

Flipflops

module 13

11/12/2023

0.0.1 Latch problems - Continuation

The output can respond to any input within an enable is active. This could cause asynchronous behaviour.

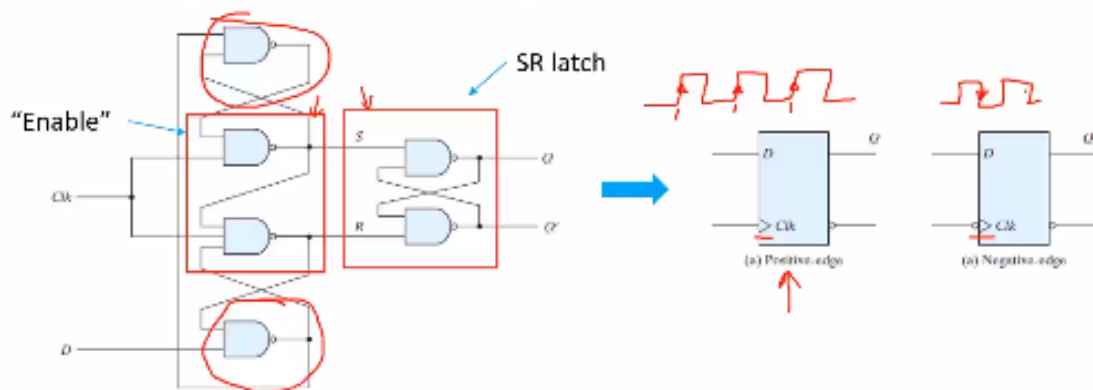
A solution to this is creating a transition enable (creating **flipflops**)

- Enable is only active when transitioning from active LOW to active HIGH or vice versa
- Only register input on clock's edges (rising or falling)

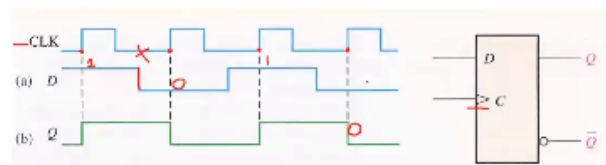
1 D flipflop

A flip flop has D latch behaviour, but operates on a clock edge.

- Triangles on clock schematics denote a clock input



D Flip-Flop		
D	Q	
0	0	Reset
1	1	Set

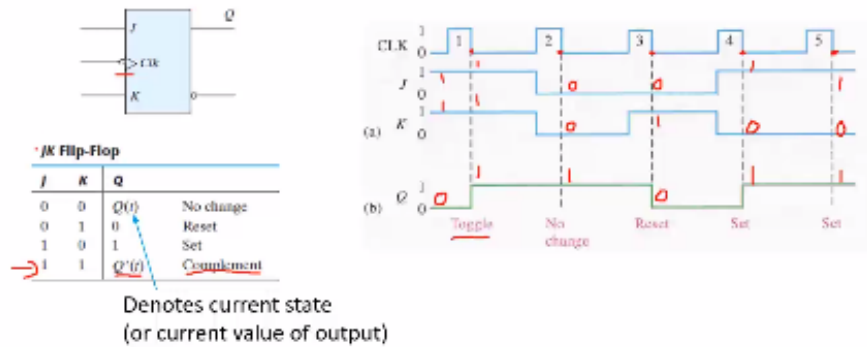


2 JK Flip Flop

Equivalent to the SR latch, but edge triggered and no unstable input condition.

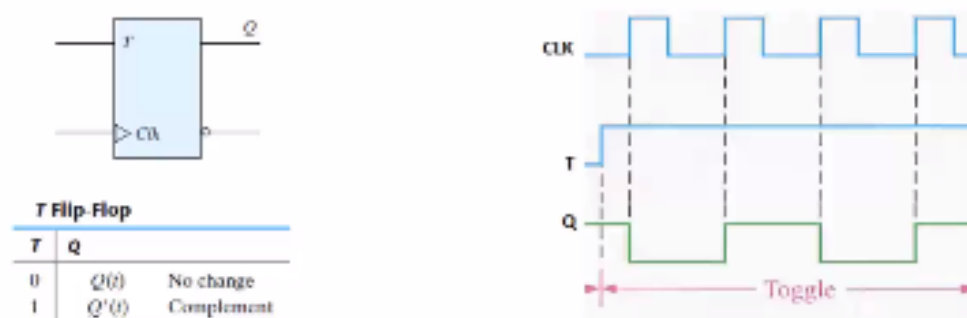
- J is "set"
- K is "reset"

In the case of both inputs being active, the output toggles (complement).



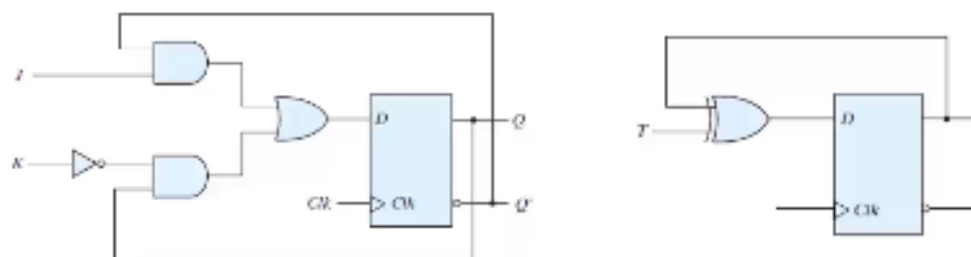
3 T flip Flop

- Output toggles between HIGH and LOW as long as T is HIGH



4 Making Other Flips Flops from D

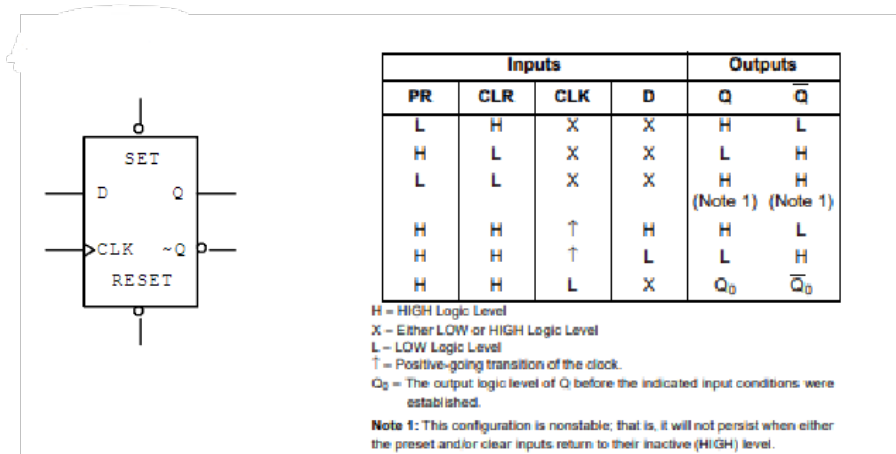
* D flip flop can make JK and T flip flops



5 Asynchronous Inputs

These inputs are not dependent on the clock. As soon as they change, the output is affected.

- They are help to initialize to a given state, or clear to a starting state
- Changes output in between clock edges
- Typically active low



6 Flip Flop Uses

They exist as basic storage elements in digital logic

- Counters
- Timers
- Memory
- Timers
- Frequency Dividers
- Sequential logic circuits
- Registers

7 Analysis of Sequential Logic Circuits

State equations are similar to Boolean expressions from combinational logic → describe the output and transition logic of circuit.

State tables are similar to truth tables → describe state transitions and output given combination of inputs.

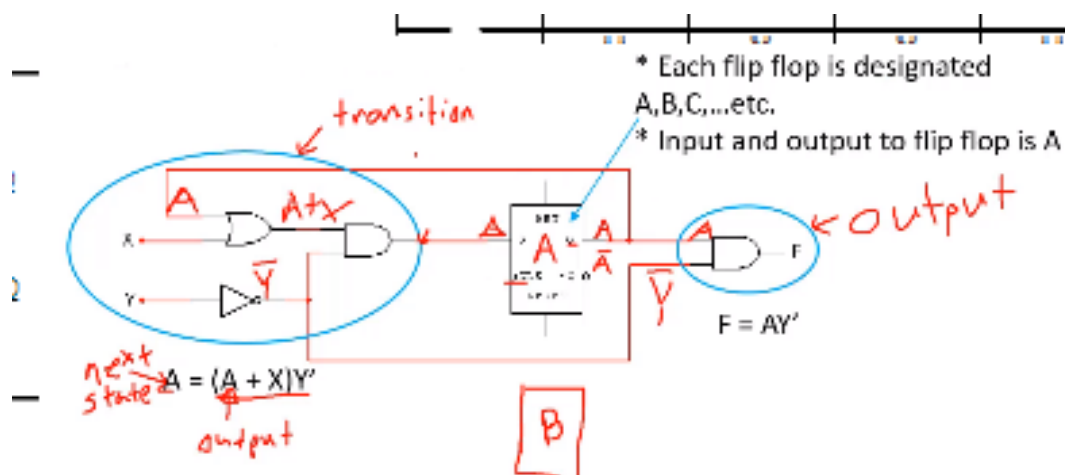
State diagrams are visual representations of the state table.

7.1 Circuit to State Equation

State equation is the boolean expression for circuit.

Will have multiple equations

- One for output of circuit F
- One to describe, state, or input to flipflops



Example

What are the state equations for following circuits?

