

roboDNA

F5m Amp Build Cookbook

This cookbook details the steps I took to build my F5m Nelson Pass amp. It is intended to be used as a reference specific to my own personal build, and not as an official Build Guide.

WARNING:

THIS BUILD INVOLVES POWER SOURCES WHICH CAN CAUSE SERIOUS INJURY.

DO NOT USE THIS DOCUMENT AS A BUILD GUIDE.

REFER TO YOUR AMP's OFFICIAL DOCUMENTATION FOR SAFE BUILDING INSTRUCTIONS.

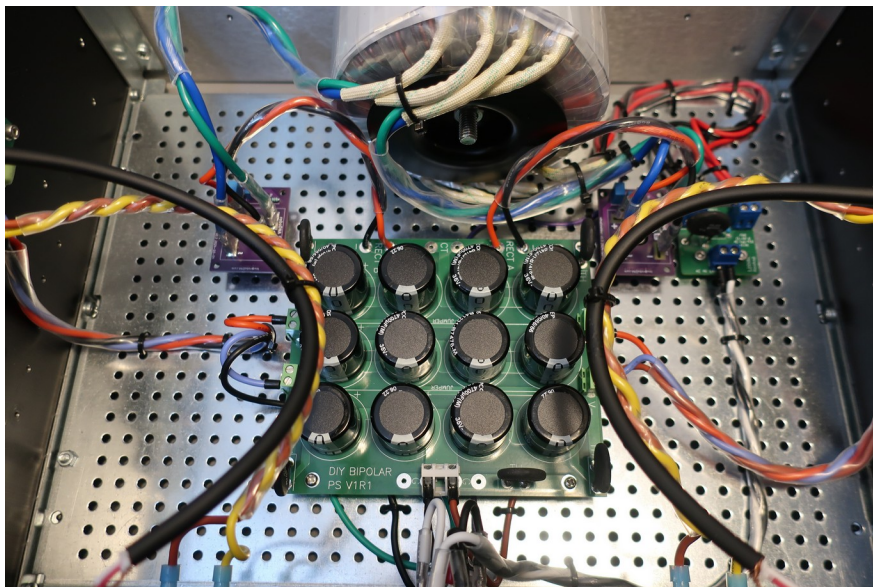


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roboDNA

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Section 1 - Case

The F5m needs a chassis around 4U x 350mm or larger, depending on voltage and bias.

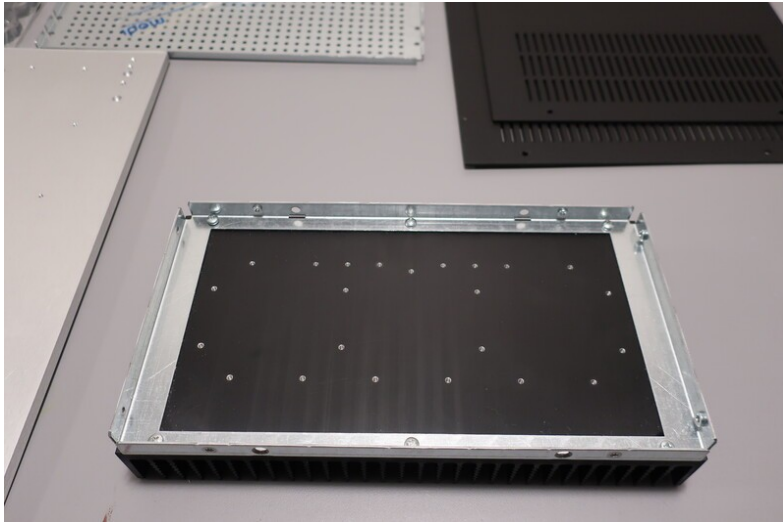
I used the ModuShop Deluxe400 chasis and base grid, with CNC machined front handles.

Use a soft cloth between the work bench and the heat sinks and front face plate during assembly.

Step 1 - Heatsink Frames

- A. Attach each frame to a heatsink using 6 silver screws.
- B. Leave the screws tight enough to hold the frame flush to the heatsink, but loose enough to allow the frame to move

(Fig 1.1)



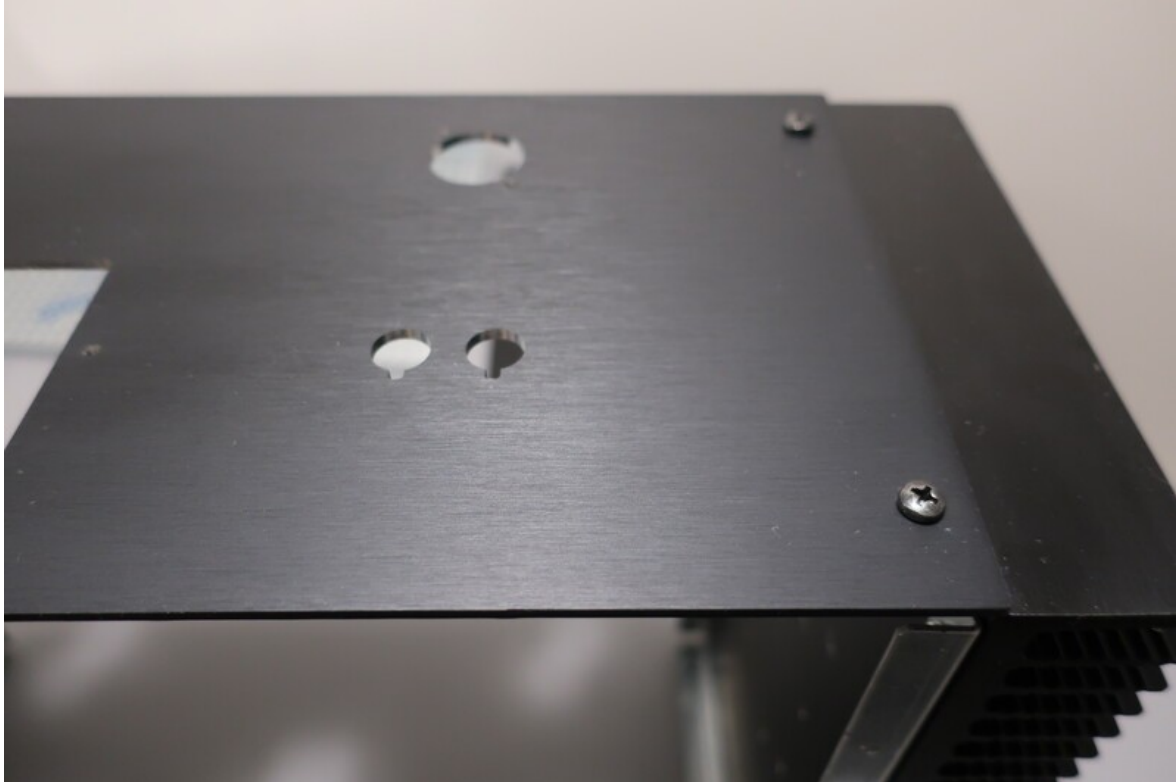
(Fig 1.2)



Step 2 - Back Panel

- A. Stand the 2 heat sinks vertically on your workbench.
- B. Leaving the heatsinks vertical, place the back panel on top of the ends of the heatsinks.
- C. Using black screws and nuts, attach the panel to the heat sinks, leaving the screws slightly loose. (*Fig 2.1*)

(*Fig 2.1*)



Step 3 - Bottom Panel

- A. Lay the case horizontally flat.
- B. Line up the 4 panel holes with the holes on each heatsink frame. (*Fig 3.1*)
- C. Attach the bottom panel using small black hex screws, leaving them slightly loose. (*Fig 3.2*)

Fig 3.1



Fig 3.2



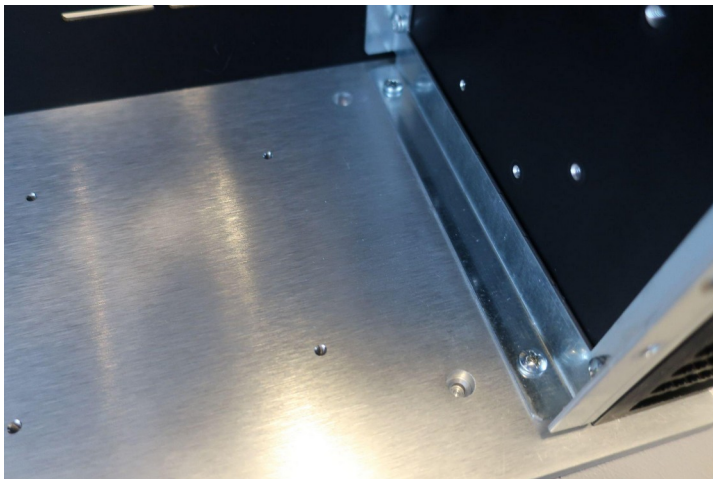
Step 4 - Front Panel

- A. Lay the main front aluminum/iron panel face down and lift the heatsinks and back panel onto it. (*Fig 4.1*)
- B. Line up the heatsink frame screw holes to the front panel screw holes.
- C. Using 2 silver screws per side, attach the heatsink frame to the front panel. Tighten the screws. Do not overtighten. (*Fig 4.2*)

(*Fig 4.1*)



(*Fig 4.2*)



Step 5 - Tighten Frames and Back Panel

- A. Flip the case over so that it lays flat horizontally. Ensure it lays flush with the workbench (*Fig 5.1*)
- B. Slide the front panel over the edge of the workbench (*Fig 5.2*)
- C. Tighten all 6 screws for each heatsink frame. (*Fig 5.3*)
- D. Tighten all 4 screws and nuts for the back panel. (*Fig 5.4*)

Fig 5.1

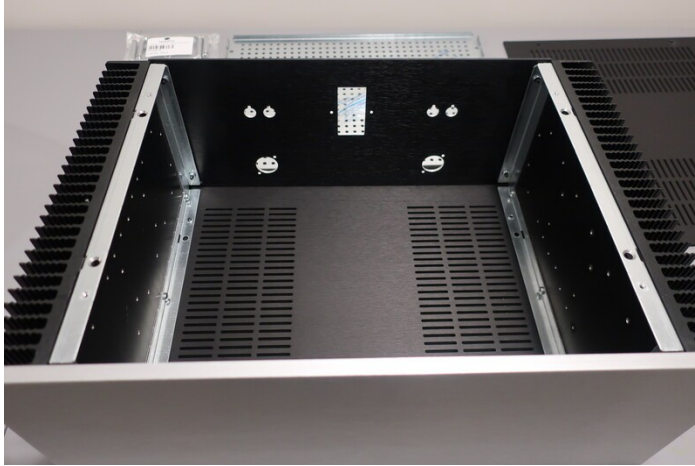


Fig 5.2



Fig 5.3



Fig 5.4



Step 6 - Tighten Bottom Panel

- A. Flip the case over with the bottom panel facing up. (Fig 6.1)
- B. Tighten all 4 hex screws.

Fig 6.1



Step 7 - Fit Top Panel

- A. Flip the case over so that it lays flat horizontally, with the top panel side facing up. (*Fig 7.1*)
- B. Ensure all holes on the top panel align with the holes in the heatsink frames. Leave screws off until the PSU and boards have been mounted inside the case.

Fig 7.1



Step 8 - Drill LED Holes

TBD

Step 9 - Install Handles

TBD

Step 10 - Install Feet

TBD

Step 11 - Grounding Case

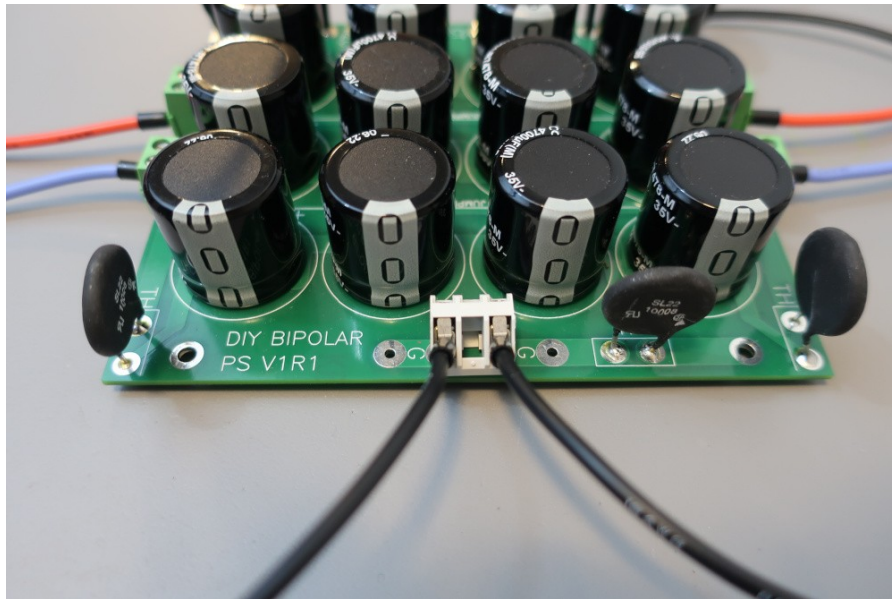
Verify that all panels / heatsinks are earth grounded. Removing the powder coat at the attachment points is certainly a good idea. Add a grounding wire from heatsinks and panels to base plate.

Section 2 - Nelson Pass Power Supply Board

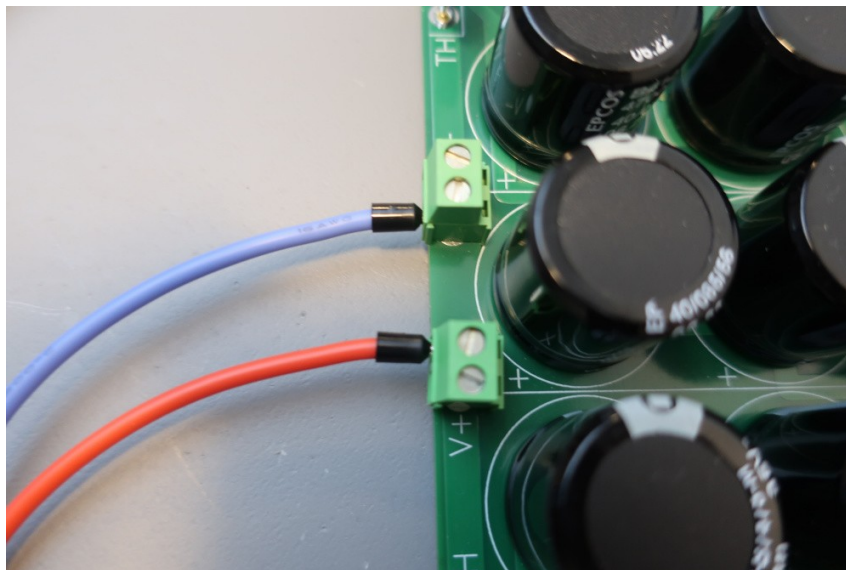
The Nelson Pass PSU kit from diyaudio.com was used.

Assembly was straightforward and did not require a guide.

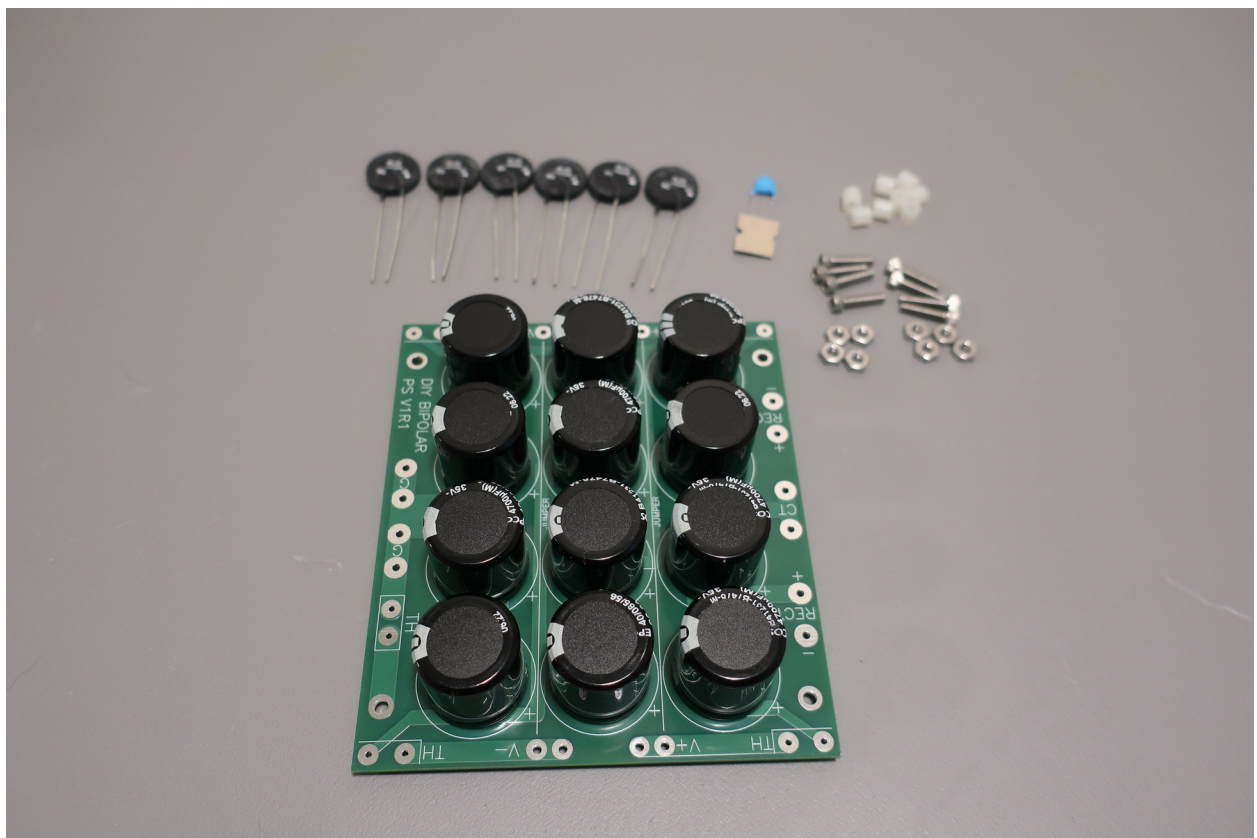
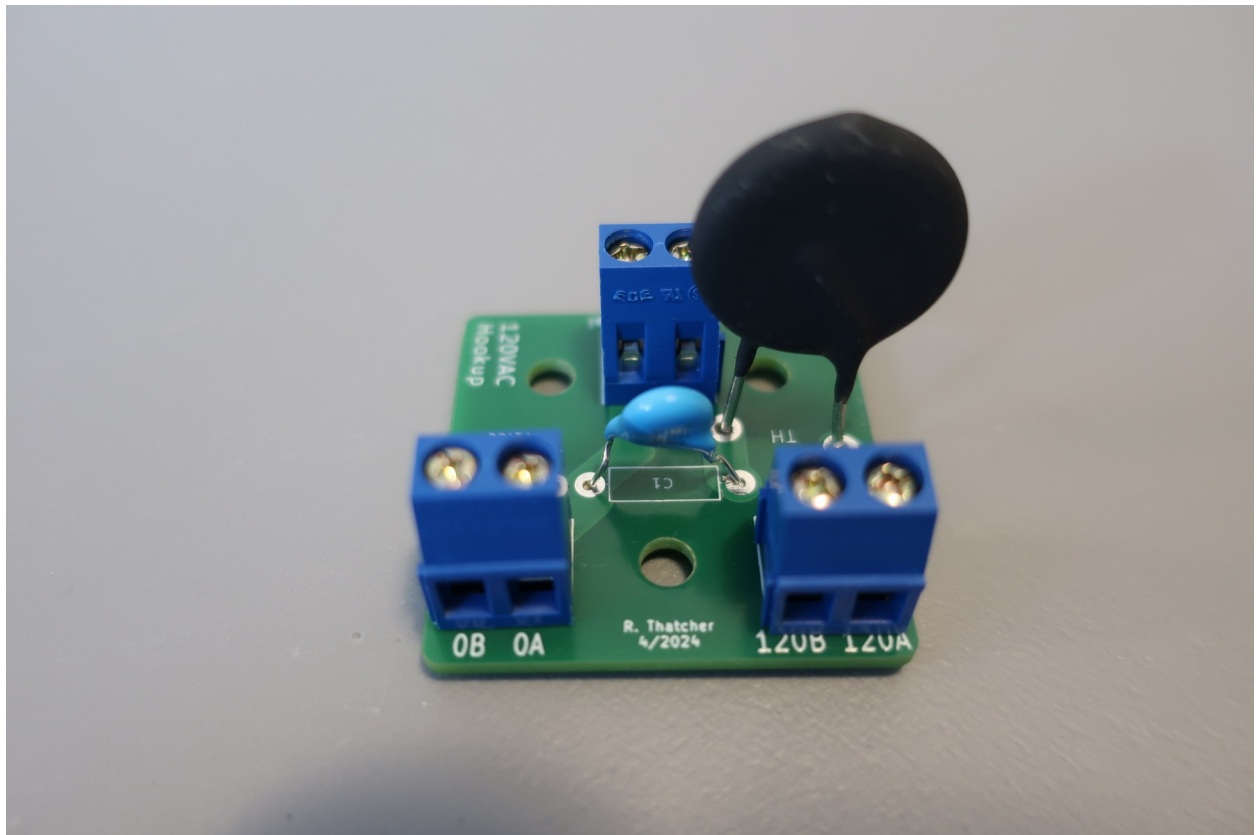
Wiring from the amp boards to the PSU are terminated with Ferrule boot lace terminals on the PSU side, and direct soldered on the amp board side. The Ferrule terminals insert into screw terminals.



Grey screw headers have slightly wider pitch to fit the pcb footprint.

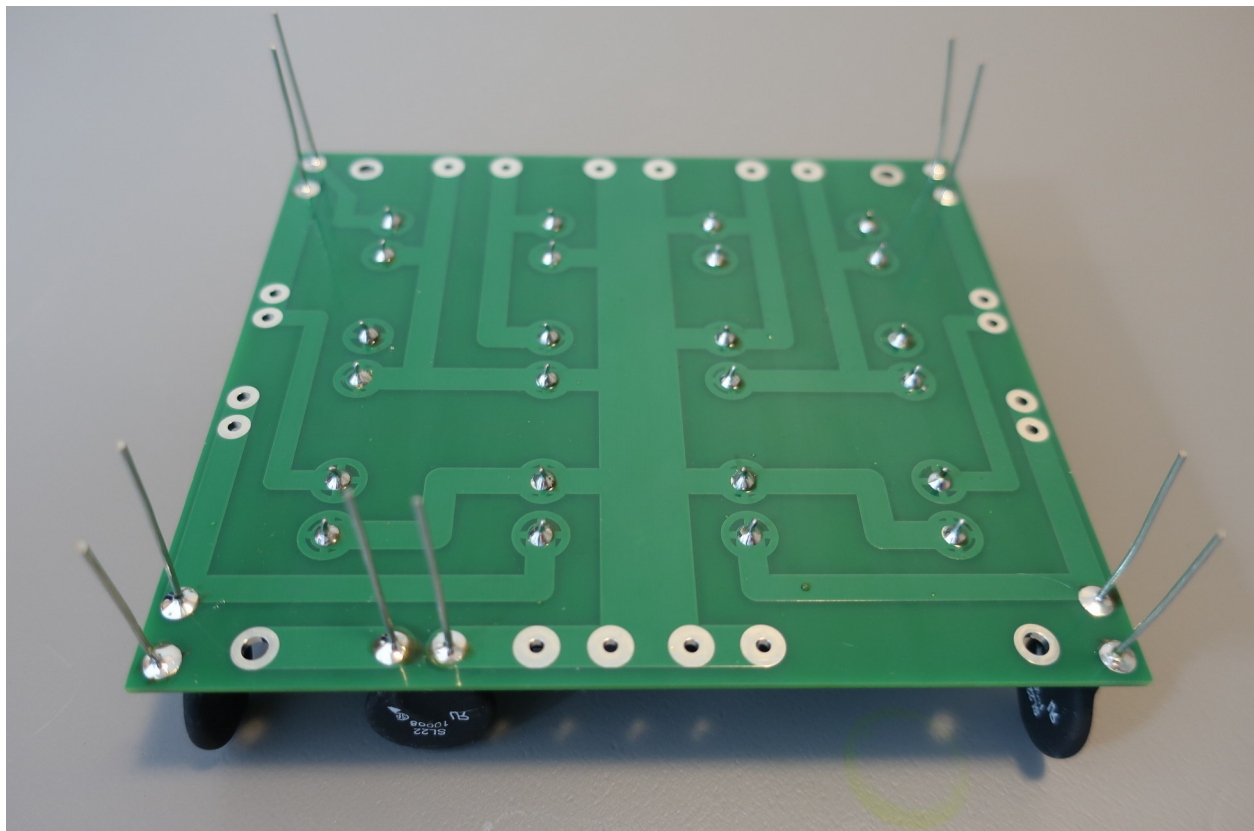


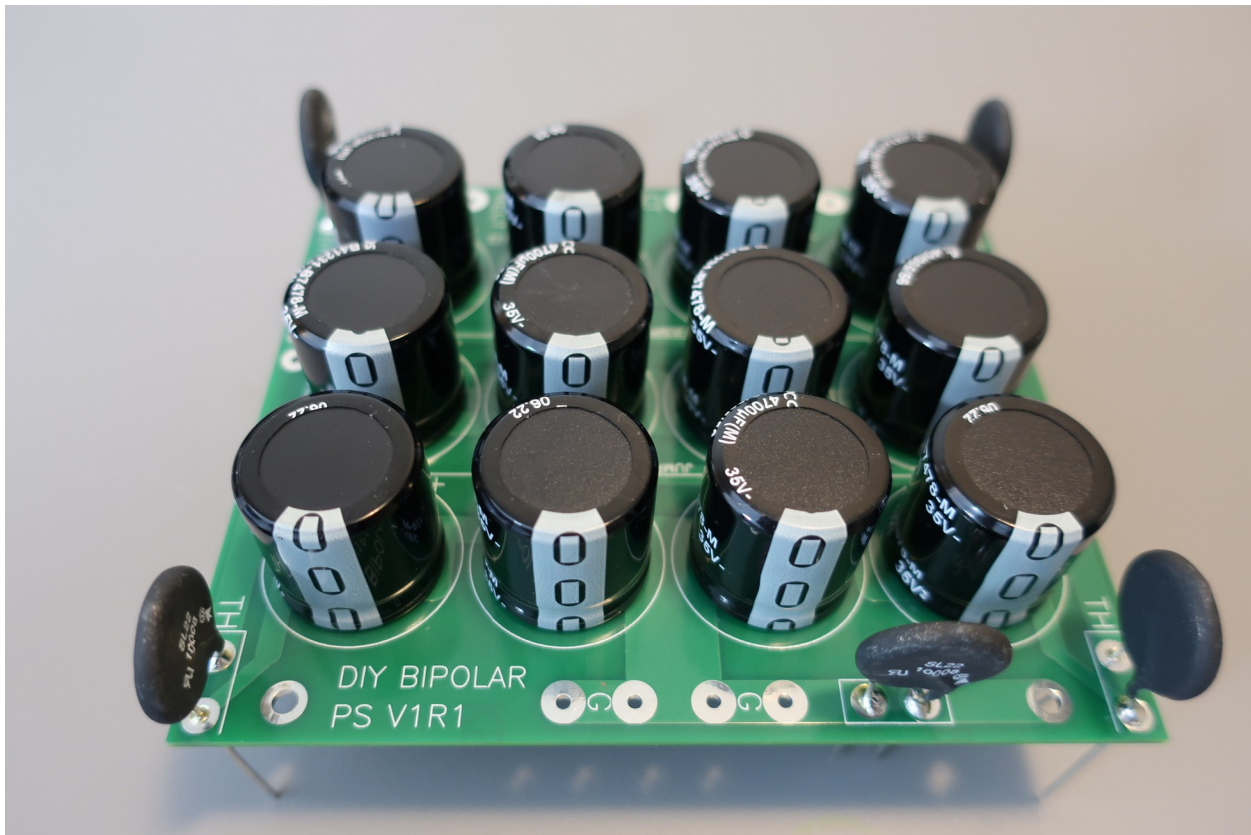
Standard screw terminals





Leave resistors raised up from board.





Wiring from the rectifiers to the PSU board were terminated with a blue faston connector on the rectifier end, and soldered directly to board on the PSU side.

For wires going from the PSU to the Amp boards:

Red = Positive

Blue = Negative

Brown = Ground (note wires in the image below are wrong; they should be brown instead of black.)

For wires going from the PSU to the Rectifiers:

Black = +

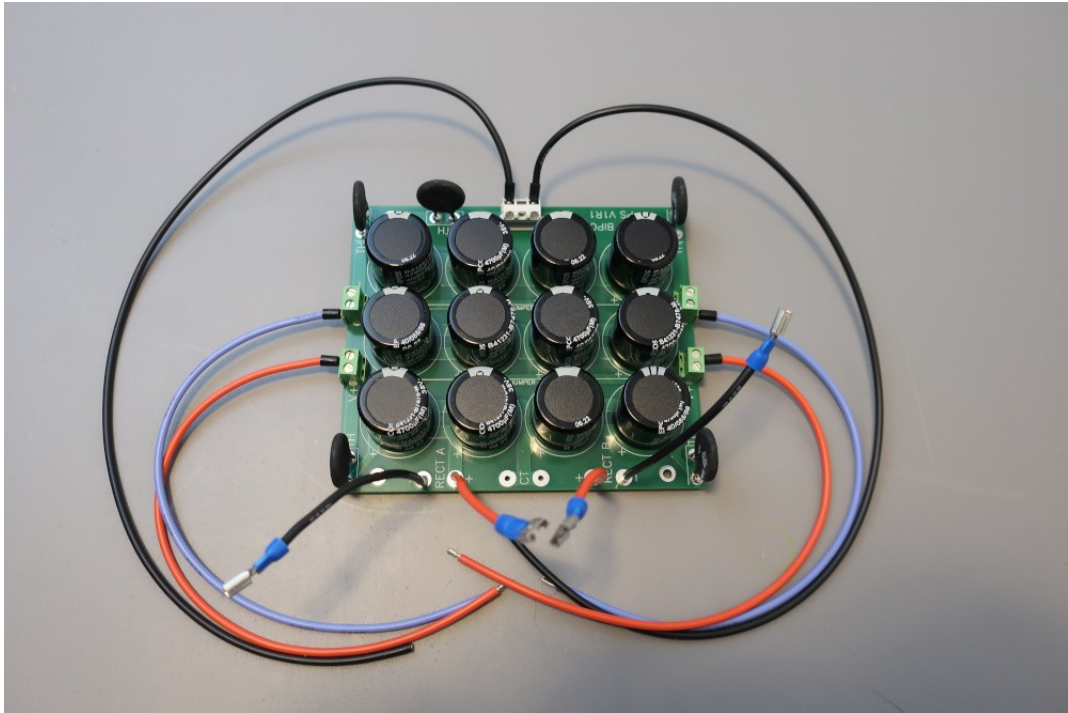
Red = -

(note wires in image below are wrong; red and black are swapped)

Transformer CT to CT on PCB

Single rectifier + to RECT A + on PCB

Single rectifier - to RECT B - on PCB

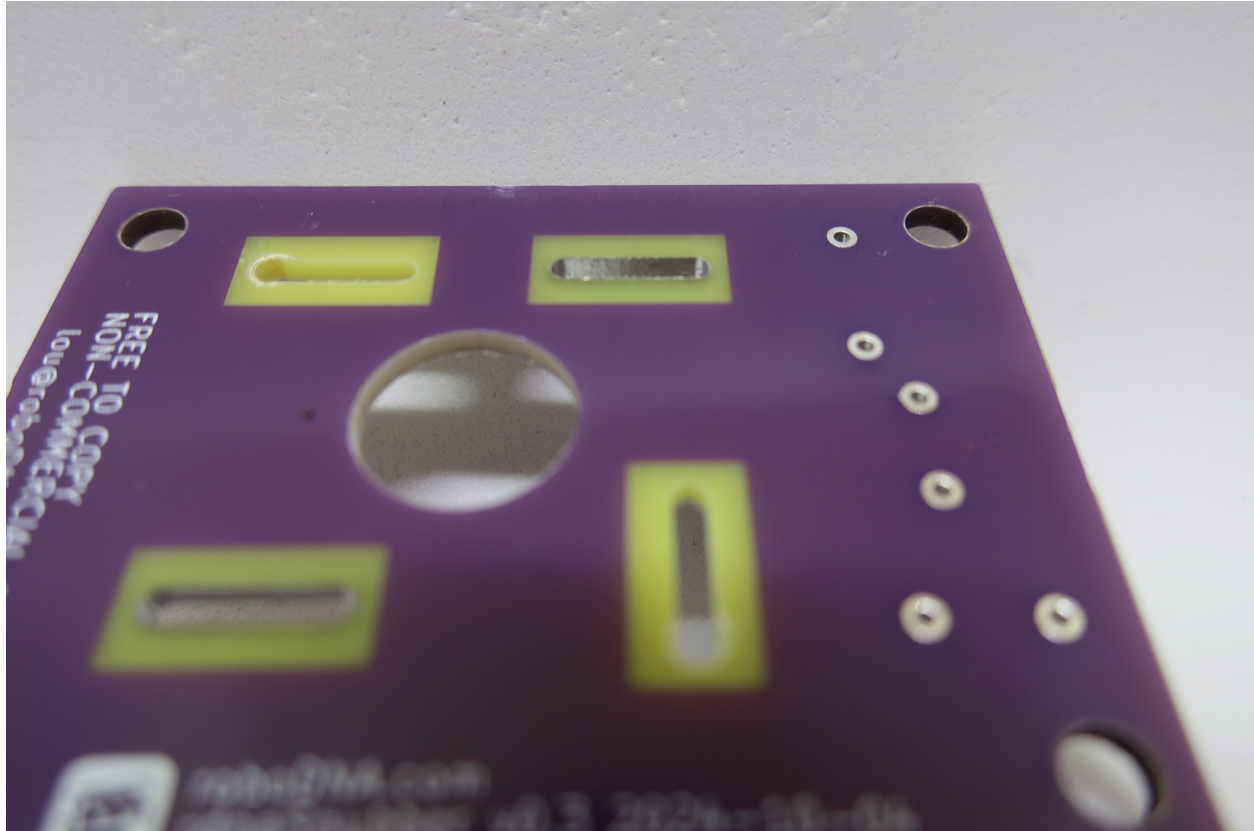


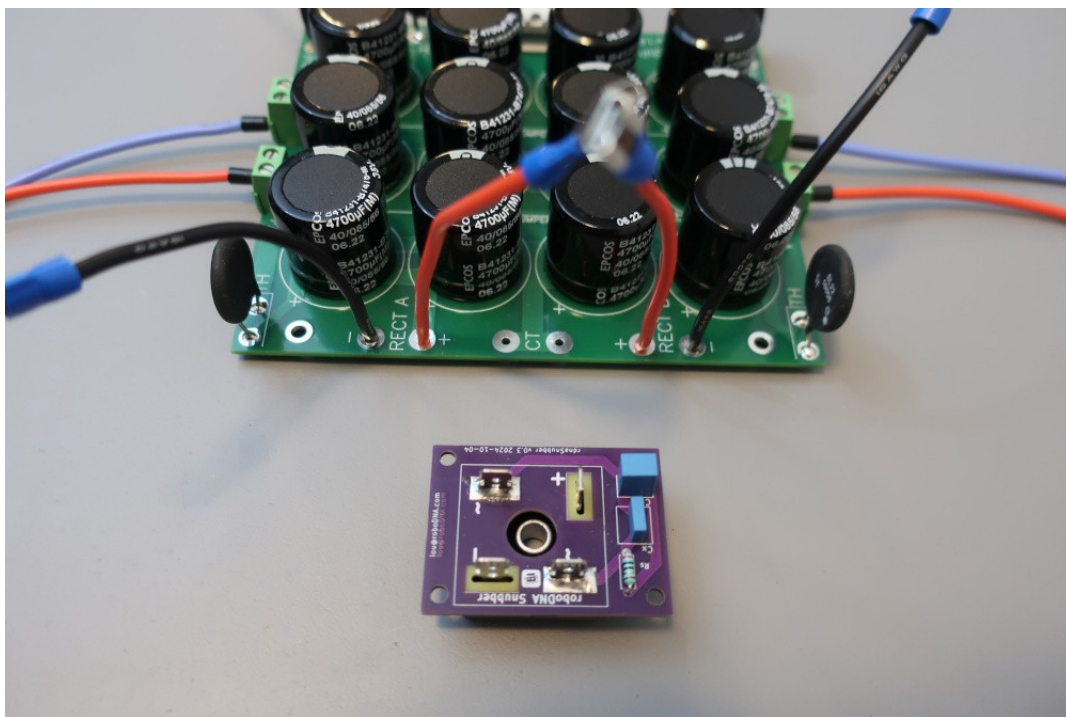
Section 3 - Snubber Board

I manufactured a custom snubber board which did not come with the Nelson Pass PSU kit. I have made the PCB available on DIYAudio.com You can get the gerber files to get some made at JLCPCB or others pcb manufacturing house.

roboDNA Snubber Gerber Files:

<https://www.diyaudio.com/community/threads/rectifier-snubber-daughterboard-robodna.417903/#post-7822740>





Snubber Board Resistor and Capacitors

A 20ohm 1/4 watt resistor was used:

Mouser: 708-RNF14FTD20R0

Here's the two caps everyone recommends.

10nF - 495-2534-1-ND. (5%)

B32529C3103J189

Or

495-77011-1 (10%)

B32529C3154K189

150nF -

B32529C3154J289

Section 4 - F5m Amp Boards

The F5m kit from DIYAudio.com was used.

NOTE: Ensure the correct MOSFETs are mounted:

Mosfet IRFP9140 goes to Q3

Mosfet IRFP140 goes to Q4

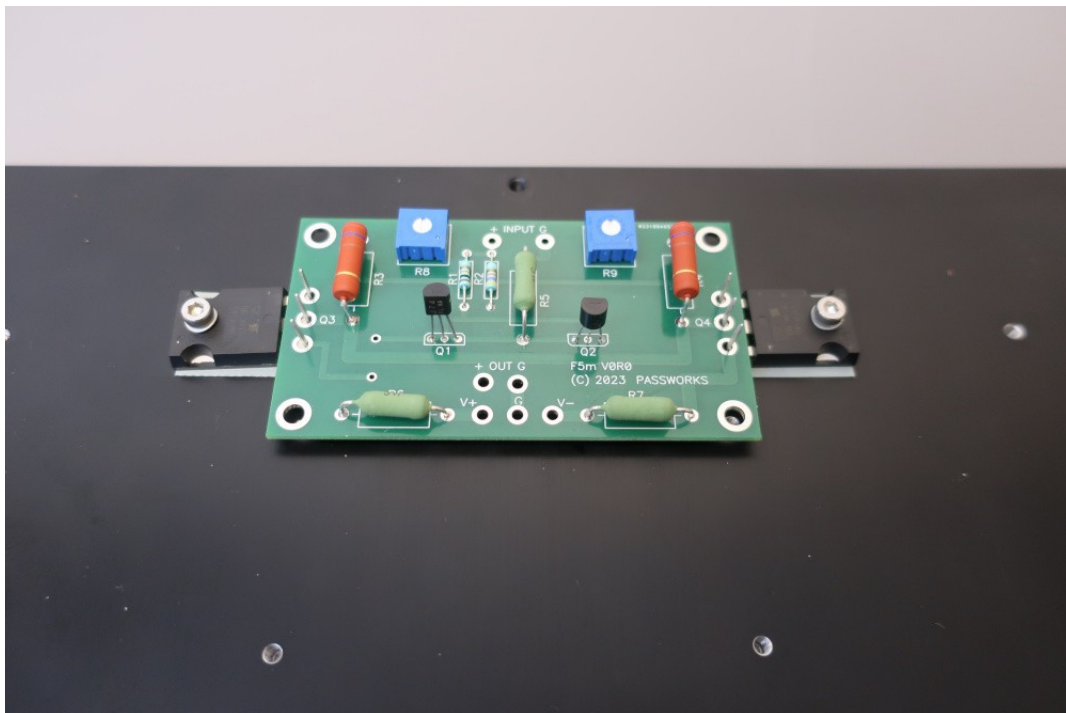
NOTE: Ensure the correct transistors are mounted:

2SK170 = Q1

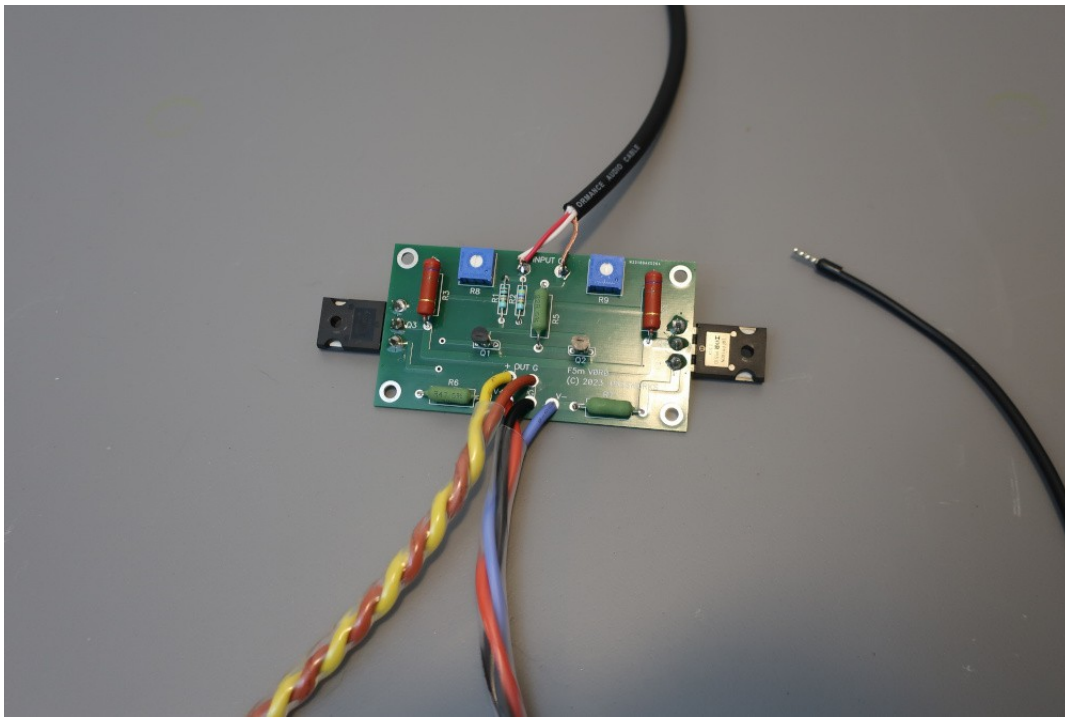
2SJ74 = Q2

Build Steps:

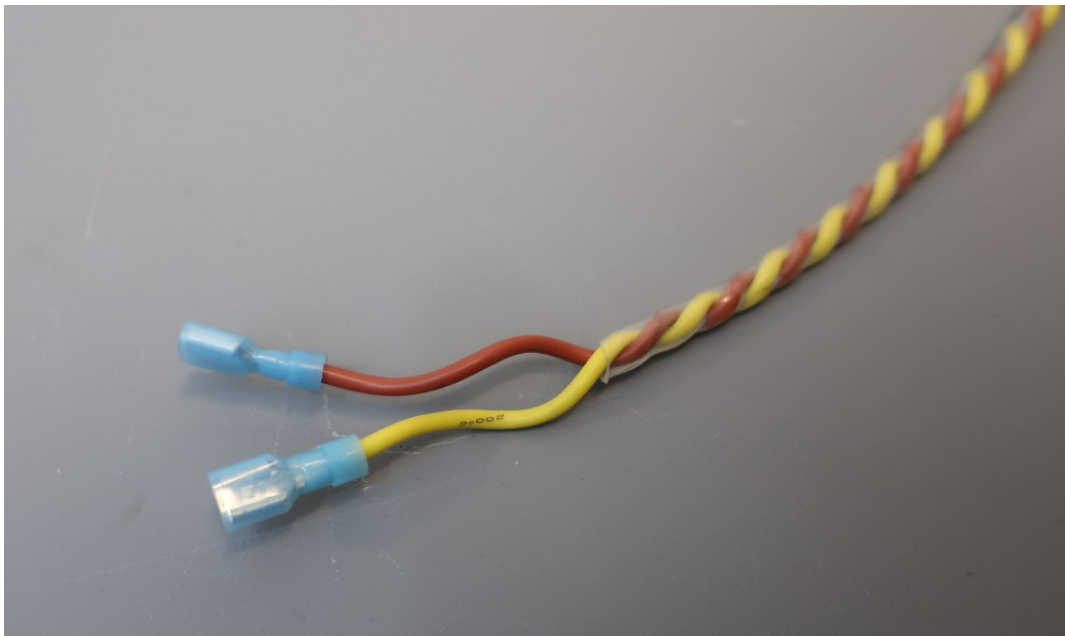
- Solder the 1/4w resistors first, then the triacs, then the 5w resistors. Leave them raised off the board for cooling.
- Set a heatlink flat on a workbench.
- Bend the MOSFET leads at a 90degree angle where they widen (see picture for bend direction)
- Mount MOSFETs onto the heatsink on top of insulator pads, and screw them in loosely.
- Place the PCB on top of the MOSFETs and screw the PCB to the heatsink using 2 risers and screws.
- Tighten PCB and MOSFET screws. Solder the MOSFET pins onto the PCB.



Amp board mounted to heatsink with just MOSFET screws. Still need to add 2 pcb mounting screws.

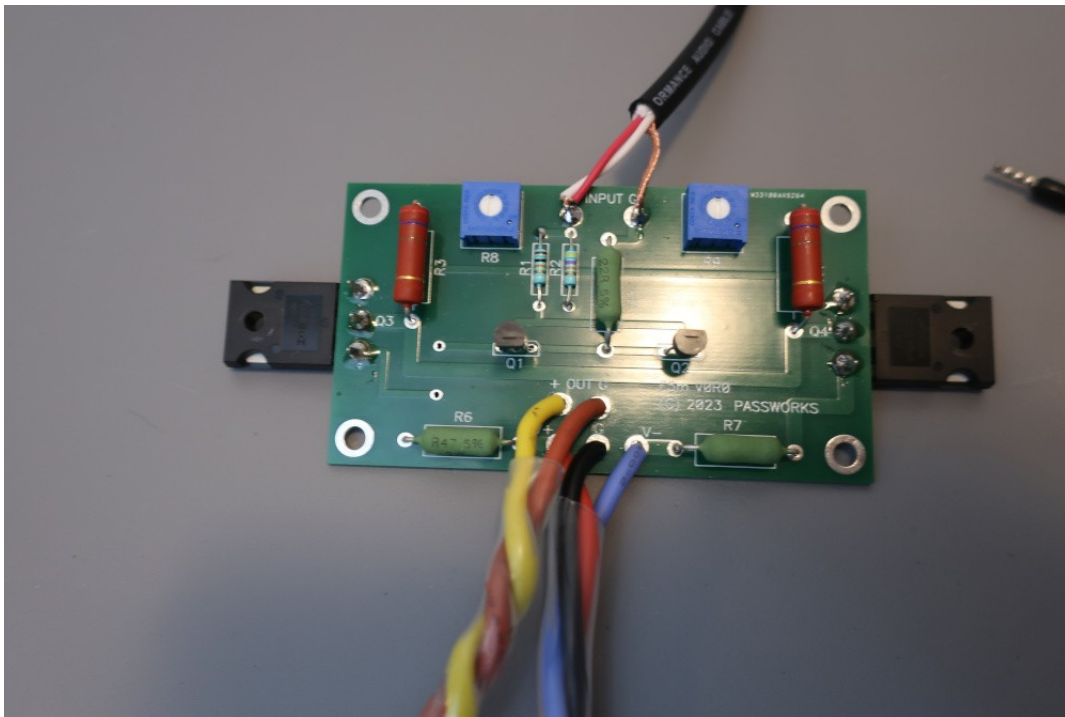


Wires soldered directly to AMP board, with bootlace terminal.

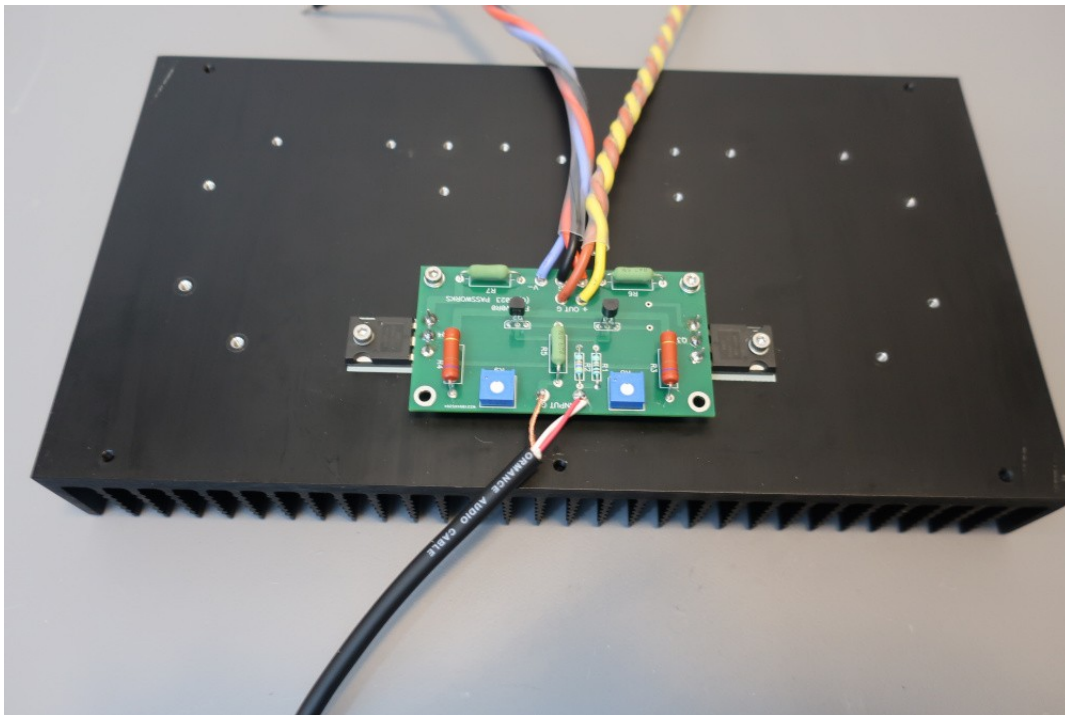


Soldering terminals to wire (B&S) is not required for amp output to speakers.
Lightly twisted and transparent shrink tubing.

Use a 1.1Nm or 1.2Nm torque wrench to fasten MOSFET screws into heatsink.



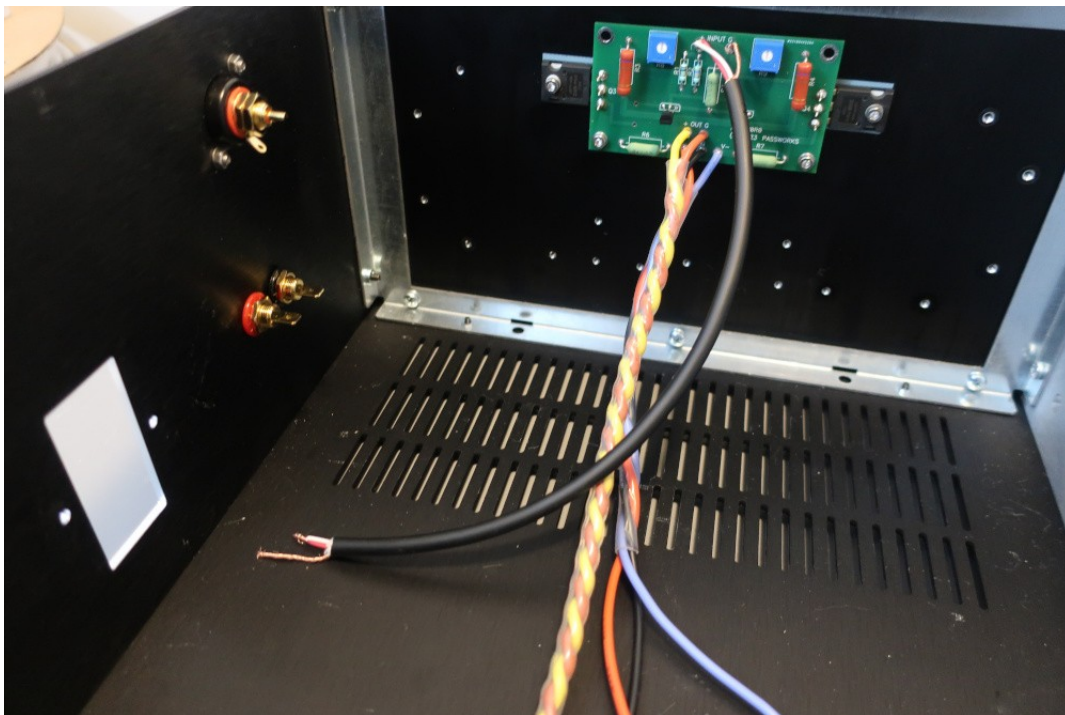
Amp board



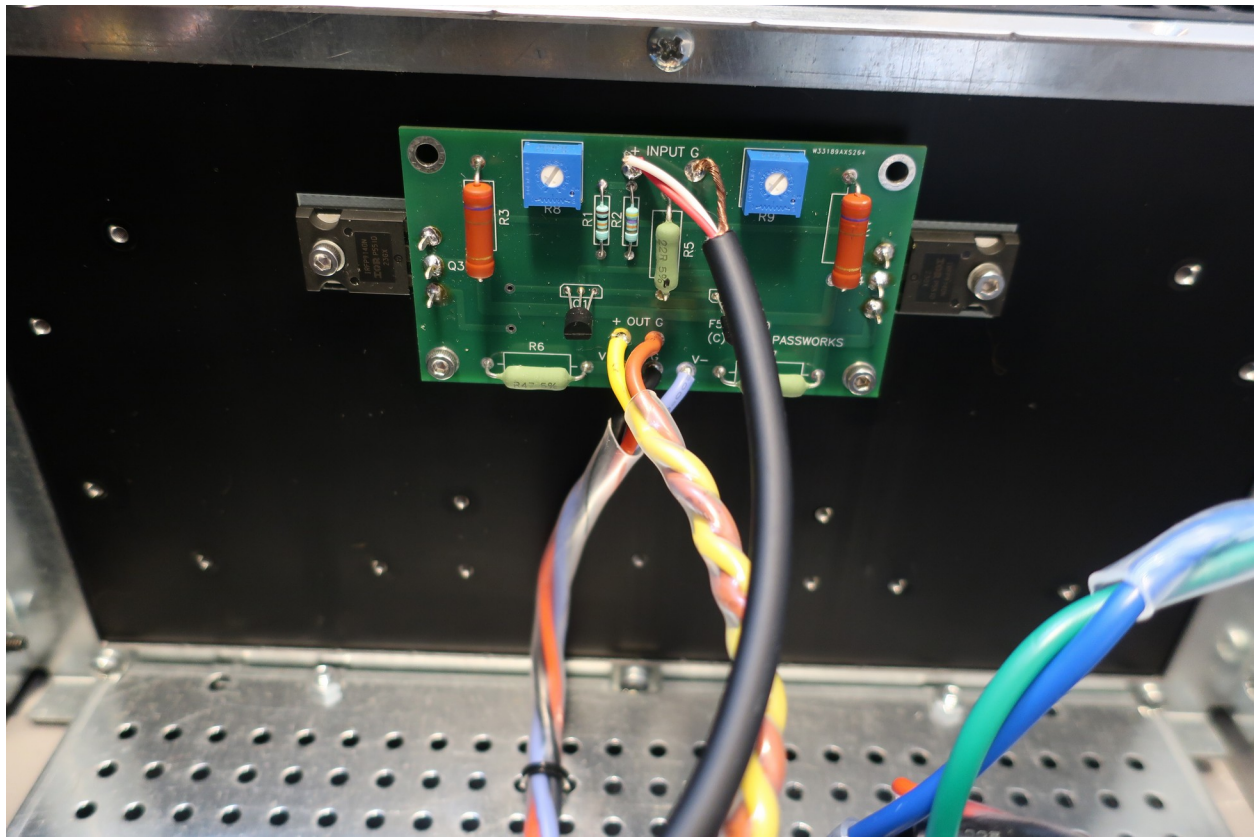
Amp board mounted to heatsink with insulation pads between heatsink and MOSFET tab.



Amp Mounted in case. Bent washers are used for MOSFET screws. Tighten just enough to bend washers slightly.



Ensure output wires reach binding posts and RCA input jack on back panel.



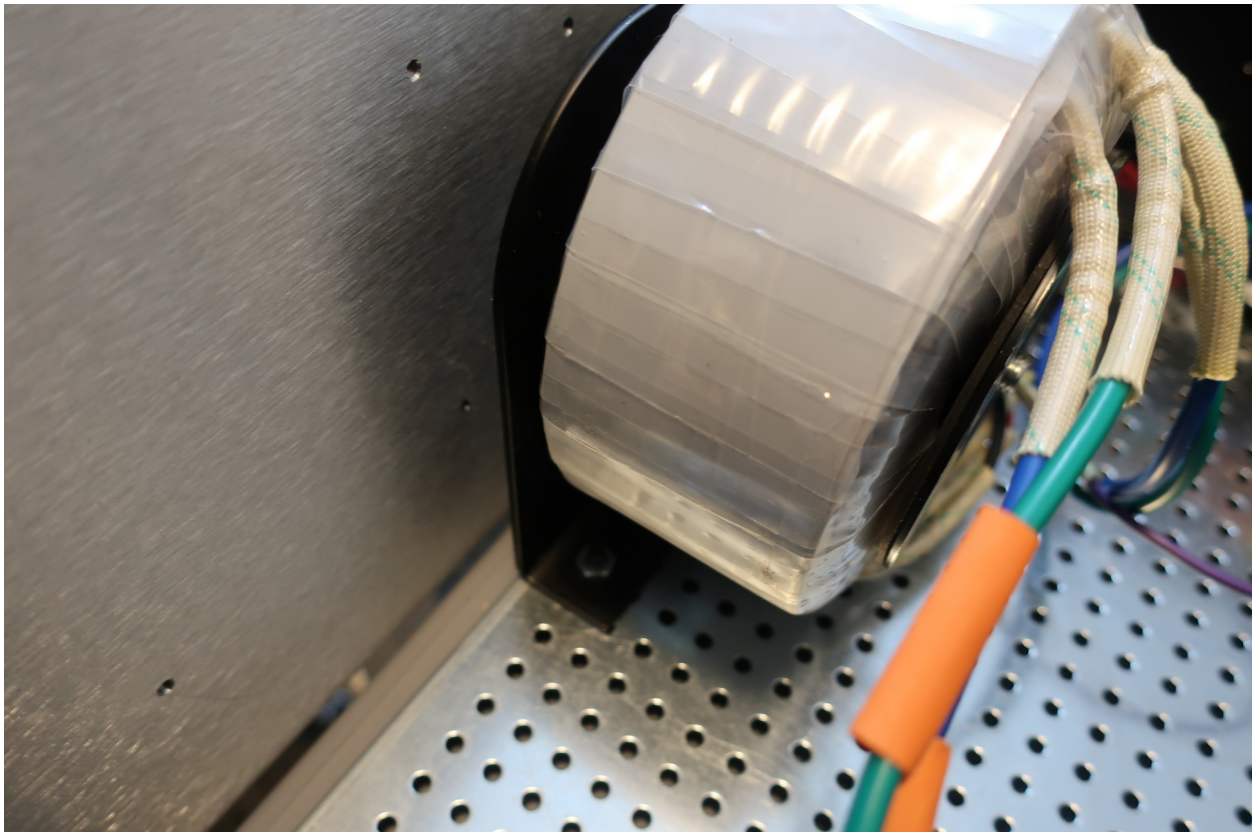
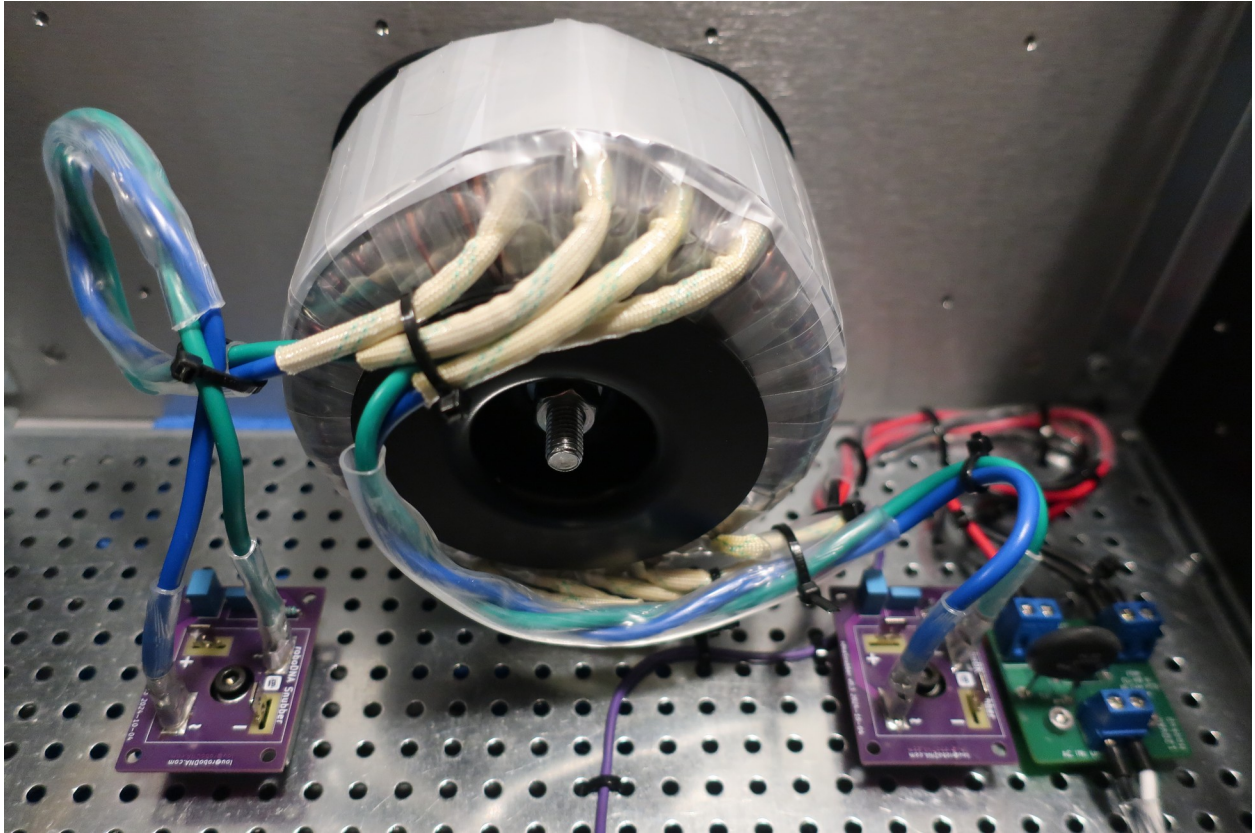
Solder audio cable shield to input G(round)

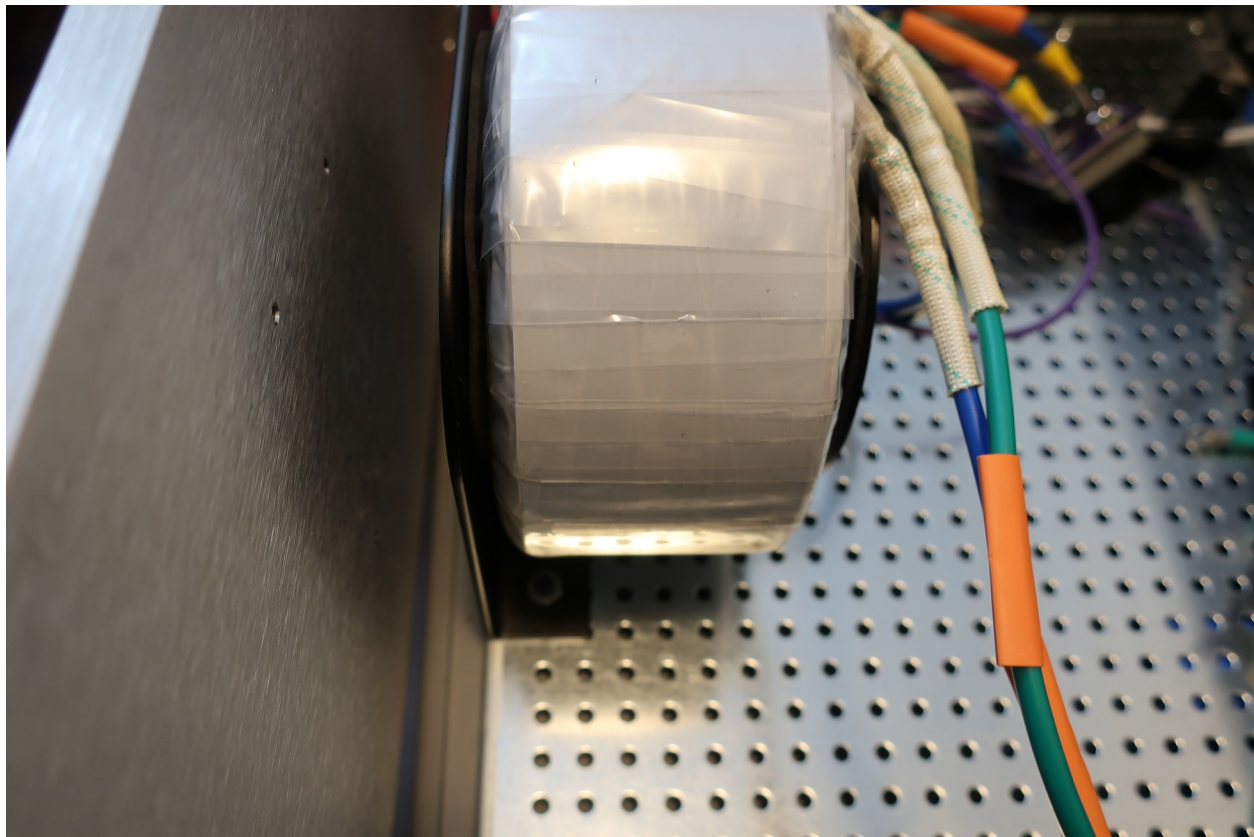


Turn trim pots all the way down, counter clockwise.

Section 5 - Transformer

An Antek AS-328 Transformer was used with a CL-200 L mounting bracket.





The transformer was mounted vertically to lessen magnetic interference.

The transformer should supply 18VAC or 20VAC secondaries.

Transformers can be custom ordered with static shield and magnetic shield, with several rounds of same ferrous tape used for core, wound on circumference, prior to final plastic tape layer.

Red and Black primary wires for Antek AS-3218:

The black wires go to hot/Live. The black wires connect to inner layer and red wires connect to outer layer.

Some options for 120VAC main line include: Antek AS-3218 or AS-3220. A step-up to AS-4218 or AS-4220 is also fine.

With +/-18VAC secondaries the rectified DC voltage is root mean squared, so $18V \times 1.414 = 25.45VDC$. Due to inefficiencies and voltage drop in the filter circuit of the PSU, approx. 24VDC is supplied resulting in two "rails", one +24 VDC and one -24VDC.

Each amp PCB gets both rails.

The power entry module needs a fuse sized based on the transformer. A 300VA transformer will need $300 V \times A / 120 V = 2.5 A$ fuse on the hot/line wire. That value slow blow (time delay) fuse, or lower, will protect the transformer. The fuse is typically integrated into the PEM.

Grounding to chassis is critical for safety. The AC ground in goes straight to chassis.

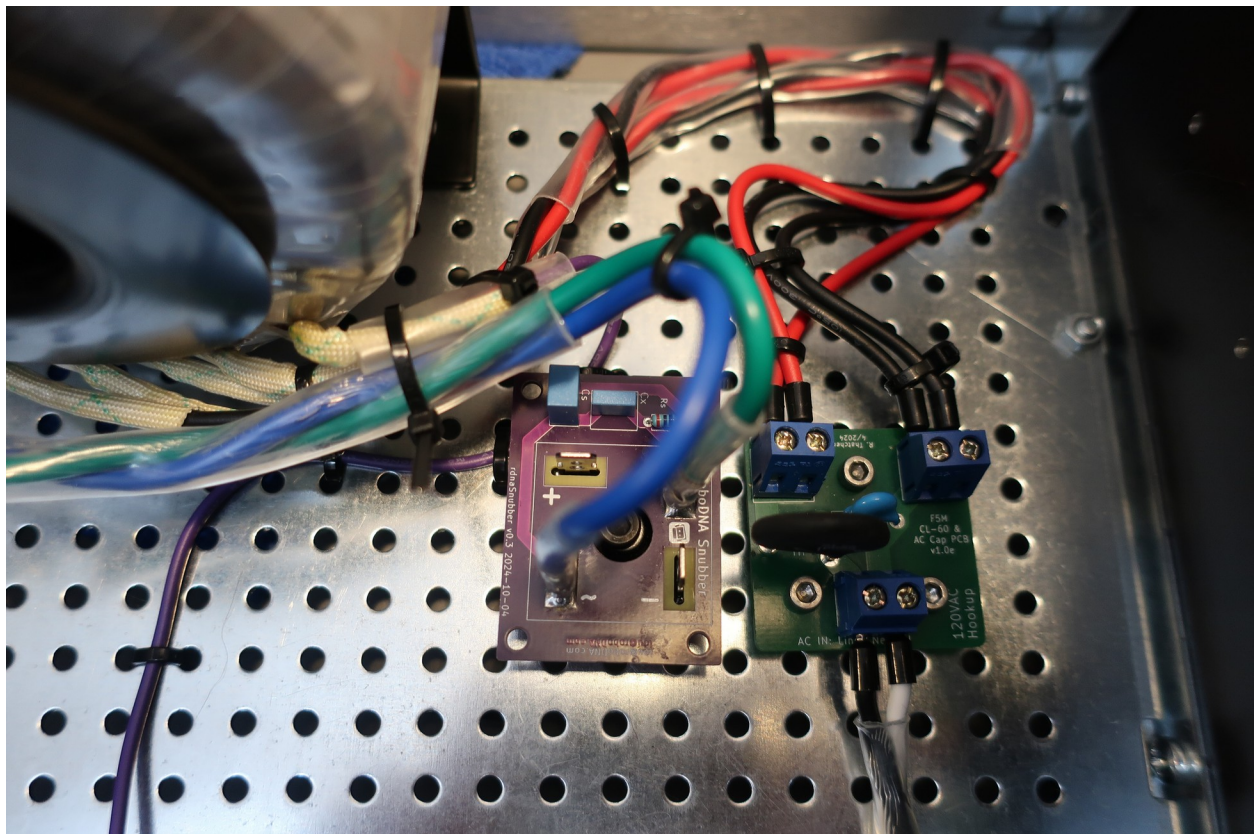
If both the hot and neutral wires are fused, for safety, the neutral fuse should be higher current capacity so that in the event of a fault, the hot fuse will blow. If the neutral blows instead, the hot line is still live and there is still electricity in the chassis which is dangerous. Therefore the neutral fuse should be 10A slow blow and the line fuse (hot) should be VA of transformer divided by 120V. For example 300VA transformer/120V = about 2-3A.

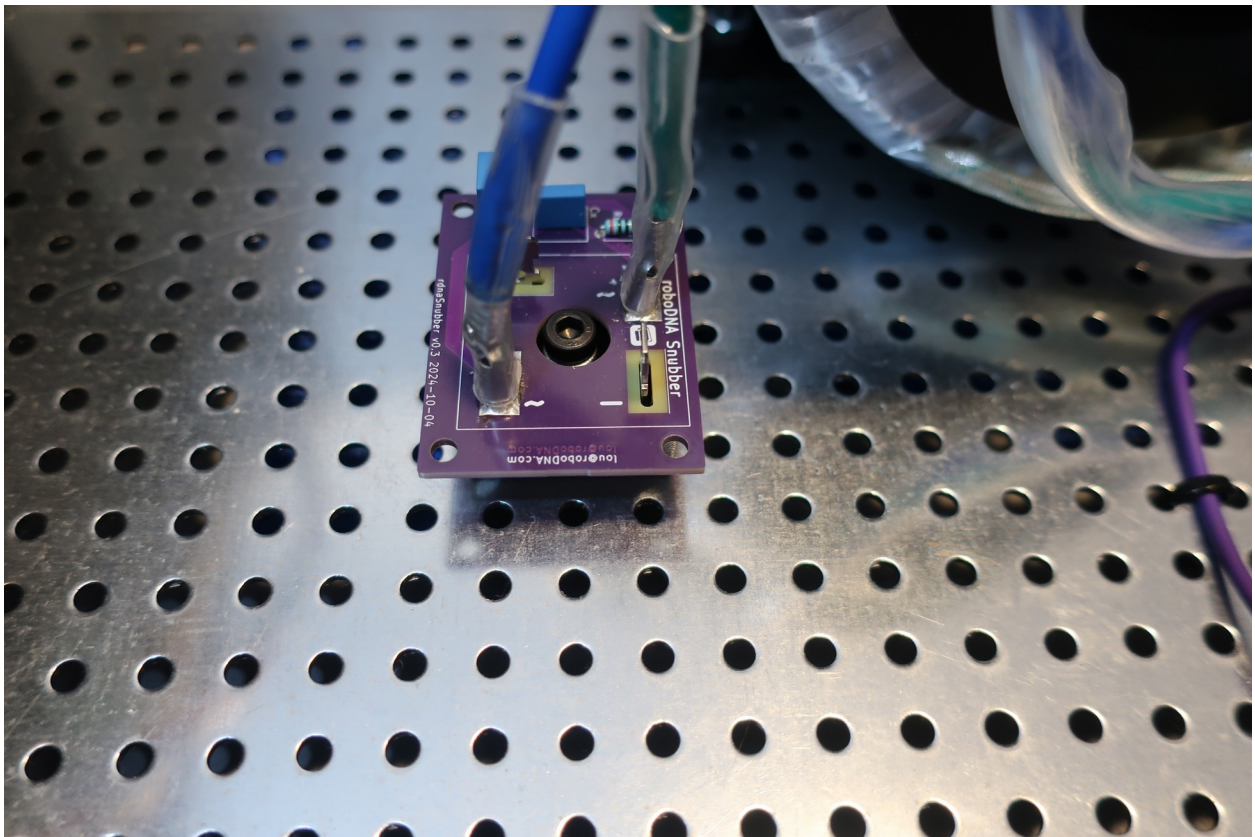
Identifying the primary and secondary windings is important. DMM was used to assist.

For 120V line input into the transformer (US, Canada), wires 2 and 4 connect together (Red colors); this connects the “hot” or “line”. Wires 1 and 3 connect together (Black colors) and these become your “neutral”.

For secondary wire identification, a multimeter was used to check to make sure the secondaries have continuity (0 ohms on the resistance setting). Wire 5 and 6 should have continuity, similarly, wire 7 and 8 should have continuity. Wires 5 and 8 should not have continuity and should read infinite. Similarly wires 6 and 7 should not have continuity.

Wires 6 and 7 are your ‘CENTER TAP’ and should be connected together.





Power supply secondary connected to snubber board.
Snubber board bolted to the bottom grid using 4M screw and washer. Ensure screw does not touch bottom panel.

Section 6 - Power Entry Module (PEM)

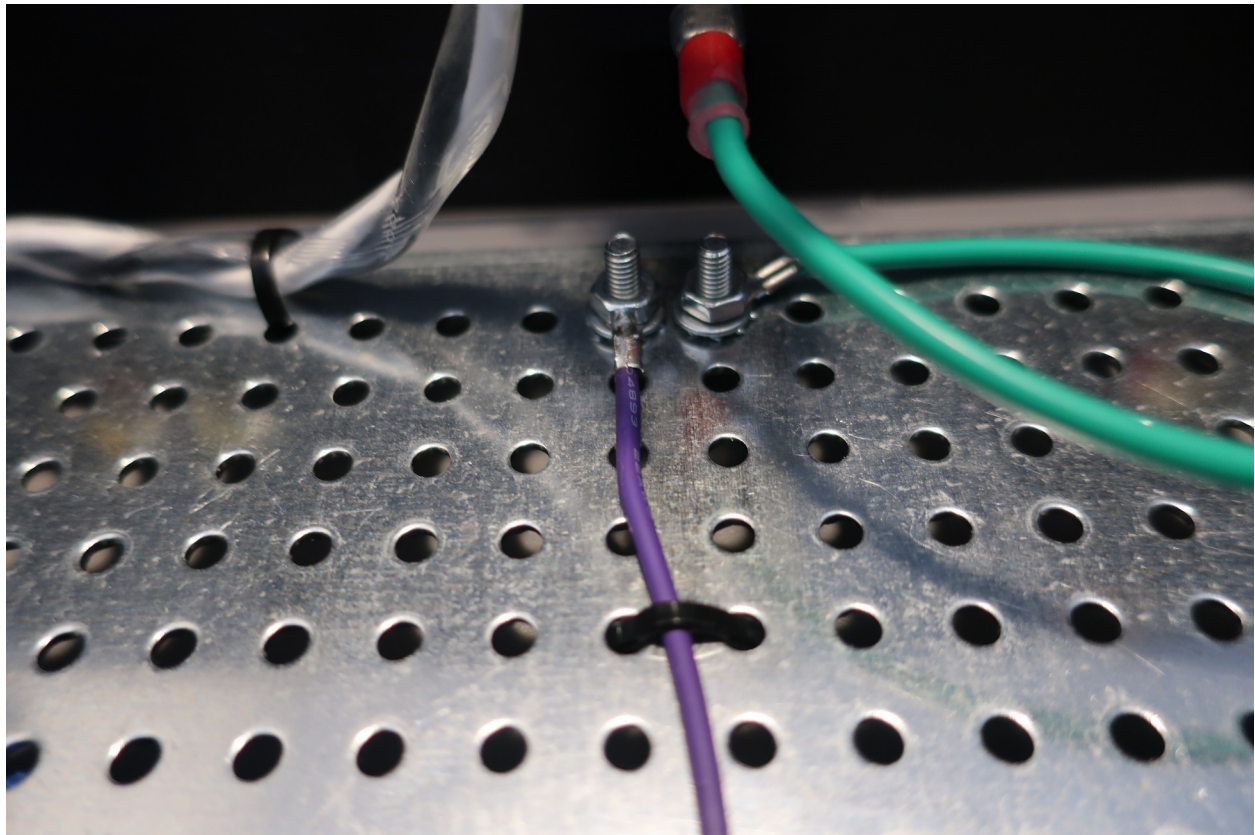
Some PEMs have filtering in them but are more expensive.

A non-filtered Schurter PEM was used. I came with a 2 fuse drawer. I used a 2.5A fuse on live and 10A on neutral.

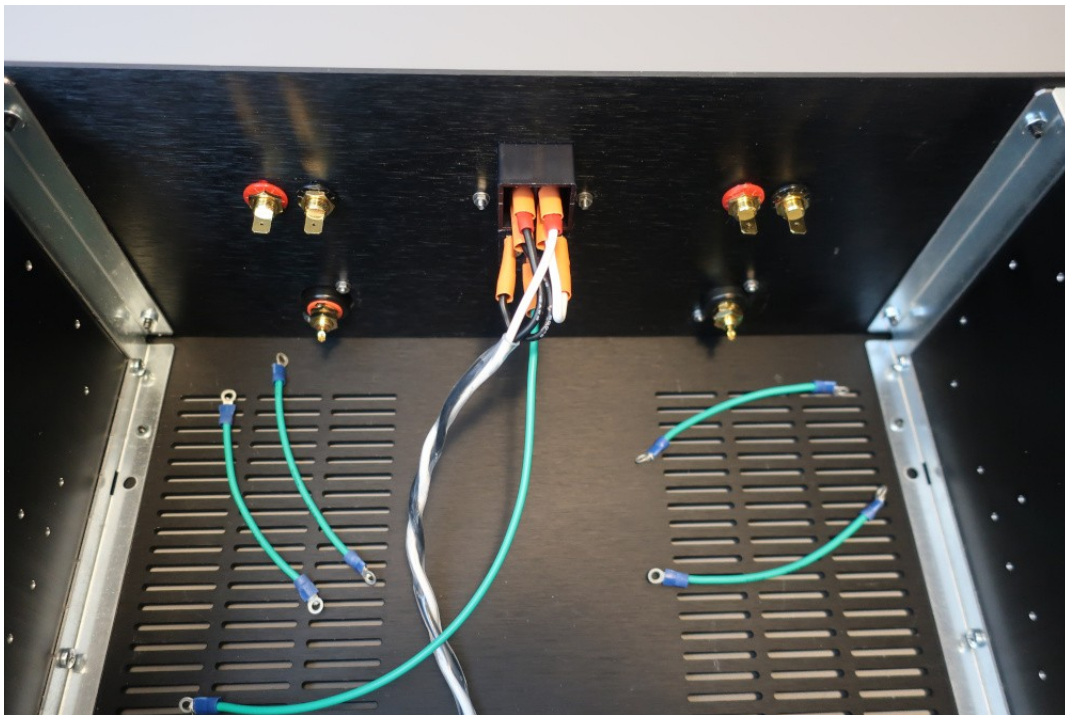
At the power entry module safety ground location, do not use any type of quick connector on the safety ground wire to chassis. The safety ground wire is intended to be permanently fastened for safety so that it cannot be accidentally disconnected. Solder the wire to the power entry module.

If both the hot and neutral wires are fused, for safety, the neutral fuse should be higher current capacity so that in the event of a fault, the hot fuse will blow. If the neutral blows instead, the hot line is still live and there is still electricity in the chassis which is dangerous. Therefore the neutral fuse should be a high value like 10A slow blow in your example and the line fuse (hot) should be VA of transformer divided by 120V. For example $300\text{VA transformer}/120\text{V} = \text{about } 2\text{-}3\text{A}$.

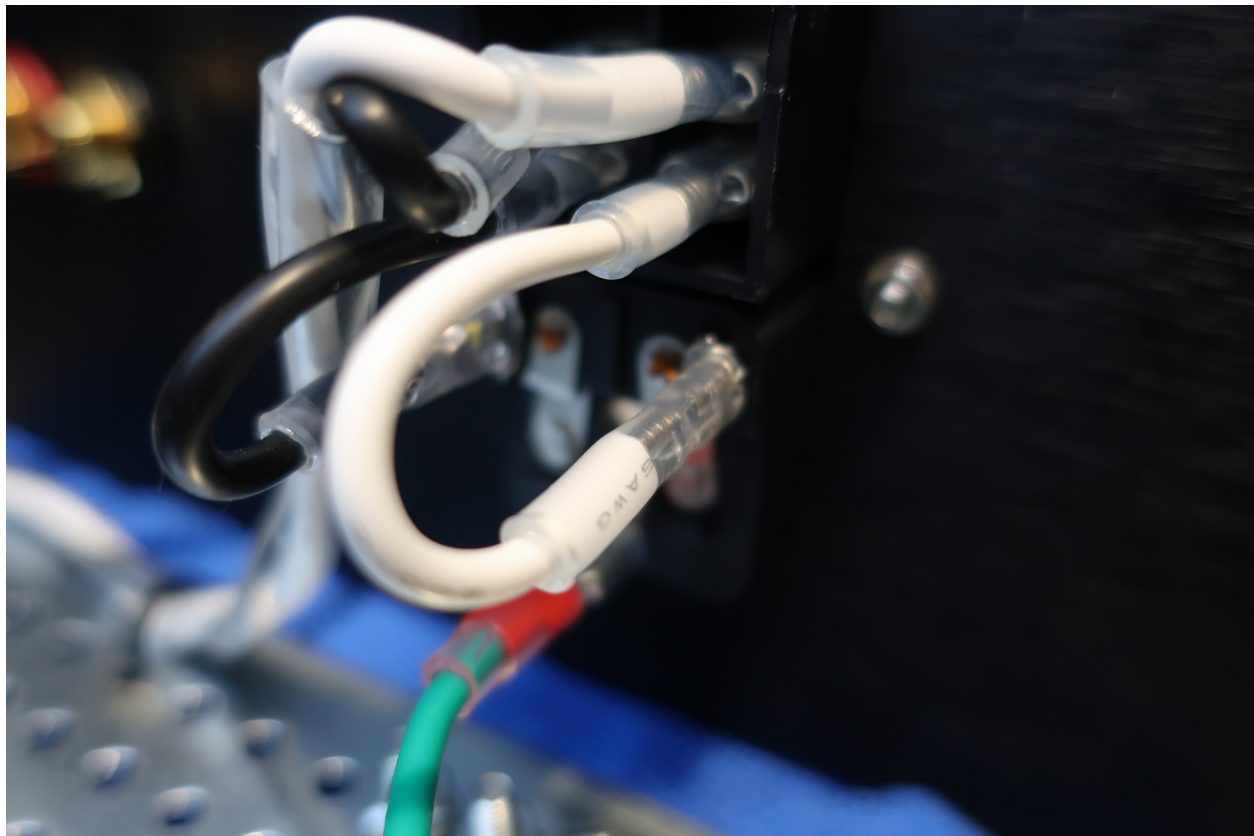
Configure a star ground and connect everything's that is ground to the one point on the chassis, and then connect that point directly to the PEM mains earth coming from the PEM.



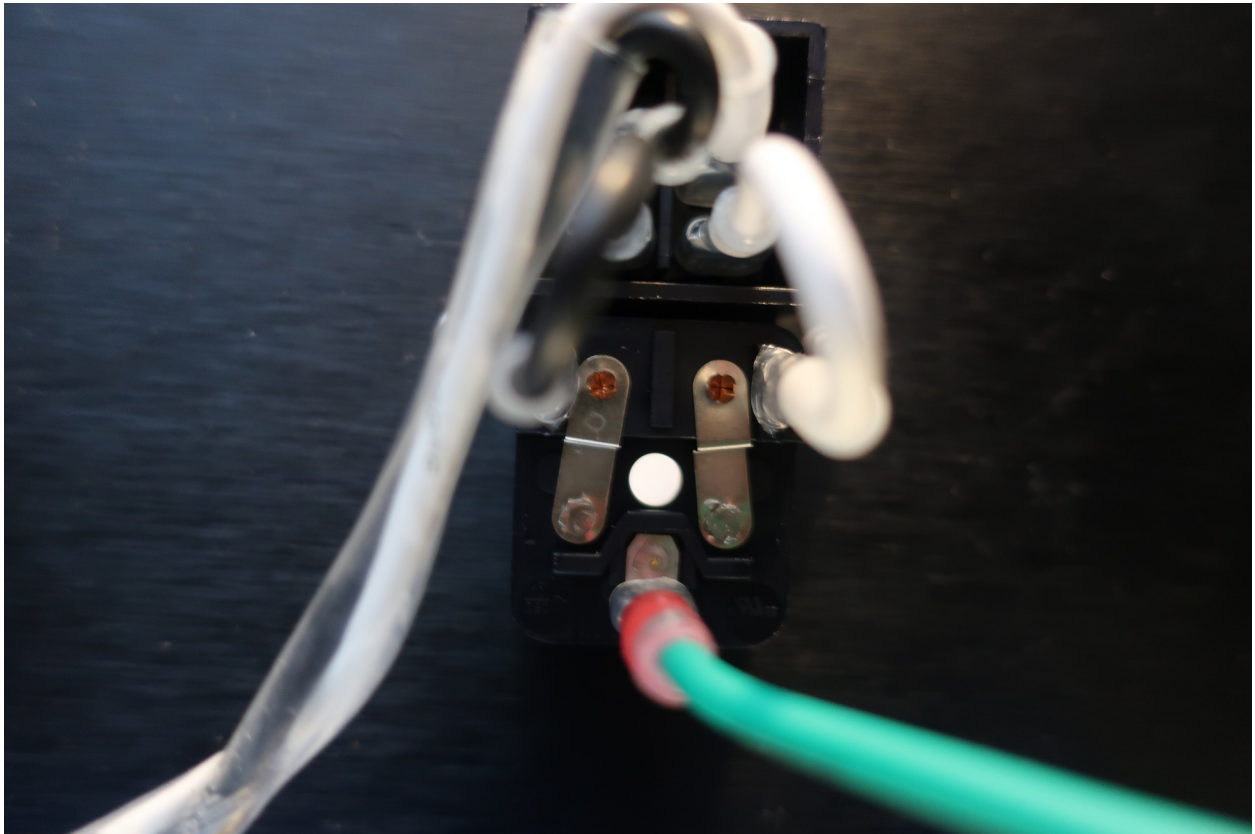
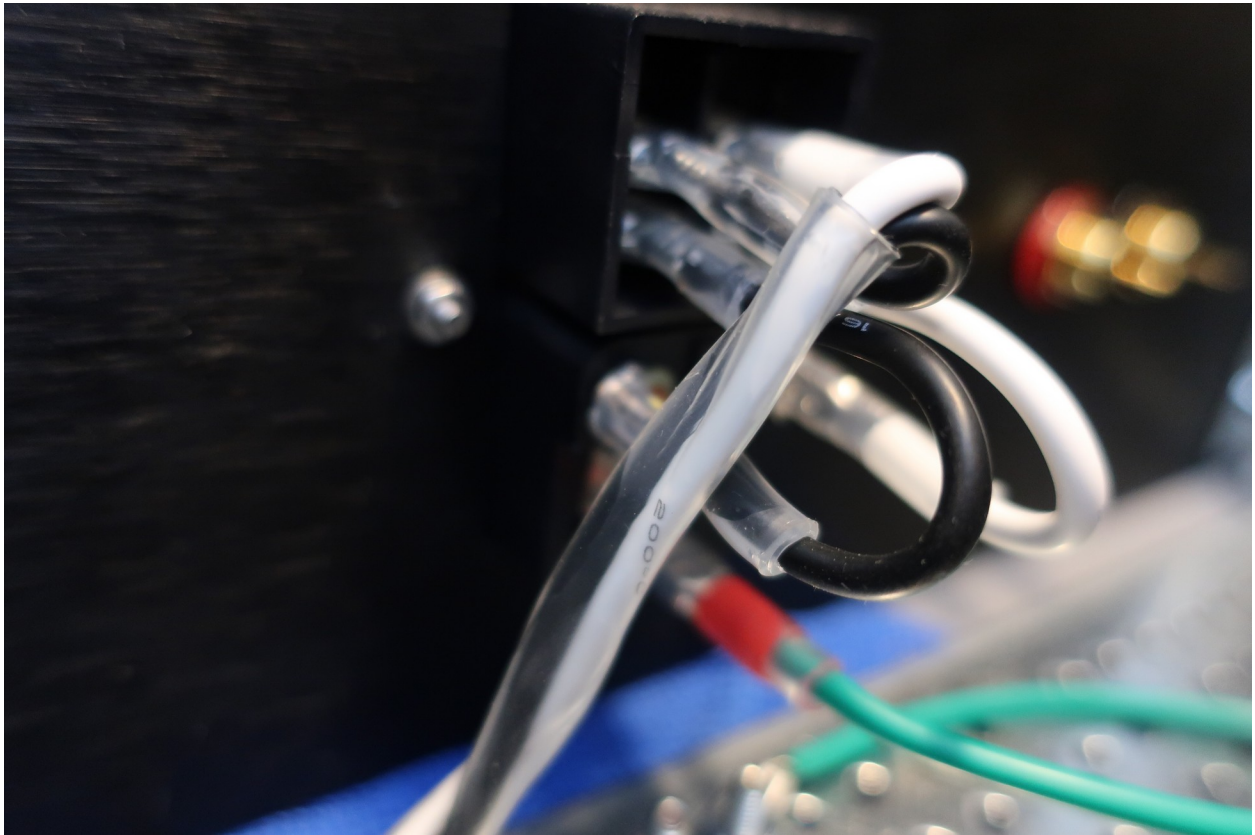
Ensure the PEM's earth wire has sufficient slack and not zip tied in case the PEM gets pulled out, mains earth is the last to disconnect.

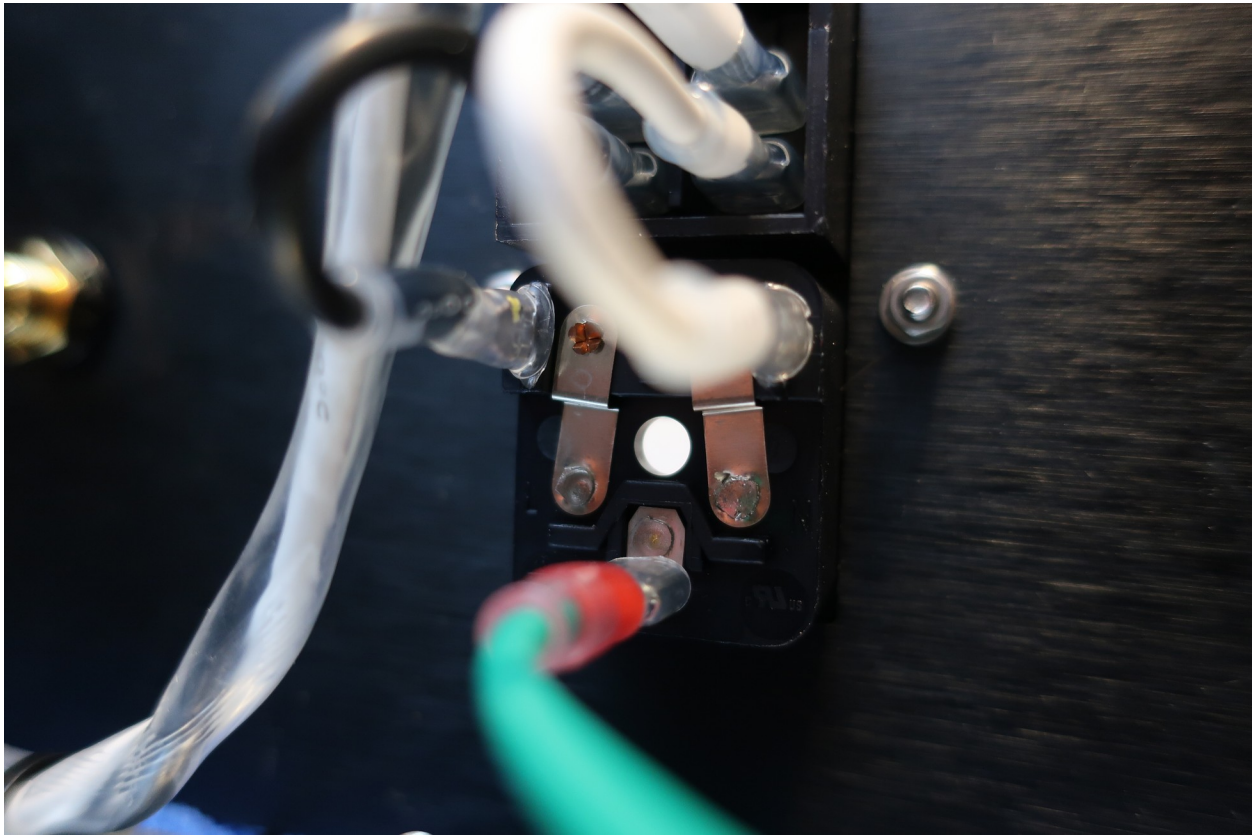


Earth ground wires to ground all panels to bottom grid.



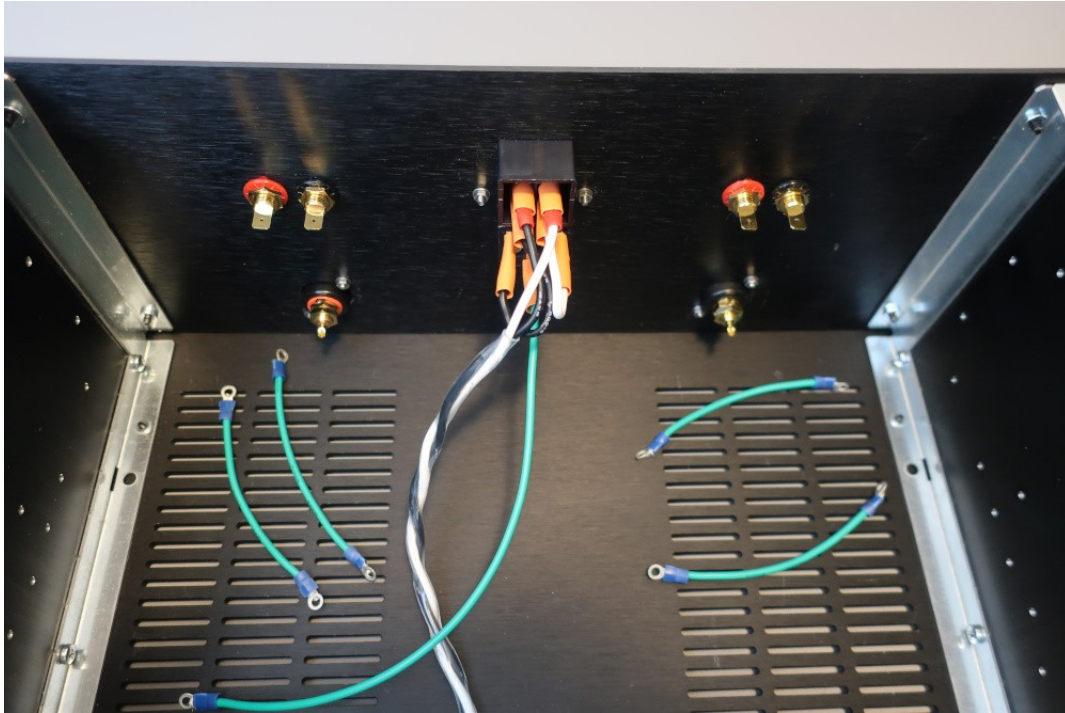
The small leads are soldered. The bottom/larger leads are not soldered. Used blue Faston terminal (B&S)





Section 7 - Binding Posts and RCA Jacks

Binding posts are from DIYAudio.com
RCA Input Jacks are from Mouser.



Section 8 - Wiring and Connectors

I chose Blue for -VCC, Red for +VCC, Brown for both GNDs, and Yellow for LSOUT.

Colors to consider avoiding are black, white, and green as those are almost always associated with mains power (live, neutral, and earth).

Remove insulation from blue Fastron connectors, and soldered wires to terminal. Used transparent heatshrink.



Belts and Suspenders (B&S) soldering and crimping with transparent shrink tubing. Blue spade connector insulation removed.

Used flexible, generic, silicon jacketed 16AWG wire for all DC power and speaker connections. Input wiring is Mogami W2552 or CAT6 twisted pair.

Zip tie wires to bottom grid.

Wire Mangement Post:

<https://www.diyaudio.com/community/threads/wire-post-for-wire-mangement-3d-print.410484/>

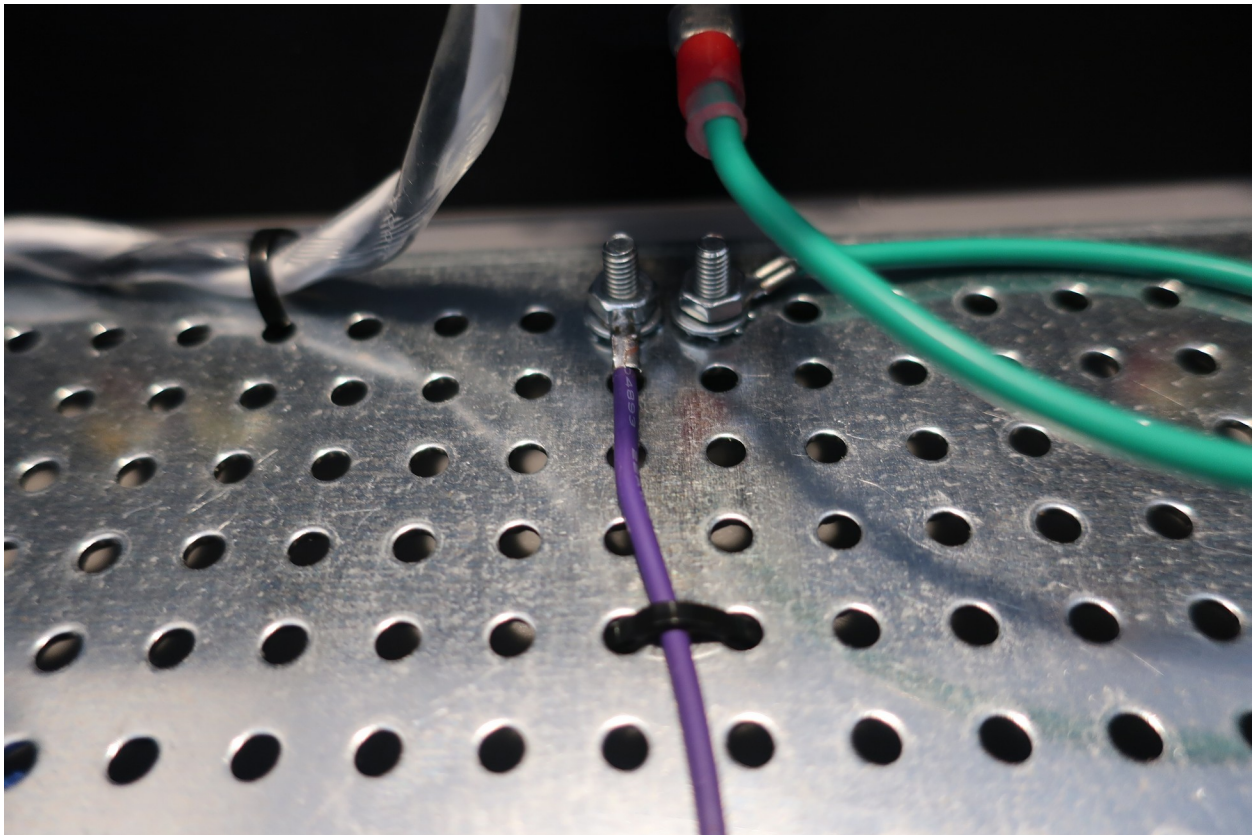
TE Connectivity AMP Connectors
A111048TR-ND - Tape & Reel (TR)

Terminals:

DigiKey Part Number
A27723TR-ND - Tape & Reel (TR)
A27723CT-ND - Cut Tape (CT)
Manufacturer
TE Connectivity AMP Connectors
Manufacturer Product Number
60196-2

Mouser #:571-2238196-3
Mfr. #:
2238196-3
Mfr.:TE Connectivity / AMP

Mouser Part #
571-6409051
DigiKey Part Number
A0904-ND
Manufacturer
TE Connectivity AMP Connectors
Manufacturer Product Number



Bolt each earth ground to grid using their own nuts/bolts.
Use a star washer.
Use blue loctite

Screw Headers

Mouser 710-691216710002 (5mm pitch) For power supply board and power input board.

Mouser 710-691216810101 (10mm pitch) For power supply board.

Shrink Tubing

Heat shrink tube from Amazon (XFH 1/4" and 3/8").

Write up on how to twist the wires up tight:

<https://www.diyaudio.com/community/threads/iron-pre-essentials-kits-for-the-diya-store-register-your-interest.390509/post-7768639>

Use 3:1 marine grade transparent heat shrink in 1/4" for 2x 16ga wires, 5/16" for 3x 16ga wires, and 3/8" for 4x 16ga wires. XFH on amazon.

Section 9 - Dim Bulb Tester

I build a dim bulb tester to protect the amp when powering it up for the first time, or after working on it.

All parts were from Home Depot.

100Watt incandescent light.

PVC 2 Gang box.

Standard light switch and plug.

Computer Power Cable.

Light Socket with Plug adapter.

Home Depot cut 2 meters of black, white and green electrical wire.

Use a Y adapter for more than 1 bulb.



Section 10 - Testing

Installed the back panel.



Tested earth ground to all panels and heat sink.

Reminder to wear shock proof gloves and only use 1 hand when working inside the case. (1 hand in pocket).

Always check and drain capacitors even if it was not plugged in or turned on.

Test the following:

V+/gnd

V-/gnd

line/gnd

neut/gnd

secondaries to gnd

V+ and V- attached in the correct positions on the PS board

The trimmers should be turned counterclockwise prior to your initial power up. You can verify by measuring the resistance across trim resistors R8 and R9. (Ideally they will be close to zero and you'll likely have to measure from the underside of the PCB.)

Plug the amp into AC and begin the hour long warmup prior to setting final DC Offset and bias. Let the amp cool down completely, then redo another hour warmup and re-check bias. (helps catching construction issues and early device failures)

Before initial powerup, Ohm check the metal case of the mosfets to chassis gnd. Then check V+ to gnd and V- to gnd to make sure there are no shorts.

Check to make sure the DC offset is within acceptable range.

Check across each Source resistor and adjust the bias pot for each mosfet a little bit to make sure that the bias can be adjusted both directions.

Testing without AMP Boards Disconnected:

- Disconnect amp boards from PSU board.
- Add electrical tape around ends of wires.
- Ensure fuses are installed and correct values.
- Use power strip with trip breaker.
- Ensure amp PEM is off.
- Ensure DBT is off.
- Ensure power button on power bar is off.
- Connect amp to Dim Bulb Tester.
- Connect Dim Bulb Tester to power bar.
- Connect power bar to wall.
- Turn on power bar, turn on amp and turn on DBT.
- Light should glow slightly for under a second.
- Leave on for a few seconds and turn off.

Testing with Amp Boards Connected:

- Turn off amp, DBT and power bar. Disconnect power cable going into PEM.
- Remove top panel.
- Discharge all capacitors. (using 100ohm resistor to ground)
- Check capacitors for voltage. (repeat discharge if still showing over 10v)

Connect 1 amp board to the PSU and re-test using DBT.

Turn on amp and turn off right away if it makes 'sizzling' sounds, emmits smoke or burning smell.

Ensure DBT does not light up. Turn off amp, drain caps and check for defects if it does.

Use REW software to check noise.

<https://www.diyaudio.com/community/threads/how-to-distortion-measurements-with-rew.338511/>

Section 11 - Tuning

Use a DMm to check bias. Set up 4 DMM's all at once and bias left and right channels at the same time. Measure DC voltage across just one resistor (the voltage is essentially same across R6 and R7) and the DC voltage across the speaker terminals for DC offset. Adjust both pots to get the bias set while maintaining 0VDC offset.

Section 12 - Parts

M3 standoffs (5mm with 3mm thread depth)

M3 x 5mm screws

M3 x 10mm screws

M3 washers

(not in kit, but get some) M3 split washers

M3 fender washers

Black M3 x 8mm machine screws (for mounting inputs / PEM)

M3 Keps nuts

PEM (Can't remember exact one, but it's been posted)

Neutrik D-type mount RCAs.

<https://www.mouser.com/ProductDetail/693-4304.6090>

<https://www.mouser.com/ProductDetail/568-NF2D-B-2>

<https://www.mouser.com/ProductDetail/568-NF2D-B-9>

<https://www.mouser.com/ProductDetail/568-NC3FD-LX-M3-B> (M3 threaded, shouldn't need nuts to hold it in)

6-8mm stainless steel standoffs with a 4mm M3 thread.

Buy the binding posts from the diyaudio store.

PEM : Schurter 4304.6090 (needs two fuses, 2.5A on line (aka hot) and 10A on neutral.

<https://www.mouser.com/ProductDetail/568-MI2D-B-2>

Neutrik NF2D

RED (NF2D-B-2)

[https://www.mouser.com/](https://www.mouser.com/ProductDetail/568-MI2D-B-2)

[ProductDetail/568-MI2D-B-2](https://www.mouser.com/ProductDetail/568-MI2D-B-2)

BLACK (NF2D-B-0):

<https://www.mouser.com/ProductDetail/Neutrik/NF2D-B-0?qs=6LylQoPC2SsqWVCMn6Fzzg==>

Buy a kit of slow blow (aka "time delay") 5x20mm fuses:

https://www.amazon.com/gp/aw/d/B07Z61RL1N?psc=1&ref=ppx_pop_mob_b_asin_title

M3 kit

https://www.amazon.com/gp/aw/d/B07L65DHV6?psc=1&ref=ppx_pop_mob_b_asin_title

Brass Hex Standoffs Kit:

https://www.amazon.com/gp/aw/d/B07CNF3W7B?psc=1&ref=ppx_pop_mob_b_asin_title

Remington Industries

<https://www.remingtonindustries.com/hook-up-wire/electronics/>

Hexagonal Ferrule Crimping Tool Kit, Preciva AWG23-10 Self-Adjustable Ratchet Wire

Crimping Tool Kit Crimper Plier Set with 1900PCS Wire Terminals Crimping Connectors Wire End Ferrules

Molex 194130110 Solderless Terminals Kit, Non-Insulated Terminals

Channellock 909 9.5-Inch Wire Crimping Tool | Electrician's Terminal Crimp Pliers with Cutter are Designed for Insulated and Non-Insulated Connections

Molex 39100 Series Barrier Terminal Blocks

<https://www.mouser.com/c/connectors/terminal-blocks/barrier-terminal-blocks/?m=Molex&series=39100>