

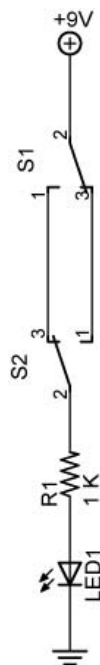
## Switches, Connectors, Protection Devices

### Cornerstone Electronics Technology and Robotics I Week 8

- Administration:
  - Prayer
  - Turn in quiz
- Electricity and Electronics, **Section 3.3**, Common Circuit Devices:
  - **Switches:** Control the on and off flow of electrons through a circuit.
    - The electrical circuit within a switch is described in terms of poles and throws.
      - A single-pole (SP) means that the switch provides one path for the electrons flow and
      - Single-throw (ST) means the switch controls only one circuit.
        - SPST switch symbol:

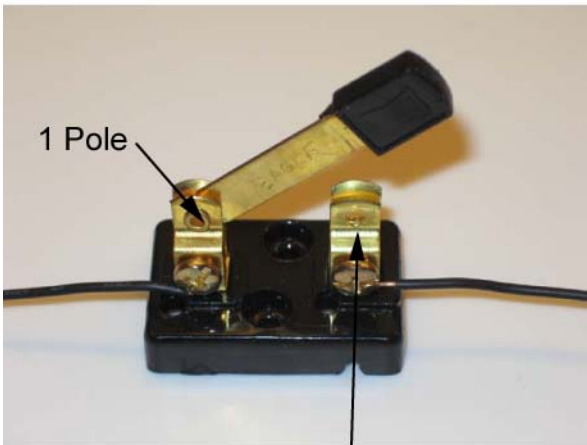


- A single-pole double-throw switch (SPDT) has only one common connection point that can complete two different circuits. See symbol below.
  - Wire the 3-way switch (SPDT) circuit below and flip the switches:



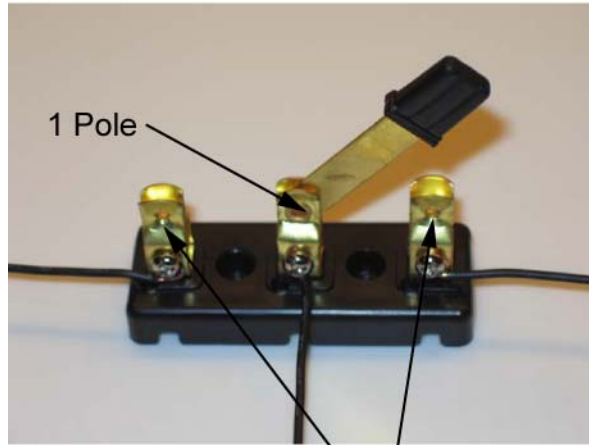
- See: <http://www.rkm.com.au/ANIMATIONS/animation-three-way-switch.html>
- A double-pole double-throw switch (DPDT) has two common connection points and can provide two circuit paths simultaneously. See symbol below.

## Basic Switch Symbols and Corresponding Photos



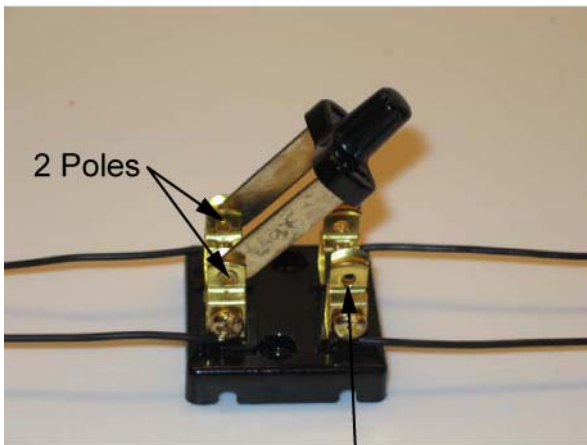
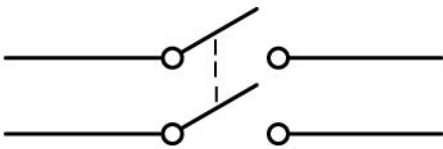
1 Throw

**SPST Switch and Symbol**



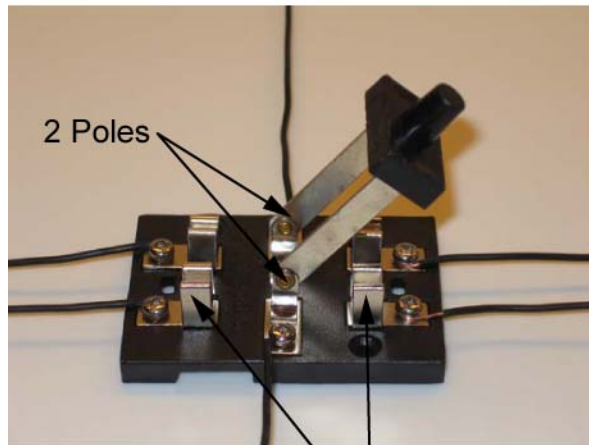
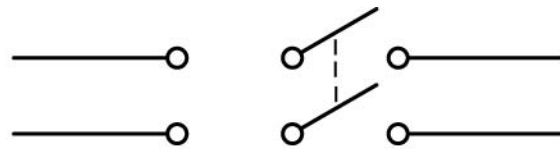
2 Throws

**SPDT Switch and Symbol**



1 Throw

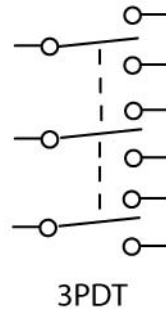
**DPST Switch and Symbol**



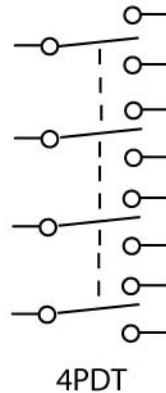
2 Throws

**DPDT Switch and Symbol**

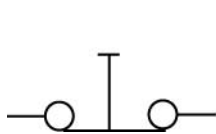
- 3PDT switch example and symbol:



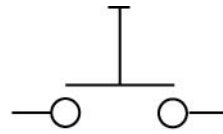
- 4PDT switch example and symbol:



- Samples
- Momentary switches:
  - Momentary switches are called that because they only make contact while they are being pressed.
  - Normally open (NO) and normally closed (NO)
  - Demonstrate samples and symbols:



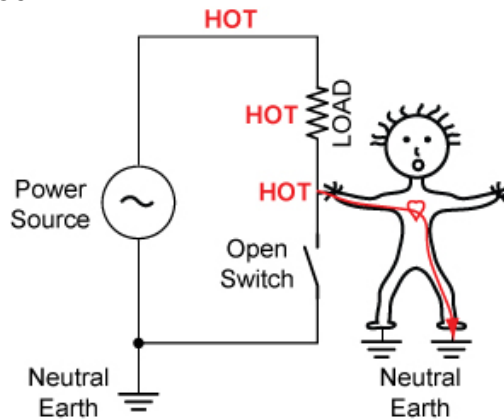
**Normally Closed (NC)**



**Normally Open (NO)**

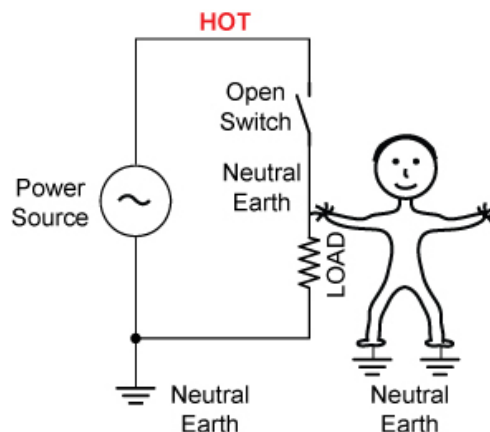
- ROV switches as an example
  - Wire LED circuit and determine whether the momentary switches are NO or NC.
- Switch Ratings:
  - Ampacity rating
  - Voltage rating
  - Demonstrate switch failure

- High side and low side switching:
  - In low voltage electronics, the position of the voltage source, the switch, and the load makes little difference. Since they are in a series circuit, the components can be rearranged without changing the performance of the circuit.
  - In higher voltage electronics, the wrong switch placement can be hazardous or even lethal. Examine the **low side switch** circuit below. One side of the power source is tied to earth while the other is at a dangerously high voltage (**HOT**). Since the switch is open, no current flows through the load so there is no voltage drop across the load ( $V_{LOAD} = I_{LOAD} \times R_{LOAD}$ ,  $I_{LOAD} = 0A$  therefore  $V_{LOAD} = 0V$ ). The worker sees the switch in the off position and thinks he is safe to work on the equipment (load). Unfortunately, he stands on the ground which is at the same potential as the grounded side of the power source and touches the HOT load or connecting wires. Current flows through the unsuspecting worker resulting in a serious shock.



**Low Side Switch**

- Relocating the switch to the **high side** eliminates the hazard. With no voltage drop across the load, the load and the connecting wires are at the voltage of neutral earth thus eliminating any hazardous potential. See the circuit below.

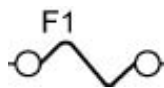


**High Side Switch**

- <http://www2.tech.purdue.edu/Eet/Courses/eet257/Text%20Errata/p395.pdf>

- Other Web References:
  - <http://www.kpsec.freeuk.com/components/switch.htm>
- **Connectors:**
  - Solderless terminals
  - Molex
  - Banana
  - BNC
  - Others
- **Circuit Protection Devices:**
  - Circuit protection devices are an essential part of a power distribution system to prevent fire or damage. When too much current flows through a wire, it may overheat and be damaged or even start a fire.
  - Fuses:

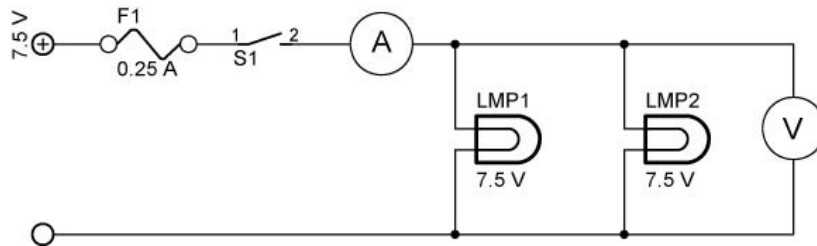
- Symbol:



- The fuse is a metal strip or wire which can carry a stated current. If the current rises above this value the fuse will melt.
- If the fuse melts (blows) then there is an open circuit and no current can then flow thus protecting the equipment or circuit by isolating it from the power source.
- Circuit Breakers:
  - A circuit breaker is found in an electrical service panel and is an electrical device used to protect the electrical wiring from an overloaded (overcurrent) condition when exposed to more electrical current than it is designed to handle.
  - Unlike the fuse which is rendered useless when it blows, the circuit breaker is not damaged when it “trips”, and can be reset.
  - Perform Switches, Connectors, Protection Devices Lab 1 – Fuses

## Electronics Technology and Robotics I Week 8 Switches, Connectors, Protection Devices Lab 1 – Fuses

- **Purpose:** The purpose of this lab is to acquaint the student with the function of a fuse.
- **Apparatus and Materials:**
  - 1 – DC Power Supply
  - 1 – 0.25 A Fuse (Radio Shack #270-1002)
  - 2 – 7.5 V Lamps
  - 2 – Lamp Holders
  - 2 – Digital Multimeters
  - 1 – Knife Switch
  - Alligator Leads
- **Procedure:**
  - Wire the circuit below using alligator leads.
  - Insert the Lamp 1 only and adjust the DC power supply to bring the lamp to the 7.5 V rating. Record the current reading when the lamp is at 7.5V.
  - Insert Lamp 2 lamp and adjust the DC power supply to bring both lamps to their 7.5 V rating. Watch the current readings as you increase the voltage.
  - If necessary, add a third lamp in parallel to “blow” the fuse.
  - Write your conclusions



- **Results:**

Lamps in Circuit	Current in A
Lamp 1 Only	
Lamp 1 + Lamp 2	
Lamp 1 + Lamp 2 + Lamp 3	

- **Conclusions:**