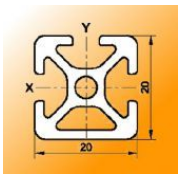
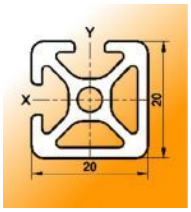
OCLab2 assembly instruction

Preliminary remarks:

For the following instruction photos, the standard aluminum X-profiles (20 I-Typ Nut 5) were used.
Later, we used partly closed X-profiles as shown in the last photos of the ready assembled OCLab2.



3N I-Type Slot 5



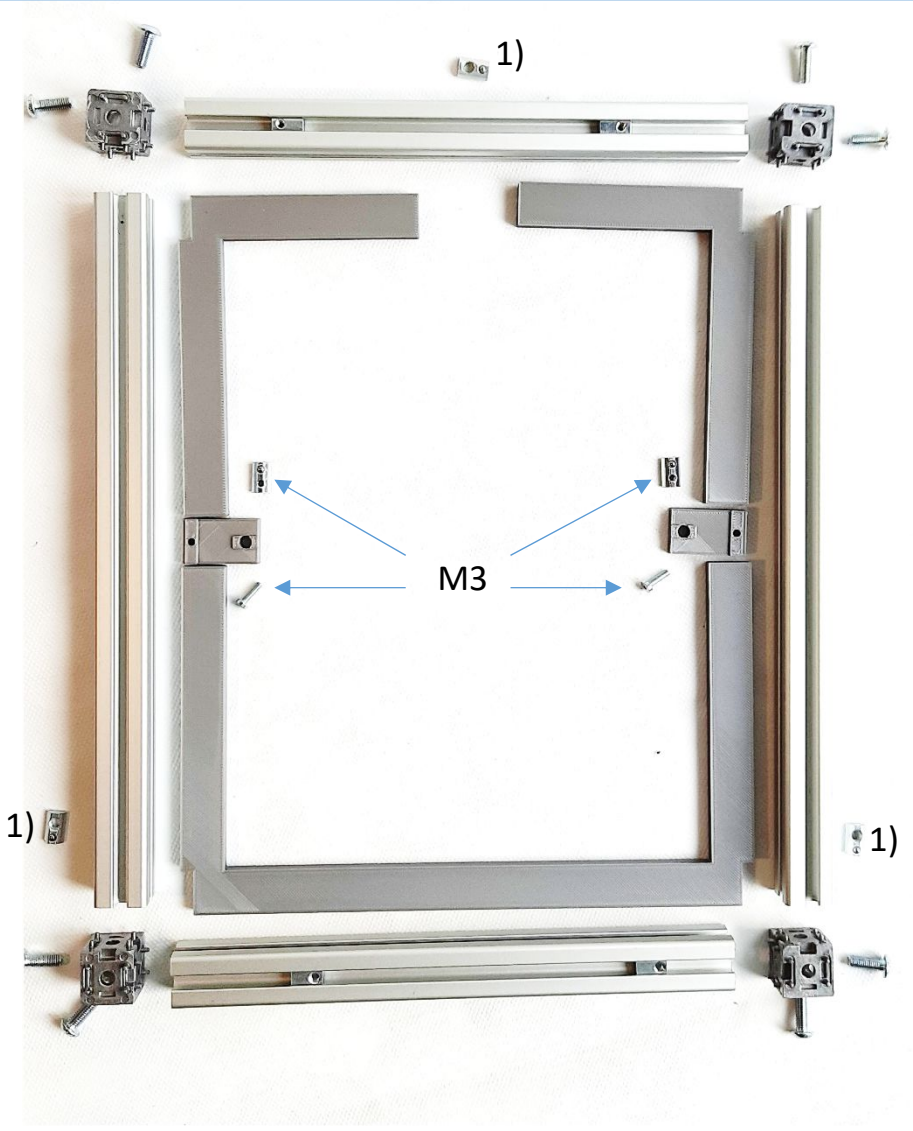
2NVS I-Type Slot 5

www.motedis.com

Drilling the screw holes of printed parts will mostly be necessary.

Bottom frame

2 x aluminum profile 20x20 3N I-Type Slot 5, 270 mm
2 x aluminum profile 20x20 3N I-Type Slot 5, 215 mm
4 x cube connector 20-3D I-type slot 5
3 x sliding nut M5 (for the feet)
4 x sliding nut M4 (for Y-moving
2 x sliding nut M3
8 x screw M5 x 10
2 x screw M3 x 6
Printed parts: connector_Z_axis_center, faces_frames: bottom_front, bottom_back



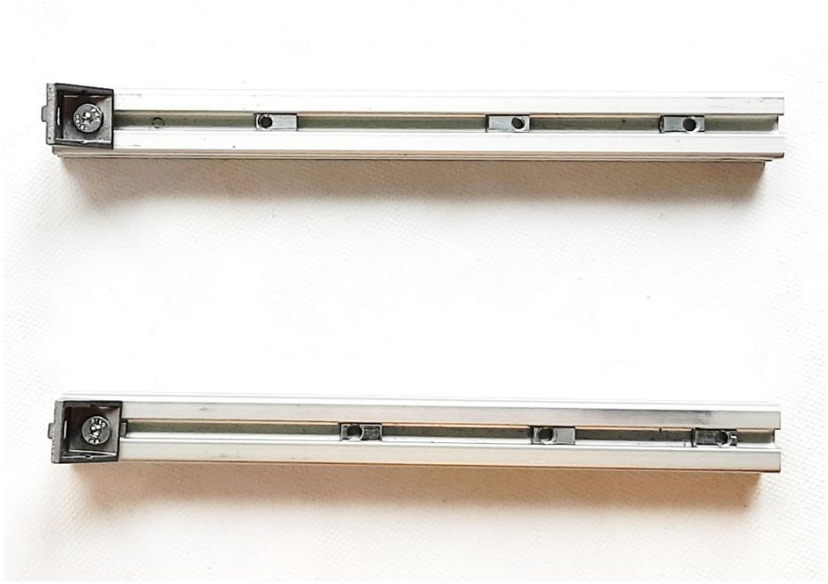
1) At the bottom of the profile (for the feet)

Ready mounted

Z-axes

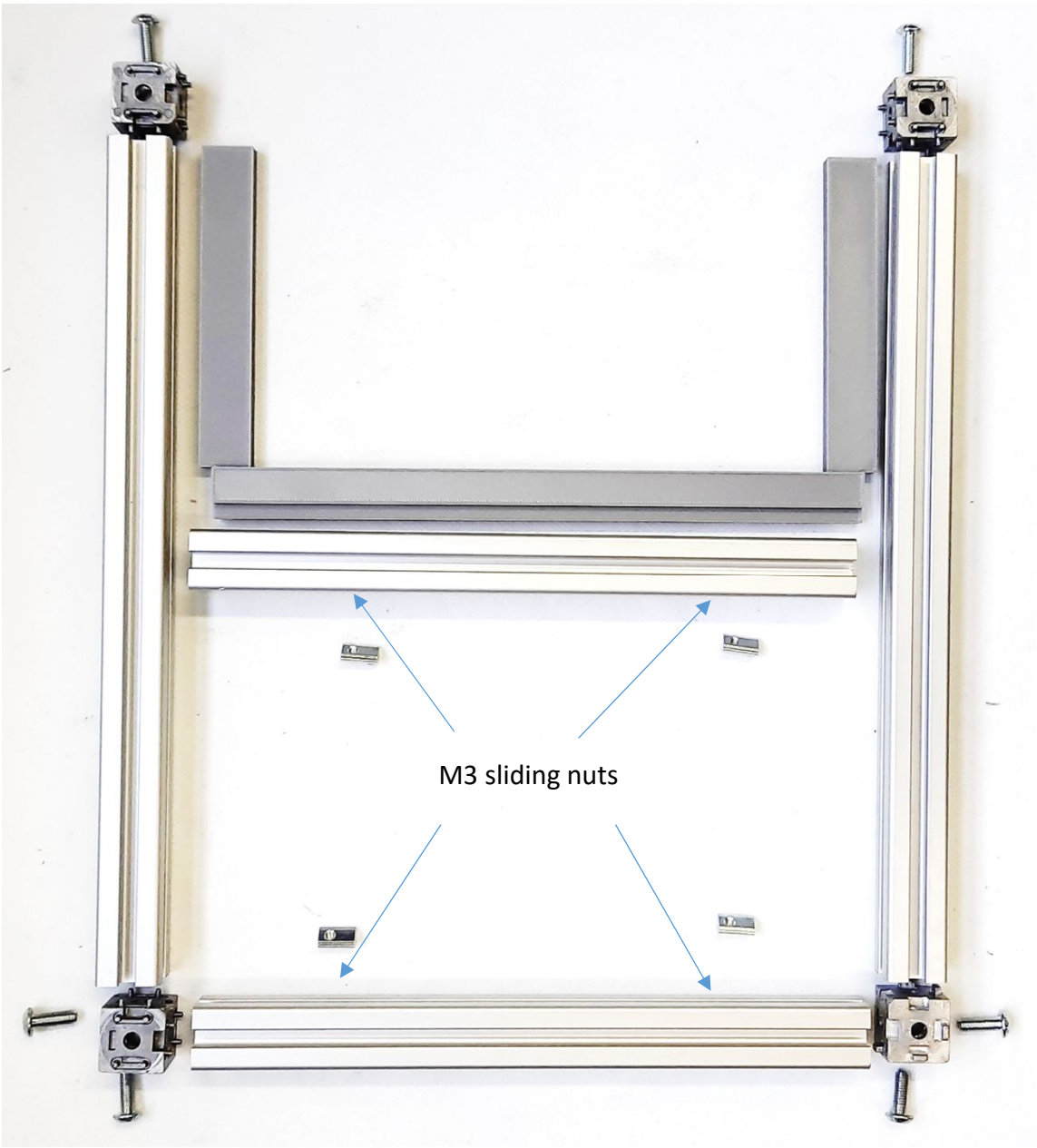
4 x aluminum profile 20x20 2NVS I-Type Slot 5, 210 mm (edges)
2 x aluminum profile 20x20 3N I-Type Slot 5, 210 mm (center)
6 x sliding nut M5
4 x sliding nut M4 (z-axis back)
4 x screw M5 x 10
2 x bracket 20x20 I-type Slot 5
2 x screw M5 x 6

Ready mounted

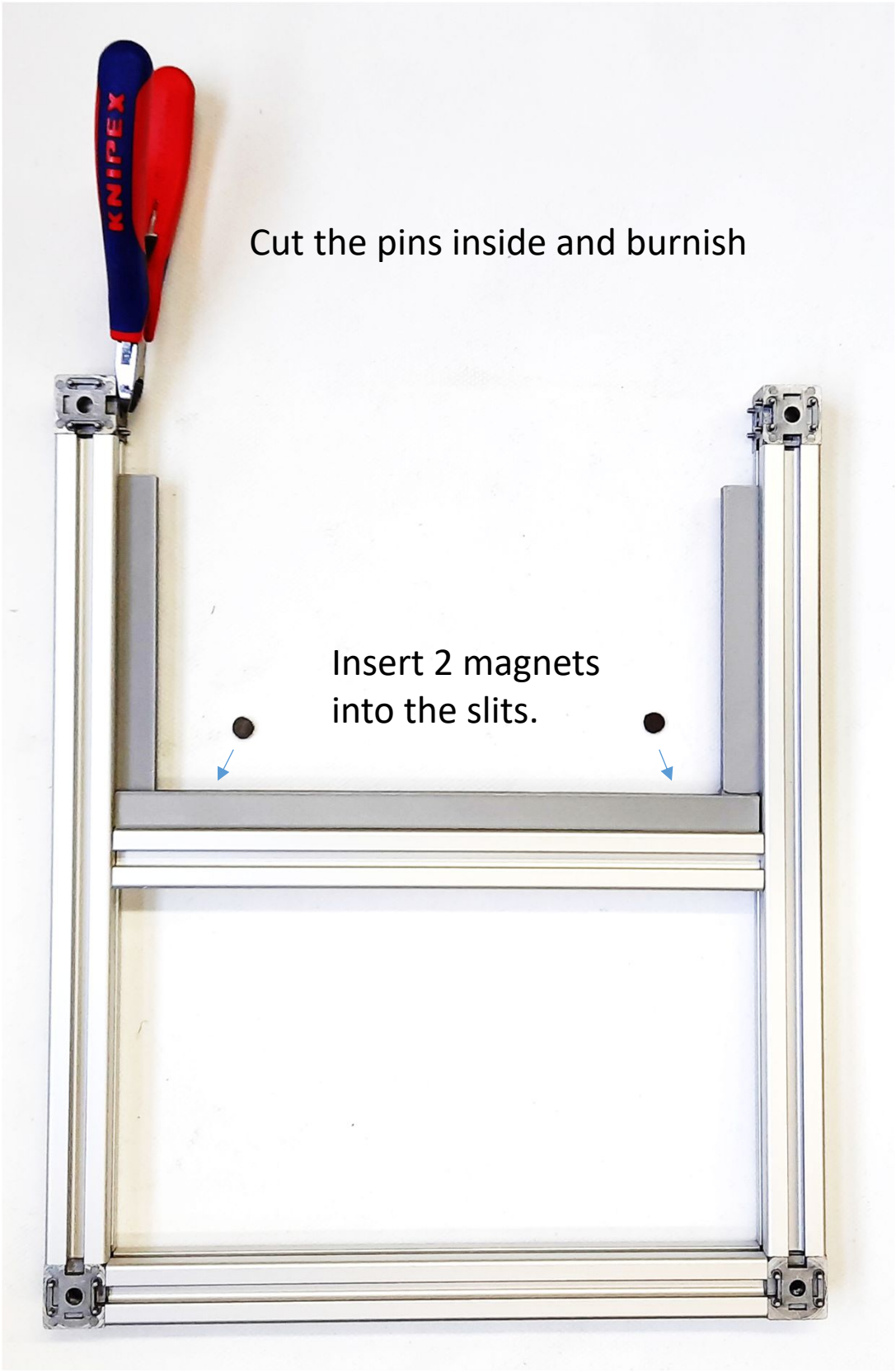


Top frame

2 x aluminum profile 20x20 2NVS I-Type Slot 5, 270 mm
1 x aluminum profile 20x20 3N I-Type Slot 5, 215 mm (center)
1 x aluminum profile 20x20 2NVS I-Type Slot 5, 215 mm (back)
4 x sliding nut M3 (for electronics housing)
2 x sliding nut M5 (for the center z-axes brackets)
6 x screw M5 x 10
2 x magnets Ø 8 mm x 3 mm
Printed part: cover_top

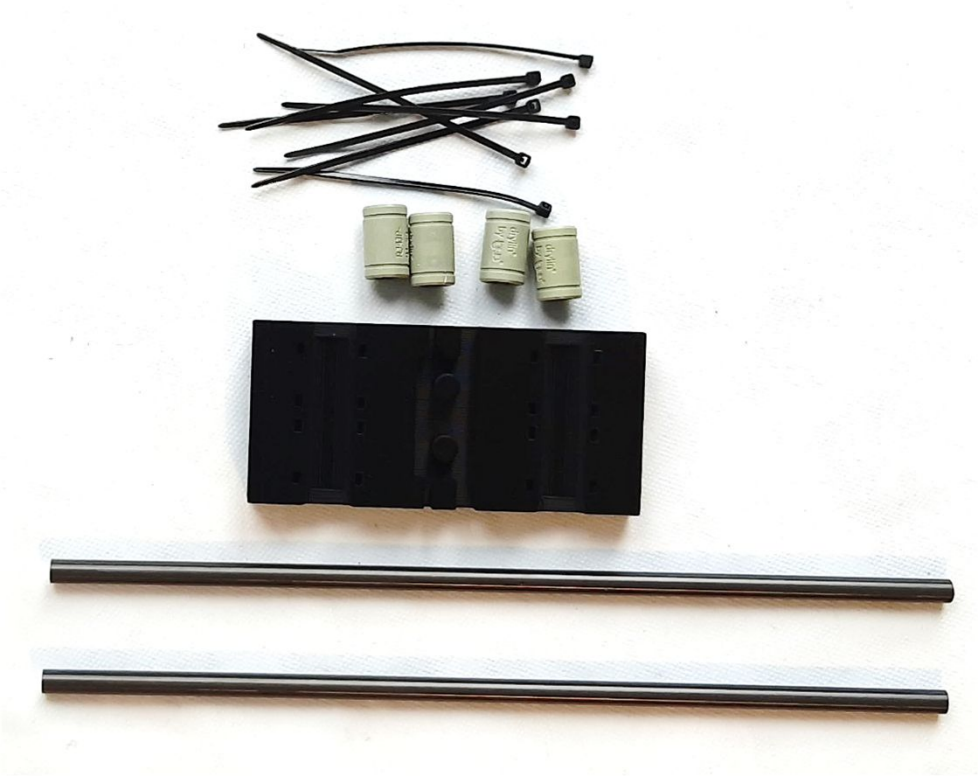


Ready mounted

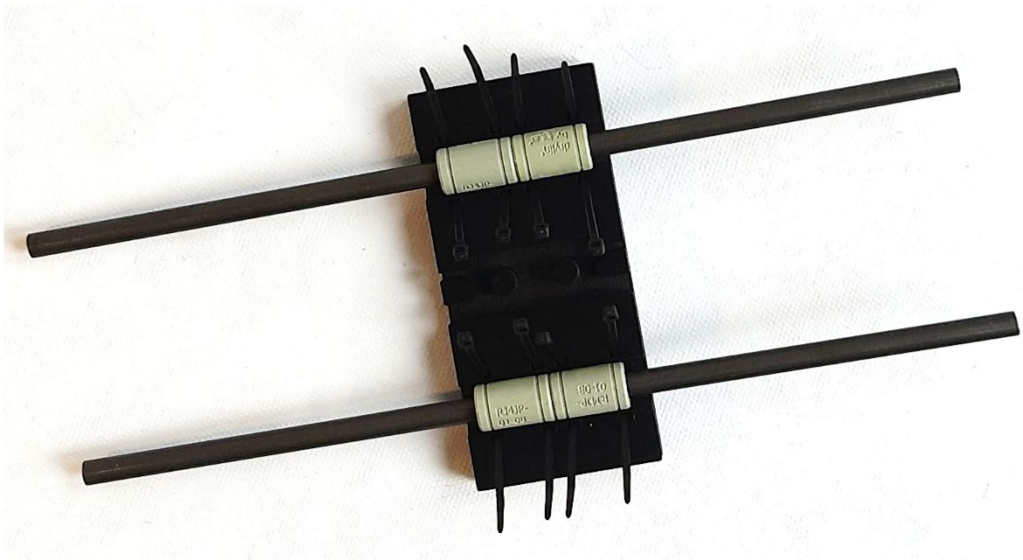


Y-moving

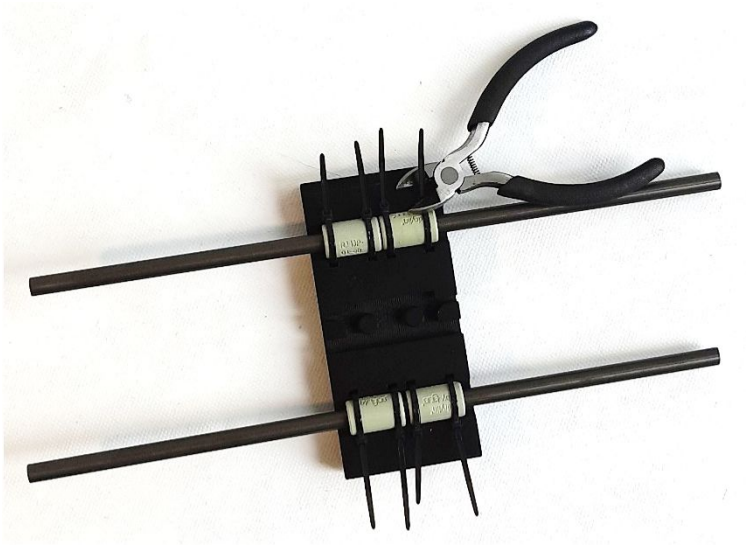
2 x aluminum rod, Ø 8 mm, 280 mm
4 x Igus RJ4JP-01-08 linear bearing
8 x zip ties, 2.5x100 mm
Printed part: Y_moving

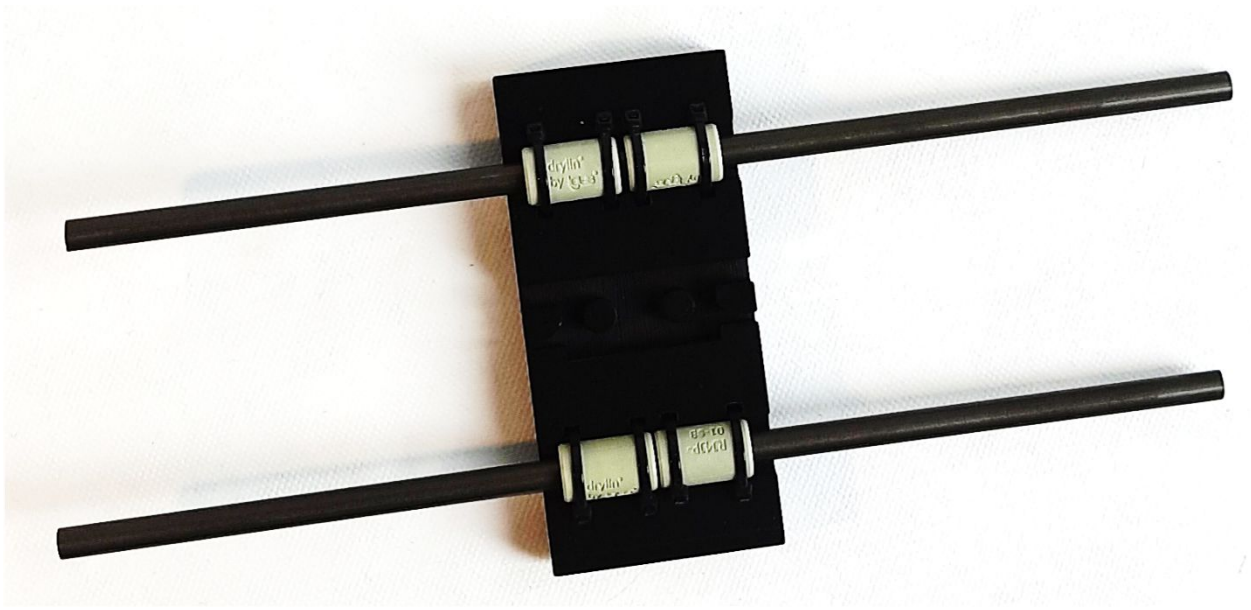


Placing the parts



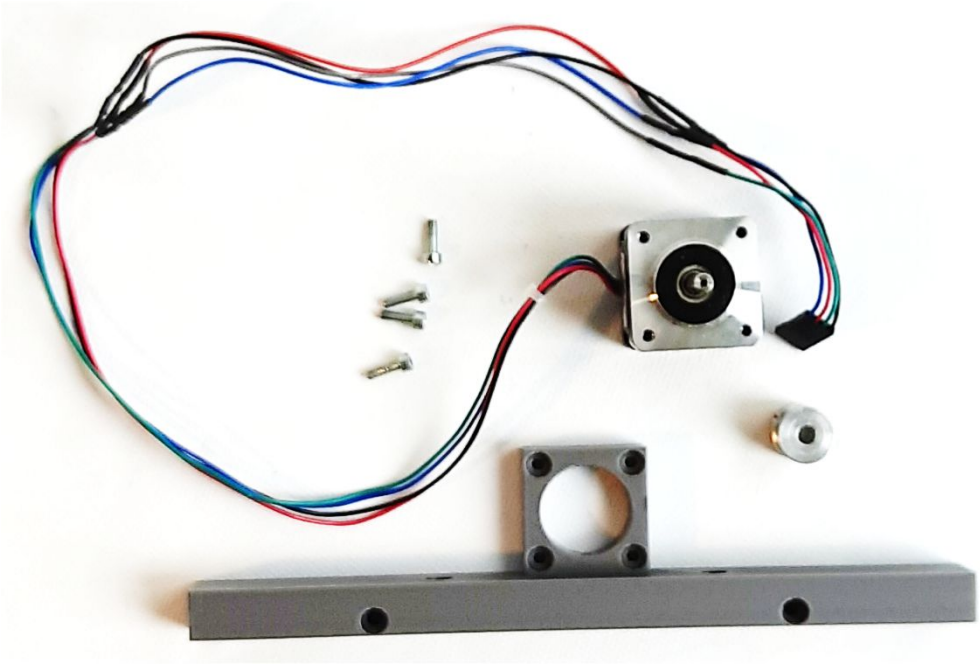
Close the zip ties and cut the overlap



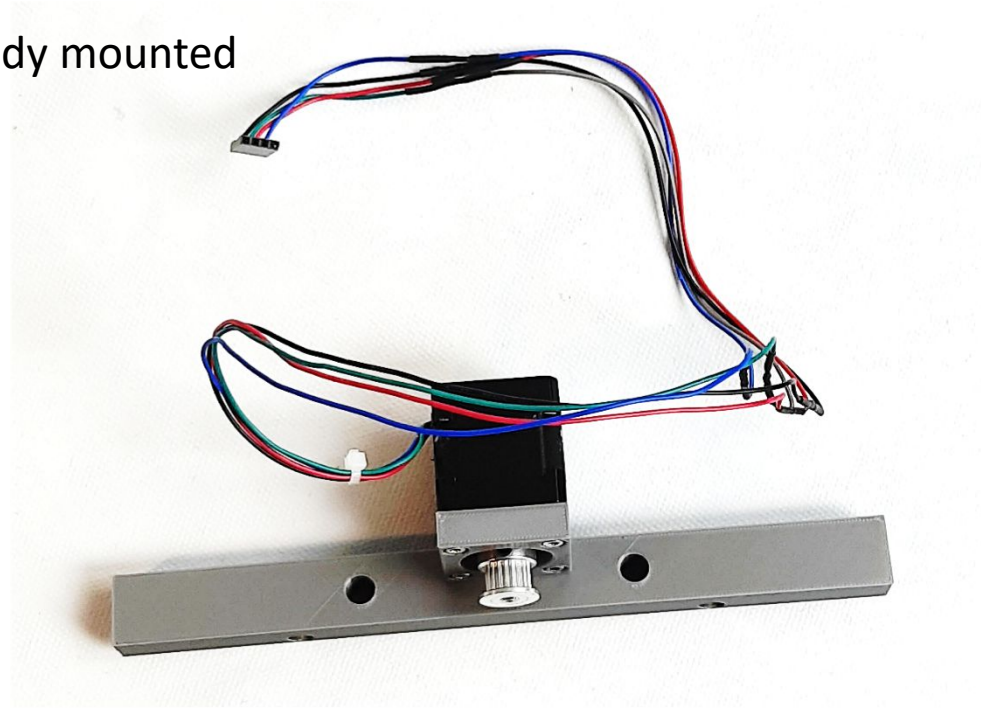


Preparing the Y-motor

1 x stepper motor Nema 14
1 x GT2 pulley 20 teeths
4 x screw M3 x 10 DIN 912
Printed part: Y_motor

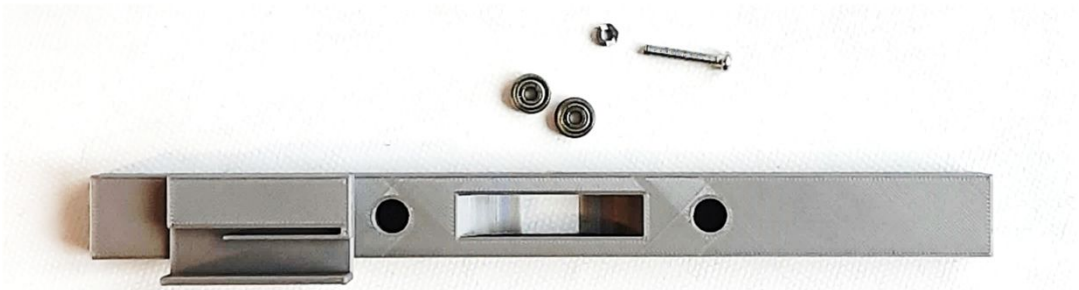


Ready mounted



Preparing the Y-end

2 x 623ZZ ball bearing: 3x10x4 mm
1 x screw M3 x 25 DIN 912 with nut
Printed part: Y_end

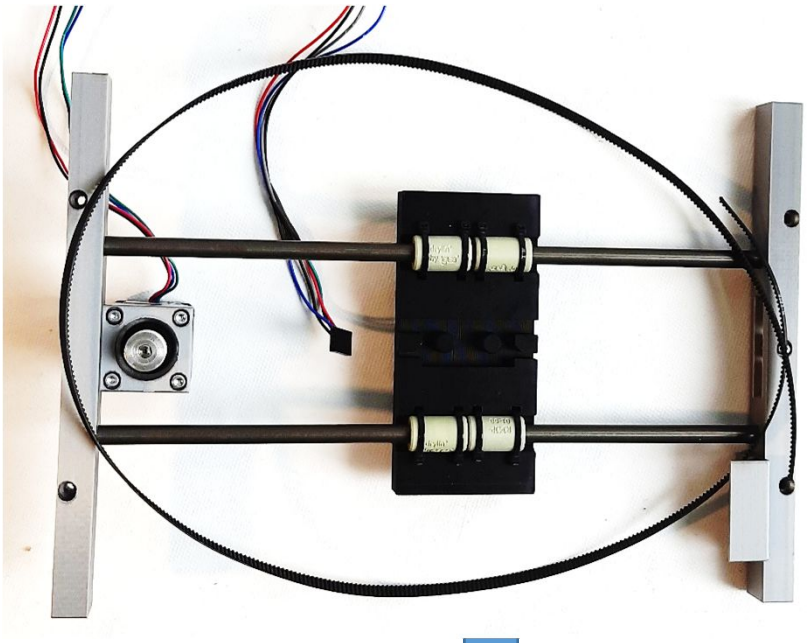


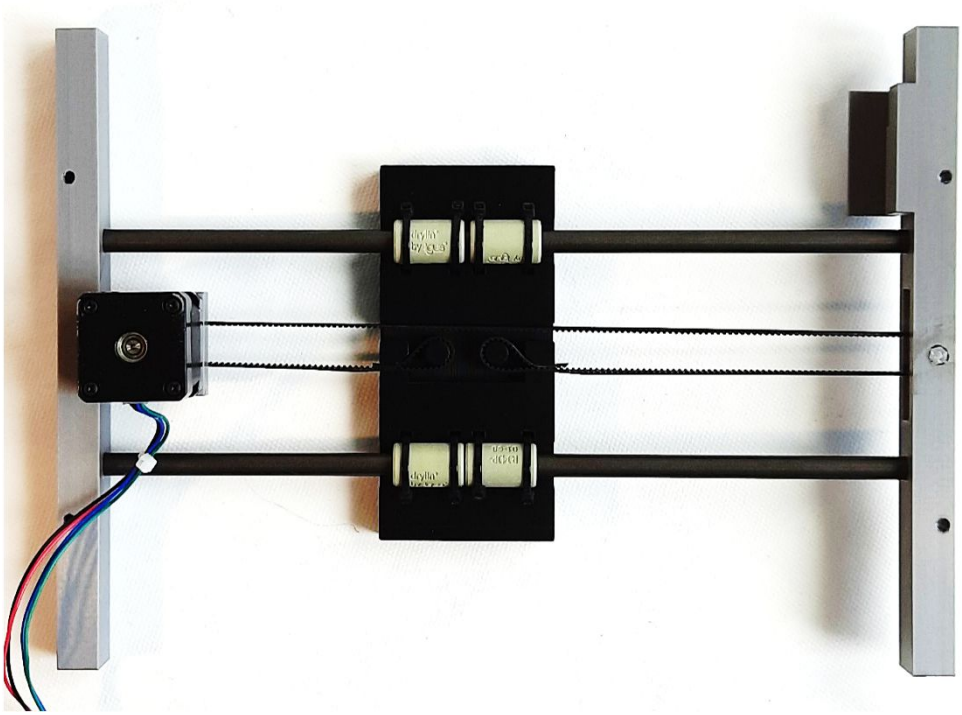
Ready mounted

Burnish the screw‘s overlap

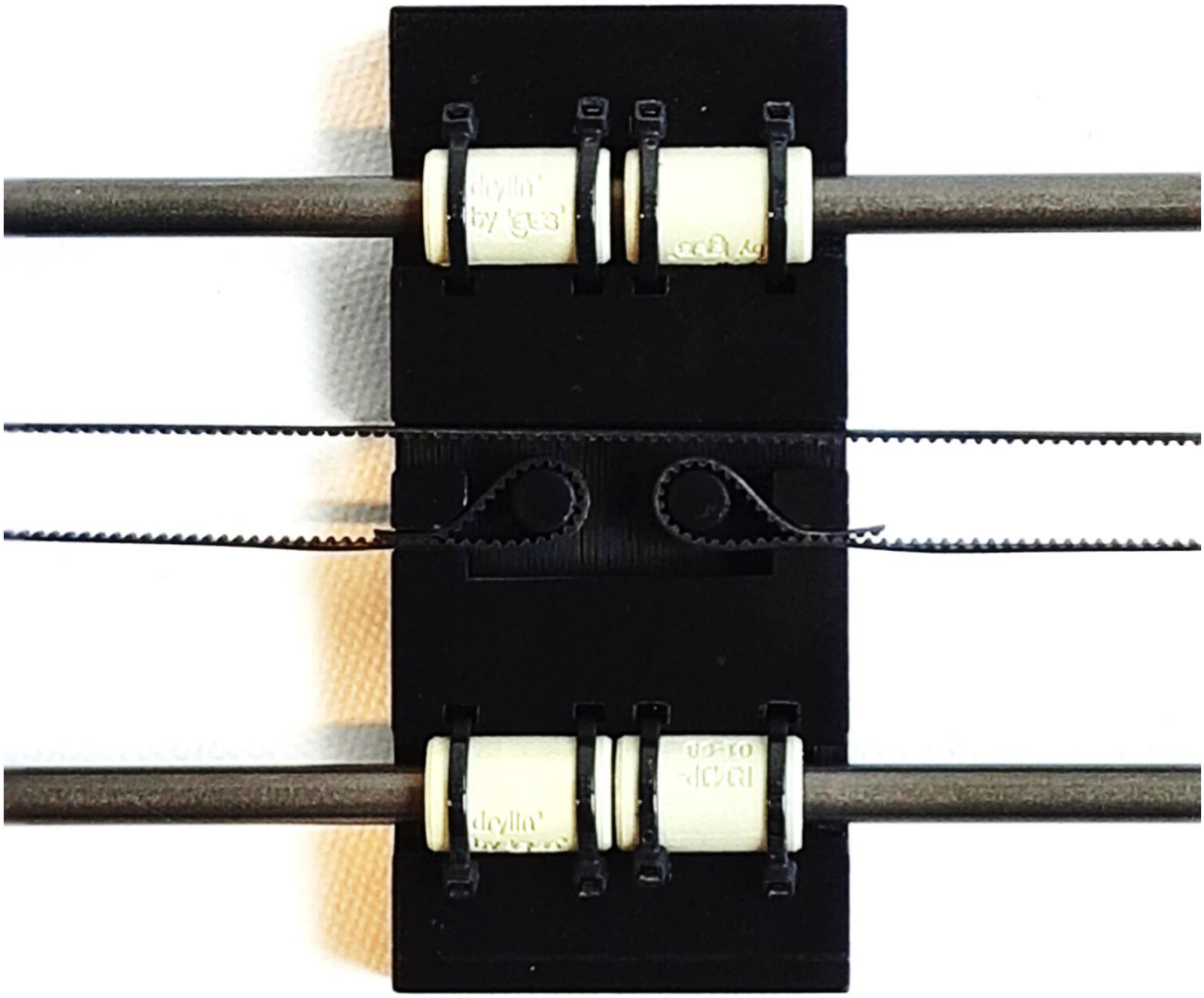
Preparing the Y-moving

Y-motor and y-end mounted
Y-moving mounted
GT2 Timing belt 6 mm, 1 m



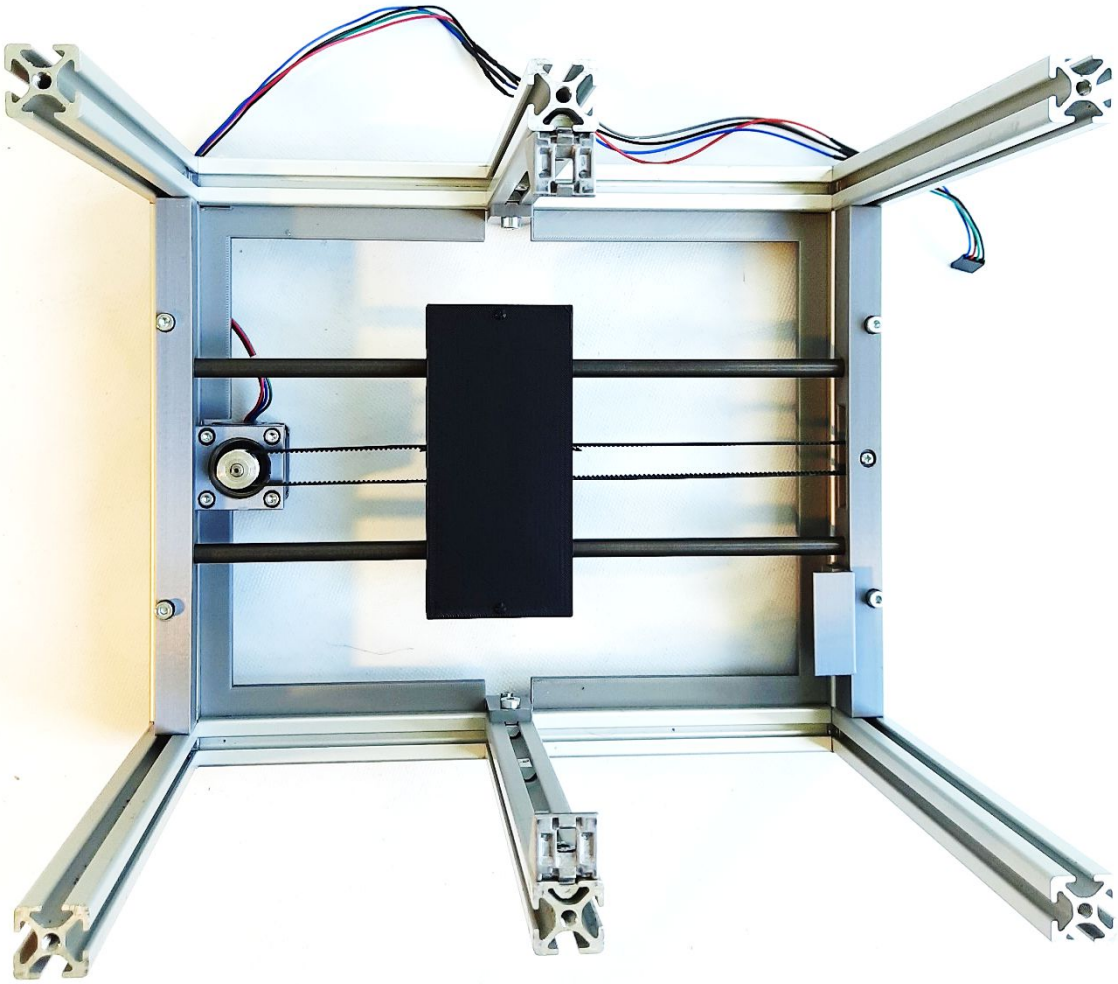


Fix the timing belt under slight tension and cut the overlap.



Mounting the Y-moving

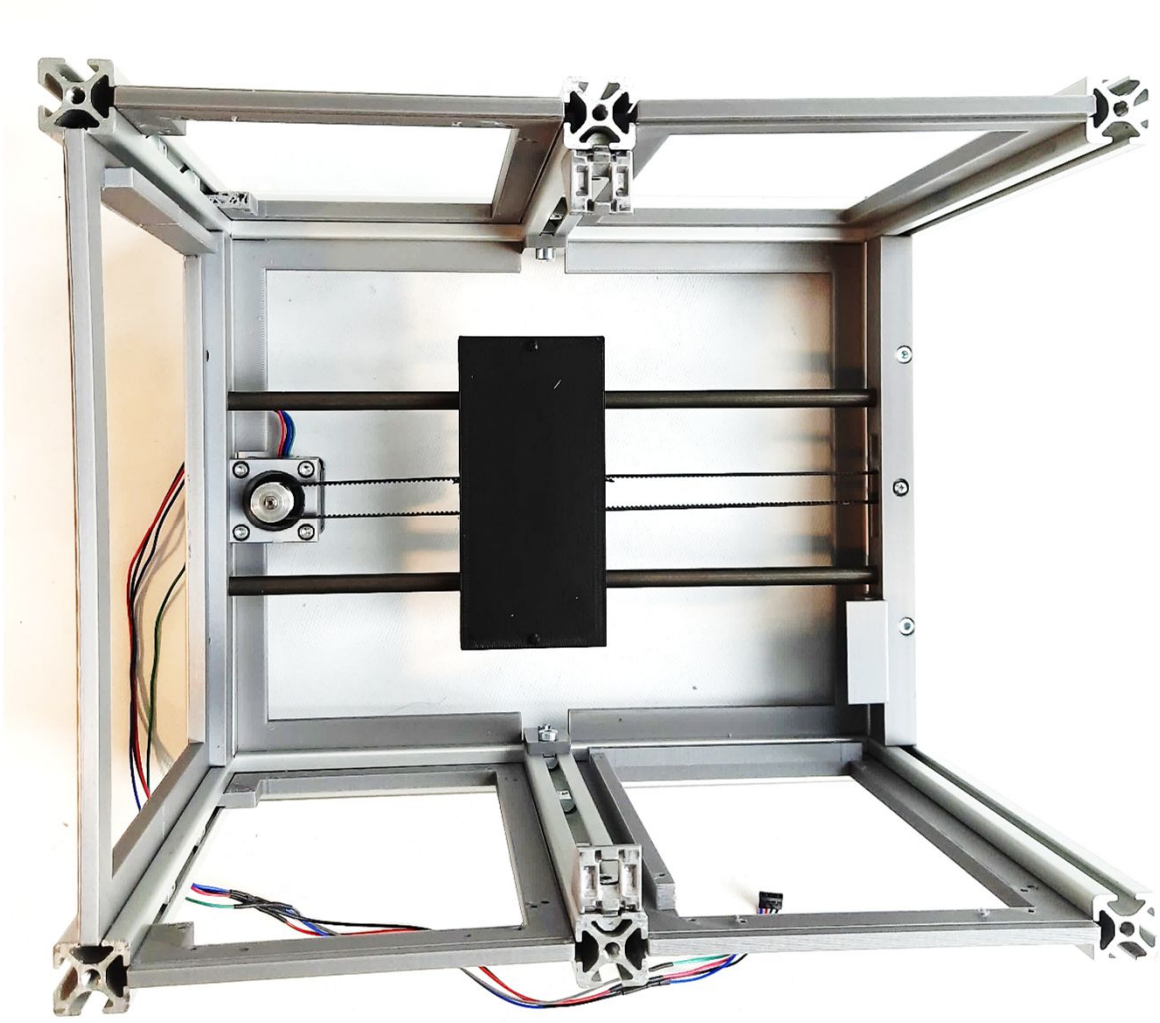
Y-moving fully mounted
4 x screw M4 x 20, DIN 7984



Frames for the faces

Printed parts: left_front_cable_channel, right_front, 2 x sides_back, back_bottom, back_top, front

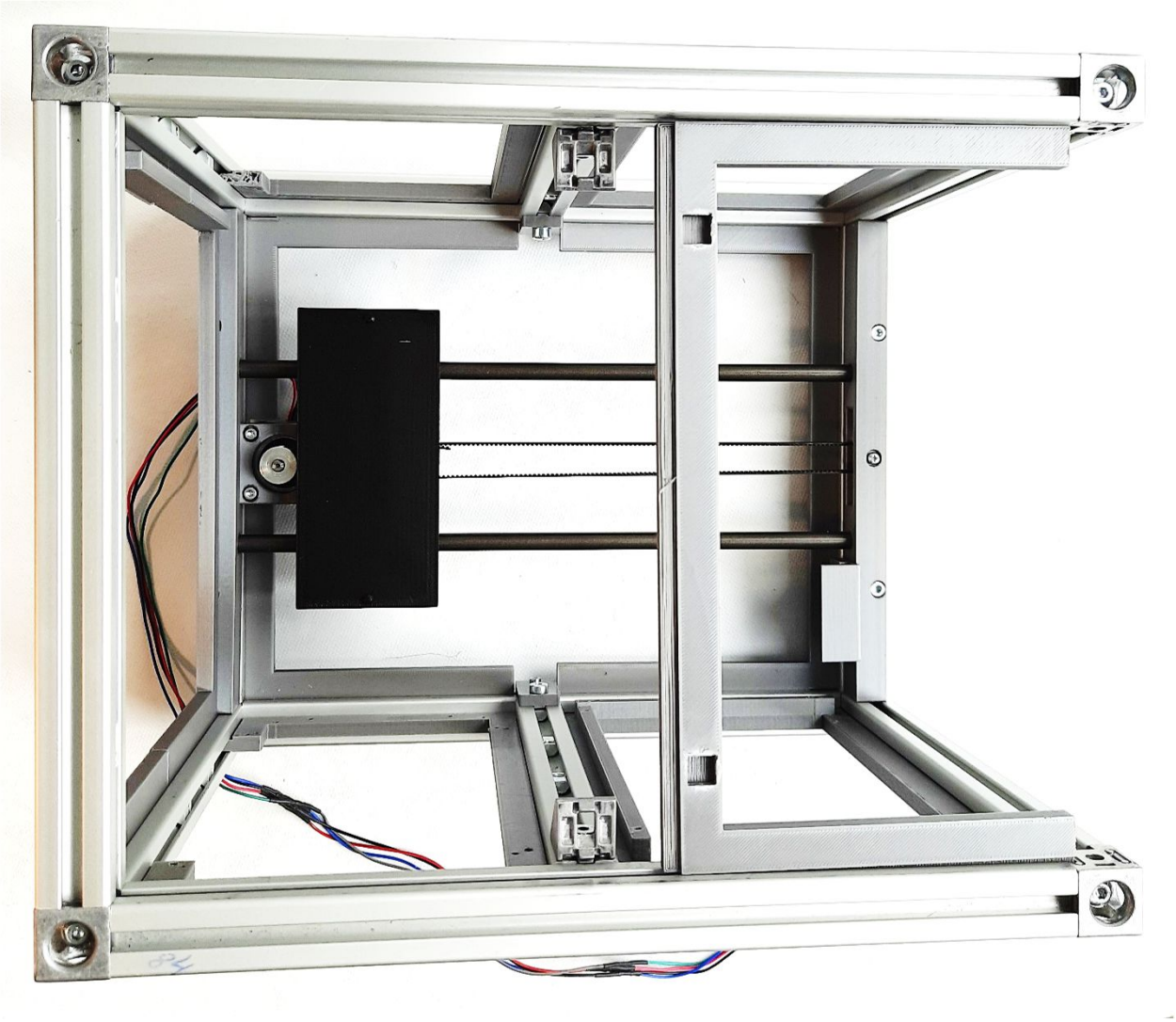
Insert the respective frames.



Top frame

Top frame mounted 4 x screw M5 x 10

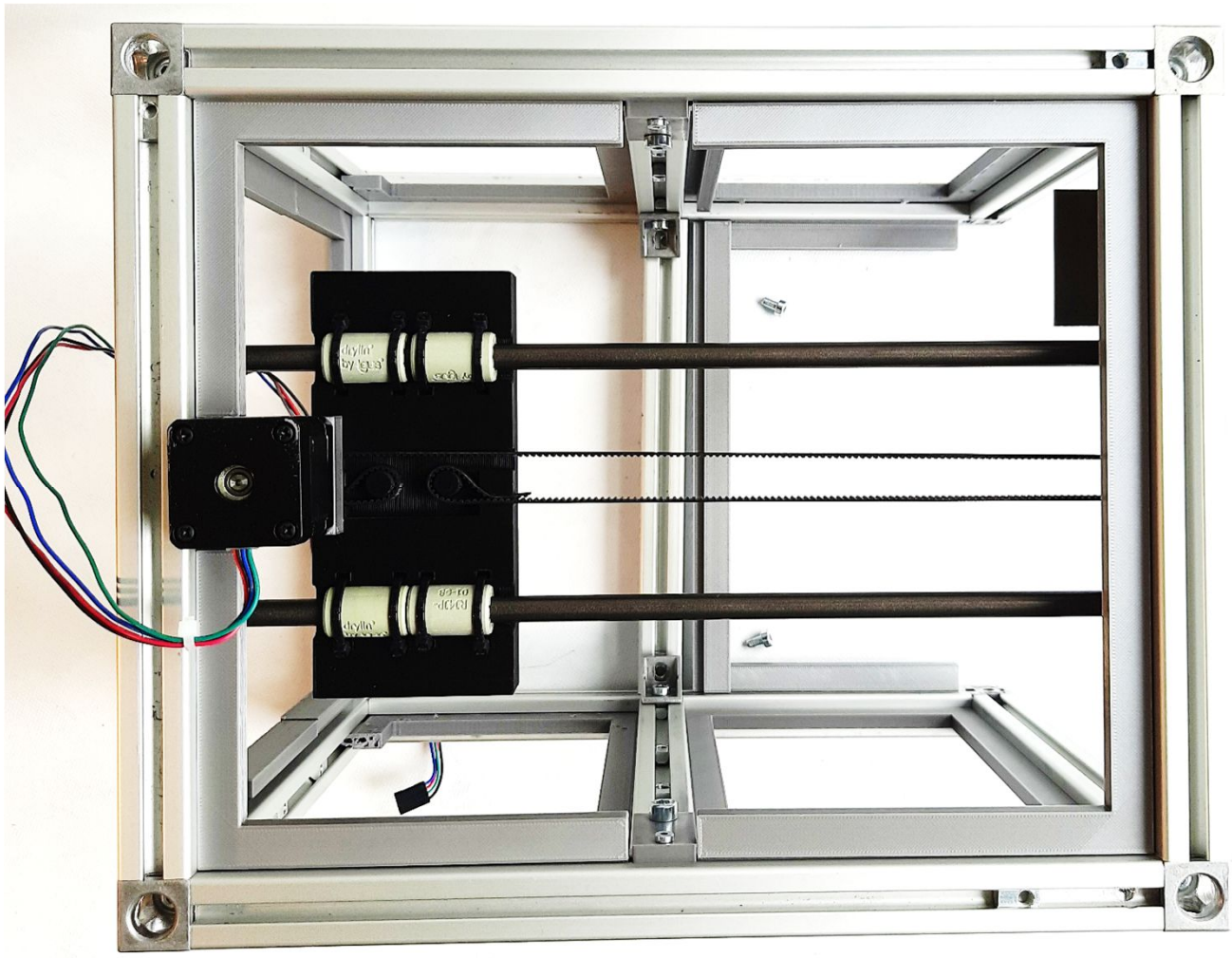
Mount the top farme with 4 screws.



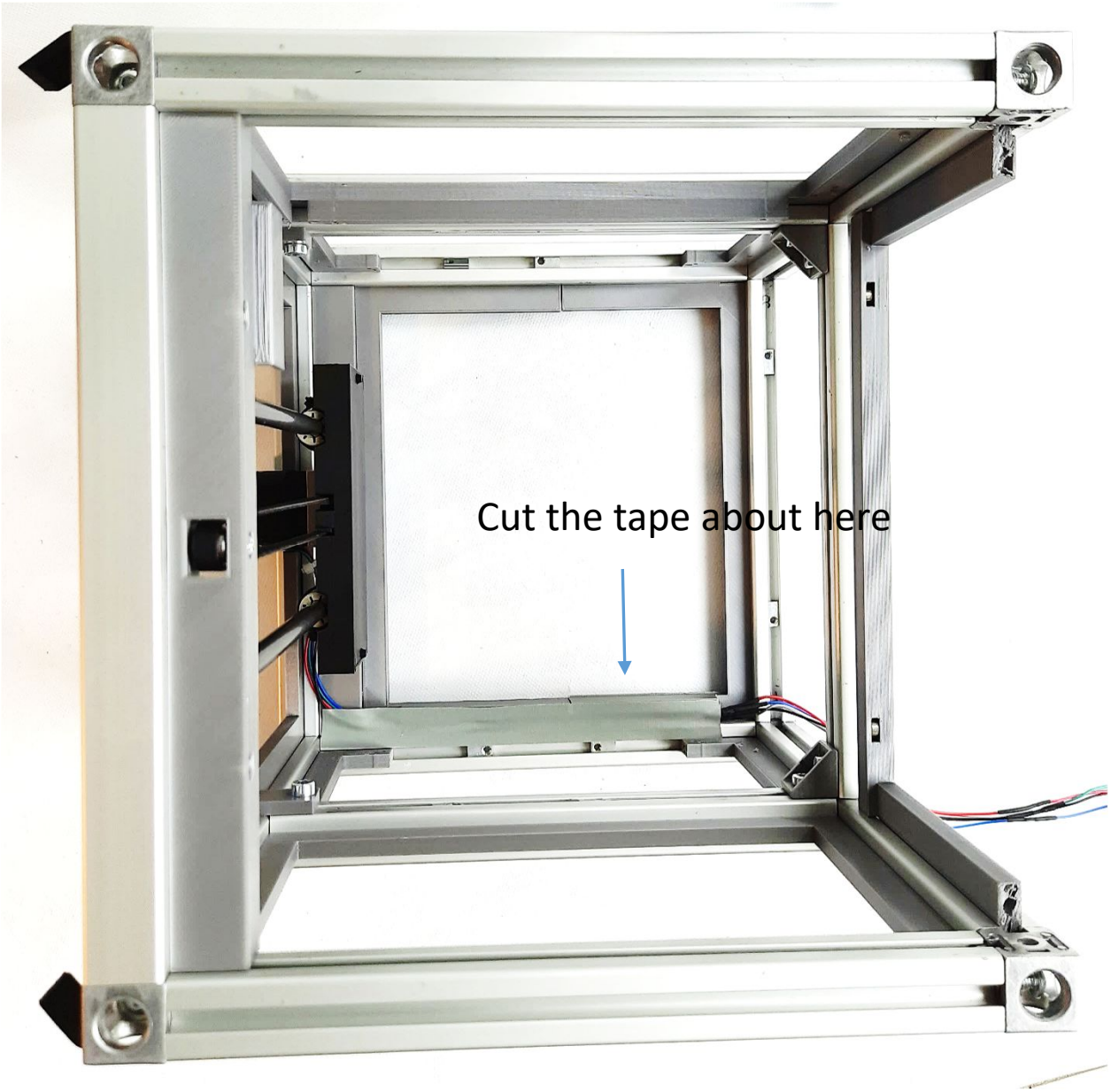
Top frame, continued

X-profile top center mounted with 2 brackets
2 x screw M5 x 6

Turn the buttom of the cage top and mount the top center profile with the frame with 2 screws.



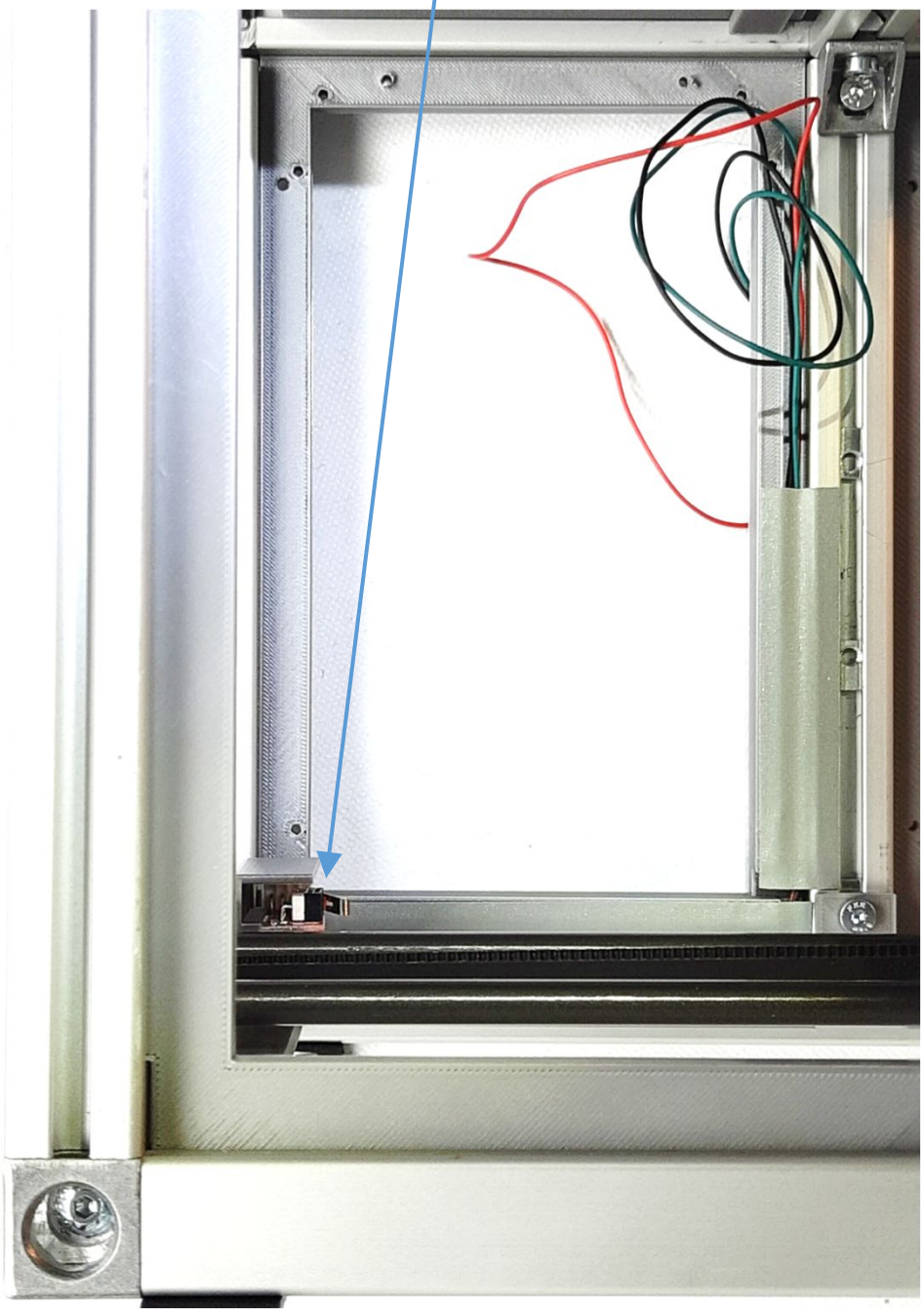
Guide the Y-motor cables through the back cable channel and fix them with a tape.



Y-endstop

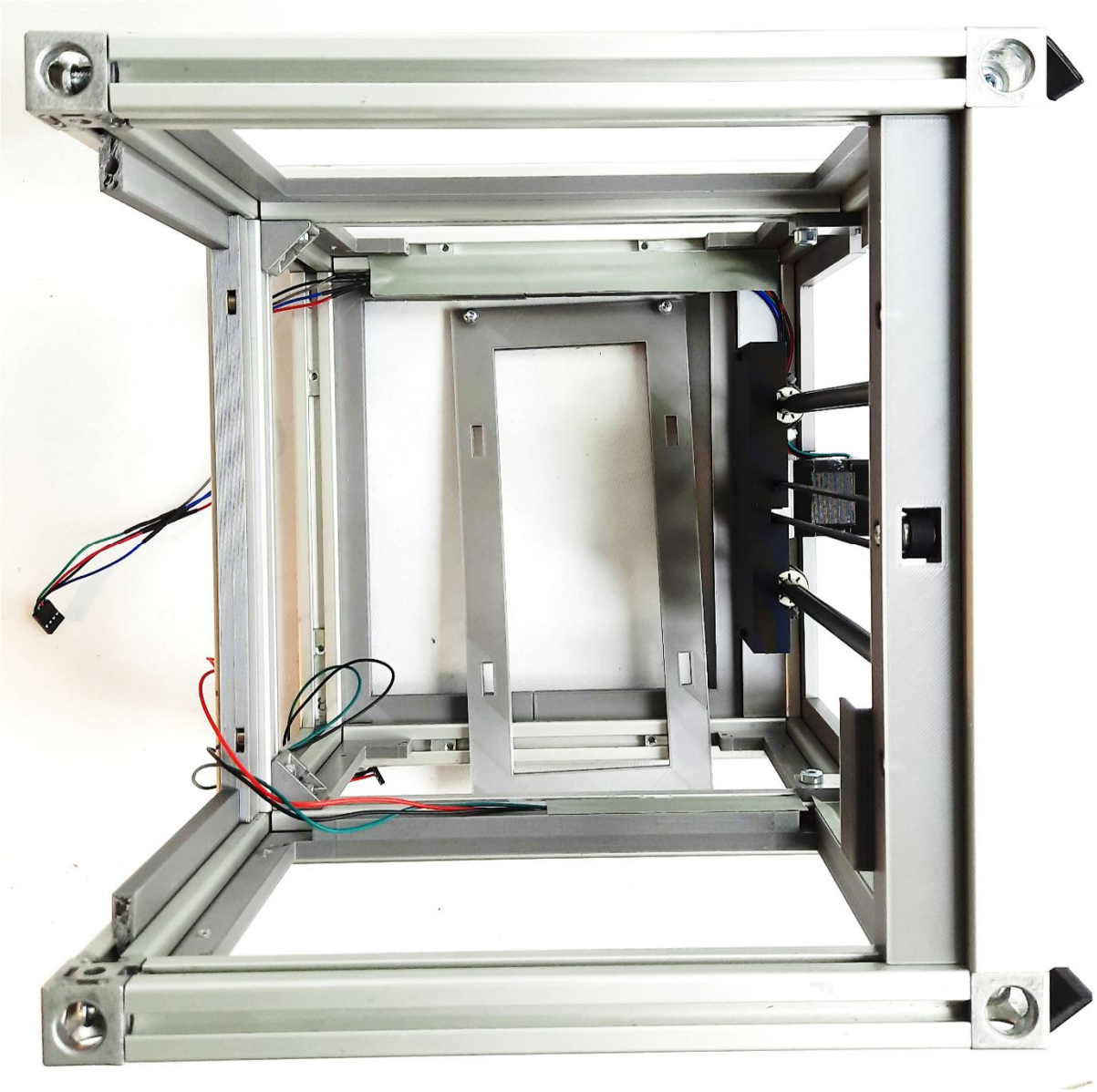
1 x mechanical endstop boards kit

Insert the endstop into the Y-end.
Guide the cables along the left frame and the left cable channel, and fix them with a tape.

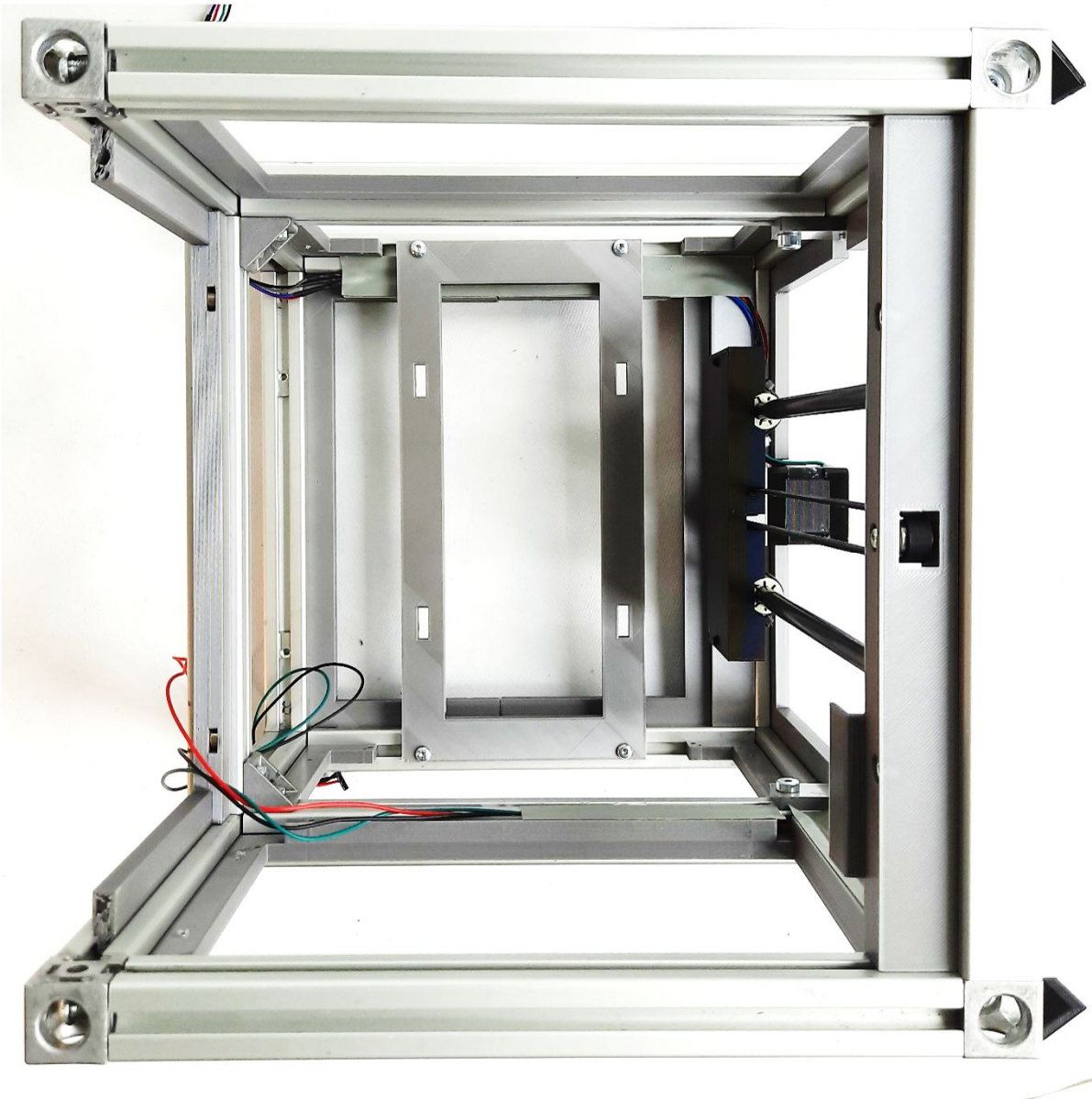


Camera tower holder

4 x M4 x 6 mm
Printed part: mounting_frame



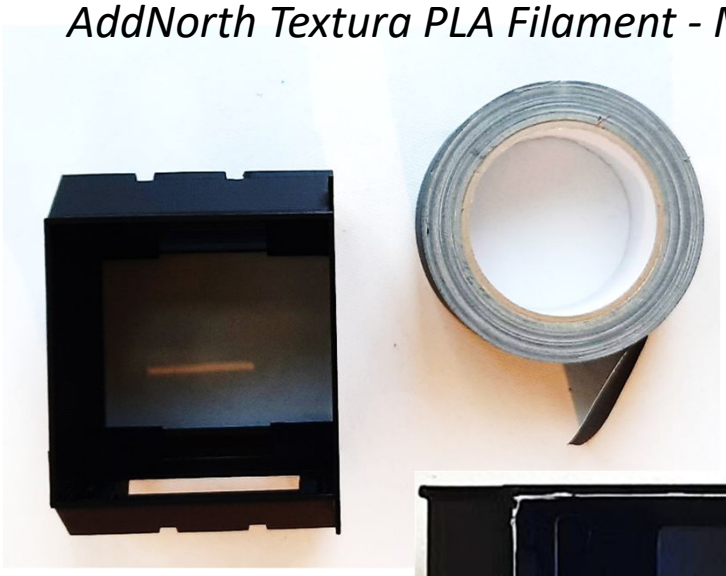
Ready mounted, fix the screws only slightly, allowing to move the holder.

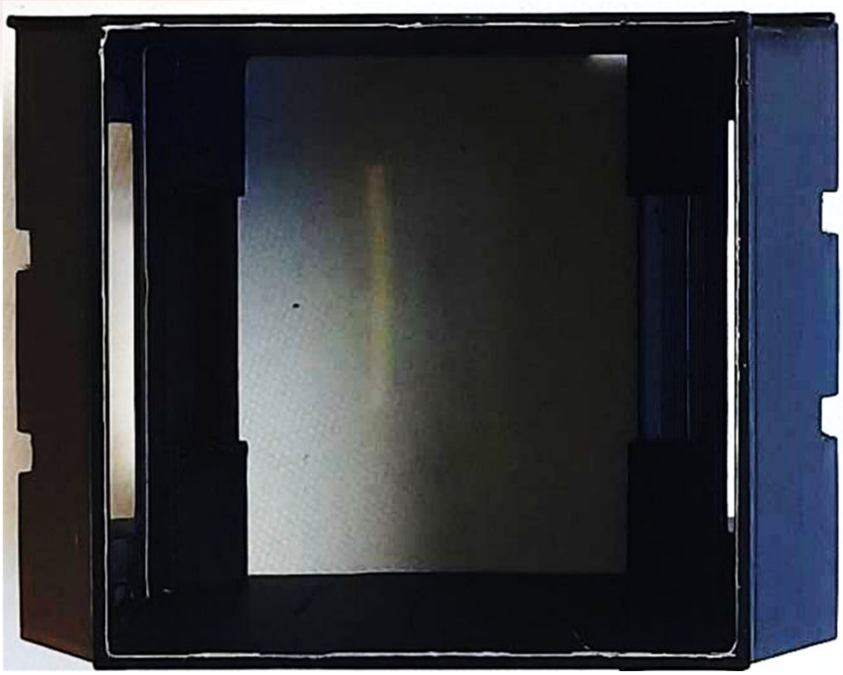


Camera tower

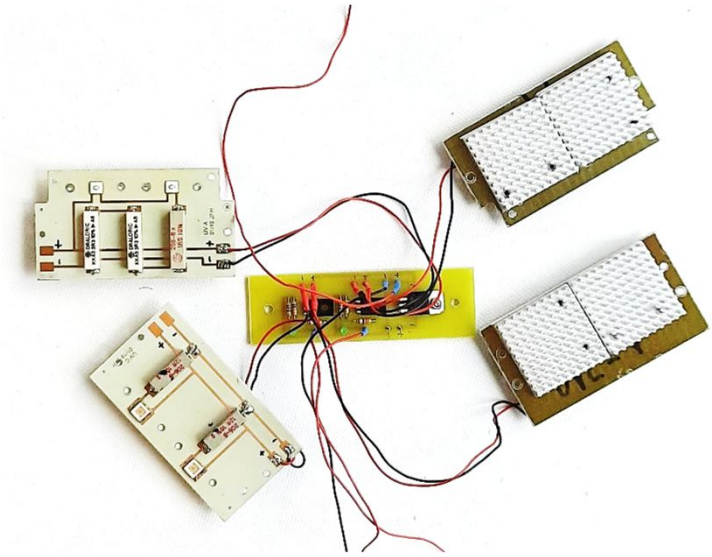
Printed part: camera_tower
Matte black tape, 50 mm
UVA- and UVC-LED boards (see attached Eagle files)
2 black glass filters, like HEBO HU 02, 50 x 50 x 3 mm
1 black glass filter, like HEBO HU 01, 50 x 50 x 1 mm
Screws: 10 x SPAX 2.5 mm, 4 x M4 x 6 with nuts

Line the inside of the tower with the matte black tape, as far as possible. This is to prevent light reflections at the walls. Alternatively, print the tower with a matte filament like *AddNorth Textura PLA Filament - Matte Black*.

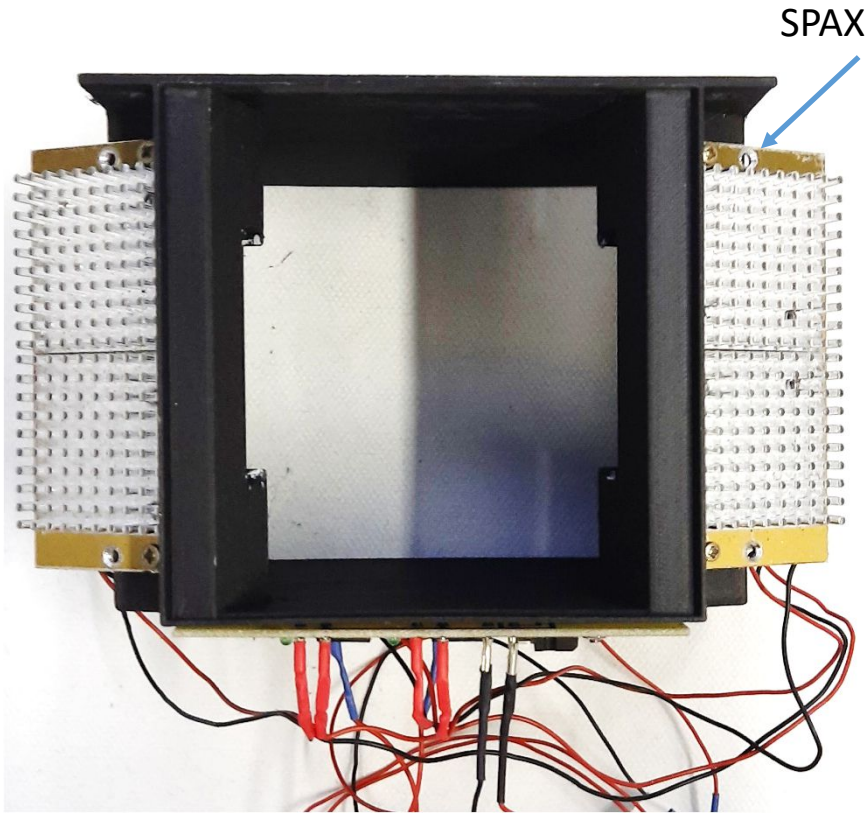


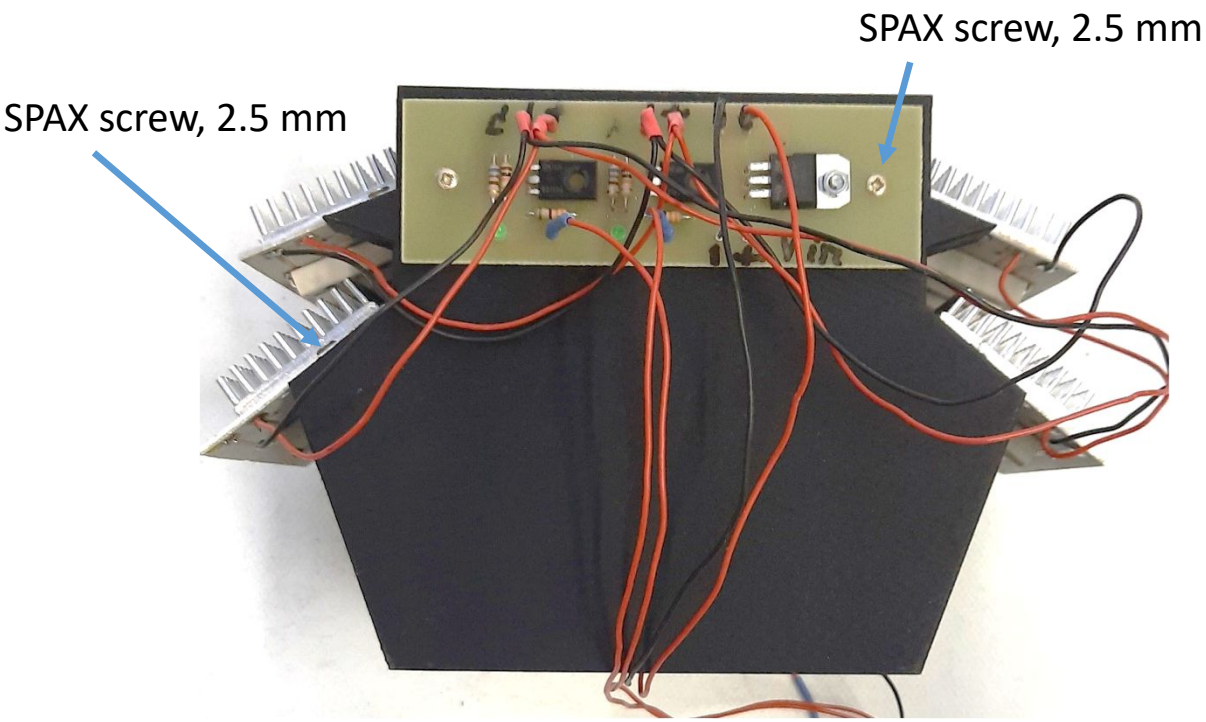


Connect the cables to the central supply board (see attached descriptions „cables and more“).

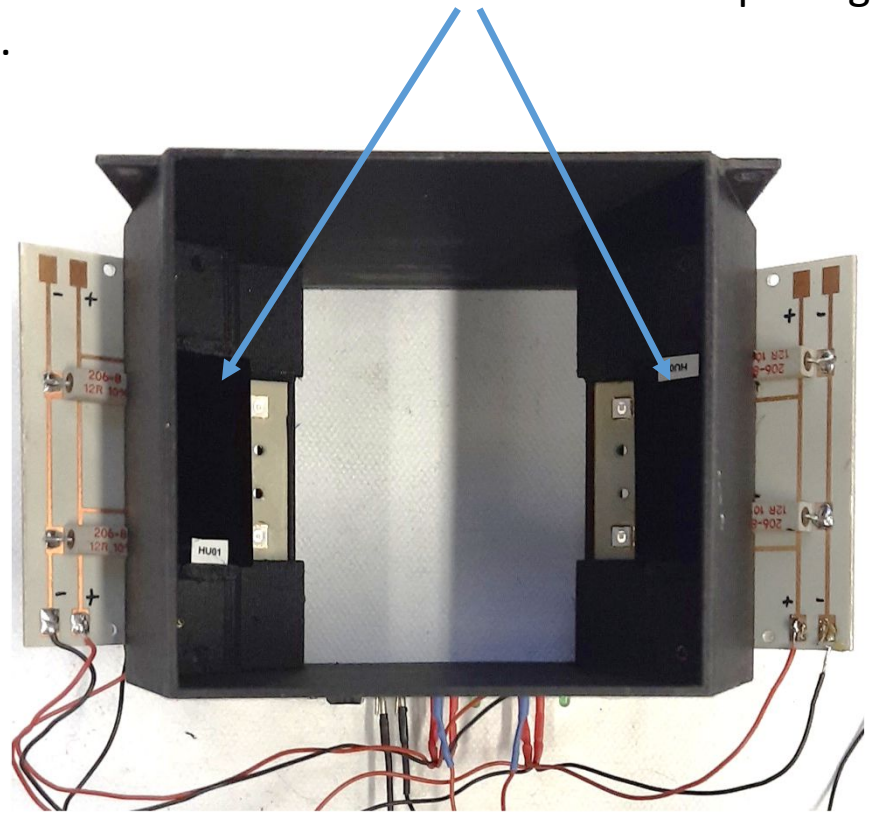


Insert the LED boards (UVA at the top) and fix them with screws.
Mount the central supply board in front of the tower with 2 screws.



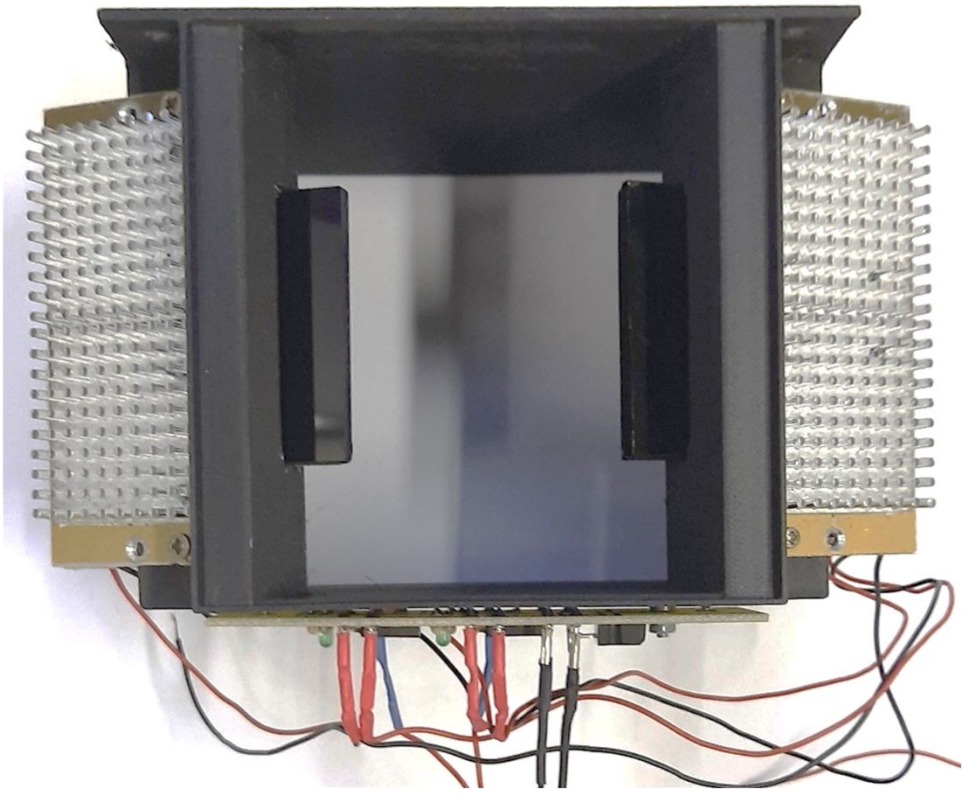


From the 1-mm HU 01 glass filter, cut two pieces of 50 x 15 mm and insert them into the lower slits under the openings for the UVC LEDs.

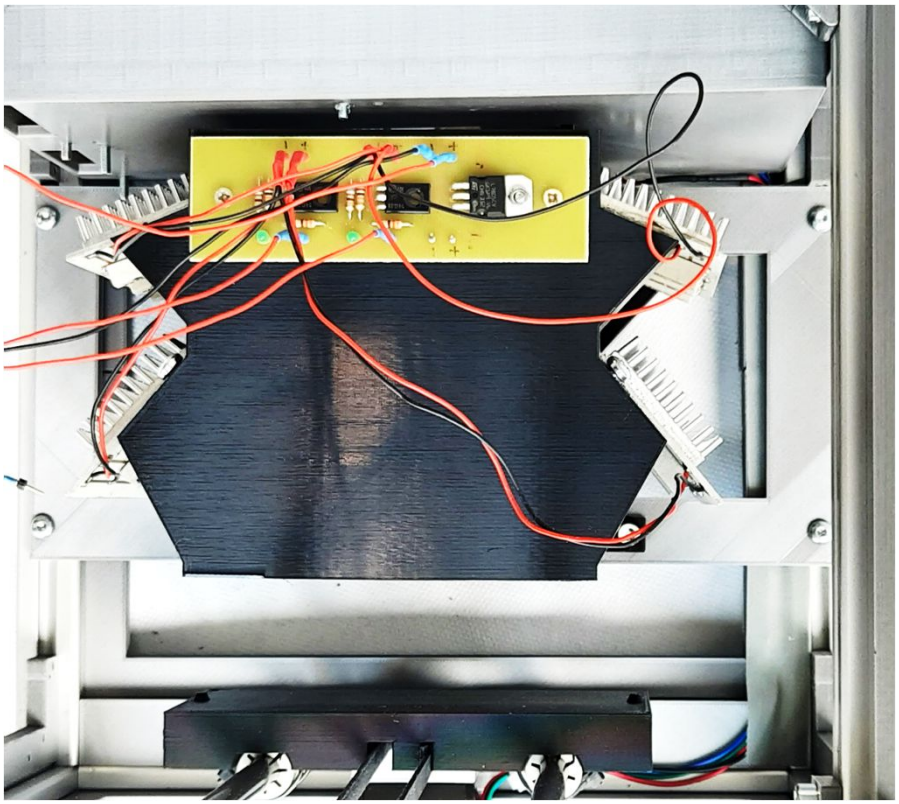


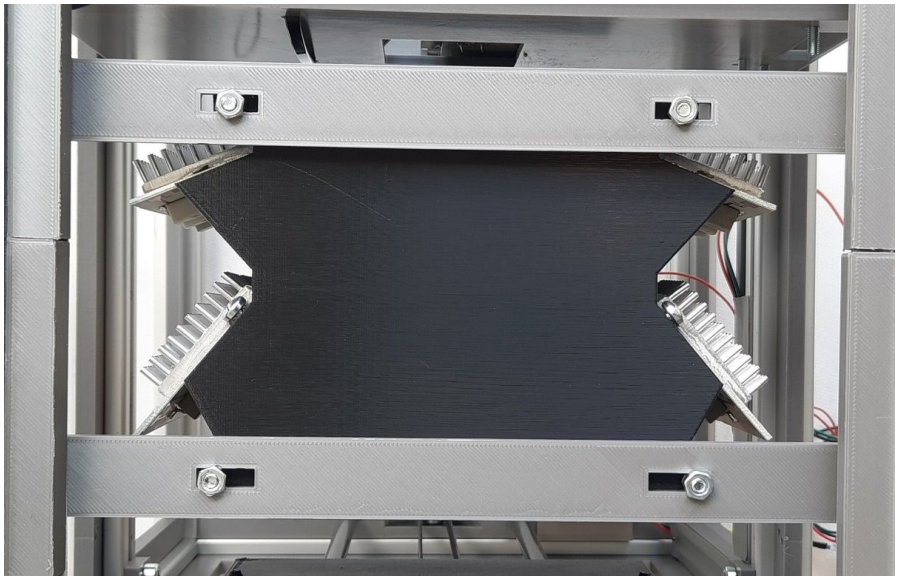
View from the bottom

Cut the 3-mm glass filters in the middle and insert two of them into each upper slit under the openings for the UVA LEDs.

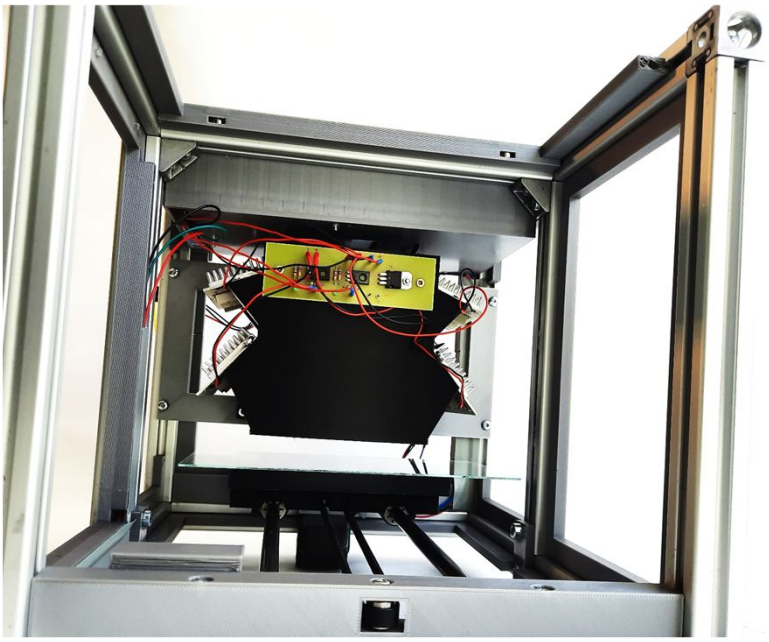


Bring the camera tower in place and fix it at the tower holder with M4 screws and nuts

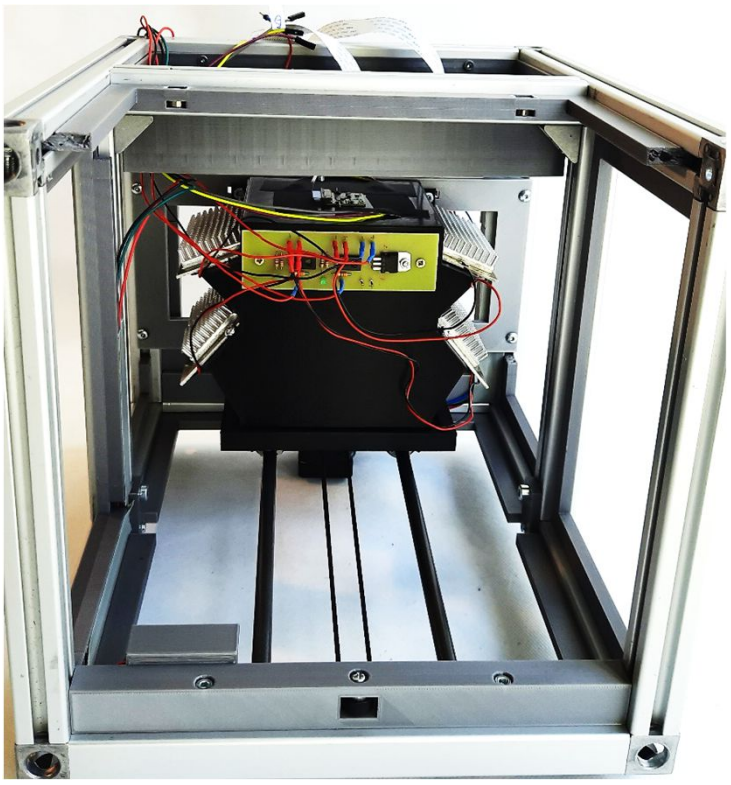




Place the plate holder onto the Y-moving and a glass plate or another plate of about 1 mm onto the plate holder. (Alternatively, use the *tower_distance_check* provided with the *plateholder.scad* file.)



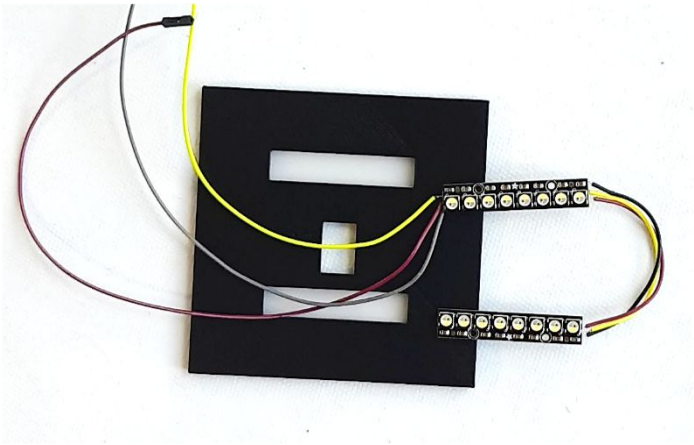
Move the camera tower down onto the glass plate, center it above the plate holder and fix all screws.
Remove the glass plate.



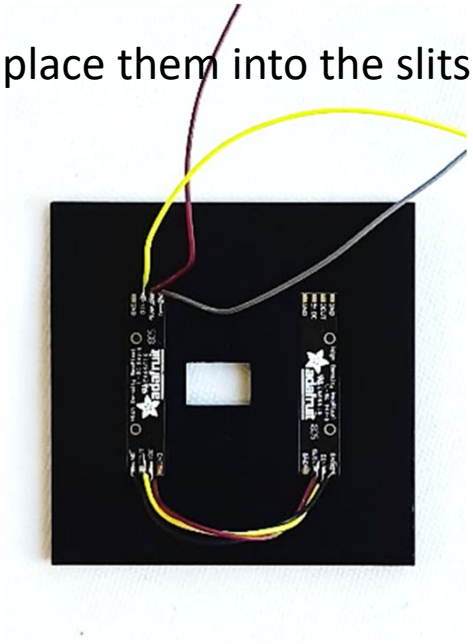
Camera holder

2 x Adafruit NeoPixel Stick - 8 x 5050 RGBW LEDs
Raspberry Pi camera V2.1
Raspberry camera cable 30 cm
Diffusor film, PP, 0.5 mm
Printed parts: camera_holder

Solder the cables (30 cm, jumper female) to the LED sticks,

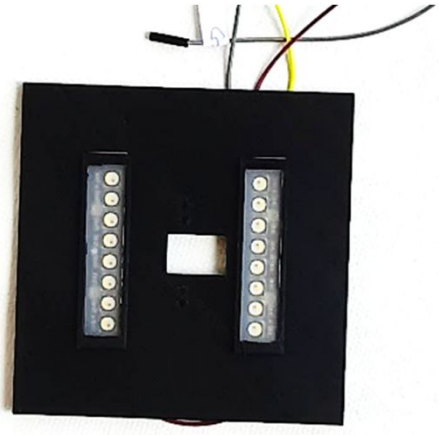


place them into the slits …

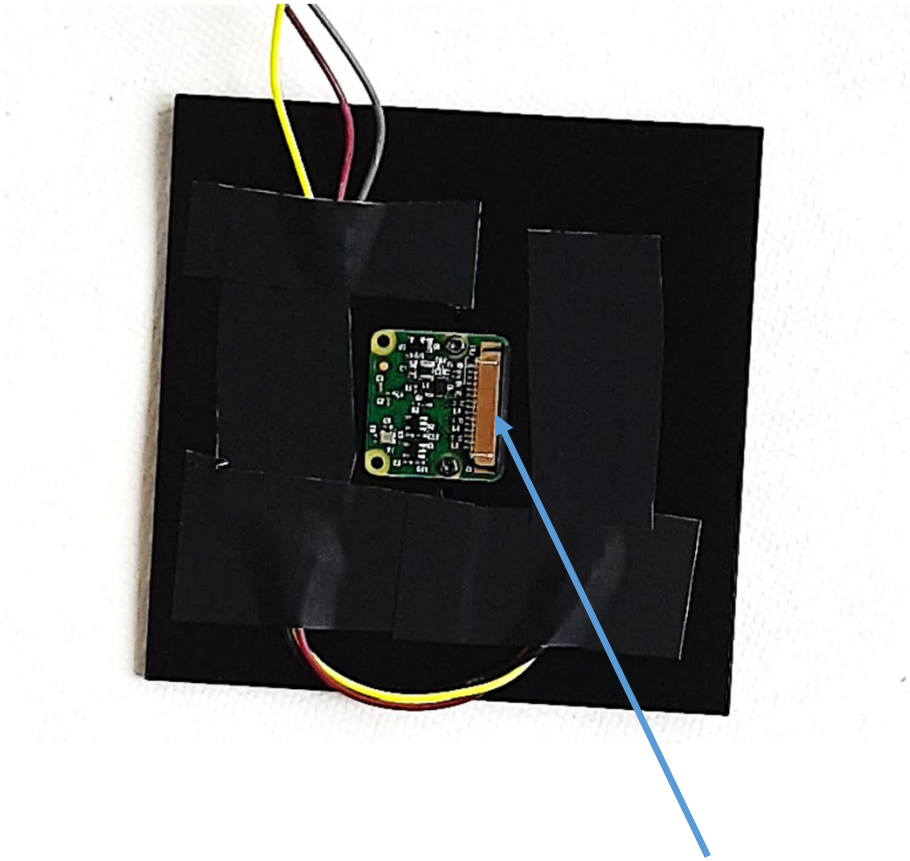


and fix them with tapes.

Insert 2 sandwiches of diffusor films into the holders.



Mount the Pi camera module with 2 small screws (1.5 mm).



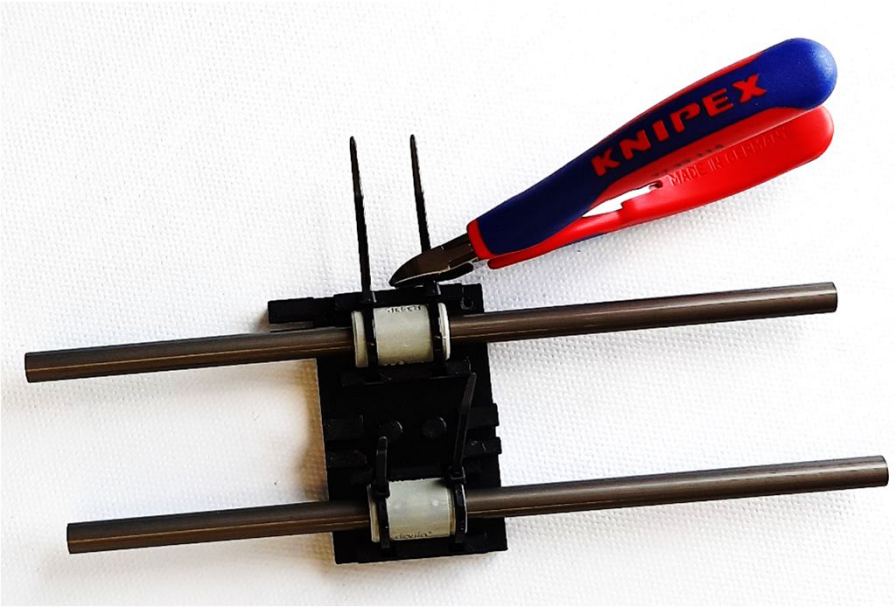
Insert the flat camera cable into the plug and fix it with the plastic clip.

See also:
https://projects.raspberrypi.org/en/projects/getting-started-with-picamera

X-moving

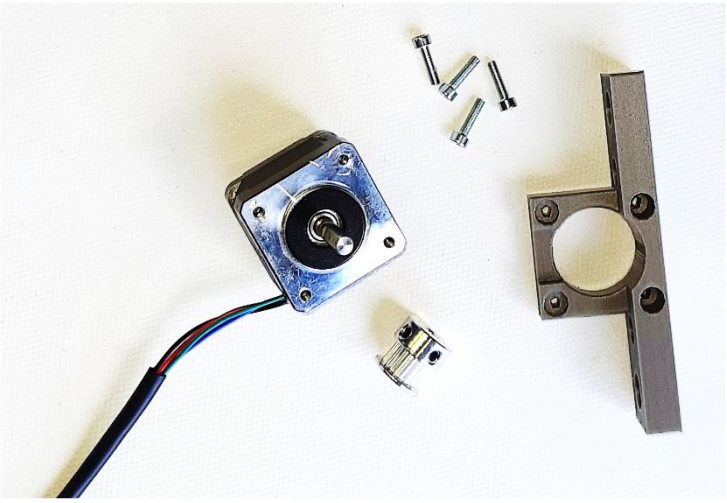
2 x aluminum rod, Ø 8 mm, 205 mm
2 x Igus RJ4JP-01-08 linear bearing
4 x zip ties, 2.5x100 mm
Printed parts: X_moving

Mount the bearings with the zip ties.

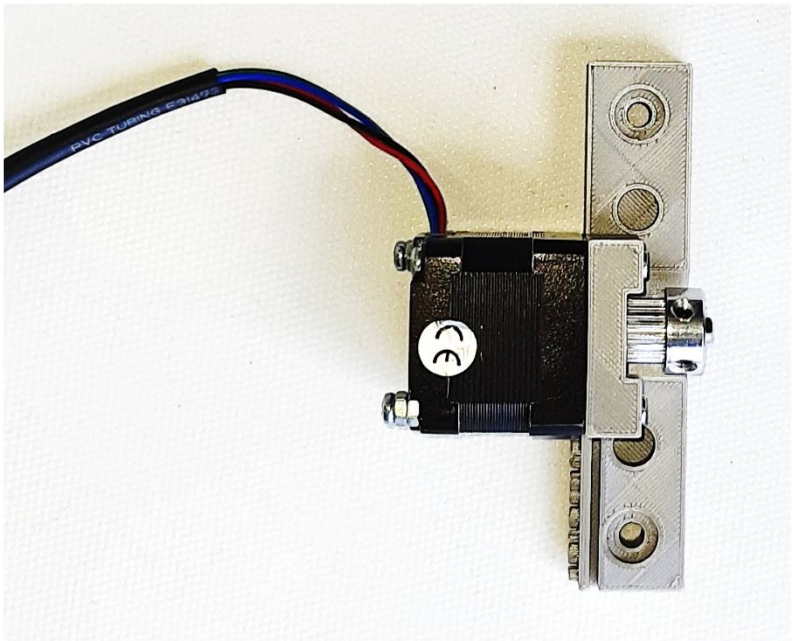


Preparing the X-motor

1 x stepper motor Nema 14
1 x GT2 pulley 20 teeths
4 x screw M3 x 10 DIN 912
Printed part: X_motor

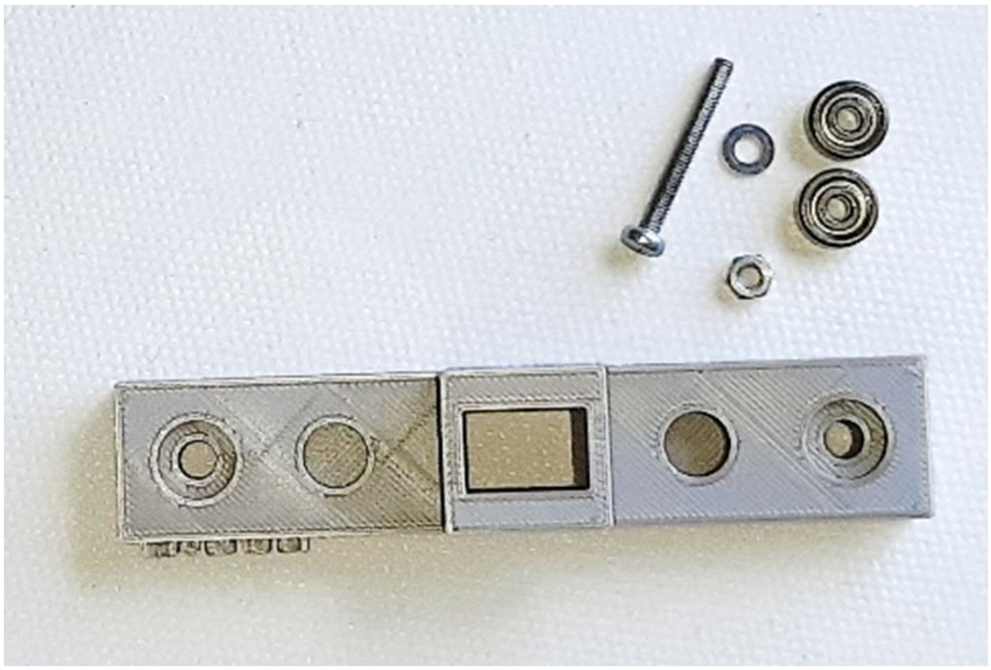


Ready mounted

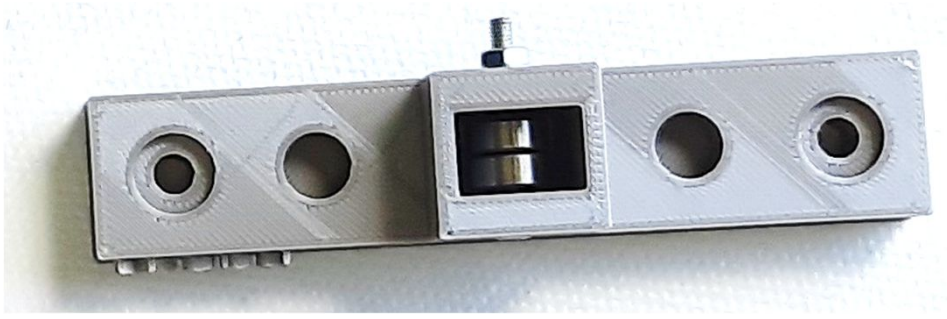


Preparing the X-end

2 x 623ZZ ball bearing: 3x10x4 mm
1 x screw M3 x 25 DIN 912 with nut
Printed part: X_end

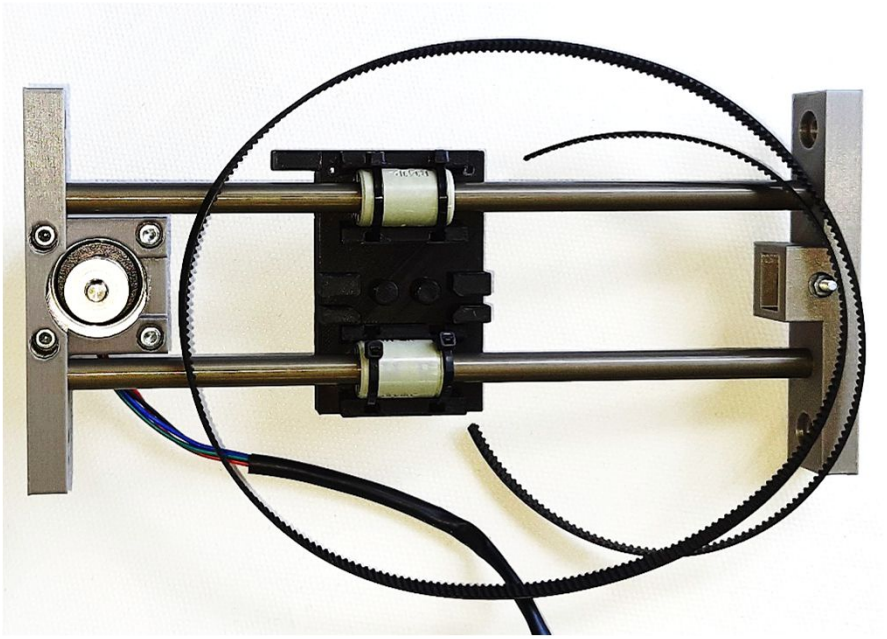


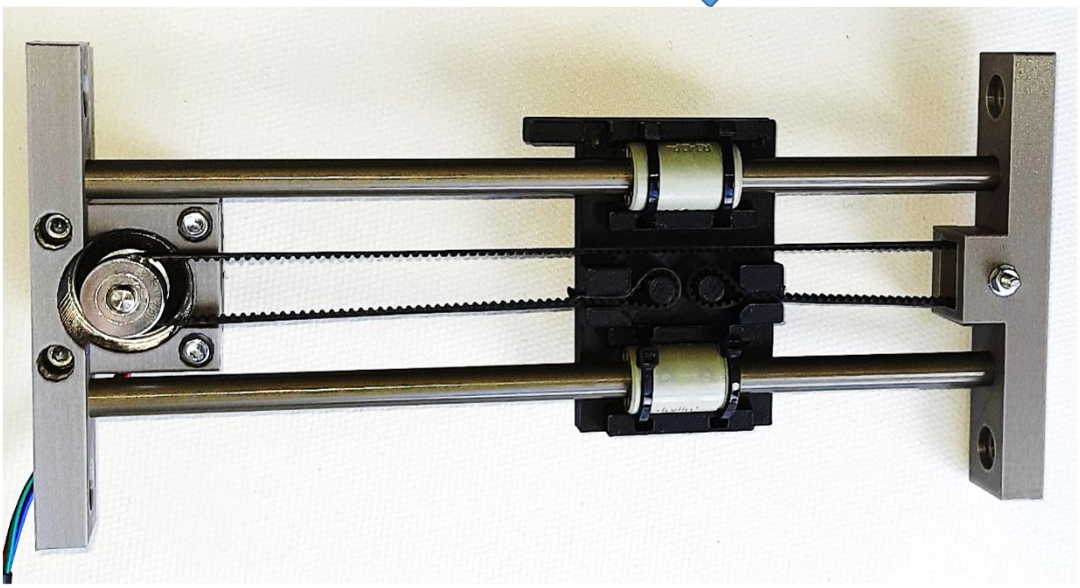
Ready mounted



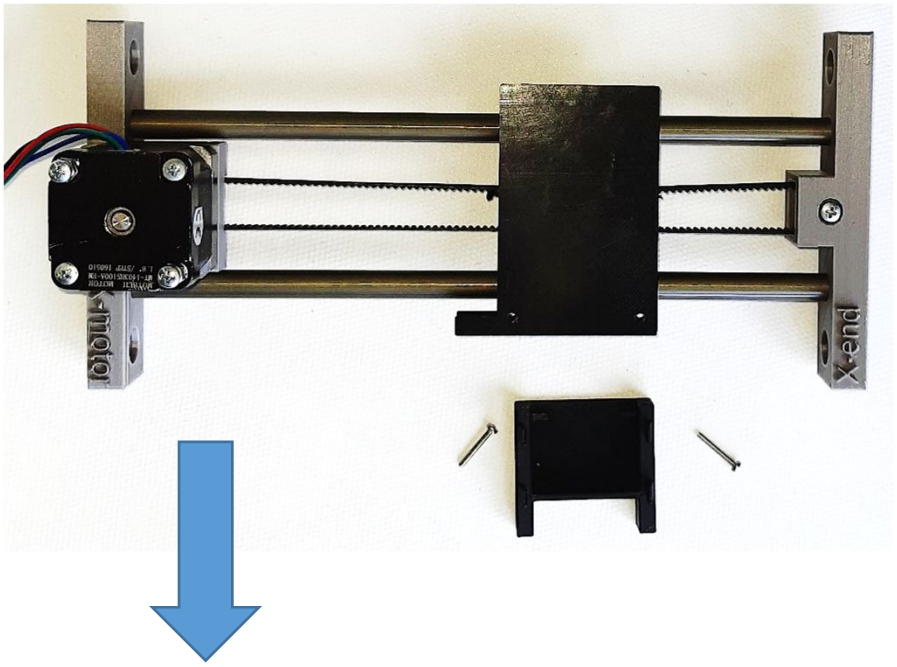
Preparing the X-moving

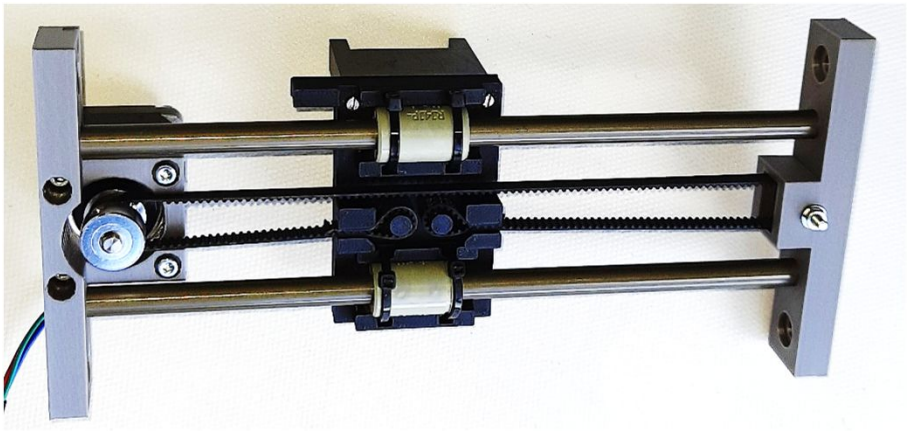
X-motor and X-end mounted
X-moving mounted
GT2 Timing belt 6 mm, 1 m
2 screws M2 x 10 mm, 2 screws M5x10 mm
1 end stop
Printed part: printhead_bottom

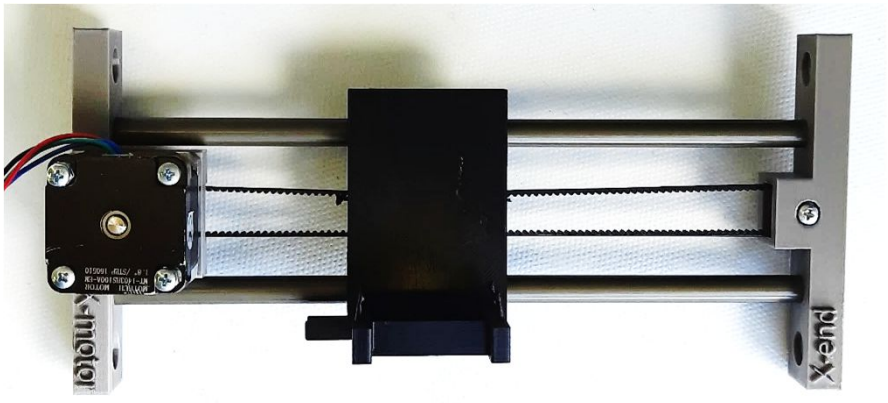




Mount the printhead_bottom with 2 screws.







Bring the mounted X-moving into place and fix it with 4 M5x10 screws.

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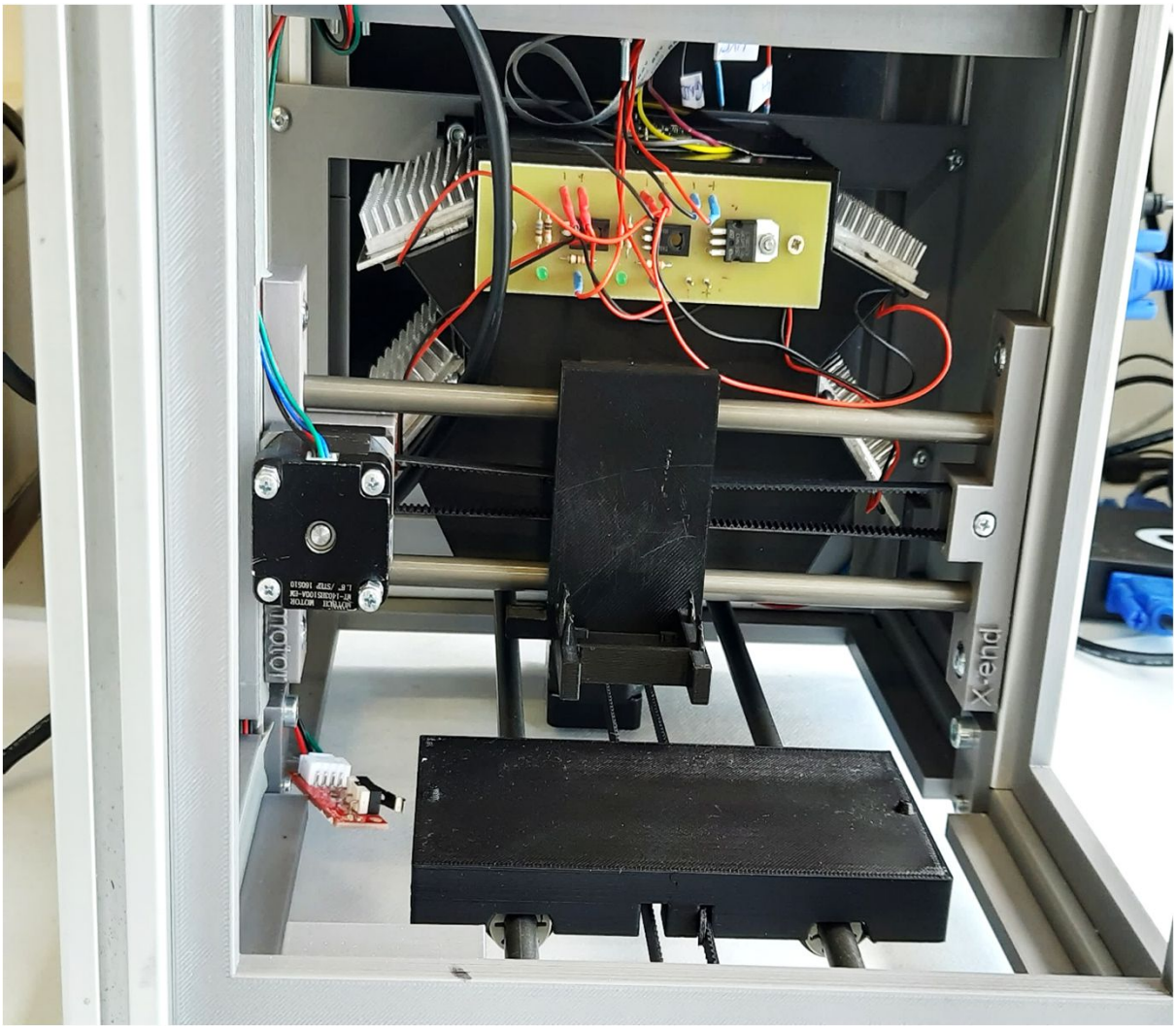
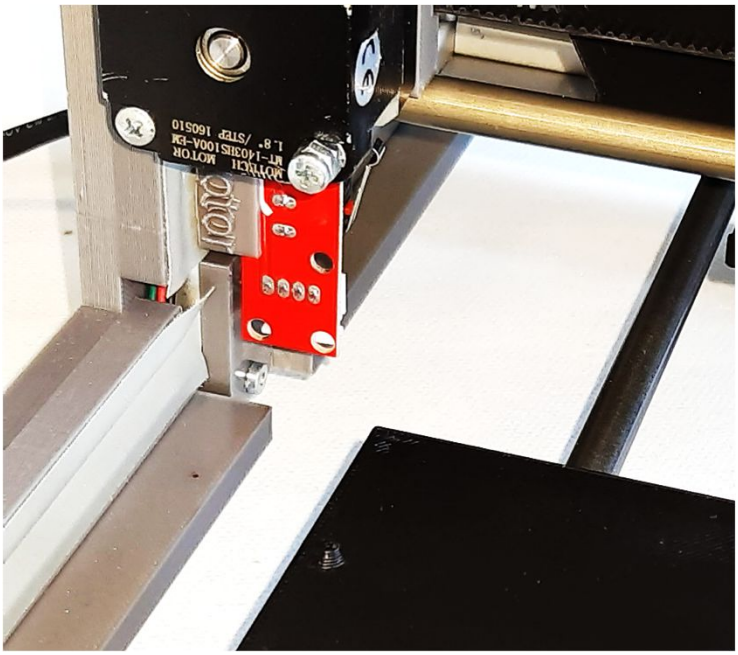


Insert the end stop and guide the cables into the electronic housing.



Place the board with the spring contacts into the printhead_bottom, guide the cable into the electronic housing, and fix the cable with a tape onto the X-moving.

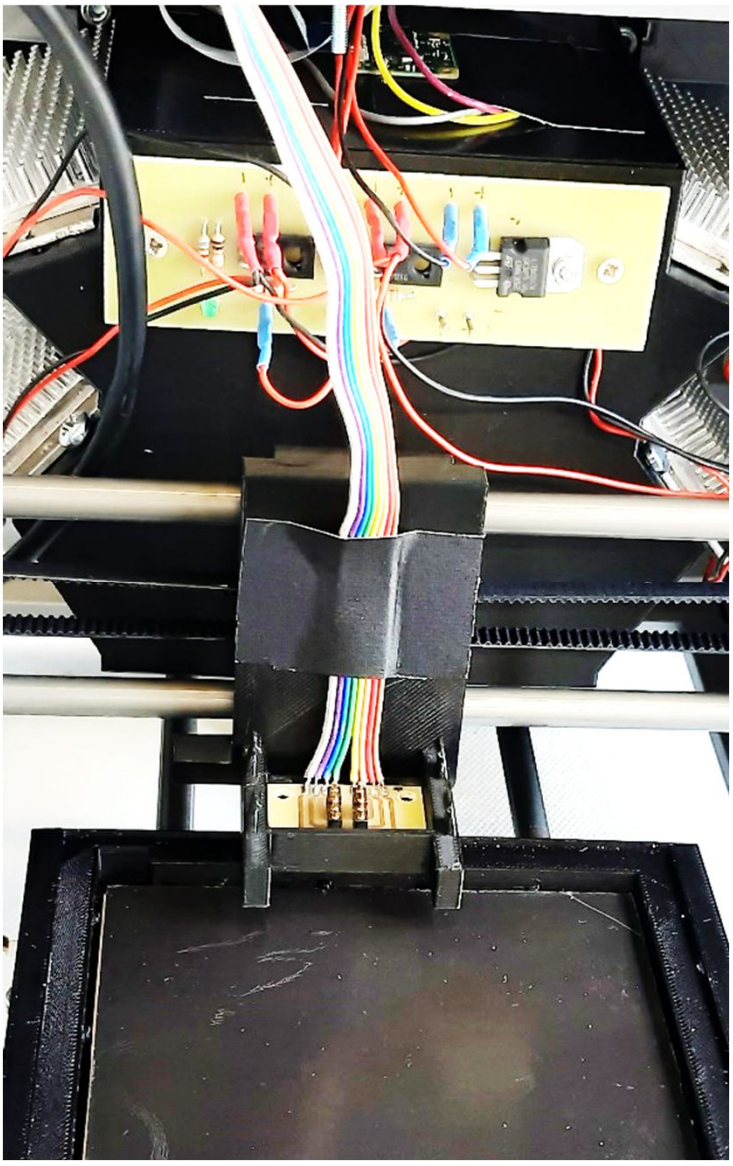
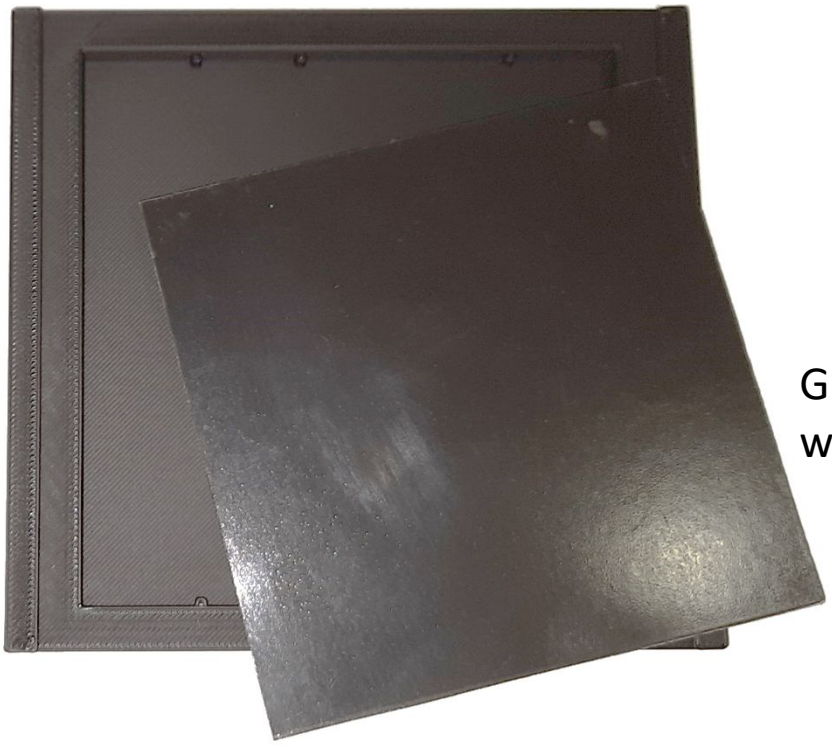


Plate holder

4 x magnets Ø 8 mm x 3 mm
Ferro foil plain brown uncoated, sticked onto a glass plate, 100 mm x 100 mm
Printed part: Y_moving/plate_holder

Consider the polarity of the magnets! Therefore, place them above the magnets of the Y-moving and press them in parallel into the slits of the plate holder.



Glass plate
with ferro foil

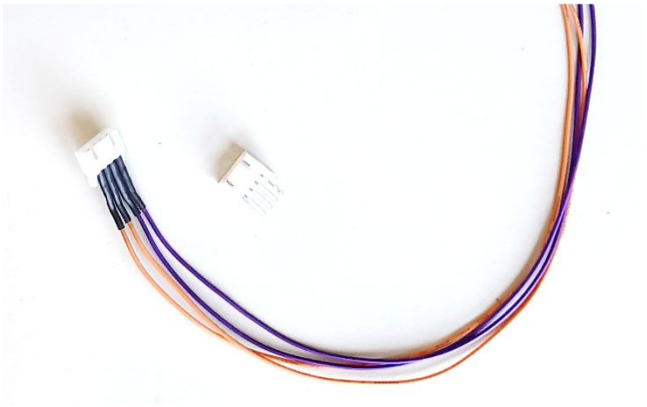
The idea is to fix HPTLC plates smaller than 100 mm x 100 mm with magnets.

Heated plate holder

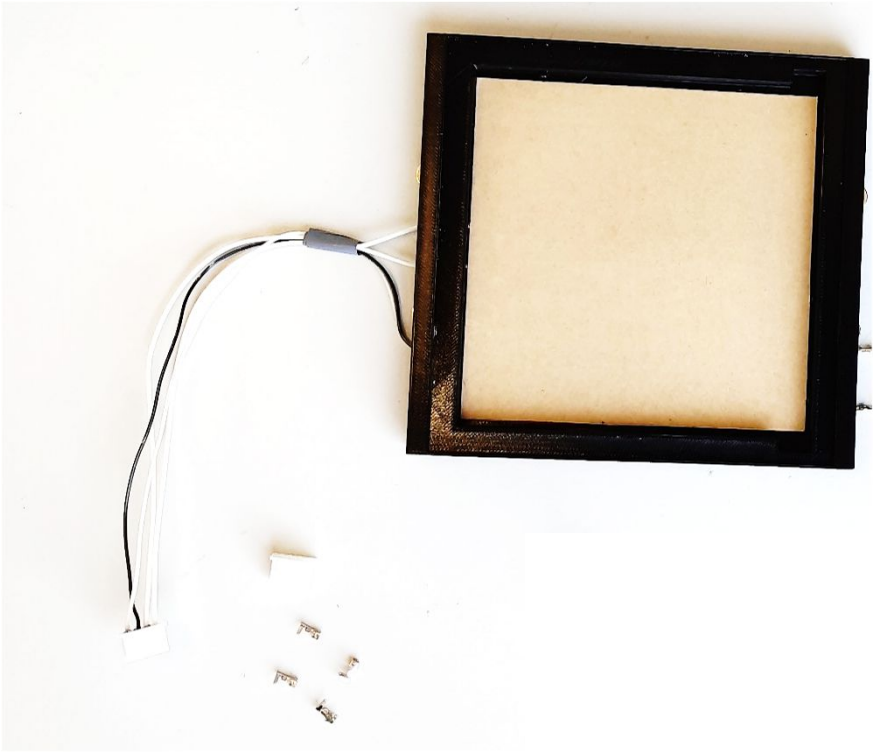
Heating mat, 100 mm x 100 mm
NTC Thermistor
Socket housing, 1x4-pin, pin header, straight, 1x4-pin, crimp contact, socket-XH
6 Jumper wires female-to-female, 25 cm
4 Jumper wires male-to-female, 15 cm
Ferro foil plain brown uncoated
Glass plate, 100 mm x 100 mm x 1 mm
Printed parts: plateholder_heating_mat

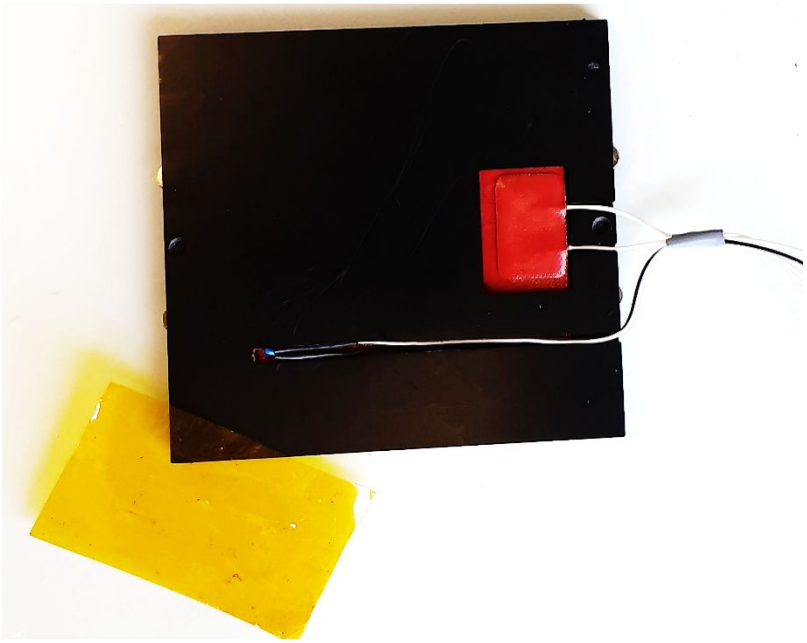
Solder 2 jumper wires (25 cm) to the thermistor and protect the connections with heat shrink tubings.

Solder the 4 jumper wires (25 cm, extended with 4 wires 15 cm) to the pin header and protect the connections with heat shrink tubings.

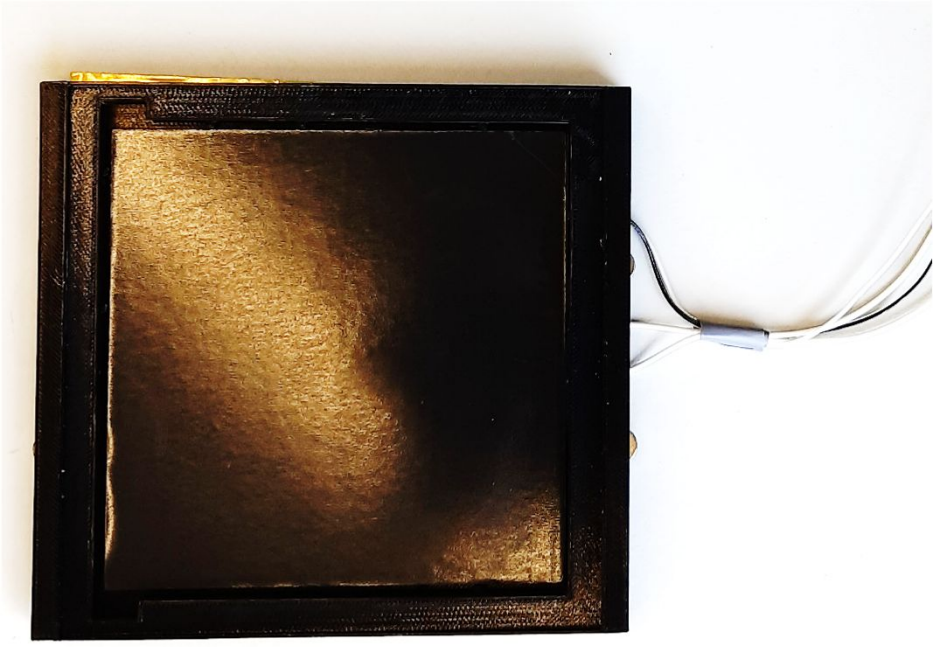


Place the heating mat and the thermistor into the plate holder and fix the thermistor with a thin tape.
Cut the 4 cables at 20 cm outside the plate holder, mount the crimp contacts, and insert them into the socket housing.



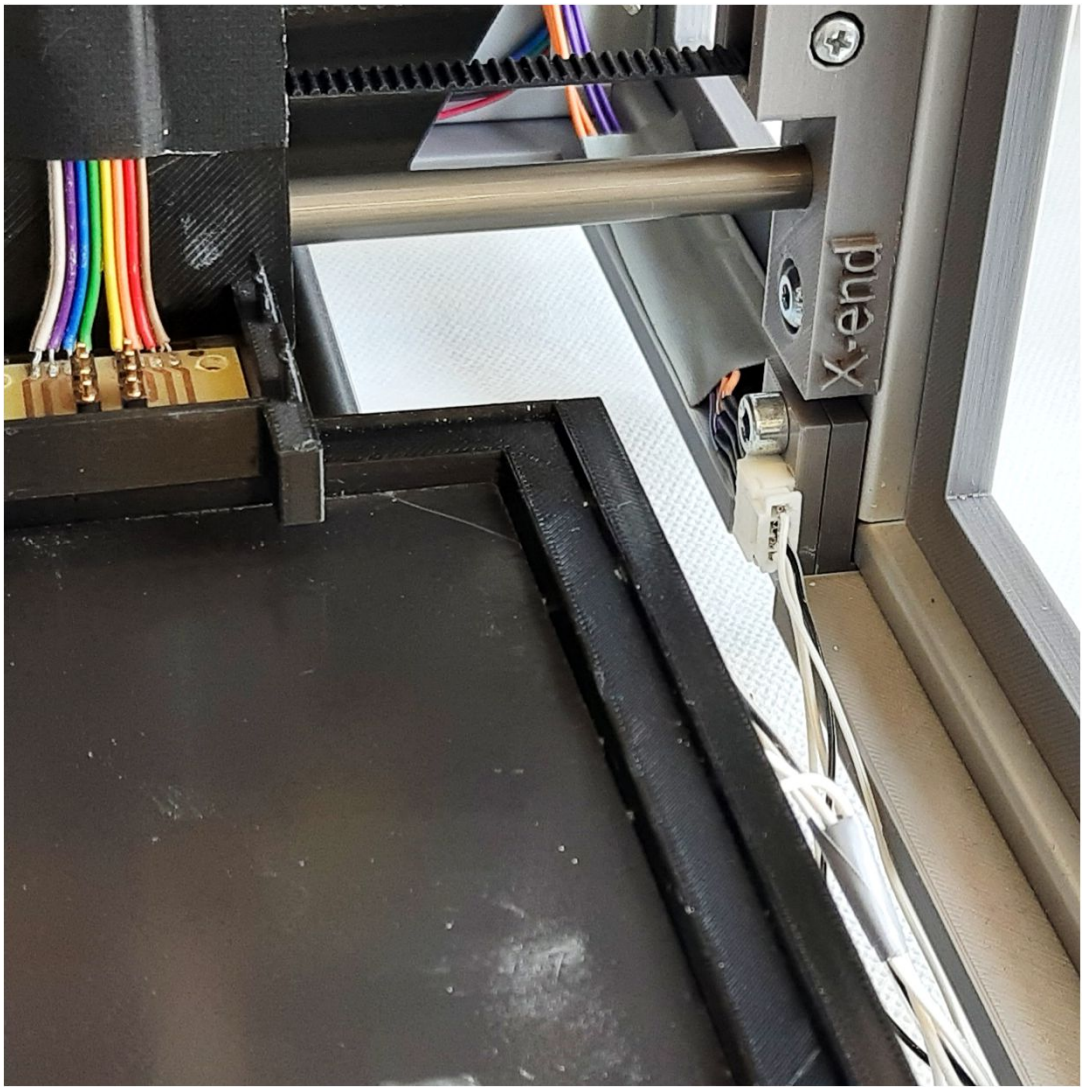


Cut the ferro foil to roughly 11 cm x 11 cm and fix it onto the glass plate. Cut the overlaying foil along the edges of the glass plate.
The coated glass plate is placed into the plate holder (with or without heating mat).



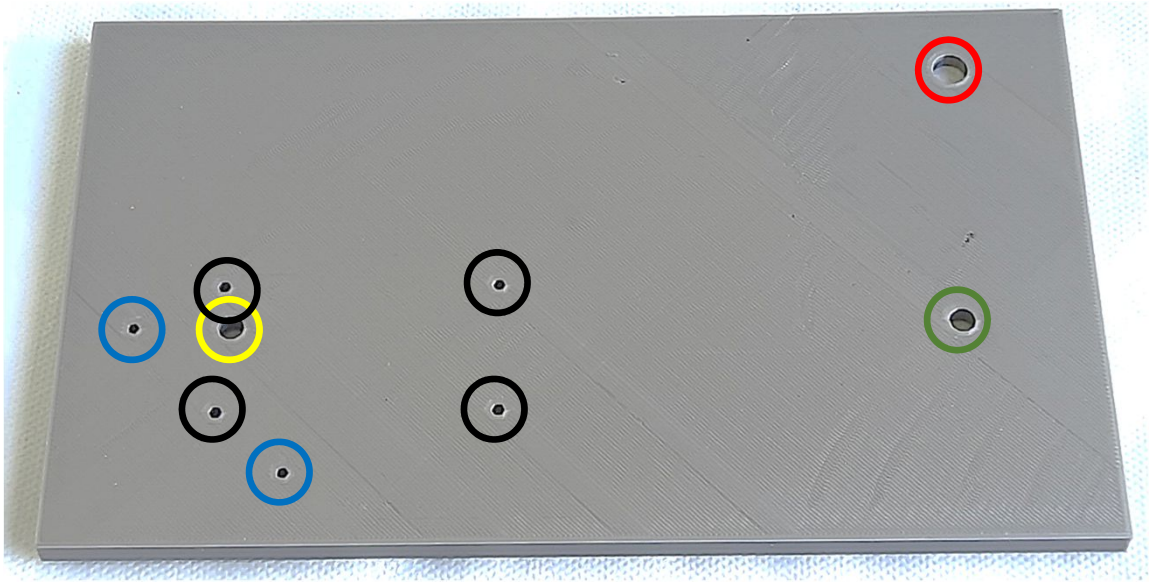
Fix the pin header with a drop of glue onto the plate_heating_connector and mount it over the connector_z_axis (10 mm screws).
Guide the cables into the electronic housing while fixing them with tape.

Plug the heated plate holder.



Faces

Drilling jig



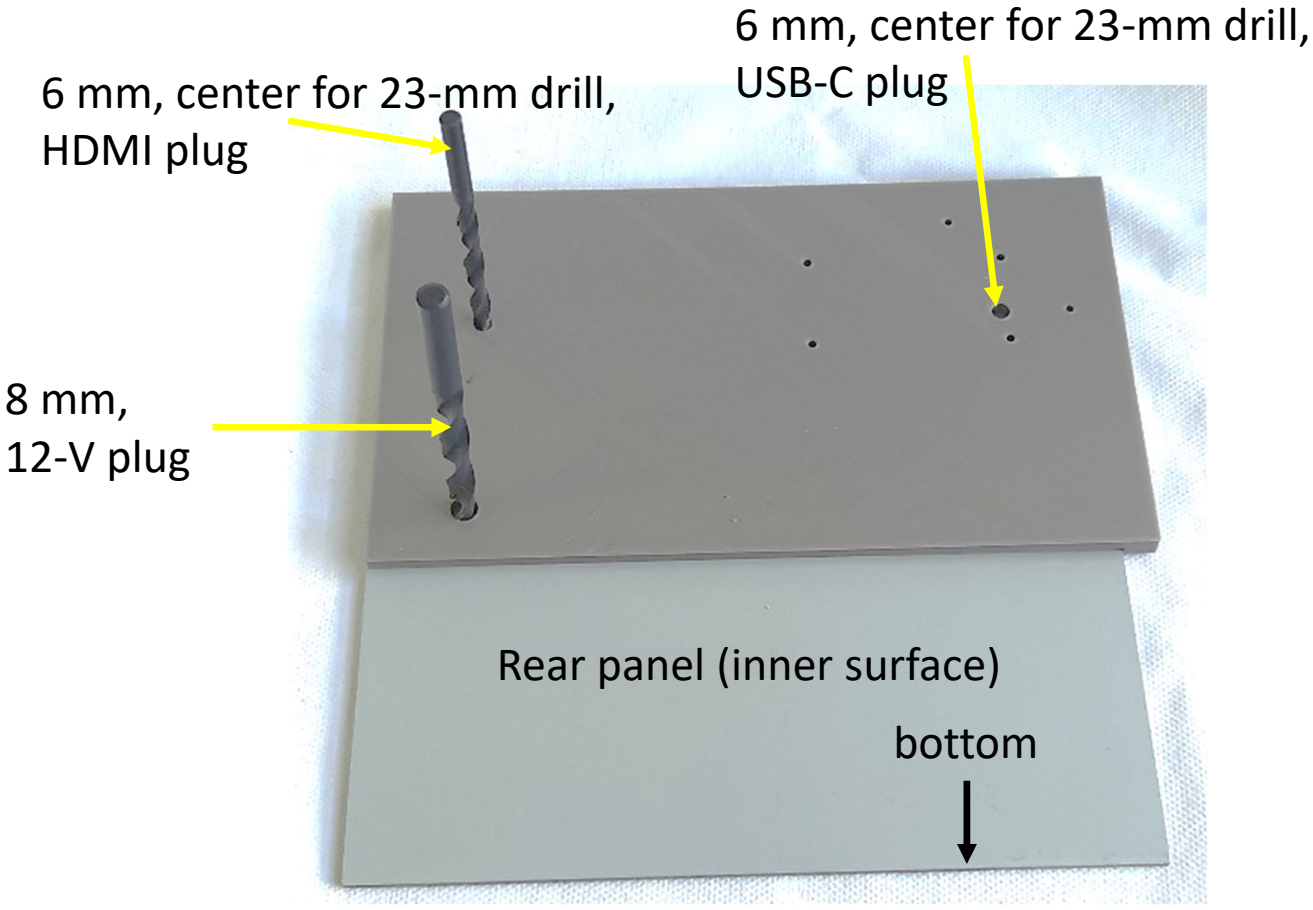
Mounting the faces

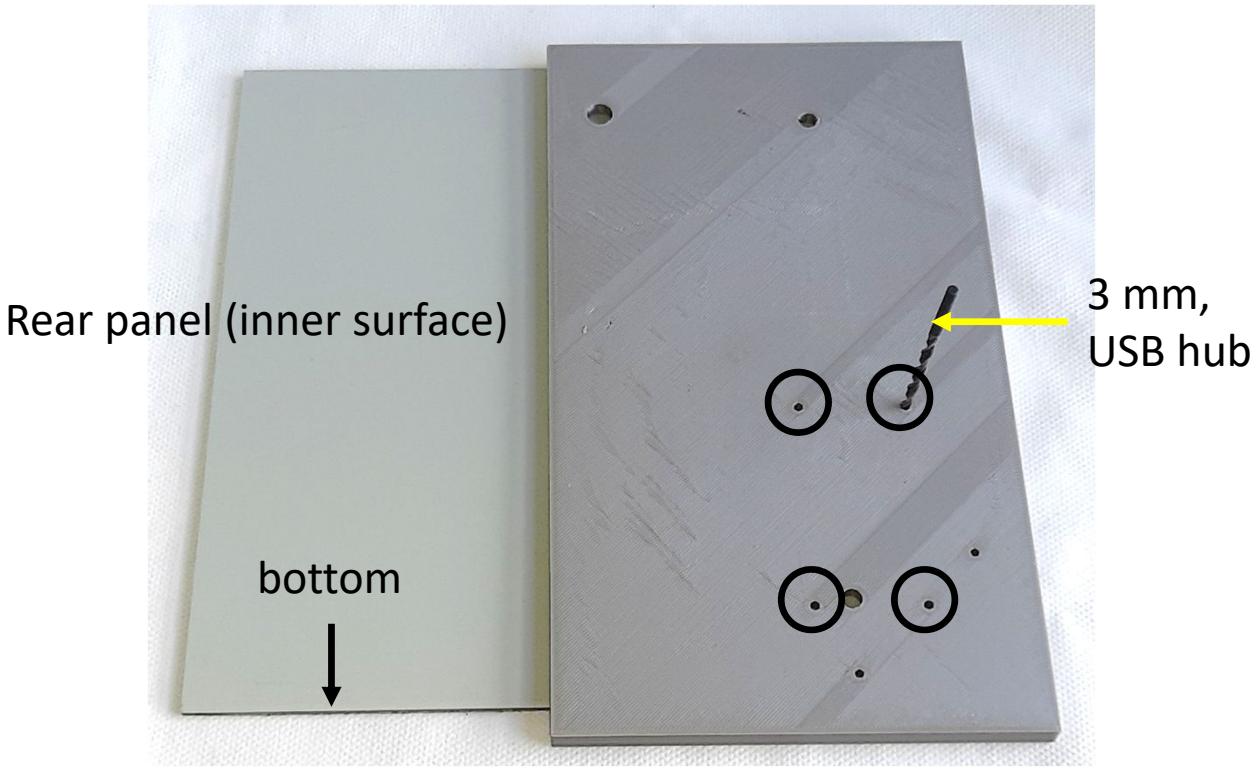
HDMI plug, center for 23-mm drill

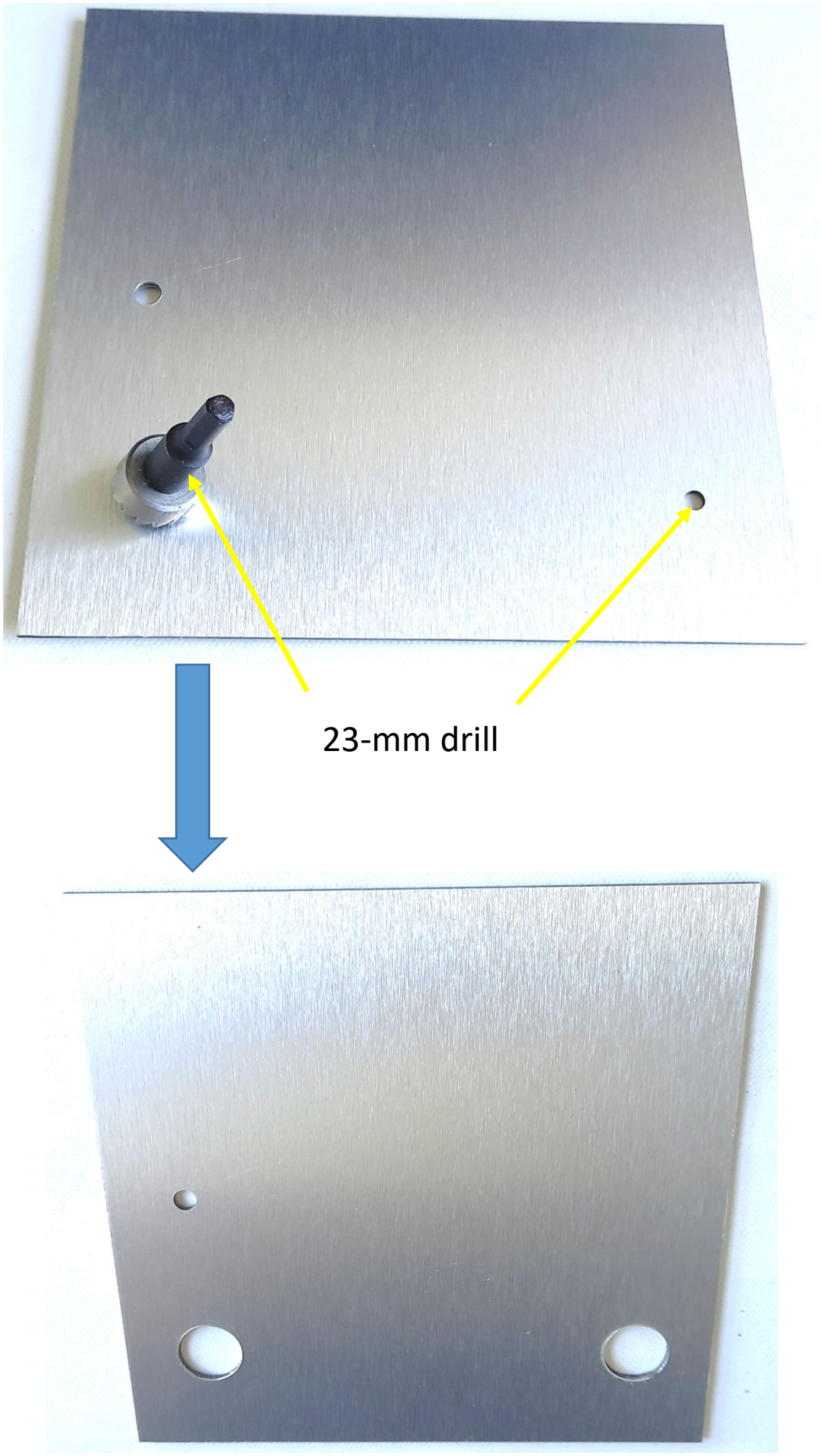
Mounting the USB hub

Hole for 12-V plug

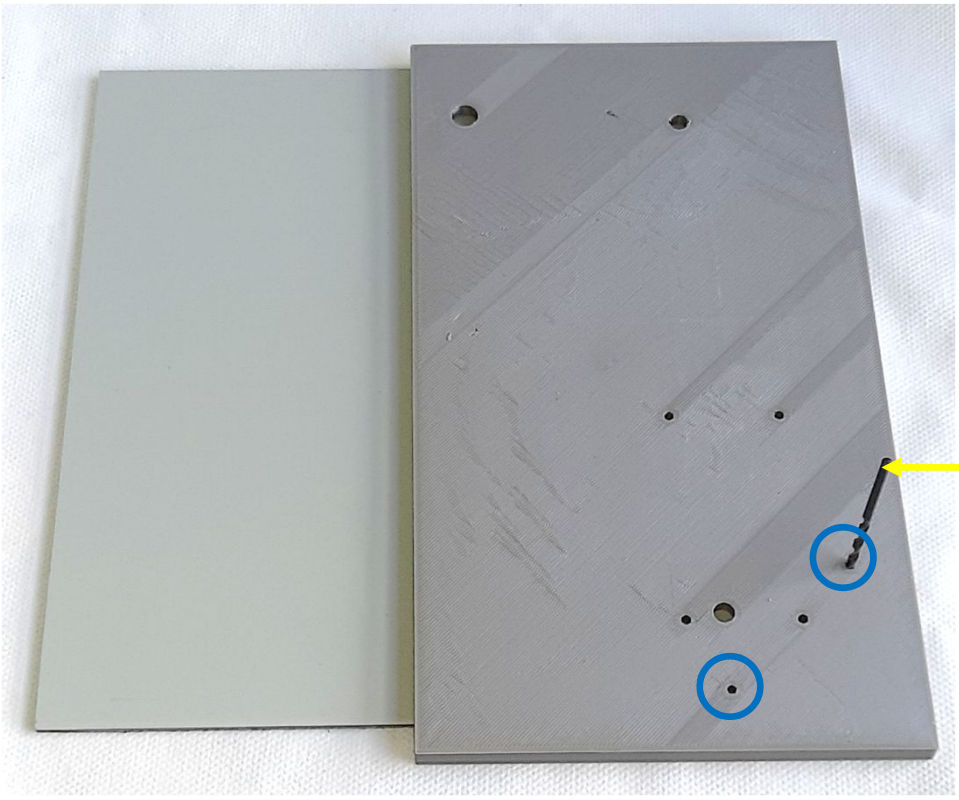
USB-C plug, center for 23-mm drill


6 mm, center for 23-mm drill,
HDMI plug
6 mm, center for 23-mm drill,
USB-C plug
8 mm,
12-V plug
Rear panel (inner surface)
bottom


Rear panel (inner surface)
3 mm,
USB hub
bottom

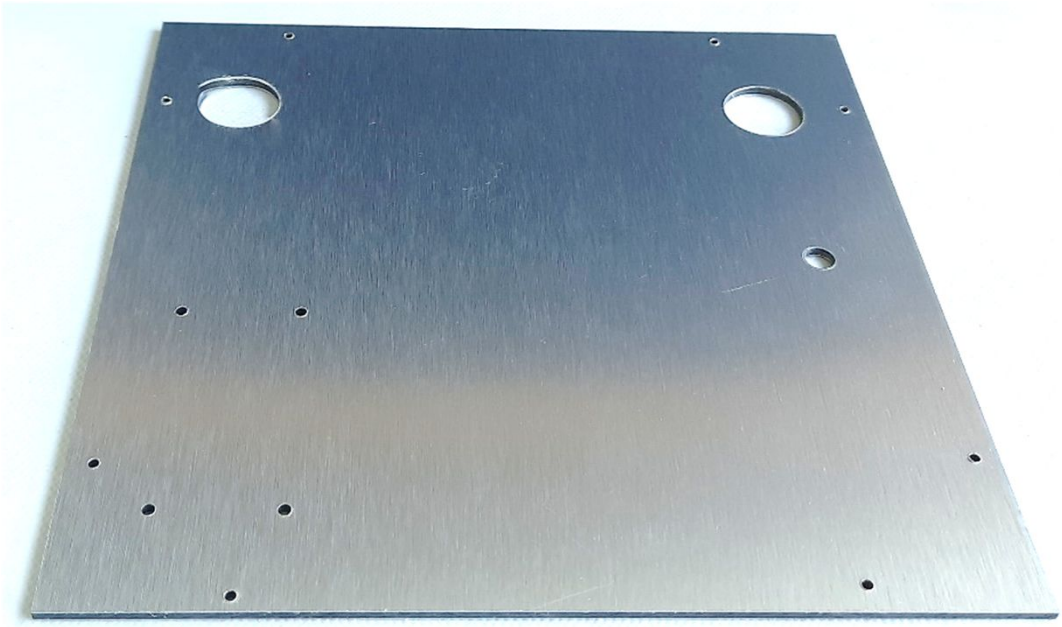

23-mm drill

Preparing the faces



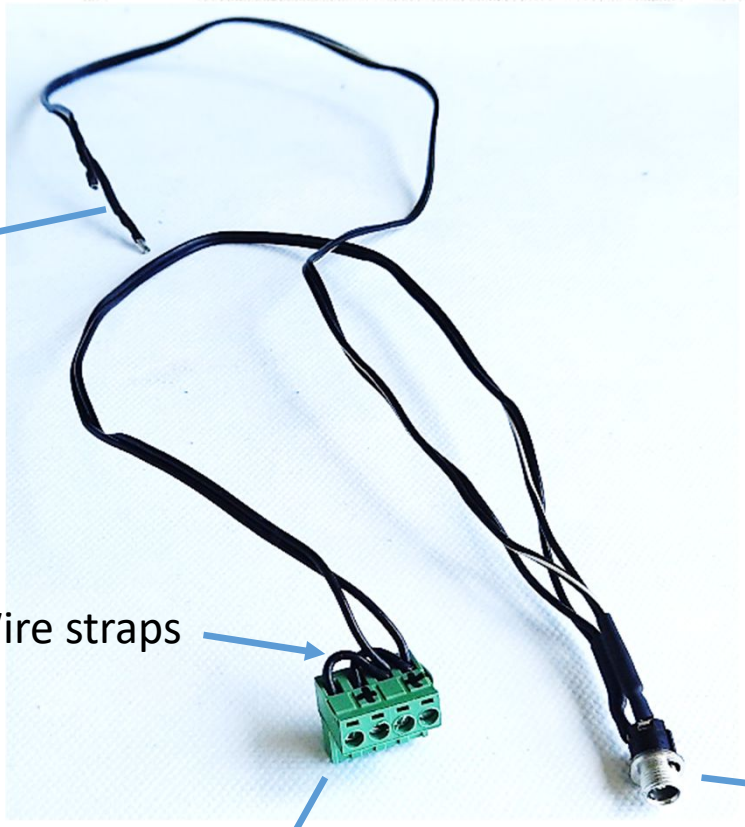
… to be continued for all edges

Ready prepared rear panel

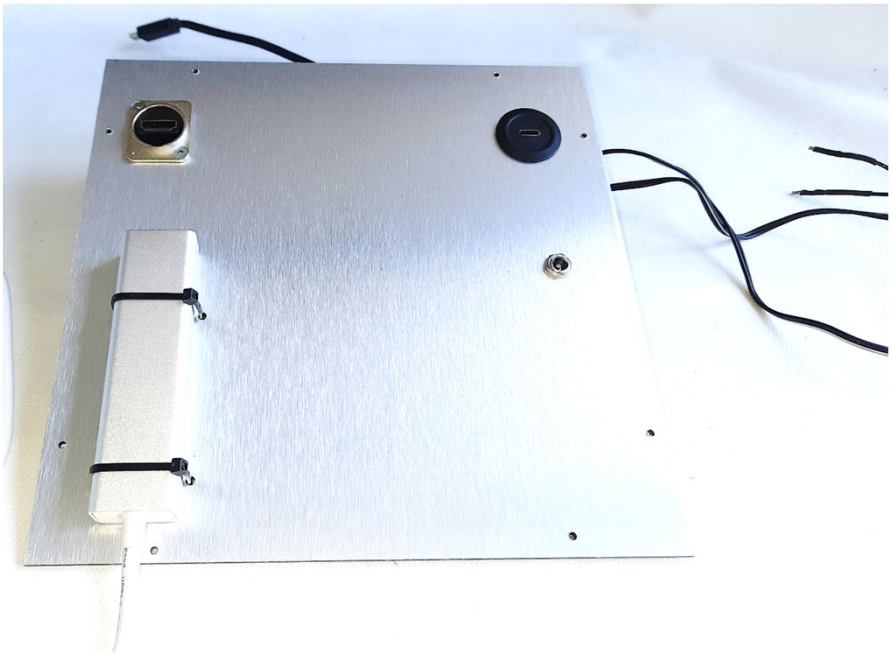


Preparing the 12-V plug

2 two-core cables (30 cm) 2 single-core cables (2 cm, wire straps) DC power jack socket, 5.5 x 2.1 mm 2 Wire termination Power plug Ramps 1.4 board



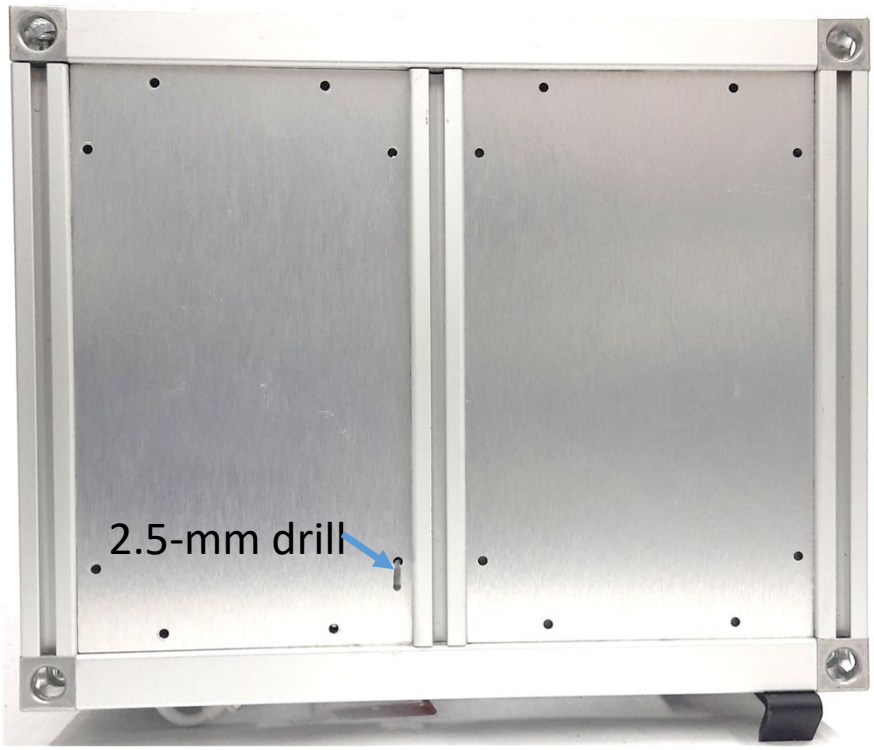
Ready prepared …



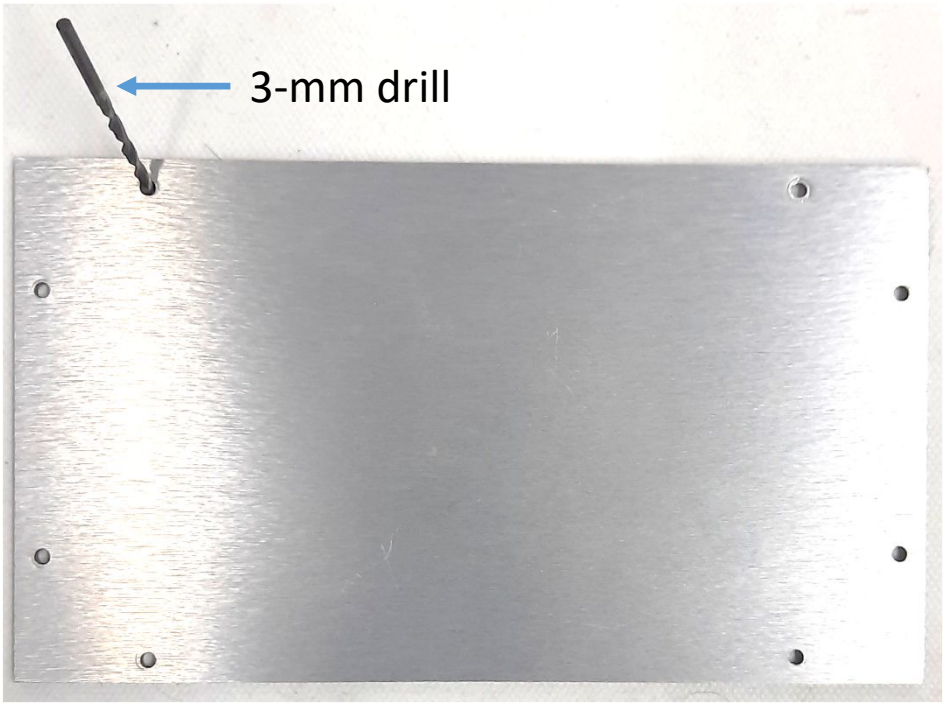
… and ready placed rear panel.

Mounting the faces

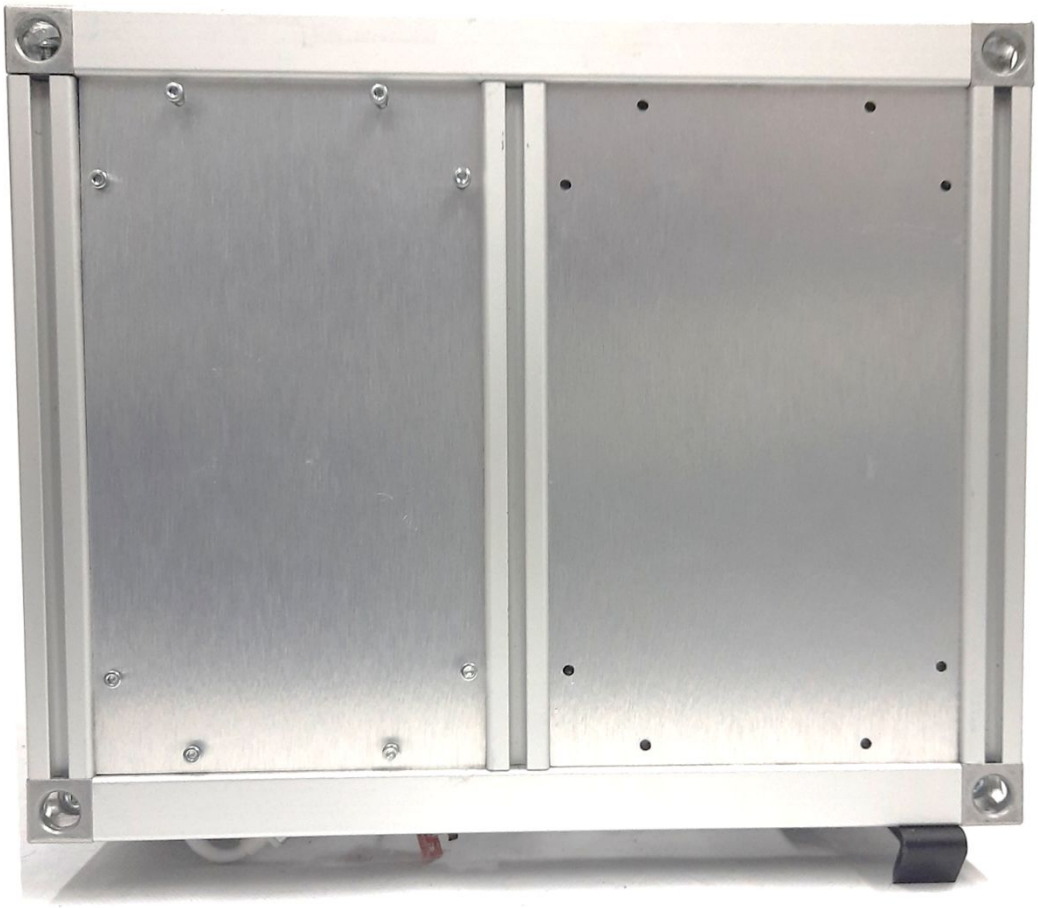
Bring the faces into place and drill through the prepared holes into the frames.



Take off the faces again and enlarge the holes to 3 mm.

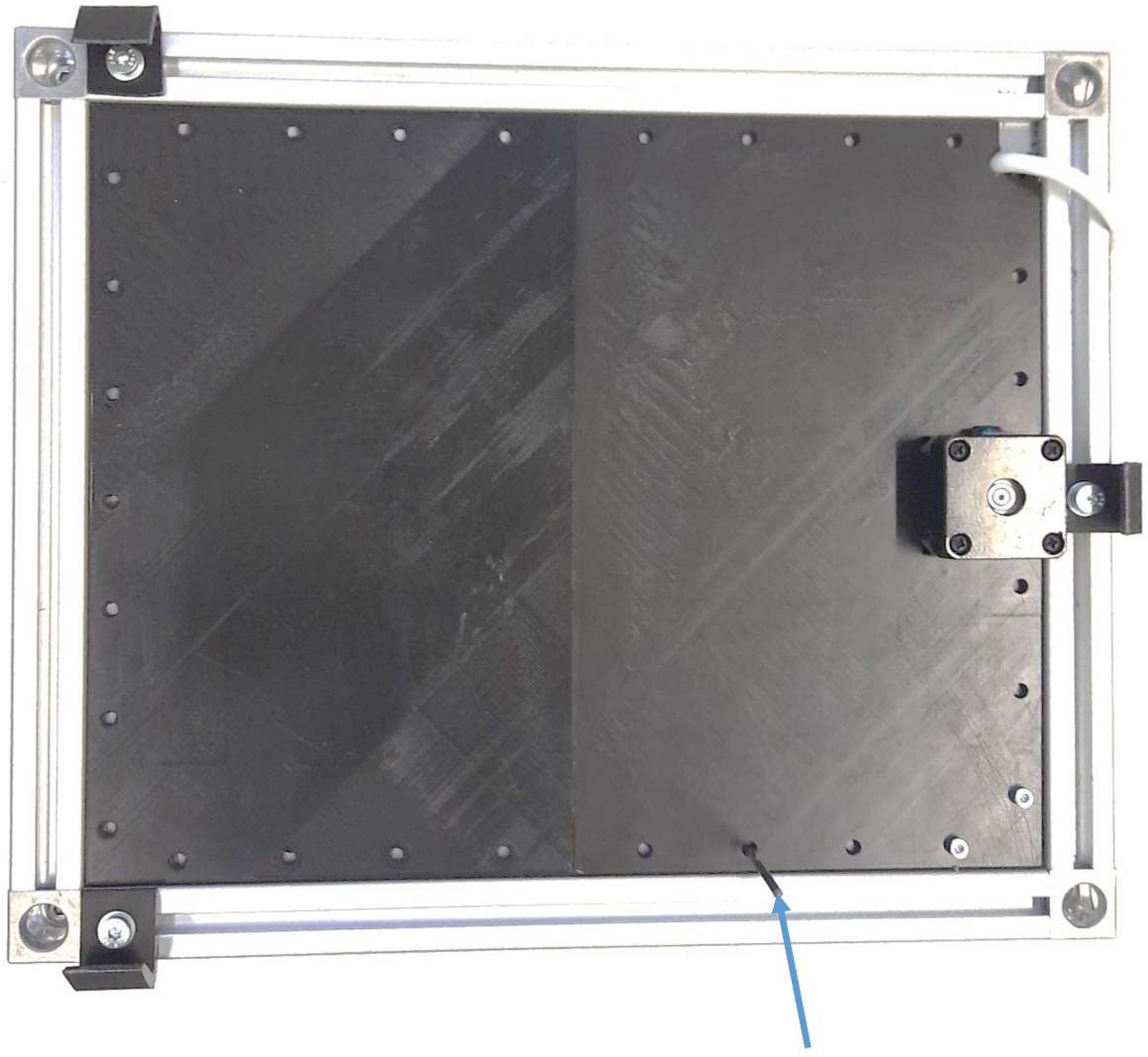


Bring the faces back into place and and fix them with 8 x 3 mm screws.



Mounting the bottom plate

Printed parts: bottom_plate_back, bottom_plate_front
20 Screws 3 x 8 mm

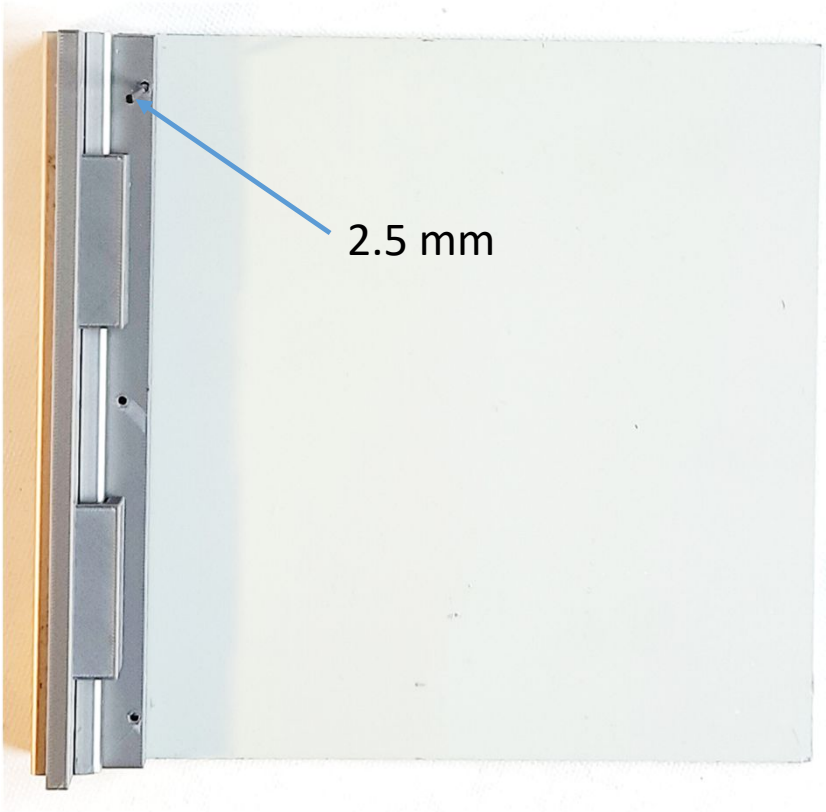


2.5-mm drill

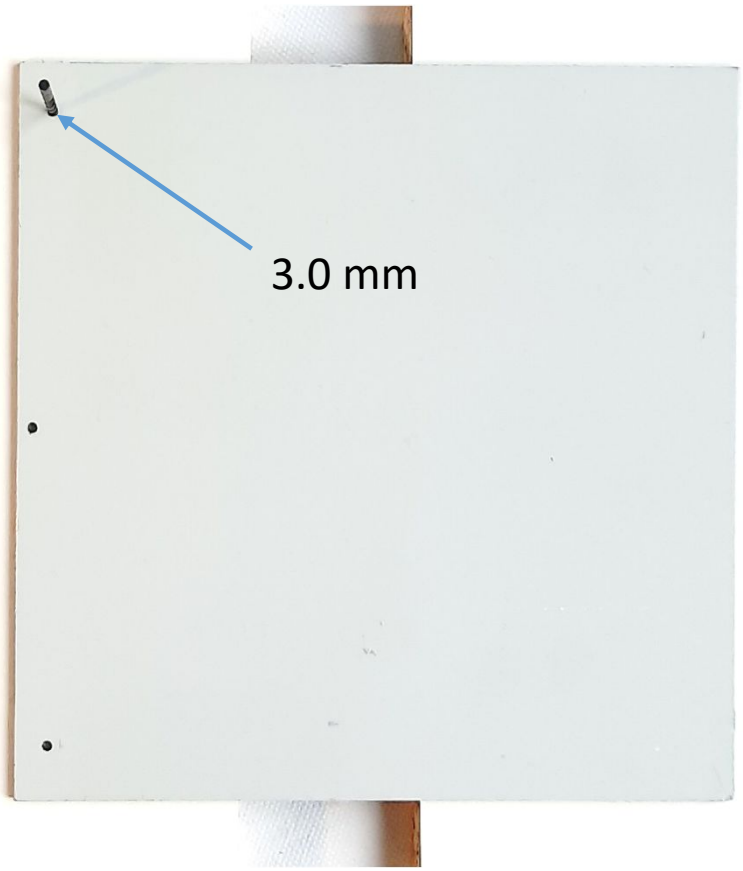
Detachable front-cover

1 x Aluminum Profile 20x20 2NVS I-Type Slot 5, 214 mm
6 x M3 x 8 mm
Printed parts: faces_frames: cover_mounting, oc_lab
Alupanel 21,4 cm x 21 cm and 21,4 cm x 13 cm
2 magnets 8 x 3 mm

Place the cover mountig exactly over the panels and drill with 2.5 mm through the panels.



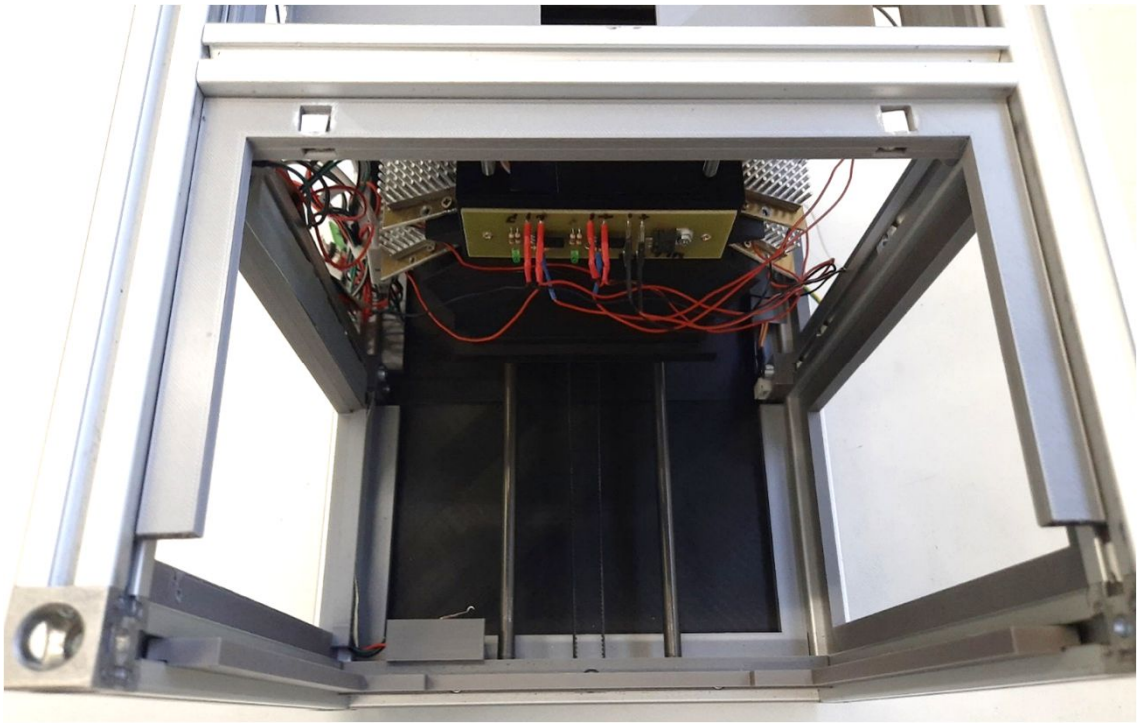
Thereafter, bore the wholes in the panels to 3 mm …



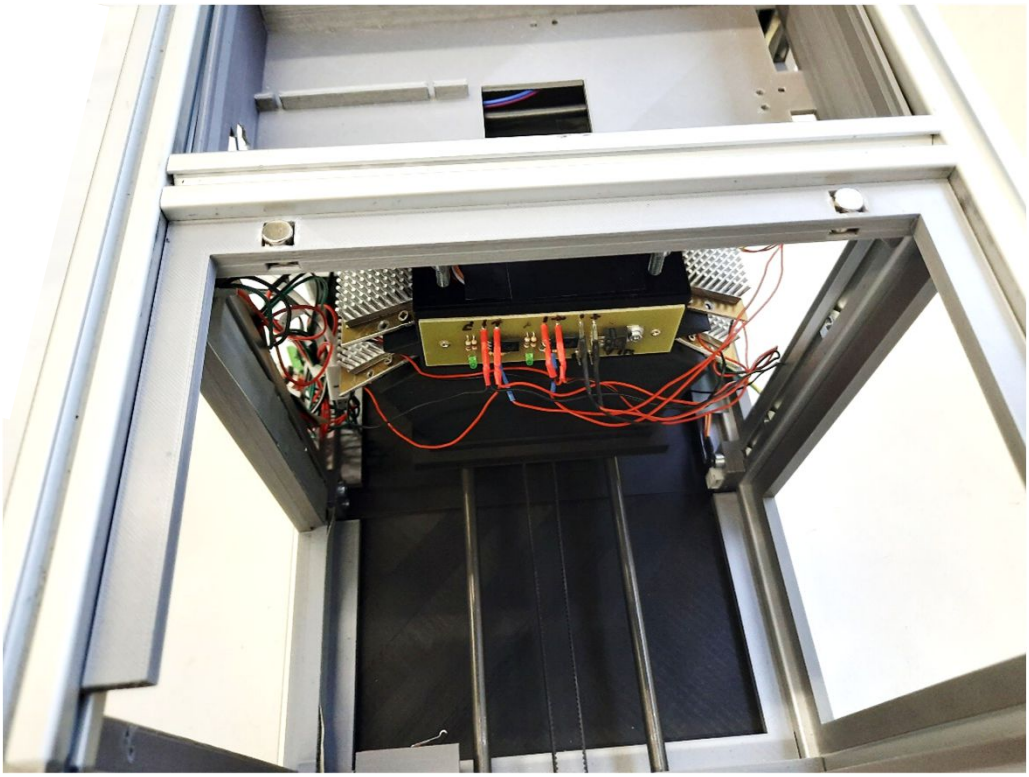
and mount the panels with the 3-mm screws.

Finally, fix the OCLab logo with some drops of glue.
Of course, you also can create your own logo.

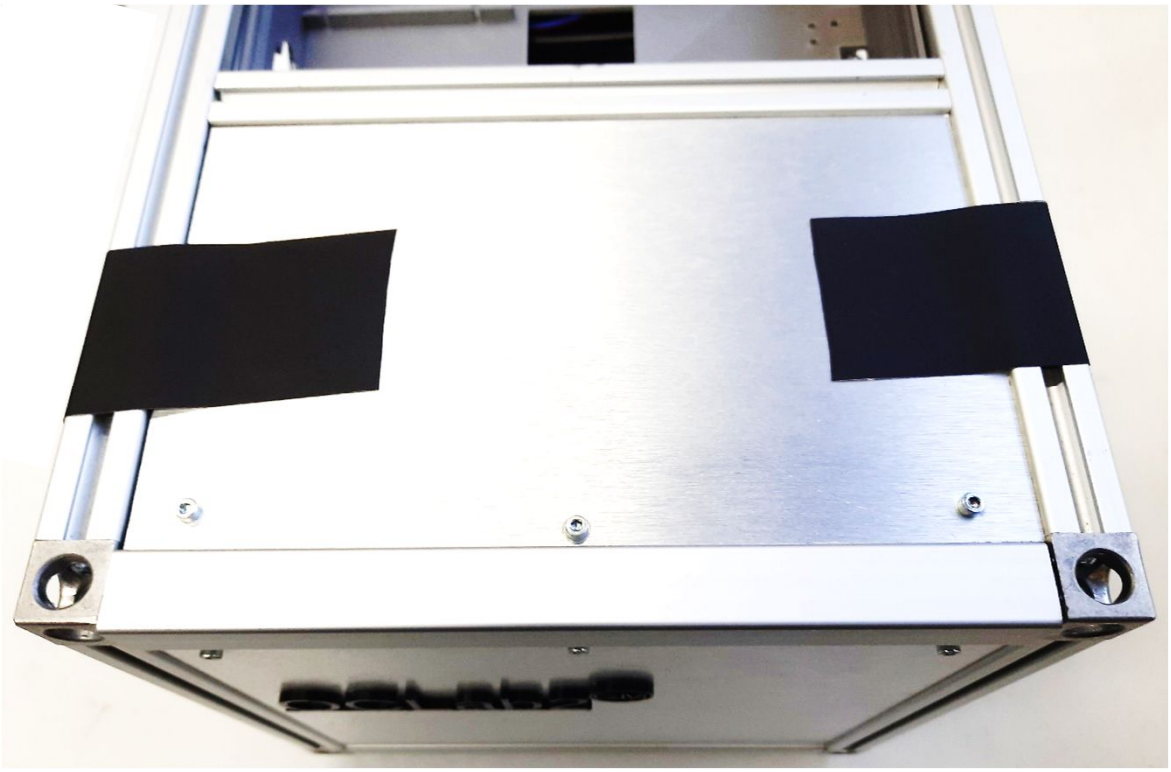
Place two small card boards into the magnets‘ holes, …



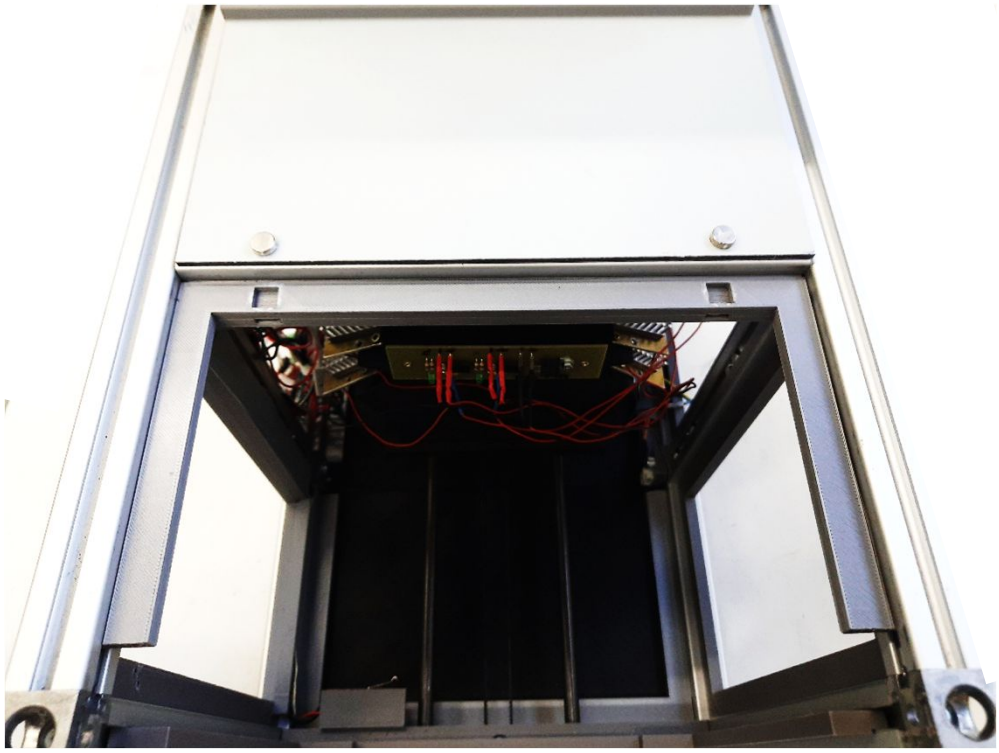
… followed by two magnets.



Give a small drop of glue onto the magnets, bring the top cover into place and fix it with tapes, until the glue hardened.



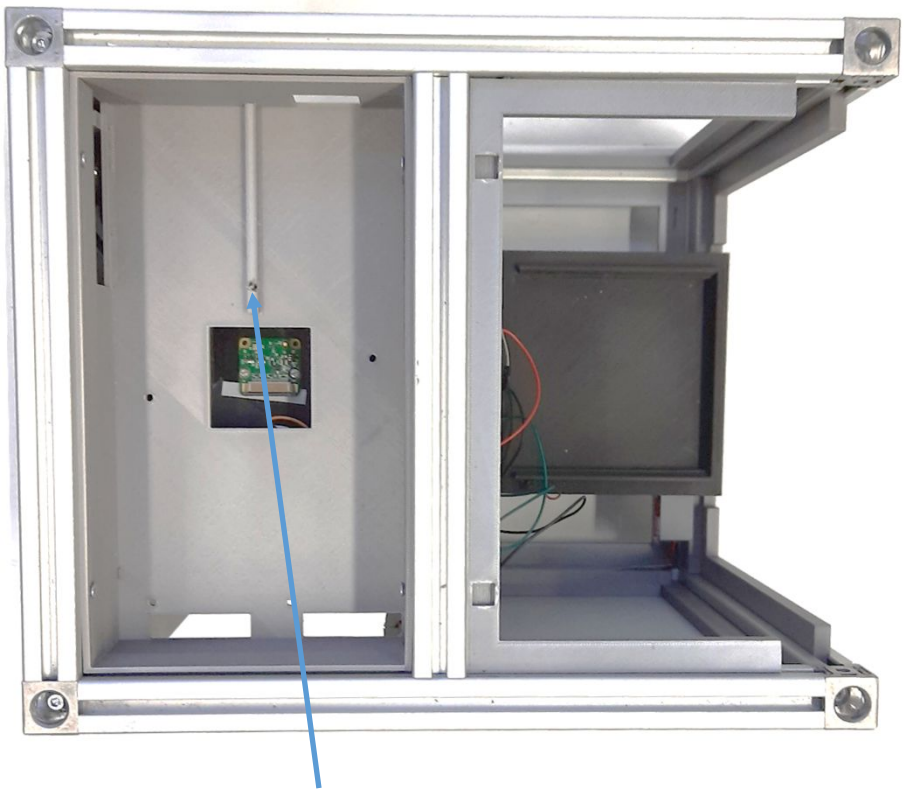
Finally it looks like this.



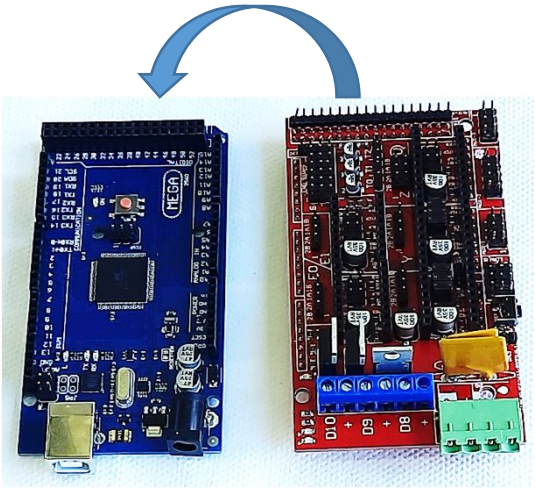
Electronics housing

Printed part: housing_electronics 6 screws 3 x 6 mm 2 screws 3 x 20 mm 1 screw 4 x 6 mm Raspberry Pi 4B Arduino mega 2560 Ramps 1.4 board Inkshield

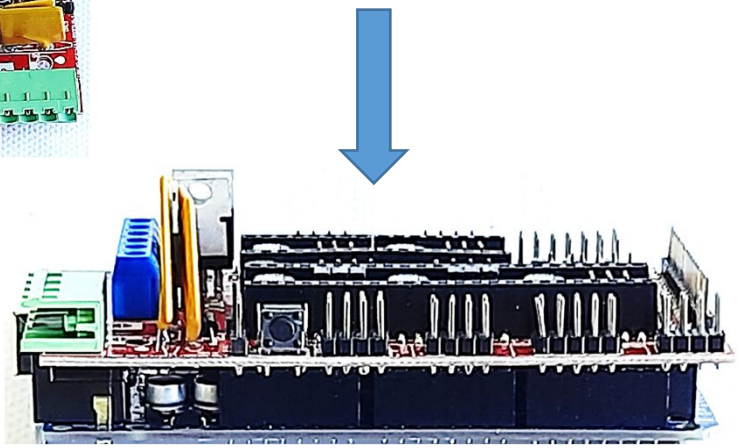
Insert the electronics housing into the OCLab und fix it with 4 screws 3 x 6 mm.



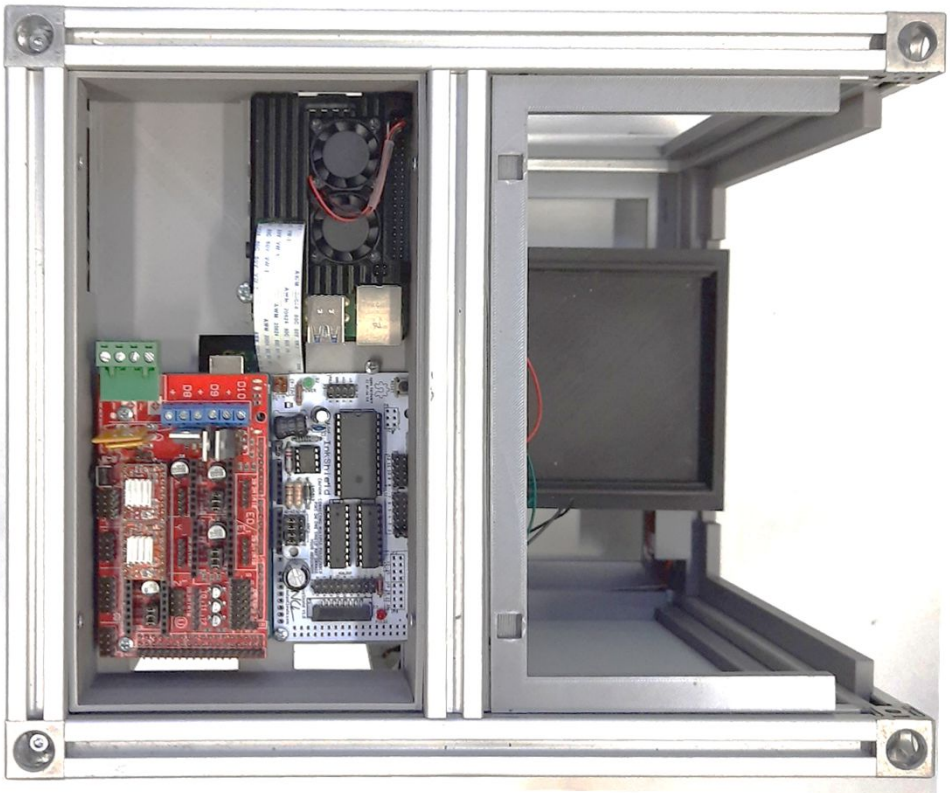
Drill a 4-mm hole here to fix the Raspberry Pi.



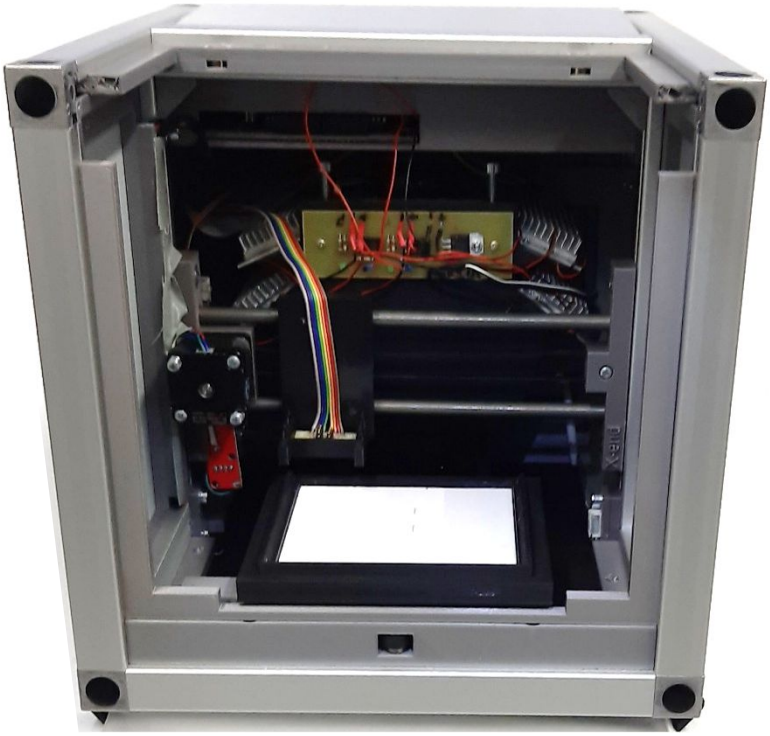
Press the Ramps board carefully onto the Arduino ...



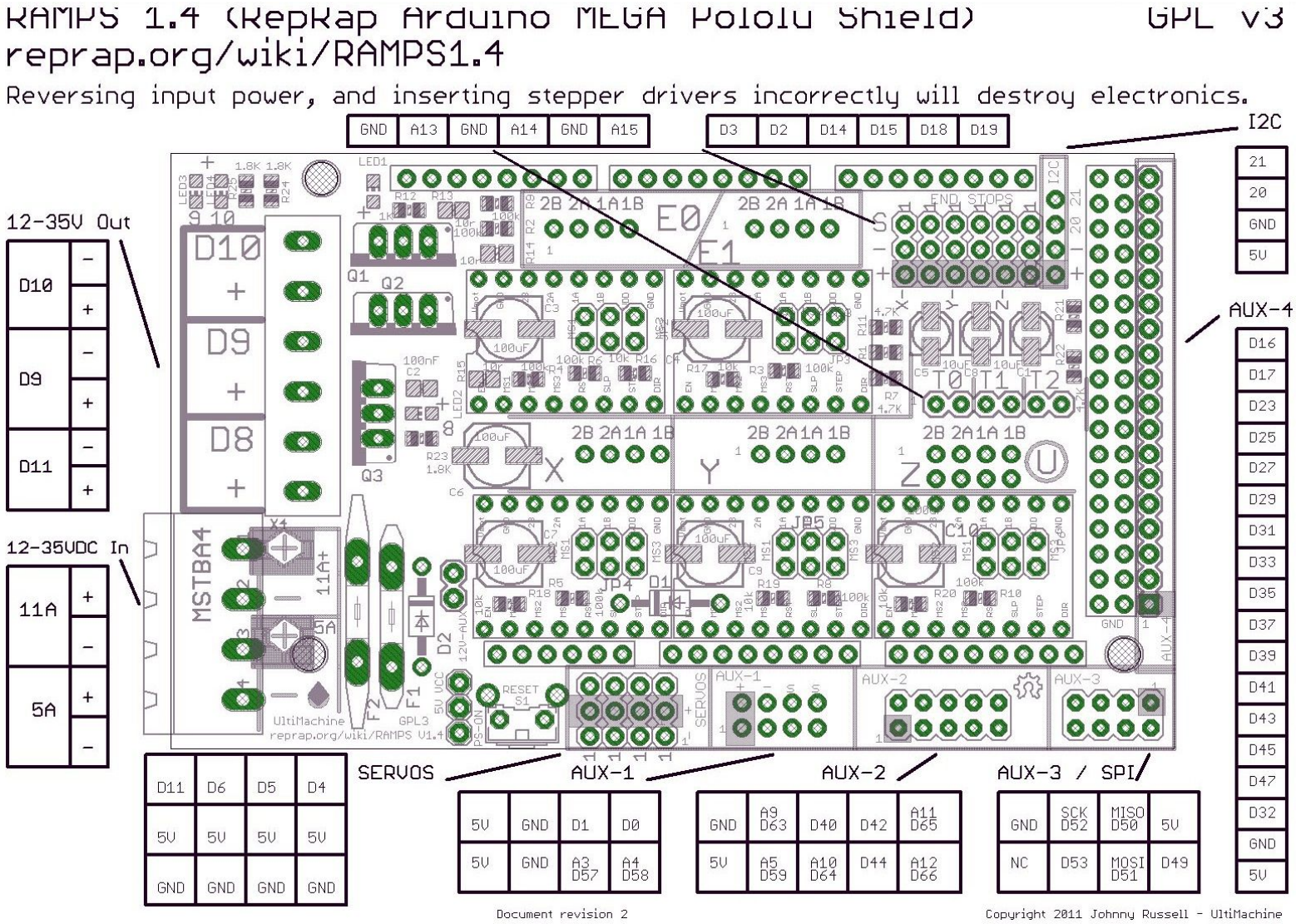
… place it into the electronics housing, together with the Raspberry Pi and the inkshield and fix all boards with screws.



Final model

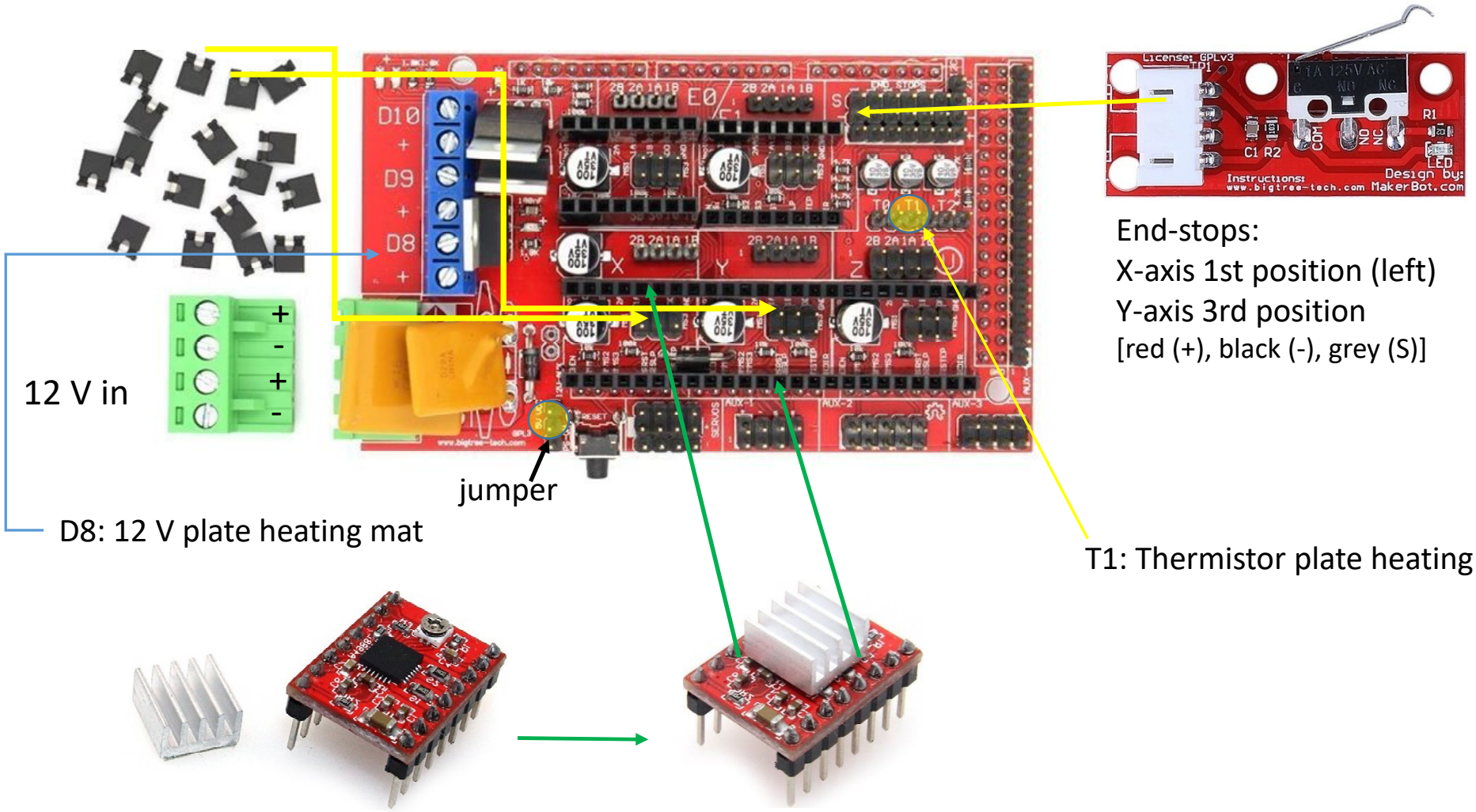


Cables and more



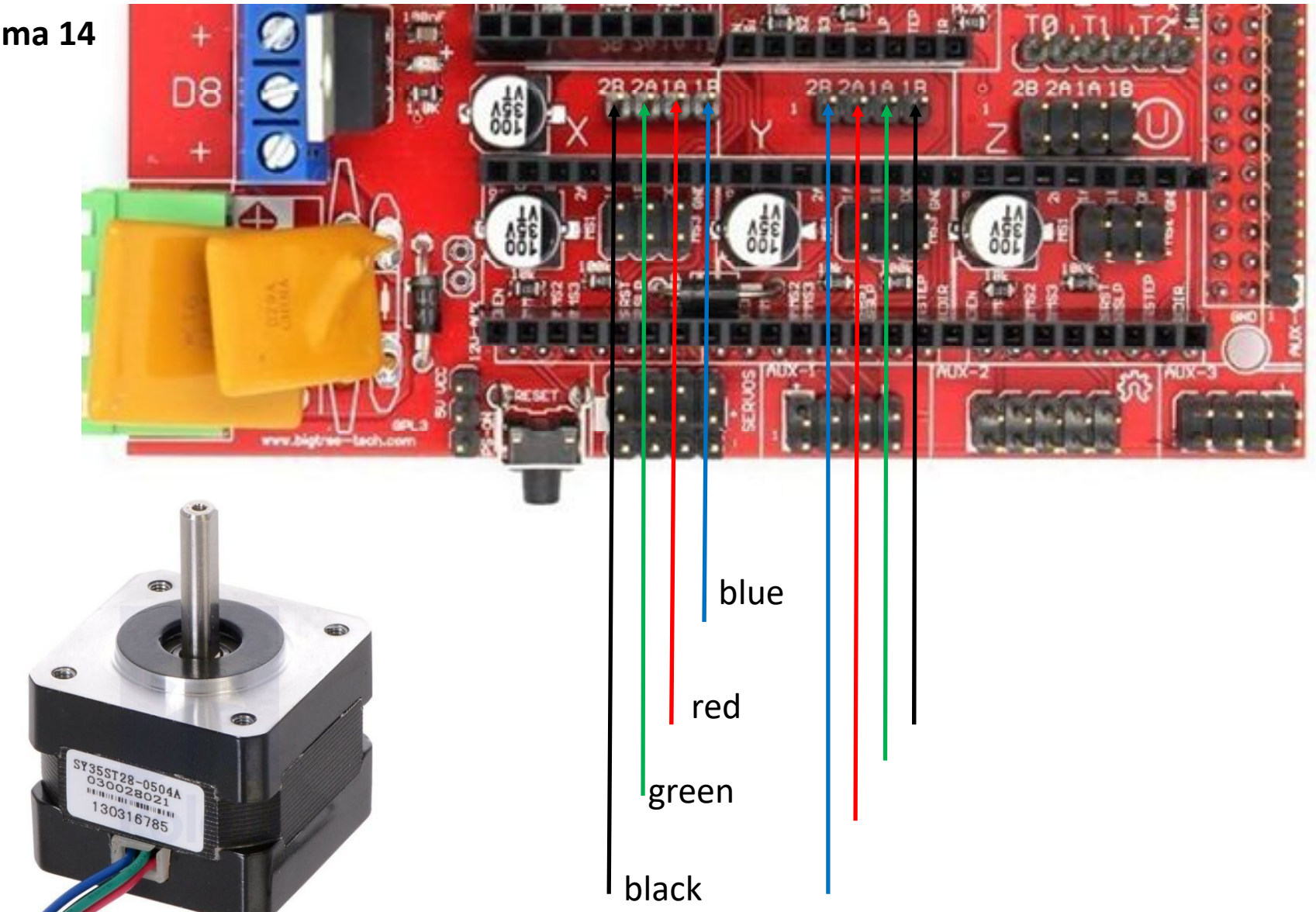
reprap.org/wiki/RAMPS1.4

Preparing the Ramps 1.4 board



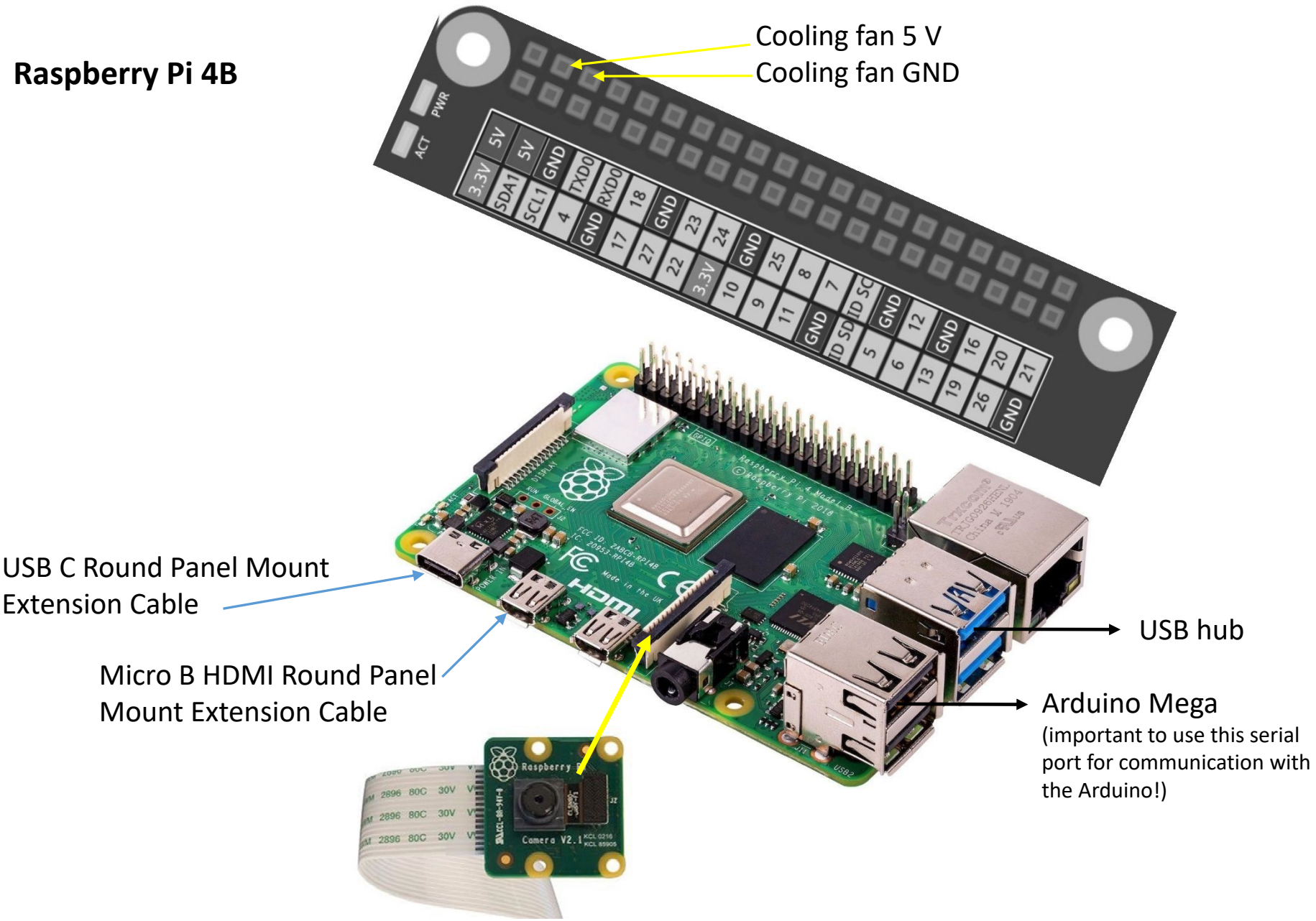
3 jumpers in both x- and y-motor controller ports
1 jumper for 5 V availability
2 motor controllers to be attached to the respective X- and Y-motor ports
(regulation screw (motor voltage, do not change!) to the right)

Nema 14



If the motor goes in the wrong direction, reverse the plug.

Raspberry Pi 4B

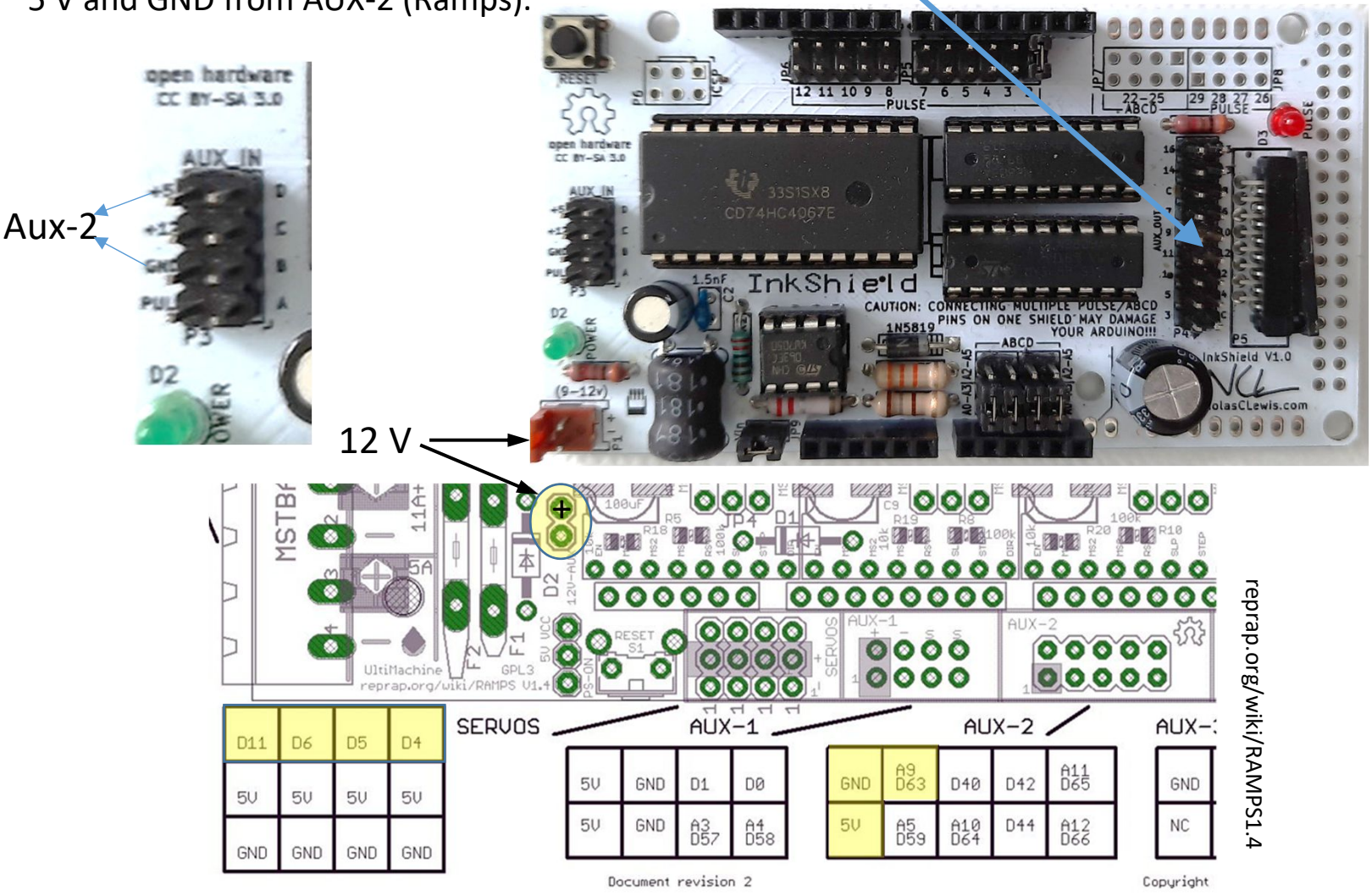


Preparing the inkshield, follow the assembly instructions given here:
http://nicholasclewis.com/projects/inkshield/assembly/

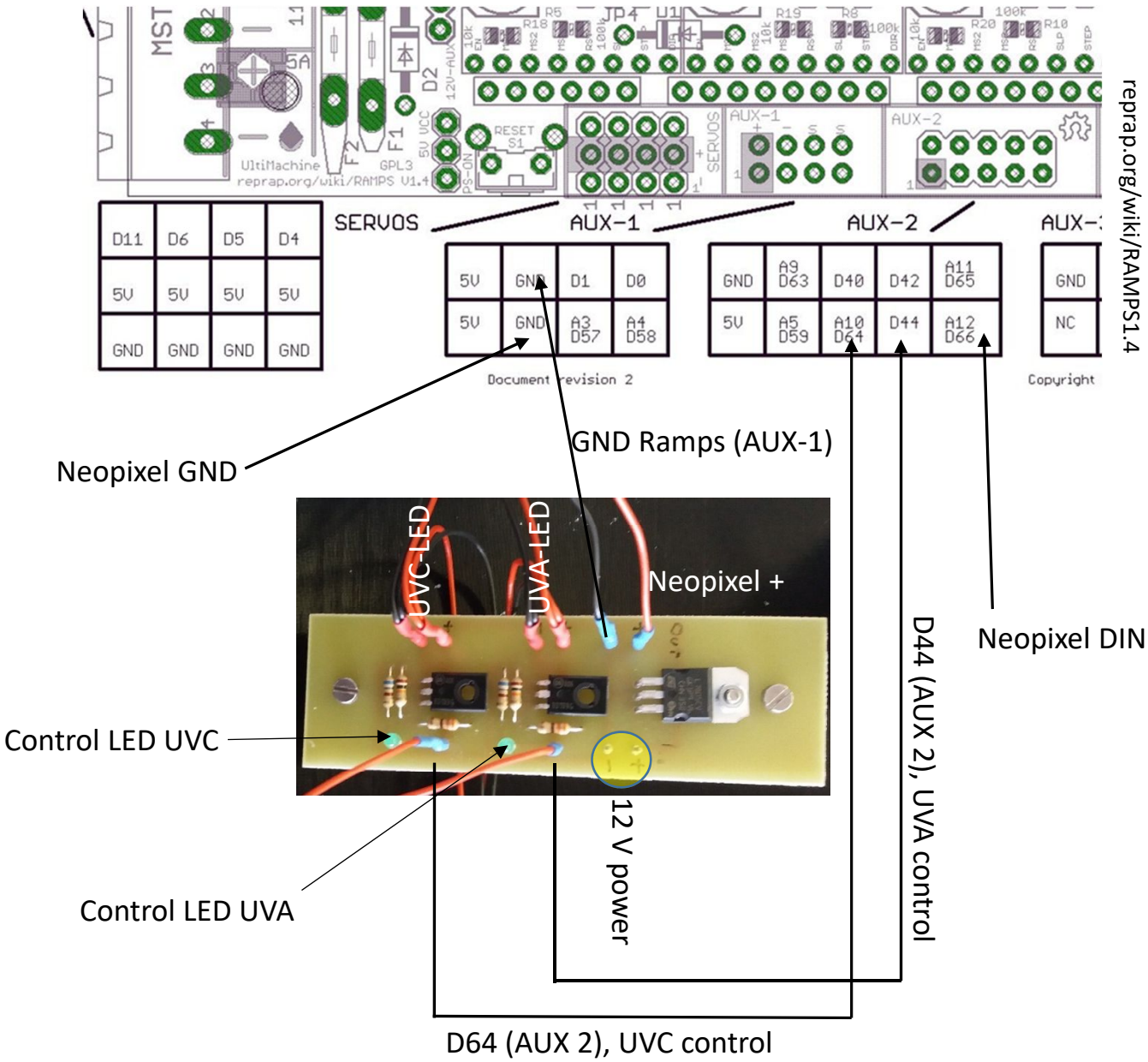
http://nerdcreationlab.com/store/

Ink-shield wirings

Connect the spring contact board with the pin plug.
The auxiliary input and SERVOS must be used and the connections are:
"A"= D11,"B"= D6,"C"= D5,"D"= D4,"pulse"=D63.
12 V can be taken from the Ramps (left from the X-motor driver)
5 V and GND from AUX-2 (Ramps).

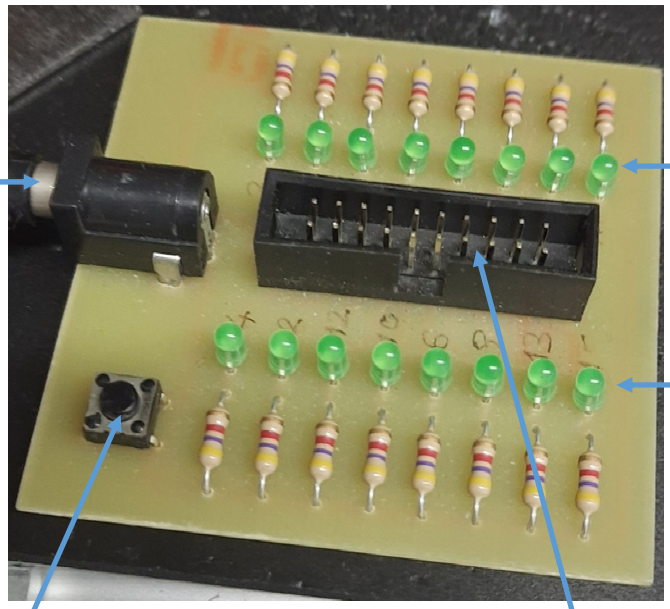


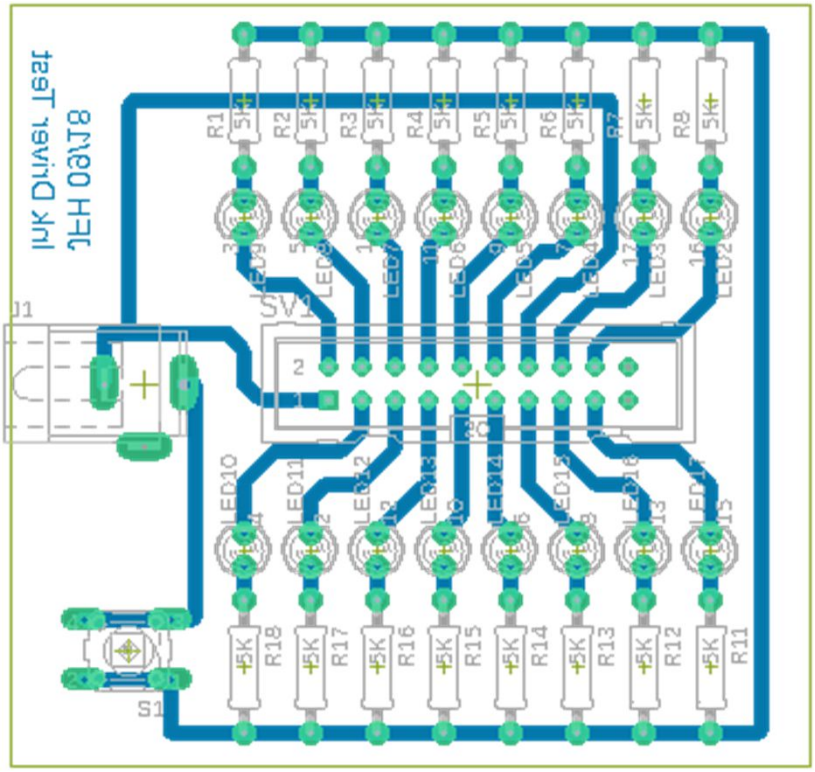
Neopixel RGBW + UV LEDs wirings



Nozzle check board

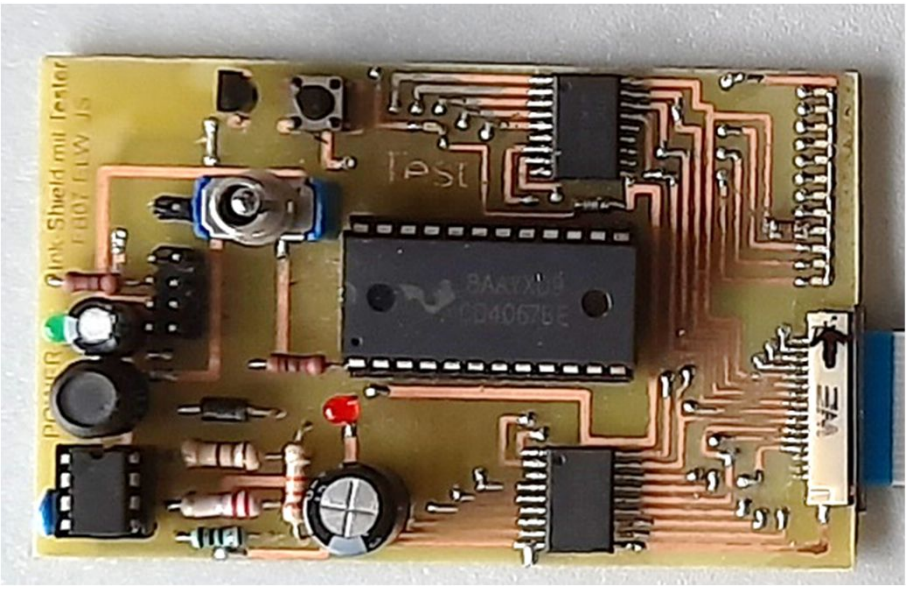
See enclosed Eagle file

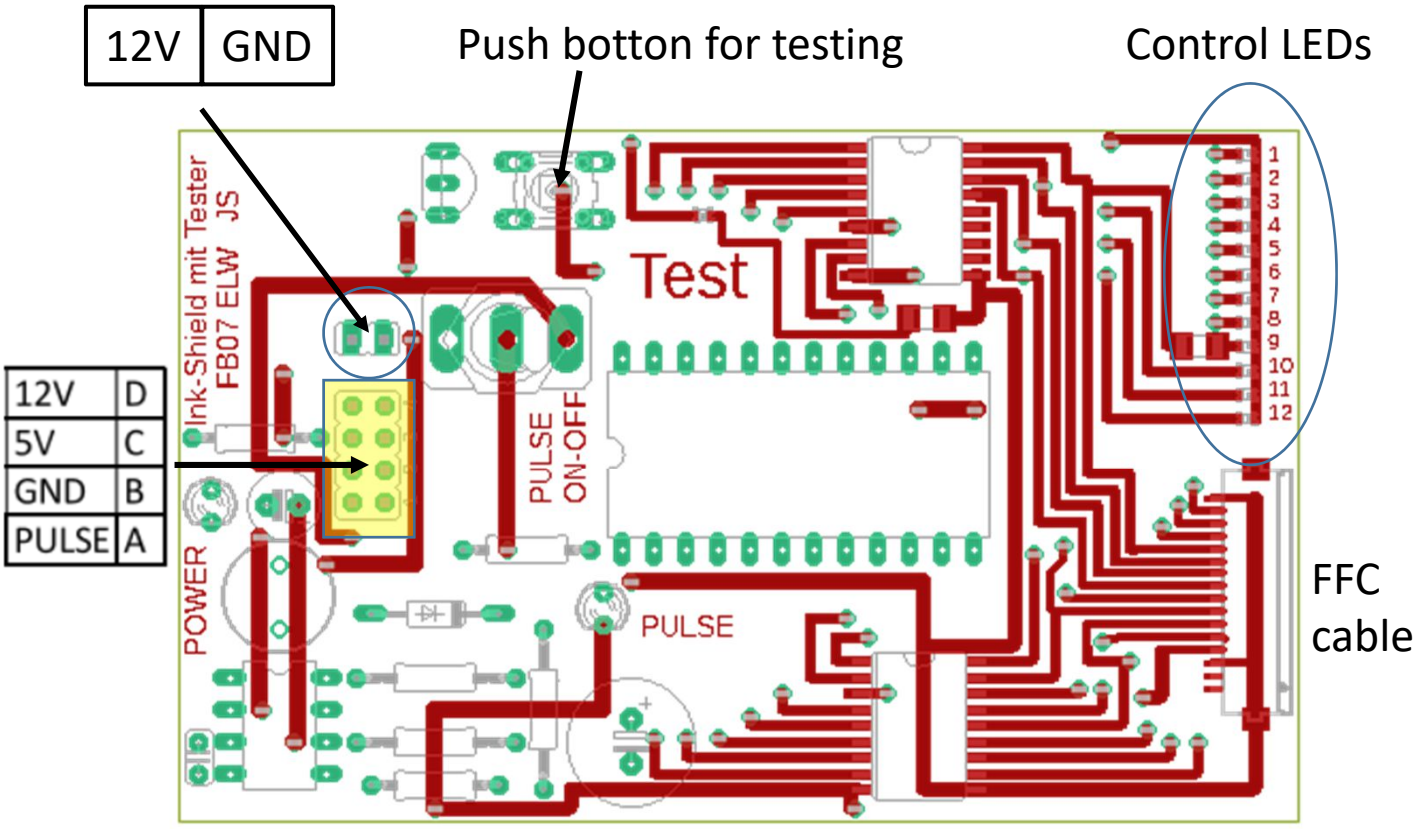




Ink-jet board with nozzle tester

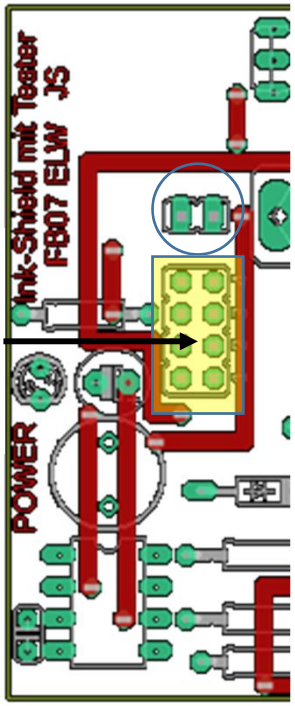
See enclosed Eagle files
cable FFC 16 pos., 1.00 mm, 12"

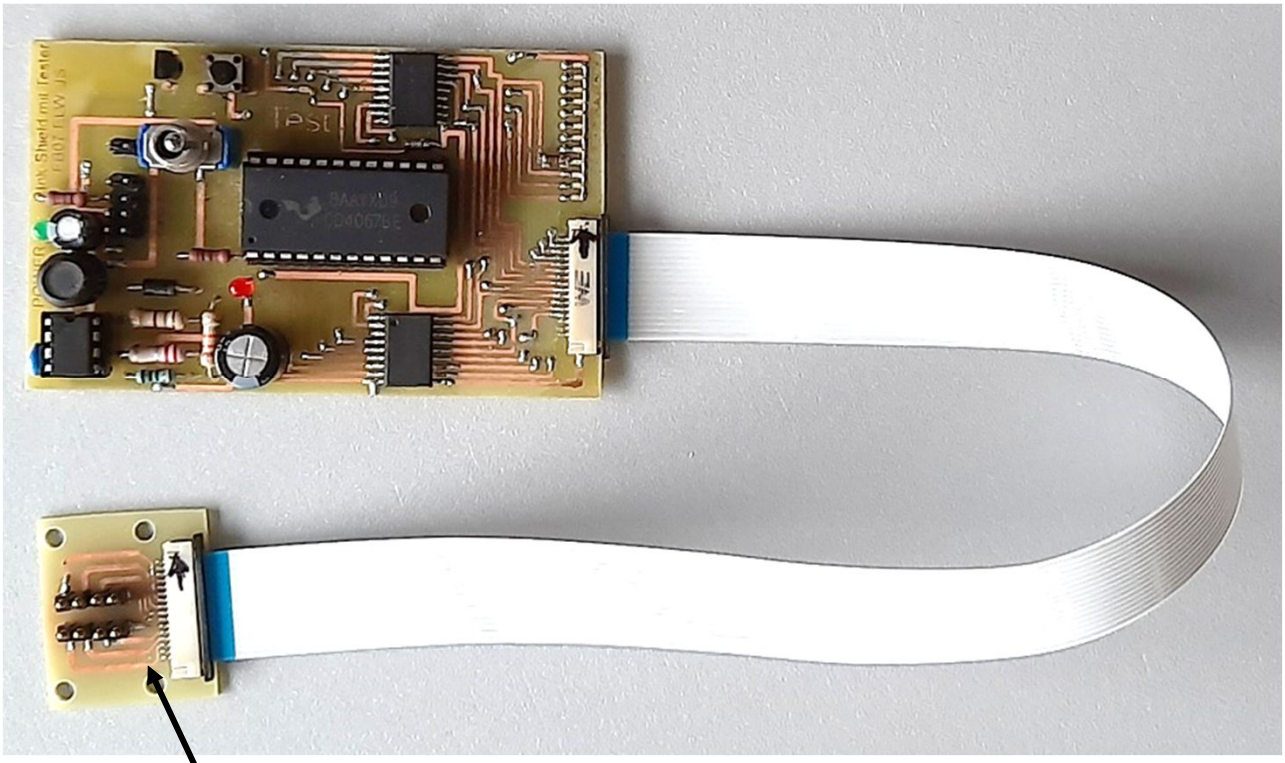




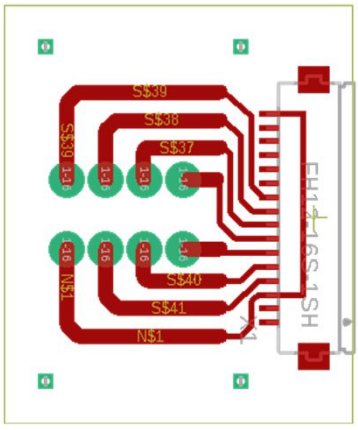
Attention: the 5 V and 12 V pins are reversed as compared to the commercial inkshield! (see section „cables and more“)

12V	D
5V	C
GND	B
PULSE	A



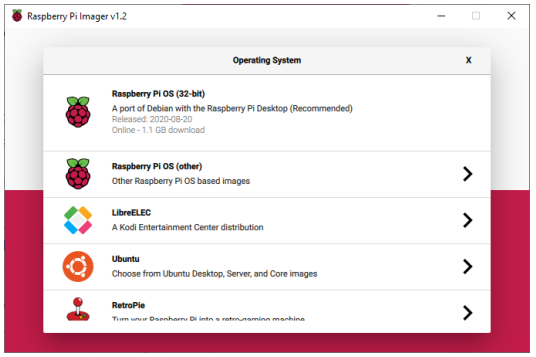


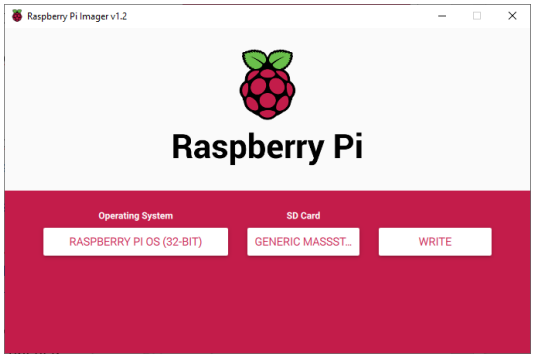
Spring contacts board



Installing the Raspberry Pi operating system with desktop

1. Install the ‘Raspberry Pi Imager‘ downloaded from https://www.raspberrypi.org/downloads/
2. Open the imager and choose OS: Raspberry Pi OS (32-bit), Raspberry Pi with Desktop
3. Choose SD card (micro SD, preferably 16 GB, class 10)
4. Click WRITE



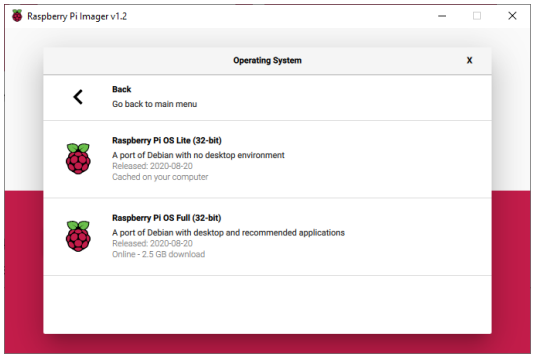


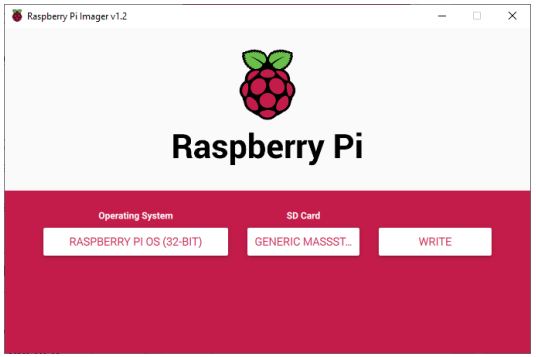
5. After writing is finished, insert the SD card into the Raspberry Pi and boot it by connecting to power.
6. Follow the instructions for configuration.
7. Open the Raspberry-Pi configuration and select the tab Interfaces.
8. Enable: Camera, SSH, VNC, I2C, Serial Port, Remote GPIO
9. Select the tab Performance and increase GPU Memory to 512 MB.
10. Click Okay and reboot.

Now you can use the Raspberry like a desktop PC and can connect it *via* VNC.

Installing the Raspberry Pi OS lite (without desktop)

1. Open the imager and choose OS: Raspberry Pi OS (other) and select Raspberry Pi OS lite (32-bit)
2. Choose SD card (micro SD, preferably 16 GB, class 10)
3. Click WRITE





4. After writing is finished, insert the SD card into the Raspberry Pi and boot it by connecting to power.
5. Run: sudo raspi-config and configure country, language, keyboard, timezone.
6. Configure the interfaces and enable: Camera, SSH, I2C, Serial Port, Remote GPIO
7. Select the tab 4 Performance -> P2 GPU Memory and increase GPU Memory to 512 MB.
8. Click Okay and leave the configuration without reboot.
9. Perform the OS update by running the commands: sudo apt-get update and sudo apt-get upgrade.
10. Finally, reboot the system.

Now you can use the Raspberry only in the CLI, typing commands in the terminal, and you can connect it *via* SSH.

Problems with time server

You may run into problems, if date and time is not correctly synchronized, hindering the OS update and further installations.

In this case activate the debian time server (uncomment the line) or select a proper time server working for you.

Therefore open the timesyncd.conf:

```
sudo nano /etc/systemd/timesyncd.conf
```

….

```
[Time]
#NTP=
#FallbackNTP=0.debian.pool.ntp.org 1.debian.pool.ntp.org 2.debian.pool.ntp.org $
#FallbackNTP=[your time server]
```

Following by:

```
sudo timedatectl set-ntp true
sudo reboot
```

Then wait until date and time is correctly synchronized.

Firmware and Software installation

A) Firmware

For the firmware, there are two options:

- download and flashing with the help of the Raspberry Pi
- download and flashing with the help of a Windows/Mac PC/notebook

In any case, you have first to downlaod and install the Arduino IDE (https://www.arduino.cc/en/software), following the instructions given here: https://www.arduino.cc/en/Guide.

1. Raspberry Pi

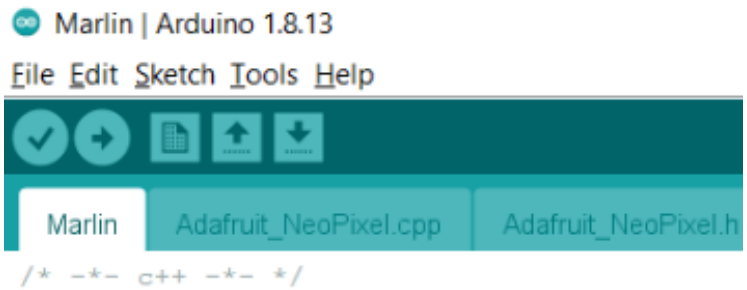
To install the Arduino software, open a terminal and run the following commands:

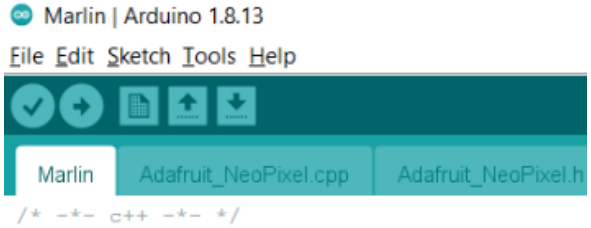
```
tar -xJvf Downloads/arduino-1.8.13-linuxarm.tar.xz
cd Downloads/arduino-1.8.13
sudo ./install.sh
```

To download the OCLab2 repository, use the following commands:

```
cd /home/pi/Downloads
git clone https://github.com/OfficeChromatography/oclab2.git
```

Then open the file manager and go to the folder Downloads/oclab2/Marlin. Double-click on marlin.ino, whereafter the Arduino IDE will be opened.





Click on Tools and select the Arduino Mega and the port the Arduino is connected to the Raspberry Pi with an USB cable.
Click on Sketch and select Upload.

2. PC/Notebook

Install the Arduino software by executing the downloaded exe file

To clone git, 'Git on Windows and Mac OS X' have to be installed: https://www.jcchouinard.com/install-git/

After installation, open Git bash and run the following command in the terminal:

```
cd Downloads
git clone https://github.com/OfficeChromatography/oclab2.git
```

Then open the file manager and go to the folder Downloads/oclab2/Marlin.
Double click on marlin.ino, whereafter the Arduino IDE will be opened.

Click on Tools and select the Arduino Mega and the port the Arduino is connected to the PC/notebook with an USB cable.
Click on Sketch and select Upload.

B) Software

To install the OC_manager2 software, open a terminal on the Raspberry Pi (being in /home/pi) and run the following command:

```
git clone https://github.com/OfficeChromatography/OC_manager2.git
```

[OC in capital letters!!]

Open the file /home/pi/OC_manager2/sudo_bash.txt, copy the single line (for the desktop or lite version) and paste it into the terminal, for example:

```
sudo bash OC_manager2/oc_manager_install_desktop.sh |& tee oc-install.txt
```

followed by ENTER.

The install script will install all necessary libraries and software packages, followed by a reboot. In case of problems, you can consult the logfile /home/pi/oc-install.txt.
In case of problems, also consult the README_R_packages_versions file cloned with OC_manager2.

Ready prepared image file

Alternatively, you can download an image (2.3 GB) of Raspberry OS with Desktop together with the OC_manager2 set-up, following this link. If you prefer to use the Raspberry OS lite (no desktop), you can find the respective image (1.1 GB) here.

Using the 'Raspberry Pi Imager', flash the image onto an SD card and boot the Raspberry Pi.
User = pi
Password = oc_lab2
Open the Raspberry Pi configuration to select your settings in the Localisation tab.
Perform an OS upgrade with:

```
sudo apt update
sudo apt upgrade
```

and reboot.

Static IP adress

It is recommended to set a static IP adress on the Raspberry Pi by running the following command in a terminal

```
sudo nano /etc/dhcpcd.conf
```

and filling out the following lines:

```
interface eth0 (or eth1 using the USB hub for LAN connection)
static ip_address=
static routers=
static domain_name_servers=
```

Save the changes with Ctrl+O, and close the file with Ctrl+X.

Then you can directly access the OC_manager2 through a browser from any PC/notebook in your network by typing the IP adress in the adress field.
Therefore, however, you have to enable a Crontab job, accessed by:

```
sudo crontab -e
```

Once in the editor, add this line, which will launch the application at reboot:

```
@reboot Rscript /home/pi/OC_manager2/app_exec.R
```

Save the changes with Ctrl+O, leave the editor with Ctrl+X and reboot the system.

At the Raspberry, the OC Manager2 will be available in the browser at http://127.0.0.1 (localhost).
Therefore, best configure the browser to start with the custom URL http://127.0.0.1/

Opening OC Manager2 from a terminal

In case of problems, open the OC Manager2 from a terminal, to catch the error messages, with the following commands:

```
cd OC_manager2
R
shiny::runApp()
```

Guidance on using OC Manager2

A guidance on using the OC Manager2 is available in the Folder ‚Instructions‘ of the downloaded OC_manager2.