

HARDROCK-50 USA Version Assembly Instructions



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1. INTRODUCTION

Congratulations on your purchase of a Hardrock-50 linear amplifier kit. The HR-50 is designed to provide 50W of RF power output with a drive level of 5 watts or less on the 160, 80, 40, 30, 20, 17 and 15 meter Amateur Radio frequency bands. The HR-50 is supplied as an easy to build kit that includes 3 printed circuit boards (PCBs), all necessary electrical and mechanical components and a rugged, professionally manufactured, aluminum enclosure. All surface mount components on the PCBs are installed using the latest pick and place technology and soldered with state of the art reflow equipment.

The HR-50 is designed to provide higher power operation for low power analog and digital radios. Several interface options are available or under development for popular transceivers. Users are encouraged to customize the HR50 amplifier to meet their specific operating needs. Here is a list of possible modifications that licensed Amateur Radio operators have made to their HR-50 amplifiers:

- Expanded frequency coverage to include 12, 10 and 6M Amateur Radio Bands (power output on 6M is 35W).
- QSK circuit to replace the mechanical T/R relay with diode switching for extremely fast turn-around time.
- Adding a second amplifier stage to lower drive requirements to the 0.5W input range to work with low power Software Defined radio kits.

Building the HR-50 will be an excellent experience. The instructions have been thoroughly tested and updated with builder input to insure a successful build. Real time support is available from the entire HR-50 community at HobbyPCB.com/forums, seven days a week, 24 hours a day. And if for some reason you cannot get you amplifier going, contact me personally at WA2EUJ@arrl.net and I will personally make arrangements to fix your amplifier.

The HR50 is designed to be rugged, both mechanically and electrically. The extruded aluminum case with 1/8" end panels is virtually indestructible, ready for backpacking or field day and laser etched labels and bright LCV display make the HR-50 look good in your home station as well. Electrically, the HR-50 is rated to operate in to any passive load from a dead short to open circuit and anywhere in between without reducing the output power, the input can withstand twice the rated input power indefinitely and power supply is tolerant to 16V.

2. SPECIFICATIONS

ITEM	SPECIFICATION
Frequency Range	160, 80, 40, 30, 20, 17, 15 meter Amateur Radio Bands
Input Power	5W maximum
Output Power	50W nominal
DC Power	12-14 Volts, 10 Amps typical, 12A maximum
Keying Modes	Stand-by, Carrier Operated, Push-to-Talk
Input/Output Jacks	UHF Connectors
Size	4.25" W by 3.5" H by 7.5" D (not including switches and connectors)
Weight	2 lbs, 14 oz

3. ASSEMBLY OVERVIEW

Assembling the Hardrock-50 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, 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 and email is all it will take to get you a replacement.

The assembly is organized into the following subassemblies:

- Front Panel PCB
- Back Panel PCB
- Inductors and Transformers
- Amplifier PCB
- Final Assembly
- Test and Alignment

They are presented in this order as you need all of the PCBs to proceed to final assembly and you need the inductors and transformers to build the amplifier PCB. The inventory information is the first thing so you can make sure that nothing is missing. There are a few required tools:

- Soldering iron – A small temperature controlled unit is the best.
- Solder – Rosin core, fairly tin
- Screwdrivers – All of the screws in the kit a Philips
- Tweezers – For holding small parts and reaching tight areas
- Long-nose pliers – For general mechanical assembly and crimping pins
- 1/4" Nutdriver – Not essential but helps with panel assembly
- Center punch – For marking hole locations, you can use a nail if necessary
- Drill – A small press would be great but a hand drill will work
- Toothpick – For unbraiding coax
- Adjustment tool or small flat blade screwdriver – Turning pots
- Digital Multimeter – Doing resistance checks and setting bias current
- Power Supply – Powering the amp during testing
- QRP Transceiver – The reason you bought the amp in the first place
- Test Equipment and cables for Alignment listed in Section 9

Other things that could come in handy are #4 and #6 taps and a tap handle. I like to tap the holes in the case with a #6 tap and use #6 screws rather than the M3's I think that they fit better. Sometimes it works better to use a tap on the #4 holes but the new screws do OK. A universal crimp tool is nice for the crimp pins but there's only 2 of them so make sure you plan on crimping other things before you drop \$30 on one. I like to use flux when I solder but then you'll need some solvent too.

4. CONTROL PCB INVENTORY



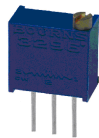







PART ID	DESCRIPTION	PICTURE	QUANTITY
JP101	10 PIN DUAL ROW HEADER		1
JP102	20 PIN DUAL ROW HEADER SOCKET		1
R111	10K POTENTIOMETER		1
S102, S102, S103	PUSH BUTTON SWITCH		3
LCD101	2X16 CHARACTER LCD DISPLAY		1
D105	BI-COLOR LED		1
LCD101 HEADER	16 PIN SINGLE ROW HEADER		1
LCD MOUNTING SCREWS	#4 1/2" MACHINE SCREWS		4
PCB MOUNTING SCREWS	#4 3/4" MACHINE SCREWS		3
STANDOFFS	0.375" NYLON CONTROL PCB STANDOFFS		3
STANDOFFS	0.188" NYLON LCD MOUNTING STANDOFFS		4
MOUNTING WASHERS	#4 LOCK WASHERS		7
MOUNTING NUTS	#4 Machine Nuts		7

1. REAR PANEL PCB INVENTORY

PART ID	DESCRIPTION	PICTURE	QUANTITY
Y301	12MHZ CRYSTAL		1
X301	DB9 ACCESSORY JACK		1
JP302	10 PIN DUAL ROW HEADER		1
X303	USB TYPE B VERTICAL PCB MOUNT CONNECTOR		1
X104	RCA JACK METAL VERTICAL PTT IN		1
FRONT/REAR PANEL CABLE	10 PIN IDC CABLE		1
PCB MOUNTING SCREWS	#4 5/8" MACHINE SCREWS		3
SPACERS	0.25" NYLON PCB SPACERS		3
MOUNTING NUTS	#4 MACHINE NUTS		4
MOUNTING WASHERS	LOCK WASHERS		3

2. AMPLIFIER PCB INVENTORY

PART ID	DESCRIPTION	PICTURE	QUANTITY
13.8VDC, GND	TERMINAL, MALE DISCONNECT, 6.35MM		2
J1	20 PIN DUAL ROW RIGHT ANGLE MALE HEADER		1
AMP_IN	2 PIN HEADER		1
DRV	3 PIN HEADER		1
L7,L6,L9,L8,L11,L10	T50-6 POWDERED IRON CORE		6
L13,L12,L14,L15	T50-2 POWERED IRON CORE		4
Q1, Q2, Q3, Q4	RD16HHF1		4
RF_IN, RF_OUT	RCA JACK METAL VERTICAL		2
RLY1	RELAY DPDT 5A 12V COIL		1
RLY2, RLY3, RLY4, RLY5, RLY6, RLY7, RLY8, RLY9, RLY10, RLY11, RLY12, RLY13, RLY14, RLY15	RELAY DPDT 2A 12V COIL		14
L5, T1, T3	BN43-202 BINOCULAR CORE		3

T2	T-75-43 OUTPUT TRANSFORMER		1
U2	LM35 TEMPERATURE SENSOR		1
VR1, VR2, VR3, VR4	1K 25 TURN POTENTIOMETER		4
TOROID WIRE	#22 ENAMELED WIRE		10'
DIRECTIONAL COUPLER WIRE	#30 KYNAR WIRE		3'
DIRECTIONAL COUPLER AND T1 WIRE	#22 TEFLON WIRE 12" WHITE, 6" BLUE		18"
T2 and L5 WIRE	#18 TEFLON WIRE		2'
RLY_OUT TO AMP_IN COAX JUMPER	2 PIN HOUSING		1
RLY_OUT TO AMP_IN COAX JUMPER	CONTACT		2
COAX JUMPER, RLY_OUT TO AMP_IN, INPUT to RF_IN, OUTPUT to RF_OUT	RG-174		1'

3. CHASSIS PACK INVENTORY

PART ID	DESCRIPTION	PICTURE	QUANTITY
RF INPUT RF OUTPUT	UHF PANEL CONNECTOR		2
POWER SWITCH	POWER ROCKER SWITCH		1
FRONT PANEL MOUNTING REAR PANEL MOUNTING	M3 SELF TAPPING PANEL MOUNTING SCREWS		8
UHF CONNECTOR MOUNTING POWERPOLE MOUNTING	#4 3/8" MACHINE SCREWS		9
UHF CONNECTOR MOUNTING POWERPOLE MOUNTING	#4 MACHINE NUTS		12
UHF CONNECTOR MOUNTING POWERPOLE MOUNTING	#4 LOCK WASHERS		12
COAX JUMPER ASSEMBLIES	RCA MALE CONNECTOR		2
DC INPUT CABLE ASSEMBLY	POWERPOLE TO SPADE TERMINALS, #18 2 COND		1
POWER SWITCH CABLE	2-PIN CONNECTOR W/HEADER, .10"		1
PCB MOUNTING	#4 1/2" THREAD CUTTING SCREW		4
MOSFET MOUNTING	#4 1/4" THREAD CUTTING SCREW		4
PCB MOUNTING	1/4" BRASS STAND-OFF		6
RFIN/RFOUT GROUND CONNECTORS	#6 RED SPADE CONNECTORS		2

HEAT SINK COMPOUND	PAPER SACHET		3
HEAT SINK DRILLING FOR SELF TAPPING SCREWS	#41 DRILL BIT		1
DRIVER MOUNTING SCREWS	#4 5/8" MACHINE SCREWS		3
CHASSIS FEET	1/2" DIAMETER x 1/4" HIGH ROUND RUBBER FEET		4
POWERPOLE MOUNTING	ALUMINUM M-SHAPED BRACKET		1

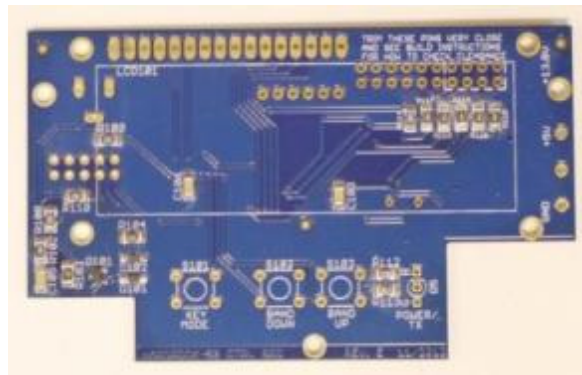
4. FRONT PANEL PCB

This section covers the assembly of the front panel and control PCB. Required tools and supplies are; soldering iron, diagonal cutters, Philips screwdriver and long-nose pliers. From the kit you will need the front panel PCB:

FRONT SIDE



BACK SIDE



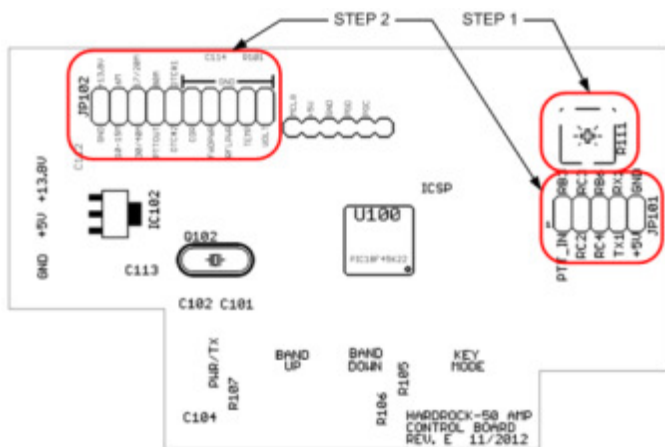
You'll also need the “Front Panel Pack” in your kit. It is easy to pick out because it has the LCD in a bubble wrap package. Verify all parts below are in your pack. The inventory for the "Front Panel Pack" is in section 1. Be careful when emptying out the pack as the #4 nylon washers are very small and easy to lose.

Please read these instructions first and follow these steps carefully to ensure success. If you install certain parts before others, you aren't guaranteed an accurate fit of the entire assembly.

Components in Step 1 - 2 are mounted on the front side of the Front Panel Board

☐ **STEP 1:** Press TrimPot R111 firmly into the holes and solder in place.

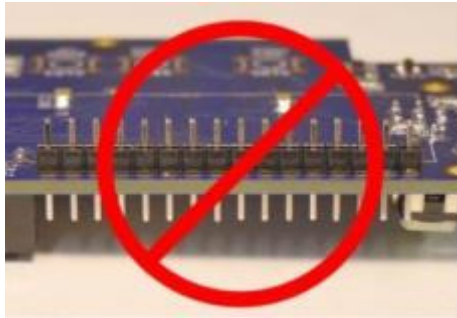
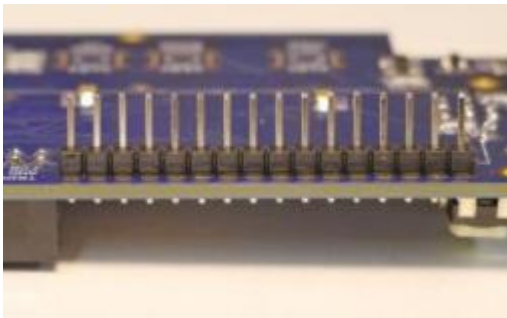
☐ **STEP 2:** Install the Female Header JP102 and Male Header JP101. Make sure JP102 especially is at a right angle to the board. Do this by first applying solder to one pin and then pressing it down firmly while holding your iron to that pin ensuring it's seated firmly on the board. Solder the opposite corner and then the rest of the pins. After soldering JP102, clip the pins as close as possible to the board. You will see a note on the silk screen about 8 pins in particular, if these aren't clipped super close, they can short on part of the LCD that hangs down in this area. After attaching the LCD, you can look through the side to ensure proper clearance of the LCD tab to these pins.



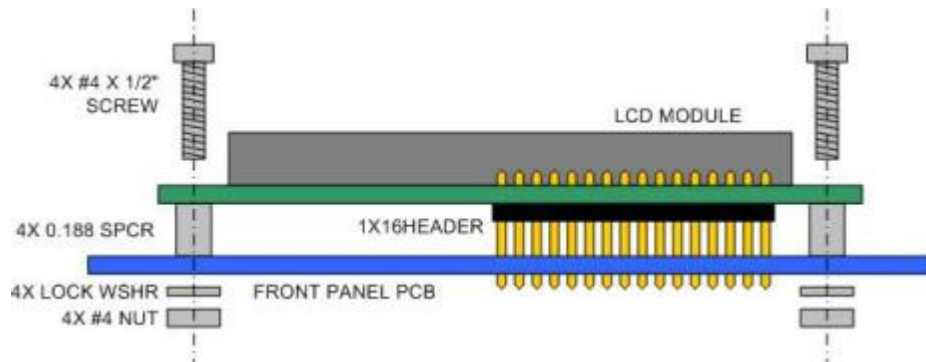
The remaining components are mounted on the back side side of the Front Panel Board

- ☐ **Step 3:** Find the 1x16 header. Count the pins and ensure there are 16. If there are extra, carefully snap the excess off.

The 1X16 header has a long side and a short side it is important to insert the short side into the PCB and have the long side sticking up.

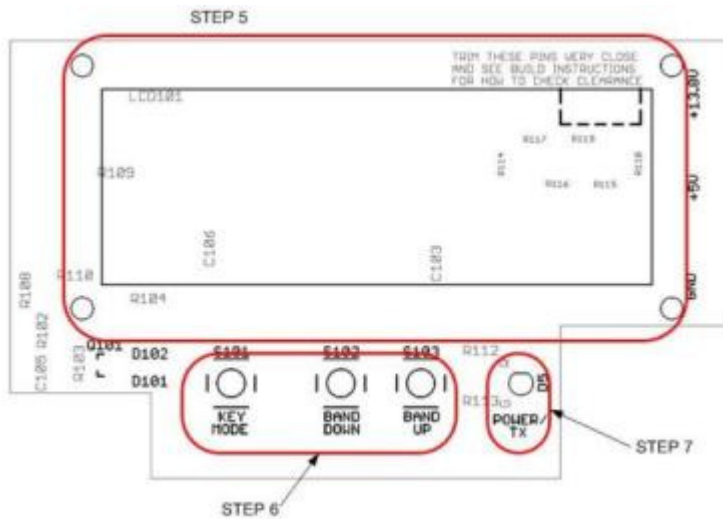


- ☐ **Step 4:** Insert the 1x16 header into the LCD module with the short pins protruding up through the holes in the LCD. Solder one pin and check for square. DO NOT solder the rest of the pins at this point.
- ☐ **Step 5:** Using 4 – 0.188” nylon spacers, 4 - #4 1/2” screws, 4 – #4 lock washers and 4 – #4 nuts mount the LCD to the control panel. It is easiest if you first insert the one screw nearest the 2x10 header, JP101, and loosely tighten it down. Then holding the control board with the LCD facing up, insert the spacer between the LCD and the control board and align. Slide the screw through both PCBs and the spacer and then attach the washer and nut. Once all 4 screws are in, tighten them finger tight for now. DO NOT SOLDER the LCD at this time.



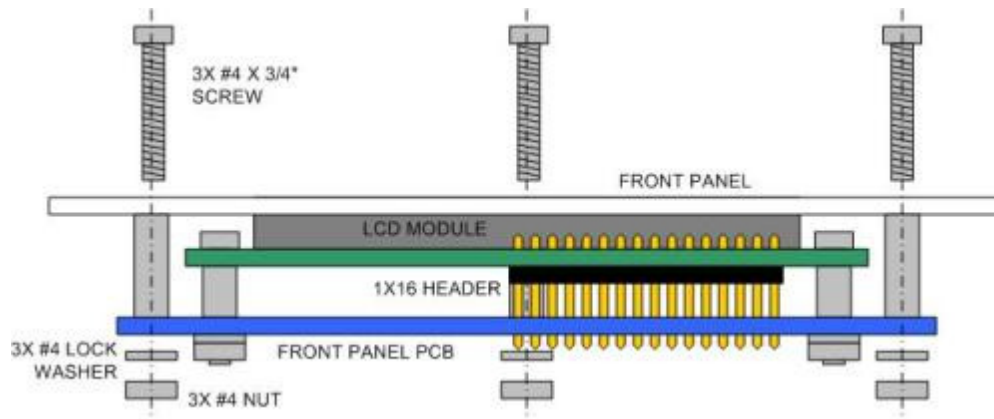
☐ **Step 6:** Insert the 3 push button switches, S101, S102 and S103 into their holes. DO NOT SOLDER

☐ **Step 7:** Insert the bi-color LED, D5, into its holes. Note the flat side of the LED and align with the markings on the silk screen. The 2nd to the longest lead should be facing the “R” on the silkscreen. DO NOT SOLDER



☐ **Step 8:** Align the front panel with the LCD, pushbuttons and LED. The fit is snug. If it doesn't easily slide over the parts, loosen the LCD mounting screws to provide some “wobble room”.

☐ **Step 9:** Using 3 - #4 0.375" spacers, 3 - #4 3/4" screws, 3 - #4 lock washers and 3 - #4 nuts, mount the panel assembly to the front panel.

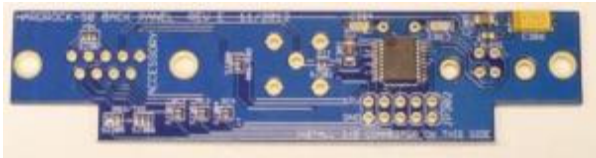


- ☐ **Step 10:** Tighten the all 7 mounting screws so that they are snug. For the screws that hold the LCD module to the Front Panel PCB use a long-nose plier to hold the head of the screw and turn the nut with a nut driver or second pair of pliers.
- ☐ **Step 11:** Solder the buttons, LED and the 16 leads of the LCD to the Front Panel PCB.
- ☐ **Step 12:** Remove the 3 sets of hardware holding the front panel in place.
- ☐ **Step 13:** Solder the remaining 15 pins of the header to the LCD module and re-tighten the hardware holding the LCD module to the Front Panel PCB.
- ☐ **Step 14:** Reinstall the front panel with the 3 sets of hardware and tighten.

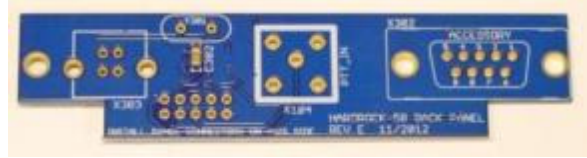
5. BACK PANEL PCB

This section covers the assembly of the rear panel and back panel PCB. Required tools and supplies are; soldering iron, diagonal cutters, Philips screwdriver and long-nose pliers. From the kit you will need the Back Panel PCB:

Front:



Rear:



You'll also need the "Rear Panel Pack" which is the pack with the 12" ribbon cable in it. Check to make sure that all of the required parts are present using the "Rear Panel Inventory" which can be found Section 2.

☐ **Step 1:** Insert and solder the 2X5 header at location JP302. The header mounts on the front side of the PCB and solders to the back side. Make sure that the header is flush with the PCB.



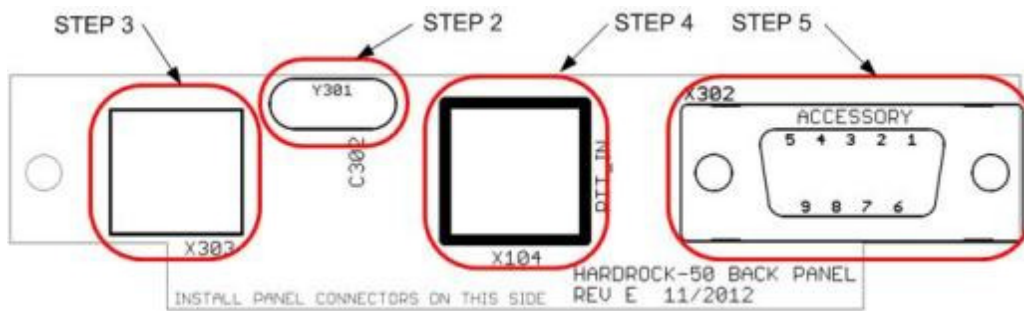
Note the remaining components mount on Rear side of the PCB and solder is applied to the front side.

☐ **Step 2:** Insert and solder the 12 MHz crystal at location Y301. When soldering the crystal, it is recommended for it to be slightly off of the board. You can achieve this by sliding a cut off lead from a through hole part or a folded up slip of paper under the crystal while soldering.

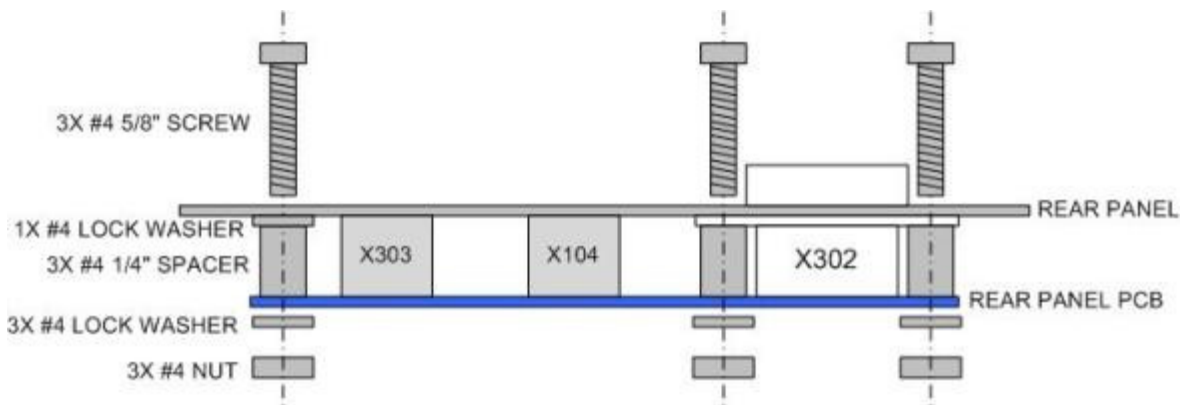
☐ **Step 3:** Insert and solder the USB connector at location X303.

☐ **Step 4:** Insert and solder the RCA connector at location X104 (PTT_IN). Caution: The RCA connector will be hot after soldering.

☐ **Step 5:** Insert the DB9 Accessory Jack at location X302 (Do not solder at this time).



□ **Step 6:** Using three #4 5/8" screws, 0.25" spacers, and #4 nuts and four #4 lock washers and one nylon washer, attach the Rear Panel PCB to the Rear Panel as shown. One of the lock washers is used to make up the difference caused by the DB9 (X302) connector as shown.



□ **Step 7:** Tighten all hardware and solder the 9 pins of the DB9.

6. INDUCTORS AND TRANSFORMERS

This section describes the construction of the inductors and transformers that will be installed on the Amplifier PCB in the next section. The Amplifier pack consists 2 bags of parts. The parts needed for the inductors and transformers are in one of the bags, look for a bag with toroid and balun cores in it.

Tips for Winding Toroidal Inductors:

1. The enameled on wire included with the kit is designed to be removed by heat. No scraping is required. After the inductor is wound, tin the end with a soldering iron which will remove the enamel and prepare the inductor for installation on the PCB. But there's a trick, in order to get the enamel hot enough burn off you must get molten solder in contact with bare copper which, since we aren't scraping, means the end of the wire. So get a nice ball of solder on the tip of the iron and put the ball on the very tip of the wire, Then you will see the enamel cook right off. Maybe when you are cutting the wire after the toroid is wound, cut the wire on a bias to expose more bare wire.
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 inset the initial turn of wire and add turns to the right. This will insure 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.

L1 – L4 are SMT inductors installed at the contract manufacturer. Inspect them and check for 50 ohms of resistance between the gate pad of Q1 through Q4 and the center pin of VR1 through VR4 respectively. The center pins of VR1 through VR4 should also be greater than 1M to ground.

☐ **L5** - two loops of #18 wire through a BN43-202 Core. The wires are cut to 3" (75mm) each and stripped so that the insulation is 1 5/8" (65mm) long.



L6, L7 are not installed in this version of the amplifier

☐ **L8, L10, L11** - 9Turns (7") of #22 enameled wire on a T50-6 Core (yellow), tinned



☐ **L9** - 7 Turns (6") of #22 enameled wire on a T50-6 Core (yellow), tinned



☐ **L12, L13** - 12 Turns (9") of #22 enameled wire on a T50-2 Core (red), tinned



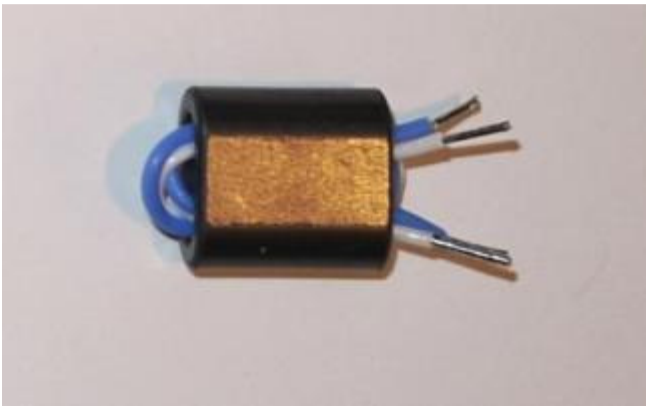
☐ **L14** - 17 Turns (12") of #22 enameled wire on a T50-2 Core (red), tinned



☐ **L15** - 24 Turns (16") of #22 enameled wire on a T50-2 Core (red), tinned



☐ **T1** - two windings each with 2 turns of #22 teflon wire. One winding uses white wire, the other uses blue wire for easy identification. Cut two pieces of Teflon wire, one white, one blue each 4 1/2" long. Wrap each wire 2 turns on a BN43-202 binocular core, that is up one hole down the other, up the first one again and down the second for each wire. Dress the wires so white is on one side, blue on the other, trim to 1/2", strip the wires and lightly tin.



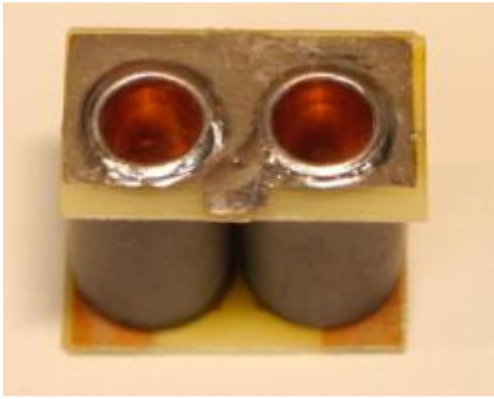
☐ **T2** - Thoroughly tin both ends of T2's core,

CAUTION - after you do this the core will be HOT!!

Let me make this extremely clear. T2 looks like this from the manufacturer:



You need to make it look like this:



Notice the solder flowing all the way around the copper tubes and up onto the ends of the tubes.

NOT THIS WAY:



with the solder only on the PCB ends and not on the tubes. There needs to be excellent electrical contact with very low resistance between the ends and the tubes! If you send me your amplifier to fix and T2 isn't tinned correctly I will be very disappointed.

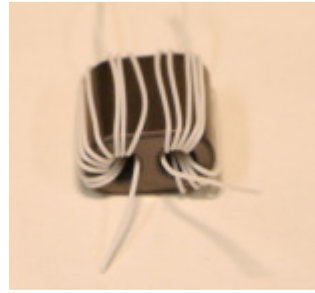
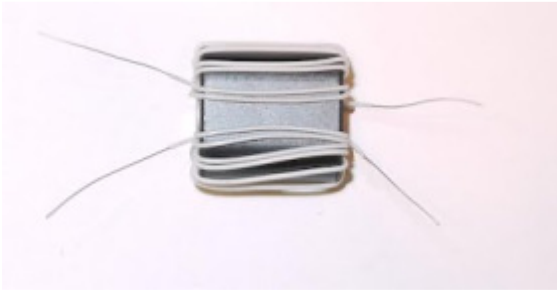
After you do this the entire core will be **HOT**

Even after you wait 5 minutes it will still be **HOT**, it won't look hot but it will burn your fingers believe me, I know. I had to tin the ends of another core to get the 'not this way' picture and I burned my fingers again.

Set T2 aside for now, the four turn secondary will be added after the core is soldered to the Amplifier PCB in the next section.

☐ **T3** – There are a total of 4 windings on the BN43-202 core that T3 is wound on at this time we will be installing the two 10 turn windings. The 2 single turn windings will be added after the core is soldered to the Amplifier PCB in the next section.

Wind 2 windings each using 18" of #30 Kynar wire, 10 turns, one winding through each hole in a BN43-202 core, like this:

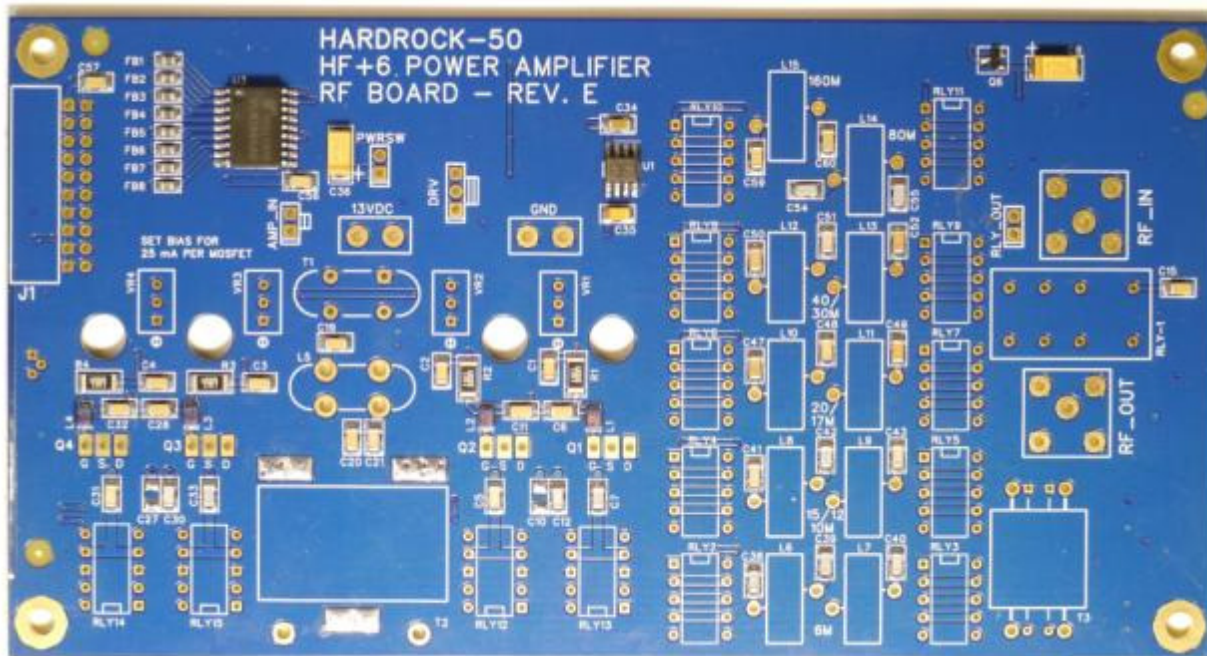


You should be able to count 10 white wires in each hole in the core.

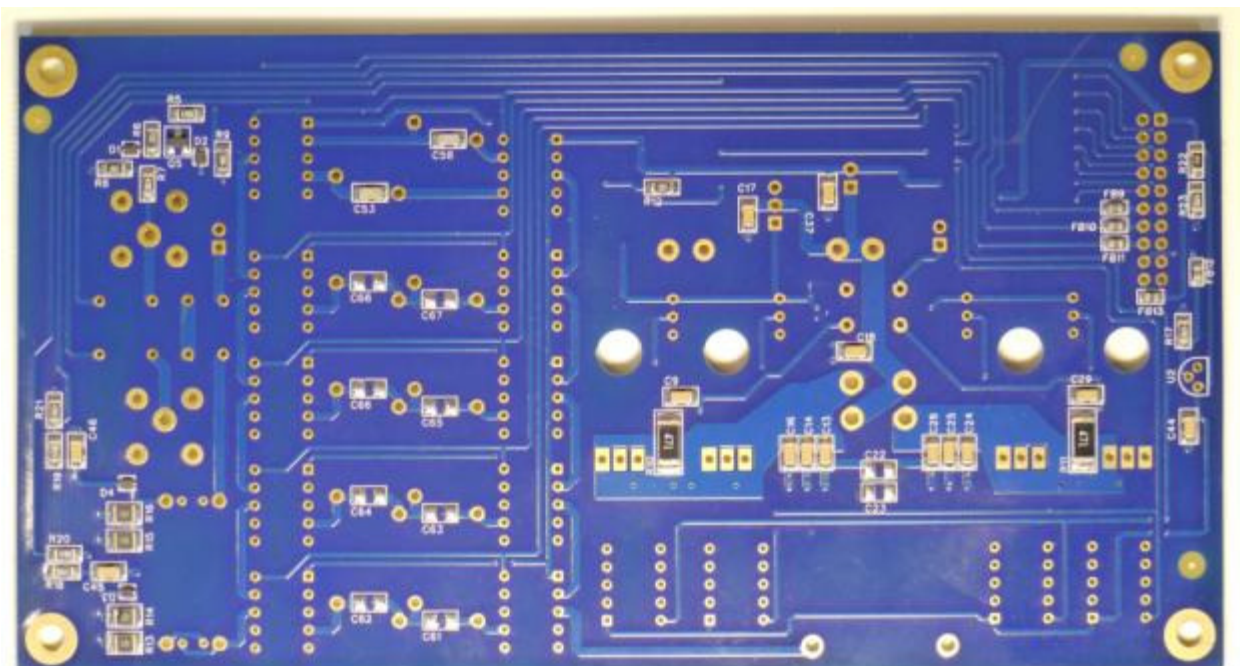
7. AMPLIFIER PCB

This section covers the assembly of the Amplifier PCB. Required tools and supplies are; soldering iron, diagonal cutters, tweezers and long-nose pliers. From the kit you will need the Amplifier PCB:

FRONT:



REAR:

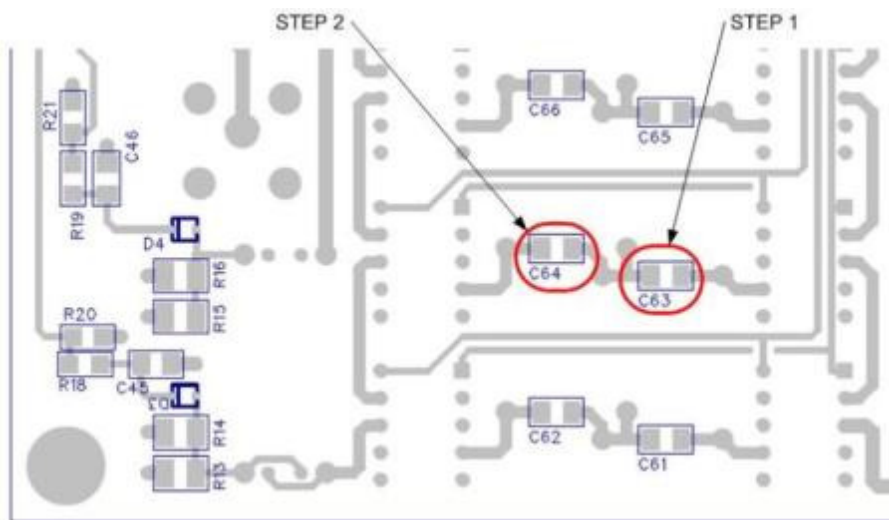


You'll also need the "Amplifier Pack" which is the pack with the 14 orange relays in it. Check to make sure that all of the required parts are present using the "Amplifier Inventory" which can be found Section 3.

☐ **Step 1:** Solder four ¼" brass stand-offs to the back side of the amplifier PCB at each of the four corners. The brass stand-offs are located in the chassis pack and are actually nickel plated brass for easy soldering and are silver colored. The easiest way that I have found to do this is to inset one of the M3 screws through the stand-off then through the back side of the PCB to keep everything lined up while soldering then use heat and patience to flow the solder all the way around the stand-off, remove the heat and wait for the solder to solidify then remove the M3 screw (with something other than you fingers because it will be HOT).

☐ **Step 2:** Add 39 pF 1206 surface mount capacitor, C63, on the rear side of the PCB as shown in the diagram below. Location C63 already has solder applied to the pads, simply hold the 39 PF in place with a pair of tweezers and flow the solder with a hot soldering iron to mount the component.

☐ **Step 3:** Add 120 pF 1206 surface mount capacitor, C64, on the rear side of the PCB as shown in the diagram below. Location C64 already has solder applied to the pads, simply hold the 120 PF in place with a pair of tweezers and flow the solder with a hot soldering iron to mount the component.



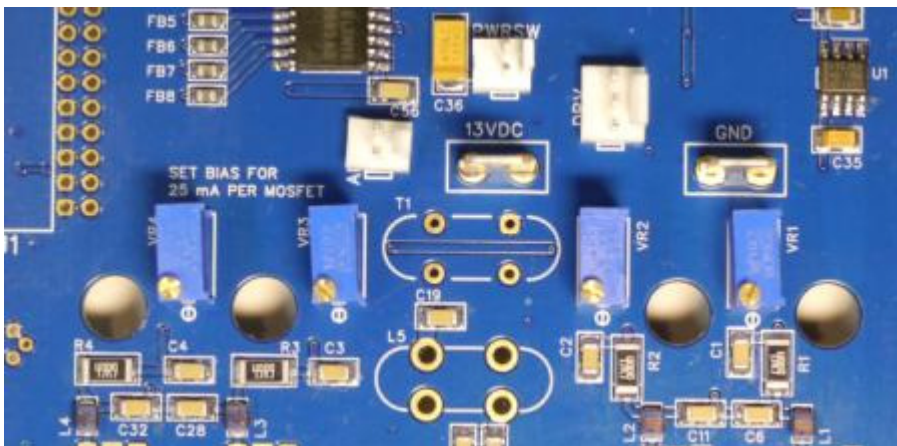
☐ **Step 4:** Install relays RLY2, RLY3, RLY4, RLY5, RLY6, RLY7, RLY8, RLY9, RLY10, RLY11, RLY12, RLY13, RLY14 and RLY15 at the locations indicated on the silk screen. Relay orientation is determined by the line painted on the relay, not by any notches in the case of the relay. The easiest way to do this is place the relays as indicated on the front side of the PCB then place a flat object (maybe a hard cover book or a small piece of wood) on top of the relays. The flat object must be big enough to cover all of the relays. Then, holding the PCB, relays and flat object like a sandwich, flip the whole thing over. Then solder one pin on each relay, pressing down on the PCB in the area of the relay it ensure that the relay is flush with the PCB. You can then pick up the PCB with the relays attached by a single pin each. Inspect each relay for position (should be flush with the PCB) and orientation (line

on the relay matched the notch on the silk screen), adjust if necessary. Then turn the PCB over and solder the other 9 pins on each relay.

☐ **Step 5:** Insert a 2 PIN Header at location AMP_IN and a 3 PIN Header at location DRV. Both headers have an orientation tab with is indicated silk screen. Both orientation tabs are in the same direction which is towards the edge of the PCB with RLY-1 as shown. Open the Chassis Pack of parts and remove the 2 PIN header from the power switch cable and insert it into the PCB at location PWRSW, the orientation is not important. Solder all pins making sure that the headers are flush with the PCB.

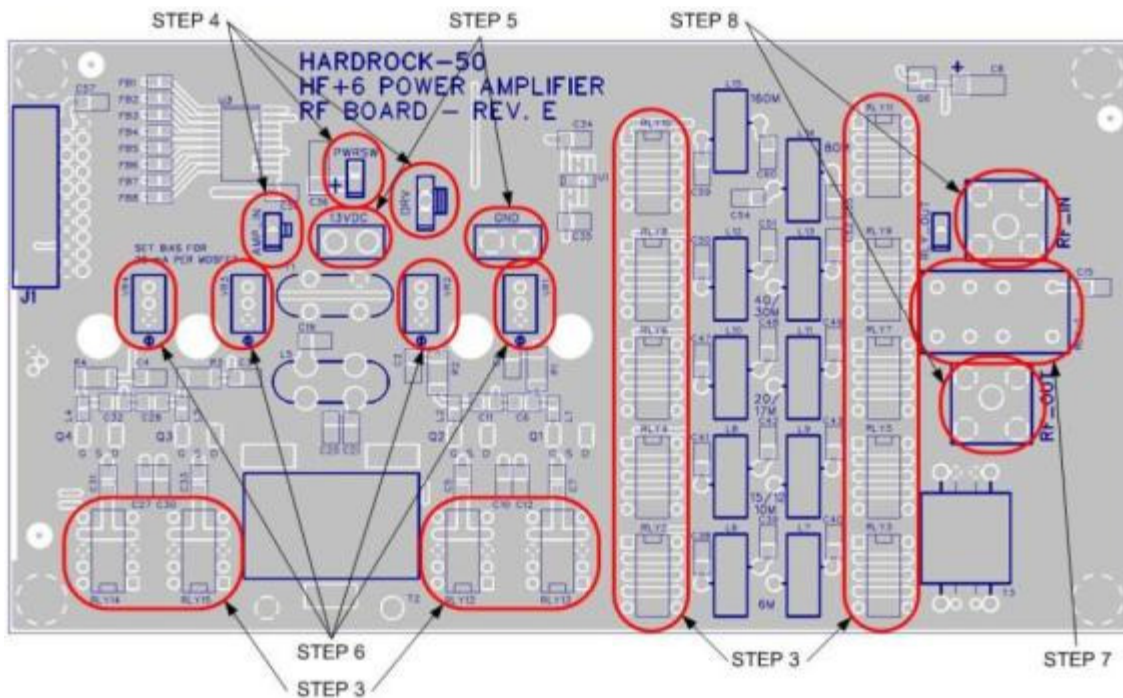
☐ **Step 6:** Install the two 6.35MM (1/4") power terminals at the locations 13.8V and GND. You may find it easier to tack it with some solder from the bottom, then heat from the top to ease into place. Once placed, add additional solder to keep in place. Completed terminals should be perpendicular to the PCB.

☐ **Step 7:** Install 1K trimpots at locations VR1, VR2, VR3, VR4. The silkscreen shows the proper position of the adjustment screw. Solder and trim the component leads. Turn each adjustment screw counter clockwise at least 25 turns to ensure that the bias voltage is 0V.



☐ **Step 8:** Install the T/R relay at location RLY1, solder all pins.

☐ **Step 9:** Install RCA jacks at RF_IN and RF_OUT locations, solder all pins. The RCA jacks get HOT during this operation.

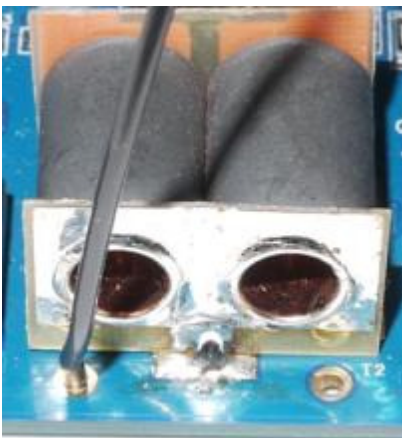


☐ **Step 10:** Install the inductors constructed in section 7 is indicated:

- L6, L7 Not Used in this version of the Hardrock-50
- L9 T50-6 core, 7 turns #22 enameled wire
- L8, L10, L11 T50-6 core, 9 turns #22 enameled wire
- L12, L13 T50-2 core, 12 turns #22 enameled wire
- L14 T50-2 core, 17 turns #22 enameled wire
- L15 T50-2 core, 24 turns #22 enameled wire

Solder and trim the leads of L8 through L15

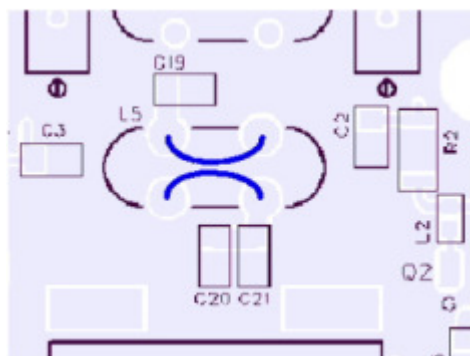
☐ **Step 11:** Install T2. The core for T2 must be tinned, detailed instructions and pictures are in section 7. Then solder the core to the PCB pads. Cut 18" of #18 teflon wire and solder on end to the PCB like so:



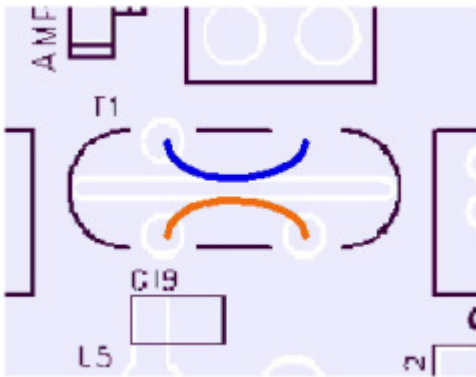
Wind 4 turns through the core then solder the other end to the PCB. That's up and back 4 times which makes four passes on the L5 side and 3 passes on the PCB edge side. I've seen two units come back wound with 5 turns which really messes with the output power. The tighter you wind this, the more power you'll have on 6 meters. It should look like this when you are done.



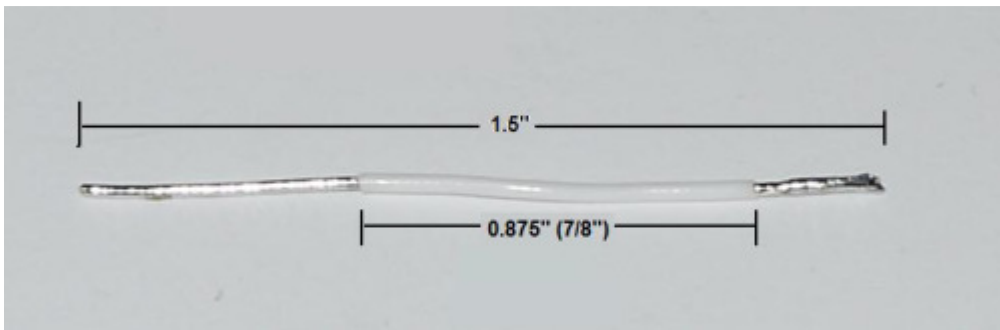
☐ **Step 12:** L5 has two identical windings; each is a single turn of #18 wire. The windings should be parallel and not cross or twist anywhere in the core, it's a tight fit so it would be difficult to twist them. The insert L5 into the PCB with the windings as shown, the two windings are identical so it doesn't matter which side is which. Solder and trim the leads.



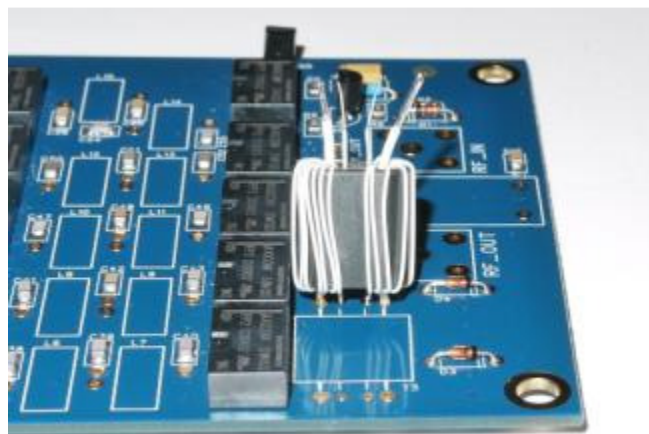
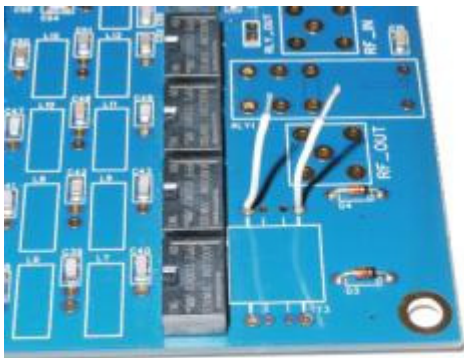
☐ **Step 13:** T1 consists of two windings of #22 teflon wire, 2 turns each, one white, one blue. The two colors of wire are to help identify the two windings. Insert T1 into the PCB as shown, (the orange line represents the white winding), solder and trim the excess wire.



□ **Step 14:** Cut 2 each, 1.5" pieces of white #22 Teflon wire, Strip the ends so that the insulation remaining is 7/8" long, the length of the bare wires is not important just so it's long enough to go through the PCB. Tin the ends:

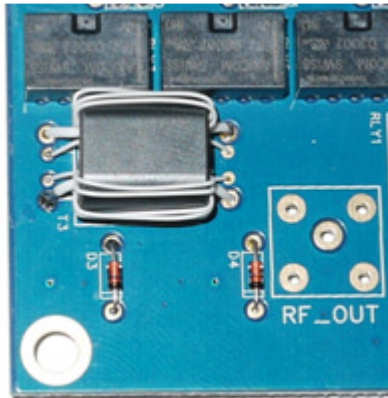


□ **Step 15:** Solder the 2 prepared #22 wires in to the holes in the T2 footprint as shown. Slide the BN43-202 core with the #30 windings over the protruding #22 wires. Make sure that the #30 wires go into the corresponding holes in the PCB. No wires should cross each other.



Not that these images show a rev C PCB, rev D and later D3 and D4 are SMT units on the bottom of the PCB. This does not impact the mounting of T3.

- **Step 16:** Bend the core over, parallel to the PCB, insert the remaining #22 and #30 wires in their corresponding holes, and solder all unsoldered connections.



- **Step 17:** Cut a 6" piece of RG-174 and prepare the ends as described below.

UNSTRIPPED MINIATURE
COAX RG-174, RG-316, etc.



REMOVE 0.75" OF THE
OUTER JACKET EXPOSING
THE BRAIDED SHIELD



USING A TOOTHPICK, OR
SIMILAR, UNBRAID THE
SHIELD AND GATHER THE
SHIELD WIRES ON ONE SIDE



WRAP A PIECE OF BARE #22
WIRE AROUND THE SHIELD
WIRES AND SOLDER



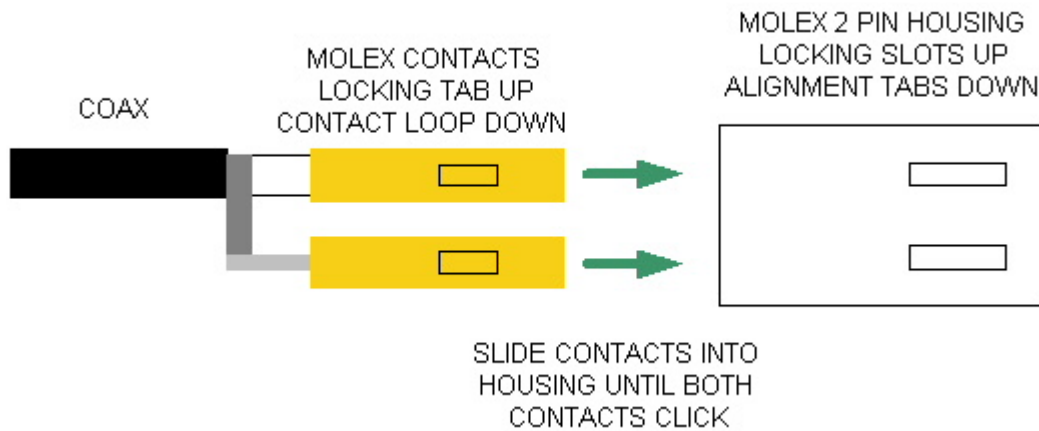
SOLDER HERE.
CAREFUL NOT TO MELT
THE INSULATION

TRIM EXCESS SHIELD.
STRIP AND TIN CENTER
CONDUCTOR. DO NOT MELT
THE DIELECTRIC



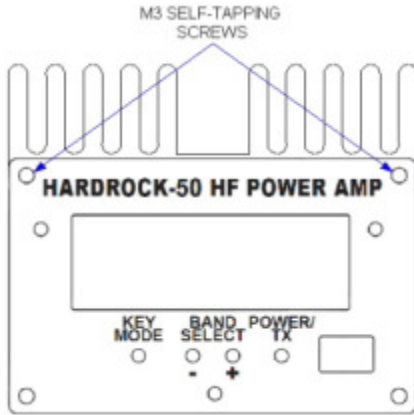
TRIM HERE

□ **Step 18:** Using pliers squeeze a header receptacle contact onto the shield and center conductors of one end of the prepared coax. **IMPORTANT:** the contacts must face the correct way to go into the housing so that the shield and center conductor are on the correct side of the housing. The contacts must also be close to the same extension:

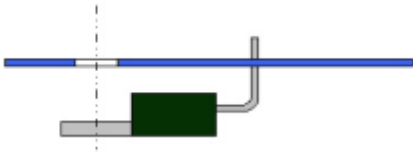


8. FINAL ASSEMBLY

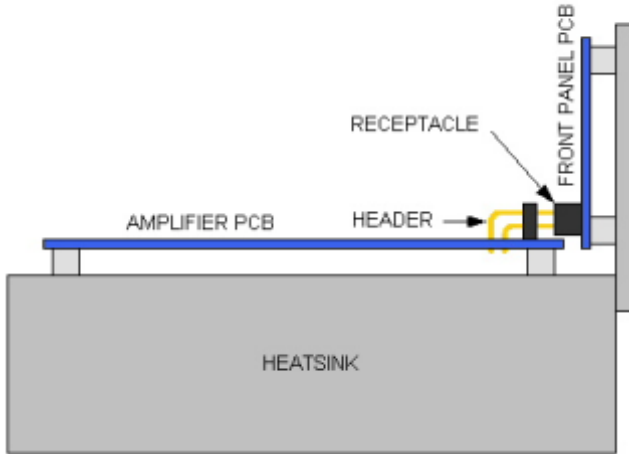
☐ **Step 1:** Attach the front panel to the heatsink portion of the enclosure using 2 of the M3 self-tapping panel screws.



☐ **Step 2:** Bend the leads of the RD16HHF1 MOSFETs upwards so that when the leads are inserted through the amplifier PCB the hole in the mounting tab aligns with the access hole in the amplifier PCB. Insert the 4 bent MOSFETs into the amplifier PCB. Insert the LM35 temperature sensor at its location on the bottom of the amplifier PCB. **DO NOT SOLDER THE MOSFETS OR LM35 AT THIS TIME.**



☐ **Step 3:** Place the dual row 20 pin right angle header in its place in the amplifier PCB. Plug the dual row header on the amplifier board into the corresponding receptacle on the control PCB.



☐ **Step 4:** When everything lines up nicely and the amplifier PCB is centered on the heatsink, solder the corner pins of the dual row header. Adjust the height of the LM35 so it is almost in contact with the heatsink solder and trim the leads. Then remove the amplifier PCB and solder all pins of the dual row header on the back side of the amplifier PCB.

☐ **Step 5:** Press the power switch into the front panel. Trim the power switch cable to 4" and solder the end of the power switch cable without the housing to the power switch. The 2 pin header that came with the power switch cable should already be installed at location marked PWRSW on the amplifier PCB.

☐ **Step 6:** Reconnect the amplifier PCB and the front panel PCB carefully realign the amplifier PCB and using a center punch (or nail), mark the 4 mounting hole in the corner of the PCB and the 4 mounting holes in the MOSFET tabs.

☐ **Step 7:** Remove the amplifier PCB and front panel from the heatsink and using the #41 drill bit provided drill four holes for the mounting screws and 4 holes for the MOSFETs. The holes for the PCB mounting do not need to go all the way through the heatsink only 1/4" - 3/8" (6-9mm) deep, the holes for the MOSFETs need to be drilled all the way through the heatsink. Remove burrs and drill filings.

It's a good idea to screw each thread-cutting screw into its hole before attempting to mount the PCB or the MOSFETs. The first time you tighten the screw, you are performing a tapping operation so work the screw like a tap by advancing 2/3 of a turn then backing off 1/3 of a turn to clear the filings and repeat 2/3 ahead, 1/3 back until the screw is seated. Then remove the screw entirely and dump the filings out of the hole.

☐ **Step 8:** Apply a small amount of heatsink compound to the heatsink side of the MOSFETs and the top of the LM35. Attach the amplifier PCB to the heatsink with the four 1/2" mounting screws and the MOSFETs with the four 1/4" mounting screws. Solder and trim the MOSFET leads.

☐ **Step 9:** Attach the front panel to the heatsink making certain the 20 pin header properly engages the 20 pin housing. Tighten the 2 M3 front panel screws and connect the power switch cable to the header on the amplifier PCB at the PWRSW location.

☐ **Step 10:** Mount the Powerpole on the power cable assembly to the rear panel using the small E shaped Powerpole bracket, a #4 3/8" screw, nut and lock washer.

☐ **Step 11:** Cut two 3" lengths of RG-174. Remove 1/2" (12mm) of the outer jacket from and of each cable, unbraid the shield using a toothpick or similar and install a RCA plug one the end of each cable. Note that the RCA plugs come in different colors. Install the outer cover on the RCA plug.



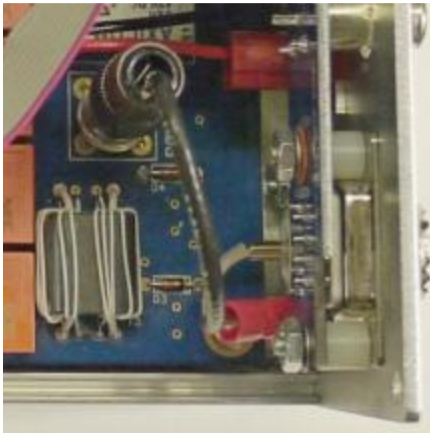
☐ **Step 12:** Remove 0.75" (20mm) of the outer jacket from the other end of the cables, unbraid the shield using a toothpick or similar, gather the shield wires and crimp the spade lug onto the shield.



☐ **Step 13:** Mount the two UHF connectors to the rear panes using eight #4 3/8" (9.5mm) screws, nuts and lock washers. Place the spade lug on the shield wires on one of the mounting screws to make a ground connection, solder the center conductor to the center pin of the UHF connector. Keep the shield connection as short as possible to prevent RF interference within the amplifier.



□ **Step 14:** Attach the rear panel to the heatsink with two M3 screws. Attach the power cable to the amplifier PCB, black wire to the 1/4 spade terminal labeled GND, red wire to the spade terminal labeled 13VDC. Connect the INPUT RCA plug to the RCA jack at location RF_IN and the OUTPUT RCA plug to the RCA jack at location RF_OUT. Attach the ribbon cable between the front panel PCB and the read panel PCB.



Congratulations, at this point the assembly of you Hoardrock-50 Amplifier is complete with the exception of the bottom cover. Wait to install the bottom cover until the alignment procedure in the next section is complete.

9. ALIGNMENT PROCEDURE

TEST EQUIPMENT REQUIRED FOR ALIGNING A HARDROCK-50 AMPLIFIER



- A 13.8V (nominal), 15A (minimum) power supply, meters are convenient but not required:
- A digital multimeter with a DC current range that has a resolution of 1 mA or better.
- Various clip leads for connecting the power supply, DMM and amplifier.

OPTIONAL EQUIPMENT FOR MORE ADVANCED TESTING



- HF+6 QRP transceiver (you probably have this or why did you buy a HR50?)
- 50 Ohm load rated for 100 watts or more.
- HF+6 Wattmeter rated for at least 100 watts.

BASIC CHECKOUT

Inspection: Once assembly is completed perform a final inspection of cabling, connectors, solder joints to make sure that everything looks OK and is connected in the correct manner.

Preset Potentiometers: Turn VR1-VR4 on the amp PCB fully counter-clockwise, the multi-turn pots do not have a stop at the end of their travel so just turn them CCW 25 turns or more. The amplifier

circuit is designed so that no damage will occur to the MOSFETs with any setting of VR1-VR4 but the bias voltage needs to be 0V (fully CCW) to properly adjust the amplifier. Set R111 on the control PCB about 1/2 way through it's range. It controls the contrast of the LCD.

Ohmmeter test:

☐ **Test 1:** Set the DMM to read resistance. With the power switch in the 'off' position measure the place the positive meter lead on the red Powerpole contact and negative lead on ground. The reading may change as capacitors in the circuit charge but the final resistance should be in excess of 100k Ohms.

☐ **Test 2:** Place the power switch in the 'on' position make the same resistance measurement You should now see a resistance of at least 1.5k ohms.

☐ **Test 3:** Keep the negative lead on ground and measure the resistance of each of the MOSFETs (Q1 – Q4) gate pins (the gate pin is marked with a 'G' on the silkscreen). Each of these will measure between 40 and 60 Ohms.

Note: If the resistance is lower than specified in tests 1, 2 or 3 do not apply power to the amplifier. Doing so may cause component damage. See the troubleshooting guide for tips on where to look for problems.

It is now safe to apply power to the amplifier. When power is applied, the front panel LCD will display a row of filled rectangles for a few seconds, followed by the firmware identification screen for 3 seconds then enter the stand-by screen which displays the Keying Mode, Band, Temperature and DC input voltage. If the display is blank or difficult to read, adjust the contrast control, R111, on the control PCB.

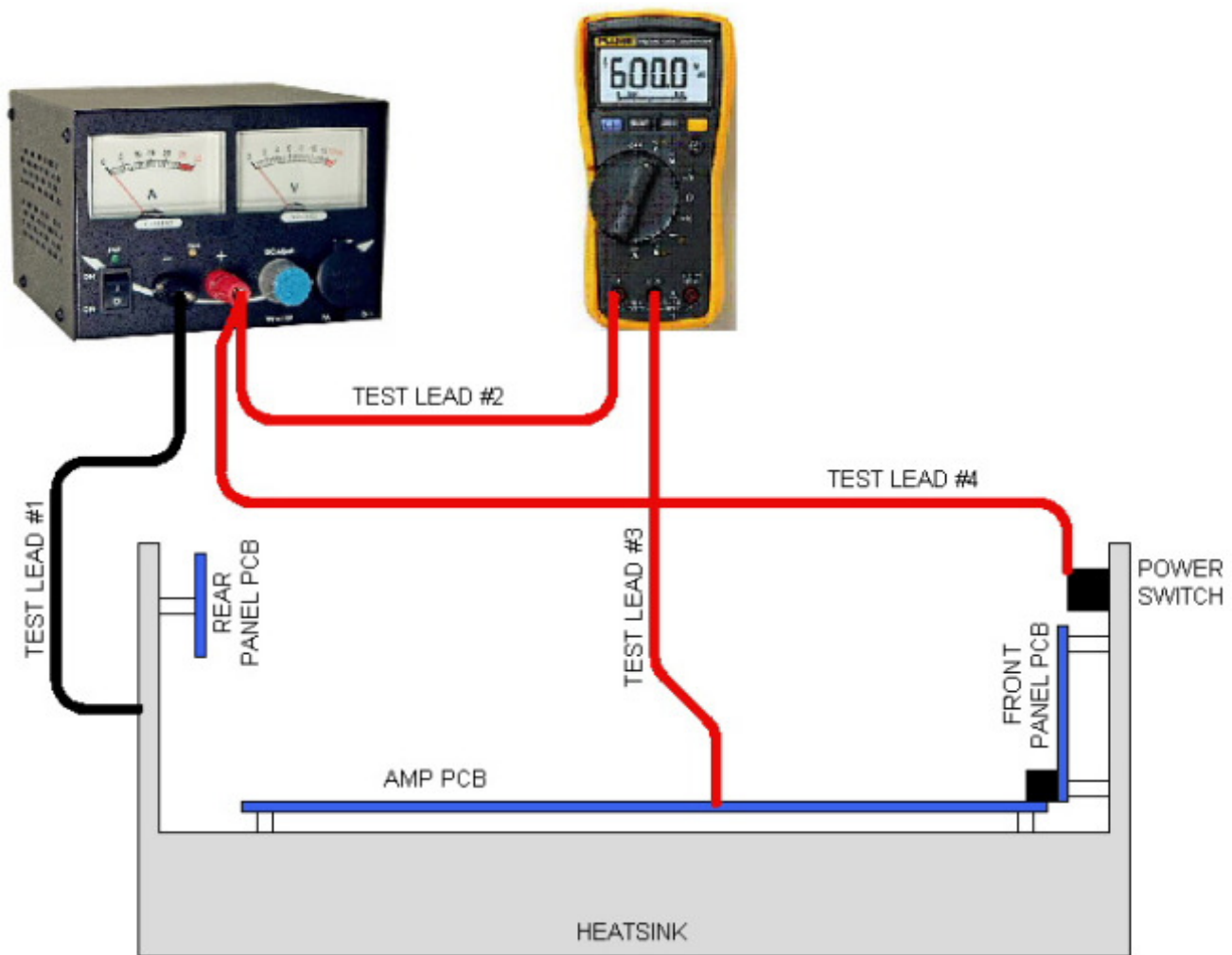
Set-up for adjusting the DC Bias:

☐ **Step 1:** Use the DMM in a voltage setting to verify that the voltage output of your DC power supply is between 12.5 and 14 volts. If it is adjustable, set it to 13.8 volts then turn off the DC supply.

☐ **Step 2:** Set the DMM to read DC current, full scale should be at least 200 mA and the resolution should be no more than 1 mA, preferably 0.1 mA.

☐ **Step 3:** Connect test leads #1 - #3 as shown

- Test Lead #1: From the negative terminal on the power supply to the chassis of the amplifier, the black powerpole, or 1/4" terminal on the amp PCB labeled 'GND'
- Test Lead #2: From the positive terminal on the power supply to the positive DC current terminal of the DMM.
- Test Lead #3: From the negative DC current (common) terminal of the DMM to the red powerpole or the 1/4" terminal labeled "13VDC"



☐ **Step 4:** Make sure that the power switch on the Hardrock-50 is in the 'off' position. Before connecting test lead #4 turn on the DC power supply, the DC current should be 0 mA.

☐ **Step 5:** Carefully connect test lead #4 between the positive terminal of the power supply and one of the terminals on the power switch. If the Hardrock-50 does not power up, connect test lead #4 to the other terminal of the switch. The Hardrock-50 amplifier should be powered on, the DMM should read 0 mA and the power switch should be 'off'. If these conditions are met it is safe to proceed to the next step.

☐ **Step 6:** Using the Key Mode button, select PTT mode.

☐ **Step 7:** Use a 5th test lead to ground the center pin of the PTT jack on the rear panel, keying the amplifier.

At this point the DC current should still read 0 mA, if not make sure that all of the bias pots are set fully CCW and installed in the PCB in the correct orientation.

☐ **Step 8:** Rotate the adjustment VR1 on the amplifier PCB clockwise until the DC current reached 20 mA.

☐ **Step 9:** Rotate the adjustment VR2 on the amplifier PCB clockwise until the DC current reached 40 mA.

☐ **Step 10:** Rotate the adjustment VR3 on the amplifier PCB clockwise until the DC current reached 60 mA.

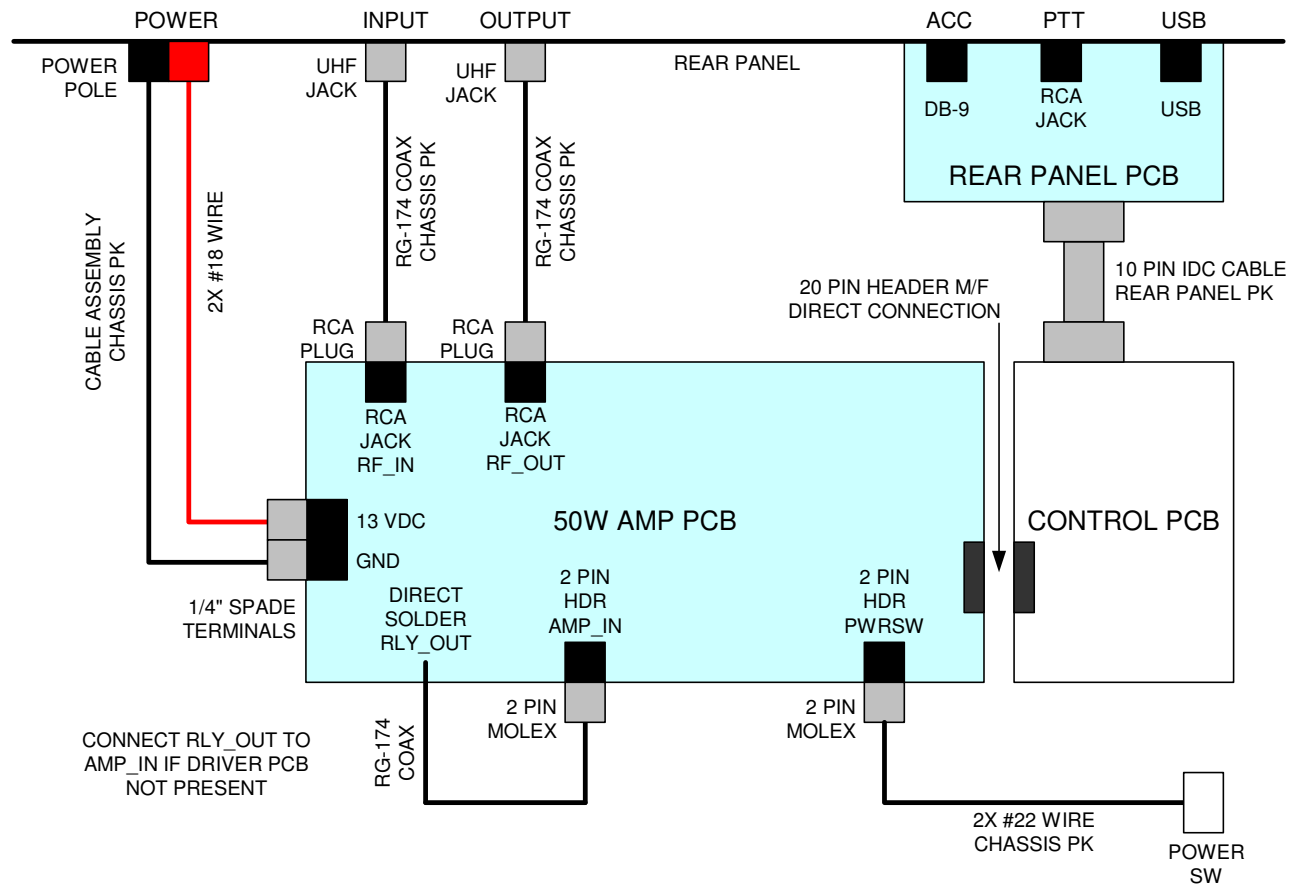
☐ **Step 11:** Rotate the adjustment VR4 on the amplifier PCB clockwise until the DC current reached 80 mA.

Nothing happens for quite a few turns then the current rises quickly, try to perform these adjustments as quickly as possible to keep the temperature drift as small as possible.

☐ **Step 12:** Remove the test lead from the PTT line to unkey the amplifier and the DC current should return to 0 mA.

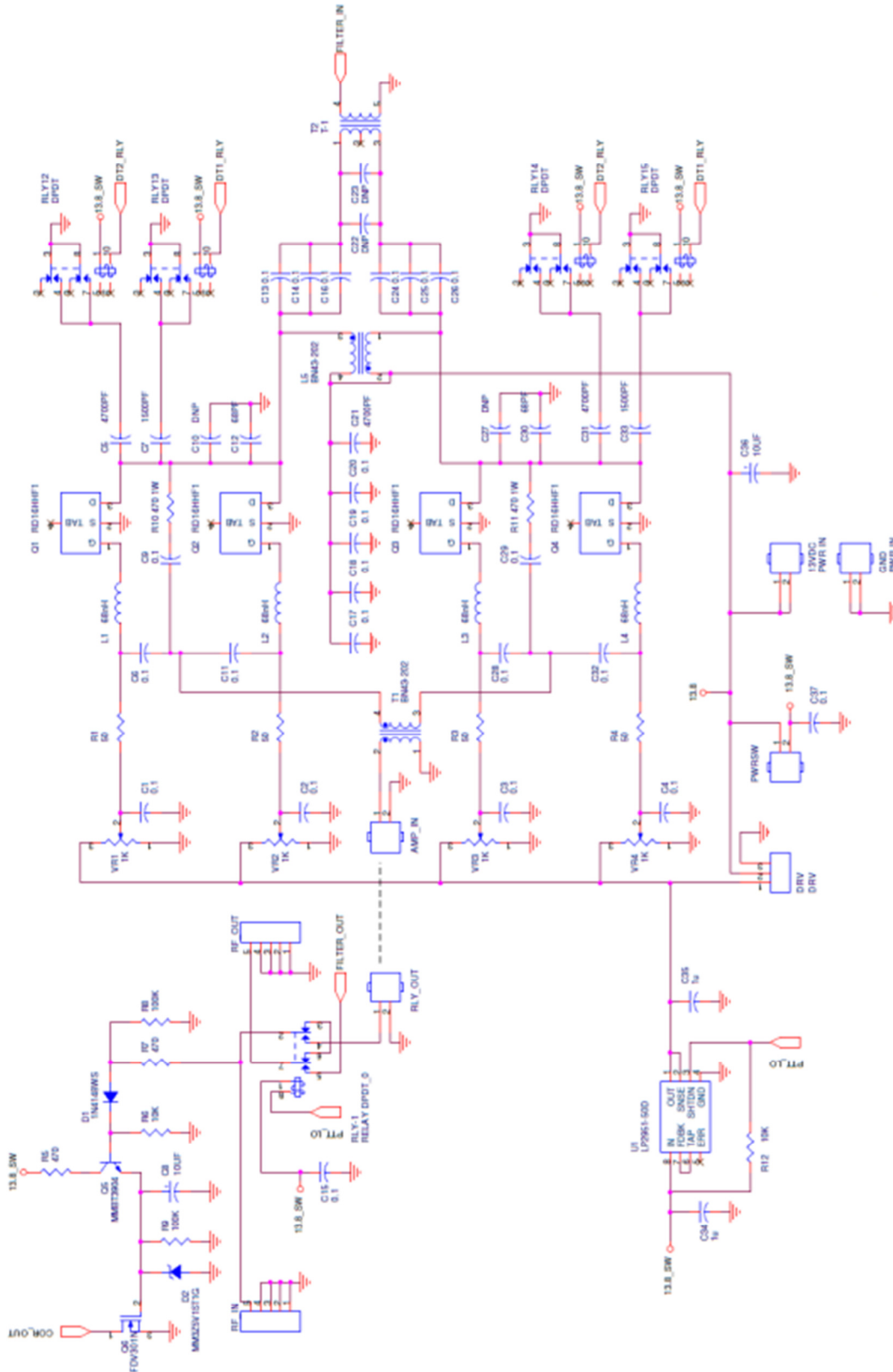
☐ **Step 13:** Install the bottom cover and your Hardrock-50 is ready to operate.

10. Chassis Wiring Diagram

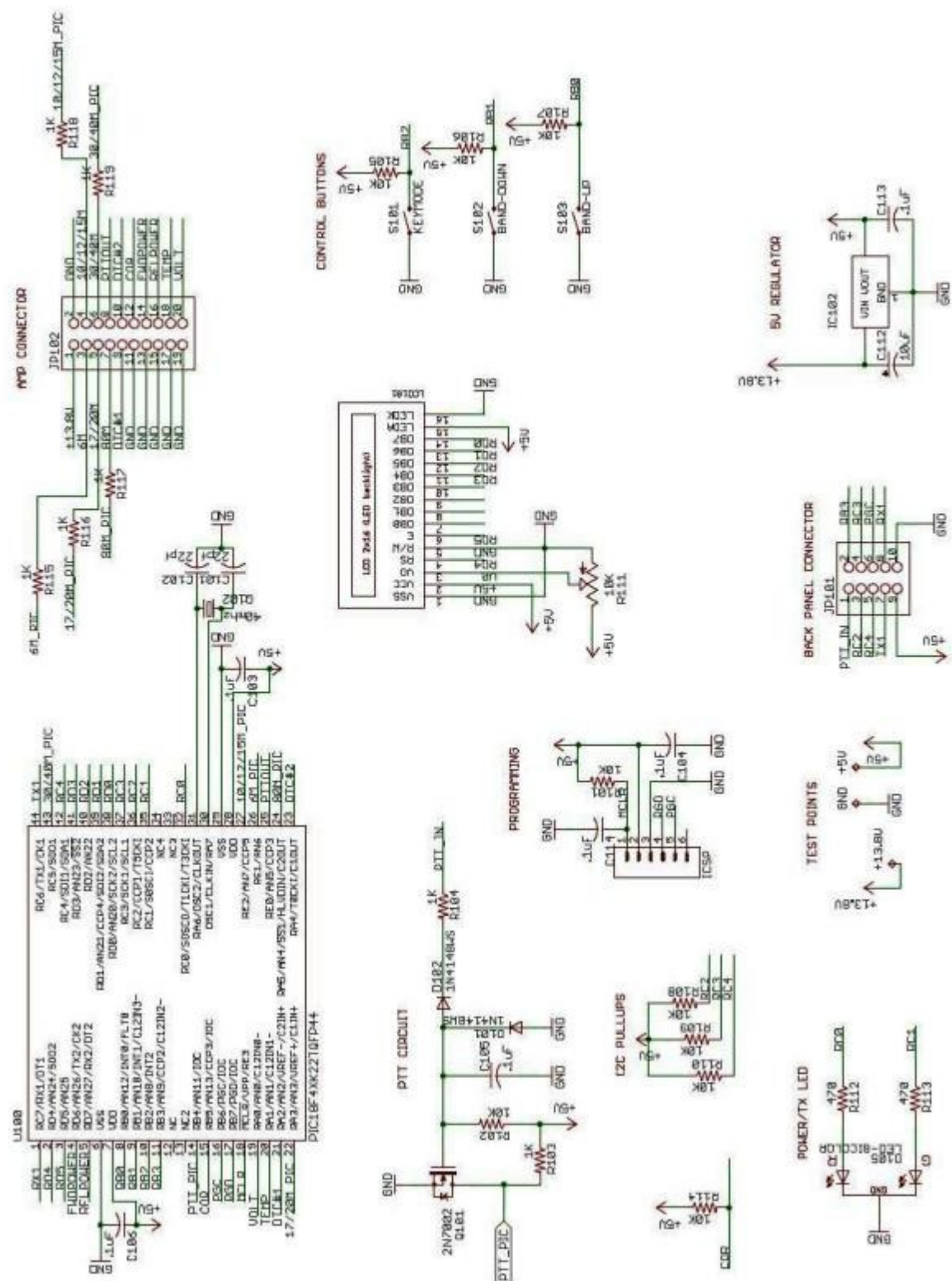


11. AMPLIFIER PCB SCHEMATIC

Amplifier PCB Schematic Page 1



12. CONTROL PCB SCHEMATIC



13. REAR PANEL PCB SCHEMATIC

