

# Servo Joystick

SKU: 3109-0008-0001-V1.0



The Servo Joystick is a servo controller with 3 outputs and user-definable settings. The side-to-side and forward-and-aft movement of the joystick controls two outputs that can be either mixed or independent, as well as independently reversed. The BTN output, controlled by pressing the joystick like a button, can be set to cycle through 2 or 3 positions. The Servo Joystick also offers an adjustable PWM range (up to 500µs to 2500µs). Along with its wide input voltage range, these options allow you to expertly control a wide variety of servos.

**The input voltage is passed directly to the servos, so a compatible voltage must be used.**

## Features:

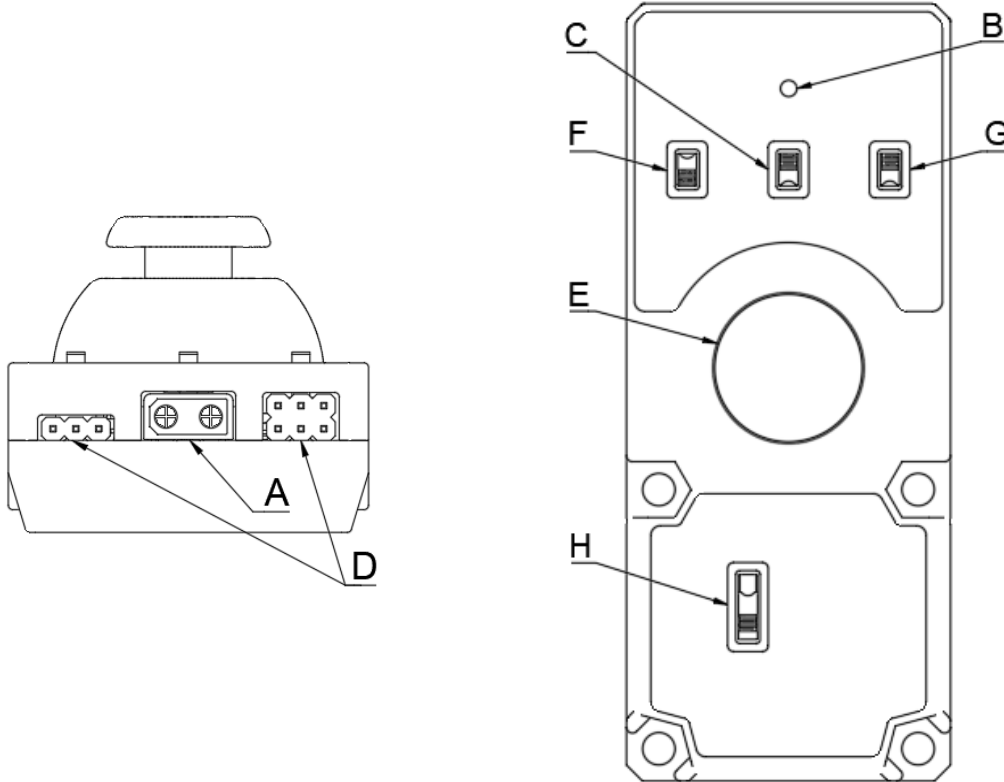
- Configurable PWM Range
- Independent X&Y Reversing
- Output Mixing
- 2 or 3 Position PWM Switch
- Reverse Voltage Protection
- Voltage Surge Protection
- Fully-Encased Rugged Design
- goBILDA® Hole Pattern

SUMMARY OF PRODUCT RATINGS	
Input Voltage	5V – 15V
No Load Current Draw	20 mA
Input Power Connector	XT30 or TJC8
Servo Output Connectors	3

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## 1 Hardware Overview



Hardware Overview		
ID	Name	Description
A	XT30 Input	Power source connection
B	Power LED	Blue LED used to indicate when powered and ON
C	ON / OFF	Cuts off or allows power from the XT-30
D	Servo Connectors	TJC8 servo headers (& alternate power source connection)
E	Joystick	Interface used to control X & Y outputs
F	MIX ON / MIX OFF	Determines if X & Y outputs are mixed
G	2 POS / 3 POS	Determines how many positions the BTN output toggles between
H	PWM Range	Determines the minimum and maximum PWM range for all outputs

## 1.1 Powering the Servo Joystick

The Servo Joystick is designed to accept a battery or a wall-mounted power supply as a power source. When powered from a battery, the Servo Joystick recovers some voltage fed back from the servo and stores it in the battery for later use. Alternatively, when a wall-mounted power supply is used, these over-voltage events are suppressed and kept from feeding back to the power supply. This avoids triggering over-voltage protection on wall-mounted power supplies.

- **The main power connector is an XT30.** The Servo Joystick can also be powered through any of the male header pins (+ and - pins).
- **The Power LED** blinks 3 times when the Servo Joystick is first turned on and remains illuminated solid while powered and ON. It is also used to indicate when the direction of X or Y has been reversed (see section [3.2](#) for details).
- The **ON / OFF switch** controls the flow of power from the XT30 port. When the **ON / OFF switch** is in the OFF position, the Servo Joystick will pull no current, no power will be supplied to the outputs, and the LED will be off. When the ON / OFF switch is in the ON position, the Power LED will blink 3 times and stay illuminated to indicate that the Servo Joystick is powered on.
- When power is supplied via the **TJC8 connectors**, the on/off state of the Joystick will be unaffected by your operation of the Joystick's ON / OFF switch. Be aware that reverse voltage protection only applies to power supplied via the XT30 port.

## 1.2 Controlling Servos

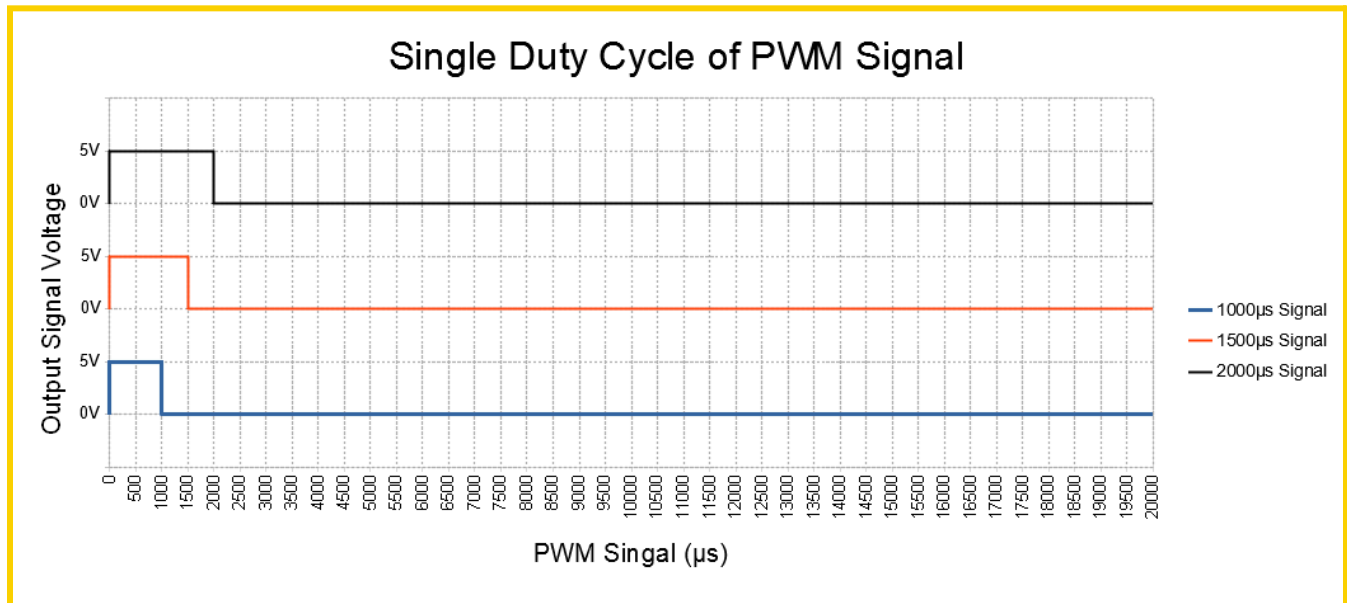
The joystick is the interface used to control the X & Y and BTN outputs.

- Movement of the joystick in any direction controls the two **X & Y outputs**.
- The joystick can be pressed like a button to control the single **BTN output**. The joystick and its relation to the outputs is described in detail in sections [3.3](#) and [3.4](#).

The **servo connectors** are male header pins with 2.54mm (0.100") spacing. These pins fit a standard TJC8 servo connector. The pins provide signal (s), power (+), and ground (-).

## 2 Control Interface

Servo position is controlled by a PWM signal controlled by movement of the joystick or set by pressing the joystick. This signal is typically referenced in terms of the time in which its square wave is high. The duty cycle of this signal is adjustable, but the maximum is between 2.5% and 12.5%. This 2.5% to 12.5% duty cycle refers to the maximum range of 500 $\mu$ s to 2500 $\mu$ s when the signal is high; outside this proportion of time, the signal is low.



## 3 Features

### 3.1 Configurable PWM Range

The Servo Joystick provides 4 configurable PWM output ranges:

- 1050µs - 1950µs
- 850µs - 2150µs
- 600µs - 2400µs
- 500µs - 2500µs

The PWM ranges below allow control of different servos while utilizing the entire throw of the joystick. Note that different brands of servos may have large variations in the PWM range. If you're using a goBILDA® Servo, reference the servo page for the maximum PWM range the servo is able to accept, as well as its corresponding rotation.

- **1050µs-1950µs** is the smallest PWM range. This range allows most servos to rotate 90 degrees. Many servos are able to rotate further if given a wider range. This range is also appropriate for goBILDA® linear servos.
- **850µs-2150µs** is a wider signal range that most servos can utilize for more rotation. This is the typical maximum signal range for Hitec and Savox digital servos.
- **600µs-2400µs** typically allows an analog servo to rotate 180 degrees. This range is too wide for some servos. If a servo does not recognize the signal while nearing the extremes, reduce the signal range to one of the narrower options. Additionally, if the servo buzzes at either extreme, it is hitting the mechanical limit of the gear train, and the PWM range needs to be decreased.
- **500µs-2500µs** is the maximum PWM range of the Servo Joystick and allows a goBILDA® servo to achieve a full 300 degrees of travel.

The PWM range can be changed using the switch near the bottom of the Servo Joystick.

## 3.2 Independent X&Y Reversing

The X&Y outputs of the Servo Joystick can be independently reversed during startup. By default, the X PWM output increases when the joystick is moved to the right and decreases when the joystick is moved to the left, while the Y PWM output increases when the joystick is moved forward and decreases when the joystick is moved backward.

To reverse X or Y directions, follow the steps below:

1. Begin with the Servo Joystick in the OFF position.
2. Press and hold the joystick button and turn the Servo Joystick ON. Release the button once the LED begins blinking rapidly.
3. While the LED is blinking rapidly (you have about 5 seconds), move the joystick to the extreme in the direction you wish to reverse. Successful input is signified by 3 slow blinks.
  - a. If you want to reverse the X direction, move the joystick completely to the left or right.
  - b. If you want to reverse the Y direction, move the joystick completely forward or backward.

**NOTE:** You may reverse both channels during this operation. You can also reverse one by completing steps 1-4, then cycle power and repeat the steps to reverse the other.

4. Once you have made your desired inputs, wait for the LED to change from rapid blinking to solid. This may take up to 5 seconds. When the LED is solid, the changes have been saved, and you may use the Servo Joystick as normal.

Direction reversals are saved and recalled through power cycles. Reversing a direction affects the X&Y outputs in both MIX ON and MIX OFF modes.

## 3.3 Output Mixing

The X & Y outputs of the Servo Joystick can be mixed or independent using the MIX ON / MIX OFF switch. When switched to MIX OFF, the top output corresponds to joystick movement in the X direction, and the bottom output corresponds to joystick movement in the Y direction.

When switched to MIX ON, the X & Y outputs are combinations of each other:

- Top Output (X) = Y PWM + (X PWM - Middle PWM (1500µs))
- Bottom Output (Y) = Y PWM - (X PWM - Middle PWM (1500µs))

When neither X or Y is reversed and the Servo Joystick is set to MIX ON:

- Joystick Forward – Top (X) and bottom (Y) outputs are both maximum PWM
- Joystick Backward – Top (X) and bottom (Y) outputs are both minimum PWM
- Joystick Left – Top (X) is maximum PWM and bottom (Y) is minimum PWM
- Joystick Right – Top (X) is minimum PWM and bottom (Y) is maximum PWM

## 3.4 2 or 3 Position BTN Output

The BTN output acts as a PWM switch that can be set to 2 or 3 positions. The output is changed when the joystick is pressed and released like a button.

- 2 POS – When the joystick is pressed, the output toggles between the minimum and maximum PWM range. If the range is set to 500-2500 $\mu$ s, the BTN output starts at 500 $\mu$ s; when the joystick is pressed, it will change to 2500 $\mu$ s. If the joystick is pressed again, it will switch back to 500 $\mu$ s. This will continue each time the joystick is clicked. This setting can be useful when controlling a claw. This state is also saved through power cycles.
- 3 POS – When the joystick is clicked, the BTN output toggles between the minimum, middle, and maximum PWM range. If the range is set to 600-2400 $\mu$ s, the BTN output will start at 600 $\mu$ s. Once the joystick is pressed, the output will change to 1500 $\mu$ s; when it is pressed again, the output will change to 2400 $\mu$ s. A subsequent press will return the output to 1500 $\mu$ s, and the press after that will return it to 600 $\mu$ s. This setting is useful when moving a robot arm between 3 positions. This state is saved through power cycles.

## 3.5 Reverse Voltage Protection

The Servo Joystick has reverse-voltage protection that is implemented in two forms. Firstly, the XT30 main power connector is keyed; a mating XT30 connector cannot be plugged in at the wrong orientation. Reverse-voltage protection circuitry is also implemented to protect the entire board. This feature only protects against reverse voltage coming in through the XT30 connector. The TJC8 servo connector pins are unprotected and can still provide power of the opposite polarity to any servos that are plugged in. Be aware that not all servos have the same level of protection against reverse voltage.

## 3.6 Voltage Surge Protection

Servos are a closed feedback loop between a motor, controller, and sensor. When reaching a target, the system will reduce speed and dissipate the excess motor energy as electricity that can find its way back into the main power lines. Closed feedback systems often do not provide premium power supply protection. Voltage surges are typically not an issue when using a battery as the main power supply, as a battery will simply absorb this energy, charging it slightly. When using a power supply, however, these voltage surges can damage a power supply or trip its protection features, turning itself off. In both outcomes, these voltage surges need to be reduced as much as possible. In the Servo Joystick, a voltage-suppressing circuit is implemented to actively and adaptively suppress any voltage surges and ensure a good user experience during any power application.

This system is adaptive to any input voltage. On boot, the device records a stable input voltage and suppresses any voltage spike. It adapts over time to increase or decrease slowly to follow a clean power supply voltage.

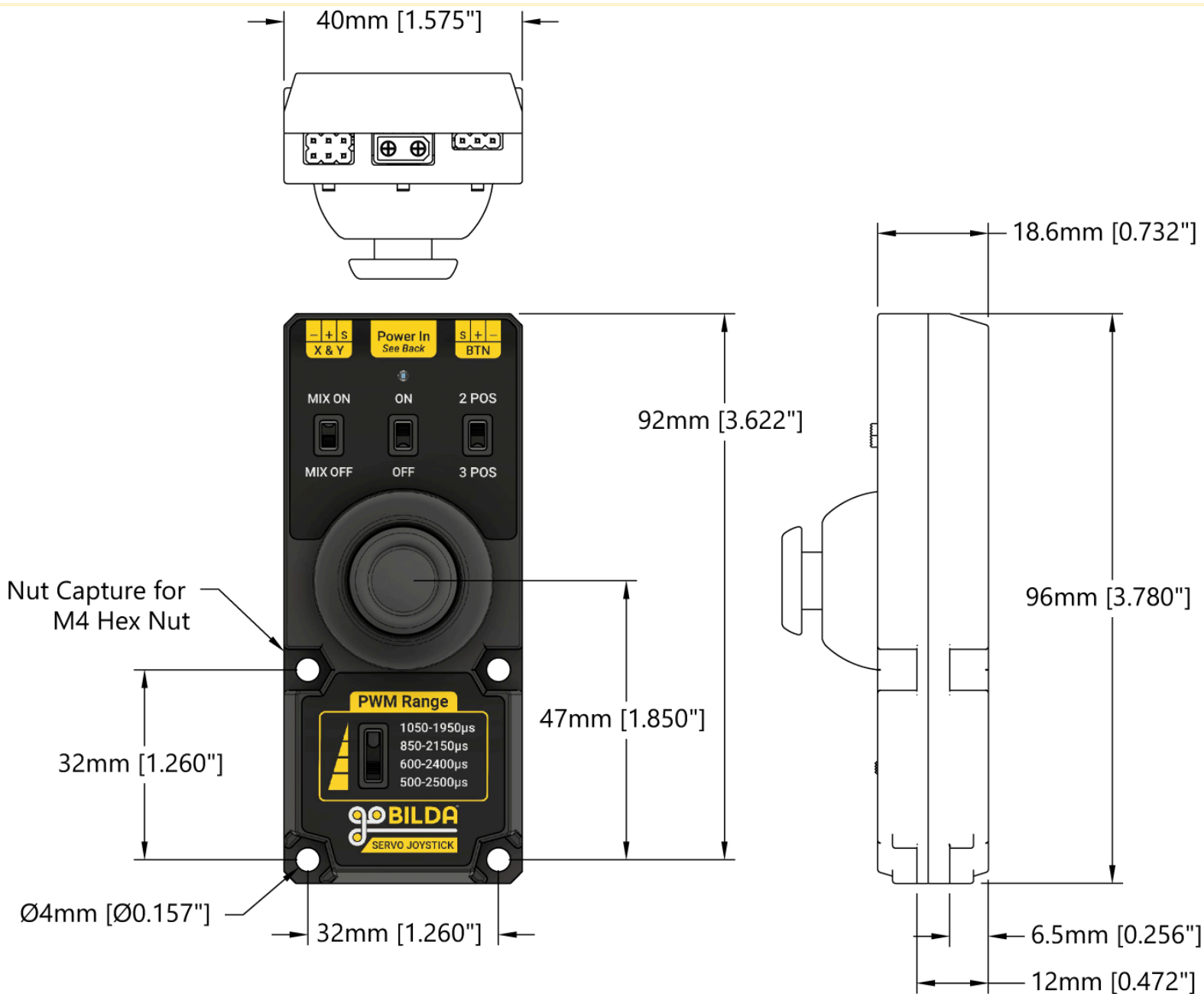


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## 5 Schematic/Drill Guide



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