



PLTW Engineering

10-12/Electrical Switches

May 11, 2020



10-12/DE

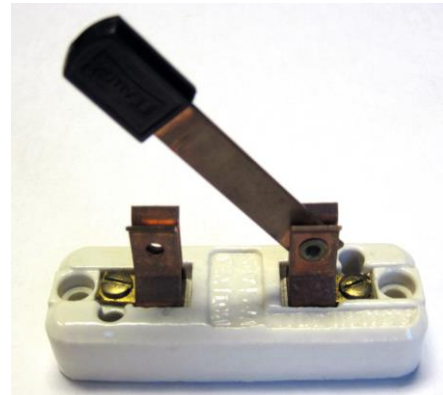
Lesson: 5/11/2020

Objective/Learning Target: Students will be able to apply switch components to basic electrical circuit simulations.

What is an electrical switch?

An electrical switch is any device used to interrupt the flow of electrons in a circuit.

There are many different types of switches, and many switch configurations.





Types of electrical switches

The simplest type of switch is one where two electrical conductors are brought in contact with each other by the motion of an actuating mechanism.

Other switches are more complex, containing electronic circuits able to turn on or off depending on some physical stimulus (such as light or magnetic field) sensed.



Function of electrical switches?

The final output of any switch will be a pair of wire-connection terminals that will either be connected together by the switch's internal contact mechanism - closed - or not connected together - open.

With the switch closed power is being consumed. With the switch open, the circuit is not energized.



Schematics of electrical switches

Any switch designed to be operated by a person is generally called a *hand switch*, and they are manufactured in several varieties that appear drawn in electrical schematics differently as well.

Lets take a look at some of the symbols and what they denote.

Toggle electrical switches

Toggle Switch



Toggle switches are actuated by a lever angled in one of two or more positions. The common light switch used in household wiring is an example of a toggle switch. Most toggle switches will come to rest in any of their lever positions, while others have an internal spring mechanism returning the lever to a certain *normal* position.

Push button electrical switches

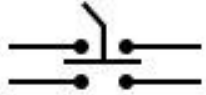
Pushbutton Switch



Pushbutton switches are two-position devices actuated with a button that is pressed and released. Most pushbutton switches have an internal spring mechanism returning the button to its “out,” or “unpressed,” position. Some pushbutton switches will latch alternately on or off with every push of the button. Other pushbutton switches will stay in their “in,” or “pressed,” position until the button is pulled back out.

Selector electrical switch

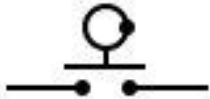
Selector Switch



Selector switches are actuated with a rotary knob or lever of some sort to select one of two or more positions. Like the toggle switch, selector switches can either rest in any of their positions or contain spring-return mechanisms for momentary operation.

Joystick electrical switch

Joystick Switch



A joystick switch is actuated by a lever free to move in more than one axis of motion. One or more of several switch contact mechanisms are actuated depending on which way the lever is pushed, and sometimes by how far it is pushed. The circle-and-dot notation on the switch symbol represents the direction of joystick lever motion required to actuate the contact.

Limit electrical switch

Lever Actuator Limit Switch



These limit switches closely resemble rugged toggle or selector hand switches fitted with a lever pushed by the machine part. Often, the levers are tipped with a small roller bearing, preventing the lever from being worn off by repeated contact with the machine part.



Process electrical switches

In many industrial processes, it is necessary to monitor various physical quantities with switches.

Such switches can be used to sound alarms, indicating that a process variable has exceeded normal parameters, or they can be used to shut down processes or equipment if those variables have reached dangerous or destructive levels.

There are a handful of these switches you need to know.

Process electrical switches

Pressure Switch



Gas or liquid pressure can be used to actuate a switch mechanism if that pressure is applied to a piston, diaphragm, or bellows, which converts pressure to mechanical force.

Process electrical switches

Liquid Level Switch



A floating object can be used to actuate a switch mechanism when the liquid level in a tank rises past a certain point. If the liquid is electrically conductive, the liquid itself can be used as a conductor to bridge between two metal probes inserted into the tank at the required depth. The conductivity technique is usually implemented with a special design of relay triggered by a small amount of current through the conductive liquid. In most cases it is impractical and dangerous to switch the full load current of the circuit through a liquid.

Process electrical switches

Liquid Flow Switch



Inserted into a pipe, a flow switch will detect any gas or liquid flow rate in excess of a certain threshold, usually with a small paddle or vane which is pushed by the flow. Other flow switches are constructed as differential pressure switches, measuring the pressure drop across a restriction built into the pipe.

Process electrical switches

An inexpensive temperature-sensing mechanism is the “bimetallic strip:” a thin strip of two metals, joined back-to-back, each metal having a different rate of thermal expansion. When the strip heats or cools, differing rates of thermal expansion between the two metals causes it to bend. The bending of the strip can then be used to actuate a switch contact mechanism. Other temperature switches use a brass bulb filled with either a liquid or gas, with a tiny tube connecting the bulb to a pressure-sensing switch. As the bulb is heated, the gas or liquid expands, generating a pressure increase which then actuates the switch mechanism.

Temperature Switch





Electrical switch design consideration

There is more than one way to implement a switch to monitor a physical process or serve as an operator control.

There is usually no single “perfect” switch for any application, although some obviously exhibit certain advantages over others.

Switches must be intelligently matched to the task for efficient and reliable operation.

Quiz yourself

1. Machine motion actuate which type of switch?
2. Name a physical process which could trigger process switch.
3. Human touch can activate this type of switch.
4. Explain the theory of continuity in electrical circuits.
5. Identify the following types of switches, according to their style of actuation (how each switch is physically operated):





Helpful links

[All about circuits - switch types](#)

[Youtube explanation of electrical switch types](#)