Amirkabir University of Technology (Tehran Polytechnic)

Electronic Project

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Introduction

Dimmer in English: Dimmer is used to adjust the amount of voltage or brightness and in the automotive industry is called the switch to change the strong light (high light) and low light (low light).

Upon receiving the voltage, this device provides voltage from near zero to near the source voltage as output. Dimmers have different types and designs depending on the type of application.

Dimmers are available in AC and DC types, the dimmer uses an electronic component called a triac.

This device is used to increase or decrease the light of house lamps and areas where the light used varies. A dimmer is a variable resistor or potentiometer. It is installed in the circuit of the phase wire path (such as installing a single bridge switch). The dimmer structure has two contacts, one of which is the phase input point and the other is the phase output point. Since the dimmer controls the voltage, it is one of the methods of controlling the speed of electric motors, so the dimmer can be used as a speed controller for single-phase electric motors with low power, such as ceiling fan motors.

Types of dimmers

Resistance) manual(

- o In this type of dimmer, the work of controlling and adjusting the fire angle of the triac is done by a resistor and a potentiometer.
- o By turning the dimmer volume, the light of the lamp increases and decreases.

Digital

- o In digital dimmer, the triac fire angle is controlled digitally by the processor and the keys Pressure or remote control is performed.
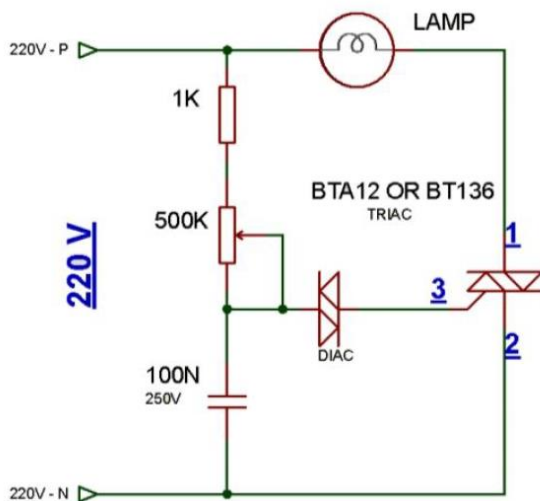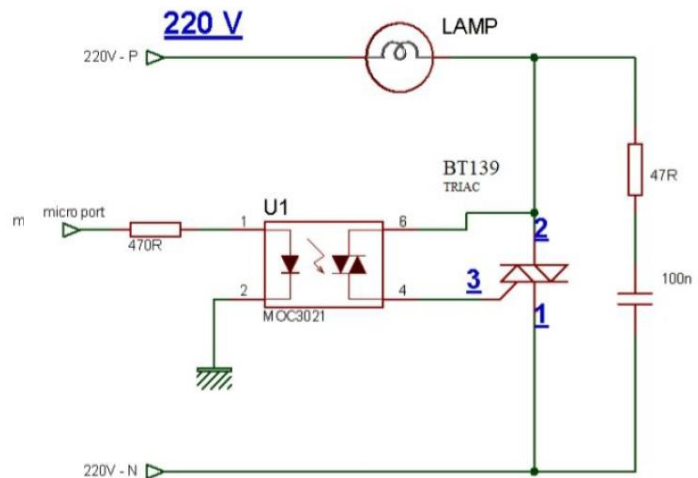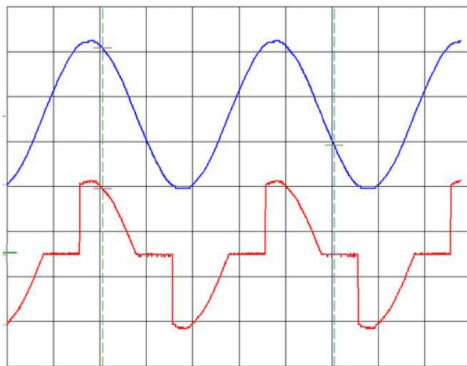

Figure 2 Resistor dimmer circuit

Figure 1 Digital dimmer circuit

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Equipment Item Use the door Making Dimmer

In making a dimmer, regardless of the type of dimmer, the accessories mentioned are used.

triac

Triac is a high-speed solid-state component that has the ability to switch and control the AC power of a sine waveform. The Triac acts exactly like two ordinary thyristors connected in parallel (back to back), and because of this structure, the two thyristors will have a common gate base. The input signal phase control controls the power average it delivers, although the triac is excited and turned on in both the positive and negative half-cycles of the input signal.

Figure 4 pieces of Triac

Figure 3 Triac output form

Digital dimmer control

- There are a variety of control methods available today, including:
- Control via button or key
- •Touch control system
- Remote control
    - Remote control (Wi-Fi or red Mauden)
    - Audio control system, response to specific audio signals

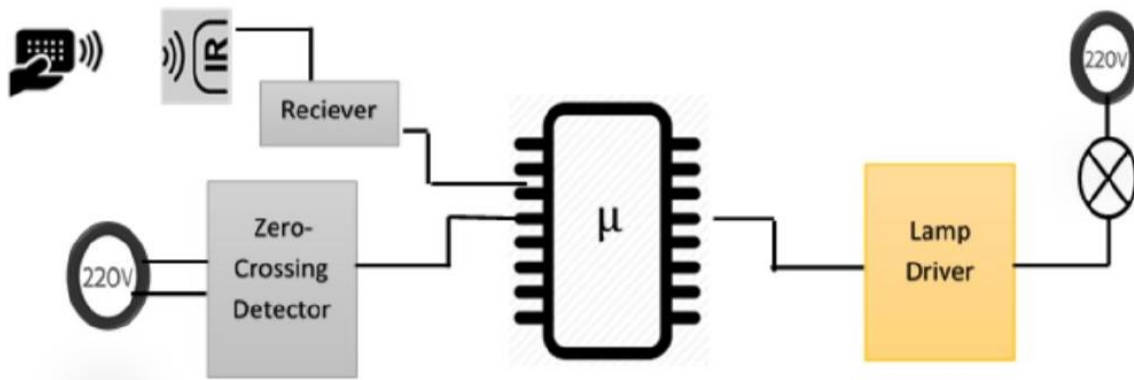In this project, we intend to implement a digital dimmer that is controlled with an infrared remote control ..

Figure 5 General dimmer circuit

Different parts of dimmer design

A sub-digital digital dimmer consists of the following parts:

.1Control circuit (microcontroller and remote control)

.2Zero crossing detector

.3Power circuit (for load control)

In the following, we will describe each of the sections.

Control circuit

In order to transmit information through infrared, it is necessary to perform modeling. Because it was initially assumed that the number of keys was limited (two + and - keys to increase or decrease the light), we moved on to analog implementation.
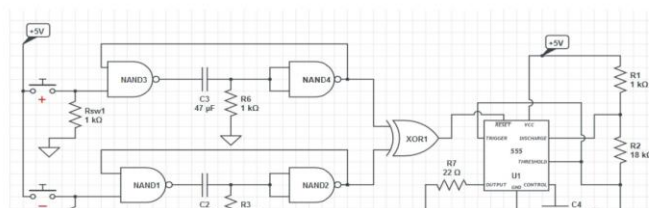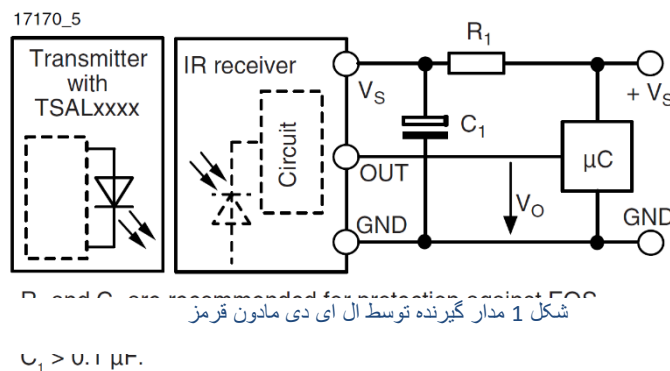

Figure 6 Transmitter circuit by infrared LED

Information about each key after diagnosing the status of the key. It is placed in the width of the pulse. By considering a monostable circuit for each switch separately (with different pulse widths, the pulse width is 30 milliseconds for the + key and 10 milliseconds for the - key). The generated pulses go to an XOR and its output goes to pin 4 of 555 timer (RESET pin) and causes one if the same pulse generated as the pulse generated at the output of the monostable, the stabilization circuit to turn on and a wave at its output. Create a square with the intended frequency. Here, due to the use of TSOP1138 as an infrared receiver, the stable circuit must produce a

17170_5

Transmitter with TSALxxxx

IR receiver Circuit

V_S

OUT

GND

R_1

C_1

$+ V_S$

μC

V_O

GND

شکل 1 مدار گیرنده توسط ال ای دی مادون قرمز

$C_1 > 0.1 \mu F.$

frequency of 38 kHz so that the receiver can detect it. After the pulse generated by the infrared transmitter was sent. In the receiver, after detecting the pulse at its output, it is placed at the LOW level equal to the width of the pulse, and if the output signal source is lost, it is placed at the High level. Finally, the output goes to the microcontroller with the following circuit, and after processing, it is detected which key is pressed.

Cross Zero Detector

The function of Triac is to break the AC voltage, but if this voltage is broken by an improper point, the so-called lamp will flash. The best place to fail at zero moment is the voltage. For this purpose, an orbit is designed to identify this moment. So by passing this moment, a pulse is produced. This pulse is

intermittently transmitted to the control unit, by detecting this micro moment after a certain time, it stimulates the Triac base, thus the Triac passes the voltage and turns on the lamp. There are various ways to do this, for example one of them is to use a comparator (operational amplifier). Its circuit is shown in the figure below.
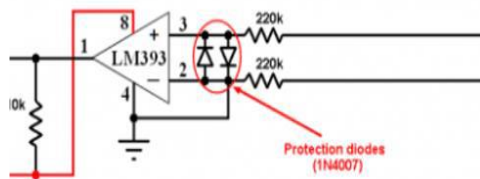

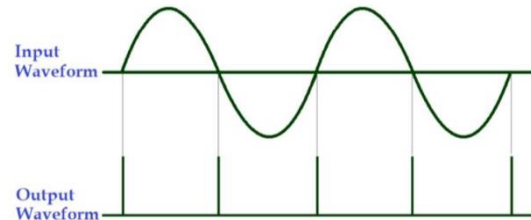Figure 9 Zero detector circuit example

Figure 8 Zero detector circuit output

There are several circuits that can do this. The circuit used in this project is below. The operation of the circuit is such that the city electricity is rectified after passing through the diode bridge and goes to the optocoupler. Yes, the diode is on ... the transistor goes to saturation, the output is zero, so we have a rising edge of the micro when this interrupt comes. After a certain period of time (depending on the amount of light we have adjusted by the switches) it produces a pulse at its output that goes to the power circuit. The
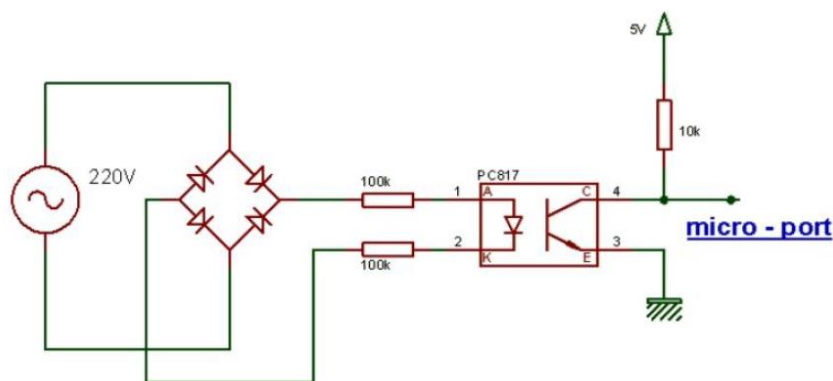

Figure 10 Zero detector circuit

amount of delay time of sending the command pulse actually determines the angle of fire in the circuit. This time can be adjusted by infrared remote control. In other words, these two switches play the role of the same volume control in a normal dimmer.

Power circuit

 The pulse generated by the micro is given to the moc3021 gate and causes it to be excited. By turning on and turning on the diode, the current required to excite the Triac gate is generated by the other side and causes the current to pass through the lamp. Makes the circuit work properly. It is a command that comes here from the previous floor. That is, we must
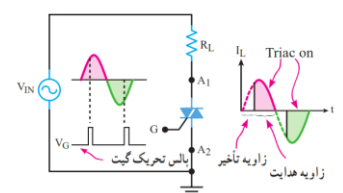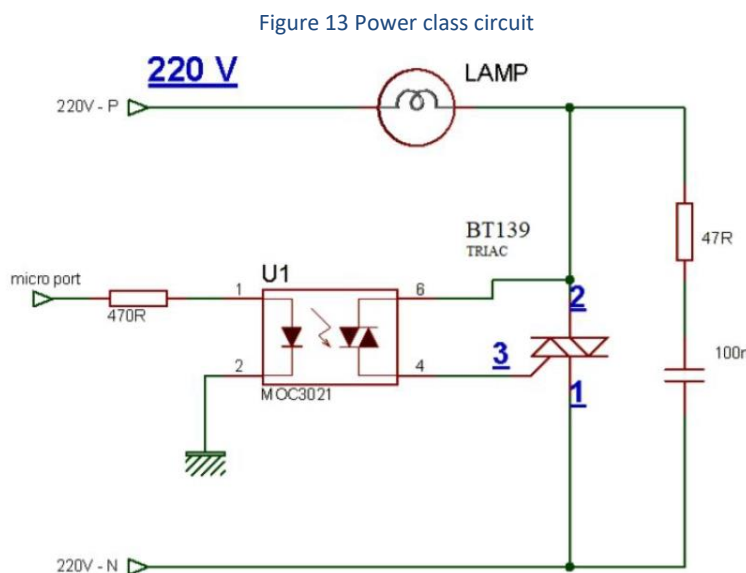
Figure 13 Power class circuit

Figure 11 How to control the phase by Triac

Figure 12 Diac octocopler

recognize the passage of zeros correctly and not miss any of them. In addition, it is designed to reduce noise and disturbing harmonics in a 100 nf capacitor and a 47 ohm resistor. As mentioned, Triac is used to control the load. Triac has the ability to control the power consumption of the lamp by cutting off the AC voltage. Triac after Triac by An excited pulse passes current. In the figure, at some point in the positive half-cycle of the input AC

signal, the triac is cut off, then the triac gate is excited by a pulse and the triac is switched on and the current passes through the load. Diak is used to set up Triac. One of the important features of Diak is that when the current is turned on, it creates an instantaneous needle shape that is suitable for stimulating gates such as thyristors and triacs. This feature is used to generate a needle wave. Diak optocoupler can be used to prevent microcurrent flow.

Because the voltage is 220V on one side and 5V on the microVoltage side, we had to use modules to isolate the circuit. We turn off the current half of the cycle every time
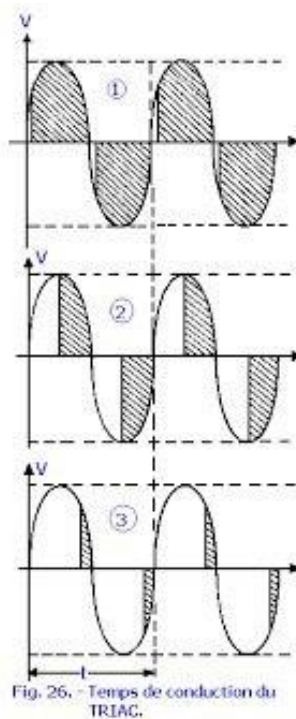

Fig. 26. - Temps de conduction du TRIAC.

Figure 14 Output diagram

Code :

```c
/*AC Light Control

 */

#include  <TimerOne.h>        // Avaiable from
http://www.arduino.cc/playground/Code/Timer1

int AC_pin =3;               // Output to Opto Triac

volatile int i=0;            // Variable to use as a counter volatile as it is in an
interrupt

volatile boolean zero_cross=0;  // Boolean to store a "switch" to tell us if we
have crossed zero

int inpPin=4;

int dim = 0;                 // Dimming level (0-128)  0 = on, 128 = 0ff

int inc=1;                   // counting up or down, 1=up, -1=down

int inString ;

int freqStep = 75;   // This is the delay-per-brightness step in microseconds.

bool flag = true;

int stat=10;

volatile unsigned long intCh1Rise; //Time of the rising edge.
```

volatile unsigned long PulseLength; //Pulselenght in uS.// For 60 Hz it should be 65

int Brightness=10;

int tempo=100;

// It is calculated based on the frequency of your voltage supply (50Hz or 60Hz)

// and the number of brightness steps you want.

// Realize that there are 2 zerocrossing per cycle. This means

// zero crossing happens at 120Hz for a 60Hz supply or 100Hz for a 50Hz supply.

// To calculate freqStep divide the length of one full half-wave of the power

// cycle (in microseconds) by the number of brightness steps.

// (120 Hz=8333uS) / 128 brightness steps = 65 uS / brightness step

// (100Hz=10000uS) / 128 steps = 75uS/step

```
void setup() {

  Serial.begin(9600);                 // Begin setup

  pinMode(AC_pin, OUTPUT);                  // Set the Triac pin as output

  attachInterrupt(0, zero_cross_detect, RISING);   // Attach an Interupt to
Pin 2 (interupt 0) for Zero Cross Detection
```

```
   Timer1.initialize(freqStep);              // Initialize TimerOne library for the
freq we need

   Timer1.attachInterrupt(dim_check, freqStep);

   // Use the TimerOne Library to attach an interrupt

   // to the function we use to check to see if it is

   // the right time to fire the triac.  This function

   // will now run every freqStep in microseconds.

}

void zero_cross_detect() {

   zero_cross = true;              // set the boolean to true to tell our dimming
function that a zero cross has occured

   i=0;

   digitalWrite(AC_pin, LOW);     // turn off TRIAC (and AC)

}

// Turn on the TRIAC at the appropriate time

void dim_check() {

   if(zero_cross == true) {

      if(i>=dim) {

         digitalWrite(AC_pin, HIGH);  // turn on light
```

```
      i=0;  // reset time step counter

      zero_cross = false; //reset zero cross detection

    }

    else {

     i++; // increment time step counter

    }

   }

}


void loop()

{




/*



      if (Serial.available())

      {

    inString=Serial.parseInt();

    if(inString>0)
```

```
{

 dim=map (inString,100,1,0,128);


}



  }

  }

   */



  if((digitalRead(inpPin)) == LOW && (flag == true))

  {

  flag = false;

  intCh1Rise = micros();

  }

 if((digitalRead(inpPin)) == HIGH && (flag == false))

 {

  flag = true;

  PulseLength = micros() - intCh1Rise;

  if(PulseLength > 30000)
```

```
{

  Serial.println("sum");

  if(stat < 10)

  {

    stat = stat + 1;

    Serial.println("sum");

    tempo=Brightness+tempo;

    Serial.println(tempo,DEC);

    dim=map (tempo,100,1,0,128);

  }

  else

    stat = 10;


}

else if(PulseLength > 5000 && PulseLength < 20000)

{

  Serial.println("Substract");

  if (stat > 0)

  {
```

```
        Serial.println("Substract");

        stat = stat - 1;

        tempo=tempo-Brightness;

        Serial.println(tempo,DEC);

        dim=map (tempo,100,1,0,128);

     }

   else

     stat = 0;

  }


 }
}
```