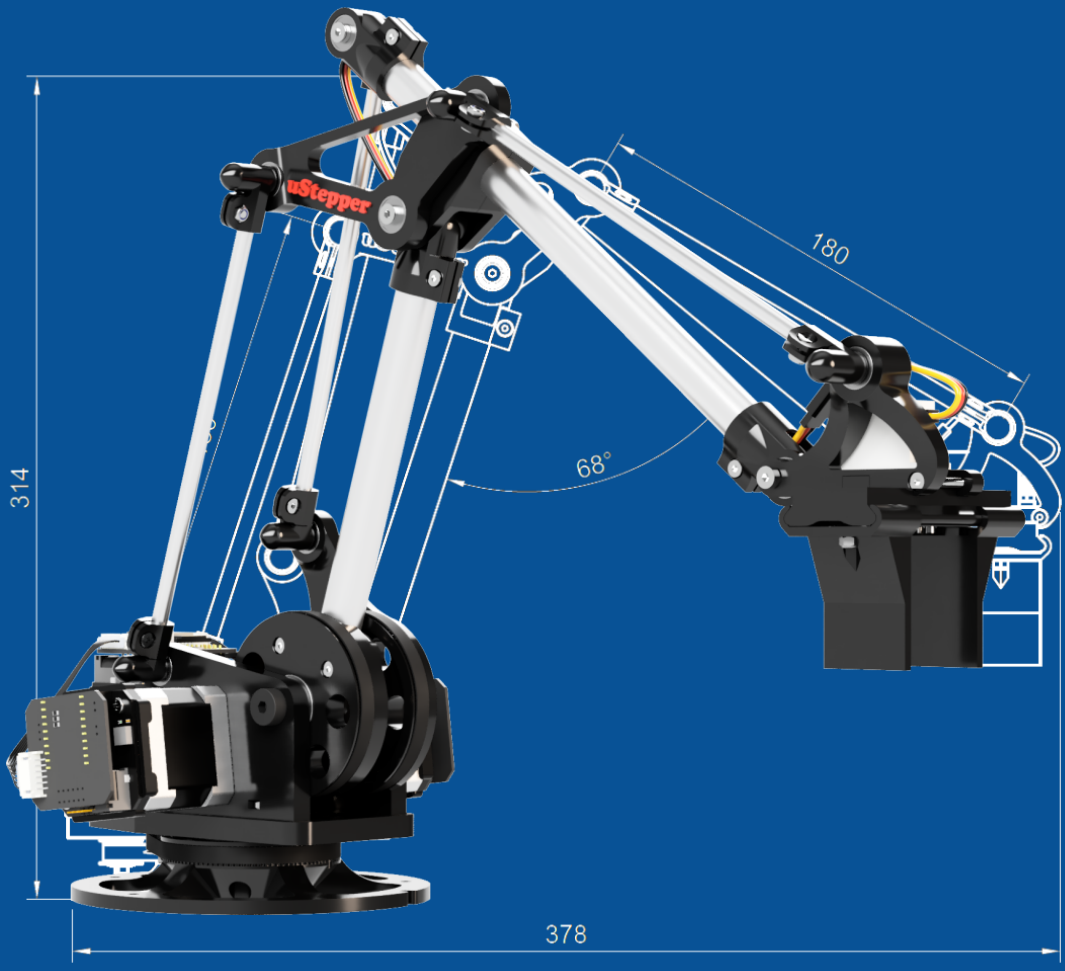
uStepper Robot Arm 4

Complete kit



Introduction

This document describes the assembly and use of uStepper Robot Arm 4 complete kit.

Product: **uStepper** Robot Arm 4 - Complete kit

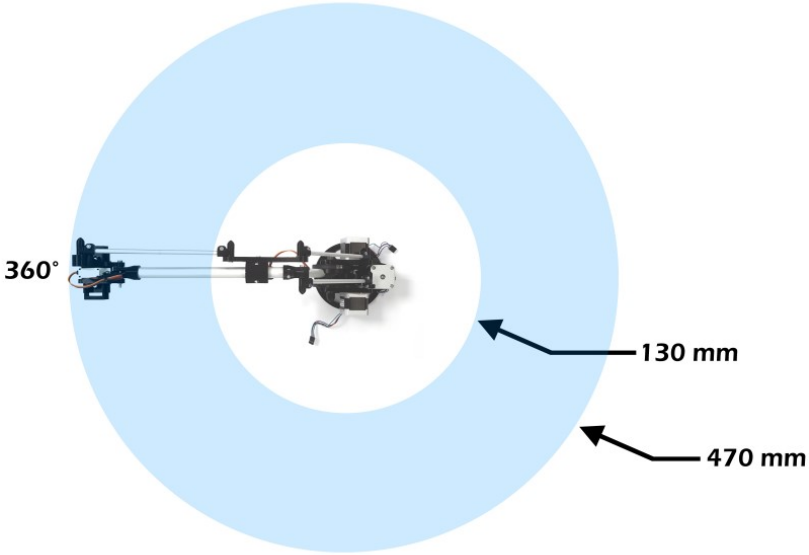
Document revision: 1.2

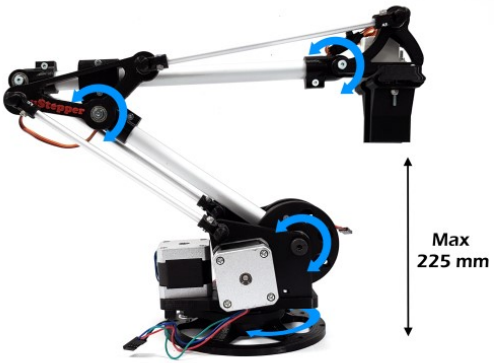
Author: MGN

Approved by: THO

Approval date: October 28 2020

Specifications



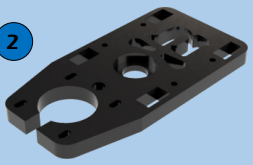


Weight (including stepper motors)	1460 g
Material	PLA plastic and Aluminum (tubes)
No. of axes	3
Maximum lift (close to base / furthest from base)	500 g / 250 g
Gear ratios (all axes)	5.1:1
Stepper motor torque	0.42 Nm
Mini servo torque	0.25 Nm @ 5 V

Bill Of Materials

1 x

2 x



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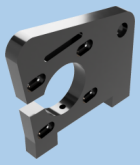

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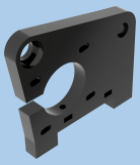

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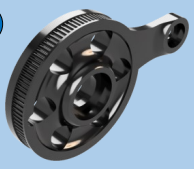

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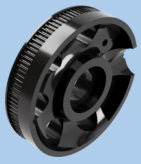

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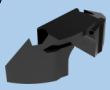

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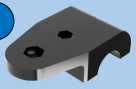

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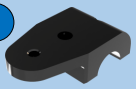


10 x

11 x

12 x

13 x

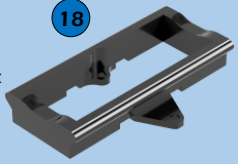
14 x

15 x

16 x

17 x

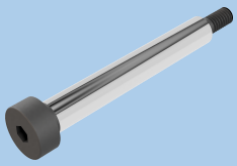
18 x



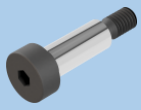
19 x

20 x

Bill Of Materials



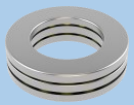
1 x shoulder bolt 7379-8-M6-55



1 x shoulder bolt 7379-8-M6-20

5 x 608ZZ Bearing

12 x 624ZZ Bearing



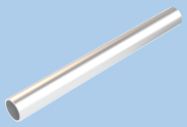
1 x 51105 Bearing

1 x F8-16M Bearing

3 x GT2 20T motor gear

3 x Belt GT2 228

1 x Tube 15 mm x 225 mm

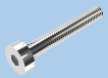


1 x Tube 15 mm x 155 mm

2 x Tube 6 mm x 170 mm
1 x Tube 6 mm x 180 mm

2 x M3 x 6 mm

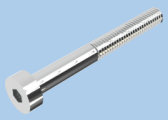
26 x M3 x 10 mm



7 x M3 x 20 mm

3 x M3 x 25 mm

5 x M4 x 20 mm



3 x M4 x 35 mm

7 x M3 nut

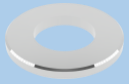
16 x M3 SL nut

8 x M4 SL nut

2 x M6 SL nut

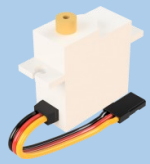
5 x M4 washer

1 x M6 washer

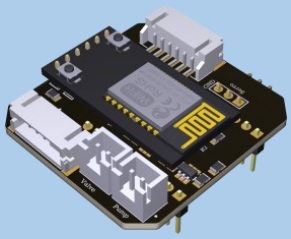


1 x M8 washer

Bill Of Materials



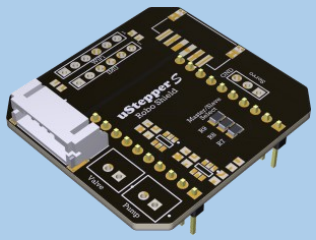
1 x HK15148B Digital MG Servo



1 x Robot Shield Master w. WiFi

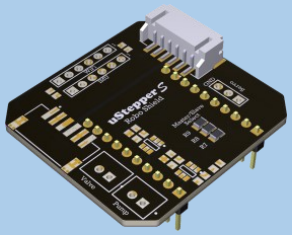
2 x JST cable

1 x 60 cm Servo Cable

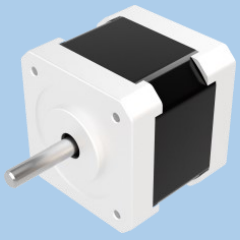


1 x Robot Shield Slave 1

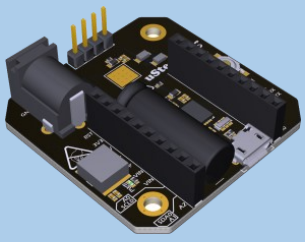
1 x 25T x 20 mm Servo Horn Set



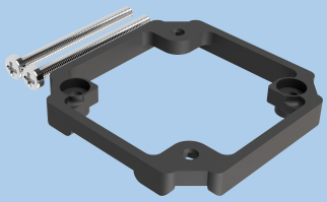
1 x Robot Shield Slave 2



3 x NEMA 17 Stepper Motor



3 x uStepper S DC-jack w. accessories



3 x uStepper Permanent Mount

1:1 Nuts & Bolts

M3 x 6 mm

M3 x 10 mm

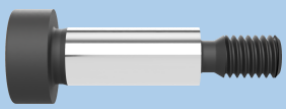
M3 x 20 mm

M3 x 25 mm

M4 x 20 mm

M4 x 35 mm

M6 x 20 mm



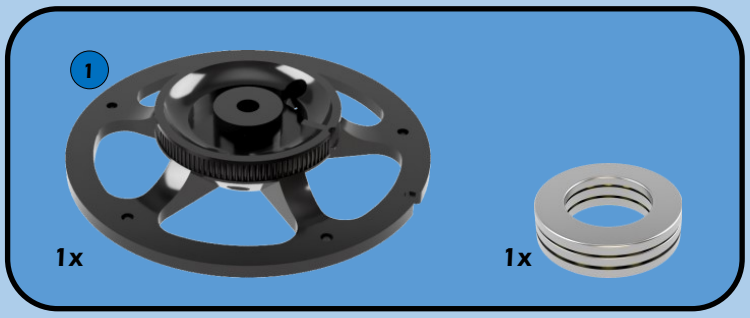
M6 x 55 mm

M3 nut

M4 nut

M6 nut

Robot Arm Assembly



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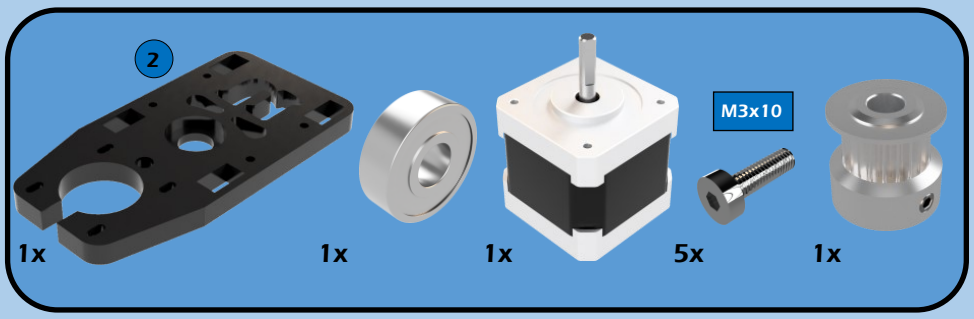

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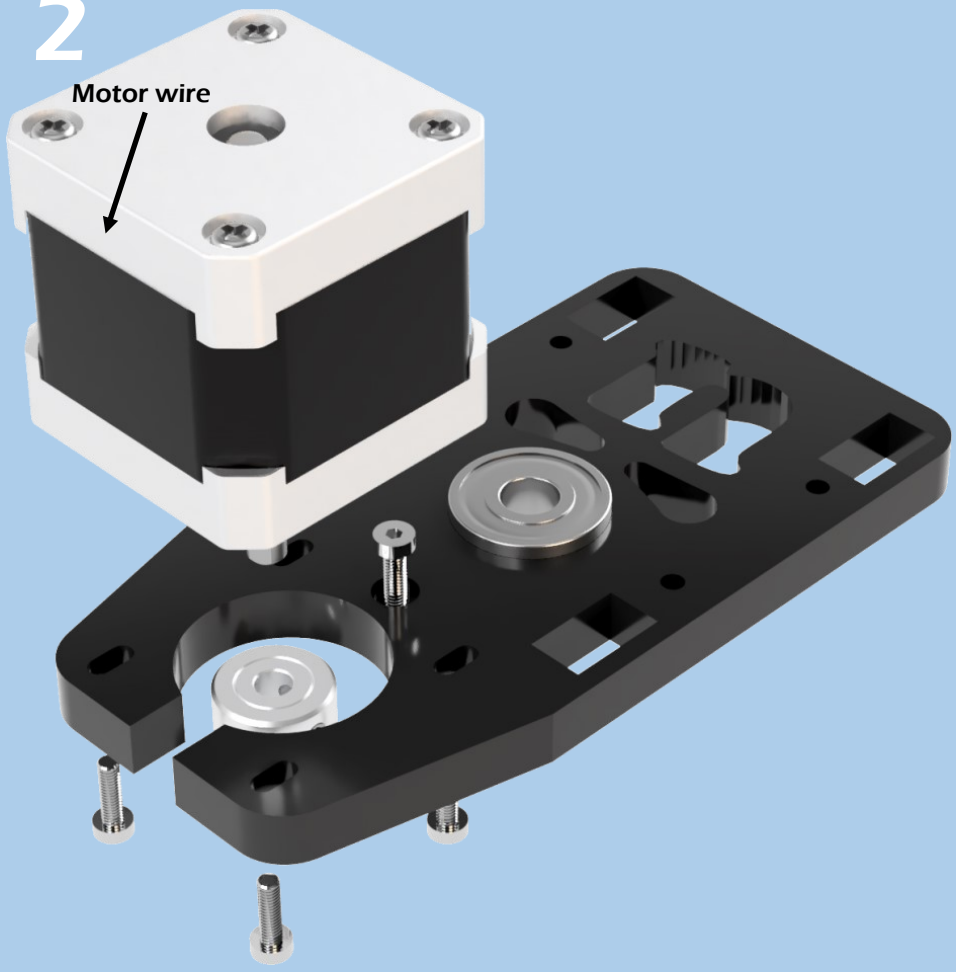

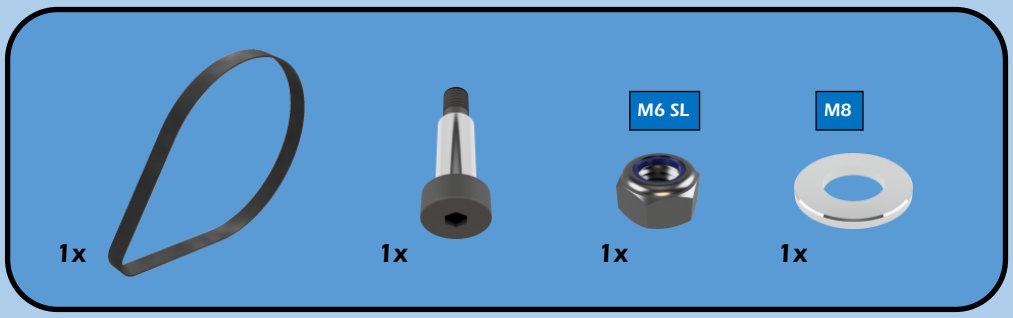

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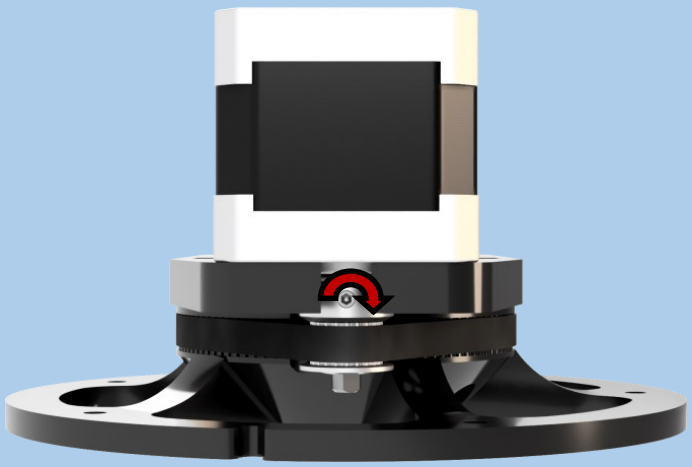

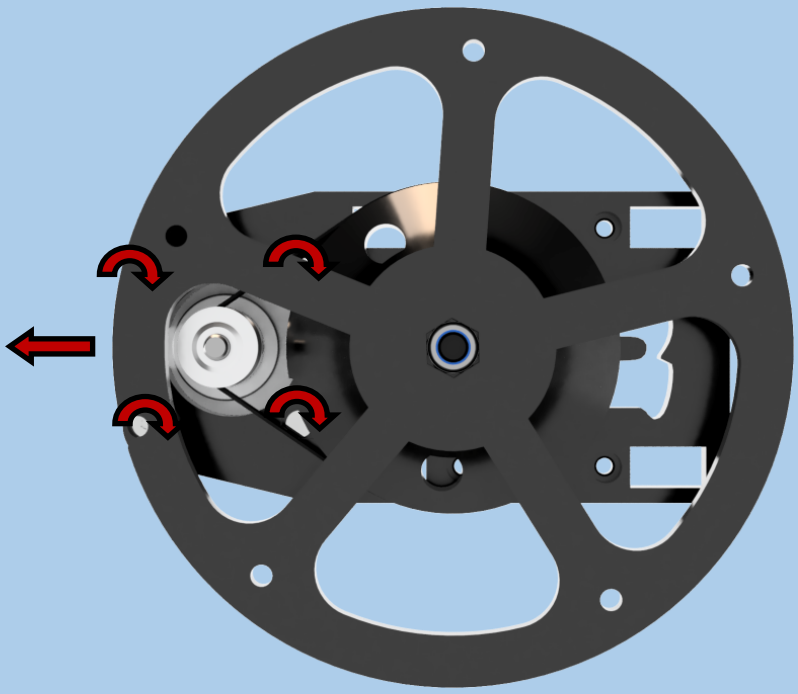

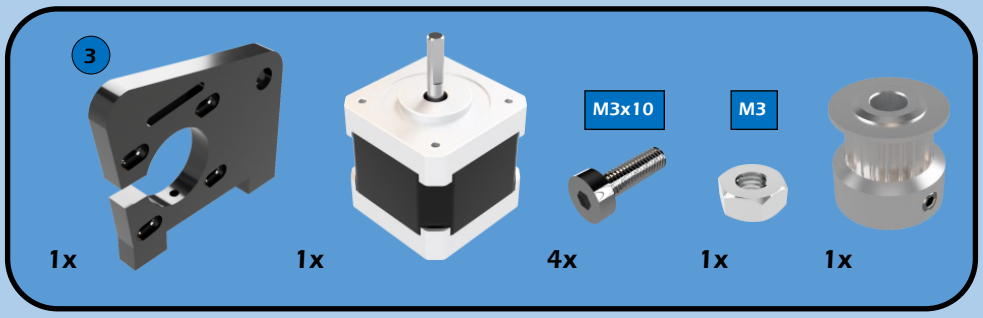

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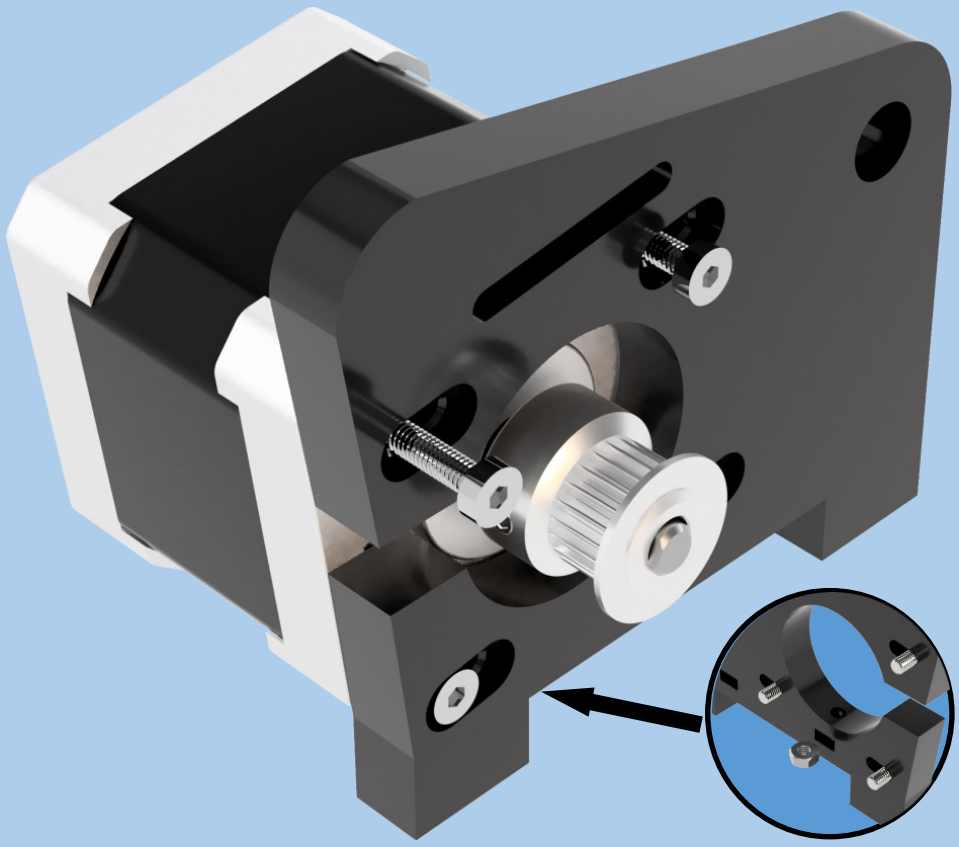

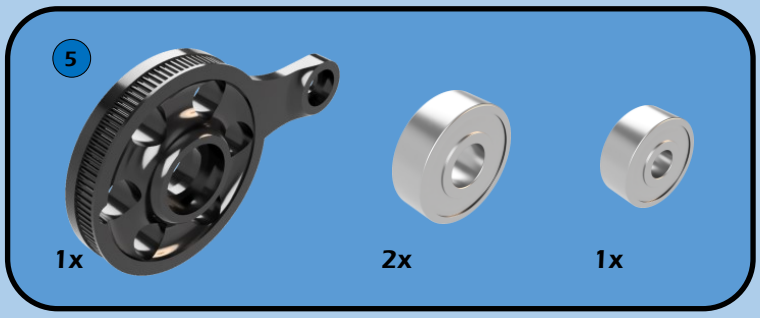

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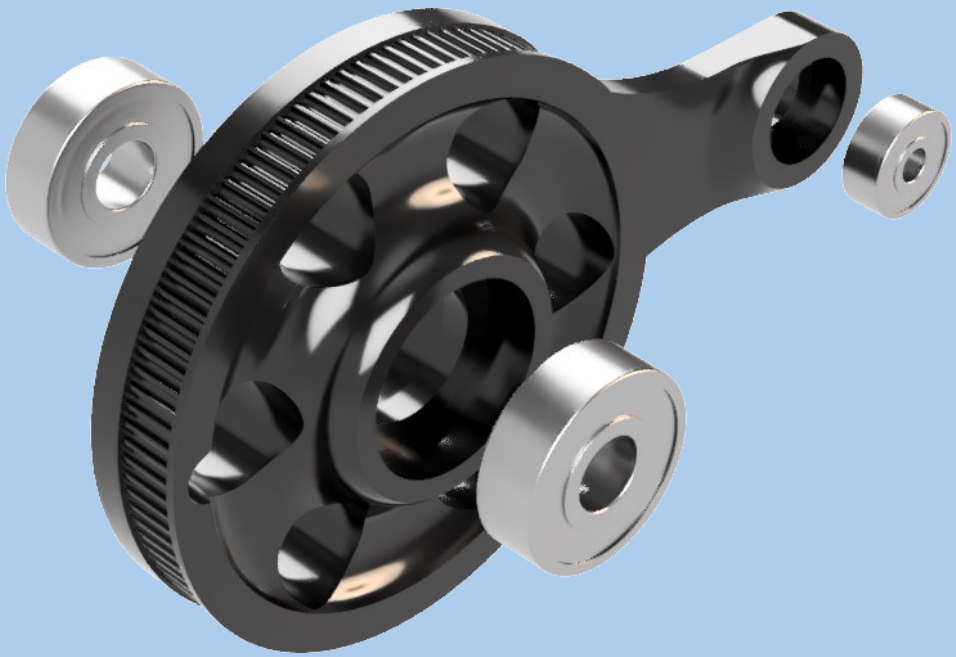

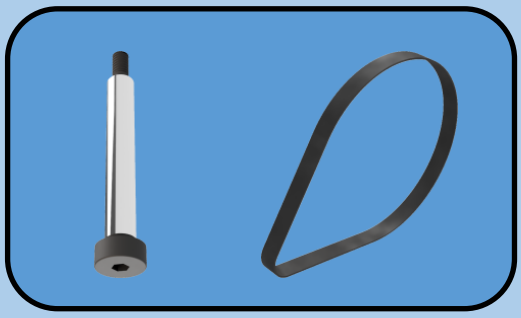

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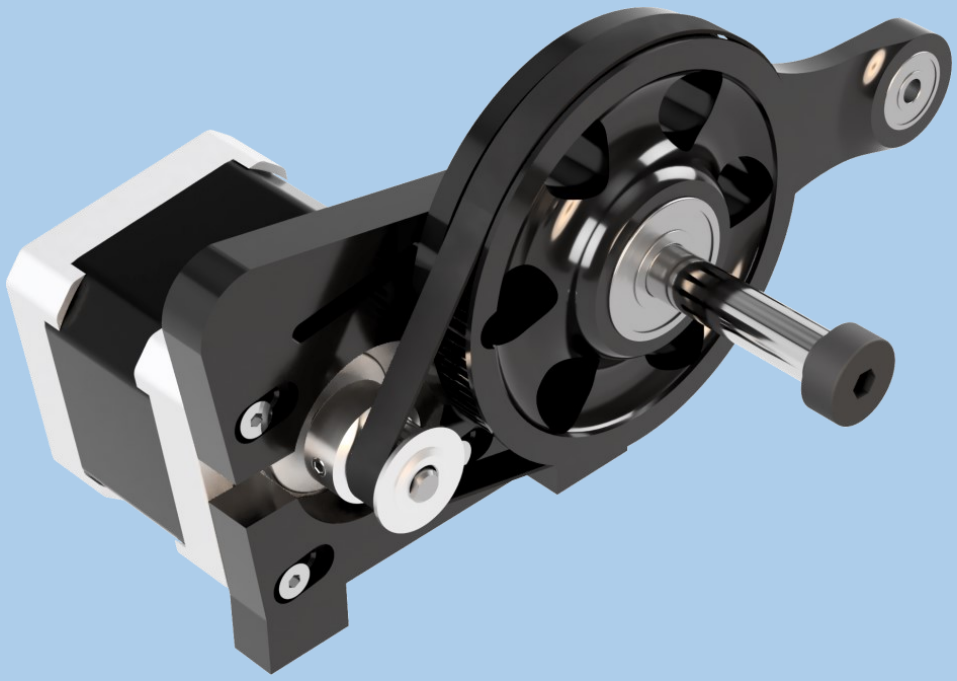

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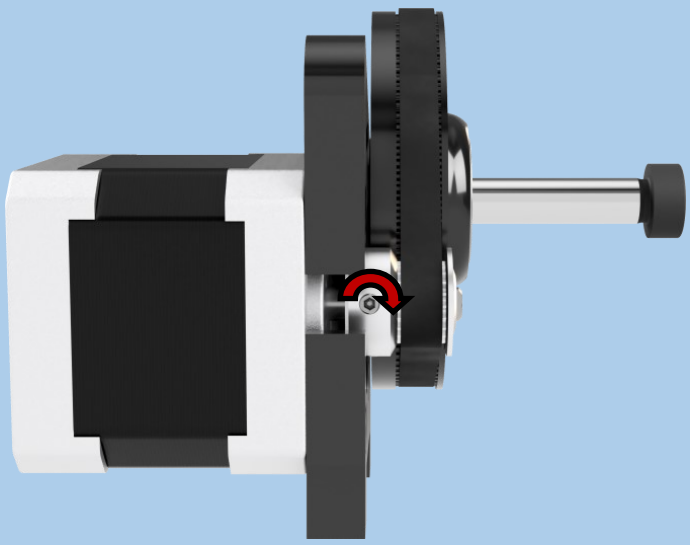

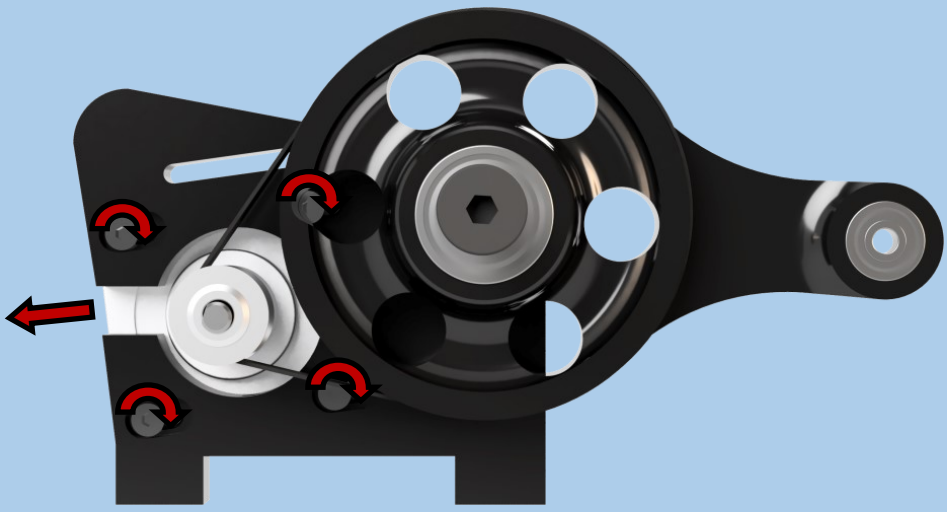

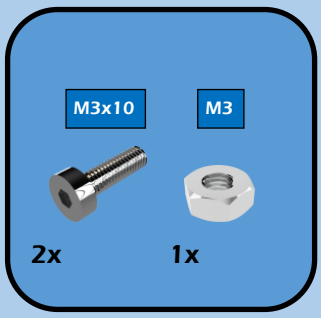

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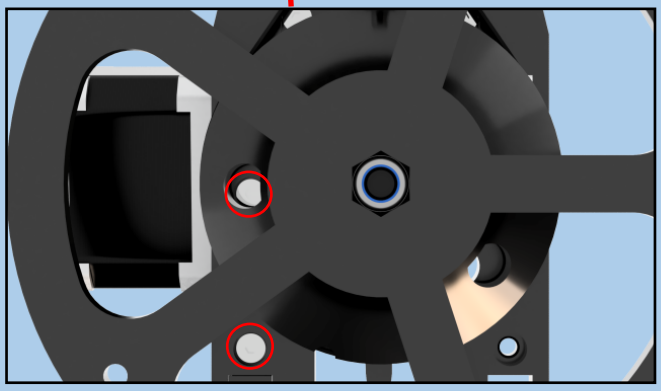
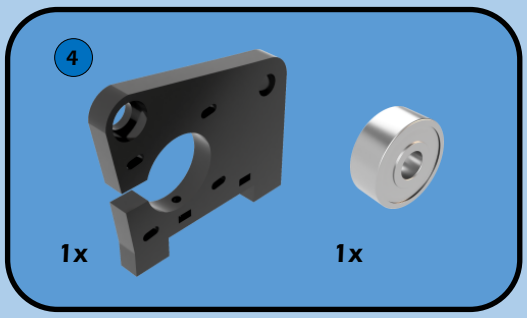


Bottom View



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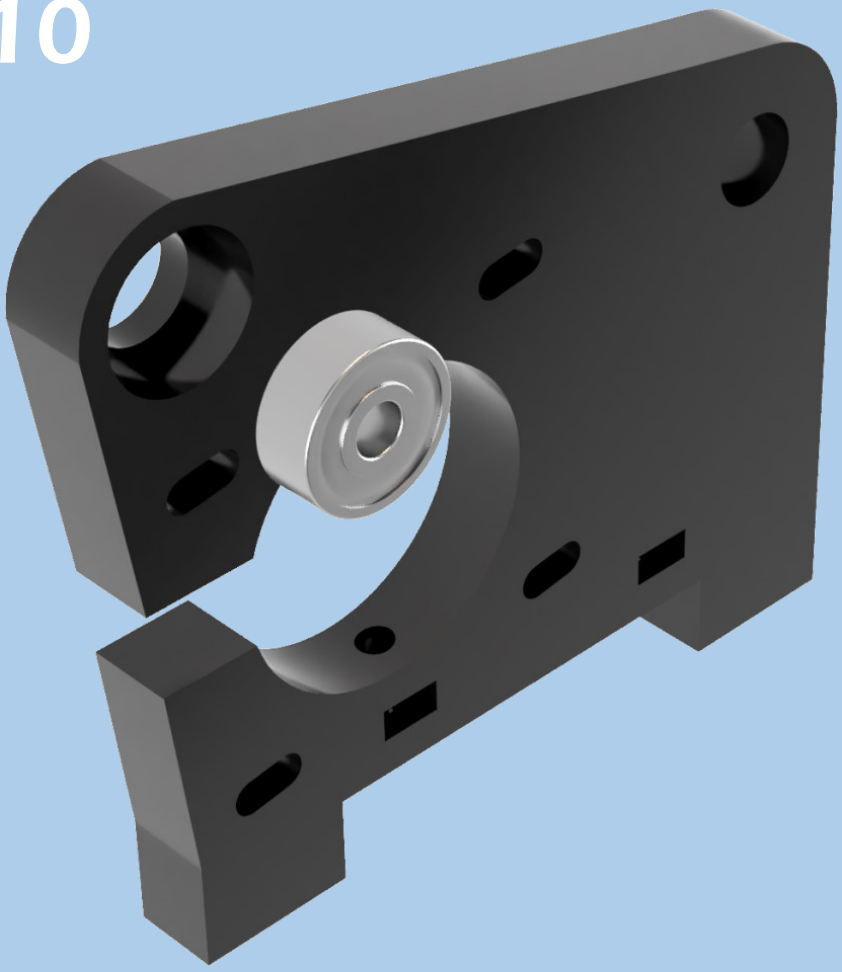
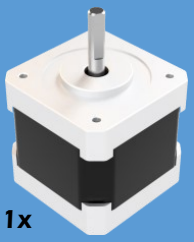
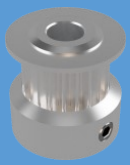




1x

M3x10

4x



1x

M3

1x

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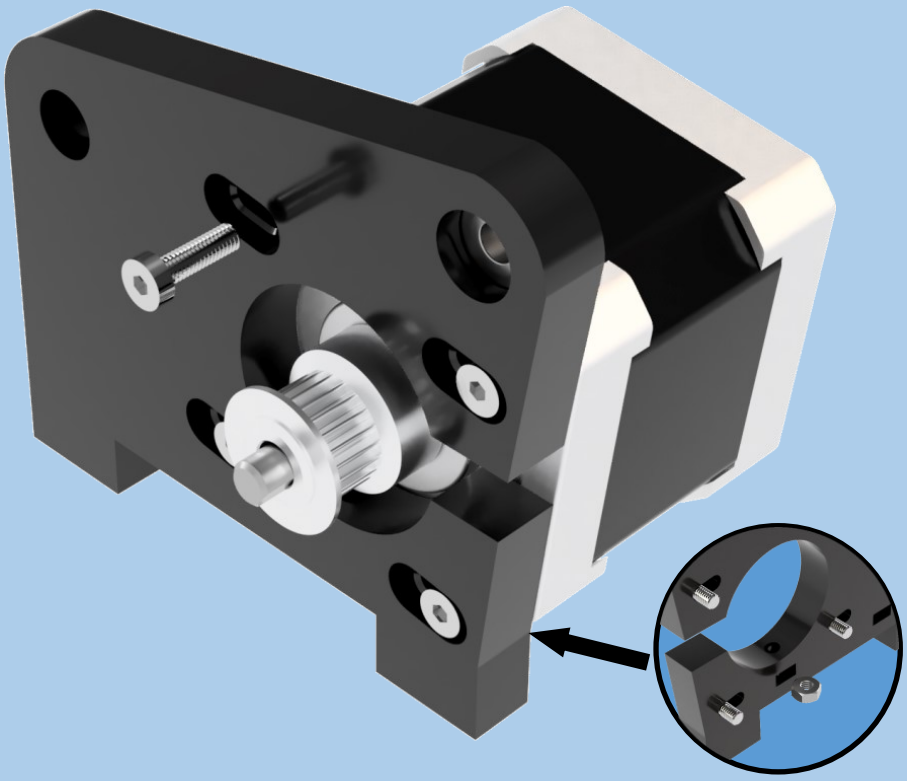

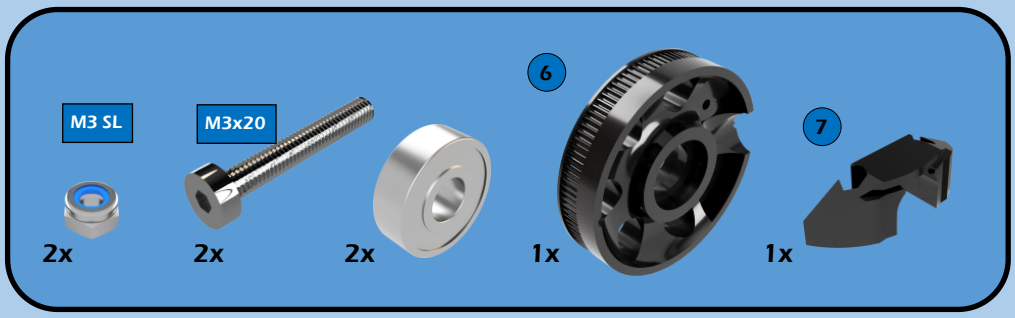

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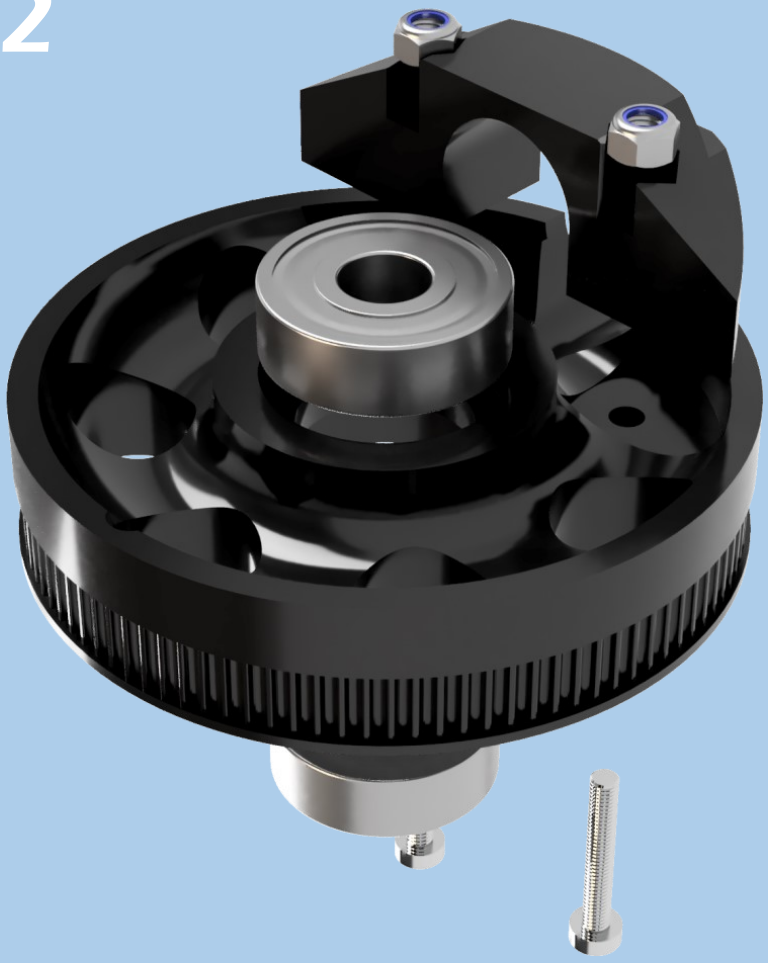

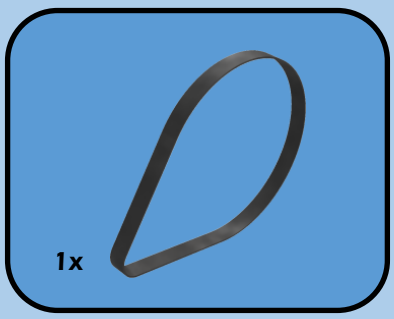

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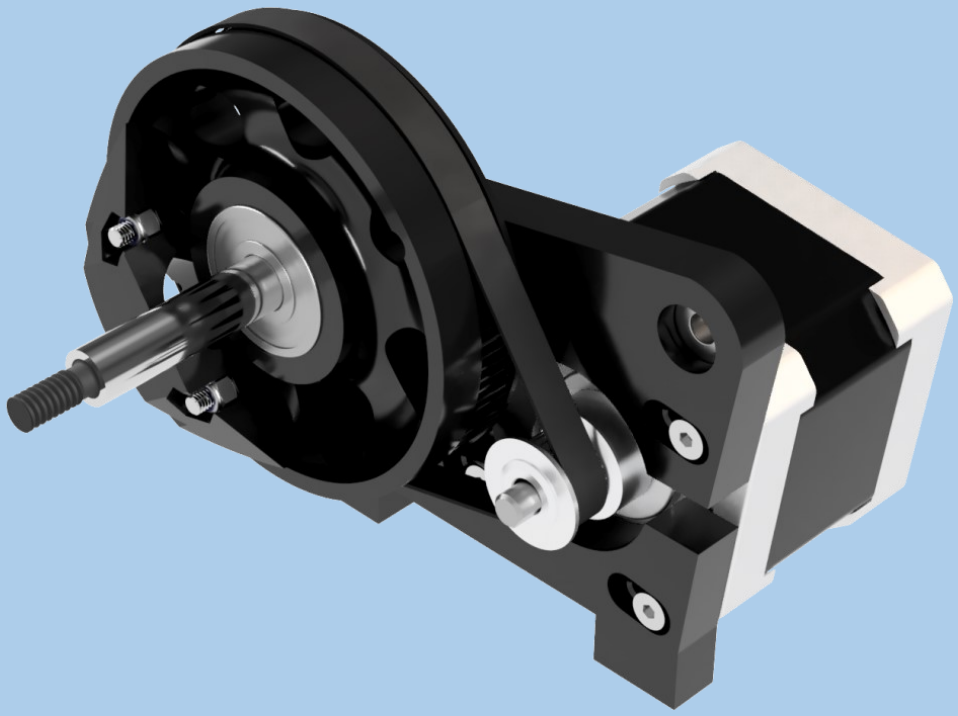

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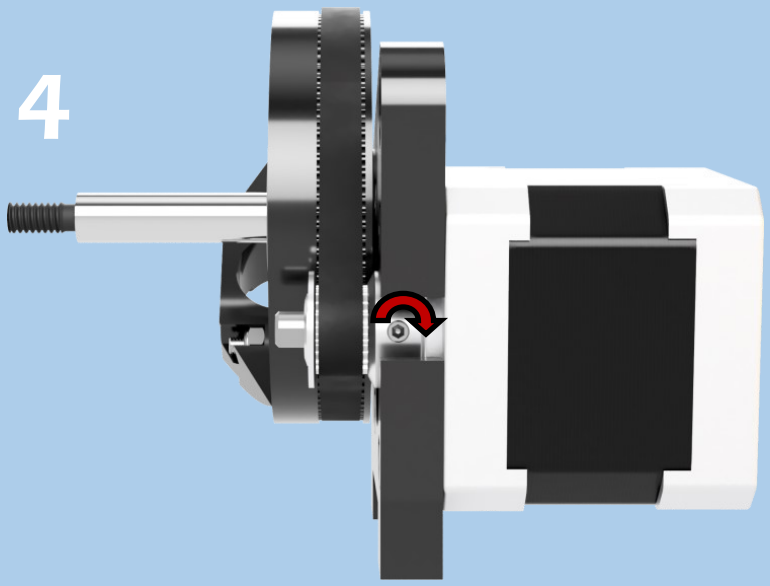

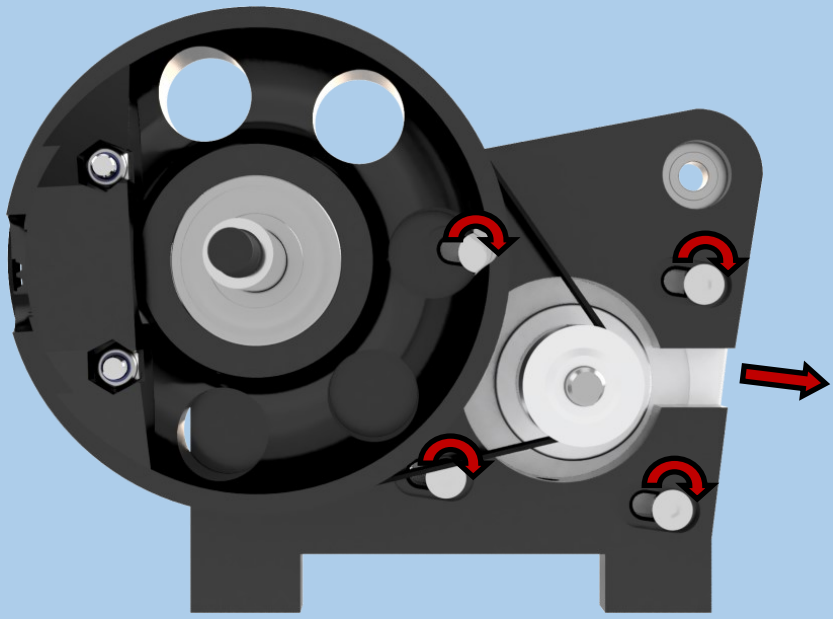

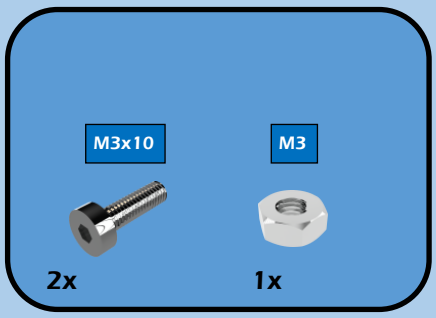

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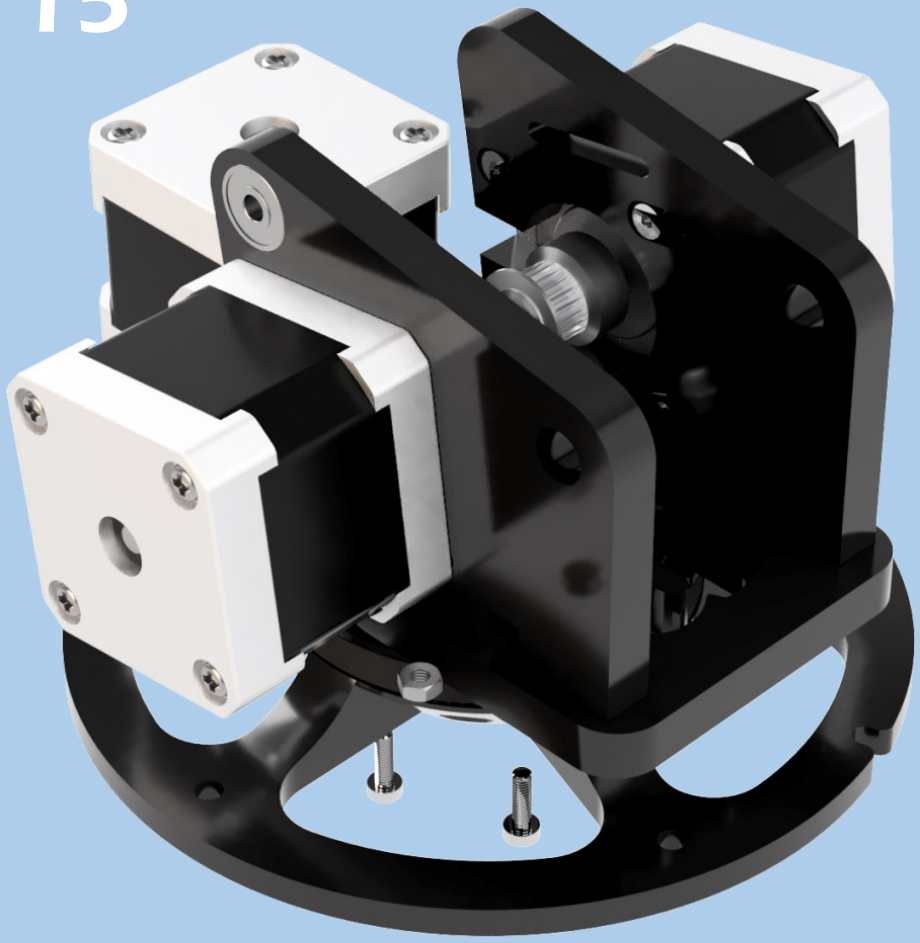

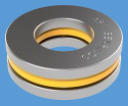

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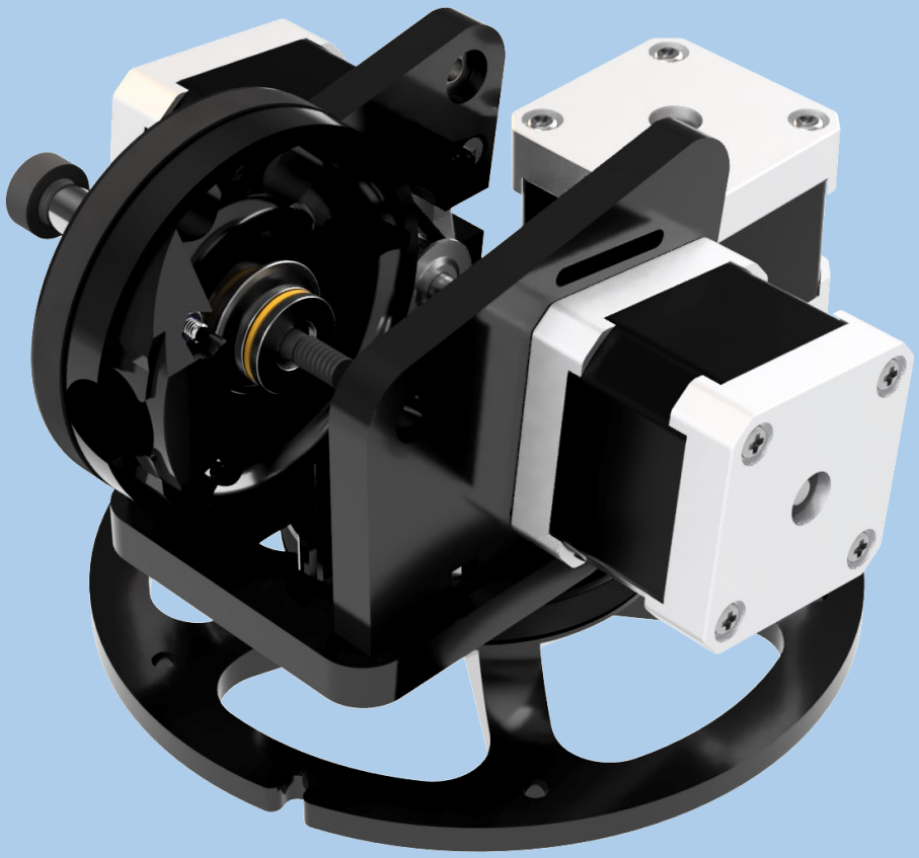

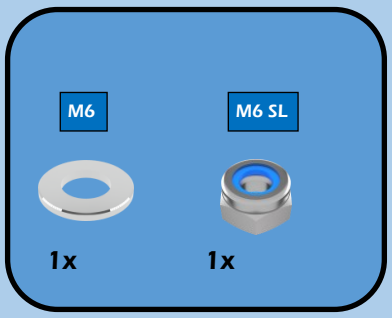

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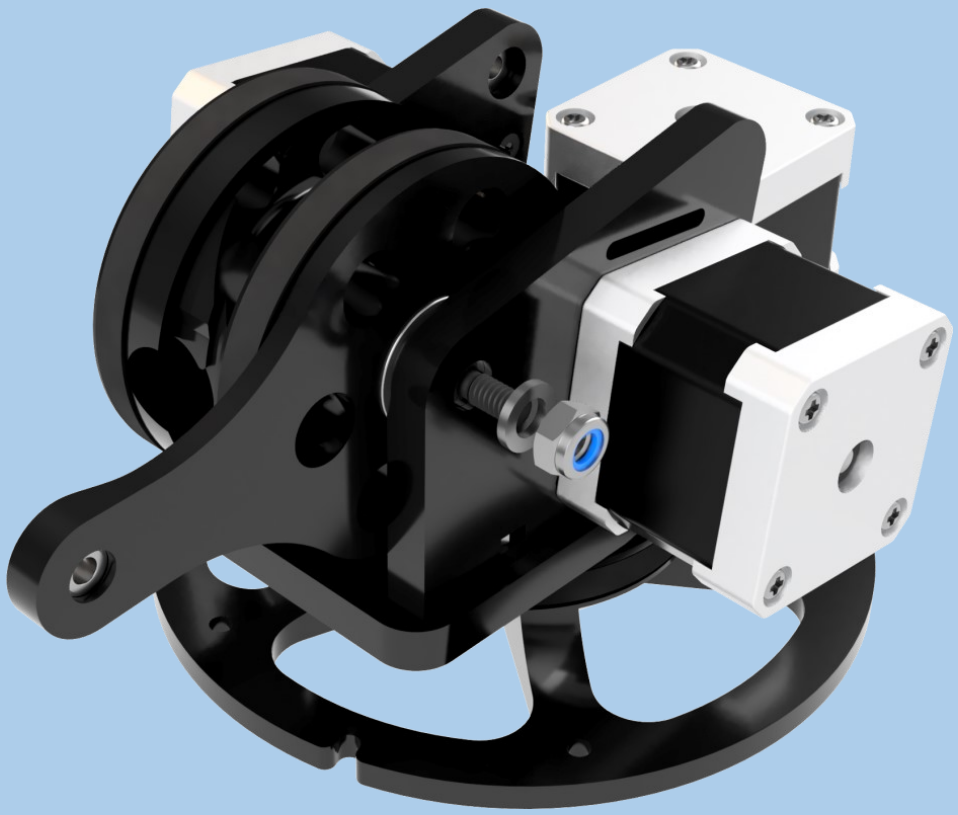

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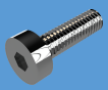
M3x10



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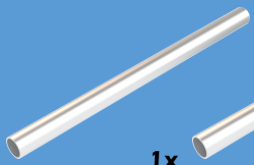
M3 SL

3x

6x



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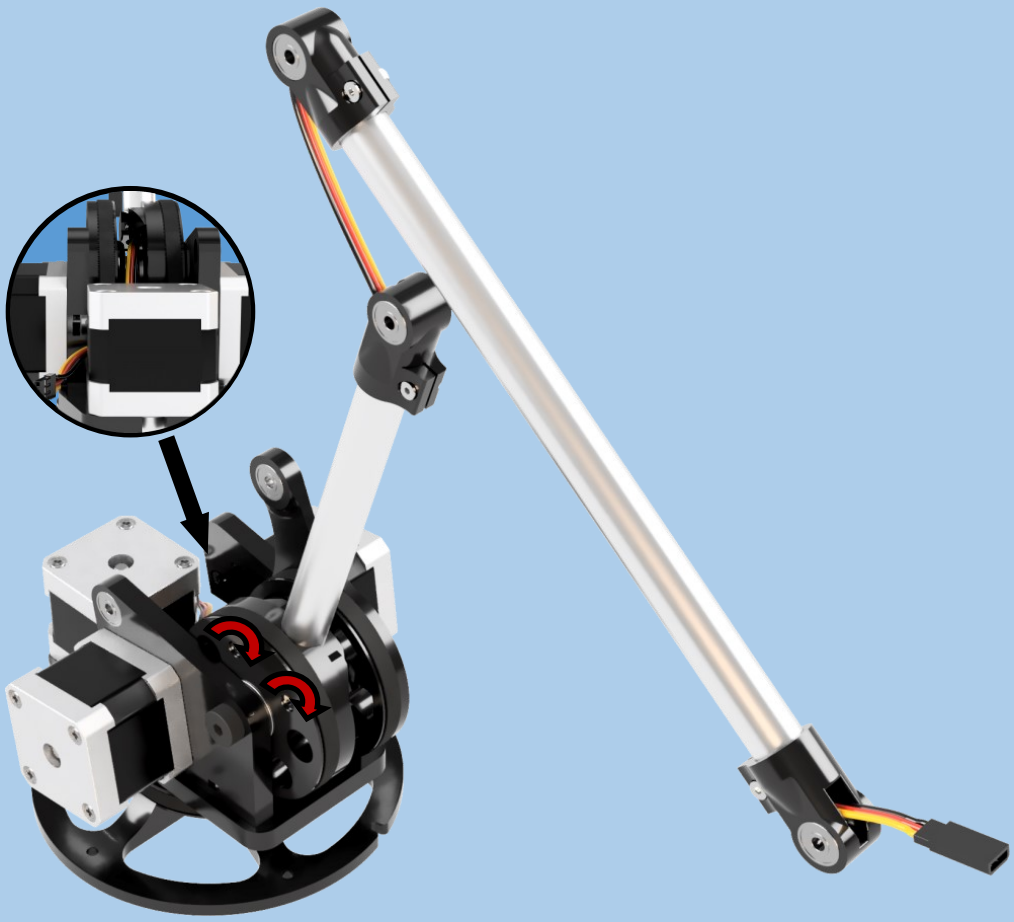

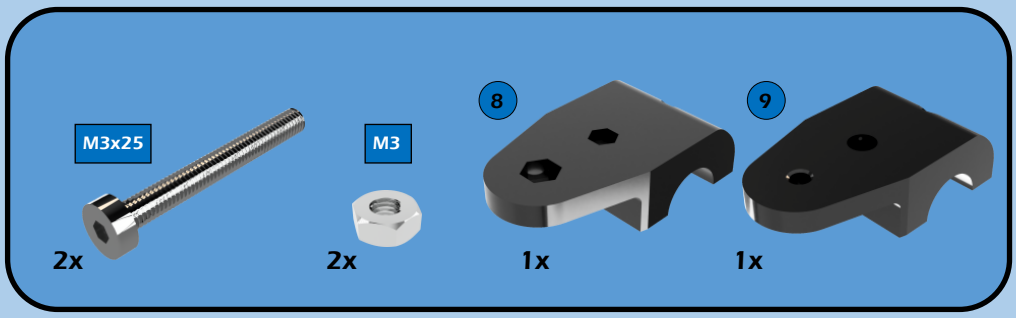

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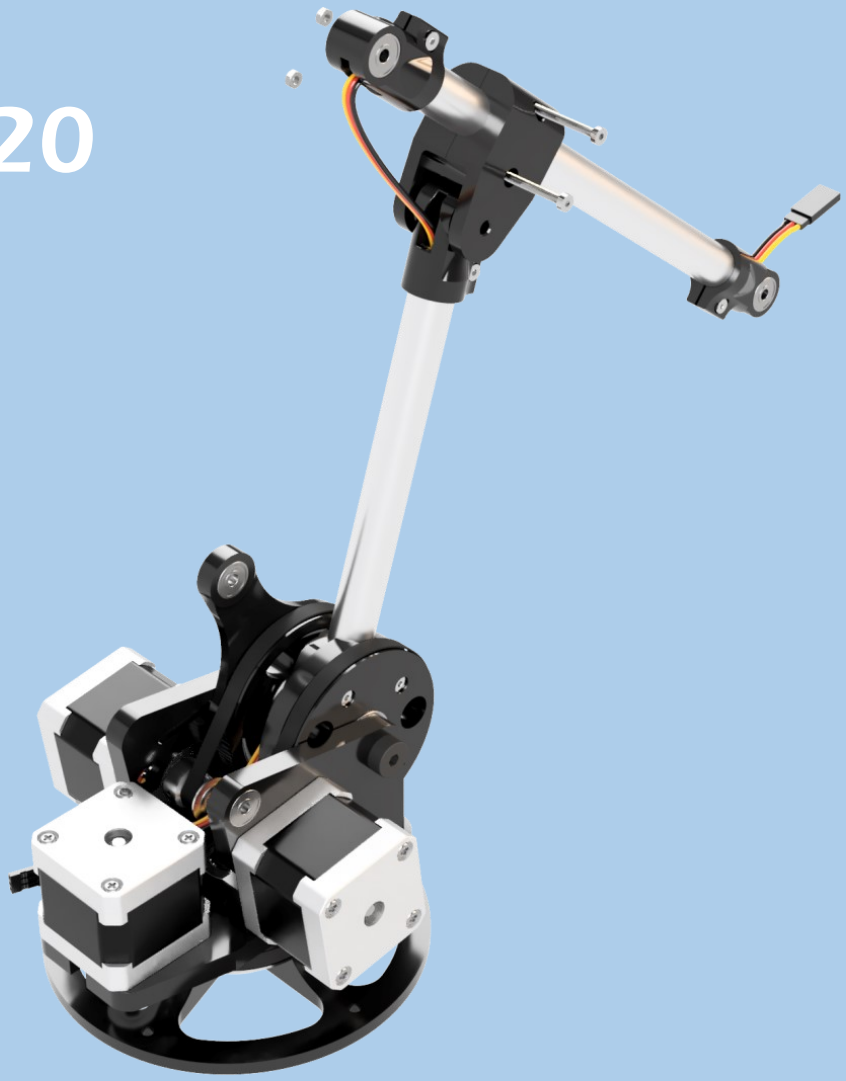

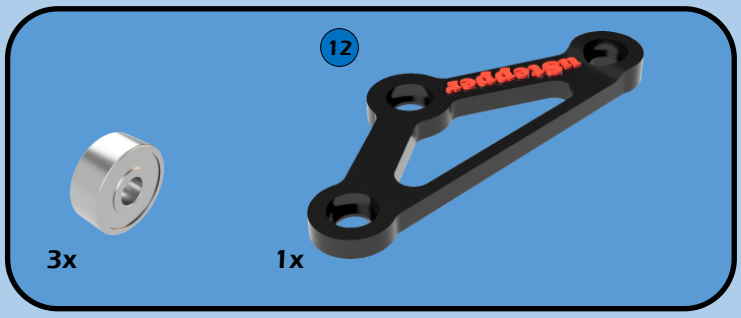

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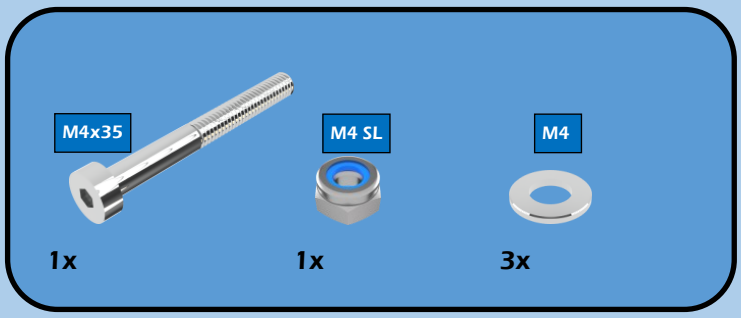

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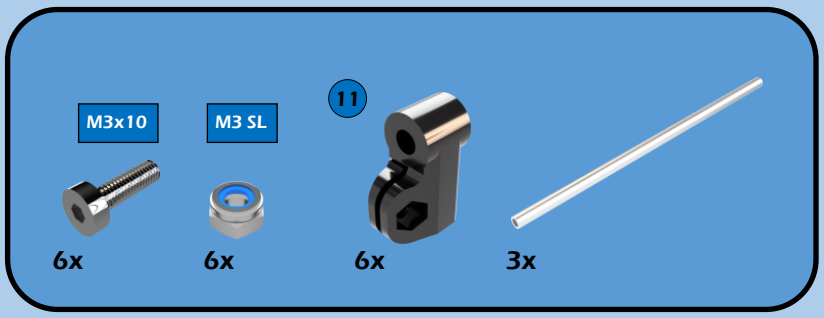

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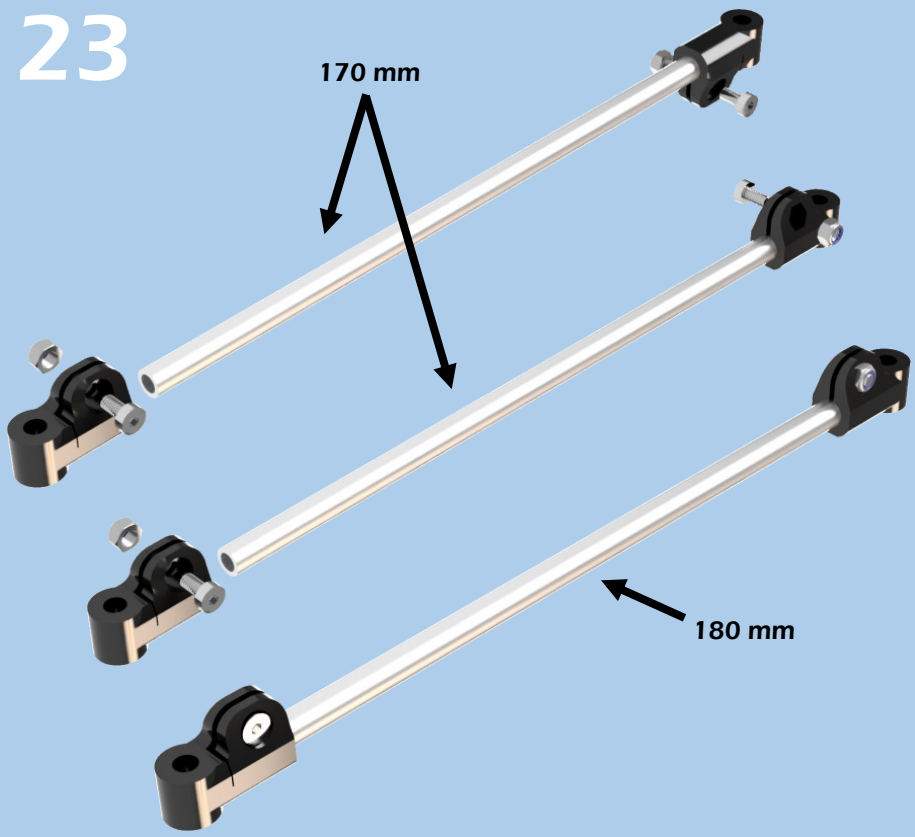

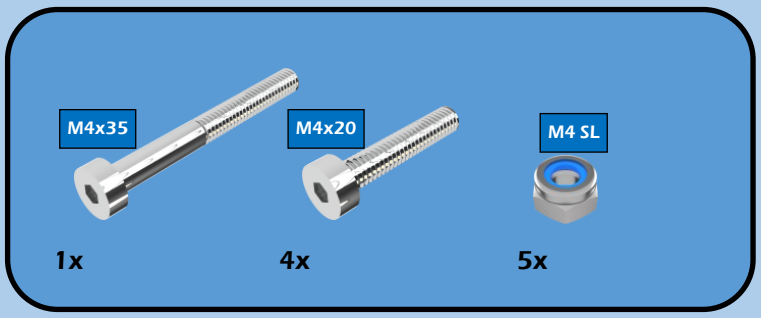

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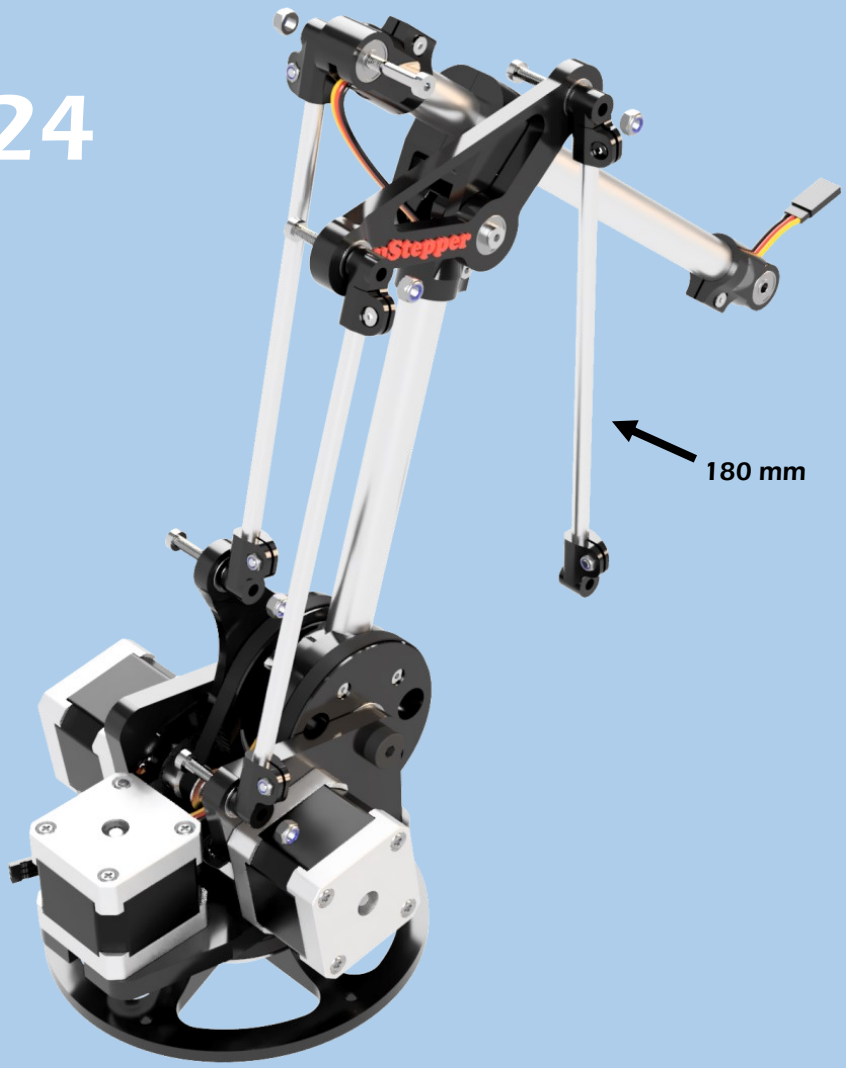
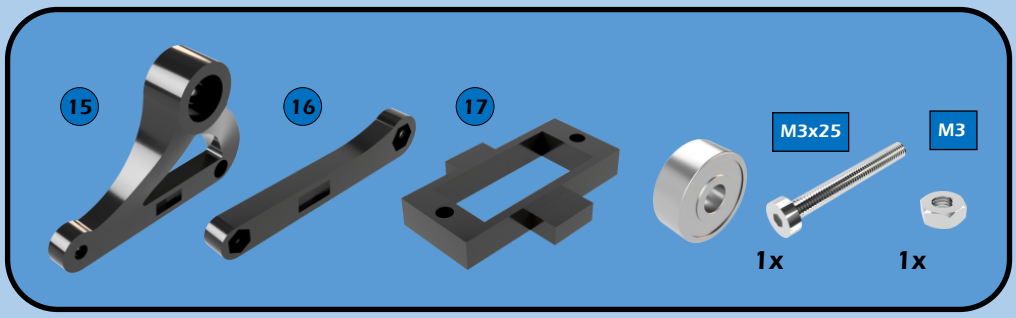



uStepper

Robot Arm Gripper Assembly



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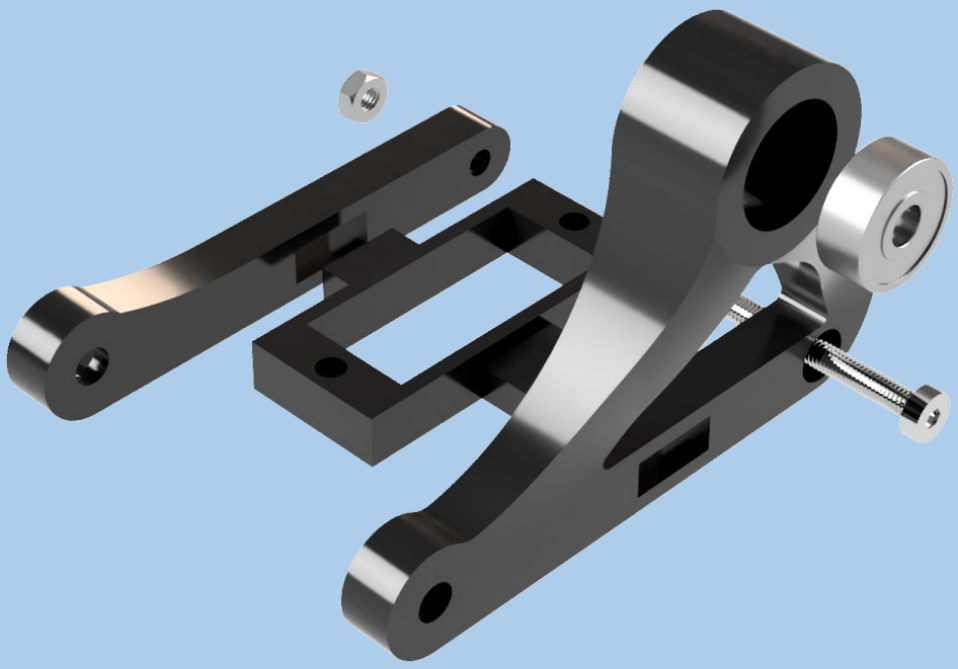

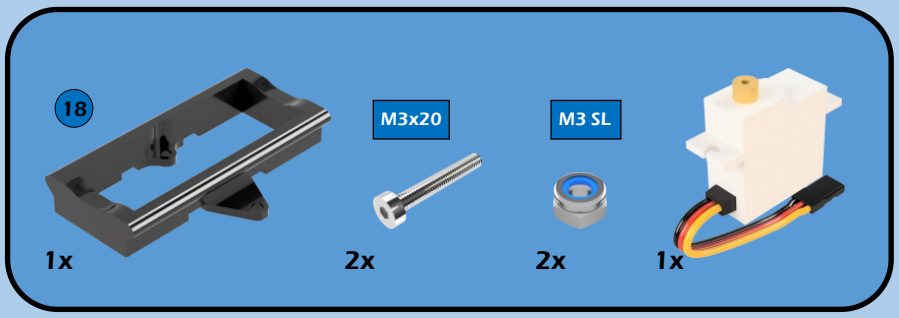

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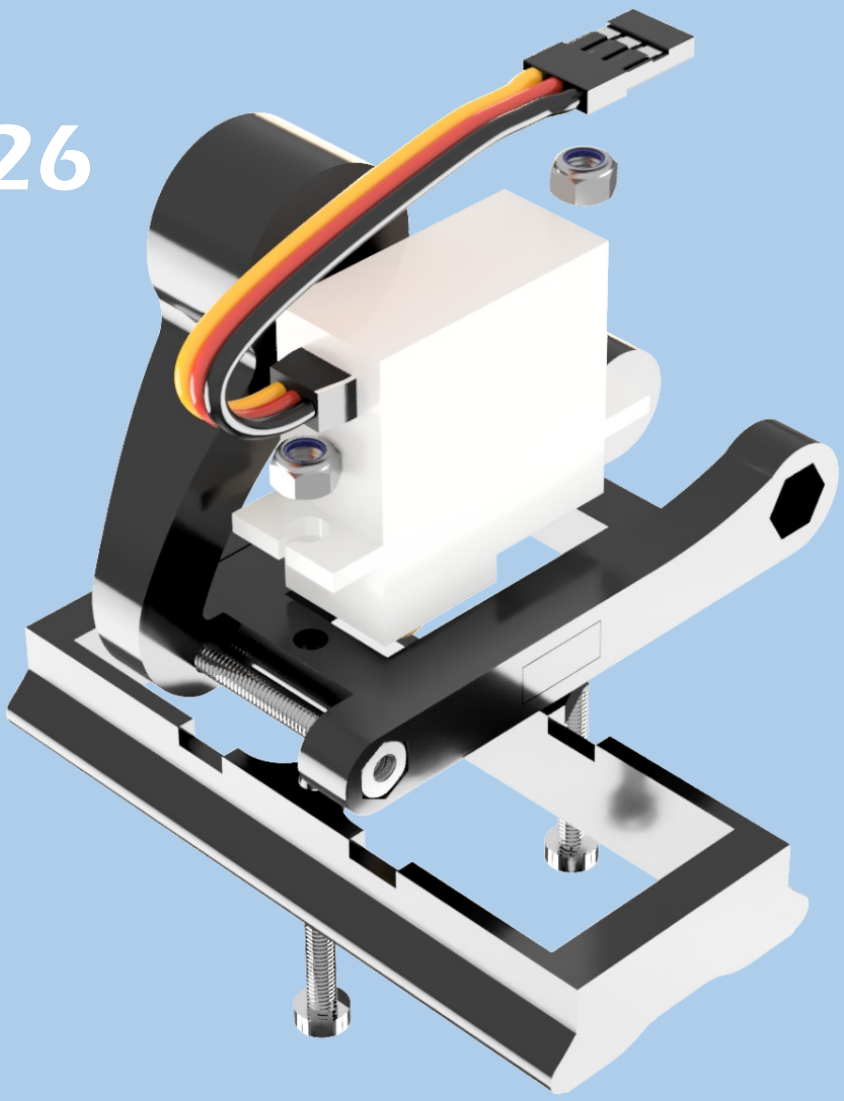

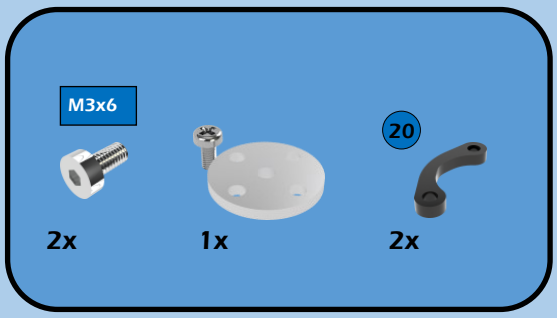

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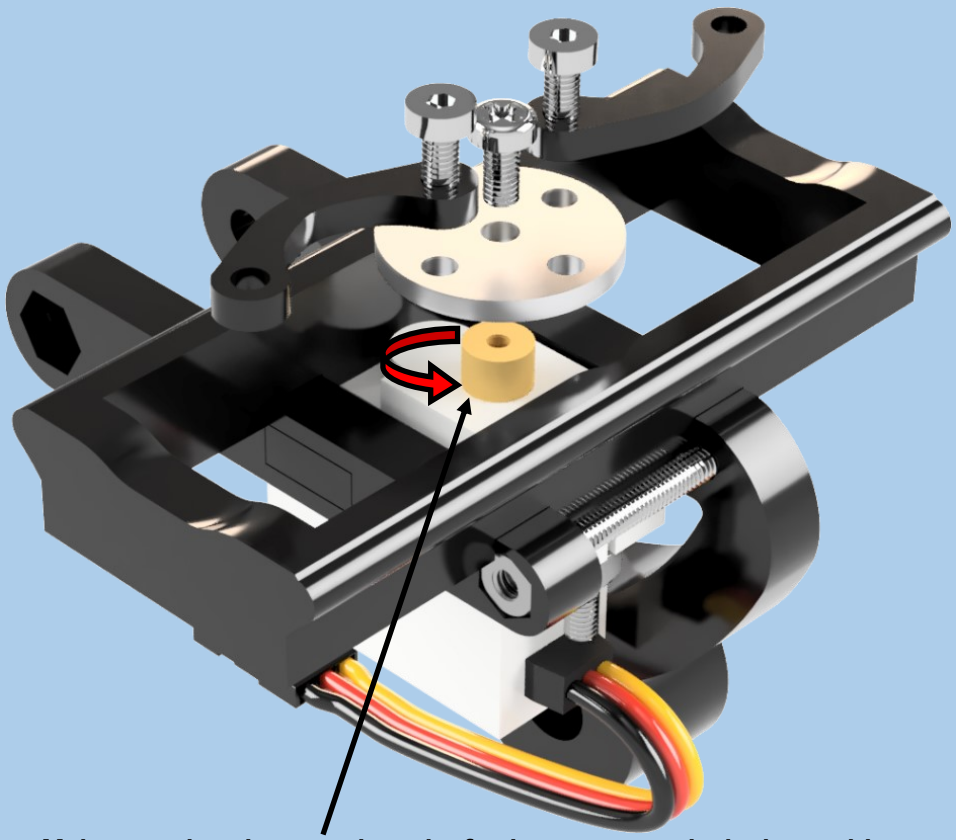
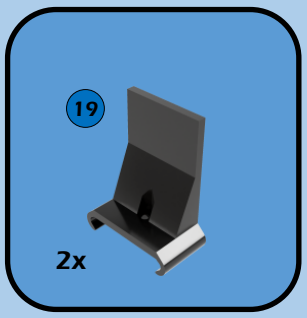


Make sure that the servo is at the furthest counter clockwise position



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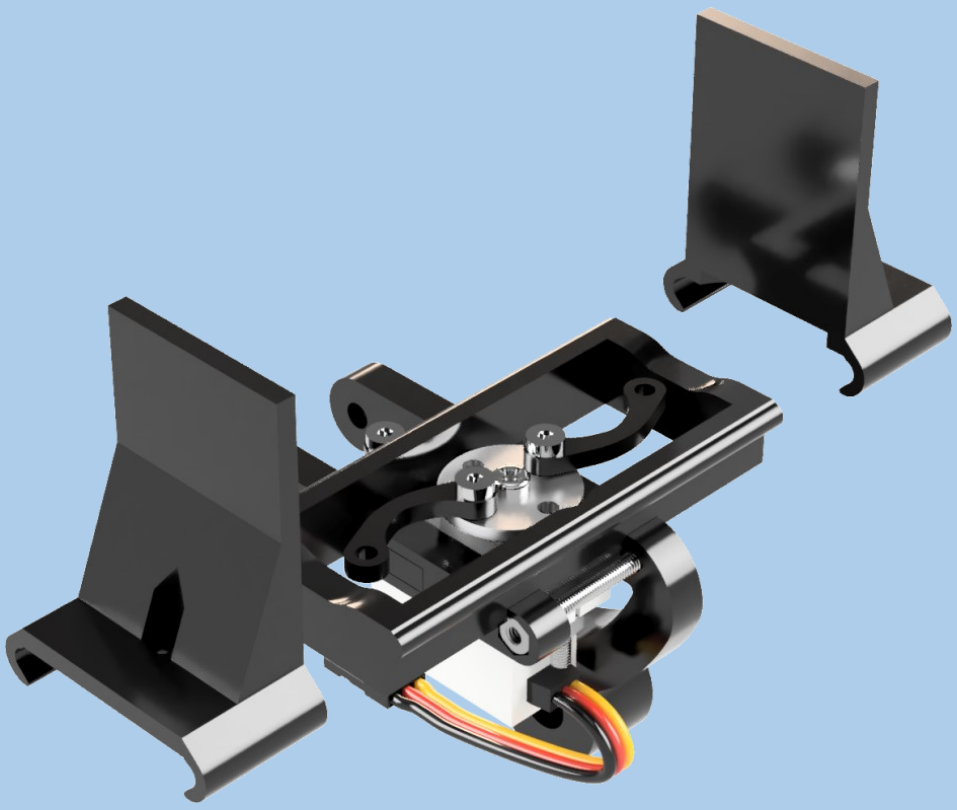

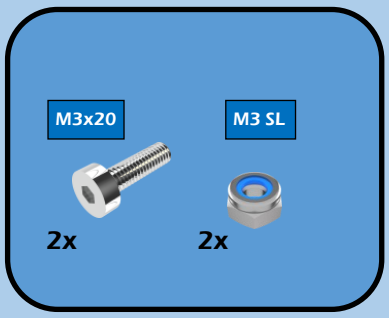

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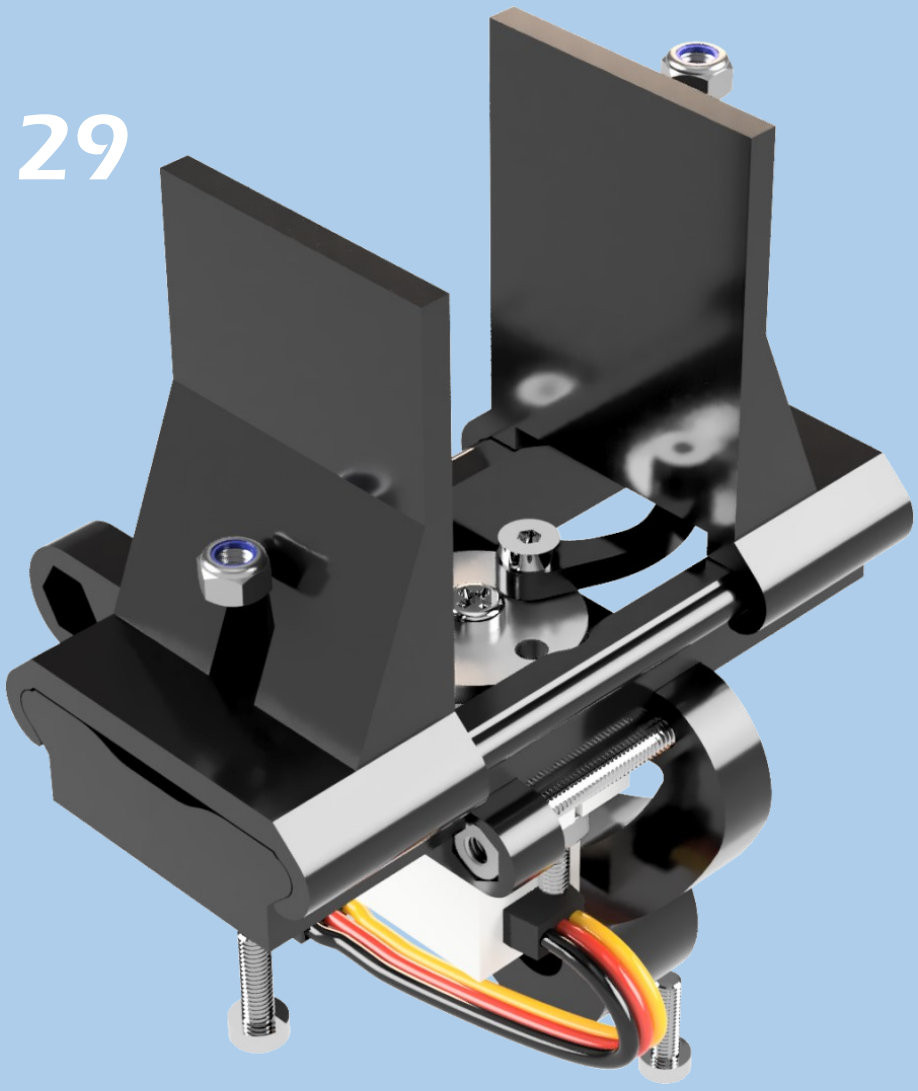
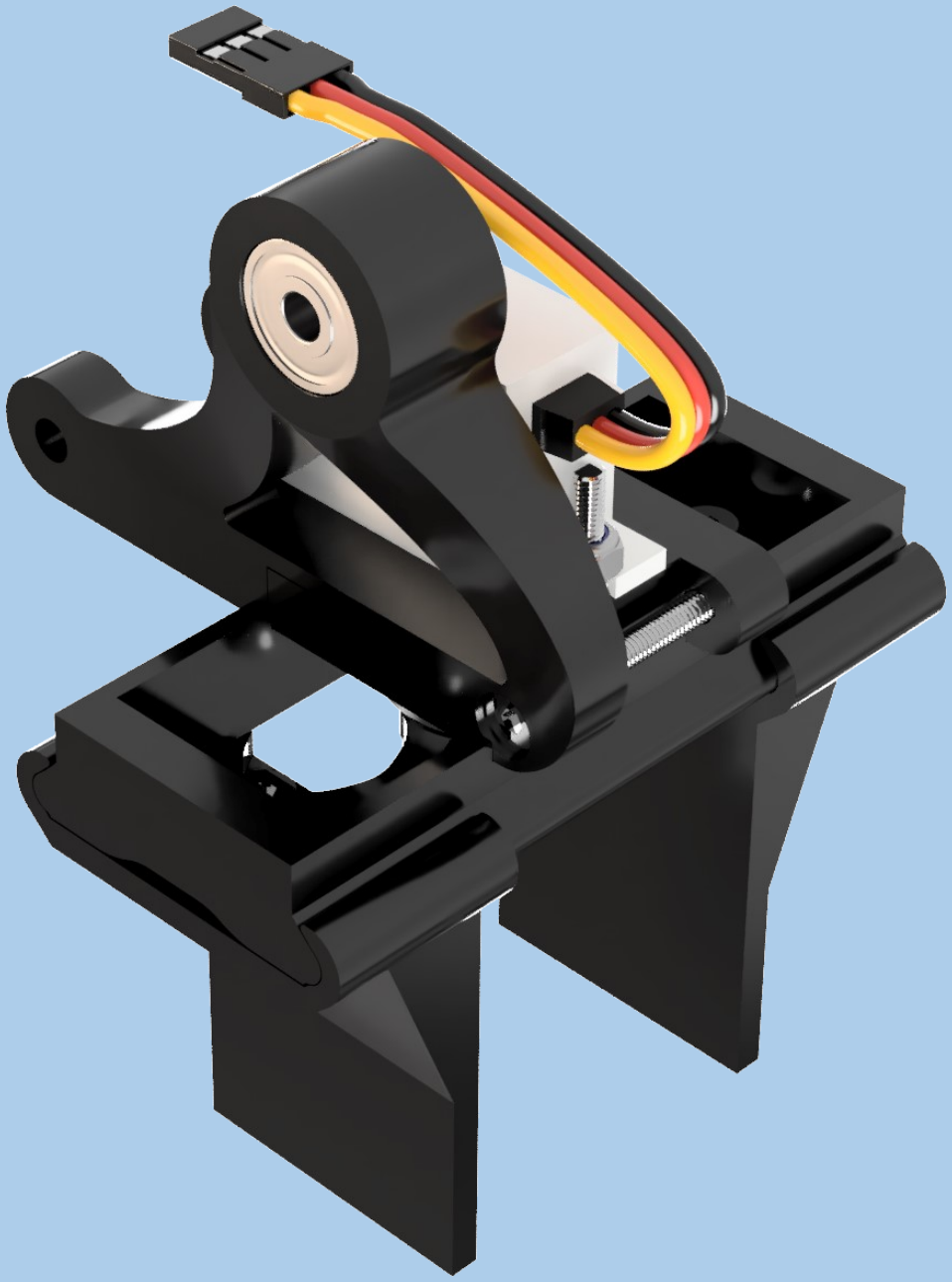
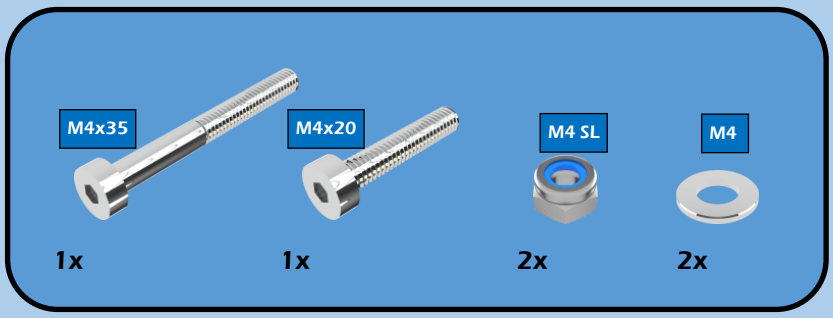




Robot Arm Gripper Mounting



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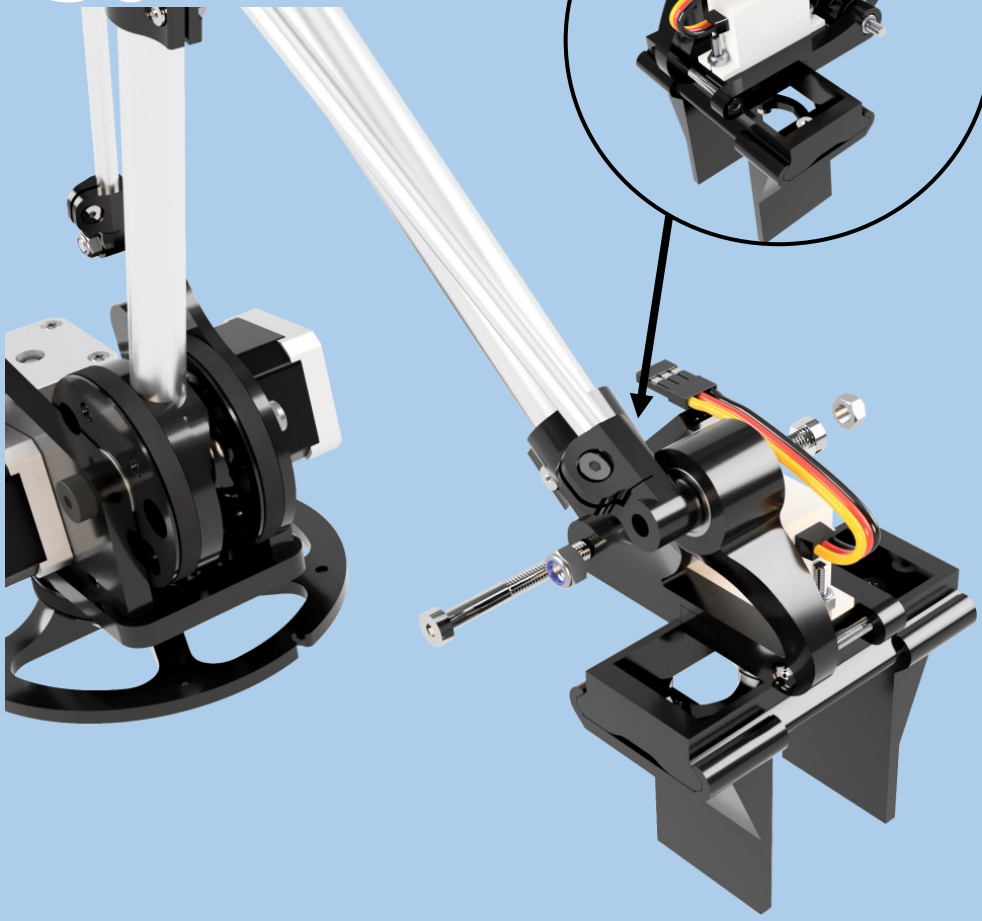

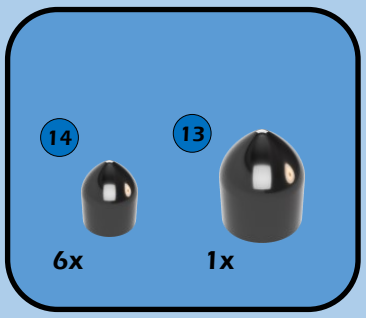

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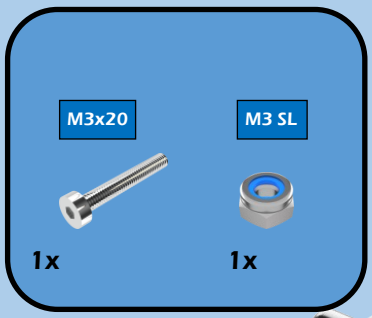
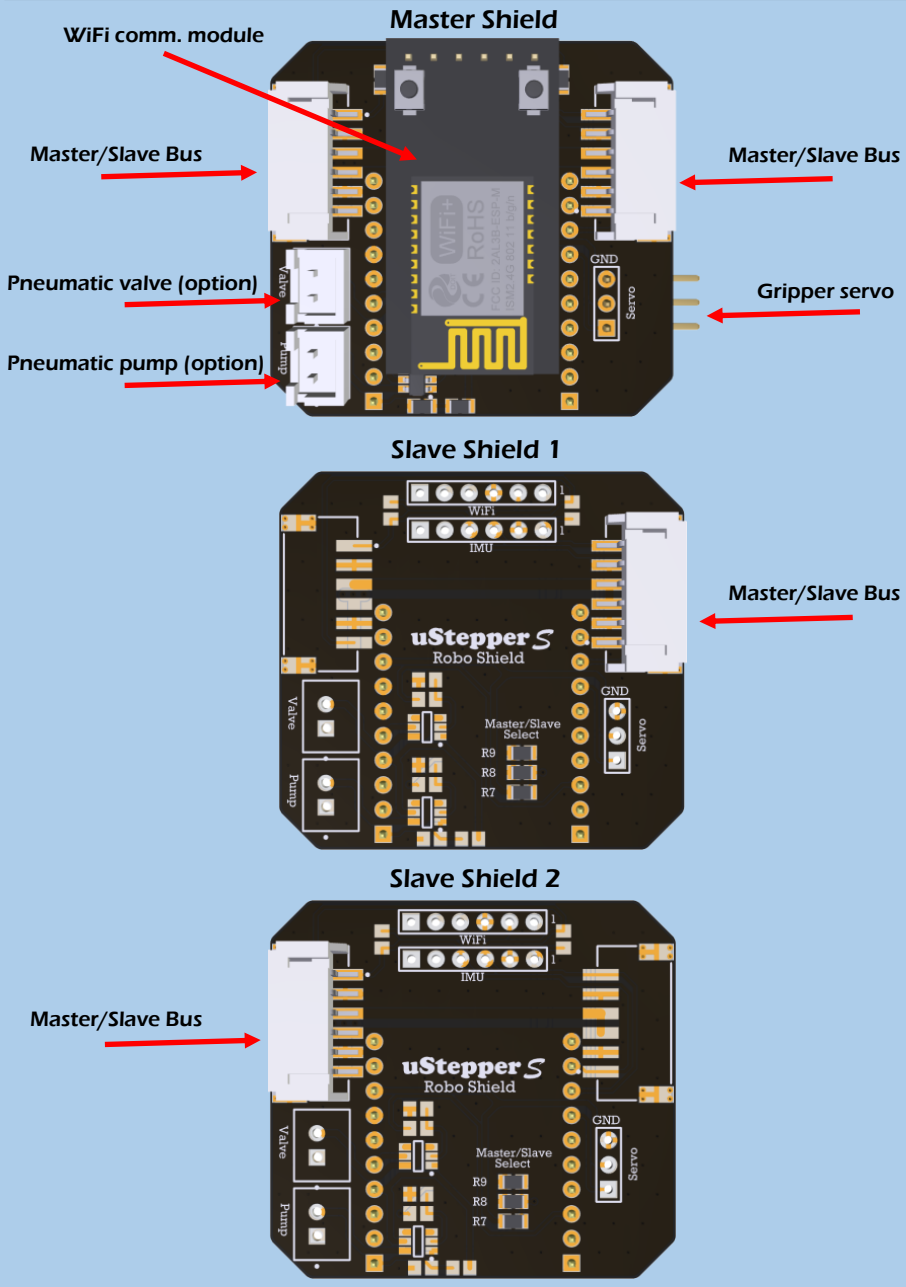
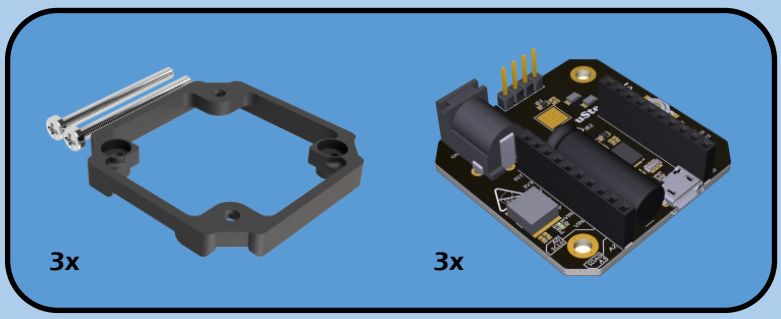


32

Robot Arm Electronics

Robot Shield Overview

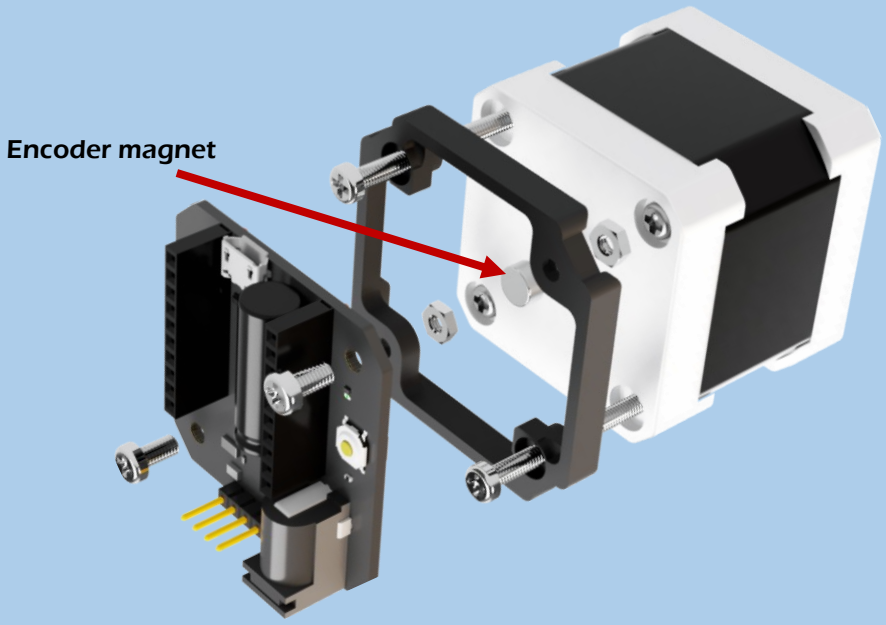


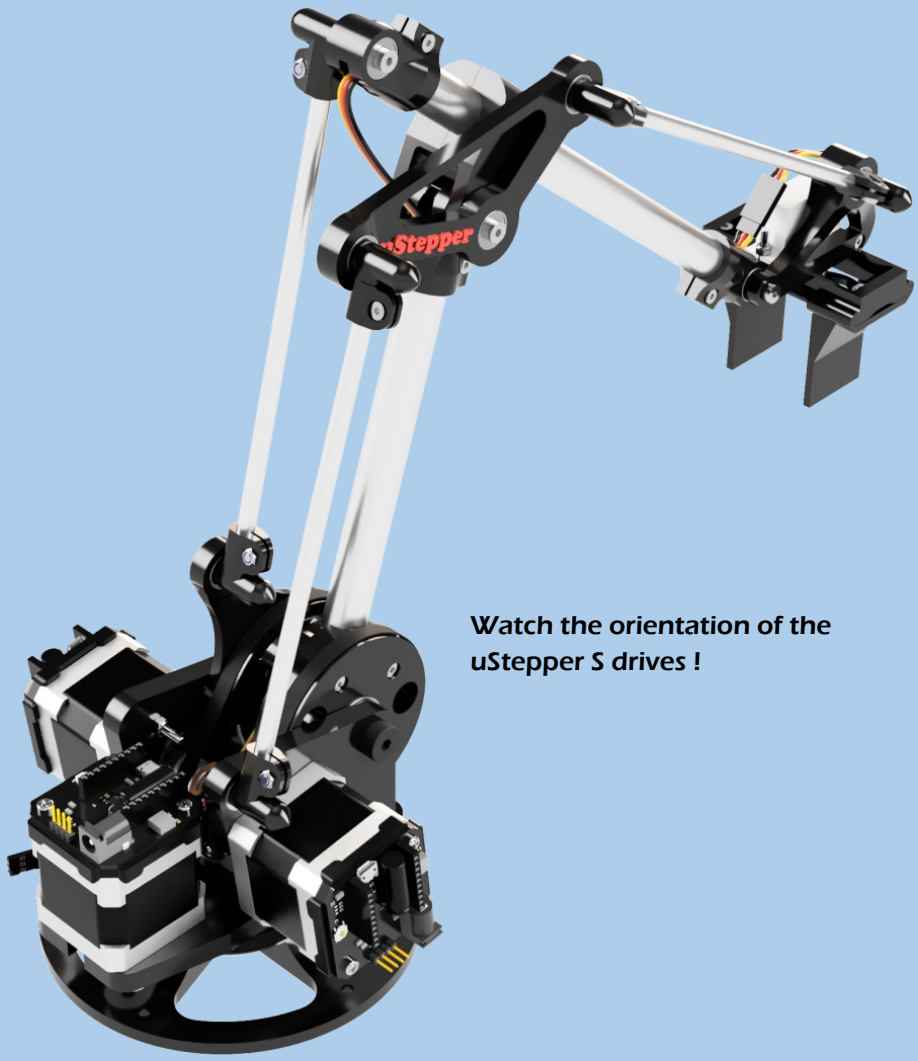


33

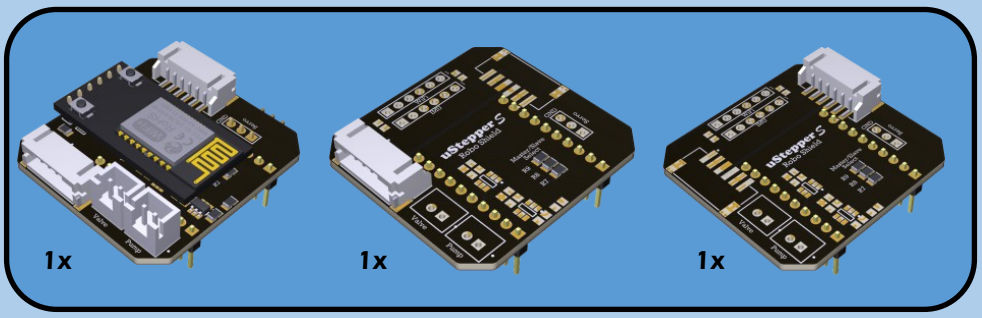
Mount uStepper S using the permanent bracket provided:

1. Remove two motor screws
2. Place encoder magnet on motor shaft
3. Insert nuts into bracket and mount bracket to motor w. two long screws
4. Secure uStepper S to the bracket with screws



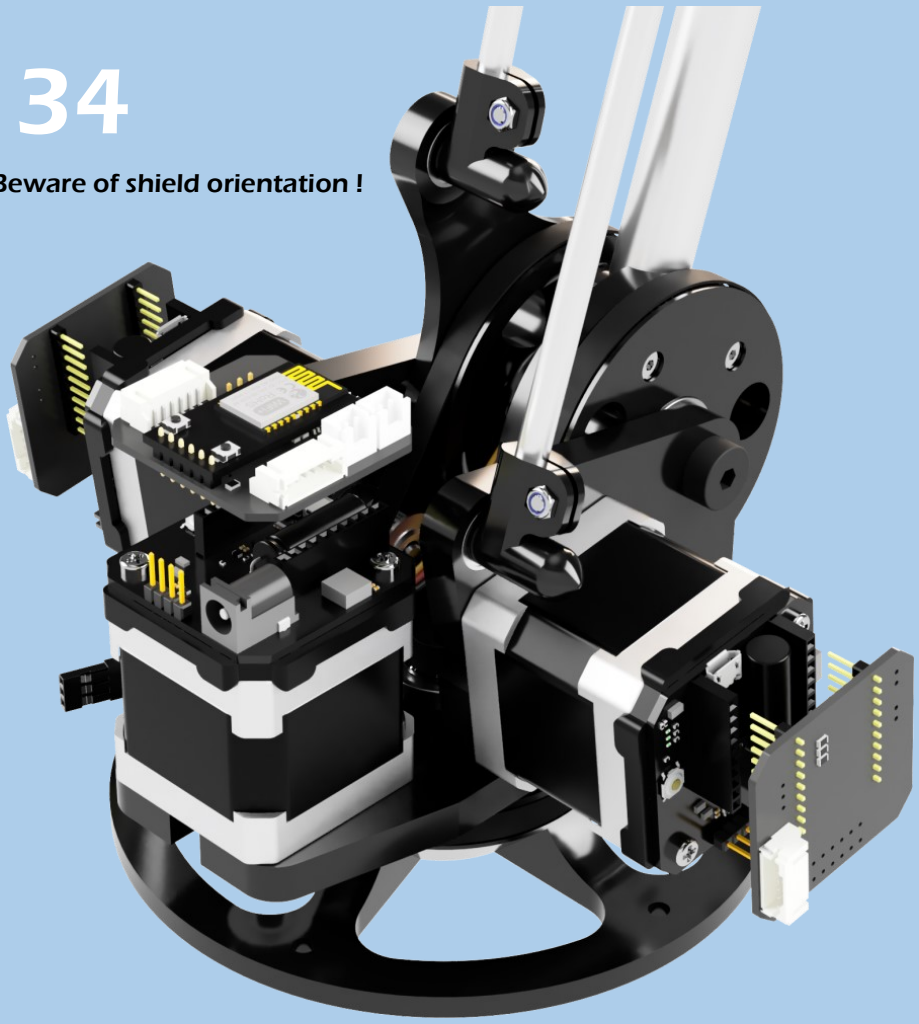


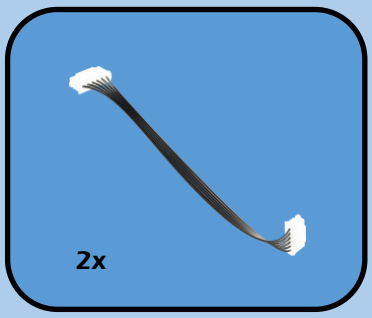
Watch the orientation of the uStepper S drives !



34

Beware of shield orientation !





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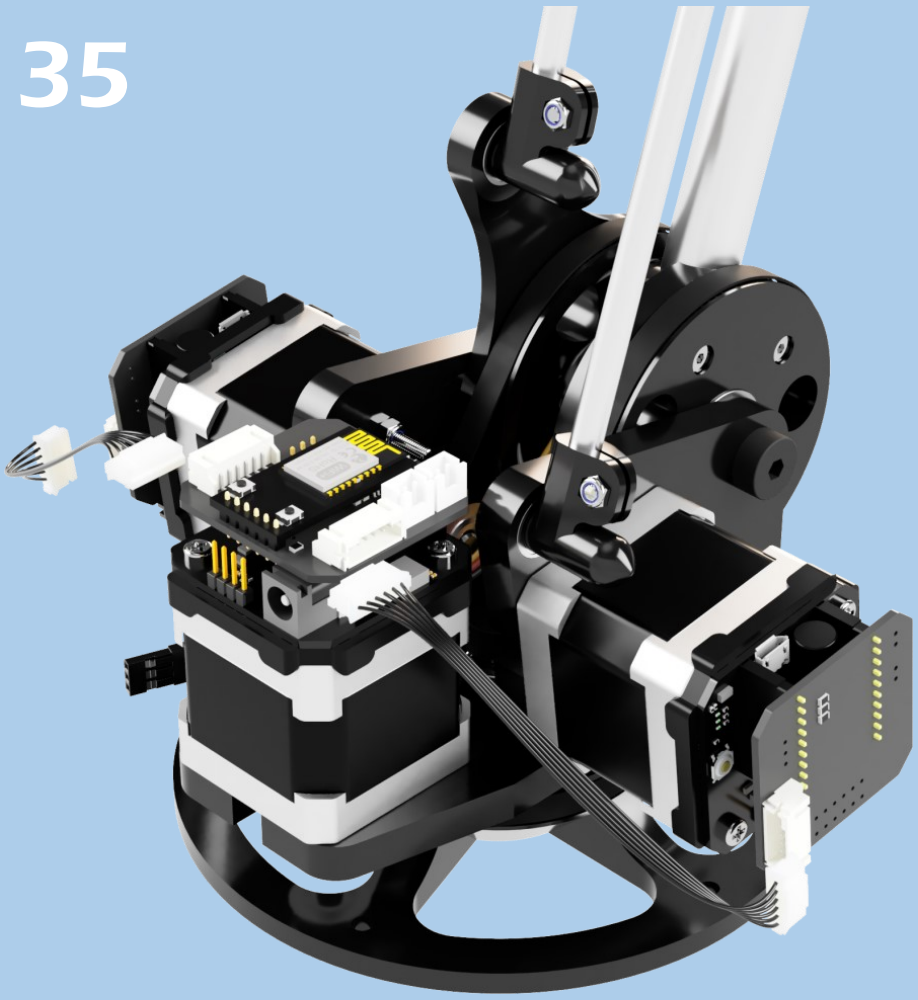
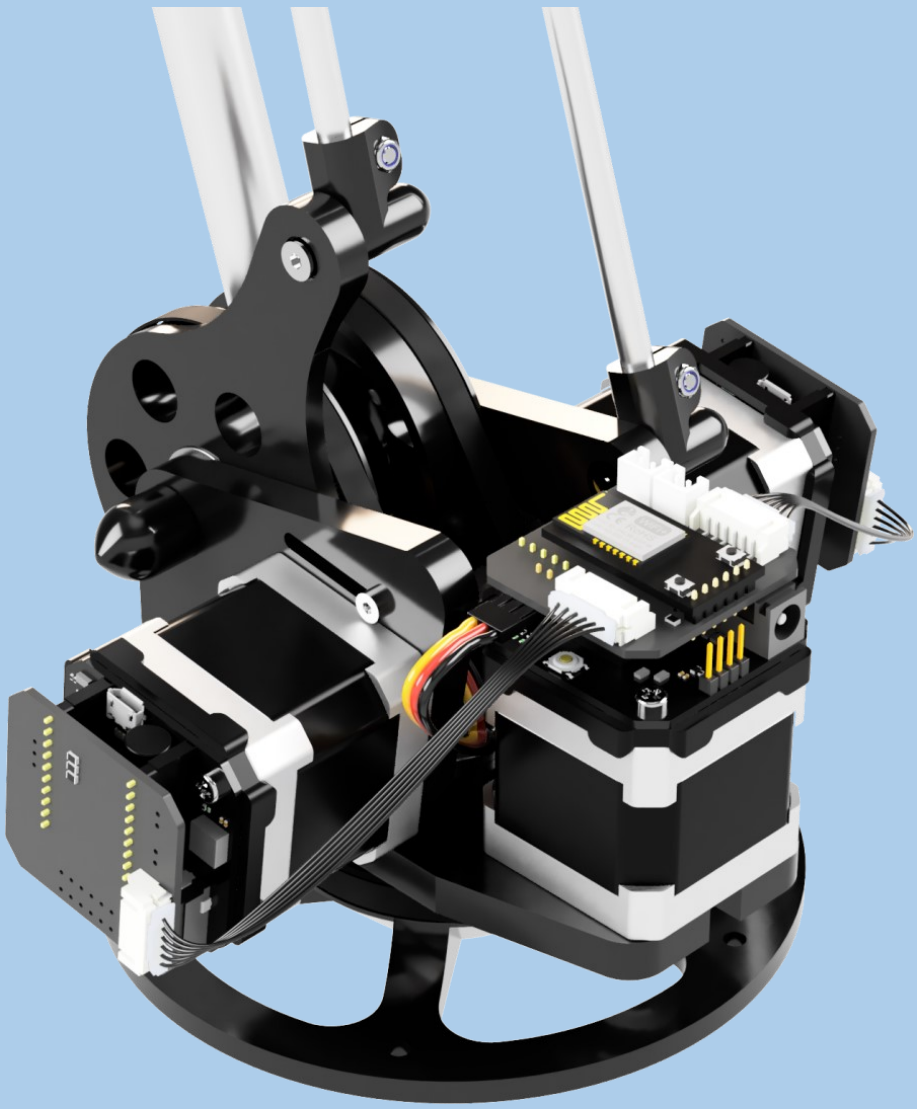
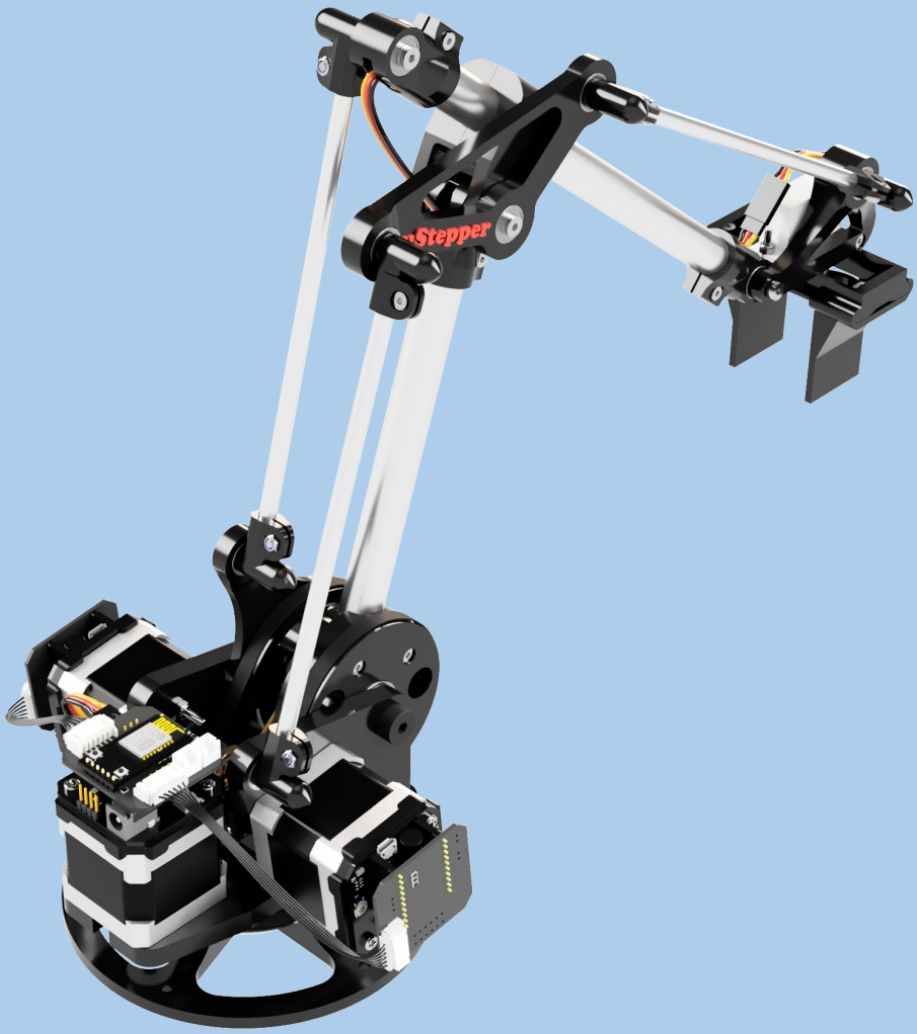






Robot Arm Programming

The uStepper Robot Arm complete kit is designed to work with the uStepper Robot Arm Arduino library which manages the communication between the Master controller (with WiFi module) and the two Slaves using the uStepper Robot Shields. Power is provided for the Master uStepper S which distributes power and signals to the two Slaves and thus only one power cord is needed.

With the uStepper Robot Arm 4 complete kit the code comes pre-loaded on both the WiFi module and the uStepper S boards. While it is important to install the boards as depicted in the prior the boards automatically detects if it is a Slave or a Master and thus no programming should be required.

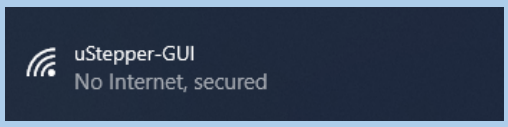
If for some reason there is a need to re-upload the code e.g. because of a new library version, please go to our GitHub and read the instructions on how to do this. You can get to the GitHub page by pressing HERE or scanning the QR code below !

SCAN ME

Connecting to the Robot Arm UI

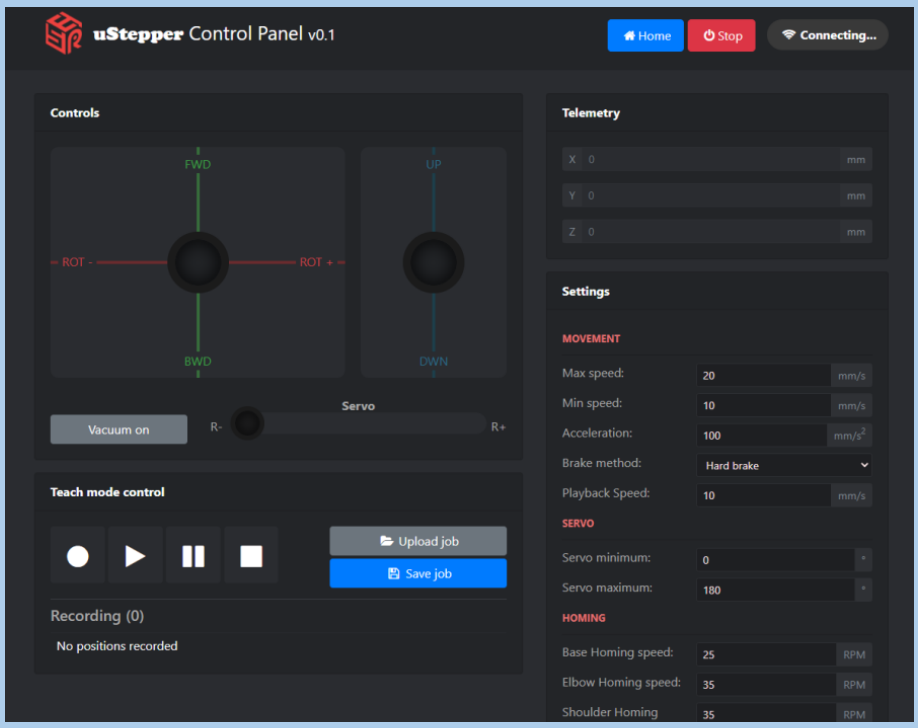
The uStepper Robot Arm WiFi module contains a webserver hosting a graphical user interface which enables you to control the arm as well as read status on e.g. the encoders.

To connect with the uStepper Robot Arm you'll need a device with WiFi and connect to "uStepper-GUI" as shown below:



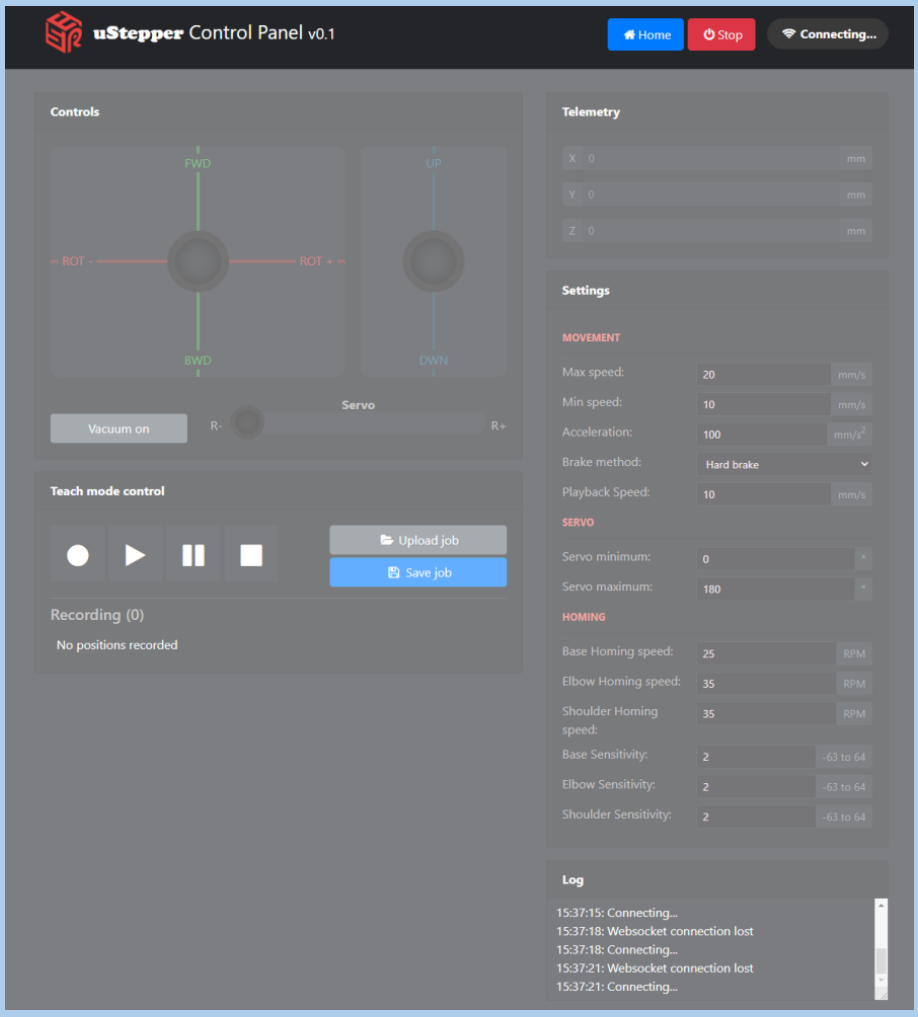
Password is "12345679"

When connected simply open up a browser window, type "192.168.4.1" and hit enter to get to the uStepper Robot Arm user interface:



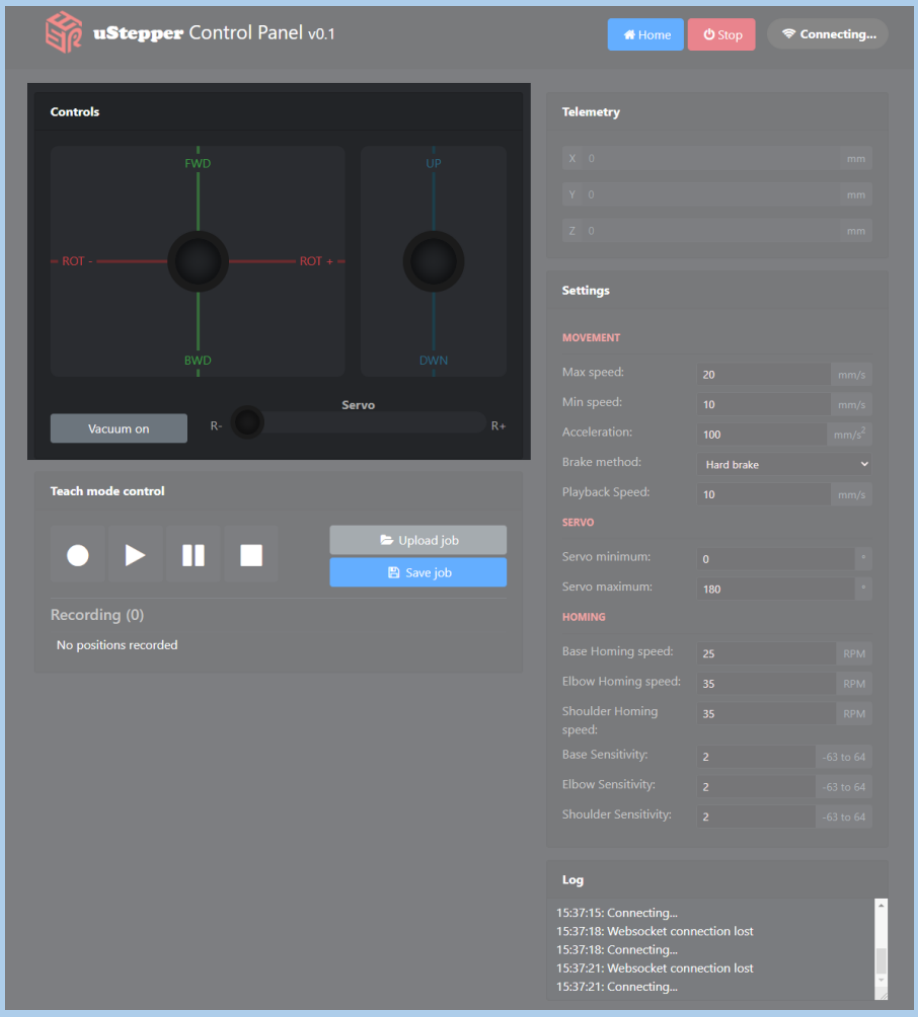
Controlling the Robot Arm

The user interface has a top bar where connection status is shown as well as a homing button for homing the Robot and a stop button for stopping it.

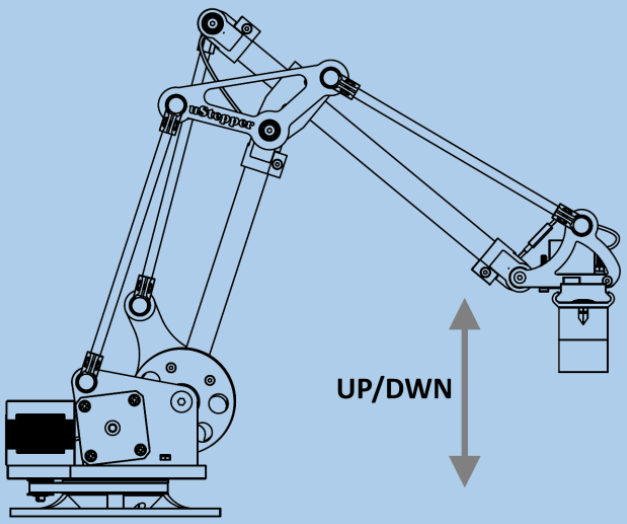


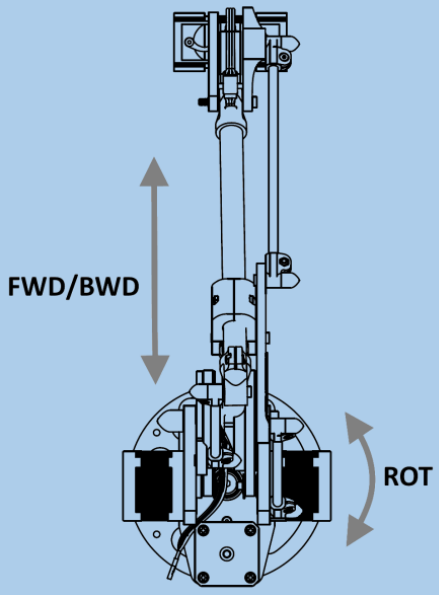
Controlling the Robot Arm

The Controls section provides two joystick style controls for moving the robot Forward/Backwards, Rotate and Up/Down (see next page). Below this is a button for activating and de-activating vacuum suction (optional part) and a slider for rotating the end effector servo.



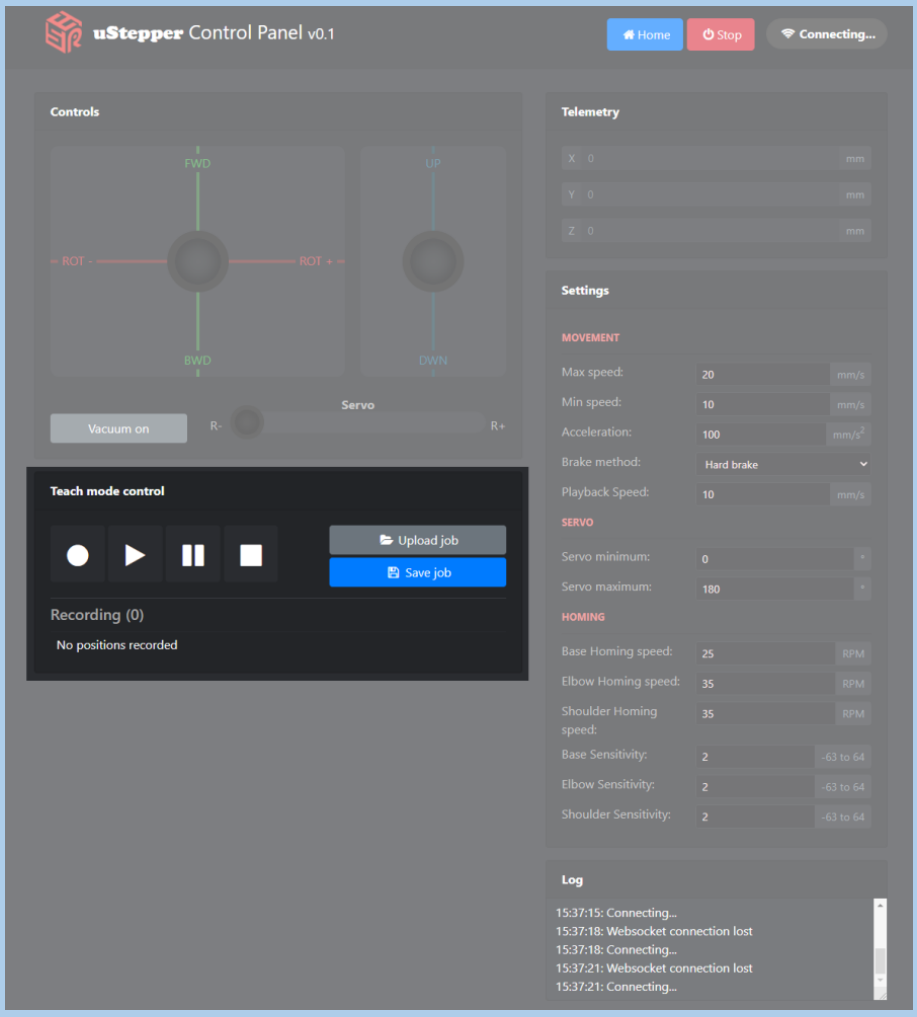
Controlling the Robot Arm





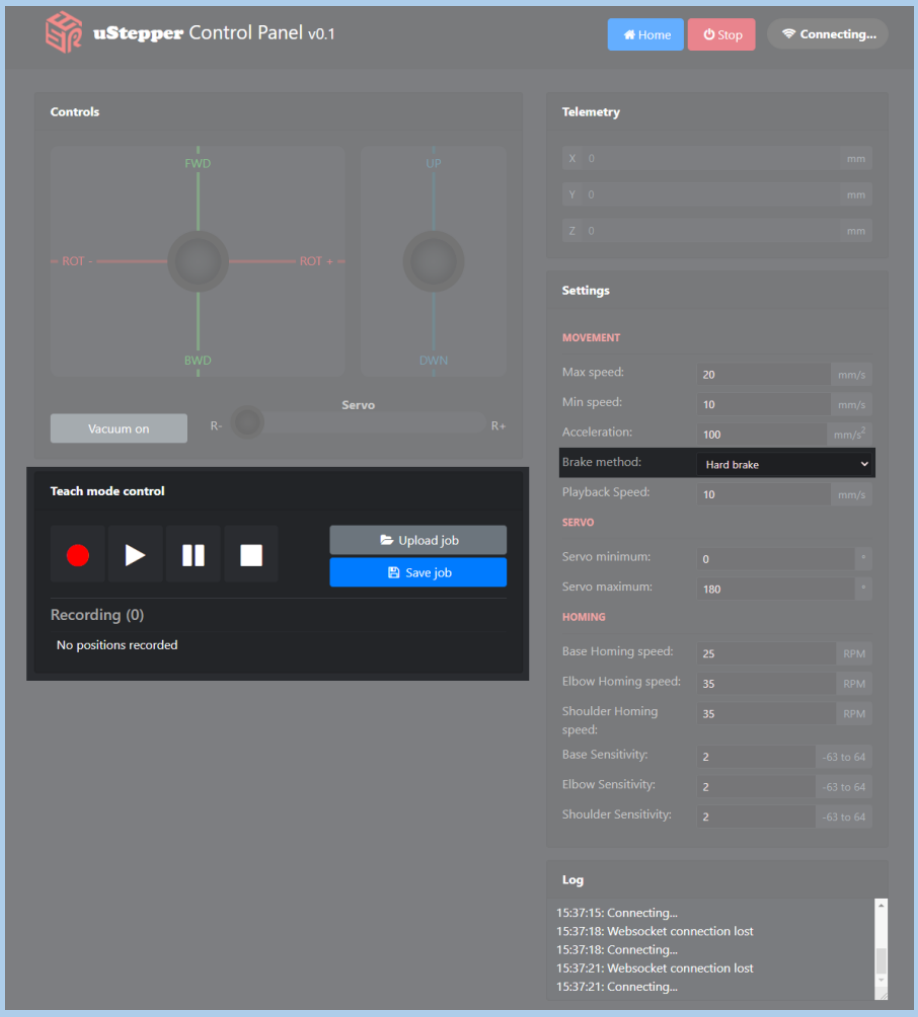
Controlling the Robot Arm

The Teach mode controls section provides buttons for recording sequences and playing them back. The recording of a sequence is started by pressing the record button—see next page for details on how to do the recordings.



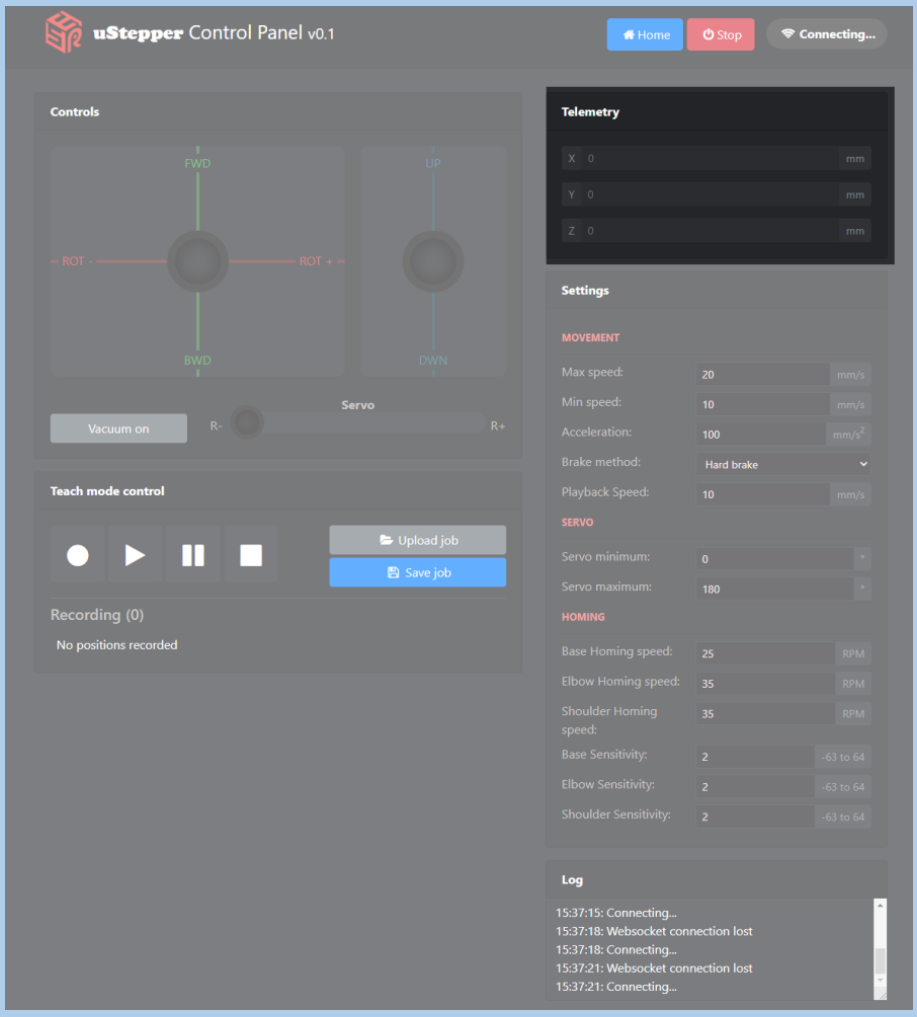
Controlling the Robot Arm

After pressing record it lights up red and it is now possible to add positions as needed. Gripper position changes from one position to another is also recorded, i.e. pressing record, closing the gripper and pressing record again will record closing of the gripper. Jobs can be saved to and loaded from an external source by using the save and upload buttons. To move the robot by hand—set the brake to Freewheel or CoolBrake.



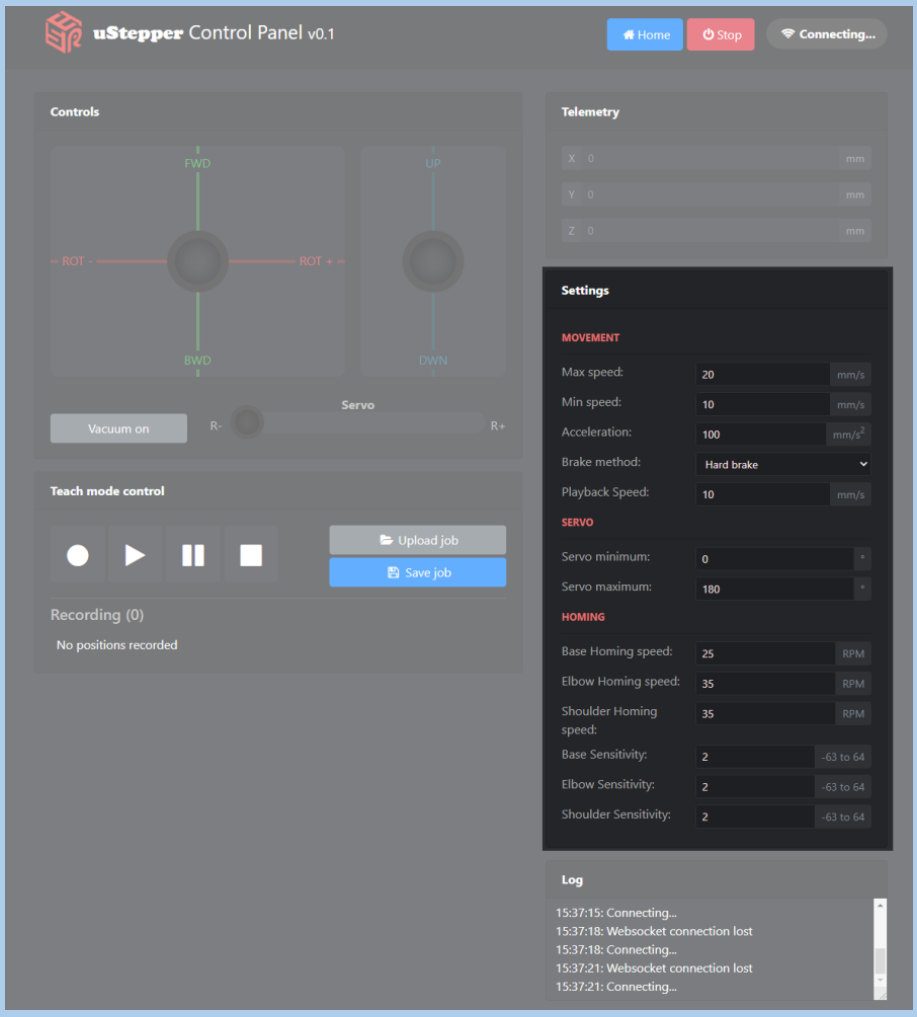
Controlling the Robot Arm

In the right corner a telemetry section is found. The current position read from the uStepper controllers is displayed here.



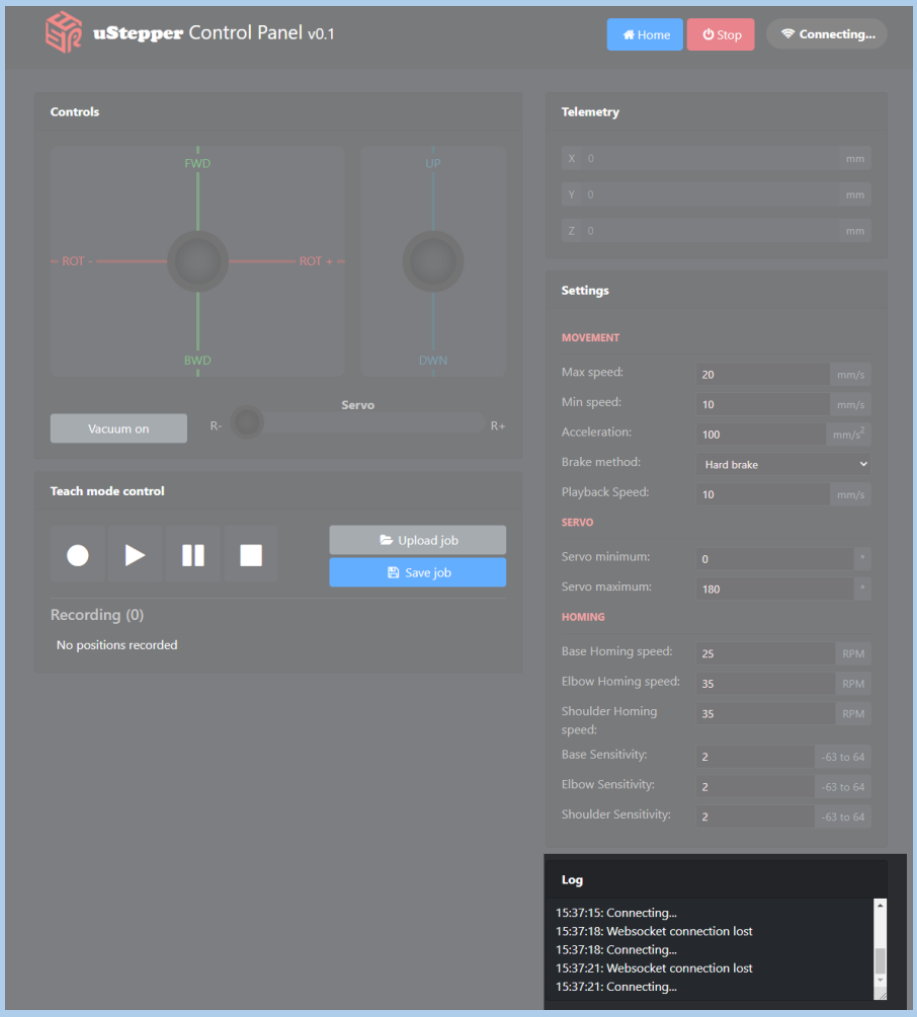
Controlling the Robot Arm

The settings section gives the ability to set max and min speed of the drives, speed of recording payback, the min and max angle of the servo (the gripper will not use the full range on all objects) and finally the homing settings - where the settings shown are usually suitable for a 19V supply voltage.



Controlling the Robot Arm

In the lower right corner a Log is constantly providing feedback from the system - making it possible to e.g. see the Robot Arm connection status like shown here.



Additional information

The uStepper Robot Arm uses our own developed Arduino library and is based on a technical document written by us.

The technical document describes the math behind controlling the Robot i.e. the kinematics. The documentation is done thoroughly and with focus on simplicity using trigonometry. The aim is to provide the math on a level where it is accessible to both hobbyists and students.

Also 3D printable spare parts, parts for grippers and a full 3D Step model is found on our Git repo.

Kinematics Calculations

Git repo

Video Tutorials

A row of video tutorials showing the assembly of the robot as well as a walkthrough of the GUI control, teach control demos and more can be found on our YouTube channel.

YouTube Channel

Disclaimer

1 Disclaimers and Limitation of Liability

1.1 uStepper ApS and/or ON Development ApS (or any individuals affiliated with either of the two companies) can not be held responsible for any damage inflicted upon mounting or interfacing with uStepper products This also includes damage to stepper motors (both electrical and mechanical) or any other 3rd party hardware connected to or interfacing with any uStepper products. Most stepper motor cases are made of aluminum, and care must be taken when preparing the mountings for uStepper.

1.2 uStepper ApS and/or ON Development APS (or any individuals affiliated with either of the two companies) can not be held responsible for any damage inflicted upon assembly of the uStepper Robot Arm. This includes damage to 3D printed parts, which must be considered to be of prototyping quality compared to injection moulded parts. Care must be taken while assembling 3D printed parts, and use of excessive force may lead to damage of the parts.

1.3 By using the uStepper products (including, but not limited to, hardware and software) you acknowledge that uStepper ApS and/or ON Development APS (or any individuals affiliated with either of the two companies) can not be held responsible for any personal injuries and/or damage to any 3rd party hardware that may occur when using the uStepper products.

1.4 To the extent permitted by law, uStepper ApS and/or ON Development APS will not be liable for any indirect or consequential loss or damage, of any kind, (including without limitation loss of business, opportunity, data, profits) arising out of or in connection with the use of any products (including, but not limited to, hardware and software), developed, produced or sold by uStepper ApS and/or ON Development APS (or any individuals affiliated with either of the two companies).

1.5 Nothing in these Terms and Conditions shall be construed so as to hold uStepper ApS and/or ON Development APS liable for death or personal injury as a result of the negligence of uStepper ApS and/or ON Development APS or that of its employees or agents.

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2.2 You agree to indemnify and hold uStepper ApS and/or ON Development APS and its employees and agents harmless from and against all liabilities, legal fees, damages, losses, costs and other expenses in relation to any claims or actions brought against uStepper ApS and/or ON Development APS arising out of any breach by you of these Terms and Conditions or other liabilities arising out of your use of products(including, but not limited to, hardware and software) developed, produced or sold by uStepper ApS and/or ON Development APS (or any individuals affiliated with either of the two companies).

3 Severance

If any of these Terms and Conditions should be determined to be invalid, illegal or unenforceable for any reason by any court of competent jurisdiction then such Term or Condition shall be severed and the remaining Terms and Conditions shall survive and remain in full force and effect and continue to be binding and enforceable.