REACH ROBOTICS

Master Arm Operator Manual

V4.1

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1 Introduction

This manual is designed help users of the Master Arm get familiar with the integration and usage of the system.

Reach Robotics website and Help Centre

Our website, www.reachrobotics.com, holds all our documentation as well as FAQs, knowledge articles, and downloads. You can find some quick links below:

- Datasheets and manuals
- FAQs
- Product theory
- Software downloads

Reach Robotics contacts

If you can't find what you're looking for on our website or Help Centre, please get in touch with Reach Robotics Support at support@reachrobotics.com. You can also get in touch with us at sales@reachrobotics.com (for all sales enquiries), or info@reachrobotics.com (for any other enquiries).

Feedback

If anything in our manuals, FAQs or knowledge articles is out-of-date, poorly explained, or erroneous, please don't hesitate to let us know. We always appreciate the opportunity to improve our documentation for the benefit of all users.

2 Safety Information

This section describes the necessary safety information and precautions relevant to the setup and operation of the Master Arm. To ensure correct and safe use of Reach Robotics products and to avoid injury and damage to property, carefully read this section and make yourself well acquainted with the contents. Follow any warnings and cautions included; these are highlighted by warning triangles and are shown as follows according to the level of danger. In conjunction with this manual, it is important that the users have knowledge of safety considerations and make correct judgments on safety procedures during operation.

2.1 Hazard Classification

DANGER	Denotes a hazard with a **high** degree of risk that will result in death or serious injury if not mitigated or avoided.
WARNING	Denotes a hazard with a **medium** degree of risk that will result in death or serious injury, or serious damage to the product, if not mitigated or avoided.
CAUTION	Denotes a hazard with a **low** degree of risk that will result in moderate or minor injury, or damage to the product, if not mitigated or avoided.
INFO	Denotes important information about a product or procedure.

2.2 Personal Safety

WARNING	Care must always be taken to ensure that the manipulator is correctly paused when not in use. Accidental input from the Master Arm can result in injury to personnel or damage to objects near the manipulator. See Button Operation for more information.
CAUTION	Do not attempt to open the joints of the Master Arm to access any part of the motors or electronics. This will void your warranty and poses a health risk due to electrical shock. It also risks damaging internal components, which will require repair at the Reach Robotics facility.

2.3 Product Safety

This equipment is compliant with Class A of CISPR 32. In a residential environment, this equipment may cause radio interference.

2.3.1 Physical Installation

Prior to operation, ensure that the controller is firmly secured using the supplied mounting kit, or an alternative solution with the appropriate specifications.

2.3.2 Operating Environment

 **WARNING**	**Explosive environments** The Master Arm is not ATEX compliant, and is not designed to meet explosion-proof specifications. Do not use the robot and controller in environments containing flammable gas, gasoline, or solvent. Explosions or fire may otherwise result.
 **CAUTION**	**Electrostatic Discharge (ESD) mitigation** In the event of electrostatic discharge (ESD), the device may become temporarily unresponsive and require reset through power cycling. Use of the device should be restricted to ESD-safe flooring where possible, and should not be used on synthetic floor coverings (nylon, polyester, olefin, etc.). Use of the device should be restricted to humidity-controlled environments with >30% relative humidity.
 **CAUTION**	**Harmful substances** The Master Arm is not designed to operate in areas in which harmful substances as defined in EN 60721 may be encountered, such as oils, acids, gases, vapours or dusts.
 **CAUTION**	**Water resistance** The Master Arm is not waterproof and must not be submerged.
 **INFO**	The Master Arm is specified for operation and storage in air between 0-35°C.

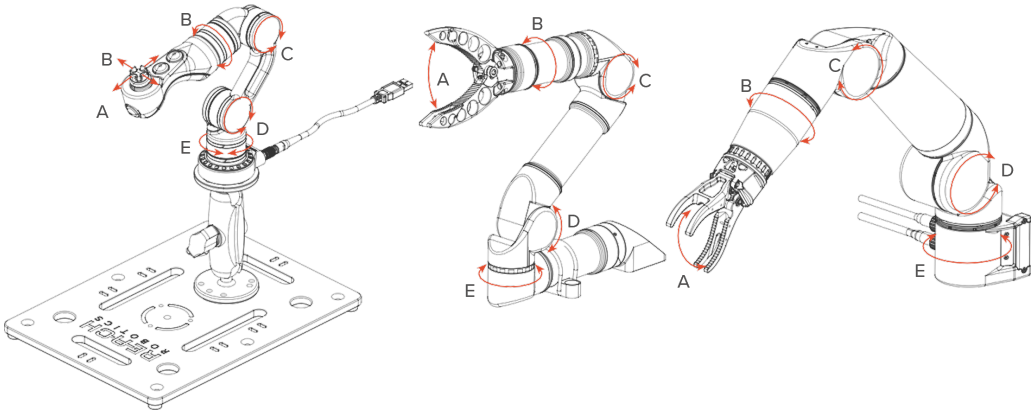
3 Product Overview

The Reach Master Arm is a one-to-one scale controller for the Reach Alpha, Reach Bravo, and Reach X manipulator range which offers intuitive remote operation where precise control is required. When connected to a Reach Robotics manipulator, the velocity of the Master Arm directly sets the velocity of the manipulator, allowing the user to control multiple axes simultaneously.

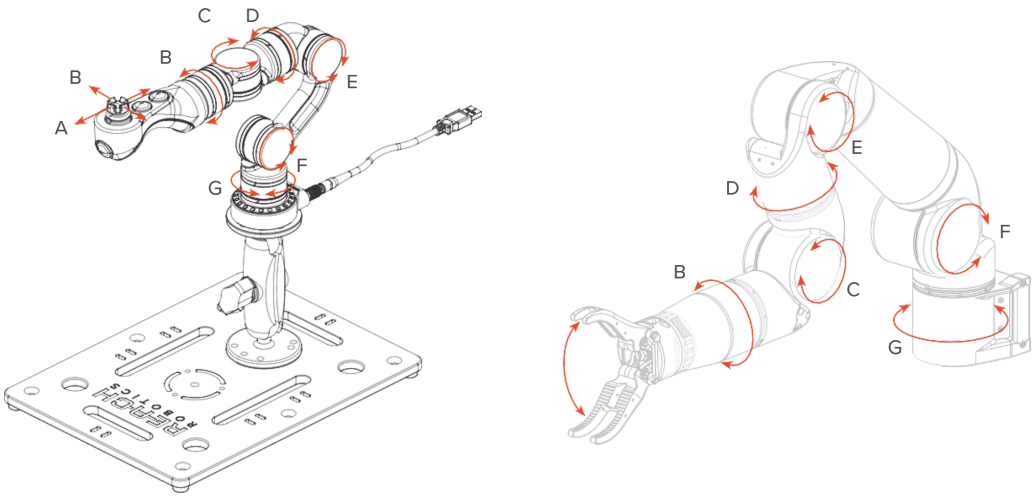
The Master Arm can also be set up to pass commands to the manipulator using the RR Software Development Kit (SDK). For more information, please talk to our Sales team.

3.1 Joint Mapping

The 5-Function Standard Master Arm is designed to control a 5-F/4DOF slave manipulator such as the Alpha 5 (RA-5001) or Bravo 5 (RB-5001), with default joint mapping as below.



The 7-F Master Arm is designed to control a 7-F/6DOF version of the Bravo (RB-7001).



INFO

The B or “wrist” joint can be controlled by either the joystick or the rotate function of the Master Arm handle. See the Reach Control manual for more information.

4 Specifications

4.1 Mechanical

	7f Master Arm RM-7201	5f Master Arm RM-5201
Functions	7	5
Weight	670 g	500 g

4.2 Environmental

	All Master Arm Controllers
Operating/storage temperature range	-10-35°C
Housing material	Handle: Delrin Body: AL6061

4.3 Electrical

	All Master Arm Controllers
Input voltage	5 V DC
Current	400 mAh

4.4 Communication

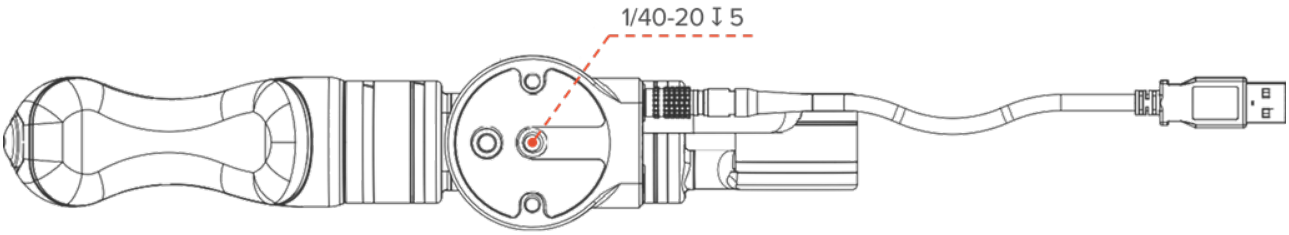
	All Master Arm Controllers
Interface low-level protocol	USB (full-duplex)
Baud rate	115200 bits/s
Word length	8 bits (including parity)
Parity	None
Stop bits	1
Proprietary communication protocol	Reach Robotics Reach System Communication Protocol

Note: Please contact Reach Robotics Sales for access to the Reach System Communication Protocol documentation.

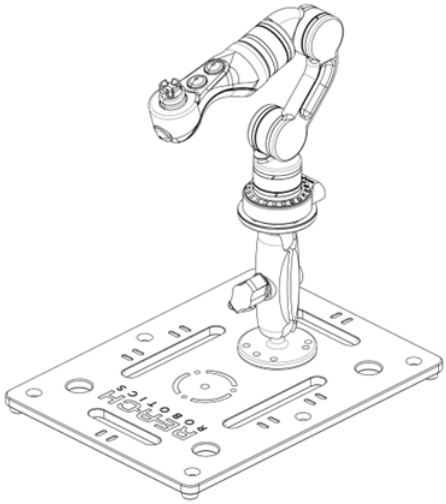
5 Interfacing

5.1 Mechanical

The Master Arm features a standard 5mm deep ¼-20 UNC camera tripod thread to allow the use of the wide range of standard camera accessories available.



Every Master Arm comes with a metal stand and adjustable mount for easy controller mounting. Attach one end of the adjustable mount to the metal plate using the provided screws and the engraved mounting positions.



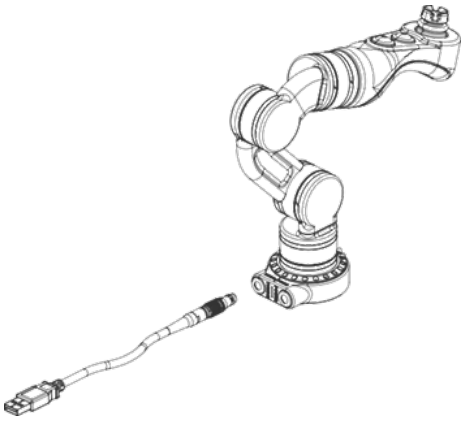
Attach the Master Arm to the top of the adjustable mount by screwing the base mounting hole onto the integrated screw.

You can adjust the angle of the mount by loosening the bolt in the centre and moving the mount to the desired position before tightening the bolt.

5.2 Electrical

The Master Arm has a 4-pin LEMO 0T connector in the base, which connects to the host computer via a standard USB-A connection using the supplied USB-to-LEMO cable.

Pin #	Description
1	PWR
2	GND
3	D+
4	D-



CAUTION

Do not use an **unpowered** USB hub to connect the Master Arm to your PC. USB 2.0 ports supply a minimum of 4.5V, which can result in insufficient voltage when coupled with voltage drop over both a USB hub and the Master Arm cable.

It is recommended to connect the Master Arm USB connector either directly to the PC, or to a **powered** USB hub.

INFO

If the base of your Master Arm has two connectors marked Power and Signal, plug the cable into the **Signal** connector.

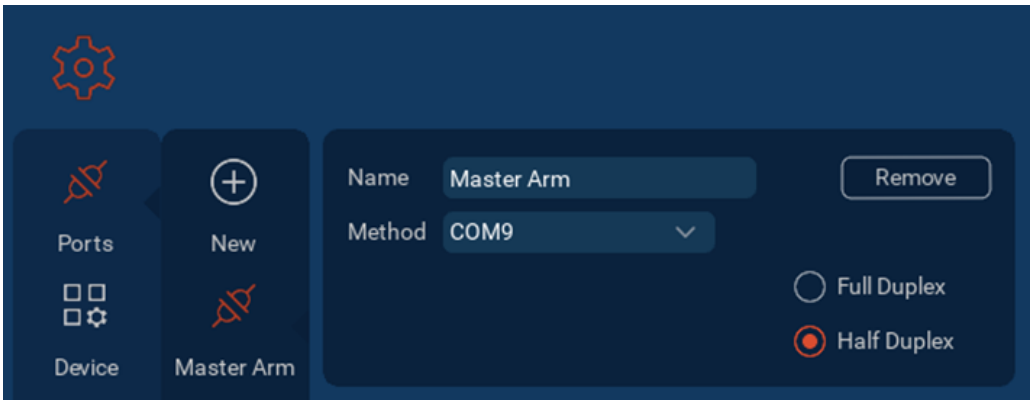
5.3 Software

5.3.1 Reach Control

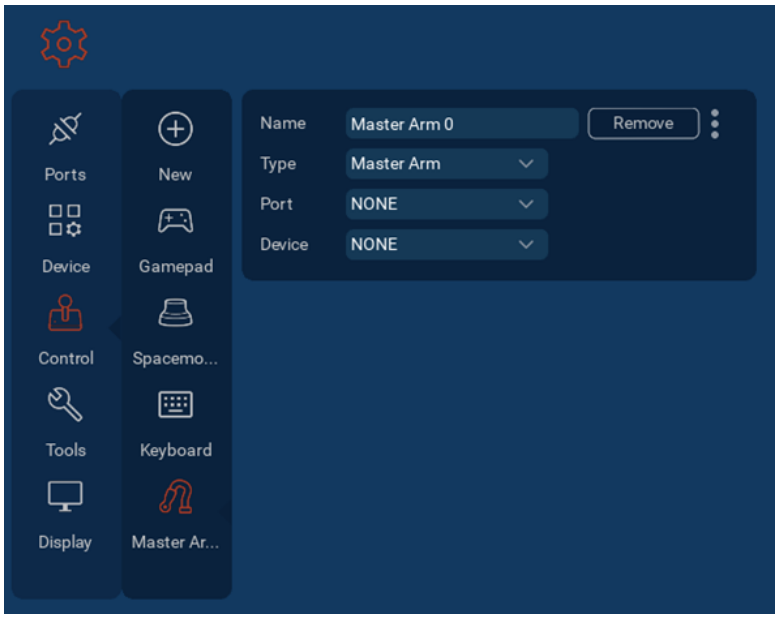
The most common way to connect to the Master Arm is to use the Reach Control software. This facilitates communication between the Master Arm and the connected manipulator and provides setup options for the controller.

You can download the Reach Control software for Windows or Linux from our website; if you have any questions, please contact Reach Robotics Support. You can also download the Reach Control manual from our website for more information on how to use the software.

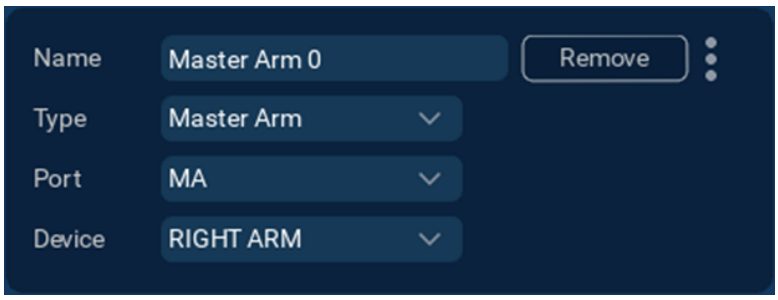
1. Open Reach Control, then go to **Settings** > **Ports** > **New**. Assign the new port a **Name** and select the COM port over which the Master Arm is communicating. Ensure **Half Duplex** is selected.



2. Go to **Settings** > **Control** > **New** to add a Master Arm, then select the newly added Master Arm to open the Master Arm panel.



3. Using the drop-down menus, select the newly added Master Arm port and the device to be controlled. Under **Type**, select **Master Arm**.



INFO	**Do not** select Legacy Master Arm. This is only relevant for early prototype units.Denotes important information about a product or procedure.

INFO	Multiple Master Arms can be added to control multiple manipulators.

5.3.2 Custom Programs

Reach Robotics can provide a Software Development Kit and Communication Protocol to aid in creating custom software for communicating with Reach products. Please contact our Sales team for more details.

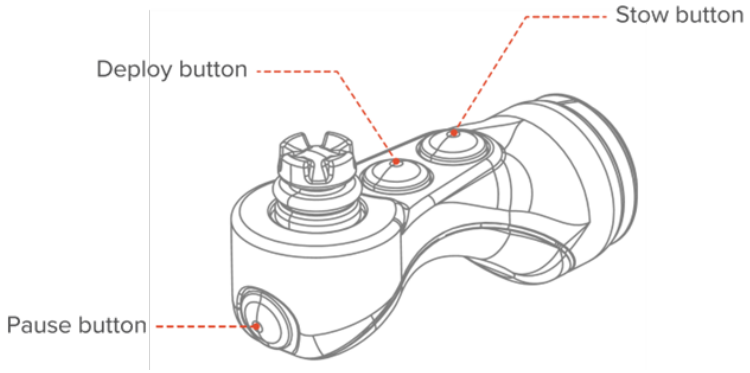
6 Operation

6.1 Button Operation

The buttons on the handle of the Master Arm are used for pausing, stowing, and deploying the connected manipulator. When the manipulator is paused, the buttons will flash blue, and the manipulator will not respond to any controller input. When the manipulator is active, the buttons will show solid blue lights, and the manipulator will respond to all controller movements.

WARNING	Care must always be taken to ensure that the manipulator is correctly paused when not in use. Accidental input from the Master Arm can result in injury to personnel or damage to objects near the manipulator.

The Deploy and Stow positions correspond to Position Presets 0 and 1 respectively, which are configured for Deploy and Stow as default. See the Reach Control manual for more information on setting up position presets.



Button action	(A) Pause	(B) Deploy	(C) Stow
Hold	Pause output	Start deploying	Start stowing
Release	Restart output	Stop deploying	Stop stowing
Double press	Stop output	Move to deploy position	Move to stow position
Hold + (A) Pause	-	Set deploy position	Set stow position

6.2 Functionality Test

A functionality test should be carried out each time a Master Arm is connected to a manipulator to ensure that both units are working as intended.

1. Connect the Master Arm to the manipulator using the instructions above.

2. **Making sure it is safe to do so**, press the Master Arm pause button to activate the controller. The flashing blue lights will become solid. Double press the pause button to deactivate.

3. Move each Master Arm joint through its full range of motion. Check that:
   a. The corresponding joint on the manipulator responds.
   b. The joint moves in the correct direction.
   c. The motion of controller to manipulator is a 1-to-1 ratio.
   d. The motion is smooth and complete.

CAUTION

When operating a 7-function Master Arm, the Joint D/E link may need to be supported by the non-dominant hand to avoid it dropping.

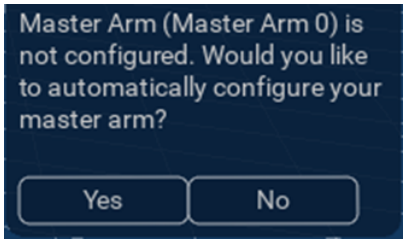
4. Press and hold the **Stow** button, and ensure the arm stows completely. Release the button to stop the movement. Repeat for the **Deploy** button.

5. Whilst moving the arm, press and hold the **Pause** button, and ensure that the arm stops responding while the button is held down. Releasing the button will engage movement again.

7 Configuration

7.1 Autoconfiguration

When Reach Control detects a Master Arm is not configured the selected device, an autoconfiguration popup will appear in the help panel. Select **Yes** to apply a default mapping for the connected manipulator.



CAUTION

Autoconfiguring a Master Arm will reset all advanced configs to their default. Use this tool with caution if you have changed any configs such as **device_id**.

8 Maintenance

8.1 General Care

- When unplugging the LEMO connector from the Master Arm, do not twist the connector. Pull it directly outwards, ensuring the red lines are aligned.
- Avoid dropping or otherwise impacting the Master Arm, as this may result in joint separation.

8.2 Repairs

If your Reach Robotics equipment becomes damaged or faulty, it may need to be returned to Reach Robotics for investigation and repair under a **Return Merchandise Authorisation** (RMA). Only a Reach Robotics engineer may authorise a return to our factory; the requirement may be determined through a phone call, email, or video call/remote access to the unit. If you suspect that an RMA may be required, please fill in this form and someone from Support will be in touch: Request an RMA

RMA Process

1. Reach Robotics Support will request details of the issue to determine whether a return is necessary.
2. If so, an RMA Number (RMAXXXX-YYMMDD) will be issued to you, and the Reach Robotics engineer will request shipping details so we can organise a pickup of the equipment. **Do not send the equipment prior to being issued an RMA Number.**
3. The equipment will be shipped to Reach Robotics Headquarters in Sydney, Australia (see Notes).

4. Our Production team will conduct an initial investigation on the unit, based on the information provided. This will take an estimated 1-2 weeks. Any delays due to the complexity of the problem will be communicated to you.
5. After the initial investigation, Reach Robotics Support will contact you with the findings of our Production team. If the unit is not under warranty, a quote for the investigation, repair work and shipping costs will be included. If the unit is under warranty, you will be notified, and the repairs will be carried out free of charge.
6. To authorise a non-warranty repair, send a PO for the work to Reach Robotics Support (see Notes). Once this is received, the repair work will start, and our Accounts team will send an invoice to you.
7. Typical repair times vary post-investigation, and the exact length of time required for the repair will depend on the product being repaired, the complexity of the repair, and the availability of spare parts.
8. Any delays to the expected shipping date will be communicated to you. Priority service may be possible; please discuss this with your usual Reach Robotics Sales Engineer.
9. When the repair is completed, our Warehouse Manager will organise returning shipping and contact you with a ship date and tracking information (see Notes).

CAUTION

Health and Safety

- Any unit returned to Reach Robotics must be safe for our staff to handle and cleaned thoroughly to comply with Australian biosecurity regulations. We require you to declare if the unit may be contaminated. If the unit has been in contact with any contamination, you must provide proof that the unit is safe to handle.
- Possible contamination sources include nuclear radiation, sewage, hazardous chemicals, biowaste, marine/freshwater life, or soil/mud.
- Reach Robotics reserves the right to refuse to handle any contaminated goods and return them to you at your own expense.

Notes

- Standard Warranty of 1-year from date received is provided on all new Reach Robotics Products. There is no warranty extension for units following an RMA unless extended warranty has been purchased prior to the RMA being raised.
- An investigation fee is chargeable on all non-warranty RMAs. This is payable even if you choose not to have your unit repaired.
- If the nature of the repair is such that you feel it is uneconomical to carry out the work, a discount on a new unit may be possible; please discuss this with your usual Reach Robotics Sales Engineer. This remains at Reach Robotics' discretion, and no discount is guaranteed.
- All RMAs are shipped EXW. Any insurance desired by the customer is the customer's responsibility and Reach Robotics can take no responsibility for shipment losses or damages.
- If you do not make a decision regarding repairing, replacing, or scrapping your RMA within 12 months of its arrival at Reach Robotics, we reserve the right to charge storage fees on a weekly basis dependent on RMA unit type.

9 Revision History

Version	Date	Author	Notes
V1.0	06/08/2019	Paul Phillips	Initial version
V1.2	07/10/2019	Paul Phillips	Master Arm redesign Front cover changed
V1.3	12/11/2019	Paul Phillips	Contact information layout changed Detailed comms guide added
V2.0	31/01/2020	Paul Phillips Anders Ridley-Smith	Reach Robotics branding Master Arm functionality Disconnection information for the Lemo plug Master Arm software connection instructions with screenshots Layout modification
V3.0	08/12/2022	Paul Phillips Anders Ridley-Smith	Better resolution diagrams added Joint and labels added for the Bravo 7 diagram Bravo 5 diagram with joint and labels added Reach Control settings for Master Arm transferred to Reach Control Manual
V3.1	18/10/2023	David Silivestru Ellie Best	Pinout of the Lemo plug Reference to RC manual for MA customisation Revision history
V4.0	05/02/2025	Ellie Best	Layout change Compliance information Temperature range
V4.1	12/11/2025	Ellie Best	Specification and general updates