# TB-Valhalla v3 - Build Guide

Last updated 9<sup>th</sup> October 2023

This document details the general build procedure and wiring guide to complete the v3.0 and v3.1 versions of the GeoSync TB-Valhalla desktop semi-modular synth.

The procedure to build all the GeoSync desktops is much the same, what changes is which modules are needed and the wiring of the "fixed signal paths". This allows you to use the synth with just a CV and GATE input , or MIDI without the need for any patch cables.

The outline procedure is :

1. Build and test all the individual modules as per the appropriate build guides for said module available from http://www.geosyncsynth.com/documentation/
2. Build the PSU, Sequencer, mixer and mult modules (as described here)
3. Prepare the Hammond case for rear panel (requires some drilling and filing of the case)
4. Wire the power, ground and fixed signal paths.

We hope you enjoy your TB-Valhalla and are happy to help answer any questions or troubleshoot any issues – contact us via the contact form on the website : https://geosyncsynth.com/contact-us/

V3.0 LFO Different                    V3.1 LFO with attenuverter

# Modules Included

The GeoSync desktop synths employ a modular approach internally, that is, they are built using the same parts as the Eurorack modules themselves. This allows for simple R&D and multiple different combinations of end product.

The TB-Valhalla v3 was the result of multiple initial designs where we have settled on the most '303' like basic voice but with multiple modulation and mixing capability that allows the synth to be used as much more than just a 303 clone. This is the first production release, although some early prototype panels and pcb sets are available of the earlier designs.

The TB-Valhalla v3 kit includes all the PCBs, and all rare parts needed to complete the build, however there is a standard BOM for the commonly available parts. The builder will also need to source a Hammond metal enclosure (mouser part number in the bom) and a suitable 12v 1A DC power brick.

To complete the TB-Valhalla v3 you will need to source the equivalent parts from the BOM's for :

- 1x TB-Super-O partial kits
- 1x TB-EFAv2 partial kit – follow the process in the EFA build guide, but the BOM as provided in the TB-Valhalla BOM document
- 1x TB-FX partial kit
- 1x TB-Seq partial kit – follow the process for building for the desktop
- 1x GS1-L – the version provided in the kit is smaller in size than the standard euro module – and the BOM varies based on the Valhalla version – v3.0 is identical to the GS1-L, v3.1 includes additional function with an attenuverter on the output of the LFO. If your LFO control PCB is **black**, then it is v3.1 – the TB-Valhalla BOM has a page on the differences.

The PSU, Mixer and mult pcbs also have a parts list, and the TB-Valhalla BOM on the website provides details of the additional parts as well as a summation of all parts needed in one list (so you don't need to go and merge all the individual BOMs!)

*To be clear, if you order the parts in the "ALL PARTS TO ORDER" section of the BOM for TB-Valhalla you will have everything you need when combined with the TB-Valhalla partial kit.*

*PLEASE READ THE ENTIRE BUILD GUIDE BEFORE STARTING TO ENSURE YOU NOTE ANY WARNINGS OR SPECIAL NOTES REGARDING SOME PARTS THAT SHOULD NOT BE FITTED ETC*

# Step 1 – Build and test the modules.

Follow the build guide and BOM for each of the modules in your desktop. I suggest you build, test and calibrate the function of each one individually to ensure simple integration.

**When building the "control boards" use the Valhalla panel as the template to mount the pots, jacks, switches and LEDs before you solder them in place. This way everything will line up nicely when it comes to final assembly.**

**The TB-EFA Rev2 as provided in the Valhalla kit is subtly different from the TB-EFA (v1) available as a stand alone module. Namely, it has more modulation inputs and a couple of extra controls. Be sure to build using the BOM provided in the TB-Valhalla BOM.**

**The sequencer board should only have 2 of the 4 4pin molex headers installed. DO NOT install headers for the two Jacks board connections, there is not enough clearance under the jacks board. Solder the wires directly to the PCB, as shown in the wiring it up section.**

**The LFO comes in two variants. TB-Valhalla v3.0 is identical in BOM and function to the GS1-L (just slightly smaller PCBs to fit into the Valhalla. V3.1 includes an attenuverter function in the LFO circuits and this requires the BOM as listed in the TB-Valhalla BOM itself. Check which version you have before ordering the parts – the LFO PCB for v3.1. is denoted by being black vs purple for v 3.0**

# Step 2 – Build the PSU, Mixer and Mults

## Building the PSU

The PSU is a simple circuit that buffers the outputs from a Mean Well DCW12A-12.
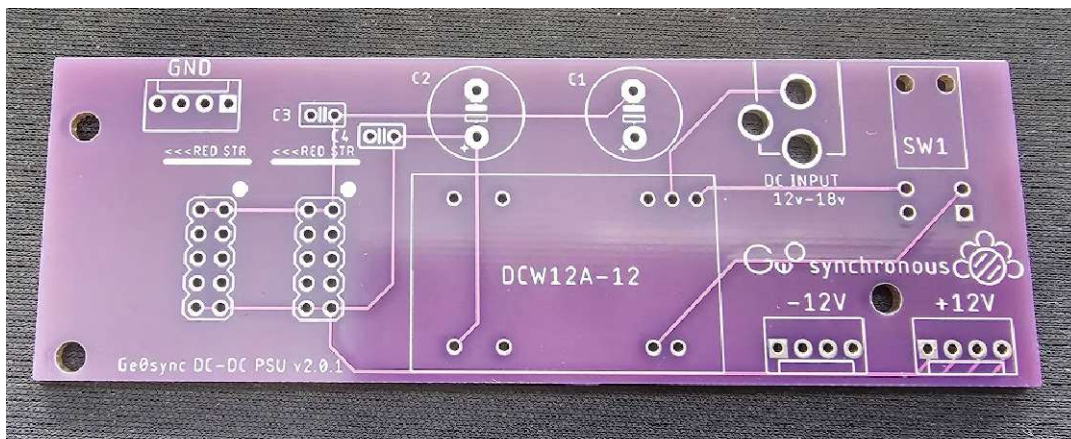


Follow normal build ordering :

1. Add the two MLCC capacitors.
2. Add the two electrolytic capacitors.
3. Add the "DC style" power connector – try and get it so the outer end is parallel with the PCB – it should overhang the PCB.

4. Add the latching power switch, it should snap firmly into place.
5. Add the two 10pin IDC headers and the three molex style connector headers.
6. Finally add the DCW12A-12 power supply module.
7. Test the power outputs provide +/- 12V respectively.
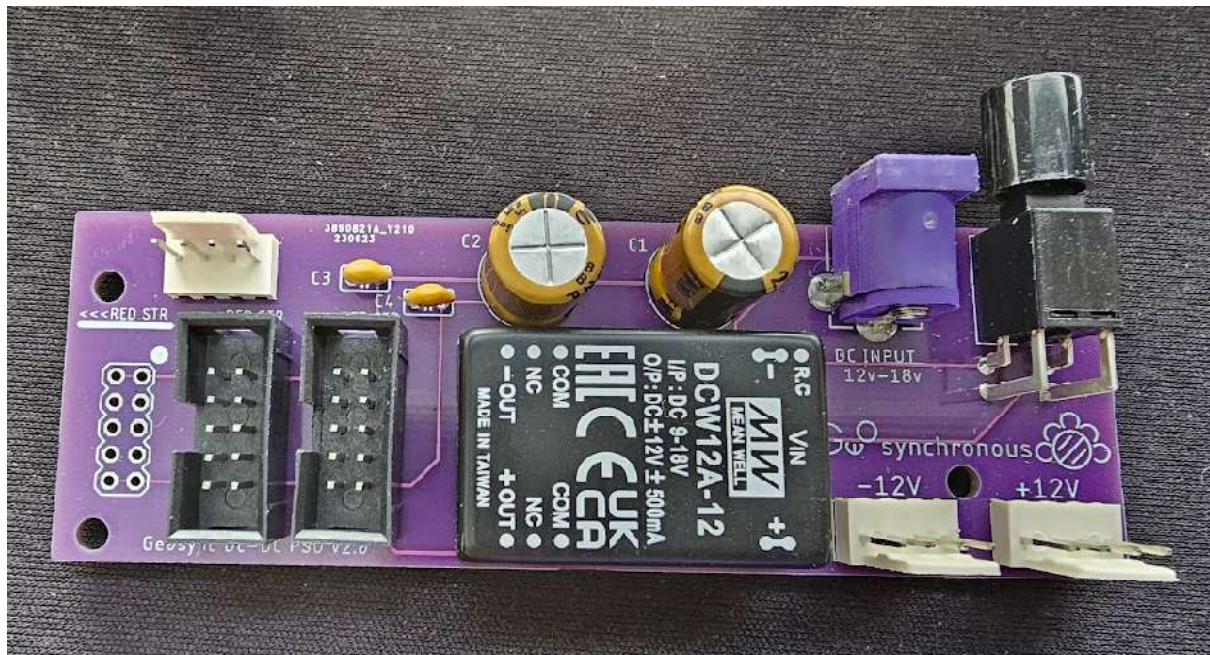


## Building the Mixer

The mixer board is a multi-purpose PCB with homes for the Sequencer encoder, the final stage output signals, the VCO mixer and a stand-alone buffered mixer.
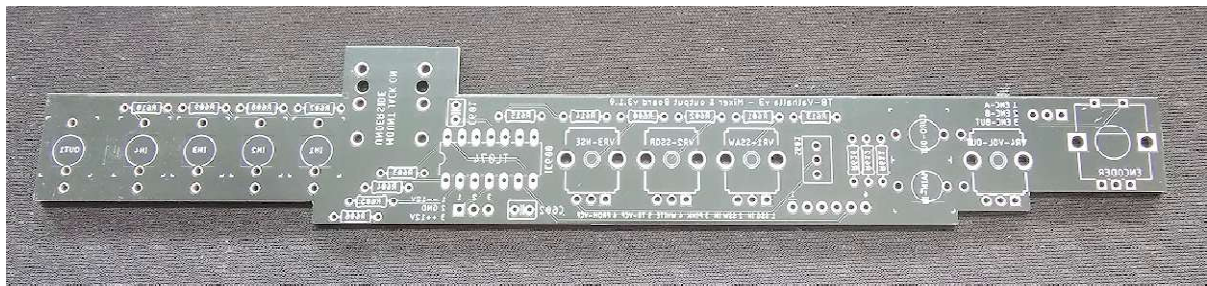


1. Add the resistors
2. Add the MLCC capacitors and IC (with socket if using)
3. Add the encoder, pots and jacks and use the TB-Valhalla main panel to ensure they are lined up square before soldering in place.
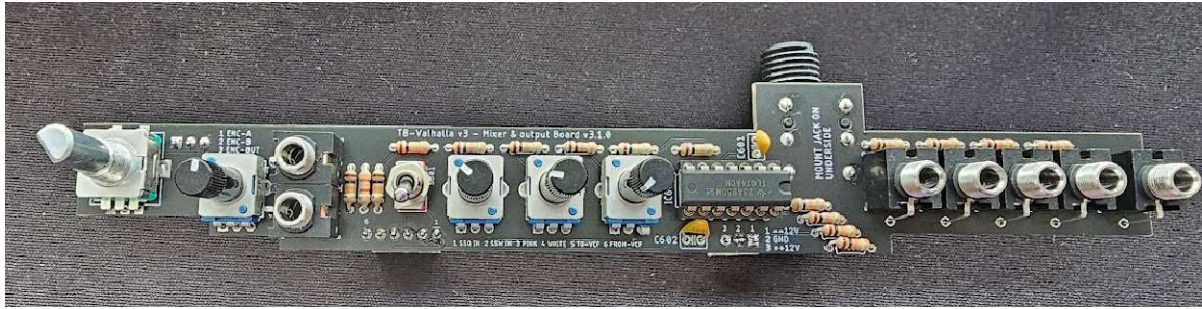
4. Turn the board over and attach the ¼" jack – it should snap in place.
5. Finally add the molex headers – note the one on the right should be the 3pin right angle connector as supplied with the kit.



## Building the Mult & Sequencer Jacks board

Really not rocket science this one… simply add the 8 jacks to each board and solder. For space reasons you need to bend the ground pin to the side on the mult and it doesn't matter if the ground pins touch each other.

To get the jacks all aligned correctly you may want to insert the jacks to the PCBs, attach them to the panel with a few jack nuts and then solder them, this way its nicely aligned with the holes in the panels. Usual euro process etc. You can do the same for the jacks board with the rear panel.

The jacks board also have 3x molex connectors, turn the PCB over and insert them on the rear of the PCB, so the jacks are on one side and the molex connectors on the reverse.



## Breakout pads

You will have noticed on some of the PCBs (mult) and the upper PCBs on the voice modules themselves there are holes with breakout pads. These will be used when we get to the end and are detailed in the wiring it all up section.

# Preparing the Hammond Case

The case needs a few holes drilled and trimmed for :

- The power input and switch.
- The audio ¼" jack output
- The reset switch and LEDs
- The MIDI jack
- Mounting holes for the rear panel.
- Mounting holes for the PSU and Sequencer boards.

As the rear panel will cover all your sins… you don't need to be specifically accurate with the holes you drill – except for the 4x 3mm mounting holes for the rear panel itself.

Here is a rough and ready example – from trial and error the best method is to attach the rear panel in place using masking tape (or other) and use it as a template to carefully mark the position of the holes needed.



For the jacks PCB, it is best to simply cut a rectangle from the rear large enough for the entire pcb to fit flush against the rear panel when the jack nuts are screwed in place.

The Hammond case is particularly tough. Get a stepped or graduated metal cutting drill bit to drill the circular holes, its easiest to cut a circle even for the rectangular DC power socket. To cut the rectangular hole for the jacks board a Dremel with a metal cutting disk works well – some nice grinding sparks too!

The audio jack is just a 10mm hole. The MIDI jack 20mm hole. The power switch and jack ~15mm - 20mm holes.  The LED and reset, just cut large enough holes that there is enough space for them. Once you attach the rear panel, using the M3 10mm plastic nuts and bolts provided with the kit, all your nasty edges go away!

The final step is to drill the 3mm holes for the mounting of the PSU and Sequencer boards to the bottom. Insert the two PCB so that they line up with the rear panel holes and again mark the 6x 3mm holes. Drill them and then use the remaining M3 10mm bolts and nuts to create standoffs for the PCBs to sit into. Take care here as you want the PCBs to line up nicely with the rear panel holes.
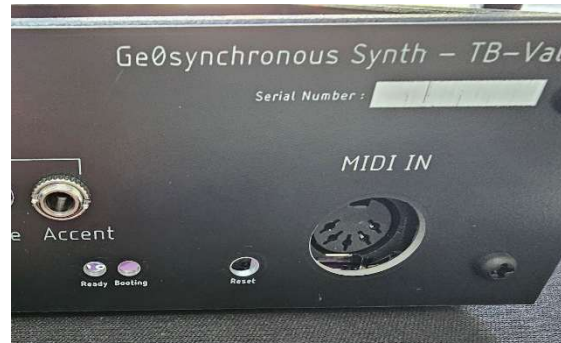




This is what it looks like when assembled from the inside and the 6x bolt heads from the under side – ignore the extra holes in the second picture – reused case!

# Assembling the Synth

Now that you've prepared the case and have the lower and rear PCBs fitted, its time to start putting it all together. Basic process is :

1. Mount the control boards of each voice module to the TB-Valhalla top panel.
2. Mount the mixer board and OLED to the top panel.
3. Crimp / make up the cables to connect between the various PCBs.
4. Add the voice lower PCBs.
5. Power on and have fun!

## Mount the modules to the panel :

As all the wires need to be soldered to the "control boards" of each module. Unscrew all the "voice boards" so you just have the control boards (the ones with all the pots and jacks)

Carefully attach each control board to the appropriate place on the panel. Secure with at least one pot nut, and a couple of jack nuts. Add the mult board also to the panel.
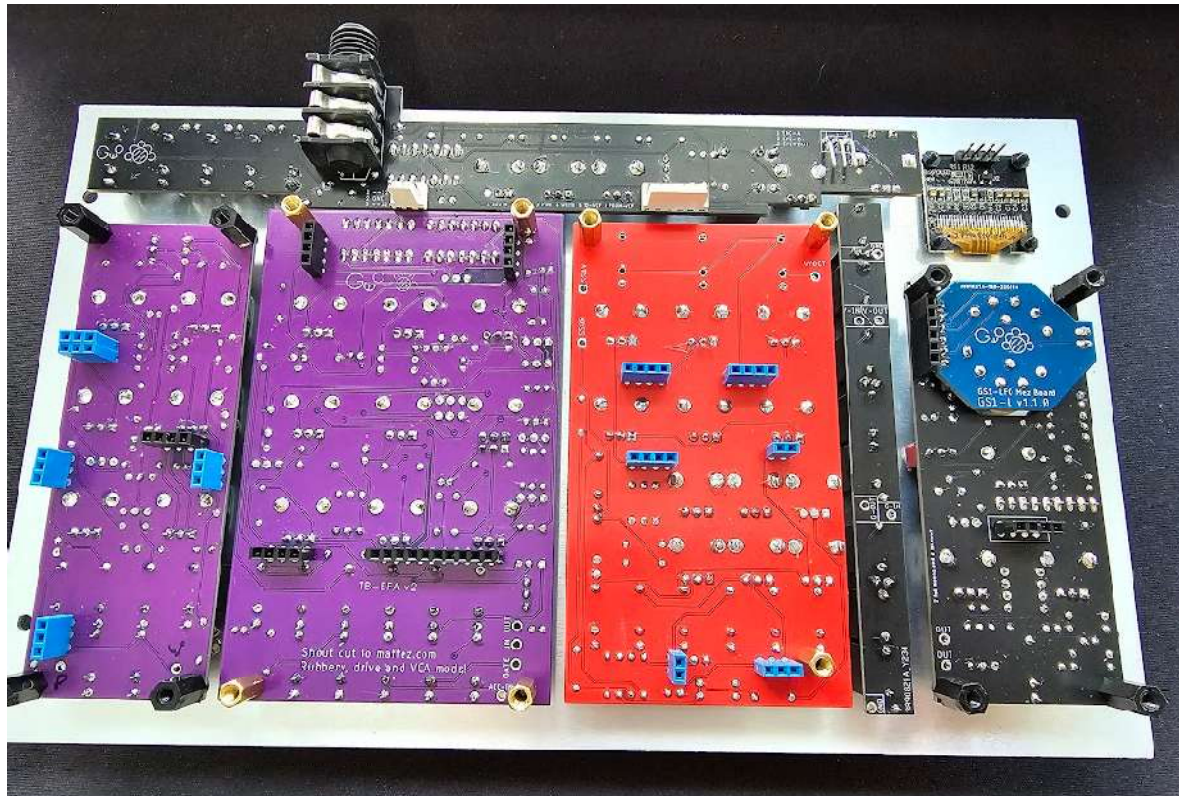
## Mounting Mixer board & Display

You should now be able to mount the Mixer board to the panel and attach the OLED using the 2mm plastic nuts and bolts as shown above.

Trim the 4 pins on the OLED side of the display PCB so they don't risk shorting on the front panel.
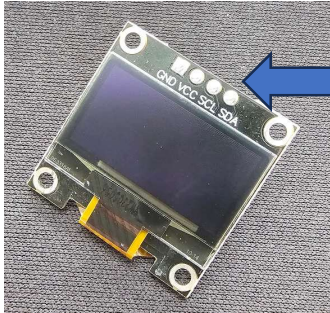


Place the panel upside down above the case as if it here "hinged" from the rear panel side – as shown. This makes it easiest to measure and attach the appropriate wires.
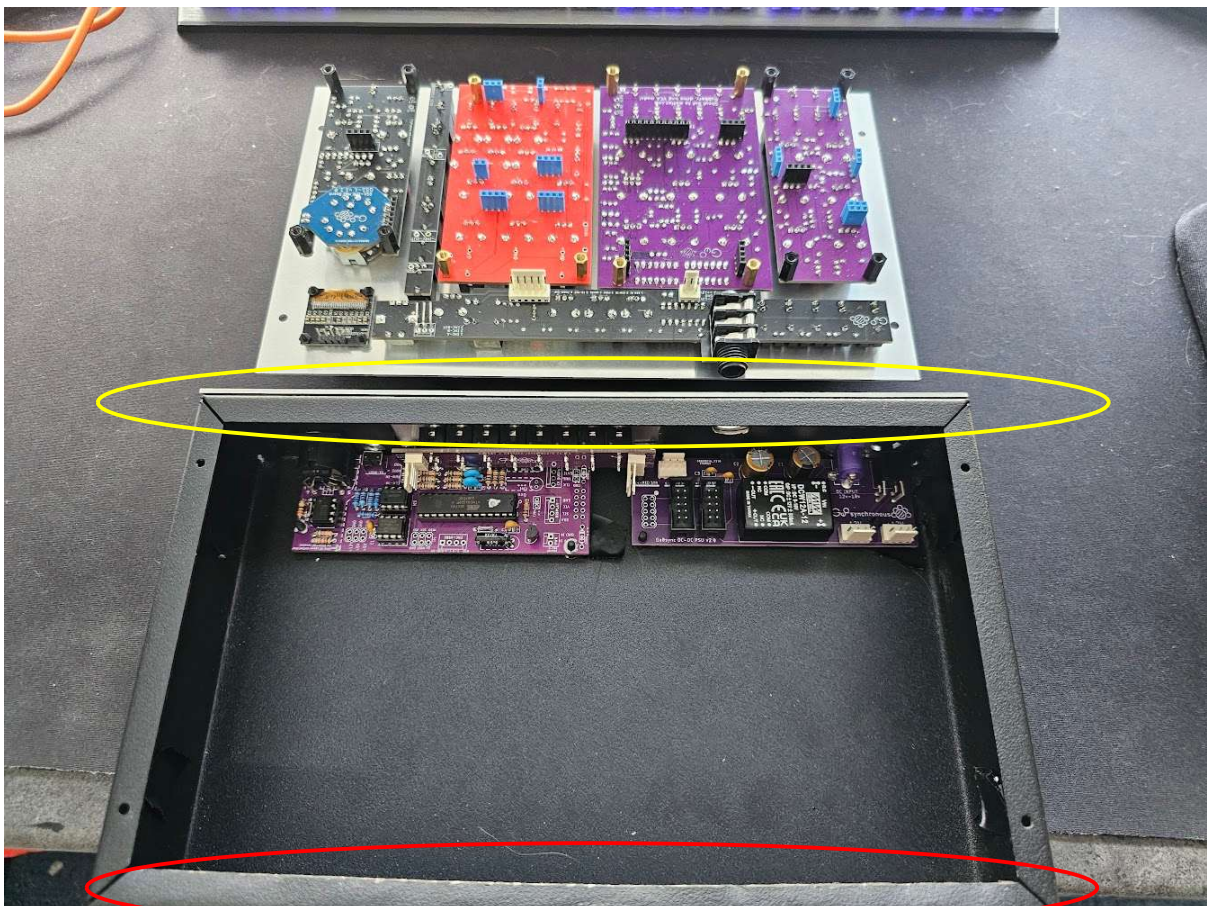


On last thing to check now is that it is going to fit! Bring the panel over (marked in yellow where the hinge point is) and carefully slide the 1/4" jack into the hole in the back panel. Now bring the front end down. The clearance between the front edge of the case and the PCBs is MINIMAL! It can be a tight squeeze to get it all in. If it won't slide in, the best solution is to carefully bend the front lip

(marked in red) downwards to give just a couple of extra mm of clearance. Some pilers or careful tapping with hammer will be needed.

When pushing the panel into place, make sure you are sliding the ¼" jack hard against the back panel. Practice doing this a couple of times, so you are comfortable with the force needed before you go any further! It's probably the fiddliest bit if the whole build!

# Wiring it all up!

The table below summarises the connections that need to be made and the **approximate** length of hookup wire needed. Basically, all the routing lines shown on the panel itself need to be wired and the sequencer connections to the Jacks and Mults boards, the encoder and the display.

**\* Those marked thus should be directly wired to the PCB in question as there is no room for a molex header.**

**For the Note CV, Gate CV and Accent CV coming from the Sequencer board, two wires are needed in this connection – one going to Jacks PCB molex, and another going to the respective pads around the synth – see below for details.**

The colour matching in the tables are the same cable, just from the different plug ends!

| | End 1 | End 2 | Length |
|---|---|---|---|
| Display | 4pin female molex to OLED | 4pin female molex to Seq PCB | |
| | 1 - GND | 1 - GND | 16cm |
| | 2 - VCC | 2 - VCC | 16cm |
| | 3 - SCL | 3 - SCL | 16cm |
| | 4 - SDA | 4- SDA | 16cm |

| | End 1 | End 2 | Length |
|---|---|---|---|
| ENC-MIDI | 3pin female molex to Mixer PCB | 4pin female molex to Seq PCB | |
| | | 1 - N/C | empty |
| | 1 - ENC-A | 2 - E-A | 14cm |
| | 2 - ENC-B | 3 - E-B | 14cm |
| | 3 - BUT | 4 - BTN | 14cm |
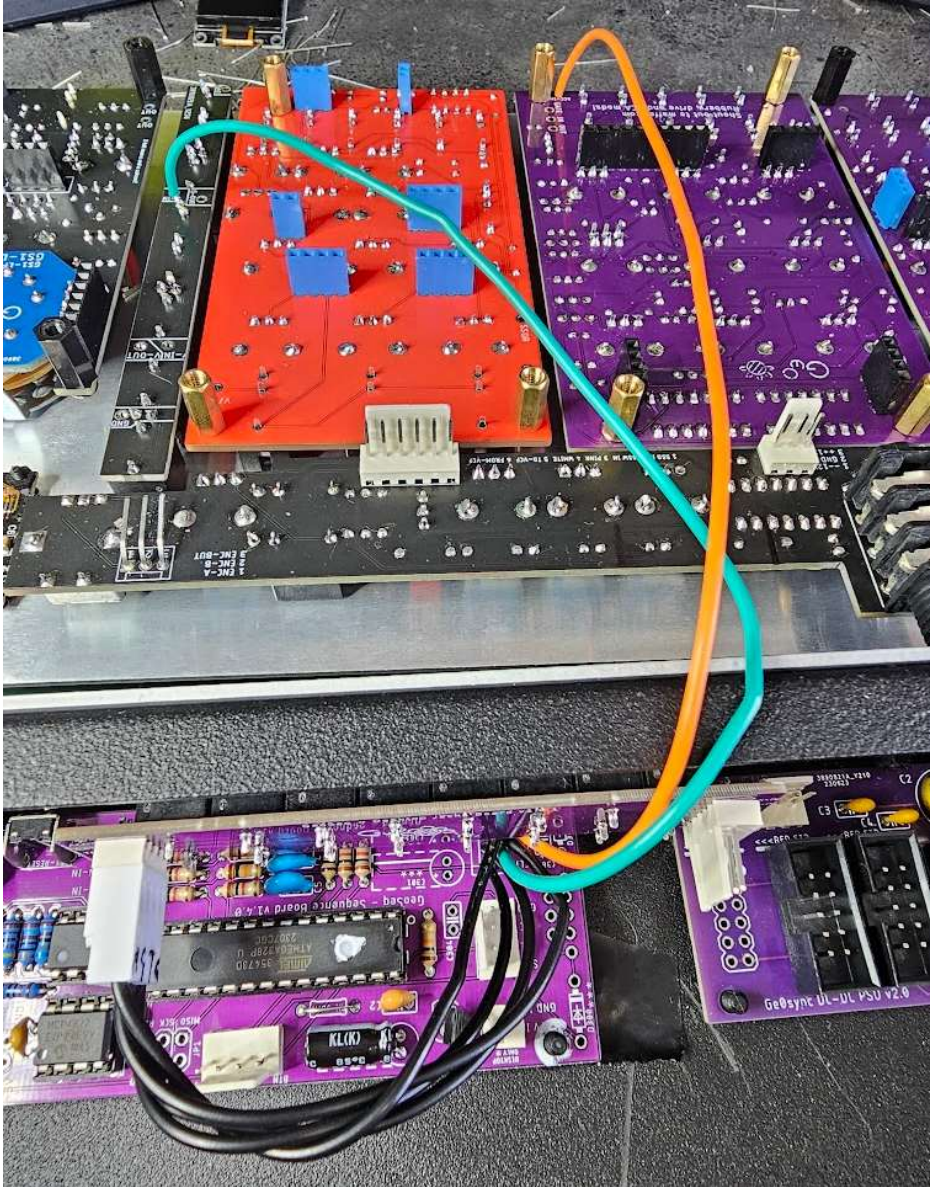
**\* Those marked thus should be directly wired to the PCB in question as there is no room for a molex header.**

\*\*\* The Accent CV coming from the Sequencer board pad needs two wires – one going to the Jacks Accent pin, and another going to the **VCF Accent** pad on the filter control board. Best to do this from the sequencer end where you can solder the two wires together before attaching directly to the Sequencer pads. See pics.

\*\*\*\* The Gate CV coming from the Sequencer board needs two wires – one going to the Sequencer Gate pad, and another going to the **Mult PCB G-IN** pad.
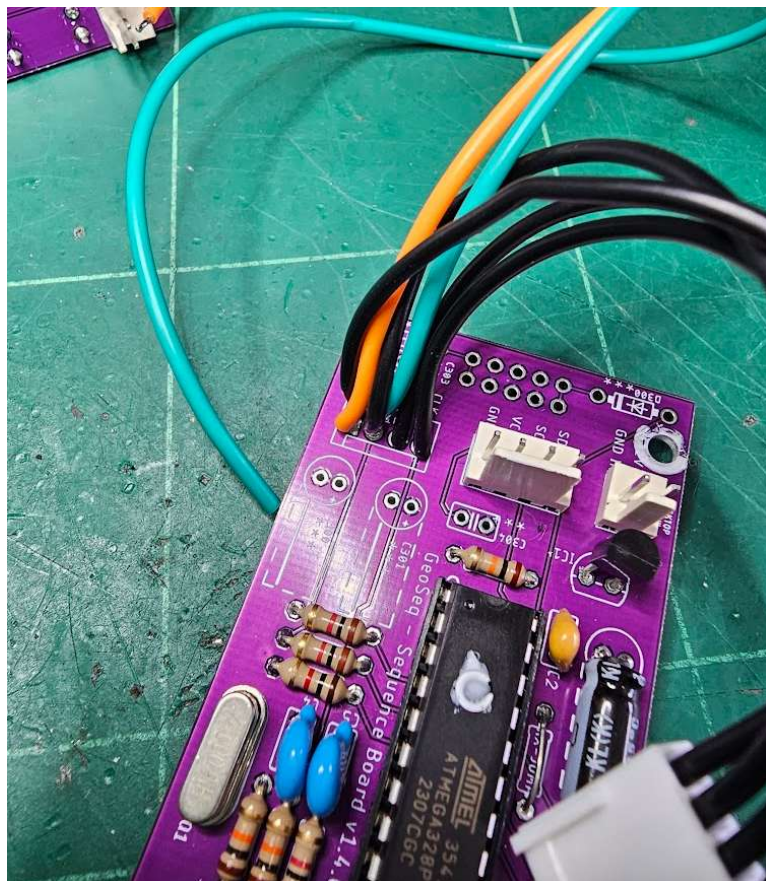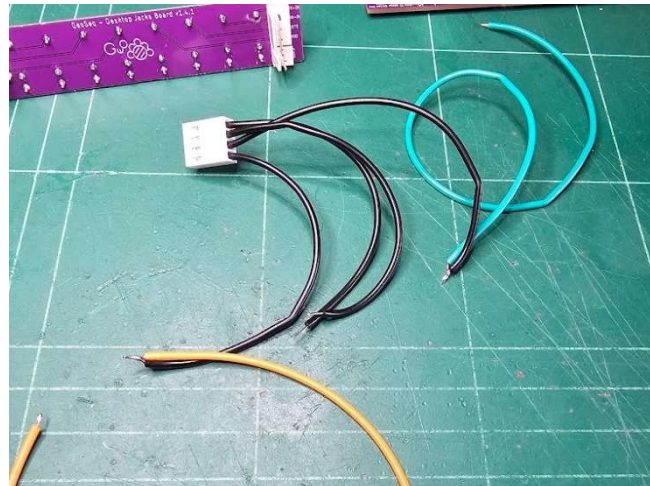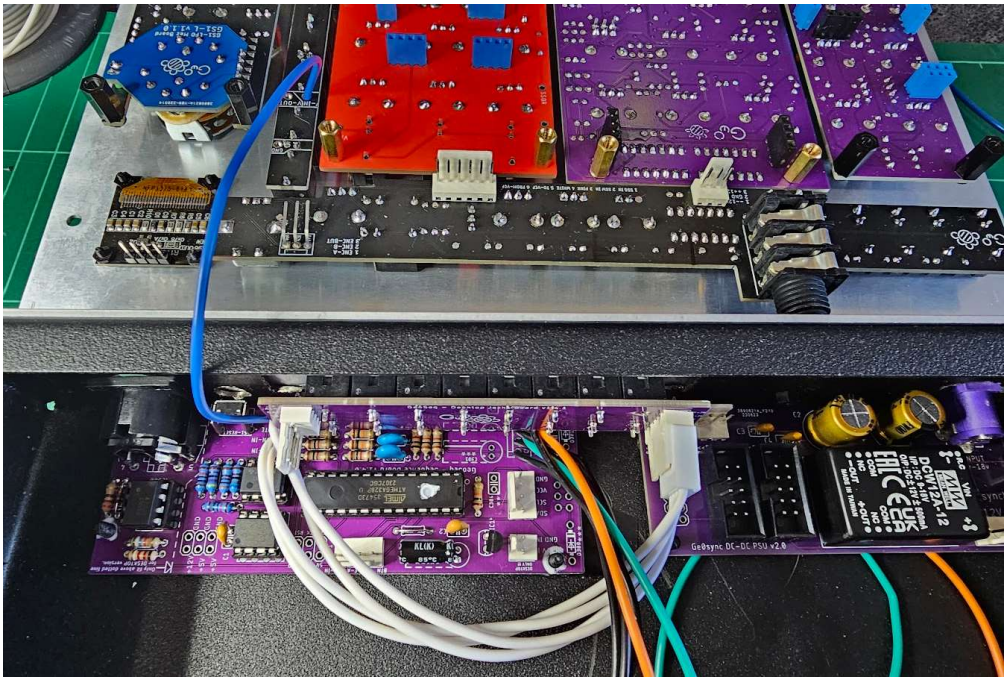
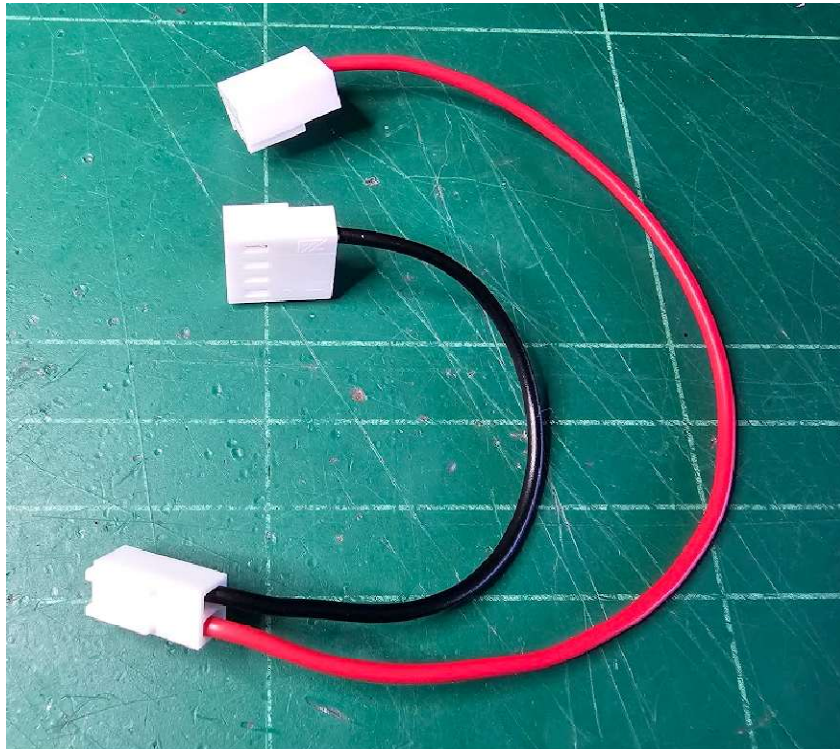| | End 1 | End 2 | Length |
|---|---|---|---|
| Sequencer CV-OUTPUT | 6 wires soldered direct to the 4 Seq PCB pads* | 4pin molex to Jacks PCB & 2 hanging wires | |
| | 1 – ACCENT* *** | 1 – ACCENT | 10cm |
| | | **VCF Accent** | **24cm** |
| | 2 – GATE* **** | 2 – GATE | 10cm |
| | | **MULT PCB – G-IN** | **24cm** |
| | 3 – TRIG* | 3 – TRIG | 10cm |
| | 4 – CLK* | 4 – CLK | 10cm |

**\* Those marked thus should be directly wired to the PCB in question as there is no room for a molex header.**

\*\* For the Note CV coming from the Sequencer board, two wires are needed in this connection – one going to the Jacks PCB [marked 3 below], and another going to the **Mult PCB V-IN** pad. (Blue wire in pictures)
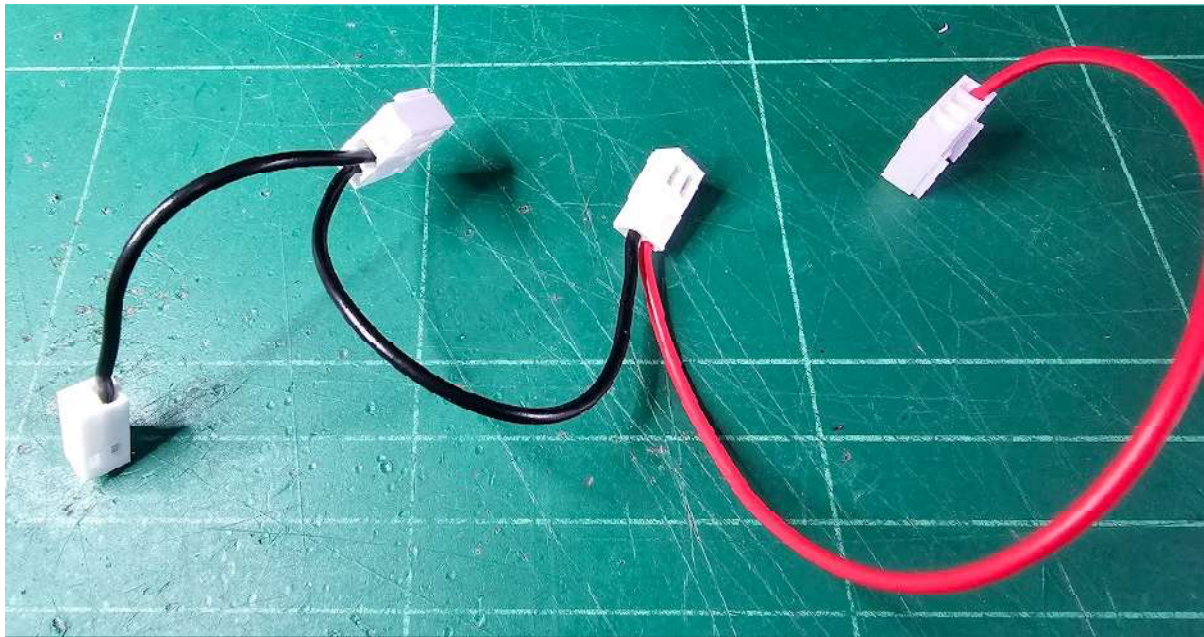


| | End 1 | End 2 | Length |
|---|---|---|---|
| CV-IN-OUT | 5 wires soldered direct to the Seq PCB pads | 4 wires to molex 4pin female | |
| | 1 – CLK-IN | 1 – CLK-IN* | 14cm |
| | 2 – RUN-IN | 2 – RUN-IN* | 14cm |
| | 3 – NOTE ** | 3 – NOTE* | 14cm |
| | | **MULT PCB – V-IN** | **17cm** |
| | 4 - MOD | 4 – MOD* | 14cm |

| | End 1 | End 2 | Length |
|---|---|---|---|
| SEQ-PWR | 2pin female molex to Seq PCB | Single pins to different plugs | |
| | 1 - GND | PSU GND Pin 1 | 10cm |
| | 2 - +12V | PSU +12V Pin 1 | 17cm |

| | End 1 | End 2 | Length |
|---|---|---|---|
| JACKS-GND | 2pin female molex to Jacks PCB | Single pins to different plugs | |
| | **1 - GND** | **PSU GND Pin 4** | **10cm** |
| | 2 N/C | | |

| | End 1 | End 2 | Length |
|---|---|---|---|
| Mixer PWR | 3pin female molex to Mixer PCB | Single pins to different plugs on PSU | |
| | 1 - --12V | PSU –12V Pin 1 | 15cm |
| | 2 – GND | PSU GND Pin 2 | 15cm |
| | 3 +12V | PSU +12V Pin2 | 15cm |
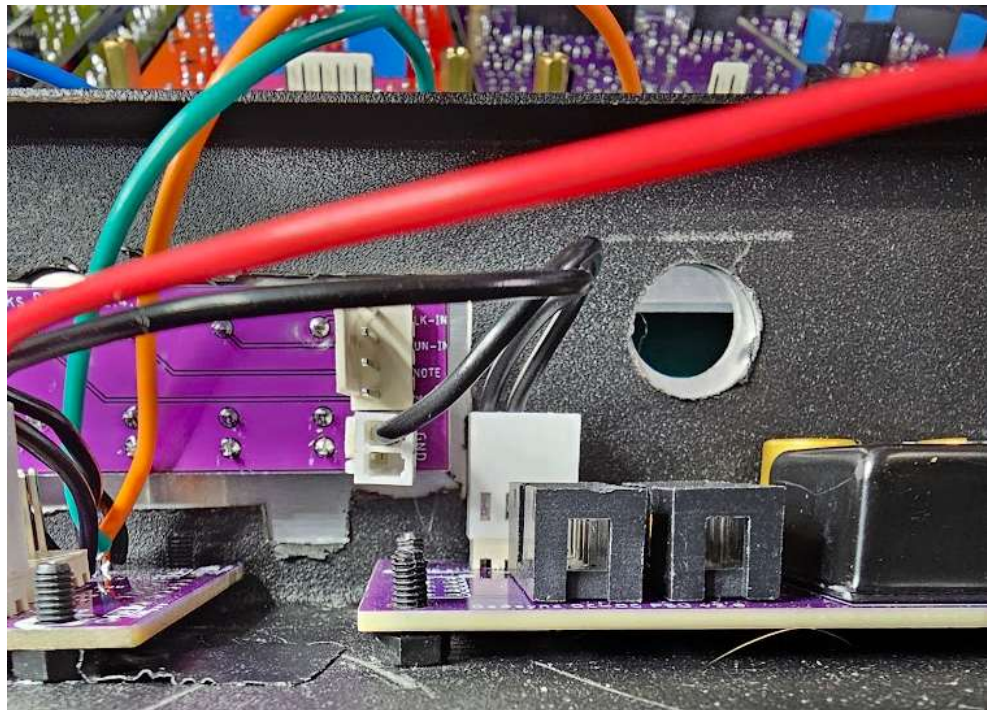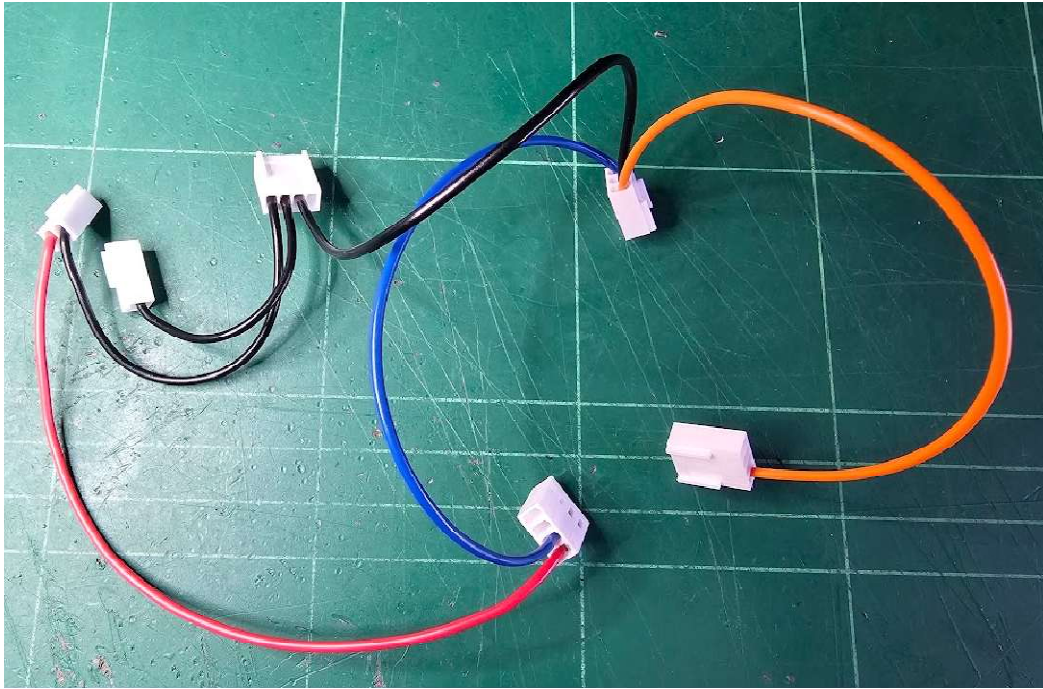
If you have completed the above – this is all done!

|  | End 1 | End 2 | Length |
|---|---|---|---|
| PSU +12V | 4pin female molex to PSU PCB | Single pins to different plugs | |
| | **1 - +12V** | **SEQ-PWR Pin 2** | **17cm** |
| | **2 - +12V** | **Mixer PWR Pin 3** | **15cm** |
| | 3 N/C | | |
| | 4 N/C | | |
| | | | |

If you have completed the above – this is all done!

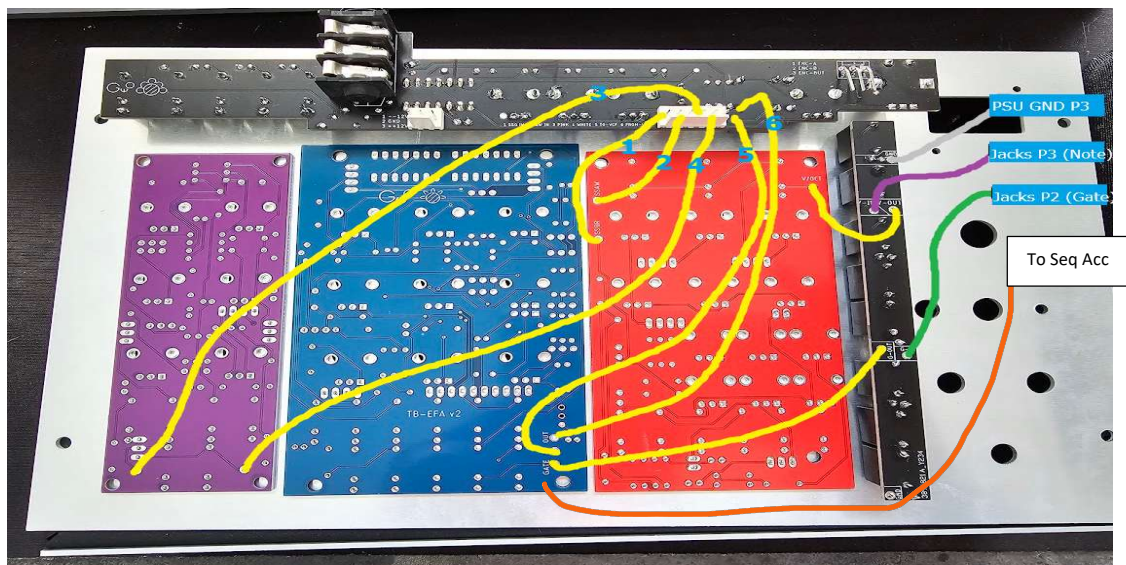|  | End 1 | End 2 | Length |
|---|---|---|---|
| PSU -12V | 4pin female molex to PSU PCB | Single pins to different plugs | |
| | **1 - --12V** | **Mixer PWR Pin 1** | **15cm** |
| | 2 N/C | | |
| | 3 N/C | | |
| | 4 N/C | | |
| | | | |

Only one more wire needed here – the final pin in the PSU GND molex to Mult PCB GND pad. [Pin 3 below]

|  | End 1 | End 2 | Length |
|---|---|---|---|
| PSU GND | 4pin female molex to PSU PCB | Single pins to different plugs / soldered direct | |
| | **1 – GND** | **SEQ-PWR Pin 1** | **10cm** |
| | 2 – GND | Mixer PWR Pin 2 | 15cm |
| | 3 – GND | Mult PCB GND Pad | 18cm |
| | **4 – GND** | **Jacks GND Pin 1** | **10cm** |
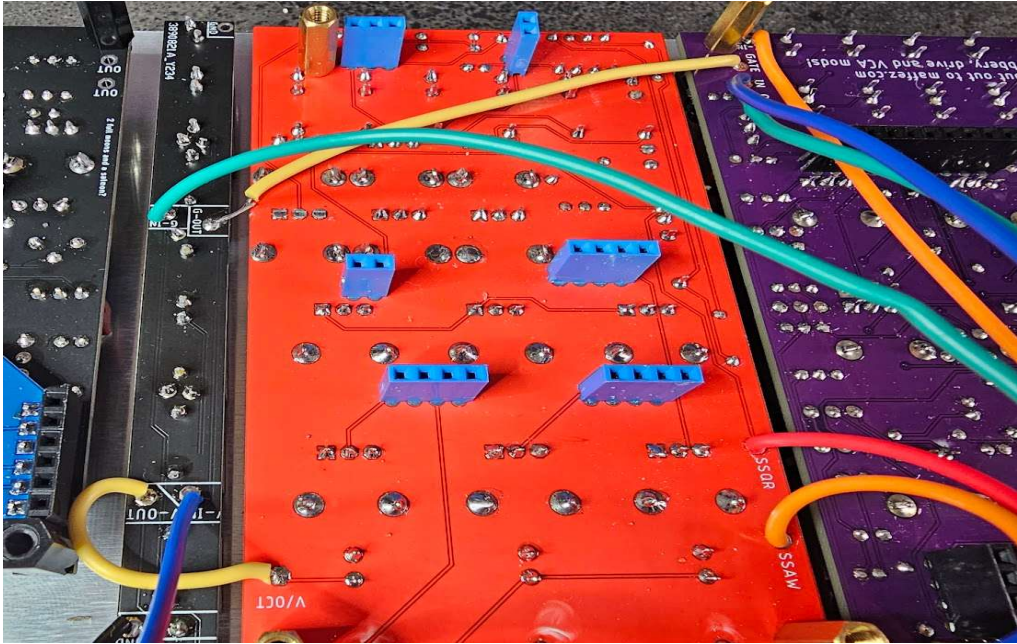
The completed power and ground loom.
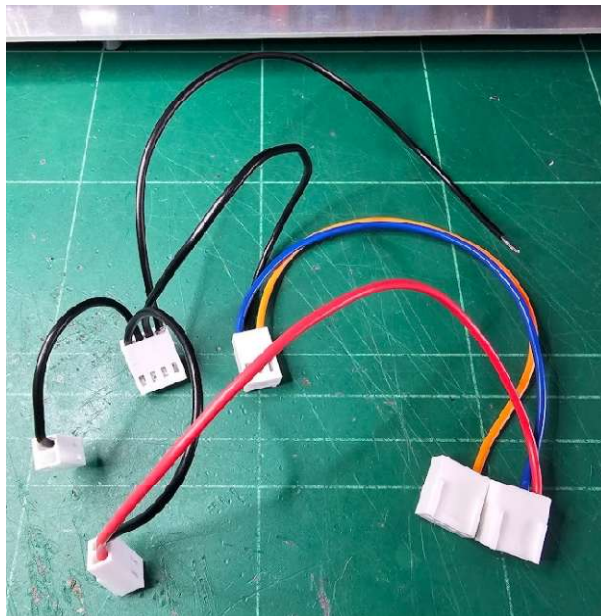
| | End 1 | End 2 | Length |
|---|---|---|---|
| Mixer 6 PIN | 6pin female molex to Mixer PCB | Single wires direct to synth control boards | |
| | **1 – SSQ IN** | **VCO Control PCB - SSQR** | **8cm** |
| | **2 – SSW IN** | **VCO Control PCB - SSAW** | **8cm** |
| | **3 - PINK** | **FX Control PCB – Pink (nearest panel edge)** | **20cm** |
| | 4 – WHITE | FX Control PCB - White | 20cm |
| | **5 – TO-VCF** | **VCF Control PCB - IN** | **15cm** |
| | **6 – FROM VCF** | **VCF Control PCB - OUT** | **15cm** |

Finally, don't forget the two highlighted yellow here, from the Mult to the VCO V/Oct and VCF Gate

| MULT PCB | End 1 | End 2 | Length |
|---|---|---|---|
| | Wires | Wires | |
| | MULT GND Pad | PSU GND Pin 3 | 20cm |
| | V-IN Pad | Jacks Pin 3 (Note) | 18cm |
| | V-OUT Pad | VCO V/Oct Pad | 4cm |
| | G-IN Pad | Jacks Pin 2 (Gate) | 24cm |
| | G-OUT | VCF Control PCB - GATE | 12cm |

# Finished all wiring!
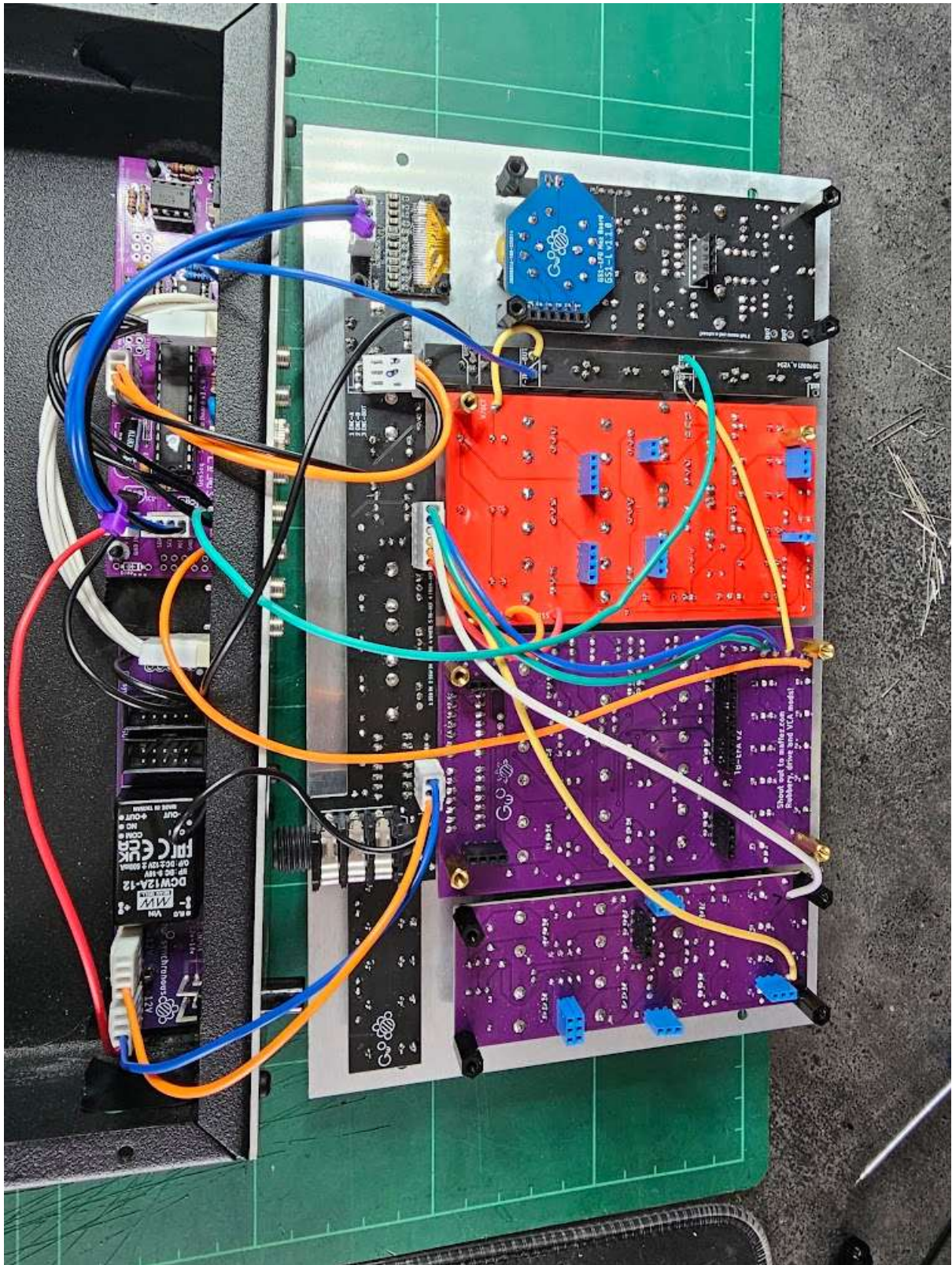
# Finishing Up

Now just add the voice PCBs back to the 4 modules and screw them into place. Don't forget to add the Euro power daisy chains from the PSU to the modules and carefully "hinge" it all back into the case, as done before, but careful not to trap any of the wires. Power up and check the Sequencer shows the boot splash and the ready LED comes on / LFO LED flashes.
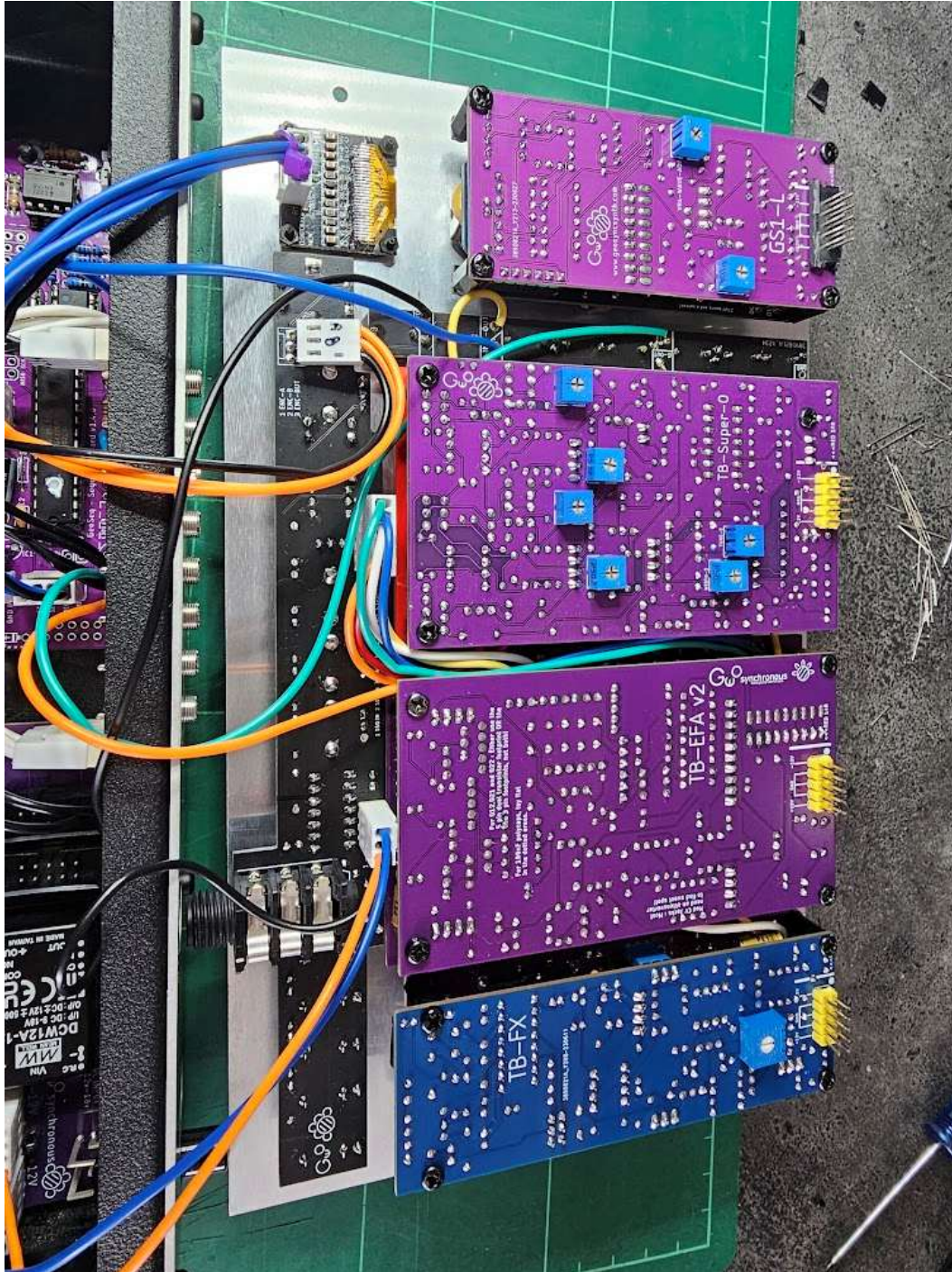
# Using the synth

All those tedious wires mean the synth is "ready to go" when you power it up. There is a fixed signal path as per the various connection lines (dotted/dashed etc) on the panel.

The minimum you need is a CV clock/run signal – or a MIDI input, and one of the two outputs, euro level (from the Volume out) or ¼" line level from the rear.

**No sound**, make sure you have the "Drive" on the VCF up, the Input level on the the mixer VCO1/2 Gain controls are up. And the volume pot is up.

**As all the hard wired paths use the "switch" pin on the jacks, you can bypass any of the hard wired signal flow by inserting a cable to that jack.**

The FX section is not patched by default. Wire the output from the VCF to the input of one or other effects – you can connect them both in serial – and then the output of the last effect back to the Volume input jack. When you connect to the VCF output, it disconnects the fixed path to the Volume in jack.


ENJOY!