

Electroplating with the Contac S4

First, some safety notes:

NO OPEN TOED SHOES WHILE USING THE PLATER!

NO LOOSE OR DANGLING CLOTHES OR HAIR!

YOU MUST WEAR THE CHEMICAL SAFETY GEAR WHEN USING THE ACID BATH (#5)!

These are super important. The plater has absolutely no protection built in for you except for a flimsy plastic cover loosely placed on top of each bath (see Fig. 2), so it's CRITICAL that you take care.

IF YOU FAIL TO PRACTICE SAFE USAGE OF THE TOOL, YOU CAN BE SUSPENDED OR BANNED FROM THE TOOLS OR THE SPACE!!

This is for both your safety and the safety of everyone around you. Please don't make us do this. It's no fun for anyone.

If acid gets on you:

1. DO NOT PANIC. Or at least try not to.
2. Yell for help.
3. Rinse the affected area for 15 minutes. Use the sink, if possible. If not, right outside the room, to the left, is an eye wash station and a shower. Use them if you need to.
4. The "help" should have called GTPD and EHS while you're rinsing. Their phone numbers are on the wall right next to the tool. The Safety Data Sheets are also right next to the tool.

However, if you follow the instructions below, wear all the chemical gear, and use common sense before touching things that might be contaminated, your risk for harm is quite low.

Okay, and with that out the way... onto the plating!

The electroplater is located in the far corner of the PCB room from the plotter and laser.

1. If your substrate is in the ProtoMat still, please remove it while noting the orientation of it. I like to take a photo.
2. If you turned the tool on previously and let it warm up, great! Skip to step 4. Otherwise, make sure you're logged into the tool on SUMS and switch on the electroplater by toggling the switch above the power cord connection on the machine (see Fig. 1). On the screen, click "OK" through all the warnings and reminders (these are all taken care of by staff regularly) until it reaching the first screen ("Prepare the PCB").
3. Go for a walk or do some other work for about forty-five minutes while the tool warms up. Bath 1 needs to heat to 50C, which it will do automatically after booting up, but it takes some time. At least a half hour.

The process begins at the "Prepare the PCB" instruction (see Fig. 4) and continues one screen at a time. Follow each step! Below are some general pointers for using the tool:

- a. There is a play button that starts the timer, if applicable, and a "Next Step" button (it's an arrow) to the right of the play button to advance to the next step. If you need to go back a step, press the "Previous Step" button. Use these to advance through the process.
- b. Each timer corresponds with a bath, and will automatically advance to the next step at the completion of the timer.
- c. A black, chemical-resistant, drip tray is located in the tool's vicinity as well. *Please use this when moving between the tool and the sink.*

For each bath:

- a. Remove the cover and place it in the slot behind the tool (see Fig. 6)
- b. Slowly lower the material attached to the pcb holder into the liquid such that the pegs seat into the PCB holder cleanly, and screw down the thumb screws before hitting play (see Fig. 8).
- c. When the timer is over, slowly remove the holder, let drip-drain for ten seconds or so, place the substrate+holder apparatus into the drip tray, and replace the bath cover.

Okay, with that out of the way, let's continue by going through each step.

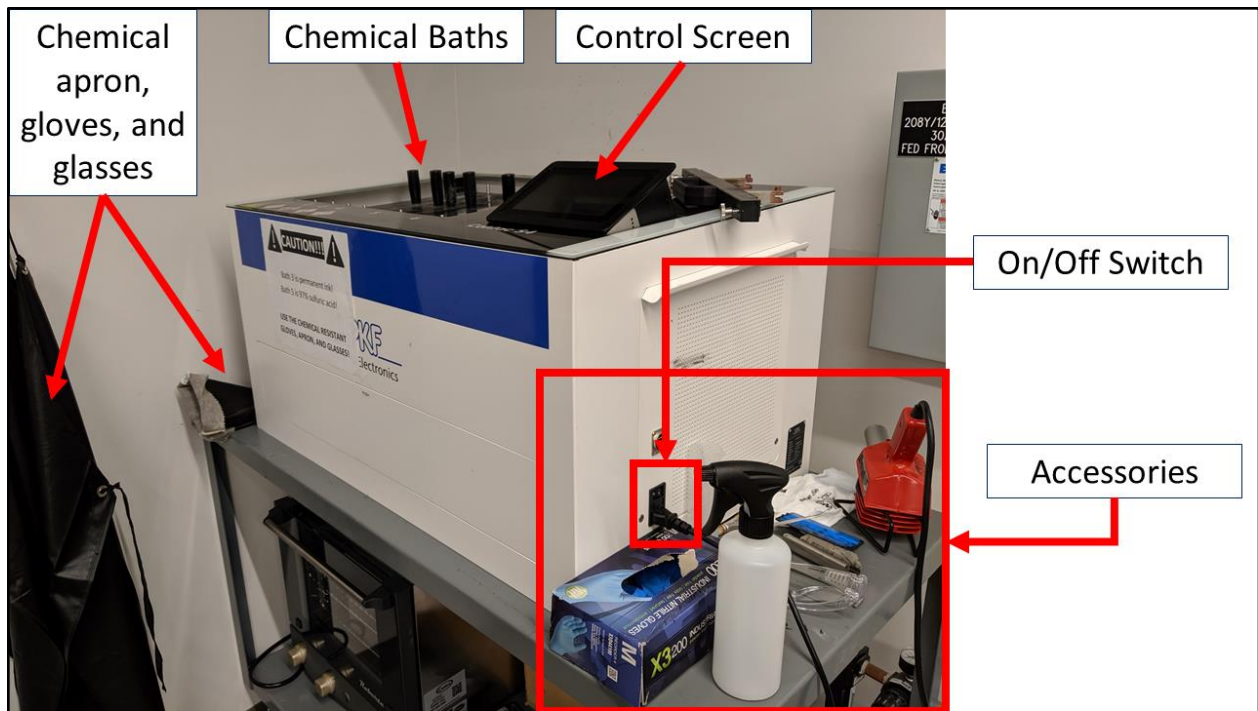


Figure 1: Contact S4 Electroplater parts locations.



Figure 2: The electroplater baths (1-6) with lids.



Figure 3: Substrate in the electroplater PCB holder with allen key.

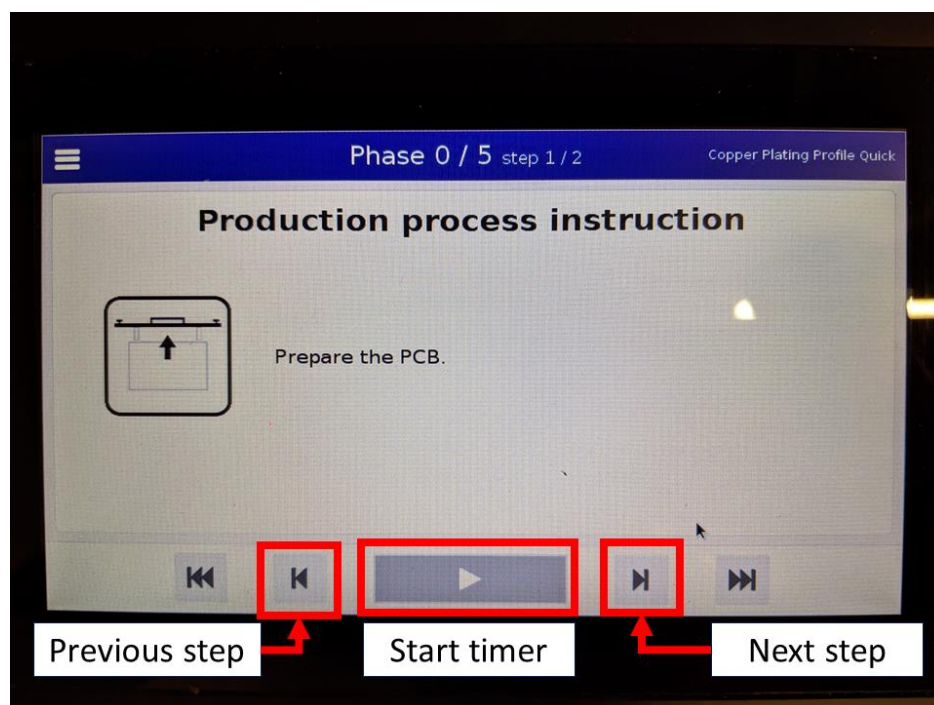


Figure 4: The start of the electroplating process, with the three necessary buttons highlighted.

4. Once the bath is warmed and the “Prepare PCB” step is loaded on the screen (as in Fig. 4), use the allen key (it should be next to the tool, in the “Accessories” region hopefully) to attach the board into the PCB holder (see Fig. 3). Note that orientation does not matter here - plating will occur on all open faces, but your design should be below the top centimeter or two of the substrate (otherwise it may not get coated by the liquid for the plating). Once you’ve done that, click “Next”.
5. Using the black drip tray (should be right on the tool, but may be in the sink), move the board and holder to the sink and rinse it off. This is removing small loose particles, so no need to scrub or anything. Using the drip tray again, move the board+holder back to the plater and click “Next” (the single right arrow).
6. The screen you see (shown in Fig. 5) is typically of the soaking steps.
 - a. Remove the plastic lid off of the bath in question (which for this step is bath 1). LET IT DRIP DRAIN INTO THE BATH. Then slot it into the narrow slot behind the tool (see Fig. 6 and Fig. 7). Note: do NOT put it into the wide slot. That one is for the acid bath, and we want to minimize cross-contamination.
 - b. On the bottom of the board holder, on either end, there are a pair of holes. One is for the knurled screw (for Bath 5). The other will be the home for the metal pegs on either end of each bath. Lower the board and holder into the bath, and slot the pegs into those holes; see Fig. 8 for what this ends up looking like. No need to tighten down the screws prior to Bath 5.
 - c. Press the “Play” button to start the timer (it’s the middle one that looks like a triangle pointing right; see Fig. 4 and Fig. 5).



Figure 5: The “Phase 1” screen, typical of the soaking screens. Note that I incorrectly did not wait for the bath to heat. Shame on me.



Figure 6: Bath 1 cover removed and placed in slot-holder behind the tool.



Figure 7: The cover for Bath 1 in the storage slot. (Note that this does NOT go into the wider slot on the right; that one is reserved for the Bath 5 cover.)

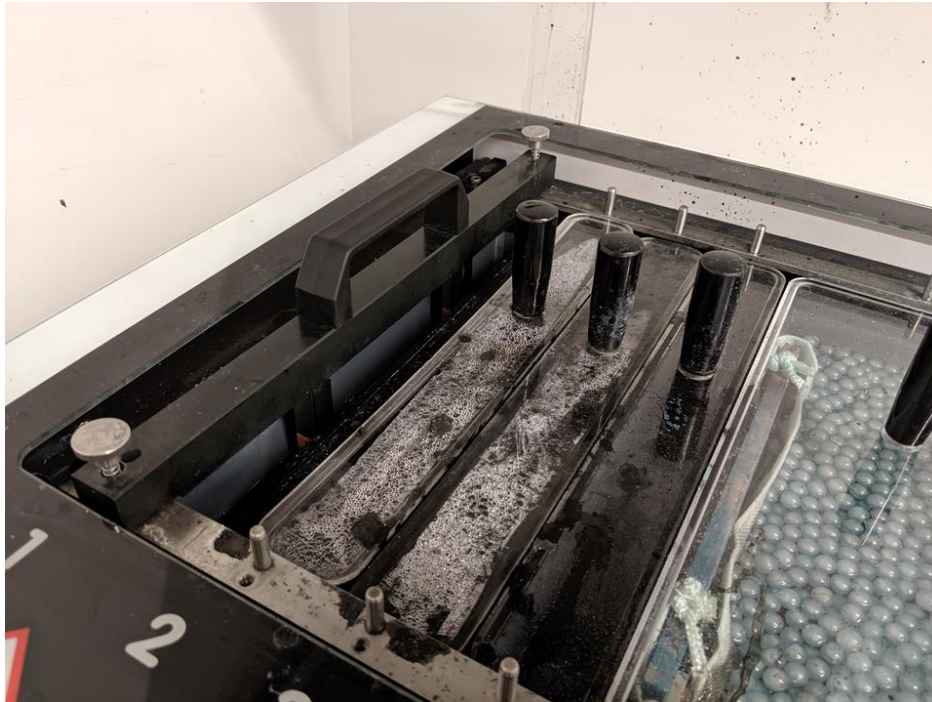


Figure 8: PCB holder seated completely into Bath 1.

7. After 15 minutes, the software will automatically move to the next step.
 - a. Remove the substrate and holder from the tool AND LET DRAIN into the bath. (The removal can require some force.)
 - b. This is a RINSE step, so use the DRIP TRAY to move the board to the sink, rinse, and the use the DRIP TRAY to move back to the tool.
 - c. Replace the cover to Bath 1.
 - d. Click "Next".
8. The tool will bring up the "Phase 2" screen that looks like the "Phase 1" screen.
 - a. Put the cover for Bath 2 into the storage slot.
 - b. Slot the substrate+holder into Bath 2.
 - c. Press "Play".
9. After 5 minutes, the software will automatically move to the next step.
 - a. Again, remove the substrate, let drain, use the drip tray to go rinse and come back.

- b. Replace the cover to Bath 2.
- c. Click “Next”.

10. Click “Next” through the demineralized water step.

- a. We don’t carry demineralized (or de-ionized) water, so if you’d like it, you’ll need to bring it yourself. Note that it’s not particularly important for the plating process since our water is not considered “hard”.

11. Next is Phase 3.

- a. Again, remove the cover to Bath 3 and place in the storage slot.
- b. LPKF recommends using a glass rod (which is next to the tool, I promise) to stir Bath 3 for 2-3 minutes before using it for a more even activation. This is good policy. Try not to drop it in; if you do, get a PI to get in touch with us (the MPIs) to ask for a new one.
- c. Slot to substrate+holder into Bath 3.
- d. Click “Play”.

12. After 15 minutes, the software will jump to the next step. THIS IS NOT A RINSE STEP!!
Read it carefully before continuing.

- a. We strongly advise wearing nitrile/latex gloves and the chemical apron for this step as the ink will stain anything and everything.
- b. Locate the squeegee next to the tool - it’s a blue credit-card-sized rectangular plastic thing in a metal stand.
- c. Slowly raise the substrate+holder out of Bath 3.
- d. Using steady swipes in the same direction (as much as possible), use the squeegee to swipe off the activator back into the bath.
 - i. Yes, BACK INTO THE BATH.
 - ii. Yes, this is annoying.
 - iii. You will not get it all, but you want to get enough of it so it’s not dripping all over the place.
- e. Rotate the substrate+holder carefully and squeegee the backside of the substrate in the same fashion.
- f. Put the substrate+holder into the drip tray and remove the substrate from the holder using the allen key.

- g. Use the drip tray to transfer all three parts (substrate, holder, and allen key) to the oven below the tool.
 - h. Place the substrate (still with some of the activator on it) into the oven and close the lid.
 - i. Set the oven temp to just above 150F (it's written on the knob), and turn the timer to 20 minutes. (Much longer than 20 minutes might bake the activator on too hard.)
 - j. While you wait:
 - i. Rinse the holder, allen key, and drip tray in the sink.
 - ii. You can click "Next" through the next three steps:
 - 1. The "Remove copper foil" step is only needed if you have copper foil on your substrate. The Hive's substrates do not have this.
 - 2. "Phase 4" is Bath 4. We actually don't use Bath 4. (Why? It's mostly useful for blind vias, according to LPKF.) So you can skip it safely. If you forget and put the board in the bath anyway, the bath is actually empty, so no harm done.
 - 3. The rinse step after Phase 4 will be done after the substrate comes out of the oven.
 - 4. After clicking "Next" through the rinse step, the tool will have some number of warnings. Click "OK" through all these to get to the "Phase 5" screen.
13. Once the oven timer goes off, make sure you have nitrile/latex gloves on and the apron before removing the substrate (it's not too hot, don't worry). Go rinse the substrate in the sink.
- a. Most of the activator will come off in the water *and that's good!* The only activator we want to remain (as much as possible) is in the holes, and the oven just cured that, meaning the activator in the holes will stay on through the rinse. Just get rid of the rest of it.
 - b. Use of a sponge or wet paper towel is recommended to get off as much of the activator off the surface as possible. Excess activator on the surface will cause uneven plating, which is quite detrimental to your etching later. *This is by far the easiest place to make an avoidable error!* Scrub it off. The stuff that's baked onto the FR4 won't go anyway; you can try by scrubbing along the edges of the substrate (which should be coated in a light cover of black ink; if not, well, you might want to go back to Phase 3 again?)

14. Re-insert the substrate into the holder with the allen key, and then bring everything back to the tool (using the drip tray, of course).
15. You should be at “Phase 5” now. (If not, click “Next” and “Ok” until you’re there.)
 - a. First, **PUT ON ALL THE CHEMICAL SAFETY GEAR** – glasses first, then apron, then gloves, with the cuffs. (I normally have a pair of latex/nitrile gloves underneath the acid gloves for comfort.) See Fig. 1 for where the safety gear is (hint: it’s right around the tool), and Fig. 9 for what the donned attire looks like.
 - b. Next, remove the cover to Bath 5 and place it in the wide storage slot behind the tool, next to the narrow one you’ve been using.
 - c. Next, slot the board+holder into Bath 5 in the same manner you’ve been doing.

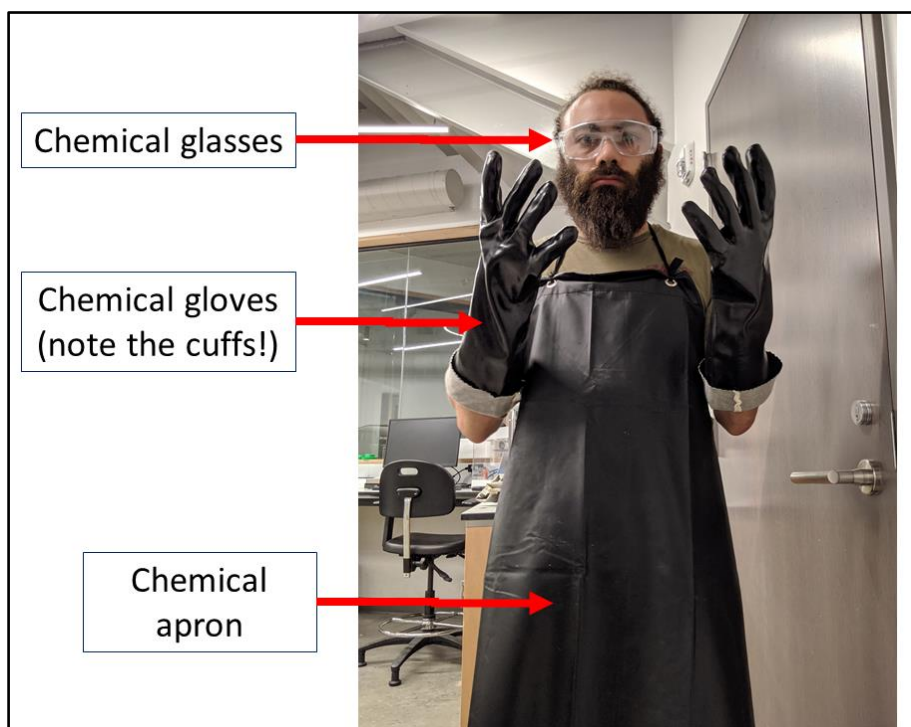


Figure 9: How to wear the chemical safety gear.

- d. Next, *screw the knurled screws down snugly!* This is critical for this step because poor contact can cause the plating to fail, or damage the tool entirely.
- e. Next, **DO NOT TOUCH THE SCREEN! DO NOT TOUCH THE SCREEN!** Go rinse the acid gloves in the sink first. Then remove the gloves and leave them hanging over the sink to dry a bit.
- f. Once the acid gloves have been rinsed and removed, you may click “Play” to start the plating process.

16. If the plater has an issue, it'll typically tell you immediately that something is wrong. Otherwise, let the process go. You can de-gown from the chemical gear now.

- a. The default process includes a flip of the substrate halfway through (1 hour after starting Bath 5). To complete this:
 - i. Put the chemical safety gear on again (glasses, then apron, then the gloves).
 - ii. Unscrew the knurled screws and slowly withdraw the substrate+holder from the bath.
 - iii. Rotate the substrate+holder 180 degrees and slot it back into the bath.
 - iv. Screw the holder back down.
 - v. **Go rinse the gloves.** Then remove them and set to dry before clicking "OK" to continue with the second half of the plate.

17. Once the plating time is up:

- a. Go place the allen key next to the sink. You'll want it in a minute.
- b. Put the chemical safety gear on again (glasses, then apron, then the gloves).
- c. Unscrew the knurled screws and slowly withdraw the substrate+holder from the bath.
- d. Let it drip drain back into the bath.
- e. Move the substrate+holder to the drip tray and replace the cover for Bath 5.
- f. Using the drip tray, bring the substrate+holder to the sink.
- g. **Rinse EVERYTHING.** This includes the substrate, the holder, the allen key, the gloves, and the drip tray.
 - i. This is slightly easier if you use the allen key to remove the substrate from the holder before starting to wash.
 - ii. Make sure to rinse everything well. It's sulfuric acid - you don't want it touching you.
 - iii. You can leave the holder to dry on the rack, the drip tray to dry upside down in the sink, and the gloves to dry over the edge of the sink. The allen key should go back to the plater table.
- h. Once everything is washed and drying, put the substrate into the oven again, 200F for 10 minutes, to dry fully. (You can leave it longer if it doesn't dry completely.)

18. While the substrate is in the oven, it's time to clean up:
 - a. Put the holder into the drip tray and put them both back on top of the plater.
 - b. Make sure the allen key is back on the plater table.
 - c. The gloves should be put back to the left of the tool.
19. Shut off the plater by toggling the on/off switch (on the right, above the power cable; see Fig. 1).

Once the substrate is dried and cooled (it'll be hot out of the oven), you can move onto the ProtoLaser for etching. You unfortunately won't be able to electrically confirm the quality of completeness of the plating job until after etching, though you can use the microscope near the ProtoMat to visually inspect the holes. YMMV.

Note: the dryness of the substrate will affect the final surface finish discoloration, so it's good to have it as dry as can be, though it will not affect the actual plating quality. That's already locked in place.