PARALLAX

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# Parallax Standard Servo (#900-00005)

The Parallax Standard Servo provides a 180° range of motion and position control for your project. This document supports the *digital* version of the Parallax Standard Servo, released in summer 2022. It is designed to drop-in replace the previous analog version for Parallax educational kits. Applications such as adding this device to a digital bus are *not* supported. For documentation of this servo's previous analog version, see the product guide version 2.2 available from the 900-00005 product page at www.parallax.com.

## Features

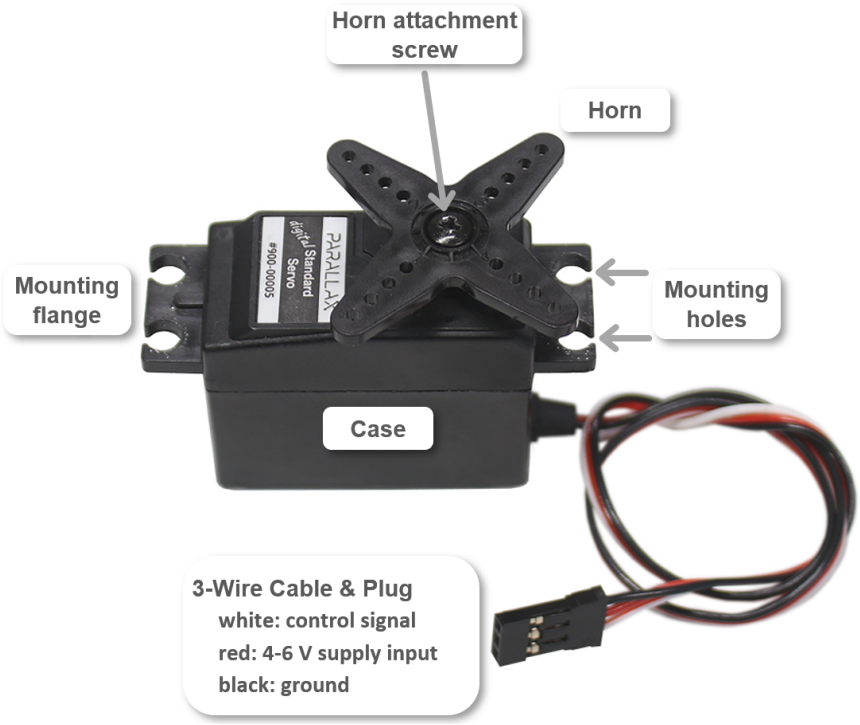

- Turns to and holds positions between 0° and 180°
- 38 oz-in torque at 6 VDC
- 4 holes for mounting screws, 2 in each flange
- Easy to interface with any Parallax microcontroller or PWM-capable device
- High-precision gears made of POM (polyacetal) resin make for smooth operation with no backlash
- Weighs only 1.48 oz (42 g)

## Key Specifications

- Gear material: POM (polyacetal)
- Spline: 3F 25-tooth
- Weight: 1.48 oz (42 g)
- Torque: 38 oz-in @ 6 V
- Speed: 0.19 sec/60 deg @ 6.0 V, 0.23 sec/60 deg @ 4.8 V.
- Supply voltage: 4 to 6 VDC
- No load voltage/current: 100 mA at 6 VDC in motion, 20 mA at resting state. *
- Communication: pulse-width modulation (50 Hz)
- Operational pulse control signal range: 500 µs to 2530 µs +/-20 µs
- Approximate angular responses to pulse widths:
  (620 µs, 1520 µs, 2420 µs) maps to (0°, 90°, 180°) with angles increasing from clockwise to counterclockwise
- Approximate internal mechanical limits: -10° and 190°
- Dimensions: approx 2.2 x 0.8 x 1.6 in (5.58 x 1.9 x 4.06 cm) excluding servo horn
- Operating temperature range: 14 to 122 °F (-10 to +50 °C)

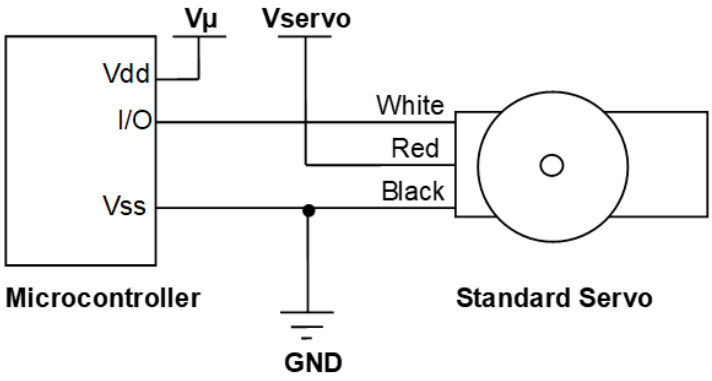
* Under certain load conditions, current can briefly increase to 500 mA or more, and the supply should be chosen to accommodate this.

## External Features




## Connection Diagram

**Vss to black wire**: microcontroller to servo common ground (0 V reference)
**Vμ**: microcontroller's positive voltage supply
**Vservo to red wire**: Separate positive supply to the servo *
**I/O to white wire**: Connection for PWM control signal transmitted from microcontroller to servo




* Vμ and Vservo are typically different supplies. This prevents sudden increases in servo current under load from causing a brown-out condition in the microcontroller. Some designs do use a single regulator to supply both, but only when the microcontroller allows a supply in the 4-6 V range and the voltage regulator supplying both devices can hold its output voltage while supplying enough current to all connected servos at simultaneous peak current.

## Voltage Specifications

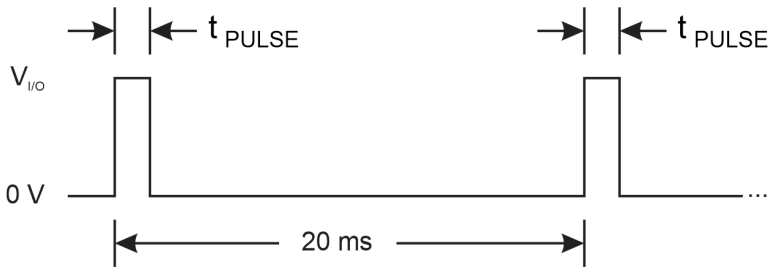
| Pin | Name | Description | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| 1 (white) | Signal | Input, TTL or CMOS | 3.3 | 5.0 | Vservo+0.2 | V |
| 2 (red) | Vservo | Power Supply | 4.0 | 5.0 | 6.0 | V |
| 3 (black) | Ground | Ground | | 0 | | V |

## Power Precautions

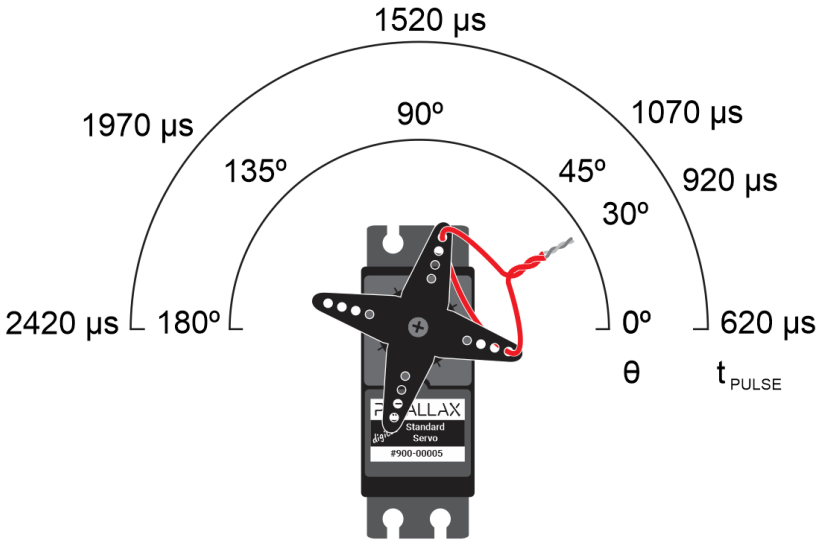
- Servo current draw can spike while under load. Be sure that your application's power supply and voltage regulator are prepared to supply adequate current for all servos used.
- Do not try to power this servo directly from microcontroller I/O pins.
- Some voltage supplies that draw power from AC sockets might not deliver their rated voltage. Avoid using one without first testing it in the no load through full load range to verify that it supplies between 4 and 6 V from 20 mA to 500 mA.

## Control Signals

The Parallax *digital* Standard Servo is controlled by pulse width modulation (PWM) signals transmitted from the microcontroller's I/O pin to the servo's white wire. The duration of the high signals is $t_{PULSE}$ in the diagrams, and they control the servo horn's angular position. While the signal is repeated every 20 ms (50 Hz), the servo will hold the angle dedicated by $t_{PULSE}$. The servo will no longer hold its position or resist opposing forces applied to the servo horn when the pulses stop, or if the pulse width delivered is outside of the servo's operational range (500 µs to 2530 µs +/-20 µs.)




Here are some examples of $t_{PULSE}$ durations for common angular positions (Θs). This setup assumes that the servo horn was unscrewed and removed from the spline, then pressed back on with the jumper wire pointing at 0° while the microcontroller was sending the servo $t_{PULSE}$ = 620 µs signals. After that, the other $t_{PULSE}$ signals will result (approximately) in the other corresponding angles.




The relationship between angle (Θ) and $t_{PULSE}$ follows these two equations. The first is for determining $t_{PULSE}$ for a desired angle (Θ), and the second is the inverse, for determining angle (Θ) given a certain $t_{PULSE}$.

$$t_{PULSE} = 10 \times \theta + 620\ \mu s$$

$$\theta = \frac{t_{PULSE} - 620\ \mu s}{10}$$

Here is an example of how the angular position to pulse duration equation might look in a microcontroller program.

```
t_pulse = 10 * angle + 620
servo_pwm(t_pulse)
```

Keep in mind that servo_pwm(t_pulse) represents a function call that sets the pulse microsecond high times every 20 ms in a repeating PWM signal to the servo. Although the function's name tends to vary with each microcontroller servo control and/or PWM API, it is a common feature and example code demonstrating it with servos should be readily available as well.

## Parallax Standard Servo vs. Parallax *digital* Standard Servo

The Parallax Standard Servo (without "digital" in the label) was in production from mid 2007 to early 2022, under the same 900-00005 stock code. While every effort was made to create a digital drop-in replacement, there's a chance some differences might be noticeable in applications that were tuned to the analog servo's behavior. If your existing application fits that description, consider these known differences and retune your application code accordingly:

- This servo has the word "digital" on its label. All earlier analog versions do not.
- Top-speed, no-load current is lower (100 mA vs. 120 mA nominal)
- Resting current is slightly higher (20 mA vs. 10 mA nominal)
- More consistent speed while turning to target angle. Specifically, the time it took the analog servo to reach a target varied more with manufacturing runs and other factors. So, in some applications, a difference in the time it takes this digital servo to reach a given target angle might be noticeable even though its rated speed has not changed.
- Instead of continuing to exert force against its mechanical limits, this servo stops applying pressure if it receives pulses outside the 500 to 2530 µs (+/- 20 µs) range. This is not normally an issue since control pulse durations that cause it to rotate beyond its mechanical limits are avoided since they cause excessive wear that can significantly reduce the device's lifespan. If your application uses pulses outside the 620 µs to 2420 µs range for holding angles outside +/- 90°, make sure to test to verify that it does not reach its mechanical limits.

For best results, use all of the same type (analog or digital) when selecting or replacing servos in your project. To use this servo with a Parallax tutorial, refer to the tutorial's documentation on learn.parallax.com.

## Revision History

3.0 supports the digital version of the Parallax Standard Servo, released in August 2022. See v 2.2 for information on the previous analog version of this servo; it is available from the 900-0000 product page at www.parallax.com.