American International University- Bangladesh

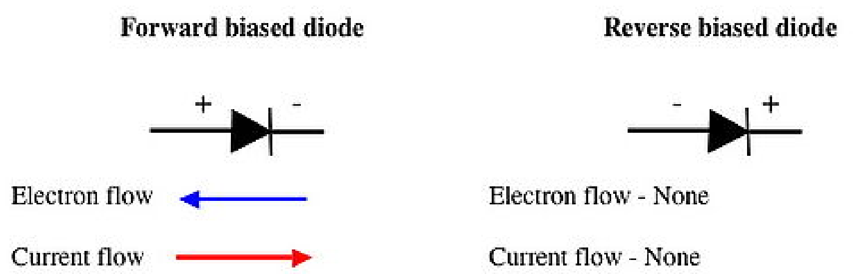
Faculty of Engineering (EEE)

Digital Electronics Laboratory

Title: Construction of Diode Logic Gates

Introduction:

A diode is a two-terminal electrical device that allows current to flow in one direction but not the other. It is like a pipe with an internal valve that allows water to flow freely in one direction but shuts down if the water tries to flow backward. The diode's two terminals are called the anode and cathode. In the diode symbol, the arrow points from the anode (flat part of triangle) toward the cathode (point of the triangle).



The device operates by allowing current to flow from anode to cathode, basically in the direction of the triangle. Recall that current is defined to flow from the more positive voltage toward the more negative voltage (electrons flow in the opposite direction). If the diode's anode is at a higher voltage than the cathode, the diode is said to be forward biased, its resistance is very low, and current flows. If the anode is at a lower voltage than the cathode, the diode is reverse-biased, its resistance is very high, and no current flows. The diode is not a perfect conductor, so there is a small voltage drop, approximately 0.7 V, across it.

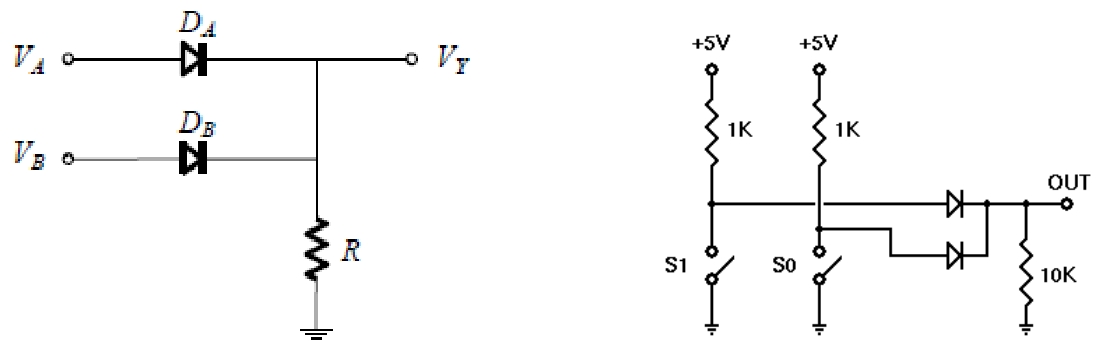
In this group of experiments we will implement some logic functions using the DL circuits and discover the potential benefits and problems of using the DL logic.

Theory and Methodology:

Diode Logic OR Gate:

A Diode Logic OR gate consists of nothing more than diodes (one for each input signal) and a resistor. Here, the 10KΩ resistor (R) is added to provide a ground reference for the output signal. If there are no input signals connected to the diodes, the output will be ground, or logic 0. Thus, an open input is equivalent to a logic 0 input, and will have no effect on the operation of the rest of the circuit.

It is possible to add any number of input diodes to this circuit, each with its separate input signal. However, two inputs are quite sufficient to demonstrate the operation of the circuit.



(a) (b)

Fig.1 DL-OR Gate

Assuming the diodes are ideal, the voltage truth table as given in Table 1(a) is obtained. The corresponding logic truth table is given in Table 1(b):

V_A (volt)	V_B (volt)	V_Y (volt)
0	0	0
0	5	5
5	0	5
5	5	5

(a)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(b)

Table 1

Diode Logic AND Gate:

A Diode Logic AND gate consists of diodes (one for each input signal) and a resistor. As with the DL OR gate, the 10KΩ resistor (R) provides a reference connection. Unlike the OR gate, however, this is a reference to +5 volts, rather than to ground. If there are no input signals connected to the diodes, the output will be +5 volts, or logic 1. Thus, an open input will not affect the rest of the circuit, which will continue to operate normally.

As with DL-OR gates, it is possible to add any number of input diodes to this circuit, each with its separate input signal. However, two inputs are quite sufficient to demonstrate the operation of the circuit.

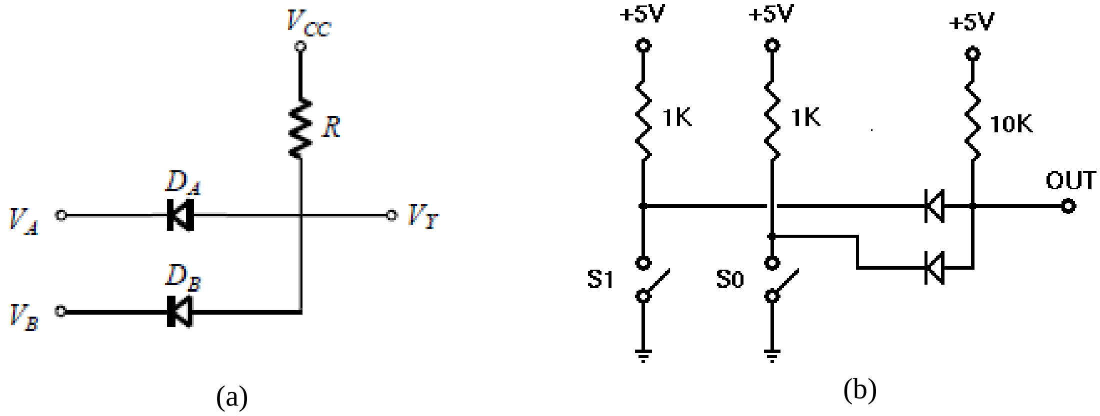


Fig.2 DL-AND Gate

Assuming the diodes are ideal, the voltage truth table of the above AND gate is as given in Table 2(a). The corresponding logic truth table is in Table 2(b).

V_A (volt)	V_B (volt)	V_Y (volt)
0	0	0
0	5	0
5	0	0
5	5	5

(a)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(b)

Table 2

Two-Input DL AND –OR Gate:

After looking at both the Diode Logic (DL) OR gate and AND gate and evaluating whether their operations were within acceptable parameters, the AND and OR gates will be cascaded. The OR gate will be used to combine the outputs of two AND gates and how well this combination works will be observed.

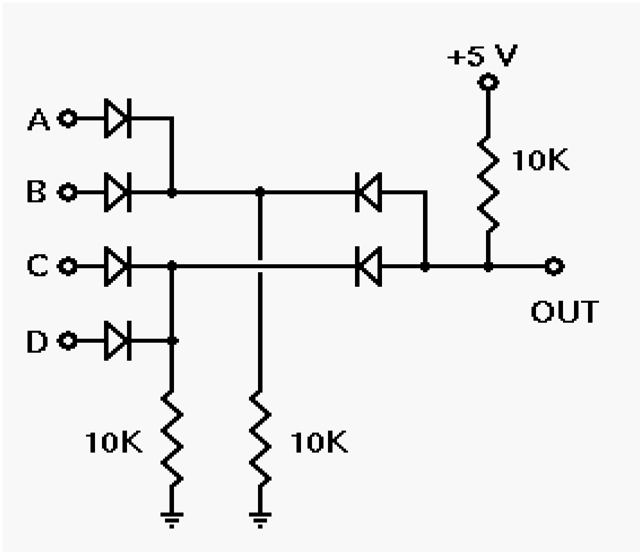


Fig.3 DL-AND-OR Gate

Diode polarity:

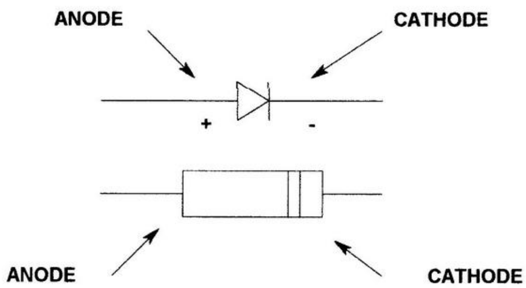


Fig.4 Diode polarity

Pre-Lab Homework:

1. Explain how a p-n junction or diode works? When does it conduct?

2. What is a wired logic?

3. Explain the operation of depletion region for different biasing conditions.

Students must install PSpice/LTSpice/ Psim software and MUST present the simulation results using transistors to the instructor before the start of the experiment.

Apparatus:

(1) 10K ohm resistor (brown-black-orange).

(2) 1N914/1N4002 diodes or equivalent.

(3) Connecting wires.

(4) Trainer Board

Precautions:

Have your instructor check all your connections after you are done setting up the circuit and make sure that you apply only enough voltage (within V_{DD}) to turn on the transistors and/or chip, otherwise it may get damaged.

Experimental Procedure:

1. Construct the DL-OR gate on your breadboard as shown in Fig. 1. Then draw a Truth Table similar to the one provided and fill in your experimental results.

2. Construct the DL-AND gate on your breadboard as shown in Fig. 2. Then draw a Truth Table similar to the one provided and fill in your experimental results.

3. Construct the DL-AND-OR gate on your breadboard as shown in Fig. 3. Before beginning the experiment, calculate your expected results for all the different input combinations and put them in a Truth Table similar to the one provided. Then draw a second Truth Table and fill it with your experimental output values.

Results and Discussion:

Students will summarize the experiment and discuss it as a whole. Interpret the data/findings and determine the extent to which the experiment was successful in complying with the goal that was initially set. Discuss any mistake you might have made while conducting the investigation and describe ways the study could have been improved.

Report:

1. For, each of the above set-ups, describe in words what the data means. Did your results match the expected ideal outputs? If not, explain why?
2. Why are diode logic gates not suitable for cascading operation?

Reference(s):

1. Thomas L. Floyd, *Digital Fundamentals*, 9th Edition, 2006, Prentice Hall.