

## C84 Microphone Preamp

Based on the innovative “Double Balanced Microphone Amplifier” circuit published by Graham John Cohen in 1984, the C84 microphone preamp offers exceptional performance in any application where extremely low distortion and neutral sonic characteristics are desired.

### Who Should Build This Kit?

The C84 is not difficult to build, but it is not intended for absolute beginners. If you’ve never built an electronic project before, 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 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

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.

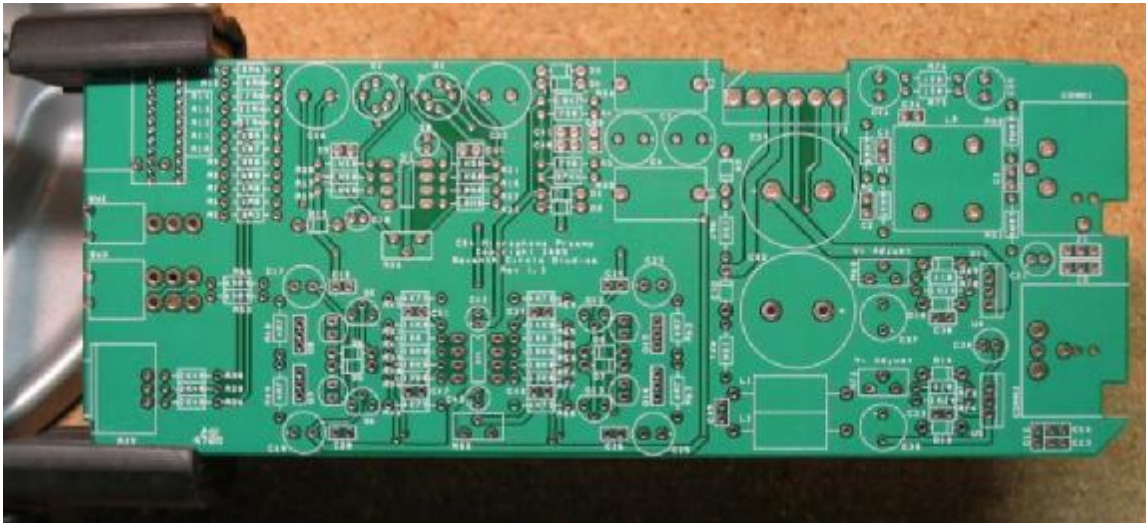
### Instruction Conventions

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.

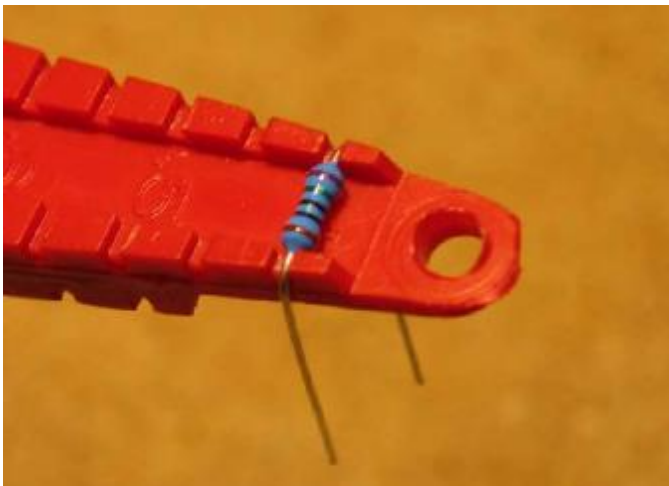
Text in **red** indicates a step that **must** be done correctly. Doing it wrong will guarantee improper operation, and probably damage components and/or the circuit board.

## Assembly

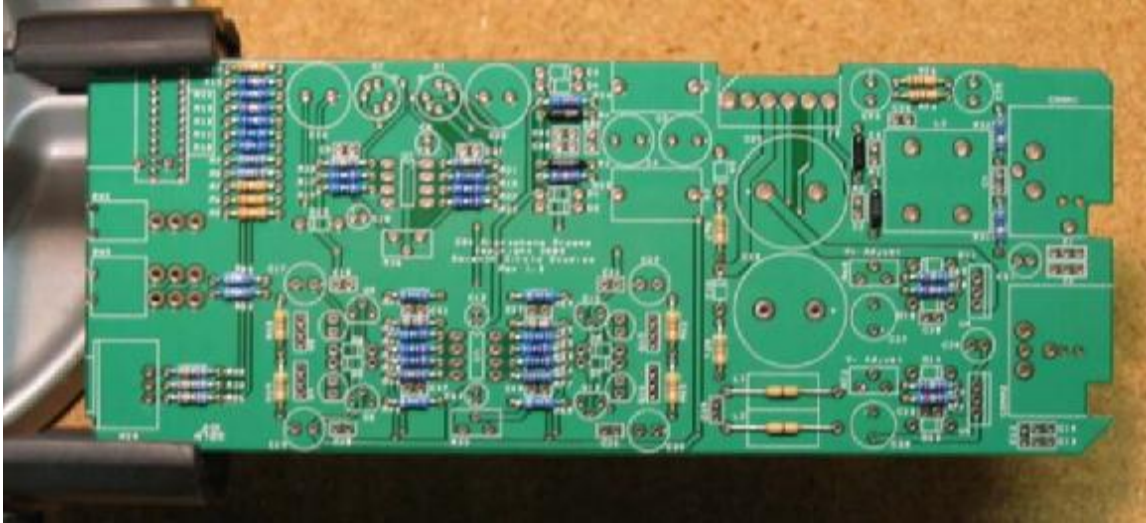
1. Before you begin, carefully unpack the kit and examine the parts. Check the contents of each small bag against the BOM to make sure all the parts have been included. If you think something's missing, please e-mail the details to [sales@seventhcircleaudio.com](mailto:sales@seventhcircleaudio.com) and 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.



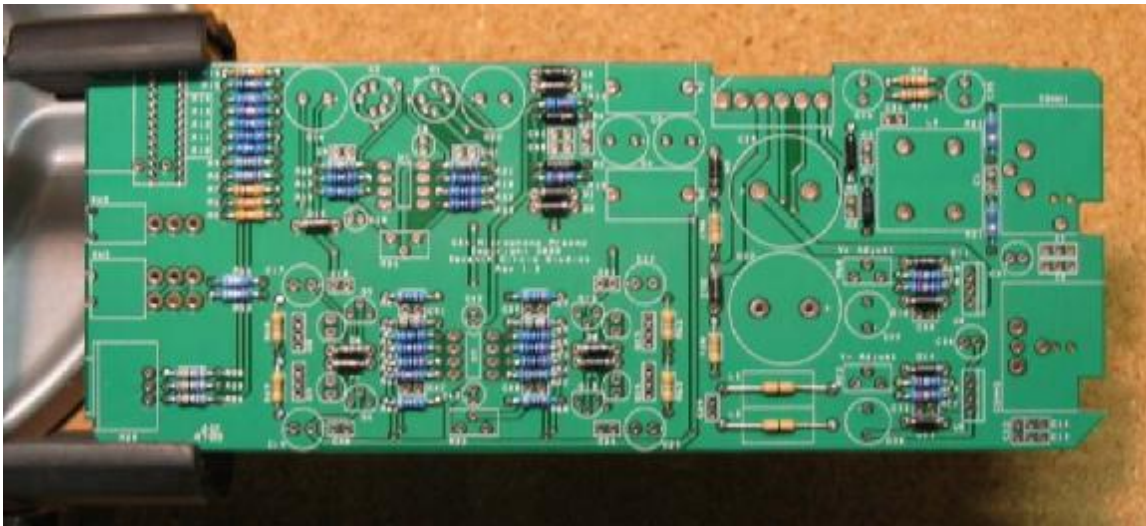
3. Before installing the resistors, prepare the leads using small needle nose pliers or a lead-forming tool as shown below. **Whatever you do, don't bend the leads at the resistor body and force them into the board.** This not only results in an ugly job, it can damage the parts.



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, just in case you've decoded 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.



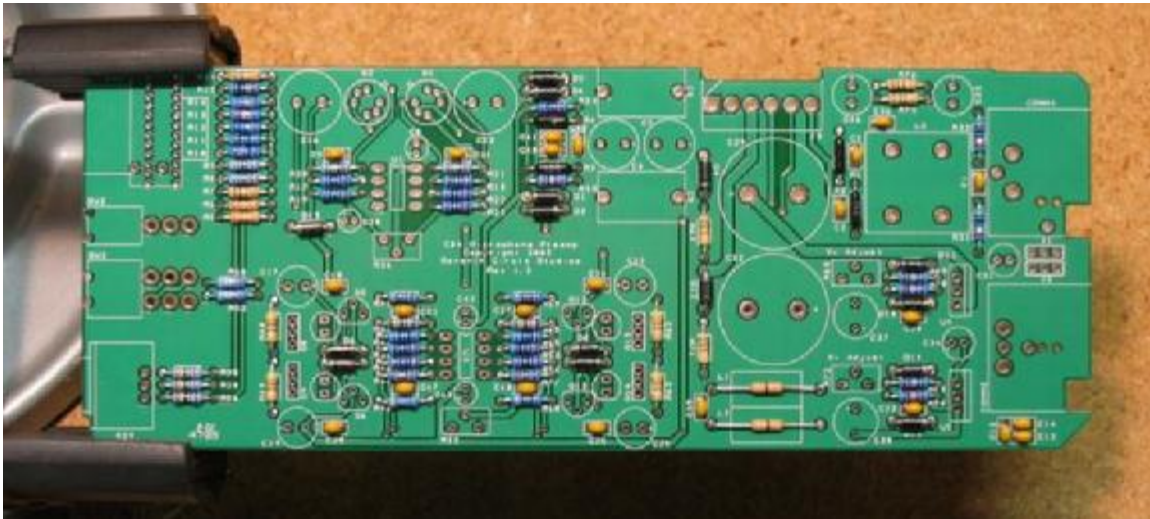
5. Next, add the protection diodes D1 through D15. **Diodes are polarized and must be installed the right way round!** The colored band on the diode matches the white band on the silkscreen.



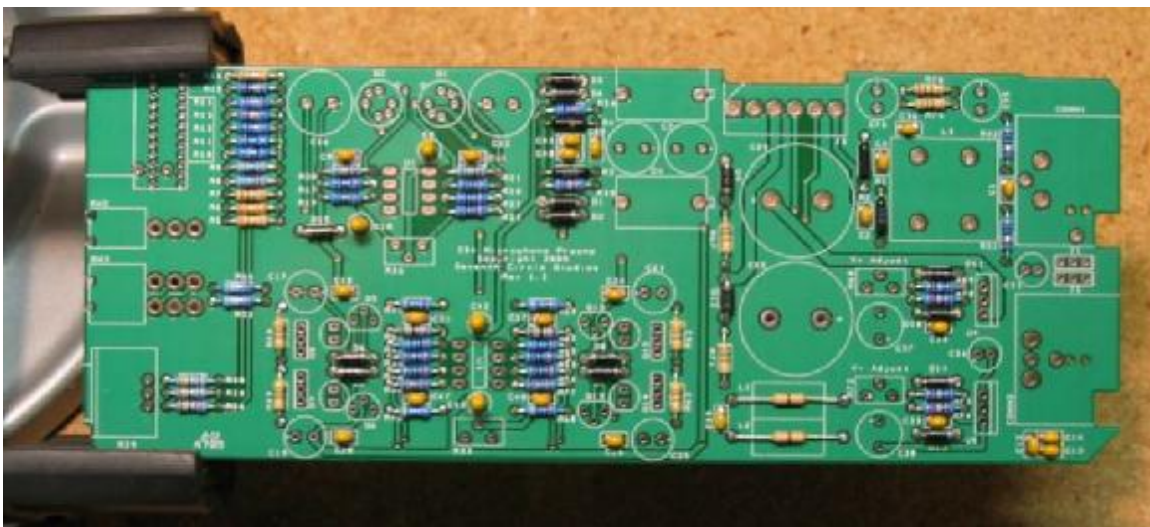


## C84 Assembly Instructions

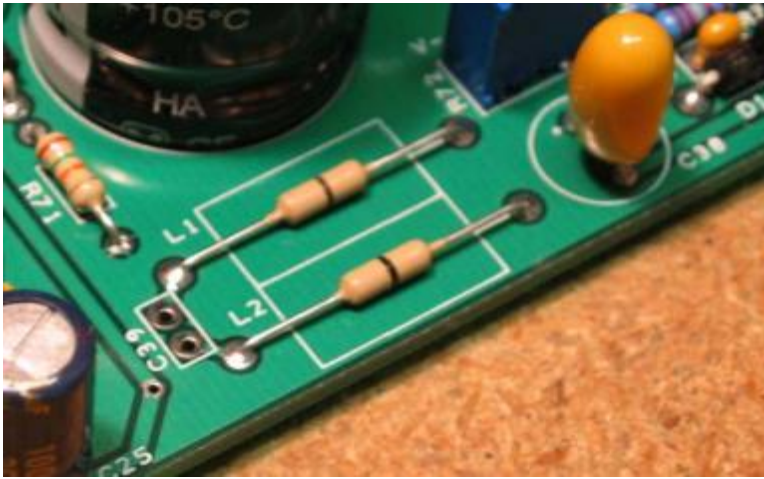
6. Add the ceramic capacitors C1, C2, C3, C9, C11, C12, C13, C14, C18, C20, C21, C24, C26, C27, C30, C33, C36, C39, C40, C41, C44, C47, and C48. These capacitors are not polarized and can be installed in either direction, **but pay close attention to the capacitor markings!** These parts all look alike, but they are not interchangeable. Putting one in the wrong spot will not prevent the preamp from passing signal, but it can seriously impair its performance.



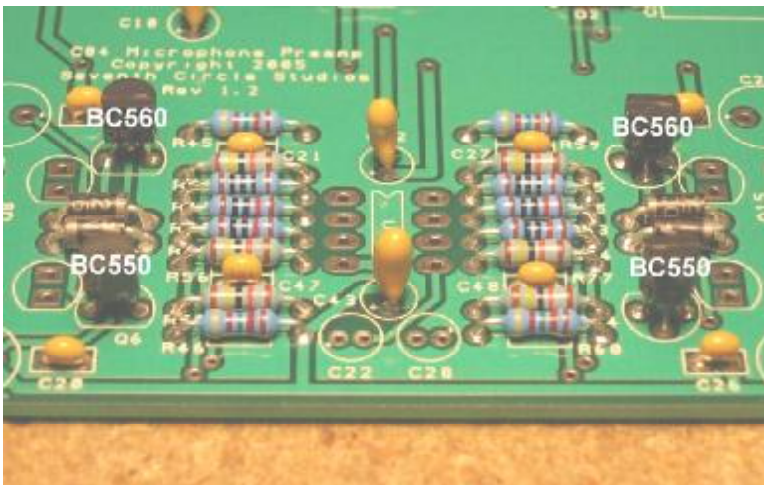
7. If you'd like the option of easily swapping or replacing the op-amps, now is the time to add the sockets. Don't add the op-amps themselves until later. **Sockets are optional and are not included in the kit.**
8. Add tantalum bypass capacitors C8, C10, C42, and C43. **Tantalum electrolytic capacitors 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.



9. If you need to drive extremely long cables (greater than 50m) or know that you'll be connecting the preamp to capacitive loads (you probably won't), add the "load isolator" inductors now. Otherwise, solder jumpers in their place as shown. **The load isolators are optional and are not included in the kit.**

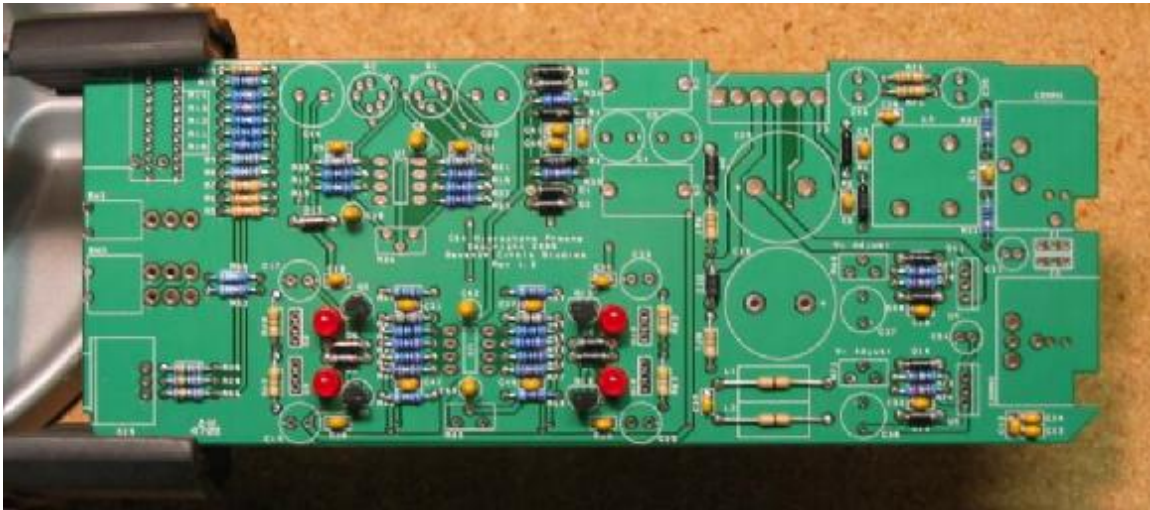


10. Add Q5, Q6, Q12, and Q13. **Make sure to install the transistors correctly!** These parts are not the same, and are not interchangeable. Align the flat side of the transistors with the flat side of the silkscreen outline.



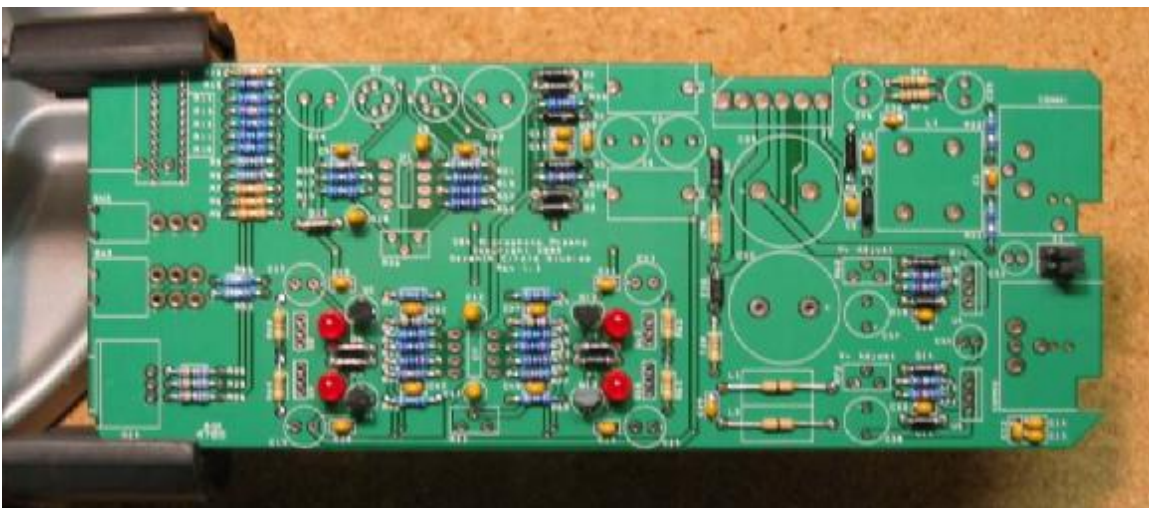


11. Insert the LEDs now. **LEDs are polarized and must be installed the right way round!** Align the flat side of the LED with the flat side of the silkscreen outline. Wiggle the LEDs until they're flush with the board.

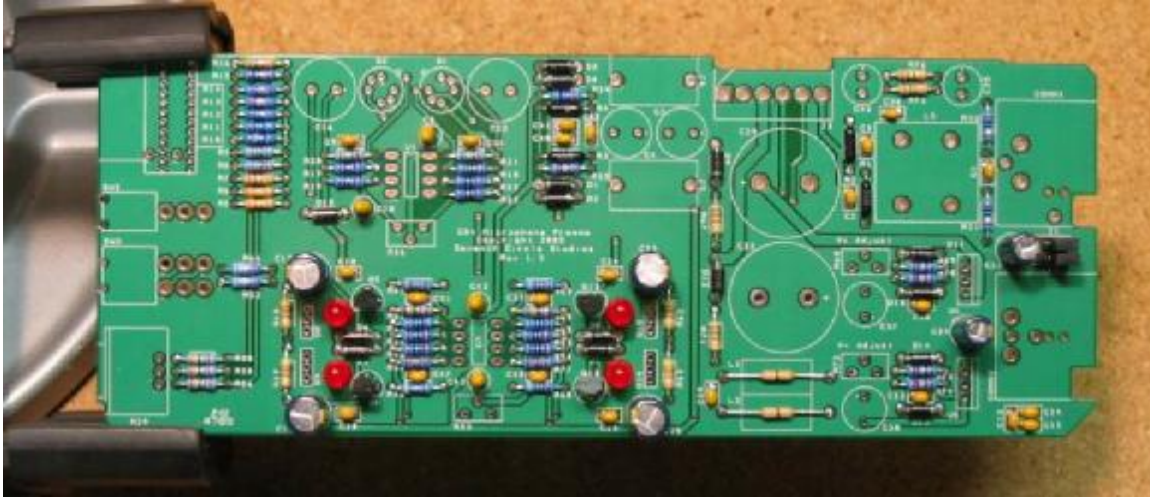


12. Add the 0.1" headers and shorting jumpers at J1 and J2. The jumpers connect the XLR cable shields as shown in the table below. Unless you encounter issues with ground loop hum, jumper pins 2 and 3 on both headers. **A jumper must be installed at J1 to complete the phantom power circuit.**

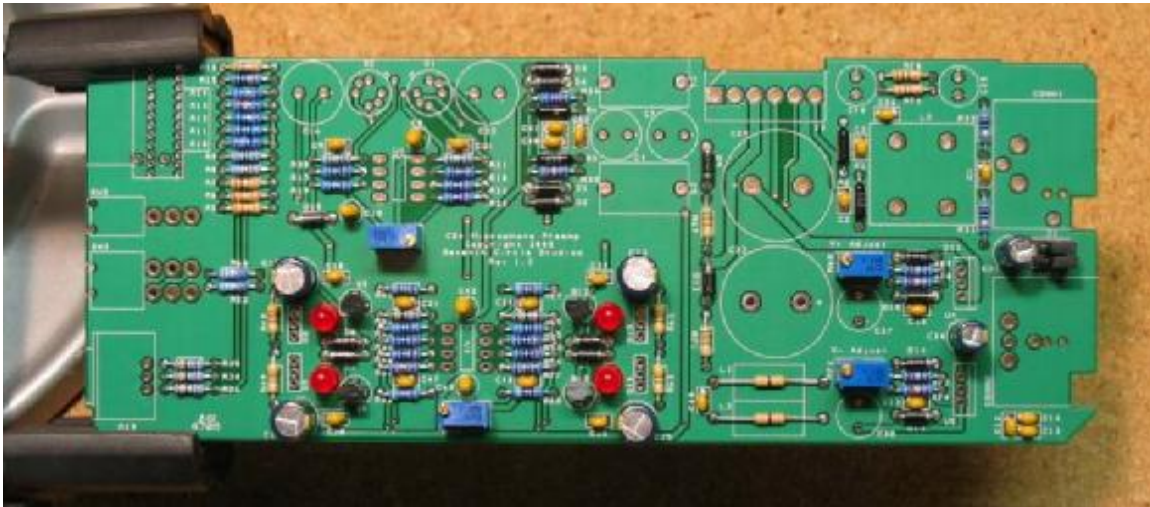
Jumper Location	Pins 1 and 2	Pins 2 and 3	No Jumper
J1 - Mic input	Power Ground	Chassis Ground	Floating
J2 - Line output	Power Ground	Chassis Ground	Floating



13. Add electrolytic capacitors C17, C19, C23, C25, C31, and C34. **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 the trim pots R33, R36, R68 and R72. **Pay close attention to the markings!** R68 and R72 are used to adjust the on-board voltage regulators. R33 and R36 trim DC offset and CMRR (Common Mode Rejection Ratio). These adjustments are described later.

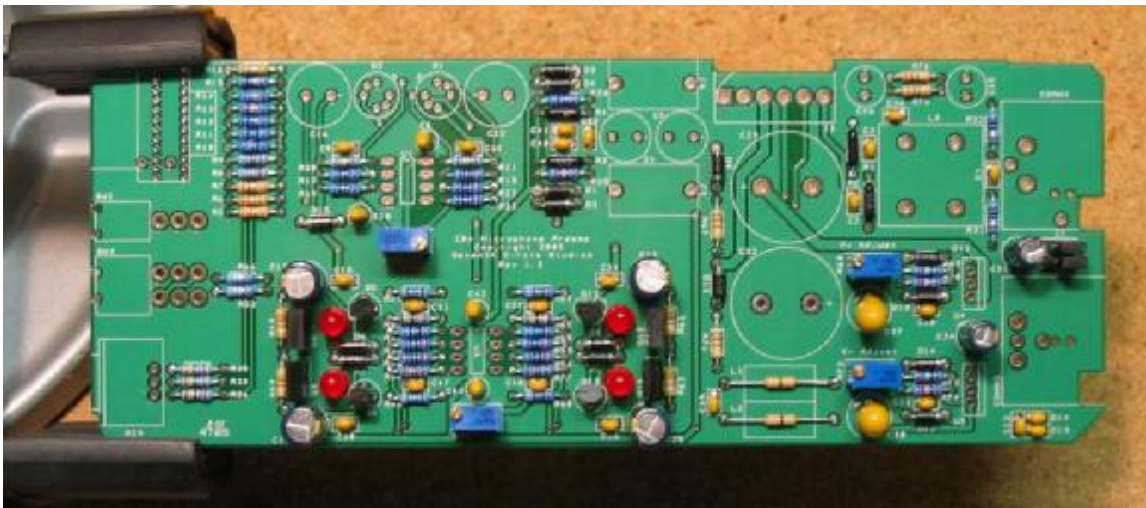




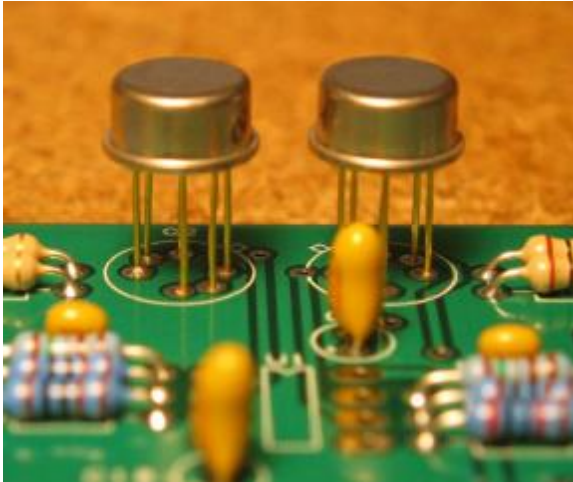
15. Add transistors Q8, Q9, Q15, and Q16. **Make sure to install the transistors correctly!** These parts are not the same, and are not interchangeable. Note the silkscreen outline is wider on one side; this indicates the back of the transistor. **Make absolutely sure you don't insert them backwards.**



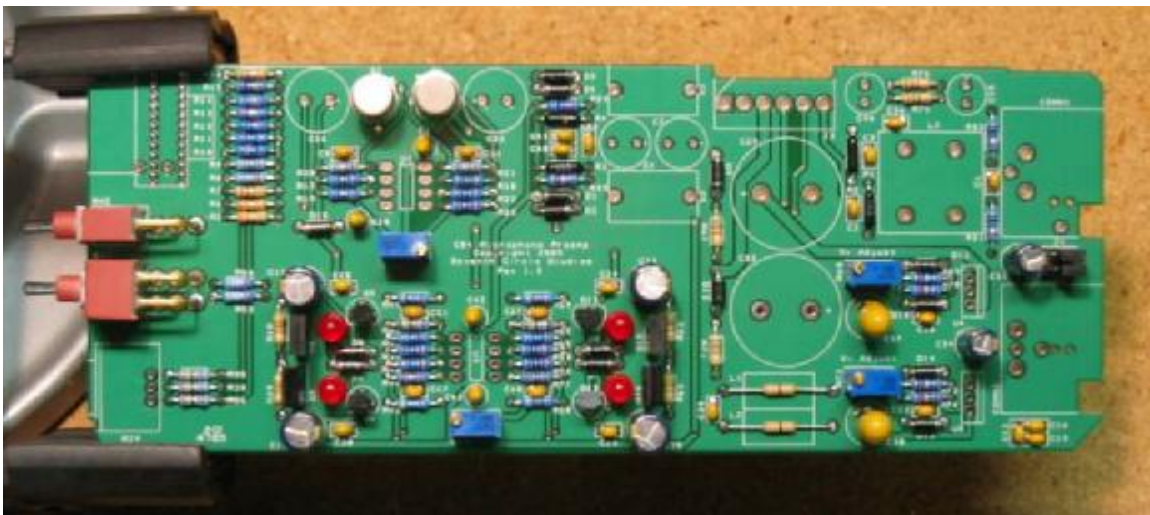
16. Add tantalum capacitors C37 and C38. **Tantalum electrolytic capacitors are polarized and must be installed the right way round!** Be absolutely sure to observe the correct polarity when installing these parts. The **positive leads** of the tantalum caps are marked with a small "+" sign. The **positive pads** on the circuit board are marked with a small "+" sign.



17. Install Q1 and Q2. Solder them offset from the board as shown, so that their tops are more or less even with the components installed in the previous 3 steps.

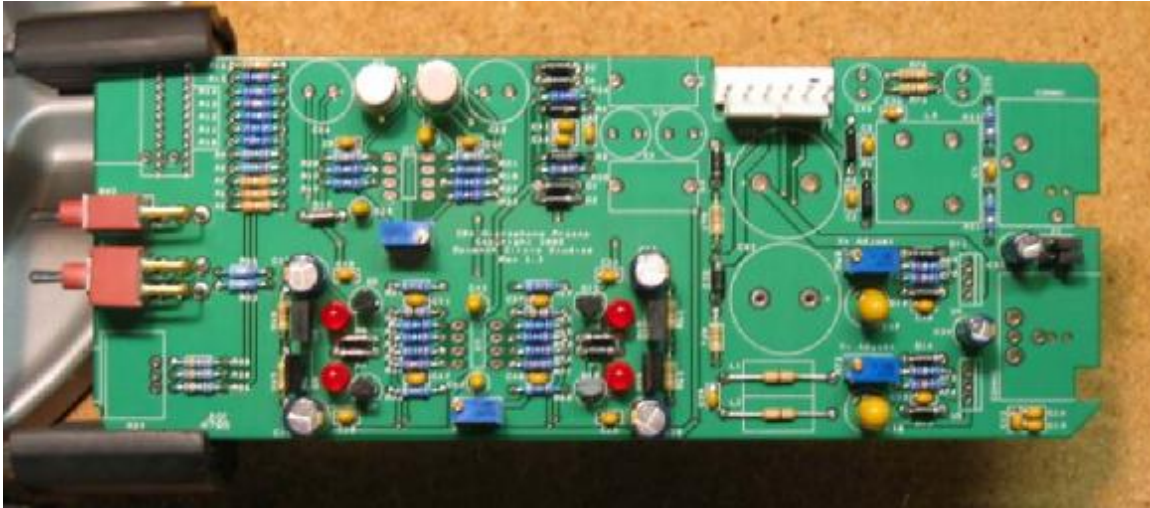


18. Carefully mount the toggle switches SW2 and SW3. Be sure they're seated flat on the board before soldering all of the pins. You may find it easier to solder the first pin with the board component side up.

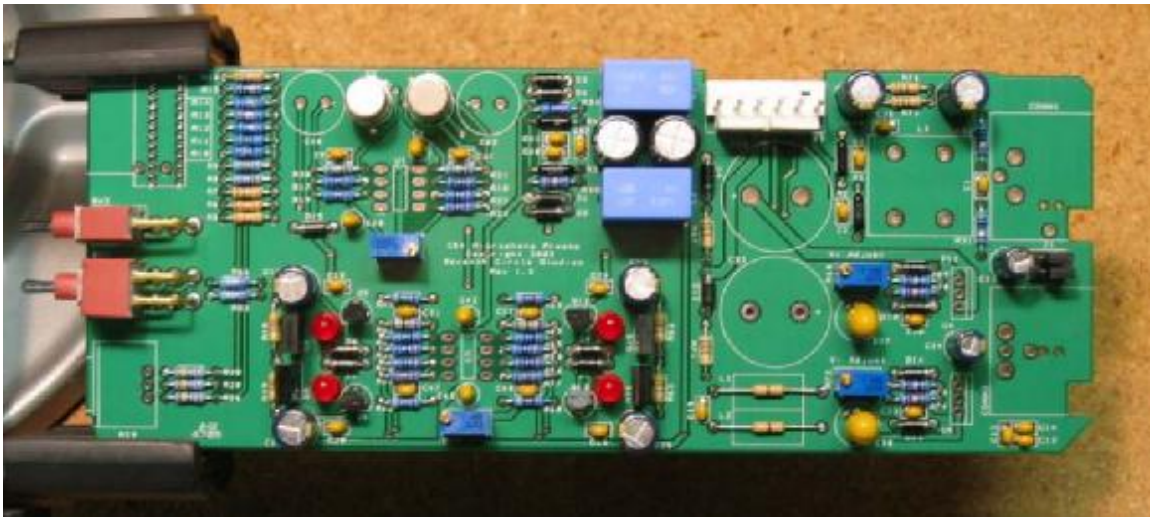




19. Add J3, the MOLEX power connector. Be sure to orient it as shown, with the locking tab away from the edge of the board.



20. Add electrolytic capacitors C4, C7, C35, and C46. C4 and C7 are not polarized, but C35 and C46 are. 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. Add polypropylene capacitors C5 and C6 as well.





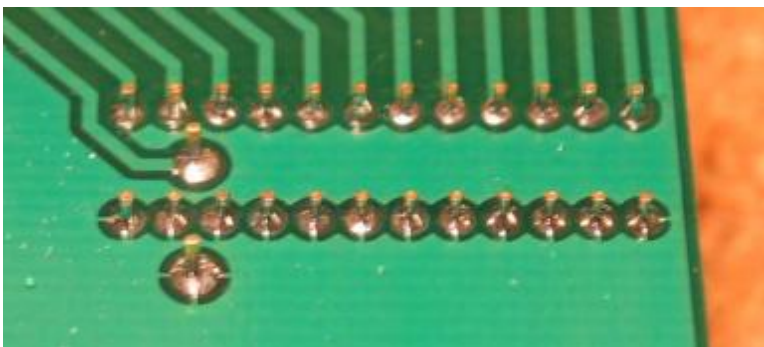
- 21.** Insert the stop pin in rotary switch SW1 at the position shown. Push the pin in completely.



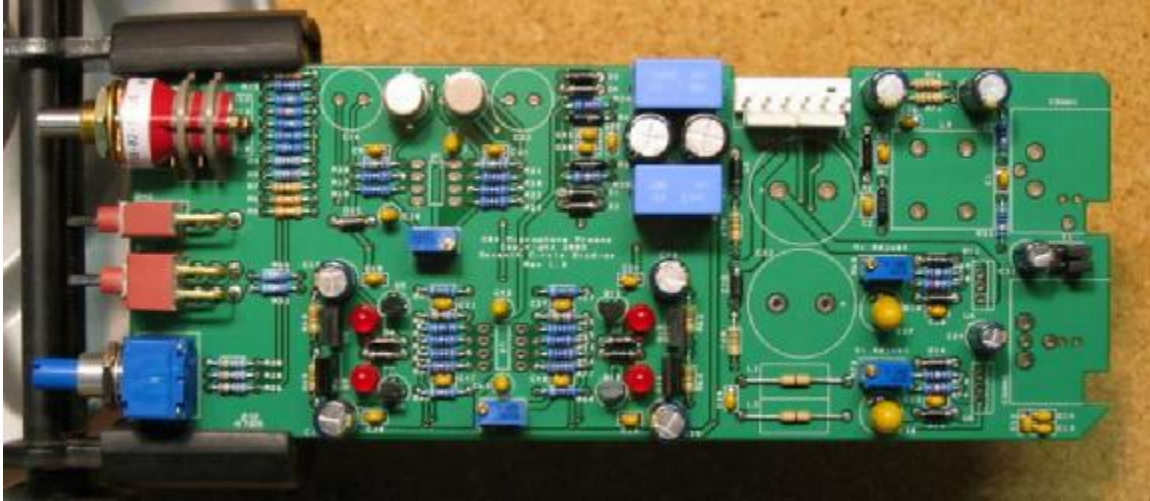
- 22.** Secure the pin with the adhesive foil supplied.



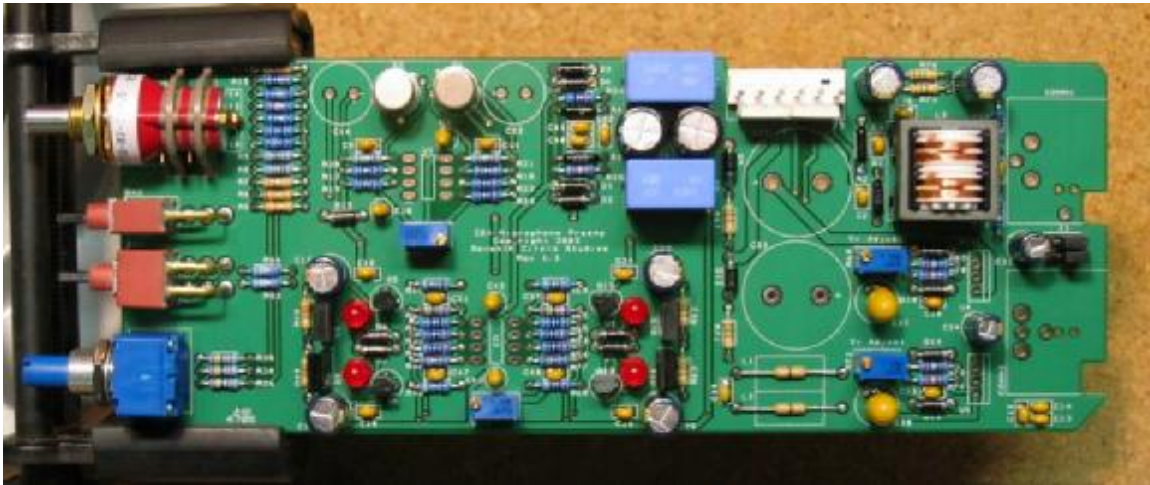
- 23.** Make sure the switch is fully seated and solder it to the board. Try to make your solder joints as neat as possible, and don't use too much solder.



- 24.** Attach gain trim control R29. 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.



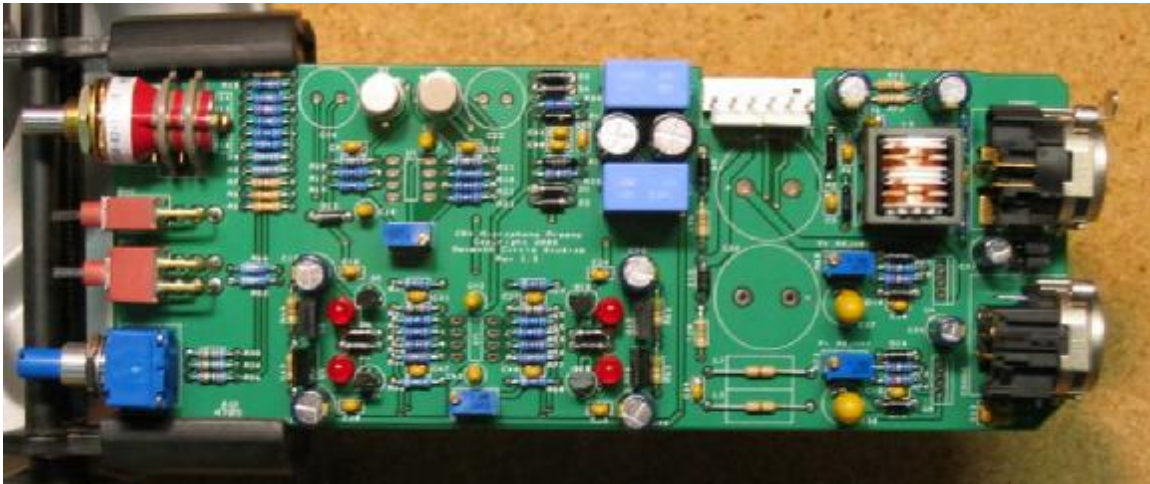
- 25.** Attach input filter L3.



- 26.** Carefully thread the mounting holes of CONN1 and CONN2 using one of the included 4-40 screws or a tap as shown. This prevents any possibility of damage to the connectors during final assembly.

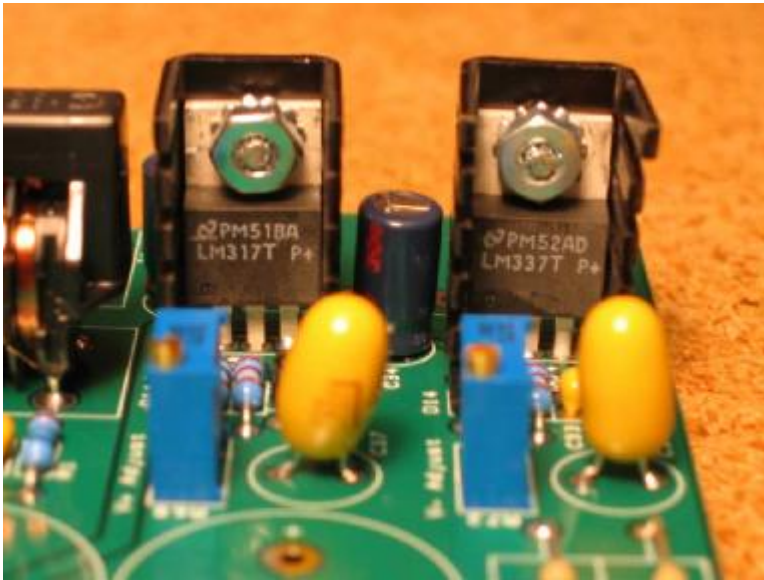


- 27.** Add CONN1 and CONN2 to the board. Make sure they're fully seated before soldering.

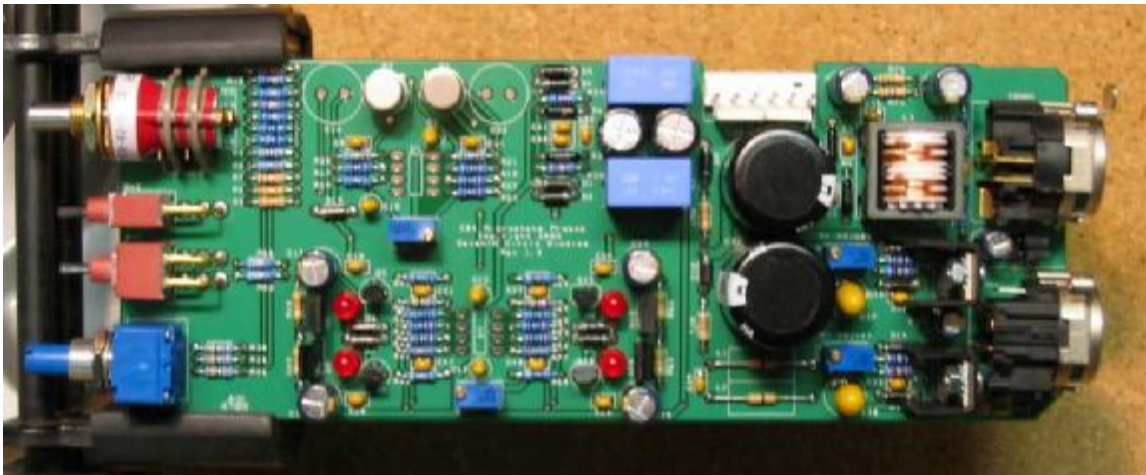




28. Using the hardware supplied, attach heat sinks to U4 and U5 and solder them in place. **Make sure to install the regulators correctly!** These parts are not the same, and are not interchangeable.



29. Install the bulk filter capacitors C29 and C32. Push them in firmly until they are 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 these parts.



- 30.** Add the last two capacitors, C16 and C22.



- 31.** Except for the op-amps, you're done! Before going on to initial power-up, carefully check your work. Make sure you haven't created any solder bridges between pads, or between a pad and the ground plane.

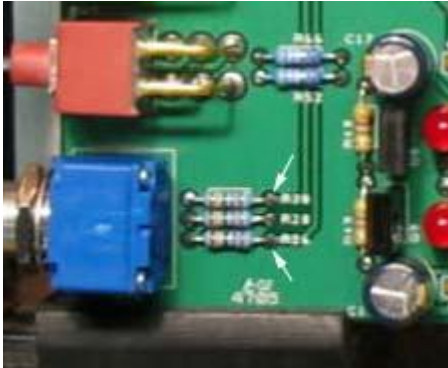
**Initial Power-Up and Testing.**

32. Again, carefully check your work. Make sure you've got the right resistors in the right locations. Make absolutely sure you've got all the transistors, diodes, and capacitors soldered in the right way round! Double check to make sure you haven't inadvertently swapped a transistor or voltage regulator. Check for poor solder joints and solder bridges, and make sure you fix any problems before continuing.
33. Just to make sure you haven't created any blatant shorts, measure the resistance between pins 1 and 2 of J3. Do the same for pins 3 and 2. If you measure a steady resistance of less than 100 ohms, don't apply power. Carefully check your work until you *find that short*.
34. Turn R68 and R72 counter-clockwise 25 full turns, or until you hear a soft click with every turn. This sets the regulators to their lowest voltage, about +/-14V.
35. Connect the PS03 to J3. Simply wire the power supply connectors together in a 1:1 fashion. That is, PS03 J2, pin 1 to C84 J3, pin 1, pin 2 to pin 2, etc. Pin 1 is toward the front, pin 6 toward the rear. Set your DMM to measure DC voltages of 20V or greater, and turn on the power. Connect the negative meter probe to J3, pin 2, and measure the voltage at U1, pin 8 and U3, pin 8. You should see about +14V in both places.
36. With the negative probe still at J3, pin 2, measure the voltage at U1, pin 4, and U3, pin 4. You should see about -14V in both places.
37. If the voltages measured in the two previous steps are way off, you have problems. Possible things to check are incorrectly installed diodes D9-D14, backwards caps C29, C32, C37, and C38, or shorts around U4, and U5.
38. With your DMM still set to read DC voltages of 20V or greater, adjust R68 and R72 for +18V at U1, pin 8 and -18V at U1, pin 4. If you need more headroom, the OPA2604s will withstand +/-24V, though they'll get very warm.
39. Remove power and allow the voltages at U1 pin 4 to drop to 0V. Solder U1 and U3 in place (or insert them into the optional sockets) and apply power. **Make sure to orient the op-amps correctly.** Align the notch in the op-amp with the notch in the silkscreen outline. Inserting them backwards will destroy the parts.



## C84 Assembly Instructions

- 40.** Connect the DMM to the outputs of U1. You can carefully probe at pins 1 and 7, but a more convenient place is at R26 and R30 as shown. Polarity is not important.



- 41.** With SW1 fully clockwise (maximum gain) and the DMM set to measure DC voltages, apply power to the C84. Adjust R36 until the voltage is as close to 0v as possible. Reduce the range on your DMM as needed as the voltage gets smaller.
- 42.** Connect the DMM to CONN2, pins 2 and 3. Polarity is not important.
- 43.** With SW1 still fully clockwise, adjust R33 until the voltage is as close to 0v as possible. Reduce the range on your DMM as needed as the voltage gets smaller.
- 44.** Congratulations! You've got a working C84 preamp.

