

### Half Adder

Half adders perform a simple binary addition of 2 bits producing 2 outputs, the sum bit (y) and carry bit (c).

#### Block Diagram

The half adder is shown in the block diagram in figure 1.

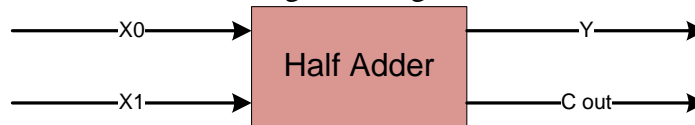
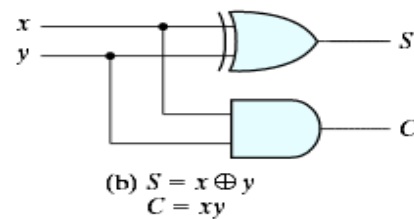
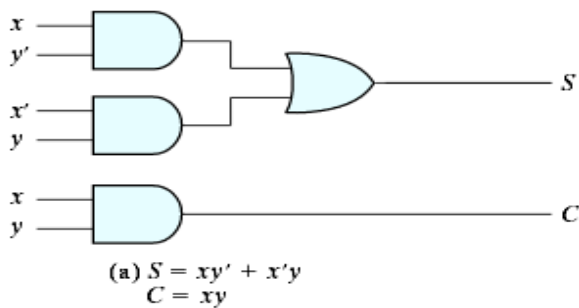


Figure 1: Block diagram for a Half Adder Circuit

#### Truth Table

Table gives the truth table for this adder.

x1	x0	y	C out
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1



**SUM=  $A \oplus B$**   
**CARRY=  $A . B$**

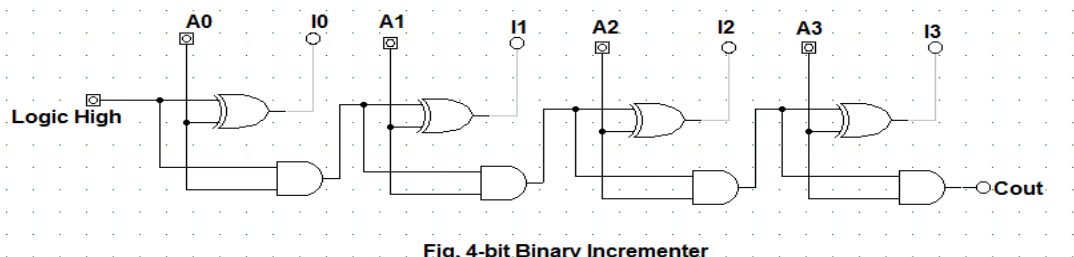


Fig. 4-bit Binary Incrementer

### Full Adder

The full adder block diagram is shown in Fig..

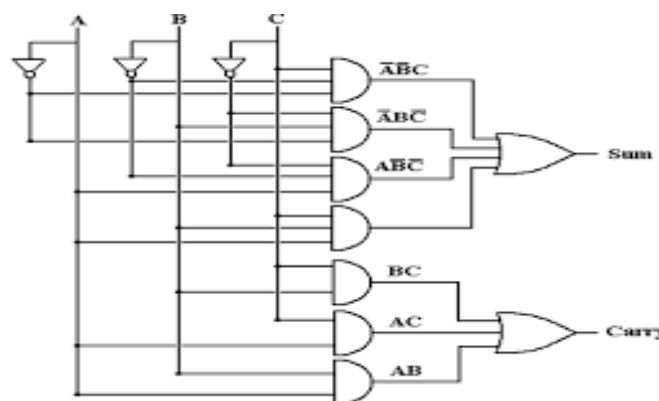


Figure: Block diagram for a Full Adder Circuit

### Truth Table

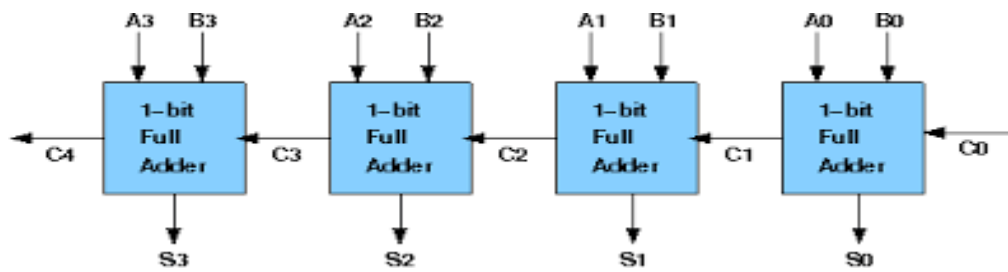
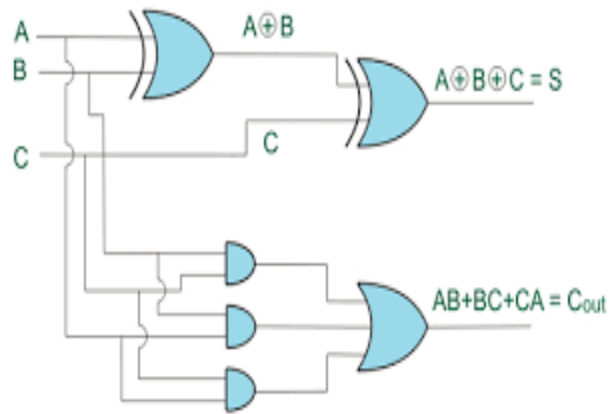
Table gives the truth table for this adder.

C in	x1	x0	S	C out
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1



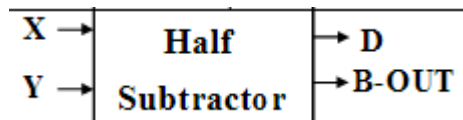
$$F = \bar{A} \cdot \bar{B} \cdot C + \bar{A} \cdot B \cdot \bar{C} + A \cdot B \cdot C + A \cdot \bar{B} \cdot \bar{C}$$

$$C_{out} = B \cdot C + A \cdot B + A \cdot C$$

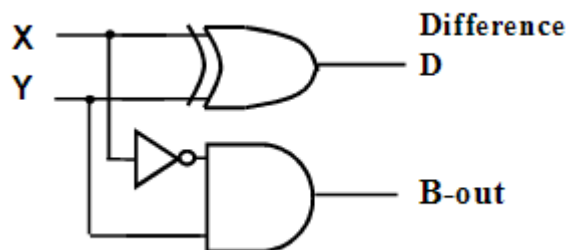


### Half Subtractor

This operation is called half subtraction and the circuit to realize it is called a half subtractor.



Inputs		Outputs	
X	Y	D	B-out
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0



$$D = X \oplus Y$$

$$B\text{-out} = X'Y$$

