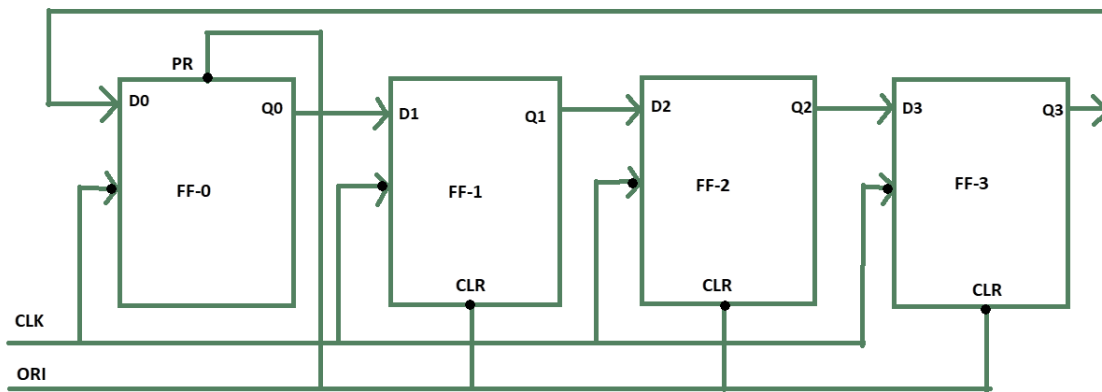## Ring Counter

A ring counter is a typical application of the Shift register. The ring counter is almost the same as the shift counter. The only change is that the output of the last flip-flop is connected to the input of the first flip-flop in the case of the ring counter but in the case of the shift register it is taken as output. Except for this, all the other things are the same.

```
 No. of states in Ring counter = No. of flip-flop used
```

So, for designing a 4-bit Ring counter we need 4 flip-flops.

Ring Counter

In this diagram, we can see that the clock pulse (CLK) is applied to all the flip-flops simultaneously. Therefore, it is a Synchronous Counter. Also, here we use Overriding input (ORI) for each flip-flop. Preset (PR) and Clear (CLR) are used as ORI. When PR is 0, then the output is 1. And when CLR is 0, then the output is 0. Both PR and CLR are active low signal that always works in value 0.

```
PR = 0, Q = 1
```

```
CLR = 0, Q = 0
```

These two values are always fixed. They are independent of the value of input D and the Clock pulse (CLK). **Working –** Here, ORI is connected to Preset (PR) in FF-0 and it is connected to Clear (CLR) in FF-1, FF-2, and FF-3. Thus, output Q = 1 is generated at FF-0, and the rest of the flip-flop generates output Q = 0. This output Q = 1 at FF-0 is known as Pre-set 1 which is used to form the ring in the Ring Counter.

		PRESETED 1			
ORI	CLK	Q0	Q1	Q2	Q3
low	X	1	0	0	0
high	low	0	1	0	0
high	low	0	0	1	0
high	low	0	0	0	1
high	low	1	0	0	0

This Preseted 1 is generated by making ORI low and that time Clock (CLK) becomes don't care. After that ORI is made to high and apply low clock pulse signal as the Clock (CLK) is negative edge triggered. After that, at each clock pulse, the preseted 1 is shifted to the next flip-flop and thus forms a Ring. From the above table, we can say that there are 4 states in a 4-bit Ring Counter.

```
4 states are:
  1 0 0 0
  0 1 0 0
  0 0 1 0
  0 0 0 1
```

In this way can design a 4-bit Ring Counter using four D flip-flops.

Types of Ring Counter: There are two types of Ring Counter:
  1. **Straight Ring Counter:** It is also known as One hot Counter. In this counter, the output of the last flip-flop is connected to the input of the first flip-flop. The main point of this Counter is that it circulates a single one (or zero) bit around the ring.

Straight Ring Counter
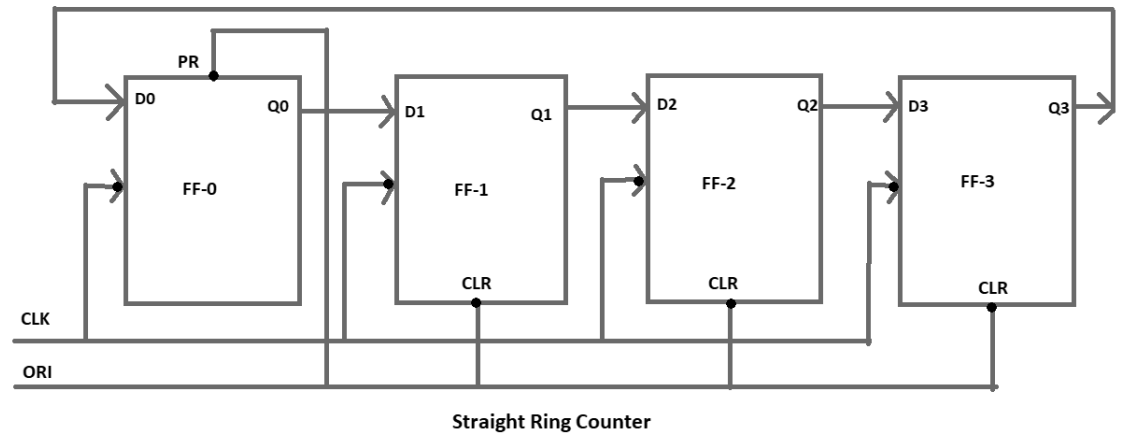
Here, we use Preset (PR) in the first flip-flop and Clock (CLK) for the last three flip-flops.

2. **Twisted Ring Counter –** It is also known as a switch-tail ring counter, walking ring counter, or Johnson counter. It connects the complement of the output of the last shift register to the input of the first register and circulates a stream of ones followed by zeros around the ring.

Twisted Ring Counter
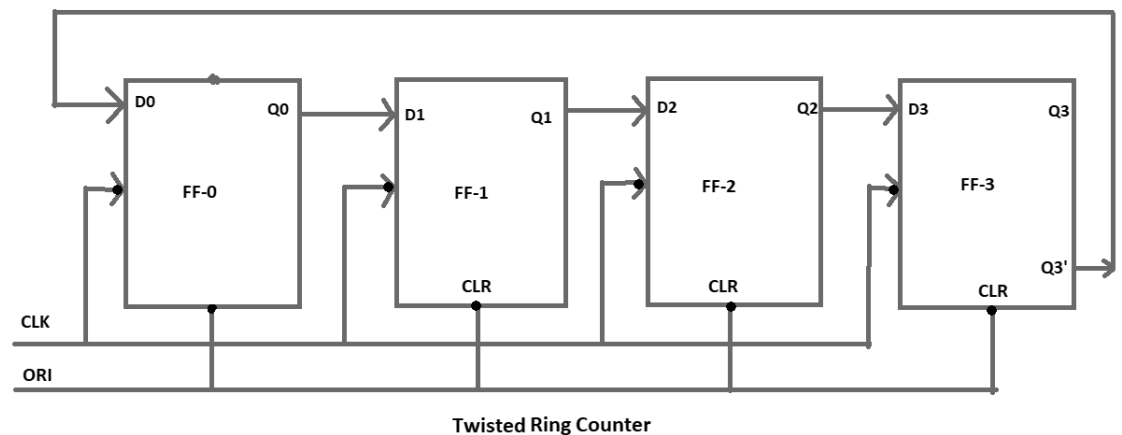
Here, we use Clock (CLK) for all the flip-flops. In the Twisted Ring Counter, the number of states = 2 X the number of flip-flops.