M17 Series Servomotors - DATASHEET

Affordable and Simple All-in-One Motion Control

From Education to Innovation

Introduction

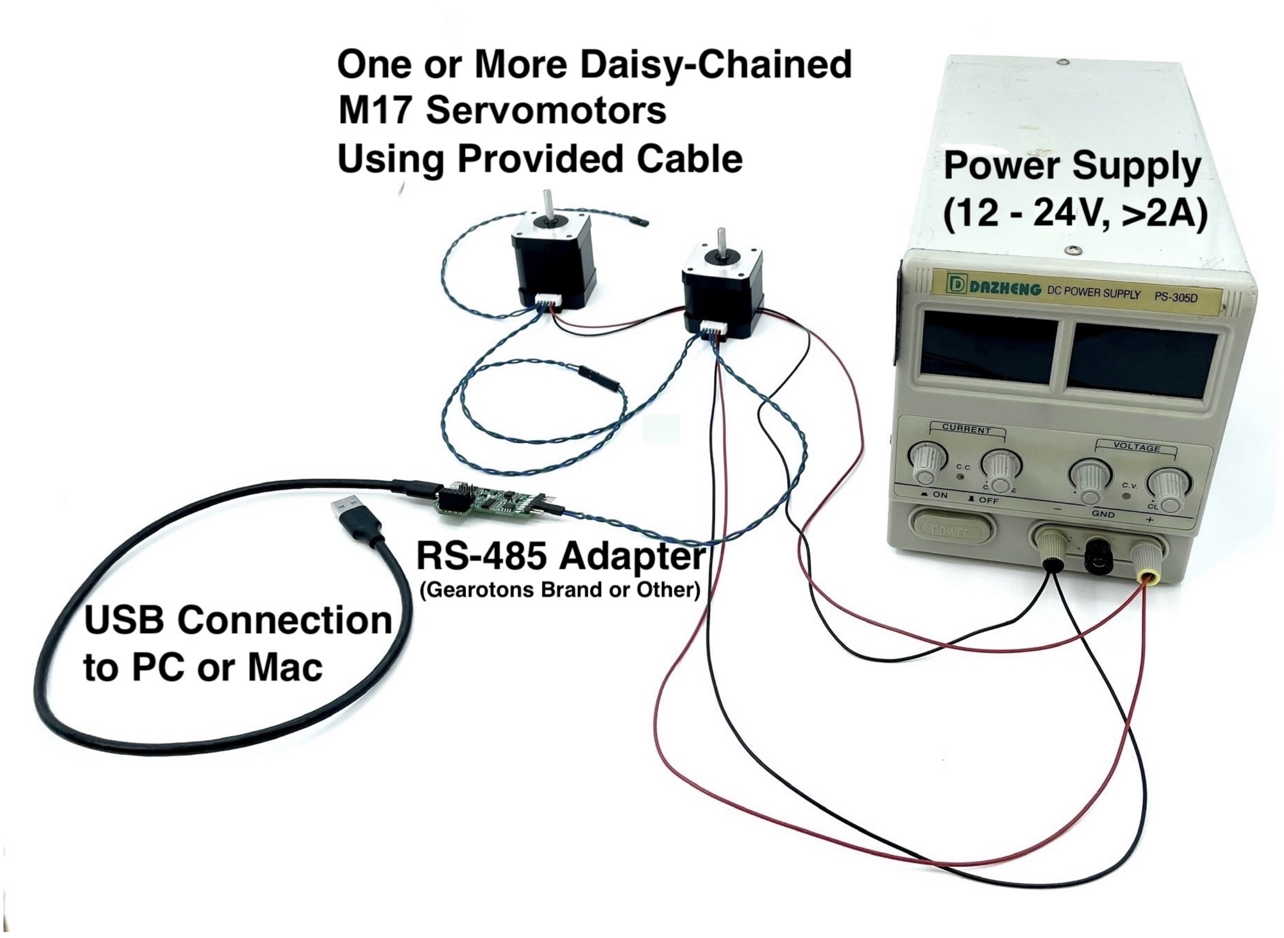
The M17 Series Servomotors are all-in-one motion control solutions that integrate a motor, motor driver, motion controller, and encoder in a single compact package. These servomotors feature a RS-485 communication interface, enabling multiple units to be daisy-chained together and controlled from a single connection point. Available in three models - M17-60, M17-48, and M17-40 - the series offers flexible options to match specific torque requirements while maintaining consistent control characteristics. Each M17 Series Servomotor comes with sophisticated control features including multiple operation modes, self-calibration capabilities, and built-in status monitoring through LED indicators. The motors can be easily controlled from any platform including Mac, PC, Raspberry Pi, or Arduino (requiring only a low-cost RS485 adapter), making them ideal for both educational and industrial applications. The series supports precise position control with trapezoid movement profiles, closed-loop control mode, and comprehensive error handling. With standardized NEMA 17 mounting dimensions, wide voltage range (12-24V), and robust communication protocol, M17 Series Servomotors provide a reliable and flexible solution for applications requiring precise motion control, from robotics and CNC machines to automated testing equipment and scientific instruments.

Key Features

- High level of integration combines a motor, motor driver, motion control system, and RS-485 commincation interface
- Compact form factor nearly the same size as a NEMA 17 stepper motor with the same specifications
- Standardized NEMA 17 mounting dimensions
- Wide voltage range (12-24V) for flexible power options
- High-precision position control with build in encoder and PID control loop that runs at 32 kHz
- Integrated over-current, over-voltage, and over-temperature protection

- High maximum speed can reach 580 RPM
- Torque-to-weight ratio is the same as an equivalent stepper motor
- Compatible with a wide variety of interfaces and hardware, such as Raspberry Pi, Arduino, ESP32, Mac, and PC
- We strive to provide excellent documentation and tutorials to get you up and running fast
- We provide AI friendly documentation in case you want your favorite AI to do all the work for you
- Suitable for robotics, CNC, automation, scientific instruments, testing jigs, 3D printers, and everything else
- Available in different sizes so you can find the right torque and price for your application

Connection Diagram


One or More Daisy-Chained M17 Servomotors Using Provided Cable
Power Supply (12 - 24V, >2A)
DAZHENG DC POWER SUPPLY PS-305D
RS-485 Adapter (Gearotons Brand or Other)
USB Connection to PC or Mac

Unit System

The M17 Series Servomotors have certain internal units so that they can perform the calculations associated with motion efficiently (using integer math). It is the responsibility of the controlling software to support multiple units of measurement for various quantities. Our Python and Arduino libraries handle unit conversions automatically, allowing you to work with your preferred units. Below are the supported units for each quantity:

Quantity	Available Units
Time	timesteps, seconds, milliseconds, minutes
Position	shaft rotations, degrees, radians, encoder counts
Velocity	rotations per second, rpm, degrees per second, radians per second, counts per second, counts per timestep
Acceleration	rotations per second squared, rpm per second, degrees per second squared, radians per second squared, counts per second squared, counts per timestep squared
Current	internal current units, milliamps, amps
Voltage	millivolts, volts
Temperature	celsius, fahrenheit, kelvin

Getting Started Guide

To help you get started with your M17 Series Servomotor, we provide a comprehensive online guide that covers everything from initial setup to advanced protocol implementations. This guide includes:

- Step-by-step setup instructions
- Detailed communication protocol documentation
- Programming examples and code snippets
- Description of error codes
- Troubleshooting tips and best practices

Click Here to Visit our Getting Started Guide

Indicator LEDs and Buttons

The servomotor has two status LEDs (Green and Red). The green LED flashes slowly to show a heart beat and quickly to indicate that the bootloader is running rather than the application. The red LED will light up briefly to show communication on the bus and will indicate fatal error codes by flashing a certain number of times.

The servomotor has two buttons labelled "Reset" and "Test". The Reset button will reset the internal microcontroller and all state will go back to default values. The Test button will cause the motor to spin. Press briefly to let it spin one way and press for more than 0.3 seconds and release to let it spin the other way. Hold down for at least 2 seconds and release to cause the motor to go to closed loop mode. Hold down for more than 15 seconds and release to let the motor perform a calibration on itself. Note that it will spin during calibration and must be able to spin freely for calibration to be successful, so remove any loads before doing this operation.

Communication Protocol Overview

The M17 Series Servomotors use RS-485 for communication, enabling multiple motors to be daisy-chained together. Each motor has a factory assigned 64-bit unique address so that it can be addressed individually on an RS-485 bus. Each motor can also be assigned a unique 1-byte alias (0-251) in order to save bytes in the communication packet and still get similar individual control. There is also a broadcast alias, which is 255. The protocol supports a comprehensive set of commands for motion control, configuration, and status monitoring. Firmware update through the RS-485 interfce is supported. Communication baud rate is fixed at 230400.

Command Reference Summary

For the up to date source of truth for all available commands, you can look at this document.

https://github.com/tomrodinger/servomotor/blob/main/python_programs/servomotor/motor_commands.json

You can also run this command:

```
pip3 install servomotor   # run this just once to install the library and programs
servomotor_command.py -c
```

This will print out the information contained in the motor_commands.json file in a nicer way and give some usage information for sending commands to the motor from the command line.

Basic Control

Command	Description
Disable MOSFETs	Disables the MOSFETS (note that MOSFETs are disabled after initial power on).
Enable MOSFETs	Enables the MOSFETS.
Reset time	Resets the absolute time to zero (call this first before issuing any movement commands)
Emergency stop	Emergency stop (stop all movement, disable MOSFETS, clear the queue)
Zero position	Make the current position the position zero (origin)
System reset	System reset / go to the bootloader. The motor will reset immediately and will enter the bootloader. If there is no command sent within a short time, the motor will exit the bootloader and run the application from the beginning.

Motion Control

Command	Description
Trapezoid move	Move immediately to the given position using the currently set speed (the speed is set by a separate command)
Go to position	Move to this new given position in the amount of time specified. Acceleration and deceleration will be applied to make the move smooth.
Homing	Homing (or in other words, move until a crash and then stop immediately)
Go to closed loop	Go to closed loop position control mode
Move with acceleration	Rotates the motor with the specified acceleration
Move with velocity	Rotates the motor with the specified velocity.
Multimove	The multimove command allows you to compose multiple moves one after another. Please note that when the queue becomes empty after all the moves are executed and the motor is not at a standstill then a fatal error will be triggered.

Configuration

Command	Description
Set maximum velocity	Sets maximum velocity (this is not used at this time)
Set maximum acceleration	Sets max acceleration
Start calibration	Starts a calibration, which will determine the average values of the hall sensors and will determine if they are working correctly
Set maximum motor current	Set the maximum motor current and maximum regeneration current. The values are stored in non-volatile memory and survive a reset.
Set safety limits	Set safety limits (to prevent motion from exceeding set bounds)
Test mode	Set or trigger a certain test mode. This is a bit undocumented at the moment. Don't use this unless you are a developer working on test cases.
Set PID constants	Set PID constants for the control loop that will try to maintain the motion trajectory.
Set max allowable position deviation	Set the amount of microsteps that the actual motor position (as measured by the hall sensors) is allowed to deviate from the desired position. Throw a fatal error if this is exceeded.
CRC32 control	Enable or disable CRC32 checking for commands

Status & Monitoring

Command	Description
Get current time	Gets the current absolute time
Get n queued items	Get the number of items currently in the movement queue (if this gets too large, don't queue any more movement commands)
Get hall sensor position	Get the position as measured by the hall sensors (this should be the actual position of the motor and if everything is ok then it will be about the same as the desired position)
Get status	Gets the status of the motor
Control hall sensor statistics	Turn on or off the gathering of statistics for the hall sensors and reset the statistics
Get hall sensor statistics	Read back the statistics gathered from the hall sensors. Useful for checking the hall sensor health and noise in the system.
Get position	Get the current desired position (which may differ a bit from the actual position as measured by the hall sensors)
Get comprehensive position	Get the desired motor position, hall sensor position, and external encoder position all in one shot
Get supply voltage	Get the measured voltage of the power supply.
Get max PID error	Get the minimum and maximum error value ovserved in the PID control loop since the last read.
Get temperature	Get the measured temperature of the motor.
Get debug values	Get debug values including motor control parameters, profiler times, hall sensor data, and other diagnostic information.
Get communication statistics	Get and optionally reset the CRC32 error counter

Device Management

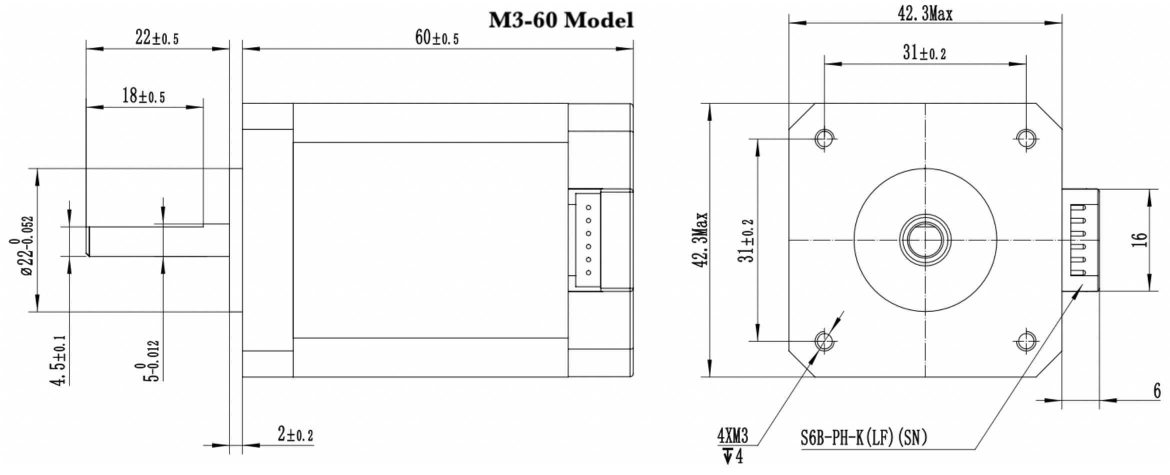
Command	Description
Time sync	Sends the master time to the motor so that it can sync its own clock (do this 10 times per second).
Get product specs	Get the update frequency (reciprocal of the time step)
Detect devices	Detect all of the devices that are connected on the RS485 interface. Devices will identify themselves at a random time within one seconde. Chance of collision is possible but unlikely. You can repeat this if you suspect a collision (like if you have devices connected but they were not discovered within one to two seconds).
Set device alias	Sets device alias
Get product info	Get product information
Firmware upgrade	This command will upgrade the flash memory of the servo motor. Before issuing a firmware upgrade command, you must do some calculations as shown in the examples.
Get product description	Get the product description.
Get firmware version	Get the firmware version or the bootloader version depending on what mode we are in. This command also returns the status bits, where the least significan bit teels us if we are currently in the bootloader (=1) or the main firmware (=0)
Ping	Send a payload containing any data and the device will respond with the same data back
Vibrate	Cause the motor to start to vary the voltage quickly and therefore to vibrate (or stop).
Identify	Identify your motor by sending this command. The motor's green LED will flash rapidly for 3 seconds.

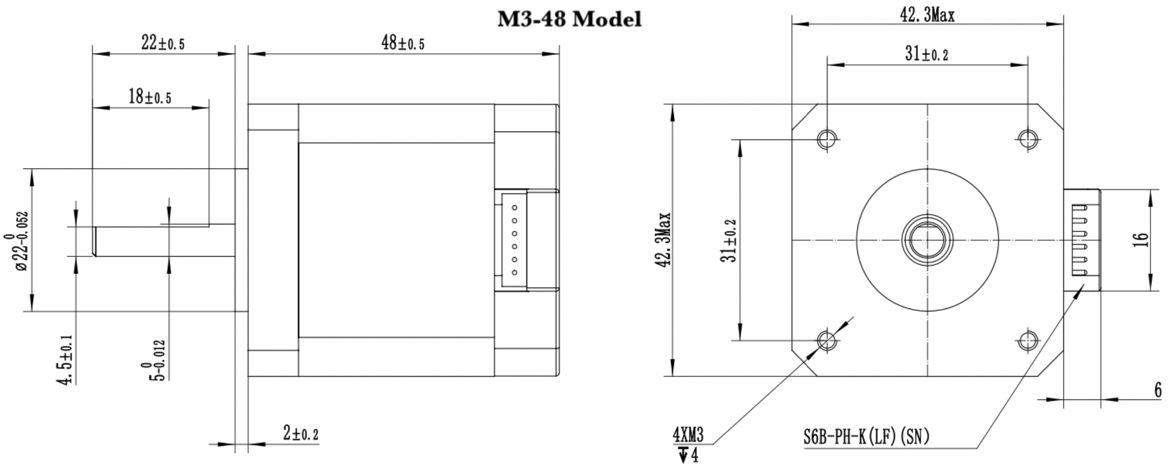
Other

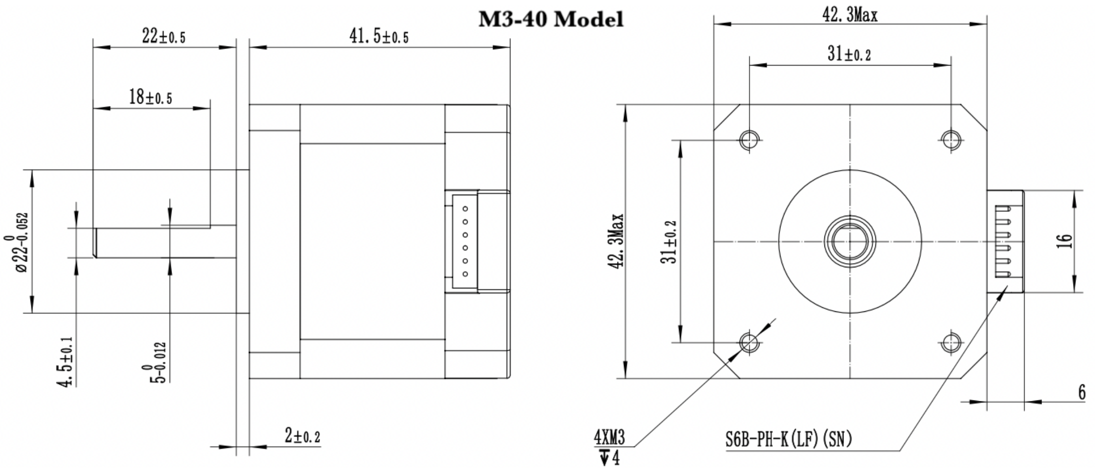
Command	Description
Capture hall sensor data	Start sending hall sensor data (work in progress; don't send this command)
Read multipurpose buffer	Read whatever is in the multipurpose buffer (the buffer is used for data generated during calibration, going to closed loop mode, and when capturing hall sensor data)

Mechanical Specifications

Parameter	M17-60	M17-48	M17-40
Dimensions (LxW)	42.2x42.2 mm	42.2x42.2 mm	42.2x42.2 mm
Height	59.8 mm	48.6 mm	41.6 mm
Shaft Length	20.4 mm	20.4 mm	18.5 mm
Weight	470g	360g	285g
Protection Class	IP20	IP20	IP20







Gearotons

Technical Specifications

Parameter	M17-60	M17-48	M17-40
Operating Voltage	12-24V	12-24V	12-24V
Rated Torque	0.65 N.m	0.55 N.m	0.42 N.m
Maximum Speed	560 RPM	560 RPM	560 RPM
Maximum Current	1.1A	1.1A	1.1A
Rated Power	38W	32W	25W

Operating Conditions

Parameter	Specification
Operating Temperature	0C to +80C
Storage Temperature	-20C to +60C
Humidity Range	20% to 80% RH (non-condensing)
Installation Environment	Indoor use only

Python Library

Our Python library provides a comprehensive interface for controlling M17 Series Servomotors. The library handles all low-level communication protocols and unit conversions, making it easy to integrate servomotor control into your Python projects.

Installation

Install the servomotor library using pip:

```
pip3 install servomotor
```

Example: Basic Motor Control

The following example demonstrates how to connect to a servomotor, enable the mosfets, and perform a trapezoid move:

```
#!/usr/bin/env python3
"""
Minimal trapezoid move: rotate 1 turn in 1 second.
Edit ALIAS below if needed. Uses rotations and seconds.
"""
import time, servomotor
from servomotor import communication

# Hard-coded settings for a minimal demo
ALIAS = 'X'                             # Device alias, change if needed
SERIAL_PORT = "/dev/tty.usbserial-110"  # Serial device path; change if needed (e.g., "COM3" on
                                        #  Windows)
DISPLACEMENT_ROTATIONS = 1.0            # 1 rotation
DURATION_SECONDS = 1.0                  # 1 second
DELAY_MARGIN = 0.10                     # +10% wait margin because the motor's clock is not
                                        #  perfectly accurate

communication.serial_port = SERIAL_PORT # if you comment this out then the program
                                        #  should prompt you for the serial port or it will use
                                        #  the last used port from a file
servomotor.open_serial_port()

m = servomotor.M3(ALIAS, time_unit="seconds", position_unit="shaft_rotations", verbose=0)
m.enable_mosfets()
m.trapezoid_move(DISPLACEMENT_ROTATIONS, DURATION_SECONDS)
time.sleep(DURATION_SECONDS * (1.0 + DELAY_MARGIN))
m.disable_mosfets()

servomotor.close_serial_port()
```

Key Features

- Support for all motor commands
- Automatic unit conversion for time, position, velocity, acceleration, current, voltage, and temperature
- Error handling and status monitoring
- Support for multiple motors on the same bus
- Get up and running in just a few lines of code

Documentation

For complete API documentation and more examples, visit:
https://github.com/tomrodinger/servomotor/tree/main/python_programs

Arduino Library

The Arduino library for M17 Series Servomotors provides an easy-to-use interface for controlling motors from Arduino boards. The library supports hardware serial communication and includes all essential motor control functions.

Installation

Install the library through the Arduino Library Manager:

- 1. Open Arduino IDE
- 2. Go to Sketch → Include Library → Manage Libraries
- 3. Search for "M17 Servomotor"
- 4. Click Install

Manual Installation

Alternatively, download the library from GitHub and install manually:
https://github.com/tomrodinger/servomotor/tree/main/arduino_library

Example: Basic Motor Control

This example shows how to initialize a motor, enable mosfets, and perform a trapezoid move:

```
// Minimal Arduino example: Trapezoid move using built■in unit conversions
// Goal: spin the motor exactly 1 rotation in 1 second, then stop.
// Sequence:
//  enable MOSFETs -> trapezoidMove(1.0 rotations, 1.0 seconds) -> wait 1.1s -> disable MOSFETs.
//
// Notes:
// - This uses the library's unit conversion (no raw counts/timesteps).
// - Configure Serial1 pins for your board (ESP32 example pins below).
// - Motor is created AFTER Serial1.begin(...) so hardware UART pins are set first.

#include <Servomotor.h>

#define ALIAS 'X'                    // Device alias
#define BAUD 230400                  // RS485 UART baud rate
#define DISPLACEMENT_ROTATIONS 1.0f // 1 rotation
#define DURATION_SECONDS 1.0f       // 1 second
#define TOLERANCE_PERCENT 10        // +10% wait margin because the motor's clock is not
                                    //  perfectly accurate
#define WAIT_MS ((unsigned long)(DURATION_SECONDS * 1000.0f * (100 + TOLERANCE_PERCENT) / 100))

// Example RS485 pins for ESP32 DevKit (change as needed for your board)
#if defined(ESP32)
#define RS485_TXD 4               // TX pin to RS485 transceiver
#define RS485_RXD 5               // RX pin from RS485 transceiver
#endif

void setup() {
  Serial.begin(115200); // Console serial for debugging

  // Create the motor; serial port opens on first instantiation.
#if defined(ESP32)
  Servomotor motor(ALIAS, Serial1, RS485_RXD, RS485_TXD);
#else
  Servomotor motor(ALIAS, Serial1);
#endif

  // Use units: rotations for position, seconds for time
  motor.setPositionUnit(PositionUnit::SHAFT_ROTATIONS);
  motor.setTimeUnit(TimeUnit::SECONDS);

  motor.enableMosfets();
  motor.trapezoidMove(DISPLACEMENT_ROTATIONS, DURATION_SECONDS);
  delay(WAIT_MS);
  motor.disableMosfets();
}

void loop() {
}
```

Hardware Connections

- Arduino TX → Motor RX (via level shifter if needed)
- Arduino RX → Motor TX (via level shifter if needed)
- Arduino GND → Motor GND
- Motor Power → 12-48V DC power supply

Key Features

- Simple, intuitive API for motor control
- Support for multiple motors on different serial ports
- Built-in error checking and timeout handling
- Compatible with Arduino Uno, Mega, Due, and other boards
- Minimal memory footprint

Additional Resources

For more examples and API reference, see the library documentation at:
https://github.com/tomrodinger/servomotor/wiki/Arduino-Library

Company Information

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Open Source

We believe in making the world better through technology. All software, firmware, and PCB design files are available here:

https://github.com/tomrodinger/servomotor

open source hardware

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For more information and technical support, please contact our sales team.