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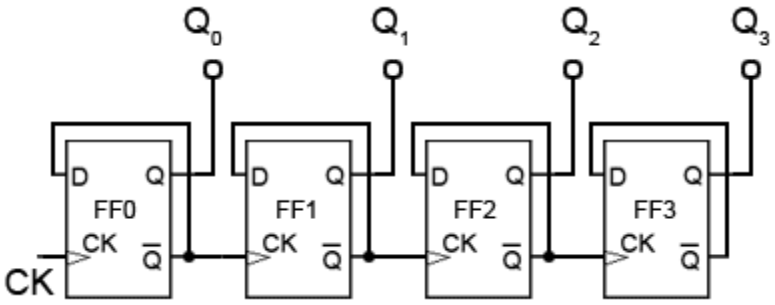
Counter

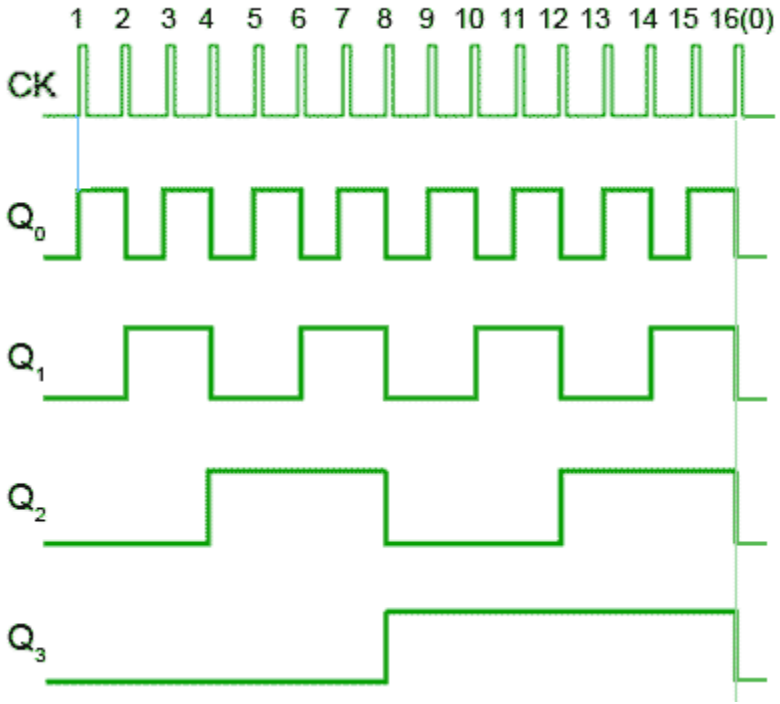
- Counters, consisting of a number of flip-flops, count a stream of pulses applied to the counter's CK input.
- The output is a binary value whose value is equal to the number of pulses received at the CK input.
- The size of the output word depends on the number of flip-flops that make up the counter.
- The output lines of a 4-bit counter represent the values 20, 21, 22 and 23, or 1,2,4 and 8 respectively.
- There are type of counter

1. Asynchronous Counter
2. Synchronous Counter

1. Asynchronous Counter

4-Bit Asynchronous Up Counter

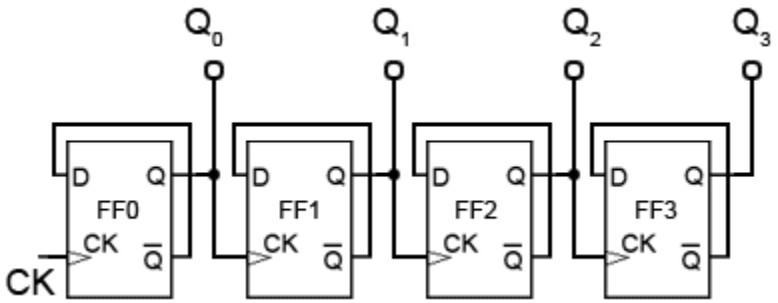




4-bit Asynchronous Up Counter Waveforms

COUNTER

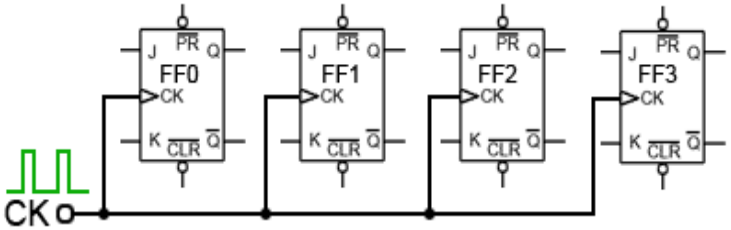
Four Bit Asynchronous Down Counter



Synchronous Counters

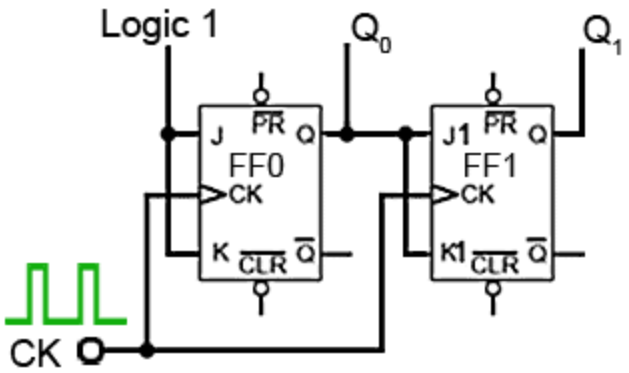
The synchronous counter provides a more reliable circuit for counting purposes, and for high-speed operation, as the clock pulses in this circuit are fed to every flip-flop in the chain at exactly the same time. Synchronous counters use JK flip-flops, as the programmable J and K inputs allow the toggling of individual flip-flops to be enabled or disabled at various stages of the count. Synchronous counters therefore eliminate the clock ripple problem, as the operation of the circuit is synchronised to the CK pulses, rather than flip-flop outputs.

Synchronous Up Counter

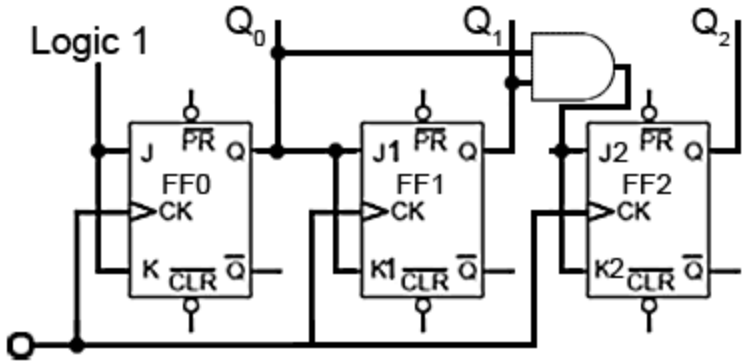


Synchronous Clock Connection

Table 5.6.1					
CK	Q_0	Q_1	J1	K1	After the CK pulse
0	0	0	0	0	No CK pulses yet
1	1	0	1	1	Q_0 toggles making J1 & K1 = 1
2	0	1	0	0	Q_0 & Q_1 toggle making J1 & K1 = 0
3	1	1	1	1	Only Q_0 toggles making J1 & K1 = 1
4	0	0	0	0	Q_0 & Q_1 toggle making J1 & K1 = 0



The First Two Stages of a Synchronous Counter



Adding a Third Stage