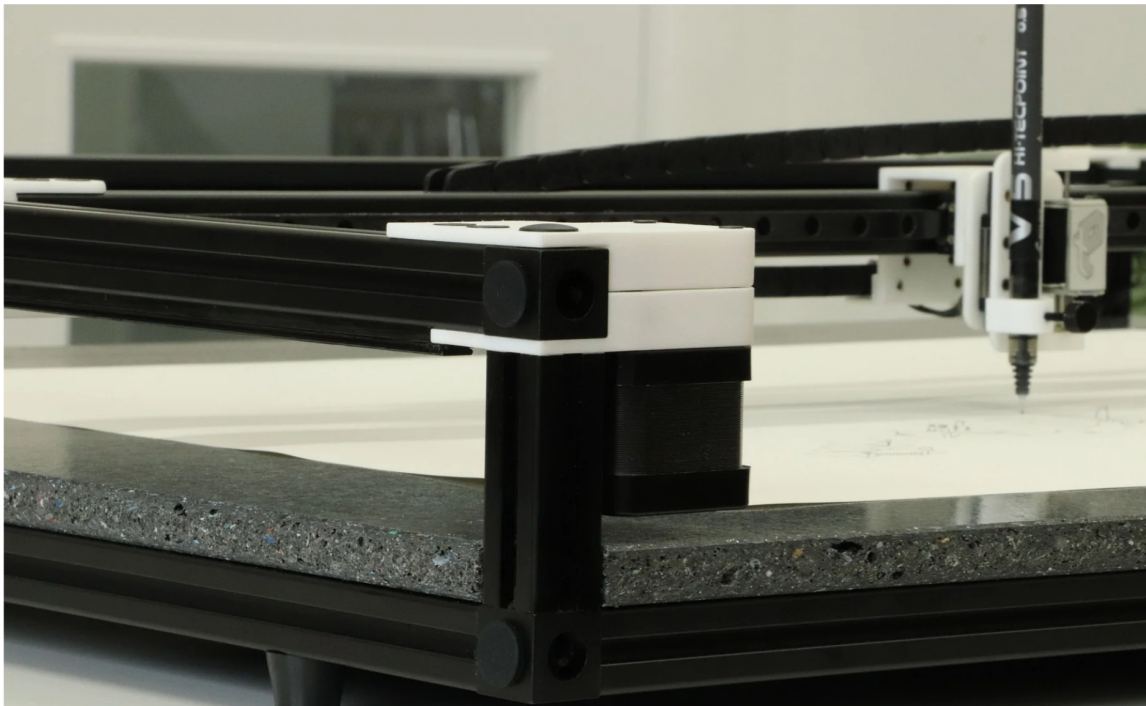


terraPen user guide



Welcome. The terraPen is an open-source pen plotter with a full A2 drawing area. This guide takes you from unboxing to your first finished drawing.

 **New here? Start at the top.**

The pages in the sidebar are in order. If you have just taken your terraPen out of the box, work through **Getting started** and **Your first plot** in sequence.

The short version

1. **Fit the toolhead.** It ships unattached — four screws and the supplied hex key.
2. **Power on.** Plug it in, then switch on at the rear right.
3. **Connect.** Join the `terraPen` Wi-Fi network, then move the plotter onto your own network.
4. **Install terraForge,** our desktop app for driving the machine.
5. **Home the machine,** fit paper, and set your pen height.
6. **Plot.**

Safety

The terraPen is an open-frame machine. There is no lid and no interlock, so the moving parts stay within reach while it works. None of this is dangerous with a little care, but read this page once before your first plot.

What the terraPen is

A tool, not a toy

The terraPen is a powered machine with **exposed moving parts**, intended for drawing on paper with pens. It is designed to be assembled and operated by adults.

Young people can absolutely use it — plenty do — but with an adult present and with the guidance on this page understood first. It is not a children's toy and should not be treated as one.

Use it for what it is for. With a drag knife fitted it will also **cut vinyl**, but it is not a laser, not a router, and not a lifting device, and the frame is not designed to be leaned on, sat on or stood on.

While the machine is running

Keep clear of the moving carriage

The carriage travels the full width of the bed, quickly, and does not stop for obstructions. Keep **fingers, hair, sleeves, jewellery and cables** away from it while a plot is running.

If you need to reach into the machine, **pause the plot first** — see **pause before abort**.

Do not try to hold, slow or guide the carriage by hand while it is powered.

Nothing stops the machine at the ends

The terraPen has **no travel limits** in software or hardware. It will happily drive into its own frame and keep pushing — the motors will not give up, and nothing intervenes.

What's in the box

Check it arrived intact

Before anything else, look over the packaging and the machine for transit damage. If you find any, **photograph it – including the packaging – and [get in touch](#) before going further.**

Then check everything below is present.

Item	Notes
terraPen plotter	1x
Stepper toolhead	Not fitted. You attach this yourself – see Fitting the toolhead
Power supply	110–240 V switching adaptor with multi-region plugs, 12 V 2 A output (UK plug shown)
Pen	A pen to get you started – most pens will fit
Calibration plot	The test drawing made on your machine before it shipped
Corner tabs	For holding paper flat on the bed
Hex keys	0.24 mm, 2.5 mm and 4 mm – you need these to fit the toolhead
SD card	Already installed, with sample files on it



Anything missing?

Get in touch on [Discord](#).

Fitting the toolhead

Your terraPen ships with the stepper toolhead **not attached**. Fitting it is the first thing to do, and it is the only assembly required.



Solenoid machines

If you have an earlier terraPen with a **solenoid pen lift**, your toolhead is already fitted — skip to **First time setup**.

You will need the hex key supplied in the box.

Steps

1. Unpack the toolhead and hold it up to its mounting on the carriage.
2. **Connect the 4-pin connector.** It is keyed, so it only goes in one way round — you cannot plug it in backwards. Push it home until it seats fully, and if it resists, turn it around rather than pressing harder.
3. Position the toolhead against the mounting and fit the **four screws**.
4. Tighten them evenly with the hex key — firm, but do not over-torque them.
5. **Tuck the wires away neatly**, using a cable tie if you need one.

That is the whole job. Once the toolhead is on, continue to **First time setup**.



Do not leave the wiring loose

The carriage moves the full width of the bed, at speed, for the length of a plot. A trailing loop of wire can snag or drag across your paper. Route it so it follows the carriage without catching on anything.



The stepper toolhead

The stepper gives roughly **14 mm** of Z travel. It is the default toolhead in **terraForge**, so you should not need to change any configuration to use it.

First time setup

This page gets your terraPen powered up and connected. Allow about five minutes.

Fit the **stepper toolhead** first if you have not already.

1. Connect the power

Both the power inlet and the switch are at the **rear right** of the plotter.

1. Connect the supplied adaptor to the inlet and plug it into the wall.
2. Switch the machine on.

2. Connect to the terraPen's Wi-Fi

Out of the box the terraPen creates its own access point — it does not join your network yet.

On your computer, open the Wi-Fi settings and look for:

- **Network name:** terraPen
- **Password:** 12345678

Join it. Your device will warn you that this network has no internet access, which is expected — you are connecting straight to the machine.

3. Open the web UI

What happens next depends on your computer:

- **Windows** — a browser page opens by itself, showing the web UI.
- **macOS** — a captive portal window opens. **Close it** and use a normal browser instead; the portal is a cut-down browser and some controls misbehave in it.

Either way, you can reach the web UI directly at:

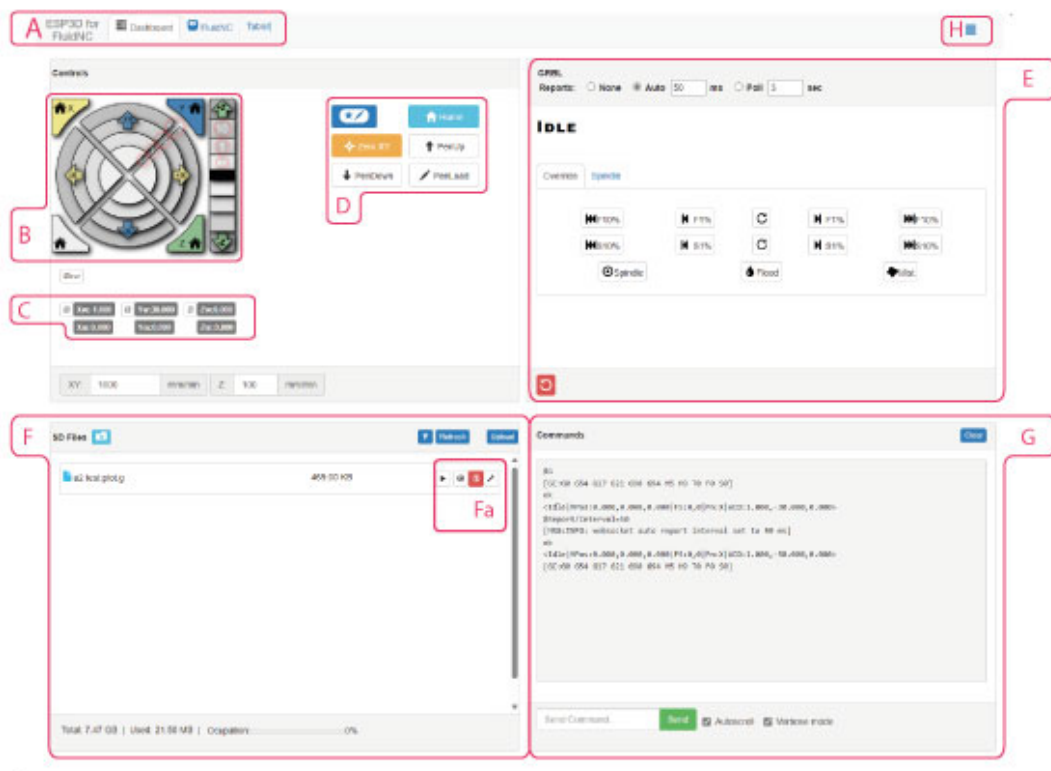
- <http://192.168.0.1>
- <http://terrapen.local>

The terraPen web UI

The terraPen serves its own web UI, so there is nothing to install. It is useful for setup, for quick checks, and when you are away from your own computer.

Plotting is done in terraForge

For everyday work — generating G-code, uploading and running jobs — use [terraForge](#). This page is a reference for the web UI.



Your screen may look different

The web UI refloWS to fit the window, so panels move around on smaller screens. Find panels by their names rather than their position.

Your first plot

This walks you through plotting one of the files already on the SD card. Do this before making your own artwork — it proves the machine works and teaches you the setup routine.

Before you start, [fit the toolhead](#), then [power up and connect](#).

1. Fit the paper

Take the calibration plot off the bed, turn it over, and put it back under the corner tabs blank side up.

Line the paper up square to the machine, with its edges parallel to the X axis, and get it as flat as you can. A ripple in the paper becomes a wobble in the drawing.

2. Home the machine

Start every session by homing. The terraPen ships with limit switches, so it can find its own position.

Clear the bed, then run the homing cycle. Any of these does it:

- **Run Homing** in [terraForge](#)'s jog panel
- **Home** in the web UI
- **\$H** in the console

The carriage moves until it finds its switches and sets its origin from them.



If homing does not work

Something is wrong with a limit switch — see [the machine is crashing into itself](#). You can still plot in the meantime by setting your origin by hand with **Set Zero**.

Moving the pen carriage

There is nothing to stop you

The terraPen has no travel limits

There are no soft limits and no hard limits set. The limit switches are used for **homing only** – they do not stop the carriage during ordinary moves.

If you keep jogging past the end of the travel, the machine will drive into its own frame and keep pushing. Nothing intervenes.

Use the large steps to cross the bed, and switch to small steps as you approach the edges. If you are not sure where the carriage is, home it first.

In terraForge

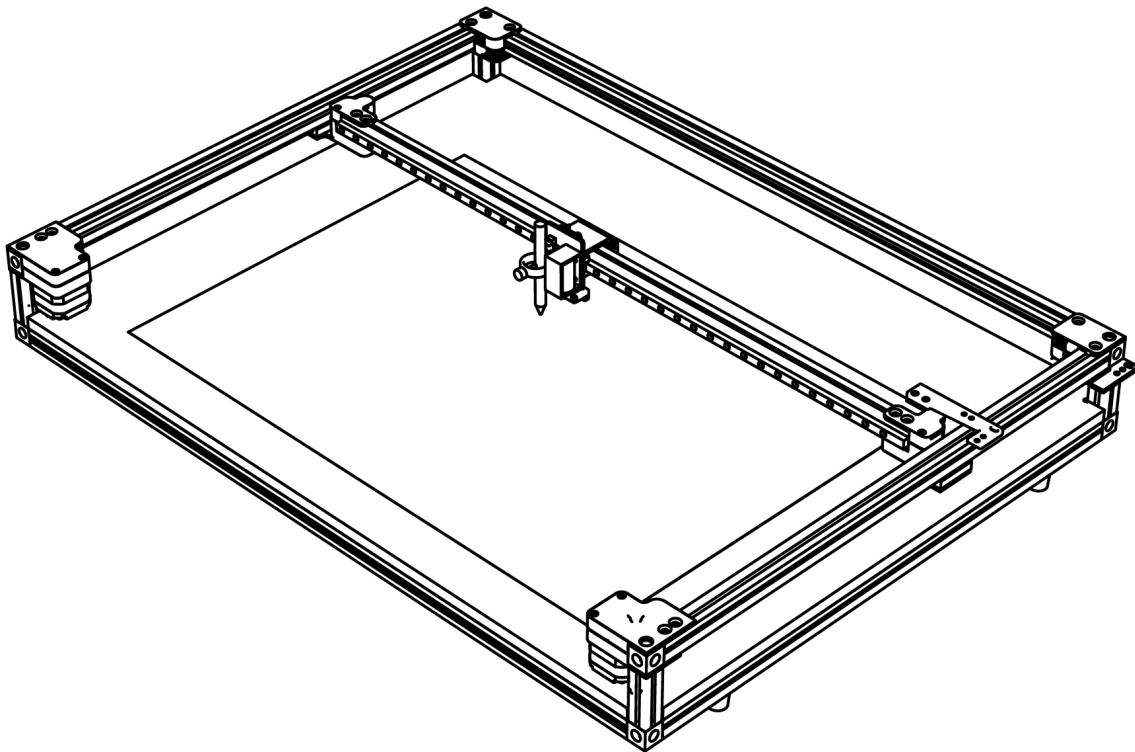
The **jog panel** in **terraForge** is the normal way to move the machine.



Plotting area and paper

How big can you go?

The terraPen plots a full A2 area — 594 × 420 mm. You can work anywhere within that, not just in the centre.



Oversized artwork is not rejected — it crashes the machine

Nothing checks whether a job fits before it runs. Send an A1 drawing to an A2 machine and the terraPen will start plotting it, drive into the end of its travel, and keep pushing.

There are no soft or hard limits to catch this — see [there is nothing to stop you](#). **Checking the artwork fits is your job, not the machine's.**

[terraForge](#) is the best protection here: it shows your artwork on a representation of the bed, so anything hanging over the edge is visible before you send it. Make sure your machine profile is set to the real bed size of 594 × 420 mm, or the picture it shows you will be wrong.

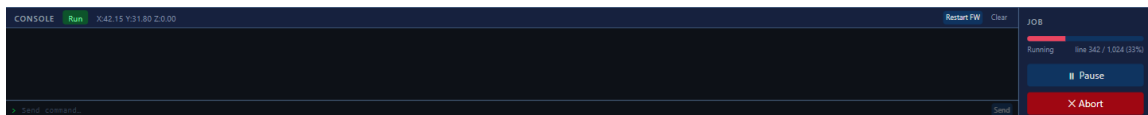
Starting, pausing and stopping a plot

Plots are run from [terraForge](#).

Starting

1. Select your file in the **file browser**, or upload it to the machine.
2. Press **Start job**.

Progress appears in the job panel, counting through the G-code line by line:



Decide whether you are staying

Make this choice **before you press Start**, because it decides whether pausing is available to you.

Once a plot is running it is driven from the terraPen's SD card, so the machine does not need your computer at all. You can close terraForge, shut the laptop, and walk away — the plot carries on to the end.



Do not reconnect to check on a running plot

Reconnecting to a plot already in progress — from either terraForge or the [web UI](#) — can overload FluidNC's websocket handling, stall the controller and **end the plot part-drawn**. You lose the sheet.

This is a limitation in the firmware, not something you have done wrong.

So there are two sensible ways to run a plot:

Stay connected	Leave terraForge open and connected for the whole plot. You keep progress and the ability to pause .

terraForge

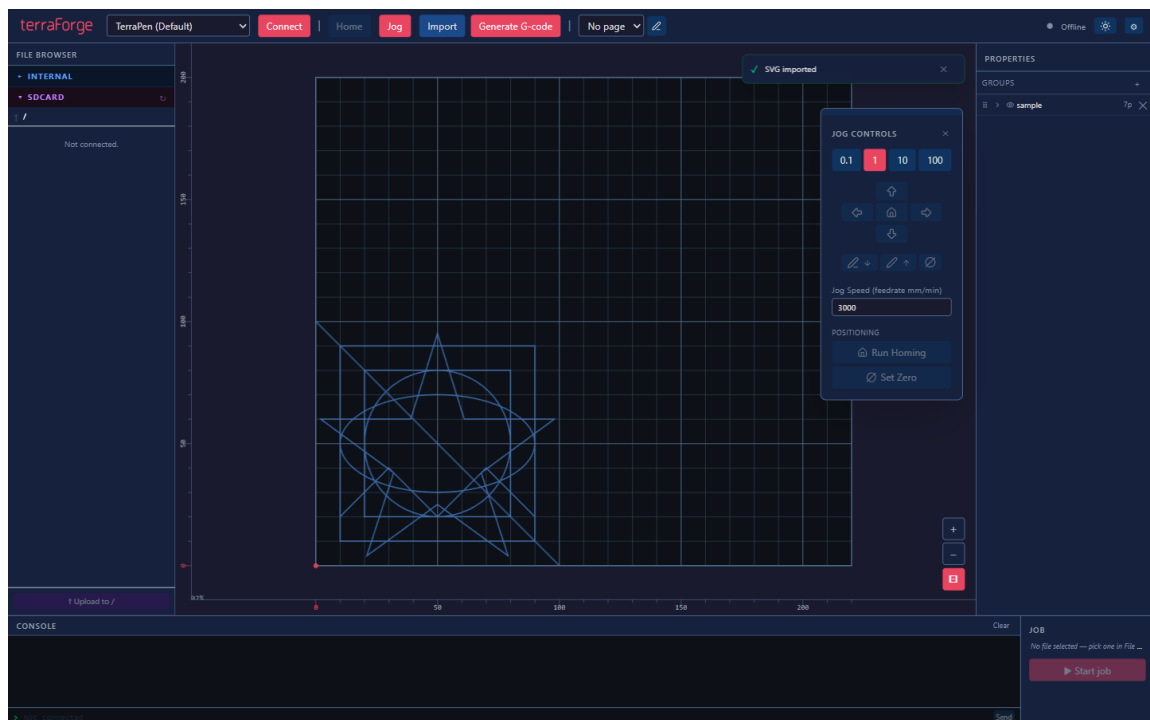
terraForge is how we recommend you drive the **terraPen**. It is our own desktop application, built for this machine, and it replaces the older routine of exporting, converting and uploading G-code by hand.

- [Download the latest release](#)
- [Full terraForge user guide](#)



Take the latest release candidate

terraForge is under active development, so the newest build is normally an RC release. That is the one to install.



Artwork sits on a representation of the bed, with the file browser on the left, jog controls to hand, and the job panel bottom right.

1. Set up your machine profile

Open the settings and create or edit a machine configuration.

Uploading files

The terraPen draws from **G-code** files — plain text instructions describing where to move and when to raise and lower the pen.



Use teerraForge

teerraForge generates G-code from your artwork, uploads it to the machine and runs it, all in one place. That is the route to use. The rest of this page covers making G-code elsewhere, and uploading by hand if you need to.

Making G-code

Any tool that outputs G-code will work:

Tool	Notes
teerraForge	Recommended. Built for the terraPen; SVG and PDF in, plot out.
Lightburn	Designed for laser cutters, but produces very well optimised G-code. Profiles provided.
Inkscape	Various G-code plugins available.
DrawingBotV3	Converts images into plottable line work and outputs G-code.
vpype	Command line toolkit for plotter work.
Laserweb	Browser-based G-code generation.
Your own code	Generative work can output G-code directly.

Save files with a `.g` extension.

Lightburn profiles and settings

Lightburn is designed for laser cutters, but it generates well-optimised G-code that works on the terraPen.



An alternative, not the recommended route

[terraForge](#) is built for this machine and needs none of the setup below. These instructions are here for people already working in Lightburn.



Solenoid machines

The profiles below cover both solenoid and servo toolheads. See [Solenoid pen lift](#) for the other settings those machines need.

Download a profile

Pick the profile matching your toolhead, from the [Lightburn-Profiles repository](#):

Your toolhead	Profile
Solenoid with pivot arm	Solenoid Relay INT Fluid NC.lbprefs
Solenoid without pivot arm	Solenoid Relay Fluid NC.lbprefs
Servo	terraPen_fluidServo.lbprefs

Settings

The canvas

Set the workspace up as an A2 canvas.

Cutting vinyl

The terraPen is a pen plotter, but swap the pen for a **drag knife** and it will cut vinyl. **terraForge** has a cutting mode to generate the right G-code.



Experimental

Vinyl cutting in terraForge is marked **experimental** and is subject to change. Expect to do some testing on offcuts before you trust it with good material.

What you need

Blade and holder	A standard vinyl blade and holder — the inexpensive Roland-compatible type is fine (example listing)
Sticky cutting mat	A Cricut-style adhesive mat to hold the vinyl flat (example listing)
Vinyl	Standard self-adhesive sign vinyl
Weeding tool	Or a scalpel and patience

The mat matters. Vinyl that lifts or shifts mid-cut ruins the job, and the sticky mat is what stops that happening.

Turning cutting mode on

Vinyl features are hidden by default.

1. Open **Settings**, then **Application Configuration**.
2. Tick **Enable vinyl cutting features (Experimental)**.

This does two things: it adds drag-knife defaults to Application Configuration, and it adds a **Vinyl** tab to the **Generate G-code** dialog.

Solenoid pen lift

Earlier terraPens used a **solenoid** to raise and lower the pen, rather than the stepper toolhead fitted to current machines.



For existing machines only

New terraPens are not supplied with a solenoid toolhead. This page is here for customers who already have one.

Everything else in this guide applies to you unchanged — setup, Wi-Fi, paper, homing, uploading, plotting, and stopping a plot. This page covers only the differences.

What is different

	Solenoid	Stepper
Pen lift	Solenoid, driven up and down	Stepper motor
On power-up	The solenoid actuates and sits upright	No visible movement
Pen delays	Needed — see below	Ignored
terraForge pen type	Solenoid (Hardware)	Stepper

Homing

No difference. Your machine has limit switches, so home it at the start of every session exactly as described in [Your first plot](#).

Pen up and pen down

A solenoid has **two positions**, not a range:

Connect to your own Wi-Fi network

By default the terraPen runs as an access point – you connect to it, which means your computer drops off the internet while you plot.

Putting the terraPen on your own network fixes that, and is how you will normally use it.

There is a more practical reason too: **file uploads are much more reliable over your own network**. Over the access point, a large plot can fail to transfer at all – see [uploading files](#).

1. Enter your network details

Connect to the `terraPen` access point and open the web UI, then open the controller settings.

Set each field in turn and click **Set** after each one. **Role comes first** – it is the field that actually switches the controller out of access point mode, and without it the machine will restart still advertising `terraPen` however correct the other details are.

Field	Set it to
Role	Change from Access Point to WiFi Client
SSID	Your network's name
Password	Your network's password

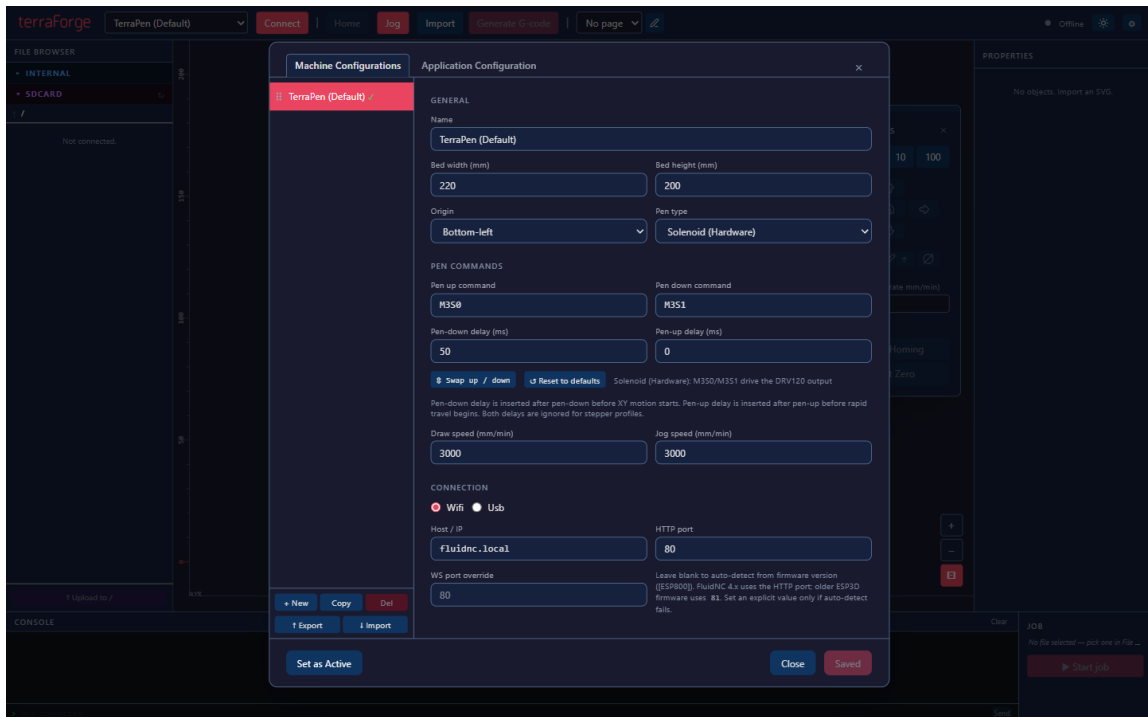
Sta/SSID	Your network  Set 
Sta/Password	 Set

Connect via USB-C

The terraPen can be driven over USB-C instead of Wi-Fi, using [terraForge](#).

Steps

1. Plug the terraPen into a wall outlet as normal.
2. Connect a USB-C cable between the terraPen and your computer.
3. In terraForge, open **machine settings** and set **Connection** to **Usb** rather than Wifi.
4. Connect.



That is all that is required. Jogging, homing, pen control, file upload and plotting all work over the cable.

Useful when Wi-Fi is awkward

A cabled connection sidesteps network problems entirely, which is worth having in a busy studio or a space with poor Wi-Fi.

Restarting the terraPen

Power cycling fixes a surprising number of problems. There are two ways to do it.

With the power switch

Use the switch at the **rear right** of the plotter. Off, a couple of seconds, then on again.

There is nothing to shut down first, so the machine takes no harm from being switched off.

Not during a plot

Cutting power mid-plot ends the job and loses the machine's position. If a plot is running and you simply want to stop it, **pause it** instead.

The exception is dangerous motion — if the machine is **driving into itself**, switch it off immediately and worry about the job afterwards.

Home again afterwards

A power cycle clears the machine's idea of where it is, so **home it** before plotting again.

From the web UI

1. Select the **ESP3D** tab (A).
2. Click the red **power** icon to reset the controller.

This restarts the controller without cutting power to the motors.

Maintenance

The terraPen needs very little looking after. This page is deliberately short, because prescribing a maintenance ritual the machine does not need would only waste your time.

Cleaning

Use a **lint-free cloth** or **solvent-free wipes**.

- Wipe down the bed and frame whenever dust builds up.
- Keep the pen holder free of ink residue.
- Clear paper dust and stray fibres off the rails.



No solvents on the rails

Solvent-based cleaners can damage the rail surfaces and strip what little lubrication is there. Lint-free and dry, or barely damp, is all that is wanted.

Lubrication

Usually not needed. Machines here have run many hours without any lubrication becoming necessary, so treat this as a fix for a symptom rather than a routine.

If the carriage starts to feel rough or noisy as it moves, a **silicone grease with PTFE** — something like [Super Lube 92003](#) — is the right sort of product.

Use very little, and wipe away the excess. Grease attracts paper dust, and too much does more harm than none at all.

Worth an occasional look

No schedule, just things to notice:

Belt	A visual check for wear or fraying

Transport and storage

The terraPen is portable enough to take to workshops, schools and shows. It is about **10 kg** and 800 × 600 mm, so it is a two-handed lift but not a heavy one.

Before you move it

1. **Take the pen out** of the holder. A pen left in place can mark the bed, leak, or catch as the carriage moves.
2. **Switch off** at the rear right and unplug the adaptor.
3. **Remove the paper** and the corner tabs.

Lifting it

Lift by the **base**, never by the gantry, the rail or the toolhead. Those parts move, and taking the machine's weight through them puts load somewhere it was not designed to go.

Taking it somewhere with different Wi-Fi

This is the part that catches people out, and it is worth setting up before you leave rather than in a hall on the morning of a show. A small travel router means the terraPen never needs reconfiguring, whatever network is available at the other end — see [trade shows](#), [schools](#) and [locked networks](#).

Take the adaptor, and a spare pen or two.

Storing it on its side

The terraPen is a big object to leave on a bench between jobs, so it is **designed to stand on its left-hand side**. There are **rubber bumpers on that side** for exactly this purpose.

Stood up, it takes very little floor space — tuck it against a wall, or between other furniture, and it stays out of the way.

1. Take the pen out and remove the paper.

Troubleshooting

Try this first

Most problems clear with a power cycle. Switch the terraPen off at the rear right, wait a few seconds, and switch it back on — see [Restarting](#). Home the machine afterwards.

The machine is crashing into itself

Power it down straight away

Switch the terraPen off at the **rear right**. Do not wait to see whether it stops on its own, and do not try to fix it while it is still moving.

An emergency stop during homing is being added to [terraForge](#); if your version has it, use it. The power switch works regardless.

There are two common causes. Neither is caught by the machine, because there are no soft or hard limits — see [there is nothing to stop you](#).

1. The artwork is bigger than the bed

The most common cause, and the easiest to rule out. An A1 drawing sent to an A2 machine will start plotting and simply run out of travel.

Check the dimensions of your artwork. In [terraForge](#) you can see it against the bed before you send it — and check your machine profile really does say 594 × 420 mm, or that picture is misleading.

2. A limit switch was not seen

If the job definitely fits, the machine did not see a switch when homing, and kept driving because nothing told it it had reached the end.

Getting support

The fastest help is on [Discord](#) — that is where we and other terraPen owners are.

Before you post, have a look at [Troubleshooting](#), which covers the faults people hit most.

What to send us

A message with the right detail gets answered in one round trip instead of five. Where you can, include:

Your machine	Stepper toolhead, or an earlier solenoid one
Versions	Your terraForge release, and the firmware if you know it
What you did	The steps that led up to it
What happened	And what you expected instead
Console output	Anything the serial console printed, copied as text

A short video beats a long description

For anything involving movement, wiring or connection settings, a few seconds of video tells us more than several paragraphs. Show the machine doing the wrong thing, and your connection settings.

Faults and damage

If the machine arrived damaged, or something has failed rather than misbehaved, say so early — photographs of the problem and of the packaging help, and we would rather replace a part than have you keep testing it.

Frequently asked questions

The terraPen is developed continuously, and its workflow differs from other plotters on the market. These are the questions we hear most often.

For symptom-by-symptom help, see [Troubleshooting](#).

Does it need assembling?

A little. The stepper toolhead ships unattached — four screws with the supplied hex key. See [Fitting the toolhead](#).

Where is the power switch?

At the **rear right** of the plotter. Plug the adaptor in, then switch it on there.

What software should I use?

[terraForge](#) — our own application, built for this machine. The terraPen also plots standard G-code, so other tools work; see [Uploading files](#).

How big can I plot?

A full A2 sheet — 594 × 420 mm.

Do I need a computer connected while it plots?

No. Artwork is stored on the terraPen's SD card, so once a plot starts you can close terraForge or take your laptop away.

But if you disconnect, do not reconnect until the plot has finished. Reconnecting part way through can stall the controller and end the plot. If you think you might want to pause, stay connected from the start — see [deciding whether you are staying](#).

Specifications

Drawing area	A2 — 594 × 420 mm
Overall size	800 × 600 × 110 mm
Weight	Approximately 10 kg
Motion	coreXY
Toolhead	Stepper pen lift, roughly 14 mm of Z travel
Controller	ESP32 based — ESP32 Plotter Controller
Firmware	FluidNC
Power supply	110–240 V switching adaptor with multi-region plugs, 12 V output
Connectivity	Wi-Fi (own access point or your network), USB-C
Storage	MicroSD card, supplied and pre-loaded
Input files	SVG, PDF and G-code via terraForge ; the machine plots G-code

Bench space

The machine is 800 × 600 mm, so allow a little more than that. Leave access to the **rear right**, where both the power inlet and the switch are.

Paper larger than the drawing area will overhang the machine, which is fine — but [the artwork itself must fit](#), or the plot will crash.

Between jobs it does not have to occupy the bench at all: the machine stands on its left-hand side on built-in rubber bumpers, taking roughly 800 × 110 mm of floor — see [transport and storage](#).

YAML configuration settings

The terraPen runs **FluidNC**. FluidNC is configured by a `.yaml` file describing the machine — its motors, its toolhead, its limits and its homing behaviour.

Your terraPen arrives already configured for its stepper toolhead. You do not need to touch any of this to plot.

When you might change it

- You have swapped toolheads — each toolhead needs its matching YAML file.
- You want to adjust settings such as **acceleration** or **feedrate**.

Travel values are not the working area

The `max_travel_mm` figures in these files do not define how much of the bed you can use — soft limits are disabled, and the real drawing area is **A2, 594 × 420 mm**.

Configuration files live in our [fluidnc-config-files repository](#).

Selecting a configuration

The active file is set by the **Config/Filename** field in the controller settings:

Config/Filename	terrapen-solenoid-int.yaml	Set
-----------------	---	-----

Set it to the YAML file matching your toolhead, then restart the controller.

Match the file to your hardware

Loading a configuration for the wrong toolhead can drive the pen into the bed or make homing move the wrong way. If you are unsure which file is right for your machine, ask on [Discord](#) before changing it.

Hardware and source files

The terraPen is open source. The mechanical design, the controller board and the firmware configuration are all published, so you can repair, modify or rebuild the machine yourself.

Mechanical

Repository	What's in it
terraPen-mechanical-design-files	3D files and bill of materials for the A2 coreXY plotter

Electronics

Repository	What's in it
ESP32_Plotter_Controller	The controller board — an ESP32 and TMC2130 two-axis design
z-axis-addon	Z-axis TMC2130 stepper driver add-on
fet_solenoid_driver	Solenoid driver, for earlier machines
12v_servo_driver_module	Servo driver module

Controller pinout

Useful when tracing a cable — the limit switches are **J5** for X and **J19** for Y.