outlet in **Figure 2**. This results in a **two-wire** cable with black and white wires being used as a switch loop between the light outlet and the single-pole switch. The National Electrical Code (**NEC**) **permits** the use of a **white** wire in a single-pole switch loop. However the **unidentified** or **black** conductor **must connect** between the **switch** and the **load**. This requirement is observed in **Figure 2**.

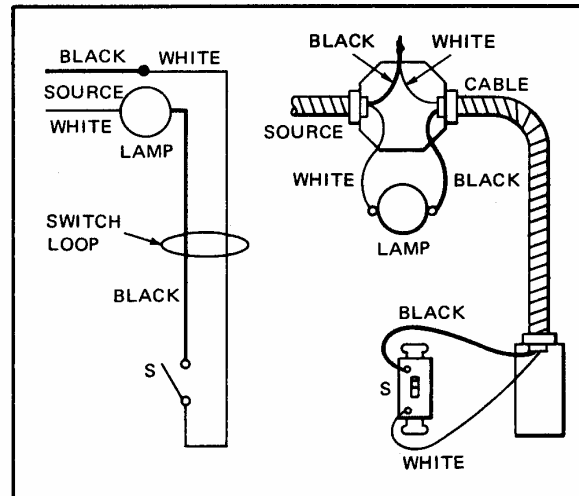


Figure 2: Single-pole switch in circuit with feed at light.

Case 3: Lamp Controlled By A Single-Pole Switch With Live Convenience Receptacle: Feed At Switch

Figure 3 gives **another** application of a single-pole switch control. The **feed** is at the **switch**, which is used to control the light outlet with the convenience outlet independent of the switch.

Case 4: Circuits Controlled With Three-Way Switches: Feed At Switch

Figure 4 represents a circuit where one **light** is to be controlled from **either of two switching** points. Many times it is convenient to be able to control a hall light from either upstairs or downstairs or possibly a garage light from either the house or the garage. Note that the feed in this circuit is at the first switch-control point.

Case 5: Circuit Controlled With Three-Way Switches: Feed At Light

Figure 5 represents a different arrangement using three-way switch control where the feed is at the light. This circuit arrangement makes it necessary to use the white wire in the cable as part of the three-way switch loop. In compliance with the NEC, **the unidentified or black wire is used as the return wire to the light outlet**.

NEC state: Cable containing an identified conductor may be used for single-pole, three-way or four-way switch loops where the connections are so made that the unidentified conductor is the return conductor from the switch to the outlet. This exception makes it unnecessary to paint the terminal of the identified conductor at the switch outlet.

Figure 6 represents **another** arrangement for **three-way switch control**. The feed is at the light with cable runs from the ceiling outlet to each of the three-way switch control points, which are located on each side of the light outlet.

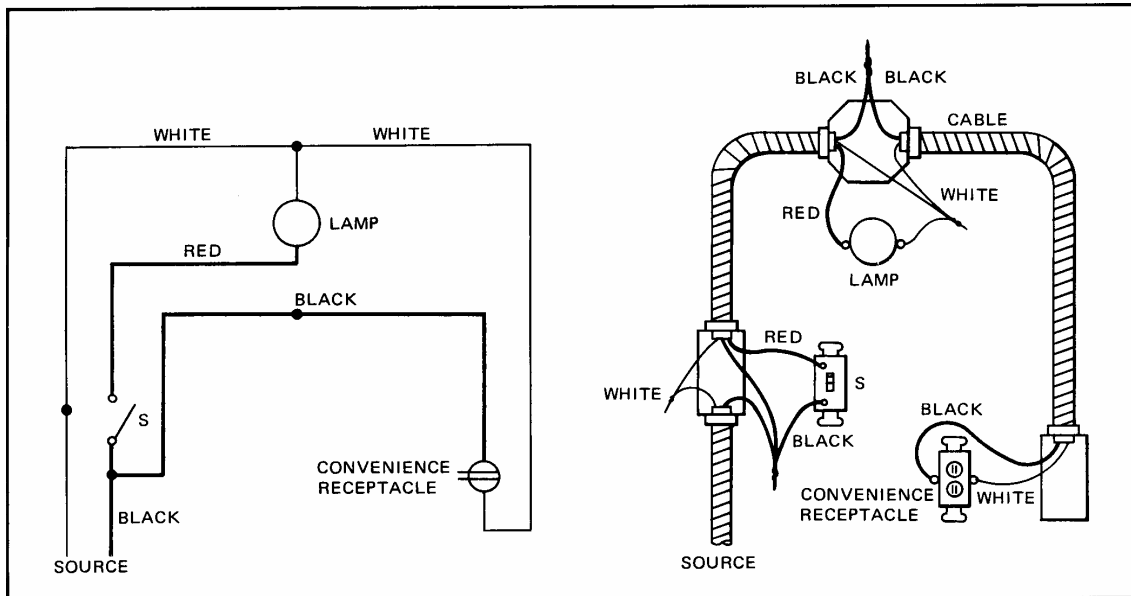


Figure 3: Lamp controlled by One-way switch with live convenience receptacle and feed at switch.

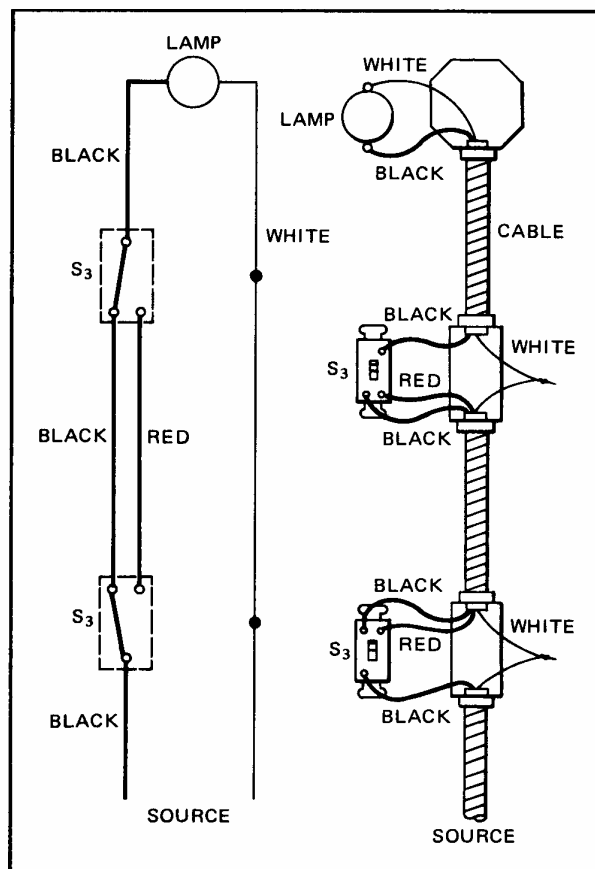


Figure 4: Circuit with three-way switches control and feed at the first switch control point.

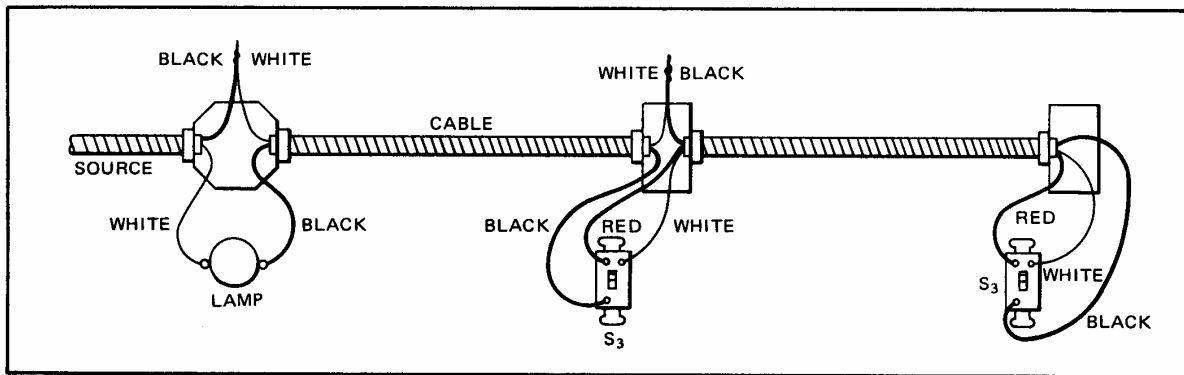


Figure 5: Circuit with three-way switch control and feed at light.

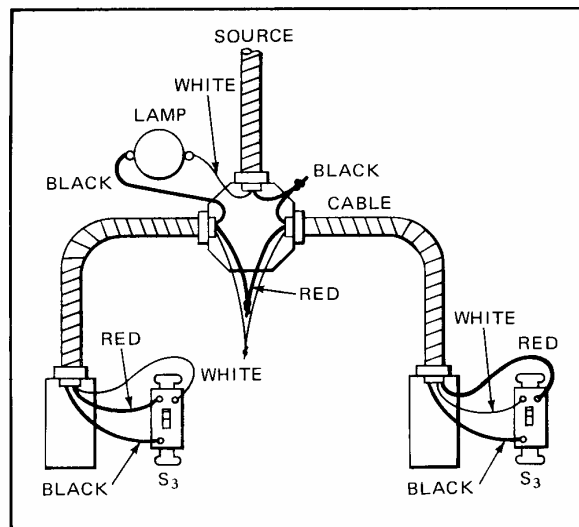


Figure 6: Alternative circuit with three-way switch control and feed at light.

Case 6: Circuit With Switch Control At Three Different Locations: Feed Through Switches

Figure 7 illustrates control of a **lamp** from anyone of **three switching** points. Care must be taken in connecting the travelers wires to the proper terminals of the four-way switch.

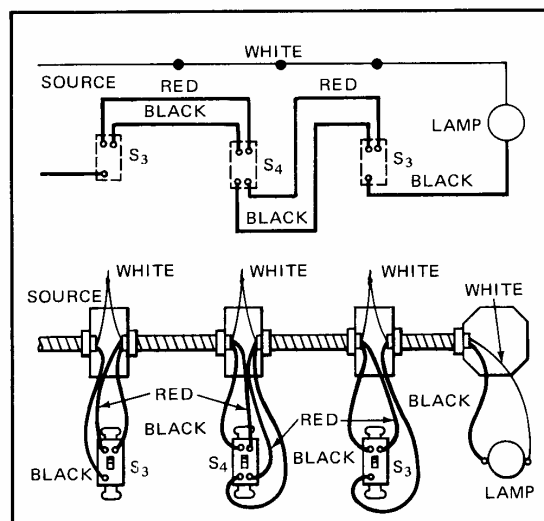


Figure 7: Circuit with switch control at three different locations.

Always make sure that the **two traveler wires** from one three-way switch are connected to the two terminals on **one side of the four-way** switch while the two travelers wires from the other three-way switch connect to the two terminals on the other side of the four-way switch.

QUESTIONS:

1. Which **color** is reserved for **grounding** conductor?
2. Explain **how** hot conductors are **identified** in electrical installation?
3. Is it **possible** to control a **lamp** from **two** different locations using two **four-way** switches? If yes, show the connections.
4. Complete the connections in the following arrangement so that both ceiling light outlets are controlled from the single-pole switch. Label the conductor colors. Assume the installation is in cable.



5. Complete the connections in the following arrangement so that both ceiling light outlets may be controlled from either three-way switch. Label the conductor colors. Assume the installation is in cable.

