L2

Interfacing Microcontroller with Relays

Project Name: Interfacing microcontroller with relay.

Objectives:

I) To understand the mechanism of a relay.
II) To operate high voltage circuit/ voltage using low voltage.
III) Successful burning process in the targeted microcontroller using PICkit 2

Apparatus List:

I) PIC16F877A Microcontroller
II) Crystal Oscillator 20 MHz
III) 2 pcs 22 pf capacitor
IV) 10K Resistor
V) 4.7K Resistor
VI) 1N4007 Diode
VII) BC547 NPN Transistor
VIII) 5 volt relay
IX) AC current source
X) 220 volt Lamp

Theory:

A relay is a simple **electromechanical switch** made up of an electromagnetand a set of contacts. Relays are found hidden in all sorts of devices. In fact, some of the first computers ever built used relays to implement Boolean gates.

Types of relay:

There are 3 main types of relays-

i) *Mechanical Relay*
ii) *Reed Relay*
iii) *Solid-State Relay*

a) ***Mechanical Relay:*** Mechanical relays are usually the largest and most rugged of all relays. For a typical mechanical relay, a current sent through a coil magnet acts to pull a flexible, spring-loaded conductive plate from one switch contact to another.

In general, mechanical relays are designed for high currents (typically 2A to 15A), but they have relatively slow switching (typically 10ms to 100ms).

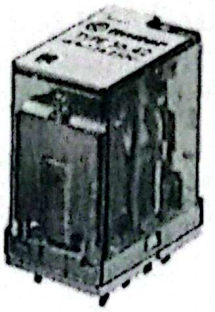

Figure-1: A typical mechanical relay.

b) Reed Relays:Reed relays are smaller than most mechanical relays and are somewhere in the middle between mechanical and solid-state relays. They are kind of the median.They are designed for moderate currents (typically 500mA to 1A) and moderately fast switching (0.2ms to 2ms).

Reed relays are switches that use electromagnets to control one or more reed switch. Reed relays, like electromechanical relays, have physical contacts that are mechanically actuated to open/close a path. For reed relays, however, the contacts are much smaller and lower mass than those used in electromechanical relays. Dry reed relays are made of coils wrapped around reed switches. The reed switch is composed of two overlapping ferromagnetic blades (called reeds) hermetically sealed within a glass or ceramic capsule that is filled with an inert gas. The reeds have contacts on their overlapping ends. When the coil is energized, the two reeds are drawn together such that their contacts complete a path through the relay. When the coil is de-energized, the spring force in the reeds pulls the contacts apart.

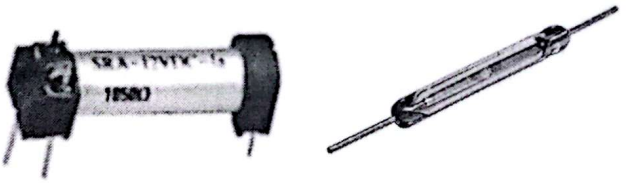

Figure-2: Typical reed relays.

Because the moving parts are small and lightweight, reed relays can switch faster than armature relays and tend to require very little power. However, they are susceptible to damage from arcing. When a spark jumps across the contacts, it can melt a small section of the reed. If the contacts are still closed when the molten section re-solidifies, the contacts may weld together. The spring force in the reeds is often insufficient to mechanically break the weld, causing the reeds to stick in the "on" position.

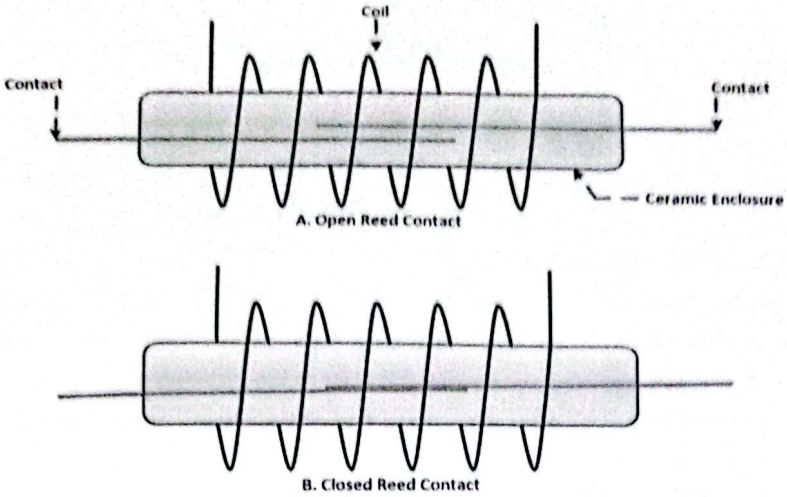

Figure: Open and Close operation of a reed relay.

c) **Solid-state Relays:** A Solid-state relay (SSR) allows you to control high-current AC loads from lower voltage DC control circuitry. Solid state relays have several advantages over mechanical relays. One such advantage is that they can be switched by a much lower voltage and at a much lower current than most mechanical relays. Also, because there's no moving contacts, solid state relays can be switched much faster and for much longer periods without wearing out.

This particular SSR can switch current loads of up to 40A with a 3-32V DC input and a zero cross trigger control method. Each one of these relays is equipped with four screw terminals (for use with ring or fork connectors) and a plastic cover that slides over the top of the relay to protect the terminals.

Figure-3: Typical SSR (Solid-state-relay)

The SSR is basically a circuit with various electronic components that has the same function as an electromechanical relay. The advantage of using SSR is that it doesn't have moving parts so it lasts longer and doesn't make any noise. So if your project needs silent operation then you can use SSR or a solid relay. The circuit diagram of a SSR is given below.

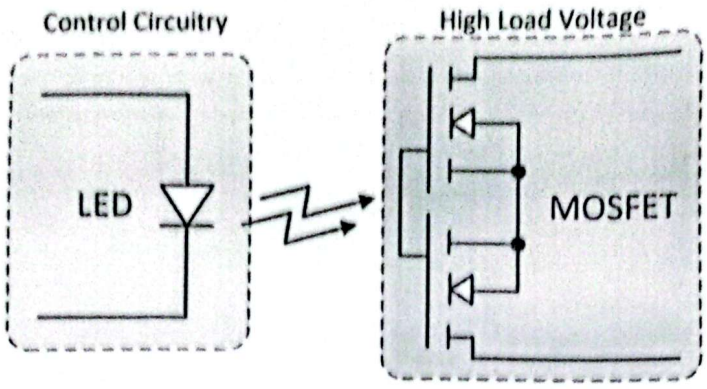

Figure: Block diagram of a Solid State Relay

d) **Latching Relay:** Latching relays are also called impulse relays. They work in the bistable mode, and thus have two relaxing states. They are also called keep relays or stay relays because as soon as the current towards this relay is switched off, the relay continues the process that it was doing in the last state. This can be achieved only with a solenoid which is operating in a ratchet and cam mechanism. It can also be done by an over-center spring mechanism or a permanent magnet mechanism in which, when the coil is kept in the relaxed point, the over-center spring holds the armature and the contacts in the right spot. This can also be done with the help of a remanent core.

In the ratchet and cam method, power consumption occurs only for a particular time. Hence it is more advantageous than the others.

e) **Polarized Relay:** These types of relays have been given more importance in the contacts. In order to protect them from atmospheric protection they are safely kept inside a vacuum or inert gas. Though these types of relays have a very low switching current and voltage ratings, they are famous for their switching speeds.

f) **Buchholz Relay:** This relay is actually used as a safety device. They are used for knowing the amount of gas present in large oil-filled transformers. They are designed in such a way that they produce a warning if it senses either the slow production of gas or fast production of gas in the transformer oil.

g) **Overload Protection Relay:** As the name implies, these relays are used to prevent the electric motors from damage by over current and short circuits. For this the heating element is kept in series with the motor. Thus when over heat occurs the bi-metallic strip connected to the motor heats up and in turn releases a spring to operate the contacts of the relay.

h) **Mercury Wetted Relay:** This relay is almost similar to the reed relay explained earlier. The only difference is that instead of inert gases, the contacts are wetted with mercury. This makes them more position sensitive and also expensive. They have to be vertically mounted for any operation. They have very low contact resistance and so can be used for timing applications. Due to these factors, this relay is not used frequently.

i) **Machine Tool Relay:** This is one of the most famous industrial relay. They are mainly used for the controlling of all kinds of machines. They have a number of contacts with easily replaceable coils. This enabkesthem to be easily converted from NO contact to NC contact. Many types of these relays can easily be setup in a control panel. Though they are very useful in industrial applications, the invention of PLC has made them farther away from industries.

j) **Contactor Relay:** This is one of the most heavy load relay ever used. They are mainly used in switching electric motors. They have a wide range of current ratings from a few amps to hundreds. The contacts of these relays are usually made with alloys containing a small percentage of silver. This is done so as to avoid the hazardous effects of arcing. These type of relays are mainly categorized in the rough use areas. So, they produce loud noises while operated and hence cannot be used in places where noise is a problem.

k) **Solid State Contractor Relay:** These relays combine both the features of solid state relays and contactor relays. As a result they have a number of advantages. They have a very good heat sink and can be designed for the correct on-off cycles. They are mainly controlled with the help of PLC, micro-processors or microcontrollers.

Factor for Selecting an Appropriate Relay:

1. The voltage and current needed to energize the coil.
2. The maximum voltage which we will get at output.
3. Number of armature.
4. Number of contacts for the armature.
5. Number of electrical contracts (N/O and N/C).

Micro C Code:

```
void main()
{
   TRISB=0x00;
   PORTB=0x00;
        while(1)
        {
                portb.f0 = 1;   //Turn on relay
                delay_ms(3000); //3s delay
                portb.f0 = 0;   //Turn off relay
                delay_ms(3000); //3s delay
        }
}
```

Circuit diagram & Simulation in Proteus ISIS:

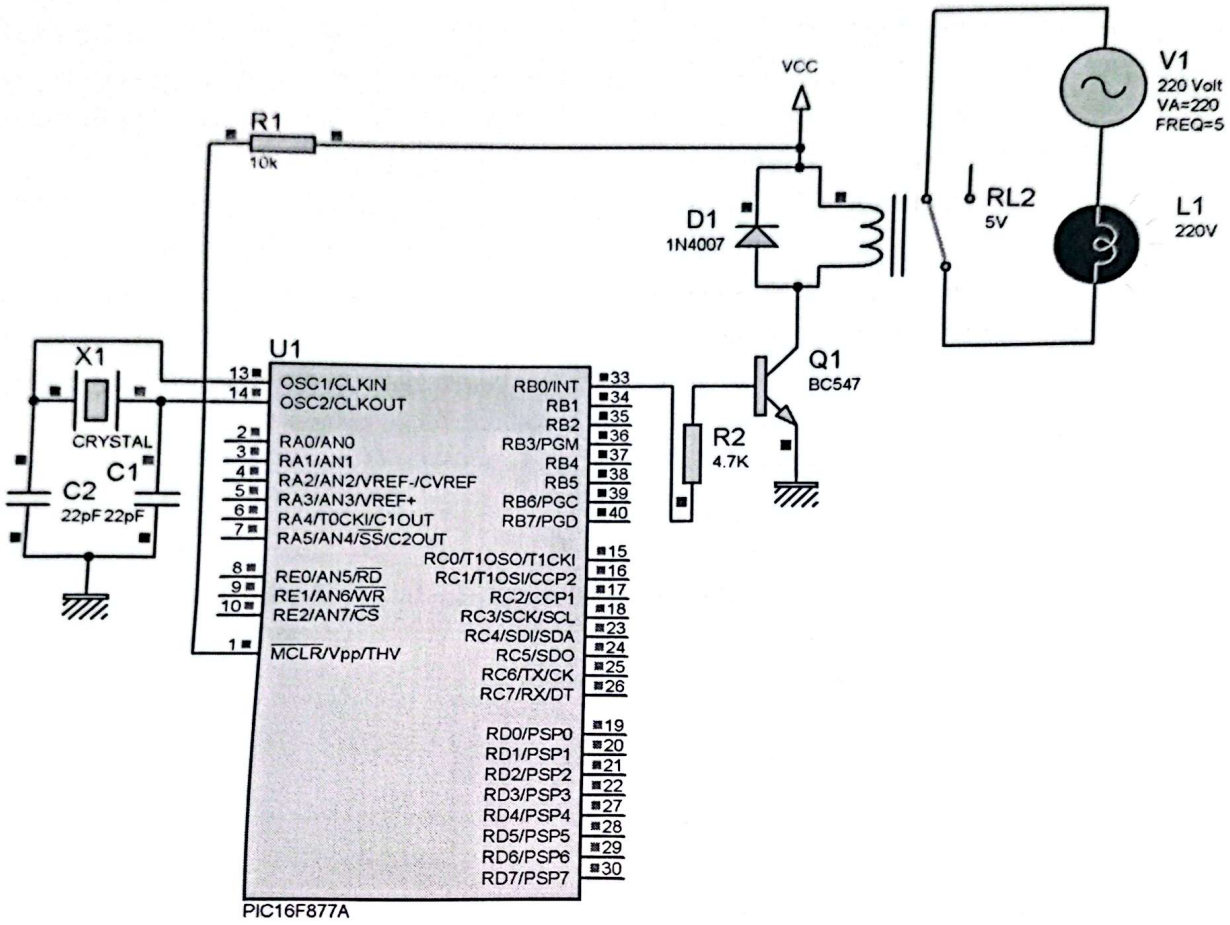

Figure-4: Relay in ON state & the lamp will glow for 3000 ms.

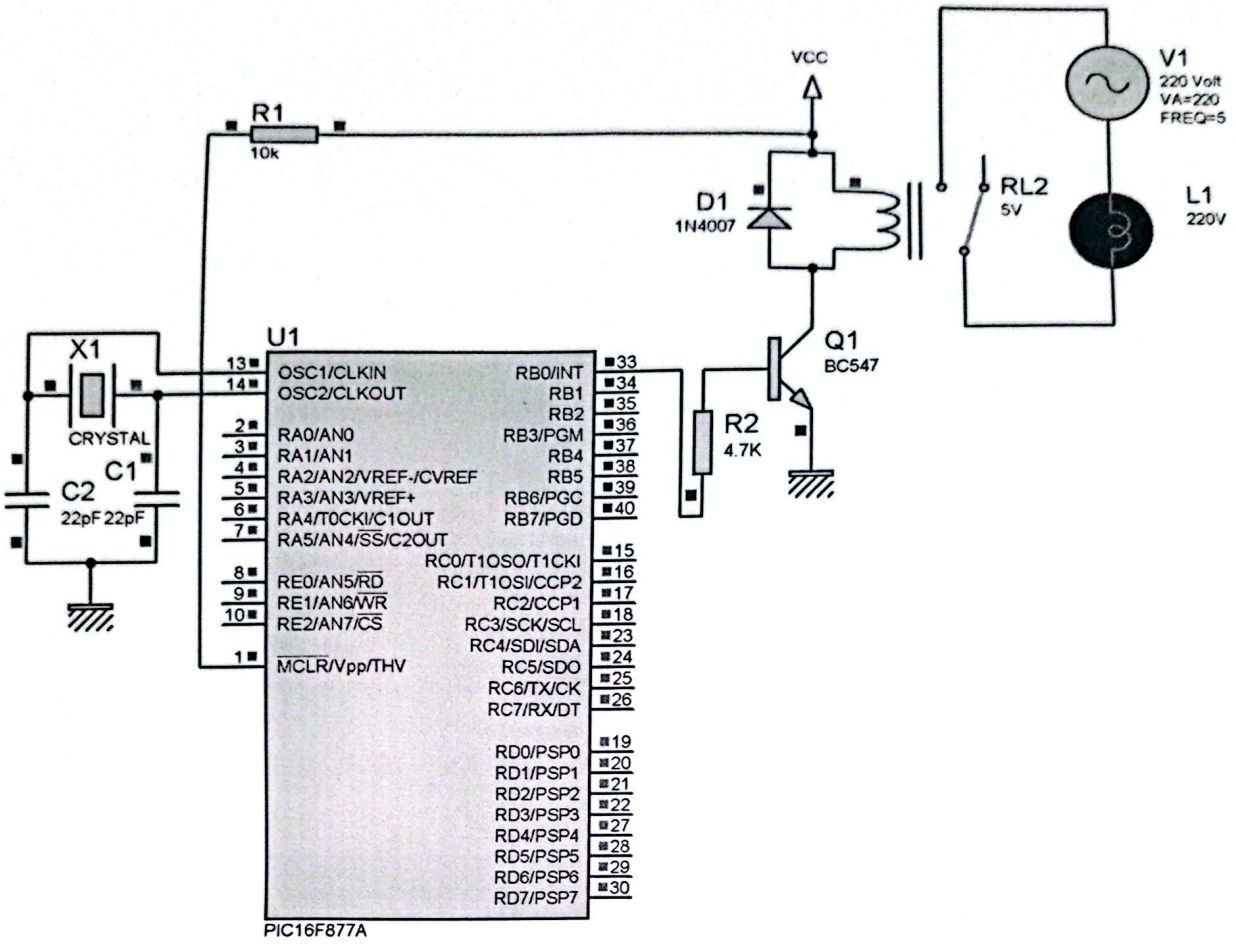

Figure-5: Relay in OFF state & the lamp will not provide light for 3000ms.

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