

# Implementation of Boolean Logic in Arduino using IC 7474 in FPGA

LAKKIREDDY VEERASIVA REDDY

lakkireddyveerasivareddy@gmail.com

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## 1 Problem

(GATE EC-2022)

Q.43. For the circuit shown, the clock frequency is  $f_0$  and the duty cycle is 25%. For the signal at the  $Q$  output of the Flip-Flop,

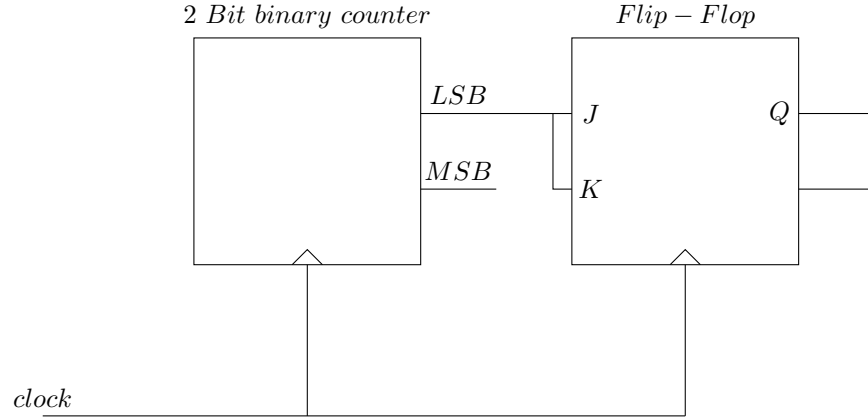


Figure 1: Circuit

1. frequency of  $\frac{f_0}{4}$  and duty cycle is 50%
2. frequency of  $\frac{f_0}{4}$  and duty cycle is 25%
3. frequency of  $\frac{f_0}{2}$  and duty cycle is 50%
4. frequency of  $f_0$  and duty cycle is 25%

## 2 Introduction

The Aim is to implement the above circuit in Arduino using IC 7474. IC 7474 is a dual positive-edge-triggered D-type flip-flop, which means it has two separate flip-flop that are triggered by the rising edge of a clock signal. A 2-bit binary counter can be implemented using 2 D Flip-flops similarly a JK Flip-flop can be implemented using one D Flip-flop. Thus we will use two IC 7474 to implement the whole circuit.

The LSB output of the 2-bit binary counter is given to J and K inputs of the JK Flip-flop which then gives the final Q output of the circuit. Since the inputs given to J and K are same it acts as T Flip-flop.

### 3 Components

COMPONENTS		
Component	Value	Quantity
Resistor	220 Ohm	1
Arduino	UNO	1
Seven Segent Display	Common Anode	1
Decoder	7447	1
Flip Flop	7474	2
Jumper Wires		20
Breadboard		1

Table 1: Components

## 4 Hardware

The IC 7474 is a type of flip-flop integrated circuit that is commonly used in digital electronics applications. It is a dual positive-edge-triggered by the rising edge of a clock signal. Below is the pin diagram of IC 7474.

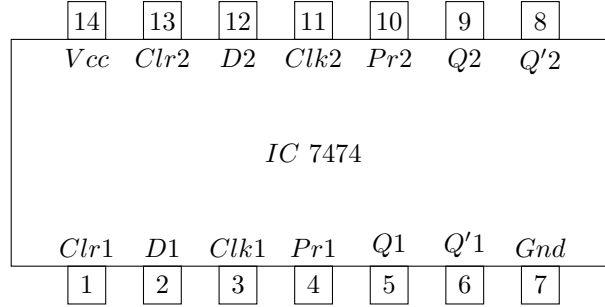


Figure 2: 7474

The connections between Arduino UNO and two IC 7474 is given in below Table

	INPUT	OUTPUT			CLOCK	Vcc	GND
ARDUINO	D6	D3	D4	D5	D2	5V	GND
7447		5			3   11	14	7
7474	5		9	2	3	14	7

Table 2: Arduino - 7474

The truth table for the circuit is given in below table

counter	MSB	LSB	J	K	Q(t)	Q(t+1)
0	0	0	0	0	0	0
1	0	1	1	1	0	1
2	1	0	0	0	1	1
3	1	1	1	1	1	0

Table 3: Truth Table

The kmap for the circuit is

		$JK$			
		00	01	11	10
$Q_n$	0	0	0	1	1
	1	1	0	0	1

Figure 3: kmap

## 5 Software

The Arduino code for the given circuit using IC 7474 is