Blue Trail Engineering Underwater Servos



Features

- Submersible up to 400 meters
- Engineered and tested for operation in seawater and fresh water
- Compact size
- Low power draw
- Corrosion-resistant titanium output shaft
- Standard R/C PWM or CAN interfaces
- Kit options available



Description

Blue Trail Engineering's Underwater Servos are compact, robust actuators for small marine robotic applications at depths of up to 400 meters. They consist of an off-the-shelf R/C servo installed in a machined enclosure with a titanium output shaft and waterproof connector. This architecture leverages decades of servo development in the R/C industry to provide extremely high reliability as well as almost limitless options for speed, torque, travel distance, and other features, all at a fraction of the cost of other subsea actuators.

Options

We offer four models of Underwater Servos, each available with an all-acetal enclosure rated to 200 meters depth or a combination acetal/anodized aluminum enclosure rated to 400 meters depth.

- The **SER-2010** (200m) and **SER-2011** (400m) feature the Hitec D954SW R/C servo. This is our least expensive model, producing 2.8 Nm of torque with a brushed motor.
- The **SER-2020** (200m) and **SER-2021** (400m) feature the Hitec HSR-M9382TH. This servo produces 3.3 Nm of torque and offers an extended travel range (up to ± 3.5 full turns of rotation with position control or continuous rotation with speed control). It uses

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a brushless motor and magnetic encoder, eliminating the most common causes of servo failure.

- The **SER-2030** (200m) and **SER-2031** (400m) feature the DB961WP servo, which produces 5.4 Nm of torque and uses a brushless motor.
- The **SER-2130** (200m) and **SER-2131** (400m) feature the MDB961WP-CAN servo, which produces 5.9 Nm of torque. It also uses a brushless motor and magnetic encoder, eliminating the most common causes of servo failure.

All of the above servos are fully assembled and pressure-tested before shipping.

We also offer the **SER-2000** (200m) and **SER-2001** (400m), kit options that allows users to select and install their own standard-sized R/C servo – including PWM, CAN, or serial servos – making this the most inexpensive and flexible option for underwater actuation. The kits come with the output shaft, bearings, and seal installed, and the user completes assembly with the servo and connector of their choice. Servos must be of the "standard" size (20-mm width) and have a 25-tooth spline. Contact Blue Trail Engineering for a list of servos that have been tested for proper fit. The user has the option to install a Cobalt bulkhead connector, a Cobalt cable with M10 penetrator, or a Blue Robotics WetLink penetrator (not included).



The SER-2000 and SER-2010 kit options allow the user to choose from a variety of servo and connector options.

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Specifications: PWM Models

	SER-2010, SER-2011	SER-2020, SER-2021	SER-2030, SER-2031
R/C Servo	Hitec D954SW	Hitec HSR-M9382TH	Hitec DB961WP
Depth Rating	SER-2010: 200 meters SER-2011: 400 meters	SER-2020: 200 meters SER-2021: 400 meters	SER-2030: 200 meters SER-2031: 400 meters
Operating Temperature	-10° C to +50° C	-10° C to +50° C	-10° C to +50° C
Output Shaft Material	titanium	titanium	titanium
Enclosure Material	SER-2010: acetal upper and lower SER-2011: acetal/hard-anodized aluminum	SER-2020: acetal upper and lower SER-2021: acetal/hard-anodized aluminum	SER-2030: acetal upper and lower SER-2031: acetal/hard-anodized aluminum
Weight in Air	SER-2010: 240 g SER-2011: 290 g	SER-2020: 240 g SER-2021: 290 g	SER-2030: 260 g SER-2031: 310 g
Weight in Water	SER-2010: 100 g SER-2011: 150 g	SER-2020: 100 g SER-2021: 150 g	SER-2030: 120 g SER-2031: 170 g
Stall Torque	1.8 Nm / 250 oz-in @ 4.8 V 2.8 Nm / 403 oz-in @ 7.4 V	3.3 Nm / 470 oz-in	5.4 Nm / 760 oz-in
No-load Speed	0.19 seconds/60 deg. @ 4.8 V 0.12 seconds/60 deg. @ 7.4 V	0.17 seconds/60 deg. @ 6.0 V 0.14 seconds/60 deg. @ 7.4 V	0.18 seconds/60 deg. @ 6.0 V 0.15 seconds/60 deg. @ 7.4 V
Control Interface	PWM, 800µs - 2200µs	PWM, 700µs - 2300µs	PWM, 900µs - 2100µs
Travel Range	± 70 deg. default, ± 100 deg. with programming*	± 230 deg. default, ± 3.5 full turns with programming*	± 60 deg. default, ± 130 deg. with programming*
Continuous Rotation	no	yes, with programming	no
Input Voltage	4.8 V - 7.4 V	6.0 V - 7.4 V	4.8 V – 8.4 V
Idle Current	0.03 A	0.03 A	0.04 A
No-load Current	0.5 A	0.25 A	0.5 A
Stall Current	5.2 A	2.7 A	8.0 A
PWM Voltage Range	3 - 5 V	3 - 5 V	3 - 5 V
Motor Type	coreless brushed	BLDC	BLDC
Feedback Type	1-million cycle potentiometer	magnetic encoder	analog potentiometer
Connector	Cobalt 3-pin bulkhead connector	Cobalt 3-pin bulkhead connector	Cobalt 3-pin bulkhead connector
*Programmable Features (requires programmer, not included)	Programmer: Hitec DPC-11, DPC-20 or HFP-30 End Point Adjustments Direction Fail Safe Position Deadband Width Speed (Slower) Soft Start Rate Overload Protection	Programmer: Hitec DPC-11 End Point Adjustments Direction Fail Safe Position Deadband Width Speed (Slower) Soft Start Rate	Programmer: Hitec DPC-11, DPC-20 or HFP-30 End Point Adjustments Direction Fail Safe Position Deadband Width Speed (Slower) Soft Start Rate Overload Protection

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Specifications: CAN Models

	SER-2130, SER-2131
R/C Servo	Hitec MDB961WP-CAN
Depth Rating	SER-2130: 200 meters SER-2131: 400 meters
Operating Temperature	-20° C to +60° C
Output Shaft Material	titanium
Enclosure Material	SER-2130: acetal upper and lower SER-2131: acetal/hard-anodized aluminum
Weight in Air	SER-2130: 260 g SER-2131: 310 g
Weight in Water	SER-2130: 120 g SER-2131: 170 g
Stall Torque	5.9 Nm / 830 oz-in
No-load Speed	0.14 seconds/60 deg.
Control Interface	CAN 2.0A,B
Travel Range	± 60 deg. default, ± 150 deg. or ±32760 turns with programming*
Continuous Rotation	no
Operating Voltage	8.0 V – 32.0 V
Idle Current	0.03 A
No-load Current	0.5 A
Stall Current	8.0 A
Motor Type	BLDC
Feedback Type	magnetic encoder
Connector	Cobalt 4-pin bulkhead connector
*Programmable Features (requires programmer, not included)	Programmer: Hitec DPC-20 End Point Adjustments Direction Fail Safe Position Deadband Width Speed (Slower) Soft Start Rate Overload Protection

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Command Interface

The SER-2010 through SER-2031 servos require a standard R/C PWM input signal. This consists of a PWM signal between 3 and 5 volts, typically at 50 Hz. The pulse width is changed to control the position of the servo.

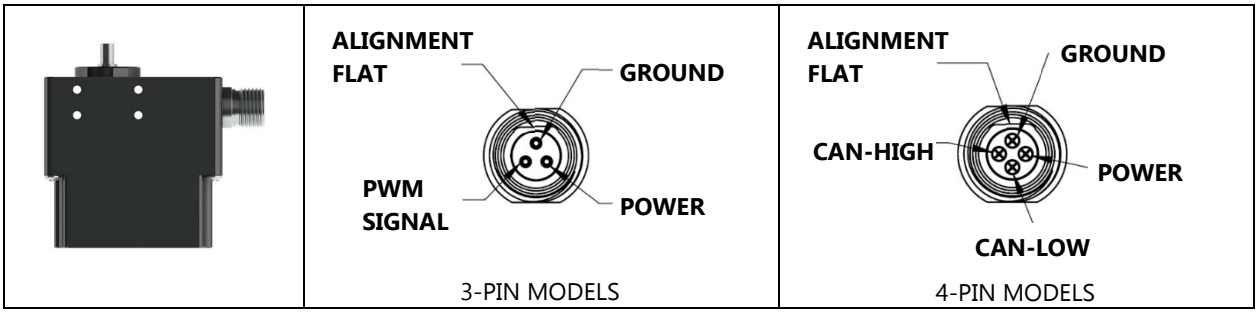
The SER-2130 and SER-2131 servos are controlled with a CAN interface.

The SER-2000 kit allows the user to select servos that operate with a standard R/C PWM input signal or with a CAN or serial interface.

For further information about command interfaces, see the servo product pages at www.bluetrailengineering.com.

Electrical Connection

The assembled servos use Cobalt bulkhead connectors. The pinouts of these connectors are shown below.



Pinout looking at mating face of bulkhead connector

The SER-2000 and SER-2001 kits provides the user with the following connection options:

- Blue Trail Engineering Cobalt bulkhead connector
- Blue Trail Engineering M10 Simple Penetrator with attached cable
- Blue Robotics M10 WetLink Penetrator with attached cable

Mechanical Interface

Servos can be mounted from the side with four M3 machine screws going through the servo, or from the top with four #6 or M3.5 self-tapping screws going into 16-mm blind holes in the servo (screws not included).

The output shaft is a titanium 6-mm diameter D-shaft. Standard set-screw shaft collars or couplers can be mounted to it, but the user should consider the intended environment and the possibility of galvanic corrosion when choosing hardware.

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Accessories

We offer the **SER-0011** Titanium Servo Hub which mounts to the servo output shaft and is secured with two screws to give a slop-free mounting surface. This makes it easy to attach control arms, wheels, gears, etc. to the servo.



Notes

Servo models which are capable of more than one full turn of motion do not have an absolute encoder on the output shaft and do not "remember" their absolute position when power is cycled. This can be problematic if the servo is being used in a multi-turn application. For example, if the servo is moved 2 turns clockwise and power is then cycled, the servo will move another 2 turns clockwise (it does not remember that it had already moved 2 turns before the power was cycled). The best way to handle this is to center the servo before turning it off.

These servos do not have internal protection against overheating or overvoltage. They can be damaged or destroyed by:

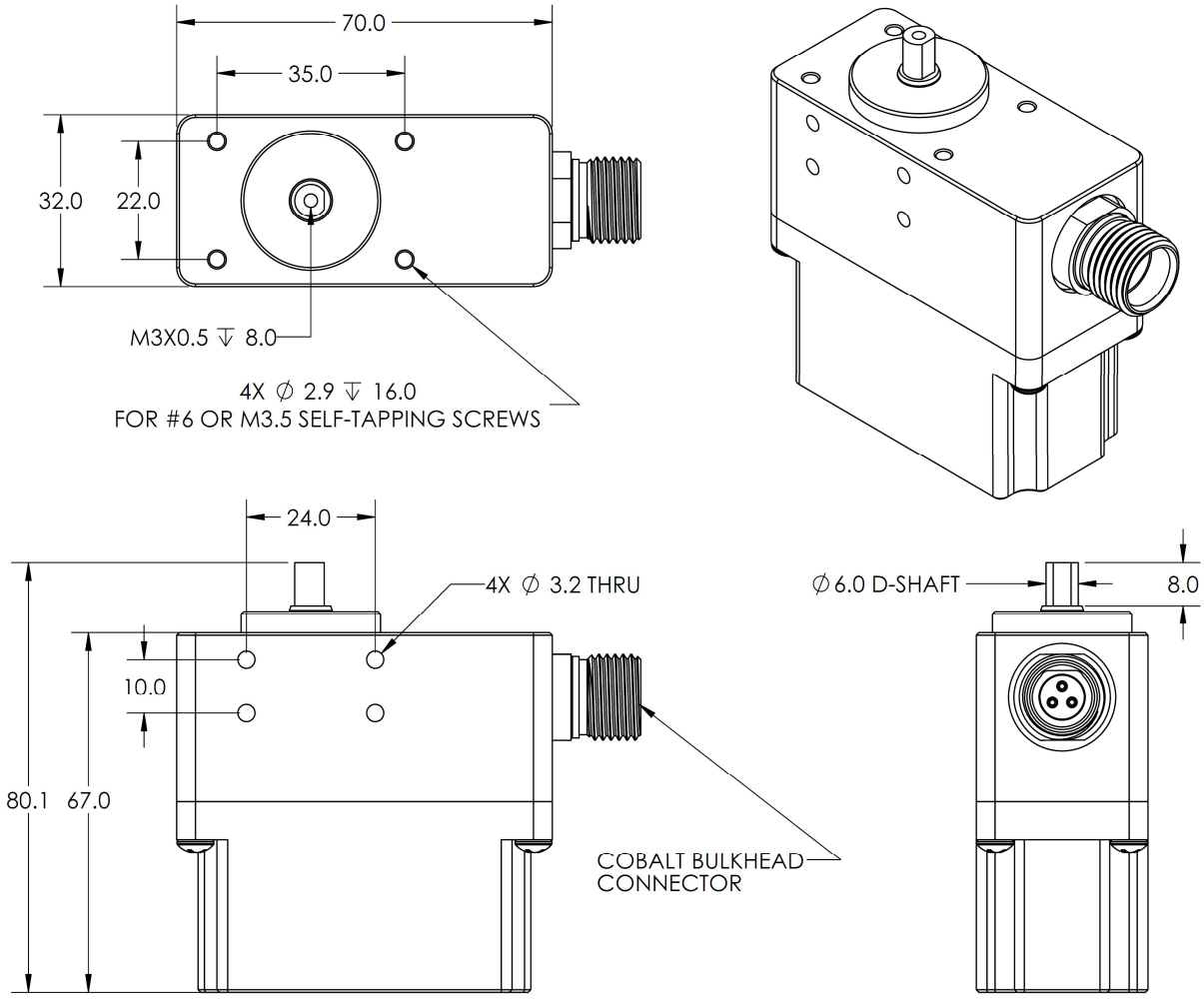
- driving the servo against a hard stop for more than 5-10 seconds
- running the servo at high torque continuously
- applying more than the recommended voltage to the servo

Users should design their electrical and mechanical systems to avoid these scenarios.

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Dimensions

All dimensions are in mm.



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