



Printess Technologies

Printessa One Operating Manual

Printess Technologies LLC | 2026

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Contents

Contents	2
1. Safety	3
Intended Use	3
Before Every Session	3
Mechanical Hazards	4
Dispense Tips and Sharps	4
Clearing a Blocked Dispense Tip	4
Moving the Printer	5
Storing the Printer	5
Power Supply	6
Electrical Safety	6
Stopping the Printer	7
Materials and Unattended Operation	7
Noise	8
2. Pronterface Setup.....	9
The Printer Is Driven by Your Computer	9
Installing Pronterface	9
Connecting to the Printer	10
Setting Safe Jog Speeds	11
The Console	11
The Jog Controls	12
Loading and Running a Print File	12
Stopping a Print	13
Optional: Macros and Custom Buttons	13
Connection Troubleshooting	13
3. G-Code Basics and Common Commands.....	14
The Axes of the Printessa One	14
Anatomy of a G-Code Line	15
Positioning Modes: G90, G91 and G92	15
Homing: G28	17
Motion Commands	18
Feed Rate (F)	19
Other Useful Commands	20
Checking G-Code Before You Run It	20
4. Maintenance	21
Greasing the Leadscrews	21
General Care	21
5. Assembly.....	22
Assembly Steps	22
Wiring	29
TMC 2209 Drivers: Potentiometer	29

1. Safety

The Printessa One is a laboratory instrument, not a consumer appliance and not a toy. It contains powered stepper motors, an unguarded moving gantry, sharp dispense tips, and mains-powered electronics. Read this section in full before the printer is powered on for the first time, and make sure every person who will operate the machine has read it as well.

Warning: The Printessa One has an open work envelope with no interlocked enclosure. The gantry, vertical axes and syringe plungers can move at any time while the printer is connected and powered, including between print moves and while a file is paused. Never place your hands inside the work envelope unless the printer is disconnected or powered off.

Intended Use

The Printessa One is intended for the deposition of soft materials, hydrogels and cell-laden bioinks from single-use luer-lock syringes onto multiwell plates, petri dishes, glass slides and custom plates, in a research or teaching laboratory. It is professional equipment, and it is intended to be used by trained personnel working under their own institution's biosafety and chemical hygiene program.

- **Who it is for.** Professional research and teaching use. The printer is not a consumer product and is not intended for use by the general public.
- **Where it is used.** Indoors, on a level and stable laboratory bench, or inside a biosafety cabinet.
- **Training assumed.** By a person who has read this manual in full, or under the direct supervision of someone who has. Competence in laboratory practice is assumed; machining or machine-tool experience is not.
- **Materials.** Hydrogels, viscous soft materials, cell suspensions and photocurable resins, loaded in 1, 3 and 5 mL sterile single-use luer-lock syringes.

Warning: The Printessa One is not a medical device. It is not intended for any clinical, diagnostic or therapeutic purpose, and nothing it produces is intended for implantation into, or administration to, a human or animal subject. Using the printer outside the intended use described here takes it outside the conditions under which it was assessed as safe.

Before Every Session

- Tie back long hair, remove loose jewelry, watches and lanyards, and secure loose sleeves or clothing.
- Wear the eye protection and gloves required by your own laboratory protocol for the material being printed.
- Confirm the printer is on a stable, level bench with clear space around the full travel of every axis.
- Route the power and USB-C cables so they cannot be snagged by the moving stage or pulled off the bench.
- Confirm nothing (tools, waste, tubing, notebooks) is resting inside the work envelope.
- Confirm both dispense tips are correctly seated and that the syringe barrels are secured in their holders.

Mechanical Hazards

The X and Y stage, the Z and A vertical axes, and the B and C plunger axes are all driven by stepper motors under software control. The printer gives no audible or visual warning before it moves.

- **Pinch points.** Pinch and crush points exist between the stage and the frame, between each carriage and its rail, and between the plunger drive and the syringe.
- **Entanglement.** Lead screws and moving carriages can catch hair, gloves, sleeves and jewelry. Keep them clear of all drive components.
- **Stored force.** The syringe plunger axes can develop substantial force. A plunger driven against a blocked or capped tip can burst a syringe or eject material under pressure.
- **Never restrain an axis.** Do not lean on, push, or attempt to hold any axis while the motors are energized. Do not restrain a moving axis by hand.

Note: If the printer is fully unplugged, the motor shafts can safely be turned by hand to reposition an axis. This is the recommended way to move an axis manually, and it is often faster than jogging with G-code when setting up.

Dispense Tips and Sharps

Printessa One dispense tips are blunt-end dispensing needles. They are not hypodermic needles, but the smaller gauges are still capable of puncturing skin and gloves, and they are a significant eye hazard at bench height.

- Keep tips capped whenever the printer is not actively printing or being primed.
- Install and remove tips with the printer disconnected or powered off, never mid-print.
- Never place a hand or face below or in line with a loaded tip. Approach the tip from the side when zeroing.
- Dispose of used tips in a rigid sharps container in accordance with your institution's policy. Do not place them in general waste.
- Do not attempt to clear a blocked tip by increasing extrusion. Remove the syringe, relieve the pressure, and replace the tip.

Warning: Zeroing the vertical axes brings the dispense tips to within a fraction of a millimeter of the build surface. Always jog the final approach in small steps at a low feed rate (F250 or slower). A tip driven into the build plate at speed will bend the tip, can damage the plate, and can knock the axis out of alignment.

Clearing a Blocked Dispense Tip

A tip blocks when material dries or cures inside it, or when a particle in the ink bridges the bore. It is the most common fault on the printer, and it is the one fault where the obvious response is the dangerous one. The plunger drive can develop up to 57.5 N. Behind a blocked tip that force has nowhere to go, so it is stored in the compressed material and in the syringe until something gives. What gives is usually the luer connection, and the tip then releases under pressure toward whatever is in front of it.

Warning: Never try to clear a blocked tip by extruding harder, by jogging B or C further, or by sending a larger extrusion move. Never look into a tip, and never point a loaded syringe at yourself or at anyone else while you work on it.

1. Stop the print. Disconnect in Pronterface, or unplug the power supply if an axis is still moving.
2. If the printer is still powered, jog the B or C axis back by 1 to 2 mm. This takes the drive off the plunger and lets the material in the barrel relax.
3. Power off and unplug the printer before you put a hand near the tip.
4. Lift the syringe out of its holder, keeping the tip pointed away from yourself and from anyone else, and hold it over a waste tray or an absorbent pad.
5. Unscrew the blocked tip from the luer lock slowly. Expect a small release of material as the pressure relieves.
6. Discard the tip in a rigid sharps container. Do not clear it and reuse it.
7. Fit a fresh tip, prime it by hand until material appears, reseal the syringe, and re-establish the Z or A datum with G92 before you resume. See Section 3.

Note: If the blockage is in the barrel rather than in the tip, discard the whole syringe. A partially cleared barrel blocks again mid-print, usually at the worst moment.

Moving the Printer

The Printessa One weighs approximately 3.5 kg and has an integrated handle so that it can be carried in one hand into and out of a biosafety cabinet. Prepare it before you lift it.

- **Unload the syringes.** Remove both syringes before you carry the printer. A syringe left in its holder is still under plunger load, and it can dispense or leak in transit.
- **Cap the tips.** Cap or remove both dispense tips. A fitted tip sits at hand height while the printer is being carried and is a puncture hazard to the person carrying it.
- **Disconnect first.** Disconnect the power supply and the USB-C cable first, so neither can snag or drag a connected item off the bench.
- **Use the handle.** Lift by the integrated handle only. Do not lift the printer by the gantry, a carriage, a lead screw or a syringe holder.

Note: Carrying the printer does not disturb the X and Y reference, because those axes are homed against their endstops. It does not preserve the Z and A datum, which is cleared by the disconnection. Re-zero the vertical axes with G92 after every move. See Section 3.

Storing the Printer

- **Unload first.** Unload both syringes and cap or remove both dispense tips before the printer is put away. Material left in a barrel will dry or cure and will block the tip.
- **Clean it.** Clean the build plate, the frame and the syringe holders, and wipe dried material off the lead screws and rails. See Section 4.

- **Where.** Store the printer indoors in a dry place, out of direct sunlight. Prolonged ultraviolet exposure embrittles acrylic.
- **How.** Keep it flat and upright, with nothing resting on the gantry or on either printhead carriage, and do not stack anything on top of it.
- **Packaging.** Keep the original packaging if you can. It is the safest way to move the printer any further than between rooms.

Note: Storage does not preserve the coordinate reference. Home X and Y, then re-establish the Z, A, B and C datum with G92, before the first print after the printer has been put away. See Section 3.

Power Supply

The power supply is not supplied with the printer. You must obtain one that meets the specification below before the printer can be used. A supply that does not meet it can damage the control board, and a supply that is not certified for your market will invalidate the printer's declared electromagnetic compatibility.

Requirement	Specification
Output voltage	24 V DC
Output current	2.5 A minimum (60 W)
Connector	5.5 x 2.5 mm barrel plug, center positive.
Mains input	100 to 240 V AC, 50/60 Hz
Certification	Must carry the markings required in your market. In the European Union and the United Kingdom this means CE or UKCA marking and conformity with the Low Voltage and EMC legislation.
Qualified model	MEAN WELL GSM60A24. This is the unit the Printessa One was tested with for its EMC qualification. Use this model, or an equivalent that meets every line above.

Warning: Check that your supply is center positive before you connect it for the first time. A supply of the correct voltage but reversed polarity will destroy the control board immediately, and this damage is not covered by warranty.

Electrical Safety

- Use only a power supply that meets the specification above. Substituting a supply of a different voltage or polarity will damage the control board.
- Disconnect mains power before opening any panel, reseating a connector, or working on the control board or wiring.
- Keep all liquids, including bioinks, buffers, crosslinkers and cleaning solutions, away from the control board, the motors and the wiring harness.
- If material is spilled onto the electronics, disconnect mains power immediately and do not reconnect until the assembly is fully dry and has been inspected.

- Inspect the power and USB-C cables for damage before each session. Do not use a printer with a damaged cable, connector or strain relief.
- Do not modify the wiring, replace the stepper drivers, or alter the driver current settings unless instructed to do so by Printess Technologies support.

Stopping the Printer

There is no dedicated hardware emergency stop button on the Printessa One. The power connector is the designated emergency stop. Disconnecting it removes power from all six motors at once and every axis stops where it stands. The lead screws are self-locking, so nothing descends or drifts afterwards. Use whichever of the following is fastest for the situation, and know these before you start your first print.

Situation	Action
Immediate danger to a person, or an axis about to crash	Switch off or unplug the power supply at the outlet. All motion stops at once. This is the primary emergency stop.
Print is going wrong but nothing is in danger	In Pronterface, click “Disconnect” and then “Connect”. This halts the running file. See Section 2, Stopping a Print.
Immediate danger, and the power connector is not the nearest thing to hand	Unplug the USB-C cable at the printer. Motion stops. Use the power connector in preference where you can reach it, because it is the designated emergency stop and it also removes power from the motors.
Firmware-level halt from the console	Send M112. The controller enters an emergency stop state and stops all motion. The board must then be reset and reconnected before it will accept further commands. This requires the host computer to still be responding.

Warning: After any emergency stop, and after every reconnection, the printer has lost its coordinate reference. Before printing again, home X and Y, then manually position and zero Z, A, B and C with G92. If you do not use the X/Y end-stops, repeat the full manual zeroing procedure instead. Running a file against a stale datum is the most common way to crash a dispense tip.

Materials and Unattended Operation

- **Materials.** This manual covers the safe operation of the machine. Handling, storage, containment and disposal of the materials you print, including any cell-laden bioinks, crosslinkers and solvents, remain governed by your own institution’s biosafety and chemical hygiene protocols and by the safety data sheet for each material.
- **Unattended prints.** Print jobs on the Printessa One can run for a long time, and the printer must stay connected to a running computer for all of it. Do not leave a print running overnight or in an unoccupied room.
- **Housekeeping.** Keep the work envelope, build plate and dispense tips clean between runs. Cured or dried material on a rail, screw or plunger is a common cause of skipped steps and layer shifts.

Noise

The A-weighted emission sound pressure level at the operating position does not exceed 70 dB(A). The printer has no fan, pump or compressor, and its six stepper motors are microstepped and run at print speeds up to 6 mm/s.

2. Pronterface Setup

Pronterface is the host program that connects your computer to the Printessa One. It is where you jog the axes, type G-code commands by hand, zero the printer, and run the files you export from PrintessFlow. PrintessFlow slices; Pronterface prints.

Pronterface is part of the open-source Printrun suite. It is free, and it runs on Windows, macOS and Linux.

The Printer Is Driven by Your Computer

The Printessa One is not a standalone machine. It has no screen, no control knob and no SD card slot, and it cannot store or run a print file on its own. Every command it executes arrives over the USB-C cable from Pronterface, one line at a time, for the entire duration of the print.

This has three practical consequences:

- **Stay connected.** The printer must stay connected to your computer for the whole print, from the first line to the last. Unplugging the USB-C cable, or closing Pronterface, stops the print immediately and leaves the job unfinished.
- **Keep the computer awake.** The computer must stay awake and running Pronterface. If it sleeps, hibernates, restarts for an update, or the user account logs out, the stream of commands stops and so does the print. Disable sleep and automatic updates on the machine that drives the printer.
- **Pronterface is the control.** Because Pronterface is the only thing driving the printer, it is also the fastest way to stop it. Disconnecting ends the print. See [Stopping a Print](#), later in this section.

Warning: Do not unplug the USB-C cable, close Pronterface, or let the computer sleep while a print is running unless you intend to abandon the job. The print cannot be resumed from where it stopped: the printer loses its coordinate reference the moment the connection drops, and you must re-establish the datum before running anything else.

Note: This section uses G-code commands such as M114, G91 and G1 in its examples. They are explained in full in [Section 3, G-Code Basics and Common Commands](#). You do not need to read that section first, but keep it to hand while you work through this one.

Installing Pronterface

1. Go to the Printrun releases page: github.com/kliment/Printrun/releases
2. Open the “Assets” list on the most recent release and download the pre-compiled build for your operating system.

3. Unzip the download and run the Pronterface executable inside. No installer is required.

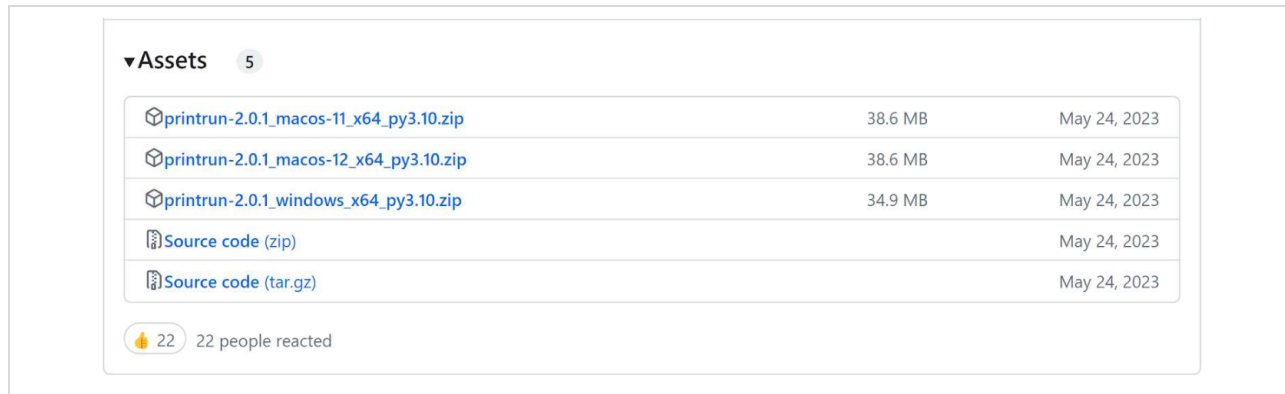


Figure 1: Assets list on a Printron release. Version numbers and file names will differ from those shown

- x64 is the 64-bit build. Try this one first; it is correct for almost all current machines.
- x86 is the 32-bit build. Use it only if the x64 build will not start.
- On macOS, choose the build that matches your macOS version, and check whether an Apple Silicon (ARM64) build is offered for your Mac.

Note: If your operating system blocks the download or the first launch because the application is unsigned, allow it through your security settings in the usual way for unsigned open-source software. Follow your institution's IT policy.

Connecting to the Printer

1. Power on the Printessa One, then connect it to your computer with the USB-C cable.
2. Close any other program that may be holding the serial port. This includes VSCode if you have just used it to upload firmware, and any other instance of Pronterface.
3. Open Pronterface.
4. Click the "Port" button to refresh the list of available ports, then choose your printer from the drop-down next to it.
5. Confirm the baud rate field reads 115200.
6. Click "Connect". The log pane on the right will show the firmware banner once the connection is established.



Figure 2: Pronterface connection bar: port, baud rate, and the XY and Z jog speeds

Note: The port name looks different on each platform. On Windows it is a COM port such as COM3; on macOS it is a path such as /dev/tty.usbmodem146301; on Linux it is usually /dev/ttyUSB0 or

/dev/ttyACM0. If no port appears at all, the printer is not powered, the cable is data-only, or a driver is missing.

- If the log fills with errors mentioning “line number” or “checksum”, the connection is unreliable. Reduce the baud rate and reconnect.
- If Pronterface connects but the printer ignores commands, another program is probably still holding the port. Close it and reconnect.

Setting Safe Jog Speeds

Immediately after connecting, and before touching anything else, correct the jog speeds in the connection bar. Pronterface ships with defaults intended for a filament printer, and they are far too fast for the Printessa One.

Field	Default	Set to	Why
XY	3000	300	The stage motors stall well below the default rate.
Z	200	200 (unchanged)	Suitable for the vertical axes. Reduce further when approaching the build plate.

Warning: Correct the XY jog rate before you jog anything. Driving the stage at the default 3000 mm/min will stall the motors, and a stalled axis loses steps silently, so the printer’s idea of where it is no longer matches reality.

The Console

The console at the bottom right of the Pronterface window is where you type G-code commands one line at a time. This is the primary way to work with the Printessa One: it is how you position the stage, zero the extruders, prime a syringe and check the current position.



Figure 3: The Pronterface console. Type a command and press Send or Enter

Type a command and press Enter, or click Send. For example:

```
M114          ; report current position
G91           ; switch to relative positioning
G1 X10 F250    ; move 10 mm in X at a safe feed rate
```

Note: Get into the habit of running M114 before and after any manual move. It is the fastest way to confirm the printer’s coordinate reference matches what you expect.

The Jog Controls

Pronterface provides a graphical jog control for quick manual moves. The rings select the step size (0.1, 1, 10 or 100 mm) and the arrows move the corresponding axis.

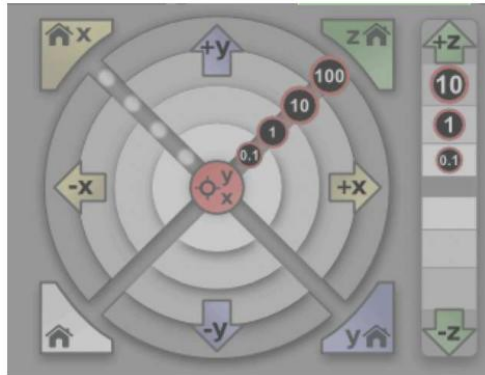


Figure 4: The Pronterface jog control. Ring selects step size; arrows move the axis

Warning: The jog buttons silently reset the printer to absolute positioning (G90), even if you have just set G91 in the console. For this reason we recommend not using the jog control at all, and moving instead by sending commands such as G1 X10 F250 from the console. If you do use the jog buttons, re-issue G91 before any relative move you type afterwards.

Note: The jog control only exposes X, Y and Z. The A, B and C axes of the Printessa One have no buttons and must be driven from the console.

Loading and Running a Print File

1. Slice your model in PrintessFlow and export it with “Save to Disk”. Save it as a .txt or .gcode file.
 2. Complete the pre-print checklist: home X and Y (or manually zero them), manually position and zero Z and A, and confirm B and C are set to 0.
 3. In Pronterface, click “Load file” at the top center and select your exported file.
 4. Check the estimated print time and the loaded file name shown in the status bar.
 5. Click “Print” to begin. Progress is reported in the log pane.
 6. Leave Pronterface open and the printer connected until the print finishes. Pronterface feeds the file to the printer line by line for the whole job.
- **Buttons that do nothing.** The “SD”, “Pause” and “Off” buttons do nothing on the Printessa One. The printer has no SD card and cannot run a file on its own. Do not use them.
 - **Plain text only.** Files must be plain text. Rich text (.rtf) will not run. If you are editing G-code in TextEdit on macOS, go to Preferences, select Plain Text, and then create a new document.

Warning: Always complete the pre-print checklist before clicking Print. Incorrectly zeroed extruders are the single most common cause of a failed print, and the failure mode is a dispense tip driven into the build plate.

Stopping a Print

Pronterface has no working pause on the Printessa One. To stop a running file:

1. Click “Disconnect”, then “Connect”. This ends the running file.
2. If the printer must stop instantly, switch off or unplug the power supply instead. See Section 1, Stopping the Printer.

Warning: Every disconnection clears the coordinate reference. Before you print again, home X and Y, manually position and zero Z and A, and re-issue G92 with B and C set to 0. If you do not use the X/Y end-stops, repeat the full manual zeroing procedure instead.

Optional: Macros and Custom Buttons

Pronterface can store frequently used command sequences as macros bound to custom buttons. A macro for your standard zeroing sequence, or for priming a syringe, saves a good deal of typing once your workflow settles. See the Printrun documentation:

github.com/kliment/Printrun#using-macros-and-custom-buttons

Connection Troubleshooting

Symptom	Likely cause and fix
No ports listed in the drop-down	Printer not powered, USB-C cable is charge-only, or the USB serial driver is not installed. Try another cable first, then click “Port” to refresh.
Port listed but connection fails	Another program is holding the port. Close VSCode, any second copy of Pronterface, and any serial monitor, then reconnect.
Errors mentioning “line number” or “checksum”	Serial communication is unreliable. Lower the baud rate and reconnect. Check the cable and avoid USB hubs.
Connects, but nothing moves	No feed rate has been set, or the file is not running. Send M114 to confirm the printer responds, then a small G1 move with an explicit F value.
Motors buzz or stall instead of moving	Feed rate is too high. Reduce the XY jog rate to 300 and the F value in your commands to 250 or 300.
Axis moves the wrong way or the wrong axis moves	The axis mapping is not what you assumed. Re-check the axis table in Section 3, The Axes of the Printessa One, and verify each axis individually with a small jog.
Printer will not accept commands after an emergency stop	M112 requires a controller reset. Disconnect, reset or power-cycle the board, reconnect, and re-establish the datum.

3. G-Code Basics and Common Commands

G-code is the plain-text language the Printessa One speaks. Every motion the printer makes, whether it comes from a file sliced in PrintessFlow or from a command you type by hand, is a line of G-code. You do not need to write G-code to run a sliced print, but you do need to read and type it to set up the printer, to zero the axes, and to diagnose a print that is going wrong.

This section covers the commands you will actually use on the Printessa One. For the complete reference, see reprap.org/wiki/G-code and marlinfw.org/meta/gcode.

The Axes of the Printessa One

The Printessa One has six independently driven axes. Two position the stage, two set the height of each printhead, and two drive the syringe plungers. Learn these before you send the printer any command.

Axis	Drives	Positive direction
X	Stage, left and right	Left
Y	Stage, front and back	Forward, toward the front
Z	Extruder 1 height	Up, away from the build plate
A	Extruder 2 height	Up, away from the build plate
B	Extruder 1 syringe plunger	Down, dispenses material
C	Extruder 2 syringe plunger	Down, dispenses material

Warning: Positive X moves the stage to the left and positive Y moves it toward the front, which is the opposite of the convention on most desktop 3D printers. If you are used to another machine, confirm both directions with a small jog before you run anything. The coordinate diagrams later in this section illustrate coordinate space, not the physical orientation of the printer.

Note: The vertical axes and the extrusion axes have opposite sign conventions. Positive Z and A move a printhead up and away from the plate; positive B and C push a plunger down and dispense material. A negative B or C move retracts the plunger.

Extruder 1 therefore uses the Z and B axes, and Extruder 2 uses the A and C axes. Standard Cura G-code has only one height axis and one extrusion axis, so the PrintessFlow post-processing scripts rename them on export:

Extruder	Cura axis	Printessa One axis
T0 (Extruder 1)	E (extrusion)	B
T0 (Extruder 1)	Z (height)	Z (unchanged)
T1 (Extruder 2)	E (extrusion)	C
T1 (Extruder 2)	Z (height)	A

Before running your first print, jog each axis a few millimeters on its own and watch what moves. Confirming the mapping by eye takes two minutes and prevents most first-day crashes.

Anatomy of a G-Code Line

A line of G-code is a command word followed by parameters:

```
G1 X10 Y5 F300 ; move to X=10, Y=5 at 300 mm/min
```

- **G1** The command word (G1) says what to do. G commands control motion; M commands control the machine.
- **X10 Y5** Axis parameters (X10, Y5) give the target for each axis. Any axis you leave out simply does not move.
- **F300** F sets the feed rate in mm/min. It is sticky: once set, it applies to every following move until you change it.
- **; ...** Everything after a semicolon is a comment and is ignored by the printer.

Note: G1 and G01 are the same command. Use the short form. Command words are not case sensitive, but this manual and PrintessFlow both write them in upper case.

Positioning Modes: G90, G91 and G92

The single most important thing to understand about G-code is that a coordinate means nothing until you have told the printer what mode it is in and where zero is.

Command	Description
G90	Absolute positioning. Every coordinate is measured from the origin you defined. Must be on its own line.
G91	Incremental (relative) positioning. Every coordinate is a distance from wherever the printer is right now. Must be on its own line.
G92	Set the current position. Declares that the printer is standing at the coordinates you give, without moving anything. This is how you define your origin.

The example below moves from the origin to points 1, 2 and 3. Points 1 and 2 are reached in absolute mode, and point 3 in relative mode, purely to show both:

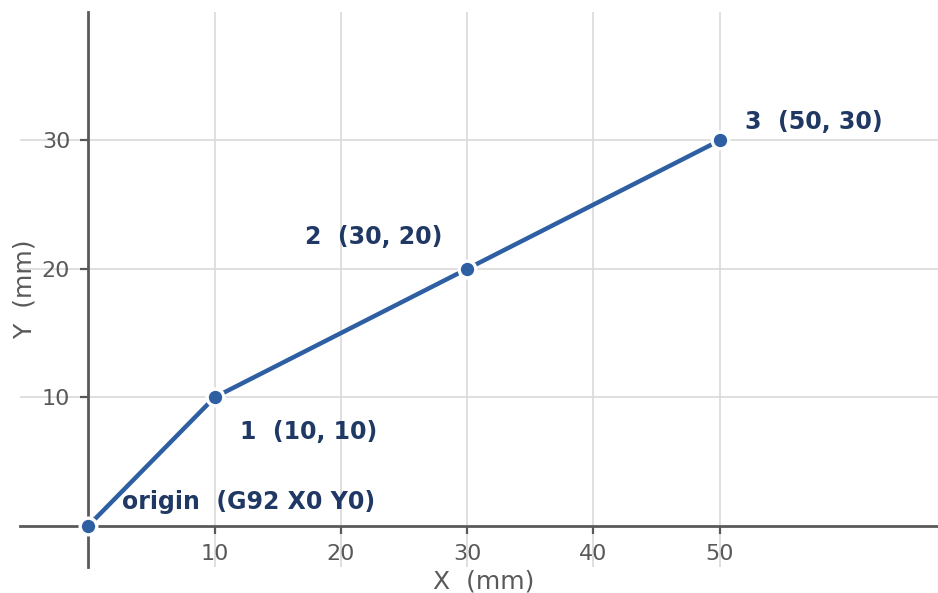


Figure 5: Absolute and incremental positioning, moving to points 1, 2 and 3

```
G90                ; absolute positioning
G92 X0 Y0          ; call the current position (0, 0)

G1 X10 Y10 F300    ; move to (10, 10), point 1
G1 X30 Y20 F300    ; move to (30, 20), point 2

G91                ; incremental positioning
G1 X20 Y10 F300    ; move 20 in X and 10 in Y, arriving at point 3
```

With respect to the coordinate system defined above, the printer is now at (50, 30). Switching to relative mode to reach point 3 was for the sake of the example and was not necessary. Which mode you use is up to you, and one will usually feel more natural than the other for a given task.

Warning: You must re-issue G92 every time you reconnect to the printer. As long as you stay connected, the printer remembers its absolute position between scripts. The moment you disconnect, that reference is gone, and any absolute move afterwards will be measured from the wrong place.

A second example, drawing a 5 mm square in each mode:

```
G91                      ; relative
G1 X5 Y0 F300
G1 X0 Y5 F300
G1 X-5 Y0 F300
G1 X0 Y-5 F300

G90                      ; absolute
G92 X0 Y0                ; define the current location as (0, 0)
G1 X5 Y0 F300
G1 X5 Y5 F300
G1 X0 Y5 F300
G1 X0 Y0 F300
```

Homing: G28

G28 establishes the stage datum by driving the X and/or Y axis to its end-stop and setting that position as zero. The Printessa One has end-stops on X and Y only; the Z, A, B and C axes are zeroed manually with G92.

Choose which stage axis to home by listing its letter after the command. The letters take no value: write G28 X, not G28 X0. Listing no letters homes every axis that has an end-stop, which means X and Y.

```
G28                      ; home every axis with an end-stop (X and Y)
G28 X                    ; home X only
G28 Y                    ; home Y only
G28 X Y                  ; home X and Y
G92 Z0 A0                ; set the current printhead heights as zero
G92 B0 C0                ; set the current plunger positions as zero
```

Warning: Homing drives X or Y until it reaches its end-stop, and it will not stop for anything in the way. Clear the stage before homing. When homing via PrintessFlow, it first raises the printhead in use to an absolute height of 50 mm above the zero you set, so that it clears any well plate or petri dish on the stage before X and Y home.

Note: Z and A have no homing end-stops, and B and C have no end-stops either. Position these axes manually and zero them with G92. A typical pre-print zeroing step therefore sets Z and A at the desired tip height and explicitly sets B and C to 0.

You rarely need to type G28 by hand for a sliced print. When X/Y homing is enabled in the PrintessFlow Slice panel, PrintessFlow homes the stage at the start of the file and applies the configured Zero Offset.

Note that for PrintessFlow, zeros are set in accordance with the stock buildplate, as a G92 command is added after homing. Z and A must still be positioned and zeroed manually. Type G28 yourself when setting up, recovering after a disconnection, or re-establishing the stage datum after an emergency stop.

Motion Commands

G1: straight-line move

G1 moves in a straight line to the coordinates given. On the Printessa One a G1 line can combine stage motion, height changes and extrusion: include B or C to dispense while moving, or omit them to travel without extruding.

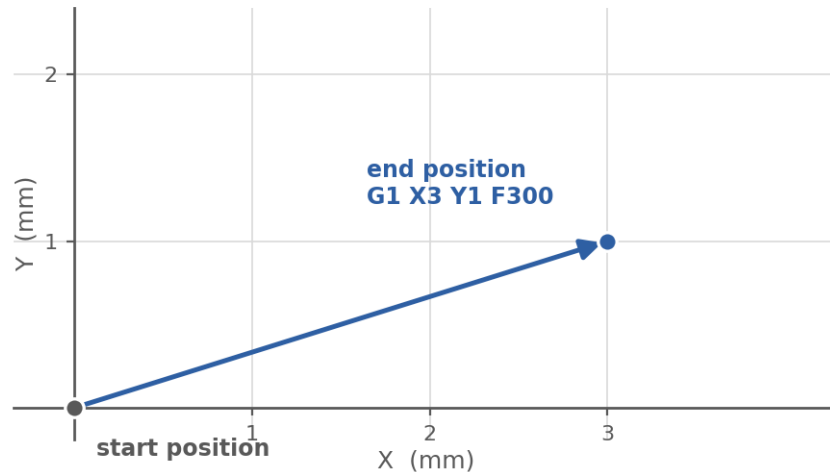


Figure 6: G1 moves in a straight line from the current position to the target

```
G90          ; absolute positioning
G92 X0 Y0    ; define the origin
G1 X3 Y1 F300 ; straight-line move to (3, 1)
```

Note: There is no separate command for a non-extruding move on the Printessa One. Extrusion is controlled explicitly by the B and C axes, so simply omit B and C from a G1 line and the printer travels without dispensing.

G2 and G3: arcs and circles

G2 cuts a clockwise arc and G3 a counter-clockwise arc. X and Y give the end point of the arc, and I and J give the offset from the start point to the center of the arc.

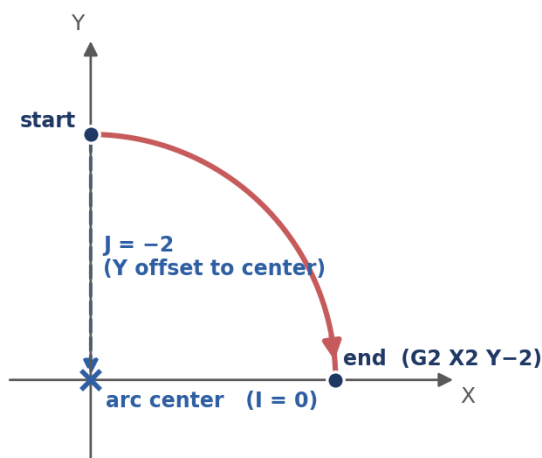


Figure 7: A clockwise arc: X and Y set the end point, I and J locate the center

```
G91          ; incremental positioning
G2 X2 Y-2 I0 J-2 ; clockwise quarter arc of radius 2
```

- X and Y set the point at which the arc ends. Omit them and the printer cuts a full circle.
- I and J are the X and Y offsets from the start point to the arc center. They are always read as relative values, even in absolute (G90) mode.

Note: If you specify an end point that does not lie on the arc, the printer moves to the nearest point that does. Preview arcs in a G-code visualizer before running them.

Feed Rate (F)

F sets the feed rate in millimeters per minute, and it applies to every axis, including the B and C plungers. On a move that combines stage motion with extrusion, F sets the speed of the move as a whole, and the firmware paces B and C so that the commanded extrusion finishes at the same moment as the X, Y, Z and A motion. On a move that drives a plunger on its own, such as priming a syringe, F is what sets the plunger speed, so never leave it out. PrintessFlow primes and retracts at F240 by default, which is a reasonable starting point by hand.

- Use F250 to F300 as a starting point. Higher feed rates can stall the motors, which causes lost steps and a shifted print.
- Always include an F value on the first motion command you send after connecting. Until you set one, the printer uses a stored default that may be far too fast.
- F is sticky. Once set it persists until you change it or disconnect, but repeating it on each motion line costs nothing and makes a file easier to read.
- In PrintessFlow, print settings are given in mm/s. The exported feed rate is $F = \text{speed} \times 60$.

Warning: On first startup, always specify a feed rate. The printer defaults to an extremely high value that can damage the mechanism. F250 (250 mm/min) is safe for manual positioning.

Other Useful Commands

Command	Description
G4	Dwell. Wait before running the next line. P is milliseconds, S is seconds. G4 P2000 waits two seconds.
G28	Home X and/or Y to the installed end-stops and set that stage position as zero. Z, A, B and C are zeroed manually with G92. See Homing: G28 earlier in this section.
G60	Save the current position.
G61	Return to the saved position. G61 XY F300 returns only the X and Y axes.
M114	Report the current position in absolute coordinates. The most useful diagnostic command on the printer.
M106	Set a fan pin output. Used to drive the mixing nozzle motor, which is wired to the fan pins. P is the pin number, S is the duty cycle out of 255. M106 P0 S40 activates; M106 P0 S0 deactivates.
M112	Emergency stop. Halts all motion at the firmware level. The board must be reset and reconnected afterwards.
M2	End of program. Conventional at the end of a G-code file, though Pronterface does not require it.
;	Everything after a semicolon on a line is a comment and is ignored.

Checking G-Code Before You Run It

Reading a toolpath off the screen is far cheaper than crashing a dispense tip. Two checks are worth making on any file you have written or edited by hand.

- **Visualize it.** Paste the file into a G-code visualizer such as ncviewer.com to see the path it will trace. Most visualizers only understand X, Y and Z, so you may need to temporarily rename or strip the A, B and C moves before pasting.
- **Check the feed rates.** Scan for the highest F value in the file and confirm it is within the range your motors can follow. Anything much above F300 is worth questioning.

Note: The first line of a hand-written file must be G90 or G91. If the printer does not know which positioning mode it is in, the first move is unpredictable.

4. Maintenance

The Printessa One needs very little looking after. The only scheduled maintenance the machine requires is applying silicone grease to the leadscrews. There is nothing to tension, nothing to replace on a schedule, and no consumable parts inside the motion system.

Greasing the Leadscrews

Every axis on the Printessa One is driven by a leadscrew: X and Y for the stage, Z and A for the two printhead heights, and B and C for the syringe plungers. A thin film of silicone grease on each screw keeps motion smooth and quiet, and prevents the binding that causes an axis to stall and lose steps.

You will need:

- Silicone grease.
- A clean, lint-free cloth or wipe.

Warning: Use silicone grease only. Petroleum-based and lithium greases attack the plastic nuts and the acrylic panels, and will do lasting damage to the motion system.

1. Power off and unplug the printer. Never grease a leadscrew while the motors are energized.
2. Wipe each leadscrew down with a clean cloth to remove old grease, dust and any dried material.
3. Apply a thin film of silicone grease along each screw. A light coating is all that is needed; excess grease attracts dust.
4. Turn the motor shafts by hand to run each carriage through its full travel a few times, working the grease into the nut and along the screw.
5. Wipe away any grease that has been pushed to the ends of the screws or onto the frame.

Note: Keep grease off the build plate, the dispense tips and anything that will contact your samples. If grease reaches the build surface, clean it thoroughly before the next print.

Re-grease whenever an axis starts to sound rough or run less smoothly than usual, and as part of routine servicing. An axis that stalls, buzzes or loses position for no other obvious reason is often simply running dry.

General Care

Beyond greasing the leadscrews, the printer only needs to be kept clean:

- Wipe cured or dried material off the build plate, the frame and the syringe holders between runs.
- Keep the leadscrews and rails free of dried material. Deposits on a screw cause exactly the same binding that missing grease does.
- Keep liquids away from the control board, the motors and the wiring harness. See Section 1, Electrical Safety.
- Cap or remove dispense tips when the printer is not in use so material cannot dry inside them.

5. Assembly

Note: Your Printessa One arrives fully assembled and wired. Nothing in this section needs to be done before you print. It is here so that you know how your printer is put together.

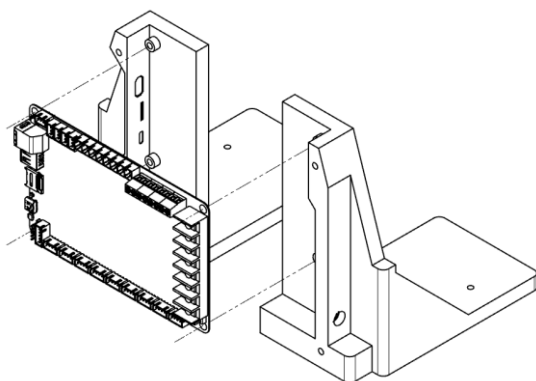
The fourteen steps below show the order in which the printer is built. The wiring that connects the motors and end-stops to the board follows at the end of the section.

Read it to understand what sits where, to identify a part before you ask about it, or as a reference if you ever need to take a panel off, replace a motor or trace a cable.

Warning: If you do open the printer, unplug the power supply first and leave it unplugged until everything is back together and every connector has been checked. See Section 1, Electrical Safety.

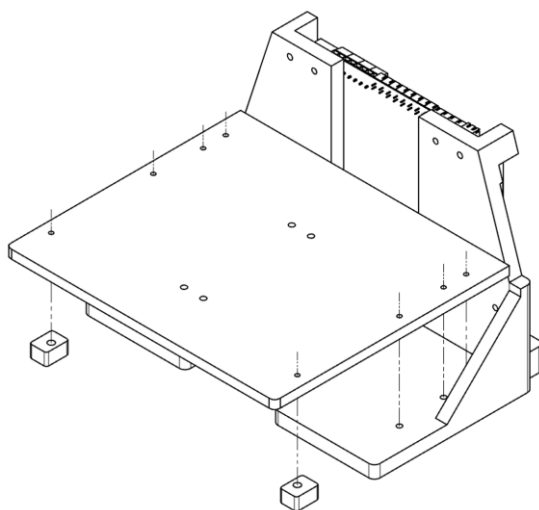
Note: The Printessa One uses dedicated X- and Y-axis end-stop mounts. Each end-stop is secured to its mount with two M3 x 6 bolts, while the mount itself reuses the two M3 x 6 motor-housing screws. In the fourteen main assembly steps below, the fasteners are M3 x 12 except Step 11, which uses eight M3 x 45 bolts.

Assembly Steps



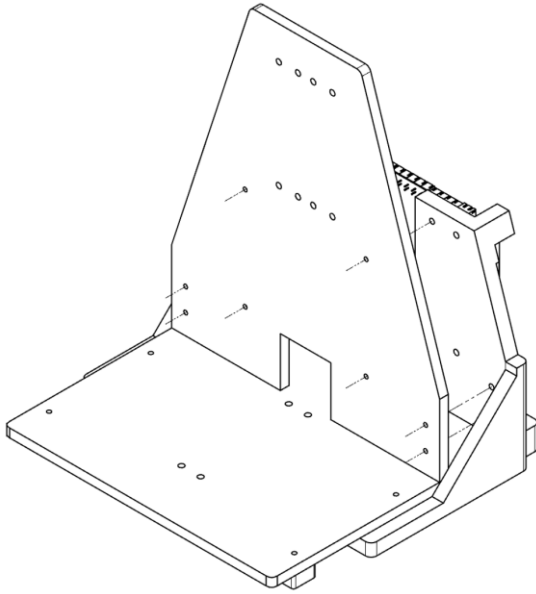
Step 1

Install the BigTreeTech Octopus Pro v1.1 board onto the left and right braces. To align the I/O, hook the USB port into its corresponding opening, align the USB-C port, and fasten the board with four M3 x 12 bolts.



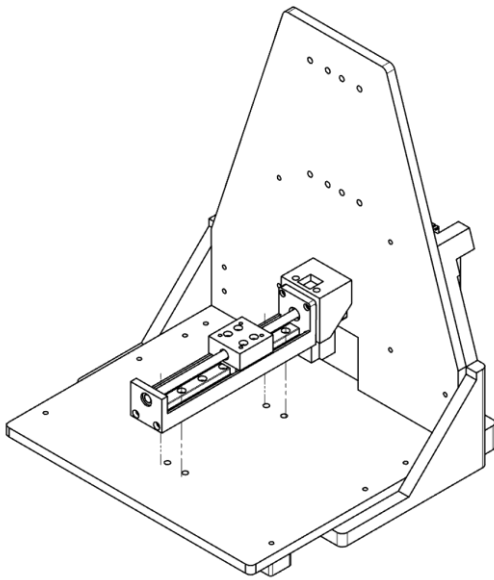
Step 2

After the BigTreeTech board is installed, use eight M3 x 12 bolts to fasten the base plate to the braces and printer feet.



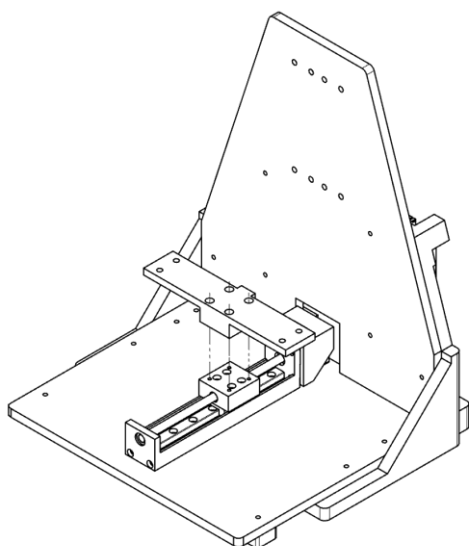
Step 3

Fasten the back plate to the left and right braces using eight M3 x 12 bolts.



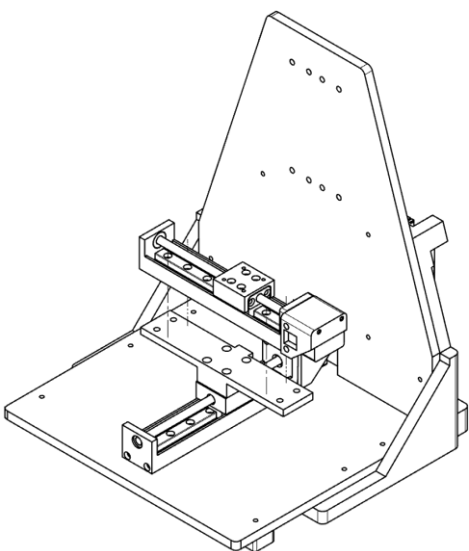
Step 4

Fasten the assembled Y-axis stepper motor and end-stop to the base plate using four M3 x 12 bolts.



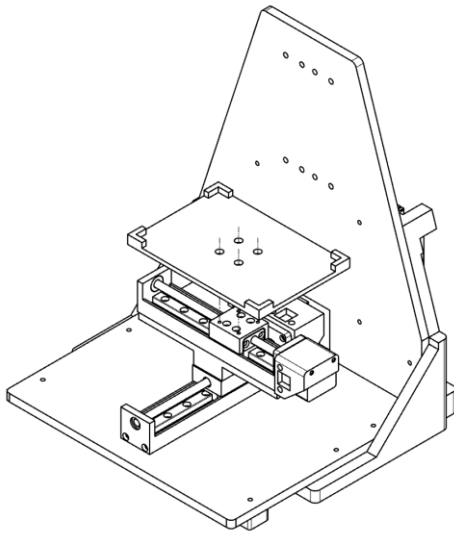
Step 5

Install the X/Y connector on top of the Y-axis motor using four M3 x 12 bolts.



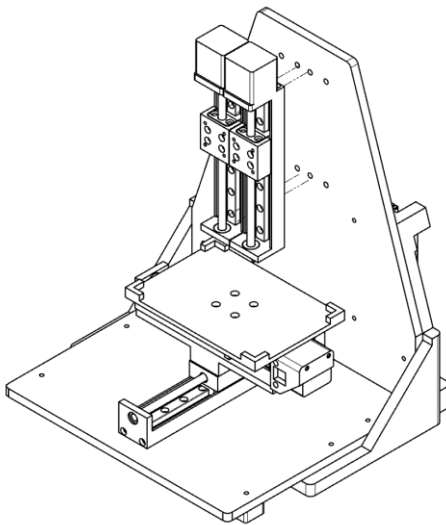
Step 6

Mount the X-axis stepper motor on top of the X/Y connector using four M3 x 12 bolts.



Step 7

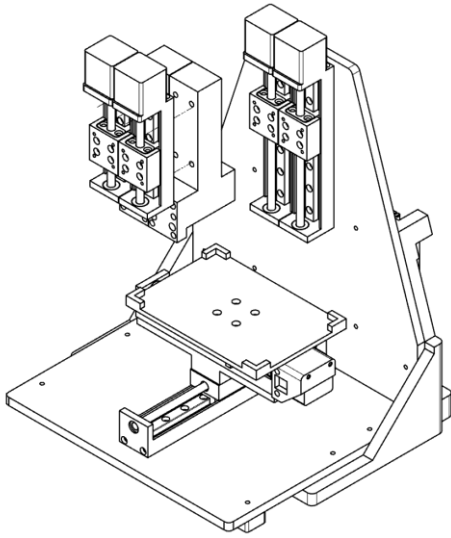
Install the well plate holder on top of the X-axis stepper motor using four M3 x 12 bolts.



Step 8

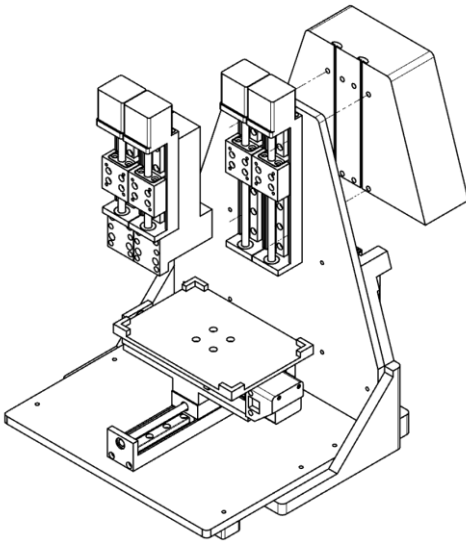
Initially mount the Z- and A-axis stepper motors using only the four inner M3 x 12 bolts. Leave the outer mounting holes open; they will be used to attach the carrying handle.

Use ONLY the inner mounting bolts at this stage.



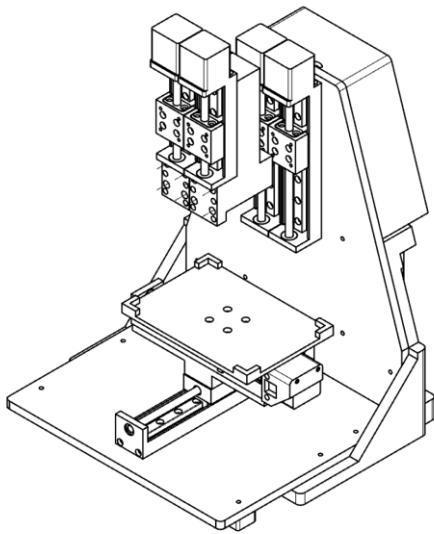
Step 9

Before mounting the carrying handle, install the B- and C-axis stepper motors onto the Z/A-axis connectors using eight M3 x 12 bolts.



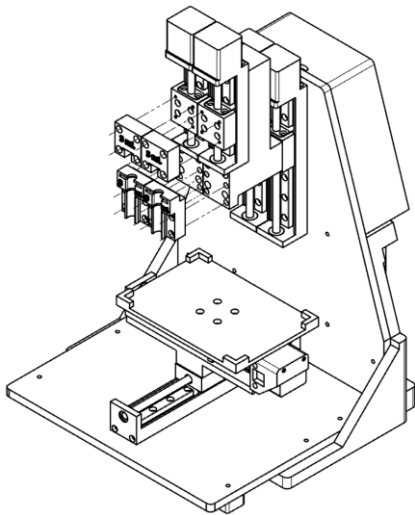
Step 10

Route the Z-, A-, B-, and C-axis wires through the designated channels in the carrying handle so that they are fully contained. Using the remaining holes for the Z- and A-axis stepper motors, fasten the carrying handle to the back of the acrylic plate with four M3 x 12 bolts.



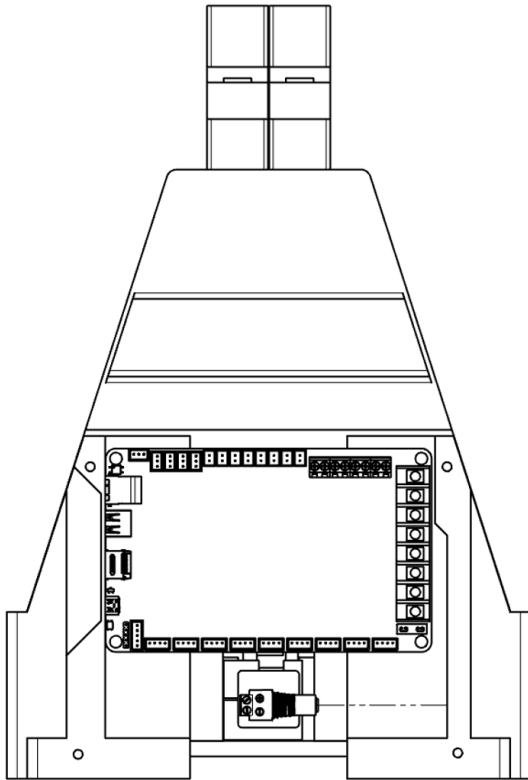
Step 11

After fastening the carrying handle, mount the B- and C-axis stepper-motor assemblies to the corresponding Z- and A-axis motors using eight M3 x 45 bolts.



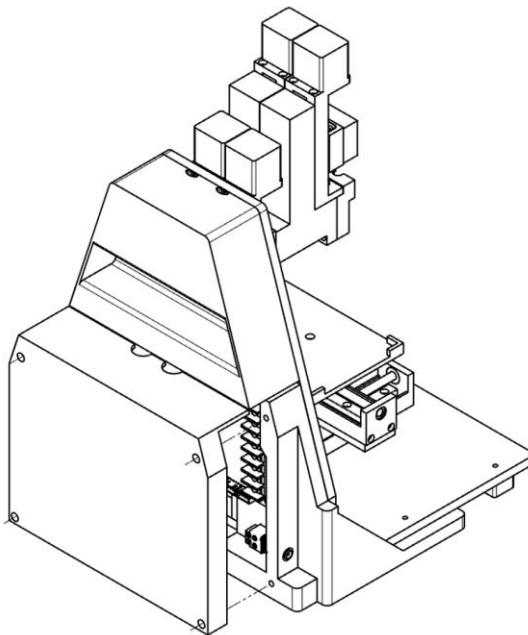
Step 12

Complete the extruder assembly by mounting the desired syringe barrel and plunger holders to the corresponding B- and C-axis stepper motors using sixteen M3 x 12 bolts.



Step 13

Turn the printer around and press-fit the female barrel plug into the left brace. The fit should be snug enough for the power supply to be connected and disconnected without moving the plug.



Step 14

After wiring the motors and end-stops to the board, install the rear cover using four M3 x 12 bolts.

Note: The rear cover in step 14 goes on last for a reason: once it is fitted, the board and the motor connectors are no longer accessible. Anything that needs to reach them, including the wiring described next, happens with the cover off.

Wiring

All six motors and the two X/Y end-stops connect to a single BigTreeTech Octopus Pro v1.1 board. The ports are not interchangeable.

TMC 2209 Drivers: Potentiometer

The potentiometer on each TMC2209 driver is adjusted to a **VREF of 0.5 V $\pm$ 0.03 V**. This sets the driver's maximum motor phase current, limiting the current supplied to the motor windings and helping prevent the NEMA 11 stepper motors from overheating. To verify the VREF, place the positive probe of a multimeter on the potentiometer adjustment screw (or VREF test point, if available) and the negative probe on a ground point while the driver is powered.

Motor and End-Stop Mapping

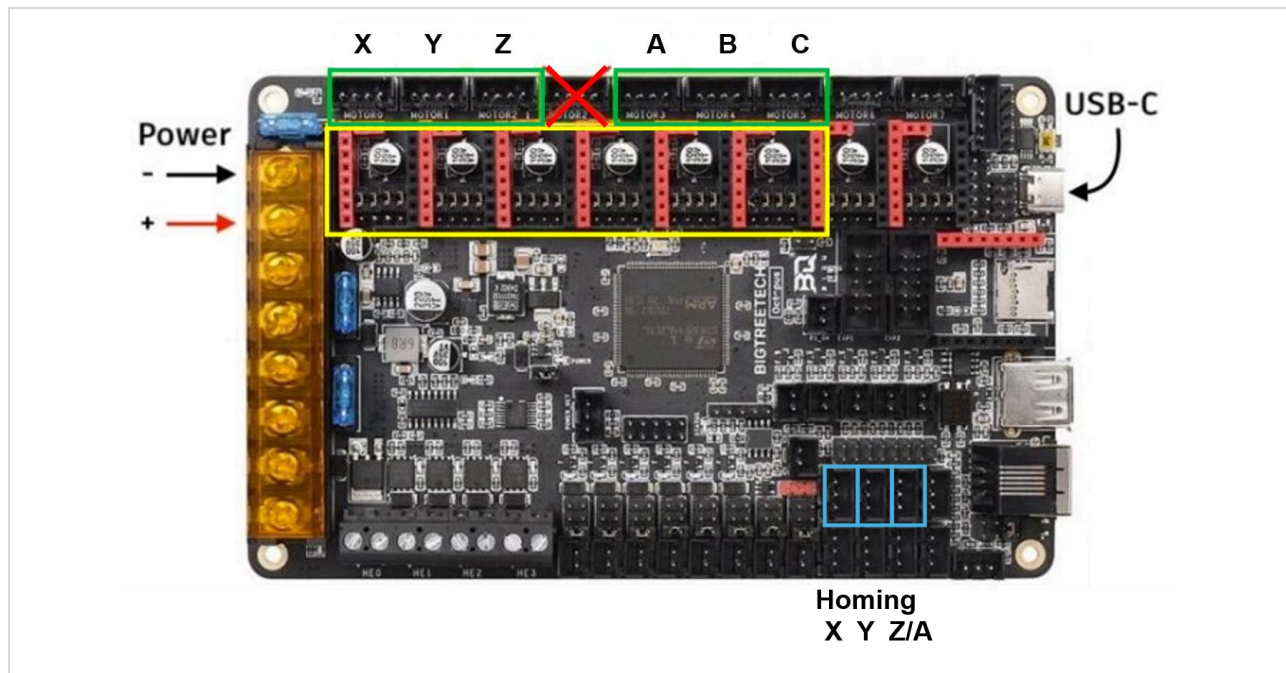


Figure 8: Octopus Pro v1.1 motor ports, power terminal and USB-C, labeled by axis

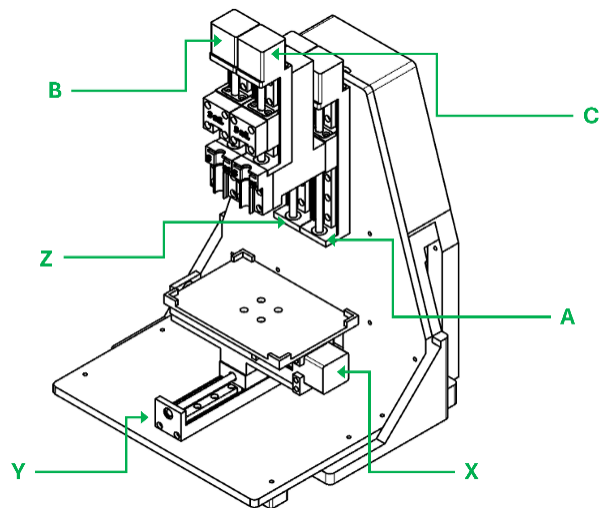


Figure 9: Where each axis sits on the printer

Axis	Motor port	End-stop
X	MOTOR0	Homing X
Y	MOTOR1	Homing Y
Z	MOTOR2	None
A	MOTOR3	None
B	MOTOR4	None
C	MOTOR5	None

Note: MOTOR2_1, MOTOR6 and MOTOR7 are not used on the Printessa One. MOTOR2_1 sits between MOTOR2 and MOTOR3 on the board, so count the headers rather than assuming the ports run consecutively. The axis assignments here match the axis table in Section 3, The Axes of the Printessa One.

Note: Only X and Y use homing end-stops. Z and A are manually positioned and zeroed with G92, and the B and C plunger axes are also zeroed with G92. See Section 3, Homing: G28.

End-Stop Wiring

The two X/Y end-stop connectors are wired in reverse of the factory order. This is already done on your printer:

	Order, left to right
Factory	WHITE, BLACK, RED
Required	RED, BLACK, WHITE

Warning: If you ever replace an end-stop or re-make one of these connectors, check the pin order before power is applied. Wiring one in the factory order puts supply voltage across the wrong pin and can damage the end-stop or the board.

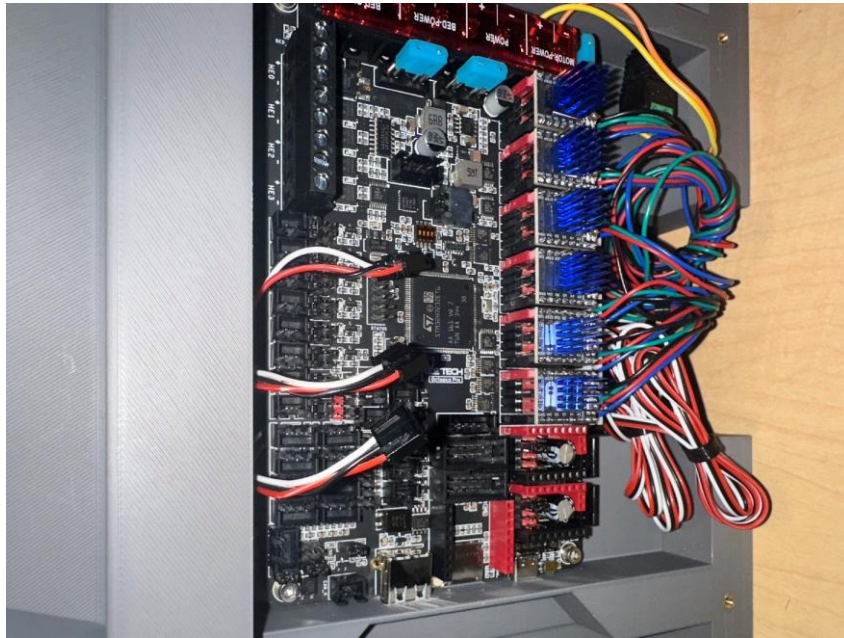


Figure 10: End-stop and motor wiring routed to the board

Happy Printing!