Seventh Circle Audio

N72 Microphone Preamp

Based on the BA183 amplifier circuit used in the 1066, 1073, 1272, and other Neve console modules, the N72 microphone preamp will deliver the same immediately recognizable transformer-colored character to your recordings.

Who Should Build This Kit?
The N72 is not difficult to build, but it is not intended for beginners. You should have built at least one project on a printed circuit board (PCB) before trying the N72. Sorry, but soldering cables doesn't count. If you've never built an electronic project of any kind, this is probably not the one to start with. To guarantee success make sure you have:

- The ability to make basic voltage and resistance measurements using a digital multi-meter (DMM).
- At least a rudimentary understanding of Ohm's Law and the relationship between voltage, current, and resistance.
- Some experience soldering on printed circuit boards.
- The patience to follow instructions precisely and work carefully.

Essential Tools
Fine tipped 20-30 watt soldering iron w/ cleaning sponge (Hakko 936 or similar)
Eutectic (63/37) rosin core or "no clean" solder (.025" diameter is usually best)
Good-quality DMM
Small needle nose pliers
Small diagonal cutters
Wire stripper
Phillips screwdriver (#1)
Precision straight blade screwdriver (for adjusting potentiometers)

Highly Recommended Tools Lead bender (Mouser 5166 -801) T-Handle wrench and 4-40 tap (Hanson 12001 and 8012) MOLEX crimp tool (Waldom W-HT1919 or equivalent) Magnifying glass

Optional Tools
Panavise w/ circuit board head
1/4" nut driver
5/16" nut driver
Oscilloscope
Signal generator

Work Area

Find a clean, flat, stable, well-lit surface on which to work. An anti-static mat is recommended for this project. If you're in a dry, static-prone environment, it's highly recommended. The importance of good lighting can't be overstated. Component markings are tiny, and you'll be deciphering a lot of them.

Soldering Technique

Make sure your iron's tip is tinned properly, and keep it clean! The trick to making perfect solder joints is to heat the joint quickly and thoroughly before applying the solder, and a properly tinned and clean tip is essential for this. Apply enough solder to form a "fillet" between the lead and the pad, a little mound of solder that smoothly transitions from the plane of the board up to the lead, **but don't use too much**. The finished joint should be smooth and shiny, not rough or gritty looking.

If you've never soldered a board with plated-through holes, you might be surprised to discover how difficult it can be to remove a component once you've soldered it in place. If you're using solder wick to correct a mistake, be very careful not to overheat the pads, since they will eventually delaminate and "lift". It's often better to sacrifice the component and remove its leads individually, and start over with a new part. If for some reason you need to unsolder a multipin component (like a rotary switch or integrated circuit), remove as much solder as you can with solder wick or a solder sucker, and then use a small heat gun to heat all the leads simultaneously. With care, you can remove the component without damaging the board.

Instruction Conventions

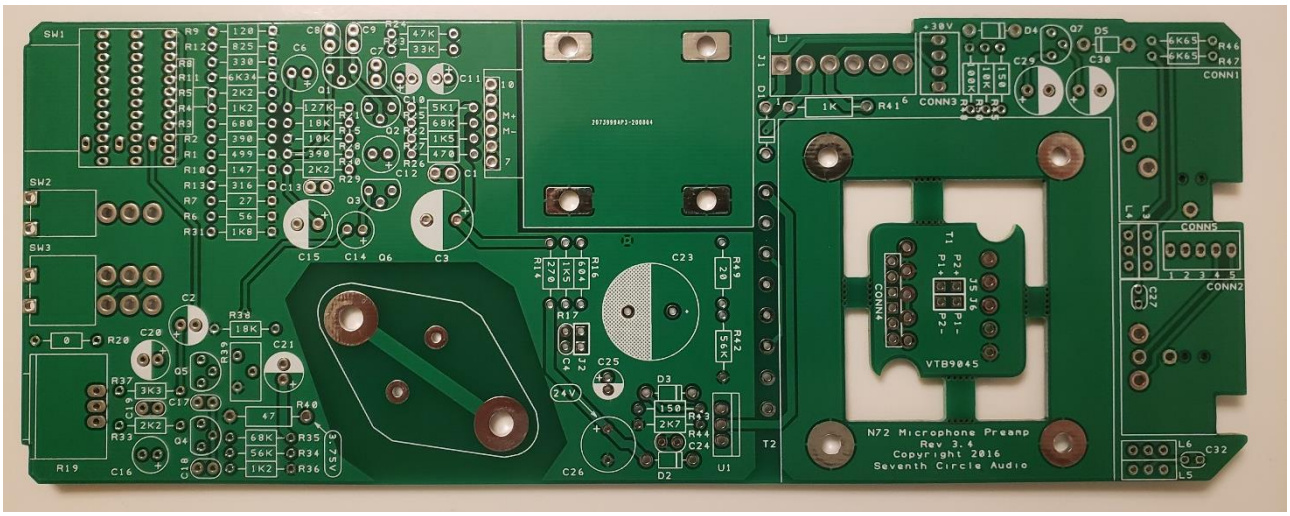
Text in **orange** indicates a step where extra care needs to be taken. Doing it wrong isn't a disaster, but it'll need to be corrected.

Text in **red** indicates a step that **must** be done correctly. Doing it wrong will guarantee improper operation, and probably damage components and/or the circuit board.

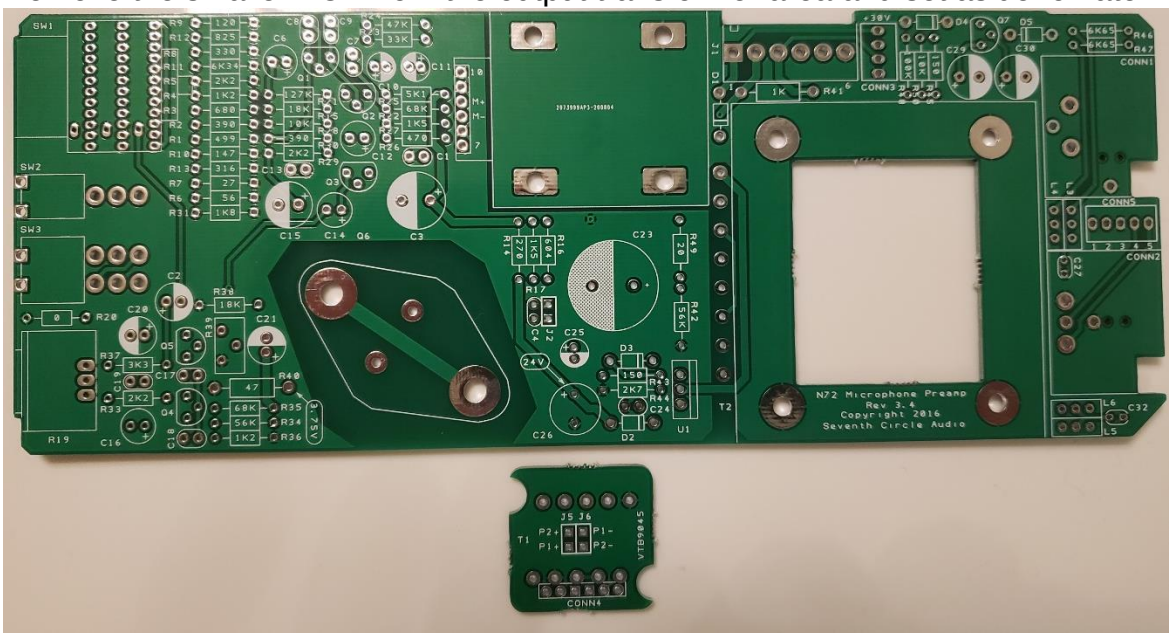
Assembly

1. Before you begin, carefully unpack the kit and examine the parts. Check the contents of each small bag against the BOM to make sure all the parts have been included. If you think something's missing, please e-mail the details to sales@seventhcircleaudio.com and we'll ship replacement parts ASAP.

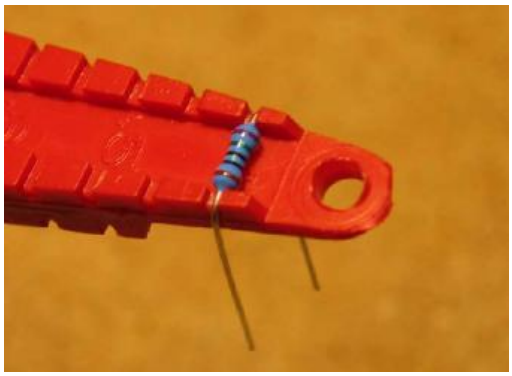
2. Generally, the idea when "stuffing" or "populating" a circuit board by hand is to start with the lowest profile parts, such as the resistors, and work your way up to the taller components. In each step below, insert the components, flip the board onto your work surface component-side down, and carefully solder and trim the leads. Use a piece of stiff cardboard to hold the parts in place while you flip the board. First, orient the board as shown.



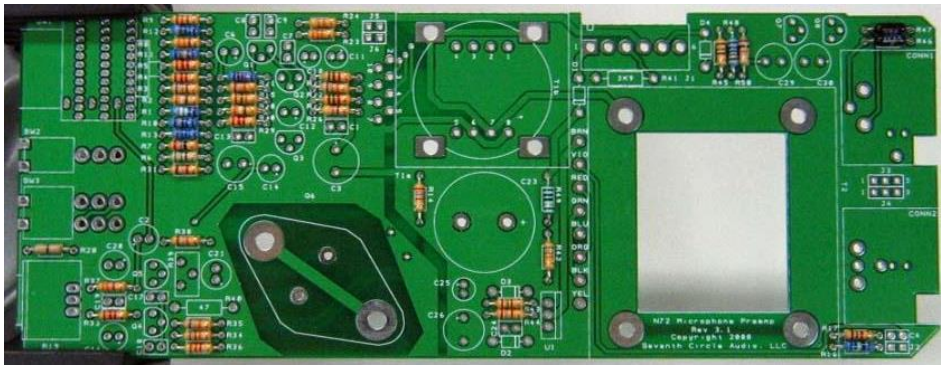
3. Remove the smaller PCB from the output transformer area and set aside for later.



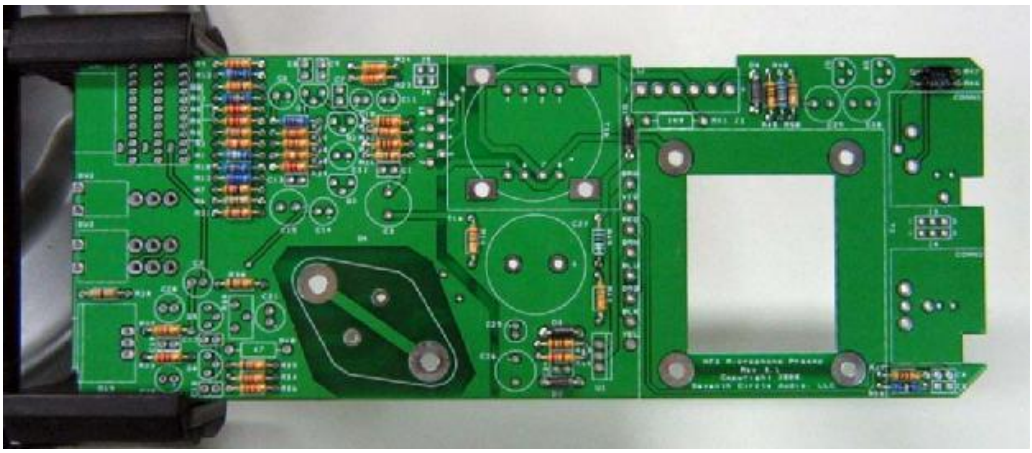
4. Before installing the resistors, prepare the leads using small needle nose pliers or a lead-forming tool as shown below. Whatever you do, don't bend the leads at the resistor body and force them into the board. This not only results in an ugly job, it can damage the parts.



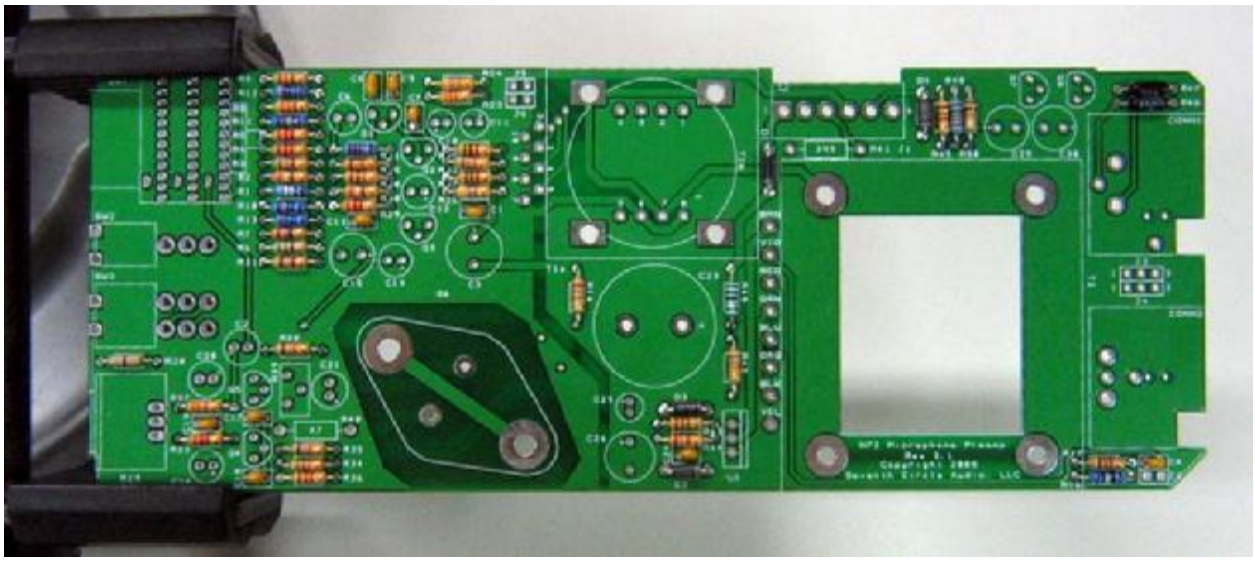
4. Insert the 1/4-watt resistors. Check the Bill of Materials (BOM) for help in reading the resistor color bands. It's also a good idea to actually measure each resistor with your DMM as you place it on the board in case you've read it incorrectly. Don't rely on the photos for component placement. If the resistor value silk-screened on the board doesn't agree with the value on the schematic or parts list, follow the schematic.



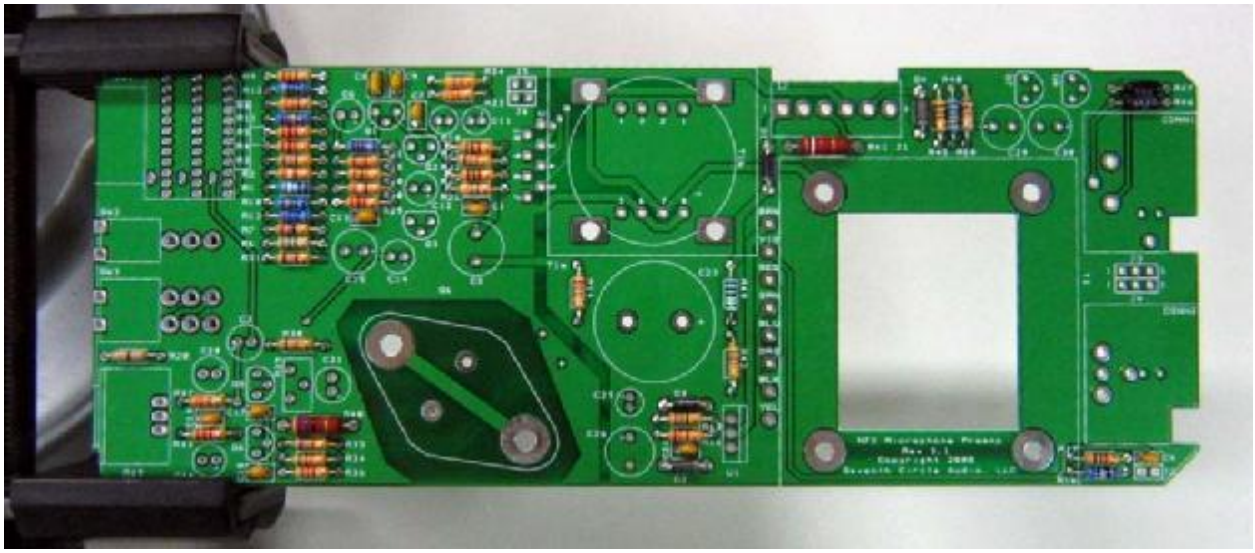
5. Add protection diodes D1 through D5. **Diodes are polarized and must be installed the right way round!** The colored band on the diode matches the white band on the silkscreen.



6. Add the ceramic capacitors. These capacitors are not polarized and can be installed in either direction, **but pay close attention to the capacitor markings!** These parts look very similar but they are not interchangeable. Putting one in the wrong spot may not prevent the N72 from passing signal, but it could seriously impair its performance.

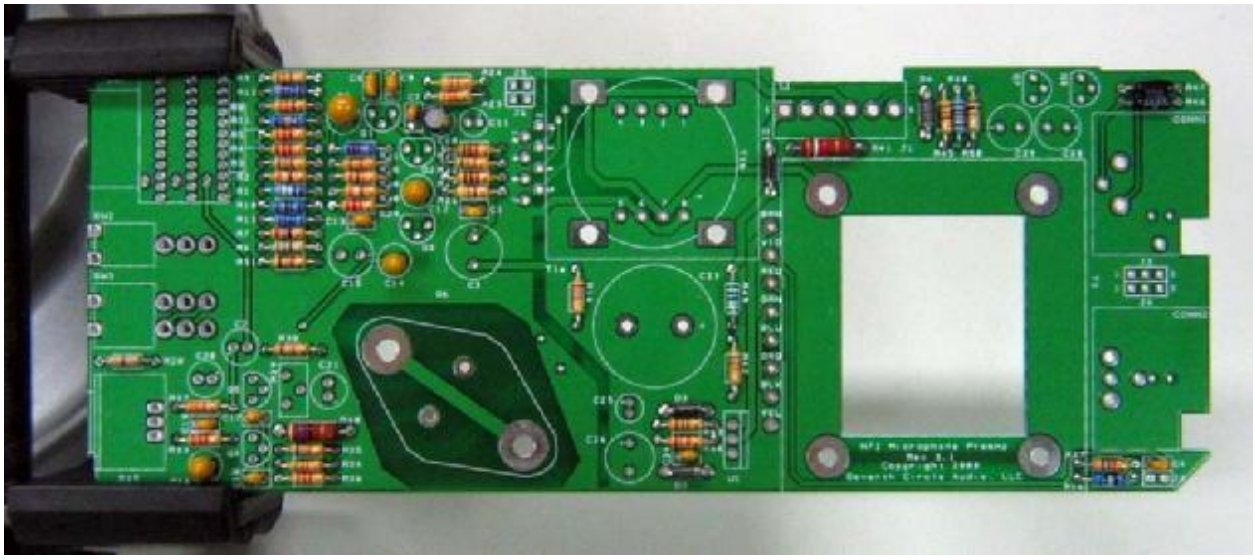


7. Add the large resistors at R40 and R41. Add blue, 3-pin filters (For Rev 3.4)

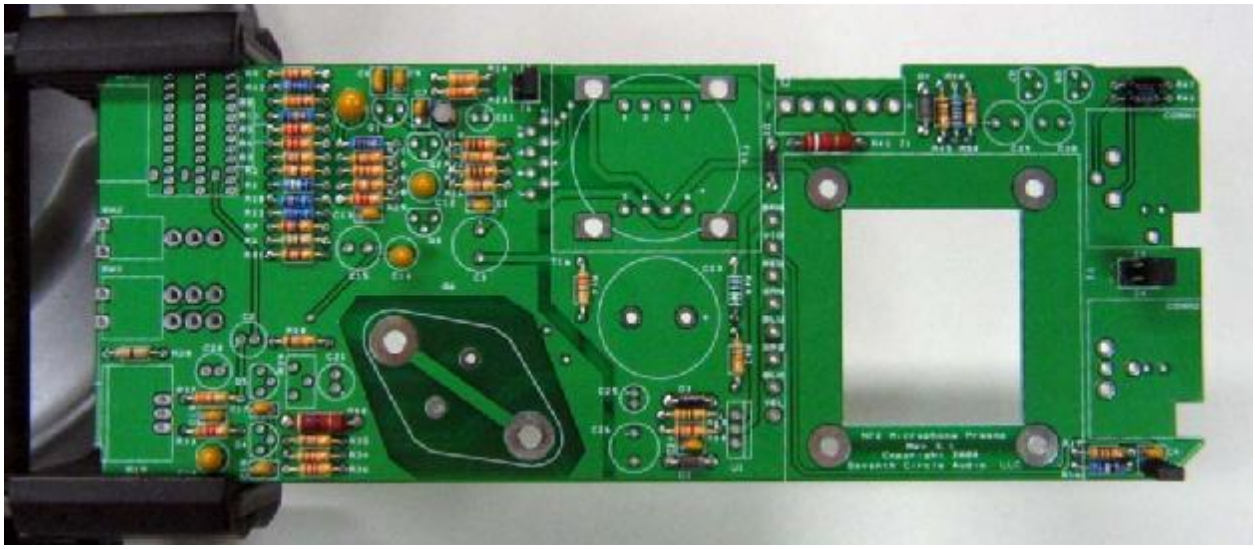


8. Add electrolytic capacitor C10. **Electrolytic capacitors are polarized and must be installed the right way round!** Be absolutely sure to observe the correct polarity when installing these parts. The **negative leads** of the electrolytic caps are marked with a colored stripe. The **positive pads** on the circuit board are marked with a small "+" sign.

9. Add the tantalum capacitors C6, C12, C14 and C16. **Tantalum electrolytic capacitors are polarized and must be installed the right way round!** Be absolutely sure to observe the correct polarity when installing these parts. The **positive leads** of the tantalum caps are marked with a small "+" sign. The **positive pads** on the circuit board are marked with a small "+" sign.

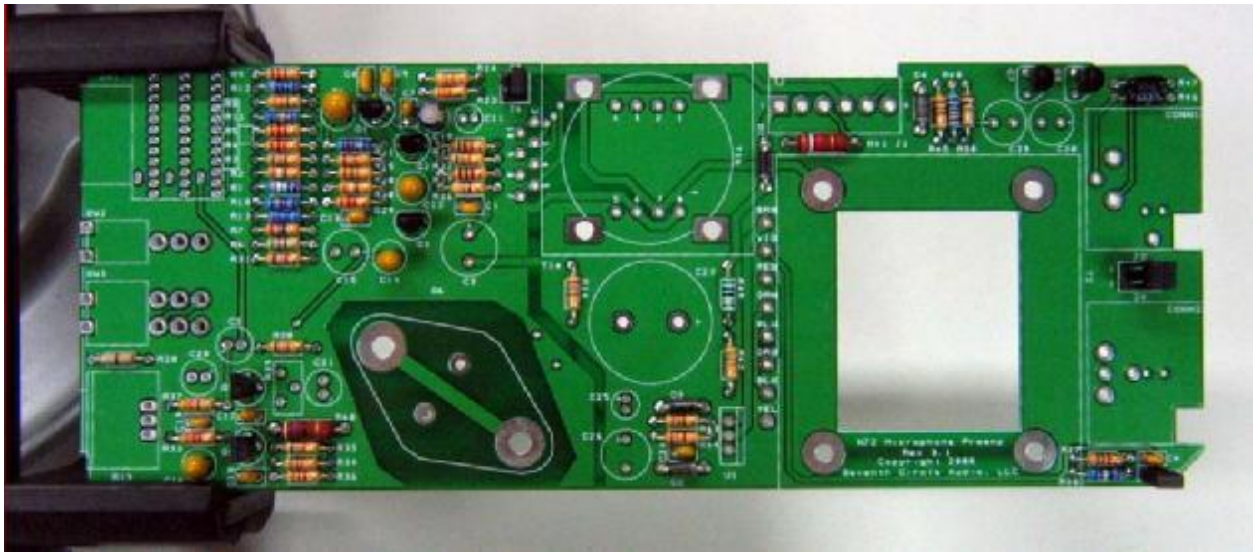


10. Add the 0.1" headers J2 through J6. (Not all necessary for Rev 3.4) See the **Jumper Settings** section at the end of this document for information on using the jumpers.

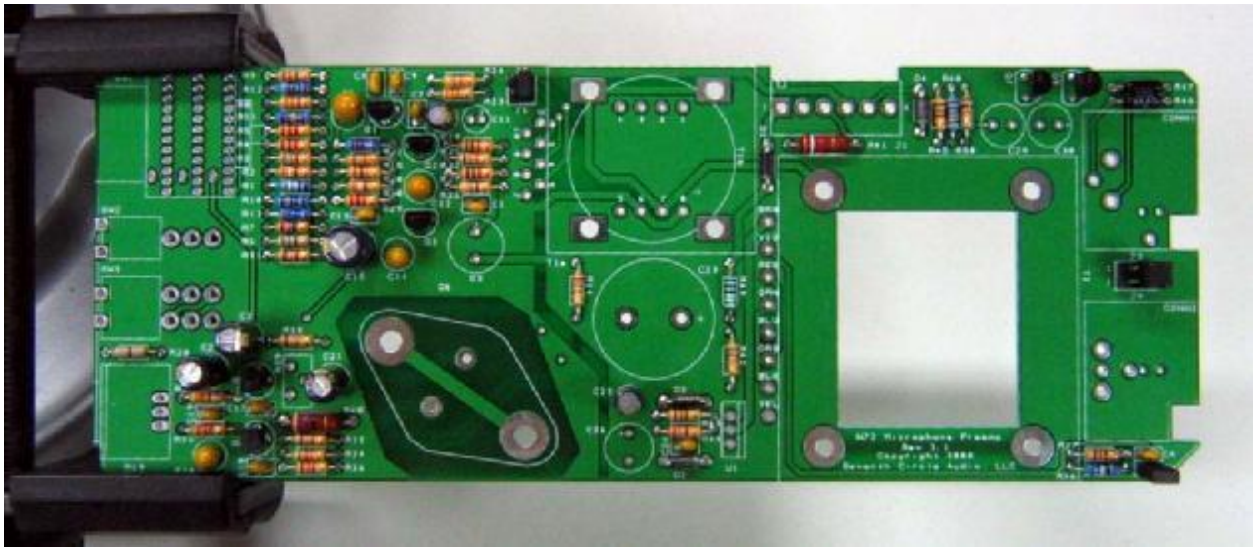


11. Install BC184C transistors Q1 through Q5. These parts are **not** the same and are **not** interchangeable with the MPSA06 transistor. **You must read the part numbers!** Align the flat side of the transistor with the flat side of the silkscreen outline. Do not push the transistors too far into the board.

12. Add Q7. This part is **not** the same and are **not** interchangeable with the BC184C transistors. **You must read the part numbers!** Align the flat side of the transistor with the flat side of the silkscreen outline. Do not push the transistors too far into the board.

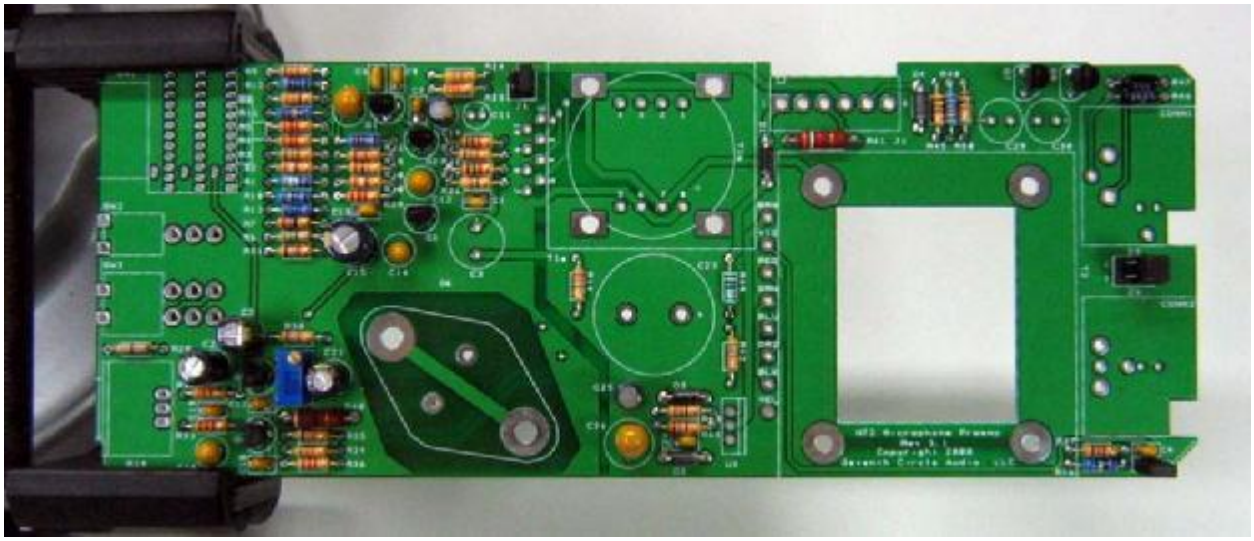


13. Add C2, C15, C20, C21, and C25. Again, **electrolytic capacitors are polarized and must be installed the right way round!** Be absolutely sure to observe the correct polarity when installing these parts. The **negative leads** of the electrolytic caps are marked with a colored stripe. The **positive pads** on the circuit board are marked with a small "+" sign.

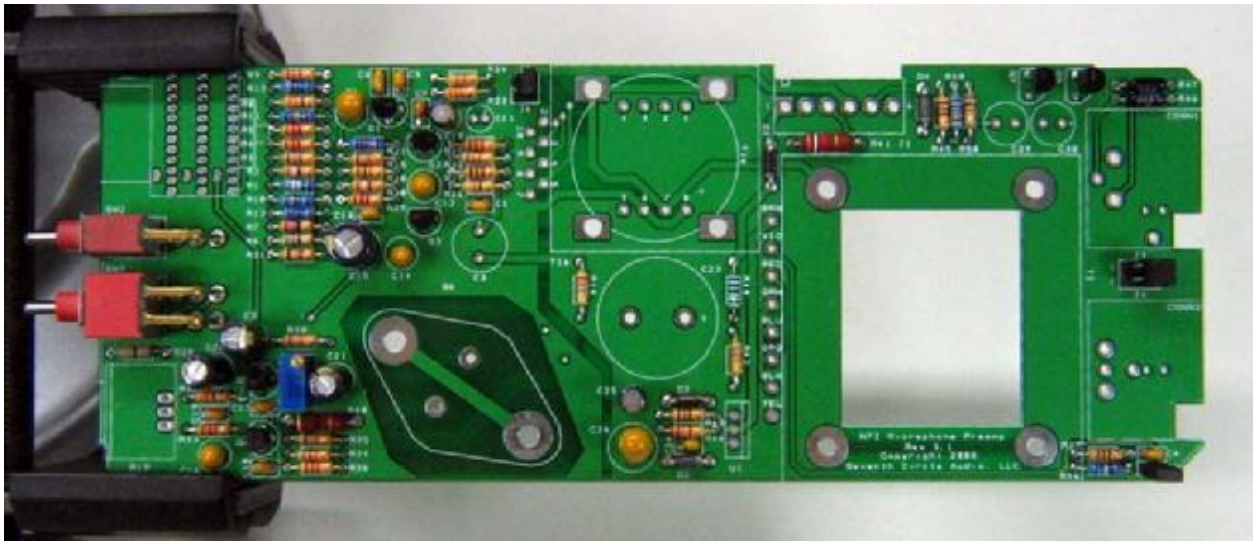


14. Add R39, the bias trim potentiometer.

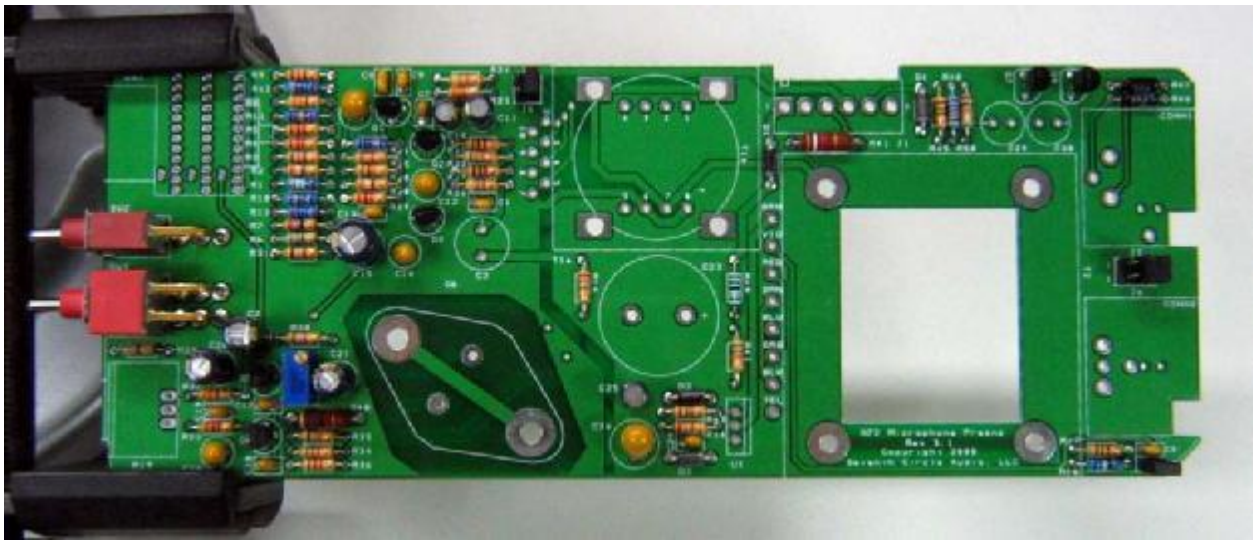
15. Install tantalum capacitor C26. Again, **tantalum capacitors are polarized and must be installed the right way round!** Be absolutely sure to observe the correct polarity when installing these parts. The **positive leads** of the tantalum caps are marked with a small "+" sign. The **positive pads** on the circuit board are marked with a small "+" sign.



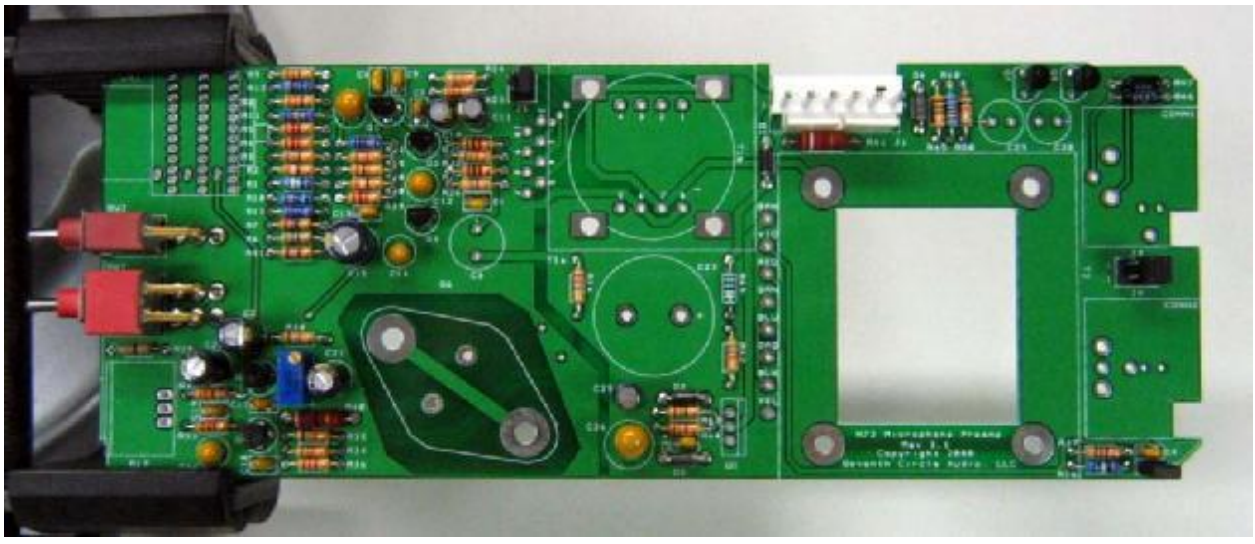
16. Carefully mount the toggle switches. Be sure they're seated flat on the board before soldering all of the pins. You may find it easier to solder the first pin with the board component side up.



17. Install C11. Again, **electrolytic capacitors are polarized and must be installed the right way round!** Be absolutely sure to observe the correct polarity when installing these parts. The **negative leads** of the electrolytic caps are marked with a colored stripe. The **positive pads** on the circuit board are marked with a small "+" sign.



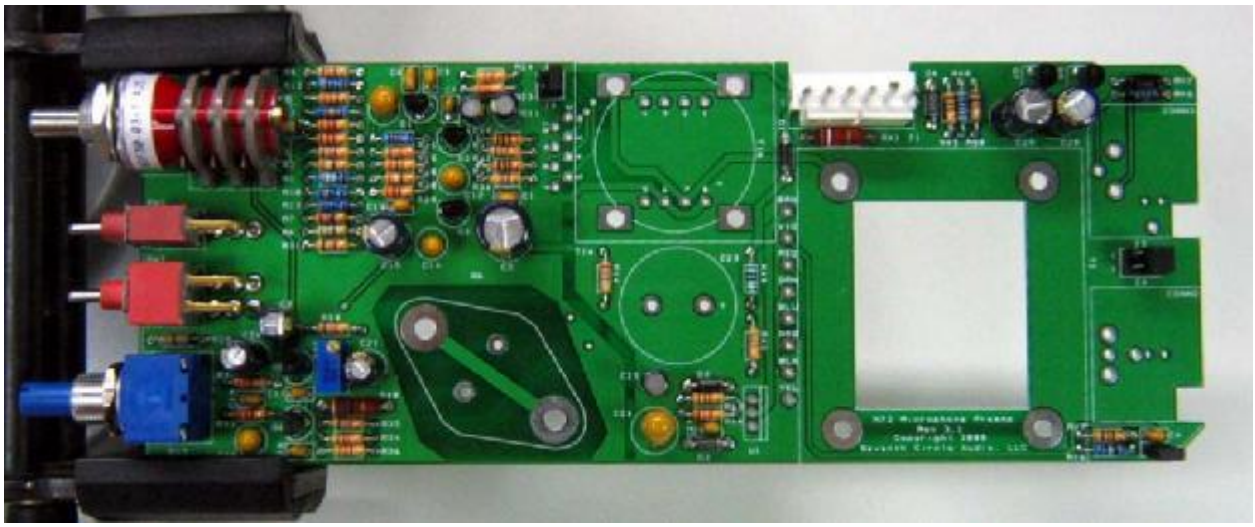
18. Add J1, the MOLEX power connector. Be sure to orient it as shown, with the locking tab away from the edge of the board.



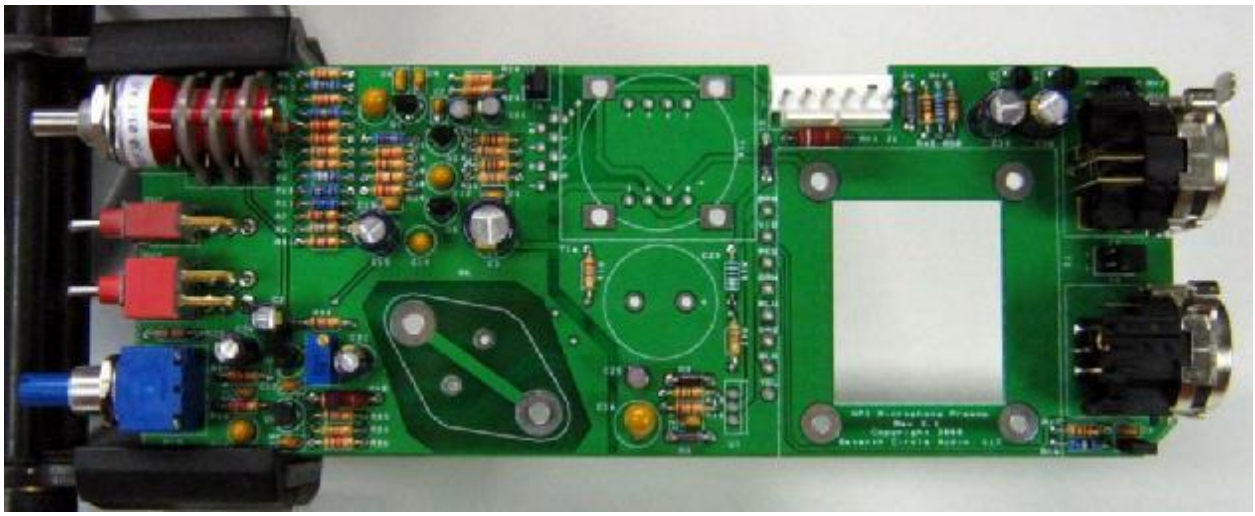
19. Add C3, C29 and C30. Again, **electrolytic capacitors are polarized and must be installed the right way round!** Be absolutely sure to observe the correct polarity when installing these parts. The **negative leads** of the electrolytic caps are marked with a colored stripe. The **positive pads** on the circuit board are marked with a small "+" sign.

22. Make sure the rotary switch is fully seated and solder it to the board. Try to make your solder joints as neat as possible, and don't use too much solder.

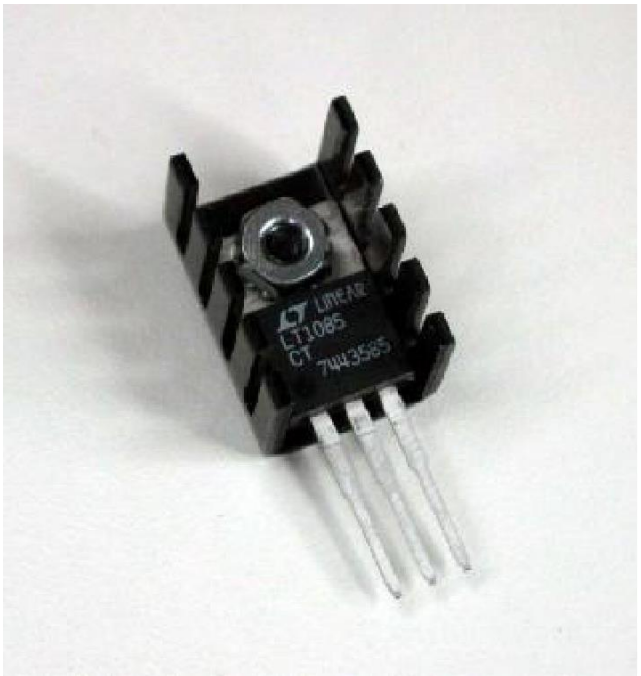
23. Attach gain trim control / output fader R19. Make sure the control is seated flat to the board before soldering the leads. You may want to add a small dab of silicone adhesive to the bottom of the control to hold it more securely, but it isn't necessary. If you want R19 to act as a 6dB trim control instead of a full fader, install a 10K resistor at R20 instead of a jumper.

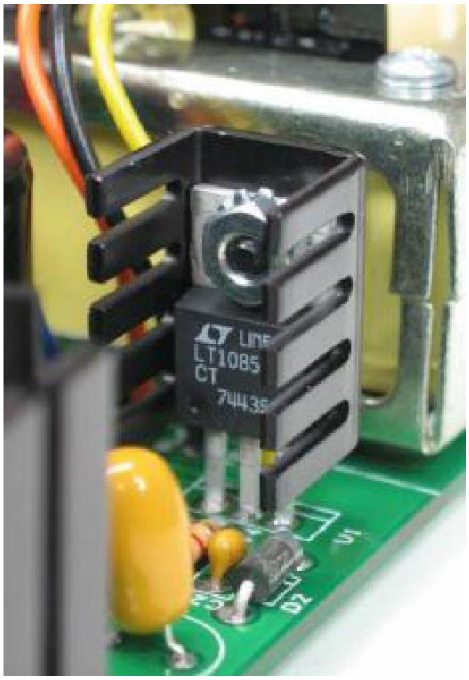


25. Add CONN1 and CONN2 to the board. Make sure they're fully seated before soldering. **Use the BLACK ¼" screws with the XLR's!!!**



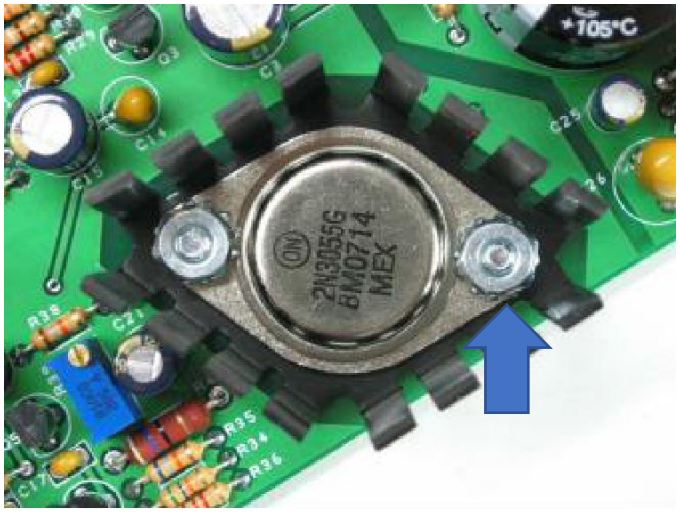
26. Using a #4-40 x ¼" screw and a #4 Keps nut, attach the small heat sink to voltage regulator U1. **Insert the screw from the back.** Solder the regulator to the board as shown.



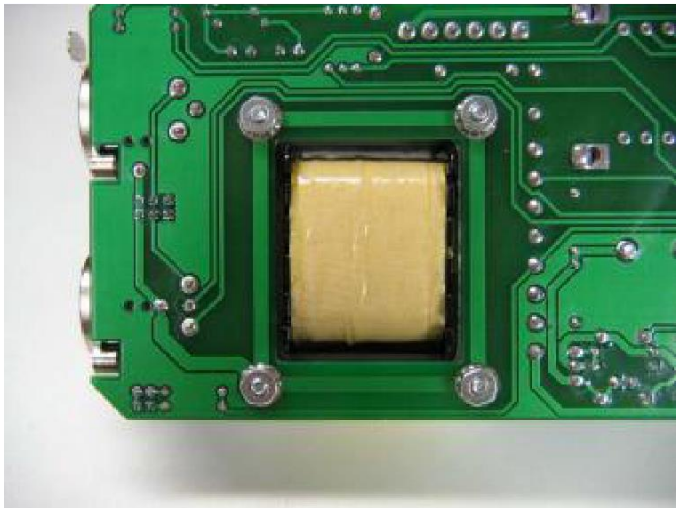


27. Install Q6 and large heat sink. Place the transistor into the heat sink first, and then maneuver the leads into the PCB. Note that the holes in the heat sink are offset to match the leads on the 2N3055. **Don't mount the heat sink backwards.** Insert two #6-32 x 3/8" screws **from the bottom of the board** and secure with #6 Keps nuts. Solder Q6 to the board.

MAKE ABSOLUTLY SURE THAT THE FINS OF THE HEATSINK DO NOT GO PAST THE EDGE OF THE PCB!!! THIS WILL SHORT TO THE CHASSIS CAUSING PARTS TO FRY! BEND THE FINS UP AWAY FROM THE BOARD EDGE SLIGHTLY, IF NEEDED!



28. Mount the output transformer to the board using four #4-40 x 1 ¼" screws. If you are installing into a PC01, don't mount yet, but do attach the wires! Use a nylon spacer on each screw to separate the transformer from the circuit board. Try the 1/8" spacers first. If they're too big, use the 1/16" spacers. Secure with #4 Keps nuts.

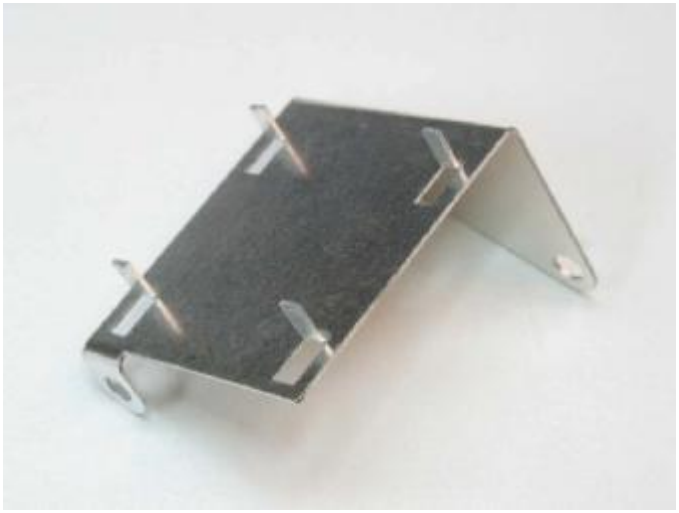


29. Trim the leads to length and strip about 1/4" of insulation from the ends. Twist the strands together and tin each lead with solder.

30. Solder the leads as shown. The color code is screened onto the PC board.
BROWN, VIOLET, RED, GREEN, BLUE, ORANGE, BLACK, YELLOW

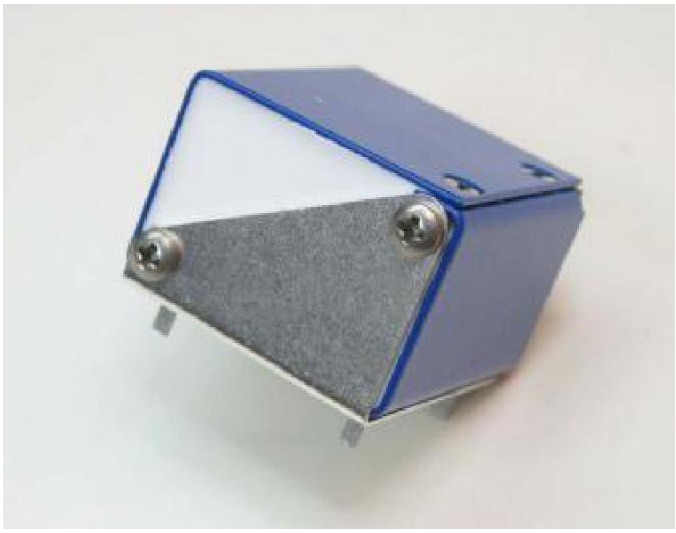
31. Install filter capacitor C23. Push it in firmly until **fully seated against the board**. Again, **electrolytic capacitors are polarized and must be installed the right way round!** Be absolutely sure to observe the correct polarity when installing C23.

32. Bend the tabs on the input transformer mounting bracket as shown.

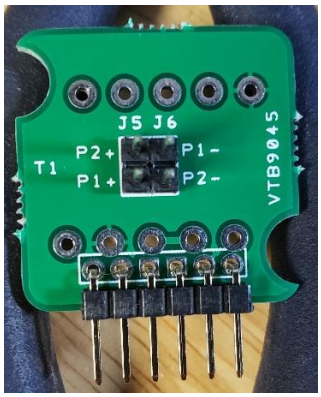


33. Attach the input transformer to the bracket using one of the existing screws on the front…

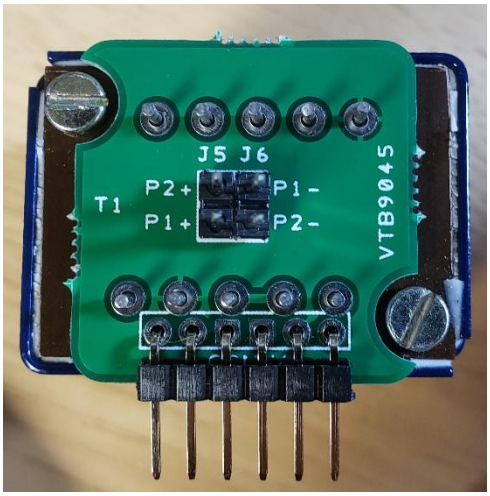
34. and two #4-48 screws on the back.



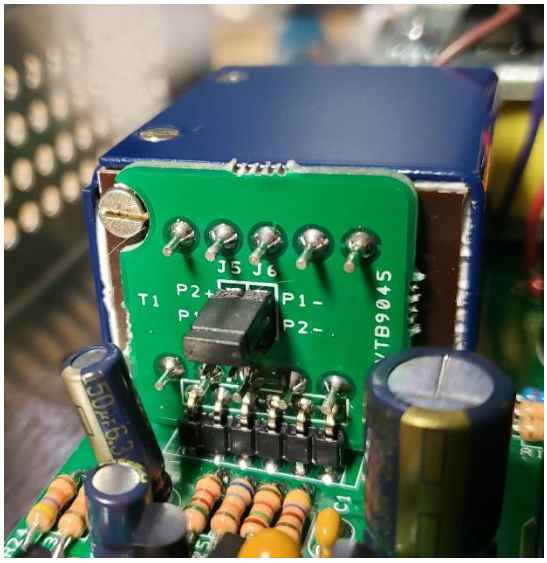
35. Add J5, J6 and Conn 4 to the small PCB.



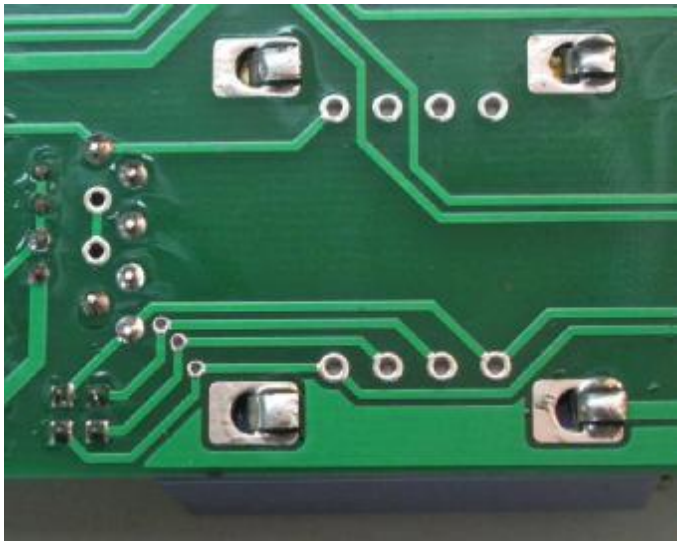
36. Place the PCB onto the pins of the blue input transformer, making sure that pins 2-6 are on top and 7-11 on the bottom. Solder the pins to the PCB.



41. Maneuver the leads into their respective holes on the PCB.



42. Bend the mounting tabs over until the bracket is secure. Solder the tabs and transformer leads as shown.



Initial Power-Up and Testing.

43. Before applying power, carefully check your work. Make sure you've got the right resistors in the right locations. Make absolutely sure you've got all the diodes and electrolytic capacitors soldered in the right way round! Double-check your input transformer wiring. Check for poor solder joints and solder bridges, and make sure you fix any problems before continuing.

44. Just to make sure you haven't created any blatant shorts, measure the resistance between pins 1 and 2 of J1. Do the same for pins 3 and 2. If you measure a steady resistance under 100 ohms, don't apply power. Carefully check your work until you *find that short.*

45. **Turn R39 counter-clockwise 25 full turns, OR until you hear a soft click with every revolution**. This turns the output transistors off so when you apply power there will be minimal current draw.

46. Connect the output of your PS03 to J1. Wire the power supply connectors together in a 1:1 fashion. That is, PS03 J2, pin 1 to N72 J1, pin 1, pin 2 to pin 2, etc. Apply power while keeping your finger on R40. If R40 gets too hot to touch or starts to smoke, disconnect the power immediately and check for mistakes. Possible things to look for are a miswired output transformer, loose Q6 mounting screws, improperly installed Q5 or Q6, shorts around Q6's heat sink, or incorrect resistor values around Q4, Q5, and Q6.

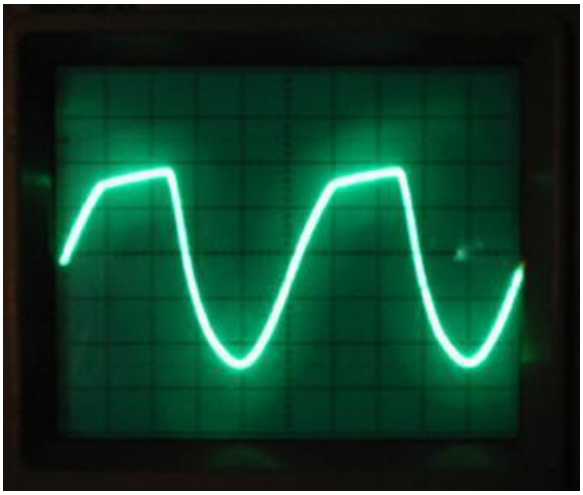
47. Set your DMM to read DC voltage of 20V or greater, and connect the negative lead to J1, pin 2 and the positive lead to the point on the PCB marked **"3.75V".** This is to the left of the large transistor and heatsink. Adjust R39 until the voltage gets to 3.75V. If you can't adjust the voltage to within 0.1V of 3.75, you've got problems. Go back and find 'em.

48. This is a table of voltages measured at each lead of each transistor in the circuit, which you can use to troubleshoot your N72 if it does not pass a signal or otherwise misbehaves. Your N72 should produce similar voltages, but even if it doesn't you don't necessarily have a problem. The important thing to recognize is the relationship between the collector, emitter, and base voltages. The collector will be the most positive, followed by the base and emitter. The base voltage should always be about 0.6V higher than the emitter voltage. If two pins on a transistor have exactly the same voltage, or the collector measures less then the base, for example, then you have a problem.

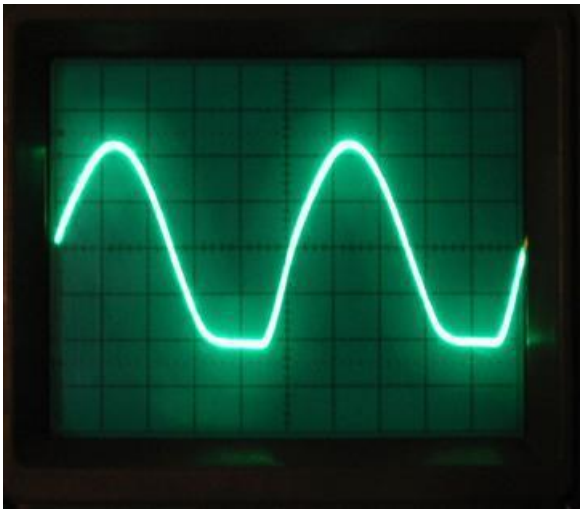
	Collector			Base			Emitter		
	Low	Avg	High	Low	Avg	High	Low	Avg	High
Q1	3.9	3.9	3.9	2.4	2.4	2.5	1.9	1.9	1.9
Q2	12.7	13.0	13.2	3.9	3.9	3.9	3.3	3.3	3.3
Q3	21.1	21.6	22.0	12.7	12.9	13.2	12.0	12.3	12.5
Q4	4.8	4.9	4.9	0.8	0.8	0.9	0.3	0.3	0.3
Q5	21.6	22.2	22.6	4.8	4.9	4.9	4.3	4.3	4.4
Q6	21.6	22.2	22.6	4.3	4.3	4.4	3.7	3.7	3.8

49. Fine Bias Adjustment (if you have an oscilloscope). This step is optional.

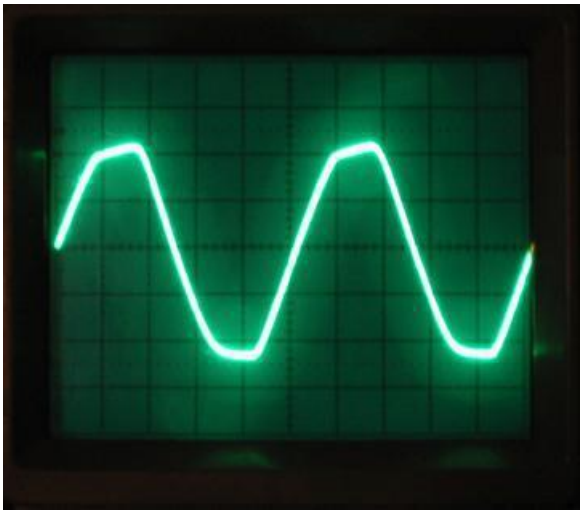
With a signal generator, apply a 0.5Vpp, 1KHz sine wave to pins 2 and 3 of CONN1, the XLR input connector. Rotate S1 fully CCW (minimum gain), then click back 5 positions CW. Connect an oscilloscope to the output connector CONN2. Connect the probe tip to pin 2 and the probe ground to pin 3. Set the vertical resolution to 10V/div and the horizontal resolution to 0.2mS/div. Rotate R19 fully clockwise. You should see a badly clipped sine wave. Back off R19 until the amp is just clipping both halves of the signal. Adjust R39 until the clipping is symmetrical. Note that the output at clipping is a whopping 49Vpp (27dBu). This is enough output to beat just about any tape machine or A/D converter into submission, or even to drive headphones to painful levels, so do be careful.



Positive Clipping



Negative Clipping



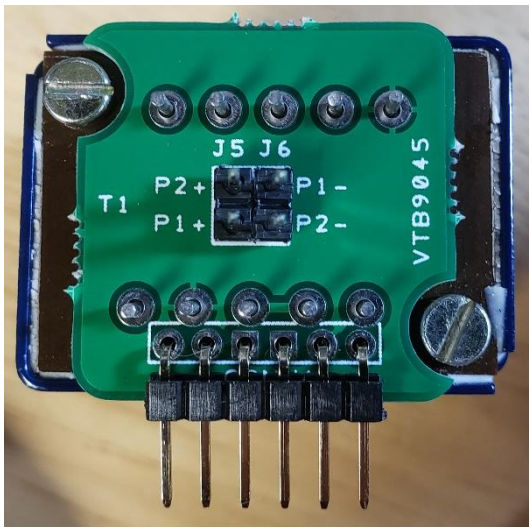
Symmetrical Clipping

Jumper Settings

50. J2 gives the option to connect a 604-ohm load resistor across the output. **Unless** you're connecting the N72 to a piece of older gear with 600 ohm input impedance, **install a jumper at J2**.

51. J5 and J6 allow input impedance to be switched from 300 ohms to 1200 ohms. Use a single jumper across J5 to J6 (P2+ to P1-) for 1200 ohms (recommended).

52. **Grounding Jumpers only needed for previous Rev's. Not 3.4! Set to Power GND unless having noise issues.**



53. Use two jumpers for 300 ohms (P2+ to P1+) and (P1- to P2-).