

COUNTERS

A Counter is a register capable of counting the number of clock pulse arriving at its clock input.

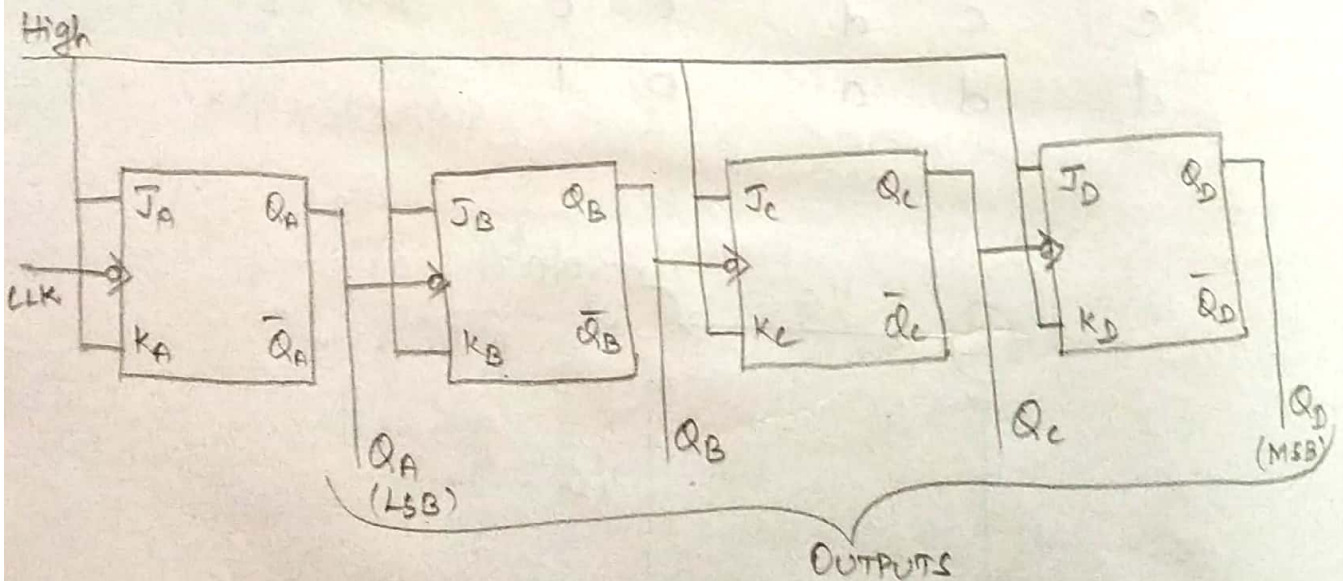
Counters are classified into 2 types.

- * Asynchronous (Ripple) Counter
- * Synchronous Counter.

Asynchronous (Ripple) Counter.

- * Asynchronous Up-counter
- * Asynchronous Down-counter

Asynchronous Up Counter (Ripple)



Initially the register is cleared, $Q_D Q_C Q_B Q_A = 0000$

During the first clock pulse Flip Flop A triggers

$$\therefore Q_A = 1, Q_B = Q_C = Q_D = 0$$

$$\therefore Q_D Q_C Q_B Q_A = 0001$$

At the second clock pulse Flip Flop A triggers

therefore Q_A changes from 1 to 0 which triggers

Flip Flop B therefore $Q_B = 1, Q_A = Q_C = Q_D = 0$

$$\therefore Q_D Q_C Q_B Q_A = 0010$$

At the third clock pulse Flip Flop A triggers

therefore Q_A changes from 0 to 1 this never triggers Flip Flop B because 0 to 1 transition gives a positive edge triggering but here the Flip Flops are triggered only at negative edge (1 to 0 transition)

$$\therefore Q_A = Q_B = 1, Q_C = Q_D = 0$$

$$Q_D Q_C Q_B Q_A = 0011$$

At fourth clock pulse Flip Flop A triggers

$\therefore Q_A$ changes from 1 to 0 this triggers Flip Flop B

therefore Q_B changes from 1 to 0. The change in

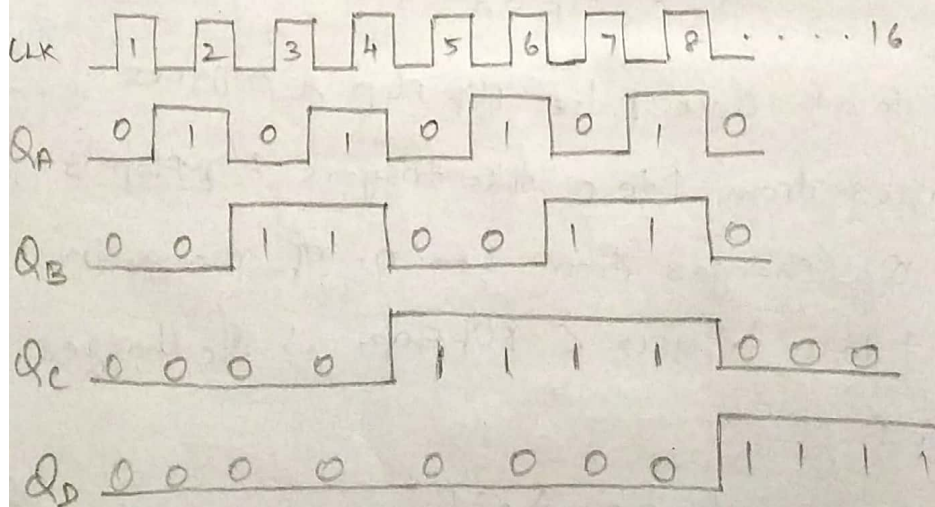
Q_B from 1 to 0 triggers C flip flop. $\therefore Q_C$ changes

from 0 to 1.

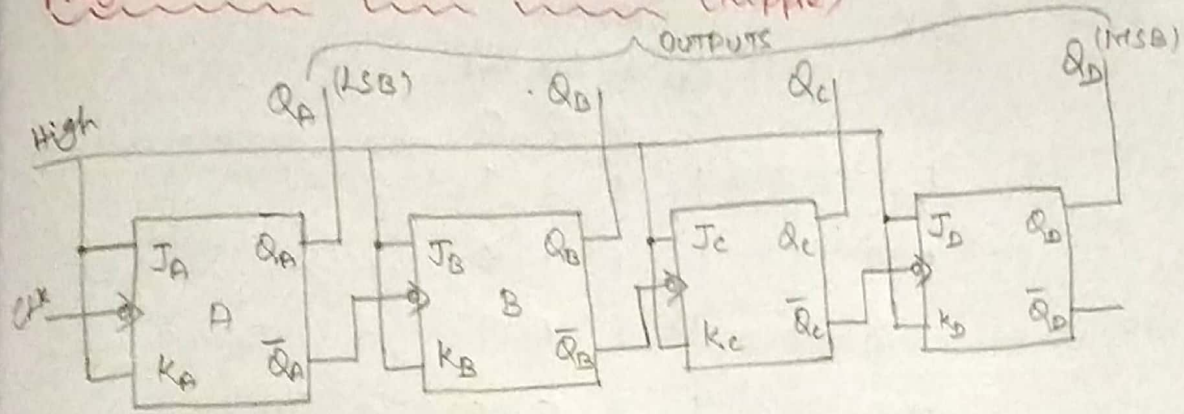
$$\therefore Q_A = Q_B = Q_D = 0, Q_C = 1$$

$$Q_D Q_C Q_B Q_A = 0100$$

CLK	OUTPUTS			
	Q _D	Q _C	Q _B	Q _A
-	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1



Asynchronous Down Counter (Ripple)



Initially the register is cleared $Q_D Q_C Q_B Q_A = 0000$

During the first clock pulse Flip Flop A triggers

$\therefore Q_A$ changes from 0 to 1 also \bar{Q}_A changes from 1 to 0.

This triggers B flip flop $\therefore Q_B$ changes from 0 to 1

also \bar{Q}_B changes from 1 to 0 which triggers C flip flop.

Hence Q_C changes from 0 to 1 and \bar{Q}_C changes from 1 to 0 which further triggers flip flop D.

$$Q_D Q_C Q_B Q_A = 1111$$

$$\bar{Q}_D \bar{Q}_C \bar{Q}_B \bar{Q}_A = 0000$$

During the second clock pulse Flip Flop A triggers

therefore Q_A changes from 1 to 0 also \bar{Q}_A changes from 0 to 1 which never triggers B flip flop.

Therefore C and D flip flop are not triggered.

$$Q_D Q_C Q_B Q_A = 1110.$$

CLK	OUTPUTS			
	Q _D	Q _C	Q _B	Q _A
-	0	0	0	0
1	1	1	1	1
2	1	1	1	0
3	1	1	0	1
4	1	1	0	0
5	1	0	1	1
6	1	0	1	0
7	1	0	0	1
8	1	0	0	0
9	0	1	1	1
10	0	1	1	0
11	0	1	0	1
12	0	1	0	0
13	0	0	1	1
14	0	0	1	0
15	0	0	0	1
16	0	0	0	0

