Voltera Maintenance and Troubleshooting

ENGR241 Survey Paper

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Scope

The purpose of this document is to discuss various maintenance and troubleshooting tips for the Voltera V-One tool. This document is meant to supplement the support documents available on the Voltera website [1]. As this tool is new to SNF, and relatively new to the market, users should expect some teething issues and try to work with the SNF and Voltera staff to resolve issues and improve the tool.

Points of Contact

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Motor Skip

When both X- and Y-direction motors move at maximum speed, the drive system may "catch" and cause the motors to skip and grind. Symptoms are severe grinding noises and grossly incorrect positioning. This can easily be seen during the trace step of PCB printing, where the Voltera will trace in an incorrect location.

The issue has been resolved by manually limiting the maximum speeds of the motors in the GCode, but new firmware updates may reset this and bring the issue back. Voltera is aware of the issue and should be issuing their own firmware patches soon. If any grinding noise is heard while using the machine, users should stop immediately and contact Swaroop to resolve the issue.

Emergency Stop

The Voltera has two options to stop a print in progress:
- Regular stop
- Emergency stop

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Regular stop causes the Voltera to stop **after** printing the current discretized segment (see Print Quality). Emergency stop causes the Voltera to stop **immediately**. We recommend using the emergency stop in **all circumstances** because of the significant delay in using regular stop. The emergency stop button in the Voltera software is shown in Figure 1.
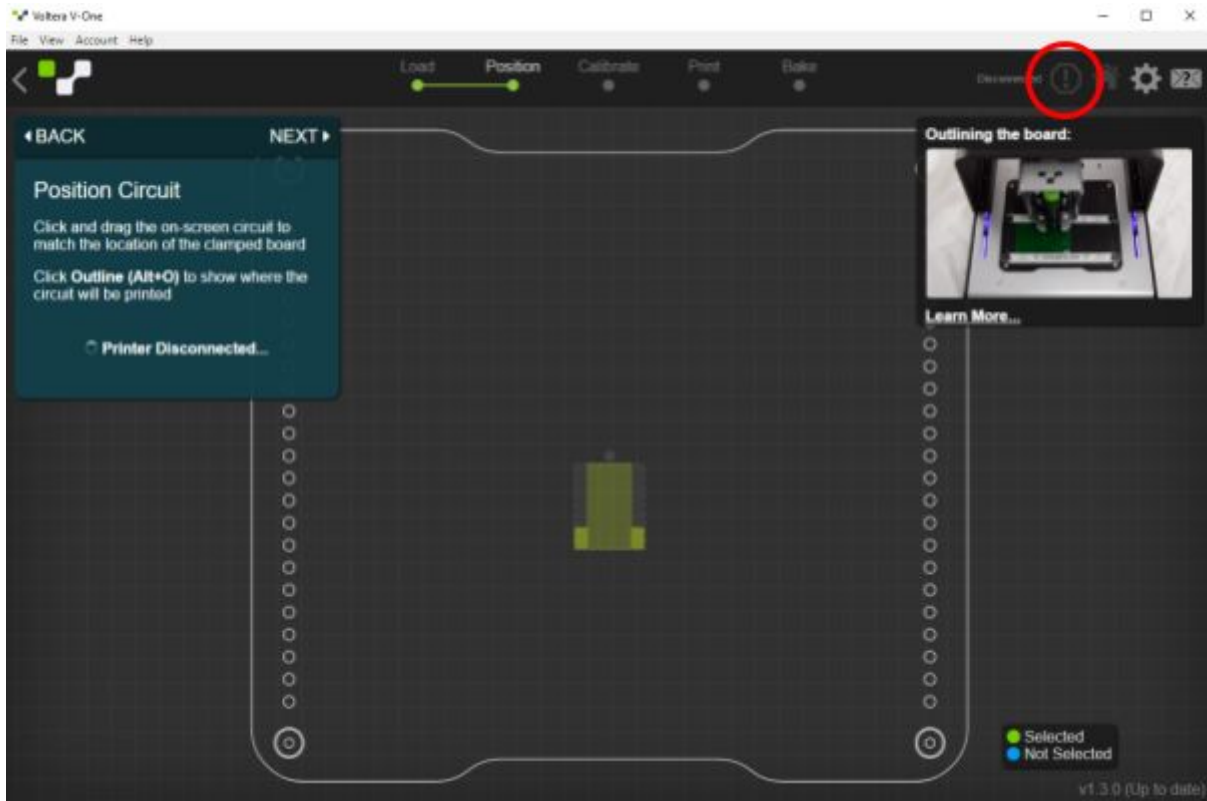

Figure 1: The emergency stop button is circled in red. It is not clearly visible so users should memorize its location and be ready to press it immediately if something is wrong.

Ink Quality

The most significant issue impacting ink quality is the formation of bubbles and voids in the ink. These will cause breaks in printed circuits and generally lower print quality. To minimize bubble formation, we recommend the following:

- When inks are not in use, store **upright** in a temperature-controlled enclosure set to the recommended storage temperature for the particular ink.
- Before printing with an ink, place it **upright** and warm up the ink to **room temperature**.
- Inspect the plastic seal inside the ink cartridge that separates the ink from the lead screw. If the seal is damaged or distorted, it should be replaced. See Figure 2.
- Right before use, hand-prime and extrude the ink manually onto a substrate to verify that there are no bubbles in the ink. If the extruded ink has breaks, continue extruding manually until there are no more breaks. See Figure 3.
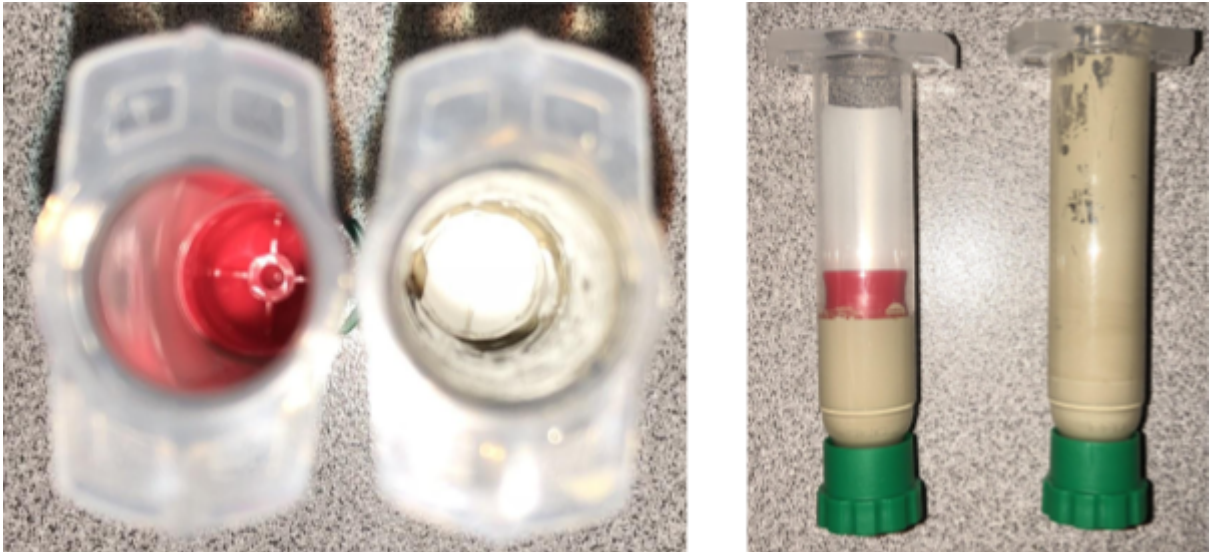
Figure 2: Top and front views of cartridges with good (left) and damaged (right) seals.

INSERT FIGURE 3: Hand-priming and dispensing diagram

Print Quality

Many factors impact print quality, but two important ones for very closely spaced geometries are the trim length and the anti-stringing distance. When a Gerber file is imported, the Voltera software discretizes the Gerber geometry into discrete segments. This can be seen in Figure 4. The purpose of the segments is to allow for easy reprinting to repair segments that are broken or didn't print properly. The length of each segment is controlled by the trim length parameter.
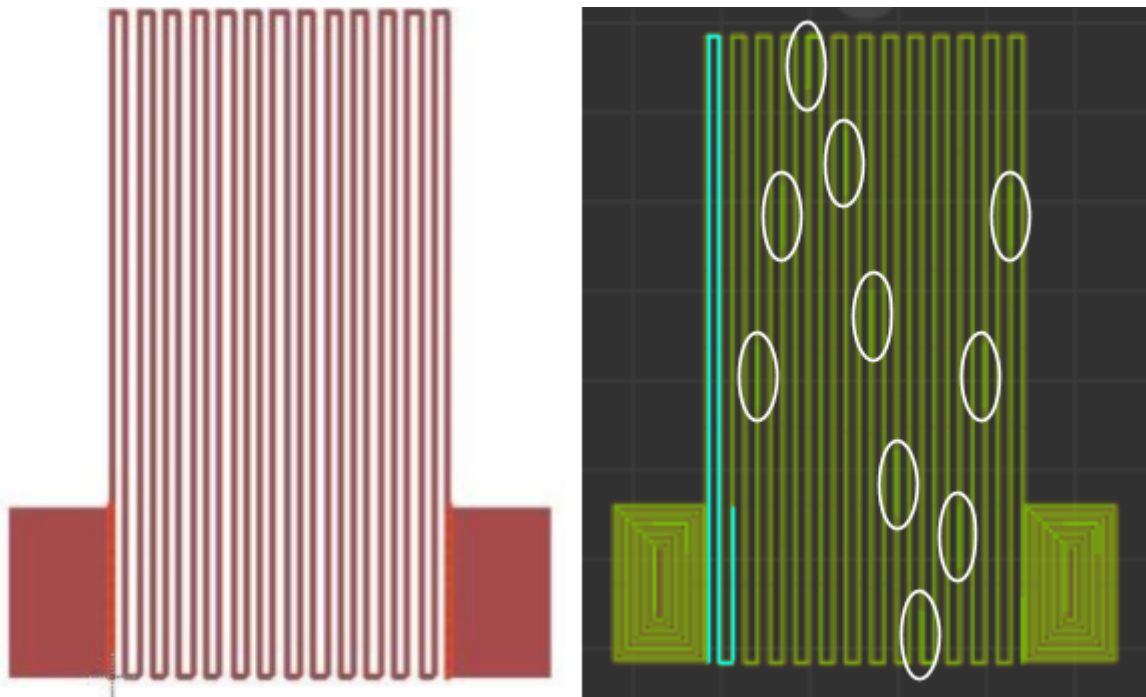

Figure 4: (Left) Gerber file. (Right) Discretized geometry, with an individual segment highlighted in cyan. Regions of overlapping segments are marked with a white circle.

Between segments, the nozzle resets itself to reduce thinning of the ink. This can be seen in Figure 5, where the segment gets thinner from start to finish. To connect segments, the Voltera turns around and retraces a certain amount from the previous segment, causing an overlap. The amount of overlap is controlled by the anti-stringing distance parameter. This overlap step catches any ink "strings" dangling from the nozzle and ensures connectivity between adjacent segments. However, depending on the ink, it typically creates an ink blob at the overlapping section. The effect is more pronounced on inks with lower viscosity. The ink blob can cause unintentional shorting of neighboring traces, as shown in Figure 5, limiting the spacing between neighboring geometry.
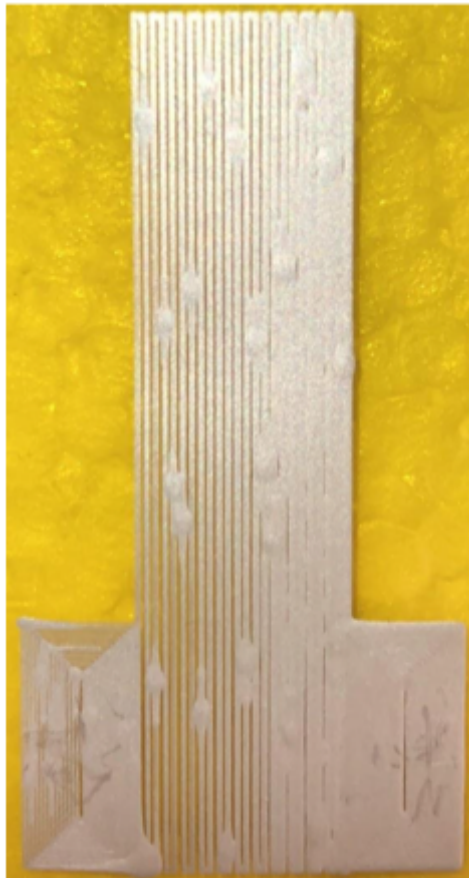

Figure 5: Thinning out can be observed along a trim length. Between trim lengths, ink blobs are used to prevent disconnects but also create short circuits.

A screenshot of the Voltera software showing where to change the trim length and anti-stringing distance parameters is shown in Figure 6.
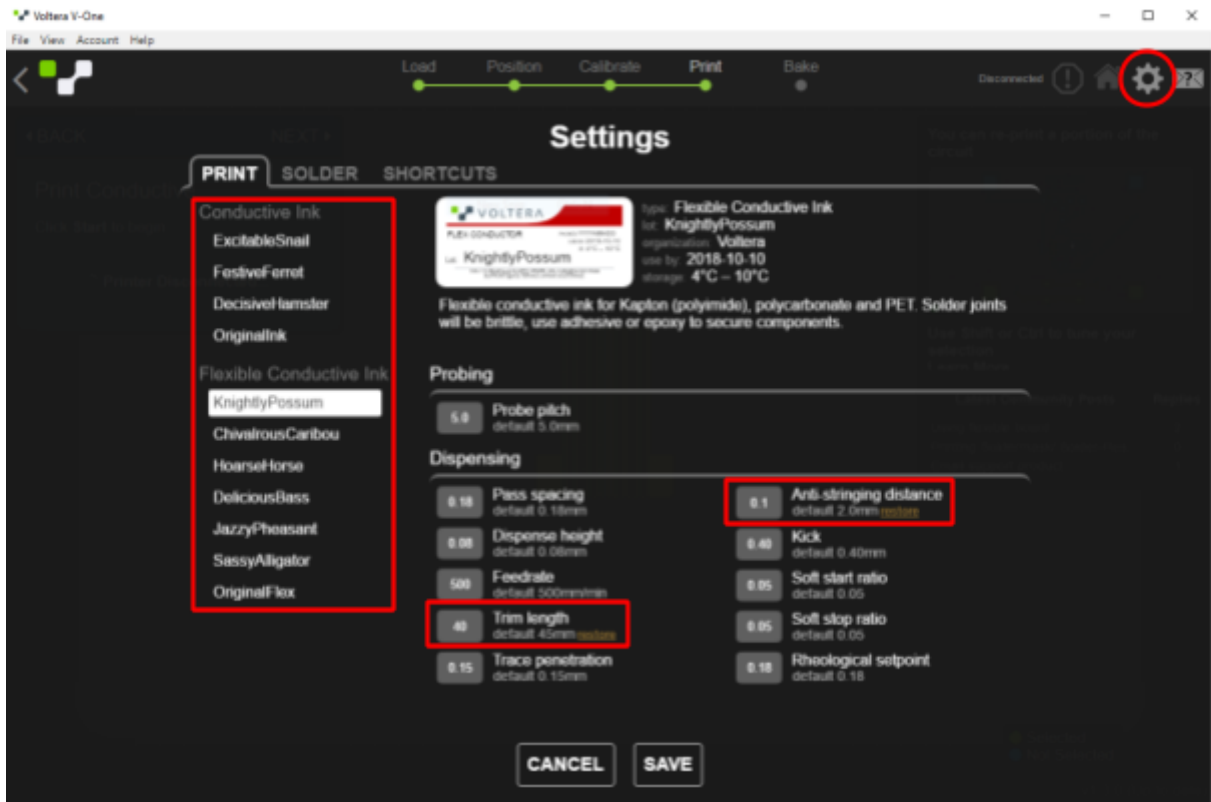
Figure 6: To access the Settings menu, click the gear icon in the upper right. Make sure to click the correct ink in the left menu before editing parameters.

Cleaning

The two limit switches (shown in Figure 7) should be cleaned **after every print**. Q-tips and isopropyl alcohol work well to clean the recesses of the switches.

Figure 7: Limit switches (circled in red) should be cleaned with a Q-tip after every print to prevent inaccurate homing and positioning.

To prevent the nozzles from clogging, they should be purged with isopropyl alcohol (or another applicable solvent) using a syringe after **every print session**, as shown in Figure 8.
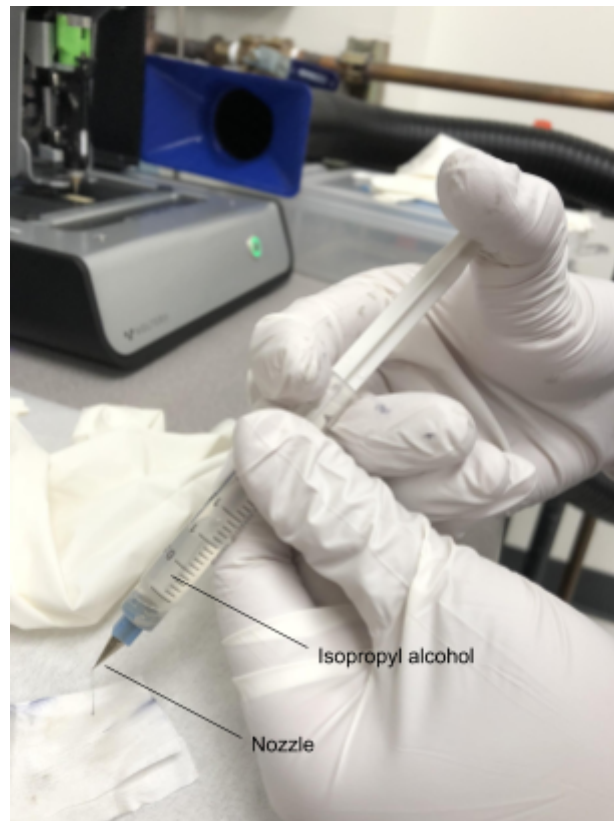

Figure 8: Purging a nozzle of leftover ink using a syringe filled with isopropyl alcohol.

(1) After printing, the nozzle should be screwed onto a clean disposable syringe filled with solvent (in the case of Voltera inks, IPA), and the nozzle should be purged until mixture exiting is clear.
(2) Once the nozzle is purged, it can be placed in its plastic holder, filled with the appropriate solvent (caution: some solvents may damage the plastic parts of the nozzle. We found IPA and acetone to be safe)
(3) The drowned nozzles can be stored in the refrigerator at the temperature the ink is kept at. This can slow or stop curing of the remaining ink in the nozzle, preventing it from clogging

If the nozzle has become clogged, it can be placed in an ultrasonic bath. We found that on our unit 40% power for 30 minutes was enough, but this can be increased if necessary.
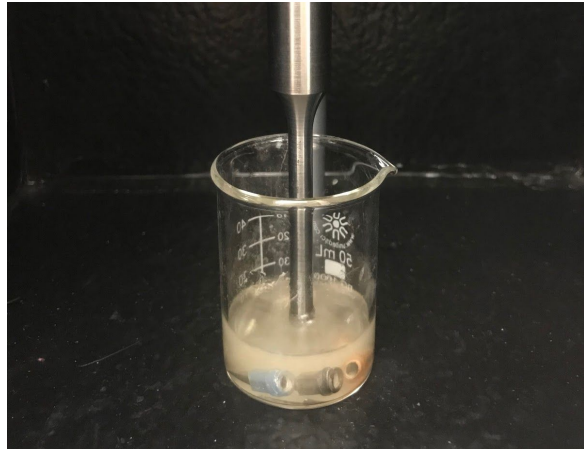
Figure 9: Sonicating the nozzles in acetone bath.

References

[1] https://support.voltera.io/hc/en-us