



## On Novel Circuit In Yielding An And State in Triple Ways.

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# On Novel Circuit In Yielding An And State in Triple Ways.

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**Abstract.** This is a look at different ways of switching in yielding an and state circuit. The first look at switching circuit, second on diode or transistor circuit and finally on use of and gate. Digital logic implementation in both Verilog and VHDL are provided.

**Keywords.** *Switch, Transistor, Gate, MoS, Circuit, Digital Logic.*

## 1 Introduction

### SPST, SPDT, DPST, AND DPDT EXPLAINED

#### What do SPST, SPDT, DPST, and DPDT mean?

**SP and DP refer to single pole and double pole, ST and DT refer to single throw and double throw.**

**Pole** refers to the number of circuits controlled by the switch: SP switches control only one electrical circuit. DP switches control two independent circuits (and act like two identical switches that are mechanically linked). Do not confuse 'pole' with 'terminal'. The DPST switch, for example, has four terminals, but it is a DP, not a 4P switch.

**Throw** refers to the extreme position of the actuator: ST switches close a circuit at only one position. The other position of the handle is Off. DT switches close a circuit in the Up position, as well as the Down position (On-On). A DT switch can also have a center position (frequently On-Off-On).

Single pole/throw and double pole/throw switches are by far the most common switches, but triple and quadruple configurations are also available. They are commonly denoted 3PST, 3PDT, 4PDT, etc.

There are several types of switches in electrical perspective. The basic switch with on/off states and open /closed describes any switch either in circuit(transistor) or mechanical form. In trying to switch states in circuit will be circuitry.

Mechanical switches turn to be pushed down which may be off on release or permanently down on. Switches can be SPST, SPDT, DPST, DPDT, Analog Switch, Mechanical Switch and more. Background information on switches can be found in [1]. A Single Pole Single Throw (SPST) switch is a switch that only has a single

Source: [Little fuse.](#)

Input and can connect only to one output. This means it only has one input terminal and only one output terminal. A Single Pole Single Throw switch serves in circuits as on-off switches. When the switch is open, the circuit is off.

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Human equipment interaction is required to be implemented with a switch for any electrical

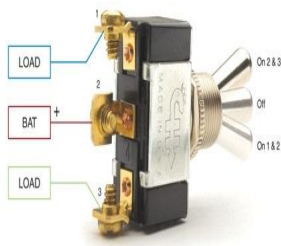


Figure 1: SPST.

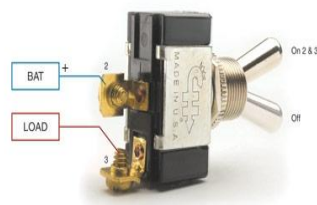


Figure 2: SPST

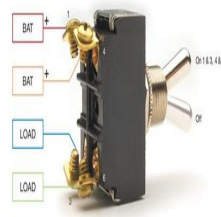


Figure 3: DPST.

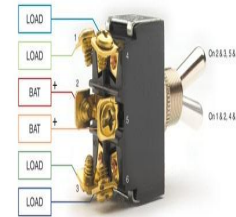


Figure 4. DPDT

### Switches Configuration by Function

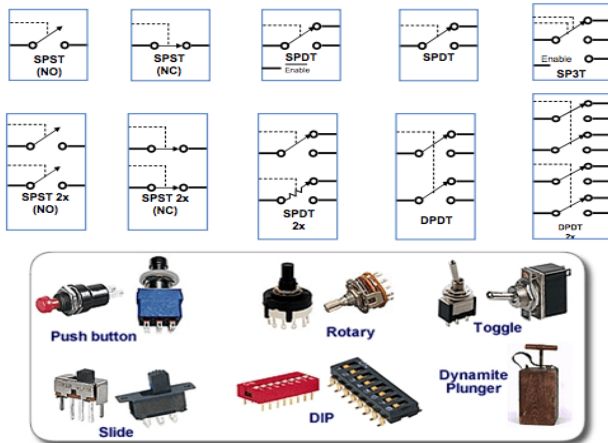


Figure 5: Different Switches.

or electronic hardware. Switches are safe for humans and will prevent shock at all times (unless you get shock in wire touch on power). Good times in long enough days sitting in halls, switching bulbs on walls and turning on equipments at home. Pushdown switches can be attached to encoded keyboards used in designing game in entertaining places. Complex

electrical or electronic equipment can be controlled by just a switch. Switch processing is a concept used in describing a processing program that allows a switch panel to control the functions in the program. Switch button is used to describe certain push areas used to control the switching on or off of devices like mobile phone, Television, Remote Control and more. The keyboard has many switches to indicate or communicate with the computer system to the exact key pressed whether alphanumeric or special characters. A closed switch will allow current to flow through to the yawning load that feeds on voltage source. An open switch places a barrier to current flow in building control means to a circuit. It can sometimes feel like a malfunctioning in equipment usage if power mains is connected and switch is off. A spoiled switch can hinder the correct functional mode of an equipment. This can lead to a spoilt equipment. Modern radio technique is used in providing alternative to providing a service equipment with spoiled switch. On days of spoiled switch can create stress and headache problems if the favorite football game is timed to watch. This is not different with any man. I switched on my TV

manually before writing this article. Pushing down or pressing on a switch is sometimes referred to as manual process. I like to switch my electrical stuff on at home- Washing machine to get my clothes clean, Rice cooker to get rice cooked, Iron to straighten or press my shirts, Microwave to heat cold food and more. Fun time with interactive switches brings electrical power to our homes everyday. I guess you have touched a switch today.

## 2 Circuits

This section shows the circuits of and switching circuit in providing a yield of and states described in the switch states in the tabular form:

Switch 1	Switch 2	Circuit State
OFF	OFF	OFF
OFF	ON	OFF
ON	OFF	OFF
ON	ON	ON

A switching circuit described here shows a pictorial form of two switches connected in series with a voltage source and a bulb load. The main point is that two switches will automatically change the power supply to the load element if both switches are switched on. Power supply across load which is bulb will light on. If any one is switched off then the supply of power will be 0 at the load side. A closed switch indicates binary 1 while an open-ended switch will indicate a binary 0. If both switches are on then it is an and state.

I will illustrate the scenarios of the above mentioned with schematic captures. The schematic is an electric circuit that diagrams the position of components.

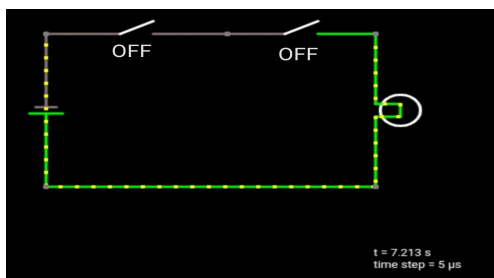
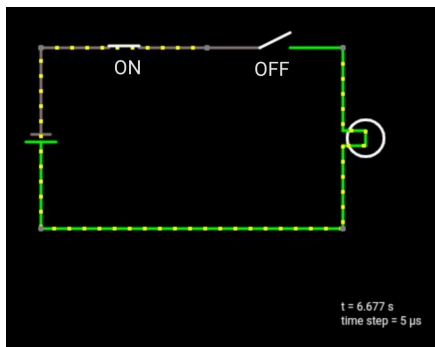


Figure 6: OFF-OFF Switch Circuit-And Switching Circuit

The basic and circuit is implemented with the circuit diagram in Figure 6. There are three components in the schematic capture.

Figure 7: ON-OFF Switch Circuit.



Switch 1 is the left component and switch 2 is the right component. Here switch 1 is ON state while switch 2 is OFF.

The next circuit is ON-ON Switch State

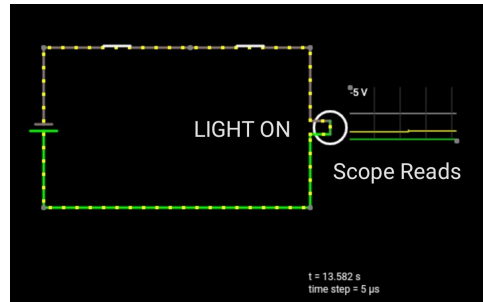


Figure 8: ON-ON Switch Circuit.

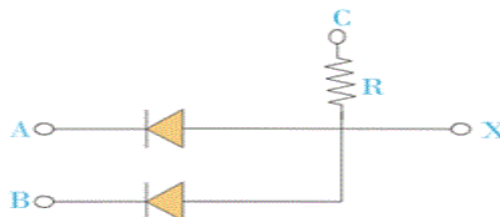
The text implementation of switching circuit are shown at the end of article.

## Diode or Transistor Implementation

A diode[2] is defined as a two-terminal electronic component that only conducts current in one direction (so long as it is operated within a specified voltage level). An ideal diode will have zero resistance in one direction, and infinite resistance in the reverse direction.

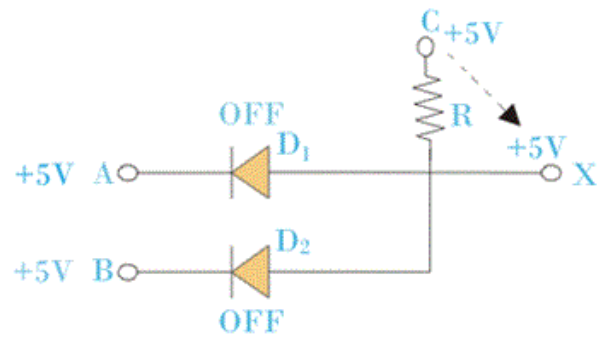
These diodes begin conducting electricity only if a certain threshold voltage is present in the forward direction (i.e. the “low resistance” direction). The diode is said to be “forward biased” when conducting current in this direction. When connected within a circuit in the reverse direction (i.e. the “high resistance” direction), the diode is said to be “reverse biased”.

A PN junction is the simplest form of the semiconductor diode. In ideal conditions, this PN junction behaves as a short circuit when it is forward biased, and as an open circuit when it is in the reverse biased. The name diode is derived from “di-ode” which means a device that has two electrodes. Normally an AND gate is designed by either diodes or transistors. When diodes are used to design AND gate, it is called a diode AND gate. The basic circuit of a diode

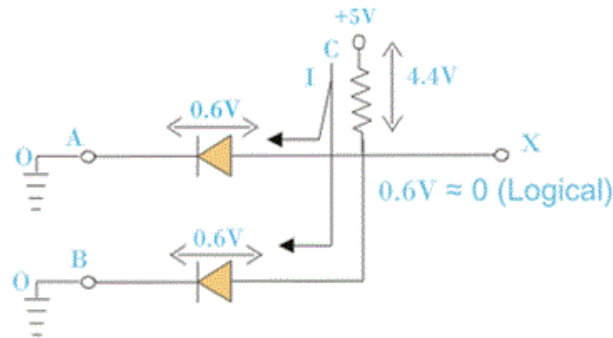


AND gate is as shown:

In the above diode circuit, we first apply +5V at C. Now if we apply +5V at A and B, both of the diodes are reversed biased and hence behave both diodes as OFF or open circuit.



In this situation as both diodes are OFF, no current will flow through resistor R and voltage of C (+5V) will also appear at X. As the supply voltage +5V appears at X, the output of the circuit is considered as high or logical 1.



Now, if either point A or B or both are applied with 0 Volt or they are grounded, the respective diode will become forward biased and hence behaves as 'ON' or short-circuited. In this condition, supply voltage +5V at point C will get a path through either of diodes or both to the ground potential.

### And Logic Gate

An AND gate is a logic gate having two or more inputs and a single output. An AND gate operates on logical multiplication rules. In this gate, if either of the inputs is low (0), then the output is also low. If all of the inputs are high (1), then the output will also be high. An AND gate can have any number of inputs, although 2 input and 3 input AND gates are the most common.

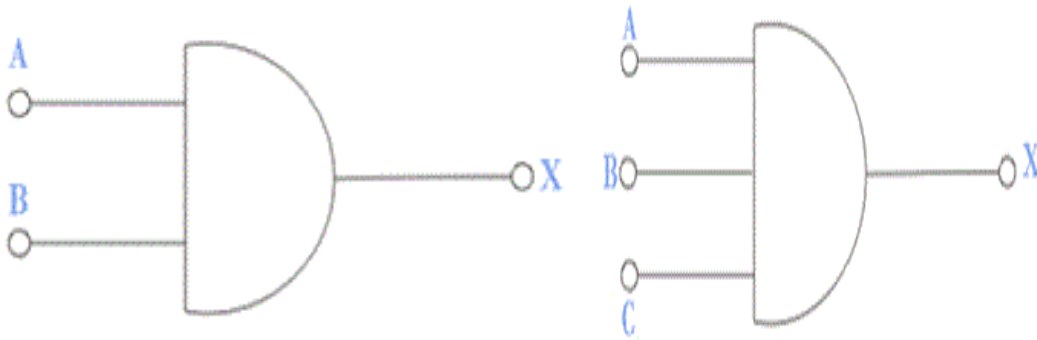
*And Truth Table*

Input 1(A)	Input 2 (B)	Output(C)
0	0	0
0	1	0
1	0	0
1	1	1

And is symbolised by a diagram which is shown below:

Figure 9: 2-Input And Gate.

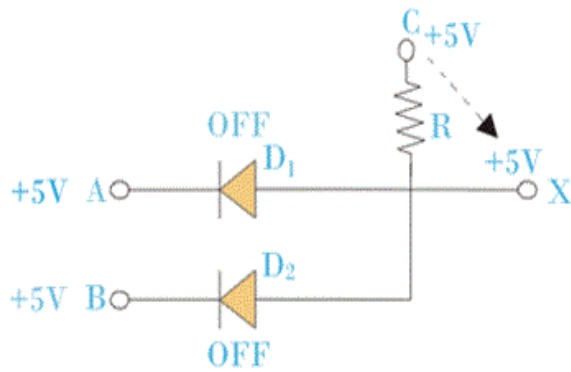
Figure 10: 3-Input And Gate



*3-Input And Gate Truth Table*

Input 1 (A)	Input 2(B)	Input 3(C)	Output(X)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

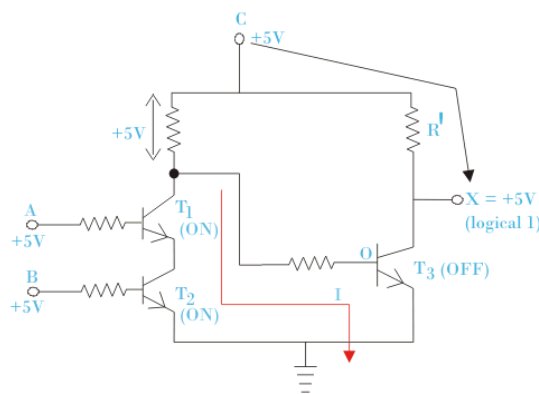
An AND logic gate can also be realized from the transistor AND gate. The transistor circuit diagram for an AND gate is shown below:



Now we will check what will be the logical value of X if both A and B are at high logical value. If we apply +5V at both A and B i.e. at the base of transistor T1 and T2 respectively.

This makes both the transistor T1 and T2 are in ON condition. Enter supply voltage will drop across R and the base potential of the transistor T3 will be zero and T3 becomes in OFF condition. As a result, the supply voltage +5V

appears at X, and X will become logically 1 or high.



### 3 Conclusion

This article looked at "and" circuits in terms of switch based implementation, diode based implementation and transistor based implementation. Finally, logic gate implementation is discussed. Verilog or VHDL Code for and implementation is shown in Appendix. The text code for the switching circuit is also provided.

#### Appendix : Text Code

*And circuit*

```

$ 1 0.000005 10.20027730826997 50 5 50
v 224 128 224 320 0 0 40 5 0 0 0.5
s 224 128 400 128 0 0 false
s 400 128 544 128 0 0 false
w 224 320 544 320 0
181 544 128 544 320 0 331.16663539008266 100 120 0.4 0.4

```



## Verilog Code: AND GATE

```
module andhw(c,a,b);  
    output c;  
    input a,b;  
    wire c;  
    and1 u1(c,a,b);  
endmodule
```

## VHDL Code : And Gate

```
library ieee;  
use ieee.std_logic_1164.all;  
entity and_gate is  
    port(a:    in std_logic;  
         b: in std_logic;  
         c: out std_logic);  
end entity;  
architecture dataflow of and_gate is  
begin  
c <= a and b;  
end dataflow;
```

## Further Reading

- [1] Littlefuse. Online Accessed by <https://m.littelfuse.com/technical-resources/technical-centers/commercial-vehicle-technical-center/poles-and-throws.aspx>
- [2]Diode.Online Accessed <https://www.electrical4u.com/logical-and-gate/>.
- [3]Electronic Professional Tool. Mobile App. Circuit Design Tool.
- [4]1364-2005 — IEEE Standard for Verilog Hardware Description Language. 2006. doi:10.1109/IEEESTD.2006.99495. ISBN 0-7381-4850-4.
- [5]1364-2005 — IEEE Standard for Verilog Hardware Description Language. 2006. doi:10.1109/IEEESTD.2006.99495. ISBN 0-7381-4850-4.
- [6]1364-1995 — IEEE Standard Hardware Description Language Based on the Verilog(R) Hardware Description Language. 1996. doi:10.1109/IEEESTD.1996.81542. ISBN 978-0-7381-3065-1.
- [7]Thomas, Donald E.; Moorby, Phillip R. (2013). The Verilog® Hardware Description Language (3rd ed.). Springer. ISBN 978-1475724646
- [8]Verilog syntax – A description of the syntax in Backus-Naur form. This predates the IEEE-1364 standard.