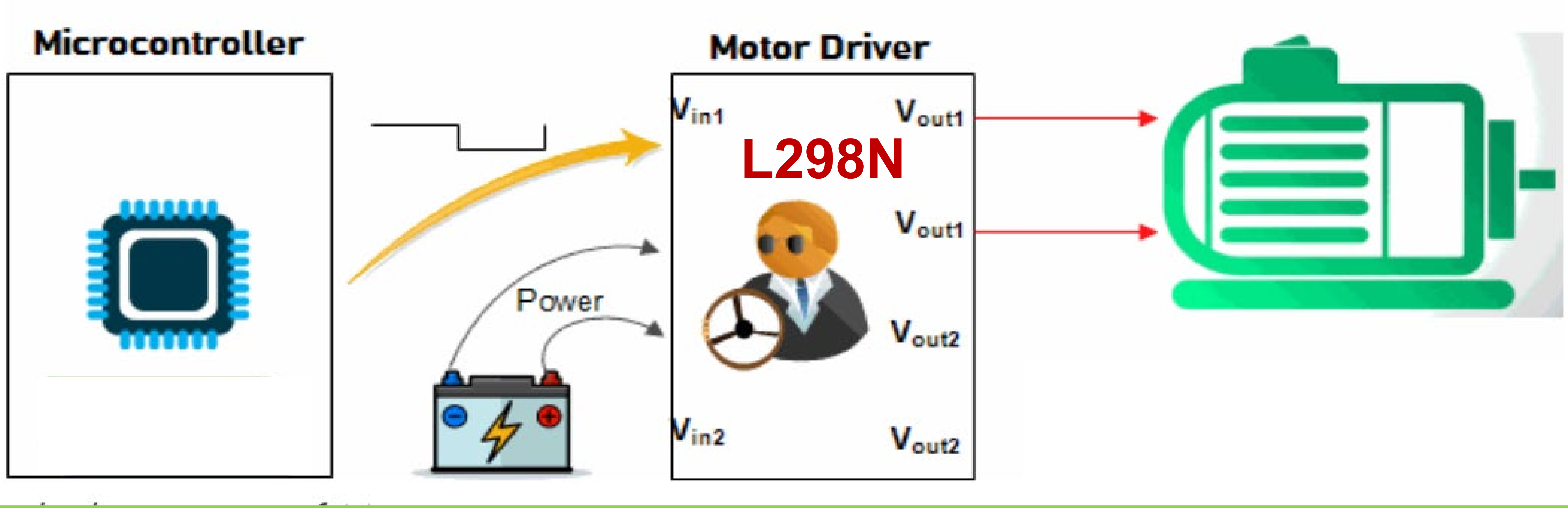
Pi Club Sharing Session

L298N Dual Channel H-Bridge Motor Driver Module

Sunday, 4 Jun 2023 @ TRL

What is a Motor Driver?



A motor driver module takes the low voltage input from a controller like Raspberry Pi Pico. This input logic controls the direction of DC motors connected to the motor driver.

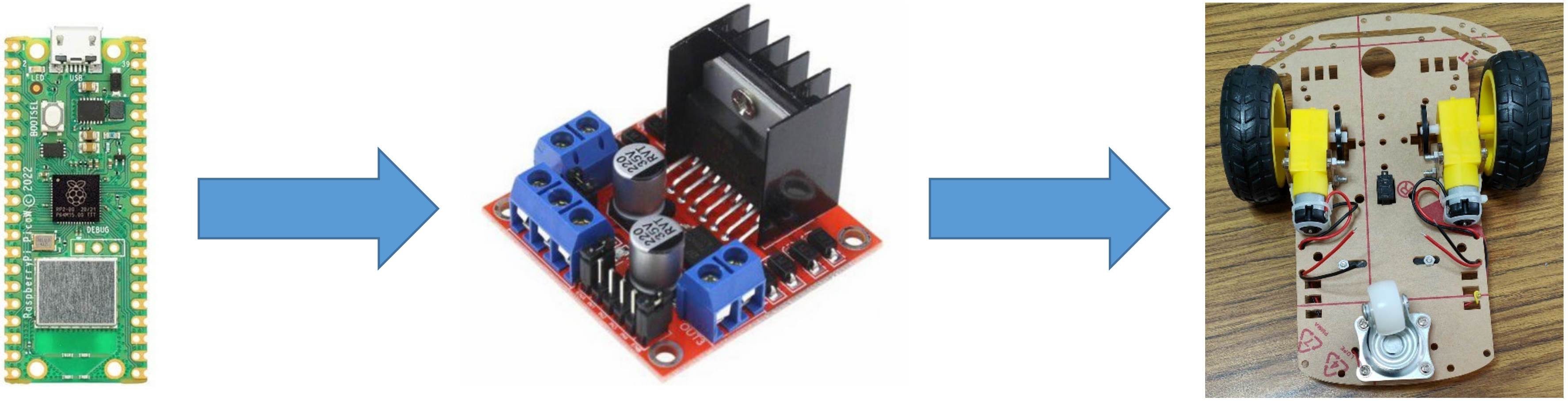
A motor driver controls the speed and direction of an electric motor based on the commands or instructions it receives from the controller.

How Does L298N Dual H-Bridge Motor Driver Work?

L298N uses two types of control techniques:

H-Bridge – For controlling direction of motor rotation

PWM – For controlling rotational speed of motor.



RPi Pico W Microcontroller

L298N Dual H-Bridge Motor Driver

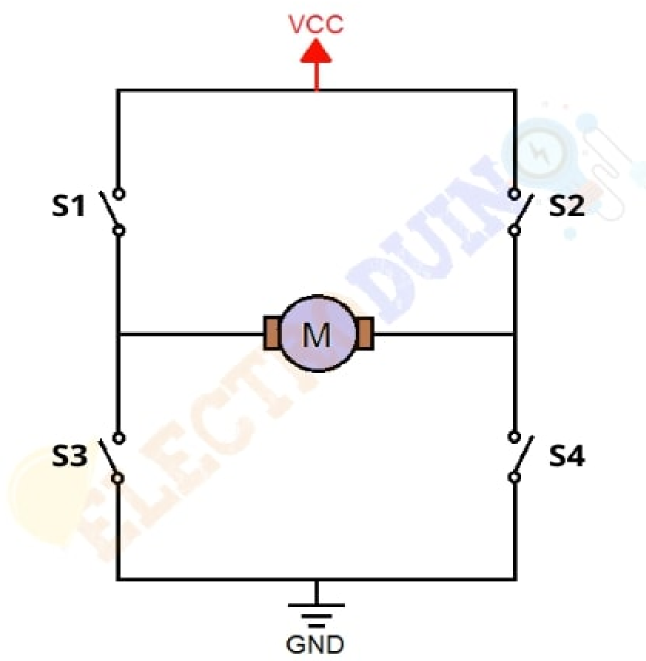
2 X DC Gear Motors

H-Bridge Technique

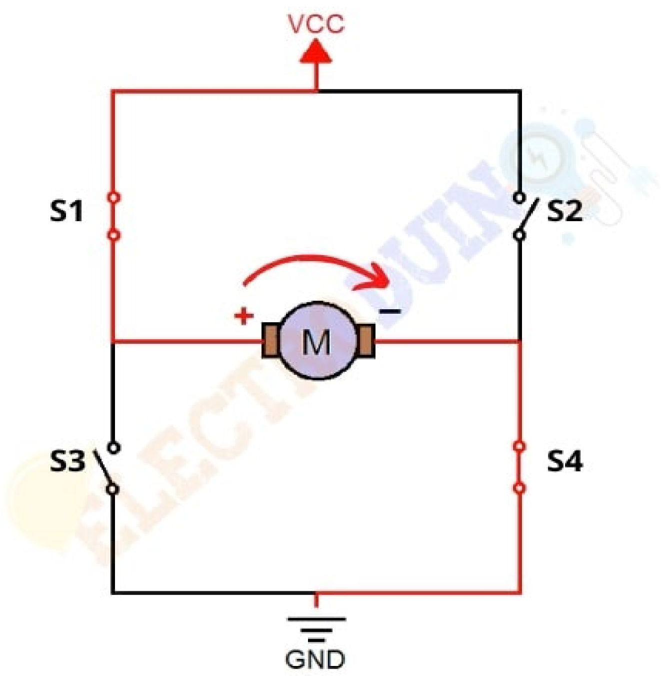
L298N motor driver uses the H-Bridge technique to control the direction of rotation of a DC motor.

In this technique, H-Bridge controlled DC motor rotating direction by changing the polarity of motor input voltage.

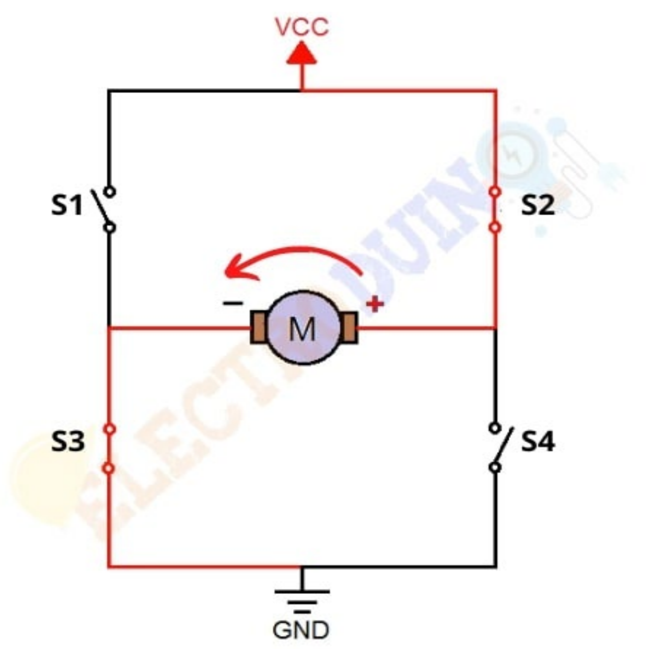
H-Bridge Technique



If S1, S2, S3, and S4 are open, no current flows through the motor windings. Under this condition, the motor will not rotate.



If switches S1 and S4 are closed, the motor left terminal is connected to the positive (+) supply Vcc and the motor right terminal is connected to the ground. Under this condition, motor will rotate in in a clockwise direction.



When switches S2 and S3 are closed, the motor right terminal is connected to the positive (+) supply Vcc and the motor left terminal is connected to the ground. Under this condition motor will rotates in a an anticlockwise direction.

PWM (Pulse Width Modulation) Techniques

L298N motor driver uses the PWM technique to control the speed of rotation of a DC motor. In this technique, the speed of a DC motor can be controlled by changing the motor input voltage.

Pulse Width Modulation is a technique where the average value of the input voltage is adjusted by sending a series of ON-OFF pulses. The average voltage is proportional to the width of the pulses.

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Duty cycle, *D*, or, δ=TonTon+Toff.

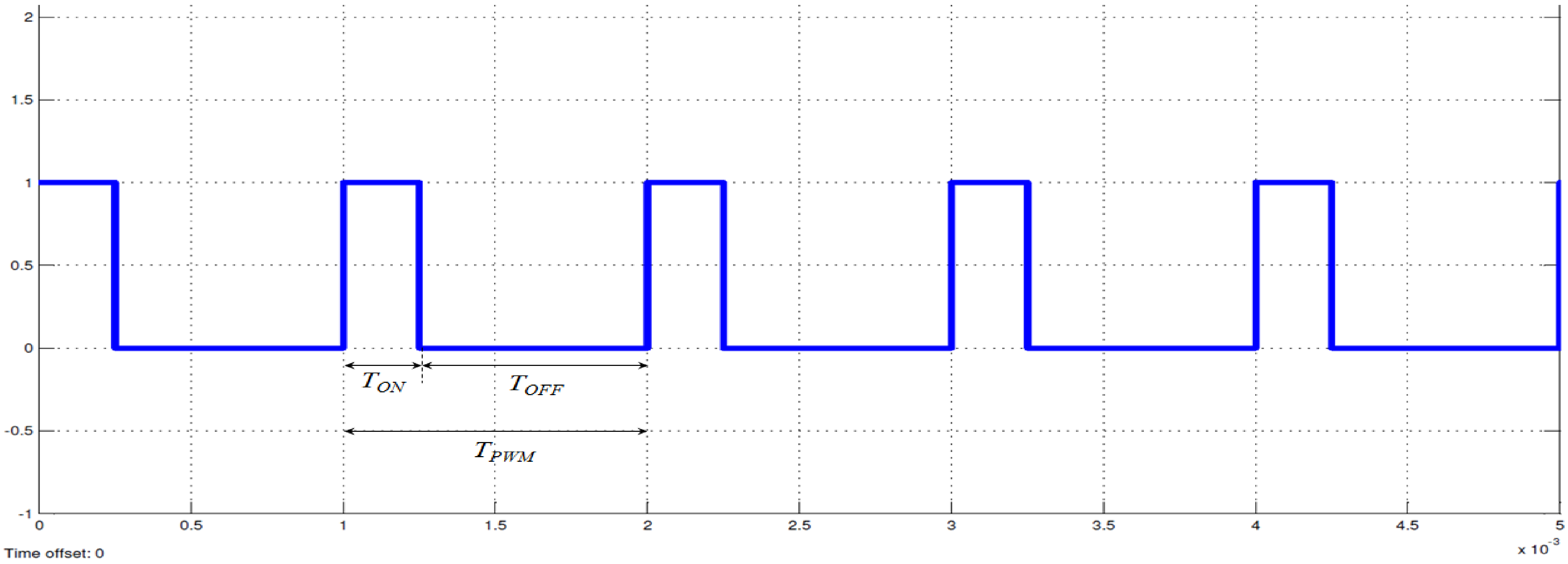
PWM – Duty Cycle

Duty cycle of a Pulse Width Modulated (PWM) signal is effective “ON-time” of the PWM signal in each switching cycle.

Duty Cycle is usually expressed as % of On-time with respect to switching time.

$$\text{Duty Cycle, D} = \frac{\text{Ton}}{\text{Ton + Toff}}$$

PWM – Duty Cycle



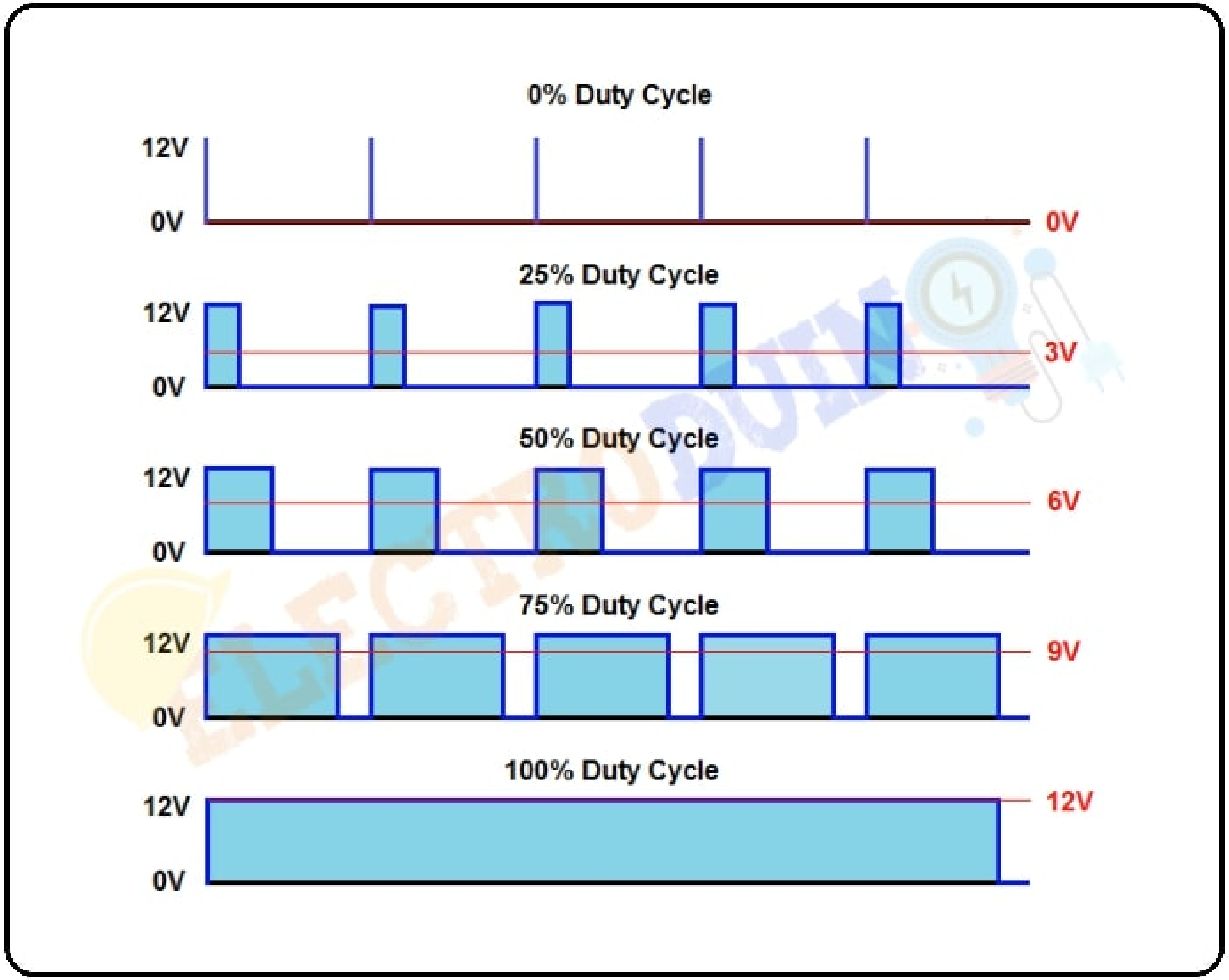
Shown above is a 1 kHz PWM signal. The PWM signal is *ON* for 0.25 ms and *OFF* for 0.75 ms.

Therefore, Duty Cycle D = 0.25 / (0.25 = 0.75) = 0.25 – 25%

T_{PWM} = 1 / $f_{switching}$ = 1 / 1 kHz = 0.001 s = 1 ms

RPi Pico Frequency range of the PWM signal **7 Hz to 125 MHz**

PWM – Duty Cycle

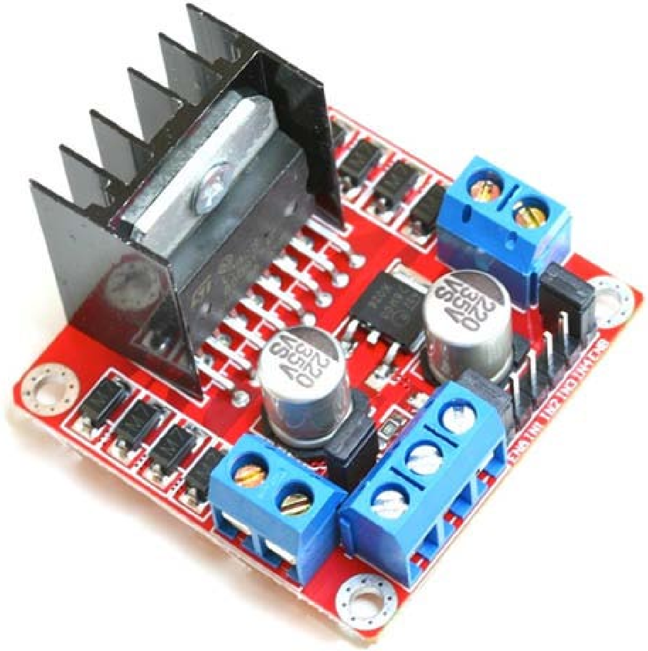


L298N Dual H-Bridge Motor Driver

The L298N motor driver allows independently control of two DC motors of up to 2A each in both directions.

It is ideal for robotic applications and well suited for connection to a microcontroller requiring just a couple of control lines per motor. It can also be interfaced with simple manual switches, Transistor-Transistor Logic (TTL) logic gates, relays, etc.

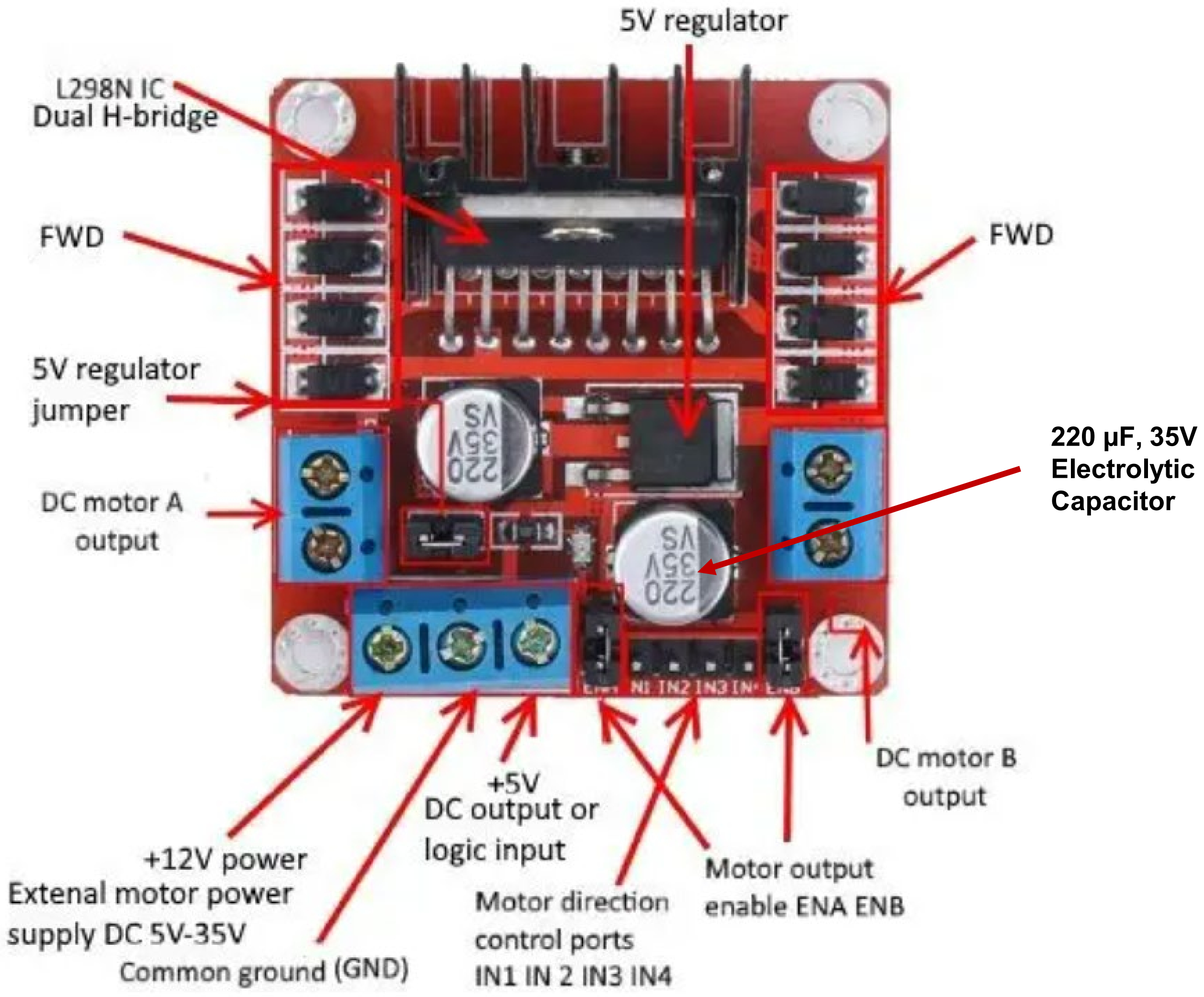
This motor driver is equipped with power LED indicators, on-board +5V regulator and protection diodes.



L298N Motor Driver Module Pinouts

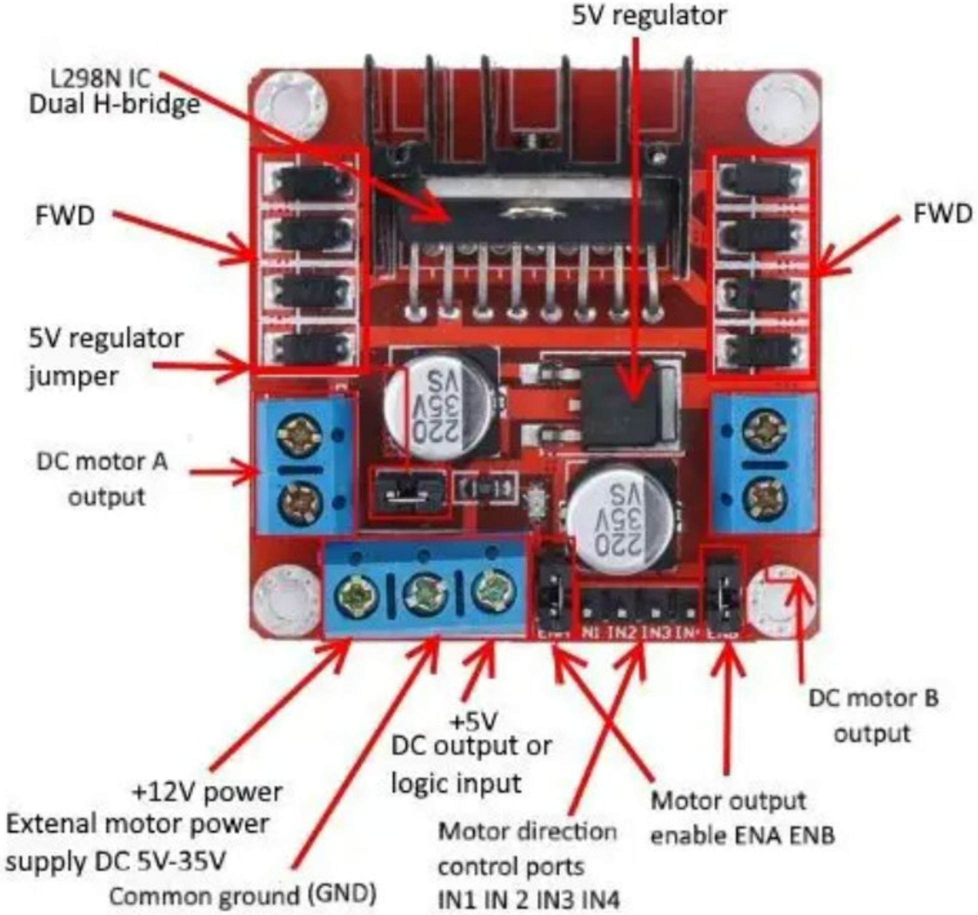
The L298N Motor Driver module consists of an L298 IC Dual H-bridge, 5V Voltage Regulator, Resistors, Capacitor, Power LED, jumpers.

Two DC motor output pins, 12-volt external motor power supply, motor direction control pins (IN1, IN2, IN3, IN4), motor output enable pins (ENA, ENB), and a heat sink.



Pinouts of L298N Motor driver Module

L298N Motor Driver Module Pinouts



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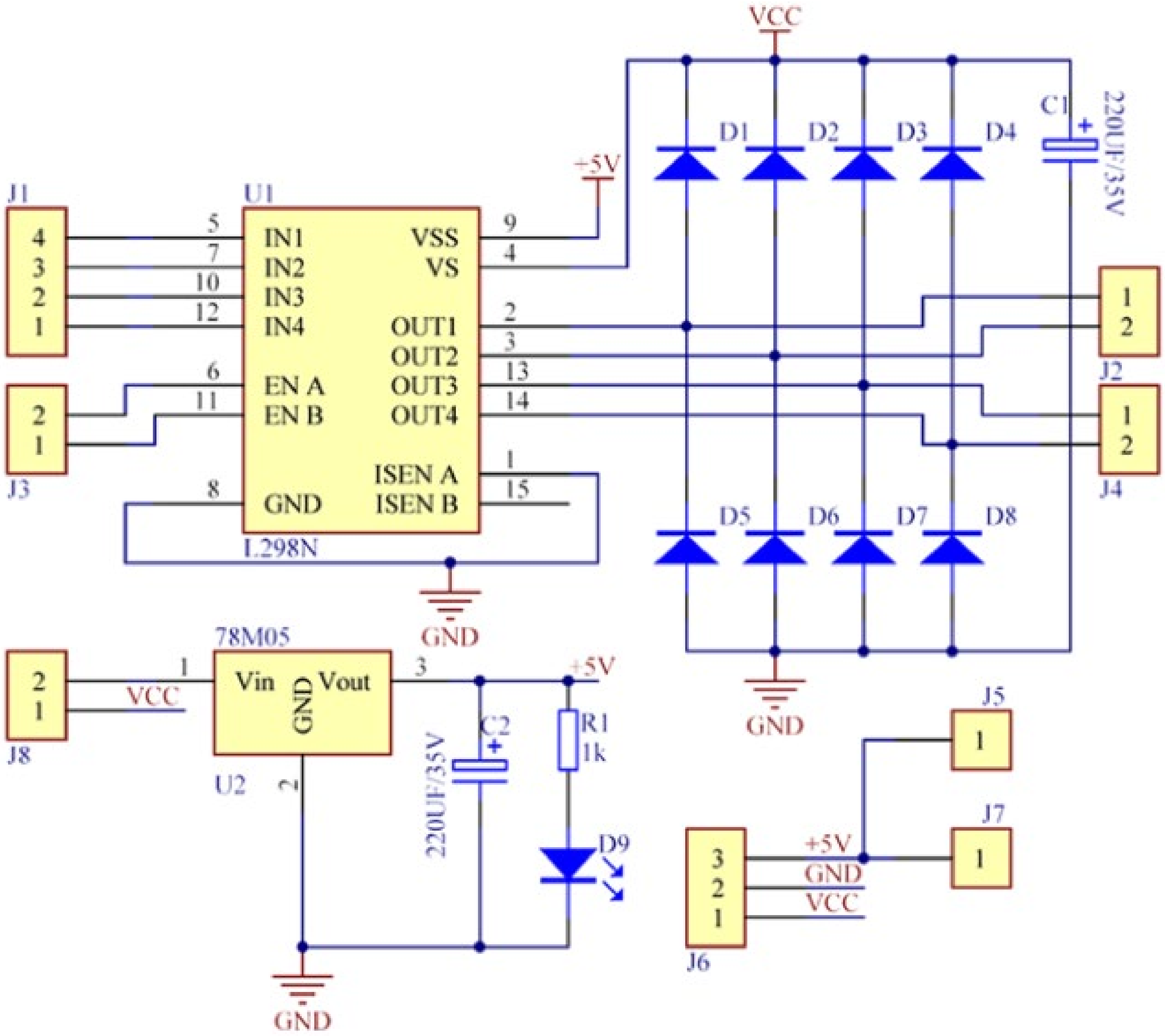


L298N Motor Driver Module Pinouts

VCC pin supplies power to the motor. Voltage anywhere between 5 to 35V can be applied.

GND is the common ground pin.

5V pin supplies power to the switching logic circuitry inside the L298N IC. If the 5V-EN jumper is in place, this pin acts as output and can be used to power up the Raspberry Pi Pico W. If the 5V-EN jumper is removed, you need to connect it to the 5V pin on Raspberry Pi Pico W.

ENA pins are utilized to control the speed of Motor A. Supplying this pin with HIGH logic makes the Motor A rotate, supplying it with LOW logic causes the motor to stop. Removing the jumper and connecting this pin to the PWM input let us control the speed of the Motor A.

IN1 & IN2 pins are used to control the direction of Motor A. If IN1 is HIGH and IN2 is LOW, Motor A spins in a certain direction. To change the direction, make IN1 LOW and IN2 HIGH. If both the inputs are either HIGH or LOW, the Motor A stops.

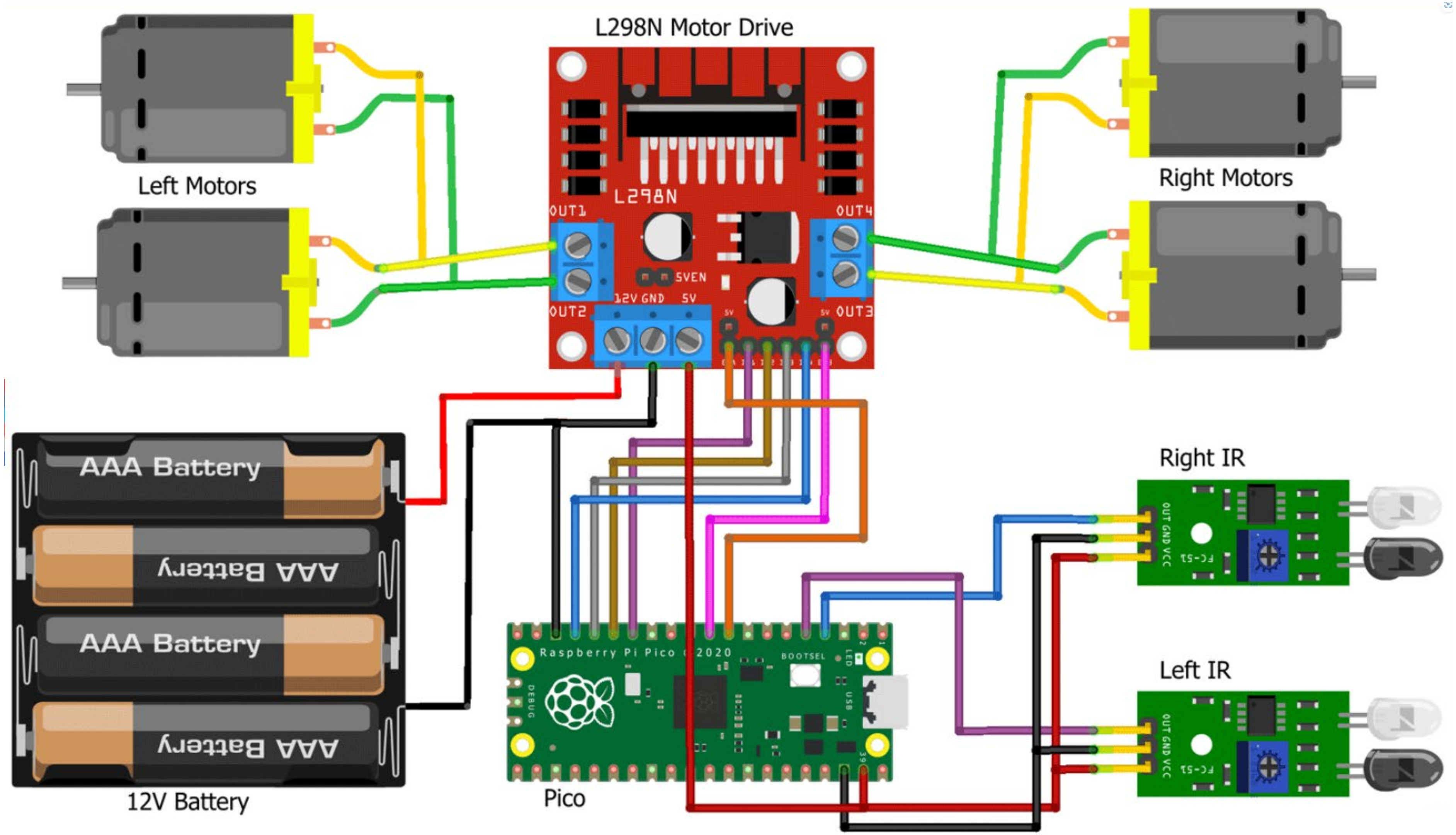
IN3 & IN4 pins are used to control the direction of the Motor B. If IN3 is HIGH and IN4 is LOW, Motor B spins in a certain direction. To change the direction, make IN3 LOW and IN4 HIGH. If both the inputs are either HIGH or LOW, the Motor B stops.

ENB pin can be used to control the speed of Motor B. Supplying this pin with the HIGH signal makes the Motor B turn, supplying it LOW cause the motor to stop. Removing the jumper and interfacing this pin to PWM information let us control the speed of Motor B.

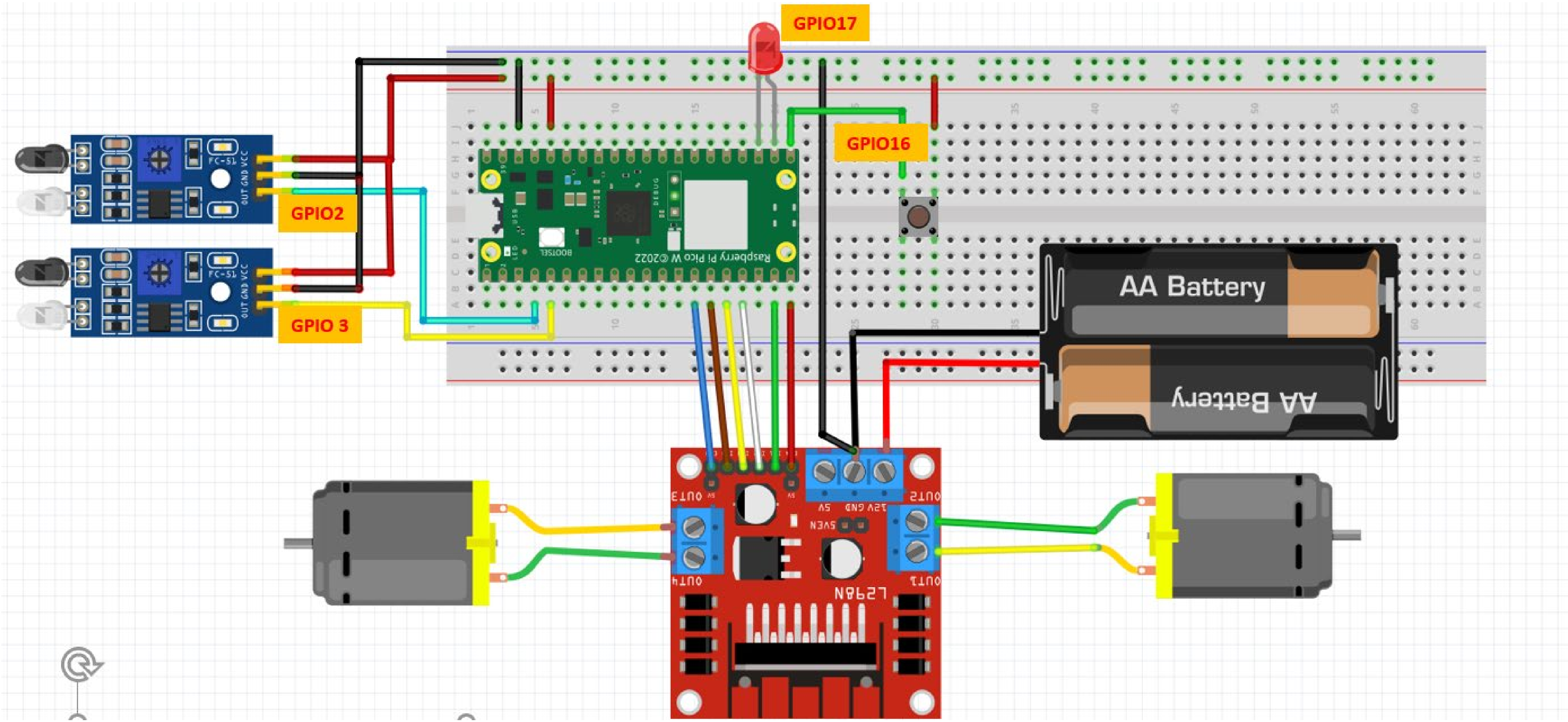
OUT1 & OUT2 pins are connected to Motor A.

OUT3 & OUT4 pins are connected to Motor B.

Example 1: Circuit Connection of L298N with RPi Pico



Example 2: Circuit Connection of L298N with RPi Pico



End of Sharing Session