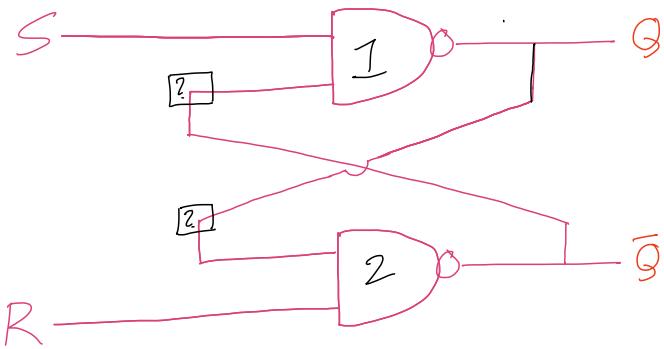


SR Latch (using Nand gate)



truth table :

S	R	Q	\bar{Q}
0	0	not used	
0	1	1	0
1	0	0	1
1	1	memory (no change)	

next state = present state

A	B	$(AB)^1$
0	0	1
0	1	1
1	0	1
1	1	0

Case 1:

$$S=0, R=1, \quad Q=1, \quad \bar{Q}=0$$

$$S=1, R=1, \quad Q=1, \quad \bar{Q}=0$$

Case 2:

$$S=1, R=0, \quad Q=0, \quad \bar{Q}=1$$

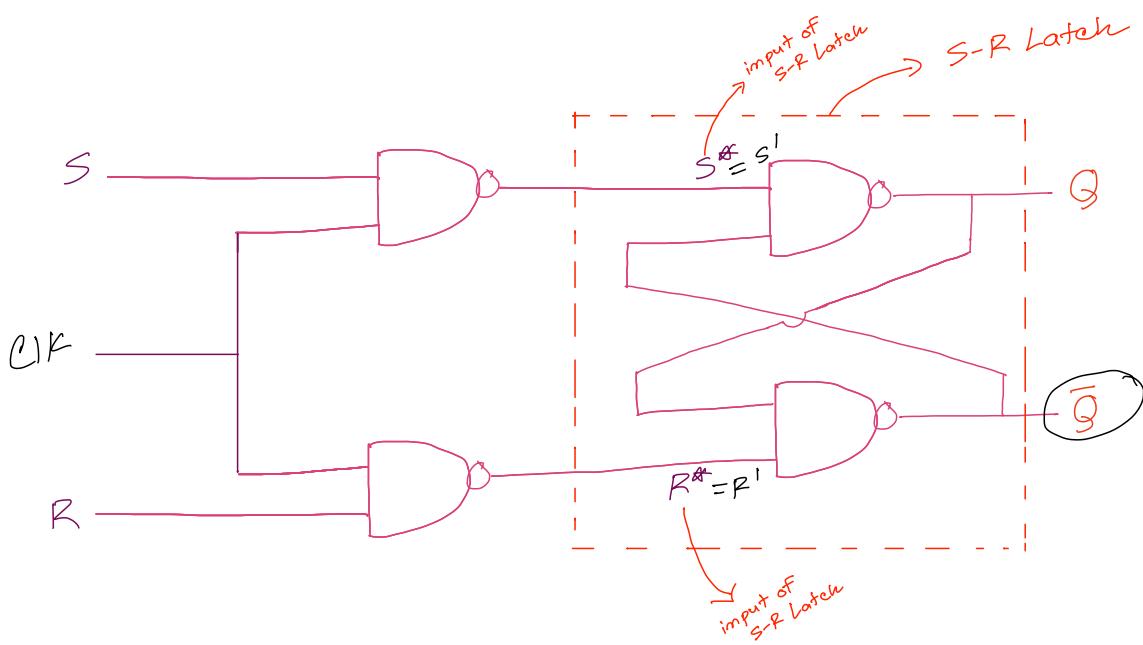
$$S=1, R=1, \quad Q=0, \quad \bar{Q}=1$$

Case 3:

$$S=0, R=0, \quad Q=1, \quad \bar{Q}=1$$

SR Flip-Flop

- Block Diagram
- Truth table
- Characteristic table
- Excitation table



*truth table of
S-R F.F:
Flip-Flop's
input*

S	R	S^*	R^*	Q	\bar{Q}
0	0	1	1	memory	
0	1	1	0	0	1
1	0	0	1	1	0
1	1	0	0	not used	

S-R Flip Flops truth table:

S	R	Q	\bar{Q}
0	0	memory	
0	1	0	1
1	0	1	0
1	1	not used	

*truth table :
of S-R latch*

S	R	Q	\bar{Q}
0	0	not used	
0	1	1	0
1	0	0	1
1	1	memory / no change	

Characteristic table: (depending on the flip-flop's inputs) and present state what would be the next state)

present state		next state	
$Q(t)$	S	R	$Q(t+1)$
0 ✕	0	0	0
0 ✕	0	1 ✕	0
0 ✕	1	0 ✕	1
0	1	1	not used
1	0	0 ✕	1
1 ✕	0	1 ✕	0
1 ✕	1	0 ✕	1
1	1	1	not used

$$Q(t) = Q$$

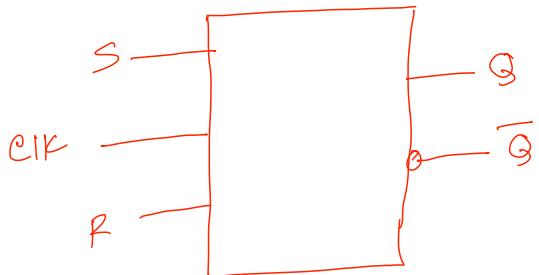
$$Q(t+1) = Q^+$$

Excitation table:

(Analyzing the flip-flops present and next state we try to determine what might be the input(s) was.

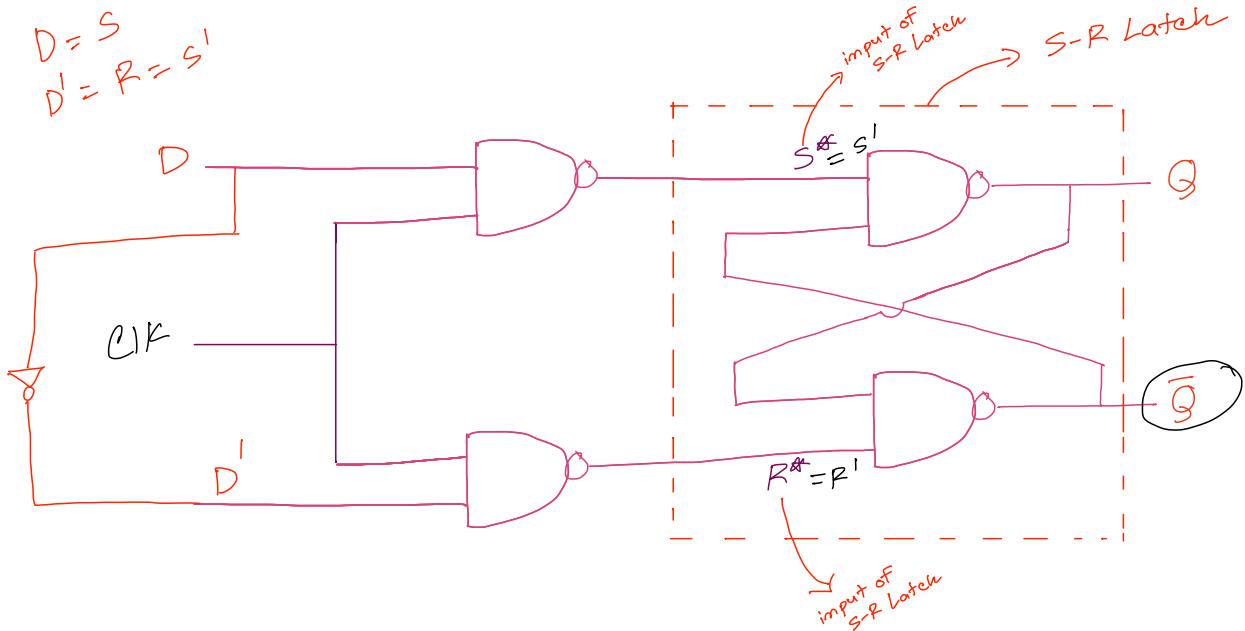
present
and next
state

present and next state		flip-flops input(s)	
$Q(t)$	$Q(t+1)$	S	R
0	0	0	✗
0	1	1	0
1	0	0	1
1	1	✗	0



D Flip-Flop

- Block Diagram
- Truth table
- Characteristic table
- Excitation table



S-R Flip Flops truth table:

S	R	Q	\bar{Q}
0	0	memory	X
0	1	0	1
1	0	1	0
1	1	not used	

D
S-R Flip Flops truth table:

D	D'	Q	\bar{Q}
0	0	memory	
0	1	0	1
1	0	1	0
1	1	not used	

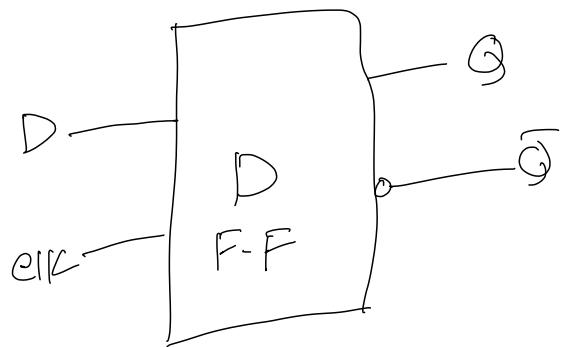
Characteristic table:

$Q(t)$	D	$Q(t+1)$
0	0	0
0	1	1
1	0	0
1	1	1

D	Q	\bar{Q}
0	0	1
1	1	0

Excitation table:

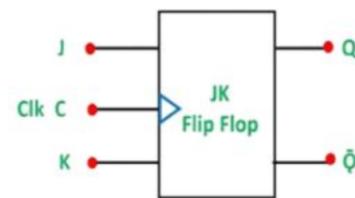
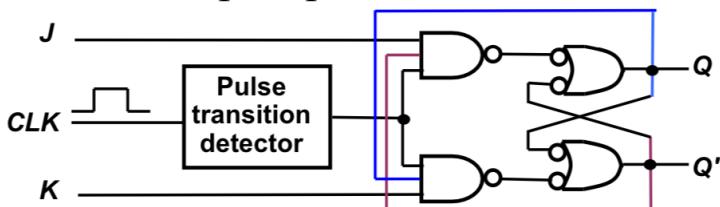
$Q(t)$	$Q(t+1)$	D
0	0	0
0	1	1
1	0	0
1	1	1



- Block Diagram
- Truth table
- Characteristic table
- Excitation table

J-K Flip-flop

- J-K flip-flop.



Truth Table

- Characteristic table.

Q	J	K	$Q(t+1)$
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

J	K	Q	Q'
0	0	Memory/ No change	
0	1	0	1
1	0	1	0
1	1	Toggle → next state = present state!	

This truth table is same as SR except the last row
 This is because, J-K FF solves only that "Not Used" problem of SR FF and keeps everything else same as before

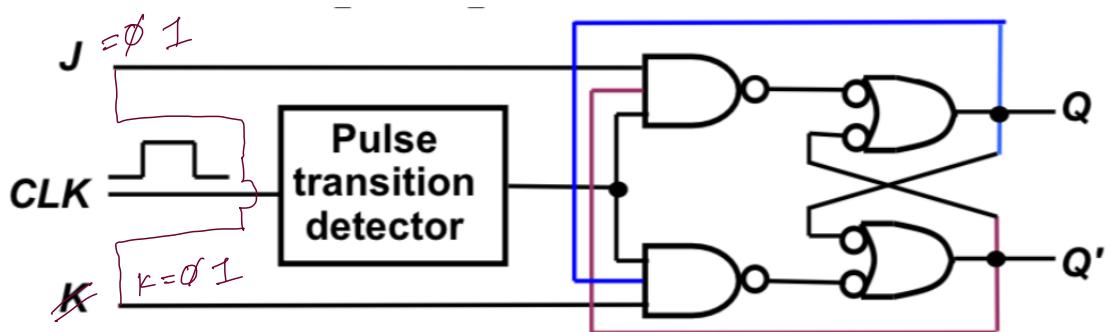
Excitation table:

$Q(t)$	$Q(t+1)$	J	K
0	0	0	×
0	1	1	×
1	0	×	1
1	1	×	0

T Flip-Flop

$$\begin{aligned} J &= T \\ K &= \bar{T} \end{aligned}$$

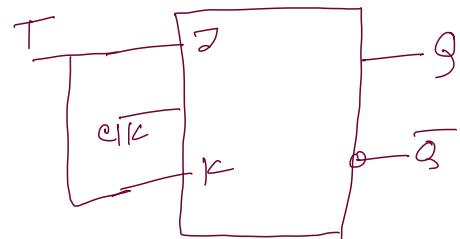
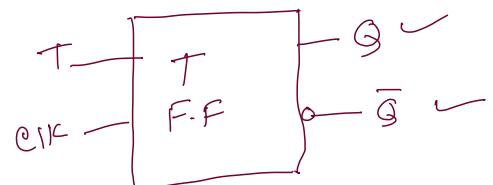
- ✓ → Block Diagram
- Truth table
- Characteristic table
- Excitation table



Truth Table of J-K Flip-Flop

J	K	Q	\bar{Q}
0	0	Memory/ No change	
0	1	0	1
1	0	1	0
1	1	Toggle	

next state
= present state'



Truth Table of T-Flip Flop

T	Q	\bar{Q}
0	No Change	
1	Toggle	

Characteristics Table

$Q(t)$	T	$Q(t+1)$
0	0	0
0	1	1
1	0	1
1	1	0

Excitation Table:

$Q(t)$	$Q(t+1)$	T
0	0	0
0	1	1
1	0	1
1	1	0