

ENGR 3421: Robotics I

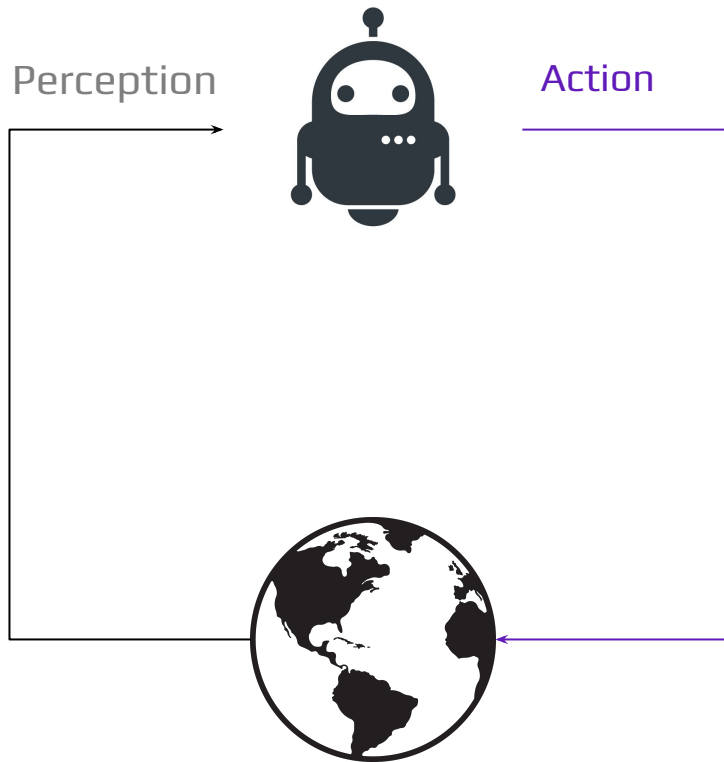
Motors Spin-Up

09/05/2023

Outline

- DC Motor
- Servo Motor

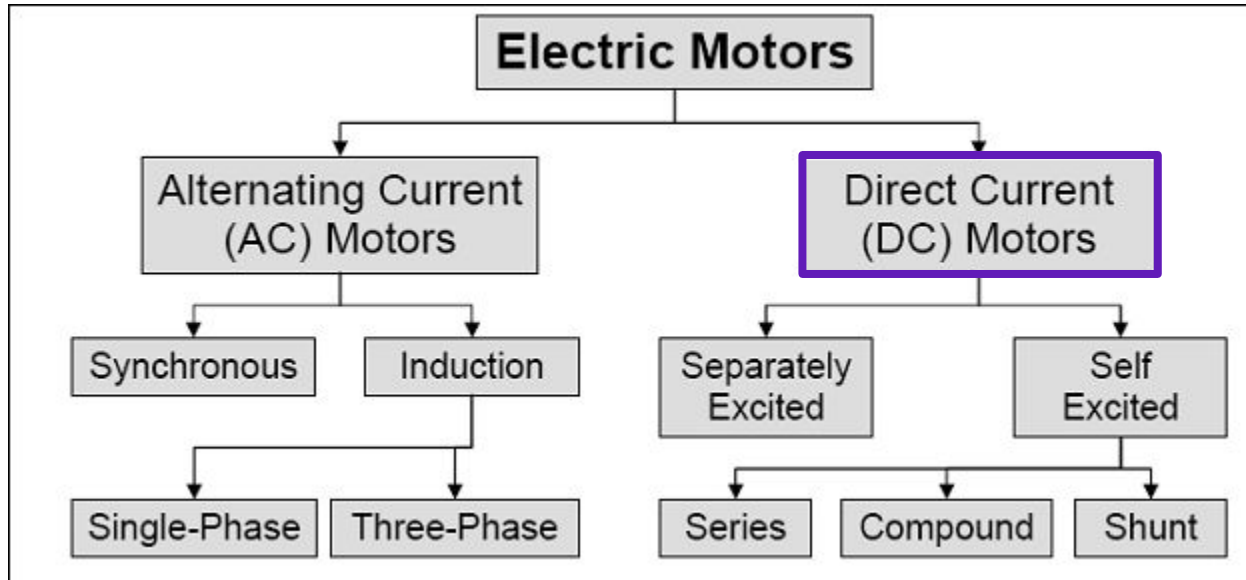
A Robot Needs to Move



Actuators

- Motors
- Hydraulic Actuators
- Pneumatic Actuators
- Solenoids
- Artificial Muscles
- ...

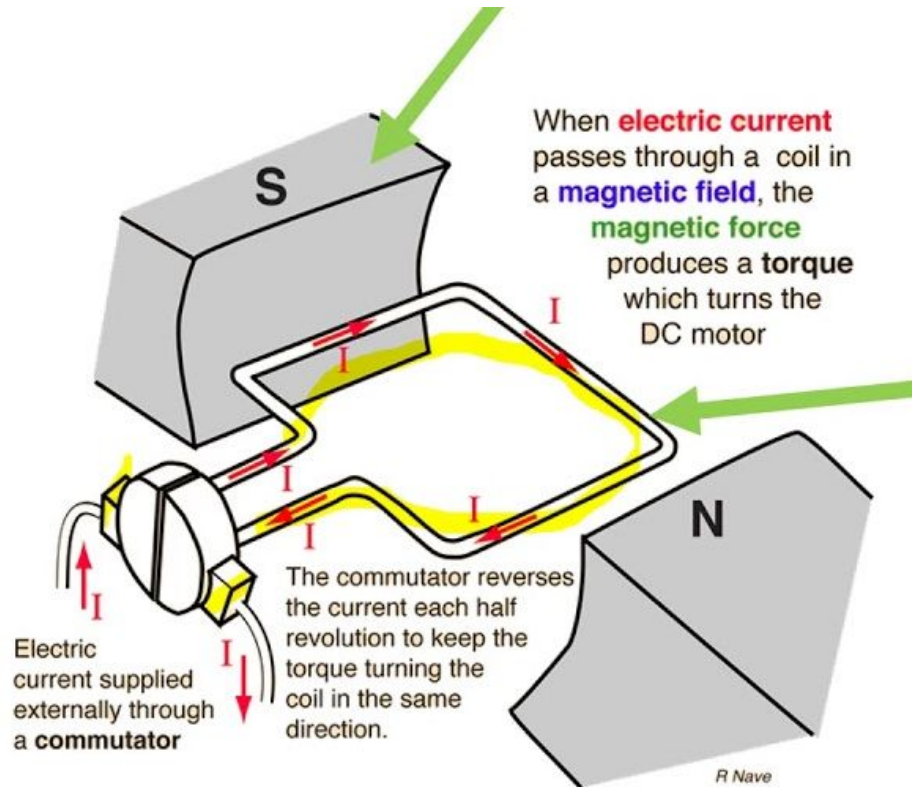
Types of Motors



DC Motors



How does a DC Motor Work



Gearmotor



www.pololu.com

voltage	no-load performance	stall extrapolation
6 V	210 RPM, 500 mA	9.1 kg · cm (130 oz · in), 6.0 A

Gear ratio: 46.85:1

No-load speed @ 6V: 210 rpm

No-load current @ 6V: 0.50 A

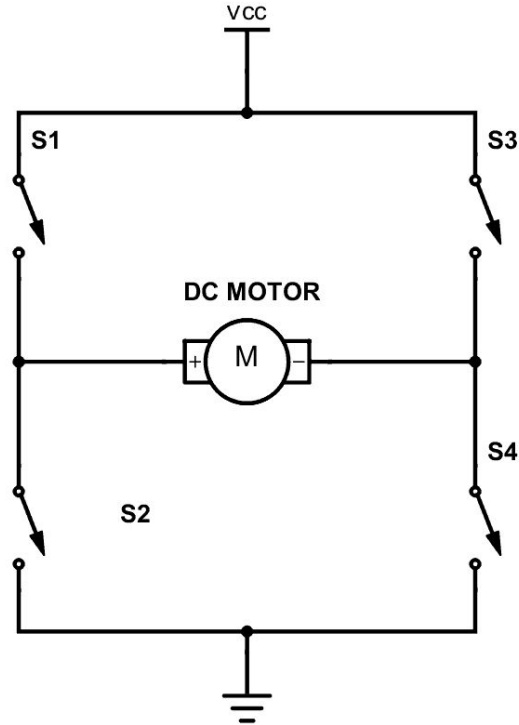
Stall current @ 6V: 6.0 A

Stall torque @ 6V: 9.1 kg · cm

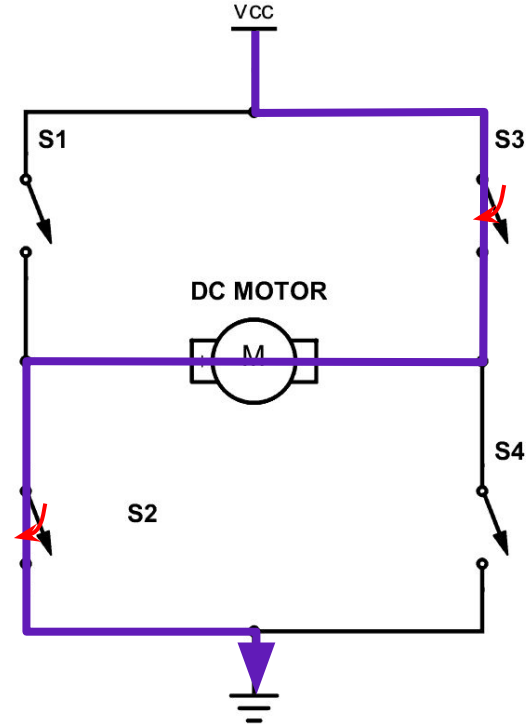
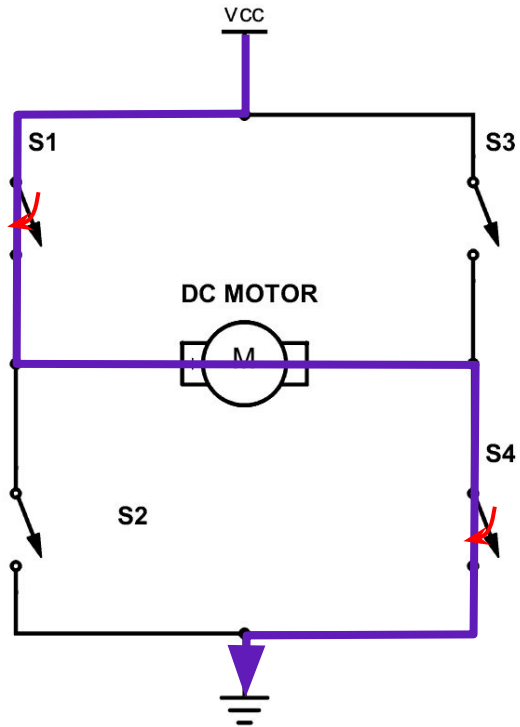
Max output power @ 6V: 4.9 W

Motor type: 6V, 6.0A stall (HP 6V)

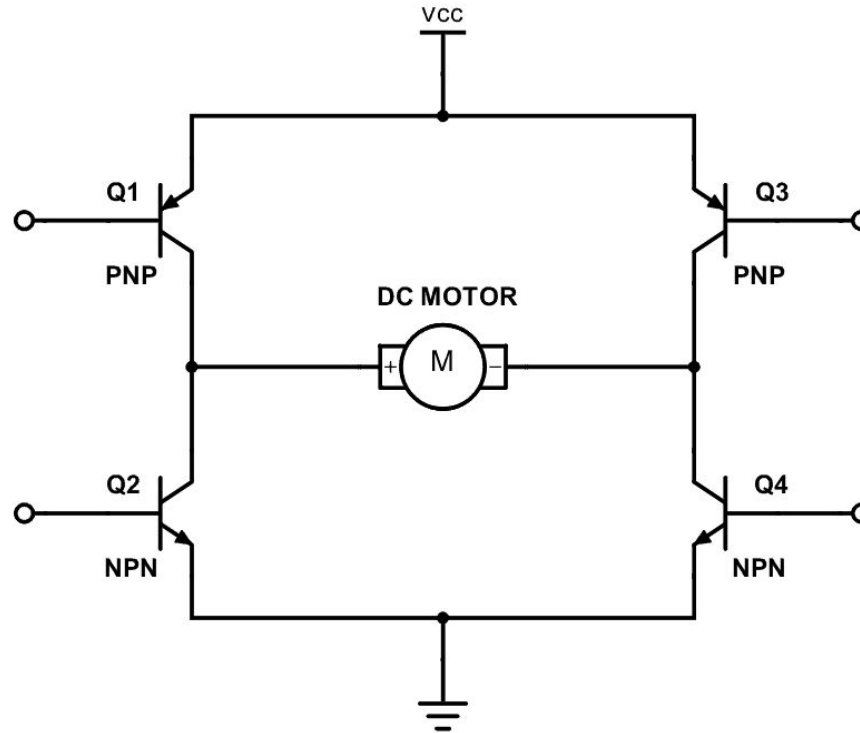
H-bridge Driving Circuit



H-bridge Driving Circuit



Transistor H-bridge



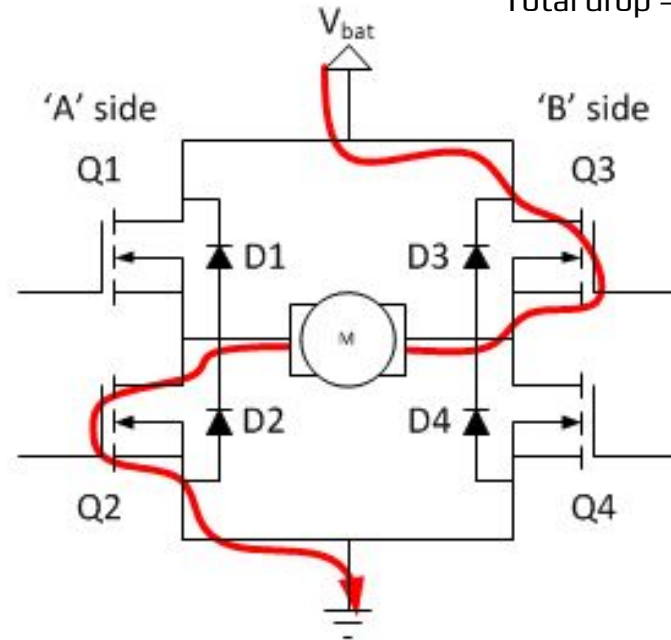
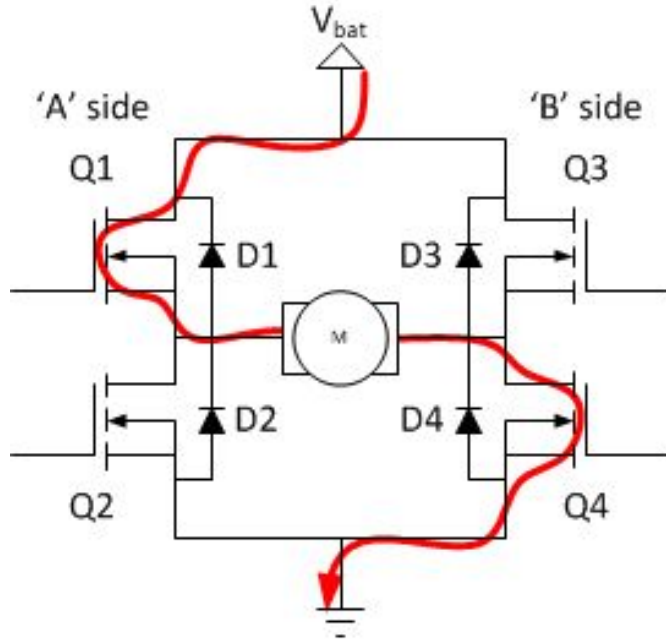
Transistors drop = 0.7 V

Total drop = 1.4 V

MOSFET H-bridge

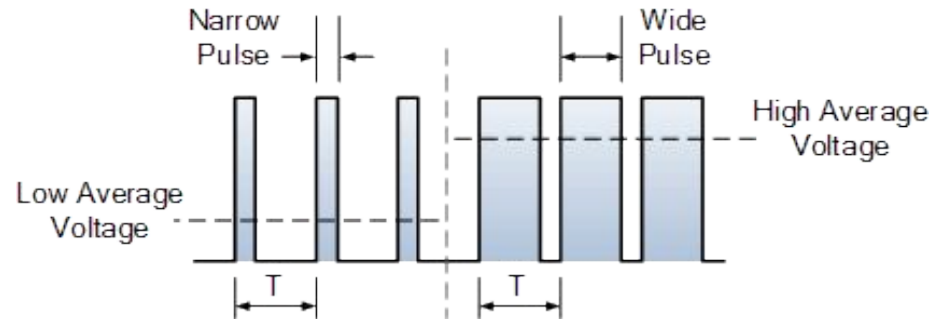
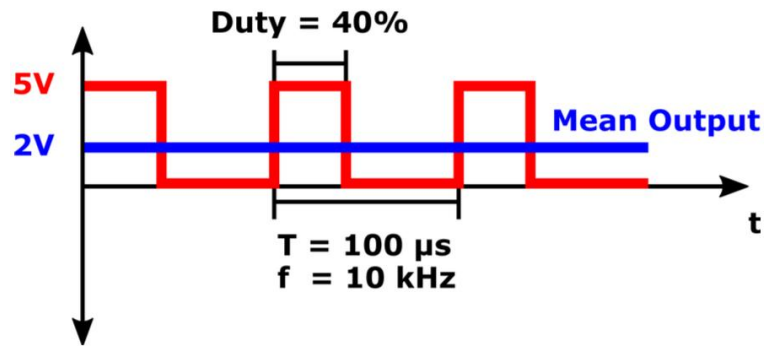
MOSFET drop = 0.1 V

Total drop = 0.2 V



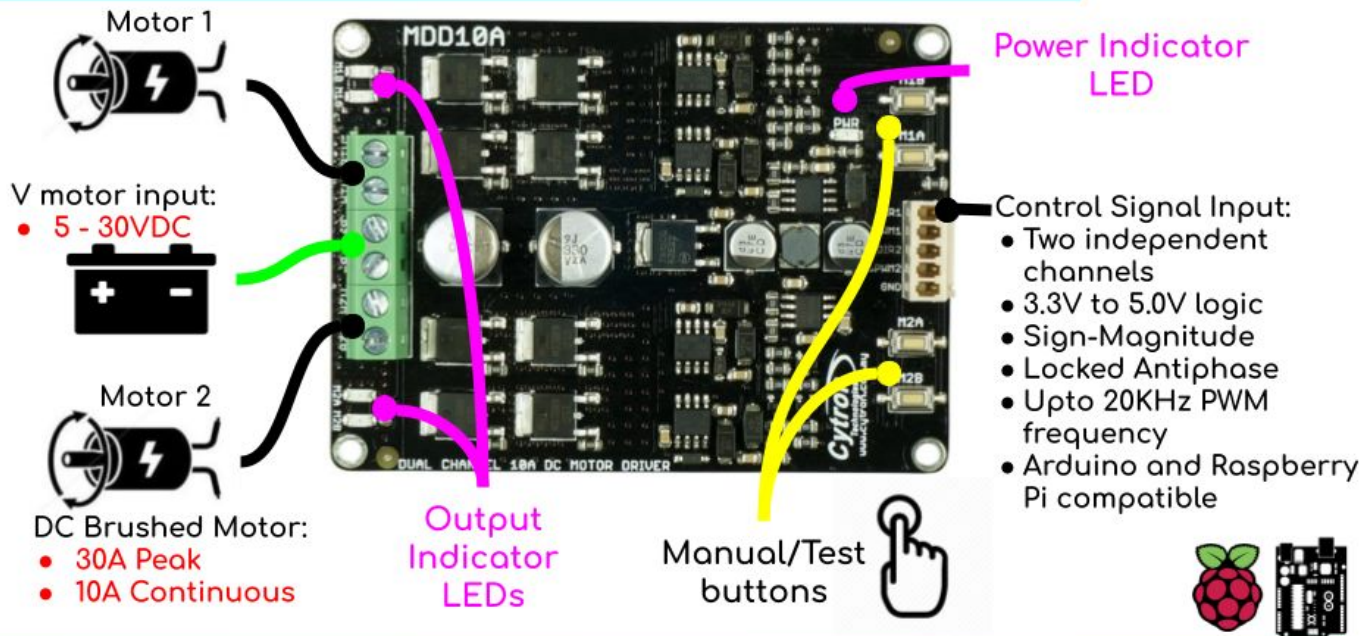
Pulse Width Modulation (PWM)

PWM SIGNAL

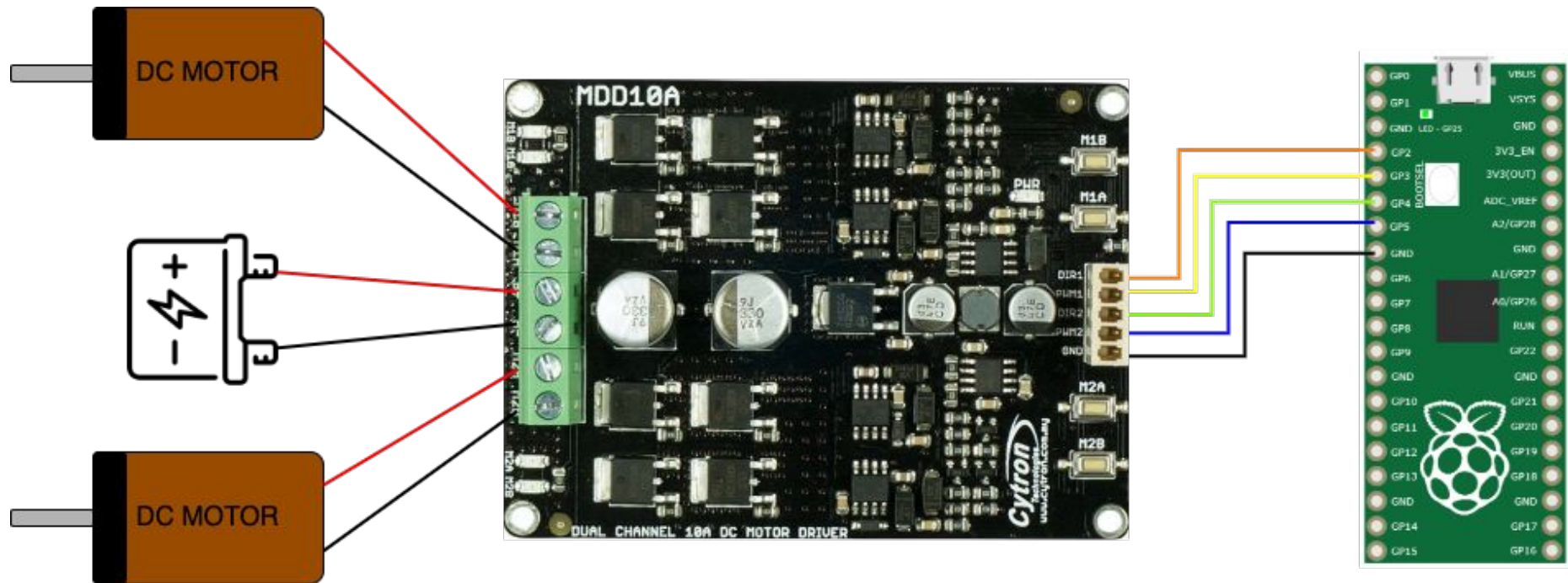


Motor Driver Board – MDD10A

MDD10A Dual Channel 10Amp DC Motor Driver



MDD10A Wiring



Drive DC Motors

```
from machine import Pin, PWM
```

```
# SETUP
```

```
DIR1 = Pin(2, Pin.OUT)
```

```
PWM1 = PWM(Pin(3))
```

```
DIR2 = Pin(4, Pin.OUT)
```

```
PWM2 = PWM(Pin(5))
```

```
PWM1.freq(100)
```

```
PWM2.freq(100)
```

```
# LOOP
```

```
DIR1.value(0)
```

```
for duty in range(65536):
```

```
    PWM1.duty_u16(duty)
```

```
for duty in reversed(range(65536)):
```

```
    PWM1.duty_u16(duty)
```

```
DIR1.value(1)
```

```
for duty in range(65536):
```

```
    PWM1.duty_u16(duty)
```

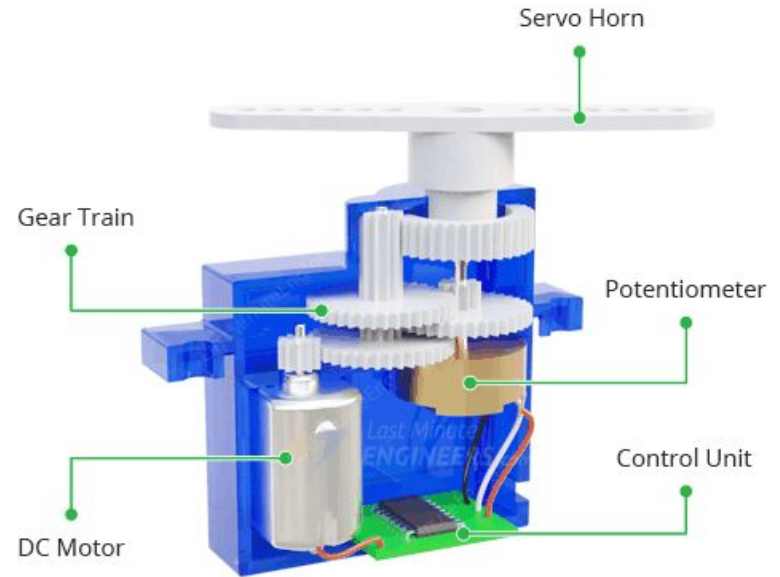
```
for duty in reversed(range(65536)):
```

```
    PWM1.duty_u16(duty)
```

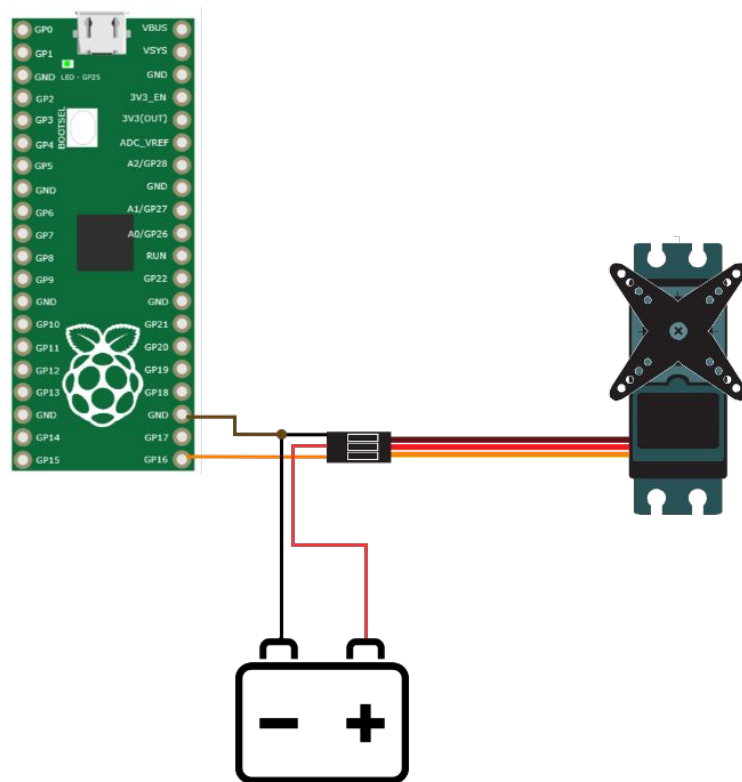
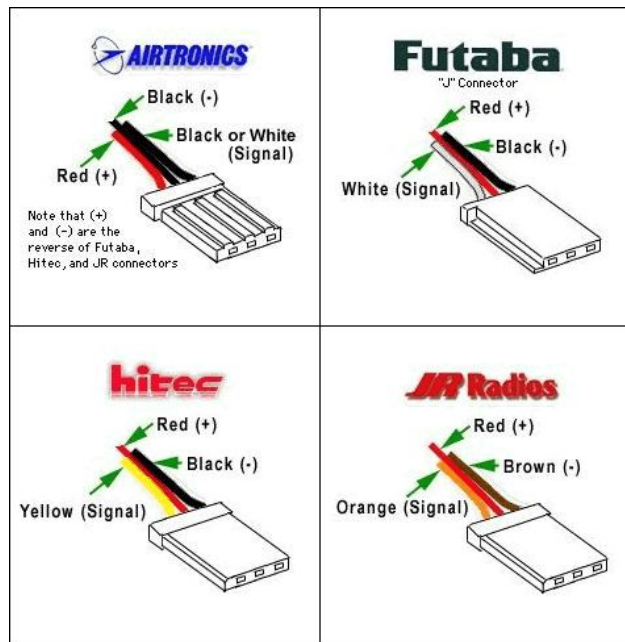

Servo Motor

A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration.

- We use hobbyist servo motor.
- Range of motion usually limited to 90, 180, 270 degrees.
- There are continuous rotation servo motors.
- Use a PWM signal with 50 Hz frequency to control.
- ...



Servo Motor Wiring



Drive A Servo Motor

```
from machine import Pin, PWM
from time import sleep
```

```
# SETUP
```

```
servo = PWM(Pin(13))
servo.freq(50)
```

```
# LOOP
```

```
servo.duty_ns(int(500*1000))
sleep(1)
servo.duty_ns(int(1500*1000))
sleep(1)
servo.duty_ns(int(1000*1000))
sleep(1)
```

```
"""
```

```
Require micropython-servo library:
```

```
https://pypi.org/project/micropython-servo/
```

```
"""
```

```
from servo import Servo
```

```
from time import sleep
```

```
# SETUP
```

```
my_servo = Servo(pin_id=13)
```

```
my_servo.write(0)
```

```
sleep(1)
```

```
# LOOP
```

```
for i in range(181):
```

```
    my_servo.write(i)
```

```
    print(f"angel: {i} deg")
```

```
    sleep(0.1)
```

```
my_servo.write(90)
```

```
sleep(1)
```