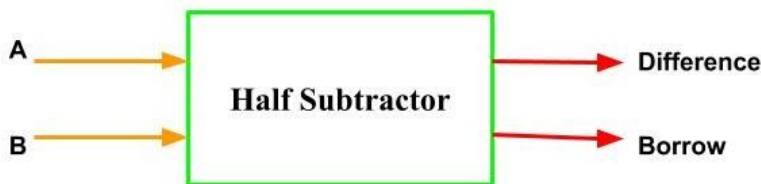


# HALF SUBTRACTOR AND FULL SUBTRACTOR

## HALF SUBTRACTOR

Half subtractor is the most essential combinational logic circuit which is used in digital electronics. Basically, this is an electronic device or in other terms, we can say it as a logic circuit. Half subtractor is used to perform two binary digits subtraction. In the previous article, we have already discussed the concepts of half adder and a full adder circuit which uses the binary numbers for the calculation. Similarly, the subtractor circuit uses binary numbers (0,1) for the subtraction. The circuit of the half subtractor can be built with two logic gates namely NAND and EX-OR gates. This circuit gives two elements such as the difference as well as the borrow. This article gives half subtractor theory concept which includes theories like what is a subtractor, half subtractor with the truth table, etc.

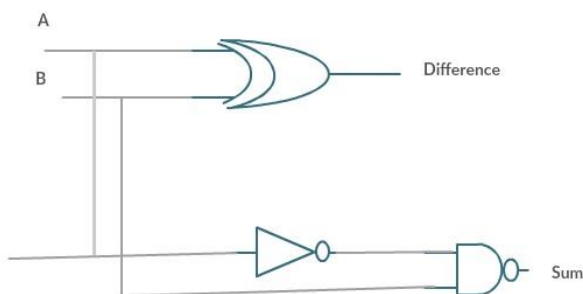


As in binary subtraction, the major digit is 1, we can generate borrow while the subtrahend 1 is superior to minuend 0 and due to this, borrow will need. The following example gives the binary subtraction of two binary bits.

First Digit	Second Digit	Difference	Borrow
0	0	0	0
0	1	1	0
1	0	1	1
1	1	0	0

In the above subtraction, the two digits can be represented with A and B. These two digits can be subtracted and gives the resultant bits as difference and borrow.

When we observe the first two and fourth rows, the difference of these rows, then the difference and borrow are similar because subtrahend is lesser than the minuend. Similarly, when we observe the third row, the minuend value is subtracted from the subtrahend. So the difference and borrow bits are 1 because the subtrahend digit is superior to the minuend digit.



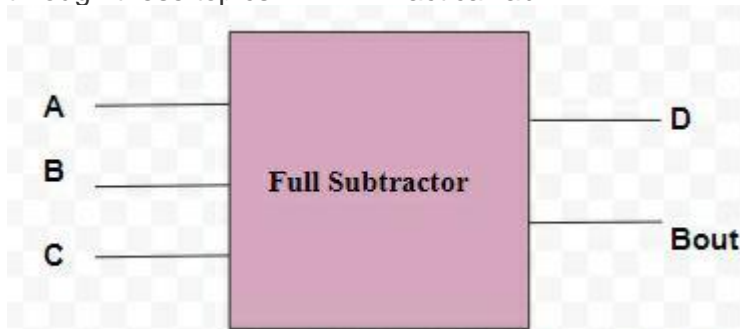
$$\text{Difference} = A \text{ XOR } B$$

$$\text{BORROW} = A' \cdot B = (\text{NOT } A) \text{ AND } B$$

# FULL SUBTRACTOR

Generally, the full subtractor is one of the most used and essential combinational logic circuits. It is a basic electronic device, used to perform subtraction of two binary numbers. In the earlier article, already we have given the basic theory of half adder & a full adder which uses the binary digits for the computation. Likewise, the full-subtractor uses binary digits like 0,1 for the subtraction. The circuit of full subtractor can be built with logic gates such as OR, Ex-OR, NAND gate. The inputs of this subtractor are A, B, Bin and outputs are D, Bout.

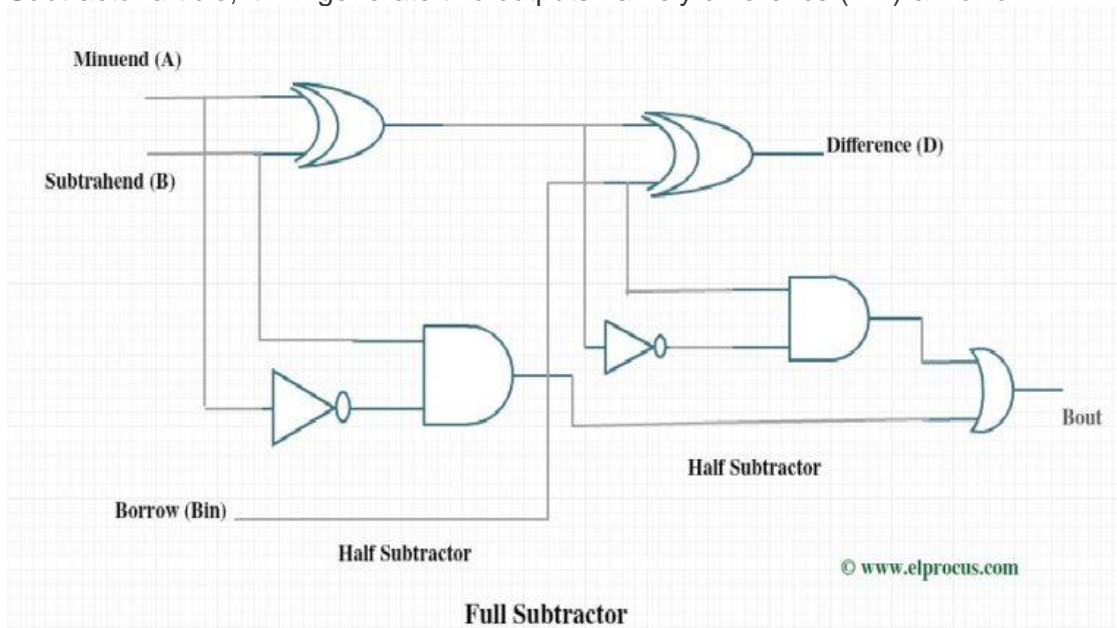
This article gives full-subtractor theory idea which comprises the premises like what is a subtractor, full subtractor design with logic gates, truth table, etc. This article is useful for engineering students who can go through these topics in HDL Practical lab.



A full subtractor is formed by two half subtractors, which involves three inputs such as minuend, subtrahend and borrow, borrow bit among the inputs is obtained from subtraction of two binary digits and is subtracted from next higher order pair of bits, outputs as difference and borrow.

The circuit diagram of full subtractor using basic gates is shown in the following block diagram. This circuit can be done with two half-Subtractor circuits.

In the initial half-Subtractor circuit, the binary inputs are A and B. As we have discussed in the previous half-Subtractor article, it will generate two outputs namely difference (Diff) & Borrow.



The difference o/p of the left subtractor is given to the Left half-Subtractor circuit's. Diff output is further provided to the input of the right half Subtractor circuit. We offered the Borrow in bit across the other i/p of next half subtractor circuit. Once more it will give Diff out as well as Borrow out the bit. The final output of this subtractor is Diff output.

On the other hand, the Borrow out of both the half Subtractor circuits is connected to OR logic gate. Later than giving out OR logic for two output bits of the subtractor, we acquire the final Borrow out of the subtractor. The last Borrow out to signify the MSB (a most significant bit).

Inputs			Outputs	
A	B	B <sub>in</sub>	D	B <sub>out</sub>
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

**Table 3.9 Truth table for full-subtractor**

The full subtractor expression for Difference is,

$$D = A'B'B_{in} + AB'B_{in}' + A'BB_{in}' + ABB_{in}$$

The full-subtractor expression for Borrow is,

$$B_{out} = A'B_{in} + A'B + BB_{in}$$

Made by : Rohnak Agarwal, 18.11.2019

Source : elprocus.com