

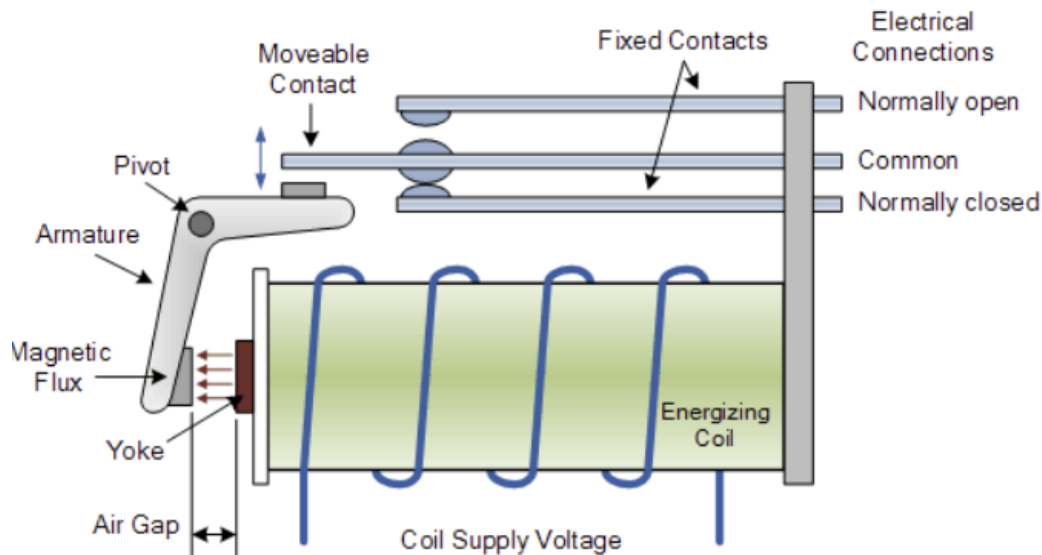
Arduino - Relay

Relay modules are essential components in many control and automation systems. They are components that have the ability to switch on and off larger loads using a lower input power. In most laboratories, relays are used to control pumps and other timed equipment. Additionally, they are widely used in various fields such as industrial control systems, home automation (lights, fans), automotive electronics (ignition, fuel pumps), and telecommunications, among others.

Relay modules have many advantages over traditional switches. They have the ability to isolate the electrical components. This is useful for applications where the circuits are connected to multiple paths. Relays can also handle high voltage and high current loads, making them ideal for use in power control applications.

How the relay works

The basic structure of a relay module is comprised of an electromagnet, a spring-loaded armature (coil), and a set of normally open (NO) and normally closed (NC) contacts. The two inputs are low trigger and high trigger. The outputs are the open and closed contacts.



Detailed look into a relay. Note the coil and the armature used to energize and de-energize.

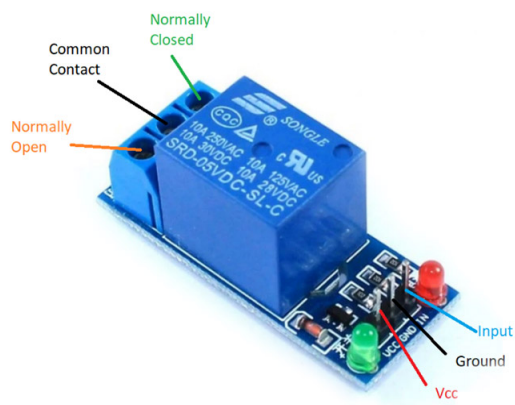
When there is no voltage applied across the coil, the switch is open and the device is inactive. Once a sufficient voltage is applied across the coil, the switch closes and the device turns on. This is the case for a high level trigger that is normally open. The opposite is true for high level trigger in a normally closed case.

Essentially, when the electromagnet is energized, the coil is attracted towards the electromagnet, causing the normally open (NO) contacts to close and the normally closed (NC) contacts to open. This connects the load to the power source, thus switching the high voltage or high current circuit. When the electromagnet is de-energized, the spring-loaded coil returns to its original position, disconnecting the load from the power source.

How to set up with arduino

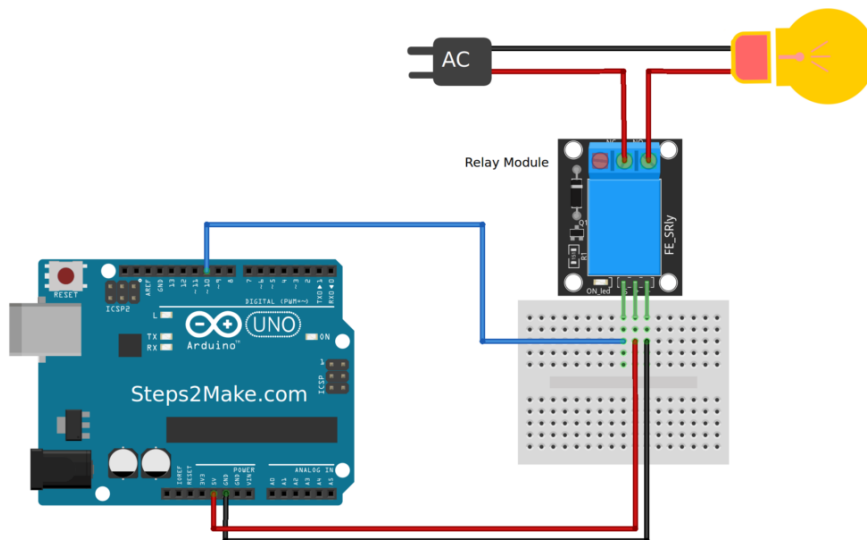
What you require to set up a flashing LED using a 1 channel relay module.

- 1) An Arduino Uno
- 2) 1 Channel relay module
- 3) 1 LED
- 4) A 5v External DC power supply
- 5) Jumper wires



Two different types of relays with same functionality

Wiring



Connection Outline

Take three jumper wires and connect Vcc, ground, and input ports to a breadboard. Using additional jumper wires follow the connections below.

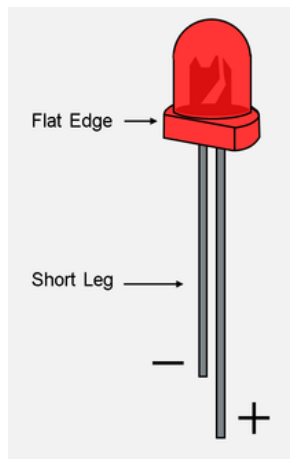
Relay → Arduino

Ground → Gnd

Vcc → 5 v

Input → any number 2-13. In this case 10 was used.

Now take your LED. This can be inserted into the breadboard or connected using jumper wires. The shorter end of the LED needs to be grounded and the longer side has to be connected to the normally closed (NC) port on the relay.



Taking your external power supply, connect the negative side to ground on the breadboard and positive to common contact (COM). Both the led and power supply ground can be connected to the same row used by the relay on the breadboard. As described above, we can determine the functionality of the relay by setting either NC or normally open (NO) to be the high level trigger. In this case we will be using NC.

Some Code

```
#define relayPin 10 // can define your own pin used
```

```
void setup() {  
  pinMode(relayPin, OUTPUT);  
}
```

```
void loop() {  
  digitalWrite(relayPin, LOW);  
  delay(10000); // how long you want it to stay in that position 1000=1second
```

```
digitalWrite(relayPin, HIGH);  
delay(10000);  
}
```

When setting the relayPin to low, there is 0V being sent to the relay keeping the light off. After 10 seconds, the arduino programs the pin to high (5v) making the LED turn on for 10 seconds. This will keep repeating until the user disconnects.

This code can be expanded upon as relays come with multiple channels and can be used to control many devices at once. There are also many different types of relays. In this example an electromechanical relay was used. Other types include Solid-State, reed, and hybrids of electromagnets and semiconductor materials.

Further Applications

Relay modules offer many advantages. One of the largest advantages is the simplicity of using them. They can be controlled easily with just a coil voltage, as opposed to alternate approaches, such as having a complicated circuit with a mosfet and gate driver acting as a switch. Alternate benefit of the cost effective nature of this solution, making it good for high quality industrial applications. Some downsides of the relay is that switching speeds are slower compared to a mosfet based approach. Hence, the relay can not be used for an application such as a BLDC motor driver, where high switching speeds are required to drive the motor. Another disadvantage is the excessive sizing of this device.

Overall relays are best fit for applications where simplicity/ cost effectiveness is desired in non-fast switching applications. Relay modules play a crucial role in many control and automation systems due to their reliability, durability, and versatility. They provide an electrically isolated and controlled means for switching high voltage or high power circuits. With the advancements in technology and the growing demand for automation and control systems, relay modules are likely to play an even more important role in the future.

- 1) http://wiki.sunfounder.cc/index.php?title=4_Channel_5V_Relay_Module
- 2) <https://components101.com/switches/5v-single-channel-relay-module-pinout-features-applications-working-datasheet>
- 3) <https://www.mroelectric.com/blog/how-does-a-relay-work/>
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3 sources and 750 words

767 w/o code

855 w/ code