renkforce

GB Operating Instructions

3D-Printer Construction Kit RF2000

Order No. 1395718

3D-Printer RF2000

Order No. 1395717

CE

Table of Contents

GB

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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 arrow symbol indicates special advice and operating information.

Observe the operating instructions!

3. Intended Use

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

This product is only approved for connection to 230 V/AC, 50 Hz alternating voltage.

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.

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. All company names and product names are trademarks of their respective owners. All rights reserved.

ATTENTION Mains voltage - the connection, installation and wiring of the electrical components must only be performed by an electrician who is familiar with the applicable safety provisions. Before commissioning, inspection according to the applicable safety provisions must be performed by an electrician.

Observe all safety and assembly notes in these operating instructions!

Current operating instructions

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

Attention! Important note on shipping of the printer!

Keep the original outer packaging, the inlay and the transport protection well! Only this permits safe transport, e.g. for guarantee/warranty!

Please observe the separate packaging instruction as well.

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!

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

This version of the instruction is valid as of development firmware version RF.01.37 or higher and repetier host software version 1.6.2 or higher. If your printer has an older firmware or your computer an older software installed, first install the latest versions.

Install the next master firmware version as soon as it is available.

On this, observe chapter "20. Firmware Update" or Chapter "18. Software Repetier Host".

Update the enclosed memory card as well. The corresponding download can be found on the respective product page of our website or in the download area.

4. Safety Information

In case of damage caused by non-compliance with these operating instructions, the warranty/guarantee will expire. We do not assume liability for any consequential damage.

We do not assume any liability for property damage and personal injury caused by improper use or non-compliance with the safety instructions. In such cases the warranty/guarantee is voided.

Dear Customer: The following safety information is intended not only for the protection of the device but also for the protection of your health. Please read the following items carefully.

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.
- The mains unit corresponds to the applicable CE provisions. Compliance with the applicable CE provisions for the finished construction kit, whoever, is subject to the constructor of the construction kit and also essentially depends on precise work during assembly.
- 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.
- This device is a protection class I product. The voltage source must be a proper mains socket (230 V/AC, 50 Hz) of the public mains with a protective ground contact.
- The mains socket to which 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.
- 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) 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 switch at the rear of the device must be easy to reach so that the device can be switched off 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 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 product, make sure that the mains cable is not pinched or damaged by sharp edges.

c) Operation

- Push the emergency off switch at once if there is any electrical or mechanical problem! The printer will be powered down by this. Only reset the emergency off switch 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 and the heating plate grow very hot in operation. Never touch these parts during or just after operation. Let them cool down sufficiently first (approx. 60 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.
- Do not touch the mains cable if it is damaged. 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 with a damaged mains line.
- Never touch the mains line or the mains plug 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.

d) Socket

- The socket on the rear of the 3D printer serves to connect suitable devices, e.g. the mill available as an accessory. The socket is controlled separately by the 3D-printer as required.

  Never connect any other devices here that are not intended for operation in connection with the 3D-printer.
- Do not overload the socket. The maximum permitted output power is indicated on the socket (also see chapter "25. Technical Data").
- The mains cable must not be squeezed or damaged by sharp edges. • Do not put any objects onto the mains cable and do not step on it. Place the mains cable so that no one can trip over it and that the mains lug is easily accessible.

  Also place the mains cable so that there can be no damage when operating the 3D-printer.
- Always pull a mains plug from the socket by the provided grip; never pull out a mains plug from the socket by the cable!
- Do not connect in series! Do not connect any socket strip to the socket of the 3D-printer.
- Do not operate covered!
- Voltage-free only when the plug is pulled! The socket is controlled separately by the 3D-printer. The mains voltage therefore may increase inadvertently.

  For example, if you want to operate a mill via the 3D-printer socket, first pull the mains plug of the mill from the 3D-printer socket before changing, e.g., the mill head.

5. Feature Description

- Printing space approx. 230 x 180 x 200 mm (D x W x H)
- Play-free profile rail guides and ball-threaded drives for maximum precision
- Automatic printing plate measurement
- Heating plate of glass ceramics
- 2 high-precision extruders with exchangeable printing nozzle for 2-coloured printing
- Integrated long-lived industrial 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
- Breaking and abrasion-free cable guides across energy guide chains

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 two printing heads and heating bed, 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.

While actually printing, the filament material is transported to the two print heads (extruders) separately from two filament rolls (bicoloured printing). However, it is also possible to use only one print head (one-coloured printing).

In the extruders, the filament material is melted and then applied to the heating plate via a fine extruder nozzles layer by layer.

The heating plate moves in the Y and Z directions, the extruders move in the X-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.

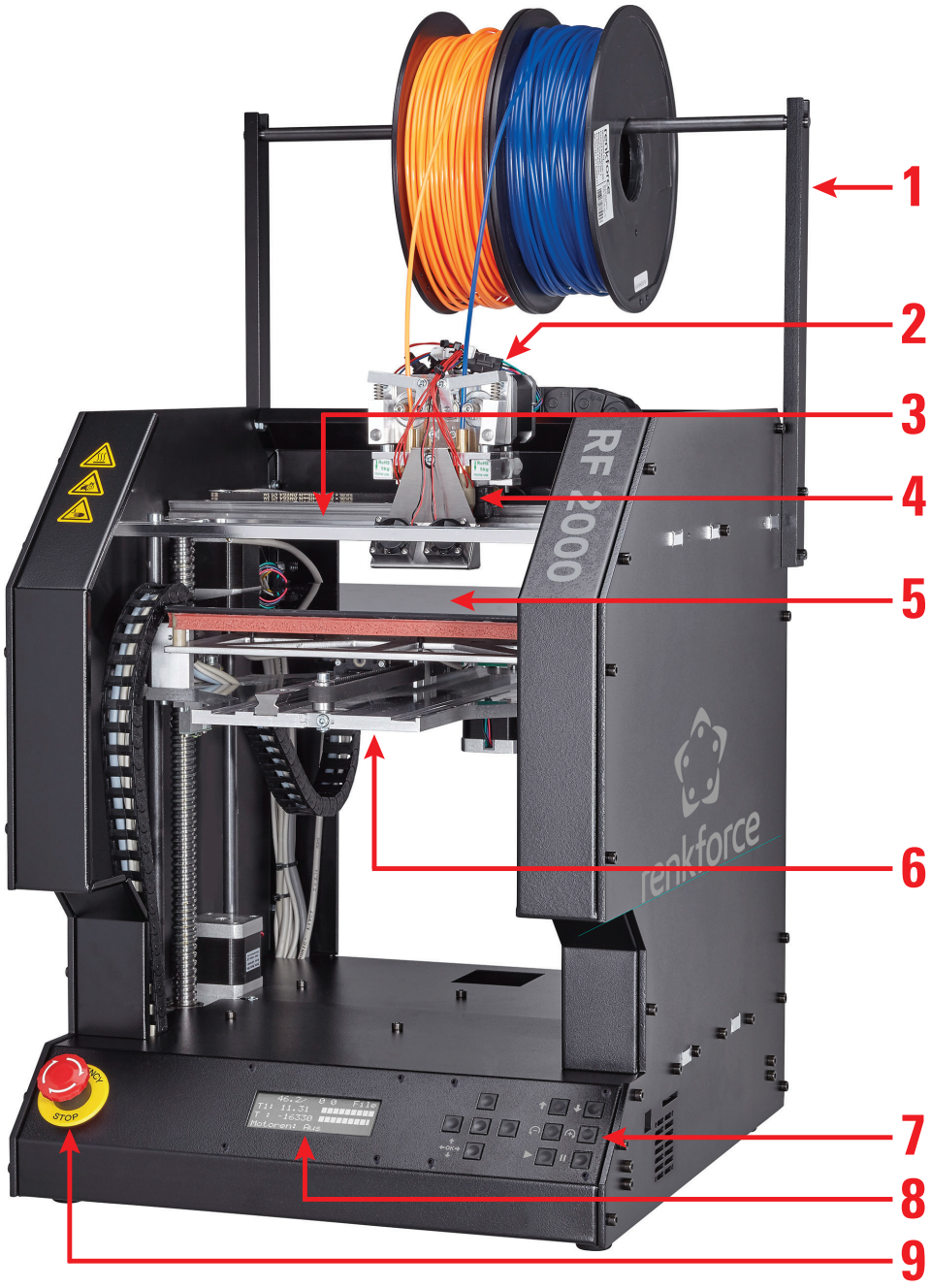
Additionally, the adhesion of the printed object on the printing plate is influenced by printing plate temperature, filament material, shape of the printed object and surface properties of the printing plate.

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

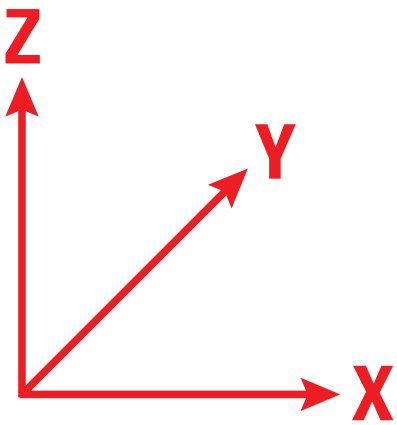
For the above reasons, it is not possible to achieve high-quality print results at once and without previous experiments.

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



(1) Filament holder
(2) Extruder carriage
(3) X-plate
(4) 2 extruders
(5) Heating plate of glass ceramics
(6) Y-plate
(7) Operating button field
(8) Display
(9) Emergency off switch



→ In the small figure, the printing directions (x, y and z) are indicated.

8. Required Tools and Material

- Different screwdrivers (cross-head and slotted)
- Hex key 1.5 mm / 2 mm / 2.5 mm / 3 mm / 4 mm
- Hexagon wrench 4 mm / 5 mm / 5.5 mm / 7 mm
- Stop angle
- Calliper
- Wire cutter
- Small flat pliers and small long-nose pliers
- Threadlocker varnish, medium strength
- Feeler gauge (recommended) (up to 1.0 mm in 0.05 mm steps)
- Hot-glue gun (optional)

9. Assembly of the Mechanical Parts

The following chapters refer to the assembly of the 3D printing construction kit, but are also interesting for owners of the ready-made device as information for later accessory assembly.

If you have purchased the finished device, you can skip the following chapters and continue directly with the chapter "12. First Commissioning".

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.

The stainless steel parts of the construction kit are very sensitive to dirt. Wash your hands before installing these parts and use cotton gloves if necessary. Remove the protective film only directly before assembly.

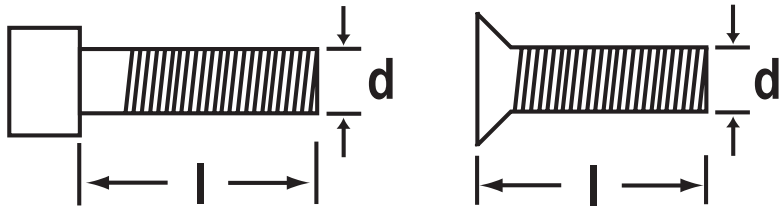
Always observe the images during assembly. Here, the assembly locations and correct alignment of the components are shown.

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.

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

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

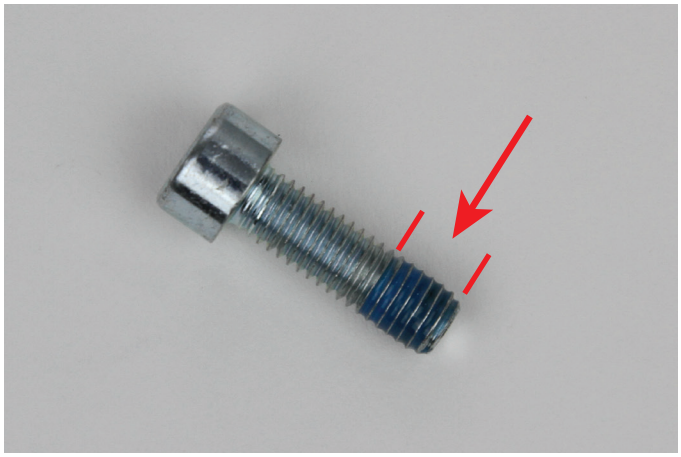


Application of the threadlocker varnish

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

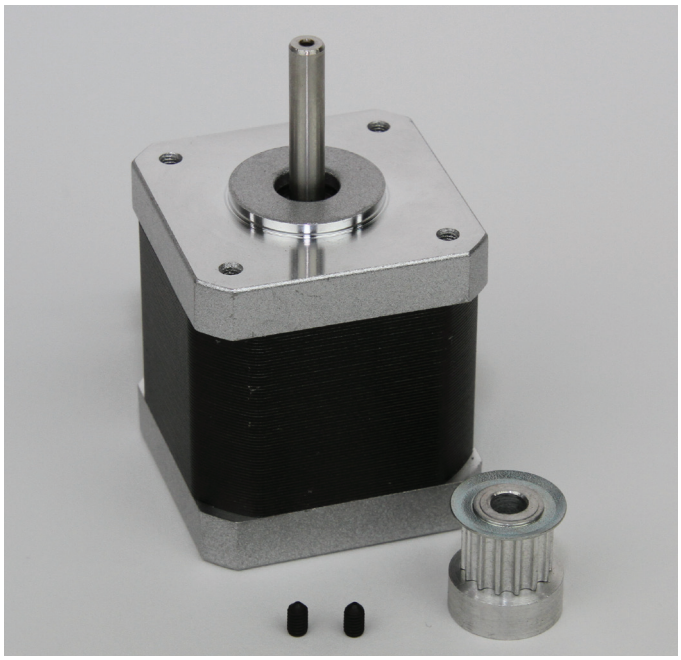
Procedure:

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.



b) Assembly of the Components

Attachment of the motor pinion to the actuators

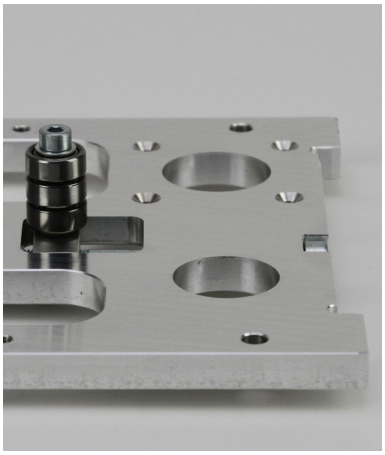


3 x actuator
3 x sprocket 14Z (small pinion, outer diameter 16 mm)
6 x threaded pin M3x5

Push sprocket onto axe of the actuator and attach it with 2 threaded pins each. Apply the threaded pins with threadlocker varnish.
The motor axis must end flush with the upper edge of the sprocket.
Repeat the steps for the two other step motors.

Assembly of the bottom plate

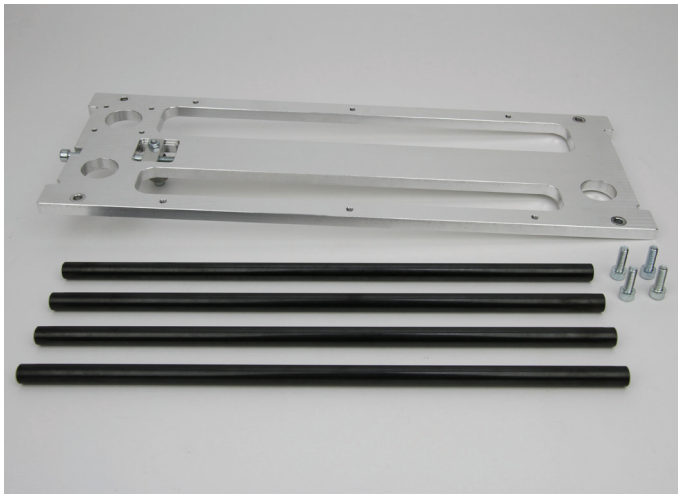
Assembly of the belt tensioner



1 x bottom plate
1 x belt tensioner basic body
1 x nut M4
1 x cylinder head screw M4x30
4 x washer (diameter inside/outside 4.3/8.8 mm)
3 x ball bearing 624ZZ (diameter inside/outside (3.8/13 mm)
1 x cylinder head screw M5x70 (fully threaded)

Insert the belt tensioner basic body into the intended breakout of the bottom plate. The cross-bore of the belt tensioner basic body and the bore in the bottom plate must align.
Push the screw M5x70 into the bottom plate from the right and turn it into the basic body. The screw head is supported against the housing side part to be installed later so that the belt tensioner function is only present after assembly of the side part.
Use the bottom plate. Push the washers onto the M4x30 screw alternatingly with the ball bearings.
Screw the screw equipped in this manner, as shown in the figure on the right, into the belt tensioner basic body and tighten it well. Counter the screw with the nut at the belt tensioner basic body (in the figure on the bottom of the bottom plate).

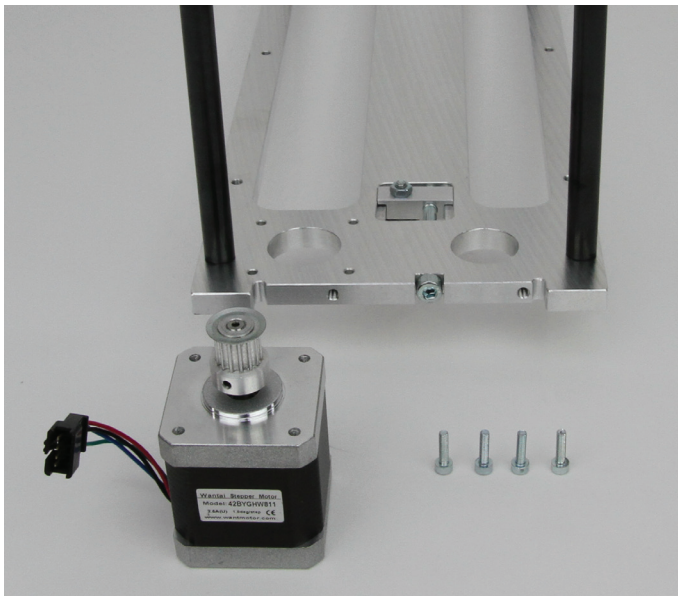
Assembly of the Spacers

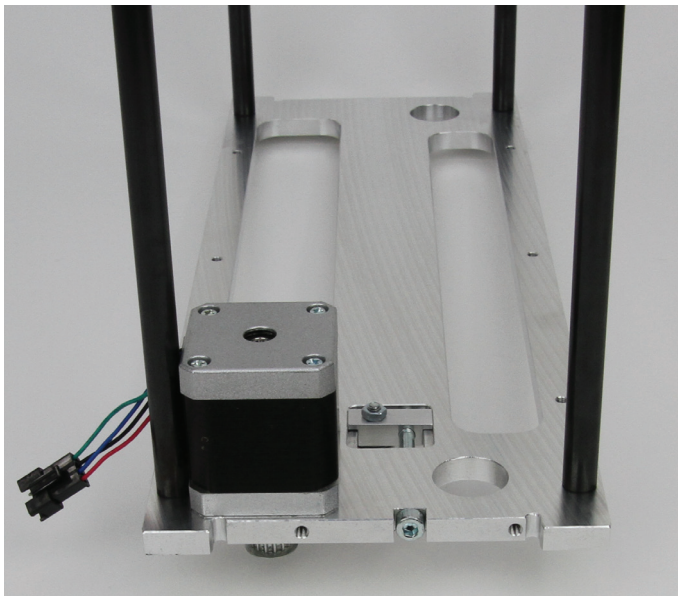


1 x bottom plate
4 x spacers
4 x cylinder head screw M5x16

Attach the spacers with the screws to the top of the bottom plate as shown (the belt tensioner points down).
Apply screws with threadlocker varnish.

Assembly of the drive motor

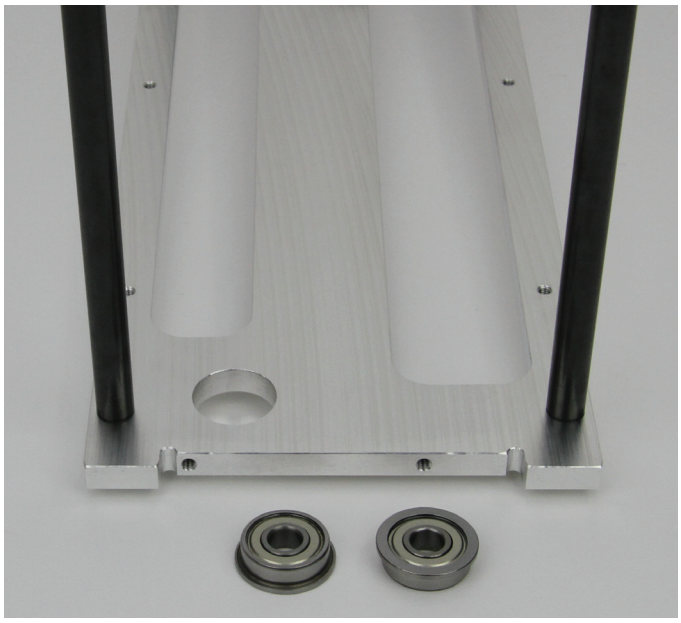


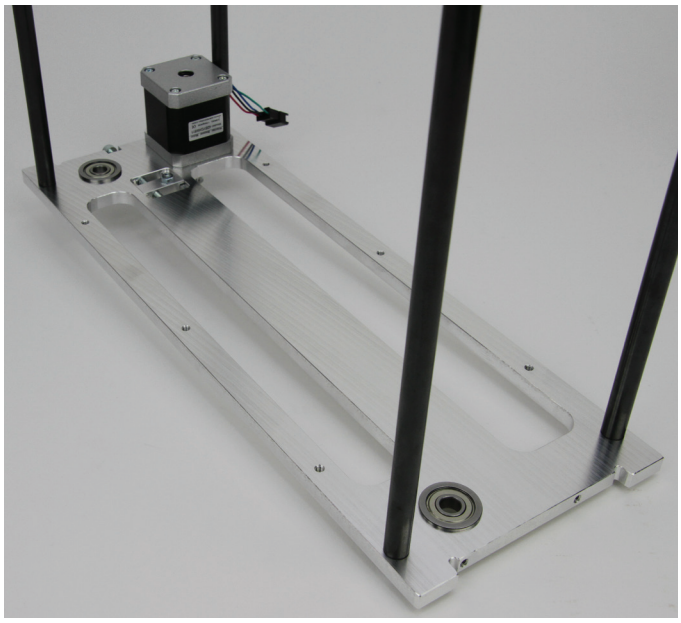


1 x bottom plate
1 x actuator
4 x cylinder head screw M3x12

Attach the actuator to the bottom plate with the 4 screws as shown in the figure.
Apply screws with threadlocker varnish.
The cable exit of the actuator must point in the opposite direction of the belt tensioner (see image).

Inserting the grooved ball bearings



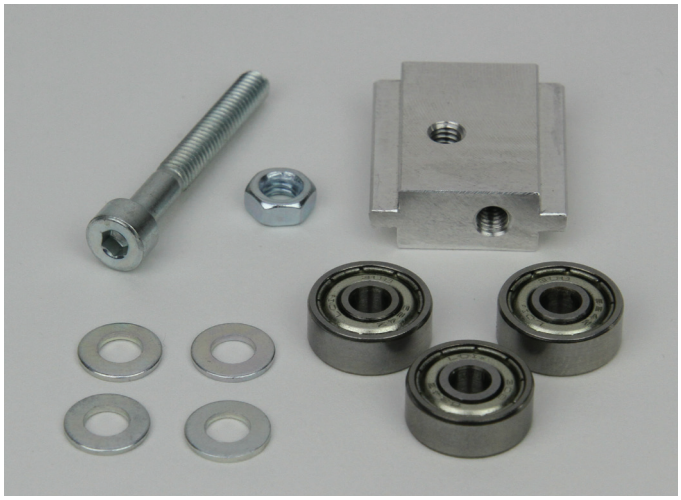


1 x bottom plate
2 x grooved ball bearings

Insert the grooved ball bearings into the corresponding bores of the bottom plate from above.
Turn the grooved ball bearings slightly, when inserting them into the bores. Do not apply any force. The flanges of the grooved ball bearings must be cleanly aligned with the top of the bottom plate.

Assembly of the X plate

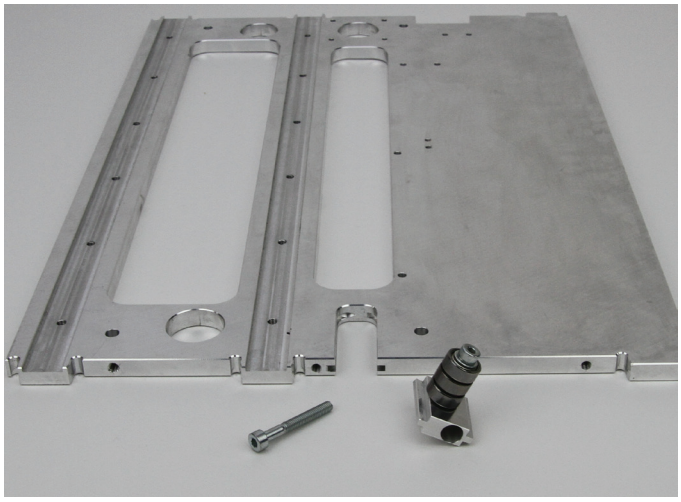
Installation of the belt tensioner

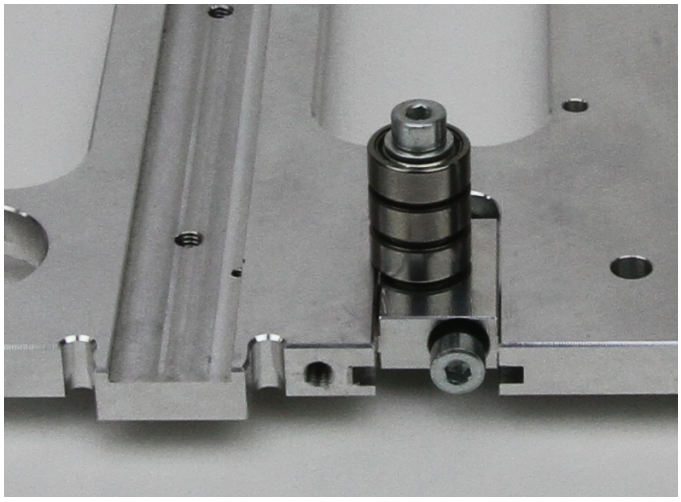


1 x cylinder head screw M4x30
1 x nut M4
1 x belt tensioner basic body
4 x washer (diameter inside/outside 4.3/8.8 mm)
3 x ball bearing 624ZZ (diameter inside/outside (3.8/13 mm)

Push washers onto the screw with the ball bearings alternatingly.
Screw the screw into the belt tensioner basic body as shown in the figure and tighten it well.
Counter the screw with a nut.

Attachment of belt tensioner to the X-plate



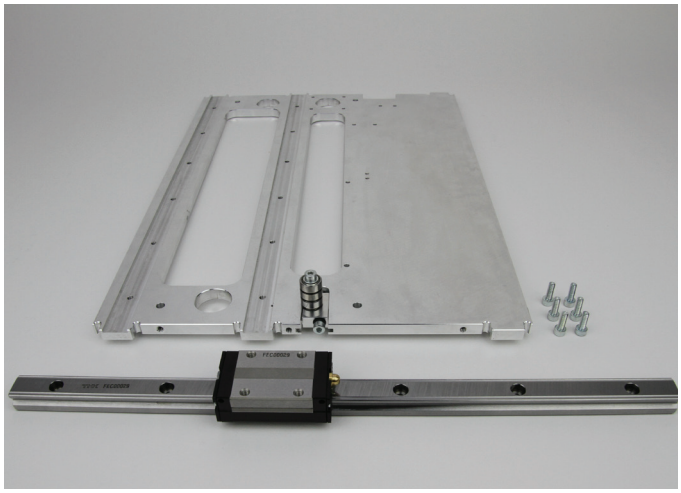


1 x X-plate
1 x cylinder head screw M4x30
1 x assembly belt tensioner (see above)

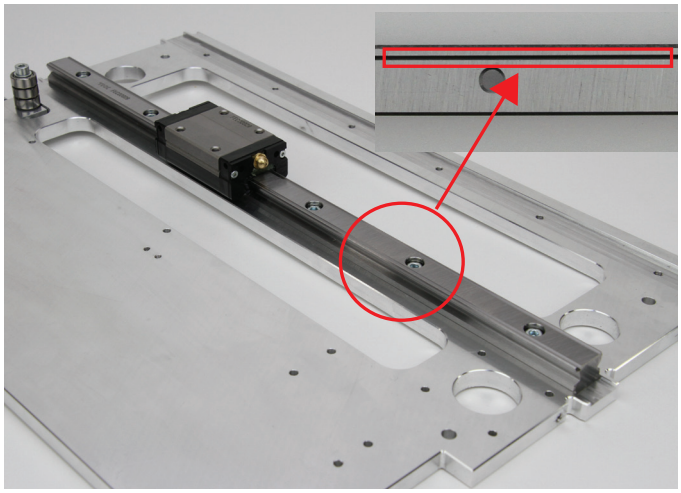
Push the belt tensioner assembly into the intended section of the X-plate and turn the screw into the belt tensioner.
Observe the position of the bore in the belt tensioner (must be on the right as shown in the figure). The ball bearings must be on the grooved side of the X-plate.

Attachment of the guide rail

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

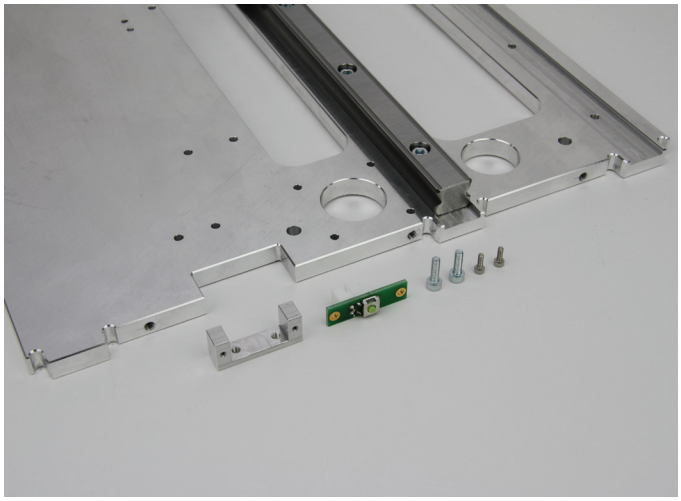


1 x X-plate
6 x cylinder head screws M4x12
1 x guide rail with guide carriage

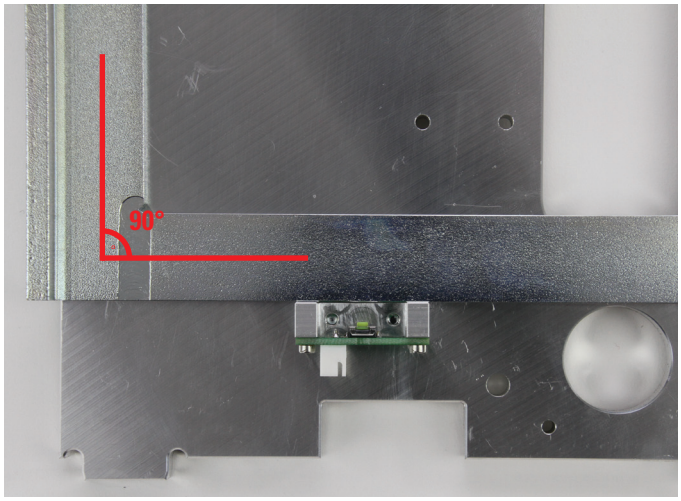


Insert the guide rail into the middle groove next to the belt tensioner of the X-plate and attach with the screws.
The lower groove on the guide rail must point to the side of the belt tensioner.

Attaching the limit switch for the X-direction

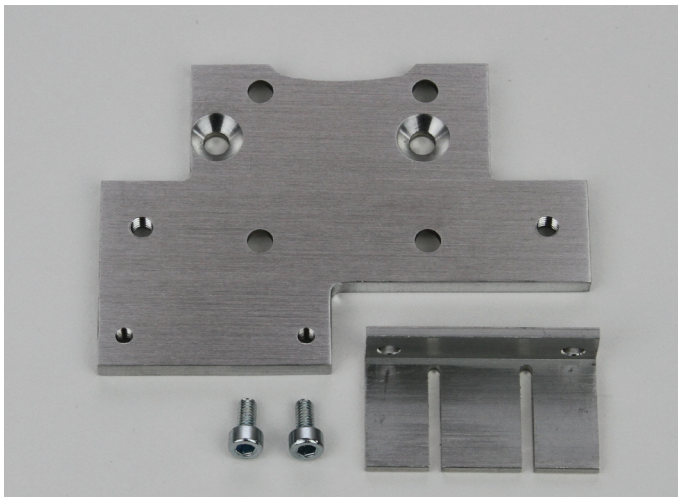


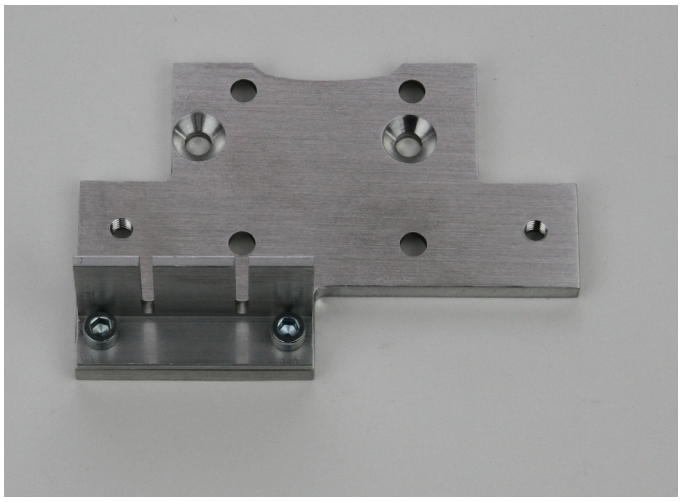
1 x X-plate
1 x holder for limit switch
1 x limit switch PCB
2 x cylinder head screw M3x10
2 x cylinder head screw M2x6



Install the limit switch PCB with the M2x6-screws to the holder so that the plug connector points away from the holder (see figure).
Then align the limit switch with the holder with a stop angle at a right angle to the X-plate and attach it onto the X-plate with the M3x10 screws.

Attachment of the belt holder to the guide carriage plate

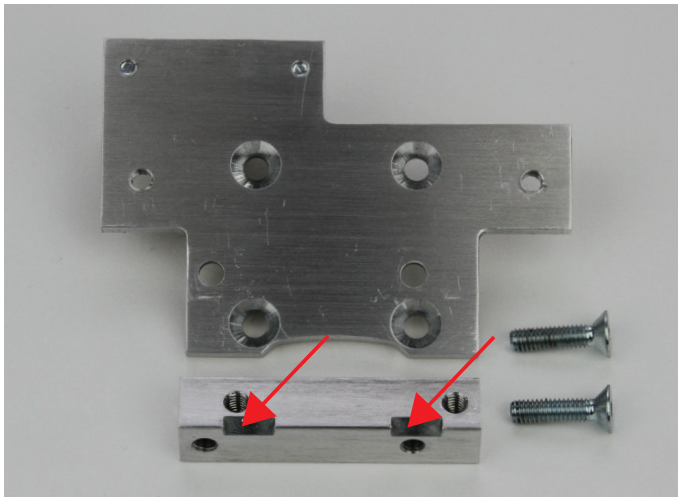


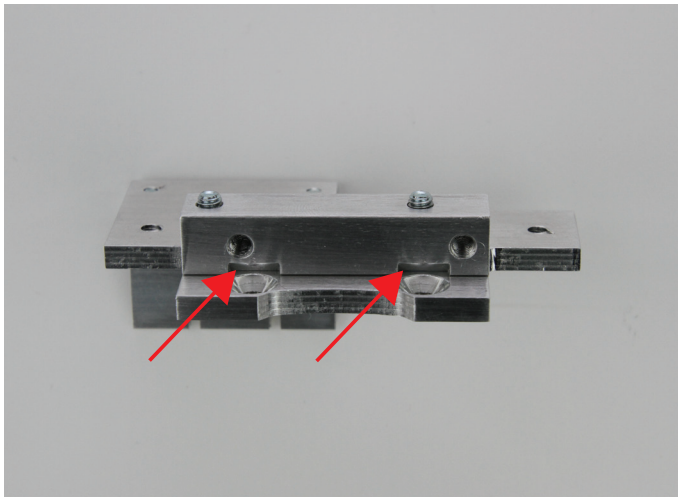


1 x guide carriage plate
2 x cylinder head screw M3x6
1 x belt holder

Attach the belt holder at the bottom of the guide carriage plate with the two screws as shown.
Apply screws with threadlocker varnish.

Assembly of the infeed holder

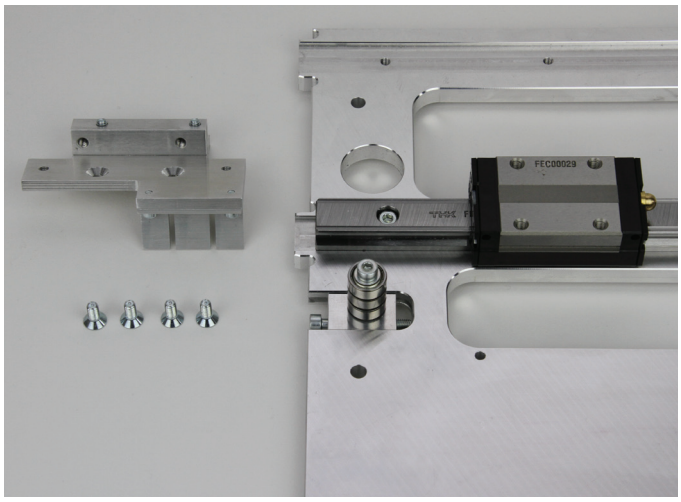


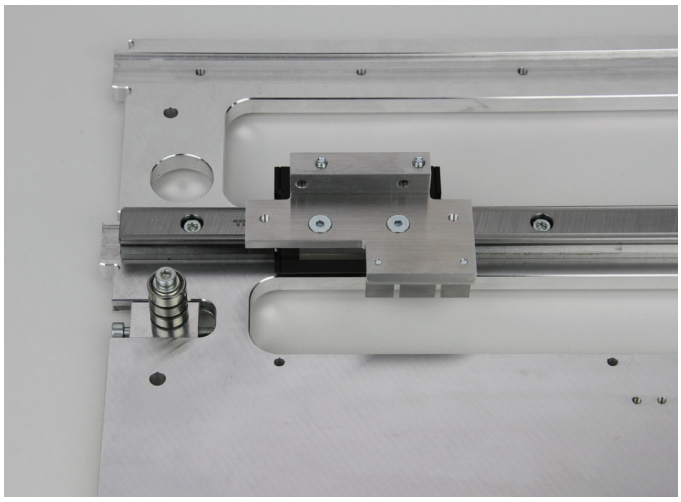


1 x guide carriage plate
1 x infeed holding block
2 x countersunk head screw M4x16

Infeed the holding block attached under the plate with the two countersunk head screws M4x16. The two disconnections at the infeed holding block must point to the recessed bores as shown (see arrows). Tighten the screws well, since the extruder will acquire play later otherwise. Apply screws with threadlocker varnish.

Assembly of the guide carriage plate on the guide carriage

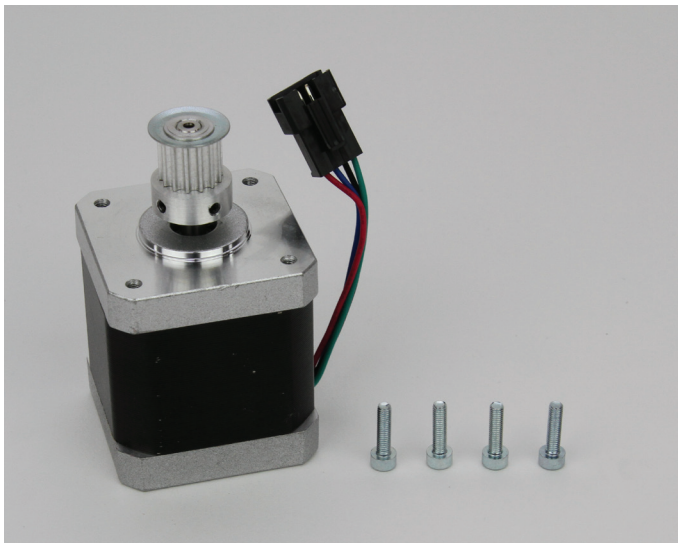


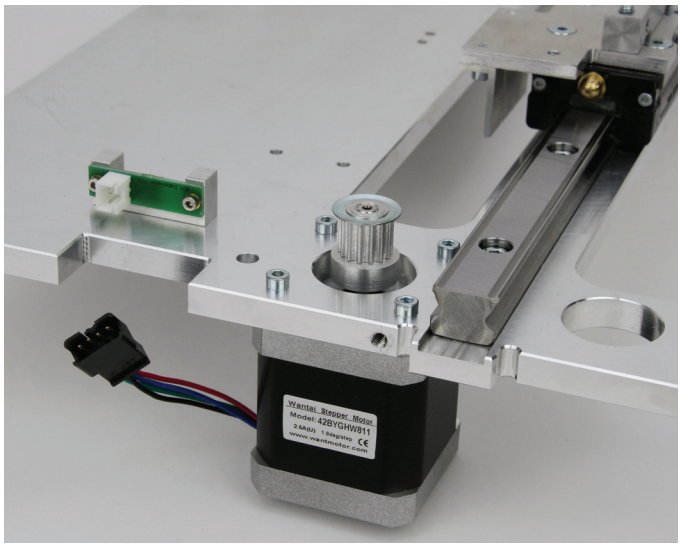


1 x guide carriage plate
1 x X-plate
4 x countersunk head screw M4x10

Attach the guide carriage plate to the guide carriage with the 4 countersunk head screws. First screw in the two screws at the disconnections. Apply screws with threadlocker varnish. The belt holders must be on the side with the previously installed belt tensioner.

Installing the motor

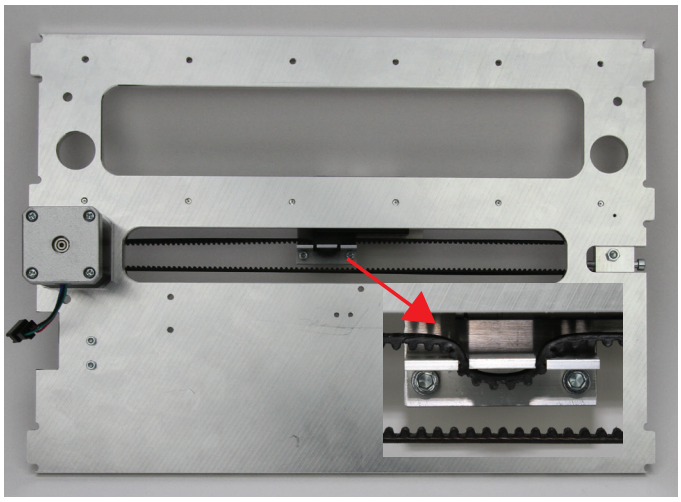


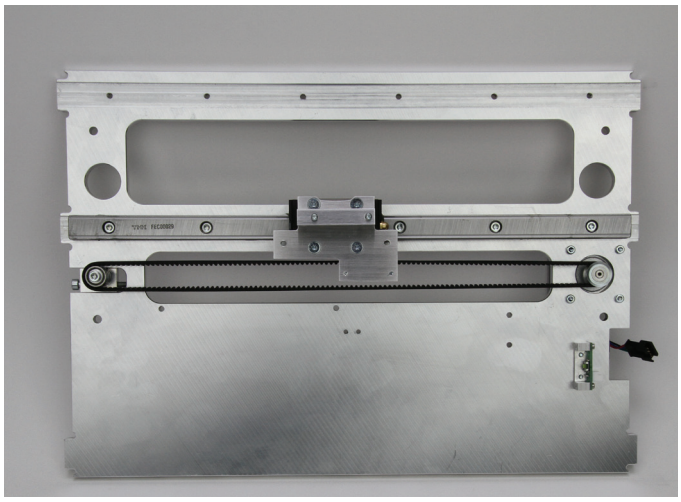


1 x actuator
4 x cylinder head screw M3x12

Attach the actuator to the X-plate with the 4 screws as shown in the figure.
Apply screws with threadlocker varnish.
The cable exit of the actuator must point in the direction of the limit switch as shown.

Attaching the toothed belt.



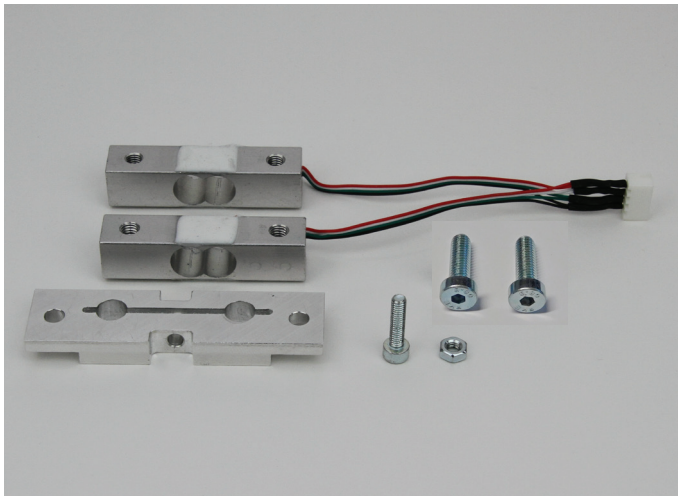


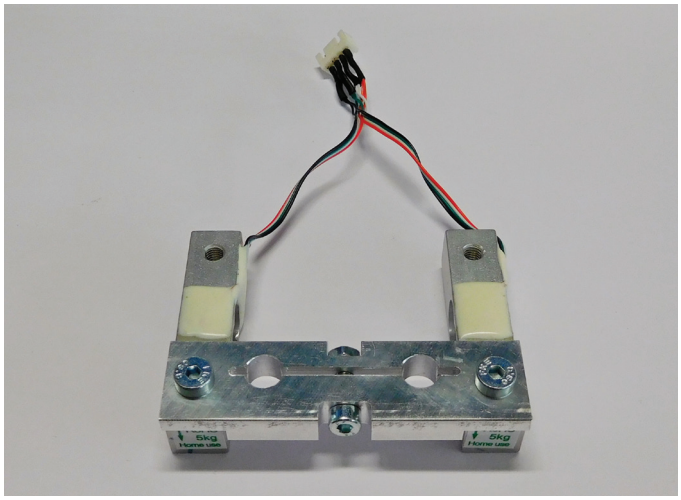
1 x toothed belt 675 mm

Relieve belt tensioner entirely.
Insert the toothed belt on the motor pinion and then into the belt holders as shown in the first figure.
Then put the toothed belt across the belt tensioner.
Tension the toothed belt by turning the belt tensioner screw until it can still easily be turned by 180° with two fingers.

Caution:
The toothed belt must not be tensioned too strongly. If the belt tensioner bends, the belt tension must be reduced under all circumstances.
A method for more precise setting of the belt tension is found in the chapter "21. Maintenance".

Assembly of the strain gauges and the extruder holder

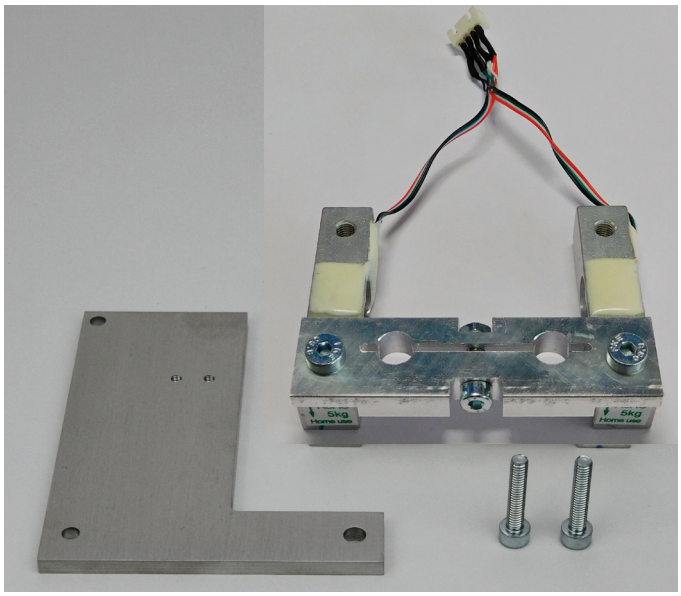


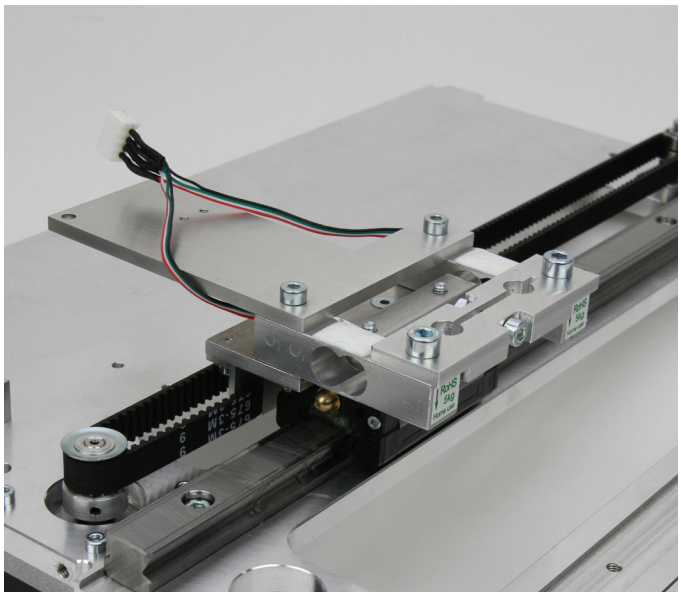


2 x strain gauges
1 x extruder holder
1 x cylinder head screw M4x16
2 x cylinder head screw M5x16 with flat head
1 x nut M4

Loosely attach the screw M4x16 with the nut M4 in the middle hole of the extruder holder. The nut must be placed in the narrower cut-out (see figure).
Loosely attach the extruder holder to the strain gauges with the two screws M5x16 (flat head). The head of screw M4x16 must point away from the cables as illustrated. Apply the two M5-screws with threadlocker varnish.
The arrows at the head sides of the strain gauges must point down.

Attaching the extruder holder and strain gauges



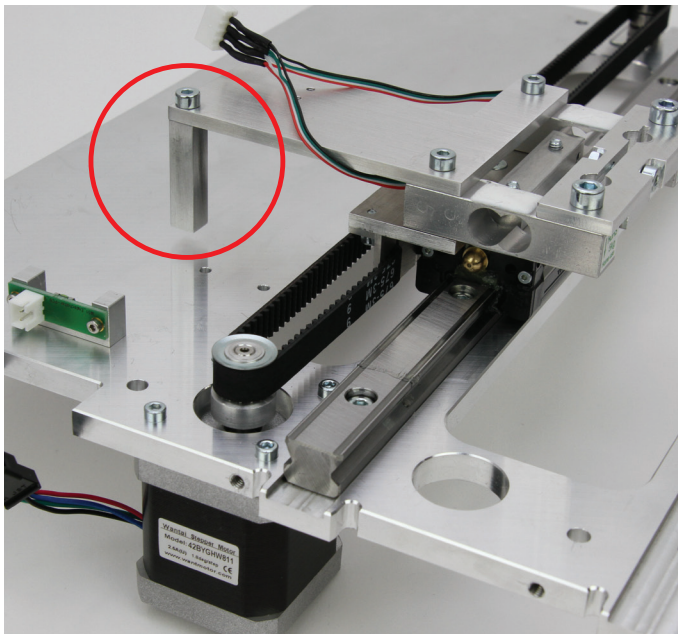


1 x holding plate for end stop actuation
1 x assembly extruder holder with strain gauges
2 x cylinder head screw M4x20

Please note that the following pictures show only the normal M5 screw, without flat head.

Attach the assembly from the previous construction section together with the holding plate of the end stop actuation to the guide carriage as shown.
Apply screws with threadlocker varnish.
Attention, the connection lines of the strain gauges must be placed above the holding plate (see figure).
Now tighten the two screws of the extruder holder as well.

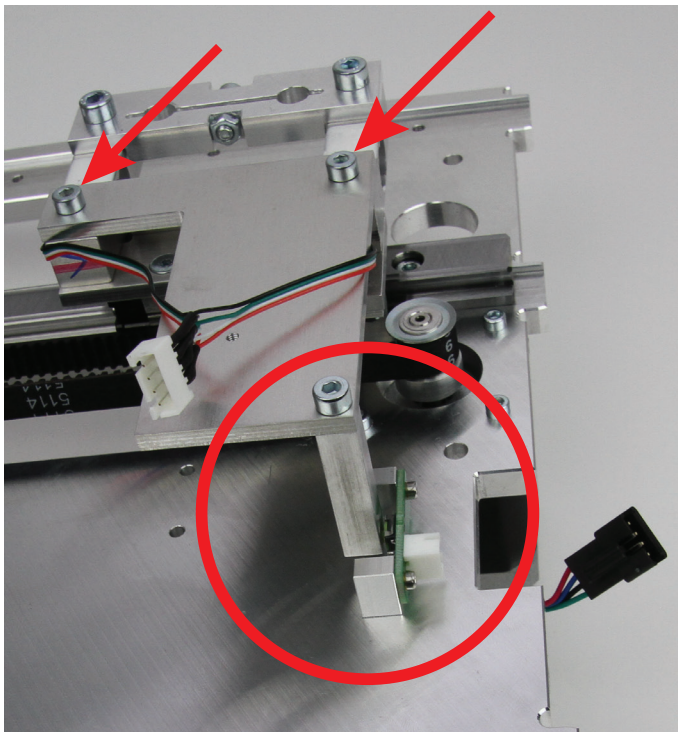
Installing the end stop actuation



1 x end stop actuation
1 x cylinder head screw M4x10

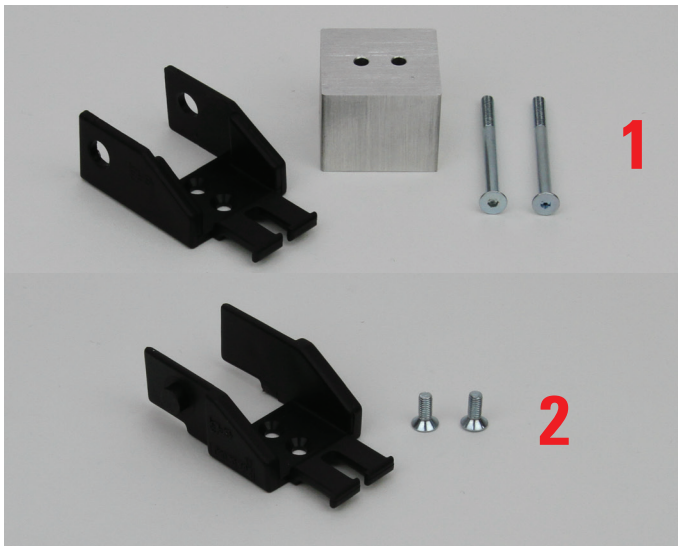
Install the unit with the cylinder head screw as illustrated (red circle).

Checking the end stop

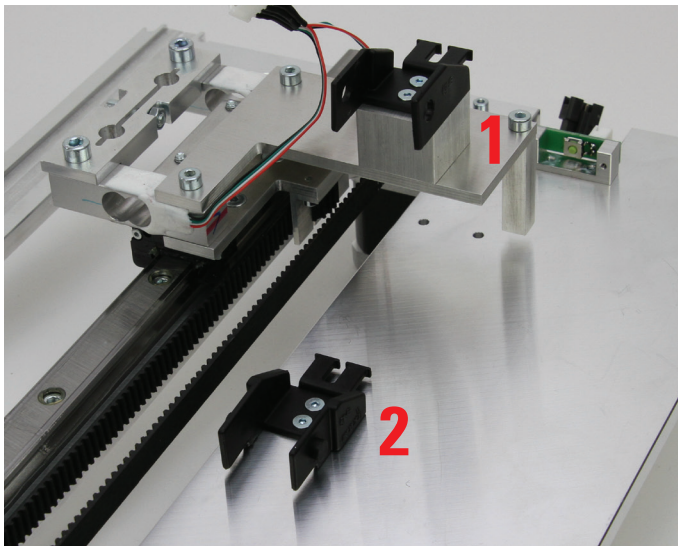


After the limit switch actuation has been installed, move the extruder carriage to check whether the limit switch (circle in the figure) is tripped by slight pressure from the end stop actuation (triggering leads to a slight click).
If the limit switch is not actuated, loosen the screws again (arrows on the screen) and twist the holding plate for the end stop actuation a little until the limit switch can be actuated.

Assembly of the drag chain end pieces



1 x drag chain end piece with hole
1 x drag chain end piece holding block
2 x countersunk screw M3x30
1 x drag chain end piece with nipple
2 x countersunk screw M3x8



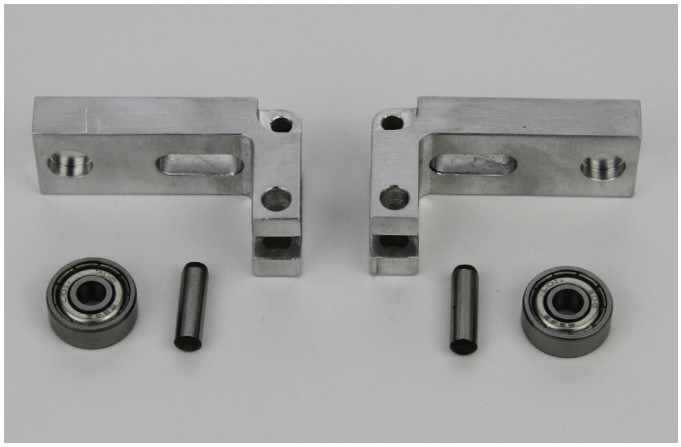
Install the drag chain end pieces as shown in the figure.
Drag chain end piece with nipple = X-plate
Drag chain end piece with hole = Extruder carriage

Installation of the knurls on the infeed motors

2 x actuator
2 x feed knurl
2 x threaded pin M3x5

Push the feed knurl onto the axis of the actuator and attach it with the threaded pin. Apply the threaded pin with threadlocker varnish.
The feed knurl must be as close as possible to the motor. As reference for the distance, push a sheet of paper folded twice between the knurl and the motor.
Repeat all steps for the other actuator.

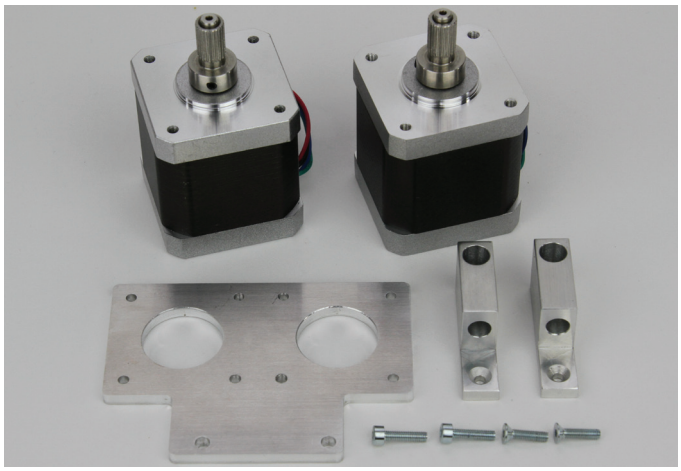
Assembly of the ball bearing holders

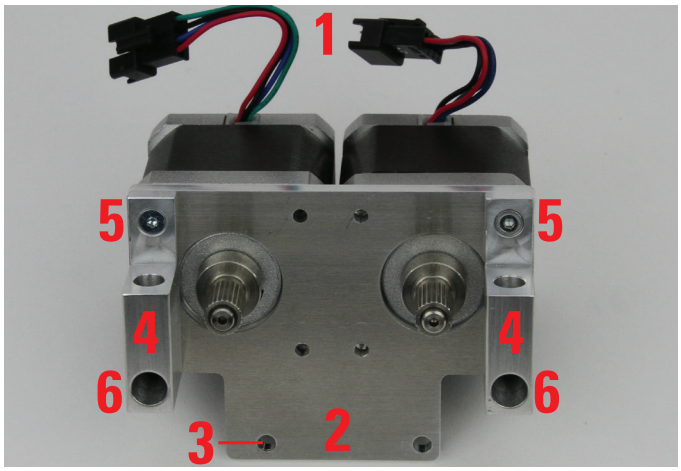


2 x ball bearing holder
2 x ball bearing 624ZZ (diameter inside/outside (3.8/13 mm)
2 x cylinder pin 4x14 mm

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 into the holder and the ball bearing with a hammer until the pin is entirely inside the hole in the holder. Use a mounting mandrel or punch if necessary.
Install the second ball bearing holder in the same way.

Assembly of the filament infeed unit

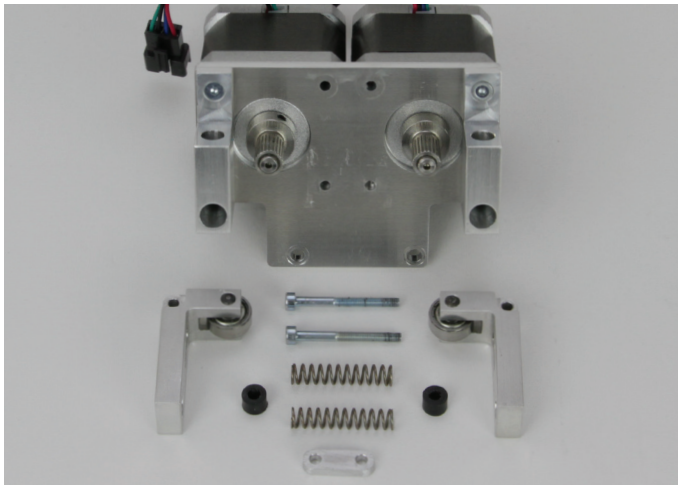


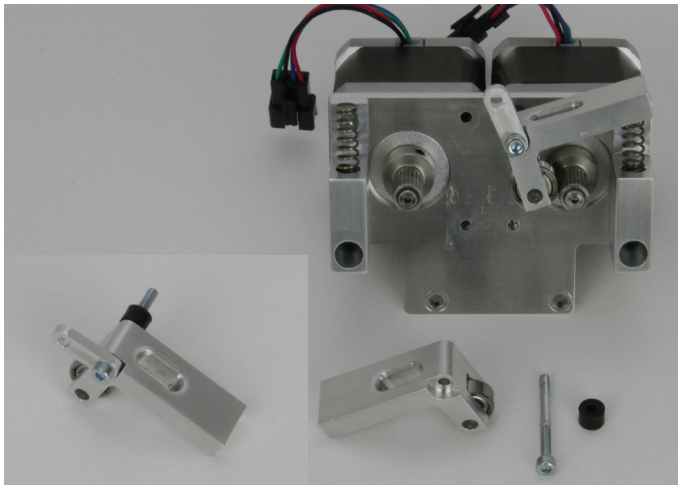


2 x feed motor
1 x motor holding plate
2 x spring holding lock
2 x cylinder head screw M3x12
2 x countersunk screw M3x12

For easier installation, place the motors side by side with the knurls pointing up. Put on the motor holding plate. The cable exit of both motors (1) must point away from the attachment of the motor holding plate (2). The motor holding plate must be used so that the indented mounting hole (3) as illustrated is on the left side.
Install the two spring holder blocks (4) to the motors through the motor holding plate. Use the two hexagon head screws on top (5). Use the two cylinder head screws at the bottom (6).
Apply all screws with threadlocker varnish.

Installation of the ball bearing holders at the filament feed unit





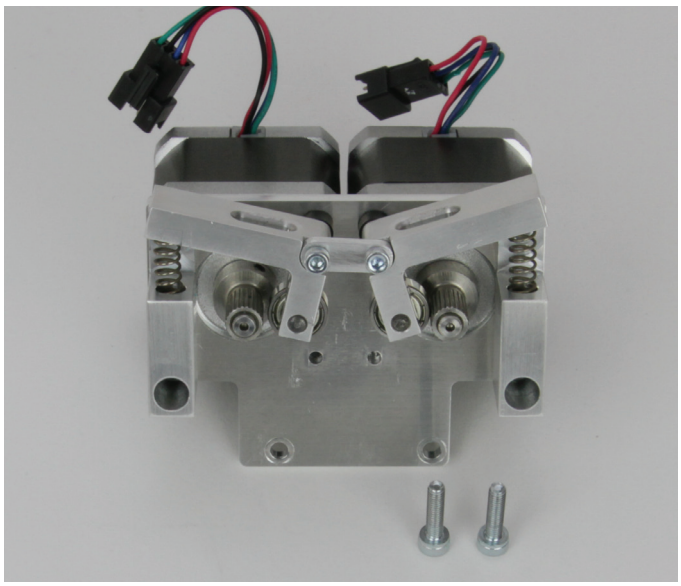
1 x filament feed unit
2 x ball bearing holder
2 x cylinder head screw M3x30
2 x spring
2 x spacer roller 5 mm
1 x counter-bearing

Important! Since approx. July 2016, the delivery has included 3 sets of springs (soft; hard (2 mm shorter than the soft ones); very hard (about 5 mm longer than the two others). We recommend using the "very hard" springs at once for PLA and ABS printing. Optionally, you can use some kind of support in the spring holding block when using the two other springs.

Push one spring each from above into the two spring holding blocks. Assemble the first ball bearing holder as shown in the small image (screw - counter-bearing - ball bearing holder - spacer roll). The counter-bearing must be placed in the cut-out of the ball bearing holder. Then install it on the filament feed unit, as illustrated. First attach the spring to the cut-out at the bottom of the ball bearing holder. Push the second screw through the counter-bearing, then push on the ball bearing holder and the spacer roll and install it on the filament feed unit as before.
Apply threadlocker to both screws and tighten them until the ball bearing holder can be moved smoothly.

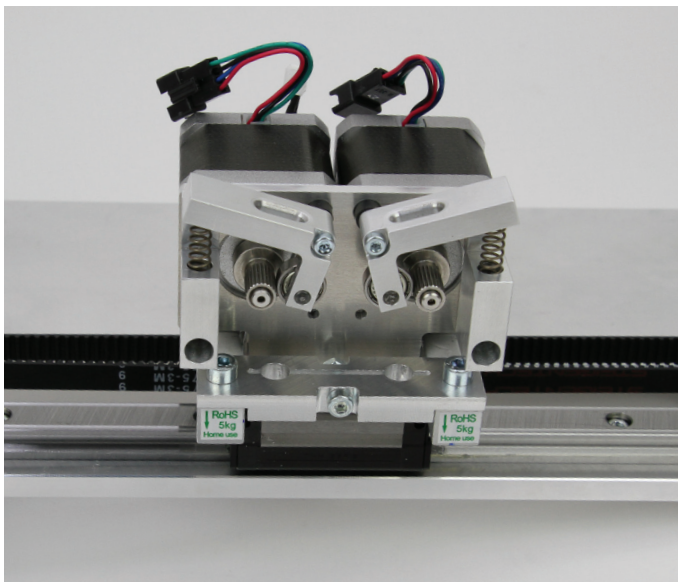
→ If you have purchased your printer before July 2016 or if the "very hard" springs were missing, you can order them from our support free of charge.

Assembly of the filament infeed unit at the guide carriage



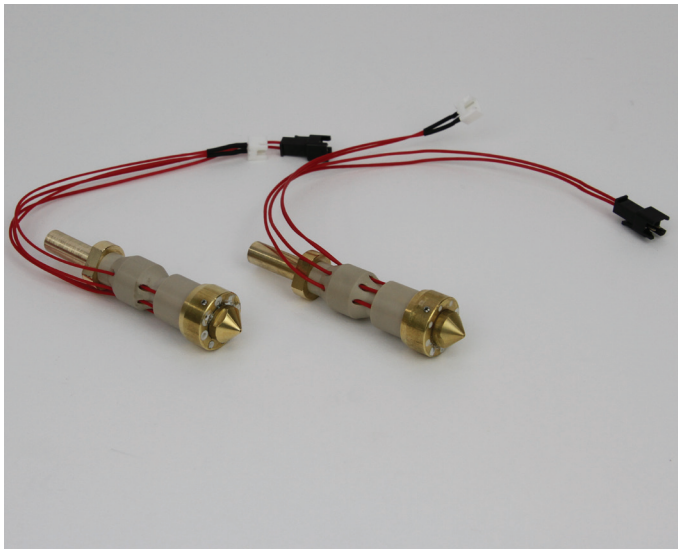
1 x filament feed unit
2 x cylinder head screw M4x16

Please note! Since the counter-bearing was inserted as an improvement on short notice it is, unfortunately, not shown in all pictures.

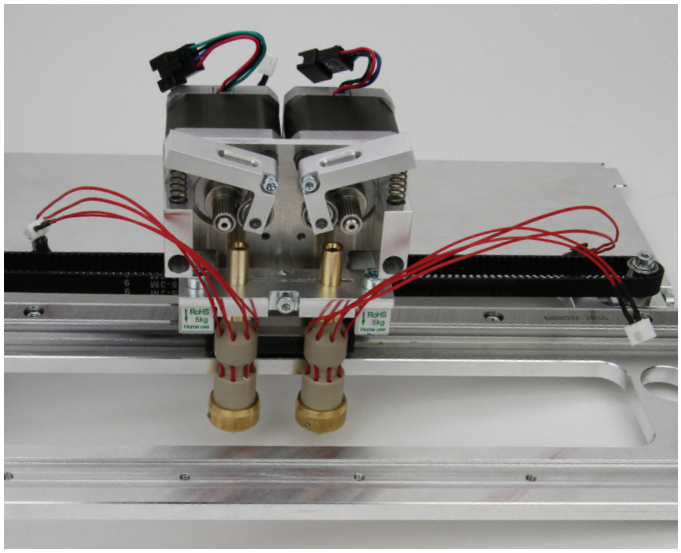


Attach the filament feed unit to the guide carriage as shown. The two attachment holes are located below the extruder holder.
Apply both screws with threadlocker.

Installing the two extruders

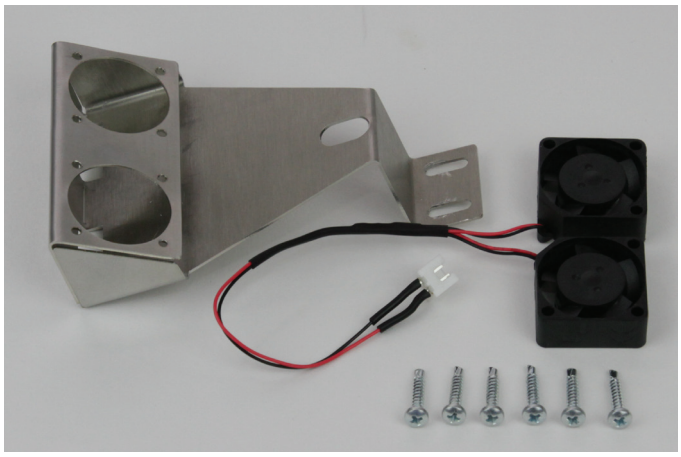


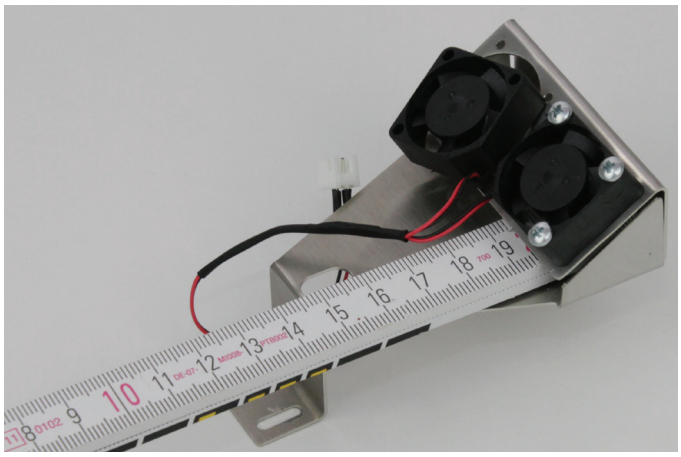
2 x extruder



Insert both extruders from below into the extruder holder until they reach the top. Then attach them with the cylinder head screw between the extruders.
During assembly, observe that the connection lines of the extruder are not caught or damaged.
Attention - The extruder housing (hot end) must not touch any other parts, since the measuring results of the strain gauges would be incorrect then and the heat bed scan could no longer be performed successfully.

Assembly of the fan sheet

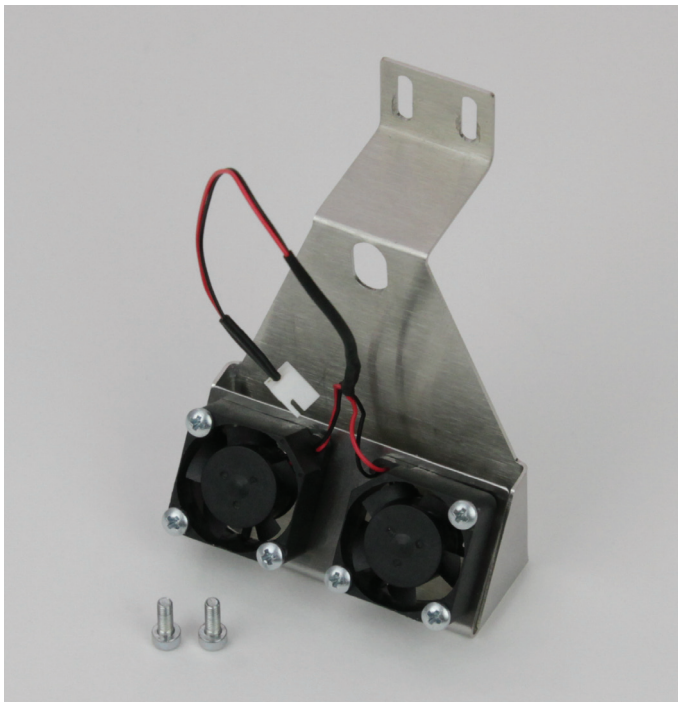


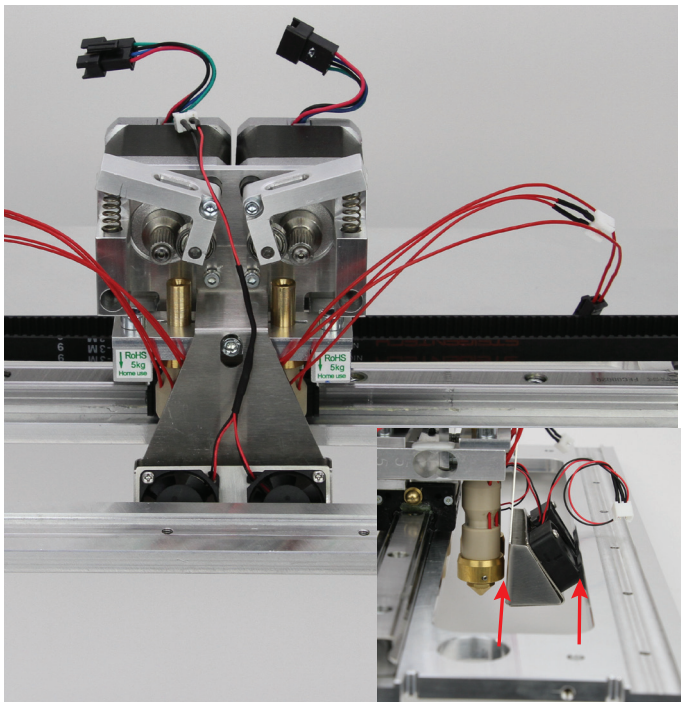


1 x fan sheet
1 x double fan
6 x sheet screw ST2.2x16

Install both fans with 3 sheet screws each to the fan sheet as shown. Support the fan sheet on a table top during installation. Use a yardstick or something similar for countering.
The blowing direction (marked by an arrow in the fan) must be inwards during installation.

Attaching the fan sheet

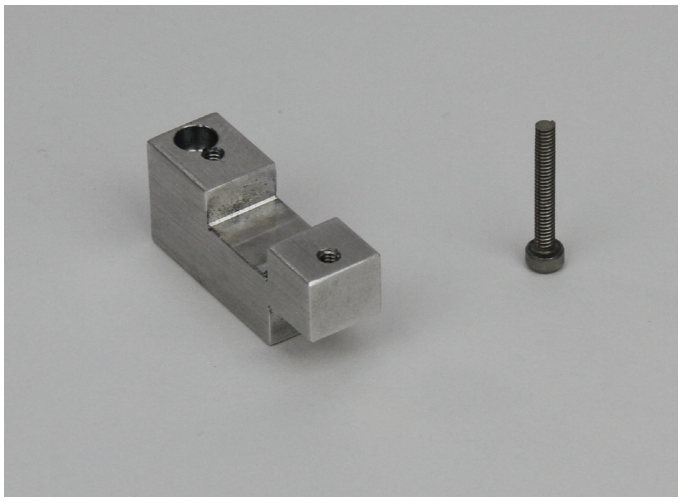




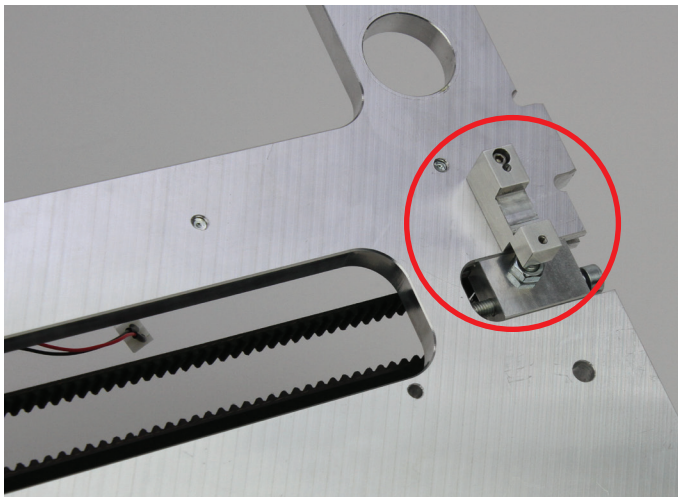
1 x fan sheet completely installed
2 x cylinder head screw M3x8

Install the fan sheet to the filament feed unit with the two cylinder head screws as illustrated.
Align the fan sheet height so that it is not supported on the extruder holder and that the lower edge is higher than the two tips of the extruder nozzles.
Attention! Always ensure that the fan sheet does not touch the extruders and that the fans do not touch the X-plate (see small figure).

Installation of the light barrier holding block



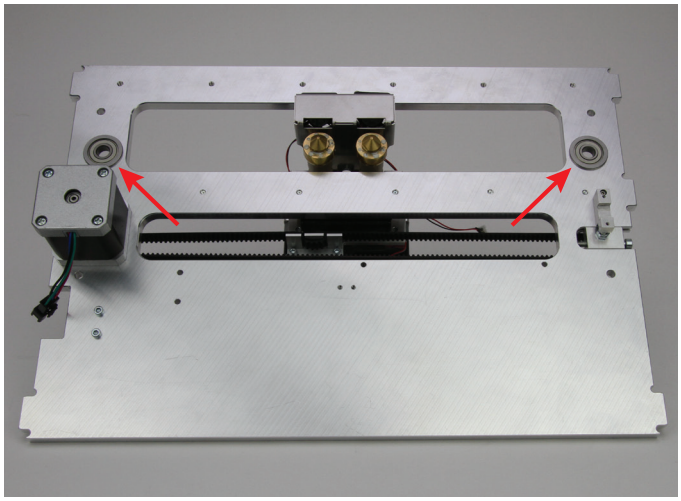
1 x light barrier holding block
1 x cylinder head screw M2x14



Attach the light barrier holding block to the X-plate with the cylinder head screw as illustrated and align it straight.

Inserting the grooved ball bearings

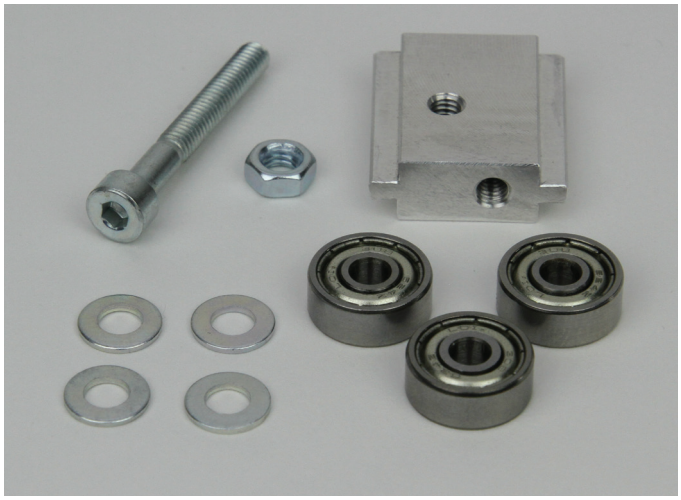
2 x grooved ball bearings



Insert the grooved ball bearings into the corresponding bores of the X-plate from below.
Turn the grooved ball bearings slightly, when inserting them into the bores. Do not apply any force. The flanges of the grooved ball bearings must be cleanly aligned with the bottom of the X-plate.

Assembly of the Y-plate

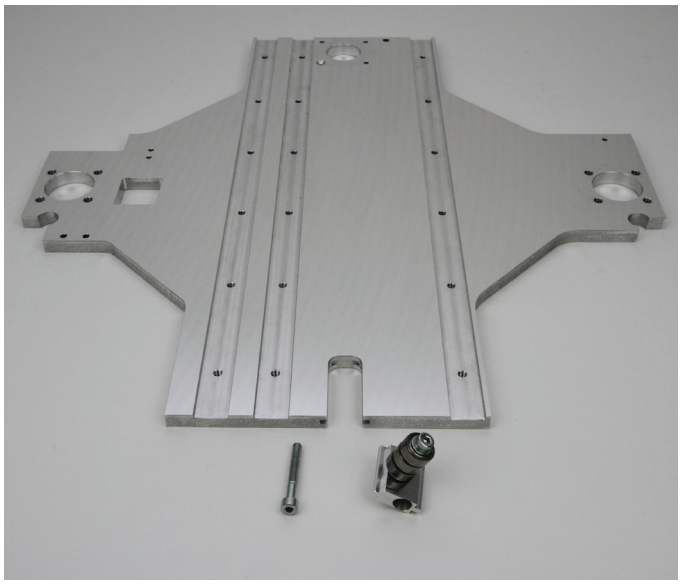
Installation of the belt tensioner



1 x cylinder head screw M4x30
1 x nut M4
1 x belt tensioner basic body
4 x washer (diameter inside/outside 4.3/8.8 mm)
3 x ball bearing 624ZZ (diameter inside/outside (3.8/13 mm)

Push washers onto the screw with the ball bearings alternatingly.
Screw the screw into the belt tensioner basic body as shown in the figure and tighten it well.
Counter the screw with a nut.

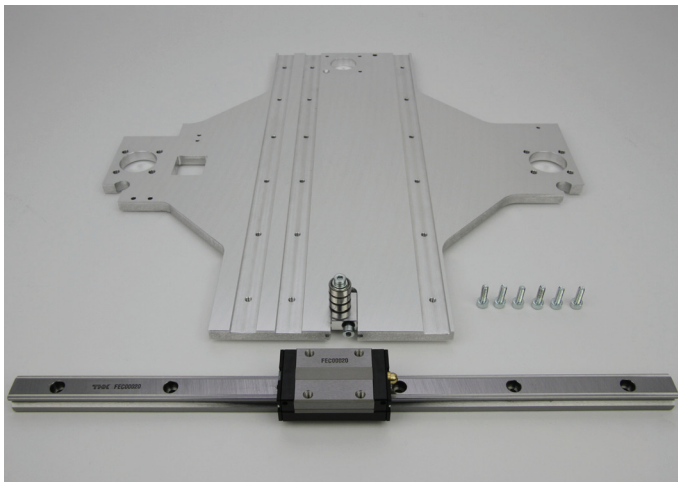
Attachment of belt tensioner to the Y-plate

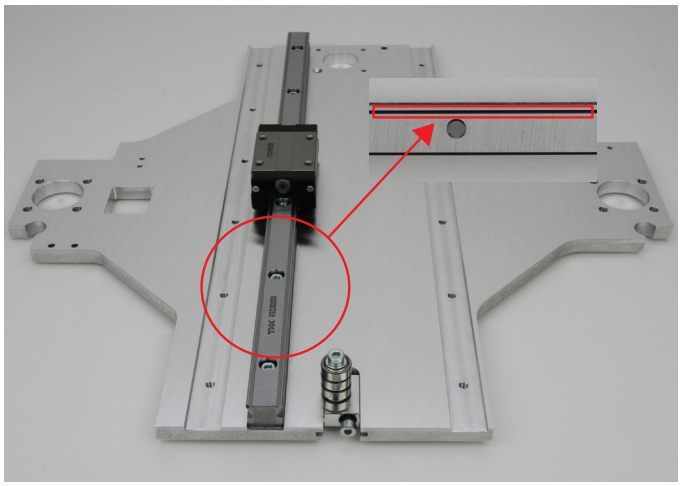


1 x Y-plate
1 x assembly belt tensioner (previous construction step)
1 x cylinder head screw M4x30

Push the belt tensioner assembly into the intended section of the X-plate and turn the screw into the belt tensioner.
The ball bearings must point to the grooved side of the Y-plate and the bore in the belt tensioner must be on the right (see figure).

Attachment of the guide rail

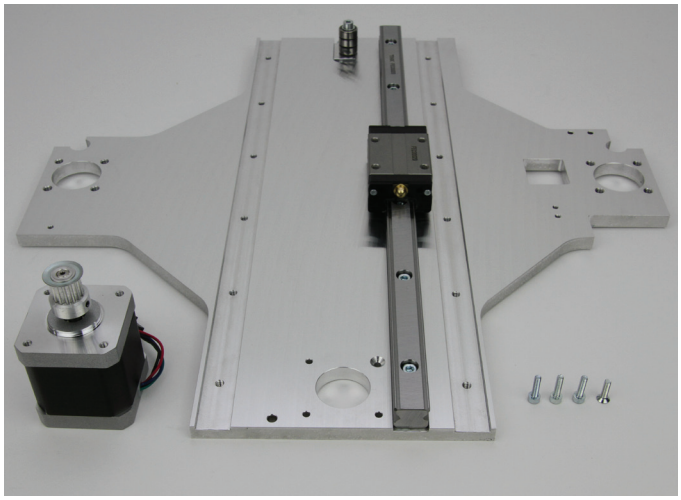


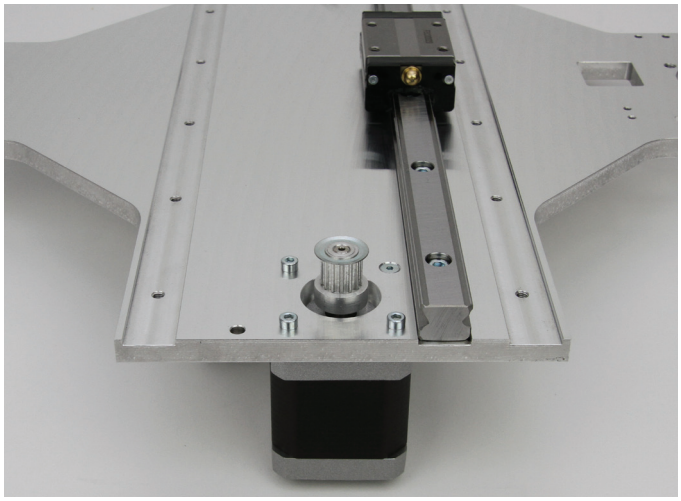


1 x Y-plate
1 x guide rails
6 x cylinder head screws M4x12

Insert the guide rail into the middle groove of the Y-plate and attach it with the screws.
The lower groove on the guide rail must point to the plate centre.

Assembly of the drive motor

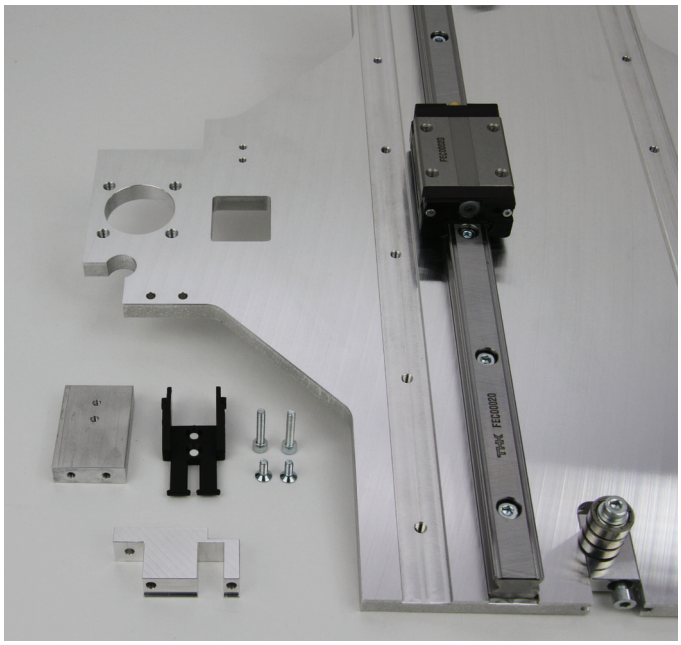


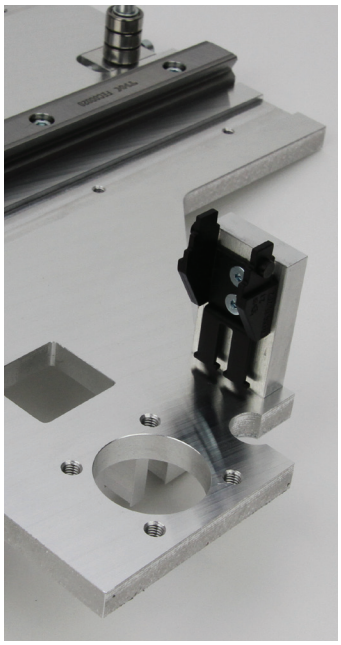


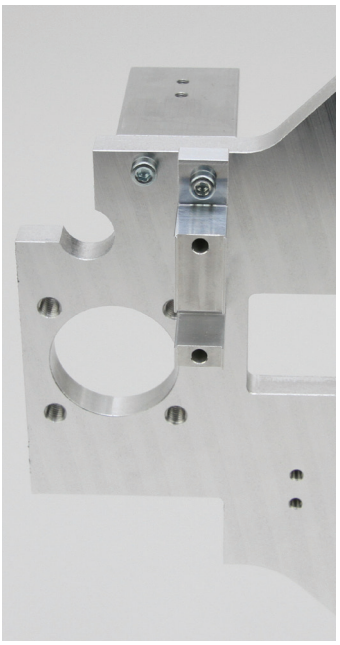
1 x actuator
1 x Y-plate
3 x cylinder head screw M3x12
1 x countersunk screw M3x12

Attach the actuator to the Y-plate with the 3 cylinder head screws and the countersunk screw as shown in the figure.
Use the countersunk screw for the countersunk bore.
Apply screws with threadlocker varnish.
The cable exit at the motor must point to the middle of the Y-plate (i.e. in the figure backwards).

Installation of the drag chain end piece on top and the limit switch holding block at the bottom



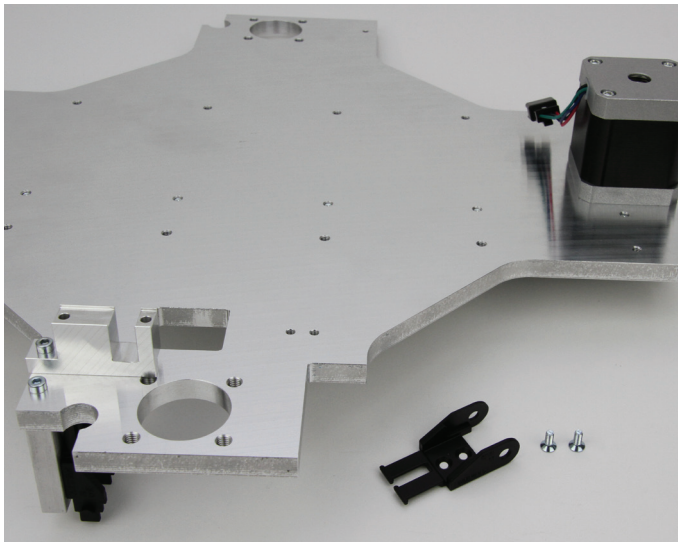


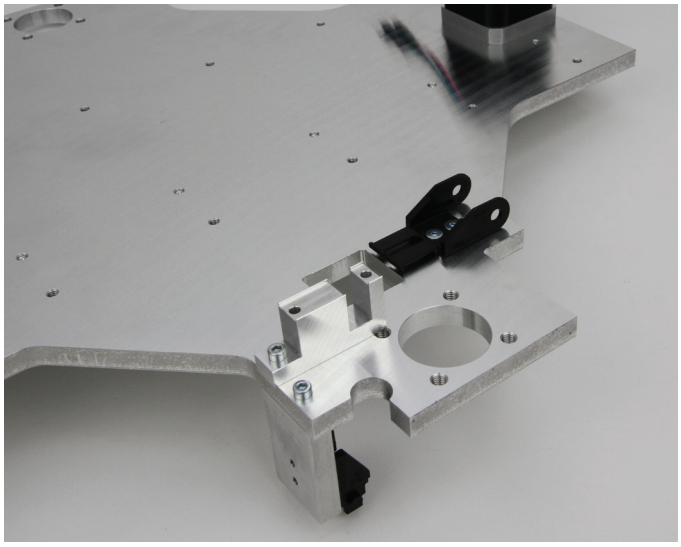


1 x holding block for guide rail
1 x drag chain end piece with nipple
1 x limit switch holding block
2 x cylinder head screw M3x16
2 x countersunk screw M3x8

Attach the drag chain end piece with the countersunk screws at the holding block.
Attach the holding block to the grooved upper side of the Y-plate with a cylinder head screw (screw hole towards the outside).
Attach the holding block for the limit switch with the second cylinder head screw from below.

Assembly of the drag chain end piece bottom

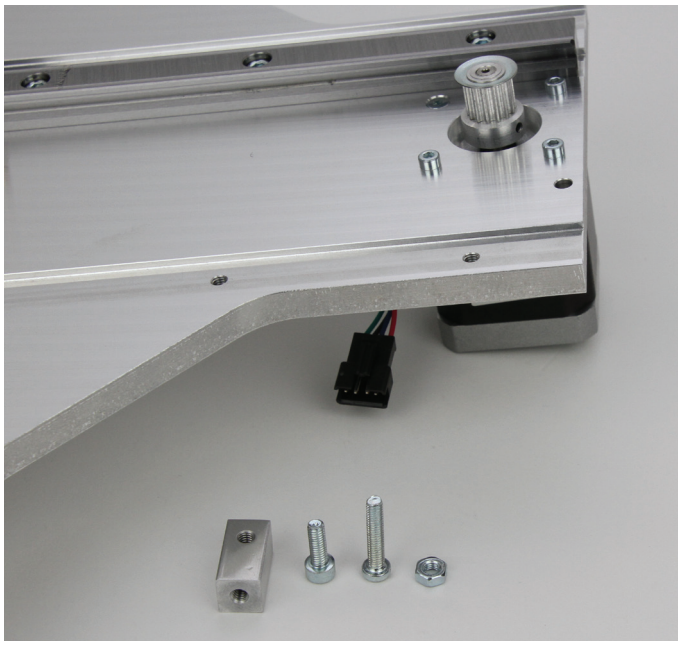


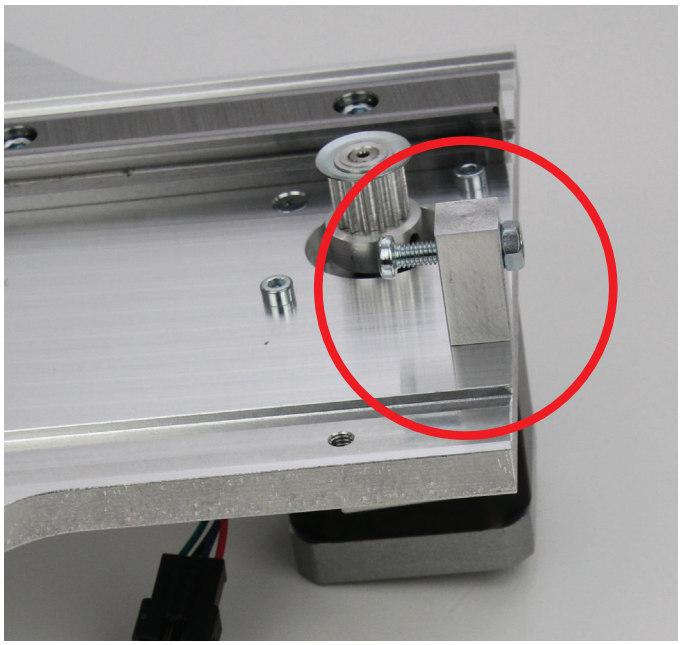


1 x drag chain end piece with hole
2 x countersunk screw M3x8

Attach the drag chain end piece with the countersunk screws as shown in the figure on the ungrooved lower side of the Y-plate.

Installing the limit switch actuation

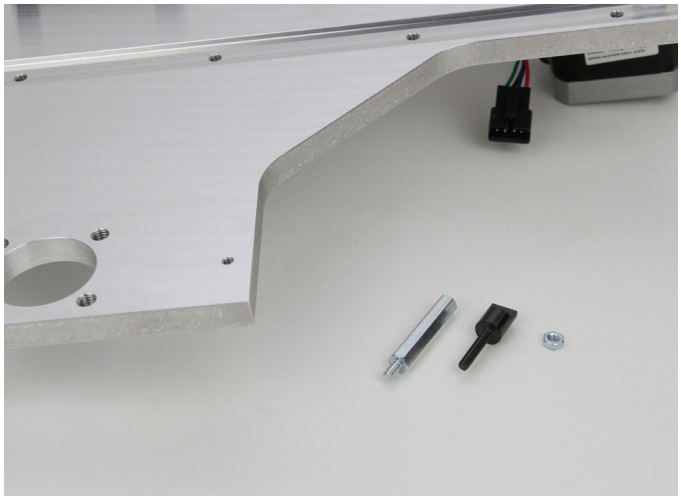


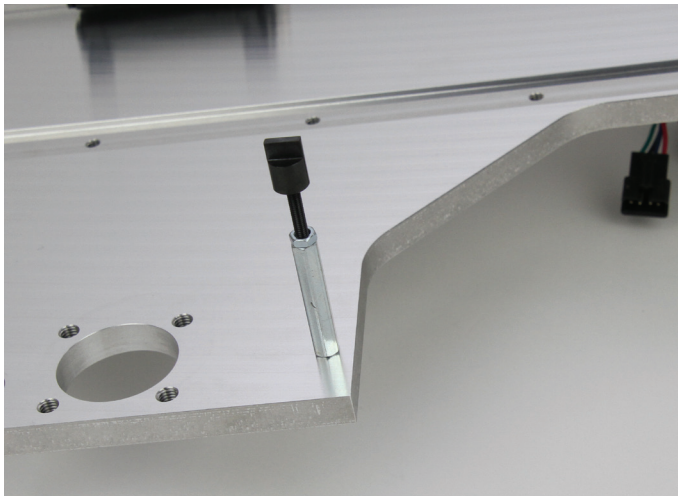


1 x actuation for limit switch
1 x cylinder head screw M4x12
1 x cylinder head screw M4x20
1 x nut M4

Turn the cylinder head screw into the aluminium block and counter it with the nut on the opposite side. The screw thread must end with the nut.
Install the actuation of the limit switch as shown in the figure at the Y-plate. The actuation must be aligned so that the screw head can actuate the limit switch at the undertable.
Once the table is installed, check the actuation and adjust if necessary.

Installing the actuation for the Z-stop

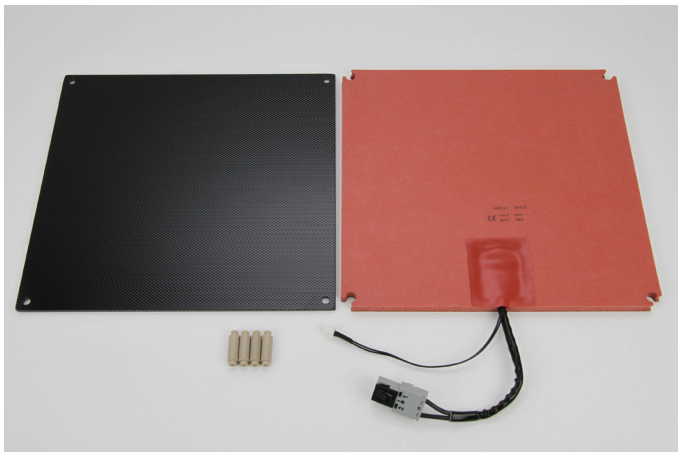


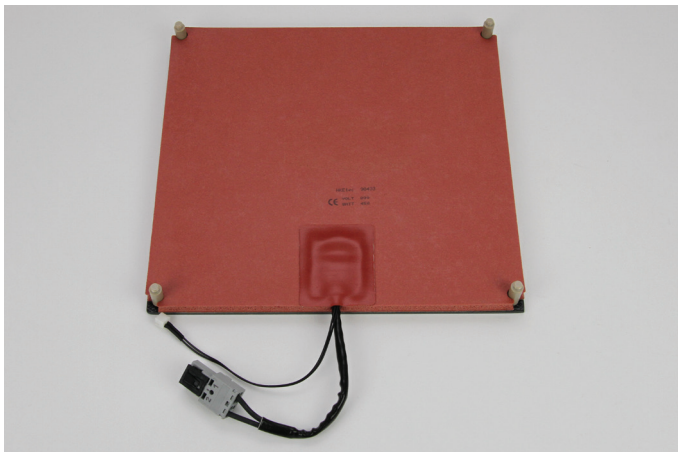


1 x hexagon threaded bolt M3
1 x actuation for Z-stop M3
1 x nut M3

Turn the hexagon thread bolt into the Y-plate from above as shown.
Turn the actuation for the Z-stop into the hexagon threaded bolt and counter only slightly with the nut.

Glue connection of the heating plate

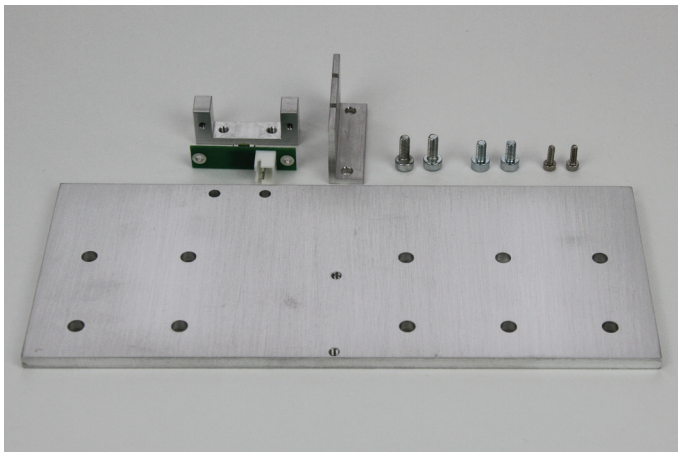


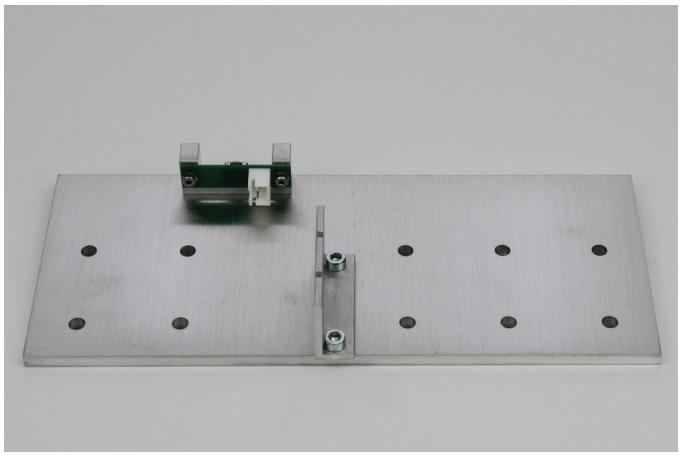


1 x glass ceramics plate
1 x heater (self-adhesive)
4 x spacer bolts

Plug the spacer bolts with the thread bores to the bottom of the glass ceramics plate (side with structure) and provisionally fasten with 4 screws if necessary.
Caution: Only tighten the screws slightly since there is the danger that the plate will break otherwise.
Check the alignment of the heating by pushing the heating across the spacer bolts. The heating must then be supported fold-free with the side with the protection foil against the bottom of the plate and must not protrude at the edges.
Clear the bottom of the plate of dust and grease with a rag and solvent.
Then remove the protective foil from the heating and finally glue the heating to the bottom of the glass ceramics plate without blisters.

Installing the holder of the under-table plate

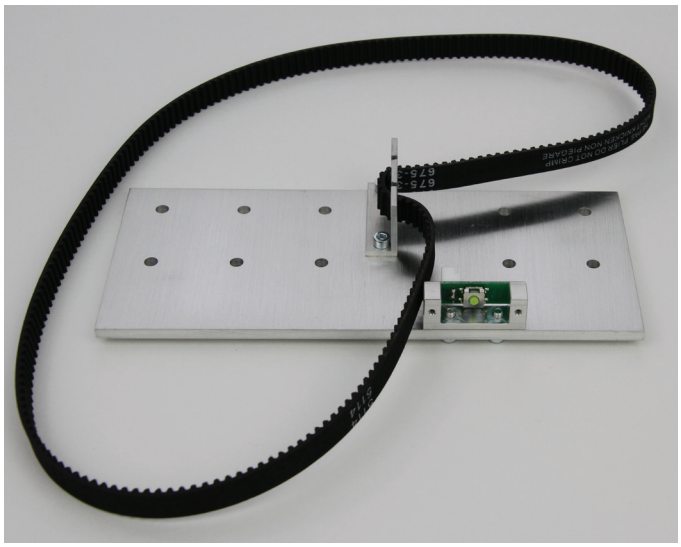


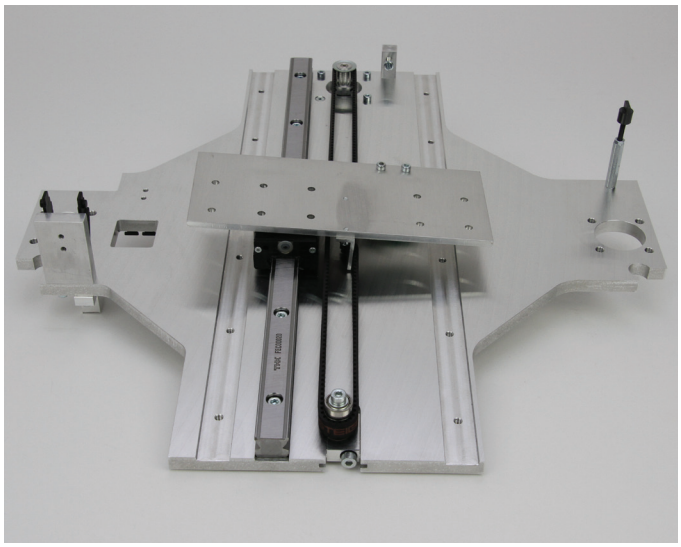


1 x limit switch holder
1 x limit switch PCB
1 x belt tappet angle
2 x cylinder head screw M3x8
2 x cylinder head screw M3x6
2 x cylinder head screw M2x6
1 x undertable holder

Attach the limit switch holder to the undertable plate with the screws M3x8.
Install the limit switch PCB with the M2x6-screws to the limit switch holder.
Install the belt tappet angles with the screws M3x6 as shown in the figure.
Apply the screws of the belt tappet angle with threadlocker varnish.

Application of the toothed belt



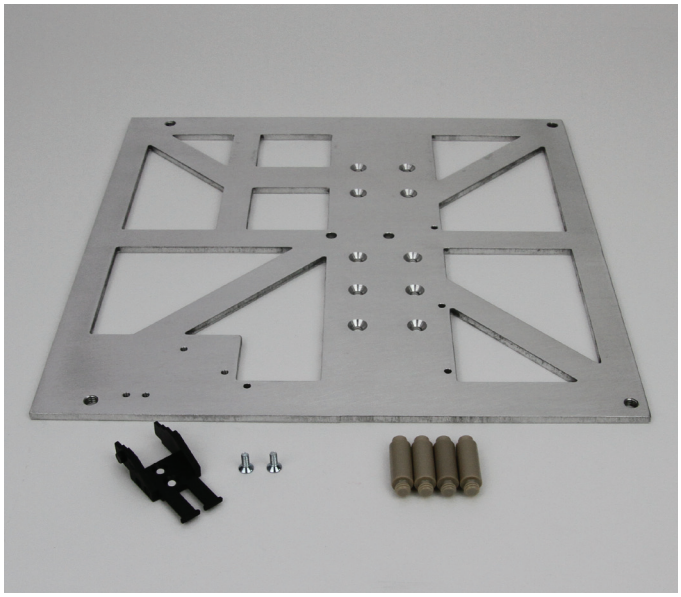


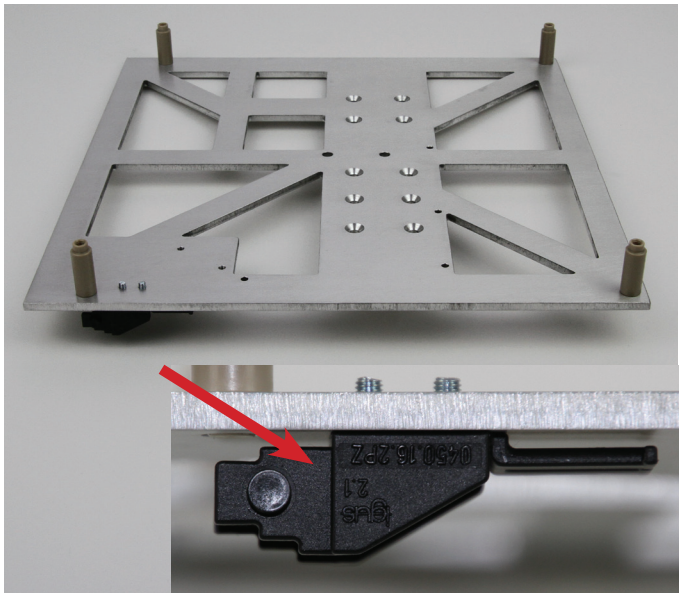
1 x undertable holder from the previous step
1 x toothed belt 675 mm

Insert the toothed belt into the belt tappet angle as shown in the left figure.
Relieve the belt tensioner of the Y-plate all the way.
Turn the undertable holder and put the toothed belt onto pinion and belt tensioner as shown in the figure. The limit switch must be at the rear right for this.
The undertable holder is only placed on the guide carriage here (do not screw on yet).
Tension the toothed belt by turning the belt tensioner screw until it can still easily be turned by 180° with two fingers.

Caution:
The toothed belt must not be tensioned too strongly. If the belt tensioner bends, the belt tension must be reduced under all circumstances.
A method for more precise setting of the belt tension is found in the chapter "21. Maintenance".

Assembly of the undertable

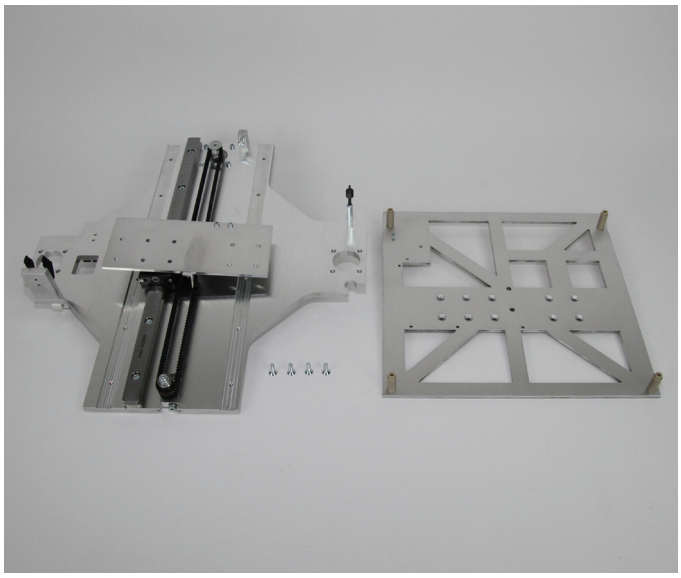


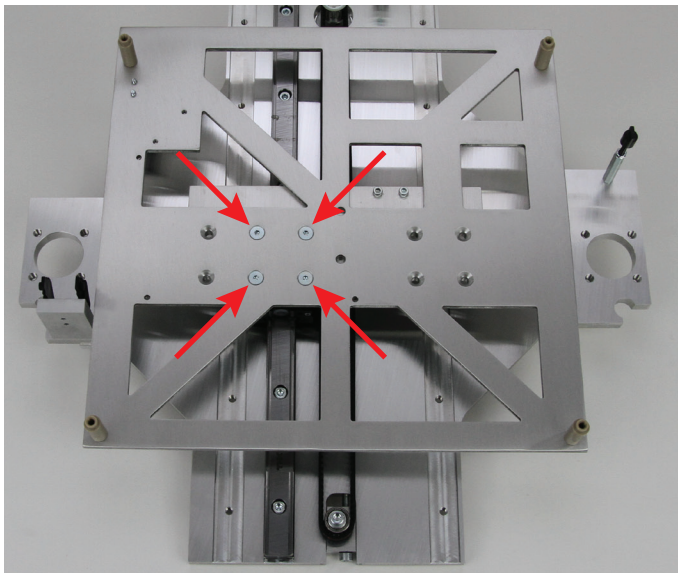


1 x undertable
1 x drag chain end piece with nipple
2 x countersunk screw M3x8
4 x spacer bolts

Screw in the spacer bolts into the top of the undertable (side with recessed bores).
Install the drag chain end piece on the bottom of the undertable with the two hexagon head screws as illustrated.

Assembly of the undertable



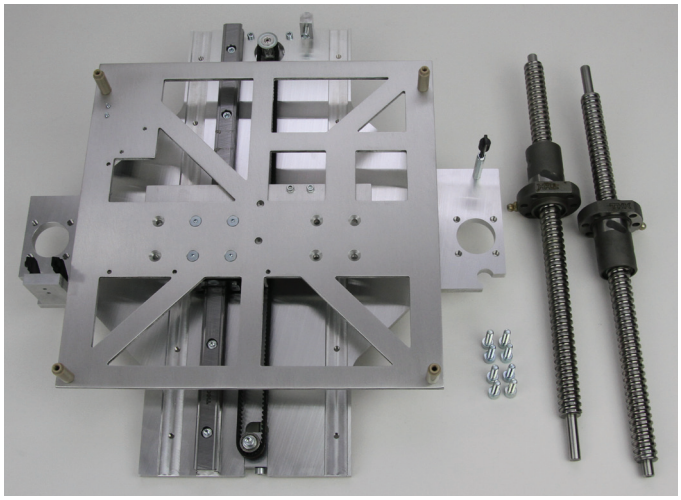


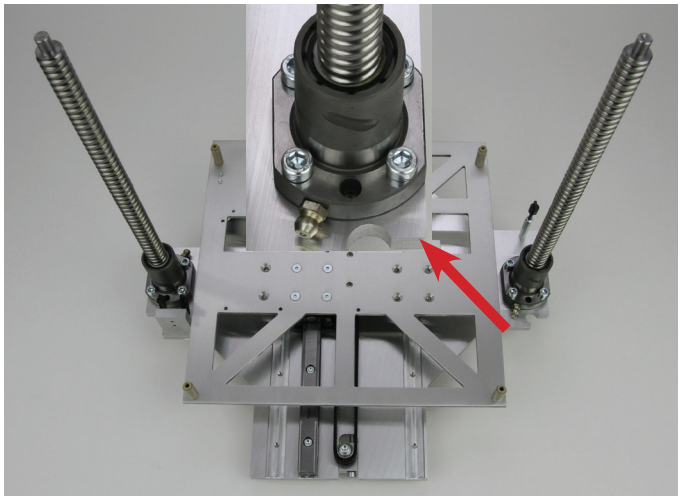
1 x Y-plate
1 x undertable
4 x countersunk head screw M4x12

Attach the undertable and the undertable holder on the guide carriage with the 4 hexagon head screws as illustrated.
Apply screws with threadlocker varnish.
Put the entire Y-plate vertically while holding the table to ensure that the undertable is installed straight.
The edge on which the belt tensioner is located must be at the bottom and supported on a straight surface. Carefully lower the table. If it is not completely supported on the ground like the Y-plate, loosen the 4 hexagon head screws slightly and adjust the table.

Installing the ball-threaded drives

The nuts must never be removed from the ball-threaded drives, since the bearing balls would fall out otherwise. This would be irreparable. Loss of guarantee/warranty!



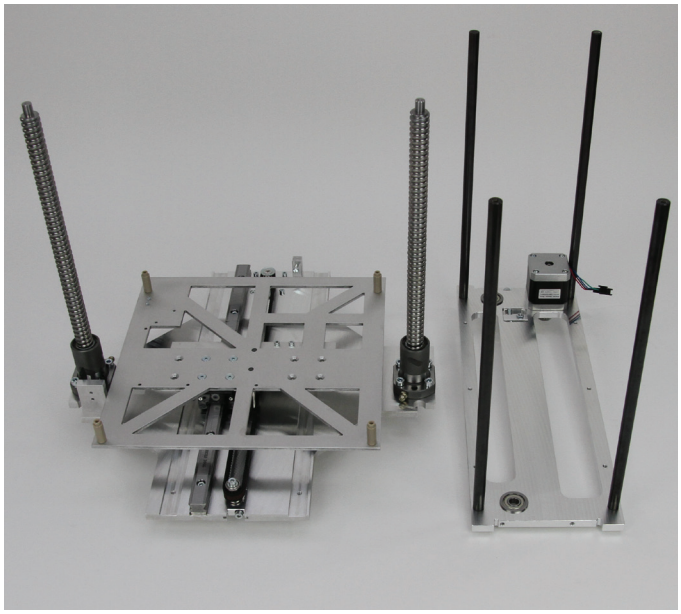


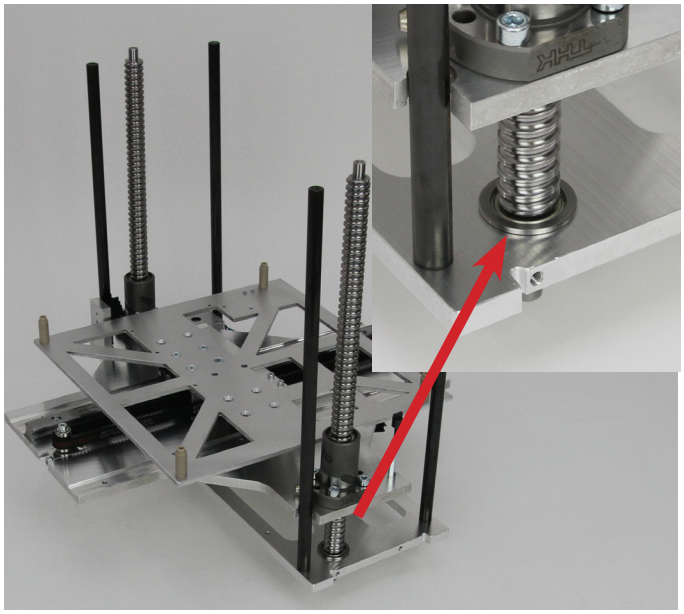
1 x Y-plate
8 x cylinder head screw M5x16
2 x ball-threaded drive

Attach the two ball-threaded drives to the Y-plate as illustrated with 4 screws each. Only turn on the screws loosely by hand here, however.
Observe the position of the lubrication nipples. They must both point to the inside of the device.
The flattened sides of the attachments must end flush with the outer edge of the Y-plate.

Assembly of the Mechanical Basic Construction

Connection of the bottom plate to the Y-plate

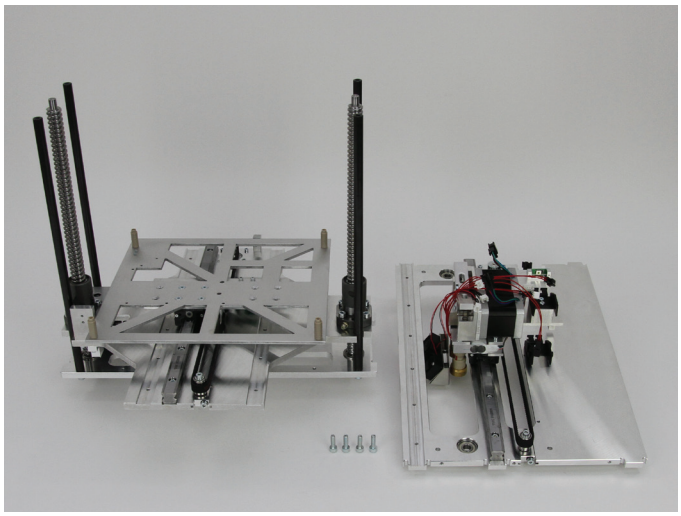


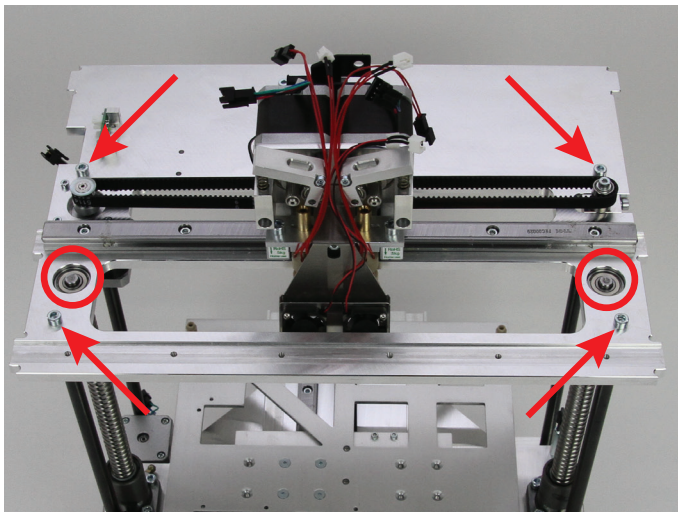


1 x Y-plate
1 x bottom plate

When inserting the ball-threaded drives into the bottom plate, always observe that the spindles are turned out precisely the same length and are not offset against each other.
If this is not the case, the ball-threaded drives must be adjusted to each other by turning.
Thread the Y-plate into the spacers of the bottom plate with the two mill-outs from above.
The ball-threaded drives must be cleanly flush against the grooved ball bearings in the bottom plate after assembly (see small figure).

Assembly of the X-plate

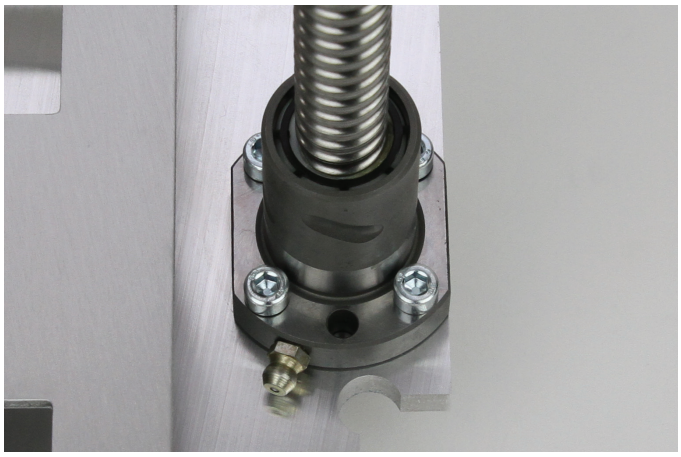




1 x basic frame
4 x cylinder head screw M5x16
1 x X-plate

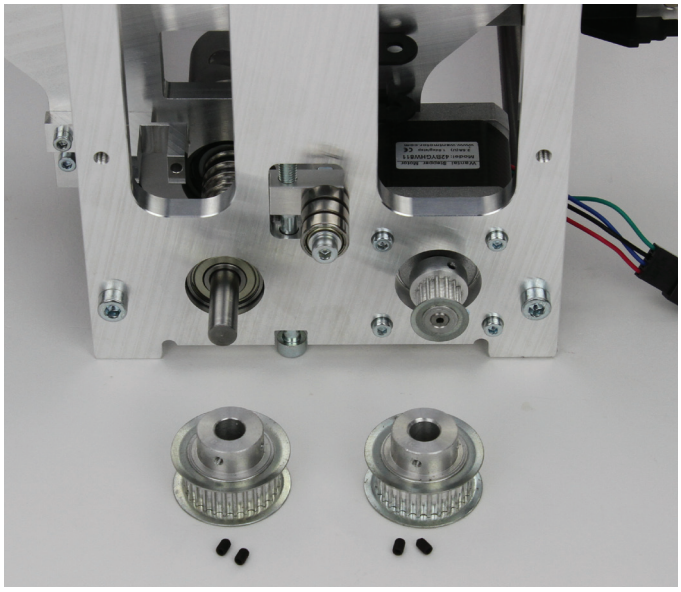
Push the X-plate onto the basic frame of the bottom plate and Y-plate (see previous construction step) and attach it to the spacers (see arrow in the figure) with the screws.
Apply screws with threadlocker varnish.
The ball-threaded drives must be cleanly flush against the grooved ball bearings in the X-plate after assembly.

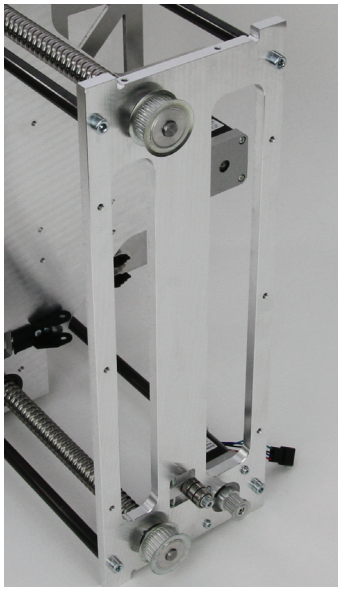
Tighten the ball-threaded drives

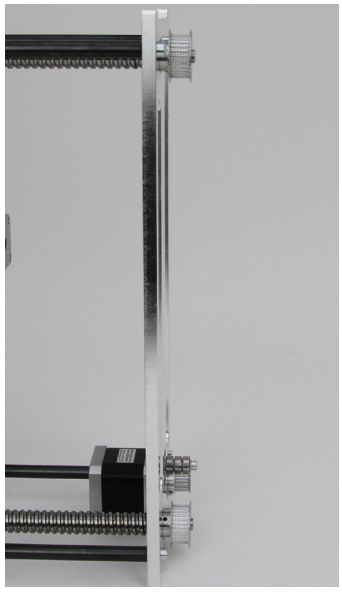


Now finally tighten the attachment screws of the ball-threaded drives on both sides of the printer (4 screws each).

Assembly of the pinions at the thread circulation spindles





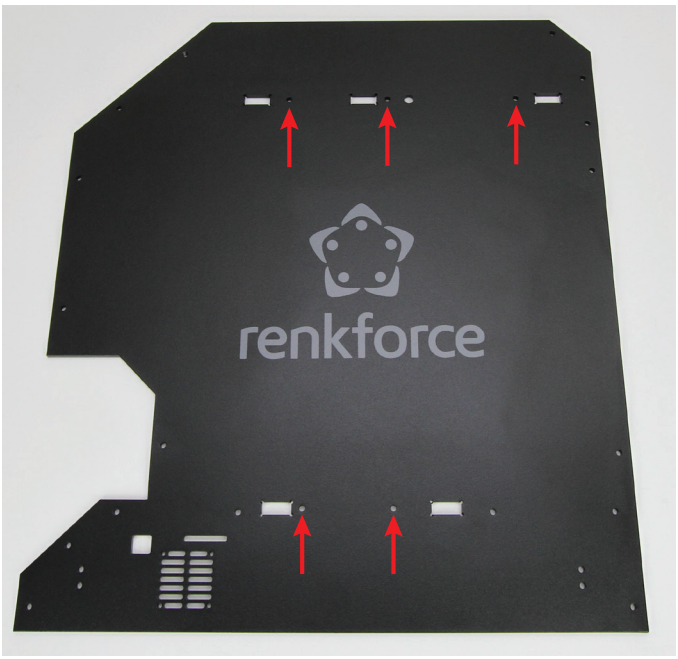


1 x basic frame
2 x sprocket 28Z (large pinion, outer diameter 32 mm)
4 x threaded pins M3x5

Push the sprockets onto the ends of the thread circulation spindles and attach with the threaded pins.
Then align the position of the pinions so that the toothed areas are at a level with the toothed area of the motor pinion.
If applicable, correct the position of the motor pinion.
Important! Attach the sprocket that is not at the motor (the upper one in the figure) only slightly with a threaded pin to keep it from falling out. Screw in the second threaded pin loosely.

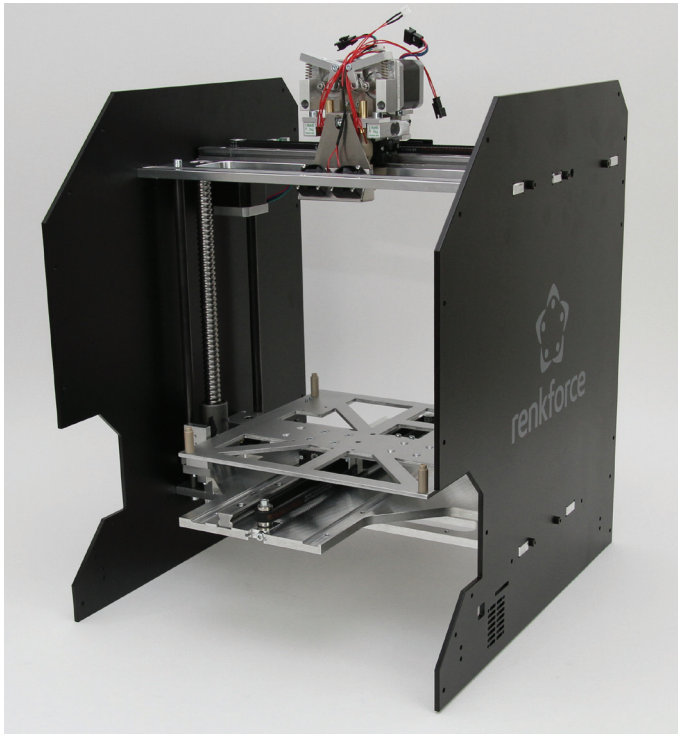
When installing the two large sprockets, their orientation does not matter. It is only important that the tooth areas of the two sprockets are aligned with the motor sprocket.

Assembly of the side parts



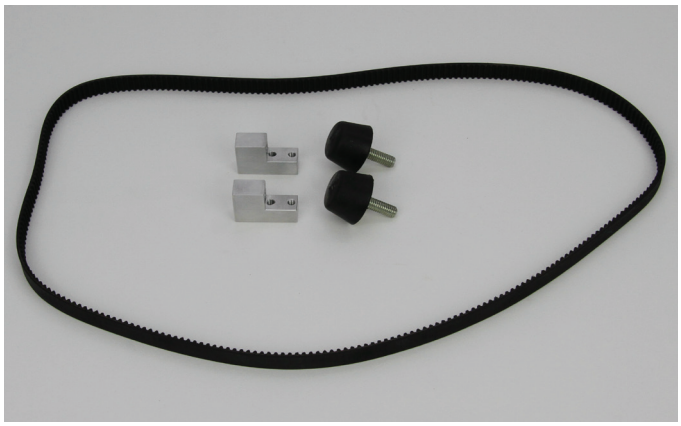
1 x side part left
1 x side part right
10x cylinder head screw M4x10 black

The side parts are attached to the basic frame with the 5 bores marked in the figure.

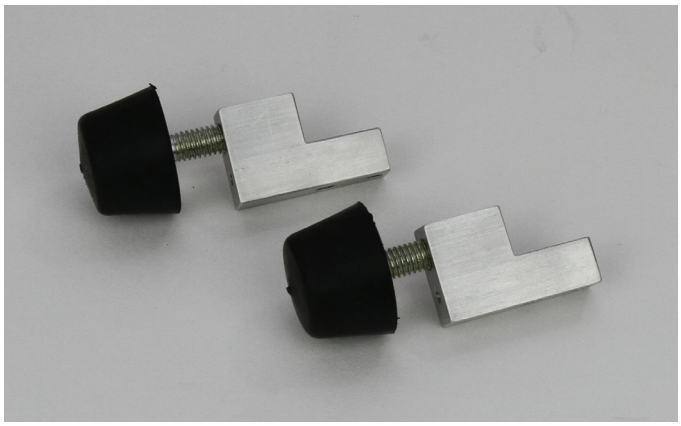


Push the side parts onto the basic frame on the sides and attach them with 5 screws each.
The side part with the openings for the USB connection and the memory card is installed on the right side.
The openings of the side parts must be cleanly inserted into the tabs at the bottom and X plate.
Note: The side parts are sensitive to scratching!

Completing the Z-drive

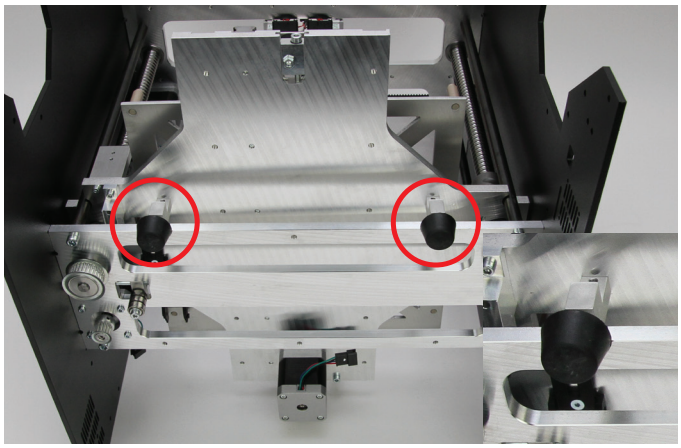


1 x toothed belt 822 mm
2 x foot holder
2 x rubber foot

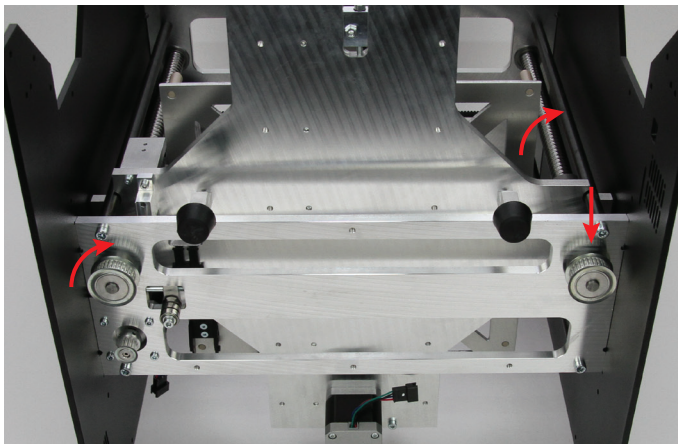


Loosely screw the two rubber feet as shown in the picture into the foot holders.

Basic alignment of the ball-threaded drives

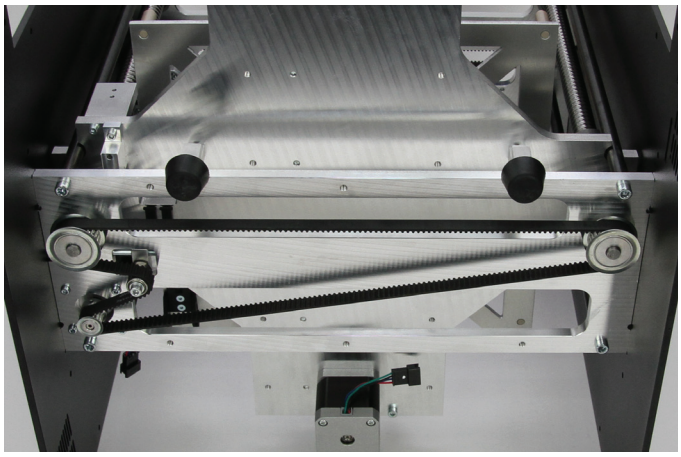


Tip the basic frame backwards (do not turn it upside-down) and attach the two foot holders to the bottom plate, as shown in the small figure. Only tighten the two feet slightly so that the holders do not fall out.



First loosen the threaded pin again with which the right sprocket (straight arrow in the figure) was attached slightly before, so that it can be turned without moving the ball-threaded drive. The distance from the bottom plate should no longer be changed, however.
Finally, move the Y-plate down by turning the left sprockets and the right ball-threaded drive until it is supported on the two foot holders.

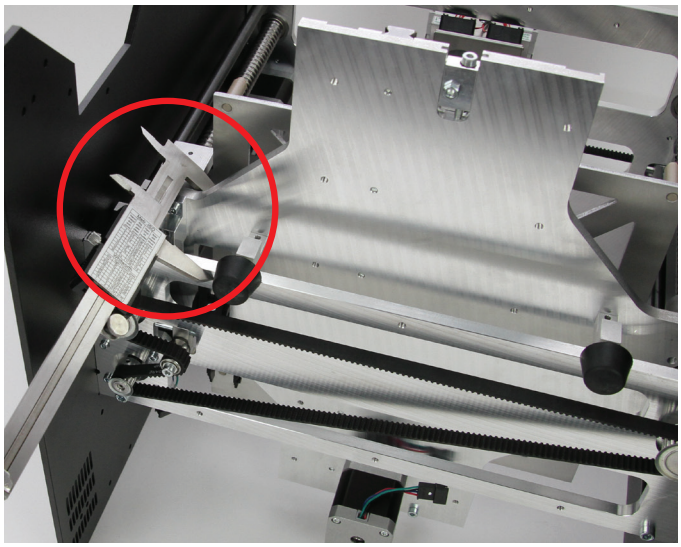
Assembly of the toothed belt



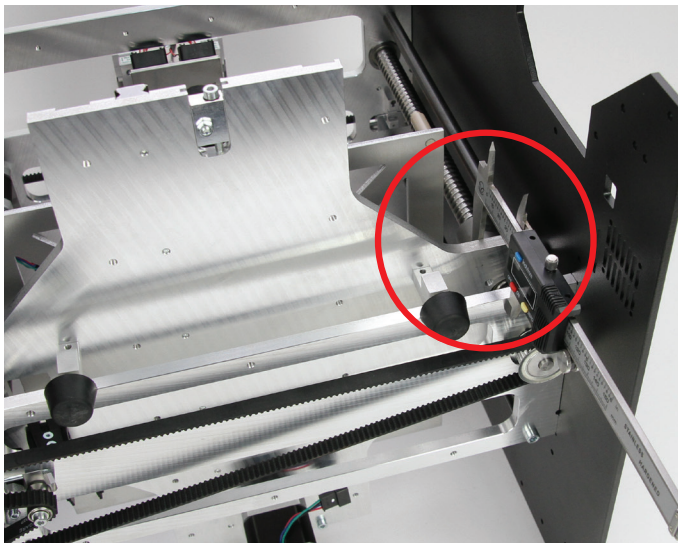
Entirely relieve the belt tensioner of the bottom plate (on the outside of the left side).
Install the toothed belt as shown in the figure.
First attach the belt to the left sprocket and hold it.
Then attach the right sprocket and tension it clockwise (the piece between the two sprockets should be tensed as well as possible).
Important! The right sprocket must be aligned so that one of the two threaded pins can be tightened later.
Now attach the belt to the motor pinion and pull it over the belt tensioner. Still keep the toothed belt tensed.

Tension the toothed belt of the bottom plate by turning the belt tensioner screw (see arrow) until it can still be easily turned by 180° with two fingers.
Caution:
The toothed belt must not be tensioned too strongly. If the belt tensioner bends, the belt tension must be reduced under all circumstances.
A method for more precise setting of the belt tension is found in the chapter "21. Maintenance".

Precise alignment of the ball-threaded drives

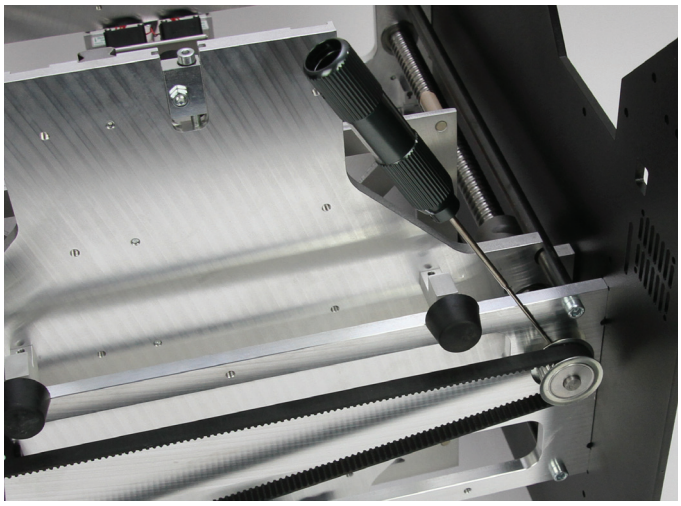


Measure the distance between the bottom plate and the Y plate with a calliper on the left.

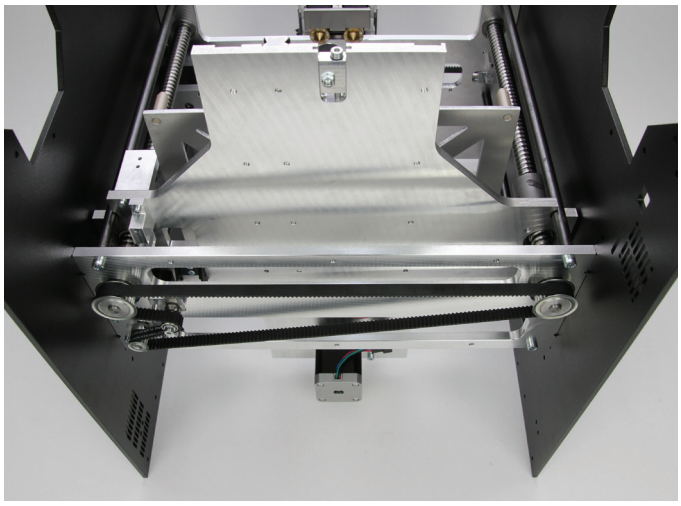


Then measure the distance on the right.
The distance must be precisely the same on both sides.
If required, the distance can also be adjusted by turning the spindles on the right side.

Attaching the sprocket



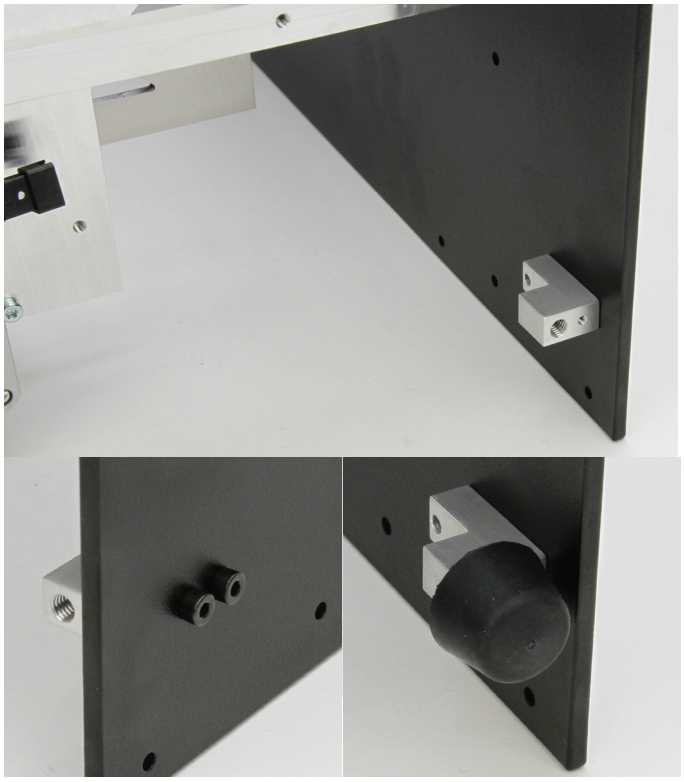
When the distance on the two sides matches precisely, tighten the accessible threaded pin.



Move the Y-plate up with the toothed belt until you can access the second threaded pin. Tighten it as well.
Remove the two foot holders.

Installing the foot holders

4 x rubber foot
4 x foot holder
10x cylinder head screw M4x10 black

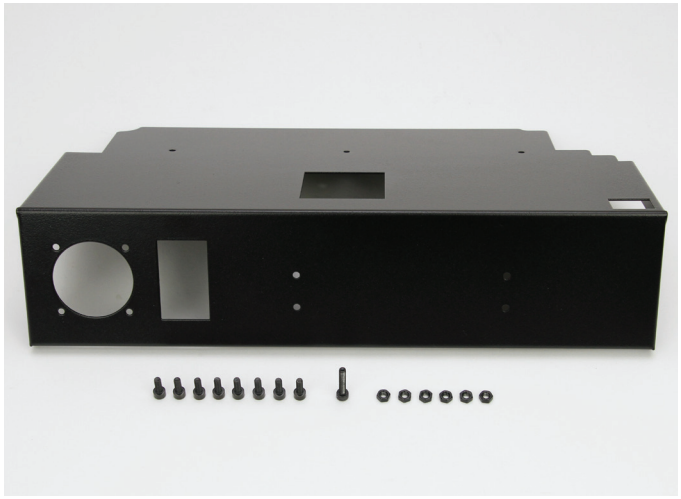


Attach the foot holders with the broad side down to the side parts (see small figure on the left) with 2 screws M4x10 each as illustrated in the upper figure.
Do not tighten the screws M4x10 completely yet. This is done after the bottom sheet is installed.
Turn the rubber feet into the foot holders from below (see small figure on the right).

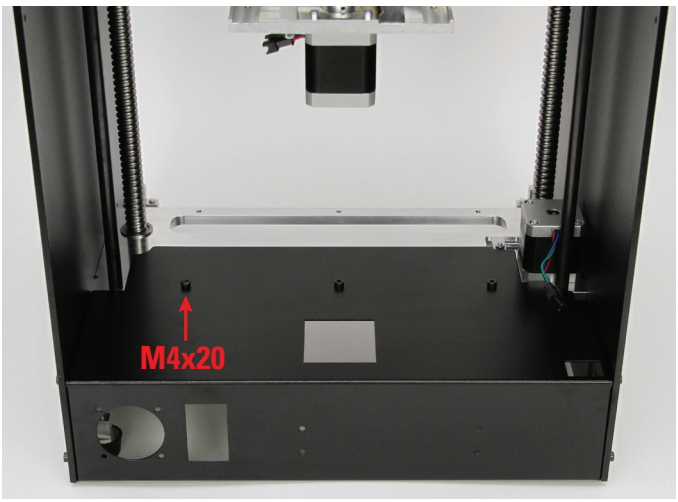
Assembly of the covers

Observe sharp edges in these parts. There is a danger of injury at careless handling.

Installation of the rear cover



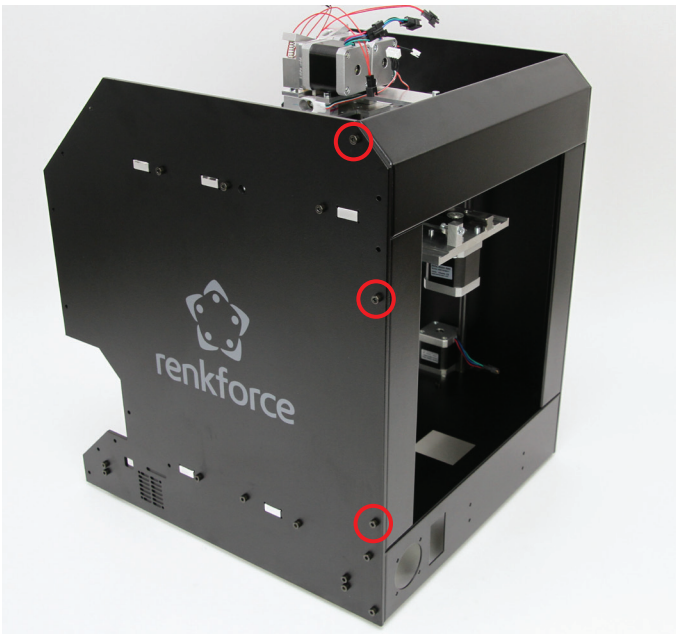
1 x rear cover
10x cylinder head screw M4x10 black
1 x cylinder head screw M4x20 black
6 x nut M4 black



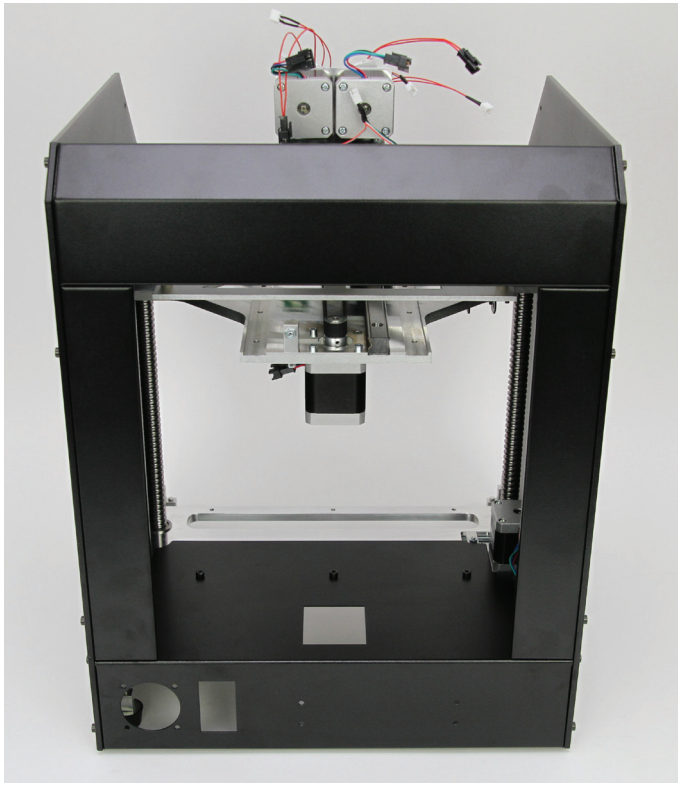
Attach the rear cover to the basic frame with the screws and nuts as shown.
Use 6 screws with nuts at the side parts and 3 screws centrally at the bottom plate. Screw the screw M4x20 into the left position as shown in the figure.

Attachment of the rear cover parts

1 x rear head cover
2 x rear side covers
6 x cylinder head screw M4x10 black
6 x nut M4 black

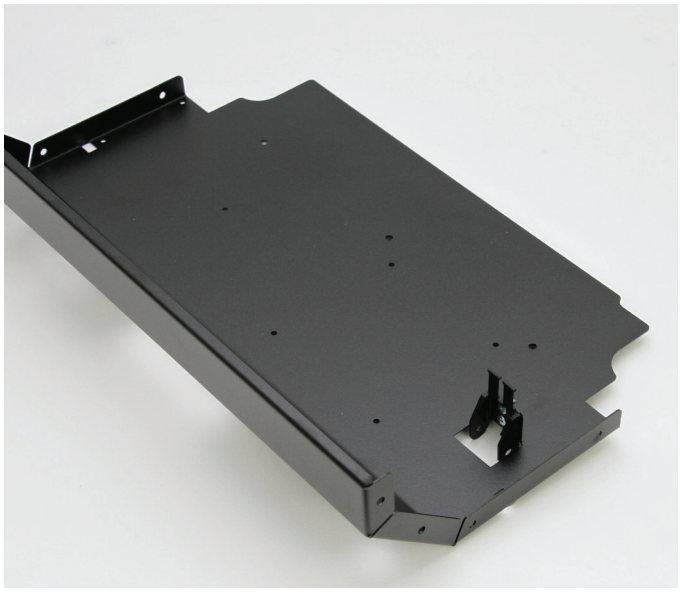


The rear cover parts are attached to the basic frame with the 3 bores per side as marked in the figure. The other bores remain clear for now.



Insert the rear covers into the basic mechanics and attach them to the side parts with the screws as shown.

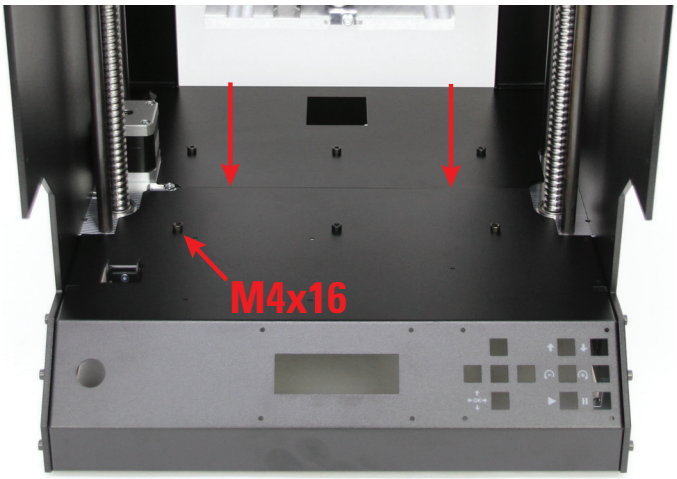
Preparation of the operating cover



1 x operating cover
1 x drag chain end piece with hole
2 x countersunk screw M3x8
2 x nut M3
10x cylinder head screw M4x10 black
1 x cylinder head screw M4x16 black
8 x nut M4 black

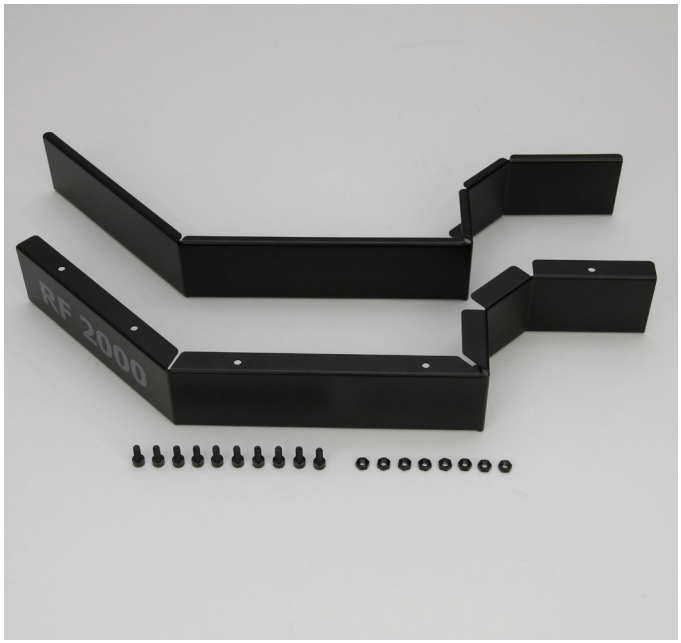
Install the drag chain end piece in the cut-out of the operating cover with the countersunk screws and the nuts (M3) as shown in the figure.

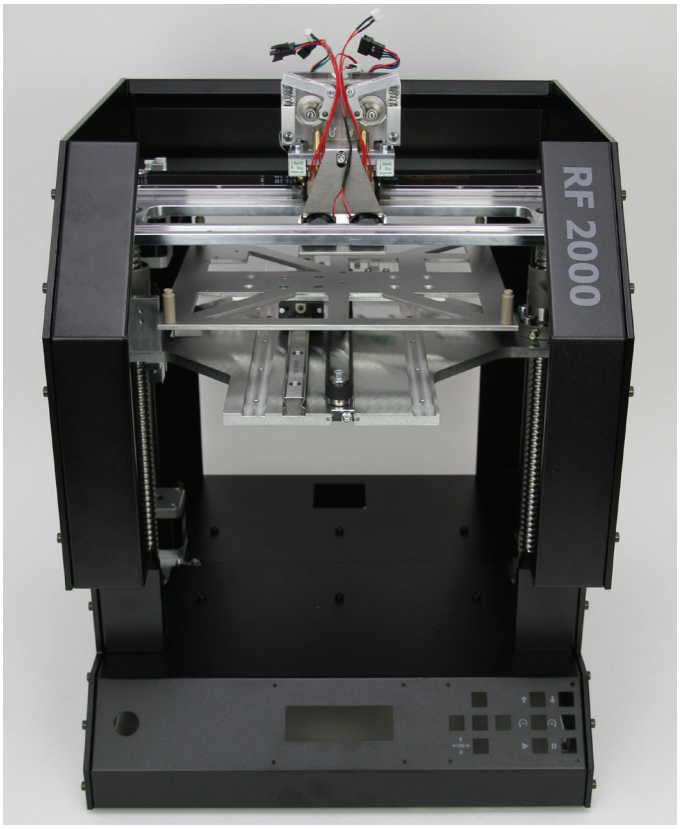
Installation of the operating cover



Insert the operating cover into the basic mechanics as shown and attach it with the screws as shown in the figure.
Use 8 screws with nuts at the side parts and 3 screws centrally at the bottom plate, including the screw M4x16 in the left position.
Observe that the operating cover and rear cover meet in the middle of the device (see arrows above) and do not overlap or form a gap.

Installation of the sight protection blinds





1 x sight protection blind right
1 x sight protection blind left
10x cylinder head screw M4x10 black
10x nut M4 black

Attach the sight protection blinds on the side of the side parts with 5 screws and 5 nuts per side.

10. Wiring of the Electrical Components

a) General Information

ATTENTION Mains voltage - the connection, installation and wiring of the electrical components must only be performed by an electrician who is familiar with the applicable safety provisions. Before commissioning, inspection according to the applicable safety provisions must be performed by an electrician.

During the connection work, the mains line must never be connected to the mains.

Drag chains

→ The energy drag chains have tabs on one side of the links through which the lines are pushed into the chains.

When pushing in the lines, always push in the stronger lines first and then the thinner ones. If the tabs of the drag chains do not return to their initial position when pushed in, the tabs can be pulled back carefully with long-nosed pliers.

The lines must be cleanly placed next to each other in the energy drag chain and must not be twisted.

When clipping in the drag chain ends into already-installed drag chain end pieces, small flat pliers with which the end links of the energy drag chains are latched in the nipples or holes of the end pieces are helpful. Observe that the drag chain ends latch cleanly with the end pieces. Do not apply any great force, since the plastic material would be damaged otherwise and the drag chain or end piece would be rendered useless (loss of warranty/guarantee!).

There are 3 energy drag chains in the delivery. One large energy drag chain with 10 links and two smaller energy drag chains with 20 and 25 links. The description of the individual work steps shows which energy drag chains are to be used where.

Lines

→ Lines that may be swapped are marked with numbers.

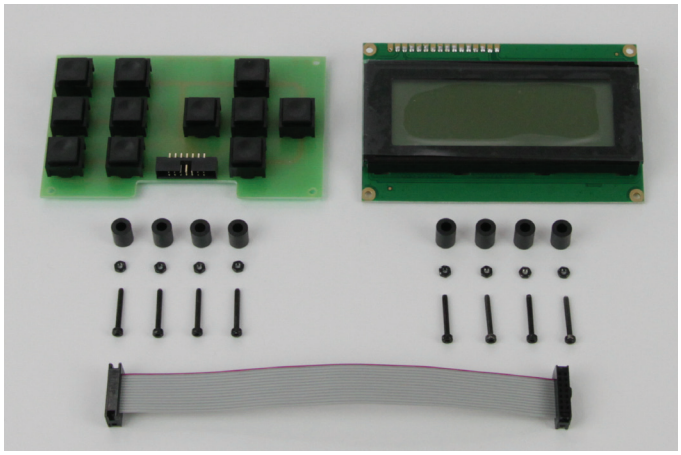
These numbers are placed on labels and line ends that are connected to the PCBs in the device socket. Therefore, observe that the marked line ends must be placed in the device socket when placing the lines.

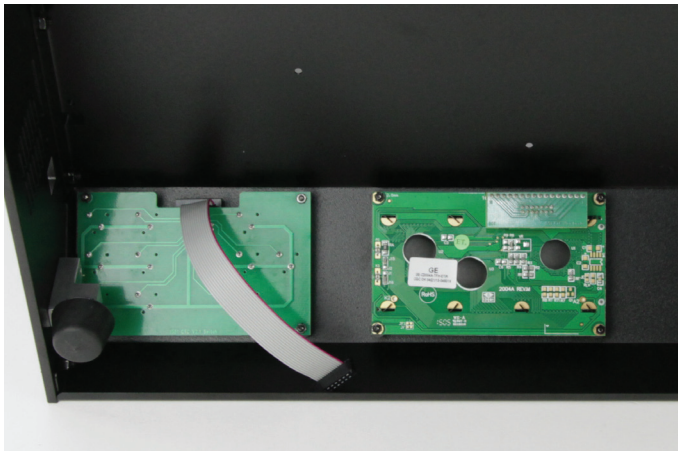
In the Annex, you will find a wiring plan for the main PCB in which the required line connections are marked.

b) Installation and Connection of the PCBs and Components

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.

Installation of the display and keyboard PCB



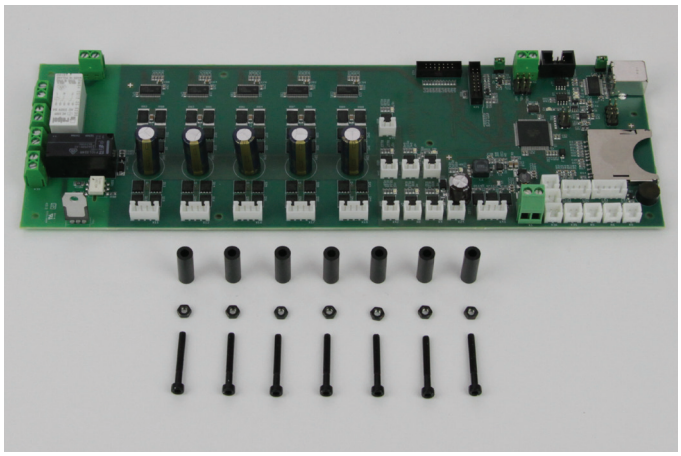


1 x keyboard PCB
1 x display PCB
4 x spacer roller 8 mm for keyboard PCB
4 x spacer roller 9 mm for display PCB
8 x nut M2 (black)
8 x cylinder head screw M2x16 (black)
1 x flat band line with twisted plugs (line 15)

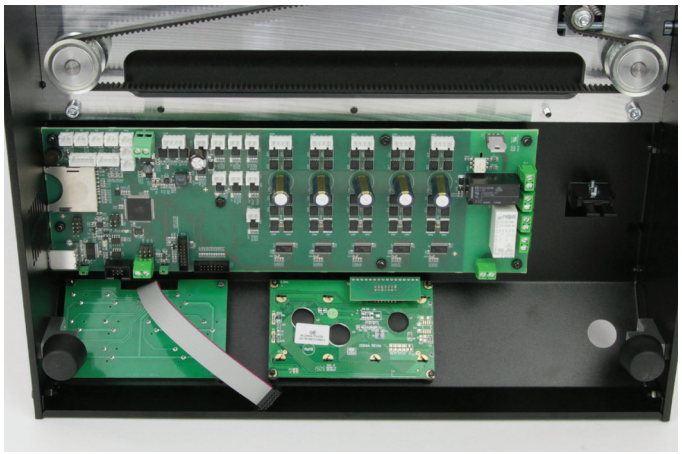
Attach the flat band line to the keyboard PCB. Observe correct position of the latching tabs at the plugs.
Install the keyboard PCB with the spacer rollers 8 mm as shown in the figure. The spacer rollers may be fastened to the PCB with a drop of hot glue for easier assembly first.
Apply all screws in the area of the nuts with threadlocker varnish.
The plug connector with the flat band line must point to the top of the device.
Align the PCB so that the buttons are not caught in the housing cut-outs.
If necessary, screw off the foot holder in the area of the keyboard PCB for installation.

Remove the protective foil from the display.
Install the display PCB with the spacer rollers 9 mm as shown in the figure. Apply all screws in the area of the nuts with threadlocker varnish.
The small additional PCB with the plug connector point to the top of the device.
Align the PCB so that the display is at a right angle to the housing cut-out.

Installation of the main PCB

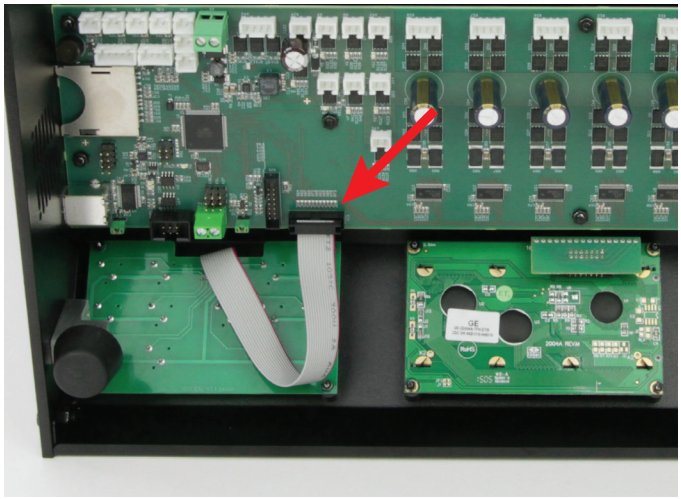


1 x main PCB
7 x spacer roller 20 mm
7 x nut M3 (black)
7 x cylinder head screw M3x25 (black)

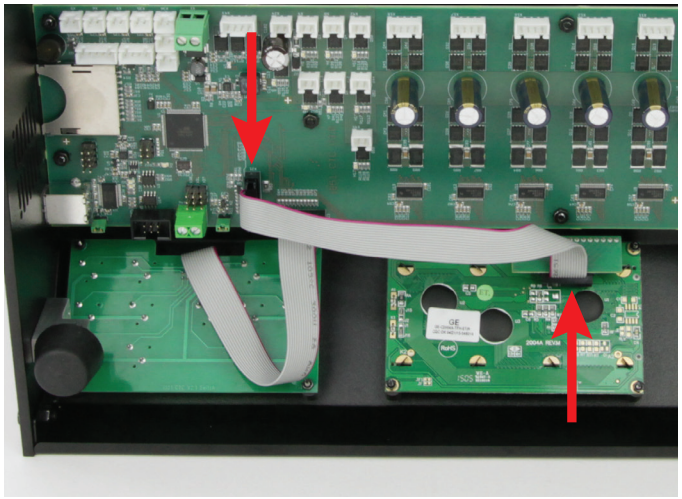


Install the main PCB with the spacer rollers 20 mm as shown in the figure. The spacer rollers may be fastened to the PCB with a drop of hot glue for easier assembly first.
Apply all screws in the area of the nuts with threadlocker varnish.
Align the PCB so that the USB connection and the memory card reader are placed cleanly behind the respective housing cut-outs.

Connection of display and keyboard PCB

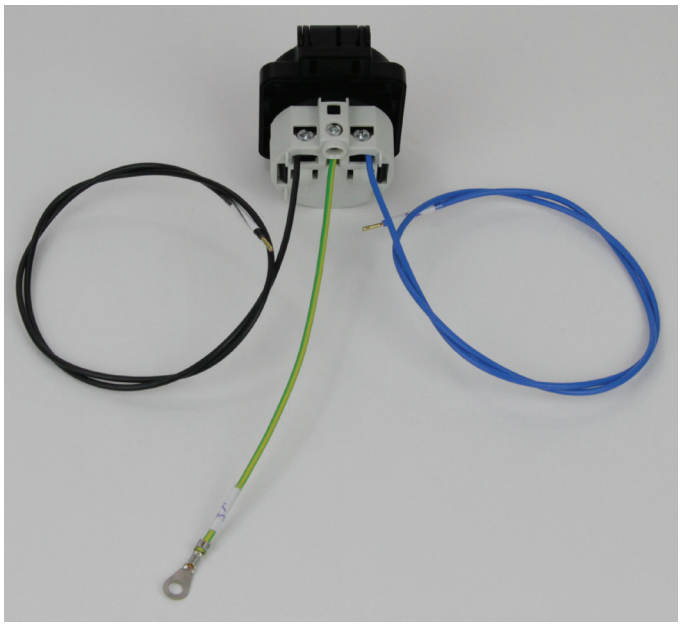


Connect the flat-band line (line 15) already connected to the keyboard PCB to plug strip X23 of the main PCB.
Optionally, the plug connections can be secured with a drop of hot-glue.



Connect the remaining flat band line to the untwisted plugs (line 16) at the display PCB and the plug strip X21 of the main PCB. Observe correct position of the latching tabs at the plugs again.
Optionally, the plug connections can be secured with a drop of hot-glue.

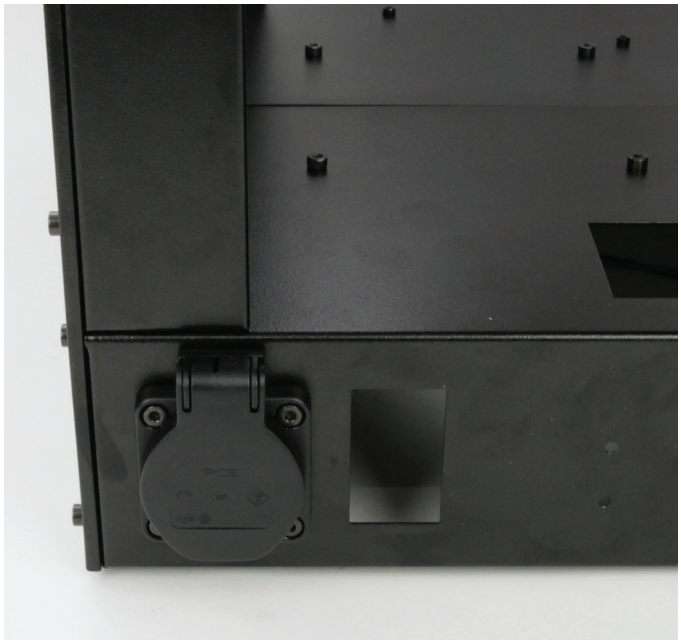
Connection of the lines to the socket

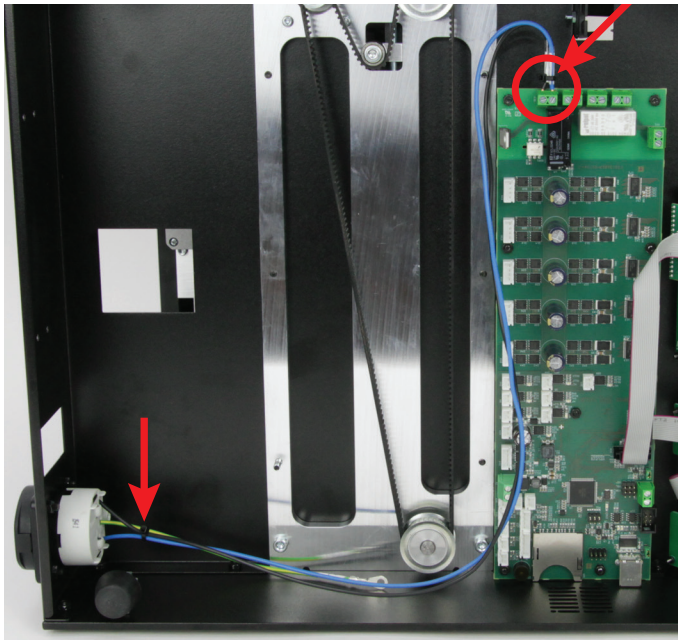


1 x power plug
4 x cylinder head screw M4x10 black
4 x nut M4 black
1 x line with ring eyelet green/yellow (17 cm) (line 31)
1 x line blue (60 cm) (line 27)
1 x line black (60 cm) (line 27)

Connect the black line as illustrated (from the rear view of the socket) to the left terminal.
Connect the blue line to the right terminal.
Connect line with the ring eyelet socket green/yellow to the middle terminal.

Installation and Connection of the Power Plug

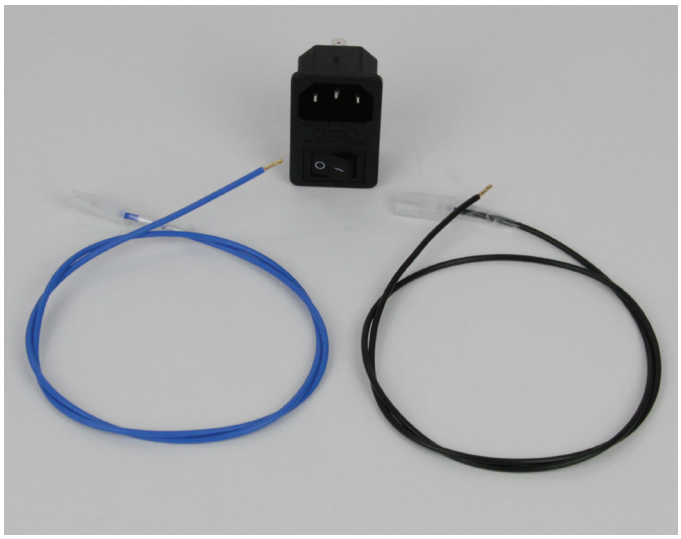


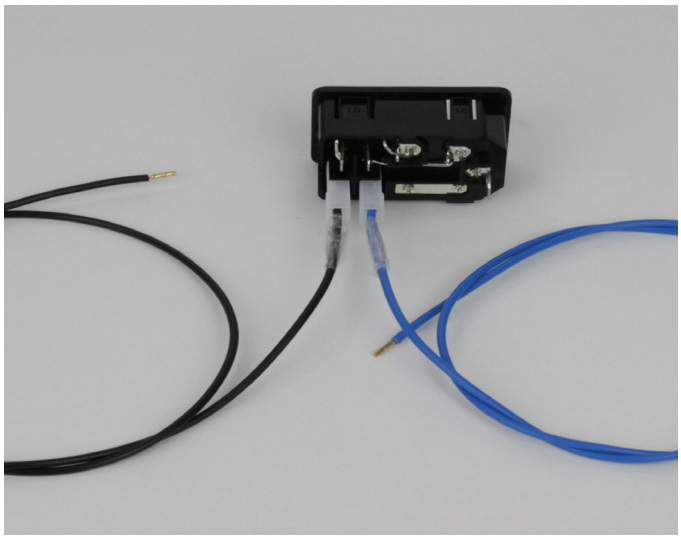


Push the socket with the cables into the corresponding opening from behind and secure it with screws and nuts. The lid must open upwards.

Connect the black and blue lines of the socket to the terminals X39 (see circle in the figure) of the main PCB. Viewed as in the figure, the black line must be connected on the left and the blue one on the right in the terminal.
Tie both lines together with a small cable tie (99 mm) close to the connection terminal and power plug (see arrows in the figure).
The line with the ring eyelet (green/yellow) is only connected later.

Connection of the lines to the low-power device combination socket

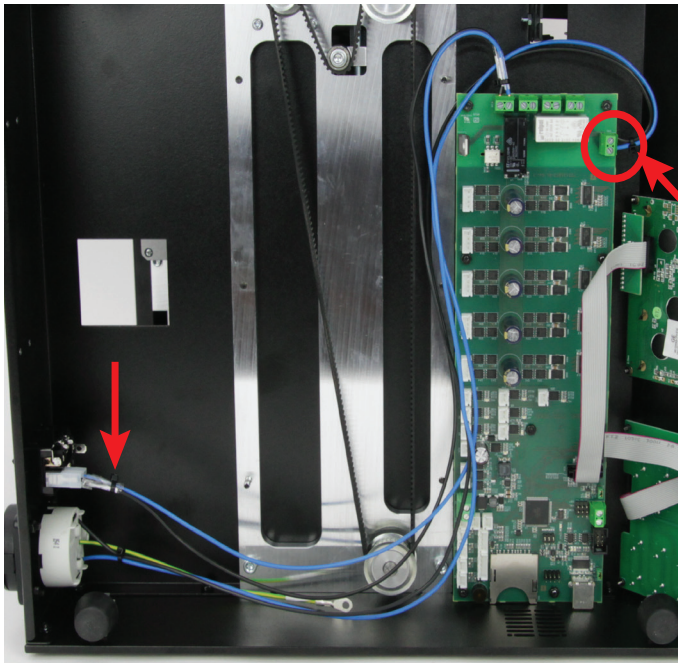




1 x low-power device combination socket
1 x line blue (64 cm) (line 24)
1 x line black (64 cm) (line 24)

With the low-power device combination socket placed as illustrated, connect the black line to the terminal at the very left and connect the blue line to the terminal (N) to its right.

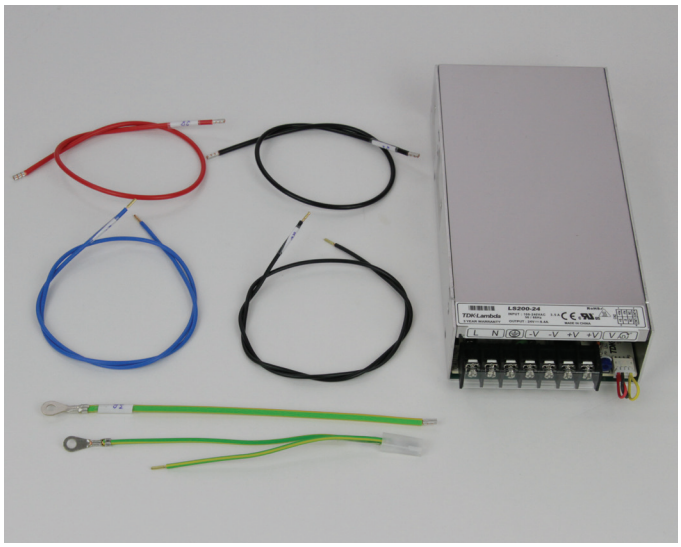
Installation and connection of the low-power device combination socket

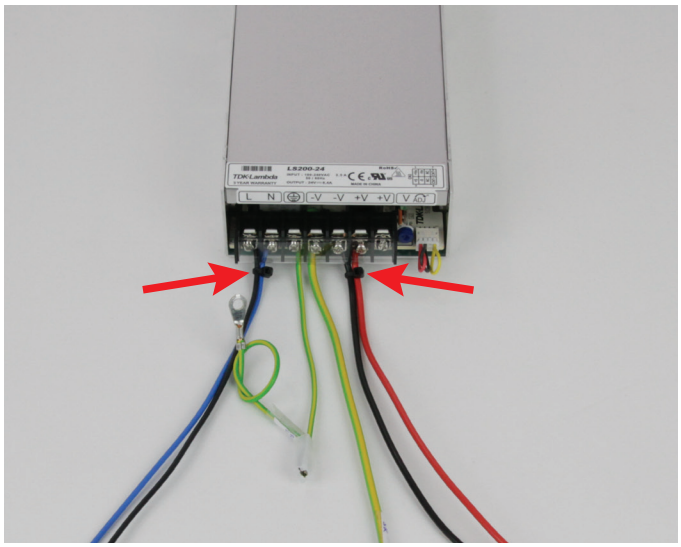


Clip the low-power combination socket into the corresponding cut-out of the rear cover. The socket must be inserted so that the switch points down.

Connect the black and blue lines of the low-power device combination socket to the terminals X41 (see circle in the figure) of the main PCB. Viewed as in the figure, the black line must be connected at the top and the blue one at the bottom in the terminal.
Tie both lines together with a small cable tie (99 mm) close to the connection terminal and power plug (see arrows in the figure).

Connection of the lines at the mains unit





1 x mains unit
1 x line red (37 cm) (line 28)
1 x line black (37 cm) (line 28)
1 x line blue (55 cm) (line 26)
1 x line black (55 cm) (line 26)
1 x line with ring eyelet green/yellow (18 cm, 2.5 mm²) (line 32)
1 x line with flat plug connector and ring eyelet green/yellow (15 cm) (line 23)

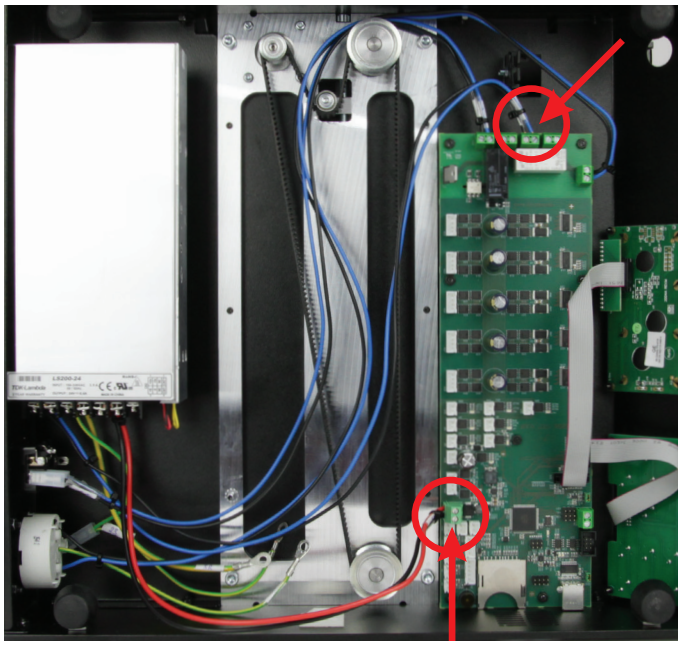
Remove the transparent protective cover from the clamping strip of the mains unit.
Connect the black line (55 cm) to terminal L and the blue line (55 cm) to terminal N at the mains unit.
Connect the line with the flat plug connector and the ring eyelet socket (green/yellow) to the protective ground terminal ⏚ at the mains unit.
Connect the line with the ring eyelet (green/yellow) (18 cm, 2.5 mm²) to the terminal -V at the mains unit.
Connect the line black (37 cm) to the terminal -V at the mains unit.
Connect the line red (37 cm) to the terminal +V at the mains unit.
Put on the transparent protective cover at the clamping strip of the mains unit again.
Tie together the lines at the terminals L and N, as well as +V and -V with a small cable tie (99 mm) each close to the connection terminal (see arrow in the figure).

Installation of the mains unit

1 x mains unit with already-connected lines
4 x cylinder head screw M4x6

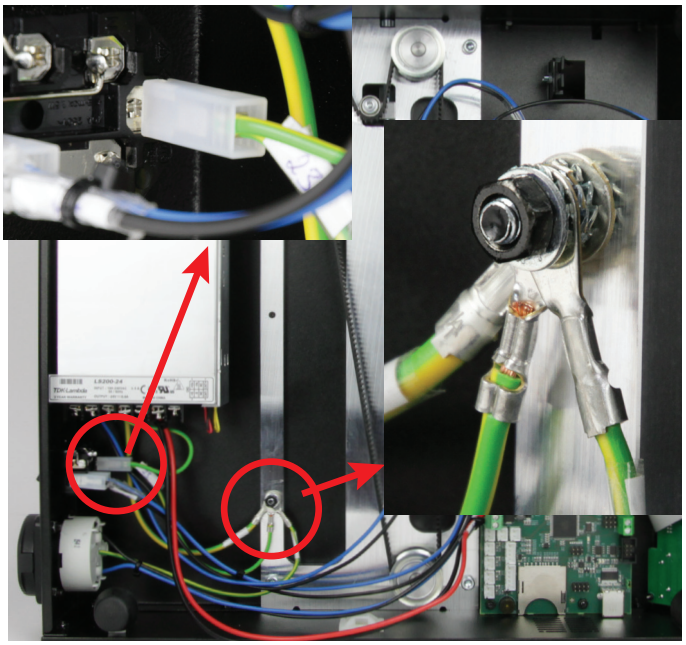
Attach the mains unit with the 4 screws to the rear cover so that the connections point to the mains socket.

Connection of the mains unit



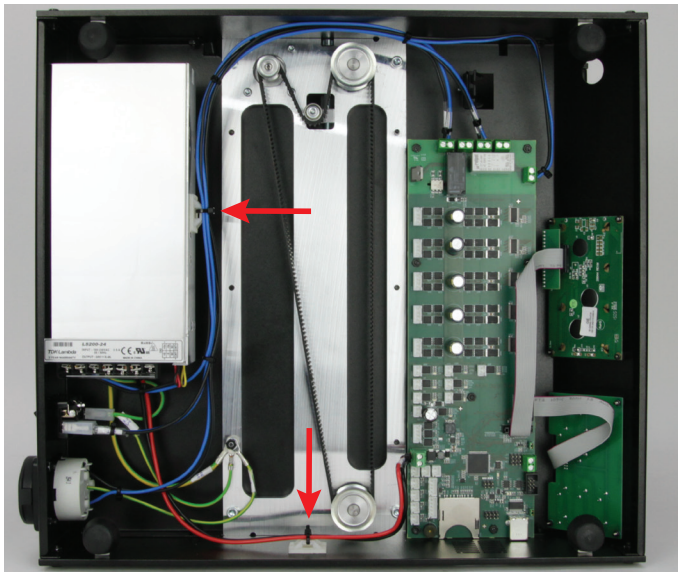
Connect the black and blue lines to the terminals X37 (see circle in the figure) of the main PCB. Viewed as in the figure, the black line must be connected on the left and the blue one on the right in the terminal.
Tie both lines together with a small cable tie (99 mm) close to the connection terminal (see arrow in the figure).
Connect the red and black lines (37 cm each) to the terminals X1 of the main PCB.
Attention! Observe polarity of the lines:
red = + (upper terminal in the figure)
black = - (lower terminal in the figure)

Connection of the protective ground



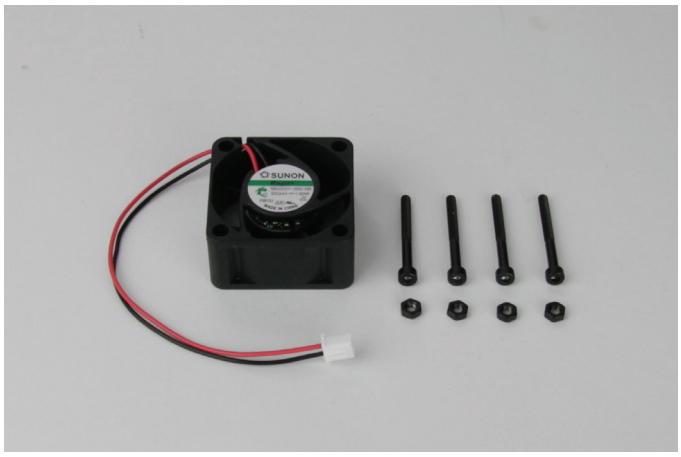
Connect the line with flat plug connector (green/yellow) to the protective ground tab of the low-power device combination socket (see small figure at the upper left).
Connect the ring eyelets of the green/yellow lines (protective ground mains unit, -V mains unit, protective ground socket) to the long attachment screw of the rear cover as illustrated.
Caution: This connection creates the safety-technically important contact between the housing parts and the protective ground. Always observe the position of the washers and sprockets:
Housing > sprocket > ring eyelet > sprocket > ring eyelet > sprocket > ring eyelet > sprocket > washer > nut M4 (see section figure on the right)

Placing the lines

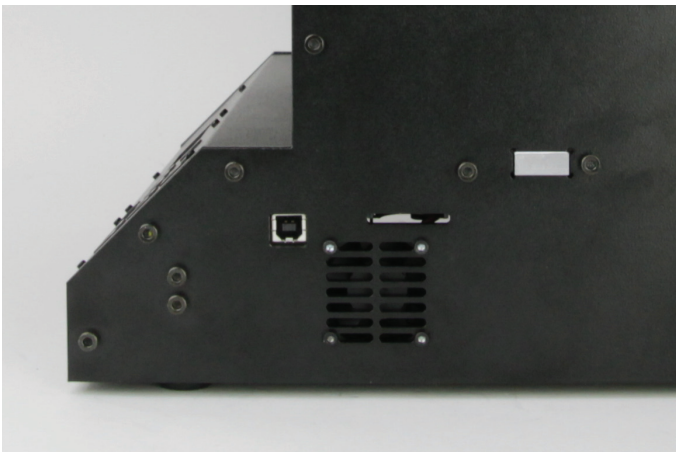


Route the lines cleanly with cable ties and two self-adhesive cable tie holders (see arrows) and secure them. The lines must not get into the rotating toothed belts in operation.

Installation of the fan for the main PCB

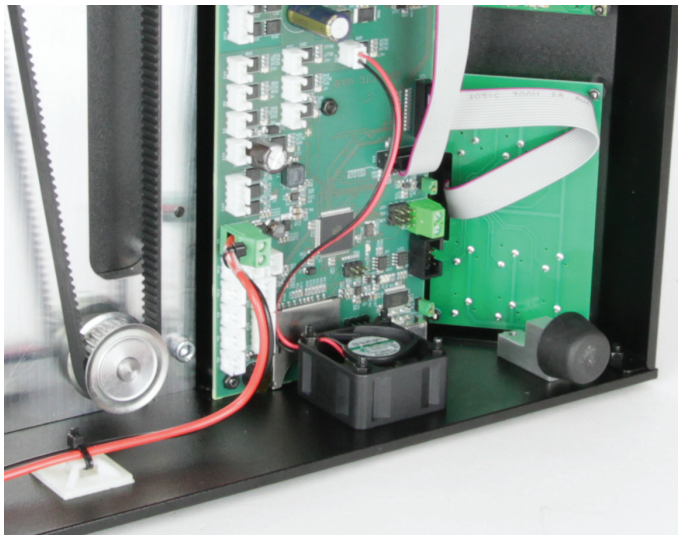


1 x fan 40x40
4 x cylinder head screw M3x30 (black)
4 x nut M3 (black)



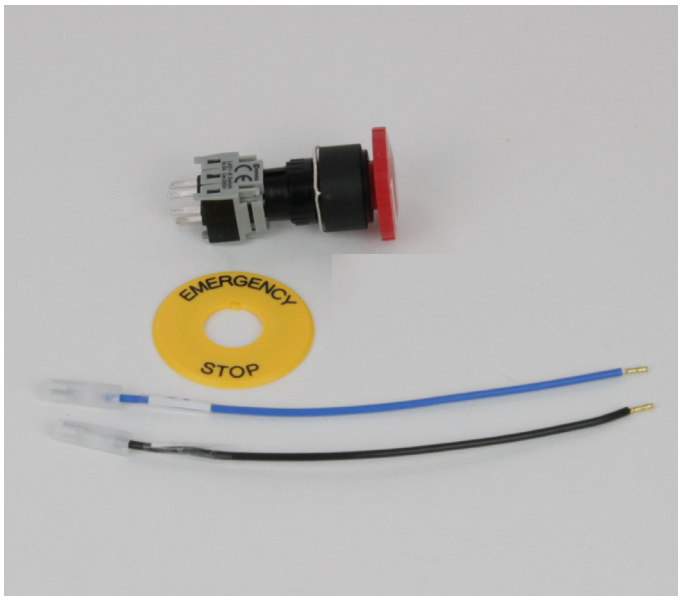
Install the fan with the 4 cylinder head screws and the 4 nuts on the inner right side part as illustrated.
Observe that the blowing direction (marked by an arrow on the fan) points towards the inside.
The fan also should be installed so that the connection cable points to the main PCB and the connection X1 (also see next figure).

Connection of the fan

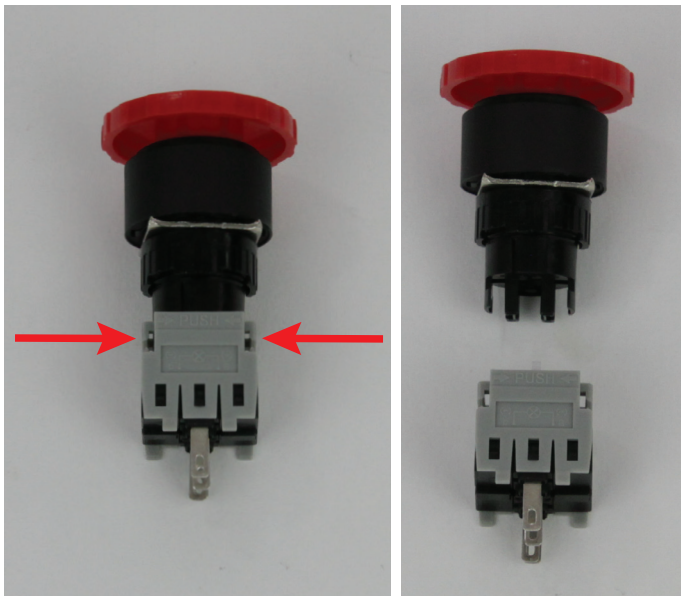


Connect the fan as illustrated to the connection X45 of the main PCB.

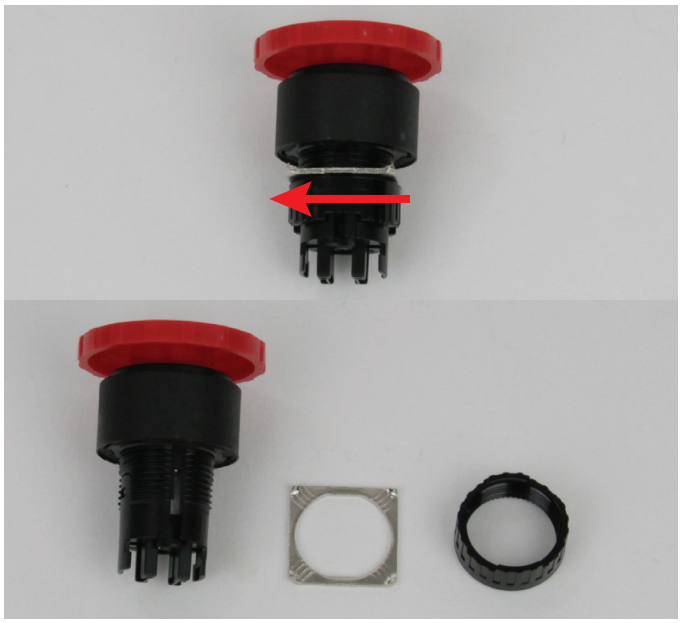
Preparing the emergency off switch



1 x emergency off switch
1 x name plate "EMERGENCY STOP"
1 x line blue (15 cm) (line 25)
1 x line black (15 cm) (line 25)



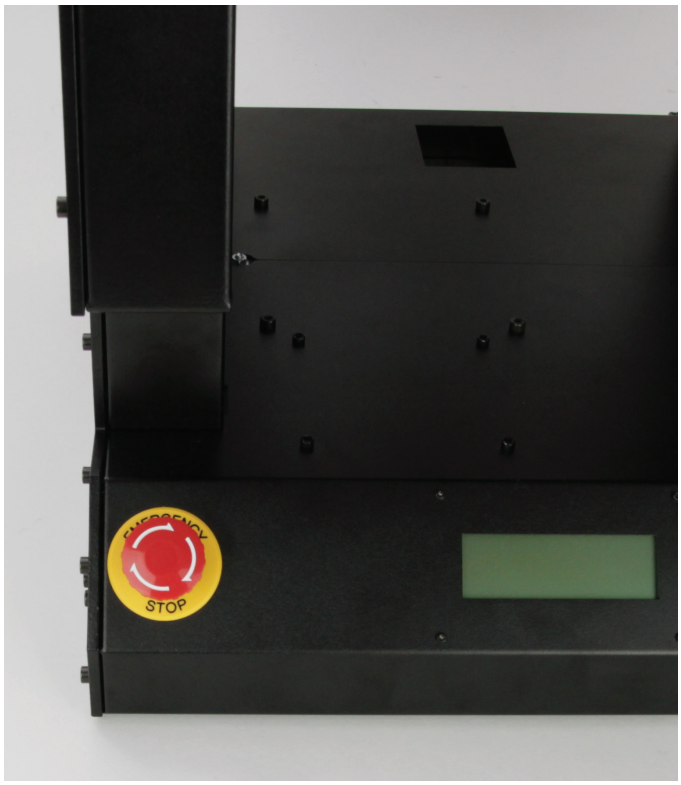
To disassemble the emergency off switch, push the latch from both sides at the same time and pull the switch apart.



Unscrew the plastic attachment nut counter-clockwise and remove the metal washer.

The emergency off switch must be installed in this sequence.
The left parts in the figure on the outside (from bottom up), the right parts in the figure on the inside (from top down).

Installation and connection of the emergency off switch



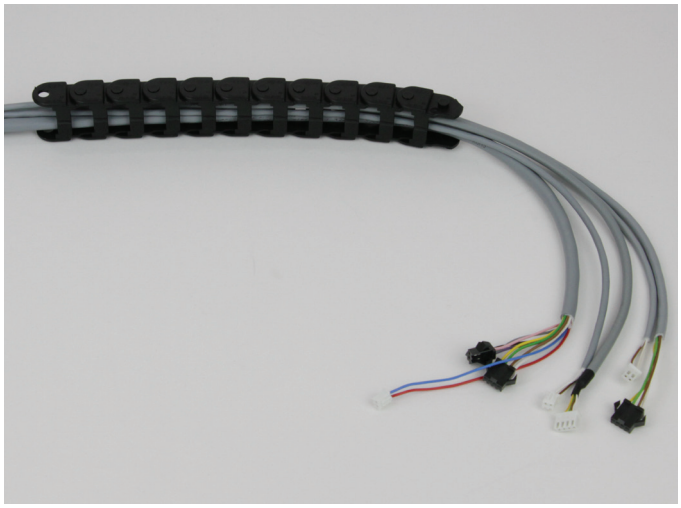
First push the name plate onto the switch. It must be pushed onto the switch in the guide. Then insert the switch into the opening.
From the inside, first push the metal washer onto the switch with the curved corners towards the housing. Then screw on the plastic nut (flat side towards the housing).
Ensure that the name plate is aligned straight.

Push on the electrical part of the switch again.
Push the two lines onto the two middle contacts "**NC**" (the two outer contacts must stay free). The polarity is irrelevant for this.
Connect the black and blue lines to the terminals X40 (see circle in the figure) of the main PCB. Viewed as in the figure, the black line must be connected on the left and the blue one on the right in the terminal.
Tie both lines together with a small cable tie (99 mm) close to the connection terminal and emergency off switch (see arrows in the figure).
Route the cables cleanly.

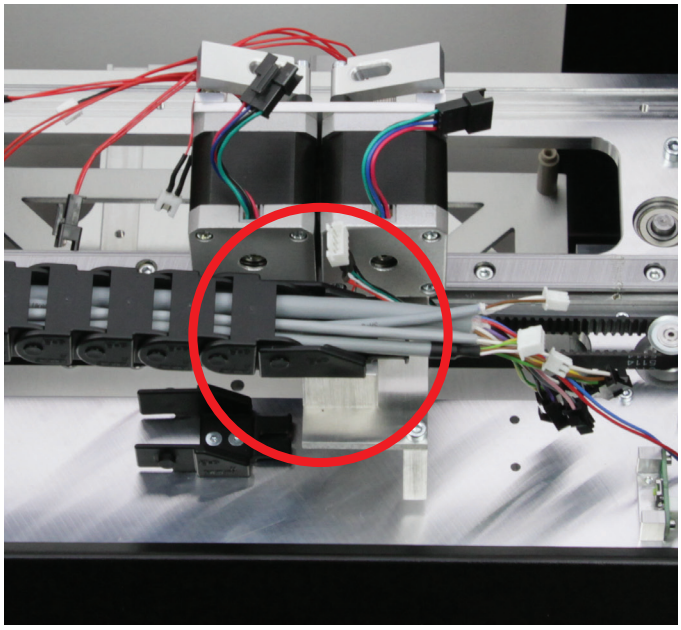
c) Wiring of the Components

Extruder

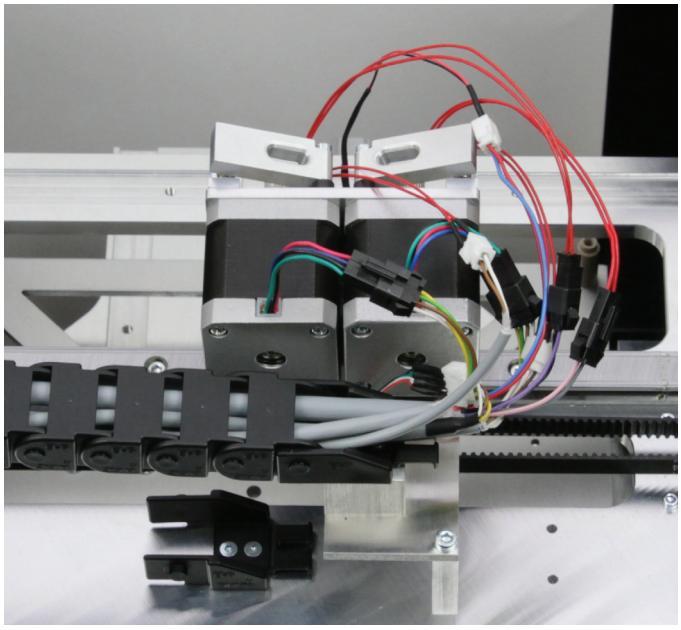
Energy drag chain large, 10 links
Lines 04, 05, 11, 12 and 14



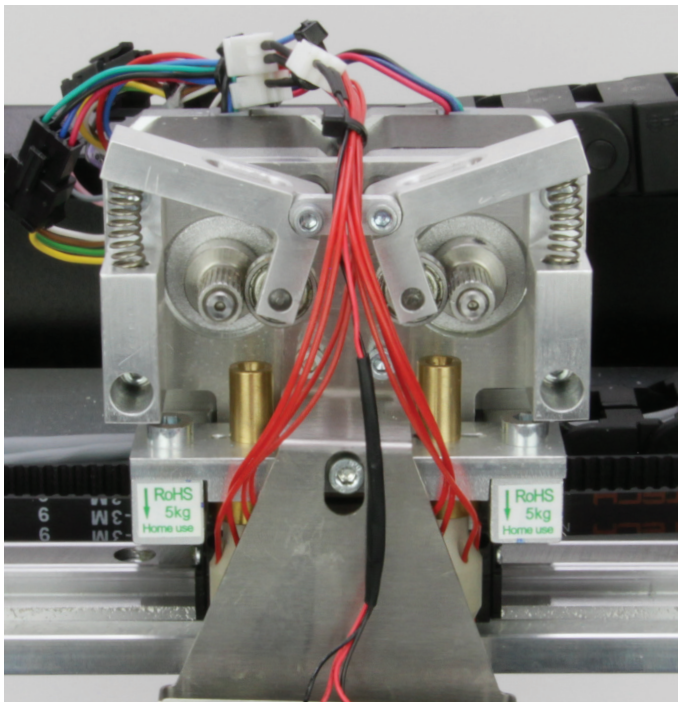
Push the lines into the energy drag chain so that the end link points to the line ends without label (with the number of the line) with the nipples.



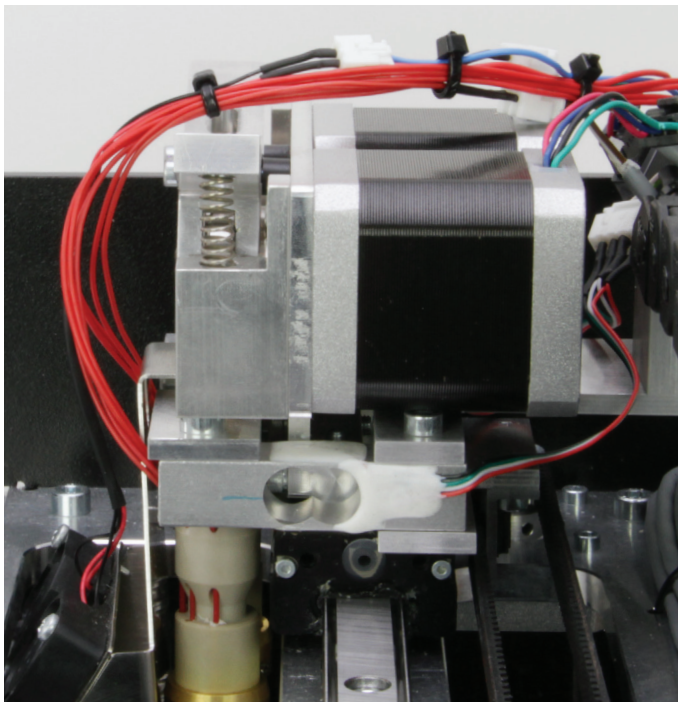
Latch the energy drag chain at the extruder carriage and pull the lines from the drag chain until they can be plugged into the connections of the extruder carriage cleanly placed.



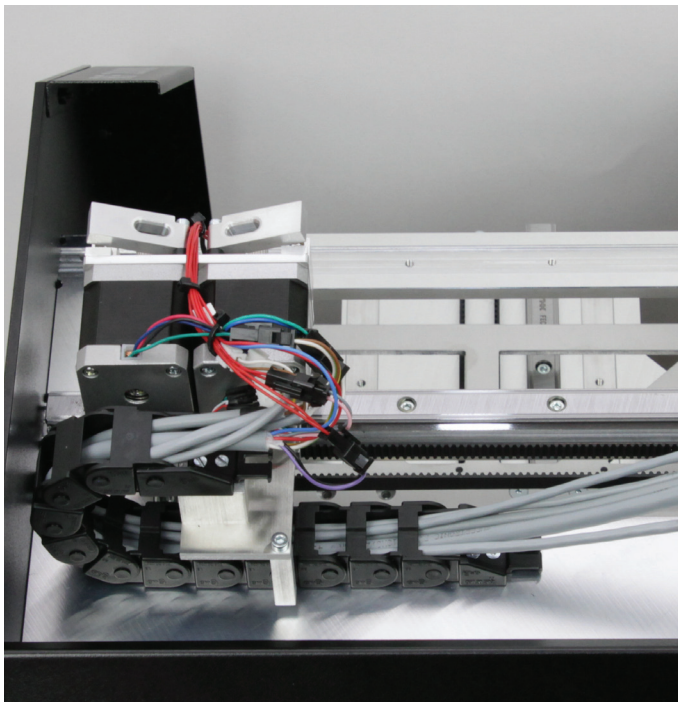
Connect the lines to the respective matching plugs.
Viewed from the front, extruder 0 (1st extruder) is the left one. In the figure above, it is the right one accordingly.
Line 04:
4-pin white/brown/green/yellow - motor extruder 0
2-pin blue/red - fan
2-pin pink/grey - heater extruder 0 (black plug)
2-pin violet/black - heater extruder 1 (black plug)
Line 05:
Motor extruder 1
Line 11:
Temperature sensor extruder 0 (white plug)
Line 12:
Temperature sensor extruder 1 (white plug)
Line 14:
Elongation measuring strip



Place the lines cleanly with small cable ties (99 mm).
Important! The cables of the two extruders and the fan must never be tensed! They must be routed loosely. Otherwise, there may be problems at calibration!

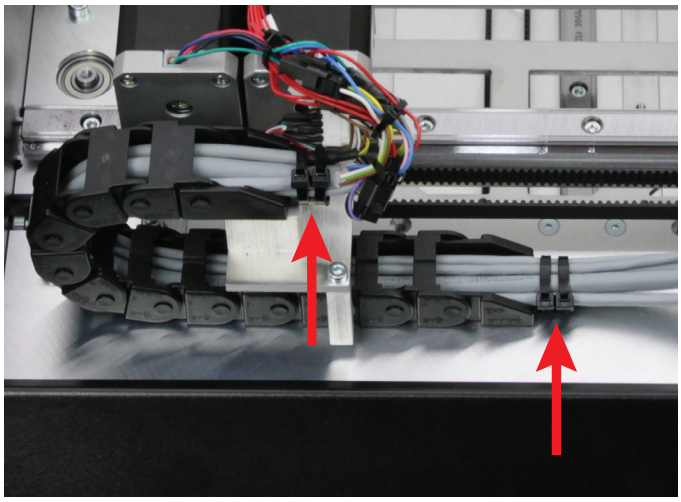


As mentioned before, the cables must never be tensed! The side view should look roughly as in the picture above.

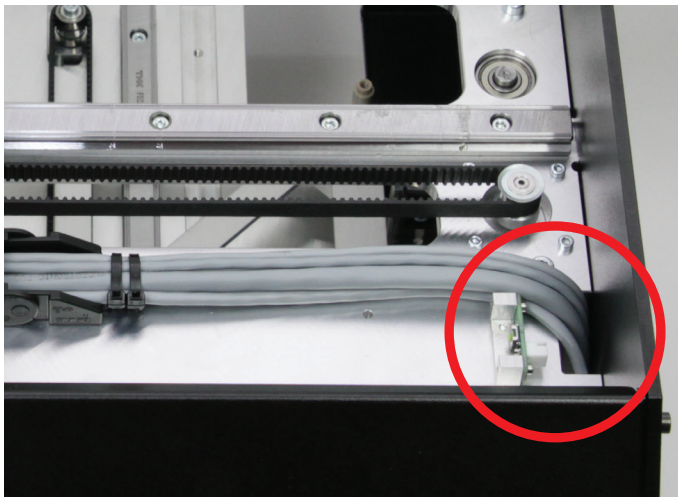


Carefully thread the cables through under the holding plate, past the limit switch actuator. Then latch the energy drag chain on the free end piece.

Fastening the lines

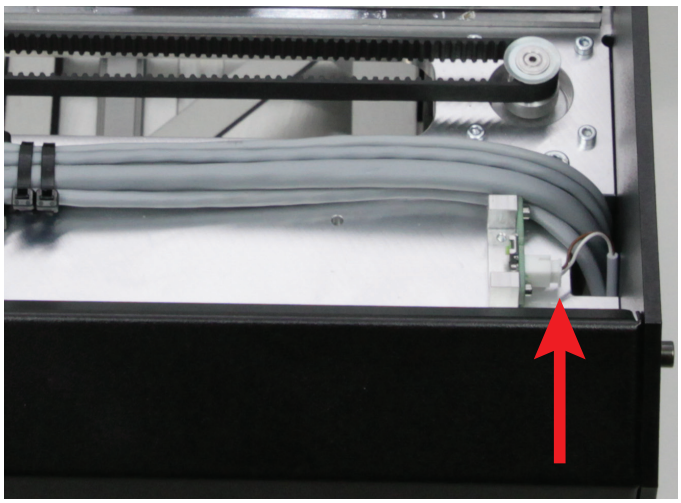


Apply two large cable ties (142 mm) for tension relief each at the two drag chain end pieces.



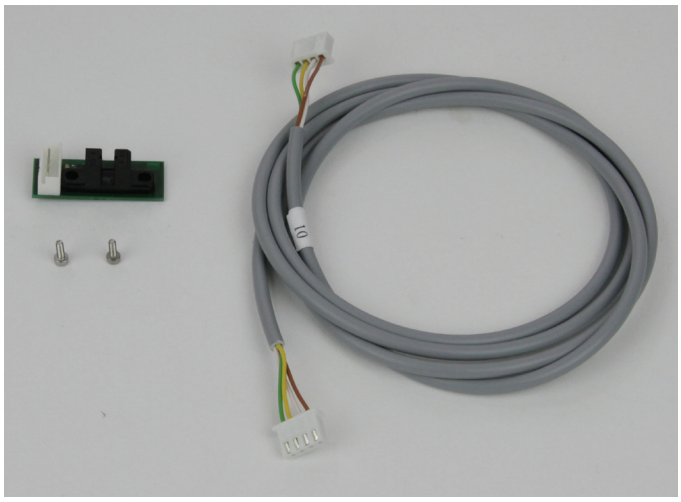
Place the free line ends through the opening in the X-plate past the limit switch and down.

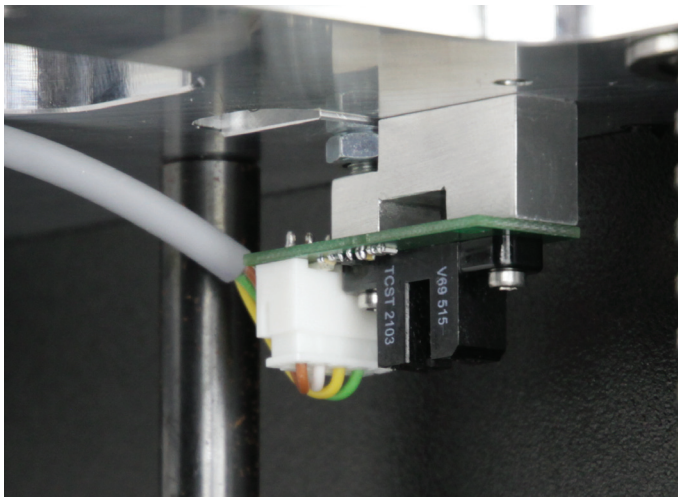
Connection of the limit switch for the X-direction



Plug the line 07 into the plug connector of the limit switch on the X-plate and also route the line down through the opening tin in the X-plate.

Installation of the limit switch for the Z-direction (Z-min-limit switch at the X-plate)

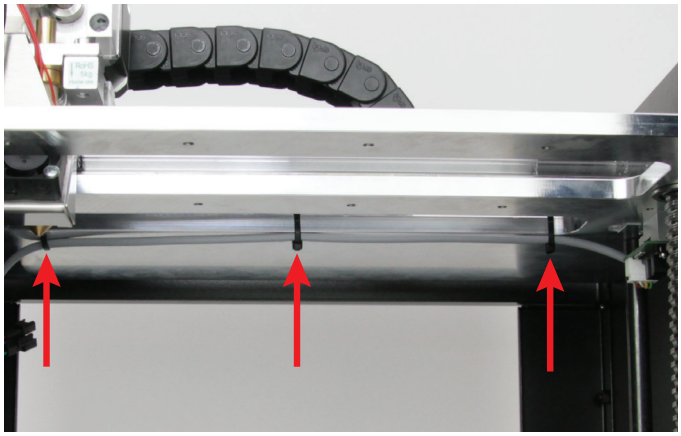


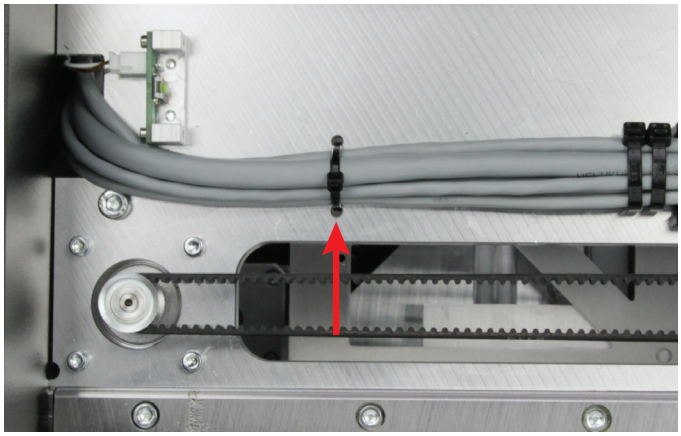


1 x light barrier
2 x cylinder head screw M2x6
1 x line 10

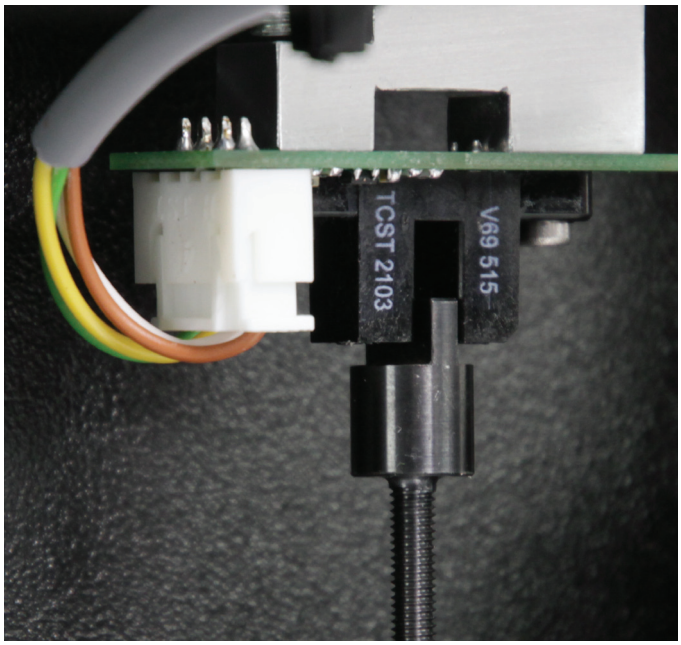
Install the light barrier with the two screws to the light barrier holding block of the X-plate from below as illustrated. The connection for the cable must point backwards.
Push the line 10 into the plug connector of the light barrier.

Placing the line of the Z-stop

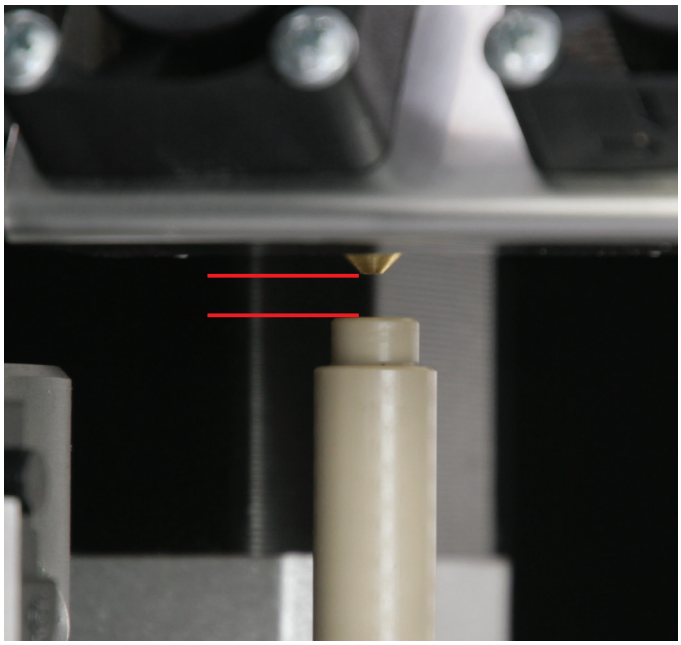




Place the line of the upper limit switch for the Z direction along the bore below the X plate and secure it with two small cable ties (99 mm) (see arrow in the middle and on the right in the figure above).
Attach a third small cable tie (99 mm) (left arrow in the figure) that additionally connects the lines to the extruder carriage at the top of the X-plate (right arrow in the figure).



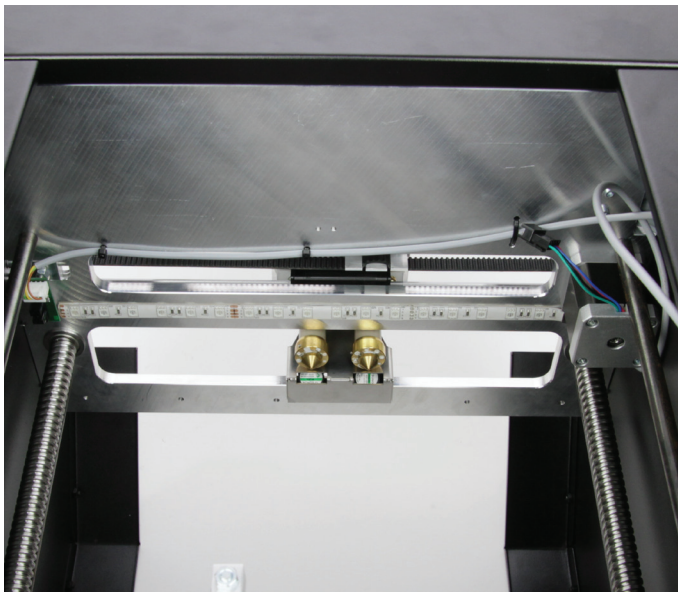
Turn the toothed belt at the base plate manually so that the Y-plate moves up.
Turn until the actuation for the Z-stop has moved into the light barrier as illustrated.
When moving in, ensure that the actuation is at the middle of the light barrier and not hitting it on the right or left.
Attention: When making this setting, observe that the extruder does not impact anywhere, which would damage it.



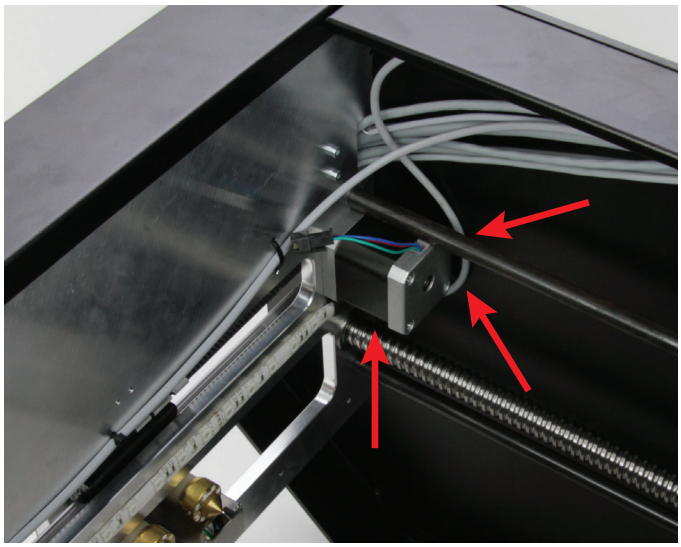
Adjust the actuation so that there are a few millimetres distance between the extruder nozzle and the spacer bolts when the actuation has moved into the light barrier as shown in the figure above.

Installation of the LED strip

1 x LED strip with connection line (line 29)



Glue the LED strip as illustrated to the X-plate from below, precisely below the guide rail. Degrease the adhesive areas first.
The connection line must end with the motor of the X-plate.
Caution:
The LED strip must not touch the light barrier holding block.



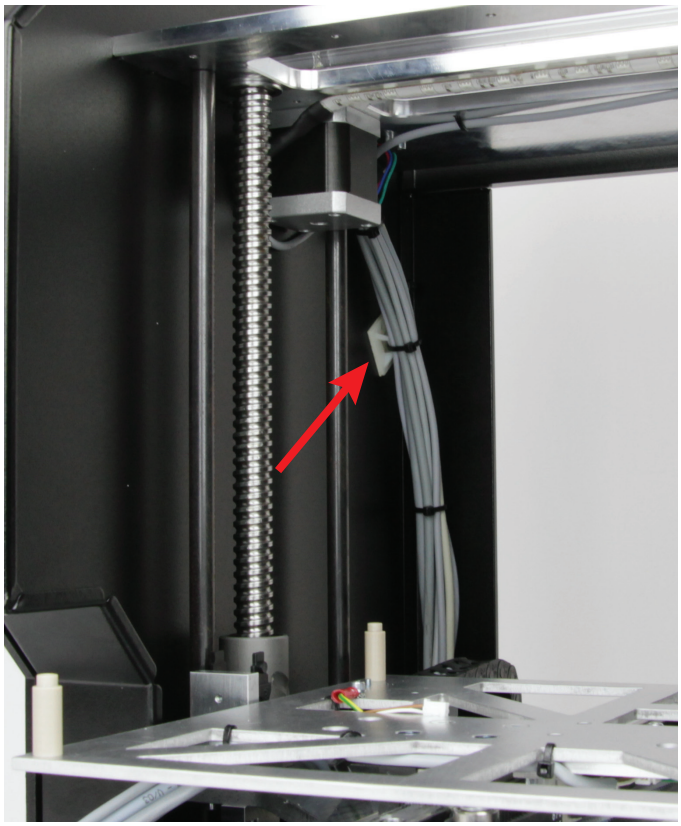
Route the connection line of the LED strip along the side wall around the bottom of the motor and past metal spacers. Then route it down with the other cables in the train.

Connection of the X motor

1 x line 01 (X-motor)

Connect the line 01 to the X-motor and place it downwards together with the lines from the extruder carriage and the lines from the limit switches for the X- and Z-directions and the line of the LED strip.

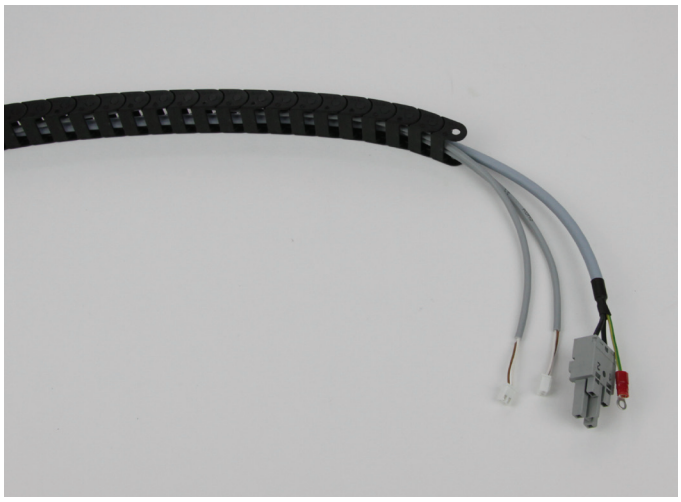
Placing and fastening the lines



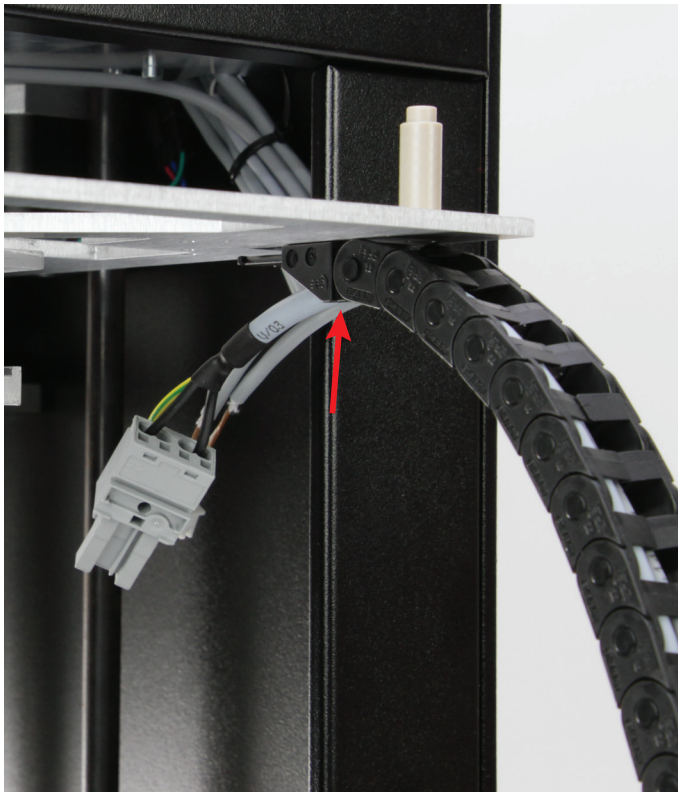
Route the line strand into the device socket (see arrow in the figure on the left) through the opening in the rear cover and secure it with small cable ties (99 mm) and a self-adhesive cable tie holder (see arrow in the figure on the right).

Connection of the heat bed and the limit switch for the Y-direction

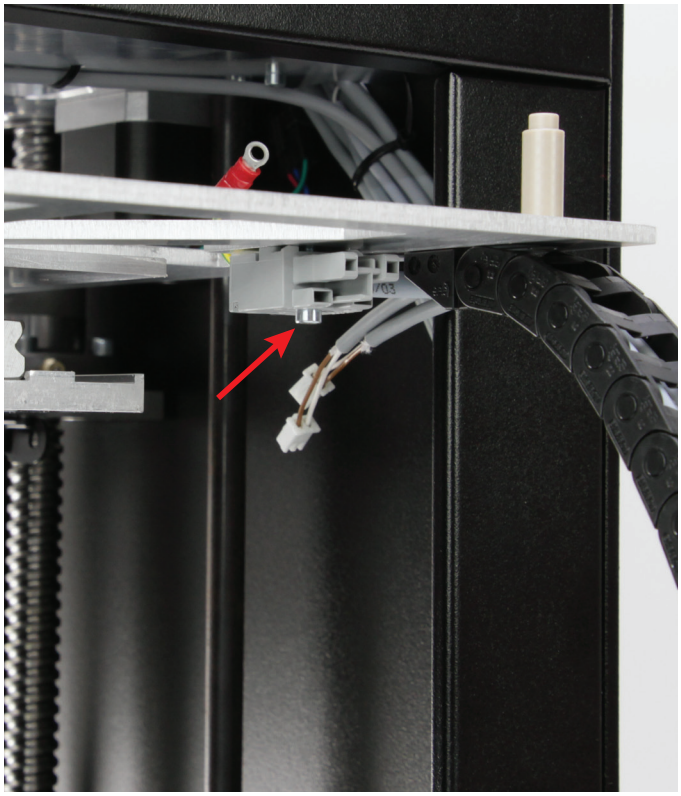
1 x energy drag chain small, 20 links
1 x lines 06 (heater)
1 x lines 08 (limit switch Y)
1 x lines 13 (temperature sensor heat bed)



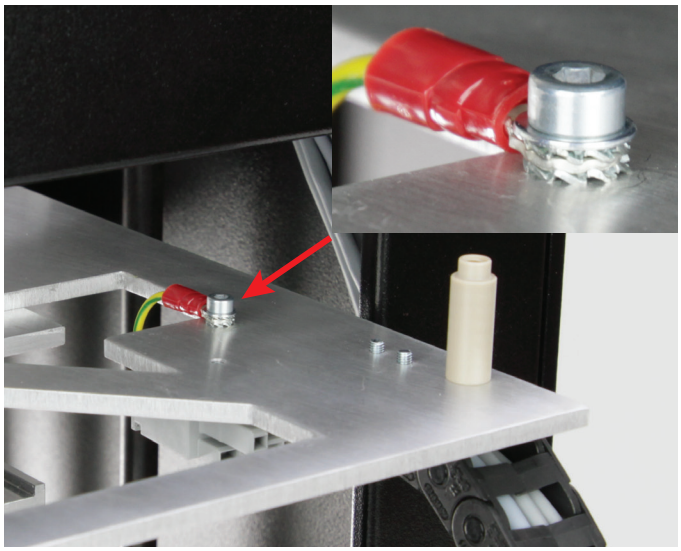
Push the lines into the energy drag chain so that the end link points to the line ends without label with the holes.



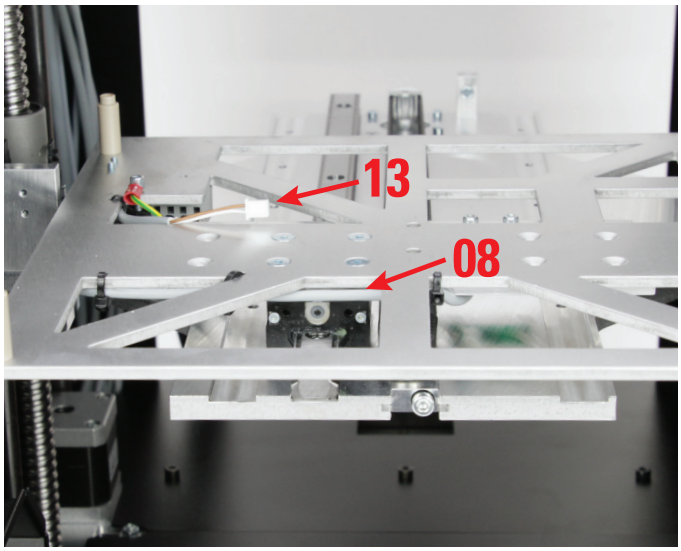
Latch the energy drag chain at the end piece of the undertable and pull the lines out of the drag chain far enough to be placed cleanly.



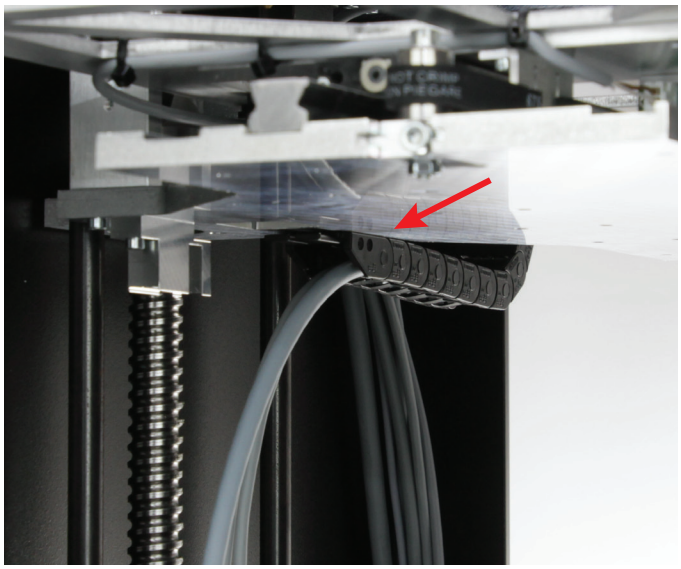
Install the plug connectors for the power supply of the heating plate with a cylinder head screw M3x16 at the bottom of the undertable.



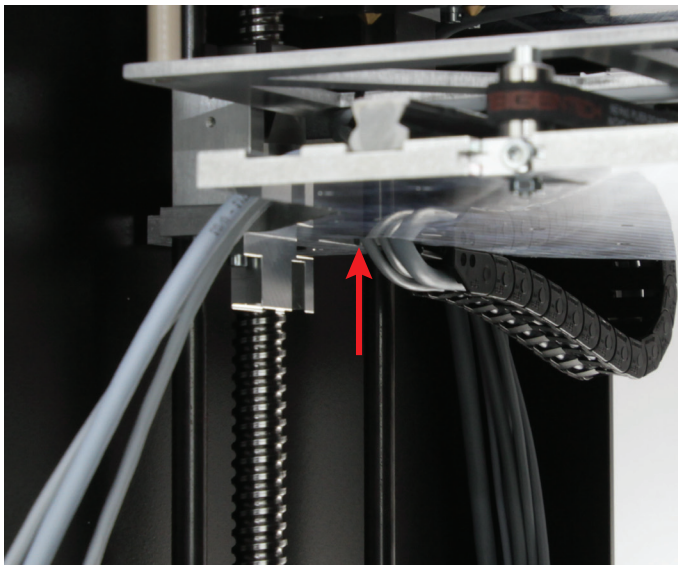
Connect the protective ground (green/yellow line with ring eyelet) with a cylinder head screw M3x10, a washer and two sprockets at the top of the undertable.
Caution: This connection creates the safety-technically important contact between the housing parts and the protective ground. Always observe the position of the washers and sprockets:
Screw head > washer > sprocket > ring eyelet > sprocket > undertable (see image section)



Connect the line 08 with the plug connector of the limit switch for the Y-direction and place the line.
Let the line 13 protrude from the drag chain by about 8 cm and attach it to the bore in the undertable with a small cable tie (99 mm). The thermal sensor of the heating plate is attached here later.

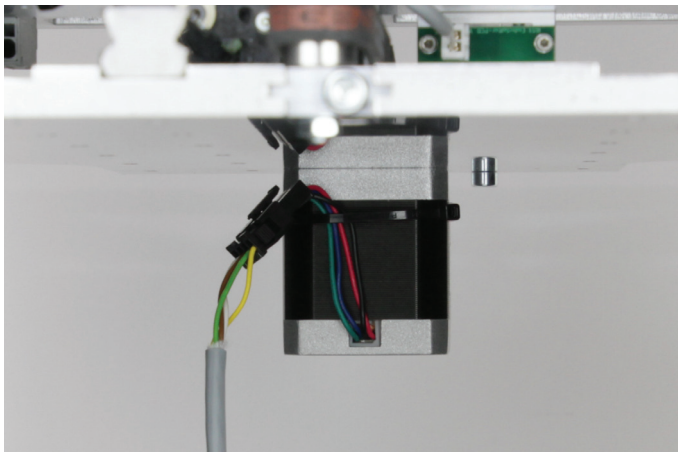


Latch the other end of the energy drag chain at the end piece of the Y-plate.

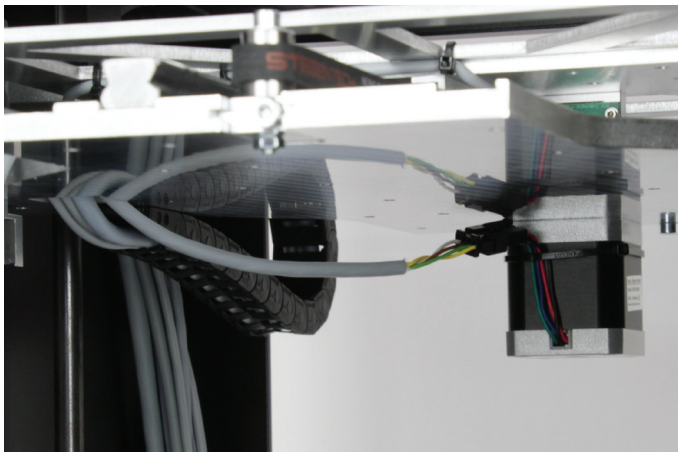


Route the lines of the energy drag chain upwards through the opening in the Y-plate.

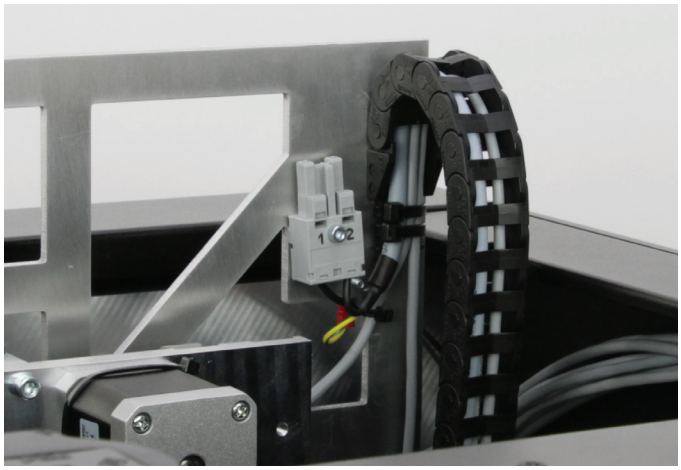
Connection of the Y-motor



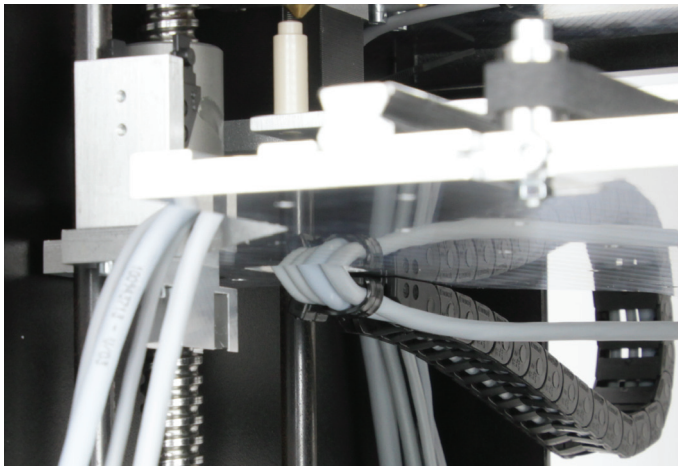
Connect the line 02 (Y-motor) to the plug connector of the Y-motor and fasten the line to the motor with 2 large cable ties (142 mm) that are combined as shown.



Route the line 02 through the opening in the Y-plate upwards as well.



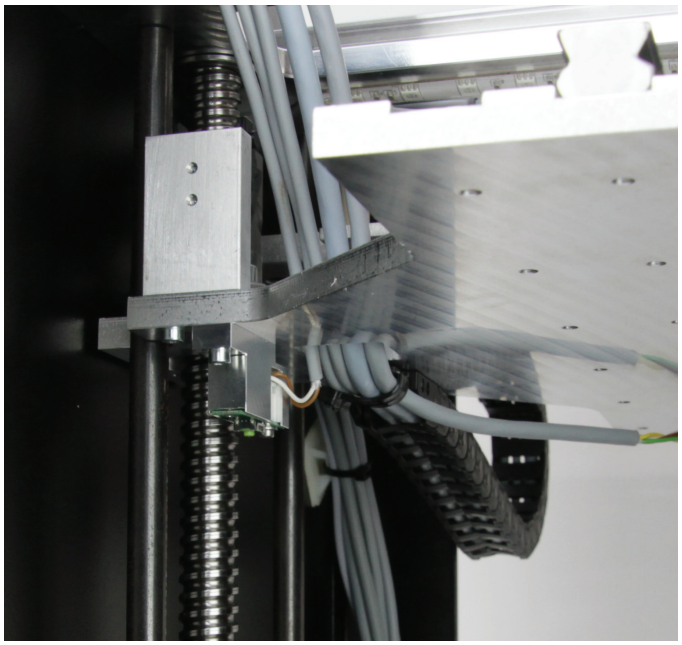
Apply two large cable ties (142 mm) for tension relief each at the two drag chain end pieces.



For the lower drag chain end piece at the Y-plate, include the line to the Y-motor in the tension relief.

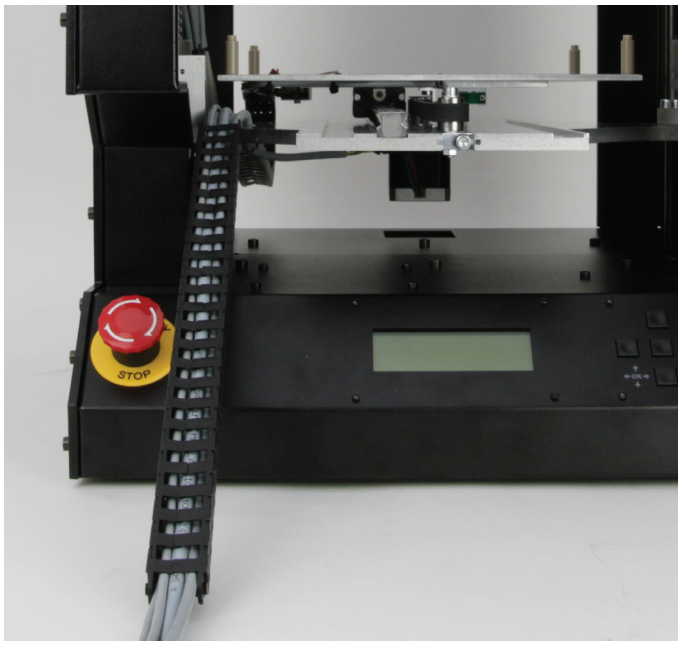
Installation and connection of the limit switch for the Z-direction (Z-max-limit switch at the Y-plate)

1 x line 09
1 x limit switch PCB
1 x cylinder head screw M2x16
1 x washer M2

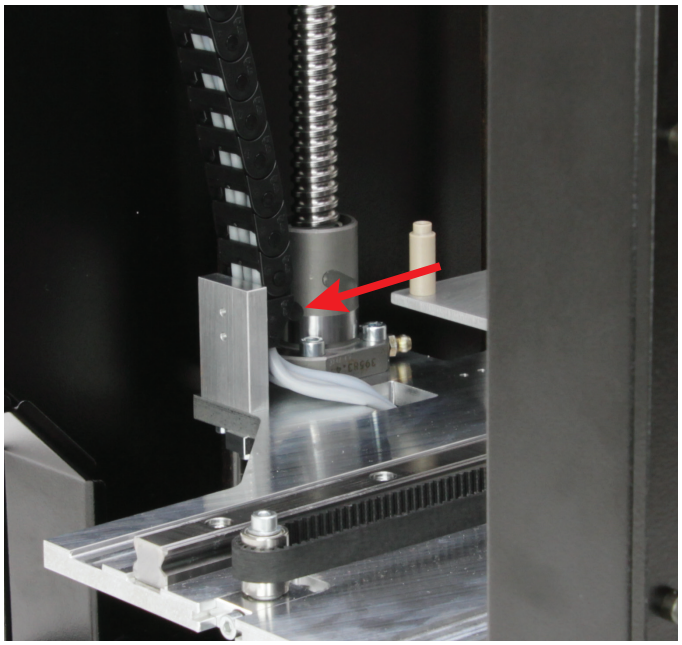


Connect the plug of line 09, without a label, to the limit switch PCB. Install the PCB with the screw and washer as illustrated to the limit switch holding block of the Y-plate from below.
The screw must be turned into the rear hole for this. The connection cable must be routed out at the right as illustrated.
Route the line through the hole in the Y-plate upwards and to the other lines.

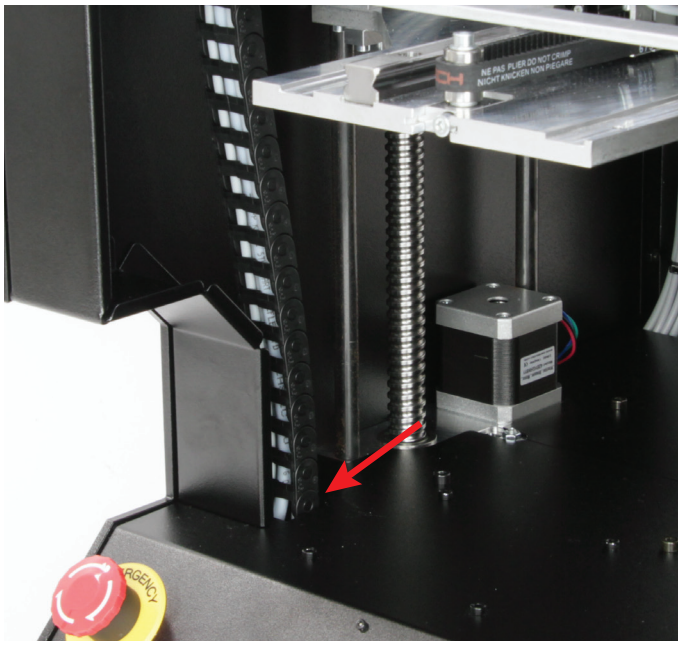
Placing the energy drag chain from the Y-plate to the operating cover



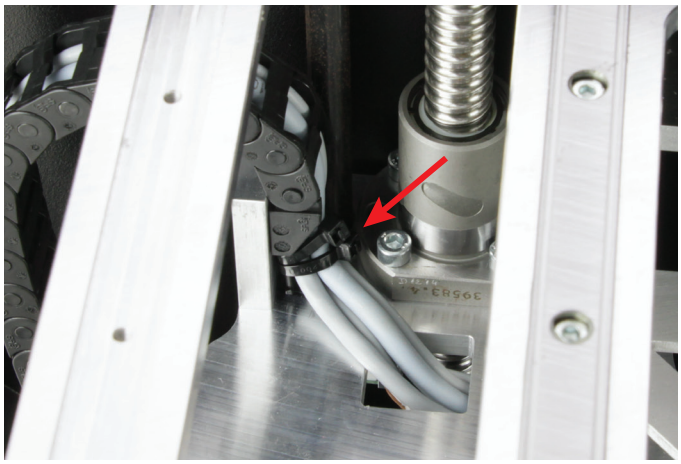
Push the lines coming from the hole in the Y-plate into the last remaining energy drag chain (small, 25 links) so that the end link with the nipples points at the line ends with the label.

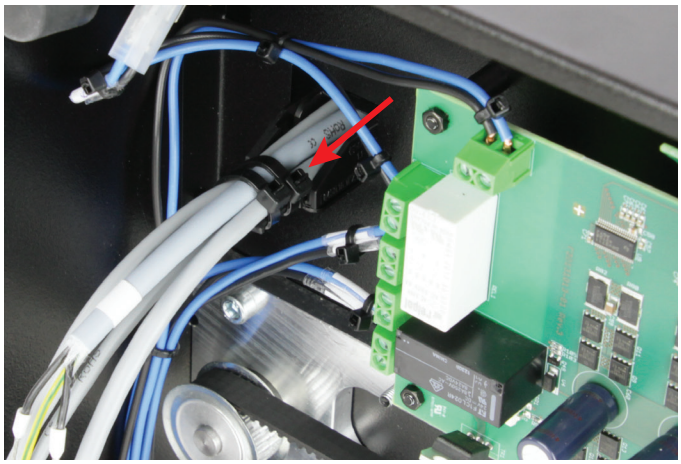


Latch the energy drag chain in the end piece at the Y-plate.



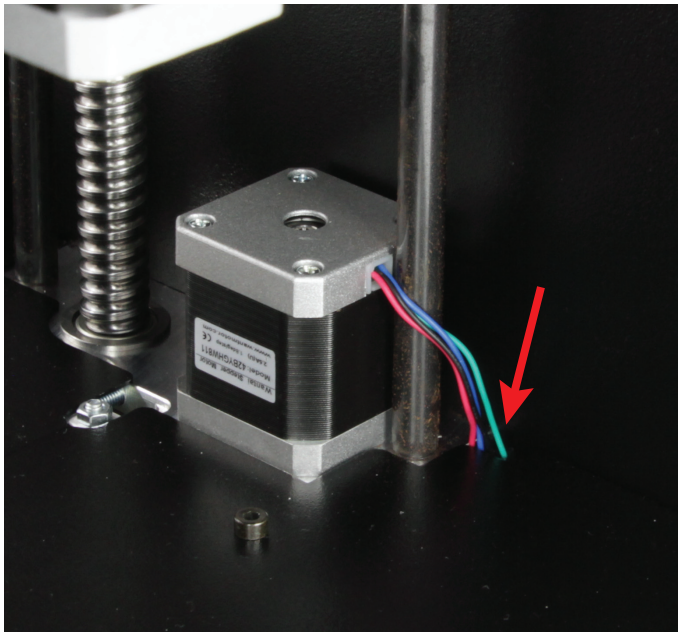
Route the lines down through the hole in the operating cover and latch the open end of the energy drag chain in the end piece of the operating cover.



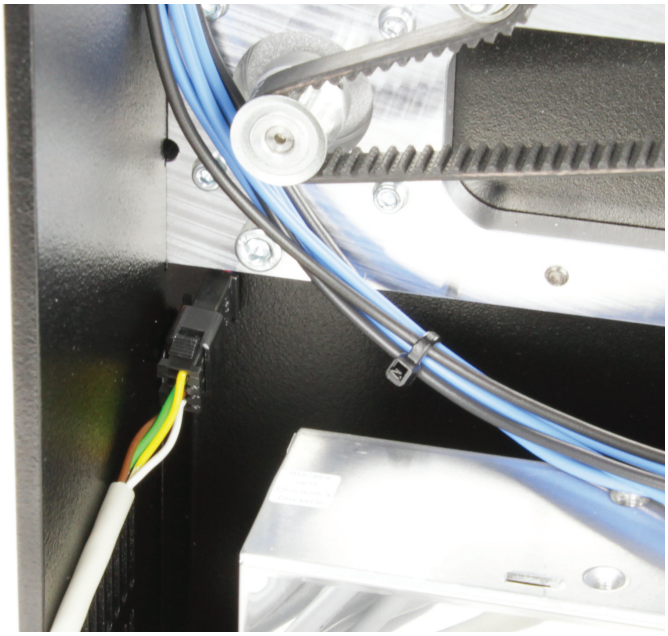


Attach two large cable ties (142 mm) each to the drag chain end pieces at the Y-plate (upper figure) and the operating cover (lower figure) for tension relief.

Connection of the Z motor

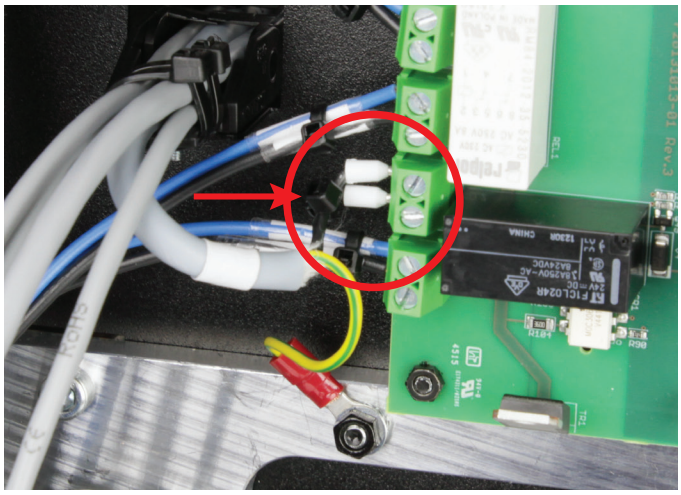


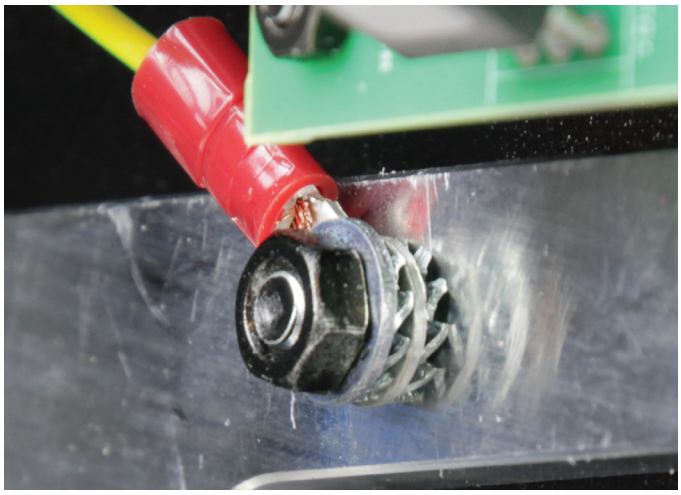
Push the plug connector at the Z-motor through the opening in the rear cover.



Connect the line 03 to the plug connector of the Z-motor.

Connection of the device lines





First connect the heater of the printing bed (line 06). The two black lines are connected to terminal X38 (see circle in the left figure) of the main PCB.

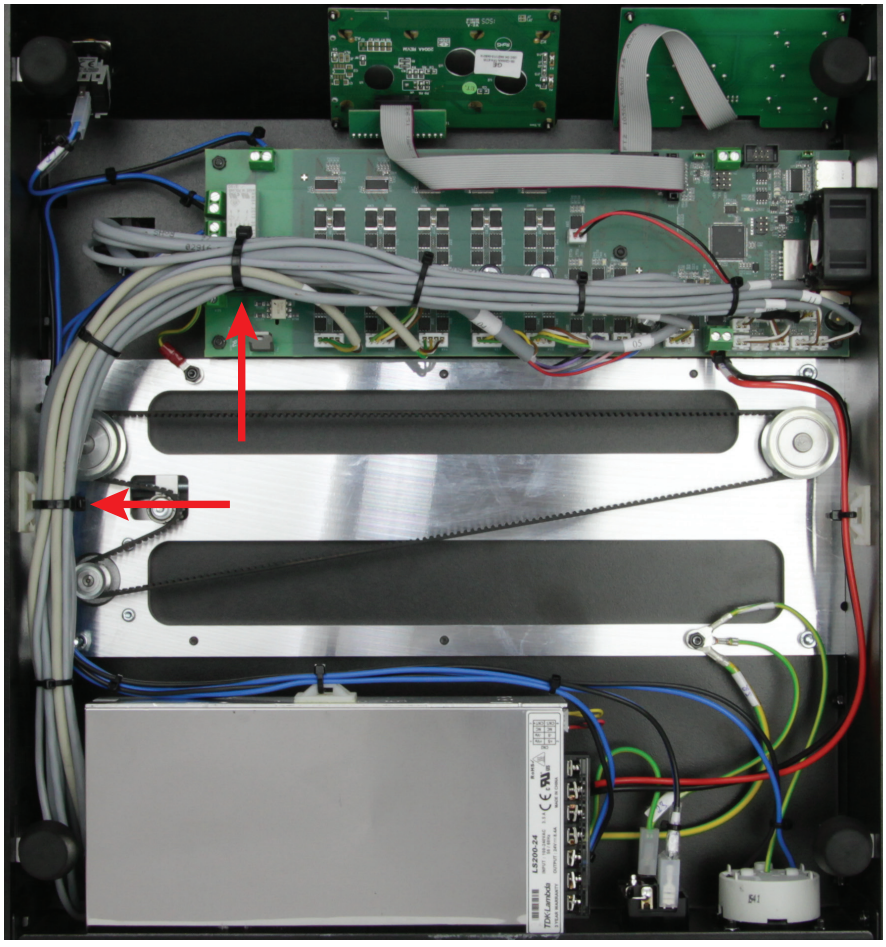
The ring eyelet of the protective ground at line 06 is attached with sprockets and an additional nut at the left attachment screw of the operating unit cover.

Caution: This connection creates the safety-technically important contact between the housing parts and the protective ground. Always observe the position of the washers and sprockets:

Housing > sprocket > ring eyelet > sprocket > washer > nut M4 (see right figure)

Tie both lines of the heating plate together at terminal X38 with a small cable tie (99 mm) close to the connection terminal (see arrow in the left figure).

Connect all other device lines as described on the following page to the main PCB. The figure shows how the cables are to be routed for this.



Line	terminal main PCB	connected components
01	X11	Motor X-direction
02	X12	Motor Y-direction
03	X16	Motor Z-direction
04 (4-pin)	X17	Motor extruder 0
04 (2-pin pink/grey)	X4	Heater extruder 0
04 (2-pin violet/bl.)	X8	Heating extruder 1
04 (2-pin red/blue)	X24	Extruder fan
05	X18	Motor extruder 1
07	X13	Limit switch X-direction
08	X14	Limit switch Y-direction
09	X36	Limit switch Z-direction (Z-Max-limit switch at the Y-plate)
10	X15	Limit switch Z-direction (light barrier) (Z-Min-limit switch at the X-plate)
11	X5	Temperature sensor extruder 0
12	X6	Temperature sensor extruder 1
13	X9	Temperature sensor heating plate
14	X7	Strain gauges (DMS)
29	X43	LED lighting

Route all lines cleanly with small (99 mm) and large (142 mm) cable ties and a self-adhesive cable tie holder and secure them. Use large cable ties (142 mm) where all control cables are combined and for the cable tie holder (see arrows in the figure).

The lines must not get into the rotating toothed belts in operation.

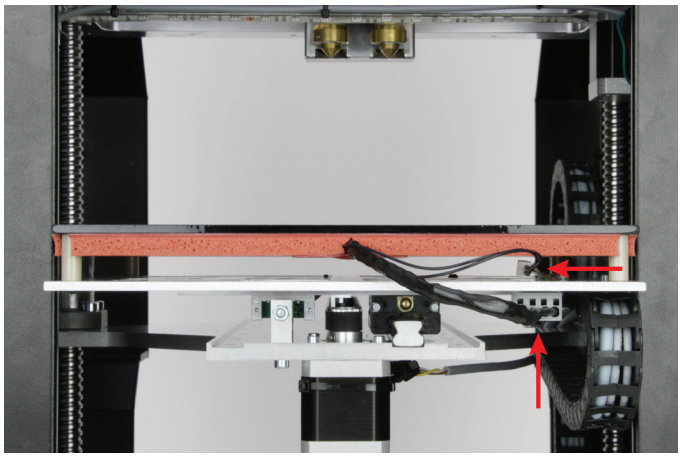
Overview of the lines already connected to the main PCB:

Line	terminal main PCB	connected components
06	X38 + Protective ground (left screw operating unit cover)	heater printing bed
15	X23	Keyboard
16	X16	Display
24	X41	Mains switch (230 V/AC, 50 Hz)
25	X40	Emergency off switch
26	X37	Mains unit
27	X39	Socket
28	X1	24 V/DC operating voltage main PCB
30	X45	Housing fan

11. Final Work

→ 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.

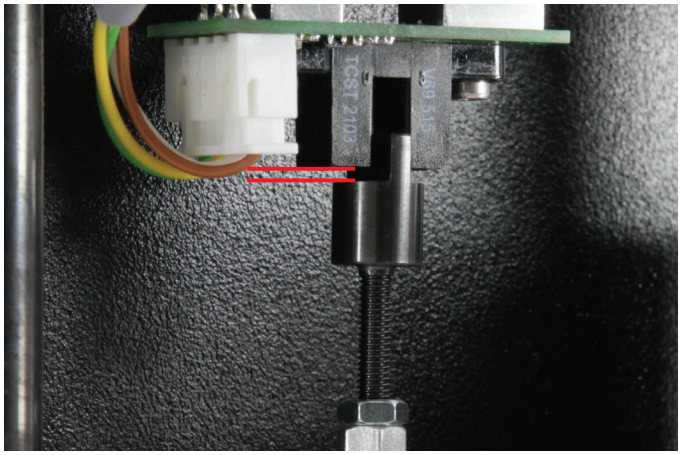
Mounting and connection of the heating plate

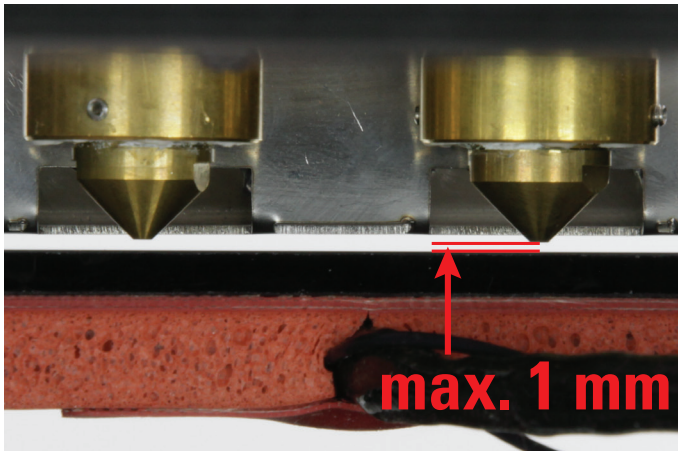


Place the heating plate onto the spacer bolts of the undertable and connect the two plug connectors from line 06 and 13.

Important! When inserting the printing plate, ensure that the glass ceramic actually is supported on the spacer bolts rather than the silicone heating pad.

Basic setting of the limit switch for the Z-direction





Manually move the Y-plate up (by moving the belt of the ball-threaded drives) until the actuation for the Z-stop is retracted as shown in the figure. The distance marked with the 2 red dashes is important. It should be about 1 mm.
This position corresponds to the Z-Home position as well.
Caution: The extruders must not touch the heating plate. If you cannot move the actuation for the Z-stop far enough into the light barrier, lower the Y-plate and turn the actuation out a little for the Z-stop.
No force must be applied to the heating plates, since otherwise the glass ceramics would break otherwise (loss of warranty/ guarantee).
You can use, e.g., a feeler gauge sheet with 0.9 mm as spacer for the following settings.

The Z-stop must be set so that there is no more than 1 mm distance between the extruder nozzle and the heating plate. The distance should not be any less than 0.8 mm, however. The gauge sheet should just fit between the nozzle and heating plate without application of force.
Loosen the counter nut and turn the actuation for the Z-stop into the hexagon threaded bolt until the distance fits. Check the distance after 1 to 3 half turns each.
Move the extruder and the heating plate manually and ensure that the extruders cannot touch the heating plate anywhere in the working area and that the same distance is approximately complied with everywhere.
If this is not the case, the undertable plate must be aligned carefully. However, the heating plate must be taken off first (danger of breaking!).
After this setting, counter the setting screw with the nut again.

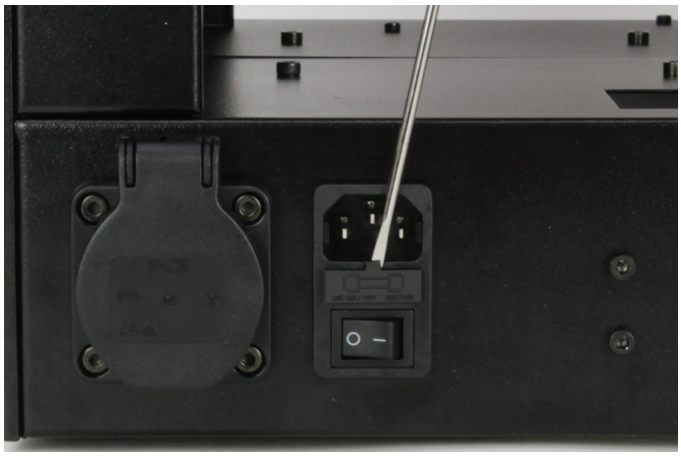
Attachment of the bottom cover

Fasten the die heating plate with the two plastic securing screws (wing screws PA6.6 nature M4x6 mm from the delivery), so that it cannot fall out and be damaged when the printer is tipped.

1 x bottom sheet
4 x cylinder head screw M3x6
4 x rubber foot

Turn the rubber feet from the foot holders.
Insert the bottom sheet with the folds towards the housing outside.
First insert the edge at the housing rear and then fold the bottom sheet against the housing.
Attach the bottom sheet to the foot holders with the four cylinder head screws M3x6.
Turn 4 rubber feet into the foot holders.
If the bores do not align cleanly and the rubber feet or the M3 screws cannot be turned in without resistance, the attachment screws of the foot holders must be loosened again slightly.
After turning in the rubber feet, finally tighten the foot holder attachment screws.

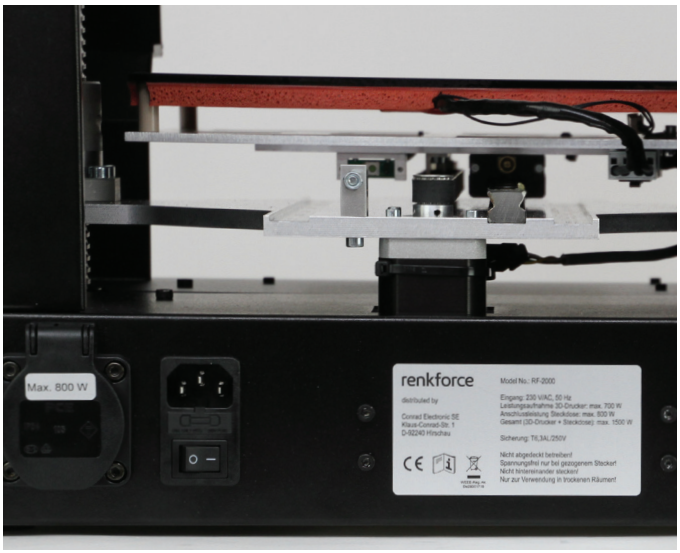
Inserting the mains fuse



Lever the fuse holder off the low power device combination socket with a suitable screwdriver.

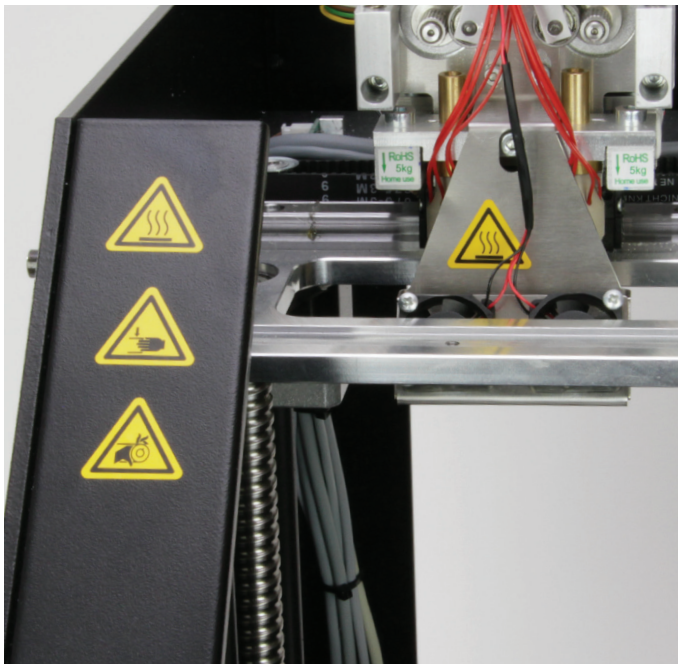
Insert the fuse as shown in the fuse holder and push it back into the low power device combination socket.

Gluing on the rating plate and warning signs



Glue the rating plate to the housing between the screws of the mains unit.
Glue the sticker "Max. 800 W" to the socket cover.
Degrease the adhesive areas first.

Attach the silver warning text sign well visible to the printer as illustrated.
Degrease the adhesive area first.



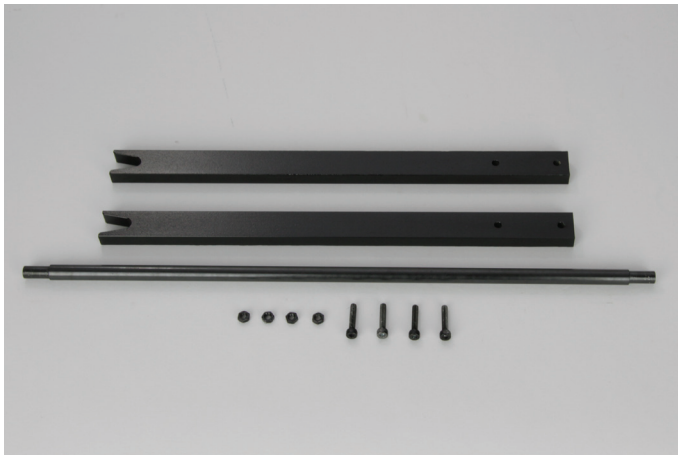
Attach the 3 yellow warning sign stickers "Hot surface", "Danger of hand injury" and "Danger of crushing" to the diagonal part of the left sight protection cover well visible.
Attach the additional warning sign sticker "Hot surface" well visible to the fan sheet of the extruder carriage as illustrated.
Degrease the adhesive areas first.

12. Initial Commissioning

Before initial commissioning, all transport protections or fuses that have been installed during installation or for transport must be removed. Do not forget the two wing screws of plastic that secure the heat bed either!

a) Installation of the Filament Holder

Assembly of the filament holder

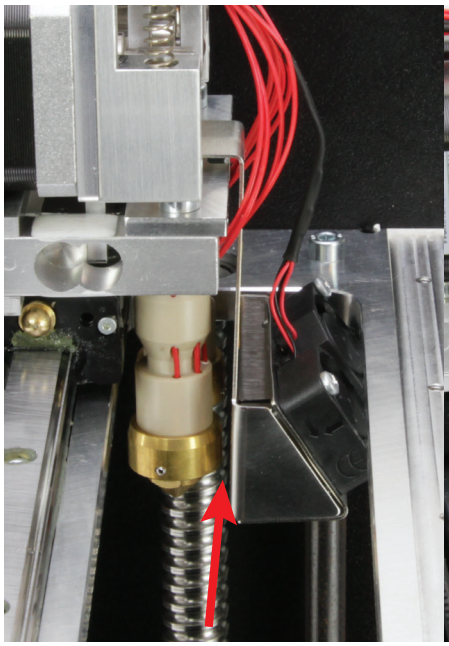


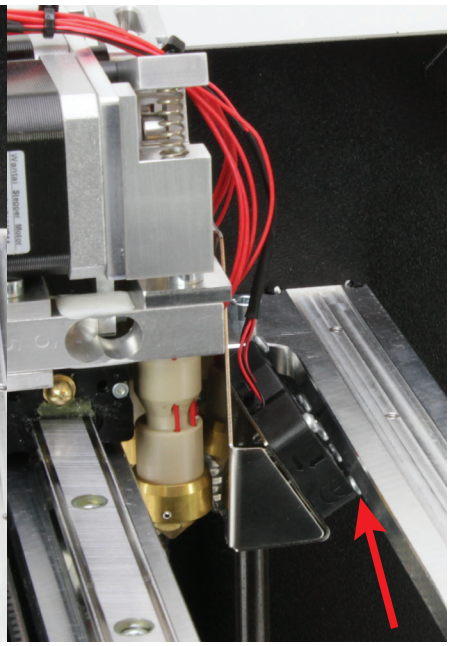
2 x filament holder part
1 x shaft for filament holder
4 x nut M4 (black)
4 x cylinder head screw M4x20 (black)

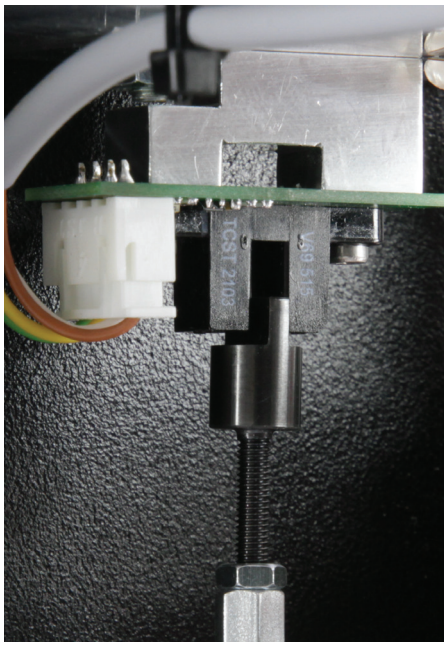
The two filament holder parts are installed on one side of the printer each in the two upper rear holes (see arrows in the figure).
If you have purchased the assembled unit, the 4 cylinder head screws and nuts are already hand-tightly turned into the holes.
Remove the 4 screws with their nuts.

Install the two filament holder parts as illustrated with the 4 screws and nuts.
Insert the shaft for the filament holder at the top of the guides.

b) Inspection of the Fan Sheet and the Actuation for the Z-Limit Switch







- Before you take the printer into operation, check the fan sheet at the extruder carriage (see figures above).

  Always ensure that the fan sheet does not touch the extruders and that the fans do not touch the X-plate (see arrows in the two figures).

  If it is in contact with one of the two points, unscrew the fan sheet and adjust it.

- Also make sure to check the actuation for the Z-limit switch.

  It must be aligned so that it can cleanly move into the light barrier (see right figure). Also check that the counter nut of the actuation is tightened and the actuation cannot be adjusted.

c) Setup and Transport

When setting up the 3D printer, observe that the mains switch or the mains line at the low power device combination socket 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. The emergency off switch must be easy to reach as well!

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, secure the heat bed with the enclosed white plastic screws. Secure all other parts with adhesive tape or cable ties or use the original packaging.

→ Use only the original packaging for shipping! Especially observe that the heat bed is secured with the two plastic screws and that the two parts of the original packaging are additionally pushed onto the heat bed.

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 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.

Do not let the mains cable come into contact with other cables.

Be careful when handling mains cables and mains connections. Mains voltage may cause potentially fatal electric shock.

Make sure that no cables lie around openly. Install cables professionally to prevent accidents.

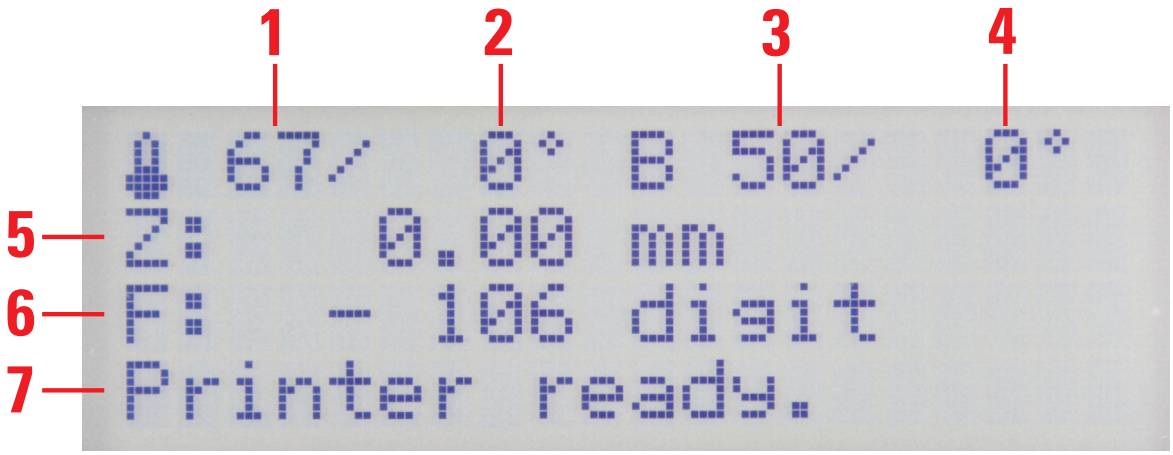
Before plugging in the mains plug, ensure that the device voltage indicated at the 3D printer corresponds to the available mains voltage. Do not connect the device if the indication does not correspond to the available mains voltage. Incorrect supply voltage may lead to irreparable damage to the device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

If the printer suffers any malfunction or if there is any other problem, you can push the "emergency off switch" to quickly disconnect the printer's voltage supply. Remove the problem before taking the printer into operation again. Then turn the emergency off switch clockwise. This unlatches it.

- Plug the low power device plug of the mains line into the low power device combination socket at the rear of the device.
- Plug the mains plug of the mains line into a protective contact socket.
- Switch on the printer with the mains switch at the low power device combination socket (put the switch in position I).
- The lighting is low again and the display will briefly show the welcome screen and the installed firmware; then the main menu appears.
- The LED at the Z-limit switch (light barrier) is lit red permanently.

→ Before continuing with commissioning, check if new firmware is available. On this, observe chapter "20. Firmware Update".

Description of the main menu:



(1) Temperature active extruder (actual)

(2) Temperature active extruder (target)

(3) Temperature heat bed (actual)

(4) Temperature heat bed (target)

(5) Z-position in mm; calculation from Z-Min (Z-Home) or from the heat bed surface; setting of the reference point in the menu: "**Configuration" - "General" - "Z Scale: Surface/Z Min**"

When the automatic Z-compensation is active, the display will show "**Cmp**" next to the Z-position (5).

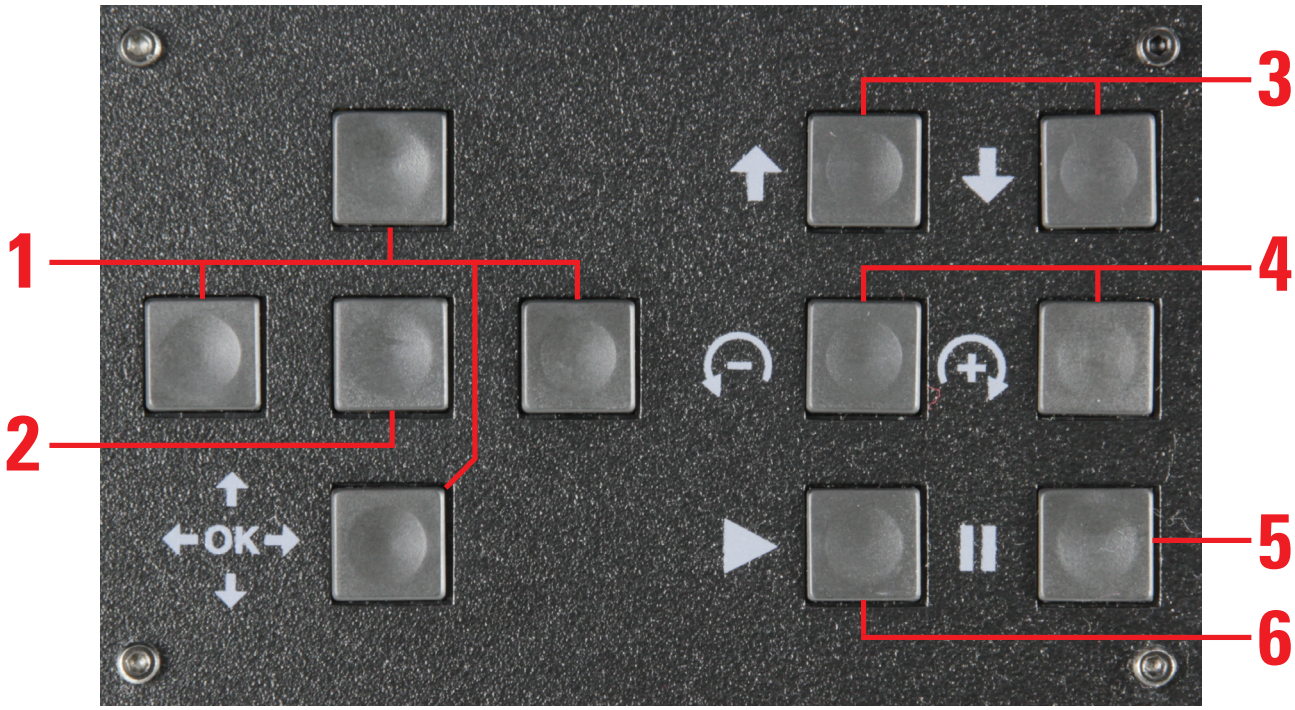
(6) Measured value of the print sensors at the extruder

(7) Status information

→ The target temperatures are not displayed here yet, since the extruders and heating bed are not heated yet.

13. Operation at the Printer

a) Function description of the operating buttons



(1) Direction buttons for navigation in the menu structure ("**left**" / "**right**" / "**top**" / "**bottom**")

The left direction button switches the LED lighting to white light as well.
Pushing the button again will switch back to the previous condition.

(2) OK button for confirmation of a selection in the menu

(3) Move the heating or Y-plate up/down

(4) Filament feed of the active extruder - = back/+ = forward

Attention! The filament feed works only for the active extruder and if it is heated up!

(5) Printing break

Push 1 x: Print stops

Push 2 x: Print stops and printing head moves away from printed object (the previous position remains saved)

(6) Continuation of print after a printing pause

b) Description of the Extruders

The printer has 2 extruders.

The printer menu and the G-code have an "**Extruder 0**" and an "**Extruder 1**".

The repetier host software has an "**Extruder 1**" and an "**Extruder 2**".

The left extruder (from the front view) ins called "**Extruder 0**" in the printer menu and the G-code. In the repetier host software, it is "**Extruder 1**".

The right extruder is "**Extruder 1**" in the printer menu and the G-code, but "**Extruder 2**" in the repetier host software.

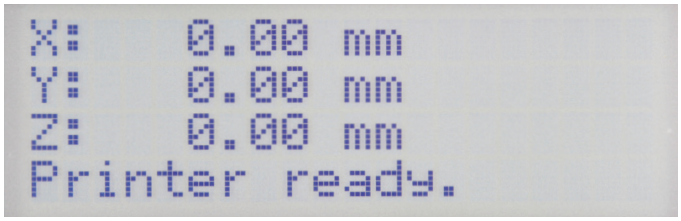
Back to the overview:

Side (from the front view)	Menu printer/G-code	Repetier host
Left	Extruder 0	Extruder 1
Right	Extruder 1	Extruder 2

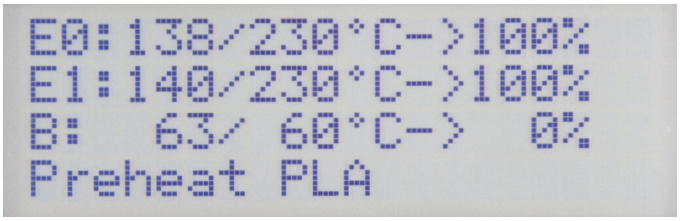
c) The Expanded Main Menu

The main menu contains the main display (see "Description of the main menu") and 3 further views.

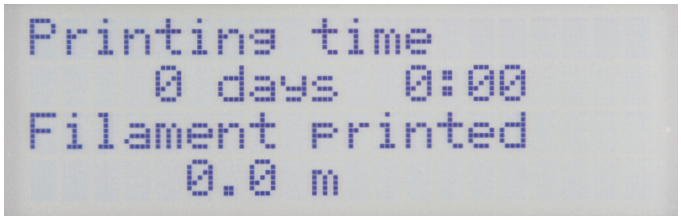
You can reach them via the direction buttons "**top**" and "**bottom**" (1). The displays are switched through in sequence. For example, if you push the button "**down**" four times, the main display will be shown again.



1 x button "**down**" (1) pushed.
This shows the current positions of the individual axes.



2 x button "**down**" (1) pushed.
This overview shows the current temperature values of the two extruders and the heating plate.



3 x button "**down**" (1) pushed.
This shows the entire printing time and the filament used up to now.

d) Menu Overview

Operation takes place via the left key block at the printer:

- The direction buttons are used for navigation in the menu structure ("**left**" / "**right**" / "**top**" / "**bottom**")
- The button OK is used to confirm a selection in the menu and to call the menu structure from the main menu (description above under "Function Description of the Operating Buttons").

⟶ The menu structure may deviate slightly depending on firmware.

Quick Settings	Home All		
	RGB Light:	Off/White/Auto/Manual	
	Output Object		
	Speed Multiply:100%		
	Flow Multiply:100%		
	Preheat PLA		
	Preheat ABS		
	Cooldown		
	Disable Stepper		
	230V Output: On/Off		
	Restart	Restart now?	
		Yes	
		No	

Print File	Back		
	Files		
Position	Home All		
	Home X		
	Home Y		
	Home Z		
	Position X	X: 0.00 mm	
		Endstop min: On/Off	
		Endstop max: N/A	
		Single Move/1 mm/10 mm/50 mm/Single Steps	
	Position Y	Y: 0.00 mm	
		Endstop min: On/Off	
		Endstop max: N/A	
		Single Move/1 mm/10 mm/50 mm/Single Steps	
	Position Z	Z: 0.00 mm	
		Endstop min: On/Off	
		Endstop max: On/Off	
		Single Move/1 mm/10 mm/50 mm/Single Steps	
	Position Extruder	E: 0.00 mm	
		1 click = 1 mm	
Extruder	Temp. Bed: 0°C		
	Temp. 0 : 0°C		
	Temp. 1 : 0°C		
	Extruder 0 off		
	Extruder 1 off		
	Active Extruder: 0/1		
	Position Extruder	E: 0.00 mm	
		1 click = 1 mm	
	Load Filament		
	Unload Filament		
	Set E Origin		
Fan speed	Fan Speed: 0%		
	Turn Fan off		
	Fan to 25%		
	Fan to 50%		
	Fan to 75%		
	Fan to 100%		
SD Card	Print file	Back	
		Files	
	Delete file	Back	
		Files	

Configuration	General	Baudrate: 115200	
		Stepper off	[s]: 600
			0 = never
		All off	[s]: 0
			0 = never
		Beeper: On/Off	
		Mode: Printer/Miller	
		Z Scale: Surface/Z Min	
		Extruder Offset X	
		Extruder Offset Y	
	Acceleration	Print X: 1000	
		Print Y: 1000	
		Print Z: 100	
		Move X: 1000	
		Move Y: 1000	
		Move Z: 100	
		X/Y-Jerk: 10.0	
		Z-Jerk : 0.1	
	Feedrate	Max X: 500	
		Max Y: 500	
		Max Z: 50	
		Home X: 165	
		Home Y: 165	
		Home Z: 10	
	Z Calibration	Scan	
		Scan PLA	
		Scan ABS	
		Z-Offset	Z: 0 um
		Position Z	Z: 0.00 mm
			Endstop min: On/Off
			Endstop max: On/Off
			Single Move/1 mm/10 mm/50 mm/Single Steps
		Set Z Matrix: 1 (1-9)	
	Restore Defaults		

e) Functions of the Individual Menu Items

Quick Settings		
Home All	Move all axes into the home position	
RGB Light	Switches the LED-lighting between off, white, automatic and manual	
Output Object	Moves the heating plate to the removal position	
Speed Multiply	Sets the printing speed	
Flow Multiply	Sets the material flow speed	
Preheat PLA	Preheating of the heating plate and extruder to PLA temperature	
Preheat ABS	Preheating of the heating plate and extruder to ABS temperature	
Cooldown	Cool downs (all heatings off)	
Disable Stepper	Switches off all motors	
230 V Output	Switches the socket at the rear of the printer on and off	
Restart	Restarts the firmware	
Print File	Print from SD card (only visible if SD card is inserted)	
Position		
Home All	Move all axes into the home position	
Home X	Move X-axis into the home position	
Home Y	Move Y-axis into the home position	
Home Z	Move Z-axis into the home position	
Position X	X: 0.00 mm	Moves X-axis into an adjustable position; move with the arrows "**up**"/"**down**" (1)
	Endstop min:	Display of the limit switch condition
	Single Move	Switches the length of the movement per push of the button; switch with the arrow "**right**" (1): Single Move = Moves until the button is released 1 mm/10 mm/50 mm = Movement per push of a button by the chosen length in mm Single Steps = Movement by single steps; 1 push of button = 1 single step
Position Y	Y: 0.00 mm	Moves Y-axis into an adjustable position; move with the arrows "**up**"/"**down**" (1)
	Endstop min:	Display of the limit switch condition
	Single Move	Switches the length of the movement per push of the button; switch with the arrow "**right**" (1): Single Move = Moves until the button is released 1 mm/10 mm/50 mm = Movement by the chosen length in mm Single Steps = Movement by single steps; 1 push of button = 1 single step
Position Z	Z: 0.00 mm	Moves Z-axis into an adjustable position; move with the arrows "**up**"/"**down**" (1)
	Endstop min:	Displays the limit switch condition min. (light barrier)
	Endstop max:	Displays the limit switch condition max. (bottom at the Y-plate)
	Single Move	Switches the length of the movement per push of the button; switch with the arrow "**right**" (1): Single Move = Moves until the button is released 1 mm/10 mm/50 mm = Movement by the chosen length in mm Single Steps = Movement by single steps; 1 push of button = 1 single step
Position Extruder	Manually operate extruder infeed / 1 mm per click/works only if the extruder is heated up	

Extruder		
Temp. Bed: 0 °C	Manually adjusting the heat bed temperature	
Temp. 0 : 0 °C	Manually setting the extruder temperature for extruder 0 (e.g. for filament change)	
Temp. 1 : 0 °C	Manually setting the extruder temperature for extruder 1 (e.g. for filament change)	
Extruder 0 Off	Switches off heater of the 1st extruder	
Extruder 1 Off	Switches off heater of the 2nd extruder	
Active Extruder	Specifies which extruder is active (push OK to switch)	
Position Extruder	Manually operate extruder infeed/1 mm per click/works only if the extruder is heated up	
Load Filament	Inserting the filament/extruder is heated up automatically, then the filament is pulled in	
Unload Filament	Removing the filament/extruder is heated up automatically, then the filament is moved out	
Set E Origin	Setting a new zero position	
Fan Speed		
Fan Speed: 0%	Displays the current fan speed (0% - 100%)	
Turn Fan off	Switches the fan off; is only displayed if the fan has been switched on manually	
Fan to 25%	Sets the fan speed to 25%	
Fan to 50%	Sets the fan speed to 50%	
Fan to 75%	Sets the fan speed to 75%	
Fan to 100%	Sets the fan speed to 100%	
SD Card		
Print File	Starts printing from SD card	
Delete File	Delete file from SD card (then the file to be deleted is selected)	
Configuration		
General	Baudrate: 115200	Sets the transfer speed from the computer
	Stepper off	Time setting until the motors are switched off in standby
	All off	Time setting until the motors and heaters are switched off in standby
	Beeper: On/Off	Switches the button sound on or off
	Mode: Printer/Miller	Switches between the printer and mill modes
	Z Scale: Surface/Z Min	Specifies point Z = 0 for the display Z (5) in the main menu: Z Min: specifies Z-Min, i.e. the Z home position as zero position Surface: specifies the surface of the heat bed as zero position
	Extruder Offset X	Specifies the distance between the two extruders in the X-direction (Standard = 33.896; indication in mm)
	Extruder Offset Y	Specifies the distance between the two extruders in the Y-direction (Standard = 0.098; indication in mm)
Acceleration	Print X: 1000	Sets the max. printing acceleration of the X-axis
	Print Y: 1000	Sets the max. printing acceleration of the Y-axis
	Print Z: 100	Sets the max. printing acceleration of the Z-axis
	Move X: 1000	Sets the max. travelling speed of the X-axis
	Move Y: 1000	Sets the max. travelling speed of the Y-axis
	Move Z: 100	Sets the max. travelling speed of the Z-axis
	X/Y-Jerk: 10.0	Max. acceleration of the X- and Y-axes at small steps
	Z-Jerk : 0.1	Max. acceleration of the Z axis at small steps

Feedrate	Max X: 500	Max. speed of the X-axis	
	Max Y: 500	Max. speed of the Y-axis	
	Max Z: 50	Max. speed of the Z-axis	
	Home X: 165	Max. speed of the X-axis when moving to the home position	
	Home Y: 165	Max. speed of the Y-axis when moving to the home position	
	Home Z: 10	Max. speed of the Z-axis when moving to the home position	
Z Calibration	Scan	Fast heat bed calibration	
	Scan PLA	Heat bed calibration at typical PLA temperatures	
	Scan ABS	Heat bed calibration at typical ABS temperatures	
	Z-Offset	Shifts the distance between the nozzle and heating plate in Z-direction by the value indicated (standard = 0 µm)	
	Position Z	Z: 0.00 mm	Moves Z-axis to an adjustable position; Move with the arrows "**up**"/"**down**" (1)
		Endstop min:	Displays the limit switch condition min. (light barrier)
		Endstop max:	Displays the limit switch condition max. (bottom at the Y-plate)
		Single Move	Switches the length of the movement per push of the button; switch with the arrow "**right**" (1): Single Move = Moves until the button is released 1 mm/10 mm/50 mm = Movement by the chosen length in mm Single Steps = Movement by single steps; 1 push of button = 1 single step
	Set Z Matrix: 1	Up to 9 heat bed scans can be saved.	
Restore Defaults	Resets the settings to defaults		

14. Calibration

a) General Notes on Calibration

Attention! Never touch the hot extruders or the hot heat bed! 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.

No filament may be entered in the two extruders during calibration, since the measured values would otherwise be falsified.

If there already is some filament in the extruders, it must be completely removed from the two extruders before calibration. For this, observe chapter "15. c) Removing and Changing the Filament" or method 3 in chapter "21. b) Cleaning".

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

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

⟶ **Ensure that the spacer bolts are fully screwed into the undertable and that the heating plate is supported level on the spacer bolts.**

This calibration cannot replace correct basic settings of the limit switch for the Z-direction or the setting of the distance between the nozzle and the heat bed. It serves to balance out slight irregularities of the heating plate while printing.

Before you perform calibration, first check if new firmware is available and install this. Observe chapter "20. Firmware Update". The update to the new version may cause data of the heat bed scan to be deleted. To check this, just read out the data with the command "M3013", as described in chapter "19. a) Determining the Highest Position of the Heating Plate". If this shows a matrix, it has not been deleted.

Calibration should be performed now and then. It is a prerequisite for high printing quality. In any case, calibrate after transporting the 3D-printer, changing the heating plate or updating the firmware.

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

In the heat bed scans "**Scan PLA**" and "**Scan ABS**", everything is done automatically after "Setting the distance between the nozzle and the heating plate", except for alignment of the other extruder. This means that the printer will heat up to the accordingly needed temperatures automatically and will determine the distance between the nozzle and the heating plate at printing temperature automatically. The determined offset is automatically considered in all future printouts. The Z-offset in the firmware menu or via the command "**M3006**" in the G-code can be 0 in most cases.

The heat bed scan via "**Scan**" is faster because it is performed at lower temperatures and the firmware therefore does not have to wait until the PLA or ABS temperatures are reached. Possible changes to the distance between the heat bed and the extruder due to changed temperatures when printing cannot be considered by the firmware. Therefore, the corresponding Z-offset can be determined manually and then set in the firmware menu or via the command "**M3006**" in the G-code.

The Z-matrix determined by the heat bed scan can store up to 9 different memory slots. The active Z-matrix can be selected via the "**Set Z-Matrix**" menu and the command "**M3009**" in the G-code. This means that the heat bed scan can be performed and saved separately for different materials and/or Slicer settings. Before starting printing, the respective optimal Z-matrix can be loaded and used for Z-compensation.

However, observe that using more than one matrix may require manual correction of the Z-offset value again, since the calibration changes the position of the two extruders mechanically.

b) Setting the Distance between the Nozzle and the Heating Plate

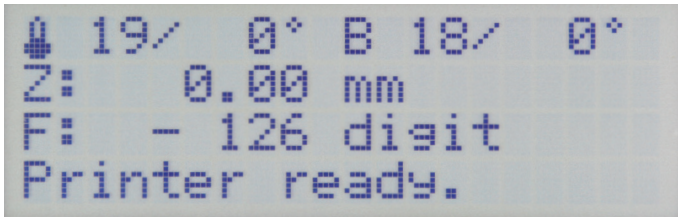
→ Only the left extruder (viewed from the front) (Extruder 0) is used for calibration. The distance between the nozzle and the heating plate must be set to 0.3 mm.

Important! Determine the position with the smallest distance between the nozzle and the heating plate in the cold condition. This means that if the extruders or the heating plate have heated up before, you need to let them cool off entirely first!

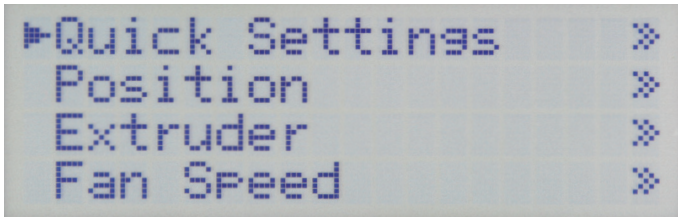
The left extruder is set when hot!

Attention! Never touch the hot extruder or the heating plate during the settings! There is a danger of burns!

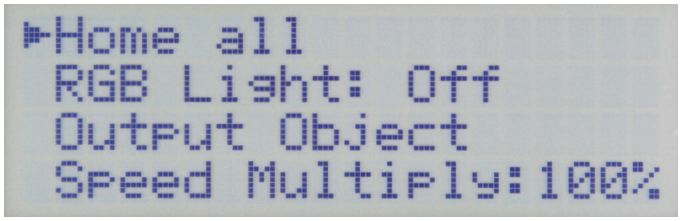
Determining the position with the smallest distance



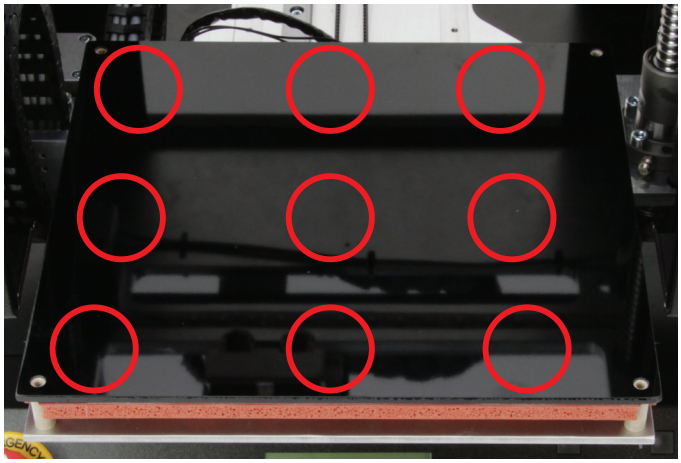
First move all printer axes to their home positions (**Home All**). Push **OK** in the main menu (2).



Push **OK** again to open the menu "**Quick Settings**".

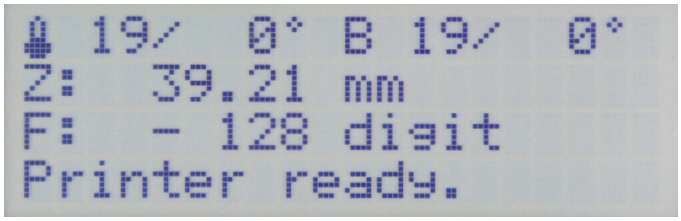


In order to move all axes to the home position, confirm with **OK**. Then switch off the printer.

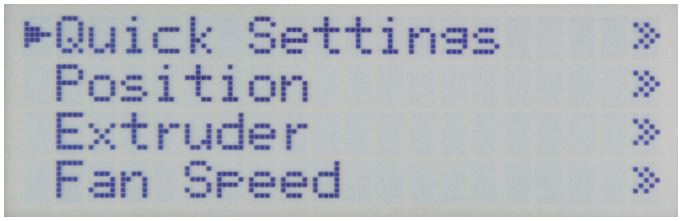


Now determine the position on the heating plate where the distance between the nozzle of the left extruder and the heating plate is smallest.
For this, target the 9 positions that are marked at the top of the picture. For this, carefully move the extruder carriage and the heat bed. It is easiest to determine the right position with a feeler gauge.
Leave the extruder carriage and the heat bed in the position where you have determined the smallest distance.

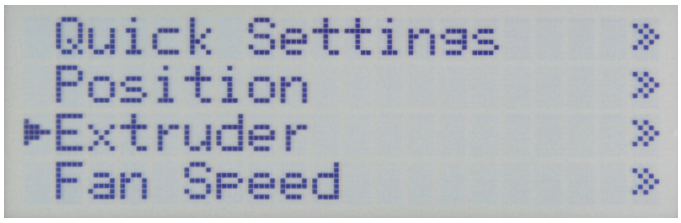
Heating up the setting temperature



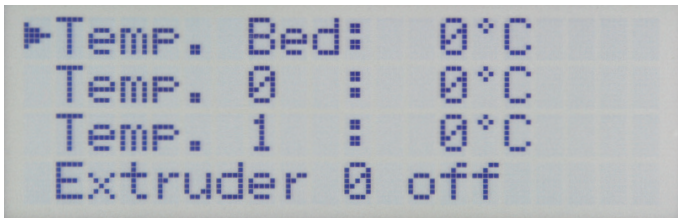
Switch on the printer again and move the heat bed down a few centimetres with the arrow "**down**" (3) once the main menu is displayed. Then push **OK**.



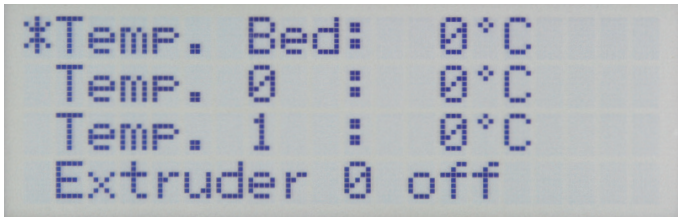
Use the direction buttons (1) to navigate to menu item "**Extruder**".



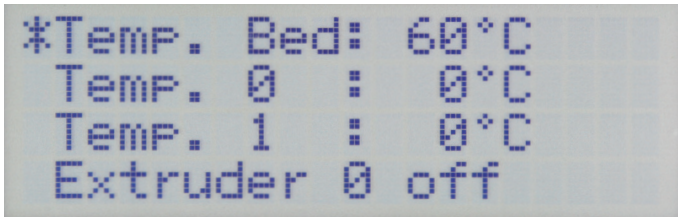
Push **OK**.



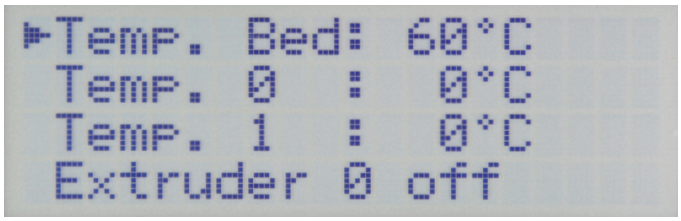
Push **OK** again to select "**Temp. Bed**".



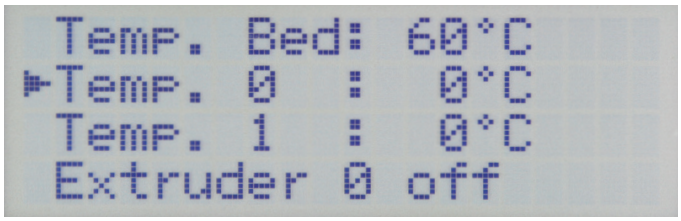
Use the direction buttons to set the temperature for the heat bed. Since the distance is to be set at printing temperature, set **PLA** to "**60 °C**" and **ABS** to "**120 °C**".



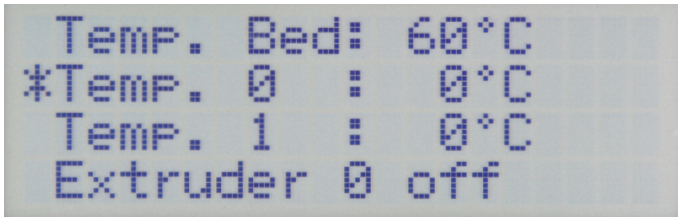
Push **OK**.



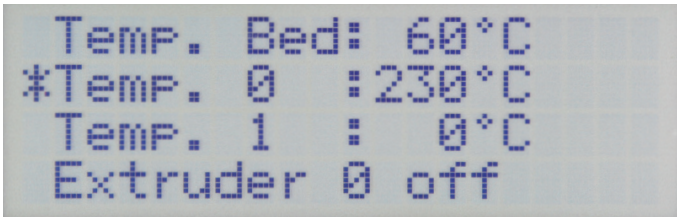
Select "**Temp. 0**" with the direction buttons.



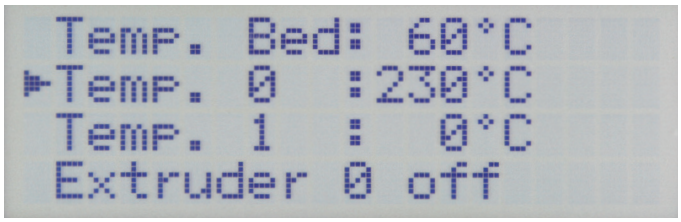
Push **OK**.



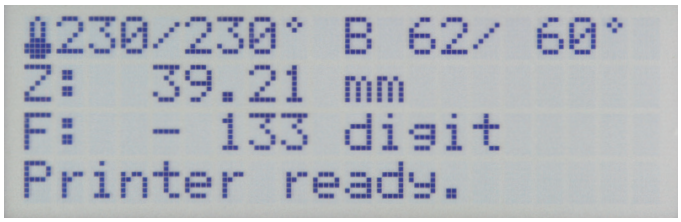
Use the direction buttons to set the temperature for the left extruder. Since the distance is to be set at printing temperature, set **PLA** to "**230 °C**" and **ABS** to "**260 °C**".



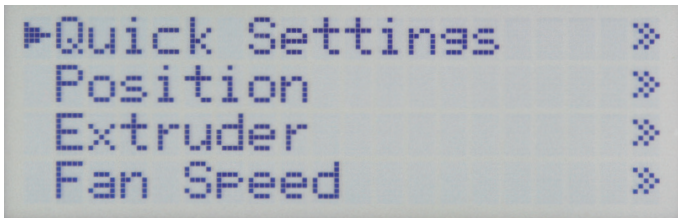
Push **OK**.



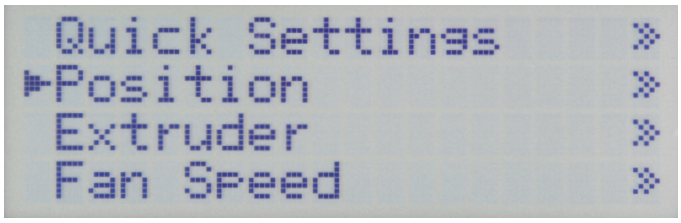
Push the direction button "**left**" 2 x to return to the main menu.



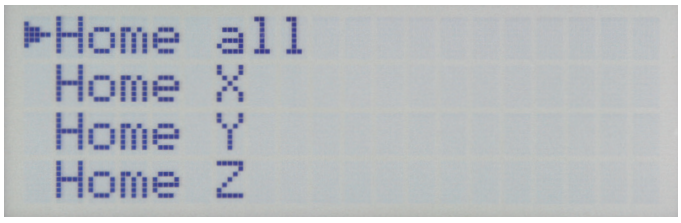
Wait until the actual temperature of the left extruder and the heating plate reflects your setting.
Let both continue to heat up for at least another 10 minutes until the heating plate temperature has stabilised and it is entirely heated through, and the extruder has completely expanded.
Then push **OK**.



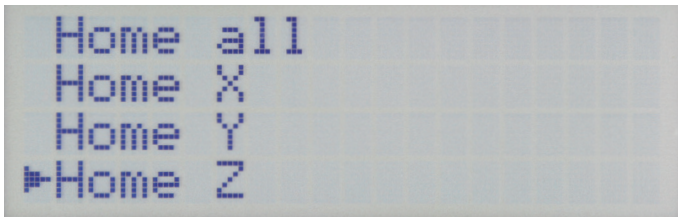
Use the direction buttons to navigate to menu item "**Position**".



Push **OK**.

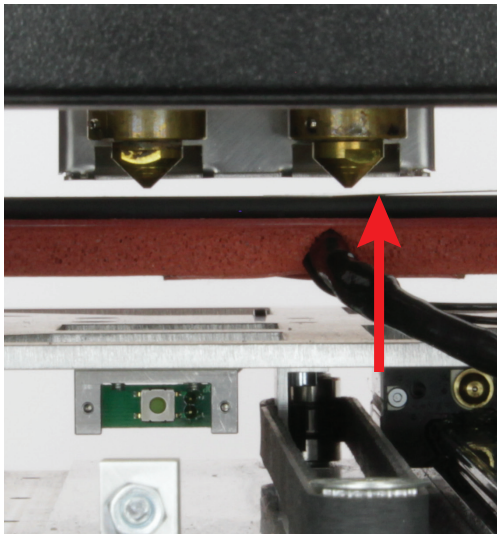


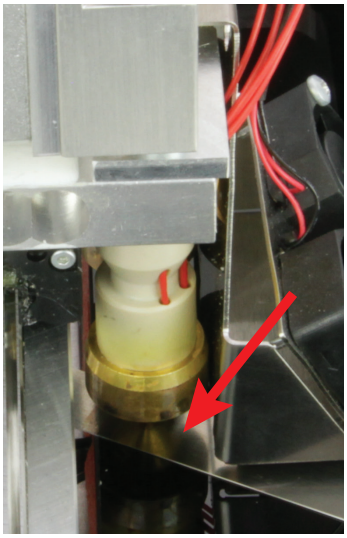
Use the direction buttons to navigate to menu item "**Home Z**".



Push **OK**, to move the heating plate to the Z-Home position.

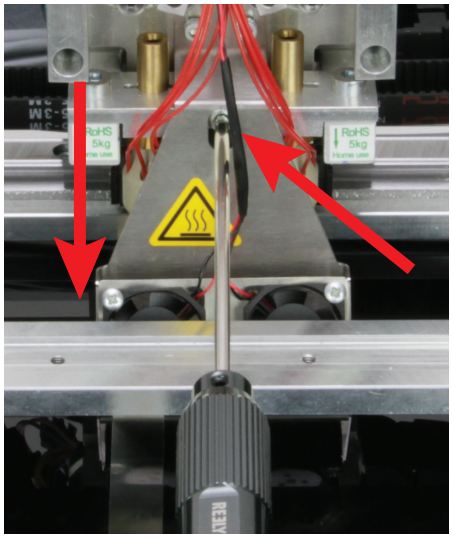
Setting the left extruder (extruder 0)



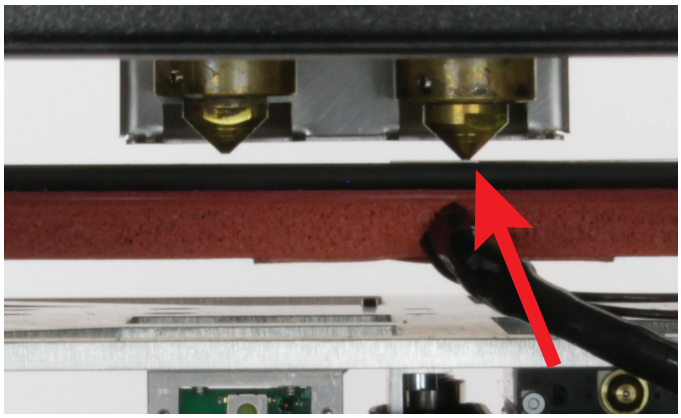


Take the strip of calibration tape (0.3 mm) (optional), or an 0.3 mm strip of a feeler gauge and push it carefully between the left extruder and the heating plate.

Observe that the left figure has been recorded from the rear view. Therefore, extruder 0 is the right one here.



Hold the right, cold extruder, e.g., with a flat-head screwdriver and carefully release the screw of the extruder holder in the middle of the fan sheet.
If you have a feeler gauge at hand, you can place a strip at 0.6 to 1.0 mm under the right extruder, depending on what fits under it easily.



Before you tighten the screw of the extruders again, the left extruder must be loosely supported on the calibration strip (0.3 mm) and the right extruder must be at the very top if possible (stop extruder holder). Then tighten the middle screw of the screw of the extruder holder again and remove the calibration strips.
Switch off the heater of the two extruders and the heating plate and let them both cool off.

Observe that the figure has been recorded from the rear view. Therefore, extruder 0 is the right one here.

Attention! Never touch the hot extruder or the heating plate during the settings! There is a danger of burns!

No force must be applied to the heating plates, since otherwise the glass ceramics would break otherwise (loss of warranty/ guarantee). The position of the heating plate may change by this as well.

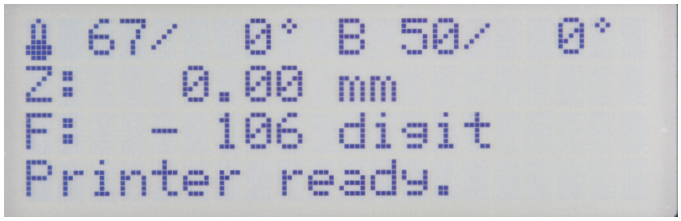
→ Once this setting and a subsequent head bed scan have been performed successfully, the repetier host software can be used to determine the proper position of the smallest distance.

For this, observe chapter "19. a) Determining the Highest Position of the Heating Plate".

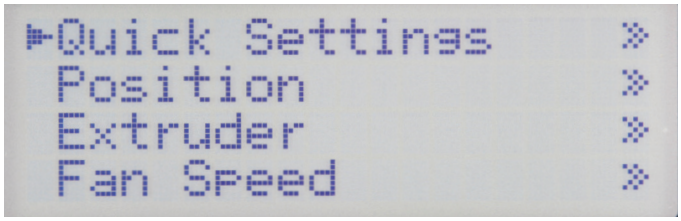
c) Executing the Head Bed Scan for PLA or ABS

⟶ The text under the respective figure describes which buttons must be pushed or what must be set when this display is shown.

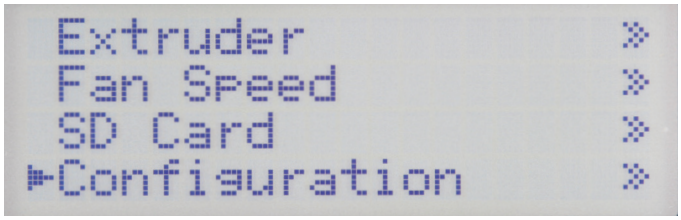
Start of the heat bed scan



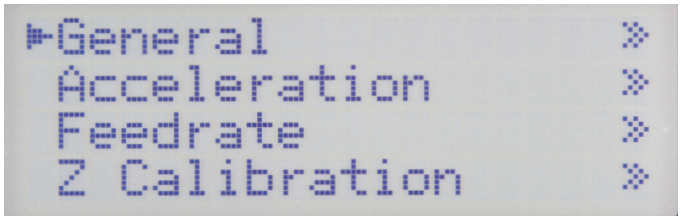
Push **OK** (2) in the main menu.



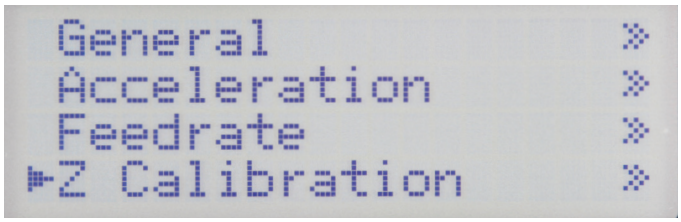
Use the direction buttons (1) to move to the menu item "**Configuration**".



Push **OK**.

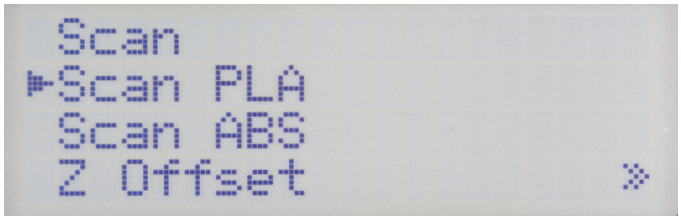


Select "**Z Calibration**" with the direction buttons.

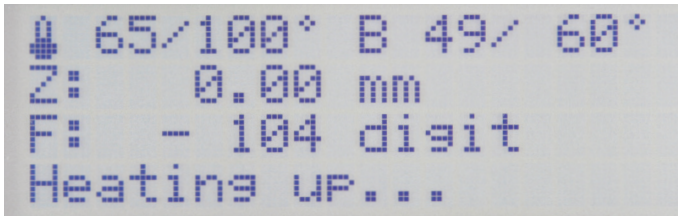


Push **OK**.

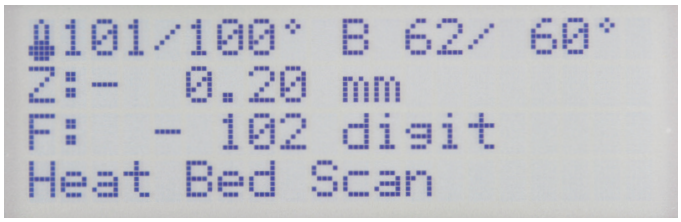
Use the direction buttons to move to the menu item "**Scan PLA**" or "**Scan ABS**" (depending on what materials you want to perform the scan for).



Push **OK** to start the selected scan.
Push the direction button "**left**" 2 x to return to the main menu.

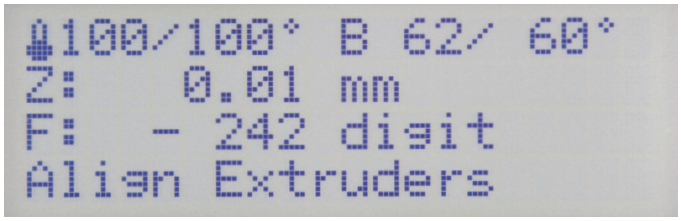


The printer now heats up the heat bed and both extruders automatically (heat bed PLA = 60 °C, ABS = 120 °C; both extruders PLA = 100 °C, ABS = 100 °C).
When the temperatures have been reached, the printer will wait for 10 minutes to ensure that the extruder and the head bed are heated through entirely.



Then the heat bed scan starts automatically.

Align the right extruder and determine the current distance between the nozzle and heating plate at printing temperature.



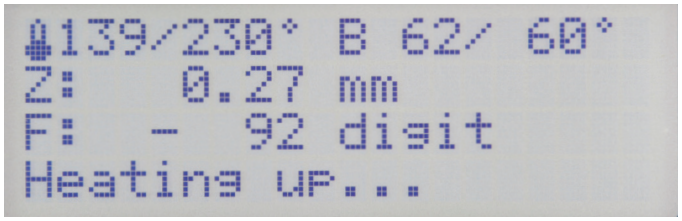
After the measurement has been performed, the heating plate and the extruder carriage return to their home positions and then immediately move to the middle of the heating plate.
The display shows "**Align Extruders**".
This means that the second extruder must be aligned now.

Loosen the screw at the extruder holder and carefully let the second extruder (extruder 1) down onto the heating plate. The two extruders should be supported equally well.

Then tighten the screw at the extruder holder again.

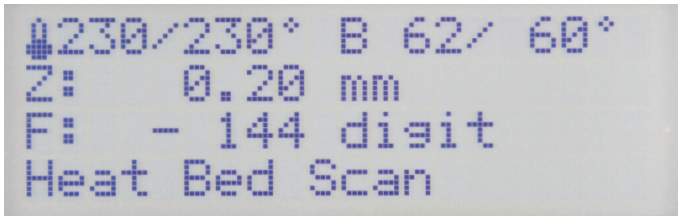
Push the button "**Play**" (5) to continue the heat bed scan.

Attention! Never touch the hot extruder or the heating plate during the settings! There is a danger of burns!



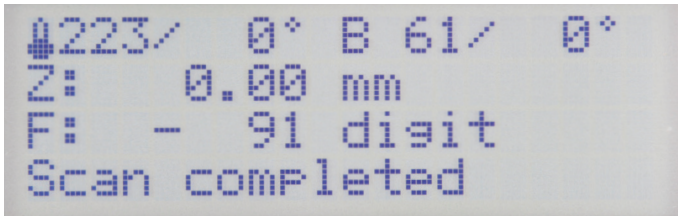
The printer moves to the home position with its Z-axis. The printing table is lowered a little.
Directly after this, it automatically heats up the extruders to printing temperature. The temperature depends on which scan you performed (PLA = 230 °C, ABS = 260 °C).
The temperature of the heat bed remains at the temperature already set (PLA = 60 °C, ABS = 120 °C).

When the temperature has been reached, the printer will wait for 10 minutes to ensure that the extruders are heated through entirely.



Then the printer will determine the current distance between the nozzle and heating plate at printing temperature.
This will be saved and automatically accepted for all printouts.
Usually, the Z-offset value no longer needs to be set.

Finally, the printer moves all axes to their home positions and switches off the heaters of the extruders and the heat bed.



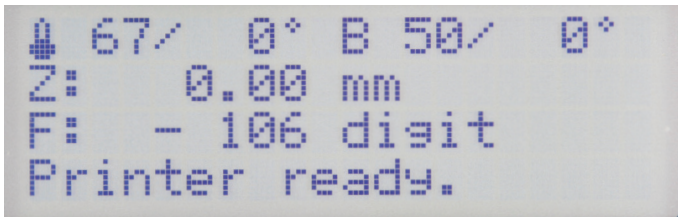
When "**Scan completed**" is displayed in the status bar, the scan is complete.

If the display shows "**Scan aborted**" at any time, this means that measurement has been aborted.
In this case, observe chapter "22. Troubleshooting".

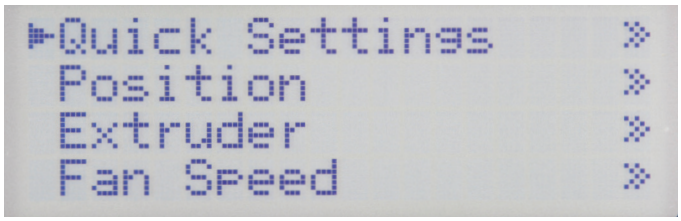
d) Executing the Quick Head Bed Scan

→ The text under the respective figure describes which buttons must be pushed or what must be set when this display is shown.

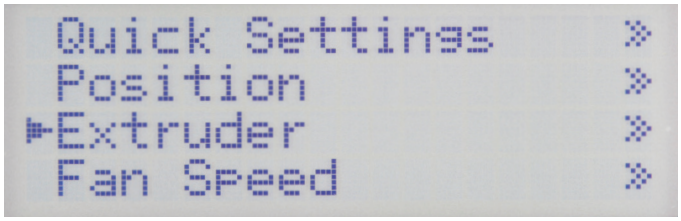
Heating up the heat bed and the extruders



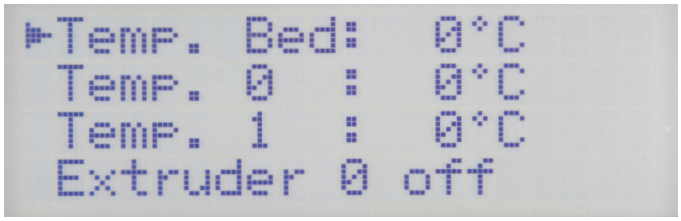
Push **OK** (2) in the main menu.



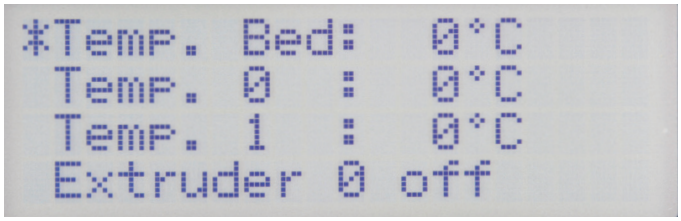
Select "**Extruder**" with the direction buttons (1).



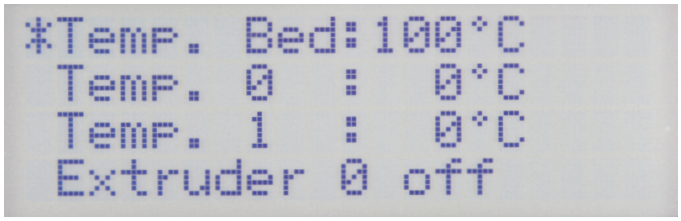
Push **OK**.



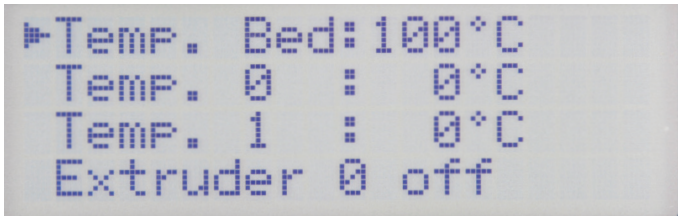
Push **OK** to select "**Temp. Bed**".



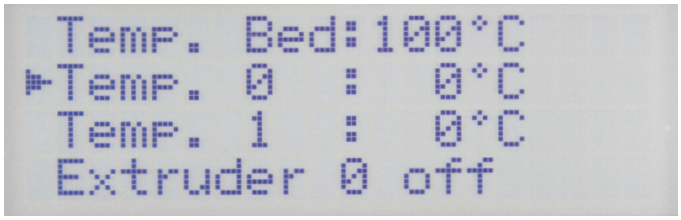
Set "**100 °C**" with the direction buttons.



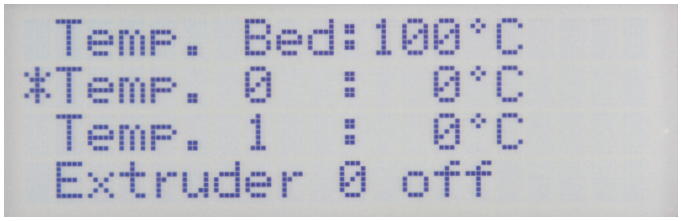
Push **OK**.



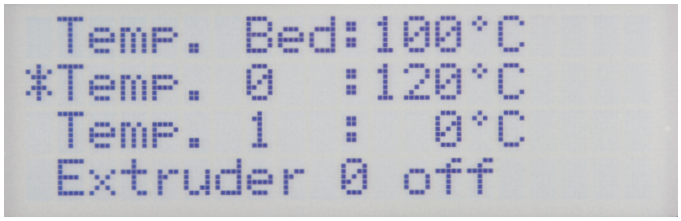
Select "**Temp. 0**" with the direction buttons.



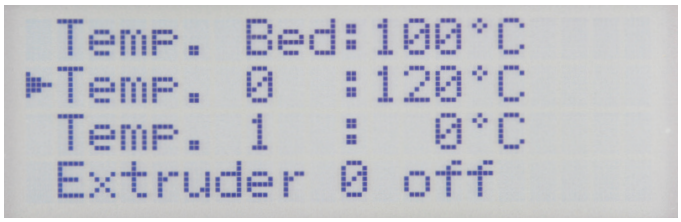
Push **OK**.



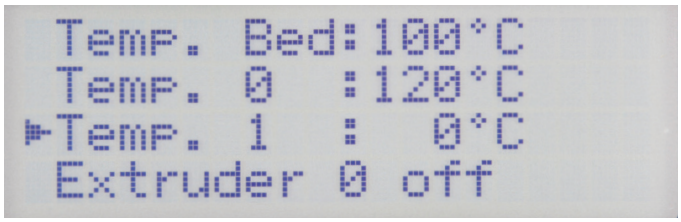
Set "**120 °C**" with the direction buttons.



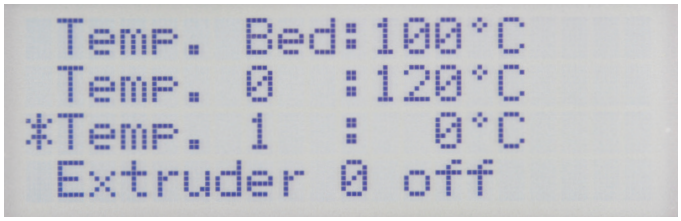
Push **OK**.



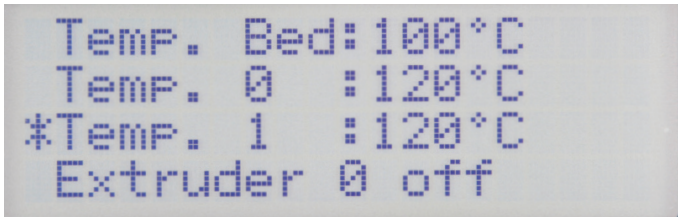
Select "**Temp. 1**" with the direction buttons.



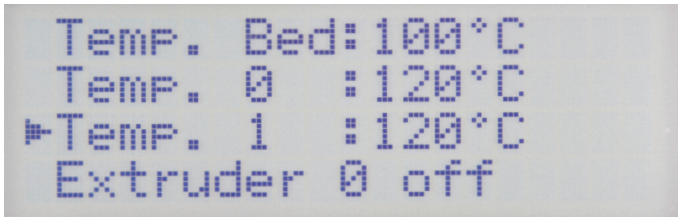
Push **OK**.



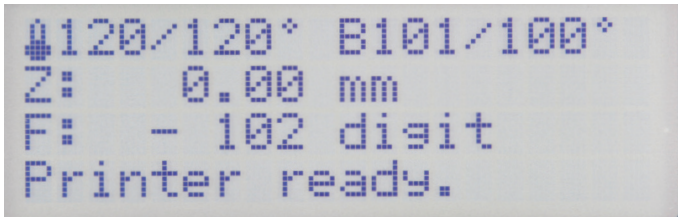
Set "**120 °C**" with the direction buttons.



Push **OK**.

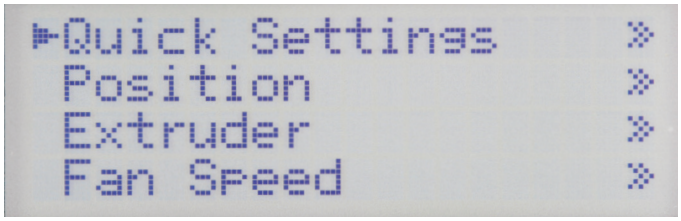


Push the direction button "**left**" 2 x to return to the main menu.

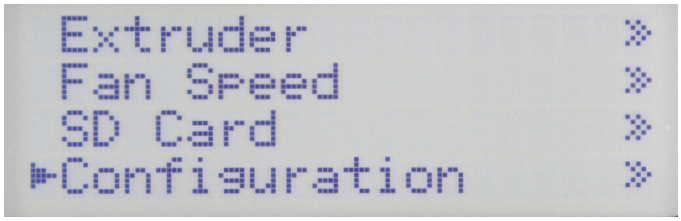


Wait until the actual temperature of the extruders in the display is 120 °C and the actual temperature of the heating plate is 100 °C. Then let them heat up for at least another 10 minutes until the heating plate temperature has stabilised and it is entirely heated through and the extruder has completely expanded.
Then push **OK**.

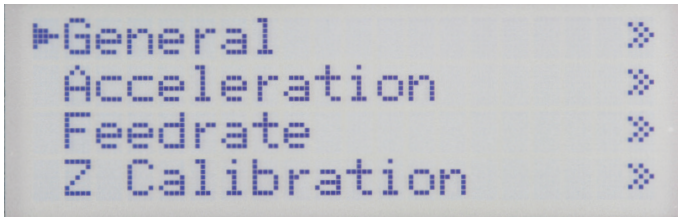
Start of the heat bed scan



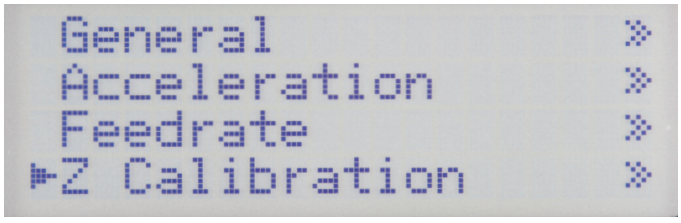
Use the direction buttons to move to the menu item "**Configuration**".



Push **OK**.

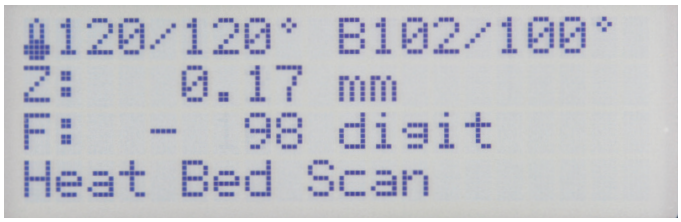


Select "**Z Calibration**" with the direction buttons.



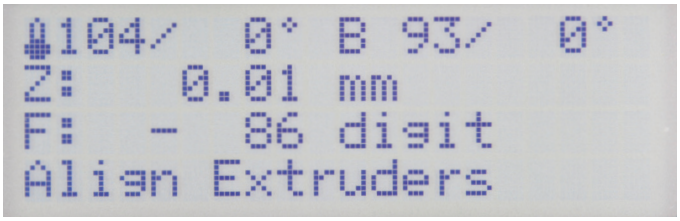
Push **OK**.

Push **OK** to select "**Scan**".
Push the direction button "**left**" 3 x to return to the main menu.



The status display of the main menu shows "**Heat Bed Scan**". The geometry of the heating plate is now measured automatically. This process will take a while.

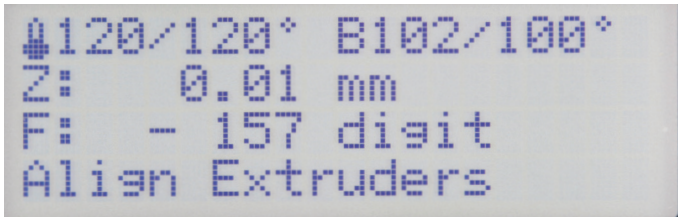
Aligning the right extruder



After the measurement has been performed, the heating plate and the extruder carriage return to their home positions and then immediately move to the middle of the heating plate.
The heating of the extruders and the heating plate is switched off automatically.
The display shows "**Align Extruders**".
This means that the second extruder must be aligned now.

Heat up the heating plate to 100 °C again and the two extruders to 120 °C. Proceed as described in this chapter, in item "Heating up the heat bed and the extruders".

Wait for at least 10 minutes when the set temperatures are reached.



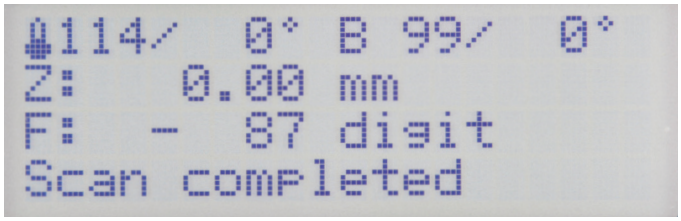
The extruder 0 should now be supported entirely on the heating plate.

Loosen the screw at the extruder holder and carefully let the second extruder (extruder 1) down onto the heating plate. The two extruders should be supported equally well.

Then tighten the screw at the extruder holder again.

Press the button "**Play**" (6) to terminate Heat Bed Scan.

Attention! Never touch the hot extruder or the heating plate during the settings! There is a danger of burns!

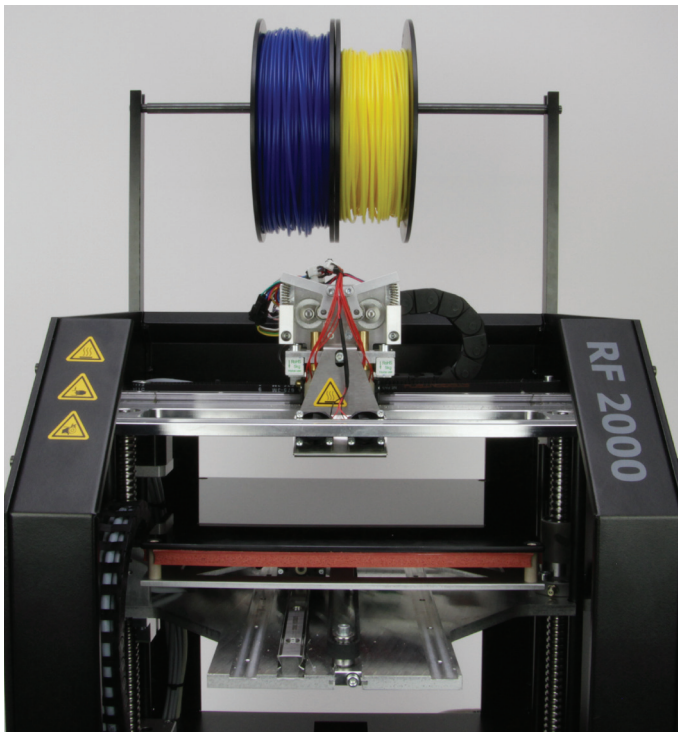


When "**Scan completed**" is displayed in the status bar, the scan is complete and the values are saved.

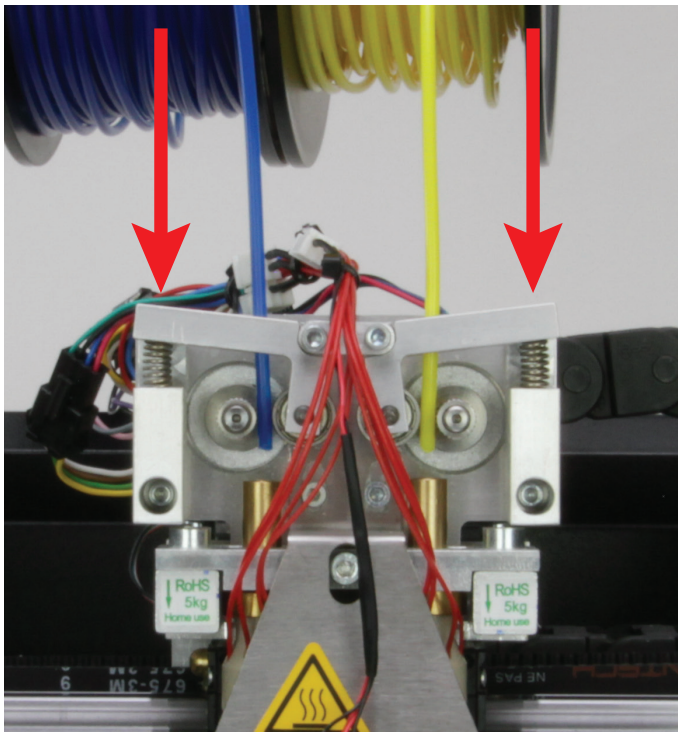
If the display shows "**Scan aborted**", this means that measurement has been aborted.
In this case, observe chapter "22. Troubleshooting".

15. Inserting, Removing and Changing the Filament

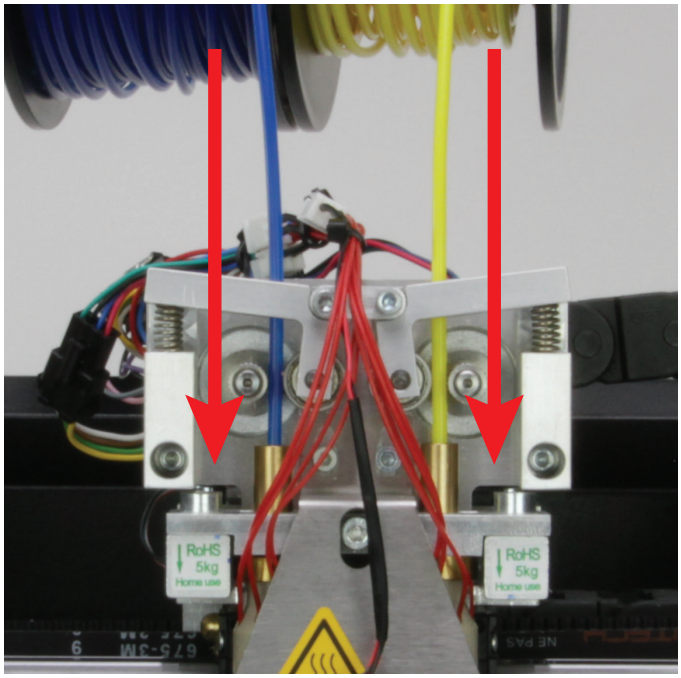
a) Inserting the Filament - Mechanical Part



Push the filament rolls on the shaft of the filament holder. The filament rolls must move freely.



Push the ball bearing holder on the outside and insert the filament through the ball bearing holder.



Insert the filament past the feed motor into the extruder to the stop. The filament must be guided in a straight line from the top between the feed motor and the ball bearing into the bore at the extruder. It must be possible for the feed motor to turn without slippage or catching when pulling or pushing at the filament.

Then, if you have not done so yet, switch on the printer and move the printing plate down manually with the "down" (3) arrow, so that the filament can exit well.

b) Inserting the Filament via the Printer Menu

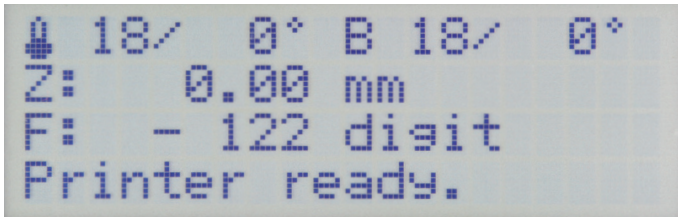
Before inserting, removing or changing the filament, the corresponding extruder must be heated up so that the filament can be inserted into or removed from the extruder cleanly.

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

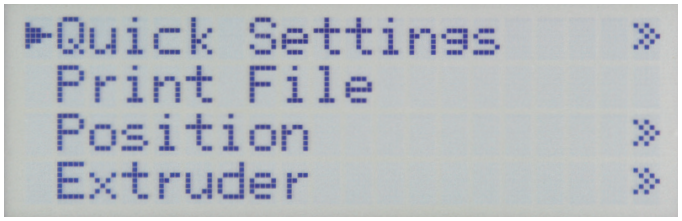
Always wait for the eextruder temperature to be reached at filament change and let the extruder heat for approx. another minute, since the extruder may break otherwise.

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

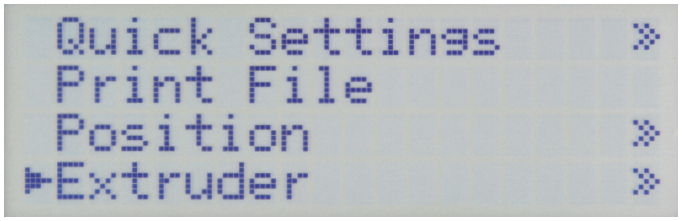
Left extruder (extruder 0)



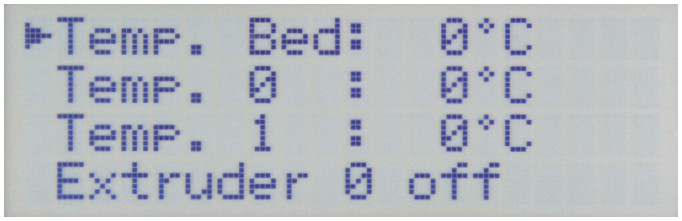
Push **OK** (2) from the main menu.



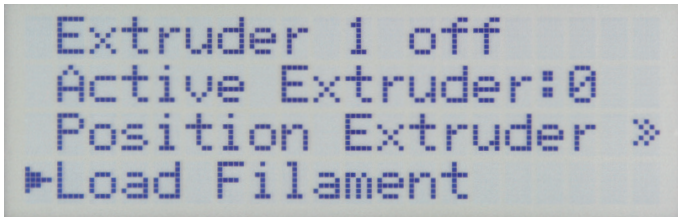
Select "**Extruder**" with the direction buttons (1).



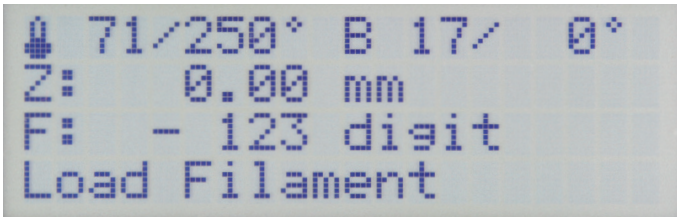
Push **OK**.



Move to "**Load Filament**" with the direction buttons.



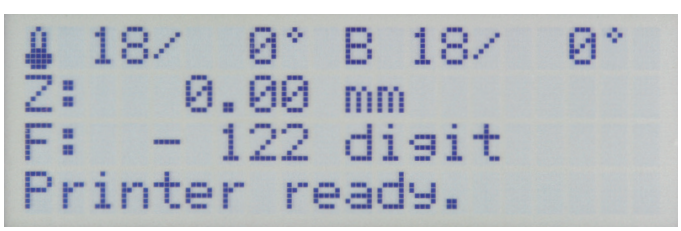
Push **OK**.
Important! The menu item "**Active Extruder**" must show "**0**". Only then is the left extruder chosen as the active one.



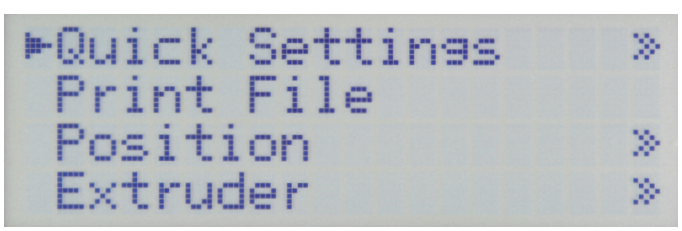
The printer will now automatically heat up the active extruder (after activation, this always is extruder 0, i.e. the left one). When it has reached the pre-set target temperature, the filament will be pulled in. The process is automatically ended after some time and the extruder heater is switched off.

Right extruder (extruder 1)

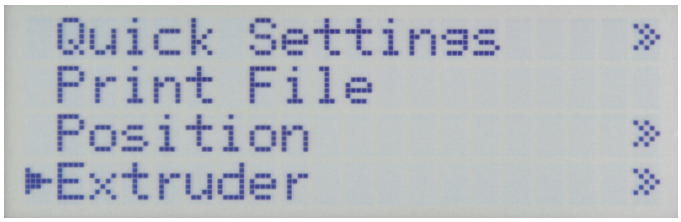
→ The path described below for inserting the filament is an alternative to the preceding path. Of course, you can insert the filament in both extruders either way.



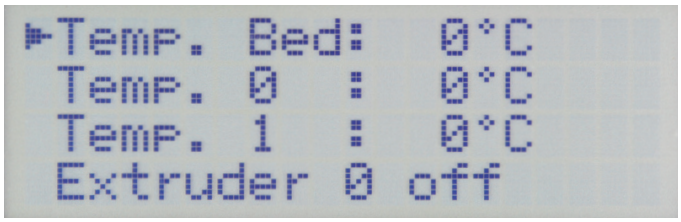
Push **OK** from the main menu.



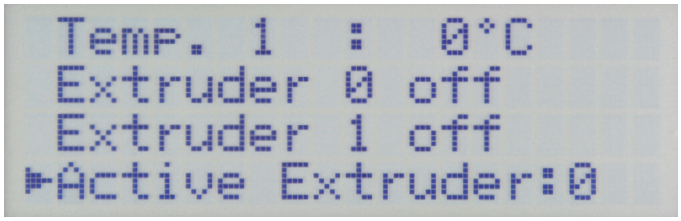
Select "**Extruder**" with the direction buttons.



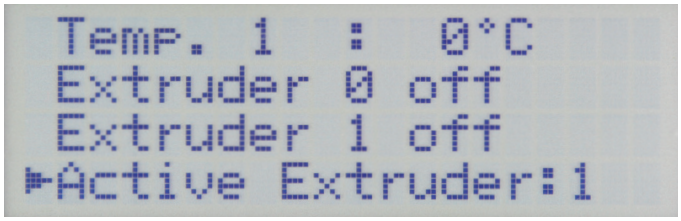
Push **OK**.



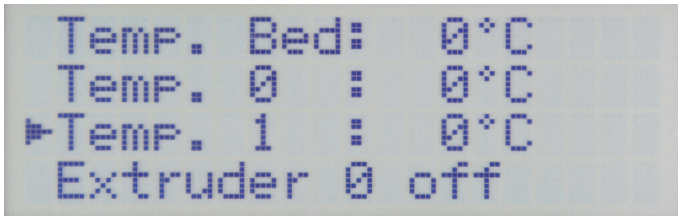
Move to "**Active Extruder**" with the direction buttons.



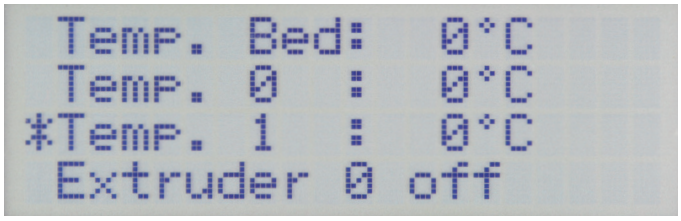
Push **OK**. Then the 2nd extruder is chosen as the active one (extruder 1).



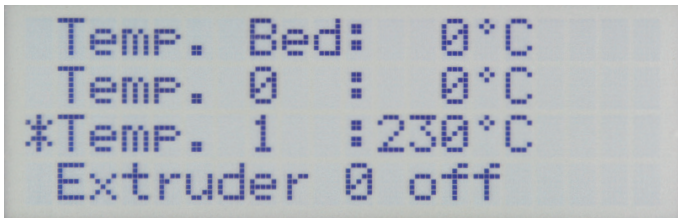
Use the direction buttons to move to the menu item "**Temp. 1**".



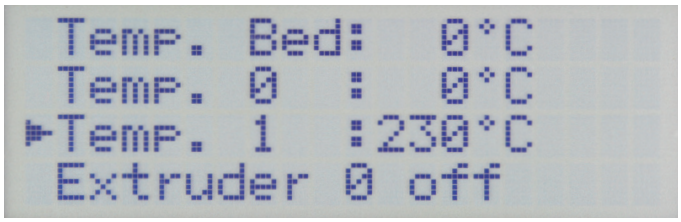
Push **OK**.



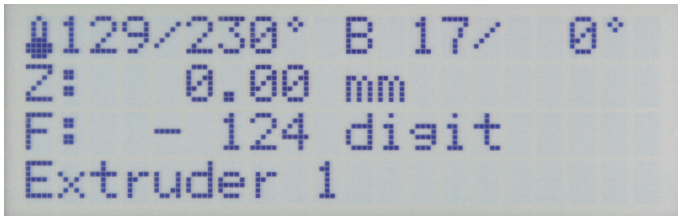
Use the direction buttons to set "**200 - 230 °C**" (e.g. for PLA).



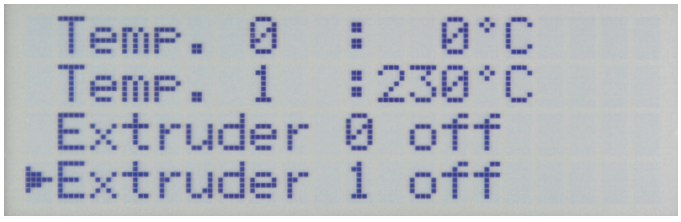
Push **OK**.



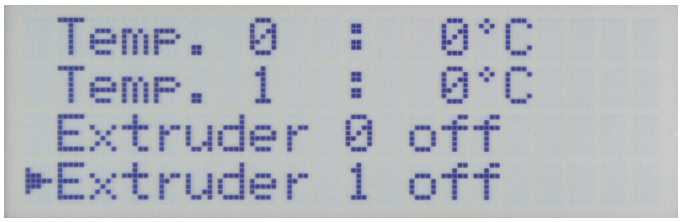
Push the direction button "**left**" 2 x to return to the main menu.



Wait until the extruder is completely heated.
Then use the button "**Filament feed +**" (4) to insert and extrude the filament.



When the filament is inserted, switch back to the menu "**Extruder**" and move to the menu item "**Extruder 1 off**".
Then push **OK**, to switch off the extruder heater.



The filament is now inserted.
Push the direction button "**left**" 2 x to return to the main menu.
Important! For the 2nd extruder, always choose extruder 1 as the active one. Then you can also perform insertion with the function "**Load Filament**".

c) Removing and Changing the Filament

⟶ **Hold the filament when it moves out of the extruder. 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. However, instead of "**Load Filament**", choose "**Unload Filament**" in the menu "**Extruder**".

The active extruder is heated up automatically. Then the filament is removed from the extruder after a short waiting period.

Of course, you can do this manually. For this, use the button "**Filament feed -**" (4) after the extruder is heated up.

Changing the filament

Proceed in the same manner when changing the filament. Remove the filament ("**Unload Filament**") and then insert the new filament ("**Load Filament**").

If you perform this process manually, you can insert the new filament at once after removal.

⟶ No matter if you use the function "**Load Filament**" or insert the filament with the infeed buttons, always observe that the outflow of the filament from the nozzle and the press-on pressure of the ball bearing holder must be the same in both extruders.

16. 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 printing with PLA filament, cover the heating plate with cleaning tape or a slightly structured crepe tape. You can purchase a special adhesive tape that has been developed for precisely this purpose. Alternatively, you can also use hair spray or a special glue stick.

You can find the print files on the enclosed SD card in the folder GCODE. The finished print data are saved in folder "PLA".

Important! If you have no experience with ABS yet, we urgently recommend printing with PLA first and to familiarise yourself with the settings that may lead to different results.

→ **Before starting, update the enclosed memory card if you have not done so yet. The corresponding download can be found on the respective product page of our website or in the download area.**

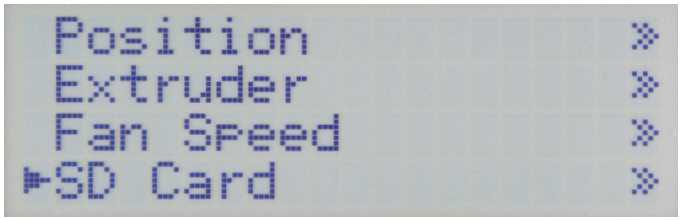
In our example, we print a single-coloured object in single extruder mode. This means that only the active extruder, which is usually the left one (extruder 0), is used. If you want to print with the right extruder instead, select the item "**Active Extruder**" with the button OK in menu "**Extruder**" to switch the active extruder from 0 to 1.

According to your selection, a filament, preferably PLA, must be inserted in the active extruder.

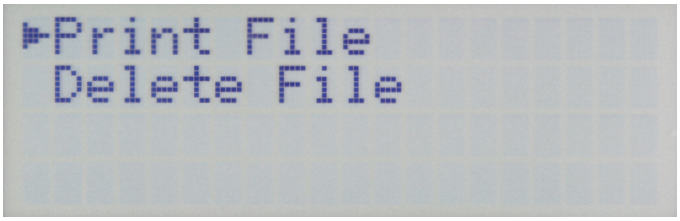
Push the enclosed SD card into the SD card reader at the right of the 3D printer.

→ **Important! The contacts of the memory card must point to the printer and upwards when inserting! When the cart is pushed entirely into the slot, it will latch. Just push the card again for removal!**

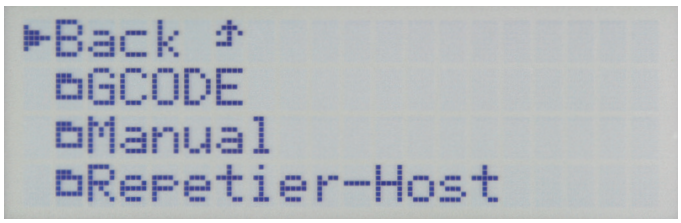
The card is detected automatically after plugging in. Before removal, switch to the main menu. Of course, you must not print from the memory card right then.



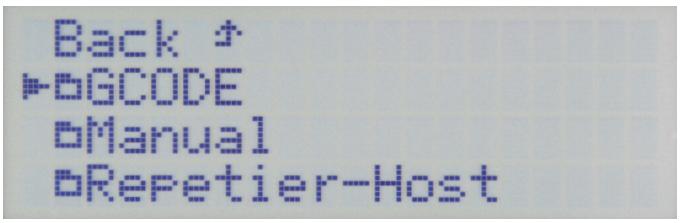
Push **OK** (2) in the main menu and select (1) "**SD-Card**" with the direction buttons. Push **OK** again.



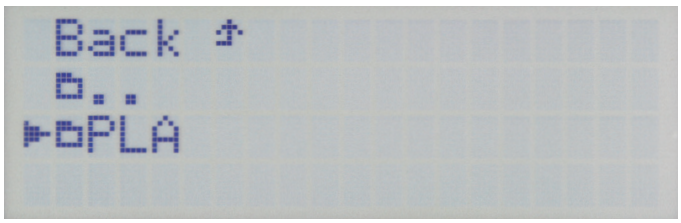
Select "**Print file**" and confirm with **OK**.



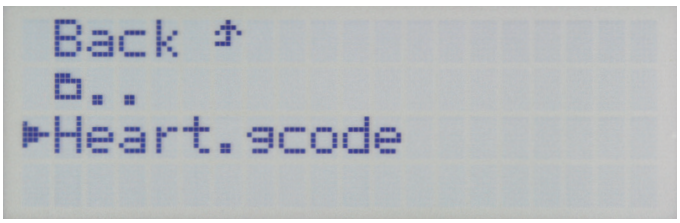
Select the folder "**GCODE**" in the folder structure of the SD card with the direction buttons.



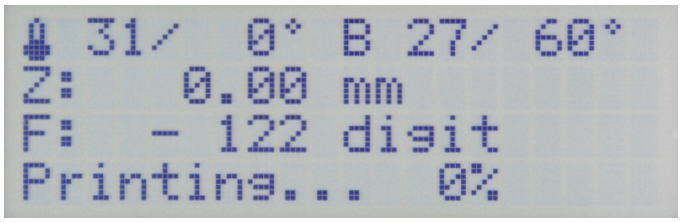
Confirm with **OK** and navigate to the sub-folder "**PLA**".



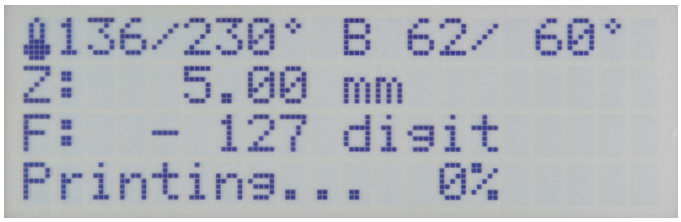
Confirm with **OK** and use the direction buttons to move to the file "**Heart.gcode**". If necessary, open the folder "**Heart**" first.



Confirm again with **OK**. The display switches back to the main menu.



The heating plate is heated up first.



Then the axes move to the home position and the extruder is heated. Once the extruder has reached its operating temperature, printing starts.

→ The progress of heating of the heating plate and extruder can be tracked based on the temperature displays in the upper display line.

The printing progress can be tracked in the lower status display.

During the first centimetres of printing, the distance between the heating plate and the extruders can be fine-adjusted manually with the buttons for heating plate movement (3). If you push the buttons for heating plate movement (3), do not keep the buttons pushed, but only tap them!

For this setting, observe that the extruders must not touch the heating plate since the heating plate and also the nozzles may be damaged otherwise (loss of warranty/guarantee).

→ If you have performed the heat bed scan for PLA (Scan PLA) or ABS (Scan ABS), the printer should already set the optimal distance between the nozzle and heating plate when printing. If you have only performed a quick head bed scan (Scan), you can adjust the distance with the item "**Z Offset**" in the menu "**Configuration**" - "**Z Calibration**".

When the automatic Z-compensation is active, the display will show "**Cmp**" next to the Z-position (5).

If no filament escapes from the extruder at first, the filament infeed button (4) must be pushed until filament escapes.

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

→ By default, the two fans at the extruder run starting at the 4th layer for PLA and ABS, provided that the slicer settings have not been changed.

Depending on the printed object, the printing result at ABS may be better without the fans, however. In that case, switch off the fans in the slicer settings.

If the two fans do not run properly, check if they may be attached unevenly.

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, a, knife, etc.

Do not apply any mechanical force to the heating plate. Danger of heating plate breaking (loss of warranty/guarantee)!

→ 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.

In the download area of the printer's product page on our website www.conrad.com, you can find a printing file "Roll holder" for download. You can install this on the filament holder to support the filament rolls.

17. 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.

Heat bed temperature

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.

ABS needs a heating bed for printing. Otherwise it will not adhere at all or only insufficiently. Here, a temperature of approx. 120 to 130 °C should be tried out.

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.

18. 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 enclosed SD card holds a custom version of the software that contains the printer settings and configuration files for the RF2000 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 can be found in our shop www.conrad.com on the product page of the printer. 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 SD-card (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®:

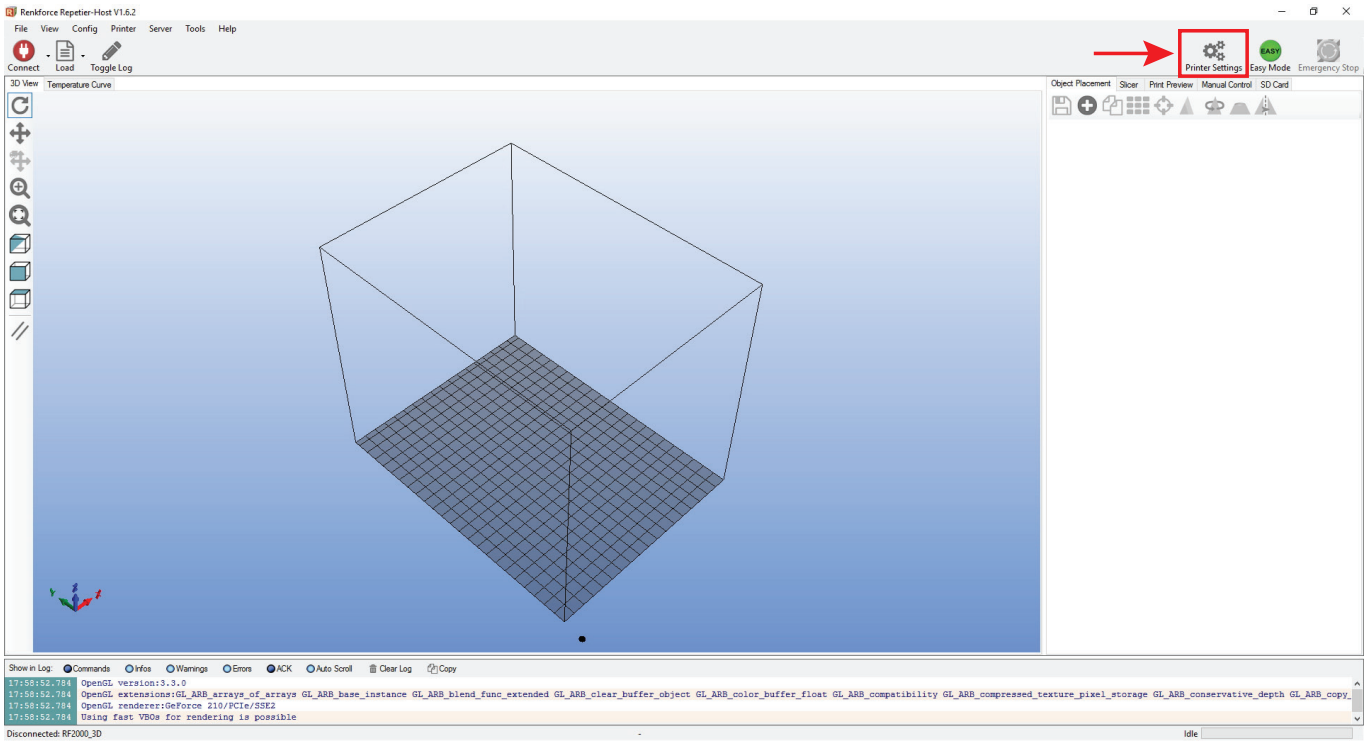
Microsoft .Net Framework 4 must be installed on the computer. This software can be downloaded free of charge from www.microsoft.com or installed subsequently in the operating system via the Windows® features.

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.



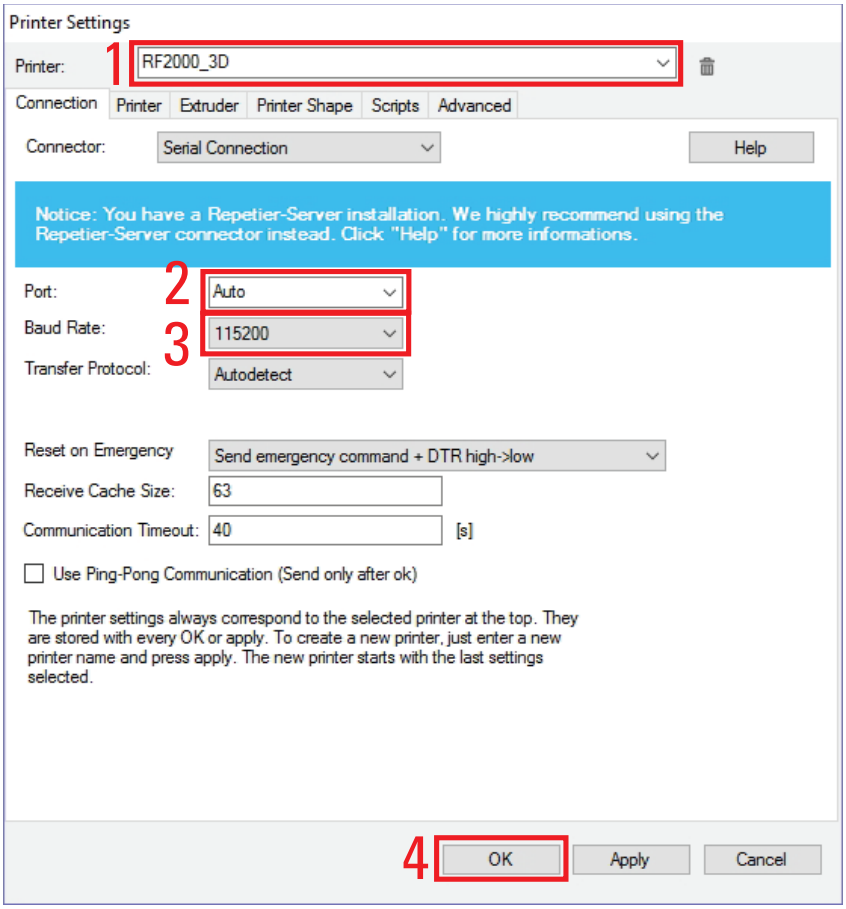
- Select the printer "**RF2000_3D**" in the menu above (1).
- Set the port and check the baud rate. If you have selected the right printer in (1), the baudrate (3) is already correctly pre-set to "**115200**".

→ 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).

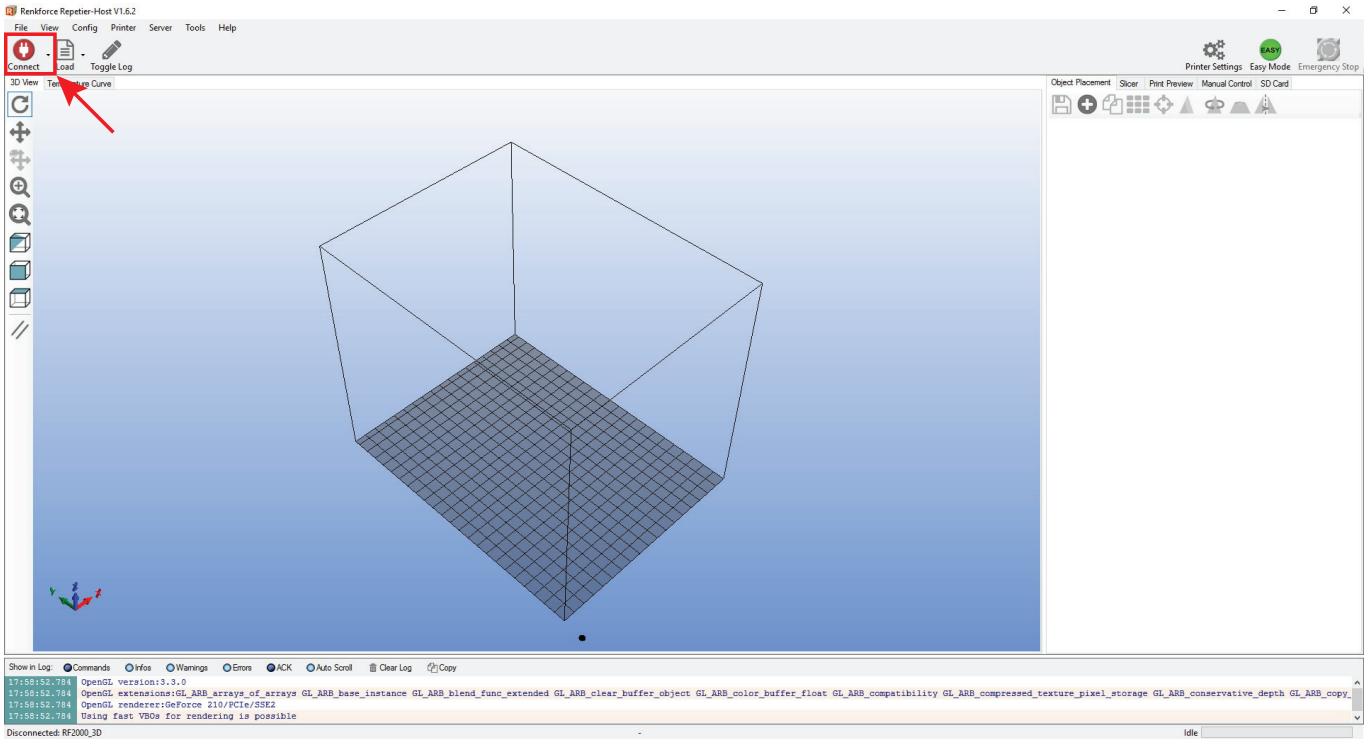
If this does not work properly for you, you can check the port in the device manager of the control panel, under connections (COM and LPT).

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

- Click "**OK**" (4).

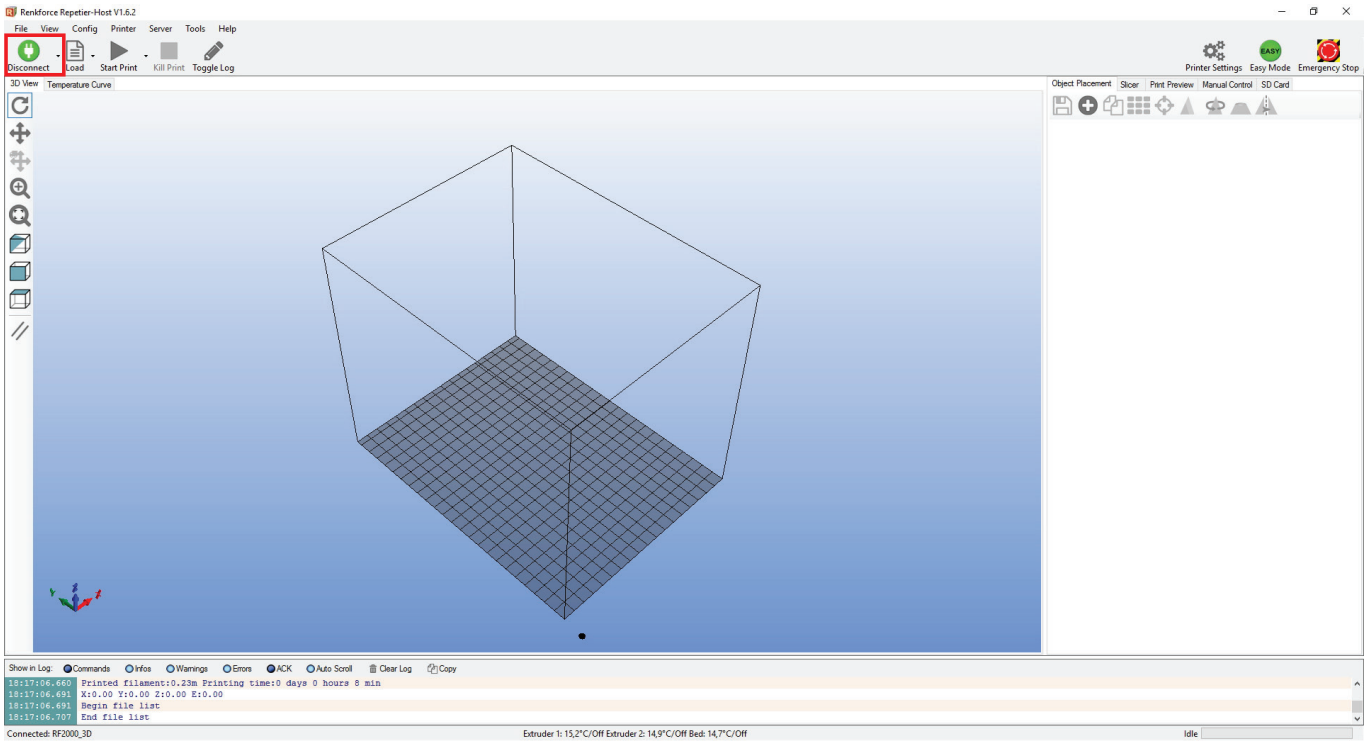


Click "**Connect**" in the upper left of the main screen of the software.



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.

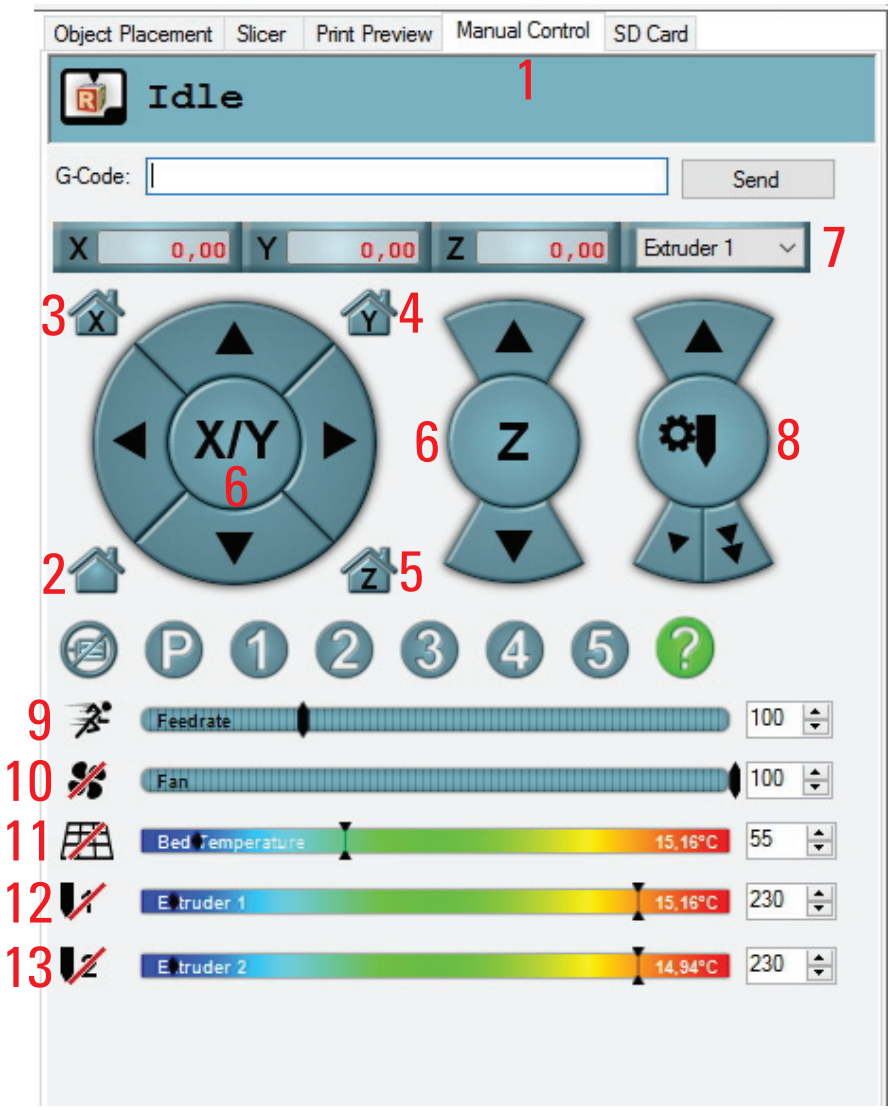


d) Manual Operation via the Software

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 finished 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

(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 heat bed on/off; To the right of this, the temperature can be set.

(12) Switching the extruder heater for the 1st extruder (the left one at the printer) on/off; To the right of this, the temperature can be set.

(13) Switching the extruder heater for the 2nd extruder (the right one at the printer) 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:

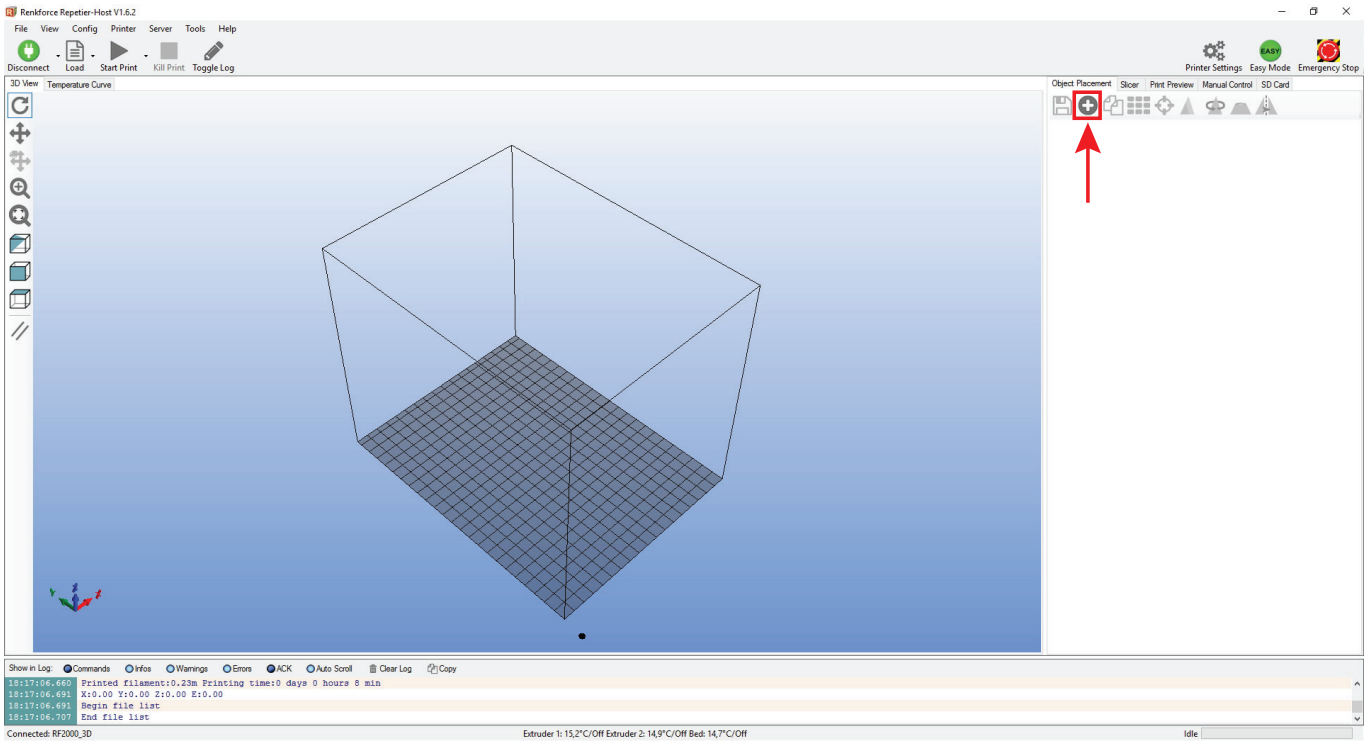
*.stl (STL-files)

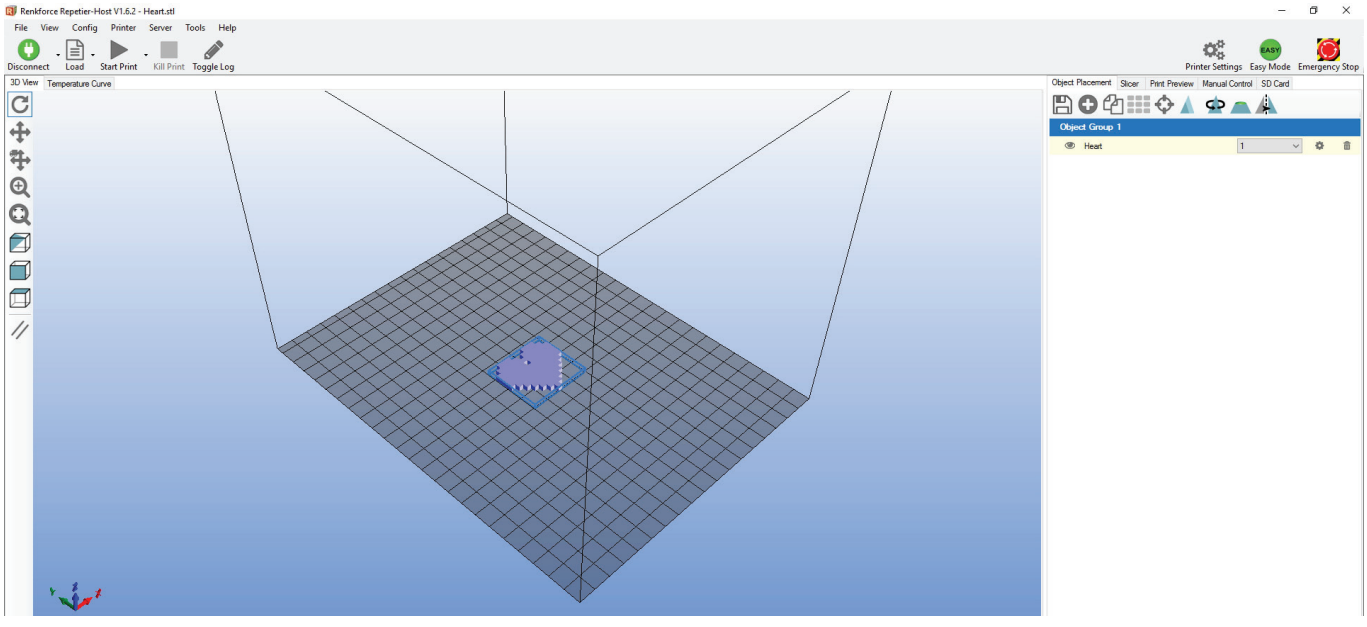
*.obj (OBJ-files)

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

In the folder "**STL**" on the enclosed SD card, 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

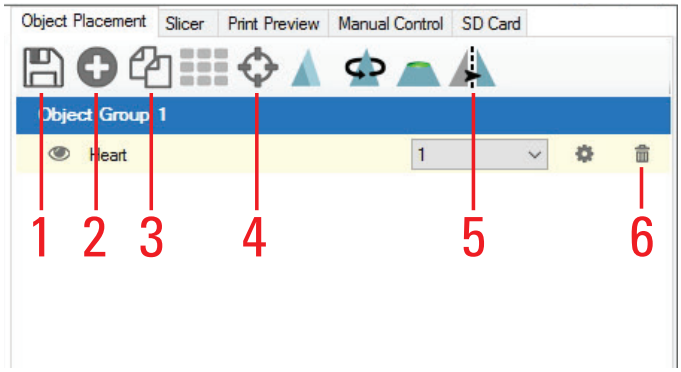
(6) Deleting the object from the printing plate

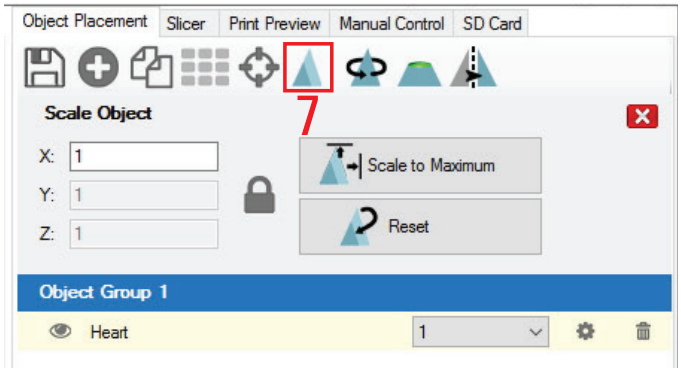
(7) Scaling the object

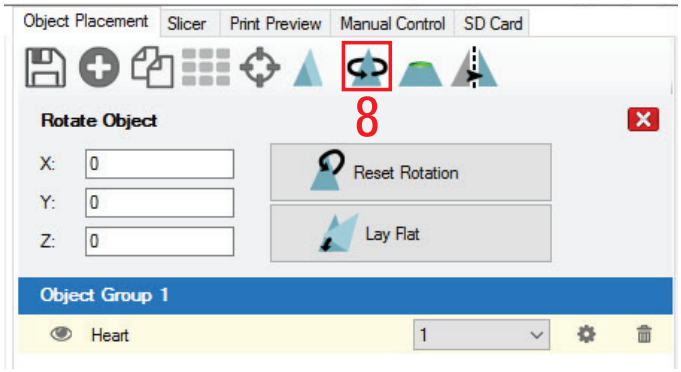
→ Use the scaling function to compensate the size retention of the printed object here as well. If it is known, e.g., that the filament material used shrinks by 2 %, set the scaling to the value 1.02 (this is an approximate reference value). After printout, you can measure the object and adjust scaling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

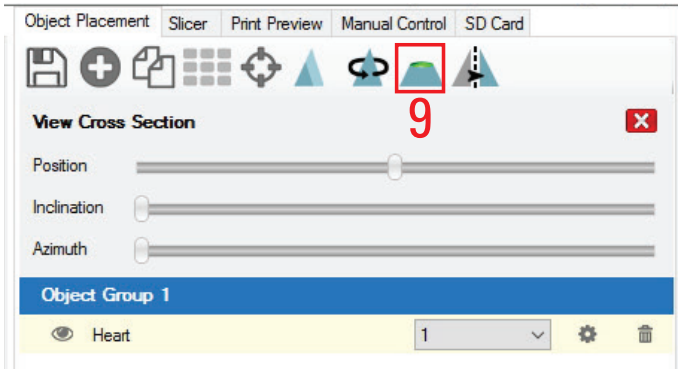
(8) Turning the object

(9) Showing the cross-section of the object





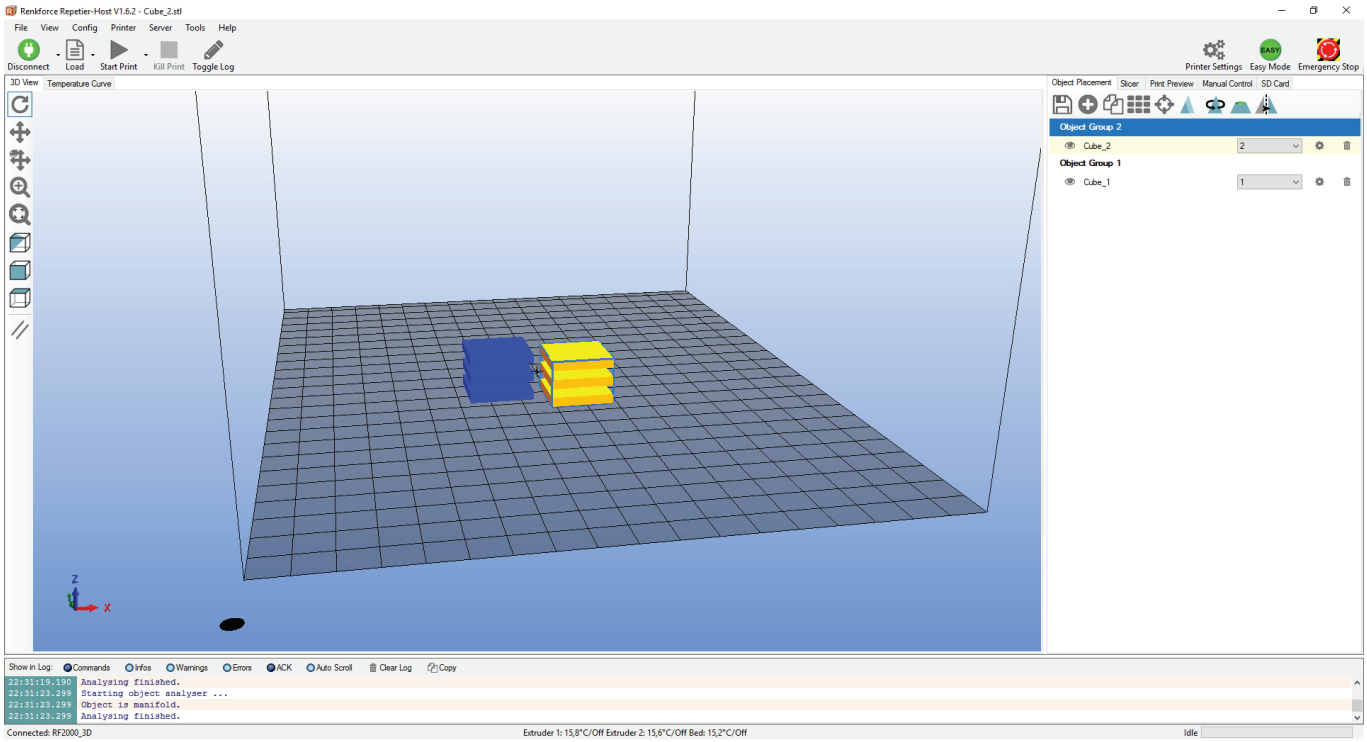




Placing the object to be printed for 2-coloured print

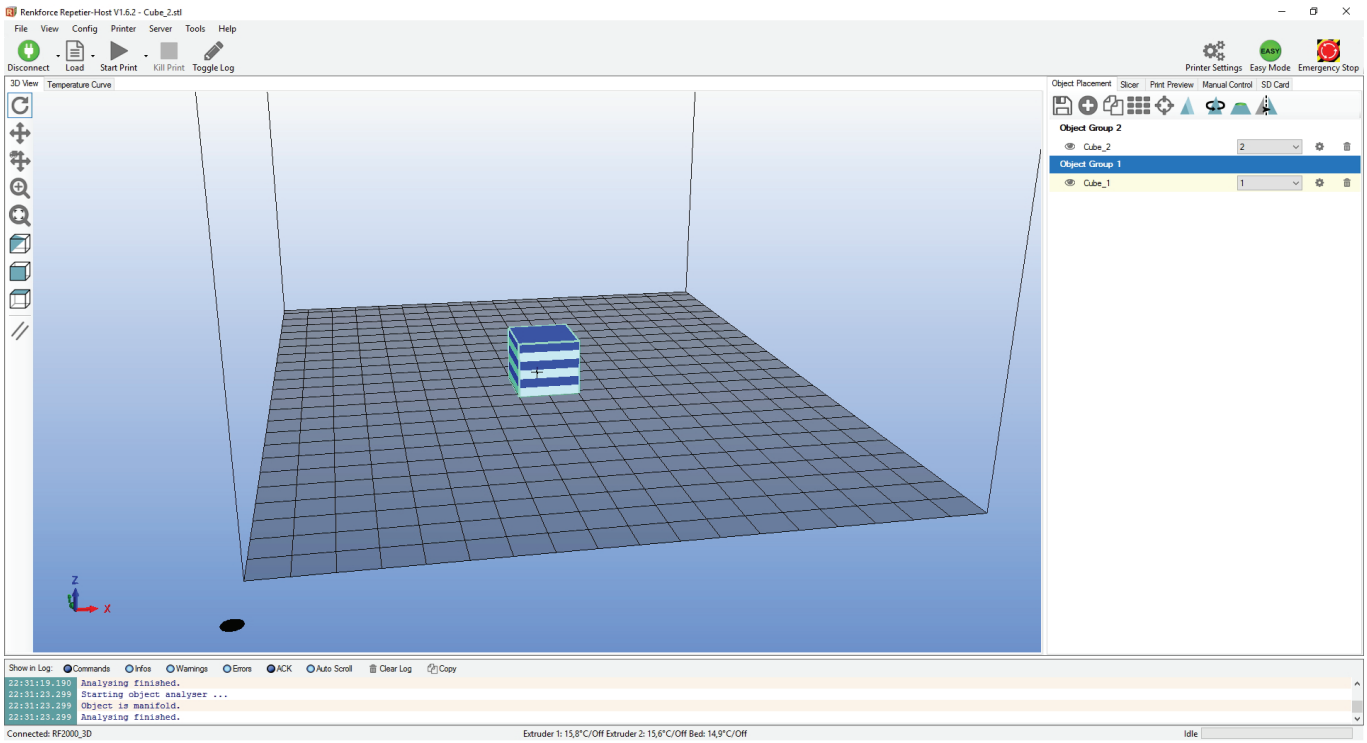
Two 3D-object files are usually used for printing a two-coloured object. The SD-card holds, e.g., a 2-coloured cube "**Cube_1.stl**" and "**Cube_2.stl**". One part is for the 1st extruder, the other part for the 2nd extruder.

Insert the first file first and then the second file in the software as described above.



Now centre the two print objects. For this, select the objects in the tab "**Object Placement**" (click the yellow beam) in sequence and then click centre (4). This will join the two parts that were previously displayed separately on the printing plate.

Then select "**Cube_2**" in our example and switch the extruder from 1 to 2 in the drop down menu.



f) Preparation for Print

To be able to print the object, it first needs to be sliced into individual printing layers or disassembled. 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_Extruder

Example: **RF2000_PLA300_200_04_S** =

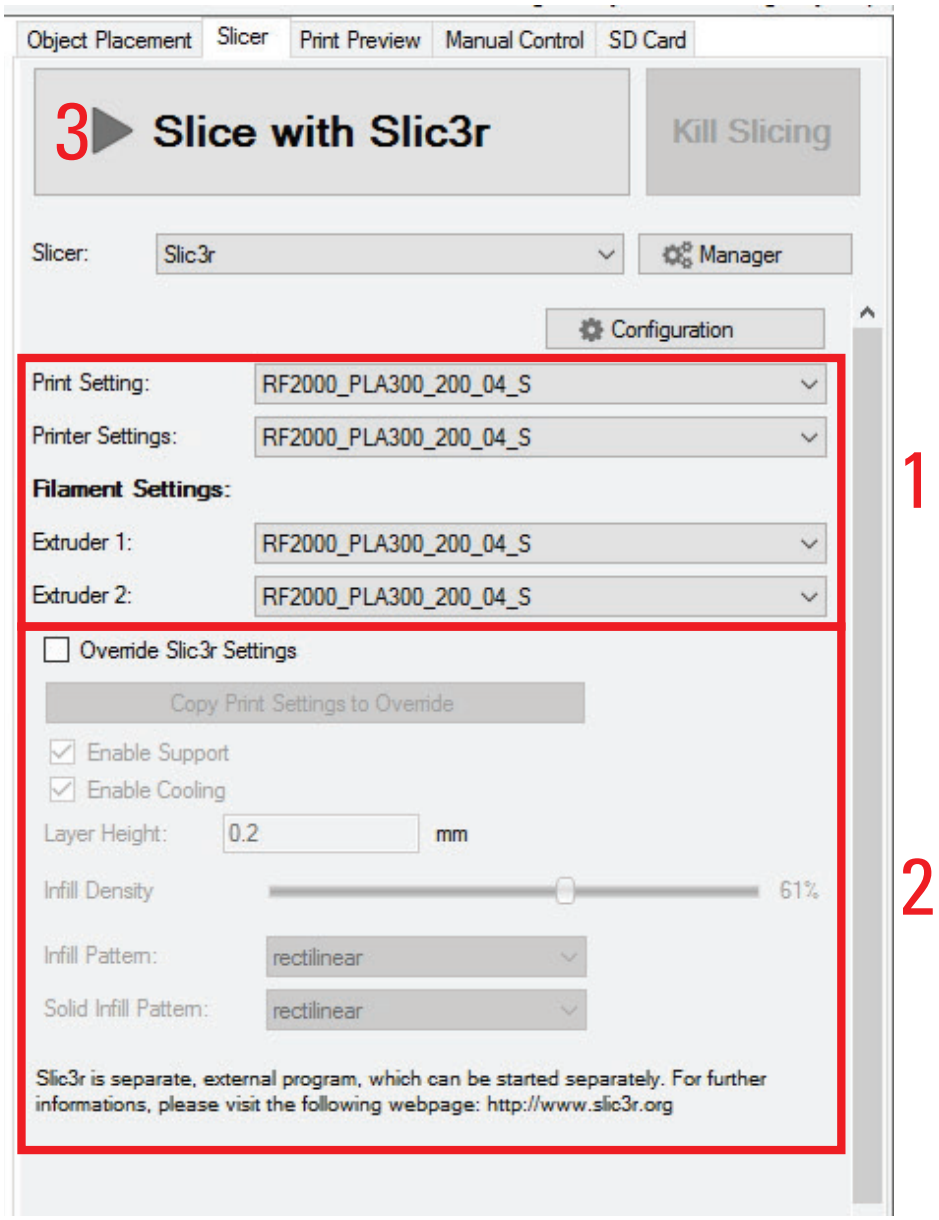
RF2000_3 mm PLA_Layer thickness 200 µm (= 0.2 mm)_Nozzle diameter 0.4 mm_Single Extruder

→ The S at the end in our example means "Single Extruder". If you want to slice and print a 2-coloured object, you need to select the settings with a D at the end here. D means "Dual Extruder".

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

(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.



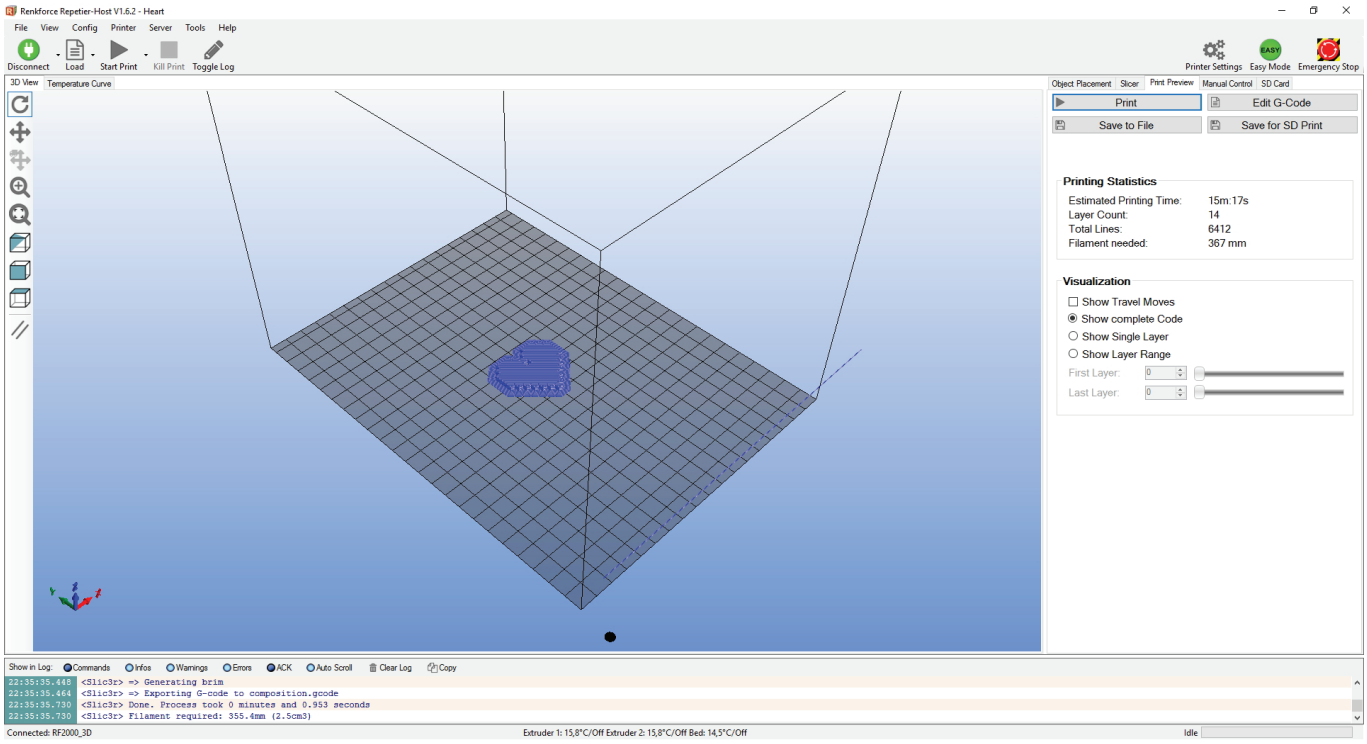
The finished printing file appears in the graphics window after calculation.

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

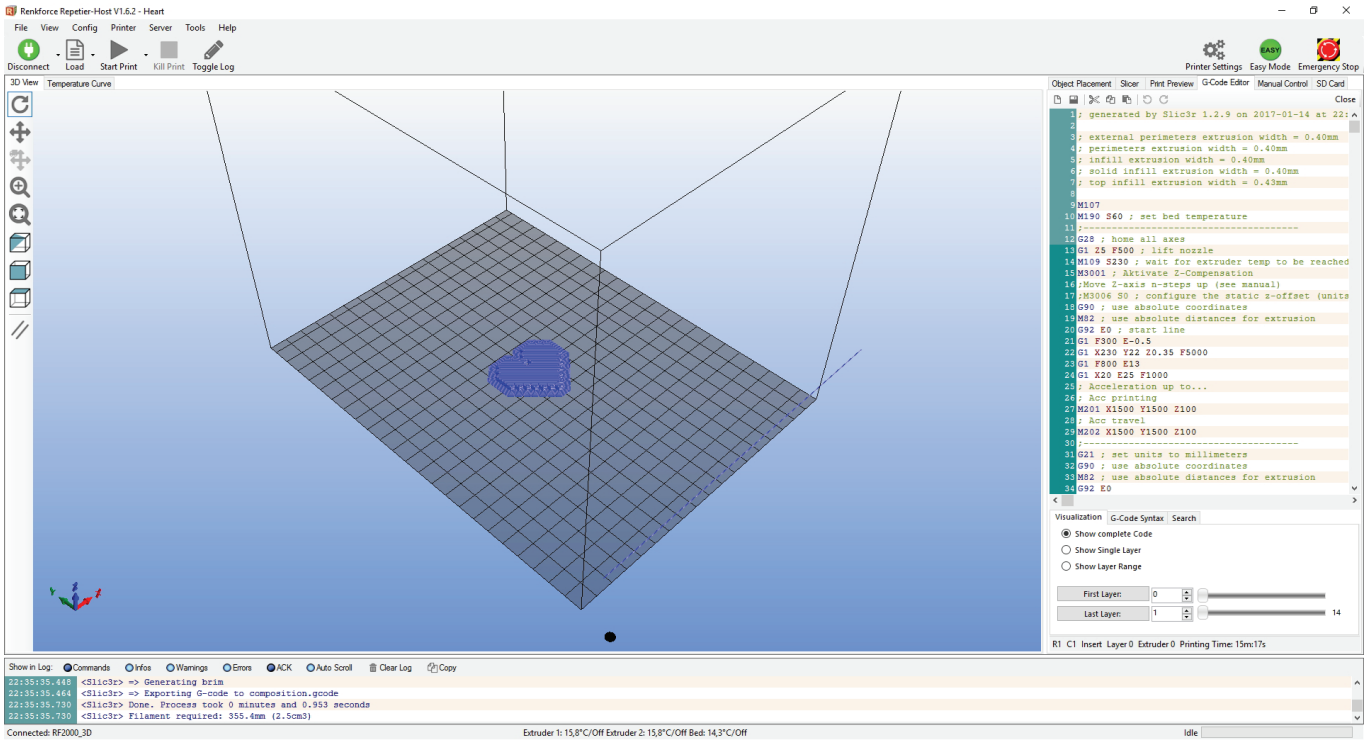
This layer view serves to check for errors before printing.

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.

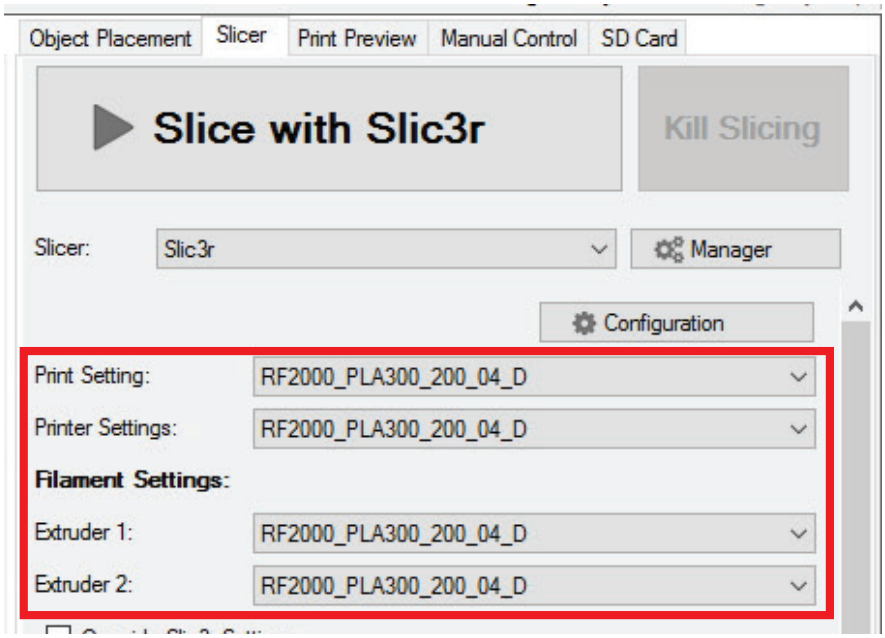


If you click "**G-code Editor**" at the upper right, the G-code editor will open and the G-code (the layer description) will be displayed. The control below can influence the layer view.

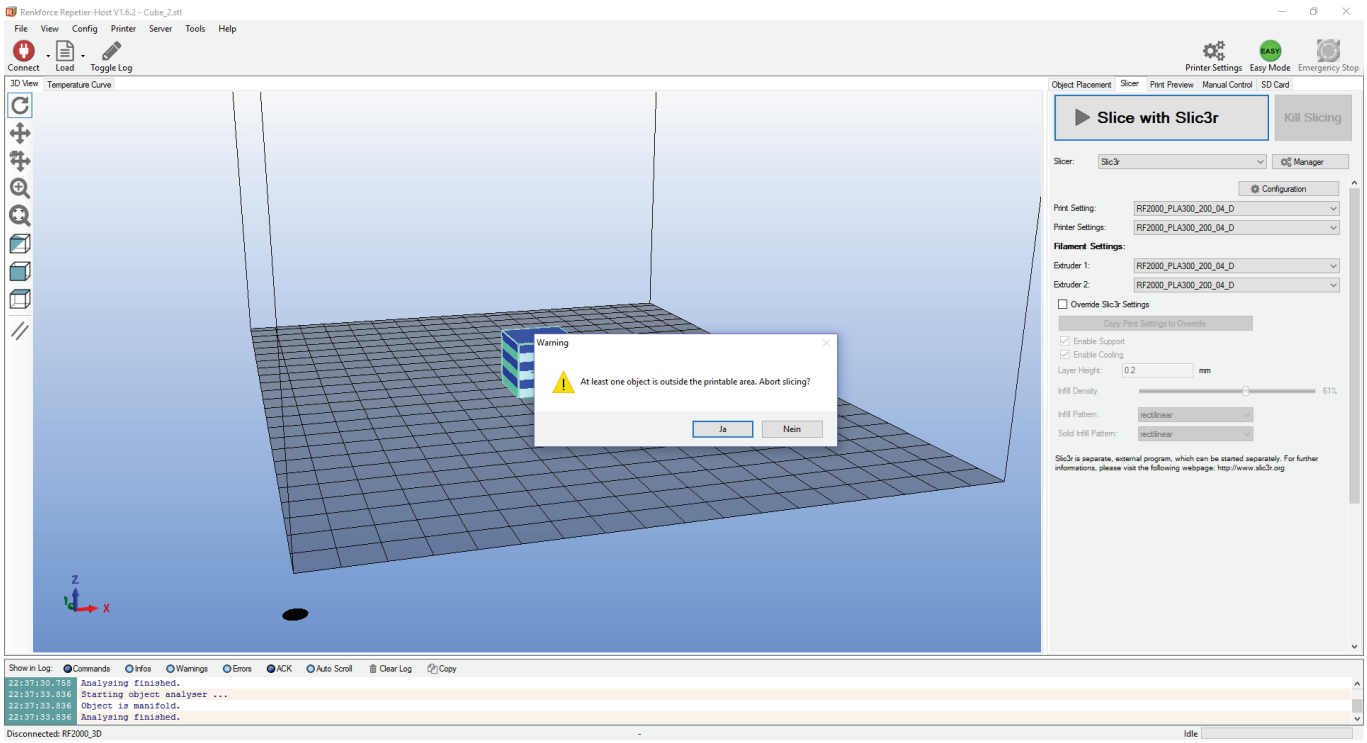


Preparation of the object to be printed for 2-coloured print

Now select the slicer settings that end with "**D**" for dual (e.g. "**RF2000_PLA300_200_04_D**").



If a message "**At least one object is outside of the printed area...**" appears when starting slicing, click "**No**" in any case.



→ This cube is also very suitable for setting the extruder offset for X and Y. You can find the functions "**Extruder Offset X**" and "**Extruder Offset Y**" in the menu, under "**Configuration**" - "**General**".

This setting corrects the distances of the two extruders. X corrects the distance between the two extruders, i.e. when the printed object is offset to one side. Y corrects the distance when the extruders are offset backwards or forwards, because one part of the cube is too far at the front and the other too far at the back.

Important! The reference extruder is always the left one (extruder 0). See chapter "19. c) Fine Adjustment of the Two Extruders" in these operating instructions.

g) Print

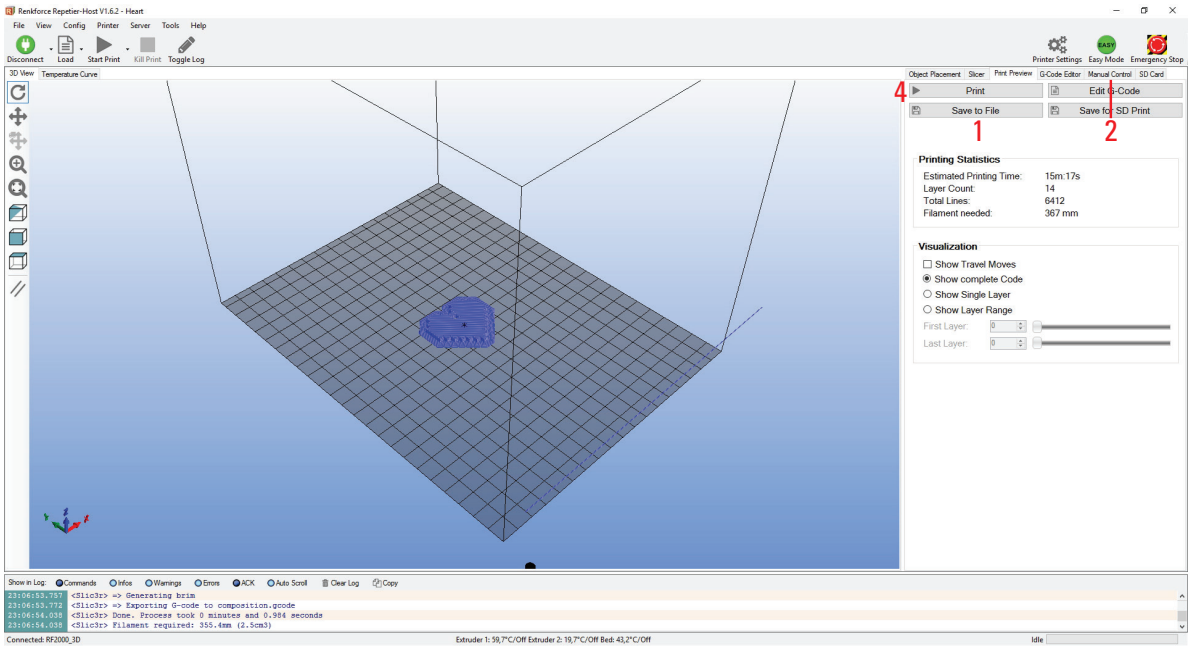
The printing file produced in this manner can be printed now. There are two options for this:

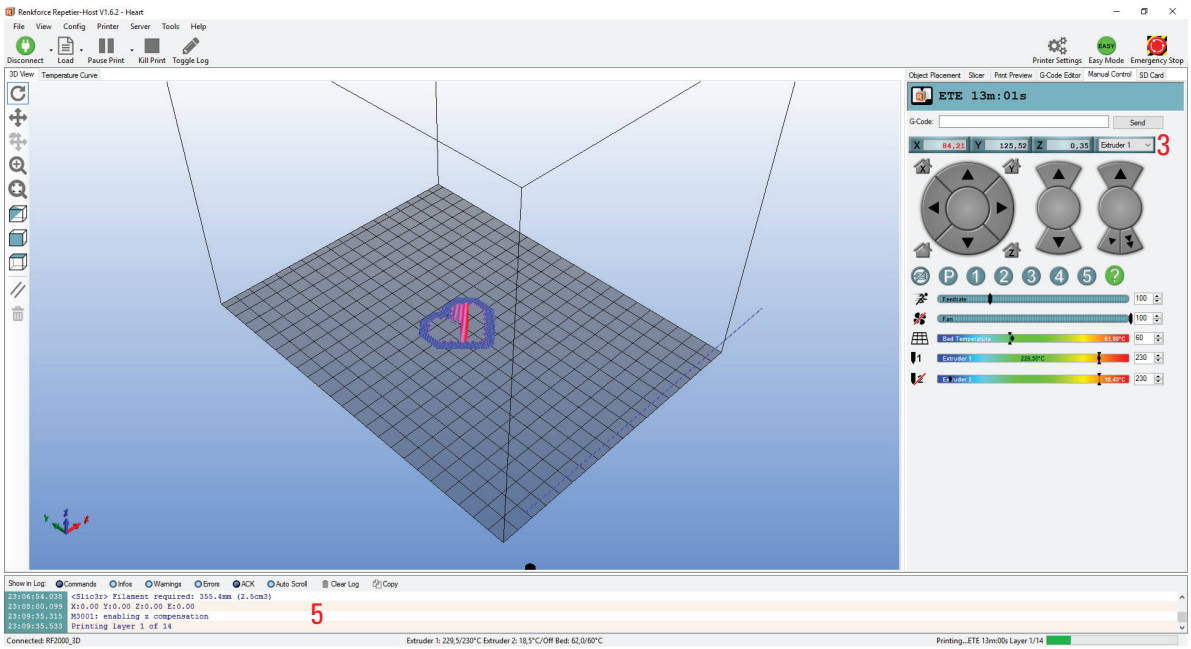
- Save the printing file on an SD card to print out stand-alone. For this, click "**Save to file**" (1). This saves the file as *.gcode and must be set at the same time when you save the file from the G-code editor (disc icon). The precise content of the G-code will be saved into the file here.
- The second possibility is to send the file directly to the connected 3D printer via the USB interface of the computer and print it.
- Before you start printing in single mode, however, check which extruder is active. This is irrelevant for dual mode. For this, click the tab "**Manual Control**" (2). In the drop down menu (3) (lower figure) there, you can select the desired extruder to use for the printout.

  Extruder 1 (in the Software/Manual Control) = Extruder 0 (at the printer and in the G-code) = the left one from the front view

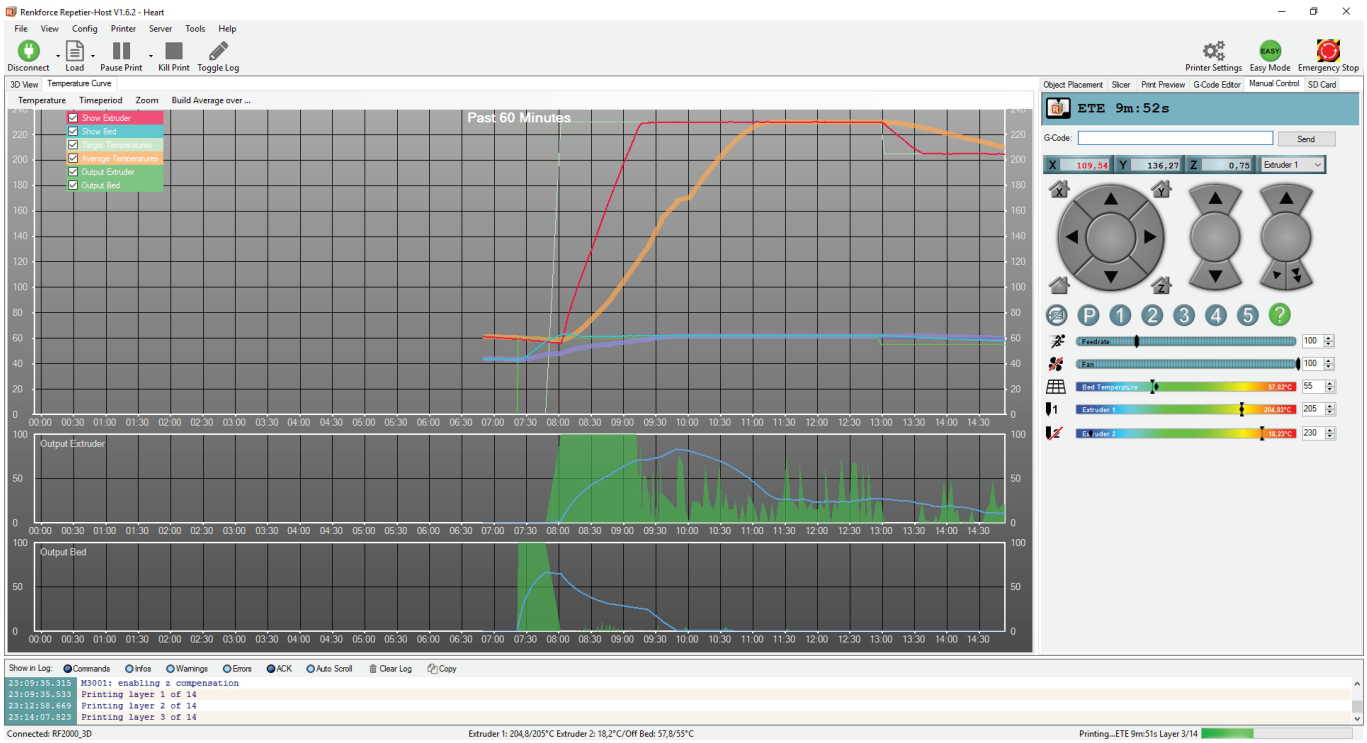
  Extruder 2 (in the Software/Manual Control) = Extruder 1 (at the printer and in the G-code) = the right one from the front view

- Click "**Print Preview**" and then the button "**Print**" (4), to start the printout.
- While printing, the log window (5) below the image shows current information on software, slicer and printer.





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 heating plate and the extruders can be fine-adjusted manually with the buttons for heating plate movement (3). If you push the buttons for heating plate movement (3), do not keep the buttons pushed, but only tap them!

For this setting, observe that the extruders must not touch the heating plate since the heating plate and also the nozzles may be damaged otherwise (loss of warranty/guarantee).

→ If you have performed the heat bed scan for PLA (Scan PLA) or ABS (Scan ABS), the printer should already set the optimal distance between the nozzle and heating plate when printing. If you have only performed a quick head bed scan (Scan), you can adjust the distance with the item "**Z Offset**" in the menu "**Configuration**" - "**Z Calibration**".

When the automatic Z-compensation is active, the display will show "**Cmp**" next to the Z-position (5).

If no filament escapes from the extruder at first, the filament infeed button (4) must be pushed until filament escapes.

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

→ By default, the two fans at the extruder run starting at the 4th layer for PLA and ABS, provided that the slicer settings have not been changed.

Depending on the printed object, the printing result at ABS may be better without the fans, however. In that case, switch off the fans in the slicer settings.

If the two fans do not run properly, check if they may be attached unevenly.

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 heating plate. Danger of heating plate breaking (loss of warranty/guarantee)!

→ 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.

In the download area of the printer's product page on our website www.conrad.com, you can find a printing file "Roll holder" for download. You can install this on the filament holder to support the filament rolls.

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.

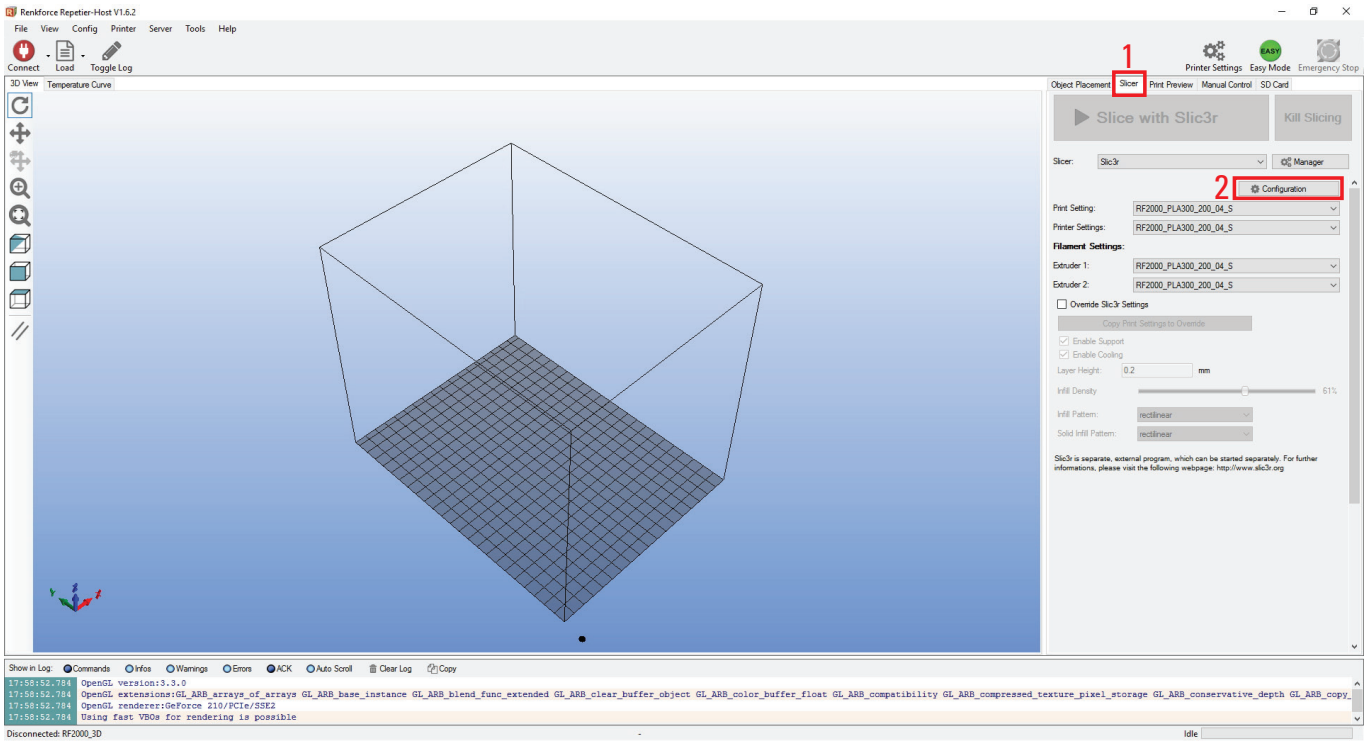
Beginners should first work with the basic settings that are integrated in the custom version in any case.

→ 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.

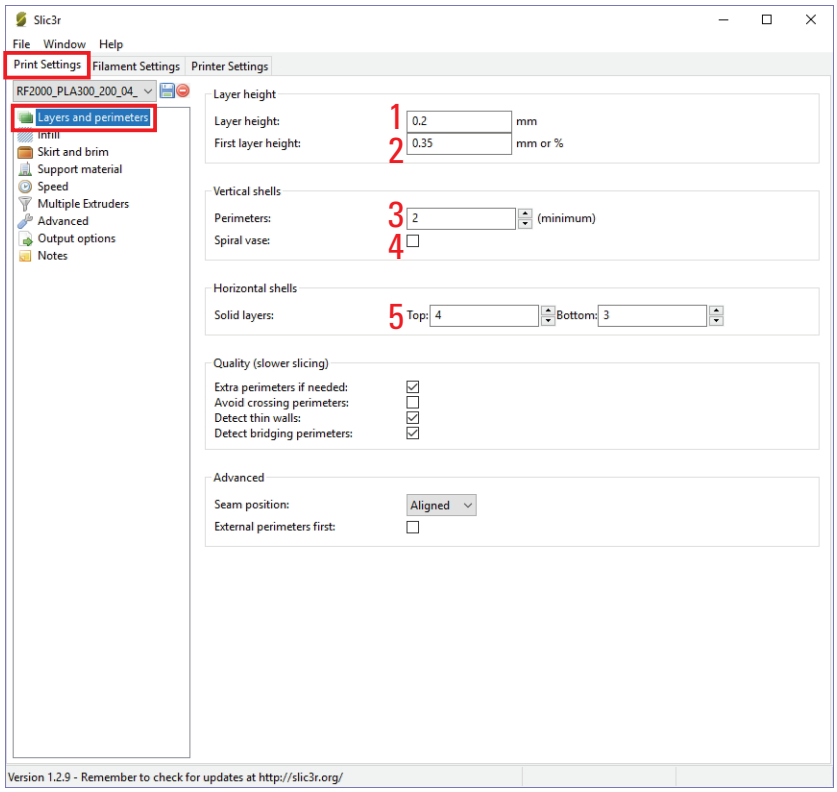
For more information, read the integrated online help function.

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



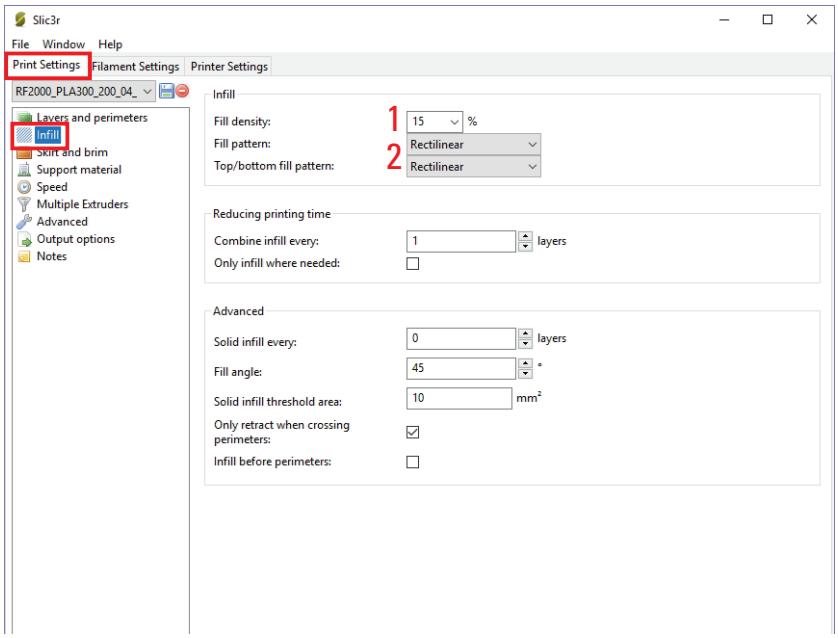
(1) Layer height (accuracy/resolution of the printed object)

(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)

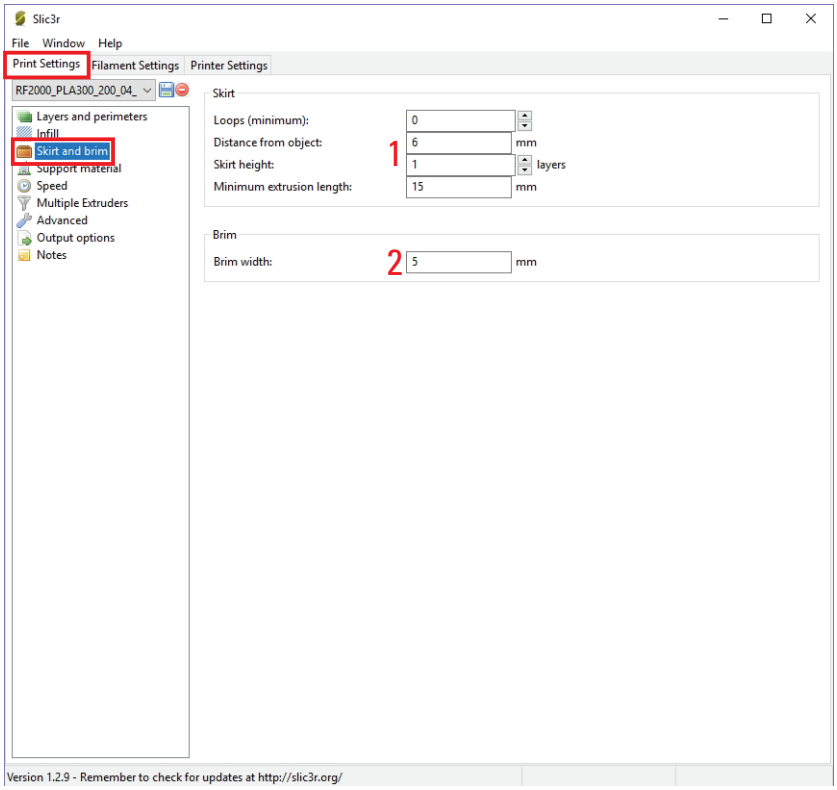
(5) Filled layer number top/bottom



(1) Object filling (0-100%)

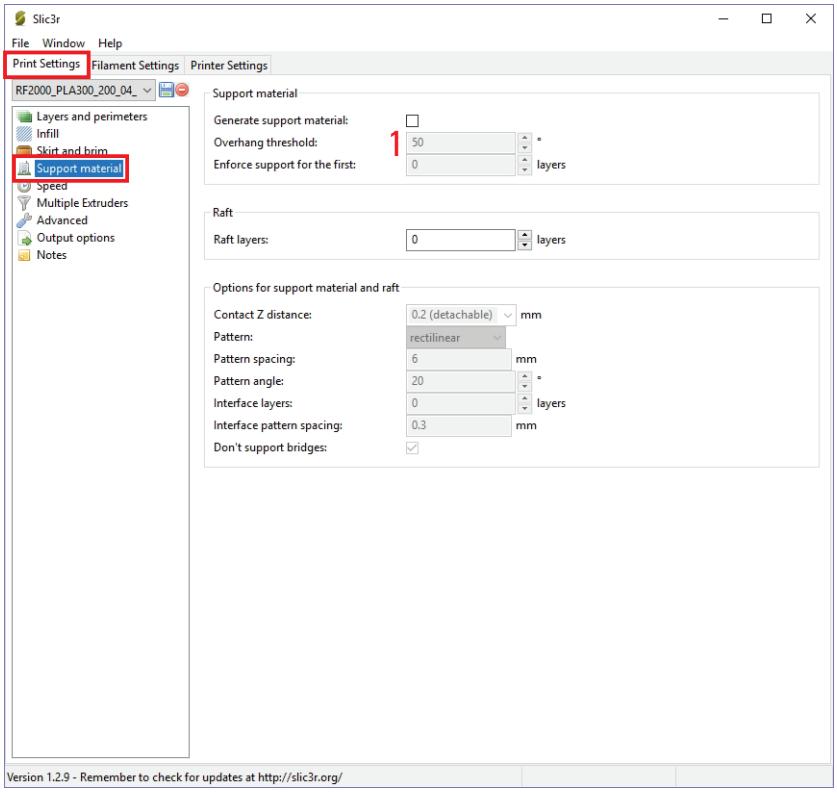
⟶ We recommend object filling of 10% to 40%.

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



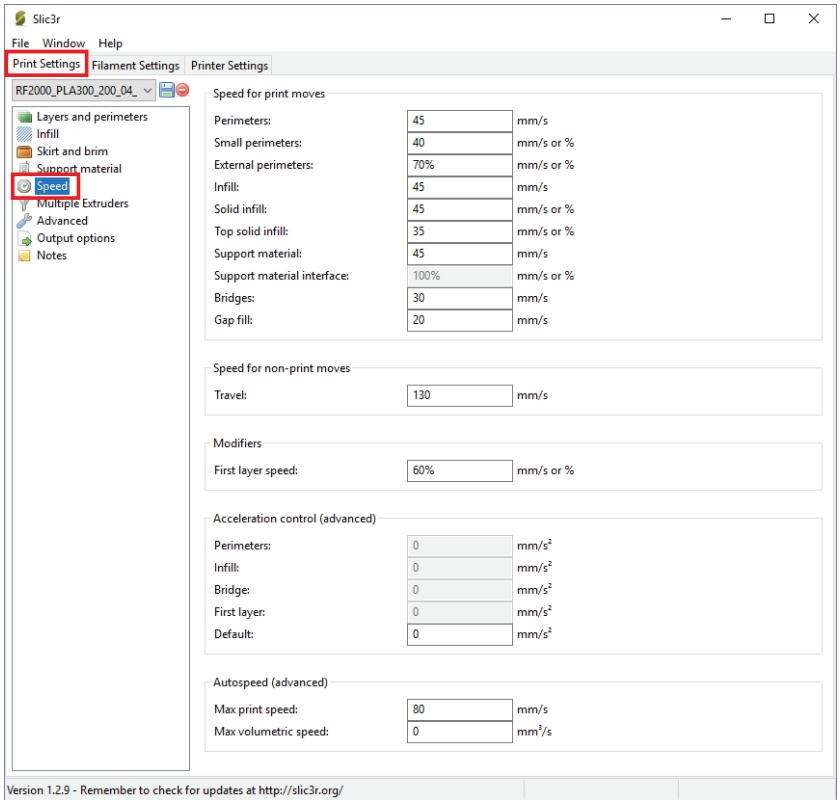
(1) Loops are circles, that are drawn around the object when printing starts, stabilise the filament flow before the actual object is printed. Here, number, distance from the object, height and minimum length are specified.

(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.

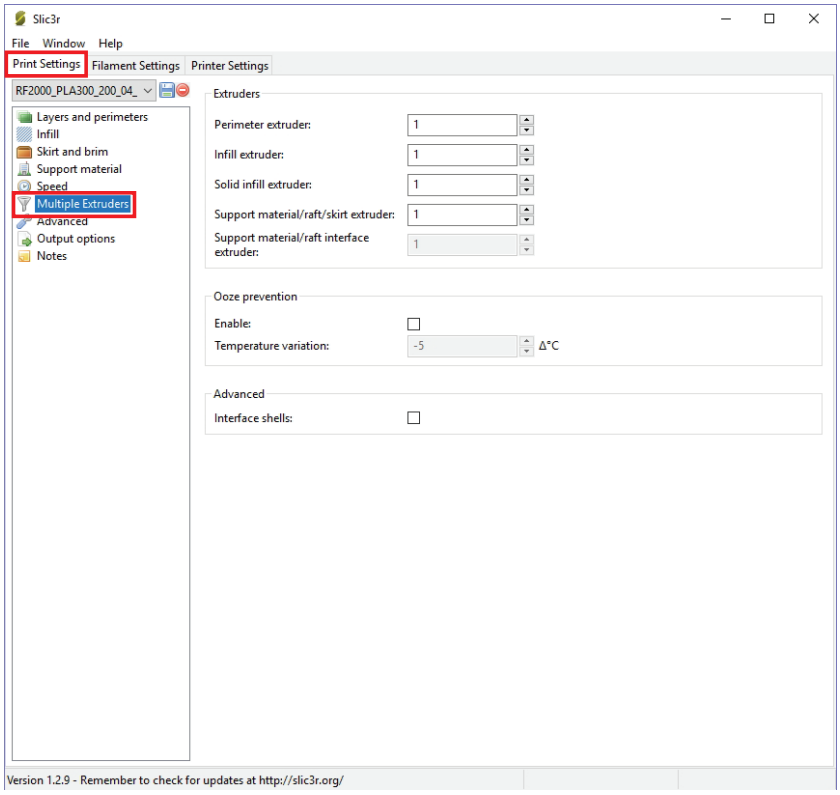


(1) Selection and adjustment of the supporting material that is needed when printing complex objects such as bridges or hollow spaces (poss. required for printing object with overhangs > 45°).

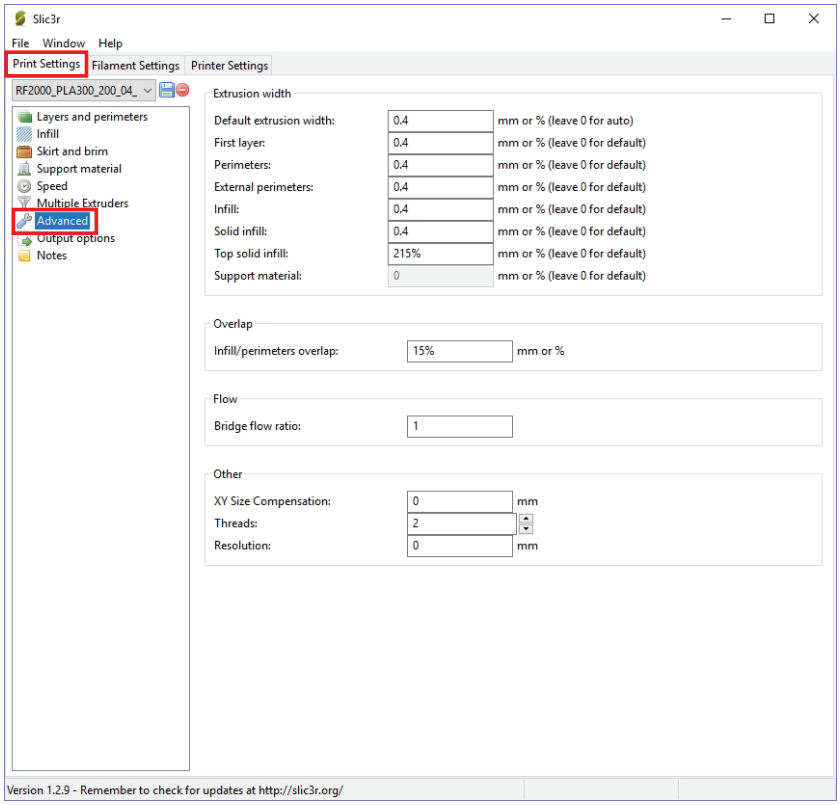
⟶ The first printing attempts should be without a supporting brim since the result is usually better this way.



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

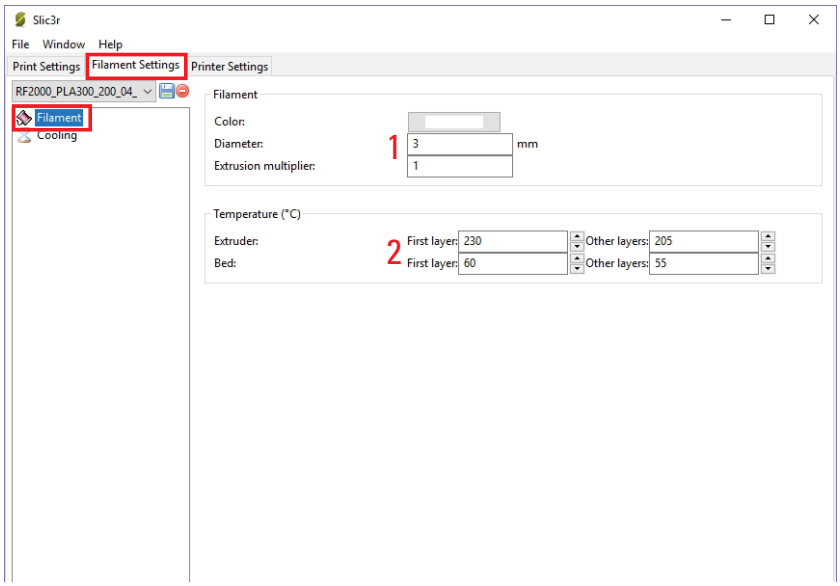


Here, the extruders can be assigned. For example, it is not possible to use one of the two extruders for "**Infill**" only.



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

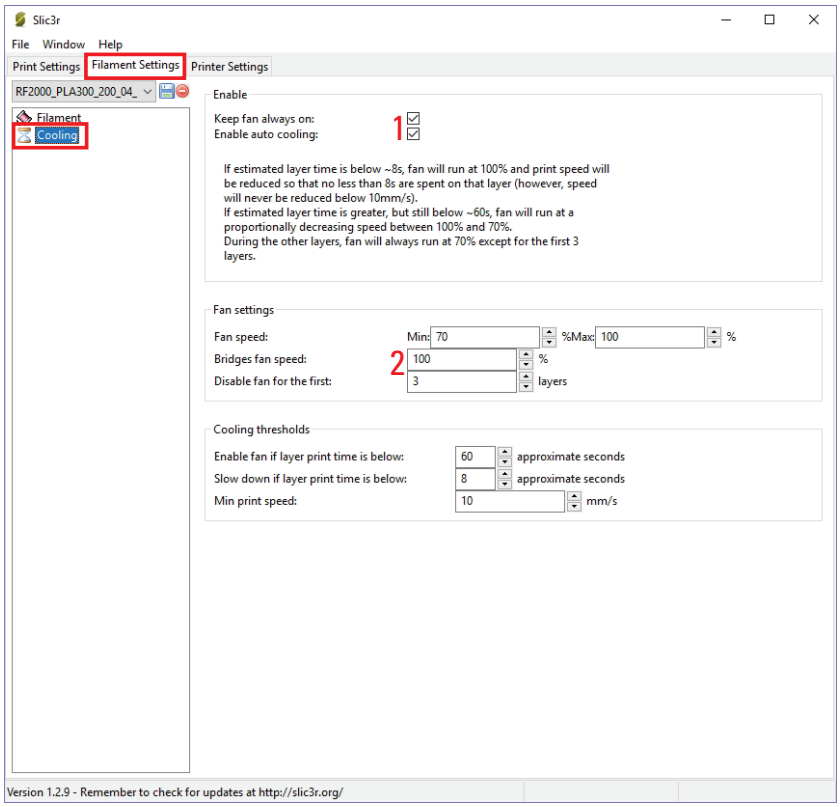


(1) Filament diameter and filament diameter tolerances according to the manufacturer's specifications are set here. If no manufacturer's specification is present, these values can also be measured with a calliper (measure 1 m of filament material in 10 different points and then set the average here).

(2) Temperature settings for extruder and heating bed separated by first and all other layers.

⟶ Observe the settings recommended by the filament manufacturer!

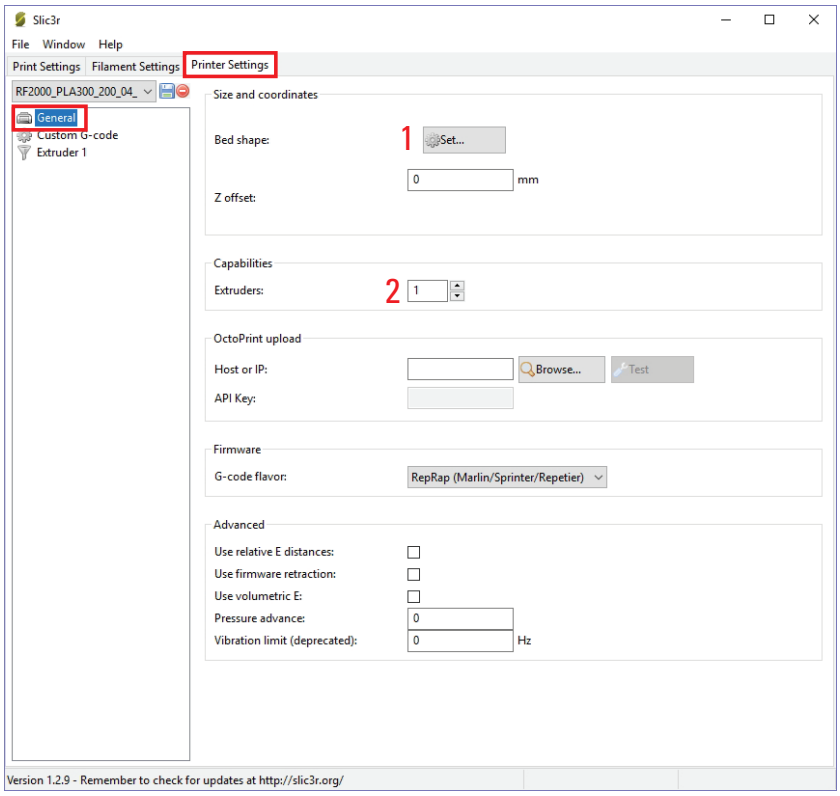
Since the best values may fluctuate extremely depending on the filament manufacturer, perform your own tests based on the presettings to achieve the best printing quality. When performing the tests, proceed in 5 °C steps and compare the results during or after printing with other settings. The first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



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

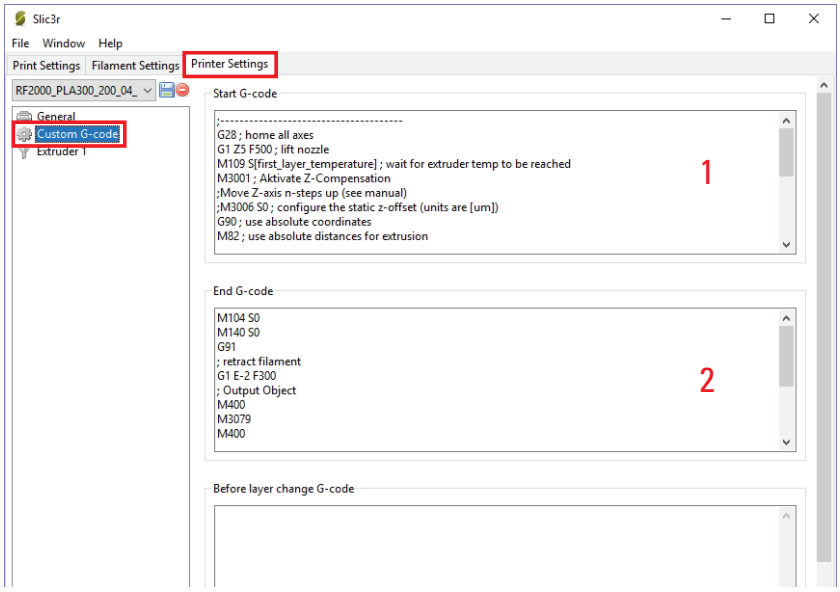
(2) Setting of the fan speed.

Printer Settings



(1) Geometric data of the heating plate

(2) Number of the extruders



(1) The starting code contains the first commands that the 3D printer performs. Here, e.g. a Z-compensation can be started.

The Z-compensation command then could be the following:

M3006 S-100 (-100 are 100 µm or 0.1 mm in this case)

If the value is prefixed with a - , the distance between the nozzle and heat bed reduces. A + will increase it.

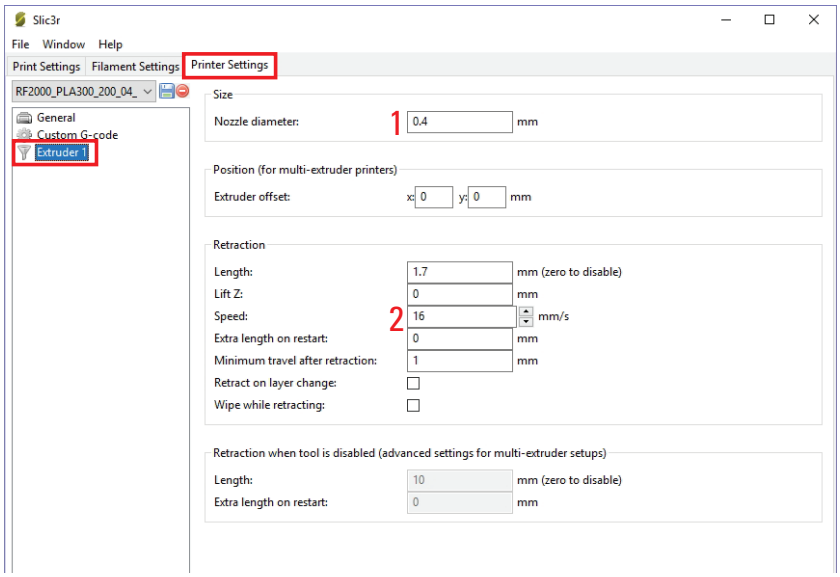
(2) The end code will be performed at the end of the print and could contain, e.g. the run into a removal position for the printed object.

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

Find a G-code below that controls the LED lighting. It can be integrated, e.g., into the start code or the end code. You can also use only parts of this. The comment (after the ;) says what the code does.

The RGB control must be set to "**Manual**" in the "**Quick Settings**" menu for this.

M3308 P0 ; switch the lights off
G4 S5 ; wait 5 seconds
M3308 P1 ; switch the lights to white
G4 S5 ; wait 5 seconds
M3307 P1 S255 ; set the red component of the manual color to 255
M3307 P2 S0 ; set the green component of the manual color to 0
M3307 P3 S0 ; set the blue component of the manual color to 0
M3308 P3 ; switch to the manual color (= red)
G4 S10 ; wait 10 seconds
M3307 P2 S255 ; set the green component of the manual color to 255
G4 S10 ; wait 10 seconds
M3307 P1 S0; set the red component of the manual color to 0
G4 S10 ; wait 10 seconds
M3307 P3 S255 ; set the blue component of the manual color to 255
G4 S10 ; wait 10 seconds
M3307 P2 S0 ; set the green component of the manual color to 0
G4 S10 ; wait 10 seconds
M3307 P1 S255 ; set the red component of the manual color to 255
G4 S10 ; wait 10 seconds
M3307 P3 S0 ; set the blue component of the manual color to 0
G4 S10 ; wait 10 seconds
M3308 P2 ; switch the lights to automatic
G4 S10 ; wait 10 seconds



(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.

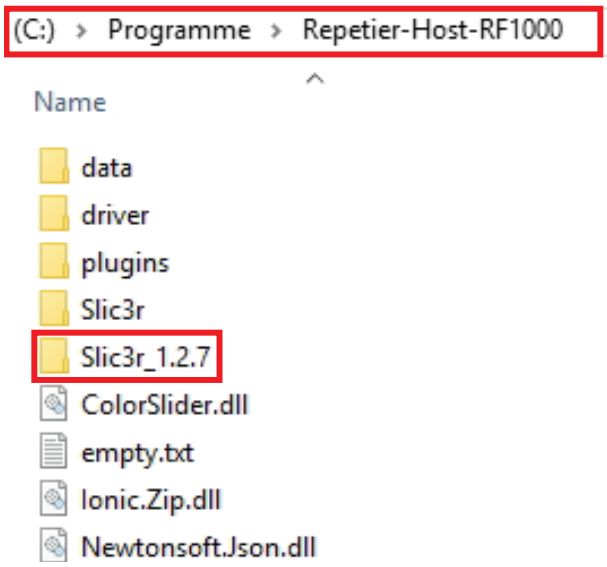
- Rename the unpacked folder "**Slic3r**". Adding, e.g., the version number is recommended here.

  "**Slic3r_1.2.7**"

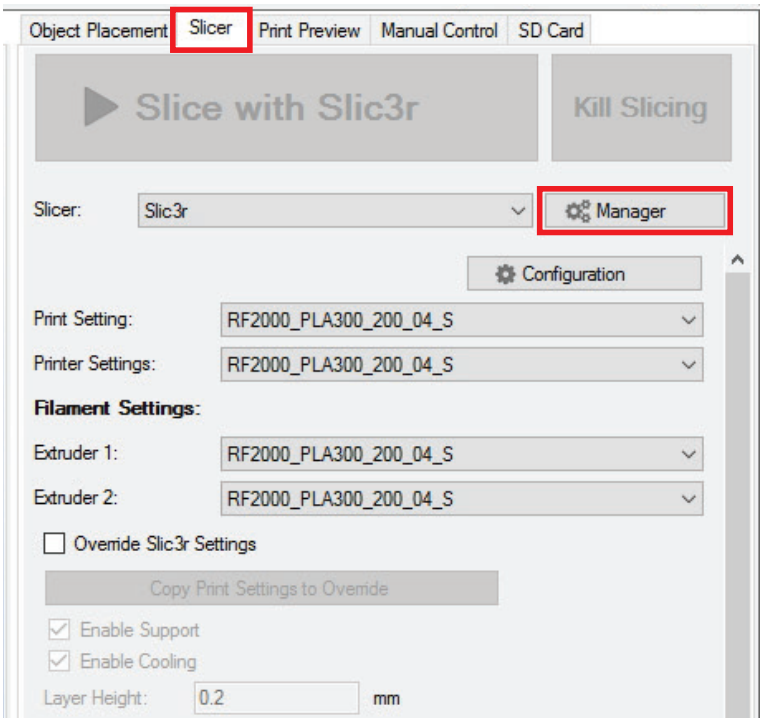
- Copy this renamed folder or, best, move it into the program directory of the repetier host software. This is also the program directory of the original Slicer.

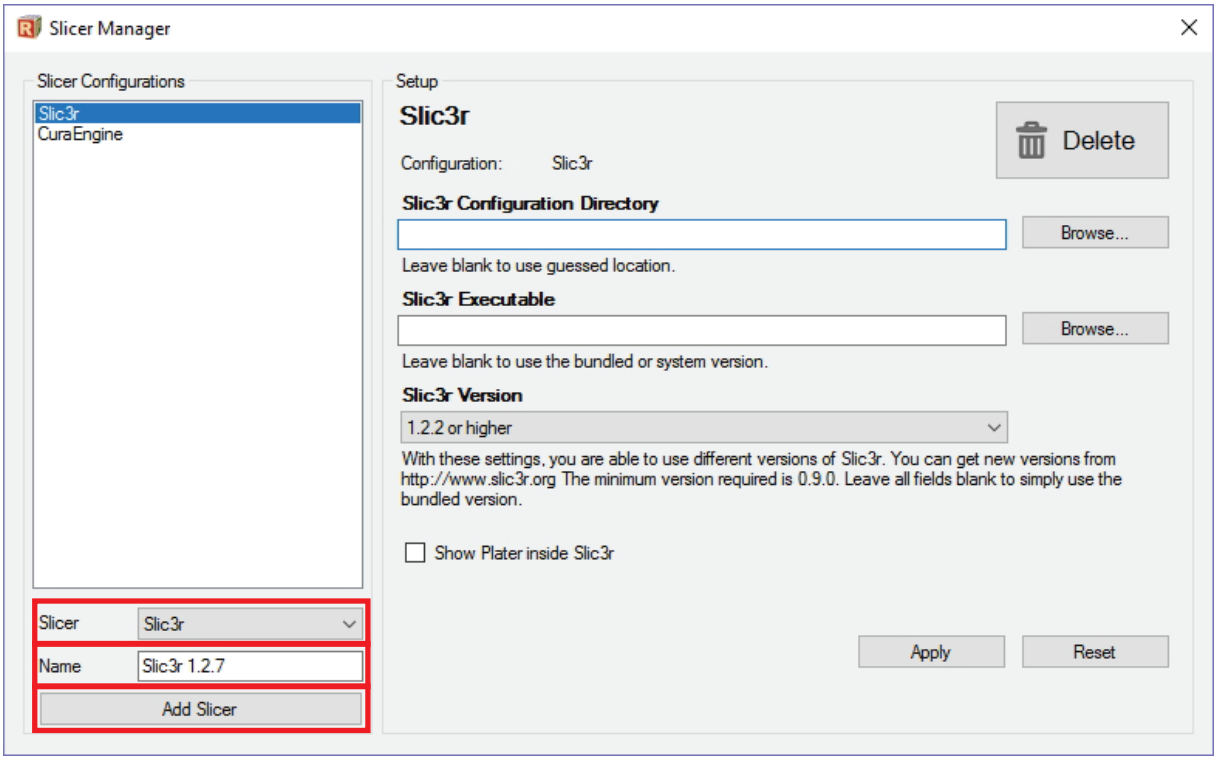
  \Program Files\Repetier-Host-RF1000

→ 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!

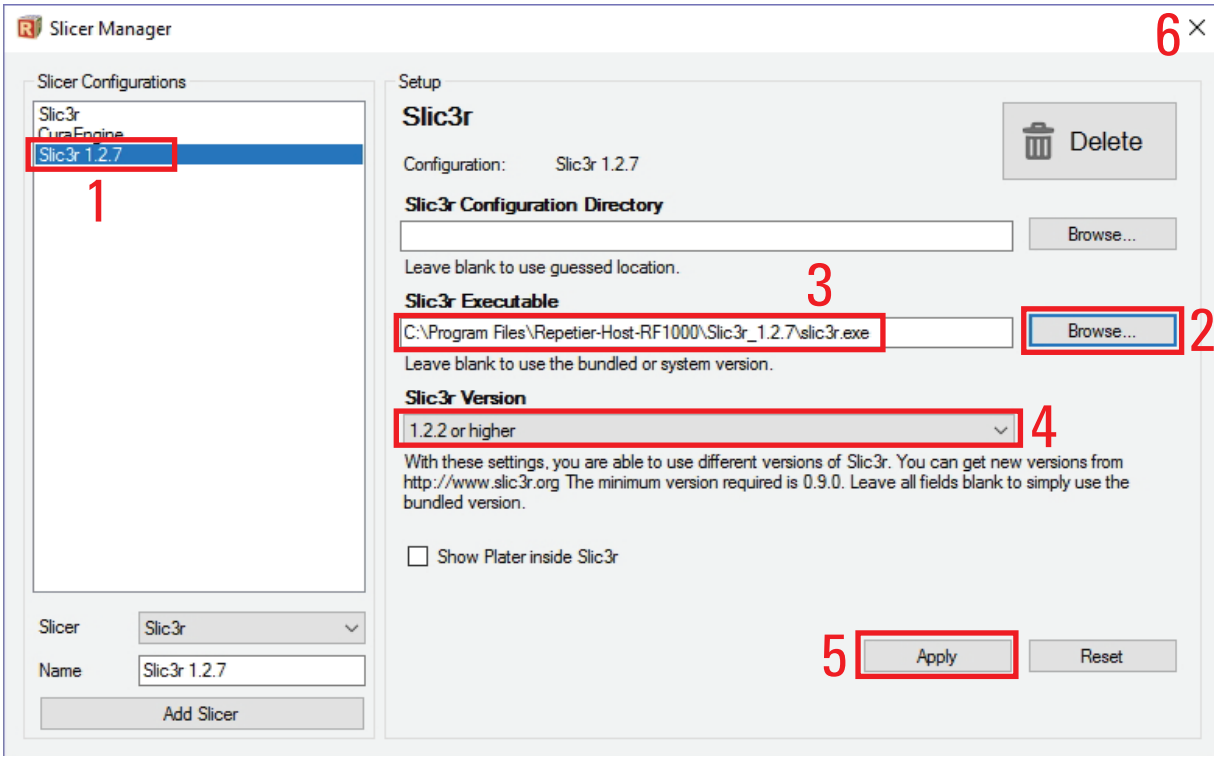


- Now open the repetier host software.
- Click the tab "**Slicer**" and then the button "**Manager**".



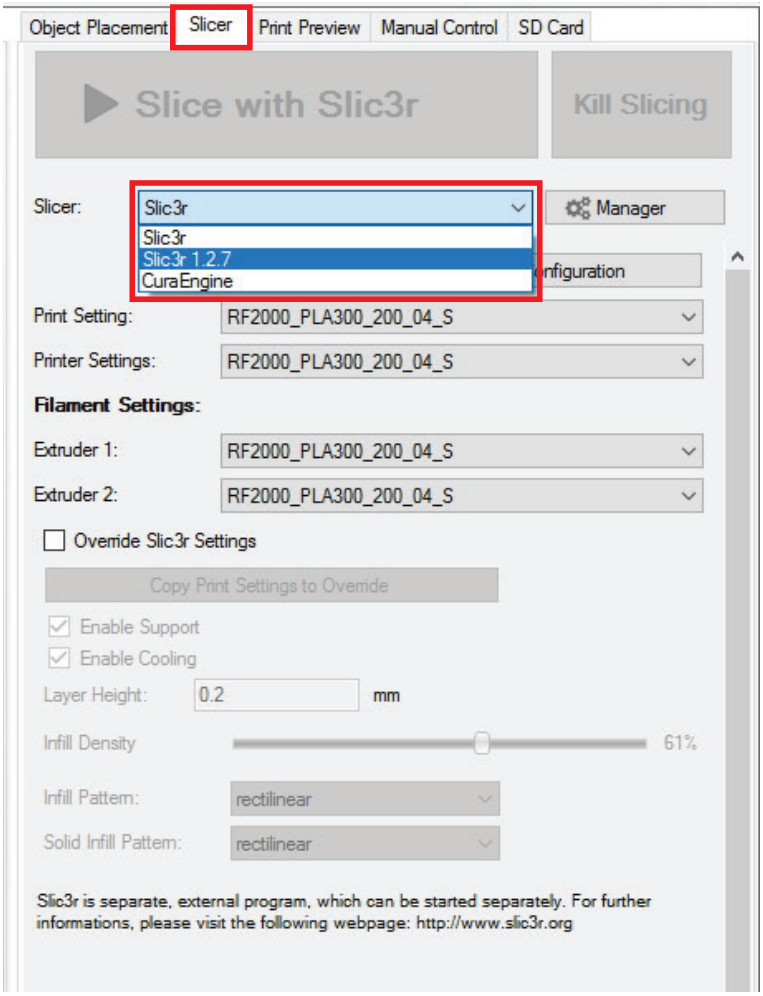


- In the menu "**Slicer**", choose the desired Slicer that you want to integrate. In our example, this would be the standard selection "**Slic3r**".
- In the field "**Name**", enter the desired name and confirm by clicking "**Add Slicer**".



- 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 Setting**" and "**Filament Settings**" 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.

19. Expanded Calibration

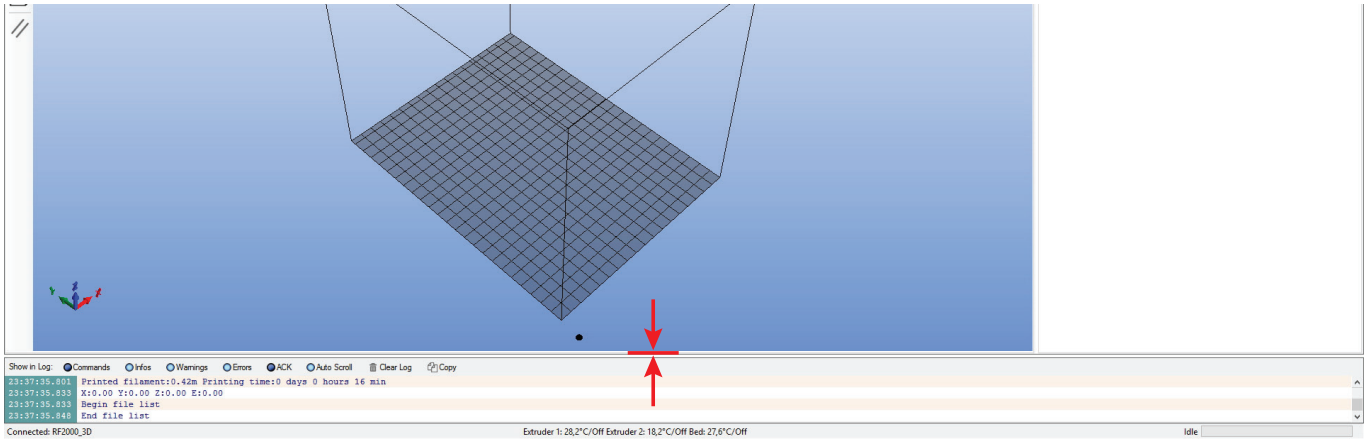
a) Determining the Highest Position of the Heating Plate

As soon as the head bed scan has been performed once, the repetier host software can be used to read the matrix of the heating plate scan. The values of the matrix can be used to determine the position on the heating plate that has the shortest distance from the nozzle. This can generally be used for all other scans while nothing changes at the heat bed.

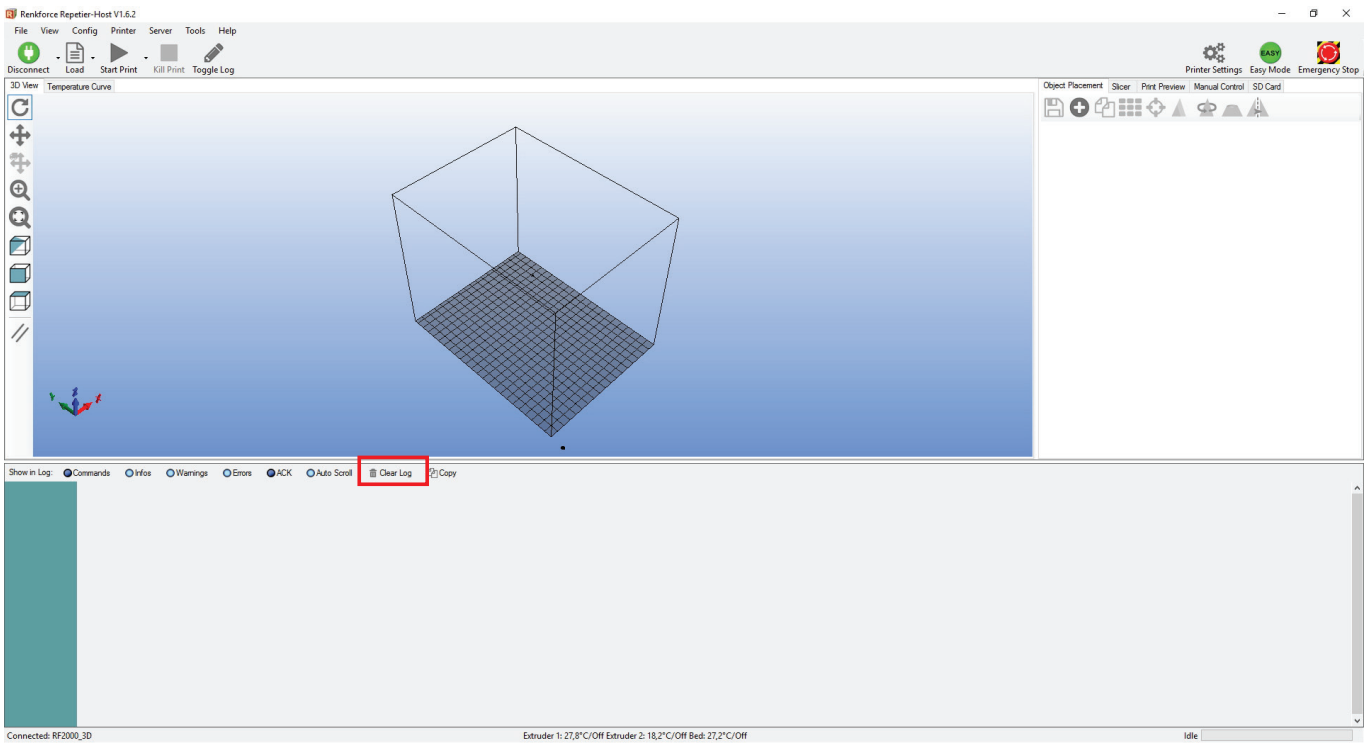
Preparation

- If it has not been done yet, perform a heat bed scan as it is described in chapter "14. Calibration".
- If it has not been done yet, install the software repetier host incl. the drivers and connect the printer to the computer (see chapter "18. 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 "**Disconnect**" below.

Reading out the matrix



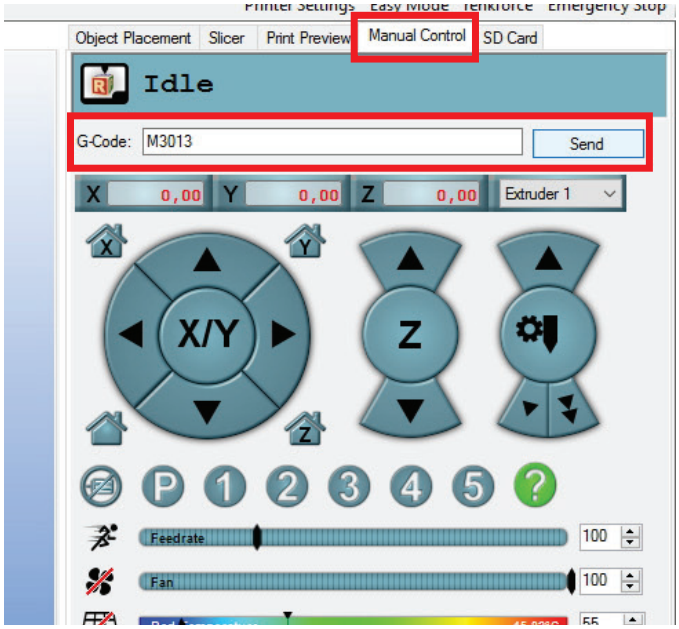
- First, draw the lower part of the window where the log is shown a little up with the mouse.



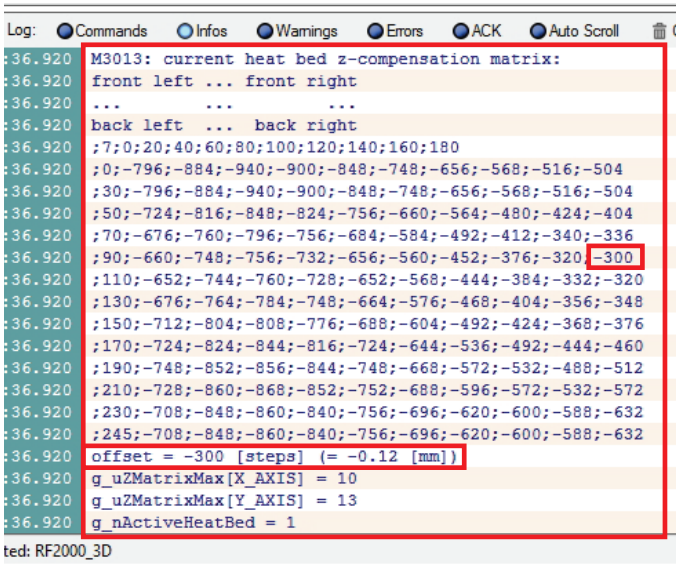
- Click "**Clear log**".

- Click the tab "**Manual Control**" on top.
- In the field "**G-Code**", enter "**M3013**" (without the quotation marks) and click the button "**Send**".

  The command "**M3013**" outputs the values in steps. If you use the command "**M3013 P1**" instead, the values are output in mm.



- The log field now shows the values of the matrix.
- The first series of numbers (;7;0;20;40;...) indicates the position of the value in the X-direction in mm, with 7 representing the format of the matrix and not being relevant for the position in X- and Y-directions.
- The position in the Y-direction is also indicated in mm by the figures at the beginning of each row of figures (;0;30;50;...).
- Also observe that the value (-796) at the upper left, i.e. in position X=0 and Y=0, is located at the front left of the heating plate when looking at the printer from the front left. The value (-632) at the lower right, in position X=180 and Y=245, is at the rear right on the heating plate.
- The offset value indicated under the full values (larger, red box), indicates the lowest value. This then is the position where the nozzle has the smallest distance from the heating plate. In our example, the offset value is -300 steps.



- Now find the offset value in your matrix. In our example, the -300 steps are in position X 180 and Y 90. You need to set the nozzle to 0.3 mm in this position in the next heat bed scan.
- To the right, you can see the matrix again, presented a little better structured. The Z-offset value -300 is bolded here.
- The values in the matrix can be briefly explained as follows:

  The values are indicated in steps. 2560 steps in Z-direction equal precisely 1 mm. The values indicate the distance between the surface of the heating plate and the trigger point of the Z-limit switch "Z-Min" (Z home position).

  This means that in position X 180 and Y 90, the distance between the heating plate and the Z Home position is 300 steps.
- If everything is set correctly mechanically, the values in the matrix must all be negative.

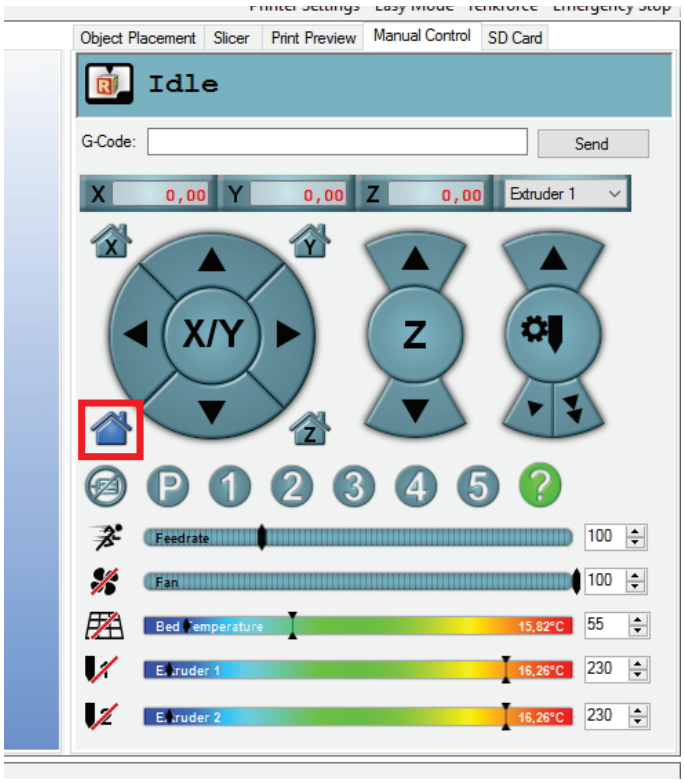
	front left									front right
	0	20	40	60	80	100	120	140	160	180
0	-796	-884	-940	-900	-848	-748	-656	-568	-516	-504
30	-796	-884	-940	-900	-848	-748	-656	-568	-516	-504
50	-724	-816	-848	-824	-756	-660	-564	-480	-424	-404
70	-676	-760	-796	-756	-684	-584	-492	-412	-340	-336
90	-660	-748	-756	-732	-656	-560	-452	-376	-320	**-300**
110	-652	-744	-760	-728	-652	-568	-444	-384	-332	-320
130	-676	-764	-784	-748	-664	-576	-468	-404	-356	-348
150	-712	-804	-808	-776	-688	-604	-492	-424	-368	-376
170	-724	-824	-844	-816	-724	-644	-536	-492	-444	-460
190	-748	-852	-856	-844	-748	-668	-572	-532	-488	-512
210	-728	-860	-868	-852	-752	-688	-596	-572	-532	-572
230	-708	-848	-860	-840	-756	-696	-620	-600	-588	-632
245	-708	-848	-860	-840	-756	-696	-620	-600	-588	-632
	back left									back right

Move to the offset position

- First move all axes to their home position.

  For this, click the unlabelled house icon.

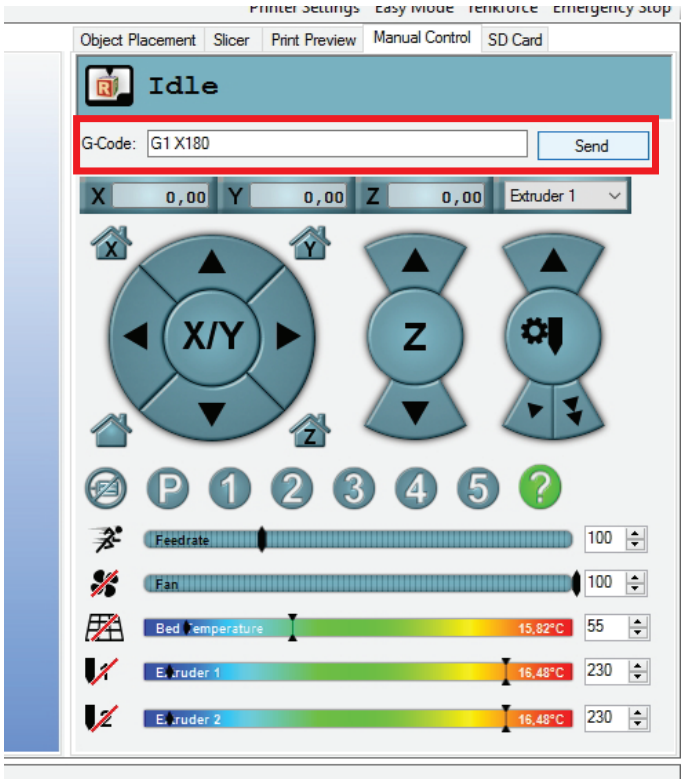
⟶ If the figures in the fields X, Y and Z are red, no home position has been moved to yet. The software accordingly does not know where the printer axes are currently located. Once the home positions are reached, the colour turns black.



- Now move the X-axis to the position previously read.
- For this, enter the command "**G1 X180**" (without quotation marks) in the field "**G-Code**" and click "**Send**". Replace 180 by your X-value.

  The printer moves the X-axis to the position. In our example, this is the X-position 180.

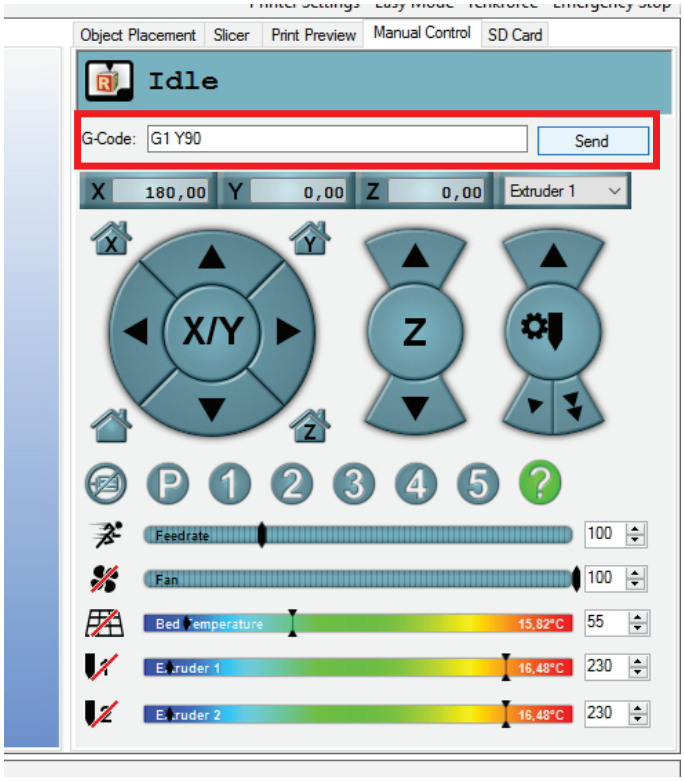
⟶ When the position is reached, the field X will show the current position. In our example, this is 180.00.



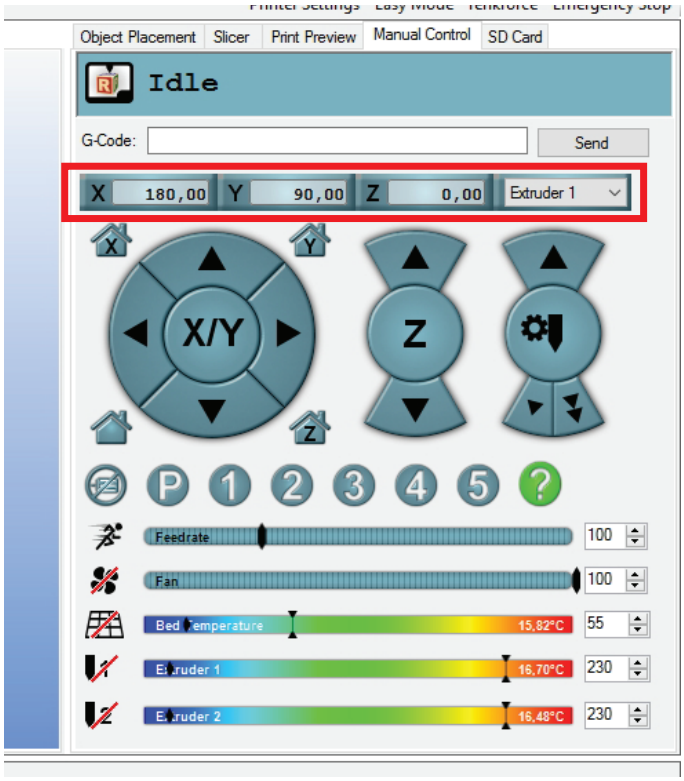
- Now move the Y-axis to the position previously read.
- For this, enter the command "**G1 Y90**" (without quotation marks) in the field "**G-Code**" and click "**Send**". Replace 90 by your Y-value.

  The printer moves the Y-axis to the position. In our example, this is the Y-position 90.

⟶ When the position is reached, the field Y will show the current position. In our example, this is 90.00.



- If everything worked correctly, the X and Y fields now display the two values read and the printer has also moved to these positions.
- Now set the extruder as described in Chapter "14. b) Setting the Distance between the Nozzle and the Heating Plate"; then perform a heat bed scan.



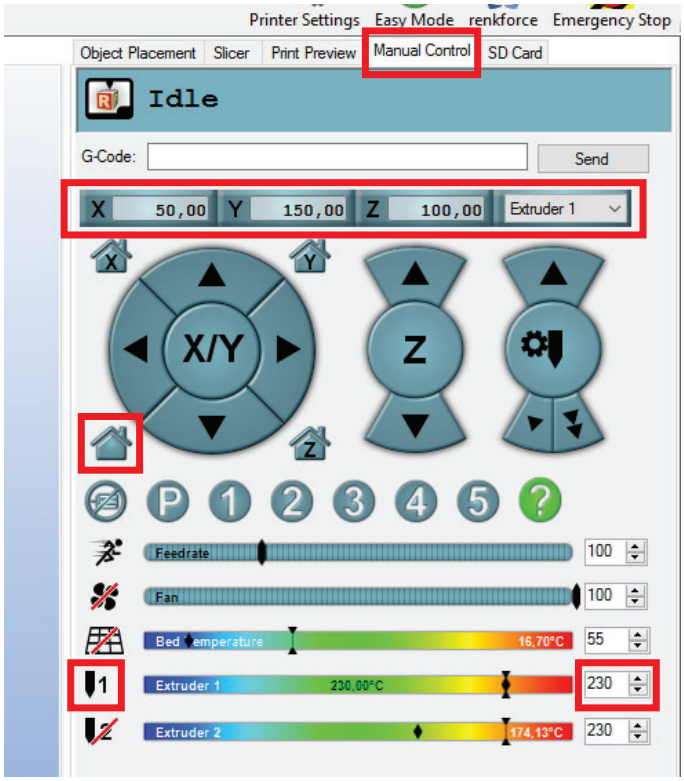
b) Fine Adjustment of the Filament Infeed

This chapter describes how to adjust the filament feed precisely, e.g. to compensate for the tolerance of the feed knurl. In our example, the left filament feed is calibrated.

Preparation

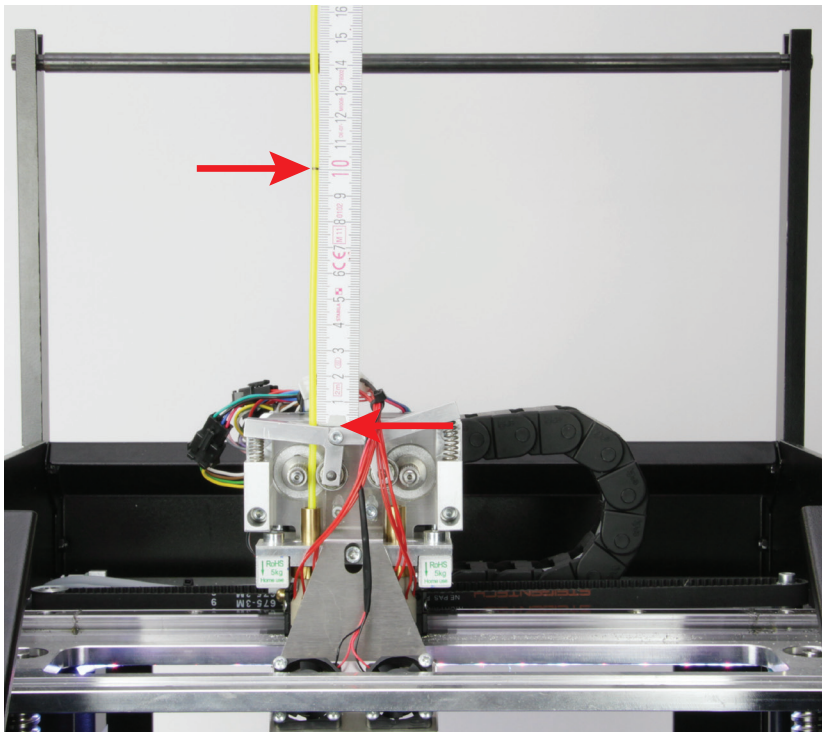
- If it has not been done yet, install the software repetier host incl. the drivers and connect the printer to the computer (see chapter "18. Software "Repetier Host").
- If necessary, set the COM port and connect the printer. The symbol at the upper left must be green and it must say "**Disconnect**" 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 1 (left extruder/extruder 0 in the firmware) 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.



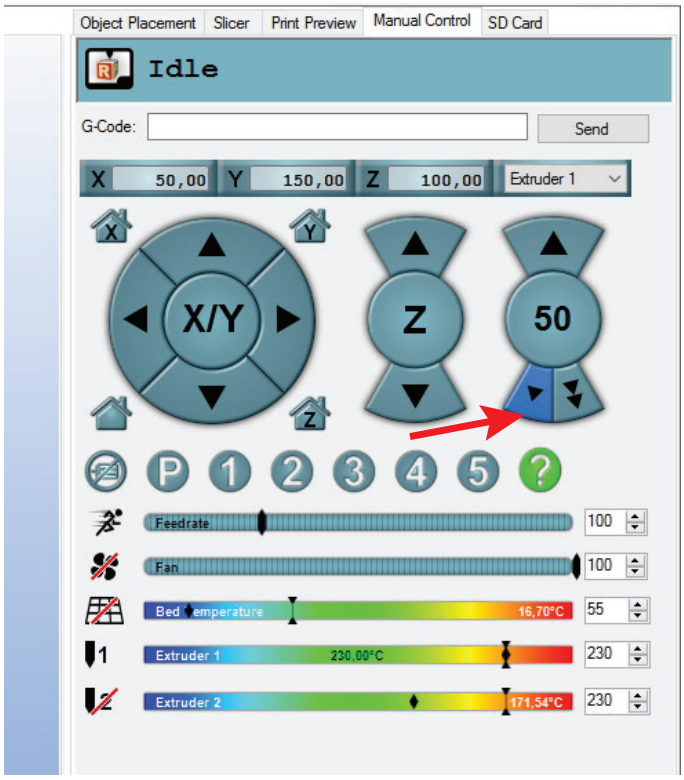
Measuring the feed

- Mark 100 mm or 10 cm precisely at the inserted filament, starting at the upper edge of the ball bearing.
- Always apply the measure on the inside as shown in the figure. This prevents the ball bearing holder from being pushed down. When you measure the right side later, apply your measure to the left side of the filament.

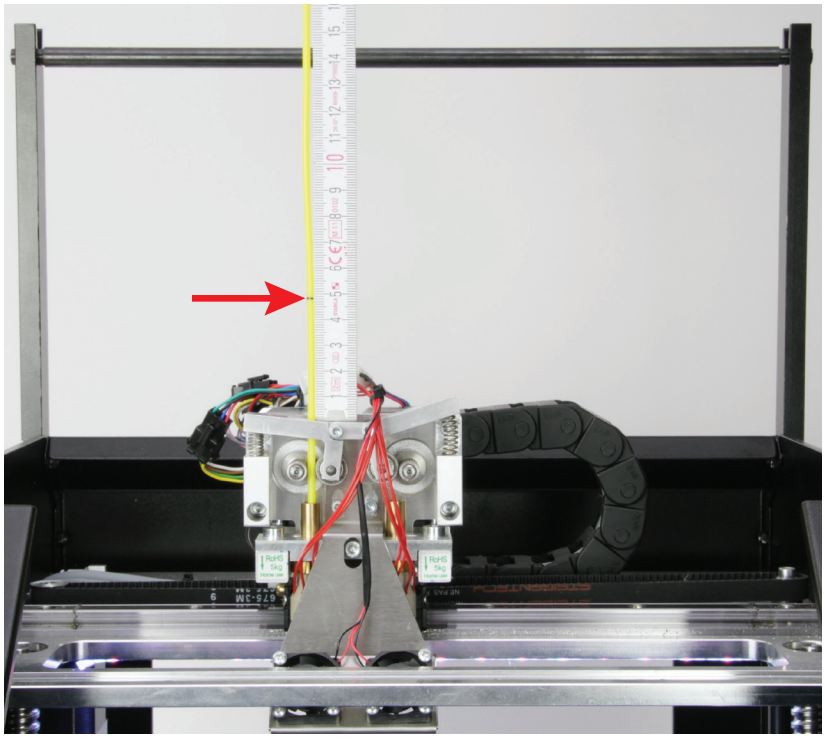


- When the filament is marked, feed in precisely 50 mm. For this, move the mouse over the arrow at the lower left in the right control (see red arrow). When the mouse pointer is all the way at the bottom (see arrow tip of the red arrow) and the middle shows 50, click precisely once.
- The filament motor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

→ If the infeed does not react when you click the arrow, send the command "**G92 E0**" to the printer (enter the command in the field "**G-Code**" and click "**Send**").



- Now measure the remaining distance between the ball bearing holder and the mark just as you did when marking before.
- In our example, 48 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

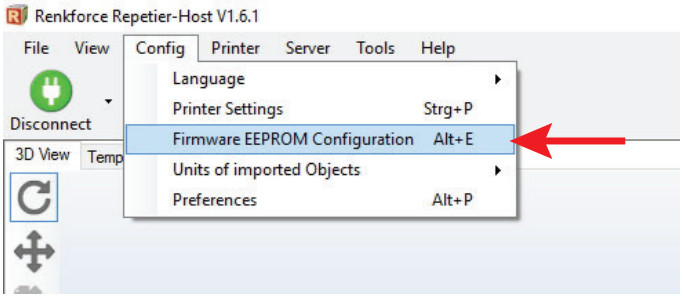
100 mm - 48 mm = 52 mm

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

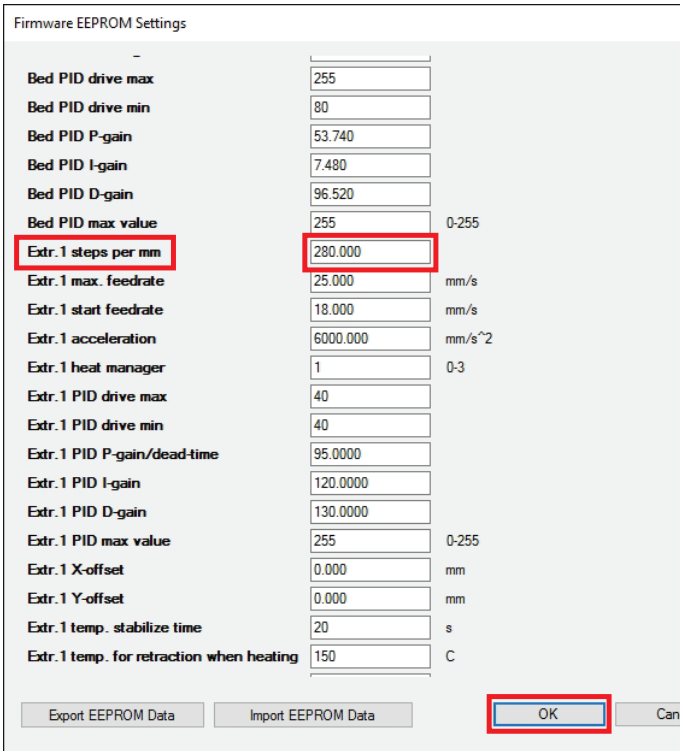
50 mm : 52 mm * 280.000 = 269.231

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



- In the new window, scroll until you see "**Extr. 1 steps per mm**".
- Change the default value **280.000** to the value calculated anew before. In our example, enter **269.231** in the field.

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



→ The value for the left extruder (extruder 1 in the software/extruder 0 in the firmware) is now adjusted and corrected. 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 280.000 for your calculation, but the value currently entered in the EEPROM.

Then perform the same procedure with the right extruder (extruder 2 in the software/extruder 1 in the firmware). The procedure is nearly identical. Switch off the heater of the left extruder again and heat up the right extruder. Switch to extruder 2 (drop down menu in extruder 1).

Enter the corrected value in field "**Extr. 2 steps per mm**".

c) Fine Adjustment of Both Extruders

In order to produce a perfect 2-coloured print, you may need to adjust the distances between the two extruders. This is also called the extruder offset. If the offset setting does not match the mechanical situation, the layers printed by extruder 0 and extruder 1 will not match 100% either.

The firmware has 2 setting options for this. You can find the setting values in the menu item "**Configuration**" - "**General**".

"Extruder Offset X"

- This value indicates the distance between the two extruders when you look at the printer from the front.
- The default value for this is "**33.896**". This means **33.896 mm**.

"Extruder Offset Y"

- This value indicates the differences between extruder 1 (right) and extruder 0 (left) in the Y-direction backwards or forwards.
- The default value for this is "**0.098**". This means **0.098 mm** or **98 µm**.

Determining the correct correction value

Determine the offset using the bicoloured cube "**DUAL_CUBE.GCODE**" from the SD card. This cube is printed several times. The first time, it is printed using the default settings (Extruder Offset X and Y).

The first cube is used to determine the offset for X and Y, e.g. using a calliper, and added to or subtracted from the default value.

Then the cube is printed again.

Repeat this until the layers are all cleanly on top of each other.

→ The cube is made up of six layers. They are printed alternatingly by extruder 0 and 1. The 1st layer (all the way down, orange) is printed by extruder 0, the 2nd one (black) by extruder 1, the 3rd one by extruder 0 again, etc. This assumes that you are using the G-code file from the SD card. If you slice the cube yourself and swap the extruders, the 1st layer will be printed by extruder 1. Therefore, ensure that you slice the cube so that the bottom layer is printed by extruder 0.

Front view of the 1st printout (offset X)
Offset in X-direction in this example: 0.5 mm or 500 µm

View from the right (offset Y)
Offset in Y-direction in this example: 0.3 mm or 300 µm

If the layers of extruder 1 (black) protrude to the left in the front view (left figure, offset X), as in this example, this is a negative value. The default value (33.896) therefore must be corrected downwards by the offset (in our example 0.5 mm). The value to be set would be approx. 33.396. It is possible that you do not hit the last digit precisely. This can be neglected. If the black layer protrudes to the right, you need to adjust the value upwards.

If the black layers of extruder 1 protrude to the front when viewed from the right (offset Y), the value is also negative. The default value (**0.098**) would therefore have to be set to approx. **-0.202**.

Setting the determined values

To set the value, first open the item "**Configuration**" in the menu and then the item "**General**".

Navigate to "**Extruder Offset X**" and press **OK** (2).

Set the determined value for the offset X with the two buttons "**up**" and "**down**" (1).
Confirm with "**OK**" button (2).

Navigate to the item "**Extruder Offset Y**" and press **OK** (2) again.

Set the determined value for the offset Y with the two buttons "**up**" and "**down**" (1).

Confirm the selection again with the **OK** button (2).

⟶ When you have set the values, print the cube again and check the offset. If the layers of the 2 extruders are not precisely on top of each other yet, correct the values and print out the cube again. Repeat this until the layers are precisely on top of each other.

If the layers of extruder 1 protrude on both sides, the extruders may not have the same height. In this case, perform a heat bed scan and particularly observe when lowering the 2nd extruder that it is supported as well on the heat bed as the 1st extruder.

d) Correction of the Heating Plate Temperature

The firmware makes it possible to adjust the temperature of the heating plate. For this, the actual temperature on the surface must be measured at different temperature settings. The measured values then must be entered in the firmware. This way, the printer can adjust the temperature automatically.

⟶ Before starting, check if a new firmware version is available. If this is the case, download it, unpack the ZIP archive and install the firmware on your printer. Observe chapter "20. Firmware Update".

- The firmware has 6 temperatures defined: 60, 80, 100, 120, 140, 160 °C.
- First set 60 °C at the printer.

⟶ When the temperature is reached, wait for at least another 10 minutes for the printing bed to be heated through entirely and the temperature to stabilise.

- Then measure the heating bed temperature in different locations.

Do not touch the hot printing bed when measuring! Danger of burns!

Use a suitable meter. We recommend, e.g., a thermal imaging camera or a thermometer with surface sensor (NiCr-Ni or K-bead).

- Determine the average of the different measurements.
- Then heat up to 80 °C and repeat this. Proceed in the same manner with the other temperatures 100, 120, 140 and 160 °C.
- When you have determined all temperatures, open the firmware on your computer as described in chapter "20. Firmware-Update".
- Enlarge the Arduino program window on the entire screen.
- Navigate to the tab "**RF2000.h**" (1 in the figure below) and in it approximately to line 582 (may vary slightly depending on the firmware).

- The line "**#define BED_SETPOINT_TEMPERATURES {60, 80, 100, 120, 140, 160}**" (2) defines the target temperatures.

  These are the temperatures that are set at printer. If everything is going optimally, they will also apply at the surface of the heating plate.

- The line "**#define BED_MEASURED_TEMPERATURES {58, 76, 94, 112, 130, 150}**" (3) defines the measured values. The temperature here has already been adjusted a little in the factory.
- Enter your measured values in this line (3) or replace the existing ones by the ones you measured. This way, the printer knows that, e.g., only 112 °C are present at the surface of the heating plate in spite of 120 °C being set, and can adjust the temperature accordingly.

  The measured values can, of course, also be lower (as in the example) or higher.

- When you have changed all values, click the button with the arrow down to save the changes (4).
- Then you must upload the changed firmware to the printer. Observe chapter "20. Firmware Update".

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.

Download firmware

→ For firmware updates, see **https://github.com/RF1000/Repetier-Firmware**. The latest firmware updates for the RF1000 and the RF2000 are provided there. You can choose between two "**Branches**":

"**Master**" is the last released version of the firmware.

"**Development**" is the version of the firmware that is currently subject to development.

The firmware link can also be reached in the custom software Repetier-Host under "**Help**" > "**RF1000 Firmware**".

- First, select the desired "**Branch**", click the button "**Clone or download**" and the "**Download ZIP**", in order to download the firmware. The downloaded archive always contains the firmware for the RF1000 and RF2000. Unpack the ZIP file.

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 "Disconnect").

Use only Arduino version 1.6.5. This is also included on the SD card (newest version).

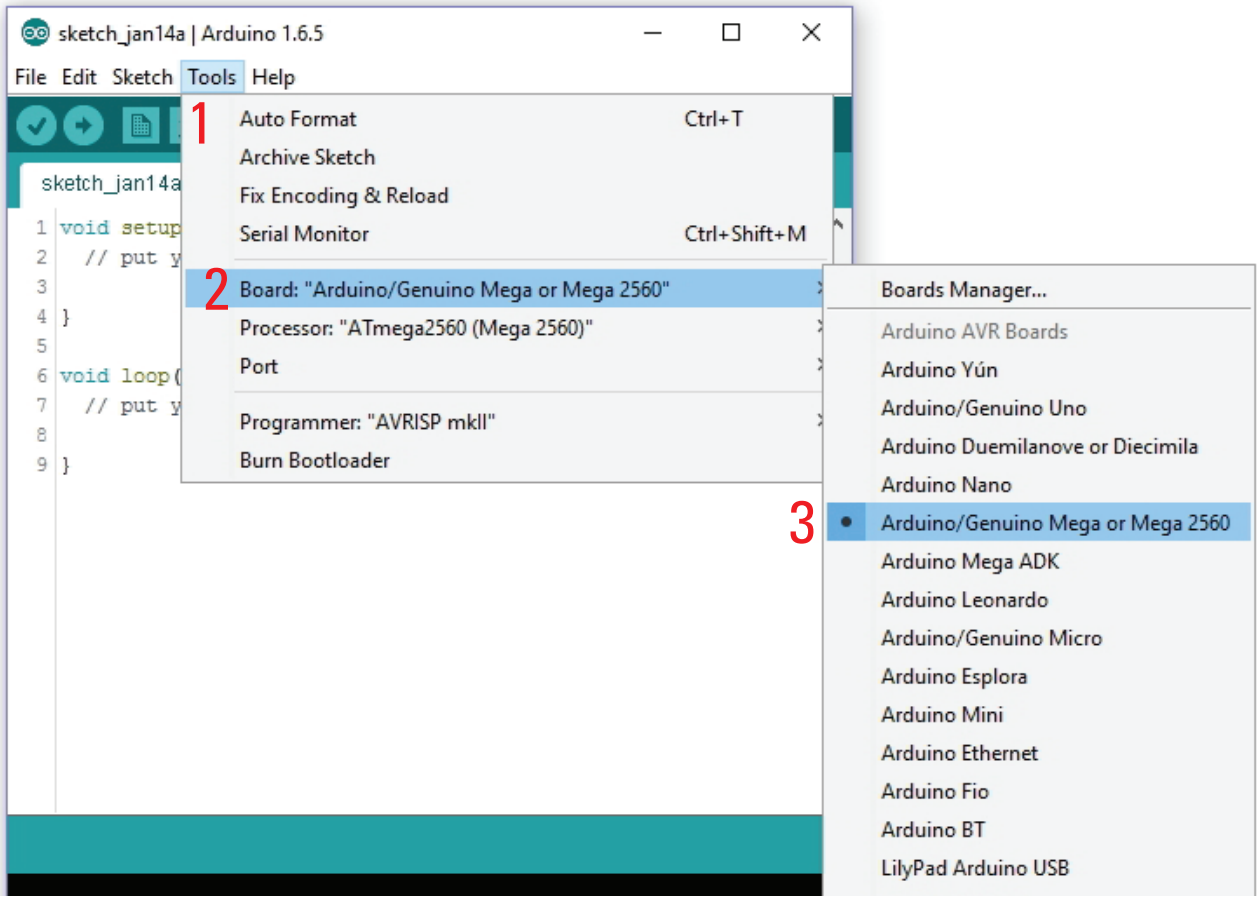
- Execute the file "**arduino.exe**", which is on the enclosed SD-card (folder "**Arduino**" and its version subfolders until you find the file "**arduino.exe**").

→ Alternativ download the newest version. 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.

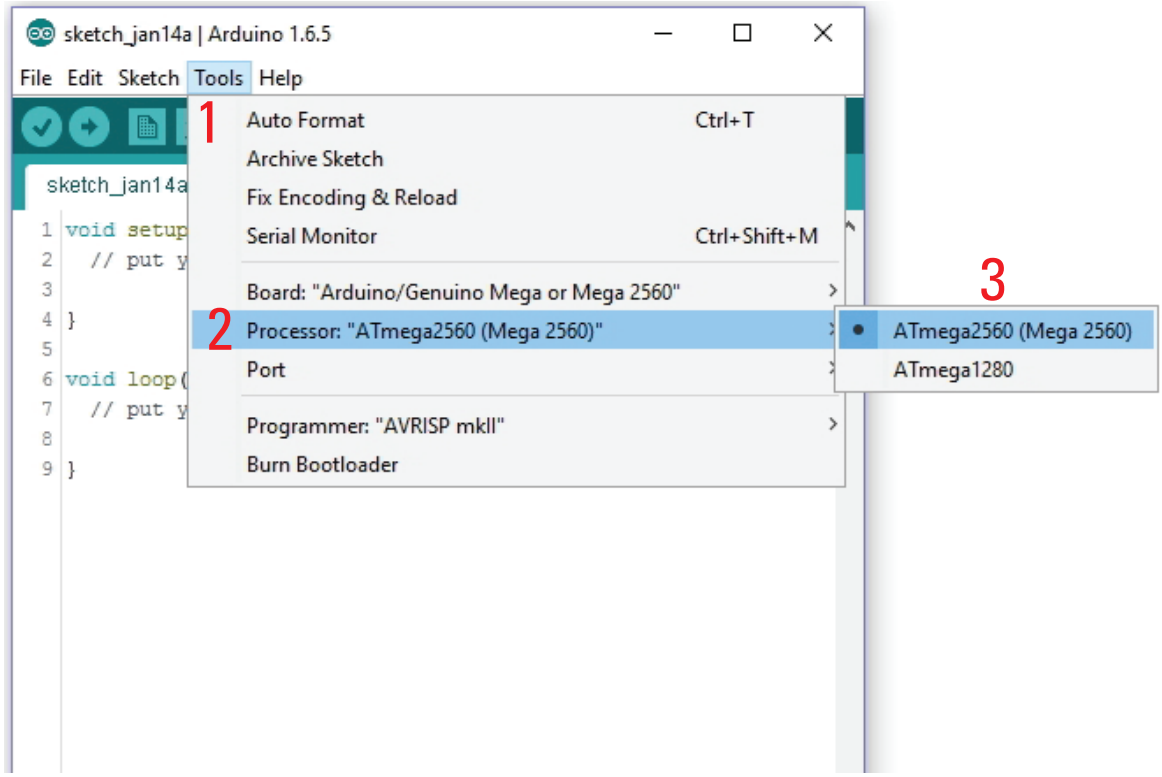
https://www.arduino.cc/en/Main/Software

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

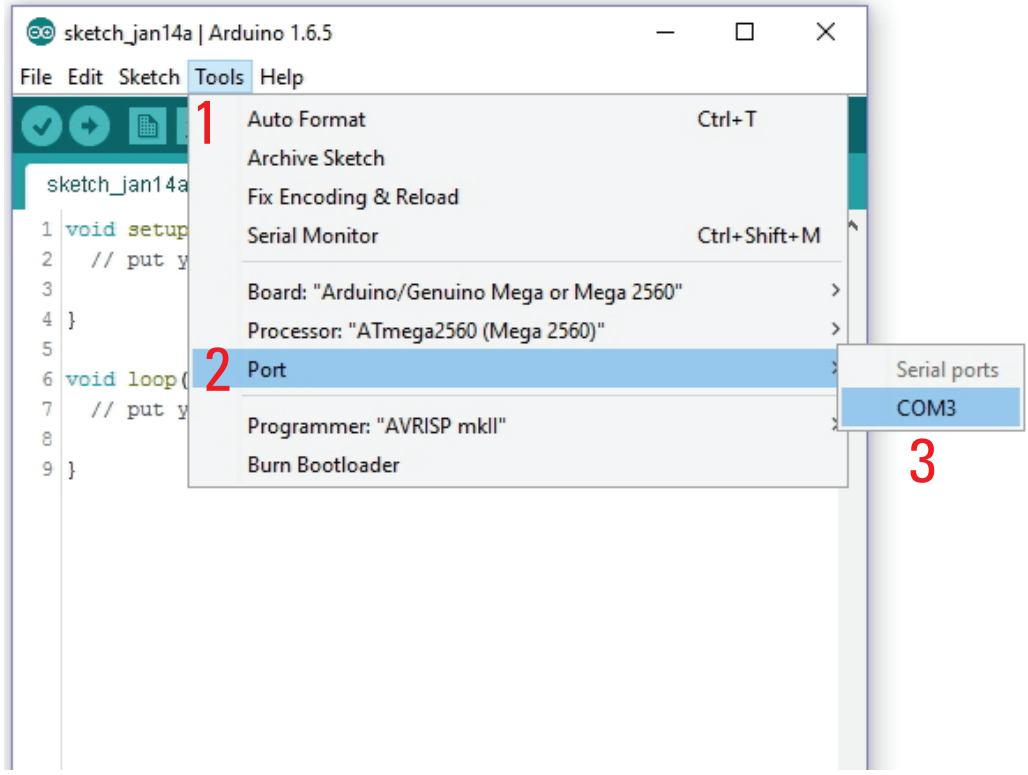
https://www.arduino.cc/download_handler.php?f=/arduino-1.6.5-r5-windows.exe



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

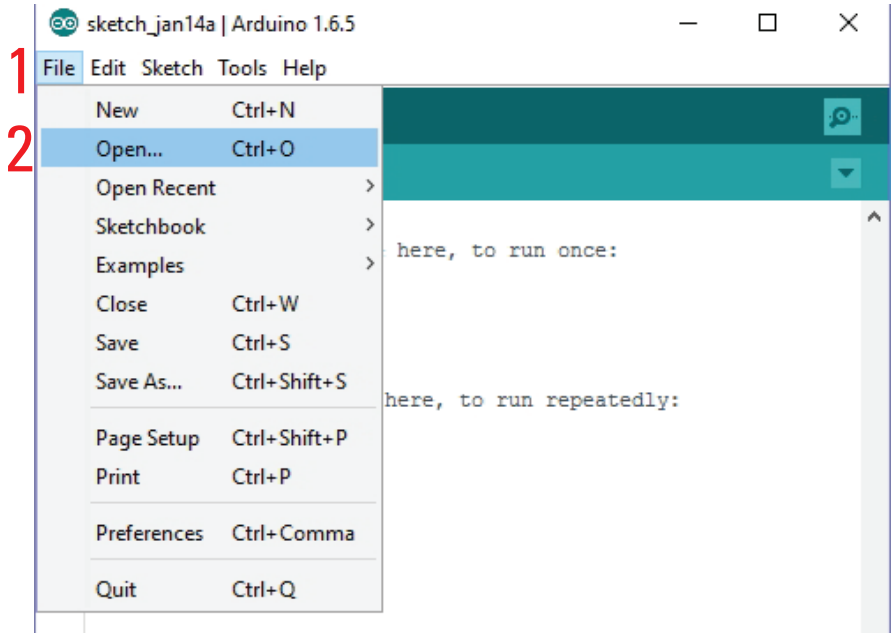


- In the menu "**Tools**" (1), select option "**Processor**" (2) and set the type "**ATmega2560 (Mega 2560)**" (3).



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

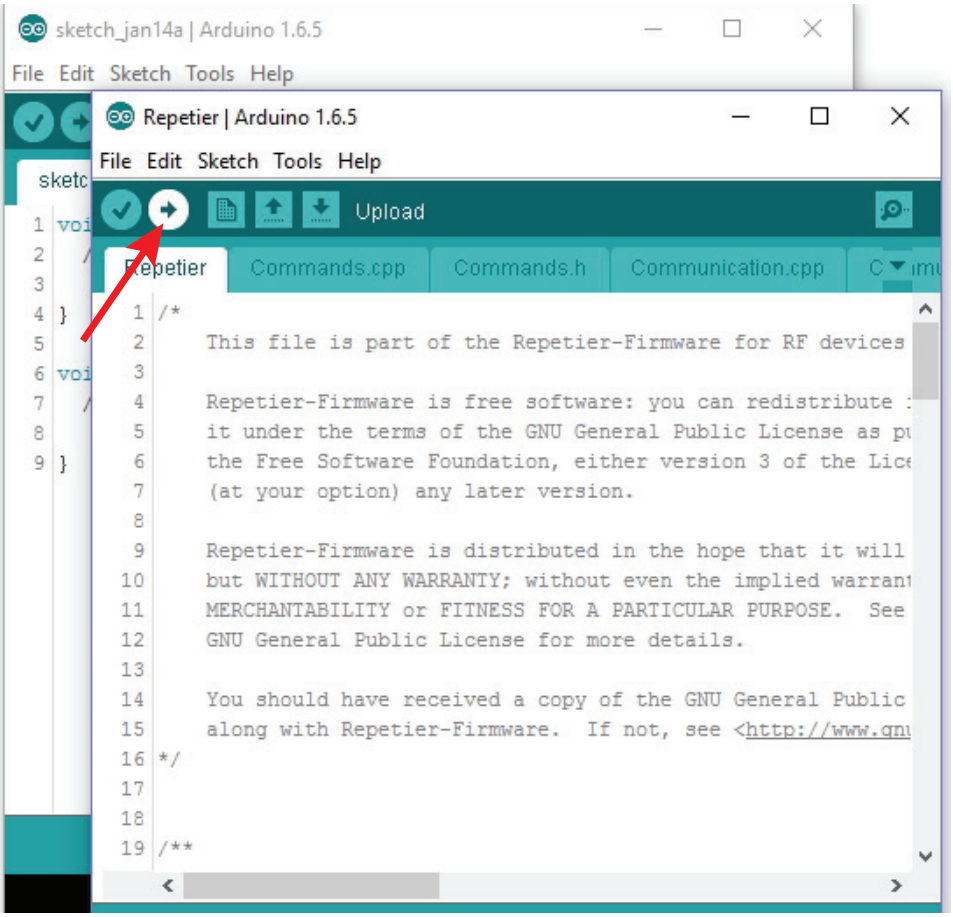
⟶ The port number is system-dependent. You can find it in the device manager of the control panel, under connections (COM and LPT).



- In the menu "**File**", choose the option "**Open...**" and select the file "**Repetier.ino**" from the downloaded firmware folder.

⟶ The file "**Repetier.ino**" can be found via the following file path: „**Repetier-Firmware-master\RF2000\Repetier**“

- 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 cable and the casing.

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

Always observe the following safety information before cleaning or servicing the 3D printer:

Live components may be exposed if covers are opened or components are removed.

The device must be disconnected from all power sources before any servicing or repair work is carried out.

Capacitors inside the device may still carry voltage even though they have been disconnected from all power sources.

Only qualified experts familiar with the hazards involved and the relevant regulations must perform repairs.

If you are working over the printing plate (for example, on the extruder), cover it with appropriate protection (e.g., a cardboard box).The printing plate can easily be destroyed by falling components (Loss of guarantee/warranty).

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

Attention: 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, ABS = 270 °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 and for ABS to approx. 110-130 °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 upwards 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, e.g. for a heat bed scan.

It is recommended to also wipe the nozzle a few times, e.g. with a paper towel, while cooling off.

Cleaning the heating plate

Attention: Danger of burns. Let the heating plate cool off before cleaning.

Clean and degrease the heating plate thoroughly with a soft rag and some acetone after each print.

c) Fuse Replacement

If you have to replace the fuse, ensure that you only use fuses of the specified type and rated current (see "Technical Data") as a replacement.

Never repair fuses or bridge the fuse holder.

- Unplug the mains plug from the mains socket and disconnect the low-voltage line from the low power device combination socket at the rear of the device.
- Using a suitable screwdriver to push the fuse holder out of the low power device combination socket carefully.
- Remove the defective fuse and replace it by a new fuse of the indicated type.
- Carefully push the fuse holder with the new fuse back into the low power device combination socket at the device.
- After this, you can reconnect the device to the mains voltage and take it into operation.

d) Checking the Belt Tension

- Check the tension of the drive belts now and then.
- If required, retention them by setting the belt tensioner with the setting screws so that the toothed belts can still be twisted by 180° easily with two fingers.

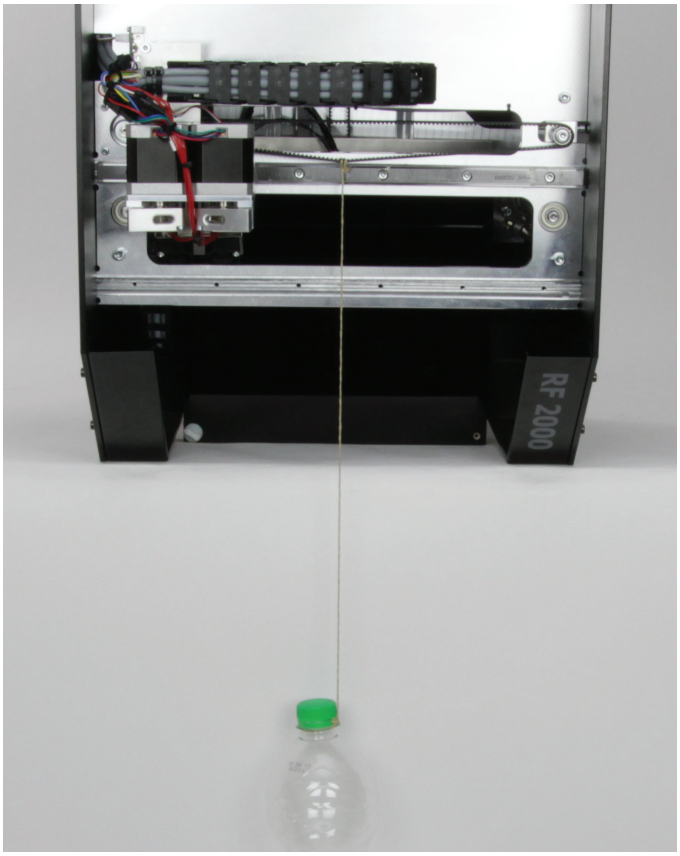
The toothed belts must not be tensioned too strongly. If a belt tensioner bends, the belt tension must be reduced under all circumstances.

Method for precise setting of the belt tension

For this, you need a weight of 1 kg, such as a water bottle filled with water to reach the specified weight of 1 kg. You also need a cord for attachment.

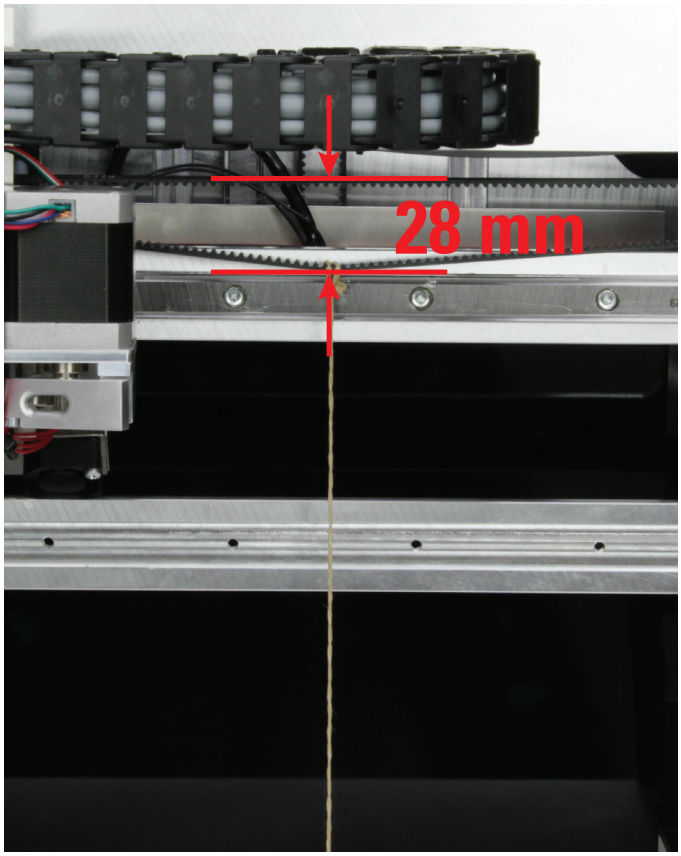
Fasten the die heating plate with the two plastic securing screws (wing screws PA6.6 nature M4x6 mm from the delivery), so that it cannot fall out and be damaged when the printer is tipped.

Place a soft support under the printer so that it is not scratched when tipping and so that it cannot damage the table top.

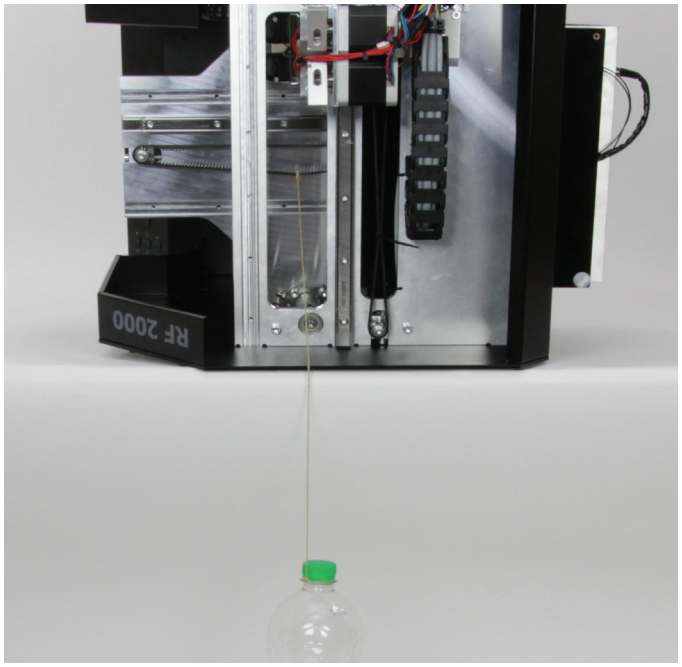


Now tip the printer to its front near the edge of the table and attach the weight in the middle to the part of the toothed belt for the X-direction that is now at the bottom using the cord.

The weight must be suspended so that it can move freely.



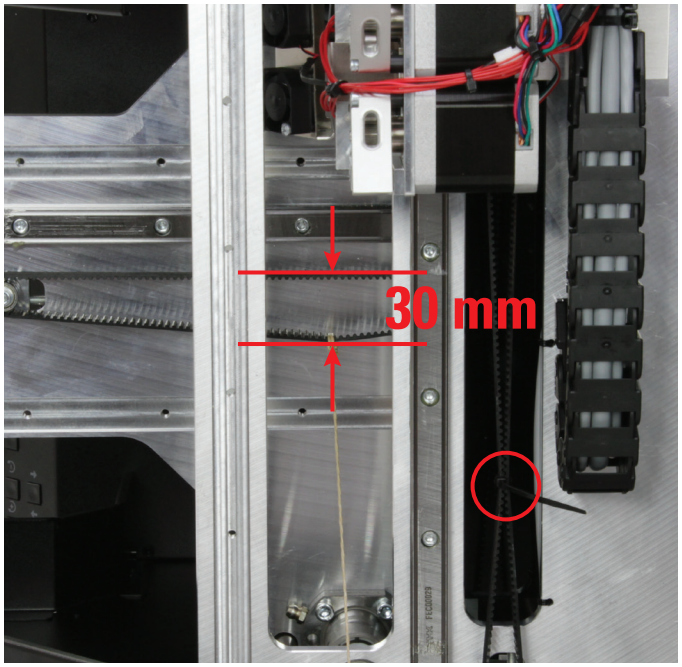
Measure the distance between the two toothed belt halves as illustrated. Set a distance of 28 mm with the belt tensioner (measured at the outside of the toothed belt).



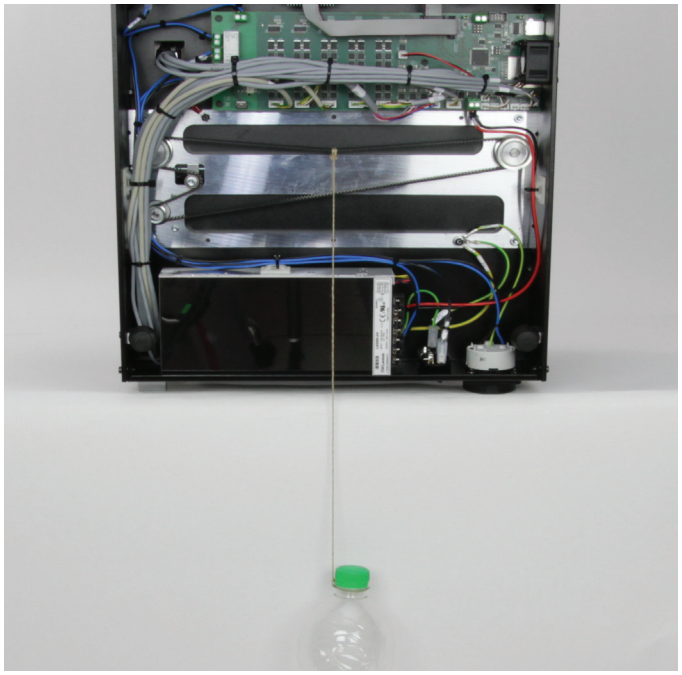
Now tip the printer to the right side near the edge of the table and attach the weight to the part of the toothed belt for the Y-direction that is now at the bottom using the cord.

For the extruder carriage to stay at the top as illustrated, simply bind the toothed belt together with a cable tie (see circle in the right image).

The weight must be suspended so that it can move freely. The string may touch the side part on top.

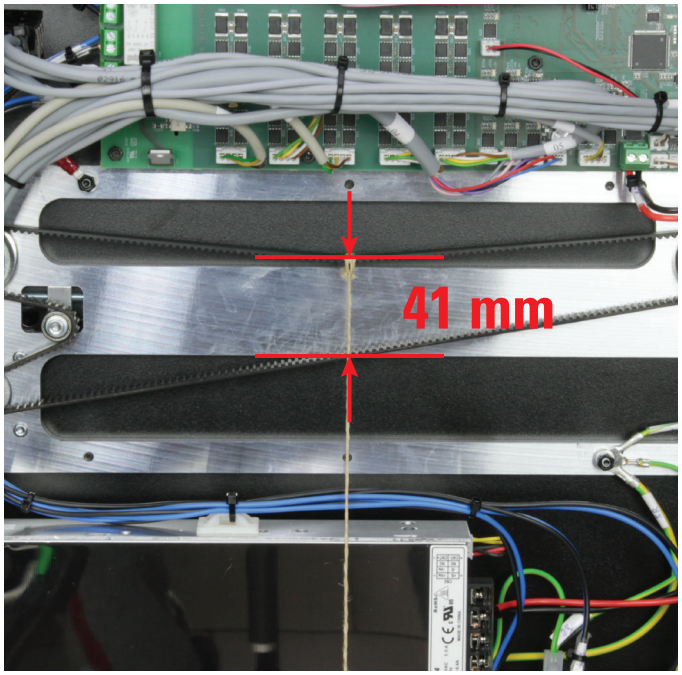


Measure the distance between the two toothed belt halves as illustrated. Set a distance of 30 mm with the belt tensioner (measured at the outside of the toothed belt).



Tip the printer onto its back close to the edge of the table and remove the bottom sheet. Attach the weight in the middle to the part of the toothed belt for the Z-direction that is now at the top with the cord.

The weight must be suspended to be freely movable but may touch the mains unit housing. This is not a problem.

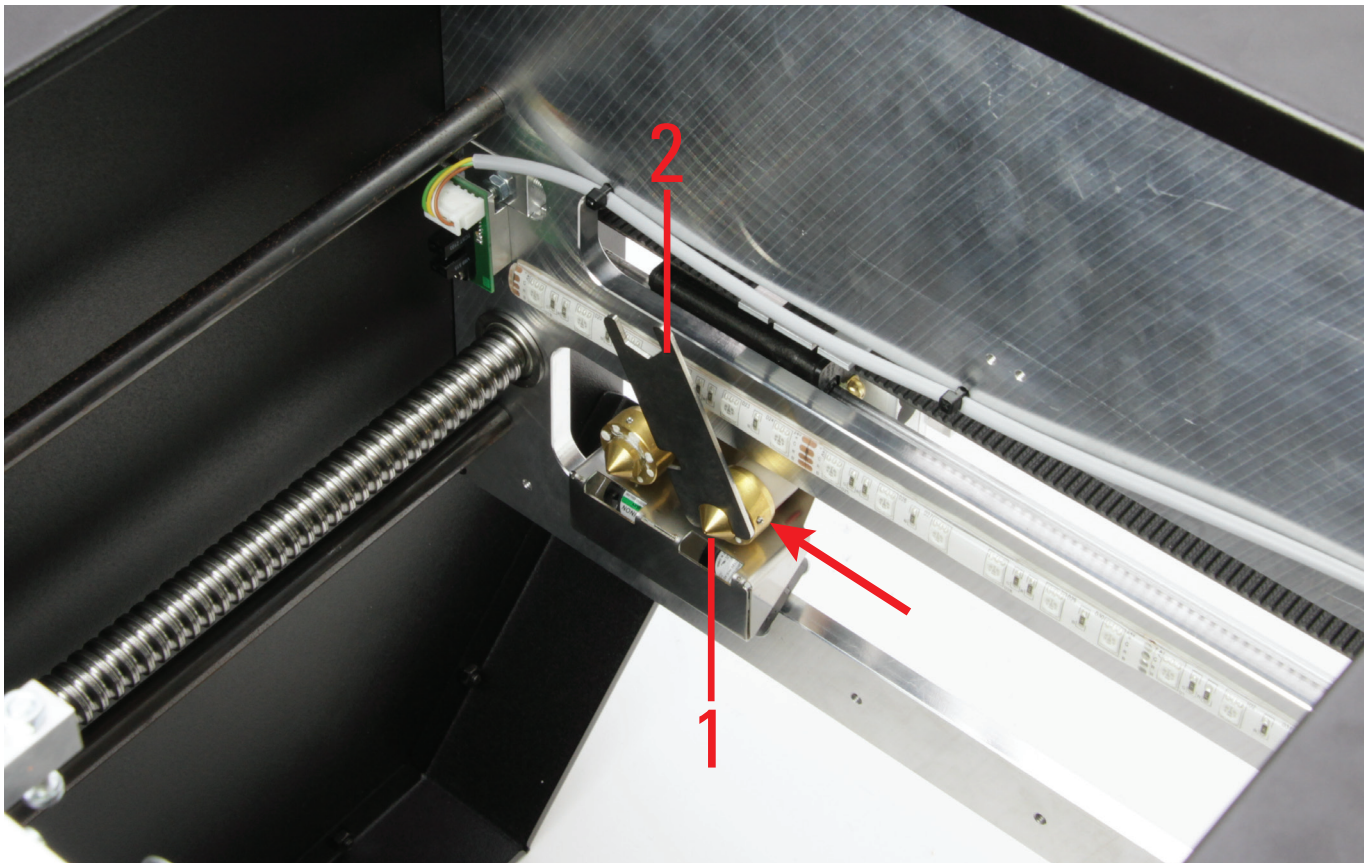


Measure the distance between the two toothed belt halves as illustrated. Set a distance of 41 mm with the belt tensioner (measured at the outside of the toothed belt).

e) Nozzle Change

Attention: 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 "15. c) Removing and Changing the Filament".
- Screw off the extruder nozzle (1) from the extruder with the enclosed 10 mm hexagon wrench (2). Make sure to secure the extruder against twisting with suitable pliers by the lower enclosure for this (see arrow). Do not damage the two threaded pins, however.



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.

- Clean the thread at the extruder of filament residue (e.g. with a brass brush).
- Insert a new seal into the new nozzle and carefully screw it onto the extruder. Secure the extruder against twisting again with suitable pliers.
- Carefully screw in the new extruder nozzle. Never apply any strong forces for this.
- Then insert the filament again as described in "Inserting the Filament".
- Switch off the extruder heating again and have the extruder cool off.

Views of the available 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 heat bed due to a printing error, and is scraped or damaged by this.

Nozzle 0.4 mm (standard) - two marking rings

Nozzle 0.5 mm - no marking ring

Nozzle 0.3 mm - one marking ring

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 switching on. The display and print space lighting remain dark:

- Check the connection of the mains line.
- Check the mains socket. Is it properly supplied with current?
- Check the mains fuse (also see "Fuse change" in chapter "21. Maintenance").

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 ball-threaded drives make strange sounds or run stiffly:

- Check that the Y-plate is in parallel to the bottom plate.
- Installation may cause the two ball-threaded drives and the Y-plate to be tensed against each other.

  Release the 4 screws that hold the ball-threaded drives to the Y-plate on both sides until you can move the Y-plate.

  Then tighten all screws crosswise in sequence, first slightly and then firmly again.

⟶ Perform calibration and the heat bed scan in any case!

Calibration of the heating plate stops. The display shows the message "Scan aborted":

- No filament must be inserted during calibration! Remove the filament if necessary and repeat the heat bed scan.
- The extruder nozzle must be clean from the outside (if required, heat and wipe off first – caution: hot nozzle!)
- Perform the basic settings of the limit switch for the Z-direction again (see chapter "11. Final Work"). The plate distance must not be too large.
- Repeat setting of the distance between the nozzle and the heating plate (see chapter "14. Calibration").
- The extruder housing (hot end) or its connection cable may touch other parts. In this case, loosen the screws of the extruder holder and the screws at the basic infeed part, and align the parts so that they do not touch any other components.
- The connection lines of the extruders and the fan may be placed with too much tension.

  The cables must be placed loosely and without any tension. Every movement of the cables will cause the measured values of the strain gauges (DMS) to change. If necessary, tighten the cables a little more to produce a nice loop at the front of the extruder carriage and to make sure that the cables are not tensed.

- The strain gauges (DMS) may have been installed tensed. Proceed as follows to check this (no filament must be inserted):

  Note the measured value of the strain gauges. This is the value "F" (6) in the main menu. It is indicated in "digit". Push the extruder carriage or the strain gauges and the extruder holder from above and below, from the left and right. After the value has changed when pushing, it must approximately return to the starting position. The difference from the starting value should not exceed 10 digits.

  Next, push the extruder carriage from the left to the right bit by bit. The DMS value should be about the same in each Y-position. The difference should not be more than 10 digits.

  If you find in one of the two tests that the value deviates too far, release all screws of the strain gauges and then tighten them again evenly.

⟶ No filament must be inserted for any of the tests and when releasing the screws!

The print has defects:

- Check the extruder and heating bed temperature settings. 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 heating plate and extruder is set incorrectly. Perform Z 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.

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 grub screw may have come loose. If the feed knurl slips in spite of the grub screw being tightened, slightly file down the motor axis in the area of the grub screw to reduce slippage.
- Check that the filament material runs into the extruder from above cleanly. It must be able to run past the extruder motor from above and into the bore of the extruder without scraping or clamping anywhere. If this is not the case, loosen the screws of the extruder holder and the screws at the feed basic part and align the parts so that the filament is cleanly inserted into the extruder.
- The extruder-nozzle is clogged. Heat up the extruder and actuate the manual feed 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.

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).
- If the value measured by the printing sensors at the extruder exceeds a threshold, the printer will automatically switch to pause mode for reasons of safety. Printing can be started again by pushing the button for continuing printing (play button). If this happens frequently, the print sensors are installed under tension. In this case, loosen the screws of the print sensors and then retighten them evenly.

The printed object does not adhere to the heating plate:

- The temperature of the heating plate is 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 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.
- There are residues on the heating plate that prevent adhesion of the object. Rub the heating plate with a soft cloth that is soaked with a solvent (e.g. acetone).
- The heating plate has not reached the set temperature yet.
- At PLA printing of small objects with a small footprint, it is recommended to apply the heating plate with cleaning tape or a slightly structured crepe tape before printing. This increases adhesion of the printed object on the base plate.

The printed object cannot be removed from the heating plate:

- Wait until the heating plate has cooled down to less than 40 °C.
- Use a glass scraper or a knife to remove the object.

There are problems when printing ABS:

- ABS-printing is very sensitive to drafts. This may cause the printed object to deform, the print to be interrupted and in the worst case cause damage to the glass ceramics.

  Therefore, we recommend keeping drafts as low as possible. This is most easily done with the optional "Housing" (Conrad item no. 1407356).
- Let the printed object cool off slowly and evenly after completion before you remove it from the heat bed.
- Use suitable adhesive tape, e.g. Kapton tape or blue crepe tape (Conrad item no. 1093104).

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 heating plate and the extruders may heat up strongly in operation. Do not touch these parts during or just after operation. Let these parts cool off first.

24. Disposal

The product does not belong in the household waste!

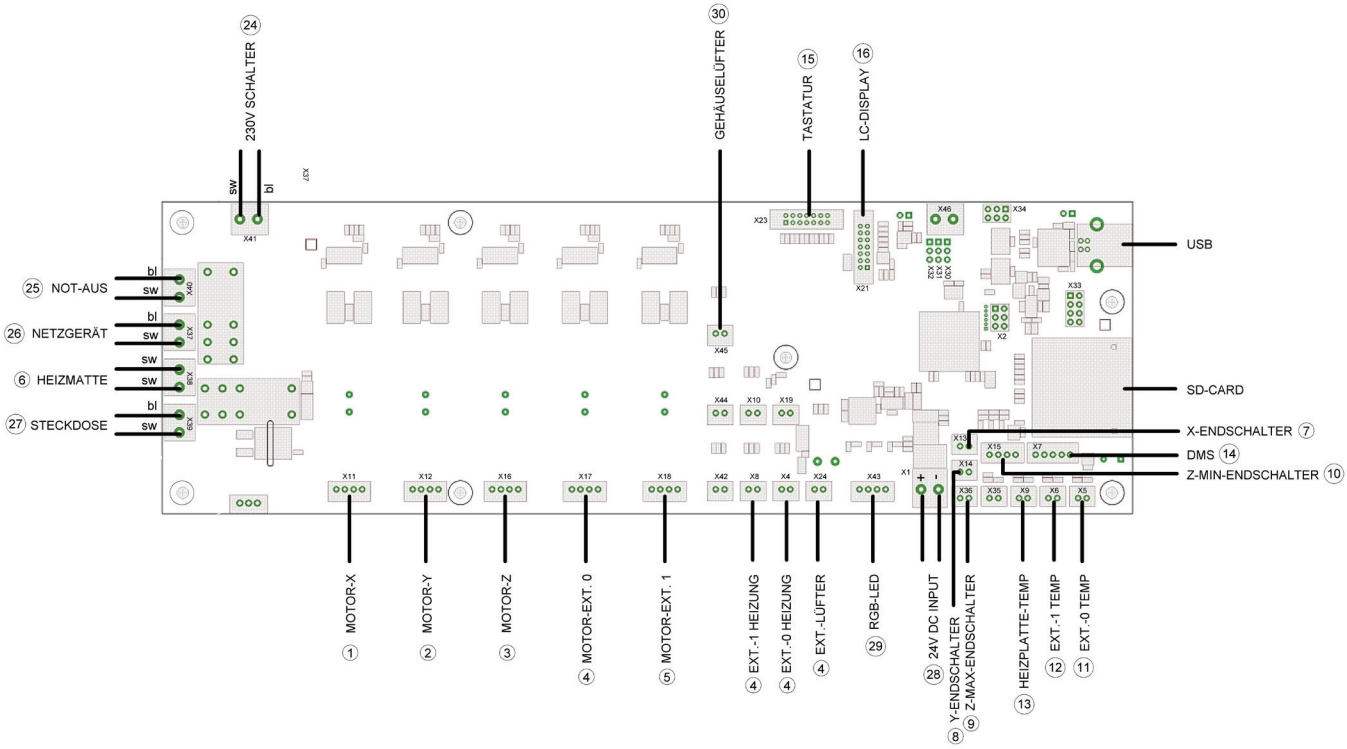
Dispose of the product according to the relevant statutory regulations at the end of its service life.

25. Technical Data

Operating voltage	230 V/AC, 50 Hz
Power intake 3D printer	max. 700 W
Connection output socket	max. 800 W
Total power intake	max. 1500 W
Fuse	T6.3AL/250 V (5 x 20 mm, slow-acting trigger)
Production process	FFF (Fused Filament Fabrication) / FDM (Fused Deposition Modelling)
Printing space (D x W x H)	approx. 230 x 180 x 200 mm
Printing layer thickness	0.05 - 0.3 mm
Nozzle diameter	0.4 mm
Suitable filament material	ABS, PLA, PVA, EcoPLA™, PET, Taulman, Layrick, Bendlay, Laywood-D3, HIPS and smartABS
Filament diameter	Standard max. 3 mm; optional 1.75 mm with separately available extruders
Power of the heating plate	450 W
Extruder temperature	120 – 270 °C
Heating plate temperature	55 – 160 °C
Interfaces	USB 2.0 and SD/SDHC card reader
Dimensions (W x H x D)	375 x 500 x 410 mm
Weight	19.5 kg

26. Annex

a) Wiring Plan of the Main PCB



Abbreviations used

230 V SWITCH = This is where the cable from the low-power device combination socket is connected.

EXT. = extruder

DMS = elongation measuring strip

Z-MAX LIMIT SWITCH = Limit switch installed at the bottom of the Y-plate

Z-MINLIMIT SWITCH = Limit switch installed at the bottom of the X-plate (light barrier)

The number designations at the lines correspond to the cable marks at the individual cables.

b) Notes on the Print Files (G-Code Files) on the Enclosed SD Card

The folder "**GCODE**" on the enclosed SD card holds various finished printing files.

These files do not need to be sliced with a software like the repetier host first. They can be printed right from the SD card (also see "16. First Print of an Example Object from the SD Card").

The files are enclosed in the folder "**GCODE**" and "**PLA**".

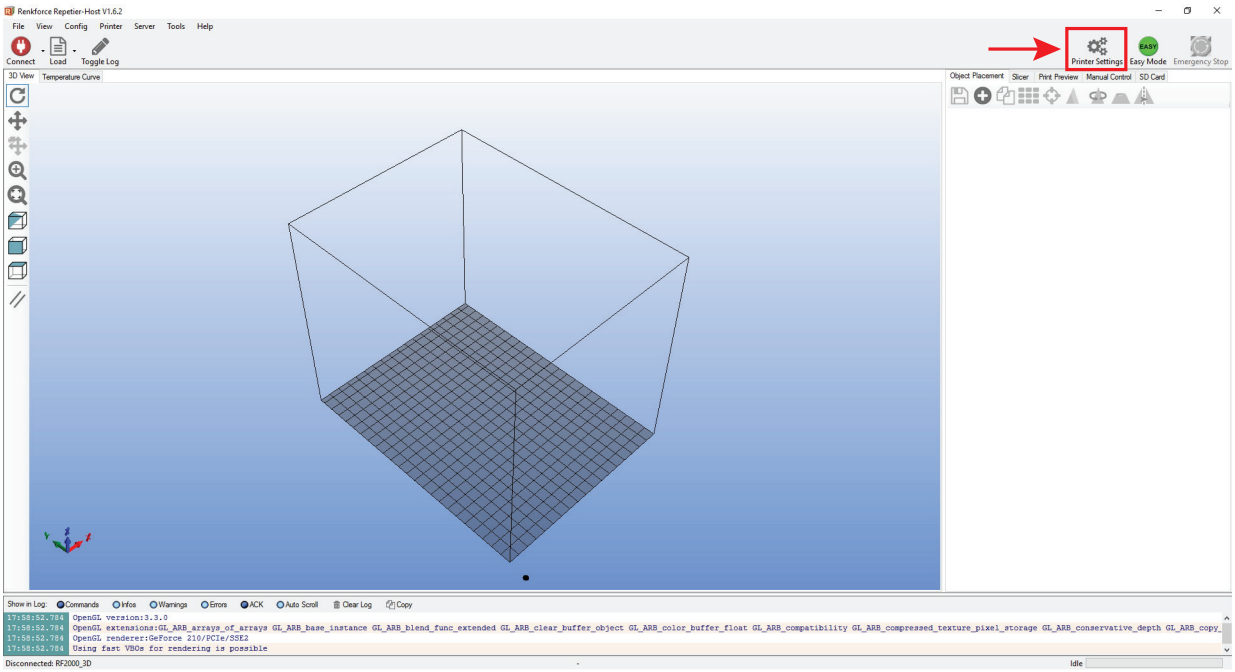
Example: Heart.gcode in the folder PLA = small heart for printing with PLA filament

⟶ **Please update the enclosed memory card before using the files. The corresponding download can be found on the respective product page of our website or in the download area.**

c) Setup of 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.

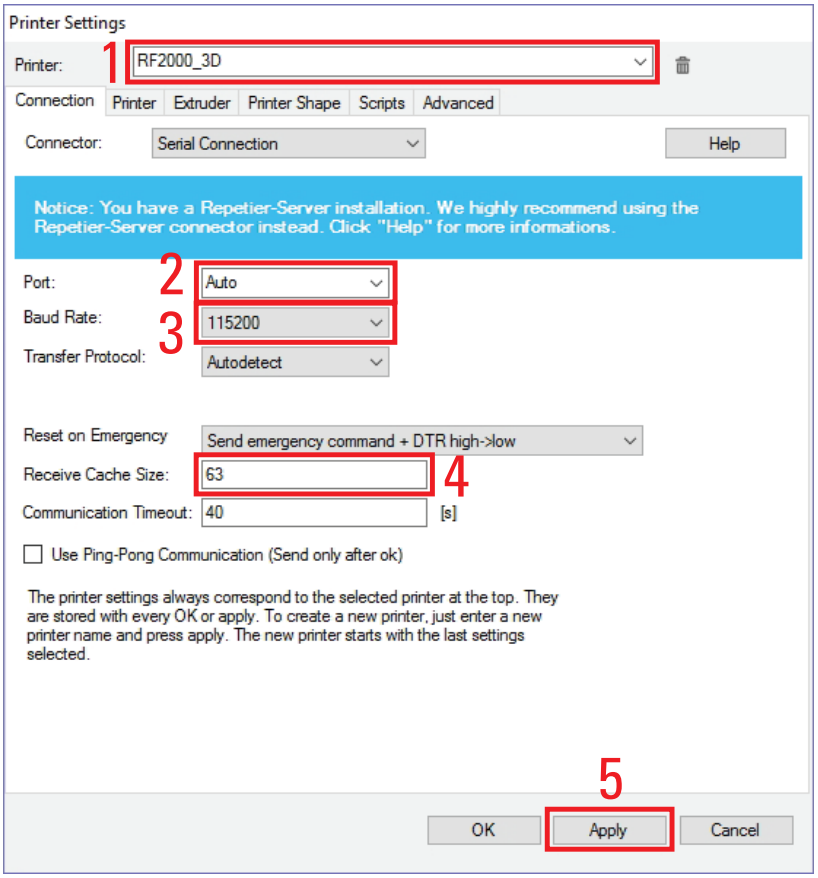


- Name your printer as RF2000_3D (1) in the following window in tab "**Connection**" or assign a name of your own.
- Set the port and baud rate. The baud rate must be set to "**115200**" (3).

→ 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).

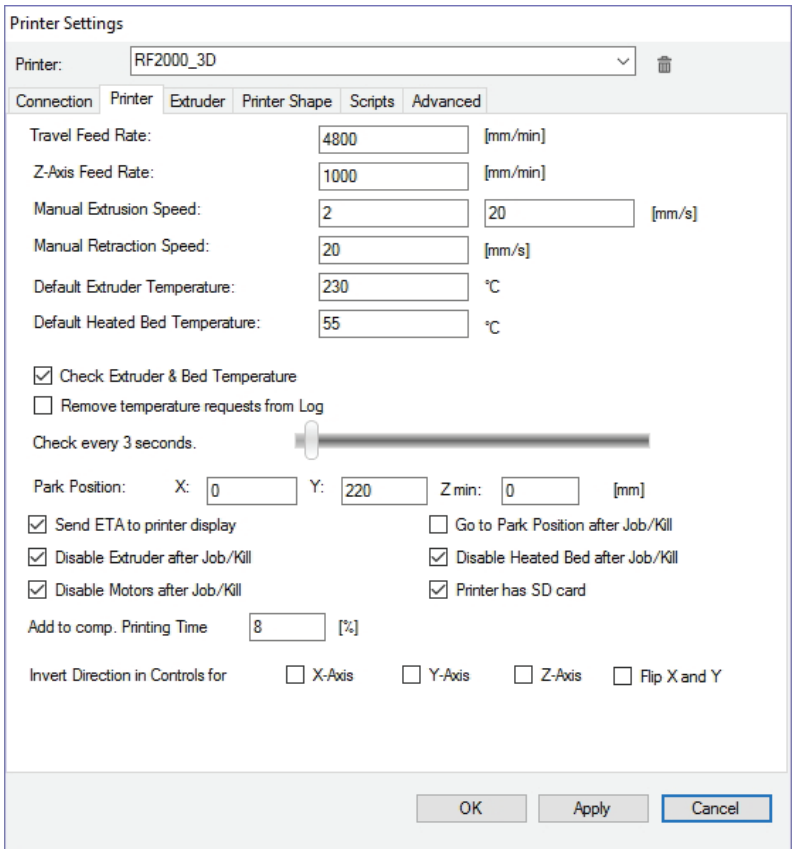
Then set the COM-port from the device manager in the software.



- Set the receiver cache size as shown (4).
- Click "**Apply**" (5).

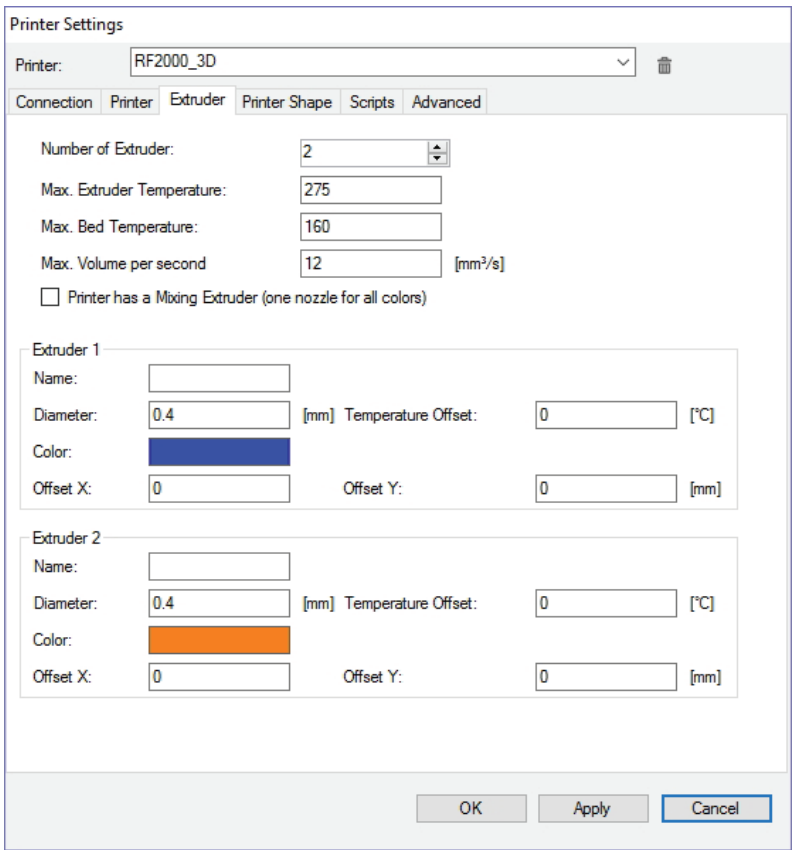
Click the tab "**Printer**".

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



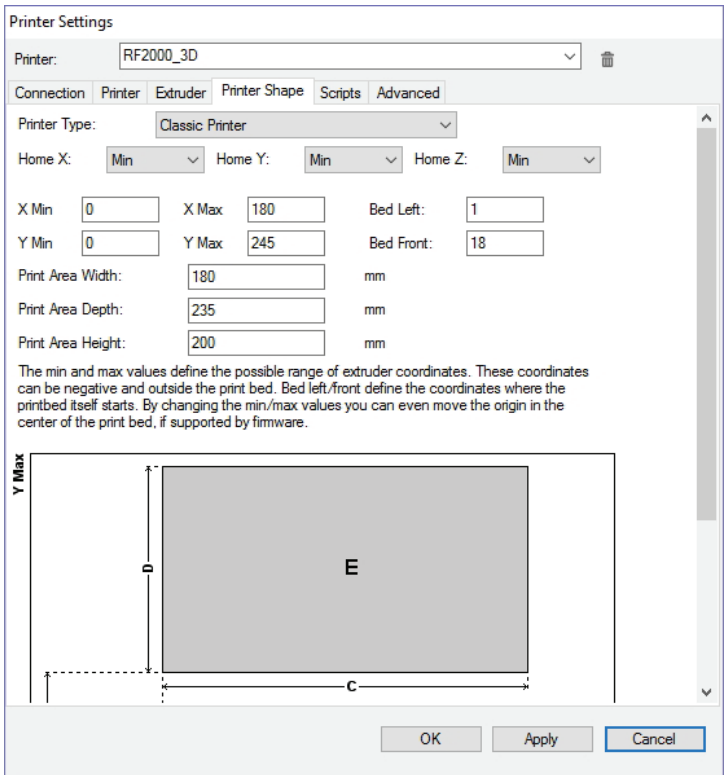
Click the tab "**Extruder**".

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



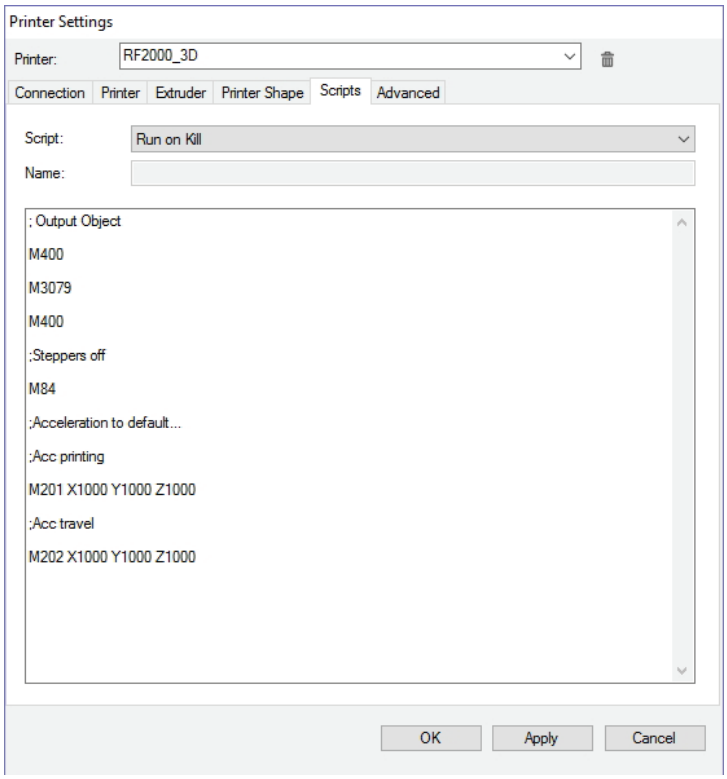
Click the tab "**Printer Shapes**".

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.



If you configure the slicer settings yourself, enter the following text here under "**Runs after cancellation**":

; Output Object
M400
M3079
M400
;Steppers off
M84
;Acceleration to default...
;Acc printing
M201 X1000 Y1000 Z1000
;Acc travel
M202 X1000 Y1000 Z1000

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

Click "**OK**".

d) Status and Error Messages

⟶ Some of the messages are displayed for a certain time and will then disappear again on their own. Other messages, such as those starting with "Error:", are displayed until the user confirms them. Briefly push the button "**OK**" (2).

Status Messages

(Are displayed on the printer display)

Printer ready.	Is shown when the RF is ready for printing.
Miller ready.	Is shown when the RF is ready for milling.
Heating Extruder	Is displayed when an extruder heater has been activated because M109 has been received.
Heating Bed	Is displayed when a bed heater has been activated because M190 has been received.
Home X	Is displayed when the RF is homing the x-axis.
Home Y	Is displayed when the RF is homing the y-axis.
Home Z	Is displayed when the RF is homing the z-axis.
Killed	Is displayed when the RF was switched off the motors and radiators because it: - has not performed any commands for a while This "while" can be set via M85 or the "All off" menu. - the operating mode (printing/milling) has switched
Stepper disabled	Is displayed when the RF has switched off the motors because it: - has not performed any commands for a while This "while" can be set via M85 or the "All off" menu. - the operating mode (printing/milling) has switched
Heat Bed Scan	Is displayed while the heat bed scan is active.
Align Extruders	Is displayed at the end of the heat bed scan when the user must align the two extruders.
Scan completed	Is displayed when the heat bed scan has been completed successfully.
Scan aborted	Is displayed when the heat bed scan has been cancelled. For more information on the errors that occurred, see the log file of the repetier host.
Work Bed Scan	Is displayed while the work piece scan is active.
Scan completed	Is displayed when the work piece scan has been completed successfully. For more information on the errors that occurred, see the log file of the repetier host.
Scan aborted	Is displayed when the work piece scan has been cancelled.
Preheat PLA	Is displayed when the extruder and heat bed are heated to PLA temperatures because the menu item "Preheat PLA" has been chosen.
Preheat ABS	Is displayed when the extruder and heat bed are heated to ABS temperatures because the menu item "Preheat ABS" has been chosen.
Cooldown	Is displayed when the extruder and heat bed are switched off because the menu item "Cooldown" has been chosen.
Printing…	Is displayed when printing is active.
Milling…	Is displayed when milling is active.
Paused	Is displayed when the current print/milling process has been paused.
Unload Filament	Is displayed when the filament is output because the menu item "Unload Filament" has been chosen.
Load Filament	Is displayed when the filament is pulled in because the menu item "Load Filament" has been chosen.
Find Z Origin	Is displayed during the search for the Z-origin.
Search completed	Is displayed when the search for the Z-origin has been successfully completed.
Search aborted	Is displayed when the search for the Z-origin has been cancelled. For more information on the errors that occurred, see the log file of the repetier host.
Start Miller	Is displayed when the user is to switch on the miller.
Test SG	Is displayed while the DMS test is active.
Test completed	Is displayed when the DMS test has been completed successfully.
Test aborted	Is displayed when the DMS test has been cancelled. For more information on the errors that occurred, see the log file of the repetier host.

SD Card removed	Is displayed when the RF recognises that the SD card has been removed.
SD Card inserted	Is displayed when the RF recognises that the SD card has been inserted.
Uploading…	Is displayed when a file is transferred to the SD card.
SERVICE	Is displayed when the firmware finds at activation that the service interval has been reached (or exceeded). This function is currently switched off by default.

Error Messages

(Are either displayed in the printer display or in the log file of the repetier host software)

Error: Set Origin Home unknown	Is displayed when the origin cannot be set because the home position is not known. Can be caused by: - G92 - M3115 - the menu item "Set XY Origin"
Error: Heat Bed Scan Operation denied	Is displayed when someone tries to start the heat bed scan while printing is active. Can be caused by: - M3010 - the menu item "Scan Heat Bed"
Error: Heat Bed Scan Saving failed	Is displayed when the determined matrix could not be saved after the heat bed scan. This error theoretically should never happen.
Error: Work Part Scan Operation denied	Is displayed when someone tries to start the work piece scan while milling is active. Can be caused by: - M3150 - the menu item "Scan Work Part"
Error: Work Part Scan Saving failed	Is displayed when the determined matrix could not be saved after the work piece scan. This error theoretically should never happen.
Error: Output Object Operation denied	Is displayed when someone tries to start output object while printing/milling is active. Can be caused by: - M3079 - the menu item "Output Object"
Error: Output Object Home unknown	Is displayed when the output object is not possible because the home position is not known. Can be caused by: - M3079 - the menu item "Output Object" - when printing/milling from the SD card has been completed
Error: Park Heat Bed Operation denied	Is displayed when someone tries to start park head bed while printing/milling is active. Can be caused by: - M3080 - the menu item "Park Heat Bed" This function is currently switched off by default.
Error: Pause Home unknown	Is displayed when printing/milling cannot be paused because the home position is not known. Can be caused by: - M25 - Emergency Pause - the menu item "Pause Print" - the menu item "Pause Mill" - the hardware button "Pause" This error theoretically should never happen.
Error: Pause Operation denied	Is displayed when printing/milling cannot be paused because printing/milling is not currently active. Can be caused by: - M25 - the hardware button "Pause"

Error: Z Compensation Invalid Matrix	Is displayed when the Z-compensation cannot be activated (or the Z-compensation matrix cannot be displayed) because the Z-compensation matrix is not present or invalid. Can be caused by: - M3001 - M3013 - M3141 - M3153
Error: Z Compensation Home unknown	Is displayed when Z-compensation cannot be activated because the home position is not known. Can be caused by: - M3001 - M3141
Error: Change Mode Operation denied	Is displayed when the operating mode cannot be changed because: - printing/milling is underway - a heat bed scan is underway - a work piece scan is underway - search for the z-origin is underway - the DMS-test is underway Can be caused by: - the menu item "Mode"
Error: Change Z Type Operation denied	Is displayed when the Z-type cannot be changed because printing/milling is currently underway. Can be caused by: - the menu item "Z Type"
Error: Change Hotend Operation denied	Is displayed when the hotend type cannot be changed because printing is currently underway. Can be caused by: - the menu item "Hotend"
Error: Change Miller Operation denied	Is displayed when the mill type cannot be changed because milling is currently underway. Can be caused by: - the menu item "Miller"
Error: Delete File Operation denied	Is displayed when a file cannot be deleted from the SD card because printing/milling is currently underway. Can be caused by: - M30 - the menu item "Delete File"
Error: X-Axis Home unknown	Is displayed when the X-axis cannot be moved because the home position is not known. Can be caused by: - the menu item "Position X"
Error: X-Axis Operation denied	Is displayed when the X-axis cannot be moved because printing/milling is currently underway. Can be caused by: - the menu item "Position X"
Error: X-Axis Min reached	Is displayed when the X-axis cannot be moved because the X-min has tripped. Can be caused by: - the menu item "Position X"
Error: X-Axis Max reached	Is displayed when the X-axis cannot be moved because the maximum X-position is already reached. Can be caused by: - the menu item "Position X"
Error: Y-Axis Home unknown	Is displayed when the Y-axis cannot be moved because the home position is not known. Can be caused by: - the menu item "Position Y"
Error: Y-Axis Operation denied	Is displayed when the Y-axis cannot be moved because printing/milling is currently underway. Can be caused by: - the menu item "Position Y"
Error: Y-Axis Min reached	Is displayed when the Y-axis cannot be moved because the Y-min has tripped. Can be caused by: - the menu item "Position Y"
Error: Y-Axis Max reached	Is displayed when the Y-axis cannot be moved because the maximum Y-position is already reached. Can be caused by: - the menu item "Position Y"

Error: Z-Axis Home unknown	Is displayed when the Z-axis cannot be moved because the home position is not known. Can be caused by: - the menu item "Position Z" - the hardware button "up" - the hardware button "down"
Error: Z-Axis Operation denied	Is displayed when the Z-axis cannot be moved because the bed would then run into the extruder. Can be caused by: - the menu item "Position Z" - the hardware button "up"
Error: Z-Axis Min reached	Is displayed when the Z-axis cannot be moved because the Z-min has tripped. Can be caused by: - the menu item "Position Z" - the hardware button "up"
Error: Z-Axis Max reached	Is displayed when the Z-axis cannot be moved because: - Z-max has tripped - the maximum Z-position has been reached Can be caused by: - the menu item "Position Z" - the hardware button "down"
Error: Extruder Operation denied	Is displayed when the extruder cannot be moved because it is too cold. Can be caused by: - the hardware button "Extract" - the hardware button "Retract" - the menu item "Load Filament" - the menu item "Unload Filament" - the menu item "Position Extruder"
Error: Determine PID Temperature wrong	Is displayed when it is found during automatic determination of the PID values that the actual temperature is getting too high. Can be caused by: - M303
Error: Determine PID Timeout	Is displayed when automatic determination of the PID values cannot be completed within 20 minutes. Can be caused by: - M303
Error: Temperature Manager Sensor Error	Is displayed when a temperature sensor error is found (= the sensor returns a temperature < -10 or > +300 °C). The firmware must be restarted before the temperature sensors will be evaluated again.
Error: Emergency Z Block	Is displayed when all other movements in Z-direction are blocked due to too-high DMS values. The firmware must be restarted before movement in the Z-direction is possible again.
Warning: Emergency Pause	Is displayed when the current print/milling process has been paused due to too-high DMS values. To continue printing/milling, push the "Continue" button.
Heating up…	Is displayed when the firmware is waiting after starting the heat bed scan until the extruder and/or the heat bed has heated up.
Cooling down…	Is displayed when the firmware is waiting after starting the heat bed scan until the extruder and/or the heat bed has cooled off.
Outputting…	Is displayed when Output Object is being executed.
Pausing…	Is displayed when moving to the Pause-Position.
Continuing…	Is displayed when moving to the Continue-Position.
Driving free Z	Is displayed when Z-Max - is cleared in the scope of Z-homing - is cleared after the end of printing/milling
PID determined	Is displayed when automatic determination of the PID-values has been successfully completed.

e) Recommended Tightening Torque of the Screws

Description	Thread size	Torque
Attachment of the threaded pin to the motor pinion	M3	0.7 Nm
Attachment of the ball bearing for belt tensioner to the basic body	M4	3 Nm
Attachment of the spacer to the bottom plate	M5	5.4 Nm
Attachment of the actuator to the bottom plate	M3	1.7 Nm
Attachment of the ball bearing to the belt tensioner basic body	M4	3 Nm
Attachment of the guide rail to the X-plate	M4	3.5 Nm
Attachment of the limit switch to the limit switch holder	M2	0.3 Nm
Attachment of the limit switch holder to the X-plate	M3	1 Nm
Attachment of the belt holder to the guide carriage plate	M3	1.1 Nm
Attachment of the infeed holding block to the guide carriage plate	M4	4 Nm
Attachment of the guide carriage plate to the guide carriage	M4	4 Nm
Attachment of the actuator to the X-plate	M3	1.7 Nm
Attachment of the extruder holder to the strain gauges	M5	5.4 Nm
Attachment of the holding plate for the end stop with strain gauge to the guide carriage plate	M4	3 Nm
Attachment of the end stop to the holder plate for end stop actuation	M4	3 Nm
Attachment of the drag chain end piece to the holder for the end stop	M4	1.2 Nm
Attachment of the threaded pin to the small pinion on the actuator motor	M3	0.7 Nm
Attachment of the motor to the motor holder and the spring holding block (cylinder head screw)	M3	1.7 Nm
Attachment of the motor to the motor holder and the spring holding block (recessed-head screw)	M3	1.5 Nm
Attachment of the motor to the motor holder and the ball-bearing holder (cylinder head screw)	M3	1.7 Nm
Attachment of the motor holder to the infeed holding block	M4	4 Nm
Attachment of the extruder	M4	3 Nm
Attachment fan to fan sheet	until the screw is flush with the fan	
Attachment of the motor to the motor holder and the fan sheet	M3	1.7 Nm
Attachment of the light barrier holding block to the X-plate	M2	0.3 Nm
Attachment of the ball bearing to the belt tensioner basic body	M4	3 Nm
Attachment of the guide rail to the Y-plate	M4	3.5 Nm
Attachment of the actuator to the Y-plate	M3	1.7 Nm
Attachment of the drag chain end piece to the holding block for the guide rail	M3	1.2 Nm
Attachment of the holding block for the guide rail with limit switch holding block to the Y-plate	M3	1.9 Nm
Attachment of the drag chain end piece to the Y-plate	M3	1.2 Nm
Attachment of the actuation for the end stop to the Y-plate	M4	3.4 Nm
Attachment of the hexagon threaded bolts for the limit switch actuation to the Y-plate	M3	1.1 Nm
Attachment of the holder for the limit switch holder	M2	0.3 Nm
Attachment of the undertable holder to the limit switch holder	M3	1.1 Nm
Attachment of the undertable holder to the belt tappet angle	M3	1.1 Nm
Attachment of the drag chain end piece to the undertable	M3	1.2 Nm
Attachment of the undertable to the Y-plate with the guide carriage	M4	4 Nm
Attachment of the threaded circulation spindles to the Y-plate	M5	5.4 Nm
Attachment of the left and right side parts	M4	4 Nm

Description	Thread size	Torque
Attachment of the pinion to the ball circulation spindle	M3	0.7 Nm
Attachment of the foot holder to the side parts	M4	4 Nm
Attachment of the rear cover to the side parts and bottom plate	M4	2.9 Nm
Attachment of the rear side covers and rear head cover to the side parts	M4	2.9 Nm
Attachment of the drag chain end piece to the operating cover	M3	1.1 Nm
Attachment of the operating cover to the side parts and bottom plate	M4	2.9 Nm
Attachment of the right and left sight protection cover to the side parts	M4	2.9 Nm
Attachment of the display PCB and keyboard PCB to the operating cover	M2	0.3 Nm
Attachment of the main PCB to the operating cover	M3	1.1 Nm
Attachment of the socket to the rear cover	M4	1.0 Nm
Attachment of the mains unit to the rear cover	M4	2.5 Nm
Attachment of the earthing cable (low-voltage device combination socket, mains socket and mains unit) bottom plate	M4	2.5 Nm
Attachment of the fan to the right side part	M3	1.0 Nm
Attachment of the limit switch with light barrier to the light barrier holding block	M2	0.3 Nm
Attachment of the plug to the undertable	M3	1.0 Nm
Attachment of the earthing cable of line 06 to the undertable	M3	1.0 Nm
Attachment of the limit switch to the limit switch holding block of the Y-plate	M2	0.3 Nm
Attachment of the earthing cable of line 06 to the bottom plate	M4	2.5 Nm
Attachment of the bottom sheet to the foot holders	M3	1.1 Nm
Attachment of the filament holder to the side parts	M4	2.9 Nm

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