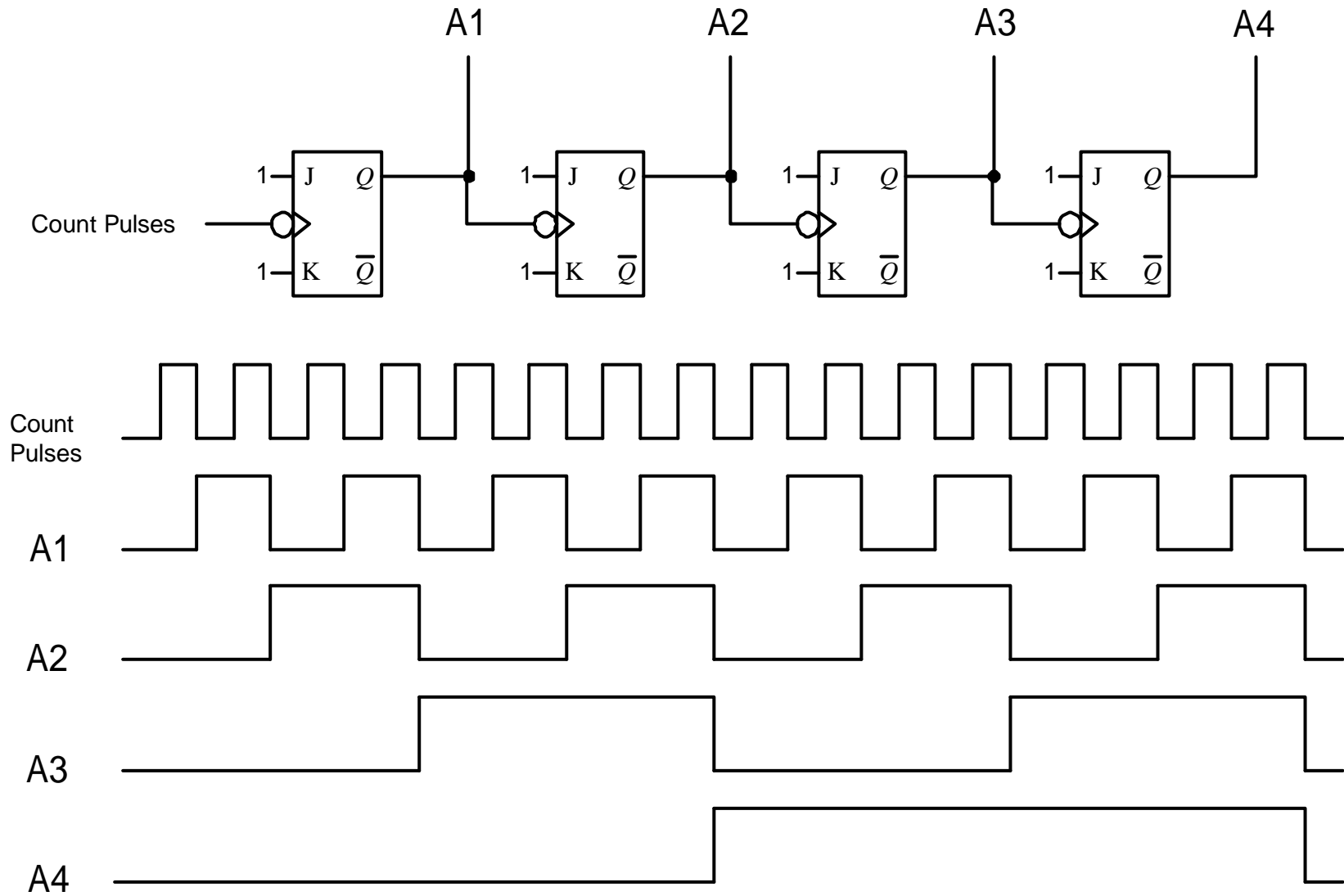
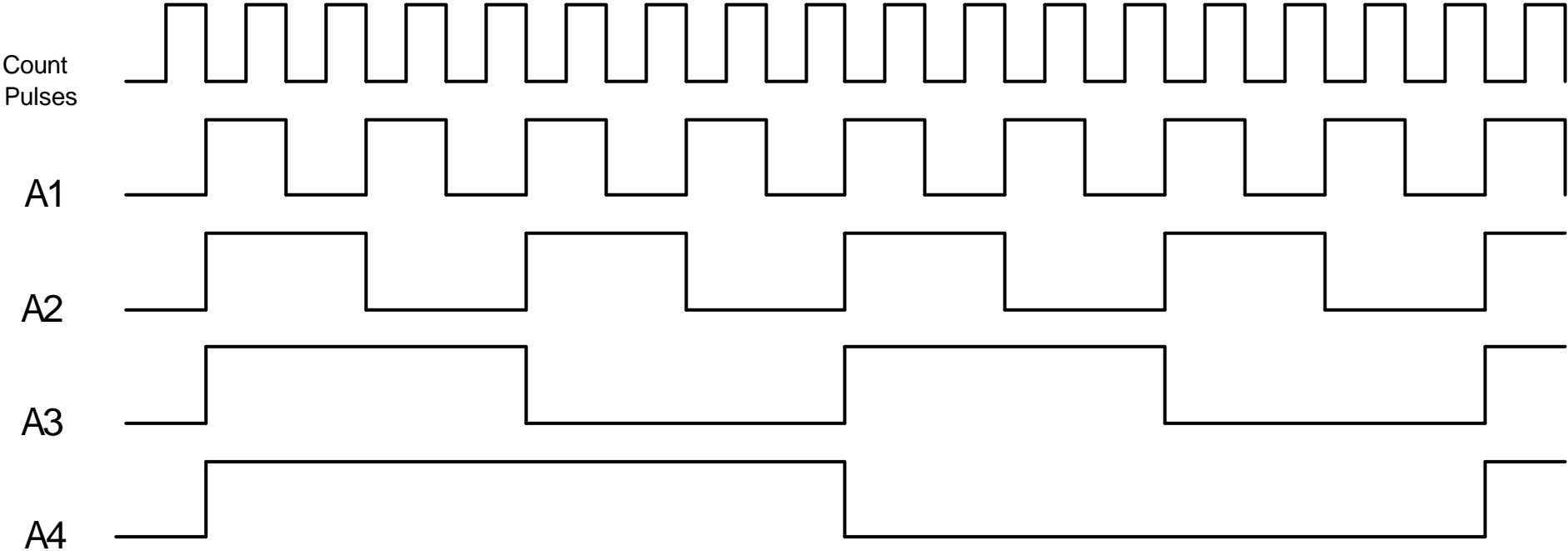
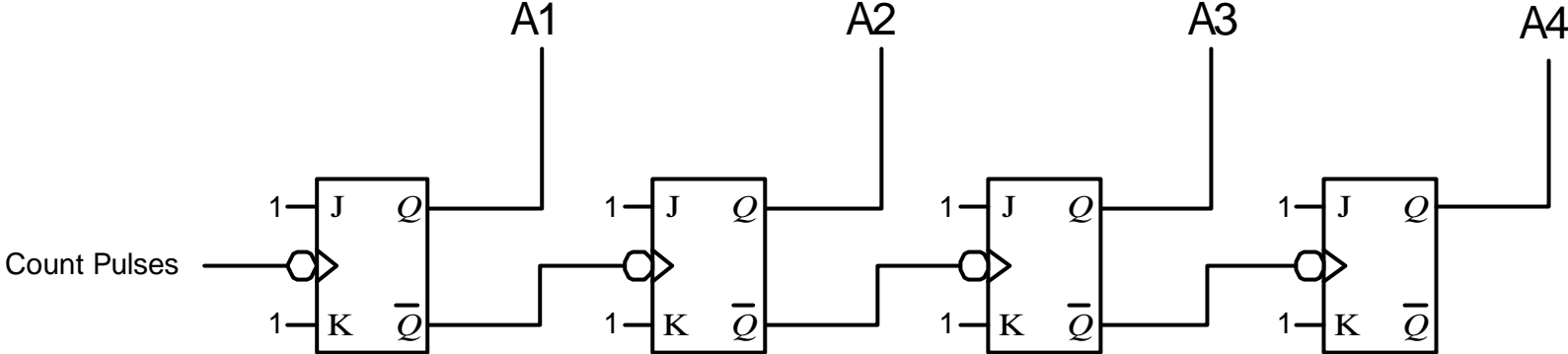


# Binary Ripple Counter (Count Up)

---

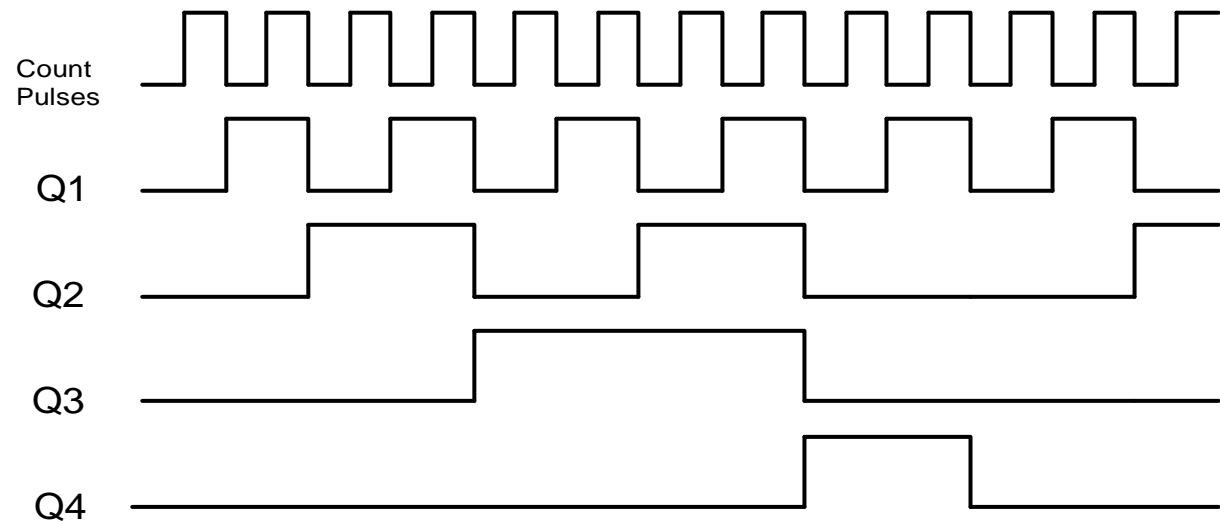
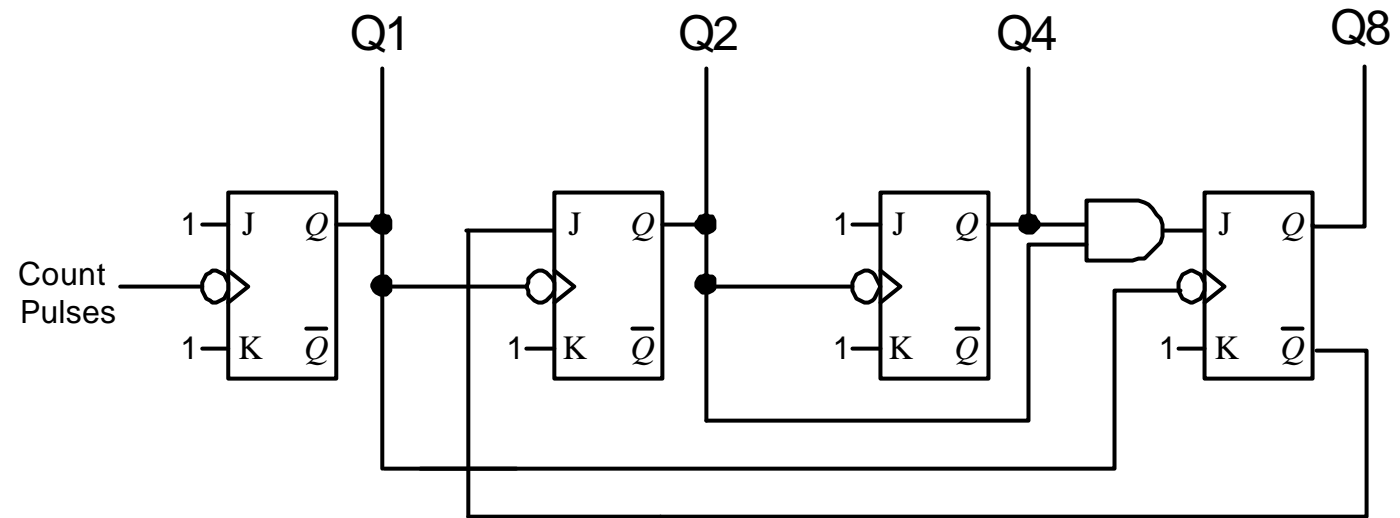


# Binary Ripple Counter (Count Down)



# BCD Ripple Counter

Q8	Q4	Q2	Q1
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1



- Toggle

Q1 : CP(1 0)

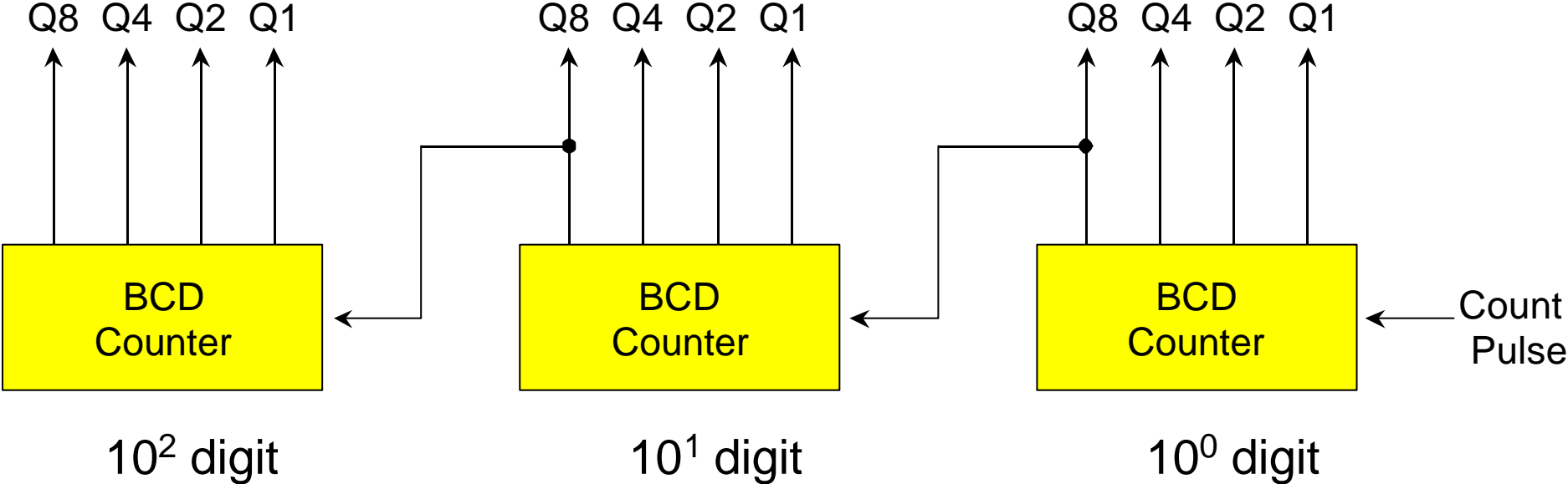
Q2 : Q8=0 and  
Q1(1 0)

Q4 : Q2(1 0)

Q8 : Q4Q2=11 and  
Q1 (1 0)

# BCD Ripple Counter

---



# Binary Synchronous Counter (Count Up)

A4	A3	A2	A1	J4	K4	J3	K3	J2	K2	J1	K1
0	0	0	0	0	X	0	X	0	X	1	X
0	0	0	1	0	X	0	X	1	X	X	1
0	0	1	0	0	X	0	X	X	0	1	X
0	0	1	1	0	X	1	X	X	1	X	1
0	1	0	0	0	X	X	0	0	X	1	X
0	1	0	1	0	X	X	0	1	X	X	1
0	1	1	0	0	X	X	0	X	0	1	X
0	1	1	1	1	X	X	1	X	1	X	1
1	0	0	0	X	0	0	X	0	X	1	X
1	0	0	1	X	0	0	X	1	X	X	1
1	0	1	0	X	0	0	X	X	0	1	X
1	0	1	1	X	0	1	X	X	1	X	1
1	1	0	0	X	0	X	0	0	X	1	X
1	1	0	1	X	0	X	0	1	X	X	1
1	1	1	0	X	0	X	0	X	0	1	X
1	1	1	1	X	1	X	1	X	1	X	1

$$JA_1=1$$

$$KA_1=1$$

$$JA_2= A_1$$

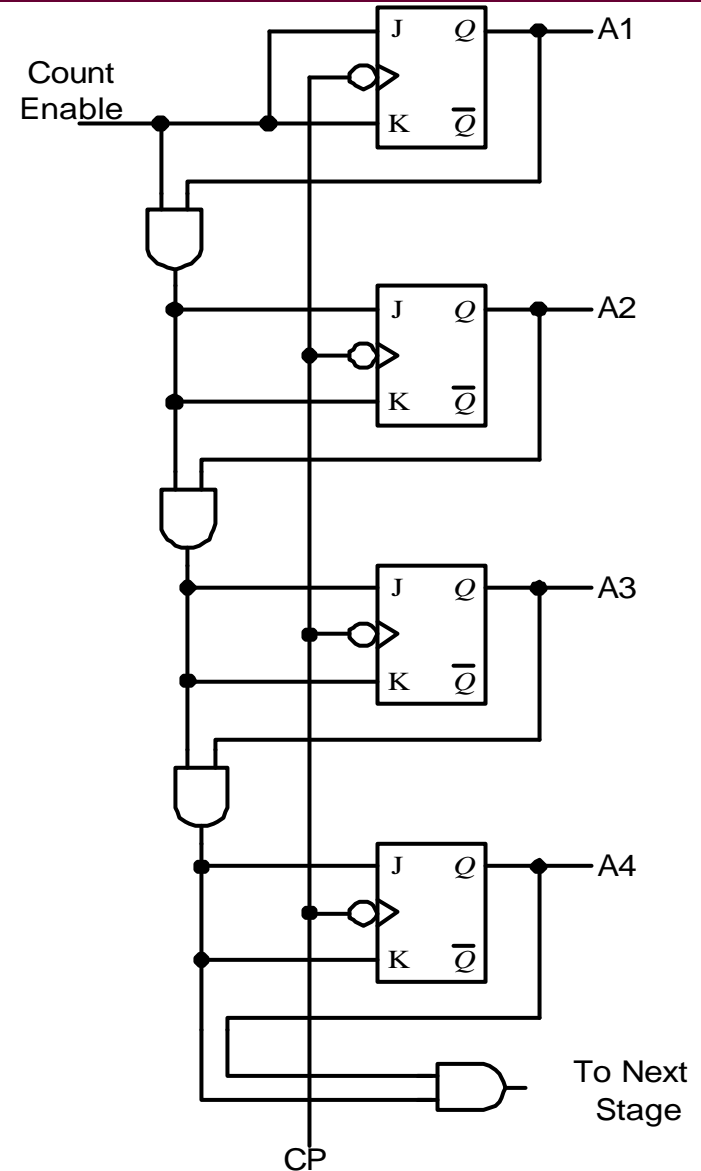
$$KA_2= A_1$$

$$JA_3= A_2A_1$$

$$KA_3= A_2A_1$$

$$JA_4= A_3A_2A_1$$

$$KA_4= A_3A_2A_1$$



# Binary Synchronous Counter (Count Down)

A4	A3	A2	A1	JA4	KA4	JA3	KA3	JA2	KA2	JA1	KA1
1	1	1	1	X	0	X	0	X	0	X	1
1	1	1	0	X	0	X	0	X	1	1	X
1	1	0	1	X	0	X	0	0	X	X	1
1	1	0	0	X	0	X	1	1	X	1	X
1	0	1	1	X	0	0	X	X	0	X	1
1	0	1	0	X	0	0	X	X	1	1	X
1	0	0	1	X	0	0	X	0	X	X	1
1	0	0	0	X	1	1	X	1	X	1	X
0	1	1	1	0	X	X	0	X	0	X	1
0	1	1	0	0	X	X	0	X	1	1	X
0	1	0	1	0	X	X	0	0	X	X	1
0	1	0	0	0	X	X	1	1	X	1	X
0	0	1	1	0	X	0	X	X	0	X	1
0	0	1	0	0	X	0	X	X	1	1	X
0	0	0	1	0	X	0	X	0	X	X	1
0	0	0	0	1	X	1	X	1	X	1	X

$$JA_1 = 1$$

$$KA_1 = 1$$

$$JA_2 = \overline{A_1}$$

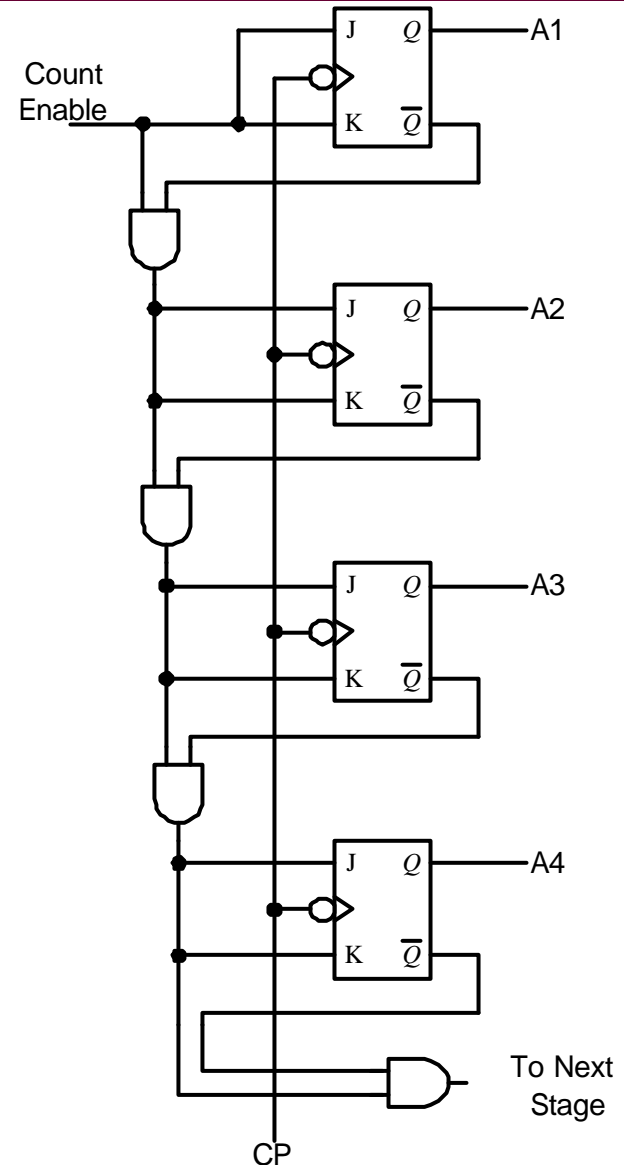
$$KA_2 = \overline{A_1}$$

$$JA_3 = \overline{\overline{A_2} \overline{A_1}}$$

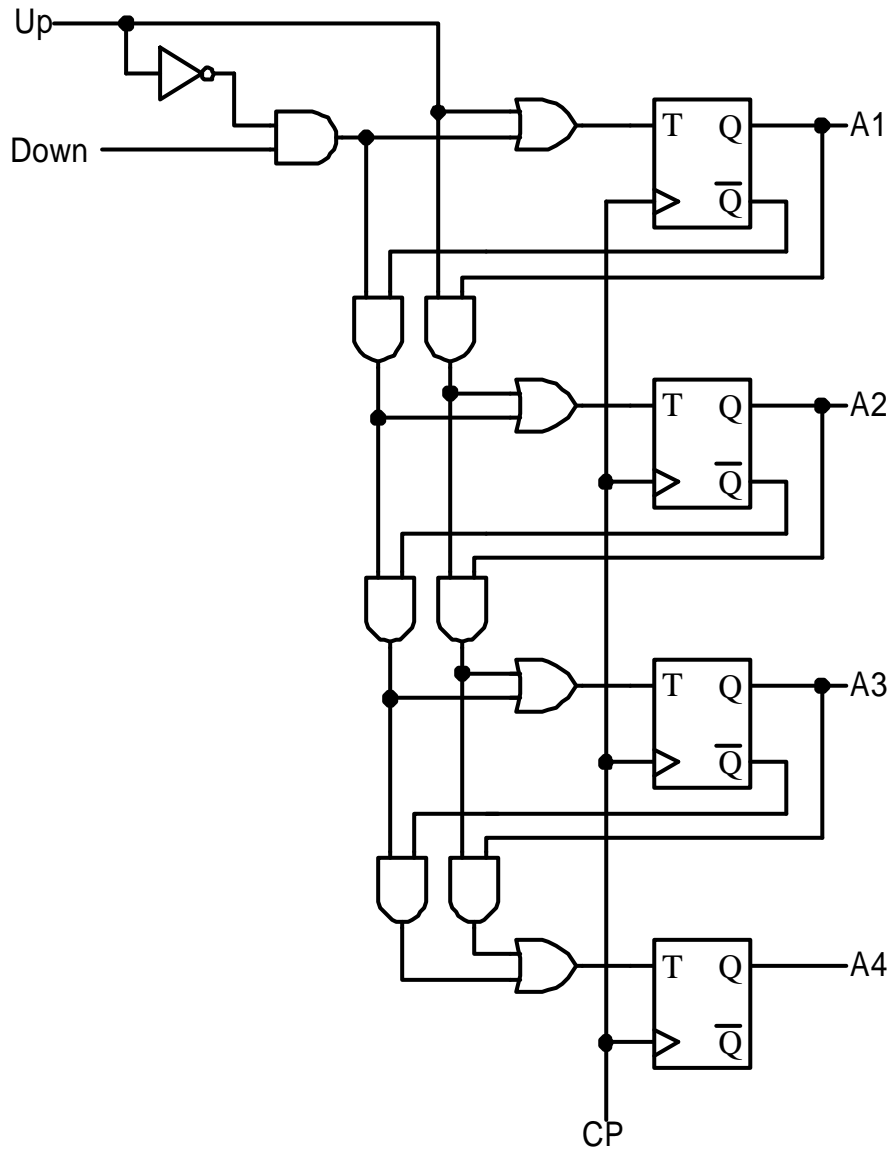
$$KA_3 = \overline{A_2} \overline{A_1}$$

$$JA_4 = \overline{\overline{A_3} \overline{A_2} \overline{A_1}}$$

$$KA_4 = \overline{A_3} \overline{A_2} \overline{A_1}$$



# Binary Synchronous Counter (Count Up/Down)



Up	Down	Function
0	0	No change
0	1	Count down ( $Q' \ T$ )
1	0	Count up ( $Q \ T$ )
1	1	Count Up ( $Q \ T$ )

# BCD Synchronous Counter

Present State				Out	FF Input			
Q8	Q4	Q2	Q1	y	TQ8	TQ4	TQ2	TQ1
0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	1	1
0	0	1	0	0	0	0	0	1
0	0	1	1	0	0	1	1	1
0	1	0	0	0	0	0	0	1
0	1	0	1	0	0	0	1	1
0	1	1	0	0	0	0	0	1
0	1	1	1	0	1	1	1	1
1	0	0	0	0	0	0	0	1
1	0	0	1	1	1	0	0	1

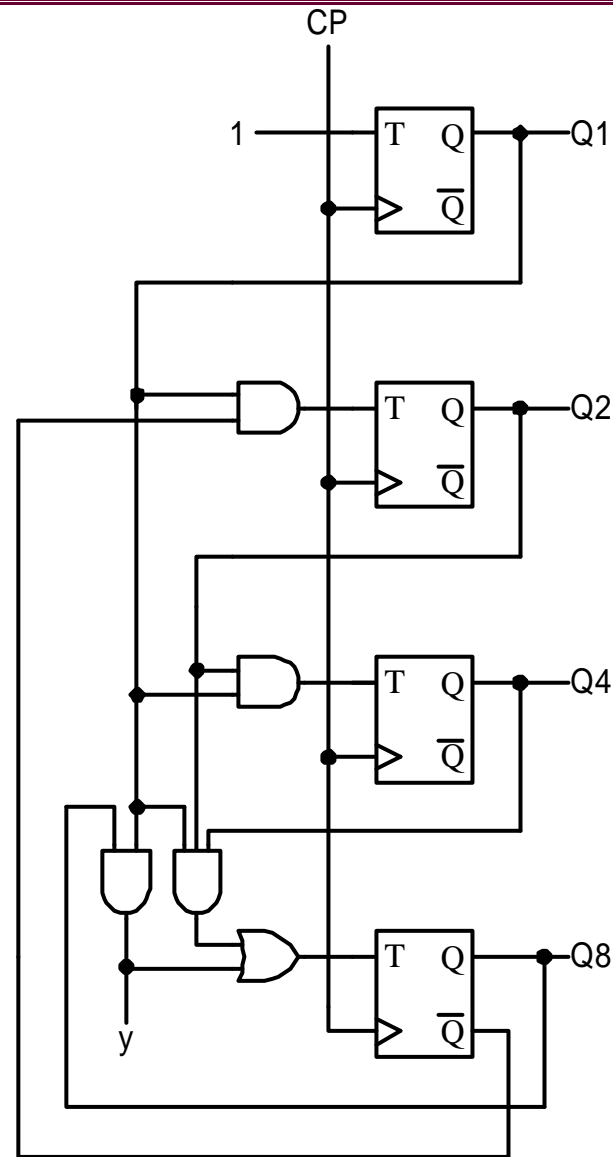
$$TQ_1 = 1$$

$$TQ_2 = \overline{Q_8} Q_1$$

$$TQ_4 = Q_2 Q_1$$

$$TQ_8 = Q_8 Q_1 + Q_4 Q_2 Q_1$$

$$y = Q_8 Q_1$$





# 4-Bit Counter with D FF

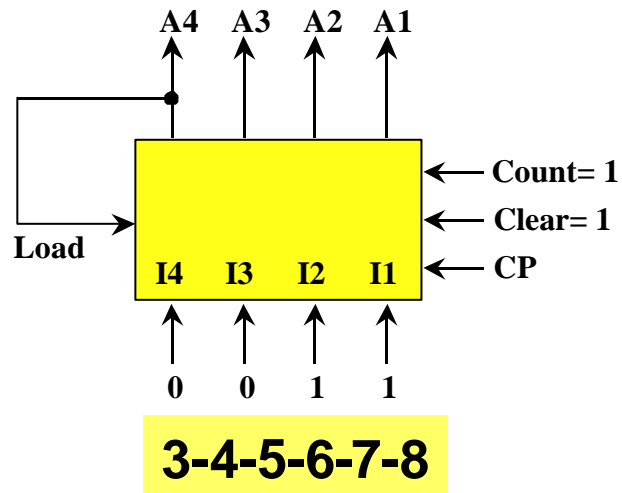
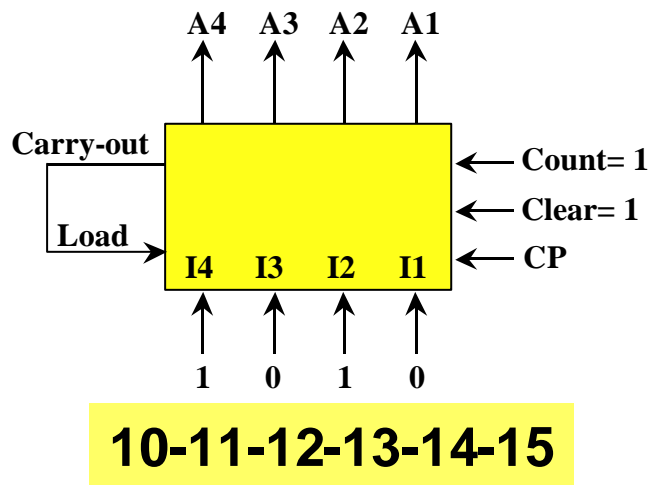
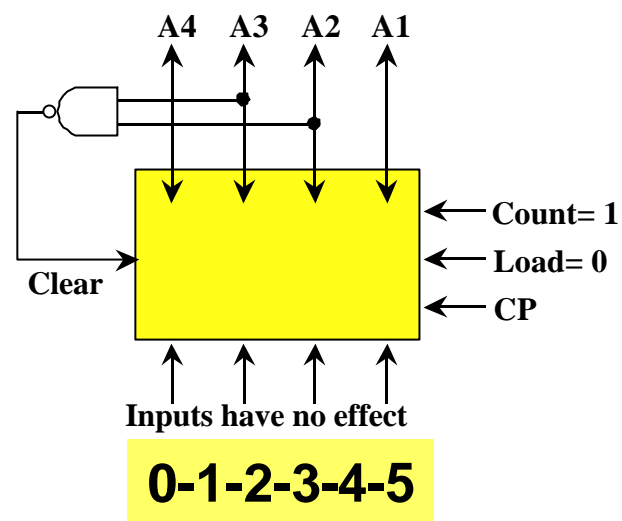
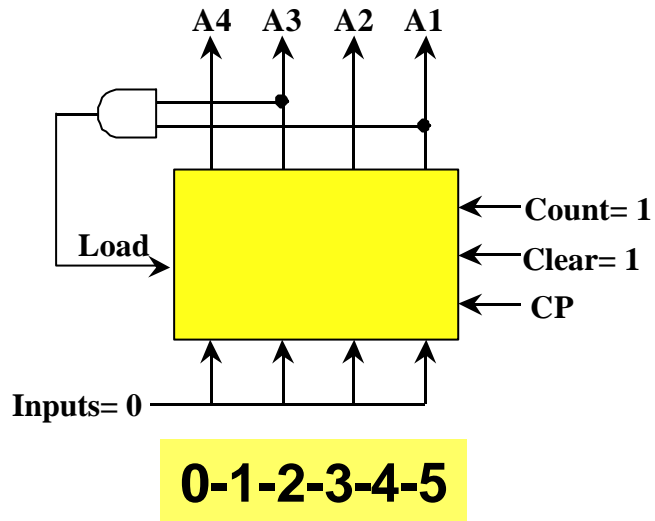
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# **Binary Synchronous Counter with Parallel Load**

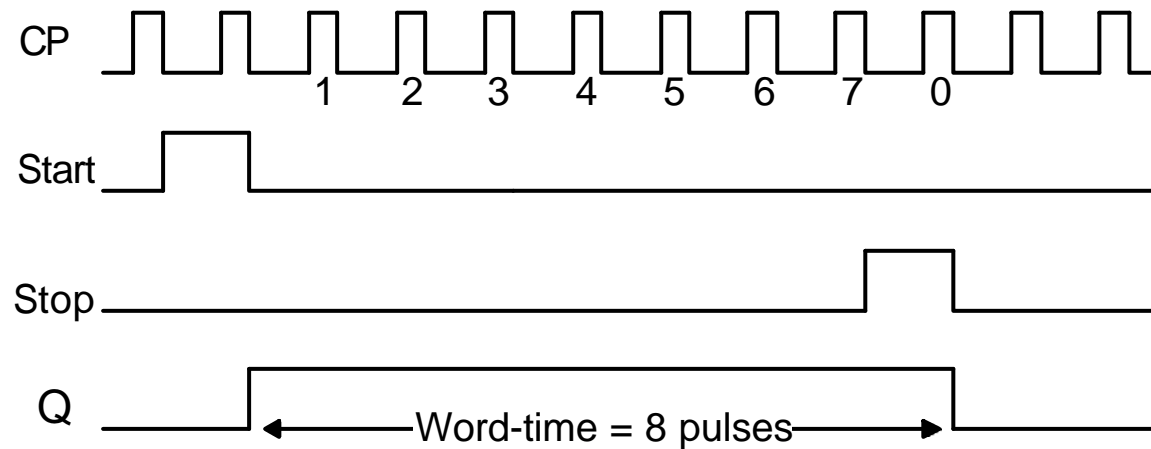
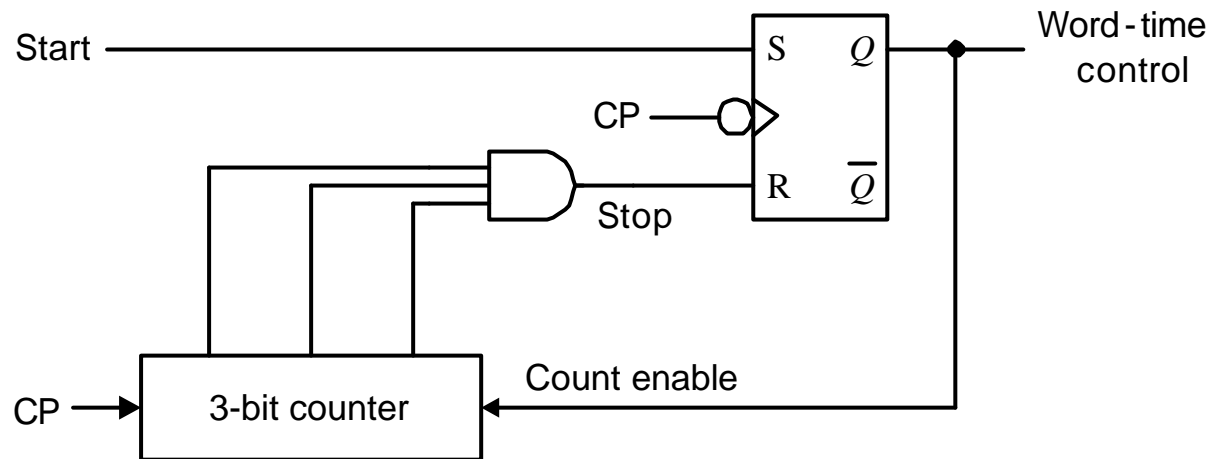
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**Refer to Vert07.ppt !!**

# Modulo-6 Counter with Binary Counter



# Word-Time Control Signal



start pulse =1 가

FF set (Q=1)

counter enable

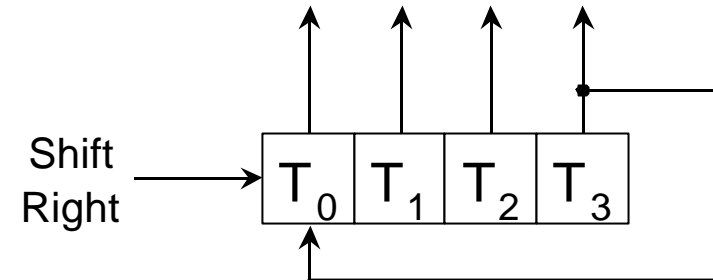
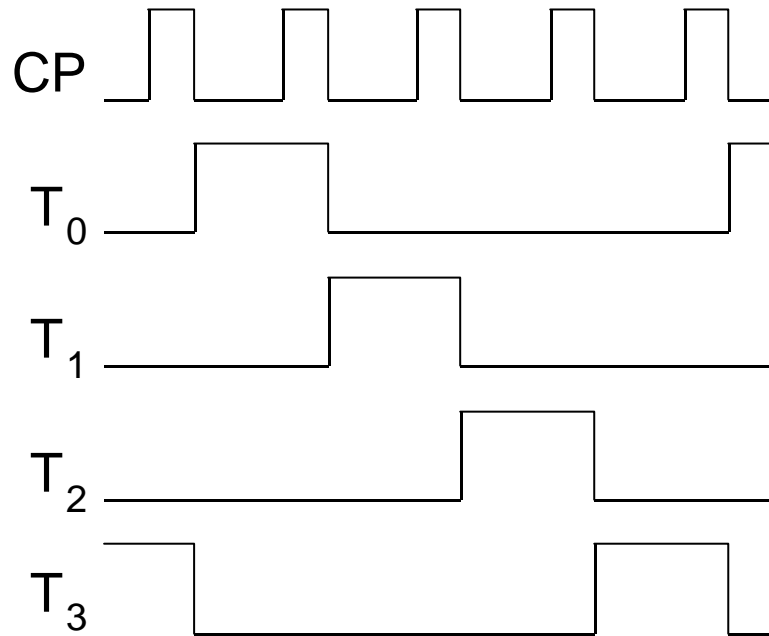
count

(000 111)

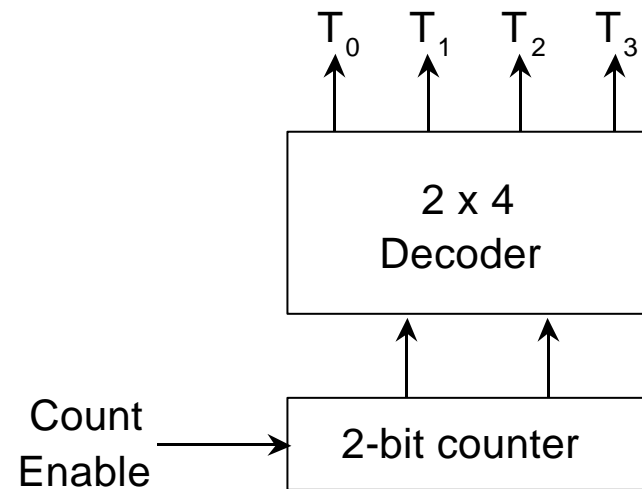
111 stop pulse =1

FF reset (Q=0)

# Timing Signal

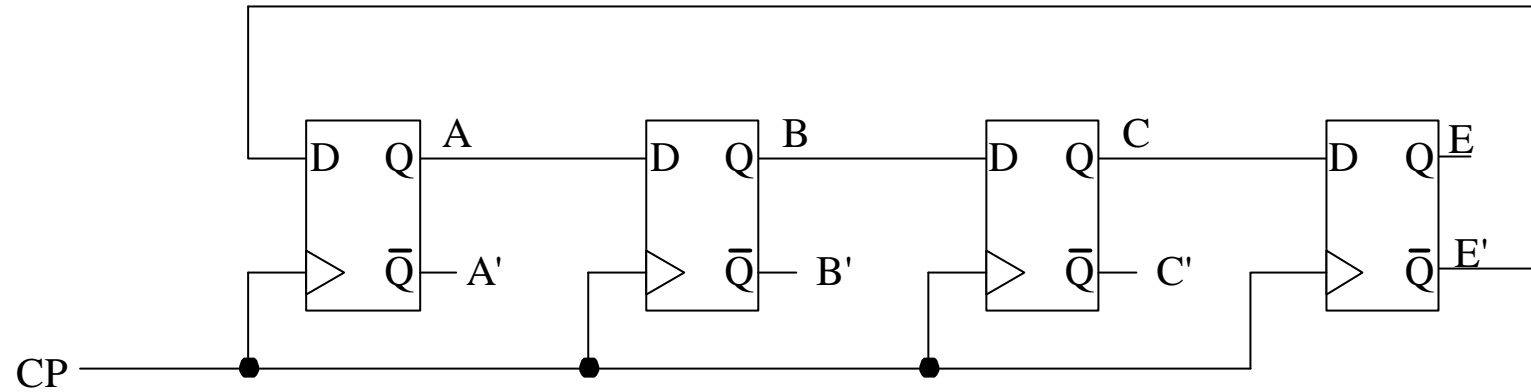


Ring counter  
(initial value = 1000)



Counter and decoder

# Johnson Counter



Sequence Number	FF Outputs				AND gate required for output
	A	B	C	E	
1	0	0	0	0	$A'E'$
2	1	0	0	0	$AB'$
3	1	1	0	0	$BC'$
4	1	1	1	0	$CE'$
5	1	1	1	1	$AE$
6	0	1	1	1	$A'B$
7	0	0	1	1	$B'C$
8	0	0	0	1	$C'E$

# Ring Counter

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# Johnson Counter

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