

## Lab 11

# Ripple Counters

### OBJECTIVES

After completing this experiment, you will be able to:

- Design and verify a 4-bit Ripple Counter
- Design and verify MOD-10 and MOD-12 Ripple Counter
- Explain how a Ripple Counter can be used as a frequency divider

### COMPONENTS REQUIRED

- Two 7476 (JK Flip-Flop ICs)
- One 7400 (2-Input NAND gate)

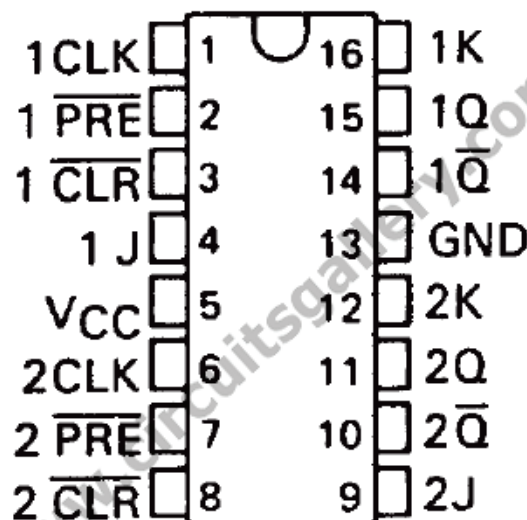
### THEORY

A circuit used for counting the pulses is known as Counter. Basically there are two types of Counters: Asynchronous Counters (Ripple Counters) and Synchronous Counters.

**Asynchronous Counter:** In the case of an Asynchronous Counter, all the Flip-Flops are not clocked simultaneously. This Counter is simple in operation & requires a minimum of hardware. But its speed is slow. Each FF is triggered by a previous FF o/p. Each FF takes its own time to give o/p (due to propagation delay). So final settling time is high.

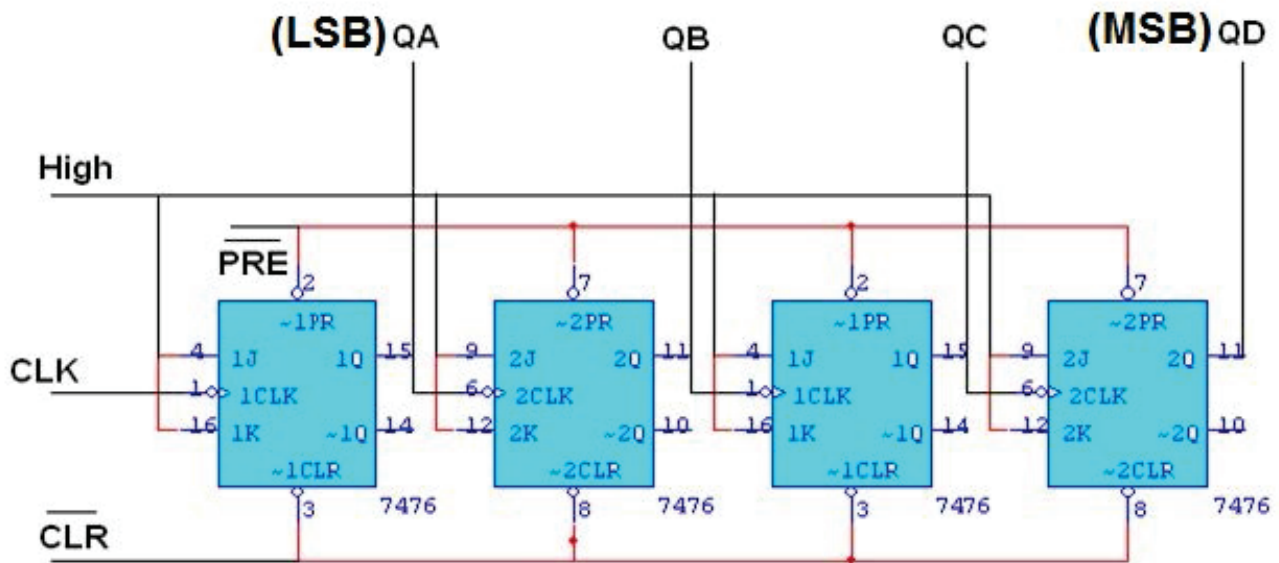
**Synchronous Counter:** In Synchronous Counter all the FFs are clocked simultaneously. It is complex in construction, but speed is more. In this case since each FF is clocked simultaneously thus settling time is the delay time of single FF.

### PIN DIAGRAM FOR IC 7476



**7476**

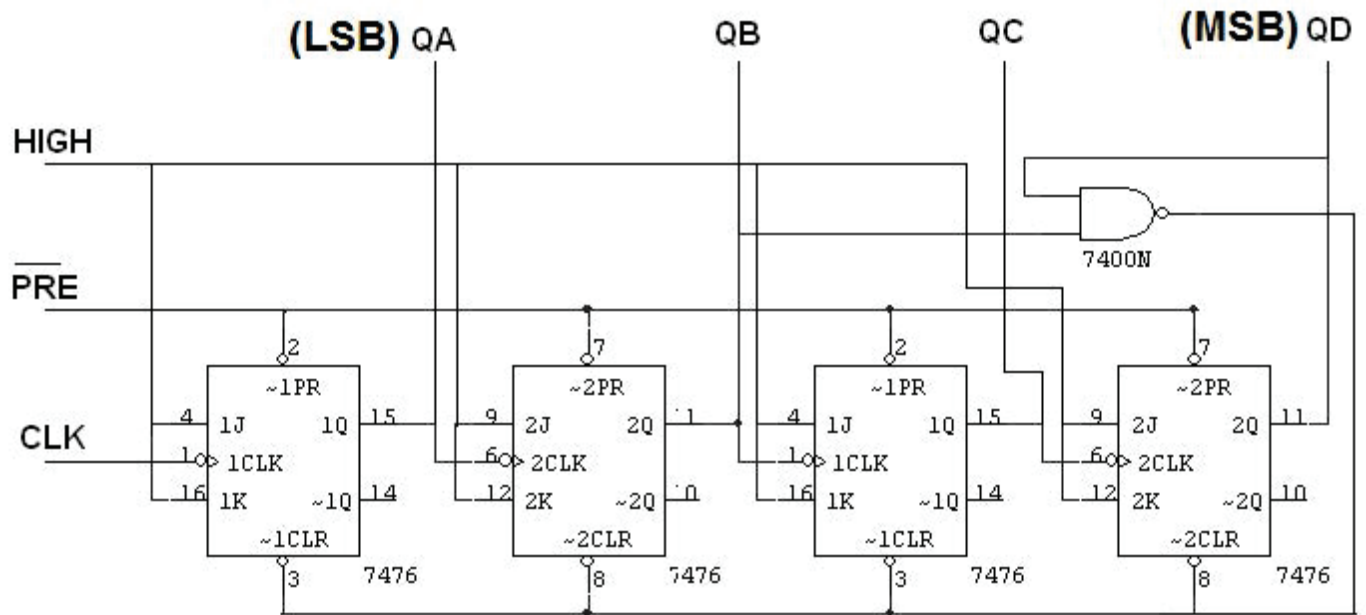
## LOGIC DIAGRAM FOR 4-BIT RIPPLE COUNTER



## TRUTH TABLE

CLK	QA	QB	QC	QD
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

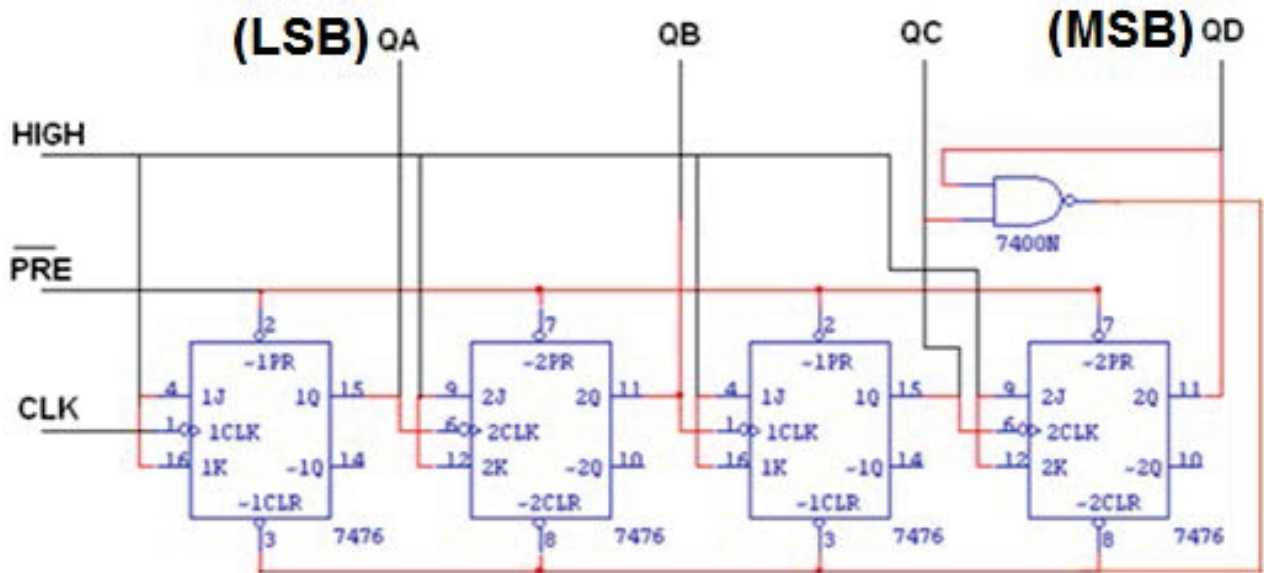
## LOGIC DIAGRAM FOR MOD-10 RIPPLE COUNTER:



## TRUTH TABLE

CLK	QA	QB	QC	QD
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	0	0	0

## LOGIC DIAGRAM FOR MOD-12 RIPPLE COUNTER



## TRUTH TABLE

CLK	QA	QB	QC	QD
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	0	0

## PROCEDURE

- Connections are given as per circuit diagram.
- Logical inputs are given as per circuit diagram.
- Observe the output and verify the truth table.
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## REVIEW QUESTIONS

1. Counters can be used as frequency dividers. When the clock frequency in the 4-bit Ripple Counter given above is 1 kHz, what will be the output frequency of Flip-Flop A and Flip-Flop B?  
 $f_A =$  \_\_\_\_\_  
 $f_B =$  \_\_\_\_\_
2. Would inverters on the clock inputs change the count direction of a Ripple Counter?
3. How many Flip-Flops are needed to build a MOD-5 Counter?