

BLUEPRINT LAB

REACH SYSTEM

INTEGRATION MANUAL

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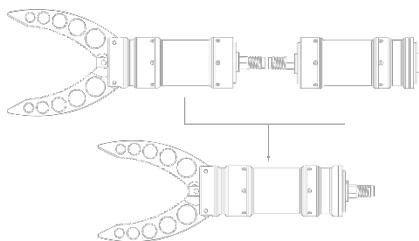
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1 OVERVIEW

The Reach System is the world's smallest, lightest subsea manipulator system. We designed this advanced manipulator to open up new possibilities for remote intervention and inspection in harsh environments. This manual predominantly applies to the Reach 5 Mini (often termed 'manipulator' in this document) but applies more generally to other Reach Mini actuators (e.g. 3 or 4-Function variants) as well.

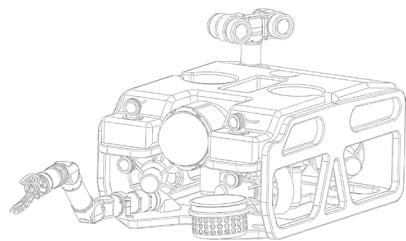
1.1 PRODUCT FEATURES

Modular by Design



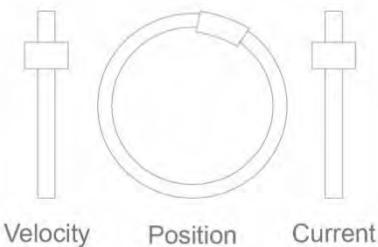
The modular design allows for rapid OEM upgrades and repairs. Compatibility between modules increases reliability across the entire range and allows for ease of customization. Interchangeable end-effectors allow for quick mission-specific fit outs.

Underwater Ready



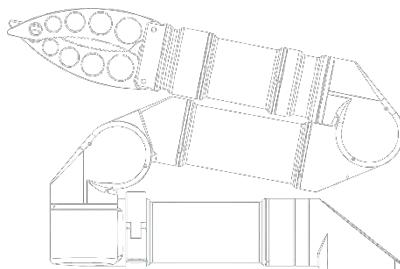
The Reach 5 Mini is capable of operating at depths of 300m for extended periods of time. Each unit undergoes rigorous testing prior to shipping to ensure seal and structural integrity when operating in harsh environments. Our products have been validated by customers around the world and have logged over 1000 hours at depth.

Full Control



Position, speed and current feedback extends the Reach Mini manipulator abilities to performing delicate tasks. Proprietary control algorithms ensure accurate response and enhanced control through multiple human machine interfaces.

Small Size



A standard external diameter of 40mm and weight of less than 900g in water, the Reach 5 Mini provides unparalleled functionality for unmanned remotely operated vehicles where size and weight are critical.

1.2 DIMENSIONS AND COORDINATES

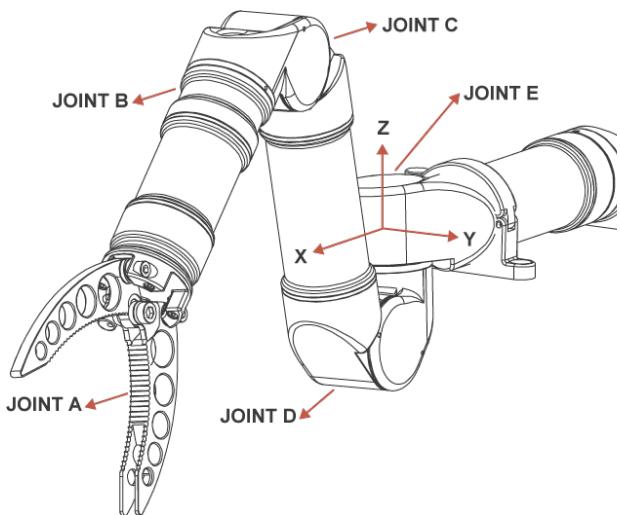


Figure 1 – Joints and Origin

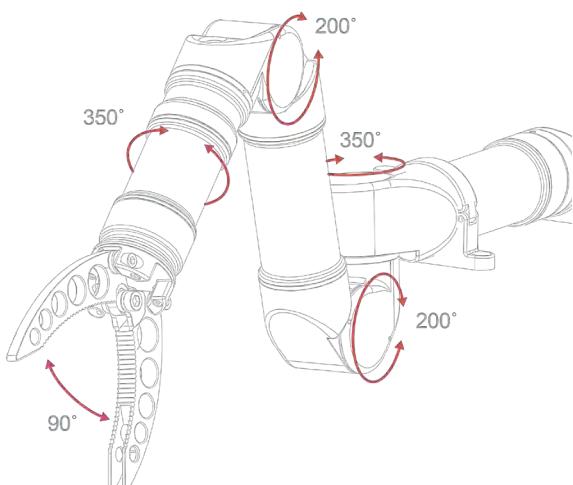


Figure 2 Joint Limits

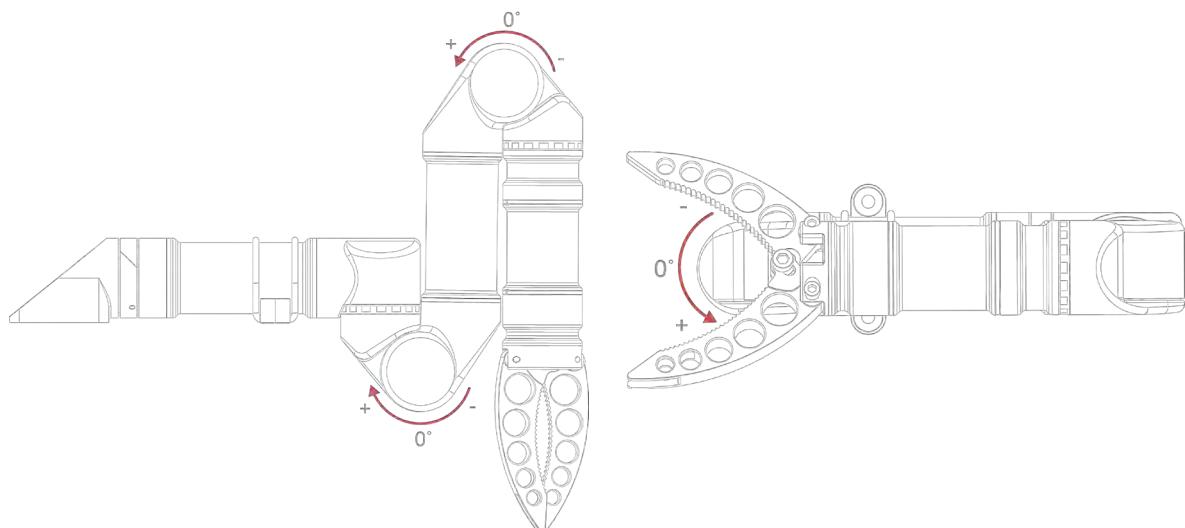


Figure 3 Zero Point/Travel/Direction & Zero Point

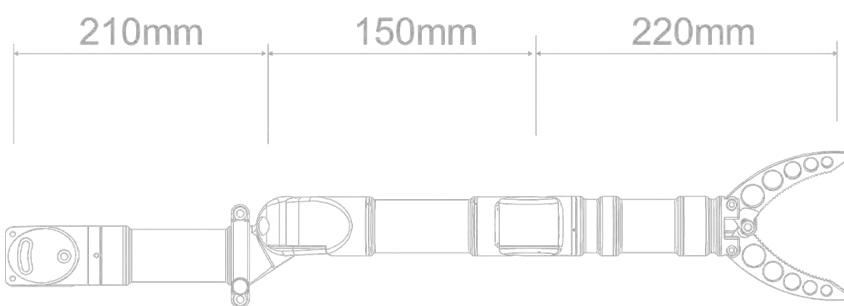


Figure 4 Axis Length

1.3 SPECIFICATIONS

Mechanical

Specification	Joint A	Joint B	Joint C	Joint D	Joint E
Weight Air	1250g				
Weight Water	880g				
Dimensions	570xΦ40mm (Mounting Base to Jaw Tip)				
Max Lift (Full Reach)	2Kg				
Torque/Force	600N	0.6Nm	10Nm	10Nm	10Nm
Rate	3mm/s	50°/s	30°/s	30°/s	30°/s
Travel	22mm	330°	200°	200°	350°

Environmental

Depth	300m Below Sea Level
Temperature	-10°C to +45°C
Shock	200Gs/1ms
Housing Material	Hard Anodised 6061 Aluminium

Electrical

Voltage Range	18-30V DC <i>(Lower voltage is allowed, but will limit speed)</i>
Power(max)	35W
Communication	Full Duplex RS232 or Half Duplex RS485
Connector	Teledyne 6 Pin IE(W)-55 Impulse

Kinematic, Dynamic, and Other Properties

The Blueprint Lab Github repository contains documents regarding the Kinematic and Dynamic properties of Reach System manipulators.

Available at: <https://github.com/blueprint-lab>

2 INTERFACING

Mechanical

The Reach 5 Mini offers a variety of mounting configurations. These are easily implemented using the supplied two-part mounting kit. This kit is designed to absorb moderate shock to help protect the Reach 5 Mini from external impact.

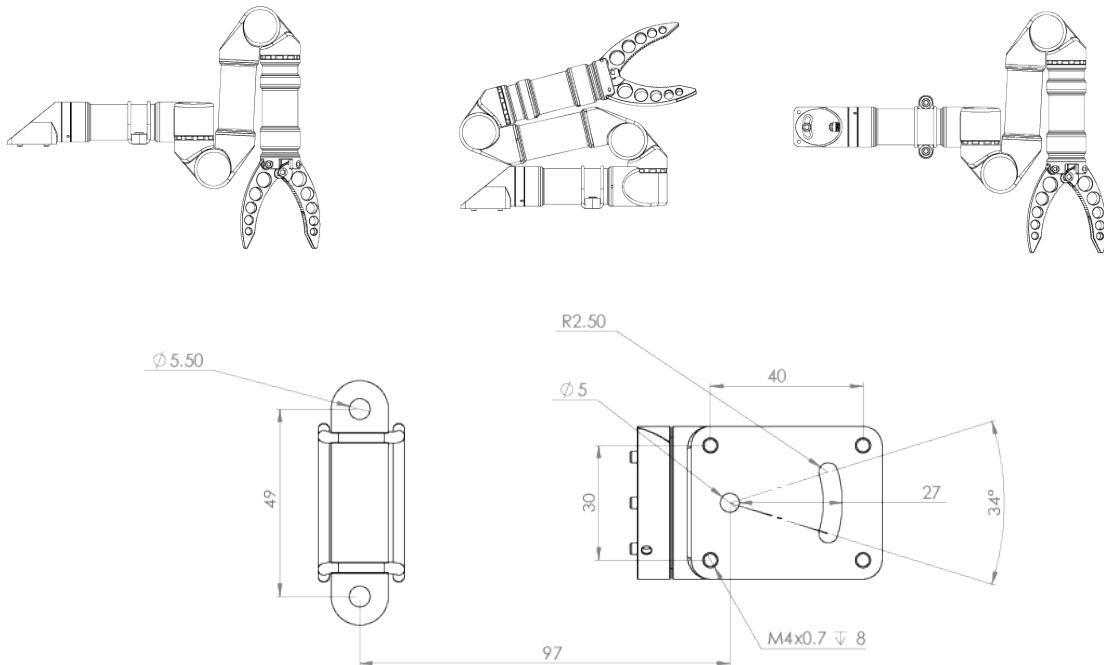


Figure 5 Mounting Dimensions of Mounting Kit

Electrical

The standard interface for the Reach 5 Mini is a Teledyne 6 Pin IE(W)-55 Impulse Connector. The mating connector is a Teledyne 6 Pin IE(W)-55 Impulse CCP Connector. It is important that the serial device and the Reach 5 Mini share a common ground. Failing to do so could damage the device.

(NOTE: If your whip has a **Brown** cable this is a legacy configuration. Please conduct Blueprint Lab for the interface information.

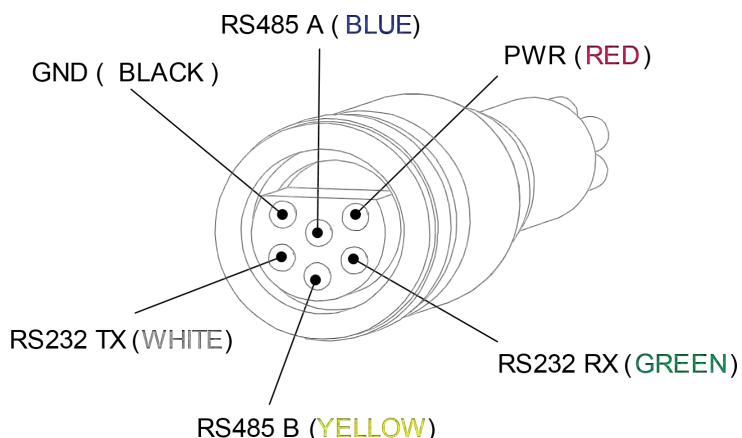


Figure 6 IMPULSE IE55 FEMALE Whip - Female Face View

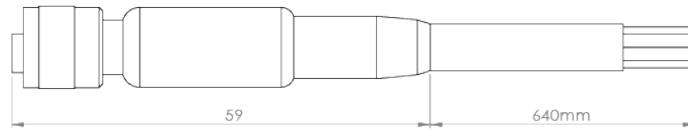


Figure 7 IMPULSE IE55 CCP Dimensions (mm)

Communication

The Reach 5 Mini communicates via a serial RS232 or RS485 interface. The serial connection should be configured via the Reach Control software suite or manually using the following specification.

Serial Specifications	
Baud	115200 bits/s
Word Length	8 bits (including parity)
Parity	None
Stop Bits	1

When using an RS232 device the connection is full duplex whilst when using RS485 it is half duplex. The Reach 5 Mini will respond to demands on either RS232 or 485 without needing to be configured. Data being transmitted from the R5M will be done via both COM ports. For more information on the serial protocol please refer to the Serial Protocol Document at <https://github.com/blueprint-lab>.

3 BENCH SETUP

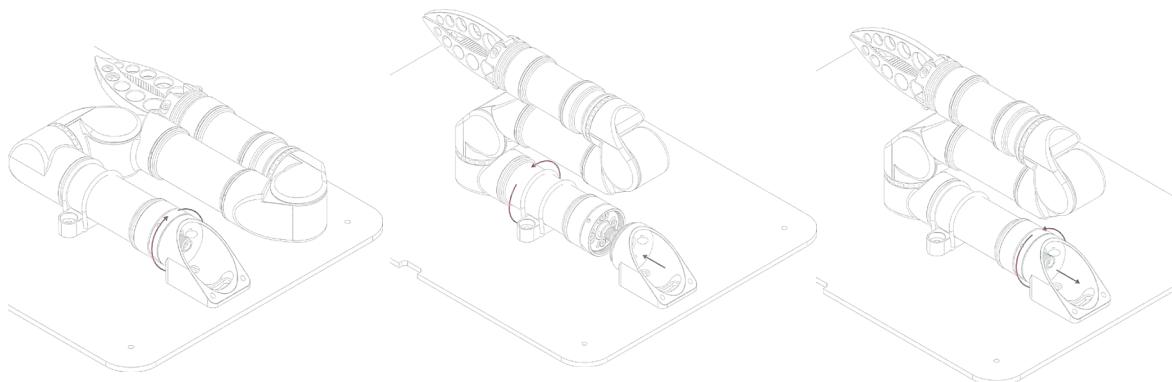
Prior to vehicle integration activities, a bench level test is recommended in the first instance. This builds familiarity from the ground up and assists with product acceptance. The following procedure will walk you through the bench setup procedure.

You Will Need

- ✓ Reach 5 Mini manipulator
- ✓ Test Cable
- ✓ Power Supply or Battery
- ✓ PC or Laptop running Windows
- ✓ (Optional) 3D Mouse or Gamepad
- ✓ Supplied Break-out-board with USB cable or alternative serial connection (RS232 or RS485)
- ✓ An installation of Reach Control Lite (included with purchase) or Reach Control
- ✓ RS1 Mounting Kit

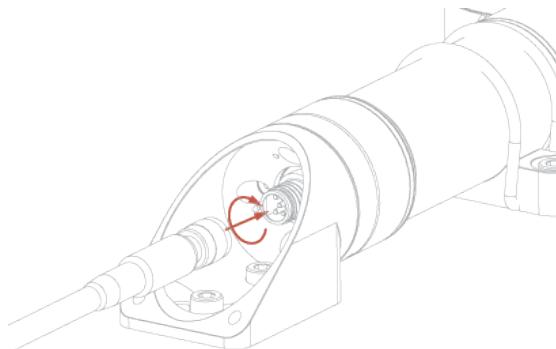
Step 1

Remove the manipulator and stand from the transport case and place on the bench. Loosen the mount locking nut, rotate the manipulator 90 degrees to the upright position, align the pins and retighten.



Step 2

Ensure the manipulator is upright and free from obstruction. Connect the 6-Pin Female Impulse Connector to the 6-Pin Male connector on the rear of the manipulator by lining up, inserting and then rotating to fasten.



Step 3

Connect the Break-out-board to the PC/Laptop via the supplied USB cable. You may plug the USB into either the RS232 or RS485 slot as both outputs are wired to the manipulator by default.

For users who are bypassing the Break-out-board and using their own serial connection setup, ensure that TX of the manipulator goes to RX of the controller and vice versa.

Step 4 – Reach Control Setup

Install the latest version of Reach Control/Reach Control Lite by double clicking on the supplier installer .exe file and following the installation wizard. Run the application on the completion of install or open via the start menu.

If you need a copy of Reach Control supplied, please contact Blueprint Lab.

Step 6 – External Control Setup

If using an external controller such as a 3D Mouse or a gamepad controller, plug this into the computer now and turn it on. Without powering on the manipulator, move the external device control inputs. The arrows light up and the 2D animation portrays a simulated response.

Note: if using the Master Arm controller, you can set that device up now, following the steps in the Master Arm Operator's Manual.

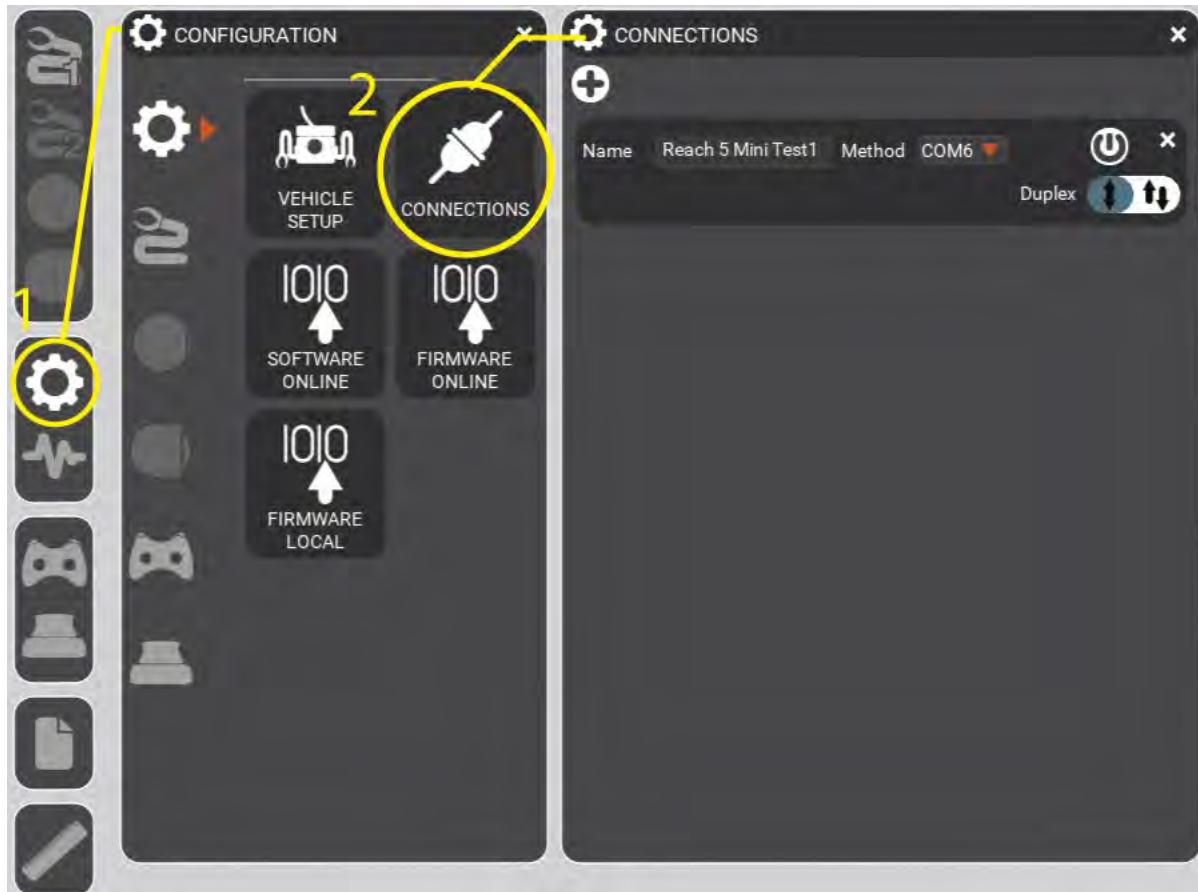


Figure 8 3D Space Mouse Simulation (Left), Gamepad Controller Simulation (Right)

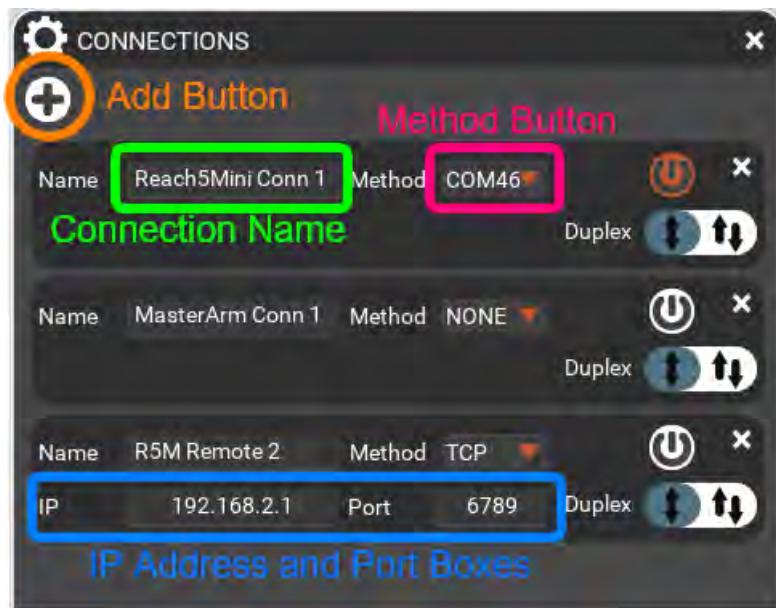
Step 7 – Communication Setup

This step connects the control PC or Laptop to the manipulator.

1. Click on the gear icon on the main screen to open the CONFIGURATION panel. Click on the second gear icon in this panel if not already selected.
2. Click on the CONNECTIONS icon to open the CONNECTIONS panel.



3. By default, one connection will have been created. Connections can be added by clicking on the '+' in the top left.
4. Set a connection name by typing into the Name textbox.
5. Set a connection method by clicking on the orange arrow on the Method Button. This will bring up a list of the serial COM ports and the option to set UDP or TCP (IPv4) connections. Click on the COM port name or the UDP/TCP options to set those connections.
6. TIP: One way to quickly determine the COM port number for a device is to compare the list of COM ports with the serial connection plugged in and unplugged. The relevant COM port will be the one that appears/disappears.

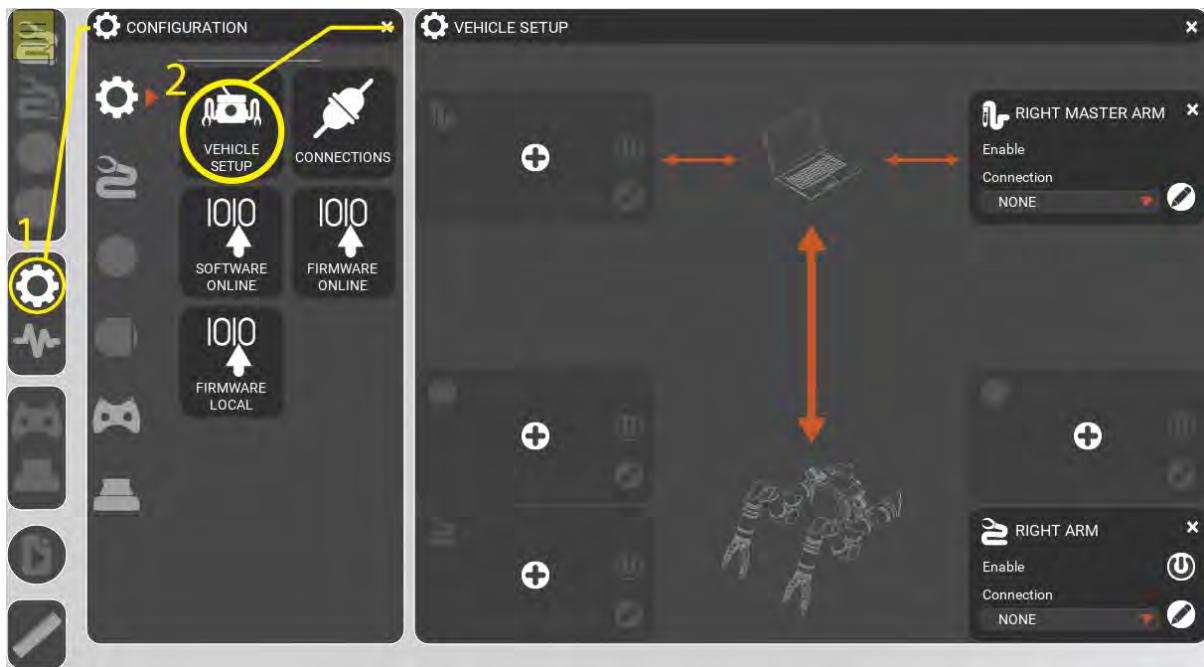


7. If you chose UDP or TCP, the IP Address and Port boxes will appear where you can type in the IPV4 IP Address and Port numbers.
8. Click on whether the connection is full or half duplex. You can set the connection to half duplex by clicking on the double-ended arrow in the duplex box, or full duplex by clicking on the two arrows pointing different directions in the duplex box. If you are using the manipulator's RS485 bus, then you must set the connection to half duplex. If you are using the manipulator's RS232 bus, then you can set the connection to full duplex.
9. To enable the connection, click on the power icon near the top right of each connection tab. This must be done to allow communications through it. If the power icon is orange, then it has successfully connected, otherwise your connection may not be set up correctly.
10. You may close the CONNECTIONS panel after configuration.

Step 9 – Vehicle Setup

This step configures the vehicle system (or bench setup) according to the manipulators, controllers, and any other devices in use.

1. Click on the gear icon on the main screen to open the CONFIGURATION panel. Click on the second gear icon in this panel if not already selected.
2. Click on the VEHICLE SETUP icon to open the VEHICLE SETUP panel.



3. In the VEHICLE SETUP panel, a list of products will be shown. The RIGHT ARM tab will be shown as default.
4. Click on the Add button for each product you need.

For example: If you have one Reach 5 Mini and one Master Arm, click on the Add button on the bottom right product tab (RIGHT ARM) if not already set, and the Add button for the panel on the top right product tab (RIGHT ARM).

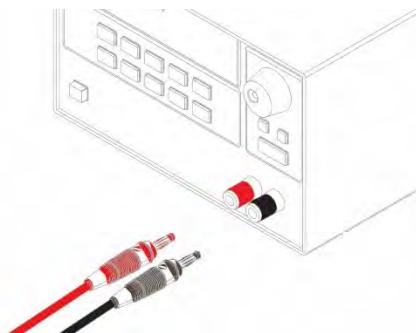
5. Set your chosen products to their respective connections by clicking on the orange arrow in the Connection drop-down box in Product.
6. If not already illuminated (orange), click on the Enable button on the Product tab. When illuminated, the product can communicate on the selected connection (if active).



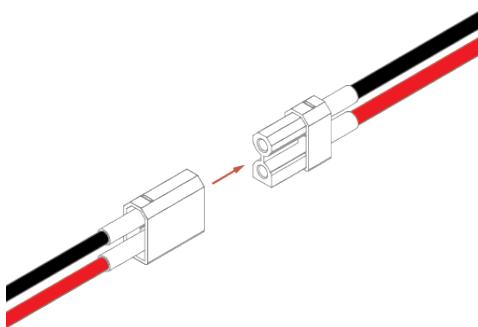
Step 10 – Power Supply

Connect power to the Break-out-board via the supplied power adaptor.

In the case of a bench top power supply connect the ground lead from the RS1 to the GND of the power supply. If you have made your own cable ensure the Ground (GND) on the serial connector is connected to the ground on the power supply. Connect the positive (PWR+) of the RS1 to the positive terminal of the power supply and turn on the power supply.



If you are using a wall adapter connect the XT30 Connector as shown and then plug the adapter into the wall.



Step 11 – Power On and Condition Check

Turn the power supply on.

Five seconds after powering the manipulator, the R5M MODEL panel will update with the current orientation of the manipulator (Figure 8). Additionally, the MONITOR panel (accessed via the heartbeat icon) will begin to show data readings for all joints on the manipulator (Figure 9).



Figure 8 - Reach 5 Mini 3D Model

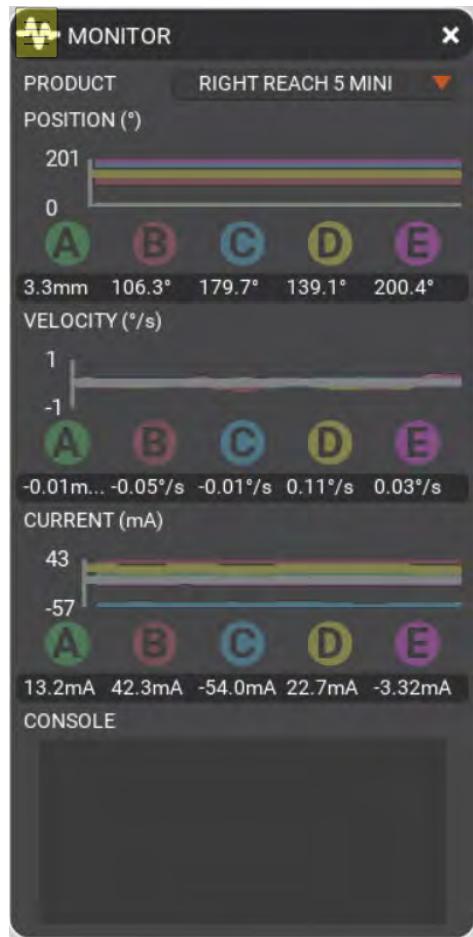


Figure 9 - Monitor Panel

If there is no update to these displays, check your connections and repeat the connection steps.

Step 12 – Control Check

The final step in the bench test is to ensure that all joints are active, receiving commands, and responding in the expected manner. Using a control method of your choice as detailed in Section 0 (we recommend the software control panel), actuate each joint of the manipulator and ensure that the joint responds and moves correctly.

This is the end of the bench test. You are now ready to further integrate and test the manipulator for your specific application.

4 CONTROL

4.1 Arm Control Panel

The joints of the manipulator can be manually controlled using the control panel. A graphic display indicates the joints that can be moved and sliders are available for changing the primary parameters.

- Access the ARM 1 CONTROL panel at the top left of Reach Control's main screen. If you have a second Reach 5 Mini, you can control it using the ARM 2 CONTROL panel, which is accessed via the similar icon underneath the ARM 1 CONTROL icon.



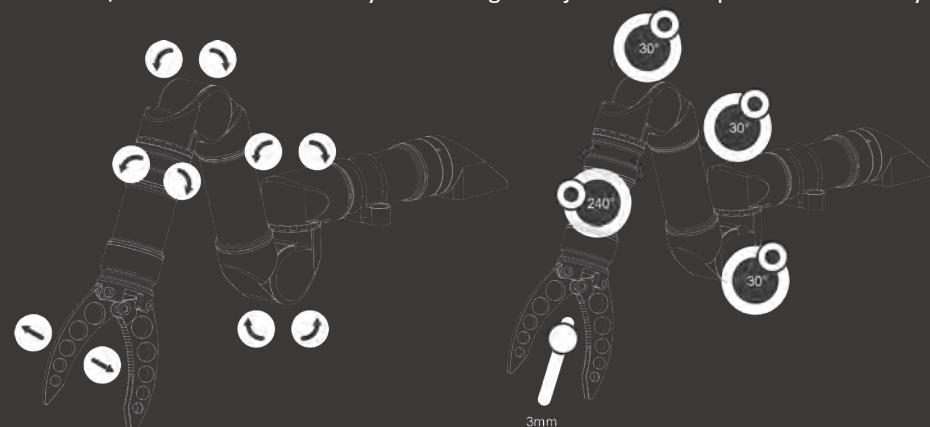
- The Stow button moves the Reach 5 Mini to its stow position. This can be set in the Installation panel.



- The Position/Velocity Slider sets which mode the joints will be controlled in.



- The dials/arrows are for manually controlling each joint in either position or velocity.



- The Velocity gain slider sets the speed of the joint when the arrow buttons are pressed



- The Torque Output slider sets the percentage torque output of all the joints besides the jaw open and close and inline rotate. It is recommended this remains at 50% when bench testing.



- The Grip Force Slider sets the amount of force applied by the jaws.



(Note that these sliders only have an effect on GUI control, and not on other control modes)

4.2 Human Machine Interface (HMI)

Reach Control can take controller demands from a 3D Mouse or Gamepad. (For Master Arm users, please see Section 4.4)

When connecting either a 3D Mouse or a Gamepad, the appropriate window will appear and display feedback and control options. Moving the HMI in their respective axes will simulate the movement on the manipulator simulation as well as highlight the controller input.



Figure 23 3D Mouse Panel



Figure 24 Gamepad Input

Depending on the task being performed, the HMI panels offer the ability to quickly change the responsiveness of the controller using the exponential settings.

- Slider to the left provides a small output demands for most of the controller input. Useful for fine-tuned, slower control.



- The Slider in the centre is a linear mapping where 50% input will provide a 50% output. This is standard mode.



- Slider to the right provides a large output demand for a small controller demand. Useful for fast, responsive movements.



4.2.1 Manual Mode

In manual mode the joints are controlled independently and commands do not make use of the kinematics engine. By default, the controls of the 3D Mouse and Gamepad are pre-mapped to specific functions. These can be changed in the settings panel. The mounting orientation selected during the installation setup will dictate the direction of rotation (see Section 5).

- When the Kinematics Icon is white the controller is being used in Manual Mode



4.2.2 Controller Mapping in Manual Mode

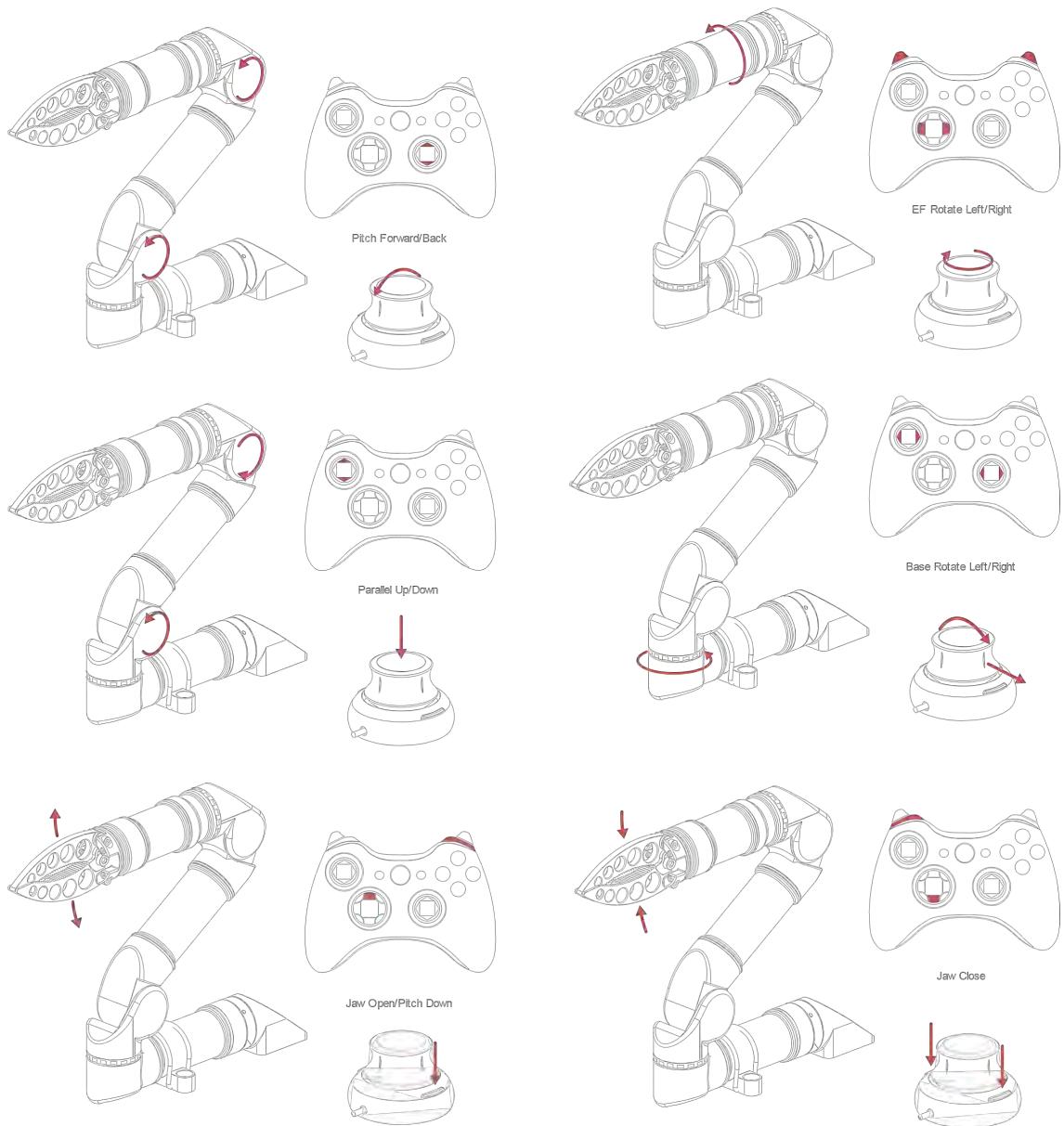


Figure 25 Controller Mapping in Manual Mode

4.2.3 Kinematics Mode (Global Coordinates)

In Kinematics mode the movements are performed in the world frame in accordance with the orientation of the base given in Figure 10. This mode is useful when trying to track a straight line with respect to the base where manually combining joints movements may prove difficult.

- When the Kinematics Icon is orange the controller is being used in Kinematics Mode

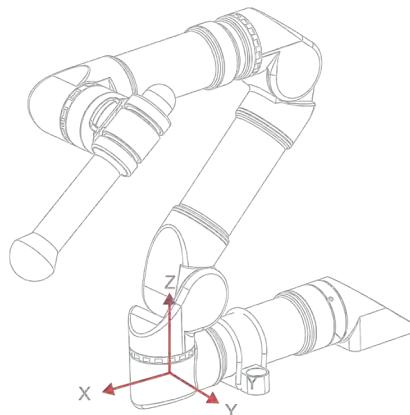
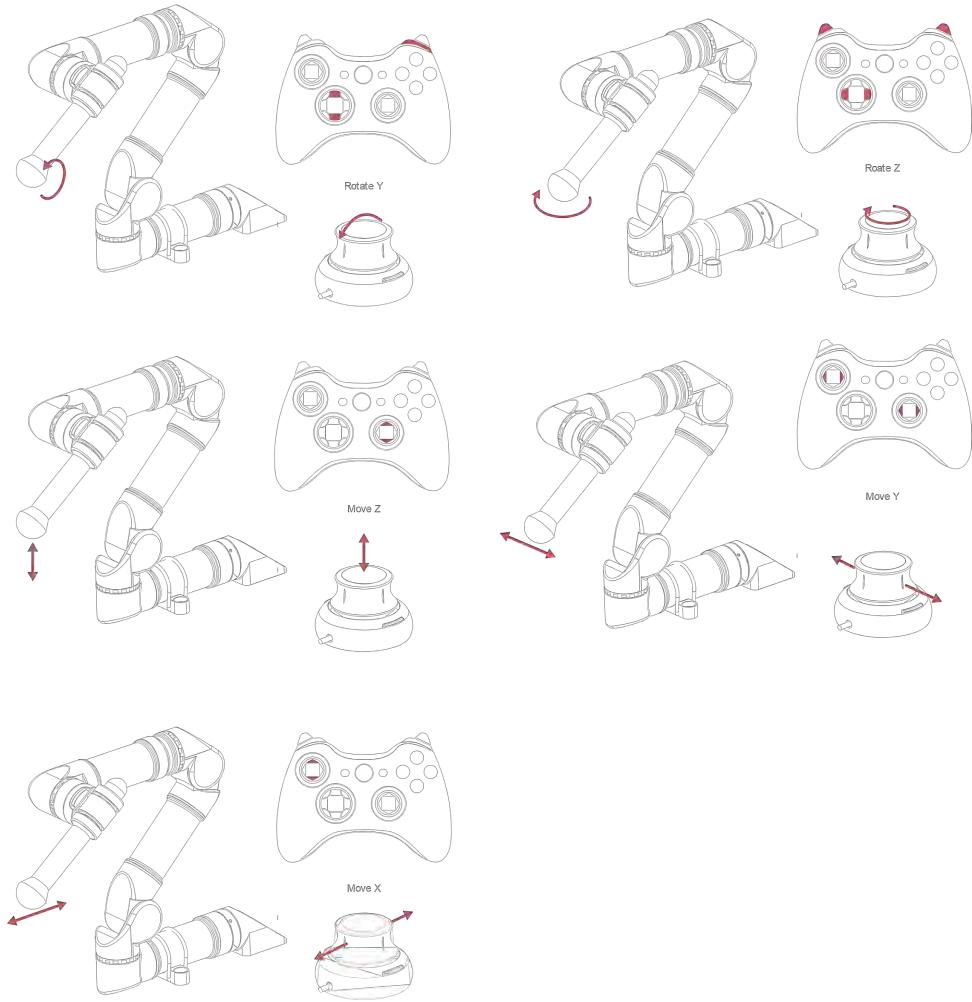


Figure 10 - Kinematics Coordinate Reference Frame (Global Mode)

4.2.4 Controller Mapping in Kinematics (Global) Mode



4.2.5 Kinematics Mode (End Effector Coordinates)

When used in End Effector Coordinate mode, the manipulator moves in the frame of the end-effector (Figure 11). This is useful when following lines that are not at right angles with the base. Set the end-effector (probe) orthogonal to the object you are trying to follow and then control in end-effector kinematics mode.

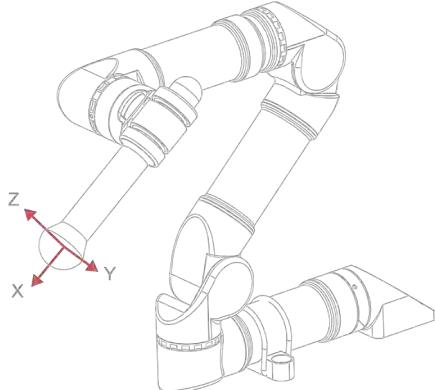
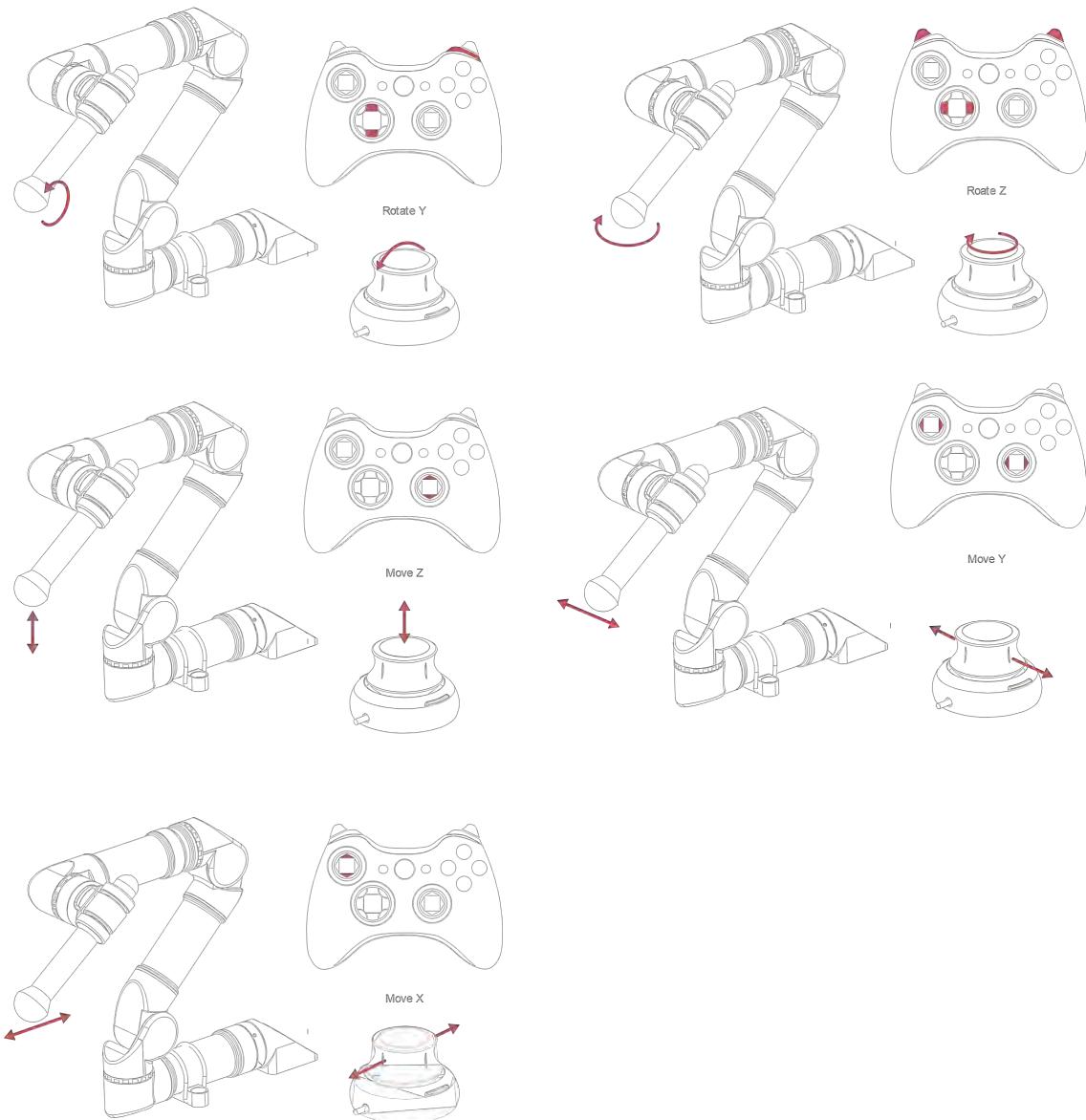


Figure 11 - Kinematics Coordinate Reference Frame (End-Effector Mode)

4.2.6 Controller Mapping in Kinematics (End-Effector) Mode



4.3 HMI Advanced Setup

Reach Control provides a way of setting custom mappings for the Gamepad and 3D Mouse.

4.3.1 Gamepad Advanced Setup

To set a custom Gamepad mapping, select the Gamepad Icon on the left of the CONFIGURATION panel. There are multiple axes that can be edited, allowing for multiple commands. The buttons required to save and select custom mappings are described below.



Figure 27 HMI Gamepad Advanced Setup

- **Map Select:** Dropdown Box that allows you to choose from a list of Gamepad mappings, including your own custom saved settings. The mapping chosen gets set and can be used immediately.
- **Delete:** Deletes the currently set mapping from the saved list.
- **Save as:** Saves the current mapping given the name in the Map Name box.
- **Map Name:** Editable text box allowing you to write your own name for your custom mapping.

To create a custom axis mapping, edit the information in each axis list. The buttons are described below.

- **Mode:** Set the mode for the mapping: E.g. Velocity or position for an axis, or kinematics control.
- **Product:** Dropdown menu to select the product you want to associate the control axis with.
- **ID:** The joint axis to associate with a manual control axis, or the kinematics direction if the mode was set to kinematics.
- **Alt:** Toggles a dropdown list of custom options to edit, such as sensitivity.
- **DBL:** Sets which buttons on the controller controls the axis or kinematic direction. The button on the left sets the direction of control.
- **DBR:** Alternative buttons to set which controller buttons on the controller control the axis or kinematics direction. The button on the left sets the direction of control. For example, if you want to have a button control a joint in the positive direction and another button for controlling in the negative direction.

4.3.2 3D Mouse Advanced Setup

To set a custom 3D Mouse mapping, select the 3D Mouse Icon on the left of the CONFIGURATION panel. There are multiple axes that can be edited, allowing for multiple commands. The buttons required to save and select between your custom mapping and the default mapping are described below.



Figure 28 HMI 3D Mouse Advanced Setup

- **Mapping buttons ‘Default’ and ‘Custom’:** Sets whether you are using the default mapping or your custom mapping. Note: You cannot have more than one custom mapping.
- **Product:** Dropdown menu to select the product you want to associate with the 3D Mouse. Only one product can use the 3D Mouse at a time.

To create a custom axis mapping, edit the information in the mapping section. The buttons are described below.

- **Mode:** Set the mode for the mapping: E.g. velocity or position for an axis, or kinematics control.
- **ID:** The joint axis to associate with a manual control axis, or the kinematics direction if the mode was set to kinematics.
- **Alt:** Toggles a dropdown list of custom options to edit, such as sensitivity.
- **DBL:** Sets which buttons on the controller controls the axis or kinematic direction. The button on the left sets the direction of control.
- **DBR:** Alternative buttons to set which controller buttons on the controller control the axis or kinematics direction. The button on the left sets the direction of control. For example, if you want to have a button control a joint in the positive direction and another button for controlling in the negative direction.

4.4 Master Arm Control

Information regarding control of Reach System manipulators with the Master Arm control can be found in the Master Arm Operator’s Manual available from Blueprint Lab.

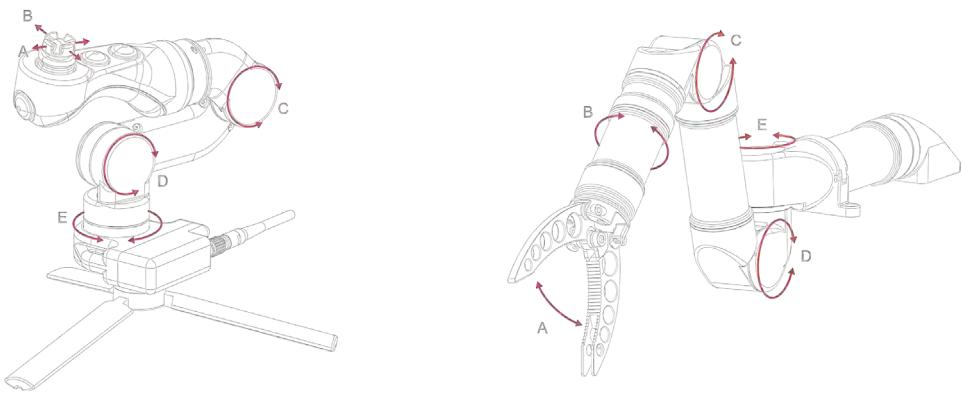


Figure 12 - Master Arm Control Mapping for the R5M

5 PLATFORM INSTALLATION

The manipulator is designed to be integrated onto different vehicle platforms. The following steps will ensure a safe and reliable installation on most unmanned vehicles. For information regarding the installation on common ROV platforms specific instructions may be available. Please contact Blueprint Lab regarding your vehicle integration requirements for more information.

5.1 Hardware Mounting Setup

Step 1

Select whether the manipulator is to be mounted upright or inverted. The mounting kit can rotate through 360 degrees to allow for attachment to surfaces at different orientations.

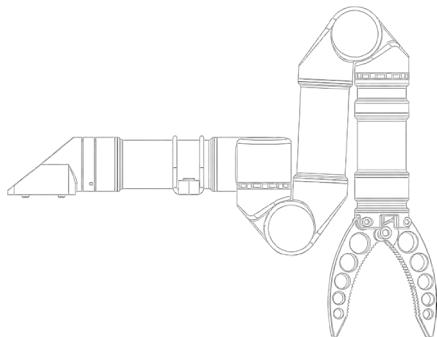


Figure 13 Inverted

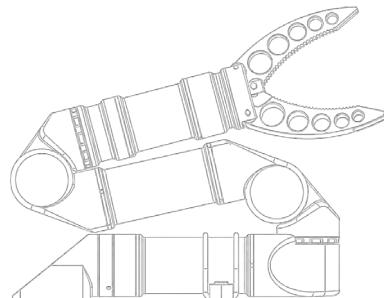


Figure 14 Upright

Step 2

Using the mounting kit hole dimensions (see mounting kit diagram on Page 6), secure the rear mounting bracket and the forward mounting bracket to the host platform surface. The rear mounting bracket can either be secured with 2 x M5 bolts from the top or with 4 x M4 bolts into the tapped holes on the bottom.

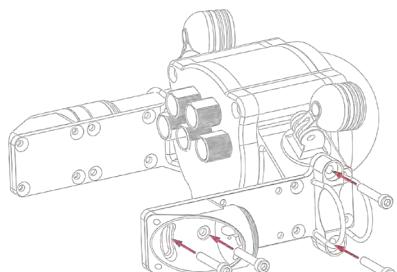


Figure 15 M5 from Top

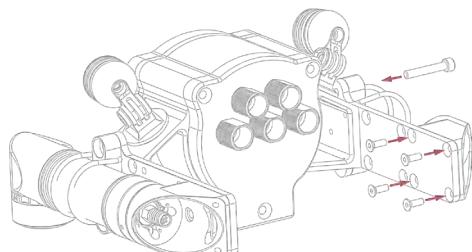


Figure 1613 M4 from Bottom

Step 3

Attach the manipulator by feeding the base through the O-ring and securing it with locking nut at the desired orientation.

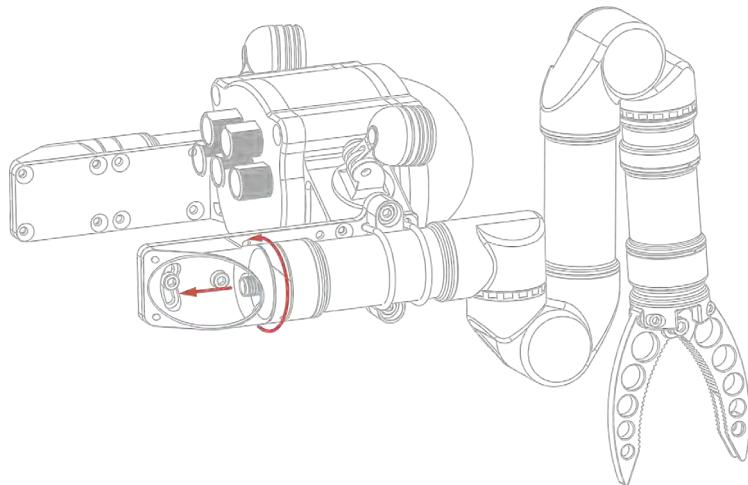


Figure 17 Insert through O-ring and Tighten Locking Nut

Step 4

Connect the manipulator cable by inserting the female Impulse connector and rotating the locking nut. Connect the manipulator to the host PC running Reach Control using the same steps given in Section 3, per your specific communication and power setup.

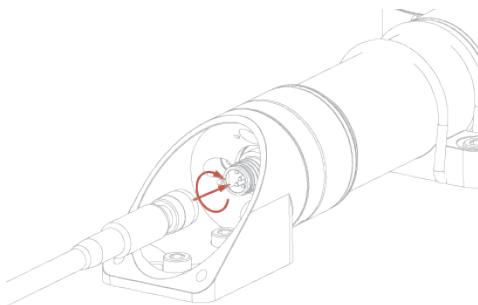


Figure 18 Insert Connector and Rotate Nut

5.2 Software Setup for Hardware Constraints and Requirements via Reach Control

Step 1

In Reach Control open the window and select the Reach 5 Mini tab. Click on the Installation Icon to bring up the installation window.

- This icon brings up the configuration panel. Within the configuration panel you can access settings for all connected devices



- This is the Reach 5 Mini icon and within the context of the configuration page it will display all the available configuration options.



- This is the Reach 5 Mini Installation Icon and on clicking will open the available installation settings.



INSTALLATION

Step 2

Select which product you wish to set the hardware constraints via the dropdown product selection box at the top left of the INSTALLATION panel. The next steps should be done for each product you are using.

Step 3

If you require having more than one manipulator on the same RS232 or RS485 communications bus, then follow the below steps.

1. Connect both the first and second Reach 5 Mini to Reach Control. You must know which Reach 5 Mini is the designated second arm to share on the RS232/485 bus to proceed with this.
2. Create the connections as needed, with the second Reach 5 Mini in the LEFT ARM slot. See Section 3, steps 7-9.
3. Select the second Reach 5 Mini in the product selection box at the top of the INSTALLATION panel. This should be called the LEFT ARM.
4. In the text box next to the text 'PRODUCT DEVICES PREFIX', type in the Reach 5 Mini device range for that product. For example, for the first Reach 5 Mini (RIGHT ARM) it should be '0', and the second Reach 5 Mini (LEFT ARM) on the same communication bus it should be '1'.
5. Both Reach 5 Mini should operate independently from here.

Step 4

This step is to set up the packets you require from the manipulator on a regular heartbeat. This is in the 'REQUEST PACKETS' section of the INSTALLATION panel. It is recommended to leave it set to the defaults, unless otherwise required.

For the 5 default packets (VELOCITY, POSITION, CURRENT, MODE, KM_END_POS), you can toggle these on or off by selecting the checkbox to the left of each of these. If the checkbox is orange, then Reach Control is requesting the packet.

If you require packets other than the default, you can add it to the list by selecting the packet from the generated list of the dropdown boxes on the right on the 'REQUEST PACKETS' section.

Step 5

Move the manipulator to the position you wish to stow it in, either via a HMI controller or the R5M CONTROL panels. To save this stow position, click on the MAP button. This can then be tested by moving away from the stored position and then clicking the stow button; the manipulator should return to the mapped position.

Step 6

Within the INSTALLATION settings window select the appropriate mounting orientation according to your setup. This will affect both control input and workspace restrictions.

- In this configuration the Reach 5 Mini is mounted upright with its base joint point upwards



- In this configuration, with the slider to the right the Reach 5 Mini is mounted inverted with the base joint pointing downwards. Note that this is independent of the installation of the mounting kit.



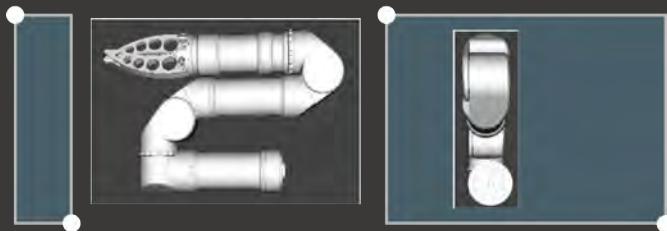
Step 7

Workspace restrictions provide a means of dictating 'keep out' areas for the manipulator. For a given installation there could be any number of obstacles limiting the available movement. By adding obstacles to the workspace the manipulator will ensure that it does not enter into those areas preventing damage to itself and the vehicle.

- The Enable button turns that obstacle on or off



- Dragging the corners of the rectangle changes the dimensions and position of the specific obstacle with respect the origin of the Reach 5 Mini.



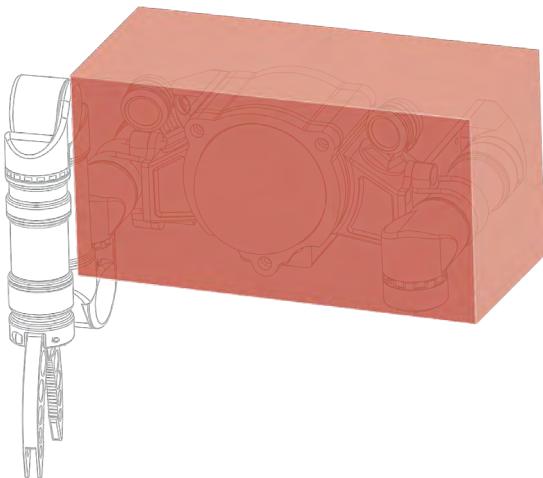


Figure 20 Rectangular Prism Obstacle

Step 8

If you have recently switched between end-effectors (e.g. between grabber and cutter), then you should re-calibrate the push rod. This is done in the END-EFFECTOR panel, opened by clicking on the END EFFECTOR icon in the CONFIGURATION panel.

1. Select which manipulator you wish to calibrate, via the dropdown box above the 'AUTO LIMIT' button.
2. Calibrate the product by clicking the 'AUTO LIMIT' button.

This will actuate the push rod to self-determine its limits based on the attached tool.



Figure 21 END EFFECTOR panel

Step 9

If you have the probe holder version of the manipulator, then you must set your probe positions and lengths. This is done via the PROBE INSTALLATION panel accessed via the PROBE INSTALLATION icon in the CONFIGURATION panel.

1. Select which product requires the probe distances to be set via the dropdown box next to the 'Select Product:' text.
2. Press the Refresh button.
3. Replace the measurements in the white boxes per your particular probe measurements. This is required in millimetres.
4. Press the Save button when done.

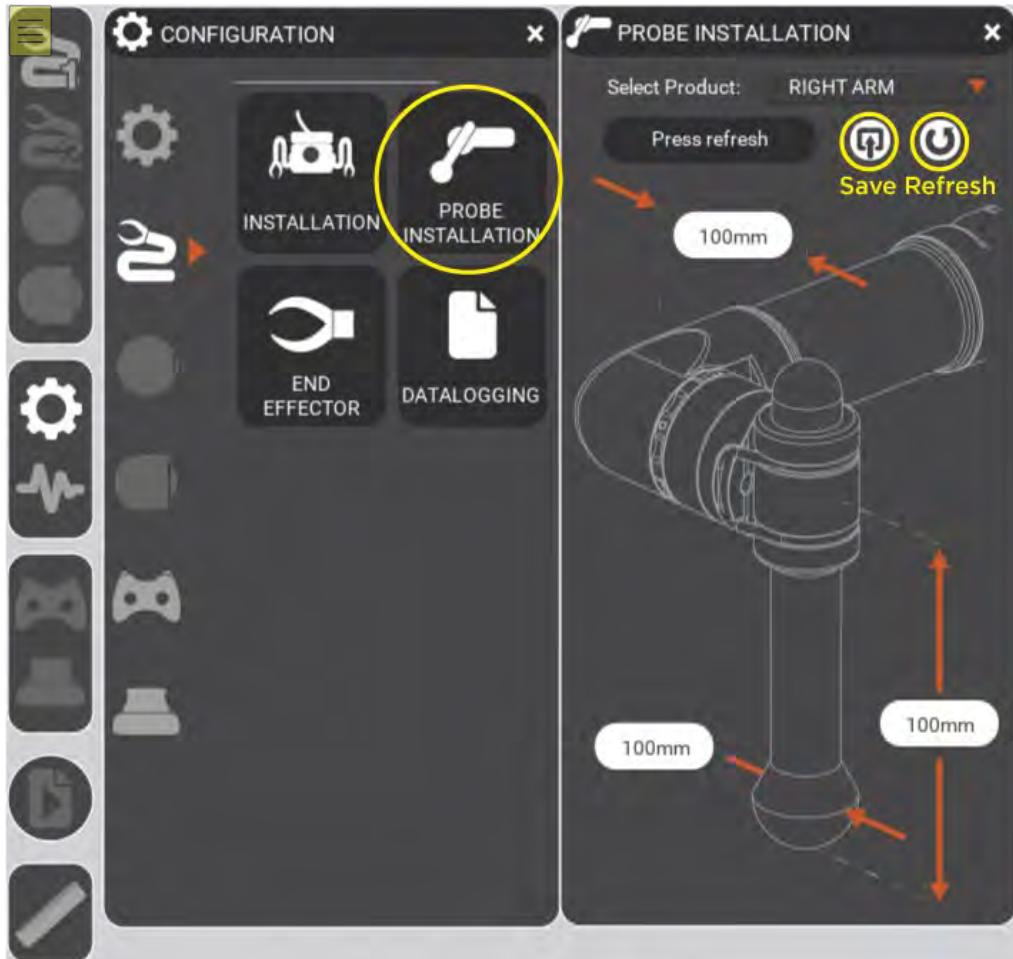


Figure 22 PROBE INSTALLATION panel

6 ADDITIONAL REACH CONTROL WIDGETS

6.1 MONITOR PANEL

The MONITOR PANEL is useful for diagnostics and to observe the state of each joint during operation. The MONITOR PANEL is opened via the heartbeat icon and allows for the position, velocity and current of each joint to be displayed on a graph.

- The drop-down list selects which product will be monitored
- PRODUCT R5M 1 
- The graphs display the respective state over time. Selecting the different axis toggles their display state from on to off.

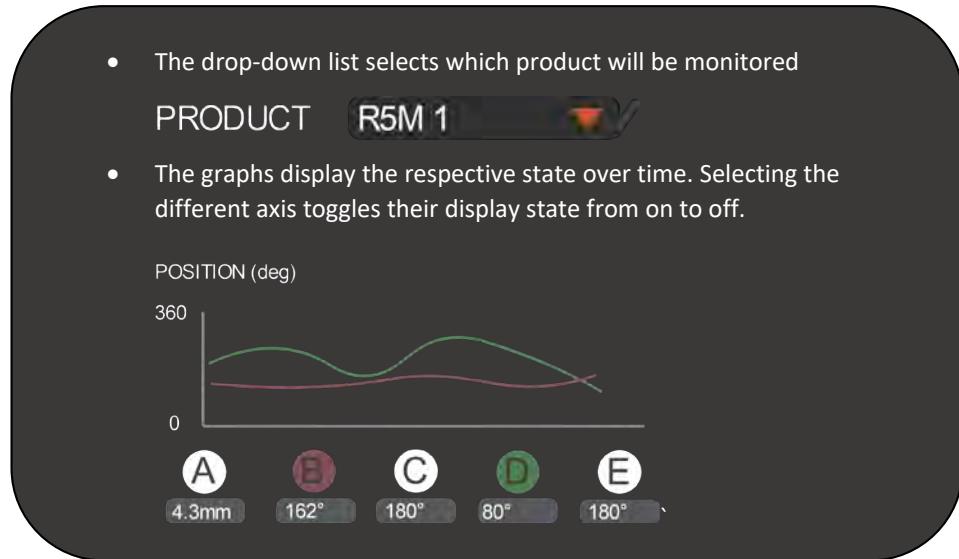


Figure 29 MONITOR PANEL icon on the main screen (Left) and MONITOR PANEL functionality (Right)

6.2 MEASURE TOOL

The MEASURE TOOL provides a means of measuring the distance between one end-effector position and another. The distance is the straight-line distance and is useful for determining the size of an object or measuring defects when conducting an inspection task.



Figure 30 MEASURE TOOL icon on the main screen (Left) and Measure Tool (Right)

The distance measurement is updated in real time and displayed in the top most readout indicated by the orange pointer.

- The pin icon sets the origin to the current end effector location and zeros the measurement readout.



- The plus icon saves the measurement and adds it to the list. It also resets the origin to start a new measurement from the current position.



6.3 DATA LOGGER

The data logger tool provides a means to log data from your Blueprint Lab products. This is recorded in the comma-separated value (.csv) format, which is compatible with most spreadsheet document editors (e.g. Microsoft Excel, LibreOffice). The data logger remembers the latest settings and these are loaded on start of Reach Control.

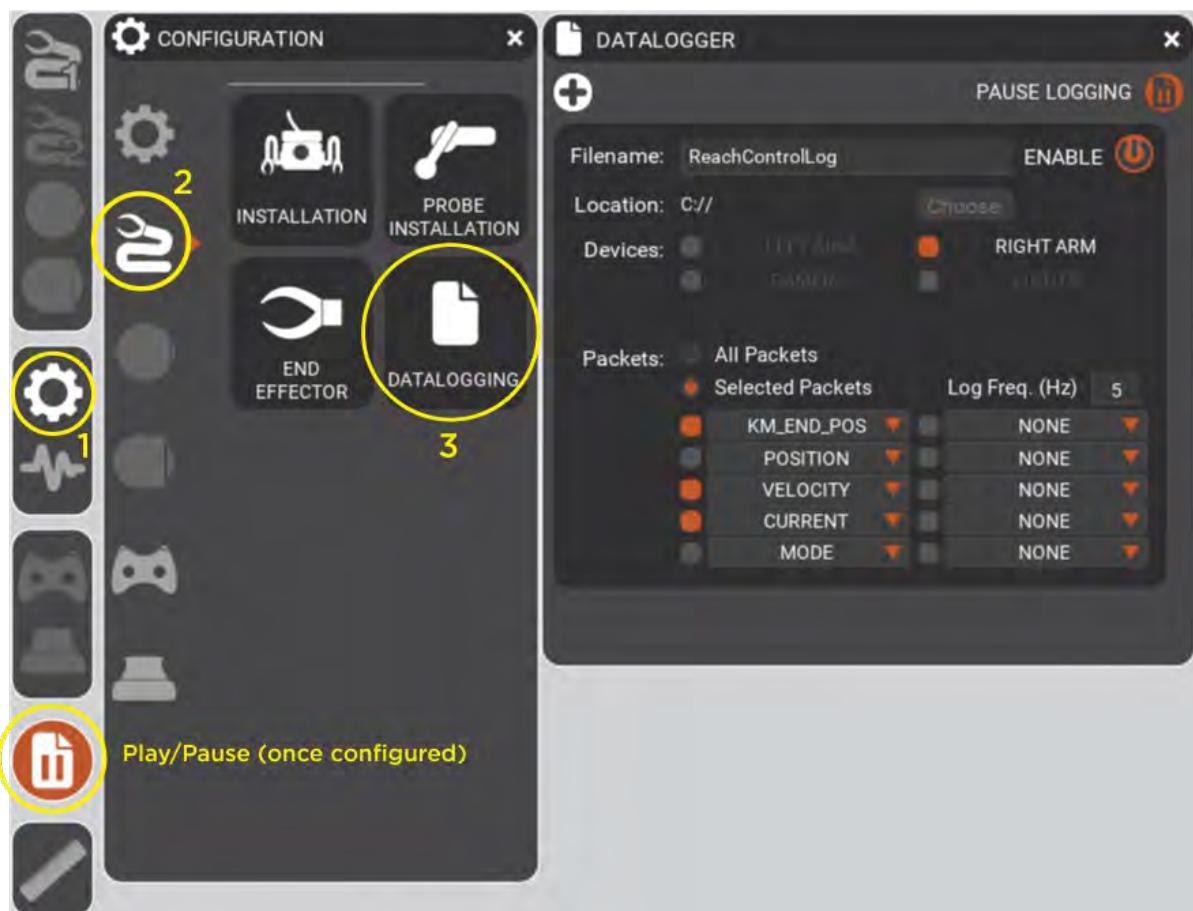


Figure 31 Data Logger Panel

6.3.1 First Time Setup or Editing of Data Logger Settings

Open the DATA LOGGER panel via the CONFIGURATION panel.

Step 1

Select a file name you wish to log data as (saved in the comma-separated value '.csv' format). This can be done by writing a value in the box next to the text 'Filename:'. The output file name will be written in the format: '<chosen_file_name>_<YYYYMMDD>_<HHMMSS>.csv'. For example, if the chosen name is 'ReachControlLog', the date is 13/01/2020, and the time of clicking the ENABLE button is 12:22:26 pm, then the saved file will be named 'ReachControlLog_20200113_122226.csv'. Note: The ENABLE button must be off, otherwise you will not be able to edit the name.

Step 2

Select the location (folder) that you wish to record the log files to. The currently selected location will be shown to the right of the 'Location:' text (shortened automatically if the location name is too long). To select a location, click on the 'Choose' button and follow the prompts. Note: The ENABLE button must be off, otherwise you will not be able to edit the location.

Step 3

Select the products that you wish the log file to record from. This is done via the buttons to the right of the text 'Devices:'. The product will be recorded if the selected button is flashing orange. If the product is greyed-out and unable to be selected, then you must enable to product via the VEHICLE SETUP wizard in the CONFIGURATION panel in ReachControl (see Section 8).

Step 4

Select which method you wish the data logger to record by. Select one of the 2 methods by selecting one of the buttons described (the button with the orange is the selected mode):

- 'All Packets': This mode records all incoming packets from the selected products.
- 'Selected Packets': This mode requests the packets chosen to record at the frequency set in the box next to the 'Log Freq. (Hz)' text. This frequency can be edited by the user by typing in the box, with a range from 0-5Hz (if you choose a value outside this range, it will default back to 5).

Step 5

If you chose the 'Selected Packets' mode, then you must select which packets you want to record. To select the packets, click on the orange arrows on each of the boxes below the 'Selected Packets' text, and select the packet from the generated list. 'NONE' represent no packet. However, the packet will not be set to record unless the small button to the left of the packet selection box is orange (representing 'on'). This can be toggled on and off by clicking on the small button.

Step 6

To enable the data logger (not record, but prepare to record), click on the ENABLE button. The data logger is enabled when the ENABLE button is orange. This will create the file using the chosen filename in the location that you have chosen. The ENABLE button will not turn on if you have not chosen a filename and location. If the ENABLE button is on, then you also will not be able to change the filename and location.

Step 7

To start the data logger and log data to the specified file, you must toggle one of the two 'Log Data' buttons. One of the 'Log Data' buttons is on the main screen, while another is in the top of the DATALOGGING panel. These buttons will flash orange when the data logger is running and recording data.

6.3.2 After First Time Setup

After setting up the data logger for the first time, you can run the data logger with the auto-saved previous settings without having to open the DATALOGGING panel. This auto-saved setting remembers whether the ENABLE button was pressed, meaning you do not have to re-enable it via the DATA LOGGER panel on start.

Running the data logger can be done via toggling the ‘Log Data’ button at the bottom left of Reach Control’s main screen. This button will flash orange when logging data. Toggling it off will pause the logging.

Note: If the Data logger is disabled (ENABLE button is off) or there is an error, the ‘**Log Data**’ buttons will not flash and recording will not happen.

- **ENABLE button:** Used to set the datalogger’s settings and create the file. This must be turned on to record data. The datalogger is enabled when ENABLE button is orange, and off when it is white.

- **Log Data buttons:** These are used to start/stop logging data. The datalogger must be enabled before this button records data. These flash orange when logging data.


‘Log Data’ icon in DATALOGGING panel and on Reach Control main screen

6.4 CAMERA

For operators making use of Blueprint Lab subsea-rated lights, the CAMERA TOOL provides a simple means of operating these.

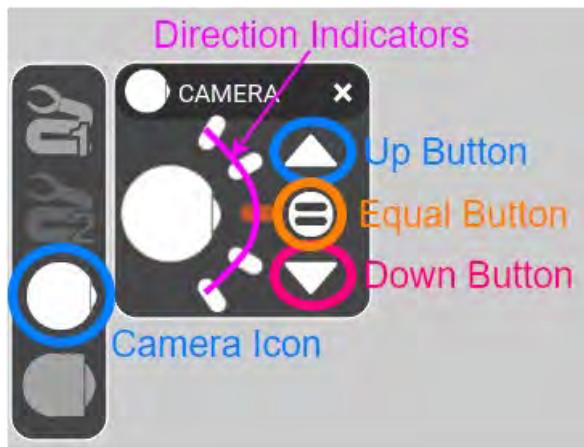


Figure 14 - CAMERA TOOL Functionality

To set up the camera controller, follow these steps:

1. Set up the camera via the VEHICLE SETUP panel and its connection via the CONNECTIONS panel. See Section 8.
2. Once the camera is set up, the Camera icon on Reach Control’s main screen becomes available to click. Click on the Camera icon to bring up the CAMERA panel.

3. If the camera and its connection is setup correctly, then the Direction Indicators will display the camera's current orientation. The direction indicator that corresponds to its direction will become orange.
4. Clicking the Equal button will centre the camera's direction.
5. Clicking the Up button will move the camera angle up, while clicking the Down button will move the camera angle down.

6.5 LIGHT

To set up the lights controller, follow these steps:

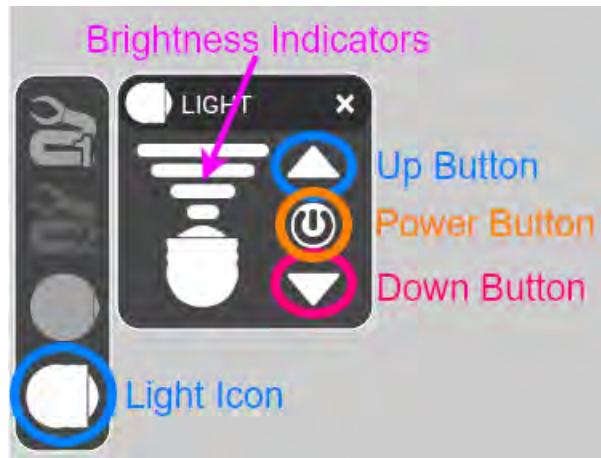


Figure 34 LIGHT panel

1. Set up the lights via the VEHICLE SETUP panel and its connection via the CONNECTIONS panel. See Section 8 to help with this.
2. Once the lights are set up, the Light icon on Reach Control's main screen become available to click. Click on the Light icon to bring up the LIGHT panel.
3. If the camera and its connection is setup correctly, then the Brightness Indicators will display the lights current brightness setting. The more orange bars in the brightness indicators, the brighter the lights are.
4. The Power button will display whether the lights are on or not. If the power button is orange, then the lights are on. Clicking this button will toggle the lights on or off.
5. Clicking the Up button will increase the brightness, while clicking the Down button will decrease the brightness.

7 MAINTENANCE

The three main software and firmware maintenance tools can be access via the CONFIGURATION panel. These tools are the SOFTWARE ONLINE tool, FIRMWARE ONLINE tool, and the FIRMWARE LOCAL tool.

- The SOFTWARE ONLINE tool is used to update Reach Control to the latest version via the internet.
- The FIRMWARE ONLINE and FIRMWARE LOCAL tool are designed to update the firmware on the various manipulators including the Reach 5 Mini.

Using these software maintenance tools comes at a risk, and it is highly recommended to contact Blueprint Lab prior to following the below steps if you are at all unsure about the operation.

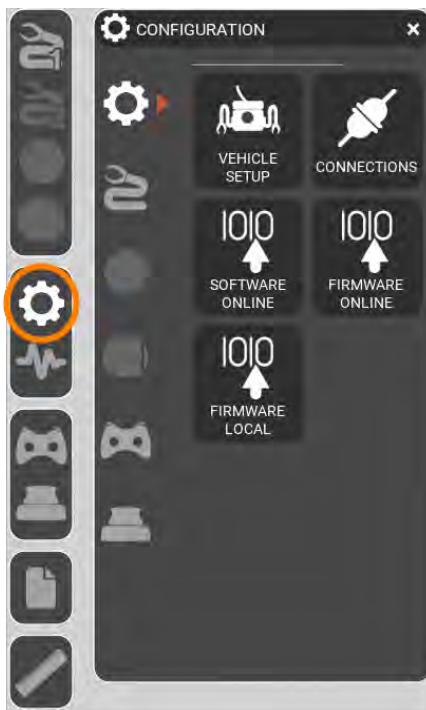


Figure 35 CONFIGURATION panel for software/firmware updates

7.1 REACH CONTROL - SOFTWARE UPDATE

Reach Control (since v2.0.0) has the ability to do online software updates. This requires an active internet connection. To access this tool, click on the SOFTWARE ONLINE icon in the CONFIGURATION panel.



Figure 36 SOFTWARE UPDATER panel

Once the SOFTWARE UPDATER tool is open, it will immediately check online if there is an update, displaying an 'Update' button if the latest version number is larger than your current Reach Control version. The Windows version of Reach Control will download the update file (currently ~60MB in size). Do not attempt to control products during this update. Reach Control will shut down and run the update file after downloading the file.

If there is an error in checking for an update, then check to make sure you are connected to the internet and click the refresh icon on the left of the SOFTWARE UPDATER tool.

7.2 FIRMWARE – ONLINE UPDATE

Reach Control has a tool for updating the firmware on the products, including the Reach 5 Mini, via downloading an online file and installing. This is called the FIRMWARE ONLINE tool, accessed by the CONFIGURATION panel in Reach Control. This requires an active internet connection. To use this tool, follow the below steps:



Figure 37 FIRMWARE ONLINE update panel for Reach 5 Mini updates

1. Make sure that the update is recommended by Blueprint Lab.
2. Make sure the product you want to update is powered and connected to Reach Control.
3. Via the dropdown tool next to the text 'Product:' (accessed by clicking the orange arrow), select which product you wish to update.
4. Click the 'Check for Update' button. This will check online for the latest firmware file, while requesting for the firmware version on the manipulator.
5. The online file will display its version next to the text 'LATEST VERSION:'. If this does not show the version, check to make sure you are connected to the internet, then re-click the 'Check for Update' button.
6. The current firmware version on the manipulator will be displayed next to the text 'CURRENT VERSION:'. If this does not show the version. Check to make sure your manipulator is powered and connected to Reach Control, then re-click the 'Check for Update' button.
7. If there is an update, a box on the right of the FIRMWARE ONLINE panel will appear either say 'Force Upload' if your current firmware version is equal to or greater than the online version (not recommended unless necessary), or 'Update Now' if the online version is greater than the current version.
8. Once you click on the update button, Reach Control will ask if you wish to power cycle or not. Pressing 'CANCEL' will stop the update.
9. If you wish to power cycle: Turn off the manipulator's power source, click 'YES', then power on the manipulator. This will then start the update.
10. If you choose 'NO', the update will begin as it is.
11. After the update starts, the 'Update Status' bar and the 'Message:' text will display the update's progress.
12. If the update is successful, then wait for the arm to reboot. This could take a few minutes. An easy way to check if this is complete is to open the MONITOR panel and wait for all the devices on the graph to start.

7.3 FIRMWARE – LOCAL UPDATE

If you need to install a version of the firmware that does not match the online version, then you must use the FIRMWARE LOCAL tool accessed via the CONFIGURATION panel in Reach Control. To use this tool, follow the below steps.

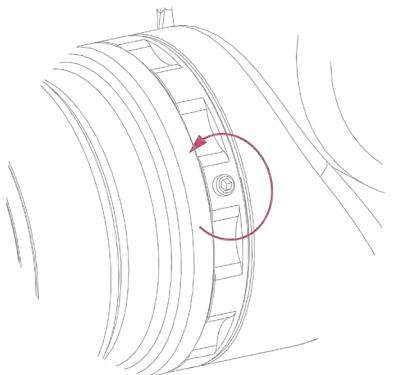


Figure 38 FIRMWARE LOCAL update panel for manipulator updates

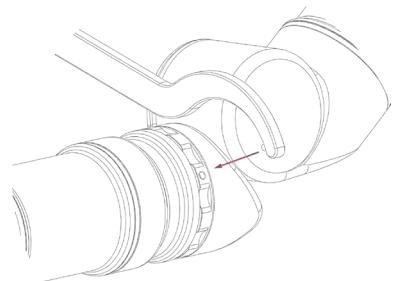
1. Make sure that the update is recommended by Blueprint Lab, and that you download the firmware file to your local machine.
2. Select the connection that the manipulator is connected to, via the orange arrow on the box next to the 'Connection:' text.
3. Select the serial parity required. This by default will be EVEN, and should remain as this unless required otherwise.
4. Select the firmware file. This can be done via clicking on the box next to the text 'File (.hex):' and following the prompts.
5. Once these are selected, a button below will appear stating 'Upload Update?'
6. Once you click on the update button, Reach Control will ask if you wish to power cycle or not. Pressing 'CANCEL' will stop the update.
7. If you wish to power cycle: Turn off the manipulator's power source, click 'YES', then power on the manipulator. This will then start the update.
8. If you choose 'NO', the update will begin as it is.
9. After the update starts, the 'Update Status' bar and the 'Message:' text will display the update's progress.
10. Once the update is complete, wait for the arm to reboot (this could take a few minutes). To check when this is complete, open the MONITOR panel (heartbeat icon) and wait for all the devices on the graph to start transmitting data again.
11. It is recommended to close and restart Reach Control prior to continuing.

7.4 MODULE REPLACEMENT

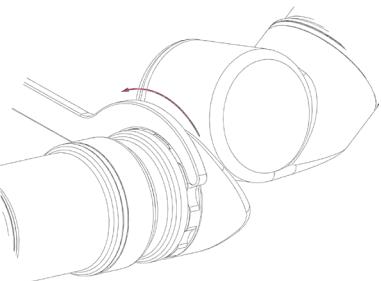
In the instance a module needs to be replaced (such as swapping an end-effector between a grabber and a pan-tilt unit), please carefully follow the steps laid out below. It is recommended that you contact your supplier prior to performing this procedure if it is your first time.



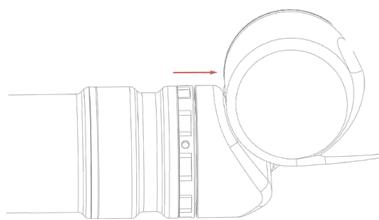
1. Loosen the M2.5 Grub screw securing the locking nut at the base of the module you are replacing.



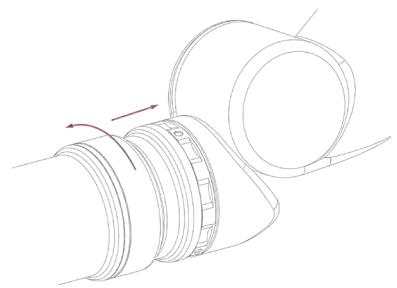
2. Insert the supplied spanner into one of the holes on the locking nut at the base of the module you are replacing.



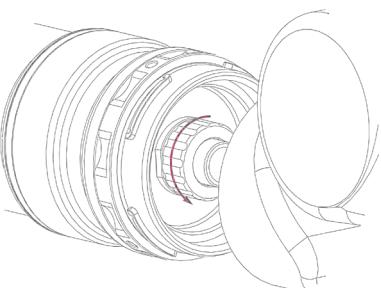
3. Rotate the spanner to loosen the nut.



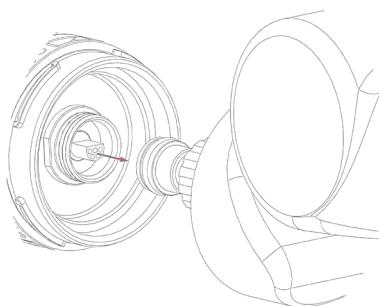
4. Push the male module into the female.



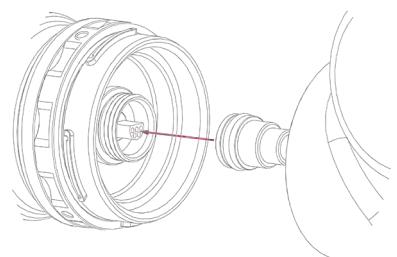
5. While pushing rotate 45 degrees. At 45 degrees carefully pull to remove.



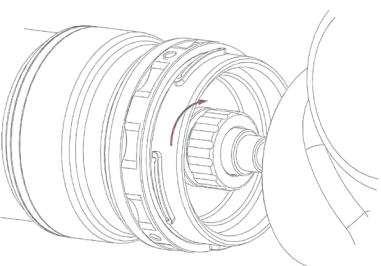
6. Loosen nut securing connector.



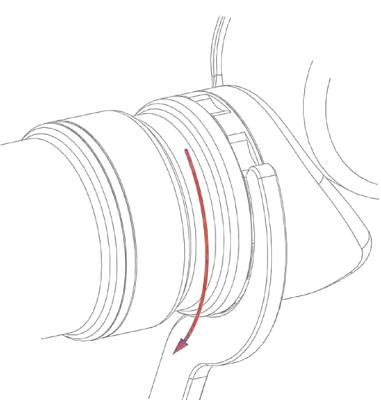
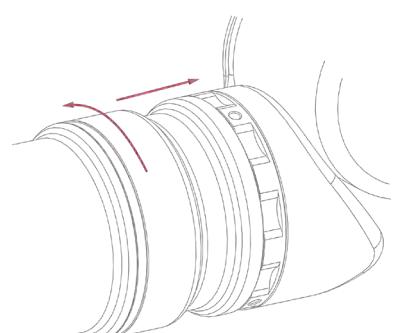
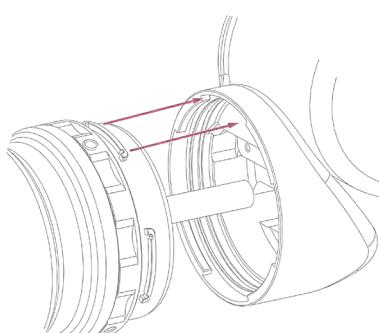
7. Remove connector plug by gently pulling on the cable.



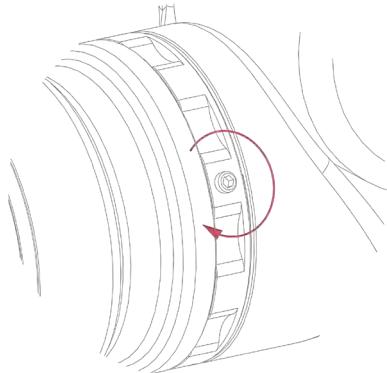
8. Apply grease to internal o-ring and male insert. Insert connector into new module by lining up the flat and pushing.



9. Tighten nut with fingers.



10. Line up bayonet teeth with female. Ensure the Red dots are offset by 45 degrees and not their direction. Insert male module into female. Ensure grease is applied to both surfaces.



11. Rotate module to 45 degrees to align the red dots. Pull apart to feel teeth engage.

12. Tighten looking nut.

13. Tighten Grubscrew.