Binary Multiplier

2×2 Bit Multiplier

This multiplier can multiply two numbers having bit size = 2 i.e. the multiplier and multiplicand can be of 2 bits. The product bit size will be the sum of the bit size of the input i.e. **2+2=4**. The maximum range of its output is **3 x 3 = 9**. So we can accommodate decimal 9 in 4 bits. It is another way of finding the bit size of the product.

Suppose multiplicand $\mathbf{A_1\ A_0}$ & multiplier $\mathbf{B_1\ B_0}$ & $\mathbf{P_3\ P_2\ P_1\ P_0}$ as a product of the 2×2 multiplier.

First, multiplicand A_1A_0 is multiplied with LSB B_0 of the multiplier to obtain the partial product. This is obtained using AND gates. Then the same multiplicand is multiplied (AND) with the 2^{nd} LSB to get the 2^{nd} partial product. The multiplicand is multiplied with each bit of the multiplier (from LSB to MSB) to obtain partial products.

The number of partial products is equal to the number of bit size of the multiplier. In 2×2 multiplier, multiplier size is 2 bits so we get 2 partial products.

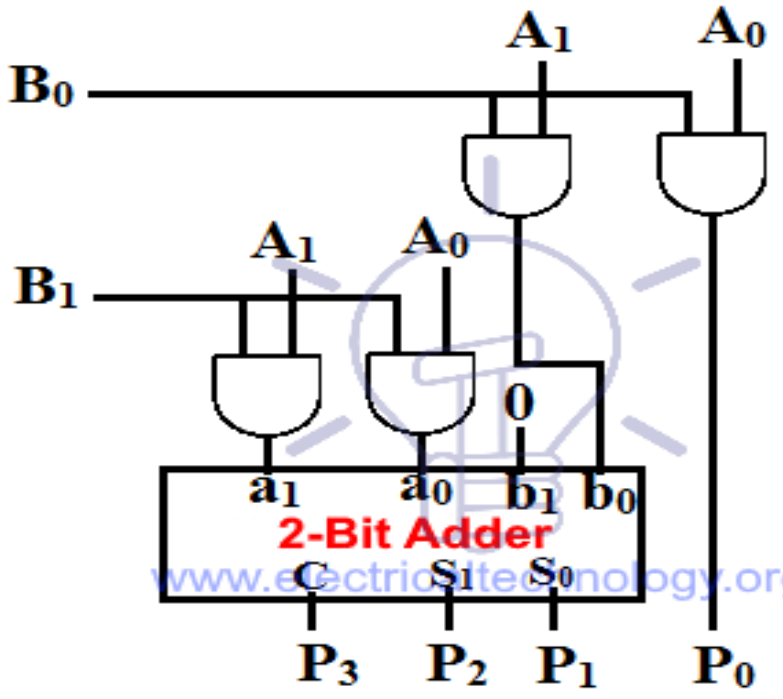
2×2 Bit Multiplier using 2-Bit Full Adder

if we use 2-bit full adder all we have to do is to know which term should be added.

The partial product of LSBs of inputs is the LSB of the product. So it should remain untouched.

The other terms of each partial product should be considered and added using 2-bit full adder.

Construction and design schematic of 2×2 bit multiplier is given in the figure below;



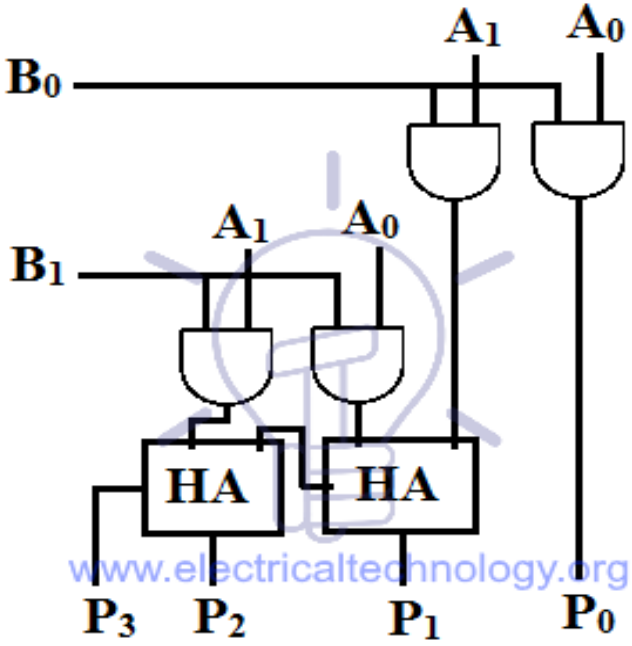
Schematic of 2x2 Bit Multiplier Using 2-Bit Full Adder

2×2 Bit Multiplier using Individual Single Bit Adders

Single bit adders can be half adder & full adder. The difference between half adder & full adder is that half adder can only add 2 numbers and full adder can add 3 numbers including the carry in from previous addition.

However, in this condition, we only need half adder because the numbers to be added are only 2.

Schematic of 2×2 bit multiplier using single bit adder is given in the figure below.



Schematic of 2x2 Bit Multiplier Using Single Bit Adder

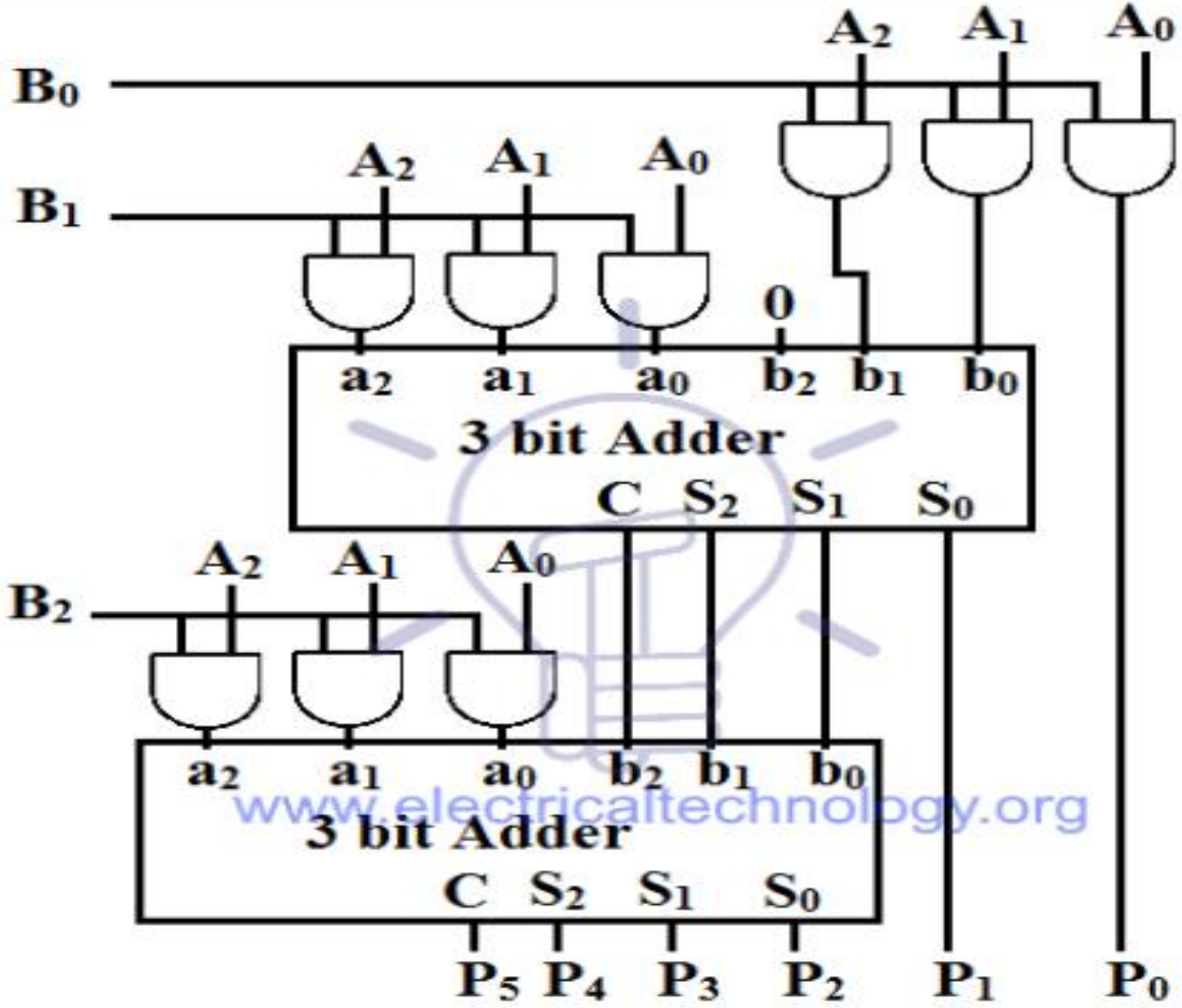
3×3 Bit Multiplier using 3-Bit Full Adder

This method is easy compared to the other method. We only have to use two 3-bit full adders to add these 3 partial products.

The LSB of the first partial product should not be touched. It will flow out as LSB of Product.

The first two partial products should be added together using 3-bit full adder. Then the sum of that adder should be added to the third partial product using another full adder.

While adding these partial products, the LSB of the sum of each adder should be routed directly as output and the remaining 3 bits of the sum should be added to the next partial product.



Schematic of 3x3 Multiplier Using 3-Bit Full Adder