renkforce

GB Operating Instructions

RF2000 v2 Finished Device Dual Extruder (FGD)

Order no. 1563098

RF2000 v2 Finished Device Single Extruder (FGS)

Order no. 1563099

RF2000 v2 Construction Kit Single Extruder (BSS)

Order no. 1563100

CE

Table of contents

GB

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:

International: www.conrad.com/contact

United Kingdom: www.conrad-electronic.co.uk/contact

2. Explanation of symbols

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

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

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

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

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

This symbol warns of hand injury from the belt drive.

The symbol with the arrow indicates special advice and notes.

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.

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

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. This also applies to repair work.

Observe all safety and assembly notes in these operating instructions and in the assembly 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.

4. Scope of delivery

a) RF2000 v2 Finished Device (Single and Dual Extruder) (FGS and FGD)

- RF2000 v2 finished device (single and dual-extruder) (FGS and FGD)
- Filament holder
- Mains cable
- SD card
- Spatula
- Notice sheet
- Packaging instruction
- Operating instructions (as a digital download)

b) RF2000 v2 Construction Kit (Single Extruder) (BSS)

- All necessary parts for installation of the printer (single extruder) (BSS)
- Filament holder
- Mains cable
- SD card
- Spatula
- Notice sheet
- Packaging instruction
- Operating and assembly instructions (digital as a download)

5. Important advice and notes - Please read!

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. This also applies to repair work.

Observe all safety and assembly notes in these operating instructions and in the assembly instructions!

Attention! Important note on shipping of the printer!

→ **Please keep the original outer packaging and the inlay 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 master firmware version RF.01.42 or higher and Repetier-Host software version 2.0.5 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 "12. Software and firmware installation" or chapter "20. Firmware update with the Arduino™ IDE".

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.

Important Note for maintenance and repair

→ **If there are any further errors in your printer or any expanded maintenance (e.g. exchange of the entire extruder or parts of it), we recommend that you have a look at the assembly instructions of the RF2000 v2 construction kit. This can be very helpful if all construction steps are described most precisely.**

You can find the instructions on the product page of the construction kit (Conrad order no. 1563100) or in the download area on our website (see item "Current Operating Instructions" in chapter "3. Intended use").

Important Note for using the spatula

The enclosed spatula is meant for removal of the objects that are still stuck to the printing plate and that are difficult to remove without help.

→ **Proceed with the utmost care when using the spatula!**

The spatula should only be used if there is any printing film or adhesive tape on the printing plate. Also use the spatula only at a very flat angle.

Non-observation of the notes or wrong handling may damage the surface of the printing plate and thus influence the print quality! This may also cause loss of the warranty/guarantee!

6. Safety notes

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.
- 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.
- Attention, LED light:
  Never look into the LED beam!
  Never watch directly or with optical instruments!
- 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 cannot judge the dangers involved when handling electrical devices.
- 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 printing 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. 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 device via the 3D printer socket, first pull the mains plug of the device from the 3D printer socket before performing any work on it.

7. Feature description

- Printing space (W x D x H) (X, Y, Z) Single extruder approx. 200 x 290 x 185 mm; Dual extruder approx. 170 x 290 x 185 mm
- Play-free profile rail guides and ball-threaded drives for maximum precision
- Automatic printing plate measurement
- Heated printing plate of aluminium
- 1 high-precision extruder with replaceable printing nozzle and quick change function (RF2000 v2 single extruder)
- 2 high-precision extruder for 2-coloured printing with replaceable printing nozzle and quick change function (RF2000 v2 dual extruder)
- Extruder unit with quick-change function
- 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

8. 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 temperature for the printing head or printing heads and printing plate, 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 prints the file layer for layer according to the FFF (Fused Filament Fabrication) / FDM (Fused Deposition Modelling) procedure.

At the actual print, the filament material is transported from a filament roll to the print head (extruder). For the dual extruder and two-coloured printing, this is done alterantingly with the two print heads.

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

The heated printing plate moves in the Y and Z directions, the extruder unit moves 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.

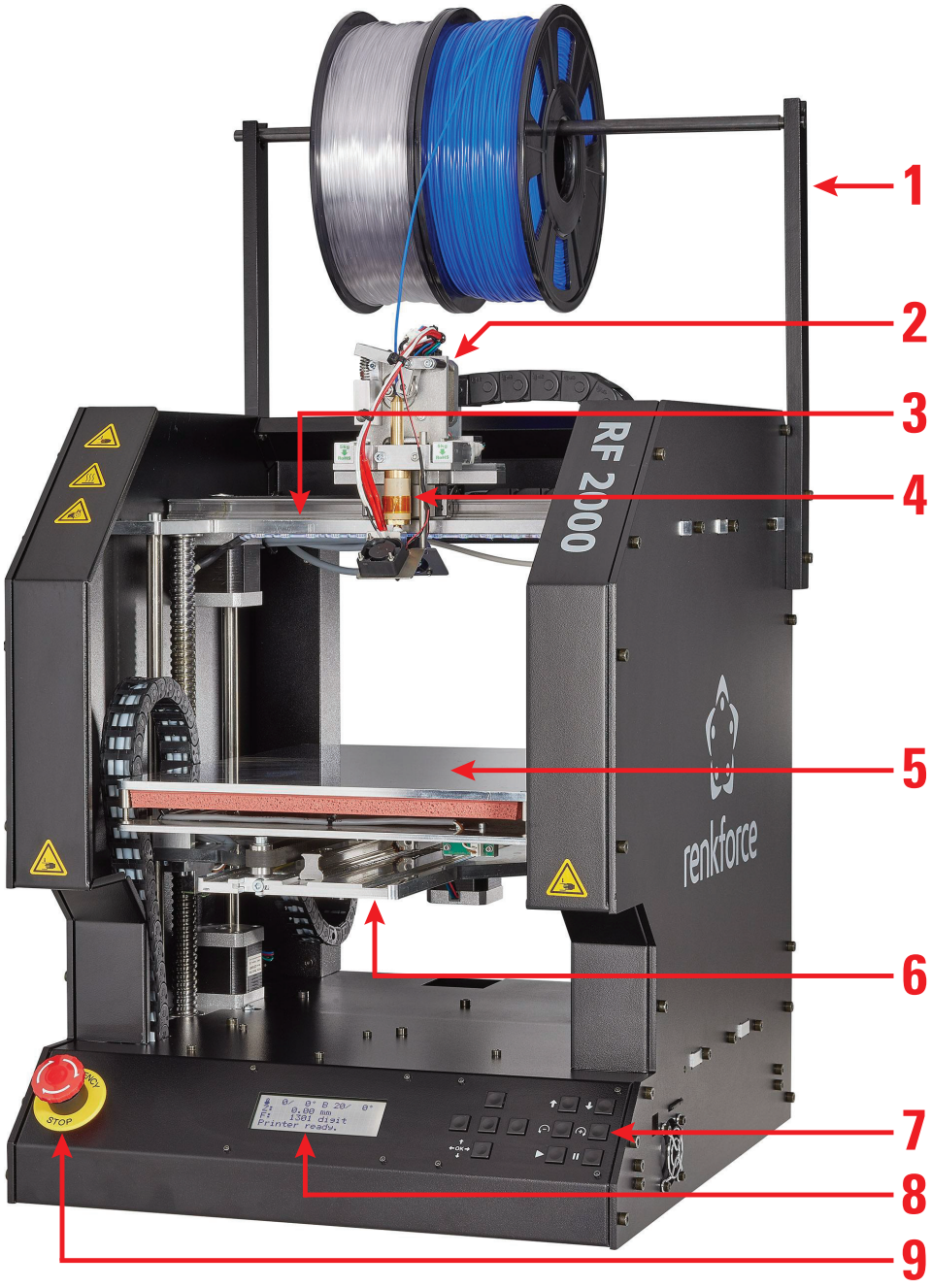
Ambience influences such as drafts, grease on the printing plate, etc. also play a role in the quality and adhesion of the printed object.

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.

9. Overview of the most important parts

a) Single extruder



(1) Filament holder

(2) Extruder unit

(3) X-plate

(4) 1 extruder (single extruder)

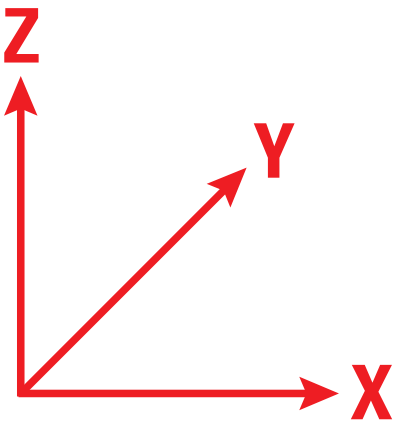
(5) Heating plate of glass ceramics

(6) Y-plate

(7) Operating button field

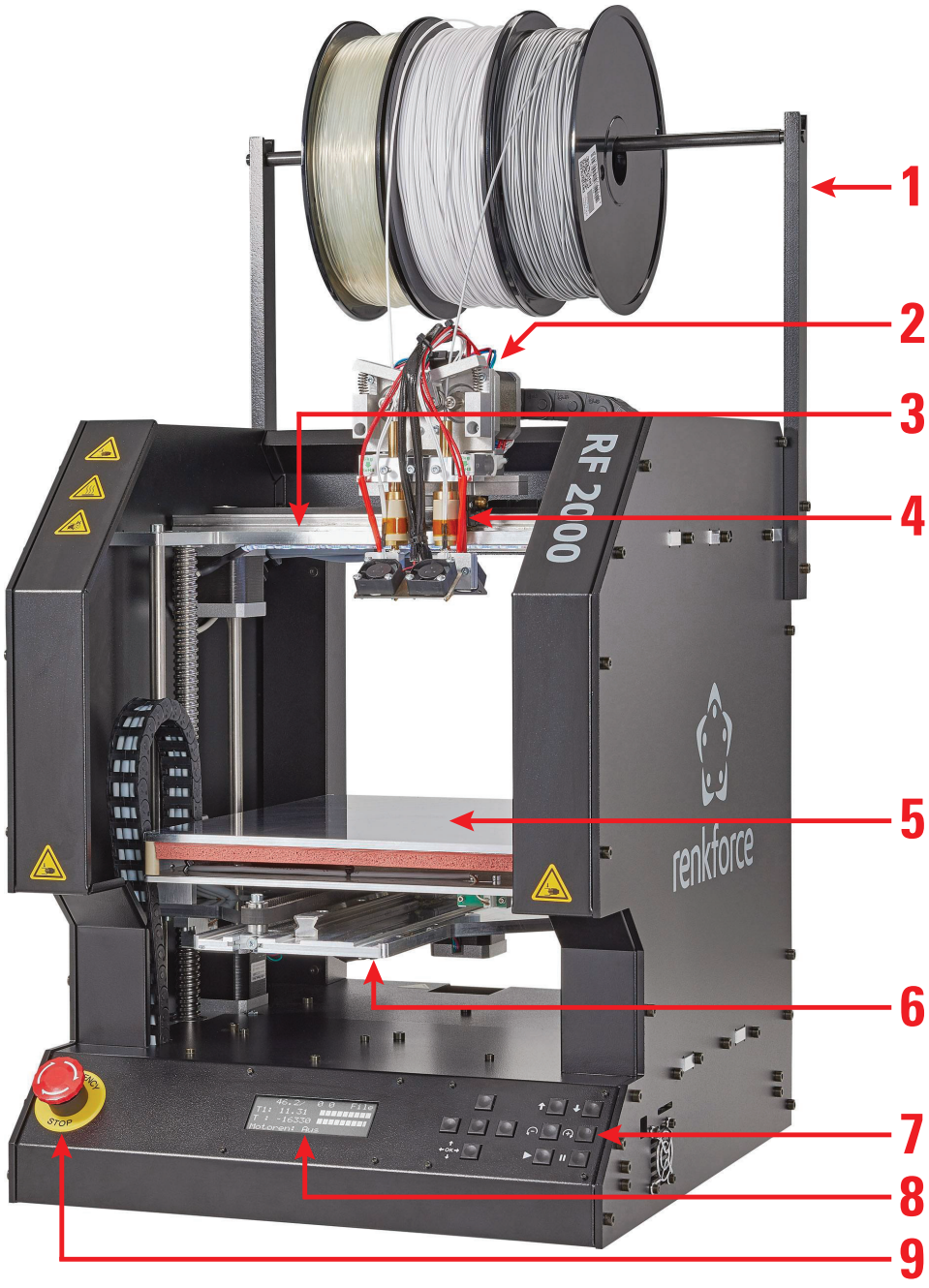
(8) Display

(9) Emergency off switch

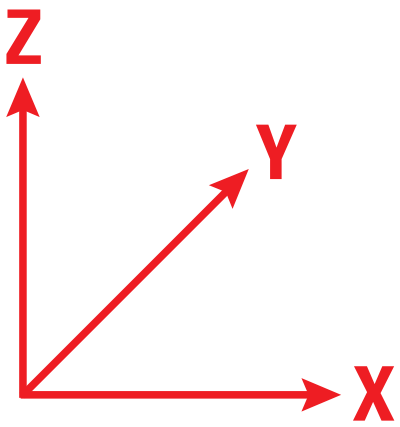


⟶ In the small figure, the printing directions (x, y and z) are indicated.

b) Dual extruder



(1) Filament holder
(2) Extruder unit
(3) X-plate
(4) 2 extruder (dual extruder)
(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.

10. Required tools and material

For use, calibration and maintenance

- Hex keys 2.5 mm / 3 mm / 4 mm
- External hex key socket wrenches 7 mm / 8 mm
- External hex key open-ended wrenches 5.5 mm / 7 mm / 8 mm / 11 mm
- Special adhesive tape in order to improve adhesion at certain filaments (e.g. PLA); our recommendation: blue adhesive tape, Conrad order no. 1093104

For possible repairs

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

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

- Hammer
- Stop angle
- Calliper
- Wire cutter
- Combination pliers, small flat pliers and small long-nose pliers
- Threadlocker varnish, medium strength
- Feeler gauge 0.3 mm, 0.8 mm, 0.9 mm 1.0 mm (recommended up to 1.0 mm in 0.05 mm steps)
- Hot-glue gun (optional)

11. First commissioning

a) Overview of the first steps

The following overview shows the first, important steps with the RF2000 v2. This is a brief summary of the subsequent chapters until your first print with the printer.

- Completion of initial commissioning.

  Some important things are explained to you here that you should do in any case after transport and unpacking. The chapter "Initial Commissioning" also contains important notes on correct setup of the printer and, of course, correct connection, incl. important safety notes.

- Download of the software/firmware package.

  We regularly provide new versions of the download package on our website. It contains the current firmware and software as well as current printing examples.

- Update of the firmware of the printer.

  Before you continue, always check the firmware version of your printer first and update the firmware if necessary. Errors are frequently removed here and new functions may be installed.

- Familiarise yourself with the general operation of the printer.

  Before you are able to sensibly use the printer, become familiar with its operation. We will not only introduce operation via the key pad to you, but also briefly explain the menu of the printer.

- Execution of the calibration.

  Calibration (basic setting of the Z-limit switch; setting of the extruders, execution of a printing plate scan) is one of the most important subjects of the operating instructions. Only if you have correctly performed calibration will you also achieve a good printout.

- First insertion of the filament.

  We will explain to you how you can insert or exchange or replace the filament correctly and what must be observed in this.

- Your first print of an example object from the SD Card.

  We will lead you to your first printout step by step using an example from the enclosed SD card. Also observe our notes at the end of the chapter after printing out and the general notes in the chapter below.

Before you start initial commissioning, all transport protections or fuses that have been installed during installation or for transport must be removed.

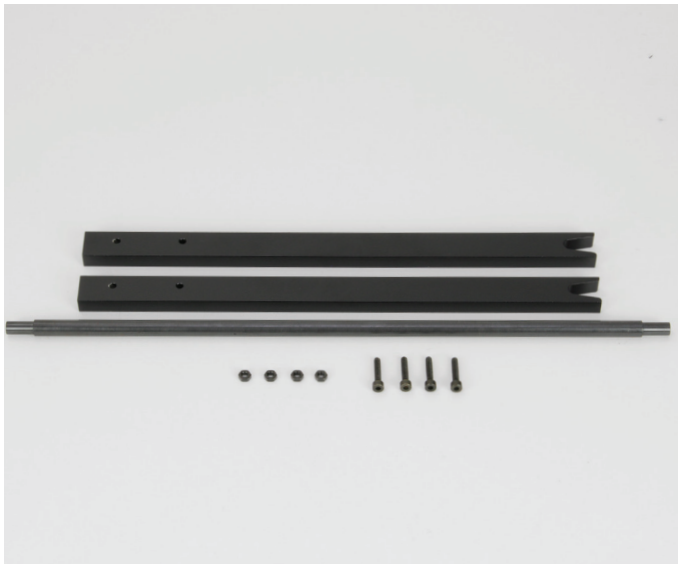
→ The finished device (single and dual extruder) has blue crepe adhesive tape stuck to the printing plate in the factory. This improves adhesion of the printed object. This special blue adhesive tape can be re-ordered at our shop under Conrad order no. 1093104.

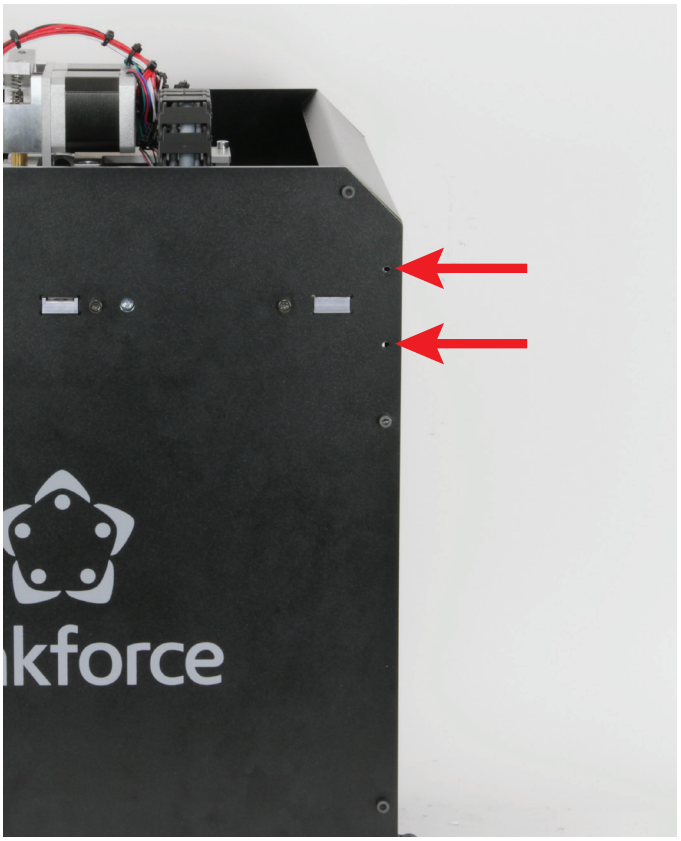
The printer also has a test printout enclosed that was produced in the scope of production.

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.

b) Installation of the filament holder

Assembly of the filament holder

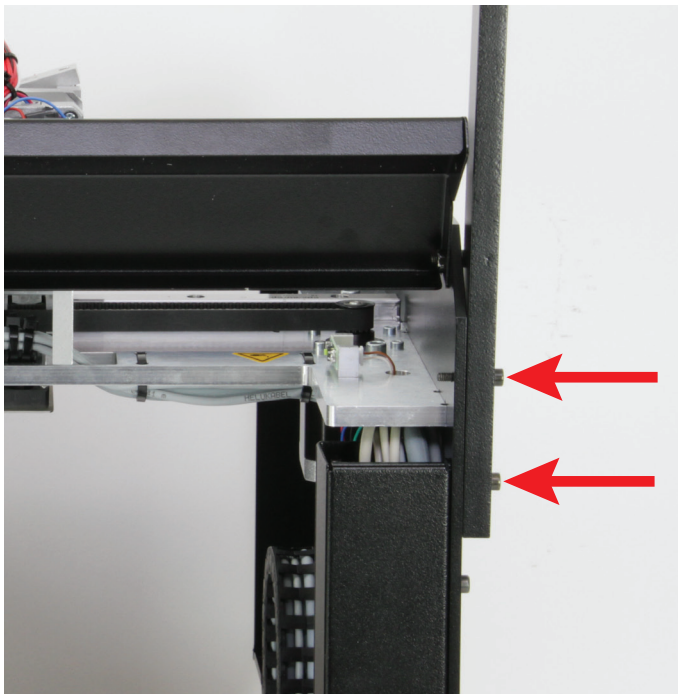




2 x filament holder part
1 x shaft for filament holder
4 x nut M4 (black)
4 x cylinder head screw M4x20 (black)

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 finished device, the 4 cylinder-head screws and nuts will be enclosed.

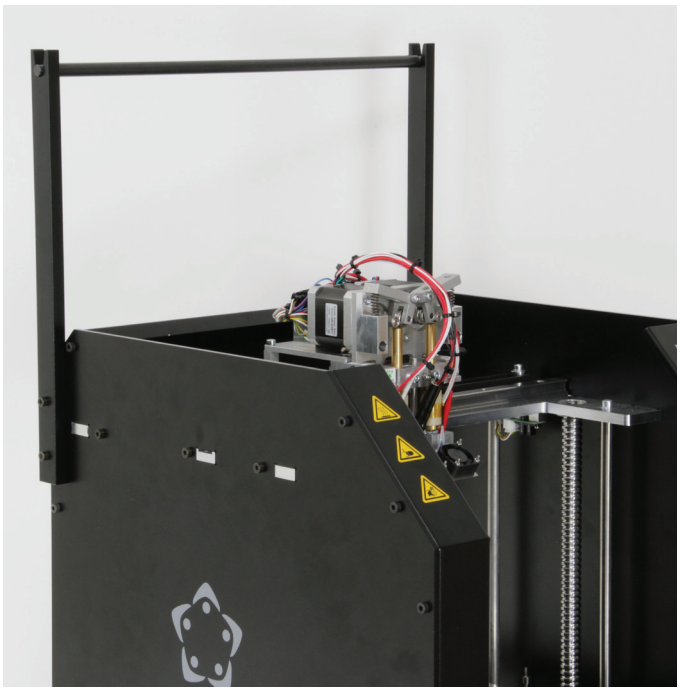
→ Please note! The two filament holder parts must be installed so that they end with the rear edge of the respective side part.



Fold the rear head cover up so that you can have access to the lower attachment screw of the right filament holder (from the rear view).
Insert one cylinder-head screw each into the two mounting holes.

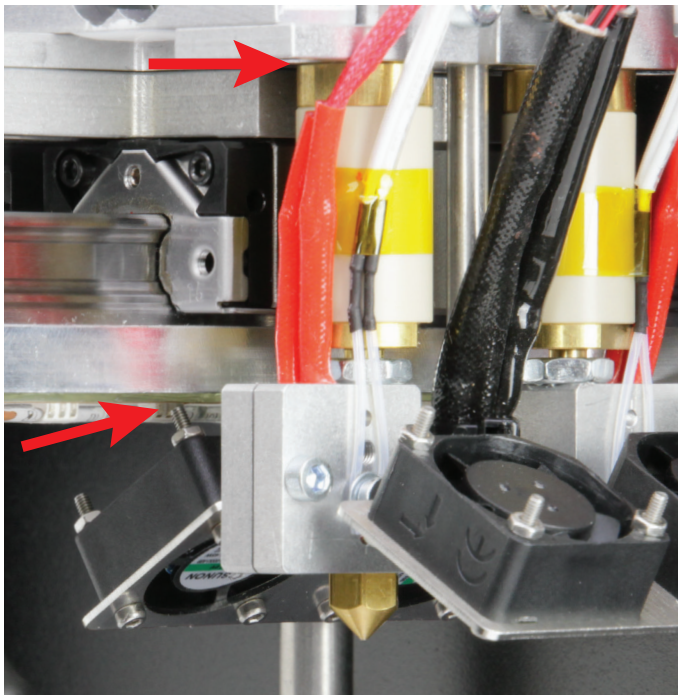
Attach the upper screw hand-tight with a nut M4. It currently only serves to secure.
Attach the lower holding screw of the filament holder and tighten it at once.
It is easiest to install the nut with one finger and then tighten it with a hexagon socket wrench.

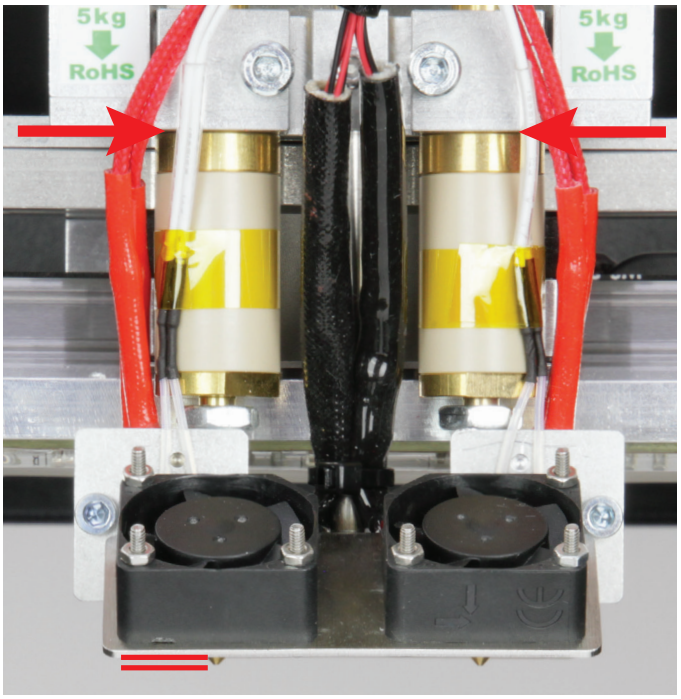
Remove the safety screw and fold down the rear head cover again.
Then install the safety screw you previously removed in the mounting hole again and then the filament holder on the left (from the rear view).



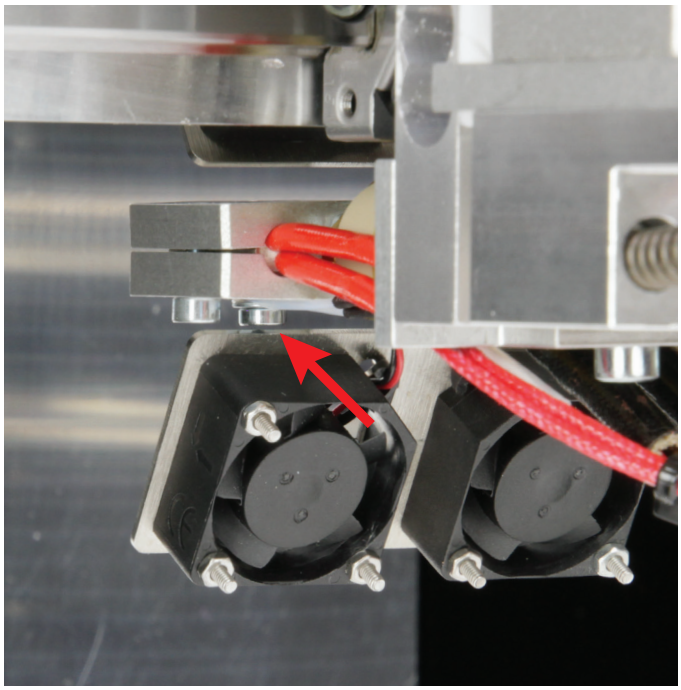
Finally, insert the shaft for the filament holder at the top of the guides.

c) Inspection of the fan sheet and the actuation for the Z-limit switch

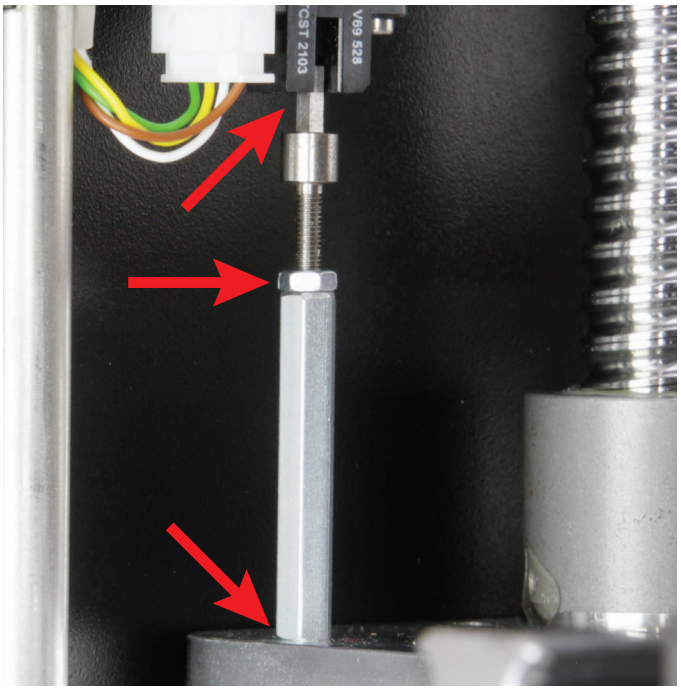




The two extruders should be in the home position. This means that they both need to touch the extruder holder on top.
The fan sheet height must be set so that the two upper screws of the two rear fans do not tough the X-plate (left figure). At the same time, the fan sheet must be above the two tips of the extruder nozzles (right figure). Of course, it should also be as straight as possible in reference to the extruder nozzles.



Additional, you need to observe that the fan sheet must not touch the attachment screws of the temperature sensors of the two extruders.



Also make sure to check the actuation for the Z-limit switch.
This must be aligned so that the square is aligned in parallel with the light barrier and can move into it cleanly. Also check that the hexagon threaded bolt and the counter nut of the actuation are tightened and that the entire unit or the actuation cannot be adjusted.

d) 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.
- When you want to transport the 3D printer, secure all other movable parts with adhesive tape or cable ties or best use the original packaging.

⟶ Use only the original packaging for shipping! Particularly note that the two parts of the original packaging are pushed onto the heat bed.

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

e) 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.

12. Software and firmware installation

a) Download and unpacking of the software/firmware package

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

The download package is at the same time the content of the SD card. This means that if a new version is available online here, you should update your SD card at the same time.

- Open the web browser and navigate either to the product page of the printer in our shop www.conrad.com or to our download page (see chapter "3. Intended use" - Current operating instructions).
- Download the package "**RF2000v2_SD_Vx.x.zip**" here (Vx.x designates the package version).
- Unpack the downloaded ZIP file on your hard disc. Note that the archive has a very deep path due to the firmware contained. Therefore, we recommend directly unpacking the package into a folder on, e.g., C:\ or D:\.
- Update your SD card when you have unpacked the package. Also check the firmware version of your printer and the version of your Repetier-Host. If the download package contains a newer version, update it!
- Find a brief explanation on the folders contained below.

"**Arduino**"	This folder holds the matching Arduino™ version in its current status to match the firmware of the printer. The text file additionally contains the download link.
"**Firmware**"	Firmware version for the software Arduino™.
"**Manual**"	This contains a text file with information on the download of the instructions.
"**PLA-GCODE**"	Printing examples for PLA that are already sliced. These can be printed directly from the SD card.
"**Repetier-Host**"	The custom version of the software Repetier-Host.
"**STL**"	Print examples that are not sliced yet.
"**Version.txt**"	In this text file, the version number of the download package is noted.

b) General information on the Repetier-Host software

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

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

The enclosed SD card or the archive you have downloaded before holds a custom version of the software that contains the printer settings and configuration files for the RF2000 v2 in the folder "Repetier-Host".

We urgently recommend to install the custom version of the software since then you do not need to configure the software and the required drives are already installed as well.

The respective updated Custom version of the software always is contained in the download package "RF2000v2_SD_Vx.x.zip".

This version of the instruction is valid as of the Repetier-Host software version 2.0.5 or higher.

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

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

The software Repetier-Host performs the following tasks:

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

c) Installation of the Repetier-Host software

- Install the file "**setupRepetierHostRenkforce_x_x_x.exe**" from the directory "**Repetier-Host**" from the download package or 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.

d) Updating of the firmware

⟶ **Before you continue, first check if a new version of the firmware is available.**

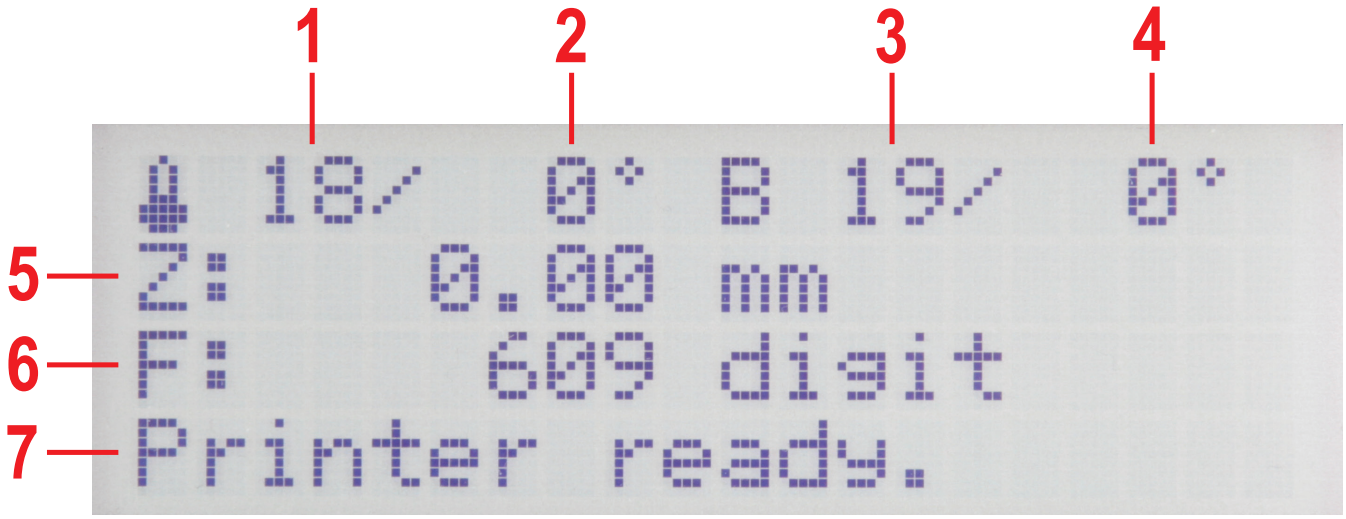
The updated version of the firmware always is contained in the download package "RF2000v2_SD_Vx.x.zip". The firmware is also available for download on Github.

On this and the update process, always observe chapter "20. Firmware update with the Arduino™ IDE".

13. Operation at the printer

a) Description of the main display

This is the first display in the main menu. The further displays that you can call in the main menu are described in chapter "13. d) The expanded main menu".



(1) Temperature active extruder (actual)

(2) Temperature active extruder (target)

(3) Temperature heating printing plate (actual)

(4) Temperature heating printing plate (target)

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

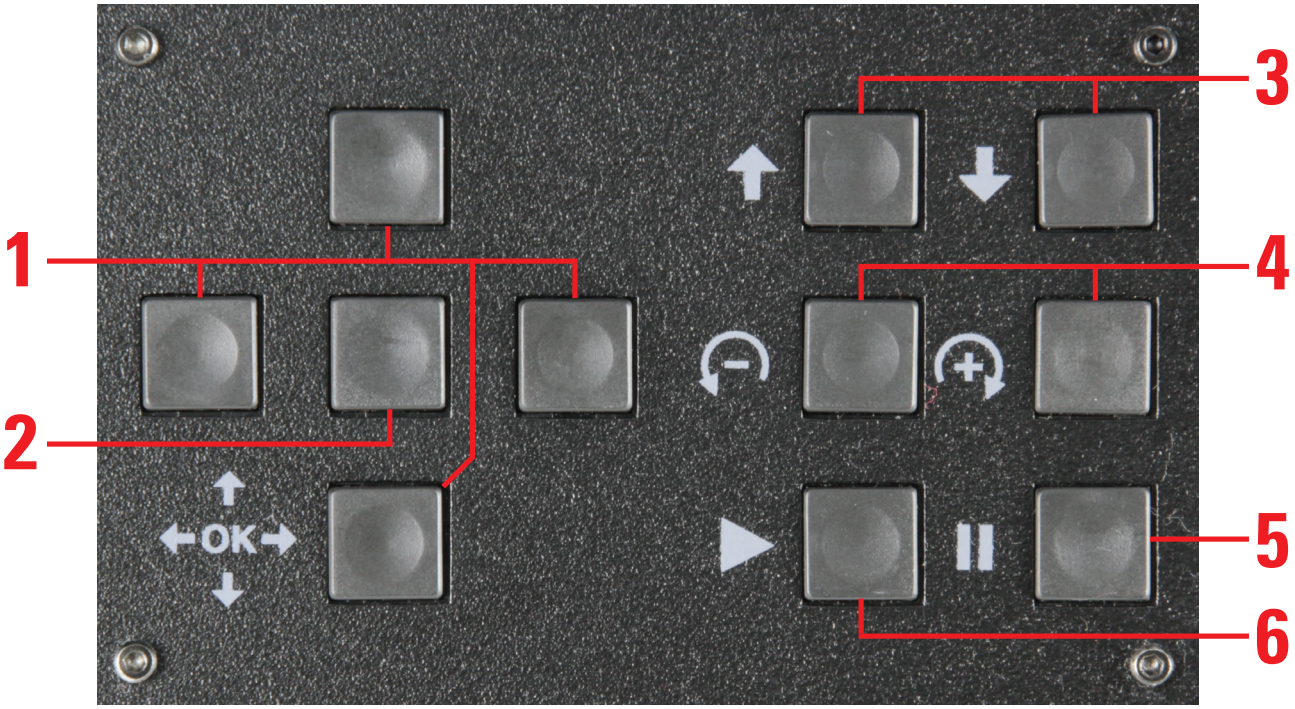
When the automatic Z-compensation is active, the display will show "**Cmp**" next to the Z-position (5).

(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 heat bed are not heated yet.

b) Function description of the operating buttons



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

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 printing 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 to printing temperature!

(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

c) Description of the extruders

The printer with dual extruder (as finished device or retrofitted) 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:

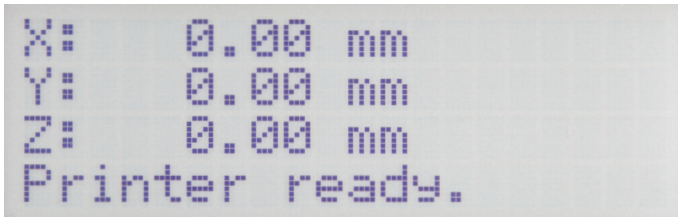
Side (from the front view)	Menu printer/G-Code	Repetier-Host
Left	Extruder 0	Extruder 1
Right	Extruder 1	Extruder 2

→ The printers with single extruder names it in the printer menu and the G-code as "**Extruder 0**". In the software, this is "**Extruder 1**".

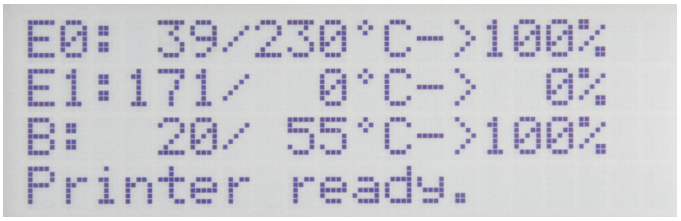
d) The expanded main menu

The main menu contains the main display (see chapter "13. a) Description of the main menu") and 4 further views.

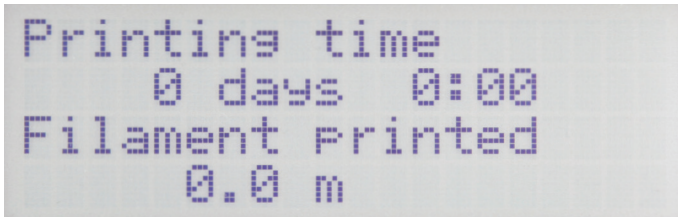
You can reach them via the direction buttons "**up**" and "**down**" (1). The displays are switched through in sequence. For example, if you push the button "**down**" five times, the main display will be shown again.



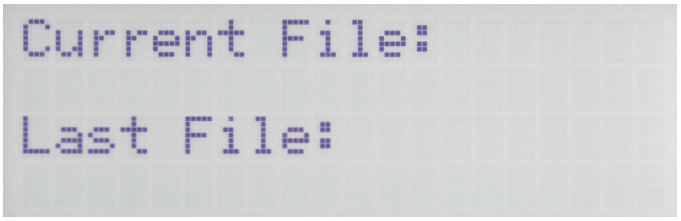
1 x button "**down**" (1) pushed.
This shows the current positions of the individual axes.



2 x button "**down**" (1) pushed.
This overview shows the current temperature values (actual/target) of the two extruders and the printing plate. The percentage at the very right of each line shows the current heating output.



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



4 x button "**down**" (1) pushed.
This overview shows the current printing file at the top and the last printed printing file at the bottom.

e) 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**" / "**up**" / "**down**")
- 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 "13. b) 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: Off/On	
	Restart	Restart now?
		Yes
		No

Print File	Back	
	Files	
Position	Home all	
	Home X	
	Home Y	
	Home Z	
	Position X	X: 0.00 mm
		End stop min: Off/On
		End stop max: N/A
		Single Move/1 mm/10 mm/50 mm/Single Steps
	Position Y	Y: 0.00 mm
		End stop min: On/Off
		End stop max: N/A
		Single Move/1 mm/10 mm/50 mm/Single Steps
	Position Z	Z: 0.00 mm
		End stop min: On/Off
		End stop max: Off/On
		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	Baud Rate: 115200	
		Stepper off	[s]: 600
			0 = never
		All off	[s]: 0
			0 = never
		Beeper: On/Off	
		Mode: Printer/Miller	
		Z Scale: Z Min/Surface	
		Hotend: V3	
		Extruder Offset X	[mm]: 33,594
		Extruder Offset Y	[mm]: 0,000
	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	
	Feed rate	Max X: 500	
		Max Y: 500	
		Max Z: 50	
		Home X: 80	
		Home Y: 80	
		Home Z: 10	
	Z Calibration	Scan	
		Scan PLA	
		Scan ABS	
		Align Extruders	
		Z Offset	Z: 0 by
		Position Z	Z: 0.00 mm
			End stop min: On/Off
			End stop max: Off/On
			Single Move/1 mm/10 mm/50 mm/Single Steps
		Set Z Matrix: 1 (1-9)	
	Restore Defaults		

f) 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	Moving heating plate to removal position	
Speed Multiply	Setting of the printing speed	
Flow Multiply	Setting of 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	Cooling down (all heatings off)	
Disable Stepper	Switching 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)
	End stop 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)
	End stop 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)
	End stop min:	Displays the limit switch condition min. (light barrier)
	End stop 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 extruder 0 (e.g. for filament change)	
Temp. 1 : 0 °C	Manually setting the extruder temperature 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	Set the new zero point	
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	Start print from SD card	
Delete File	Delete file from SD card (then the file to be deleted is selected)	
Configuration		
General	Baud Rate: 115200	Setting of 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: Z Min/Surface	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
	Hotend: V3	Switches between the versions of extruders (the RF2000 v2 only supports the hotend V3)
	Extruder Offset X	Specifies the distance between the two extruders in the X-direction (Standard = 33.594; indication in mm)
	Extruder Offset Y	Specifies the distance between the two extruders in the Y-direction (Standard = 0.000; 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 axis at small steps
	Z-Jerk : 0.1	Max. acceleration of the Z axis at small steps

Configuration			
Feed rate	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: 80	Max. speed of the X-axis when moving to the home position	
	Home Y: 80	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	Quick printing plate calibration	
	Scan PLA	Printing plate calibration with typical PLA-temperatures	
	Scan ABS	Printing plate calibration with typical ABS-temperatures	
	Align Extruders	Alignment of the two extruders without printing plate calibration With this point, the two extruders can be aligned subsequently without printing plate scan. The extruders must be manually heated to the desired temperature.	
	Z Offset	Shifts the distance between the nozzle and heating plate in Z-direction by the specified value (standard = 0 µm)	
	Position Z	Z: 0.00 mm	Moves Z-axis to an adjustable position; Move with the arrows "**up**"/"**down**" (1)
		End stop min:	Displays the limit switch condition min. (light barrier)
		End stop 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) Overview of calibration

This provides a brief overview of the calibration of the RF2000 v2.

- Determining the position with the smallest distance.

  Here, you can determine the highest position on the printing plate that has the shortest distance from the extruder nozzle. All settings are based on this position. Therefore, you should determine this position as precisely as possible.

- Basic settings of the upper Z-limit switch.

  This setting usually is only required once. The only exception is when something changes on the printing plate or the extruders. Here, you should at least check the setting and adjust it if applicable. If you have acquired a finished device, these settings were made at production already. Since transport can also influence this, we recommend checking the proper settings.

- Heating up the setting temperature.

  The set temperature here is the standard printing temperature of PLA (extruder 230 °C; printing plate 60 °C) or ABS (extruder 260 °C; printing plate 120 °C).

⟶ Please note that the correct temperatures depend on the filament used. Therefore, we recommend repeating the setting with the optimal printing temperature of the filament used.

- Setting the left extruder (extruder 0).

  Here, the extruder (in the dual extruder the left one) is set to 0.3 mm in the hot condition for the printing plate scan (at the highest position of the printing plate).

- Executing the Head Bed Scan

  We recommend the performing the Head Bed Scan for PLA ("**Scan PLA**") or ABS ("**Scan ABS**"). In this case, the printer automatically heats up to the corresponding temperatures. You only need to lower the two extruders to the printing plate upon request in the dual extruder.

  For the quick head bed scan ("**Scan**"), you need to set everything manually, incl. the Z-offset. On this, observe chapter "14. e) Executing the quick head bed scan". For the settings for the Z-offset, see the menu "**Configuration**" - "**Z Calibration**" - "**Z Offset**". Alternatively, the Z-offset can also be controlled via the G-code.

b) General notes on calibration

Attention! Never touch the hot extruders or the hot printing plate! 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 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 they 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 distance bolts are completely screwed into the lower table, the printing plate is supported level on the spacer bolts and the four attachment screws are completely screwed into the spacer bolts. The printing plate must not wobble!**

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

⟶ **Before you perform calibration, first check if new firmware is available and install this. Observe chapter "12. Software and firmware installation" and chapter "20. Firmware update with the Arduino™ IDE". 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 printing 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.

The subsequent destruction is based on the dual extruder version. For owners of the single extruder printer, however, this is nearly identical.

For the finished devices, the complete calibration incl. a heat bed scan "**Scan PLA**" has already been performed. Therefore, the "**basic settings of the upper Z-limit switch (Z-min.; light barrier)"** should fit already. The settings of the left extruder and the heat bed scan must be repeated several times and the heat bed scan must be performed again anyway after each transport. This requires "**determination of the position with the smallest distance**" once as well. Owners of the construction kit perform the calibration completely.

In the heat bed scans "**Scan PLA**" and "**Scan ABS**", everything is done automatically after "**Setting the distance between the nozzle and the printing 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 printing 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 printing plate 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.

c) Setting the distance between the nozzle and the printing plate

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

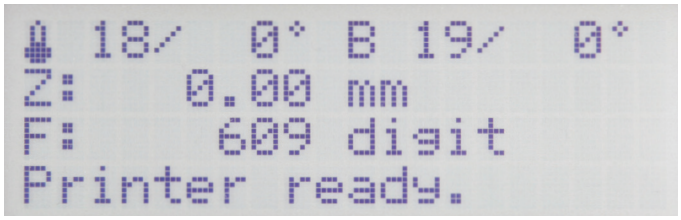
Important! Determine the position with the smallest distance between the nozzle and the heating plate in the cold condition. The basic setting of the upper Z-limit switch (Z-min.; light barrier) also takes place in the cold condition. This means that if the extruders or the printing plate have heated up before, you need to let them cool off entirely first!

The left extruder is set when hot!

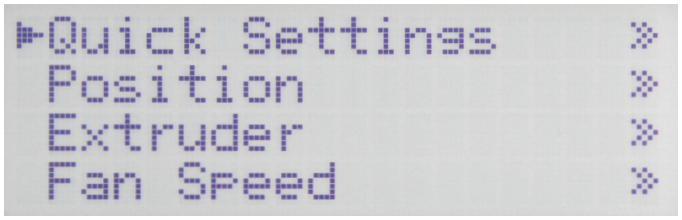
If you have acquired a finished device, check whether the distance is between 0.8 mm and 1.0 mm when determining the highest position of the printing plate. If applicable, repeat the "basic setting of the upper Z-limit switch (Z-min.; light barrier)" on the next page.

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

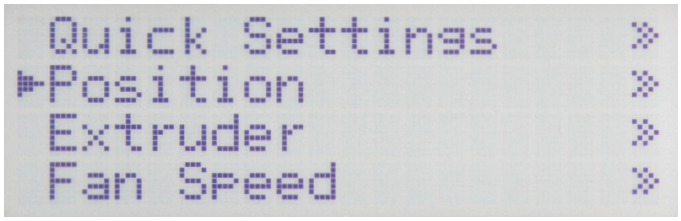
Determining the position with the smallest distance



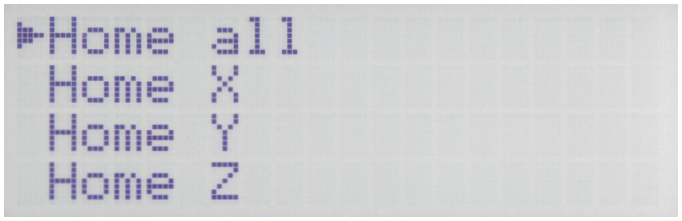
First move the printer Z-axis to its home position (**Home Z**). Briefly push the button **OK** (2) in the main display.



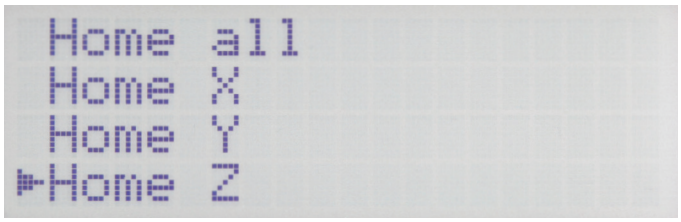
Use the direction buttons (1) to navigate to menu item "**Position**".



Push **OK**.

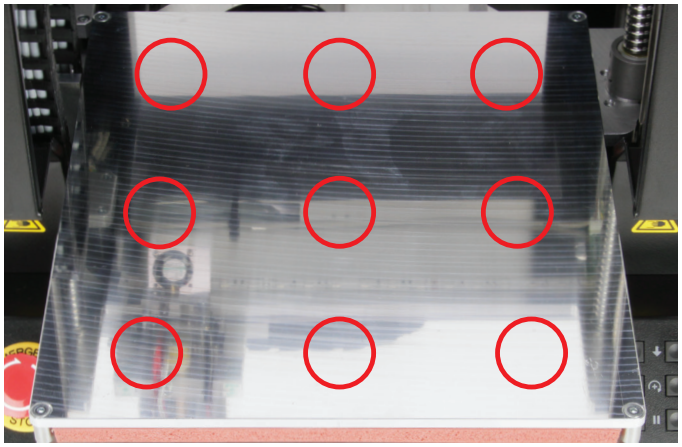


Use the direction buttons to navigate to menu item "**Home Z**".



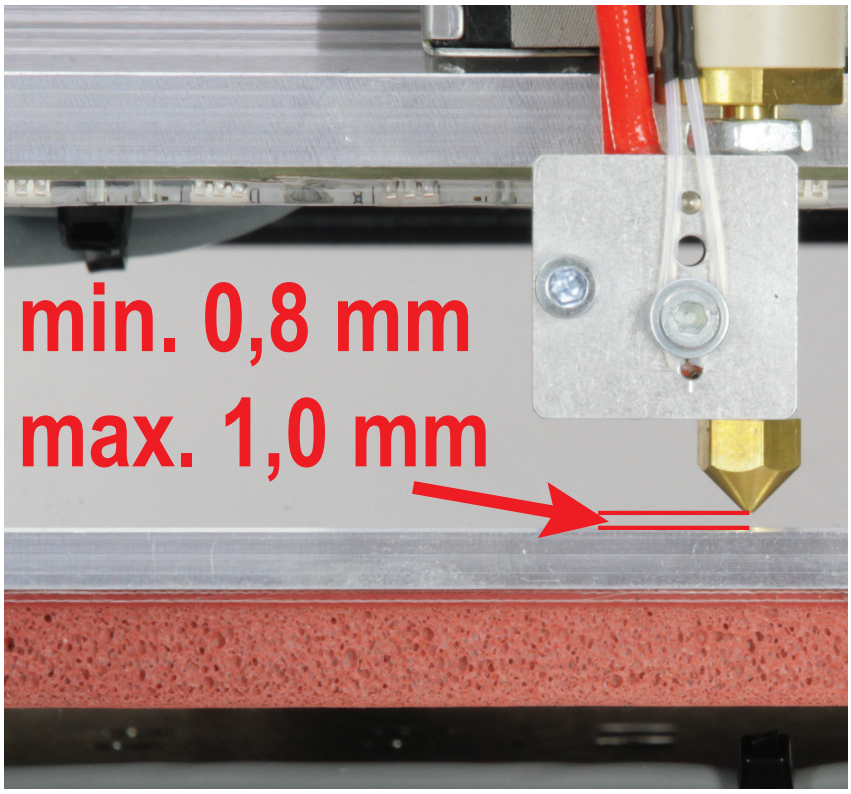
Push **OK**, to move the printing plate to the Z-Home position.

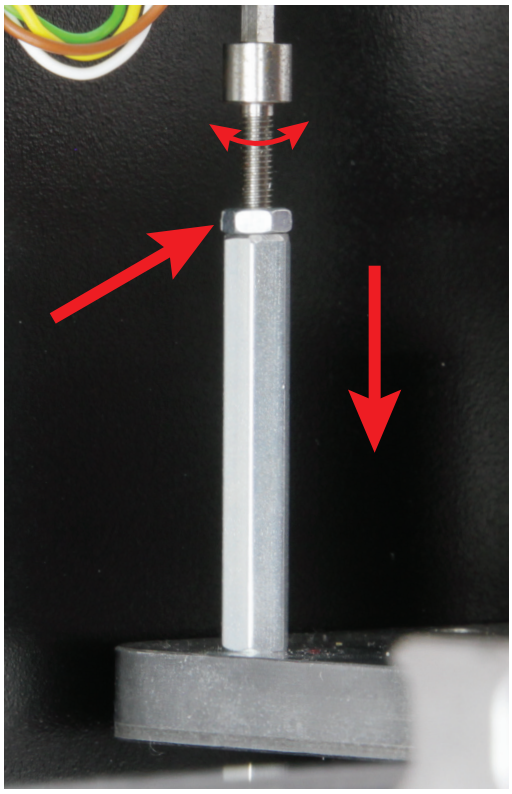
→ **Attention! The extruders must not touch the printing plate during the subsequent setting. If this is the case, lower the Y-plate a little with the arrow button "down" (3) and turn out the actuation for the Z-stop a little.**



Now determine the position on the printing plate where the distance between the nozzle of the left extruder and the printing 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 printing plate by hand. It is easiest to determine the right position with a feeler gauge.
Leave the extruder carriage and the printing plate in the position where you have determined the smallest distance.

Basic setting of the upper Z-limit switch (Z-min.; light barrier)





For finished devices, this **basic setting of the upper Z-limit switch** has already been performed. If you have checked the distance at "**Determination of the position with the smallest distance**" and this is correct, you can skip this page and continue with "**Heating up to the setting temperature**".

If something changes at the printing plate later, check the distance again and adjust it if necessary.

Before you start making your settings, check if the extruder or extruders are at the very top and contacting the extruder holder. This is a basic prerequisite for the subsequent setting!

We recommend determining the distance settings with a gauge sheet with 0.9 mm and one gauge sheet with 0.8 mm and 1.0 mm to be certain.

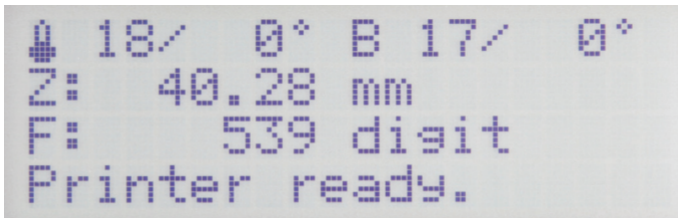
→ If your printer is equipped with the dual extruder, proceed in the same manner for the subsequent description. Set the distance using the left extruder (viewed from the front).

The Z-stop must be set so that there is no more than 1 mm distance between the extruder nozzle and the printing plate. The distance should not be any less than 0.8 mm, however. The gauge sheet with 0.9 mm should just fit between the nozzle and printing plate without application of force.

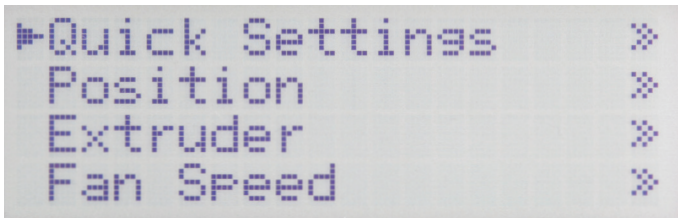
For adjustment, leave the extruder and printing plate in the position or move it to the position where you previously determined the shortest distance.
Move the printing plate into the Z-Home position (see "**Determination of the position with the smallest distance**").
Measure the distance between nozzle and printing plate. If this needs to be corrected, move the printing plate down with the arrow button "**down**" (3) until you can reach the actuation for the Z-limit switch.
Loosen the counter nut and turn the actuation for the Z-stop into the hexagon threaded bolt in or out until the distance fits.
Check the distance after 1 to 3 half turns (tighten the counter nut manually and move it to the Z-Home position).
Then move the extruder and the printing plate manually to ensure that the extruders cannot touch the printing plate anywhere in the working area and that the same distance is approximately complied with everywhere. These should never be less than 0.8 mm and not much more than 1 mm if possible.
After this setting, counter the setting screw with the nut again.

The distance between the highest and lowest points on the printing plate must not exceed 0.2 mm.
If the distance is larger or if you cannot make the above setting correctly, the Y-plate or the undertable.
If the distance between the left and right is too large, the ball thread drives may need to be adjusted. For this, observe chapter "12. e) Assembly of the mechanical basic construction" in the assembly instructions of the RF2000 v2 construction kit.
If the distance between the front and rear is not correct, the undertable needs to be aligned with care. The printing plate must be unscrewed first and taken off for this, however.

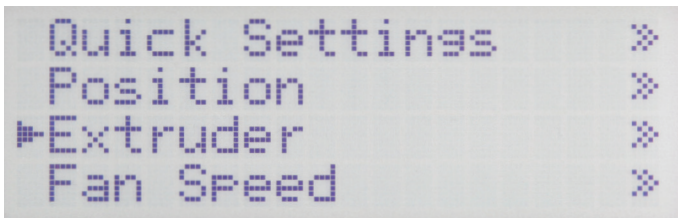
Heating up the setting temperature



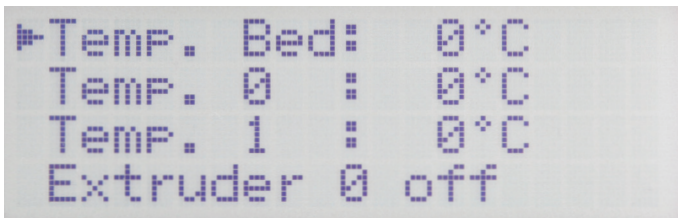
Move the printing plate down by a few centimetres with the arrow button "**down**" (3).
Then push **OK**.



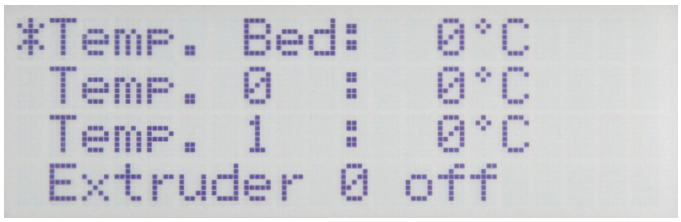
Use the direction buttons (1) to navigate to menu item "**Extruder**".



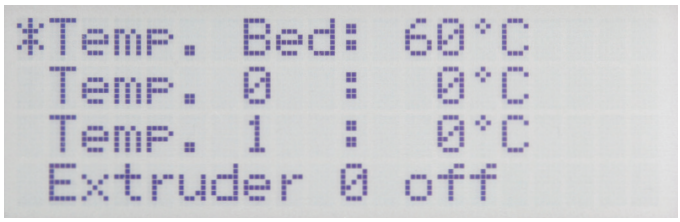
Push **OK**.



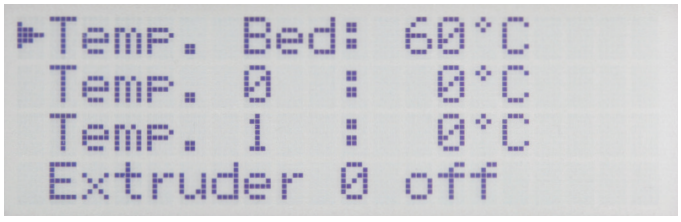
Push **OK** again to select "**Temp. Bed**".



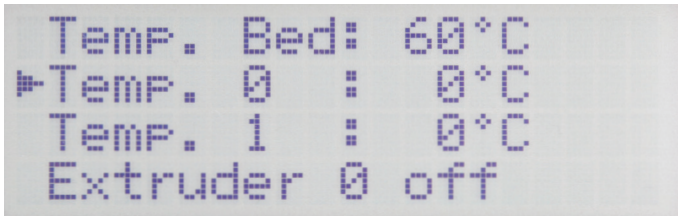
Set the temperature for the printing plate with the direction buttons. Since the distance is to be set at printing temperature, set **PLA** to "**60 °C**" and **ABS** to "**120 °C**".



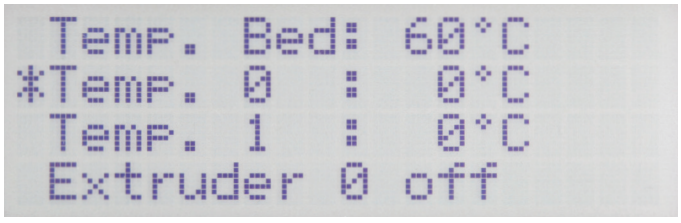
Push **OK**.



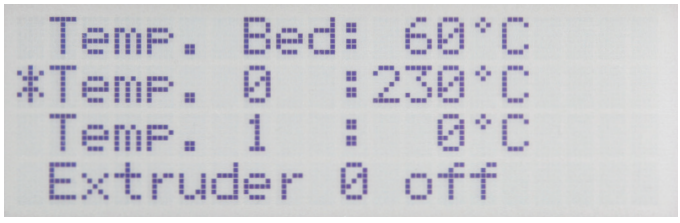
Use the direction buttons to select "**Temp. 0**".



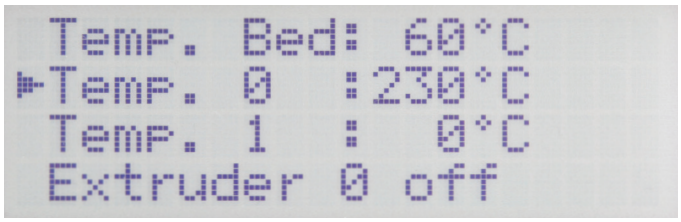
Push **OK**.



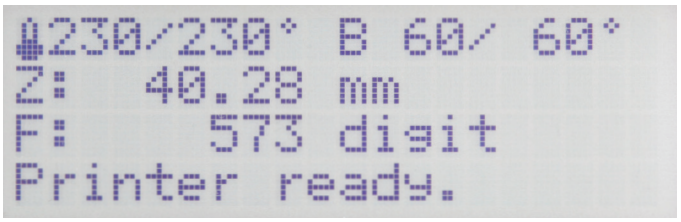
Set the temperature for the left extruder with the direction buttons. Since the distance is to be set at printing temperature, set **PLA** to "**230 °C**" and **ABS** to "**260 °C**".



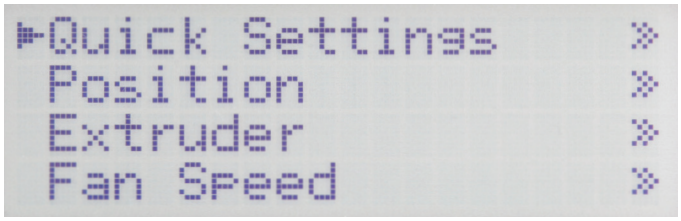
Push **OK**.



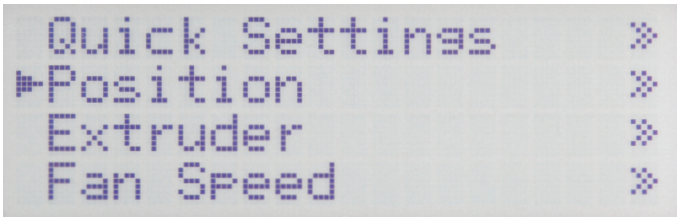
Push the direction button "**left**" 2 x to return to the main menu.



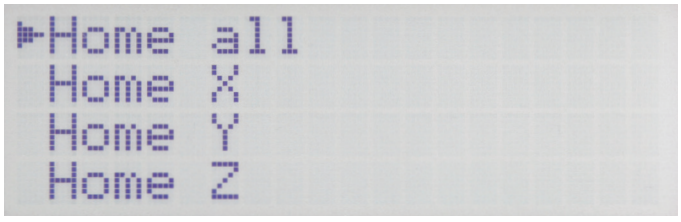
Wait until the actual temperature of the left extruder and the printing plate reflects your setting.
Let both continue to heat up for at least another 10 minutes until the printing plate temperature has stabilised and it is entirely heated through, and the extruder has completely expanded.
Then push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



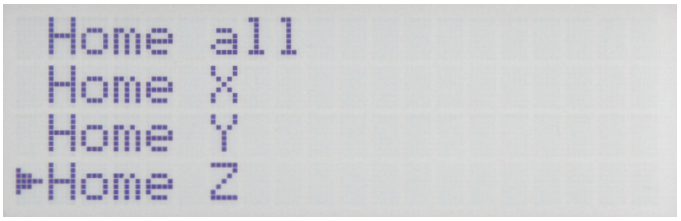
Use the direction buttons to navigate to menu item "**Position**".



Push **OK**.



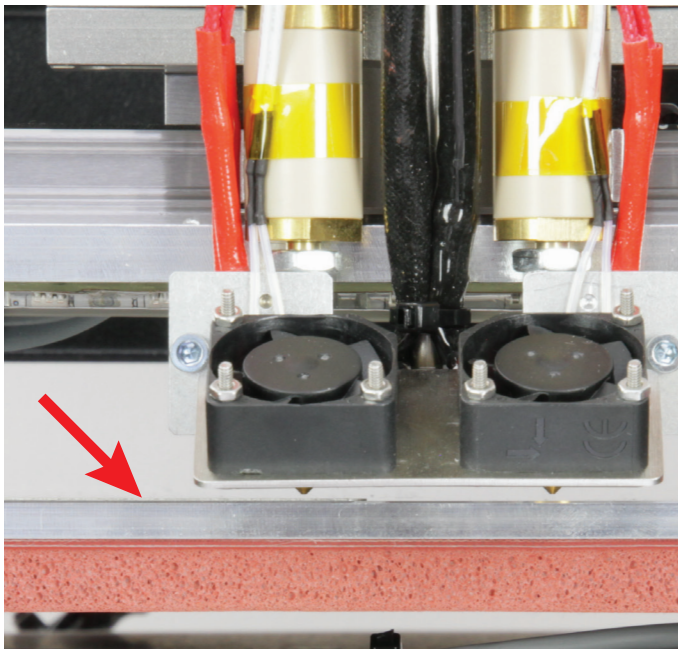
Use the direction buttons to navigate to menu item "**Home Z**".



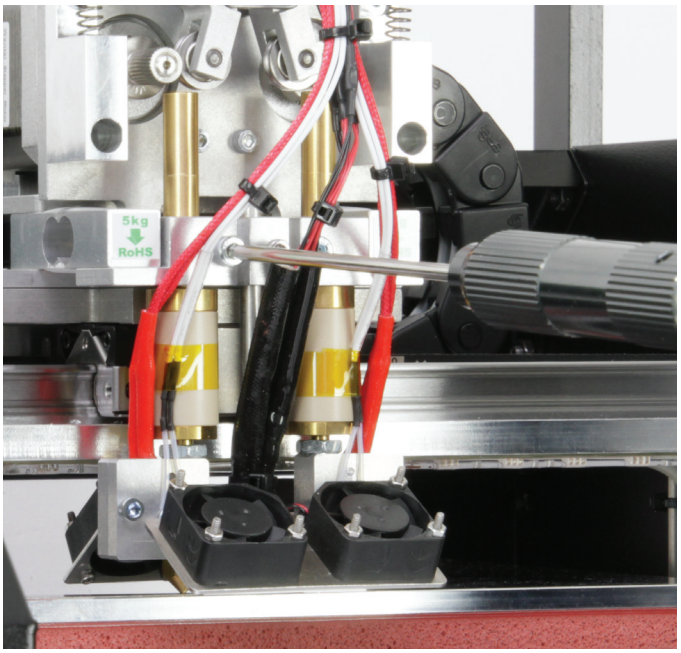
Push **OK**, to move the printing plate to the Z-Home position.

⟶ For the following setting, the extruder (or the left one in case of the dual extruder) still needs to be in the position where the shortest distance between the nozzle and printing plate was previously determined.

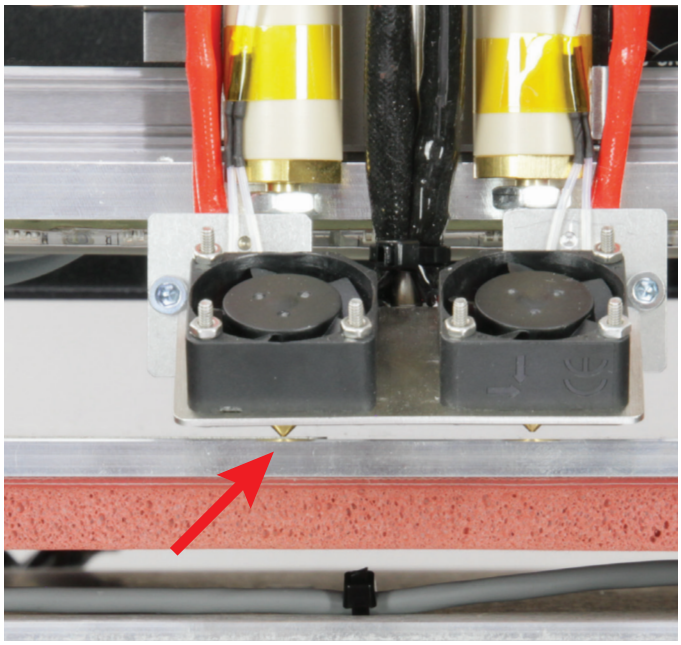
Setting the left extruder (extruder 0)



Take a 0.3 mm strip of a feeler gauge and carefully push it between the left extruder and the printing plate (see arrow in the figure).



Hold the left extruder at the top at the inlet and carefully release the left screw of the extruder holder.
Carefully lower the extruder to the strip of the feeler gauge.



Before you tighten the extruder screw again, the left extruder must be applied loosely to the calibration strip (0.3 mm).
Then tighten the left screw of the extruder holder again and remove the calibration strips.
Switch off the heater of the two extruders and the printing plate and let them both cool off.

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

No force must be applied to the printing plate, since this can change its position.

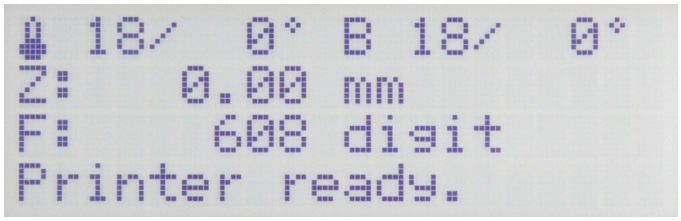
→ Once this setting and a subsequent head bed scan have been performed successfully, the Repetier-Host software can be used to determine the proper position of the smallest distance.

For this, observe chapter “19. a) Determining the highest position of the printing plate".

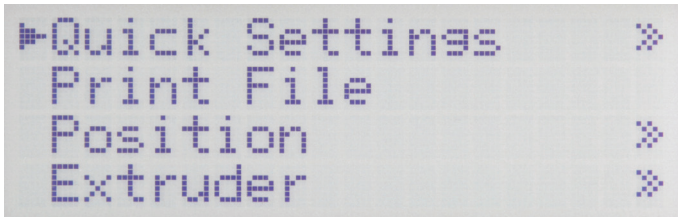
d) Executing the head bed scan for PLA or ABS

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

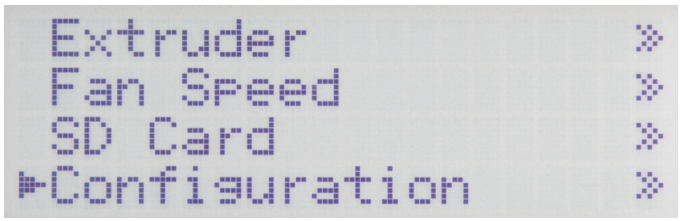
Start of the heat bed scan



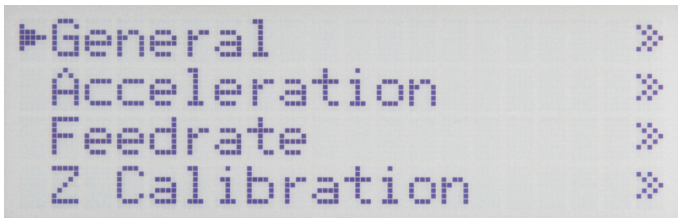
Briefly push the button **OK** (2) in the main display.



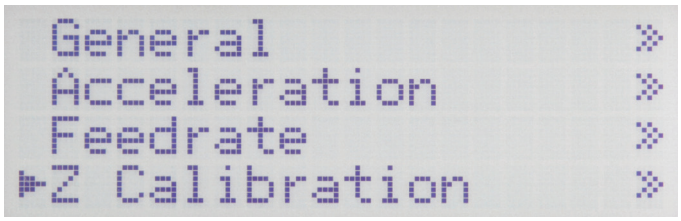
Use the direction buttons (1) to move to the menu item "**Configuration**".



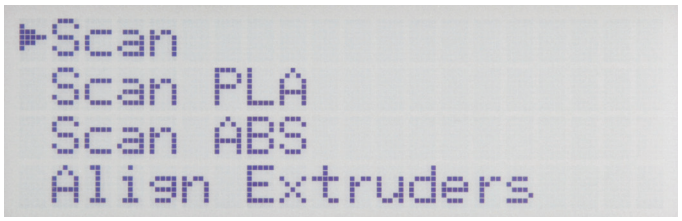
Push **OK**.



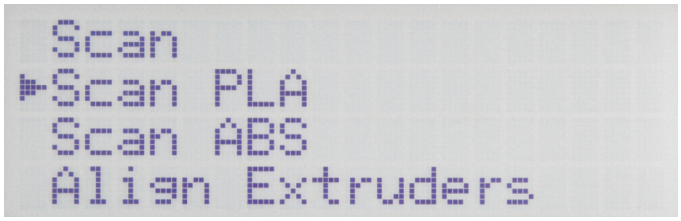
Use the direction buttons to select "**Z Calibration**".



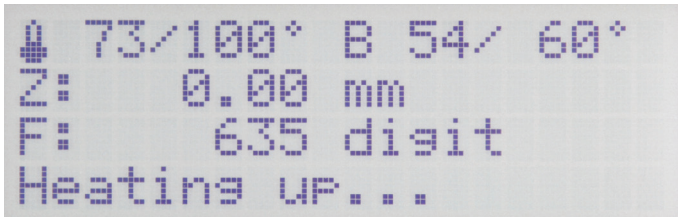
Push **OK**.



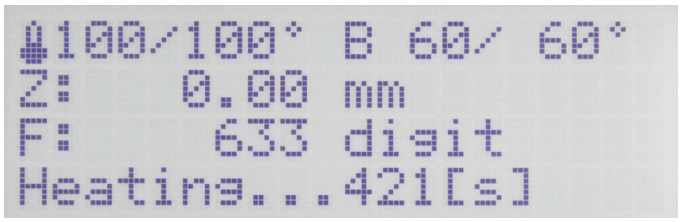
Use the direction buttons to move to the menu item "**Scan PLA**" or "**Scan ABS**" (depending on what materials you want to perform the scan for).



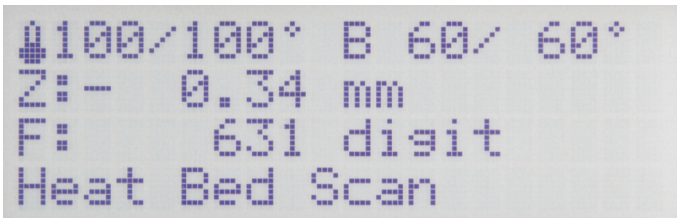
Push **OK**, to select "**Scan PLA**" and start the heat bed scan for PLA this way. Push the direction button "**left**" 3 x to return to the main menu.



The printer now heats up the printing plate and both extruders automatically (printing plate PLA = 60 °C, ABS = 120 °C; both extruders PLA = 100 °C, ABS = 100 °C).

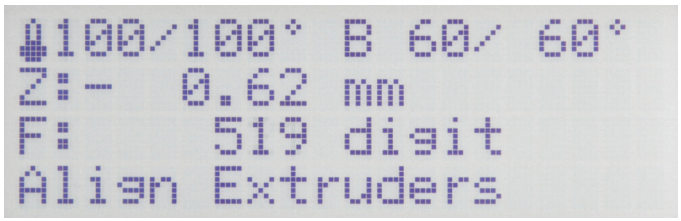


When the temperatures have been reached, the printer will wait for 10 minutes to ensure that the extruder and the printing plate are heated through entirely. The waiting time is displayed in seconds in the status bar.



Then the heat bed scan starts automatically.

Aligning the two extruders



After the measurement has been performed, the printing plate and the extruder unit return to their home positions and then immediately move to the middle of the printing plate.
The display shows "**Align Extruders**".
This means that the second extruder must be aligned now.
The extruder 0 should now be supported nearly entirely on the printing plate.
To be certain, first release the holding screw of the left extruder (extruder 0), so that it is actually supported on the printing plate.

Then release the screw of the right extruder (extruder 1) and lower it carefully onto the printing plate.

Now tighten the two screws again in sequence. Best hold the extruder at the very top of the inlet. This prevents them from twisting and hitting the fan sheet. Both extruders must be applied to the printing plate with the same force.

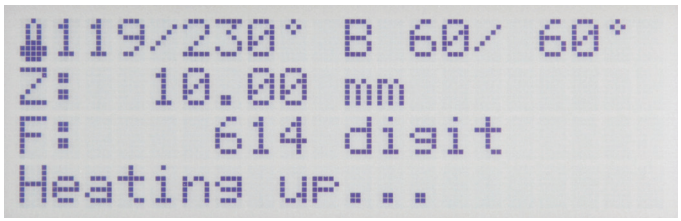
Press the button "**Play**" (6) to terminate Heat Bed Scan.

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

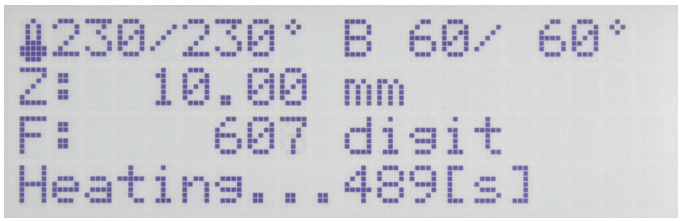
Attention! Always stay near the printer while printing. This applies specifically in this place, since the printer is waiting for your action and input. The firmware has a safety deactivation integrated that cancels the process after 60 minutes, but the extruders should only be kept at temperature for the time needed without filament.

→ Printers with a single extruder do not require alignment of the two extruders, of course. After a successful head bed scan, the distance between the nozzle and printing plate is determined automatically here. The process therefore continues seamlessly without any action on your part.

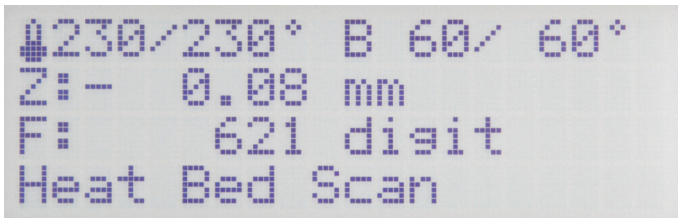
Determination of the current distance between the nozzle and printing plate at printing temperature.



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).

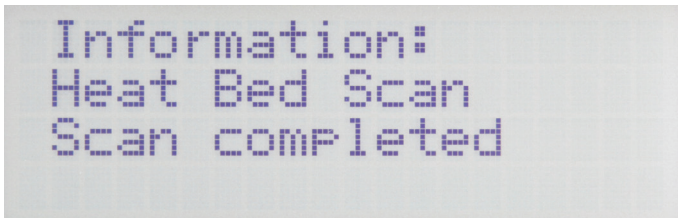


When the temperature has been reached, the printer will wait for 10 minutes to ensure that the extruders are heated through entirely.
The waiting time is displayed in seconds in the status bar.

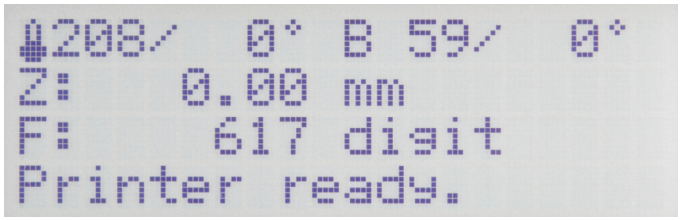


Then the printer will determine the current distance between the nozzle and printing plate at printing temperature.
This will be saved and automatically accepted for all printouts.
Usually, the Z-offset value no longer needs to be set.

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



When the information "**Scan completed**" is displayed as shown in the figure, the scan has been completed successfully and the values have been saved.
Confirm the message with **OK**.



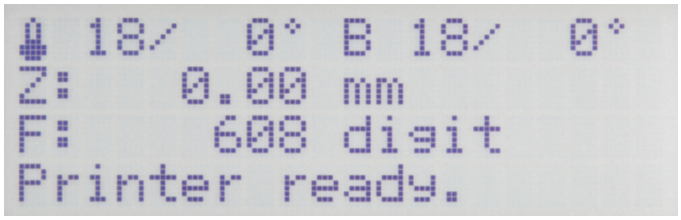
The printer switches back to the main display.
You can use the printer now. Best continue by inserting the filament.

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

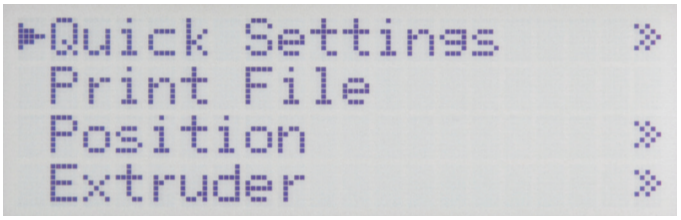
e) Executing the quick head bed scan

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

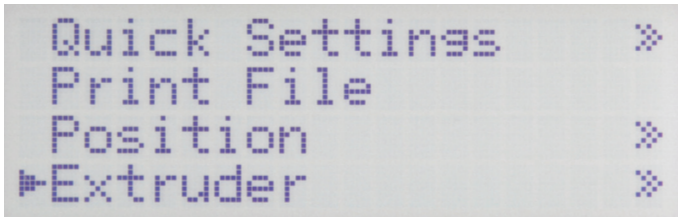
Heating up the printing plate and the extruders



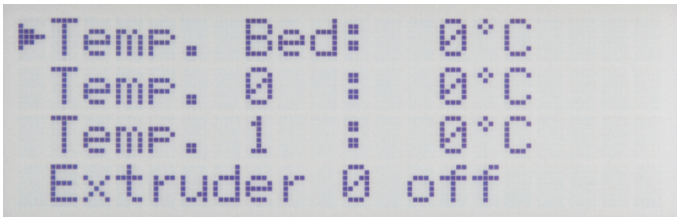
Briefly push the button **OK** (2) in the main display.



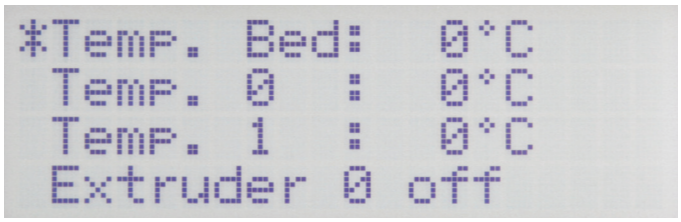
Use the direction buttons (1) to select "**Extruder**".



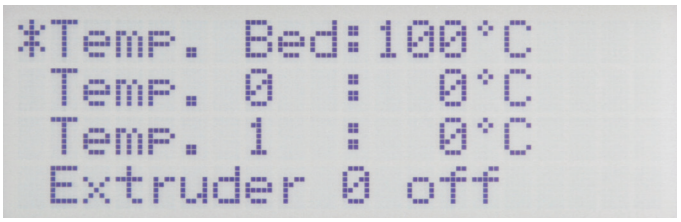
Push **OK**.



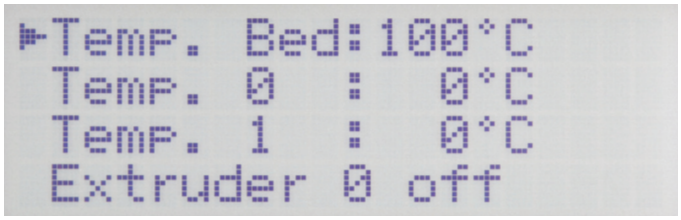
Push **OK** to select "**Temp. Bed**".



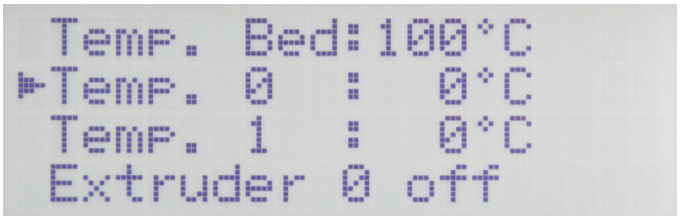
Use the direction buttons to set "**100 °C**".



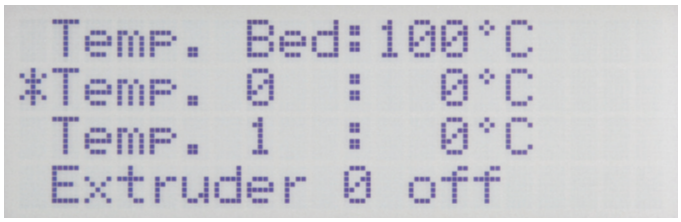
Push **OK**.



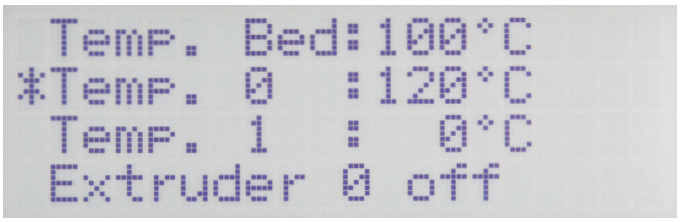
Use the direction buttons to select "**Temp. 0**".



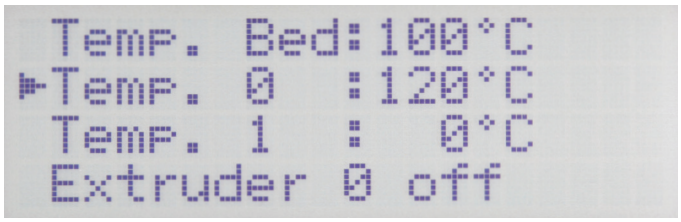
Push **OK**.



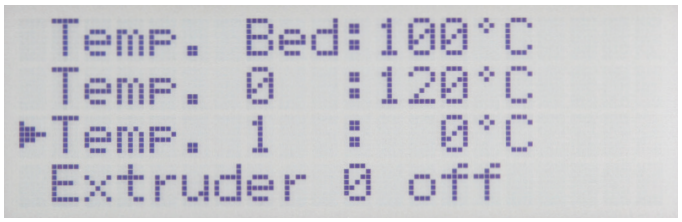
Use the direction buttons to set "**120 °C**".



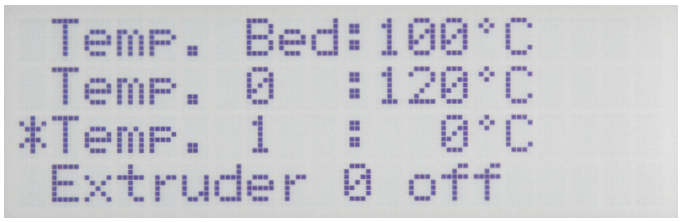
Push **OK**.



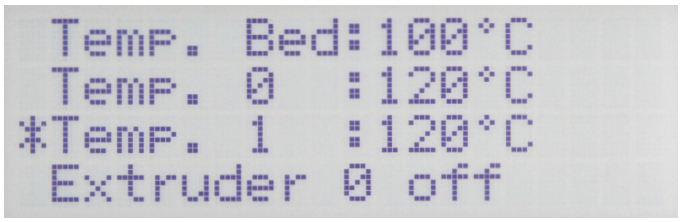
Use the direction buttons to select "**Temp. 1**".



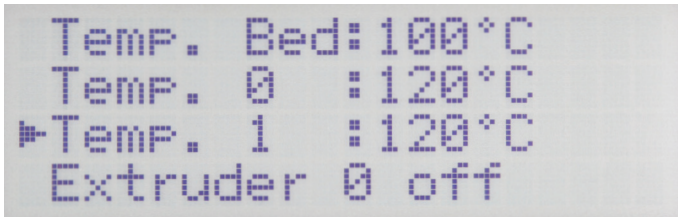
Push **OK**.



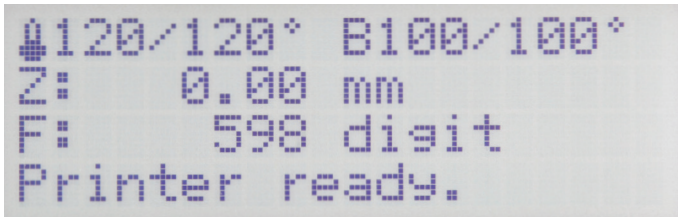
Use the direction buttons to set "**120 °C**".



Push **OK**.

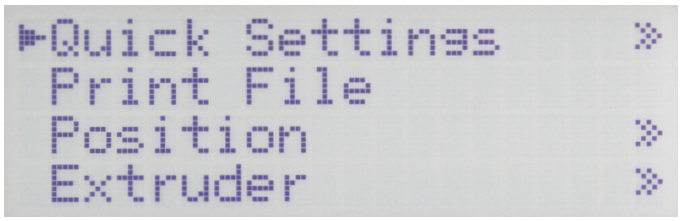


Push the direction button "**left**" 2 x to return to the main menu.

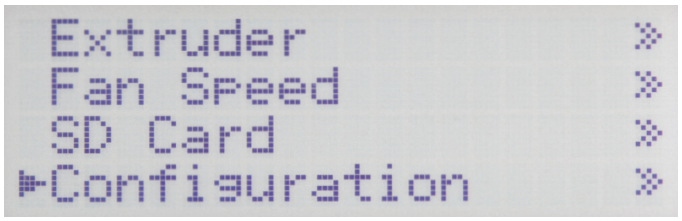


Wait until the actual temperature of the extruders in the display is 120 °C and the actual temperature of the printing plate is 100 °C.
Let then both continue to heat up for at least another 10 minutes until the printing plate temperature has stabilised and it is entirely heated through, and the extruder have completely expanded.
Then push **OK**.

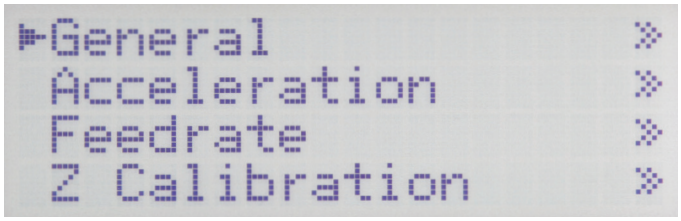
Start of the heat bed scan



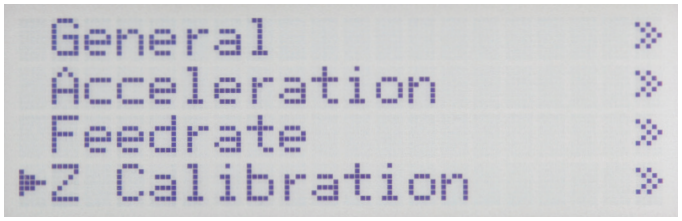
Use the direction buttons to move to item "**Configuration**".



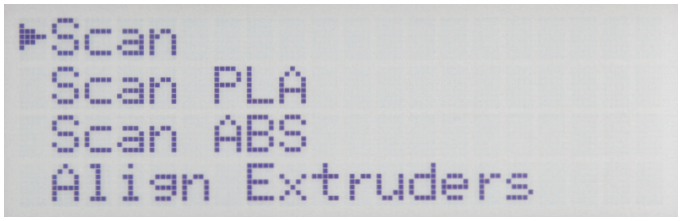
Push **OK**.



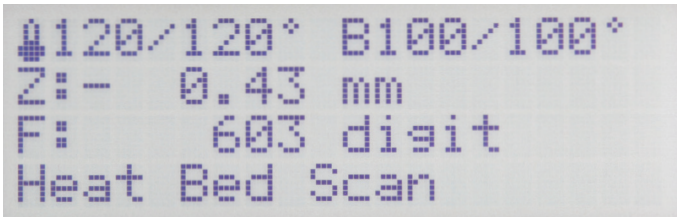
Use the direction buttons to select "**Z Calibration**".



Push **OK**.

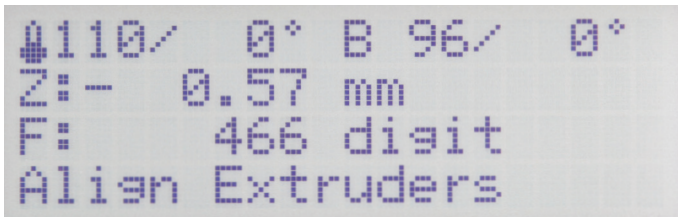


Push **OK**, to select "**Scan**" and start the heat bed scan this way. Push the direction button "**left**" 3 x to return to the main menu.



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

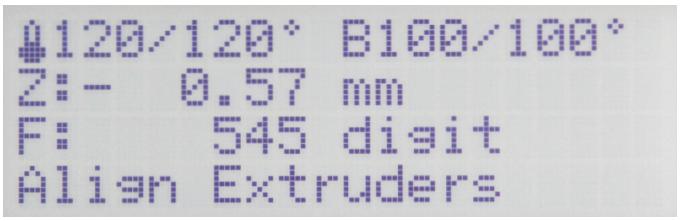
Aligning the right extruder



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

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

Again, wait for at least 10 minutes when the set temperatures are reached.



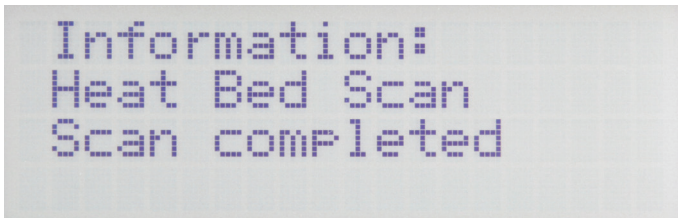
The extruder 0 should now be supported nearly entirely on the printing plate.
To be certain, first release the holding screw of the left extruder (extruder 0), so that it is actually supported on the printing plate.

Then release the screw of the right extruder (extruder 1) and lower it carefully onto the printing plate.

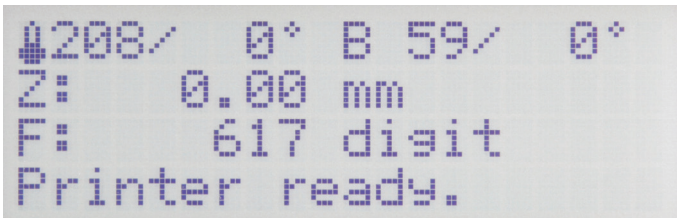
Now tighten the two screws again in sequence. Best hold the extruder at the very top of the inlet. This prevents them from twisting and hitting the fan sheet. Both extruders must be applied to the printing plate with the same force.

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

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



When the information "**Scan completed**" is displayed as shown in the figure, the scan has been completed successfully and the values have been saved.
Confirm the message with **OK**.



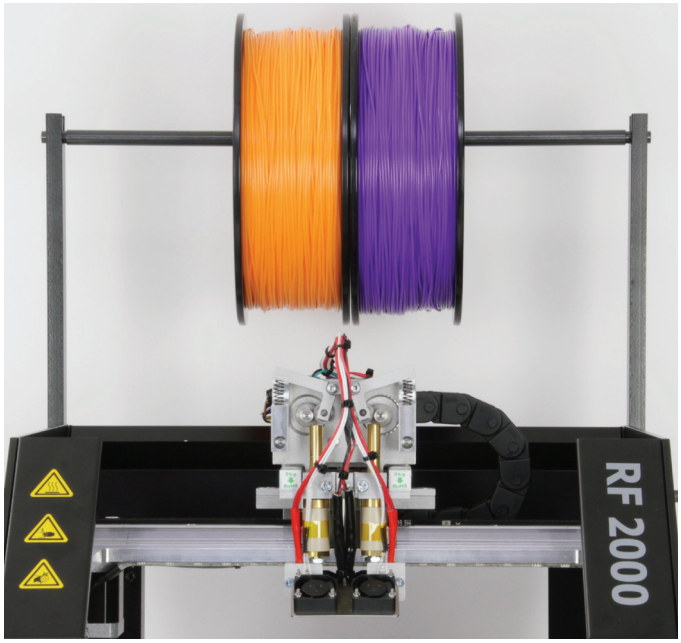
The printer switches back to the main display.
You can use the printer now. Best continue by inserting the filament.

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

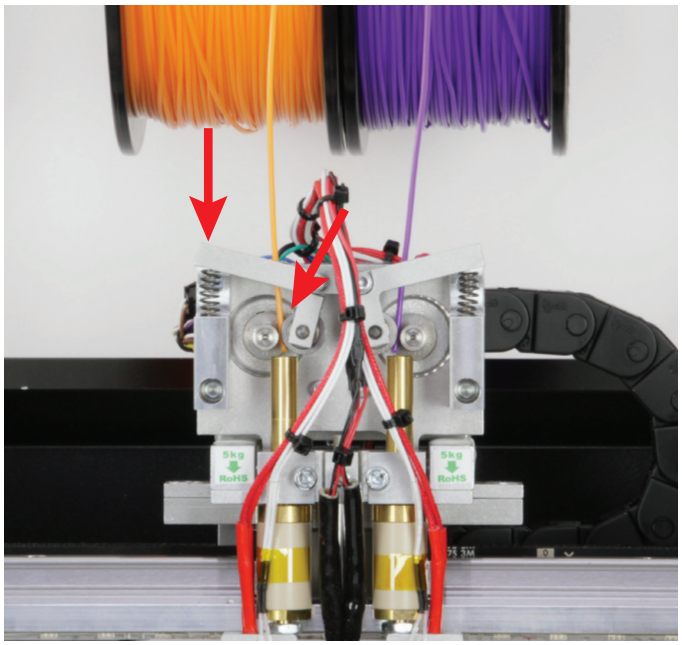
In this version of the head bed scan ("**Scan**"), you need to manually set the Z-offset (distance between nozzle/printing plate when printing the first layer) after the scan. For the settings for the Z-offset, see the menu "**Configuration**" - "**Z Calibration**" - "**Z Offset**". Alternatively, the Z-offset can also be controlled via the G-code.

15. Inserting, removing and changing the filament

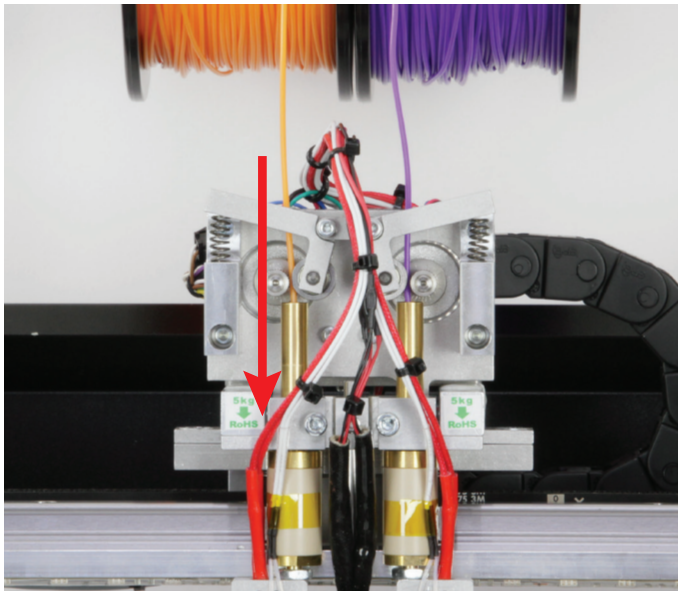
a) Inserting the filament - Mechanical part



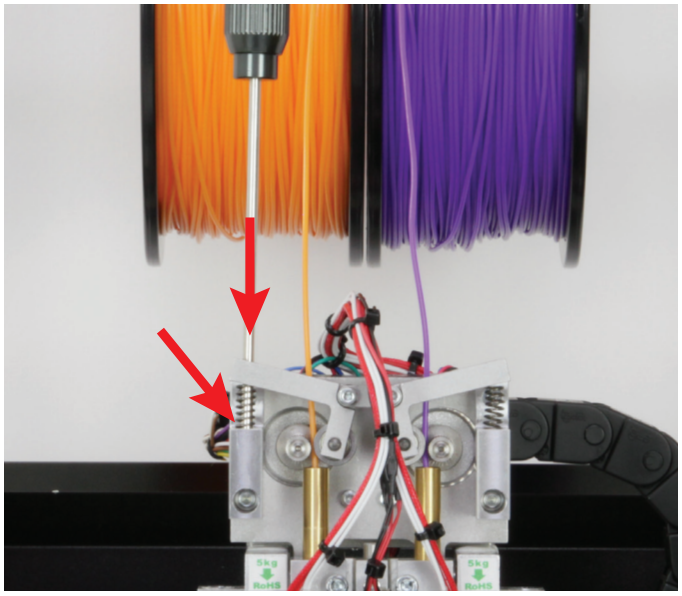
Push the filament rolls on the shaft of the filament holder. The filament rolls must move freely.



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.



To set the application pressure of the ball bearings, guide a hex key with 3 mm through the outer-most hole of the hall bearing holder and through the spring into the spring holder.
Turning the screw in the spring holder to the left turns the screw in farther and the spring relaxes. Turning it to the right will turn out the screw farther and the spring is tensed more strongly.

Then turn on the printer and move the printing plate with the arrow button "**down**" (3), manually until the filament can escape well.

b) Inserting the filament via the printer menu

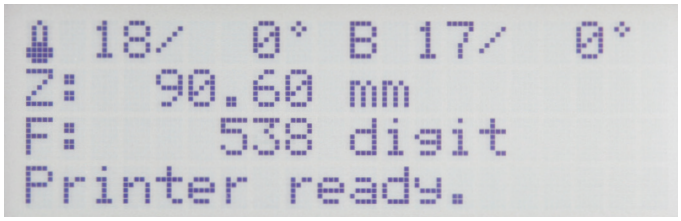
Before inserting, removing or changing the filament, the corresponding extruder must be heated up so that the filament can be inserted into or removed from the extruder cleanly.

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

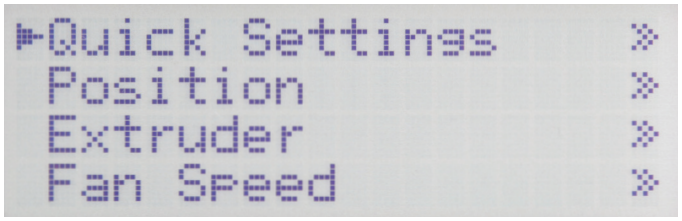
Always wait for the extruder temperature to be reached at filament change and let the extruder heat for approx. another minute.

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

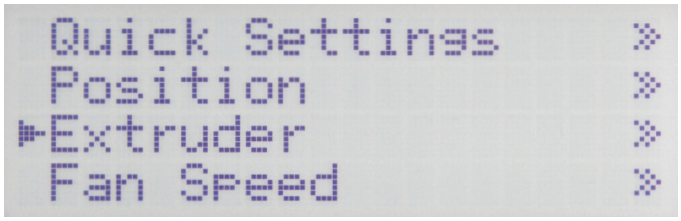
Left extruder (extruder 0)



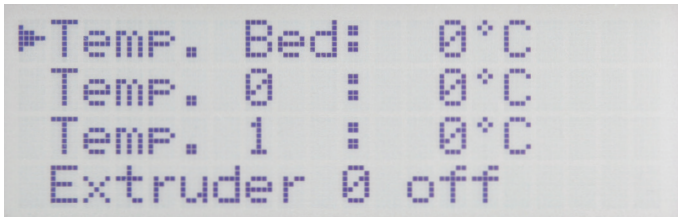
Push **OK** (2) from the main menu.



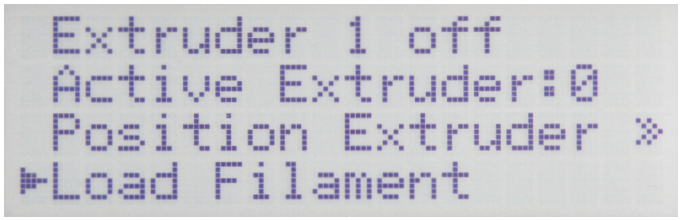
Use the direction buttons (1) to select "**Extruder**".



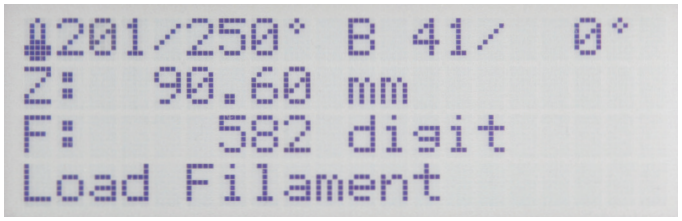
Push **OK**.



Use the direction buttons to navigate to "**Load Filament**".



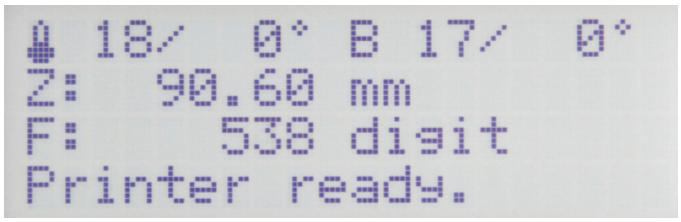
Push **OK**.
Important! The menu item "**Active Extruder**" must show "**0**". Only then is the left extruder chosen as the active one.



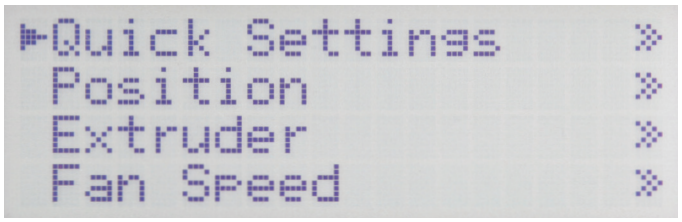
The printer will now automatically heat up the active extruder (after activation, this always is extruder 0, i.e. the left one). When it has reached the pre-set target temperature, the filament will be pulled in. The process is automatically ended after some time and the extruder heater is switched off.

Right extruder (extruder 1)

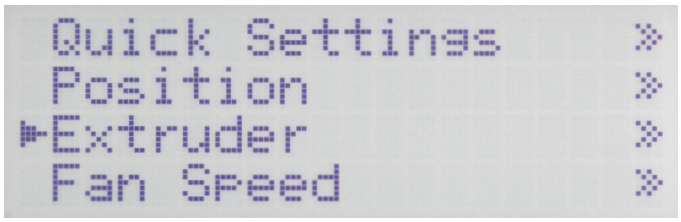
→ The path described below for inserting the filament is an alternative to the preceding path. Of course, you can insert the filament in both extruders either way.



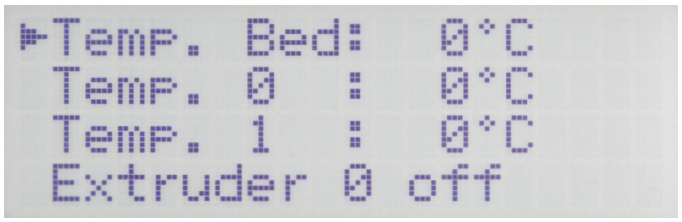
Push **OK** from the main menu.



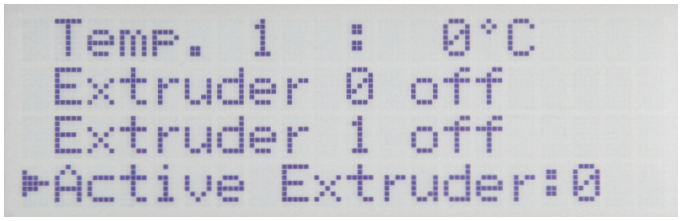
Use the direction buttons to select "**Extruder**".



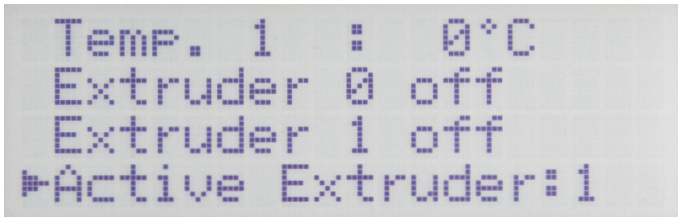
Push **OK**.



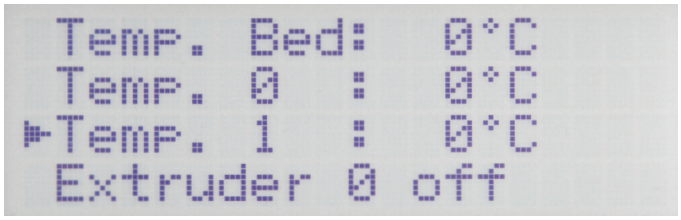
Use the direction buttons to navigate to "**Active Extruder**".



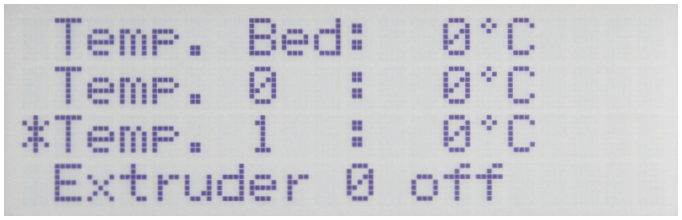
Push **OK**. Then the 2nd extruder is chosen as the active one (extruder 1).



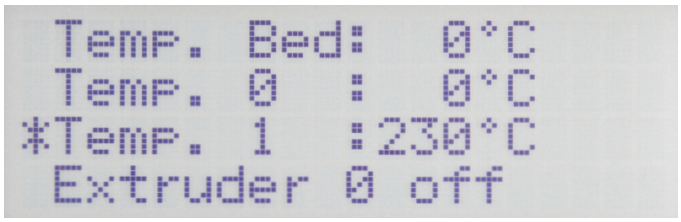
Use the direction buttons to select the item "**Temp. 1**".



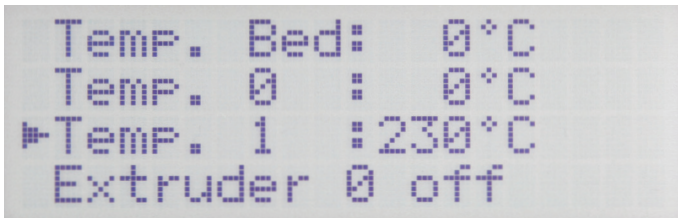
Push **OK**.



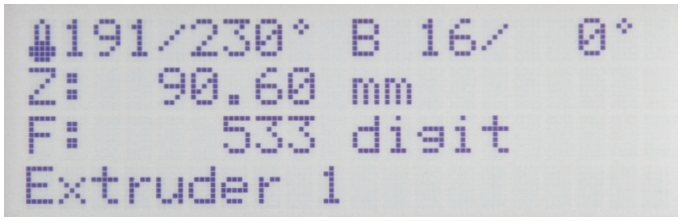
Use the direction buttons to set "**200 - 230 °C**" (e.g. for PLA).



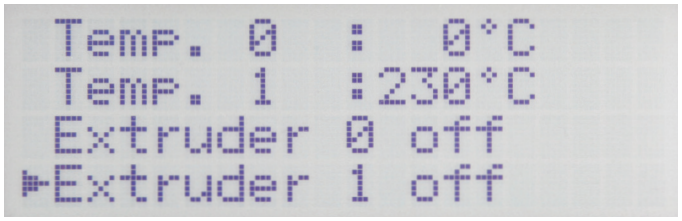
Push **OK**.



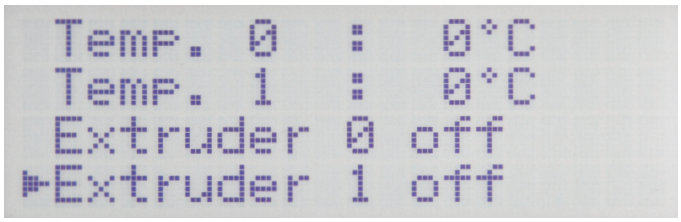
Push the direction button "**left**" 2 x to return to the main menu.



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**".
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 right 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.

When printing with PLA filament and any problems occur with adhesion of the printed objects, glue masking tape or a slightly structured crepe tape to the printing plate. 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 finished print files on the enclosed SD card in the folder PLA-GCODE.

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. On this, note the chapter "12. a) Download and unpacking of the software/firmware package".**

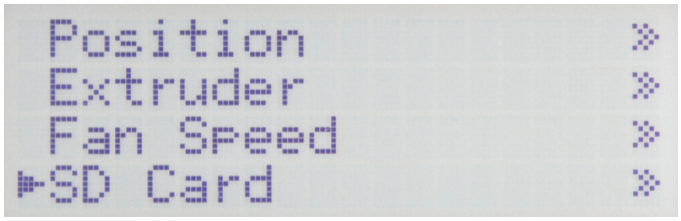
In our example, we print a single-coloured object in single extruder mode. This means that only the active extruder, which is usually the left one (extruder 0), is used. If you want to print with the right extruder instead, select the item "**Active Extruder**" with the button OK in menu "**Extruder**"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

For owners of the single extruder printer, however, this selection is not needed.

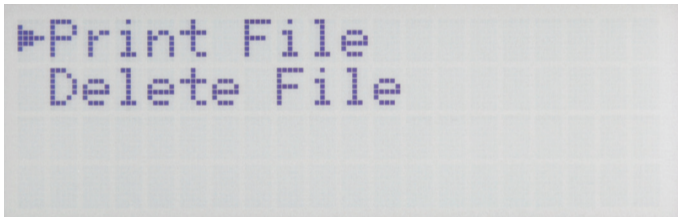
Push the enclosed SD card into the SD card reader at the right of the 3D printer.

→ **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!**

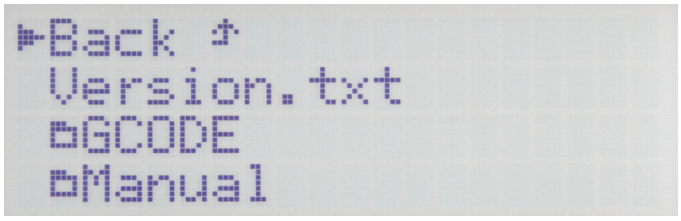
The card is detected automatically after plugging in. Before removal, switch to the main menu. Of course, you must not print from the memory card right then.



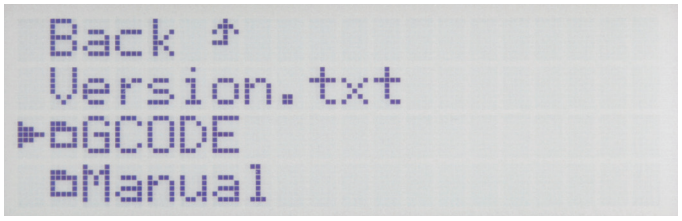
In the main display, push **OK** (2) and select "**SD Card**" with the direction buttons (1). Push **OK** again.



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

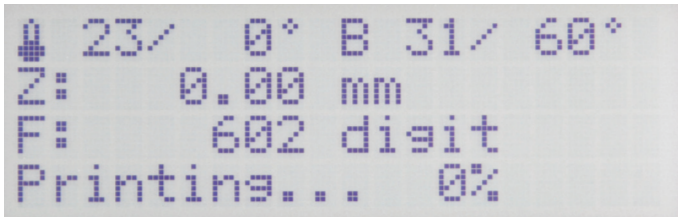


Navigate to the folder "**PLA-GCODE**" in the folder structure of the SD card with the direction buttons.

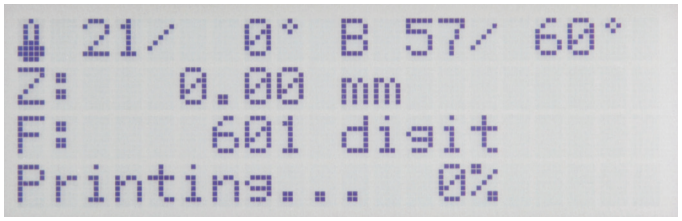


Push **OK** again.

Move to the file "**Heart.gcode**" with the direction buttons.
Push **OK** to start printing. The display switches back to the main menu.



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

For this setting, observe that the extruders must not touch the printing plate since the printing plate and the extruder 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 printing 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 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.

The tolerances of the fans may cause them to only start up at 20% or 25%.

Let the printed object cool off for a few minutes after printing. When the temperature of the printing plate is below 40 °C (see display), the printed object comes free easier from the printing 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 on the printing plate. There is a risk that the printing plate will be damaged by this (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.

When you have completed the first printout successfully, we recommend urgently that you calibrate the filament infeed (chapter "19. b) Fine adjustment of the filament infeed"). This compensates for tolerances of the infeed knurl.

Owners of printers with a dual extruder should also adjust the two extruders without delay (X and Y extruder offset). For this, observe chapter "19. c) Fine adjustment of the two extruders".

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.

Printing plate temperature

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

PLA can also be printed without a printing plate, 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 temperature of the printing plate is too high, the printed object may distort or the lower layers will cool off too slowly.

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

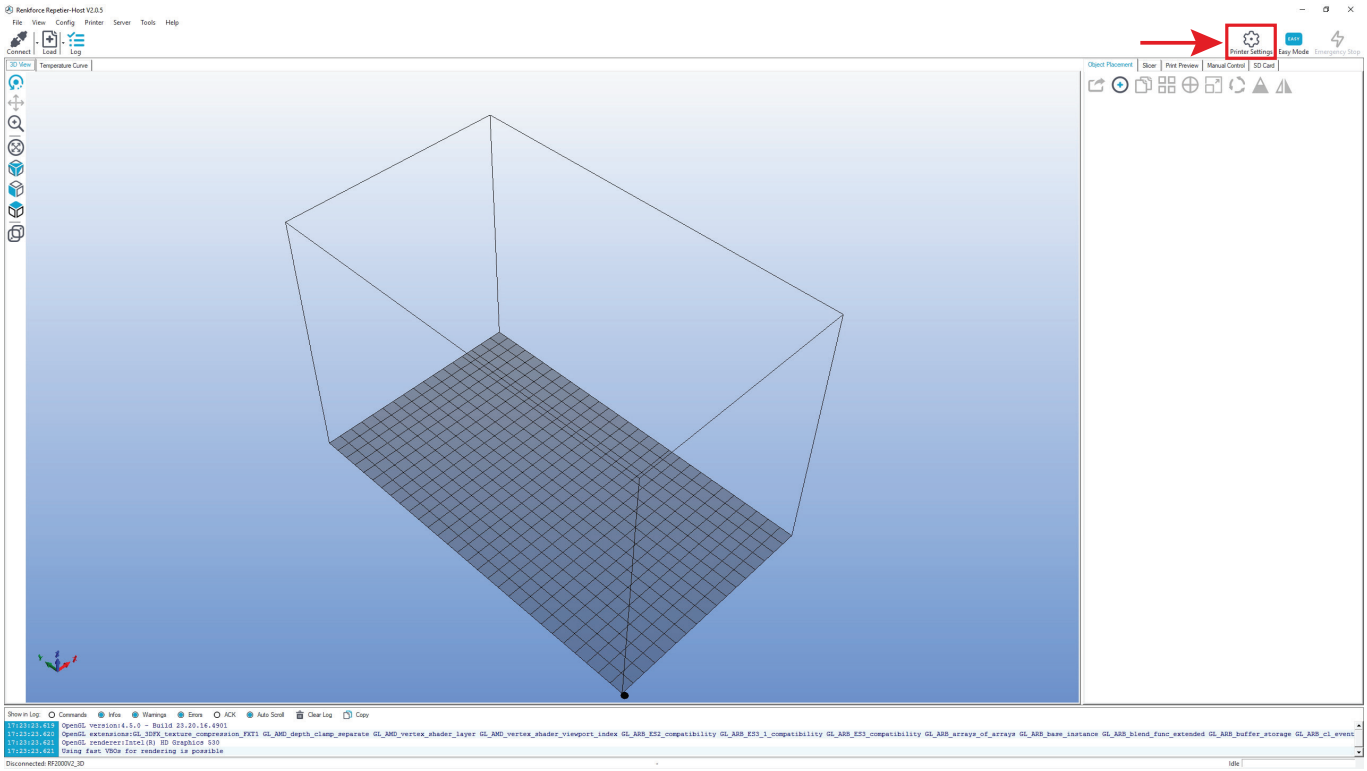
⟶ Experiment with the above parameters to find the best printer results for you depending on the material used.

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) 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 in the menu above (1). In our example, this is the "**RF2000v2_3D_Dual**" with dual extruder. Owners of the single version must select the single version "**RF2000v2_3D_Single**" accordingly.
- 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**".

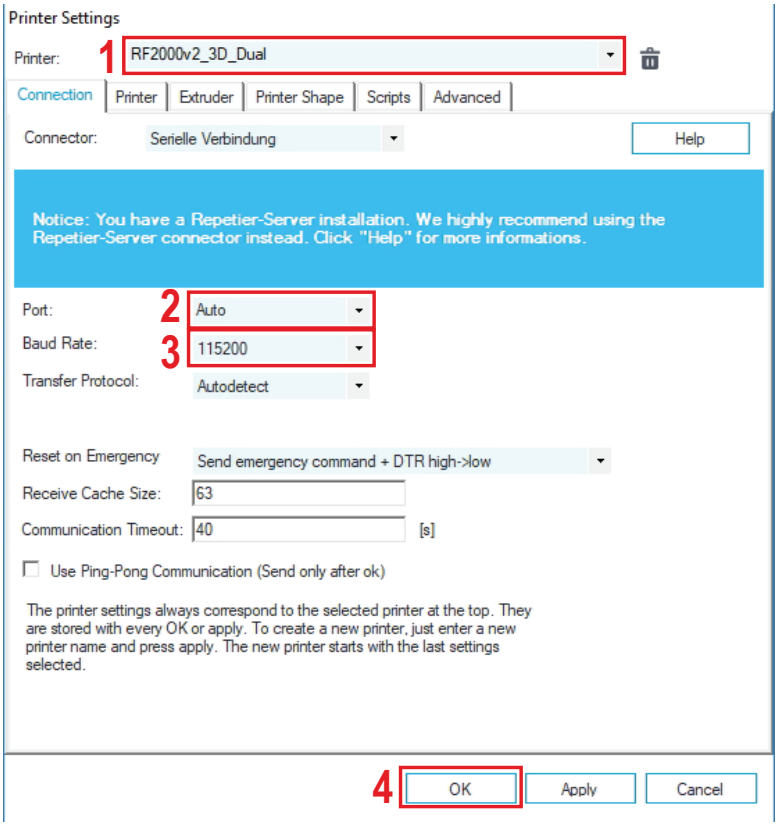
⟶ The port number (2) is system-dependent.

Usually, the setting "**Auto**" should work with the current version of the software (as of 2.0.5).

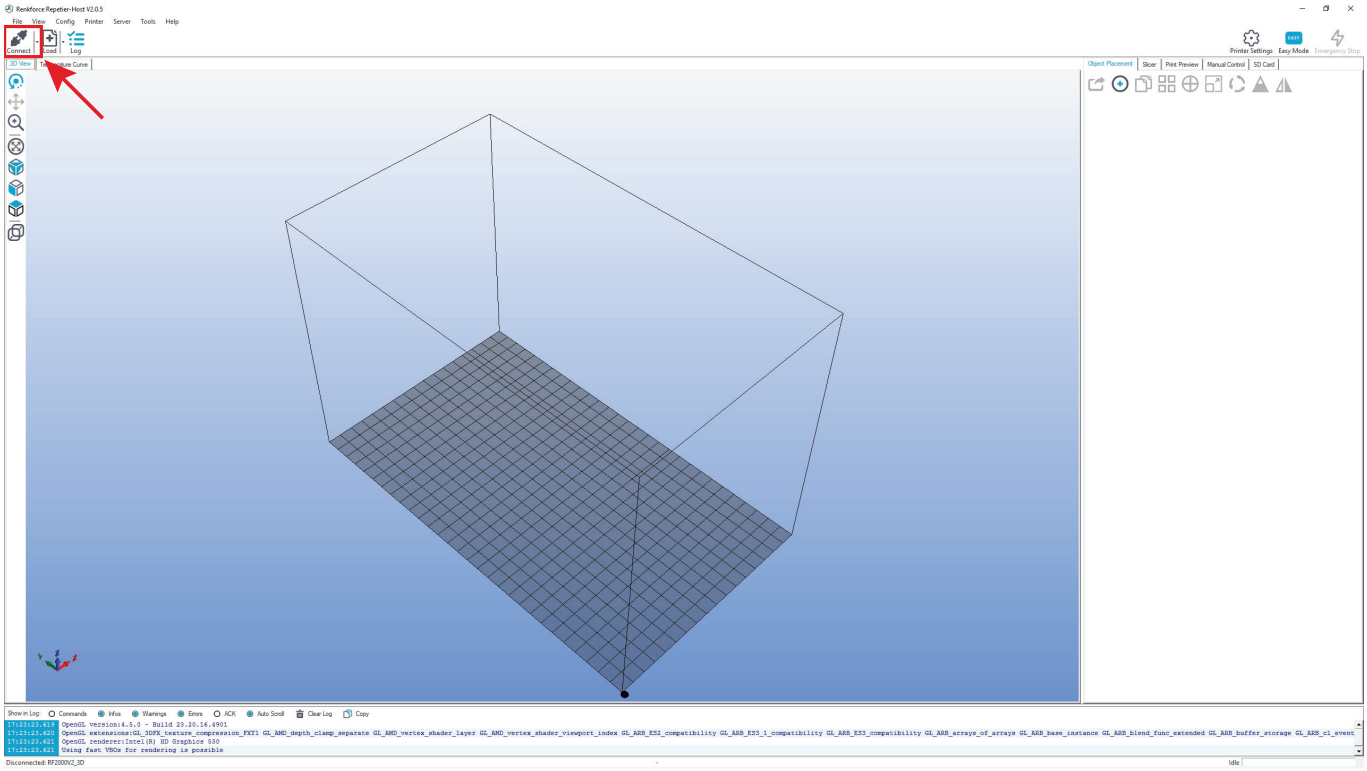
If this does not work properly for you, you can check the port in the device manager of the control panel, under connections (COM and LPT).

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

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

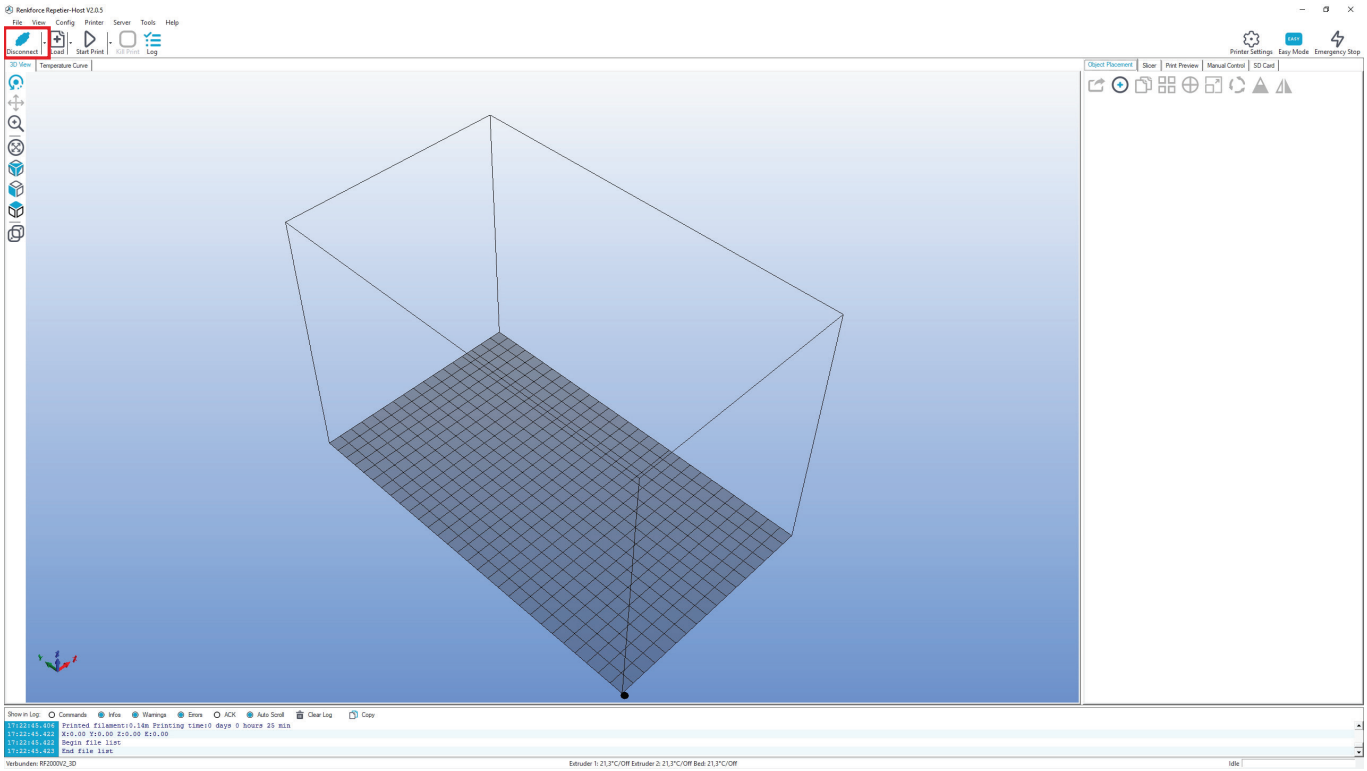


Click "**Connect**" in the upper left of the main screen of the software.



After a few seconds, the symbol swill switch to a connected plug and the label turns to "**Disconnect**".

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



b) 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) Here, a command can be sent to the printer; enter the command (e.g. G1 X50) and click "**Send**".

(3) This shows the current positions of the axes. While the text is red, the home position was not targeted yet.

(4) Selecting the extruder

(5) All axes move into the home position

(6) X-axis moves into the home position

(7) Y-axis moves into the home position

(8) Z-axis moves into the home position

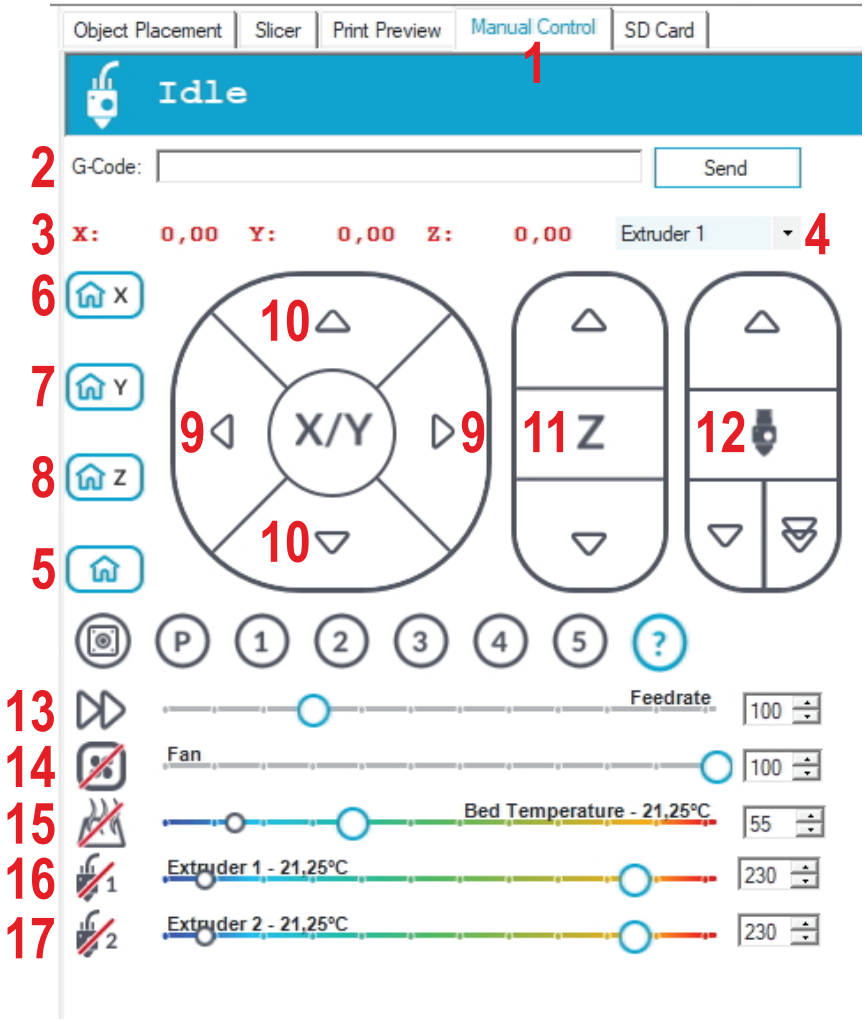
(9) The arrow icons can be used to operate the X-axis of the printer manually.

(10) The arrow icons can be used to operate the Y-axis of the printer manually.

(11) The arrow icons can be used to operate the Z-axis of the printer manually.

(12) The arrow symbols can be used to manually operate the extruder infeed of the printer for the selected extruder; the double arrow confirms the infeed for both extruders; the extruder or extruders must be heated up!

(9-12) Depending on where the arrow is clicked, differently long routes will be run; the route length is displayed when the mouse pointer leads across the corresponding button of the arrow; steps 0,1 mm, 1 mm, 10 mm, 50 mm



(13) Setting of the printing speed

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

(15) Switching the heating for the printing plate on/off; To the right of this, the temperature can be set.

(16) 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.

(17) 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.

c) 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 and displayed in a close view. The scroll wheel of the mouse can be used to zoom out of the view again so that you can see the entire virtual printing plate once more.

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

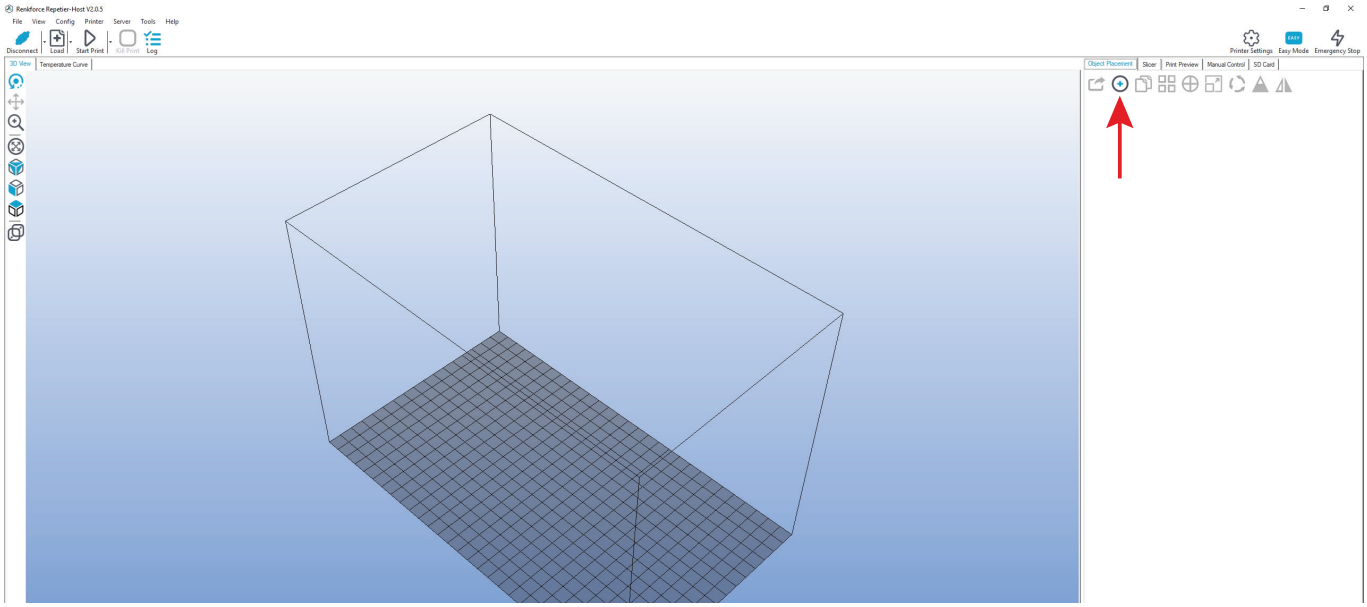
*.stl (STL-files)

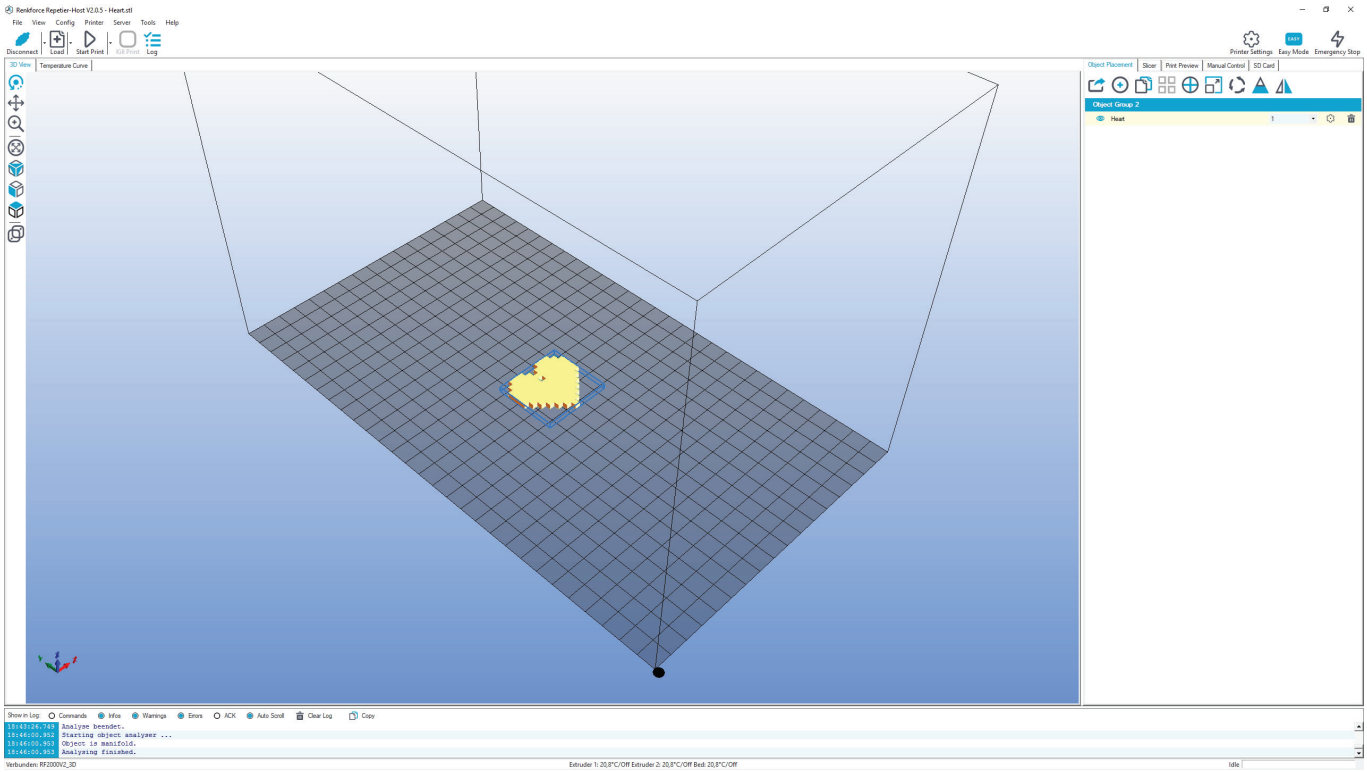
*.obj (OBJ-files)

*.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

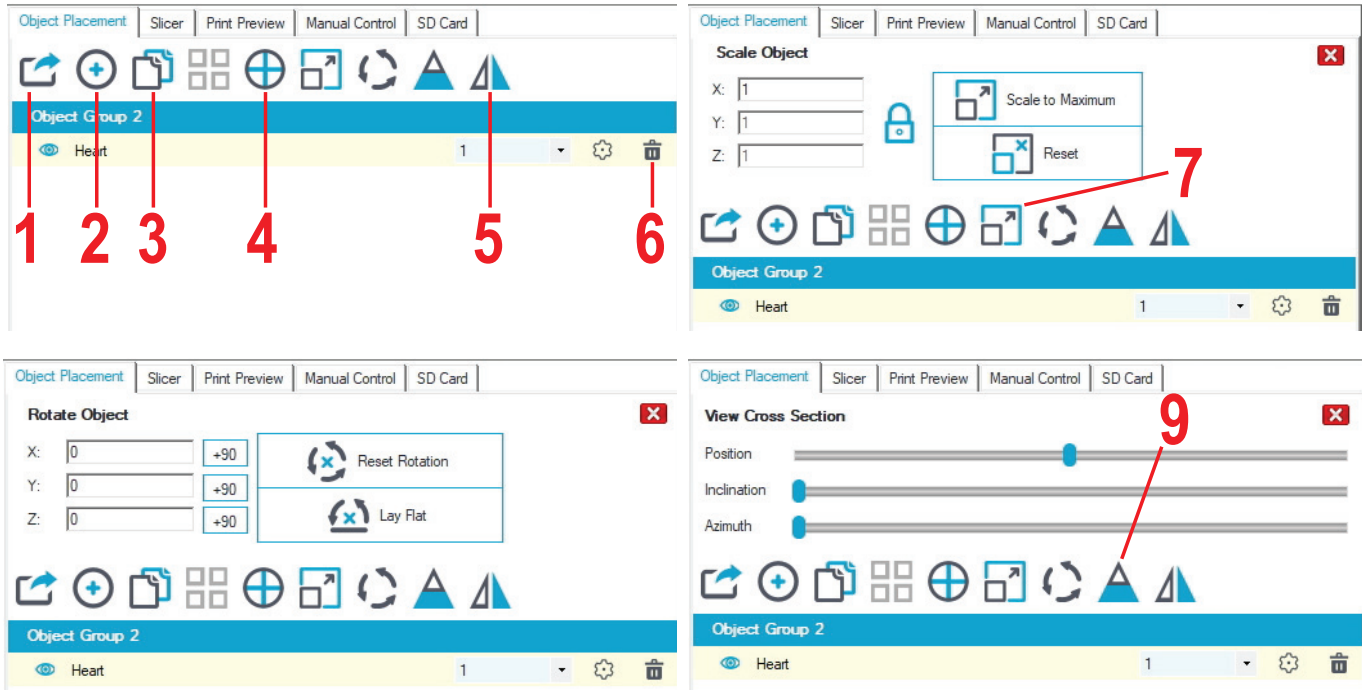
(6) Deleting the object from the printing plate

(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

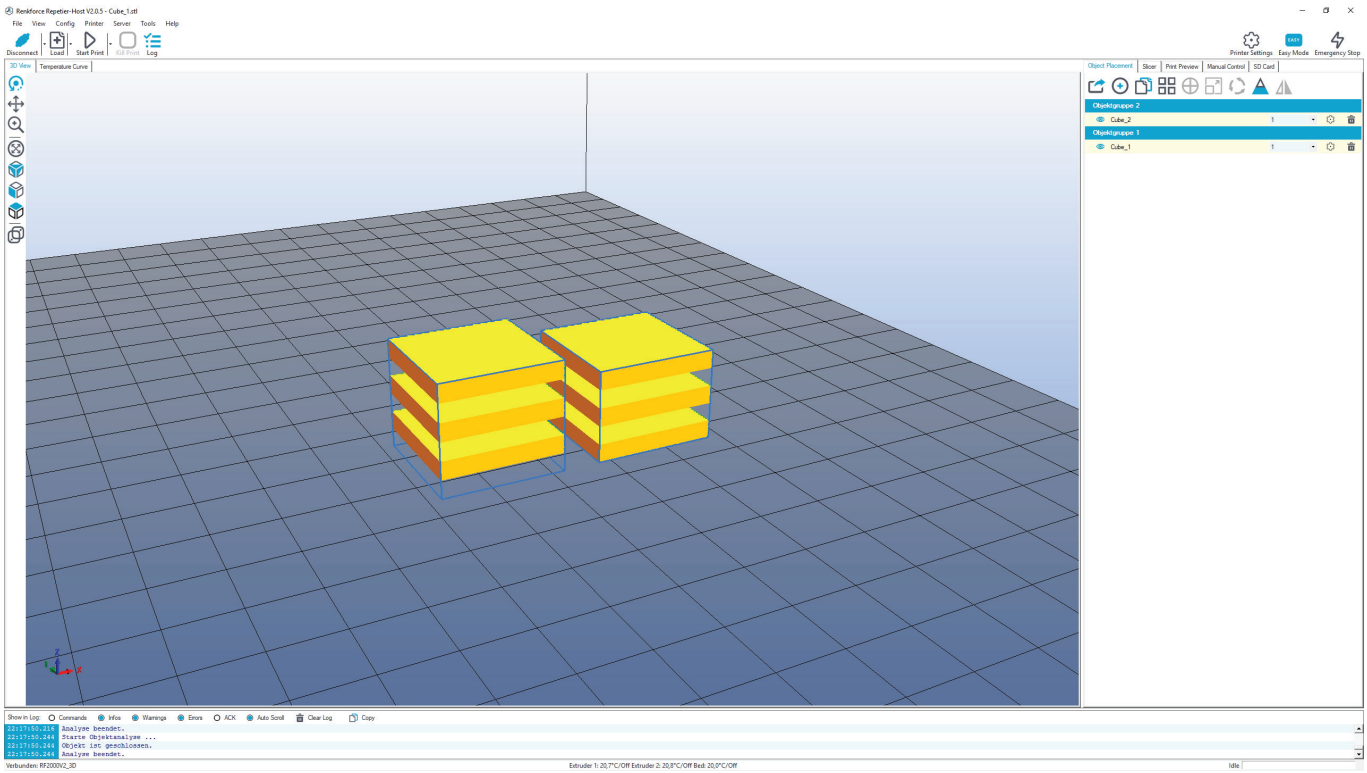
(9) Showing the cross-section of the object



Placing the object to be printed for 2-coloured print

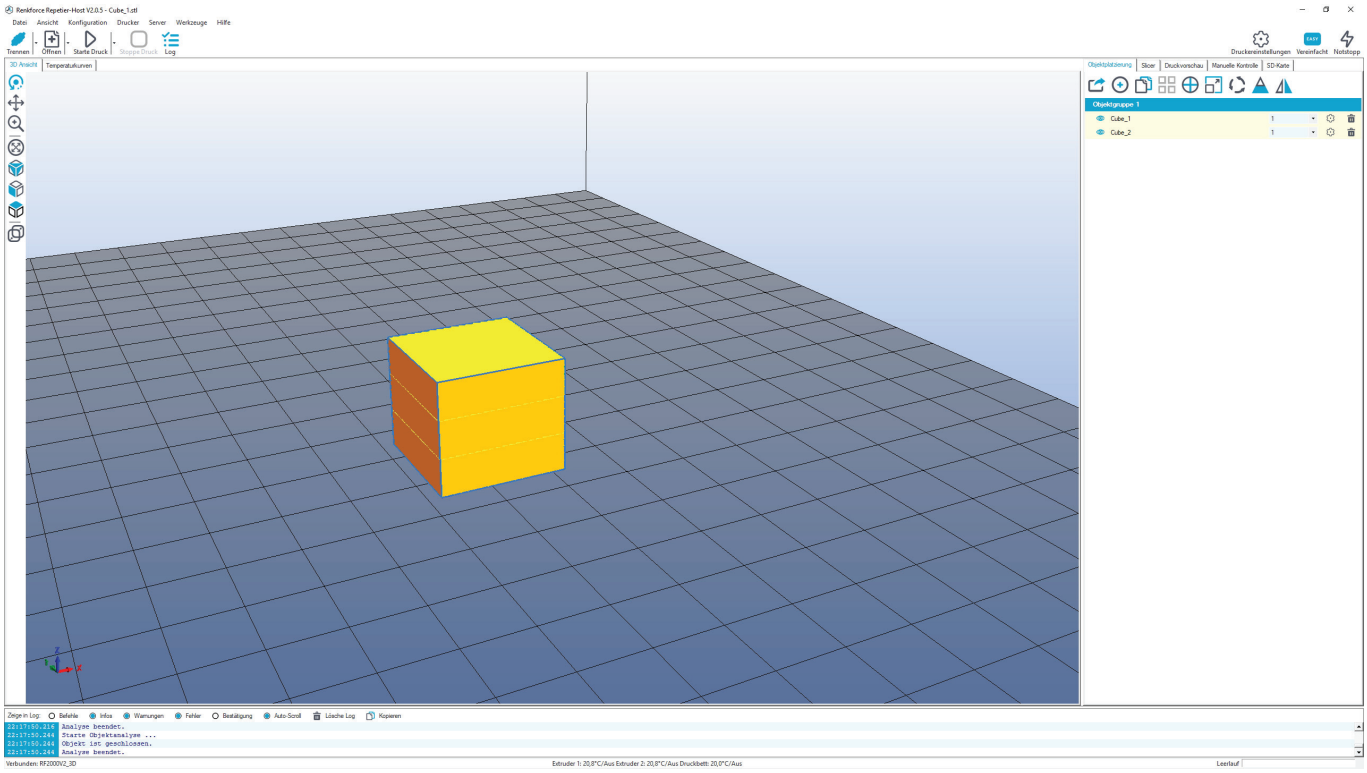
Two 3D-object files are usually used for printing a two-coloured object. The SD card holds, e.g., a 2-coloured cube "**Cube_1.stl**" and "**Cube_2.stl**". One part is for the 1st extruder, the other part for the 2nd extruder. You will find the files in the folder „**\STL\Dual_Cube**“.

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

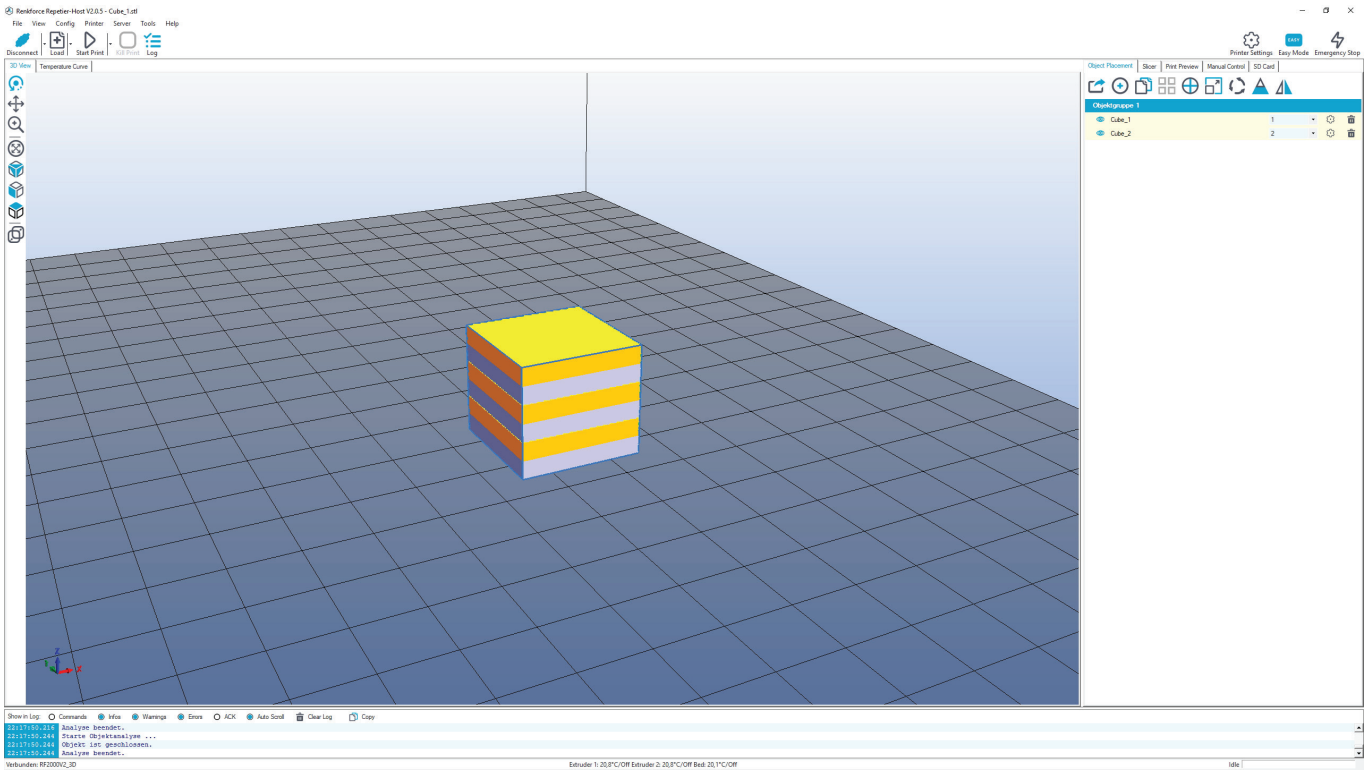


Click the yellow area of "**Cube_2**" (it is not highlighted by this) in the tab "**Object Placement**" and keep the mouse button pushed. Then pull the yellow area from "**Cube_2**" to the yellow area of "**Cube_1**". This groups them.

Now click the crosshatch (4) to centre the joined printing object.



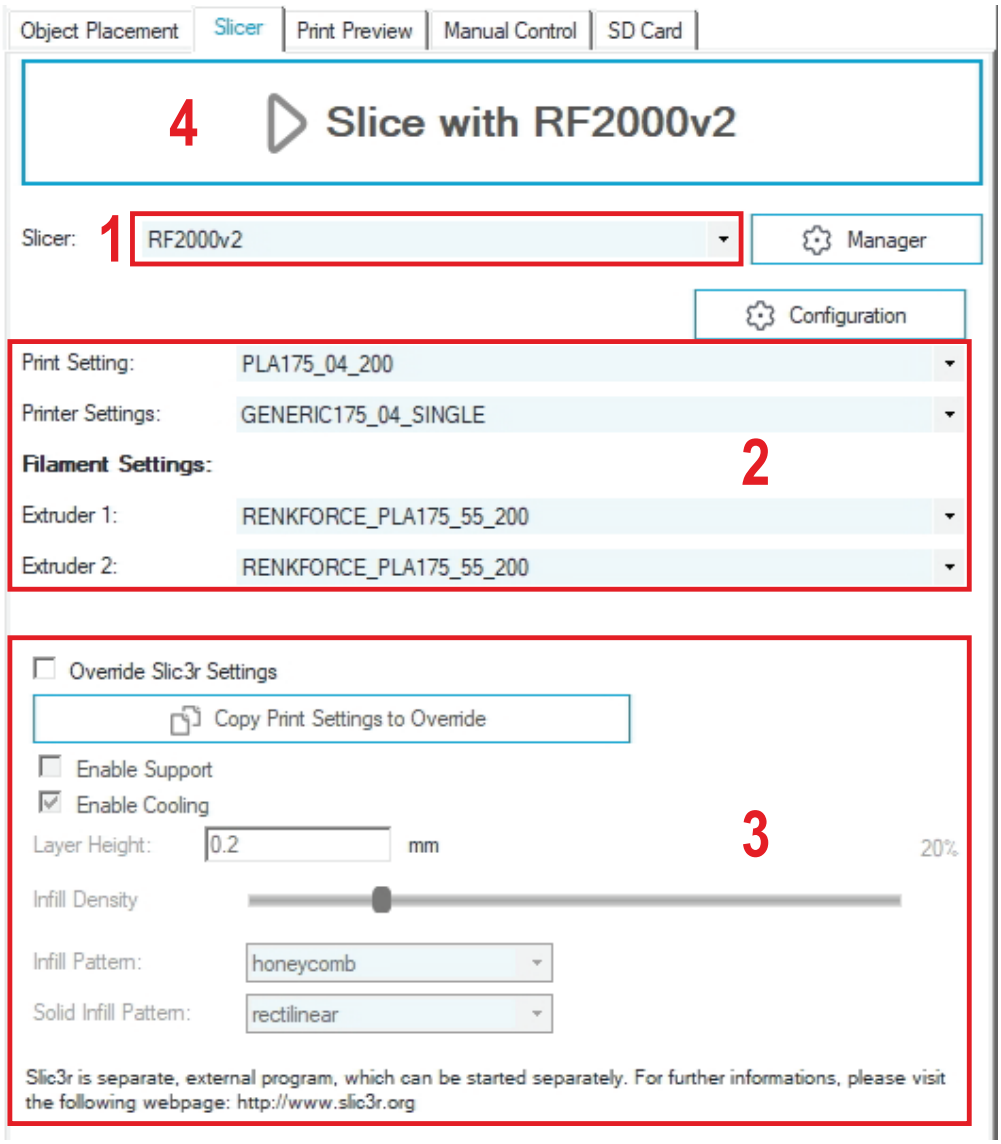
Then click the drop down menu in the yellow area behind "**Cube_2**" and switch the extruder from 1 to 2.



d) 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 the placed object to be printed for 1-coloured print



(1) Switch to the tab "**Slicer**" and select the slicer for your printer in the drop down menu "**Slicer:**". In our example, this would be the slicer "**RF2000v2**". It does not matter whether you use the RF2000 v2 with single or dual extruder. It is always the same slicer, even if you want to cut a single object with the dual extruder.

(2) Select suitable slicer settings for your print. Only such settings that are compatible with the printer chosen above appear here.
The settings are always marked with the following routine:

Print Setting (in the slicer settings "Print Settings")

Filament material_nozzle diameter_layer thickness_XXX

Example: **PLA175_04_200** =

1.75 mm PLA_nozzle diameter 0.4 mm_layer thickness 200 µm (= 0.2 mm)

⟶ If something else is attached to the setting after the layer thickness (**XXX**), this is an additional feature. There are, e.g., the following options for this:
"**VASE**" (if the printed object is to be open on top and hollow inside); "**FAST**" (this prints the object more quickly but at lesser quality); etc.

Your selection in this setting depends on the filament material used, the nozzle diameter of your extruder and the desired layer thickness.

Printer Settings (in the slicer settings also "Printer Settings")

Filament material_nozzle diameter_extruder

Example: **GENERIC175_04_SINGLE =**

1.75 mm PLA (all filament manufacturer)_nozzle diameter 0.4 mm_single extruder (for single-coloured print)

→ If you want to print an object in 1-colour, select the setting with "**SINGLE**" here. For 2-coloured printing, select the setting with "**DUAL**" (see second to next page). Owners of the printer with a single extruder can only select the setting with "**SINGLE**" here.

Their selection in this setting depends again on the filament material used and the nozzle diameter. You can also specify here whether the printout is to be produced with one or two extrudes.

Filament Settings (in the slicer settings also "Filament Settings")

Filament manufacturer_Filament-material_Printing plate-Temperature_Extruder-temperature

Example: **RENKFORCE_PLA175_55_200 =**

Filament manufacturer Renkforce_1.75 mm PLA_55 °C printing plate temperature_200 °C extruder temperature

→ If you want to print a 2-coloured object, select the same settings for extruder 1 and 2 each. Accordingly, you need to insert the same filament in either extruder as well, of course.
If you want to print out only a 1-coloured object, it does not matter what is set for the 2nd extruder. The only exception is if you use the 2nd extruder for the printout. In that case, the proper setting must be chosen for the 2nd extruder.
Of course, it is possible again to select two different filaments, e.g. for the printed object PLA and as supporting material PVA.
Owners of the printer with single extruder only can choose one extruder, of course.

Their selection in this setting depends on the manufacturer of the filament, the filament material used and the matching temperatures for the printing plate and extruder.

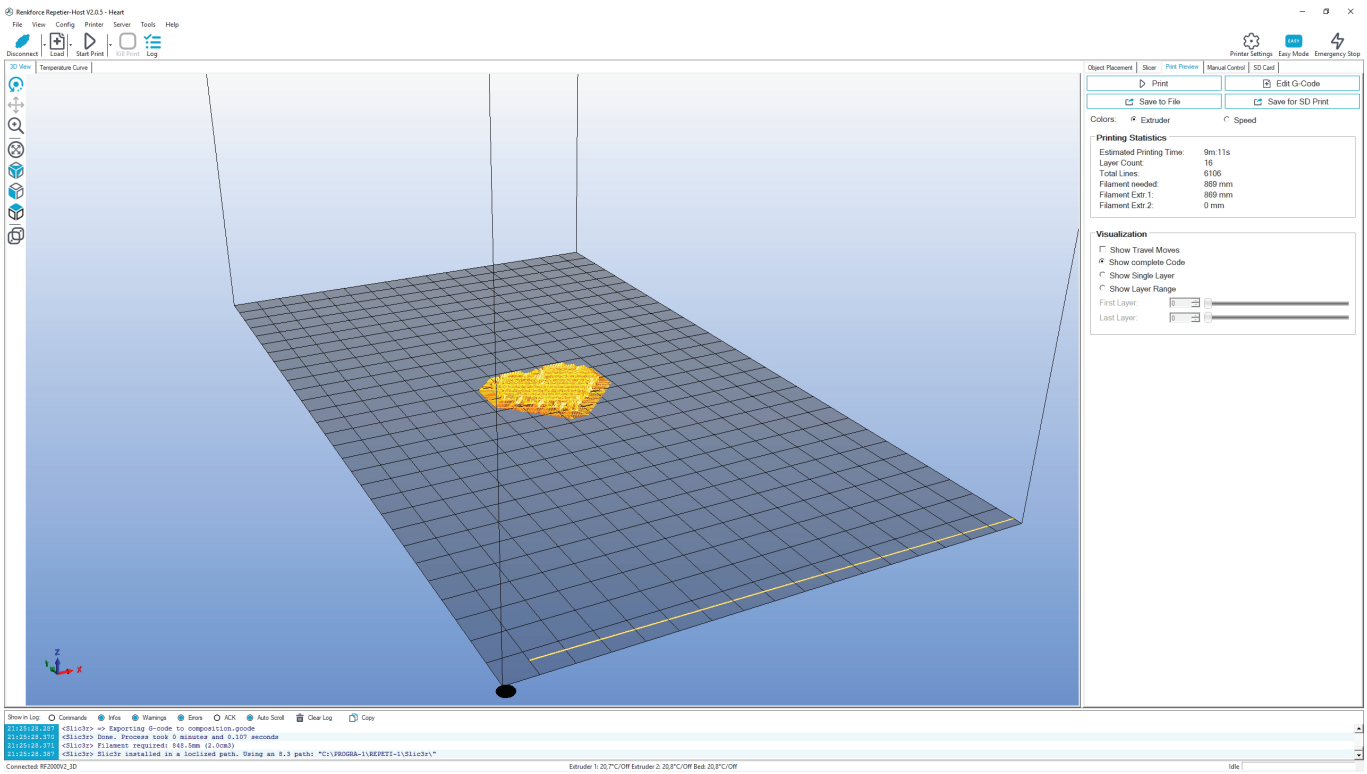
The temperatures apply from the 2nd layer onwards. For the 1st layer, the temperatures set are usually a little higher.

(3) Further settings can be made optionally here. However, this should only be done by experienced users. The online help function of the software shows what the individual functions do.

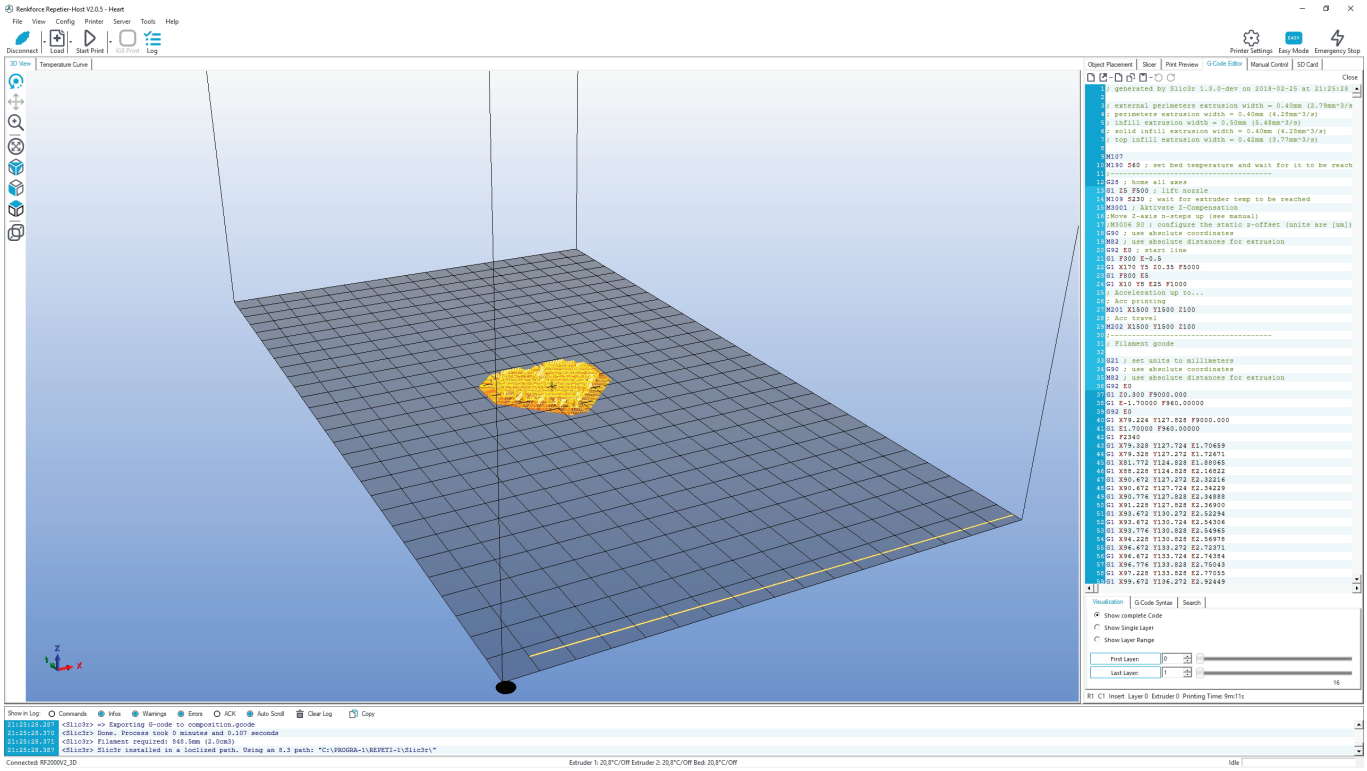
(4) Click "**Slice with RF2000v2**", to slice the 3D file.

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

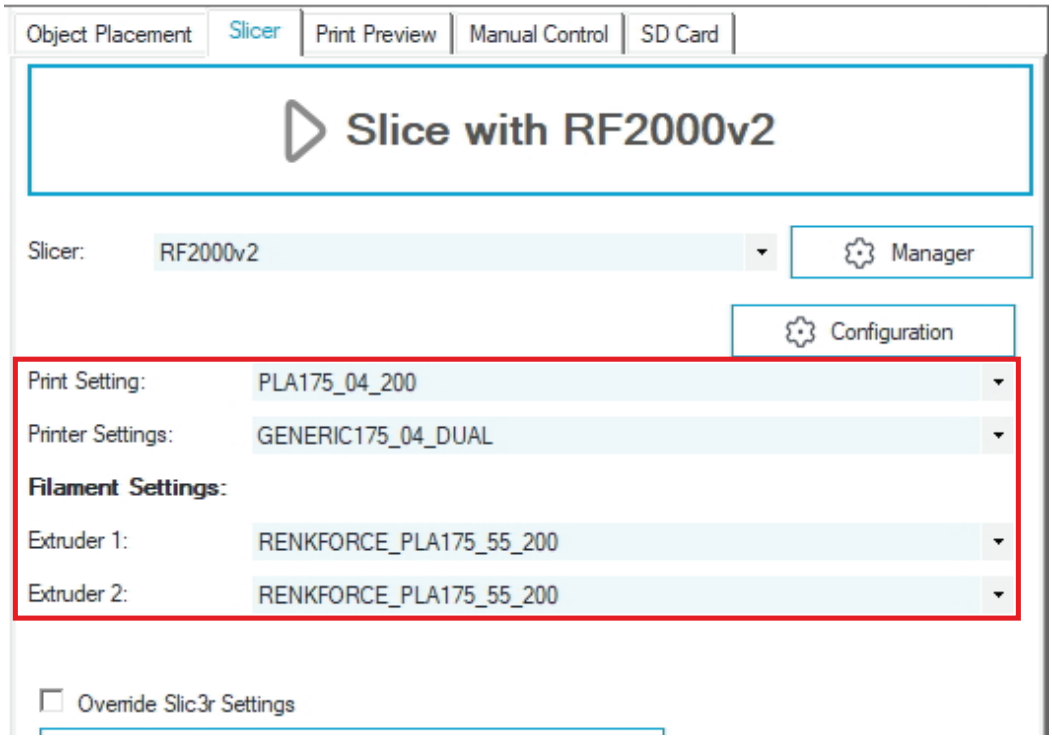
⟶ This section is only relevant for owners of the dual extruder version of the RF2000 v2.

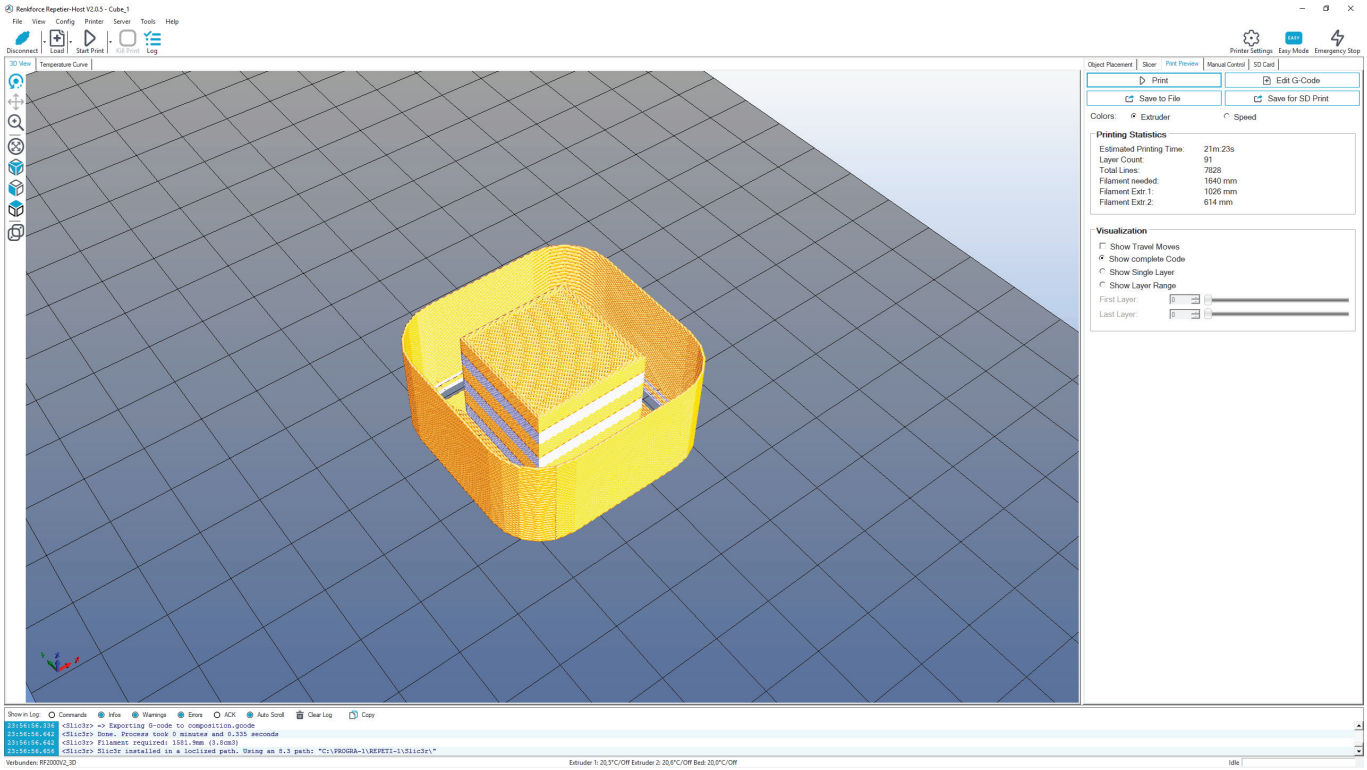
Now select a setting with the ending "**DUAL**" for slicing in the "**Printer Settings**" (e.g. "**GENERIC175_04_DUAL**").

For our example object, the same filament settings should be chosen for both extruders as well (e.g. "**RENKFORCE_PLA175_55_200**").

The selection at "**Print Setting**" is identical for dual printing and single printing.

Click "**Slice with RF2000v2**", to slice the 3D file.





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.

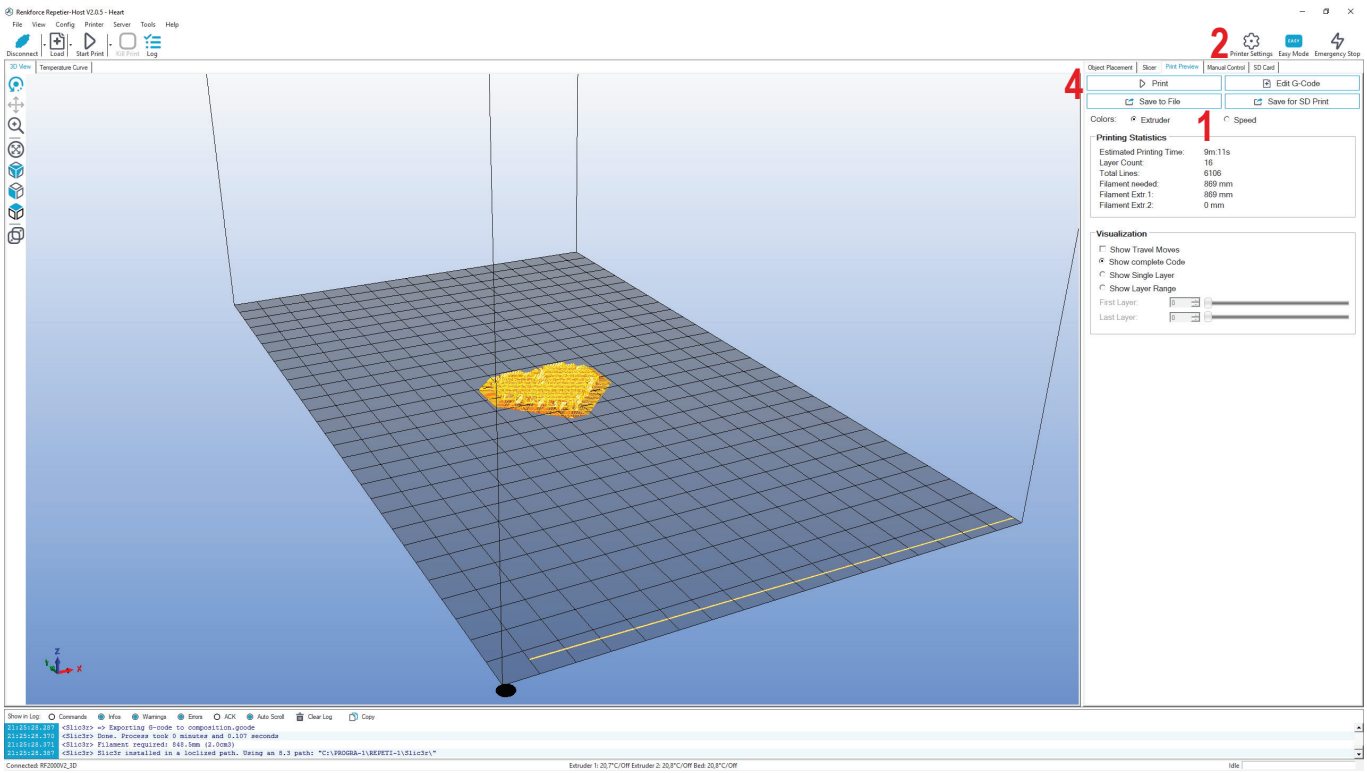
e) Print

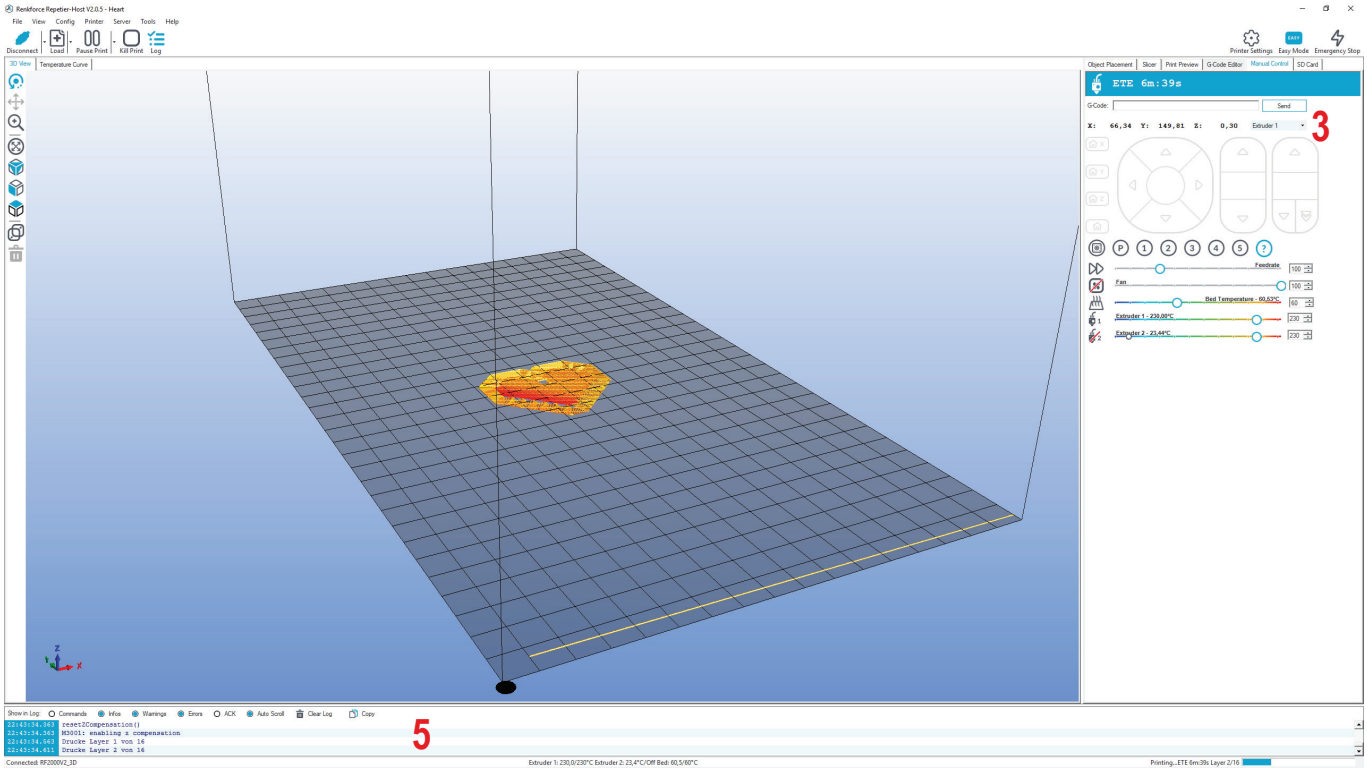
The printing file produced in this manner can be printed now. There are two options for this:

- 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) (first figure on the next page) there, you can select the desired extruder to use for the printout.

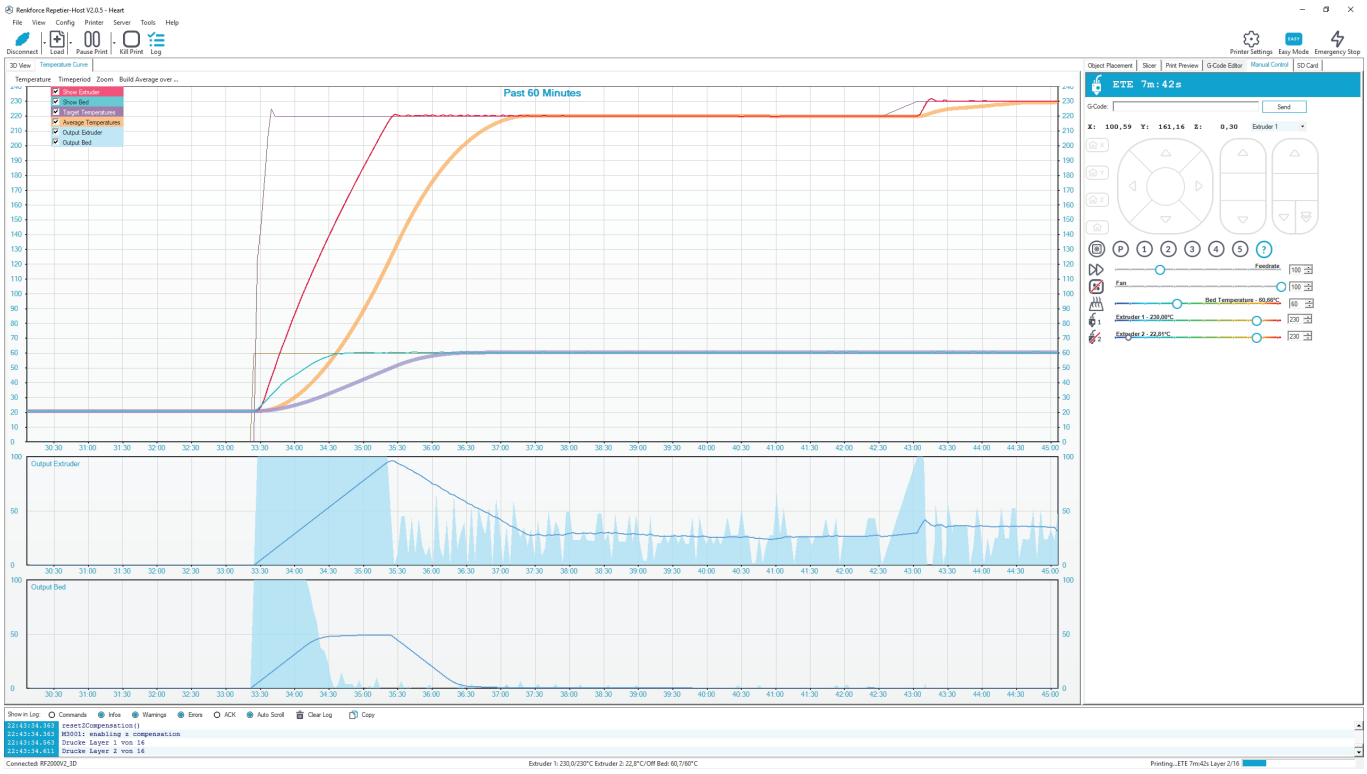
  Extruder 1 (in the software/Manual control) = extruder 0 (at the printer and in the G-code) = the left one from the front view

  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) (first figure on the next page) 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 printing plate since the printing plate and the extruder 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 printing 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 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.

The tolerances of the fans may cause them to only start up at 20% or 25%.

Let the printed object cool off for a few minutes after printing. When the temperature of the printing plate is below 40 °C (see display), the printed object comes free easier from the printing 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 on the printing plate. There is a risk that the printing plate will be damaged by this (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.

When you have completed the first printout successfully, we recommend urgently that you calibrate the filament infeed (chapter "19. b) Fine adjustment of the filament infeed"). This compensates for tolerances of the infeed knurl.

Owners of printers with a dual extruder should also adjust the two extruders without delay (X and Y extruder offset). For this, observe chapter "19. c) Fine adjustment of the two extruders".

f) 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.

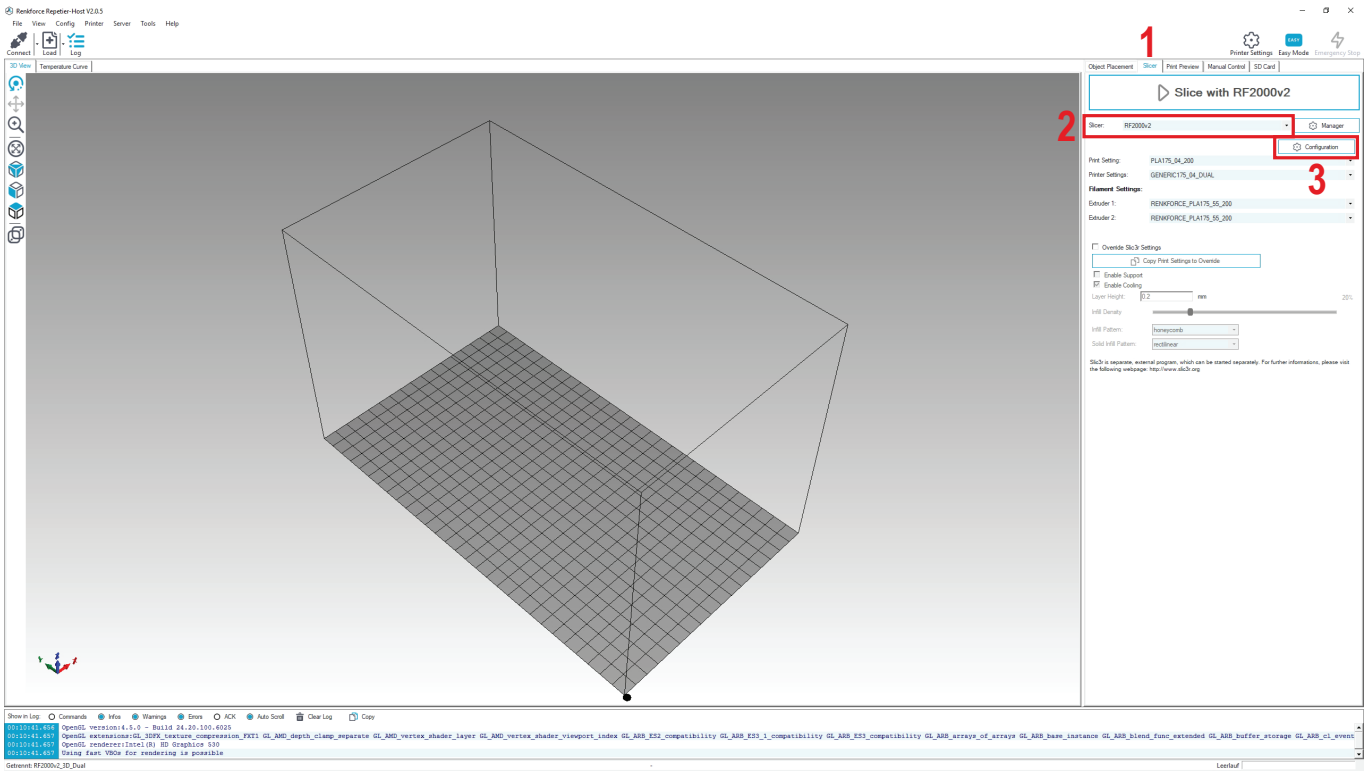
Save the different settings as a configuration setting. Assign unique names for the different configuration settings so that you can assign them uniquely to the different filament types, print resolutions, etc. later.

For more information, read the integrated online help function.

(1) Click the software in the tab "**Slicer**".

(2) Select the slicer for which you want to open the settings. In our example, this is "**RF2000v2**".

(3) Click "**Configuration**".

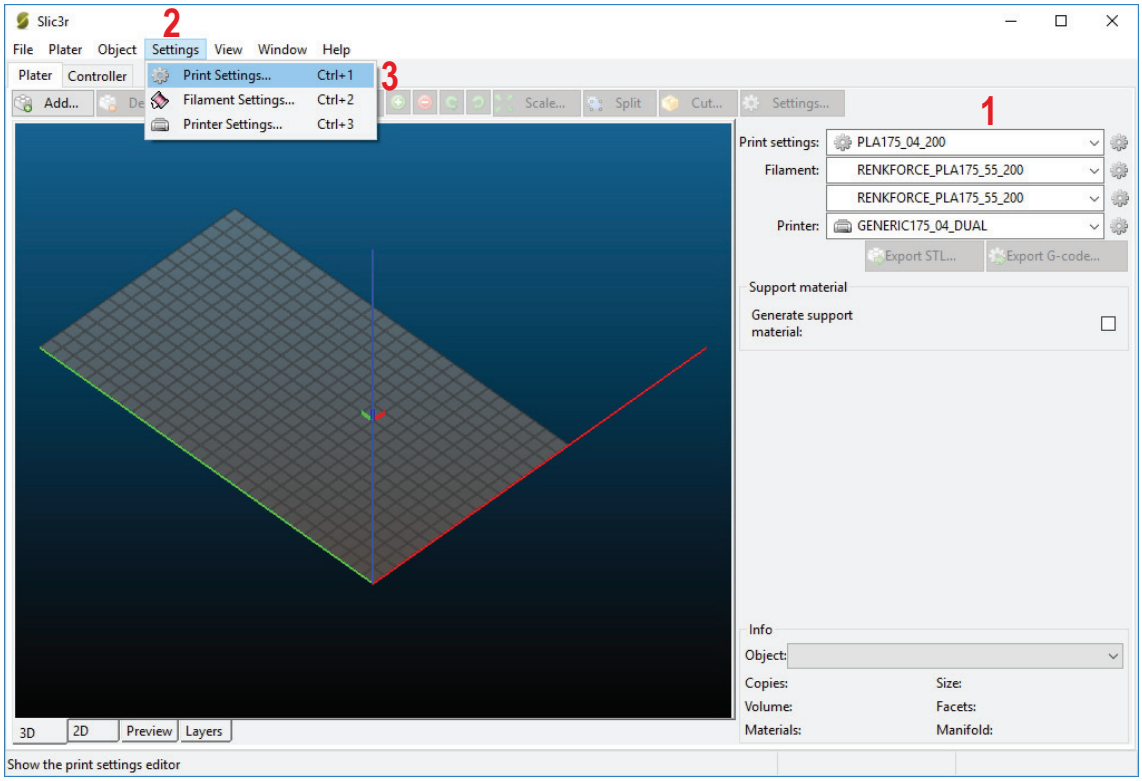


The Slicer window is opened (this may take a few seconds).

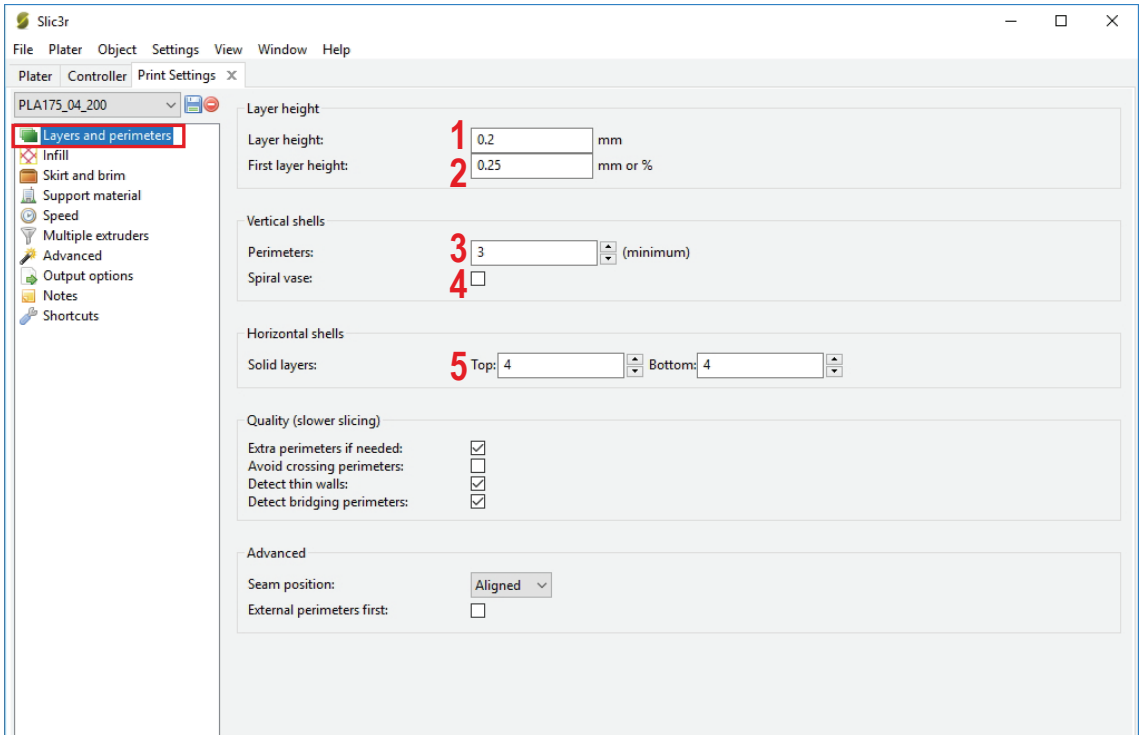
Attention! If you adjust values with decimal places on the following configuration pages, please note that the input must not be made with a comma but with a dot.

Example: „Layers and perimeters“ - „Layer heigth“:	**0.2 = right**	**0,2 = wrong**
„Filament“ - „Diameter“:	**1.75 mm = right**	**1,75 mm = wrong**
„Extruder“ - „Nozzle diameter“:	**0.4 mm = right**	**0,4 mm = wrong**

First, select the settings to be changed in the slicer window (1). Then click the menu "**Settings**" (2) and open the item "**Print Settings...**" (3).



Print Settings



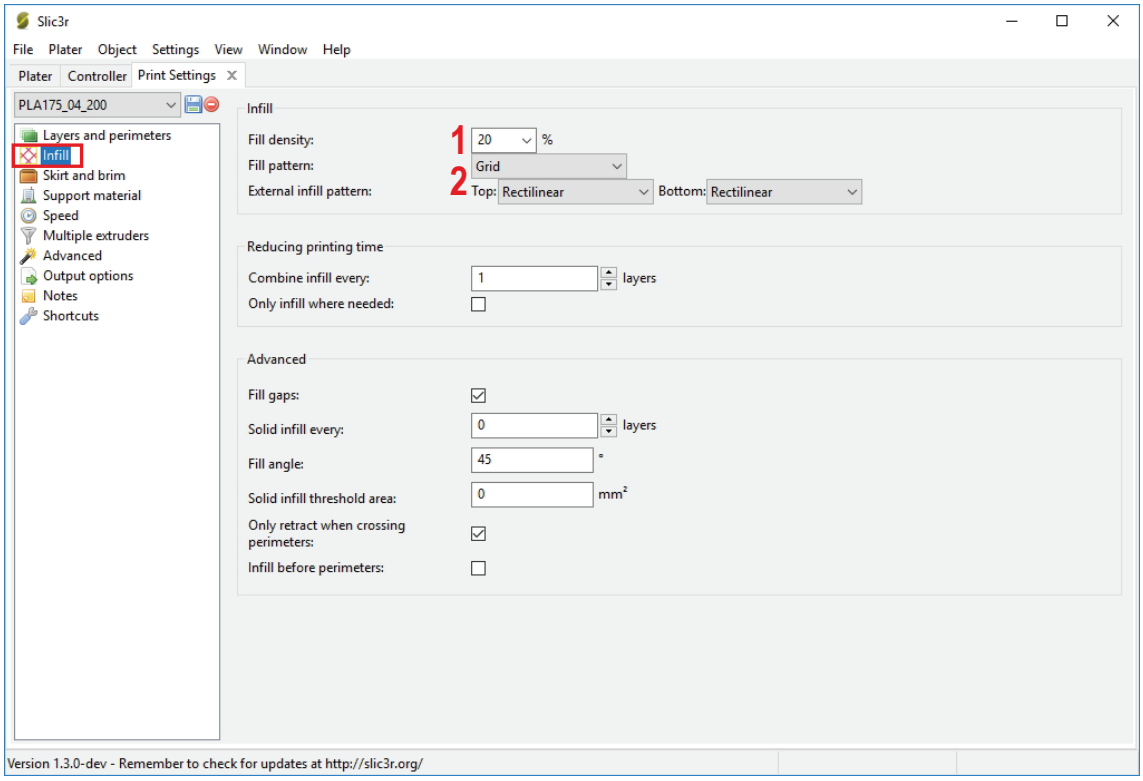
(1) Layer height (accuracy/resolution of the printed object)

(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)

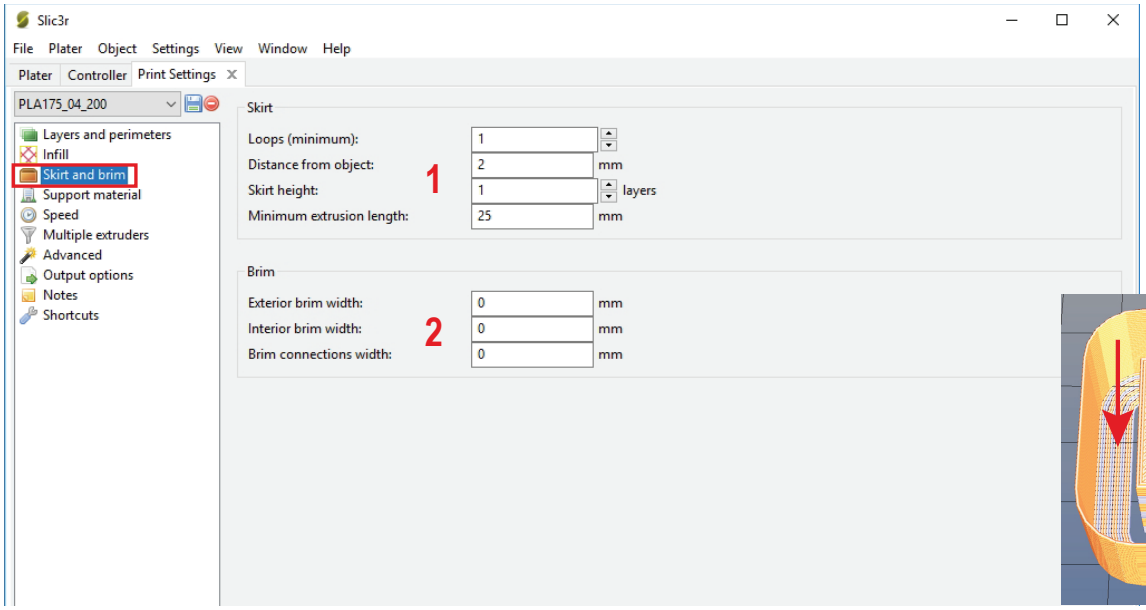
(5) Filled layer number top/bottom

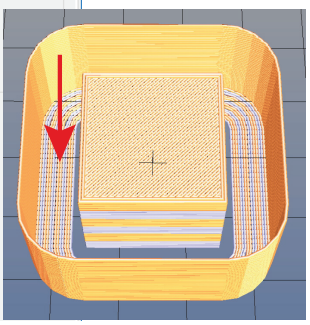


(1) Object filling (0-100%)

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

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

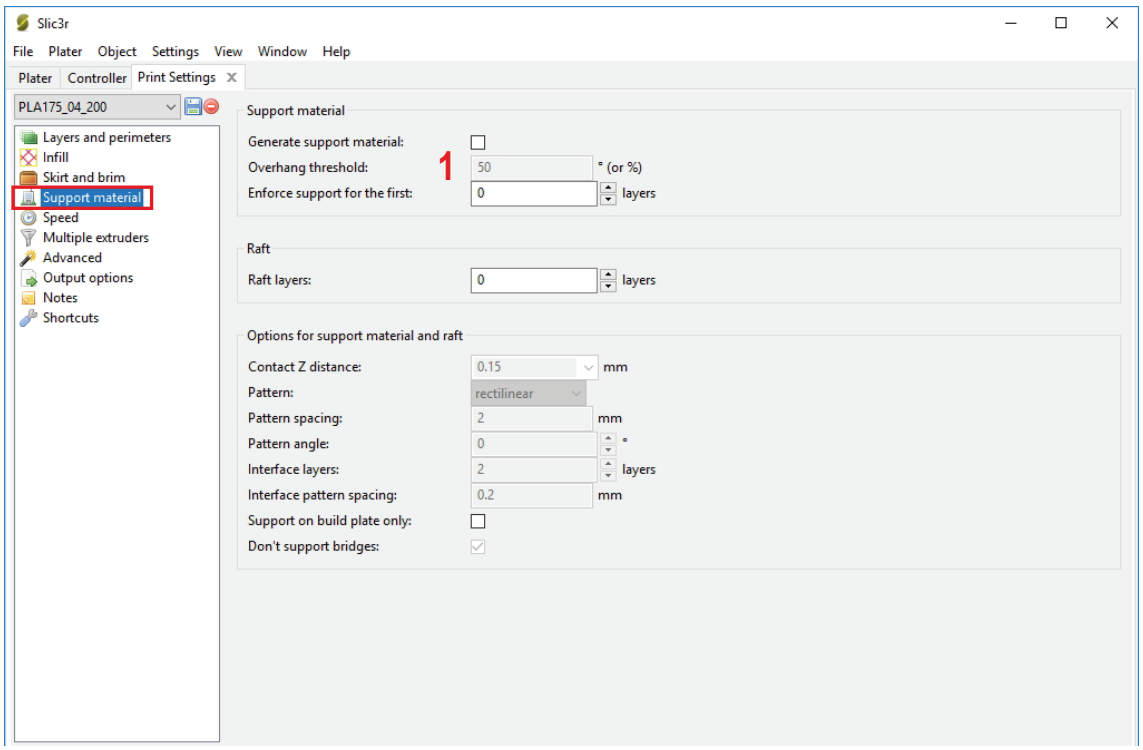




(1) Loops are circles, that are drawn around the object when printing starts, stabilise the filament flow before the actual object is printed. Here, number, distance from the object, height and minimum length are specified.

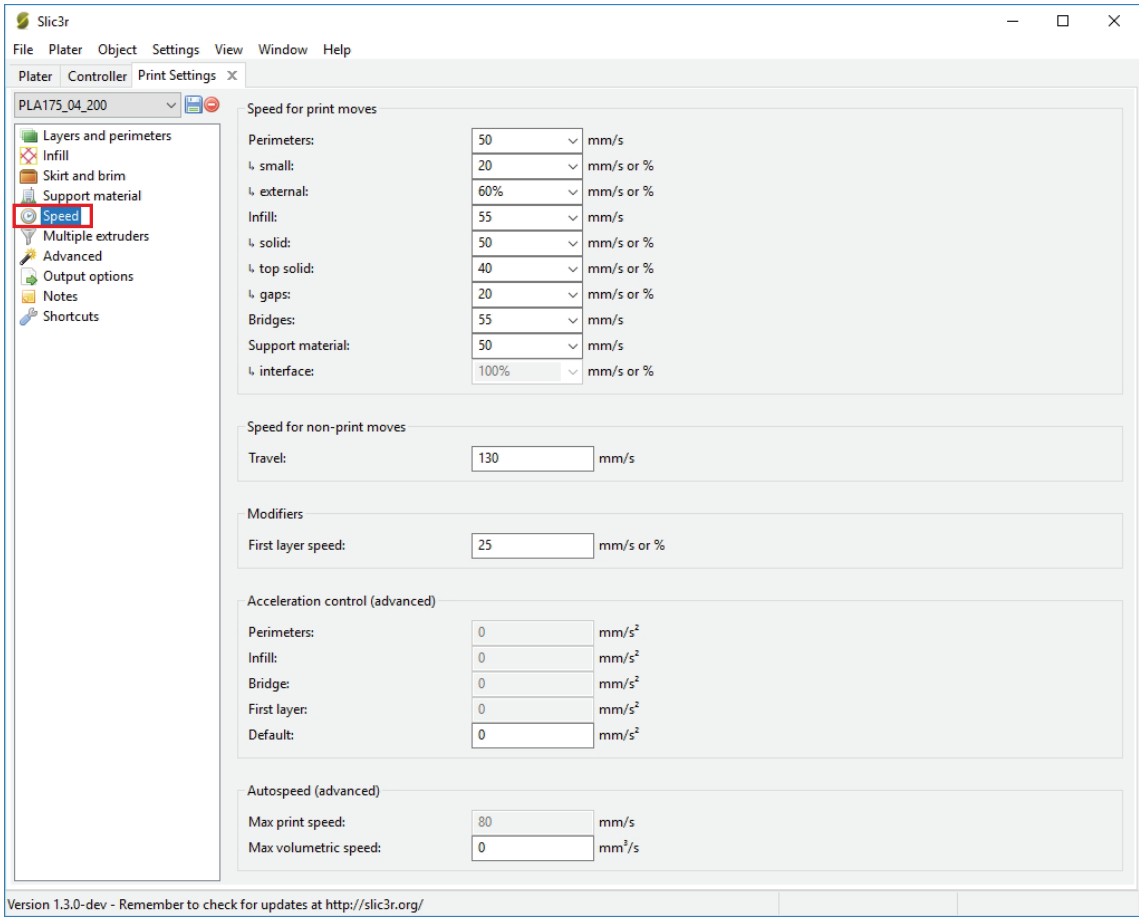
⟶ For 2-coloured printing objects, a wall will be drawn around the object that is used to wipe off the extruders. The bottom-most layer is broader than the wall here (see red arrow in the small picture). The length of this layer is specified in the setting "**Minimum extrusion length**". A value of approx. 25 mm is enough for a printed object with a diameter of up to approx. 50 mm. If you want to print larger 2-coloured objects, increase the value accordingly. Proceed with caution for this, since the layer may otherwise reach to below the printing object.

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

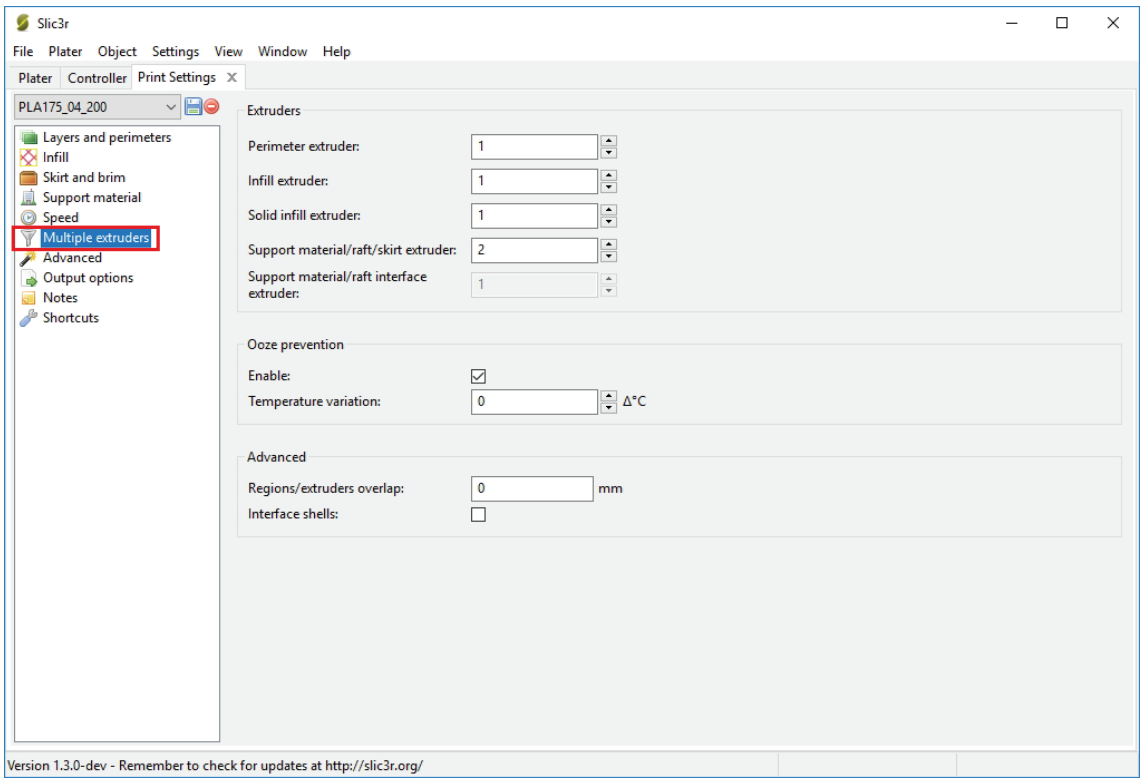


(1) Selection and adjustment of the supporting material that is needed when printing complex objects such as bridges or hollow spaces (poss. required for printing object with overhangs > 45°).

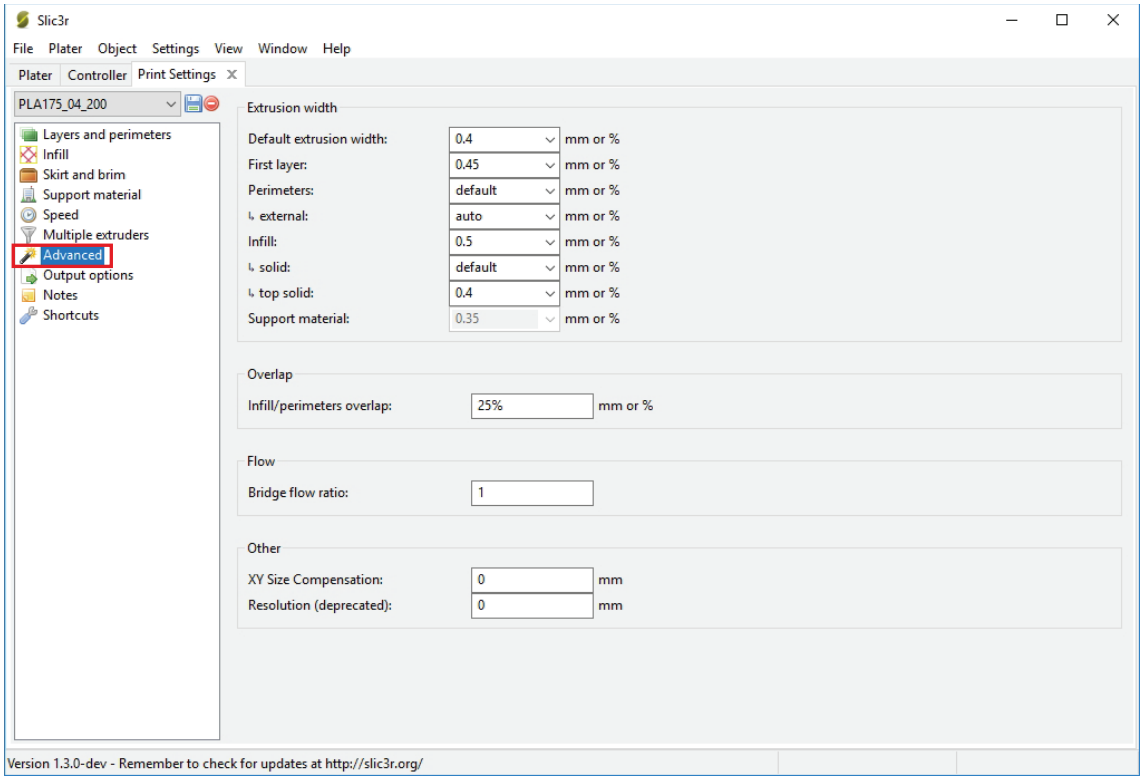
⟶ The first printing attempts should be without a supporting brim since the result here is usually better again.



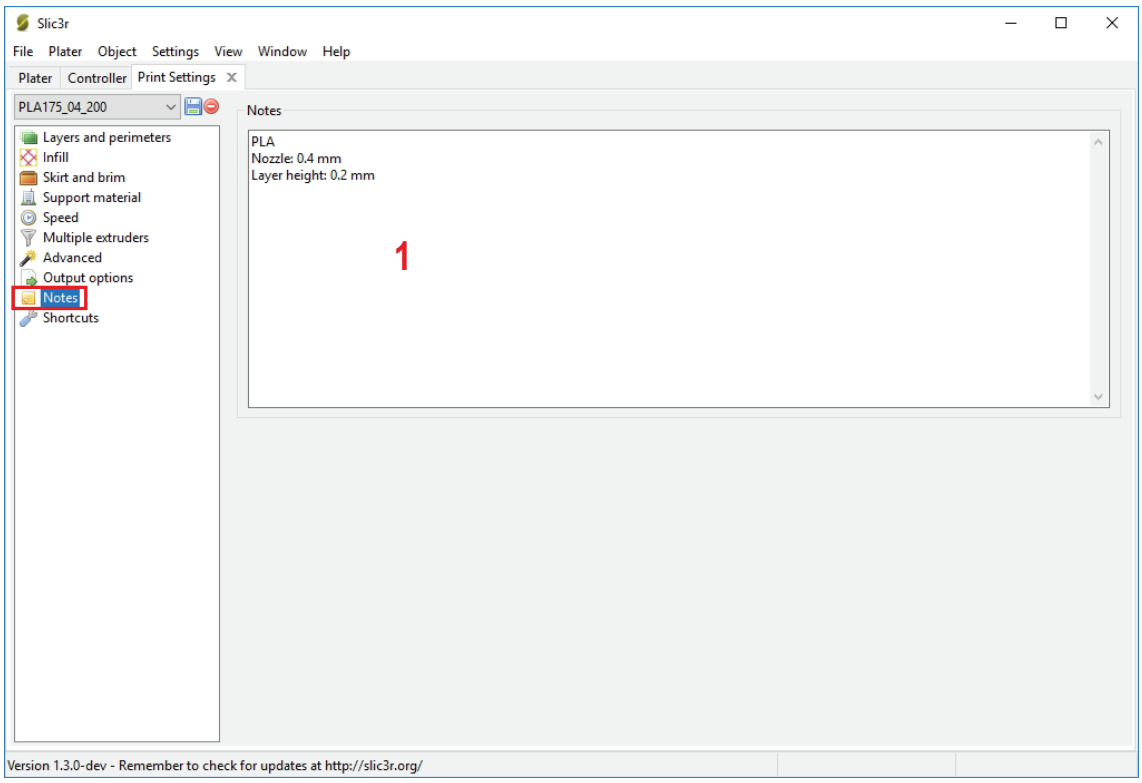
You can set or adjust all speeds here. Chance the values only in small steps.



Here, the extruders can be assigned. For example, it is 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.

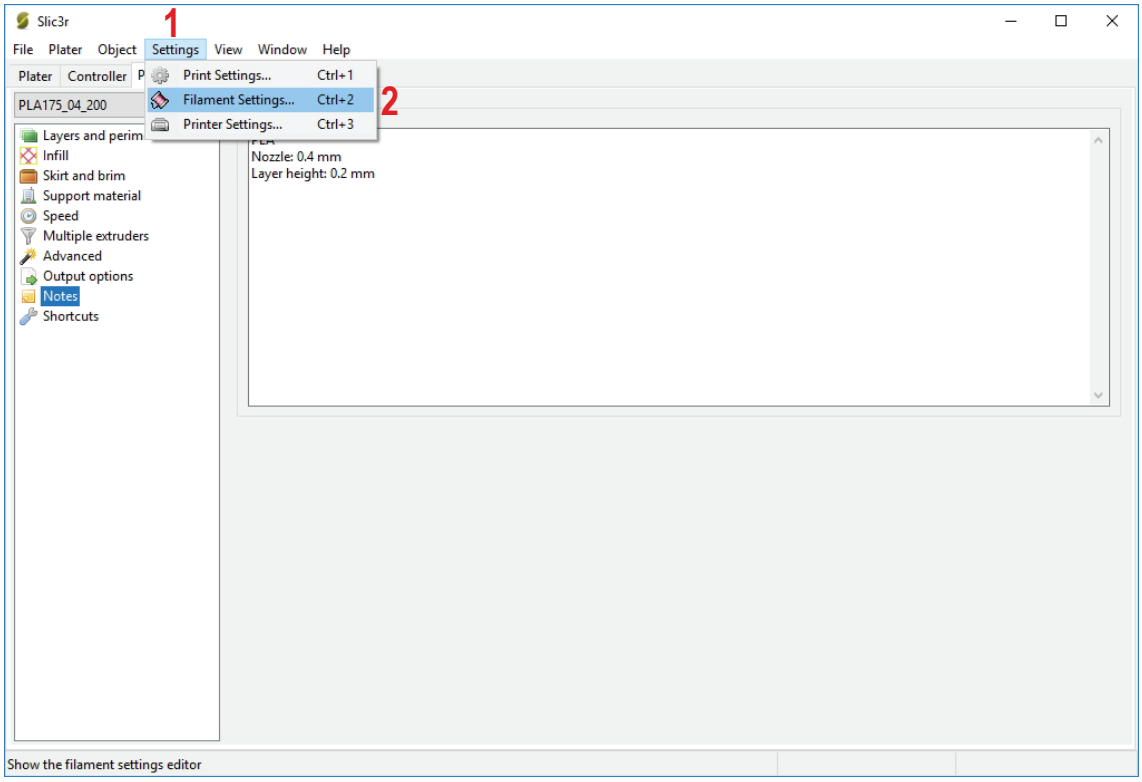


(1) The notes field may contain important information on the slicer setting. This may also contain information on the filaments with which this setting was tested or compiled.

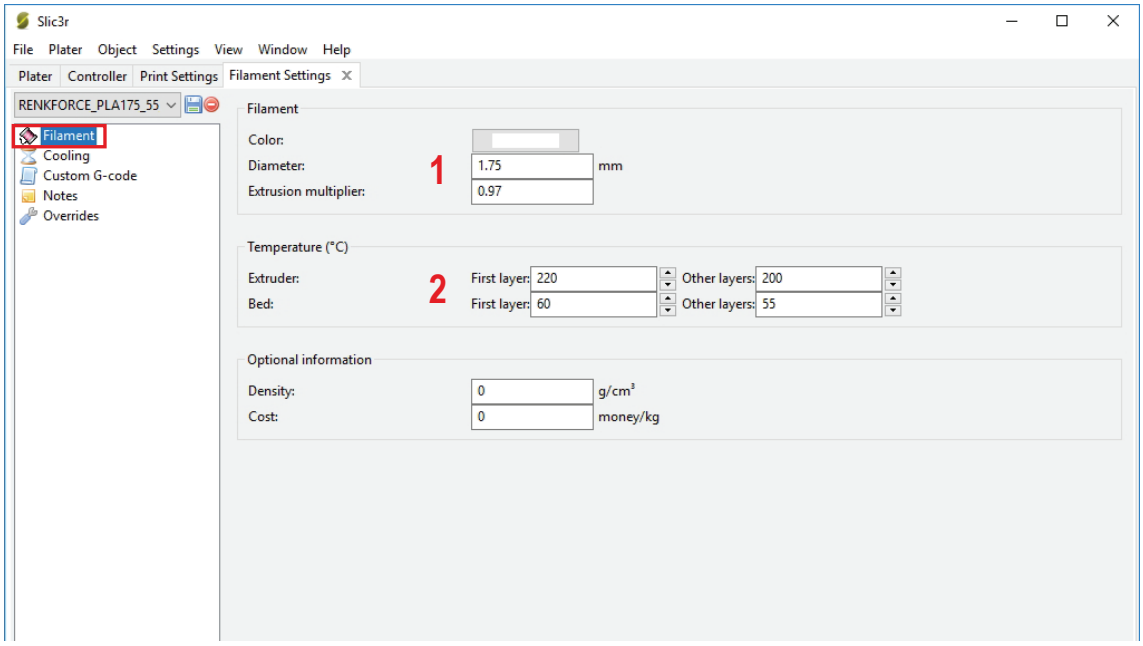
If there is a note here, it only applies to the this slicer setting, e.g. to "PLA175_200_04".

→ Please also observe the note fields in the tabs "**Filament Settings**" and "**Printer Settings**".

Click the menu "**Settings**" (1) in the slicer window and open the item "**Filament Settings...**" (2).



Filament Settings

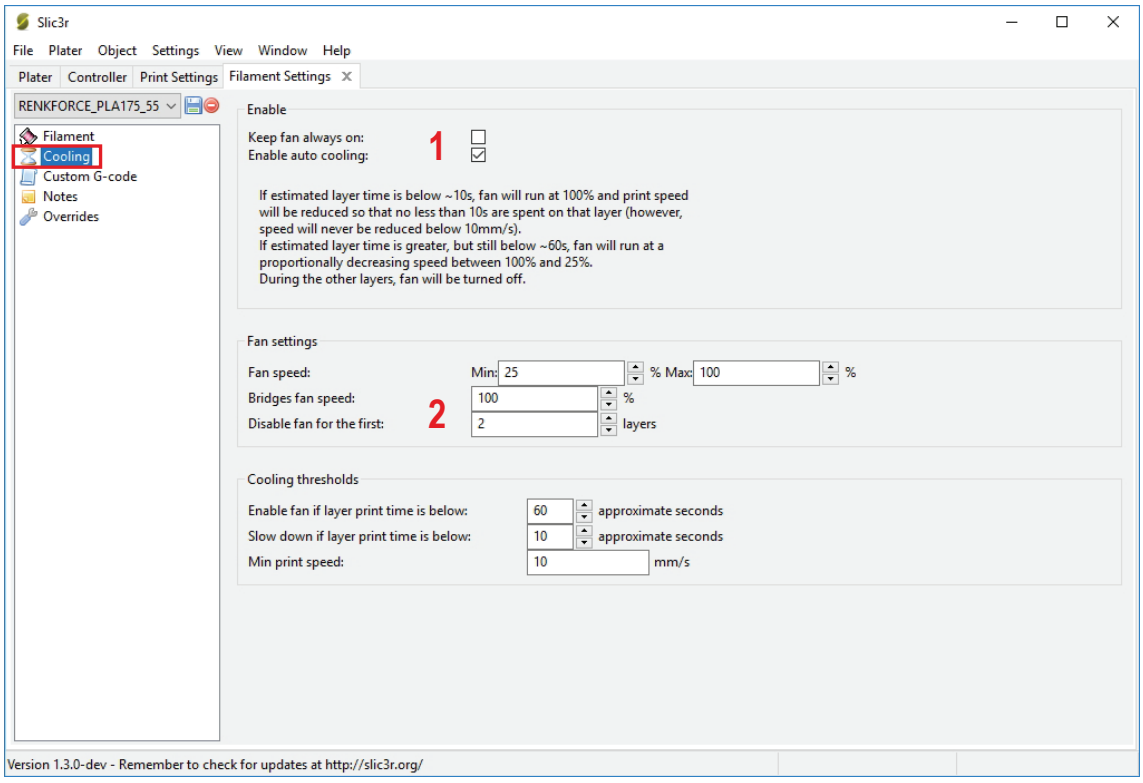


(1) Filament diameter and filament diameter tolerances according to the manufacturer's specifications are set here. If no manufacturer's specification is present, these values can also be measured with a calliper (measure 1 m of filament material in 10 different points and then set the average here).

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

⟶ Observe the settings recommended by the filament manufacturer!

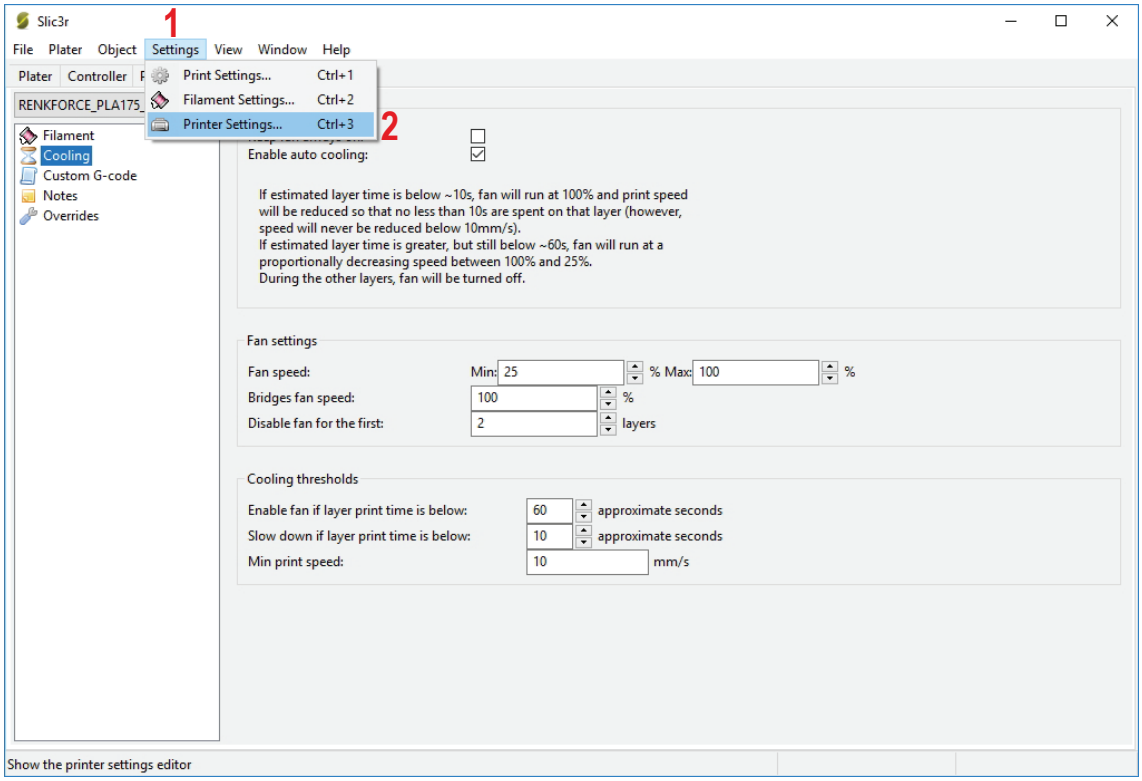
Since the best values may fluctuate extremely depending on the filament manufacturer, perform your own tests based on the presettings to achieve the best printing quality. When performing the tests, proceed in 5 °C steps and compare the results during or after printing with other settings. The first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



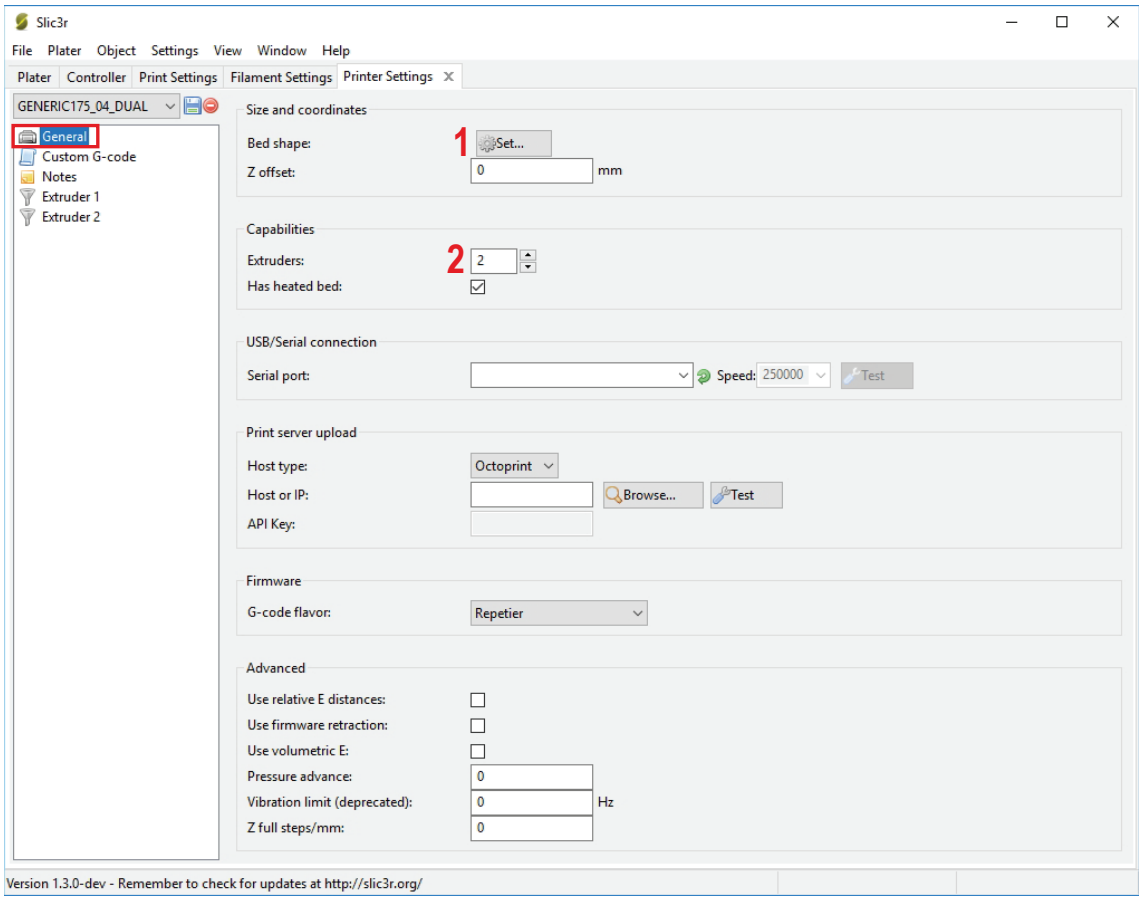
(1) Here you can choose between automatic cooling and permanent operation of the fan at the extruder.

(2) Setting of the fan speed.

Click the menu "**Settings**" (1) in the slicer window and open the item "**Printer Settings...**" (2).

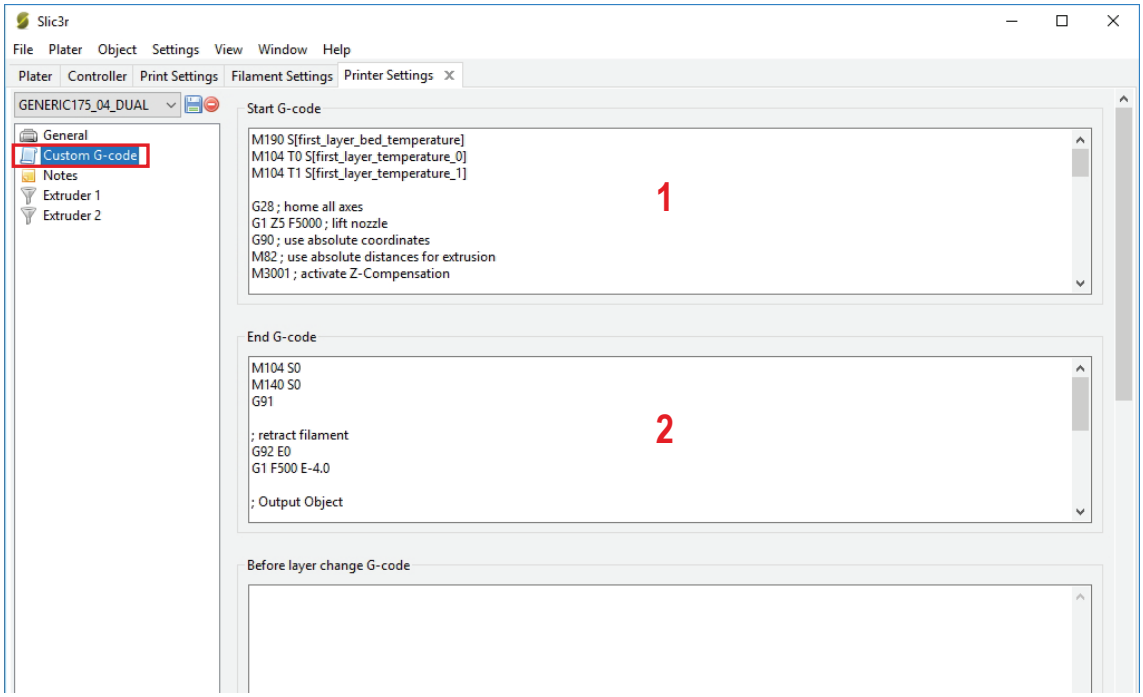


Printer Settings



(1) Geometric data of the printing plate

(2) Number of the extruders



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

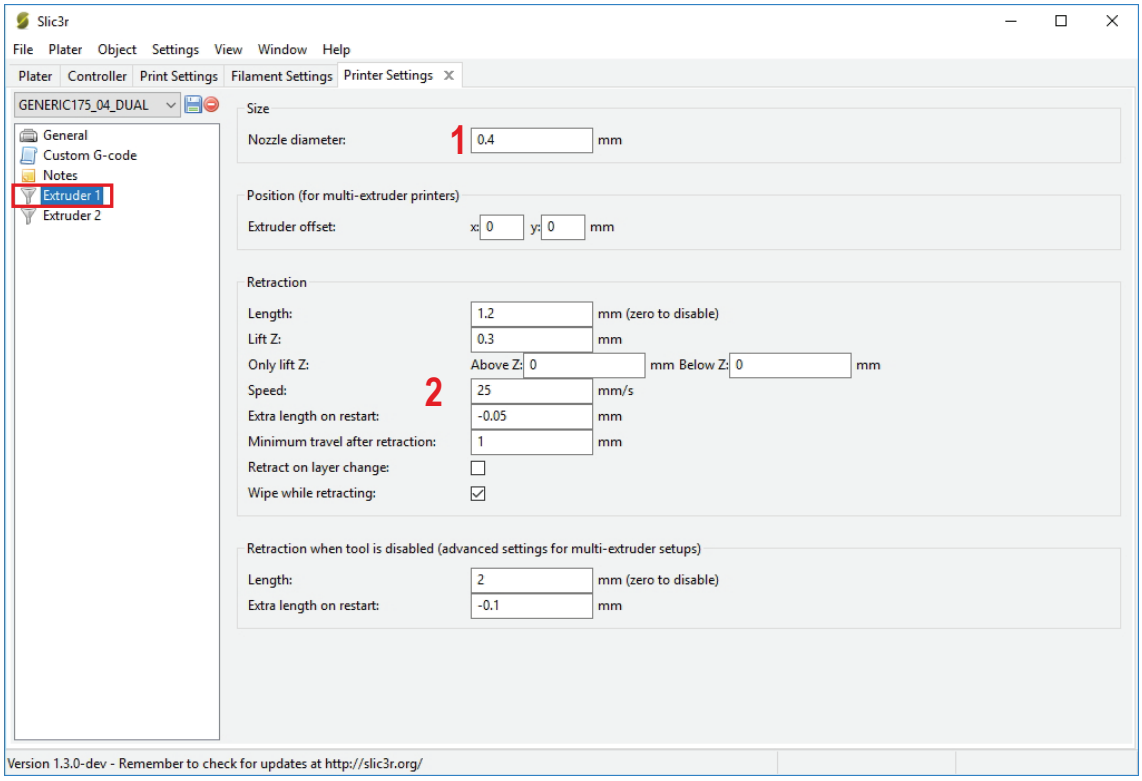
(2) The end code will be performed at the end of the print and could contain, e.g. the run into a removal position for the printed object.

⟶ 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 colour to 255
M3307 P2 S0; set the green component of the manual colour to 0
M3307 P3 S0; set the blue component of the manual colour to 0
M3308 P3; switch to the manual colour (= red)
G4 S10; wait 10 seconds
M3307 P2 S255; set the green component of the manual colour to 255
G4 S10; wait 10 seconds
M3307 P1 S0; set the red component of the manual colour to 0
G4 S10; wait 10 seconds
M3307 P3 S255 ; set the blue component of the manual colour to 255
G4 S10; wait 10 seconds
M3307 P2 S0; set the green component of the manual colour to 0
G4 S10; wait 10 seconds
M3307 P1 S255; set the red component of the manual colour to 255
G4 S10; wait 10 seconds
M3307 P3 S0; set the blue component of the manual colour 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.

⟶ The tabs "**Extruder 1**" and "**Extruder 2**" must be identical at least for the regular dual pressure.

g) 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.

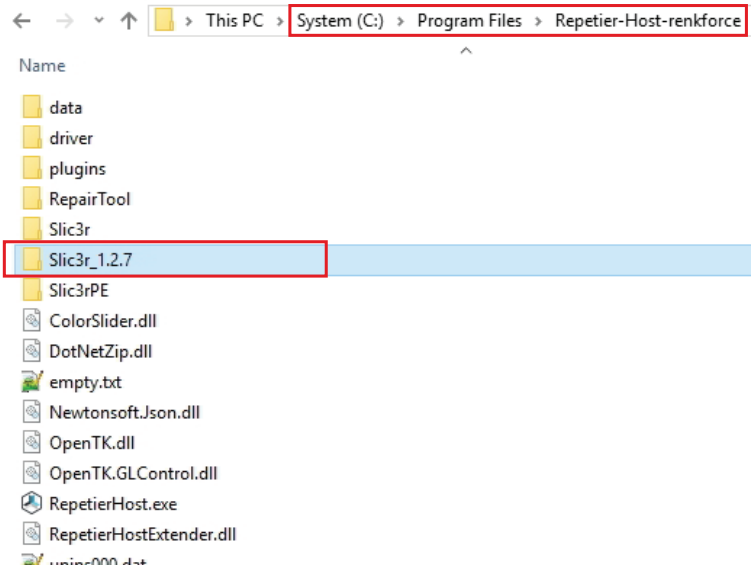
- Rename the unpacked folder "**Slic3r**". Adding, e.g., the version number is recommended here.

  "**Slic3r_1.2.7**"

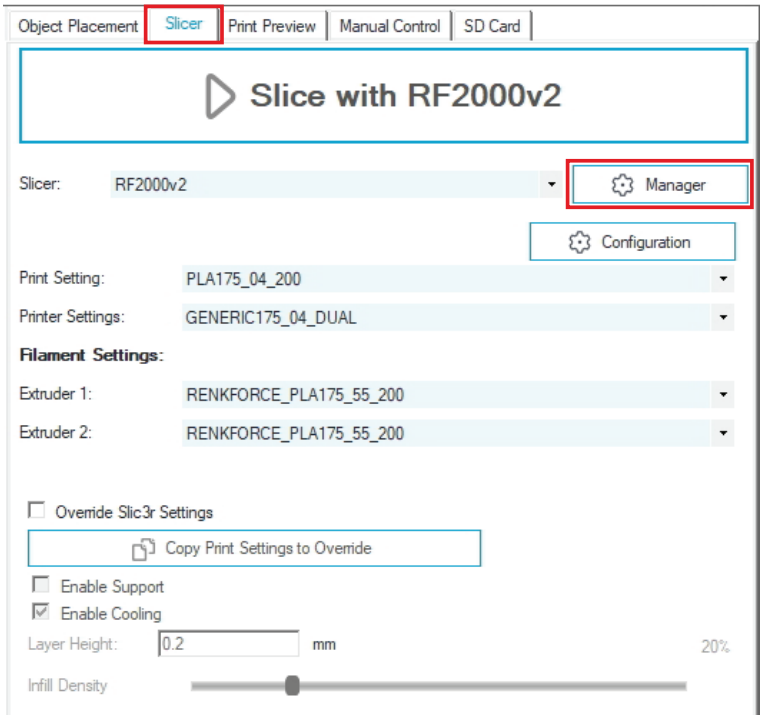
- Copy this renamed folder or, best, move it into the program directory of the Repetier-Host software. This is also the program directory of the original Slicer.

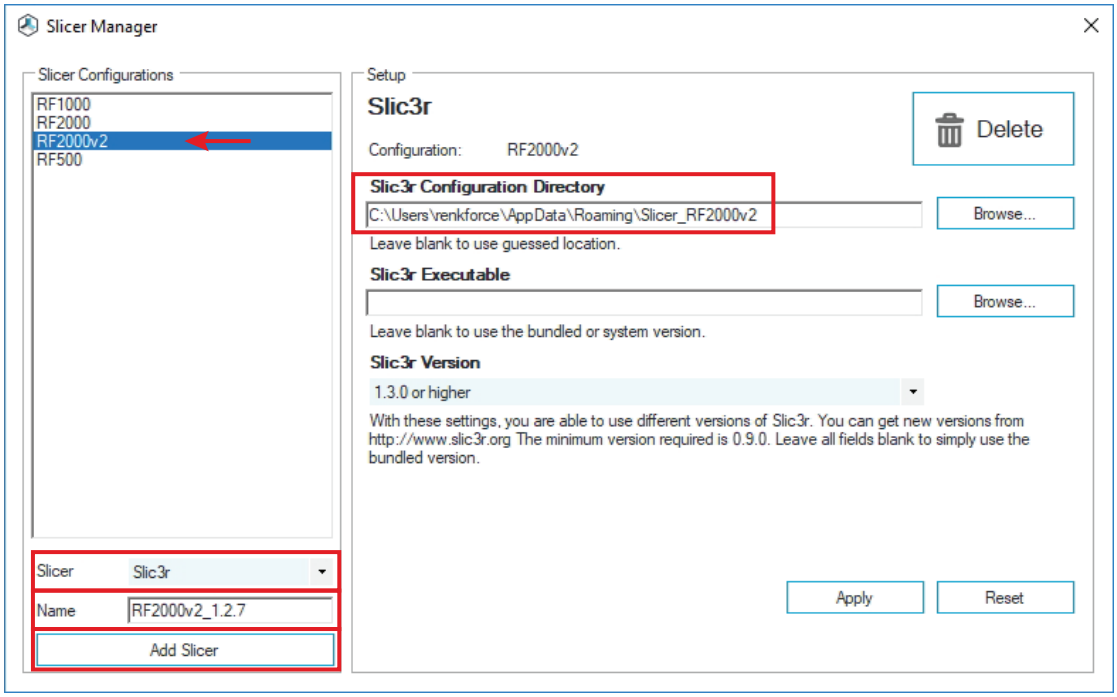
  \Program Files\Repetier-Host-renkforce

⟶ 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-renkforce**" will be overwritten!

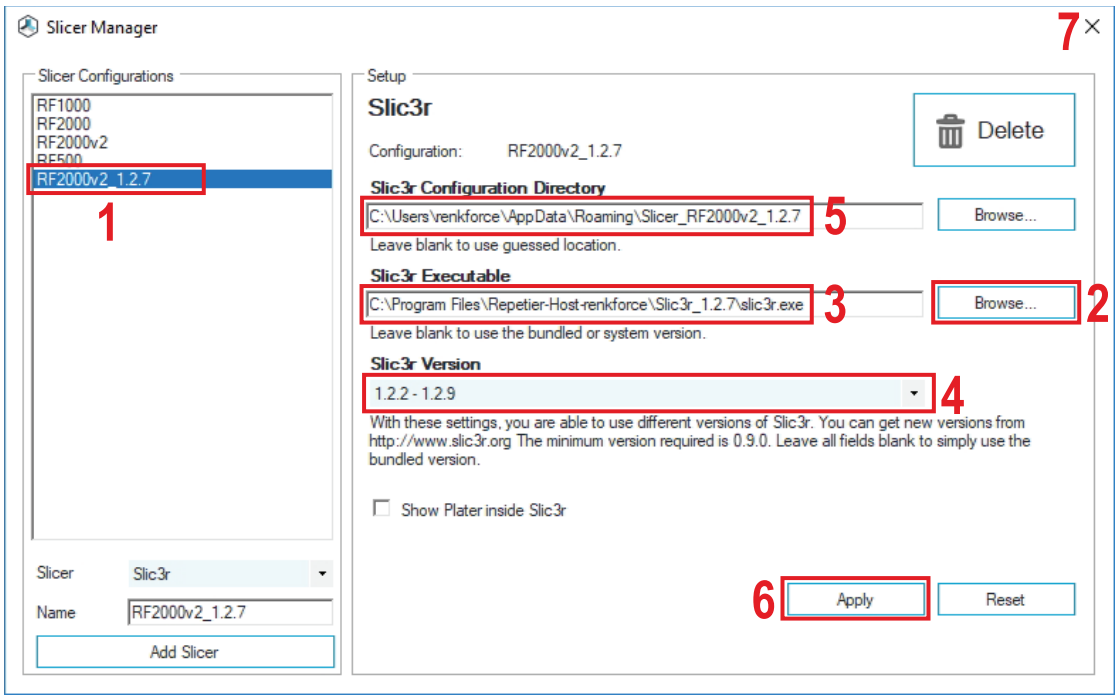


- Now open the Repetier-Host software.
- Click the tab "**Slicer**" and then the button "**Manager**".



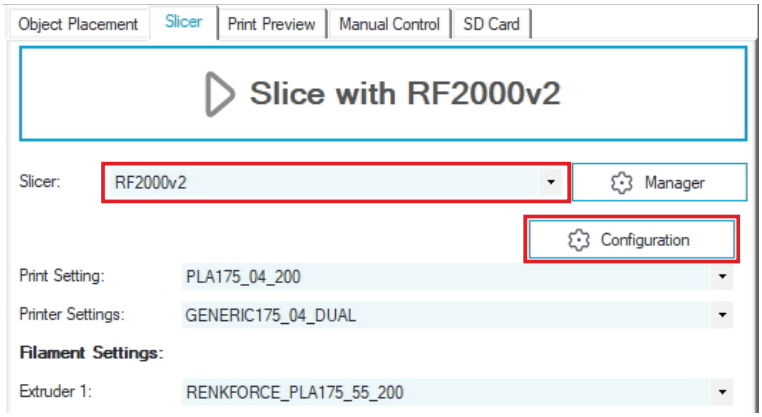


- First click the slicer of your printer and write down or copy the path of the configuration directory.
- In the menu "**Slicer**", now choose the desired Slicer that you want to integrate. In our example, this would be "**Slic3r**".
- In the field "**Name**", enter the desired name (e.g. "**RF2000v2_1.2.7**") and confirm by clicking "**Add Slicer**". When choosing the name, observe that the newly set-up slicer is also only for one printer.

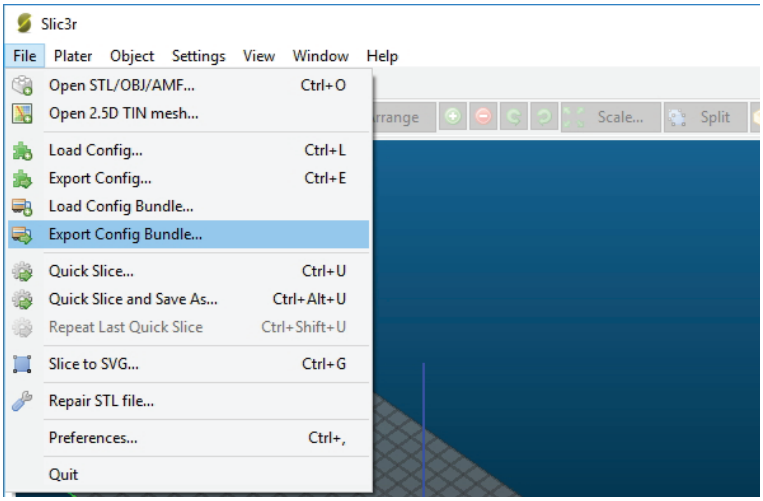


- Select the newly added Slic3r by clicking it (1).
- Right-click "**Browse...**" (2).
- Navigate to the new Slic3r program directory in the window that opens and select the starting file, in our example "**slic3r.exe**", by double-clicking (3).
- Pick the right "**Slic3r**" version (4).
- Insert the path of the previously recorded or copied configuration directory (5) and change it according to your wishes. We recommend naming the configuration directory like the newly created Slicer. The storage site generally does not matter.
- Confirm with "**Apply**" (6). Close the window with the X in the upper right corner (7).

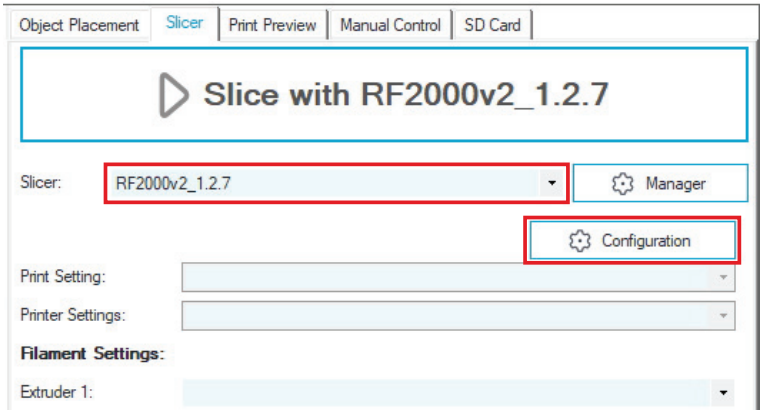
- In "**Slicer:**", select the original Slicer of your printer and click "**Configuration**".



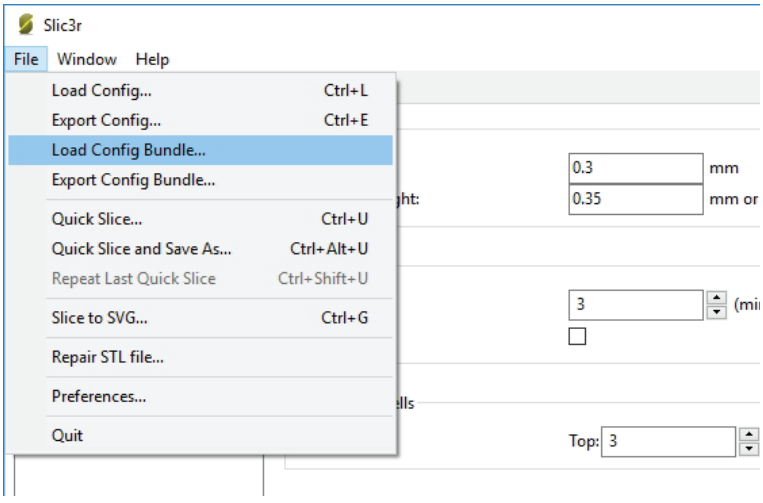
- Click "**File**" and then "**Export Config Bundle...**". Save the file on your PC.
- Close the window again.



- Now select the newly created slicer in "**Slicer:**" and click "**Configuration**" again.
- When the new window for the slicer configuration opens, the configuration assistant is displayed first. Cancel it with "**Cancel**".
- A message may be displayed to inform you of a new version. Close the message with "**No**".

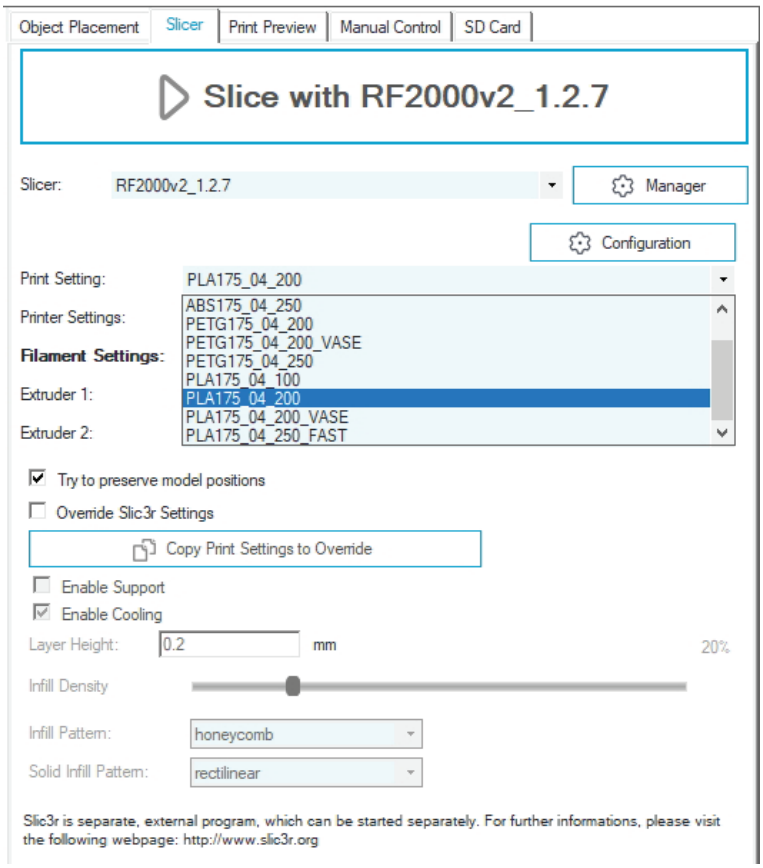


- Click "**File**" and then "**Load Config Bundle...**".
- It will be configured that the settings have been imported successfully. Confirm with "**OK**".
- Close the Slic3r configuration window.



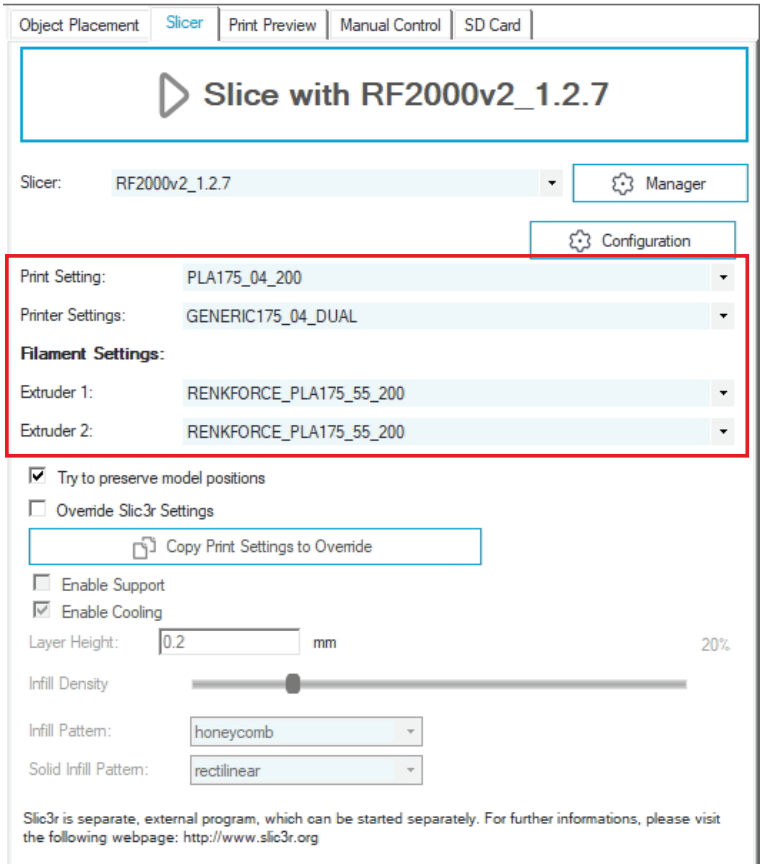
- When the new Slicer is selected at the top in "**Slicer:**", you can use the same slicer settings at the bottom in the menus ("**Print Setting**"; "**Printer Settings**"; "**Filament Settings**") as in the original slicer of your printer.

→ Please note! You may have to adapt the imported settings to the new slicer version.



- In order to slice an object with the new version, select the settings "**Print Setting**", "**Printer Settings**" and "**Filament Settings**" for the new slicer.

→ If you change anything about the settings, this will only affect the previously selected slicer, e.g. "**RF2000v2_1.2.7**".



→ 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. Extended calibration

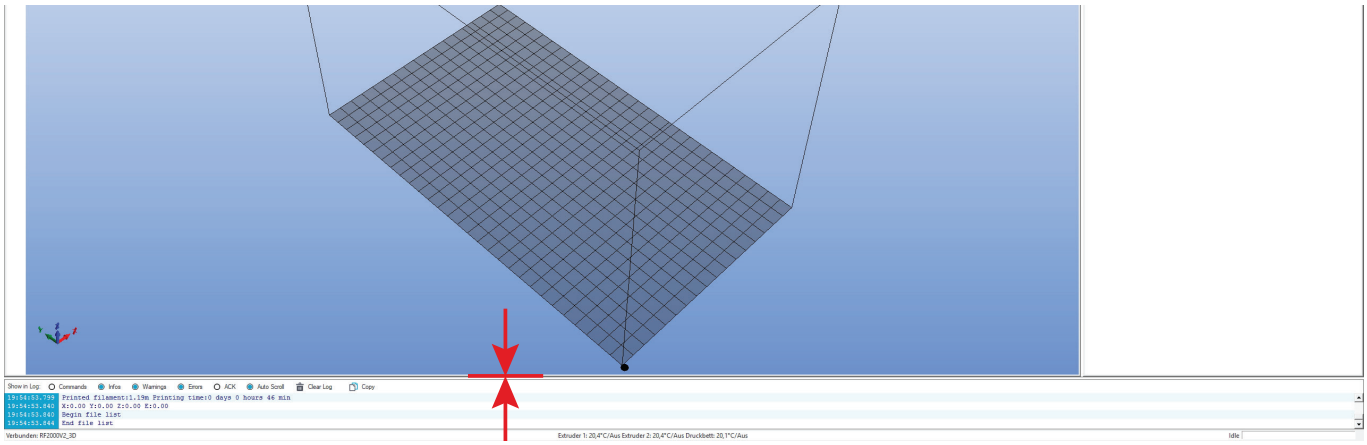
a) Determining the Highest Position of the Printing Plate

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

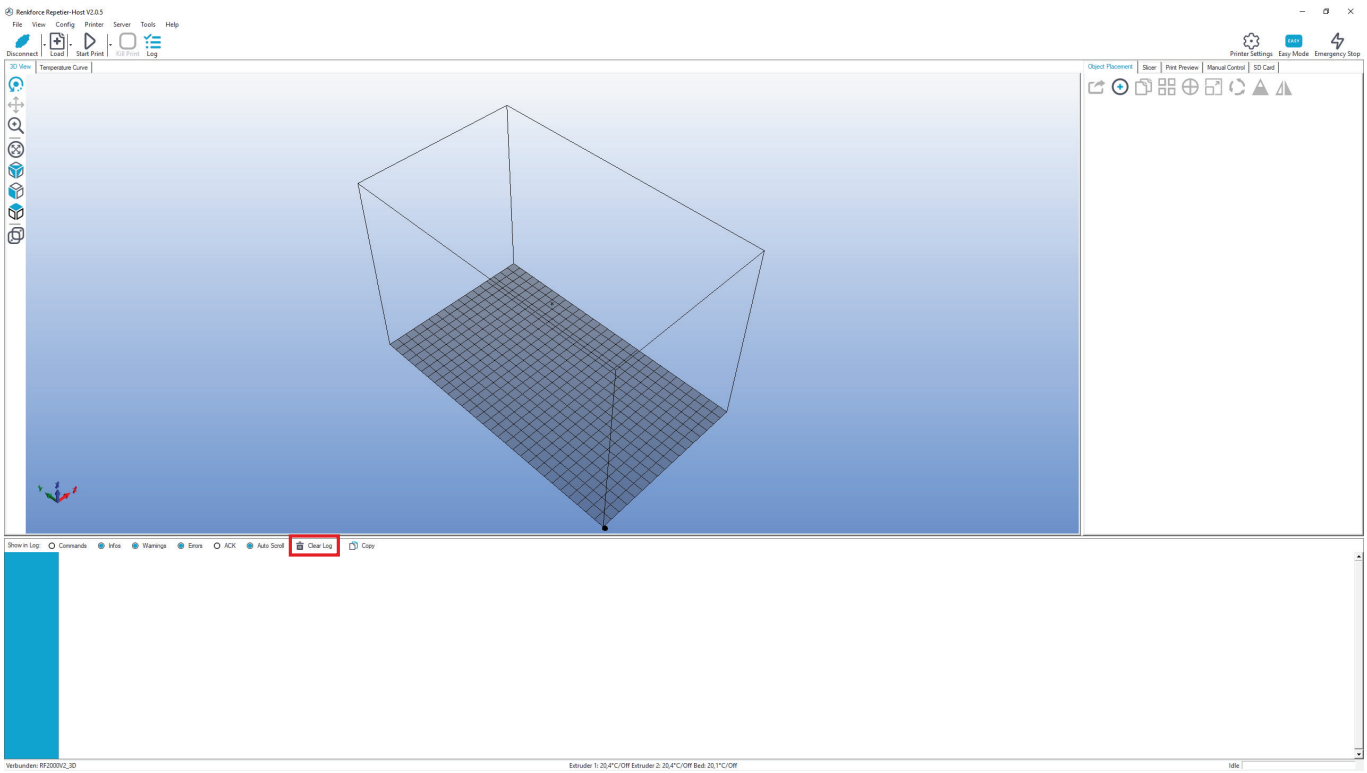
Preparation

- 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 "12. Software and firmware installation").
- If applicable, enter the COM port and connect the software to the printer (see chapter "18. a) Connection of the connected printer"). The symbol at the upper left must be green and it must say "**Disconnect**" below.

Reading out the matrix



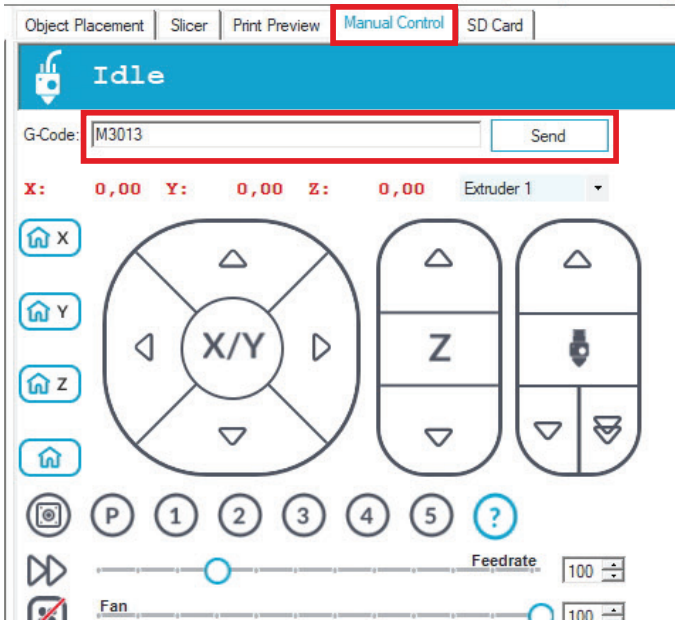
- First, draw the lower part of the window where the log is shown a little up with the mouse.



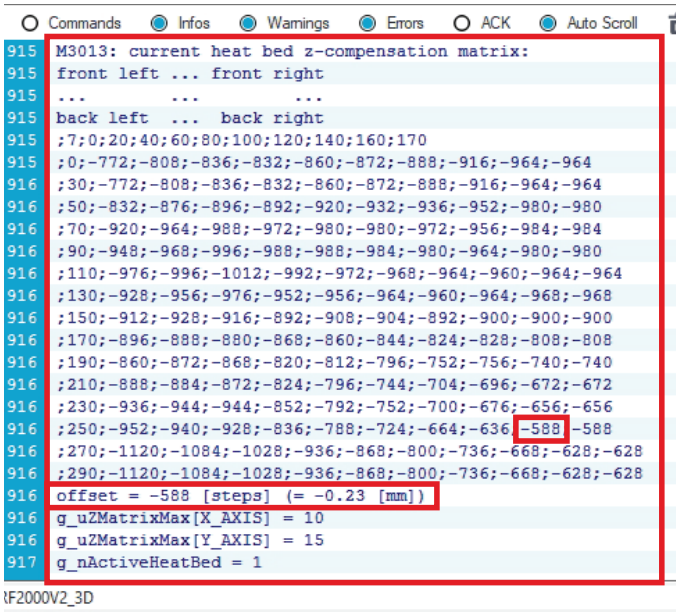
- Click "**Clear Log**".

- 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 of the matrix 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 (-772) at the upper left, i.e. in position X=0 and Y=0, is located at the front left of the printing plate when looking at the printer from the front left. The value (-628) at the lower right, in position X=170 and Y=290, 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 printing plate. In our example, the offset value is -588 steps.



- Now find the offset value in your matrix. In our example, the -588 steps are in position X 160 and Y 250. 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 -588 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 160 and Y 250, the distance between the heating plate and the Z Home position is 588 steps.
- If everything is set correctly mechanically, the values in the matrix must all be negative.

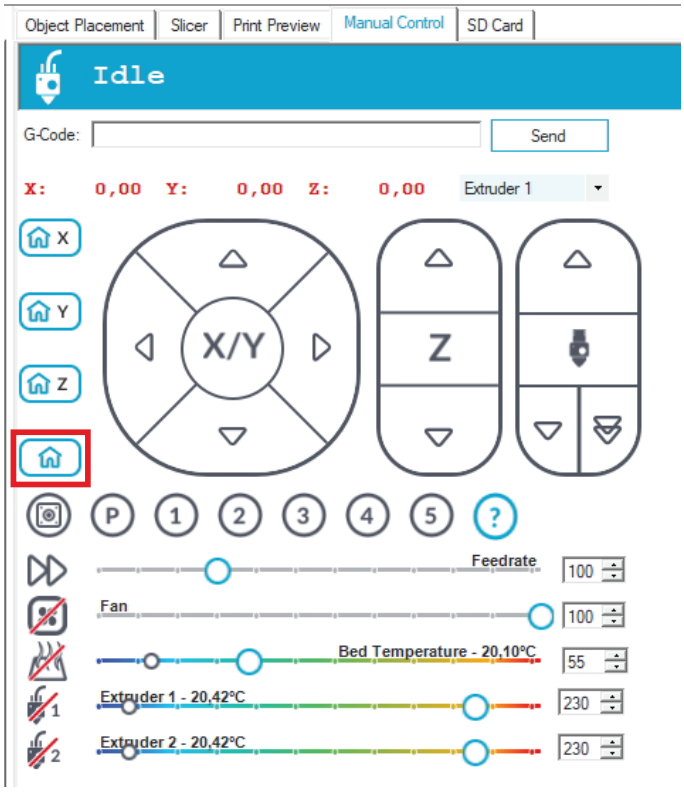
	front left								front right	
	0	20	40	60	80	100	120	140	160	170
0	-772	-808	-836	-832	-860	-872	-888	-916	-964	-964
30	-772	-808	-836	-832	-860	-872	-888	-916	-964	-964
50	-832	-876	-896	-892	-920	-932	-936	-952	-980	-980
70	-920	-964	-988	-972	-980	-980	-972	-956	-984	-984
90	-948	-968	-996	-988	-988	-984	-980	-964	-980	-980
110	-976	-996	-1012	-992	-972	-968	-964	-960	-964	-964
130	-928	-956	-976	-952	-956	-964	-960	-964	-968	-968
150	-912	-928	-916	-892	-908	-904	-892	-900	-900	-900
170	-896	-888	-880	-868	-860	-844	-824	-828	-808	-808
190	-860	-872	-868	-820	-812	-796	-752	-756	-740	-740
210	-888	-884	-872	-824	-796	-744	-704	-696	-672	-672
230	-936	-944	-944	-852	-792	-752	-700	-676	-656	-656
250	-952	-940	-928	-836	-788	-724	-664	-636	**-588**	-588
270	-1120	-1084	-1028	-936	-868	-800	-736	-668	-628	-628
290	-1120	-1084	-1028	-936	-868	-800	-736	-668	-628	-628
	back left								back right	

Move to the offset position

- First move all axes to their home position.

  For this, click the unlabelled house icon.

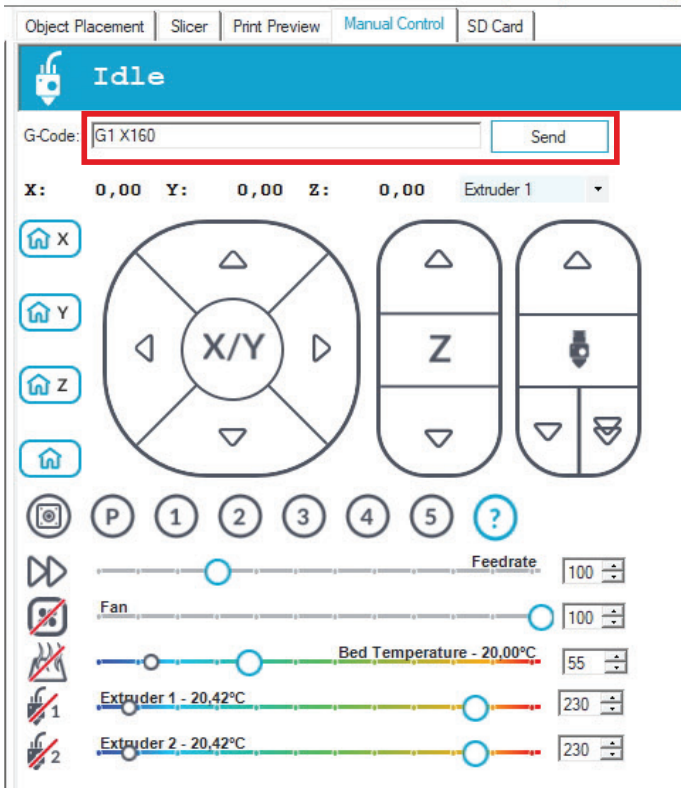
⟶ If the figures in the fields X, Y and Z are red, no home position has been moved to yet. The software accordingly does not know where the printer axes are currently located. Once the home positions are reached, the colour turns black.



- Now move the X-axis to the position previously read.
- For this, enter the command "**G1 X160**" (without quotation marks) in the field "**G-Code**" and click"**Send**". Replace 160 by your X-value.

  The printer moves the X-axis to the position. In our example, this is the X-position 160.

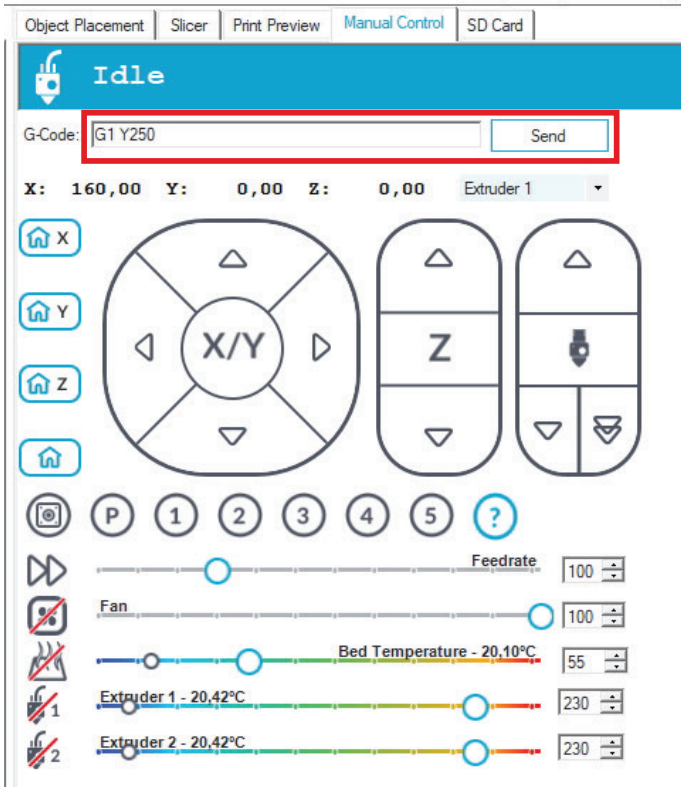
⟶ When the position is reached, the field X will show the current position. In our example, this is 160.00.



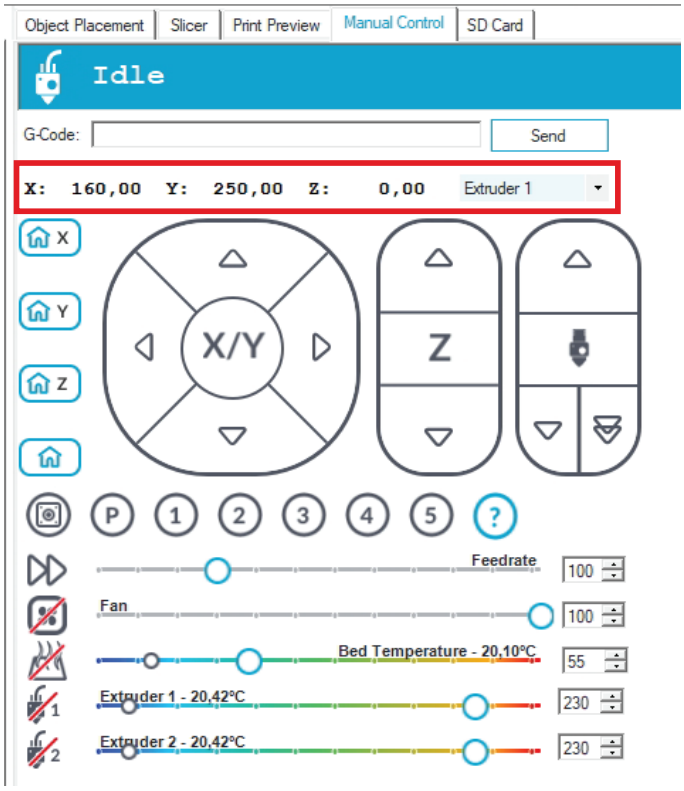
- Now move the Y-axis to the position previously read.
- For this, enter the command "**G1 Y250**" (without quotation marks) in the field "**G-Code**" and click"**Send**". Replace 250 by your Y-value.

  The printer moves the Y-axis to the position. In our example, this is the Y-position 250.

  → When the position is reached, the field Y will show the current position. In our example, this is 250.00.



- 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. c) Setting the distance between the nozzle and the printing plate"; then perform a heat bed scan.



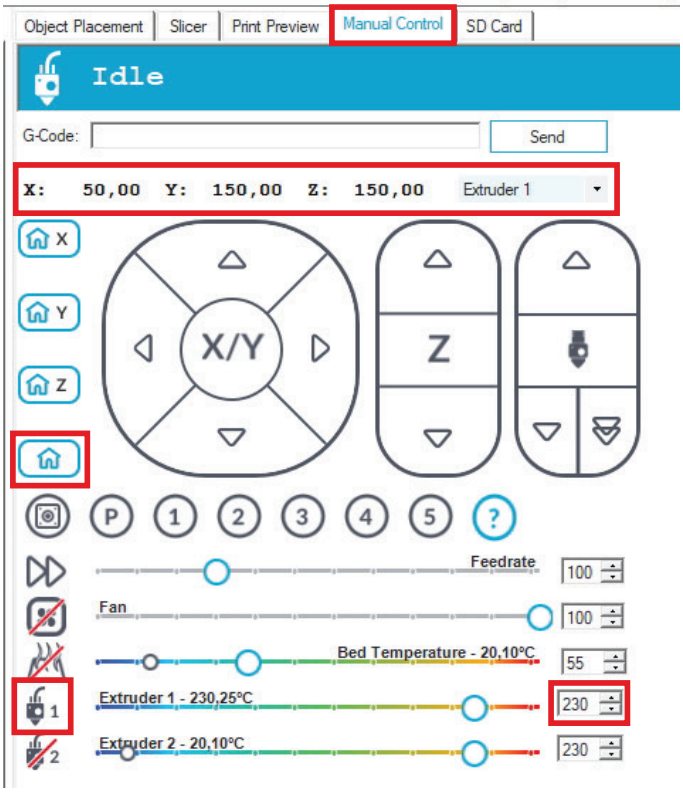
b) Fine adjustment of the filament infeed

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

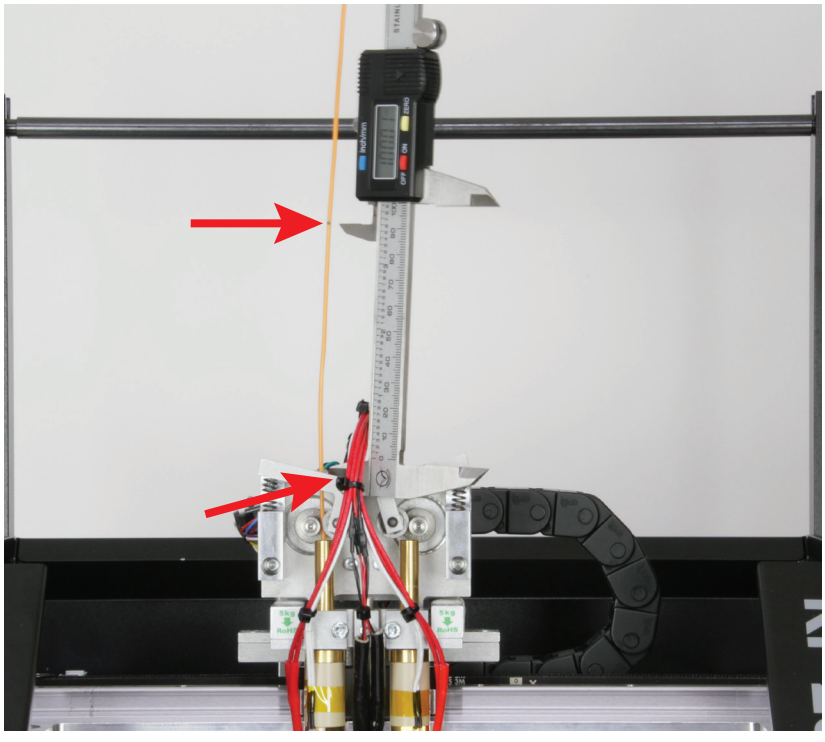
- If it has not been done yet, install the software Repetier-Host incl. the drivers and connect the printer to the computer (see chapter "12. Software and firmware Installation").
- If applicable, enter the COM port and connect the software to the printer (see chapter "18. a) Connection of the connected 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 in the middle.
- Use the arrows X/Y and Z to move the printing 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.



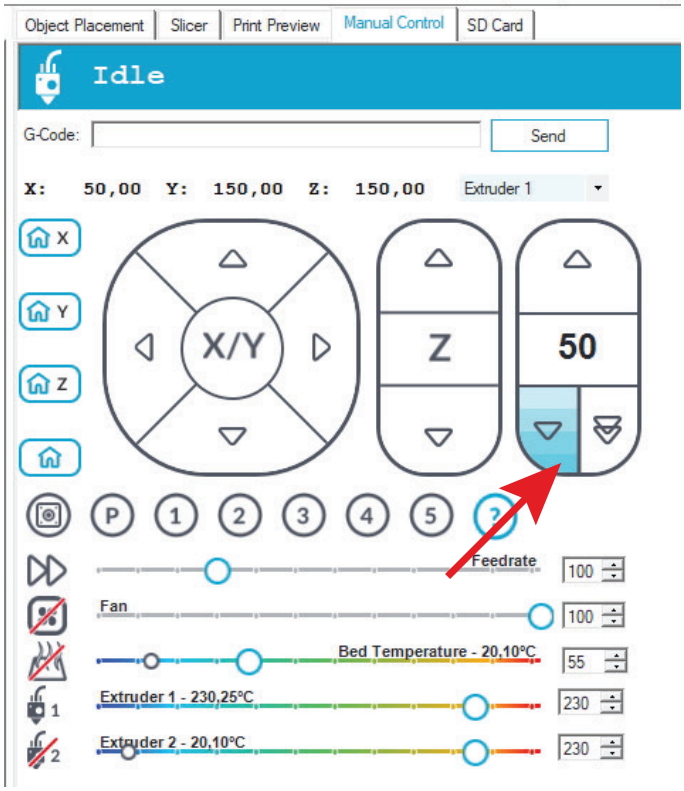
Measuring the feed

- 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.



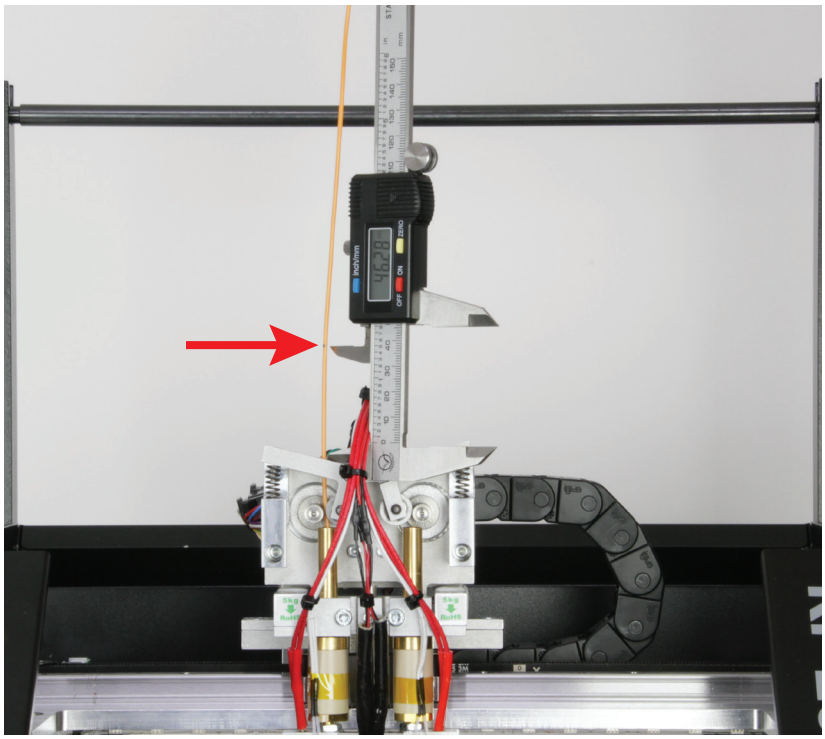
- When the filament is marked, feed in precisely 50 mm. For this, move the mouse over the arrow at the lower left in the right control (see red arrow). When the mouse pointer is all the way at the bottom (see arrow tip of the red arrow) and the middle shows 50, click precisely once.
- The filament motor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



- Now measure the remaining distance between the ball bearing holder and the mark just as you did when marking before.
- In our example, 46.28 mm are left.

→ To make the calculation example on the next page more easily comprehensible, we round down the value to 46 mm. When you perform the calibration, use the precise value for the calculation, however.



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 - 46 mm = 54 mm

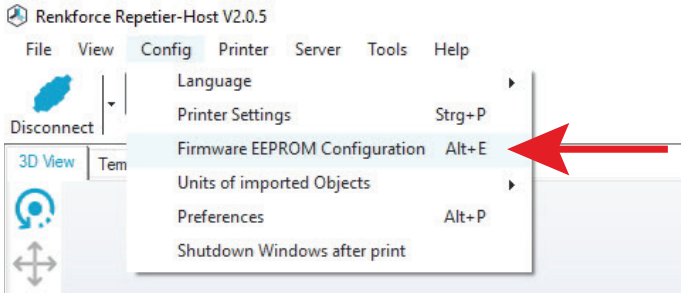
The formula for calculating the new value "Steps per mm" is as follows:

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

50 mm : 54 mm * 280.000 = 259.259

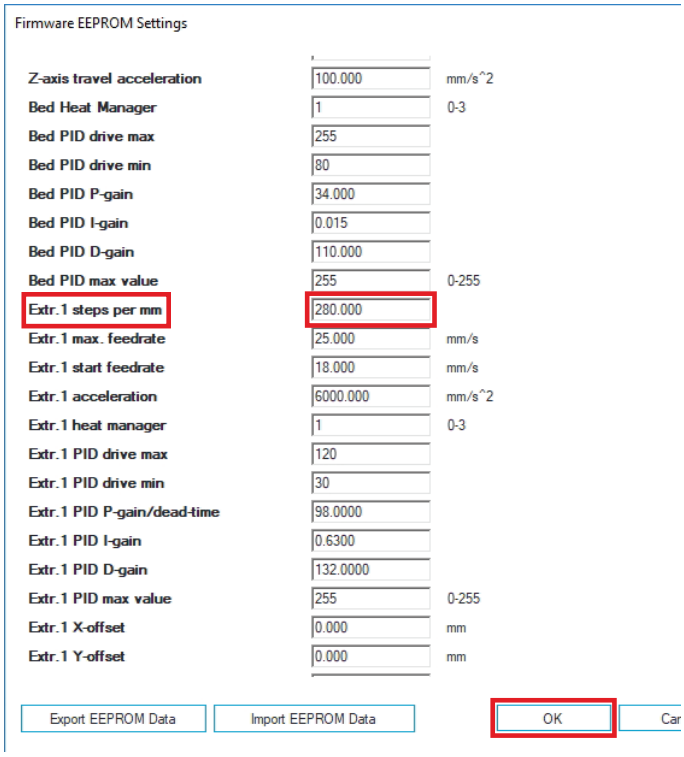
⟶ The value "**Current value steps per mm**" "**280,000**" is only an example value here. Always use the current value entered in "**Firmware EEPROM Configuration**" for the calculation!

- 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 current value to the value calculated anew before. In our example, change **280,000** to **259,259**.

  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. Read the current under "Firmware EEPROM Configuration" before calculation.

If you have acquired the printer with dual extruder, repeat 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 the two extruders

⟶ This chapter is only relevant for owners of the RF2000 v2 with dual extruder.

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 "**33.594**". This means **33.594 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 "**0.000**". This means **0.000 mm**. If the first digit behind the decimal point would be a 1 (i.e. **0.100 mm**), this would be **100 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).

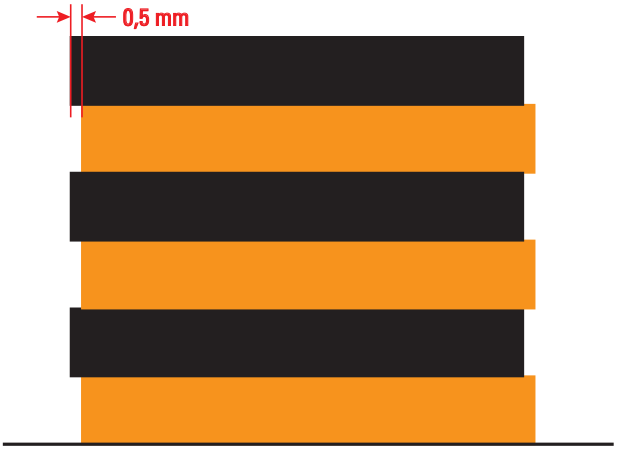
The first cube is used to determine the offset for X and Y, e.g. using a calliper, and added to or subtracted from the default value.

Then the cube is printed again.

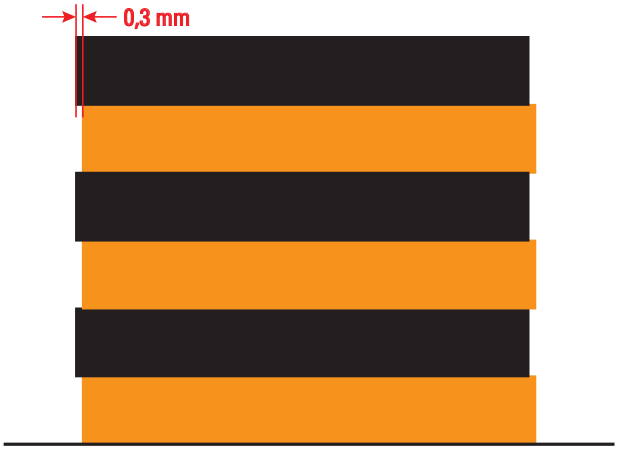
Repeat this until the layers are all cleanly on top of each other.

⟶ 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 (**33.594**) therefore must be corrected downwards by the offset (in our example 0.5 mm). The value to be set would be approx. **33.094**. 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 (**0.000**) would therefore have to be set to approx. **-0.300**.

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 printing plate temperature

The firmware makes it possible to adjust the temperature of the printing 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 with the Arduino™ IDE".

- 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 plate to be heated through entirely and the temperature to stabilise.

- Then measure the printing plate temperature in different locations.

Do not touch the hot printing plate 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 with the Arduino™ IDE".
- Enlarge the Arduino™ program window on the entire screen.
- Navigate to the tab "**RF2000V2.h**" (1 in the figure below) and in it approximately to line 584 (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 {60, 80, 100, 120, 140, 160}**" (3) defines the measured values.
- 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 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. For this, observe again chapter "20. Firmware update with the Arduino™ IDE".

20. Firmware update with the Arduino™ IDE

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.

The update with the Arduino™ IDE enables you to change the firmware before installation and to adjust it on demand.

Attention! All changes are made at your own risk! We assume no liability for this!

Download of the firmware

→ Firmware updates can be found in the current download package "**RF2000v2_SD_Vx.x.zip**" that you can download from the product page. On this, note the chapter "12. a) Download and unpacking of the software/firmware package".

You can also download the firmware from **https://github.com/RF1000/Repetier-Firmware**. The latest firmware updates for the RF1000 as well as for the RF2000 and the RF2000 v2 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.

- 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, RF2000 and RF2000 v2. 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"). The USB driver must be installed as well.

Use only Arduino™ version 1.6.5 under Windows®. This is also included in the latest version of the download package.

→ Alternatively, download the latest version of the 1.6.5. The first link leads to the main page. You can find the download there in "**PREVIOUS RELEASES**". The second (ZIP-file) and third links (installable EXE-file) lead directly to the respective download page. Then you only need to click download.

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

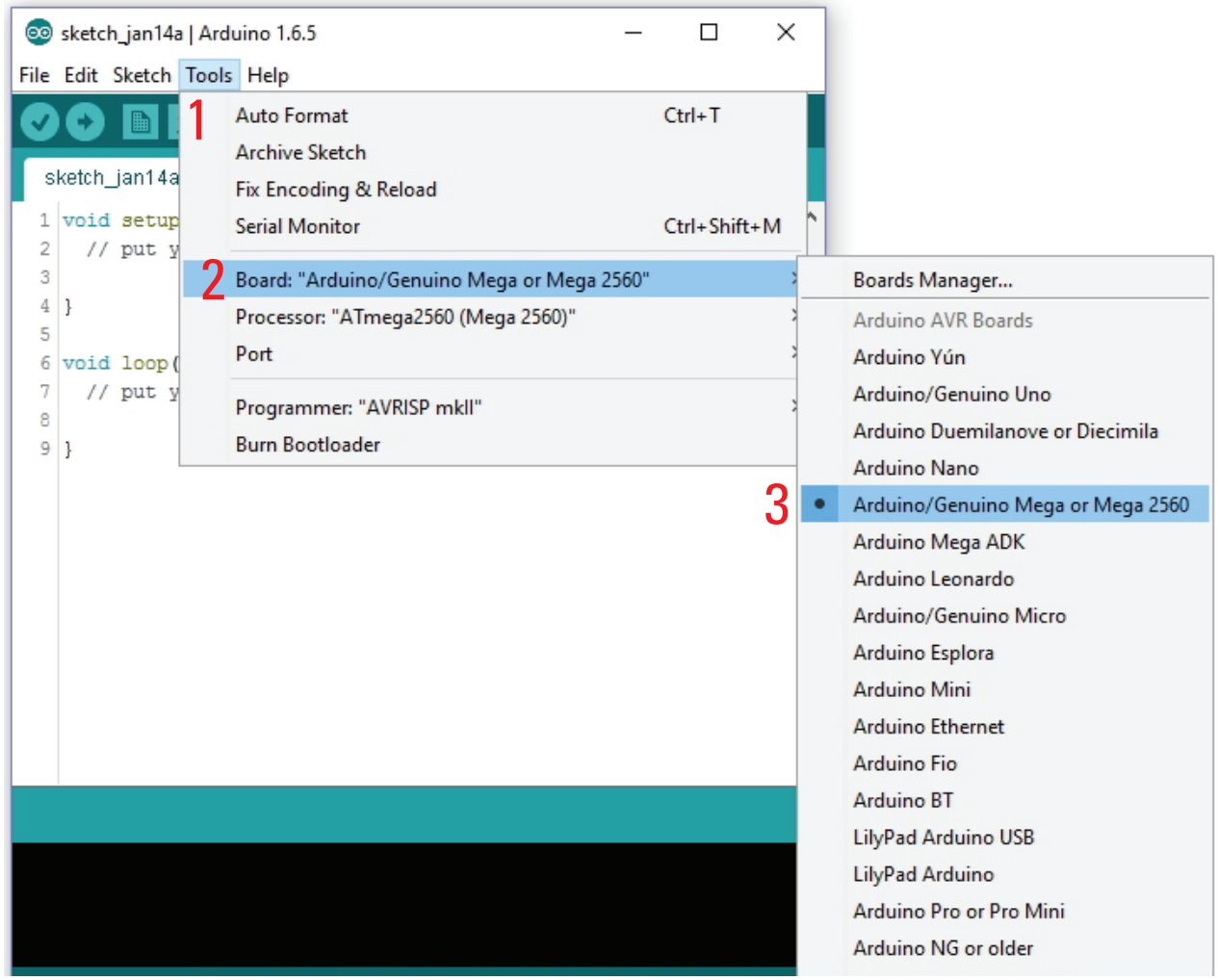
https://www.arduino.cc/download_handler.php?f=/arduino-1.6.5-r5-windows.zip

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

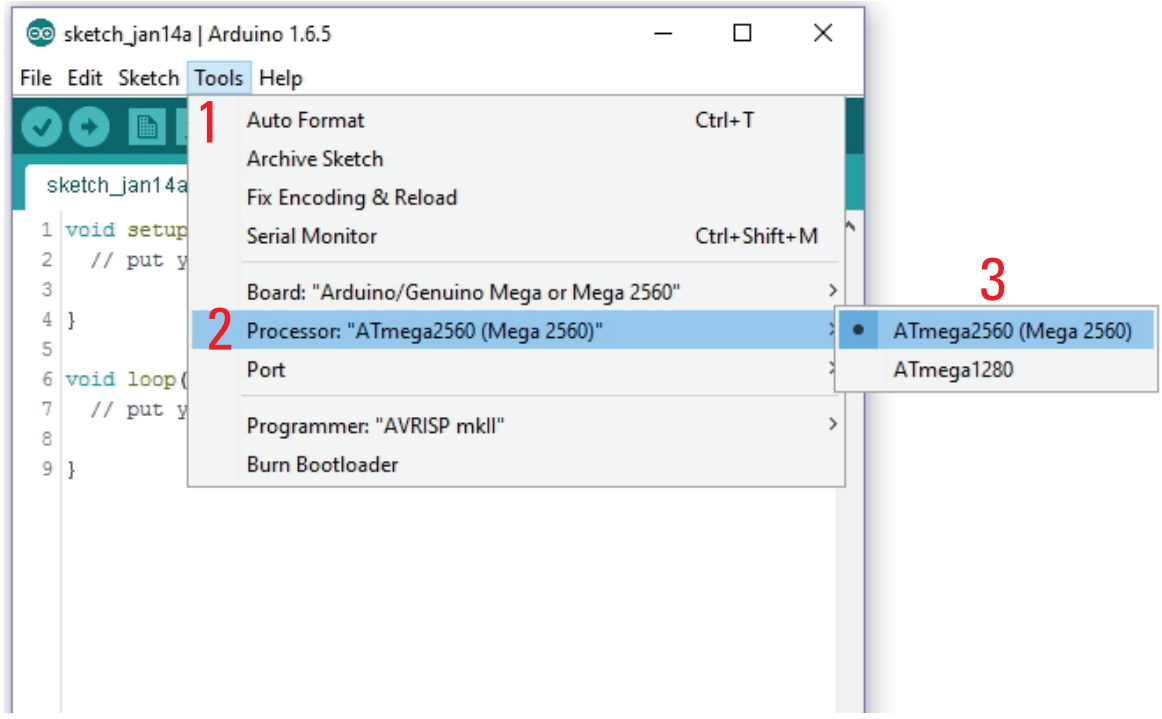
Install or unpack the downloaded Arduino™ version on your computer.

→ If you want to update with a MAC, use Arduino™ version 1.6.0 instead of version 1.6.5.

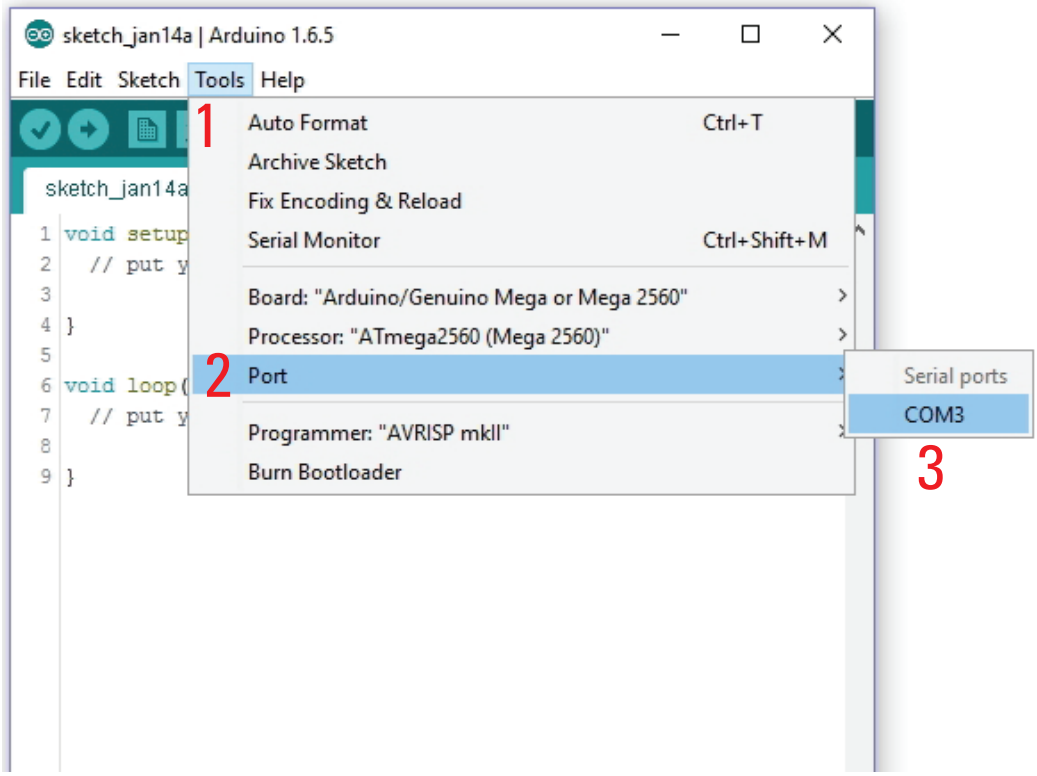
- Start the Arduino™ software.



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

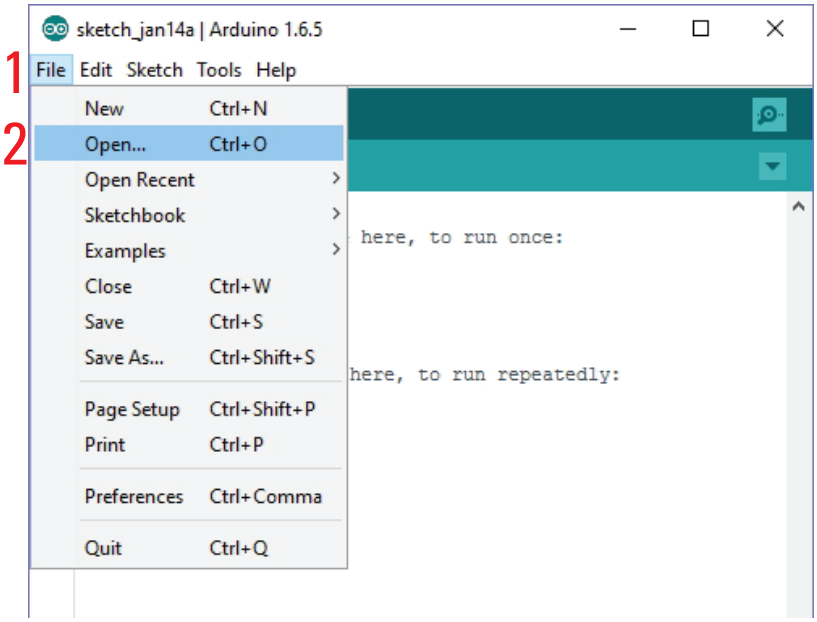


- In the menu "**Tools**" (1), select option "**Processor**" (2) and set the type "**ATmega2560 (Mega 2560)**" (3).



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

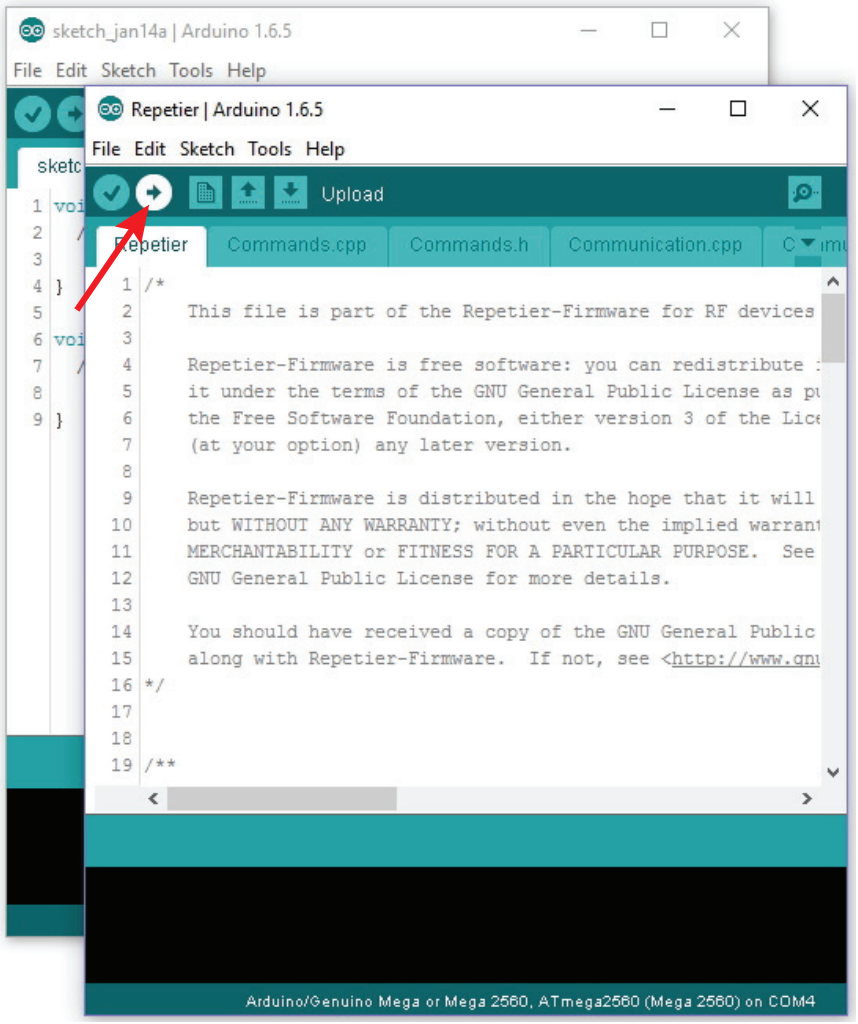
⟶ The port number is system-dependent. You can find it in the device manager of the control panel, under connections (COM and LPT).



- 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\RF2000v2\Repetier**"

- A new window opens.



- In the new window, click the button with the arrow to the right in order to compile and 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 installation, 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 perform work above the printing plate (e.g. at the extruder), cover it with a suitable protection (e.g. cardboard). Falling objects may easily damage the printing plate (loss of warranty/guarantee).

b) Cleaning

Device

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

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

Nozzle cleaning

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

Outside cleaning of the nozzle:

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

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

Inner cleaning of the nozzle:

Method 1:

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

Method 2:

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

Method 3:

If the procedure described above has not led to success, heat up the extruder to the printing temperature (PLA = 230 °C, 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 printing plate

Caution: Danger of burns. Let the printing plate cool off before cleaning.

Clean and degrease the printing 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 chapter 25. "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

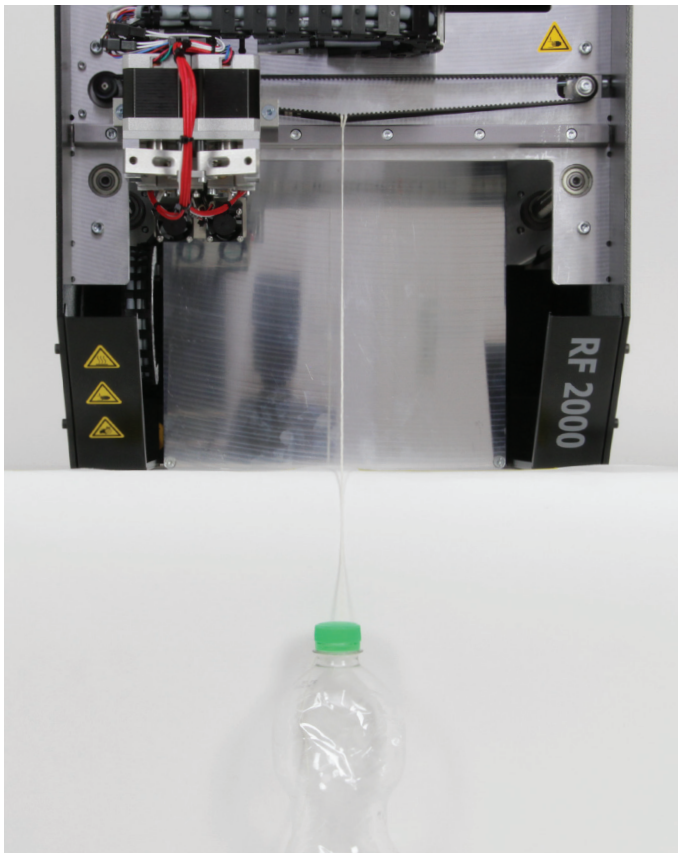
- Check the tension of the drive belts now and then.
- If required, retention them by setting the belt tensioner with the setting screws so that the toothed belts can still be twisted by 180° easily with two fingers.

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

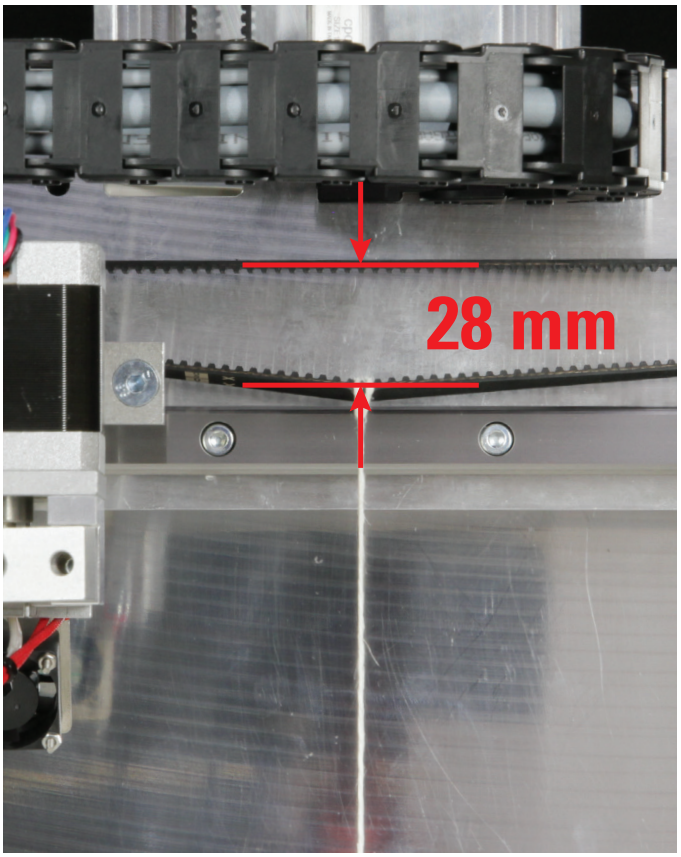
For this, you need a weight of 1 kg, such as a water bottle filled with water to reach the specified weight of 1 kg. You also need a cord for attachment.

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

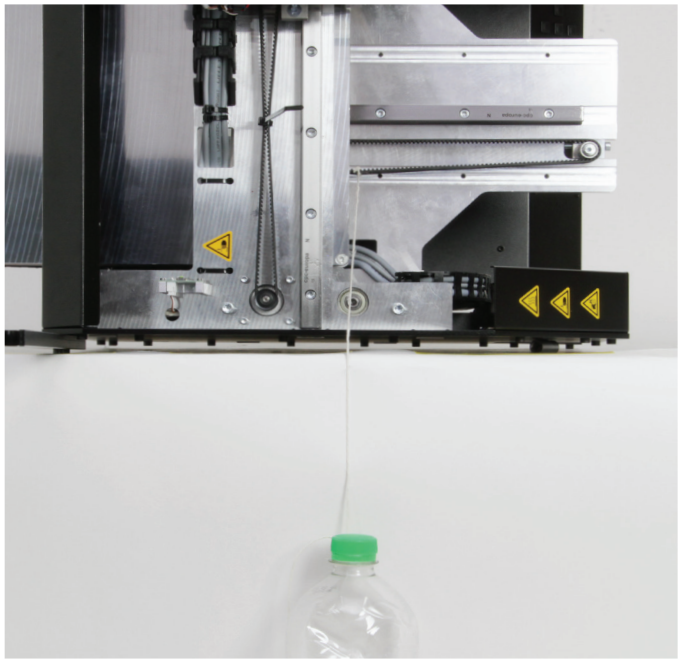


Now tip the printer to its front near the edge of the table and attach the weight in the middle to the part of the toothed belt for the X-direction that is now at the bottom using the cord.

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



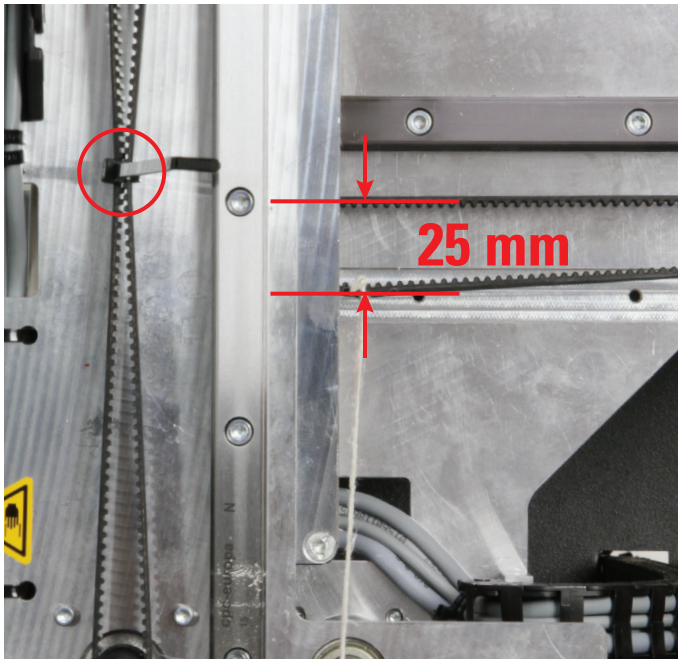
Measure the distance between the two toothed belt halves as illustrated. Set a distance of 28 mm with the belt tensioner (measured at the outside of the toothed belt).



Now tip the printer to the left 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).

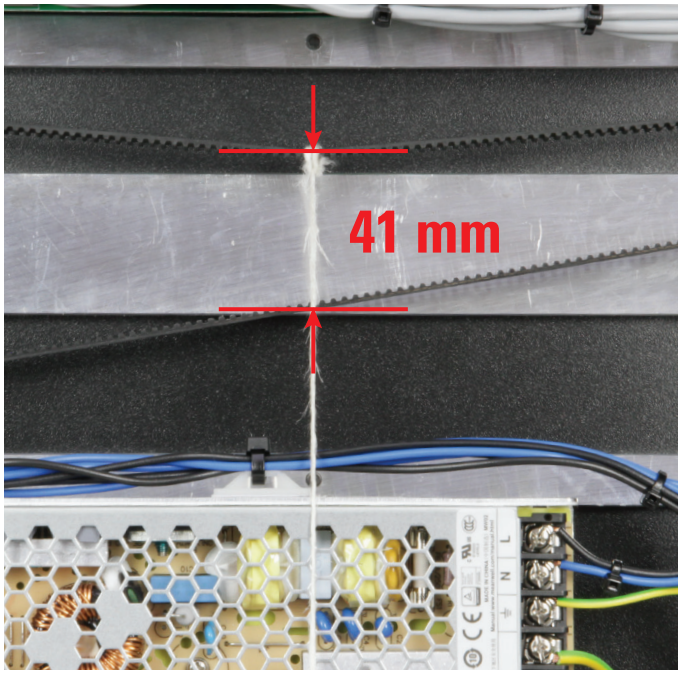
The weight must be suspended so that it can move freely. The string may touch the side part on top.



Measure the distance between the two toothed belt halves as illustrated. Set a distance of 25 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).

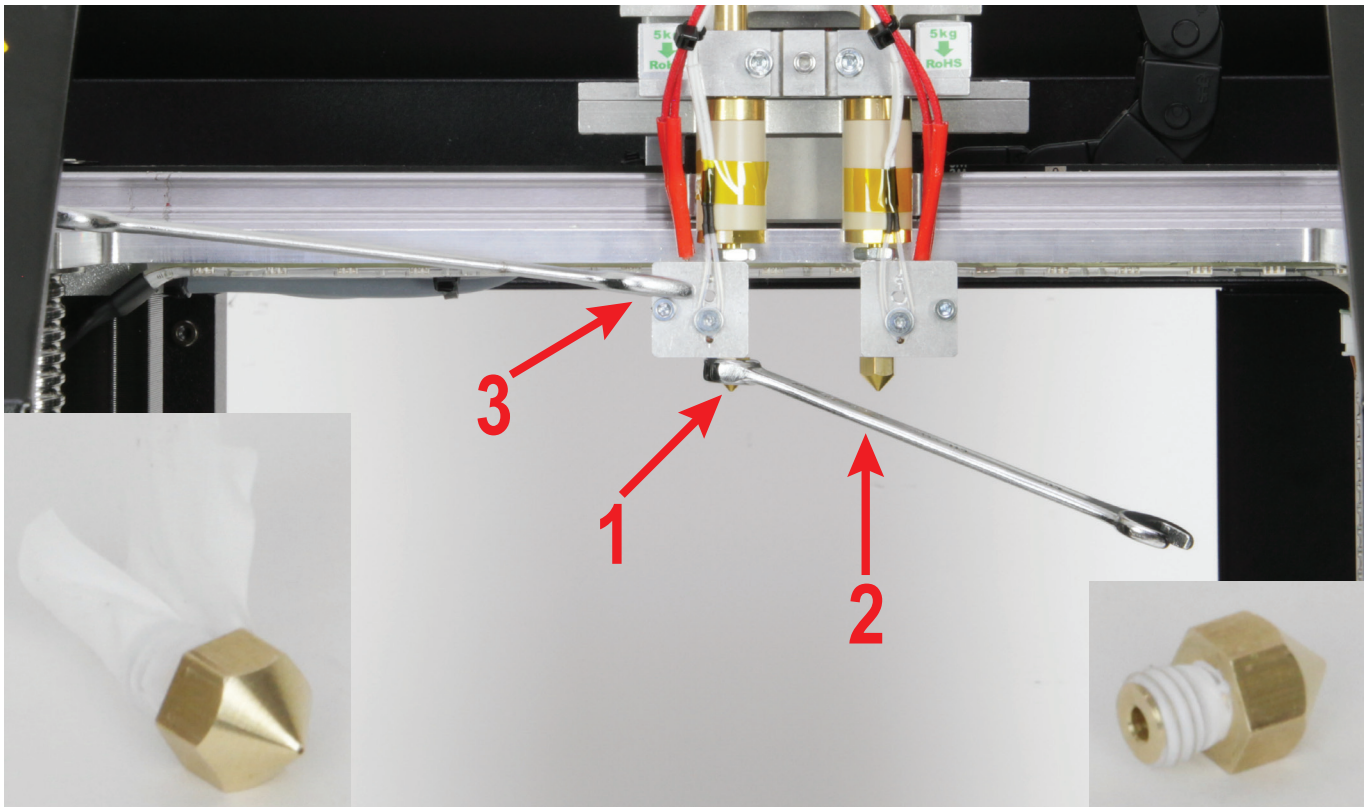
e) Nozzle change

Caution: Danger of burns. Do not directly touch the hot nozzle or 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 an 8 mm hexagon wrench or ring spanner (2). Alternatively, you can also use an 8 mm hexagon socket wrench for this. This way, the nozzle cannot fall off.

  When unscrewing the nozzle, always secure the extruder against twisting at the heating block with an 11 mm hexagon socket wrench (3).

  Never damage the line for the temperature sensor. This may lead to short circuit otherwise. Loss of guarantee/warranty!



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.

- If necessary, clean the thread of the heating block carefully with tweezers or flat pliers.
- Apply PTFE sealing tape to the new nozzle. Observe the winding direction in any case! The sealing tape must run with the thread! This means that the end of the sealing tape on the outside must not oppose the turn-in direction. Otherwise, it may happen that the sealing tape is moved when turning in and will not seal properly (see small picture on the left).

  The sealing tape must never protrude beyond the thread. The sealing tape that protrudes beyond the thread, cut it off with a sharp knife. Smooth the sealing tape well with your fingers. The ridges of the thread may be slightly visible. This way, the nozzle can be turned in more easily without the sealing tape becoming bunched up in the thread (see small picture on the right).

  For this, observe chapter "13. b) Assembly of the extruder " in the assembly instructions of the RF2000 v2 construction kit.
- Screw the new extruder nozzle carefully into the heating block and tighten it again (do not forget to secure the heating block!). Never apply any strong forces for this.
- Then put in the filament again as described in chapter "15. Inserting, removing and changing the filament".
- Switch off the extruder heating again and have the extruder cool off.

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?
- Is the correct baud rate set in the software (115200)?
- 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 printing 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!)
- Repeat setting of the distance between the nozzle and the heating plate (see chapter "14. Calibration") and especially perform the basic settings of the limit switch for the Z-direction again. The plate distance must not be too large.
- 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 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 output value should not be more than 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 printing plate 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 printing plate have reached the specified temperature.
- The distance between the printing 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 printing plate:

- The temperature of the printing 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 printing 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 printing plate that prevent adhesion of the object. Rub the printing plate with a soft cloth that is soaked with a solvent (e.g. acetone).
- The printing plate has not reached the set temperature yet.
- At PLA printing of small objects with a small footprint, it is recommended to apply the printing 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 printing 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. It may lead to deformation of the printed object and to cancellation of printing.

  Therefore, we recommend keeping drafts as low as possible. This is most easily done with the optional "Housing".
- Let the printed object cool off slowly and evenly after completion before you remove it from the printing plate.
- 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. Attention! Danger of burns!

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. 760 W

Connection output socket ..... max. 800 W

Total power intake ..... max. 1560 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 (W x D x H) ..... Single extruder approx. 200 x 290 x 185 mm (X, Y, Z)

..... Dual extruder approx. 170 x 290 x 185 mm (X, Y, Z)

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. 1.75 mm

Power of the heating plate ..... 560 W

Extruder temperature ..... 120 – 270 °C

Heating plate temperature ..... 55 – 160 °C

Interfaces ..... USB 2.0 and SD/SDHC card reader

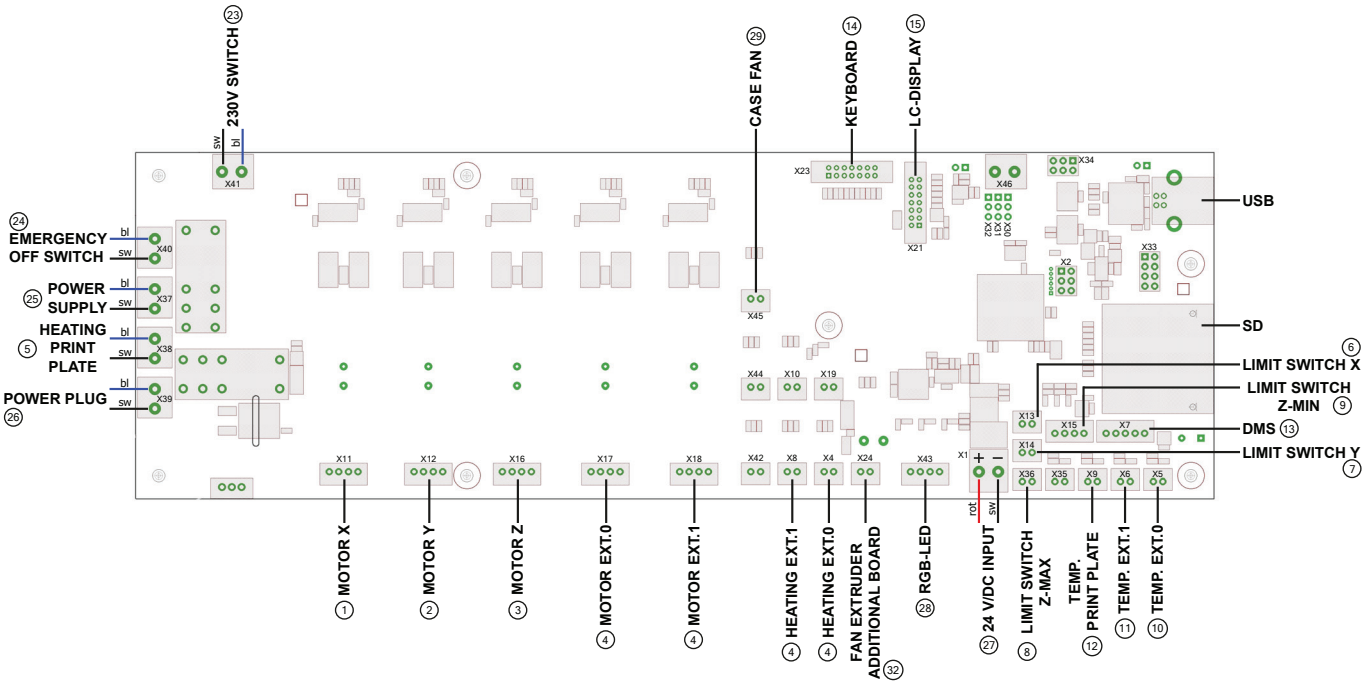
Dimensions (W x D x H) ..... 390 x 420 x 665 mm

Weight ..... 19.7 kg

26. Annex

a) Wiring plan

Connection plan of the main PCB



Abbreviations used:

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

bl = The respective blue line is connected here

sw = The respective black line is connected here

EXT. = extruder

DMS = elongation measuring strip

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

LIMIT SWITCH Z-MIN = 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.

Overview of all lines and connections

Line	Length	Connection main PCB	Pin number plug/main PCB (all pins on white plugs; colour based on pin1)	Component	Pin number plug/component (all pins on plugs; colour based on pin1)
1	735 mm	X11	4pin green/yellow/white/brown	Motor X	4pin yellow/green/brown/white
2	840 mm	X12	4pin green/yellow/white/brown	Motor Y	4pin yellow/green/brown/white
3	380 mm	X16	4pin green/yellow/white/brown	Motor Z	4pin yellow/green/brown/white

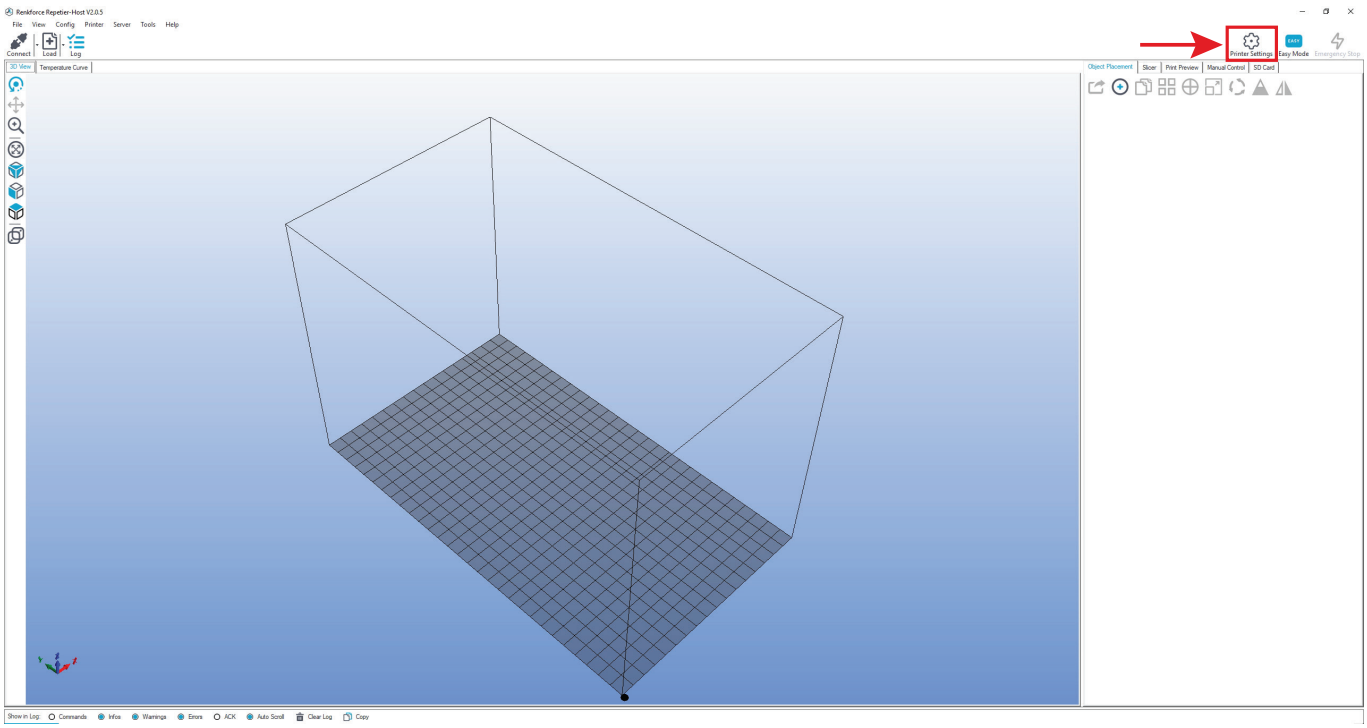
4	1440 mm	X17	4pin green/yellow/white/brown	Motor extruder 0 (1st extruder)	4pin yellow/green/brown/white
		X18	4pin yellow-brown/white-yellow/ brown-green/white-green	Motor extruder 1 (2nd extruder)	4pin white-yellow/yellow-brown/ white-green/brown-green
		Fan additional PCB	4pin red/blue/grey-pink/red-blue	Fan 1/2 (single extruder)	2pin red/blue (+ = red)
				Fan 3/4 (dual extruder only)	2pin grey-pink/red-blue (+ = grey-pink)
		X4	2pin grey/pink	Heating extruder 0 (1st extruder)	2pin grey/pink
		X8	2pin black/violet	Heating extruder 1 (2nd extruder)	2pin black/violet
5	1000 mm	X38	3pin, open ends	Heating printing plate	2-pole black + 1-pole green-yellow Ring cable lug
6	975 mm	X13	2pin brown/white	Limit switch X	2pin brown/white
7	1630 mm	X14	2pin brown/white	Limit switch Y	2pin brown/white
8	830 mm	X36	2pin brown/white	Limit switch Z-max	2pin brown/white
9	1300 mm	X15	4pin green/yellow/white/brown	Limit switch Z-min	4pin green/yellow/white/brown
10	1500 mm	X5	2pin brown/white	External temperature sensor 0 (1st extruder)	2pin brown/white
11	1500 mm	X6	2pin brown/white	External temperature sensor 1 (2nd extruder)	2pin brown/white
12	1230 mm	X9	2pin brown/white	Temperature sensor printing plate	2pin brown/white
13	1420 mm	X7	5pin yellow/brown/green/white/shield	DMS (elongation measuring strip)	4pin yellow/brown/green/white
14	150 mm	X23	14pin flat-band cable	Keyboard (twisted plug)	14pin flat-band cable
15	175 mm	X21	14pin flat-band cable	Display	14pin flat-band cable
28	1000 mm	X43	4pin	LED strip	
29	140 mm	X45	2pin red/black (+ = red)	Housing fan	
32	140 mm	X24	2pin brown/white	Fan control	3pin white/empty/brown

Line	Length	Cross-section	Connection	Pin number plug/main PCB (all pins on white plugs; colour based on pin1)	Connection	Pin number plug/component (all pins on white plugs; colour based on pin1)
22	150 mm	0.75 mm²	Casing	1pin green-yellow ring cable lug	Low-voltage device combination socket	1pin green-yellow flat cable lug
			Mains adapter protective earth	1pin green-yellow open end		
23	640 mm	0.75 mm²	Main PCB X41	1pin black open end	Low-voltage device combination socket	1pin black flat cable lug
				1pin blue open end		1pin blue flat cable lug
24	150 mm	0.75 mm²	Main PCB X40	1pin black open end	Emergency off	1pin black flat cable lug
				1pin blue open end		1pin blue flat cable lug
25	550 mm	0.75 mm²	Main PCB X37	1pin black open end	Mains unit L	1pin black open end
				1pin blue open end	Mains unit N	1pin blue open end
26	600 mm	0.75 mm²	Main PCB X39	1pin black open end	Power plug	1pin black open end
				1pin blue open end		1pin blue open end
27	370 mm	2.5 mm²	Main PCB X1	1pin red, open end (+)	Mains unit +V	1pin red, open end (+)
				1pin black open end	Mains unit -V	1pin black open end
30	170 mm	0.75 mm²	Casing	1pin green-yellow ring cable lug	Power plug Protective ground	1pin green-yellow open end
31	180 mm	2.5 mm²	Casing	1pin green-yellow ring cable lug	Mains unit -V	1pin green-yellow open end

b) Setting up the printer settings

This chapter is only targeted at users who do not have the custom version of the software installed. If you have installed the custom version, 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 "**RF2000v2_3D_Dual**" for the version with dual extruder or "**RF2000v2_3D_Single**", if you own the printer with single extruder in the tab "**Connection**" in the following window (1). Alternatively, you can also assign your own name.
- Set the port (2) and baud rate (3). The baud rate must be set to "**115200**".

→ The port number (2) is system-dependent.

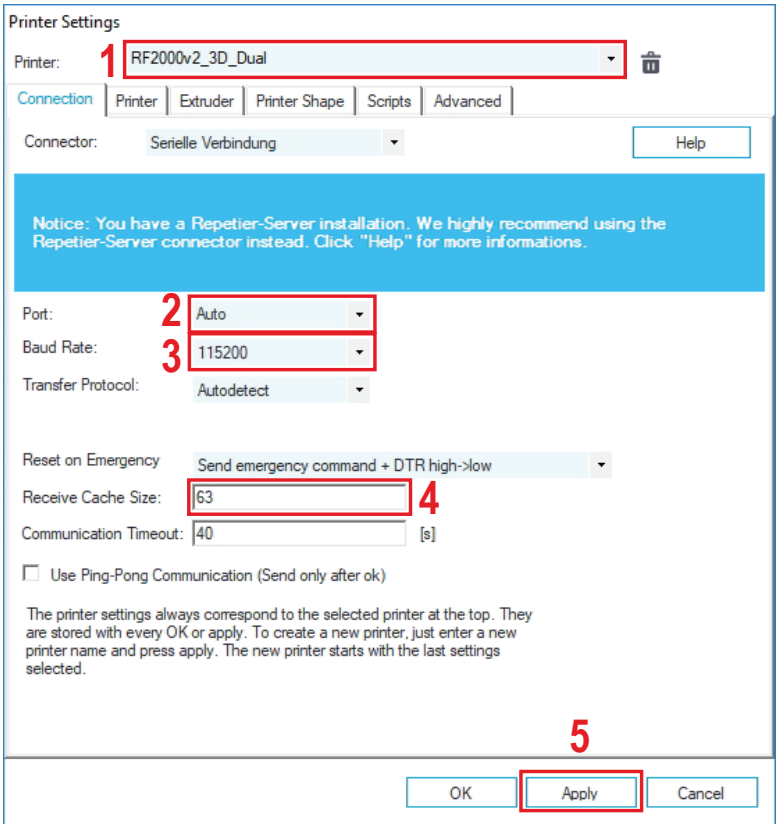
Usually, the setting "**Auto**" should work with the current version of the software (as of 2.0.5).

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 in the picture (4).

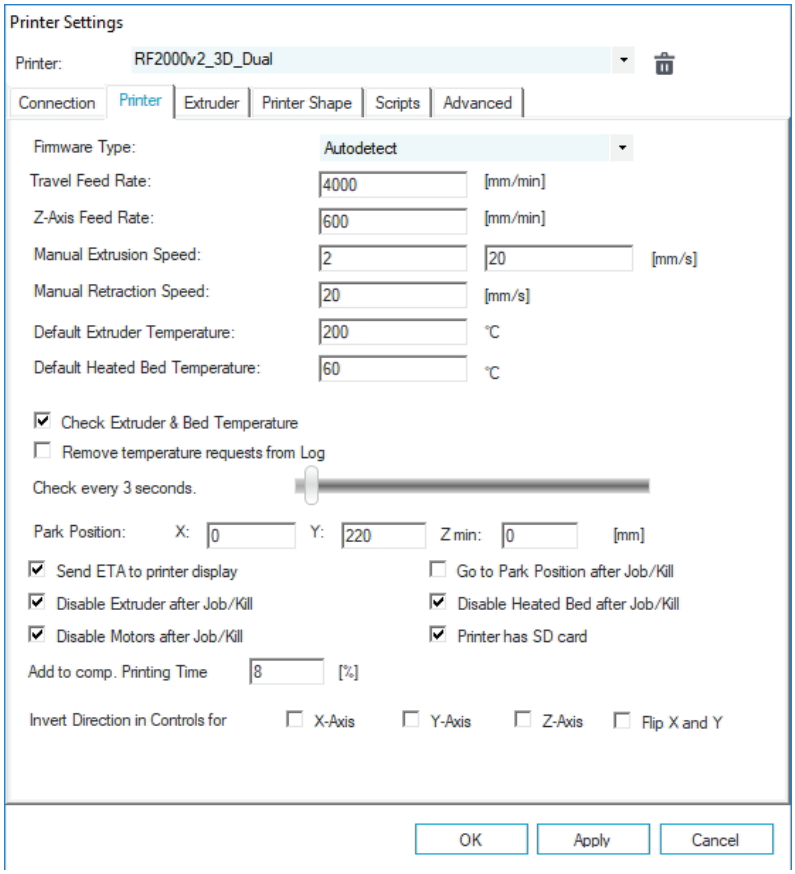
- Click "**Apply**" (5).



Click the tab "**Printer**".

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

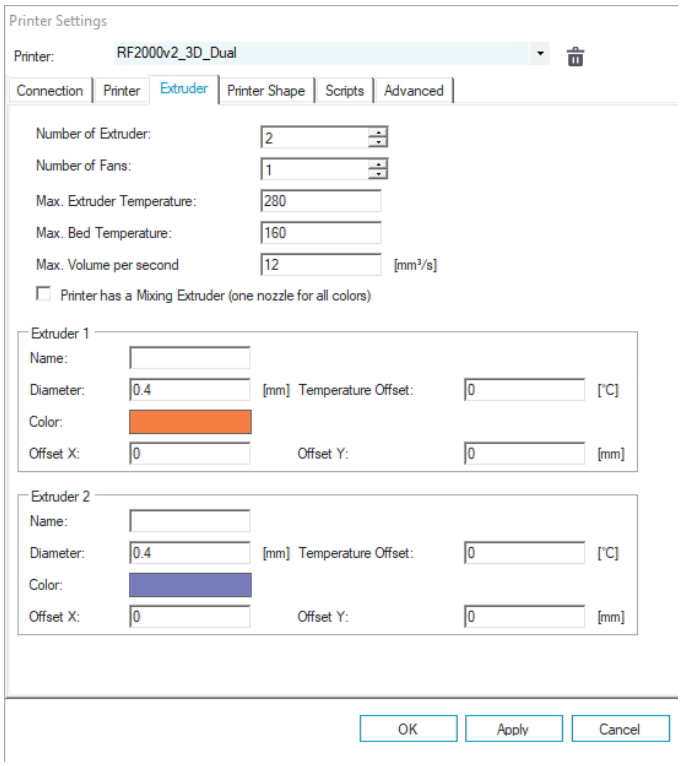
Dual and single extruder



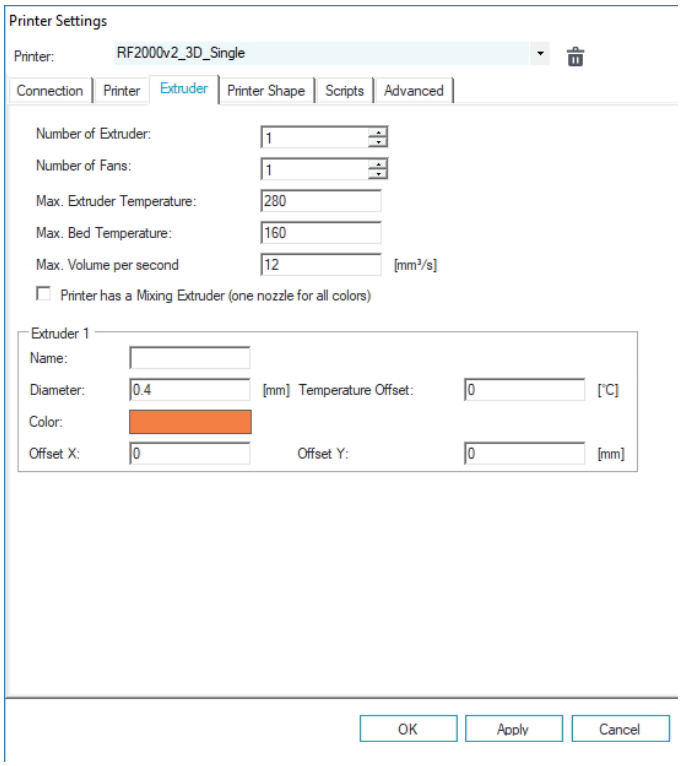
Click the tab "**Extruder**".

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

Dual extruder



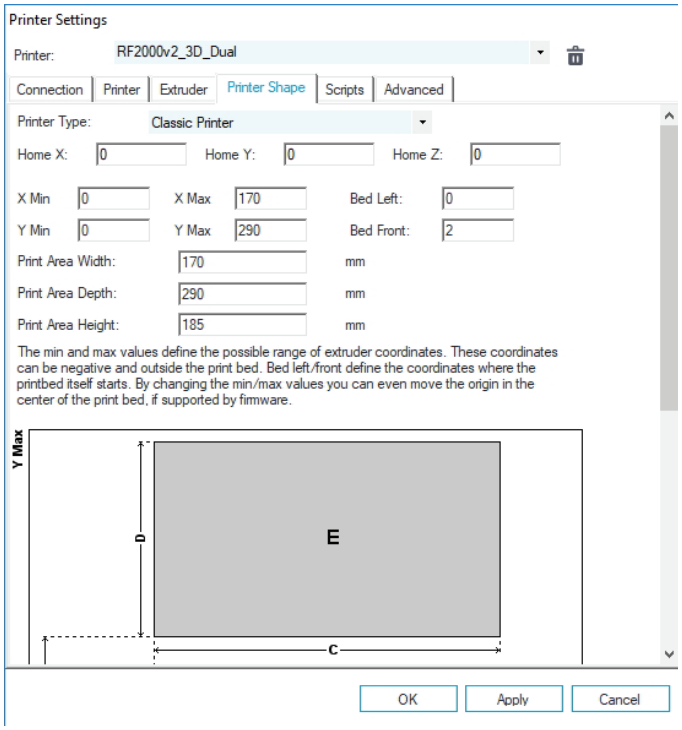
Single extruder



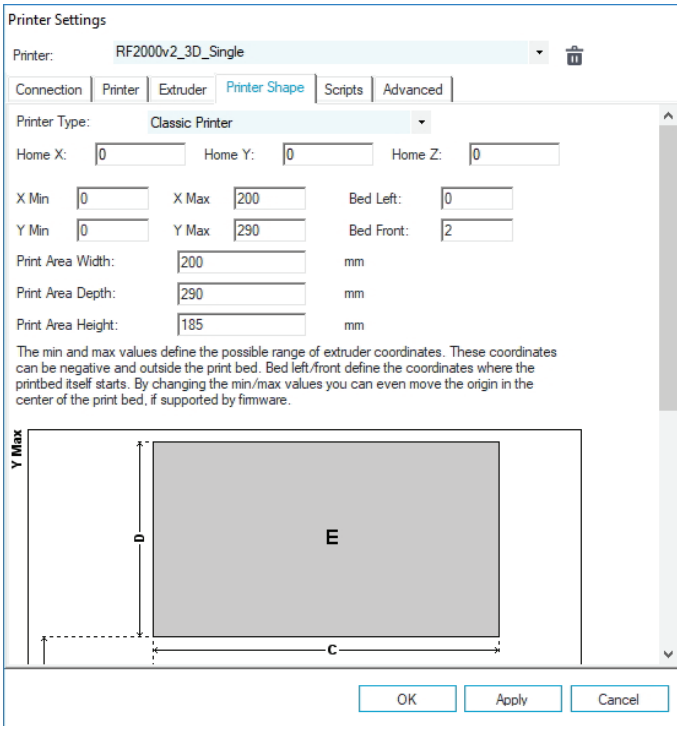
Click the tab "**Printer Shape**".

Transfer the settings 1:1 as shown in the following figure and click "**Apply**". For the printer with single extruder, enter 200 in " **Print Area Width:**".

Dual extruder



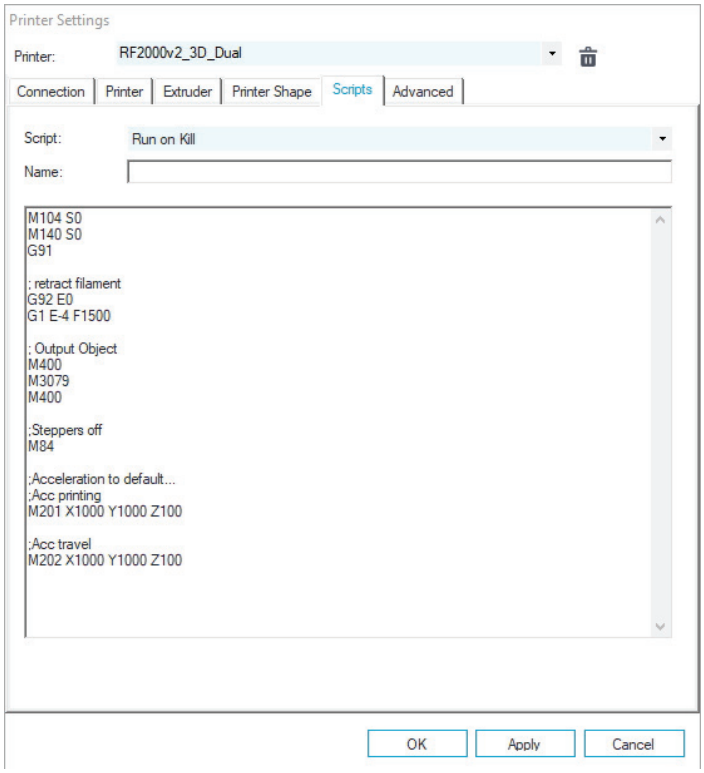
Single extruder



Click the tab "**Scripts**".

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

Dual and single extruder



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

```
M104 S0
M140 S0
G91

; retract filament
G92 E0
G1 E-4 F1500

; Output Object
M400
M3079
M400

;Steppers off
M84

;Acceleration to default...
;Acc printing
M201 X1000 Y1000 Z100

;Acc travel
M202 X1000 Y1000 Z100
```

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

Click "**OK**".

c) 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. Is displayed when "Align Extruders" has been selected in the menu.
Align aborted	Is displayed when alignment of both extruders was cancelled.
Align completed	Is displayed when alignment of both extruders was completed.
Work Part Scan	Is displayed while the work piece scan is active.
Scan completed	Is displayed when the heat bed scan has been completed successfully. 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 heat bed scan has been cancelled. Is displayed when the work piece scan has been cancelled. For more information on the errors that occurred, see the log file of the Repetier-Host.
Preheat PLA	Is displayed when the extruder and printing plate are heated to PLA temperatures because the menu item "Preheat PLA" has been chosen.
Preheat ABS	Is displayed when the extruder and printing plate are heated to ABS temperatures because the menu item "Preheat ABS" has been chosen.
Cooldown	Is displayed when the extruder and printing plate 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.
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.
SD Read Error	Is displayed when the RF recognises that a reading error has occurred.
SD Error fixed	Is shown when the RF has removed the reading error.
No SD Card	Is displayed when the RF wants to delete a file from the SD card but there is no SD card.
Uploading…	Is displayed when a file is transferred to the SD card.
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.
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: Z Compensation Operation denied	Is displayed when the Z-compensation matrix cannot be changed or deleted because: - the Z-compensation is currently active
Error: Find Z Origin Operation denied	Is displayed when the RF is in "Printer" mode.
Error: Home Operation denied	Is displayed when the "Home" position cannot be targeted 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
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: 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: 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: 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: Align Extruders Operation denied	Is displayed when the alignment of the two extruders cannot be started because: - Printing is currently being performed - Only one extruder is installed
Error: Align Extruders Temperature wrong	Is displayed when the alignment of the two extruders cannot be started because: - The temperature difference between extruder 1 and 2 is too high
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.

Information messages

(Are either displayed in the printer display or in the log file of the Repetier-Host software)

Information: Heat Bed Scan Scan completed	Is displayed when the heat bed scan has been completed successfully.
Information: Work Part Scan Scan completed	Is displayed when the work piece scan has been completed successfully.
Information: 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"
Information: 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"
Information: 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"
Information: 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 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"

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