

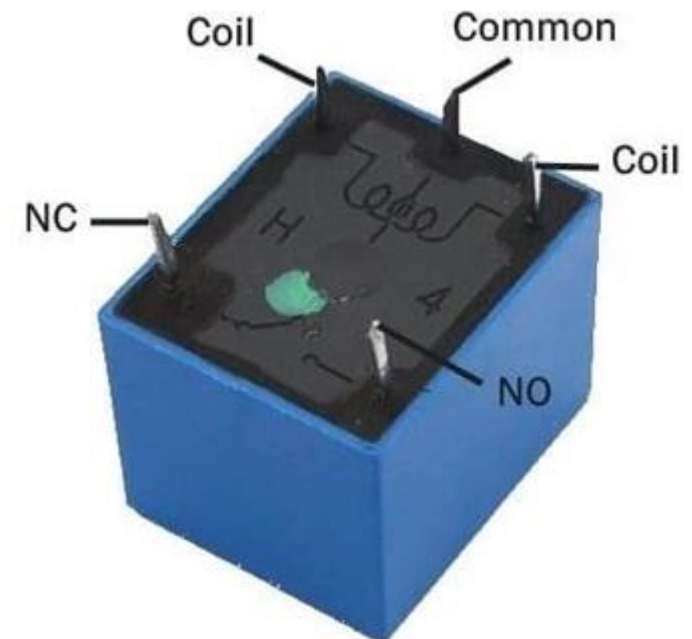
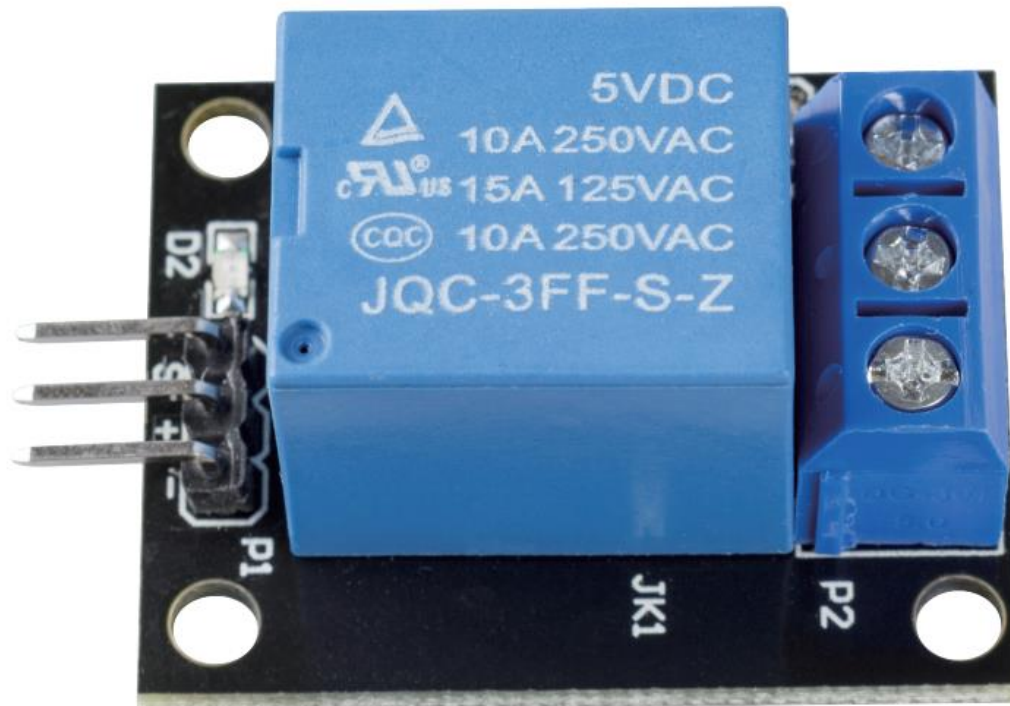
Modern IoT Technology

Introduction to Relay Switch

Relay Module

- The relay module is a module consisting of a relay and a simple circuit that can be used to control large voltage devices, such as household appliances, by outputting a low voltage such as 3.3V from the control board.
- Applications demand for switching and protection of their control circuits and other connected electrical loads and components
- For example, at the airport, relay switches conveyor belts, ensuring luggage moves efficiently. When a cart triggers a sensor, it send a signal to relay, which activates the belt's motor

Relay Module

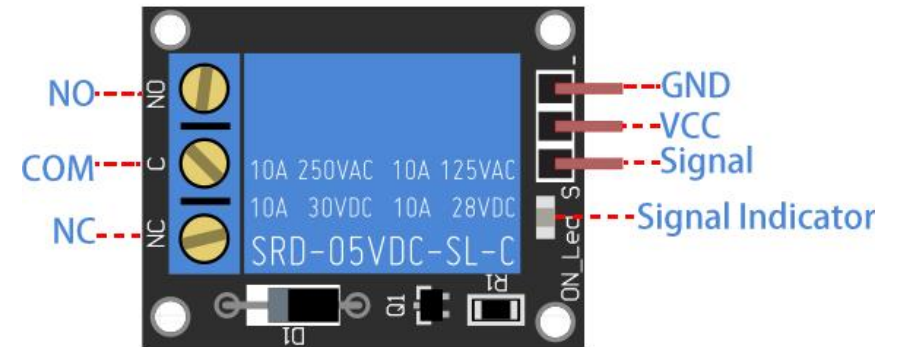


PINS OUT

• INPUT

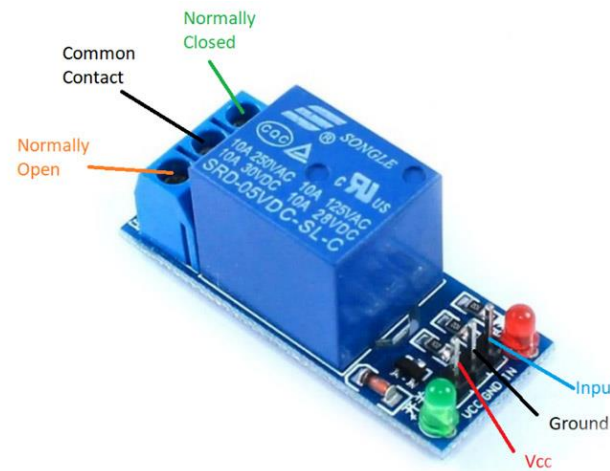
- -: GND
- +: VCC
- S: Signal pin, used to control this relay.

Input high and the relay closes, input low and the relay opens.

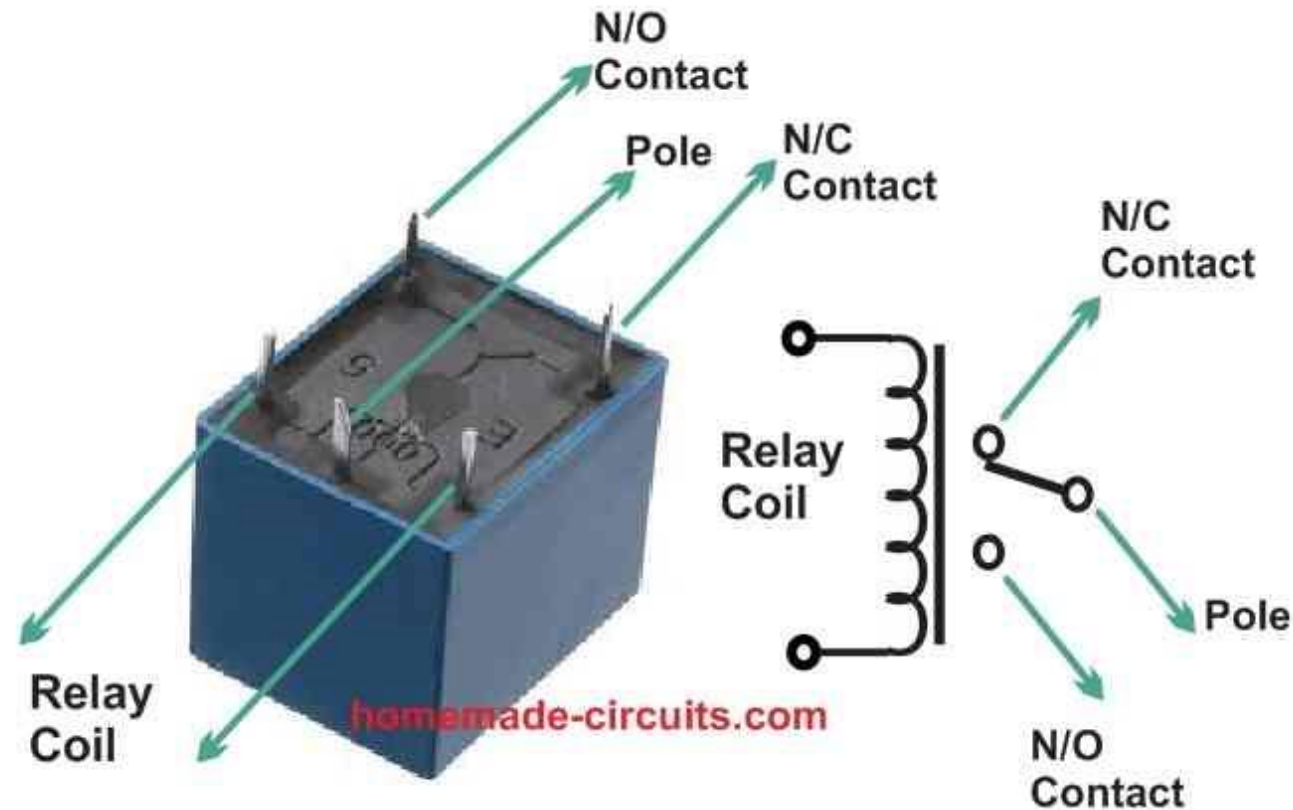


• OUTPUT

- **COM** - Common pin
- **NC** - Normally Closed
- **NO** - Normally Open



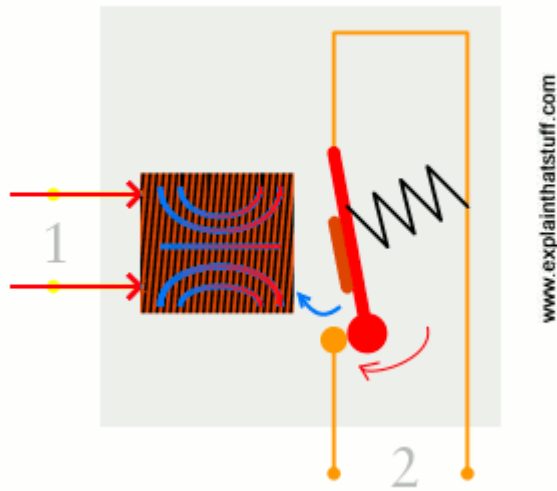
Relay components



N/C = Normally Closed
N/O = Normally Open

How relays work

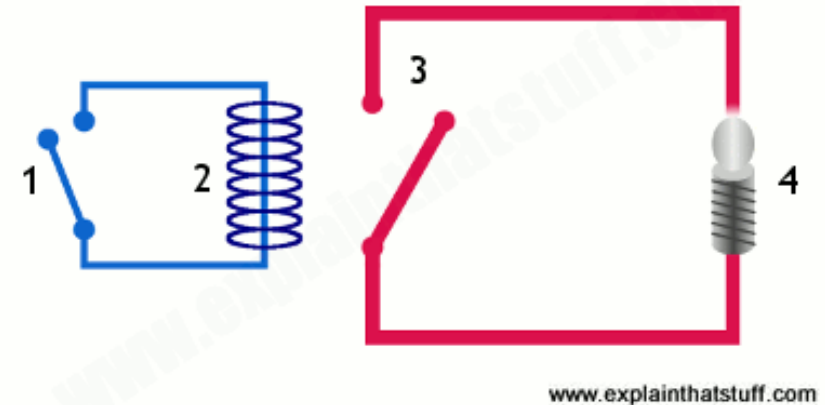
- When power flows through the first circuit (1), it activates the electromagnet (brown), generating a magnetic field (blue) that attracts a contact (red) and activates the second circuit (2). When the power is switched off, a [spring](#) pulls the contact back up to its original position, switching the second circuit off again.



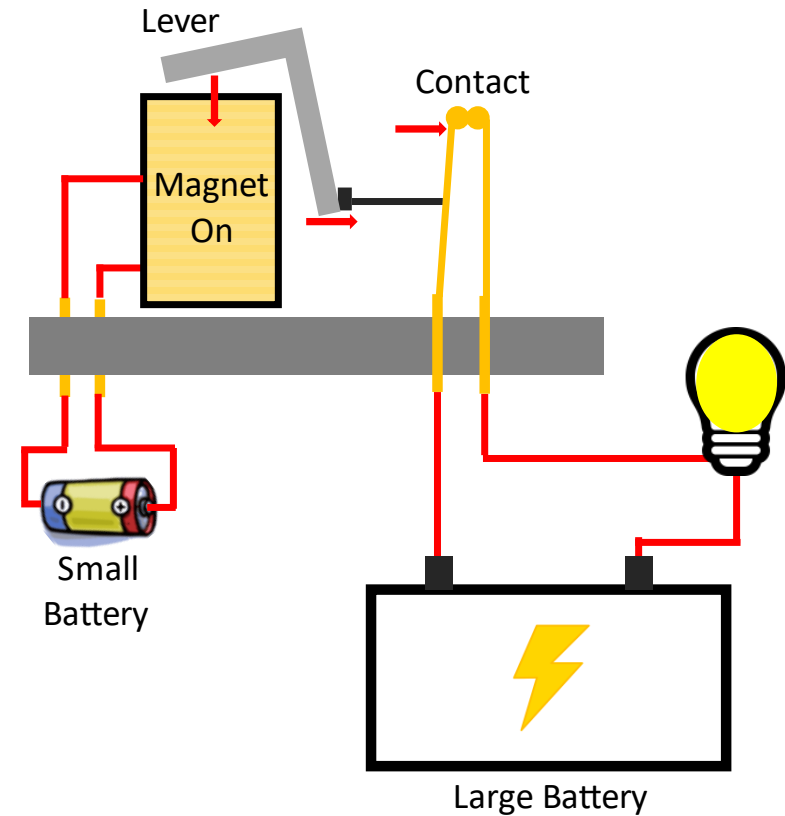
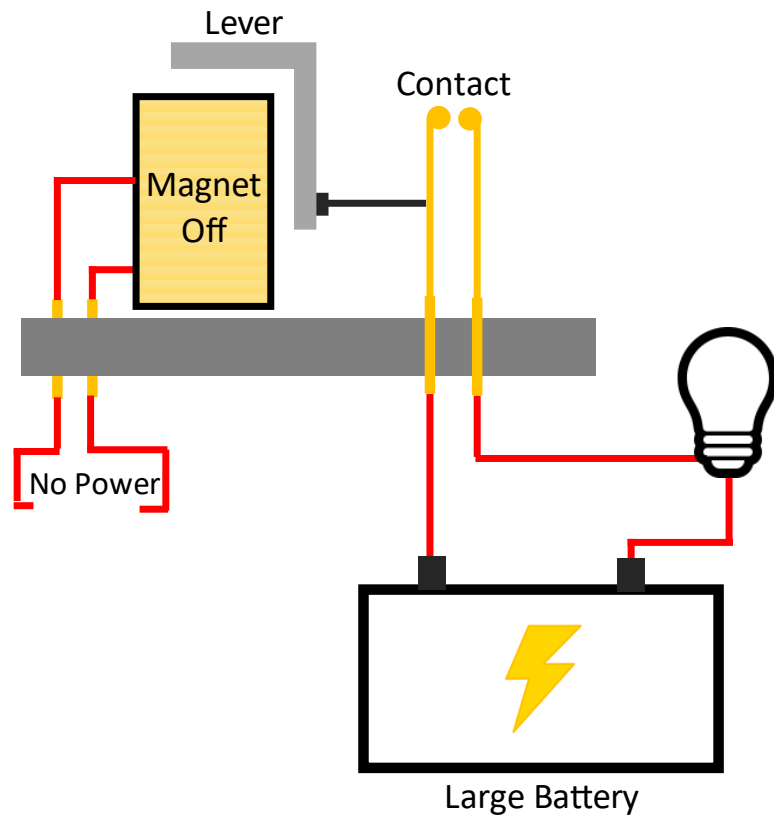
- A "normally open" (NO) relay: circuit are not connected by default
- A "normally closed" (NC) relay: the contacts are connected so a current flows through them by default)

How relays work

1. The input circuit (blue loop) is switched off and no current flows through it until something (either a sensor or a switch closing) turns it on. The output circuit (red loop) is also switched off.
2. When a small current flows in the input circuit, it activates the electromagnet (shown here as a dark blue coil), which produces a magnetic field all around it.
3. The energized electromagnet pulls the metal bar in the output circuit toward it, closing the switch and allowing a much bigger current to flow through the output circuit.
4. The output circuit operates a high-current appliance such as a [lamp](#) or an [electric motor](#).



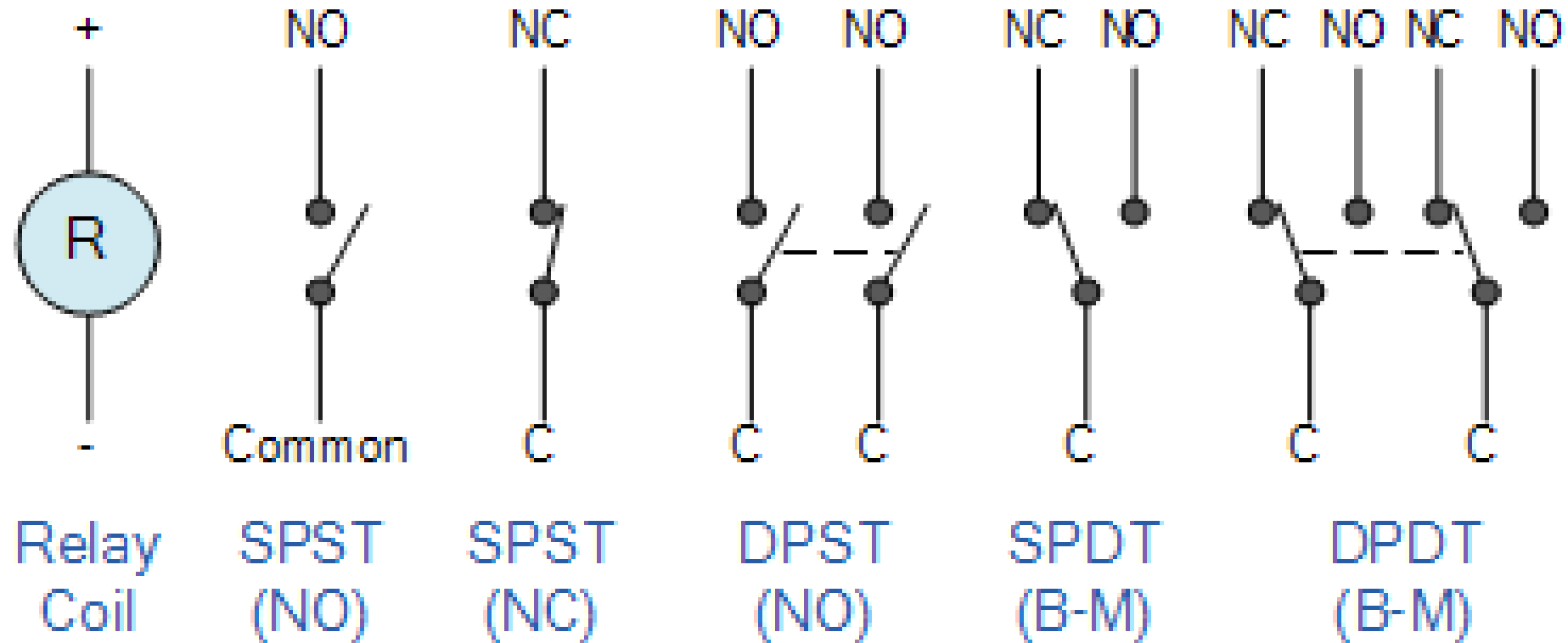
How a Relay activate a large Circuit



Electrical Relay Contact Types

- Normally Open (NO) and Normally Closed (NC)
- SPST – Single Pole Single Throw
- SPDT – Single Pole Double Throw
- DPST – Double Pole Single Throw
- DPDT – Double Pole Double Throw

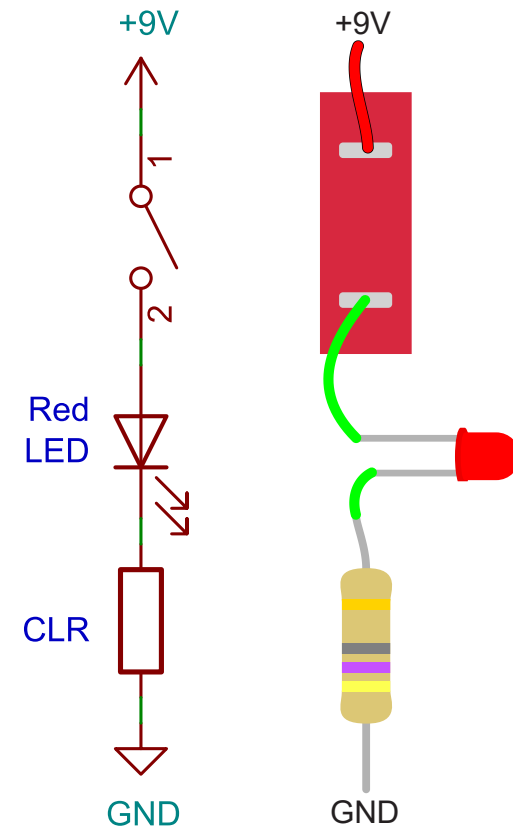
Electrical Relay Contact Types



“Single Pole Double Throw – (Break before Make)”, or SPDT – (B-M)

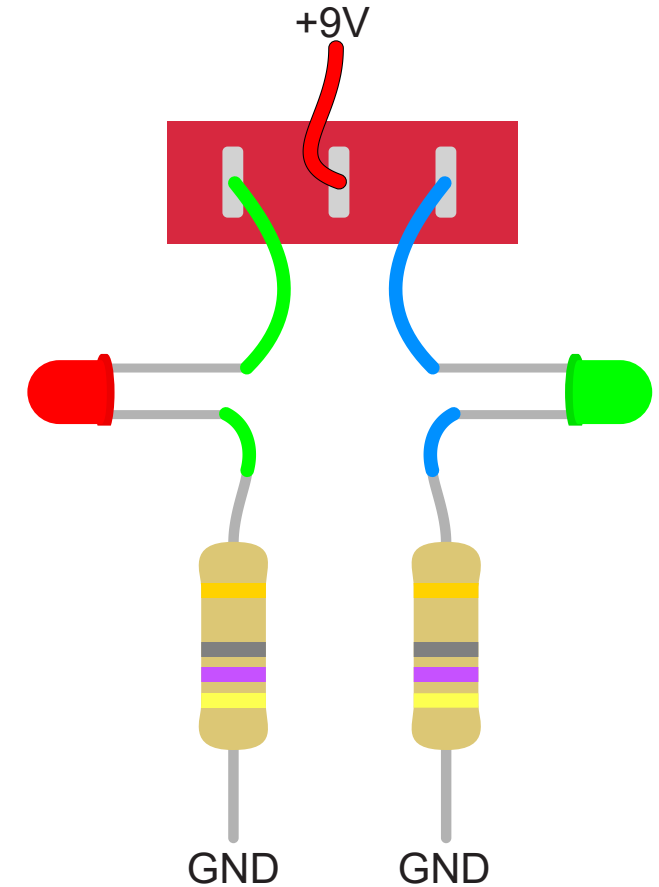
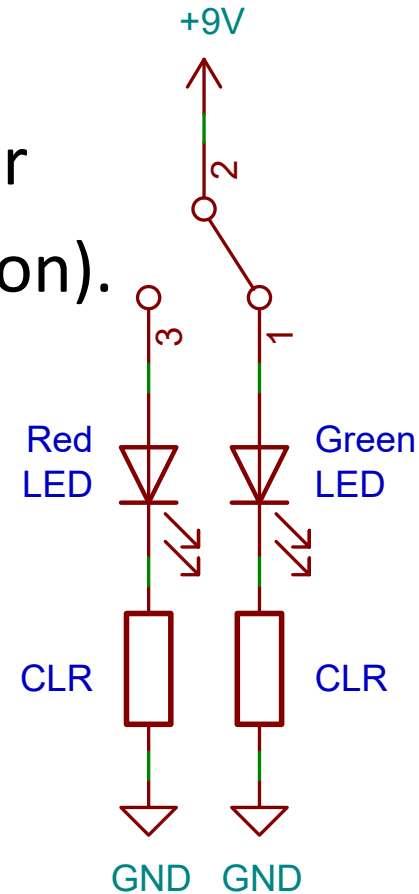
Single Pole, Single Throw switch

- SPST switch has one throw - through the red LED and current-limiting resistor (CLR) to ground
- The switch is connected, causing the LED to light up
- Or disconnected, causing an open circuit and the LED to turn off.



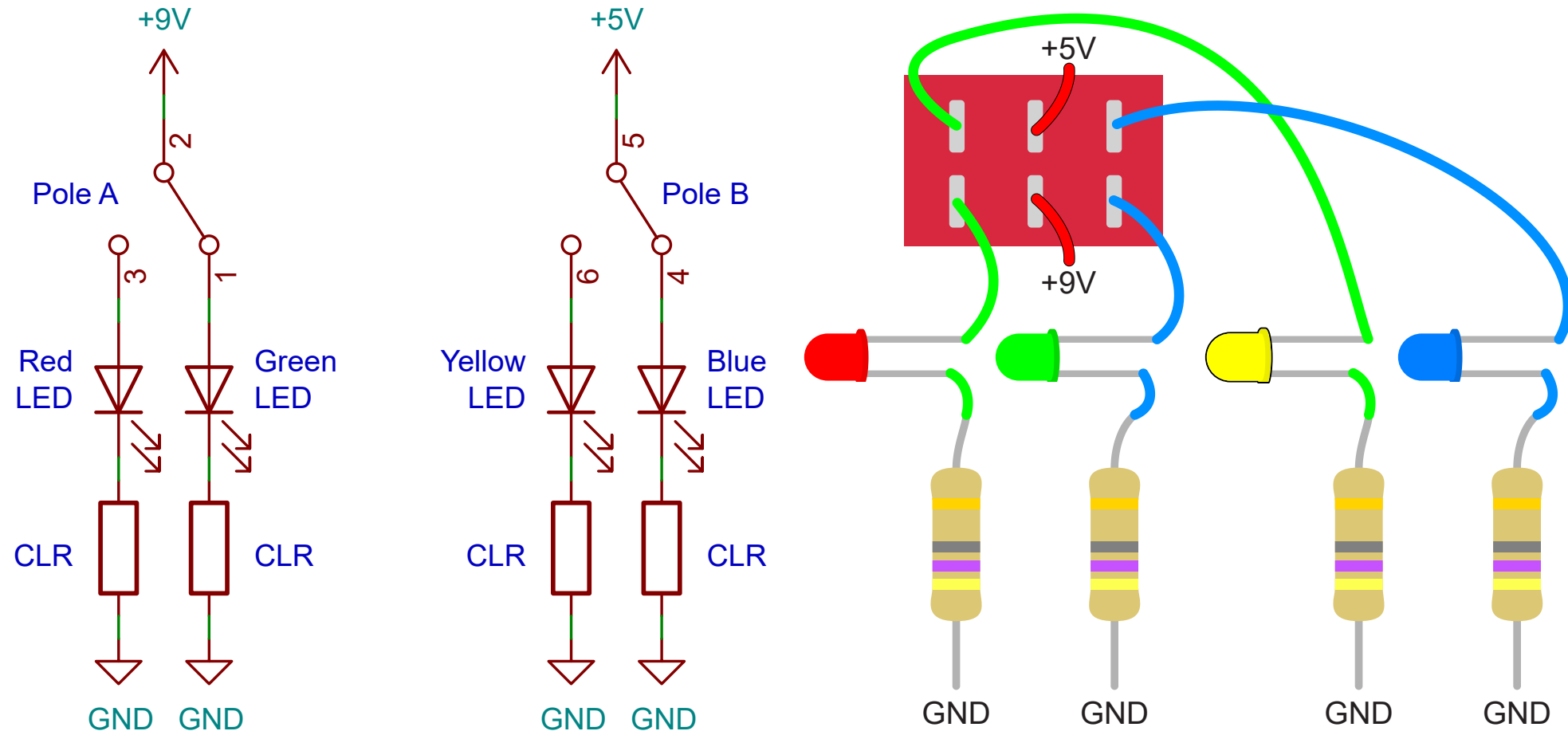
Single Pole, Double Throw switch

- A SPDT can either be connected to one output circuit (red LED on) or connected to the other (green LED on).

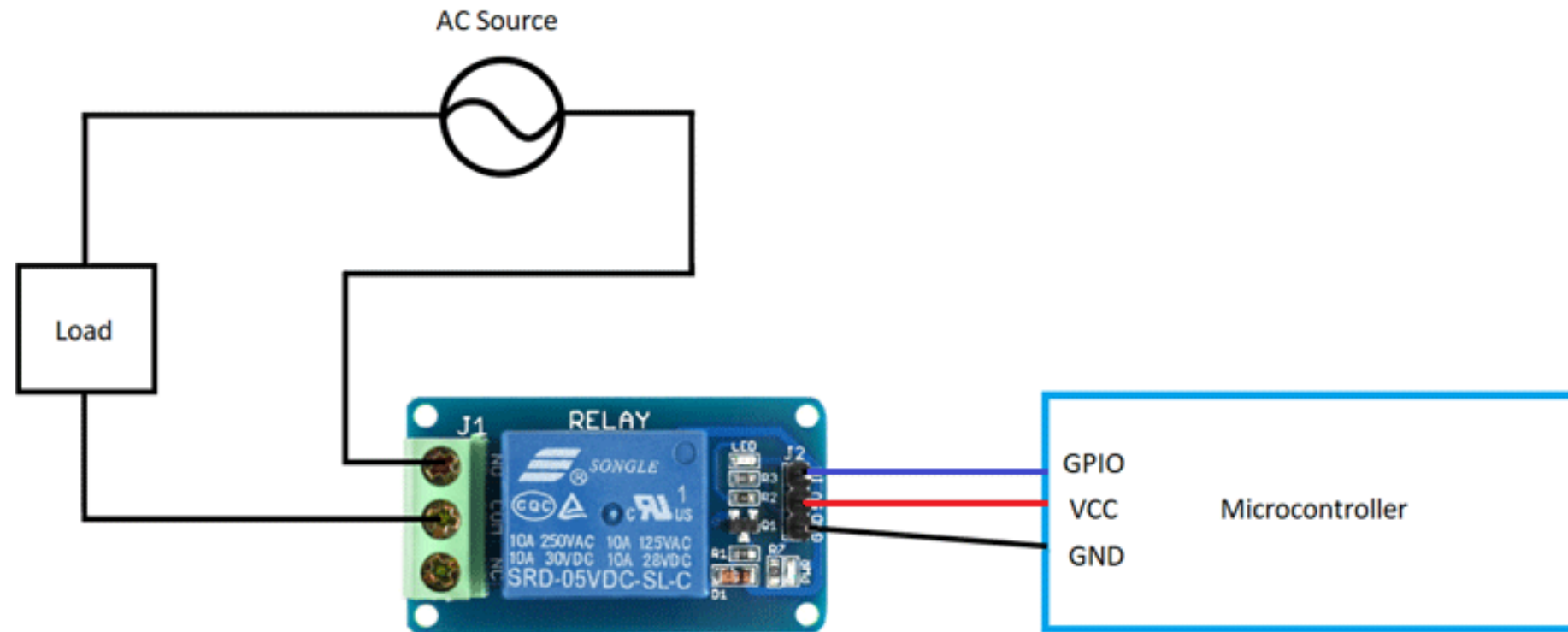


Double Pole, Double Throw switch

Two circuits are being controlled, the routing of +9V and the routing of +5V (double pole)



Relay wiring diagram



Exercise

- Control the relay with the ESP32, use a relay switch module to turn on and off an LED light.

1. Gather the Components

- Channel Relay Module
- Microcontroller (e.g., ESP32)
- LED
- Resistor (220 Ohm or similar)
- Breadboard and connecting wires

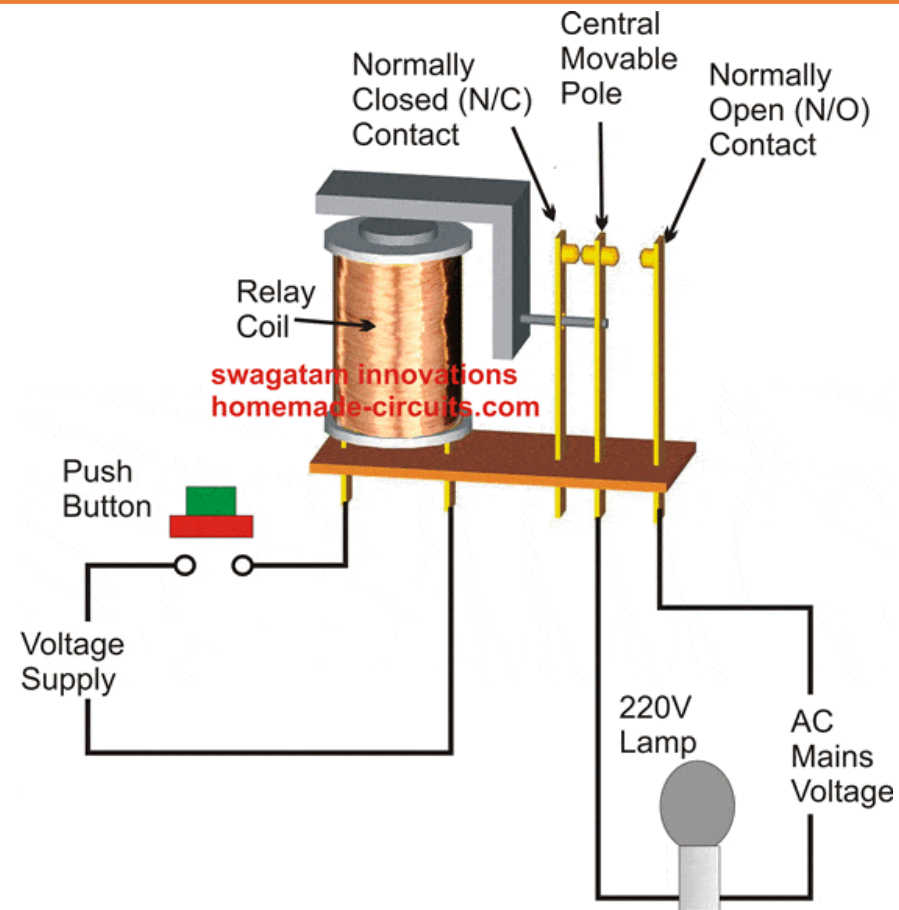
Code

```
from machine import Pin
import time

# Setup Relay (Adjust Pin number if
# needed)
relay_pin = Pin(23, Pin.OUT)
relay = Pin(relay_pin)

# Test the relay
relay.value(1) # Activate relay
time.sleep(1)
relay.value(0) # Deactivate relay
```


Exercise



Exercise

- In an automatic fan control system, an SPDT relay is used to switch a fan ON when the temperature exceeds 30°C and OFF otherwise. A temperature sensor provides a HIGH signal (5V) to energize the relay when the temperature exceeds 30°C .