

# Sequential Circuit Binary Multiplier

- Initialization
  - $A \leftarrow 0, Q_{-1} \leftarrow 0$
  - $M$  gets multiplicand.
  - $Q$  gets multiplier.
- Loop for each bit of multiplier
  - If  $Q_0 Q_{-1} = 01$  then  $A \leftarrow A + M$
  - else if  $Q_0 Q_{-1} = 10$  then  $A \leftarrow A - M$
  - Arithmetic Shift right  $A Q_0 Q_{-1}$ .
- Result contained in register combination  $AQ$ .

# Sequential Circuit Binary Multiplier

-M: 1100			Initialize
M: 0100			
A: 0000	Q: 0101	Q <sub>-1</sub> : 0	
A: 1100	Q: 0101	Q <sub>-1</sub> : 0	A ← A - M
A: 1110	Q: 0010	Q <sub>-1</sub> : 1	
A: 0010	Q: 0010	Q <sub>-1</sub> : 1	end of 1 <sup>st</sup> pass
A: 0001	Q: 0001	Q <sub>-1</sub> : 0	
A: 1101	Q: 0001	Q <sub>-1</sub> : 0	A ← A + M
A: 1110	Q: 1000	Q <sub>-1</sub> : 1	
A: 0010	Q: 1000	Q <sub>-1</sub> : 1	end of 2 <sup>nd</sup> pass
A: 0001	Q: 0100	Q <sub>-1</sub> : 1	
A: 0001	Q: 0100	Q <sub>-1</sub> : 1	A ← A - M
A: 0010	Q: 0100	Q <sub>-1</sub> : 1	
A: 0010	Q: 0100	Q <sub>-1</sub> : 1	end of 3 <sup>rd</sup> pass
A: 0001	Q: 0100	Q <sub>-1</sub> : 1	
A: 0001	Q: 0100	Q <sub>-1</sub> : 1	A ← A + M
A: 0001	Q: 0100	Q <sub>-1</sub> : 1	
A: 0001	Q: 0100	Q <sub>-1</sub> : 1	end of 4 <sup>th</sup> pass

0100 (M) \* 0101 (Q)

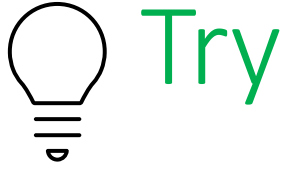
- Initialization

- $A \leftarrow 0, Q_{-1} \leftarrow 0$
- $M$  gets multiplicand.
- $Q$  gets multiplier.

- Loop for each bit of multiplier

- If  $Q_0 Q_{-1} = 01$  then  $A \leftarrow A + M$
- else if  $Q_0 Q_{-1} = 10$  then  $A \leftarrow A - M$
- Arithmetic Shift right  $A Q_0 Q_{-1}$ .

- Result contained in register combination  $AQ$ .



Try:  $11101 * 11010$  (using sequential circuit binary multiplier)  
Show the value of A and Q after the end of each pass

After this pass	A	Q
1 <sup>st</sup>	00000	01101
2 <sup>nd</sup>	11001	10110
3 <sup>rd</sup>	00011	01011
4 <sup>th</sup>	11011	00101
5 <sup>th</sup>	11101	10011