ID: 19101020

FLIP-FLOP

Flip-flop is a device where there is one or many inputs, but exactly hqve two output. One output is opposite of other output. In electronics, a flip-flop or latch is a circuit that has two stable states and can be used to store state information – a Bistable multivibrator. The circuit can be made to change state by signals applied to one or more control inputs and will have one or two outputs. It is the basic storage element in sequential logic. Flip-flops and latches are fundamental building blocks of digital electronics systems used in computers, communications, and many other types of systems.

Flip-flops and latches are used as data storage elements. A flip-flop is a device which stores a single *bit* (binary digit) of data; one of its two states represents a "one" and the other represents a "zero". Such data storage can be used for storage of *state*, and such a circuit is described as sequential logic in electronics. When used in a finite-state machine, the output and next state depend not only on its current input, but also on its current state.

It can also be used for counting of pulses, and for synchronizing variably-timed input signals to some reference timing signal. Flip-flops can be either simple (transparent or asynchronous) or clocked (synchronous). In the context of hardware description languages, the simple ones are commonly described as *latches*,[1] while the clocked ones are described as *flip-flops*.

Simple flip-flops can be built around a single pair of cross-coupled inverting elements: vacuum tubes, bipolar transistors, field effect transistors, inverters, and inverting logic gates have all been used in practical circuits. Clocked devices are specially designed for synchronous systems; such devices ignore their inputs except at the transition of a dedicated clock signal. Clocking causes the flip-flop either to change or to retain its output signal based upon the values of the input signals at the transition. Some flip-flops change output on the rising edge of the clock, others on the falling edge.

More than one input and 2 outputs. One output is opposite to other input.

LATCH FLIP-FLOP :

In the same way that gates are the building blocks of combinatorial circuits, latches and flip-flops are the building blocks of sequential circuits. While gates had to be built directly from transistors, latches can be built from gates, and flip-flops can be built from latches. Both latches and flip-flops are circuit elements whose output depends not only on the current inputs, but also on previous inputs and outputs. The difference between a latch and a flip-flop is that a latch does not have a clock signal, whereas a flip-flop always does. Latch is level-triggered (outputs can change as soon as the inputs changes) and Flip-Flop is edge-triggered (only changes state when a control signal goes from high to low or low to high).Latches are asynchronous, which means that the output changes very soon after the input changes. Most computers today, on the other hand, are synchronous, which means

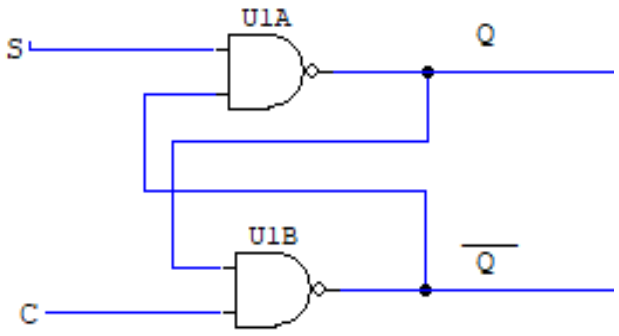
that the outputs of all the sequential circuits change simultaneously to the rhythm of a global clock signal. A flip-flop is a synchronous version of the latch

NAND LATCH :

Truth Table

S	C	Q
0	0	Invalid
0	1	1
1	0	0
1	1	No Change

Circuit Diagram

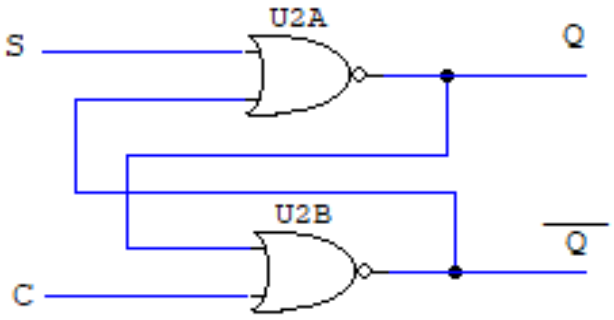


NOR LATCH :

Truth Table

S	C	Q
0	0	No Change
0	1	0
1	0	1
1	1	Invalid

Circuit Diagram



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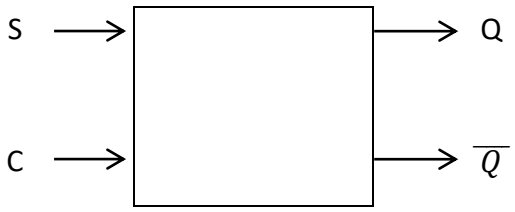


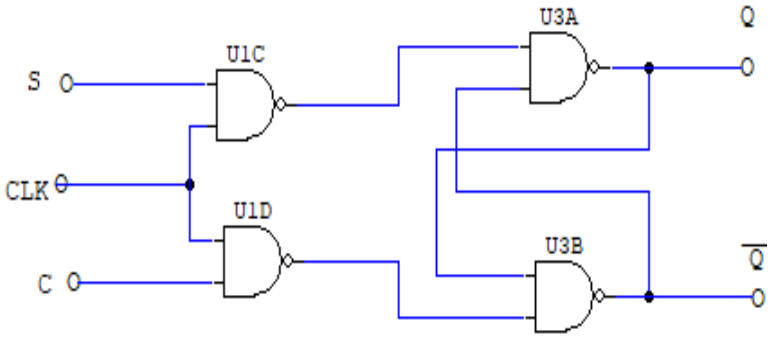
CLOCKED SC FLIP-FLOP : The SC flip-flop, also known as a *SR Latch*, can be considered as one of the most basic sequential logic circuit possible. This simple flip-flop is basically a one-bit memory bistable device that has two inputs, one which will "SET" the device (meaning the output = "1"), and is labelled S and one which will "RESET" the device (meaning the output = "0"), labelled C. Then the SR description stands for "Set-Reset". The reset input resets the flip-flop back to its original state with an output Q that will be either at a logic level "1" or logic "0" depending upon this set/reset condition. A basic NAND gate SR flip-flop circuit provides feedback from both of its outputs back to its opposing inputs and is commonly used in memory circuits to store a single data bit. Then the SR flip-flop

actually has three inputs, Set, Reset and its current output Q relating to its current state or history. The term “Flip-flop” relates to the actual operation of the device, as it can be “flipped” into one logic Set state or “flopped” back into the opposing logic Reset state.

Truth Table

S	C	CLK	Q
0	0	↑	Invalid
0	1	↑	1
1	0	↑	0
1	1	↑	No Change

Circuit Diagram

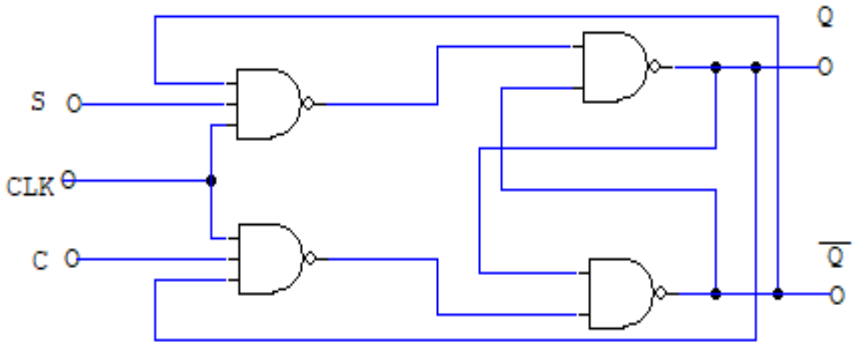


CLOCKED JK FLIP-FLOP : The **JK flip flop** is basically a gated SR flip-flop with the addition of a clock input circuitry that prevents the illegal or invalid output condition that can occur when both inputs S and R are equal to logic level “1”. Due to this additional clocked input, a JK flip-flop has four possible input combinations, “logic 1”, “logic 0”, “no change” and “toggle”. The symbol for a JK flip flop is similar to that of an *SR Bistable Latch* as seen in the previous tutorial except for the addition of a clock input. The sequential operation of the JK flip flop is exactly the same as for the previous SR flip-flop with the same “Set” and “Reset” inputs. The difference this time is that the “JK flip flop” has no invalid or forbidden input states of the SR Latch even when S and R are both at logic “1”.

Truth Table

S	C	CLK	Q
0	0	↑	No Change
0	1	↑	1
1	0	↑	0
1	1	↑	Toggle

Circuit Diagram



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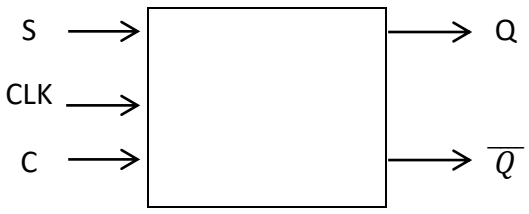


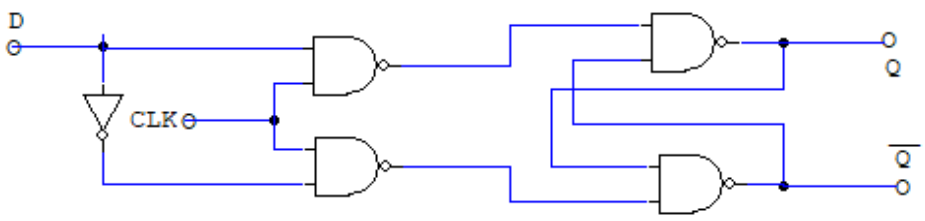
CLOCKED D FLIP-FLOP : D flip flop is a better alternative that is very popular with digital electronics. They are commonly used for counters and shift-registers and input

synchronization. In a D flip flop, the output can be only changed at the clock edge, and if the input changes at other times, the output will be unaffected. The change of state of the output is dependent on the rising edge of the clock. The output (Q) is same as the input and can only change at the rising edge of the clock.

Truth Table

S	CLK	Q
0	↑	0
1	↑	1

Circuit Diagram



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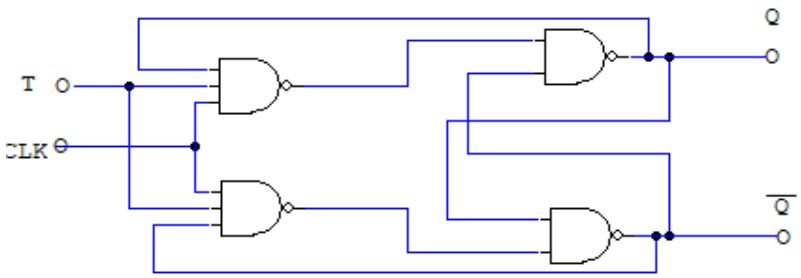
CLOCKED T FLIP-FLOP : The **Toggle Flip-flop** is another type of bistable sequential logic circuit based around the previous clocked JK flip-flop circuit. The toggle flip-flop can be used as a basic digital element for storing one bit of information, as a divide-by-two divider or as a counter. Toggle flip-flops have a single input and one or two complementary outputs of Q and $\bar{Q}$ which change state on the positive edge (rising edge) or negative edge (falling edge) of an input clock signal or pulse.

Truth Table

S	Q	Q(T+1)
0	0	0
1	0	0
0	1	1
1	1	0

Circuit Diagram



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