waveshare ST3215

waveshare ST3215 30KG High Precision Serial Bus Servo Motor User Manual

Model: ST3215 | Brand: waveshare

1. Introduction

This manual provides detailed instructions for the waveshare ST3215 30KG High Precision Serial Bus Servo Motor. It covers the product's features, setup procedures, operating modes, technical specifications, maintenance guidelines, and troubleshooting tips. Please read this manual thoroughly before operating the device to ensure proper functionality and longevity.

2. Key Features

- **High Torque Output:** Delivers up to 30kg.cm of torque at 12V, suitable for demanding robotic applications.
- **High Precision Magnetic Encoder:** Equipped with a 360° programmable magnetic encoder, offering 360-degree absolute angle control with an accuracy of 360°/4096.
- **Serial Bus Connectivity:** Supports connection of up to 253 servos in series, enabling complex multi-servo systems.
- **Two-Way Feedback:** Provides real-time feedback on position, load, speed, and input voltage for each connected servo.
- **Dual Operating Modes:** Switchable between servo angle control mode and continuous rotation motor mode.
- **Adjustable Middle Position:** Any angle can be set as the middle position for flexible assembly and calibration.
- **Acceleration Start/Stop Function:** Ensures smoother movement transitions.
- **Wide Voltage Input:** Operates on 6V to 12.6V, compatible with 2S or 3S lithium batteries.
- **Durable Construction:** Features high-strength aluminum servo wheels, high-precision copper and steel gears, and a robust nylon and fiberglass case.

3. Setup and Connection

Follow these steps to set up your waveshare ST3215 servo motor:

1. **Unpacking:** Carefully remove the servo and included accessories from the packaging. The package typically contains the ST3215 Servo, a connection cable, and mounting hardware.
2. **Mounting:** Secure the servo to your project structure using the provided screws and mounting plates. Ensure the servo is firmly attached to prevent movement during operation.

Figure 3.1: waveshare ST3215 Servo with included cable and mounting hardware.

Figure 3.2: waveshare ST3215 Servo with a mounting disc attached to the output shaft, ready for integration.

3. **Power Connection:** Connect the servo to a power supply within the 6V to 12.6V range. Ensure the polarity is correct. The servo can be directly powered by a 2S or 3S lithium battery.
4. **Serial Bus Connection:** Connect the servo to your control board (e.g., a servo driver board) using the serial bus cable. Multiple servos can be daisy-chained for serial communication.

Figure 3.3: Illustration of UART Serial Bus Control, demonstrating how multiple servos can be connected in series to a single control board. Note: A robust power supply is crucial when connecting many servos.

5. **Initial Configuration:** Refer to the programming guide for your specific control board to set the servo ID, baud rate, and operating mode.

4. Operating Modes

The ST3215 servo supports two primary operating modes:

4.1. Servo Angle Control Mode

In this mode, the servo maintains a specific angular position. You can command the servo to move to any angle within its 360° range with high precision. The 360° magnetic encoder allows for absolute angle control.

4.2. Continuous Rotation Motor Mode

This mode allows the servo to rotate continuously, functioning like a DC motor. You can control the direction and speed of rotation. This is useful for applications requiring continuous movement, such as wheels or conveyor belts.

4.3. Two-Way Feedback

The serial bus interface enables the servo to provide real-time feedback to the control system. This includes:

- **Position:** Current angular position of the servo.
- **Load:** Current load experienced by the servo.
- **Speed:** Current rotational speed.
- **Input Voltage:** Real-time voltage supplied to the servo.

Figure 4.1: Visual representation of the ST3215 servo's two-way feedback capabilities and its dual operating modes (servo and motor).

4.4. Calibrating Middle Position

The servo allows for easy calibration of its middle position:

1. Install the servo at any desired 360° orientation.
2. Using the control interface, select the option to set the current position as the middle position.
3. Confirm the setting. The servo will now consider this new position as its neutral or middle point.

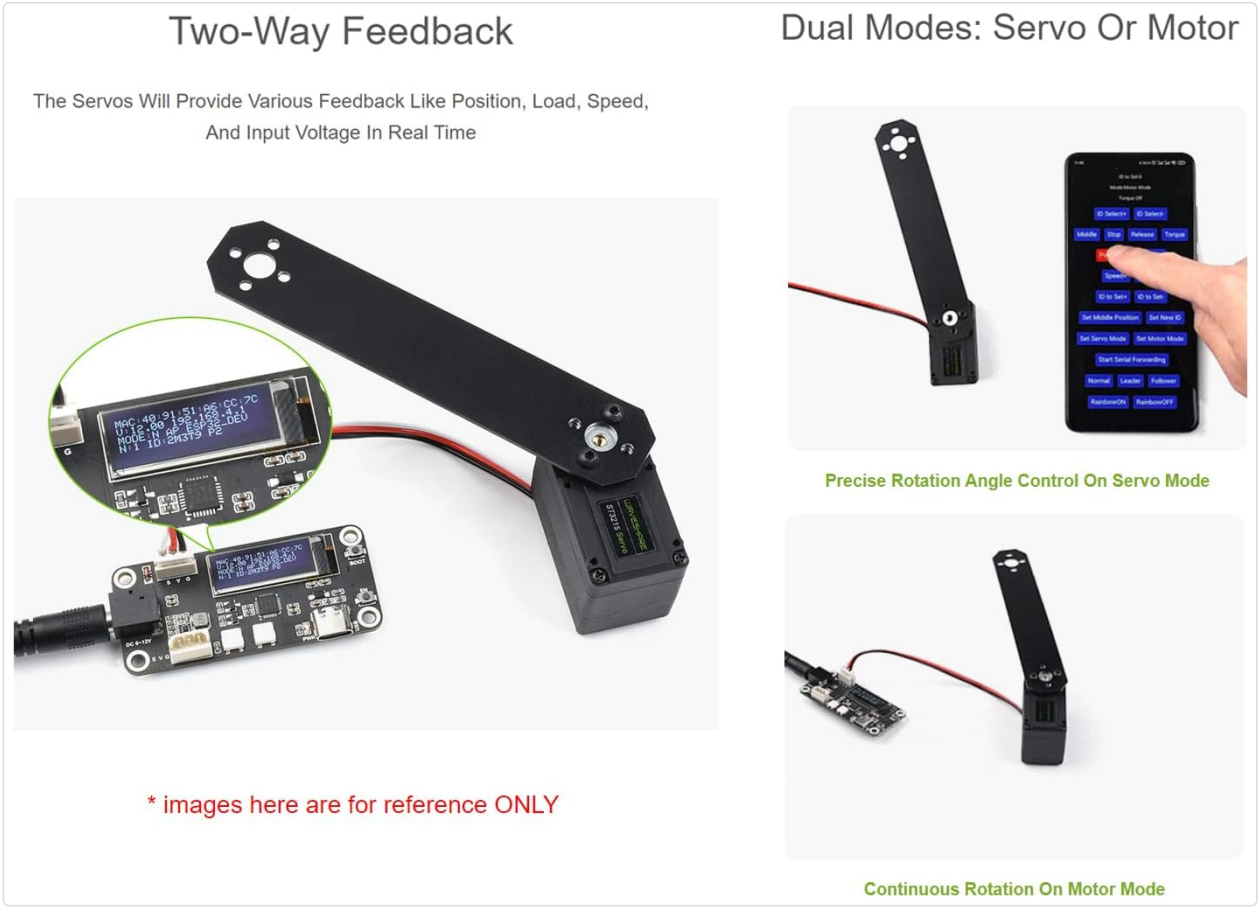


Figure 4.2: Step-by-step guide for calibrating the middle position of the ST3215 servo using a control interface.

5. Technical Specifications

Parameter	Value
Product Type	ST3215 Serial Bus Servo
Torque	30kg.cm @ 12V
Rotation Angle	360° (0~4095)
Position Sensor Resolution	360° / 4096
Mechanism Limited Angle	No Limit
Operating Voltage	6 ~ 12.6 V
Gear Type	High Precision Metal Gear
No-Load Speed	0.222 sec / 60° (45 RPM) @ 12V
Encoder Type	360° Magnetic Encoder
ID Range	0 ~ 253
Baudrate	38400bps ~ 1Mbps (1Mbps by default)
Feedback Parameters	Position, Load, Speed, Input Voltage
No-Load Current	180 mA

Parameter	Value
Locked-Rotor Current	2.7A
KT (Torque Constant)	11kg.cm/A
Dimensions (L x W x H)	45.22 x 35 x 24.72 mm (1.78 x 1.38 x 0.97 inches)
Item Weight	69g (2.64 ounces)

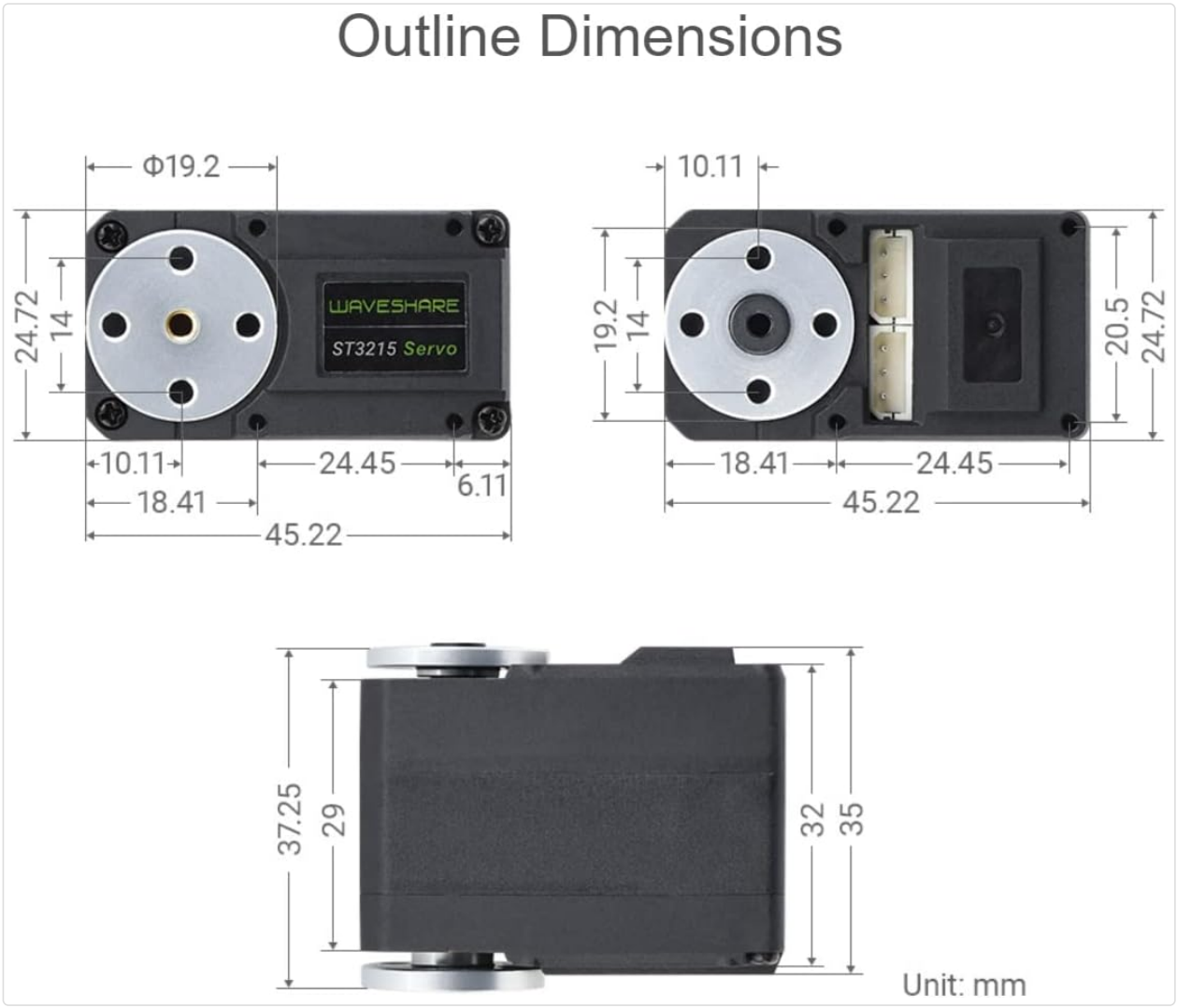


Figure 5.1: Outline dimensions of the ST3215 servo motor, with measurements in millimeters.

6. Maintenance

To ensure optimal performance and extend the lifespan of your ST3215 servo motor, consider the following maintenance guidelines:

- **Keep Clean:** Regularly clean the exterior of the servo to prevent dust and debris accumulation, especially around the output shaft and ventilation areas.
- **Avoid Overload:** Do not exceed the specified torque limits. Continuous overloading can lead to premature wear of gears and motor damage.
- **Proper Power Supply:** Always use a stable power supply within the recommended voltage range (6V to 12.6V). Incorrect voltage can damage the internal electronics.
- **Inspect Connections:** Periodically check all electrical connections for looseness or damage. Secure

connections are vital for reliable operation.

- **Environmental Conditions:** Operate the servo within appropriate temperature and humidity ranges. Avoid exposure to extreme conditions or corrosive environments.

7. Troubleshooting

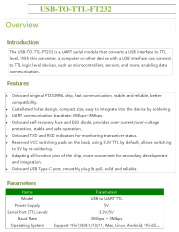
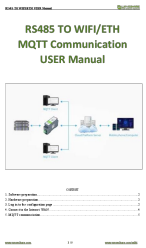
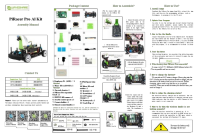
If you encounter issues with your ST3215 servo, refer to the following common problems and solutions:

Problem	Possible Cause	Solution
Servo does not respond	No power, incorrect wiring, incorrect servo ID, communication error.	Check power supply and connections. Verify servo ID and baud rate settings. Ensure the control board is functioning correctly.
Servo moves erratically or vibrates	Loose connections, mechanical obstruction, excessive load, power supply instability.	Inspect all connections. Remove any obstructions. Reduce mechanical load. Ensure power supply is stable and sufficient.
Servo overheats	Continuous high load, insufficient cooling, short circuit.	Reduce load or operating time. Ensure adequate ventilation. Check for any short circuits in wiring.
Inaccurate positioning	Encoder issue, mechanical backlash, incorrect calibration.	Recalibrate the middle position. Check for any loose gears or mechanical play.
Multiple servos not communicating	Incorrect ID assignment, power supply issues for multiple servos, baud rate mismatch.	Ensure each servo has a unique ID. Verify the power supply can handle the cumulative current draw. Confirm all servos and the controller use the same baud rate.

8. Support and Warranty

waveshare provides development resources and technical support for the ST3215 servo motor. If you encounter any issues that cannot be resolved using this manual, or require further assistance with integration and programming, please contact waveshare customer support.
For specific warranty information, please refer to the purchase documentation or contact your retailer. General warranty terms typically cover manufacturing defects for a specified period from the date of purchase.

Related Documents - ST3215

	[ST3215 Servo User Manual - Waveshare] Comprehensive user manual for the Waveshare ST3215 Servo driver board, detailing setup with ESP32, usage, AT commands, servo types, WiFi connectivity, and development examples for Arduino, Raspberry Pi, and Jetson.
	[Waveshare Pico Servo Driver: 16-Channel Control for Raspberry Pi Pico] Discover the Waveshare Pico Servo Driver, a 16-channel, 16-bit resolution module designed to expand the capabilities of the Raspberry Pi Pico. This guide details its features, specifications, and setup for controlling multiple servos with precision.
	[Waveshare WS-TTL-CAN User Manual: TTL to CAN Converter Guide] Explore the Waveshare WS-TTL-CAN module with this comprehensive user manual. Learn about its TTL and CAN communication capabilities, hardware features, parameter configuration using WS-CAN-TOOL, and various conversion examples.
	[USB-TO-TTL-FT232 UART Serial Module - Waveshare] Comprehensive guide for the Waveshare USB-TO-TTL-FT232 module, featuring the FT232RNL chip. This document details its features, onboard interface, pinout, dimensions, and provides step-by-step instructions for driver installation and usage on Windows, Linux, and macOS. Includes links to drivers and software.
	[Waveshare RS485 to WiFi/ETH MQTT Communication User Manual] Comprehensive user manual for the Waveshare RS485 to WiFi/ETH module, guiding users through software and hardware preparation, network configuration, and establishing MQTT communication with platforms like EMQX.
	[PiRacer Pro AI Kit Assembly Manual - Waveshare] Detailed assembly guide for the Waveshare PiRacer Pro AI Kit, covering package contents, step-by-step building instructions, usage tips, and troubleshooting FAQs for this educational robot platform.