

Multiplication Algorithms: Multiplication via pen and paper method is a compound practice of successive left shift and addition. But while working on digital hardware, the method is slightly different. The shift operation is a right shift instead of a left shift while the rest of the task is implemented in the following two ways:

1. Hardware Algorithm
2. Booth Algorithm

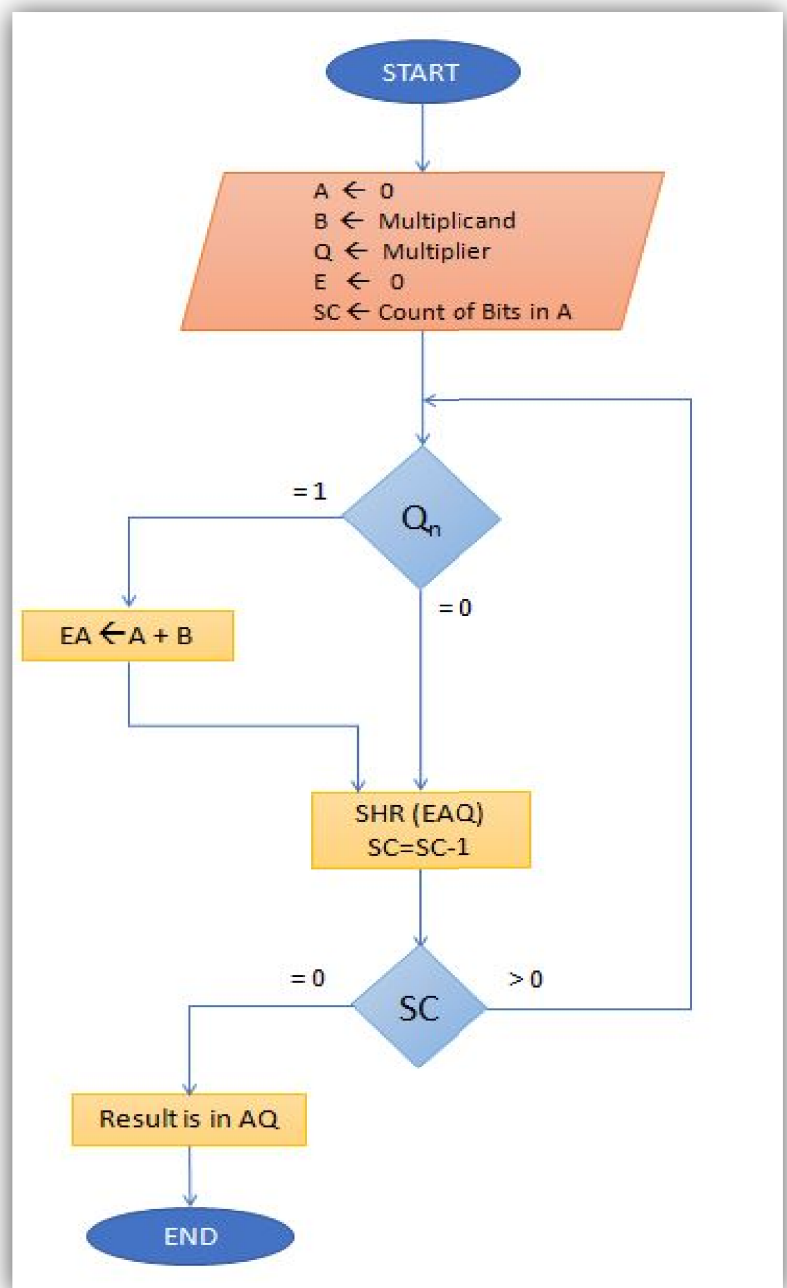
Hardware Algorithm:

The multiplicand is stored in a register B and multiplier in Q. Another register A of same size is taken as to work like Accumulator.

A sequence counter SC is taken and initialized by the total count of bits in register B. A flip-flop E is used to store the excess carry while adding A with B. A complete set of EAQ participates in logical right shift.

With each shift operation the SC is decremented. When after many iterations, SC becomes absolutely zero; we stop the process and extract the result from AQ.

Consider the following flow-chart:



The following example shows the entire operation with multiplicand (13) and multiplier (17).

The result that we get at last is 221:

Multiplicand [B] = $(13)_{10} = (001101)_2$ Multiplier [Q] = $(17)_{10} = (010001)_2$
 Accumulator [A] = 000000 E=0 SC=6

Q_n	Description	E	A	Q	SC
		0	000000	010001	110
1	EA \leftarrow A + B	0	000000	010001	
			001101		
	SHR (EAQ), SC \leftarrow SC - 1	0	001101	010001	
		0	000110	101000	
0	SHR (EAQ), SC \leftarrow SC - 1	0	000011	010100	100
0	SHR (EAQ), SC \leftarrow SC - 1	0	000001	101010	011
0	SHR (EAQ), SC \leftarrow SC - 1	0	000000	110101	010
1	EA \leftarrow A + B		000000	110101	
			001101		
	SHR (EAQ), SC \leftarrow SC - 1	0	001101	110101	001
		0	000110	111010	
0	SHR (EAQ), SC \leftarrow SC - 1	0	000011	011101	000

$(000011011101)_2 = (221)_{10}$

Assignment:

- 1.** Draw the flow chart of Hardware Algorithm.
- 2.** Multiply 23 and 21 using Hardware Algorithm.