



#### Arduino Uno:

OUTPUT I/O Pin can Supply: 0V or 5V

**Maximum DC Current per I/O Pin: 40mA**

**Each Arduino Uno OUTPUT I/O Pins can only supply 0V or 5V to the connected device**

**Issue 1:** The devices that requires other than 0V/5V, will not work with the 0V/5V Arduino OUTPUT I/O Pins

**Each Arduino Uno OUTPUT I/O Pins can only handle 40mA**

**Issue 2:** The devices that requires more than 40mA, will not work with the 40mA limit at the OUTPUT I/O Pins

**We CANNOT connect devices that is not using 5V or 0V and devices that requires more than 40mA directly to any Arduino Uno OUTPUT I/O Pins**

**Is this “The End” for Arduino Uno with device which requires other than 5V or 0V and requires more than 40mA ?**

Not really, it is NOT the end yet

We can still control those devices from Arduino Uno by using “middle-man” hardware devices, one of them is a “Relay”

- Lets look at an Example -  
Mini DC Motor

**Arduino Uno:**

OUTPUT I/O Pin can Supply: 0V or 5V

**Maximum DC Current per I/O Pin: 40mA**

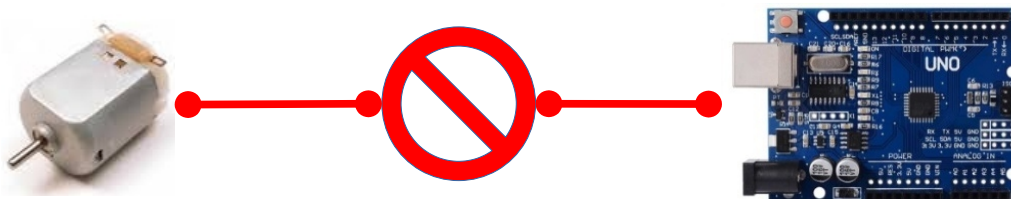


**130 Type Mini DC motor:**

Operating Voltage: 3V to 6V

**No-Load Current: 70mA**

**Loaded Current: 250mA**

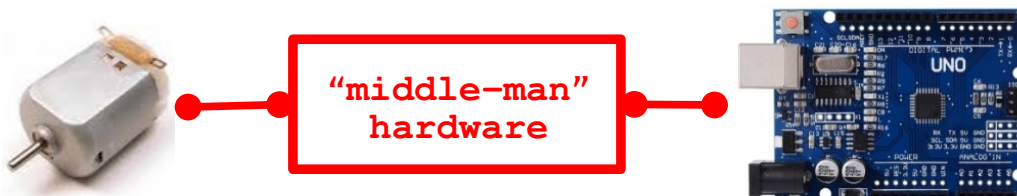


5V from Arduino Uno OUTPUT I/O Pin is fine for the DC-Motor  
**BUT**

**40mA Current Limit at the Arduino Uno OUTPUT I/O Pin is NOT enough  
for the DC-Motor**

**Motor is required for "motion". No motion, No Robotics**

**What do we do now ?**



The **"middle-man" hardware** usually have distinct physical parts in them.

**Arduino Part:** Uses 5V or 0V and less than 40mA. The connectors on this part is connected to the Arduino Uno Pins

**Device Part:** The connectors on this part is connected to devices that requires more than 5V or more than 40mA Current, they will not take power from Arduino Uno, they are connected to a separate Power Supply which can give them other than 0V/5V and more than 40mA

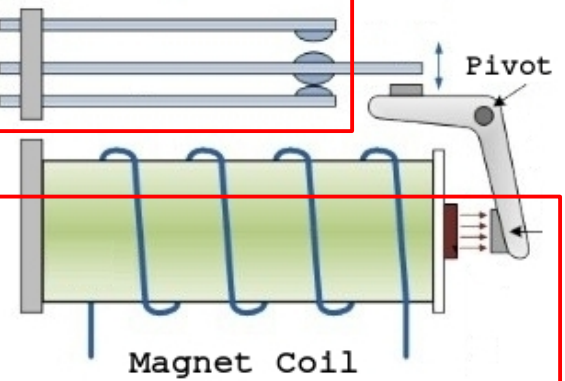
Example of a "middle-man" hardware: A Relay  
there are others...



## Raw Relay Device



NO - Normally Open  
Common  
NC - Normally Closed



**"Device Part"** is connected to Devices that is using its own Power Supply

**"Arduino Part"** does not require high voltage or Current, The **Arduino OUTPUT I/O Pins** will have enough Voltage and Current to energize the **Magnet**

## On the "Device Part",

When there **IS NO POWER** supply to the **Coil**, magnet is disabled.

**"Common"** and **"NC"** is **connected** while **"Common"** and **"NO"** is **disconnected**

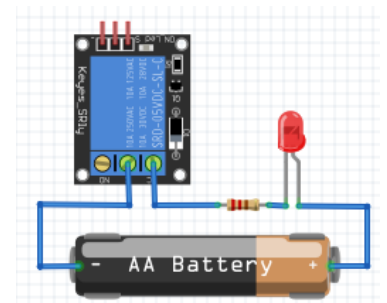
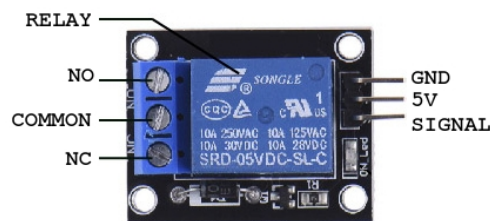
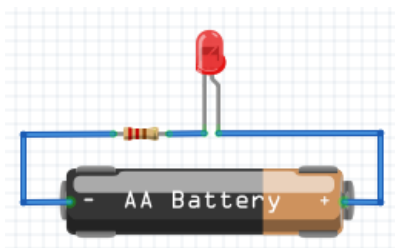
When there **IS POWER** supply to the **Coil**, magnet is enabled.

**"Common"** and **"NO"** is **connected** while **"Common"** and **"NC"** is **disconnected**

## Relay Modules

As you can see from the Raw Relay above, there is only a coil for the non-permanent magnet. When turn the magnet ON or OFF, the state of the high Power Part (similar to a SPDT switch). To turn the relay magnet ON/OFF from our Arduino OUTPUT I/O Pins with our PROGRAM, will require a few additional components. At minimum; a diode, resistor and a transistor.

That is what the Relay Modules in the picture below has,



**On the Left, LED is connected to the Battery Without Relay**

Power Supply -ve Terminal connect to Device -ve Terminal

Device +ve Terminal connect to Power Supply -ve Terminal

**On the right, LED is connected to the Battery With Relay**

Power Supply -ve Terminal connect to **"COM"**

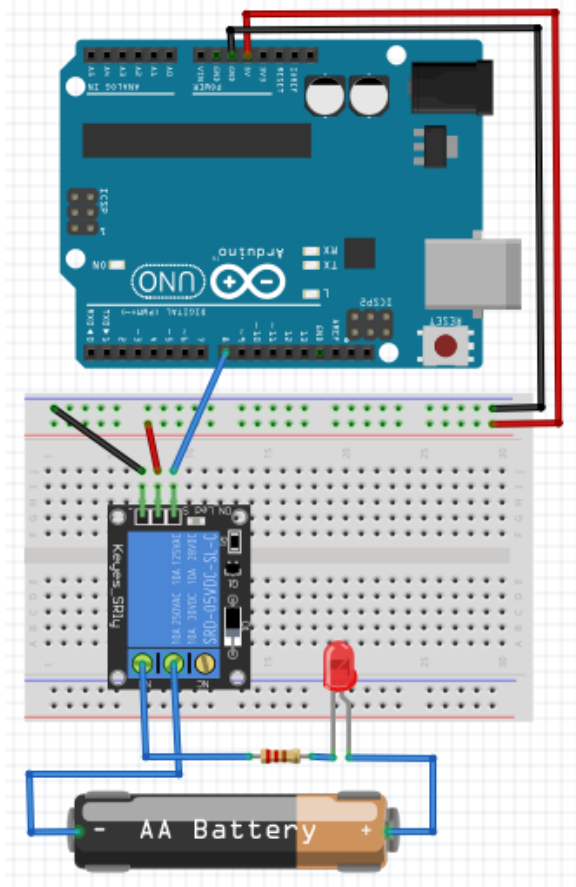
**"NC"** connect to Device -ve Terminal

Device +ve Terminal connect to Power Supply -ve Terminal

There is NO Arduino Uno yet in the picture above. The Relay can work without the Arduino Uno, it is just a SPDT Switch controlled by electro-magnet

## ATMEGA328/Arduino Uno - I/O Pin - OUTPUT - RELAY - LED

<https://github.com/teaksoon/lmaewapm>



1x Computer with Arduino IDE Software  
1x USB 2.0 Type A/B Data Cable  
1x Arduino Uno Board  
Jumper Wires

1x Solderless Breadboard  
1x 5mm bulb LED  
1x 220 Ohm resistor

1x Relay Module

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### Device Part:

Power Supply -ve Terminal to Relay Module "COM"

Relay Module "NO" to Resistor to LED -ve Terminal

LED +ve Terminal to Power Supply +ve Terminal

### Arduino Part:

Arduino Uno GND Pin to Relay Module GND Pin  
Arduino Uno 5V Pin to Relay Module VCC Pin  
Arduino Pin 8 Relay Module IN Pin

Program: io\_output\_relay\_led

```
uint8_t proc_ctr = 0;

void setup() {
  pinMode(8, OUTPUT);
  // OUTPUT I/O Pin default value = LOW
}

void loop() {
  if (proc_ctr < 5) {
    proc_ctr = proc_ctr+1;
    digitalWrite(8,HIGH); // Allow 5V into relay 'NO', 0V into relay 'NC'
    delay(1000);
    digitalWrite(8,LOW); // Allow 0V into relay 'NO', 5V into relay 'NC'
    delay(2500);
  }
}
```

This Program set I/O Pin 8 as OUTPUT Pin. Since the default Voltage for an OUTPUT Pin is 0V, 0V goes to the Relay Module "IN" Pin.. NO MAGNET

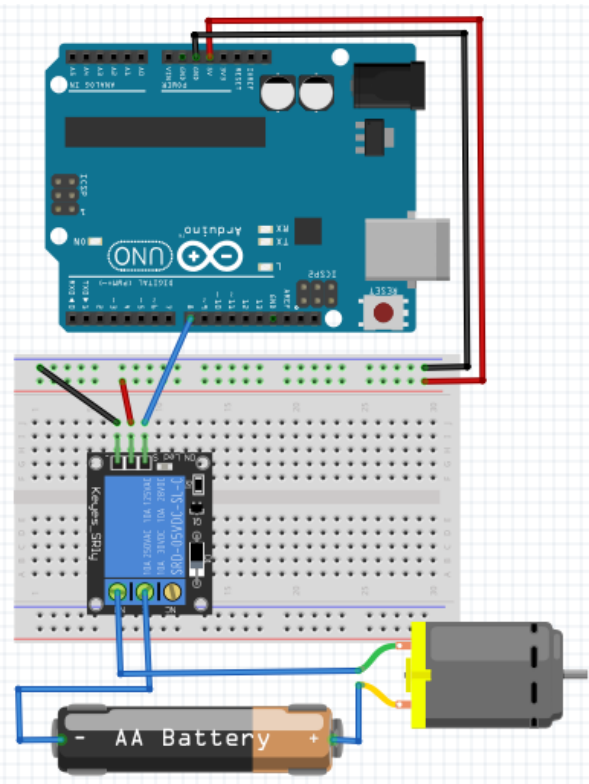
When Relay Module "IN" Pin received 5V(digitalWrite(8,HIGH)). The MAGNET is energized and Relay Module "NC" is connected to "COMMON". LED will get power supply from the Battery and the LED is turned ON

When Relay Module "IN" Pin received 0V(digitalWrite(8,LOW)). The MAGNET is no longer energized, NO MAGNET and Relay Module "NC" is disconnected from "COMMON". LED will not have any power supply from the Battery and the LED is turned OFF

From that, we will get the LED to display for 1 seconds, then turned off for 2.5 seconds, and will repeated for 5 times

## ATMEGA328/Arduino Uno - I/O Pin - OUTPUT - RELAY - DC-MOTOR

<https://github.com/teaksoon/lmaewapm>



1x Computer with Arduino IDE Software  
1x USB 2.0 Type A/B Data Cable  
1x Arduino Uno Board  
Jumper Wires

1x Solderless Breadboard  
1x DC-Motor

1x Relay Module

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### Device Part:

Power Supply -ve Terminal to Relay Module "COM"

Relay Module "NO" to DC-Motor -ve Terminal  
DC-Motor +ve Terminal to Power Supply +ve Terminal

### Arduino Part:

Arduino Uno GND Pin to Relay Module GND Pin  
Arduino Uno 5V Pin to Relay Module VCC Pin  
Arduino Pin 8 Relay Module IN Pin

Program: io\_output\_relay\_dc-motor

```
uint8_t proc_ctr = 0;

void setup() {
  pinMode(8, OUTPUT);
  // OUTPUT I/O Pin default value = LOW
}

void loop() {
  if (proc_ctr < 5) {
    proc_ctr = proc_ctr+1;
    digitalWrite(8,HIGH); // Allow 5V into relay 'NO', 0V into relay 'NC'
    delay(1000);
    digitalWrite(8,LOW); // Allow 0V into relay 'NO', 5V into relay 'NC'
    delay(2500);
  }
}
```

This Program set I/O Pin 8 as OUTPUT Pin

When Relay Module "IN" Pin received 5V(digitalWrite(8,HIGH). The MAGNET is energized and Relay Module "NC" is connected to "COMMON". DC-Motor will get power supply from the Battery and the DC-Motor Spins

When Relay Module "IN" Pin received 0V(digitalWrite(8,LOW). The MAGNET is no longer energized, NO MAGNET and Relay Module "NC" is disconnected from "COMMON". DC-Motor will not have any power supply from the Battery and the DC-Motor is turned OFF

From that, we will get the DC-Motor Spins for 1 seconds, then turned off for 2.5 seconds, and will repeated for 5 times

You will probably noticed that, this is exactly the same like the LED-Arduino Uno-Relay example. For LED we can connect directly to Arduino Uno BUT for **DC-Motor and other High Powered devices**, we have to do it this way because the Arduino I/O Pin cannot supply the Current required by this DC-Motor ( Instead of Relay, we can also use a transistor with DC-Motor - Make sure that the transistors "Current" specs allows it )