

PAT-4 POWER SUPPLY ASSEMBLY MANUAL



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Section 1: About This Manual

This manual gives the information you need to build and install a replacement power supply in the Dynaco PAT-4 Preamp. Compared to the original power supply, the replacement power supply should give better sound. That's because the outputs are electronically regulated. That means:

- The output voltage isn't affected by normal changes in input line voltage (e.g. changes in line voltages when appliances turn on and off).
- The outputs don't change with changing signal load produced by changes in the musical signal. That keeps the amplifier stage's operating point more consistent, and reduces distortion.
- The outputs have less noise and hum. That can reduce the hum and noise that appears at the preamp's outputs.

The layout of the power supply is in many ways superior to the original. For example, the impulsive noise and current path through the diodes and main filter caps has much smaller loop area than the original power supply arrangement. That diminishes hum fields when you've installed the new power supply.

Other PAT-4 Upgrades

As of this writing, the following other PAT-4 upgrades are available from Updatemydynaco, a division of Akitika LLC:

- Blue Light Kit
- Line Amp Distortion Reducer
- Tone Control Switch

The Line Amp Distortion Reducer drops the distortion of the Line Amp by a factor of ten. The Line Amp is the stage that includes the volume and tone controls. All sound from the preamp passes through the Line Amp. This upgrade should make everything played through the PAT-4 sound better.

The Tone Control Switch replaces the existing Hi Filter switch with a two position rotary switch. In the OFF position, the tone controls are disabled. In the 15 position, tone controls maintain their normal function. After this modification, the other two positions of the HI FILTER switch (10 and 7) are not available.

These upgrades can be installed in any combination.

Who Should Attempt these Projects?

You can build this kit if you can:

1. solder (using normal rosin core solder and a soldering iron).
2. use simple hand tools like screwdrivers, wire cutters, and pliers.
3. read and follow directions.

It helps if you:

1. know a bit about electronics, or
2. have a friend who knows a bit about electronics
3. can get to YouTube to watch a few helpful videos about the assembly process (not available as of this version of the manual)

Tools You'll Need

You'll need the following tools:

1. flat blade screwdriver for #6 screws
2. needle nose pliers (helpful, but not strictly necessary)
3. pencil type soldering iron of 25 to 50 Watts (no huge honking soldering guns or blowtorches)
4. wire cutters and strippers
5. Magnifying glass, if you're over 42!

Project Overview

The project consists of the following steps:

1. Building the new power supply circuit board.
2. Labeling some wires, desoldering them, and then removing the old power supply components.
3. Installing the new power supply, testing its outputs, and re-assembling the preamp.

By purchasing, using, or assembling this kit, you have agreed to hold AkitikA, LLC harmless for any injuries you may receive in its assembly and/or use. To prevent injuries:

- Wear safety glasses when soldering to prevent eye injuries.
- Always unplug the power before working on the amplifier.
- Large capacitors hold lots of energy for a long time. Before you put your hands into the amplifier:
 - Pull the AC plug!
 - Wait 1 full minute for the capacitors to discharge!
- Remove jewelry and rings from your hands and wrists, or anything that might dangle into the amplifier.
- If working in the amplifier, keep one hand in your pocket, especially if you're near the power supply or power supply wires. This can prevent serious shocks.
- Build with a buddy nearby. If you've ignored all the previous advice, they can dial 911 or get you to the hospital.

Section 2: Building the Power Supply PC Board

First, Get A Soup Bowl!

A wide, flat soup bowl makes a great holder for the parts that you'll install into the printed circuit board. So get that soup bowl, then open the parts envelope, and carefully transfer the parts into the soup bowl. Keep the parts envelope near the soup bowl as you do this. This keeps them from bouncing out of the soup bowl and into the carpet, never to be seen again.

In general, you'll start with the components that lay closest to the board, working your way toward the taller components. You will:

1. Install the resistors
2. Install the diodes (*polarity matters!*)
3. Install the small signal transistors and U1-U3 (all in TO-92 packages)
4. Install the power transistors
5. Install the tall capacitors (*polarity matters!*)

The silk screened (component side) of the PCB shows the locations for the various components. Those indications are placed a little to the side of the component locations to allow you to identify components after assembly. If you're ever in doubt about the correction locations, refer to the component locating guide, **Figure 1**. This very clearly shows all the component locations.

Install the Resistors

In general, you install the resistors by placing the body on the silk screen side of the board, and the leads through the indicated holes. Bend the leads over on the back of the board to keep the resistors from falling out until you solder them in place. Try to bend the leads in a direction that avoids solder bridges between traces that should remain disconnected.

We recommend the following procedure:

1. Insert all the resistors of the same value, e.g. R4, R5, R11, and R17.
2. Bend the leads as described above.
3. Solder the leads on the back of the board.
4. Clip the leads.

Place a check mark ✓ in the “Done(✓)” column as you complete each step.

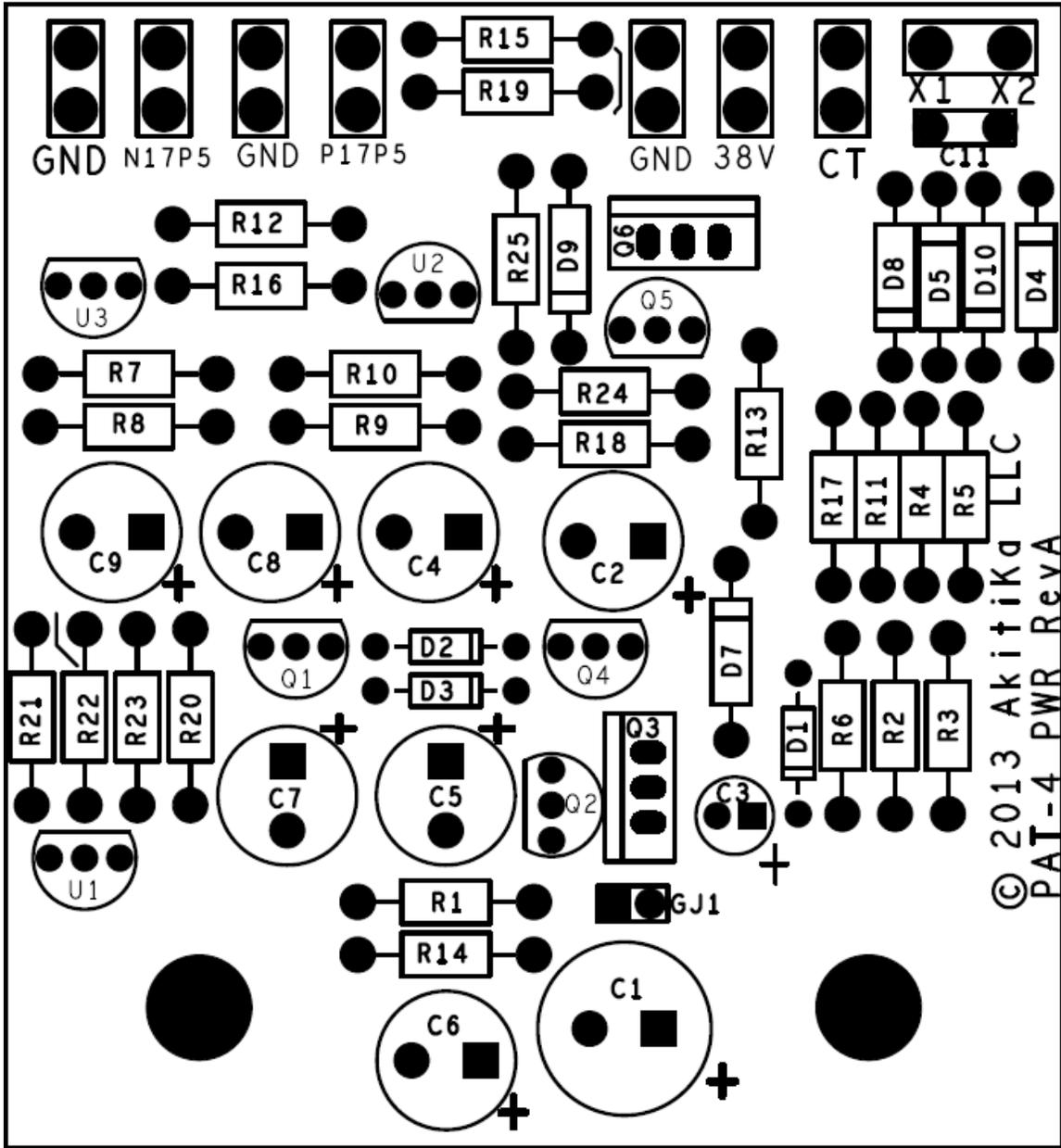


Figure 1-Component Locating Guide

Designation	Value	Color Code	Done(✓)
R4	200	Red, Black, Black, Black, Brown	
R5	200	Red, Black, Black, Black, Brown	
R11	200	Red, Black, Black, Black, Brown	
R17	200	Red, Black, Black, Black, Brown	
R3	10K	Brown, Black, Black, Red, Brown	
R8	10K	Brown, Black, Black, Red, Brown	
R9	10K	Brown, Black, Black, Red, Brown	
R20	10K	Brown, Black, Black, Red, Brown	
R23	10K	Brown, Black, Black, Red, Brown	
R14	3240	Orange, Red, Yellow, Brown, Brown	
R16	3240	Orange, Red, Yellow, Brown, Brown	
R6	1K	Brown, Black, Black, Brown, Brown	
R25	1K	Brown, Black, Black, Brown, Brown	
R12	20K	Red, Black, Black, Red, Brown	
R22	20K	Red, Black, Black, Red, Brown	
R7	60K4	Blue, Black, Yellow, Red, Brown	
R10	60K4	Blue, Black, Yellow, Red, Brown	
R21	60K4	Blue, Black, Yellow, Red, Brown	
R15	4420	Yellow, Yellow, Red, Brown, Brown	
R19	4420	Yellow, Yellow, Red, Brown, Brown	
R1	16K2	Brown, Blue, Red, Red, Brown	
R24	1 Ohm	Brown, Black, Black, Silver, Brown	
R13	23K2	Red, Orange, Red, Red, Brown	
R18	2K	Red, Black, Black, Brown, Brown	
R2	40K2	Yellow, Black, Red, Red, Brown	

Resistor Notes

- All the resistors are $\frac{1}{4}$ W, 1%, Metal Film
- K stands for 1000. Thus, 60K4 is a short-hand that means 60,400 Ohms. Some people like to convert the K notation to a number by:
 1. Replace the K by a decimal point.
 2. Multiply the resulting number by 1000.
- Resistor orientation does not matter.
- Feel free to use a DMM (digital multi-meter) to confirm the resistor values before installation.
- **You will have a 10 Ohm resistor left over at the end of this section, R26. It will be used later in a special mounting arrangement with Q3.**

Install the Diodes

Be careful! Diodes have a polarity. Make sure the band on the diode aligns with the banded end of the silk screen!

Designation	Value	Marking, type	Done(✓)
D4	1N4004	4004, 400 PIV 1 Amp	
D5	1N4004	4004	
D7	1N4004	4004	
D8	1N4004	4004	
D9	1N4004	4004	
D10	1N4004	4004	

Here's what the 1N4004 diodes look like (not to scale). The package type is known as a DO-41. The body is black, with a white stripe:



Be careful! Diodes have a polarity. Make sure the band on the diode aligns with the banded end of the silk screen!

Designation	Value	Marking, Type	Done(✓)
D1	TZX6V2C	TZX6V2, 6.2 Volt Zener, 0.5 Watt	
D2	1N4148	The number 48 is visible, 75 PIV, 100 mA	
D3	1N4148	The number 48 is visible, 75 PIV, 100 mA	

D1-D3 have a glass body. They are packaged in the DO-35 package, a smaller package than the 1N4004's.

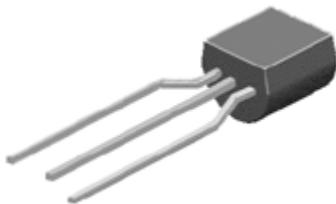


Diode Notes

The designator D6 is not used.

Install the TO-92 Package Transistors

The TO-92 package looks like this:



In some cases, the leads may be bent as the picture above shows. In other cases, you may have to spread the outside leads a bit to make it easier to insert them into the board.

Orient the transistor so its body shape matches the silk-screen outline. Leave the top of the transistor about 1/2" off the board! The lead length prevents stress on the body and keeps the transistor safe from too much heat during the soldering operation.

Designation	Type	Description	Done? (✓)
Q1	2N5551, TO-92	150 V NPN bipolar transistor	
Q4	2N5551, TO-92	150 V NPN bipolar transistor	
Q2	2N5401, TO-92	150 V PNP bipolar transistor	
Q5	2N5401, TO-92	150 V PNP bipolar transistor	

Don't use too much solder on the transistor leads. This is one place where the spacing is close enough that extra solder might cause short circuit between two leads on a given transistor. Note that Q4's collector and base are connected by the circuit board.

Install the TO-92 Package Integrated Circuits

Although the package looks the same as the transistors, the three integrated circuits installed in this step are actually voltage regulators. You may have to spread the outside leads a bit to make it easier to insert them into the board.

Orient the transistor so its body shape matches the silk-screen outline. Leave the top of the transistor about 1/2" off the board! The lead length prevents stress on the body and keeps the transistor safe from too much heat during the soldering operation.

Designation	Type	Description	Done? (✓)
U1	TL431	2.5 V adjustable shunt regulator	
U2	TL431	2.5 V adjustable shunt regulator	
U3	TL431	2.5 V adjustable shunt regulator	

Don't use too much solder on the integrated circuit leads. This is one place where the spacing is close enough that extra solder might cause short circuit between two leads on a given transistor.

Install the TO-220 Power Transistors

The TO-220 package looks like this (there may be some variation in the plastic molding):



Each of the power transistors must be specially prepared before installation.

- Install a heat sink on Q6, the TIP32C PNP power transistor before you solder it into the board. Use a 6-32.x1/4" sem-screw (has a built-in lock-washer) and a 6-32 keps nut (also has a built in lock washer). No thermal compound is needed.

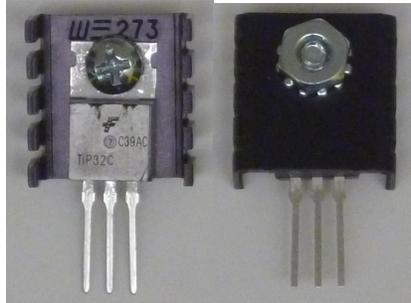


Figure 2-Front and Back views of Q6 mounted on heat sink

- Q3, a TIP31C power transistor, must be assembled with a 10 Ohm ¼ Watt resistor, R26, formed onto the emitter lead in the manner shown in Figure 3.
 - Bend the emitter lead, as shown (don't bend it repeatedly, it may break)
 - Wrap the resistor lead around the bend transistor lead
 - Form the resistor lead so the resulting three leads (the original base, collector, and the resistor extension of the emitter) will drop into the PCB



Figure 3-Q3 with resistor added to the emitter

Orient the transistor so the position of the metal tab matches the silk-screen outline. The shoulder of the leads naturally limits insertion to the correct height. Solder the outside leads first and assure that the transistors are straight, then solder the center lead.

Designation	Type	Description	Done? (✓)
Q3	TIP31C	NPN transistor, 100 V	
Q6	TIP32C	PNP transistor, 100 V	

Inspect your work for the absence of solder bridges when you're done.

Install the Capacitors

Now, the medium tall polarized electrolytic capacitors:

Designation	Value	Marking	Done? (✓)
C1	470 µF, 63 V	470 µF, 63 V, and minus sign for polarity	
C2	220 µF, 63 V	220 µF, 63 V, and minus sign for polarity	
C3	33 µF, 35 V	33 µF, 35 V, and minus sign for polarity	
C4	100 µF, 63 V	100 µF, 63 V, and minus sign for polarity	
C5	100 µF, 63 V	100 µF, 63 V, and minus sign for polarity	
C6	100 µF, 63 V	100 µF, 63 V, and minus sign for polarity	
C7	100 µF, 63 V	100 µF, 63 V, and minus sign for polarity	
C8	100 µF, 63 V	100 µF, 63 V, and minus sign for polarity	
C9	100 µF, 63 V	100 µF, 63 V, and minus sign for polarity	

And the non-polarized capacitor:

Designation	Value	Marking	Done? (✓)
C11	10 nF, 400V	10nk 400	

Note: GJ1 is not used, and no connections to it are necessary.

Remove the Old Power Supply

1. Disconnect the PAT-4 from your music system.
2. Unplug the power cord and allow the preamp to sit for one minute before moving on.

Caution: Be sure that the preamp power is unplugged! 120 VAC can be lethal! 240 VAC can be lethal!

3. Remove the 4 screws that hold the cover in place, 2 on the left side and 2 on the right side.
4. Lift the cover straight up and set it aside in a safe place.
5. Get masking tape and a pen ready. You will be labeling the wires that you are about to remove.
6. Refer to Figure 4. Desolder (or cut close to C29) the following wires from C29, the tall 3-section capacitor. As you de-solder each wire, place a masking tape label on the wire to aid re-assembly (if directed to do so).
 - a. 2 red wires connected to the semi-circle  section of the capacitor. Label these two wires "P17P5".
 - b. 2 red wires connected to the square  section of the capacitor. Label these two wires 38V.
 - c. 1 red wire connected to the triangle Δ section of the capacitor that comes from the terminal strip holding diodes D1 and D2. Remove the other end of this wire that connects to the terminal strip.
 - d. 2 black wires, one long, and one short, connected to one of the ground terminals of C29.
 - e. 2 black wires, one long and one short, connected to the other of the ground terminals of C29.
 - f. the transformer center-tap wire (typically has a red-yellow herringbone pattern) that is connected to the third ground terminal of C29. Label this wire CT.
7. Remove the two screws, nuts, and lock washers that hold C29's clamp into the chassis. Lift out C29.
8. Cut the other two low-voltage transformer (red) wires close to terminal strip where they attach to D1 and D2. Label these wires X1 and X2. It doesn't matter which wire receives which label. D1, D2, and the terminal strip are unused after the revised power supply is installed.

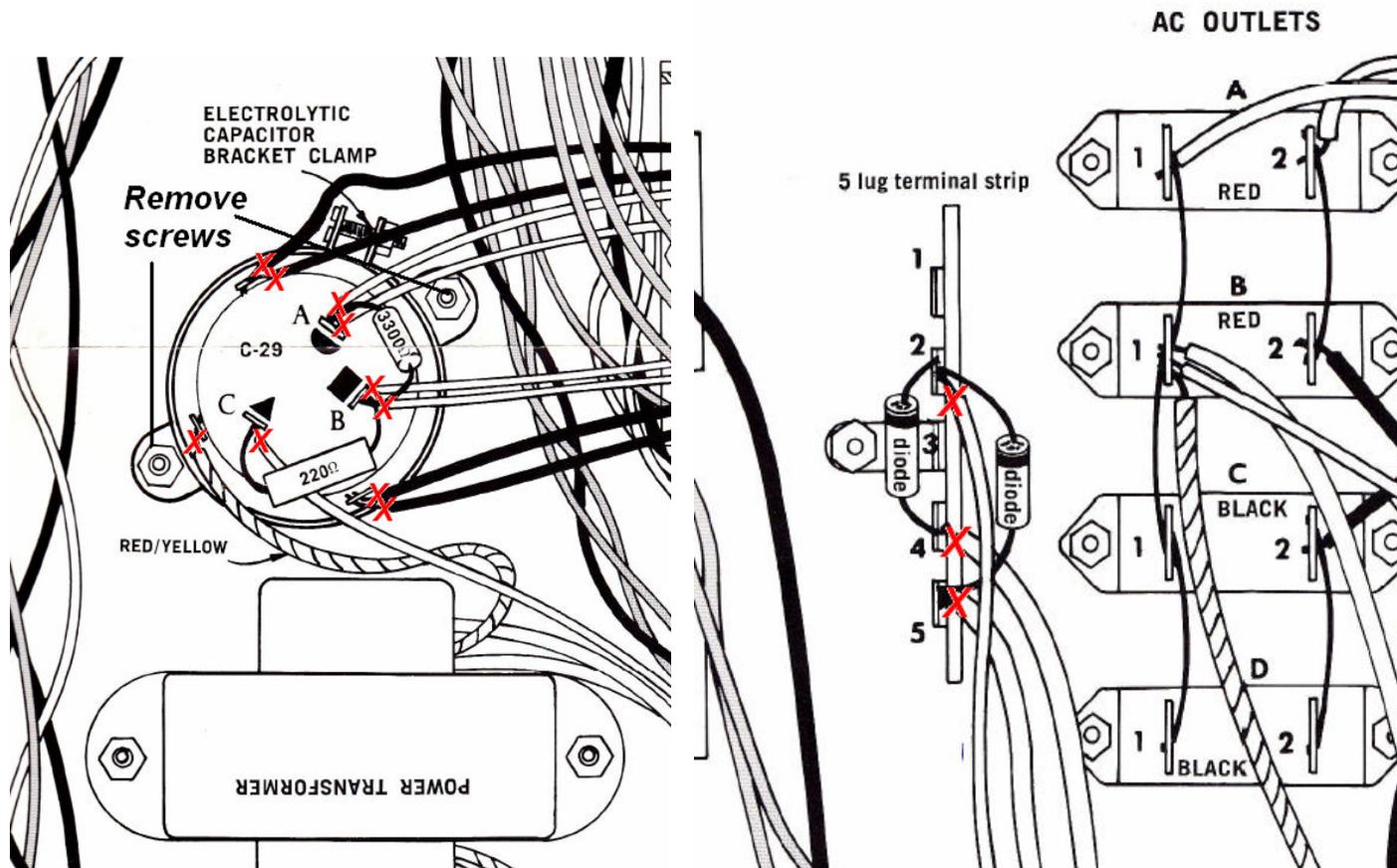


Figure 4-Showing wires to cut and screws to remove

Install the New Power Supply

1. Attach the mounting brackets to the assembled power supply PCB using two 6-32x1/4" sems screws (sems screws have the captive lock washer). Make sure that they're both straight and tight.

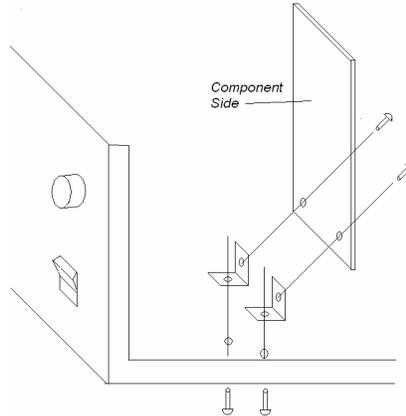


Figure 5-Mounting the power supply to the PAT-4

2. Use the old mounting holes from C29 to fasten the brackets to the chassis. **Figure 1**Figure 6, on the next page, may also clarify this bit of the assembly.

Connect the New Power Supply

All of the power connections are made in the same fashion:

1. Strip 1/4" of insulation off each of the wires to be connected.
2. Insert the wire from the solder side of the board, and solder it on the component side of the board.

Twist the insulated portions of the three transformer wires together (X1, X2, and CT). This minimizes the hum that these wires will radiate. Using the technique described above, make the connections listed in the following table:

From	Wire label	To Power Supply Board	Done? (✓)
First Transformer red wire	X1	X1 eyelet	
Second transformer red wire	X2	X2 eyelet	
Transformer Center tap wire (red/yellow)	CT	Bottom CT eyelet	
Rear PC-16 eyelet 12	38V	Bottom eyelet 38V	
Front PC-16 eyelet 12	38V	Top eyelet 38V	
Rear PC-16 short gnd wire (eyelet 11)	None	Bottom gnd, next to 38V	
Font PC-16 short gnd wire (eyelet 11)	None	Top gnd, next to 38V	
Rear PC-16 eyelet 4	P17P5	Bottom eyelet P17P5	
Front PC-16 eyelet 4	P17P5	Top eyelet P17P5	
Rear PC-16 long gnd wire (eyelet 3)	None	Bottom gnd, next to P17P5V	
Front PC-16 long gnd wire (eyelet 3)	None	Top gnd, next to P17P5V	

Note that the N17PV eyelets and the grounds to the left of them will be unused.

Final Test and Assembly

Inspect your work:

1. Make sure that all the new wires are soldered in place.
2. Make sure that there are no solder bridges

Your PAT-4 should still be disconnected from your music system and it should still be unplugged from the wall outlet.

Carefully plug in the PAT-4 to the wall outlet, taking special care to avoid contact with the high voltage (either 120 V or 240 Volt) wiring inside the PAT-4. Turn on the power switch, and give the power supply voltages a few seconds to settle. There is a slow turn-on built-in to the power supply to avoid clicks and pops upon turn-on. Set your meter to DCV and measure the following voltages *with respect to the ground terminals* on the power supply board:

1. 38V should be between 37 and 39 Volts
2. P17P5 should be between 17 and 18 Volts
3. N17P5, although not used at this point, should be between -17 and -18 volts¹.

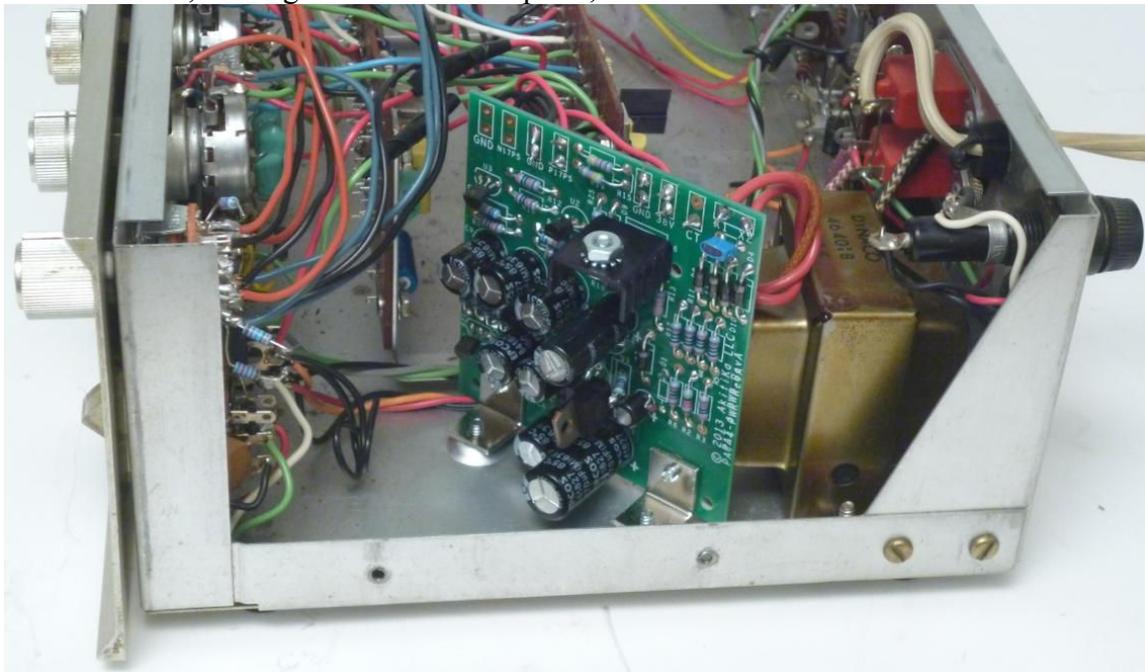


Figure 6-New Power Supply Installed in PAT-4 (this PAT-4 has tone control defeat switch)

If the voltages check out in the previous step, then:

1. Remove the AC plug from the wall outlet.
2. Wait one minute to allow the caps to discharge.
3. Put the top back on, and re-install the four screws that hold it in place.
4. Reinstall the PAT-4 to your music system.

¹ The PAT-4 doesn't use negative 17.5 volts, yet! There should be no wires connected to either N17P5 or its associated grounds.

Schematic

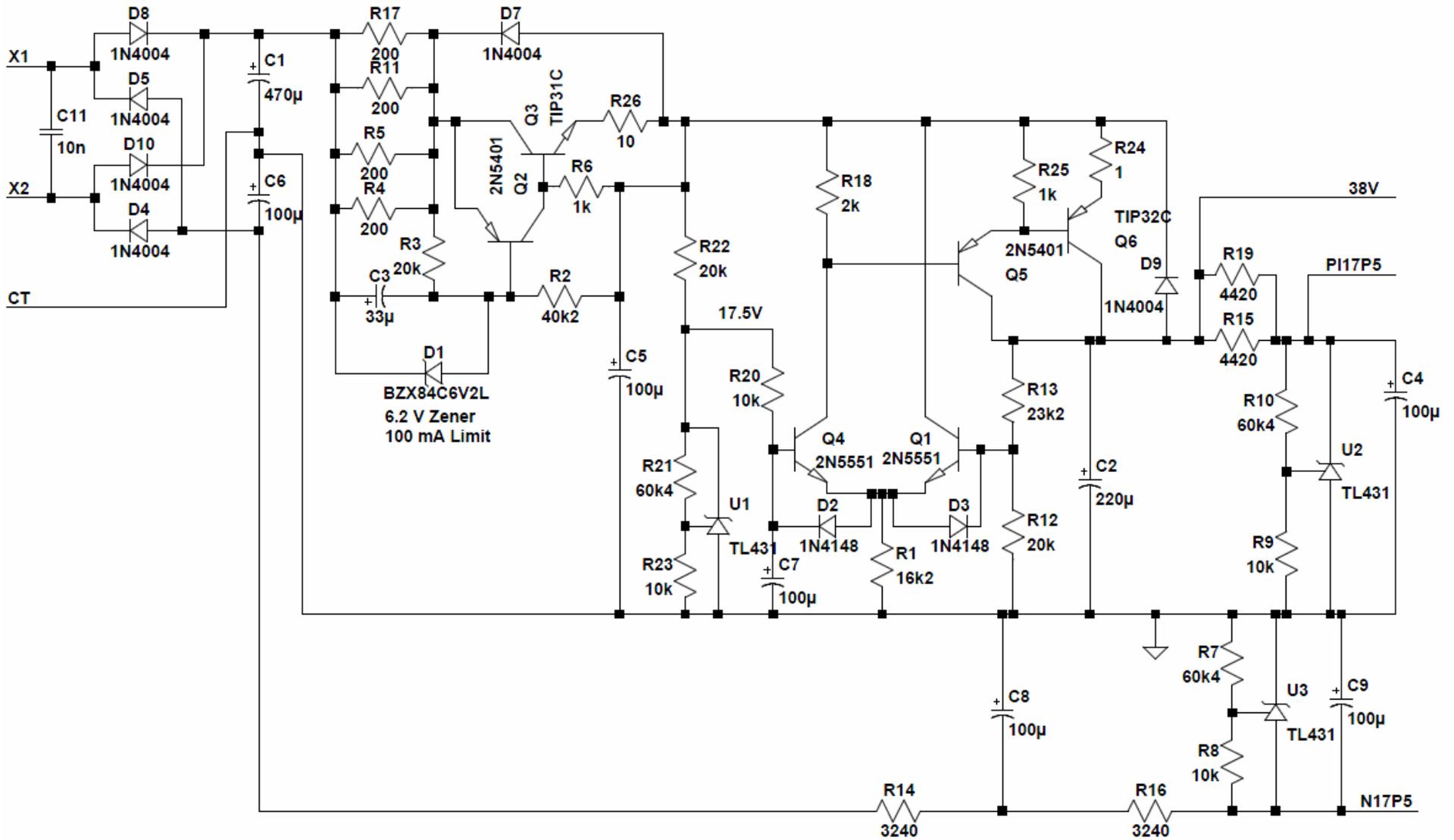


Figure 7-Schematic of the PAT-4 Electronically Regulated Power Supply. Note that Q6 has a heatsink

Resistor Color Code



Figure 8-demonstrating the resistor color code

Here's an extreme close-up of a $\frac{1}{4}$ W metal film 20K (20,000) Ohm resistor, designated by the standard resistor color code.

The colors map to numbers:

Color	Number
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

The color band positions have the following meaning:

Position	Meaning
1	Left-most Digit (e.g. most significant)
2	Next digit to the right
3	Next digit to the right.
4	Number of zeros that follow the three digits, unless: <ul style="list-style-type: none"> • Band 4 is gold => multiply by 0.1 • Band 4 is silver=> multiply by 0.01
**Yellow	Tolerance: <ul style="list-style-type: none"> • Brown =>1% • Red => 2% • Gold=> 5% • Silver=>10% • No band=>20%