Relays

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Relays, Relays, Relays.... This article will help you decide the type of relay to use on your next project.

I have seen a great many projects dealing with microcontrollers and a good many use some sort of relay to power a larger device such as a motor, light or some other power hungry device.

Why do people use relays?

They are large, noisy, mechanical devices. Being mechanical, are subject to failure more often than semiconductor devices. Years ago when I was in the Air Force, I worked on a beast called an Automatic Electric Switch. This beast had thousands of relays, and 80% of the work force was devoted to repairing and replacing them. I have spelled out why you should not use a relay. Let us examine why people do use them. One reason is that they are cheap and very easy to get your hands on. You can pick up a number of different types in any Radio Shack. They are easy to use. You don't need a degree in engineering to figure out how to use one. One other largely overlooked advantage is that a relay isolates your microcontroller circuit from the potentially dangerous voltages. Also relays are fire and forget when connected to a microcontroller output pin there is no need to pulse or otherwise control the relay until you are ready to turn it off. While there are many different types and sizes of relays, we will talk about only four types in this paper: The general purpose relay, reed relay, low signal relay, and the Solid State Relay. All have their advantages and limitations.

Reed Relay

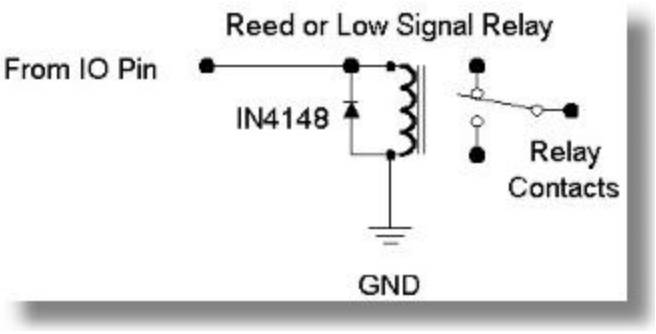
The reed relay consists of a coil of wire. Inside the coil are two or three small magnetic conductors sealed in a small glass tube. When the coil is energized, the small magnetic conductors move very slightly and make or break contact. Since the movement is so slight this gives the reed relay very distinct advantages over its larger counterpart.

- It takes very little power to energize.
- Higher speeds can be achieved because the contacts don't travel very far.
- There are a lot less moving parts on the reed relay. And since they are sealed, failure is minimized.
- Reed relays can be quite small.
- They are very quiet.

What are the disadvantages for the reed relay?

- They cannot control very large loads due to the size of their contacts.
- You won't find multi-poled reed relays.

Because the reed relay requires very little power to energize, you won't need a driver in most cases.



Normally you just connect one side of the coils to GND and the other to the I/O pin on the microcontroller. Just watch out for the contacts. In most cases you are limited to 1Amp at 120vac.

General Purpose Relay

Most relays fall into this category. This relay consists of a coil of wire with a ferrous metal in the center. A small hinged and spring loaded piece of ferrous metal floats slightly above one end of the metal in the center of the coil. When energized the metal in the center of the coil becomes magnetic and draws the floating metal towards it. This in turn causes multiple contacts to make and break.

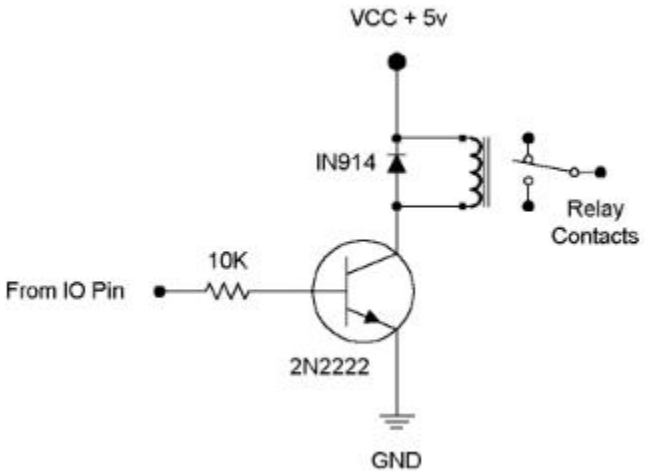
There are two major advantages to these larger relays.

- They can control multiple contacts
- They can handle very large loads

And the major disadvantages:

- They are large
- They require a driver circuit
- There are more moving parts which makes them more susceptible to failure

Let's look at a driver circuit for this larger relay.



As you can see, you are going to need a few extra parts for this relay. Just about any general purpose NPN transistor will work. The diode is used to keep the reverse voltage from destroying the transistor when the field collapses. You may need to replace the 10k resistor with a 1k in some cases.

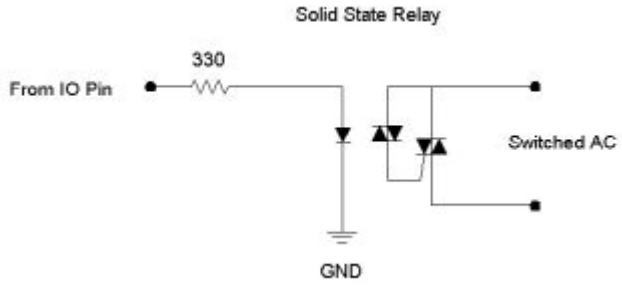
A note about the resistor. At voltage above 9 volts or so I have found the actual transistor type is important. For example at 14v the transistor will saturate and overheat. In many cases a TIP 41c (Jameco part # 179871) will work in most cases.

Low Signal Relay

Also known as PCB Relays or Telcom Relays. These relays offer the advantages of the reed relay but also sport multiple contacts and up to 2 amps of contact ratings. Some can be powered directly from the microcontroller. The ones shown here offer low signal input at 12ma and sport 1 amp at 30vdc and .5 amps at 125vac. They are DPDT so can be used to drive a small to medium sized robot. All this in a ultra small package. This particular relay can be found at Digi-Key, Part #255-1001

Solid State Relay

The Solid State Relay comes in many forms. I don't like the DC relays as they have too much resistance when turned on. However the AC relays work very nice. The one here was designed to control 120VAC up to 3A. Think of the input as a led as in most cases that's what fires the internal circuit. This particular relay will draw about 8ma when activated.



One disadvantage of this relay is cost. Solid State Relays can cost any where from $5 to $100.

Before I close, let me say a few things about reed and solid state relays. The microcontrollers that we are using can only source or sink about 25ma per pin. In addition, the total load of all the pins also have limitations. For example the PIC16F628 total load on Port A and Port B combined is 200ma. Look for a reed relay that has a coil resistance between 250 and 600 ohms at 5v.

One last thing. Some reed relays and low signal relays have built in diodes but most do not. If you are not sure it may be wise to add them. This will keep you from blowing up your microcontroller chip when the magnetic field collapses when the relay is switched off. Just tie a small switching diode across the coil. Cathode to the positive supply.

0 comments

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