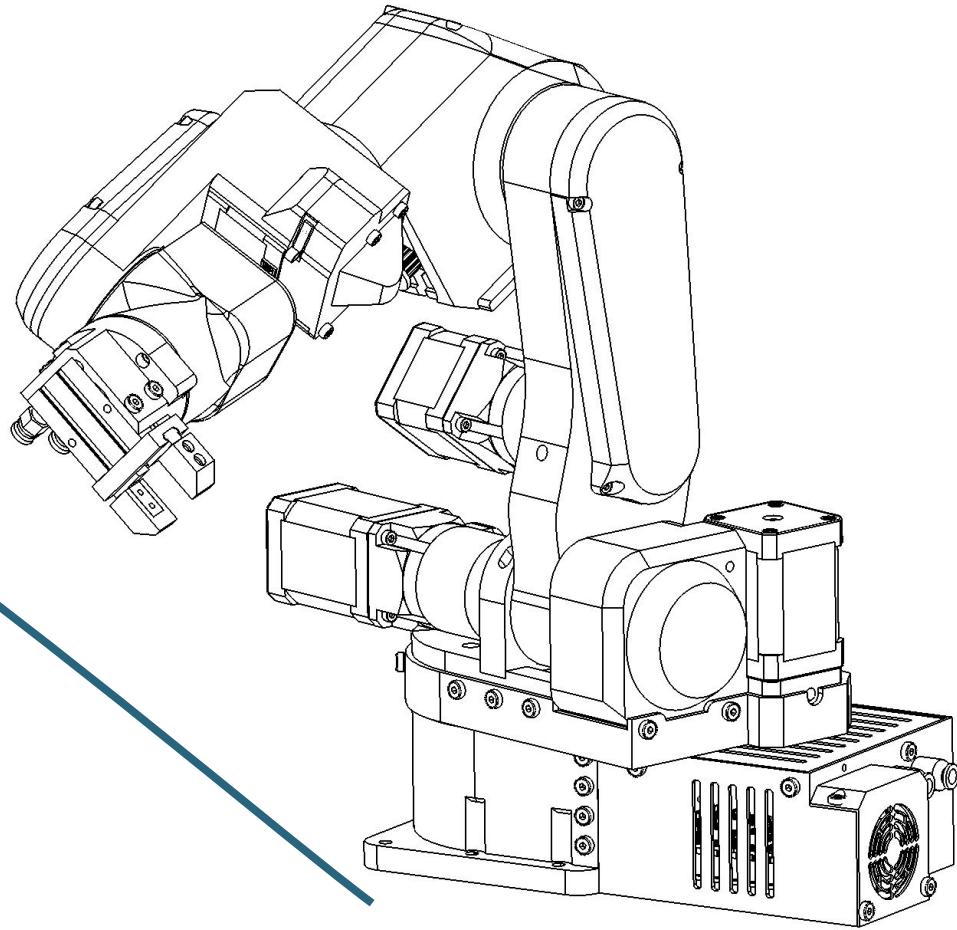


# PAROL6 ASSEMBLY MANUAL



Version 1.0, date 13.7.2023

## Warning

Before building this robot please read the whole manual! This machine can cause harm to you and people around you. It can burn, electrocute and physically hurt you if you are not careful. Please read these instructions carefully!

Also when after reading and building this robot make sure to make yourself comfortable with robot control software and how to operate it!



# Assembly manual

Welcome to the PAROL6 assembly manual. PAROL6 is open source 6 axis robotic arm aimed for education, research and small automation. It is designed by Petar Crnjak

All additional information can be found here:

- Github project repository - most up to date BOM, parts, docs, manuals...
- Docs page - latest documentation on PAROL software

You can also ask help and advice from community:

- Official discord server: [Link](#)
- Official forum
- Or send us an email at: sourcerobots@gmail.com

And you can follow us on social media:



# Assembly manual

All screws shown are same size and only for reference. For correct size read the instructions stated on the page what screw to use. Some parts are not show; mostly bearings, small screws and belts but are referenced on the page of the building instructions.

This document only shows assembly manual, all other files like BOM, printing table, STL files can be found on GitHub page of the project.

All parts should be printed with PETG material. Reference printing table for optimal infills and printing settings.

Wires are not shown but detailed instructions are given on how to route the wires.

Belts are not shown but detailed instructions are given on how to attach them correctly.

This window shows what parts you will need on this page.

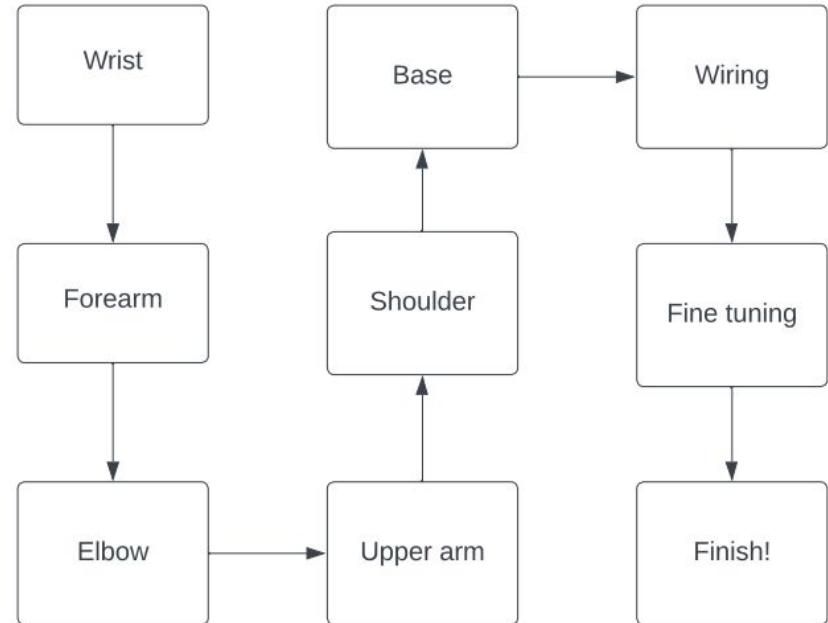
This window show building instructions.

This window shows tips and notes.

# Assembly manual - Road map on building PAROL6 and using it!

Robot needs to be built from wrist to the base. That means we start by building the wrist then lower arm, elbow, upper arm and base. Any other order will not work. This needs to be done this way since all wires pass thru the the robot.

After assembling the robot it needs to be wired up to the PAROL control board. After that some fine tuning and testing can be done.



## Assembly manual - Print preparation

Printing off all parts takes around xxx hours.

Some parts need to be printed with support. Before using those parts make sure to clean all support material.

Printer settings we used:

- Printer: Prusa MK2S
- Material: PETG
- Layer height:
- Support: Reference printing table
- Infill: Reference printing table

## Assembly manual - Wire and pneumatic tube preparation

Wires for gripper need to be twisted pair wires.

Try to follow these guidelines on how much wire length you need to have for every part of the robot.

Wire lengths:

- Motor joint 1 - 4 wires 0.8 meters
- Sensor joint 1 - 3 wires 0.8 meters
- Motor joint 2 - 4 wires 0.8 meters
- Limit switch joint 2 - 2 wires 0.8 meters
- Motor joint 3 - 4 wires 0.8 meters
- Limit switch joint 3 - 2 wires 0.8 meters
- Motor joint 4 - 4 wires 0.8 meters
- Sensor joint 4 - 3 wires 0.8 meters
- Motor joint 5 - 4 wires 0.8 meters
- Limit switch joint 5 - 2 wires 0.8 meters
- Motor joint 6 - 4 wires 0.8 meters
- Sensor joint 6 - 3 wires 0.8 meters
- Pneumatic tubes - 2 tubes 0.8 meters
- Gripper wires - 4 wire x meters (2 twisted wire pair)

Since robot is built from the wrist to the base of the robot you will have more and more wires as you reach the end. To keep it clean and easy to assemble before adding next link wrap group of wires with insulation tape (we used cloth fabric tape). For example after finishing lower arm assembly wrap Joint 6 motor with tape, Joint 5 motors with tape... Try to use tape of different color to mark different joints. This will help you A LOT when you will need to wire up the robot.

## Assembly manual - Screws and attaching parts

PAROL6 uses M3 -M5 screws to attach parts. Most functional print to print attachments are done with a crew and a undersized 3D printed hole.

For example on image at the right side we are attaching two 3D printed parts that will carry load and are not esthetic parts (esthetic parts are for example covers and robot will work without them). Screws are in this example M3 screws and holes are undersized to 2.7-2.8mm that means that when we screw in the screws we are tapping holes in 3D printed parts.

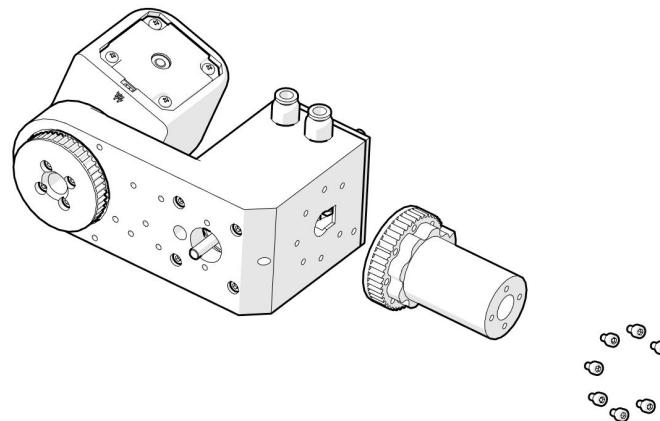
There are multiple benefits to this:

- Connection is strongest compared to tapping holes with a tap or using brass inserts
- It is simple and fast
- No need to prepare the hole, it can be printed undersized

Cons are that you can't disassemble it a lot of times. In case you feel screws slipping in the hole. Put some super glue in the hole and wait for it to cure. After that re tap the hole.

All screws are tightened with torque screwdriver with torque of xxx. If you are not using it you risk destroying your plastic parts

Most metal to metal parts require no preparation. For example attaching stepper motors or gearboxes. Those parts already have threaded holes. Attaching shaft couplers to motor shafts demands blue threadlocker. This will be discussed more later in assembly manual.



## Assembly manual - Needed tools

Tools you will need to assemble this robot:

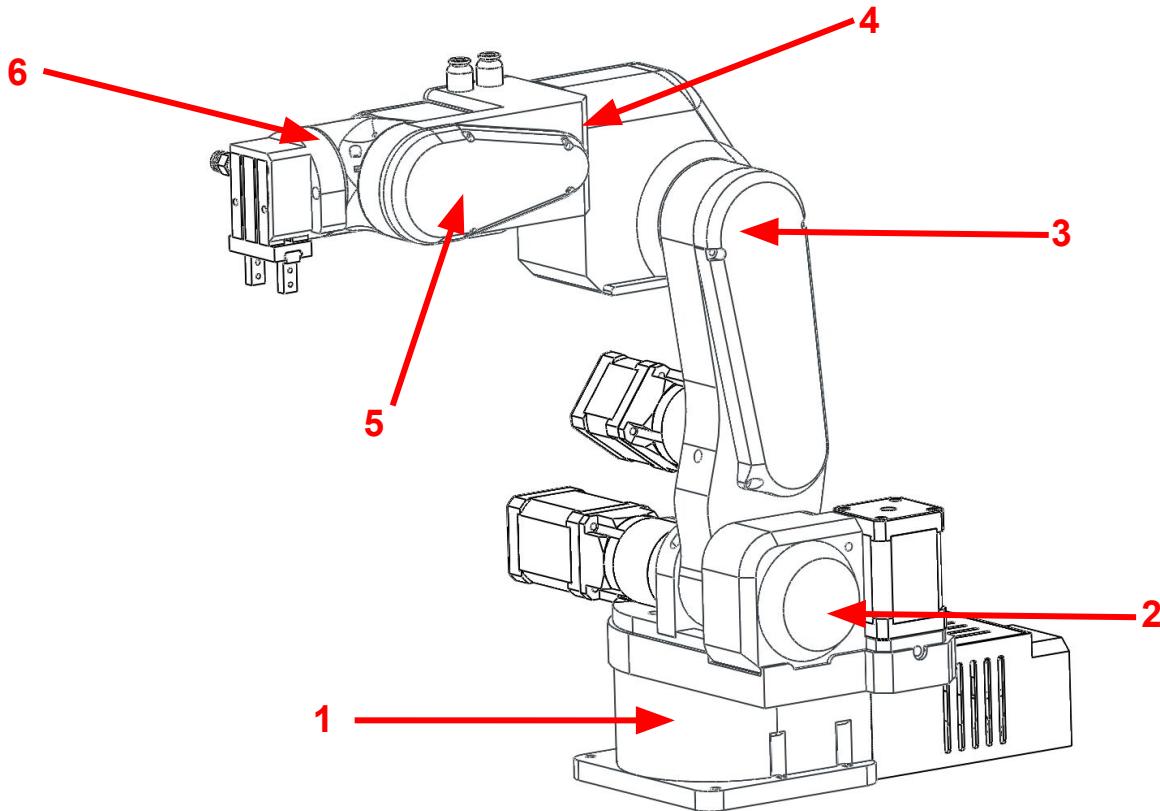
- Screwdriver set
- Drill
- Soldering iron
- Imbus wrench set
- Torque screwdriver
- Rubber hammer
- Hammer
- Pliers

For screwing we recommend using an electric screwdriver and then precision torque screwdriver. Recommended torque we keep our screws at is xxx. Use the electric screwdriver first and then tighten up with precision torque screwdriver.

## Assembly manual - Needed consumable items

- Blue threadlocker
- Lithium grease
- Insulation tape
- Solder
- Heat shrink tube
- Wire harness
- Cloth Fabric Tape

## Assembly manual - Joint numbering and names

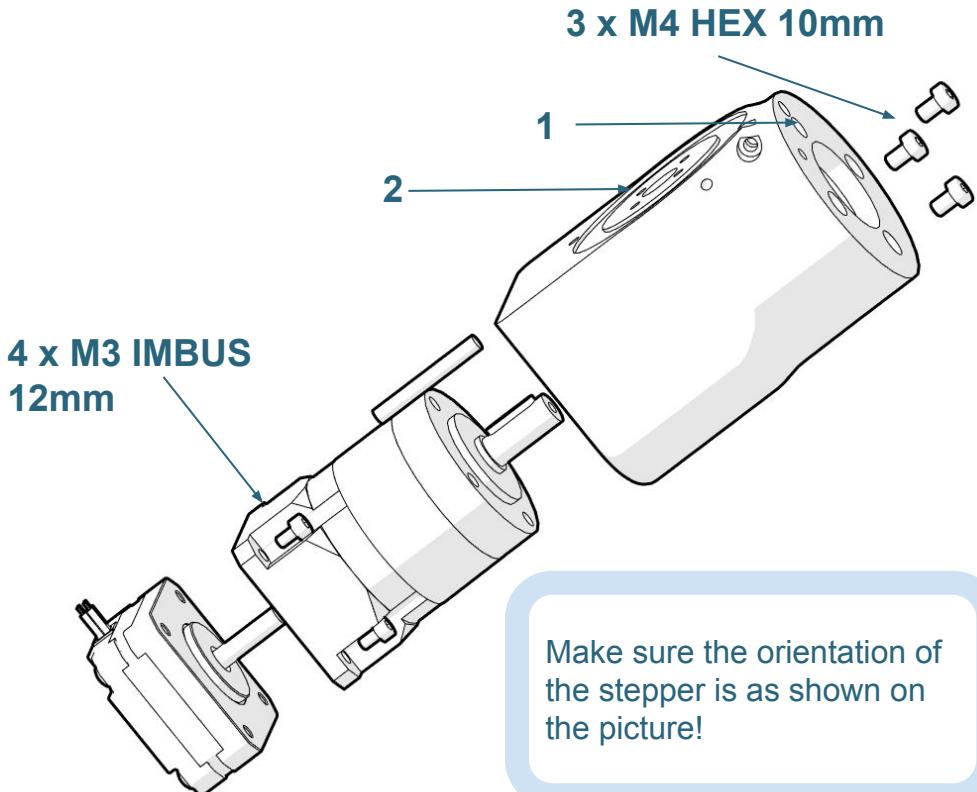


- 1 - Base
- 2 - Shoulder
- 3 - Upper arm
- 4 - Elbow
- 5 - Forearm
- 6 - Wrist

# Let's get started!!

# **Wrist assembly**

## Wrist assembly



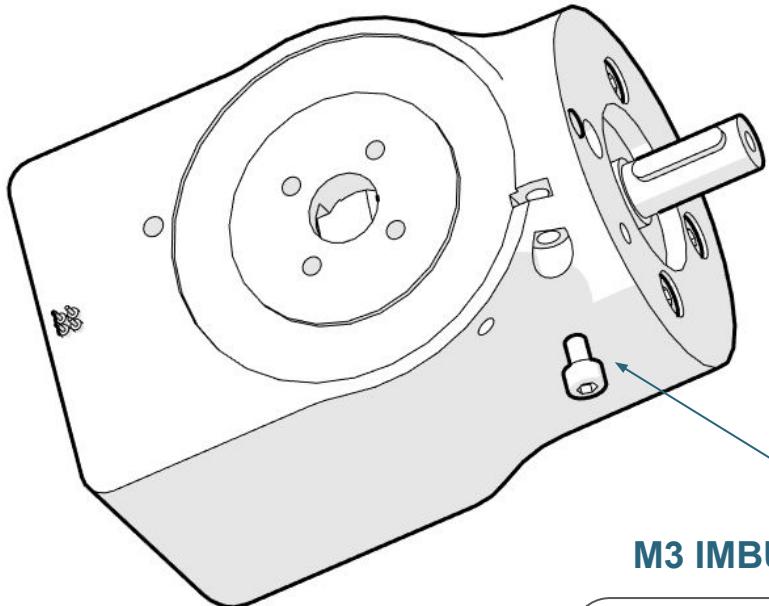
Wrist  
Gearbox 10:1  
Stepper1  
Sensor1  
3 x M4 HEX 10mm  
4 x M3 IMBUS 12mm

First attach stepper 1 to the gearbox. The gearbox comes with its own coupler that need to be tightened with 2 set screw. Holes to tighten those screws are on the side of the gearbox.

Now press fit sensor 1 in wrist part. It needs to lay flat on top part of the wrist as indicated by arrow 1.

Wires for the motor and sensor need to exit from the hole marked with arrow 2.

## Wrist assembly



M3 IMBUS 14mm

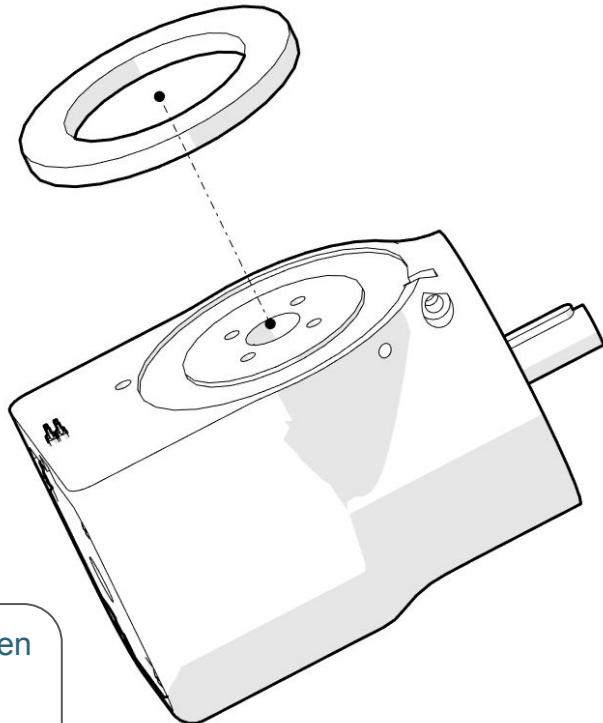
Bearing 1

\*M3 IMBUS 14mm

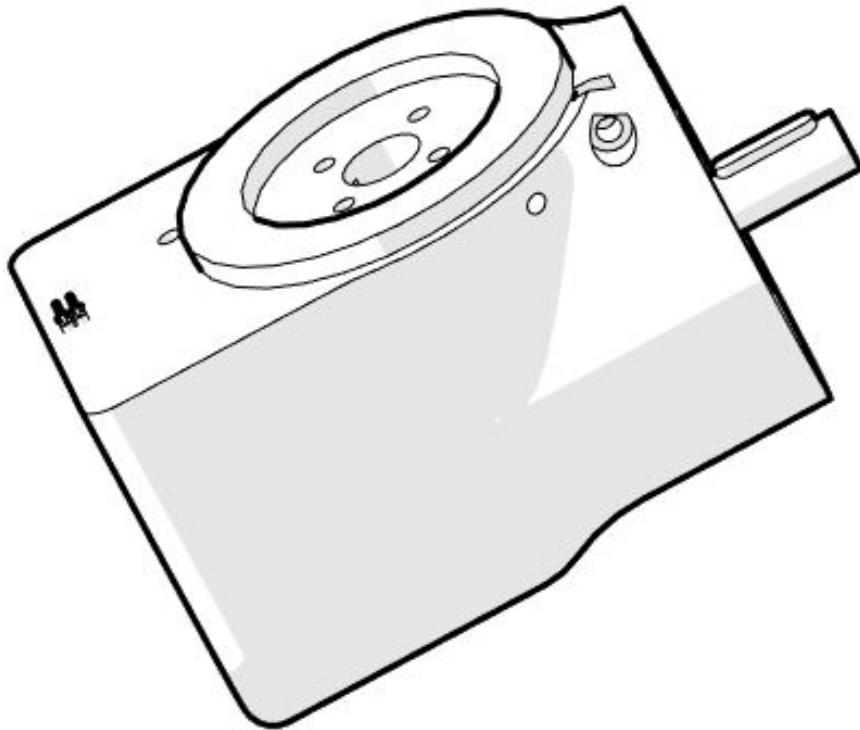
\*M3 nut

If the sensor is loose you can tighten it with M3 nut and a screw.

Attach bearing 1 to wrist part.  
Assembled part is on the next page.

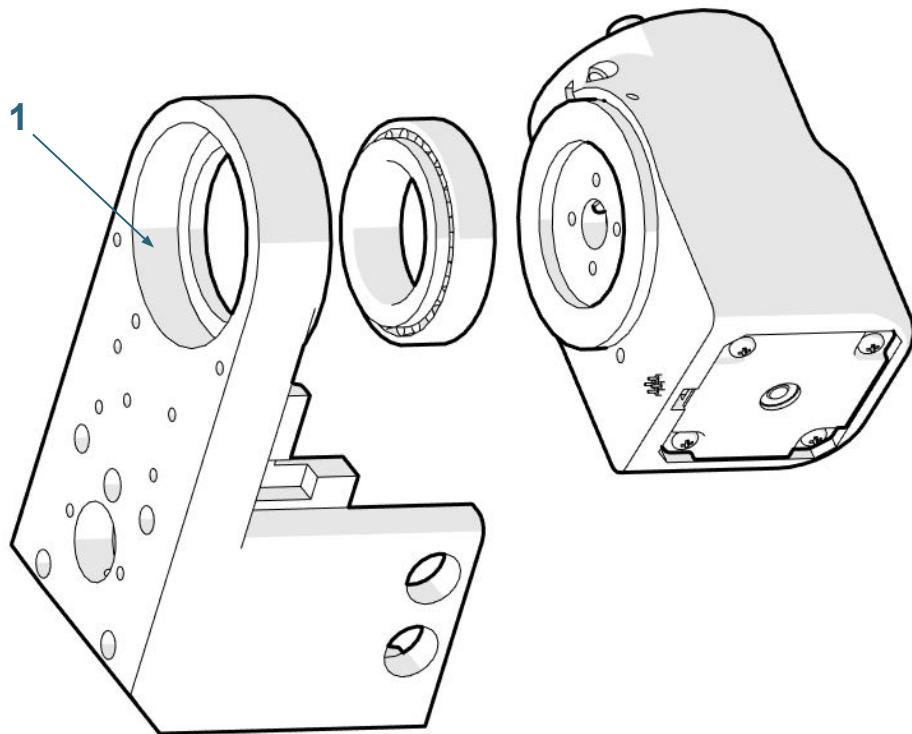


## Wrist assembly



# Forearm assembly

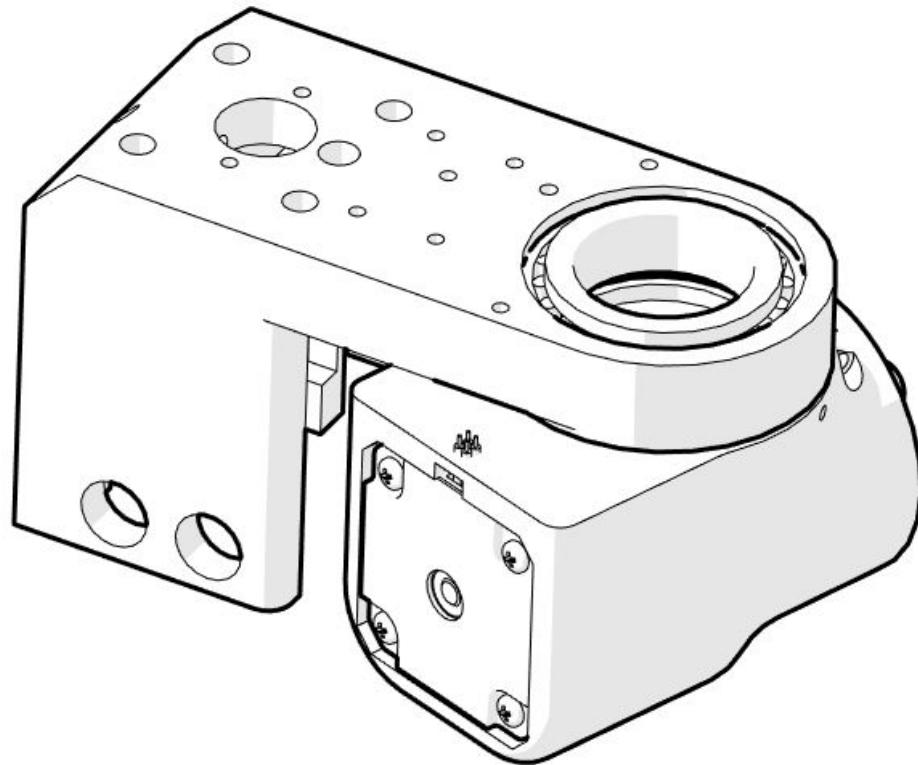
## Forearm assembly



Bearing 2  
J5\_part

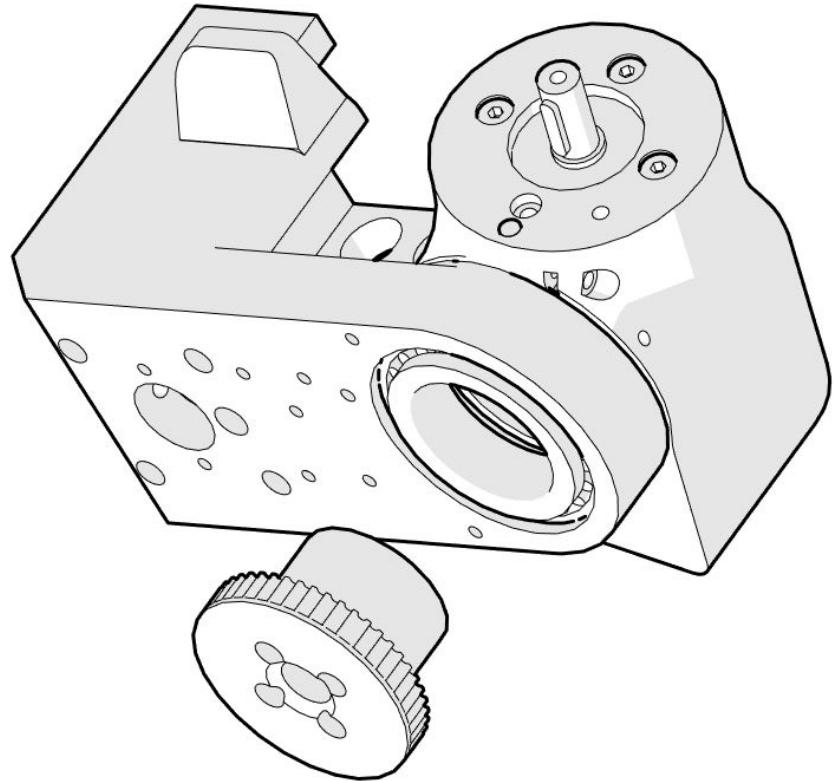
Bearing 2 need to go in the  
groove marked with arrow 1.

## Forearm assemb



Hammer in the bearing with rubber hammer. Another option is to use screwdriver and gently tap with a hammer on the whole circumference of the bearing.

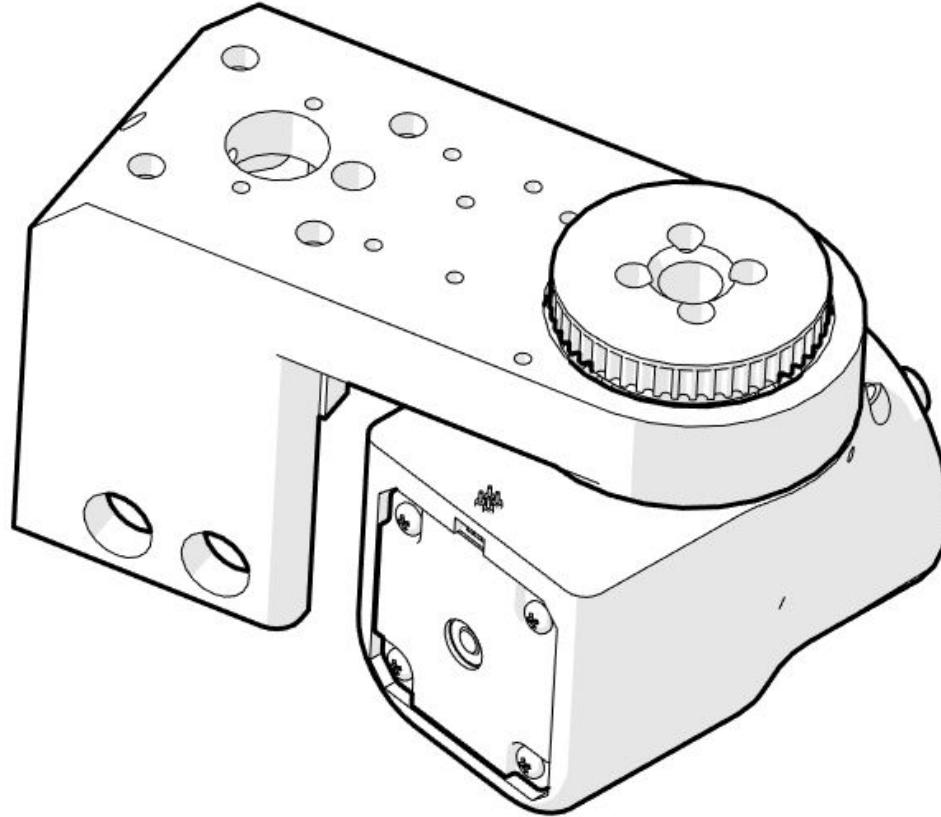
## Forearm assembly



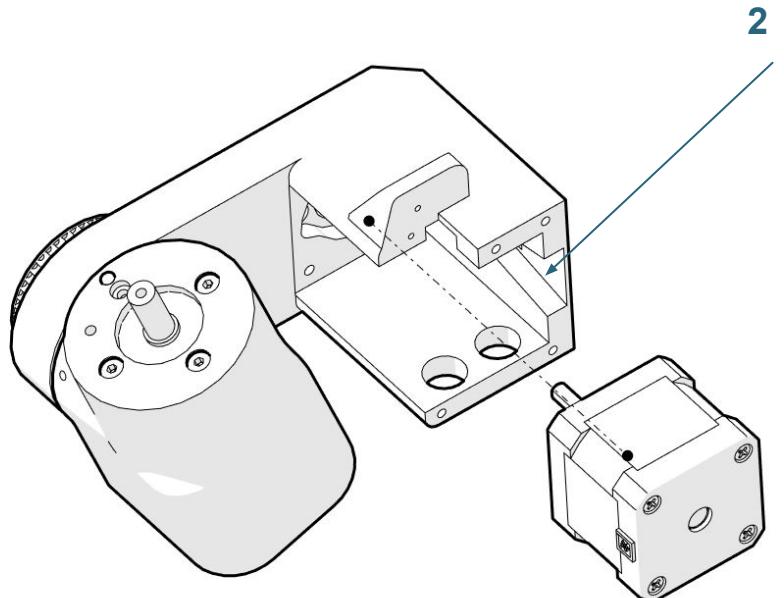
HTD3\_48\_J5\_pulley

Assembled part is on the  
next page.

## Forearm assembly



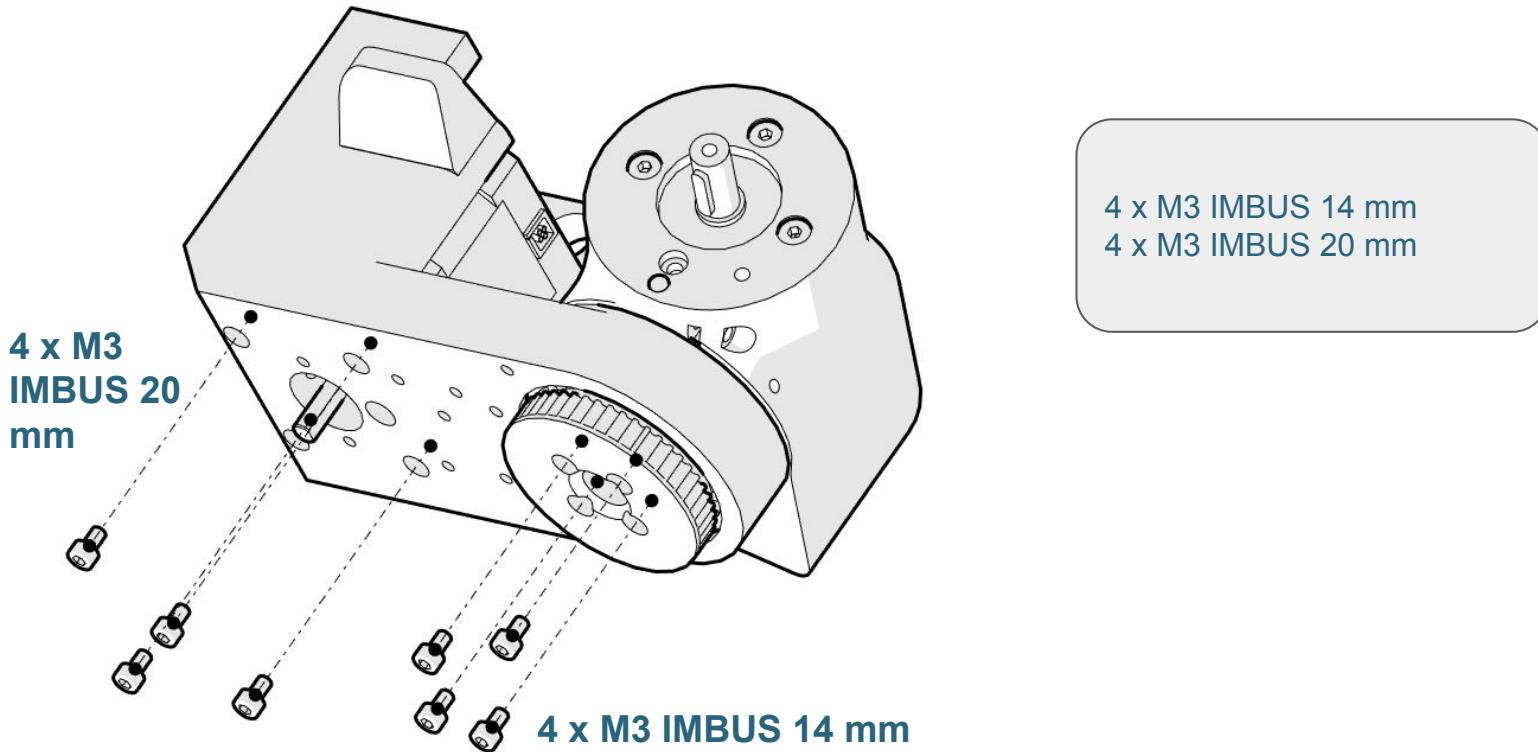
## Forearm assembly



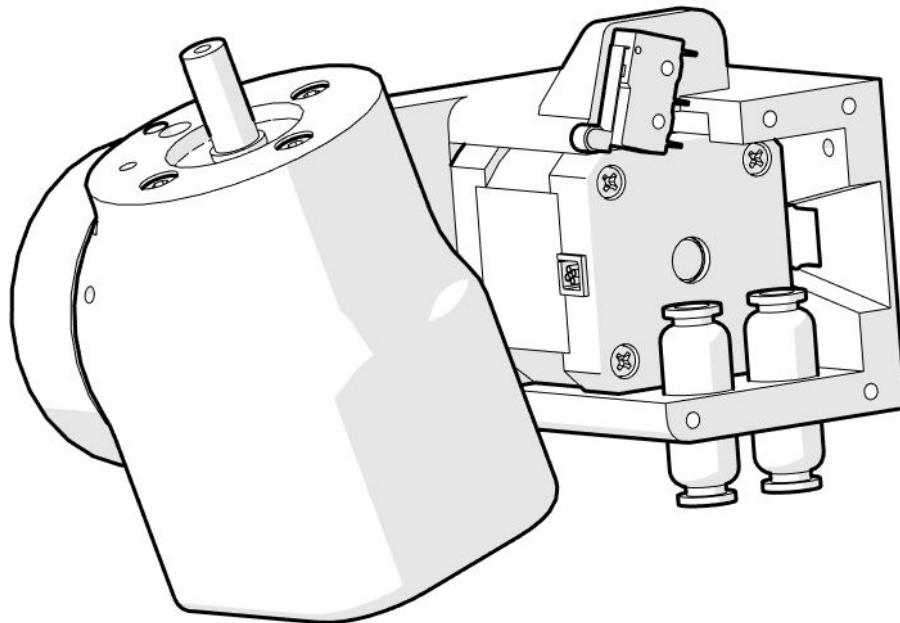
Stepper 2

Stepper wire, all other wires and pipes need to go thru the wires guide marked with arrow 1 and then thru a hole on J5 part

## Forearm assembly



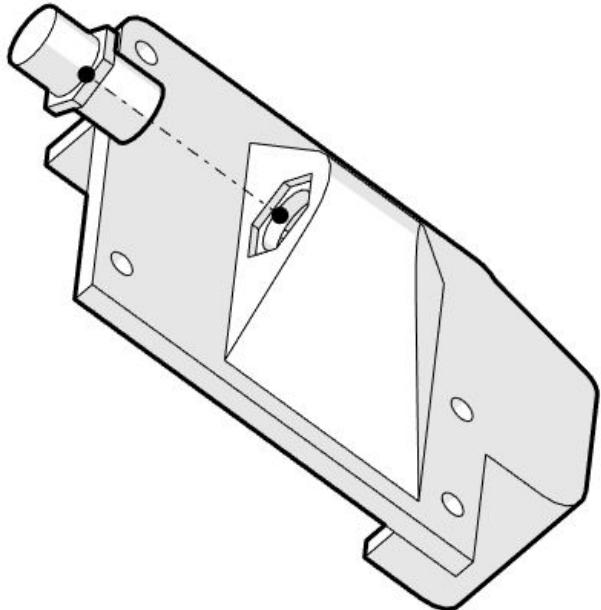
## Forearm assembly



2 x Pneumatic connector 1  
Limit switch  
2 X M2 8mm

Limit switch needs to be secured with M2 screws. Wires need to go thru a hole in J5 part. Pneumatic connectors need to be secured with provided nuts. Pneumatic tubes go thru a hole on J5 part.

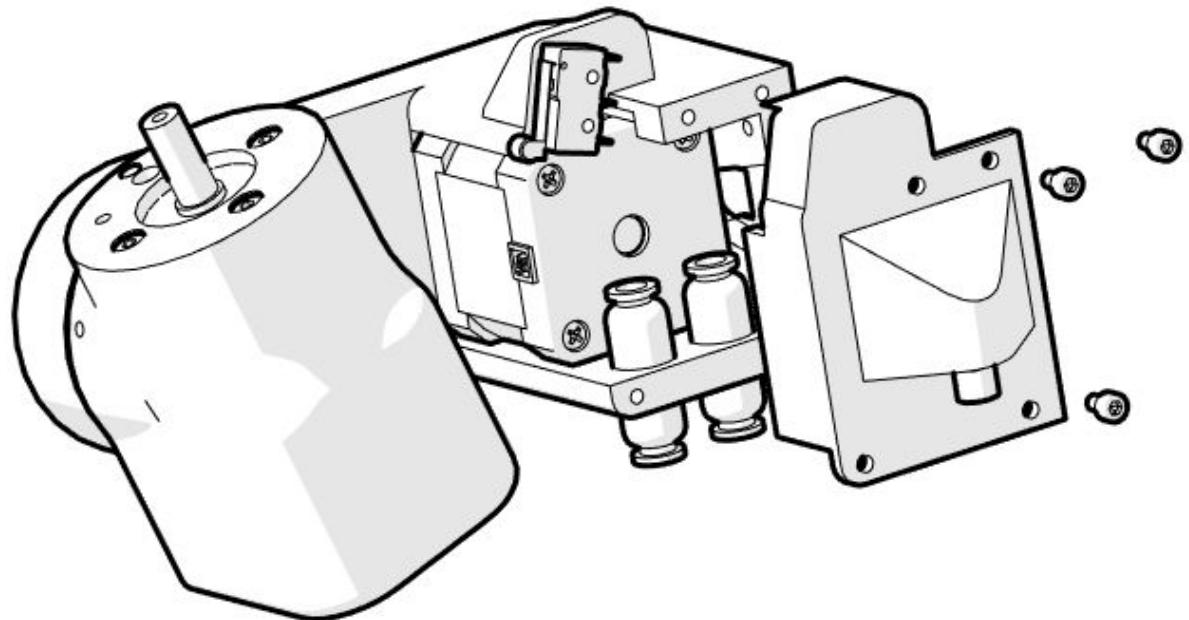
## Forearm assembly



J5\_electronics\_lid  
Gripper connector

On the gripper connector solder 4 wires of length xx. They need to be AWGxx and 2 pairs of twisted pair wire. Use heat shrink on solder joints. After placing gripper connector in lid use provided nut to tighten connector to the lid.

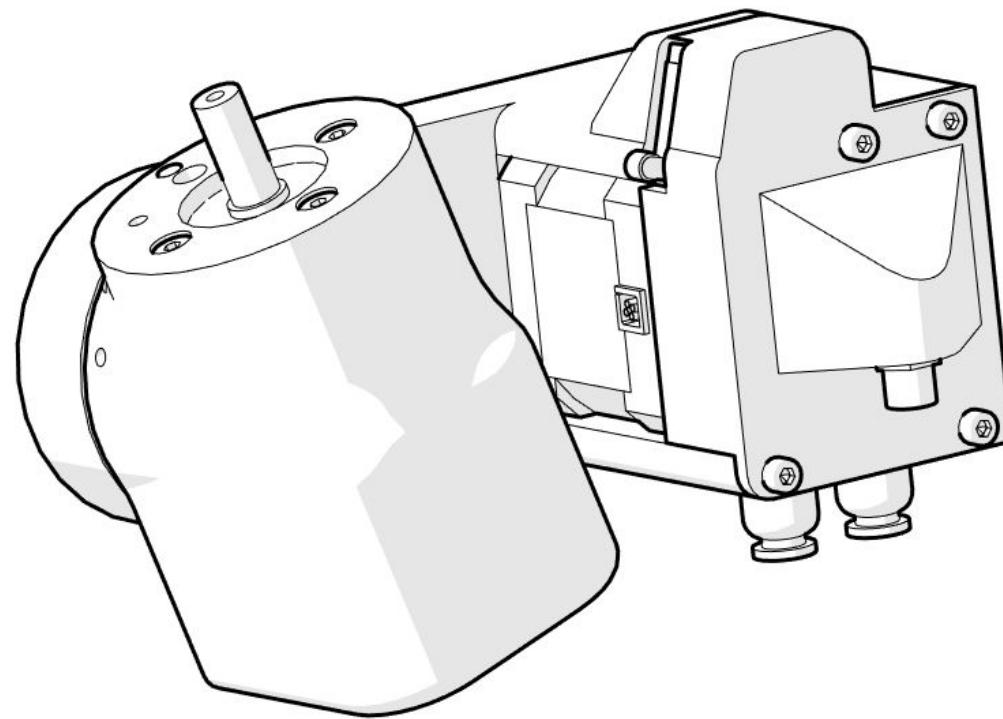
## Forearm assembly



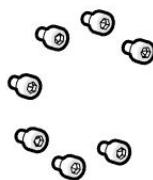
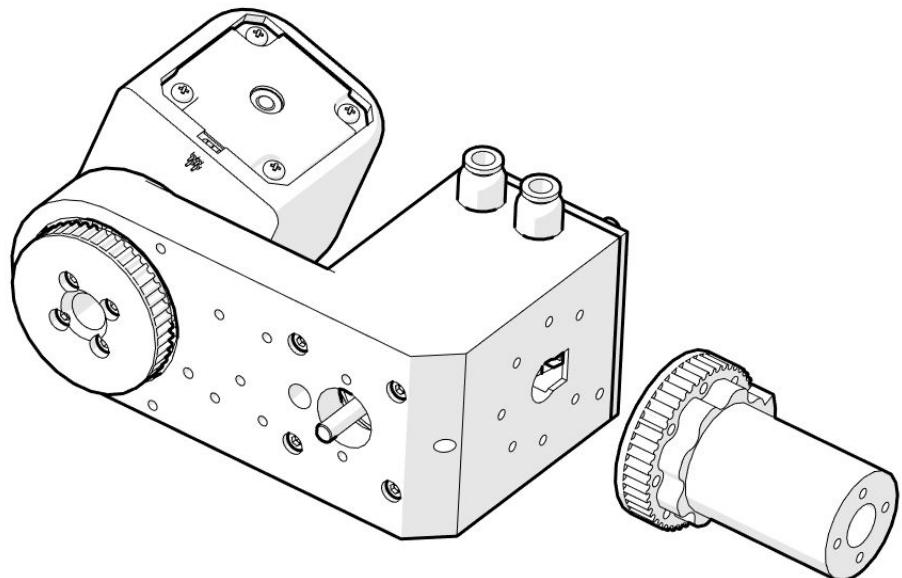
4x M3 IMBUS 8 mm



## Forearm assembly



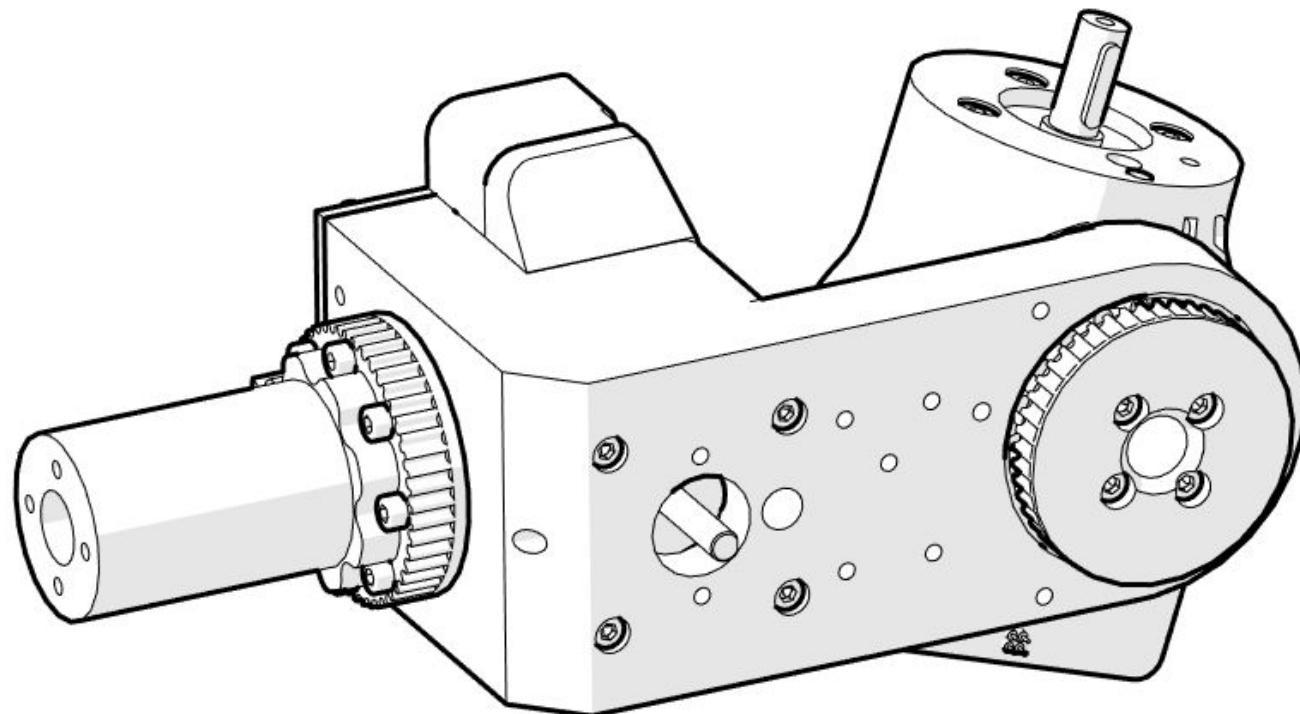
## Forearm assembly



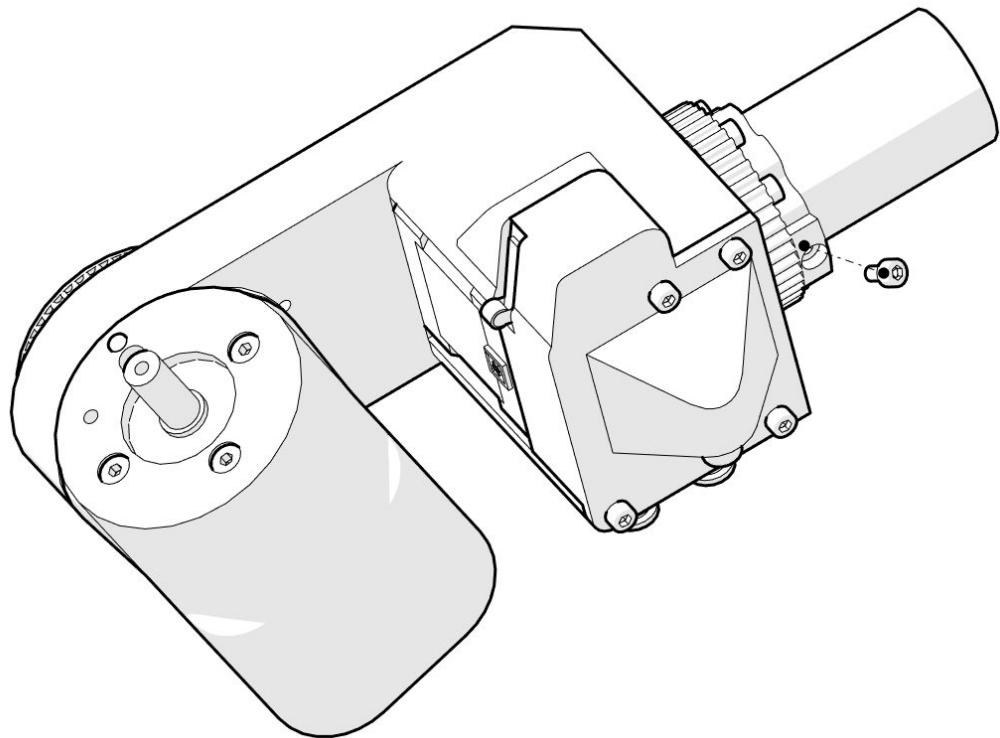
J4\_output\_pulley  
7 x M3 IMBUS 20 mm

All wires and tubes need to  
go thru J4 output pulley.  
Make note of location of  
sensor trigger screw notch.

## Forearm assembly



## Forearm assembly

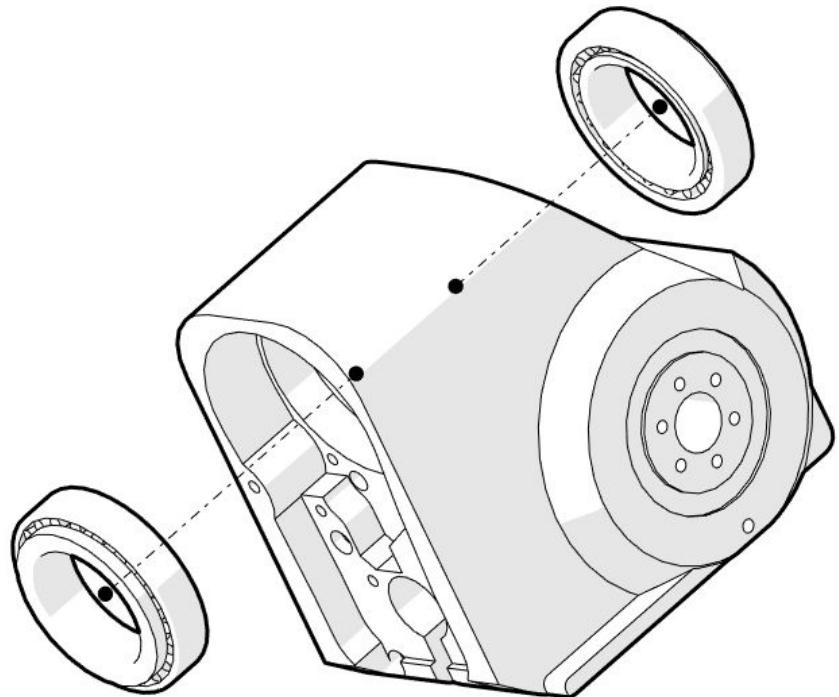


1 x M3 IMBUS 5 mm

This screw is used to trigger J4 sensor. Please use provided screw. If different screw is used sensor will trigger at wrong position and mess with robot kinematics.

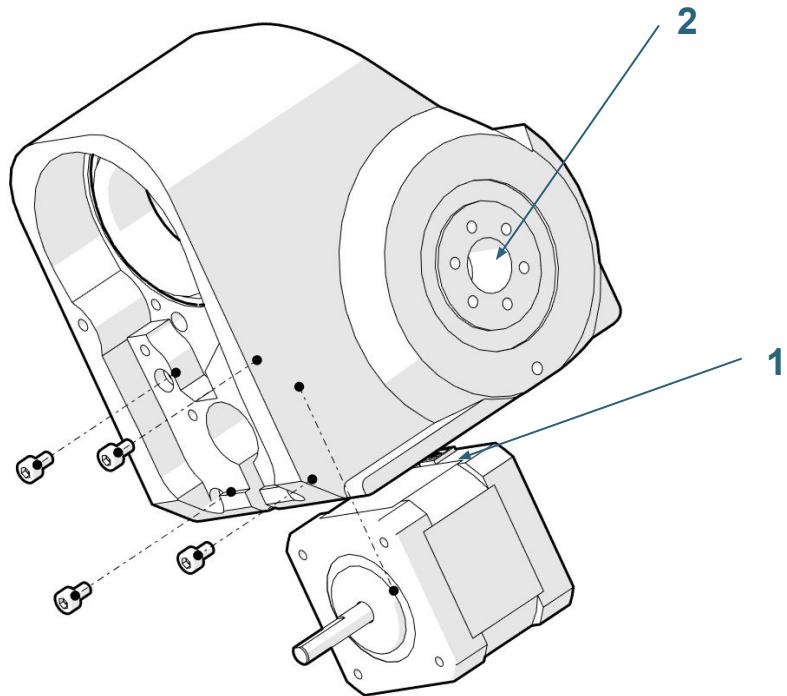
# **Elbow assembly**

## Elbow assembly



Elbow\_part  
2 x Bearing 2

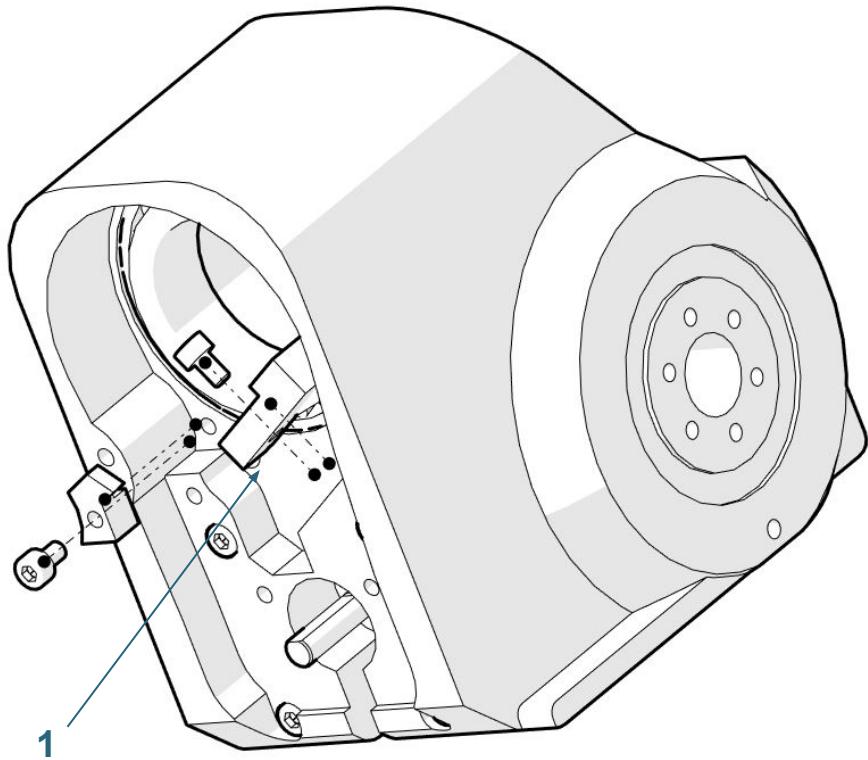
## Elbow assembly



Stepper 2  
4 x M3 IMBUS 10 mm

Secure the stepper with 4 screws. Note the position of stepper wires with arrow 1. All wires from previous steps and from subsequent steps need to go thru hole 2.

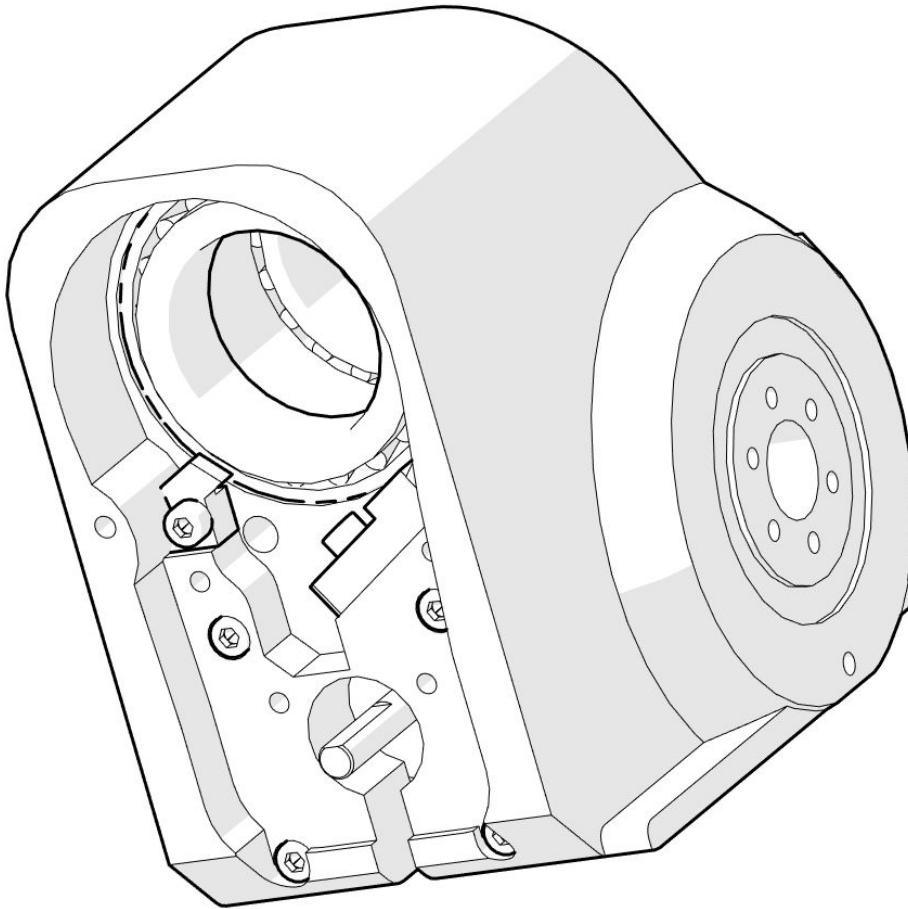
## Elbow assembly



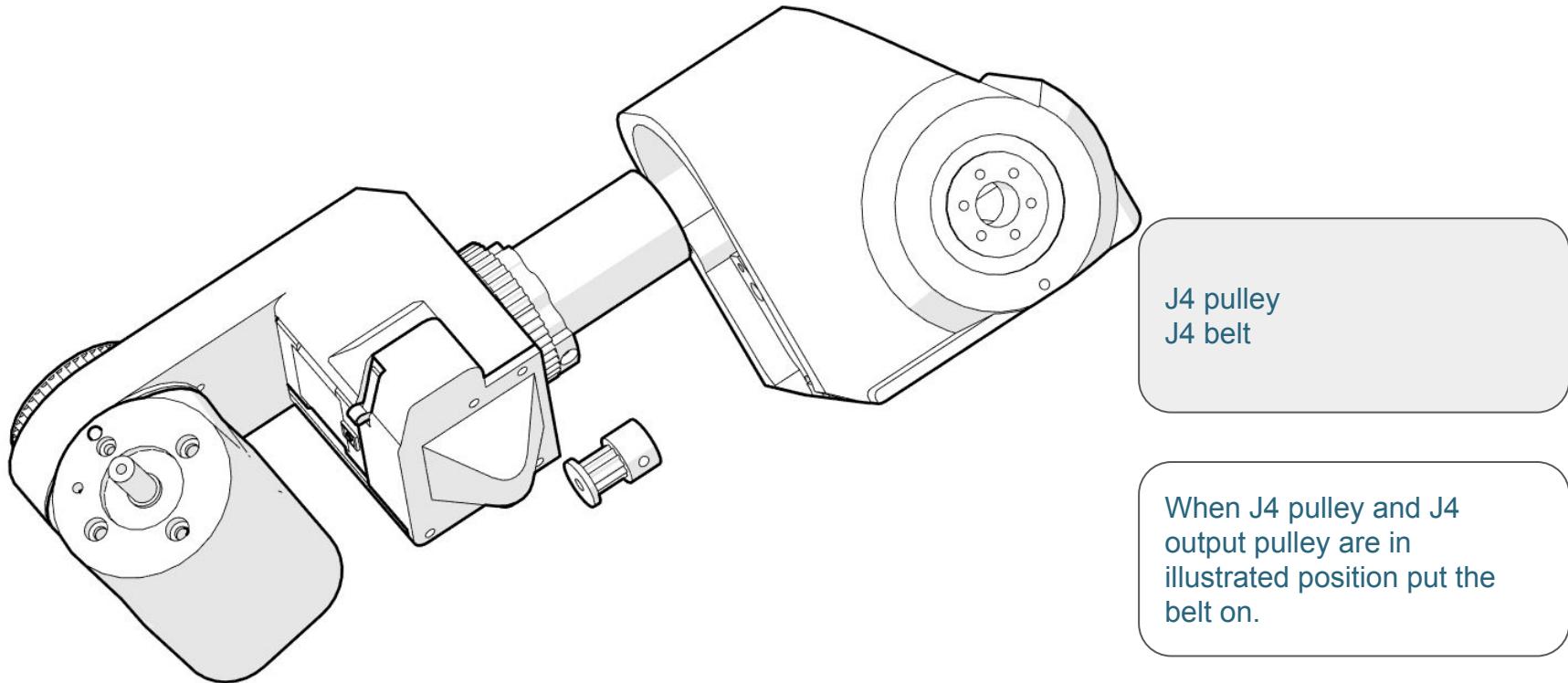
J4\_limiter  
Sensor 2  
2 x M3 IMBUS 10 mm

Wires of the sensor 2 need  
to go thru a hole marked with  
arrow 1. Assembled part is  
on the next page.

## Elbow assembly



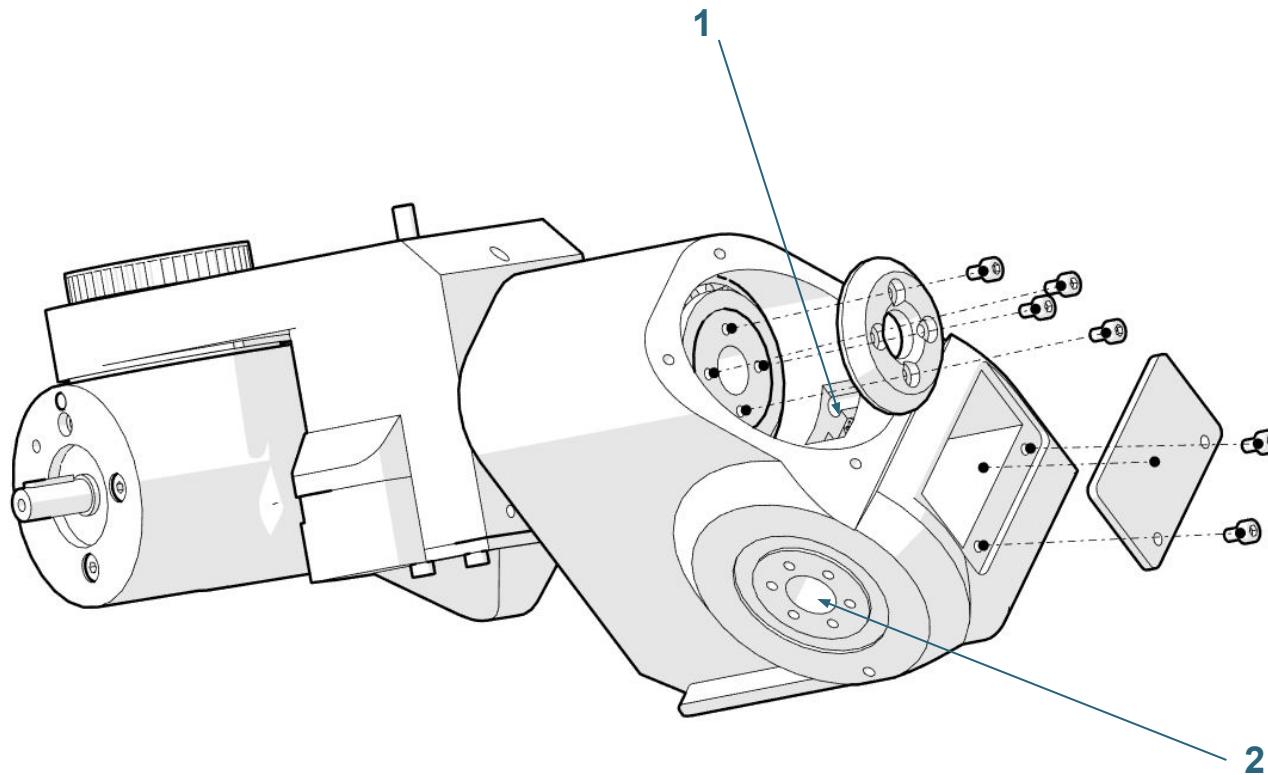
## Elbow assembly



J4 pulley  
J4 belt

When J4 pulley and J4 output pulley are in illustrated position put the belt on.

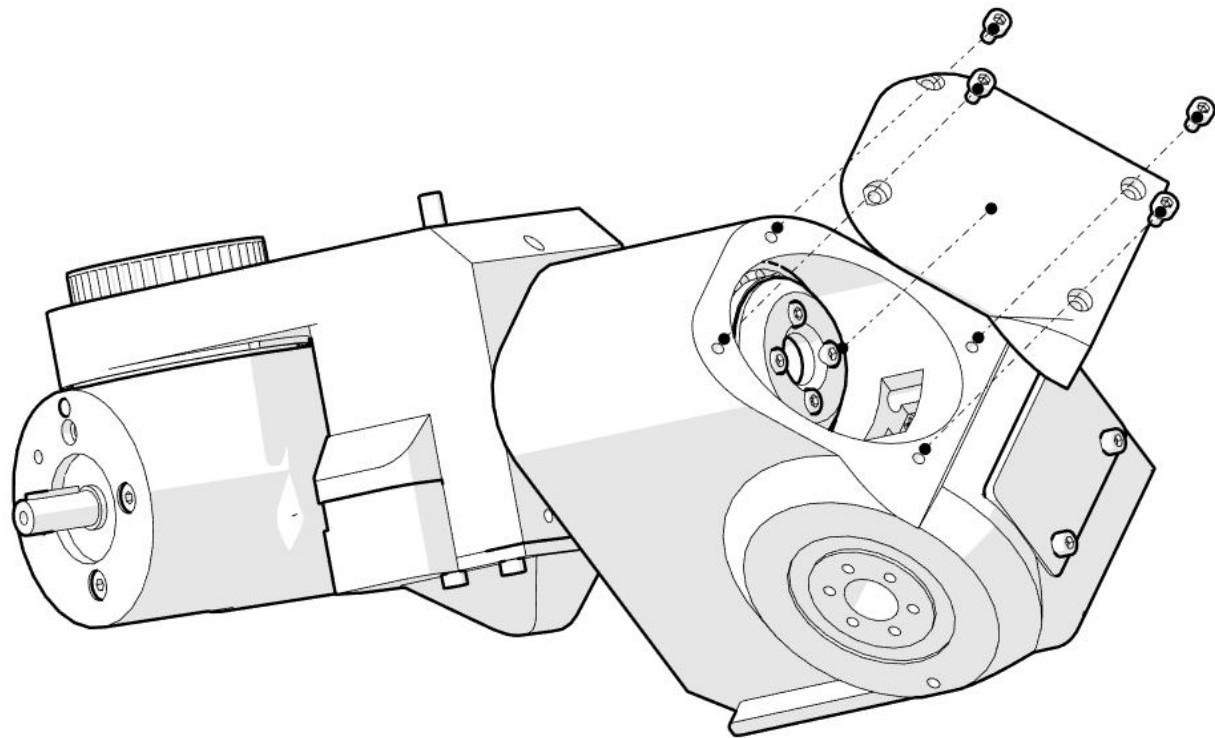
## Elbow assembly



Elbow\_lid\_2  
J4\_bearing\_backplate  
2 x M3 IMBUS 8 mm  
4 X M3 IMBUS 10 mm

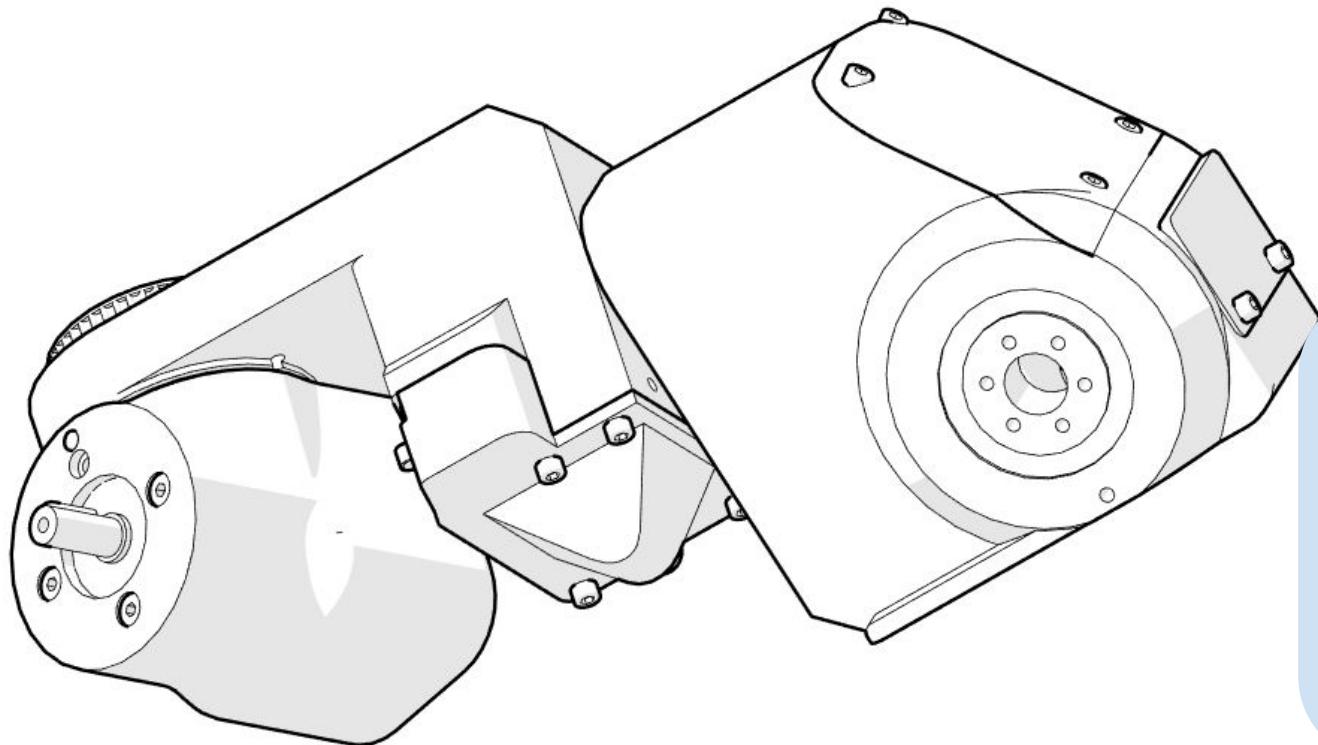
All wires and tubes need to go where arrow 1 is pointing and exit where arrow 2 is pointing.

## Elbow assembly



Elbow\_lid\_1  
4 x M3 IMBUS 8 mm

## Elbow assembly

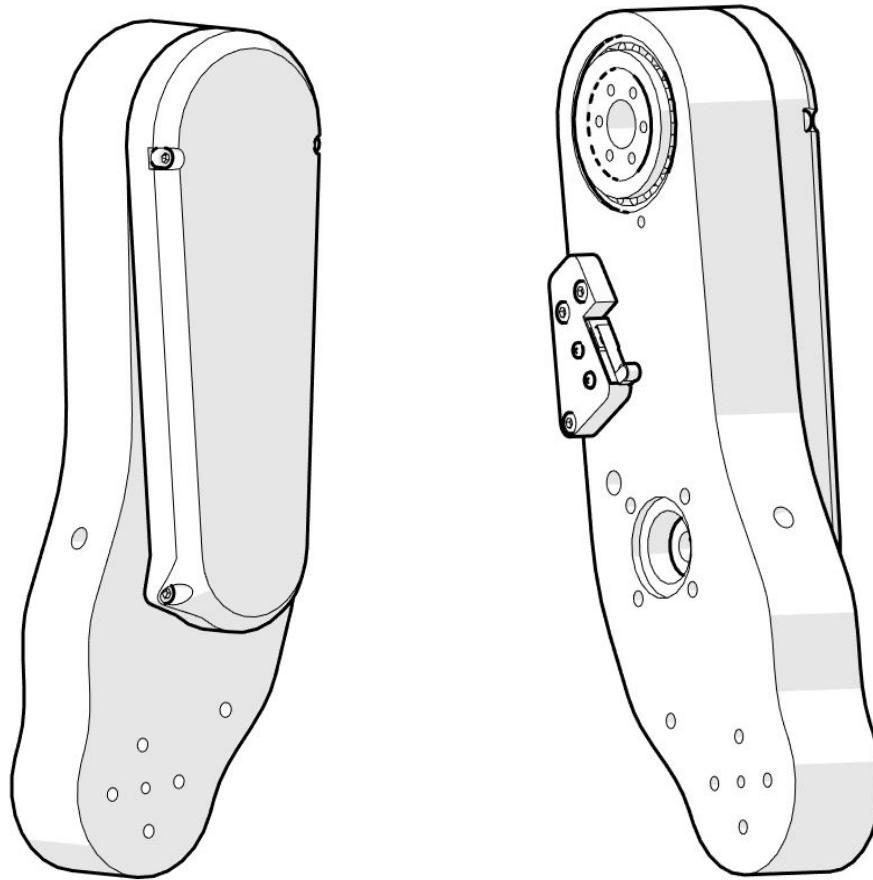


Make sure that all joints can move and that there is not much friction on specific spots. If there is you have:

1. Misaligned bearings
2. Used too much torque on bearing retainer screws.
3. Tangled wires.

# Upper arm assembly

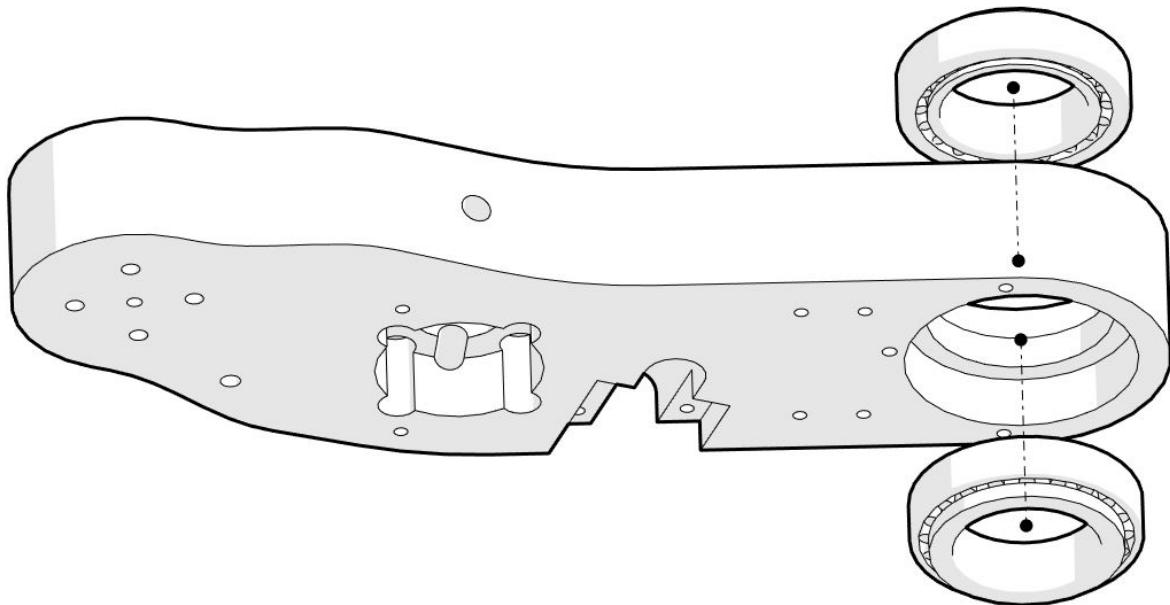
## Upper arm assembly



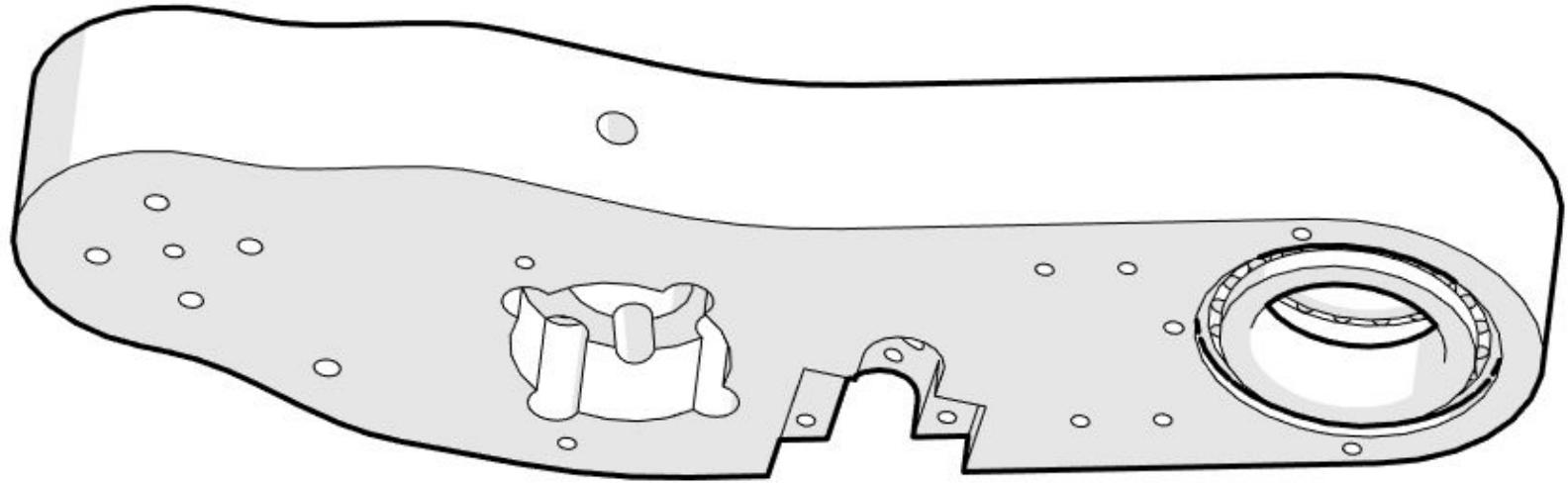
## Upper arm assembly

Bearing 2  
Upper arm

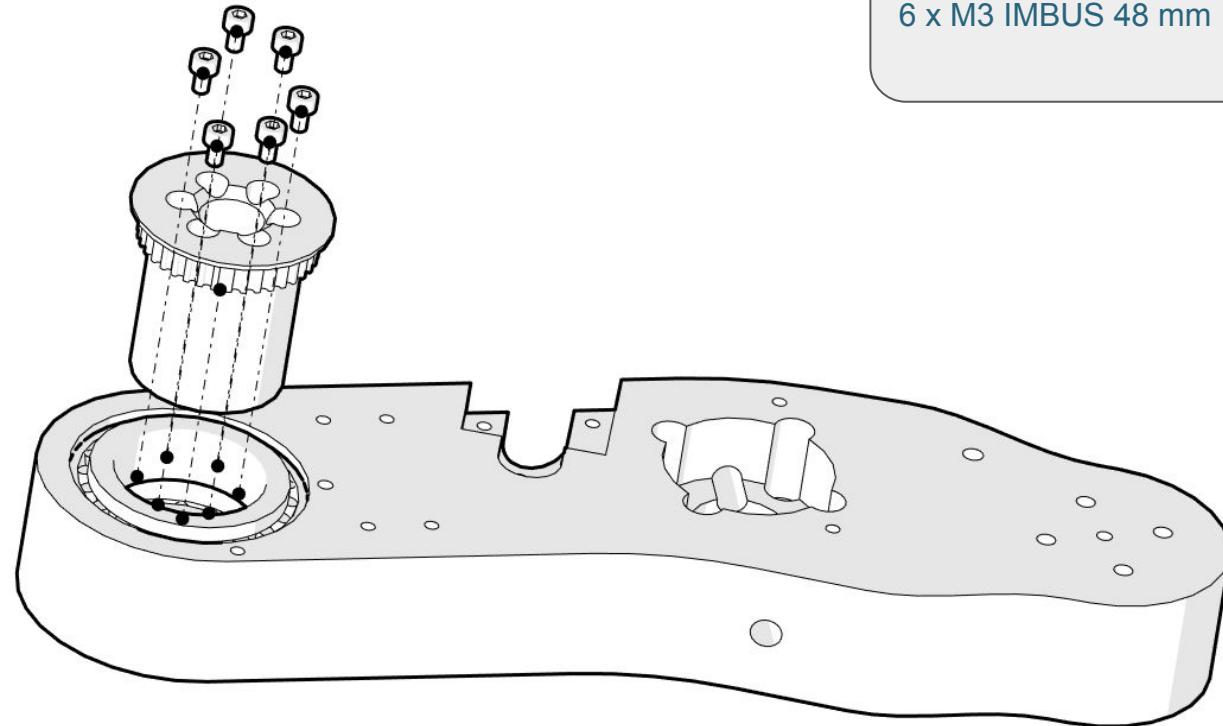
Assembled part in the next  
page.



## Upper arm assembly

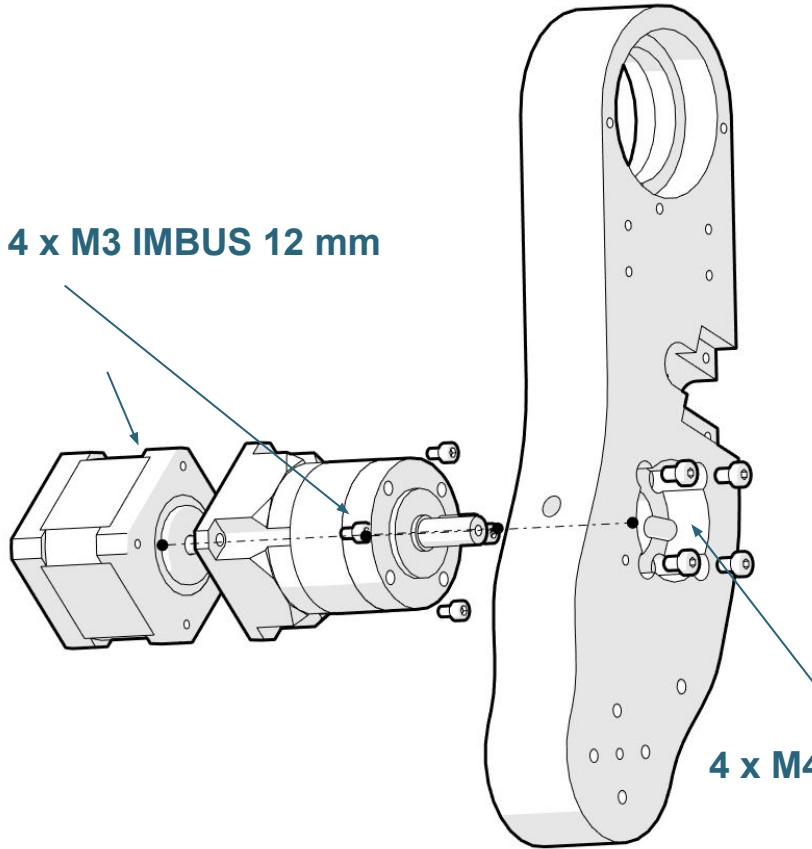


## Upper arm assembly



38\_pulley\_J3  
6 x M3 IMBUS 48 mm

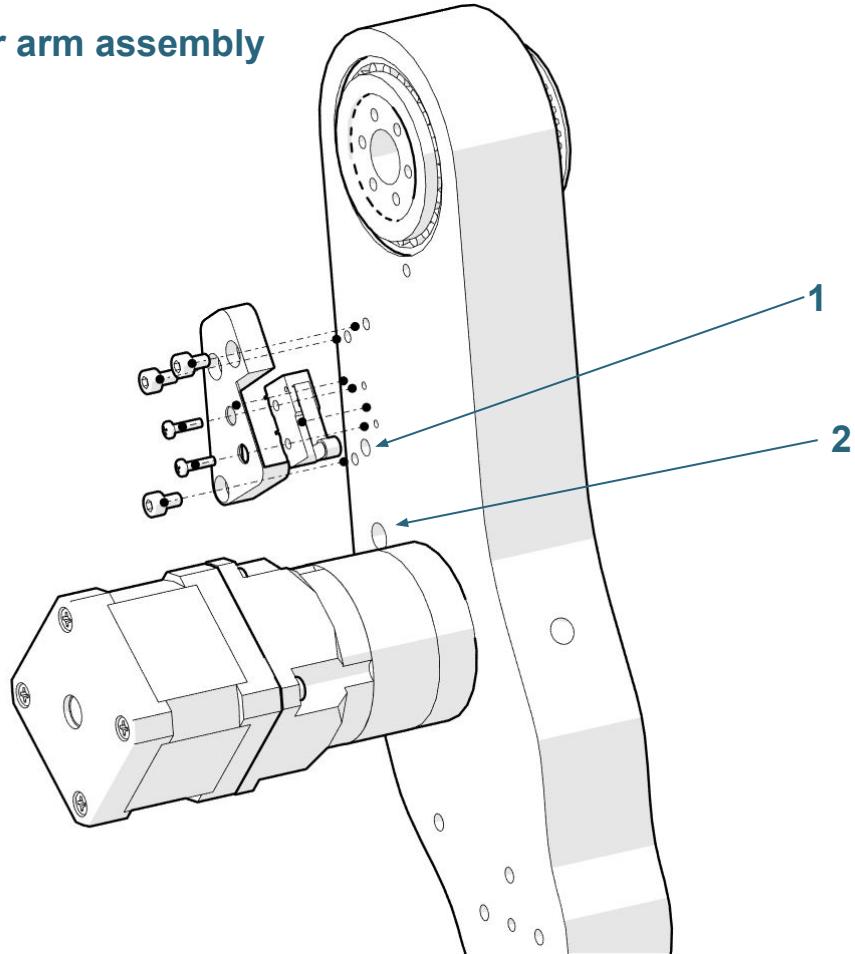
## Upper arm assembly



Stepper 2  
Gearbox 10:1  
4 x M3 IMBUSH 12 mm  
4 x M4 HEX 10mm

Make sure that that location  
of the stepper side with wires  
is as pointed by the arrow!

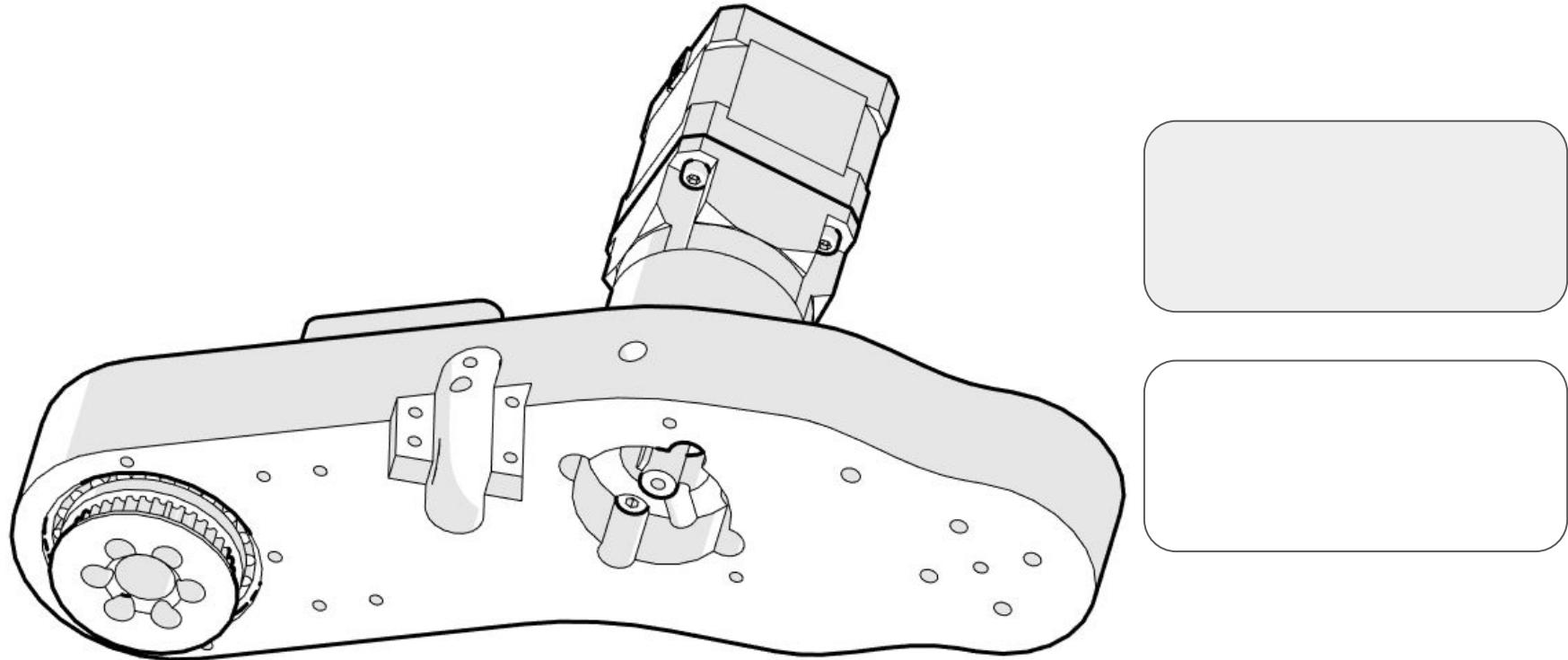
## Upper arm assembly



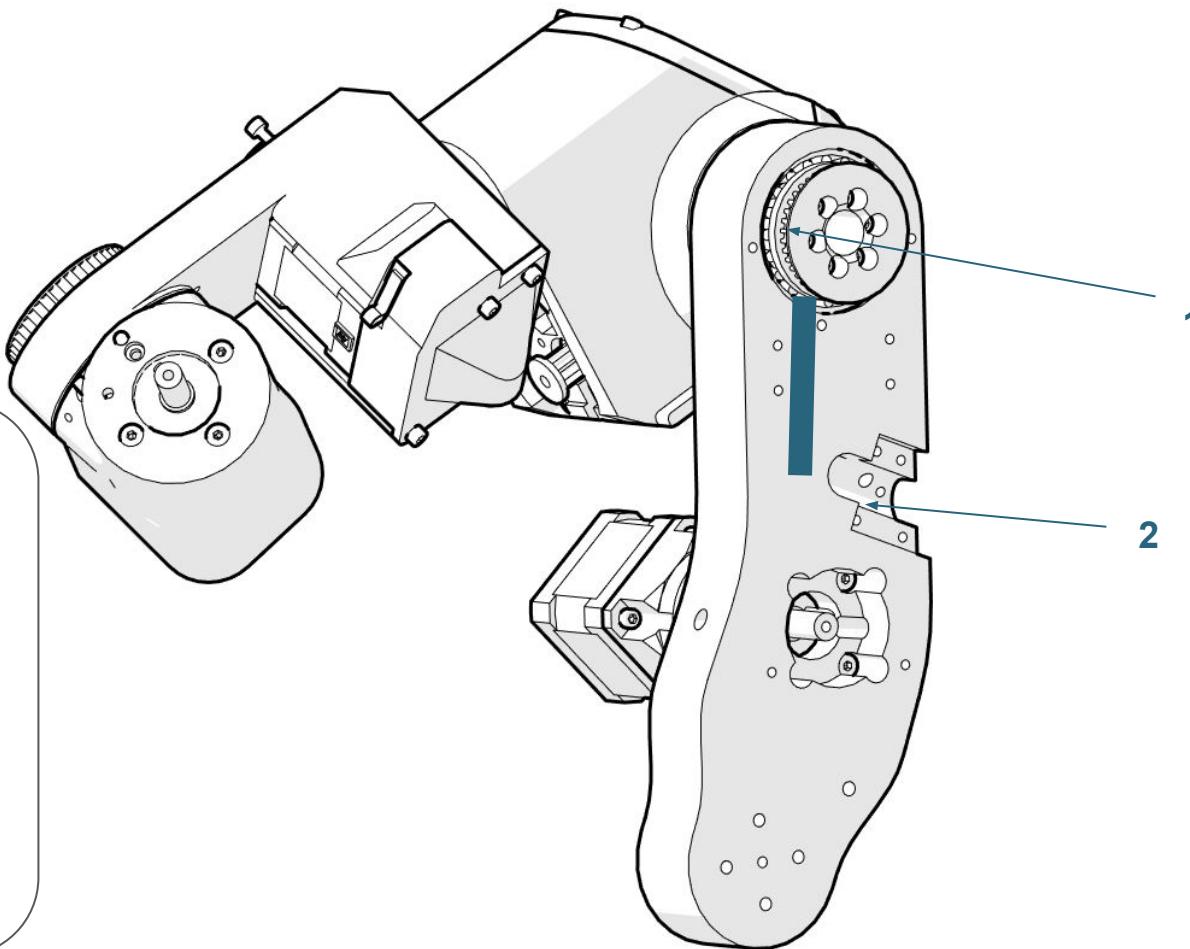
J3\_limit\_switch\_cover  
Limit switch  
3x M3 IMBUS 8 mm  
2 x M2 8 mm

Limit switch wires go thru  
hole market with arrow 1.  
Stepper wires go thru a hole  
marked with 2. Finished part  
on next page.

## Upper arm assembly



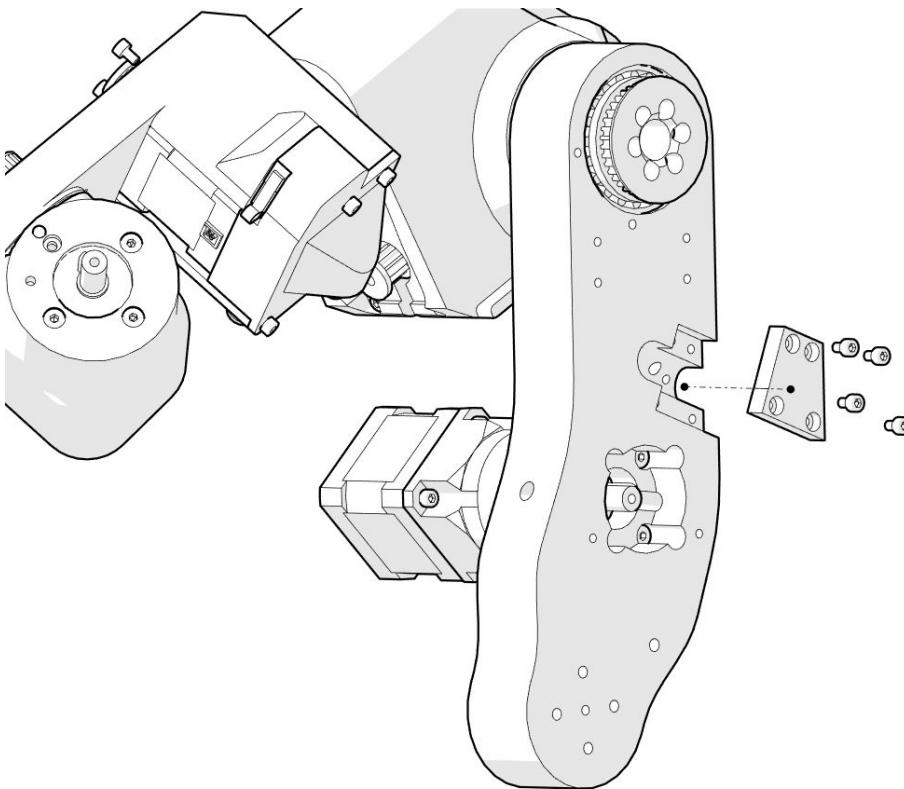
## Upper arm assembly



Attach Upper arm assembly to the Forearm assembly. Wrap the wires with cloth fabric. Wires need to go thru the hole pointed by arrow 1 to the slot pointed by arrow 2. Wires need to follow the blue line.

\*Note that you need to pull wires from J3 limit switch and J3 stepper thru the same slot!

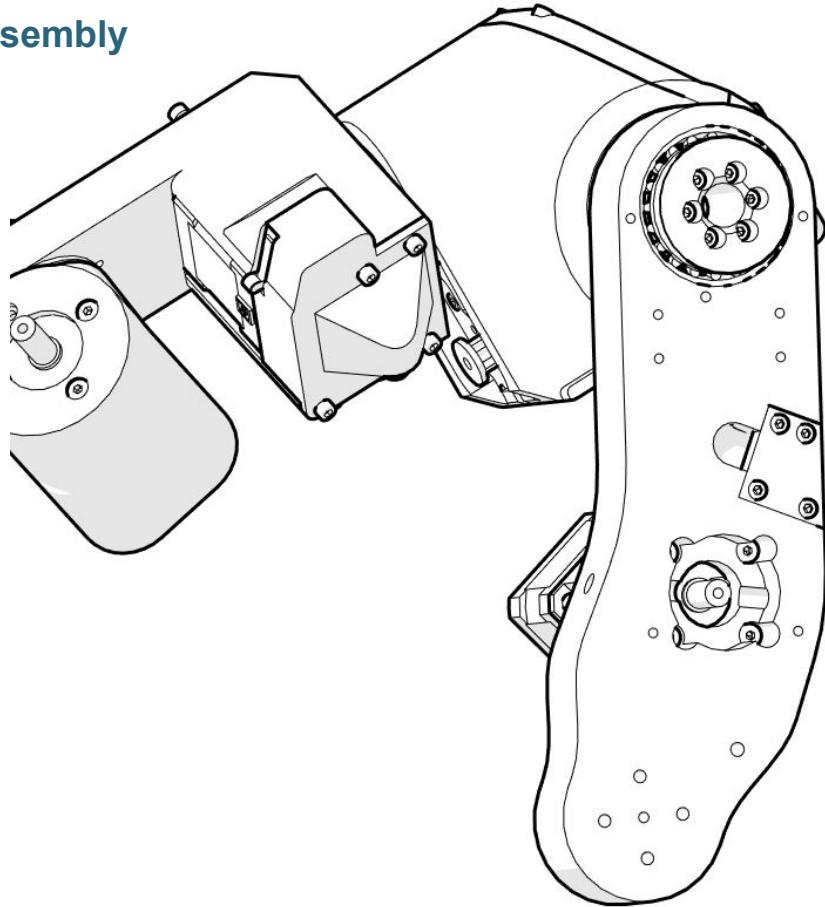
## Upper arm assembly



Upper\_arm\_wires\_cover  
4 x M3 IMBUS 8 mm

Enclose the wires by upper arm wires cover. Make sure the wires are tight.  
Assembled part on next page

## Upper arm assembly



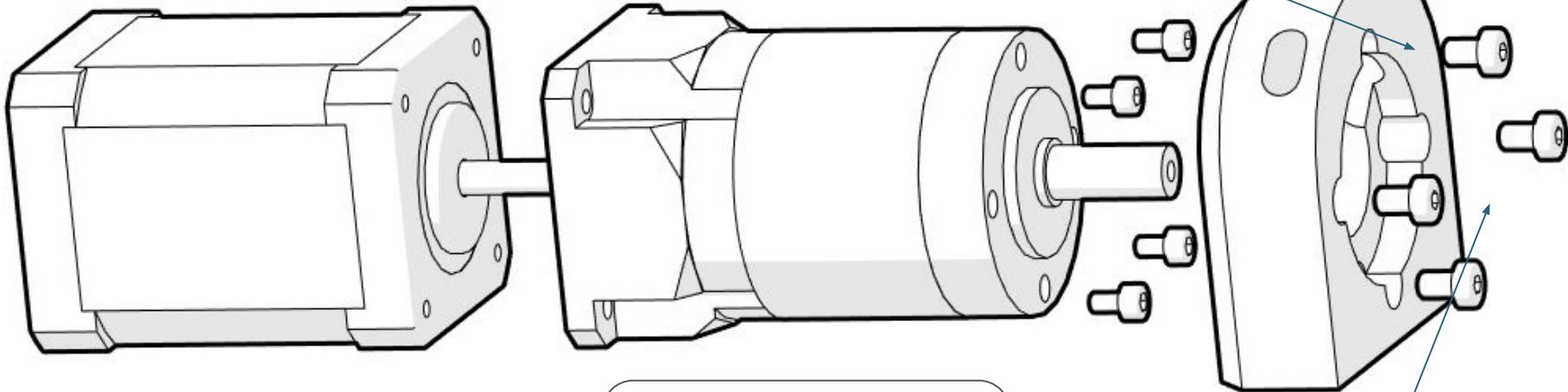
Once the wires are enclosed  
try to move joint 3.

# **Shoulder assembly**

## Shoulder assembly

J1\_turret\_motor\_holder  
Stepper 3  
Gearbox 20:1  
4 x M3 IMBUS 12 mm  
4 x M4 HEX 10 mm

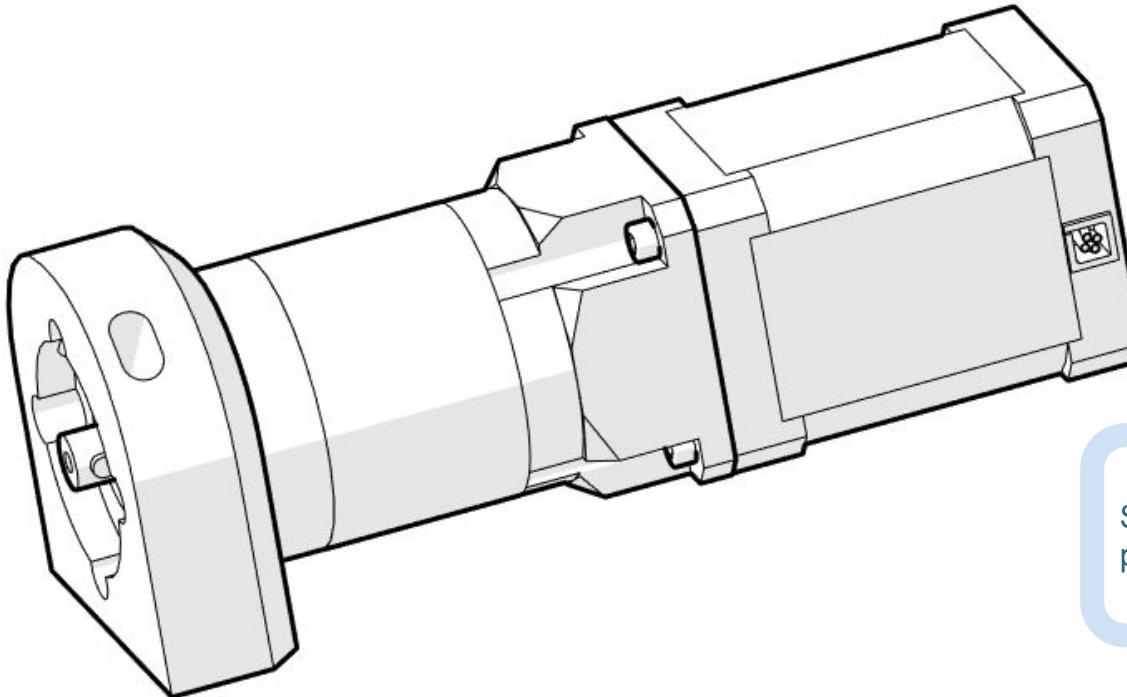
**4 x M4 HEX 10 mm**



First attach the stepper to the gearbox. After that attach turret holder to the gearbox. Assembled part is on the next page.

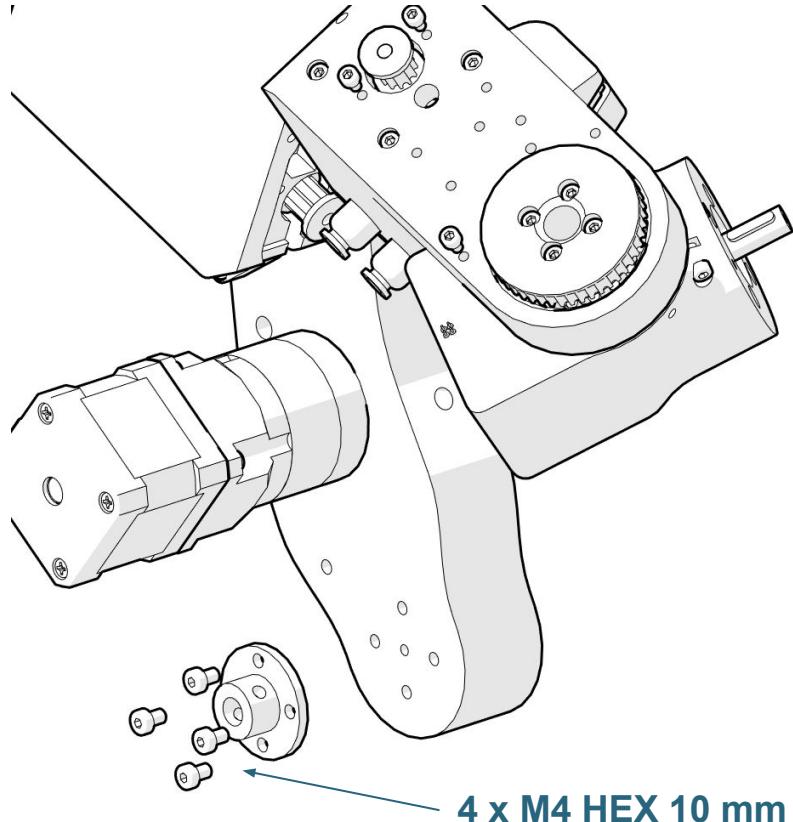
**4 x M3 IMBUS 12 mm**

## Shoulder assembly



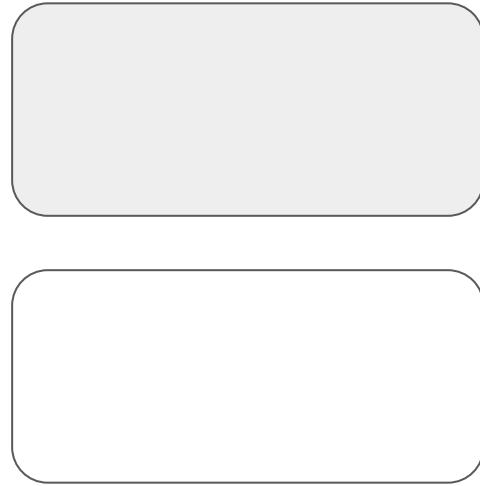
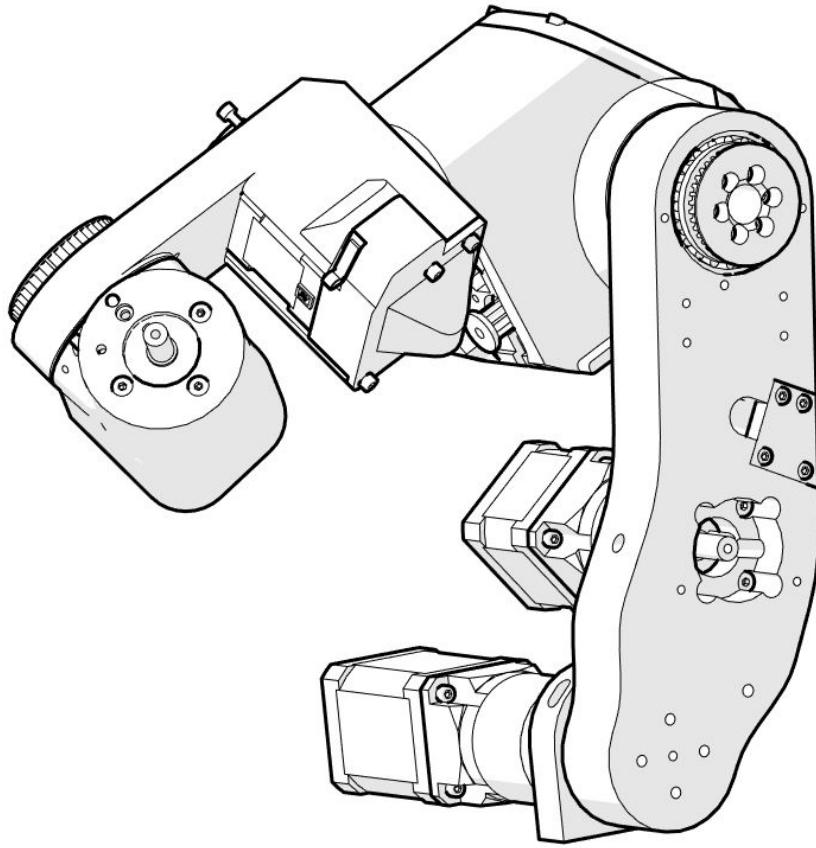
Stepper wires need to be positioned like this

## Shoulder assembly

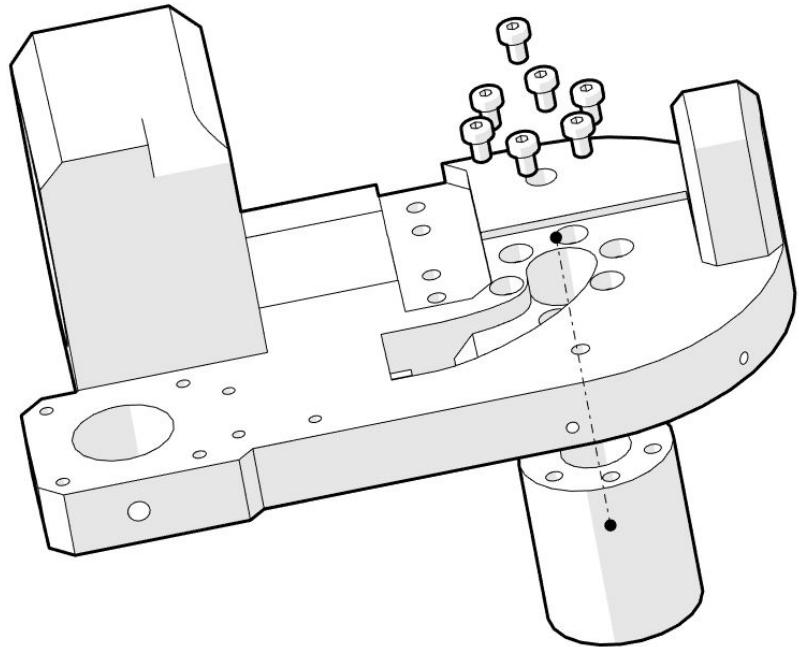


Shaft coupler  
4 x M4 HEX 10 mm

## Shoulder assembly

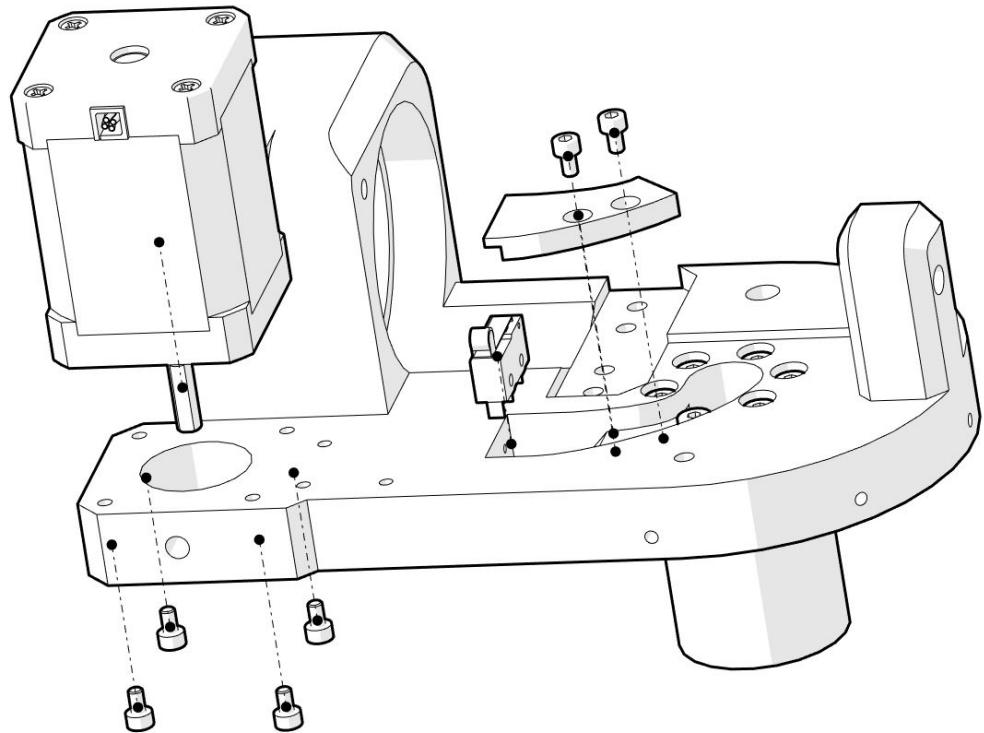


## Shoulder assembly



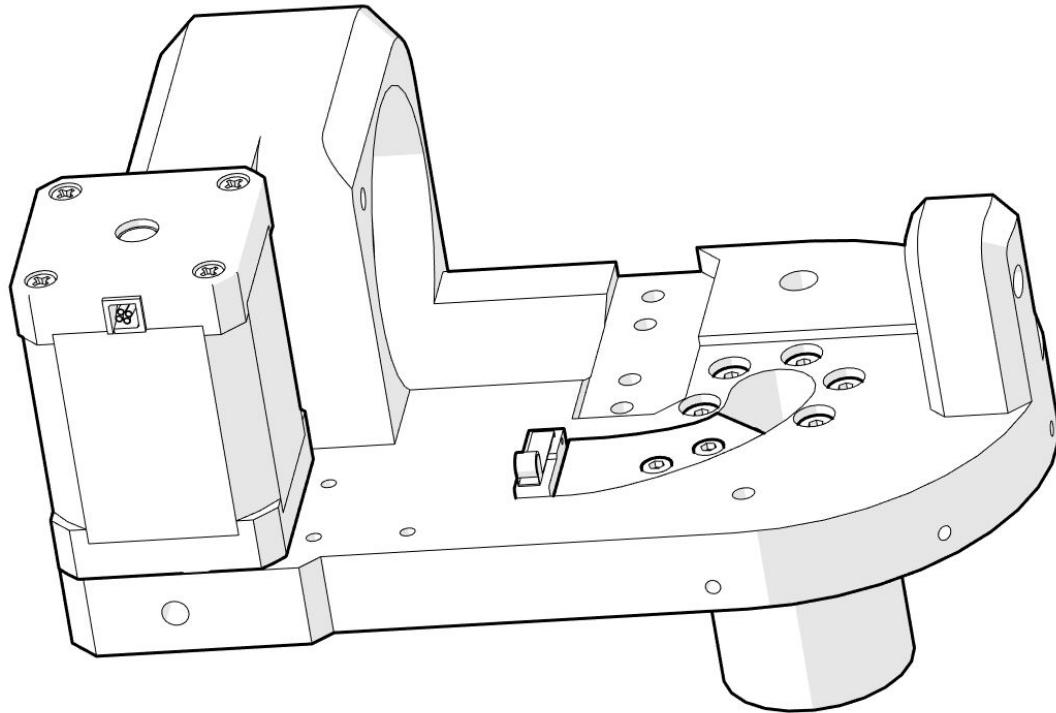
J1\_turret  
J1\_rotation\_shaft  
6 x M4 IMBUS 25 mm

## Shoulder assembly

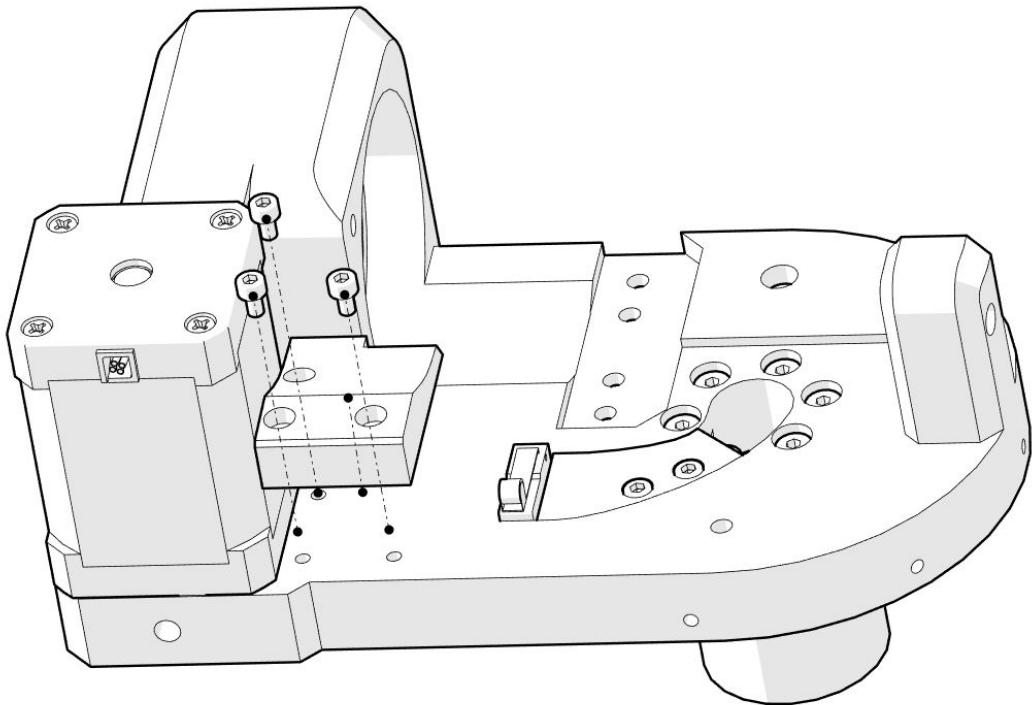


Stepper 3  
Limit switch  
J2\_limit\_switch\_cover  
2 x M3 IMBUS 8 mm  
4 x M3 IMBUS 10 mm  
2 x M2 8 mm

## Shoulder assembly

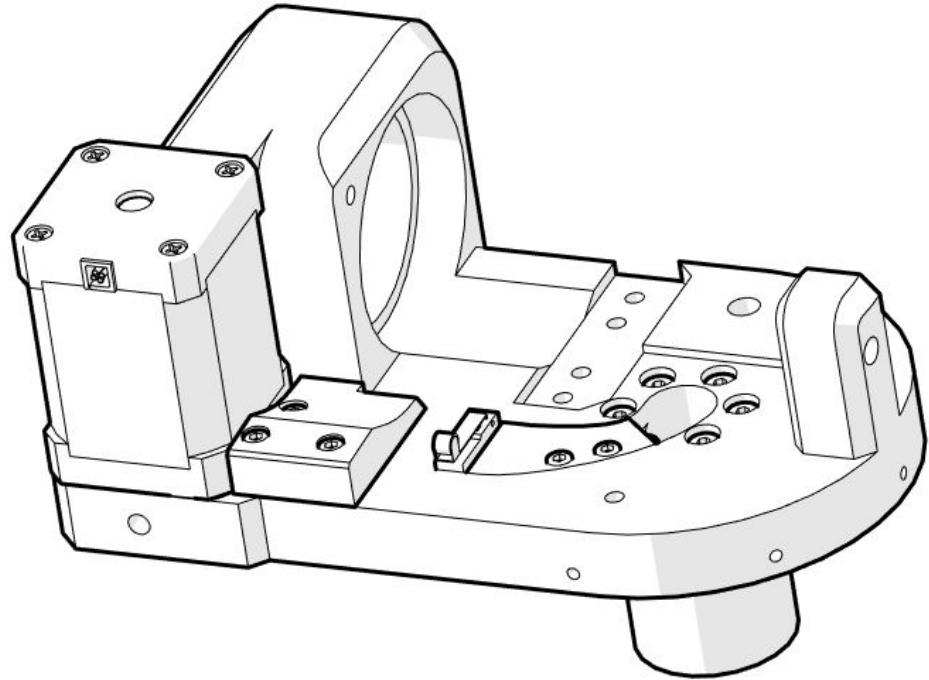


## Shoulder assembly

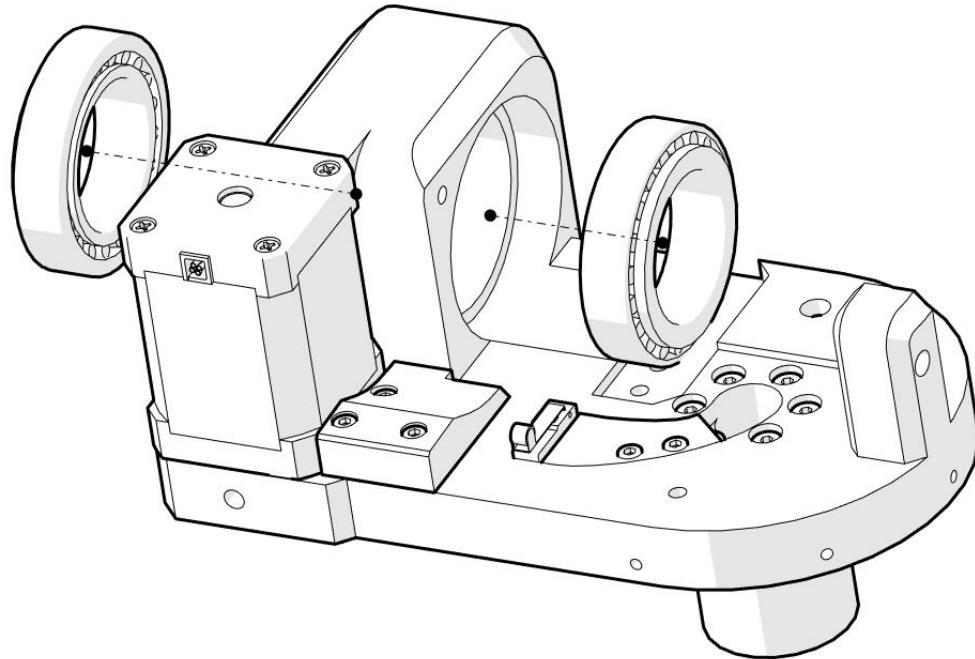


J2\_stopper\_block  
1 x M3 IMBUS 8 mm  
2 x M3 IMBUS 14 mm

## Shoulder assembly

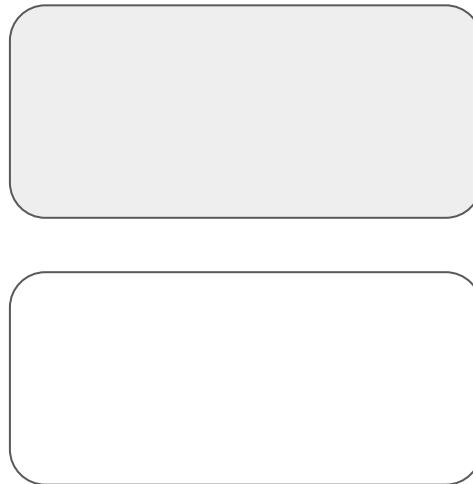
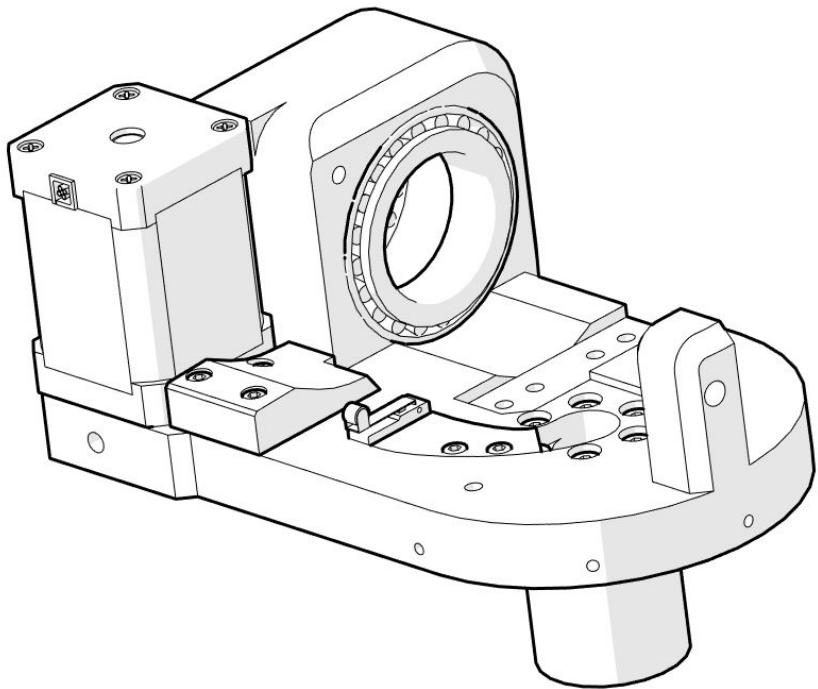


## Shoulder assembly

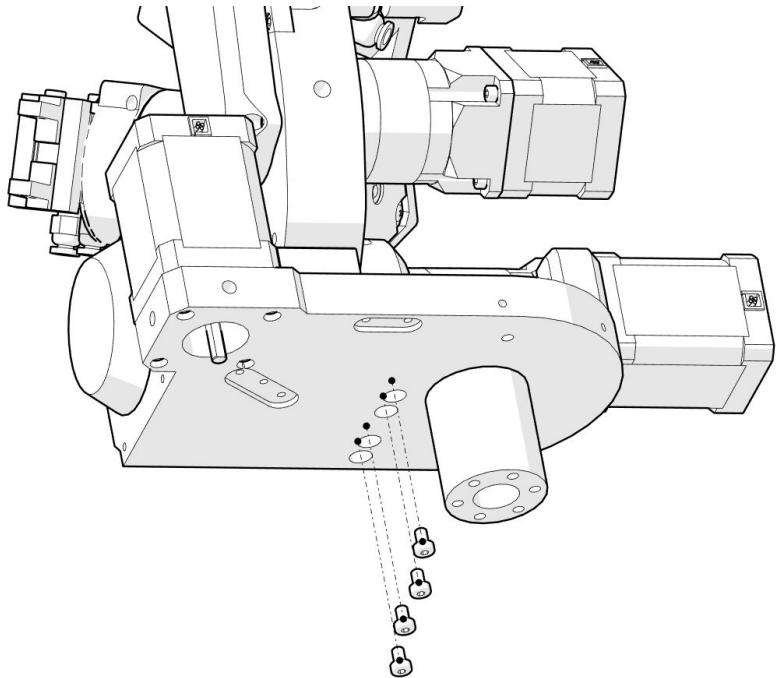


2 x Bearing 3

## Shoulder assembly

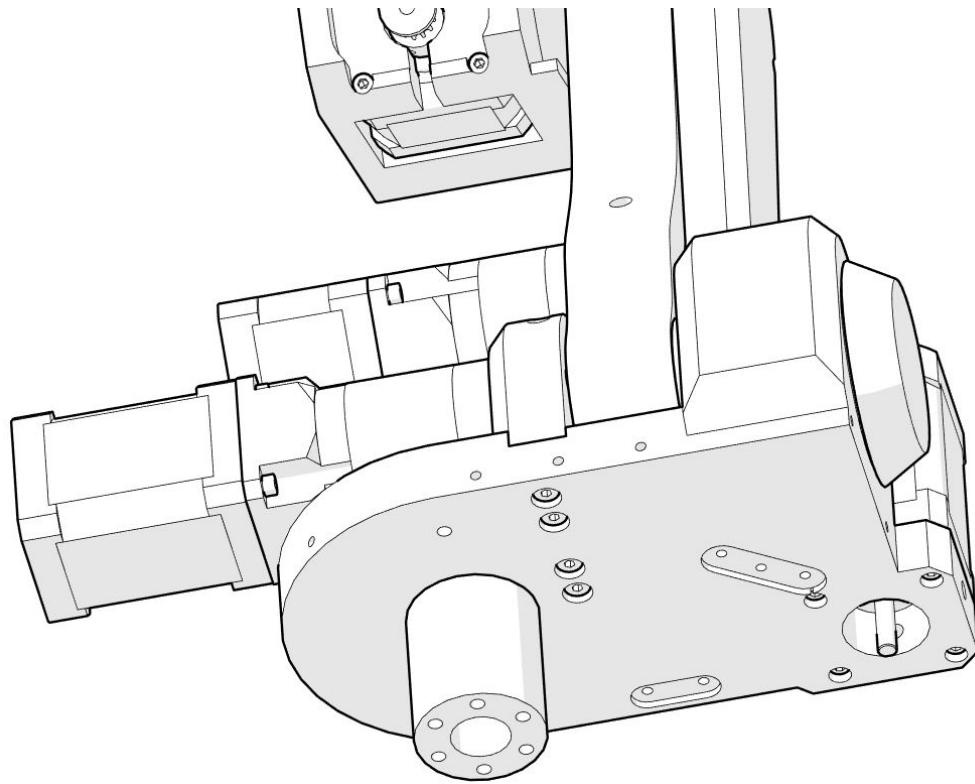


## Shoulder assembly

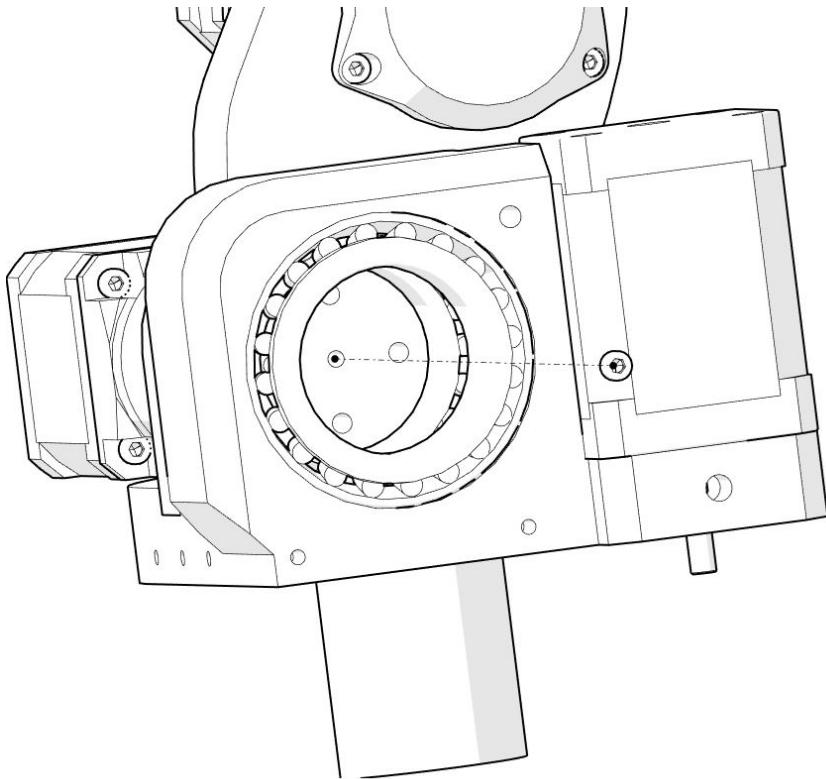


4 x M4 IMBUS 20 mm

## Shoulder assembly

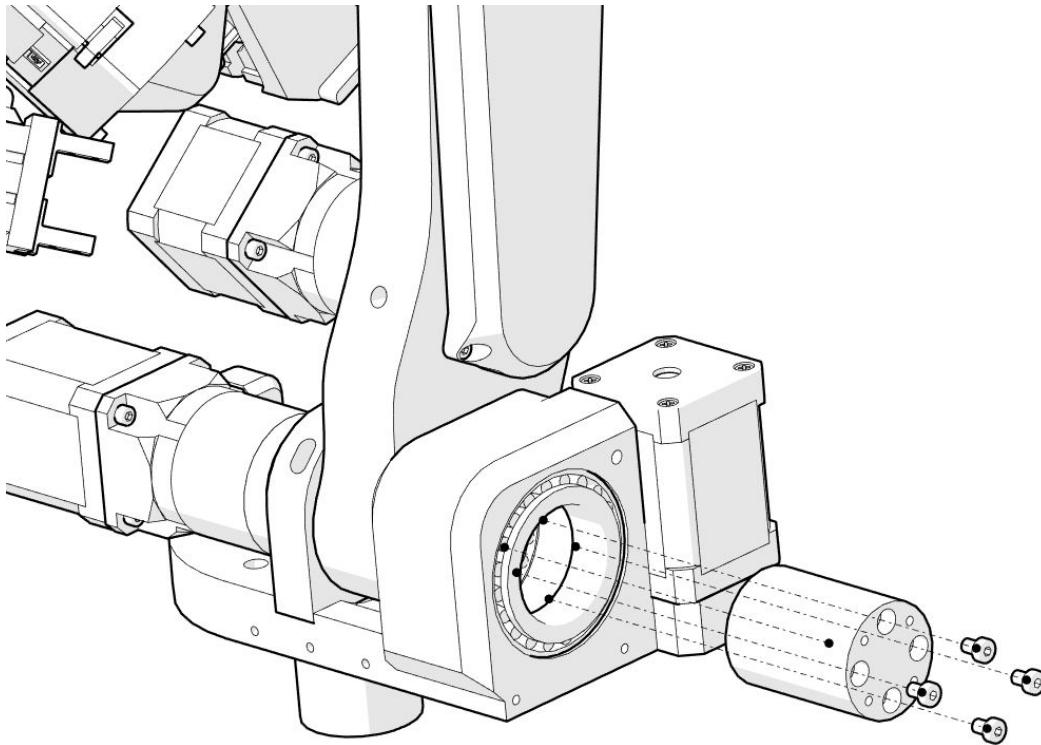


## Shoulder assembly



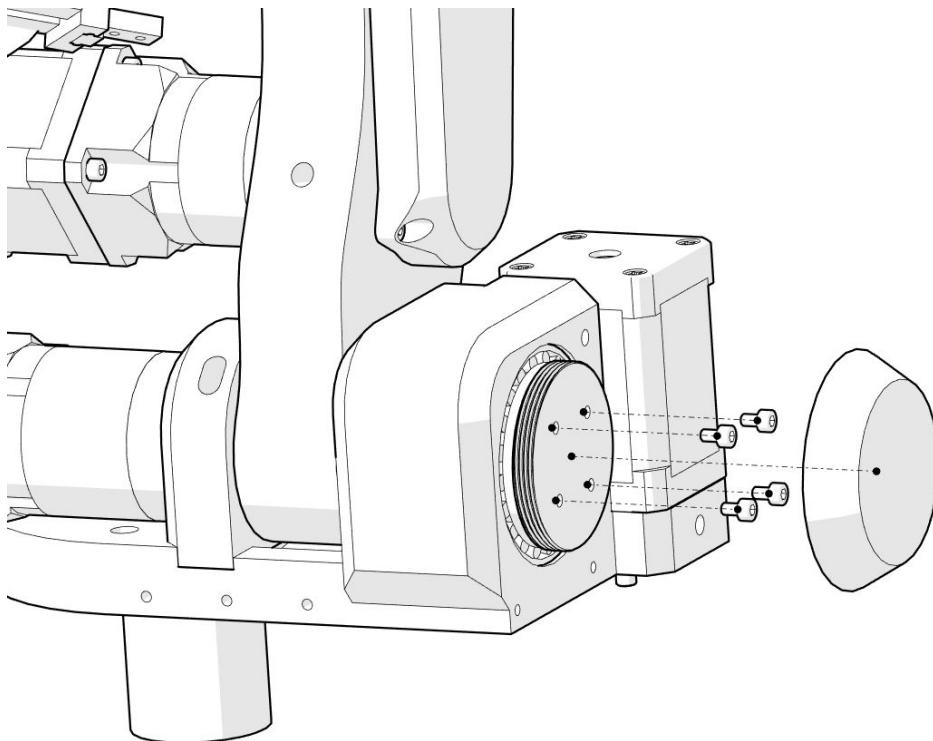
1 x M3 IMBUS 14 mm

## Shoulder assembly



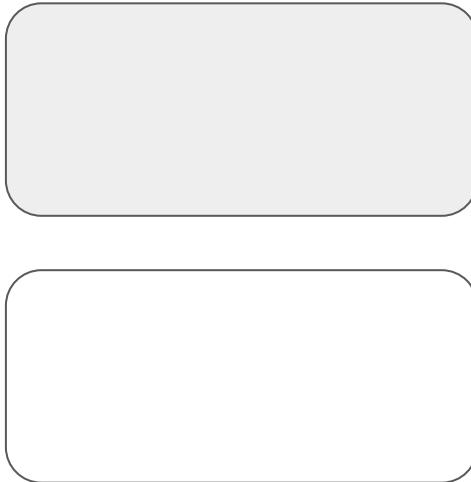
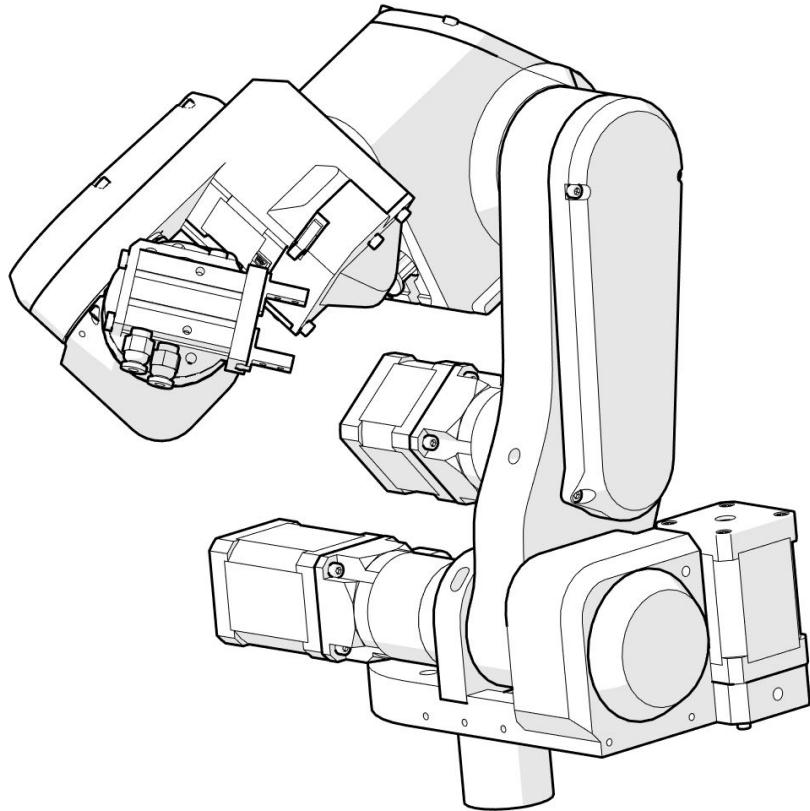
J2\_shaft  
4 x M3 IMBUS 52 mm

## Shoulder assembly

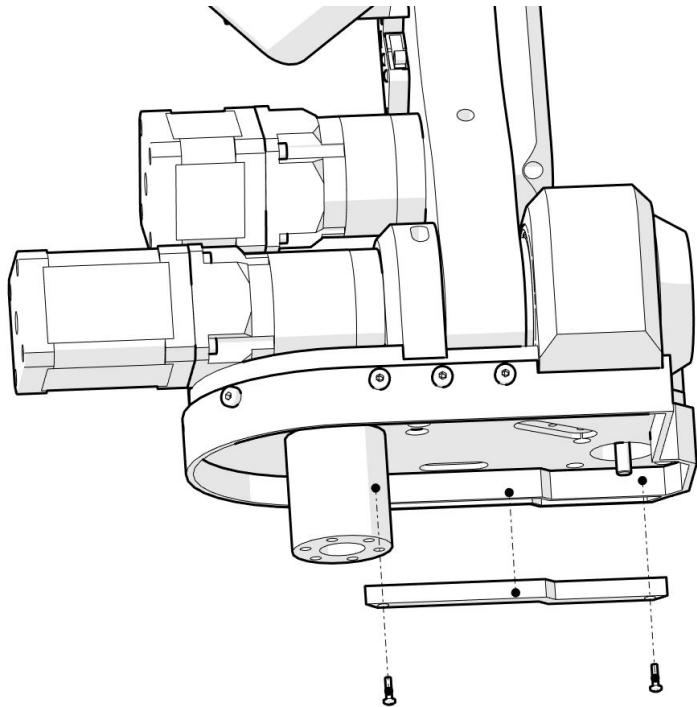


J2\_bearing\_backplate  
J2\_cover  
4 x M3 IMBUS 14 mm

## Shoulder assembly



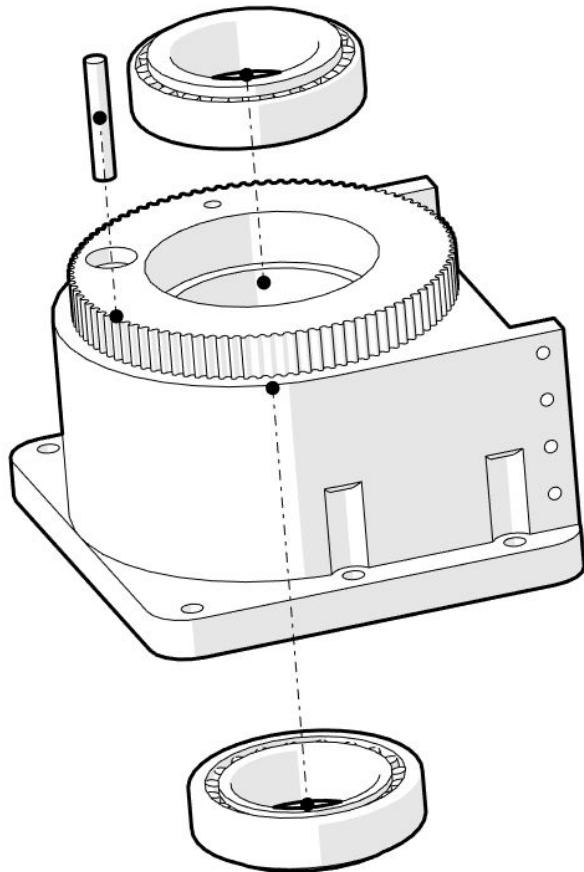
## Shoulder assembly



J1\_belt\_cover  
J1\_wires\_cover  
2 x M2 14 mm

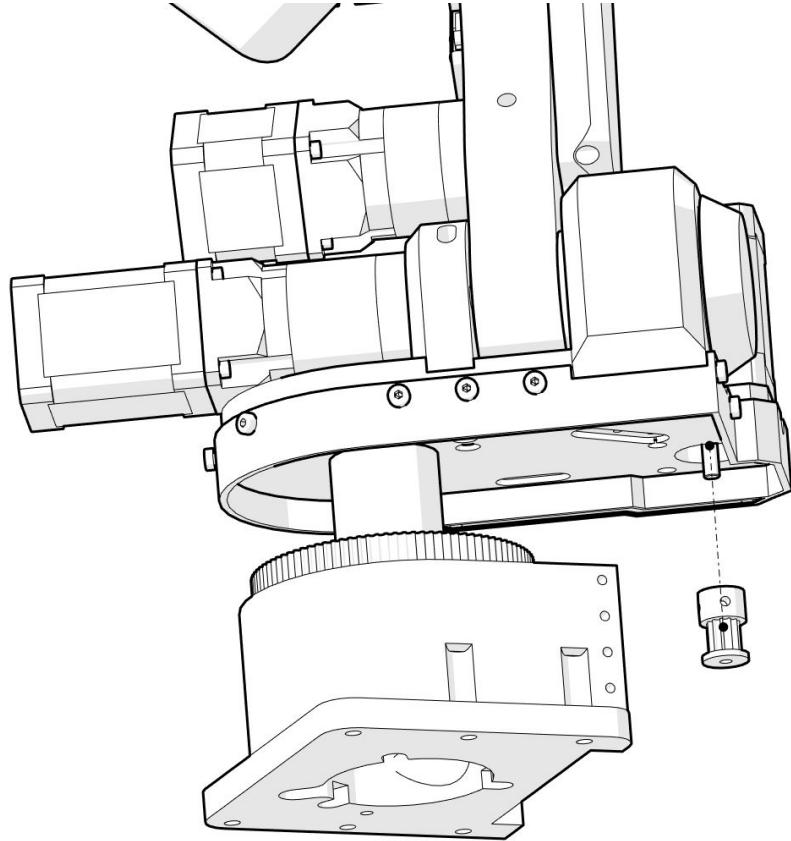
# Base assembly

## Base assembly



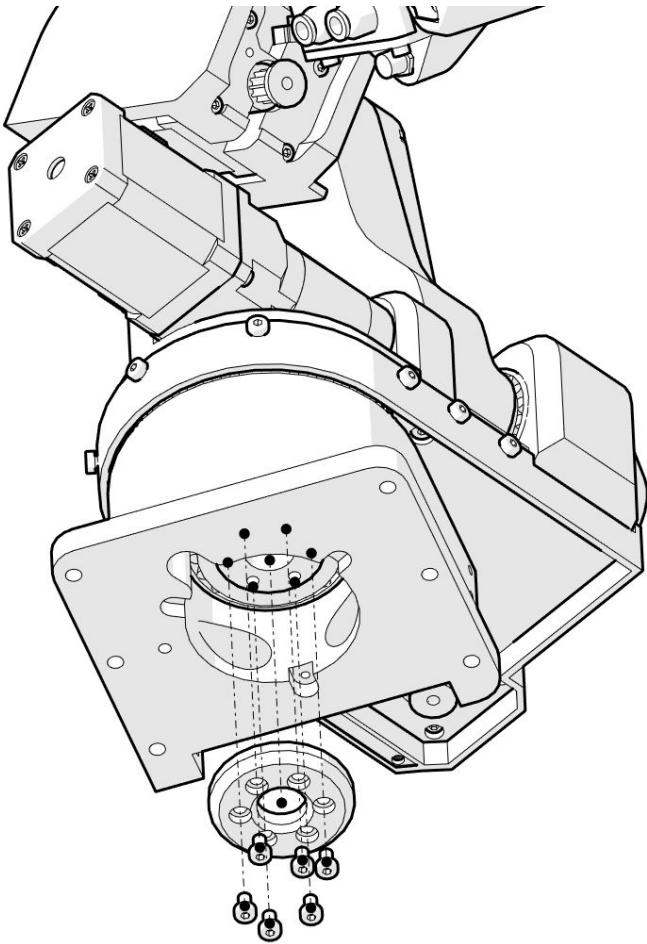
Main\_base  
2 x bearing 3  
Sensor 3

## Base assembly



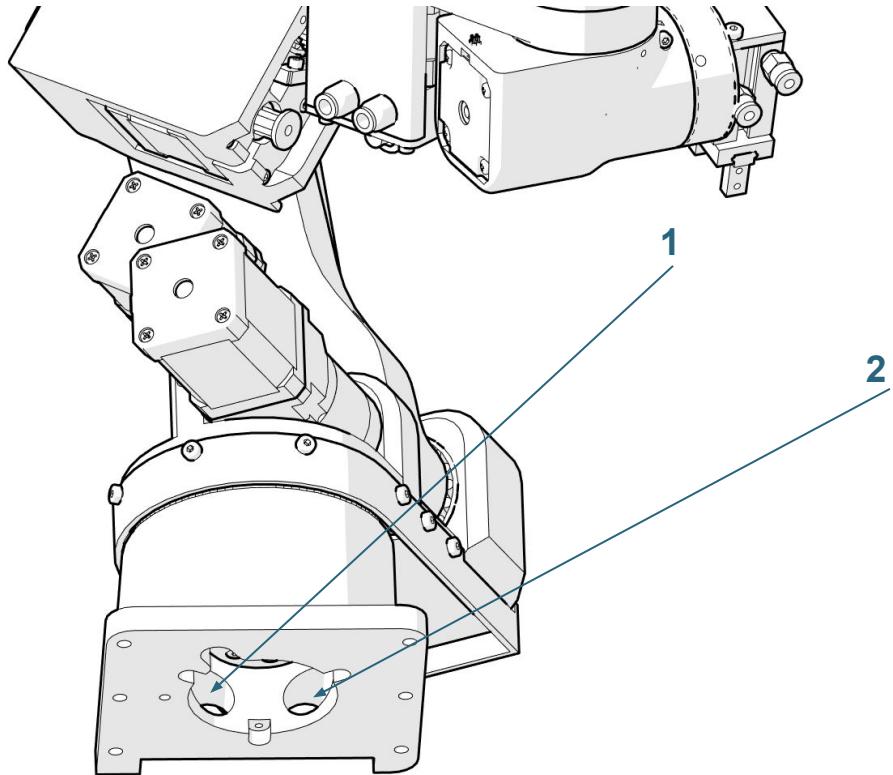
J1 pulley  
J1 belt

## Base assembly



J1\_backplate  
6 x M3 IMBUS 14 mm

## Base assembly



All robot wires need to go thru hole 1 and 2. To keep wiring mess to a minimum and reduce strain on the wires use this guide:

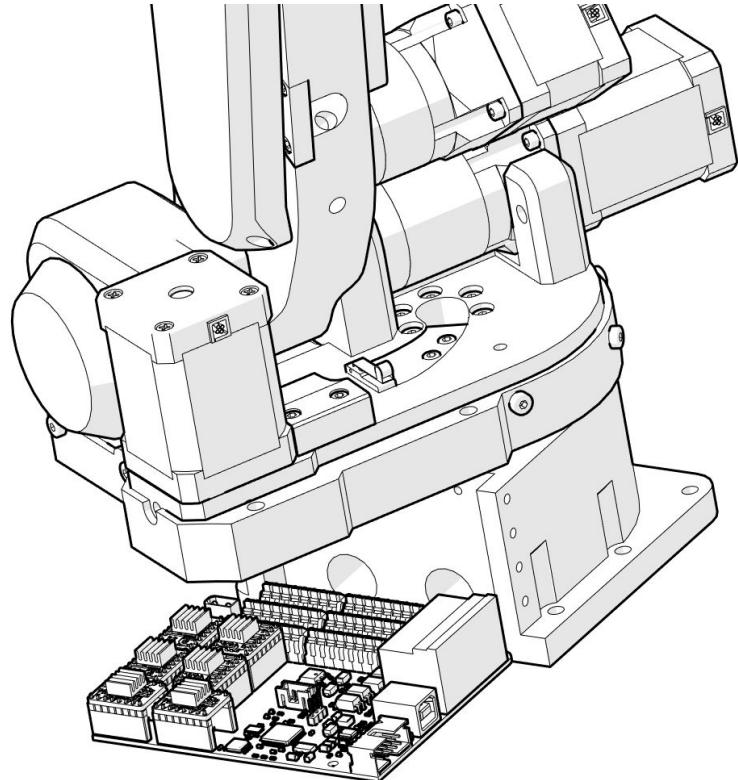
### Hole 1:

- a
- b
- c

### Hole 2:

- x
- y
- z

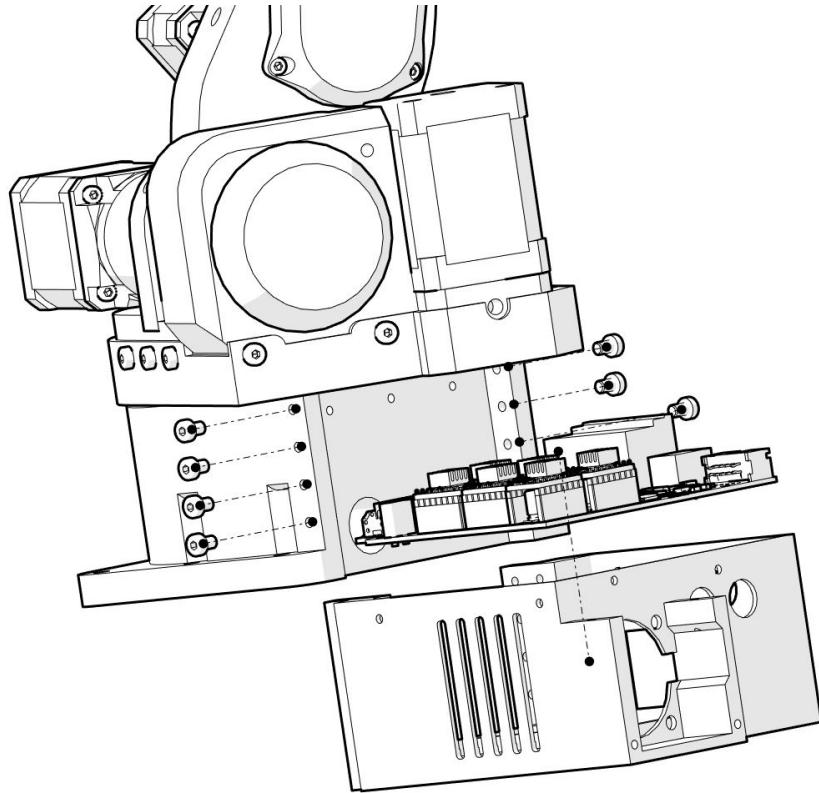
## Base assembly



PAROL6 controller board

Position the board like  
shown in the picture. Wire  
the robot by following these  
wiring instructions:

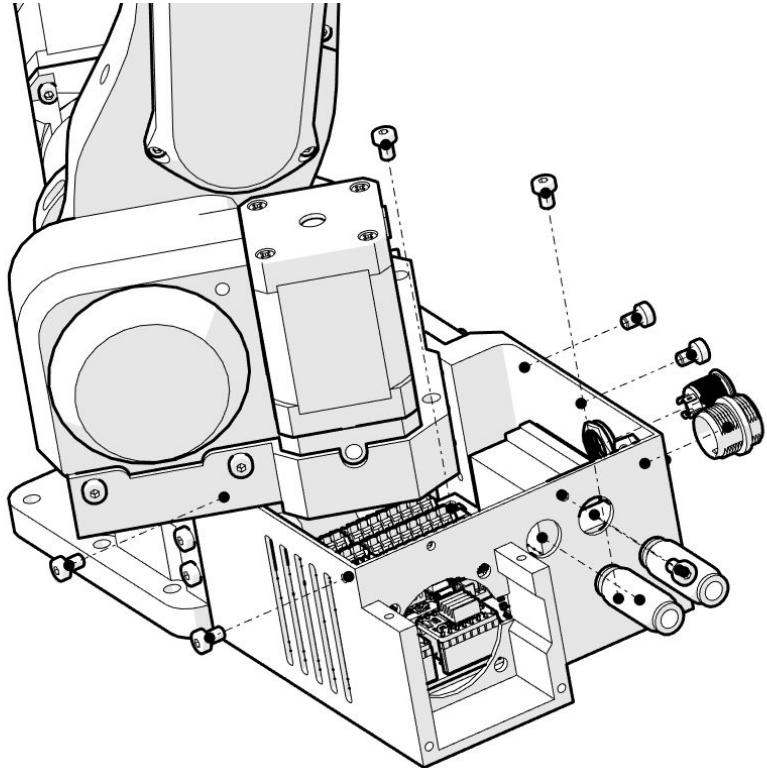
## Base assembly



Electronics case  
8 x M3 IMBUS 8 mm

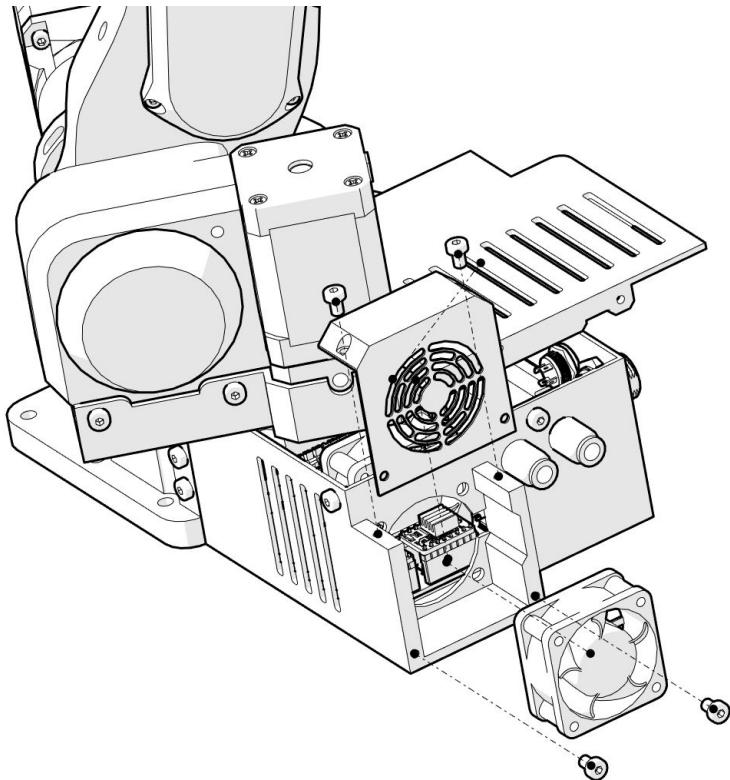
Slide the electronics case  
from the bottom of the board.  
Secure it to the robot with 8 x  
M3 screws.

## Base assembly



2 x Pneumatic connector 1  
On/Off button  
Power connector  
7 x M3 IMBUSH 8 mm

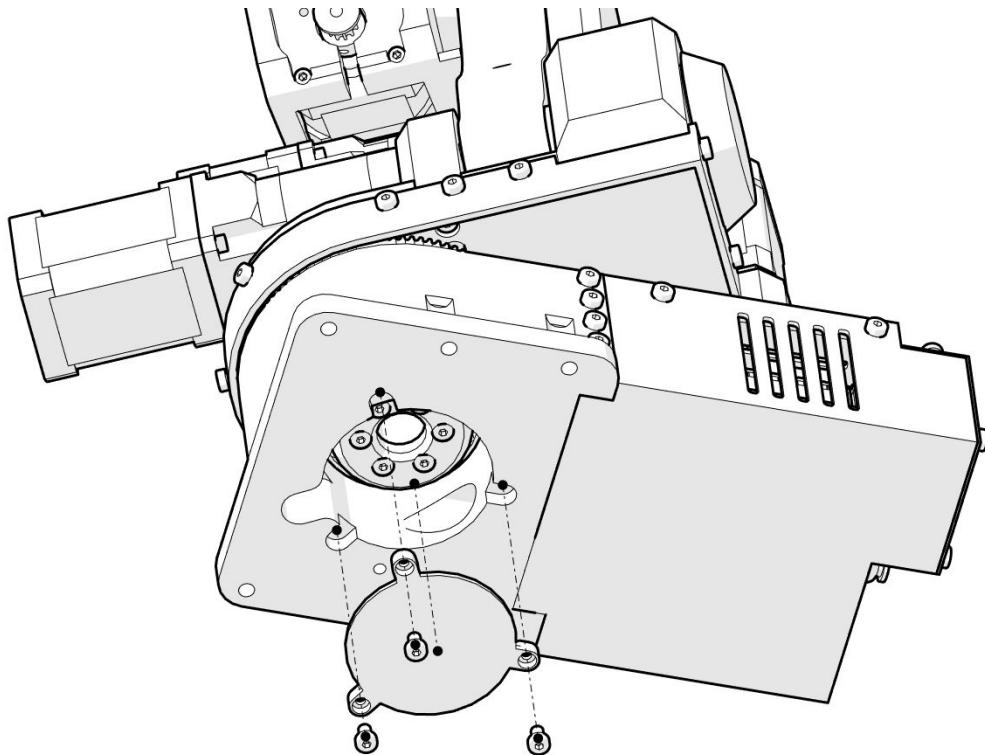
## Base assembly



Lid\_electronics  
Fan cover  
Cooling fan  
4 x M3 IMBUS 8 mm

Attach cooling fan using  
provided screws for  
NOCTUA fan. Fans wires  
need to shortened to xx mm.

## Base assembly



Bottom lid  
3 x M3 IMBUS 8 mm

## Attaching J5 and J3 belts



## Attaching joint covers



