SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE NAME : 19EC306 – Digital Circuits

II YEAR / III SEMESTER

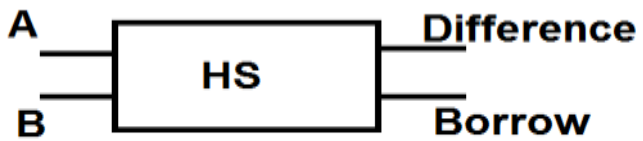
Unit I- **COMBINATIONAL CIRCUITS**

Topic : Half subtractor – Full subtractor

A half subtractor is a digital logic circuit that performs binary subtraction of two single-bit binary numbers. It has two inputs, A and B, and two outputs, DIFFERENCE and BORROW. The DIFFERENCE output is the difference between the two input bits, while the BORROW output indicates whether borrowing was necessary during the subtraction.
The half subtractor can be implemented using basic gates such as XOR and NOT gates. The DIFFERENCE output is the XOR of the two inputs A and B, while the BORROW output is the NOT of input A and the AND of inputs A and B.

Half Subtractor

Half subtractor is a combination circuit with two inputs and two outputs that are **different** and **borrow**. It produces the difference between the two binary bits at the input and also produces an output (Borrow) to indicate if a 1 has been borrowed. In the subtraction (A-B), A is called a **Minuend bit** and B is called a **Subtrahend bit**



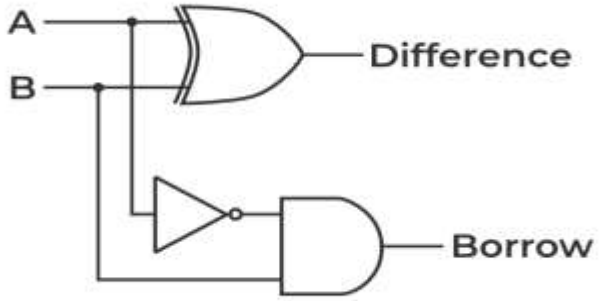
Half Subtractor

Truth Table

A	B	Diff	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

The SOP form of the Diff and Borrow is as follows:
Diff= A'B+AB’
Borrow = A'B

Implementation



Advantages of Half Adder and Half Subtractor

Simplicity, Building blocks, Low cost, Easy integration

Disadvantages of Half Adder and Half Subtractor

1.Limited functionality
2.Inefficient for multi-bit numbers
3.High propagation delay

Application of Half Subtractor in Digital Logic:

1.Calculators:
2.Alarm Frameworks:
3.Automotive Frameworks:
4.Security Frameworks:
5.Computer Frameworks:

Full Subtractor in Digital Logic

A full subtractor is a **combinational circuit** that performs subtraction of two bits, one is minuend and other is subtrahend, taking into account borrow of the previous adjacent lower minuend bit. This circuit **has three inputs and two outputs**. The three inputs A, B and Bin, denote the minuend, subtrahend, and previous borrow, respectively. The two outputs, D and Bout represent the difference and output borrow, respectively. Although subtraction is usually achieved by adding the complement of subtrahend to the minuend, it is of academic interest to work out the Truth Table and logic realisation of a full subtractor; x is the minuend; y is the subtrahend; z is the input borrow; D is the difference; and B denotes the output borrow. The corresponding maps for logic functions for outputs of the full subtractor namely difference and borrow.

Here's how a full subtractor works:

1. First, we need to convert the binary numbers to their two's complement form if we are subtracting a negative number.
2. Next, we compare the bits in the minuend and subtrahend at the corresponding positions. If the subtrahend bit is greater than or equal to the minuend bit, we need to borrow from the previous stage (if there is one) to subtract the subtrahend bit from th**e** minuend bit.
3. We subtract the two bits along with the borrow-in to get the difference bit. If the minuend bit is greater than or equal to the subtrahend bit along with the borrow-in, then the difference bit is 1, otherwise it is 0.
4. We then calculate the borrow-out bit by comparing the minuend and subtrahend bits. If the minuend bit is less than the subtrahend bit along with the borrow-in, then we need to borrow for the next stage, so the borrow-out bit is 1, otherwise it is 0.

The circuit diagram for a full subtractor usually consists of two half-subtractors and an additional OR gate to calculate the borrow-out bit. The inputs and outputs of the full subtractor are as follows:

Inputs: A: minuend bit, B: subtrahend bit, Bin: borrow-in bit from the previous stage

Outputs:

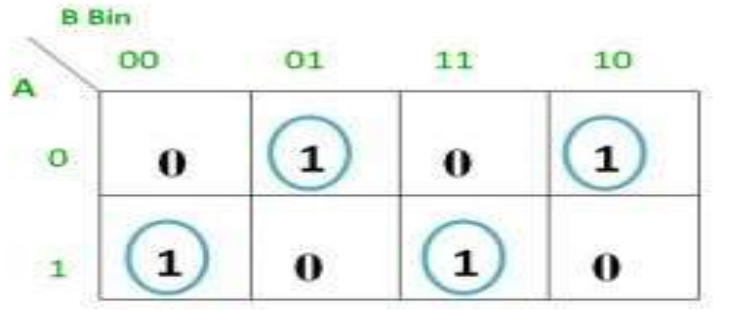
Diff: difference bit

Bout: borrow-out bit for the next stage

Truth Table –

INPUT			OUTPUT	
A	B	Bin	D	Bout
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

From above table we can draw the K-Map as shown for “difference” and “borrow”.

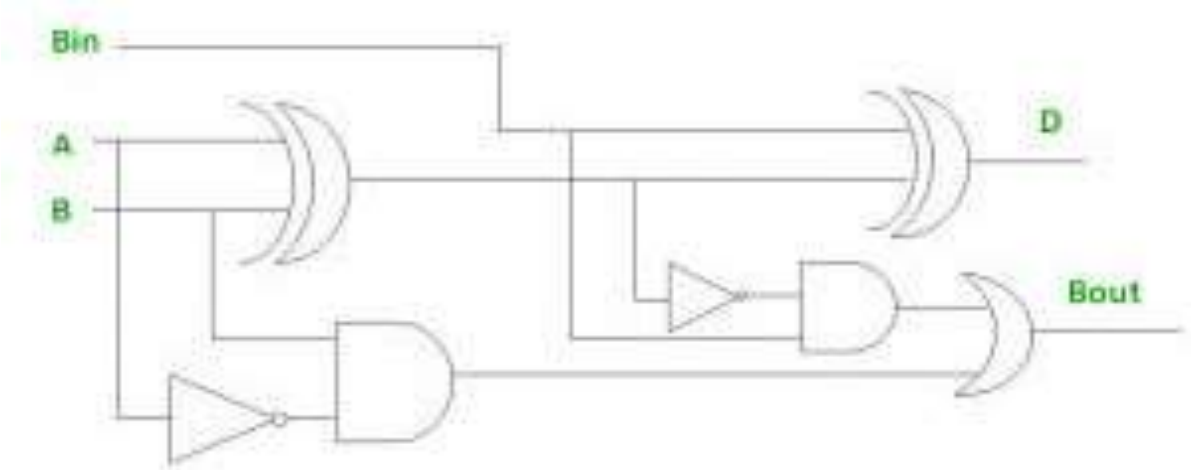


$D=A'B'Bin + AB'Bin' + A'BBin' + ABBin$

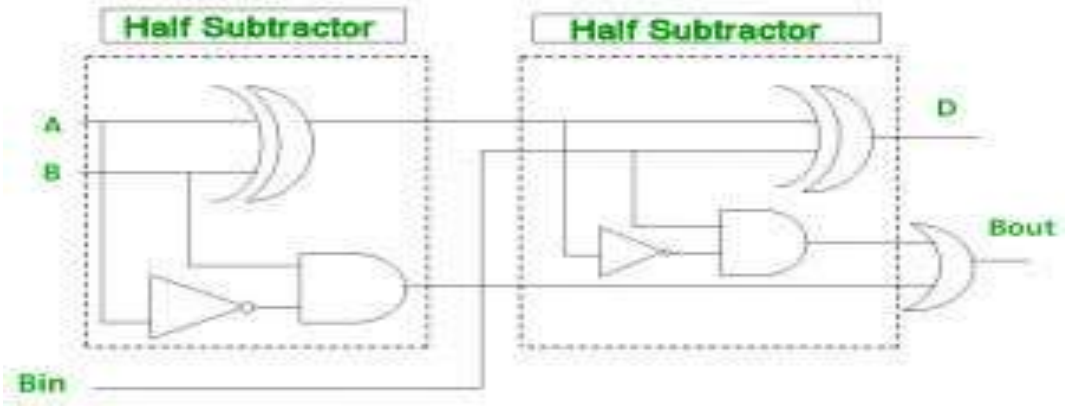
A \ B Bin	00	01	11	10
0	0	1	1	1
1	0	0	1	0

Bout=A'Bin + A'B + BBin

Logic Circuit for Full Subtractor



Implementation of Full Subtractor using Half Subtractors – 2 Half Subtractors and an OR gate is required to implement a Full Subtractor.



Any Query????

Thank you……