Hardrock-500 Assembly Instructions
Run 1 - 2020

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1. INTRODUCTION

This assembly manual covers the Hardrock-500 HF Amplifier Support Package manufactured by HobbyPCB, LLC

The Hardrock-500 is an Amplifier Support Package and contains everything needed to support in operation of a RF amplifier capable of operation in the 1.8 – 30 MHz band at power levels up to 500W.

To create a complete amplifier using the Hardrock-500, the builder must supply a suitable amplifier deck. HobbyPCB engineers have extensively tested the Hardrock-500 with the RF Power Tools, AN-1819 amplifier board that uses a pair of Microsemi VRF2933 LDMOS FETs and is capable of 400-500W output with 5 watts of drive.

ITEM	SPECIFICATION
Manufacturer	HobbyPCB, LLC.
Model Number	Hardrock-500
LPF Bands	160, 80, 60, 40, 30, 20, 17, 15, 12, 10 meter Amateur Radio Bands
AC Power Input	90-260 Volts AC, 47-63Hz, 13A max. @ 115V, 6.5A max @ 230VAC
DC Power	57V Volts, 22 Amps maximum, 1250 watts
DC Output	13.5V, 2A max for powering transceiver
Cooling	RF deck: 3 fans, 32CFM Power Supply : 1 Fan 26 CFM
In/Out Jacks	Three UHF connectors; 1 radio, 2 antenna
Size	9” W by 7” H by 14.2” D (229mm W by 178mm by 361mm) (not including switches and connectors)
Weight	16.5 lbs/7.2 Kg under 18 lbs/8.2 Kg with ATU
Metering	V_{DD} : 0 – 60 Volts I_{DD} : 0 – 20 Amperes Forward Power: 0 – 500 Watts Reflected Power: 0 – 50 Watts Drive Power: 0 – 10 Watts Temperature: 0 – 70°C VSWR: 1.0 – 9.9:1

Hardrock-500 features:

- Completely self-contained - built-in power supply for 80-260 VAC
- Light weight - 7.5 Kg (16.5 lbs.) including power supply
- Dual color LCD touch screen displays for metering and operating controls
- Full HF coverage of 160-10M amateur bands
- Seamless integration with transceivers from HobbyPCB, Elecraft, Yaesu, Elad and Xiegu
- Internal ATU and input attenuator for 100W transceivers (coming soon)
- Arduino Mega controller - 100% open source firmware
- Automatic protection for SWR, temperature, voltage, current and excessive drive
- 13.8V, 2A DC output to power QRP transceivers
- USB control for unattended/remote operation

2. Advisory and Warnings

There are several risks associated with assembling, testing and operating high power RF equipment. At HobbyPCB, LLC. safety is our highest priority and we have taken every reasonable precaution to ensure the safety of our builders when assembling and operating our products. Take a moment to read through the advisories and warnings and if you are not comfortable assuming the risks associated with this product you should return it unassembled in its original packaging for a complete refund.

AC Voltage

The AC voltages inside the Hardrock-500 are potentially dangerous. We have taken precautions inside the case of the Hardrock-500 to prevent high voltages on exposed surfaces but the potential for electrical shock still exists in the bottom portion of the chassis around the AC wiring and the power supply boards. ***Under no circumstances should AC power be connected to the Hardrock-500 with the bottom cover removed. There are no adjustments, measurements or tests that require the builder/operator to open the bottom cover with power applied to the unit. Always connect the chassis to a suitable ground using the ground stud on the rear of the unit.***

Water/Moisture

The Hardrock-500 is designed to be operated indoors in a dry location. The forced air cooling system used by the Hardrock-500 moves large quantities of air in through the front, top and bottom of the enclosure and forces it out through the rear of the enclosure. Any moisture, (rain, beverages, drips, leaks, etc), can be drawn inside the Hardrock-500 chassis creating a potentially dangerous conditions. ***Never operate the Hardrock-500 if there is the potential for water in or near the environment surrounding the Hardrock-500. If liquids are present or inadvertently enter the Hardrock-500's enclosure, immediately remove the AC power by disconnecting it at the source and do not operate the Hardrock-500 until completely dry conditions can be assured.***

High Level RF

Even though an amplifier is not included with the Hardrock-500, we anticipate that the majority of builders will add a high power amplifier to the Hardrock-500 which can create high power RF which has some inherent dangers. In the top of the chassis, the RF deck, LPF board and rear panel board all carry high-level RF energy. ***Under no circumstances should the Hardrock-500 be operated at high RF power levels with the top cover removed. There are no adjustments, measurements or tests that require the builder/operator to open the top cover with RF applied to the unit.***

Once the Hardrock-500 is fitted with a RF amplifier, the operator should ensure that the RF power is being delivered to a suitable load or antenna. The Hardrock-500 has protection circuitry and algorithms for internal circuitry but not for external equipment like loads and/or antennas that could be damaged if not sufficiently rated for the applied RF power. Antennas should be installed in a manner that prevents excessive RF exposure.

Physical Considerations

The Hardrock-500 weighs up to 18 lbs (8.2 Kg). Avoid dropping the unit. The fans on the rear of the unit pose a potential risk to fingers and other small objects. Do not block the opening in the top, bottom, front or rear of the chassis. Some of the internal parts may have sharp edges so use caution (and gloves) to prevent cuts.

3. General Assembly Instructions

Assembling the Hardrock-500 amplifier kit should be an enjoyable and rewarding experience. If at any time you feel frustrated or are having difficulty, take a break, ask questions on the forum or email, and remember that if you are having a problem with something there's a good chance that someone else has had the same issue. We have a "no questions asked" replacement part policy, so if you lose a part or need an extra length of wire or find something missing an email is all it will take to get you a replacement. Contact Support@HobbyPCB.com if you need any help.

The assembly is organized into the following subassemblies:

- Low-pass Filter assembly
- Power Supply Assembly
- Rear Panel Assembly
- Front Panel Assembly
- Amplifier Deck
- Final Assembly
- Setting the Bias

There are a few required tools:

- Soldering iron – A small temperature controlled unit is the best.
- Solder – Rosin core, fairly thin
- Screwdrivers –All of the screws in the kit are Philips
- Tweezers – For holding small parts and reaching tight areas
- Wire Stripper – For making the coax jumpers
- Long-nose pliers – For general mechanical assembly
- ¼" Nutdriver– Not essential but helps with panel assembly. If only metric tools are available use pliers or an adjustable wrench.
- Toothpick – For unbraiding coax
- Adjustment tool or small flat blade screwdriver – Turning pots
- Thread locker – Loc-Tite 242 or similar to prevent screws from loosening (optional)
- Digital Multimeter – Doing resistance checks
- QRP Transceiver – The reason you bought the amp in the first place

In a production environment, an assembly station would also include an anti-static mat and all work would be performed while wearing an anti-static wrist strap. If you are equipped with these, I encourage you to use them. If you don't have these items, use caution when handling the PCBs and touch a grounded surface before picking up the device.

AC Line Cord

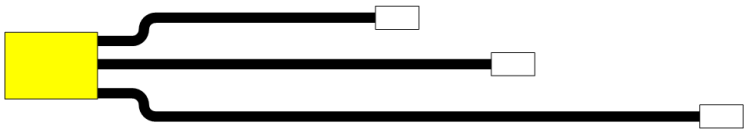
Due to the worldwide variations in AC connections, we do not supply a AC line cord for the Hardrock-500. The amp has a IEC320-C13 power connector. Make sure to use a cord made with #16 AWG or larger wire and only connect the amplifier directly to a wall output. Do not use a power strip. The performance of the unit will be compromised by an inferior AC line connection.

4. LOW-PASS ASSEMBLY INVENTORY

DESCRIPTION	PICTURE	QUANTITY
#6-32x1.75" F-F STAND-OFF		4
#6-32x3/8" PAN HEAD SCREW		4
#4-40x1/4"M-F THREADED SPACER		4
#4-40x1/4" PAN HEAD SCREW		4
#4-40 HEX NUT WITH LOCK WASHER		4
#4-40x1/4" FLAT HEAD SCREW		6
T80-6 CORE YELLOW		4
T80-2 CORE RED		8
#20 ENAMELED WIRE		15'
#28 ENAMELED WIRE		5'
#18 TEFLON WIRE (color may vary)		6”
FT82-43 GRAY		2

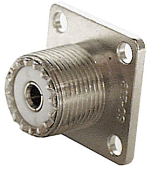
5. POWER SUPPLY ASSEMBLY INVENTORY

DESCRIPTION	PICTURE	QUANTITY
#4-40x1/4"M-F THREADED SPACER		16
#4-40 HEX NUT WITH LOCK WASHER		16
#4-40x1/4" PAN HEAD SCREW		16
#4-40x3/6" JACK SCREW W/ NUT & WASHER		2 MAYBE INSTALLED IN ACC JACK
#4-40x1/4" FLAT HEAD SCREW		6
CAP ALUM 10000UF 20% 80V SNAP		1
CAP ALUM 1000UF 20% 63V		**1**
JST 3-PIN SHELL		3
CABLE TIES COLOR MAY VARY		5
AC NEUTRAL CABLE		1

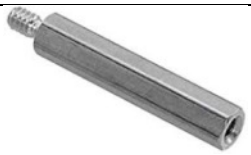
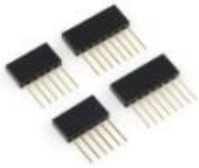
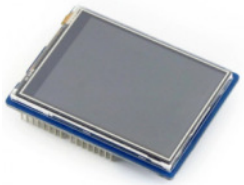
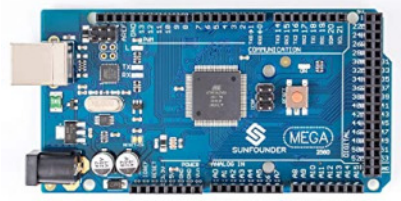
AC LINE CABLE		1
AC SWITCH WIRE #14 WIRE 19”		1
#14 RED-BLACK ZIP WIRE WITH SPADE TERMINALS 4”, 6”, 9”		3
#14 RED-BLACK ZIP WIRE 6”		1

6. REAR PANEL ASSEMBLY INVENTORY

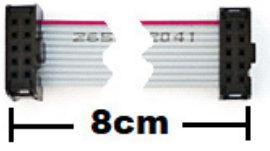
DESCRIPTION	PICTURE	QUANTITY
#4-40x3/16" JACK SCREW W/ NUT & WSR		12
#4-40x1/4" STEEL PAN HEAD SCREW		13
#4-40x1/4" M-F THREADED ALUMIN SPACER		1
#4-40 HEX NUT WITH LOCK WASHER		1
#6-32 HEX NUT NYLON BLACK		12
#6-32x1" NYLON SCREW BLACK		12
#6-32x1/2" PAN HEAD SCREW (GROUND LUG, AC INLET)		3
#6-32 HEX NUT WITH LOCK WASHER		3
#6-32 WING NUT		1
#4-40x1/2" STEEL PAN HEAD SCREW (FAN MOUNTING)		4
Ground Wire		1

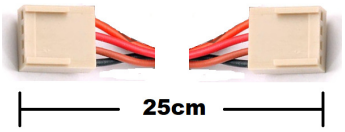
POWER ENTRY MODULE (AC INLET)		1
80MM x 25MM 12VDC FAN W/ 2-PIN CONN		1
CONN UHF CHASSIS MOUNT		3
FAN AXIAL 40MM x 20MM 12VDC		3

7. FRONT PANEL ASSEMBLY INVENTORY

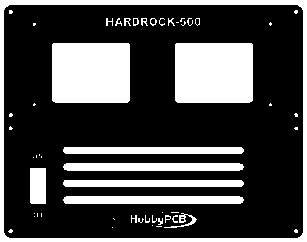
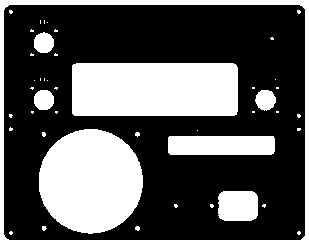
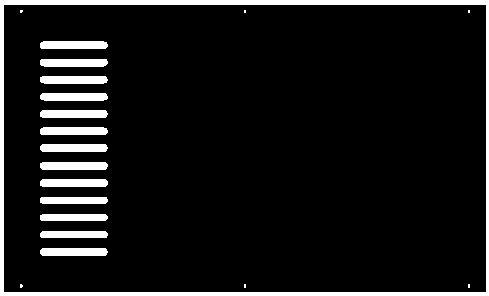
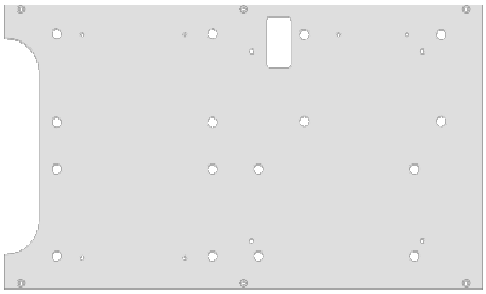
DESCRIPTION	PICTURE	QUANTITY
#4-40X3/4" M-F THREADED STAND-OFF		4
#4-40x1/4" STEEL PAN HEAD SCREW BLACK OXIDE		4
#4-40 HEX NUT WITH LOCK WASHER		4
CONN HEADER VERT 36POS 2.54MM		1
CONN HEADER VERT 40POS 2.54MM		**2**
ARDUINO STACKING HEADERS 6 PIN AND 8 PIN, 2 EA.		2
LCD DISPLAY 2.8 TOUCHSCREEN		2
ARDUINO MEGA 2560		1
CIRCUIT BREAKER WITH SWITCH, 20A, RED ILLUM		1

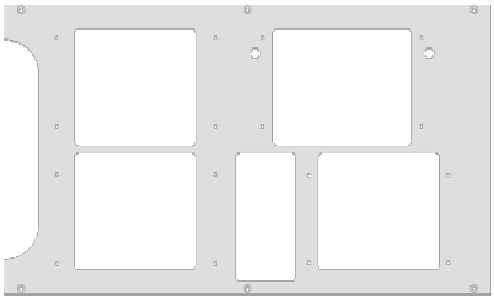
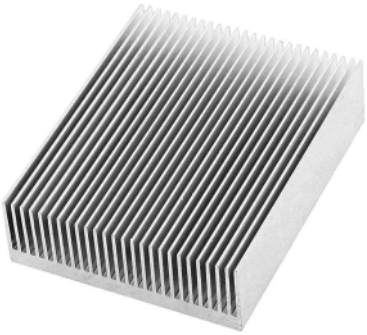
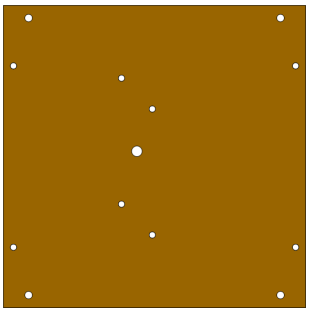
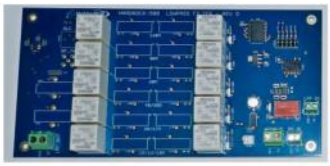
8. CHASSIS PACK INVENTORY

DESCRIPTION	PICTURE	QUANTITY
#6-32x3/8" PAN HEAD SCREW (BLACK)		16
#4-40x1/4" FLAT HEAD SCREW (BLACK)		12
#4-40x3/4” Threaded Rod		4
#4 NYLON WASHER		8
#4-40 HEX NUT WITH LOCK WASHER		4
#4-40x1/2" STEEL PAN HEAD SCREW (MOSFET MOUNTING)		4
#6-32x1/2" PAN HEAD SCREW		4
RUBBER FEET		4
RIBBON CABLE - 8CM (3”) 2x5 PIN 0.1"		1
RIBBON CABLE - 35CM (13.8”) 2x5 PIN 0.1"		2

12V Power Cables 2 PIN Polarized 35CM (13.8)		2
12V Power Cables 2 PIN Polarized 50CM (19.7”)		1
AMP CONTROL CABLE 4 PIN Polarized 25CM		1
RG-316 COAX CABLE		18”
RG-58 COAX CABLE		24”
THERMAL COMPOUND PACKET		2

9. LARGE ITEM INVENTORY

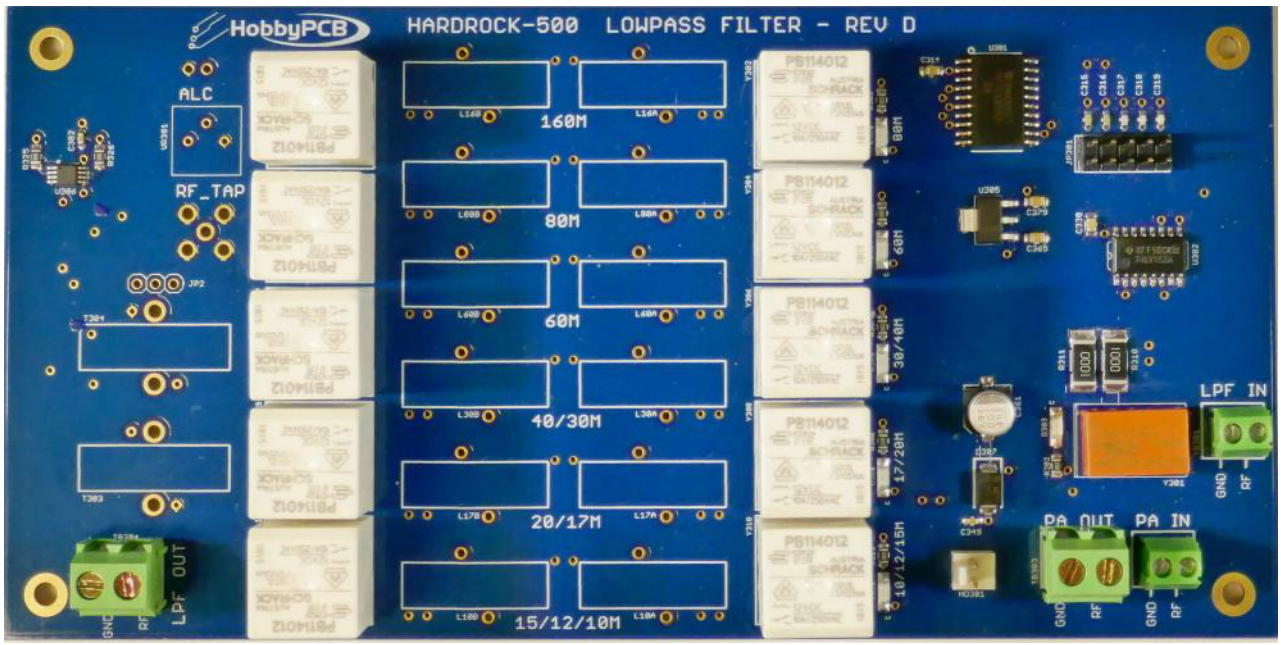
DESCRIPTION	PICTURE	QUANTITY
MEANWELL EPP-400-18 18V, 22A DC Supply		3
SIDE PANELS		4
FRONT PANEL		1
REAR PANEL		1
TOP/BOTTOM PANEL		2
PANEL - RF DECK		1

PANEL – POWER SUPPLY		1
HEATSINK		1
COPPER HEAT SPREADER		1
200mm x 200mm THERMAL PAD		1
PCB Set Power PCB, LPF PCB, Rear Panel PCB and Front Panel PCB	   	4

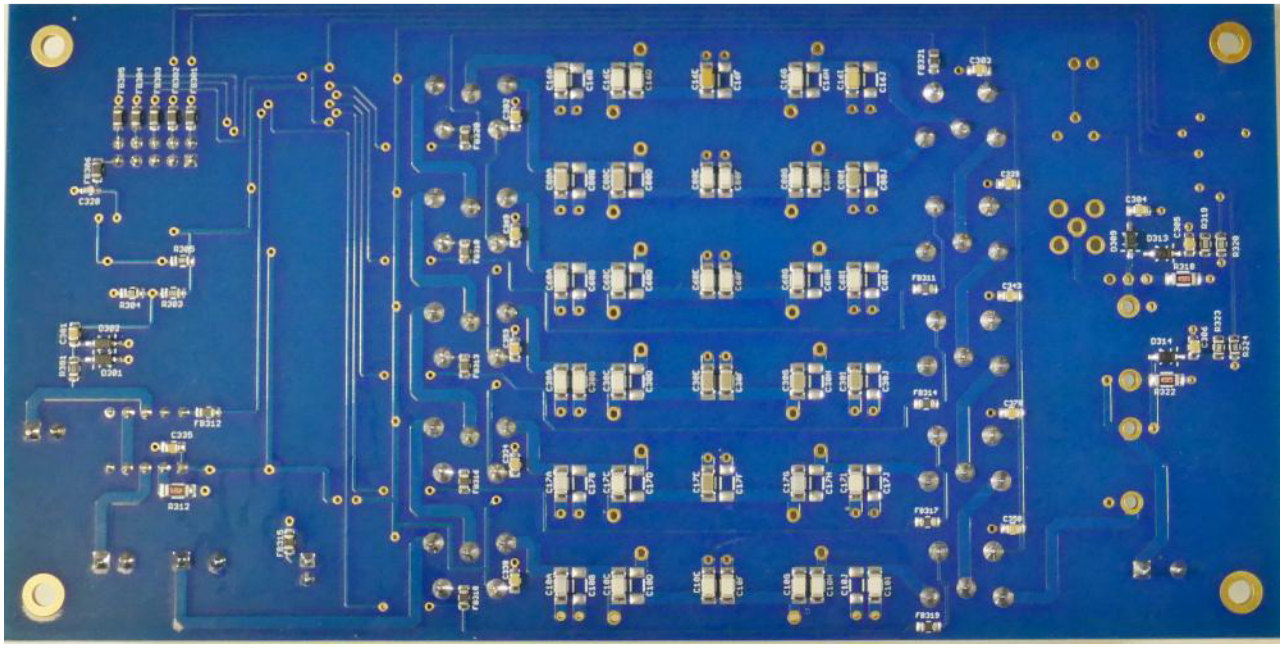
10. LPF ASSEMBLY

This section covers the steps required to construct the Low-Pass Filter Assembly. The LPF PCB is supplied without the toroidal inductors installed. These must be wound and installed on the LPF board.

Here are photos of the LPF board as supplied in the kit. Notice that several of the components are not installed. Check the photos against the PCB supplied with your kit for verification.



LPF PCB Top Side

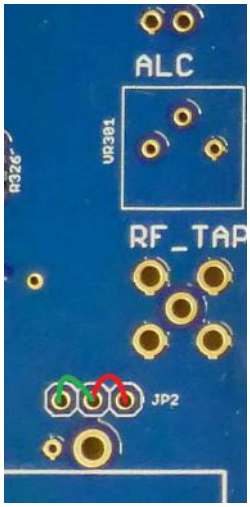

LPF PCB Bottom Side

Build Options

T303 and T304 form a directional coupler used to determine the Hardrock-500's forward and reflected power. The coupler can also be used to provide an RF tap or sample of the RF power used by some SDR transmitters to further linearize the amplifier. If you want to use this option you will need to install a SMA connector in the 'RF-TAP' location. This tap is 30 dB below the RF output and MUST be terminated in 50 ohms for the amp to work correctly.

A negative ALC voltage is available at the ALC location on the PCB. Some transmitters can use an ALC voltage to limit their output to protect the amplifier. If you want to use this option populate VR301 with a 10K ohm potentiometer and connect the ALC voltage to the ALC pins.

Assembly Instructions



☐**Step 1: Jumper** –Select the build option and install a wire jumper in JP2 as shown.

- Install a jumper wire in the green location for normal operation
- Install a jumper in the red location to use the RF-TAP. If you select this option you MUST terminate RF-TAP in 50 ohms for the amp to work properly

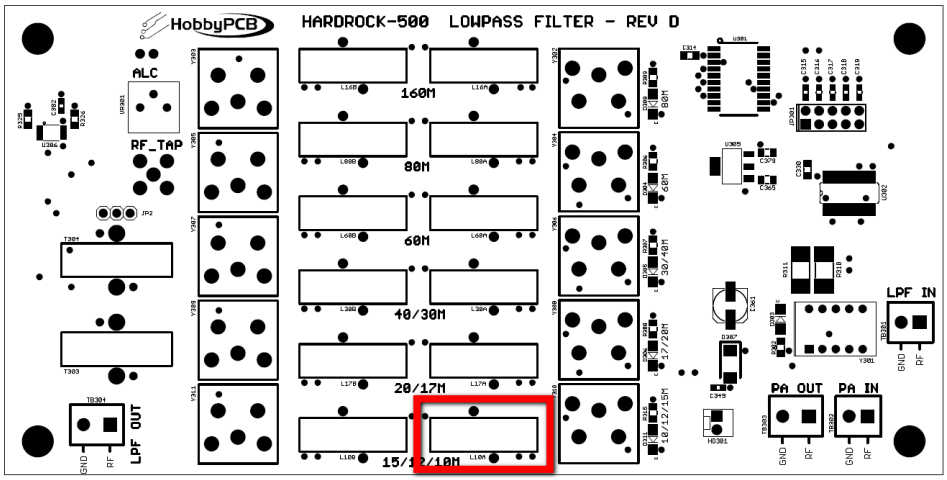
A jumper MUST be installed in one of the two locations for the Hardrock-500 to operate properly.

Tips for Winding Toroidal Inductors:

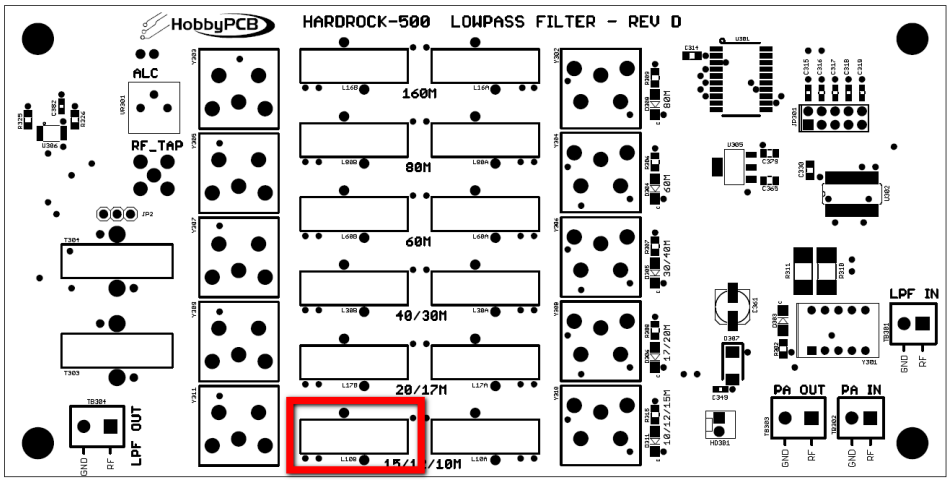
1. The enamel on wire included with the kit is designed to be removed by scraping. After the inductor is wound, scrape off as much of the enamel as possible, tin the end with a soldering iron which will remove the remaining enamel and prepare the inductor for installation on the PCB. Repeat this process until the inductor lead is thoroughly coated with solder.
2. There are two possible directions to wind a toroid. They are electrically identical but the PCB layout favors right hand winding. When winding inductors always insert the initial turn of wire and add turns to the right. This will ensure that the inductors mount nicely on the PCB.
3. Tight, neat windings not only make your finished kit look professional but tighter coils have less wire which leads to less resistance and higher Q so bend the wire around the toroid rather than loop it.
4. There seem to be multiple ways to count the turns on a toroid. We use the "turns = the number of times the wire passes through the hole in the core" method. If you feel the need to use a different method that's fine but make sure your toroids look like the ones in the photos. The photos show working/tested toroids; if you put more or less turns because you think I counted wrong, your amp will not work correctly. Count the turns however you want but make it look like the photo.

5. Since many of the toroids vary in turns count by one or two turns, insert the toroid into the PCB as soon as you finish tinning the leads. This will prevent mixing up the toroids which will prevent the low-pass filter from operating correctly.

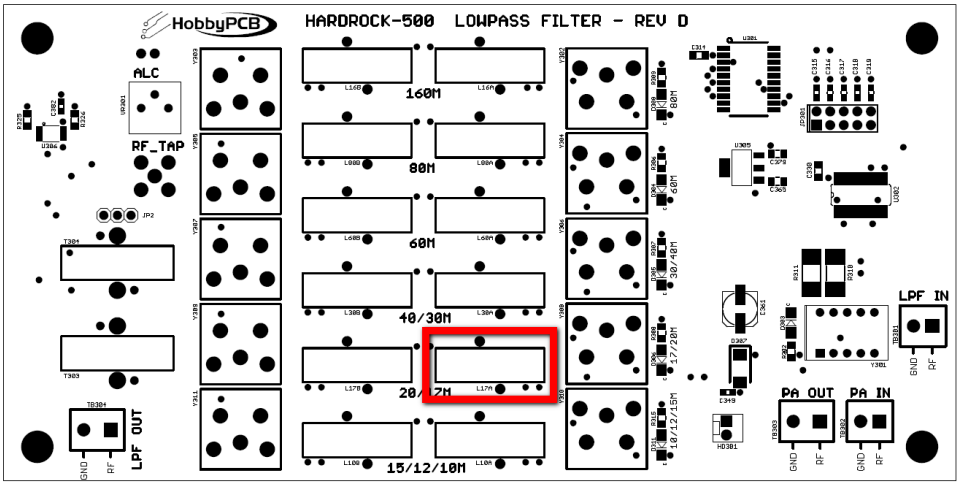
☐**Step 2: L10A** – 7 turns (8 in/20.3cm) of #20 enameled wire on a T80-6 (yellow) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



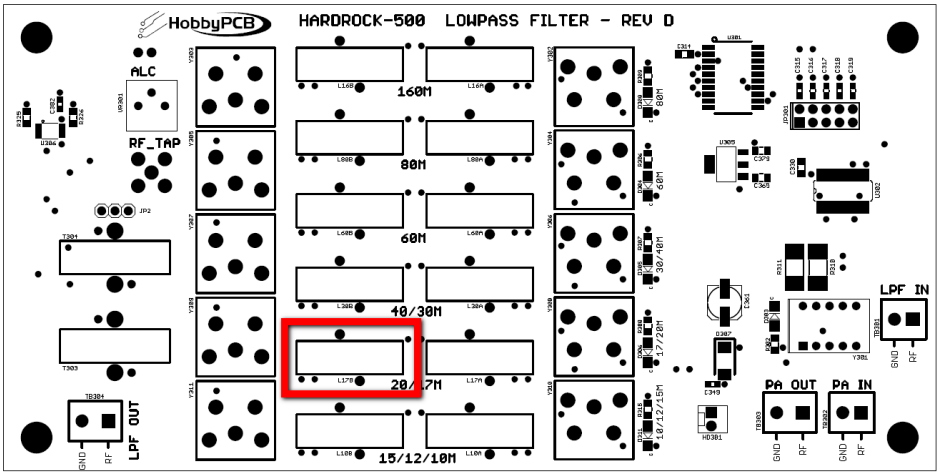
☐**Step 3: L10B** – 5 turns (7 in/17.8cm) of #20 enameled wire on a T80-6 (yellow) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



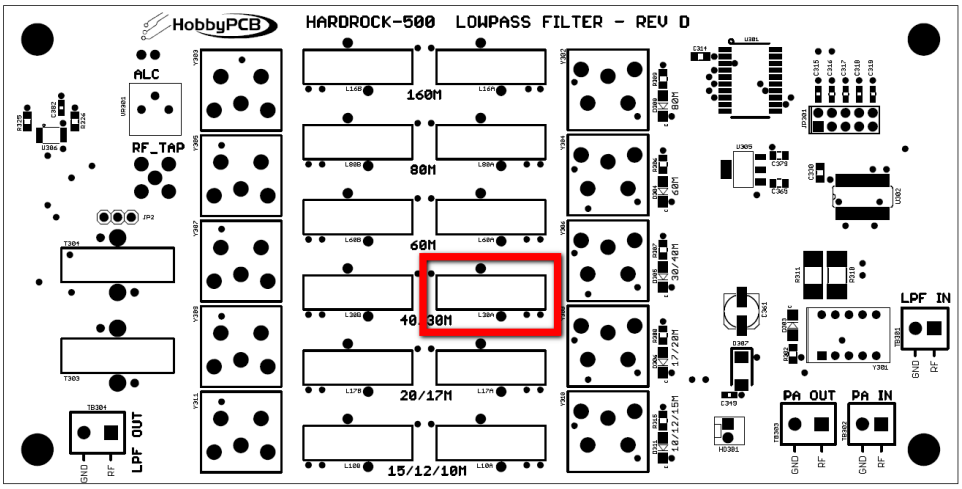
☐**Step 4: L17A** – 9 turns (10 in/25.4cm) of #20 enameled wire on a T80-6 (yellow) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



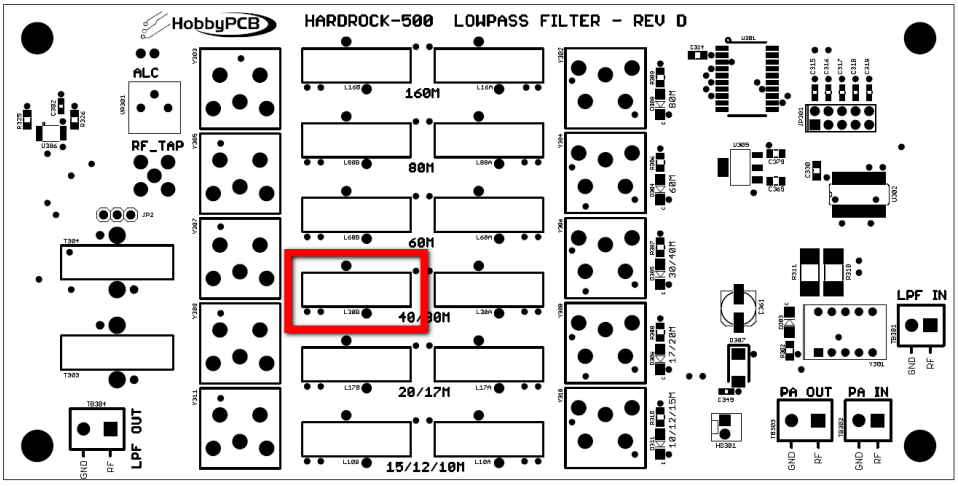
☐**Step 5: L17B** – 8 turns (10 in/25.4cm) of #20 enameled wire on a T80-6 (yellow) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



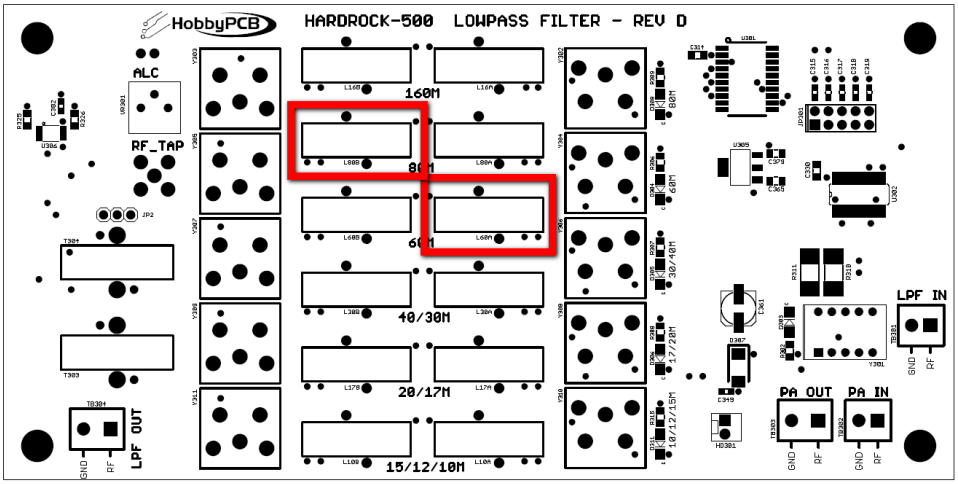
☐**Step 6: L30A** – 11 turns (12 in/30.5cm) of #20 enameled wire on a T80-2 (red) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



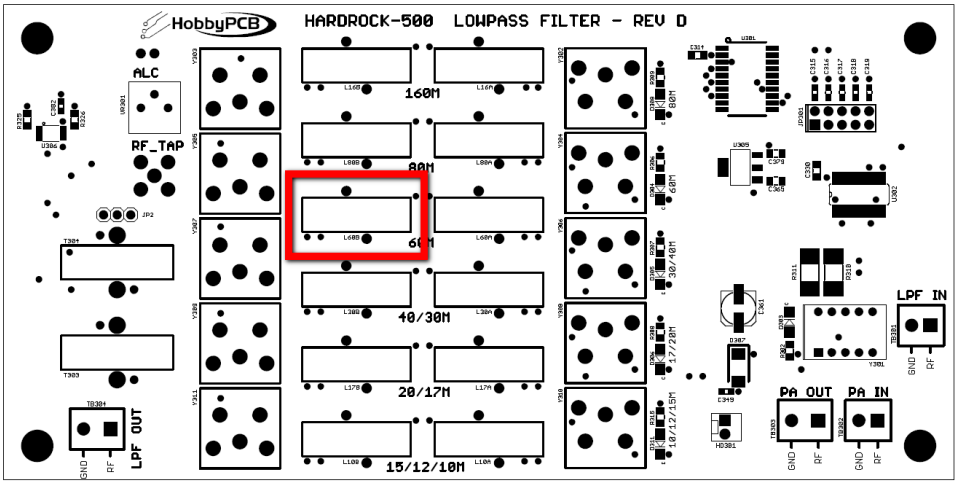
☐**Step 7: L30B** – 9 turns (10 in/25.4cm) of #20 enameled wire on a T80-2 (red) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



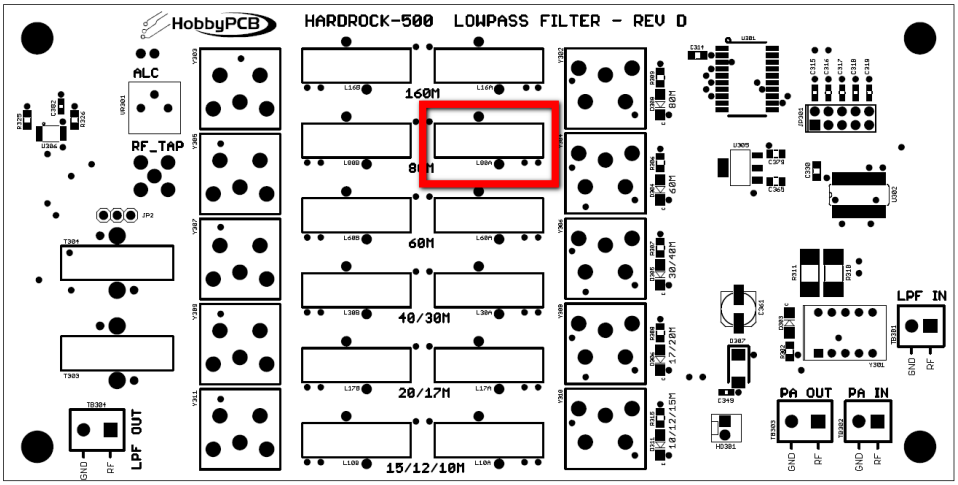
☐**Step 8: L60A & L80B** – 16 turns (17 in/43.2cm) of #20 enameled wire on a T80-2 (red) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads. ***Two of these coils are required for L60A and L80B as shown***



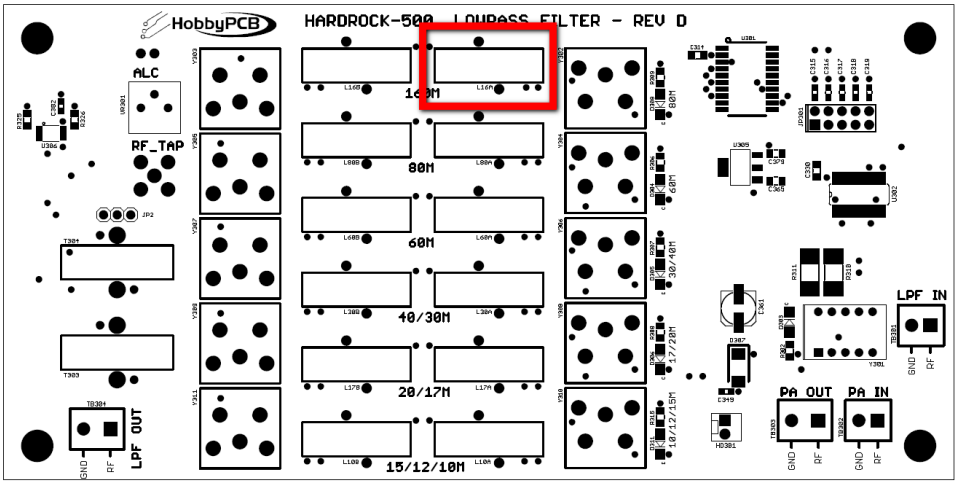
☐**Step 9: L60B** – 15 turns (16 in/40.6cm) of #20 enameled wire on a T80-2 (red) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



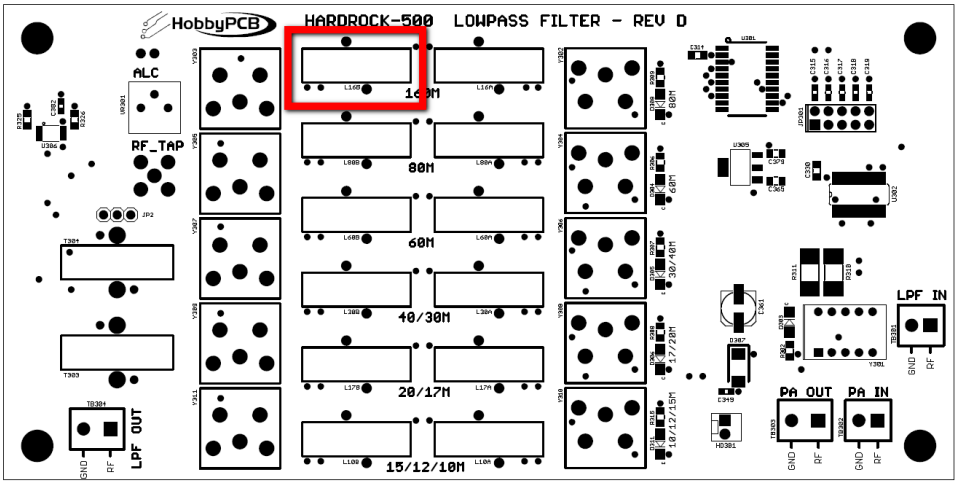
☐**Step 10: L80A** – 17 turns (18 in/45.7cm) of #20 enameled wire on a T80-2 (red) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



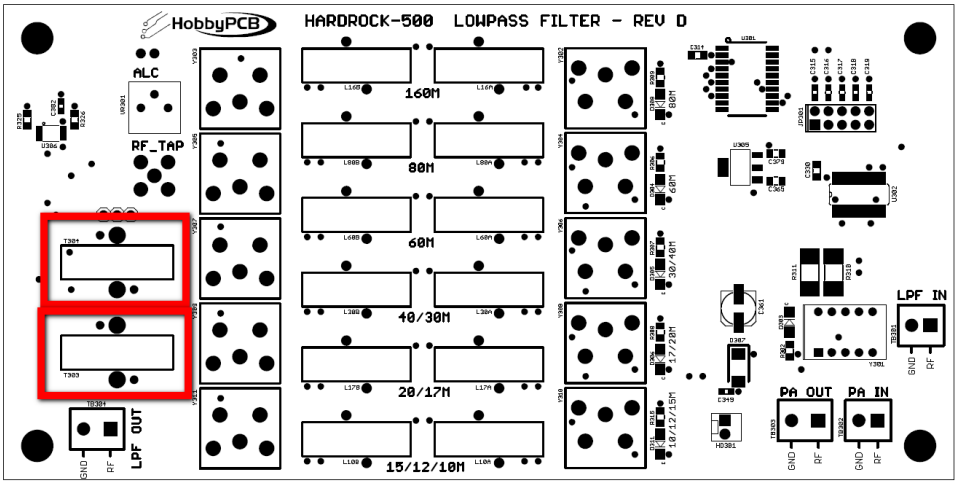
☐**Step 11: L16A** – 20 turns (20 in/50.8cm) of #20 enameled wire on a T80-2 (red) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.



☐**Step 12: L16B** – 25 turns (25 in/63.5cm) of #20 enameled wire on a T80-2 (red) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads.

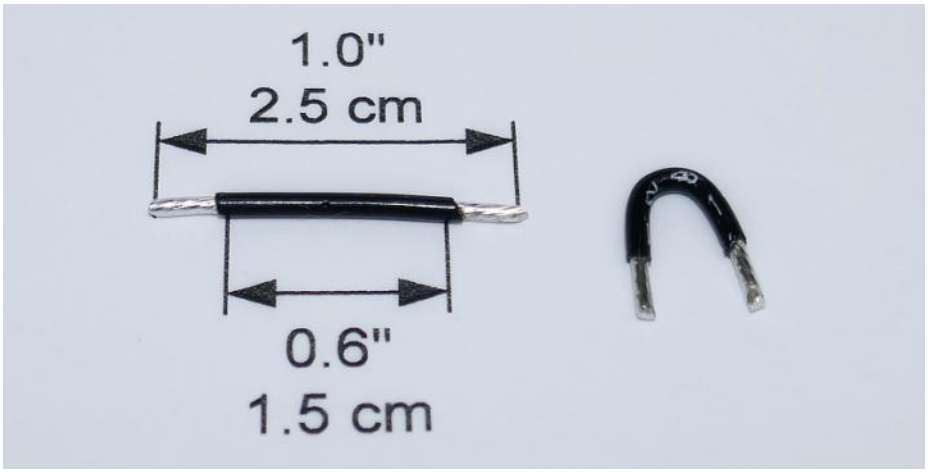


☐**Step 13: T303/T304** – 30 turns (30 in/76.2cm) of #28 enameled wire on a T82-43 (gray) toroid core. Wind the inductor, scrape and tin the leads and then insert the inductor into the PCB at the marked location. Solder and trim the excess leads. ***Two of these coils are required T303 and T304 as shown***

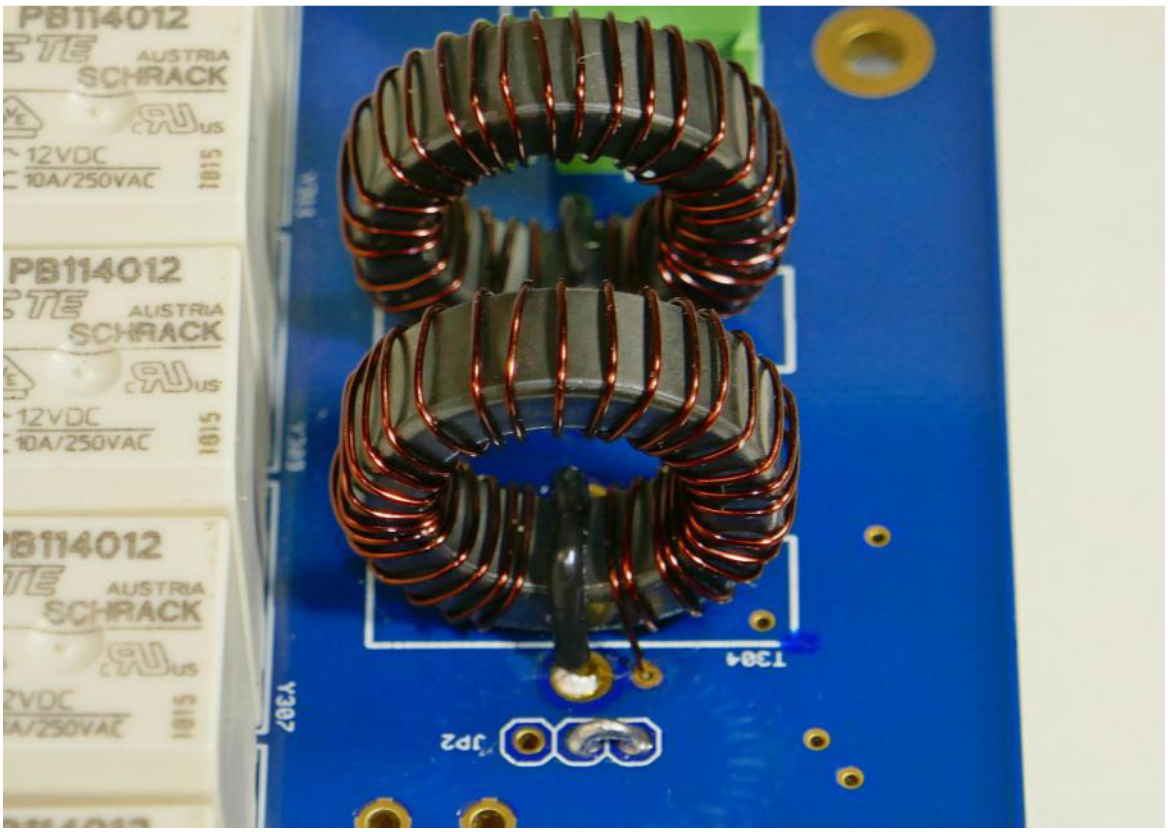


T303 and T304 each have four holes in the PCB for wires. Be sure to insert the #28 wire in the holes with the smaller diameter. The larger holes will be used in the next steps.

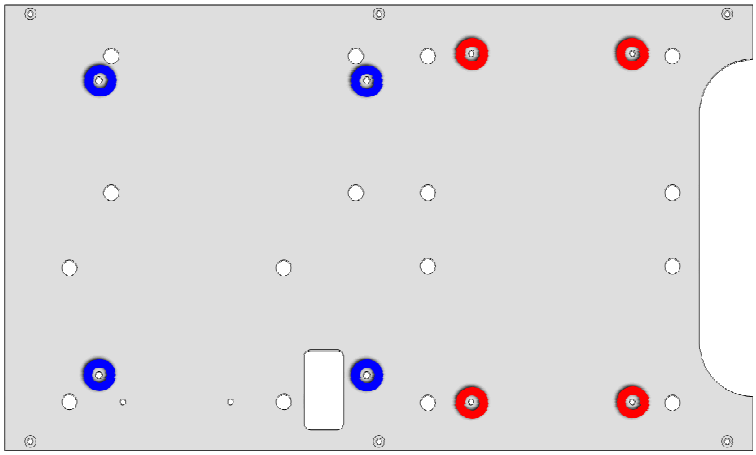
☐**Step 14: T303/T304** – cut two 1” (2.5cm) pieces of #18 Teflon wire. Strip the insulation so that it is 0.6” (1.5cm) in lengths and bend the wires into a ‘U’ shape. *Save the excess wire for the rear panel board.*



☐**Step 15: T303/T304** – insert the #18 wire ‘U’ created in step 14 through T303 and T304 into the larger diameter holes on either side of the cores. Solder the ‘U’ wires in place and trim excess leads. *Note JP2 is shown installed for normal operation.*



☐**Step 16: LPF Mounting** – Locate the RF Deck Panel and orient it so that the large cutout is to the right and the rectangular cutout in towards the bottom as shown



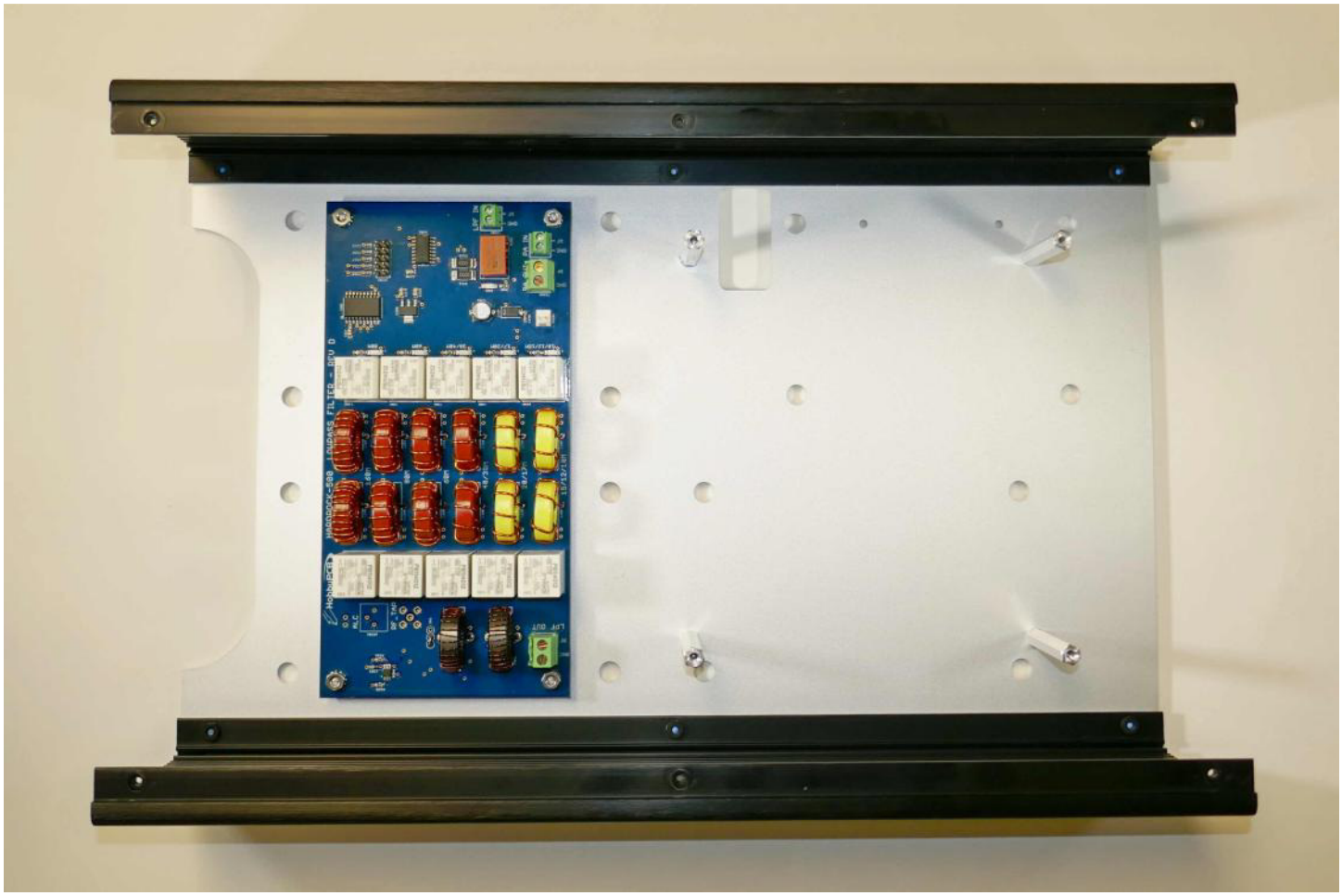
☐**Step 17: AMP Deck Hardware** – At the four locations indicated in blue, insert a #6-32x3/8" pan head screw from the opposite side the panel into a #6-32x1.75" F-F threaded stand-off. Tighten securely. Use thread-locker if available.

☐**Step 18: LPF Board Hardware** – At the four locations indicated in red, insert a #4-4x1/4" pan head screw from the opposite side the panel into a #4-40x1/4" M-F threaded aluminum spacer. Tighten securely. Use thread-locker if available.

☐**Step 19: Mount LPF Board –** Place the LPF board on the #4-40 spacers installed in the last step. T303 and T304 are at the top as shown. *If you have purchased the ATU use the #4-40x1" F-F threaded spacer from the ATU kit to affix the LPF board.* Use the #4-40 nuts with integral lock washers to secure the LPF board to the spacers.

☐**Step 20: Side Panels –** Get two of the extruded side panels and use 6 #4-40x¼" flat head screws to attach the side panels to the top of the RF Deck Panel, use thread-locker if available. *In run 1 of the amp the counter sink is on the wrong side of the panel. In this case there is plenty of clearance for the flat head screws and we decided to assemble the amps using the panels as built. The screws are not visible once the amp is assembled.*

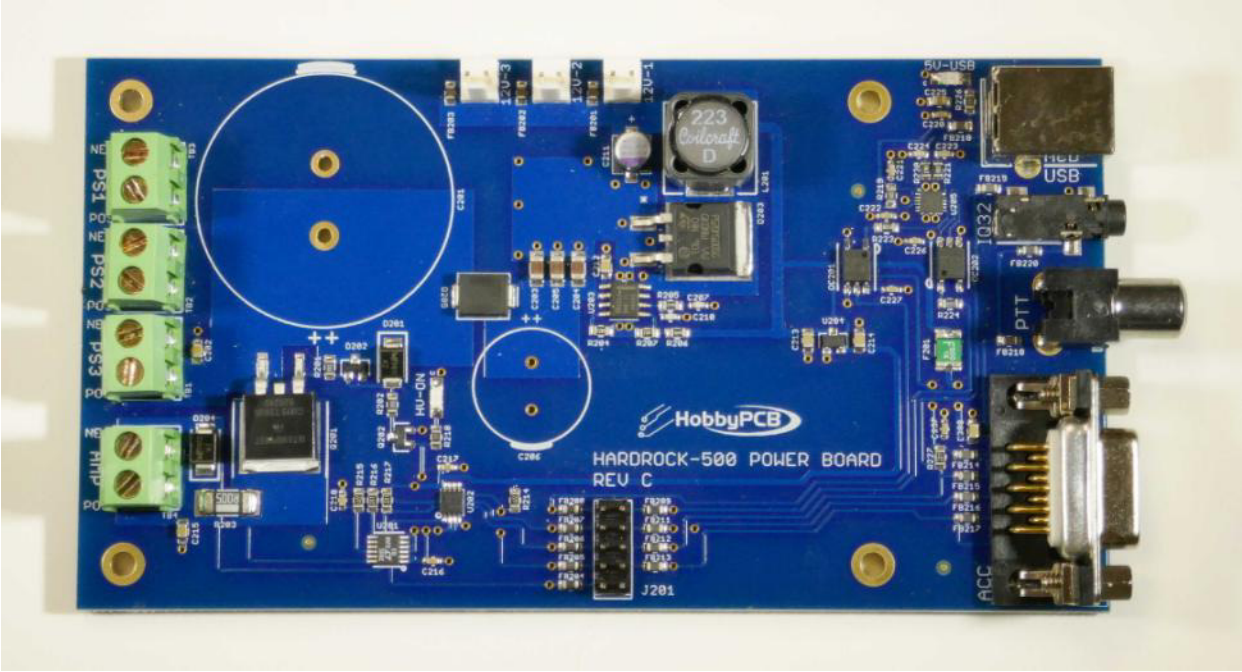
The assembly is now complete; the amp deck will be added later. Place the assembly in a safe place to avoid potentially scratching the side panels.

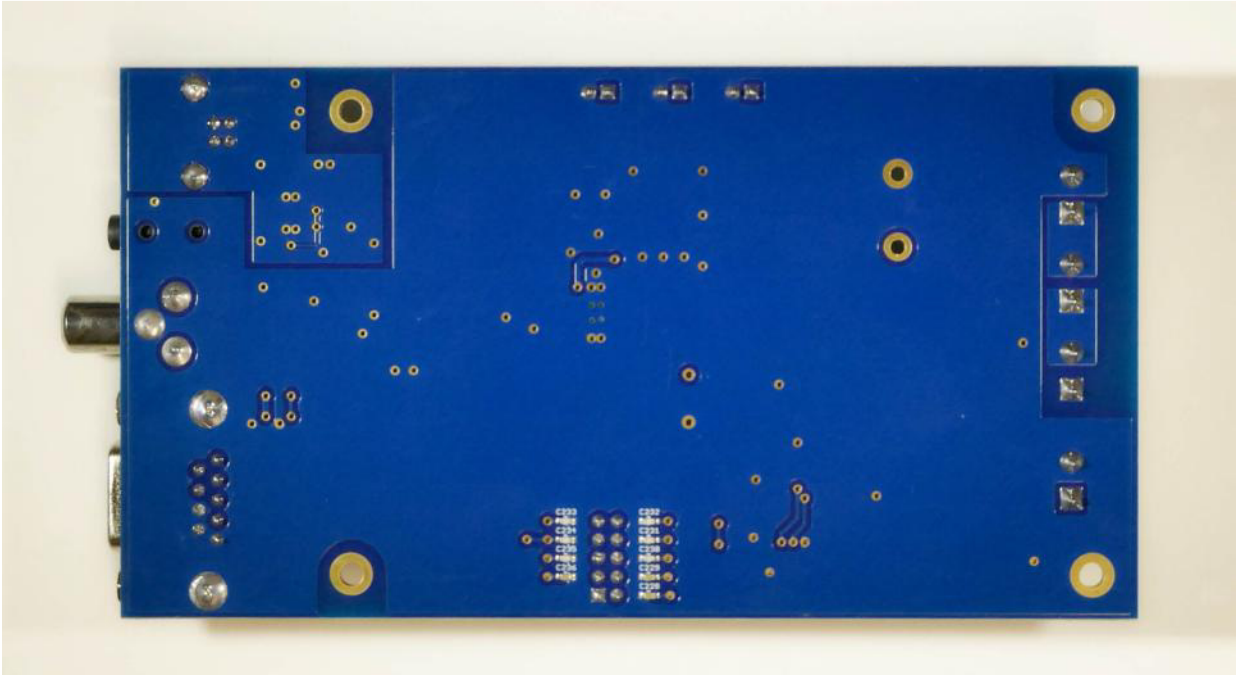


11. POWER SUPPLY ASSEMBLY

This section covers the steps requires to construct the Power Supply Assembly. The Power PCB is supplied without the large electrolytic installed. These must be installed on the Power board.

Here are photos of the Power board as supplied in the kit.





Notice, the capacitors you are about to install are polarized meaning that they have positive and negative terminals.

Unfortunately the capacitors can be inserted into the PCB in either direction potentially creating the situation where one or both capacitors are installed backwards. This would be bad; please observe the capacitor polarity when inserting the capacitors into the PCB and recheck that they are correct before soldering.

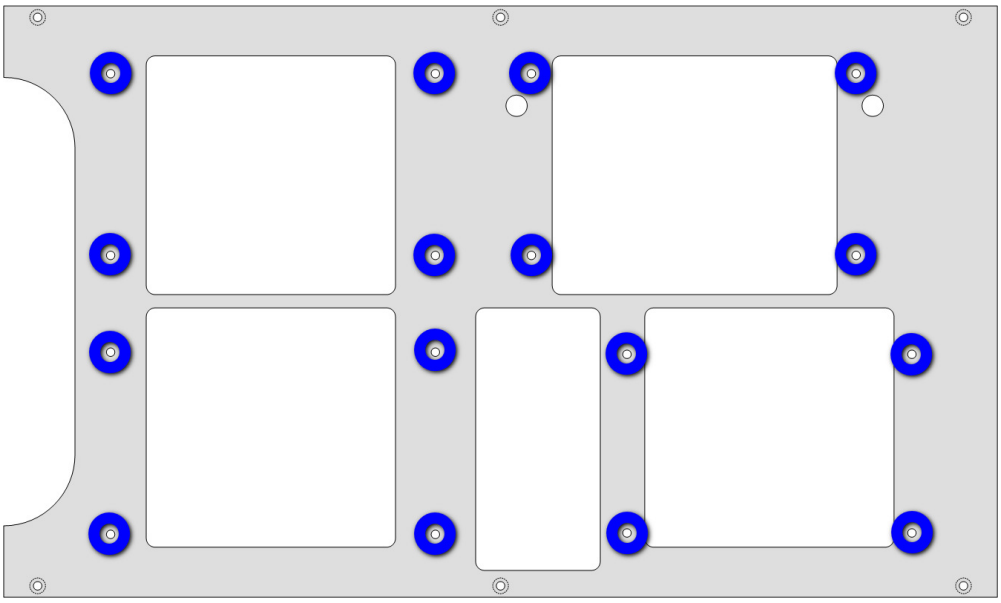
Assembly Instructions

☐**Step 1: C201**: Insert C201, the 10000 uF, 80V, capacitor into the power board with the negative side of the cap closest to the edge of the PCB. **DO NOT SOLDER AT THIS TIME.**

☐**Step 2: C206:** Insert C206, the 1000 uF, 63V, capacitor into the power board with the negative side of the cap closest to the 'C206' marking on the PCB. **DO NOT SOLDER AT THIS TIME.**

☐**Step 3: Check Capacitor Polarity** –Review the pictures and your PCB one more time to make 100% certain that C201 and C206 are oriented correctly. Solder them to the PCB and trim any excess leads.

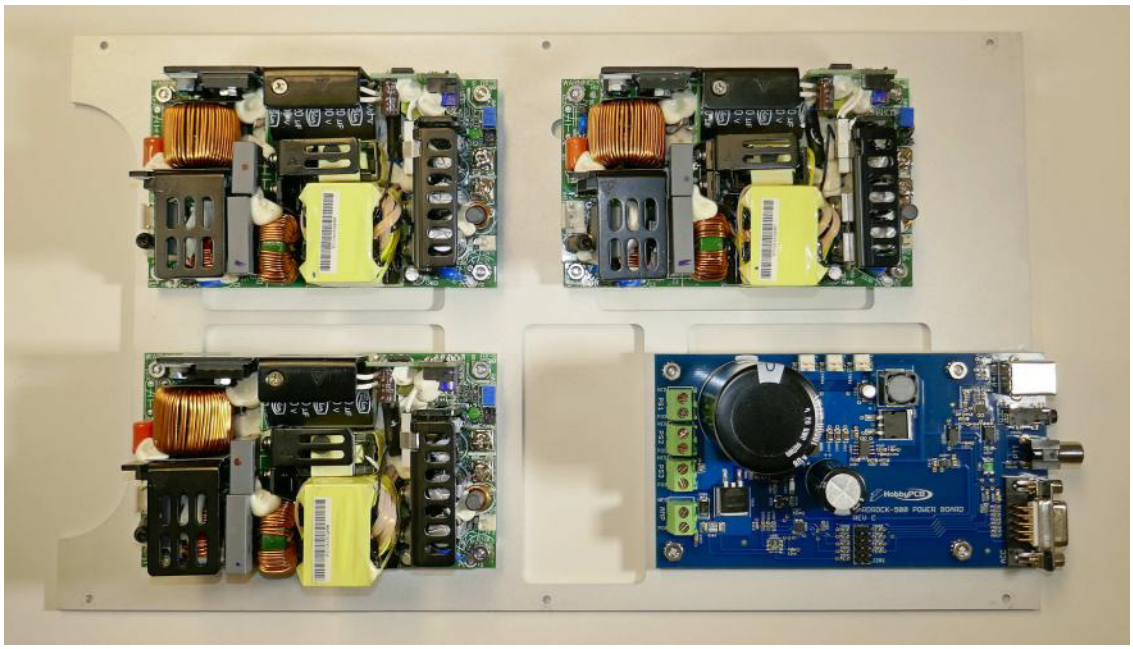
☐**Step 4: PCB Mounting** – Locate the Power Supply Panel and orient it so that the large cutout is to the left and the side with three rectangular cutouts at the bottom as shown.



☐**Step 5: PCB Hardware** – At the sixteen locations indicated in blue, insert a #4-40x1/4" pan head screw from the opposite side the panel into a #4-40x1/4" M-F threaded aluminum spacer. Tighten securely. Use thread-locker if available.

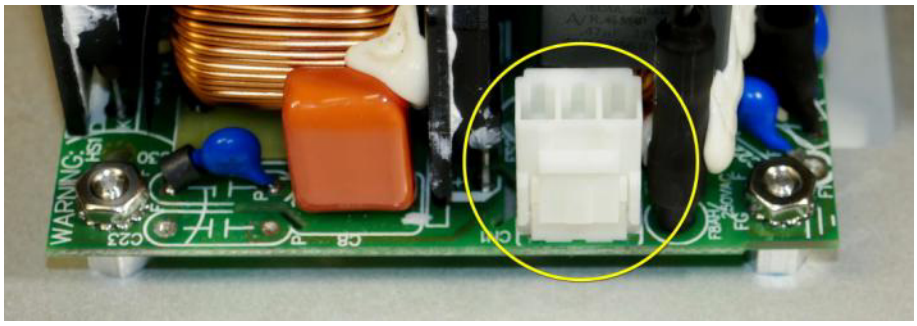
☐**Step 6: Meanwell Power Supplies** – Locate the three Meanwell power supplies (EPP400-18). Adjust SVR1 (close to the output screw terminals) for maximum (fully CW rotation). Place the supplies in the upper left, upper right and lower left positions on the power supply plate. The AC input plug goes to the left and the DC screw terminals go to the right. Secure using #4-40 nuts with integral lock washers (12 locations).

☐**Step 7: Power PCB Supplies** – Place the power PCB in the lower right position on the power supply plate, the DC terminals go to the left and the USB and DB9 connectors go to the right. Secure using #4-40 nuts with integral lock washer (4 locations).

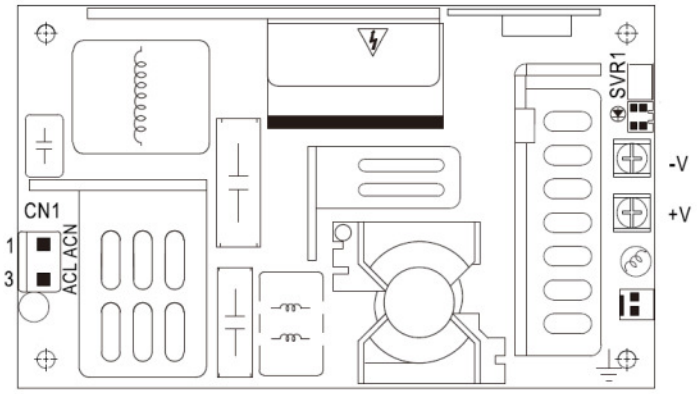


For steps 8 – 12, please view the video I created that shows how to install the AC wiring. You can view the video at https://sites.google.com/site/hobbypcbhardrock500/home/assembly-instructions.

☐**Step 8: AC Connector Shells** – Place the JST AC connector shells onto the AC header on each of the three power supplies.



This is a drawing of the Meanwell EPP400-18 power supply we are now going to make connections to: CN1 Pin 1 – AC Neutral and CN1 Pin 3 – AC Line. *Use needle nose pliers to insert the pins. The locking tab faces away from the edge of the power supply, towards the heatsink.*



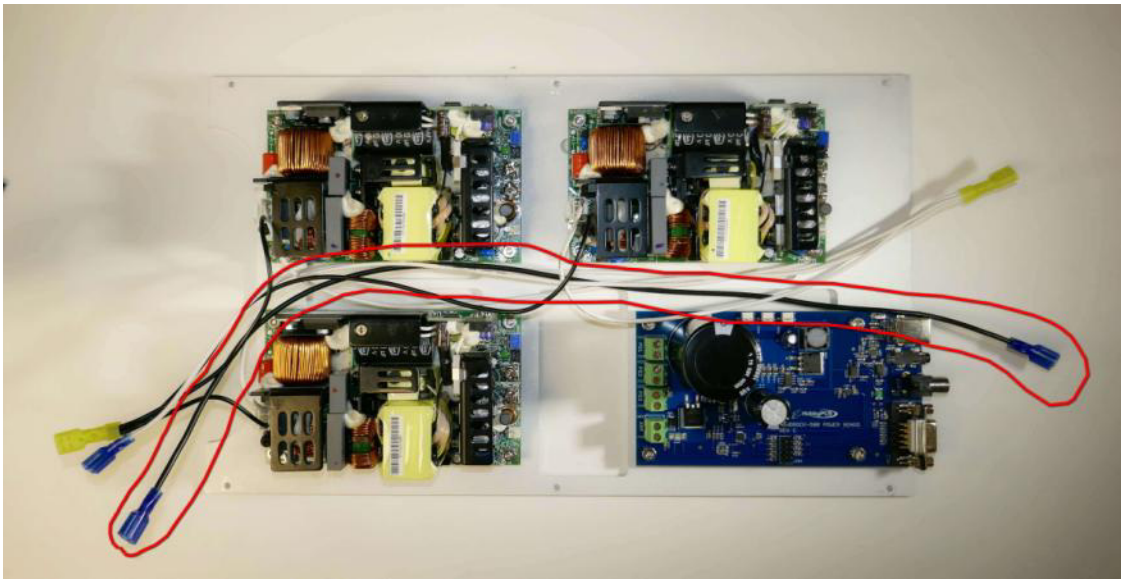
☐**Step 9: AC Neutral Wiring** – The AC Neutral Cable has four white wires; three have JST pins the fourth has a red or blue crimp connector. The common end has a yellow crimp terminal. Place this terminal at the right edge of the power supply plate.

1. Put the JST pin on the shortest wire in CN1 Pin 1 – AC Neutral of the power supply in the upper right of the power supply plate.
2. Put the JST pin on the middle length wire in CN1 Pin 1 – AC Neutral of the power supply in the upper left of the power supply plate.
3. Put the JST pin on the longest wire in CN1 Pin 1 – AC Neutral of the power supply in the lower left of the power supply plate.
4. The wire with the red or blue crimp terminal is not connected at this time

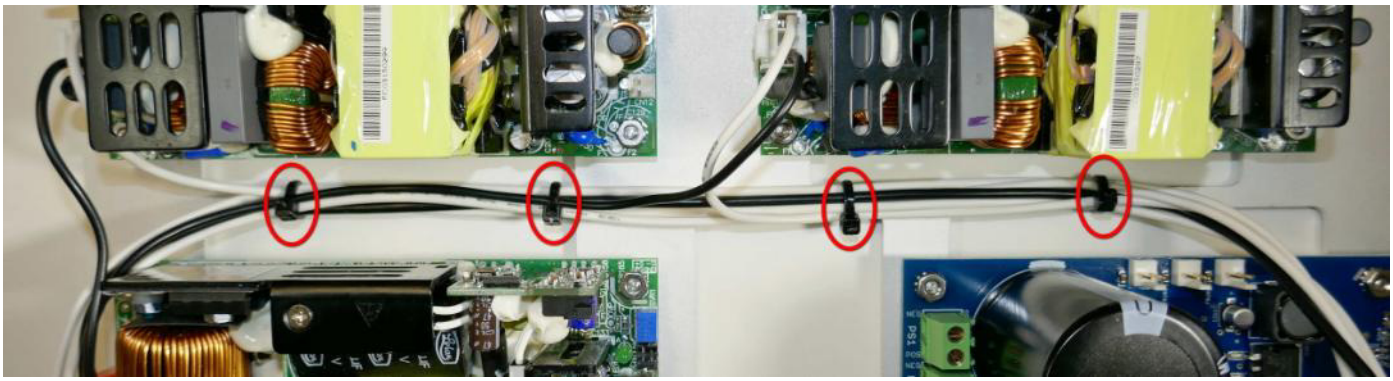
☐**Step 10: AC Line Wiring** – The AC Line Cable has three black wires with JST pins. The common end has a yellow crimp terminal, place this terminal at the left edge of the power supply plate.

1. Put the JST pin on the shortest wire in CN1 Pin 3 – AC Line of the power supply in the lower left of the power supply plate.
2. Put the JST pin on the middle length wire in CN1 Pin 3 – AC Line of the power supply in the upper left of the power supply plate.
3. Put the JST pin on the longest wire in CN1 Pin 3 – AC Line of the power supply in the upper right of the power supply plate.

☐**Step 11: AC Switch Wire** – The AC Switch wire is a single conductor with blue crimp terminals on either end. Place it with one end near each of the yellow crimp terminals. No connections are made at this time.

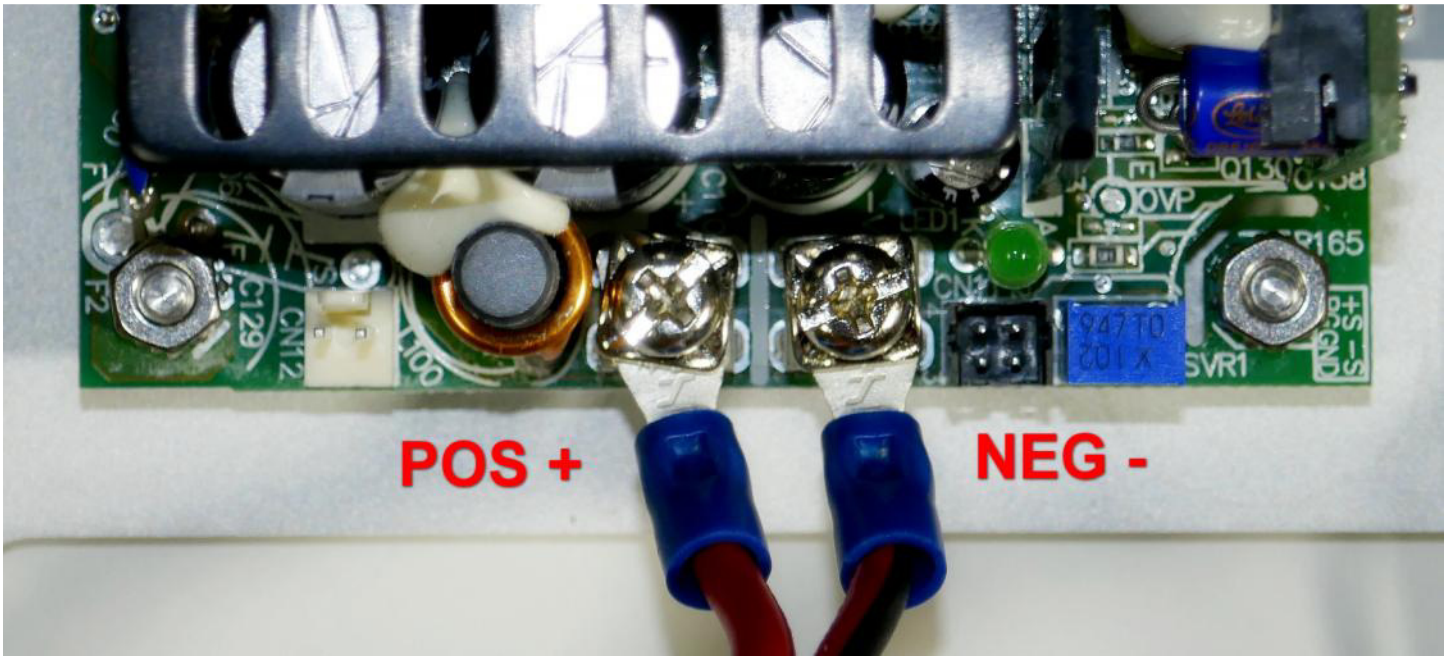


☐**Step 12: Secure AC Wiring** – secure the wire bundle to the power supply plate with four cable ties. *Make sure that the locking clip is on the wire side on the plate NOT below the plate or the two plates will not fit together.*



The DC terminals on the Meanwell power supplies have a square washer to ensure good contact with the spade terminals on the DC power cables. Be certain that these washers are on top of the terminals (not underneath) and aligned with the terminal, not diagonal.

The negative terminal is closest to the power LED and the voltage adjustment pot, as shown here:

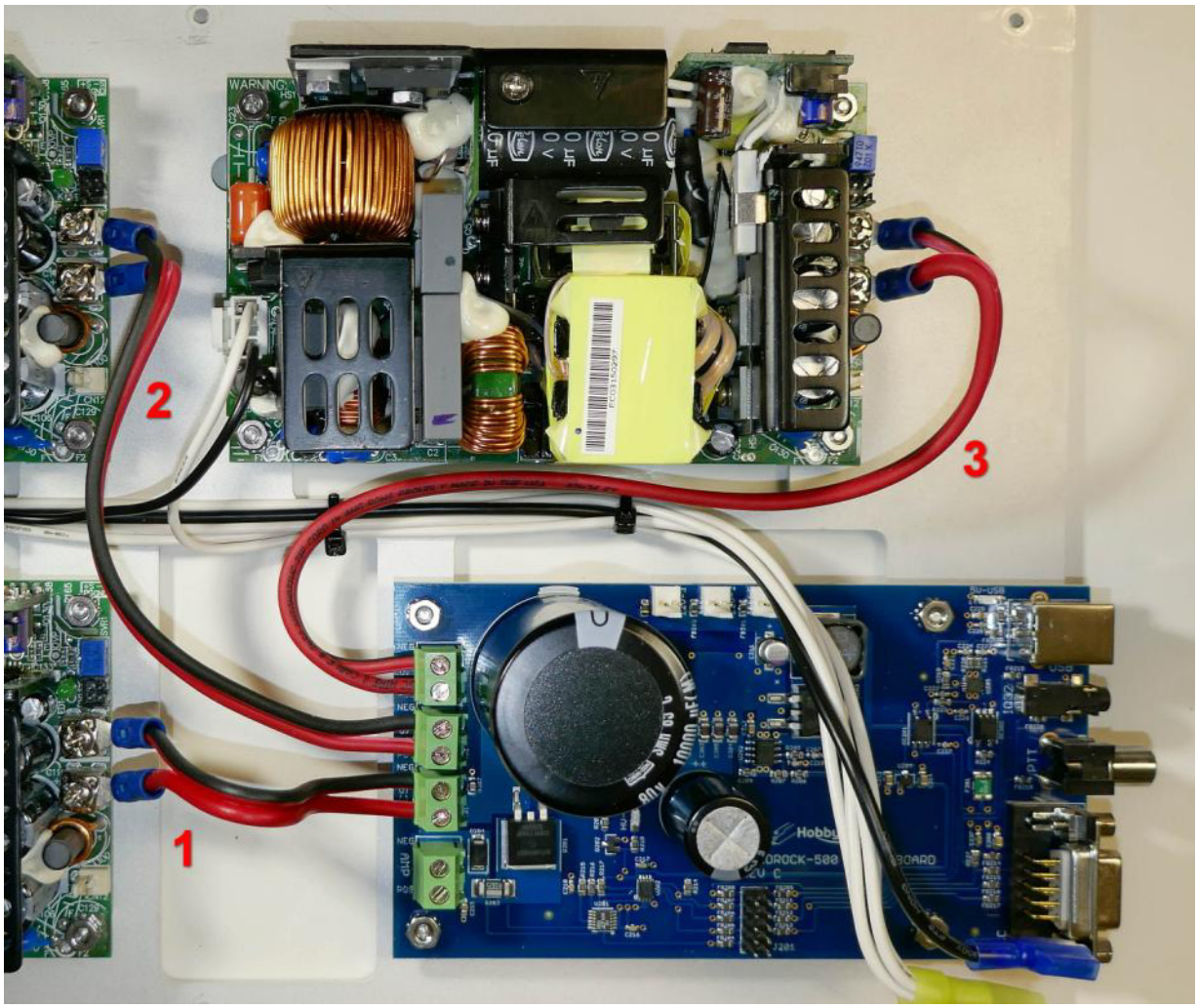


☐**Step 13: Power Board Terminal Blocks** – Loosen the screws in the terminal blocks on the power board by turning the screws CCW units you hear a click.

☐**Step 14: DC Wiring** – Locate the three power supply to power board wires, they are red/black zip cord and have blue spade terminals on one end and tinned, bare wire on the other. They are 4, 6 and 9 inches in length.

Install the three wires carefully observing the polarity with the red wire being '+' or positive and the black wire being '-' or negative. The power board is marked 'POS' for positive and 'NEG' for negative.

1. Connect the 4" DC power cable from the lower left power supply to PS3 on the power board
2. Connect the 6" DC power cable from the upper left power supply to PS2 on the power board
3. Connect the 9" DC power cable from the upper right power supply to PS1 on the power board



Leave the 'AMP' terminals on the power board unconnected at this time.

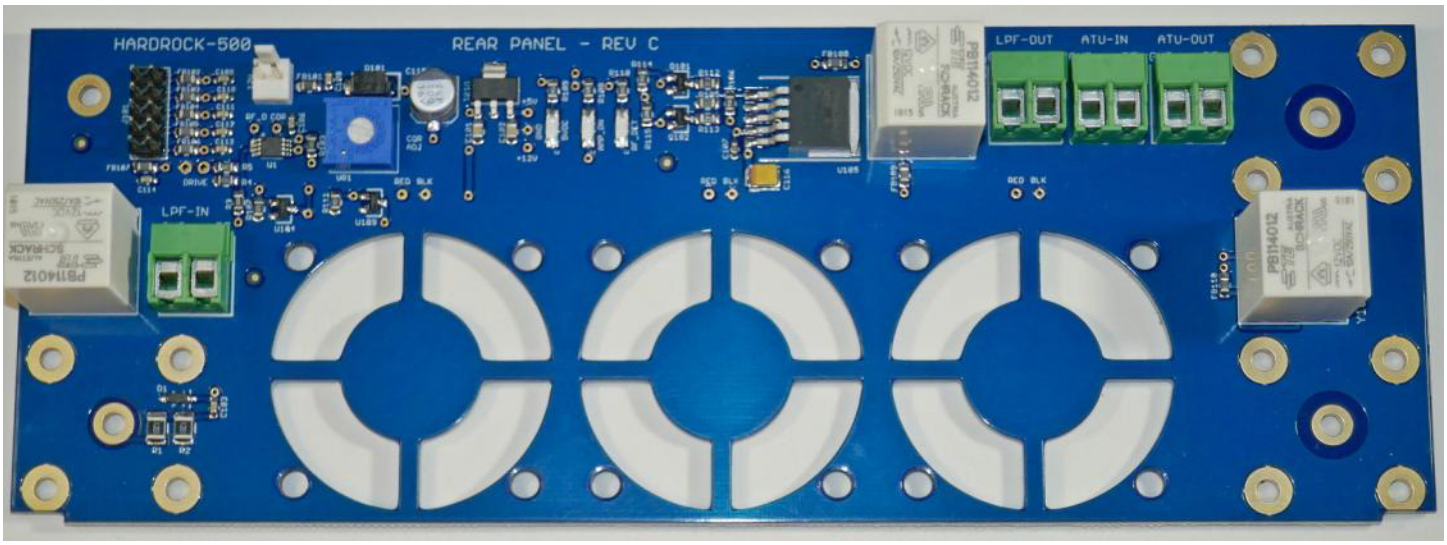
☐**Step 15: – Side Panels –** Get the two remaining extruded side panels and use 6 #4-40x¼” flat head screws to attach the side panels to the top of the power supply panel. Use thread-locker if available.

The assembly is now complete; the amp deck will be added later. Place the assembly in a safe place to avoid potentially scratching the side panels.

12. REAR PANEL ASSEMBLY

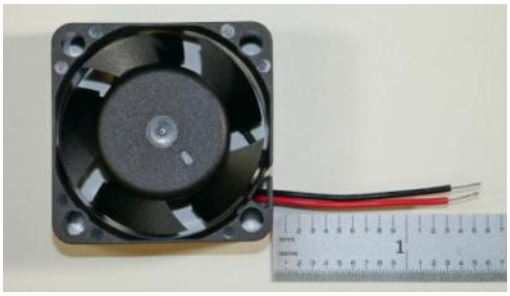
This section covers the steps required to construct the Rear Panel Assembly. To complete the Rear Panel PCB we must add the fans and the SO239 connectors.

Here are photos of the Rear Panel PCB as supplied in the kit.



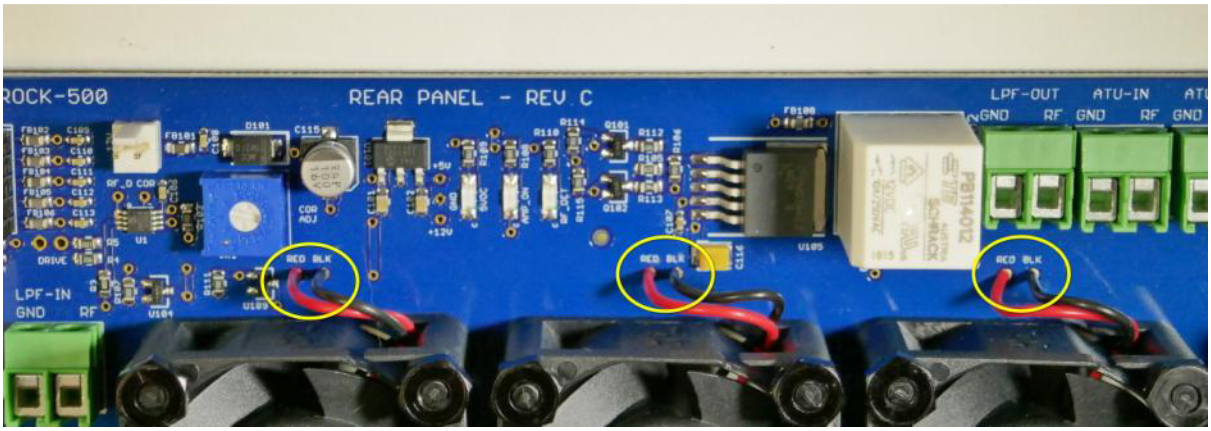
Assembly Instructions

☐**Step 1: Trim Fan Wires** – For each of the 40mm fans, trim the leads to approximately 1.5” (38mm) from the body of the fan to the end of the wires. Strip off 0.25” (6mm) of the insulation.

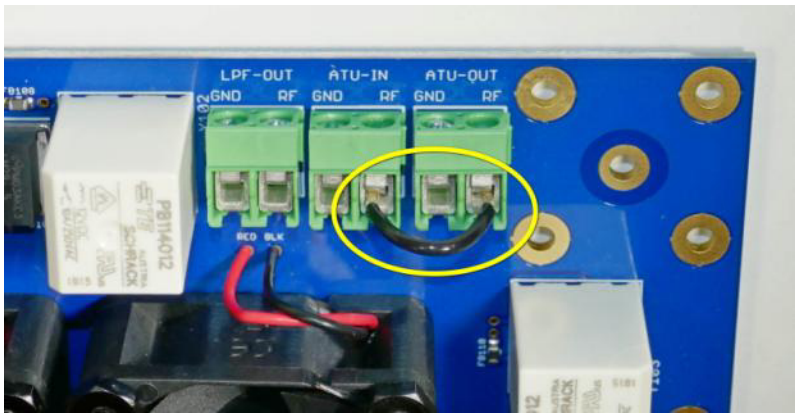


☐**Step 2: Mount Fans** – Mount the three fans to the rear panel board using 12, #6-32 1" black nylon screws and 12, #6 black nylon nuts. Orient the wires as shown (towards the top of the PCB and the label on the fan should be against the PCB. *The mounting hardware is nylon plastic. Tighten them snugly but do not over-tighten to avoid breaking the screws.*

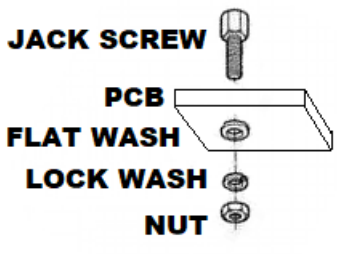
☐**Step 3: Connect Fans** – Insert the fan wires in the holes indicated on the rear panel board, solder the wires and trim any excess wire.



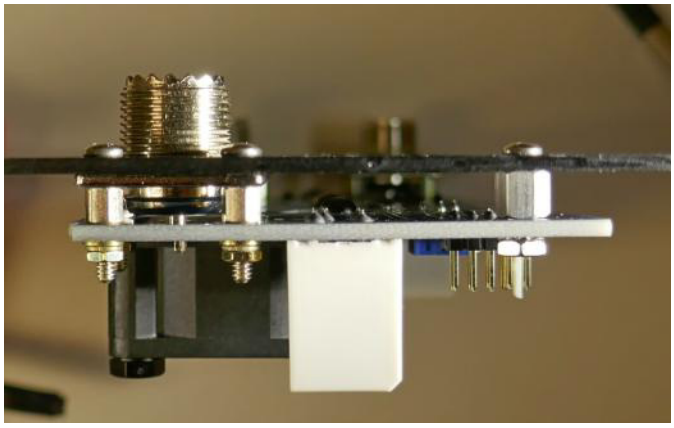
☐**Step 4: ATU Jumper –** Cut a 1.25” (32mm) section of #18 Teflon wire (from LPF board Step #14) strip the ends and create a jumper from the RF pin of ATU-IN to the RF pin of ATU-OUT. Tighten the screws in the terminal blocks.



☐**Step 5: Mounting Hardware –** Install the 12 jack screws (red), the #4-40x¼” M-F threaded spacer and the #4 hex nut (yellow) on the board. Each jack screw has a flat washer, lock washer and nut:

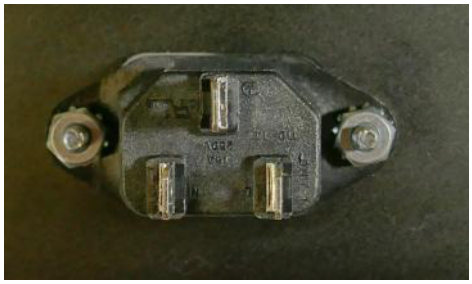


☐**Step 6: SO239 Mounting –** Place the three SO239 jacks over the jack screws with the center pins projecting through the PCB then place the rear panel over the SO239 jacks.

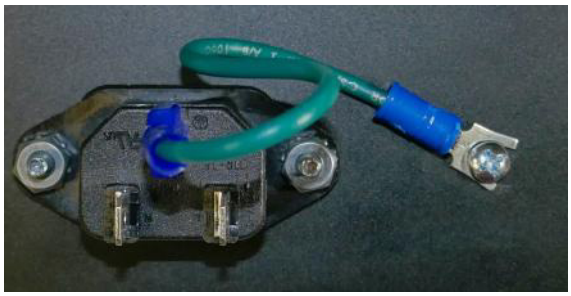


☐**Step 7: SO239 screws –** Use the thirteen #4-40x¼" screws to fasten the SO239 jacks and the ¼" spacer to the rear panel. Then solder the center pins of the SO239 jacks.

☐**Step 8: Power Inlet –** Use two #6-32x½" screws and #6-32 hex nuts with integral lock washers to attach the power inlet to the rear panel. *Please orient the inlet as shown with the ground tab up.*

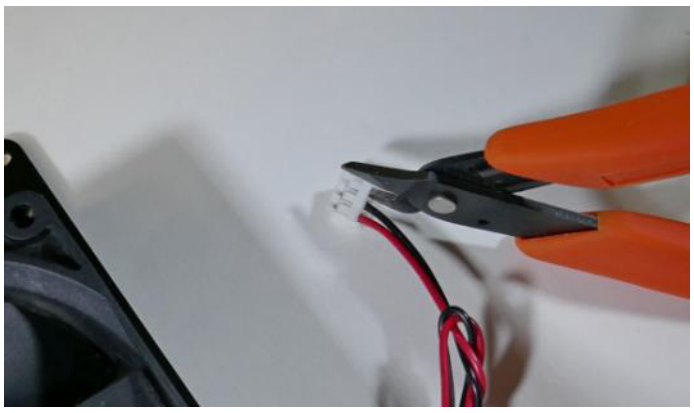


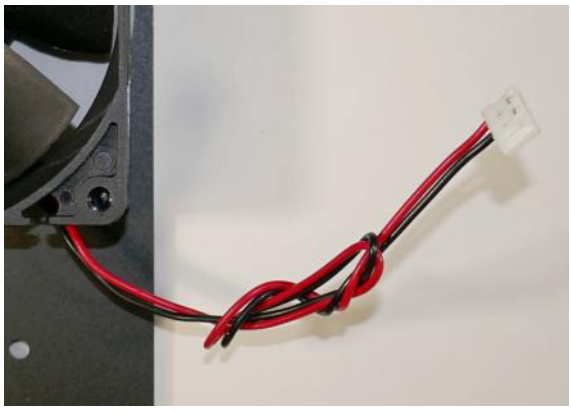
☐**Step 9: Ground Stud –** Use a #6-32x½" screw, #6-32 hex nut with an integral lock washer and the and #6-32 wing nut to secure one end of the green ground wire to the reap panel. Attach to other end of the green ground wire to the ground terminal of the power inlet.



☐**Step 10: Mount 80mm Fan –** Use the remaining four #4-40x½" to attach the 80mm fan to the rear panel, the screws tap themselves into the fan. The fan label should be visible through the rear panel and the fan wire should be on the side closest to the ground stud.

The fan plug has three positions, only two are used. Use diagonal cutters to remove the unused position. The supplied wire is a bit long so bundle it up so it cannot get into the fan when it is turning.



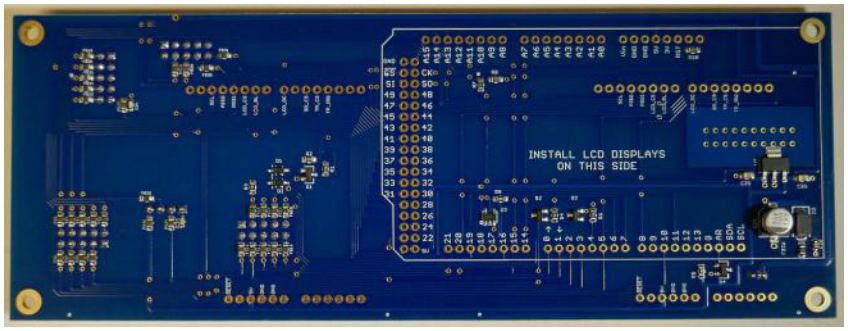


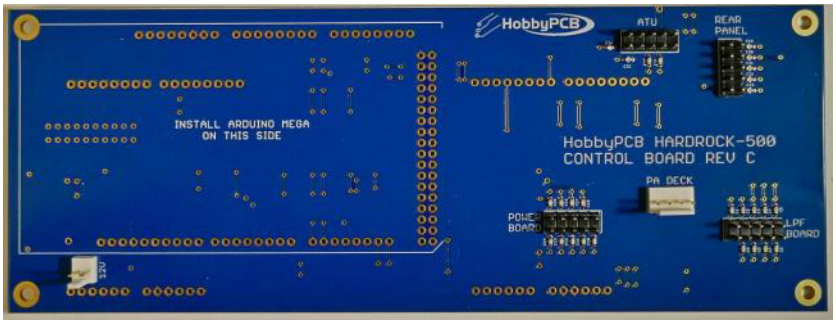
The rear panel is now complete. Set it aside until final assembly.

13. FRONT PANEL ASSEMBLY

This section covers the steps required to construct the Front Panel Assembly. To complete the Front Panel PCB we must add the LCD displays and the Arduino Mega processor. All of these components are socketed for easy replacement. Pay careful attention to which side of the PCB the LCDs and the Arduino are mounted.

Here are photos of the Front Panel board as supplied in the kit.

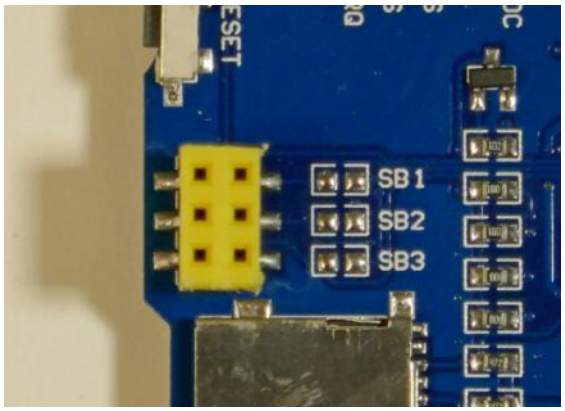




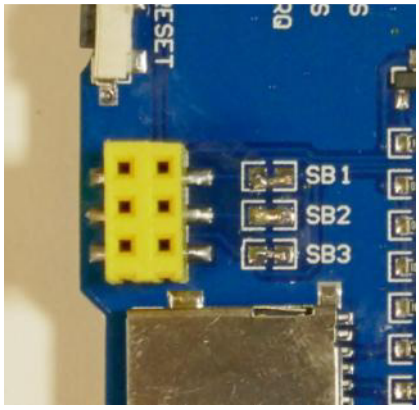
Assembly Instructions

☐**Step 1: LCD Jumper Wires** – The LCD displays need jumpers added to SB1, SB2 and SB3. *Do this on both LCD displays*

BEFORE:



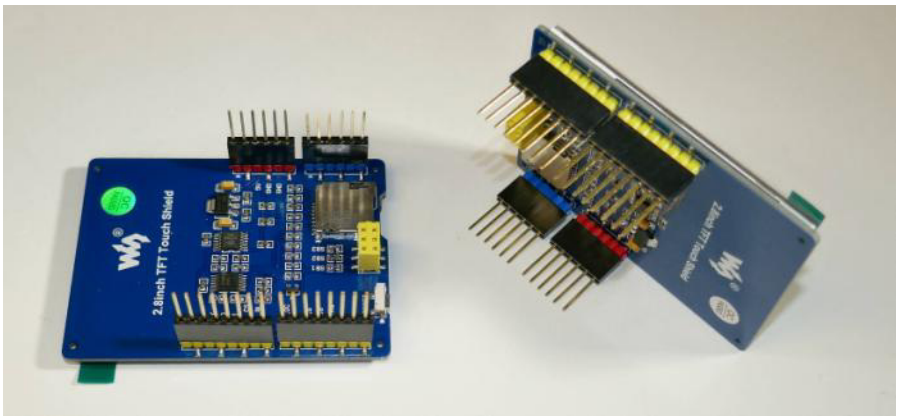
AFTER:



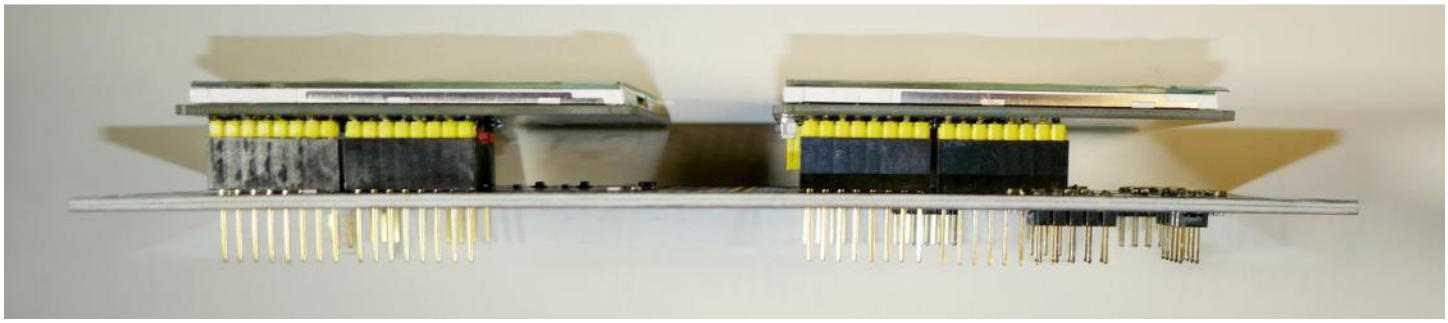
Use a component lead or small piece of wire to solder across the space between the pads of SB1, SB2 and SB3 as shown. For those not intimidated by SMT components, low value resistors will work fine and are easier (I think) to deal with than the jumper wires. Any resistor less than 100 ohms will be sufficient.

Be very careful working with the LCDs the surface is glass and can crack if dropped or twisted. Always handle the display by the edges and if you need to push it into the socket do not press on the glass. Press on the PCB edges.

☐**Step 2: Stacking Headers** – Carefully slide the Arduino stacking headers onto the pins of the LCDs. There are 6-pin and 8-pin headers, make sure that the placement is correct.



☐**Step 3: Mount LCDs** – On the side of the front panel PCB that says "INSTALL LCD DISPLAYS ON THIS SIDE", insert the LCDs with the stacking headers attached. It's a bit of a challenge to get all of the pins lined up.

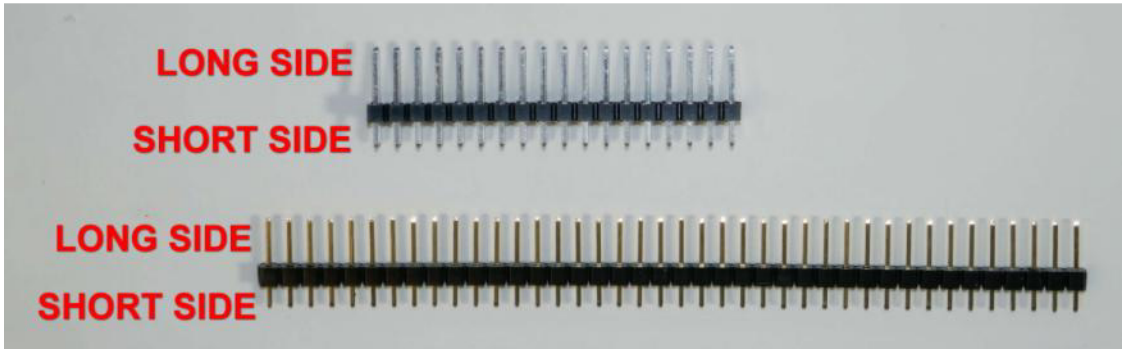


☐**Step 4: Solder/Check LCDs** – Start by placing the assembly on a flat surface and soldering a single pin on either side of each LCD then press down on the PCB close to the pin to ensure that the header is fully seated. Then check the alignment. It is critical that the headers are fully seated, flush with the PCB and perpendicular to the PCB.

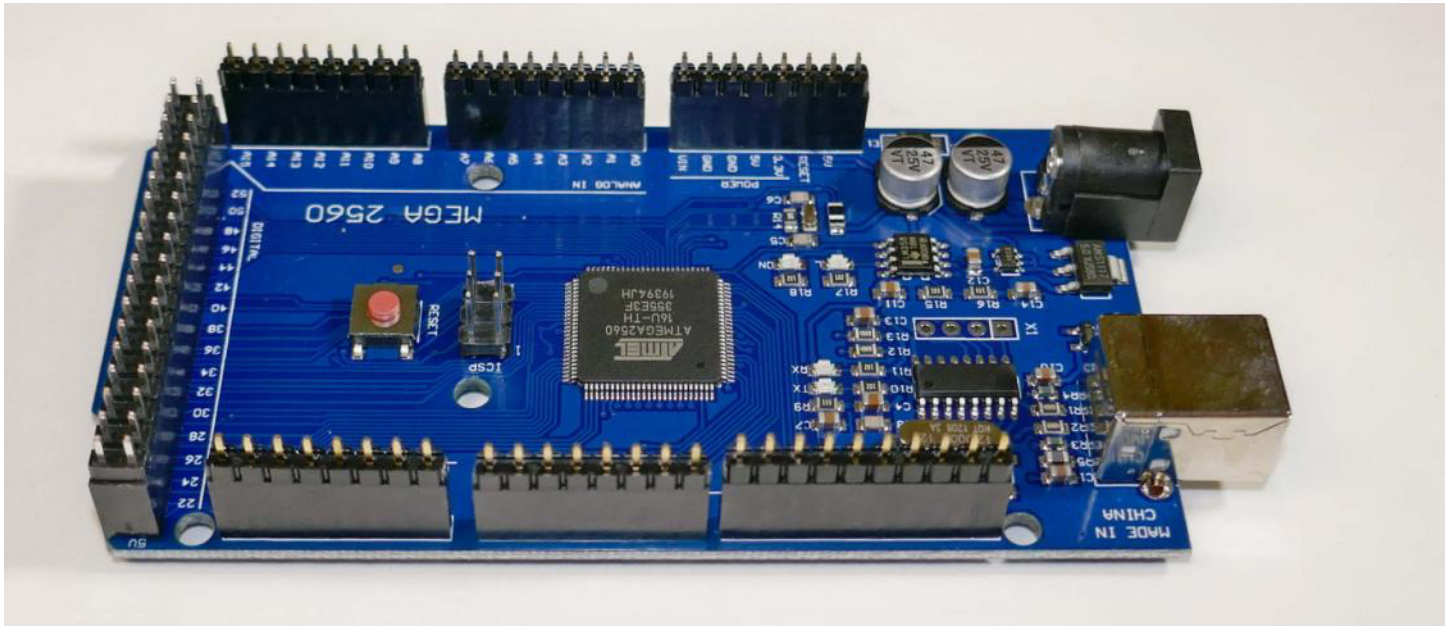
☐**Step 5: Solder the remaining LCD pins** – When you are absolutely certain that the alignment is correct, solder the remaining pins using as little solder as possible, just fill the plated through holes with solder, there's no need for a large amount of solder to accumulate on top of the board. When you are finished soldering, trim the header leads close to the PCB. *Wear eye protection while cutting the pins as they can become projectiles when you cut them.*

☐**Step 6: Remove the LCDs** – Gently remove the LCDs from the header sockets by gently rocking them side-to side until they come out. Set them in a safe place for reinstallation later.

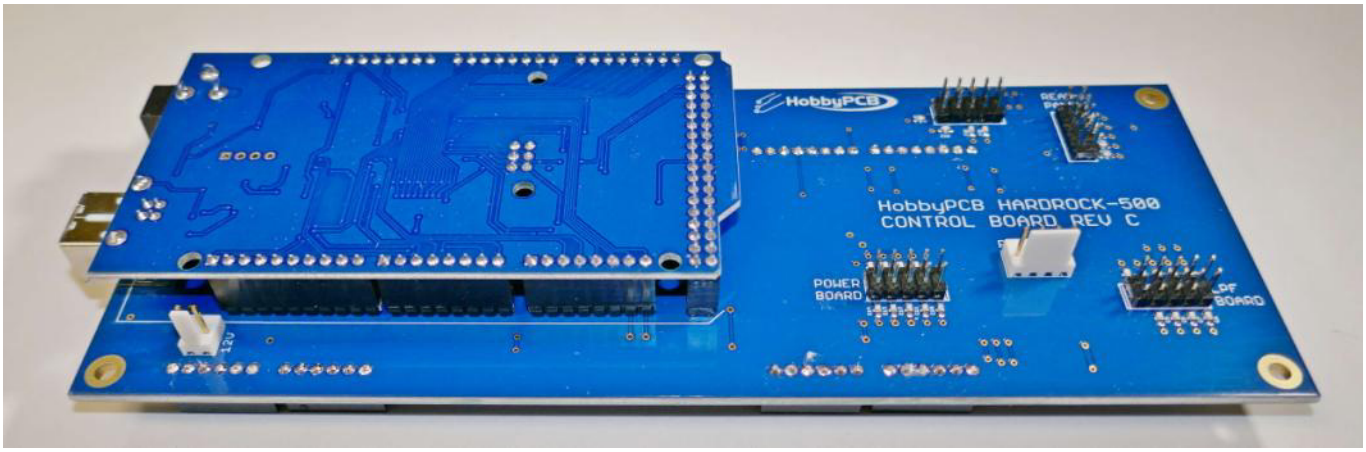
The 40 pin single row headers and the 36 pin dual row headers have a long side and a short side. The long side goes into the Arduino Mega and the short side goes into the PCB.



☐**Step 7: Insert Pins** – Insert the dual header into the dual row receptacle on the Arduino Mega. Use the 40 pin single row headers and break off the appropriate number of pins for each of the single row receptacles on the Arduino Mega. Make sure that every connection on the Mega has a header pin.



☐**Step 8: Mount Mega on PCB** – Insert the short pins into the front panel PCB on the opposite side from the LCDs, it's labeled "INSTALL ARDUINO MEGA ON THIS SIDE".

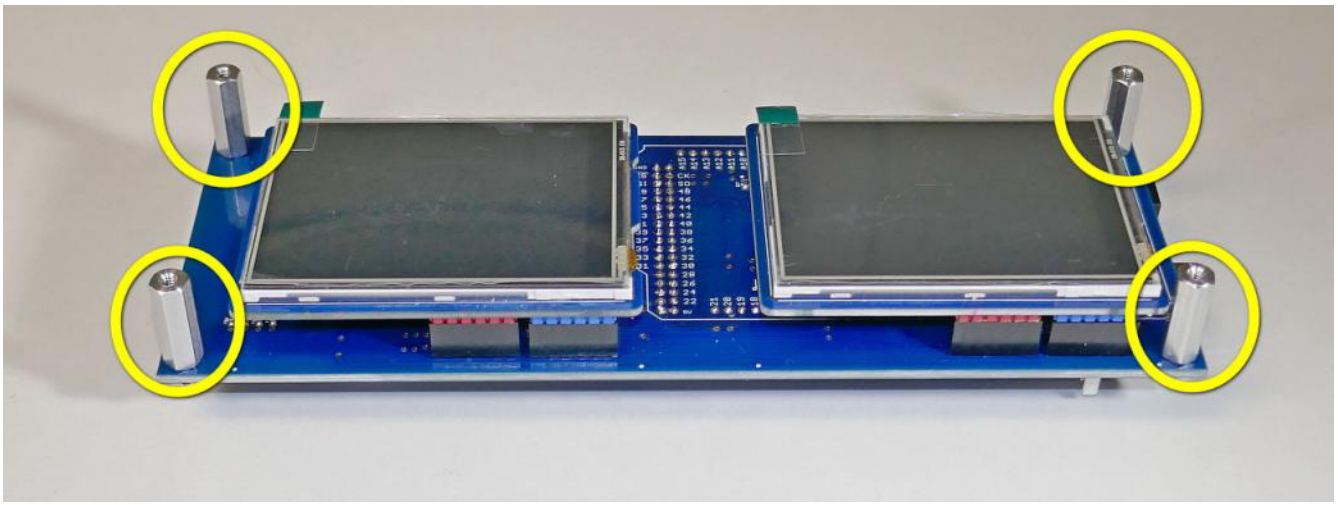


☐**Step 9: Solder Mega Pins** – Carefully solder the pins on the opposite side of the PCB from the Arduino Mega. Be sure that the Mega is flush with the PCB. Use as little solder as possible. Just fill the plated through holes with solder. There is no need for a large amount of solder to accumulate on top of the board and there is no need to trim the pins on the Mega.

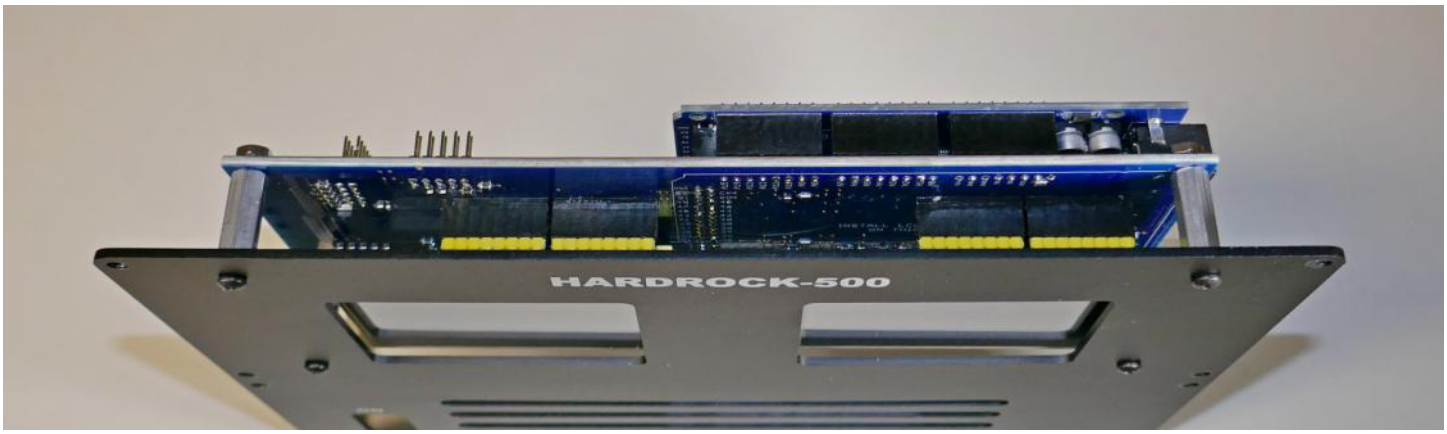
☐**Step 10: Reinsert the LCDs** – Carefully put the LCD displays back into their headers. Never push on the display or push on the PCB at the edges of the display. It is easy to break the glass on the LCD.

At this point, if you plug the USB connector on the Mega into a PC, after a few seconds, the displays should come alive and display the Hardrock-500 operating screens.

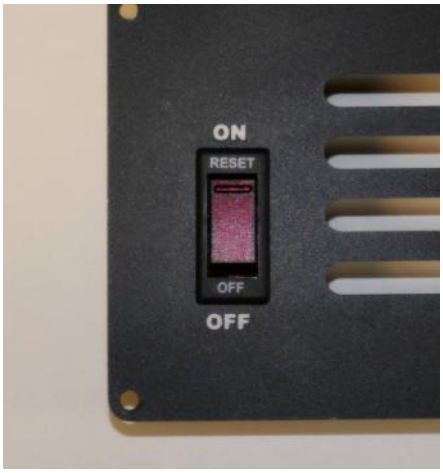
☐**Step 11: Stand-offs** – Using the #4-40 hex nuts with integral lock washers, install the four #4-40x3/4" threaded stand-offs in the corners of the front panel PCB as shown:



☐**Step 12: Front Panel** – Remove the protective film from the front of the LCDs (it's not possible to do it after you mount the front panel PCB). There are two possible ways to mount the front panel PCB to the back of the front panel, only one of these causes the LCDs to align correctly with the openings. Orient the front panel board with the LCDs aligned with their openings. Use the #4-40x¼" black screws to secure the PCB to the front panel.



☐**Step 13: Power Switch** – Insert the power switch/breaker into the opening from the front of the panel.

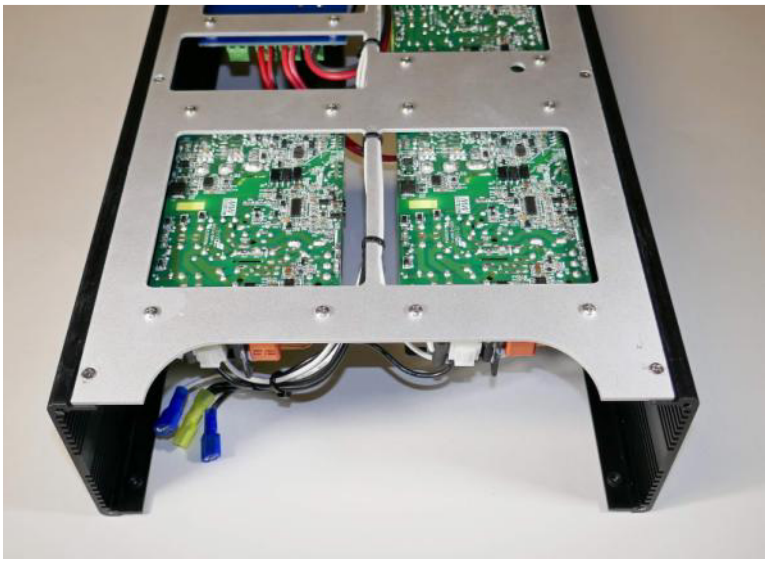


The front panel is now complete. Get ready for final assembly.

14. Final Assembly

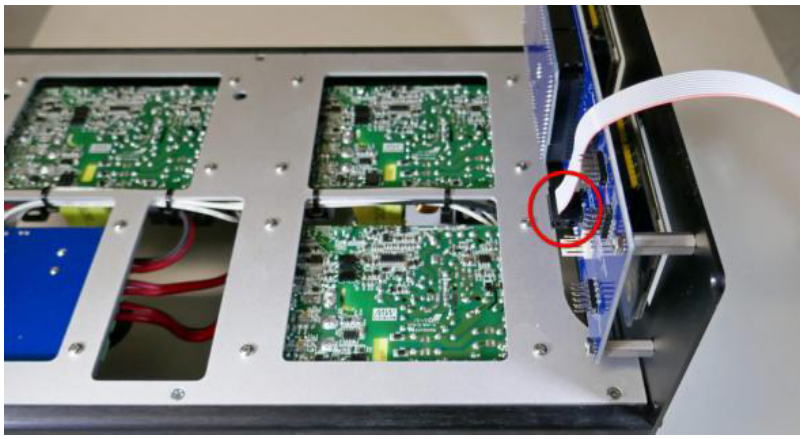
This section covers the steps requires for final assembly of the Hardrock-500 amplifier support package.

☐**Step 1: Power Supply Assembly** – Set the power supply assembly with the mounting plate on the top as shown.



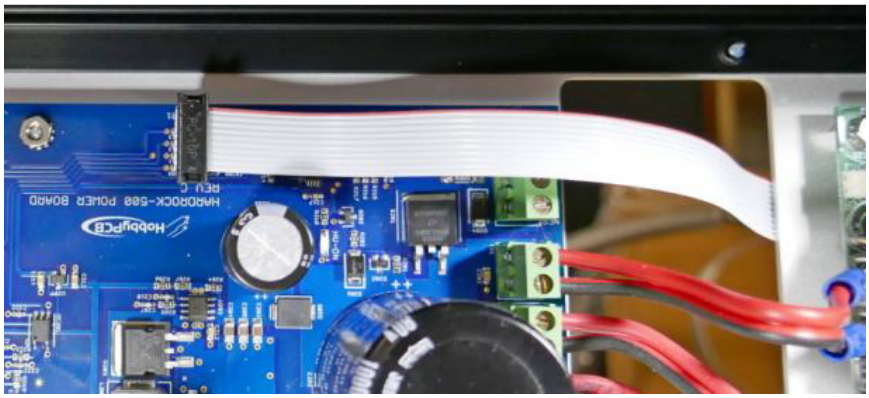
☐**Step 2: Front Panel**– Attach the front panel to the power supply assembly using four #6-32 3/8" black, pan head screws. *Do not completely tighten the screws at this time.*

☐**Step 3: 30cm Ribbon Cable** – Plug one end of the 30cm (12”) ribbon cable into the 10-pin header labeled ‘POWER BOARD’. Make sure that the pins align correctly and ribbon cable exits the cable from the top as shown.



Bend the ribbon cable back across the connector and route the cable through the rectangular opening in the power supply plate as shown. Make sure that the cable is flat and not twisted. The polarity indicator on the cable can be on either side.

Turn the assembly on its side and connect the other end of the cable to the 10 pin header on the power board. Make sure that the pins align correctly and the cable is flat with no twists.



☐**Step 4: LPF Assembly** – Place the LPF assembly on top of the power supply assembly with its mounting plate down as shown. The LPF assembly has to slide under the front panel board.

☐**Step 5: Front Panel** – Attach the front panel to the LPF assembly using four #6-32 3/8" black, pan head screws. Tighten all front panel screws.

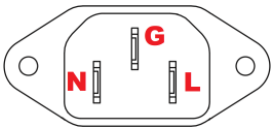
☐**Step 6: Power Switch** – The wires that connect to the power switch MUST be connected in the correct positions. Place the amplifier on its side so that the power switch connections are easily accessible. The QC or Faston connections should be tight and may require pliers to get the connecter properly seated. Make the following connections:

1. The neutral wire – single white wire (terminal may be blue or red)
2. The line distribution wire – three black wires (yellow terminal)
3. The AC line from the inlet – single black wire (blue terminal)

Use the remaining zip tie to bundle the wires going to the power switch.

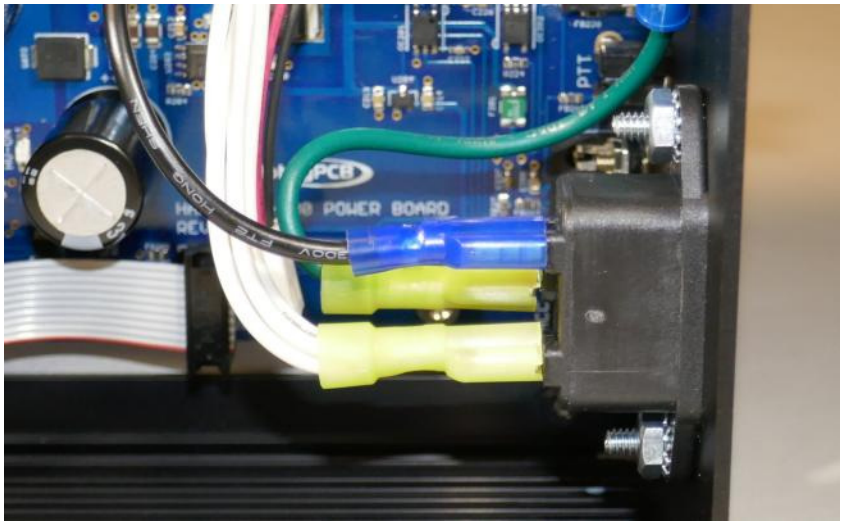
☐**Step 7: Rear Panel** – Attach the rear panel to the power supply and LPF assembly using eight #6-32 3/8" black, pan head screws. Only tighten rear panel screws after all of the screws have been inserted loosely.

☐**Step 8: AC Inlet Wires** – For safety be sure to make the correct AC line, neutral and ground connection to the AC power inlet. Looking into the connector side of the AC inlet from the rear panel are the locations of the (G)round, (L)ine and (N)eutral AC connections.

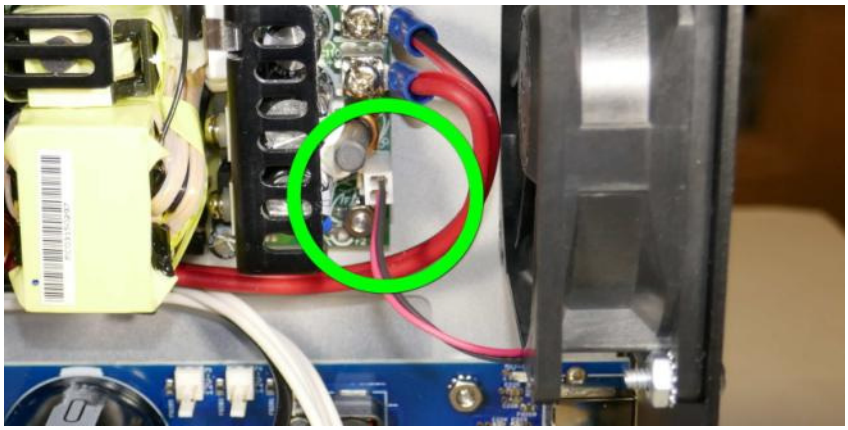


The ground connection should already be in place (chapter 12, step 9). Attach the AC line wire (blue terminal with a single black wire) and the AC neutral wire (yellow terminal white with four white wires) to the appropriate connection point on the AC inlet.

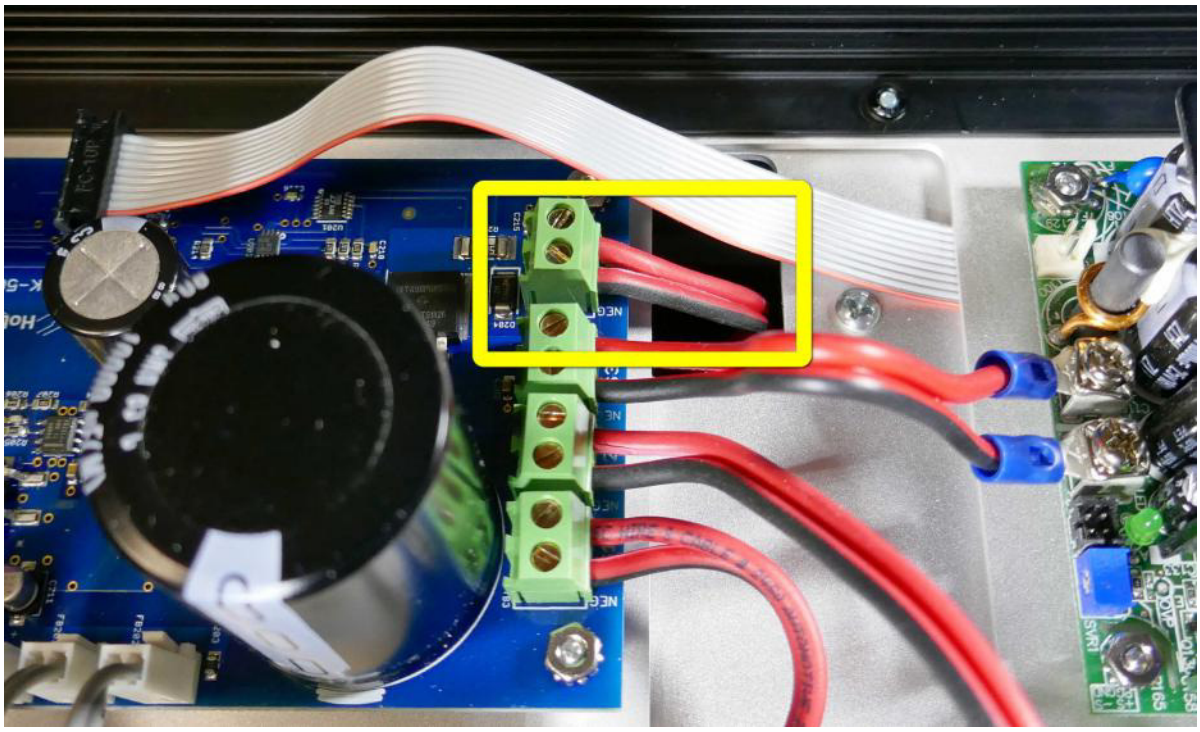
This picture is wrong (the AC inlet is upside down so hot and neutral are on opposite sides.



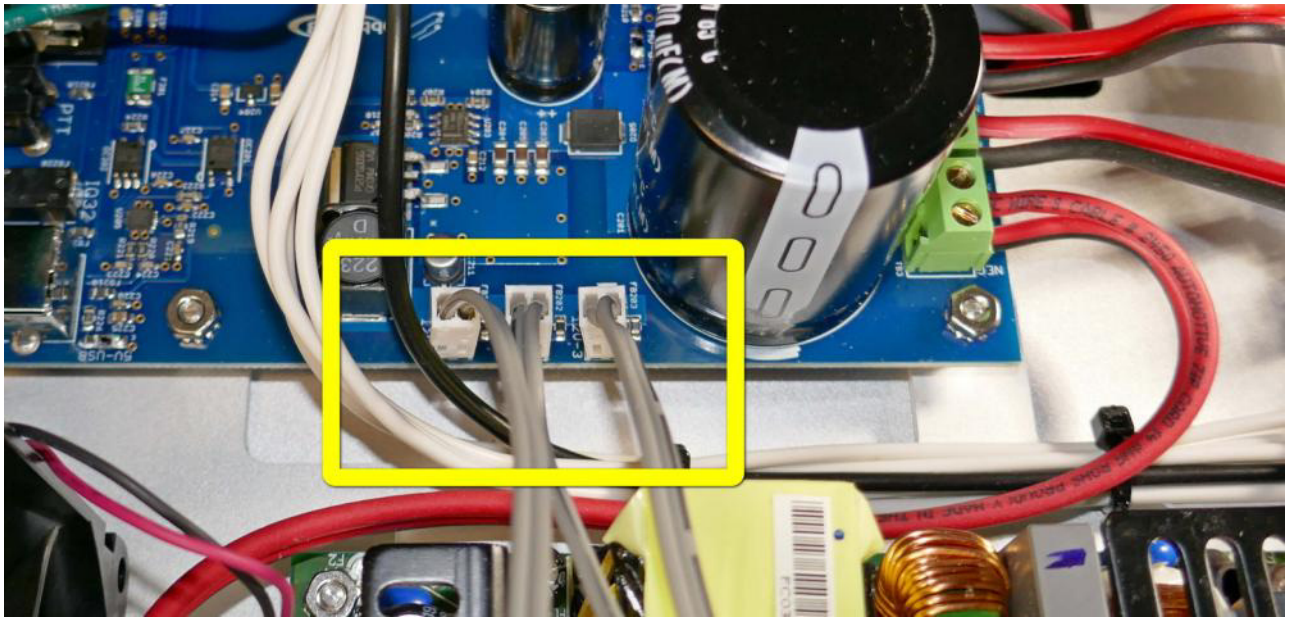
☐**Step 9: 80mm Fan Wire** – Plug the wire from the 80mm fan into the fan connection of the closest Meanwell power supply. If there is any excess wire, wrap it up neatly. The black wire is towards the DC connections.



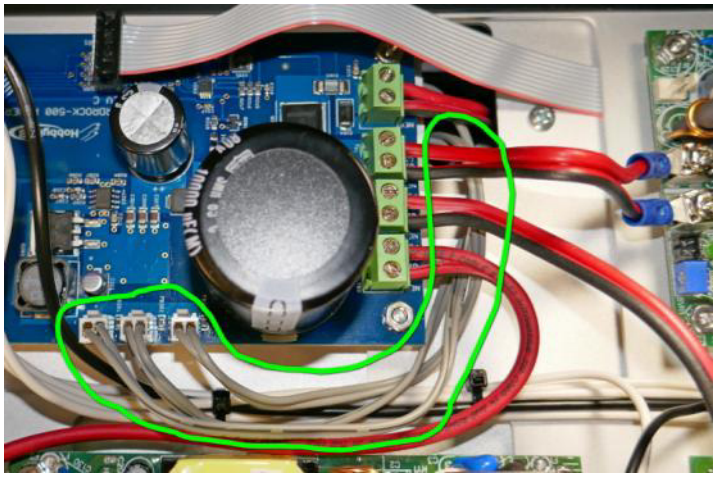
☐**Step 10: Amp Power Wire** – Insert the remaining #14 red/black zip wire (6” long with no terminals) into the AMP terminal block on the power board and tighten the screws. Route the free end of the wire through the rectangular hole adjacent to the power board.



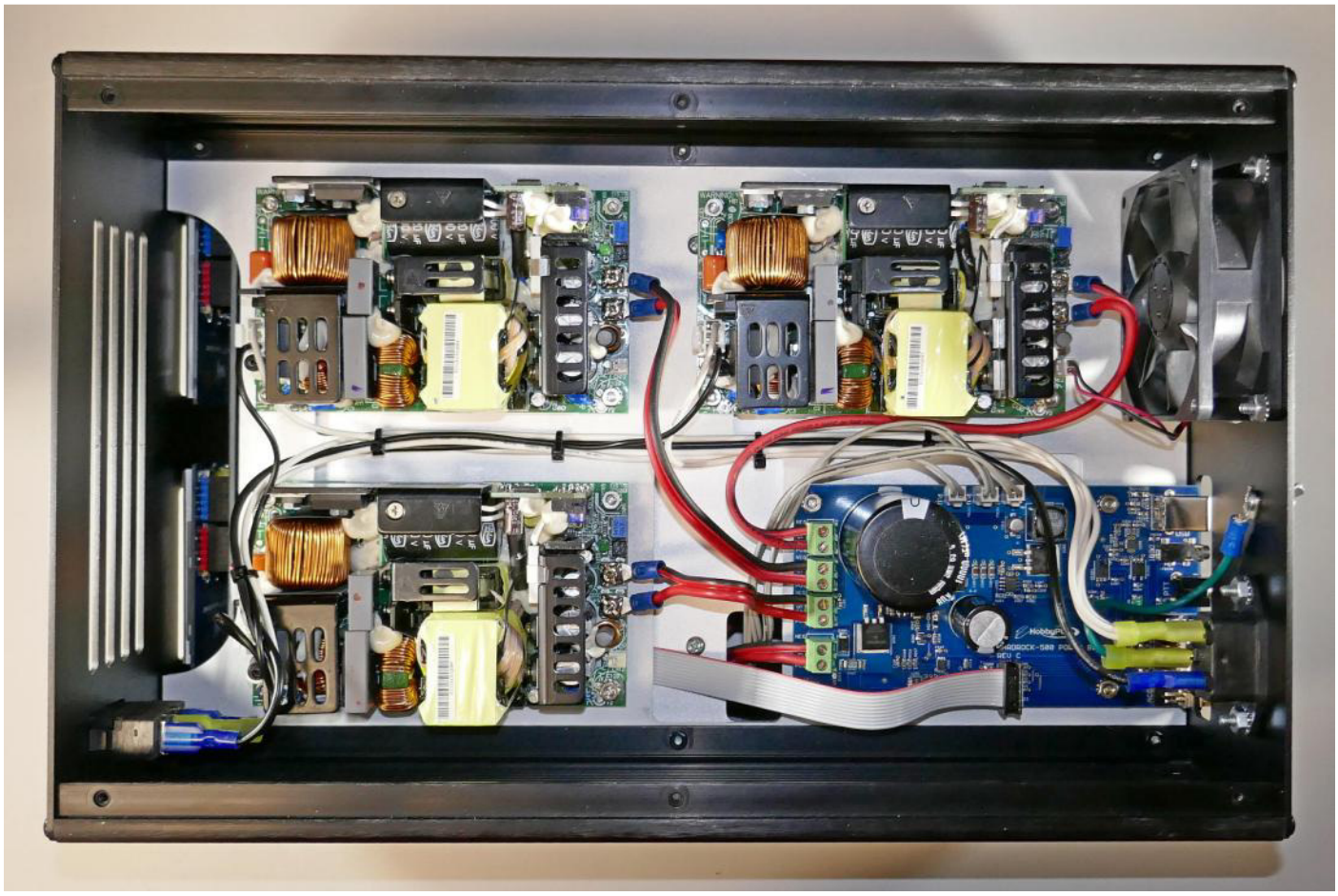
☐**Step 11: Connect 12V cables** – Plug the three 12V cables into the power board at the indicated locations. *The cables may be gray or red/black. All three locations are identical. The cables may be plugged into any 12V connector.*



☐**Step 12: Route 12V cables** – Route the other ends of the 12V cables in a bundle, under the #14 red/black wires through the rectangular opening adjacent to the power board.

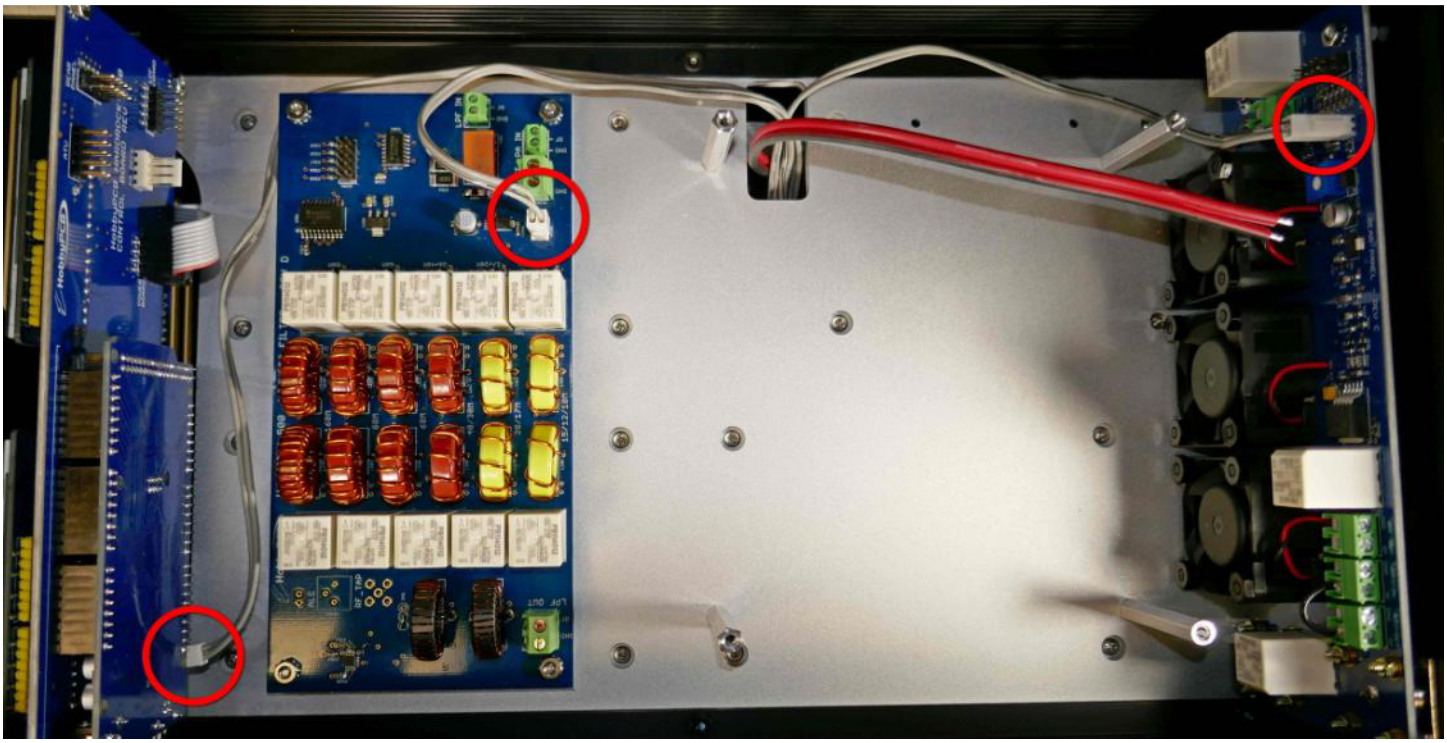


At this point the power supply section of the amplifier support kit is complete. Please compare your unit to the picture below to ensure that everything in this section is connected properly.

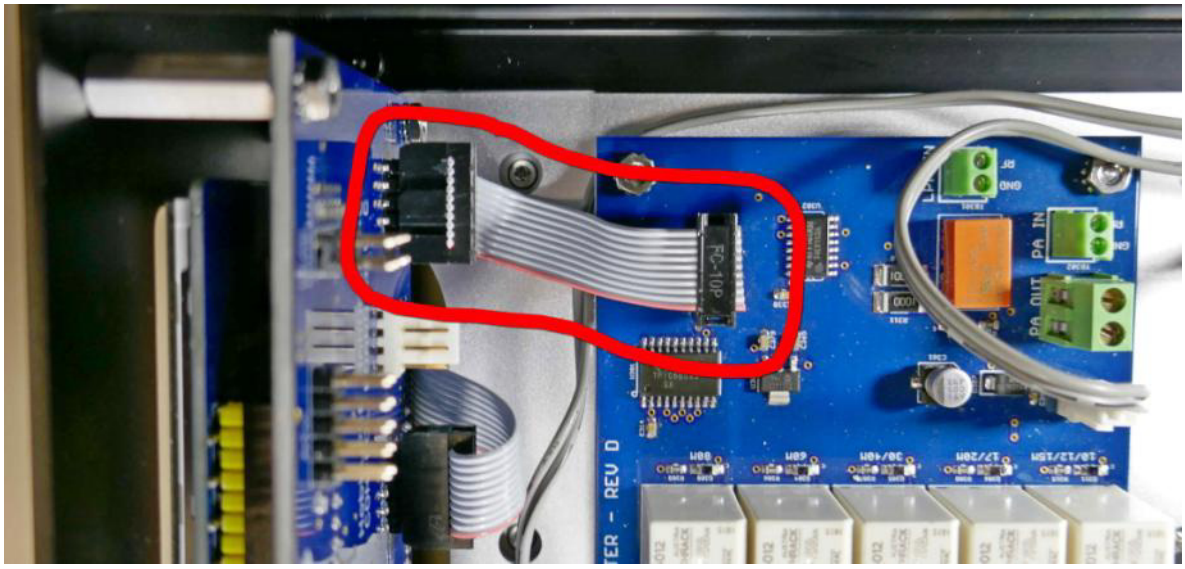


☐**Step 13: Bottom Cover and Feet** – Once you are certain that the power supply section is wired correctly install the bottom cover (both covers are identical so use either) fasten using #4-40x¼" black flat head screws (red) and install the press-on rubber feet (blue).

☐**Step 14: Connect 12V cables** – Turn the unit over and connect the 12V cables. The longest cable connects to the front panel board. The other two cables are the same length. Connect one to the LPF board and the other to the rear panel board.



☐**Step 15: Short Ribbon Cable** – Connect the short ribbon cable (3” or 8cm) to the front panel board and the LPF board. Make sure that the alignment is correct and the cable has no twists.

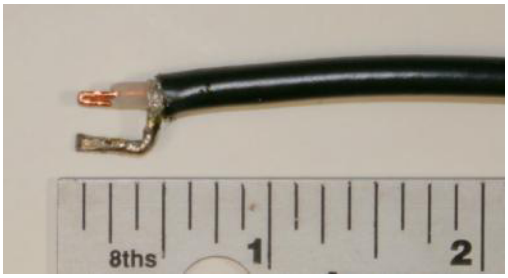


☐**Step 16: Long Ribbon Cable** – Connect the long ribbon cable (14” or 35cm) to the front panel board and the rear panel board. Make sure that the alignment is correct and the cable has no twists.

☐**Step 17: Input RF Jumper** – Cut a 10” (25.5cm) piece of RG-316 (small, brown) coaxial cable. Strip ½” (12mm) of the outer jacket from both ends. Be careful not to damage the shield wires. Unbraid the outer shield with a toothpick or similar item and gather the shield wires to one side. Remove ¼” (7mm) of the dielectric from the center conductor. With a soldering iron, tin the exposed shield and the center conductor. The dielectric and outer jacket are Teflon and will not melt so make sure that the solder flows in the shield wires all the way around the cable. Form the ends so they will fit in the 3.5mm terminal blocks and trim the ends.

☐**Step 18: Amp In RF Jumper** – Cut a 5” (13cm) piece of RG-316 coax and prepare the ends in the same manner.

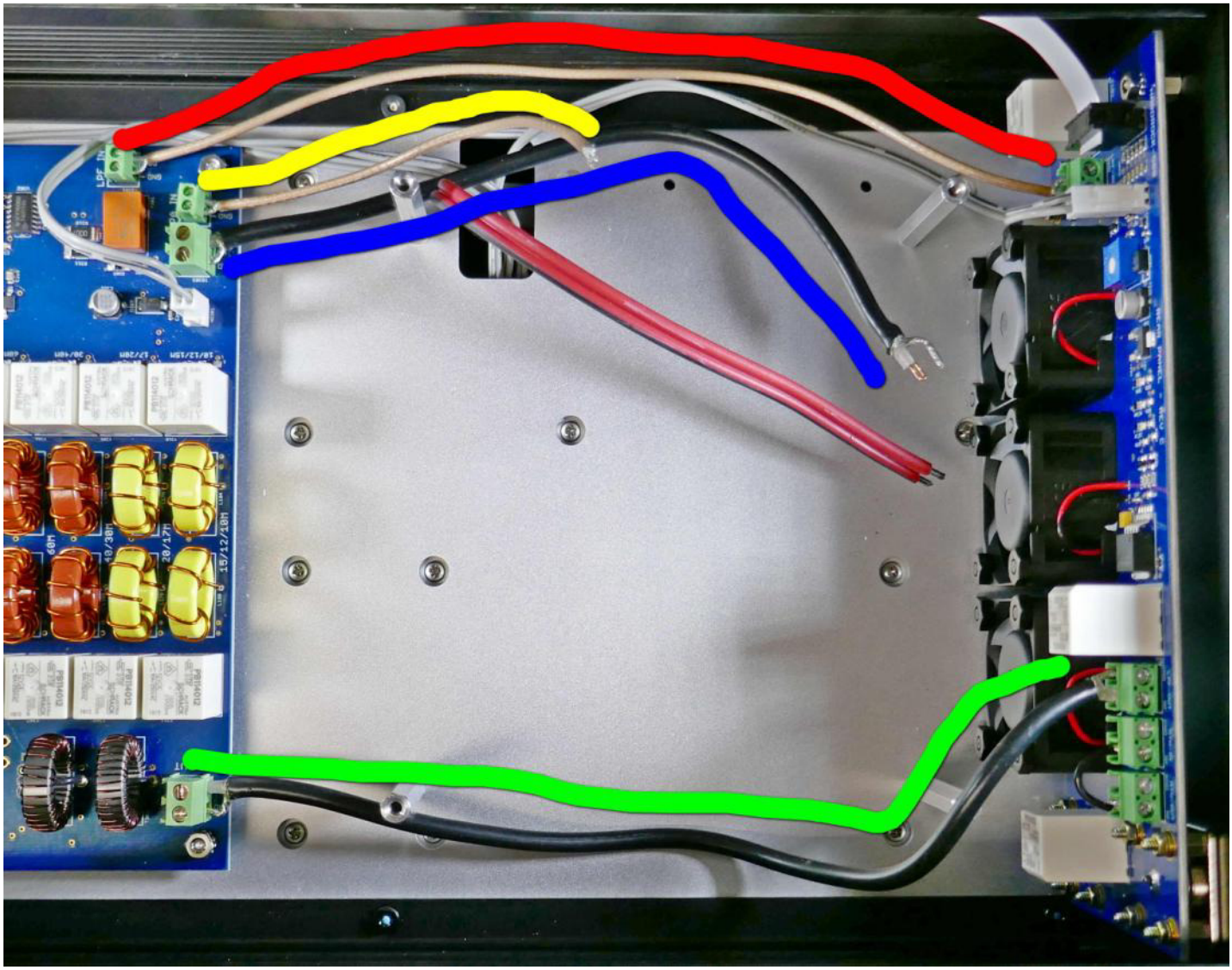
☐**Step 19: Input RF Jumper** – Cut a 11” (28cm) piece of RG-58 (large, black) coaxial cable. Strip ¾” (18mm) of the outer jacket from both ends. Be careful not to damage the shield wires. Unbraid the outer shield with a toothpick or similar item and gather the shield wires to one side. Remove 3/8” (11mm) of the dielectric from the center conductor. Use pliers for form the center conductor into a tight “u” shape. Tin the shield with solder. *Be careful because the RG-58 dielectric will melt and deform when it gets hot so keep the solder at least 1/8” (4mm) away from the dielectric and outer jacket.* Form the shield so it will fit in the terminal blocks and trim the end.



☐**Step 20: Amp In RF Jumper** – Cut a 9” (23cm) piece of RG-58 coax and prepare the ends in the same manner.

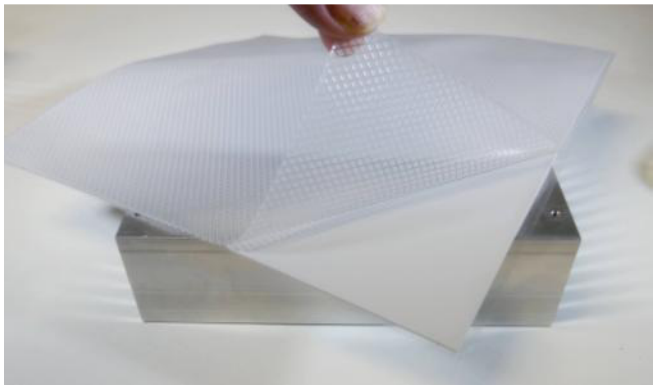
☐**Step 21: Install RF Jumpers** – Install the four coaxial jumpers that you just made. The terminal blocks must be opened by loosening the screws prior to inserting the wire. Make sure that the shield goes to the terminal labeled ‘GND’ and the center conductor goes to the terminal labeled ‘RF’.

JUMPER	**COLOR**	**ENDPOIT #1**	**ENDPOINT #2**
10” RG-316	RED	LPF IN on Rear Panel Board	LPF IN on LPF Board
5” RG-316	YELLOW	PA IN on LPF Board	Leave unconnected
9” RG-58	BLUE	PA OUT on LPF Board	Leave unconnected
11” RG58	GREEN	LPF OUT on LPF Board	LPF OUT on Rear Panel Board



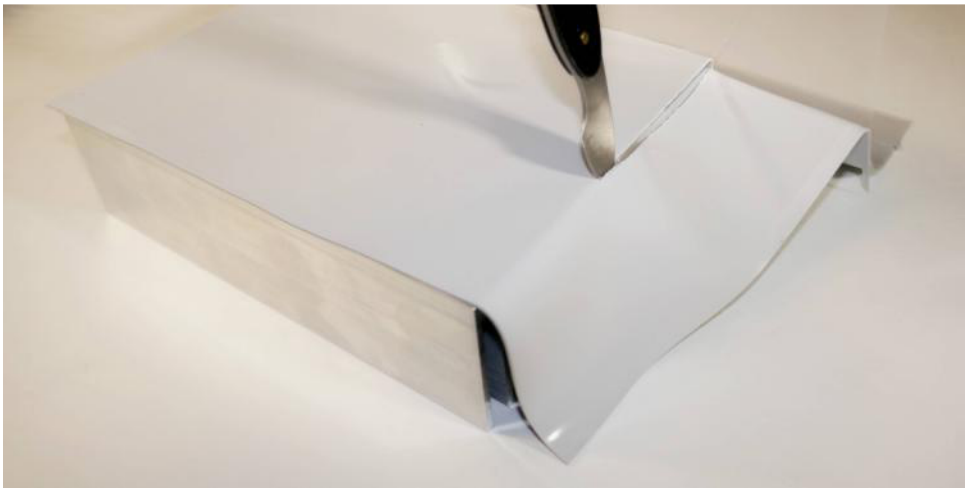
The edges of the heatsink and heat spreader may be sharp. Use care in handling these parts and consider wearing gloves during the next few steps.

☐**Step 22: Thermal Pad** – Remove the plastic backing from one side of the thermal pad.

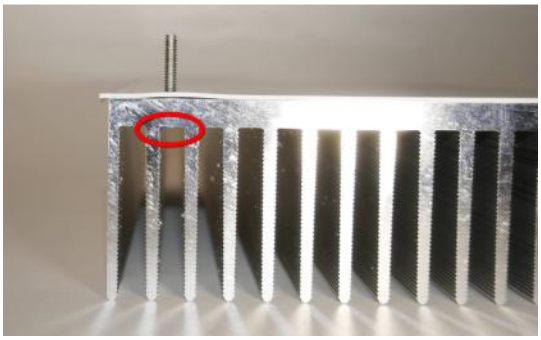


Line up one corner of the thermal pad with one corner of the heatsink and remove the other plastic sheet from the thermal pad. *The pad is 8" x 8" and the heatsink is only 4.6" x 6" so you will have some leftover thermal pad, save it, it may be useful in other projects.*

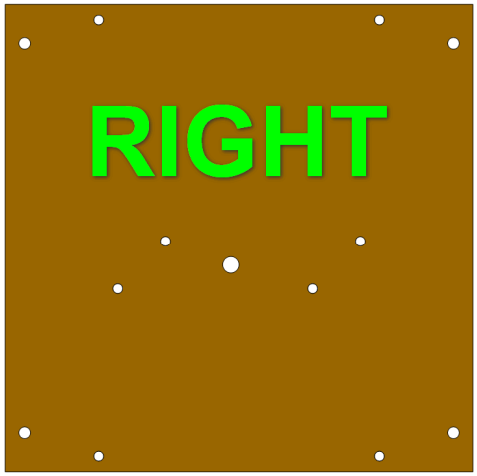
Using a sharp utility knife, trim the edges of the thermal pad to match the heatsink.

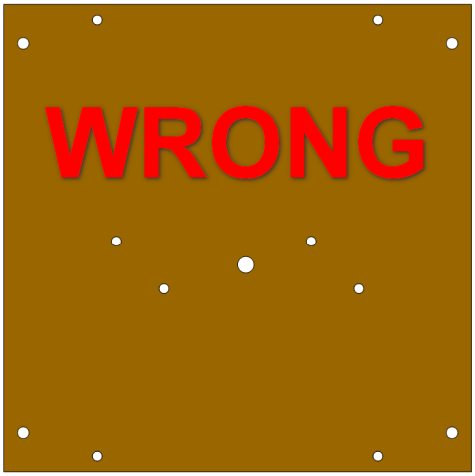


☐**Step 23: Threaded Rods** – In each of the four corners of the heatsink insert the #4-40x½" threaded rod through the thermal pad into the heatsink. Lift the corner of the heatsink and apply thread locker if desired. Thread the rod into the heatsink until the end of the rod comes through the base of the heatsink.

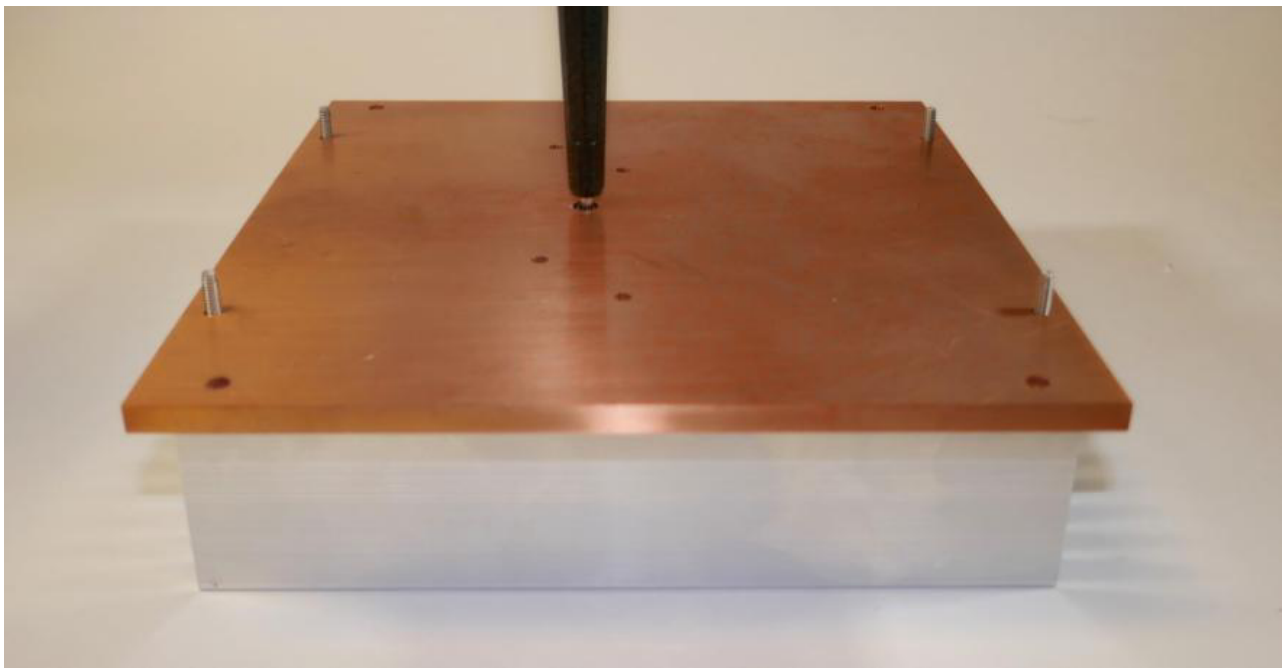


☐**Step 24: Copper Heat Spreader** – The copper heat spreader is not symmetrical and needs to line up with the holes in the heatsink. Unfortunately, with the thermal pad covering the heatsink, you cannot determine where the holes in the heatsink are. Make sure that you have the right side up:



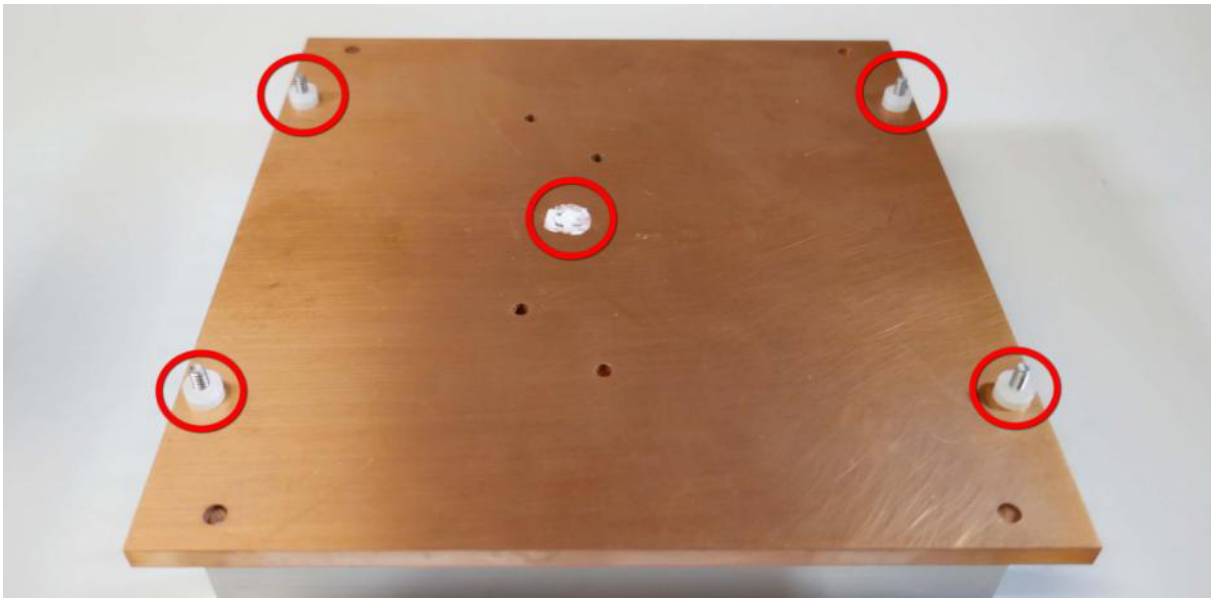


You can see the holes in the heatsink from the fin side and align the heat spreader correctly on the heatsink. If the alignment is correct, a screwdriver placed in the large hole near the center will pass through the heat spreader, through the thermal pad and through the heatsink. If it doesn't, turn the heat spreader around.



☐**Step 25: Nylon Washers** – Place one #4 nylon washers on each of the threaded rods, (the washer in the kits may be black). Put a small amount of heatsink compound in the large hole in the center of the heat spreader.

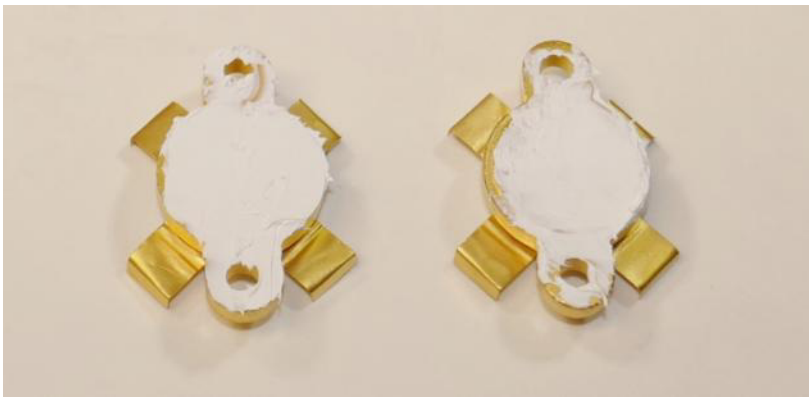
The picture shows two washers but we decided it's too high. One is better.



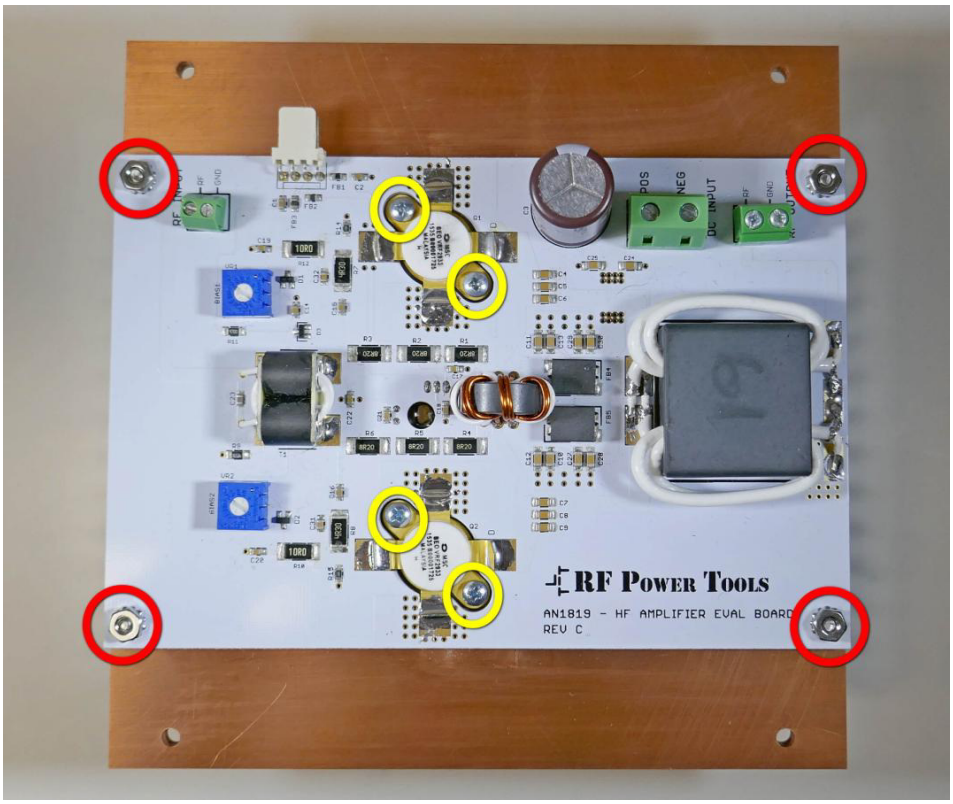
If you haven't assembled the AN1819 board, now would be a good time to do so.

Apply a small amount of heatsink compound to R13 on the AN1819 board.

☐**Step 26: VRF2933** – Bend the ends of the tabs of the VRF2933 MOSFETs upwards at a 90 degree angle. This makes replacing the VRF2933's much easier. Put a thin coat of heatsink compound on the back of each VRF2933.



☐**Step 27: AN1819 Board** – Place the AN1819 board on the heat spreader, make sure that the temperature sensor (U1) goes into the large hole in the heat spreader. Secure the AN1819 board to the heat spreader using four #4-40 hex nuts with integral lock washers (red circles). Place the VRF2933 MOSFETs in their proper locations aligning the drain tabs (the tabs with the cut-off corner) with the 'D' on the circuit board. Secure the MOSFETs using four #4-40x½" screws (yellow circles). Solder the tabs on the MOSFETs by patiently applying the soldering iron to the PCB next to the tab and applying a SMALL amount of solder to the PCB pad and waiting for the solder to flow between the PCB and the MOSFET tab. Do not worry about applying too much heat to the MOSFET. It is attached to a massive heatsink. Solder the leads of U1 and trim off any excess.

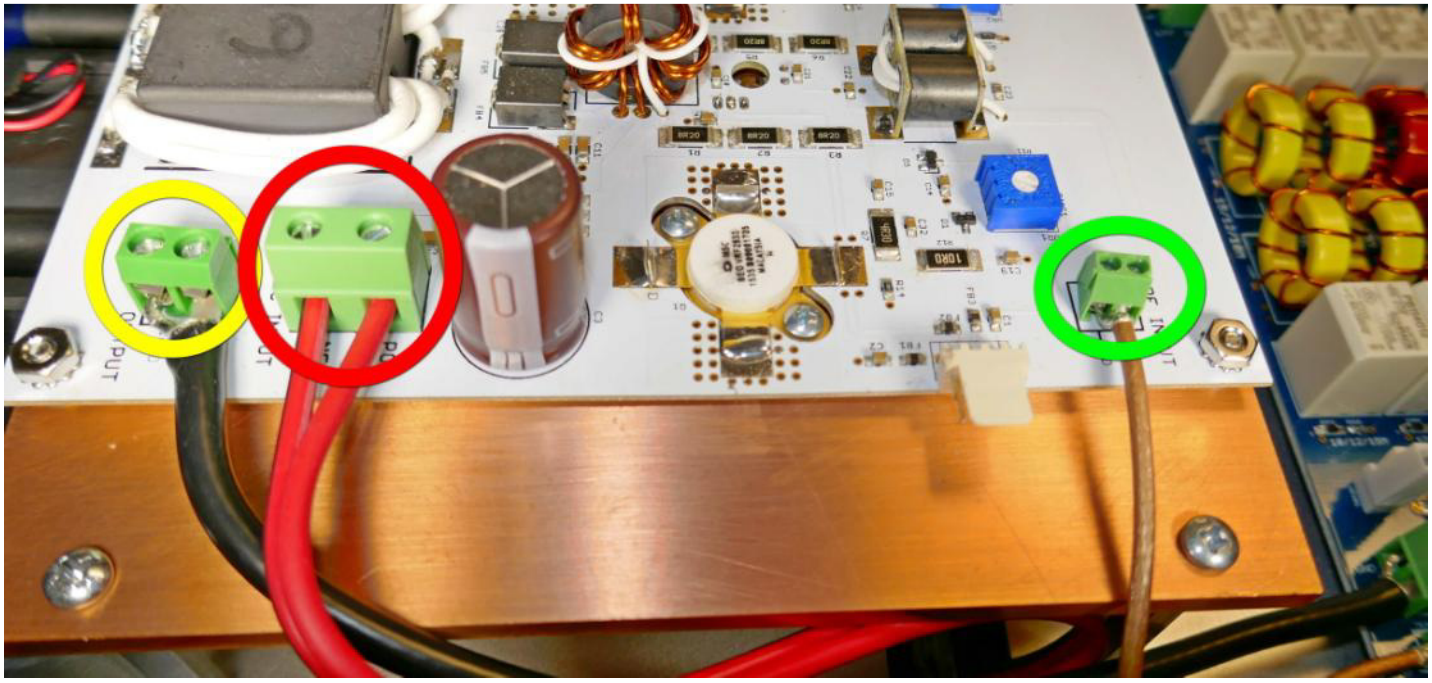


Turn the BIAS1 and BIAS2 potentiometers fully counter-clockwise (CCW).

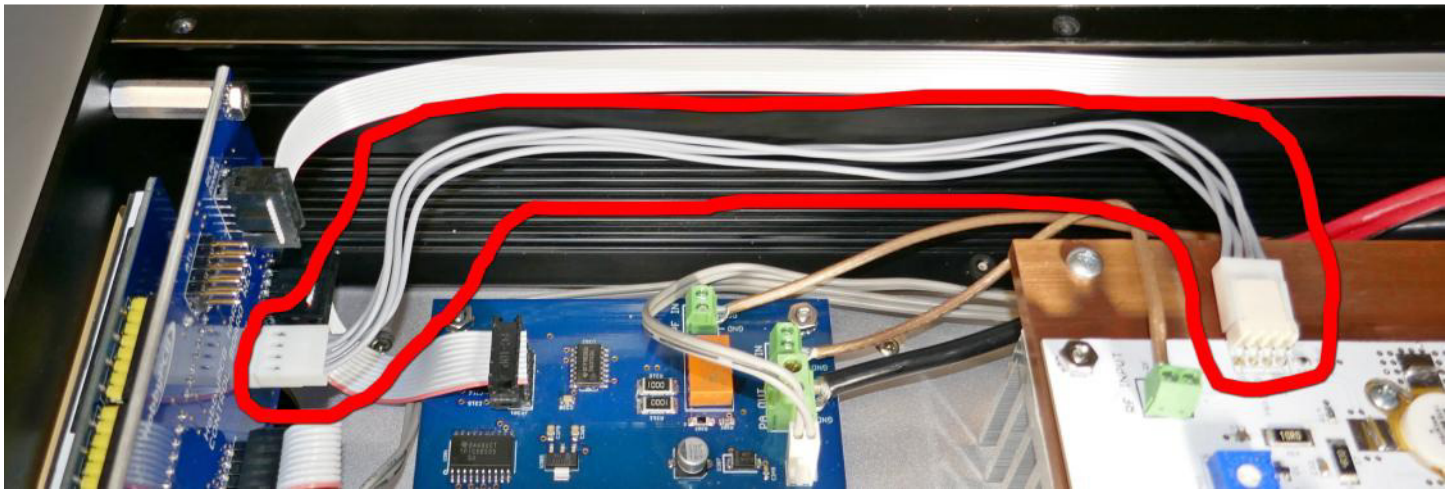
Look between the AN1819 board to make sure that none of the component leads are contacting the copper heat spreader. Adjust if necessary. Check the resistance to ground of the VRF2933 drain tabs ('D' on the PCB) it should be VERY high. Note that you are measuring C3 and meters react differently to large caps. The gate tabs (opposite the drain) should read 10K to ground.

☐**Step 28: Heatsink Assembly** – Place the heatsink assembly into the top of the amplifier support package and secure with four #6-32x½" screws.

☐**Step 29: Amplifier Cables** – Connect the RF Input (green), DC Input (red), and RF Output (yellow) cables. Be sure that the ground and RF connections are correct on the RF connections and the polarity is correct on the DC cable (red is positive, black is negative).



☐**Step 30: Amplifier Control Cable** – Connect four pin amplifier control cable between the front panel board and the AN1819 board.



Congratulations, you made it to the end. Your amp is complete except for the top cover. All we need to do is set the bias and you are ready to go.

15. Setting the Bias

This chapter covers setting the bias on the AN1819 evaluation board when installed in the Hardrock-500 amplifier support package. If you are using some other amplifier board these instructions are not applicable.

Prerequisites

You should have successfully completed all sections of amplifier assembly. The bottom cover should be installed and the top cover removed. The amplifier should be free of test cables, tools or debris. Plug the amp in with a 16 gauge power cable, directly into a wall socket; do not use extension cords or outlet strips. The performance of your amplifier depends highly on the quality of your AC supply, If the AC voltage sags, so will the output power.

☐**Step 1: Powering the Hardrock-500** – The first time you turn on the Hardrock-500, the displays will remain blank for a few seconds then draw the home screens.

☐**Step 2: Access the menu** – Touch the 'MENU' button on the right screen to bring up the menu.

☐**Step 3: Select 'Set Bias'** – Touch the left or right arrow button on the menu until 'Set Bias' appears in the upper window.

Check to make sure that both BIAS pots on the AN-1819 board are fully counter-clockwise (CCW). Turning the bias on in the next step can damage the VRF2933 MOSFETs if the BIAS pots are not fully CCW.

☐**Step 4: Set the Bias** – Touch 'SELECT' in the center of the screen to activate the bias. If the BIAS pots are set correctly, you should see 0 mA. If you see more than 10 mA press 'OK' to turn off the bias

☐**Step 5: Adjust BIAS 1** – Slowly turn the BIAS1 pot on the AN1819 board until the current reaches 250 mA. Anywhere from 235 – 250 mA is acceptable. If it goes above 260 mA, turn it down.

Pro-Tip: Slowly turn since nothing happens until the bias starts to rise quickly. Be patient.

☐**Step 6: Adjust BIAS 2** – Slowly turn the BIAS2 pot on the AN1819 board until the current reaches an additional 250 mA above the setting obtained in step 5.

☐**Step 7: Complete** – Press 'EXIT' to complete the settings.

☐**Step 8: Top Cover** – Install the top cover and fasten using #4-40x¼" black flat head screws.

Amplifier Checkout

After setting the bias and if everything works as expected it's time to try out the Hardrock-500.

Please remember that we supply the PCB's untested so even if the bias is set correctly there may be:

- Non-working or out of spec components
- Manufacturing defects
- Assembly issues

These things typically are not managed by the amps protection features which are designed to protect a functioning amplifier from external problems. If any manufacturing/assembly issues are present we would like to discover and correct them preferably without destroying the very expensive MOSFETs.

For initial testing limit the drive power to 0.5W. If your radio is not capable of reducing the output to 0.5W, get an attenuator or a different radio. Do not start testing the amp with more than 1W of RF drive.

The output of the amplifier MUST be terminated in to a known good load. A 50 ohm load is a better choice than an antenna because the load is consistent across a wide frequency range and testing into an antenna creates on-air interference. If the input power is limited to 0.5W the amp will not produce more than 50W so it is possible to test with a load rated at 100W or more.

RF Pass-Through Test

With the amp switched off, connect the load to 'Antenna 1' and the radio to the 'Radio' . When power is applied in this way it should pass directly through the amp and the radio should see a 1:1 SWR. Next, power up the amp and select antenna 1 and 'OFF' mode and when RF is applied, it should pass directly through the amp and the radio should see a 1:1 SWR. Connect the load to 'Antenna 2', select antenna 2 on the amp and when RF is applied, it should pass directly through the amp and the radio should see a 1:1 SWR. If you select 'DRV' the meter will show the drive level.

If the power does not pass through the amplifier and/or the radio sees a high SWR do not continue. There is an issue with the rear panel PCB or the test cabling that MUST be resolved before engaging the power amplifier. If you cannot find the issue contact tech support for help.

RF Power Testing

If everything in the RF Pass-Through test works as expected, it's time to apply power to the power amplifier. Connect the 50 ohm load to 'Antenna 1' and select antenna 1 on the front panel. Start on 160M or the lowest band you radio has, and select the same band on the amp. Select FWD for the amp's meter. Key up the amp then the radio and if you do not see 40-50W output immediately unkey the amp. Repeat this test for each band and if all bands have good power output then it's OK to move to high power testing.

If some bands show reduced or no power output then there may be an issue with the PA deck or LPF board that MUST be resolved before proceeding to high power testing. If you cannot find the issue contact tech support for help.

If all bands have good power output, verify that the meter is reading correctly by cycling through the meter options. FWD should show about 50W, RFL should be close to 0, DRV should show about 0.5W, VDD should be around 58V and IDD 1.5 to 3 amps depending on the band. All status indicators should be green and remain green throughout the test.

If any of the meter indications are incorrect there may be an issue with the control, rear panel, LPF or power board that MUST be resolved before proceeding to high power testing. If you cannot find the issue contact tech support for help.

If you have been testing for a while, you will observe that the temperature is increasing. This is normal and will decrease when the amp is unkeyed. At the 0.5W drive level, there may not be enough RF output for the amp to calculate the SWR. The amp's protection circuits do not monitor the SWR, only the reflected power. So if the antenna has a high SWR you can run the amp at lower power. The maximum allowable reflected power is 50W.

High Power RF Testing

If everything went as expected, increase the drive to 1W and, if your RF load is capable repeat the 0.5W drive test. As we increase the drive power we are building confidence that the amp is defect and assembly issue free and the protection circuits can protect the amp if an external issue exists. Run through the bands at 1W observing the meter parameters and checking for normal operation and if everything look good allow the amp to return to ambient temperature and increase the drive to 2W.

Be on the lookout for instability, fluctuating readings anything other than solid, stable readings. Fluctuating RF or DC readings could indicate that a component is breaking down or an issue with a connection (internal or external). If you think that something is not right, ask a question on the forum or ask technical support.

If everything is still looking good, it's time to put things on the air. Select the band where you would like to operate and again reduce the drive and try transmitting on a clear channel. Then increase the drive to get 400-500W output and you are OK to operate. If any of the indicators turn yellow or red, reduce the drive. If the status indicators are indicating an issue before the output gets to 400-500W then there might be a problem with the antenna, grounding or power system.

If you have not used the amp for a while or if you have changed antennas or cabling, it is best to reduce the drive level to test operating conditions and make sure everything is OK before running QRO. When you are confident that everypart of the system, inside and outside the amp is working, go ahead and drive the amp to 400-500W and make some contacts!

Appendix A – AN-1819 Inventory

DESCRIPTION	PICTURE	QUANTITY
C3 – 680uF 80V		1
LM35 TEMPERATURE SENSOR		1
NTC THERMISTOR – 100 OHMS		1
T1 - RF400 CORE		1
T2 - FT61 TOROID 0.63” (19mm) DIAMETER		1
T3 - TYPE 61 BINOCULAR CORE		1
#22 TEFLON WIRE		18”
#18 ENAMELED WIRE		18”
25 OHM COAX CABLE		18”
VRF2933		2

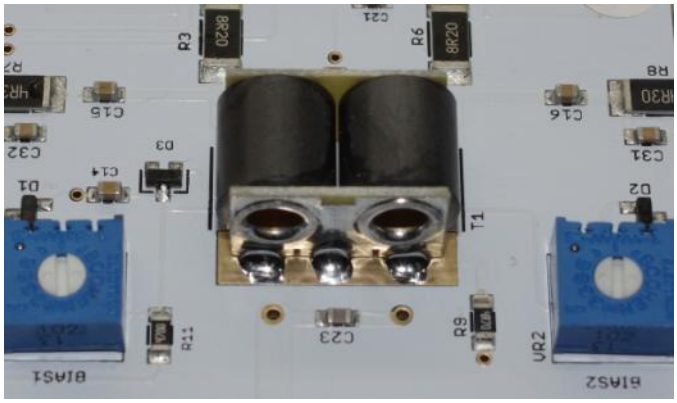
Appendix B – AN-1819 Assembly Instructions

The RF Power Tools AN-1819 evaluation board for the VRF2933 MOSFET can be installed in the Hardrock-500 amplifier to create a complete HF amplifier. We are including this section on assembling the AN-1819 with permission from RF Power Tools. Here is the AN-1918 evaluation board as supplied by RF Power Tools. *You may have to install C3.*

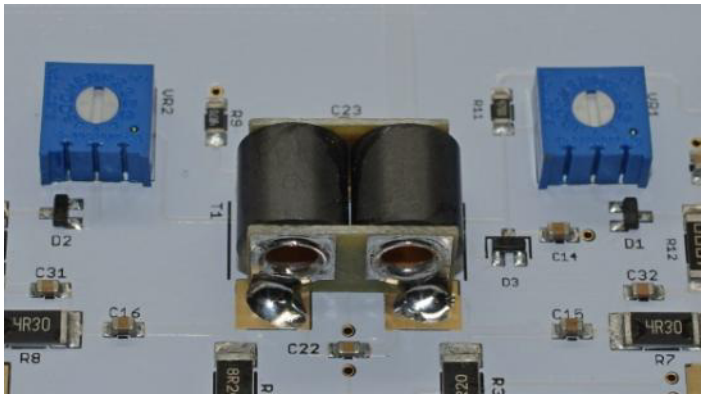
☐**Step 1: Trim Leads** – Carefully trim the leads of the terminal blocks, VR1 and VR2 so that no more than 0.1" (.25cm) projects from the bottom of the PCB. *The PCB mounts VERY close to the copper heat spreader so it is important to cut all leads on the bottom of the board as close as possible to prevent shorts.*

☐**Step 2: T1 Core** – Solder T1's core to the AN1819 PCB. One side is a solid conductor. The other side is split into two conductors. Be sure to orient the solid and split sides correctly.

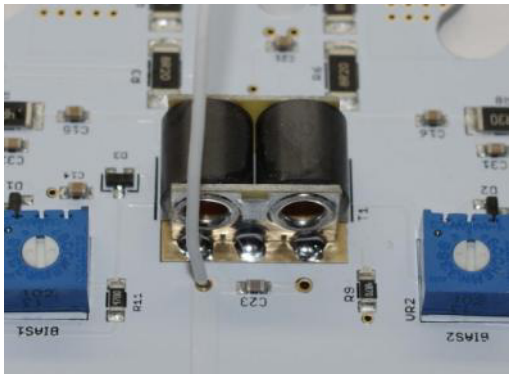
Solid End



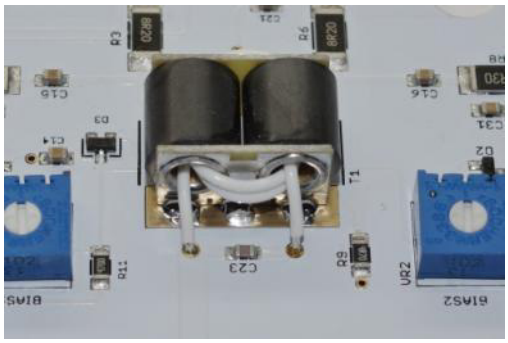
Split End



☐**Step 3: T1 Wind** – Cut an 8” (20cm) piece of #22 Teflon wire and strip ½” (1cm) of the insulation from one end of the wire. Insert the wire into the hole near C23 and R11 and solder the wire to the board and trim any excess wire flush with the PCB.



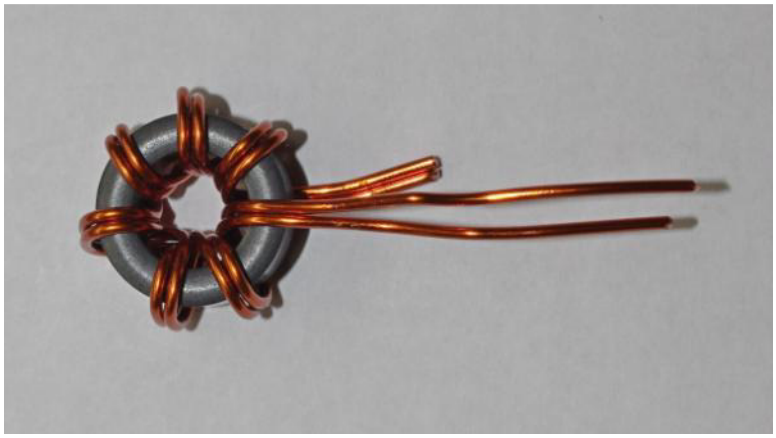
Pass the wire through the holes in the core, up and back a total of 3 times. Trim the wire, strip off the insulation and solder the wire into the hole in the PCB on the other side of C23. Trim any excess wire flush with the PCB.



You should see two wire loops on this end of the core and three loops on the other end of the core.

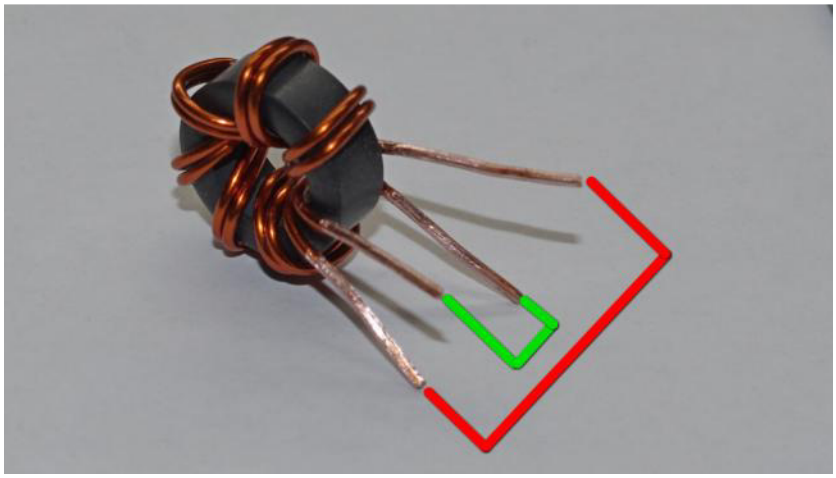
When trimming the wires on the bottom of the PCB, remember to cut them flush with the PCB, there is very little clearance between the PCB and the copper heat spreader.

☐**Step 4: T2 Wire Prep –** Cut two 8” (20 cm) pieces of #18 enameled wire and one 5” (13cm) piece of #22 Teflon wire. Using the #18 enameled wire wind two parallel windings of 7 turns on the Fair-rite 5961004901 core. Cut the wires about 0.5” (1cm) from the core. Thoroughly scrape the wire and tin the ends with solder.

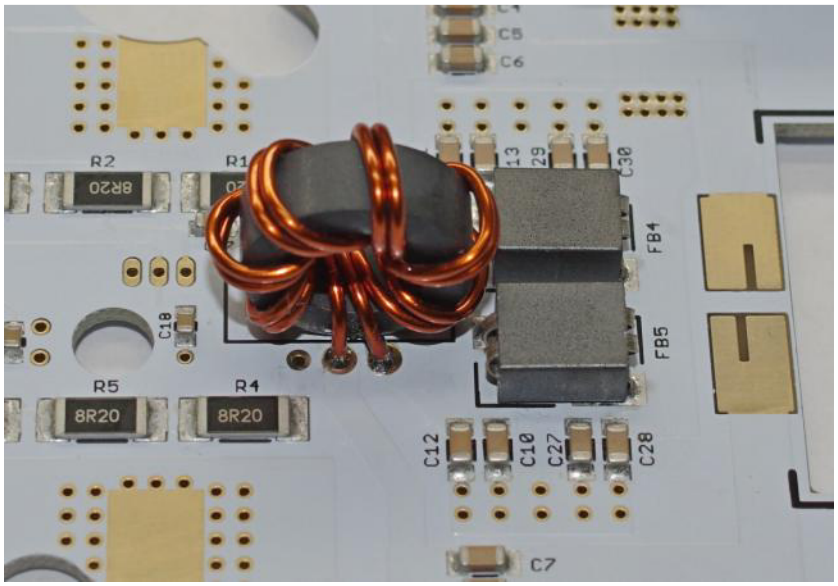


Remember all of the DC current for the amplifier passes through these windings on T2, make sure to remove all of the enamel and tin the wire completely.

☐**Step 5: T2 Lead forming –** Form the leads on T2 so that diagonal pairs of leads conduct with each other. This requires a single twist in one of the pairs of wire. In this photo the two wires indicated with red should conduct and the pair indicated with green should conduct but red should not conduct with green.

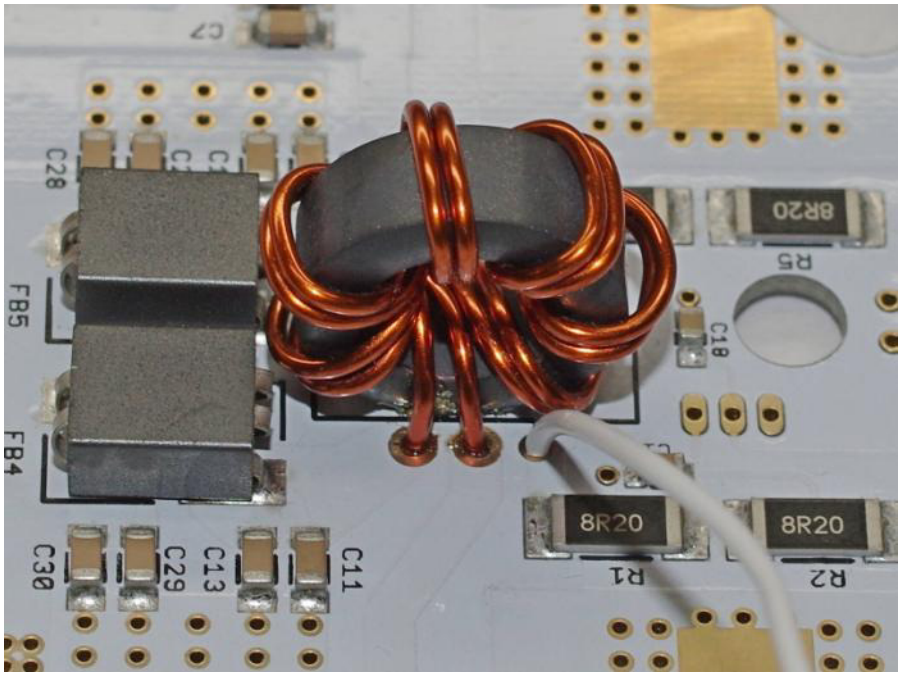


☐**Step 6: Install T2 –** Once you have the leads aligned correctly, insert the leads of T2 into the PCB. The enameled wires are inserted into the larger holes in the footprint

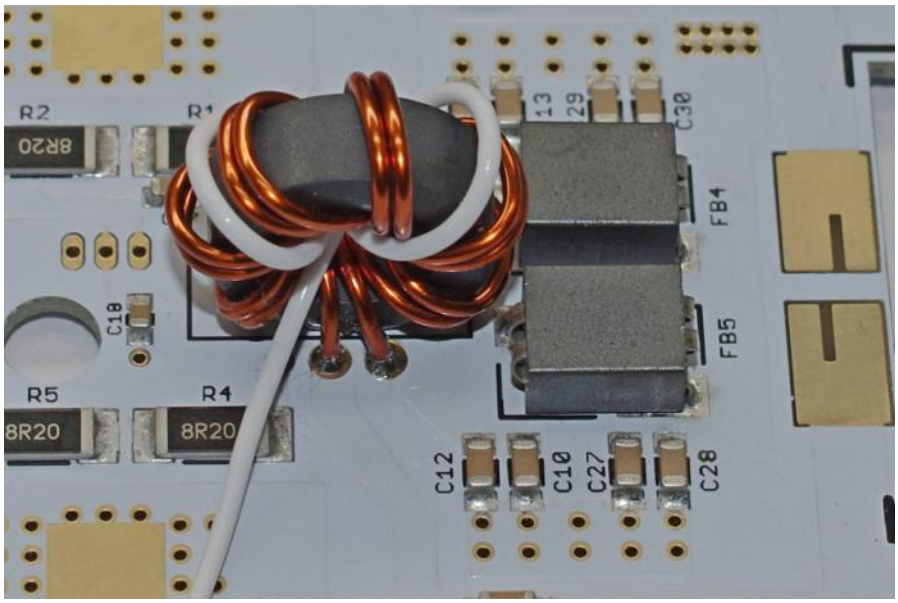


If these winding are correct, the drain tabs of Q1 and Q2 (indicated by a 'D' on the PCB) should conduct with the positive DC input. Once you have verified that this is correct solder leads of T2 to the PCB and closely trim the leads, there is very little clearance between the PCB and the heat spreader.

☐**Step 7: T2 Teflon Wire –** Strip ½" (1cm) insulation from one end of the 5" piece of Teflon wire, and insert the end into one of the smaller holes in T2's footprint. Solder the wire to the PCB and trim any excess flush with the PCB.

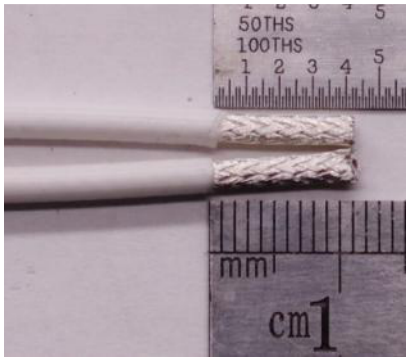


Wind the Teflon wire around T2's core passing it through the core a total of three times.



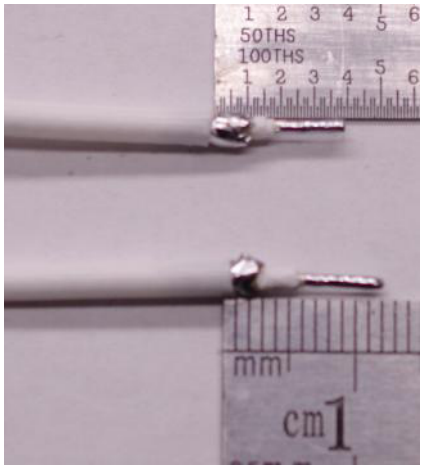
Cut the wire, strip the end and insert the wire into the remaining small hole in T2's footprint. Solder the wire to the PCB and trim any excess flush with the PCB keeping in mind the limited distance between the bottom of the PCB and the heat spreader.

☐**Step 8: T3 Coax Prep –** Cut the white, 25 ohm coax into 2 equal length pieces. Strip off 0.4” (1 cm), of the outer jacket from one end of each of the pieces.

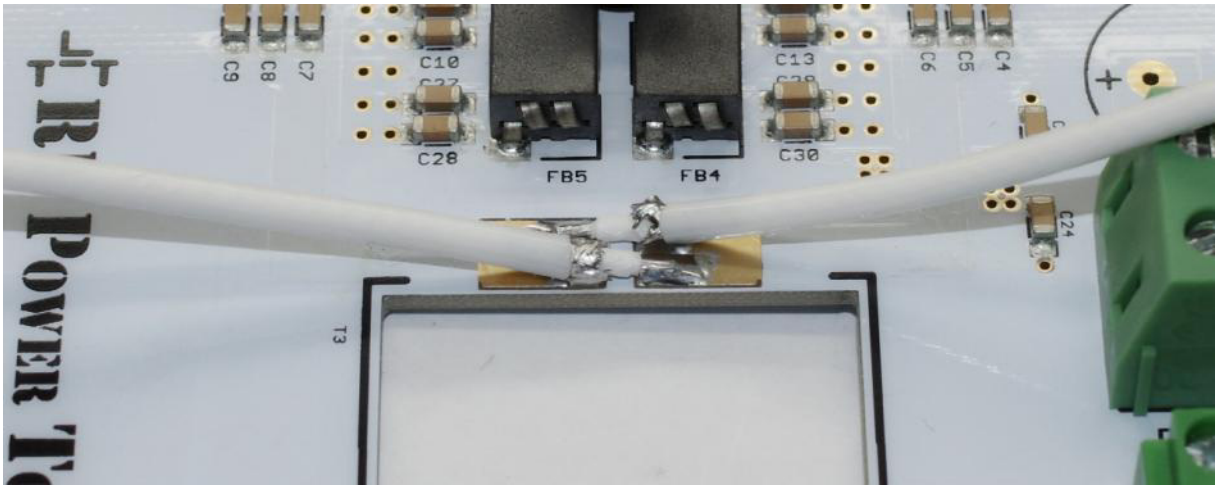


Cut the shield so about 0.1” (3mm) of the braid remains exposed.

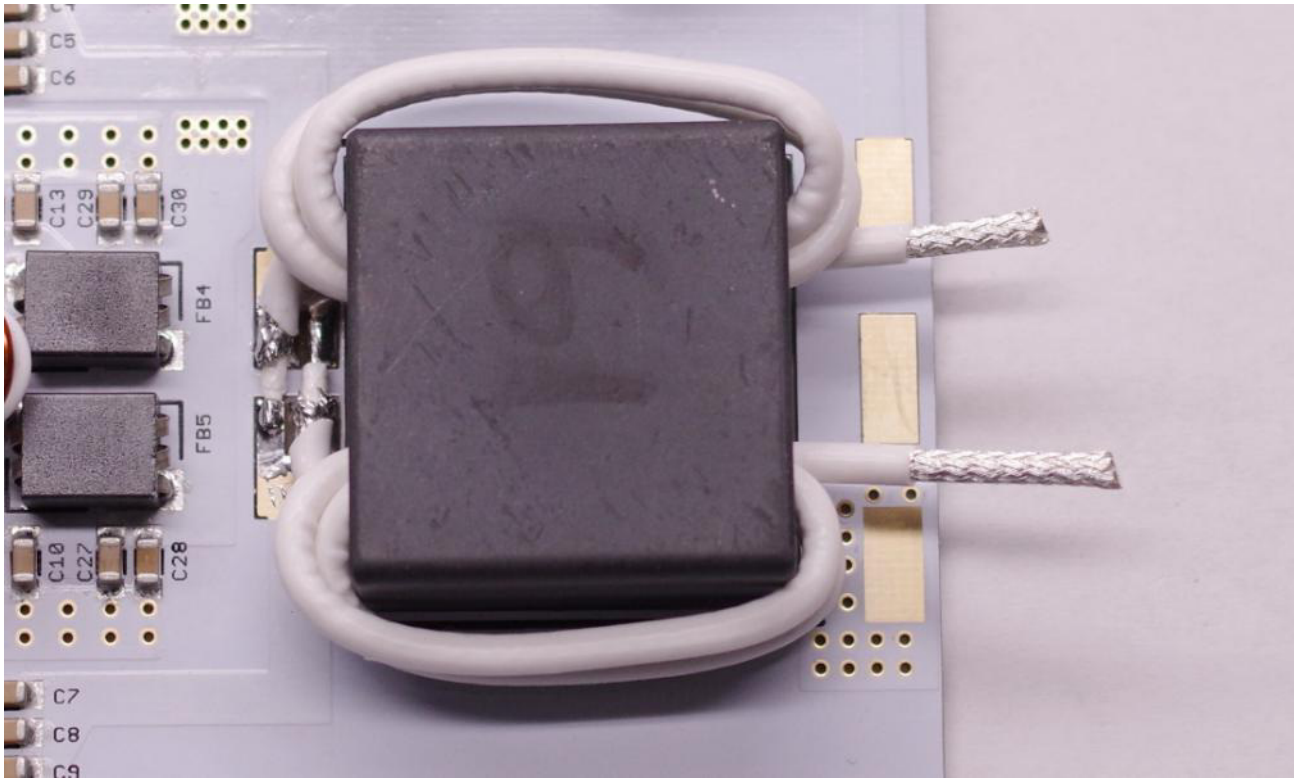
Strip 0.2” (6mm) of the dielectric and tin the shield and exposed center conductor (the outer jacket and dielectric are both Teflon that doesn’t melt).



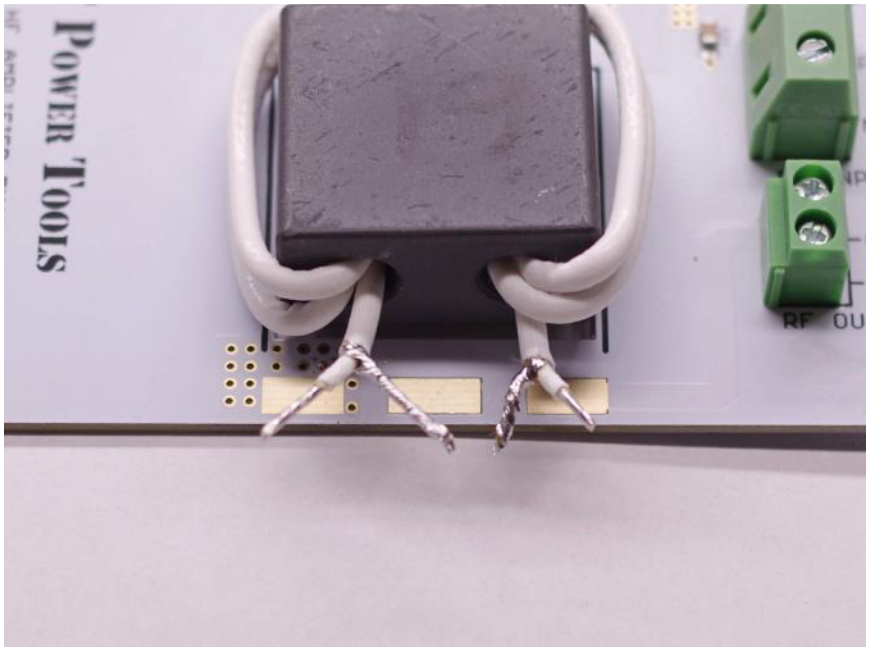
☐**Step 9: T3 Coax to PCB –** Solder the shield of one of the pieces of coax and the center conductor of the other to one of the pads of T3 on the PCB, repeat the process for the other shield and center conductor. The pad is split with wider side for the shield and the narrow side for the center conductor.



☐**Step 10: Wind T3 –** Place the rectangular core into the opening in the PCB with the holes in the core adjacent to the coax sections. Pass the coax pieces through the holes in the core then around the outside of the core and through the hole again a total of three passes through the core.



Strip the outer jacket of the protruding coax to approximately ¼" (6mm) from the core. Carefully unbraid the shield wires and gather then towards the center of the three pads on the edge of the circuit board. Strip the dielectric from the center conductors.

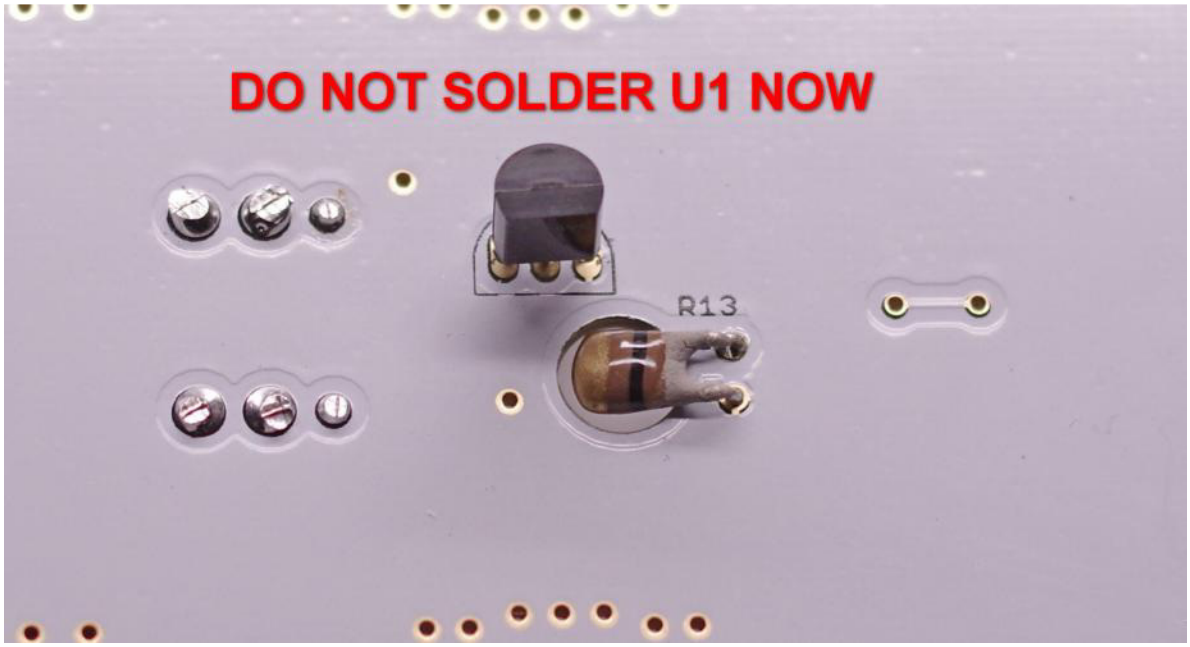


☐**Step 11: Complete T3 –** Trim the wires and solder them to the pads. With each center conductor going to one of the outer pads and both shields going to the center pad.

The shield of this coax is NOT at ground potential. Do not touch the shield while the unit is operating and do not connect any portion of the shield to ground.

☐**Step 12: Install C3 –** Insert it into the PCB carefully observing the polarity. Solder the leads and closely trim the excess leads.

☐**Step 13: Install U1 and R13 –** U1 and R13 are mounted on the back side of the PCB. Insert U1 aligning the flat side of the component with the flat side indicated on the silkscreen. R13 is not polarized. Just insert the leads into the holes and bend the component so the body is in the opening in the PCB.



Solder R13 and trim the excess leads. **DO NOT SOLDER U1 NOW.** The AN-1918 is now ready to be mounted on a suitable heatsink.