Flip-flop

SR Flip-flop

> The SR flip-flop or `latch` is a simple example of a sequential circuit. It can be constructed with two NAND gates or two NOR gates.

The properties of SR flip-flop explained why it can be used as a storage device for 1 bit and therefore could be used as a component in RAM because a value is stored but can be altered.

The alternative NAND gate circuit for the SR flip-flop has a similar structure but the labelling is different. The important difference is that setting is achieved when S=0 & R=1 and resetting with R=0 and S=1.

NOR gates implementation

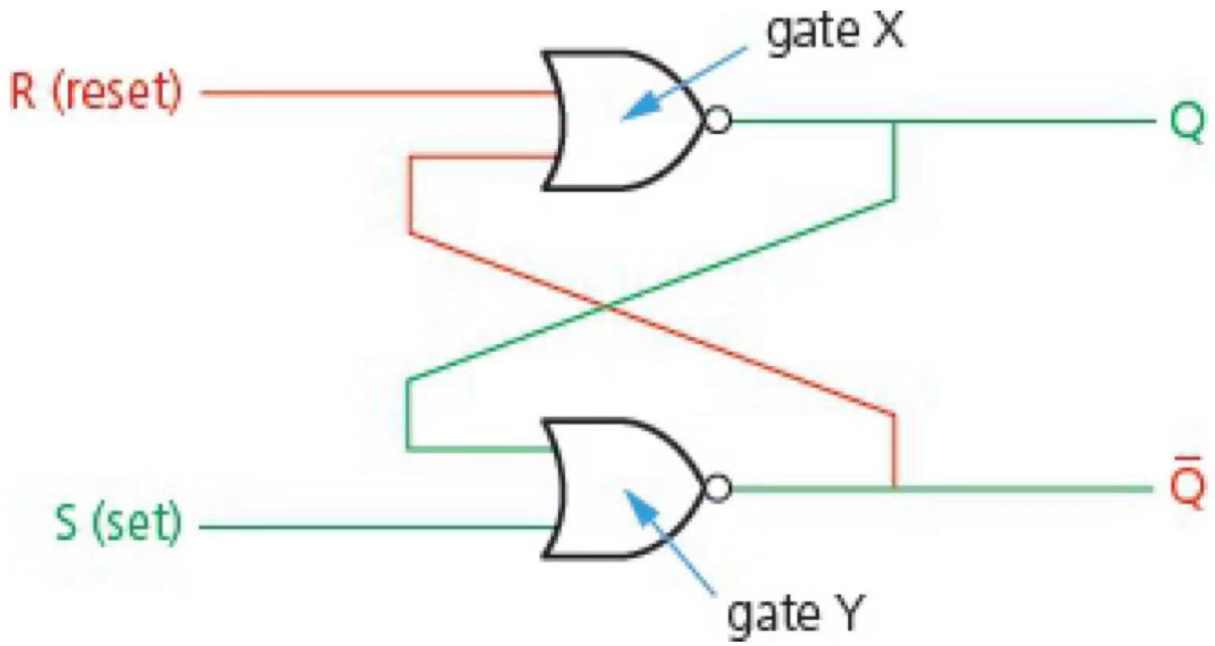
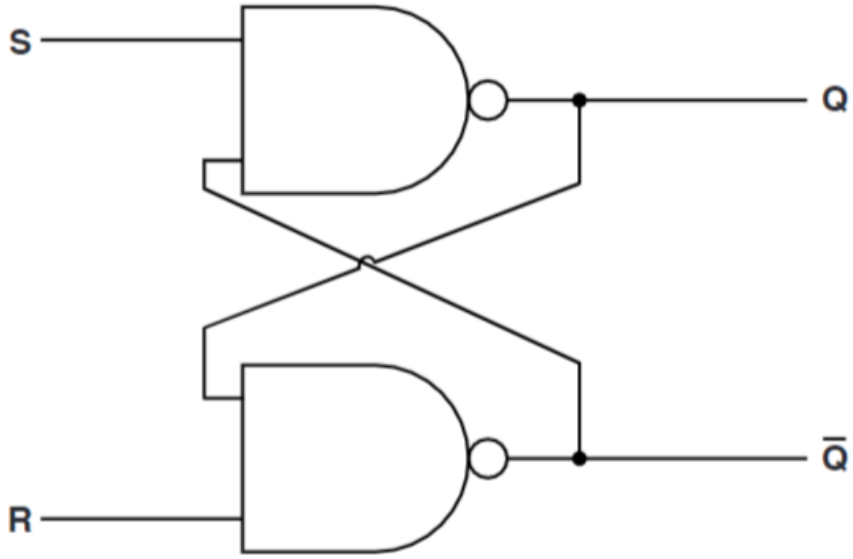


Figure 15.15 SR flip-flop circuit

NAND gate implementation

A SR flip-flop is constructed using two NAND gates.



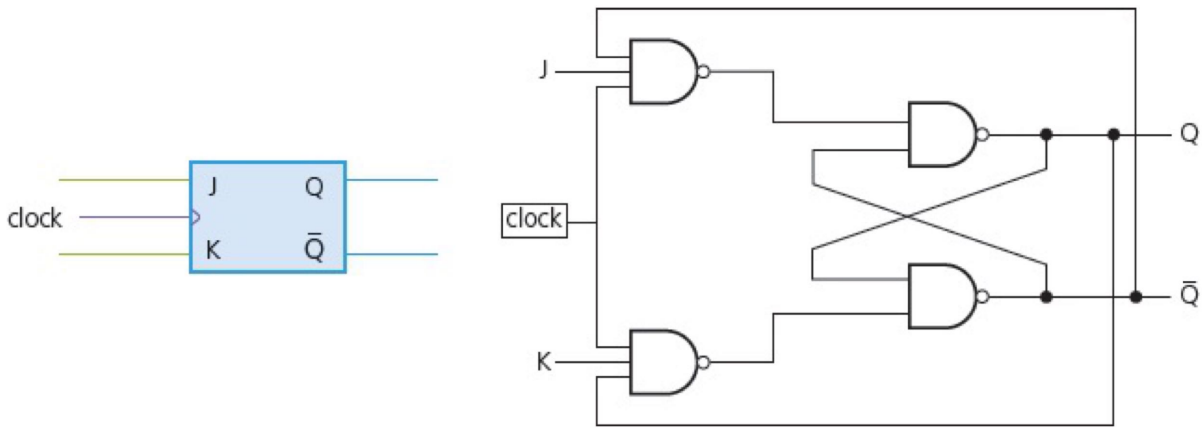
S	R	Q	$\overline{Q}$
1	0	**0**	**1**
1	1	**0**	**1**
0	1	**1**	**0**
1	1	**1**	**0**
0	0	**1**	**1**

Why is the final row a problem?

- Q and not Q have the same value
- Q and not Q should be the complement to each other
- Flip-flop becomes unstable

JK Flip-flop

> In addition to the possibility of entering an invalid state there is also the potential for a circuit to arrive in an uncertain state if inputs do not arrive quite at the same time. In order to prevent this, a circuit may include a clock pulse input to give a better chance of synchronising inputs. The JK flip-flop is an example.



J	K	Value of Q before clock pulse	Value of Q after clock pulse	OUTPUT
0	0	0	0	Q is unchanged after clock pulse
0	0	1	1	
1	0	0	1	Q = 1
1	0	1	1	
0	1	0	0	Q = 0
0	1	1	0	
1	1	0	1	Q value toggles between 0 and 1
1	1	1	0	

Past-paper questions

Why JK flip-flop is an improvement to the SR flip-flop

- The SR flip-flop has an invalid combination of SR which allows Q and not Q to have the same value
- The JK flip-flop does not allow Q and not Q to have the same value

Advantages of JK flip-flop

- All four possibilities are valid
- The 1-1 combination changes to output to logical complement
- Unstable state avoided
- Invalid state cannot occur

Explain the role of flip-flop in a computer

- A flip flop can be stored either a 1 or 0
- Computers use bits to store data
- Flip flop can therefore be used to store bits
- Memory can be created from flip-flop

Describe the role of flip-flop in a computer:

- Circuit / electrical components(construction)
- With two states
- Used for data storage elements // memory
- … to store 1 bit of data

Difference between SR flip-flop and JK flip-flop

- SR flip-flop has a undefined/invalid/intermediate state // JK flip-flop is stable
  - for a SR flip-flop constructed using two NOR gates, when S=1 and R=1. The Q and not Q will be both 0. This is invalid since Q and not Q should be the logical complement to each other.
- JK flip-flop has a clock pulse to synchronize input

A flip-flop is a Logic circuit .

It has two stable states.

A flip-flop is used for Data storage .

There are different types of flip-flop, for example SR and JK .