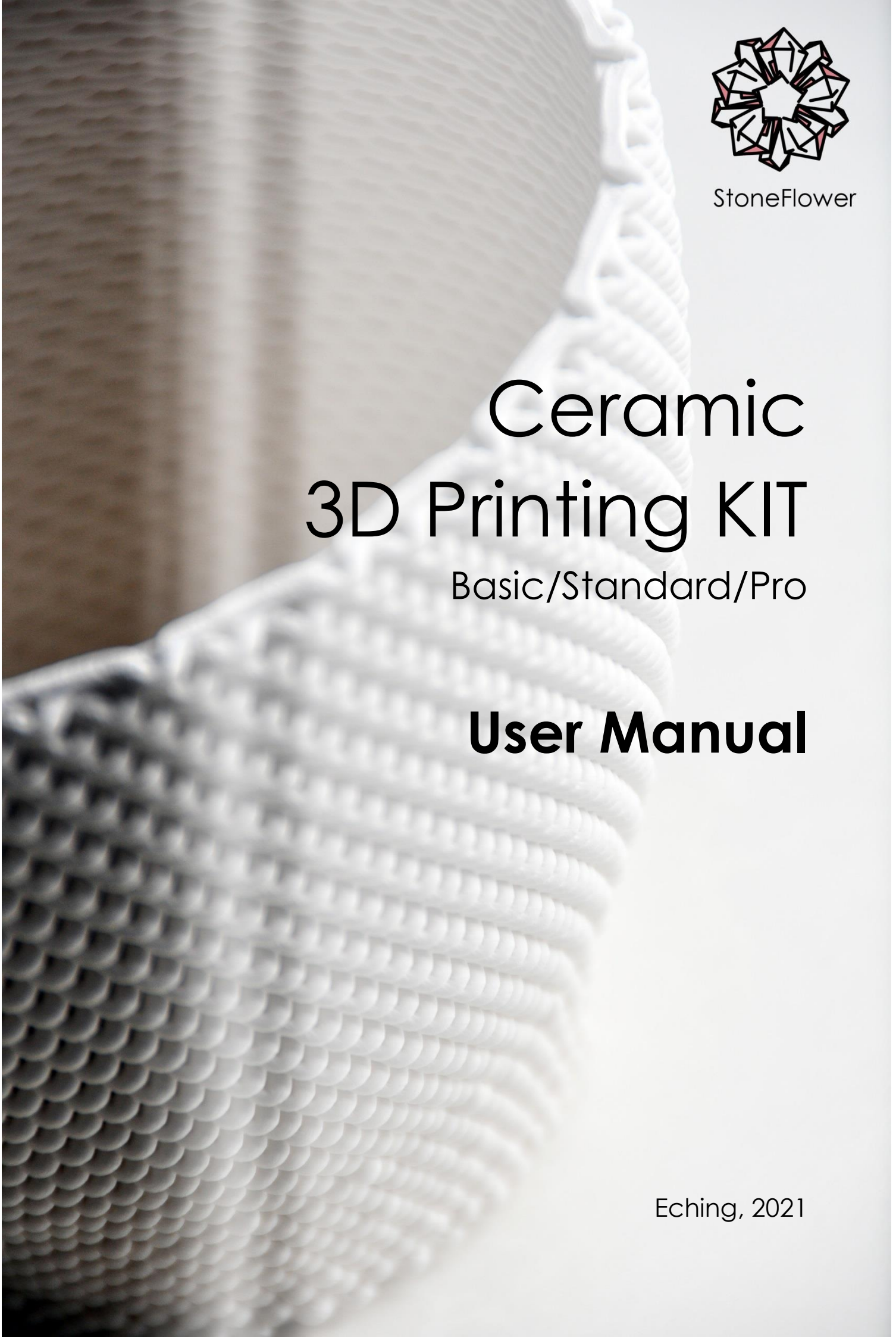


StoneFlower

Ceramic 3D Printing KIT

Basic/Standard/Pro

User Manual

Eching, 2021

Contents

Disclaimer

Please read and understand the contents of this installation and user manual. Failure to read the manual may lead to personal injury, inferior results or damage to the Ceramic 3D Printing KIT and/or 3D printer. Always make sure that anyone who uses the 3D printer knows and understands the contents of the manual to make the most out of the Ceramic 3D Printing KIT.

The conditions or methods used for assembling, handling, storage, use or disposal of the device are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, injuries, damage, or expense arising out of or in any way connected with the assembly, handling, storage, use or disposal of the product.
The information in this document was obtained from sources which we believe are reliable. However, the information is provided without any warranty, express or implied, regarding its correctness.

Intended use

Ceramic 3D Printing KIT is designed and built for dispensing and deposition of clay and porcelain within a commercial/business environment, being installed in compatible desk top 3d printer. Ceramic 3D Printing KIT is precise, safe and salient. It is perfect for prototyping and small serial production of ceramic wares, sculptures, architectural models etc. from clay/porcelain of high viscosity that provides good mechanical stability to complex shapes upon printing.

Although we achieved a very high standard in the reproduction of 3D models with the usage of KIT, the user remains responsible to qualify and validate the application of the printed object for its intended use. While we do not put any limitations on the choice of materials for extrusion with the KIT, we recommend to use clays and porcelains of moderate viscosity. Using too viscous material lead to a large loads on the motors and accelerated wear of the components. Extruder is designed to work under mechanical pressures below 10bars, and may break at higher loads. The user remains responsible to the control of the content of material and absence of any components, which may dissolve, corrode, or damage the components of the KIT upon extrusion.

The KIT is not food grade.

Ceramic 3D Printing KIT

This user manual is designed to help you start your clay printing experience.
Learn everything about using your KIT by following the instructions in
this user manual and experience how easy it is to produce great quality prints.

Your Ceramic 3D Printing KIT at glance

Figure 1.

1. Print head
2. Ram extruder
3. Hose for the material
4. Control unit and power source
5. Nozzles
6. Cables
7. Micro printing set

Micro printing set is not shown, and included in all KITs, except Basic

Print head

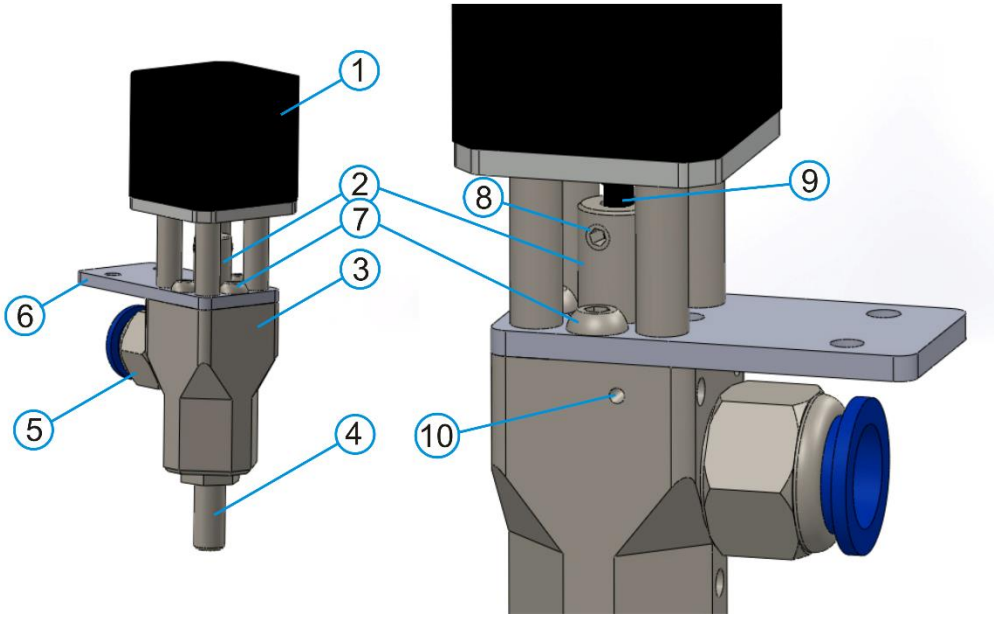


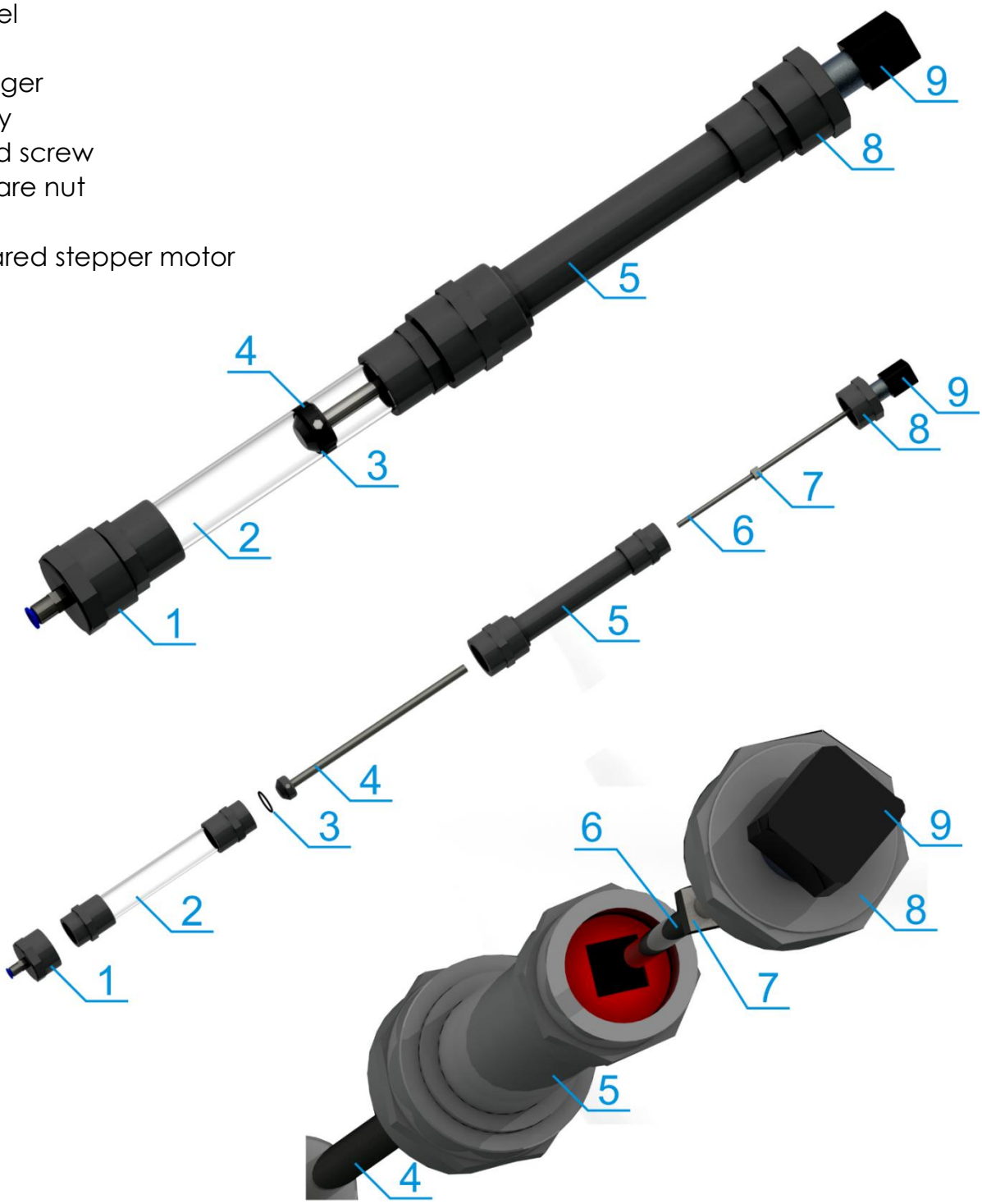
Figure 2.

1. Stepper motor
2. Auger screw
3. Stator
4. Nozzle
5. Push-in connector
6. Mount
7. Screws M5
8. threaded pin
9. Shaft of the motor
10. Threaded pin, holding the bearing

Ram extruder

Figure 3.

1. Lid of the barrel
2. Barrel
3. Seal
4. Plunger
5. Body
6. Lead screw
7. Square nut
8. Lid
9. Geared stepper motor



Control unit 3.0

Figure 4.

Specifications

Printing

Printing technology	direct mechanical extrusion
Ram extruder capacity	05L (ram extruder S) 1.5L (ram extruder L)
Nozzle diameters	1.0, 2.0, 2.5mm
Layer resolution	0.3 … 2mm
Print speed	30mm/s … 100mm/s
Travel speed	up to 100mm/s
Print head weight	450g
Pipe diameter/length	12mm X 400mm

Electrical

AC input	100-240V, 50-60Hz
Operating voltage, DC	24V, 6A

Physical dimensions and materials

Print head

Dimensions	WxDxH = 36x40x180mm
Inlet	plug-in connector, 12mm
Nozzle adapter	1/4inch x M6
Weight	450g
Material	stainless steel (auger screw, connector), nickel-plated brass (body),

Ram extruder S, 0.5L

Capacity	0.5l (900g of clay)
Internal diameter/length of barrel	45.2mm/380mm
External diameter/length	80mm/930mm
Supplied with 50cm long PU pipe	12x8mm.
Material of the barrel	PVC.
Materials of plunger	Nylon, rubber seal
Weight	3.6kg

Ram extruder S, 1.5L

Capacity	1.5l (2700g of clay)
Internal diameter/length of barrel	67.8mm/480mm
External diameter/length	110mm/1300mm
Supplied with 50cm long PU pipe	12x8mm.
Material of the barrel	PVC.
Materials of plunger	Nylon, rubber seal

Weight	5.7kg

Control unit

Dimensions WxDxH	260x160x90mm
Material	ABS/POM, rubber seal
Weight	0.7kg

If the KIT is used with the materials other than wet clay/porcelain, please check chemical compatibility with the components of the KIT first.

Conditions

Ambient operation temperature	18 … 32 °C
Storage temperature	0 … 32 °C

Cautions

CAUTION: The Ceramic 3D Printing KIT has moving parts that can cause injury. Never reach inside of the Ceramic 3D Printing KIT while it is in operation. Do not use or power on partly or completely disassembled Ceramic 3D Printing KIT. Always control Ceramic 3D Printing KIT with the power switch on the back of control unit.

CAUTION: When connecting or disconnecting parts of Ceramic 3D Printing KIT from the control unit, ensure that the power supply is turned off. Connection of motors to powered control unit may irreversibly destroy electronics of the KIT.

CAUTION: Only use the power supply provided with your Ceramic 3D Printing KIT.

Getting started

General notices

Any slicing software is compatible with the KIT: Cura 3D, Repetier, Slic3r, Simplify3D etc. Before printing you have to set/change several variables in the slicer.

1. Set target temperatures in the slicer of extruder and heated bed to zeros to disable heating and temperature control. Usually those settings one can make in the slicer.

2. Set the nozzle diameter in the slicer. By default the KIT comes with 1mm, 2mm, 2.5mm nozzles. Nozzles from micro printing set are color-coded:

Dark Green	14 Gauge	1.55mm
Black	16 Gauge	1.19mm
Jade Green	18 Gauge	0.84mm
Light pink	20 Gauge	0.6mm
Royal blue	22 Gauge	0.41mm
Red	25 Gauge	0.26mm

3. Hardware settings
Feeding clay, the print head should make about 1 to 3 rotations per second. If the print head does not rotate fast enough, printing may be difficult of impossible. One can accelerate the rotation speed of the print head changing microstepping settings in the control unit.

4. The KIT can work in two modes: KIT and PRINTER. One can switch between modes using the button of the control unit.

KIT mode: the control unit rotates the motors of the print head and ram, and one can vary the speed of rotation.

Printer mode: control unit uses the input signal, coming from the 3d printer to run the motor at the speed, set in the g-code, printer at the moment. The printing can be controlled automatically. Use of this mode requires the control unit to be connected to the printer, and parameters of the printer selected as described below.

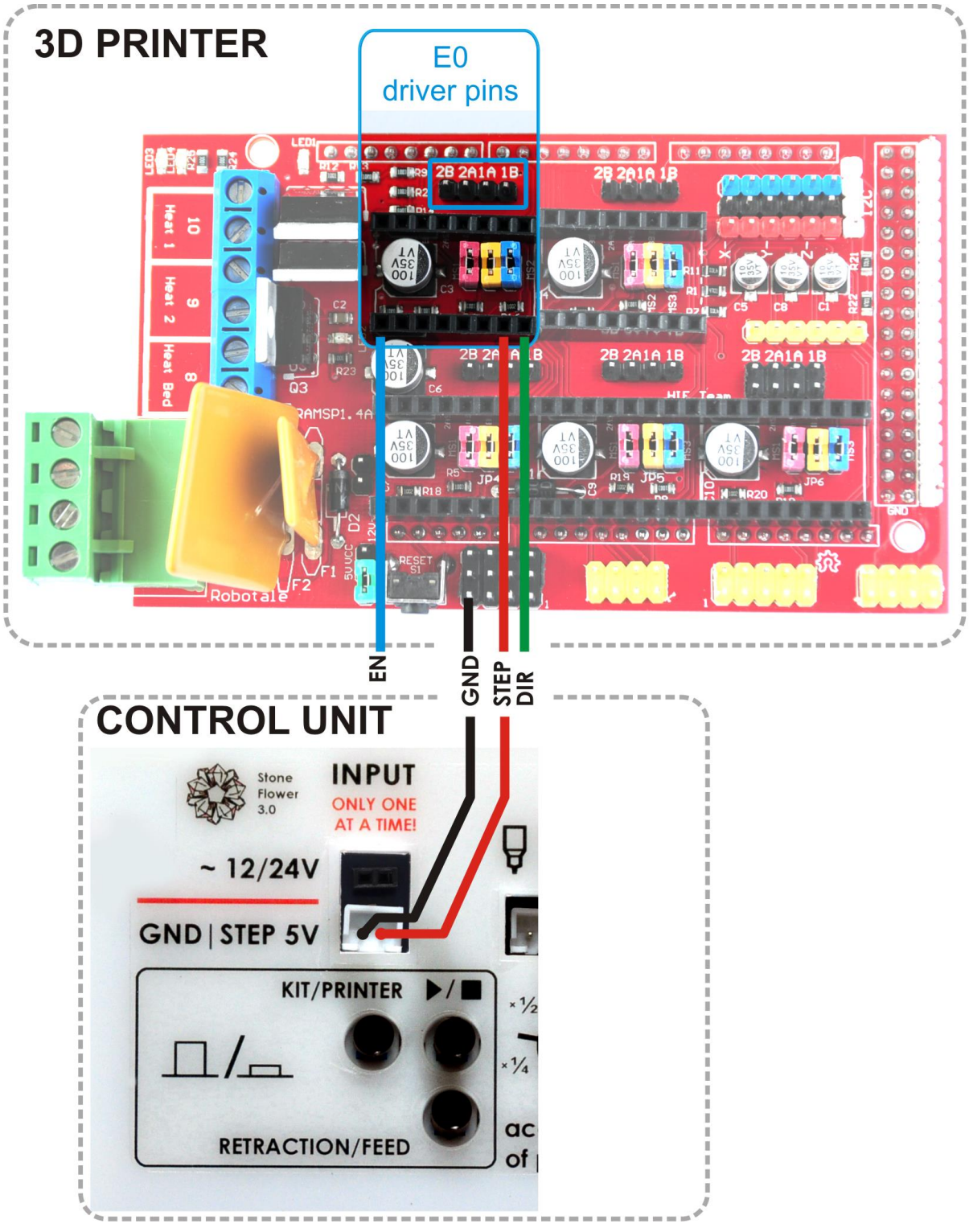
One can use logical input signal STEP and GND (Ground) with voltage amplitude up to 5V, or signal, generated by the printer for the extruder motor, and ranging from -24 to +24V (or from -12V to +12V depending on the printer). Logical input signal is preferable.

Never use both types of the input signal simultaneously. This will shortcut logical and power circuits of the printer, and will irreversibly damage electronics.

Printer Mode with logical input signal, 0..5V

You will need to find pins labeled STEP (STP) and GROUND (GND)
Signal pins are easily available on motherboards RAMPS, SMART, RUMBA, SAV MKI, Megatronics, AZSMZ Mini, Gen7, Sanguinololu, PiBot, RADDS, Smoothieboard, Azteeg X3, MKS GenV1.4 and similar or compatible boards. Those are most popular boards on the market.

Wiring diagram: connection of the STEP (STP) and GND pins to the logical input



You have to set correct *number of microsteps per mm of filament*, N_e, in your printer firmware and/or g-code. The number of micro-steps depends on many parameters, including diameter of the filament. If you want to keep printing both, clay and plastic, keep default diameter of filament, and for clay printing only change the number of microsteps and nozzle diameter.

The number of microsteps per mm of filament can be calculated as follows

$$N_e = 3200\frac{r}{p}\left(\frac{d_f}{D}\right)^2, \qquad (1)$$

Here

r is the reduction ratio of the gearbox, installed in the KIT (is given in the table below).

p is the pitch of the lead screw in the ram extruder (is given in the table below).

$\boldsymbol{d_f}$ is the diameter of the filament, you set in the slicer. If you do not print plastic, you can set arbitrary value (nozzle diameter, as an example).

D is the diameter of the plunger in the ram extruder (is given in the table below).

Table 1

Parameters of the KIT

	Extruder S, 0.5L	Extruder L, 1.5L	Micro Printing SET
Gear ratio, *r*	99.05	46.66	
Pitch of the lead screw, *p*	2mm	3mm	
Diameter of the plunger, *D*	45.2mm	67.8mm	27mm

TIP: The number of microsteps/mm of filament can be set in the slicer or right in the beginning of the g-code with the command:

```
M92 E200
```

Here N_e = 200 microsteps/mm.

TIP: You can calculate Ne on the web site, if you choose right type of the ram extruder, and control unit V1.

https://www.stoneflower3d.com/support/ceramic-3d-printing-kit-and-print-head/

Example 1:

Ram extruder S, diameter of filament is set to 1.75mm, From Eq. (1)

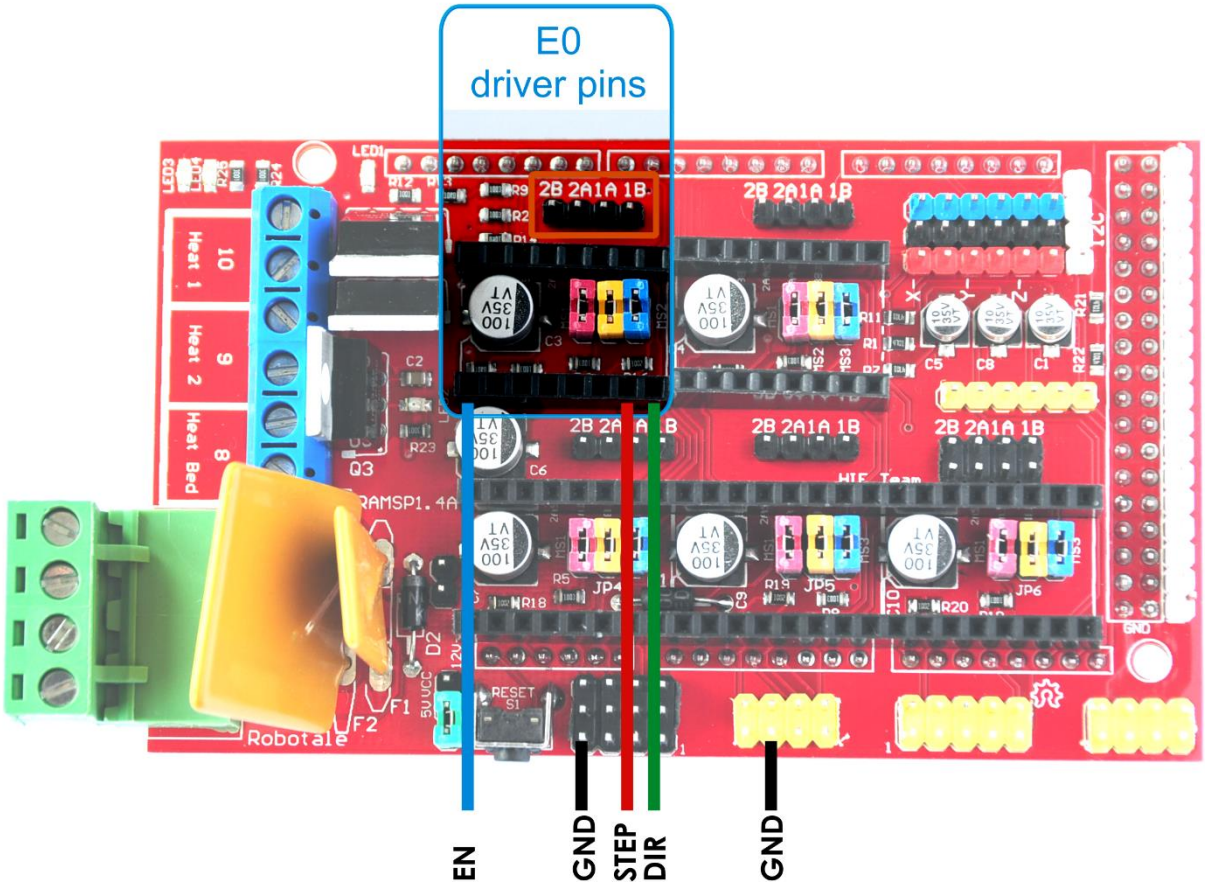
$N_e = 3200\frac{99.05}{2}\left(\frac{1.75}{45.2}\right)^2 = 237.6$ microsteps/mm

Example 2:

Ram extruder L, diameter of filament is set to 2.5mm, From Eq. (1)

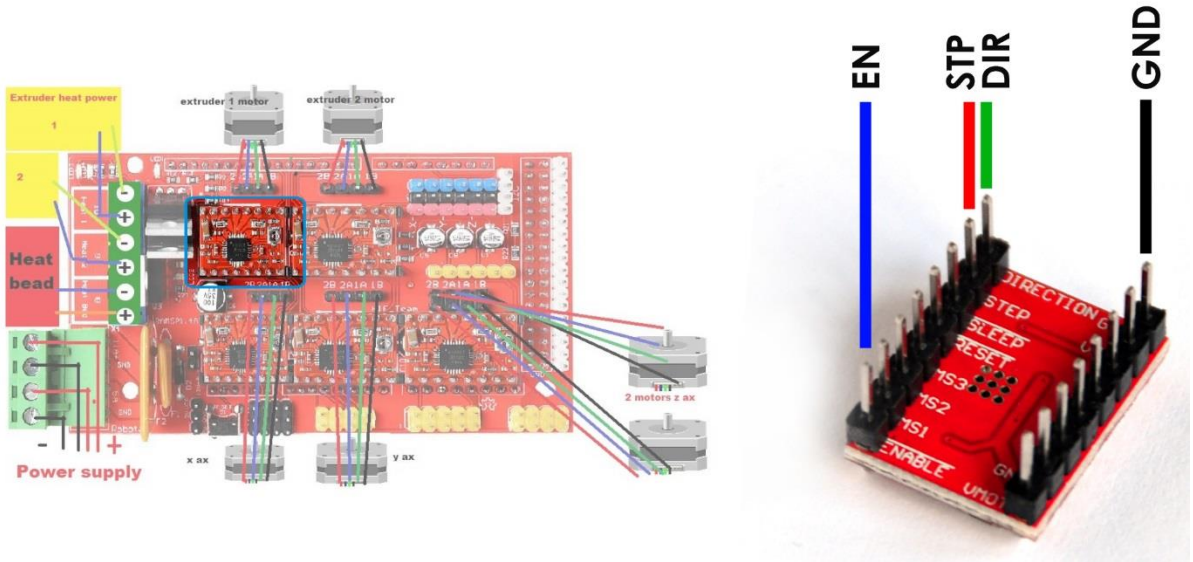
$N_e = 3200\frac{46.66}{3}\left(\frac{2.5}{45.2}\right)^2 = 67.7$ steps/mm

Signal pins: Typical examples
Ramps 1.4 (Reprap Arduino Mega Pololu Schield)



Ground pins can be found elsewhere.

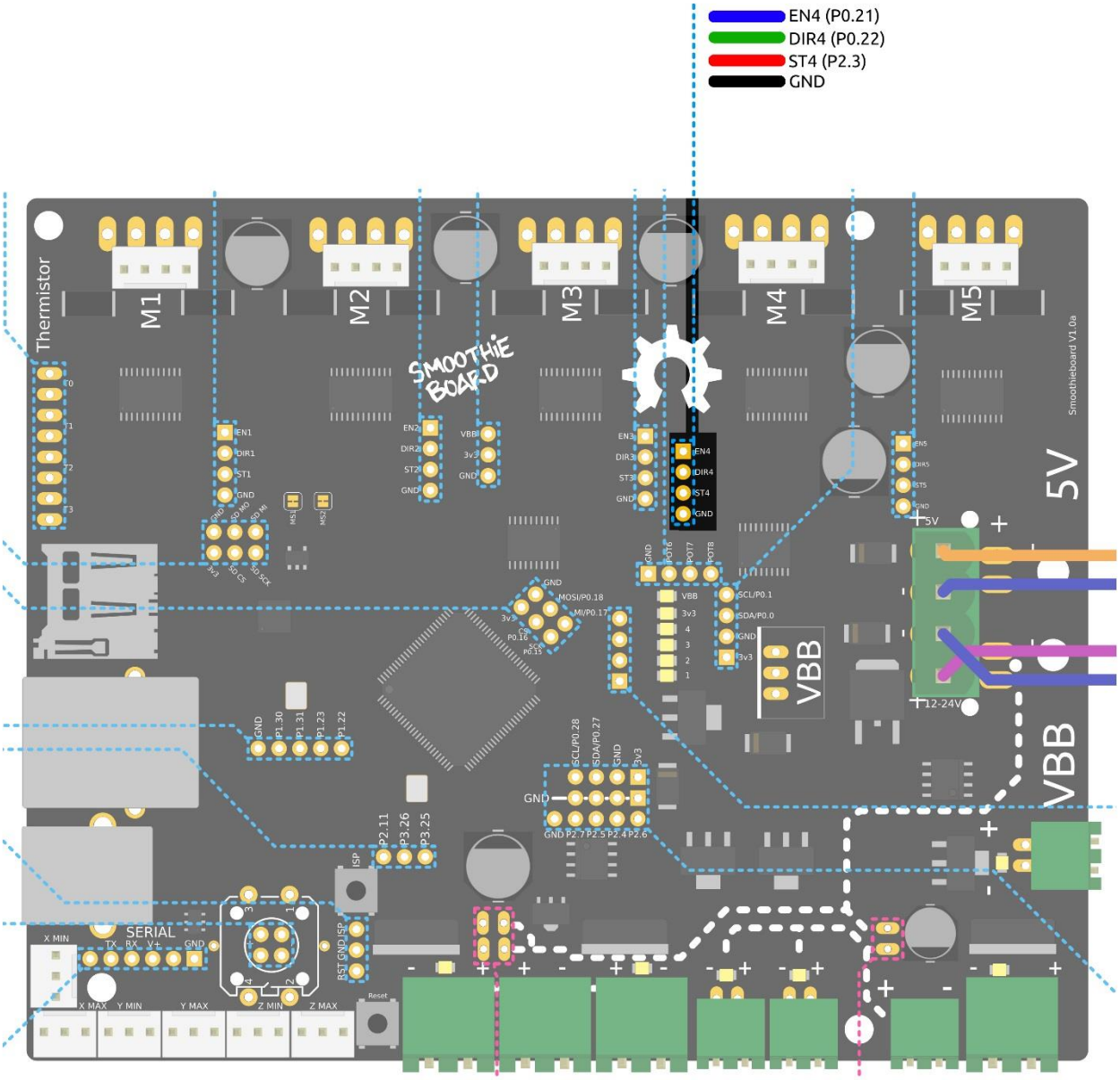
If your board has plug-in drivers, as Ramps 1.4 does, you can reach necessary pins by unplugging a stepper motor driver. Driver pins are labelled accordingly:



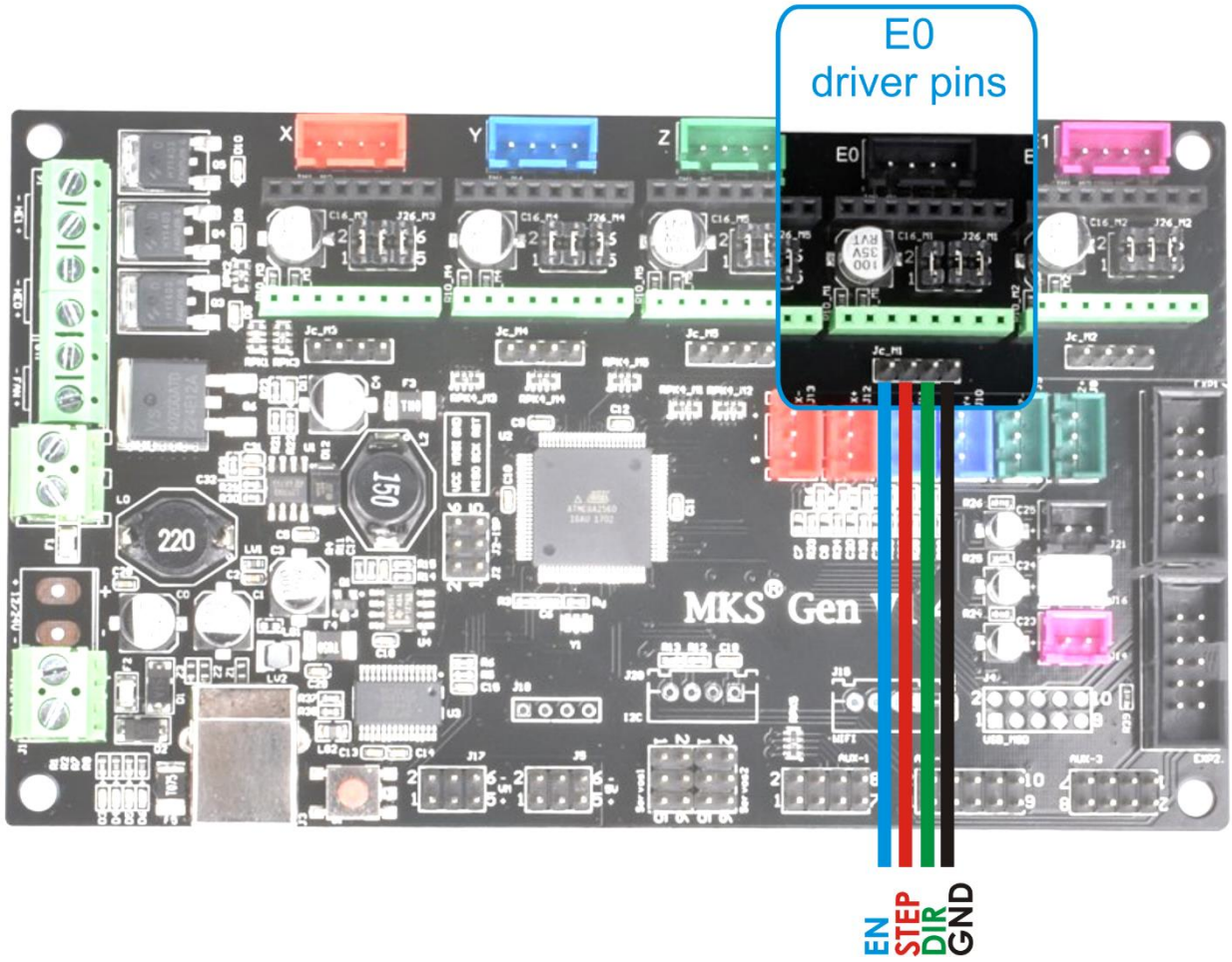
Left side: board with plug-in drivers. Right side: labelling of the plug-in driver.

Smoothieboard V1

Here are those pins for E0 extruder (all unnecessary information was removed):



Makerbase MKS GEN V1.4

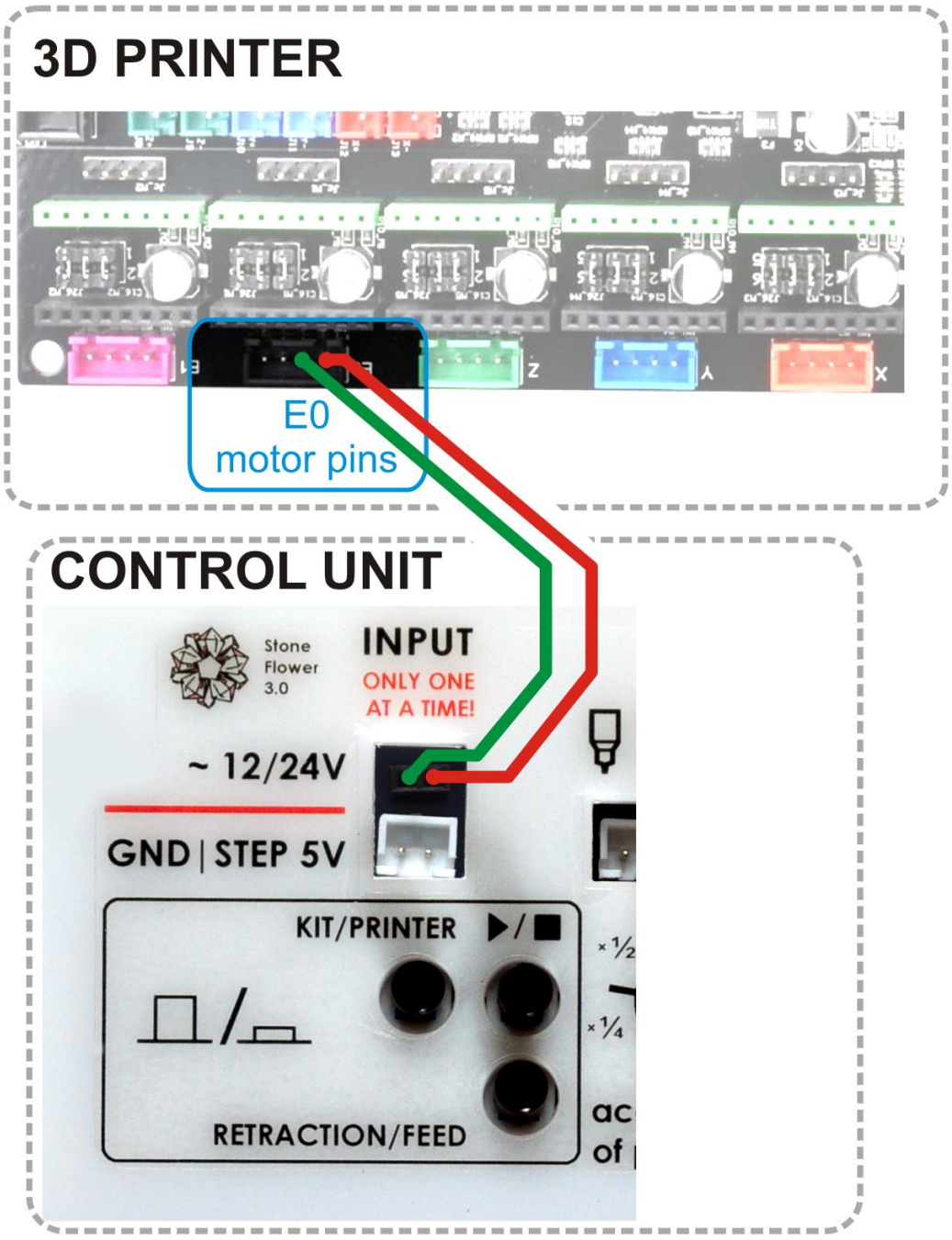


Printer Mode with input from extruder motor connector

This approach can be used for any printer, but requires more sophisticated choice of extrusion parameters, some experimenting with stepper driver settings, and may not work with some stepper motor drivers.

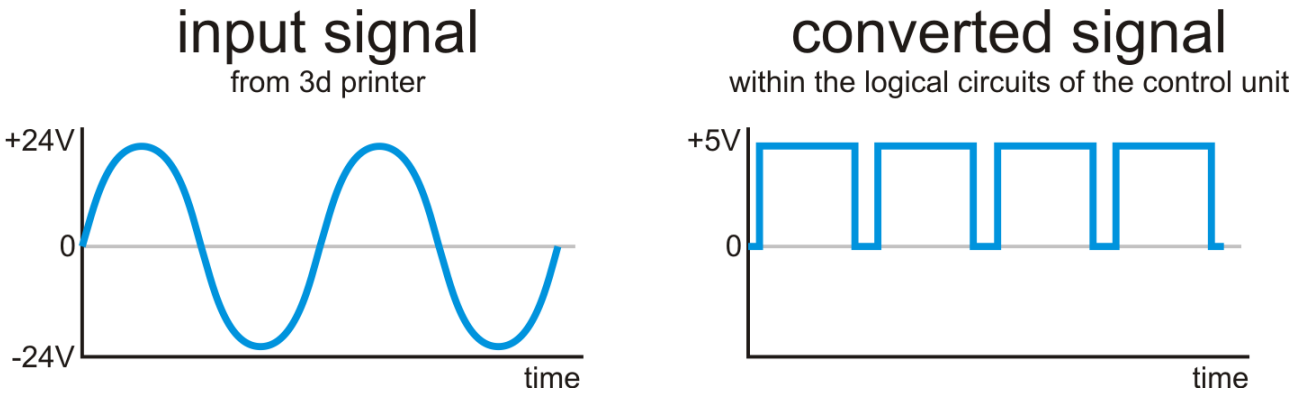
Introduction

The motherboard of the 3d printer generally has two types of circuits: logical circuits and power circuits. Power circuits drive the stepper motors, and voltage there varies periodically. The black input 2-pin connector of the control unit can work with the signal from power circuits, reaching +24V. The wiring diagram in this case:



The control unit extracts pulses from an input signal, converts them into a logical pulses, and use those pulses to rotate motors of the kit via embedded drivers.

Signal conversion inside the control unit



One has to bear in mind, that the frequency of voltage oscillations in the power circuit is significantly less than in logical circuits. As the result, the stepper motor, connected to the control unit, will rotate slowly than when it is directly connected to the motherboard of the printer. Typically the speed reduction is around

(microstepping of the extruder stepper driver in 3d printer)×*f*,

where the factor f typically equals to 2 or 4, depending on which of two phases of the power circuit is used as an input. For example if the microstepping is set to 16, the motor speed reduction will be 32:1 or 64:1.

This speed reduction has to be taken into account in the settings of your slicer or in g-code or in the firmware of your printer via corrected number of microsteps per mm of extruded filament. If you use the control unit V3.0 with input signal from extruder connector of the 3d printer, the number of micro steps per mm of filament can be calculated via Equation

$$N_e = 800 \times 2n\frac{r}{p}\left(\frac{d_f}{D}\right)^2, \qquad (2)$$

Here ***n*** is the number of microsteps, set for the stepper motor driver of extruder in your 3d printer. Typical value is 16, but values 2, 4, 8, and 256 are also possible for different printers. Find this value in the manual, or consult the manufacturer. Kit cannot work with drivers, set to the full-step mode, i.e. at $n = 1$.
r is the reduction ratio of the gearbox, installed in the KIT (is given in the table below).
p is the pitch of the lead screw in the ram extruder (is given in the table below).
d_f is the diameter of the filament, you set in the slicer. If you do not print plastic, you can set arbitrary value (nozzle diameter, as an example).
D is the diameter of the plunger in the ram extruder (is given in the table below).

TIP: The number of microsteps/mm of filament can be set in the slicer or right in the beginning of the g-code with the command:

M92 E200

Here N_e = 200 microsteps/mm.

TIP: You can calculate Ne on the web site, if you choose right type of the ram extruder, and control unit V2.1.

https://www.stoneflower3d.com/support/ceramic-3d-printing-kit-and-print-head/

Table 2

Parameters of the KIT

	Extruder S, 0.5L	Extruder L, 1.5L	Micro Printing SET
Gear ratio, *r*	99.05	46.66	
Pitch of the lead screw, *p*	2mm	3mm	
Diameter of the plunger, *D*	45.2mm	67.8mm	27mm

Example 1:
Ram extruder S, diameter of filament is set to 1.75mm, and stepper driver in the printer is set to 16 microsteps. From Eq. (2)

$N_e = 800 \times 2 \times 16 \frac{99.05}{2} \left(\frac{1.75}{45.2}\right)^2 = 1901$ microsteps/mm

Example 2:
Ram extruder L, diameter of filament is set to 2.5mm, and stepper driver in the printer is set to 4 microsteps. From Eq. (2)

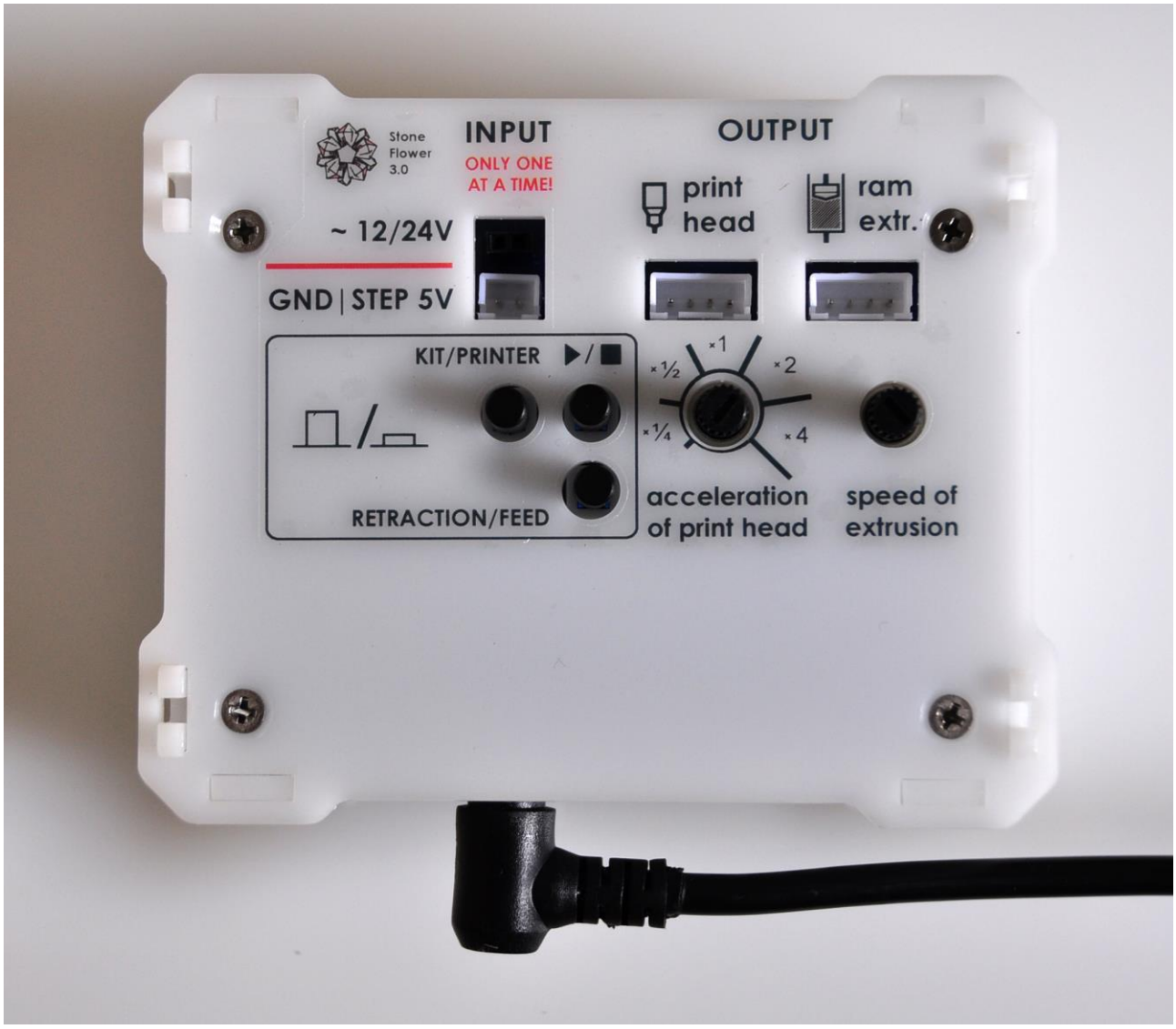
$N_e = 800 \times 2 \times 4 \frac{46.66}{3} \left(\frac{2.5}{67.8}\right)^2 = 135.4$ steps/mm

How do I check whether the number of microsteps is correct?
The print head of the KIT requires 3200 (version 2.0) or 800 microsteps (version 2.1) to make a single turn. Ask the printer with the connected KIT to extrude corresponding amount of filament and check how many turns it makes.

$\frac{800}{N_e} 2n$

For example if you have set N_e = 1901, required extrusion length is 800*2*16/1901 = 13.47mm. Send to the printer the following command:
G1 F200 E13.47.

Regulation of the Control Unit 3.0



"KIT/PRINTER" *switches control over the motors from the KIT to printer and back.*

***Start/Stop* (►/■)** the motors in the "KIT" mode

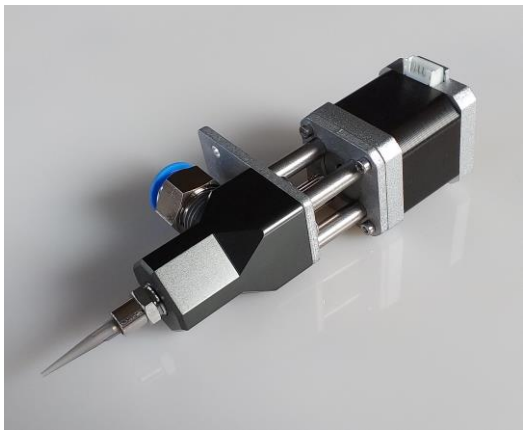
"RETRACTION/FEED" *switches direction of the motors between feed and retraction*

"Acceleration of print head"
Feeding clay, the print head should make about 1 to 3 rotations per second. If the print head does not rotate fast enough, you can use this regulator, to accelerate it.

"Speed of extrusion" Regulates the feed rate in the KIT mode. The range of available feed rates can be reprogrammed in the firmware of the control unit, if necessary. Contact us to get the firmware, or details about this option.

Connection of the extruders to the control unit

Use two 4-pin cables to connect print head (Auger extruder) and ram extruder to the **OUTPUT** connectors of the control unit:



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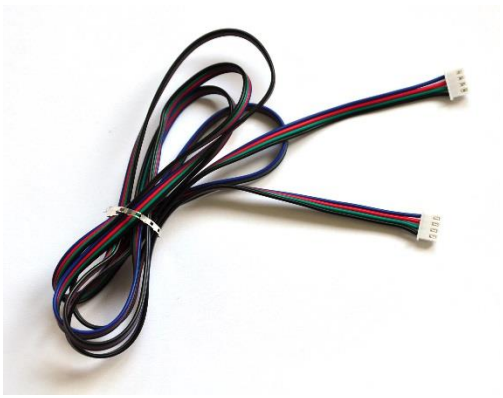

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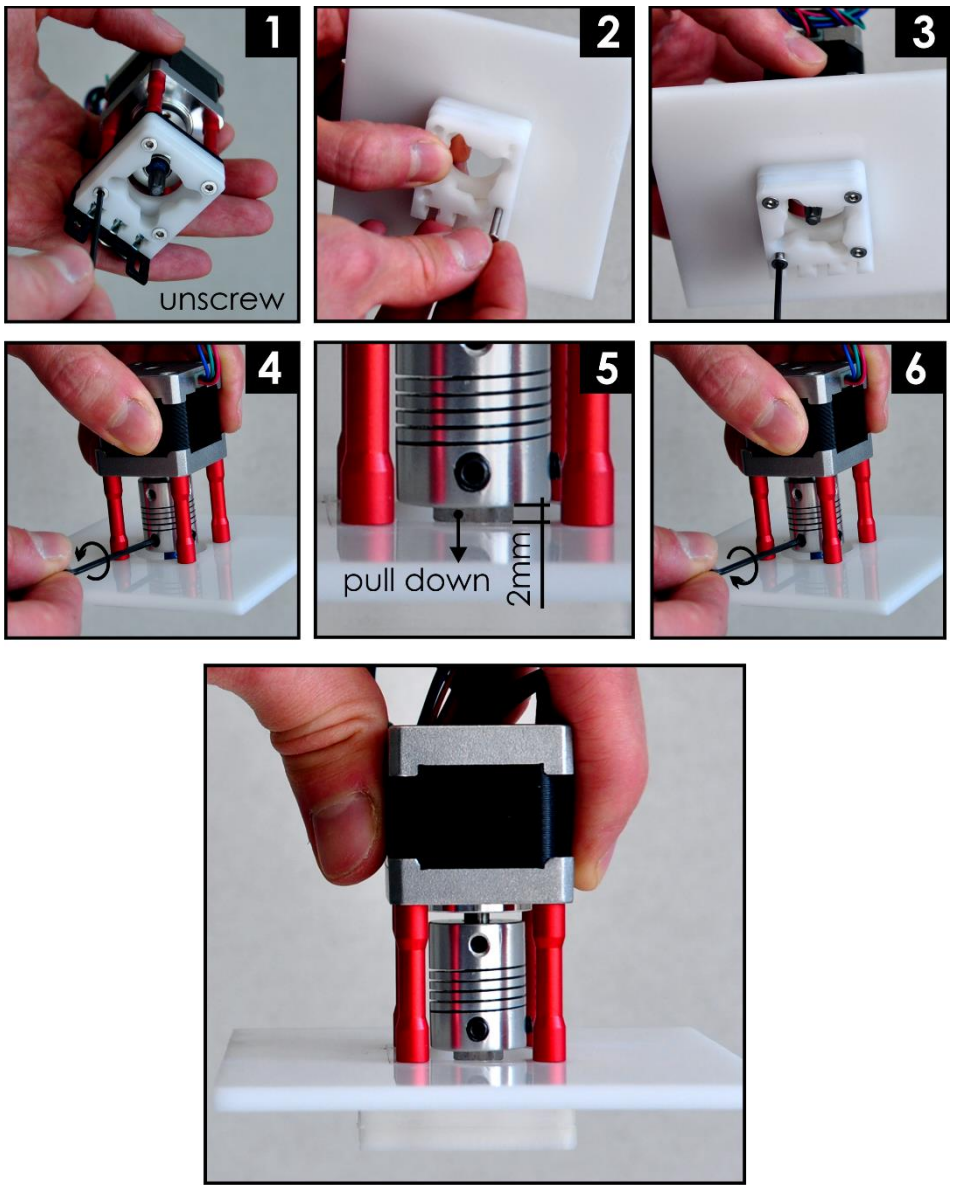
Assembly and installation of the print head

To mount the print head into your printer you can use universal Pololu bracket (preinstalled) or universal mounting plate (supplied with the print head).

Mounting plate can be milled, sawed, drilled or laser-cut before installation according to the structure of your printer. Installation of the plate is shown below:



Steps:

1. Unscrew four screws, holding the mount.
2-3. Replace Pololu bracket with the preliminary modified mounting plate and install screws back.
4. Loose bottom screws of the shaft coupling
5. Pull HEX magnetic coupler by 2mm down.
6. Tighten the screws of shaft coupling.

Assembly of the ram extruder

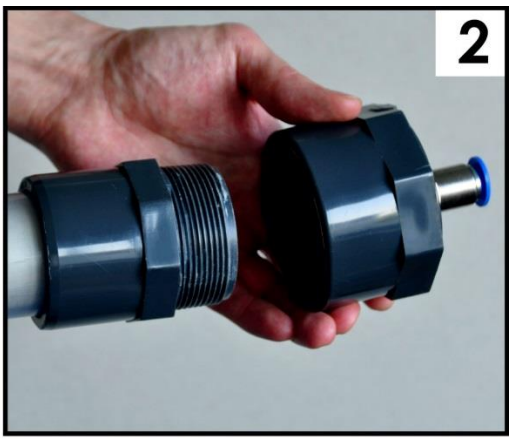
TIP: Your KIT comes with 1m long PU pipe, and you can cut it in size according to the configuration and dimensions of your printer. We found that 40cm long pipe works well with slightly diluted or even non-diluted clay. To reduce the loads on the print head, caused by the bending/tension of the pipe, it is recommended to flexibly mount or hang the ram extruder by the top vertically near the printer.

TIP: Do not tighten the threads of the ram extruder upon assembly. This facilitates disassembly after printing. Friction between parts is strong enough to keep them together without complete tightening.

Steps:

1. Fill the barrel with slightly diluted clay.
2. Put the lid onto the barrel. Insert the pipe into push-in connector of the lid.
3. Unscrew the lid with motor.
4. Rotate the nut to position it at the distance about 5cm (2 inch) from the coupler.
5. Insert the lead screw into the square tube and install the lid with motor back.
6. Insert the plunger from the opposite side.
7. Put seal on the plunger and insert the plunger into the barrel. Screw the parts together.


1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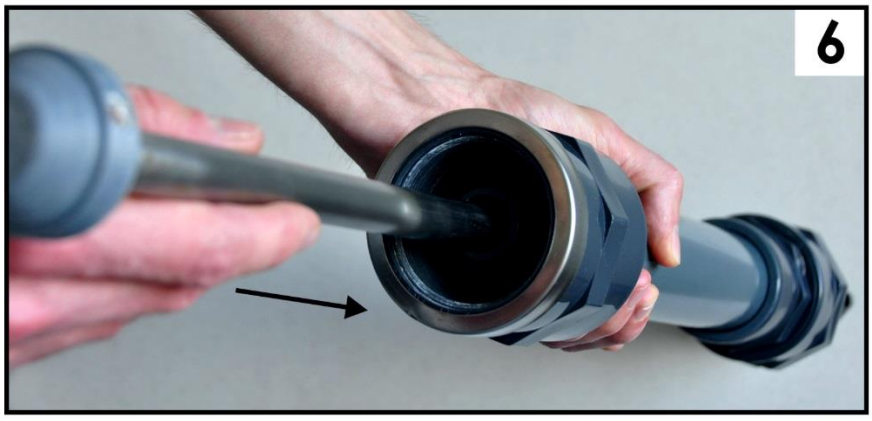
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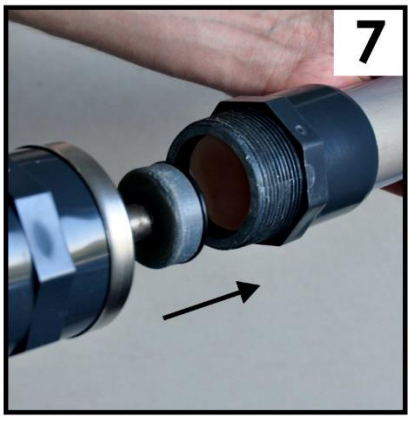
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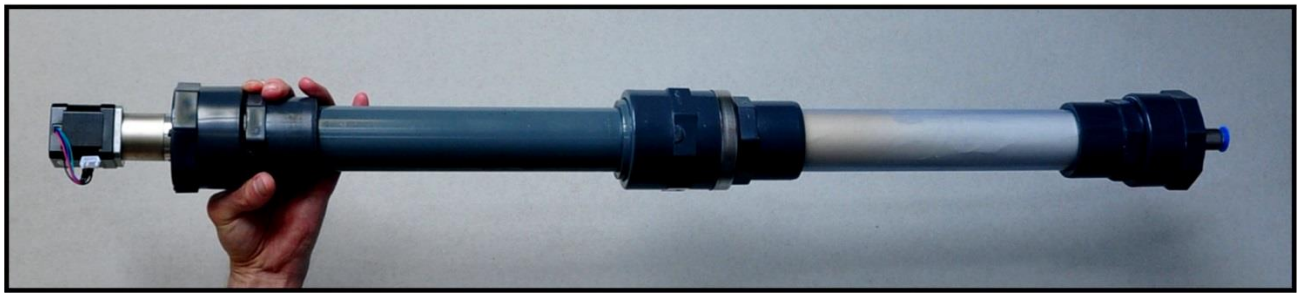


TIP: If it is difficult to disassemble the ram extruder after printing, you can use flexible oil filter wrench. Do not apply too much force upon clamping!

Start the clay extrusion

TIP: Before printing with real clay, try to run the KIT without clay, using your test G-Code. This will save your time and efforts in case of inappropriate printer settings.

During this test run make it sure that both motors of the KIT are steadily running, and the print head makes 1 to 3 turns per second. Recommended printing speed not less than 30mm/s, layer height between 0.5 and 1mm, nozzle diameter 2.5mm.

1. Check all electrical connections and signal cables.
2. Connect the free end of the pipe to the body of auger extruder (1).
3. Power on the printer and control unit.
4. Wait for about 10s before use of the control unit.
5. Set the switch "Printer/KIT" to "KIT"
6. Set the switch "Retract/Feed" to "Feed"
7. Press the button "Run". The motor of ram extruder and print head have to rotate counter-clockwise in the top view.
8. Wait until the clay fills the pipe. This may take few minutes. Be sure that the sealing is sitting in place, when plunger will be seen through the barrel.
9. Extrude clay until it appears from the nozzle.
10. Set the switch "Printer/KIT" to "Printer", select and print the object.

Printing

Printing quality significantly depends on the type of the clay, its viscosity, and printing speed. It is recommend to start with quite diluted fine clays, or porcelain, and gradually increase viscosity, if necessary. Smaller nozzles require more diluted clay. Typically, one has to add from 7 to 15% of water (by weight) to normal clay for better results. One can add about 3 to 5% of ethanol (or bioethanol) to accelerate drying of the prints, and improve their mechanical stability. Please carefully read and follow all precautions and safety rules, when using ethanol.

Optimal rotation speed of the print head is in the range from 1 to 3 rotations per second. Good printing speed to start ranges from 30 to 45 mm/s. Keep eye on the temperature of the stepper motors upon printing, and reduce the speed if they get too hot. Acceptable temperatures lie below 70°C.

TIP: If you just start printing, or paused it for few tenth of minutes, extrude a bit of clay to restore clay pressure right before printing.

TIP: The clay tends to dry in the contact with air. This may clog the nozzle (and especially nozzles of small diameters). When printing is paused, cover the nozzle with a wet cloths and plastic bag to prevent drying. Extrude a bit of clay before printing.

Clean and dry the print head and ram extruder right after use. Long exposure to the moisture can corrode the parts of the KIT, and destroy the motors. Regularly lubricate the lead screw.

Dilute clay whenever it is possible. Extrusion of too thick clay elevates power consumption, overheating of the motor, non-uniform hardening of clay inside the extruder, and unstable printing.

Escape pollution of the motor with clay. This will destroy the motor.

Infinite printing

Upon printing, the control unit switch "Printer/KIT" is set to "Printer", and your 3d printer controls the clay extrusion. When there is not enough clay in the barrel to finish printing, you can pause printing, upload more, and resume printing. This is "infinite printing" function.

1. Pause printing
2. Set switch "Printer/KIT" to "KIT"
3. Unmount and disassemble ram extruder, upload more clay to the barrel. You can switch the control unit off, and unplug the cable if necessary.
4. Mount the ram extrude, connect all cables, power on the control unit.
5. Being in the "KIT" mode, use "Run" button to refill the whole system with clay and reach clay pressure necessary for normal extrusion.
6. Set switch "Printer/KIT" to "Printer"
7. Resume printing

TIP: Loading of the clay may take some time. To prevent drying of the clay in extruder and clogging of the nozzle, wrap it with wet cloth.

Micro-printing set

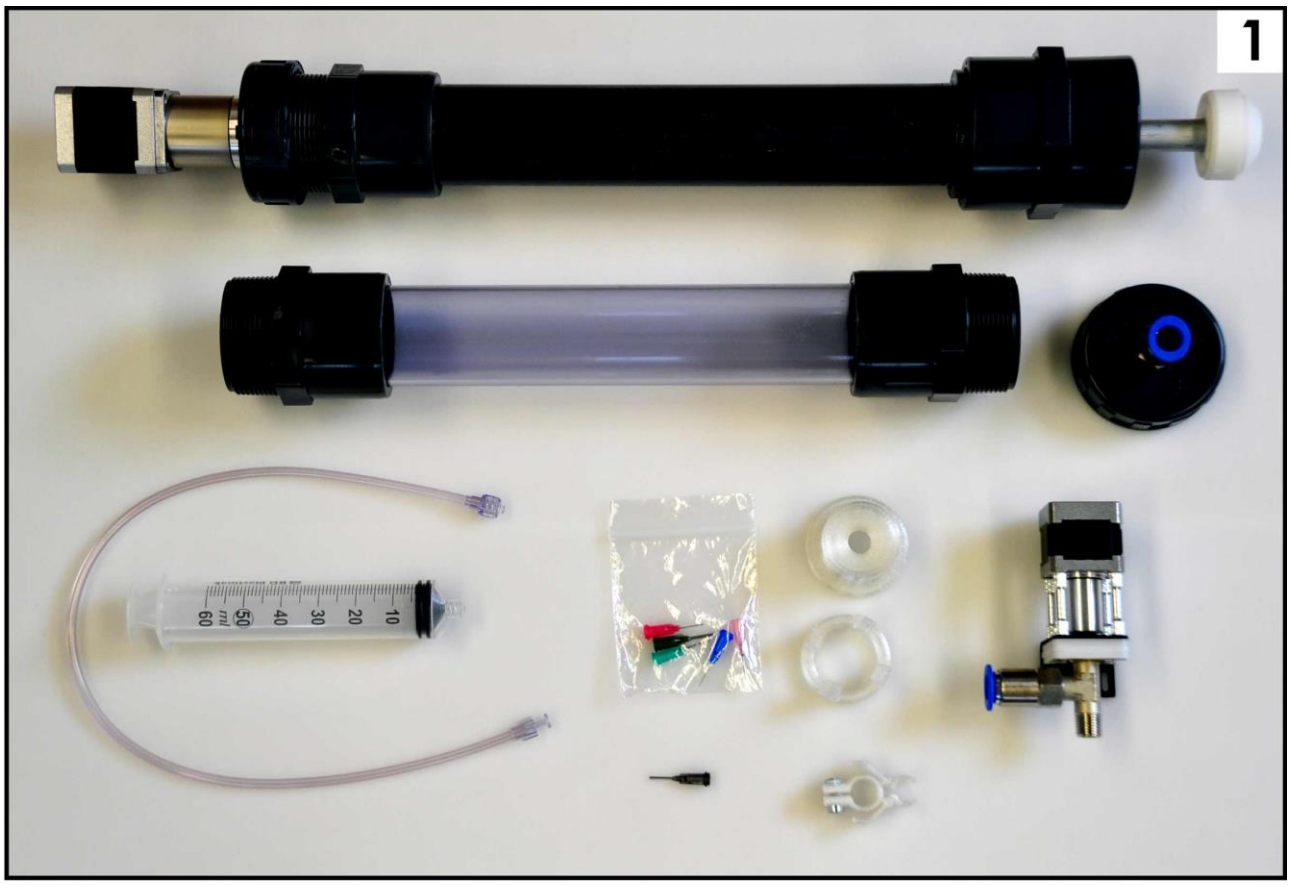
To print small amounts of different materials with low viscosity you can use micro printing set. Materials of high viscosity, such as clay, cannot be printed in that way due to small diameter of the hose. Before printing the number of microsteps per mm of filament has to be corrected in the firmware of your printer.

Assembly

1. The components
2. Cut off the flaps of the syringe (only for 0.5L ram)
3. Cut off the flaps of the hose with Luer locks
4. Fill in the syringe with your material, and assemble syringe with mounts
5. The syringe installed in the ram extruder
6. Press the flaps of the mount to insert the hose with the needle
7. install the mount on the print head
8. Fully assembled setup

Parameters of the firmware

To get correct number of microsteps per mm of filament, N_e, please use the online calculator at https://www.stoneflower3d.com/support/. Firstly, select the type of the control unit and ram extruder. Than set the diameter of the plunger, D, to 27mm (for the syringes, provided with the KIT or 3D Printer) and calculate the parameters. If necessary, use the same number of microsteps per mm of filament in your slicer as well.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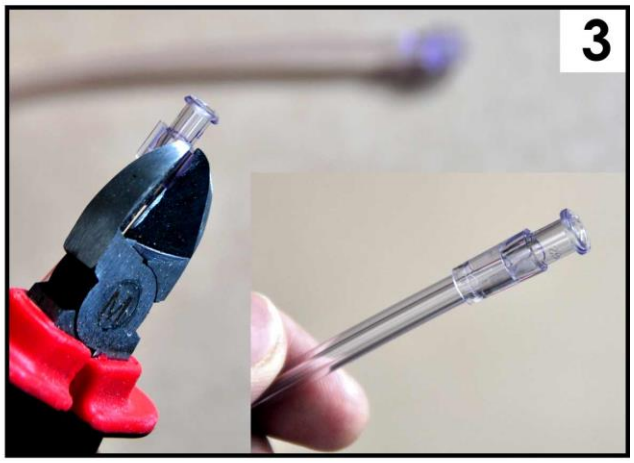
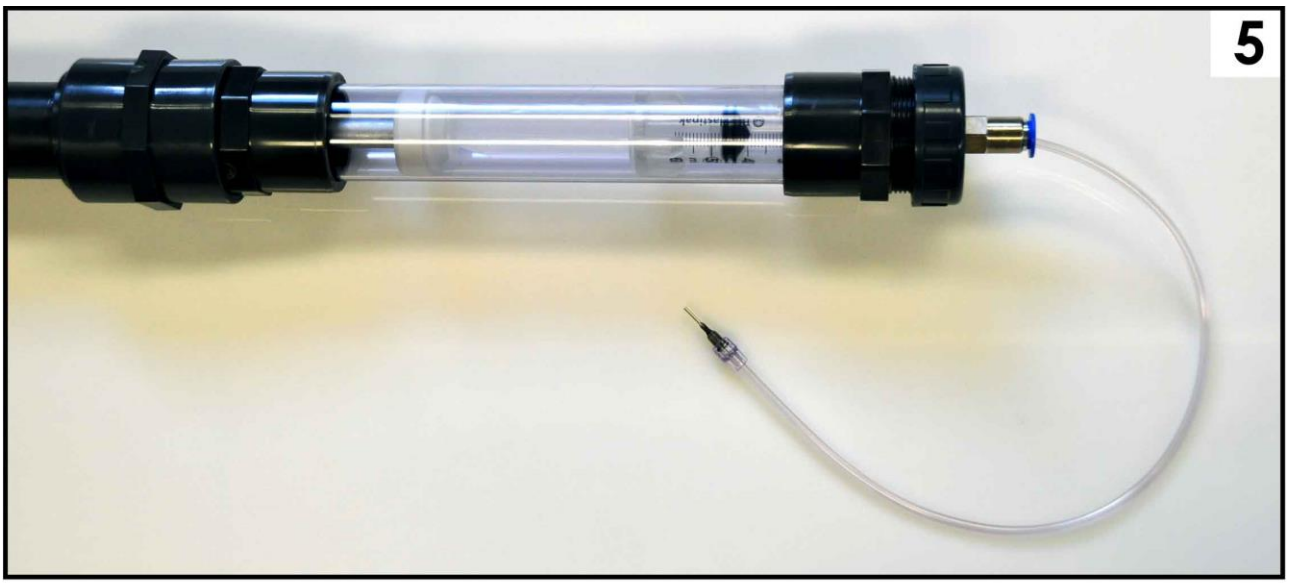
2


3


4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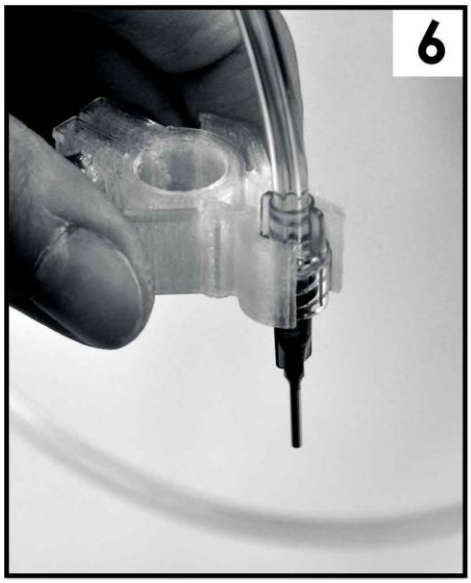
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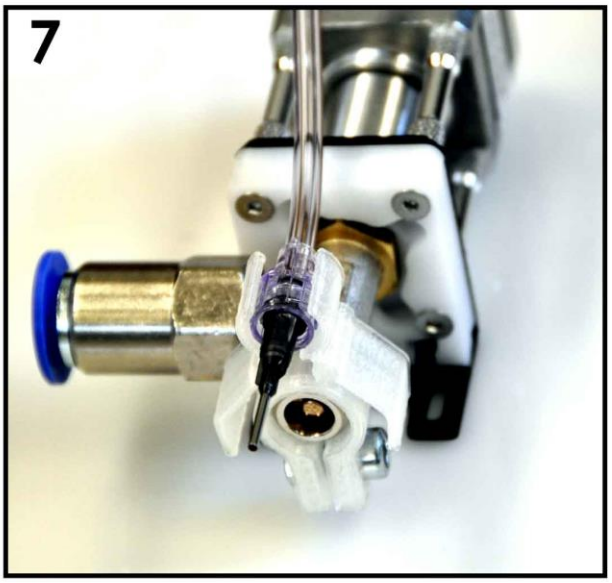
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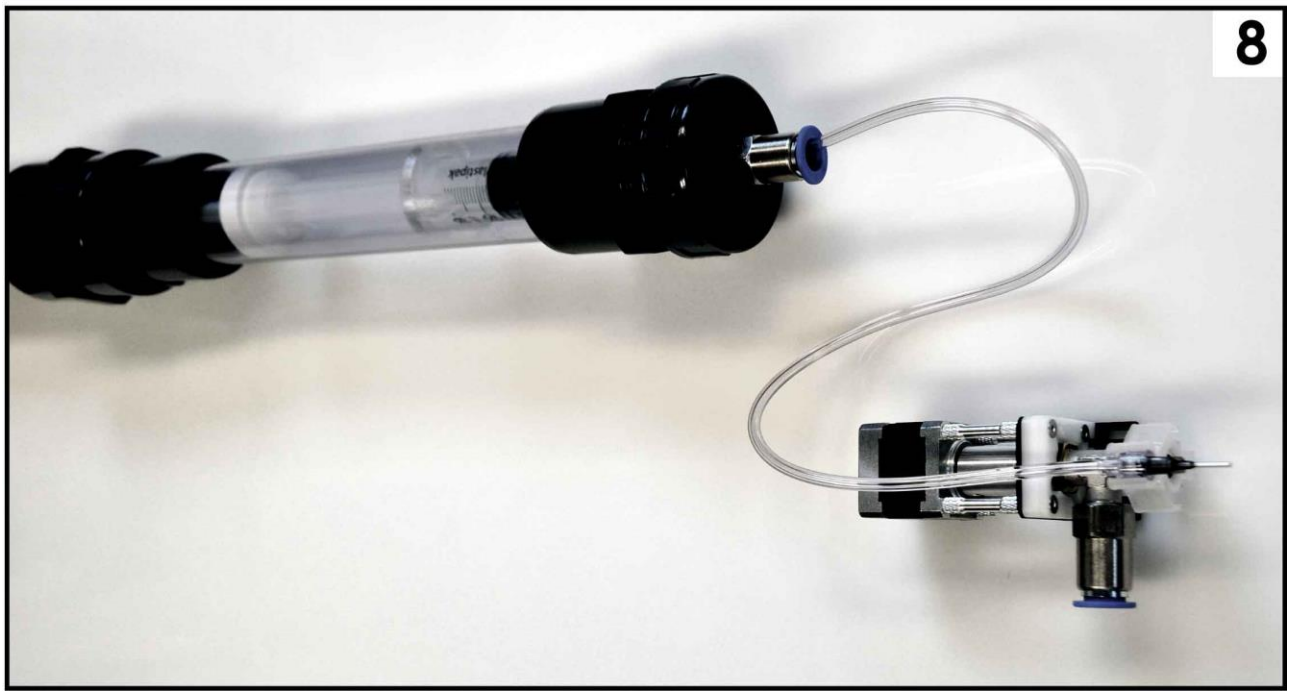
8

Troubleshooting

Problem	Possible reason and solution
Extruder rotates, but does not feed clay	Not enough pressure at the inlet of extruder. Check your clay feeding system.
Regular clogging	Check dispersity of the clay. Rinse extruder from dry clay.
Pollution of the clay, darkening upon burning	Do not run the extruder for a long time without clay flowing through. This causes wear of extruder, and pollution of the clay with metallic powder. Extrude polluted clay before printing.
Printed object bears non-desired periodic pattern (oscillating clay feeding)	1. High tension of the pipe. Reduce the distance between barrel with clay and the print head. Use longer pipe. Flexibly mount the barrel.
	2. Auger screw is too close to the nozzle and periodically blocks this. Move the screw a bit up, by moving magnetic HEX bit, as shown in section Installation/Mounting, Steps 4...6.
Amount of extruded clay goes down with time	Gradual loose of the clay pressure due to compression. Dilute clay.
Rough surface of the print	Dilute clay
Poor mechanical stability of the prints	Try to dry prints with cold air flow. Admix ethanol to clay. Add less water.
Jigging of the motor, noise, underextrusion	Check connection of the motor to the board. If this is not the reason of the problem, this can be caused by the loss of steps. Reduce the printing speed, clay viscosity, adjust (increase) the current on the stepper motor driver (but not let the motor to heat up above 70C).

EC Declaration of conformity

Product:	Add-on for 3D Printer
Models:	StoneFLower Ceramic 3D Printing KIT Basic/Standard/Pro StoneFlower print head
Manufacturer:	Anatoly Berezkin, Schillerstr. 28, 85386 Eching, Germany +49(0)16095972706 info@stoneflower3d.com
Year of affixing CE marking:	2021

I hereby declare under my sole responsibility that the products above are in compliance with the essential requirements of the Machine Directive (2006/42/EU), Electromagnetic Compatibility Directive (2014/30/EU), WEEE (2012/19/EU), RoHS II (2011/65/EU) and REACH (1907/2006/EU) by application of:

Standard:	**Title:**
EN 60950-1: 2005 (second edition) + Am1:2009 + Am2:2013	Electrical Safety
EN 55014-1:2006 + A1:2009 + A2:2011	Radiated emissions class A
EN 55014-2:1997 + AC:1997 + A1:2001 + A2:2008	Immunity
EN 62233:2008 + AC:2008	EMF related to human body

The technical documentation is kept at the Manufacturer's address.

For electrical safety aspects reference is also made to the EC-Conformity Declaration for the power supplies.

Anatoly Berezkin

CE

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Place of issue: Eching