

# SER-20XX Underwater Servos



## Features

- Submersible up to 200 meters
- Engineered and tested for operation in seawater and fresh water
- Compact size
- Low power draw
- Machined acetal enclosure
- Corrosion-resistant titanium output shaft
- Standard R/C PWM interface with options for CAN or serial interfaces

## Description

Blue Trail Engineering's SER-20XX underwater servos are compact, robust actuators for small marine robotic applications down to 200 meters. They consist of an off-the-shelf R/C servo installed in a machined acetal enclosure with a titanium output shaft and waterproof connector. By using off-the-shelf R/C servos, 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.

The SER-20XX series currently includes three models:

- The SER-2010 features a Hitec D954SW R/C servo with 29.0 kgf-cm of torque and a default travel range of  $\pm 70$  degrees.
- The SER-2020 features a Hitec HSR-M9382TH servo with 34.0 kgf-cm of torque. While its default travel range is  $\pm 230$  degrees, it can be programmed to provide up to  $\pm 3.5$  full turns of rotation with position control or continuous rotation with speed control. The HSR-M9382TH uses a brushless motor and magnetic encoder, eliminating the most common causes of servo failure.
- The SER-2000 is a kit option that allows users to select and install their own standard-sized R/C servo – including PWM, CAN, or serial servos – making it the most inexpensive and flexible option for underwater actuation. The user also has the option to install either a Cobalt bulkhead connector or a cable with M10 penetrator.

Both the SER-2010 and SER-2020 come fully assembled and tested.

The SER-2000 kit comes 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.

## Specifications

All Models		
Depth Rating	200 meters	
Operating Temperature	-10° C to +50° C	
Output Shaft Material	titanium	
Enclosure Material	acetal	
Weight in Air	240 grams	
Weight in Water	100 grams	
	SER-2010	SER-2020
R/C Servo	Hitec D954SW	Hitec HSR-M9382TH
Torque	18.0 kgf-cm / 250 oz-in @ 4.8 V 29.0 kgf-cm / 403 oz-in @ 7.4 V	34.0 kfg-cm / 470 oz-in
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
Control interface	PWM, 800µs - 2200µs	PWM, 700µs - 2300µs
Travel Range	± 70 deg. default, ± 100 deg. with programming*	± 230 deg. default, ± 3.5 full turns with programming*
*Programmable Features (requires programmer, not included)	Programmer: Hitec DPC-11 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
Operating Voltage	4.8 V - 7.4 V	6.0 V - 7.4 V
Idle Current	0.03 A	0.03 A
No-load Current	0.5 A	0.25 A
Stall Current	5.2 A	2.7 A
PWM Voltage Range	3 - 5 V	3 - 5 V
Motor Type	coreless brushed	BLDC
Feedback Type	1-million cycle potentiometer	magnetic encoder
Connector	Cobalt 3-pin bulkhead connector	Cobalt 3-pin bulkhead connector

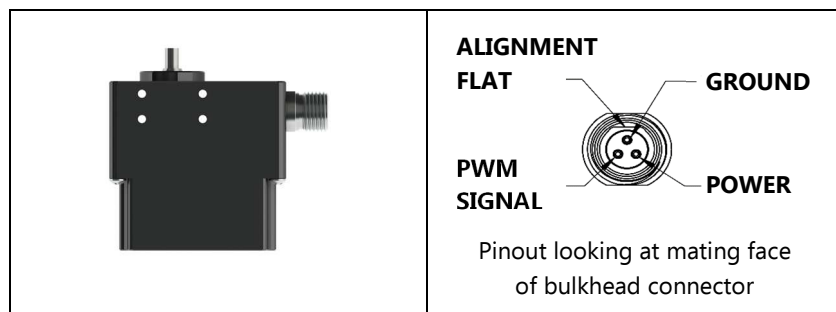
## Command Interface

The SER-2010 and SER-2010 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-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.

## Electrical Connection

The SER-2010 and SER-2020 use a Cobalt 3-pin bulkhead connector. The pinout of this connector is shown below.



The SER-2000 kit 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

The SER-20XX 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.

## Notes

Because the SER-2020 is capable of more than 1 full turn, it does not have an absolute encoder on the output shaft and does not “remember” its 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.

## Dimensions

All dimensions are in mm.

