**Lab– Asynchronous Counters**

**Objectives:**

-To build an asynchronous counter circuit using a D Flip-Flop

-To determine the timing diagrams for the various outputs of the asynchronous counter circuit

**Pre-Lab:**

What is meant by the ‘modulus’ of an asynchronous counter circuit?

**Equipment:**

Diagram

Description automatically generatedOne 7474 Dual D Flip Flop; 7400 Quad NAND gate; Two 330 Ohm resistor; Two 1.0 kOhm resistors Two LED; Function Generator; Oscilloscope

IC Pin Diagrams

Table

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*Figure1 – Pin Layout diagrams for IC 7474 and IC 7400*

**Procedure**

1.Use the pin diagram above and wire up the circuit below.

A screenshot of a cell phone

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*Figure2 – Asynchronous counter circuit[[1]](#endnote-1)*

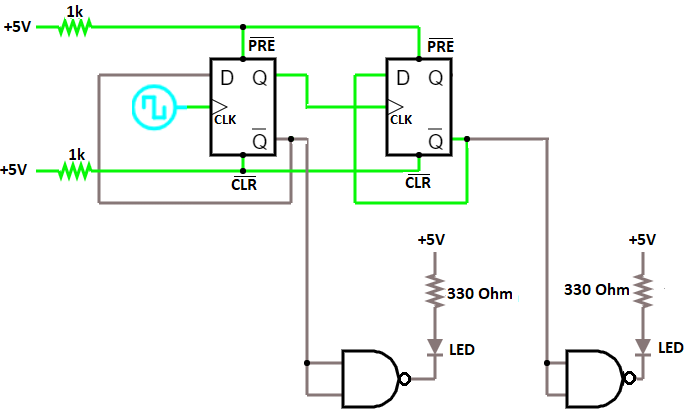
2.Make sure that you know which pins of the IC are the inputs and which are the outputs. Also, be sure you are applying power (Vcc) and ground to the correct pins of each IC otherwise your circuit will not function. The value of Vcc should be 5 Volts.

3. The and inputs should be made inactive by connecting them to a +5V source that is in series with a resistor, as shown in figure 2

4. Use a 1Hz TTL pulse from the function generator to the clock input and watch the sequence of the LEDs and how they are flashing. **Note:** When the LED is lit the output of the flip flop is a HIGH or ‘1’.

5. Set the function generator frequency to 1kHz and view the output waveforms from the left and right flip flops with a 2-channel oscilloscope. **Note:** You might need to set the oscilloscope to ‘trigger’ from channel 1 while viewing the output signal (Q) from the right flip flop on channel 1. You will view the output signal (Q) from the left flip flop using channel 2 of the oscilloscope. Triggering the oscilloscope from the signal with the smaller frequency will give you a more stable trace and allow you to easily draw the timing diagram.

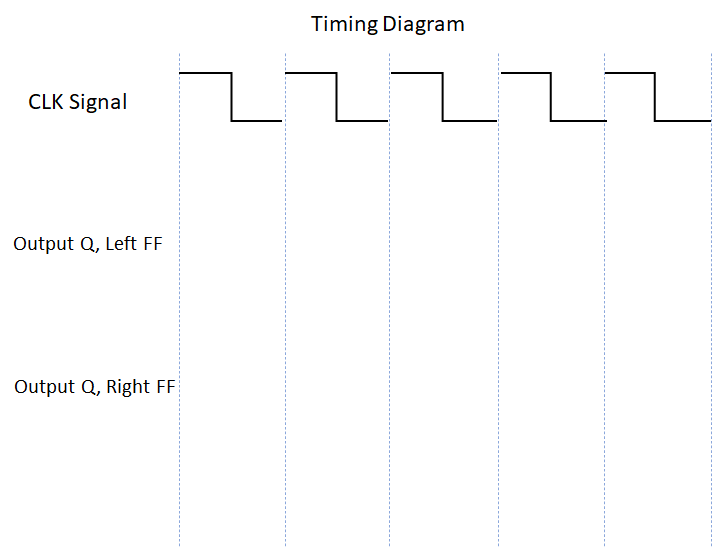
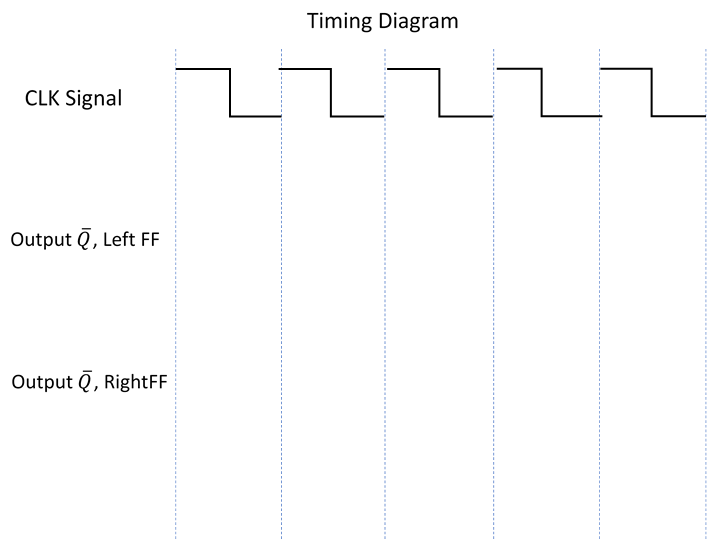
6. Modify the circuit from figure 2 as shown below. You will take the wire that connects the NAND gates and output Q and connect it to the *.*

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*Figure3 – Asynchronous counter circuit (outputs taken at )*

**Data and Observations**

Examine the inputs and outputs of the circuit above. Determine the timing diagrams for the outputs of the two flip flops. Draw them below or sketch in your notebooks. For the circuit in figure 2 connect channel 1 of the oscilloscope to the CLK pin of the left flip flop and channel 2 to output Q*.* Carefully and accurately draw the signal in timing diagrams below. Now connect channel 2 to the output pin of the right flip flop and draw the signal below. Repeat for the circuit in figure 3 but now connect channel 2 to the ‘NOT’ output (*)* of each flip flop.



**Questions**

1. Which of the circuits is counting up?
2. Compare the frequencies of the clock, left flip flop, and right flip flop signals. How are they different?

**Mini-Project**

Counters have many applications. You can use them to create a countdown timer to set off an event such as a fireworks display or to set the time in a camera to take a picture, for example. If there is time connect a BCD to decimal decoder (IC 7747A) and a 7 segment (common anode)display (LSD to the -11)circuit in the figures above.

1. All schematic diagrams were created with Falstad circuit simulator (https://falstad.com/circuit/) [↑](#endnote-ref-1)