

Lab 4: Half Subtractor

4.1 Aim

Design and verify the logic circuit of Half-subtractor using logic gate.

4.2 Objective:

- To understand the principle of binary subtraction.
- To understand half-subtractor concept.
- Use truth table and Boolean Algebra theorems in simplifying a circuit design.
- To implement half-subtractor circuit using logic gates

4.3 Apparatus Requirement:

- Prototyping board (breadboard)
- DC Power Supply 5V Battery
- Light Emitting Diode (LED)
- Digital ICs:
 - 7408 :Quad 2 input AND
 - 7486: Quad 2 input XOR
 - 7432 :Quad 2 input OR
 - 7404: Hex inverter (NOT Gate)
- Connecting Wires

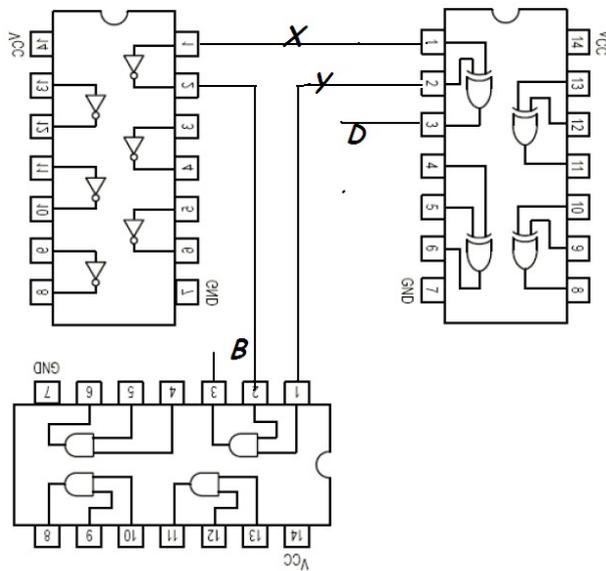


Figure 4.1: Pin Diagram of Half-Subtractor

4.4 Pin Diagram:

4.5 Theory:

Half Subtractor: The half-subtractor is a combinational circuit which is used to perform subtraction of two bits. It has two inputs, X (minuend) and Y (subtrahend) and two outputs D (difference) and B (borrow).

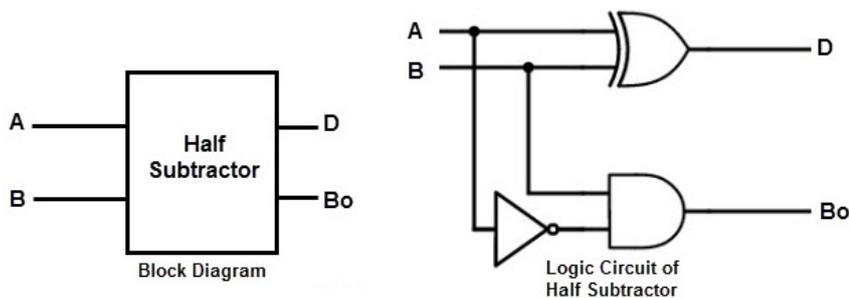


Figure 4.2: Logic Circuit and Block diagram of half-subtractor

4.6 Procedure:

- Collect the components necessary to accomplish this experiment.
- Plug the IC chip into the breadboard.

A	B	D	B ₀
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

Truth Table

$$D = A + B$$

$$B = A\bar{B}$$

Boolean Expression

Figure 4.3: Truth Table and Boolean expression of half-subtractor

- Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5V.
- According to the pin diagram of each IC mentioned above, make the connections according to circuit diagram.
- Connect the inputs of the gate to the input switches of the LED.
- Connect the output of the gate to the output LEDs.
- Once all connections have been done, turn on the power switch of the bread-board
- Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if LED is OFF Apply the various combination of inputs according to the truth table and observe the condition of Output LEDs.

4.7 Observation Table:

Full Subtractor: Input Variable: A,B,BIN, D,BOUT Output Variable: D,B LED ON: RED Light: Logic 1 LED OFF: Green Light: Logic 0

Table 4.1: Output Observation Table

Inputs		Outputs	
A	B	D	B ₀

4.8 Results and Analysis:

Verified the truth table as follows. Full Subtractor: Verified the truth table of Full Subtractor as $D = 1$ i.e LED which is connected to D terminal glows when inputs are X, Y, BIN Verified the truth table of Full Subtractor as $BOUT = 1$ i.e LED which is connected to BOUT terminal glows when inputs are X, Y, BIN

4.9 conclusion:

- To add two bits we require one XOR gate(IC 7486) to generate Difference and one AND (IC 7408) and NOT Gate(IC 7432) to generate Borrow.
- To add three bits we require two half subtractor.