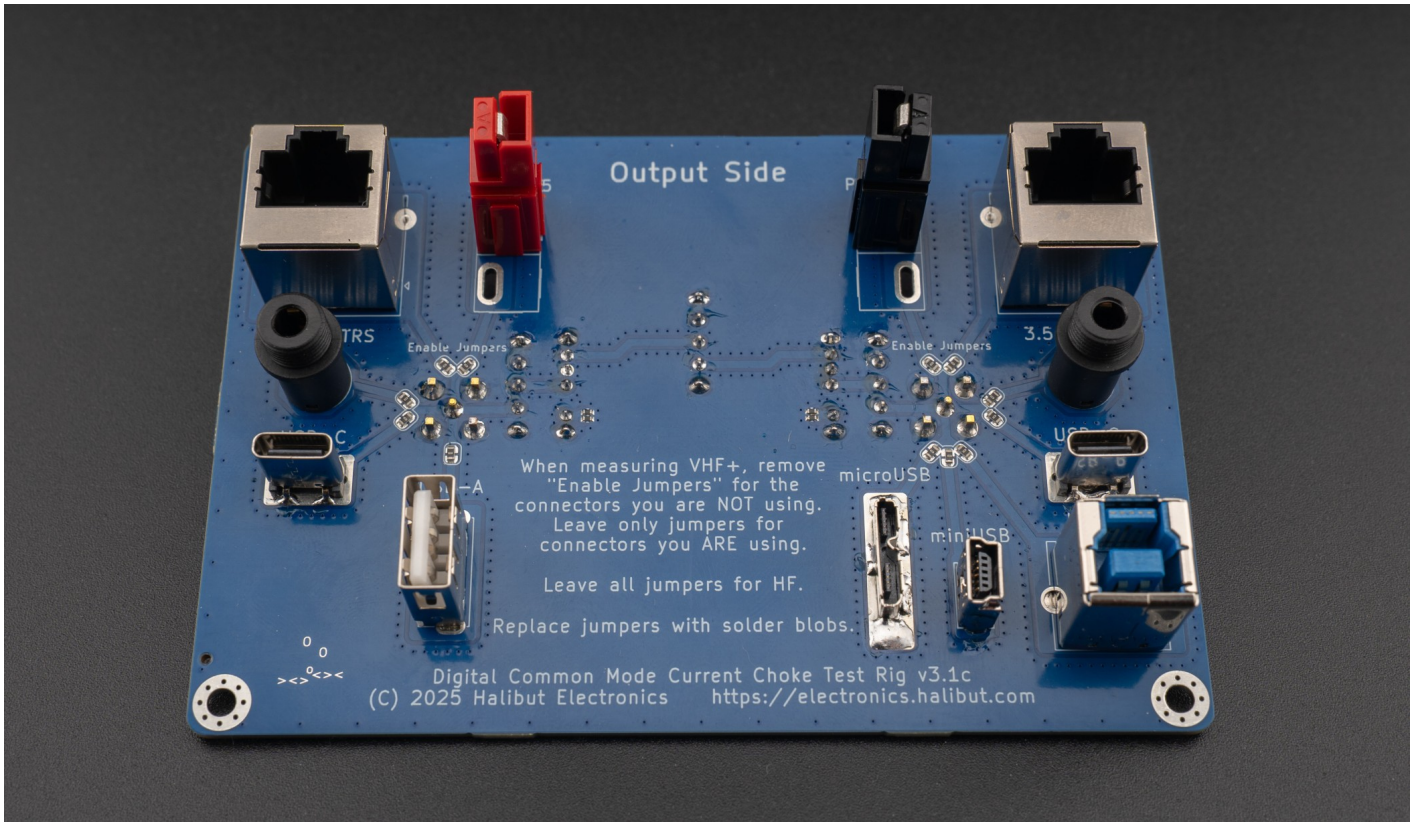
Digital CMCC Test Rig Assembly Instructions

Thank you for purchasing the Halibut Electronics Digital Common Mode Current Choke Test Rig! That's quite a mouthfull, so I'm just going to call it the Digital CMCC Test Rig, or just Digi CMCC, or Rig, etc. ...we're pretty close, on a first name basis. I like to name-drop it a lot. Gives me street cred. ...Anyway...



Digi CMCC is a kit, some assembly required. And by "some" I mean "all." But don't worry, it's pretty simple, I'll help you through it.

This version of the documentation covers v3.1 of the **DIGITAL** CMCC Test Rig. If your kit has a bunch of RF connectors, Type N, SO-239, BNC, etc, then please see the RF CMCC Assembly document instead.

Special Thanks!

I want to give an extra special thanks to the following Halibut Electronics Patreon members who give at the Barefoot Level or above at the time the Digi CMCC boards went to fabrication. You help keep the business running, with both your financial and emotional support. Thank you so much.

- AE0PQ Jordan
- WY8V San
- VE3BIC Andre
- W6MDX Tom
- AC7FD Tobias
- AE5X John
- KF5CLZ Dave
- K5IAG David
- VA3MW Mike
- KJ7OHF Lionel

Change Log

Date	Description
2022-08-18	First public revision. Assembly of v3.0c boards.
2022-11-30	Updating for v3.0d boards. Electrically identical, new silkscreen to clarify assembly.
2024-01-11	Updating for v3.1a boards. Added on-board calibration standards. Updated images.
2024-04-30	Split v3.0 into its own document: Assembly-v3.0.pdf
2025-04-21	Forked for the Digital CMCC Test Rig kit.

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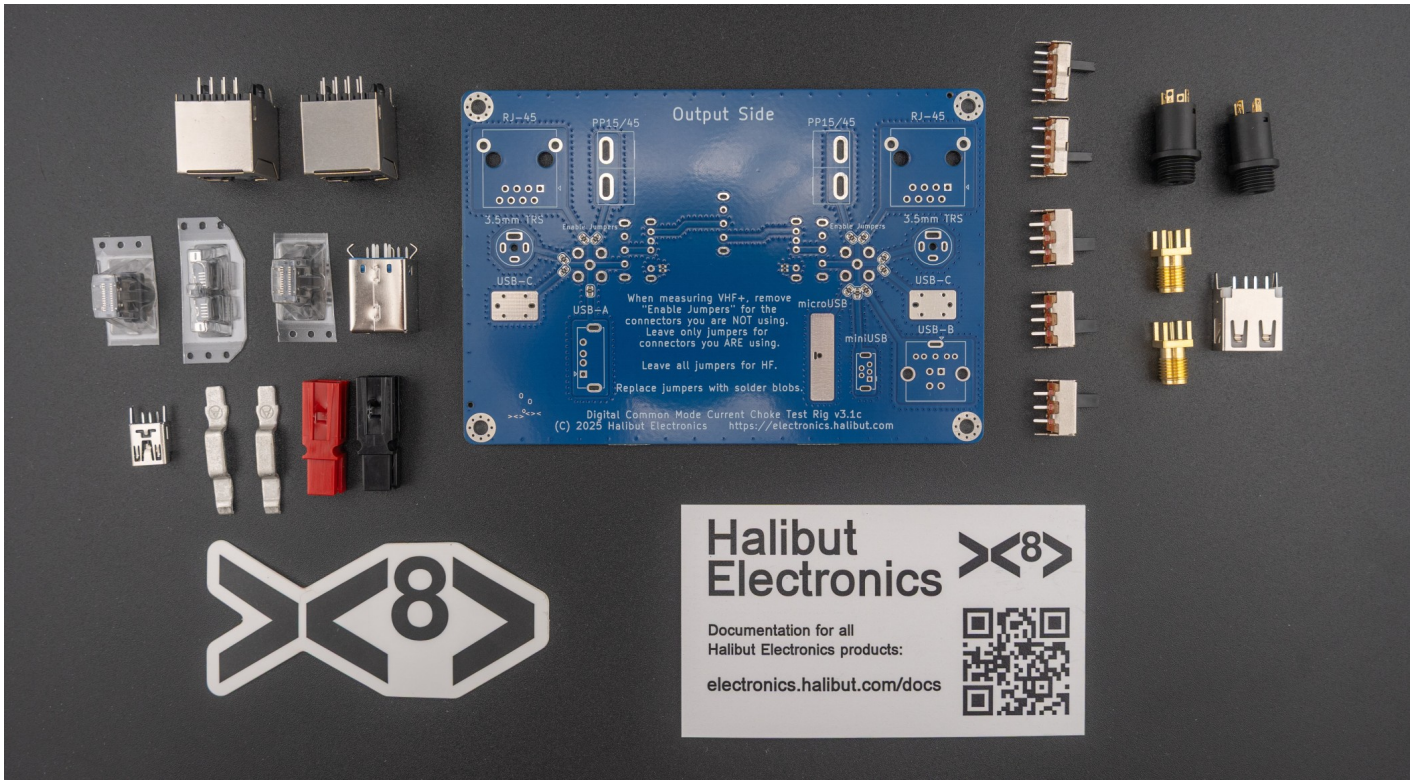
1. Parts and Tools

The kit includes all the parts needed to assemble the base kit, but you'll need to provide some tools and consumables.

1.1. Provided in the Kit

First, lets make sure your kit is complete. It should have come with the following items:



Quantity	Description
1	Circuit board
2	SMA female PCB mount connectors, to connect to your VNA.
3	Single pole, double throw (SPDT) slide switches. They have evenly spaced pins.
2	Single pole, triple throw (SP3T) slide switches. They have a gap in the pins.
2	8p8c Modular, aka RJ-45, sockets. eg: Ethernet.
2	Anderson Power Pole board mount connectors (one per side, not two pairs) eg: Power cable.
2	3.5mm TRS sockets. eg: Audio cable.
2	USB-C sockets, probably in a thin plastic container. This is the tape they come in for pick-and-place assembly.

Quantity	Description
1	USB-A socket.
1	USB-B socket, the blue kind that takes USB 2.0 or USB 3.0 cables.
1	microUSB socket, the kind that takes USB 2.0 or USB 3.0 cables. This is in the same type of thin plastic tape that the USB-C sockets are in.
1	miniUSB socket. (They never made a USB 3.0 "mini" socket.)
1	Halibut Electronics sticker (In my humble opinion, the most important part.)

If any of these parts are missing, please contact us and we'll mail you the missing parts.

1.2. Required: You Provide

You are required to provide the following:

- Soldering iron.
  - Unlike the RF CMCC Test Rig kit, nothing here requires a lot of heat. So a "normal" wattage iron is fine here.
- Solder. Either ROHS or leaded, your choice.

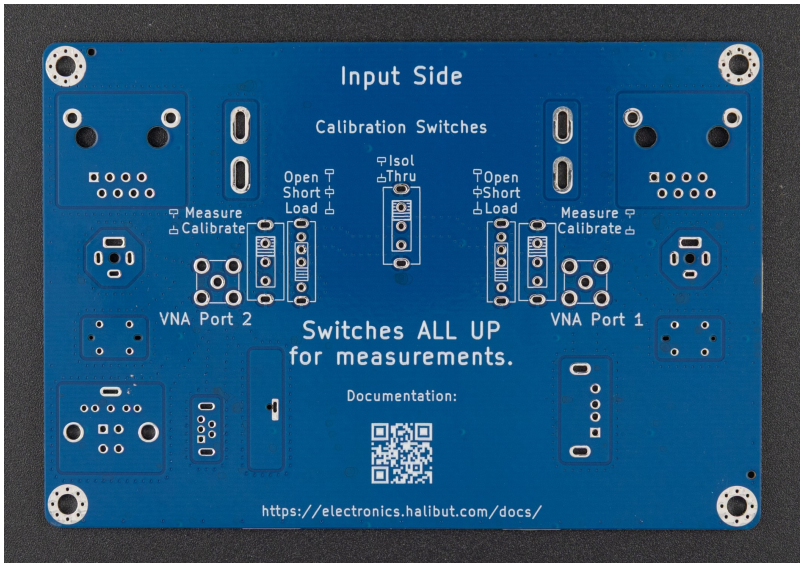
2. Assembly

Ok, you've got all the parts and all the tools. Let's do this thing.

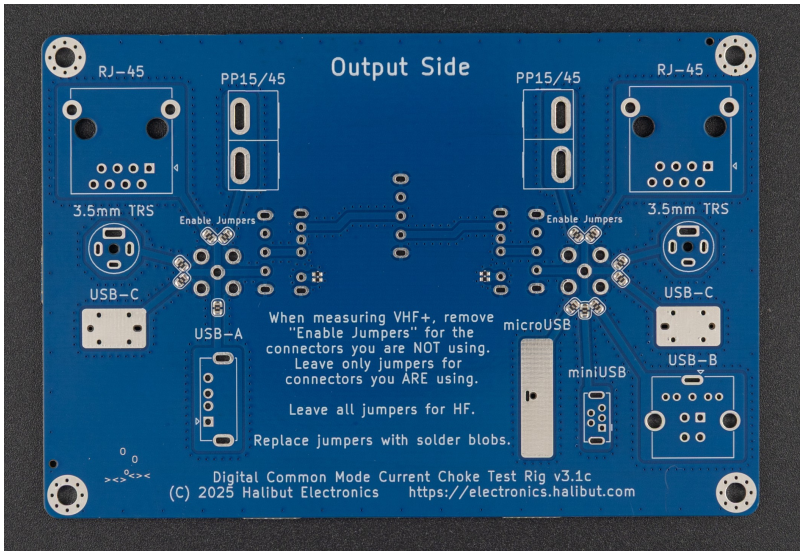
2.1. Inspect the board

The board has labels for the "Input Side" and "Output Side."

- **Input Side** has the "VNA" ports, and calibration switches:

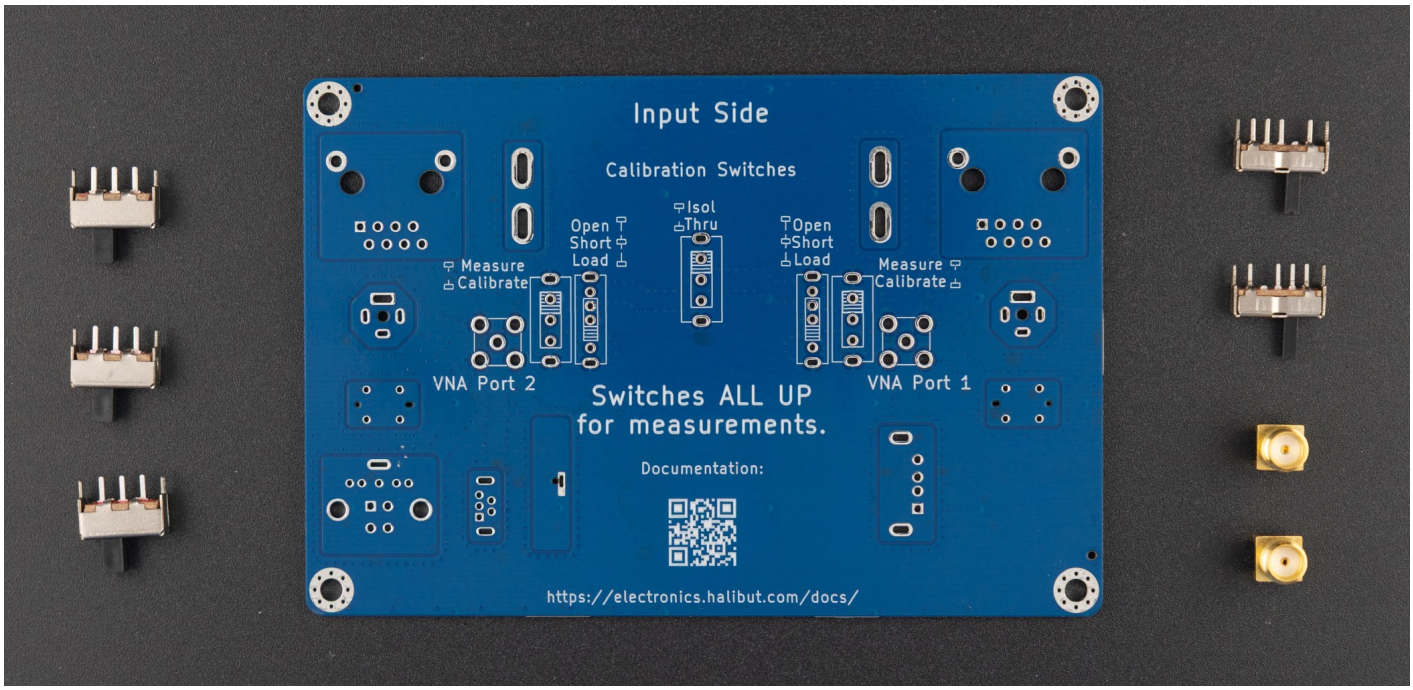


- **Output Side** has the RJ-45, Anderson Power Pole, 3.5mm, and USB sockets:



2.2. Soldering the Inputs

Parts Required



- Qty 1: Circuit board.
- Qty 3: SPDT Slide Switches. These have evenly spaced pins.
- Qty 2: SP3T Slide Switches. These have a "missing pin." Not *actually* missing.
- Qty 2: SMA female PCB mount connectors.

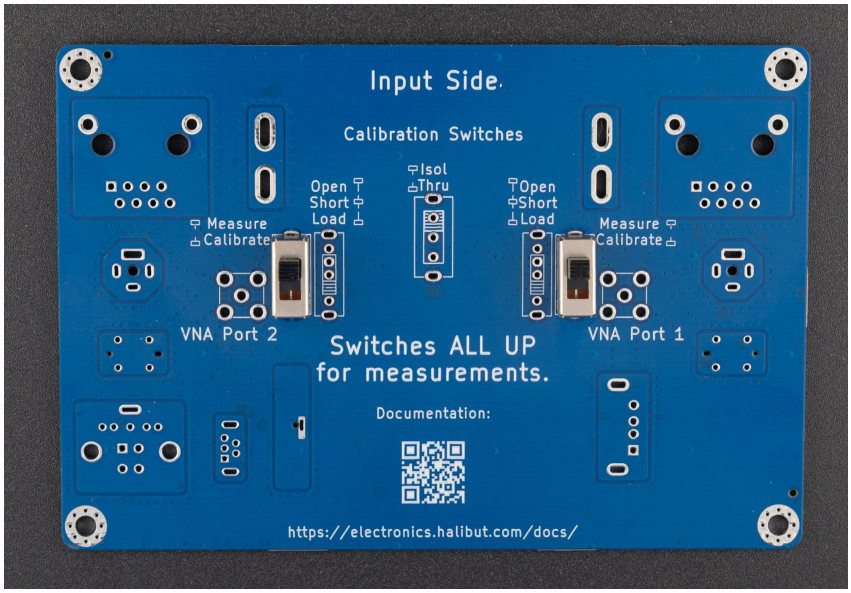
I find it easiest to start with the shortest parts first, then work through the taller parts. To that end, we'll solder the slide switches first, then the SMA sockets. (They're roughly the same size, so the order doesn't matter.)

2.2.1. Slide Switches

These switches are small and low thermal mass, so these will be quick and easy to solder, "like normal." This is as opposed to the SMA ports, which you'll get to next.

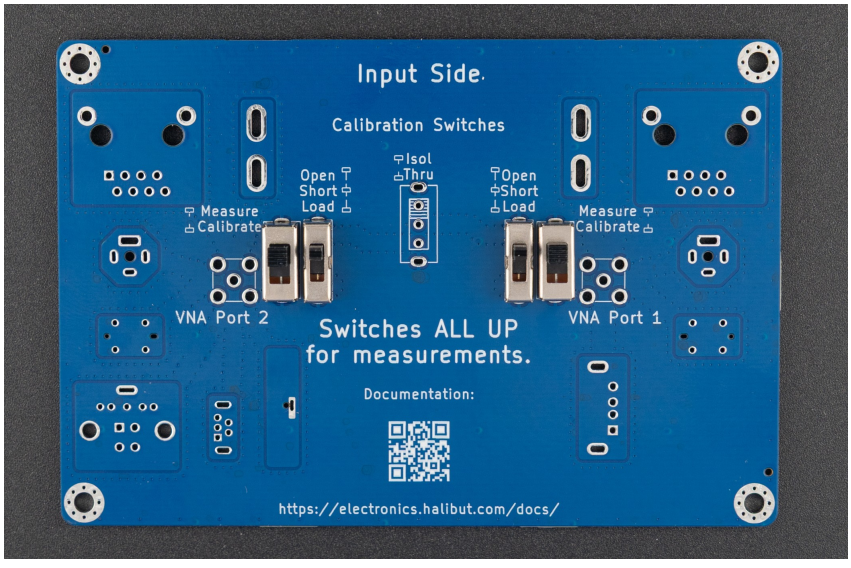
2.2.1.1. Measure/Calibrate Switches

Insert two of the three SPDT slide switches into the five pads beside the "Measure/Calibrate" silkscreens, on the Input side of the board. (We'll use the third SPDT switch later.) These switches have evenly spaced pins. The orientation of the switch doesn't matter. Solder the switches.



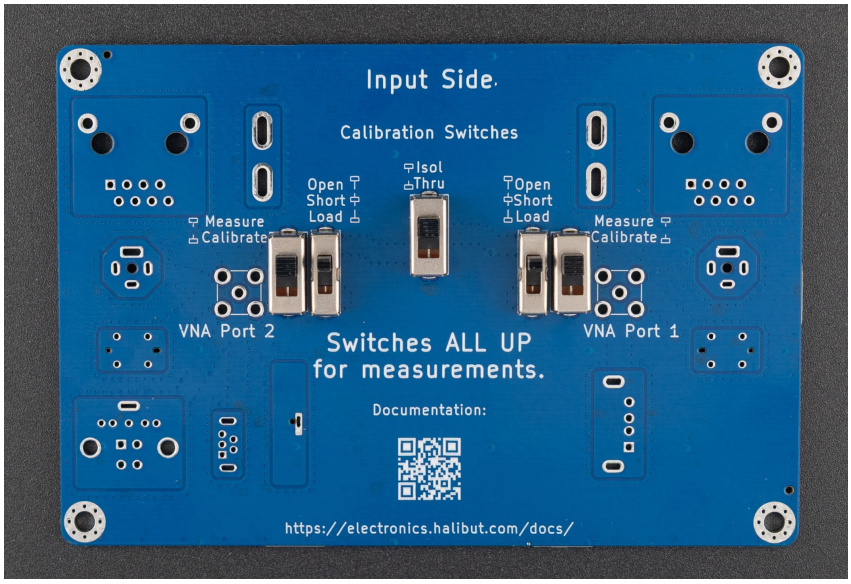
2.2.1.2. Open/Short/Load Switches

Insert the two SP3T slide switches into the six pads below the "Open/Short/Load" silkscreens, on the Input side of the board. These switches have a gap in the pins which only allows them to be inserted in a single orientation. Solder the switches.



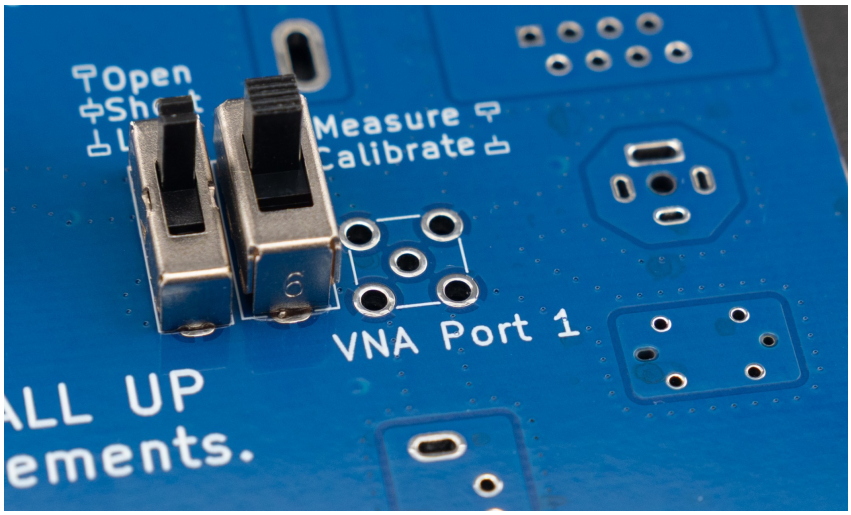
2.2.1.3. Isolation/Through Switch

Insert the third and last SPDT slide switch into the very center of the board, the five pads below "Isol/Thru" silkscreen, on the Input side of the board. This switch is exactly like the "Measure/Calibrate" switches, with evenly spaced pins. The orientation of the switch doesn't matter. Solder the switch.



2.2.2. VNA SMA Sockets

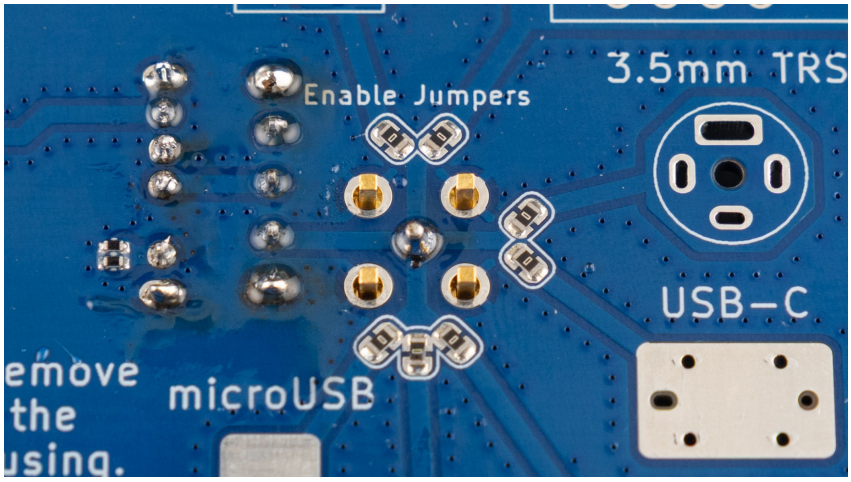
Insert the two SMA sockets into outlines immediately adjacent to the Measure/Calibrate switches on the Input side of the board.



> **Note:** SMA sockets have a lot of thermal mass, and will require more heat to solder than most through-hole components. If you have a higher wattage soldering iron, now is the time to break it out.

Insert the SMA sockets in place, then carefully flip the board over so the board is resting on the SMA sockets. The input sockets are well enough centered that it should balance like this. If not, you can solder them one at a time, holding the socket to the board with some tape, or a finger, or whatever.

Solder ONLY the center pin first! It has the lowest thermal mass on both the socket and the PCB board, and will be the easiest to solder. Also, you can solder the center pin without burning your finger holding the socket against the board. The same is not true when soldering the four outer pins. Once the center pin is soldered, it will hold the sockets in place for you to do the rest.

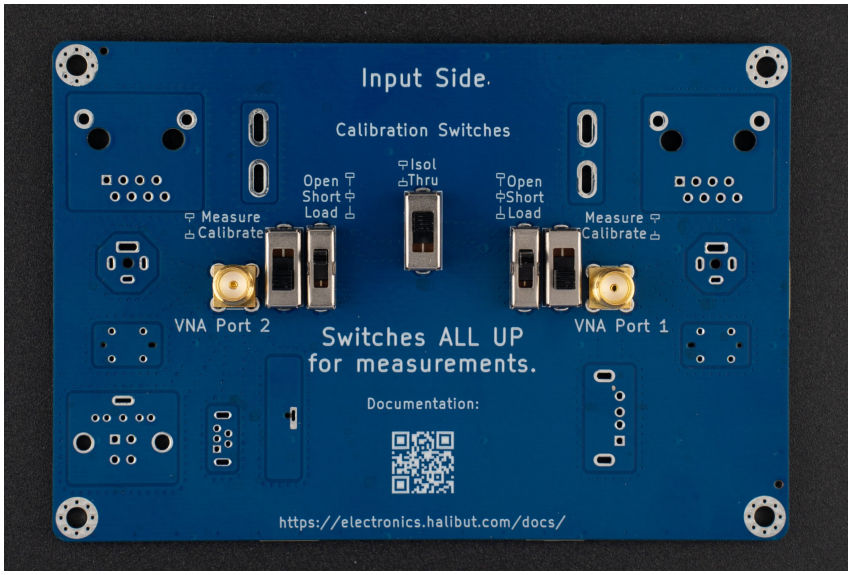


Make sure the SMA socket is flush against the board before proceeding. Reheat the center pin and adjust the socket until it is flush with the board.

Solder the four outer pins next. Take your time, these will require a lot of heat. Be careful when touching things: both the board and the SMA socket have a lot of thermal mass, and will get very hot while soldering, and stay hot for a long time after.

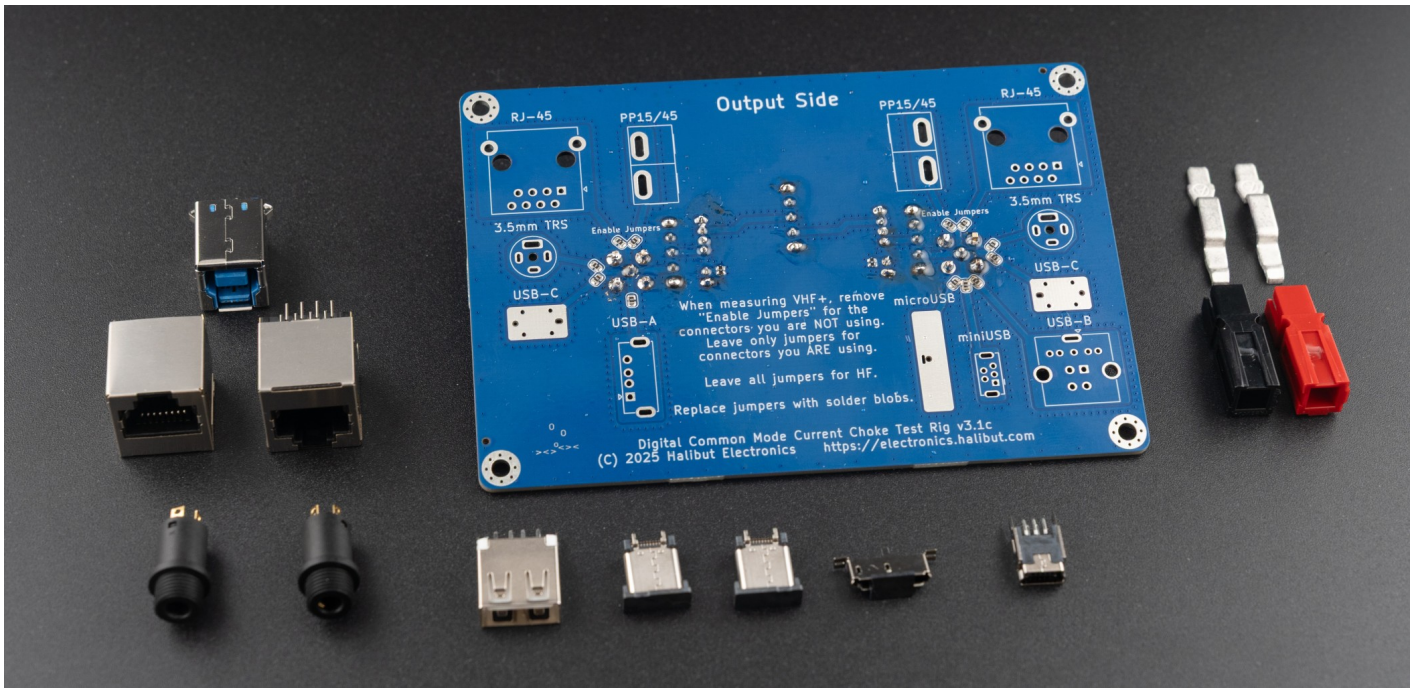
> **Tip:** Maximize surface contact between your soldering iron tip, and the SMA socket pin. Add a (very) little bit of solder to the tip of the iron; the molten solder is a liquid and will have a larger surface area to transfer heat to the SMA socket. Make sure everything is hot enough so the solder flows. You want it to look like a volcano (concave), not a donut (convex).

Do this for both SMA ports on the Input side of the board. It should look like this when you're done:



2.3. Soldering the Outputs

Parts Required



- Qty 1: microUSB socket.
- Qty 2: USB-C sockets.
- Qty 1: miniUSB socket.
- Qty 1: USB-A socket.
- Qty 1: USB-B socket.
- Qty 2: 3.5mm TRS sockets.
- Qty 2: 8p8c Modular, aka RJ-45, sockets.
- Qty 2: Anderson Power Pole PCB mount pins, and two Power Pole shells, one red and one black. (Only one per side, not "two pairs" of connectors.)

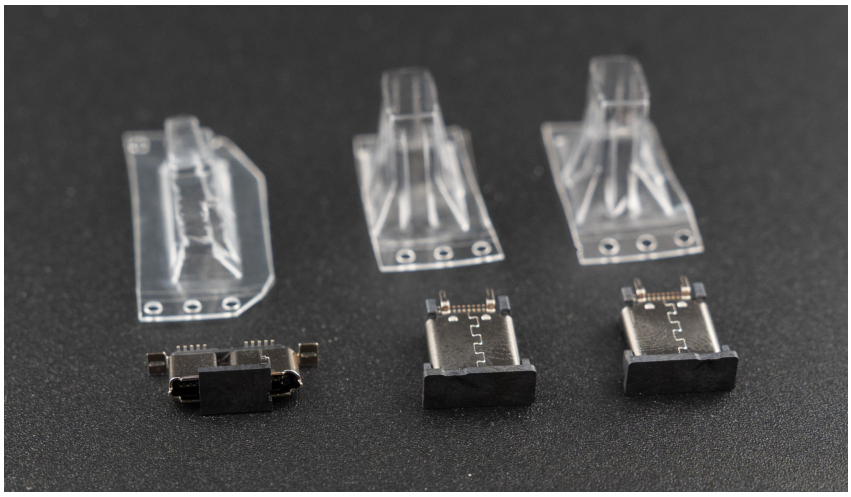
Just like the Input side, I find it easiest to start with the shortest parts first, then work through the taller parts. To that end, we'll solder the microUSB and USB-C sockets first, then miniUSB, USB-A, and USB-B sockets. Then the 3.5mm audio sockets, RJ-45 sockets, then lastly the Anderson Powerpoles.

2.3.1. microUSB and USB-C: Soldered on top side

The microUSB and USB-C sockets are both surface mount **BUT DON'T WORRY**. We don't actually care whether the surface mount pins are soldered well, or bridged together, or even soldered at all! All we need soldered are the physical attachment points of the outer shield, and these are relatively large pieces of metal.

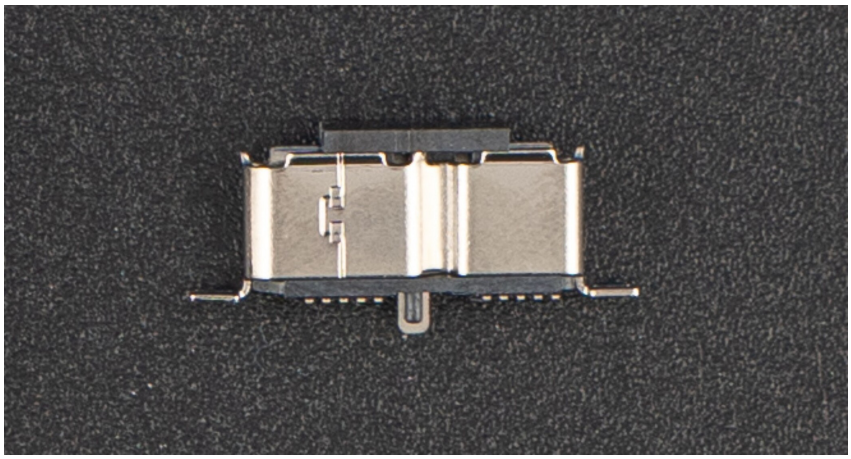
The only weird thing about them is that they are soldered on the top layer, the Output side of the board, the same side that the connector itself is on. As opposed to flipping the board over and soldering them on the back.

Being surface mount parts, they come in the little clear plastic tape reels. To get the parts out, pull off the thin clear plastic "backing" off the harder formed plastic pockets the parts rest in.



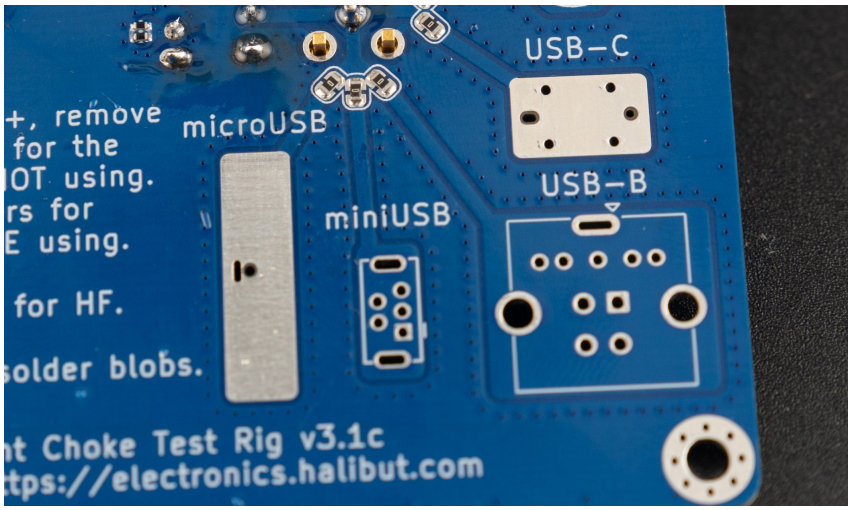
2.3.1.1. microUSB Socket

The microUSB socket is a USB-3.0 socket, meaning it has the two different parts to the connector. It is backward compatible with a "normal" microUSB (aka microUSB 2.0), so the socket can be used to test either plug.



The microUSB socket has large metal tabs on either end of the connector that solder flush to the surface of the board, and a smaller metal tab in the middle that gets inserted into the board, like a normal through-hole part, except that it's not long enough to go all the way through to the other side. There is also a small plastic bump on the bottom of the part that has to line up with the hole in the board immediately adjacent to the slot that middle tab goes into.

Also, the microUSB socket comes with a small plastic insert in the top of the socket that's used by the Pick'n'Place machine when assembling these. That plastic insert is useful when holding the part down to hand solder. But remove it before using for measurements.



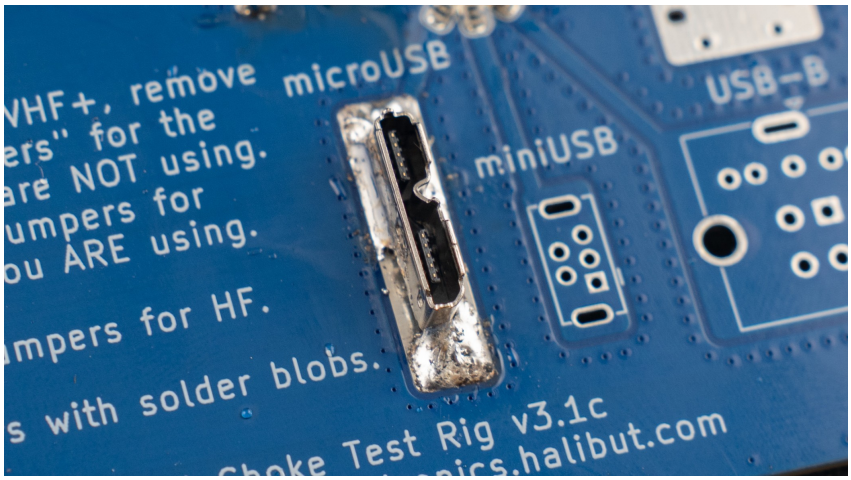
Note that the board has a large exposed pad onto which the microUSB socket will be soldered. (Same for the USB-C sockets, but we'll do those next.) The slot for the middle tab, and the hole of the plastic bump, can be seen. But otherwise, it's a very large area to solder to, to make it easier.

Insert the middle tab of the socket into the slot in the board. When the small plastic bump is lined up with the hole in the board, the two tabs on the ends will lay flat against the circuit board.

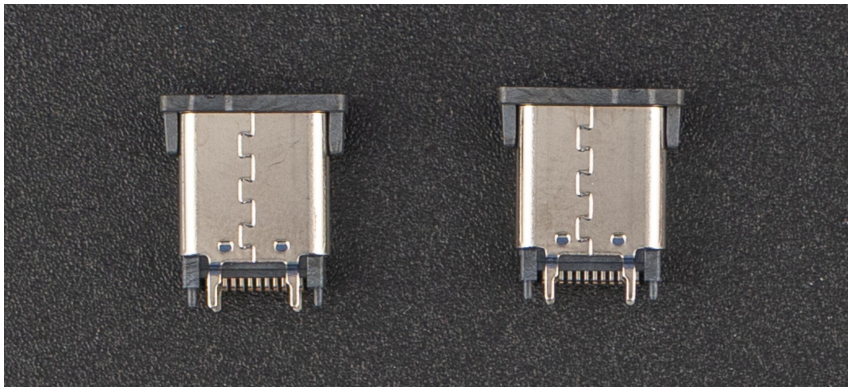
Solder the center tab first. That will hold the part into the board. Then solder the two tabs on either end of the connector.

> **Note:** Heat up both the tab on the socket, and the circuit board under it, by laying your soldering iron as flush with the metal surface of the tab as possible. Add a tiny bit of clean solder to the tip of the soldering iron first, so the liquid metal can increase the surface area of heat transfer. Then make sure you apply solder to where the tab and board meet, so it gets pulled under the metal tab and holds the socket to the board. This connection is as much structural as electrical.

There is no need to solder the pins of the socket. *whew!* Thank goodness for that. 😃



2.3.1.2. USB-C Sockets

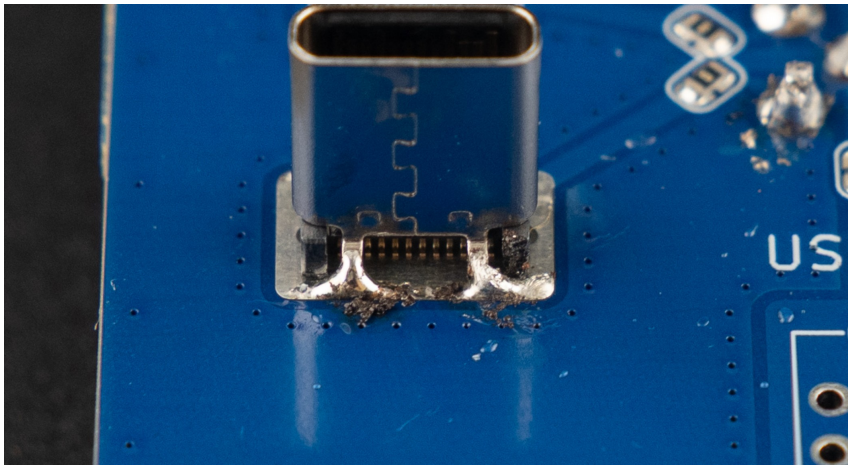


The two USB-C sockets are very similar to the microUSB socket described above. There are small plastic bumps on the bottom that have to line up with holes on the board for the socket to lay flush. There are four metal tabs on the corners of the connector that stick into the board a little bit. Again, these aren't long enough to solder from the bottom, so you must solder them from the top side.

Also like the microUSB socket, the USB-C sockets come with a small plastic insert in the top of the socket that's used by the Pick'n'Place machine when assembling these. That plastic insert is useful when holding the part down to hand solder. But remove it before using for measurements.

Insert the USB-C socket so the plastic bumps line up with the holes in the board. The metal tabs will line up with their holes in the board too.

Solder only one tab to start with. Make sure the connector is seated correctly, flush with the board. Re-heat the solder and adjust as necessary, then solder the remaining three tabs.



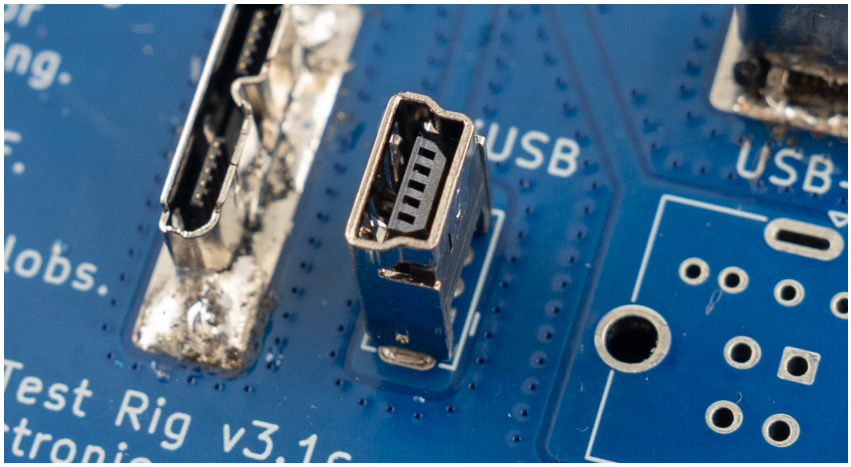
Solder both USB-C sockets, on one either half of the Output side of the board.

2.3.2. Other, more conventional, sockets

The rest of the sockets are conventional through-hole parts.

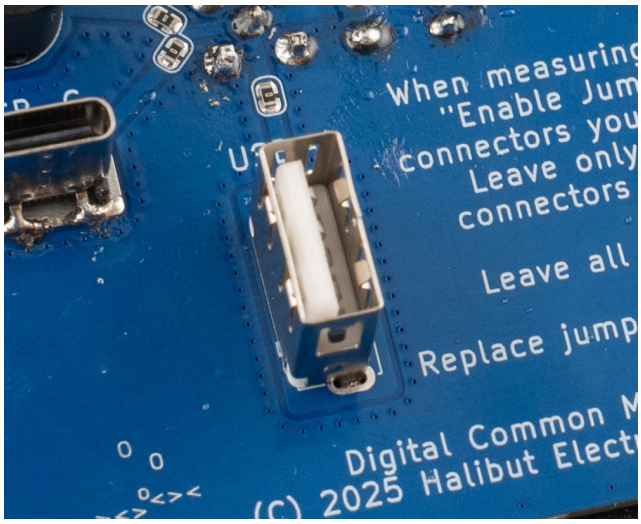
2.3.2.1. miniUSB socket

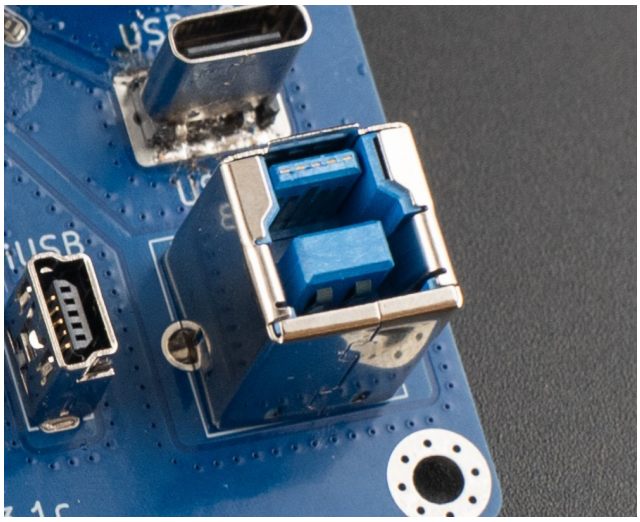
Do the miniUSB next since it's the shortest of the remaining parts.



2.3.2.2. USB-A and USB-B sockets

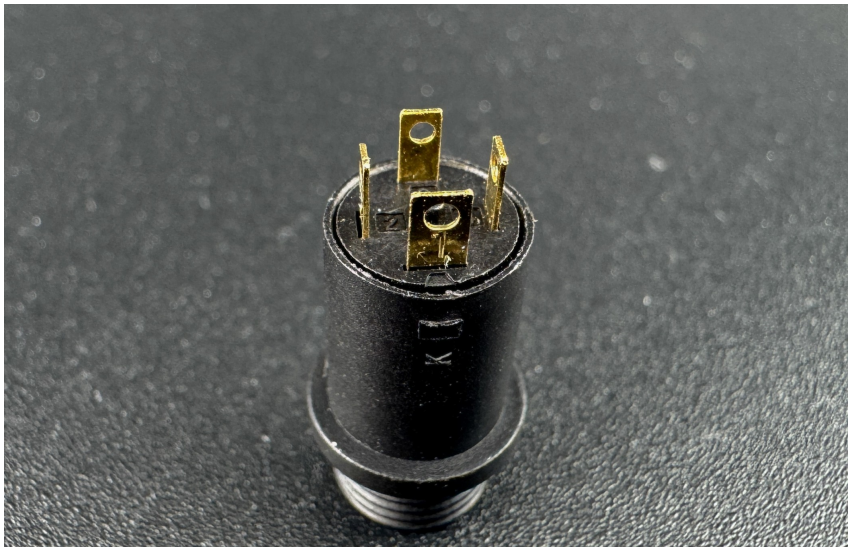
These two are about the same height and can be done at the same time.





2.3.2.3. TRS 3.5mm sockets

Note that one of the four tabs on this socket is wider than the other three. One of the pads on the board is similarly wider. Make sure you insert the socket in the correct orientation.



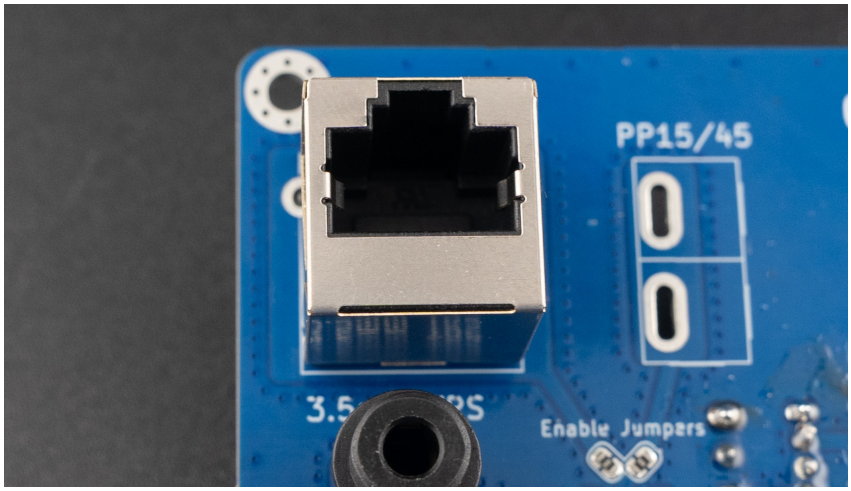
> **Warning:** In early versions of the PCB (v3.1c) the pads on this outline were ... snug ... to put it kindly. You must insert the 3.5mm sockets with a fair bit of force.
>
> I recommend inserting them enough so they are held in place by friction, then flip the board so the 3.5mm sockets are against a table or other solid work surface, and push the board down on top of them.If that doesn't work, then clip off the two tabs immediately adjacent to the wider tab, so you're left with only the wide tab (which fits loosely into the board) and the small tab opposite it (which is still snug, but at least it's only one tab to force in, not three.)
>
> In the WORST case, clip off all three of the not-wide tabs. This will still work electrically, but the socket is now only held in my a single tab and won't be nearly as structurally sound.

Make sure to solder both 3.5mm sockets, one on each side of the board. (The image is only showing one.)

2.3.2.4. RJ-45 sockets

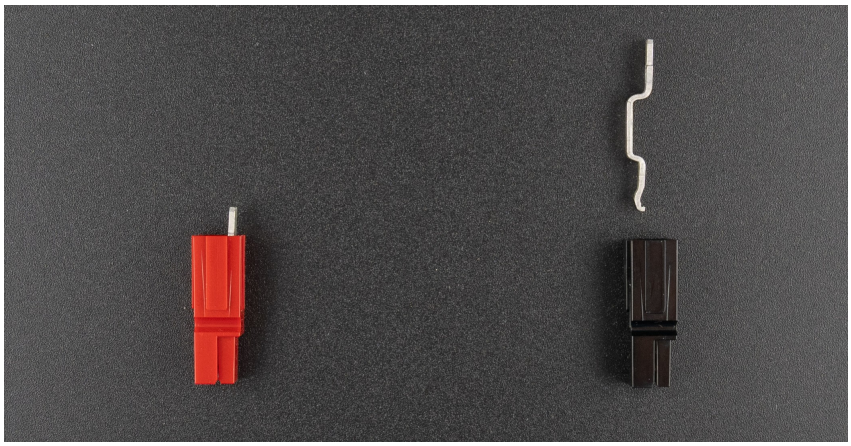
Conventional through-hole soldering here. The RJ-45 sockets click into the board and hold themselves in place for soldering. Convenient, that...

Make sure to solder both RJ45 sockets, one on each side of the board. (The image is only showing one.)



2.3.2.5. Anderson Powerpole

> **Note:** Early versions of the PCB (v3.1c) have a full 2-pin outline for the Anderson Powerpole connectors on each port (labeled "PP15/45"), totaling 4 "pins." But the kit only comes with two Powerpole pins, one for each port. For measuring common mode currents, you only need one wire to carry the current, not both. To address the fact that not all Anderson Powerpole Cables use the same orientation as the "13.8v standard" we hams use, I only included one Powerpole pin per socket. Future versions of the board will only show a single pin per port.

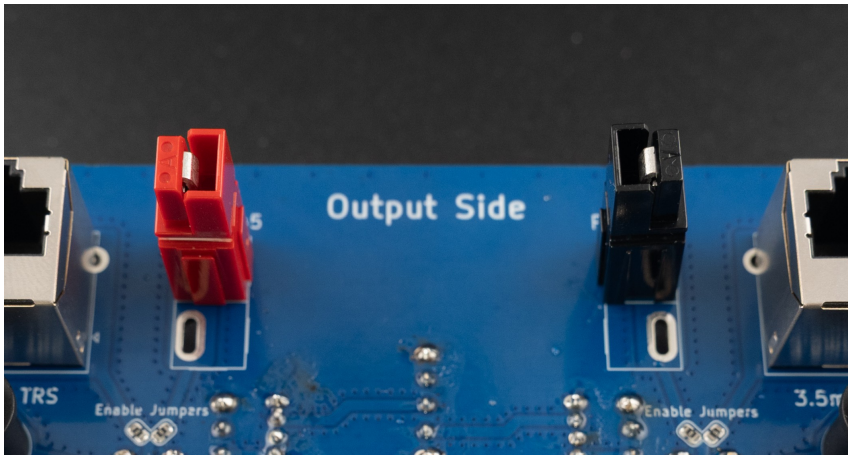


Inspect the metal tabs. Note that one end has a rounded bump on it. This is the mating surface of the connector. The other end is a straight tab, with little shoulders sticking out. This is the part that is soldered into the board.

Insert the "rounded bump" end into the plastic housing. Make sure the rounded bump is facing in such a way that it will be the side that is exposed inside the housing after it is seated in the housing. Insert it all the way so

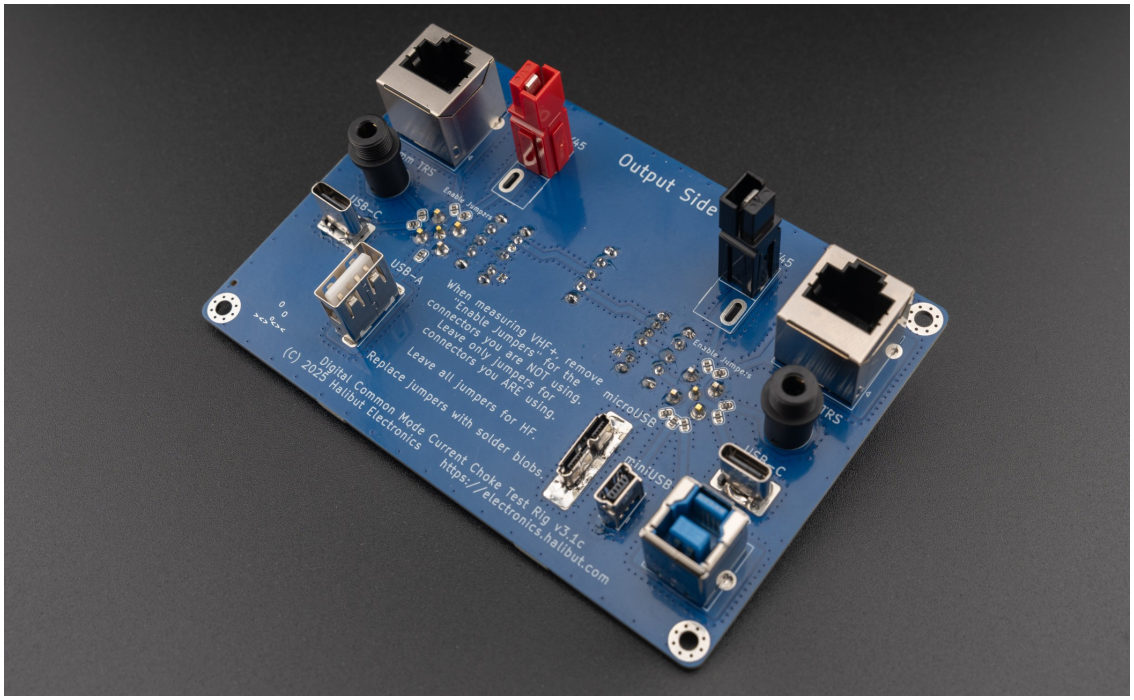
that it clicks into place. It might take some force, or pushing with a tool to save your fingers. The "shoulders" on the solder end should be nearly flush with the opposite end of the plastic housing. (Unfortunately, they are not perfectly flush, which means the plastic housing won't quite be flush with the PCB when its soldered.)

ONLY SOLDER ONE POWER POLE PER PORT! See the **Note:** above.



2.4. Completed

That's it! The Digital CMCC Test Rig is completed! It should look like this now:

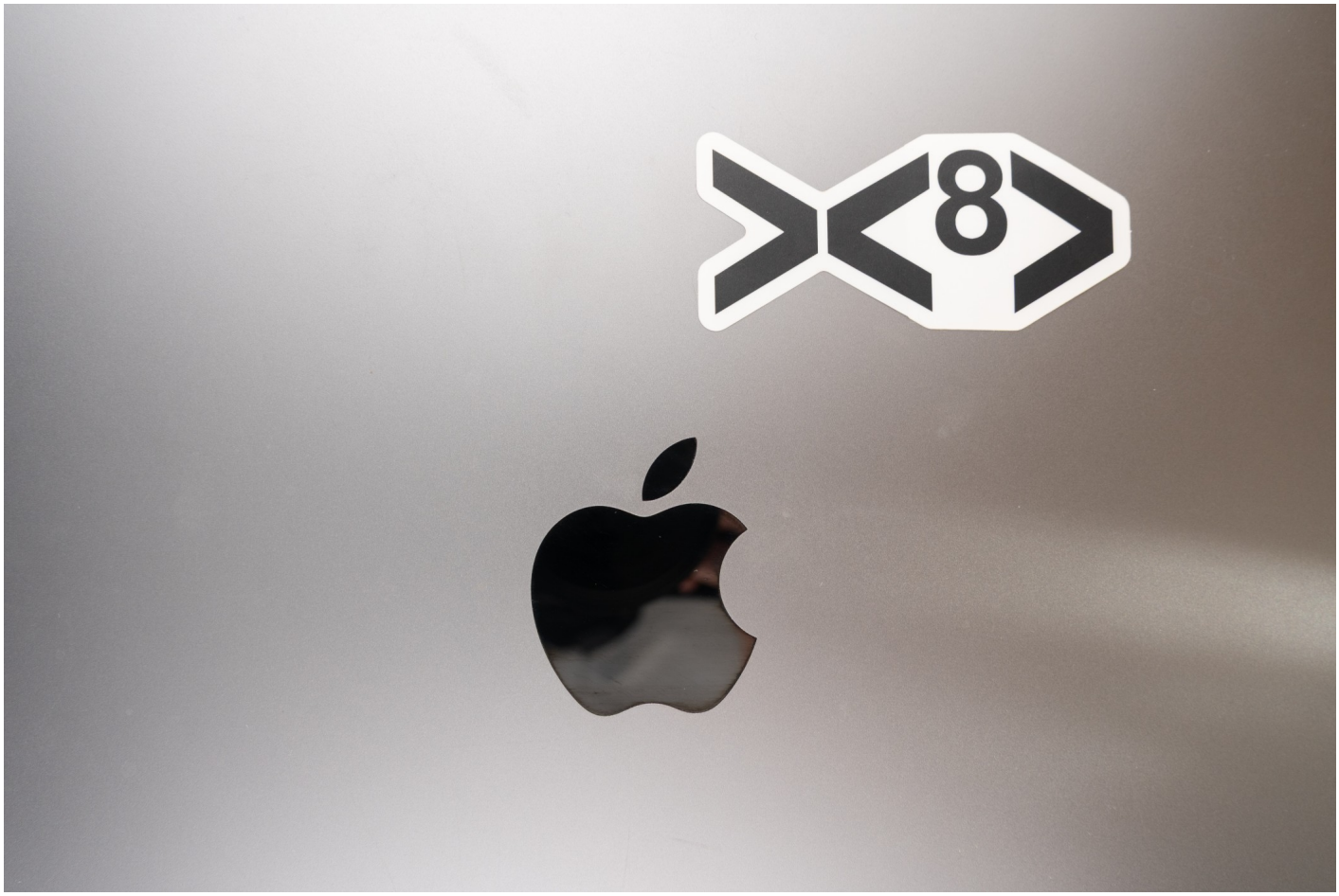


2.5. Sticker (Optional, but Highly Recommended)

Find a clean, flat, APPROPRIATE surface that needs a sticker and apply the Halibut Electronics sticker ><8> to it. Laptops are a common choice, as are filing cabinets. Also water bottles. Really, the possibilities are endless.

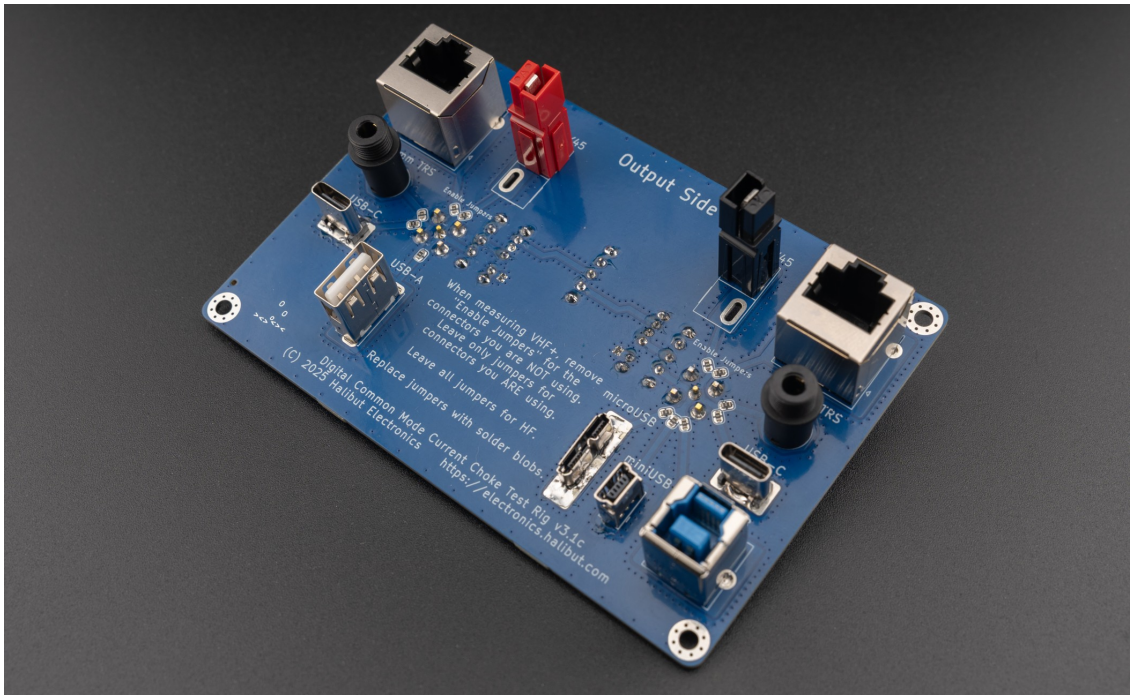
Just, please, no vandalism.

If you post to Mastodon a picture of your Halibut Electronics sticker applied to some appropriate surface, and mention @electronics@halibut.com on Mastodon, you'll probably get a follow and a boost.



3. Conclusion

That's it! Please proceed to the User Guide to learn how to measure the effectiveness of your common mode current chokes.



Feel free to come join us on the Halibut Electronics Groups.io email list:

- https://halibut-electronics.groups.io/g/general/

And follow us on the Fediverse/Mastodon:

- https://mastodon.halibut.com/@electronics

Thank you, and be good humans. 😃 73 de N6MTS -Mark