

(DE3 -5a) Diode logic AND Gate

Aim of experiment

This experiment will examine the operation of the diode AND logic gate and compare the expected outputs to the truth tables for this device.

Apparatus

Prototyping Board– DC Power Supply 5V or 9V Battery – Light Emitting Diode (LEDs) – 74193 4 Bit Synchronous Binary Counters IC – 1 k Ω Resistor – Connection Wires.

Theory of experiment

Diodes can perform switching and digital logic operations. Forward and reverse bias switch a diode between the low and high impedance states, respectively. Thus, it serves as a switch.

An AND gate is shown in *figure 1*. Logic gates have inputs and an output (Y) which is a function of the inputs. The inputs to the gate are high (logic 1), say 10 V, or low, 0 V (logic 0). In the figure, the logic levels are generated by switches. If a switch is up, the input is effectively high (1). If the switch is down, it connects a diode cathode to ground, which is low (0). The output depends on the combination of inputs at A and B. The inputs and output are customarily recorded in a “truth table” at (c) to describe the logic of a gate. At (a) all inputs are high (1). This is recorded in the last line of the truth table at (c). The output, Y, is high (1) due to the V+ on the top of the resistor. It is unaffected by open switches. At (b) switch A pulls the cathode of the connected diode low, pulling output Y low (0.7 V).

This is recorded in the third line of the truth table. The second line of the truth table describes the output with the switches reversed from (b). Switch B pulls the diode and output low. The first line of the truth table records the Output= 0 for both input low (0). The truth table describes a logical AND function. Summary: both inputs A and B high yields a high (1) out.

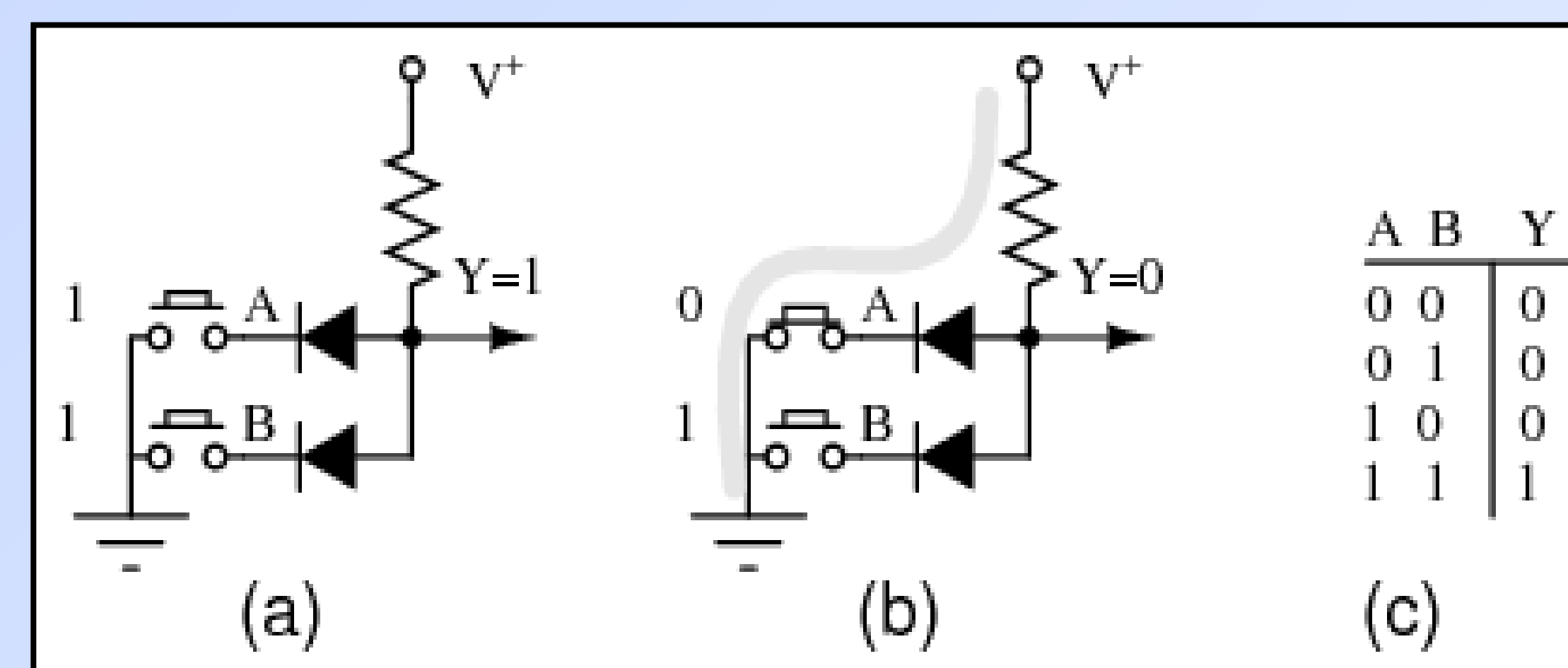


Figure 1. Diode AND gate

The AND function is similar to the multiplication in mathematics, and provides a logic 1 output only when all the inputs of the gate are at logic 1, and logic 0 output for all other input combinations. *Figure 2* contains the logic symbols and truth table for the AND function. The Boolean Equation for a 2 input AND gate, the Boolean Equation is:

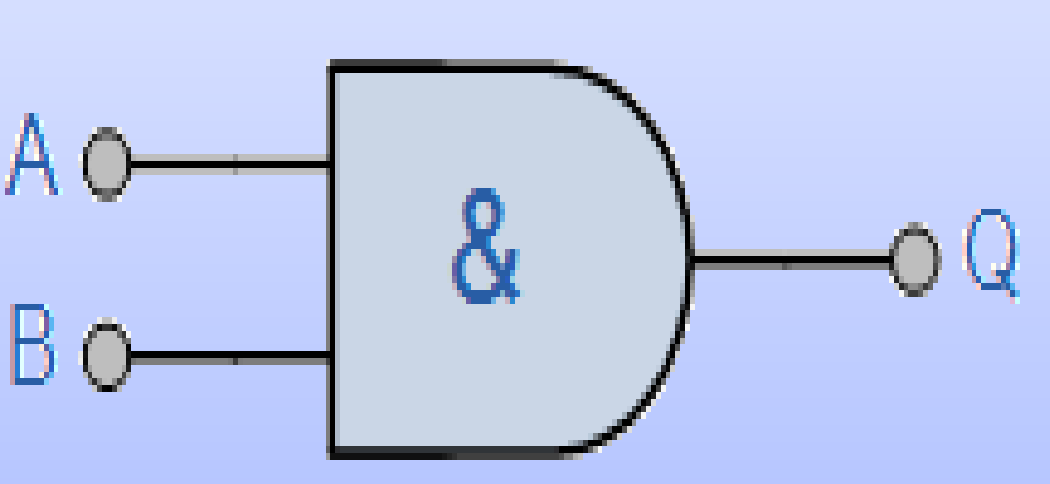
Symbol	Truth Table		
 2-input AND Gate	B	A	Q
	0	0	0
	0	1	0
	1	0	0
	1	1	1
Boolean Expression $Q = A \cdot B$		Read as A AND B gives Q	

Figure 2. logic symbols and truth table for the AND function

Procedures

1. Connect the following circuit in the Prototyping board.
2. Connect points A and B to input switches in Prototyping board, and connect output Z to output LED.
3. Change switches 1 and 2 on and off and show the output of LEDS.
4. Record the results in the following table.

Results

Switch 1 (A)	Switch 2 (B)	LED output (Z)
0	0	
1	0	
0	1	
1	1	

