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Parallax Continuous Rotation Servo (#900-00008)

The Parallax Continuous Rotation Servo provides bi-direcitonal continuous rotation with a linear response to pulse width. Two are used to power the drive wheels in the following Parallax robotics kits:

- BASIC Stamp Boe-Bot (#28132, #28832, #81031)
- SumoBot, Original (#27400) and WX (#32134)
- Shield-Bot with Arduino (#32335 & 81033)
- cyber:bot with micro:bit (#32700)

This document supports the Digital version of the Parallax Continuous Rotation Servo, released in summer 2022. It is designed to be a drop-in replacement of the previous analog version for the purpose of Parallax robotics; applications like adding this device to a digital bus are not supported. For the analog Parallax Continuous Rotation Servo previously sold, see the product guide version 2.2 available from the 900-00008 product page at www.parallax.com.

For best results, use two of the same type (analog or digital) when selecting or replacing servos for your robot.

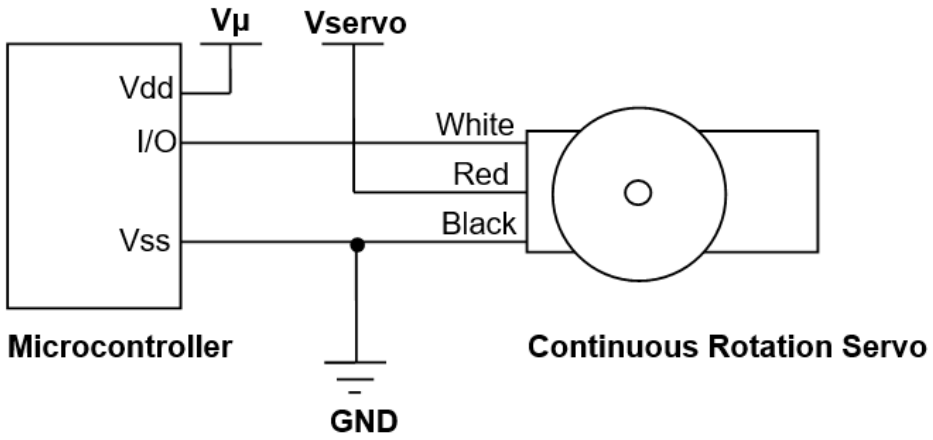
Features

- Bidirectional continuous rotation
- 0 to +/-50 RPM with 5 V supply
- Linear response to pulse-width for easy speed ramping
- Color coded cable (red VDD, white signal, black ground) with 3-pin 0.1" socket
- Accepts four mounting screws
- Easy to interface with any Parallax microcontroller or PWM-capable device

Specifications

- Gear material: POM (polyacetal)
- Spline: 3F 25-tooth
- Weight: 1.50 oz (42.5 g)
- Torque: 38 oz-in @ 6 V
- Power requirements: 4 to 6 VDC; Maximum current draw 140 +/- 50 mA at 6 VDC when operating in no load conditions, 15 mA when in static state
- Communication: pulse-width modulation
- Center pulse width: 1520 µs (before manual centering)
- Zero speed seadband: 12 µs
- Dimensions: approx 2.2 x 0.8 x 1.6 in (5.58x 1.9 x 4.06 cm) excluding servo horn
- Operating temperature range: 14 to 122 °F (-10 to +50 °C)

Electrical Connections



Vμ = microcontroller voltage supply

Vservo = 4 to 6 VDC, regulated or battery

I/O = PWM TTL or CMOS output signal, 3.3 to 5 V; < Vservo + 0.2 V

To use this servo with a Parallax robot, refer to the robot's documentation on learn.parallax.com. To use this servo with other devices, keep the following power precautions and other tips below in mind.

Power Precautions

- Power the servo with regulated 4-6 VDC, with a supply that can provide up to 500 mA as load may spike when the servo starts, stops, or turns. Four alkaline AA batteries or five NiMH rechargeable batteries in series are also acceptable as a supply for these servos.
- Servo current draw can spike while under peak load; be sure your application's regulator is rated to supply adequate current for all servos used in combination.
- Do not use this servo with an unregulated wall-mount supply. Such power supplies may deliver variable voltage far above the stated voltage.
- Do not try to power the servo directly through a microcontroller I/O pin.

Other Tips

- Calibrate (center) the servo with your project's microcontroller before permanently installing it into your application.
- Calibration requires access to the port in the side of the servo's case. For periodic recalibration, you may wish to design your project so the port remains accessible after installation.
- When using two servos for a small robot's drive wheels, use two of the same type (analog or digital).
- When using two servos for a small robot's drive wheels with servo horns pointed outwards, keep in mind that one servo must rotate clockwise while the other rotates counterclockwise at the same rate in order for the robot to drive straight.

Device Information

The Parallax continuous rotation servo relies on pulse width modulation to control the rotation speed and direction of the servo shaft. Before using the servo in a project, it is important to calibrate the servo's center setting in order to define the pulse width value at which the servo holds still (see the section Calibration – "Center" the Servo).

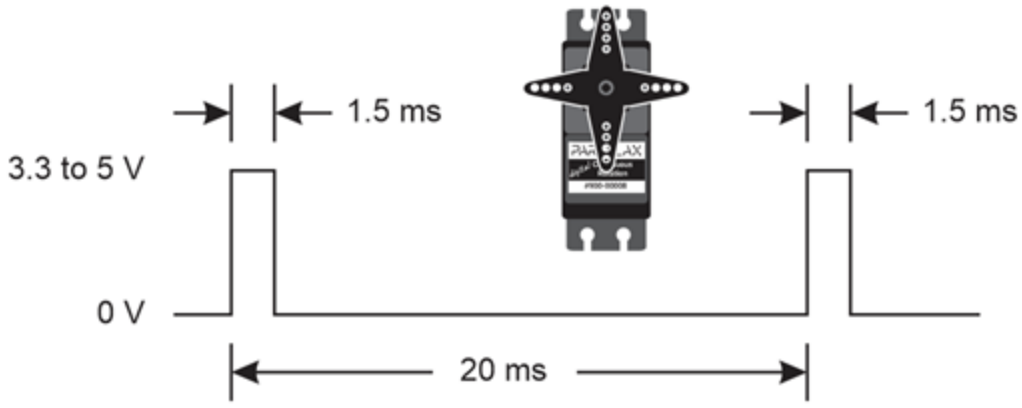
Specifications

Pin	Name	Description	Minimum	Typical	Maximum	Units
1 (White)	Signal	Input; TTL or CMOS	3.3	5.0	Vservo + 0.2	V
2 (Red)	Vservo	Power Supply	4.0	5.0	6.0	V
3 (Black)	Vss	Ground		0		V

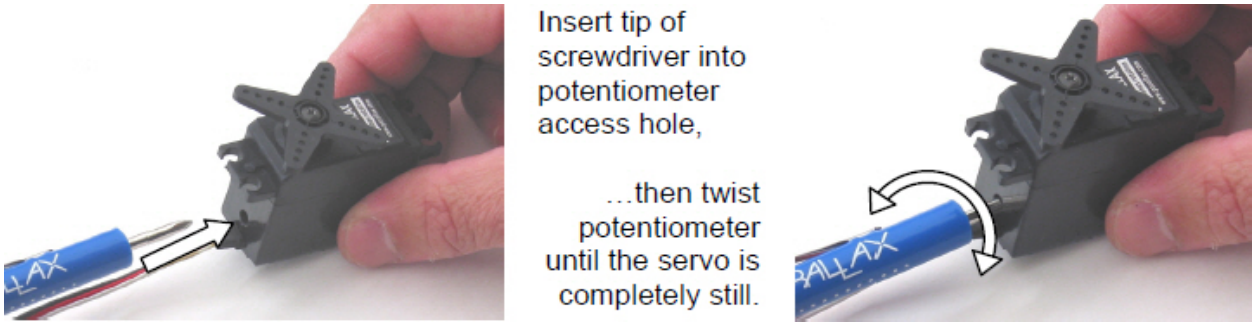
Calibration – "Center" the Servo

In most Parallax small robots, the servos are manually centered. Centering is a procedure that makes the servo stay still in response to a certain control signal.

Step 1: A microcontroller is programmed to send 1.5 ms (1500 µs) control pulses every 20 ms. In response to these pulses, a servo that has not been centered before typically responds by turning its output shaft (and horn) slowly clockwise.



Step 2: A #1 Phillips screwdriver is used to adjust the servo's trim potentiometer to make it stop turning. This establishes the 1.5 ms (1500 µs) as the signal to make the servo stay still.



NOTE: The above procedure does not ensure that the middle of the servo's deadband range is aligned with 1500 µs. For example, instead of staying still in response to pulses in the 1494 to 1506 µs range, it might instead stay still in response pulses in the 1490 µs to 1502 µs range. To more precisely center the servo around 1500 µs pulses, a microcontroller program can be written that repeatedly sends:

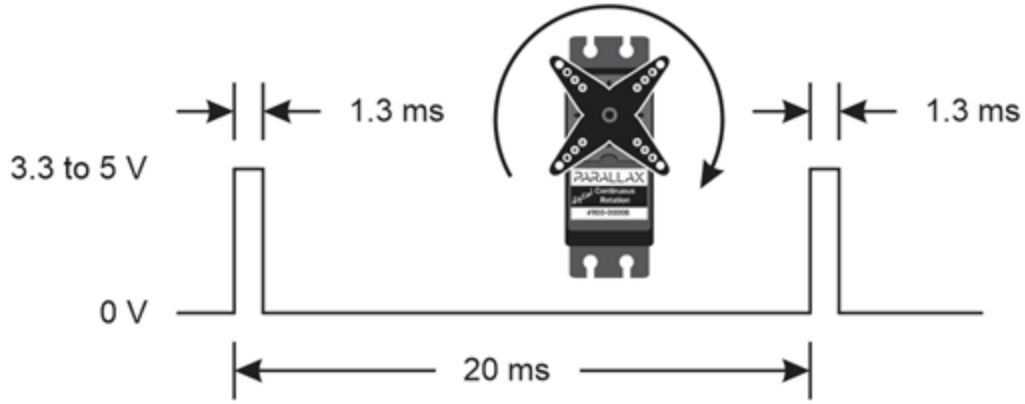
- 1485 µs pulses every 20 ms for 2 seconds
- 1515 µs pulses every 20 ms for 2 seconds.

Adjust the potentiometer with the screwdriver until the slow counterclockwise and clockwise velocities match.

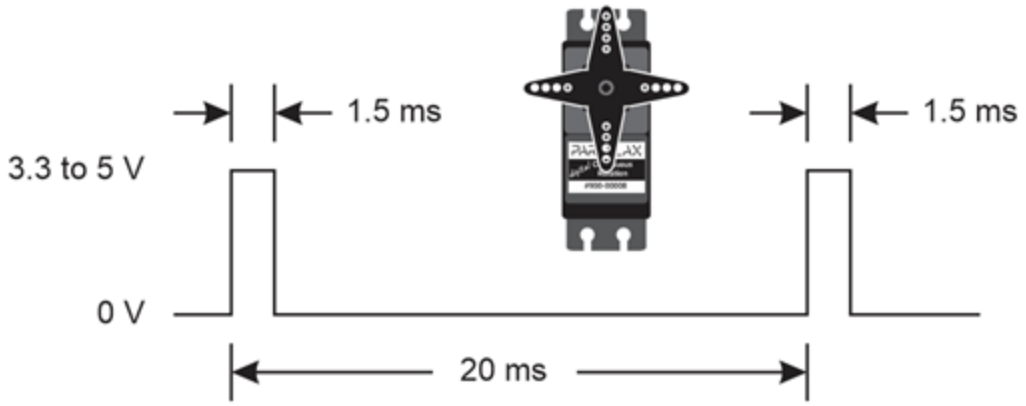
Communication Protocol

The Parallax Continuous Rotation Servo is controlled through pulse width modulation. Rotational speed and direction are determined by the duration of a high pulse, in the 1.3–-1.7 ms range. To rotate smoothly, the servo needs the control pulses to be repeated every 20 ms. Below are example timing diagrams for signals to make the servo turn full speed in both directions as well as stay still (assuming the centering procedure above has been completed):

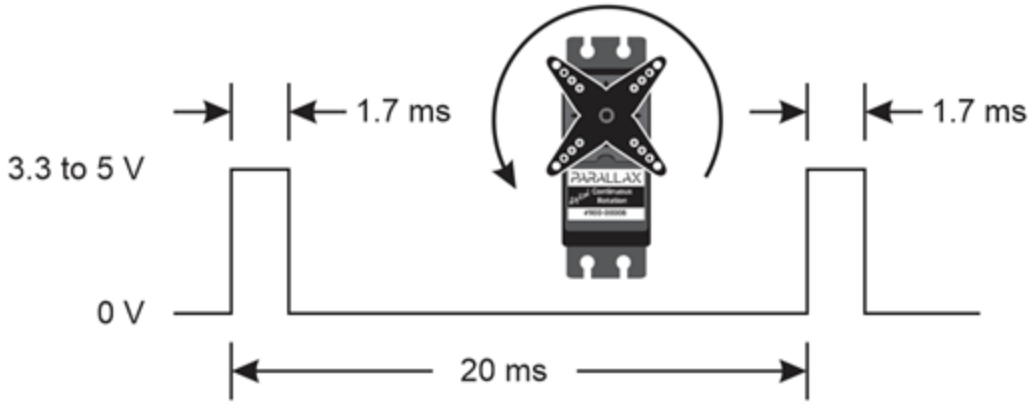
Full speed clockwise:



No rotation:

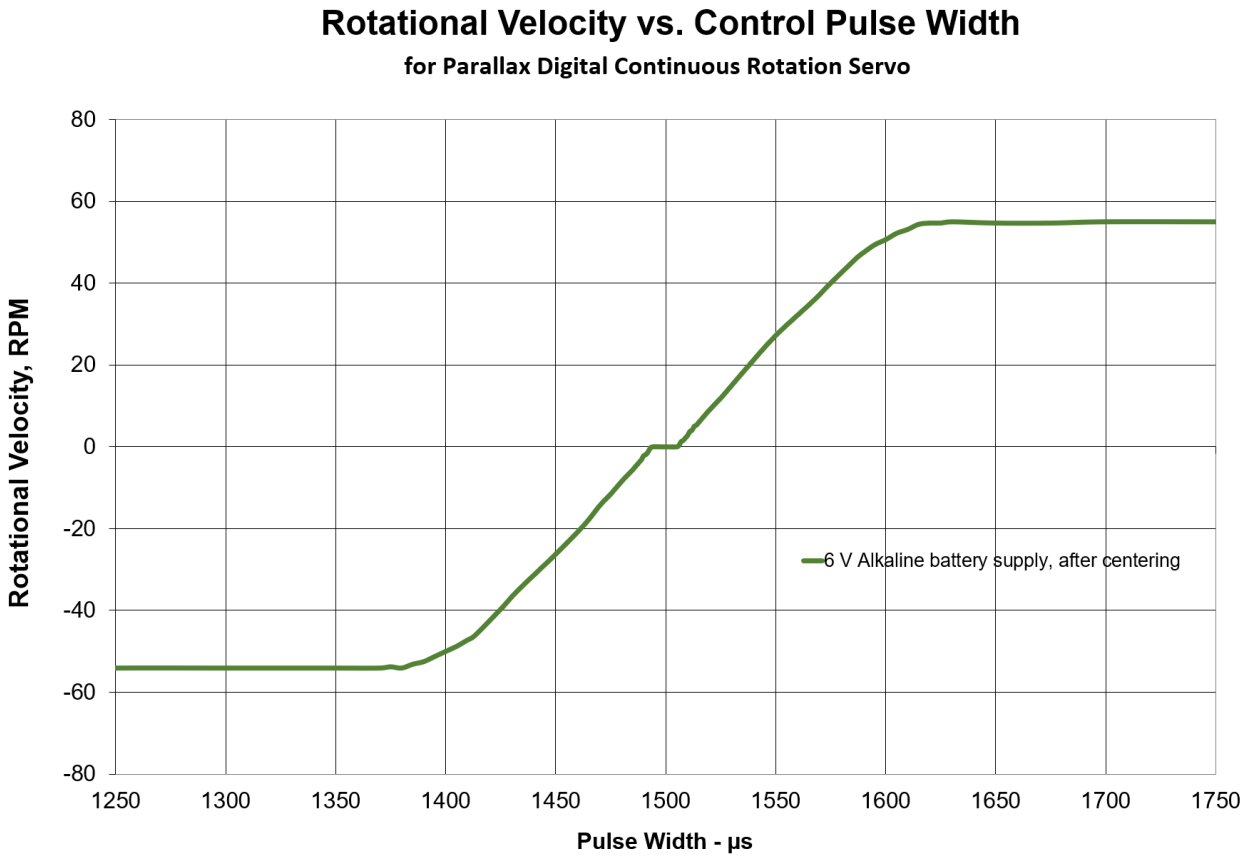


Full speed counterclockwise:



Control Servo Speed with Pulse Widths from its Transfer Function

The transfer function graph below shows the servo's velocity response to pulse width. Positive RPM values represent counterclockwise rotation; negative values represent clockwise rotation. With the servo precisely centered at 1500 µs, counterclockwise rotation speed increases linearly as the control pulse width is swept from 1506 to 1586 µs. Pulse widths at or above 1620 µs result in full speed. Likewise, clockwise rotation speed increases linearly with control pulse widths from 1494 to 1914 µs, and pulses with durations less than 1380 µs result in full speed.

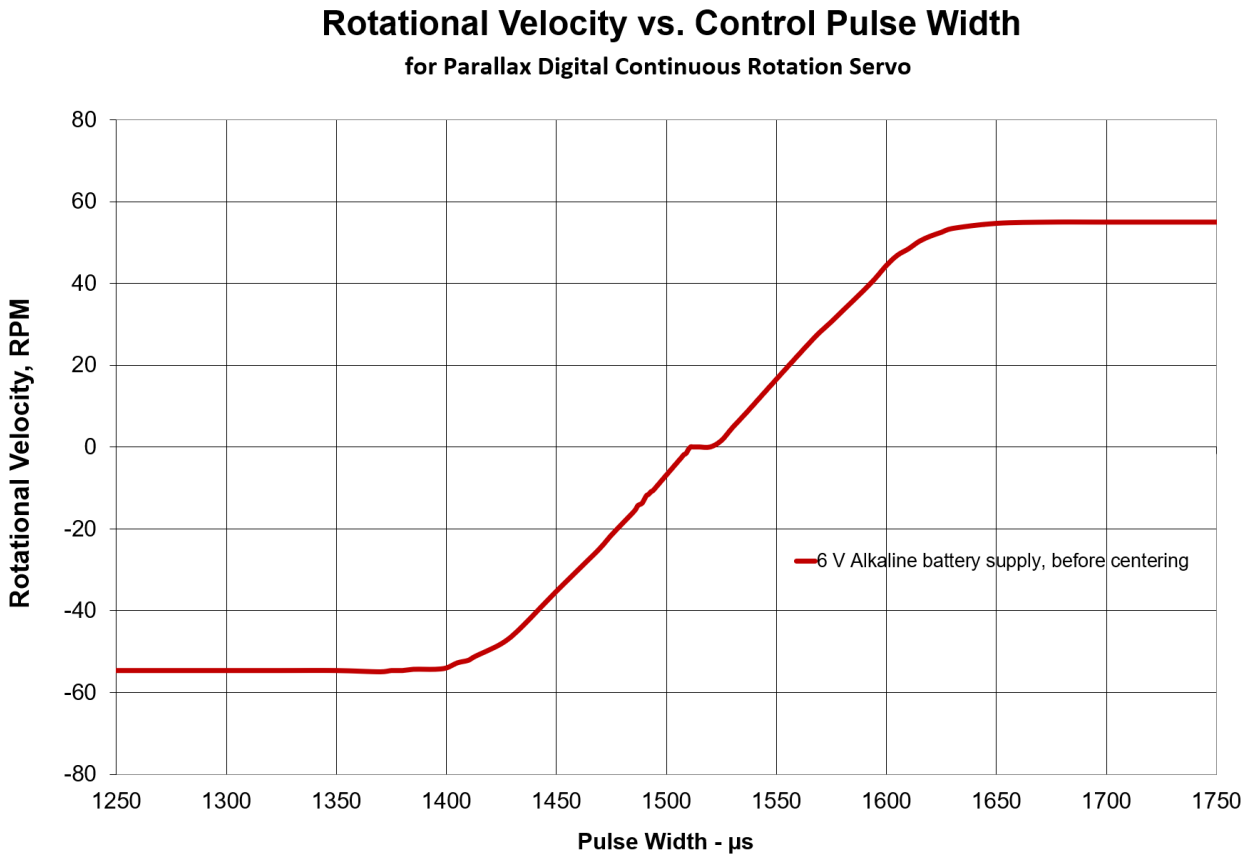


NOTES:

Variations in manufacturing, supply, temperature, and centering will affect your servo's actual values. Particularly, battery pack decay will affect the velocity response. The servos will run faster with new batteries, but the speed will decay as the batteries drain. With these variations in mind, supply voltage and control signal adjustment will be needed to suit your continuous rotation servo application.

Maximum RPM will vary with input voltage; 50 RPM @ 5 V is typical.

Before manual centering, the transfer function for a Parallax Digital Continuous Rotation Servo resembles this plot. The zero speed deadband is typically 12 µs wide, and centered at 1520 µs.



Resources and Downloads

Check for the latest servo documentation and resources on the #900-00008 product page at www.parallax.com. For servo use in a specific Parallax robot see the tutorials at learn.parallax.com.

Revision History

3.0 supports the digital version of the Parallax Continuous Rotation Servo, released in June 2022. See 2.2 for information on the previous analog version of this servo; it is available from the 900-00008 product page at www.parallax.com.