DIFFERENT TYPES OF SWITCHES AND CONNECTORS.

SET-1

Figure 1. Switches

By

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TYPES OF SWITCHES

- Mechanical Switches
  - Single Pole Single Throw Switch (SPST)
  - Single Pole Double Throw Switch (SPDT)
  - Double Pole Single Throw Switch (DPST)
  - Double Pole Double Throw Switch (DPDT)
  - Push Button Switches
  - Toggle Switches
  - Limit Switches
  - Float Switches
  - Flow Switches
  - Pressure Switches
  - Temperature Switches
  - Joystick Switches
  - Rotary Switches
  - Proximity Switches
  - Reed Switches
  - DIP / DIL Switches

- Electronic Switches
  - Bipolar Transistors
  - Power Diode
  - MOSFET
  - IGBT
  - SCR
  - TRIAC
  - DIAC
  - Gate Turn-Off Thyristor

MECHANICAL SWITCHES

Single Pole Single Throw Switch (SPST)

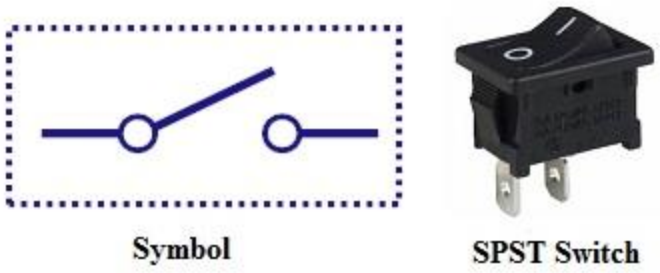


Figure 2. SPST Switch

- This is the basic ON and OFF switch consisting of one input contact and one output contact.
- It switches a single circuit and it can either make (ON) or break (OFF) the load.
- The contacts of SPST can be either normally open or normally closed configurations.

Single Pole Double Throw Switch (SPDT)

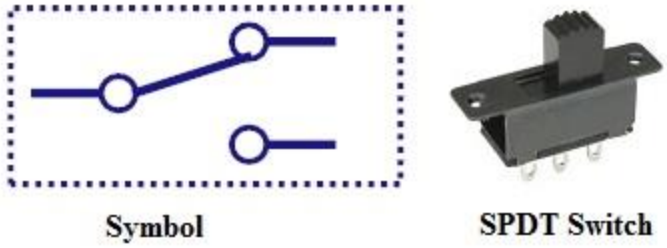


Figure 3. SPDT Switch

- This switch has three terminals, one is input contact and remaining two are output contacts.

- This means it consist two ON positions and one OFF position.
- In most of the circuits, these switches are used as changeover to connect the input between two choices of outputs.
- The contact which is connected to the input by default is referred as normally closed contact and contact which will be connected during ON operation is a normally open contact.

Double Pole Single Throw Switch (DPST)

Figure 4. DPST Switch

- This switch consists of four terminals, two input contacts and two output contacts.
- It behaves like a two separate SPST configurations, operating at the same time.
- It has only one ON position, but it can actuate the two contacts simultaneously, such that each input contact will be connected to its corresponding output contact.
- In OFF position both switches are at open state.
- This type of switches is used for controlling two different circuits at a time.
- Also, the contacts of this switch may be either normally open or normally closed configurations.

Double Pole Double Throw Switch (DPDT)

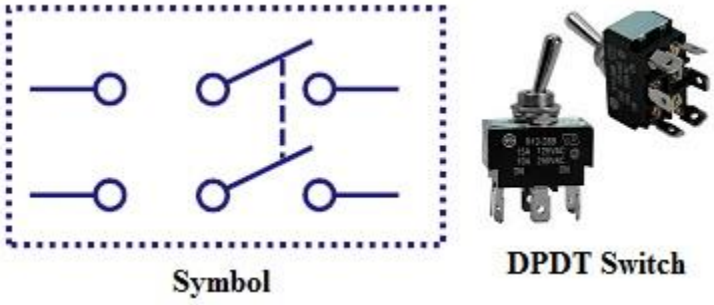


Figure 5. DPDT Switch

- This is a dual ON/OFF switch consisting of two ON positions.
- It has six terminals, two are input contacts and remaining four are the output contacts.
- It behaves like a two separate SPDT configuration, operating at the same time.
- Two input contacts are connected to the one set of output contacts in one position and in another position, input contacts are connected to the other set of output contacts.

Push Button Switch

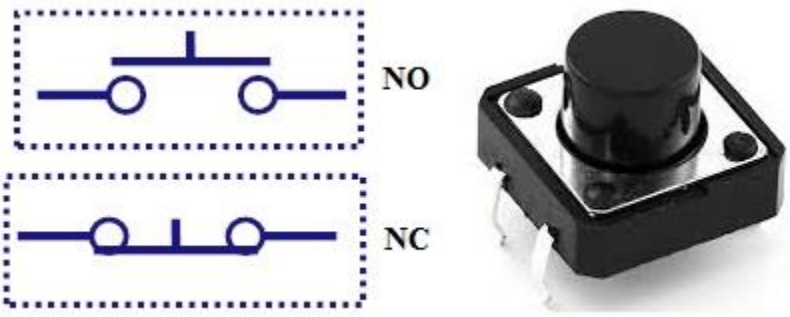


Figure 6. Push Button Switch

- It is a momentary contact switch that makes or breaks connection as long as pressure is applied (or when the button is pushed).

- Generally, this pressure is supplied by a button pressed by someone's finger.
- This button returns its normal position once the pressure is removed.
- The internal spring mechanism operates these two states (pressed and released) of a push button.
- It consists of stationary and movable contacts, of which stationary contacts are connected in series with the circuit to be switched while movable contacts are attached with a push button.
- Push buttons are majorly classified into normally open, normally closed and double acting push buttons as shown in the above figure.
- Double acting push buttons are generally used for controlling two electrical circuits.

Toggle Switch

Figure 7. Toggle Switch

- A toggle switch is manually actuated (or pushed up or down) by a mechanical handle, lever or rocking mechanism. These are commonly used as light control switches.
- Most of these switches come with two or more lever positions which are in the versions of SPDT, SPST, DPST and DPDT switch. These are used for switching high currents (as high as 10 A) and can also be used for switching small currents.

- These are available in different ratings, sizes and styles and are used for different type of applications. The ON condition can be any of their level positions, however, by convention the downward is the closed or ON position.

Limit Switch

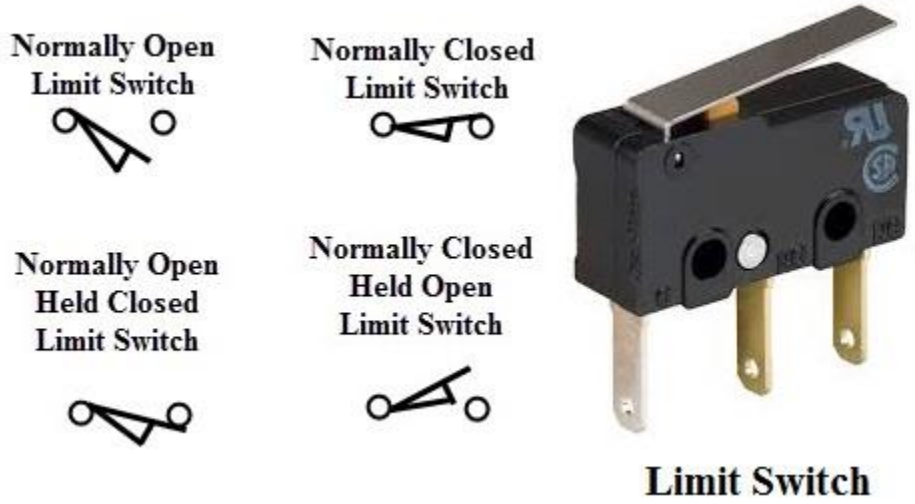


Figure 8. Toggle Switch

- The control schemes of a limit switch are shown in above figure, in which four varieties of limit switches are presented.
- Some switches are operated by the presence of an object or by the absence of objects or by the motion of machine instead of human hand operation. These switches are called as limit switches.
- These switches consist of a bumper type of arm actuated by an object. When this bumper arm is actuated, it causes the switch contacts to change position.

Float Switches

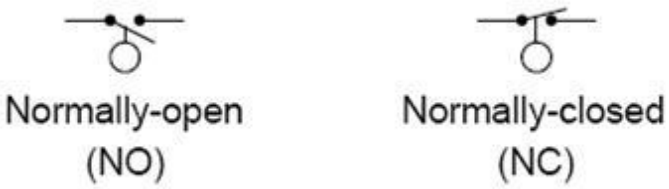


Figure 9. Float Switch

- Float switches are mainly used for controlling DC and AC motor pumps according to the liquid or water in a tank or sump.
- This switch is operated when the float (or floating object) moves downward or upward based on water level in a tank.
- This float movement of rod or chain assembly and counterweight causes to open or close electrical contacts. Another form of float switch is the mercury bulb type switch that does not consist of any float rod or chain arrangement.
- This bulb consists of mercury contacts such that when the liquid level rises or falls, the state of contacts also changes.
- The ball float switch symbol is shown in the above figure. These float switches can be normally open or normally closed type.

Flow Switches

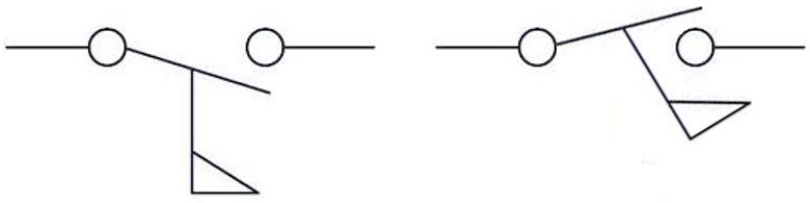


Figure 10. Flow Switch

- These are mainly used to detect the movement of liquid or air flow through a pipe or duct. The air flow switch (or a micro switch) is constructed by a snap-action.

- This micro switch is attached to a metal arm. To this metal arm, a thin plastic or metal piece is connected.
- When a large amount of air passes through the metal or plastic piece, it causes the movement of metal arm and thus operates the contacts of the switch.
- Liquid flow switches are designed with a paddle that inserted across the flow of liquid in a pipe. When liquid flows through the pipe, force exerted against the paddle changes the position of the contacts.
- The above figure shows the switch symbol used for both air flow and liquid flow. The flag symbol on the switch indicates the paddle which senses the flow or movement of liquid.
- These switches again normally open or normally closed type configurations.

Pressure Switches

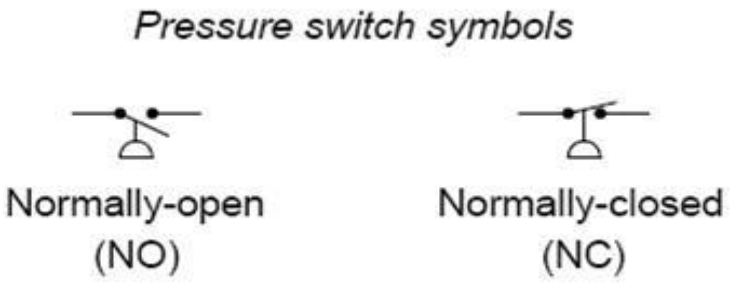


Figure 11. Pressure Switch

- These switches are commonly used in industrial applications in order to sense the pressure of hydraulic systems and pneumatic devices.
- Depends on the range of pressure to be measured, these pressure switches are classified into diaphragm operated pressure switch, metal bellow type pressure switch and piston type pressure switch.
- In all these types, pressure detection element operates a set of contacts (which can be either double pole or single pole contacts).
- This switch symbol consist a half-circle connected to a line in which flat part indicates a diaphragm. These switches may be either normally open or normally closed type configurations.

Temperature Switches

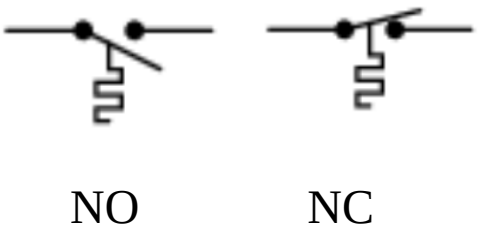


Figure 12. Temperature Switch

- The most common heat sensing element is the bimetallic strip that operates on the principle of thermal expansion.
- The bimetallic strips are made with two dissimilar metals (that are having different thermal expansion rates) and are bonded with each other.
- The switch contacts are operated when the temperature causes the strip to bend or wrap. Another method of operating the temperature switch is to use mercury glass tube.
- When the bulb is heated, mercury in the tube will expand and then generates pressure to operate the contacts.

Joystick Switch

Figure 13. Joystick Switch

- Joystick switches are manually actuated control devices used mainly in portable control equipments.
- It consists of a lever which moves freely in more than one axis of motion.

- Depending on the movement of the lever pushed, one or more switch contacts are actuated.
- These are ideally suited for lowering, raising and triggering movements to the left and right.
- These are used for building machinery, cable controls and cranes. The symbol for the joystick is shown below.

Rotary Switches

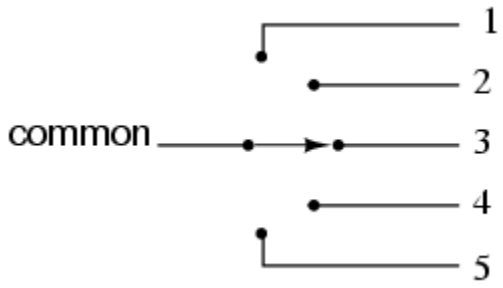


Figure 14. Rotary Switch

- These are used for connecting one line to one of many lines.
- Examples of these switches are range selectors in electrical metering equipment, channel selectors in communication devices and band selectors in multi-band radios.
- It consists of one or more moving contacts (knob) and more than one stationary contact.
- These switches are come with different arrangement of contacts such as single pole 12-way, 3-pole 4-way, 2-pole 6-way and 4-pole 3-way.

Proximity Switches

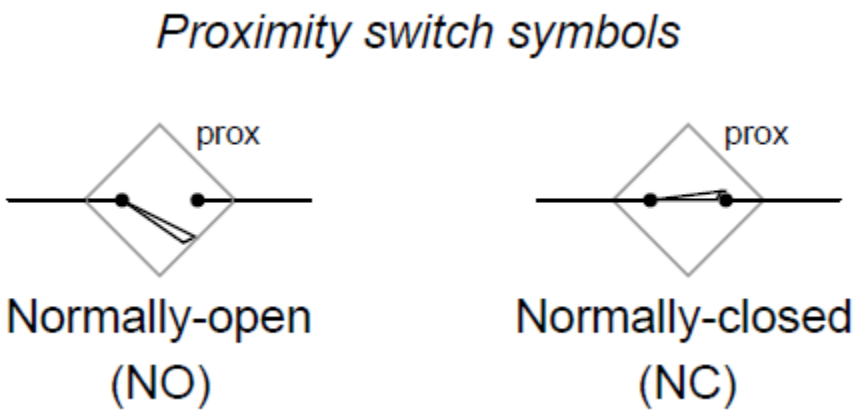


Figure 15. Proximity Switch

- Inductive proximity sensors are used for non-contact detection of metallic objects.
- Their operating principle is based on a coil and oscillator that creates an electromagnetic field in the close surroundings of the sensing surface.
- The presence of a metallic object (actuator) in the operating area causes a dampening of the oscillation amplitude.
- The rise or fall of such oscillation is identified by a threshold circuit that changes the output of the sensor.
- The operating distance of the sensor depends on the actuator's shape and size and is strictly linked to the nature of the material

Reed Switches

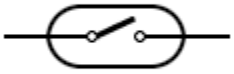


Figure 16. Reed Switch

- A reed switch is an electromagnetic switch used to control the flow of electricity in a circuit.
- They are made from two or more ferrous reeds encased within a small glass tube-like envelope, which become magnetized and move together or separate when a magnetic field is moved towards the switch.
- The switch effectively works like a gate, or a bridge, in an electric circuit so when the two reeds are in contact, electricity can flow around the circuit operating a device.
- Unlike mechanical switches they do not require something or someone to physically flick them on or off, they are controlled completely by invisible magnetic fields.

DIL/ DIP Switches

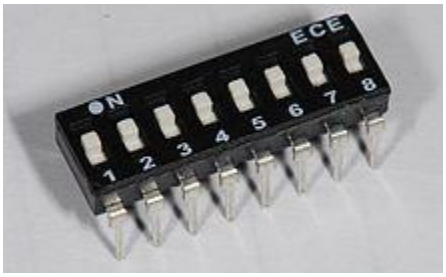


Figure 17. DIP Switch

- DIP switch can be defined as an array of simple two terminal On-Off electromechanical switches (Single Pole Single Throw) that are commonly used in electricity operations.

- The word DIP is an acronym for Dual In-line Package which means that the electrical contacts are in two rows.
- DIP switches are surface mountable and are used in those applications where multiple numbers of switches are involved in output generation.
- For instance, in a universal remote control, the DIP switch is used to set the frequency according to the device that is being operated.
- On a computer motherboard, DIP switches help in optimizing the clock speed and configuration settings according to the type of processor mounted.

ELECTRONIC SWITCHES

BJT

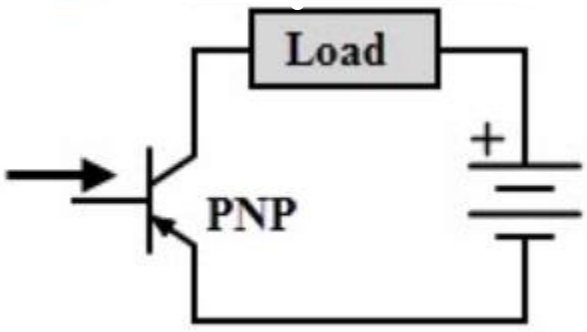


Figure 18. BJT as a Switch

- A transistor either allows the current to pass or it blocks the current as similar to working of normal switch.
- In switching circuits, transistor operates in cut-off mode for OFF or current blocking condition and in saturation mode for ON condition. The active region of the transistor is not used for switching applications.

- Both NPN and PNP transistors are operated or switched ON when a sufficient base current is supplied to it. When a small current flows though the base terminal supplied by a driving circuit (connected between the base and emitter), it causes to turns ON the collector-emitter path.
- And it is turned OFF when the base current is removed and base voltage is reduced to a slight negative value. Even though it utilizes small base current, it is capable to carry much higher currents through the collector- emitter path.

Power Diode

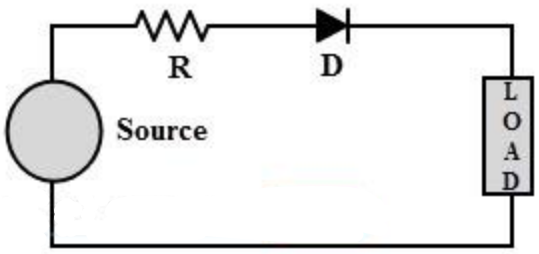


Figure 19. Power Diode as a Switch

- A diode can perform switching operations between its high and low state impedance states. Semiconductor materials like silicon and germanium are used for constructing the diodes.
- Usually, power diodes are constructed using silicon in order to operate the device at higher currents and higher junction temperatures. These are constructed by joining p and n type semiconductor materials together to form PN junction. It has two terminals namely anode and cathode.
- When the anode is made positive with respect to cathode and by the application of voltage greater than the threshold level, PN junction is forward biased and starts conducting (like ON switch). When the cathode terminal is made positive with respect to anode, PN junction reverse biased and its blocks the current flow (like OFF switch).

MOSFET

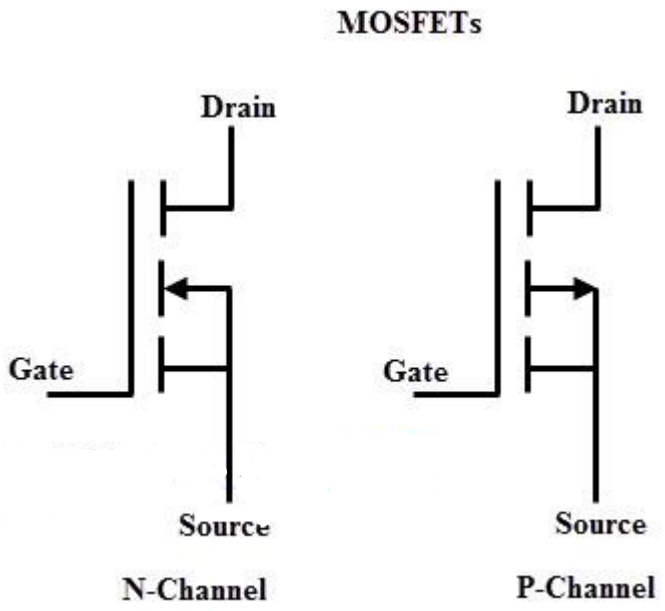


Figure 20. MOSFET as a Switch

- Metal Oxide Semiconductor Field Effect Transistor (MOSFET) is a unipolar and high frequency switching device. It is a most commonly used switching device is power electronic applications. It has three terminals namely drain (output), source (common) and gate (input).
- It is a voltage controlled device, i.e., by controlling input (gate to source) voltage, resistance between the drain and source is controlled which further determines the ON and OFF state of the device.
- MOSFETs can be a P-channel or N-channel devices. The N-channel MOSFET is tuned ON by applying a positive VGS with respect to the source (provided that VGS should be greater than threshold voltage).
- P-channel MOSFET operates in a similar manner of N-channel MOSFET but it uses reverse polarity of voltages. Both VGS and VDD are negative with respect the source to switch ON the P- channel MOSFET.

IGBT

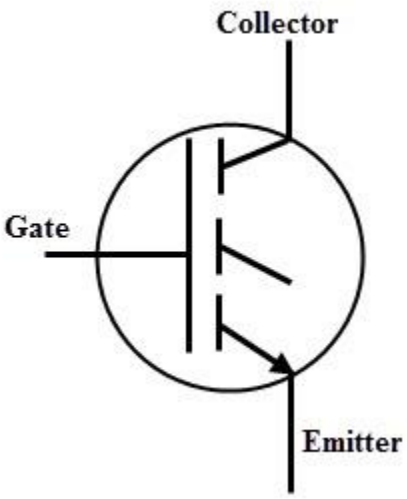


Figure 21. IGBT as a Switch

- IGBT (Insulated Gate Bipolar Transistor) combines the several advantages of bipolar junction power transistor and power MOSFET. Like a MOSFET, it is a voltage-controlled device and has lower ON state voltage drop (less than that of MOSFET and closer to power transistor).
- It is a three terminal semiconductor high speed switching device. These terminals are emitter, collector and gate.
- Similar to the MOSFET, IGBT can be turned ON by applying a positive voltage (greater than the threshold voltage) between the gate and emitter. IGBT can be turned by reducing the voltage across the gate-emitter to zero. In most of the case it needs negative voltage to reduce turn OFF losses and safely turn OFF the IGBT.

SCR

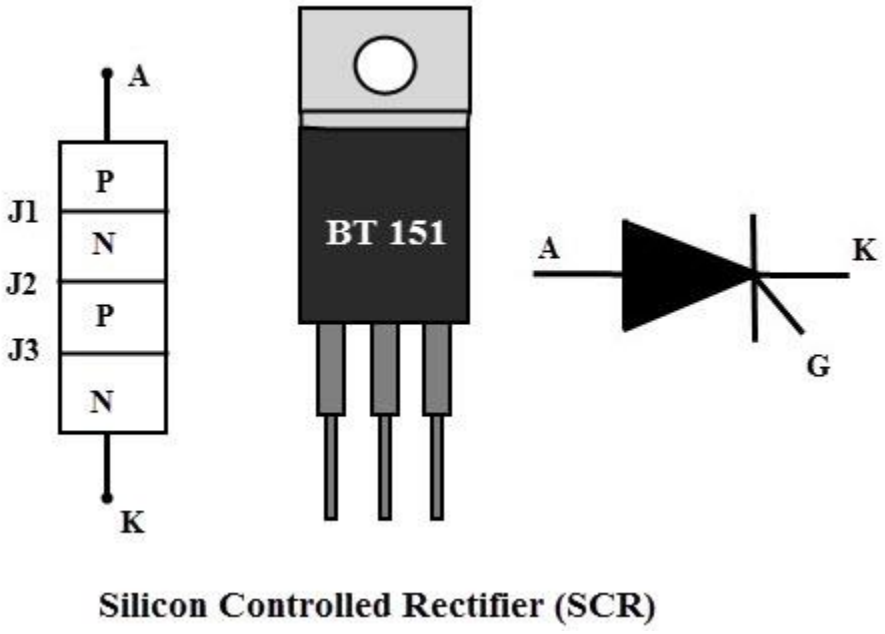


Figure 22. SCR as a Switch

- A Silicon Controlled Rectifier (SCR) most widely used high speed switching device for power control applications. It is a unidirectional device as a diode, consisting of three terminals, namely anode, cathode and gate.
- An SCR is turned ON and OFF by controlling its gate input and biasing conditions of the anode and cathode terminals. SCR consists of four layers of alternate P and N layers such that boundaries of each layer forms junctions J1, J2 and J3.

TRIAC

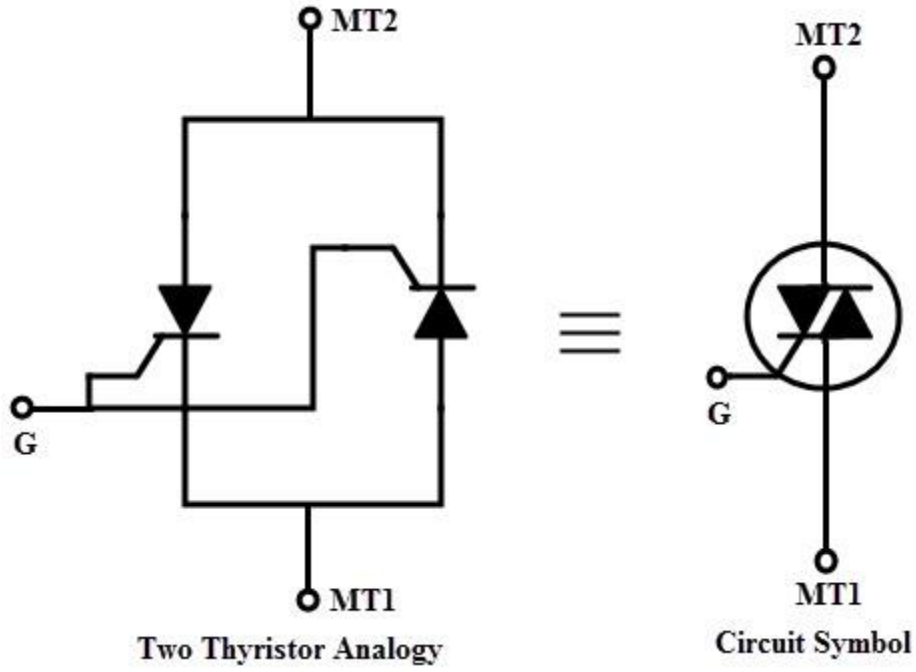
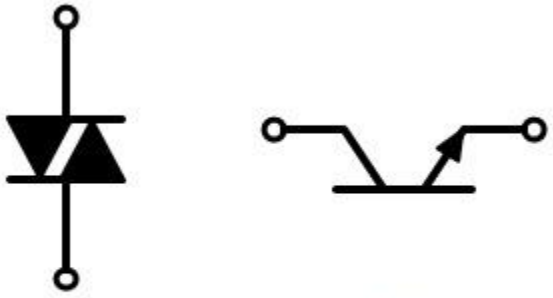


Figure 23. TRIAC as a Switch

- Triac (or TRIode AC) switch is a bidirectional switching device which is an equivalent circuit of two back to back SCRs connection with one gate terminal.
- Its capability to control AC power in both positive and negative peaks of the voltage waveform often makes these devices to be used in motor speed controllers, light dimmers, pressure control systems, motor drives and other AC control equipments.

DIAC



Symbols Used for DIAC

Figure 24. DIAC as a Switch

- A DIAC (or DIode AC switch) is bidirectional switching device and it consists of two terminals which are not named as anode and cathode. It means that a DIAC can be operated in either direction regardless of the terminal identification. This indicates that the DIAC can be used in either direction.
- When a voltage is applied across a DIAC, it either operates in forward blocking or reverse blocking mode unless the applied voltage is less than the breakover voltage. Once the voltage is increased more than breakover voltage, avalanche breakover occurs and device starts conducting.

Gate Turn-Off Thyristor

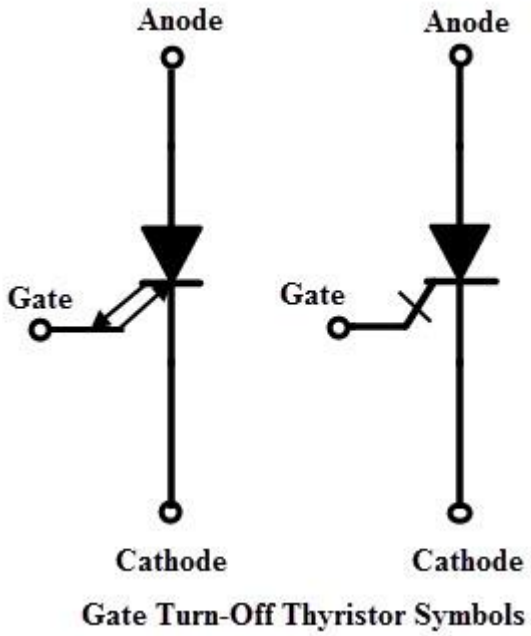


Figure 25. Gate Turn Off Thyristor as a Switch

- A GTO (Gate Turn-off Thyristor) is a bipolar semiconductor switching device. It has three terminals as anode, cathode and gate. As the name implies, this switching device is capable to turn OFF through gate terminal.
- A GTO is turned ON by applying a small positive gate current triggers the conduction mode and turned OFF by a negative pulse to the gate. GTO symbol consists of double arrows on the gate terminal which represents the bidirectional flow of current through gate terminal.

TYPES OF CONNECTORS

AC Connectors
DC Connectors
Wire Connectors

Blade Connectors
Plug and Socket Connectors
Insulation-Piercing Connectors
USB connectors

AC Connectors

Figure 26. AC Connector

- AC power connectors are mainly used to connect equipment to a wall outlet to power the device.
- Of the types of AC connectors, power plugs are for standard size devices while industrial AC power plugs are for larger industrial applications.

DC Connectors

Figure 27. DC Connector

- Unlike AC connectors, DC connectors are not standardized.
- A DC plug, a variant of a DC connector, primarily supplies smaller electronic devices with power.
- Because there are different standards of DC plugs, it's important not to accidently use incompatible variants.

Wire Connectors

Figure 28. Wire Connectors

- The purpose of a wire connector is to bring two or more wires together at a common point of connection.
- Lugs, crimps, set screws, and split-bolt types are all examples of this variant.

Blade Connectors

Figure 29. Blade Connectors

- Blade connectors feature a one wire connection—the blade connector is inserted into a blade receptacle and when the blade connector's wire makes contact with the receptor's wire a connection is made.

Plug and Socket Connectors

Figure 30. Plug and Socket Connectors

- Plug and socket connectors consist of a male and female component which fit together snugly.
- A plug, the male component, is comprised of many pins and prongs, which when inserted into the female socket, securely latch on to corresponding contacts.

Insulation-Piercing Connectors

Figure 31. Insulation-Piercing Connector

- Insulation piercing connectors are useful because they don't require uncovered wires.
- Instead, a fully covered wire is inserted into the connector, and a small device inside the opening removes the wire's covering as the wire slides into place.
- Then, the uncovered tip of the wire makes contact with the receptor, and electricity can be transmitted.

USB connectors

Figure 32. USB Connectors

- The Universal Serial Bus is a serial bus standard to interface devices, founded in 1996.
- It is currently widely used among PCs, Apple Macintosh and many other devices.
- There are several types of USB connectors, and some have been added as the specification has progressed.
- The most commonly used is the (male) series "A" plug on peripherals when the cable is fixed to the peripheral.
- If there is no cable fixed to the peripheral, the peripheral always needs to have a USB "B" socket.
- In this case a USB "A" plug to a USB "B" plug cable would be needed.
- USB "A" sockets are always used on the host PC and the USB "B" sockets on the peripherals.
- It is a 4-pin connector, surrounded by a shield.
- There are several other connectors in use, the mini-A, mini- B and mini-AB plug and socket (added in the On-The-Go Supplement to the USB 2.0 Specification).