Newton Gripper

Introduction

The *Newton Gripper* is a sealed, single function manipulator which can operate at depths of up to 300 meters. The *Newton Gripper* can be smoothly opened or closed with a servo PWM signal to provide the *BlueROV2* and other subsea vehicles with the ability to interact with the subsea environment to retrieve objects, attach recovery lines, or free a snagged tether.

Keep fingers and other body parts away from the gripper when operating! It's strong and has the potential to do some damage. Notify other crew members to do the same.

Quick Start (Open and Close with PWM signal source)

1. Connect the signal wire to a signal source such as the Pixhawk on the BlueROV2 or a 3.3v microcontroller.
   - Yellow: PWM (3.3 volts only)
2. Connect the power wires to a power source
   - Red: +9-18 volts
   - Black: Ground
3. Provide a servo PWM pulse at 1500 µs for no movement. Provide a servo PWM pulse greater than 1530 µs to open gripper. Provide a servo PWM pulse less than 1470 µs to close gripper.

Specifications

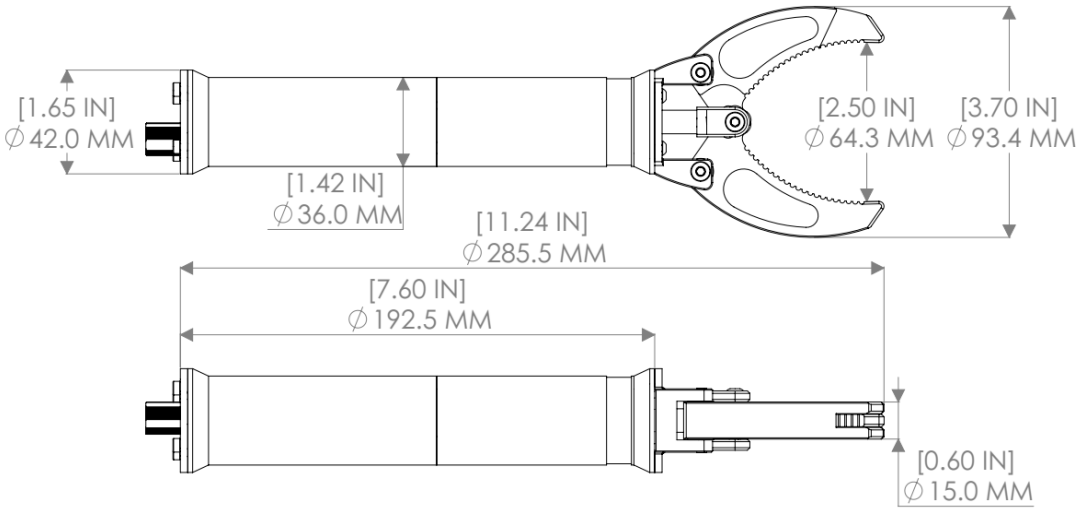
Specification Table

Electrical		
Item	**Value**	
Supply Voltage (V_{in})	9 - 18 volts	
PWM Logic Voltage	3.3 volts	
PWM Neutral Signal	1500 µs	
PWM Open Signal	>1530 µs-1900 µs	
PWM Close Signal	<1470 µs-1100 µs	
Peak Current	6 amps	
Mechanical		
Grip Force (at tip)	97N	22lb^f
Grip Force (in middle)	124N	28lb^f
Linear Piston Travel	15mm	0.59in
Jaw Opening	70mm	2.75 in
Time to Open/Close	1.6 secs	
Cable		
Cable Diameter	3.8 mm	0.15 in
Cable Length	635 mm	25 in
Cable Jacket	Black Urethane	
Conductor Insulation	Acid-Etched FEP	
Conductor Gauge	20 AWG	
Wires	Black - Ground	
	Red - Power	
	Yellow - Signal	
Physical		
Pressure Rating[1]	300 m	984 ft
Overall Length (Closed)	294 mm	11.57 in
Overall Length (Open)	300 mm	11.81 in
Body Primary Diameter	35 mm	1.38 in
Bracket Mounting Hole Spacing	16 mm	0.63 in
Bracket Screw Size	M5x0.4	
Weight in Air (w/ cable)	616 g	21.9 oz
Weight in Water (w cable)	260 g	9.2 oz

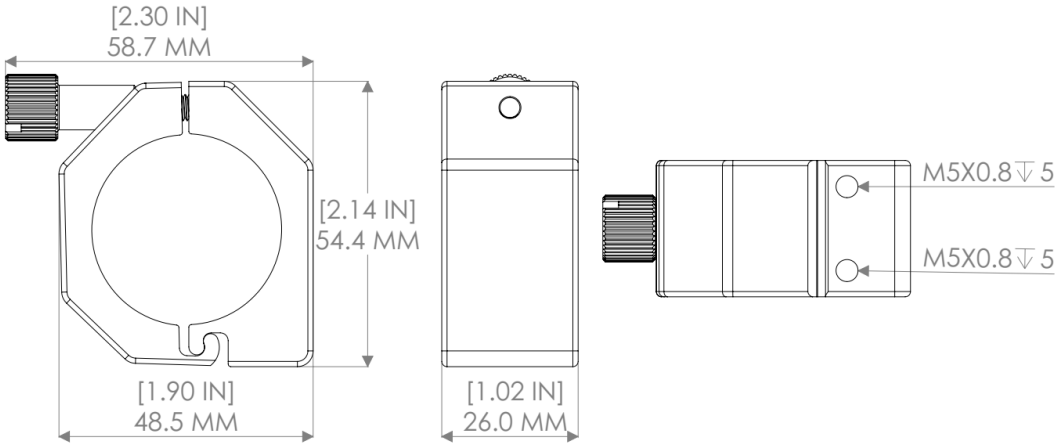
[1] Pressure rating is based on design and a conservative safety factor.

2D Drawings

Newton Gripper Assembly



Newton Gripper Mount



3D Model

All 3D models are provided in zip archives containing the follow file types:

- SolidWorks Part (.sldprt)
- IGES (.igs)
- STEP (.step)
- STL (.stl)

Newton Gripper	
Newton Gripper Assembly	NEWTON-GRIPPER-ASM-R3-PUBLIC.zip (/newton-gripper/cad/NEWTON-GRIPPER-ASM-R3-PUBLIC.zip)
Newton Gripper Mount	NEWTON-MOUNT-ASM-R1-PUBLIC.zip (/newton-gripper/cad/NEWTON-MOUNT-ASM-R1-PUBLIC.zip)

Installation

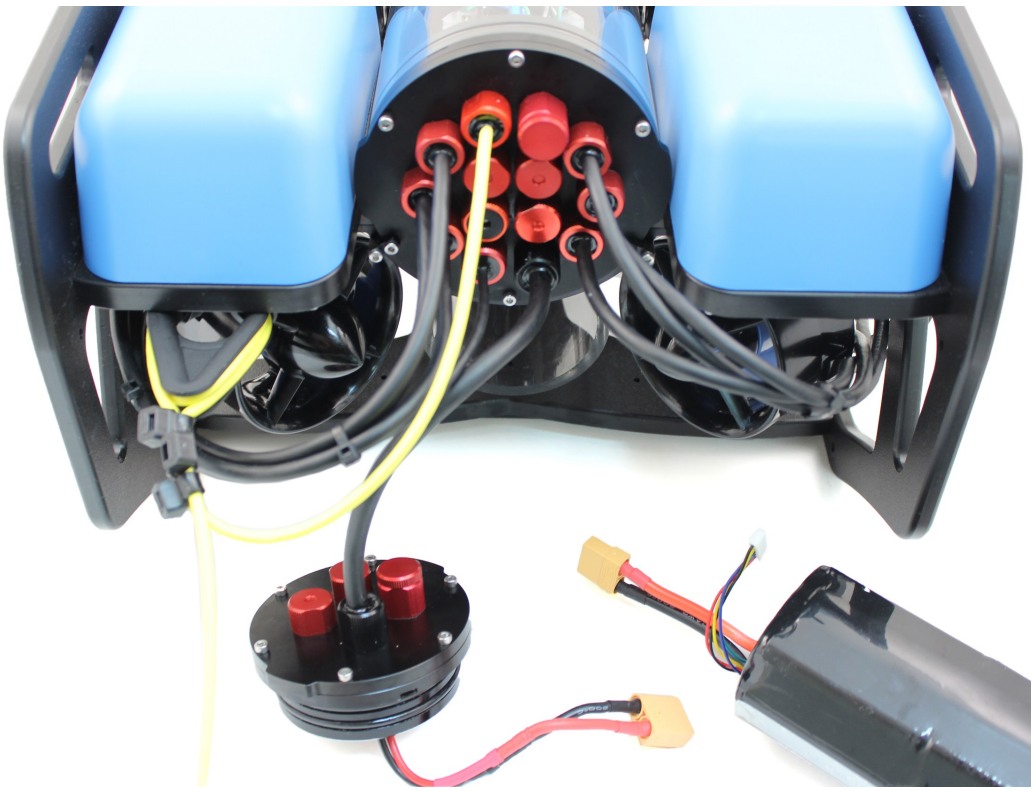
The *Newton Gripper* can be easily installed onto a BlueROV2 using the accompanying mount.

Removing a Blank Penetrator

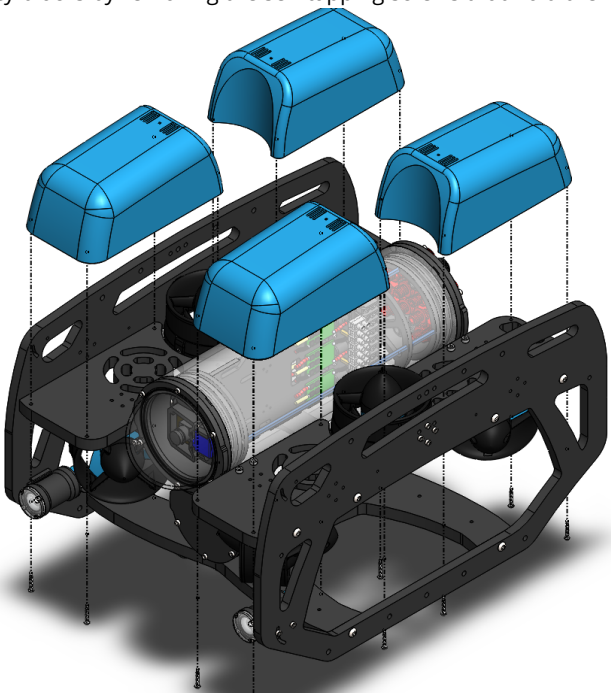
To remove a blank penetrator from your BlueROV2, you will need the following tools:

- 1 x 2.5 mm hex driver
- 1 x #1 Phillips head screwdriver
- 1 x Penetrator wrench

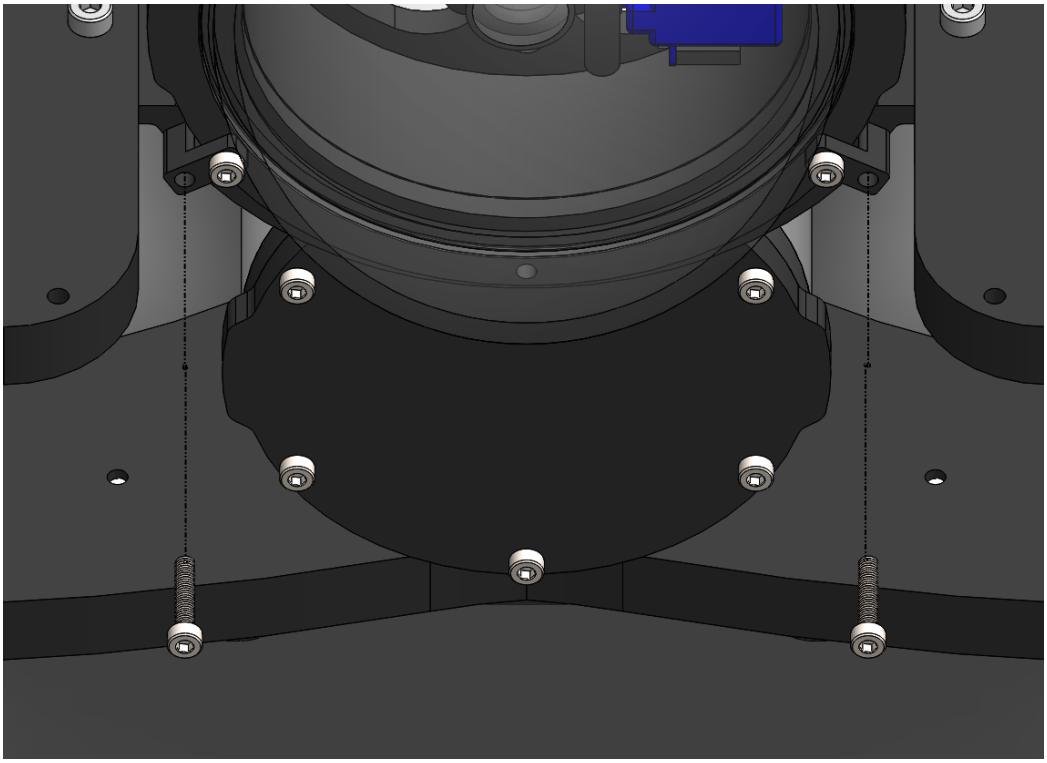
1. To ensure your ROV is completely powered off, please remove the battery completely from the 3" enclosure and place to the side.



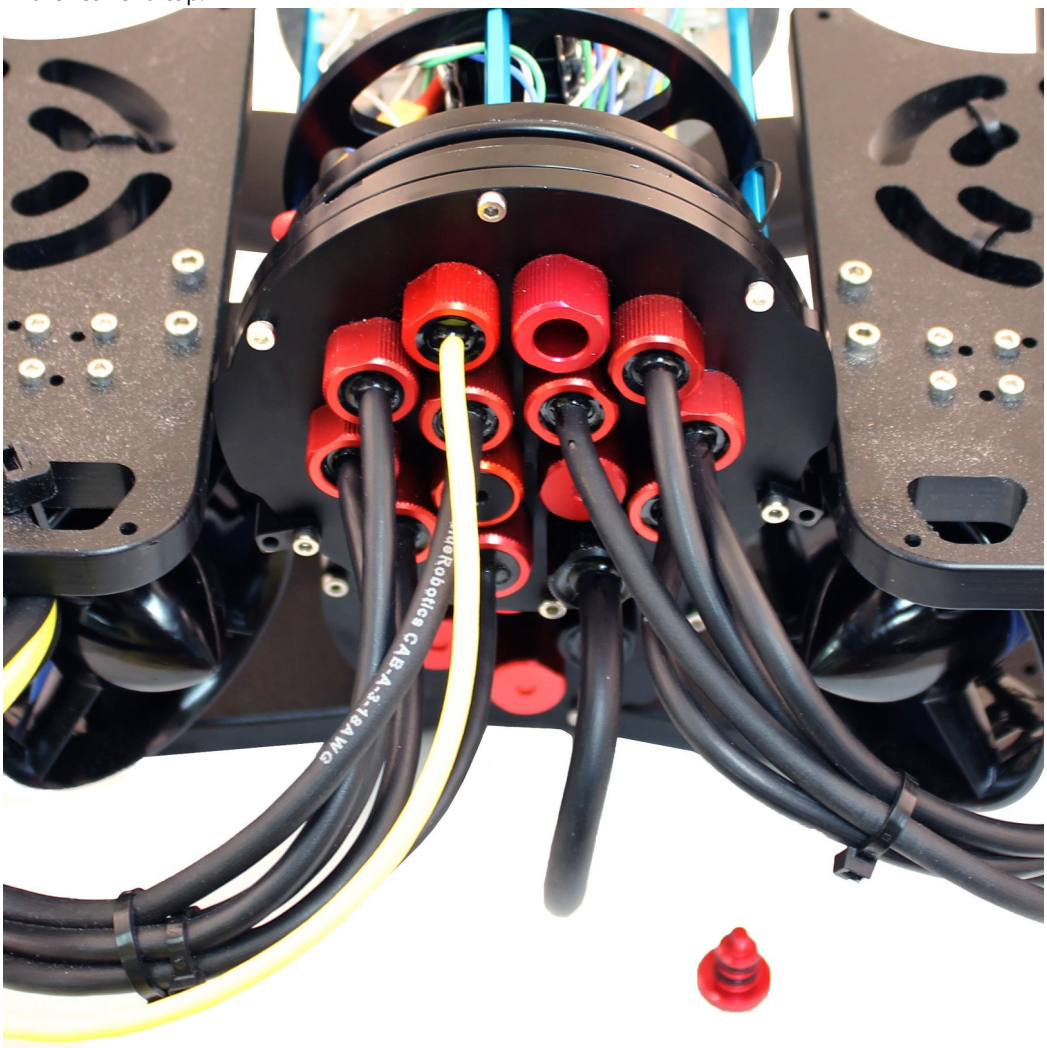
2. Remove the fairings and buoyancy blocks by removing the self-tapping screws that hold the fairings to the frame.



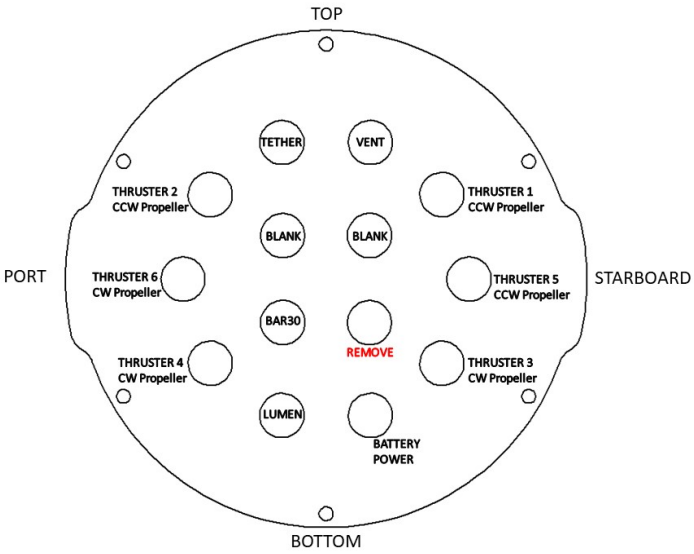
3. Remove the 4" electronics enclosure from the ROV by removing the M3x16 screws that mount the enclosure to the ROV cradle.



4. Remove the Vent Plug from the Vent Penetrator Bolt on the electronics enclosure. Remove the 4" tube and forward dome assembly from the rear end cap.



5. Remove the blank penetrator as pictured from the 4" End Cap with the penetrator wrench that came with the BlueROV2 kit.



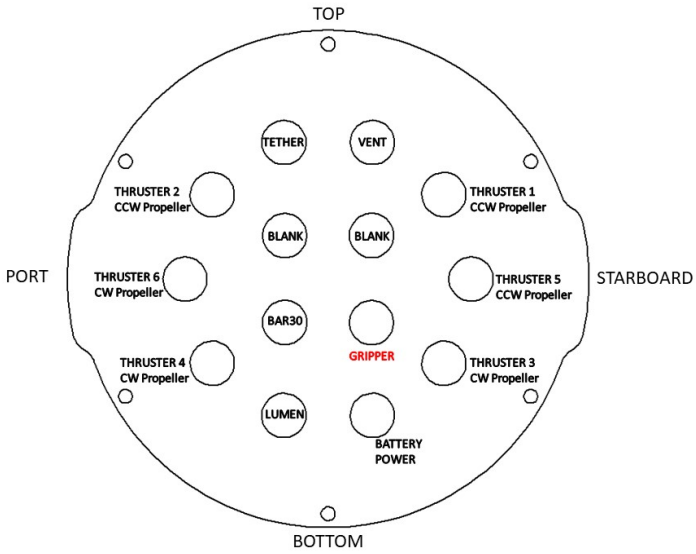
Install Newton Gripper Penetrator

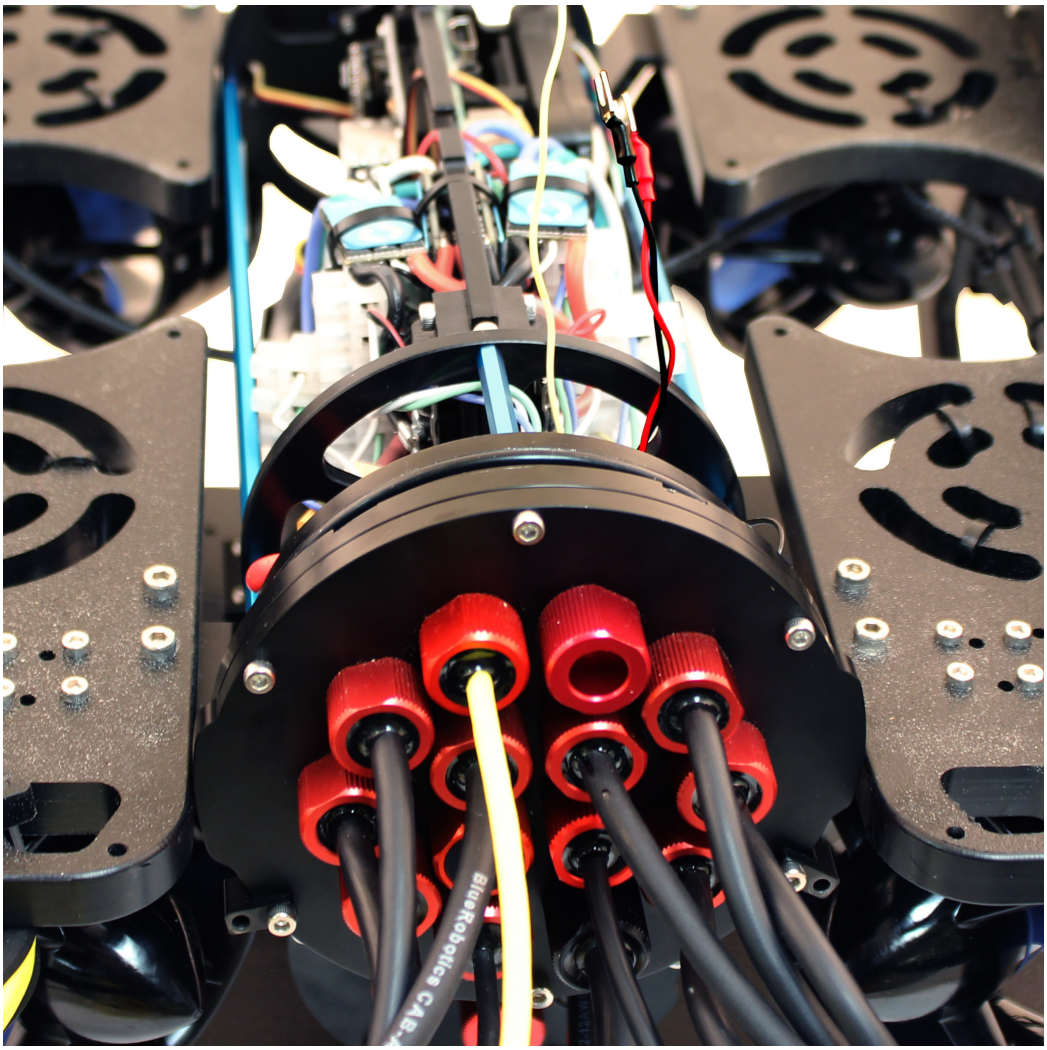
To install the Newton Gripper into the end cap, you will need the following parts and tools:

- 1 x Newton Gripper assembly
- 1 x Penetrator Nut (Red)
- 1 x Penetrator O-ring
- 1 x Silicone Grease – 10g Tube
- 1 x Isopropyl Alcohol Wipe
- 1 x Penetrator wrench

1. Wipe the exterior surface of the electronics enclosure endcap clean with isopropyl alcohol or isopropyl alcohol wipes, and make sure it is free of any particles in the areas where the penetrator O-ring will sit.
2. Remove the O-ring from the bag and apply silicone grease to it.

3. Install the O-ring onto the Gripper cable penetrator.
4. Install the Gripper cable penetrator on to the end cap in the hole you previously removed the blank penetrator from. Tighten to finger tight, then use the provided wrench to tighten it an additional ~1/16 of a turn. If you can't loosen it with your fingers, it is tight enough.



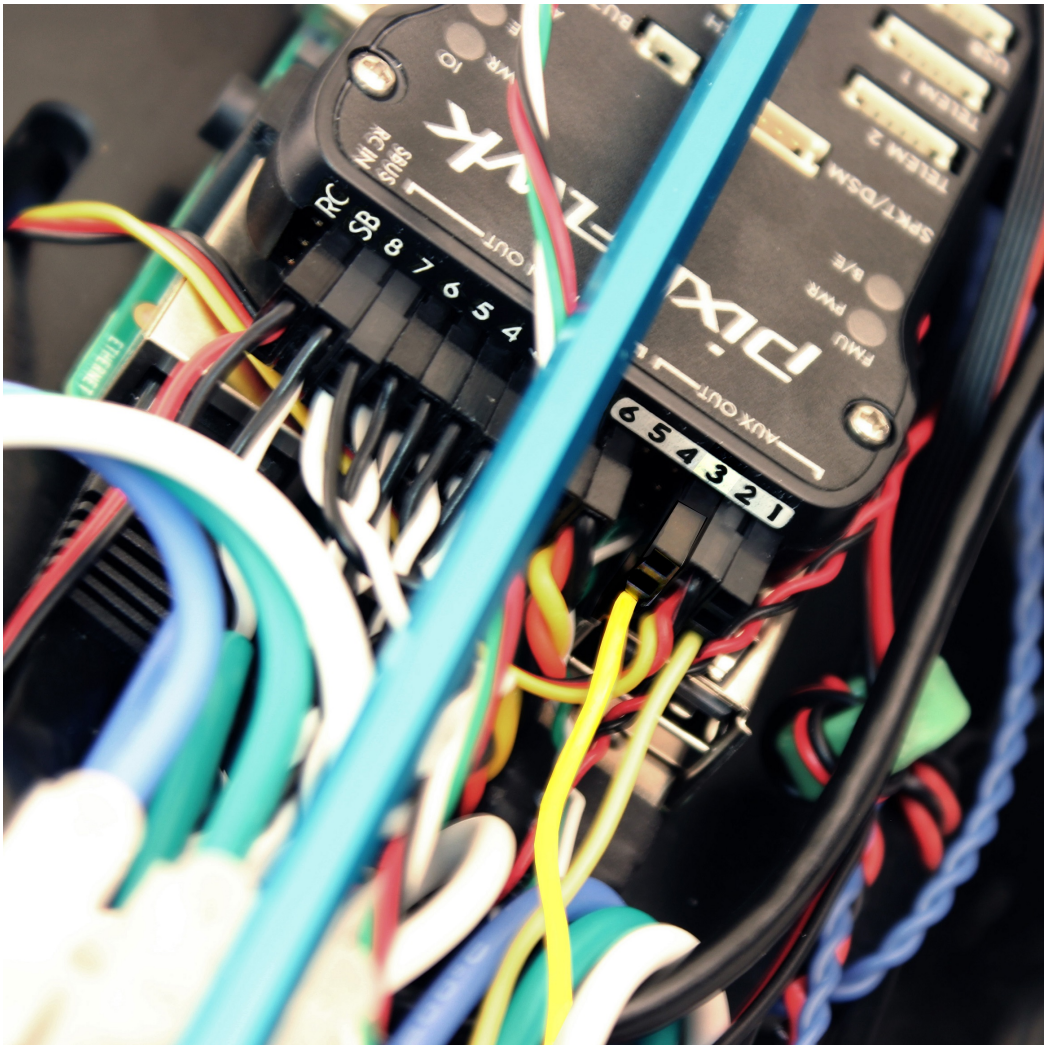


Wiring Connections

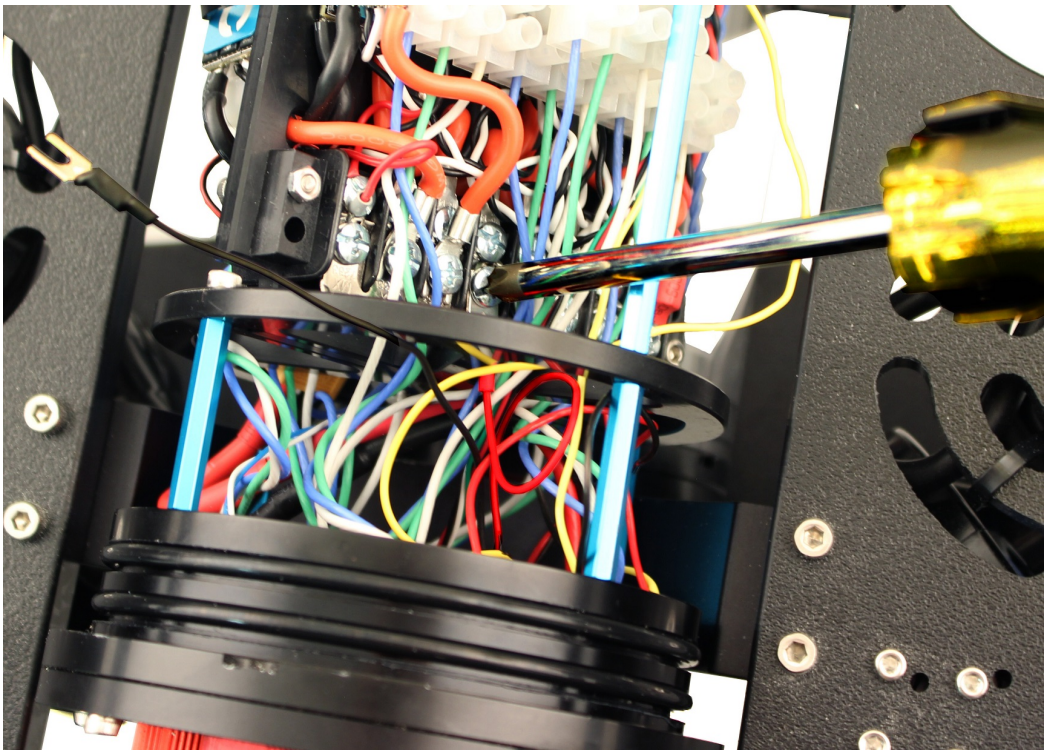
To install the Newton Gripper wires into your BlueROV2, you will need the following tool:

- 1 x Large (~#2) Phillips head screw driver

1. Plug the Gripper Signal Wire (Yellow) into Aux Channel 3 (or other free AUX Channel) with the yellow wire oriented toward the bottom of the Pixhawk.



2. Connect the power wires (red and black wires) into open screw terminals on the respective positive and negative terminal blocks.

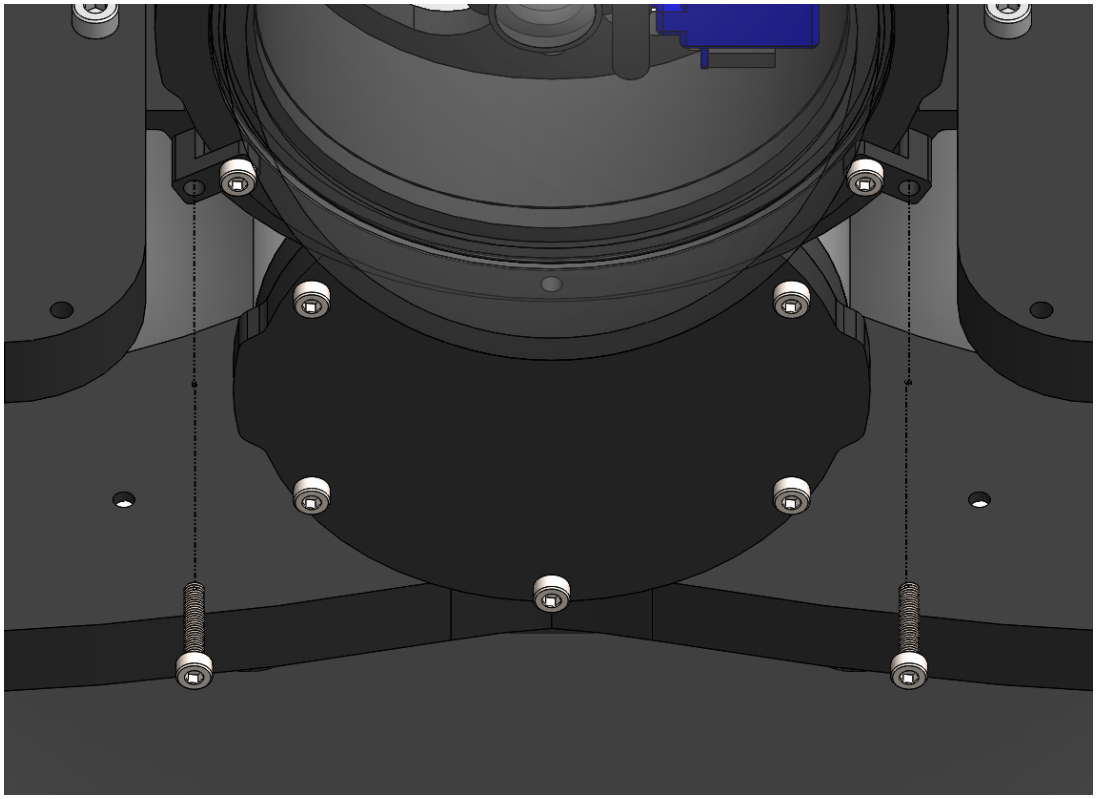


Reassemble BlueROV2 Electronics Enclosure

To reassemble your BlueROV2 electronics Enclosure, you will need the following parts and tools:

- 4 x M3x16 screws that were placed off to the side during disassembly
- 1 x Silicone Grease – 10g Tube
- 1 x 2.5 mm hex driver

1. Reinstall 4" Watertight Enclosure onto ROV with the following steps:
    - Apply silicone grease to the two radial O-rings on the O-Ring Flange (4" Series) that is attached to the Electronics Tray then install the Watertight Enclosure (4" Series) with installed Dome End Cap to the O-Ring Flange (4" Series).
    - Mount the Electronics Enclosure to the frame using the M3x16 screws so that the dome is on the same side as the front center panels (the center panels without the 3 large holes). Install the M3x16 screws through the clips and into the Enclosure Cradle (4" Series). It is easier to install these screws if the clips are not fully tightened until all screws are through the clips and threading into the Enclosure Cradle (4" Series). This allows to clips to rotate so you can find the threaded hole in the Enclosure Cradle (4" Series) easily.

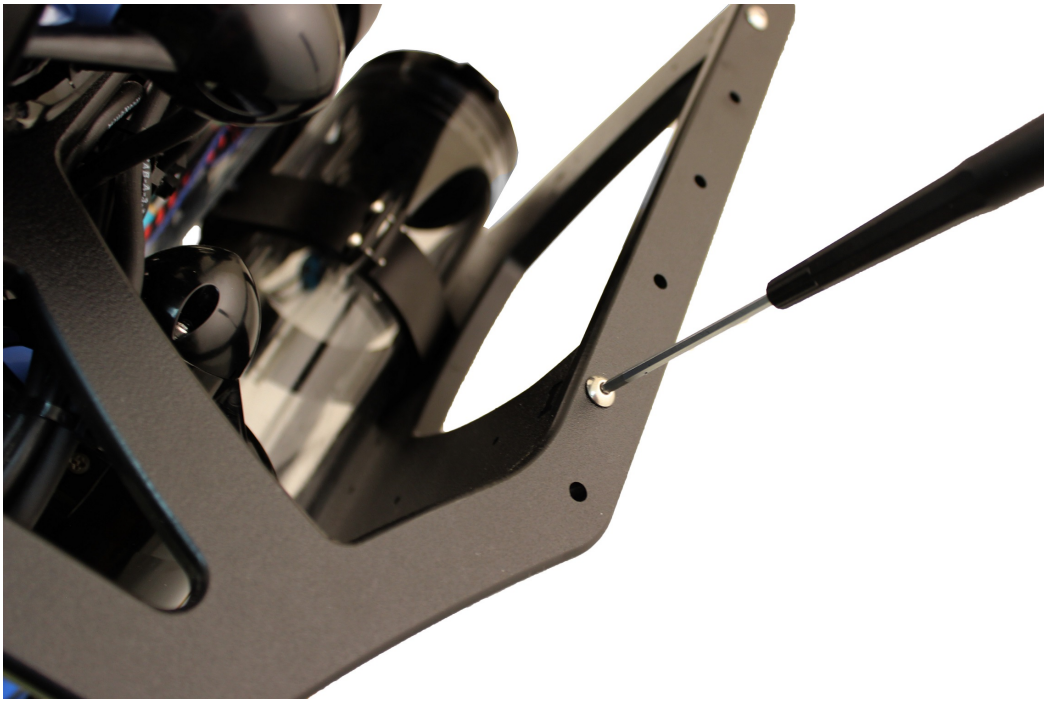


Mounting the Newton Gripper to the BlueROV2 Frame

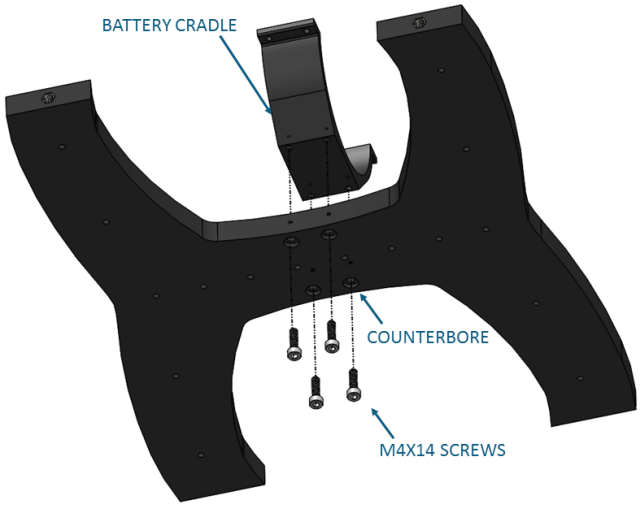
To mount the Newton Gripper to the BlueROV2 Frame, you will need the following parts and tools:

- 1 x Newton Gripper Mount Drilling Template, included with kit or available here (/newton-gripper/cad/NEWTON-GRIPPER-W-MOUNT-DRILLING-TEMPLATE-UNIVERSAL-R1.PDF) (8.5 x 11" or A4 Piece of paper, print setting "Actual")
- 1 x 5.50mm (or 7/32") drill bit (not included)
- 1 x Battery Powered Hand Drill (not included)
- 2 x M5x16 Button Head Screws
- 1 x 3 mm hex driver
- 1 x Bottle of Threadlocker

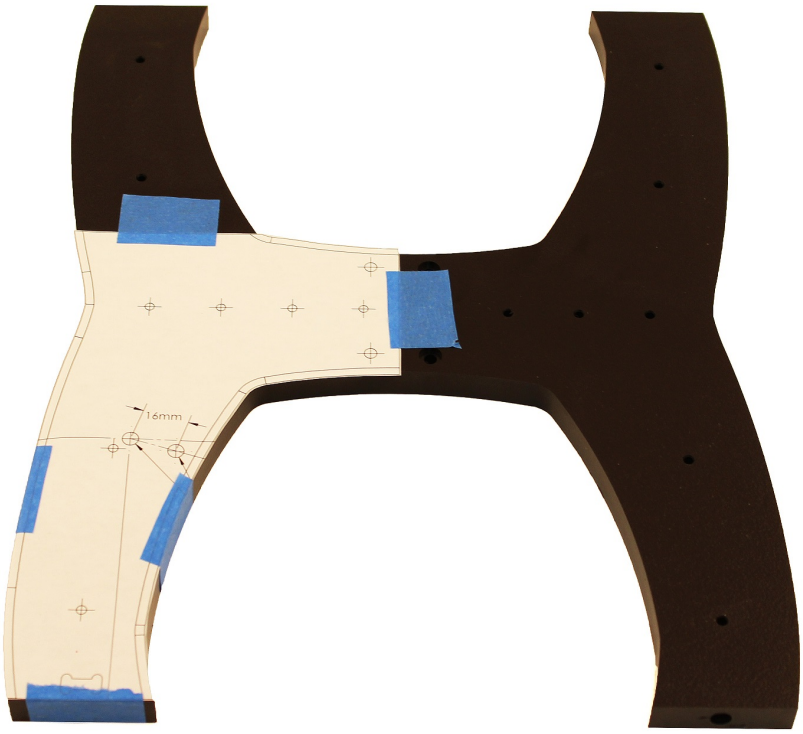
1. Remove the rear end cap from the 3" battery enclosure.
2. Remove the bottom frame panel from the BlueROV2 by removing the four M5x16 Screws.



3. Remove the 3" battery enclosure by removing the M4x14 Screws from the bottom of the frame.

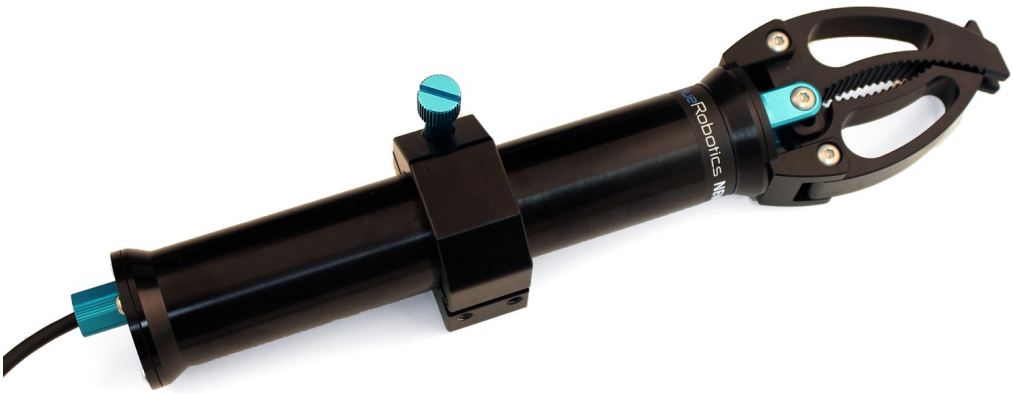


4. Cut out and align one of the the provided templates onto the bottom side (with the counterbore holes) and tape in place. You have the option of mounting the gripper to the right or left side of the vehicle.

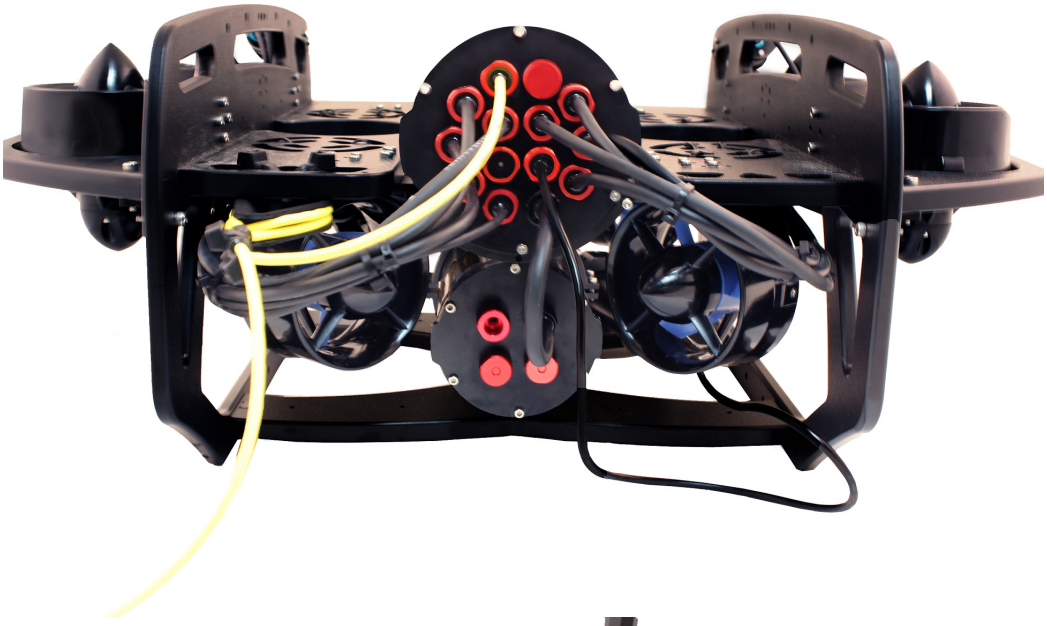


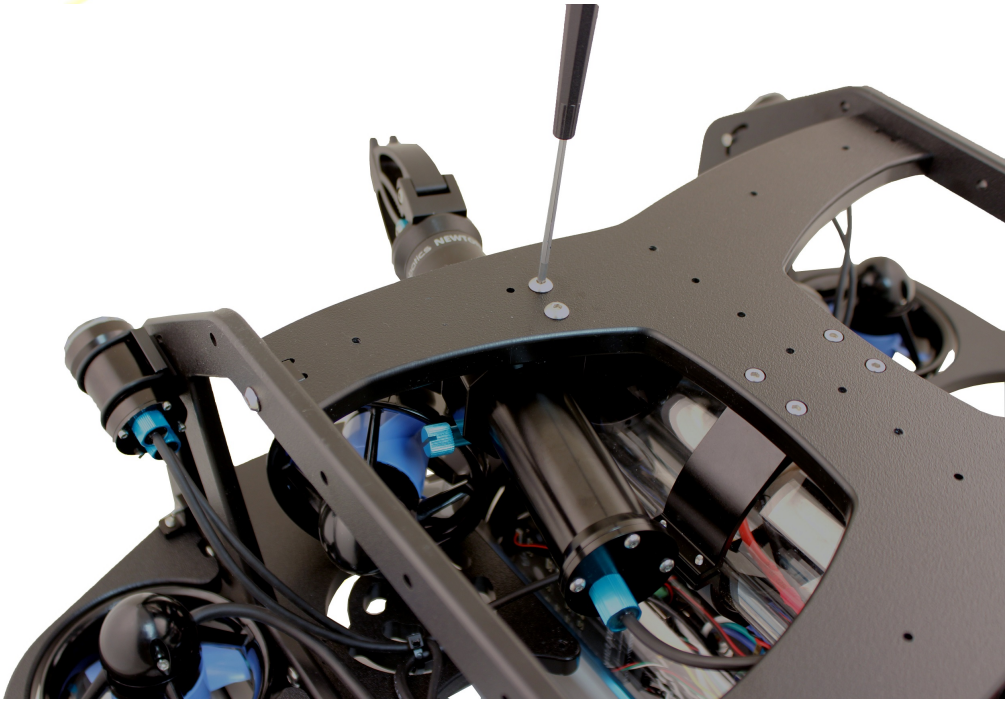
5. With a hand powered drill and 5.50mm drill bit, drill straight holes in the indicated position markings.
6. Re-attach the 3" battery enclosure to the frame with the M4x14 Screws.
7. Re-attach the bottom frame panel to the BlueROV2 with the four M5x16 Screws.
8. Place the Gripper assembly into the Mount half with the holes for mounting onto the frame.

9. Slide the other Mount half onto the gripper assembly and insert the Thumbscrew into the mount hole.



10. Coming from the aft end of the BlueROV2, weave the Gripper assembly into its mounting location, apply a drop of threadlocker to the included M5x16 Screwsand secure to the frame.

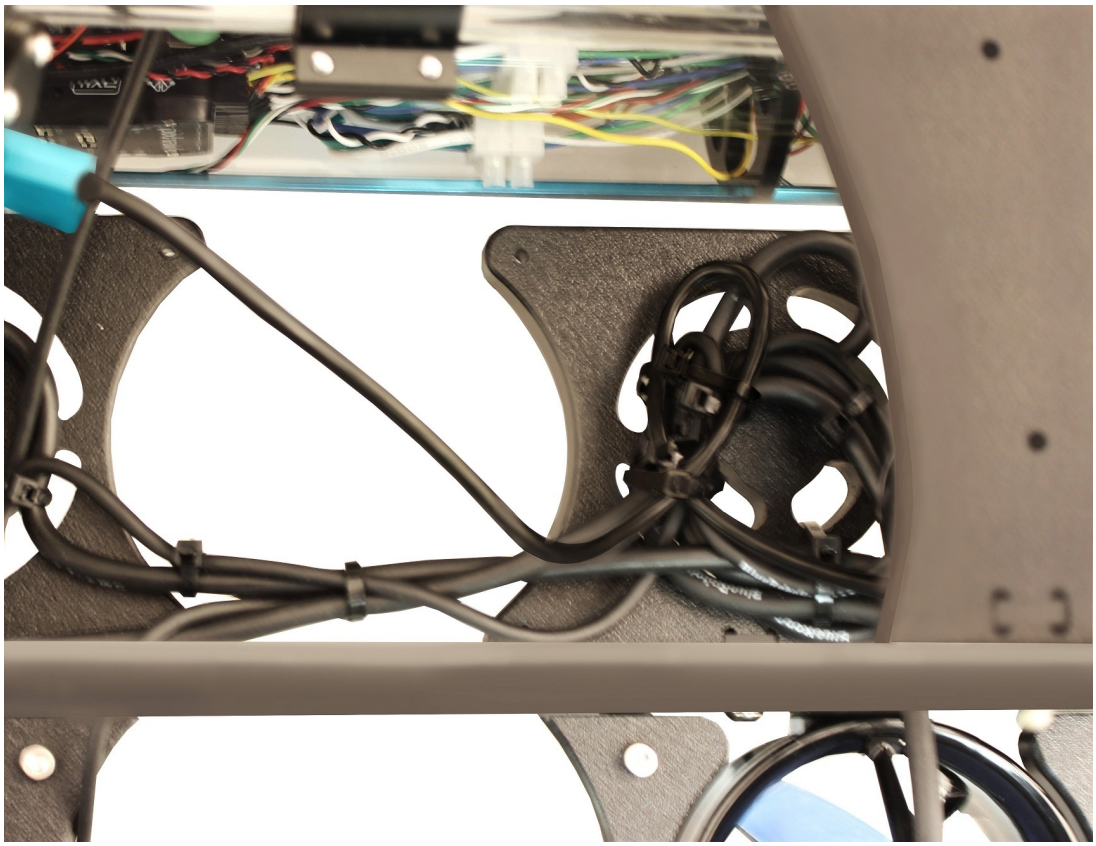




Cable Management

To clean up the external Newton Gripper cable, you will need the bag of 5 zip ties and your scissors/wire cutters.

The primary goal of cable management is to prevent the wires from getting cut by the propellers. Make sure to check that no wires can reach the propellers after you have finished routing the Newton Gripper cable. Below is an example of what the cable routing should look like.

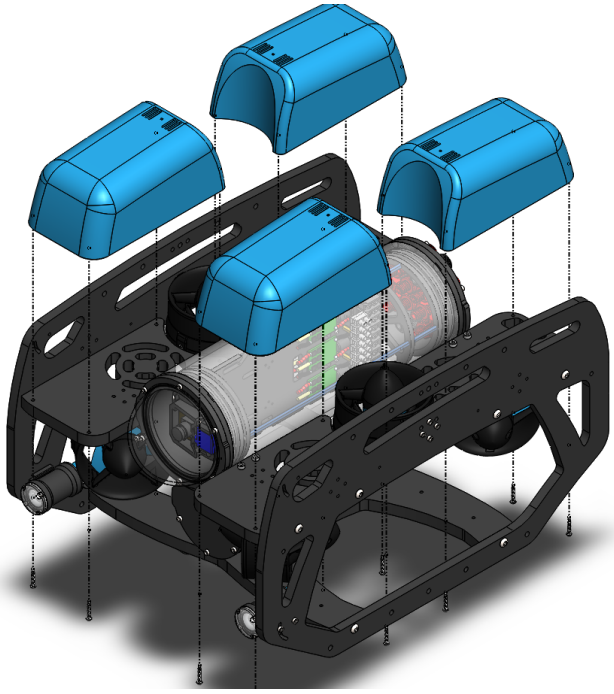


Reinstall Buoyancy Blocks and Fairings

To install the new buoyancy blocks and fairings, you will need the following parts and tools:

- 16 x Fairing screws that were placed off to the side during disassembly
- 4 x Fairings with buoyancy installed that were placed off to the side during disassembly
- 1 x #1 Phillips head screwdriver

1. Reinstall Original Fairing Blocks onto ROV by installing the screws through the center panels and into the fairings.



Adjusting Ballast on the Frame

To adjust the amount or position of ballast on the frame you need the following parts and tools:

- 7 x 200g Ballast weights (from original BlueROV2 Kit)
- 10 x 8-16 Thread, 5/8" Long, Thread-Forming Screws
- 1 x #2 Phillips head screwdriver

To get the longest battery life and the best driving experience, it is important to have the ROV close to balanced from front to back in water and close to neutrally buoyant. The Newton Gripper adds a bit of weight to the ROV, so it will need to be retrimmed based on your operating conditions. Trimming the ballast may involve a bit of trial and error.

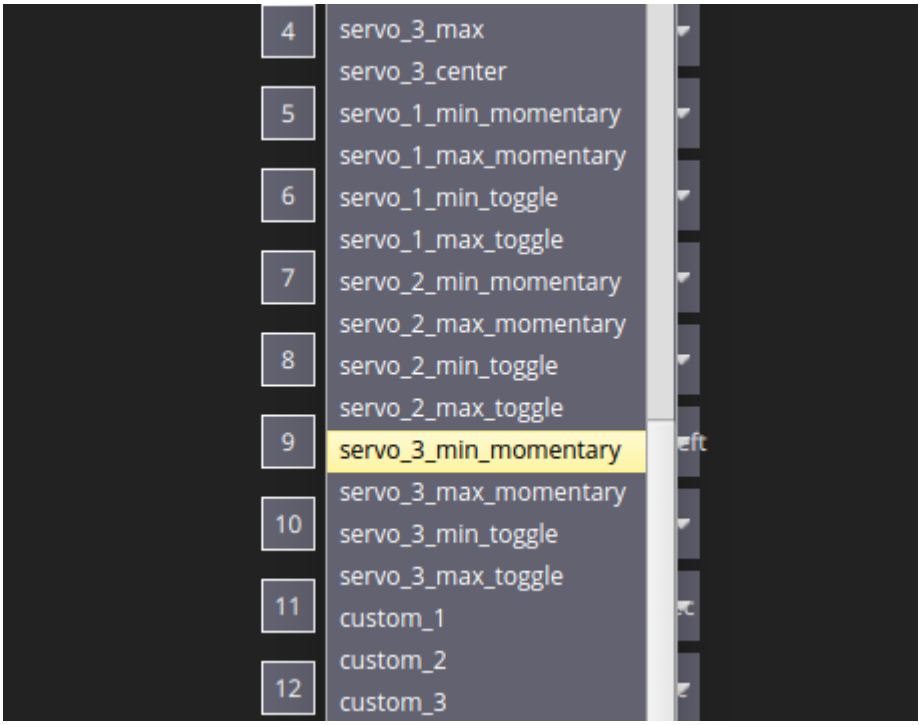
Setup in QGroundControl

The following servo settings are available on ArduSub 3.5.3 and QGroundControl v3.2.4-BlueRobotics-Rev6 or newer. If your software is out of date, please conduct a software update by following the instructions on the BlueROV2 Software Setup (http://docs.bluerobotics.com/brov2/software-setup/) page.

The *Newton Gripper* can be controlled via the following button functions:

- *servo_X_max_momentary* (open while pressed)
- *servo_X_min_momentary* (close while pressed)

where *X* is the Aux Channel to which the gripper is connected. For example, a *Newton Gripper* plugged into Aux Channel 3 can be opened and closed with the *servo_3_max_momentary* and *servo_3_min_momentary* button functions, respectively.



Note that these button functions only exist for Aux Channels 1~3. Should your *Newton Gripper* be connected to any other output channel, you will be unable to control it with joystick buttons.

You may set-up your controller buttons however you like, however the limited number of buttons means that you will have to shift the button controls around. Our preference is to assign the Gripper open and close functions to the bumper buttons so the operator still has full movement control on the joysticks. We then moved the camera tilt to being on Shift->Bumper button pushes as illustrated below in the button assignment table for a Logitech F310.

Button	Function	Shift Function
0	Disabled	Disabled
1	mode_manual	Disabled
2	mode_depth_hold	Disabled
3	mode_stabilize	Disabled

Button	Function	Shift Function
4	disarm	Disabled
5	shift	Disabled
6	arm	Disabled
7	mount_center	Disabled
8	input_hold_set	Disabled
9	**servo_3_min_momentary**	**mount_tilt_down**
10	**servo_3_max_momentary**	**mount_tilt_up**
11	gain_inc	trim_pitch_dec
12	gain_dec	trim_pitch_inc
13	lights1_dimmer	trim_roll_dec
14	lights1_brighter	trim_roll_inc
15	Disabled	Disabled

Final Test

That's it! Once powered up you should be able to control the gripper with the joystick buttons. The ROV *does not* need to be armed for the gripper to be active.