

Flip Flops

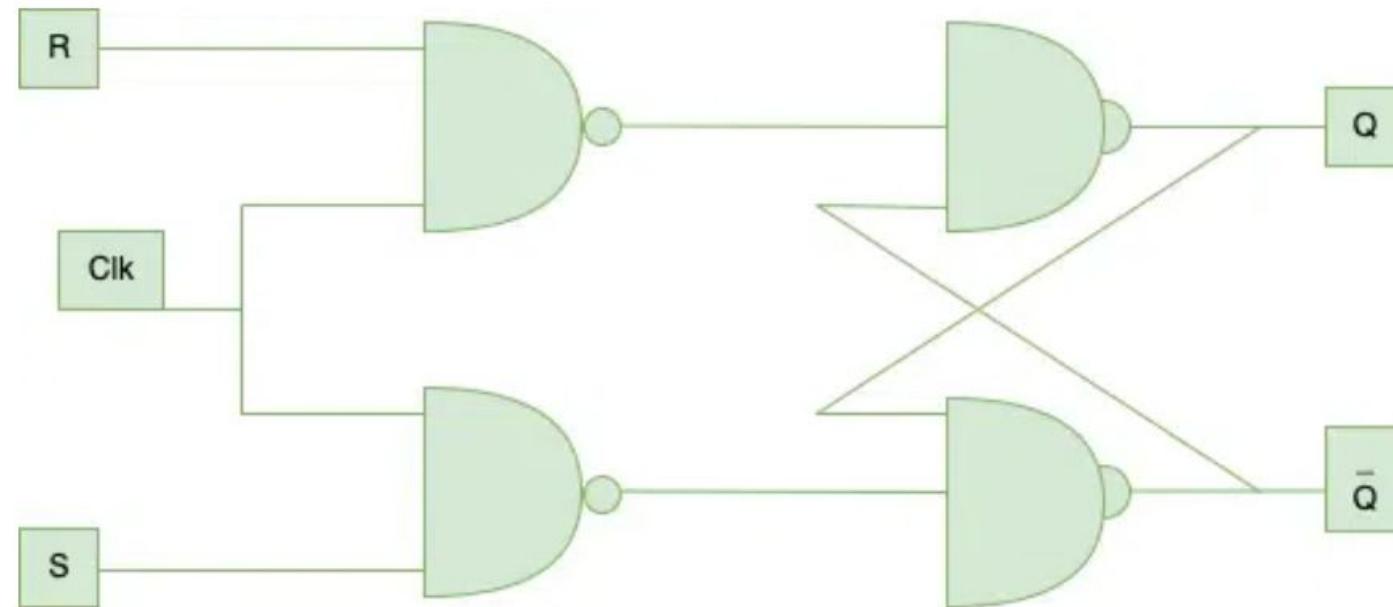
- Flip-flops are fundamental building blocks in digital electronics systems used primarily for storage and transfer of digital data.
- They are a type of bistable multivibrator, meaning they have two stable states and can thus store one bit of data.
- Here are the most common types of flip-flops and their basic operations:
 - S-R Flip Flop
 - J-K Flip Flop
 - D Flip Flop

S-R Flip Flop

- It is a Flip Flop with two inputs, one is S and other is R. **S** here stands for Set and **R** here stands for Reset.
- Set basically indicates set the flip flop which means output 1 and reset indicates resetting the flip flop which means output 0.
- Here clock pulse is supplied to operate this flip flop, hence it is clocked flip flop.

Construction of SR Flip Flop

- We can construct SR flip with two ways, one is with **2 NOR Gates + 2 AND Gates** and other is with **4 NAND Gates**.
- SR Flip Flop Construction using **4 NAND Gates**:



Truth Table of SR Flip Flop

| S | R | Q_{n+1} | State |
|---|---|-----------|---------|
| 0 | 0 | Q_n | Hold |
| 0 | 1 | 0 | Reset |
| 1 | 0 | 1 | Set |
| 1 | 1 | X | Invalid |

Applications of SR Flip Flop

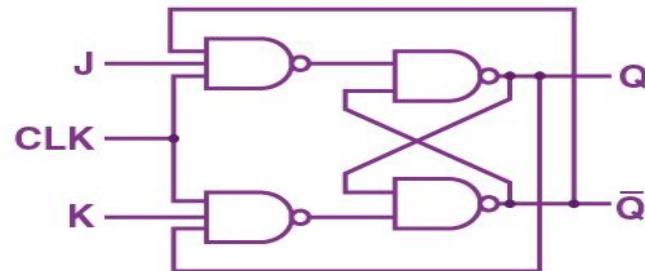
- There are numerous applications of SR Flip Flop in Digital System, which are listed below:
- **Register:** SR Flip Flop used to create register. Designer can create any size of register by combining SR Flip Flops.
- **Counters:** SR Flip Flops used in counters. Counters counts the number of events that occurs in a digital system.
- **Memory:** SR Flip Flops used to create memory which are used to store data.

J-K Flip Flop

- JK Flip Flop is an improved version of [SR flip flop](#) where the undefined state of SR Flip Flop is eliminated by providing feedback. Let us take a look at the JK flip-flop logic diagram.

J-K Flip Flop diagram and Truth Table

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Truth Table

| J | K | Q_N | Q_{N+1} |
|---|---|-------|-----------|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

| J | K | $Q(n+1)$ | State |
|---|---|----------|-----------|
| 0 | 0 | Q_n | No Change |
| 0 | 1 | 0 | RESET |
| 1 | 0 | 1 | SET |
| 1 | 1 | Q_n' | TOGGLE |

J-K Flip Flop Applications

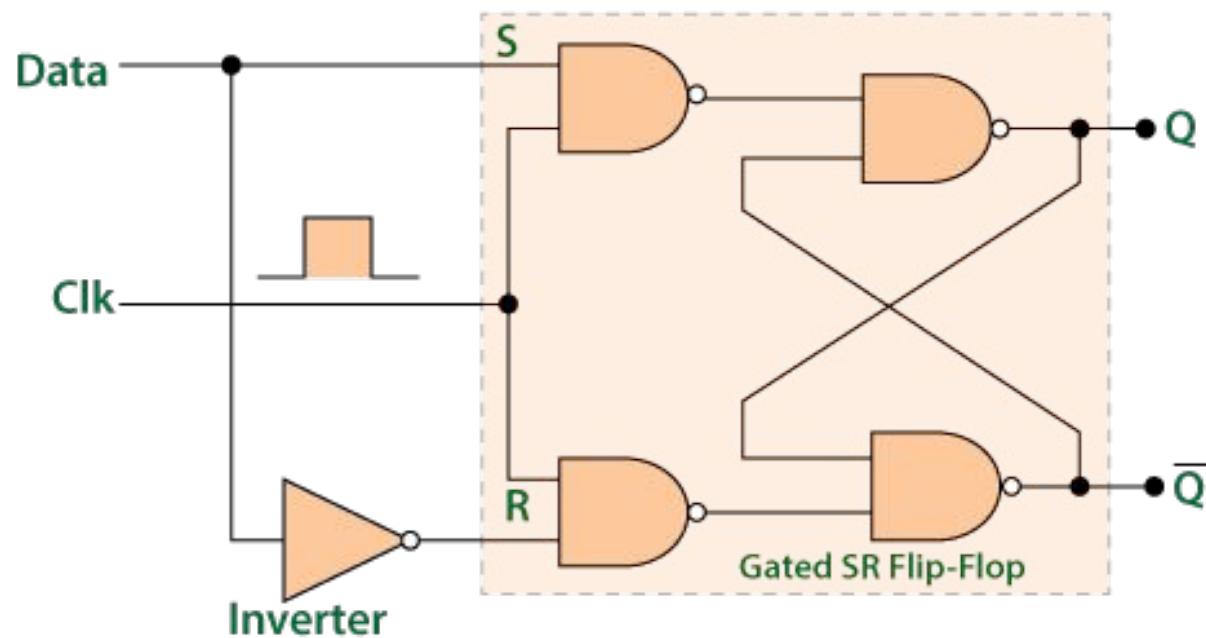
Some of the applications of JK flip-flop in real-world includes:

- **Counters:** The JK flip-flop can be used in conjunction with other digital logic gates to create a binary [counter](#). This makes it useful in real-time applications such as timers and clocks.
- **Data storage:** The JK flip-flop can be used to store temporary data in digital systems.

D Flip Flop

- The D flip flop is the most important flip flop from other clocked types. It ensures that at the same time, both the inputs, i.e., S and R, are never equal to 1.
- The Delay flip-flop is designed using a gated SR flip-flop with an inverter connected between the inputs allowing for a single input D(Data).
- This single data input, which is labeled as "D" used in place of the "Set" input and for the complementary "Reset" input, the inverter is used.

D Flip Flop Circuit Diagram and Truth Table



| Clock | D | Q | Q' | Description |
|--------------------|---|---|----|------------------|
| $\downarrow \gg 0$ | X | Q | Q' | Memory no change |
| $\uparrow \gg 1$ | 0 | 0 | 1 | Reset Q $\gg 0$ |
| $\uparrow \gg 1$ | 1 | 1 | 0 | Set Q $\gg 1$ |

