

# Implementation of the below circuit using avr-gcc

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## **Contents**

## 1 Problem

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Q.25. In the circuit shown, the clock frequency, i.e., the frequency of the clock signal, is 12 KHz. The frequency of the signal at Q2 is ..... KHz.

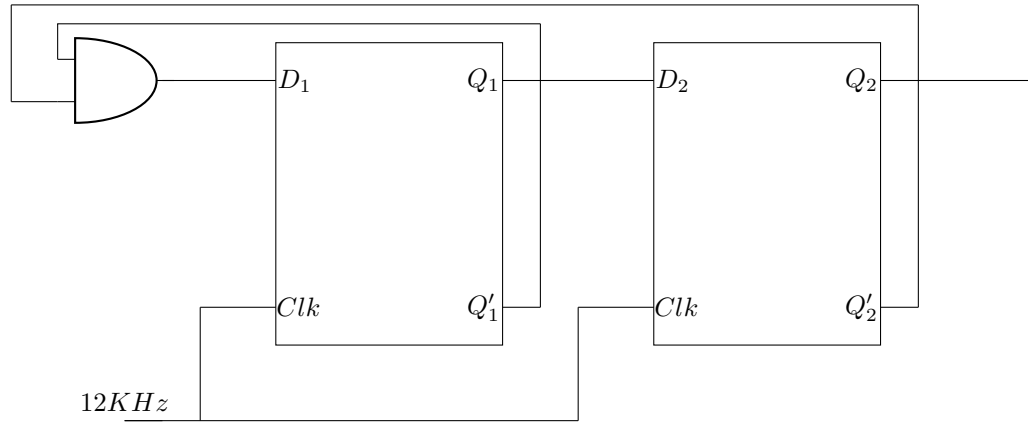


Figure 1: circuit

## 2 Introduction

The aim is to implement the above sequential circuit using D flip-flops (IC 7474) and to find out the frequency of the signal at Q2 (it is given that the frequency of the clock signal is 12KHz). IC 7474 is a dual positive edge triggered D type flip flop, which means it has two separate flip-flops that are triggered by the rising edge of a clock signal.

In the above circuit  $Q_1, Q_2$  are inputs and  $D_1, D_2$  are outputs. So, from the circuit the expressions of  $D_1$  and  $D_2$  are:

$$D_1 = Q_1' Q_2'$$

$$D_2 = Q_1$$

Below is the transition table of the above circuit which is as follows:

## 3 Components

INPUT		OUTPUT	
$Q_1$	$Q_2$	$D_1$	$D_2$
0	0	1	0
1	0	0	1
0	1	0	0

Table 1: Transition table

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

Table 2: Components

## 4 Hardware

IC 7474 is a D 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:

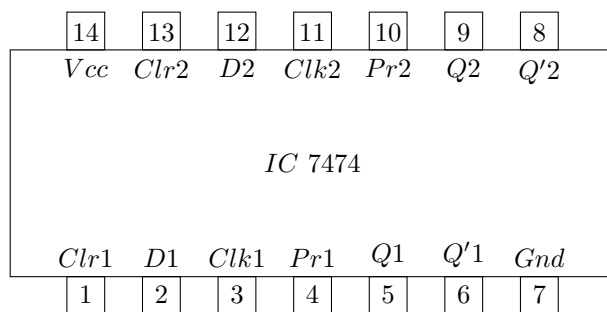


Figure 2: 7474

The connections between the arduino and IC 7474 is as follows:

	INPUT		OUTPUT		CLOCK		VCC			
ARDUINO	D2	D3	D5	D6	D13		5V			
7474	5	9	2	12	3	11	1	4	10	13
7447			1	7				16		

Table 3: connections

## 5 Software

The code to implement the above circuit is :

---

```

#include<avr/io.h>
#include<util/delay.h>
#include<stdbool.h>

int main(void)
{
    bool B,A;
    bool Q1=0,Q2=0;

    DDRD = 0b01100000;
    DDRB = 0b00100000;
    PORTD = 0b11000000;
    PORTB = 0b00000011;

    while(1)
    {
        PORTB = ((1 << PB5));

        _delay_ms(200L);

        B=((!Q1) && (!Q2));
        A=(Q1);

        PORTD = (B << 5);
        PORTD = (A << 6);

        Q1 = (PIND & (1 << PIND2)) == (1 << PIND2);
        Q2 = (PIND & (1 << PIND3)) == (1 << PIND3);

        PORTB = ((0 << PB5));

        _delay_ms(200L);
    }

    return 0;
}

```

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