renkforce

GB Operating instructions

RF500 Maker Construction Kit

Item no. 1515052

RF500 Construction Kit

Item no. 1561608

RF500 Preassembled

Item no. 1534908

CE

Table of Contents

GB

Page

1. Introduction

Dear Customer,

Thank you for purchasing this product.

This product complies with the statutory national and European requirements.

To maintain this status and to ensure safe operation, you as the user must observe these operating instructions!

These operating instructions are part of this product. They contain important notes on commissioning and handling. Also consider this if you pass on the product to any third party. Therefore, retain these operating instructions for reference!

If there are any technical questions, contact:

Germany: www.conrad.de/kontakt

Austria: www.conrad.at

www.business.conrad.at

Switzerland: www.conrad.ch

www.biz-conrad.ch

2. Explanation of Symbols

The symbol with a lightning bolt in a triangle is used where there is a health hazard, e.g. from electric shock. The device contains no parts that require servicing by the user. Therefore, never open the device.

The symbol with the exclamation mark points out particular dangers associated with handling, function and operation.

This symbol warns of hot surfaces the contact with which may cause injury.

Attention! Danger from moving parts - keep away fingers and other body parts.

This symbol warns of injury that may occur when reaching into the device in operation. Body parts may be crushed, pulled in or otherwise injured.

This symbol warns of hand injury from the belt drive.

The symbol with the arrow indicates special advice and notes.

The product is intended for use in dry indoor rooms only; it must not become damp or wet.

Observe the operating instructions!

3. Intended Use

The 3D printer produces single-coloured 3D-objects from suitable printing files. For this, suitable raw material (filament) is melted in the print head and attached in the required position for the object.

The voltage supply is provided solely via the enclosed external mains unit.

It is intended for indoor operation only. Do not use it outdoors. Contact with moisture, e.g. in bathrooms, must be avoided under all circumstances.

For reasons of safety and approval, the product must not be converted and/or changed by you. Using the product for any other purposes than those described above may damage the product. Improper use also may cause dangers such as short circuit, fire, electric shock, etc. Read the operating instructions precisely and keep them. Only pass the product on to any third parties together with the operating instructions.

This product complies with the statutory national and European requirements.

Arduino™ is a registered trade mark of Arduino S.r.l. and its affiliated companies.

Current operating instructions

Download the current operating instructions via the link www.conrad.com/downloads or scan the displayed QR code. Observe the instructions on the website.

Attention! Important note on the firmware and software of the printer!

⟶ **This version of the instruction is valid as of firmware version RF500_V1.0.3 or higher and Repetier-Host software version 1.6.2 or higher.**

Check at regular intervals whether an update of the software or firmware is available. On this, observe chapter “8. Installation of the Software and Firmware”, “19. Software “Repetier-Host”” and “20. Firmware Update”.

Attention! Important note on shipping of the printer!

⟶ **For the pressambled device keep the original outer packaging, the inlay and the transport protection well! Only this permits safe transport, e.g. for guarantee/warranty!**

For the Maker kit, please remove the glass platens and pack them separately.

We assume no liability in case of transport damage to devices that were not sent out in their original packaging or that were packed improperly in it!

4. Safety Notes

Read the operating instructions attentively and particularly observe the safety notes. If the safety notes and the information in these operating instructions regarding proper handling are not observed, we assume no liability for any resulting injury/ property damage. In such cases, the warranty/guarantee will also lapse.

a) General Information

- For safety reasons, any unauthorized conversions and/or modifications to the product deviating from these operating instructions are not permitted. Components may be damaged and thus impair the function or safety of the device.
- All persons who operate this product, mount, install, assemble it, put it into operation or service it must be trained and qualified accordingly and must observe these operating instructions.
- The 3D printer is not suitable for persons with physical, sensor or metal limitations or for inexperienced or uninformed persons.
- This product is not a toy, not to be used by children and not suitable for children. Children do not understand how dangerous electrical devices can be.
- The mechanical parts of the product are produced highly precisely. Never apply any mechanical force here. The 3D printer may be rendered useless by this.
- Do not leave any packaging material unattended. It may become a dangerous toy for children.
- If you are not sure of the correct connection or if there are any questions that are not covered by the operating instructions, do not hesitate to contact our technical support or another specialist.
- Also observe the additional safety information in the individual chapters of these instructions.

b) Mains Unit

- The mains unit is constructed pursuant to protection class II.
- The mains socket for the mains unit must be close to the device and easily accessible.
- Never pull the mains plug of the mains unit from the mains socket by pulling the cable.
- If the mains unit is damaged, do not touch it. Danger to life from electric shock!

  First deactivate all sides of the mains socket to which the mains line of the mains unit is connected (e.g. switch off the respective fuse or turn out the fuse. Then deactivate the associated FI protection switch). Only then pull the mains plug from the mains socket and take the product to a specialist workshop.
- The mains unit is only suitable for dry, closed indoor rooms; it must not become damp or wet.

  There is danger to life from electric shock!
- Protect the cables of the mains unit from sharp edges at installation, do not crush the cable.

c) Set-Up, Site of Operation

- Set up the 3D printer only on a stable, horizontal, sufficiently sized surface.
- Choose the site of operation so that children cannot reach the product.
- When setting up the 3D printer, observe that the mains plug of the mains unit must be easy to reach so that the device can be separated from the mains voltage quickly and easily in case of malfunction.
- The devices must not be exposed to any extreme temperatures, strong vibrations, high moisture, such as rain or steam or strong mechanical strain.
- Never place containers containing liquids, e.g. glasses, vases, etc. on the device or in its vicinity and do not pour any liquids out over the device. Liquids may get into the housing and impair electrical safety. This also poses great danger of fire or potentially fatal electric shock!

  If this is the case, first power down the respective mains socket on all poles (e.g. switch off circuit breaker and FI switch) and then pull the mains cable of the mains unit from the socket. Disconnect all lines from the device. Do not operate any part of the product anymore afterwards, but take it to a specialist workshop.
- Never place any sources of open fire, such as lit candles, on or right next to the device.
- When setting up the mains unit, make sure that the mains cable is not pinched or damaged by sharp edges.

d) Operation

- Pull the mains cable of the mains unit from the socket at once if there is any electrical or mechanical problem! The printer will be powered down by this. Only connect the mains unit again when the problem has been removed.
- Never reach into the 3D printer in operation. The mechanically moved parts within the printer pose a high risk of injury!
- The print head grows very hot in operation. Never touch it during or just after operation. Let it cool down sufficiently first (approx. 30 minutes).
- Disconnect the device from the mains before maintenance work or modifications (unplug the mains plug!) and let it cool down.
- In operation, there will be noise and, depending on the filament material used, smells. Observe this when selecting the site of setup and the filament material. Ensure sufficient ventilation or install an extraction system. Do not inhale arising vapours. When using any other than the recommended filament material, poisonous vapours or gases may develop.
- If the mains line of the mains unit or the mains unit itself is damaged, do not touch it. First power down the respective mains socket on all poles (e.g. switch off circuit breaker and FI switch) and then pull the mains cable from the socket. Never operate the product/ mains unit with a damaged mains line.
- Never touch the mains line or the mains plug of the mains unit with wet or damp hands. There is a risk of potentially fatal electric shock!
- Never operate the device unattended.
- Only operate the device in moderate climates, never in tropical climates.

5. Feature Description

- Printing space approx. 210 x 135 x 170 mm (W x D x H) (X, Y, Z)
- Play-free profile rail guides for maximum precision
- Easily adjustable printing plate
- Printing plate support of single-pane safety glass (only maker kit)
- Printing plate of aluminium with heating (only preassembled device)
- Highly precise extruder with replaceable printing nozzle
- Easily exchangeable external mains unit
- Display and key pad for the device operation right at the device
- Control via a computer (USB) or stand-alone operation (with SD or SDHC card) possible
- Manual control of the printing parameters possible even during operation
- Extremely stable by aluminium/steel mechanics
- Suitable for all common standard roll filament types (filament diameter 1.75 mm; roll diameter max. approx. 220 mm, distance upper edge of filament holder from bottom approx. 140 mm)

6. Working Principle of the 3D Printer

For 3D print, first a file is needed that contains the three-dimensional data of the object to be printed (a common format of such a file is, e.g., a .stl-file).

This file can be produced with the corresponding software or with a 3D-scanner. There are also many printing files online that can be downloaded to print an object as quickly as possible.

The actual printer software has the task to render the above three-dimensional file into a file that the printer can print. This is a file in which the individual print layers, the print temperatures for the printing head and heating bed (preassembled device only), etc. are specified. The file has the extension ".gcode".

This G-CODE printing file is sent to the 3D printer either via the USB interface by the computer, or an SD card with the printing file is put into the card reader and the 3D printer is used in standalone operation.

The 3D printer then prints the print file layer for layer according to the FFF (Fused Filament Fabrication) / FDM (Fused Deposition Modelling) procedure.

At the actual print, the filament material is transported from the filament roll to the print head (extruder).

In the extruder, the filament material is melted and then applied to the printing plate via a fine extruder nozzle layer by layer.

The extruder moves in the X- and Y-directions, the printing plate moves in the Z-direction. Thus, all prerequisites to produce a three-dimensional object by horizontal application of the present layers are created.

A 3D printer is a highly complex device in which many parameters must be set depending on the printer, printed object and filament material used.

Additionally, the adhesion of the printed object on the printing plate is influenced by filament material, shape of the printed object and surface properties of the printing plate.

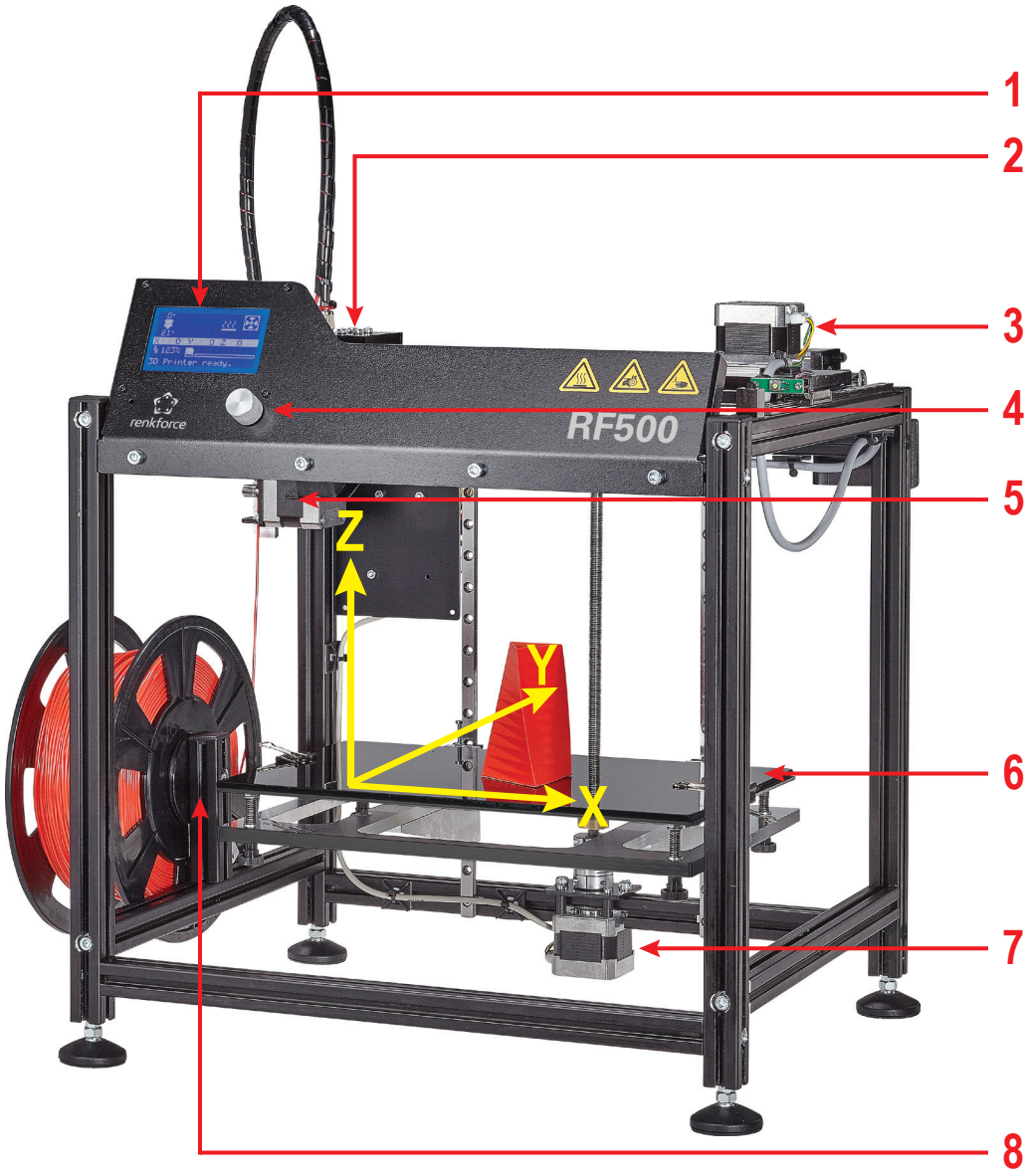
Ambience influences such as drafts, grease on the printing plate, etc. also play a role in the quality and adhesion of the printed object.

For the above reasons, it is not possible to achieve high-quality print results at once and without previous experiments.

Change the adjustable parameters in small steps to achieve the best printing results for your application. The printing examples enclosed on the SD-card provide references, but must be refined for perfect results depending on the above parameters.

7. Overview of the Most Important Parts

a) Maker Construction Kit / Construction Kit



(1) Display

(2) Extruder carriage

(3) Motor for the X-direction

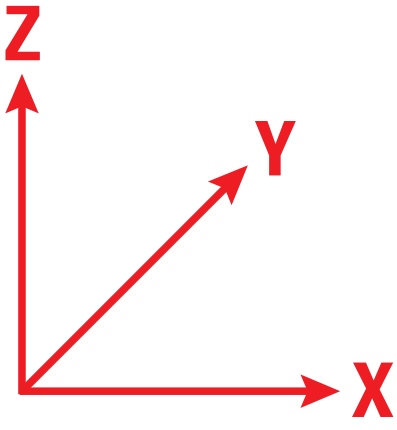
(4) Operating switch

(5) Filament feed

(6) Printing plate with printing plate support of glass

(7) Motor for the Z-direction

(8) Filament holder

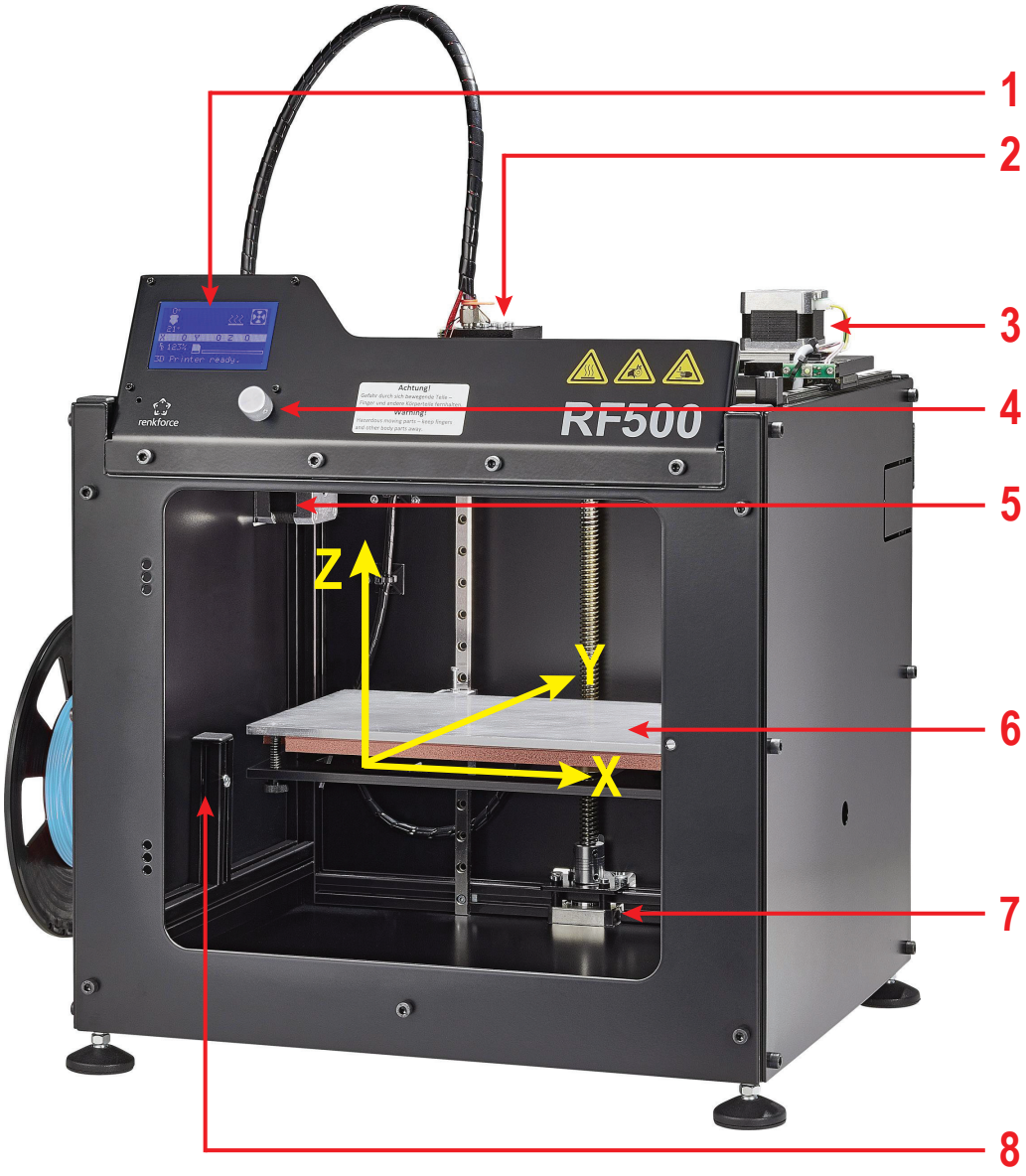


→ In the small figure on the right, the printing directions (x, y and z) are indicated in the front view.

The three yellow arrows in the figure above show the actual directions in the displayed printer.

→ In addition to the Maker kit, the kit also has a metal housing (like the finished product).

b) Preassembled Device



(1) Display

(2) Extruder carriage

(3) Motor for the X-direction

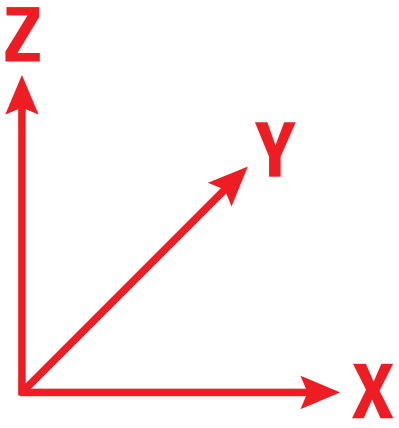
(4) Operating switch

(5) Filament feed

(6) Aluminium printing plate and heater

(7) Motor for the Z-direction

(8) Filament holder



→ In the small figure on the right, the printing directions (x, y and z) are indicated in the front view.

The three yellow arrows in the figure above show the actual directions in the displayed printer.

→ The preassembled device has an aluminium printing plate with heating in contrast to the maker kit. The preassembled device also has a metal housing. The heating and housing can be retrofitted with the construction kit.

8. Software and Firmware Installation

a) Download and Unpacking of the Software/Firmware Package

⟶ **The software, firmware, tools and printing examples needed for the printer are available online as a download package. This is regularly updated. Therefore, check occasionally whether a new version may be available.**

- Open the web browser and navigate either to the product page of the printer in our shop www.conrad.com or to our download page (see chapter "3. Intended Use" - Current operating instructions).
- Download the package "**BUNDEL_Vx_x_x_RENKFORCE_RF500**" here (x_x_x designates the package version).
- Unpack the downloaded ZIP file on your hard disc. Note that the archive has a very deep path due to the firmware and Arduino™ software contained. Therefore, we recommend directly unpacking the package into a folder on, e.g., C:\ or D:\.
- Find a brief explanation on the folders contained below.

"Arduino"	A text file with a download link for the Arduino™ software is contained here. This is needed, e.g., to install the firmware without updater.
"Firmware Updater"	The firmware updater installs the firmware (hex version) with just a few clicks.
"Firmware-Hex"	Firmware version for the firmware updater ("RF500-withoutBed" = without heating; "RF500-withBed" = with heating).
"Firmware-Source"	Firmware version for the software Arduino™.
"GCODE-PLA"	Printing examples that are already sliced. Can be printed directly from an SD-card.
"Repeater Host"	The Repeater Host software.
"STL"	Print examples that are not sliced yet.

b) General Information on the Repeater Host Software

It is unfortunately not possible to explain the complete function of the enclosed software in the scope of this instruction. For this, we refer to the integrated online help function and the information on www.repetier.com.

The basic operation and the path to the first printout are, however, described below to that you can get a result quickly and easily.

The archive you downloaded before holds a custom version of the software that contains the printer settings and configuration files for the RF500 in the folder "Repetier-Host". We urgently recommend to install the custom version of the software since then you do not need to configure the software and the required drives are already installed as well.

The respective updated Custom version of the software always is contained in the download package "BUNDEL_Vx_x_x_RENKFORCE_RF500".

This version of the instruction is valid as of the Repetier-Host software version 1.6.2 or higher.

Configuration of the software and driver installation are explained below in the Annex to these instructions for the sake of completeness. However, the software only needs to be configured if you install the basic version of the software from www.repetier.com.

If you have already installed a previous basic version of the software, the old version can be uninstalled and the custom version can be newly installed. The slicer settings of the previous version are not deleted and reappear in the custom version.

The software Repetier-Host performs the following tasks:

- Placement of the 3D-object to be printed on the printing plate.
- Slicing of the object to be printed into thin layers that the 3D printer can print out layer for layer. The result of this process is a G-code file.
- Review of the G-code files for error and printability.
- Sending the G-code files to the printer or saving on an SD card for standalone print.
- Monitoring the 3D printer in operation.
- Setting and storage of printer- and filament-specific data.

c) Installation of the Repeater Host Software

- Install the file "**setupRepetierHostRenkforce_x_x_x.exe**" from the directory "**Repetier-Host**" from the download package (x_x_x designates the software version here).

→ Installation of the custom version of the Repetier-Host requires administrator rights, since the necessary configuration files and printer settings will not be installed otherwise. If the corresponding message appears in Windows®, confirm it with Yes in any case. The installation will otherwise be interrupted.

If setup asks if you want to install the serial drivers ("Install serial driver"), do this in any case for the first installation, since the printer will not be recognised otherwise.

- Alternatively, the installation file for the basic version of the software can also be downloaded from www.repetier.com. There, MacOS X- and LINUX versions of this software are offered as well.

→ Prerequisites for installing under Windows®:

Microsoft .Net Framework 4 must be installed on the computer. This software can be downloaded free of charge from www.microsoft.com or installed subsequently in the operating system via the Windows® features.

The further system requirements for installation of Repetier-Host (also for other operating systems) are found on www.repetier.com.

Updates for Repetier-Host are regularly published under www.repetier.com. Updates of the custom version can be found on www.conrad.com in the download area on the product page of the 3D-printer.

d) Installation and Updating of the Firmware

→ **At delivery, no firmware is installed on the main PCB of the construction kit. The firmware must be installed once before installation of the main PCB. Installation takes place via the firmware updater.**

This step has already been performed in production on the preassembled device. However, we recommend that you check before commissioning whether the latest firmware is already installed.

New versions of the firmware are contained in the download package "BUNDEL_Vx_x_x_RENKFORCE_RF500".

The following description is valid for first installation (construction kit only), as well as later when updating the firmware (construction kit and preassembled device).

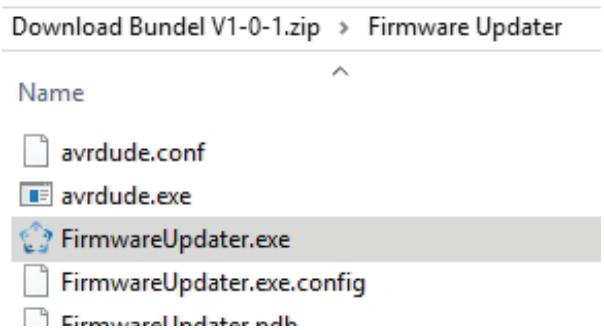
Alternatively, chapter "20. Firmware Update" describes how to install the firmware with the Arduino™-software.

Update process

- After you have installed the repeater host software incl. the serial drivers, connect the main PCB (only the Arduino™-PCB without the additional PCB) to your computer by USB.

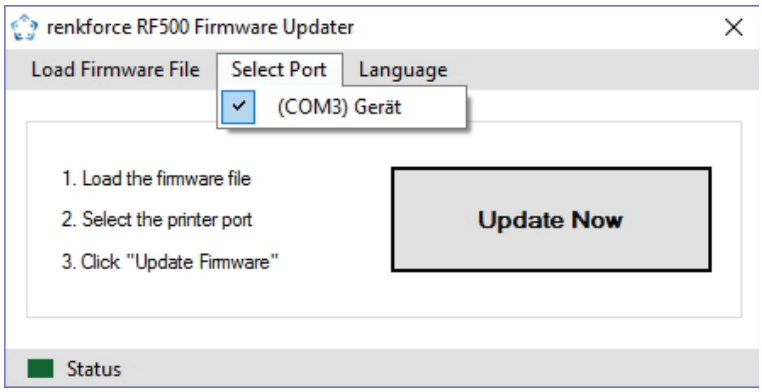
  The PCB is supplied with power via USB. This is enough to install the firmware.

- Start the file "**FirmwareUpdater.exe**" with administrator rights. You can find the program in the unpacked download bundle, in the directory "**Firmware Updater**".

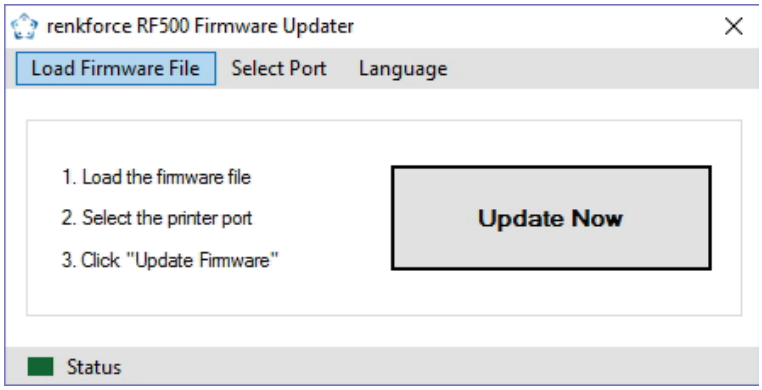


- First, set your language if necessary. For this, click the menu "**Language**" or "**Sprache**". Select English or German as your language.

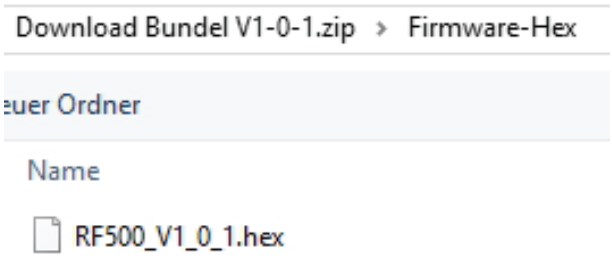
- Now select the desired serial connection. For this, click "**Select Port**". If more than one device is displayed, briefly disconnect the main PCB at the USB connection and then recommend it. The device that disappeared briefly is the right one.



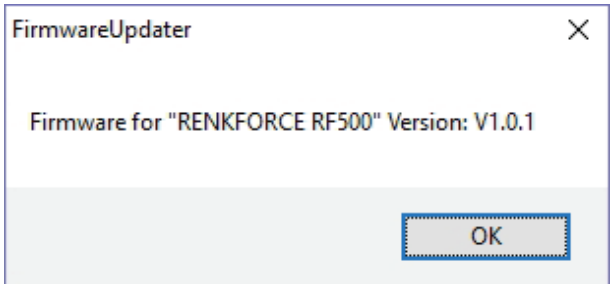
- To select the firmware file, click "**Load Firmware File**".



- Usually, the folder in the download bundle that contains the firmware will be opened now. If this is not the case, open the folder "**Firmware-Hex**" manually. Then open the corresponding subfolder "**RF500-withBed**" (for the preassembled device) or "**RF500-withoutBed**" (for the construction kit). Open the firmware file "**RF500_Vx_x_x.hex**" in it.
- To start the update, click "**Update now**".



- The firmware version will be displayed. Confirm with "**OK**".



- To start the update, click "**Update now**" in the main window.
- There will be another query whether you really want to perform the update. Confirm with "**Yes**".

  The update will now be installed. During this, the display in the lower left of the updater and on the main PCB will flash.
- Once the message shows that the update is complete, confirm it with "OK".
- Next, push the button at the main PCB, wait for a few seconds and then disconnect the cable from the USB connection again.

⟶ If you update later, while the PCB is already installed, remove the USB cable and voltage supply from the printer after the update. Wait for about 20 seconds to connect both again.

9. Required Tools and Material

→ The second part ("Maker-construction kit / construction kit") of this chapter ("9. Required Tools and Material") and the 3 subsequent chapters ("10. Assembly of the Mechanical Parts", "11. Mounting of the Electrical Components" and "12. Final Work") generally are only relevant for purchasers of the maker construction kit / construction kit. Owners of the preassembled device can skip those chapters.

However, the chapters are helpful when there is an error or smaller repairs are necessary.

Preassembled device

- Hex key 4 mm

Maker-construction kit / construction kit

- Different screwdrivers (cross-head and slotted)
- Hex key 1.5 mm / 2 mm / 2.5 mm / 3 mm / 4 mm
- External hex key socket wrenches 4 mm / 5 mm / 5.5 mm / 6 mm / 7 mm
- External hex key open-ended wrenches 5 mm / 6 mm / 7 mm / 8 mm / 10 mm / 11 mm / 13 mm

→ A hexagon socket wrench or a hexagon spanner may be used in some cases.

- Hammer
- Stop angle
- Calliper
- Wire cutter
- Small flat pliers and small long-nose pliers
- Threadlocker varnish, medium strength
- Feeler gauge 0.3 mm
- Multimeter for voltage measuring (300 mV / 500 mV); measurement range < 1 V

10. Assembly of the Mechanical Parts

→ This chapter ("10. Assembly of the Mechanical Parts") generally is only relevant for purchasers of the maker construction kit / construction kit. Owners of the preassembled device can skip this chapter. However, the chapter is helpful when there is an error or smaller repairs are necessary.

a) General Information

Take enough time for the assembly. Hurrying often leads to mistakes that may damage components or ruin the time benefit by elaborate rework.

The workplace should be sufficiently large and clean so that the different components and assemblies can be put down and installed easily.

Always observe the images during assembly. Here, the assembly locations and correct alignment of the components are shown.

All mechanical components of the construction kit are produced extremely precisely. Never apply any force during assembly. All parts can be assembled without any great application of force. If this is not the case, rethink the assembly step and reread the corresponding description in these instructions.

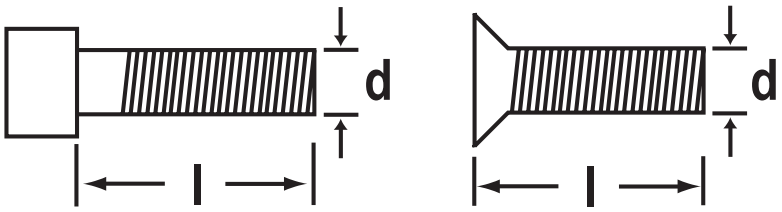
When tightening the screws, ensure that you do not tighten them too tightly. Many screws are turned into aluminium threads and therefore must not be tightened as far as it would be possible, e.g., in steel threads. A table with the recommended tightening torques of the screws can be found in the appendix of these instructions.

→ If you have ordered an operational accessories kit (e.g. housing kit or heating plate kit) along with the construction set, read the instructions of the respective kits before installing the construction kit. This may change individual work steps.

Sort the screws by size before assembly. This facilitates assembly, since you do not have to look for individual screws.

The delivery includes some screws, nuts and other small parts in larger numbers than necessary. They are meant as replacements in case a screw or similar material is lost in assembly.

For cylinder head screws, the length (l) is measured without the screw head; for countersunk-head screws, the length measurement takes place with the screw head. The diameter (d) is always measured by the thread.

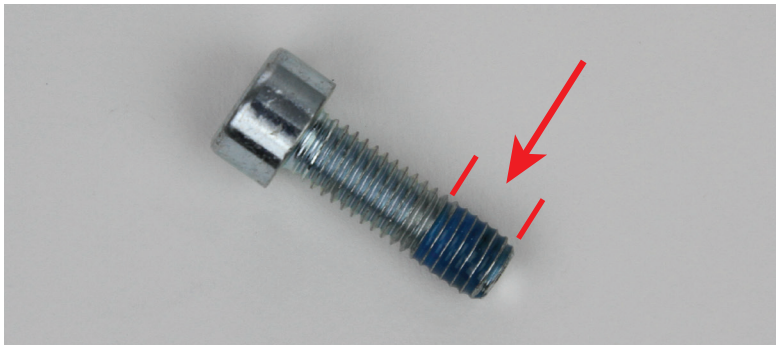


Application of the threadlocker varnish

In the following instruction, some screws can optionally be secured with threadlocker varnish. This is indicated accordingly in the text.

Procedure:

Put a small drop of threadlocker varnish medium-strength onto the thread start. Observe that you must only use a small drop as shown in the following screen.



Use of the slot nuts

Push the slot nut into the aluminium profile slot turned by 90° longitudinally.

Push, e.g., a small hexagon socket wrench or a similar tool carefully into the slot nut's thread.

Turn the slot nut up until it "latches" and is held cleanly in the guide. Now you can move it back and forth as desired.
When you tighten the respective screw in the slot nut, always make sure that the slot nut is placed cleanly in the nut.

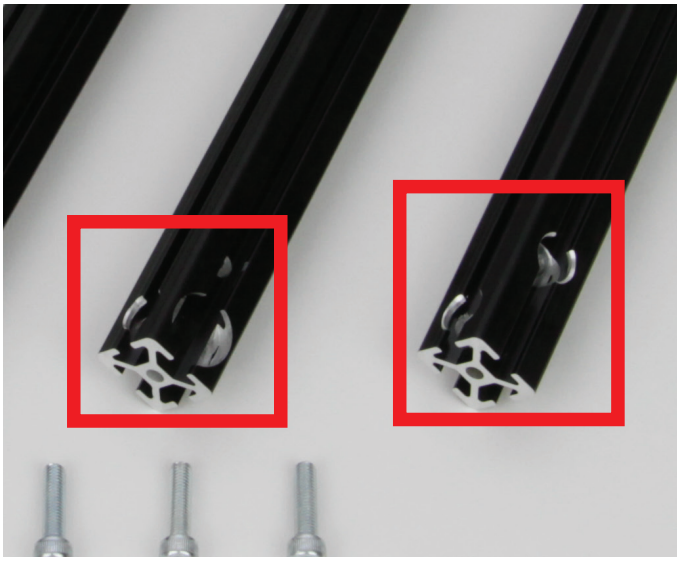
If you have to take out the slot nut, push it to the side so that it slips from the guide. Then turn it as when inserting. If the slot nut has the position shown in the 1st picture on this page, tip the thread up by 90°. If the nut protrudes from the slot, just pull it out.

Alternatively, and while the slot of the aluminium profile is still accessible, you can also push the slot nut into the slot from the side or pull it out that way.

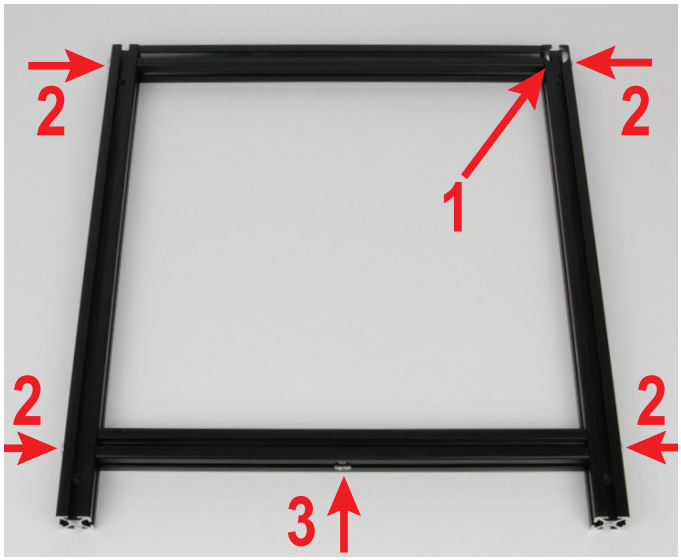
b) Assembly of the Components

Assembly of the left side part (front view)

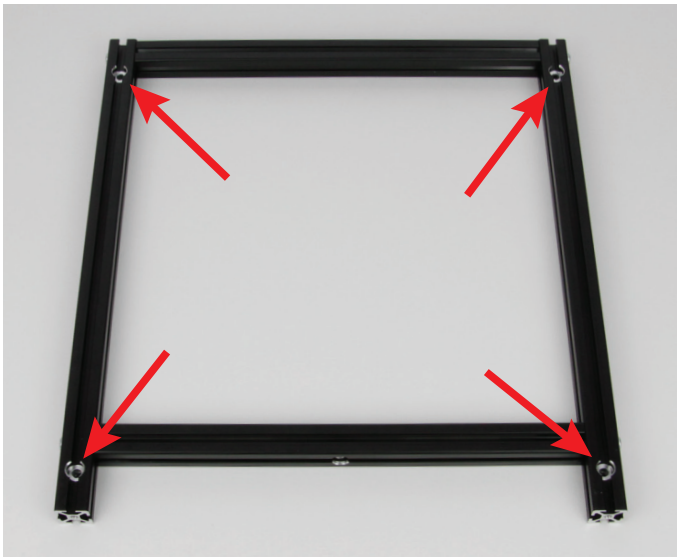
1x aluminium profile 284 mm without bore
1x aluminium profile 284 mm with bore at the centre
1x aluminium profile 356 mm with 4 bores and 1 cut-out for the ball bearing
1x aluminium profile 356 mm with 4 bores
4x cylinder head screw M5x20



The two short aluminium profiles are the same on both sides.
In the long profile with the cut-out for the ball bearing, the cut side of the bore, at the height of the cut-out for the ball bearing, must be on the left (left red box).
In the second long profile, the milled part of the upper bore, to the left of the milled side of the bore, must be below.



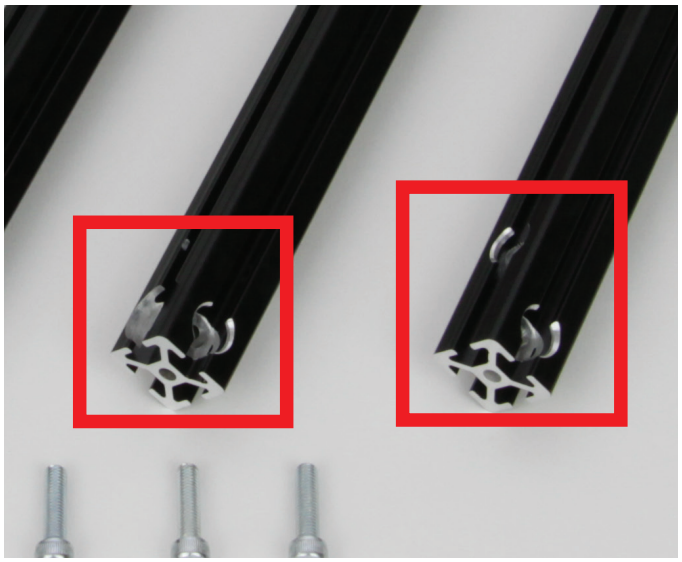
Assemble the 4 aluminium profiles as illustrated. Screw one cylinder head screw into each of the 4 bores (2), but do not tighten the screws yet. All parts must remain movable.
This figure shows the left side part from the inside. The cut-out for the ball bearing must be at the upper right (1).
The milled sides of the bore must point to the outside each (2). The screws also need to be inserted into the respective bore from the milled side bore (2).
The milled side of the bore in the lower cross-profile must point down (3).



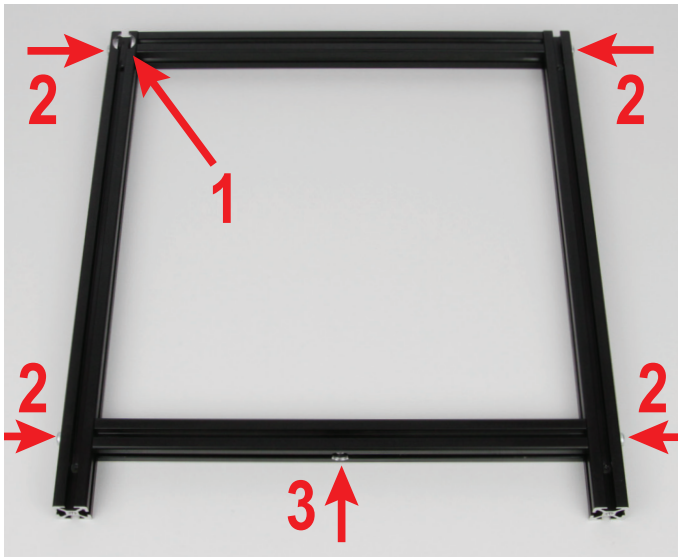
This figure shows the left side part from the outside.
As the figure shows, the milled sides of the 4 bores of the outer profiles must point up (see the 4 arrows in the figure).

Assembly of the right side part (front view)

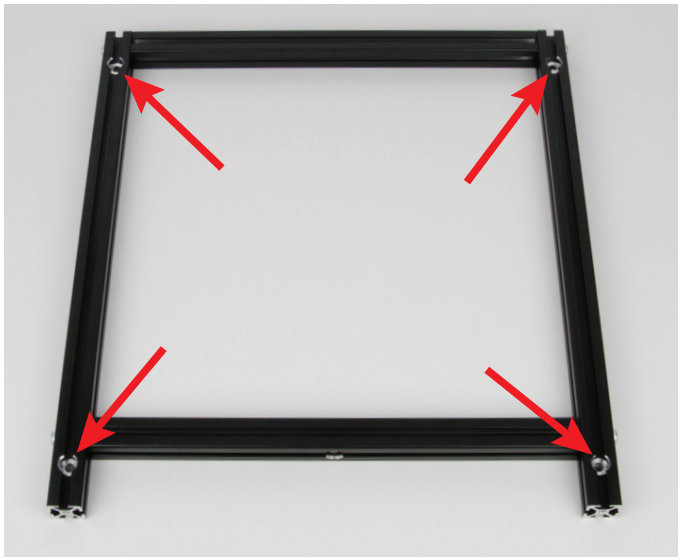
1x aluminium profile 284 mm without bore
1x aluminium profile 284 mm with bore at the centre
1x aluminium profile 356 mm with 4 bores and 1 cut-out for the ball bearing
1x aluminium profile 356 mm with 4 bores
4x cylinder head screw M5x20



The two short profiles are the same on both sides.
In the long profile with the cut-out for the ball bearing, the cut side of the bore, at the height of the cut-out for the ball bearing, must be on the right (left red box).
In the second long profile, the milled part of the upper bore, to the right of the milled side of the bore, must be below.

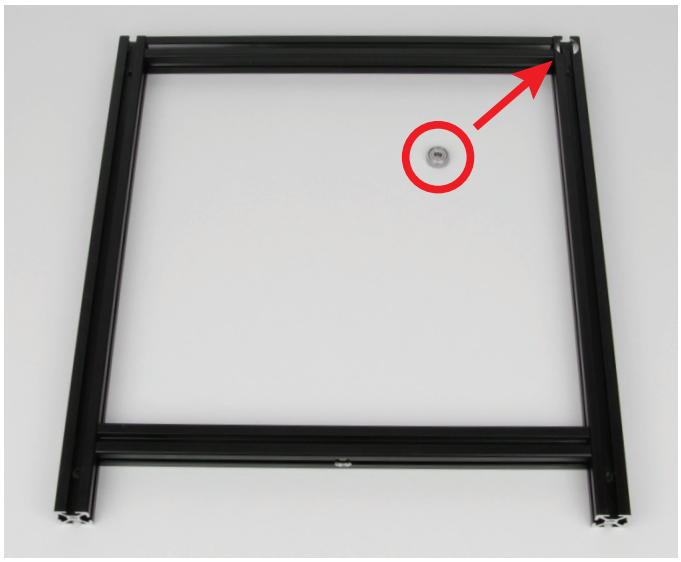


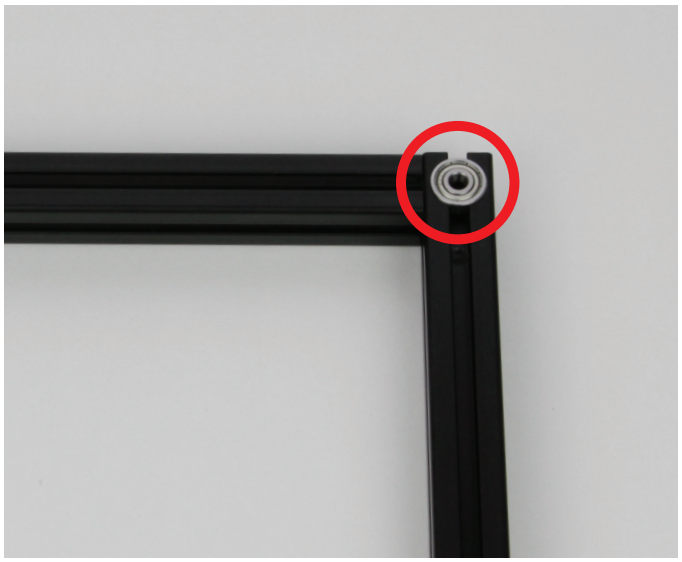
Assemble the 4 aluminium profiles as illustrated. Screw one cylinder head screw into each of the 4 bores (2), but do not tighten the screws yet. All parts must remain movable.
This figure shows the right side part from the inside. The cut-out for the ball bearing must be at the upper left (1).
The milled sides of the bore must point to the outside each (2). The screws also need to be inserted into the respective bore from the milled side bore (2).
The milled side of the bore in the lower cross-profile must point down (3).



This figure shows the right side part from the outside.
As the figure shows, the milled sides of the 4 bores of the outer profiles must point up (see the 4 arrows).

Inserting the ball bearing into the side parts.

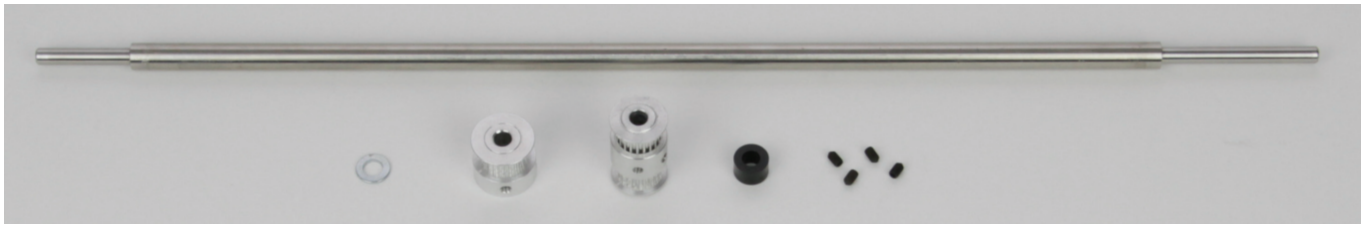




1x side part left
1x side part right
2x grooved ball bearing 625Z (diameter inside/outside 5/16 mm)

First take the left side part (see left figure) and push one of the two ball bearings into the intended cut-out.
Proceed accordingly for the right side part.

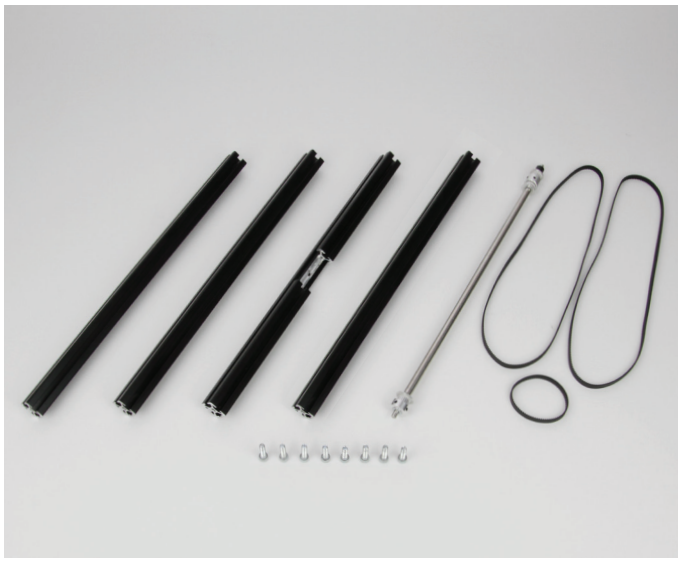
Assembly of the deflection shaft



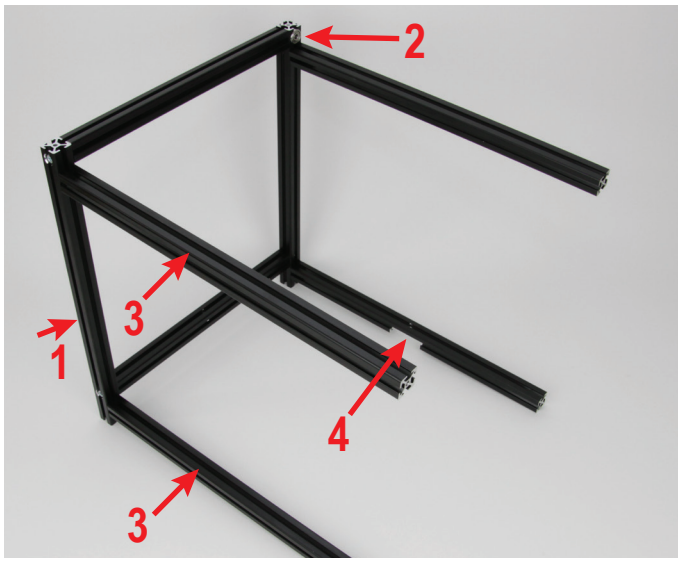
1x shaft 5 mm
1x washer (diameter inside/outside 5.3/10 mm)
1x sprocket 5 mm
1x sprocket, double, 5 mm
1x spacer 6 mm (inner diameter 5 mm)
4x threaded pin M3x5

Assemble the deflection shaft as shown in the figure above.
It will be installed in the printer later like the figure shows (frontal view).
On the left, push the sprocket onto the shaft first, followed by the washer (must be at the far outer left in the end). Observe proper alignment for the sprocket.
On the right, push the double sprocket onto the shaft first, followed by the spacer (must be at the far outer right in the end).
Screw 2 threaded rods into each of the two sprockets. Do not tighten these firmly yet!
Optionally, the threaded rods can be secured with threadlocker varnish.

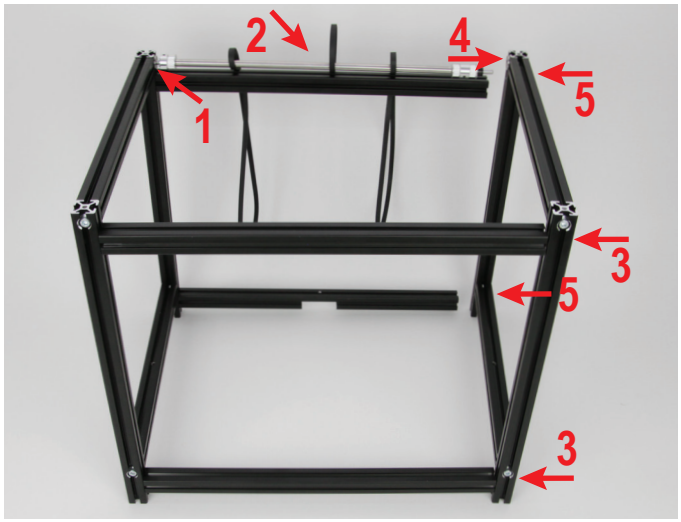
Assembly of the basic frame



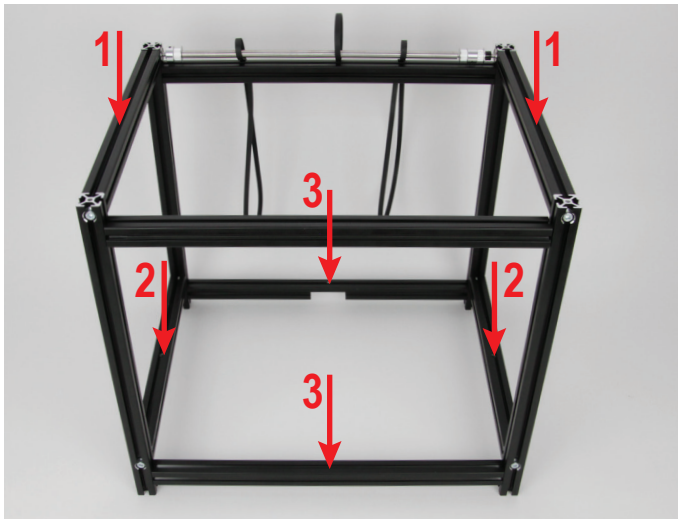
2x aluminium profile 356 mm without bore
1x aluminium profile 356 mm with square cut-out and 2 bores
1x aluminium profile 356 mm with 2 bores
1x deflection shaft, assembled
2x toothed belt 600 mm
1x toothed belt 136 mm
8x cylinder head screw M5x16
Both side parts (not illustrated)



First take the left side part. Attach the 4 aluminium profiles as illustrated with 4 M5-cylinder-head screws.
Turn in the screws only loosely. Do not tighten!
The screws always must be screwed in from the milled side of the respective bore.
The arrow (1) shows the aluminium profile on the front left side. The ball bearing (2) must point inwards at the upper rear.
The two aluminium profiles without bore go to the front (3).
At the rear, the profile with the two bores must be attached at the top. The profile must be aligned so that the two bores point to the lower profile.
Attach the profile with the square cut-out at the bottom. The cut-out must be pointed down (4).

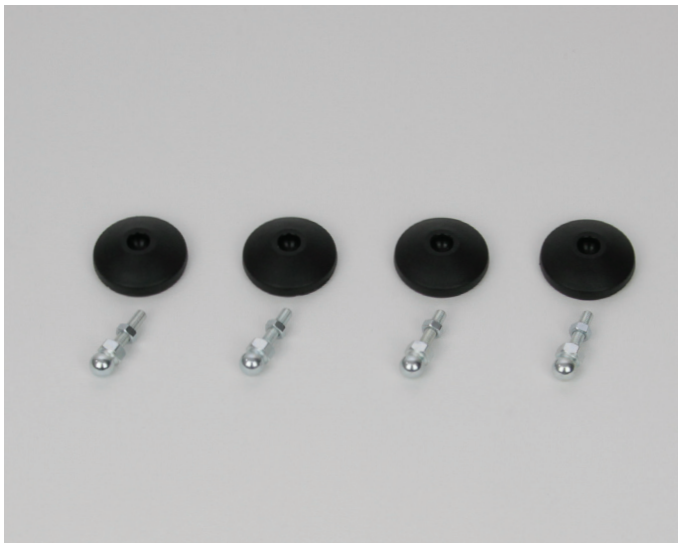


Take the assembled deflection shaft and push it into the ball bearing of the left side part (1). The three toothed belts are now simply pushed onto the shaft (2). The small toothed belt must be centred. Now attach the right side part loosely to the two front aluminium profiles (3) with 2 cylinder-head screws. Then push the deflection shaft into the ball bearing of the right side part (4). Finally, attach the right side part to the two rear profiles (5).



Now all M5 cylinder-head screws of the basic frame are tightened. It must be placed on a level, straight surface, and should not wobble when all screws are tightened.
Push the two upper cross-profiles (1) or 2 of the lower profiles (2) and (3) when tightening.
First tighten all screws slightly in sequence and hold all profiles straight. When the frame is standing level and no longer wobbles, tighten the screws all the way.

Installing the articulated feet

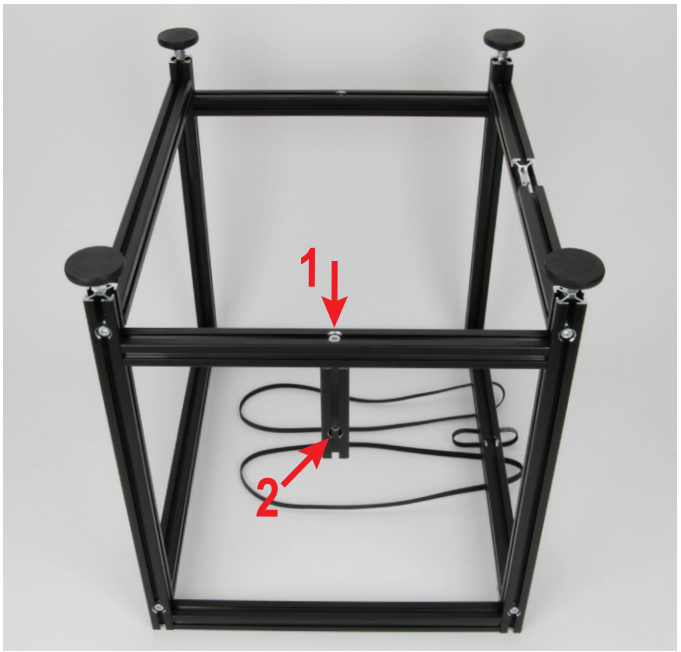


4x foot
4x ball-head screw Ø40 M5x20 incl. counter-nut

Screw the counter-nut to the stop in all four ball-head screws.
Take the basic frame and put it upside-down. Do not crush the toothed belts.
Screw one ball-head screw each into the bottom of the vertical aluminium profiles (1). Screw the screws in to the stop.
Push one foot onto each ball head with the ball of your thumb (2).
Finally, align the feet. Place the basic frame on a level, straight surface. After setting the feet, tighten the counter-nut towards the aluminium profile.

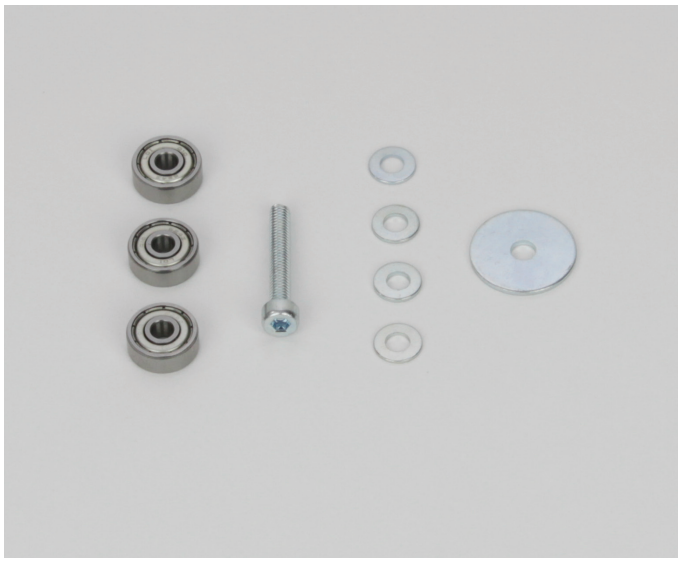
Installing the aluminium profiles for the filament holder

1x aluminium profile 86 mm with bore
1x cylinder head screw M5x20



The aluminium profile for the filament holder is attached from the front view to the lower cross-profile of the left side part.
Attach the aluminium profile as illustrated with the cylinder-head screw (1).
The profile must be aligned so that the milled side of the bore is pointing inwards (2).

Assembly of the belt tensioners (Y-direction)



3x grooved ball bearing 624Z (diameter inside/outside 4/13 mm)
1x cylinder head screw M4x25
4x washer (diameter inside/outside 4.3/9 mm)
1x washer (diameter inside/outside 4.3/20 mm)
2 belt tensioners are needed. The parts list makes up one belt tensioner.

Push the washers onto the screw alternatingly with the ball bearings (**screw - washer - ball bearing - washer - ball bearing - washer - ball bearing - washer - washer 20 mm**).

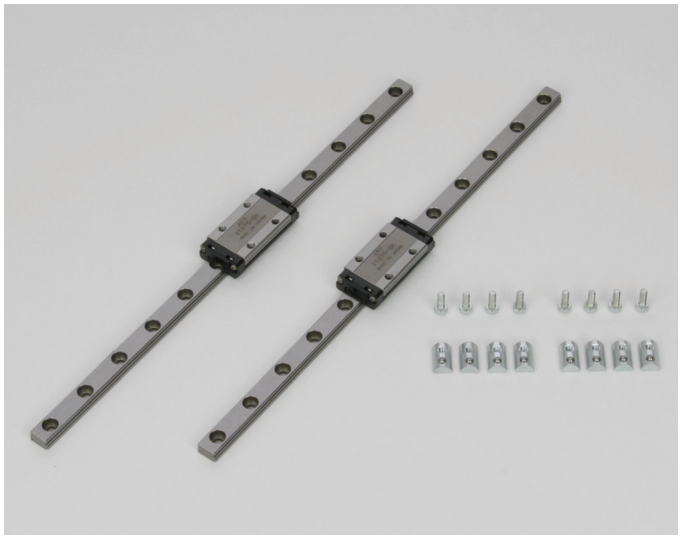
Installation of the belt tensioners (Y-direction)

2x belt tensioners assembled
2x slot nut M4

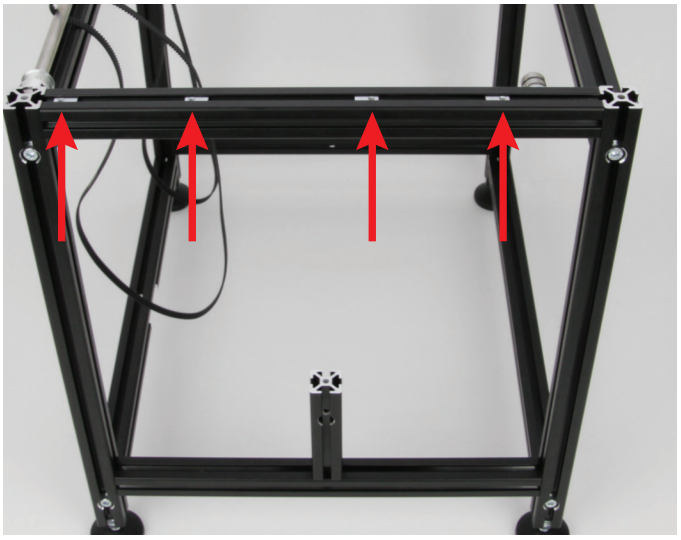
Push one slot nut each into the inside of the upper aluminium profiles of the side parts and attach one belt tensioner each to it.
Do not tighten the screws firmly yet.

Installation of the guide rails for the Y-direction

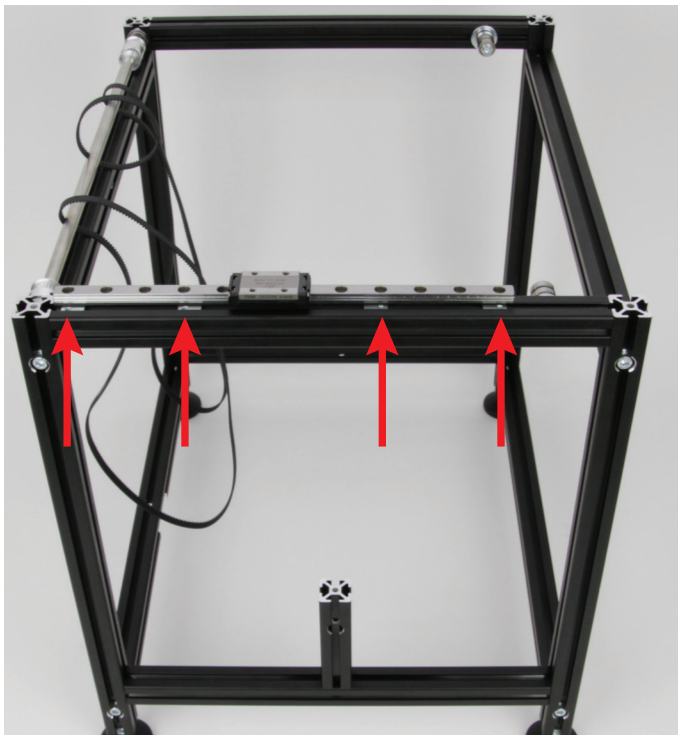
The guide carriage can generally be pushed off of the respective guide rail, since the bearing balls are combined in a chain. However, we recommend avoiding this if possible.



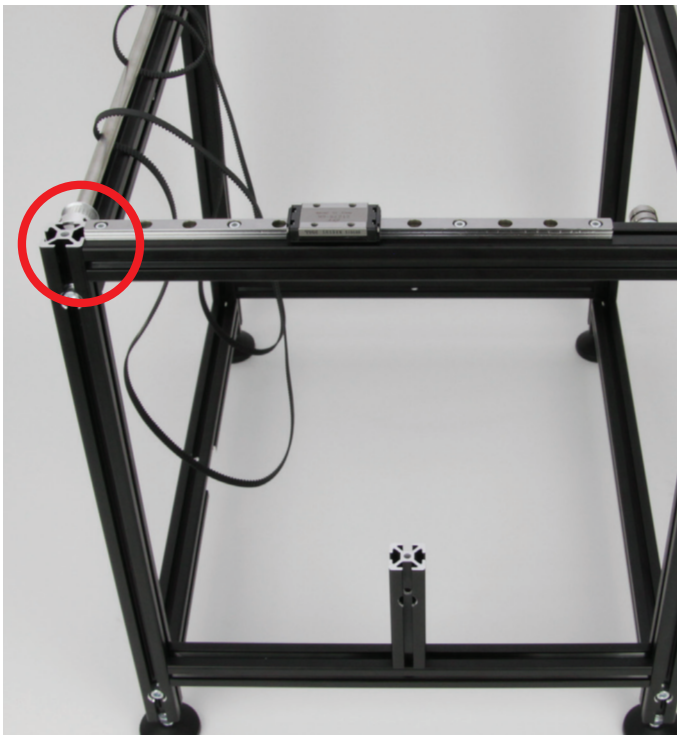
2x guide rail with guide carriage (235 mm)
8x cylinder head screw M3x8
8x slot nut M3



Push 4 slot nuts into the upper aluminium profiles of the two respective side parts 4 slot nuts. For the other ones, the thread must point outwards in each case.

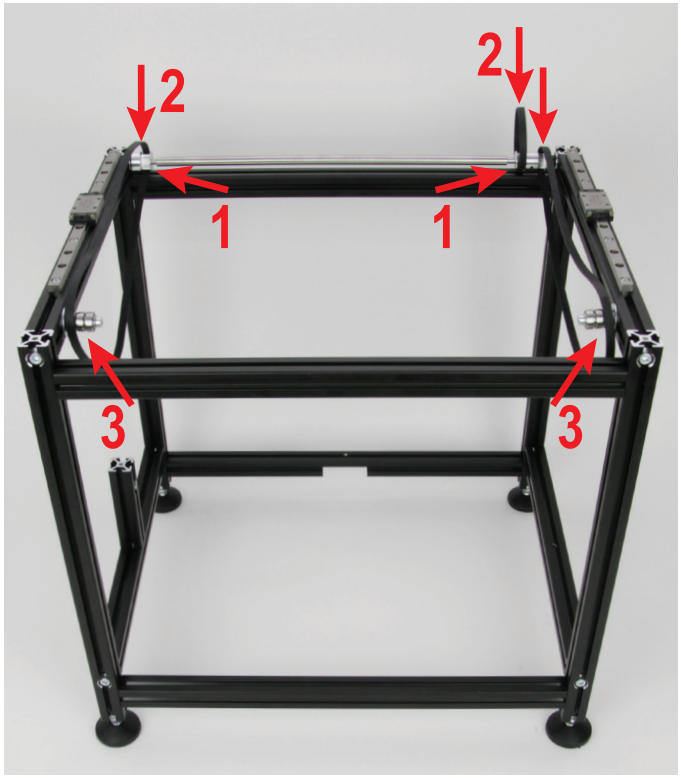


Remove the two cable ties from the guide rails.
Hold a guide rail with guide carriage against the slot nuts and align the slot nuts on both sides as illustrated.

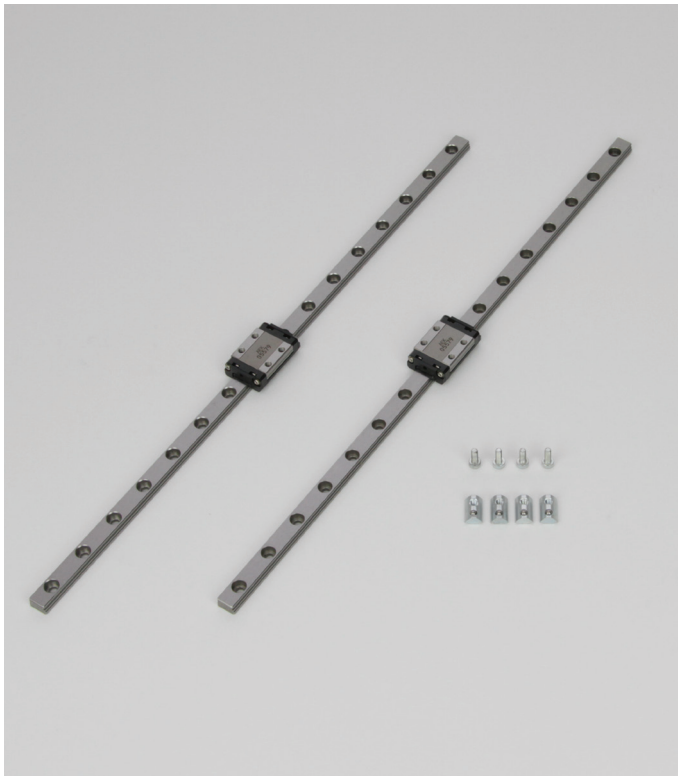


Attach one guide rail with guide carriage each loosely to the two profiles with the cylinder-head screws.
Then align the guide rail. It must end with the
aluminium profile it is attached to at the rear of the printer.
Finally, slightly tighten all screws so that the guide rail can no longer be moved.

Installation of the guide rails for the Z-direction

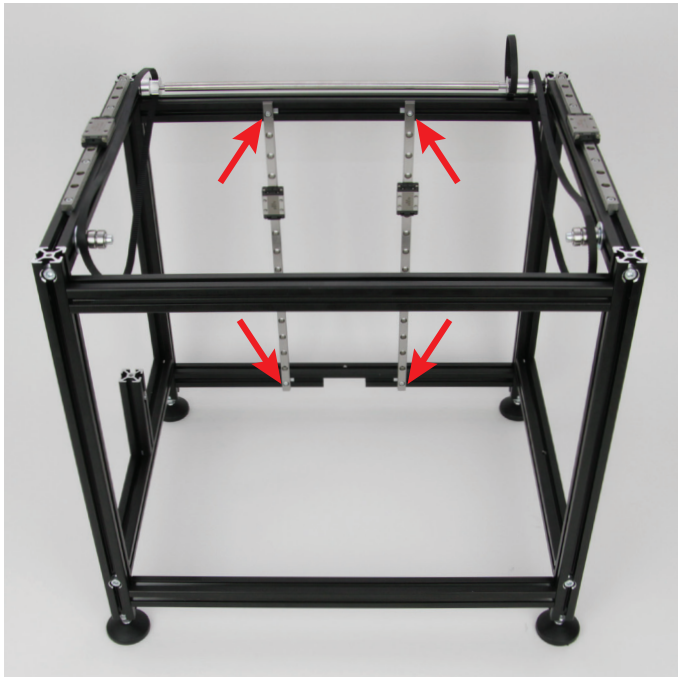


Slide the two knurls on the deflection shaft each to the outside in the direction of the side part (1).
Then attach the toothed belts to the knurls (2). Place the two long toothed belts provisionally over the two belt tensioners (3).



2x guide rail with guide carriage (320 mm)
4x cylinder head screw M3x8
4x slot nut M3

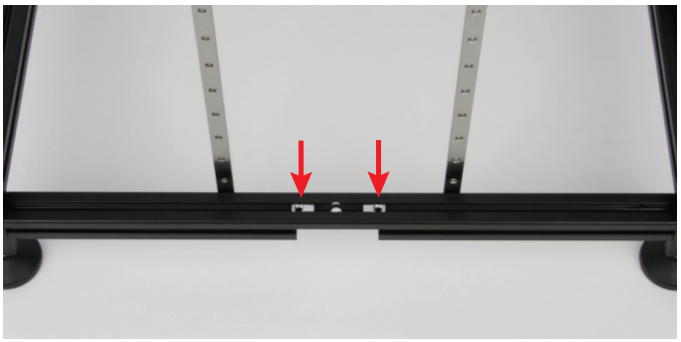
Push 2 slot nuts each into the two aluminium profiles installed cross-wise at the rear as illustrated. The slot nuts each must be aligned with the parallel bore.

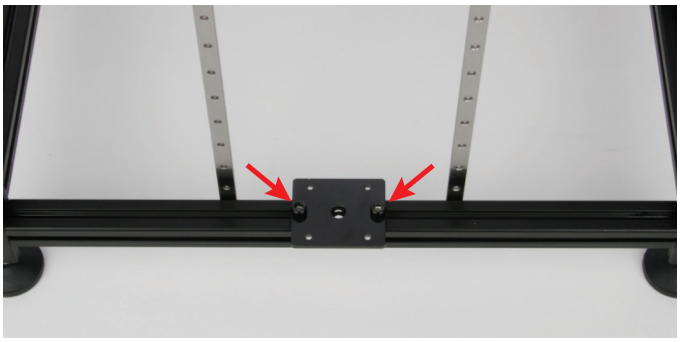


Attach the two guide rails with guide carriage to the two profiles, using the cylinder-head screws as illustrated.
Only tighten the 4 screws slightly!

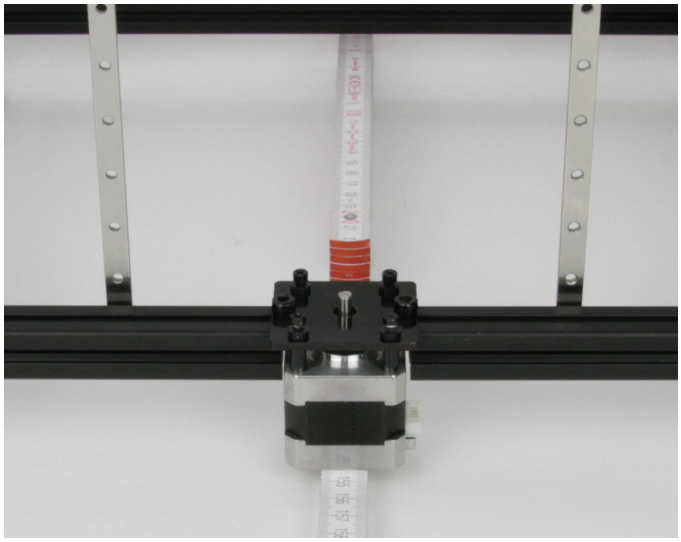
Installing the Z-motor

1x actuator
1x Z-motor holder, black
4x cylinder head screw M3x20 black
4x spacer 10 mm (diameter inside 3 mm)
4x spacer 2 mm (diameter inside 3 mm)
2x slot nut M5
4x cylinder head screw M5x8 black

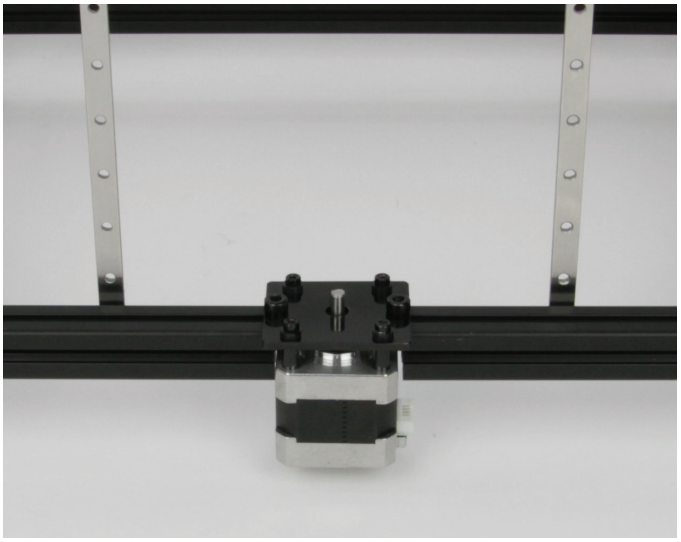




Push the 2 slot nuts into the lower aluminium profile at the rear as shown in the upper figure.
Take the Z-motor holder and attach it to the two slot nuts with the two M5-cylinder-head screws.
The Z-motor holder must be aligned above the bore of the aluminium profile. Do not tighten the screws firmly yet!

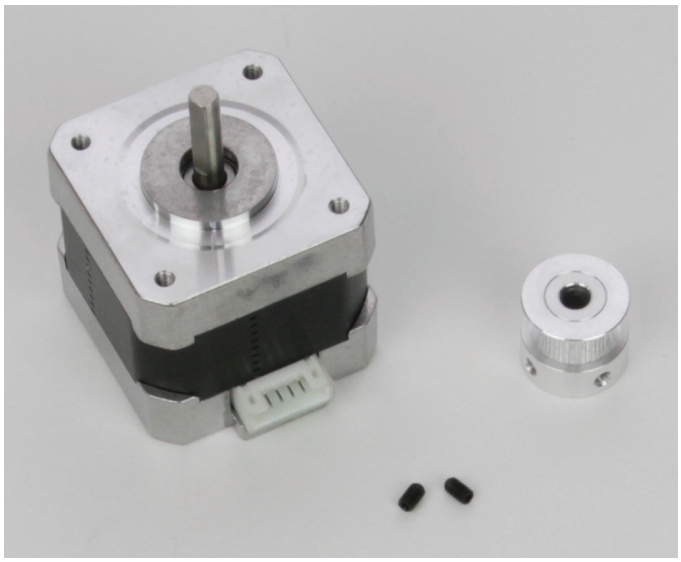


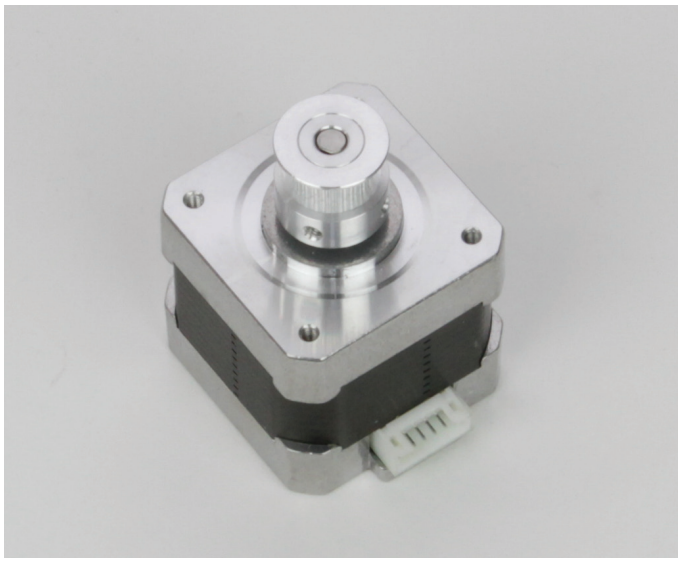
Thread the motor into the bore from below. The connection plug must be aligned with the left side of the printer, in the direction of the filament infeed (from the rear view towards the right).
For example, take a yard stick or similar and place it under the motor. Attach the motor to the Z-motor holder with 4 cylinder-head screws M3x20. A 10 mm spacer is needed between the Z-motor holder and the motor. A 2 mm spacer is needed between the Z-motor holder and the screw head.



Tighten the 4 M3-screws first.
Then tighten the two M5-cylinder-head screws. The motor shaft must be aligned centred in the bore. It must not touch the aluminium profile.

Attachment of the sprocket to the Y-motor

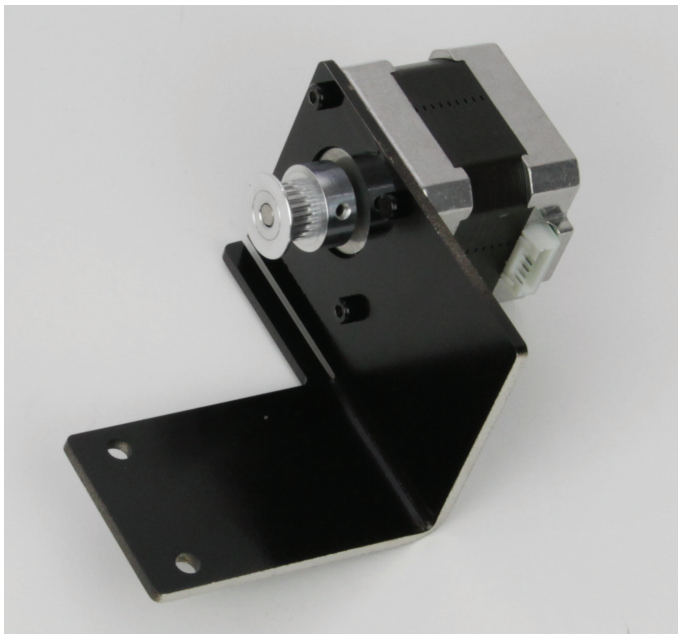




1x actuator
1x sprocket 5 mm
2x threaded pin M3x5

Push sprocket onto axe of the actuator and attach it with 2 threaded pins each. A threaded pin must meet the flattened side of the axis. Do not tighten the threaded pins fully yet.
The motor axis must end flush with the upper edge of the sprocket.
Optionally, the threaded rods can be secured with threadlocker varnish.

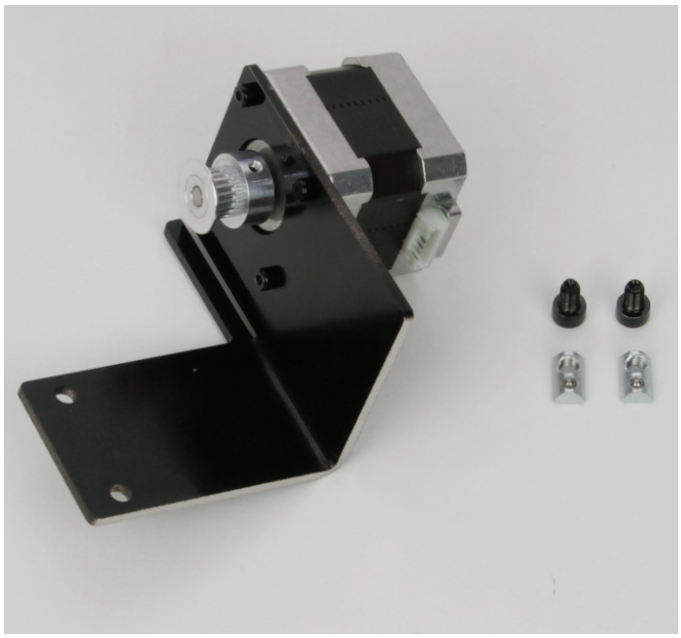
Installing the Y-motor to the Y-motor holder



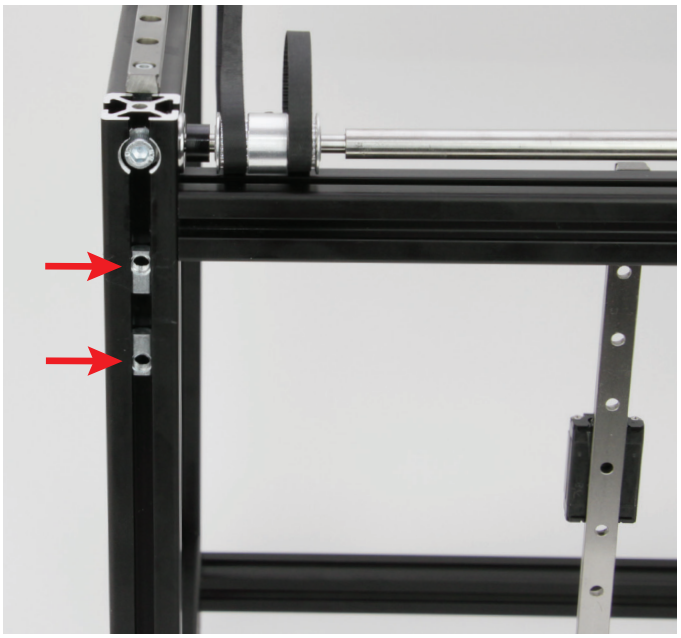
1x Y-motor holder
1x actuator with installed sprocket
4x cylinder head screw M3x8 black

Install the motor to the Y-motor holder with the 4 M3-cylinder-head screws. The motor plug must be aligned as shown in the figure.

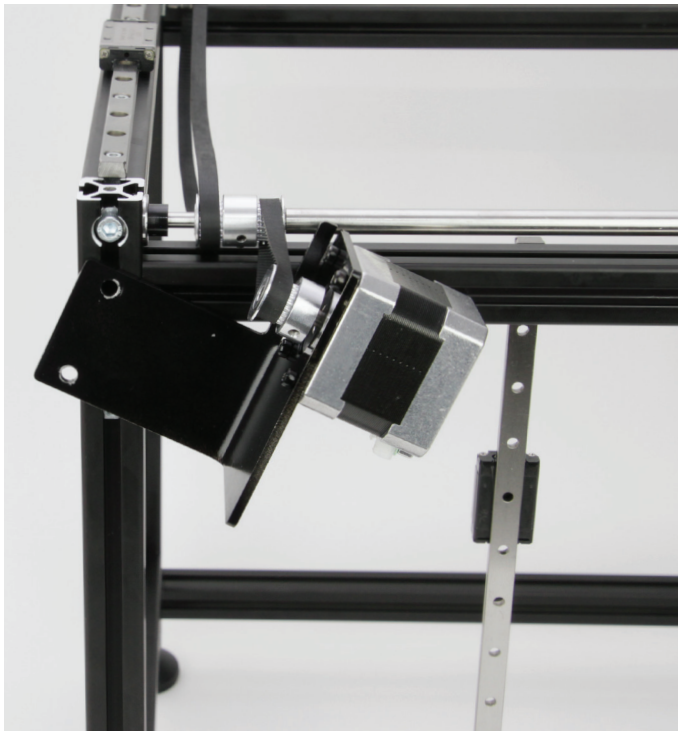
Installing the Y-motor holder to the basic frame and tensioning the toothed belt



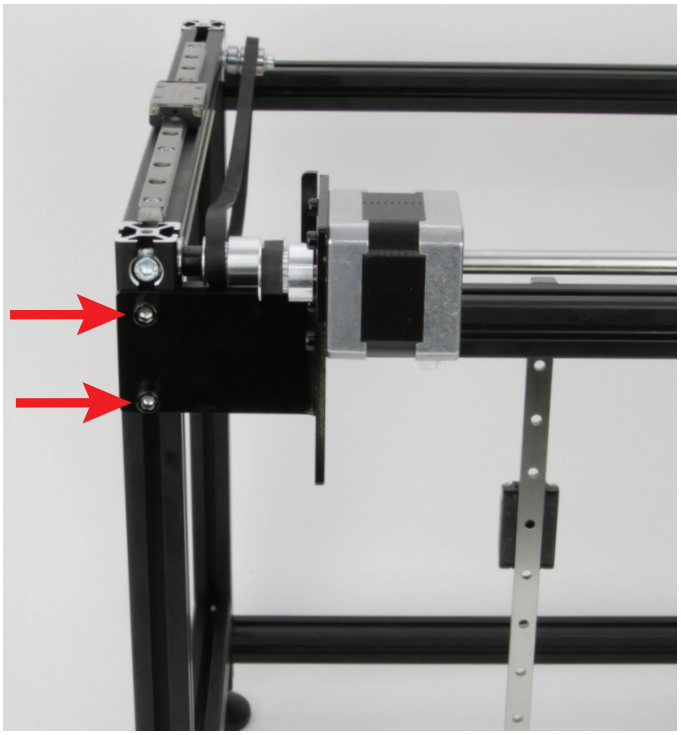
1x Y-motor holder with installed motor
4x cylinder head screw M5x8 black
2x slot nut M5



Push the 2 slot nuts into the right aluminium profile at the rear as shown in figure (where the double sprocket is installed).
The threads each must point outwards.
Align the two slot nuts with the bores of the Y-motor holder.



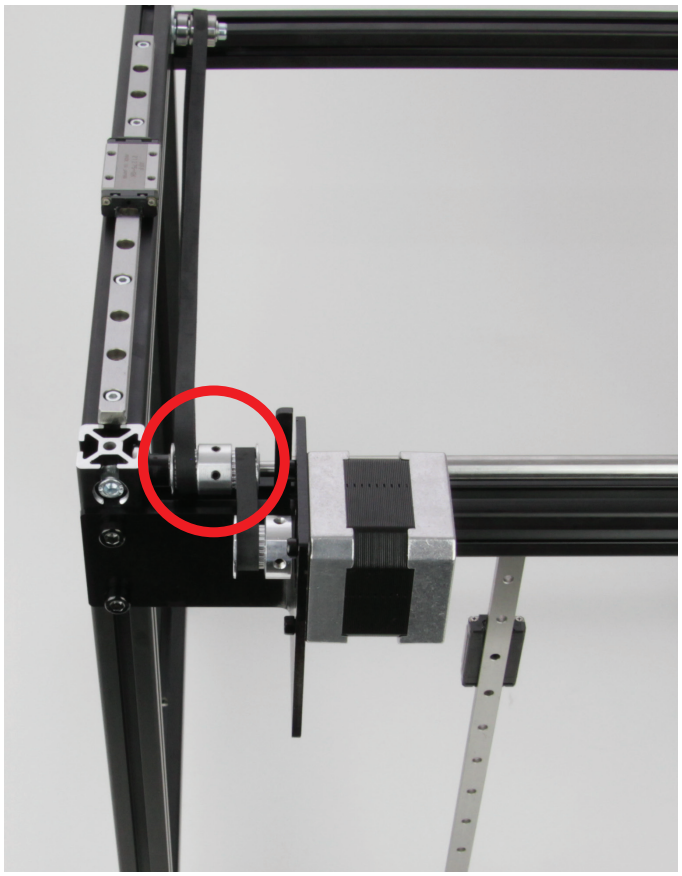
Attach the sprocket of the motor as shown in the figure to the short toothed belt of the deflection shaft.



Attach the Y-motor holder to the two slot nuts loosely with the two M5 cylinder-head screws.
To tension the toothed belt, push the Y-motor holder with the motor up until the toothed belt is tensioned so that it can still be twisted by 180° with two fingers.
Last, tighten the two screws.

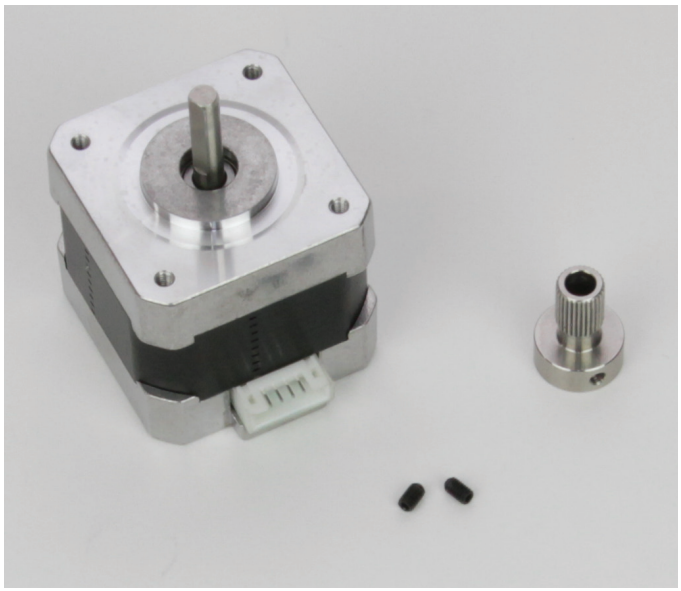
Aligning the deflection shaft and tightening the double sprocket

Now align the deflection shaft. It must be pushed into the ball bearing to the same depth as far as possible on both sides.
Check how far the shaft protrudes from the ball bearing on both sides by looking into the slot (where the screwdriver is placed with the shaft on the other side in the figure).
Take a flat-head screwdriver or a similar tool and move the shaft to the right or left until it is aligned centred.



Now check if the double sprocket is aligned with the spacer on the left. Then tighten the two threaded pins.

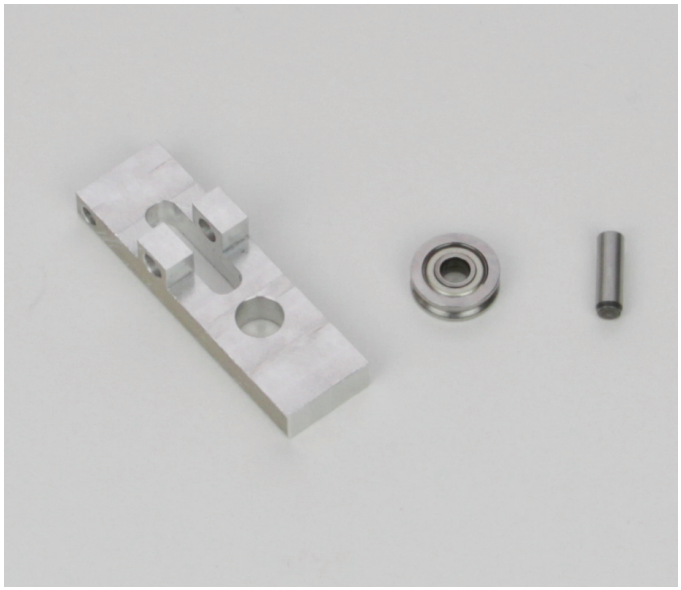
Attachment of the infeed knurl to the filament infeed motor



1x actuator
1x feed knurl 5 mm
2x threaded pin M3x5

Push the feed knurl onto axe of the actuator and attach it with 2 threaded pins each. A threaded pin must meet the flattened side of the axis.
The feed knurl must be as close as possible to the motor. As reference for the distance, push a feeler gauge sheet with 0.1 or 0.2 mm between the knurl and the motor.
Optionally, the threaded rods can be secured with threadlocker varnish.

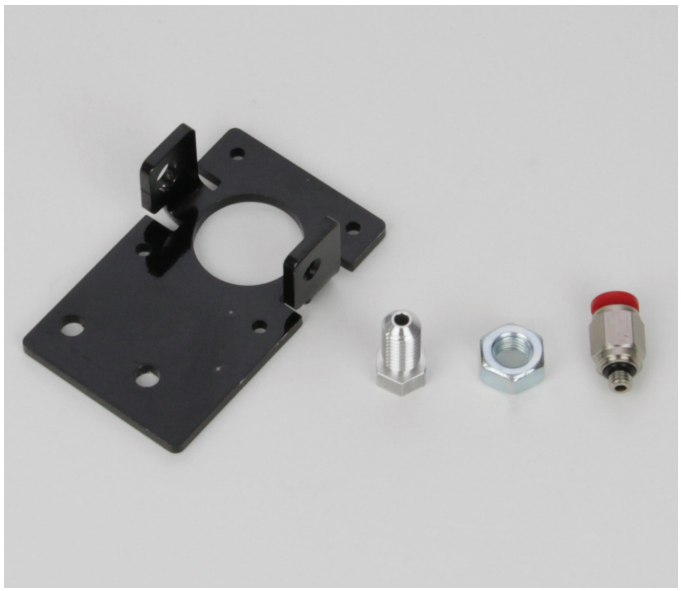
Assembly of the ball bearing holders

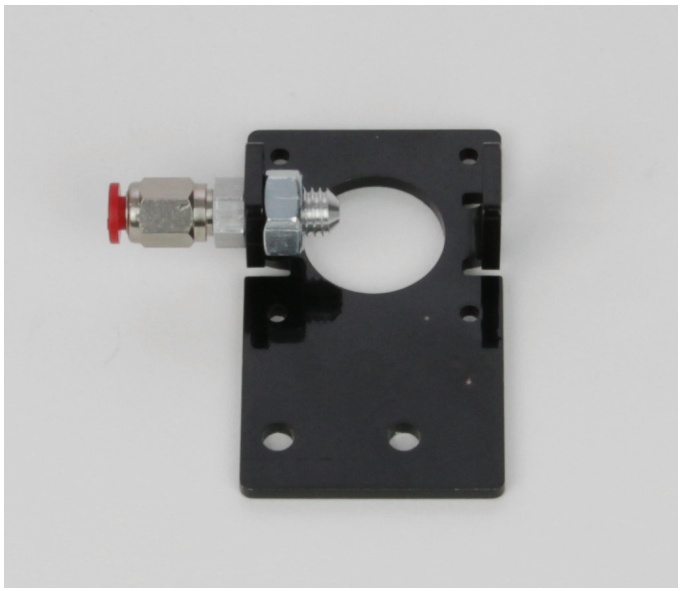


1x ball bearing holder
1x ball bearing FZ0463u-shaped (diameter inside/outside (4/13 mm)
1x cylinder pin 4x14 mm

Place the ball bearing holder on a level and firm base. Place the ball bearing into the holder cut-out and carefully drive the cylindrical pin through the holder into the ball bearing with a hammer.
Finally, use a mounting mandrel or punch to lower the pin slightly into the hole.
The ball bearing has a little play on the left and right. The pin can be moved in the ball bearing holder. The ball bearing must not protrude from the holder when you move the ball bearing back and forth.

Install the filament feed-through at the extruder motor holder.



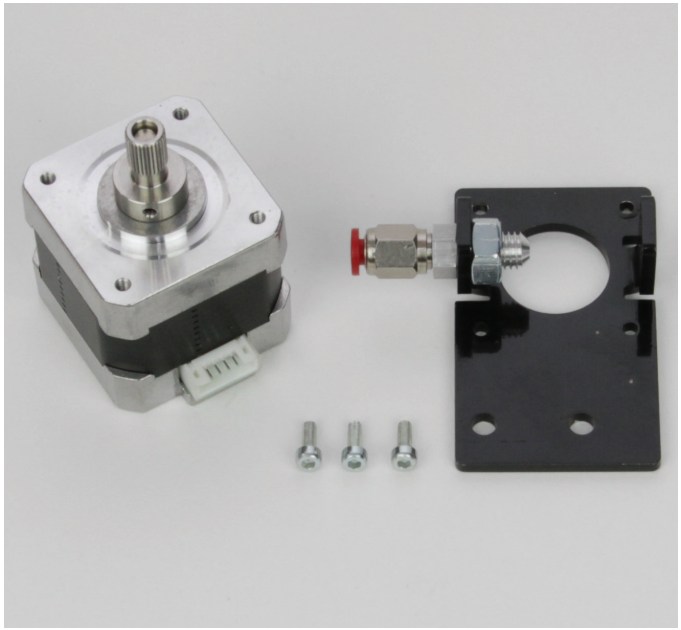


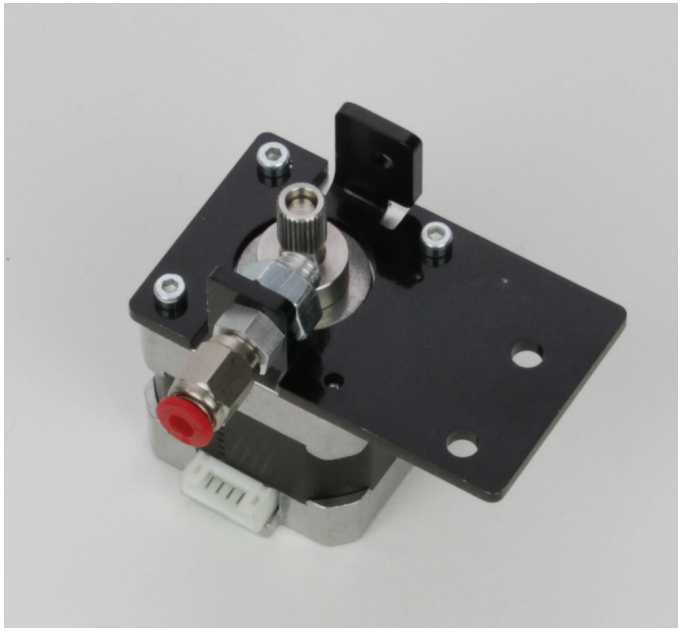
1x extruder motor holder
1x adapter
1x nut M8
1x quick closure

Install the inlet for the filament tube to the extruder motor holder as illustrated. First push the adapter into the opening from the outside and attach it with the nut. Tighten the nut with an open-faced spanner. Then screw the quick closure hand-tight as illustrated in the figure.

→ If the adapter does not fit through the opening, simply turn it into the opening. If necessary, use an external hex key to help.

Assembly of the feed motor

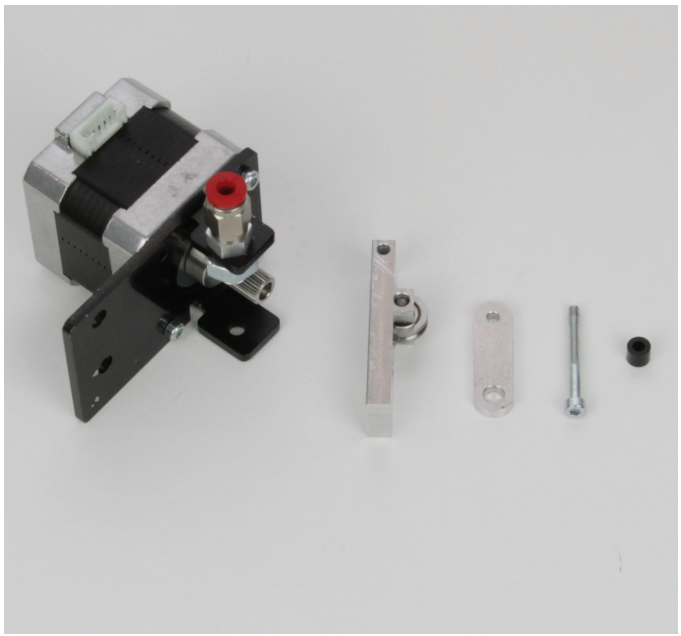




1x filament feed motor
1x extruder motor holder
3x cylinder head screw M3x8

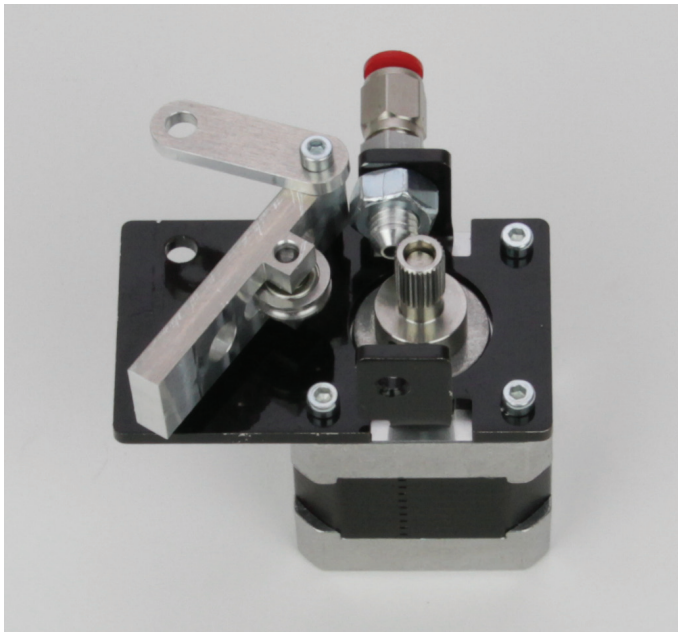
Install the inlet for the infeed motor to the extruder motor holder with the 3 cylinder-head screws as illustrated. The bore on the right (from the screen view) of the quick-closure must remain free. The connection plug of the motor must point in the same direction as the quick closure.

Assembly of the ball bearing holder



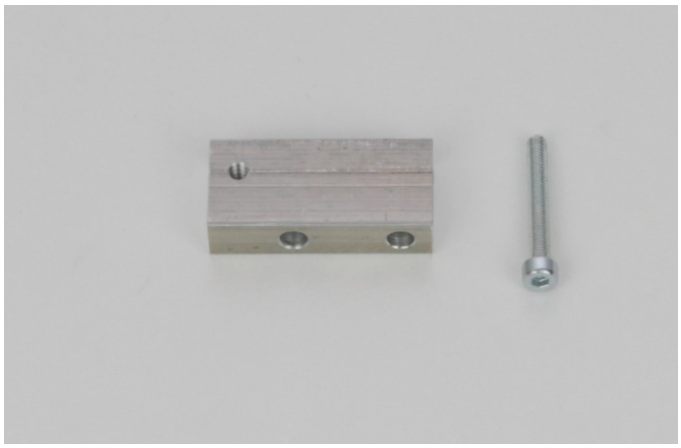
1x extruder motor holder with installed filament infeed motor
1x ball bearing holder with assembled ball bearing
1x counter-holder
1x cylinder head screw M3x30
1x spacer 5 mm (inner diameter 3 mm)

Assemble the attachment for the ball bearing holder as illustrated. The order is:
Cylinder-head screw - counter-holder (small bore) - ball bearing holder - spacer



Install the unit previously assembled in the free bore of the motor.
The cylinder-head screw must not be tightened so far that the ball bearing holder cannot be moved freely.
Apply screw with threadlocker varnish.

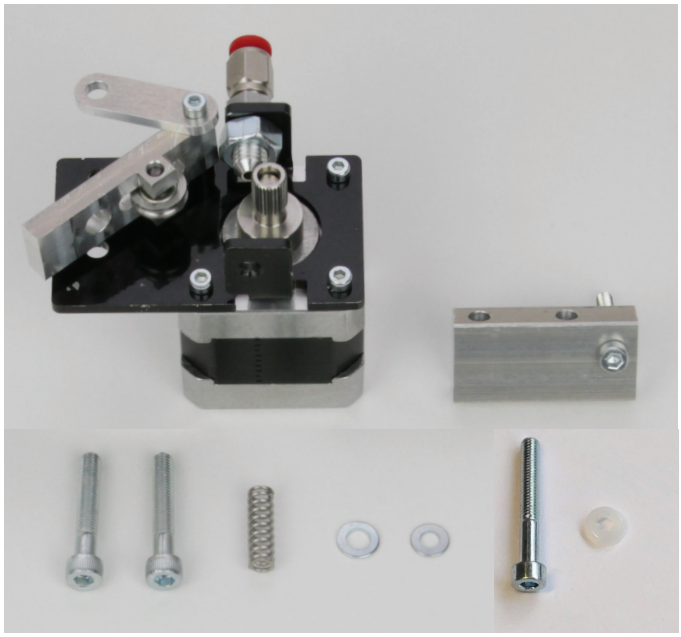
Preparation of the spring holder

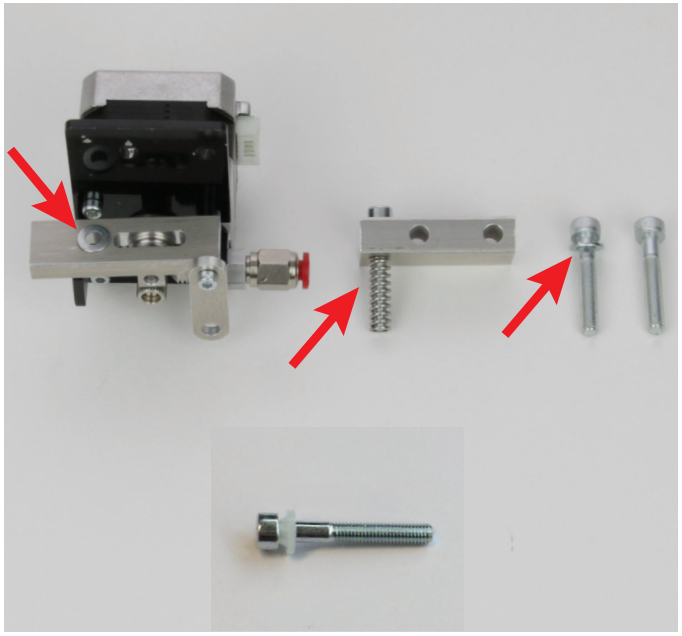


1x spring holder
1x cylinder head screw M4x30 (fully threaded)

Screw the cylinder-head screw completely into the spring holder as illustrated. Ensure that the screw is turned in from the right side since the bore is slightly offset.

Final assembly of the infeed unit



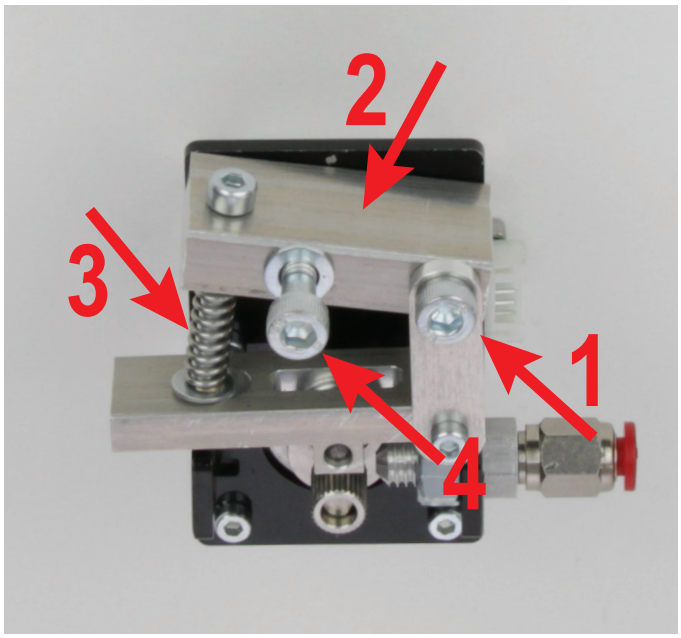


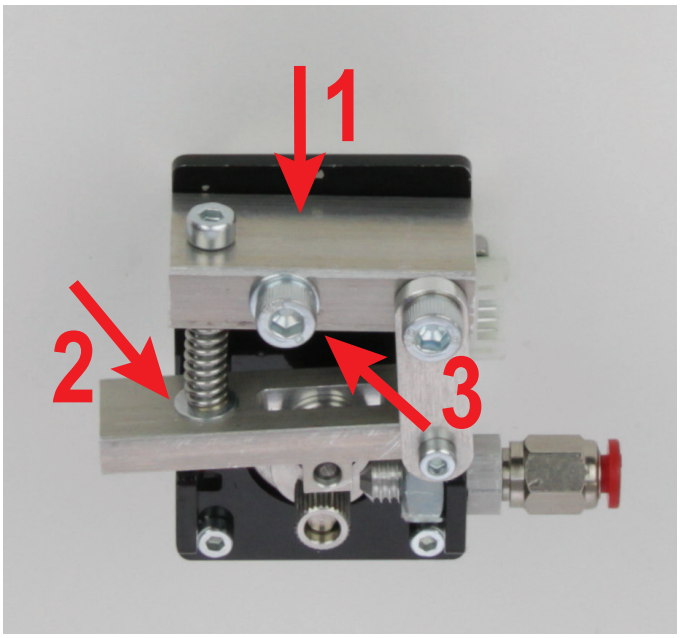
1x extruder motor holder with motor and ball bearing holder
1x spring holder
2x cylinder head screw M5x30
1x pressure spring for extruder infeed (L 20.57 mm, Ø outside 6.1 mm)
1x washer (diameter inside/outside 5.3/10 mm)
1x washer (diameter inside/outside 4.3/9 mm)

Optional, if necessary! The following parts are enclosed as an alternative to the cylinder-head screw M5x30, which is used without a washer.
1x cylinder-head screw M5x35 (at delivery as of 04-2017)
1x plastic washer (at delivery as of 04-2017)

Prepare all parts as illustrated.
Place the smaller washer M4 onto the set-up infeed unit.
Push the pressure spring onto the screw of the spring holder.
Push the larger washer M5 onto one of the two M5 cylinder-head screws.

Optional, if necessary! Use the cylinder-head screw M5x35 (at the bottom of the figure) with the plastic washer instead of the cylinder-head screw M5x30 at the very right of the screen. This is the screw that is pushed through the counter-holder.
Use the screw only when the cylinder-head screw M5x30 only barely grips when attaching the infeed unit to the frame in the slot nut.
Before use, turn the plastic washer onto the screw as illustrated.

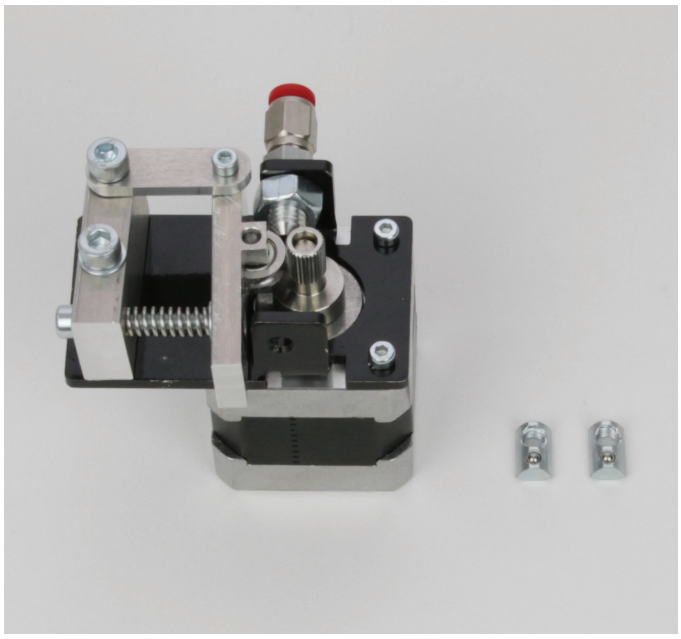




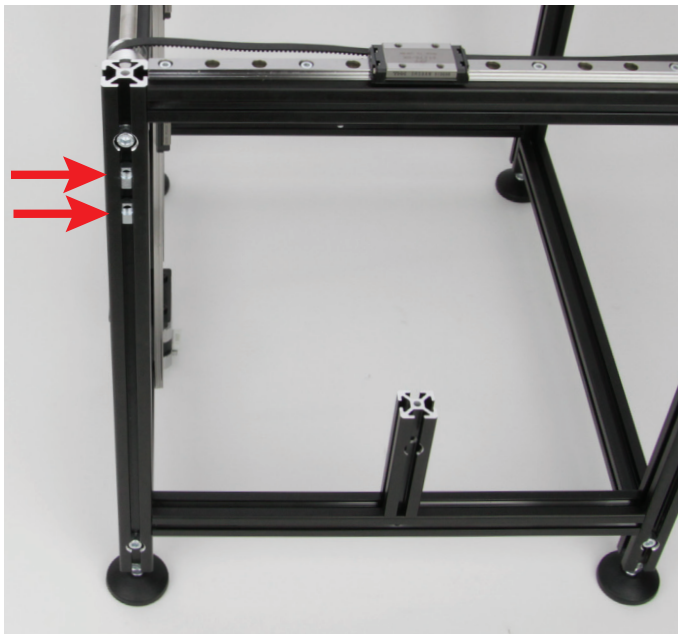
Thread the M5-cylinder-head screw without washer (or the cylinder-head screw M5x35 with the plastic washer) through the counter-holder and the right bore of the spring holder into the extruder motor holder (1).
Fold the spring holder with the pressure spring (2) onto the washer placed before washer (3).
Now push the M5-cylinder-head screw with the washer into the left bore of the spring holder (4).

Push the spring holder with the pressure spring (1) including the washer into the corresponding bore of the ball bearing holder (2). Now thread the cylinder-head screw (3) through the
left bore of the extruder motor holder.

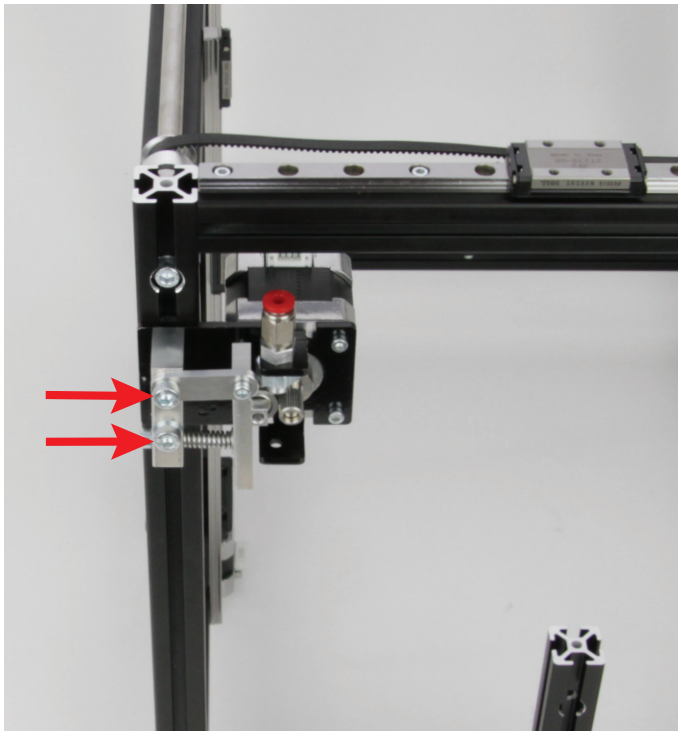
Install the infeed unit on the basic frame



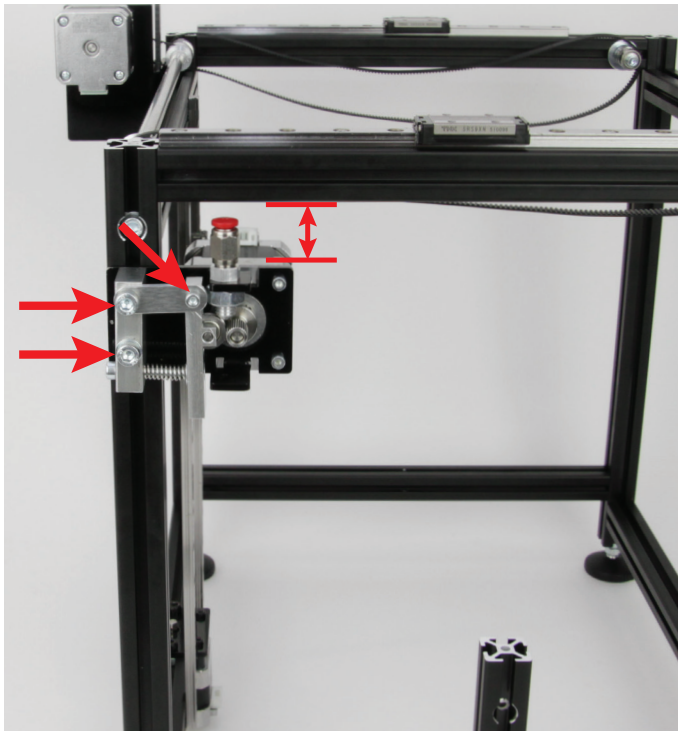
1x infeed unit
2x slot nut M5



Push the 2 slot nuts, as illustrated, into the rear aluminium profile of the left side part. The threads must both point upwards.
Align the two slot nuts with the two M5 cylinder-head screws of the infeed unit.



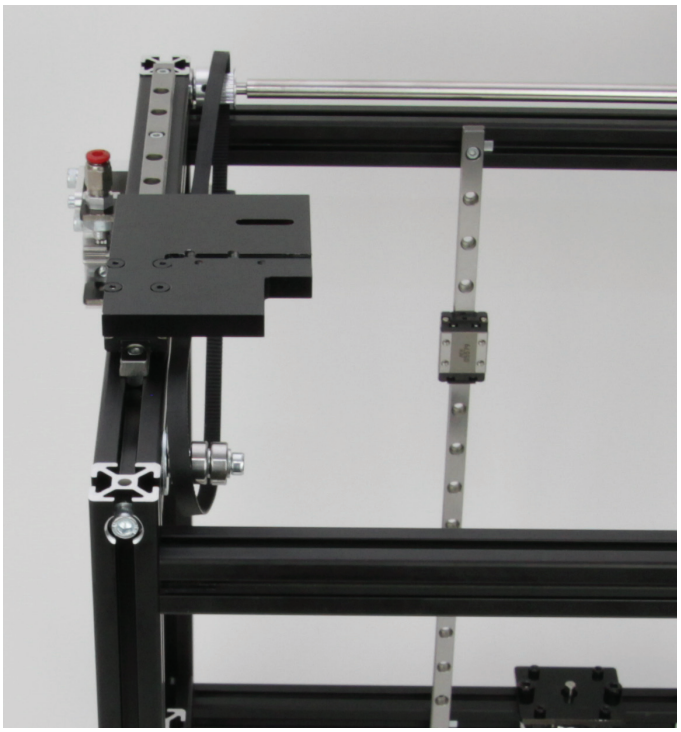
Attach the infeed unit in the two slot nuts. Tighten the two cylinder-head screws not entirely yet.



Now align the infeed unit. The distance between the lower edge of the upper aluminium profile and the upper edge of the motor should be about 28 mm.
Tighten the two cylinder head screws M5.
Finally, tighten the M3-cylinder-head screws of the ball bearing holder until the ball bearing holder can still be moved slightly.

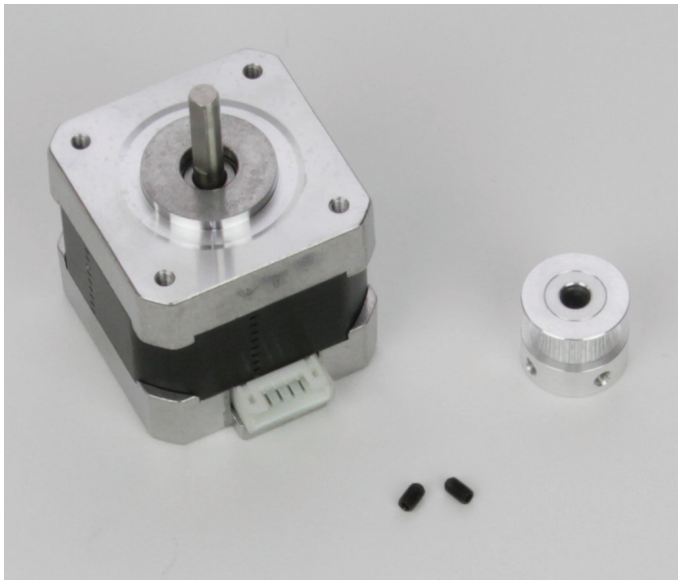
Installation of the guide carriage plate on the left of the basic frame

1x guide carriage plate left
4x countersunk head screw M3x10 black

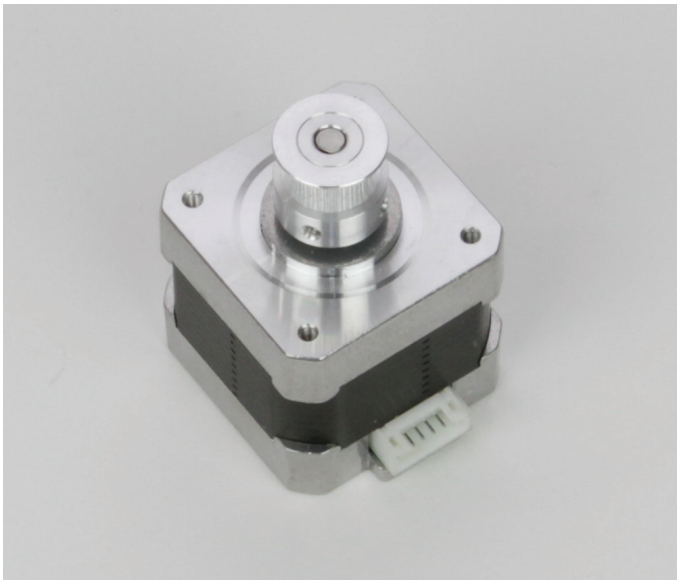


Install the left guide carriage plate with the 4 recessed-head screws on the guide carriage of the left Y-guide rail.
Optionally, the screws can be secured with threadlocker varnish.

Attachment of the sprocket to the X-motor



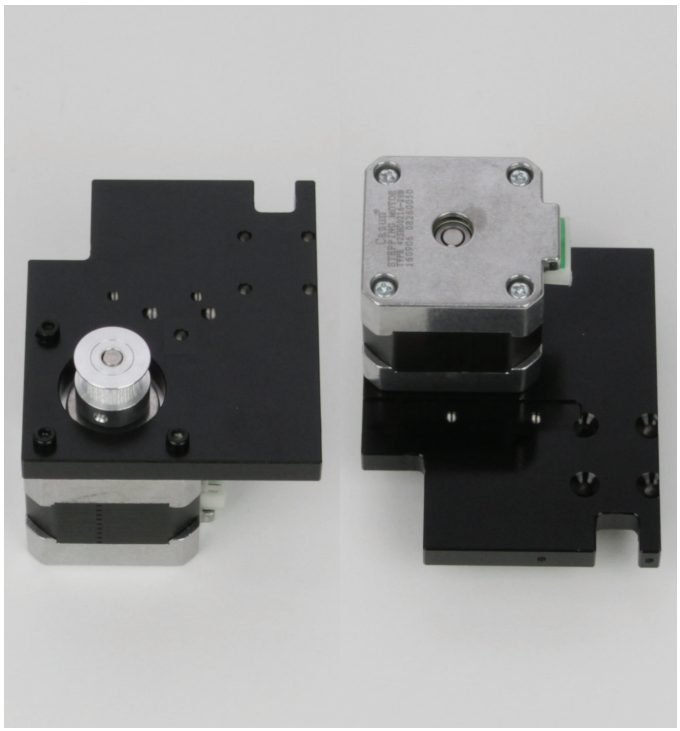
1x actuator
1x sprocket 5 mm
2x threaded pin M3x5



Push sprocket onto axe of the actuator and attach it with 2 threaded pins each. A threaded pin must meet the flattened side of the axis. The motor axis must end flush with the upper edge of the sprocket.
Optionally, the threaded rods can be secured with threadlocker varnish.

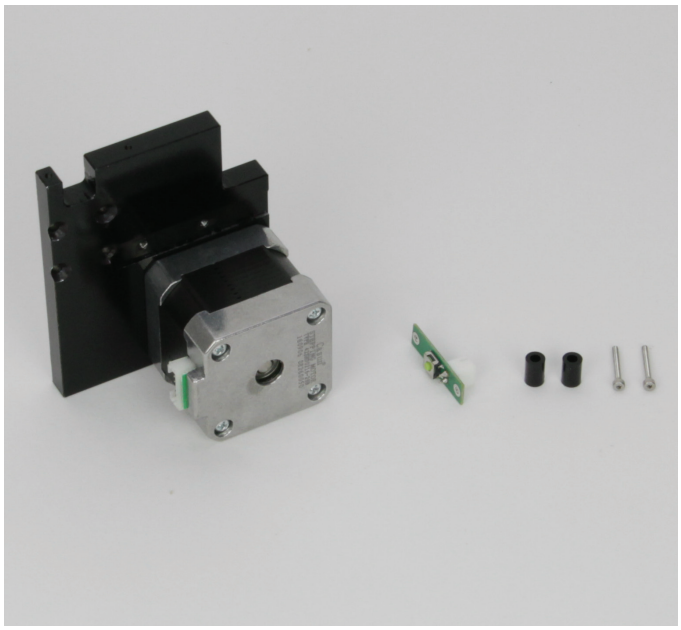
Installation of the X-motor to the right guide carriage plate

1x guide carriage plate right
1x actuator with installed sprocket
3x cylinder head screw M3x12 black

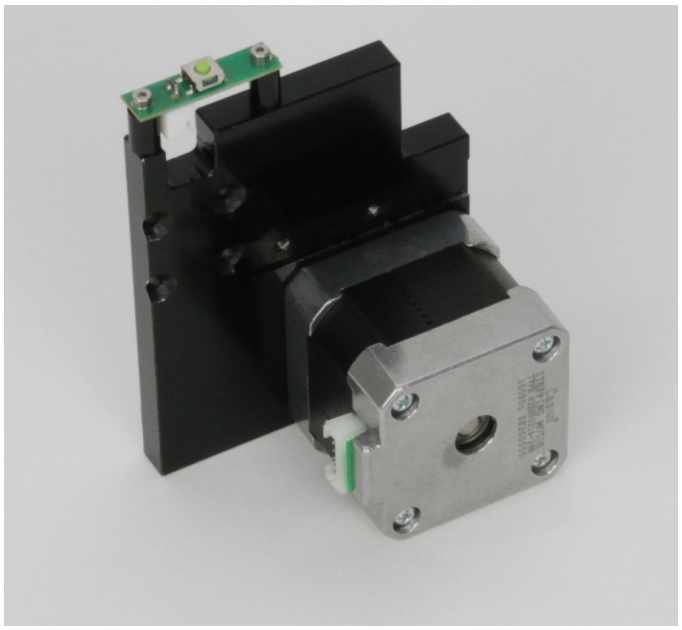


Install the motor with the 4 cylinder-head screws to the right guide carriage plate (left figure). The motor must be on the same side as the slot for the guide rail (right figure). The motor plug must be aligned as in the figure (right figure = recessed-head bores on top).

Installation of the limit switch to the right guide carriage plate

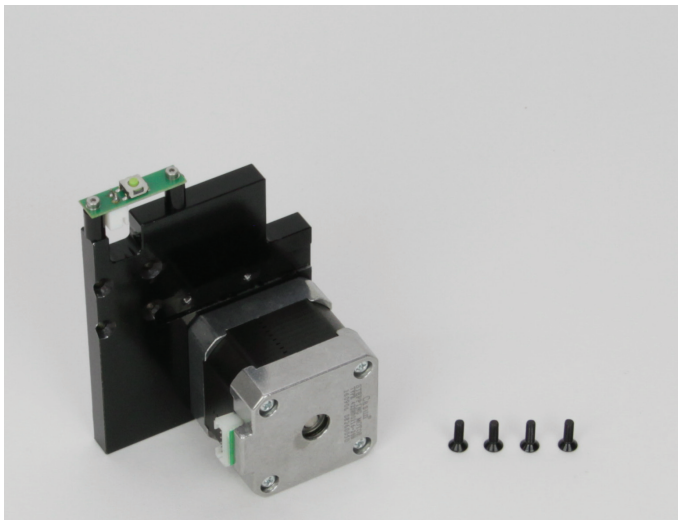


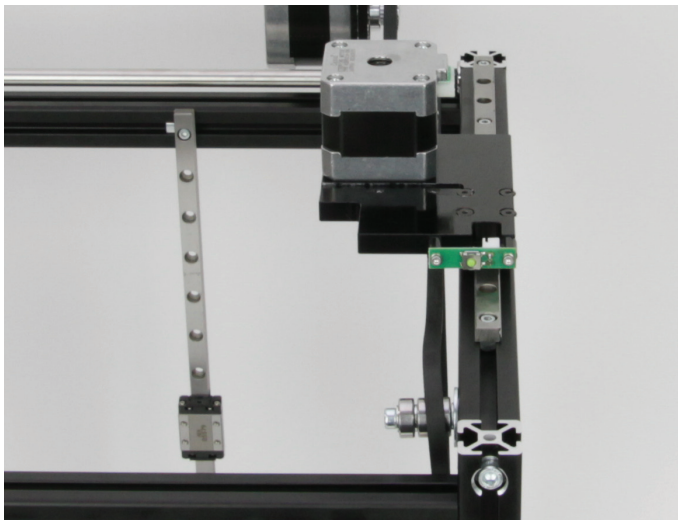
1x right guide carriage plate with installed actuator
1x limit switch PCB
2x spacer 9 mm (diameter inside 3 mm)
2x cylinder head screw M2x16



Install a limit switch PCB with the two cylinder-head screws M2x16 at the right guide carriage plate.
A spacer must be used between each guide carriage plate and the limit switch PCB.
Optionally, the screws can be secured with threadlocker varnish.

Installation of the guide carriage plate on the right of the basic frame



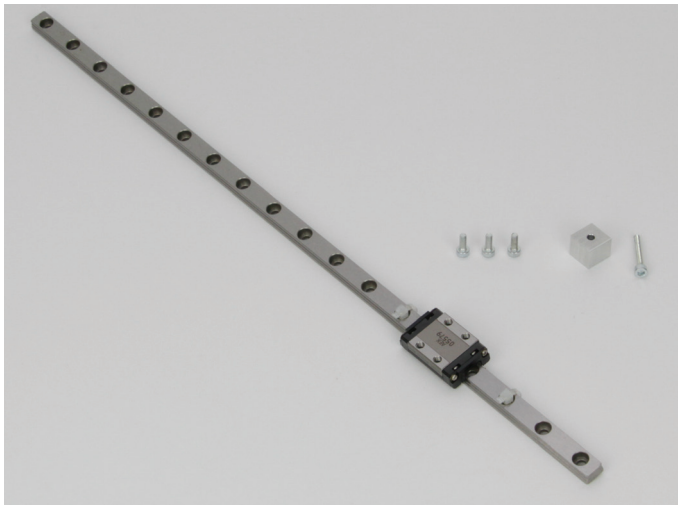


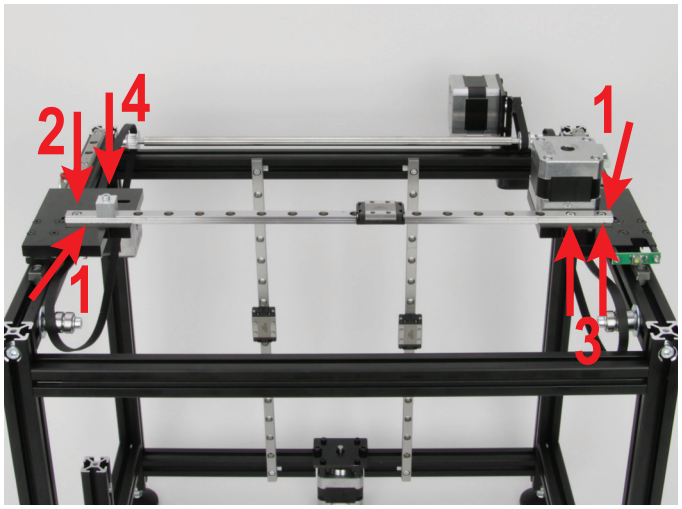
1x right guide carriage plate with motor and limit switch
4x countersunk head screw M3x10 black

Install the right guide carriage plate with the 4 recessed-head screws on the guide carriage of the right Y-guide rail.
Optionally, the screws can be secured with threadlocker varnish.

⟶ Check after installing the 2nd guide carriage plate whether both guide carriage plates are straight and parallel with the front aluminium profile installed crosswise. If this is not the case, release the attachment screws of the respective aluminium profile to which the guide rail with the guide carriage plate that is not straight is installed. Align the respective guide carriage plate and tighten the screws again.

Installation of the guide rail for the X-direction

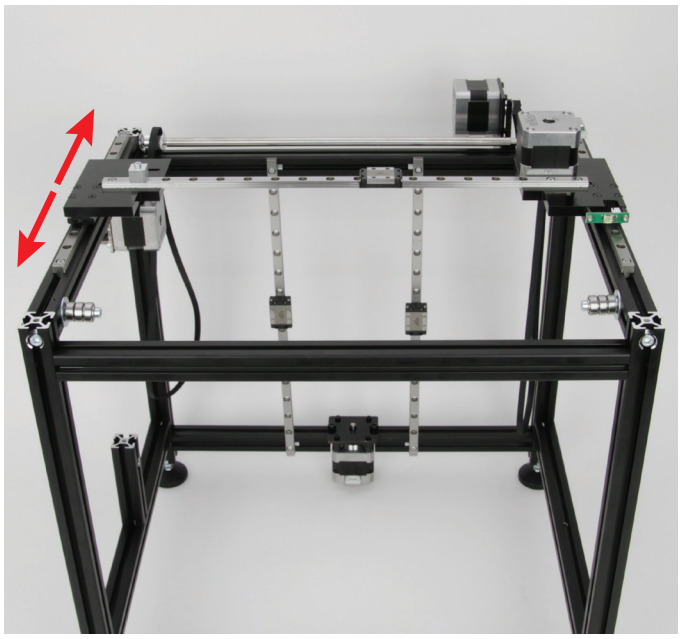




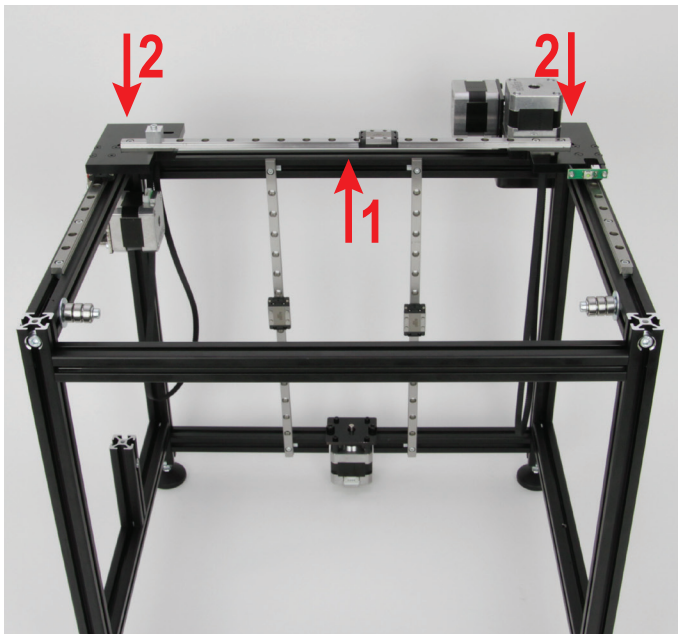
1x guide rail with guide carriage (355 mm)
3x cylinder head screw M3x8
1x aluminium block silver
1x cylinder head screw M3x20

Remove the two cable ties from the guide rail.
Release the 4 attachment screws in both Y-guide rails so that they can be moved a little.
Insert the guide rail in the groove of the left and right guide carriage plates each (1).
Loosely attach the guide rail on the left side of the outer bore with an M3x8 cylinder-head screw (2).
Use two M3x8 cylinder-head screws in the two outer-most bores for attachment on the right. Tighten the two screws only loosely as well (3).
On the left side, attach the silver aluminium block with the cylinder-head screw M3x20 (4) in the second bore.
Now tighten all 4 screws in sequence.

Tightening the Y-guide rails

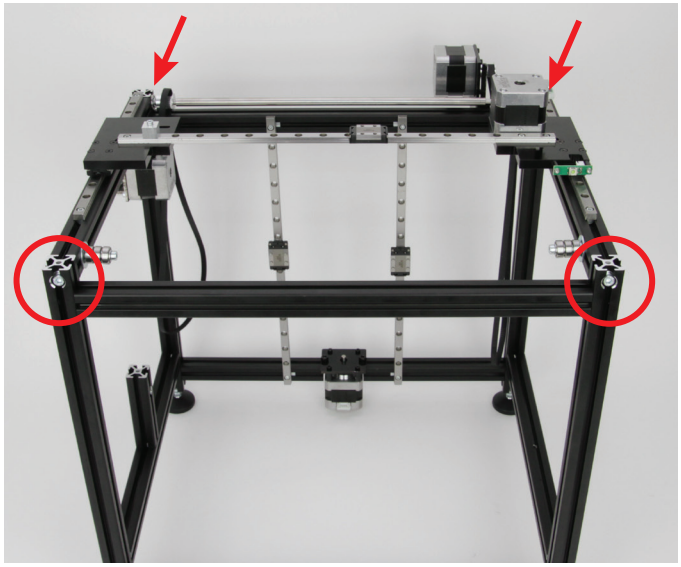


Move the X-guide rail forward and back in the Y-direction several times.
Observe that the guide carriages do not slide from the Y-guide rail.



Move the X-guide rail all the way back in the Y-direction (1), so that you can just reach the two rear-most attachment screws of the Y-guide rails anymore (2).
Tighten the two screws slightly.
Move the X-guide rail forward and back in the Y-direction several times again and tighten the next attachment screws slightly as well.
Repeat the steps until you have slightly tightened all 8 cylinder-head screws of both Y-guide rails.
Then tighten the 8 screws all the way.

Relieve the X-unit

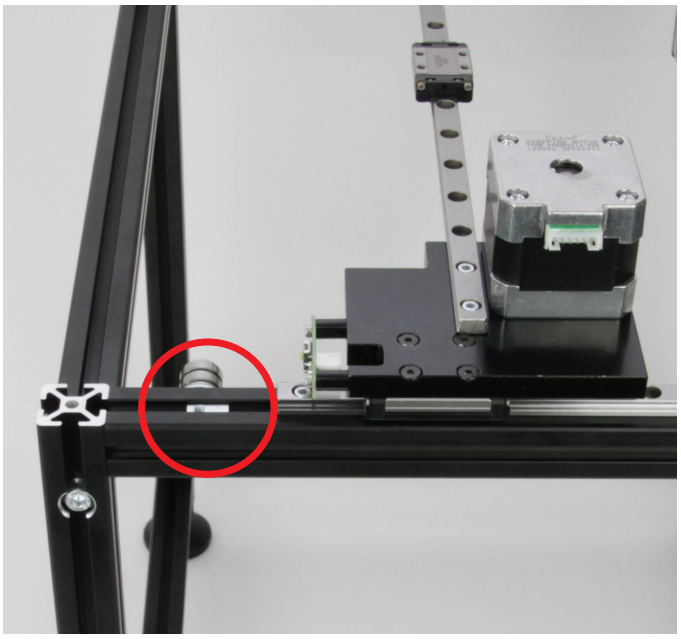


After tightening the Y-guide rails, the X-guide rail will move more stiffly in the Y-direction than before.
Therefore, the X-unit now needs to be relieved.
For this, release the 4 screws of the two aluminium profiles, on which the Y-guide rails are installed.

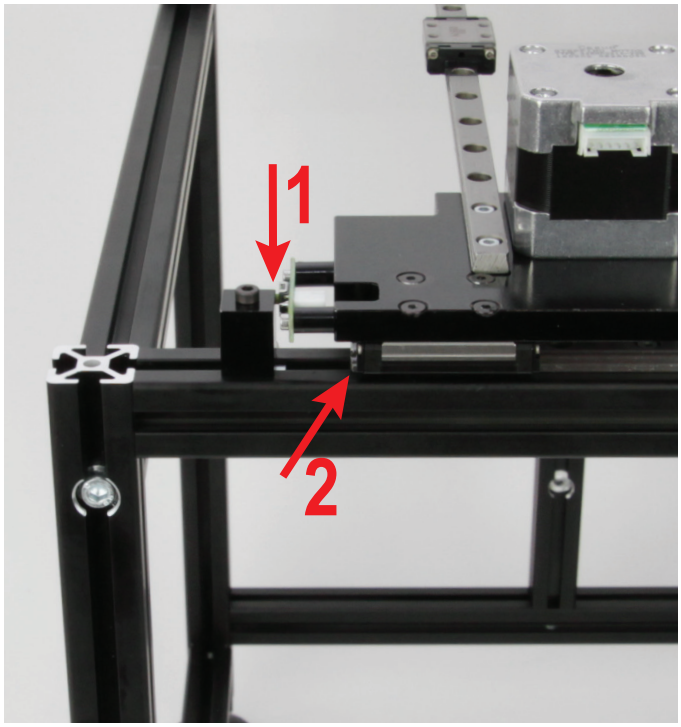
Then move the X-guide rail forward and back in the Y-direction several times again.
Finally, tighten the 4 screws of the aluminium profiles again in sequence. After tightening every single screw, the X-guide rail should move as easily in the Y-direction as before, when all 4 screws were loose.

Installation of the end stop for the Y-direction

1x aluminium block, black
1x cylinder head screw M3x20
1x slot nut M3

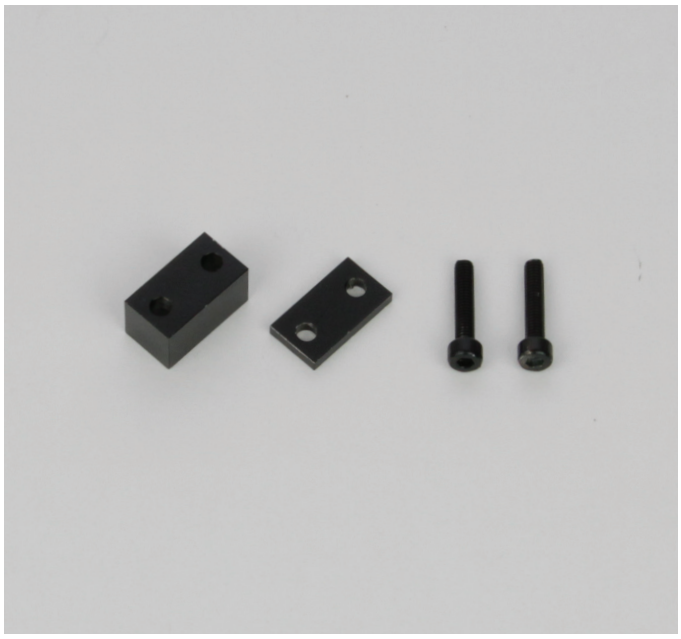


Insert the slot nut into the top of the aluminium profile with the right Y-guide rail as illustrated.

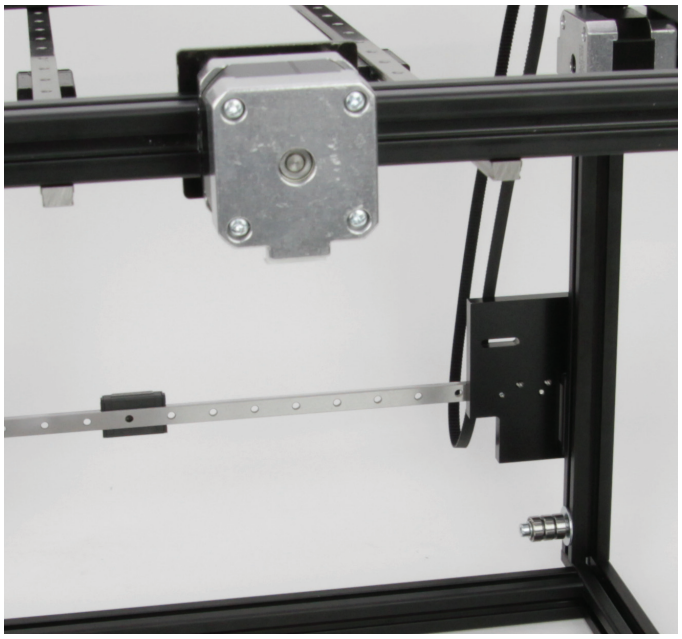


Attach the aluminium block in the slot nut with the cylinder-head screw.
The aluminium block must be aligned as follows:
When the limit switch hits the aluminium block and is actuated (1), the guide carriage still must be completely placed on the guide rail (2). However, it should be only 0.5 to 1 mm from the end of the rail (2).

Attachment of the left Y-toothed belt (viewed from the front)



1x black block with 2 bores
1x black disc with 2 bores
2x cylinder head screw M4x20

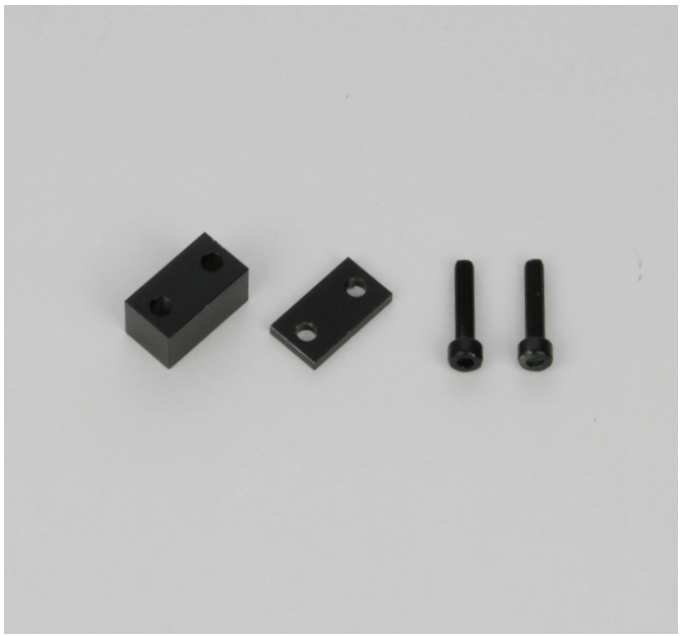


Move the X-guide rail forward in the Y-direction until the limit switch hits the end stop.
Place the basic frame on its front.
First, the left Y-toothed belt (viewed from the front) is attached.

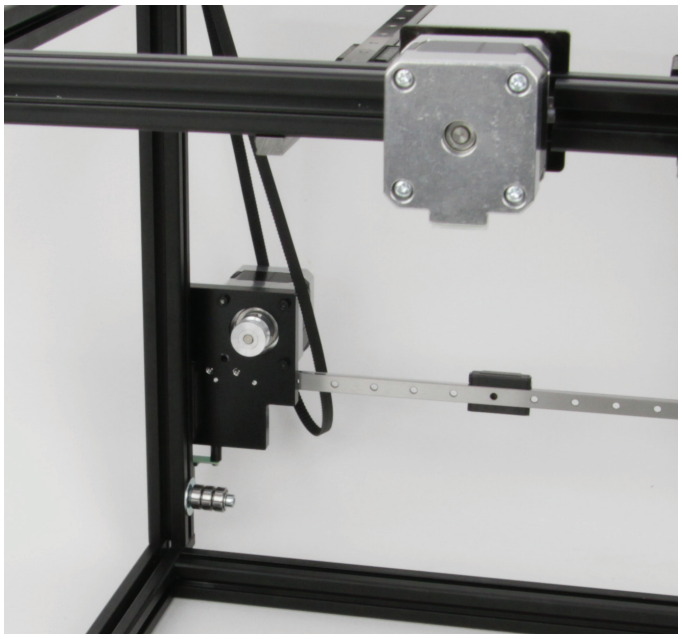
Attach the toothed belt to the bottom of the left guide carriage plate as illustrated.
The order of attachment is as follows:
Guide carriage plate - black block - toothed belt - black disc - cylinder-head screws.
Align the toothed belt so that it runs in parallel to the aluminium profile. Tighten both screws.
Optionally, the screws can be secured with threadlocker varnish.

Now attach the toothed belt to the belt tensioner.
Move the belt tensioner to clamp the belt a little and tighten the screw of the tensioner.
Final tensioning takes place when both toothed belts are attached.

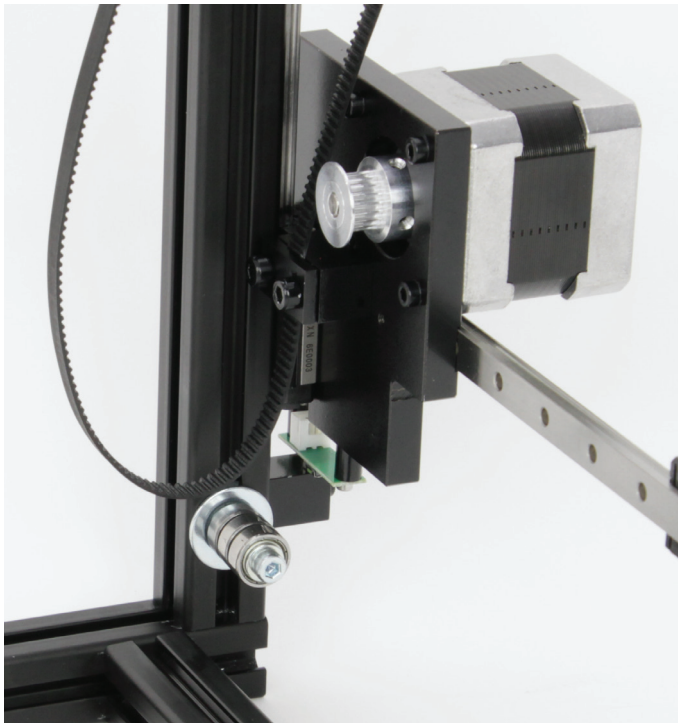
Attachment of the right Y-toothed belt (viewed from the front)



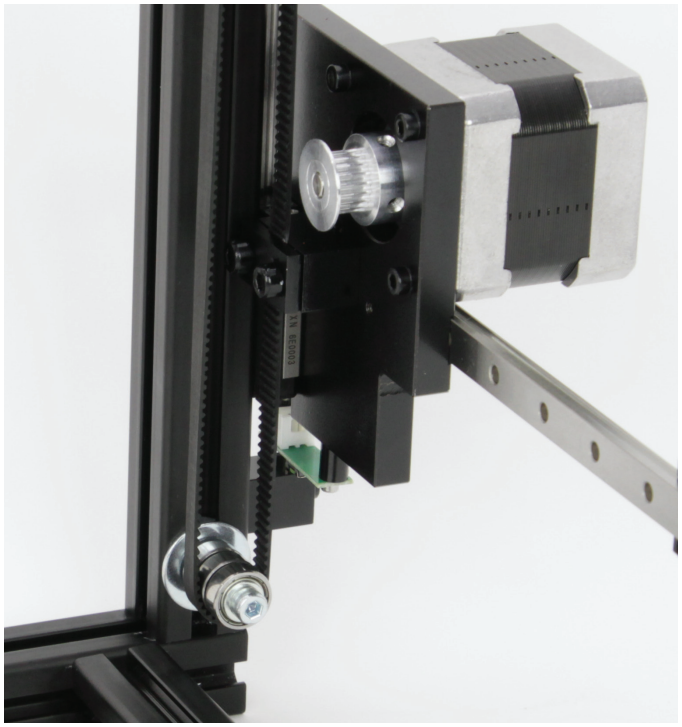
1x black block with 2 bores
1x black disc with 2 bores
2x cylinder head screw M4x20



Now, the right Y-toothed belt (viewed from the front) is attached.

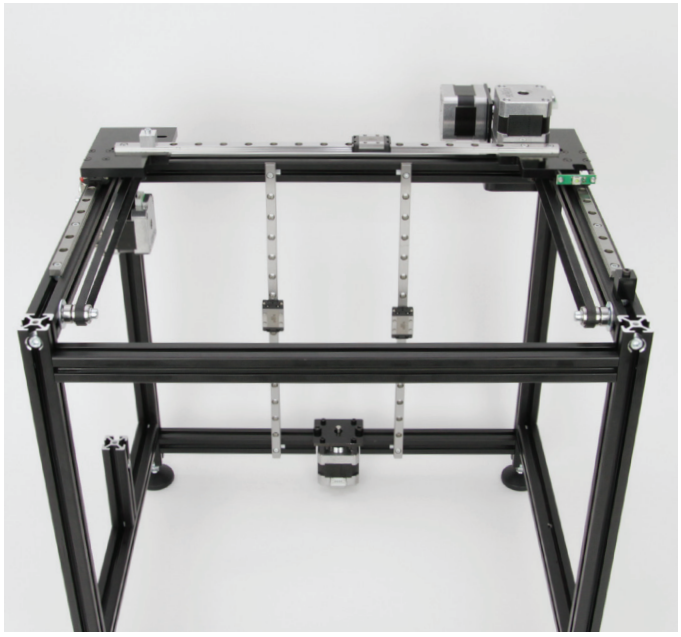


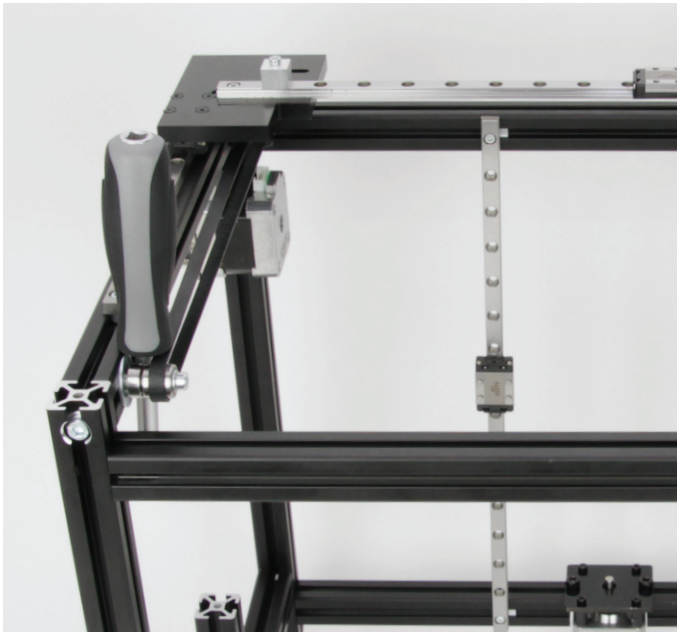
Attach the toothed belt to the bottom of the right guide carriage plate as illustrated.
The order of attachment is as follows:
Guide carriage plate - black block - toothed belt - black disc - cylinder-head screws.
Align the toothed belt so that it runs in parallel to the aluminium profile. Tighten both screws.
Optionally, the screws can be secured with threadlocker varnish.



Now attach the toothed belt to the belt tensioner.
Move the belt tensioner to clamp the belt a little and tighten the screw of the tensioner.
Final tensioning takes place subsequently.

Tensioning the toothed belts





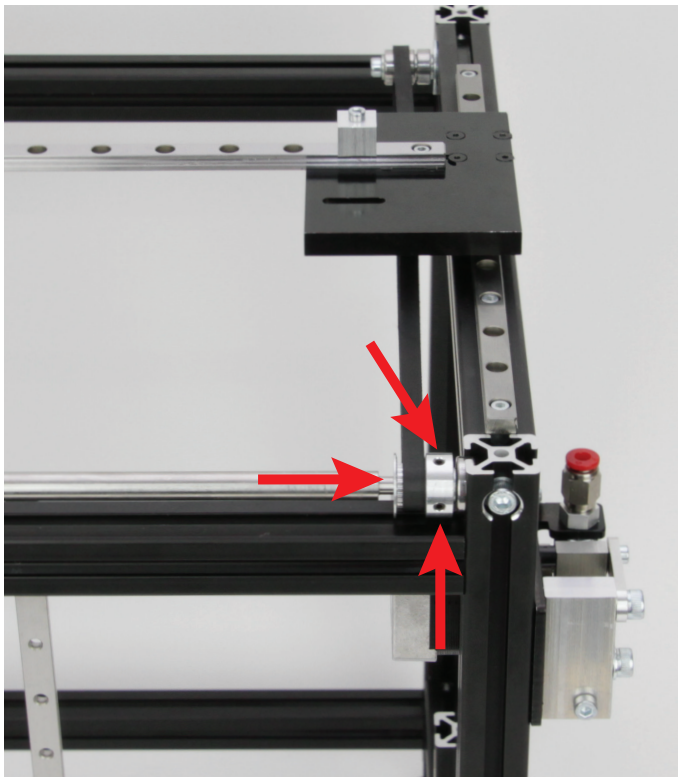
Put the basic frame on its feet again.
First release the screw of the left belt tensioner; tension the belt by pushing the belt tensioner on the inside and tighten the screw again. The toothed belt must be clamped so that it can still be twisted by 180° easily with two fingers and so that it can still be compressed easily with the fingers.

If you cannot tension the toothed belt enough by hand, use a screwdriver to move the belt tensioners forwards.

Then proceed in the same manner for the right toothed belt.

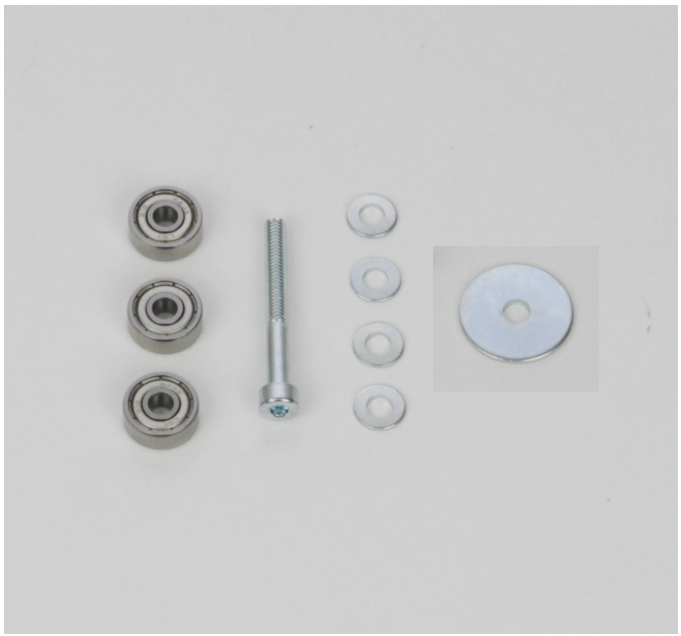
Important! Both toothed belts must be tensioned to the same degree!

Tightening the second sprocket on the deflection shaft



Push the second sprocket all the way to the outside on the deflection shaft and then tighten the two threaded pins.

Assembly of the belt tensioners (X-direction)

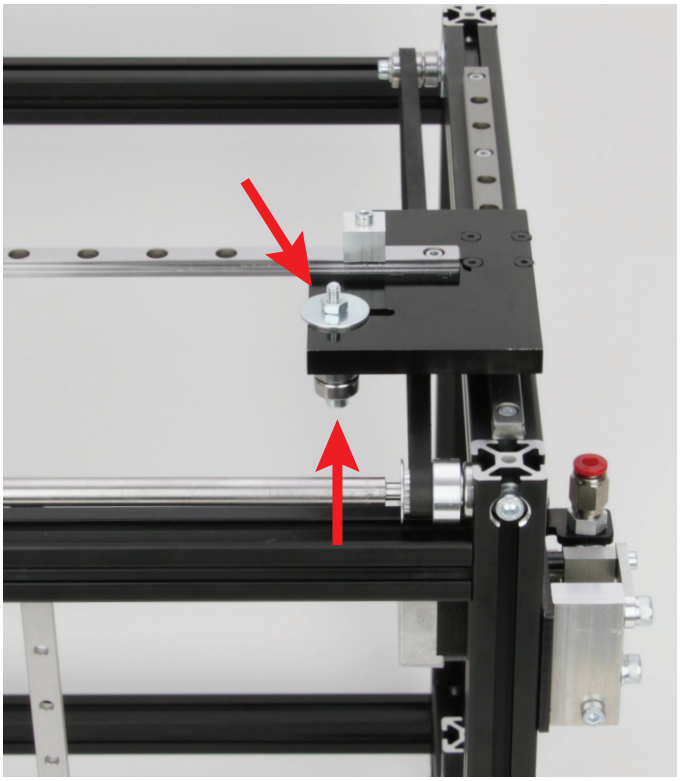


3x grooved ball bearing 624Z (diameter inside/outside 4/13 mm)
1x cylinder head screw M4x35
4x washer (diameter inside/outside 4.3/9 mm)
1x washer (diameter inside/outside 4.3/20 mm)

Push the washers onto the screw alternatingly with the ball bearings (**screw - washer - ball bearing - washer - ball bearing - washer - ball bearing - washer - washer 20 mm**).

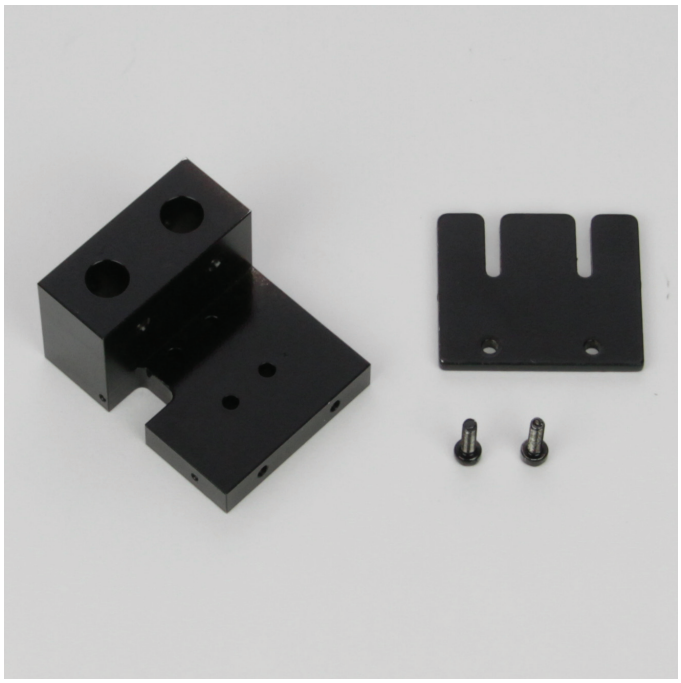
Installation of the belt tensioners (X-direction)

1x belt tensioners assembled
1x washer (diameter inside/outside 4.3/20 mm)
1x nut M4

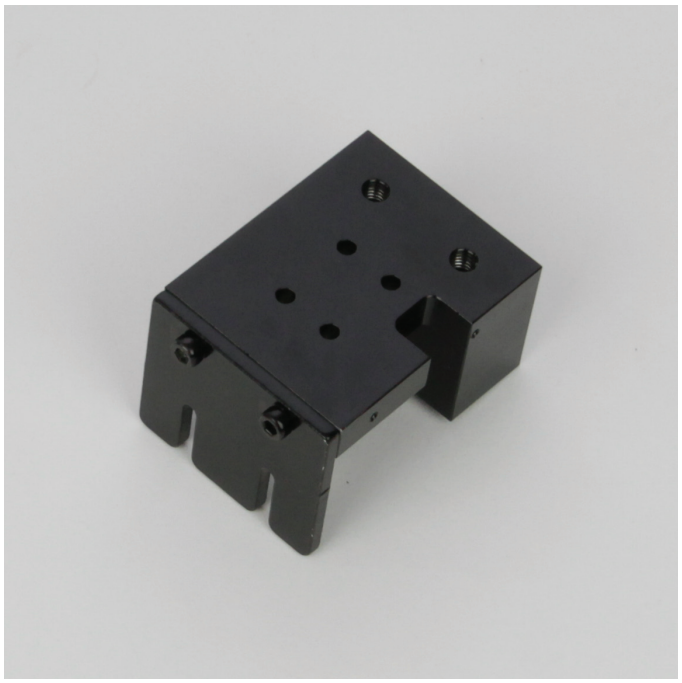


Guide the assembled belt tensioners into the cut-outs of the left guide carriage plate from below (viewed from the front, the picture has been taken from the rear view) and attach it with the washer and the nut. Only tighten the nut slightly so that the belt tensioner will still move freely.

Assembly of the extruder holders

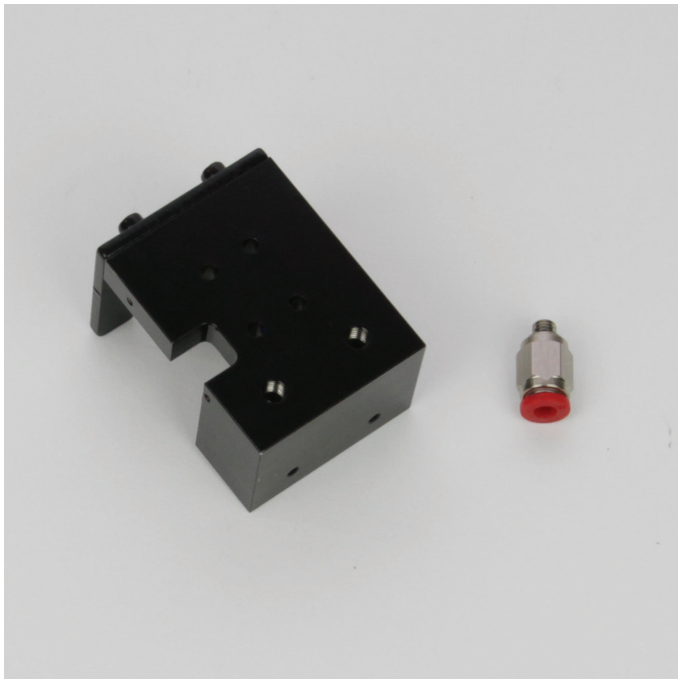


1x extruder holder
1x belt tappet
2x cylinder head screw M3x10 black

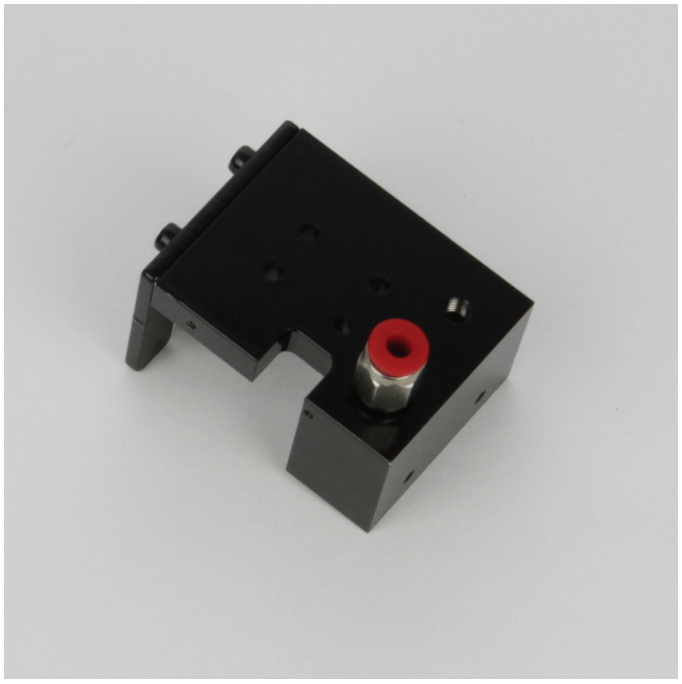


Install the belt tappet with the two cylinder-head screws at the rear of the extruder holder.
Optionally, the screws can be secured with threadlocker varnish.

Assembly of the quick closure

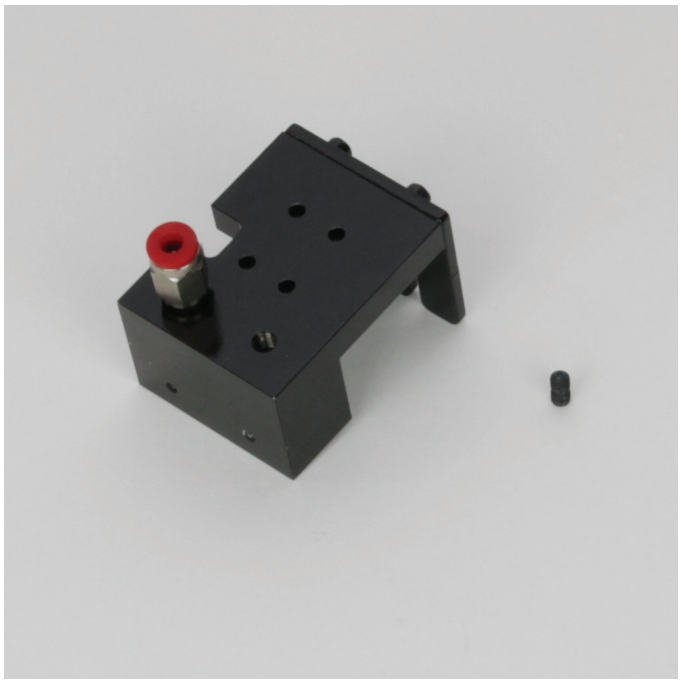


1x extruder holder
1x quick closure

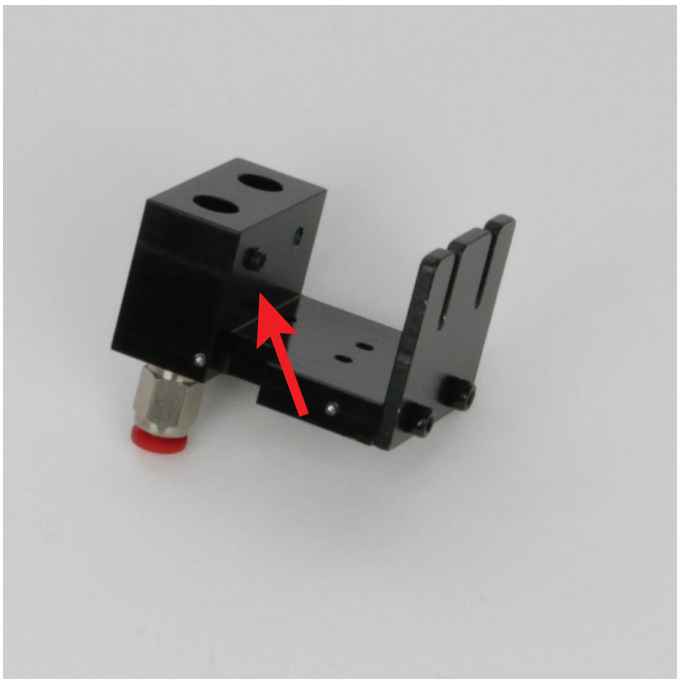


Screw the quick-closure into the left bore in the top as illustrated (bore next to the cut-out).

Turning in of the threaded pin

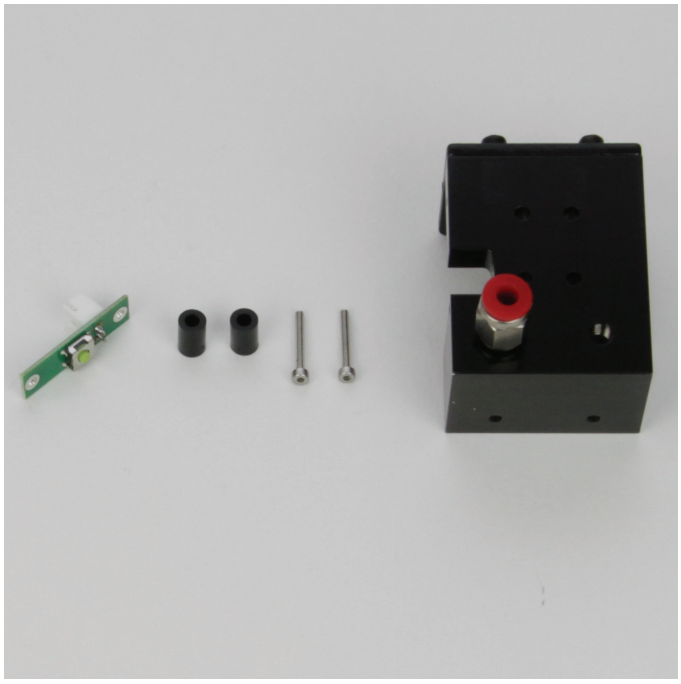


1x extruder holder
1x threaded pin M4x8

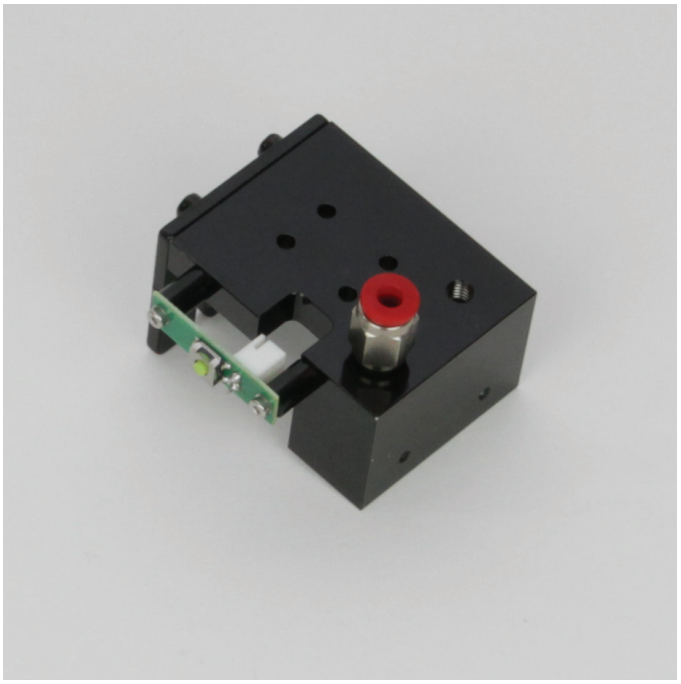


Screw the threaded pin into the bore by the quick closure from behind. Only screw in the threaded pin loosely. It must not protrude into the bore for the extruder yet.

Assembly of the limit switch and the extruder holder

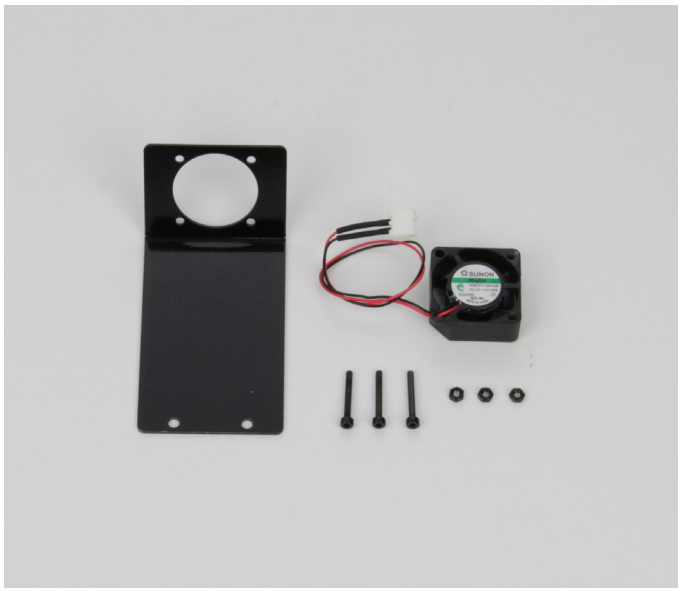


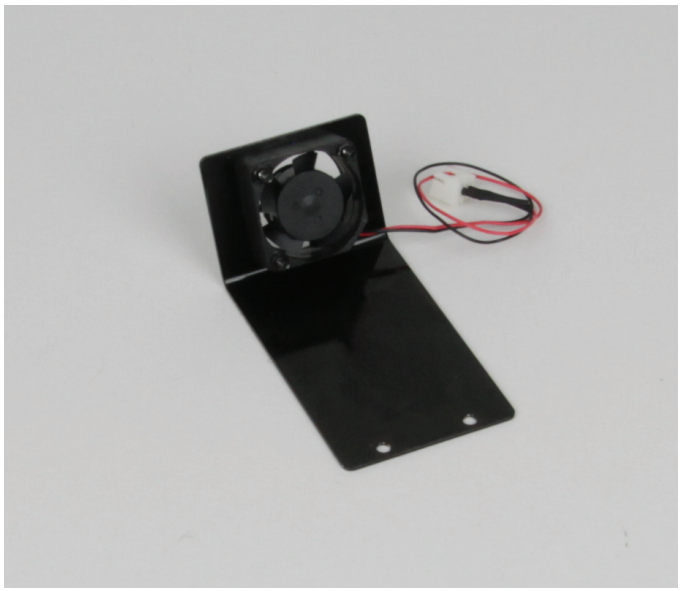
1x limit switch PCB
2x spacer 9 mm (diameter inside 3 mm)
2x cylinder head screw M2x16
1x extruder holder



Mount the limit switch PCB on the extruder holder with the two cylinder-head screws M2x16 on the left, at the cut-out.
A spacer must be used between each extruder holder and the limit switch PCB.
Optionally, the screws can be secured with threadlocker varnish.

Attaching the fan at the fan sheet

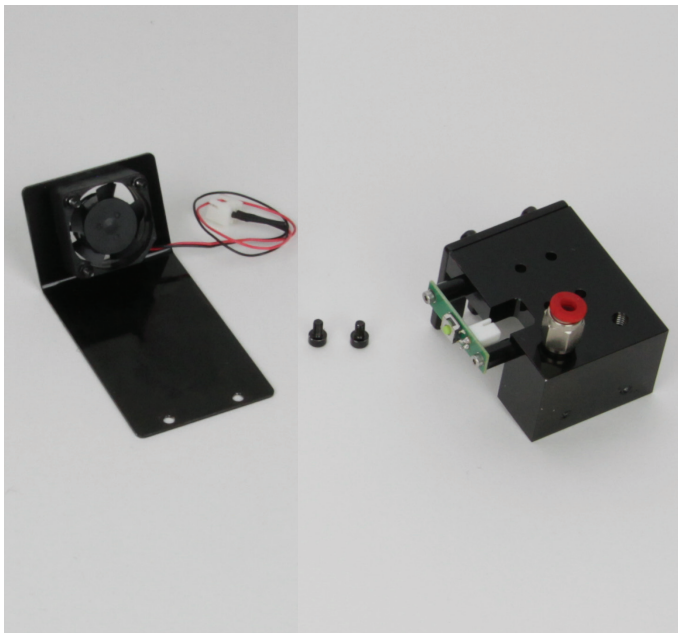


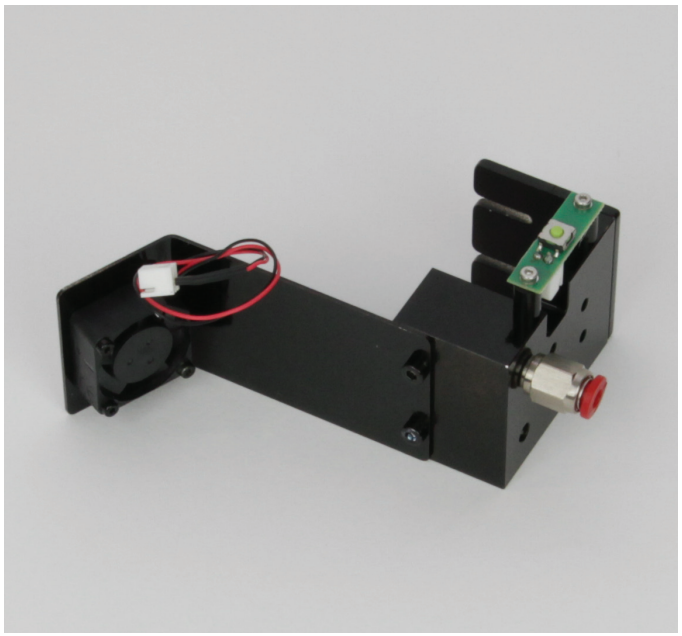


1x fan sheet
1x fan
3x cylinder head screw M2x16 black
3x nut M2 black

Install the fan on the fan sheet from above with the 3 cylinder-head screws and nuts. The screws must be pushed through the sheet and the fan from behind (from the view as illustrated). The nuts must be on top of the fan.
The fan must be aligned so that the connection cables are placed as shown in the figure and the blowing direction (marked by an arrow on the fan) goes through the fan sheet.
Optionally, the nuts can be secured with threadlocker varnish.

Assembly of the fan sheet on the extruder holder

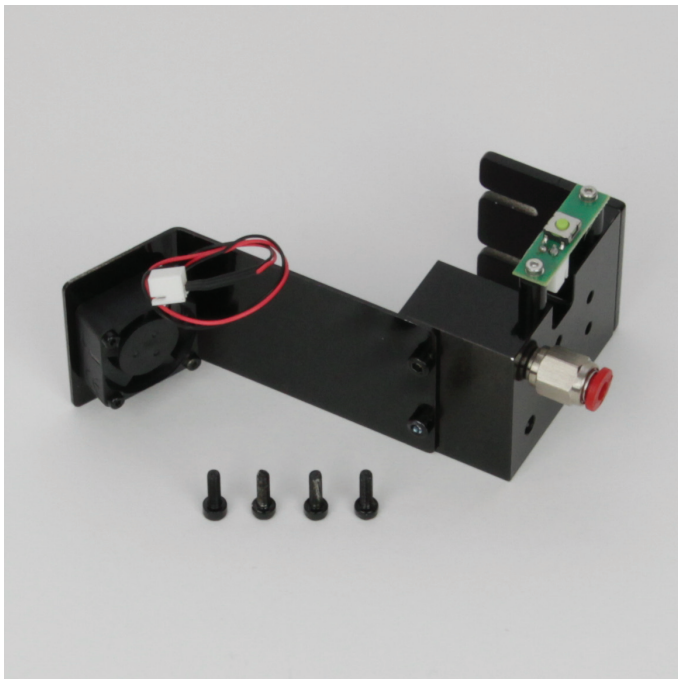




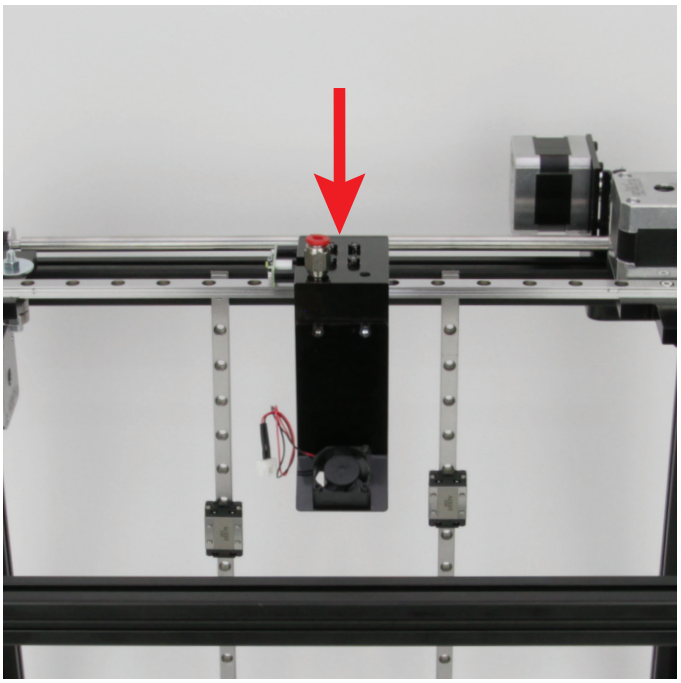
1x fan sheet with installed fan
2x cylinder head screw M3x5 black
1x extruder holder

Attach the fan sheet to the front of the extruder holder with both cylinder-head screws.
The fan must be turned away from the holder.
Optionally, the nuts can be secured with threadlocker varnish.

Assembly of the extruder holder at the X-guide carriage



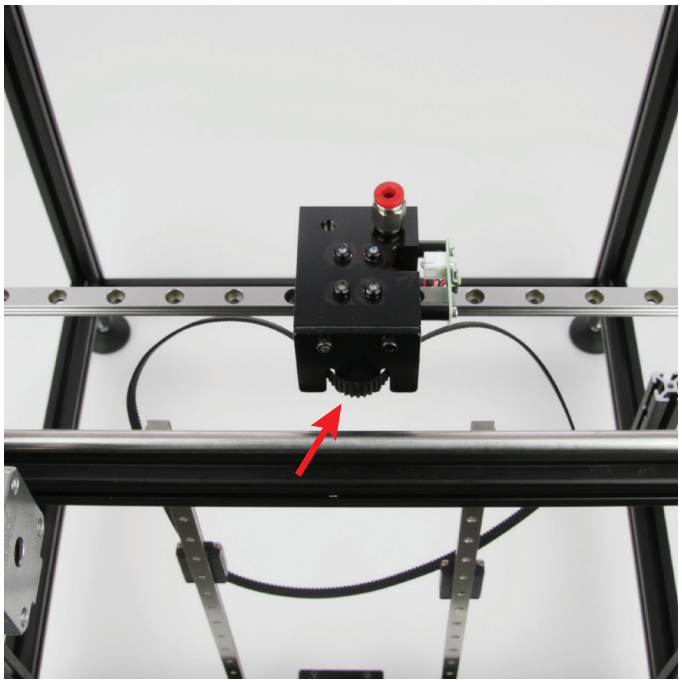
1x extruder holder assembled
4x cylinder head screw M3x10 black



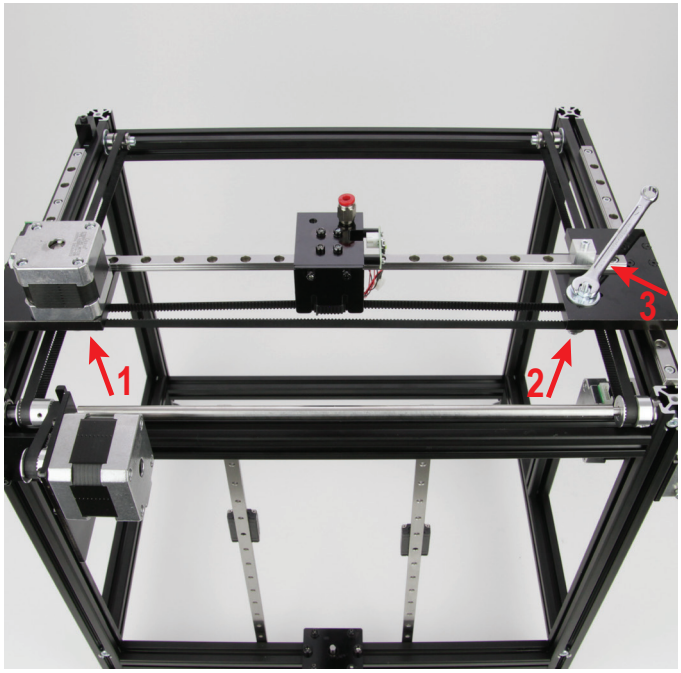
Mount the extruder holder on the X-guide carriage with the 4 cylinder-head screws.
The extruder holder must be aligned so that the fan points to the front of the printer.
Optionally, the screws can be secured with threadlocker varnish.

Assembly of the X-toothed belt

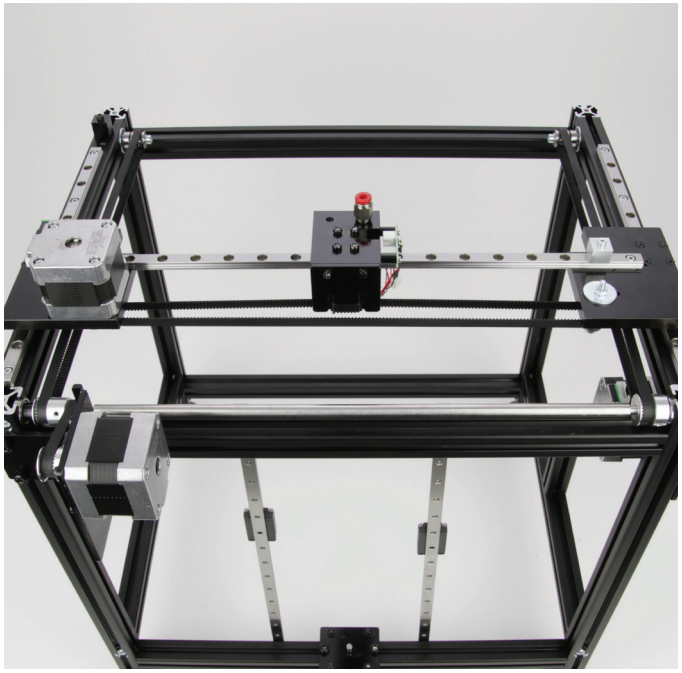
1x toothed belt 640 mm



Attach the toothed belt to the belt tappet as illustrated first.



Now attach the toothed belt to the sprocket of the X-motor (1) and then across the belt tensioner (2).
Shift the belt tensioner outwards to tension the belt and tighten the screw of the tensioner. Hold against this with the open-faced spanner 7 mm (3).
The toothed belt must be clamped so that it can still be twisted by 180° easily with two fingers and so that it can still be compressed easily with the fingers.

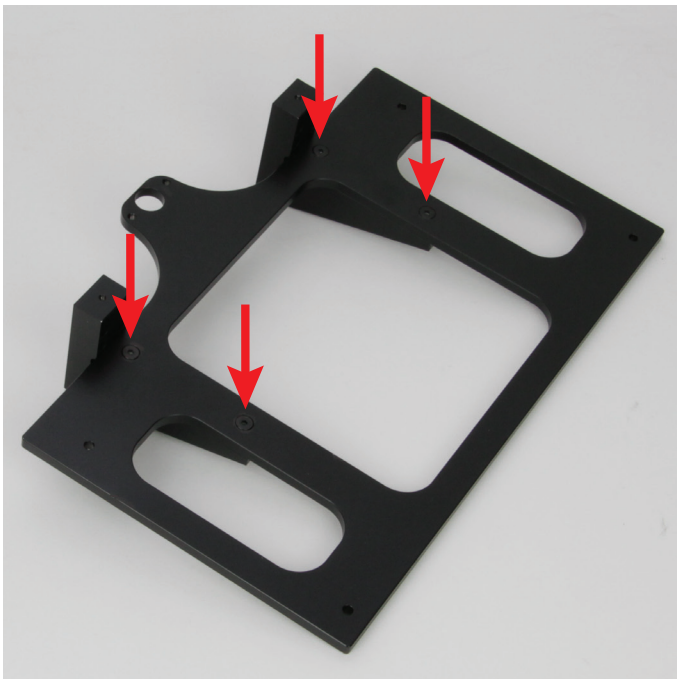


If you cannot tension the toothed belt enough by hand, use the open-faced spanner with which you tighten the nut as a lever. Carefully push the open-faced spanner against the silver aluminium block while you tighten the cylinder-head screw from below with a hexagon socket wrench.

Important! The toothed belt should be tensioned just as far as the two Y-toothed belts!

Assembly of the undertable

1x undertable
2x table tappets
4x countersunk head screw M4x10 black



Attach the two table tappets with the 4 recessed-head screws to the undertable from below. The recessed bores in the undertable must be on top.
Optionally, the screws can be secured with threadlocker varnish.

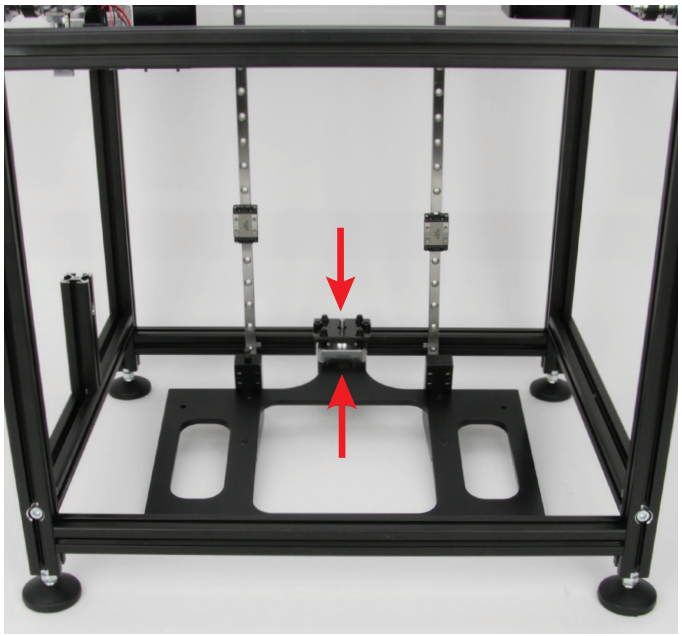
Attachment of the limit switch actuation of the Z-axis

1x undertable
1x hexagon screw M3x16 black
1x nut M3 black

Turn the nut onto the screw first. Then turn the screw into the left table tappet at the top, about halfway in.

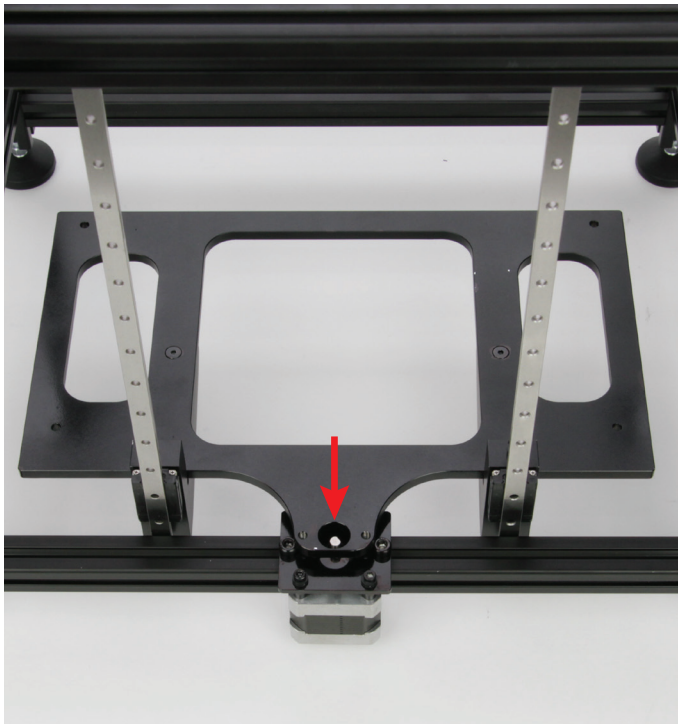
Attachment of the table to the guide rails

1x undertable
8x cylinder head screw M3x12 black



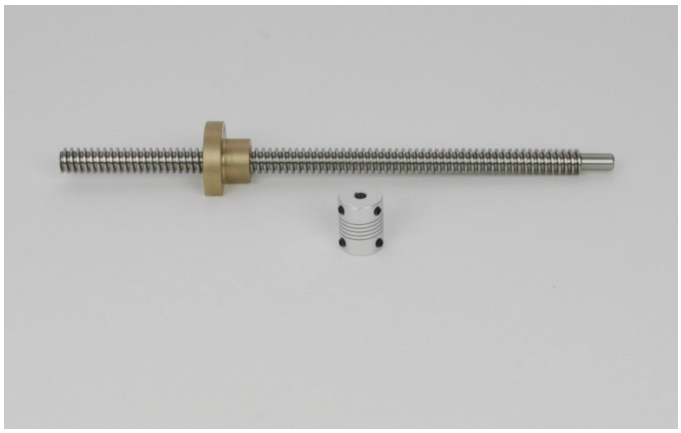
First put the table into the middle of the basic frame. The sides of the table should be in parallel to the aluminium profiles. The bore in the table (rear centre) must be aligned with the shaft of the Z-motor.
If the 4 screws of the guide rails are not loose, release them a little and move the two guide rails until the guide carriages are at the same level as the table tappet.

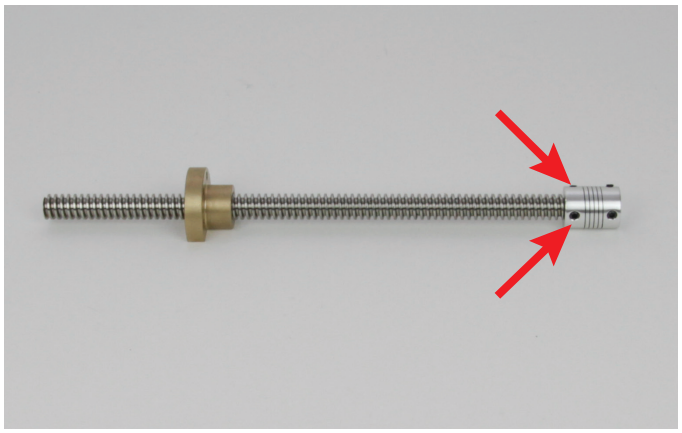
Loosely attach the table to the two guide carriages on either side with 4 cylinder-head screws.
Optionally, the screws can be secured with threadlocker varnish.



Now align the table sideways so that the bore is centred over the shaft of the Z-motor.

Assembly of the spindle





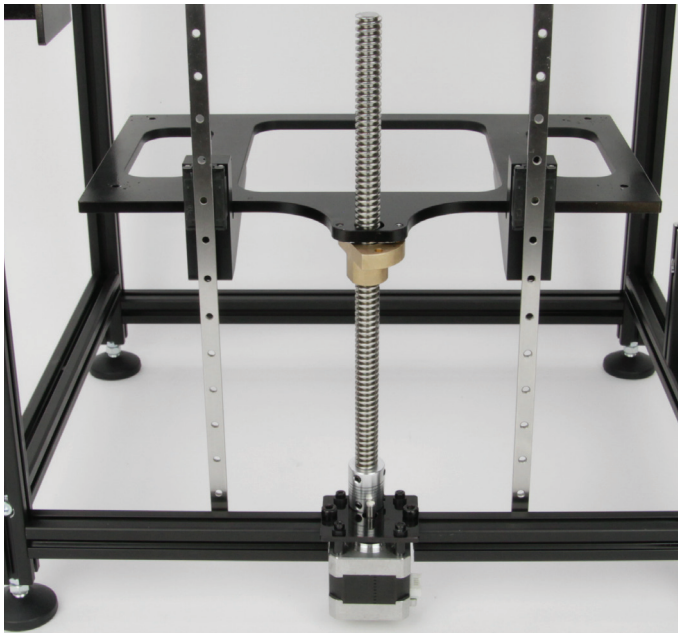
1x spindle
1x flange nut
1x clutch

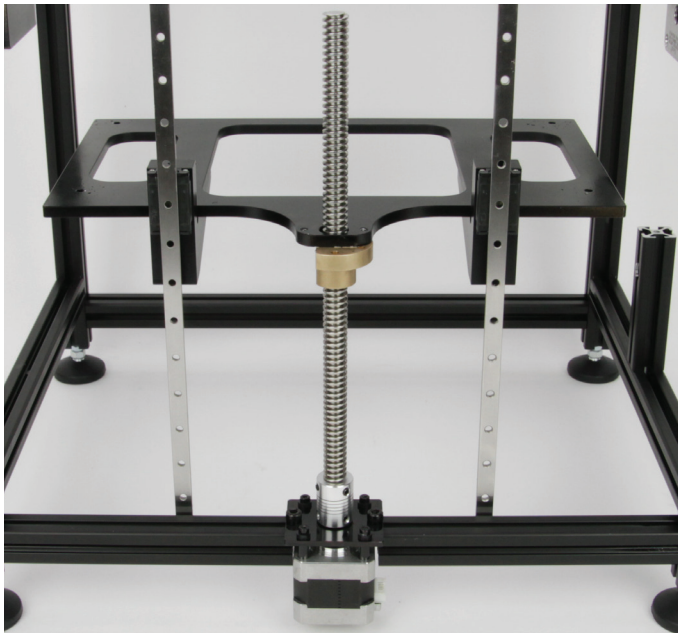
First, turn the flange nut on the side of the spindle that has no thread. Align the flange nut as shown in the picture.

→ **Grease the spindle with all-purpose grease after installation and later on demand.**

Place the coupling on the spindle on the side that has no thread. Tighten the two left threaded pins (arrows in the figure) of the coupling.
Simply leave the two right threaded pins loose in the coupling.
Optionally, the screws can be secured with threadlocker varnish.

Installation of the spindle





The flange nut on the spindle should be roughly centred.
Move the table up and thread the spindle through the table bore from below.

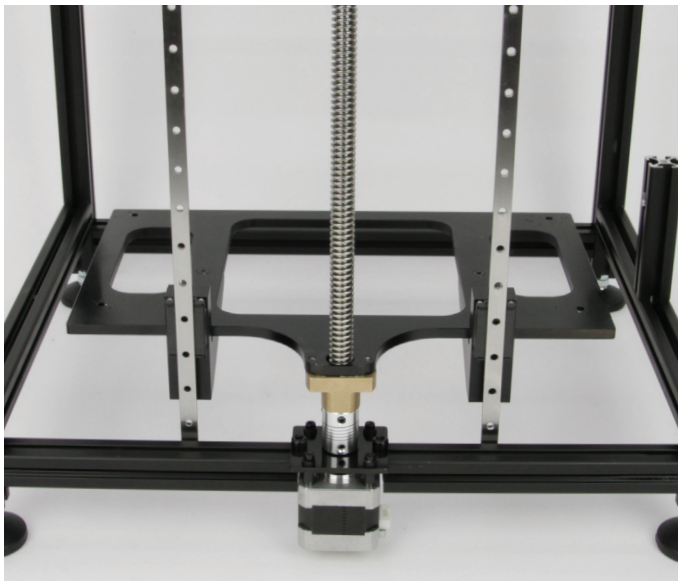
Turn the spindle until one of the two lower threaded pins of the coupling is precisely aligned with the flattened side of the motor shaft.
Push the coupling onto the motor shaft and first slightly tighten the threaded pin that you have previously aligned with the flattened side. Then tighten the other lower threaded pin slightly as well. Finally tighten both pins.

Important! The coupling level must be adjusted so that it has a distance of about 0.5 to 1 mm from the motor holding plate.

→ Also particularly observe that the spindle and the motor shaft in the coupling must not meet. They should be at a distance of approx. 3 mm. Otherwise, the coupling will no longer be functional.

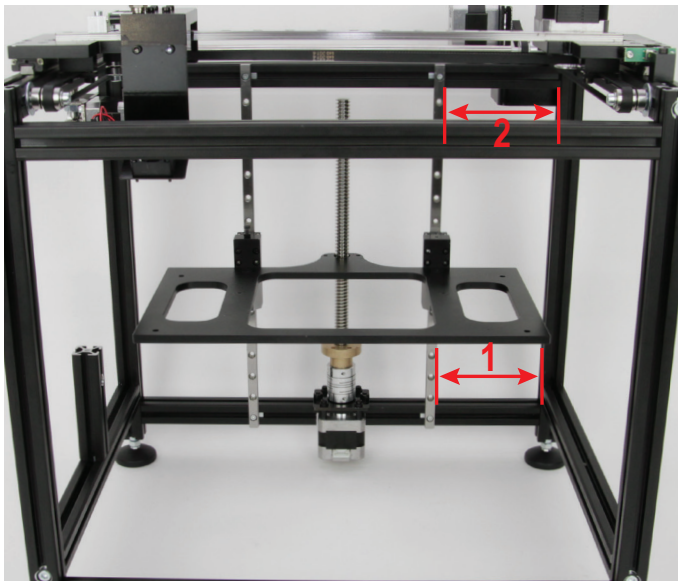
When you have tightened the screw, turn the spindle and check if the coupling moves smoothly and that it does not hit the motor holding plate.
Optionally, the threaded rods can be secured with threadlocker varnish.

Tightening of the table to the guide rails

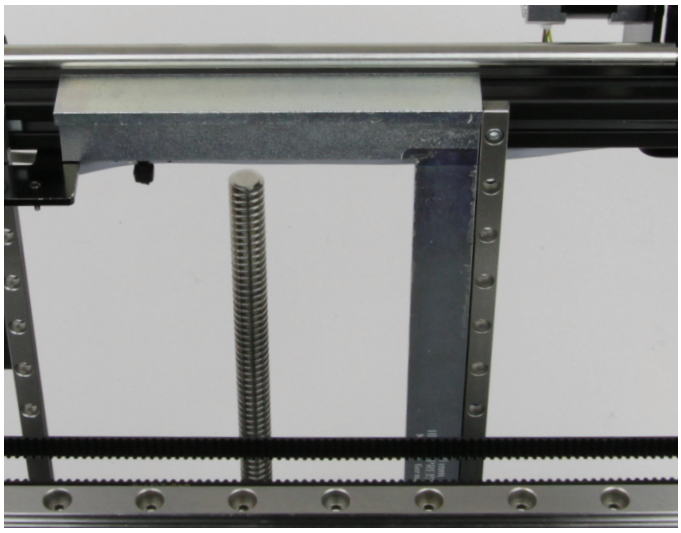


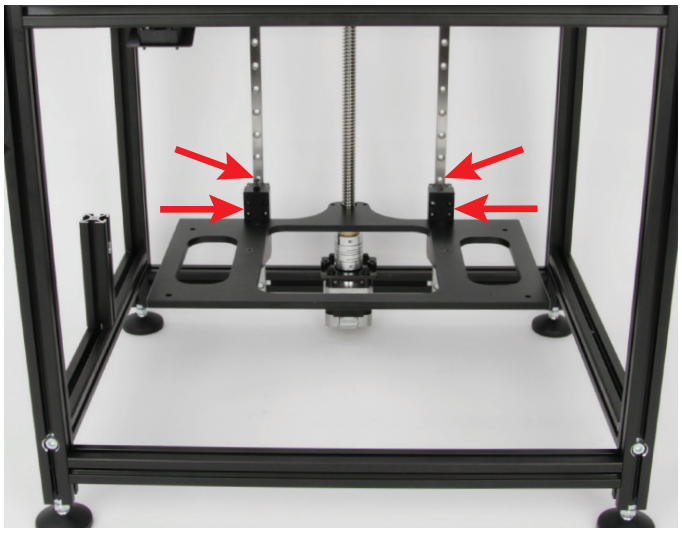
Lift the table and turn the flange nut all the way down. Then put the table onto the nut.

Move the table up and down twice and then to the middle (right figure). For the table to stay in place on its own, push a cylinder-head screw M3x10 or longer into a hole in one of the two guide rails from behind and carefully place the table down on it.



Measure the distance between the right guide rail and the right aluminium profile at the bottom (1) and top (2) each.
Align the guide rail at the bottom and top until the distance at 1 and 2 is the same. Check that the rails are straight with a stop angle additionally. Then carefully tighten first the lower screw and then the upper screw of the right guide rail slightly. Check the distance at 1 and 2 again.
Move the table up and down twice again; then let it return to the centre.
Repeat the procedure on the left.
The table should still move freely.



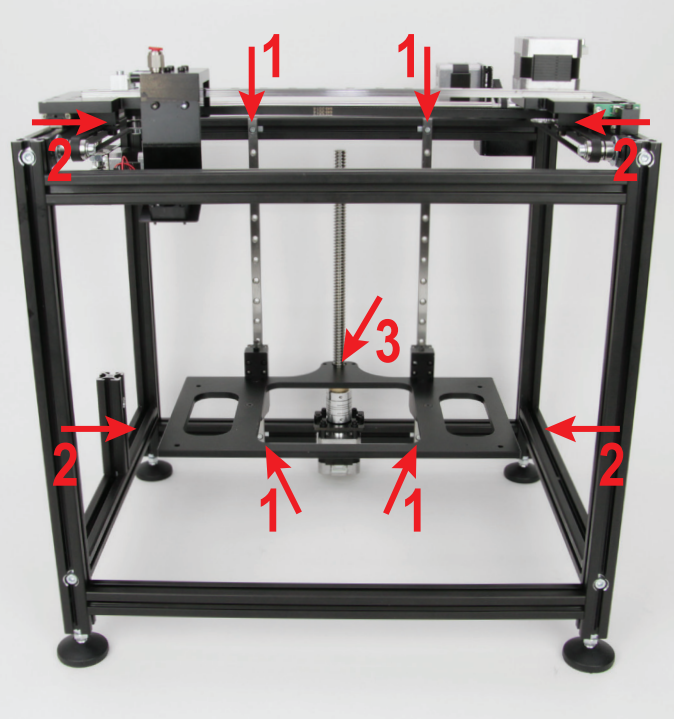


→ Check that the guide rails are straight with a stop angle several times while tightening them!

Place the stop angle on top of the upper aluminium profile.

Lower the table again and put it down on the flange nut.
Align the table straight with the holes over the guide carriage (upper arrows) and then tighten the cylinder-head screws at the left and right table tappets carefully alternatingly, first slightly and then tightly (lower arrows).

Final alignment, relieving and tightening of the guide rails

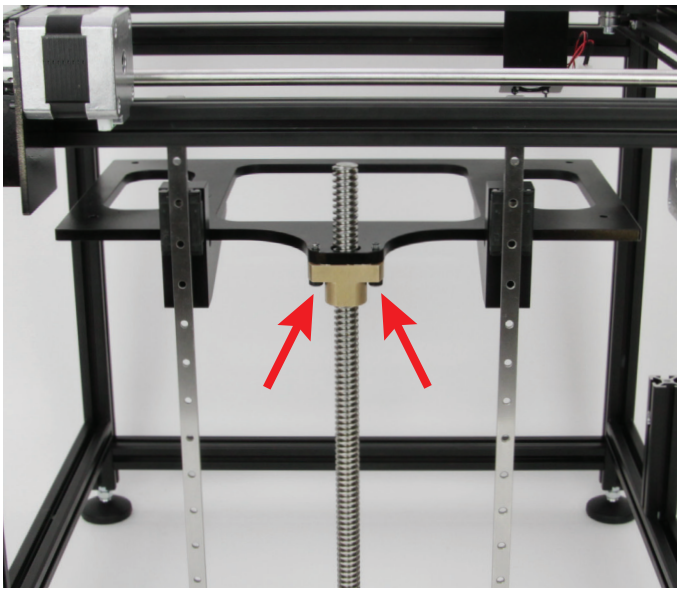


The table still must be supported on the flange nut.

- Loosen all 4 cylinder-head screws of the two guide rails (1), but only until they can be moved a little.
- Also release the 4 M5-cylinder-head screws a little that are screwed into the upper and lower aluminium profiles at the rear from the left and right (2).
- Check that the spindle is centred in the bore of the table (3). If this is not the case, adjust the table at the guide rails.
- Tighten the two lower attachment screws of the guide rails again slightly (1 bottom).
- Move the table up and down. It must not be stiff at the bottom or at the top. If it is, release the bottom screws of the guide rails again.
- Lift the table and turn the flange nut almost all the way up. Put the table back down on it (4).
- Check the upper and lower distances on both sides of the guide rails again. If necessary, align the rails.
- Check based on the holes in the guide rails again whether the table is aligned straight, and readjust if necessary.
- Now tighten the two upper screws of the guide rails slightly so that they cannot move anymore (5).
- Lift the table and turn the flange nut all the way down.
- Move the table up and down several times. It always must move evenly easily. Then put the table back down on the flange nut.
- Tighten the 4 M5 screws again a little carefully in sequences, starting with the bottom ones and following up with the upper ones (6).
- Finally, tighten the 4 attachment screws of the two guide rails.

Attach the flange nut to the table.

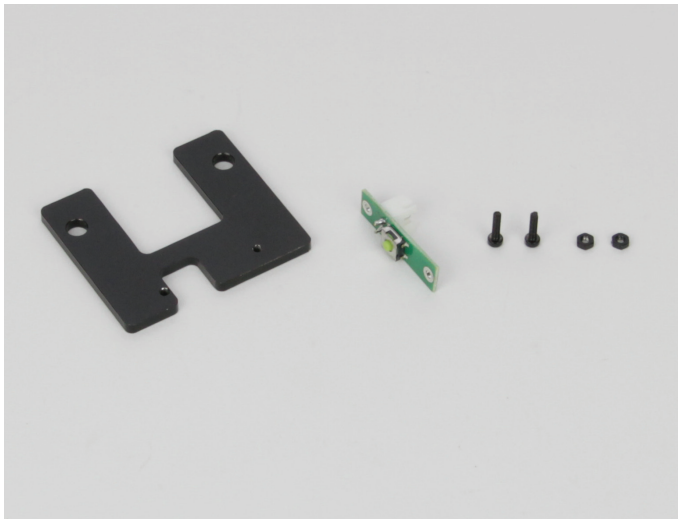
2x cylinder head screw M4x16 black



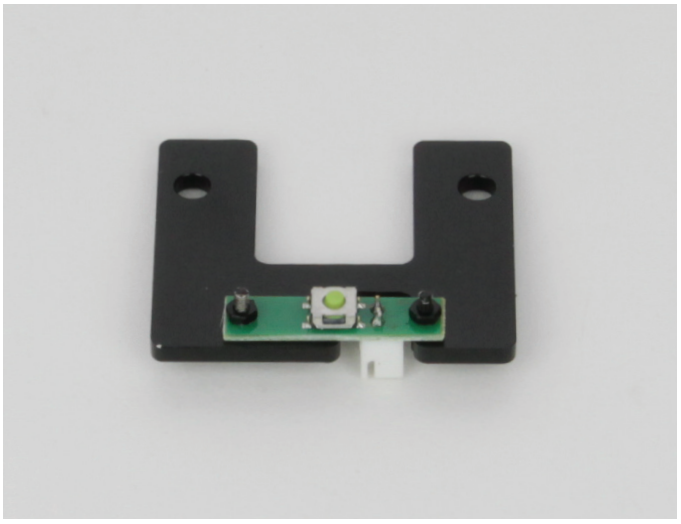
Lift the table and turn the flange nut almost all the way up. Put the table back down on it.
Turn the two cylinder-head screws into the thread bores of the table through the bores of the flange nut from below.
Tighten the screws.
Optionally, the screws can be secured with threadlocker varnish.
Lower the table again by turning the spindle.

⟶ If you find when turning the table up or down subsequently that it moves stiffly at the top or bottom, release the attachment screws of the two guide rails in sequence. Tighten the screw again before releasing the next one. You may need to release the undertable or the tappets again as well.

Assembly of the Z-limit switch

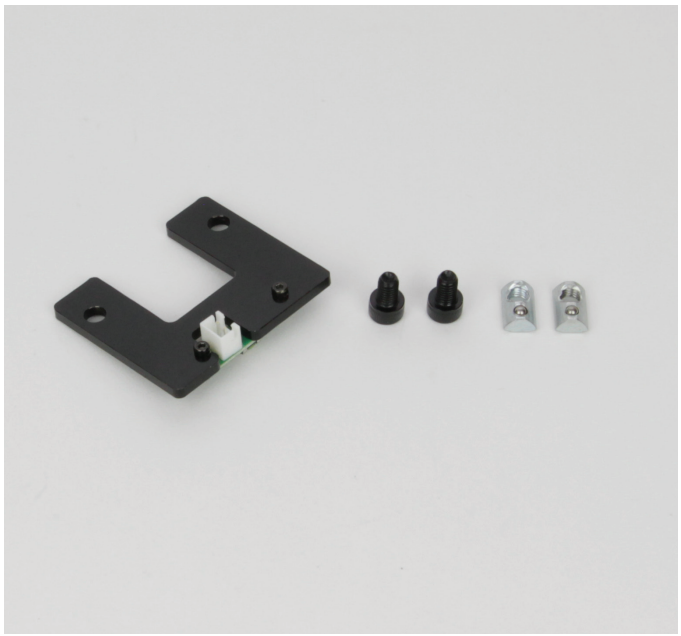


1x limit switch holder plate
1x limit switch PCB
2x cylinder head screw M2x8 black
2x nut M2 black

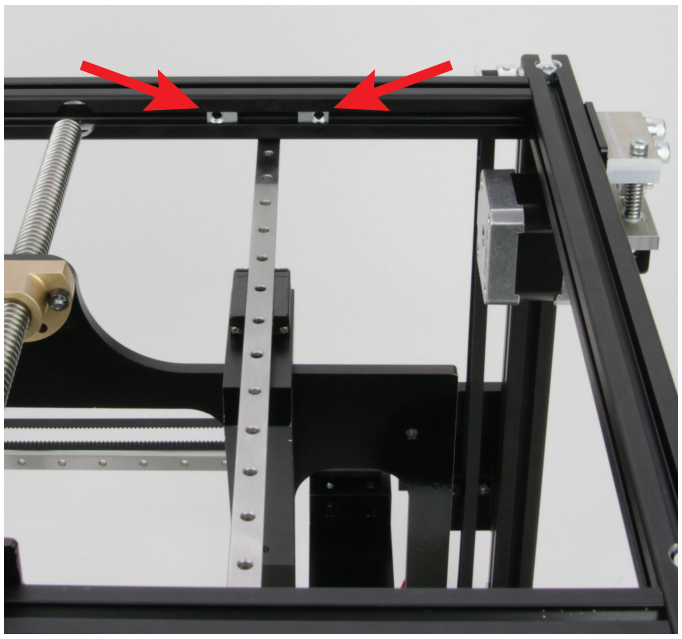


Mount the limit switch PCB on the limit switch holder plate as illustrated with the two M2-cylinder-head screws and M2 nuts. The cut-out and the limit switch must be aligned as illustrated. The two nuts must be installed on the side of the limit switch.

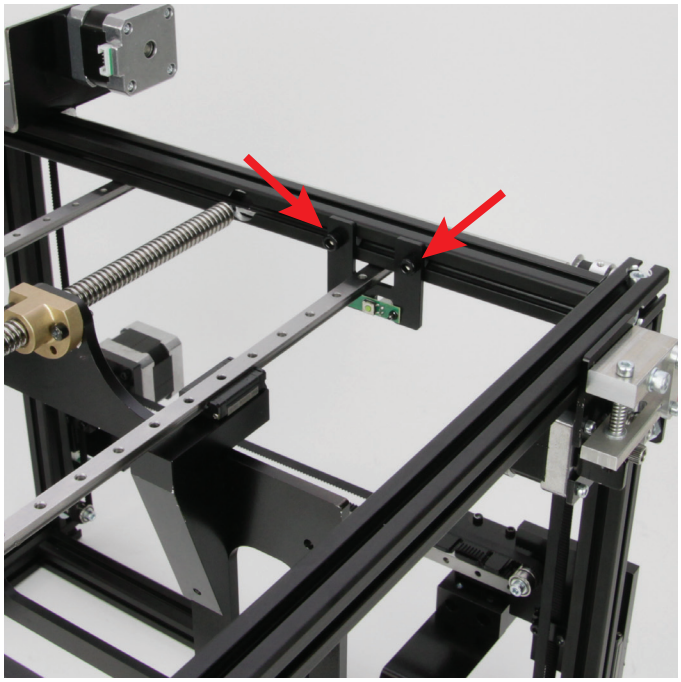
Installation of the Z-limit switch



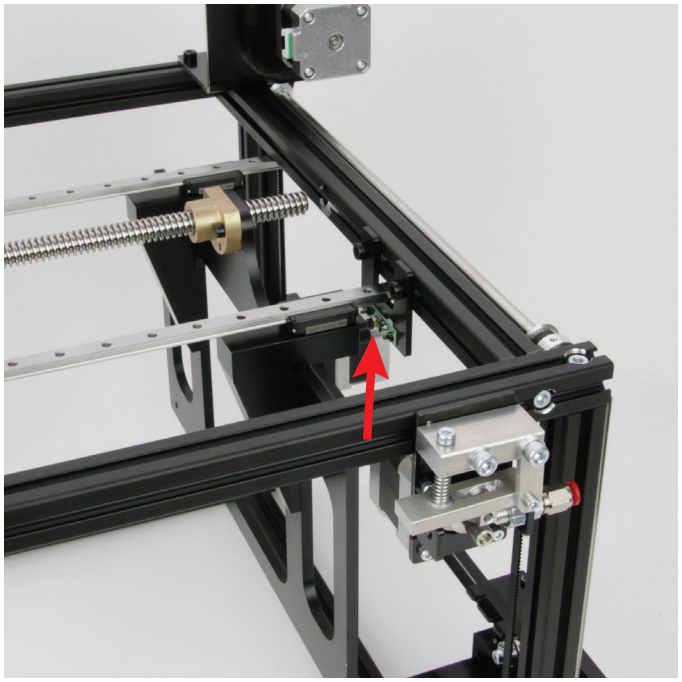
1x limit switch holder plate with limit switch
4x cylinder head screw M5x8 black
2x slot nut M5



Push the 2 slot nuts into the lower slot of the upper aluminium profile at the rear as shown in the figure.
The threads must both point outwards.
Align the two slot nuts with the hole distance of the end switch holding plate.

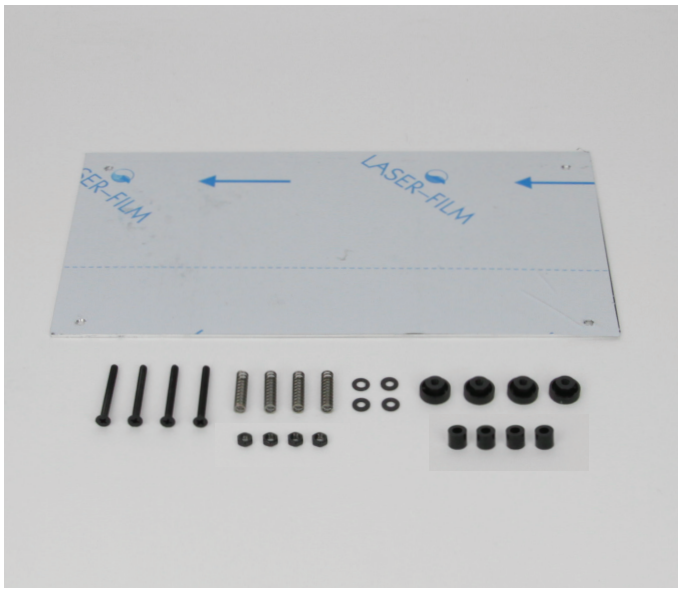


Attach the limit switch holding plate to the two slot nuts placed before loosely with the two M5 cylinder-head screws.
The unit must be aligned so that the button on the PCB points down.



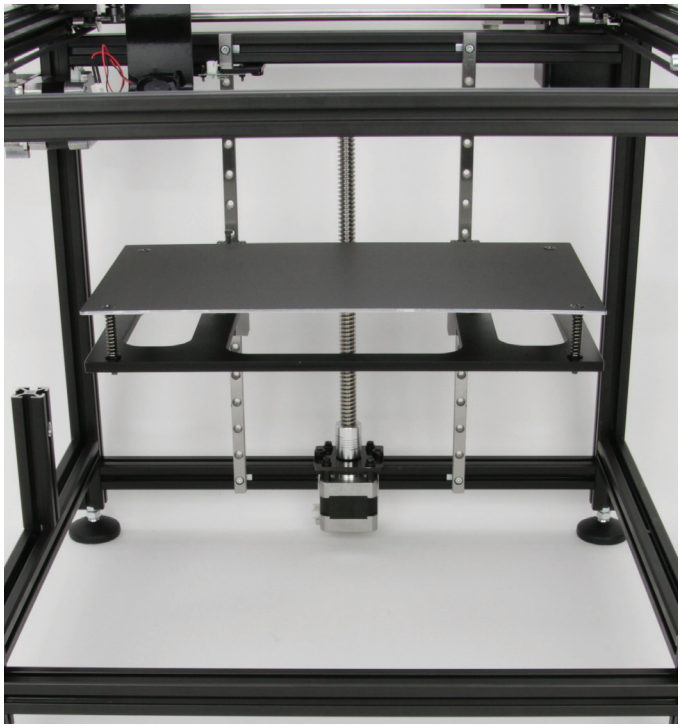
Move the table all the way up by turning the spindle.
Align the limit switch holding plate so that the button is pushed by the hexagon socket in the left table tappet (viewed from the front).
Move the table a little down again and tighten the two M5-screws.

Installation of the printing plate

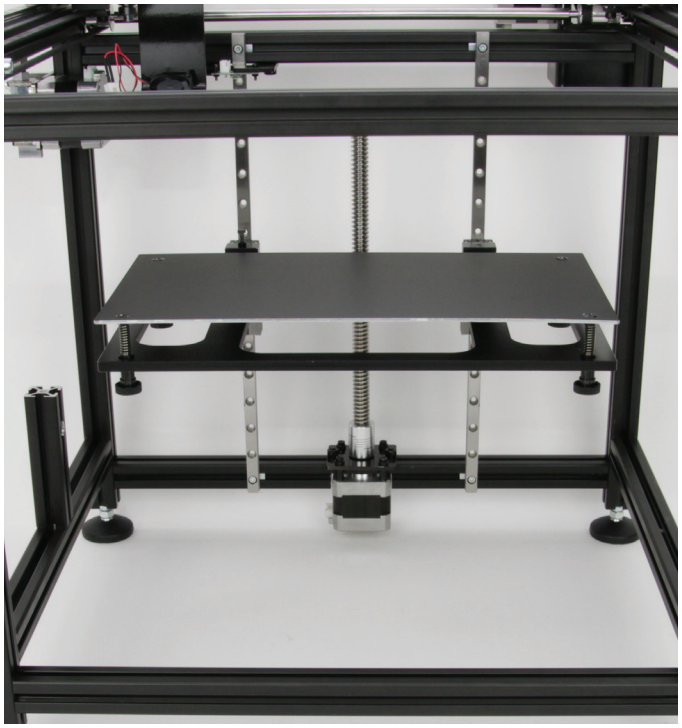


1x printing plate
4x countersunk head screw M4x40 black
4x pressure spring for printing table (length 24 mm)
4x nut M4 black
4x washer (diameter inside/outside 4.3/12 mm) black
4x knurled nut, black (plastic)
4x spacer 7 mm (diameter inside 4.2 mm)

Remove the film from the printing plate first.
Attach the 4 recessed-head screws to the printing plate with the 4 washer and the 4 nuts. The screws must be pushed in from the side with the countersunk bores.
Tighten the nuts.



Insert one screw at a time and guide them through the bores in the undertable.
The sequence is as follows:
Printing plate with the attached screw - pressure spring - undertable - spacer - knurled nut



Push the plate from above, push one spacer each onto the respective screw from below and secure them with a knurled nut.
When all 4 screws have been threaded in and secured, tighten the 4 knurled nuts evenly.

11. Mounting of the Electrical Components

This chapter ("11. Mounting of the electric components") generally is only relevant for purchasers of the maker construction kit / construction kit. Owners of the preassembled device can skip this chapter. However, the chapter is helpful when there is an error or smaller repairs are necessary.

The components on the PCBs can be damaged by electrostatic discharge. Therefore, touch, e.g. an earthed radiator before taking any PCBs into your hand.

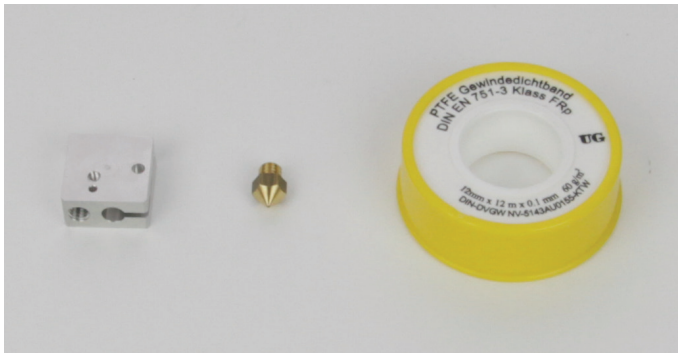
In subchapter c), you will find a wiring plan for the main PCB in which the required line connections are marked. The table also describes the assignment and properties of the individual cables.

Before you take the printer into operation, check all cables again for accuracy and proper connection on the main PCB.

If you want to mount the metal housing, please observe the additional accessory instructions before installing the main board on the board holder!

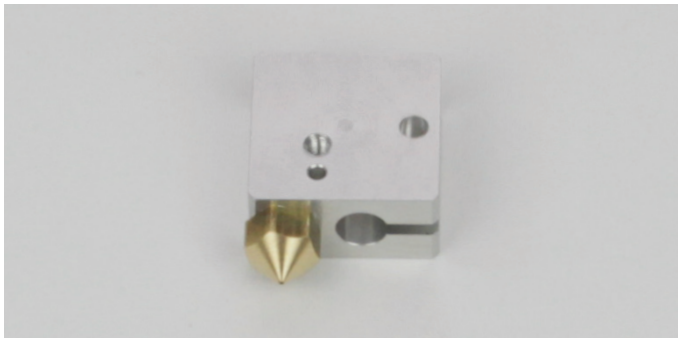
a) Installation of the Electrical Components

Assembly of the extruder



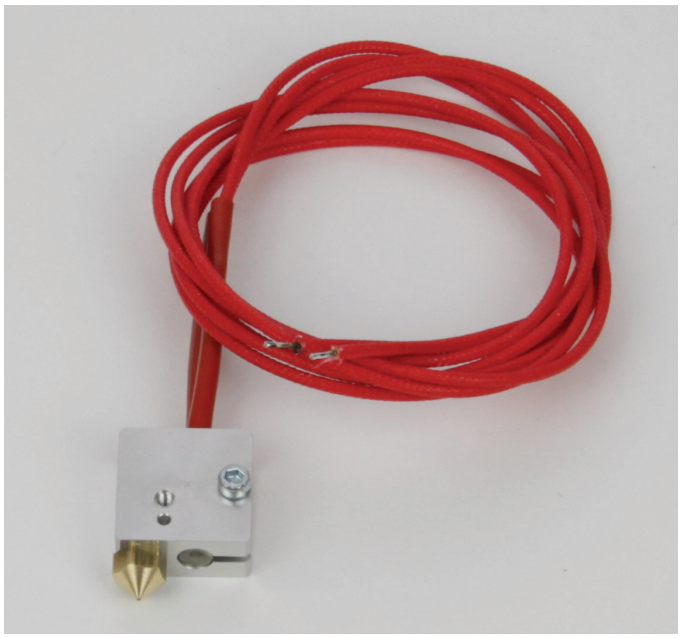
1x heating block
1x nozzle 0.4 mm
1x PTFE thread sealing tape

Cut about 2 to 3 cm thread sealing tape off of the roll and wind it around the thread of the nozzle. Cut off the sealing tape that protrudes over the thread with a sharp knife, e.g. by running the knife along the upper-most groove of the thread.
The sealing tape must never protrude beyond the thread.



Turn the nozzle into the heating block.
The nozzle must be put into the side that is closer to the bore for the temperature sensor.
Screw in the nozzle all the way and tighten it with an 8 mm open-faced spanner.
Check from the other side of the nozzle that no sealing tape is visible.

1x heating cartridge
1x cylinder head screw M3x10
1x heating block



Insert the heating cartridge into the corresponding opening from above (opposite of the nozzle).
Secure the heating cartridge with the cylinder-head screw as illustrated.

1x nozzle stock
1x PEEK part
1x PTFE insert
1x extruder infeed
1x nut M6 (flat ISO 4035)
1x PTFE thread sealing tape

Cut about 2 to 3 cm thread sealing tape off of the roll and wind it around the short thread of the nozzle stock. Cut off the sealing tape that protrudes over the thread with a sharp knife, e.g. by running the knife along the upper-most groove of the thread.
The sealing tape must never protrude beyond the thread.

Turn the nozzle stock into the PEEK part carefully. It will only fit in one side because the opening is larger on the other side.
Tighten the nozzle stock hand-tight with a 13 mm spanner.

Push the PTFE insert into the PEEK part. Take a hexagon socket wrench with at least 3 mm and push the PTFE insert entirely into the PEEK part.

Carefully turn the extruder inlet into the PEEK part and tighten it manually as far as possible.

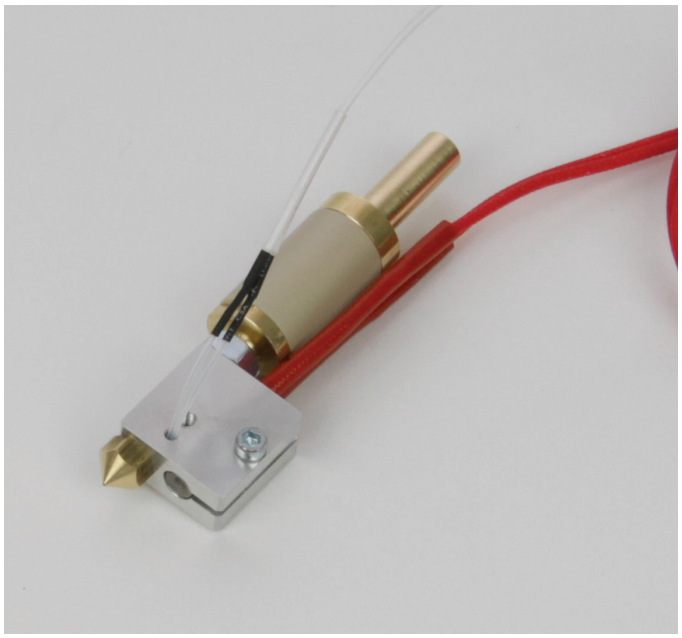
Screw the M6-nut onto the thread of the nozzle stock to the stop.
Please observe that the nut in the delivery is a little lower than in the figure.

1x extruder lower part
1x extruder upper part
1x PTFE thread sealing tape

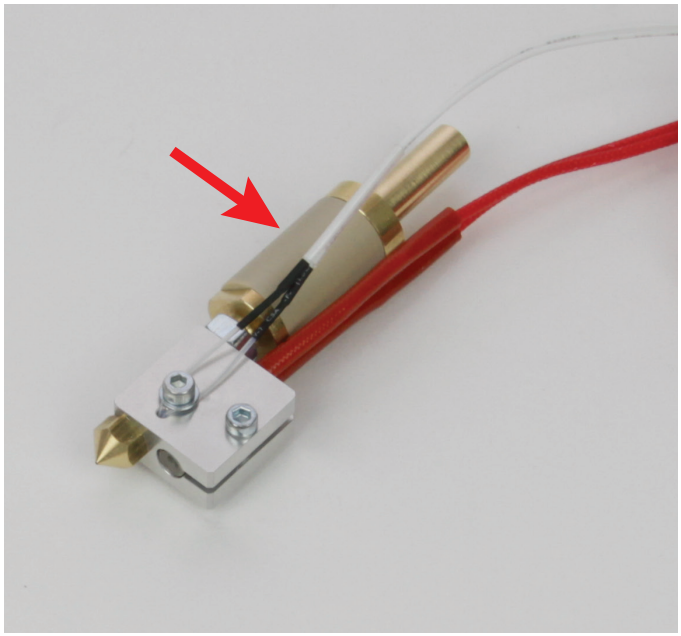
Cut about 2 to 3 cm thread sealing tape off of the roll and wind it around the thread of the nozzle stock.
The sealing tape must never protrude beyond the thread.

Turn the extruder top into the extruder bottom to the stop.
Counter the extruder top with the nut against the extruder bottom (open-faced spanner 10 mm).

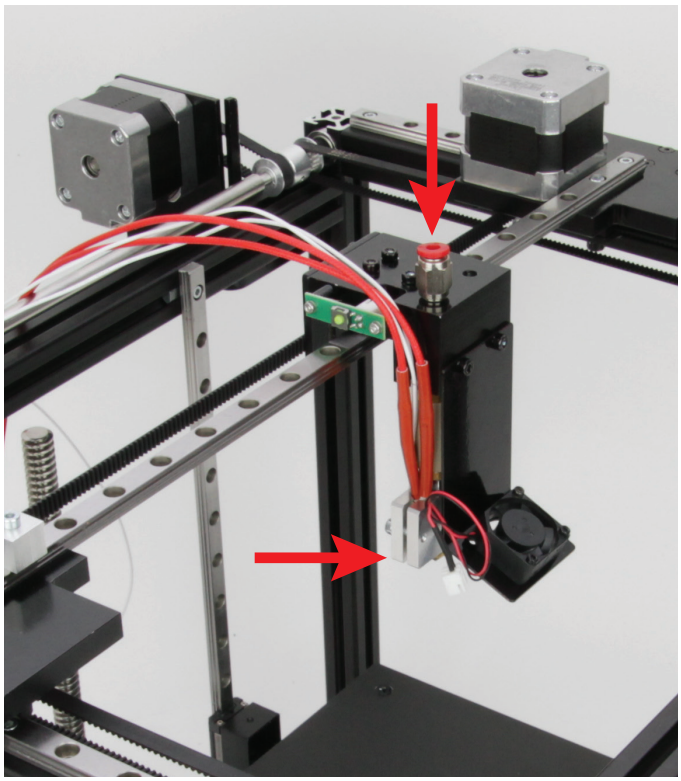
1x extruder
1x temperature sensor
1x cylinder head screw M3x8
1x washer (diameter inside/outside 3.2/7 mm)



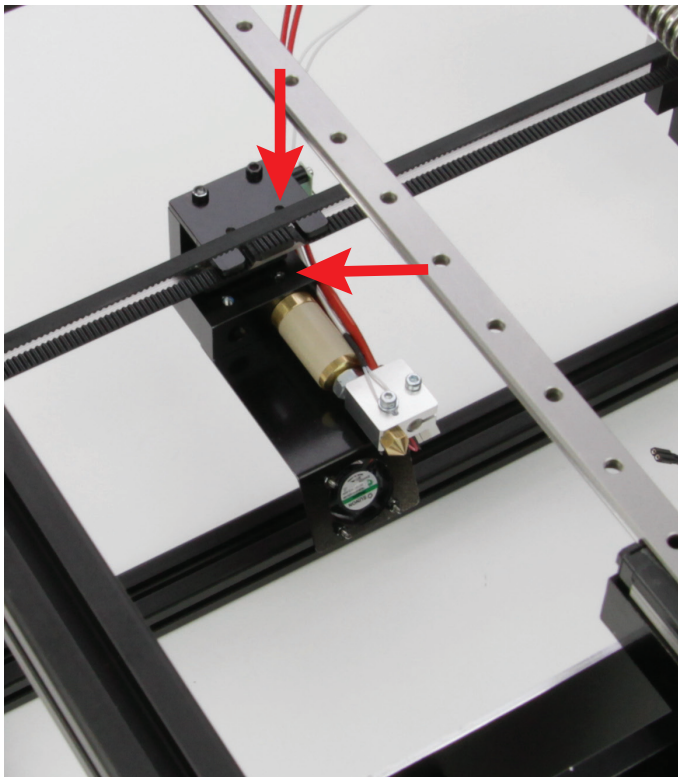
Push the temperature sensor into the small opening between the nozzle and the bore with the thread.
Attention! The temperature sensor is very sensitive! Installation therefore must be performed with the utmost care!



Attach the sensor with the cylinder-head screw and the washer. The screw must be turned between the two connection lines for this.
Only tighten the screw slightly so that the connection lines are not damaged.
Now glue a strip of Kapton adhesive tape centred around the PEEK part and the cables (arrow), to attach them to the extruder.

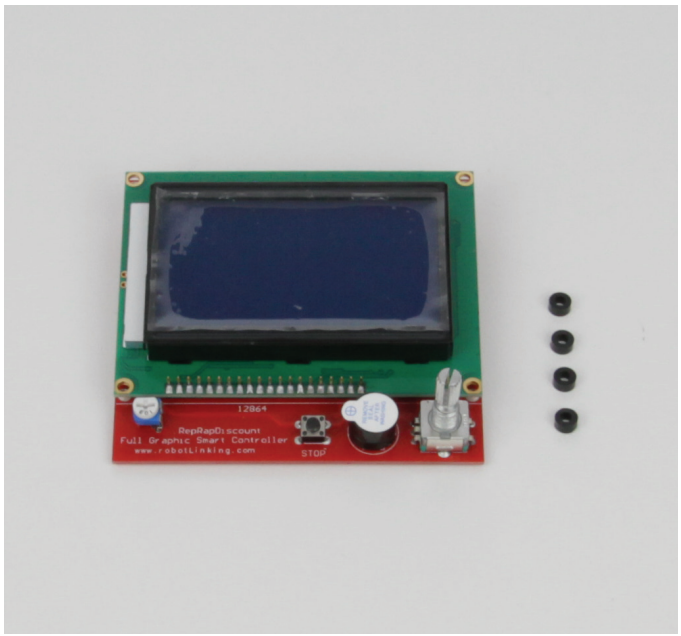


Push the extruder into the left opening of the extruder holder from below (opening where the quick-closure is installed at the top).
The extruder must be aligned so that the side of the heating block with the heating cartridge points to the left or outside (lower arrow in the figure). The heating block must run in parallel with the fan sheet.

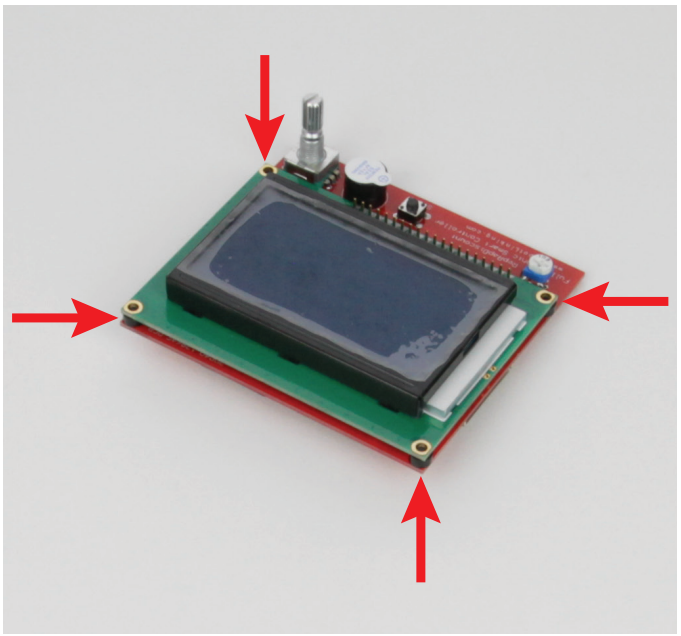


Push the extruder entirely into the opening and tighten the threaded pin.
Use either an angled hexagon socket wrench 2 mm (to tighten from below) or a straight hexagon socket wrench that you can push through the slit in of the belt tappet.

Preparation of the display

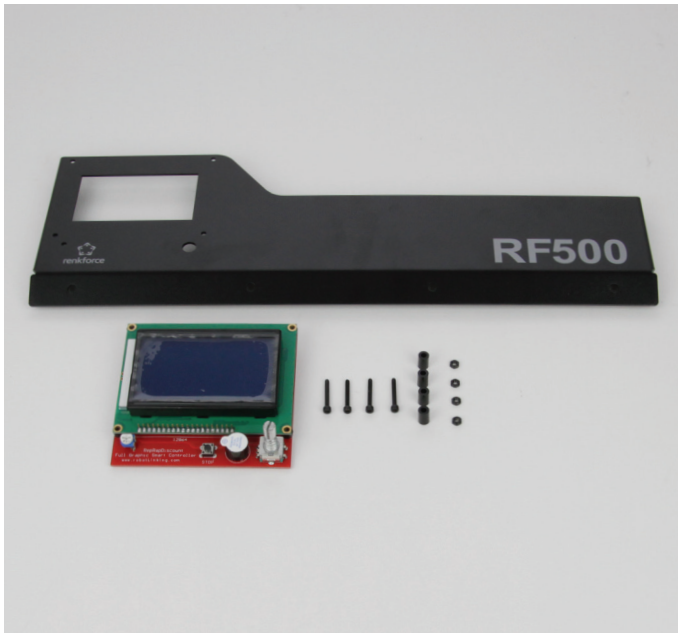


1x display
4x spacer 3 mm (diameter inside 3 mm)

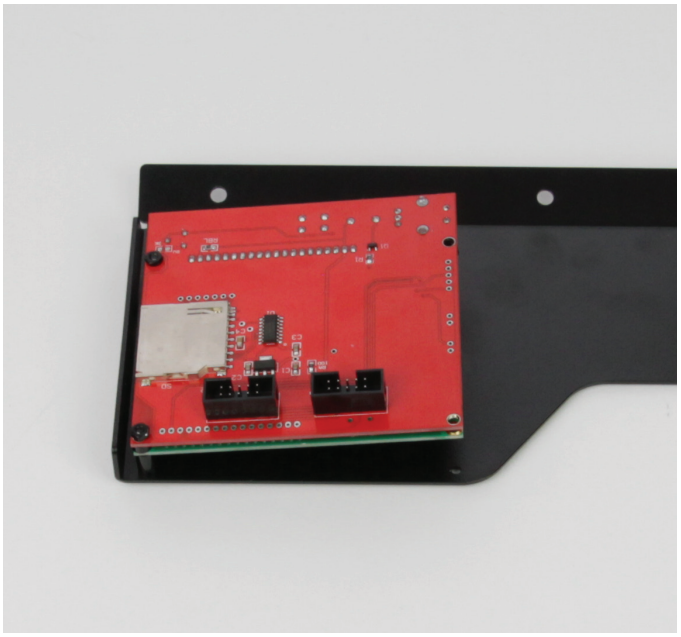


Push one spacer between the display and control PCB in each attachment hole.
Align the spacer precisely with the holes.

Installation of the display in the display holder



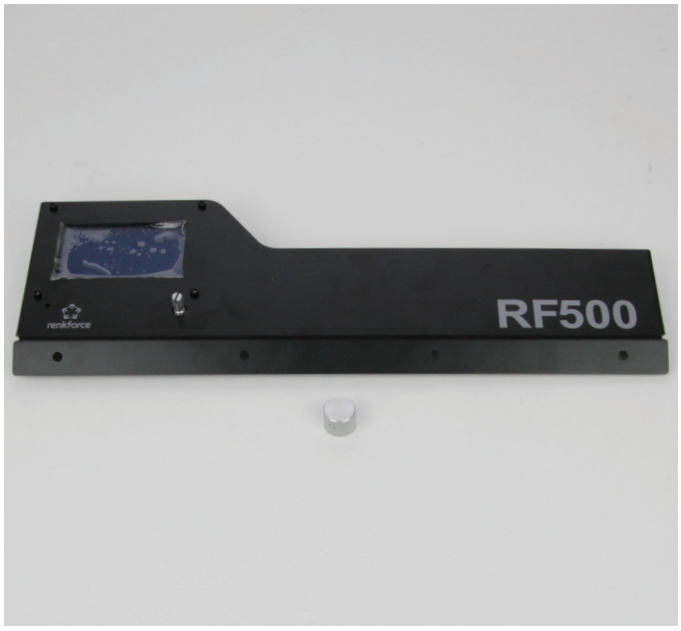
1x display holder
1x display
4x cylinder head screw M2.5x20 black
4x spacer 9 mm (diameter inside 3 mm)
4x nut M2.5 black



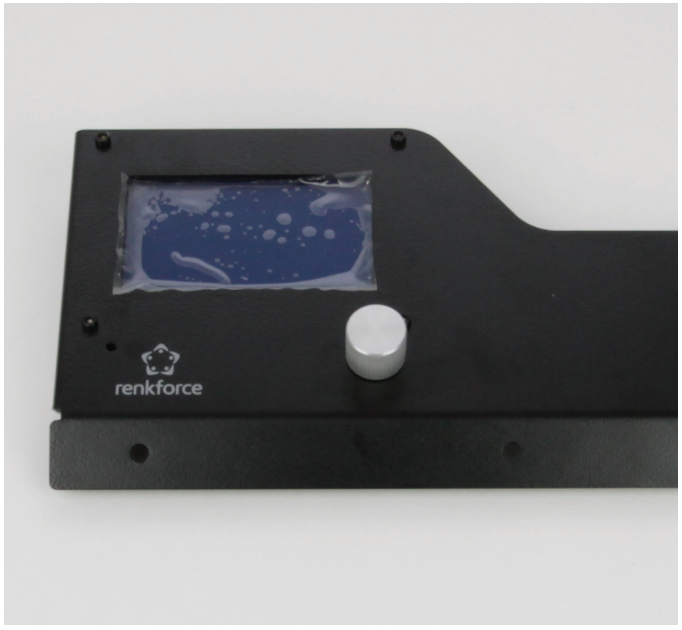
Remove the film from the display first.
Attach the display to the display holder from the inside. The dial switch must be guided through the corresponding opening.
Start at the outside.
Install the screws one at a time. After inserting a screw, secure it with a nut.
The sequence from the outside is:
Cylinder-head screw - display holder - spacer 9 mm - display (with spacer 3 mm) - nut

Align the display when all screws are inserted. Particularly observe that the dial switch does not hit the display holder. Tighten all nuts (hex key 5 mm).
You may need to align the display more precisely after commissioning.
Apply the film to the display again to protect it.

Installation of the operating button



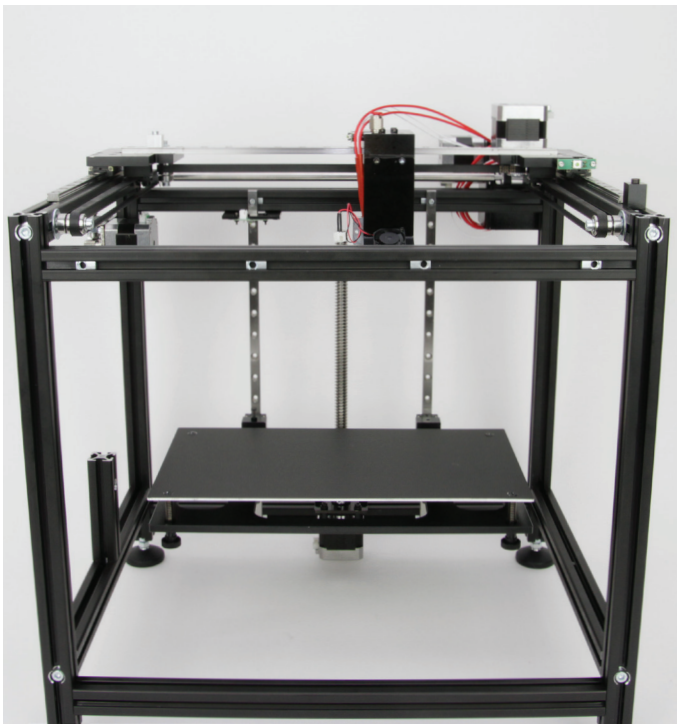
1x display holder
1x operating button



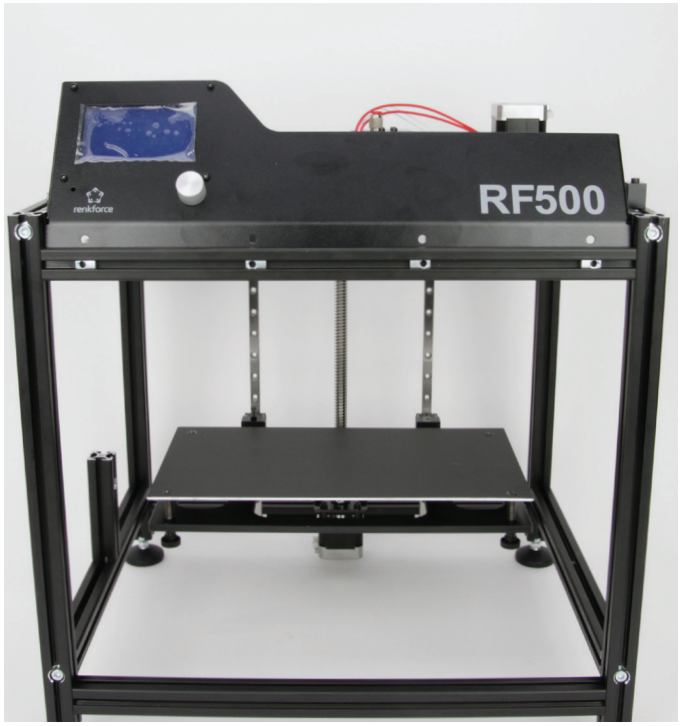
Push the operating button onto the shaft of the dial switch and attach it by tightening the slotted screw.
The button must be aligned so that it still has enough distance from the display holder to allow clean pushing of the button. The screw must meet the slot in the dial switch.
Push the operating button to test it.

Installation of the display unit

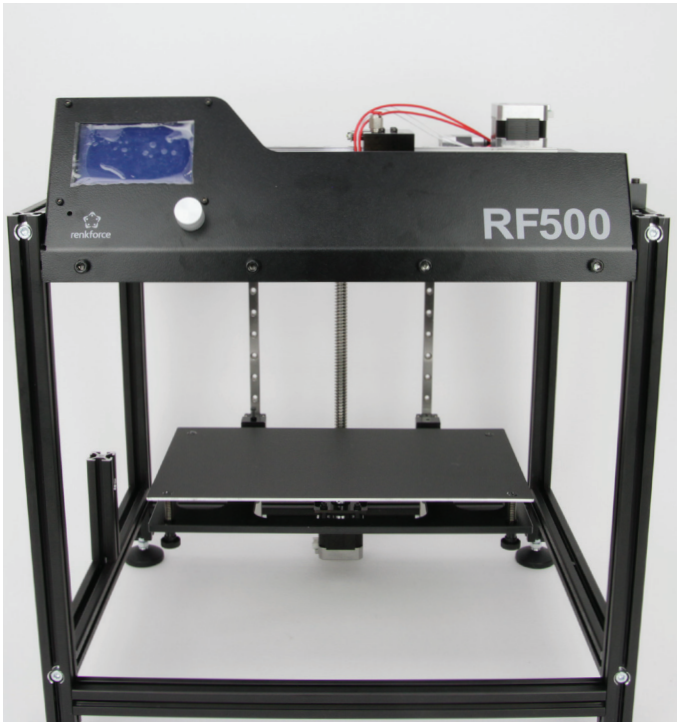
1x display unit
4x cylinder head screw M5x8 black
4x slot nut M5



Insert the 4 slot nuts into the upper aluminium profile at the front of the printer.

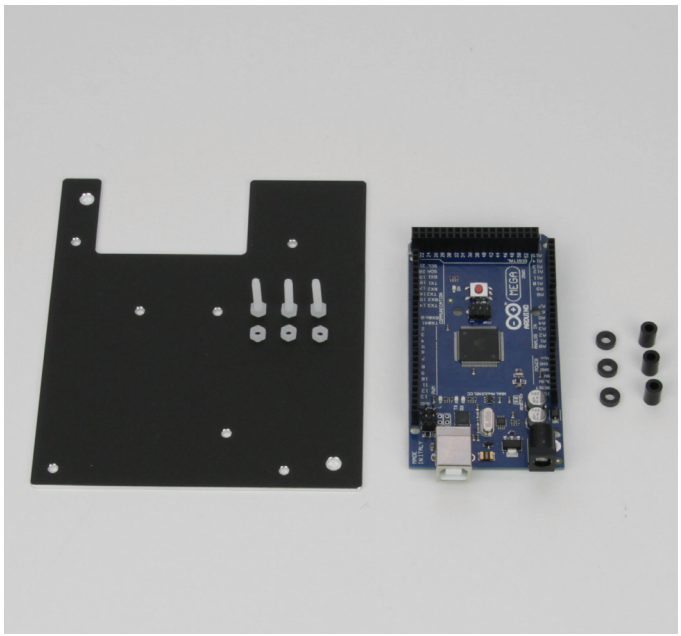


Hold the display unit against the slot nuts from above and align them with the bores in the display unit.



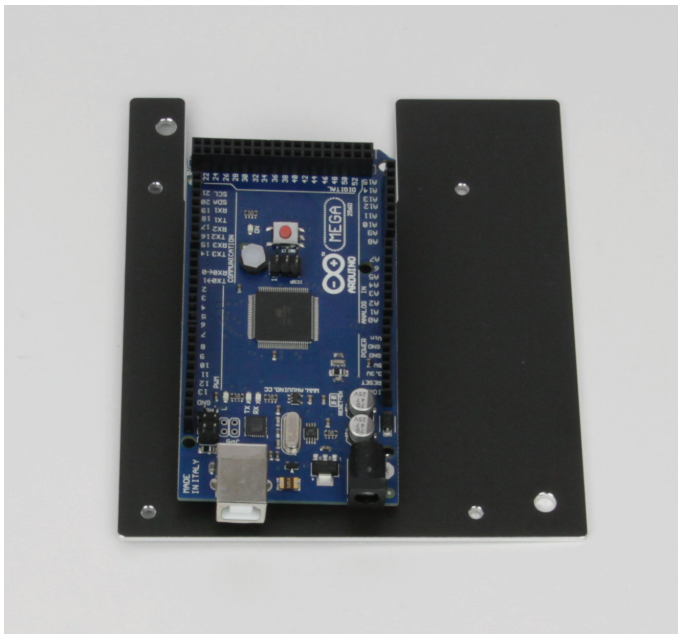
Attach the display unit to the 4 slot nuts with the M5-cylinder-head screws.
Tighten all 4 screws.

Attachment of the main PCB to the PCB holder

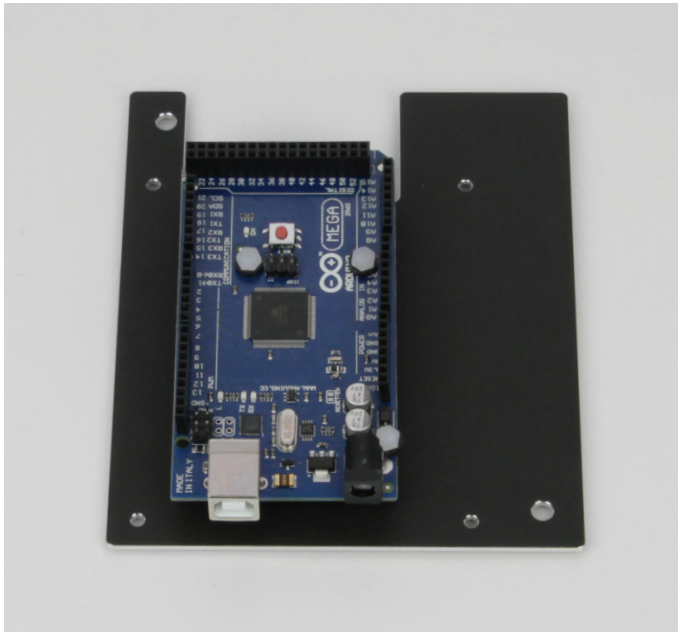


1x PCB holder
3x hexagon screw M2.5x16 (plastic)
3x nut M2.5 (plastic)
1x main PCB
3x spacer 2 mm (diameter inside 3 mm)
3x spacer 8 mm (diameter inside 3 mm)

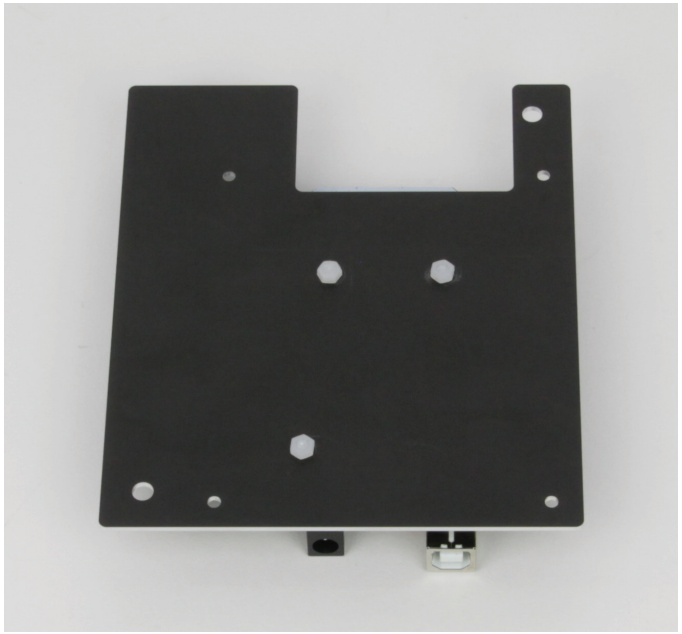
⟶ **If you want to mount the metal housing, please observe the additional accessory instructions before installing the main board on the board holder!**



Attach the main PCB to the PCB holder.
The PCB holder and the main PCB must be aligned as illustrated!
Begin with the left screw at the middle of the PCB.
Install the screws one at a time. After inserting a screw, secure it with a nut.
The order is:
Hexagon screw - spacer 2 mm - PCB - spacer 8 mm - PCB holder - nut

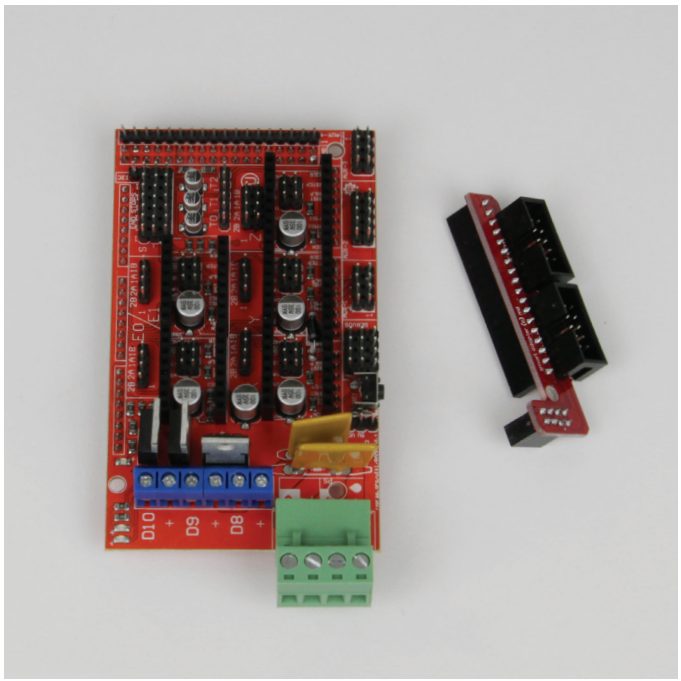


Once all screws are inserted, align the PCB straight. Carefully tighten all nuts and do not over-tighten them!

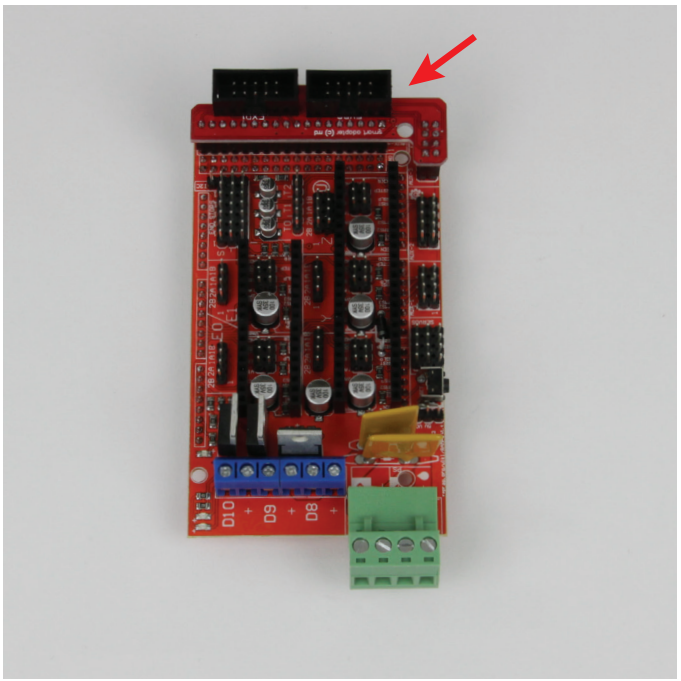


This is the view from below for inspection.

Pushing on the adapter PCB

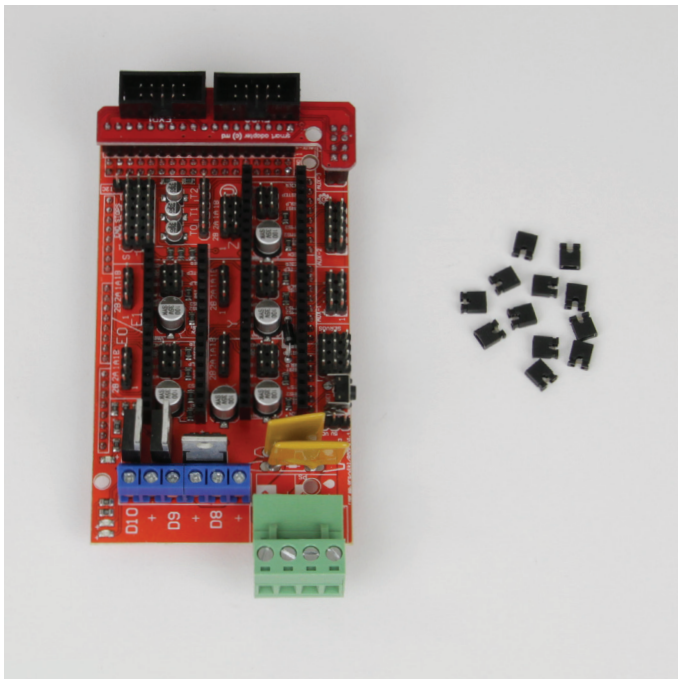


1x additional PCB
1x adapter PCB

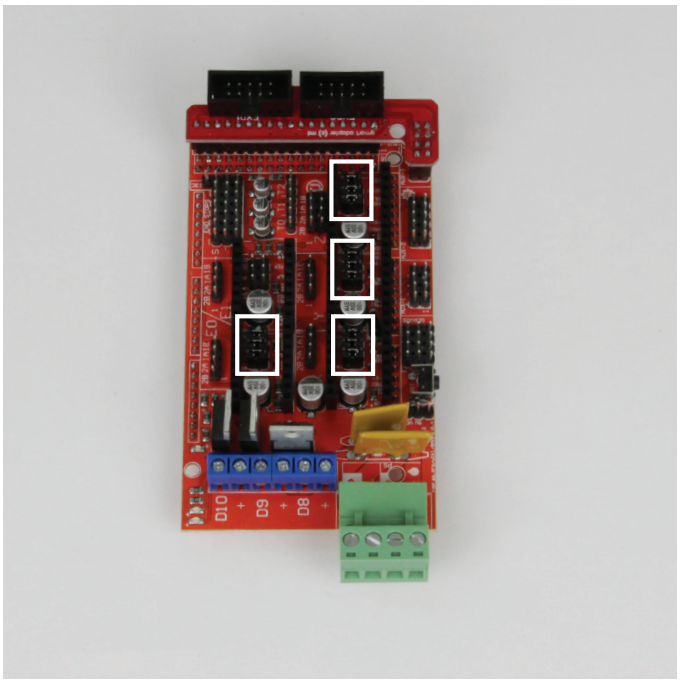


Push the adapter PCB onto the additional PCB as illustrated. All pins in the adapter PCB must be pushed into the socket strip.

Pushing the jumpers onto the additional PCB



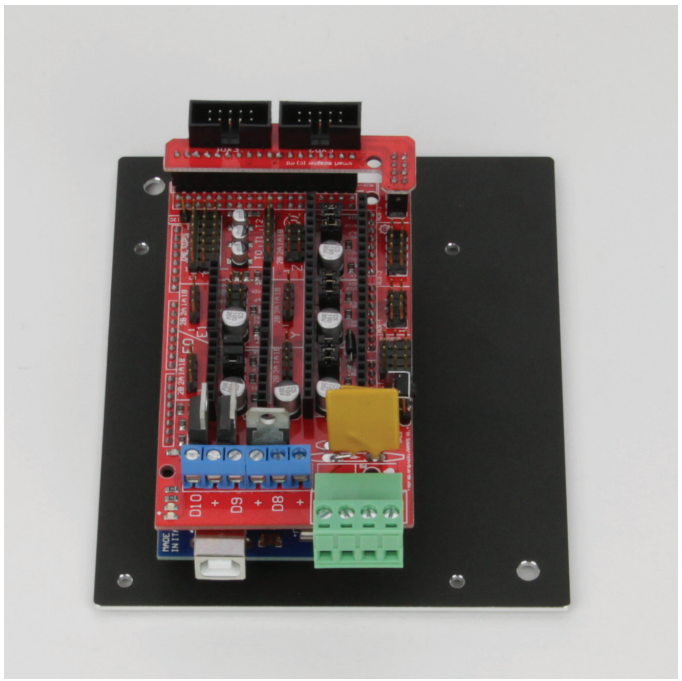
1x additional PCB
12x jumper



6 pins each are placed between the continuous pin series into which the motor drivers are inserted later (2 rows with 3 pins each). 3 jumpers each must be put onto these pins. There are 3 fields on the right side of the PCB (motors X, Y and Z), and one field on the left side (filament infeed).
Put on 3 jumpers per field as illustrated.
The 5th field at the upper left remains empty.

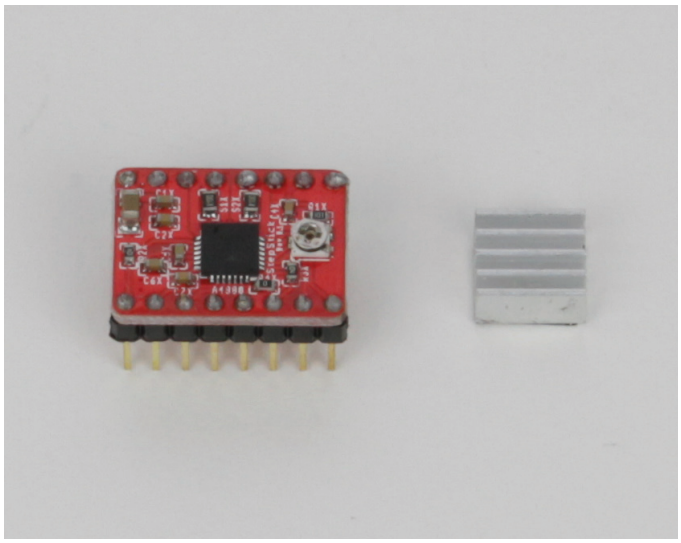
Assembly of the additional PCB

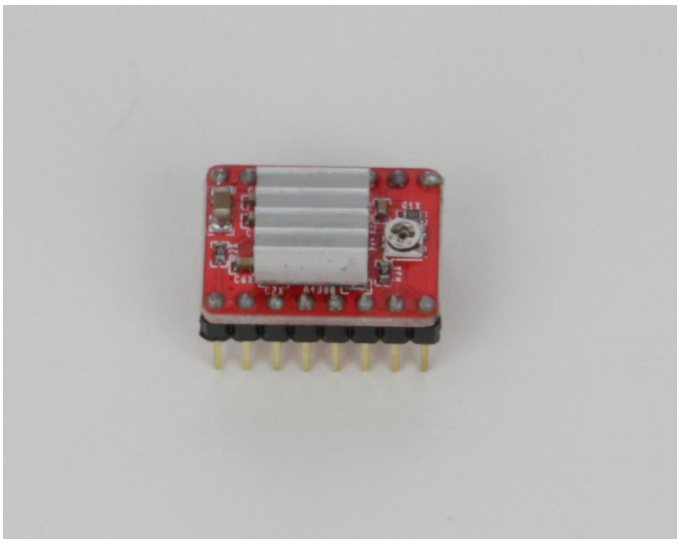
1x PCB holder with main PCB
1x additional PCB



Push the additional PCB onto the main PCB.
Use the upper double pin strip that runs across the main PCB for orientation.

Assembly of the cooling bodies on the motor drivers

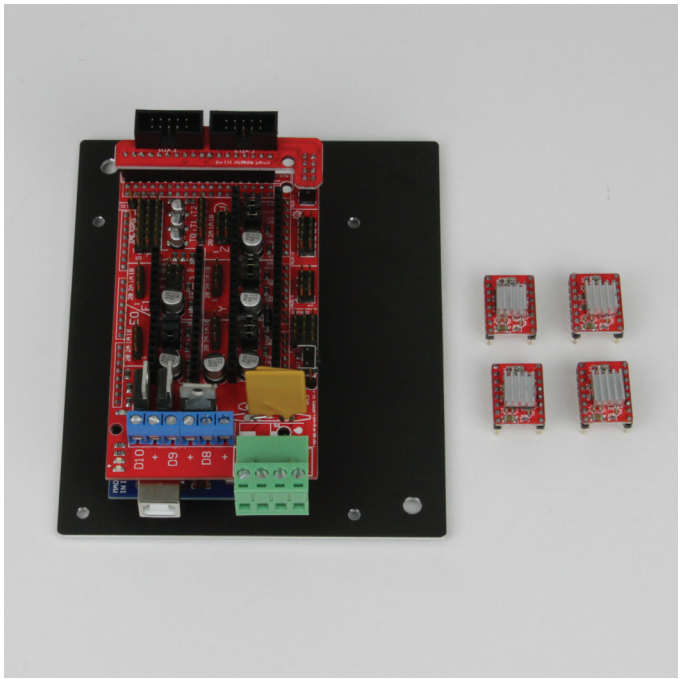


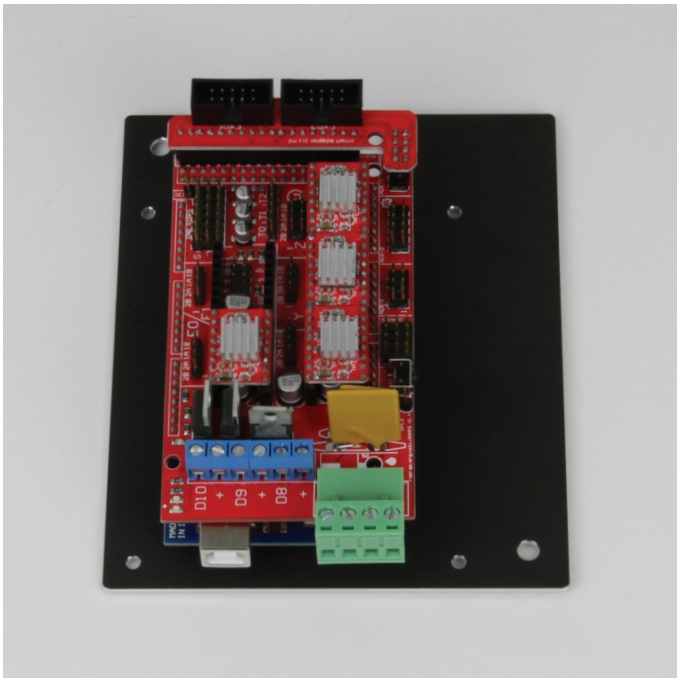


4x motor driver
4x heat sink

Remove the protective film from the bottom of the cooling element and stick it centred onto the chip of the motor driver.
Attention! Do not stick the cooling body too close to the soldering points of the pin strip! Danger of short-circuit!
Repeat this with the other 3 motor drivers.
The 5th enclosed motor driver is not needed. It is a reserve.

Assembly of the motor drivers

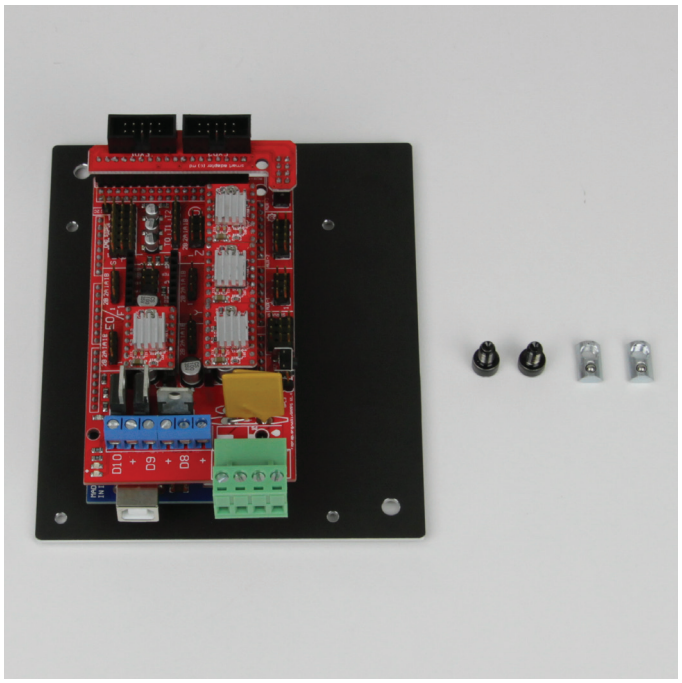




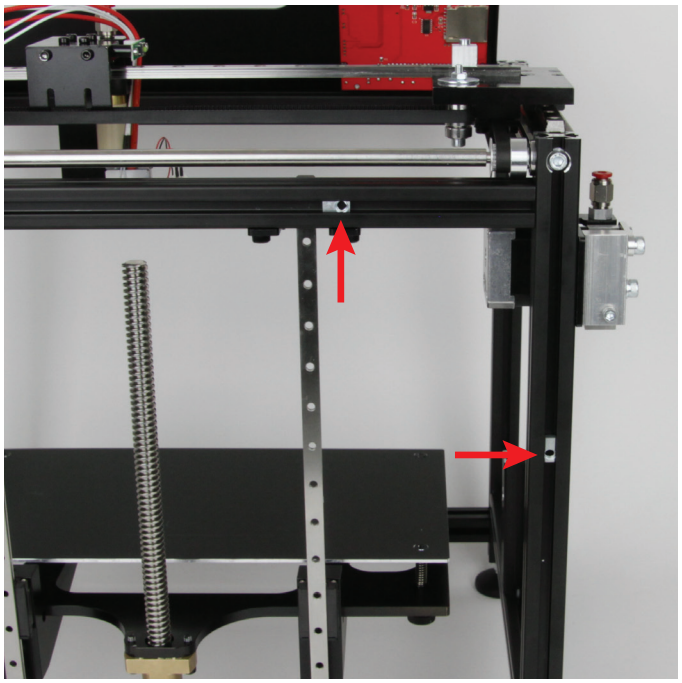
1x PCB holder with main PCB
4x motor driver

Push the motor driver onto the additional PCB as illustrated.
The potentiometers on the motor drivers always must point away from the green connection plug.
3 motor drivers must be pushed onto the right side. The pin strips present also fit precisely here.
Only 1 motor driver needs to be pushed onto the left side. It must be inserted at the very bottom of the pin strip.

Assembly of the PCB holder at the printer

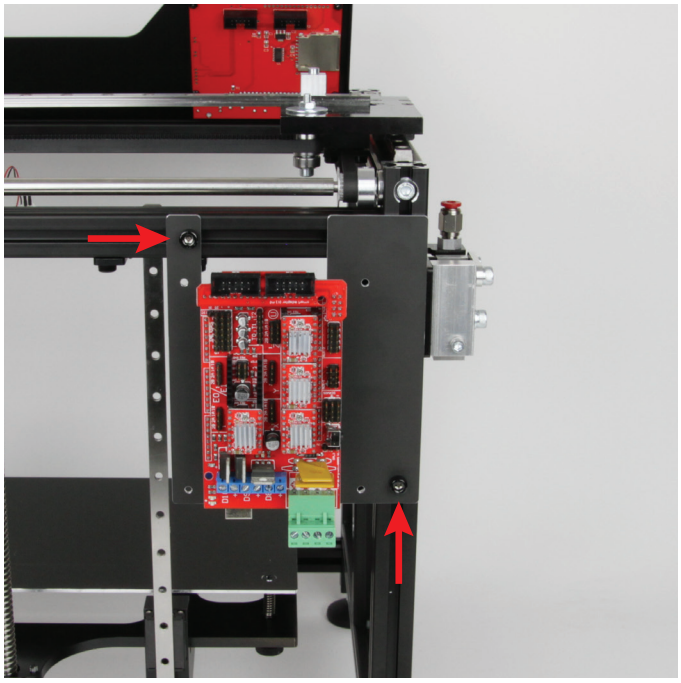


1x PCB holder with main PCB
4x cylinder head screw M5x8 black
2x slot nut M5



Push the 2 slot nuts into the groove of the upper aluminium profile and the left aluminium profile (viewed from the front) at the rear as shown in the figure. The threads must be aligned to the right or downwards as illustrated.
Hold the PCB holder against the slot nuts and align the two slot nuts with the bores in the PCB holder.

Assembly of the cooling bodies on the motor drivers

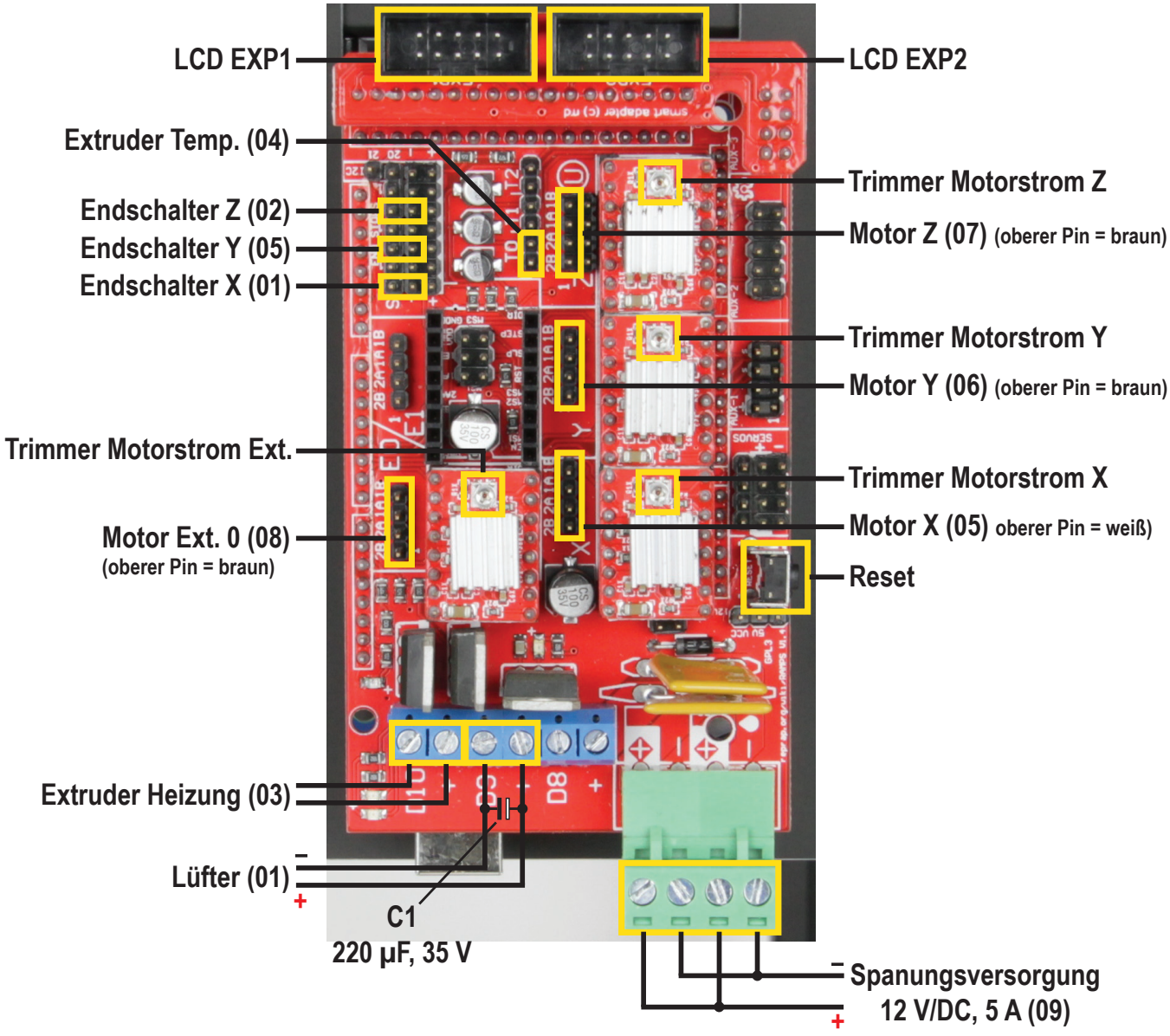


Attach the PCB holder to the two slot nuts placed before loosely with the two M5 cylinder-head screws.
Align the PCB holder with the outer edges of the two aluminium profiles. Tighten the cylinder-head screws.

b) Wiring of the Electrical Components

⟶ If you connect a cable to the main PCB, first check the correct connection in the following wiring diagram.

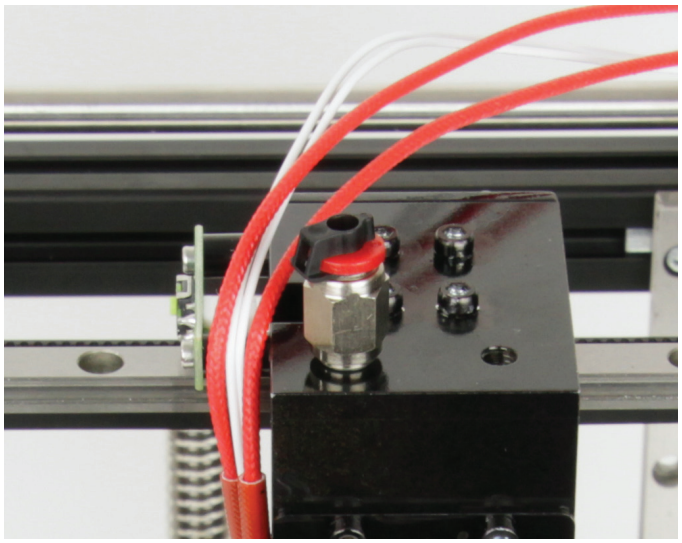
Connection plan of the main PCB



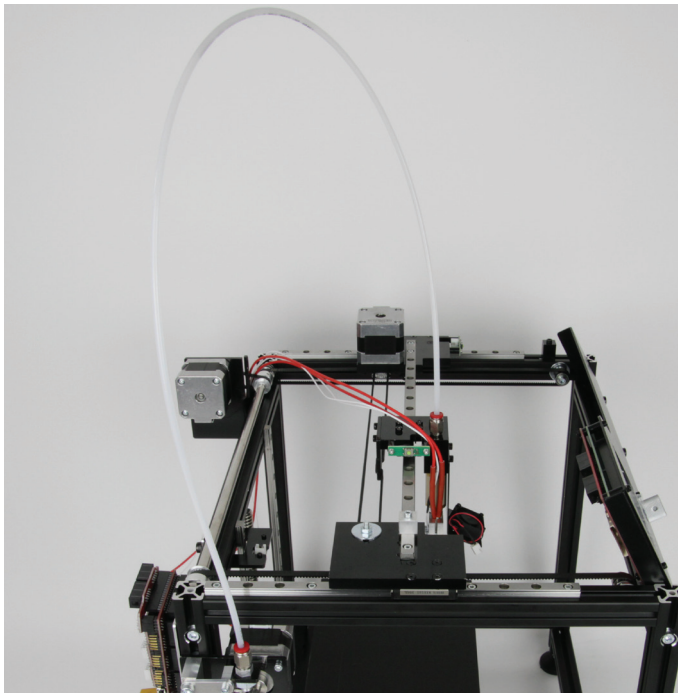
Line	Length	Connection Main PCB	Pin number of plugs (all pins on black plugs; colour based on pin1)	Component	Pin number of plugs (all pins on white plugs; colour based on pin1)
01	990 mm	D9	2pin brown/white, open	Extruder fan	2pin brown/white
		END STOPS	2pin yellow/green	Limit switch X direction	2pin yellow/green
02	220 mm	END STOPS	2pin white/brown	Limit switch Z-direction	2pin white/brown
03	920 mm	D10	2pin red, open ends	Heating cartridge extruder 0	2pin red, fixed
04	980 mm	T0	2pin white	Temperature sensor extruder 0	2pin white, fixed
05	890 mm	X	4pin yellow/brown/green/white	Motor X-direction	6pin white/brown/green/yellow
		END STOPS	2pin pink/grey	Limit switch Y-direction	2pin pink/grey
06	450 mm	Y	4pin yellow/white/green/brown	Motor Y-direction	6pin brown/white/green/yellow
07	500 mm	Z	4pin yellow/white/green/brown	Motor Z-direction	6pin yellow/green/white/brown
08	280 mm	E0	4pin yellow/white/green/brown	Motor extruder 0 (filament infeed)	6pin brown/white/green/yellow
09	85 mm	Green plug	2pin red/black, open	Jumper connection plug mains unit	2pin red/black, open

Wiring of the extruder carriage

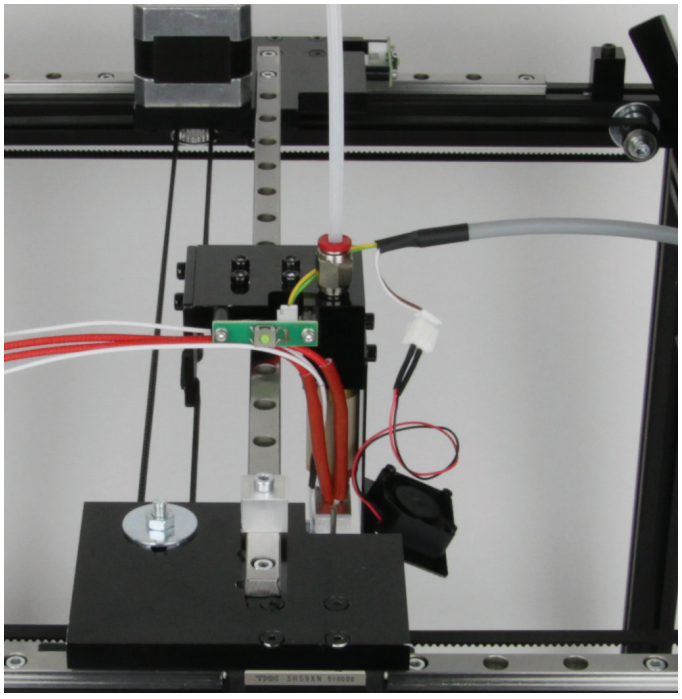
1x filament tube approx. 80 cm
1x cable 01 approx. 990 cm
2x clip for quick closure (tube protection)
1x Elko 220 µF, 25 V
1x spiral tube black



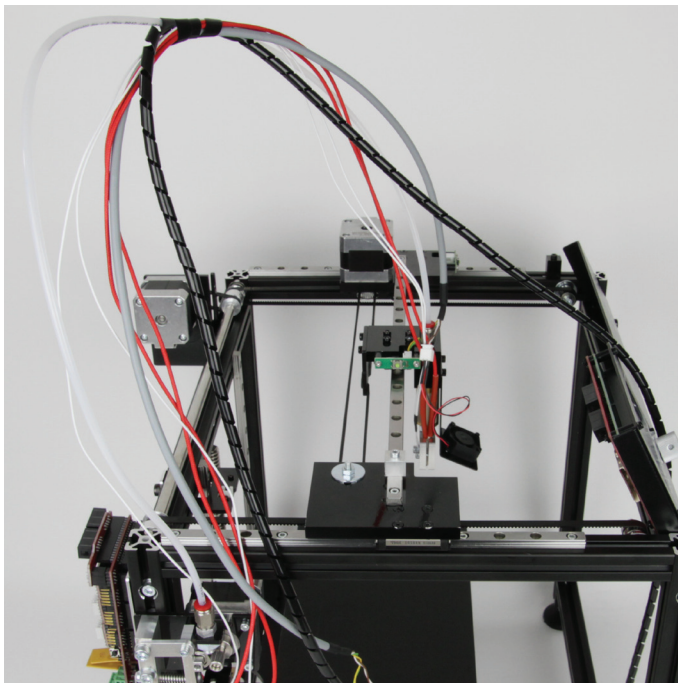
Optional: Push one clip each onto the quick-closure to additionally secure the filament tube.
Attention! You can only remove the tube when the clip is destroyed. This is of interest, e.g., for schools as well, since it prevents easy removal of the clip.
You can attach the clip to the extruder carriage at once if desired. Do this at the very end at the filament infeed unit, since the tube needs to be removed again.
Alternatively, you can print out an alternative circlip yourself. For this, the file "Sicherungsclip.stl" is included in the download bundle. This also improves the "Retract" behaviour (retracting the filament while printing).



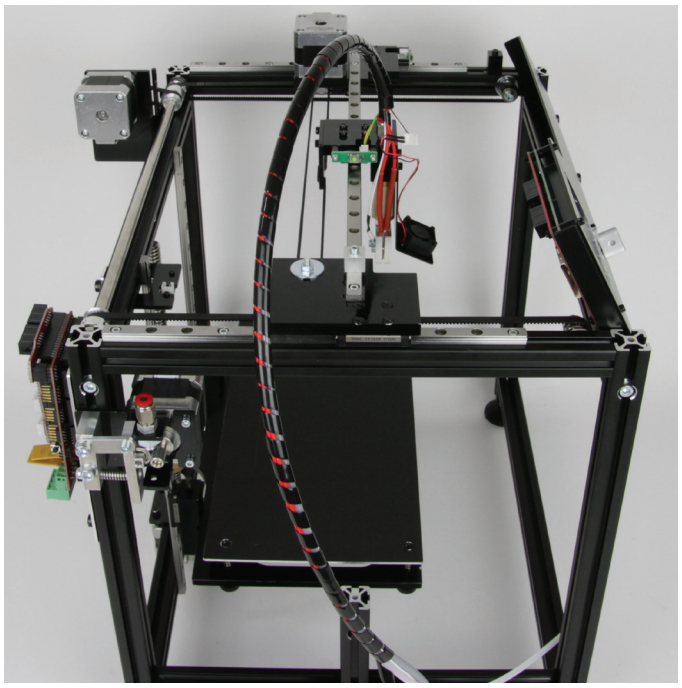
Push the filament tube into the quick closure of the extruder carriage and the filament infeed unit.



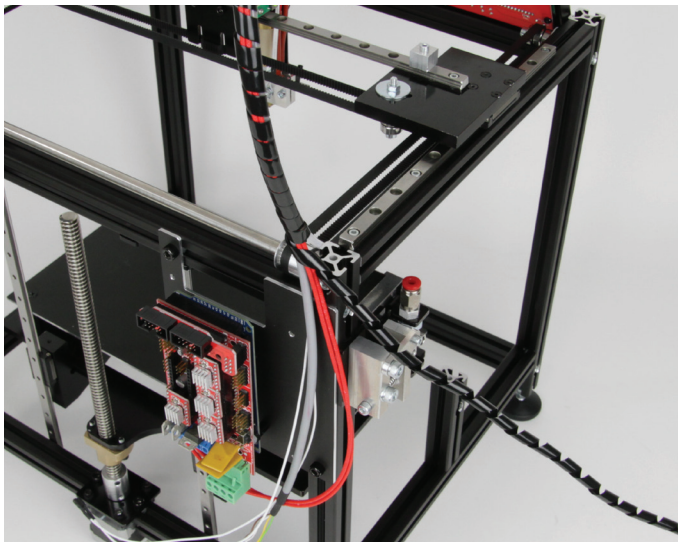
Connect the cable 01 at the extruder carriage.
Connect the plug with the yellow and green lines to the limit switch PCB; connect the plug with the brown and white lines to the fan.



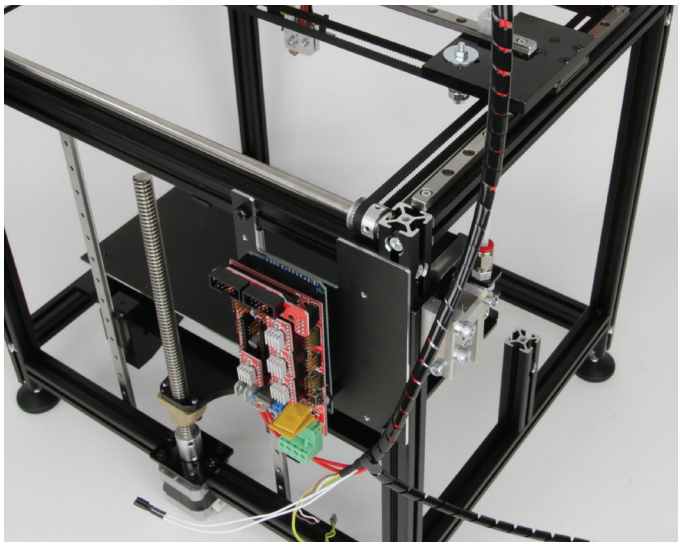
Take all lines of the extruder carriage (cable 01/lines of the heating cartridge, cable 03/lines of the temperature sensor, cable 04) and attach them to the filament tube with 2 to 4 windings of the spiral tube.
Then wind the spiral tube around the cables further in the direction of the extruder.
When you have wound a piece, tighten the spiral tube again by turning it tighter.



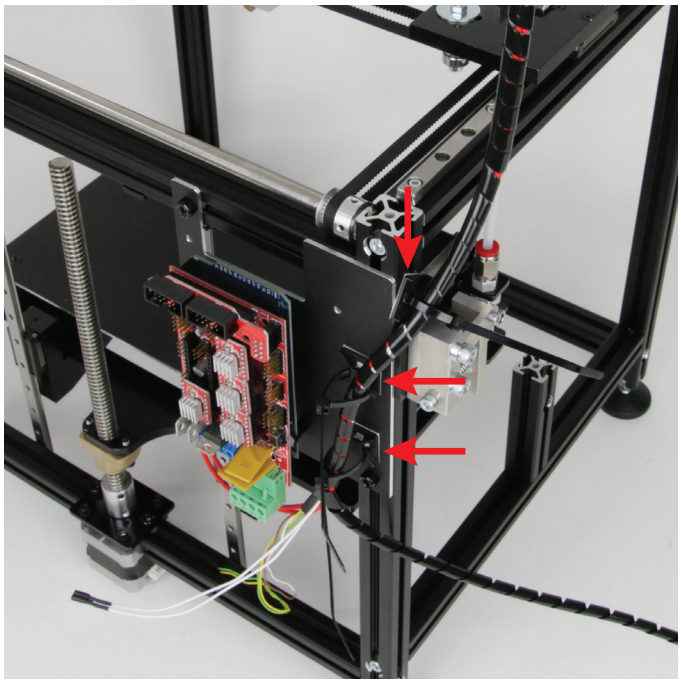
When you have reached the extruder, push the spiral tube in the direction of the filament infeed until the spiral tube has reached its end. Then wind in the direction filament infeed. It is recommended to release the filament tube again from the quick closure of the filament infeed (simply press the red plastic part) and to pull out the tube.



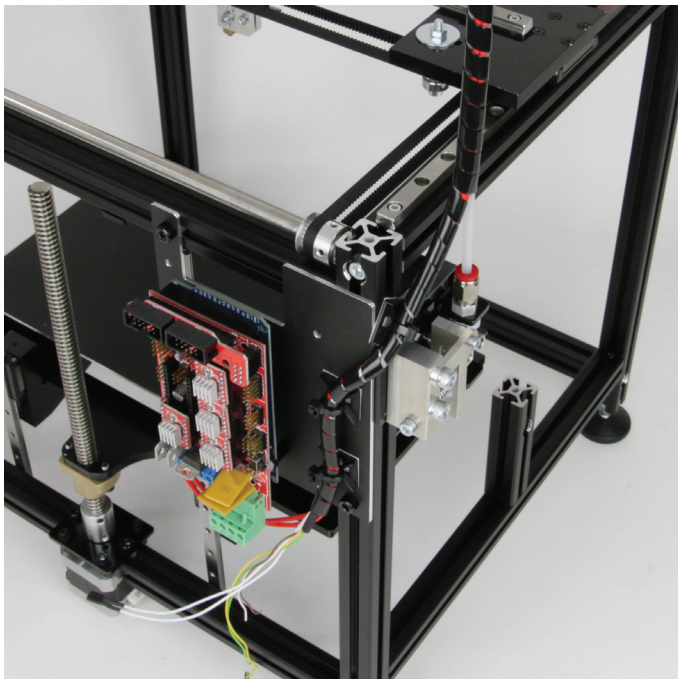
Continue winding in the filament infeed direction until the two red cables can be placed cleanly to the corresponding connection at the main PCB from the heating cartridge.
To test this, simply attach the cable strand to the aluminium profile as illustrated above.



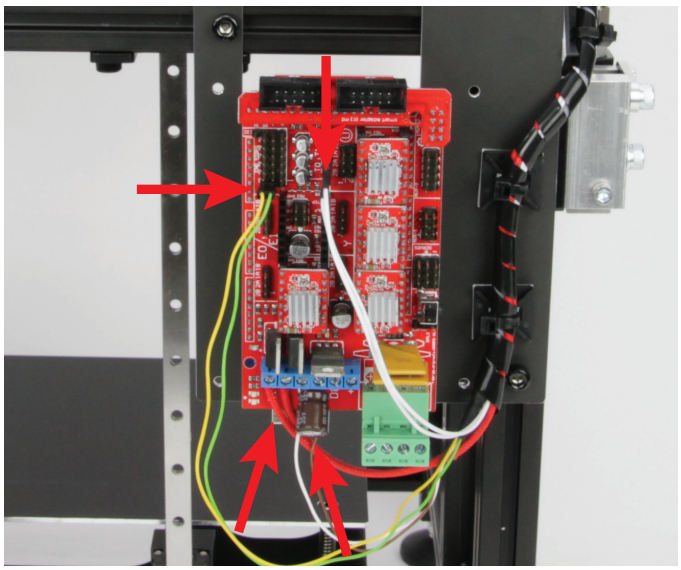
Now wind the spiral tube around the cables only, and not around the filament tube.
When you have reached the end of the outer insulation of cable 01, stop winding, tighten the spiral tube again and cut off the rest.
Connect the two red cables to the connection "**D10**" at the main PCB. The polarity is irrelevant for this.
Push the filament tube into the quick closure again.



Take 3 adhesive sockets and glue them to the printer as illustrated. Degrease the adhesive areas first.
Take 3 cable ties (142 mm) and fasten the cable strand loosely to the adhesive sockets with them.
If the cable is too tense then, you may need to cut off a piece of the filament tube so that the cables can be placed cleanly (see next figure). Cut off only a small piece at a time!



When the length is correct, tighten the cable ties at the cable strand. Now secure the cable of the fan with the short cable tie (99 mm) to the cable of the X limit switch at the extruder holder.

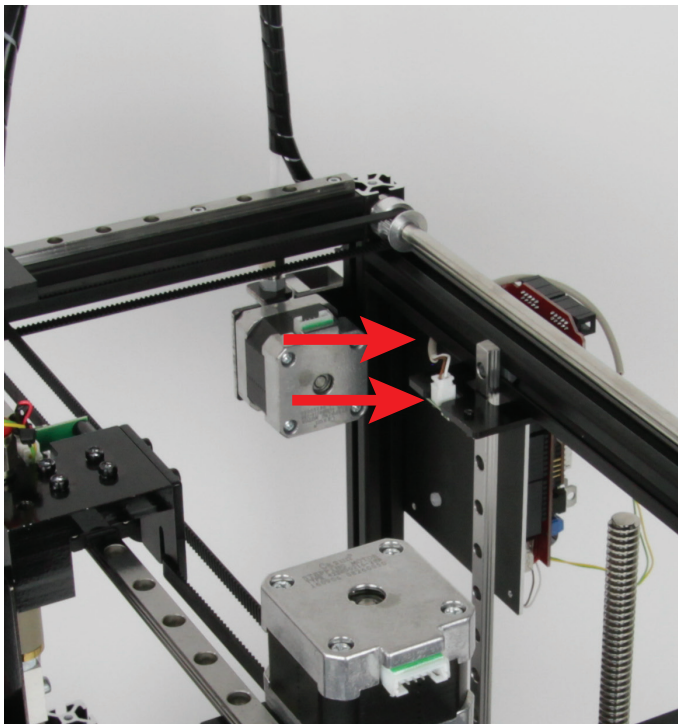


Now connect the other lines to the main PCB.
Connect the two open lines of the fan, brown and white, to the connection "**D9**". The brown line is plus/+! The elco must be connected in parallel as well here. Ensure correct polarity! The minus pole at the elco is marked with a white dash. This side must go into the terminal where the white line of the fan connected.

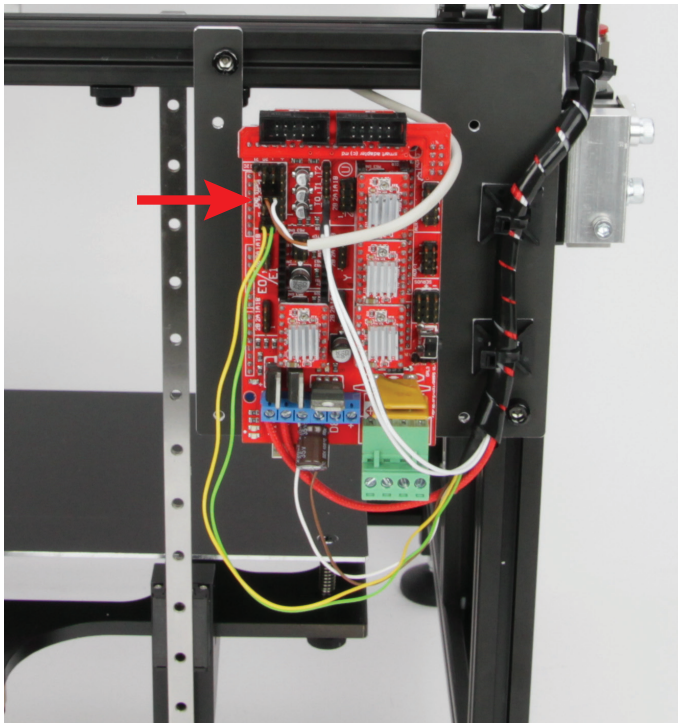
Connect the plug to the connection "**T0**" of the main PCB with the two white lines of the temperature sensor (cable 03). The polarity is irrelevant for this.
Connect the cable with the yellow and green line to the two pins that are marked with "**Limit switch X**" in the connection plan. The polarity does not matter in this cable either.

Connection of the Z limit switch

1x cable 02 approx. 220 mm



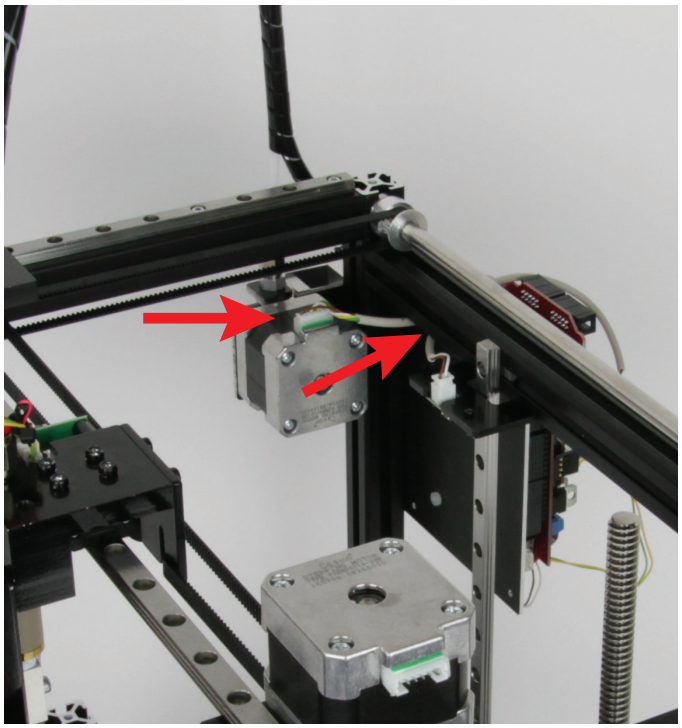
Connect cable 02 to the connection plug of the Z-limit switch PCB and place it through the cut-out of the main PCB.



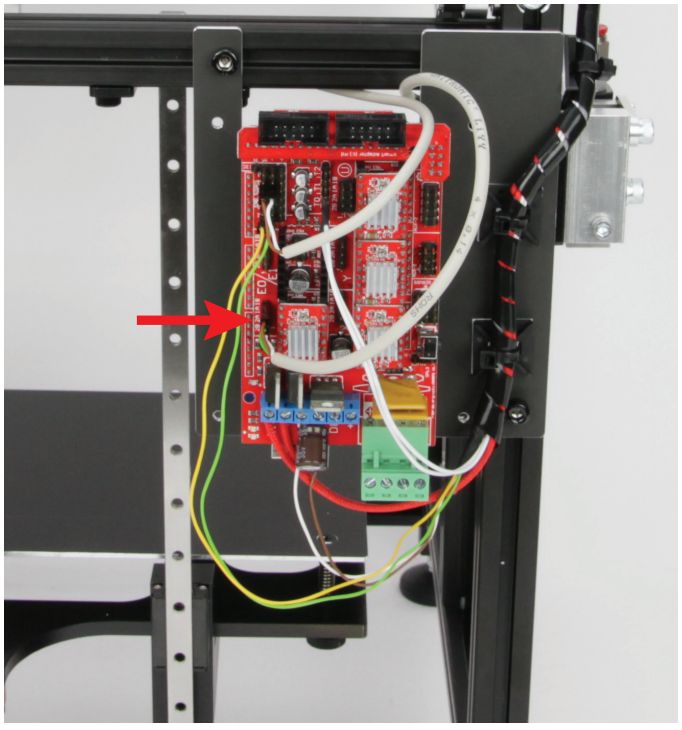
Connect the other end to the two pins that are marked "**limit switch Z**" in the connection plan. The polarity does not matter in this cable either.

Connection of the motor for filament infeed

1x cable 08 approx. 280 mm



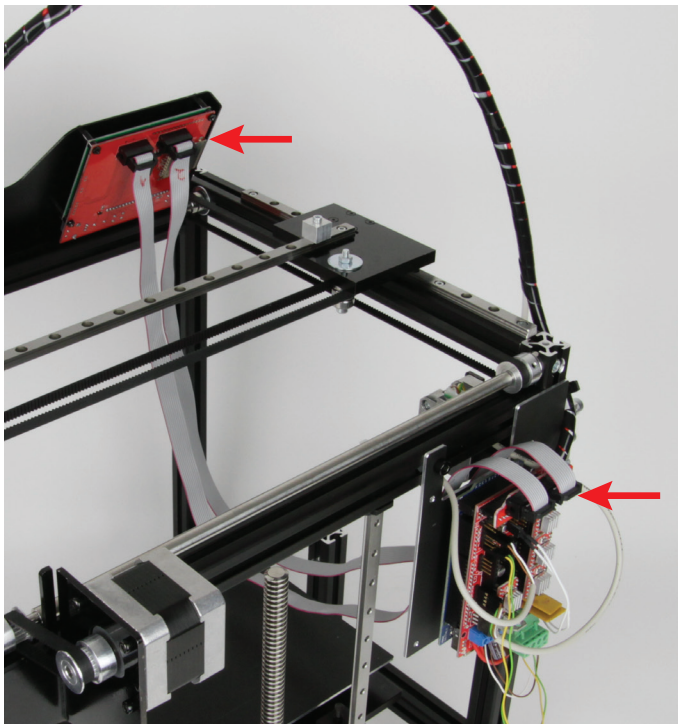
Connect cable 08 to the connection plug of the motor for the extruder and place it through the cut-out of the main PCB.



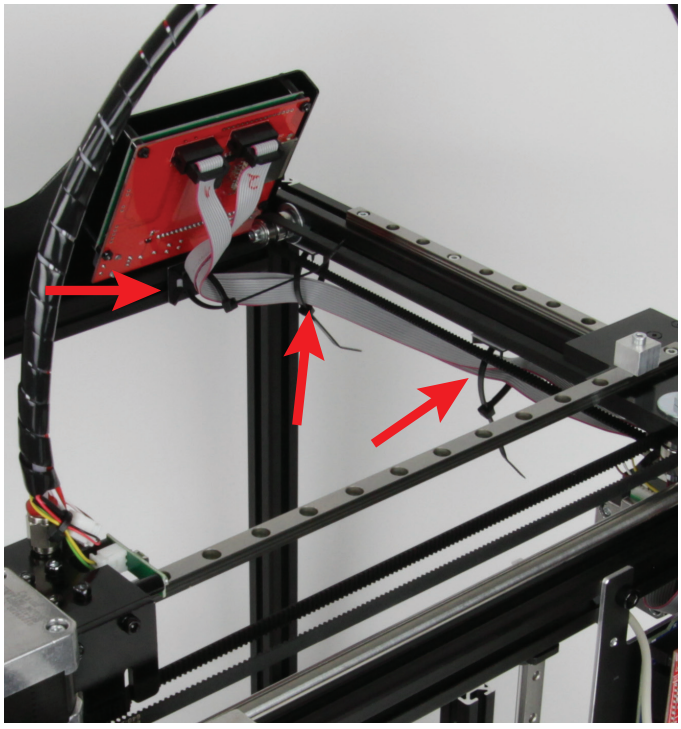
Connect the other end to the connection "**Motor ext. 0**" (see connection plan). The pin with the brown line must be at the top as shown in our figure and marked in the connection plan.

Connection of the display

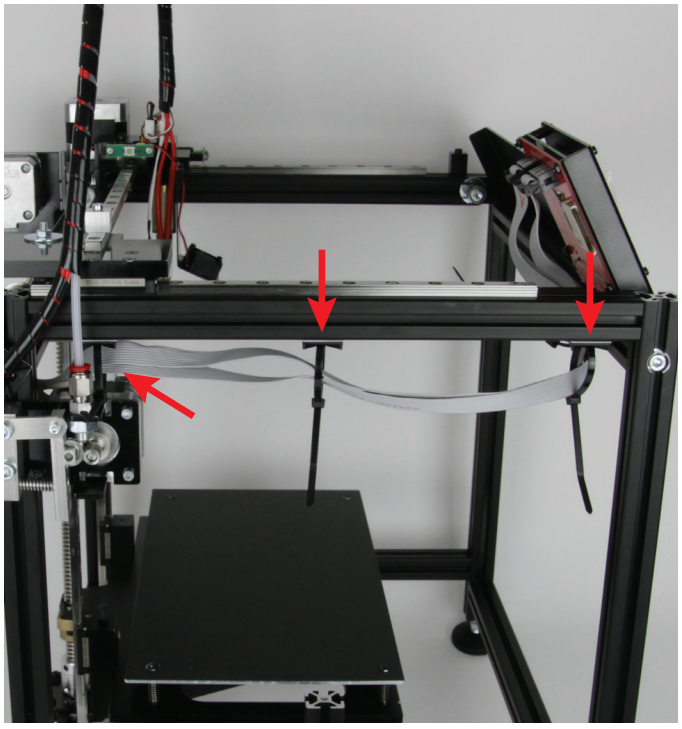
2x flat cables (both identical)



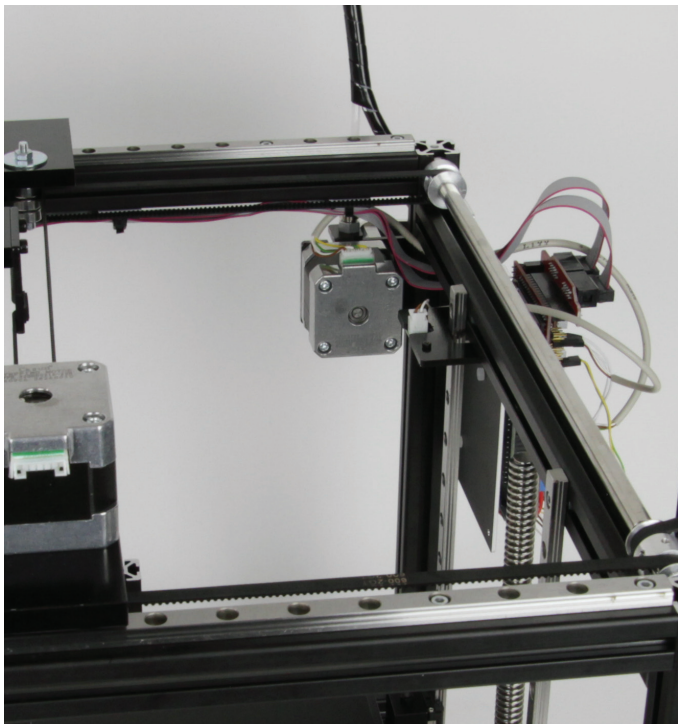
Connect the first cable to the connection "**EXP2**" at the display and the main PCB each. From the view illustrated, the cable must go into the respective right connection plug.
Then connect the other cable to the respective connection "**EXP1**" (the respective left plug).



Take the 4 adhesive sockets and 4 cable ties (142 mm) and fasten the two cables as illustrated in these two figures.

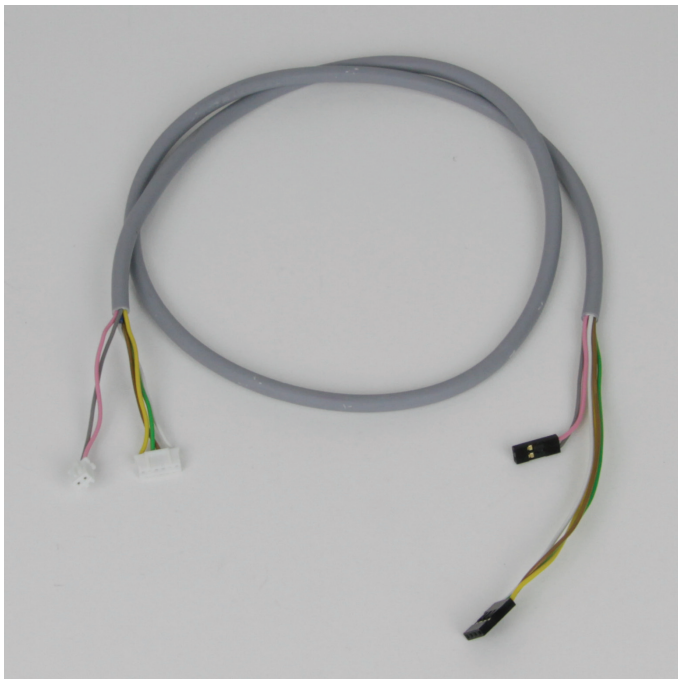


Degrease the adhesive areas first.

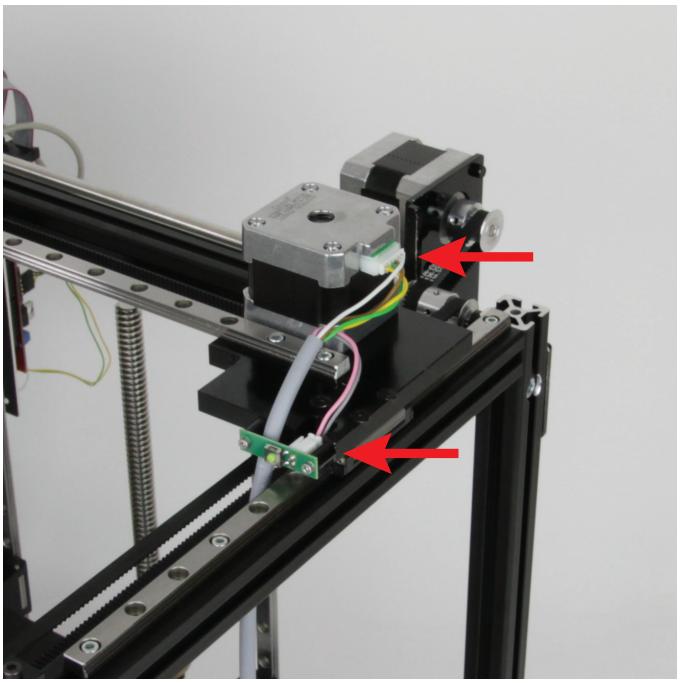


Finally, fasten the cable ties in sequence.

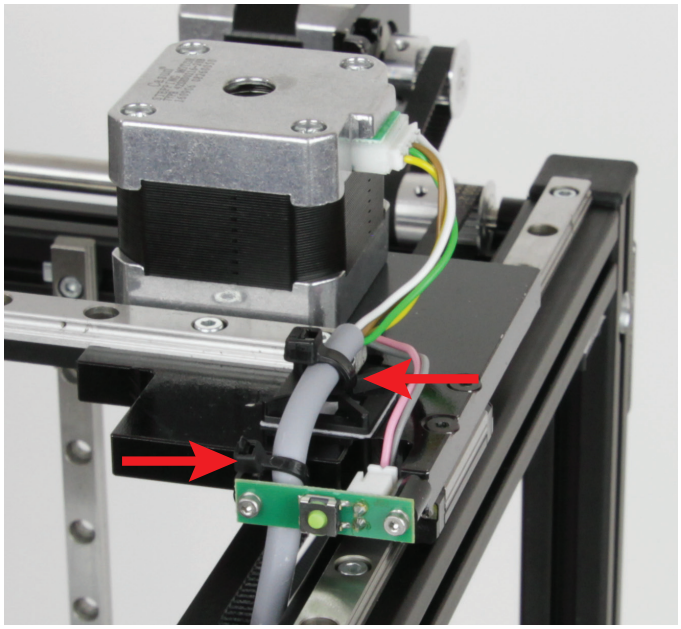
Connection of the motor for the X-direction and the Y-limit switch



1x cable 05 approx. 890 mm

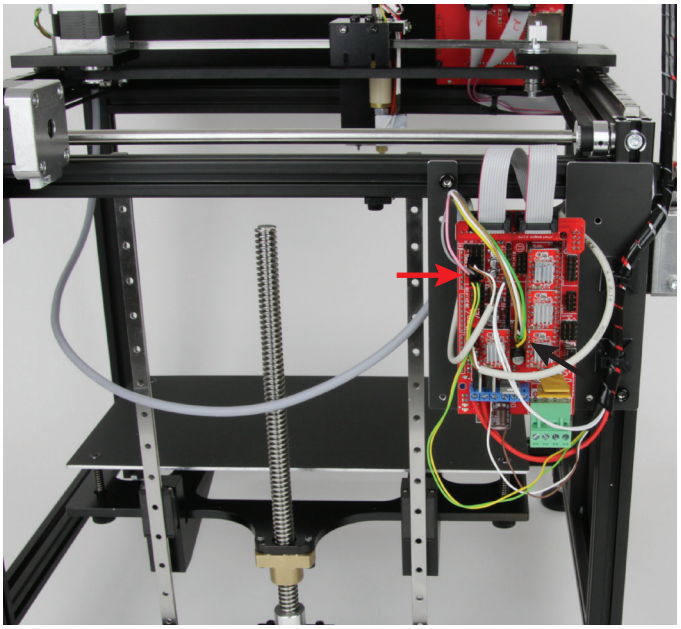


Thread the cable through between the aluminium profile and the toothed belt from below and then past the limit switch PCB at the rear. Connect the 6-pin plug to the X-motor and the 2pin one to the Y-limit switch.

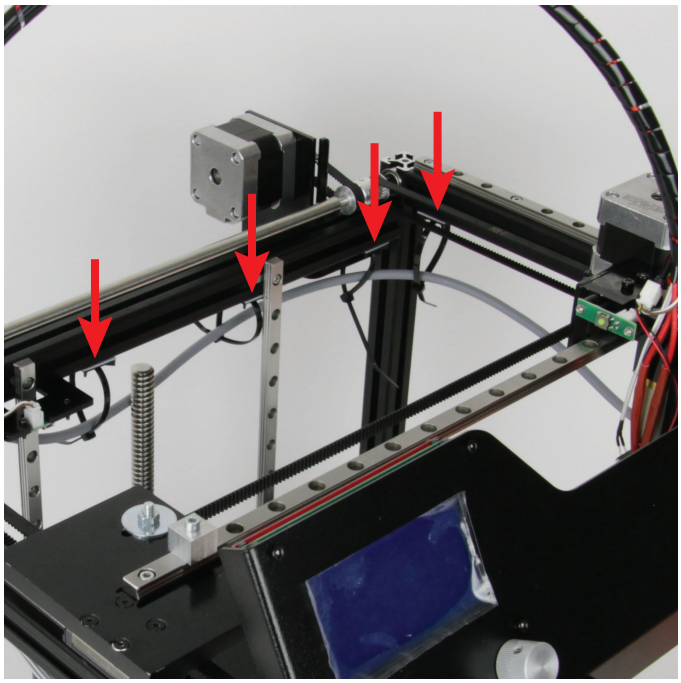


Take 1 adhesive socket, 1 cable tie (142 mm) and 1 cable tie (99 mm). Fasten the cable with the adhesive socket and the long cable tie as illustrated. Use the small cable tie to fasten the cable to the left spacer of the limit switch.
Degrease the adhesive area first.

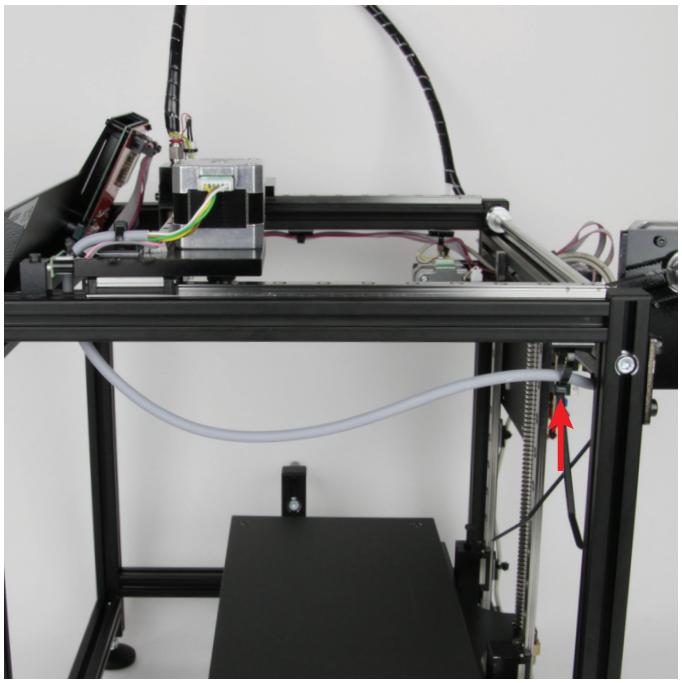
Then move the Y-axis forward in the direction of the display.



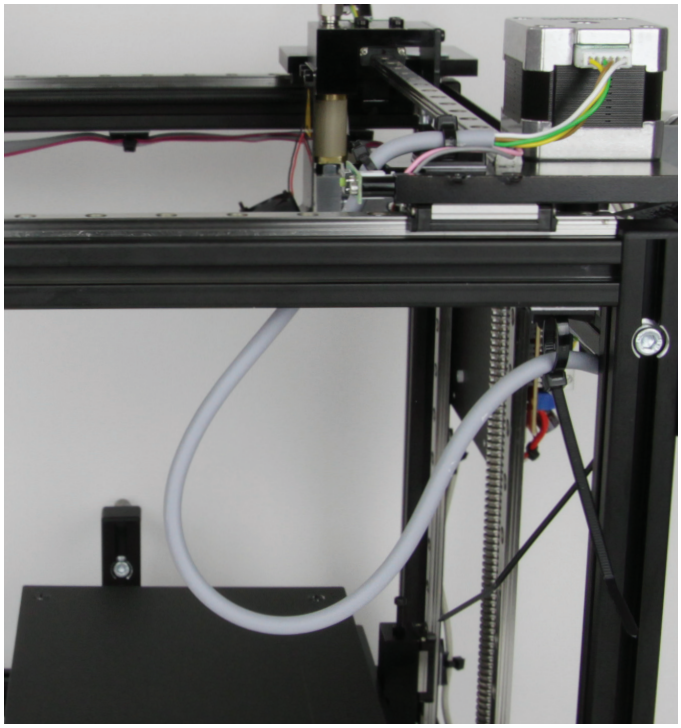
Place the cable behind the guide rails and thread it through the cut-out at the top near the main PCB from the inside.
Connect the 4pin plug to the connection marked in the connection plan with "**Motor X**". The pin with the white line must be at the top.
Connect the 2pin plug to the connection marked "**limit switch Y**" in the connection plan. The polarity is irrelevant for this.



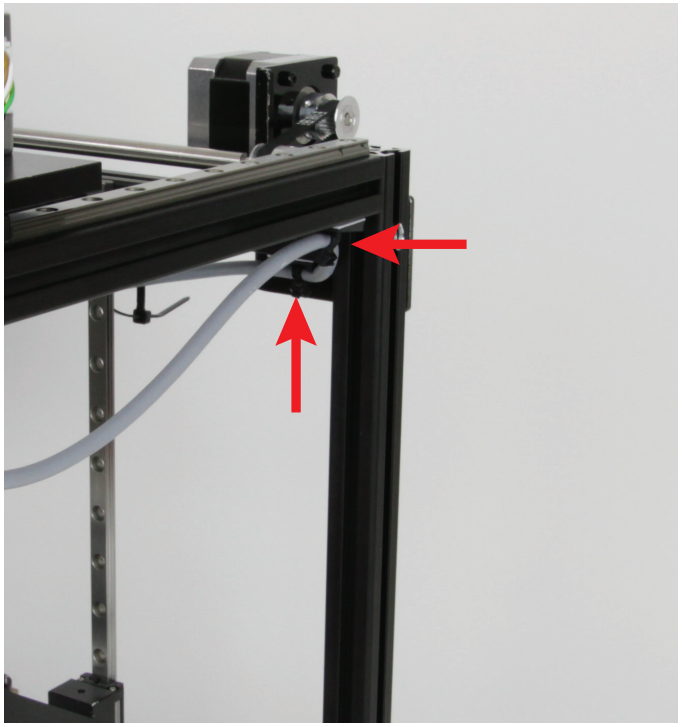
Take the 4 adhesive sockets and 4 cable ties (142 mm) and fasten the cable as illustrated in it and the right figure. Do not tighten the cable ties yet.
Degrease the adhesive areas first.



Pull the cable tie almost all the way together at the arrow so that the cable can barely be moved anymore.
Additionally hold the cable in this place and move the carriage backwards in the Y-direction.

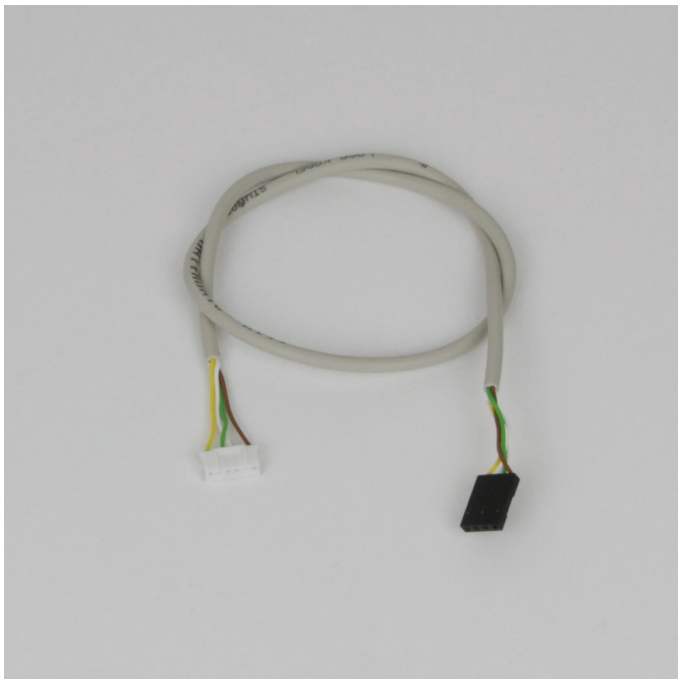


If a good loop forms as in the figure, hold the cable in that position. Otherwise, you will have to turn the cable a little more.

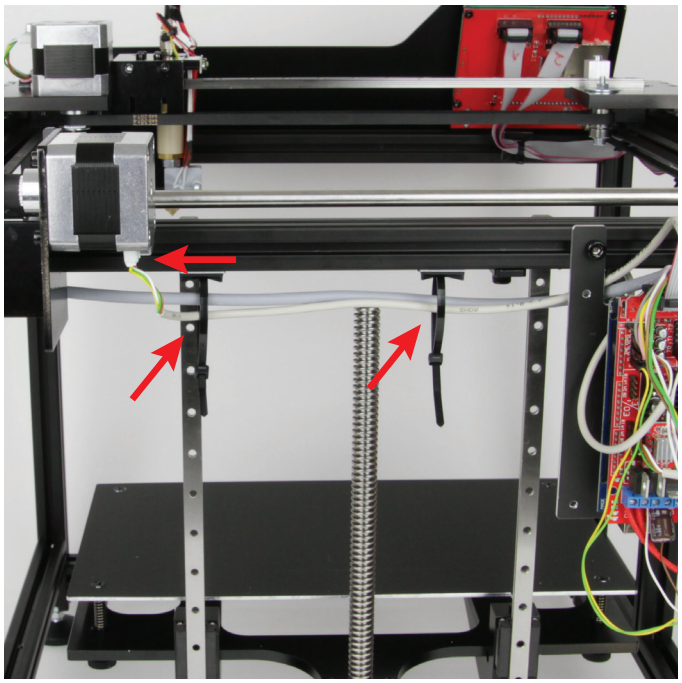


When the loop fits, tighten the two cable ties (see arrow).
Important! Leave the two other cable ties to the left open since a cable needs to be fed through here still.

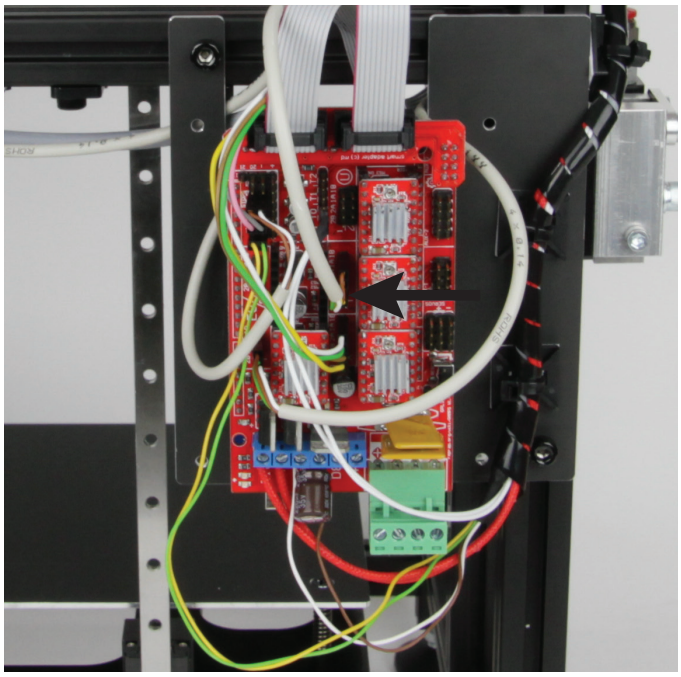
Connection of the motor for the Y-direction



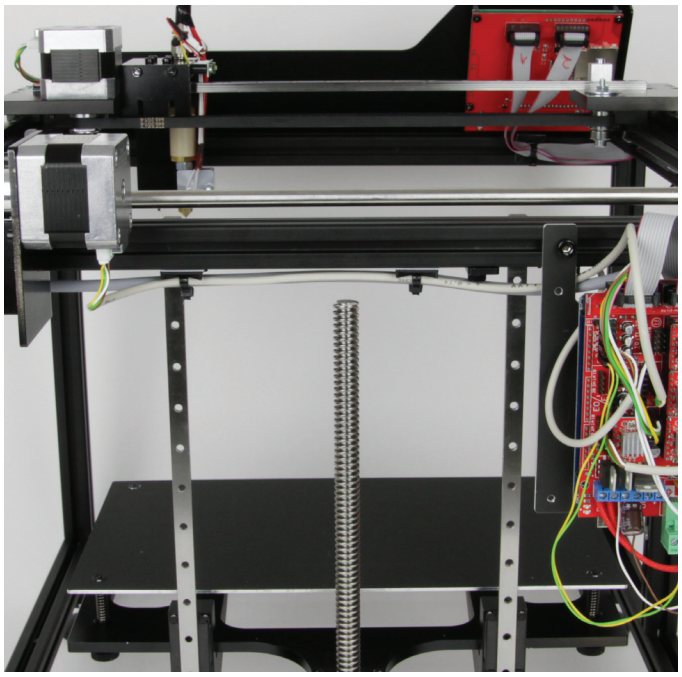
1x cable 06 approx. 450 mm
Do not swap the cable with cable 07, since it is only 50 mm longer and almost identically assigned.



Connect the 6pin plug to the Y-motor.
Thread the cable through the two open cable ties and then past behind the limit switch PCB.



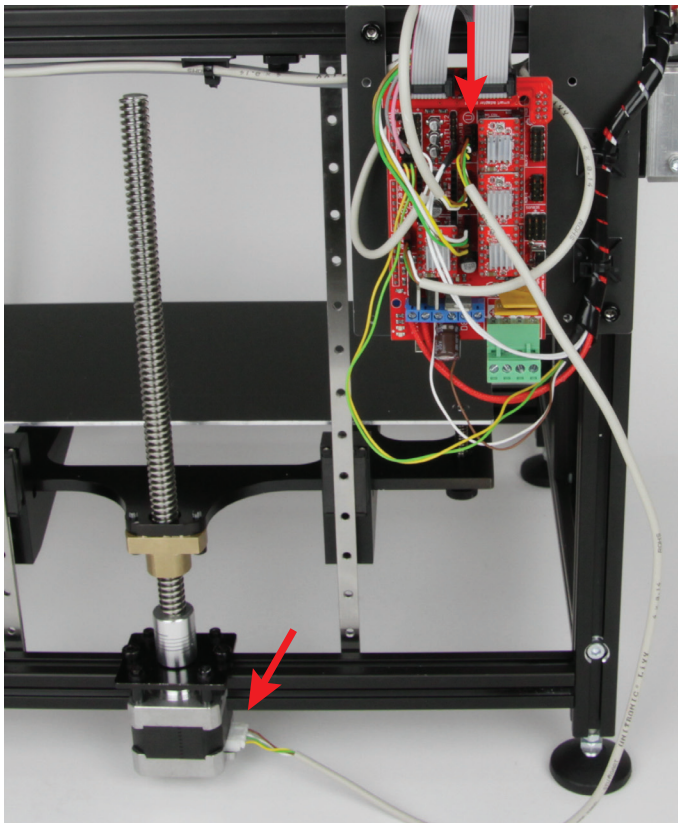
Connect the 4pin plug to the connection marked in the connection plan with "**Motor Y**". The pin with the brown line must be at the top.



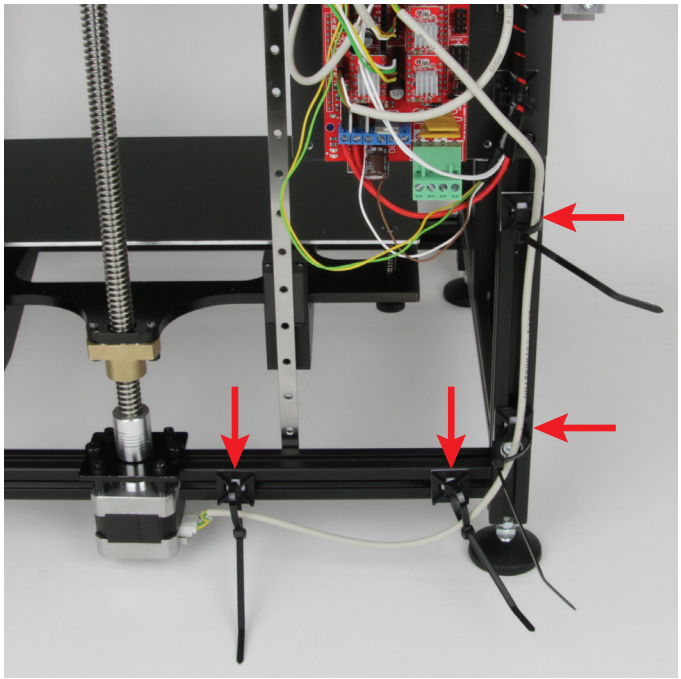
Place both cables cleanly and tighten the two cable ties.

Connection of the motor for the Z-direction

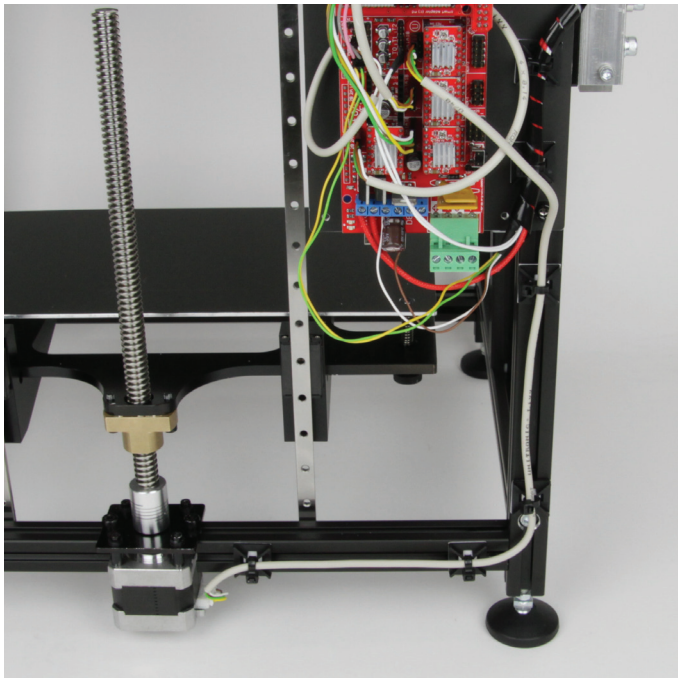
1x cable 07 approx. 500 mm
Do not swap the cable with cable 06, since it is only 50 mm shorter and almost identically assigned.



Connect the 6pin plug to the Z-motor.
Connect the 4pin plug to the connection marked in the connection plan with "**Motor Z**". The pin with the brown line must be at the top.

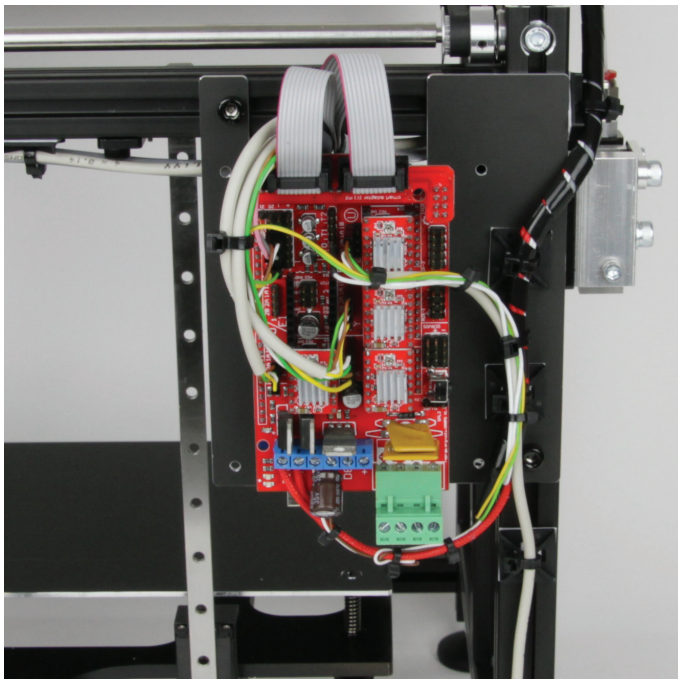


Take the 4 adhesive sockets and 4 cable ties (142 mm) and fasten the cable as illustrated.
Degrease the adhesive areas first.



Place the cable cleanly and tighten the 4 cable ties.

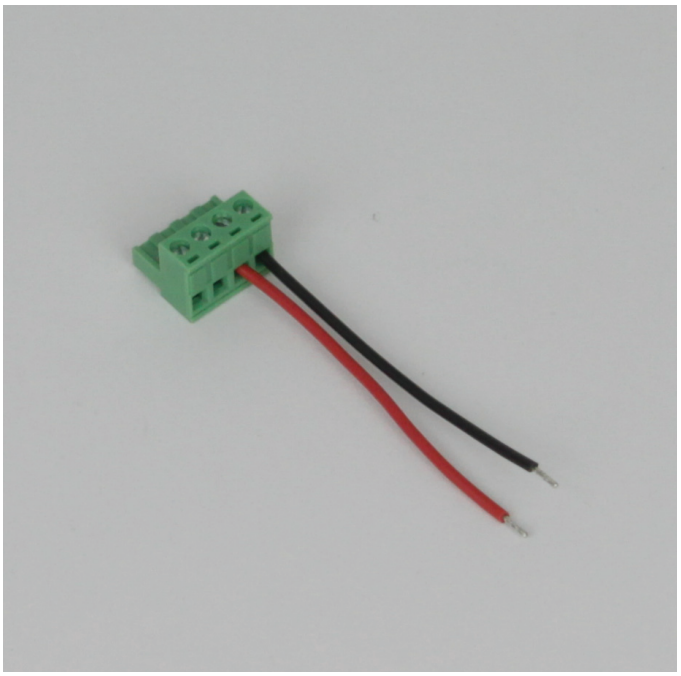
Attachment of the cables to the main PCB



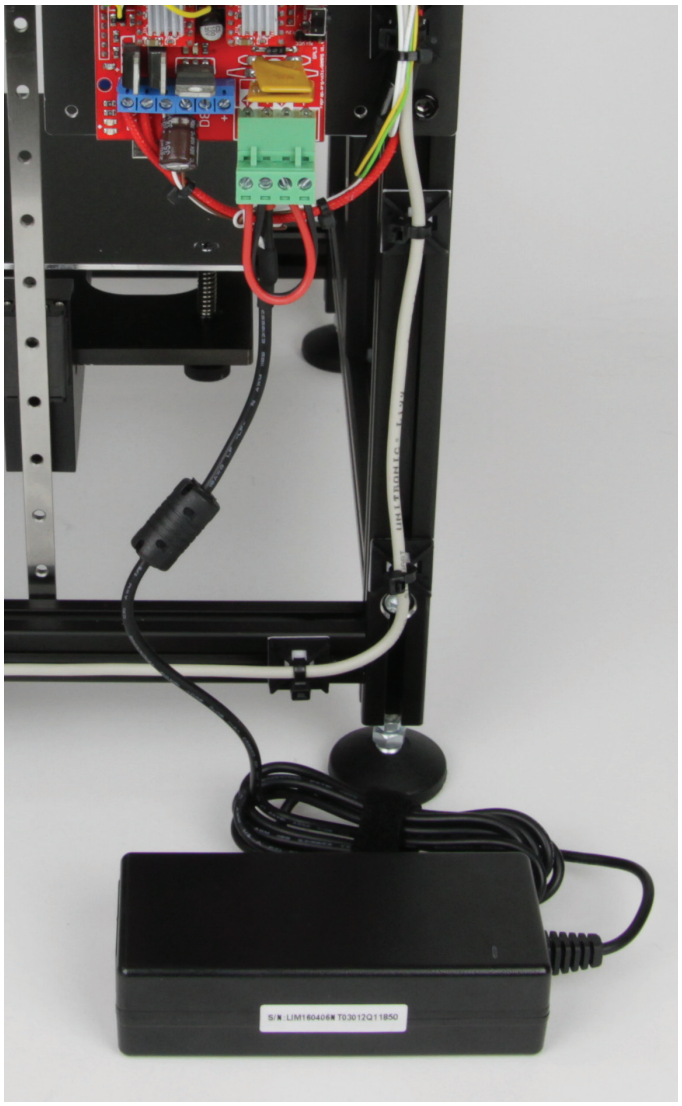
Place and fasten the cables at the main PCB.
Take long cable ties (142 mm) for the thicker cable strands and the short cable ties (99 mm) for the thinner cable strands.

Assembly of the connection plug for the mains unit

1x mains unit
1x cable 09 approx. 85 mm (2 lines; 1x red; 1x black)
1x connection plug from the main PCB (green)



Connect the two lines of cable 09 to the connection plug of the main PCB.
The black line goes into the terminal at the far right, the red one into the terminal to the left of it.



The white line of the mains unit is plus, the black one minus.
Now connect the white line of the mains unit and the red line to the left terminal of the plug.
The black line from the mains unit and the other black line go into the terminal to the right of this.

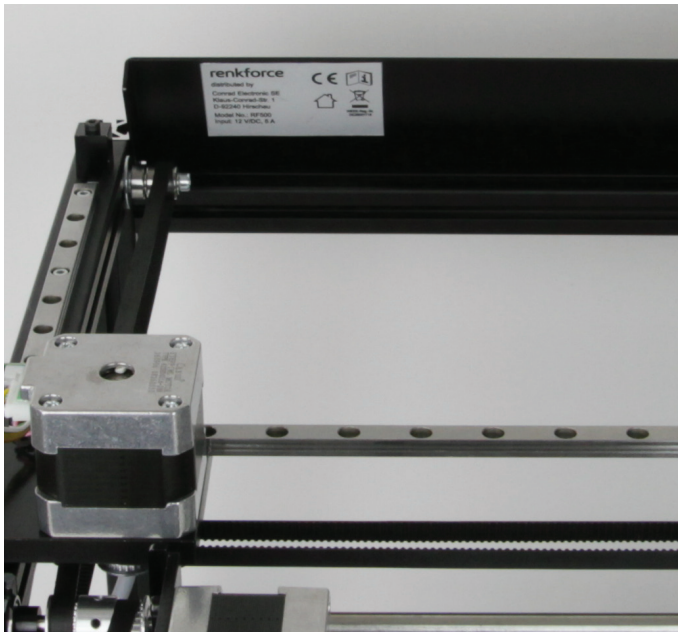
Reconnect the plug with the mains unit to the main PCB.

Of course, you can remove the plug again for further work until commissioning.

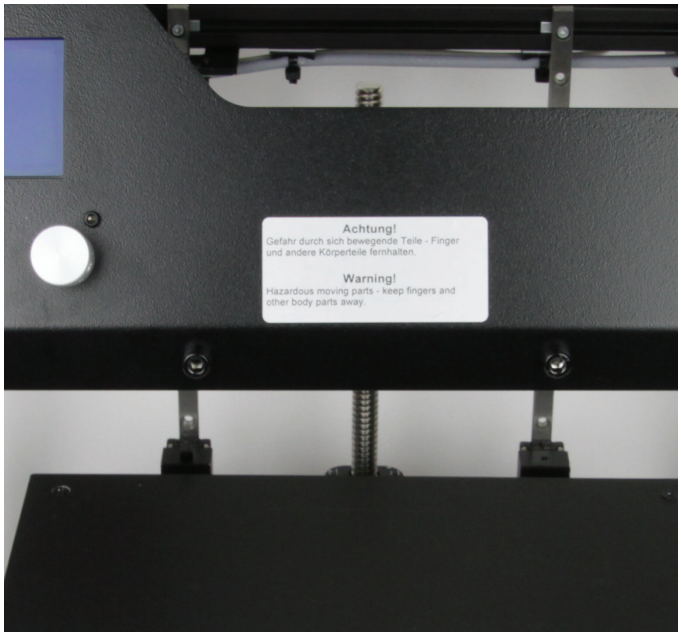
12. Final Work

⟶ This chapter ("12. Final Work") generally is only relevant for purchasers of the maker construction kit. Owners of the preassembled device can skip this chapter.

Gluing on the rating plate and warning signs

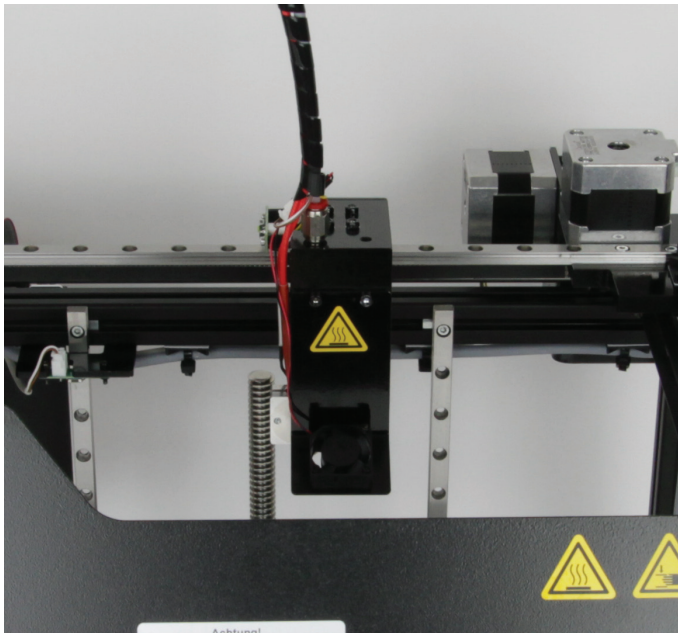


Attach the rating plate to the front cover from behind, as illustrated.
Degrease the adhesive area first.



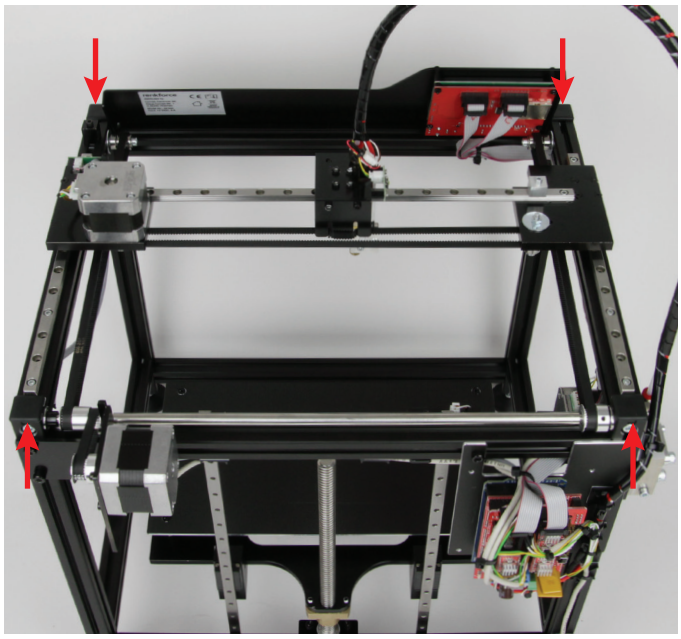
Attach the silver warning text sign well visibly to the middle of the front cover as illustrated.
Degrease the adhesive area first.

Attach the 3 yellow warning sign stickers "Hot surface", "Danger of hand injury" and "Danger of crushing" well visibly to the front cover above the "RF500" script.
Degrease the adhesive areas first.

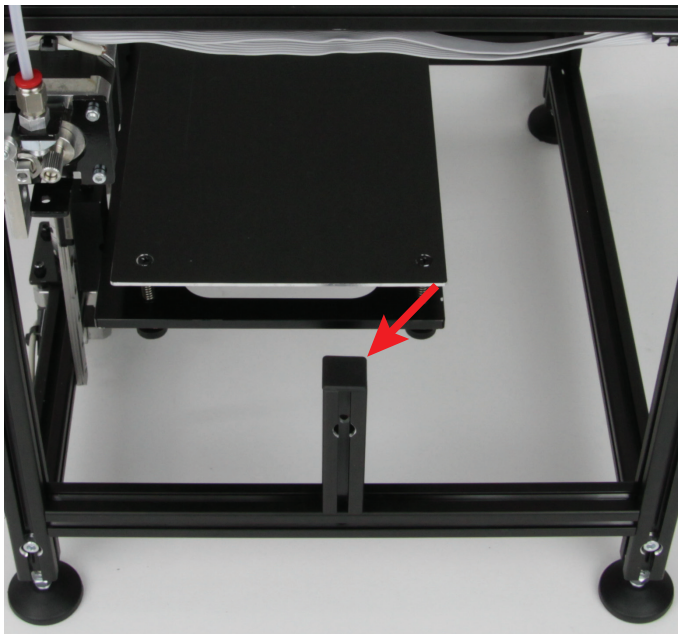


Attach the additional warning sign sticker "Hot surface" to the fan sheet of the extruder carriage.
Degrease the adhesive area first as well.

Attaching the end caps



Push one end cap each onto all four vertical aluminium profiles. If you cannot push them in manually, use a hammer and a suitable extension with a flat, supported surface.

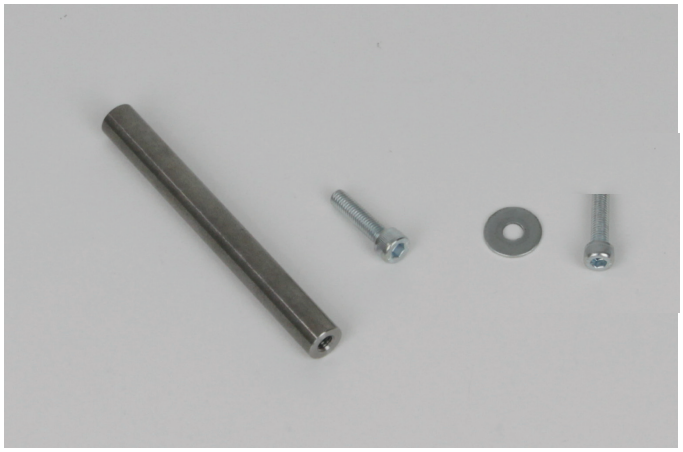


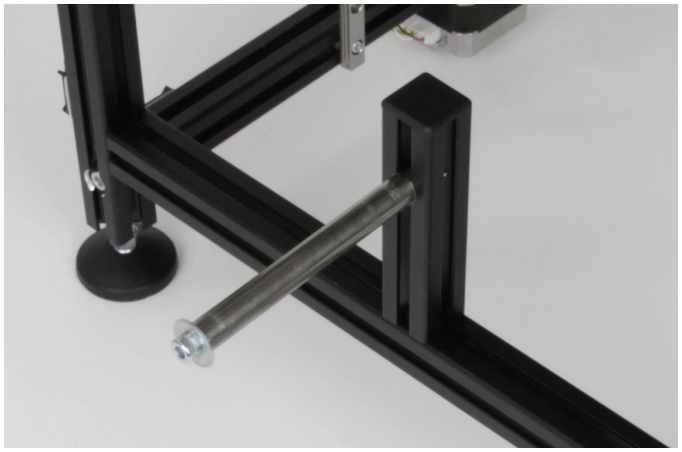
Push the fifth end cap onto the aluminium profile of the filament holder.

→ **If you purchased the kit, including the metal housing, install now the remaining parts of the housing. Please refer to the additional accessory instructions.**

13. Initial Commissioning

a) Assembly of the filament holder



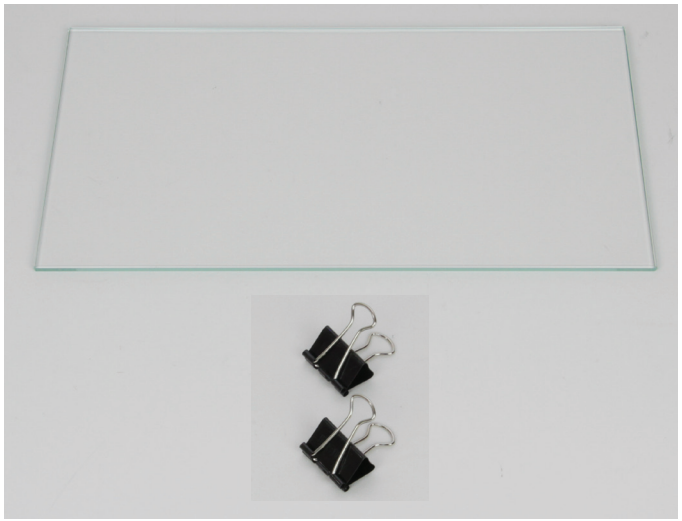


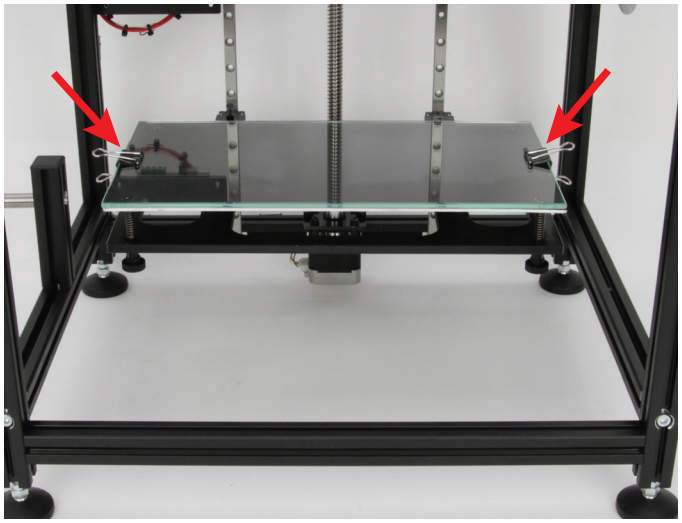
1x filament holder
1x cylinder head screw M5x20
1x washer M5 (Ø outside 15 mm)
1x cylinder head screw M5x16

Attach the filament holder to the short aluminium profile from the inside with the cylinder-head screw M5x20.
Attach the washer to the outside of the filament holder with the other cylinder-head screw.
Please note! The figure shows the construction kit. The short profile is covered by the housing in the preassembled device. Install the filament holder in the corresponding opening from the outside here.

b) Preparing and Assembling the Printing Plate Support

⟶ This sub-chapter is only relevant for buyers of the maker construction kits, since the preassembled device does not include a printing plate support of glass, but an aluminium printing plate that is already installed. Owners of the preassembled device can therefore skip this chapter.





1x printing plate support (single-pane safety glass)
2x holding brackets
1x adhesive film (size approx. like printing plate support) (not illustrated)

If you want to use the adhesive film from the delivery, stick it onto the printing plate support without bubbles.
Degrease the glass panel first.
Cut off protruding edges.

Put the glass panel onto the printing plate and attach it with the two holding brackets.
If you want to use the width of the entire printing space, do not push the holding brackets onto the printing plate entirely but only attach them at the outer-most edge. Otherwise, it is possible that the extruder nozzle catches on them. Caution is required when moving to the X and Y home positions as well when the Z-axis is already in its home position.
Wipe off the printing plate first if necessary.

c) Setup and Transport

When setting up the 3D printer, observe that the mains unit and the mains cable must be easy to reach so that the device can be switched off quickly and easily or be disconnected from the voltage supply in case of malfunction.

Ensure proper ventilation when setting up the device. Do not put the device down on soft support such as a carpet or bed, etc. the air circulation also must not be impaired by other objects. This prevents heat dissipation from the product and may lead to overheating (danger of fire).

When setting up the device, make sure that it has a stable footing and place it on a stable underground. Persons may be injured if the 3D printer drops.

When setting up the device, make sure that the connection cables are neither pinched nor damaged by sharp edges.

Always place the cables so that no one can trip over them or be caught in them. There is a danger of injury.

⟶ Never place the device on any valuable or sensitive furniture surfaces without sufficient protection.

- Put up the 3D printer on a level, stable and non-vibration-sensitive surface.
- If you want to transport the 3D-printer, disconnect the mains unit from the main PCB, by disconnecting the green plug (first disconnect the mains unit from the mains).

  Also remove the printing plate support (only in the construction kit).

⟶ Only use suitable packaging for dispatch! Particularly observe that all moving parts are secured, e.g. with cable ties!

Pack the printing plate support separately in bubble wrap (construction kit only).

We assume no liability for any transport damage caused by improper packaging of the printer!

d) Mains Connection and First Activation

The mains socket to which the mains unit of the 3D printer is connected must be close to the device and easily accessible to quickly separate the device from the mains voltage in case of an error.

Before plugging in the mains plug, ensure that the device voltage indicated at the mains unit corresponds to the available mains voltage. Do not connect the device if the indication does not correspond to the available mains voltage. Incorrect supply voltage may lead to irreparable damage to the mains unit, 3D printer and danger to the user.

Always disconnect the mains unit from the voltage supply first (pull the mains cable from the mains socket) before disconnecting or connecting the green connection plug from/to the main PCB!

⟶ If the motors are moved manually, the display may light up. This is not a malfunction. A voltage induced by the movement in the motors causes the display to light up.

- Connect the green connection plug correctly to the main PCB.
- Plug the mains plug of the mains adapter into a protective contact socket.
- Some LEDs will light up on the main PCB and the display will light up. If firmware is installed already, you will briefly see the welcome screen and the installed firmware; then the main menu appears.

⟶ If the display shows nothing and firmware has already been installed, the display contrast may need to be adjusted. There is a small hole in the display holder for this between the attachment screw at the lower left and the manufacturer's logo. You can turn it with a small flat-head screwdriver to adjust the display contrast.

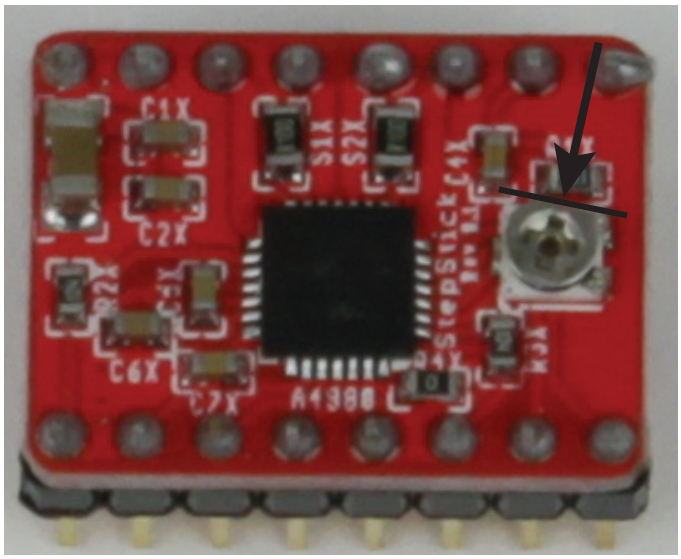
Before continuing with commissioning, check if new software or firmware is available. On this, observe chapter "8. Installation of the Software and Firmware" or "20. Firmware Update".

e) Adjustment of the Motor Driver

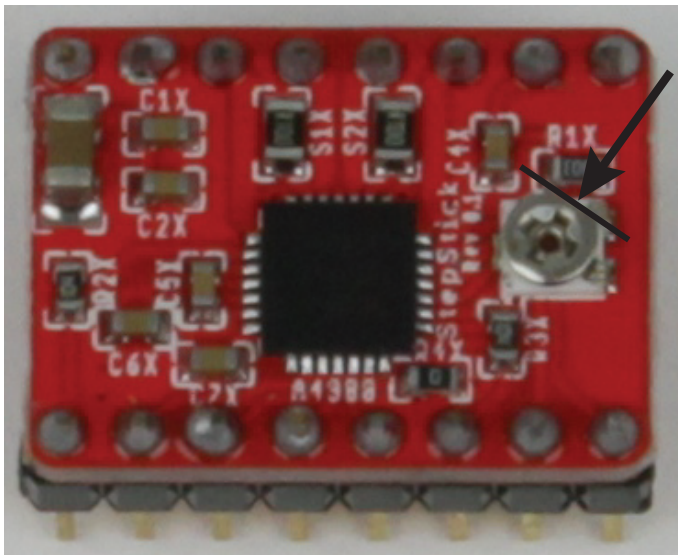
→ Before first use of the printer, the 4 motor drivers must be reconciled. This is done generally at first by comparing the potentiometer on your controller to the respective screen. Finally, the fine settings are made with a digital multimeter. This should be able to measure 300 mV and 500 mV as precisely as possible.

This subchapter is only relevant for purchasers of the maker construction kit, since the motor drivers in the preassembled device have already been reconciled in production. Owners of the preassembled device can therefore skip this chapter. It is, however also possible that the motor drivers need to be adjusted later.

General setting of the motor driver

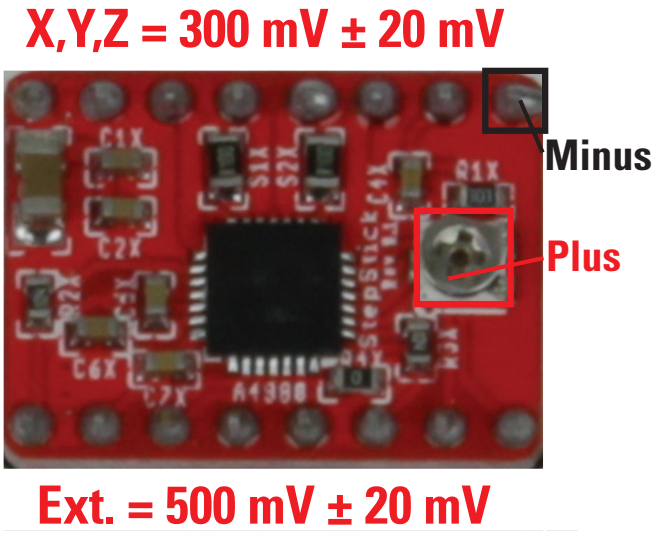


Generally adjust the potentiometers of the motor drivers for X, Y and Z, as illustrated.
Use the flattened side of the potentiometer (black bar) for reference.



Generally adjust the potentiometer of the motor driver for the infeed motor as illustrated.
Use the flattened side of the potentiometer (black bar) for reference.

Fine setting of the motor driver

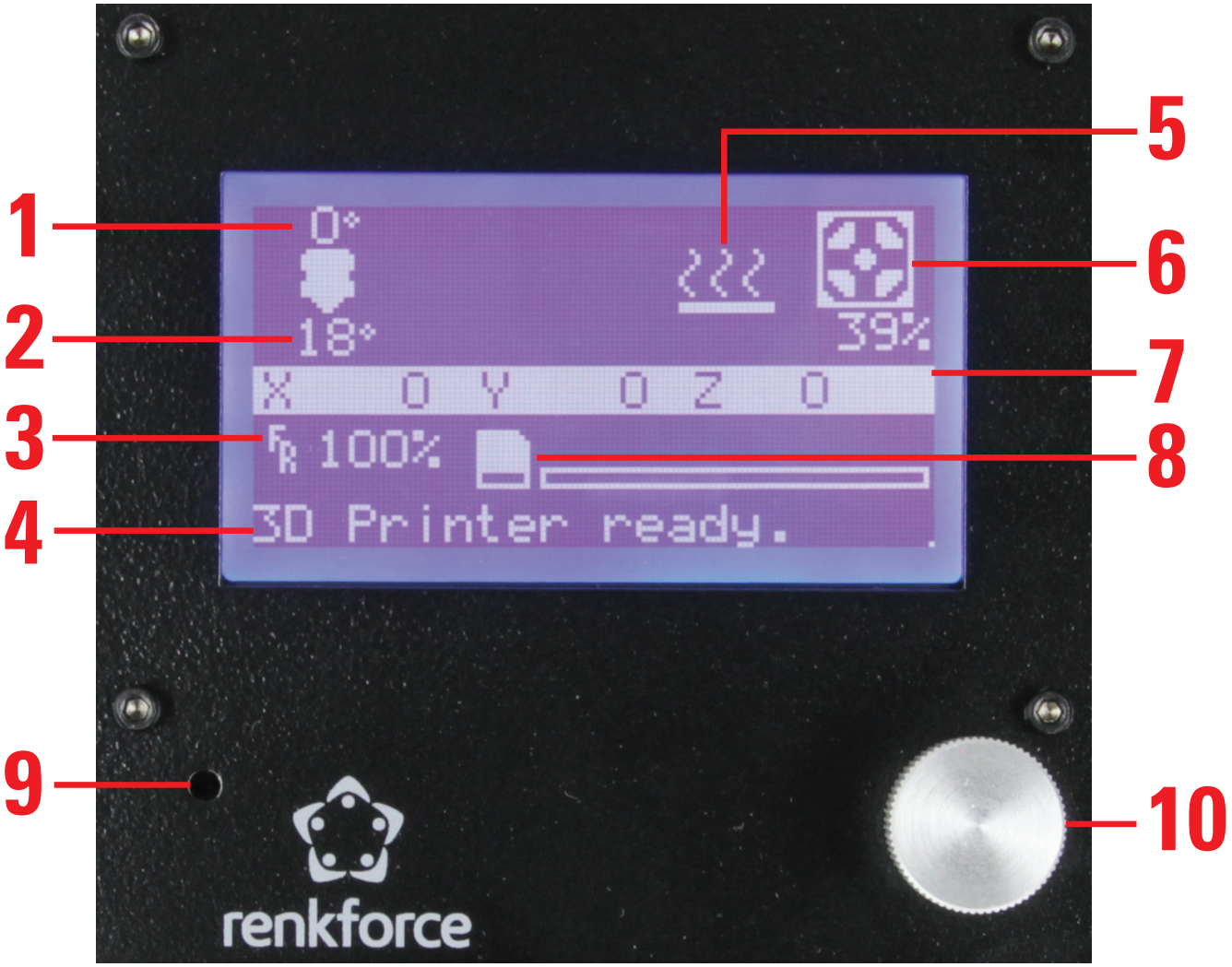


Connect the printer to the power supply.
Use a digital multimeter between the soldering point marked with a minus and the dial switch on the potentiometer marked with a plus.
Set 300 mV ± 20 mV each for the motor drivers X, Y and Z.
Set 500 mV ± 20 mV for the drivers of the infeed motor.

Attention! Particularly observe that you do not cause any short circuit on the PCB with the measuring prods!
This may cause irreparable damage.

14. Operation at the Printer

a) Display and Operating Buttons



(1) Temperature extruder (target)

⟶ The target temperature it not displayed here yet, since the extruder is not heated yet.

(2) Temperature extruder (actual)

(3) Printing speed

(4) Status information

(5) Status of the heating bed (optional)

(6) Status of the extruder fan; when it runs, the current speed in % is displayed below.

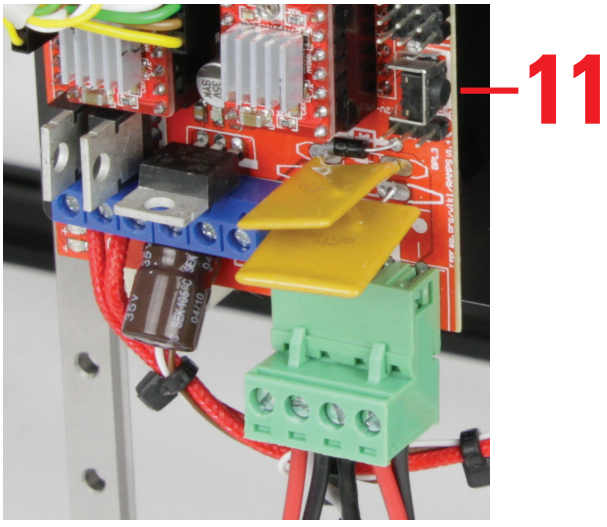
(7) Status and position of the 3 axes X, Y and Z; indication in mm

(8) Status of the SD card

(9) Setting controller for the display contrast (adjustable with a narrow flat-head screwdriver)

(10) Operating knob with button
Turn to the left/right: Direction navigation in the menu structure; Setting the temperature, positions
Button: To confirm a selection in the menu

(11) Reset button: Restarts the printer



b) Menu Overview

Operation takes place via the operating switch at the printer:

- Turning the actuating button serves navigation in the menu structure (up/down) or adjustment of values.
- Pushing the operating button serves confirmation of a selection in the menu and calling of the menu structure from the main menu.

⟶ The menu structure may deviate slightly depending on firmware.

Info screen				
Prepare	Main			
	Auto home			
	Set home offsets			
	Move axis	Prepare		
		Move 10 mm	Move axis	
			Move X	Move X: +000.0
			Move Y	Move Y: +000.0
		Move 1mm	Move axis	
			Move X	Move X: +000.0
			Move Y	Move Y: +000.0
			Move Z	Move Z: +000.0
			Extruder	Extruder: +000.0
		Move 0.1mm	Move axis	
			Move X	Move X: +000.0
			Move Y	Move Y: +000.0
			Move Z	Move Z: +000.0
			Extruder	Extruder: +000.0
	Disable steppers			
	Preheat PLA	Prepare		
		Preheat PLA		
		Preheat PLA Bed		
	Preheat ABS	Prepare		
		Preheat ABS		
		Preheat ABS Bed		
	Cooldown			
Tune	Main			
	Speed: 100	Speed: 100		
	Nozzle: 230	Nozzle: 230		
	Fan speed: 255	Fan speed: 255		
	Flow: 100	Flow: 100		
Control	Main			
	Temperature	Control		
		Nozzle: 0	Nozzle: 0	
		Bed: 0	Bed: 0	
		Fan speed: 0	Fan speed: 0	
		Autotemp: Off/On		

Control	Temperature	Ext. Min:	210	Ext. Min:	210
		Ext. Max:	250	Ext. Max:	250
		Ext. Fact:	000.10	Ext. Fact:	000.10
		PID-P:	+022.20	PID-P:	+022.20
		PID-I:	+001.08	PID-I:	+001.08
		PID-D:	+114.00	PID-D:	+114.00
		PID-C:	100	PID-C:	100
		Preheat PLA conf		Temperature	
				Fan speed:	0
				Nozzle:	180
				Bed:	70
				Store memory	
		Preheat ABS conf		Temperature	
				Fan speed:	0
				Nozzle:	240
				Bed:	110
				Store memory	
	Motion	Control			
		Accel:	1000	Accel:	1000
		VXY-jerk:	5	VXY-jerk:	5
		Vz-jerk:	+000.40	Vz-jerk:	+000.40
		Ve-jerk:	5	Ve-jerk:	5
		Vmax X:	300	Vmax X:	300
		Vmax Y:	300	Vmax Y:	300
		Vmax Z:	5	Vmax Z:	5
		Vmax E:	100	Vmax E:	100
		Vmin:	0	Vmin:	0
		VTrav min:	0	VTrav min:	0
		Amax X:	3000	Amax X:	3000
		Amax Y:	3000	Amax Y:	3000
		Amax Z:	0	Amax Z:	0
		Amax E:	9000	Amax E:	9000
		A-retract:	9000	A-retract:	9000
		A-travel:	1000	A-travel:	1000
		Xsteps/mm:	+080.00	Xsteps/mm:	+080.00
		Ysteps/mm:	+080.00	Ysteps/mm:	+080.00
		Zsteps/mm:	+1060.0	Zsteps/mm:	+1060.0
		Esteps/mm:	+0127.0	Esteps/mm:	+0127.0
	Filament	Control			
		E in mm3:	Off/On		
		Fil. Dia.:	1,750	Fil. Dia.:	1,750
	Store memory				
	Load memory				
	Restore failsafe				
No SD Card/Print from SD	Main				
	Folder structure of the SD card				

c) Functions of the Individual Menu Items

⟶ The top-most point in each submenu (to be recognised by the unwound arrow upwards) switches back to the respective previous menu. Therefore, these items are not included in the explanation.

Info screen	Switches back to the main display		
Prepare			
Auto home	Move all axes into the home position		
Set home offsets	Specify the zero point - perform a homing run with the repeater software and then execute "Set home offset"; first set the distance (works only after restart of the software) (you can also set an offset, e.g. to print onto an object)		
Move axis	Move 10 mm	Move X	Moves the X-axis in steps of 10 mm
		Move Y	Moves the Y-axis in steps of 10 mm
	Move 1mm	Move X	Moves the X-axis in steps of 1 mm
		Move Y	Moves the Y-axis in steps of 1 mm
		Move Z	Moves the Z-axis in steps of 1 mm
		Extruder	Moves the infeed motor in steps of 1 mm
	Move 0.1mm	Move X	Moves the X-axis in steps of 0.1 mm
		Move Y	Moves the Y-axis in steps of 0.1 mm
		Move Z	Moves the Z-axis in steps of 0.1 mm
		Extruder	Moves the infeed motor in steps of 0.1 mm
Disable steppers	All motors are switched off.		
Preheat PLA	Preheat PLA	Prepares the printer for printing of PLA without hot printing plate; setting in the menu item “Preheat PLA conf”	
	Preheat PLA Bed	Prepares the printer for printing of PLA with hot printing plate; setting in the menu item “Preheat PLA conf”	
Preheat ABS	Preheat ABS	Prepares the printer for printing of ABS without hot printing plate; setting in the menu item “Preheat ABS conf”	
	Preheat ABS Bed	Prepares the printer for printing of ABS with hot printing plate; setting in the menu item “Preheat ABS conf”	
Cooldown	Cooling off; all heatings are switched off		
Tune	Displayed only during printing		
Speed: 100	Change the print speed during printing		
Nozzle: 230	Change the extruder temperature during printing		
Fan speed: 255	Change the fan speed during printing		
Flow: 100	Change the filament conveying speed during printing		
Control			
Temperature	Nozzle: 0	Manually setting the temperature for extruder 0 (e.g. for filament change)	
	Bed: 0	Manually setting the temperature for the heat bed	
	Fan speed: 0	Manually setting the fan speed	
	Autotemp: Off/On	Automatic adjustment of the temperature when the printing speed is increased; printing faster = higher temp.	
	Ext. Min: 210	Min-value for the temperature limit of the autotemp setting	
	Ext. Max: 250	Max-value for the temperature limit of the autotemp setting	
	Ext. Fact: 000.10	Controller values for hot end	
	PID-P: +022.20	Controller values for hot end	
	PID-I: +001.08	Controller values for hot end	

	PID-D: +114.00	Controller values for hot end	
	PID-C: 100	Controller values for hot end	
	Preheat PLA conf	Fan speed: 0	Setting the fan speed for the function "Preheat PLA"
		Nozzle: 180	Setting the extruder temperature for the function "Preheat PLA"
		Bed: 70	Setting the printig plate temperature for the function “Preheat PLA”
		Store memory	Saves the setting for the function "Preheat PLA"
Control			
Temperature	Preheat ABS conf	Fan speed: 0	Setting the fan speed for the function "Preheat ABS"
		Nozzle: 240	Setting the extruder temperature for the function "Preheat ABS"
		Bed: 110	Setting the printig plate temperature for the function “Preheat ABS”
		Store memory	Saves the setting for the function "Preheat ABS"
Motion	Accel: 1000	Controller values for movement	
	VXY-jerk: 5	Controller values for movement	
	Vz-jerk: +000.40	Controller values for movement	
	Ve-jerk: 5	Controller values for movement	
	Vmax X: 300	Controller values for movement	
	Vmax Y: 300	Controller values for movement	
	Vmax Z: 5	Controller values for movement	
	Vmax E: 100	Controller values for movement	
	Vmin: 0	Controller values for movement	
	VTrav min: 0	Controller values for movement	
	Amax X: 3000	Controller values for movement	
	Amax Y: 3000	Controller values for movement	
	Amax Z: 0	Controller values for movement	
	Amax E: 9000	Controller values for movement	
	A-retract: 9000	Controller values for movement	
	A-travel: 1000	Controller values for movement	
	Xsteps/mm: +080.00	Controller values for movement	
	Ysteps/mm: +080.00	Controller values for movement	
	Zsteps/mm: +1060.0	Controller values for movement	
	Esteps/mm: +0127.0	Controller values for movement	
Filament	E in mm3: Off/On	Controller values for movement	
	Fil. Dia.: 1,750	Adjusting the filament diameter	
Store memory	Saves all changed settings in the EEPROM		
Load memory	Loading saved settings from the EEPROM		
Restore failsafe	Resets all settings to defaults		
No SD Card/Print from SD		No SD Card: No SD card is inserted. Print form SD: Select the print file from the SD card.	

→ For more information, see the website of the firmware manufacturer:

http://reprap.org/wiki/Marlin

http://marlinfw.org/

15. Calibration

a) General Notes on Calibration

Attention! Never touch the hot extruder or the hot heat bed (preassembled device only)!

There is a danger of burns!

When heating, there may be slight development of smoke or steam. This is normal. Please ensure the corresponding ventilation.

While calibration is underway, no filament must be inserted in the extruder.

If there already is some filament in the extruder, it must be completely removed before calibration. For this, observe chapter "16. c) Removing and Changing the Filament" or method 3 in chapter "21. b) Cleaning".

Also ensure that the extruder nozzle is clean on the outside. If it is contaminated, clean it as described in chapter "21. b) Cleaning".

The extruder or the nozzle must be cleaned so that no filament escapes anymore when they are heated to printing temperature.

⟶ The following description shows calibration universally for the maker construction kit and the preassembled device. Subchapters "15. b) Setting of the Z-Stop" and "15. d) Setting of the Printing Plate" apply to both models.

Whether to set the printing plate in the hot or cold condition depends on whether you have applied an adhesive film to the printing plate or not. By default, this is included in the delivery only for the construction kit.

It is a simple rule that calibration is performed in the cold condition with the film and in the hot condition without. This is because the adhesive film for the printing plate is only partially heat-resistant.

For hot calibration, the extruder and the heating element of the printing plate (if present) are heated to printing temperature of the respective filament (PLA: Extruder approx. 200-230 °C (depending on filament), printing bed with heating element at 60 °C (if present)). How to heat up both is described in subchapter "15. c) Heating to Printing Temperature". You can skip that chapter for cold calibration.

If you want to calibrate with the cold extruder, let it cool off entirely first.

Calibration should be performed now and then. It is a prerequisite for high printing quality. Always perform calibration after transport of the 3D-printer or after any changes to the printing plate.

The preassembled device was calibrated in production already. Before you print for the first time, check the distance between the nozzle and the printing plate in the hot condition in any case.

The figures on the display screens may vary a little depending on firmware version.

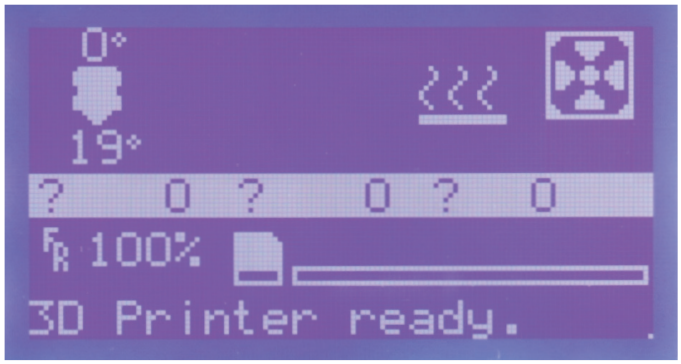
b) Setting the Z-Stop

Before starting calibration, set the end stop in the Z-direction.

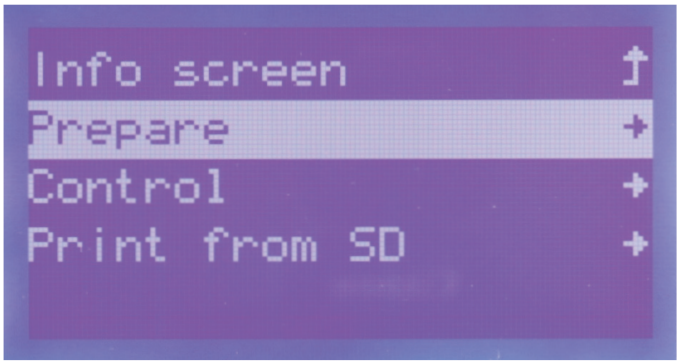
The hexagon screw should be about 1 to 2 mm in the thread. Counter the screw with the counter-nut.

⟶ Check that the Z-limit switch is clearly pushed by the hexagon screw.

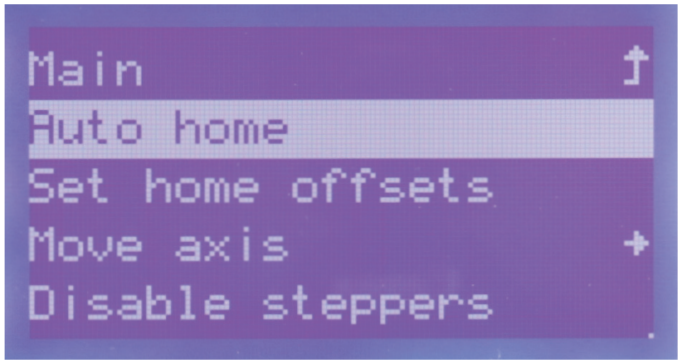
Move all axes into the home position



Push button for the operating knob (10) in the main menu.

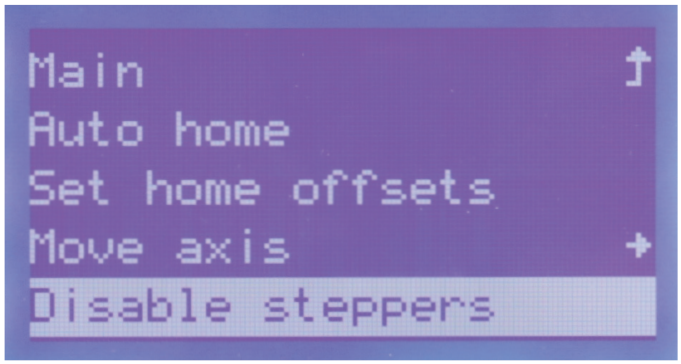


Turn the operating knob (10) until you have selected the menu item "**Prepare**" and push the button of the operating knob (10).



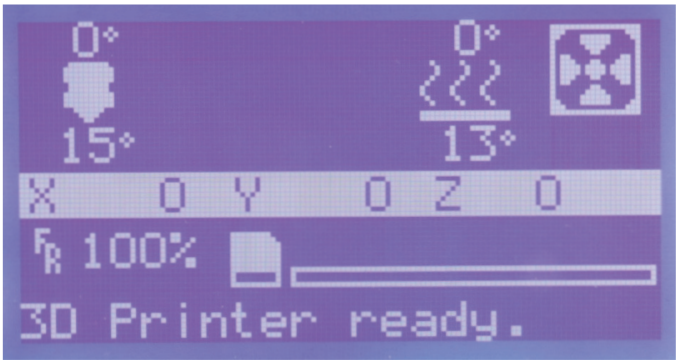
Turn the operating knob (10) until the menu item "**Auto home**" is selected. Push the button of the operating knob (10).
All axes move into the home position.

The printer will switch back to the main menu automatically after a few seconds. The axes are no longer displayed with question marks now.

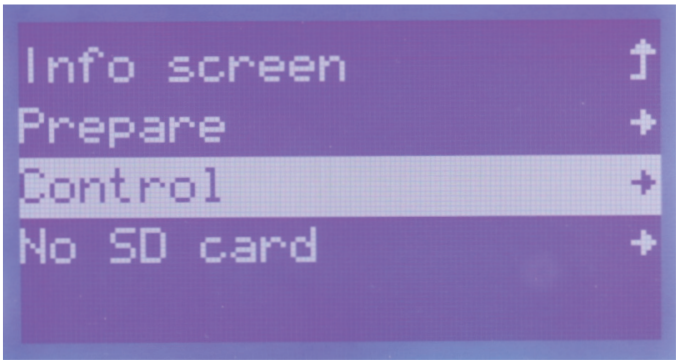


Go to the menu "**Prepare**" and navigate to item "**Disable steppers**".
Push the button of the operating knob (10).
By this, all motors are switched off so you can move the X and Y axes manually.

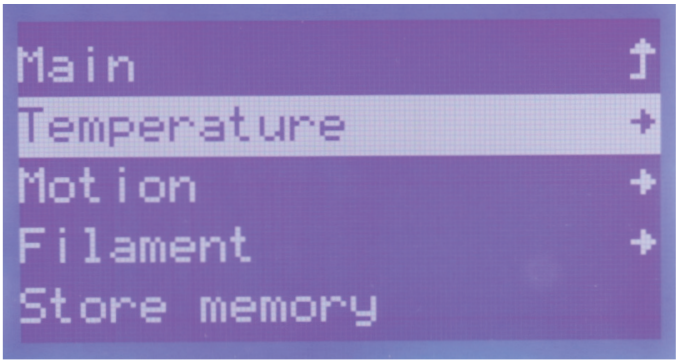
c) Heating to Printing Temperature



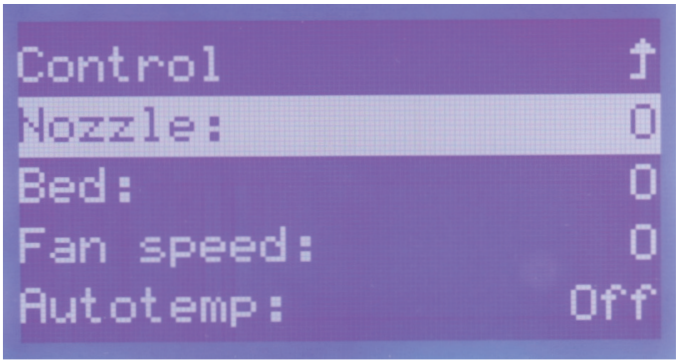
Push button for the operating knob (10) in the main menu.



Turn the operating knob (10) until you have selected the menu item "**Control**" and push the button of the operating knob (10).

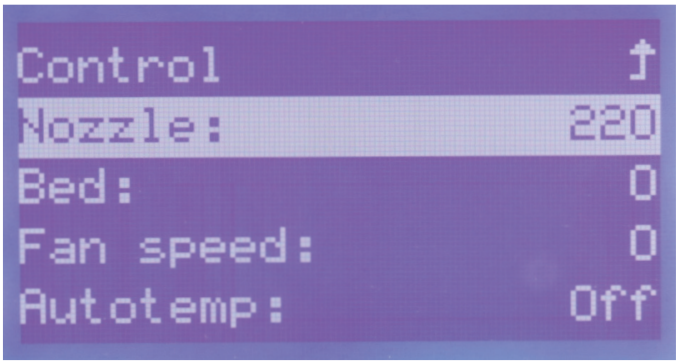


Turn the operating knob (10) until you have selected the menu item "**Temperature**" and push the button of the operating knob (10).

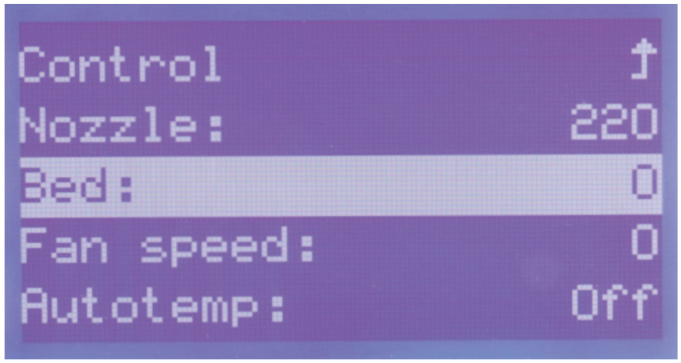


Turn the operating knob (10) until the menu item "**Nozzle: 0**" is selected and push the button of the operating knob (10).

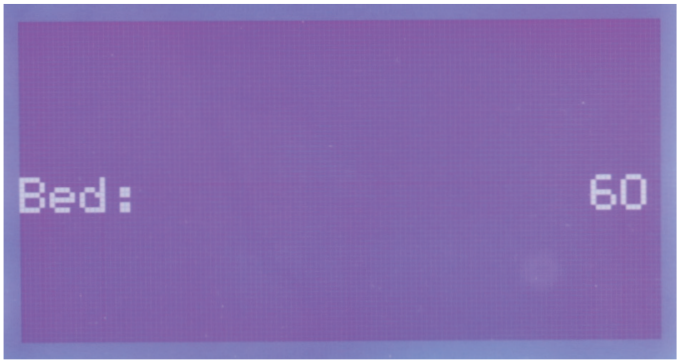
Turn the operating knob (10) to the right until the desired value "**220**" (here: 220 °C) is displayed. The extruder is heated up at once after turning.
To return to the menu, push the operating knob (10).



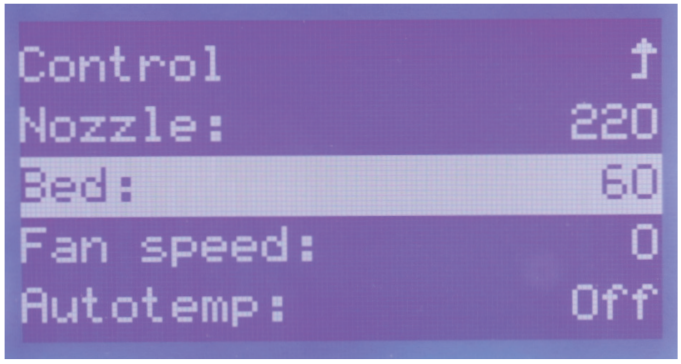
Now the same value as set before should be shown here.
In our example, we have preselected the maximum temperature of the filament used. You can adjust the value according to your filament.



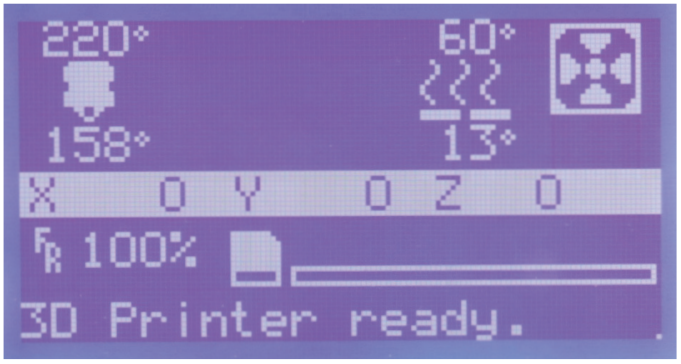
Turn the operating knob (10) until the menu item "**Bed: 0**" is selected and push the button of the operating knob (10).



Turn the operating knob (10) to the right until the desired value "**60**" (here: 60 °C) is displayed. The heating element is heated up at once after turning.
To return to the menu, push the operating knob (10).

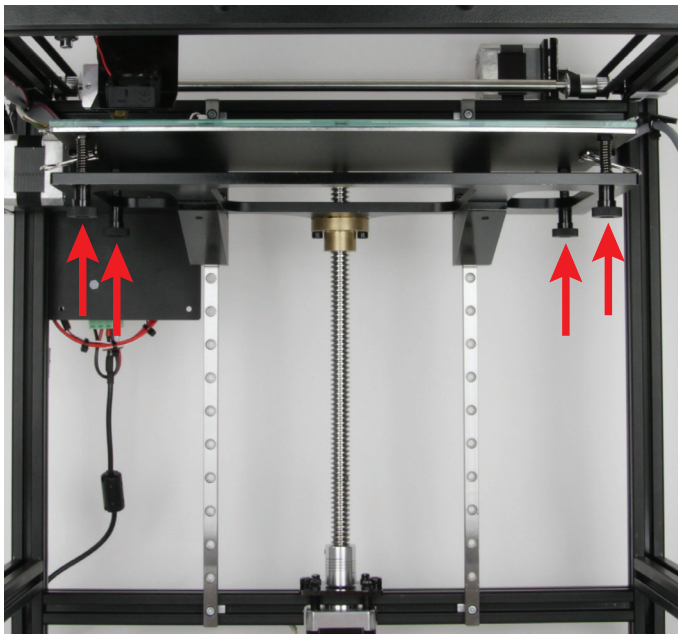


Now the same value as set before should be shown here.
In our example, we have chosen the optimal temperature for the filament used (here: PLA). You can adjust the value according to your filament.

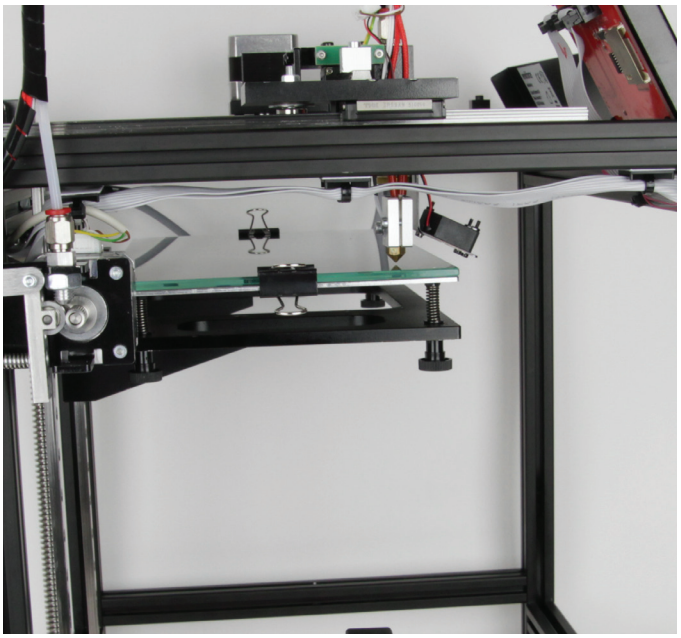


The printer will switch back to the main menu automatically after a few seconds. The previously set target temperature and the current temperature of the extruder below are displayed here.
Wait until the extruder and the heating element for the printing plate are completely heated up. Let both continue to heat for at least 10 minutes until the full expansion is reached. Then continue.

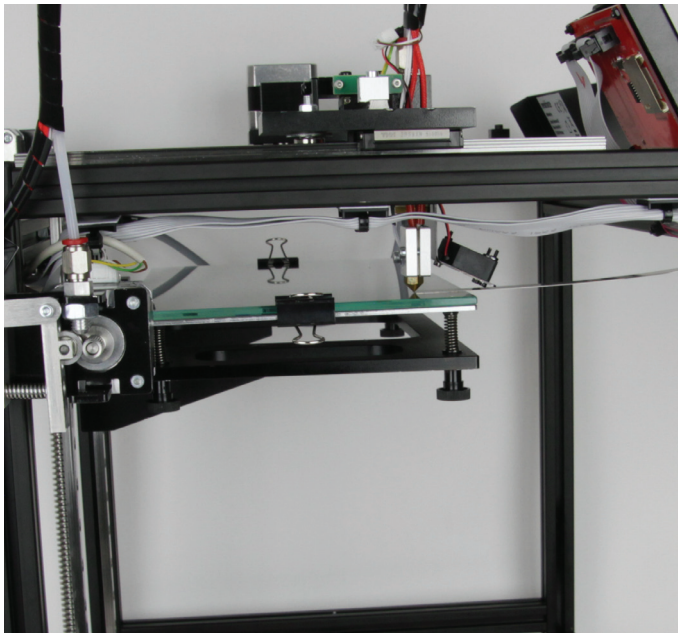
d) Setting the Printing Plate



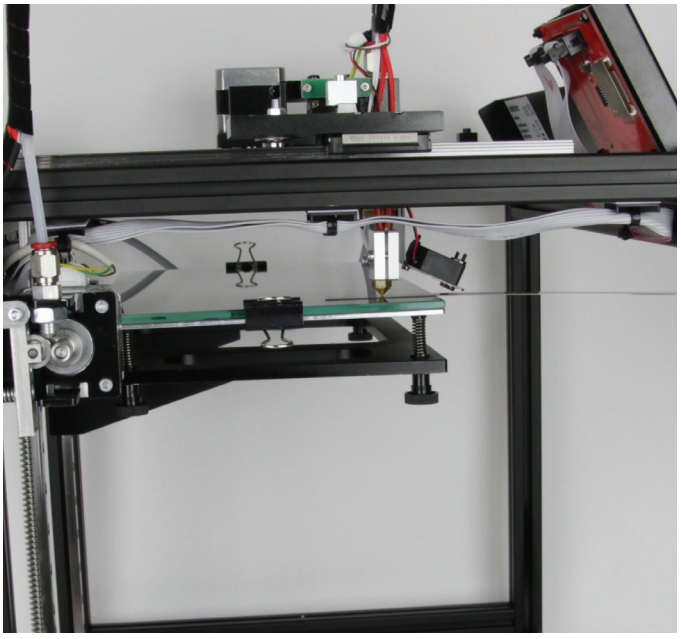
The 4 knurled nuts at the bottom of the table can be used to adjust the printing plate.
First, turn all 4 knurled nuts to the right (this will move the printing plate closer to the table), until you can move the extruder carriage to any position of the printing plate.



Generally set the distance between the nozzle and the printing plate support. The distance should be equal everywhere if possible.
Then start the fine settings.



Set a distance of 0.3 mm (feeler gauge) everywhere between the nozzle and the printing plate support for the printing plate and the nozzle. Start at the point with the largest distance and proceed in sequence.

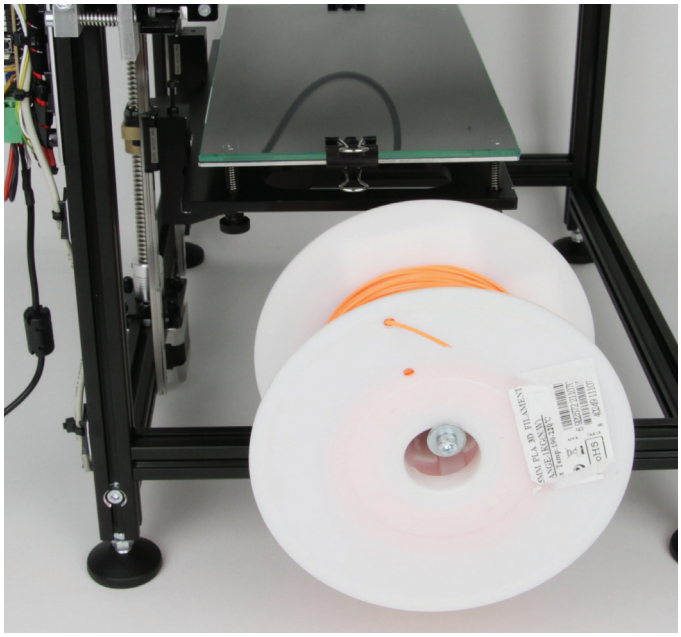


Measure the distance with a feeler gauge sheet (0.3 mm). While turning the knurled nuts, the feeler gauge sheet must not be caught between the nozzle and the printing plate support.
The feeler gauge sheet must be pushed slightly under the nozzle. When it hits, the distance is too small (figure on the left).

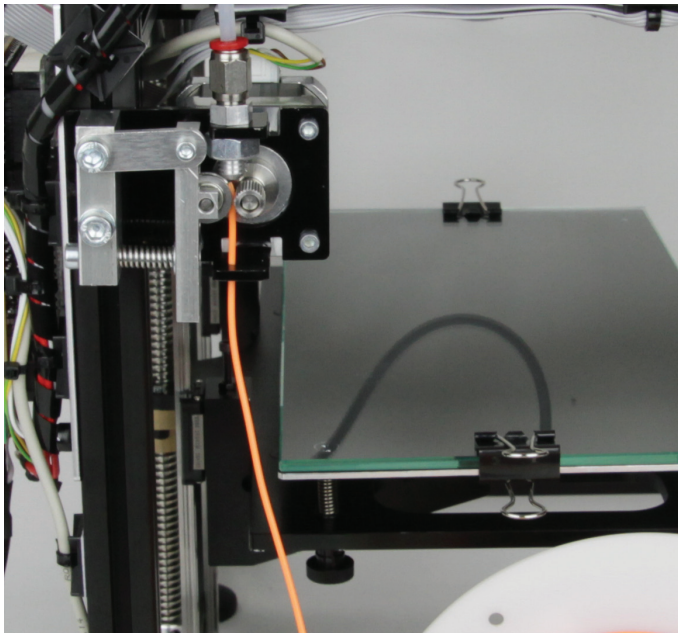
⟶ Repeat setting until the distance between the nozzle and the printing plate is 0.3 mm everywhere. Then the calibration is completed.

16. Inserting, Removing and Changing the Filament

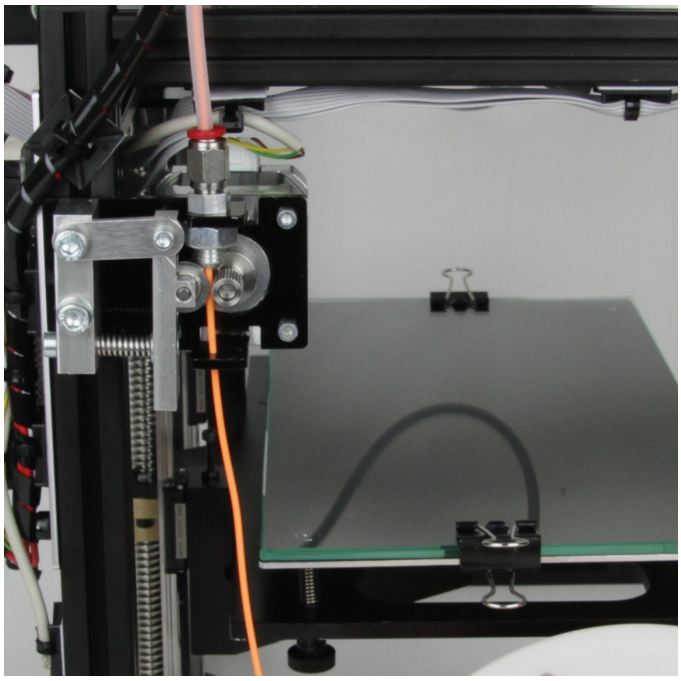
a) Inserting the Filament - Mechanical Part



Push the filament roll on the shaft of the filament holder. The filament roll must move freely.
The tip of the filament should be cut slightly diagonally. This makes insertion easier.



Push the ball bearing holder and insert the filament into the groove of the ball bearing from below through the opening of the extruder motor holder.



Push the filament past the infeed motor and through the entire filament tube. When it is visible at the other end of the tube (at the extruder), push the filament into the extruder to the stop.
Ensure that the Filament runs cleanly in the groove of the ball bearing after insertion.

It must be possible for the feed motor to turn without slippage or catching when pulling or pushing at the filament.

Then switch on the printer if you have not done so yet.

b) Inserting the Filament via the Printer Menu

Before inserting, removing or changing the filament, the corresponding extruder must be heated up so that the filament can be inserted into or removed from the extruder cleanly.

Do not touch the hot extruder nozzle when inserting, removing or changing the filament! Danger of burns!

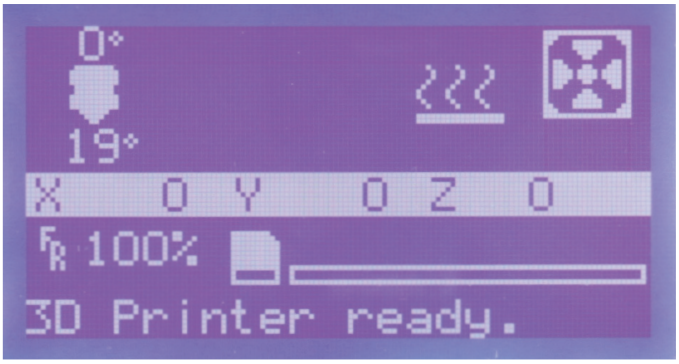
Always wait for the extruder temperature to be reached at filament change and let the extruder heat for approx. another minute, since the extruder may be damaged otherwise.

When heating, there may be slight development of smoke or steam. This is normal. Please ensure the corresponding ventilation.

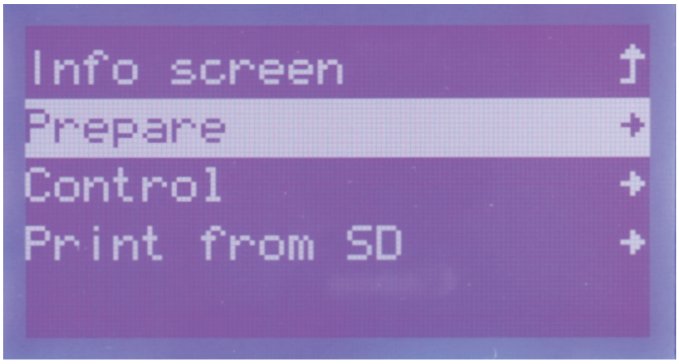
Move all axes into the home position

First, move all axes into the home positions via the function "**Auto home**". Use the description from chapter 15 as reference. Calibration".

Move all axes into a certain position

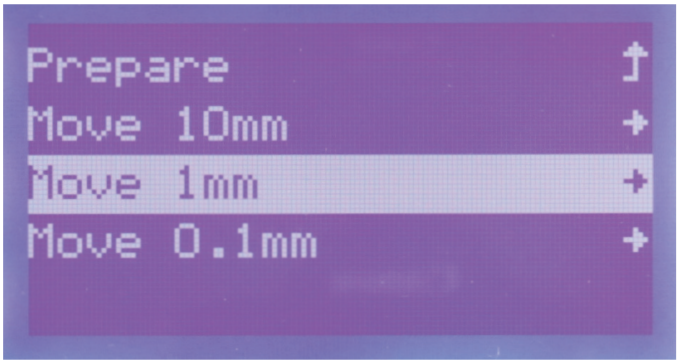


Push button for the operating knob (10) in the main menu.



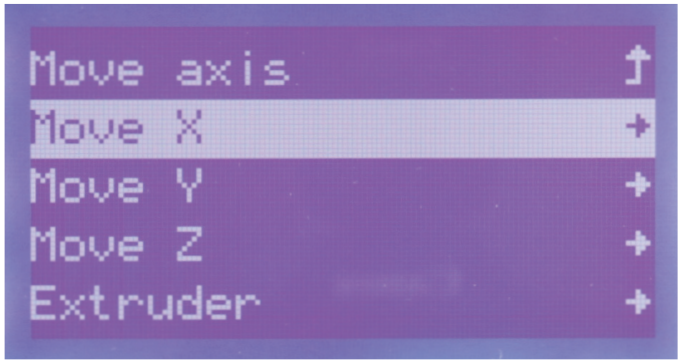
Turn the operating knob (10) until you have selected the menu item "**Prepare**" and push the button of the operating knob (10).

Turn the operating knob (10) until you have selected the menu item "**Move axis**" and push the button of the operating knob (10).

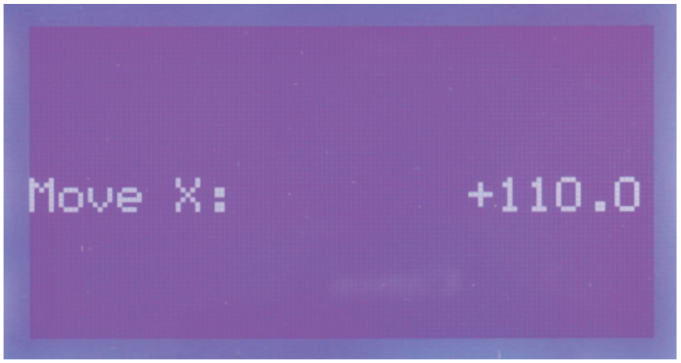


Turn the operating knob (10) until you have selected the menu item "**Move 1 mm**" and push the button of the operating knob (10).

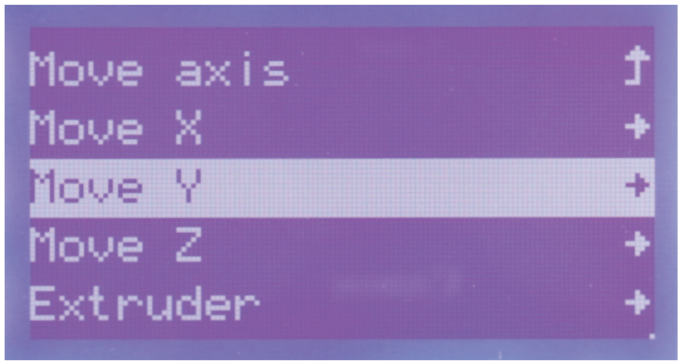
→ The following position values on the next page do not need to be observed precisely. They only serve to let the filament leave the extruder cleanly and hit the printing plate.



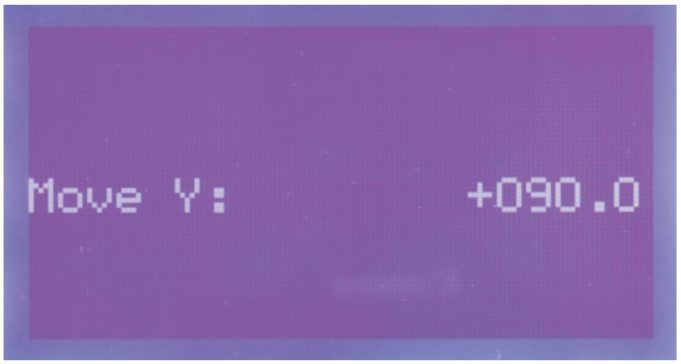
Go to the item "**Move X**" and push the button of the operating knob (10).



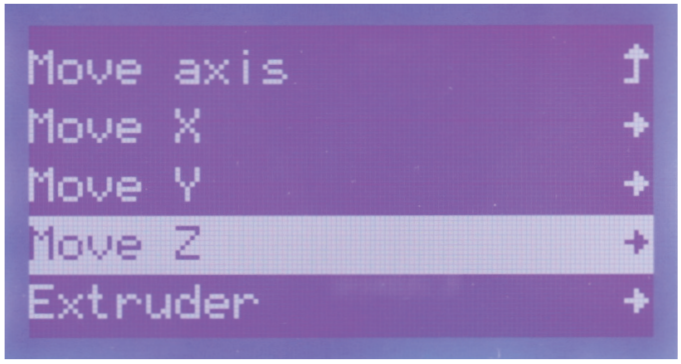
Turn the operating knob (10) to the right until the desired value "**+110.0**" is displayed. The extruder carriage is moved to the set X-position.
To return to the menu, push the operating knob (10).



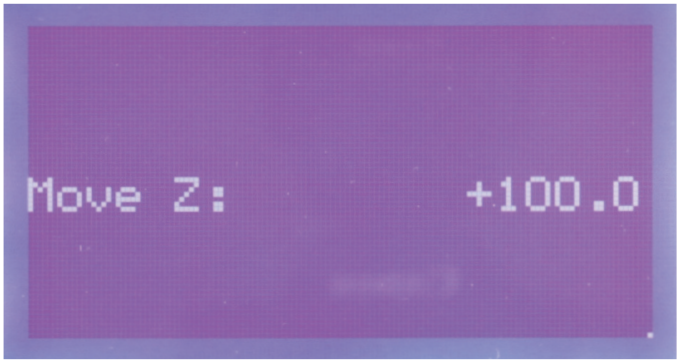
Go to the item "**Move Y**" and push the button of the operating knob (10).



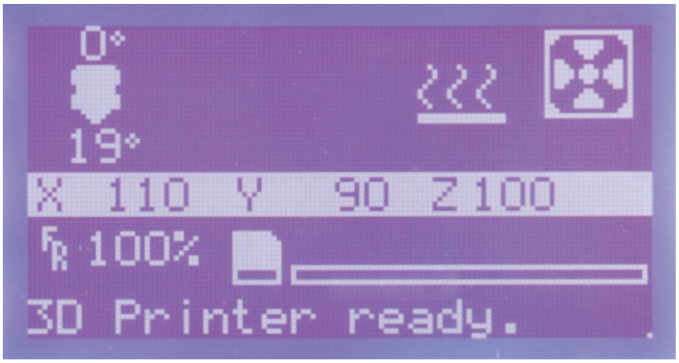
Turn the operating knob (10) to the right until the desired value "**+090.0**" is displayed. The extruder carriage is moved to the set Y-position.
To return to the menu, push the operating knob (10).



Go to the item "**Move Z**" and push the button of the operating knob (10).

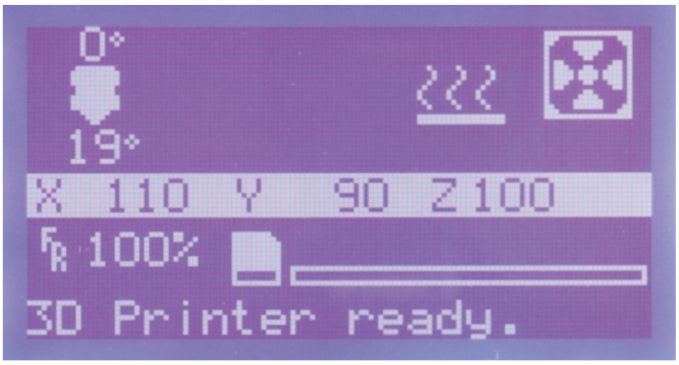


Turn the operating knob (10) to the right until the desired value "**+100.0**" is displayed. The printing plate is moved to the set position.
To return to the menu, push the operating knob (10).

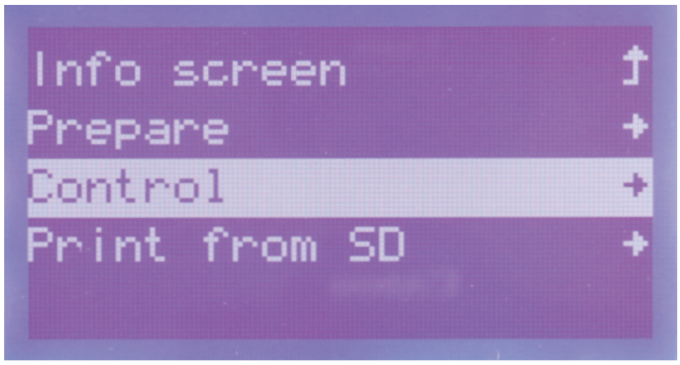


The printer will switch back to the main menu automatically after a few seconds. The axes are displayed with the current position values here now.

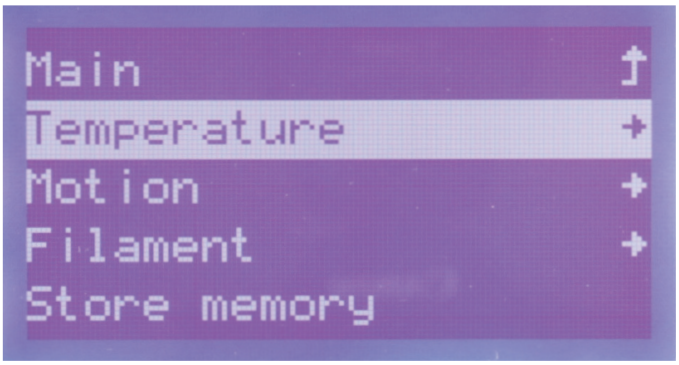
Heat up the extruder



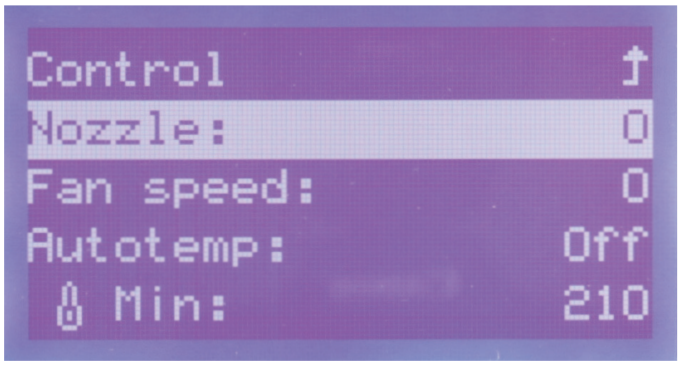
Push button for the operating knob (10) in the main menu.



Turn the operating knob (10) until you have selected the menu item "**Control**" and push the button of the operating knob (10).

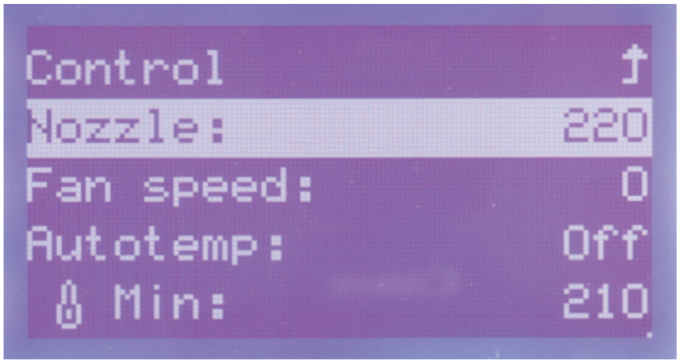


Turn the operating knob (10) until you have selected the menu item "**Temperature**" and push the button of the operating knob (10).

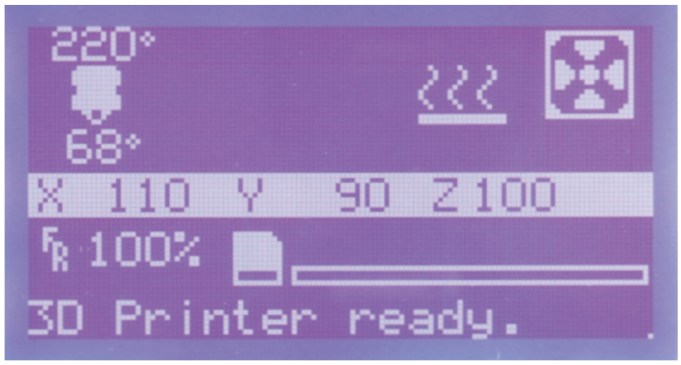


Turn the operating knob (10) until the menu item "**Nozzle: 0**" is selected and push the button of the operating knob (10).

Turn the operating knob (10) to the right until the desired value "**220**" (here: 220 °C) is displayed. The extruder is heated up at once after turning.
To return to the menu, push the operating knob (10).

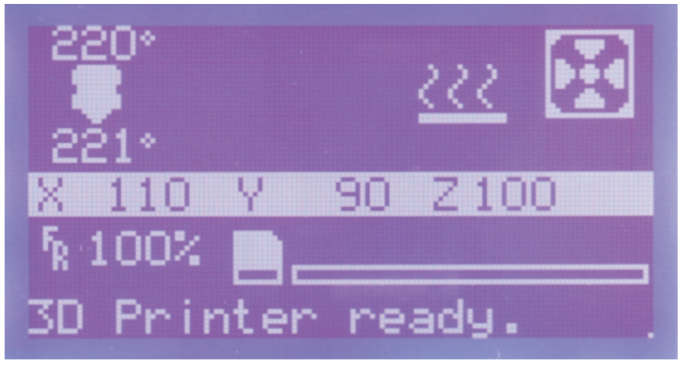


Now the same value as set before should be shown here.
In our example, we have preselected the maximum temperature of the filament used. You can adjust the value according to your filament.

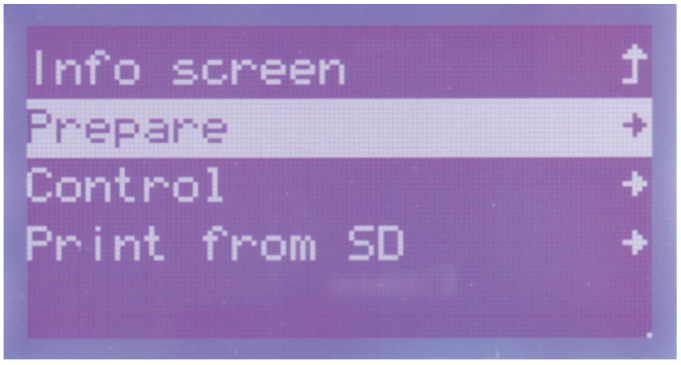


The printer will switch back to the main menu automatically after a few seconds. The previously set target temperature and the current temperature of the extruder below are displayed here.
Wait until the extruder is fully heated and let it continue to heat for one more minute. Then continue.

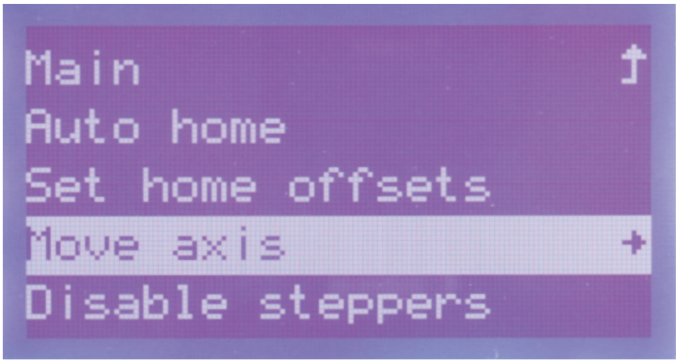
Insertion of the filament



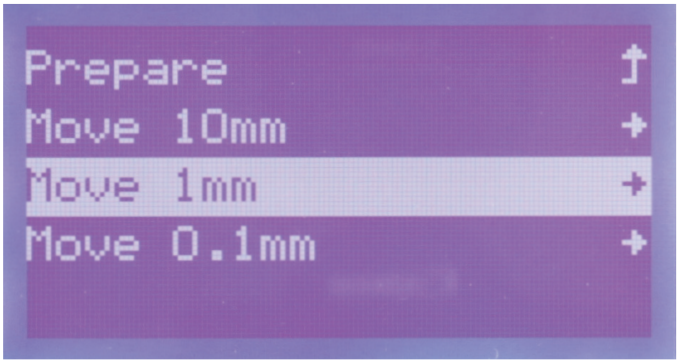
Push button for the operating knob (10) in the main menu.



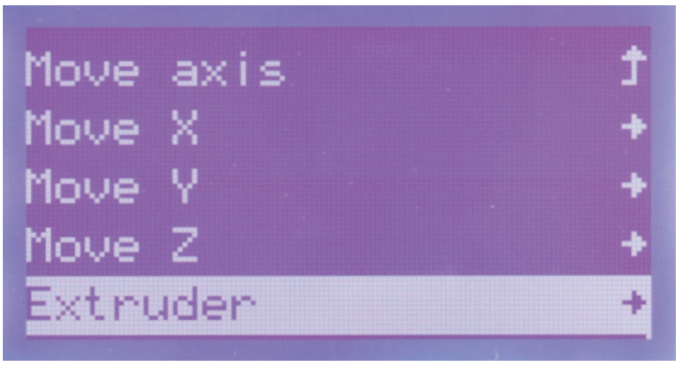
Turn the operating knob (10) until you have selected the menu item "**Prepare**" and push the button of the operating knob (10).



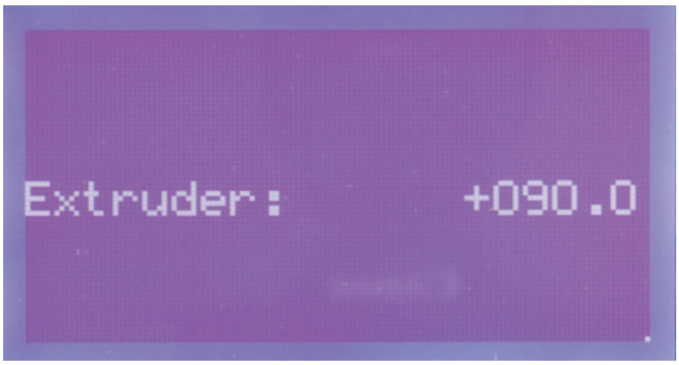
Turn the operating knob (10) until you have selected the menu item "**Move axis**" and push the button of the operating knob (10).



Turn the operating knob (10) until you have selected the menu item "**Move 1 mm**" and push the button of the operating knob (10).

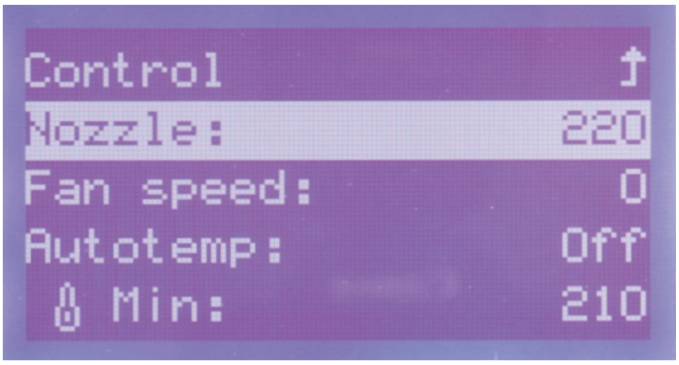


Go to the item "**Extruder**" and push the button of the operating knob (10).



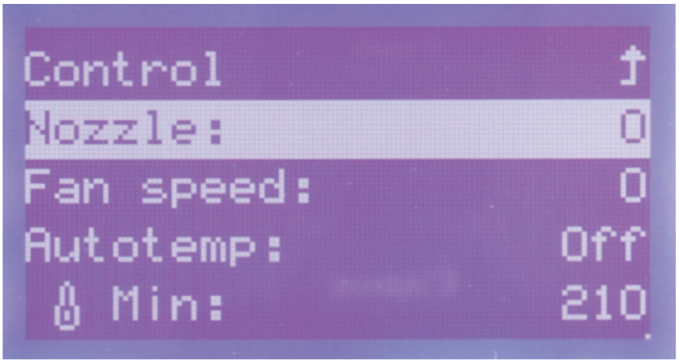
Turn the operating knob (10) to the right until the desired value, e.g., "**+090.0**" is displayed. The extruder infeed moves the filament by the set value.
You need to choose the value so that a little filament is extruded.
It is possible that you have to wait for a specific value (e.g. +030.0) to be reached before you can increase the value again.
To return to the menu, push the operating knob (10).

Switching off the extruder heating

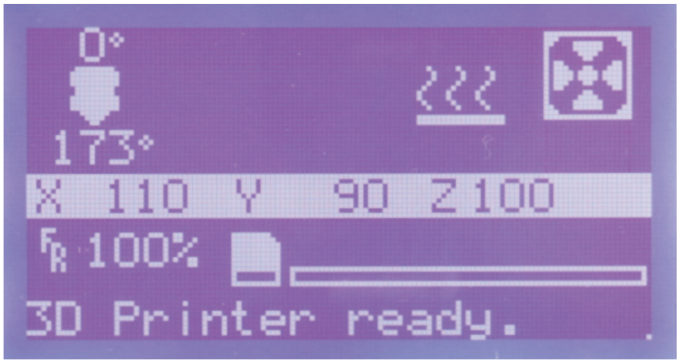


Now go to the menu "**Control**" and the item "**Nozzle: 220**", and push the button of the operating knob (10).

Turn the operating knob (10) to the left until the value is set to 0. The heating of the extruder is switched off by this.
To return to the menu, push the operating knob (10).



Now the same value 0 as set before should be displayed here.



The printer will switch back to the main menu automatically after a few seconds. Now the target temperature is displayed at 0 °C here as well. Below this, the dropping current temperature of the extruder is displayed.

→ Insertion of the filament is then completed. As an alternative to the described method, you can insert the filament manually into the extruder as well after heating.

c) Removing and Changing the Filament

→ **Hold the filament when it moves out of the ball bearing holder. Otherwise, it may jump out and cause injury. The upper layers of the respective filament roll may jump open as well, which may cause the filament to tangle.**

Removing the filament

Remove the filament according to the same procedure as used for insertion.

If you move the infeed motor after heating, do not turn the operating knob to the right, but to the left. This will move the filament out of the extruder. You can remove the filament all the way this way, or only a little way so you can pull the rest out of the filament tube by hand.

Changing the filament

Proceed in the same manner when changing the filament. First remove the filament and then insert the new filament.

If you have removed the filament after heating, you can insert the new filament right away.

17. First Print of an Example Object from the SD Card

When heating, there may be slight development of smoke or steam. This is normal. Please ensure the corresponding ventilation.

→ **If you are using PLA filament for printing and using the maker construction kit, stick the enclosed adhesive film on the printing plate for better adhesion of the printed object. Use the enclosed glue stick for the preassembled device.**

Alternatively, you can use a slightly structure masking tape or special glue adhesive masking tape (Conrad order no. 1093104) that has been developed specifically for this purpose.

The printing files can be found in the download package in the folder GCODE-PLA.

Before starting, download the current download bundle. The corresponding download can be found on the product page of our website or in the download area.

In our example, the object "**20_20_20Q.gcode**" from the download bundle is printed.

→ Please note! The preassembled file from the download bundle is sliced without heating. If you are using the preassembled device or the construction kit with heating, slice the file anew (instructions starting in chapter "19. e) Placement of a Printing Object in the Software"). You may need to activate heating in the slicer settings first (chapter "19. h) More Detailed Description of the Slicer Functions"). Alternatively, you can use the adhesive film or adhesive tape to increase adhesion.

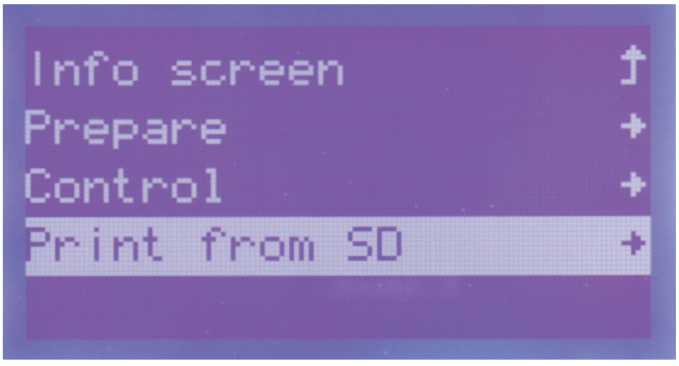
Copy the file onto your SD card.

Push the SD card with the printing file into the SD card reader at the right of the 3D printer.

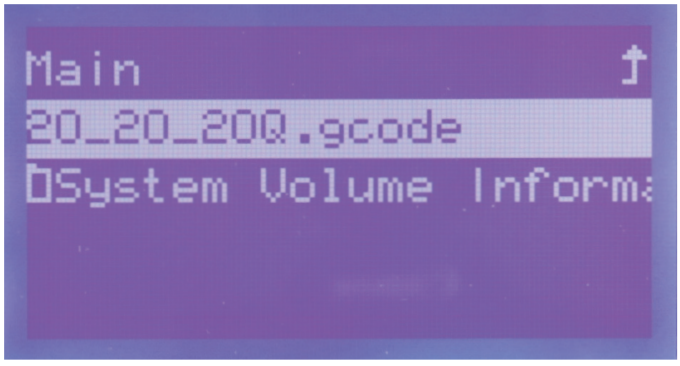
→ **Important! The contacts of the memory card must point towards you when inserting! Simply pull out the card for removal!**

The card will be recognised automatically.
The printer shows this with a corresponding message.

→ **Simply pull out the card for removal! This is not permitted while the printer is printing from the memory card.**



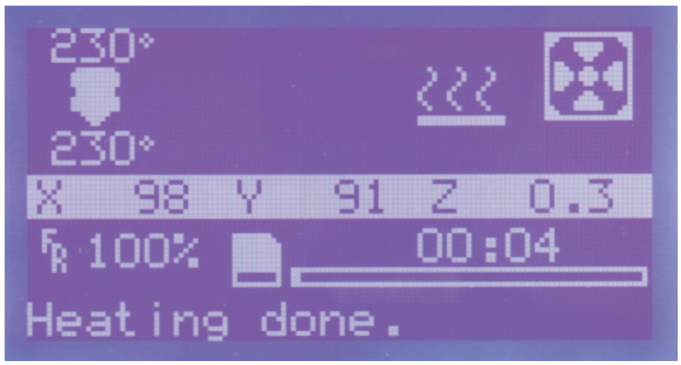
Push the button of the operating knob (10) in the main menu and turn the operating knob (10) until the menu item "**Print from SD**" is selected. Push button for the operating knob (10) again for selection.



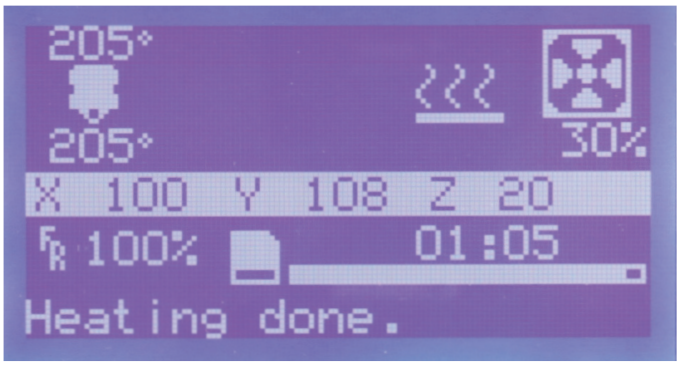
Turn the operating knob to select the file "**20_20_20Q.gcode**" and push the button of the operating knob (10).

The display switches back automatically to the main menu. Then move the axes to their home positions.

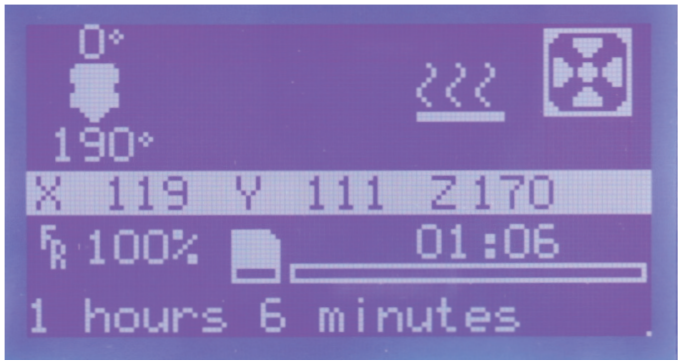
The extruder is heated up.



Once the extruder has reached its operating temperature, printing starts. The display shows the positions of the individual axes (7). The already-printed time is placed below this.



When the fan starts to run, the current speed is displayed under the fan symbol in % (6).



When printing is completed, the printing plate moves all the way down. The heating of the extruder is automatically switched off.

Printing is thus completed. You can remove the printed object after a brief cooling phase.

During the first centimetres of printing, the distance between the printing plate support and extruder can be carefully fine-adjusted manually with the 4 knurled screws at the bottom of the pressure plate. Turn all 4 knurls alternatingly and observe the printed line.

For this setting, observe that the extruder must not touch the printing plate support since it may be damaged otherwise (loss of warranty/guarantee).

It is possible that filament chips collect over time at the filament feed knurl. They should be removed under all circumstances (if possible) at once, e.g. by blowing off. Check and clean the filament feed knurl regularly! Otherwise, it is possible that the chips will adhere to the knurl and that no filament can be conveyed anymore because of this (the knurl slips through then).

→ The fan at the extruder runs by default from 4th layer for PLA and ABS, provided that the slicer settings have not been changed.

If the fan does not run properly, check if it may be attached unevenly.

When you use the preassembled device or the optional heating plate kit, let the printed object cool off for a few minutes after printing. When the temperature of the heating plate is below 40 °C (see display), the printed object comes free from the heating plate and you can remove it.

If the printed object does not come loose easily, you can loosen it carefully with a glass scraper, razor blade spatula, knife, etc.

Do not apply any mechanical force to the printing plate or the printing plate support, since this may damage the printing plate, or the glass plate (only maker construction kit) may break! Loss of guarantee/warranty!

→ To ensure stable operation, print from SD card for longer printouts. Otherwise, it is possible that printing is interrupted because the printer is restarted via the USB interface. This can be caused by restarting the PC, re-initialising the USB controller or by a virus scanner.

18. General Notes on 3D Printing

The print quality of 3D printers depends on a great many factors.

It is not always possible to achieve a satisfactory print result at the first attempt.

Extruder temperature

The best extruder temperature depends on the filament material and the printer layer thickness. The manufacturer information for the printing temperature can vary very strongly here.

Perform the first test prints at a temperature in the middle range of the manufacturer's information.

To optimise the print quality, print the same object with the same printing layer thickness and different extruder temperatures in 5 °C steps and then compare the results.

This way you can approach the best extruder temperature for different filaments and printing layer thicknesses most easily.

If the extruder temperature is set too hot, the material cannot cool off fast enough and will melt the layer below again.

If the extruder temperature is too low, the filament will not become liquid enough and the filament flow is not homogeneous. The individual filament layers also cannot combine sufficiently.

Heating bed temperature (in the preassembled device or when using the optional heating plate kit)

The optimal heat bed temperature also depends on the filament material. It permits perfect adhesion of the printed object to the heating plate.

PLA can also be printed without a heating bed, but a temperature of approx. 60 °C has turned out to be ideal.

When printing PLA (particularly at small objects with a small footprint), the heating bed should additionally be applied with cleaning tape or a slightly structured crepe tape to increase surface adhesion.

If the heating bed temperature is too high, the printed object may distort or the lower layers will cool off too slowly.

If the heating bed temperature is too low, the printed object will not adhere sufficiently or the corners will come free of the heating plate while printing.

Print layer thickness

The print layer thickness determines the height of the individual print layers and thus the resolution and quality of the printed object.

The thinner the printed layers, the better the print quality and the longer the print duration.

The thinner the printed layers, the lower the print quality and the shorter the print duration.

⟶ Experiment with the above parameters to find the best printer results for you depending on the material used.

The first print attempts should be done with PLA filament, since it is a material that can be mastered relatively easily and that is subject to fewer problems with shrinkage, accuracy and adhesion on the heating plate.

19. Software "Repetier-Host"

a) General Notes on Software

It is unfortunately not possible to explain the complete function of the enclosed software in the scope of this instruction. For this, we refer to the integrated online help function and the information on www.repetier.com.

The basic operation and the path to the first printout are, however, described below to that you can get a result quickly and easily.

The archive you downloaded before holds a custom version of the software that contains the printer settings and configuration files for the RF500 in the folder "Repetier-Host". We urgently recommend to install the custom version of the software since then you do not need to configure the software and the required drives are already installed as well.

The respective updated Custom version of the software always is contained in the download package "BUNDEL_Vx_x_x_RENKFORCE_RF500".

This version of the instruction is valid as of the Repetier-Host software version 1.6.2 or higher.

Configuration of the software and driver installation are explained below in the Annex to these instructions for the sake of completeness. However, the software only needs to be configured if you install the basic version of the software from www.repetier.com.

If you have already installed a previous basic version of the software, the old version can be uninstalled and the custom version can be newly installed. The slicer settings of the previous version are not deleted and reappear in the custom version.

The software Repetier-Host performs the following tasks:

- Placement of the 3D-object to be printed on the printing plate.
- Slicing of the object to be printed into thin layers that the 3D printer can print out layer for layer. The result of this process is a G-code file.
- Review of the G-code files for error and printability.
- Sending the G-code files to the printer or saving on an SD card for standalone print.
- Monitoring the 3D printer in operation.
- Setting and storage of printer- and filament-specific data.

b) Installation

- Install the file "**setupRepetierHostRenkforce_x_x_x.exe**" from the directory "**Repetier-Host**" from the download package (x_x_x designates the software version here).

→ Installation of the custom version of the Repetier-Host requires administrator rights, since the necessary configuration files and printer settings will not be installed otherwise. If the corresponding message appears in Windows®, confirm it with Yes in any case. The installation will otherwise be interrupted.

If setup asks if you want to install the serial drivers ("Install serial driver"), do this in any case for the first installation, since the printer will not be recognised otherwise.

- Alternatively, the installation file for the basic version of the software can also be downloaded from www.repetier.com. There, MacOS X- and LINUX versions of this software are offered as well.

→ Prerequisites for installing under Windows®:

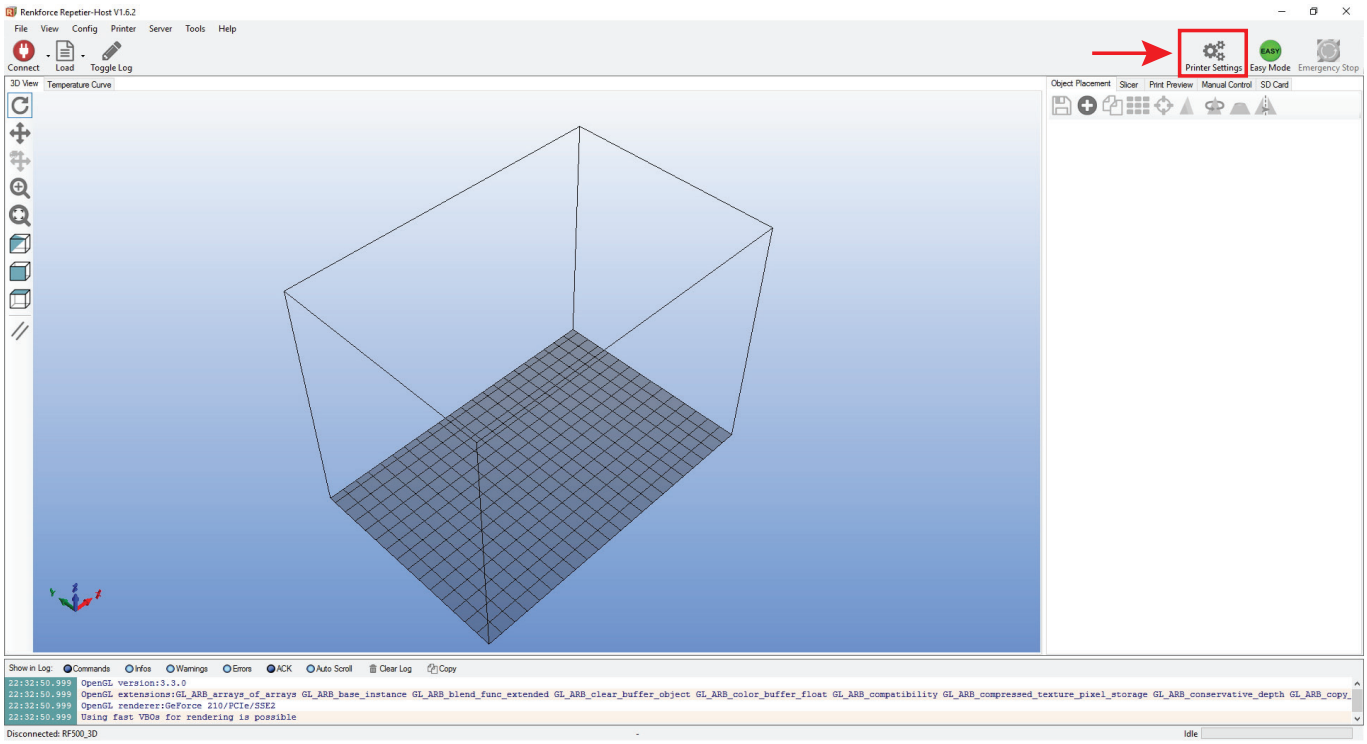
Microsoft .Net Framework 4 must be installed on the computer. This software can be downloaded free of charge from www.microsoft.com or installed subsequently in the operating system via the Windows® features.

The further system requirements for installation of Repetier-Host (also for other operating systems) are found on www.repetier.com.

Updates for Repetier-Host are regularly published under www.repetier.com. Updates of the custom version can be found on www.conrad.com in the download area on the product page of the 3D-printer.

c) Connection of the Connected Printer

Start the programme Repetier-Host and click on "**Printer Settings**" at the upper right in the window.



(1) Select the printer "**RF500_3D**" in the menu above.

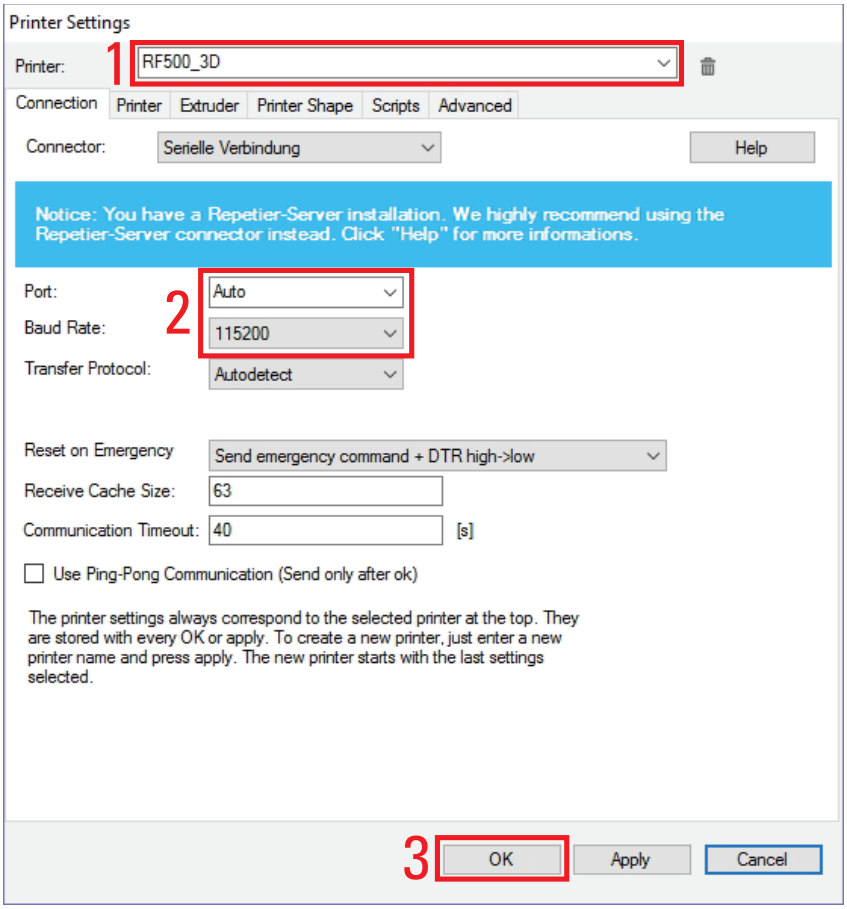
(2) Set the port and check the baud rate. If you have selected the right printer in (1), the baudrate (2) is already correctly pre-set to "**115200**".

→ The port number (2) is system-dependent. Usually, the setting "**Auto**" should work with the current version of the software (as of 1.6.2).

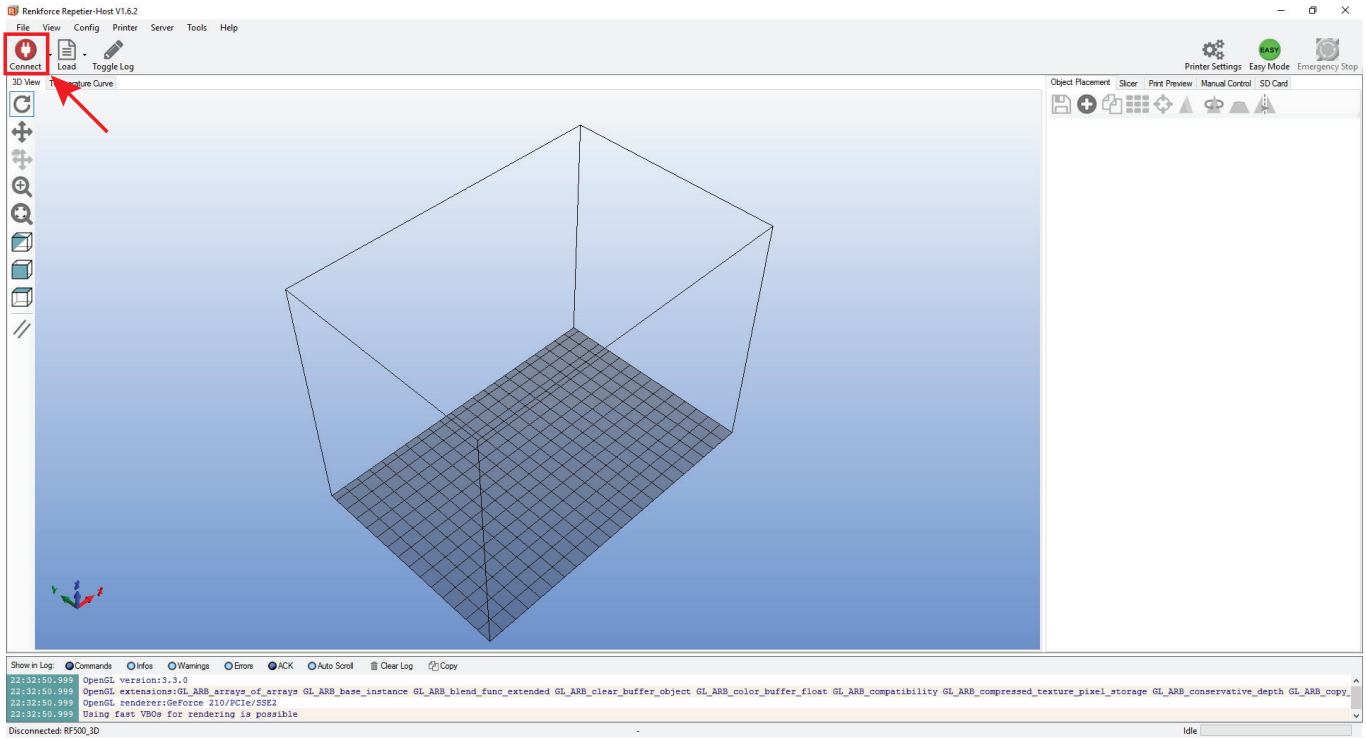
If this does not work properly for you, you can check the port in the device manager of the control panel, under connections (COM and LPT).

Then set the COM-port from the device manager in the software.

(3) Click "**OK**" (3).

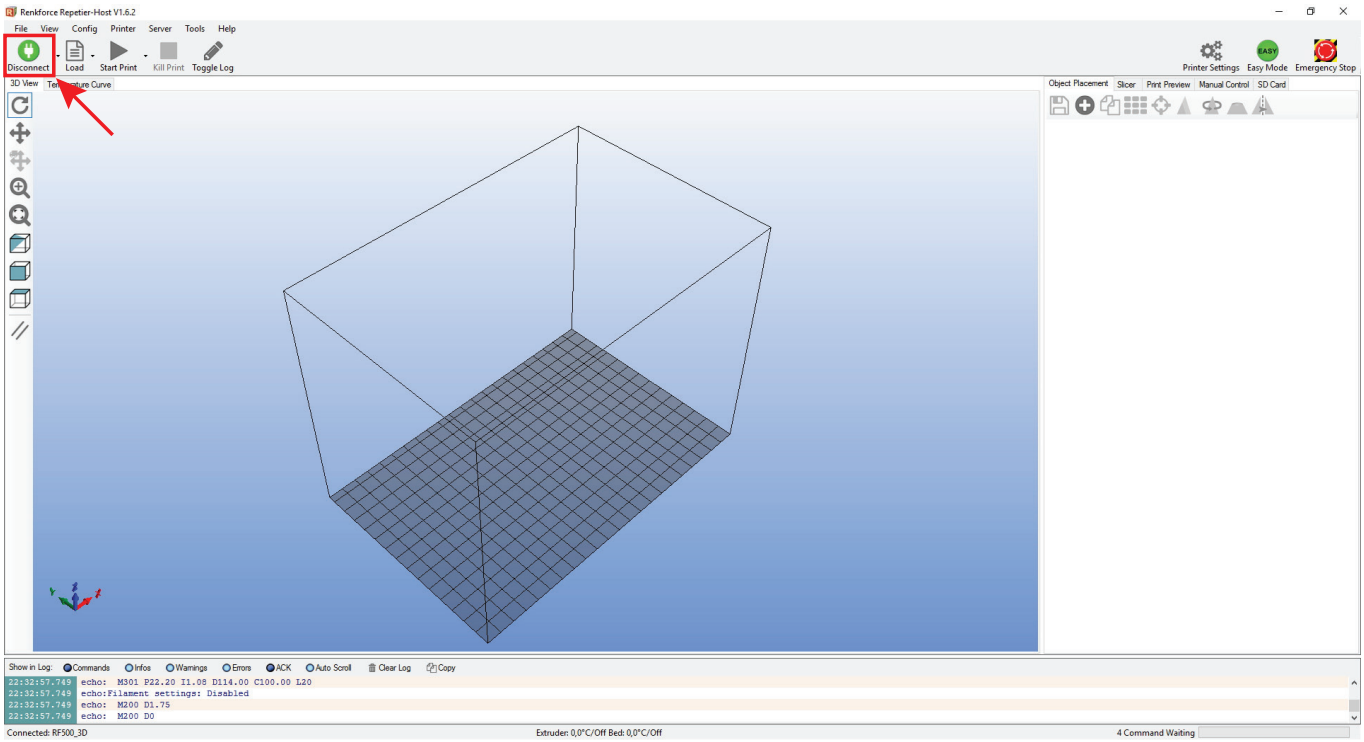


Click "**Connect**" in the upper left of the main screen of the software.



After a few seconds, the symbol appears in green and the label turns to "**Disconnect**".

The printer has successfully been connected to the software and only some manual settings can be tested.

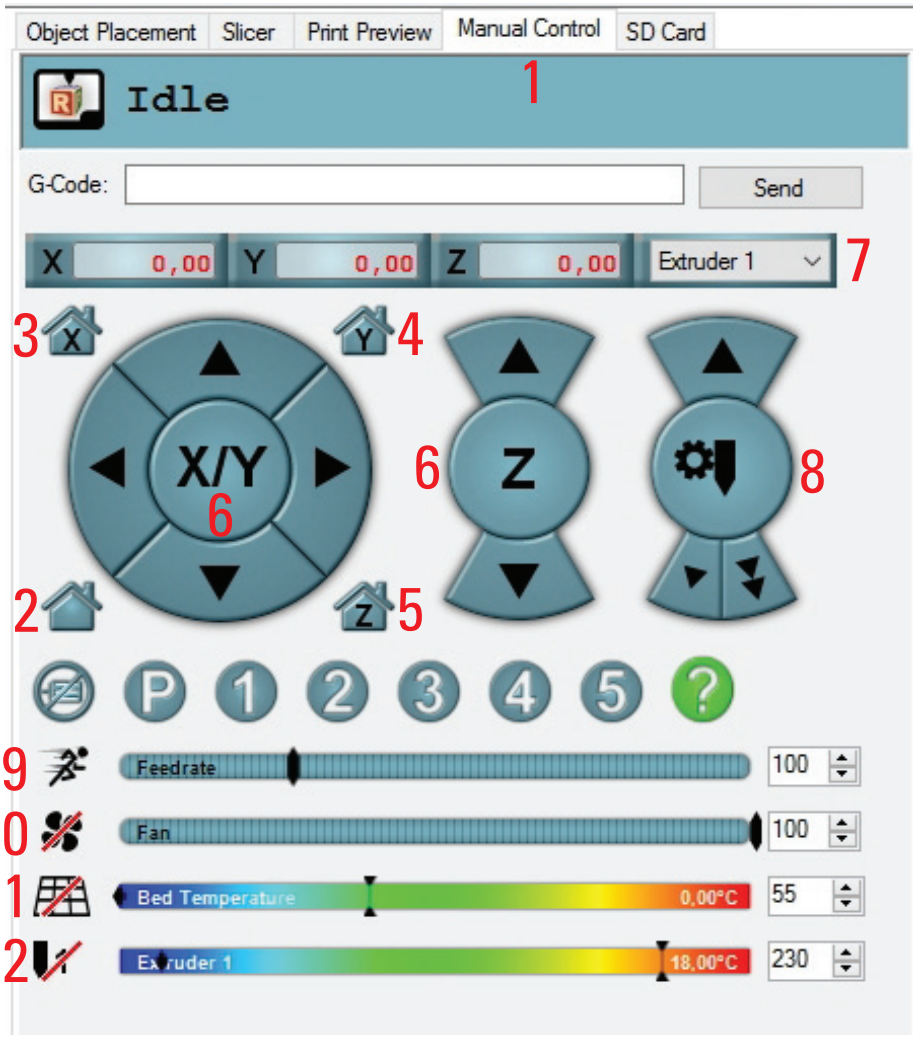


d) Manual Operation via the Software

Click the tab "**Manual Control**" (1) on the main screen of the software.

Before trying out manual printer control, the settings for the limit switches for the Z and Y axes must have been performed. In the preassembled device, the basic settings have already been performed at production but should be inspected again for reasons of safety.

If this is not observed, there may be damage to the 3D printer (loss of warranty/guarantee).



(2) All axes move into the home position

(3) X-axis moves into the home position

(4) Y-axis moves into the home position

(5) Z-axis moves into the home position

(6) The arrow icons can be used to operate the corresponding axes manually. Depending on where the arrow is clicked, differently long routes are run. The route length is displayed when the mouse pointer is moved across the corresponding button of the arrow.

(7) Selecting the extruder (optional)

(8) Filament feed for the chosen extruder (extruder must be heated up!)

(9) Setting of the printing speed

(10) Switching the fan on/off; To the right of this, the speed can be set

(11) Switching the heating bed (in the preassembled device or when using the optionally available heating plate kit) on/off; the temperature can be set on the right

(12) Switching the extruder heater for the 1st extruder (in the firmware extruder 0) on/off; To the right of this, the temperature can be set

e) Placement of a Printing Object in the Software

Click the "**+**" symbol on the main screen of the software in the object placement tab.

Select the desired file and click "**OK**".

⟶ Alternatively, you can also simply pull the file into the software.

The 3D object "drops" onto the printing plate in the main window.

⟶ The following file types can be opened with this software:

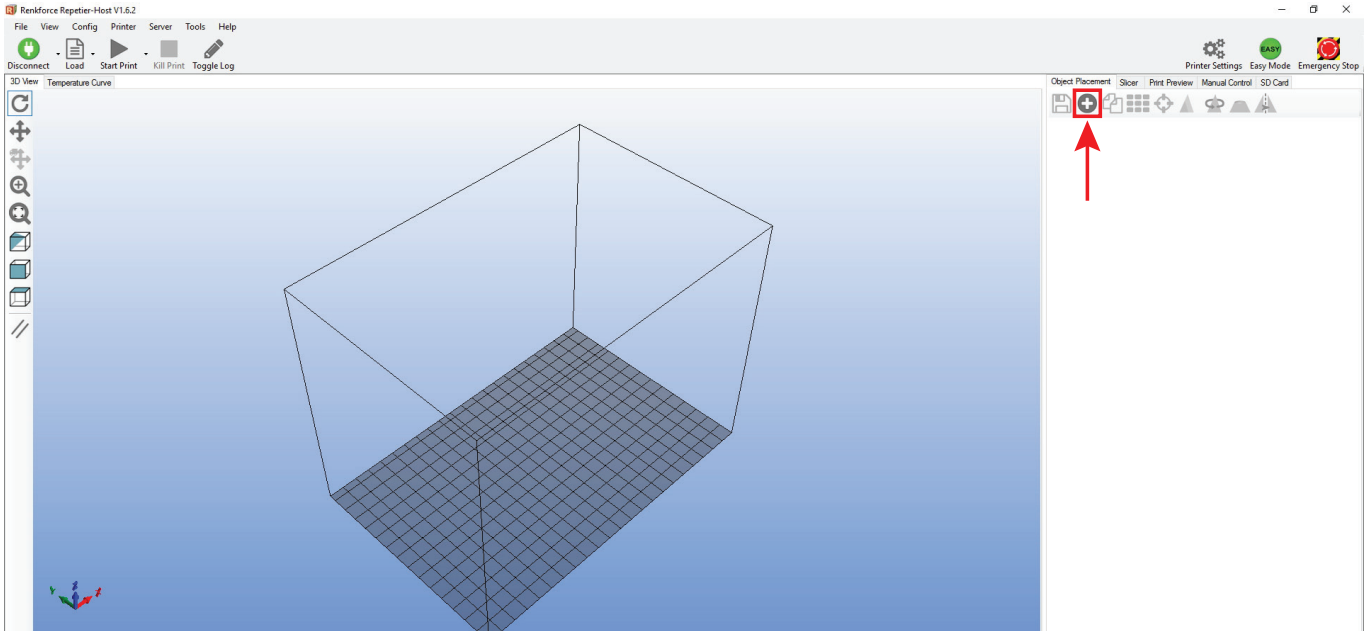
*.stl (STL-files)

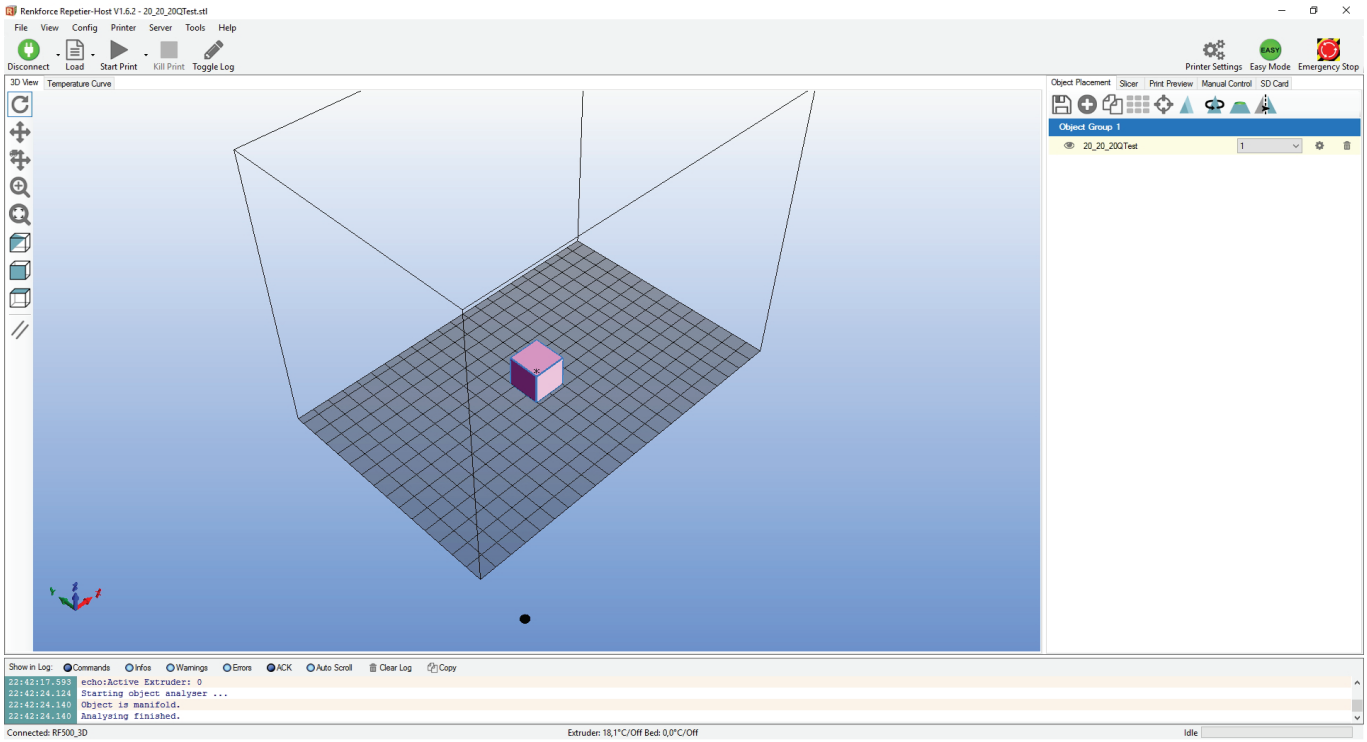
*.obj (OBJ-files)

*.3ds (3D-Studio-files)

In the folder "**STL**" in the download package, you will find a few examples for the first printing attempts. However, there are many places online where you can download 3D files (e.g. www.thingiverse.com).

Alternatively, you can, of course, also use a 3D programme to make your own.





Short description of the most important buttons in the "**Object Placement**" tab:

(1) Saving the object

(2) Adding objects (as described above); several objects can be addend

(3) Copying objects for multiple printing (in another window, the number of copies can be chosen)

(4) Centring the object on the printing plate

(5) Mirroring the object

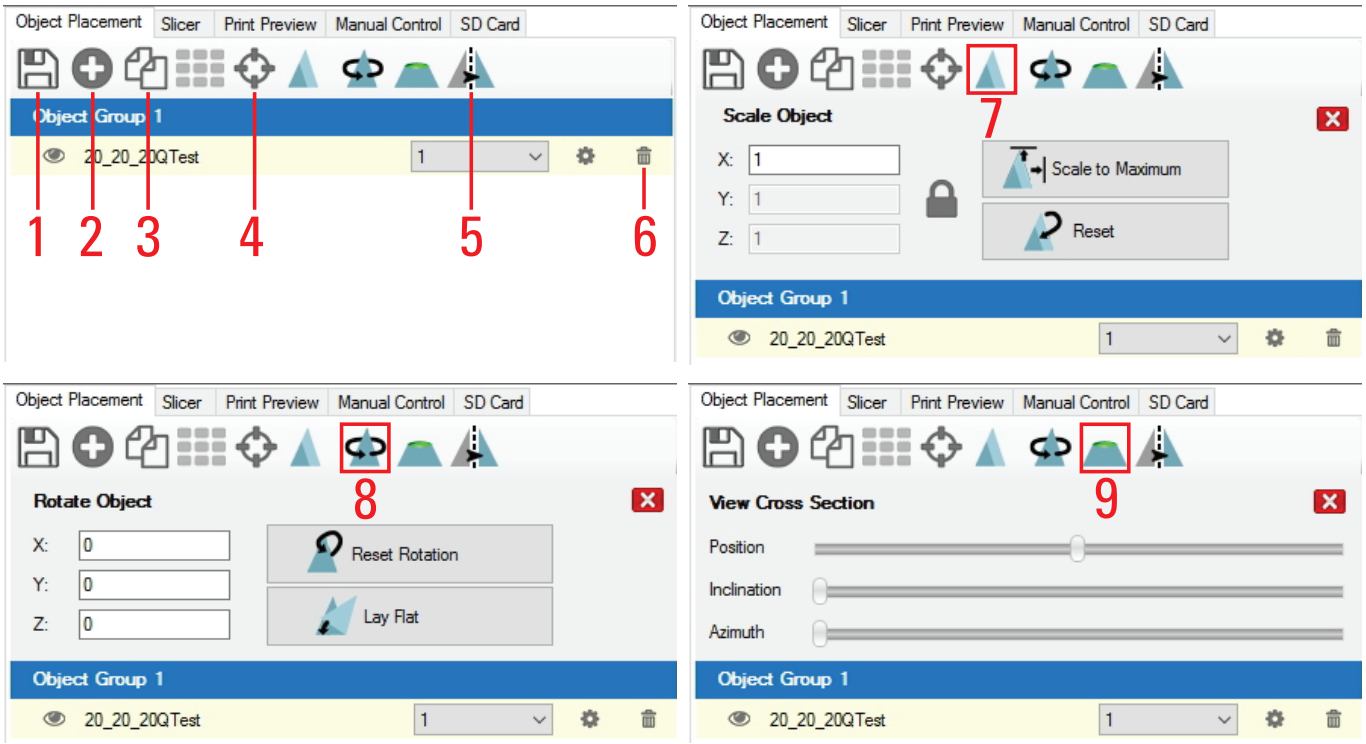
(6) Deleting the object from the printing plate

(7) Scaling the object

→ Use the scaling function to compensate the size retention of the printed object here as well. If it is known, e.g., that the filament material used shrinks by 2 %, set the scaling to the value 1.02 (this is an approximate reference value). After printout, you can measure the object and adjust scaling again if required.

(8) Turning the object

(9) Showing the cross-section of the object



f) Preparation for Print

To be able to print the object, it first needs to be sliced into individual printing layers. This process is referred to as "slicing".

Slicing of the placed printing object

(1) Select suitable slicer settings for your print.

The settings are always marked with the following routine:

Printer_Filament material_Layer thickness_Nozzle diameter

Example: **RF500_PLA175_200_04** =

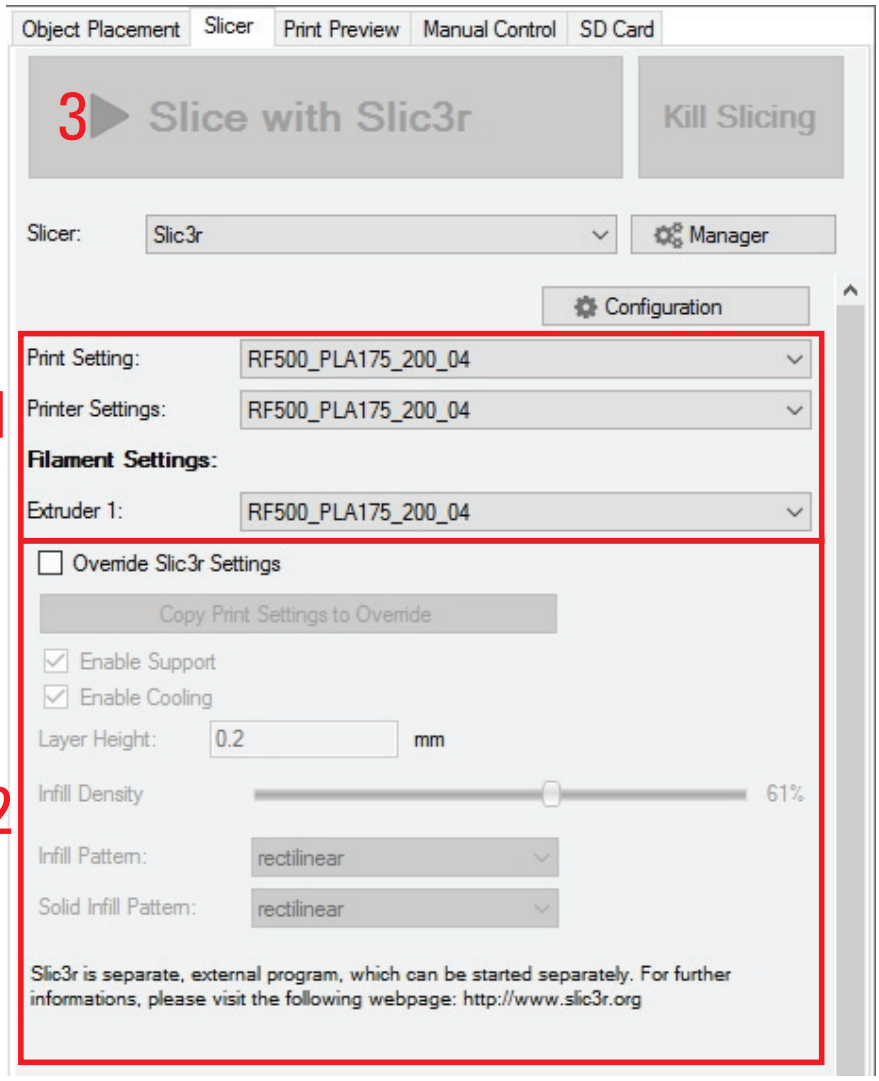
RF500_1.75 mm PLA_layer thickness 200 µm (= 0.2 mm)_nozzle diameter 0.4 mm

Always use the same settings in the input fields "Print Setting", "Printer Settings" and "Extruder 1".

→ The heating in the profiles for PLA is switched off by default. If you want to use these, you need to activate the function in the corresponding slicer profile (see chapter "19. h) More Detailed Description of the Slicer Functions").

(2) Further settings can be made optionally here. However, this should only be done by experienced users. For functions, see the online help function of the software.

(3) Click "**Slice with Slic3r**", to slice the 3D file.



→ The best printing results can be achieved with the profile with the smallest layer thickness. This would be the profile "**RF500_PLA175_100_ 04**". Printing will take longer accordingly.

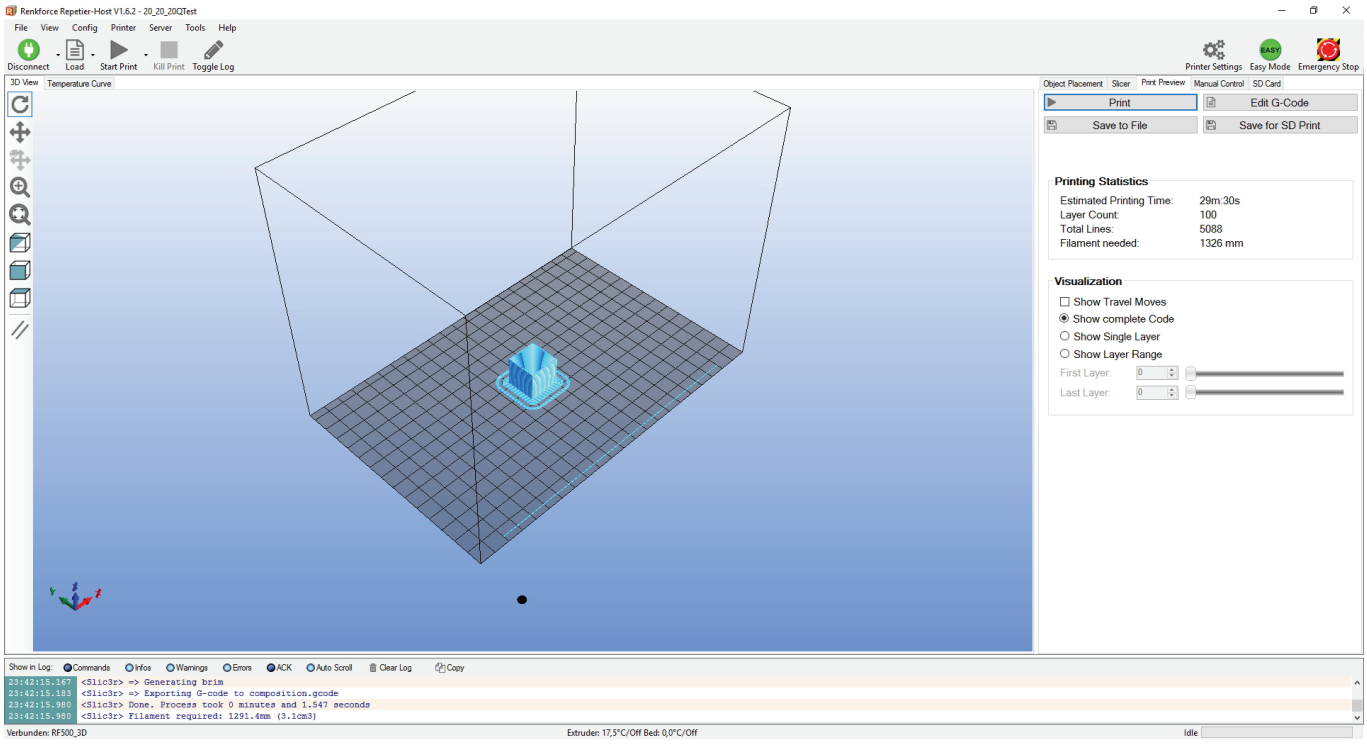
The preassembled printing file appears in the graphics window after calculation.

To the right of this, you will see a small overview for printing.

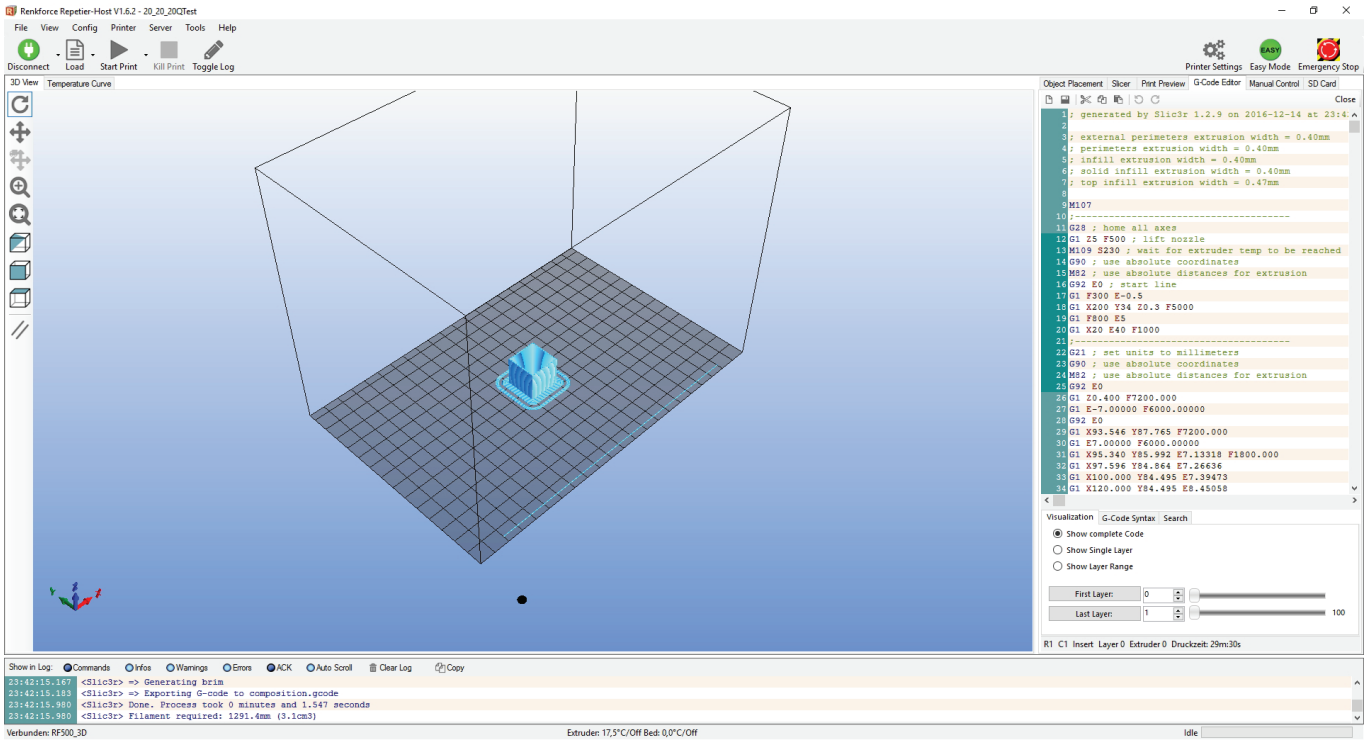
This layer view serves to check for errors before printing.

At the very left of the screen, there is a tool bar that serves view control.

⟶ For more detailed descriptions of the functions, see the online help function of the software.



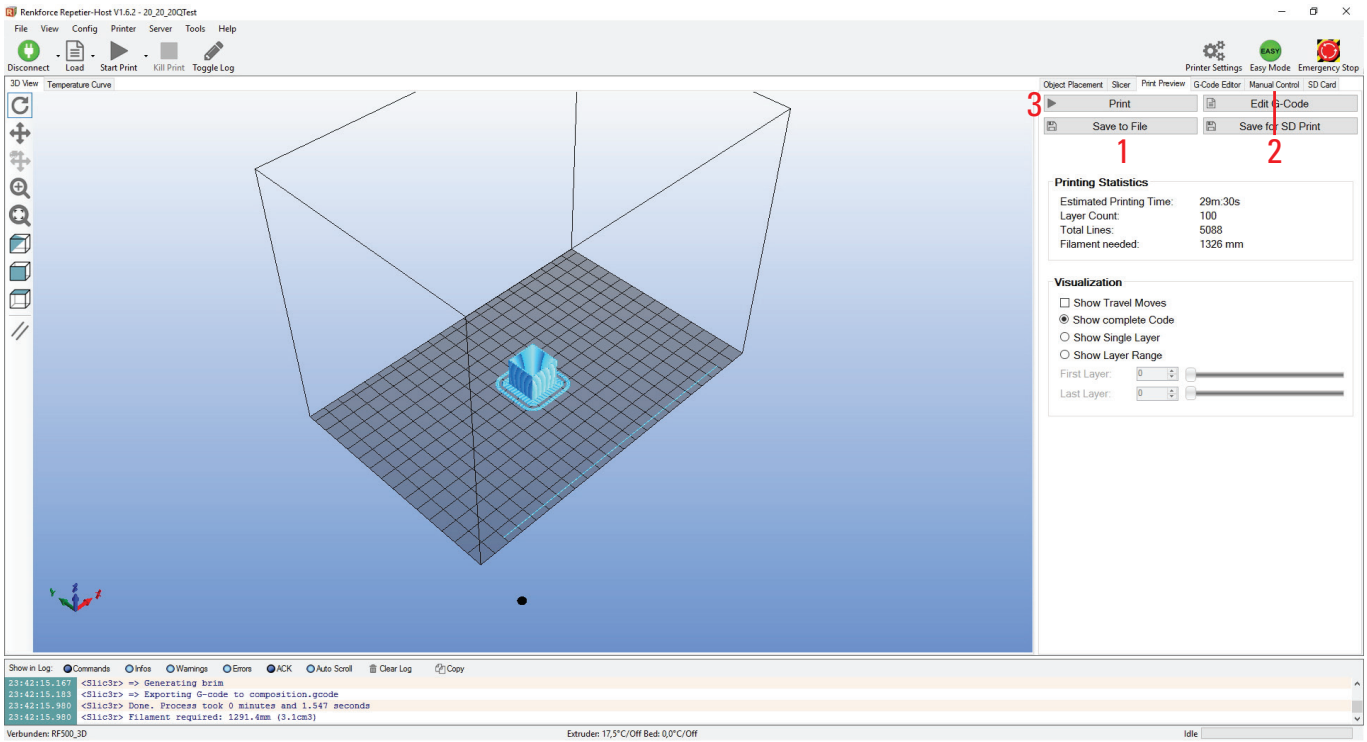
If you click "**Edit G-code**" at the upper right, the G-code editor will open and the G-code (the layer description) will be displayed. The control below can influence the layer view.

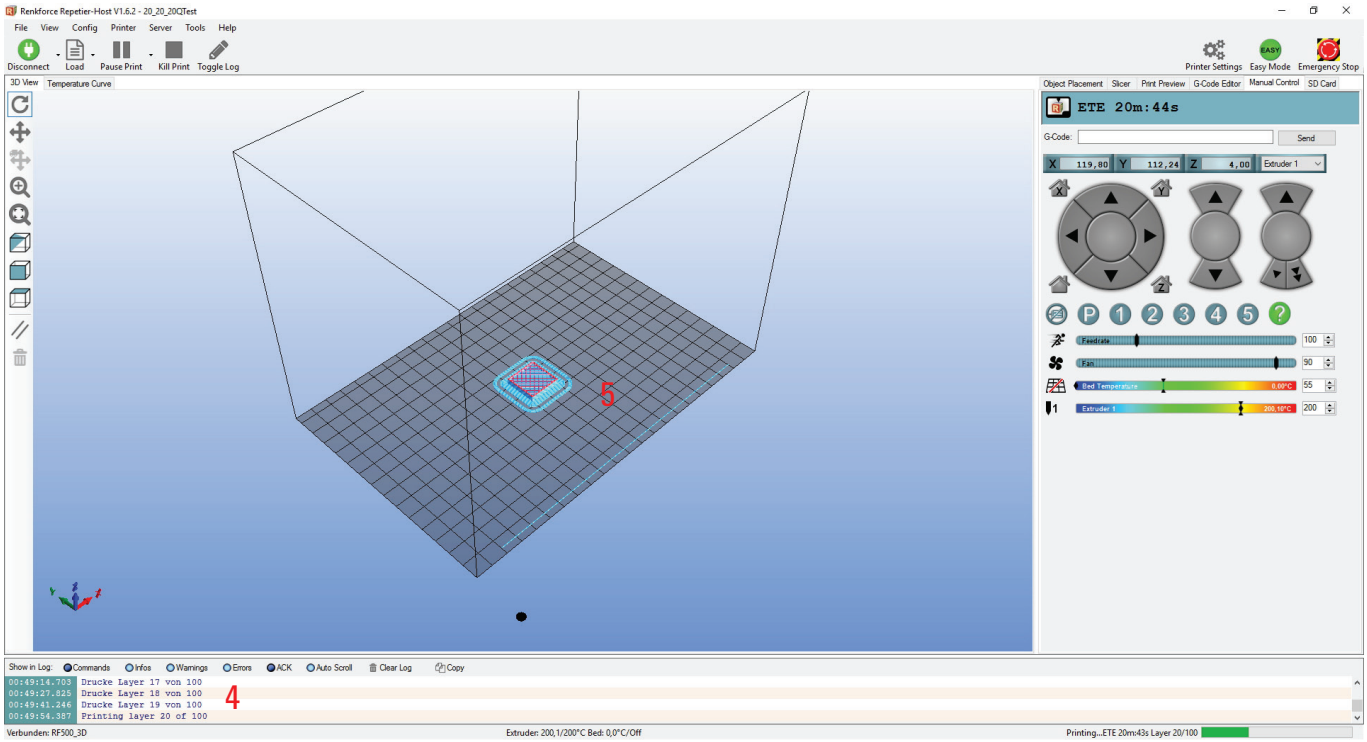


g) Printing

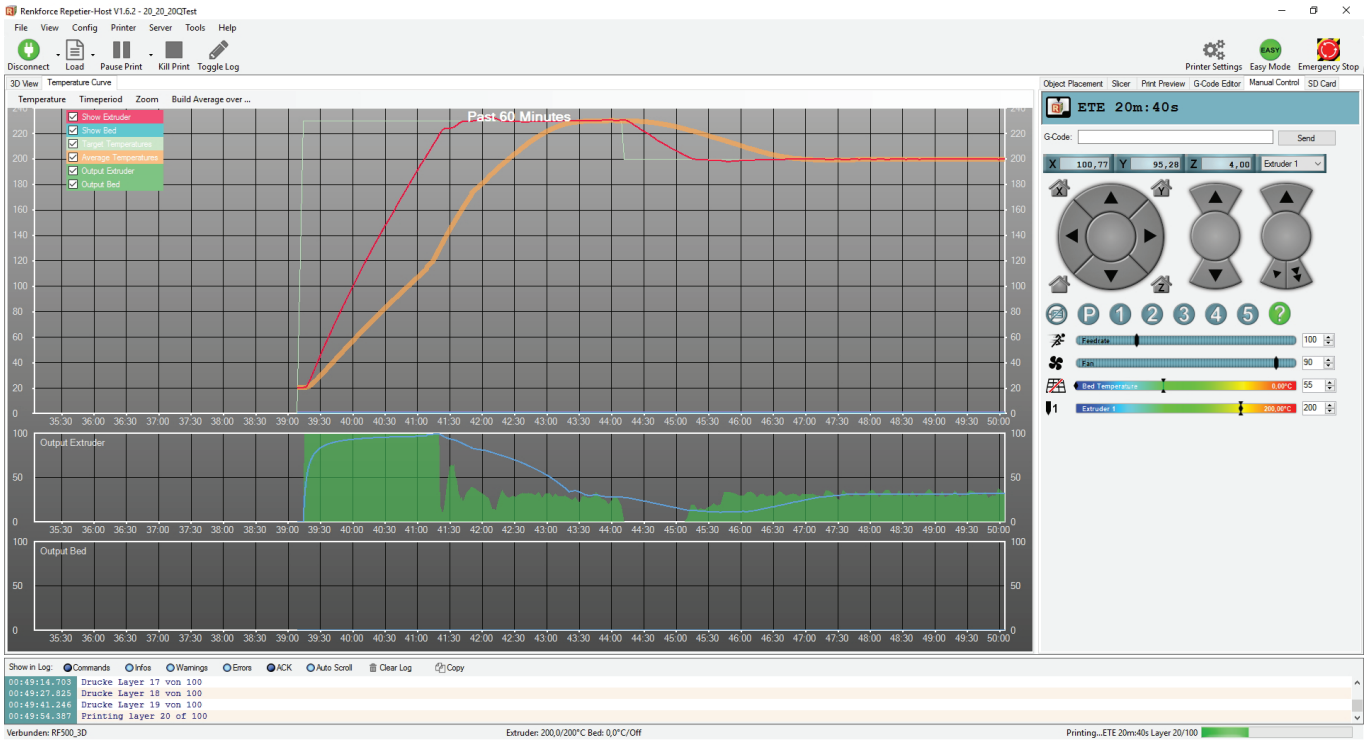
The printing file produced in this manner can be printed now. There are two options for this:

- Save the printing file on an SD card to print out stand-alone. For this, click "**Save to file**" (1). This saves the file as *.gcode and must be set at the same time when you save the file from the G-code editor (disc icon). The precise content of the G-code will be saved into the file here.
- The second possibility is to send the file directly to the connected 3D printer via the USB interface of the computer and print it.
- Click "**Print Preview**" and then the button "**Print**" (3), to start the printout.
- While printing, the log window (4) below the image shows current information on software, slicer and printer.
- You can also track progress of your print in the main window (5).





The graphics window may be switched to display temperature curves. There, the temperatures and their course are graphically displayed in a chart.



During the first centimetres of printing, the distance between the printing plate support and extruder can be carefully fine-adjusted manually with the 4 knurled screws at the bottom of the pressure plate. Turn all 4 knurls alternatingly and observe the printed line.

For this setting, observe that the extruder must not touch the printing plate support since it may be damaged otherwise (loss of warranty/guarantee).

It is possible that filament chips collect over time at the filament feed knurl. They should be removed under all circumstances (if possible) at once, e.g. by blowing off. Check and clean the filament feed knurl regularly! Otherwise, it is possible that the chips will adhere to the knurl and that no filament can be conveyed anymore because of this (the knurl slips through then).

→ The fan at the extruder runs by default from 4th layer for PLA and ABS, provided that the slicer settings have not been changed.

If the fan does not run properly, check if it may be attached unevenly.

When you use the preassembled device or the optional heating plate kit, let the printed object cool off for a few minutes after printing. When the temperature of the heating plate is below 40 °C (see display), the printed object comes free from the heating plate and you can remove it.

If the printed object does not come loose easily, you can loosen it carefully with a glass scraper, razor blade spatula, knife, etc.

Do not apply any mechanical force to the printing plate or the printing plate support, since this may damage the printing plate, or the glass plate (only maker construction kit) may break! Loss of guarantee/warranty!

→ To ensure stable operation, print from SD card for longer printouts. Otherwise, it is possible that printing is interrupted because the printer is restarted via the USB interface. This can be caused by restarting the PC, re-initialising the USB controller or by a virus scanner.

h) More Detailed Description of the Slicer Functions

Below some settings of the slicer are explained that are only to be changed by experienced users. The use of wrong settings can result in damage to the 3D printer or defective printouts.

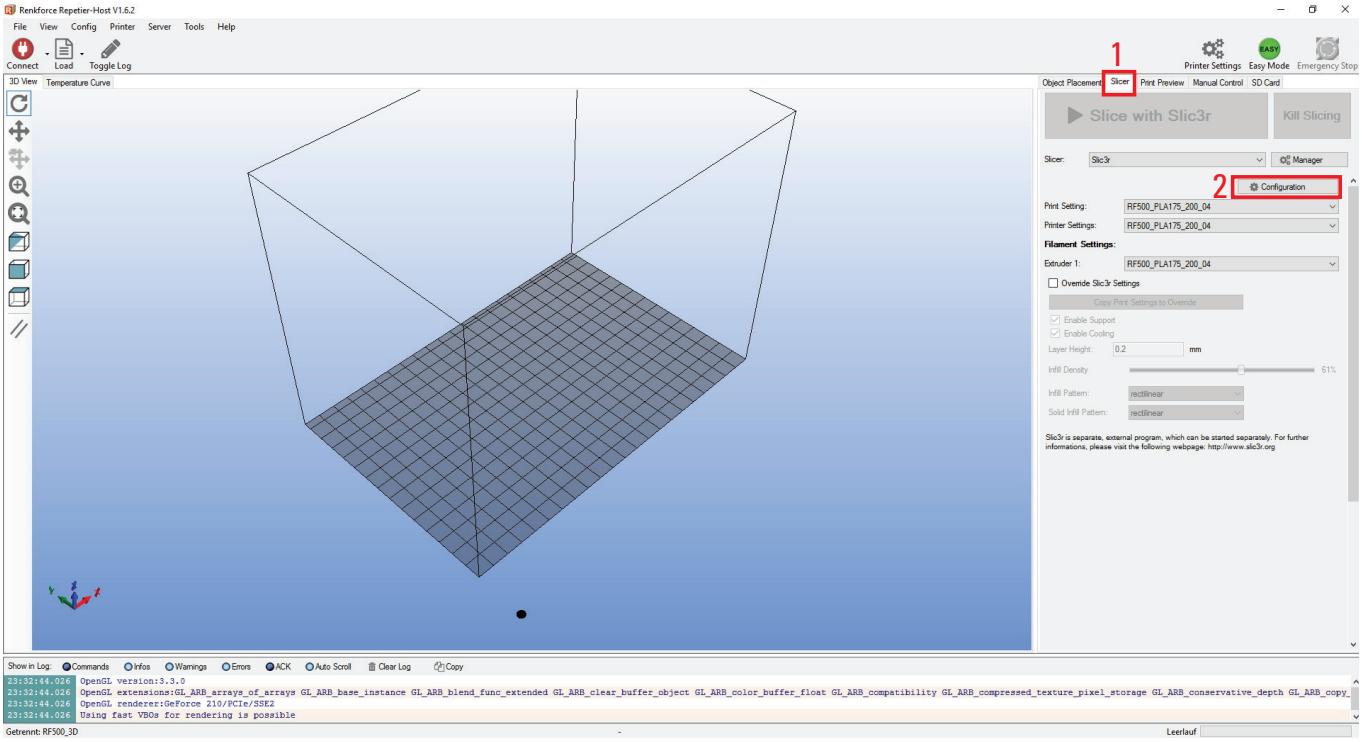
Beginners should first work with the basic settings that are integrated in the custom version in any case.

→ If you make any changes to the settings, these must be saved in the configuration settings by clicking the disc icon.

Save the different settings as a configuration setting. Assign unique names for the different configuration settings so that you can assign them uniquely to the different filament types, print resolutions, etc. later.

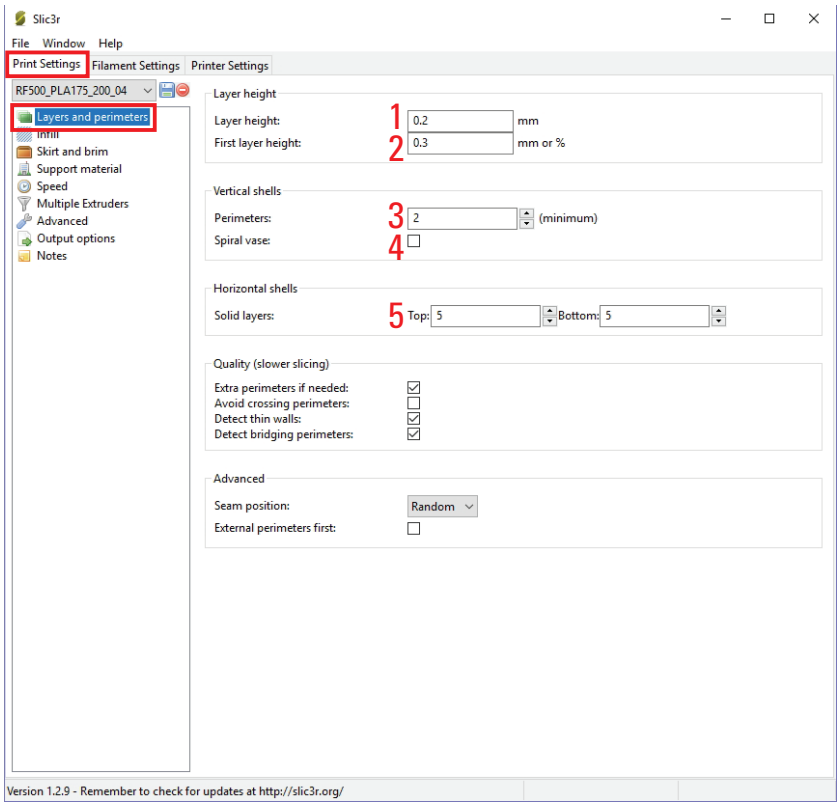
For more information, read the integrated online help function.

Click the software in the tab "**Slicer**" (1) to "**Configuration**" (2) in the right window.



The Slicer window is opened (this may take a few seconds).

Print Settings



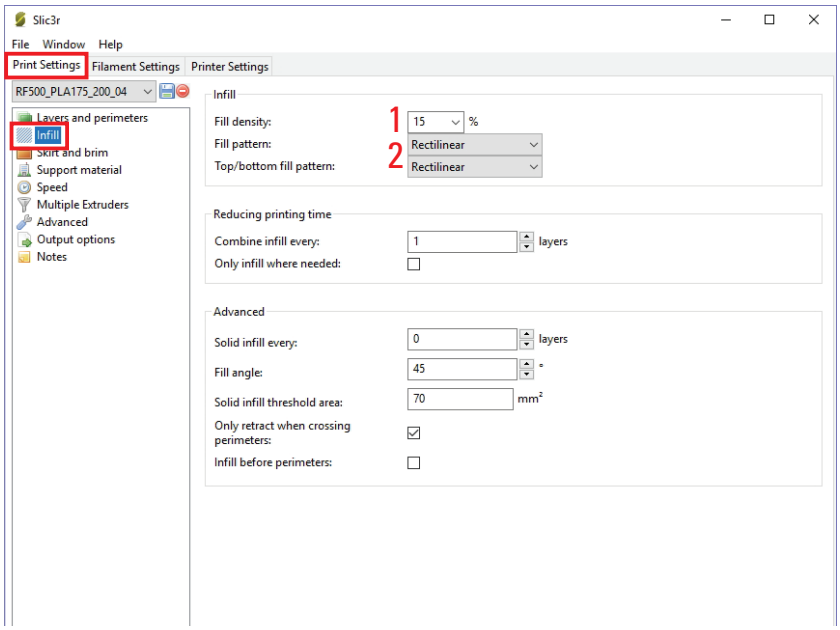
(1) Layer height (resolution of the printed object)

(2) Layer height of the first layer (influences the adjustment and adhesion on the printing plate; set the first layer a little thicker than the following layers)

(3) Number of the outer wall layers

(4) Activate for hollow bodies (e.g. vases)

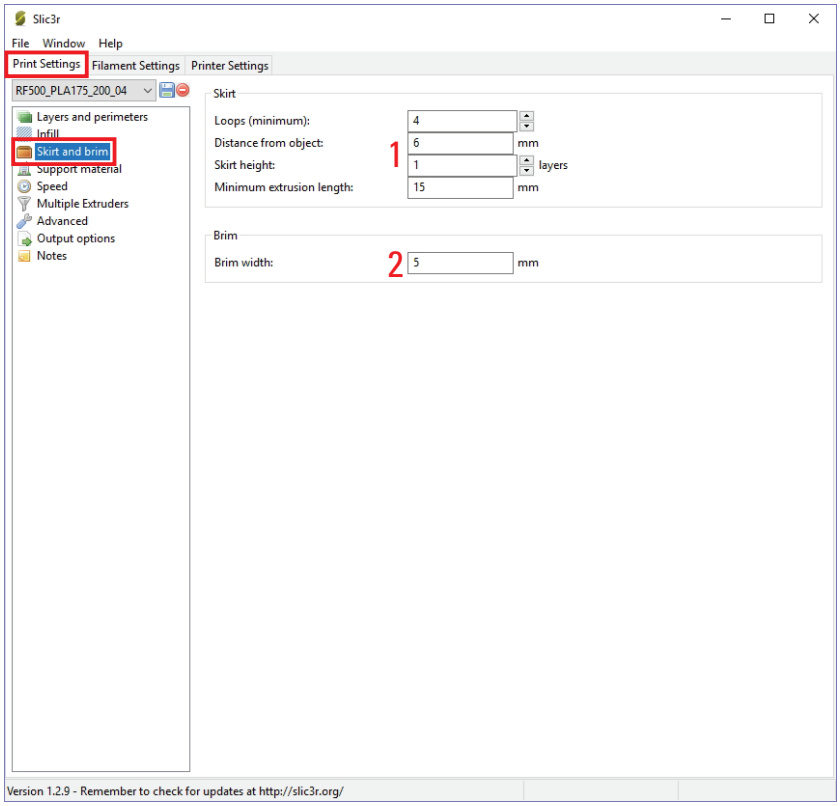
(5) Filled layer number top/bottom



(1) Object filling (0-100%)

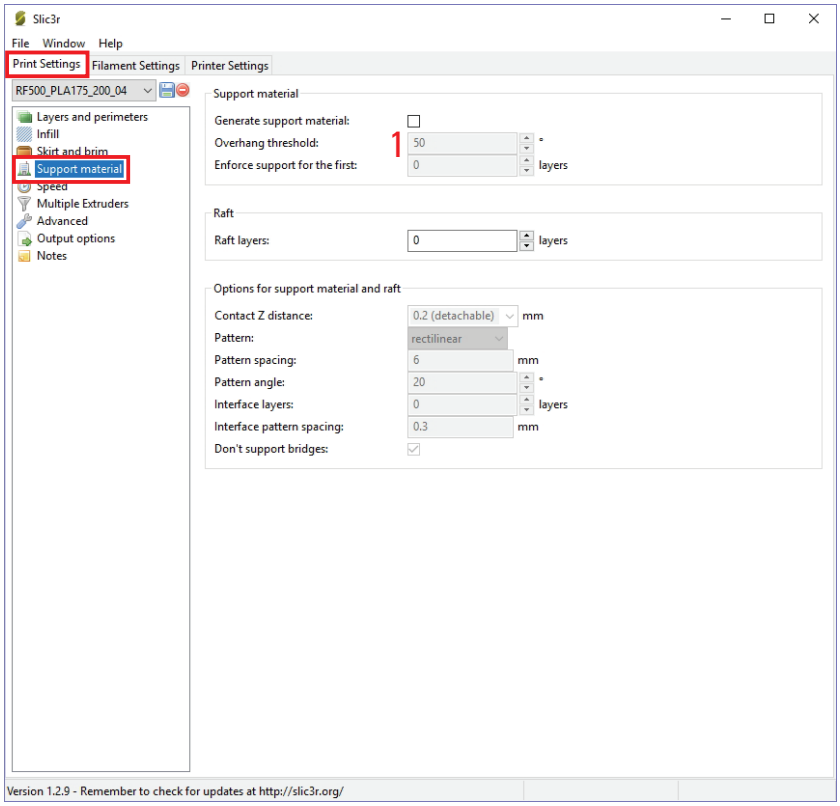
⟶ We recommend object filling of 10% to 40%.

(2) Filling pattern of the object and the first and last layer



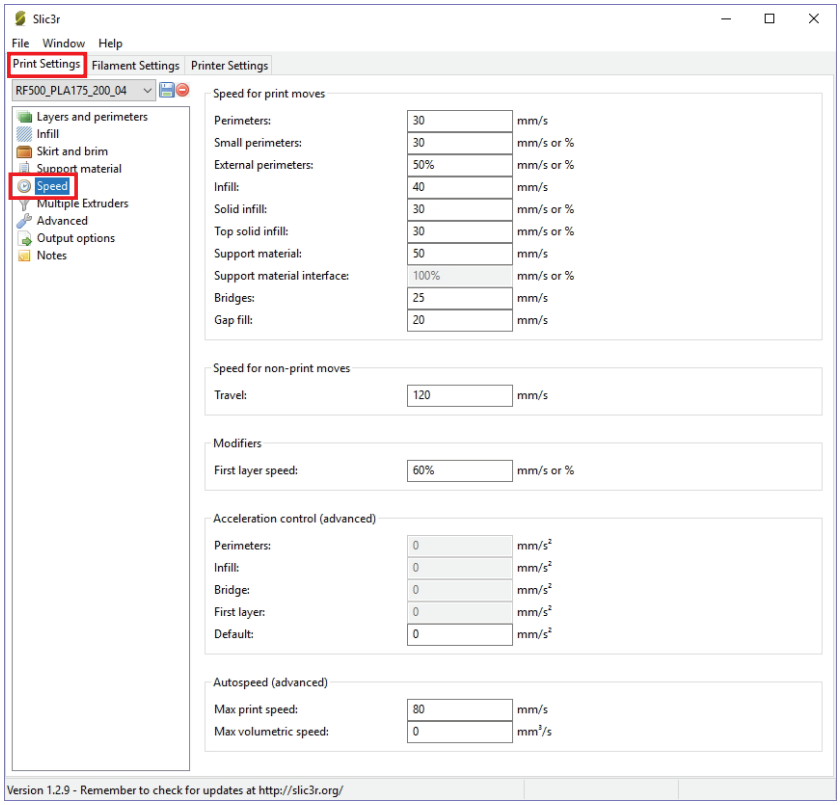
(1) Loops are circles, that are drawn around the object when printing starts, stabilise the filament flow before the actual object is printed. Here, number, distance from the object, height and minimum length are specified.

(2) "**Brim**" is a thin edge that is placed right around the object to increase the footprint and thus adhesion to the printing plate. Here, the width of the brim is specified.

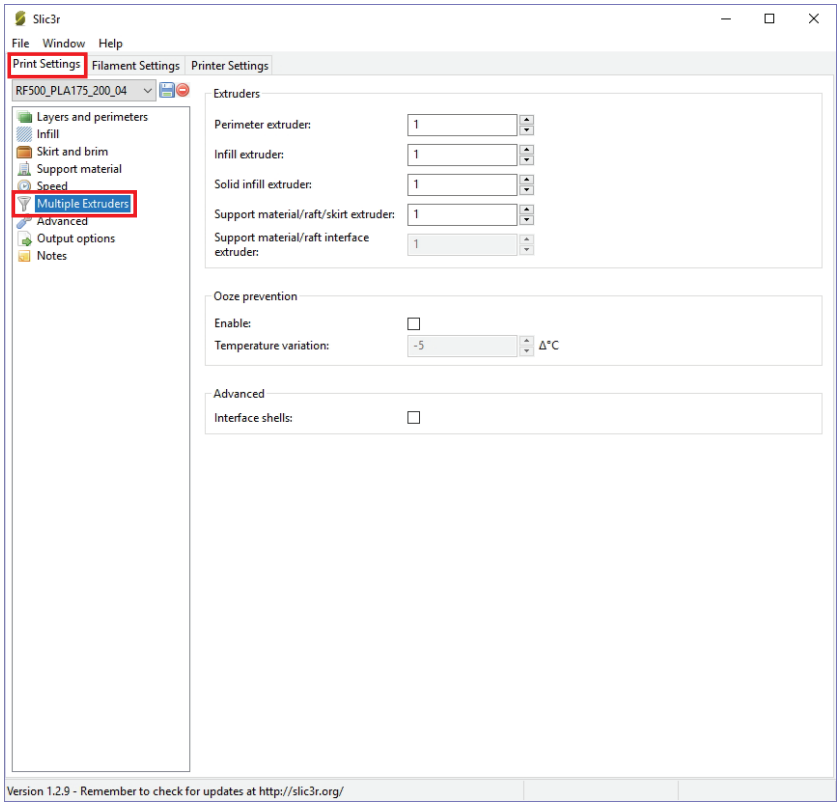


(1) Selection and adjustment of the supporting material that is needed when printing complex objects such as bridges or hollow spaces (poss. required for printing object with overhangs > 45°).

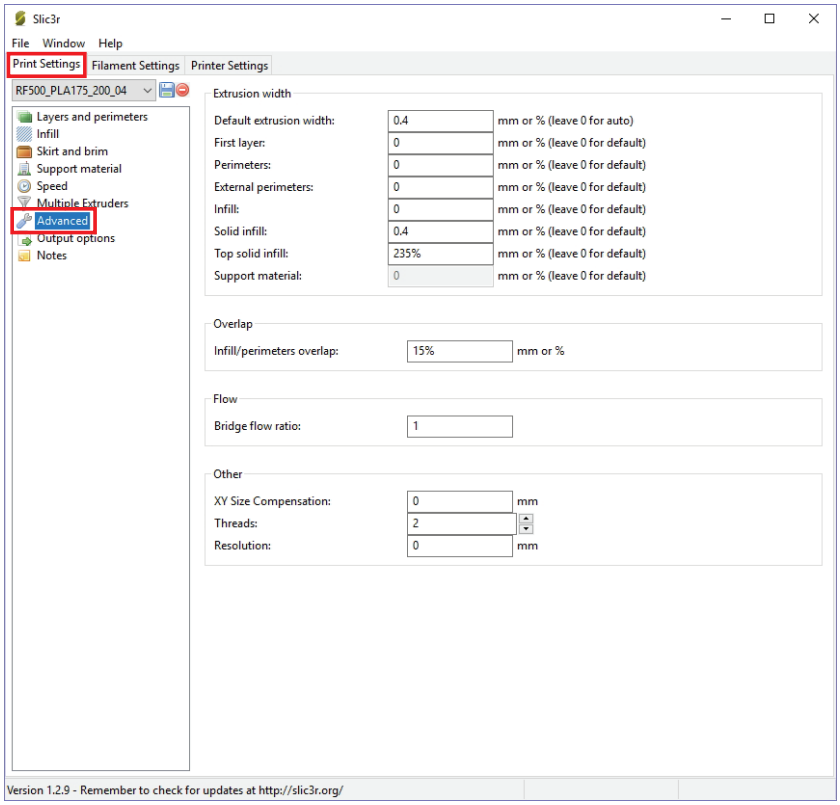
⟶ The first printing attempts should be without a supporting brim since the result here is usually better again.



You can set or adjust all speeds here. Chance the values only in small steps.

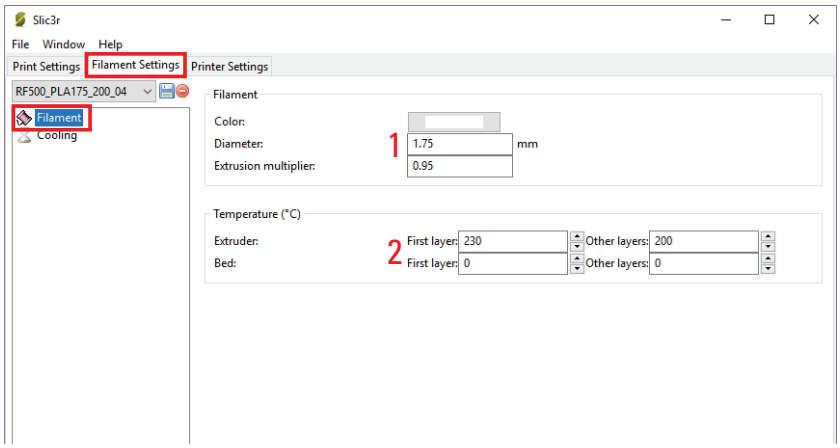


Set the number of extruders here.



The extrusion width for all the different print versions can be set here. The extrusion width is the width of the output plastic thread. E.g., this may be increased at the first layer, so that the bottom of the printed object becomes denser.

Filament Settings



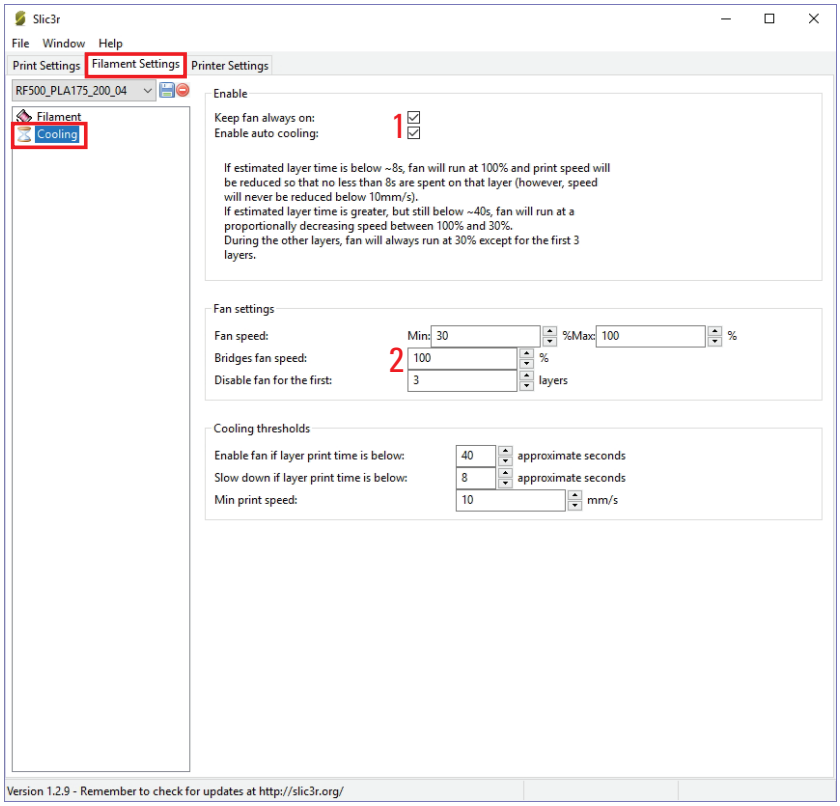
(1) Filament diameter and filament diameter tolerances according to the manufacturer's specifications are set here. If no manufacturer's specification is present, these values can also be measured with a calliper (measure 1 m of filament material in 10 different points and then set the average here).

(2) Temperature setting for the extruder and heating bed (in the preassembled device or when using the optionally available heating plate kit) separated by first and all other layers.

→ In some settings (e.g. PLA), the heating is deactivated by default. If this is to be used, the function needs to be activated first by setting a temperature.

Observe the settings recommended by the filament manufacturer!

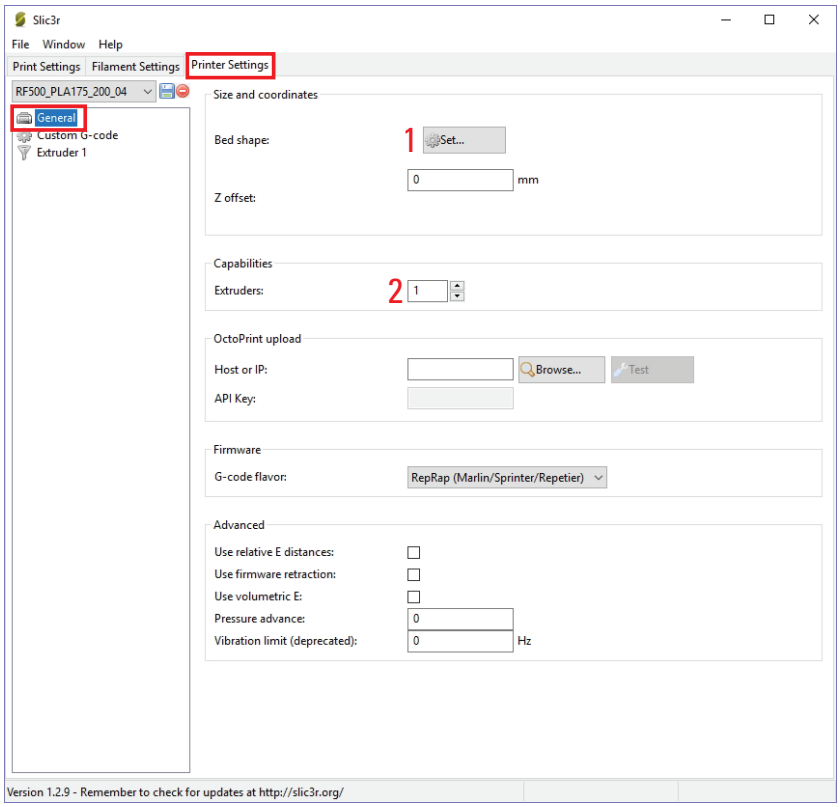
Since the best values may fluctuate extremely depending on the filament manufacturer, perform your own tests based on the presettings to achieve the best printing quality. When performing the tests, proceed in 5 °C steps and compare the results during or after printing with other settings. The first layer should always be printed a little more hotly for better adhesion on the printing plate.



(1) Here you can choose between automatic cooling and permanent operation of the fan at the extruder.

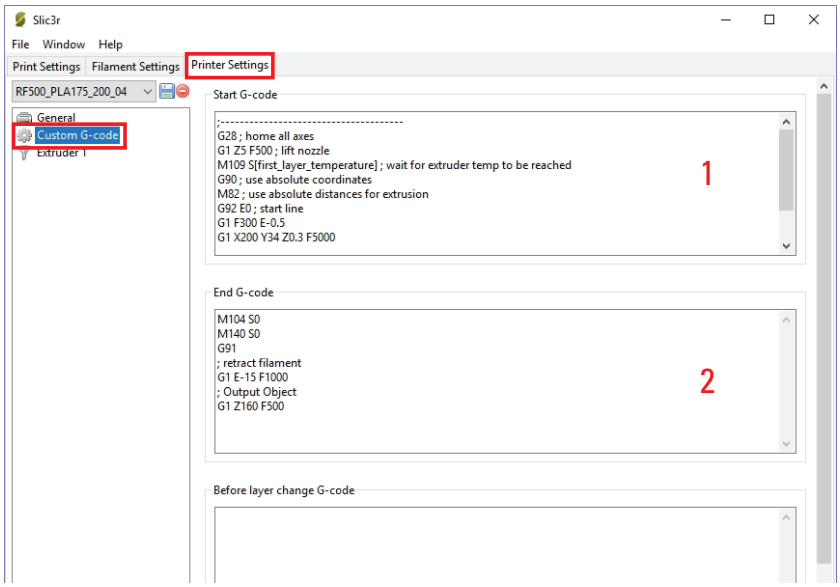
(2) Setting of the fan speed.

Printer Settings



(1) Geometric data of the printing plate

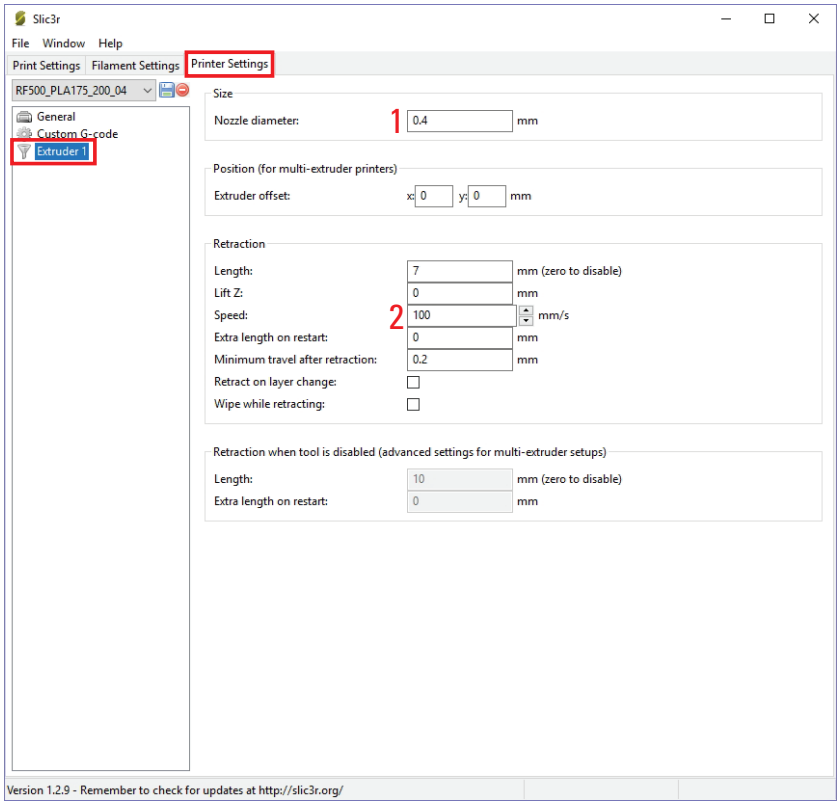
(2) Number of the extruders



(1) The starting code contains the first commands that the 3D printer performs.

(2) The end code will be performed at the end of the print and could contain, e.g. the run into a removal position for the printed object.

⟶ Detailed information on the G-Codes can be found, e.g., in **http://reprap.org/wiki/G-code**.



(1) Setting of the nozzle diameter

(2) Settings for the filament withdrawal if the extruder moves to another position of the printed object during printing. If the filament was not withdrawn here, there would be drop or string formation that would negatively influence printing quality.

i) Setting up Another Slic3r Version

⟶ This chapter describes how to set up another version of the slicer "**Slic3r**", e.g. if you want to use an older version as well or if a new version has been published since.

- First download your desired version of Slic3r. You can find the corresponding download under the following address.

  http://slic3r.org/download

  Then click the button "**Windows**".

  If you want to download an older version, click the folder "**old/**" in your web browser.

  Download the desired file.

  In our example, we have chosen experimental version 1.2.7 in 64 Bit and downloaded the following zip archive:

  "**slic3r-mswin-x64-1-2-7-experimental.zip**"

- Once the download is complete, best unpack the archive still in the download folder.

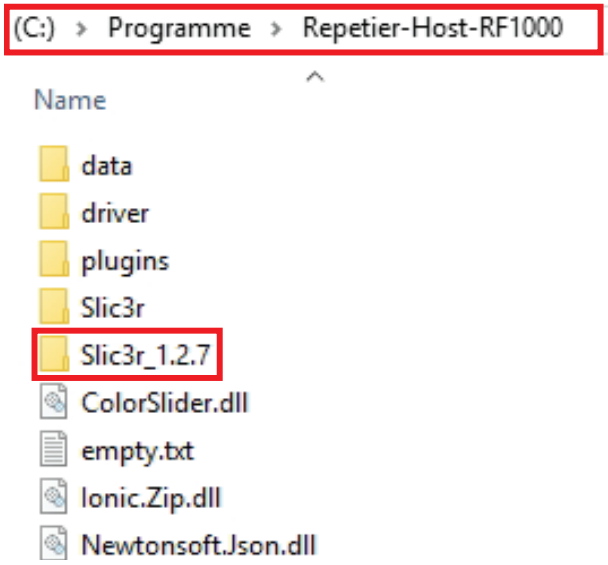
- Rename the unpacked folder "**Slic3r**". Adding, e.g., the version number is recommended here.

  "**Slic3r_1.2.7**"

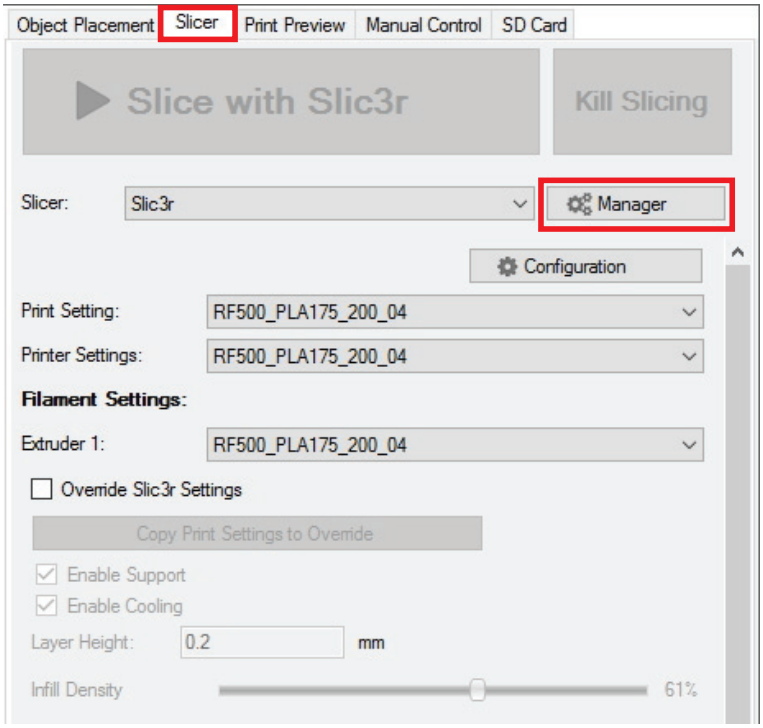
- Copy this renamed folder or, best, move it into the program directory of the Repetier-Host software. This is also the program directory of the original Slicer.

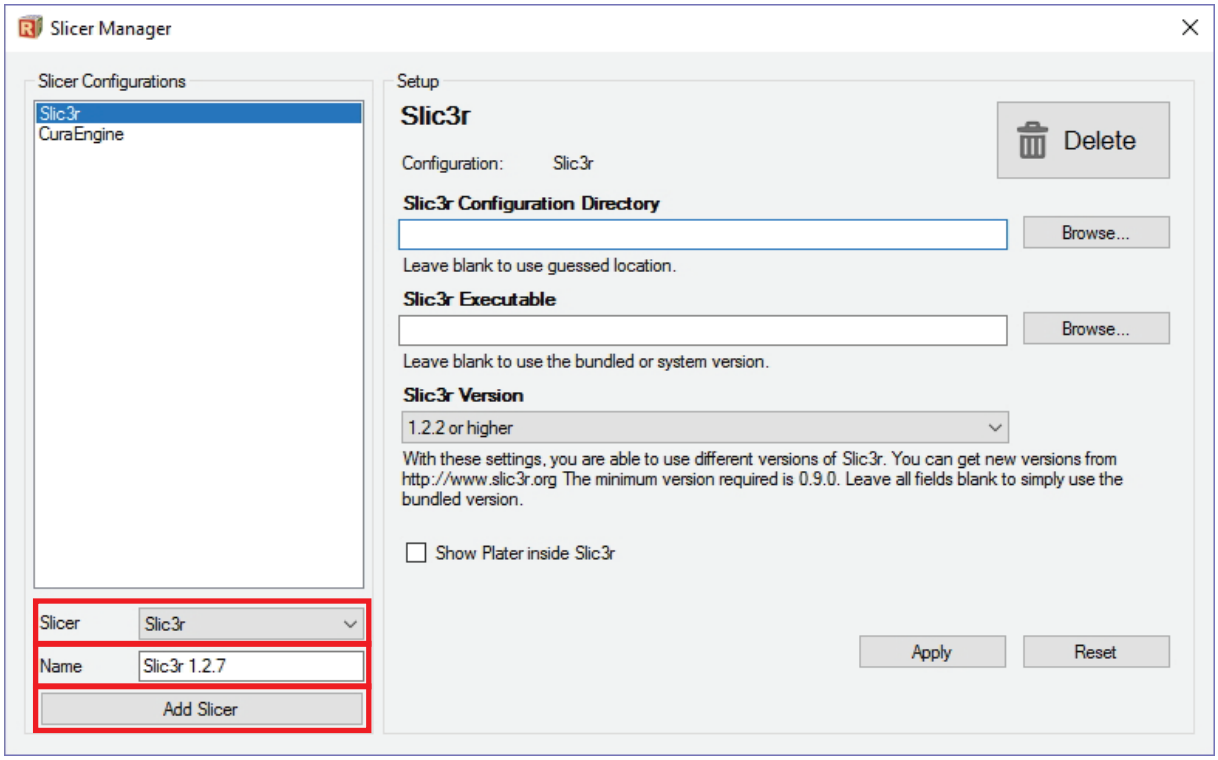
  \Programme\Repetier-Host-RF1000

⟶ Attention! If you do not rename the unpacked folder "**Slic3r**" and still copy it into the directory, the already-existing folder "**Slic3r**" in the directory "**Repetier-Host-RF1000**" will be overwritten!

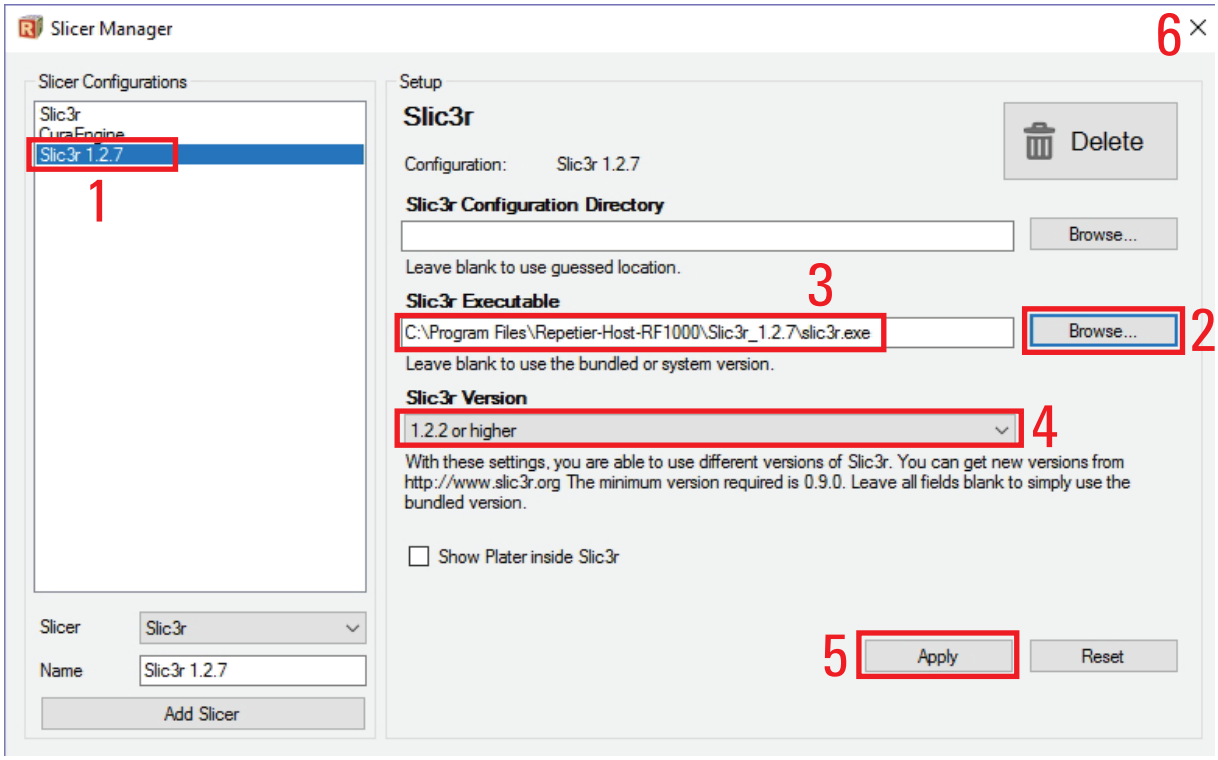


- Now open the Repetier-Host software.
- Click the tab "**Slicer**" and then the button "**Manager**".



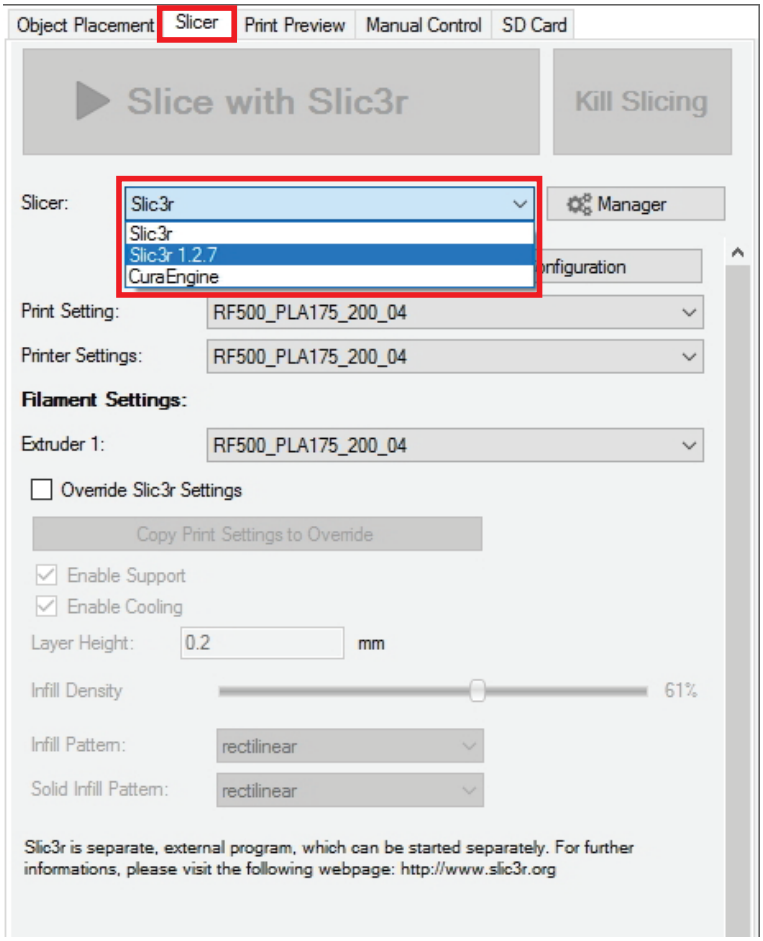


- In the menu "**Slicer**", choose the desired Slicer that you want to integrate. In our example, this would be the standard selection "**Slic3r**".
- In the field "**Name**", enter the desired name and confirm by clicking "**Add Slicer**".



- Select the newly added Slic3r by clicking it (1).
- Right-click "**Browse**" (2).
- Navigate to the new Slic3r program directory in the window that opens and select the starting file, in our example "**slic3r.exe**", by double-clicking (3).
- Select the "**Slic3r**" version (4) and confirm with "**Apply**" (5). Close the window with the X in the upper right corner (6).

- In the tab "**Slicer**", select the newly added slicer in the drop down menu to slice an object.



⟶ The settings "**Print Setting**", "**Printer Settings**" and "**Extruder 1**" are the same for both versions of the Slic3r.

⟶ Of course, the configuration menu "**Manager**" also permits integrating another Slicer. The configuration here is similar, but is individually customised to each slicer, of course.

20. Firmware Update

The firmware of the main PCB is updated frequently to optimise the properties of the 3D printer.

The currently installed firmware version of your printer is briefly displayed in the upper display line after switching on the printer.

⟶ New versions of the firmware are contained in the download package "**BUNDEL_Vx_x_x_RENKFORCE_RF500**".

Update process

The printer must be connected to the USB interface of the computer and must not be connected to any other software (for Repetier-Host, e.g. click "Separate").

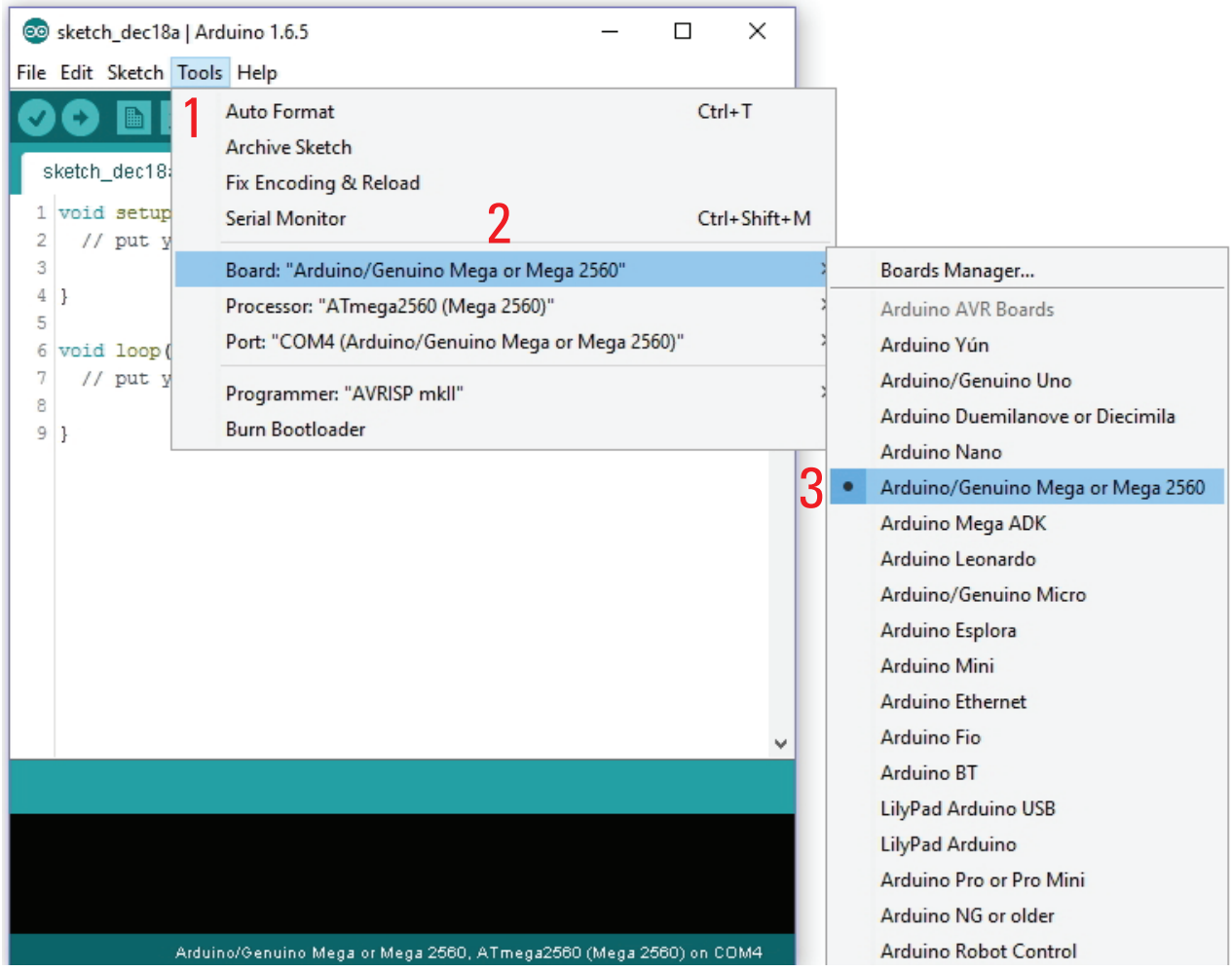
Use only Arduino version 1.6.5. The links for download can be found below or in the download package. The first link leads to the main page. You can find the download there in "PREVIOUS RELEASES". The second link downloads the right version as a ZIP file and the third link as EXE file for installation.

https://www.arduino.cc/en/Main/Software

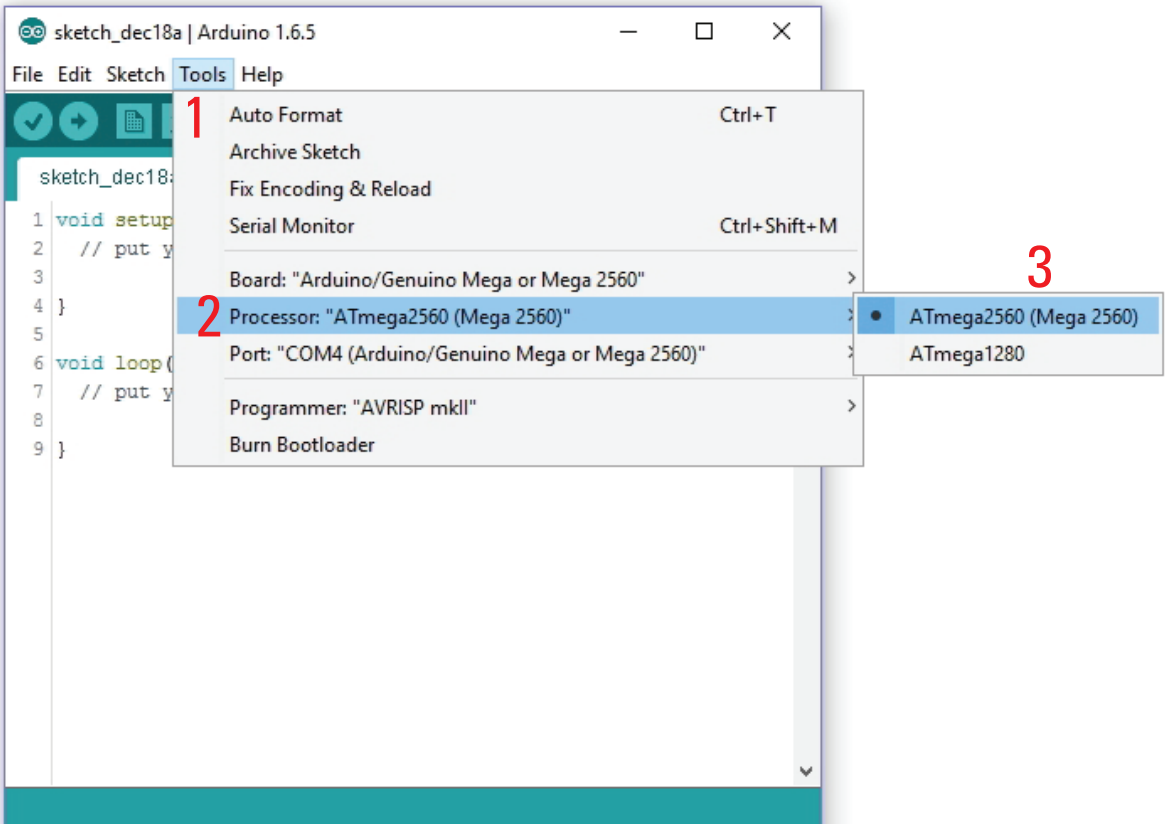
https://www.arduino.cc/download_handler.php?f=/arduino-1.6.5-r5-windows.zip

https://www.arduino.cc/download_handler.php?f=/arduino-1.6.5-r5-windows.exe

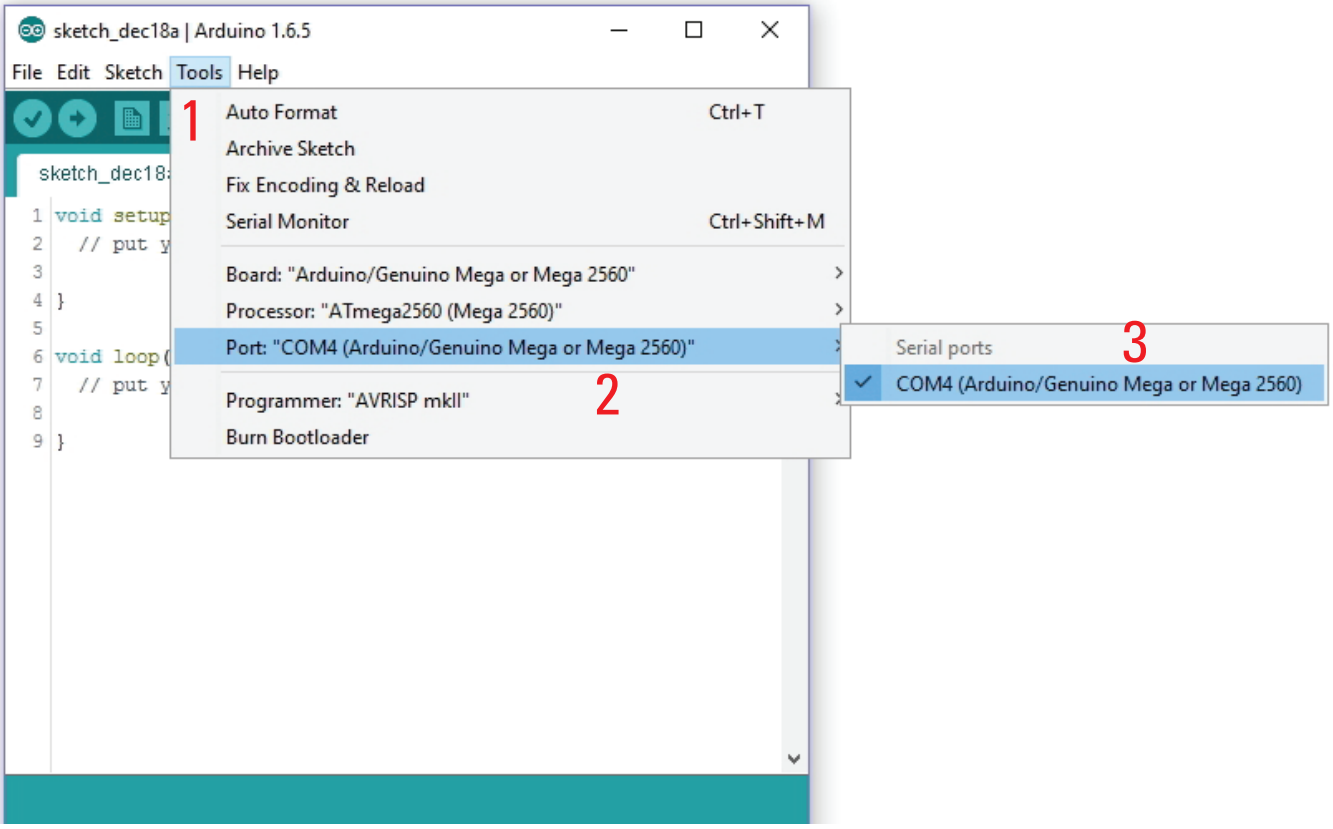
- Unpack the downloaded Arduino™ software.
- Execute the file "**arduino.exe**" (folder "**Arduino**" and its version subfolders until you find the file "**arduino.exe**").



- In the menu "**Tools**" (1), select option "**Board**" (2) and set the type "**Arduino/Genuino Mega or Mega 2560**" (3).

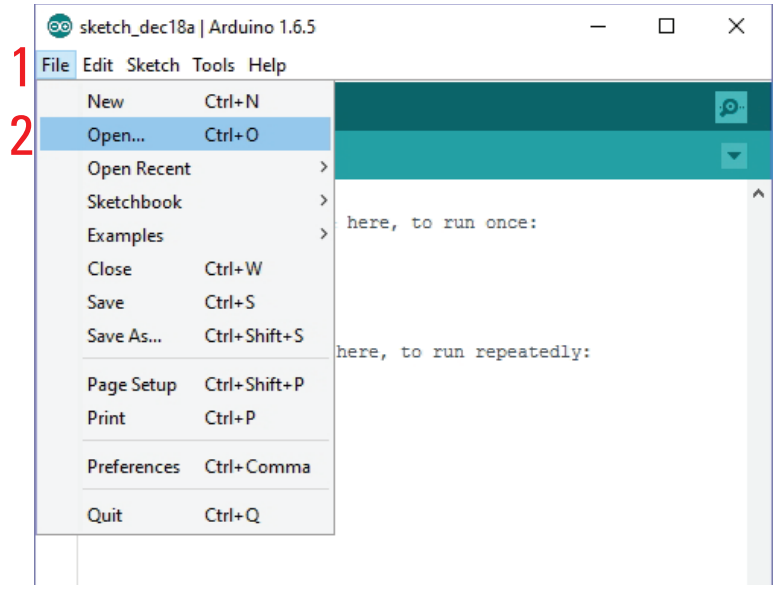


- In the menu "**Tools**" (1), select option "**Processor**" (2) and set the type "**ATmega2560 (Mega 2560)**" (3).



- In the menu "**Tools**" (1), select the option "**Port**" (2) and set the correct port (3).

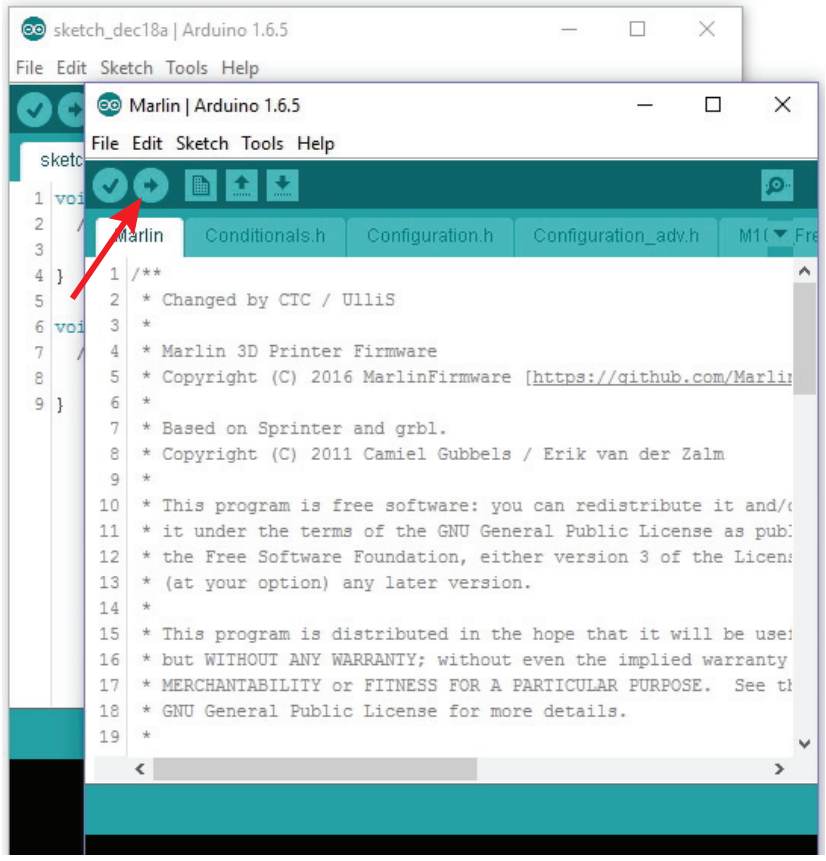
⟶ The port number is system-dependent. You can find it in the device manager of the control panel, under connections (COM and LPT).



- In the menu "**File**", choose the option "**Open...**" and select the file "**Marlin.ino**" from the download package.

→ The file "**Marlin.ino**" can be found under the following directory path, depending on whether your printer has a heating bed installed or not:
\Download Bundel Vx-x-x.zip\Firmware-Source\Firmware RF500\Marlin-with-bed\Marlin-x.x.x\Marlin\Marlin.ino
\Download Bundel Vx-x-x.zip\Firmware-Source\Firmware RF500\Marlin-without-bed\Marlin-x.x.x\Marlin\Marlin.ino

- A new window opens.



- In the new window, click the button with the arrow to the right in order to transfer the new firmware to the 3D-printer.

→ Once the update has started, the USB connection to the printer must not be interrupted. This may cause irreparable damage.

- After a successful firmware update, the 3D-printer will start again and briefly display the new firmware version in the first display line after the start.

21. Maintenance

a) General Information

Periodically verify the technical safety of the 3D printer, e.g. check for damage to the mains unit or of its mains line.

If you have reason to believe that the device can no longer be operated safely, disconnect it immediately and make sure it is not operated unintentionally. Pull the mains plug from the mains socket!

It can be assumed that safe operation is no longer possible if:

- the device is visibly damaged
- the device is no longer working
- the device was stored under unfavourable conditions over an extended period of time or
- the device has been subjected to heavy stress during transport

If you perform work above the printing plate (e.g. at the extruder), cover the glass support with a suitable protection (e.g. cardboard) or remove it first. Falling objects may easily destroy the glass plate (loss of warranty/guarantee).

b) Cleaning

Device

The outside of the 3D printer should only be cleaned with a soft, dry cloth or brush.

⟶ Never use any aggressive cleaning agents or chemical solutions on plastic parts, stickers or the display since these parts would be damaged otherwise.

Nozzle cleaning

Caution: Danger of burns. Do not touch the hot nozzle directly.

Outside cleaning of the nozzle:

Carefully wipe off the extruder nozzle after each print using tissue paper or similar.

⟶ The nozzle still has to be hot for this. If this is not the case, heat up the extruder nozzle first.

Inner cleaning of the nozzle:

Method 1:

Heat up the extruder and actuate the manual feed forward and backward several times until enough filament is extruded.

Method 2:

If the extruder continues not to extrude enough material after this procedure, let the extruder cool off to the lower melt temperature of the filament as indicated by the manufacturer (filament material must only be viscous anymore) and carefully confirm manual infeed backwards until the filament has been transported out of the extruder, including contamination. Cut off the contaminated part of the filament and reinsert it after heating up the extruder again.

Method 3:

If the procedure described above has not led to success, heat up the extruder to the printing temperature (PLA = 230 °C). Have the printer extrude some filament when the temperature is reached.

Then let the extruder cool off. For PLA to approx. 90-110 °C. The proper temperature depends greatly on the filament used. You may need to repeat this process several times with different temperatures.

When the temperature is reached, switch off the printer and pull the filament quickly out by hand and in one go. At the end, there must be a small cone that corresponds to the inner shape of the nozzle.

⟶ This method can also be used to remove all filament from the extruder. It is recommended to also wipe the nozzle a few times, e.g. with a paper towel, while cooling off.

Cleaning the printing plate

Be careful in the preassembled device or when using the optional heating plate kit: Danger of burns. Let the heating plate cool off before cleaning.

Clean and degrease the heating plate thoroughly with a soft rag after each print. If you are printing directly on the glass panel, use a little acetone for cleaning. If you are using the adhesive film use a mild detergent with alcohol.

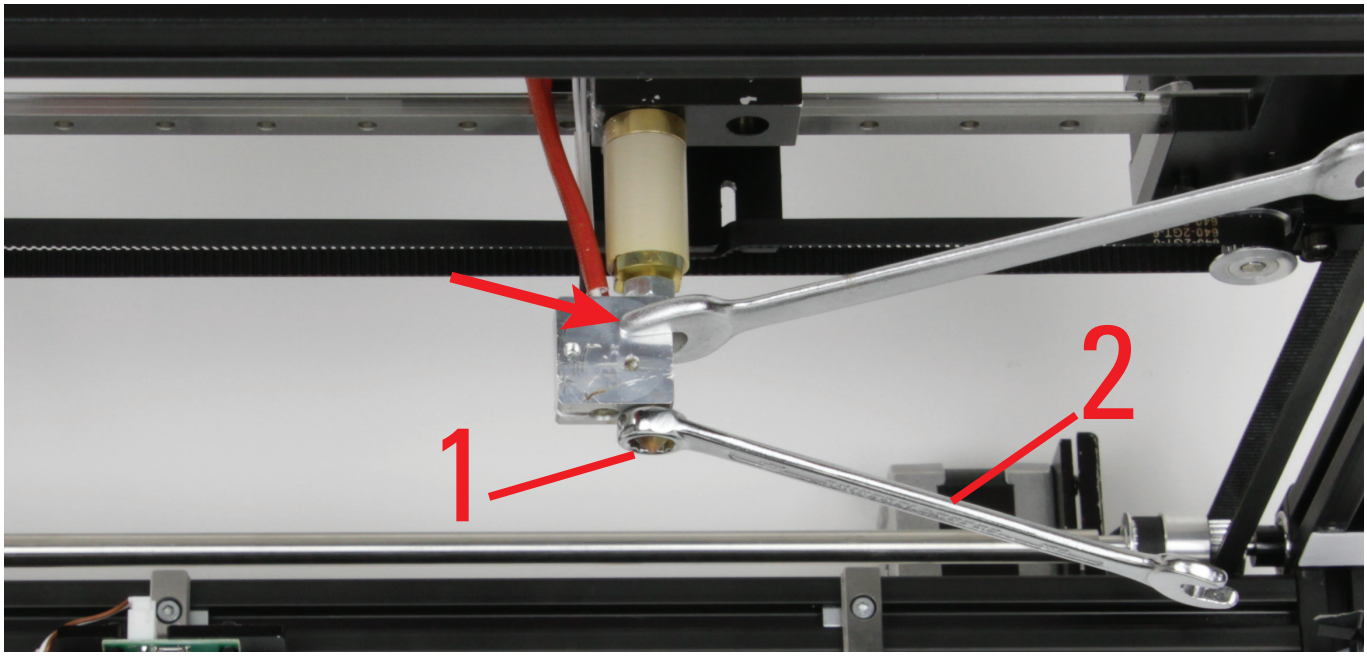
e) Nozzle Change

Caution: Danger of burns. Do not directly touch the hot nozzle and the extruder.

- To replace the extruder nozzle, the extruder must first be heated to a temperature suitable for the inserted filament material.
- When the temperature is reached, remove the inserted filament material as described in chapter "16. c) Removing and Changing the Filament".

→ For the sake of simplicity, we have removed the fan sheet for the pictures.

- Screw off the extruder nozzle (1) from the extruder with an 8 mm ring spanner, open-faced spanner or hexagon wrench (2). Secure the heating block against twisting with an 11 mm open-faced spanner. Do not damage the lines of the temperature sensor.



The extruder must not twist during nozzle change and the nozzle must never be turned when cold since the extruder may otherwise be damaged and rendered useless.

- Cut about 2 to 3 cm thread sealing tape off of the roll and wind it around the thread of the new nozzle. Cut off the sealing tape that protrudes over the thread with a sharp knife, e.g. by running the knife along the upper-most groove of the thread.

  The sealing tape must never protrude beyond the thread.

- Turn the extruder nozzle back into the heating block and tighten it carefully with a ring spanner, open-faced spanner or hexagon wrench (2). Never apply any strong forces for this.

  Secure the heating block again by twisting with an 11 mm open-faced spanner.
- Then insert the filament again as described in "Inserting the Filament".
- Switch off the extruder heating again and have the extruder cool off.

View of the nozzles

The following figures are to enable you to check your installed nozzle in case of a bad print pattern or if not enough filament is extruded. For example, it is possible that the tip of the nozzle is set incorrectly or comes into contact with the printing plate due to a printing error, and is scraped or damaged by this.

Nozzle 0.4 mm (standard)

22. Troubleshooting

With this 3D printer, you have purchased a product that is built to the state of the art and operationally safe.

Nevertheless, problems or errors may occur. Therefore, we would like to describe how to eliminate possible errors here:

Always observe the safety information!

The 3D printer does not work after connecting the voltage supply. The display and the LEDs on the main PCB remain dark:

- Check the connection of the mains line at the mains unit, the mains unit and the connection of the mains unit to the printer.
- Check the mains socket. Is it properly supplied with current?

No USB connection to the 3D printer is possible:

- Check the USB line connection.
- Is the right USB port selected in the software?
- Are the required drivers installed?
- Unplug the USB line and then plug it in again.
- Start the software again.
- Switch the 3D printer off and on again.
- Start the computer again.
- Use another USB port.
- Connect the 3D printer directly to a USB port of the computer. Do not use any USB hub.

The filament supply breaks off or there is not enough filament material supplied:

- Check the filament on the roll. It must unroll easily.
- Check if the filament material has caught on the filament roll.
- The set extruder temperature is too low for the filament material used. The feed knurl slips at the filament material.
- Check if the feed knurl slips on the motor axis of the extruder motor. The threaded pin may have come loose.
- Check that the filament material runs cleanly into the filament tube and the extruder. It must be able to run past the extruder motor from below and into the filament tube without scraping or clamping anywhere. If this is not the case, loosen the screws of the feed unit and align the parts so that the filament is cleanly inserted.
- The extruder-nozzle is clogged. Heat up the extruder and actuate the feed manually forward and backward several times until enough filament is extruded.
- Let the extruder cool down to just below the melt temperature specified by the manufacturer for the filament (filament material must only be viscous anymore) and carefully actuate the manual feed backwards until the filament with contamination has been removed from the extruder. Cut off the contaminated part of the filament and reinsert it after heating up the extruder again.

The print has defects:

- Check the temperature settings of the extruder and the heating bed (only for the preassembled device or when using the optional heating plate kit). They must match the filament material and print object. Experiment with the temperature settings in steps of 5 °C for a prefect print result.
- Only start the print when the extruder and the heating bed have reached the specified temperature.
- The distance between the printing plate and extruder is set incorrectly. Perform a calibration or set the distance more precisely when starting the print using the buttons at the 3D printer.
- When printing from the PC, do not use any other programmes requiring high computing power. Virus scanners and downloads may also impair signal transfer to the 3D printer. Try performing the same print from the SD card to ensure that the USB connection is not the cause of the problems.

Printing stops during the process:

- Check the settings of your computer. It must not switch to standby mode while printing (energy option settings) or simply shut down (installation of software or software updates during printing).
- The printing table and its guide must not be installed tensed. In this case, loosen all screws, align the parts and tighten the screws again.

The printed object does not adhere to the printing plate:

- Use the enclosed adhesive film (only in the maker construction kit) or the enclosed glue stick (only for the preassembled device). This increases adhesion of the printed object on the printing plate. You can also use cleaning tape or a slightly structured masking tape as well as Kapton masking tape or blue adhesive masking tape (Conrad order no. 1093104).
- There are residues on the printing plate that prevent adhesion of the object. Rub the printing plate with a soft cloth that is soaked with a solvent (e.g. acetone). If you are using the adhesive film, use no aggressive cleaning agents for this.

The printed object does not adhere to the printing plate (only in the preassembled device or when using the optionally available heating plate kit):

- If you are using the heating plate, the temperature of the heating plate may be set incorrectly. Experiment with the temperature settings in steps of 5 °C for a prefect print result.
- When printing problematic objects, it is beneficial to let the optional heating plate heat up for approx. 15 minutes before printing.
- Check whether the heating (red foam material) adheres cleanly to the ceramics printing plate. It must not come loose (even partially). If this is the case, the temperature distribution of the heating plate is insufficient and the printed objects cannot adhere well.
- The heating plate has not reached the set temperature yet.

The printed object cannot be removed from the heating plate (only in the preassembled device or when using the optionally available heating plate kit):

- If you are using the heating plate, wait until it has cooled off to below 40 °C.
- Use a glass scraper or a knife to remove the object.

Repairs other than those described above should only be carried out by an authorised specialist.

23. Handling

- Never connect the mains plug to a mains socket immediately after the device has been taken from a cold to a warm environment. The resulting condensation may destroy the device. Allow the device to reach room temperature before connecting it. Wait until the condensation has evaporated.
- Never pull the mains plug from the mains socket by the cable. Only pull it from the mains socket by the intended grip areas.
- Disconnect the 3D printer from the mains voltage if you are not going to use it for an extended period of time.
- Disconnect the mains plug from the mains socket during thunderstorms for reasons of safety.
- The extruder can heat up strongly in operation. Do not touch this during or just after operation. Let it cool off again.

24. Disposal

Electronic devices are recyclable and should not be disposed of in household waste!

Dispose of the product according to the relevant statutory regulations at the end of its service life.

25. Technical Data

a) Printer

Item no. / Device	1515049 / maker construction kit	1561608 / construction kit	1534908 / preassembled device
Operating voltage	12 V/DC		
Power input	max. 5 A		max. 16 A
Total power intake	max. 60 W		max. 200 W
Power of the heating plate	X		120 W
Production process	FFF (Fused Filament Fabrication) / FDM (Fused Deposition Modelling)		
Printing space (W x D x H)	approx. 210 x 135 x 170 mm (X, Y, Z)		
Printing layer thickness	0.05 - 0.3 mm		
Nozzle diameter	0.4 mm		
Suitable filament material	PLA		PLA, ABS, Bendlay, HIPS, NinjaFlex, Nylon, PET, Polyamide, PP, PS, PVA
Filament-diameter	1.75 mm		
Extruder temperature	120 - 270 °C		
Heating plate temperature.	X		max. 135 °C
Interfaces	USB 2.0 and SD/SDHC card reader		
Dimensions (W x D x W)	500 x 400 x 450 mm		
(incl. filament tube)	500 x 400 x 650 mm		
Weight	8 kg	10 kg	11 kg

b) Mains Unit

Item no. / Device	1515049 / maker construction kit	1561608 / construction kit	1534908 / preassembled device
Operating voltage	110 - 240 V/AC, 50 - 60 Hz		110 - 240 V/AC, 50/60 Hz
Output	12 V/DC, 5 A		12 V/DC, 16 A

26. Annex

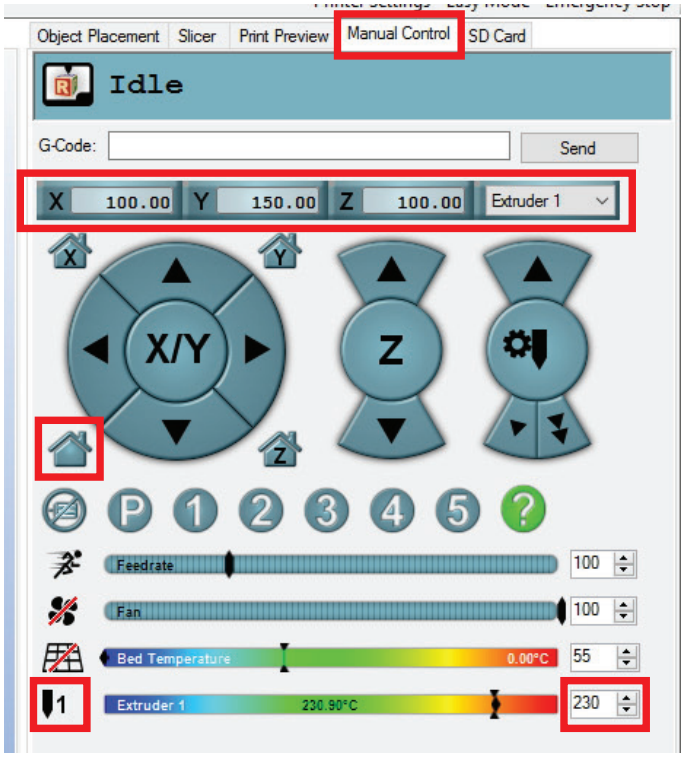
a) Fine Adjustment of the Filament Infeed

This chapter describes how to adjust the filament feed precisely, e.g. to compensate for the tolerance of the feed knurl.

Preparation

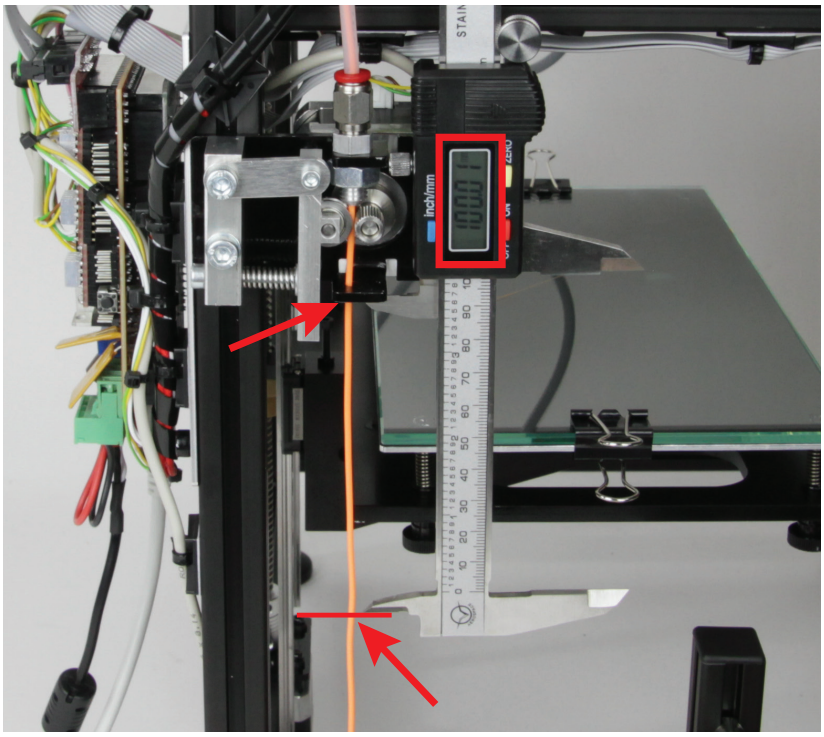
- If it has not been done yet, install the software Repetier-Host incl. the drivers and connect the printer to the computer (see chapter "19. Software "Repetier-Host"").
- If necessary, set the COM port and connect the printer. The symbol at the upper left must be green and it must say "Separate" below.
- When the printer is connected, switch to "**Manual Control**" in the software.

  The printer must only be controlled via the software throughout this process.
- Move all axis to the home position. For this, click the house icon at the lower left.
- Use the arrows X/Y and Z to move the heating plate and the extruder carriage roughly to the position indicated in the large red box. This is about making the extruder accessible easily and enabling the filament to exit the extruder well.
- Heat up the extruder to printing temperature and insert a filament. Then let it extrude a little filament. In our example, we use conventional PLA and therefore have chosen a temperature of 230 °C.

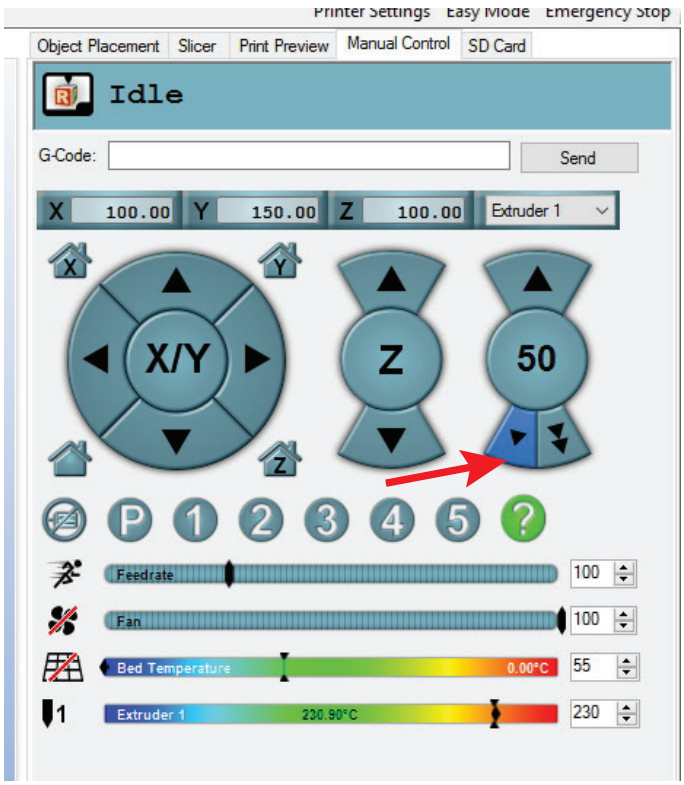


Measuring the feed

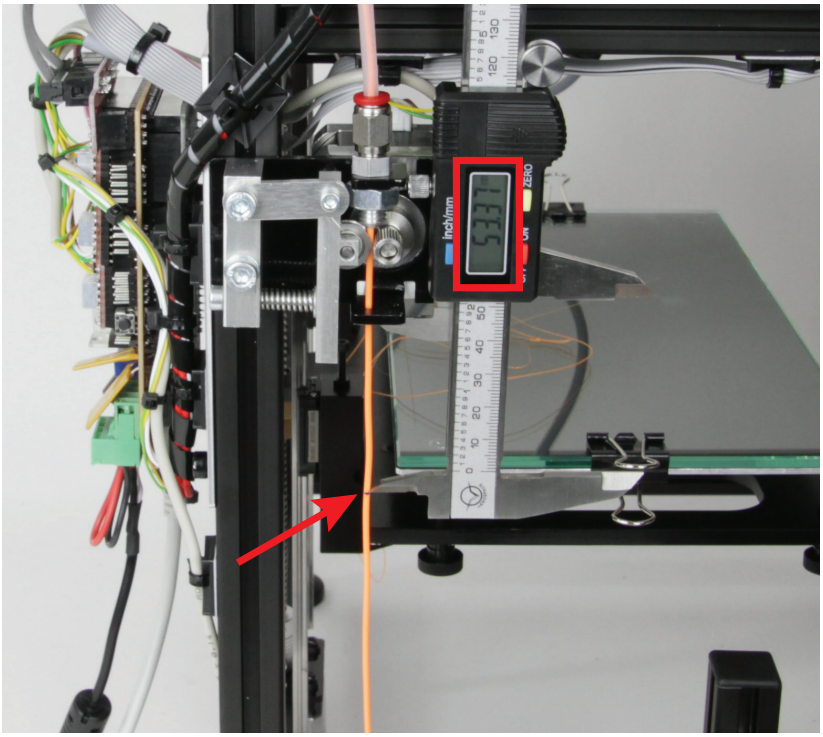
- Mark 100 mm or 10 cm precisely at the inserted filament, starting at the lower edge of the passing through of the ball bearing.



- When the filament is marked, feed in precisely 50 mm. For this, move the mouse over the arrow at the lower left in the right control (see red arrow). When the mouse pointer is all the way at the bottom (see arrow tip of the red arrow) and the middle shows 50, click precisely once.
- The filament motor now conveys precisely 50 mm filament and then stops again.



- Now measure the remaining distance between the ball bearing holder and the mark just as you did when marking before.
- In our example, 53.37 mm are left.



Calculation and correction of the feed

The formula for calculation of the actually conveyed volume is as follows:

Total length in mm - residual amount in mm = actually conveyed volume in mm

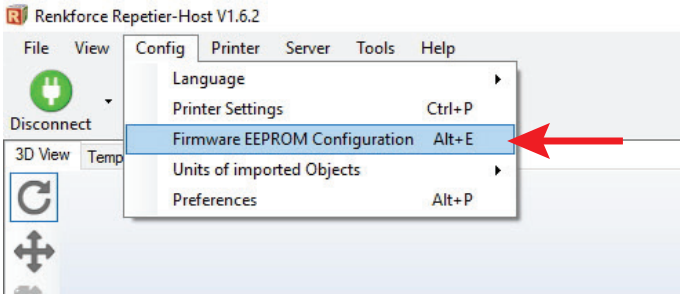
100 mm - 53.37 mm = 46.63 mm

The formula for calculating the new value "**Steps per mm**" is as follows:

Conveyed volume in mm: Actually conveyed volume in mm * Current value Steps per mm = New value Steps per mm

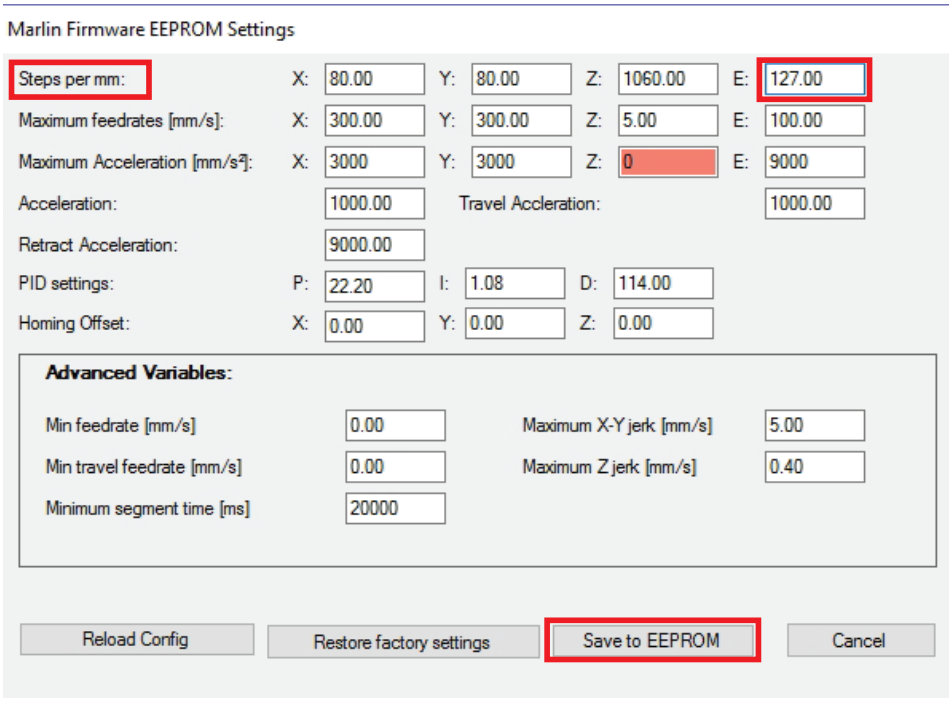
50 mm : 46.63 mm * 127.00 = 136.18

- After you have calculated the value, open the EEPROM configuration.
- In the menu bar, choose "**Configuration**" and the "**Firmware EEPROM Configuration**".



- In the new firmware, change the value in the 1st line at "**Steps per mm**", behind "**E:**"
- Change the default value **127.00** to the value calculated anew before. In our example, enter **136.18** in the field.

  Observe that you also must write the new value with a dot instead of a comma.
- To accept the change, click "**Save to EEPROM**".



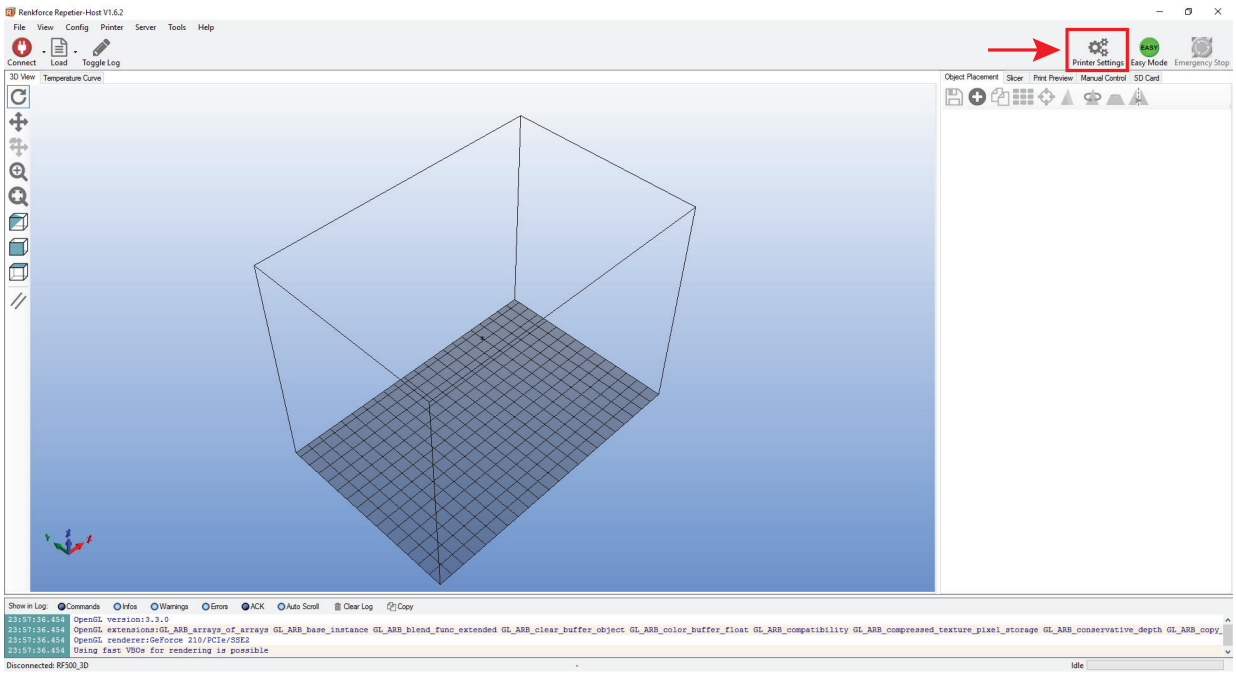
→ This adjusts and corrects the value for the filament infeed. To check the value, select 100 mm again at the filament and have it extrude 50 mm again. If 50 mm filament are left over, the value is right. Otherwise, correct it again.

Important! You always need to use the current value "Steps per mm" for calculation. If you have already changed the value, do not use 127.00 for your calculation, but the value currently entered in the EEPROM.

b) Setting up the Printer Settings

This chapter is only targeted at users who do not have the custom version of the software installed. If you have installed the custom version (can be recognised by the image of the RF1000 3D-printer when the programme starts), you may skip this chapter. It only serves information purposes then.

Start the programme Repetier-Host and click on "**Printer Settings**" at the upper right in the window.



(1) Name your printer RF500_3D in the following window in tab "**Connection**" or assign a name of your own.

(2) Set the port and baud rate. The baud rate must be set to "**115200**".

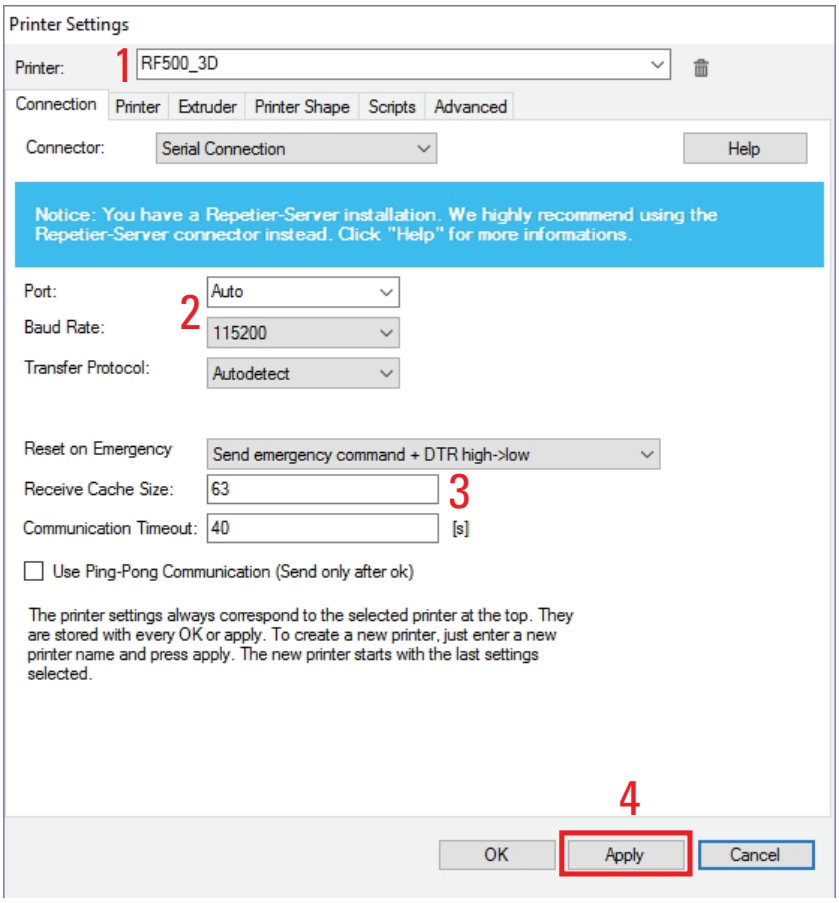
→ The port number (2) is system-dependent. Usually, the setting "**Auto**" should work with the current version of the software (as of 1.6.2).

If this does not work properly for you, you can check the port in the device manager of the control panel, under connections (COM and LPT).

Then set the COM-port from the device manager in the software.

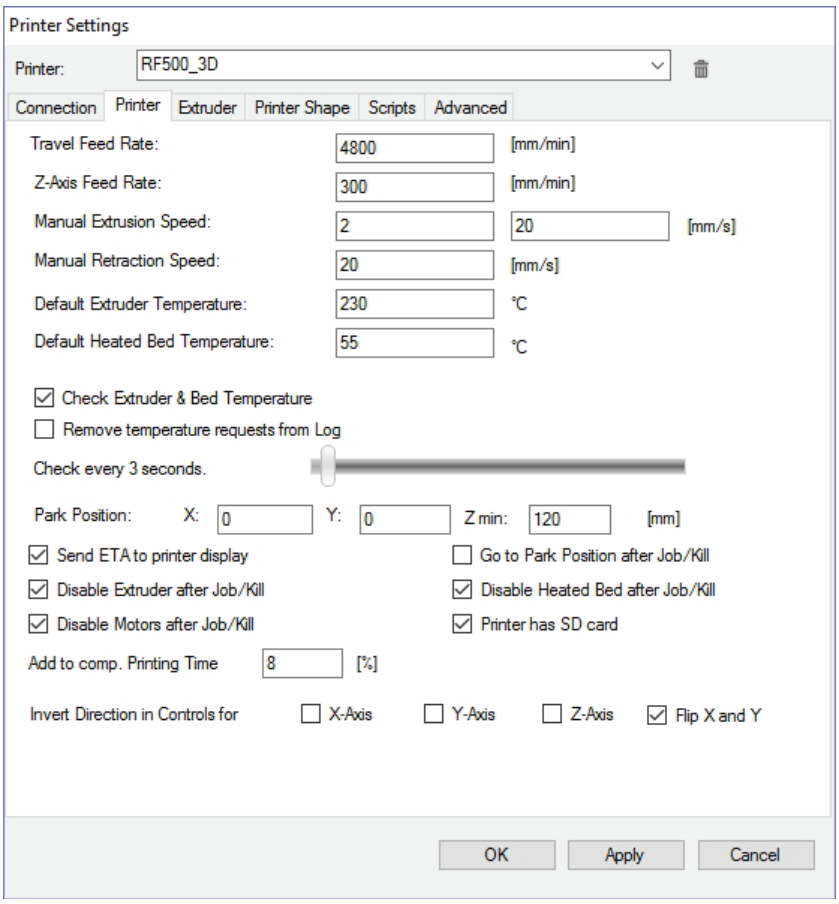
(3) Set the receiver cache size as shown (3).

(4) Click "**Apply**" (4).



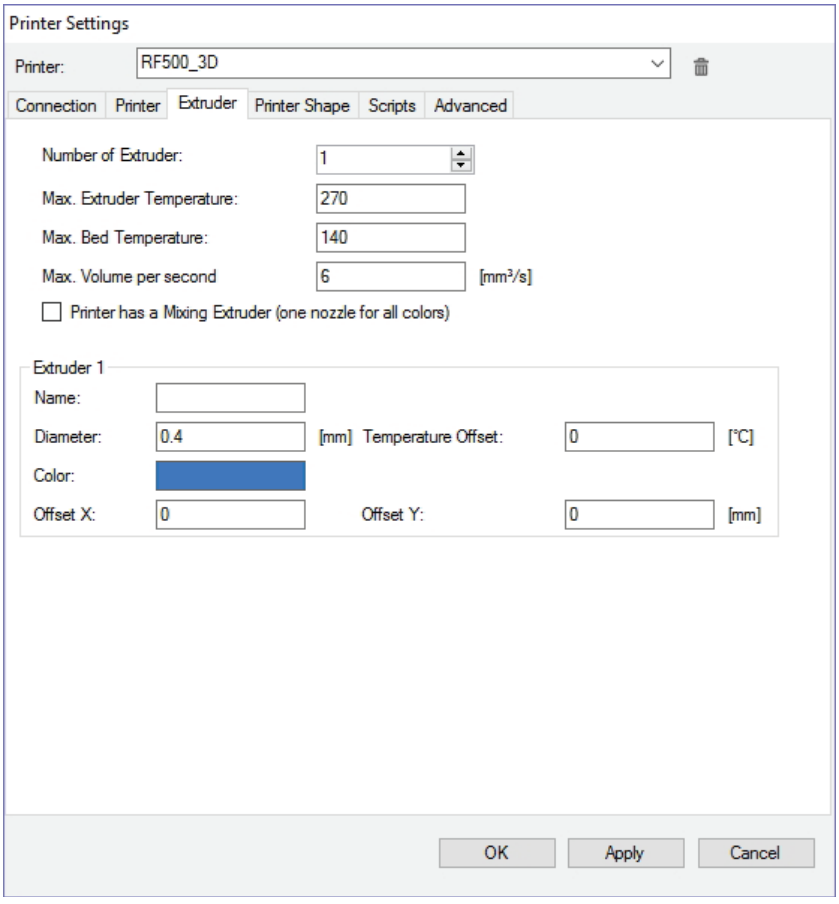
Click the tab "**Printer**".

Transfer the settings 1:1 as shown in the following figure and click "**Apply**".



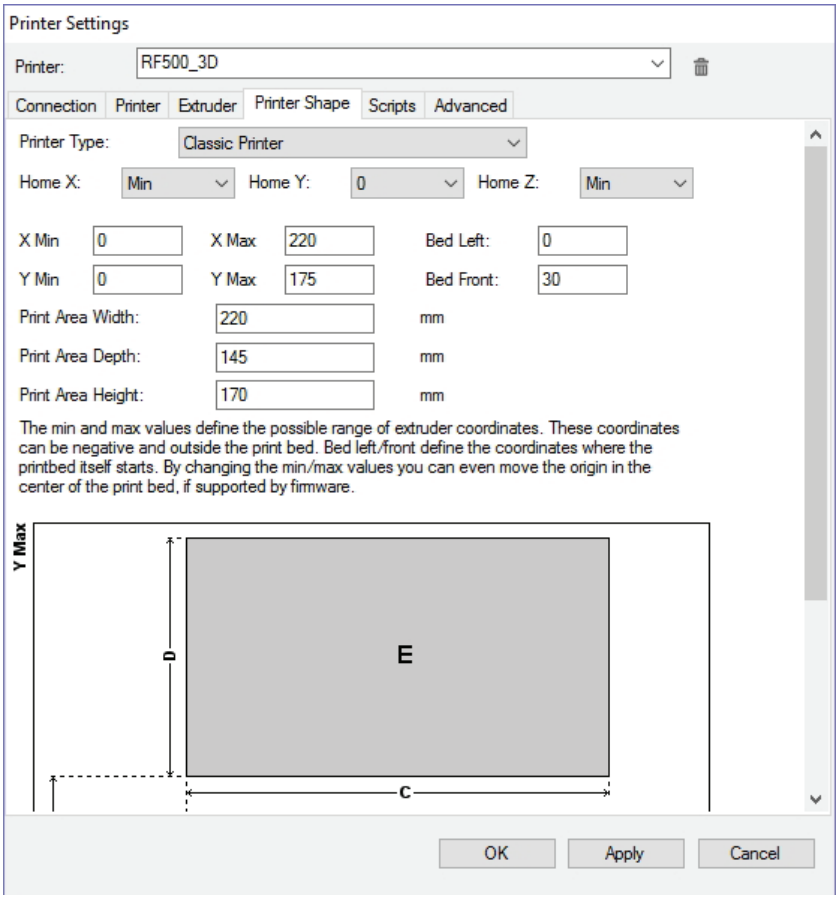
Click the tab "**Extruder**".

Transfer the settings 1:1 as shown in the following figure and click "**Apply**".



Click the tab "**Printer Shape**".

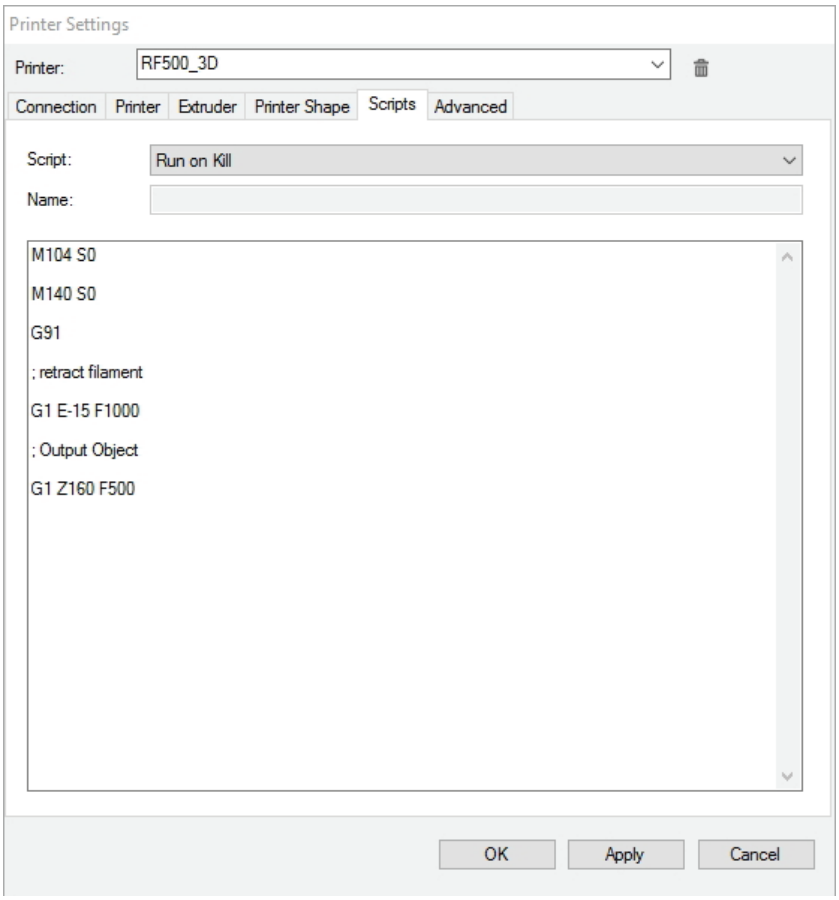
Transfer the settings 1:1 as shown in the following figure and click "**Apply**".



Click the tab "**Scripts**".

Here, you can enter, e.g., a special start code, end code, etc.

Select the script "**Run on Kill**" or create it. Accept the command lines as illustrated and click "**Apply**".



No settings are necessary in the tab "**Advanced**".

Click "**OK**".

c) Recommended Tightening Torque of the Screws

Description	Thread size	Torque
Screw together the frame	M5	3 Nm
Attach the guide rail to the frame	M3	2 Nm
Attach the motor to the motor plate	M3	1.7 Nm
Attach the plate to the frame	M5	3 Nm
Attach the sprocket to the stepper motor	M3	0.7 Nm
Motor at the Y- motor holder	M3	1.7 Nm
Y- motor holder at the frame	M5	3 Nm
Infeed knurl on the motor shaft	M3	1.7 Nm
Screw quick closure to the adapter	M5	3 Nm
Attach the adapter with the nut.	M8	5 Nm
Motor at the extruder motor holder	M3	1.7 Nm
Ball bearing holder at the filament infeed motor	M3	1.7 Nm
Screw the screw to the spring holder	M4	3 Nm
Attach the infeed unit to the frame	M5	3 Nm
Screw the left guide carriage plate to the guide carriage	M3	1.5 Nm
Attach the sprocket to the stepper motor	M3	0.7 Nm
Screw the actuator to the right guide carriage plate	M3	1.7 Nm
Screw the end stop to the right guide carriage plate	M2	0.3 Nm
Screw the right guide carriage plate to the guide carriage	M3	1.5 Nm
Screw the guide rail and the aluminium block to the guide carriage plate on the left and right	M3	1.7 Nm
Screw the black aluminium block to the frame	M3	2 Nm
Screw the black block, black disc, to the guide carriage plate on the left and right	M4	3 Nm
Tighten the screws of the sprockets	M3	0.7 Nm
Screw the extruder holder to the belt tappet	M3	1.7 Nm
Screw the quick closure to the extruder holder	M5	3 Nm
Screw the end stop to the extruder holder	M2	0.3 Nm
Screw the fan to the fan sheet	M2	0.3 Nm
Screw the fan sheet to the extruder holder	M3	1.7 Nm
Screw the extruder holder to the guide carriage	M3	1.7 Nm
Screw the belt tensioner to the left guide carriage plate	M4	3 Nm
Screw the undertable to the table tappet	M4	4 Nm
Screw the undertable to the guide carriage	M3	1.9 Nm
Clamp the coupling to the spindle	M3	1.7 Nm
Clamp the coupling to the motor shaft Z	M3	1.7 Nm
Tighten the frame again	M5	3 Nm
Attach the guide rail to the frame	M3	1.7 Nm
Screw the flange nut to the undertable	M4	4 Nm
Screw the limit switch holding plate to the limit switch	M2	0.3 Nm
Screw the limit switch holding plate to the frame	M5	3 Nm

Screw the nozzle to the heating block	M6	6 Nm
Clamp the heating cartridge to the heating block	M3	1.9 Nm
Screw the nozzle stock to the PEEK part	M6	4 Nm
Screw the extruder inlet to the PEEK part	M6	4 Nm
Screw the nozzle stock to the heating block	M6	4 Nm
Counter the heating block to the hexagon nut	M6	4 Nm
Screw the display to the display holder	M3	1.7 Nm
Screw the operating knob to the display	M3	1 Nm
Screw the display holder to the frame	M5	3 Nm
Screw the main PCB to the PCB holder	M3	0.3 Nm
Screw the PCB holder to the frame	M5	3 Nm

1515052_1534908_1561608_V7_0817_01_RR_m_EN