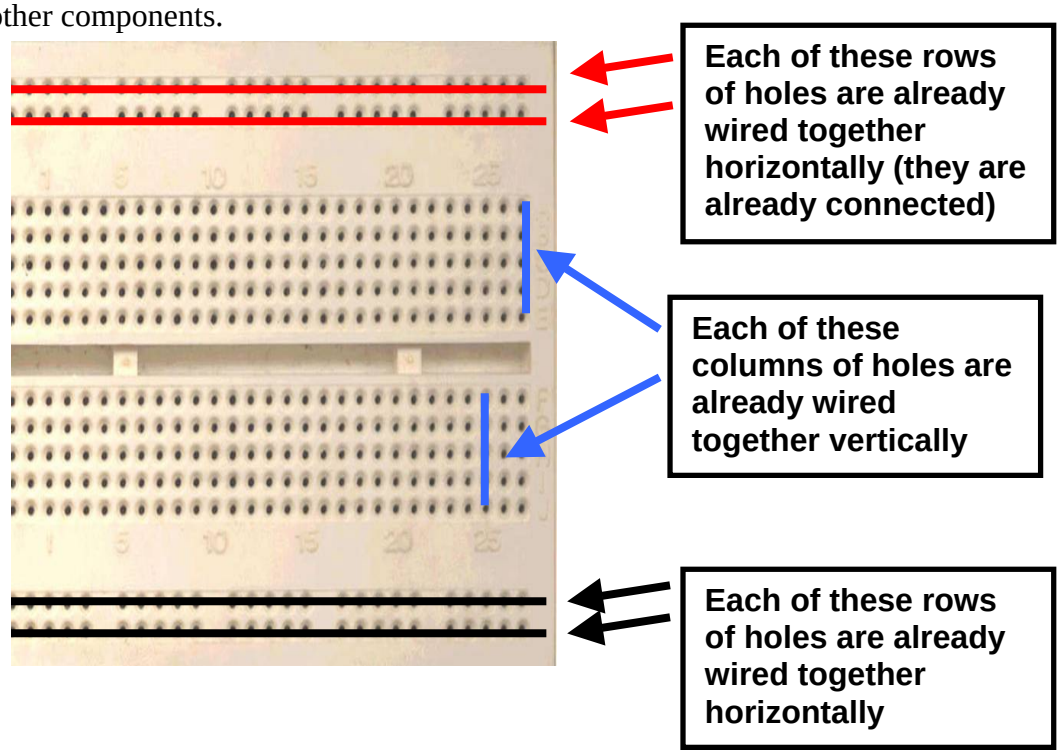
Some useful hints

Objective

1) Familiarization with the breadboard.
2) Identification of IC's and their pin numbers.
3) Inserting and removing IC's
4) Familiarization with different wire gauges and effective wiring techniques.
5) Familiarization with resistors, switches, and LED(light emitting diodes)

Discussion

In the early days of radio circuits they were built on the kitchen cutting boards(called breadboards). To this day this term is part of the electronic vocabulary. The term Breadboarding implies the building of an experimental circuit with either digital or analog or both. Today's breadboards have five socket strips to aid in breadboarding and allow an entire network to be assembled and tested without the use of solder. Examine your breadboard and you will discover that is has horizontal five hole stripes separated by deep groves in insulating material followed by two columns of vertical five socket stripes called buses to which power and ground are connected. Beneath each set of five sockets in a strip is a spring contact that connects all five sockets electrically together. Each horizontal strip is separated from the one above and below it as well as the one next to it. The stripes in each column in busses are connected together, but separated from the one next to it, which allows each bus to carry both positive and negative without experiencing a short. Some breadboards will have a horizontal buss at the top near the binding post and one at the bottom. They are very handy for supplying power and ground to the IC's and other components.

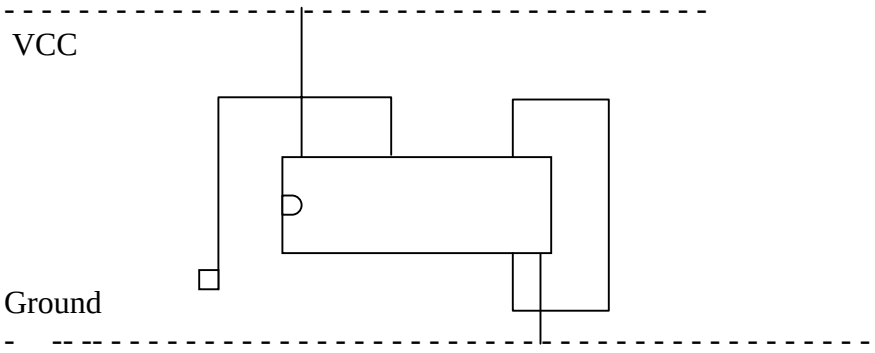


Always use insulated wire that is 20 AWG (American Wire Gauge) gauge or 22 AWG. 20 AWG has a diameter of .033 inches. The larger the AWG number the smaller the wire diameter. Use solid wire not stranded wire; strands may break off and lodge in the socket. Always use good quality diagonal cutters or wire strippers. Dull cutters will leave rough ends on the wire or burrs, which can damage the sockets. Strip about a quarter inch from each end of the wire before inserting it into the socket. Make sure that you did not nick the wire; nicked wires will break and leave bits of wire in the socket hole.

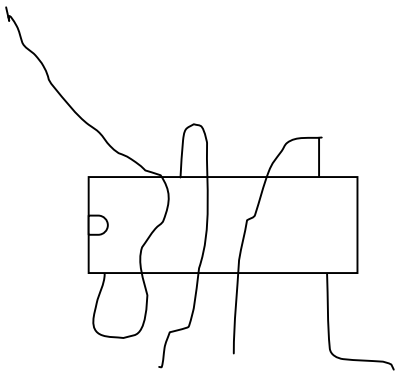
Strip-socket holes in a breadboard are spaced to match pin spacing on DIP's. Always use an extraction tool to remove an IC. If an extraction tool is no available you can use a small screwdriver by prying each up at both ends alternately.

Warning: *never remove or insert any component while the power is applied to the circuit!* This way you will not damage the component or yourself and will live long and prosperous. If you adhere to the following prime directive you will have a professional looking circuit that you will be proud to display and it will be easier to troubleshoot. The term lead dress describes the routing of wires. To start, never install wires over an IC. This way you don't need to disconnect the wires and then reconnect them when you need to remove the IC.

Good!

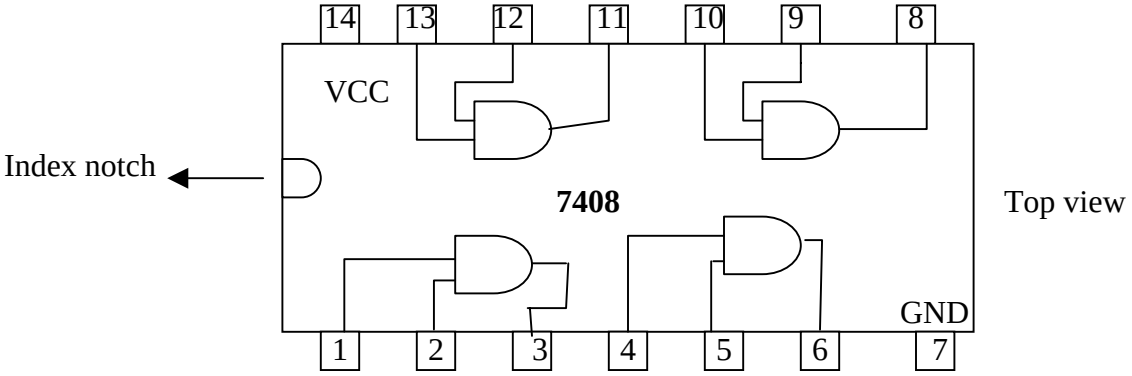


Not good!

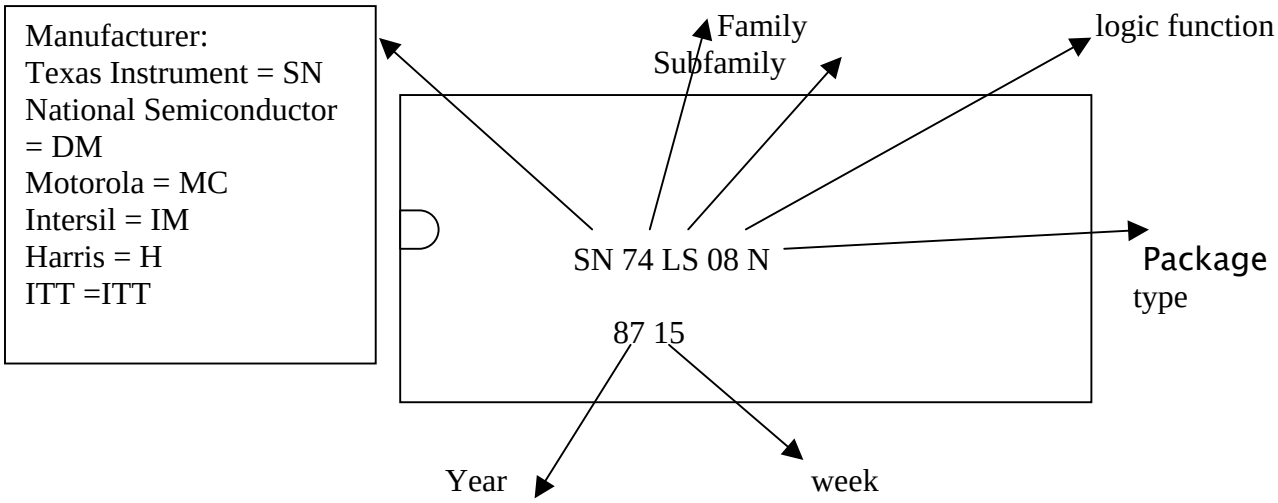


The first diagram shows the wires being dressed against the strip sockets and squared at the corners. Color wires can be used to help identify + voltage and ground. The second drawing shows the wires run any which way; this makes a sloppy looking project and extremely difficult to troubleshoot. As you can see the neater looking IC will be easier to follow the wires and the leads to test and troubleshoot. A little more time spent on wiring neatly will make your project a lot easier to work with. The way to install an IC is straddling the grove with the notch facing the binding post and the number one pin facing the left. This way you will be able to keep things in order.
All IC's need power and ground connections. They should be connected first to the busses assigned for positive and ground. This way they will not interfere with the rest of the logic wiring.

The term pinout is sometimes used to refer to the pin outline diagram of the IC as shown for the AND gate.

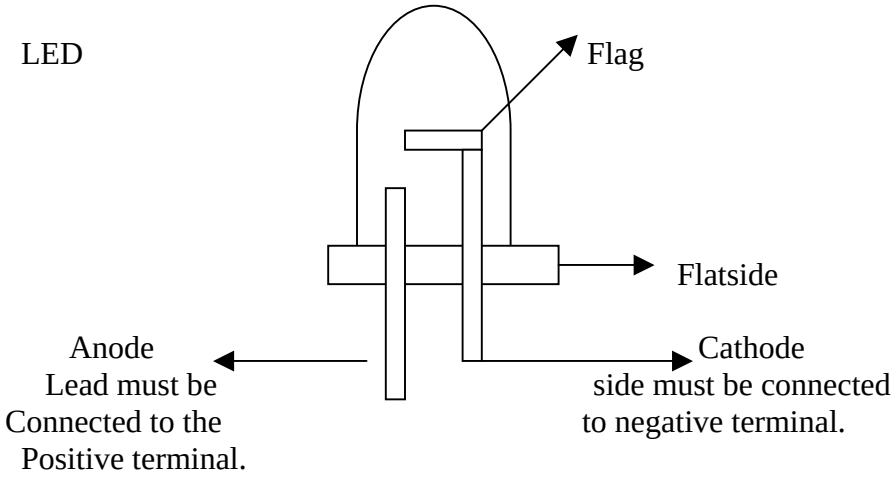


The above pinout is that of a 7408 quad two-input AND gate which has a 14 pin configuration and a TO-116 EIA packaging designation.

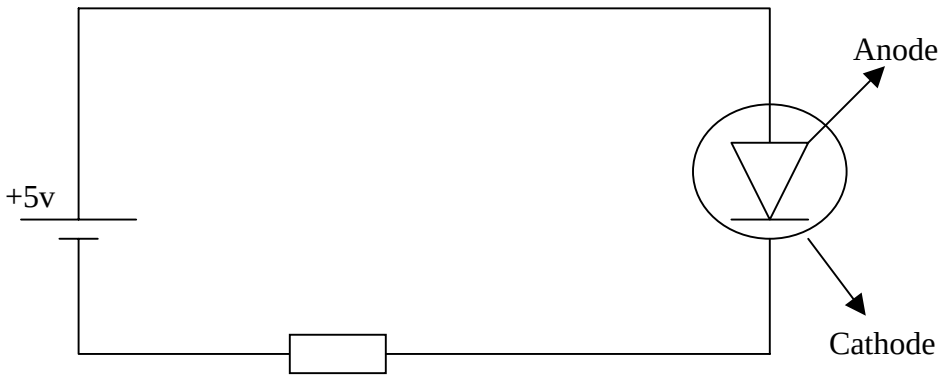


54HC / 74HC means a CMOS chip that is pin for pin compatible with TTL 54LS/74LS.
54HCT/74HCT series is a subfamily of the above.
54C/74C series is pin for pin and function equivalent to the TTL 54/74 family.

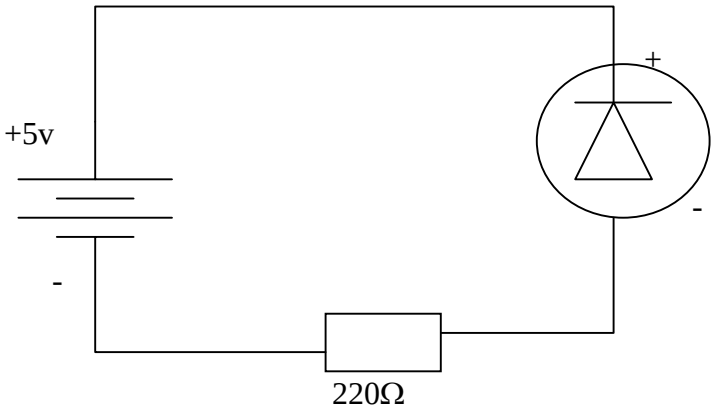
LED-light-emitting diode



The light-emitting diode is a solid state device that will light when it is forward-biased by approximately more than 2v when it starts to emit a visible light. The light can be red, green, orange, white or blue depending on the chemical structure of the material. Forward biasing the diode means connecting the anode to the positive terminal of the source and the cathode to the negative side of the source.



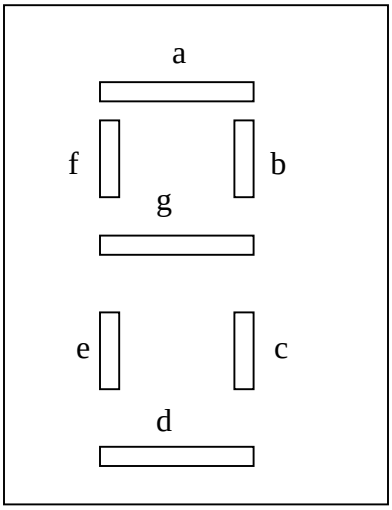
Always use a series resistor with an LED. LED is forward biased by more than 2v. It will emit light and current will flow.

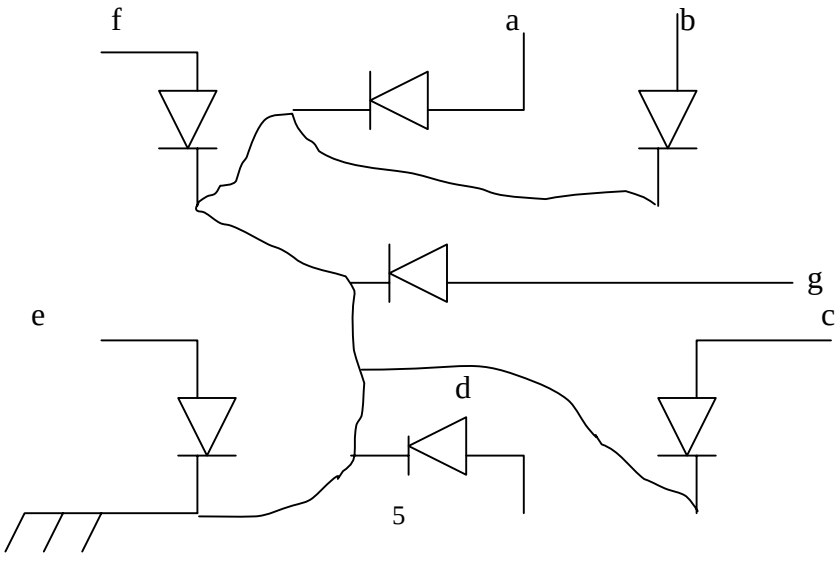


LED is reversed biased and will behave as an open switch. No current will flow and it will not emit light. The advantage of an LED over an incandescent light bulb is low power consumption and longer life.

Seven-segment display

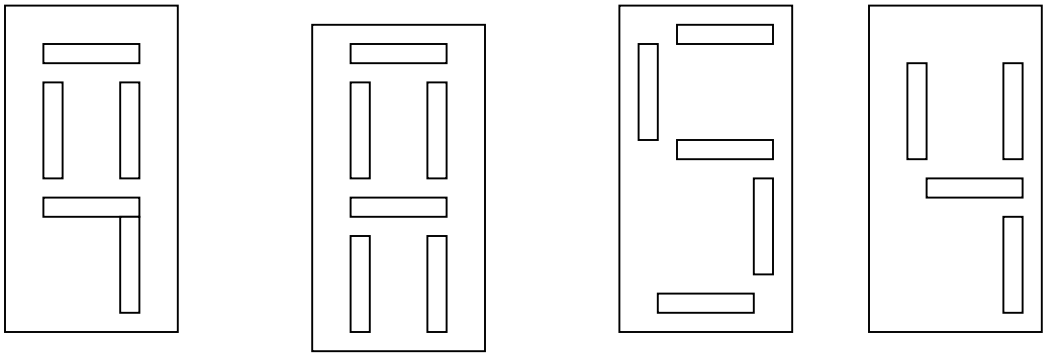
Light emitting diodes are used in seven-segment displays to show numbers and letters.





Example:

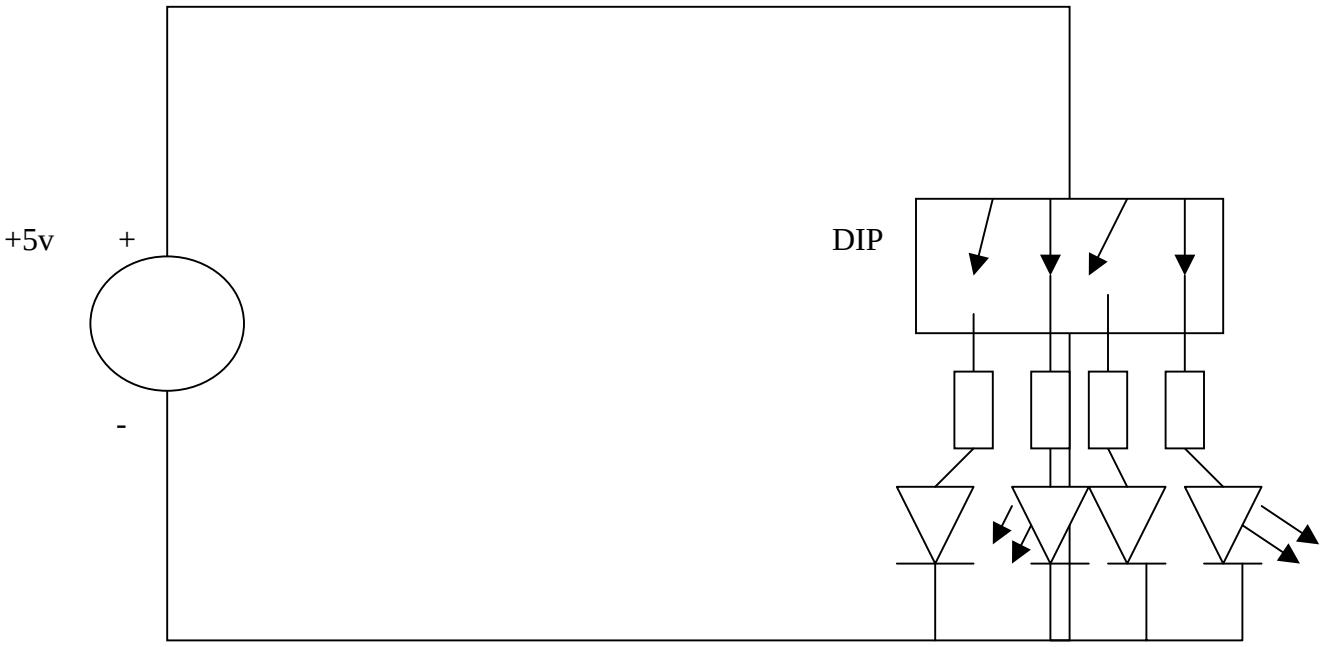
A binary pattern is the light from four seven-segment displays as shown below.



9	A	5	4
1001	1010	0101	0100

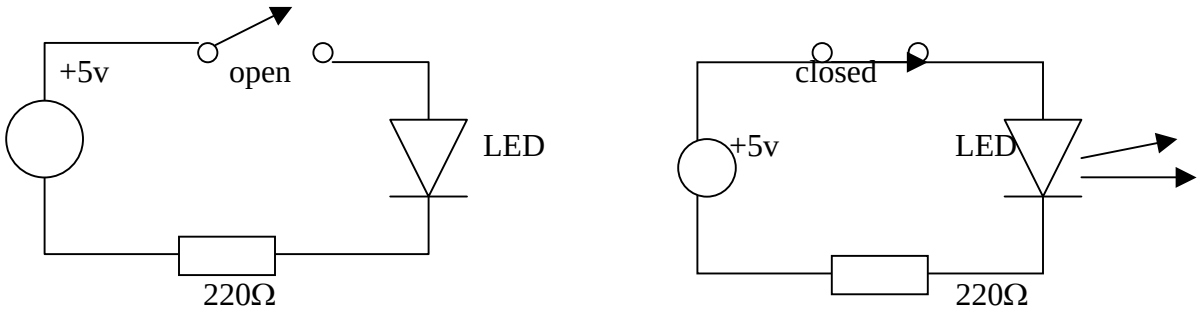
What is the decimal equivalent?

ON can be represented by 1 or +5v, and OFF can be represented by 0 or 0v. Also you can use diodes in such a way that if they are light that represents a 1 and if they are not light then it represents a 0.

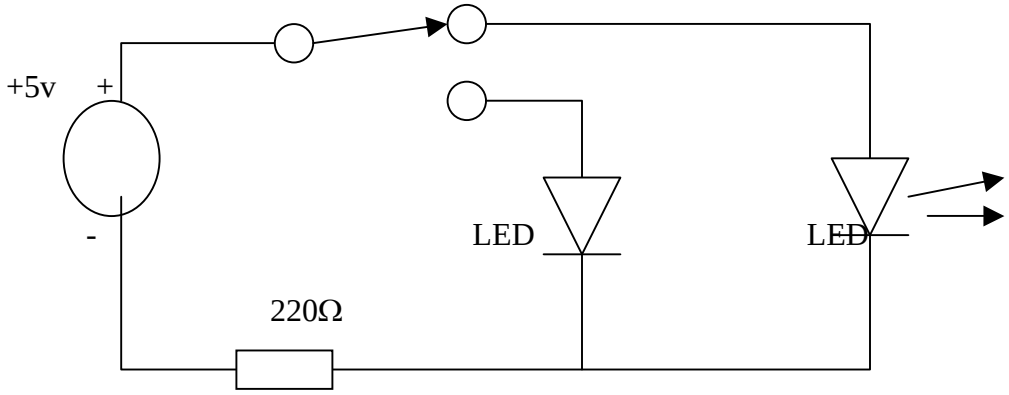


Switches

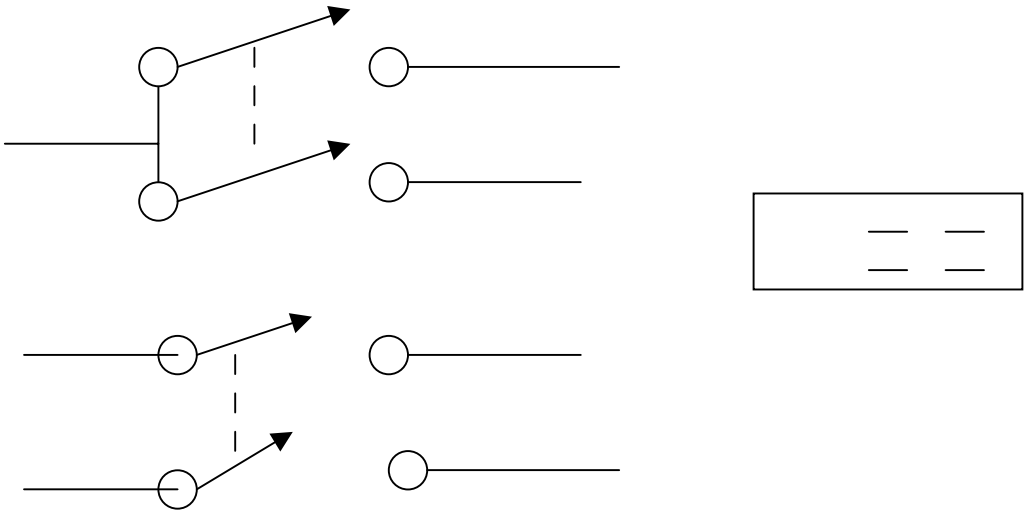
Single pole single throw (SPST).



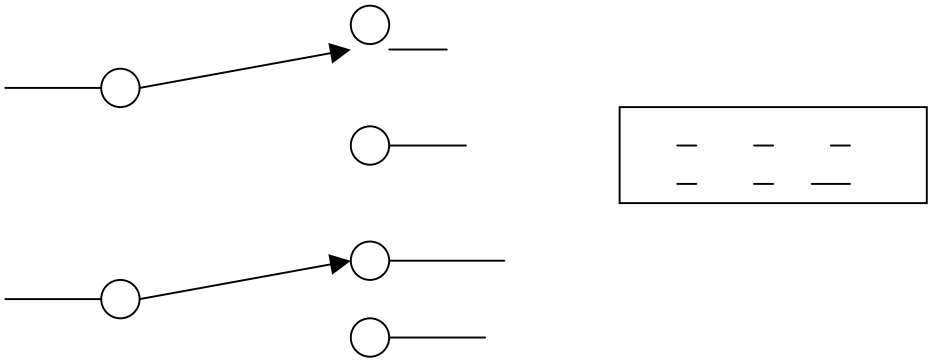
Single pole double throw (SPDT).



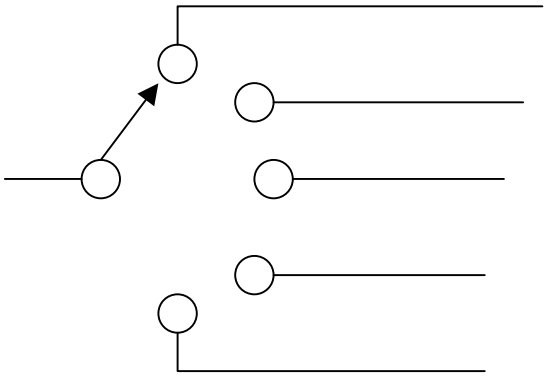
Double pole single throw (DPST).



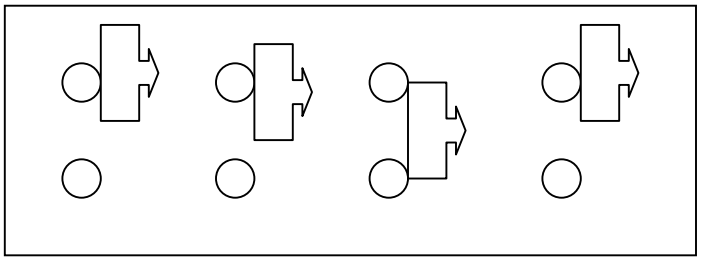
Double pole double throw (DPDT).



Rotary Switch



Dual in line switch DIP.



Push button normally open PBNO.