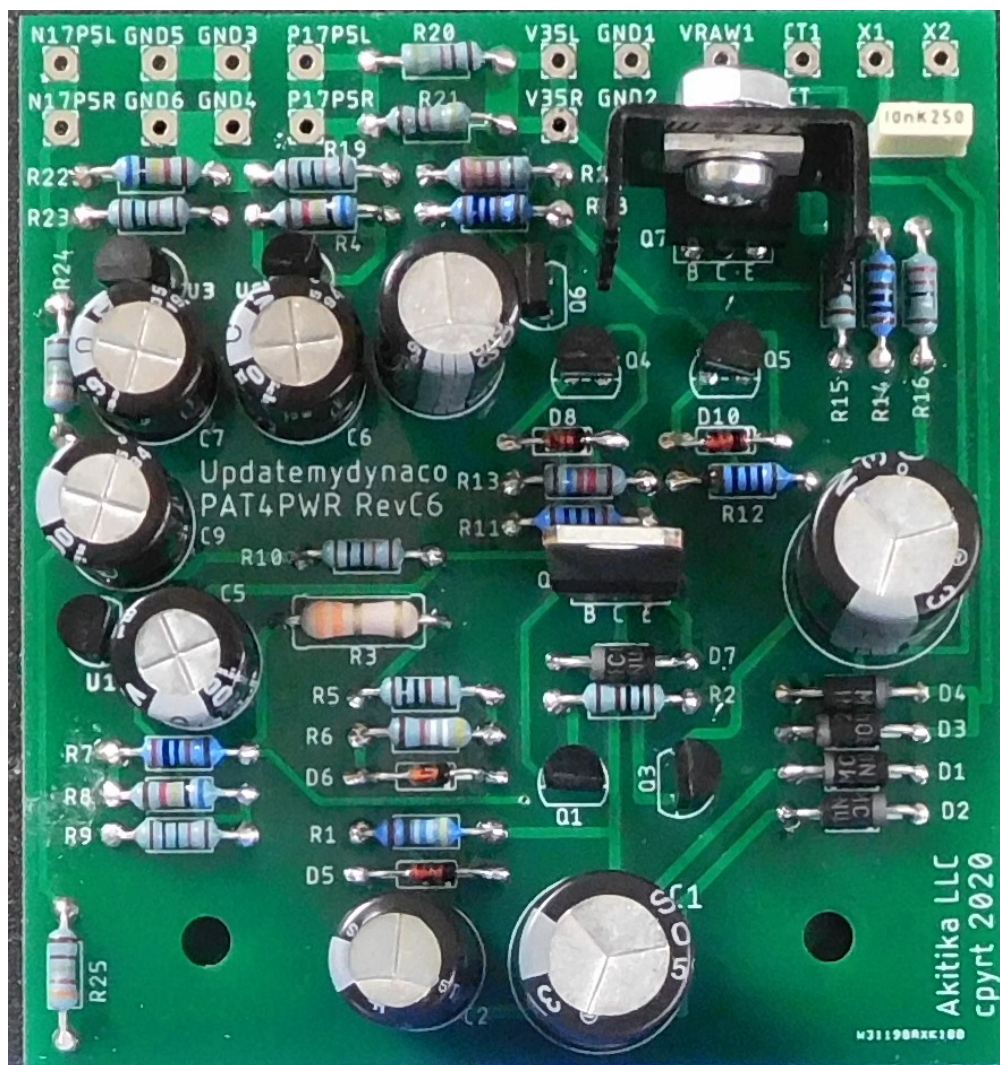


# ***PAT-4 POWER SUPPLY ASSEMBLY MANUAL Rev C Version***



(Q2 also has a heat sink in a fully populated version of this power supply)

© 2014-2022 Akitika, LLC

All rights reserved

Revision Cp09 December 2, 2022

## Table of Contents

Table of Contents .....	2
Table of Figures .....	2
Section 1: About This Manual .....	3
Other PAT-4 Upgrades .....	3
Who Should Attempt these Projects? .....	4
Tools You'll Need.....	4
Project Overview .....	5
Section 2: Building the Power Supply PC Board .....	6
First, Get A Soup Bowl! .....	6
There are two ways to build this kit.....	6
Install the Resistors .....	6
R17 Can Have Two Possible values .....	8
R20 and R21 Might not be installed .....	8
Resistor Notes .....	9
Install the 1-Watt Resistor .....	9
Install the Diodes .....	9
Install the TO-92 Package Transistors.....	10
Install the TO-92 Package Integrated Circuits.....	10
Install the TO-220 Power Transistors with Heatsinks .....	11
Install the Capacitors.....	11
Remove the Old Power Supply.....	12
Install the New Power Supply.....	14
Connect the New Power Supply .....	14
Final Test and Assembly.....	15
Schematic.....	16
Resistor Color Code.....	17

## Table of Figures

Figure 1-Component Locating Guide .....	7
Figure 2-Front and Back views of Q7 mounted on heat sink. Prepare Q2 similarly with its own heatsink .....	11
Figure 3-Showing wires to cut and screws to remove .....	13
Figure 4-Mounting the power supply to the PAT-4.....	14
Figure 5-New Power Supply Installed in PAT-4 (this PAT-4 has PAT4X, PAT4SEL, and PAT4RENEW) .....	15
Figure 6-Schematic of PAT-4 Electronically Regulated Power Supply (Rev C6).....	16
Figure 7-demonstrating the resistor color code .....	17

## Section 1: About This Manual

This manual is for the Rev C version of the PAT4PWR product. It differs from the Rev B version in that:

- Specific eyelets, VRAW1 and VRAW2 are available with the unregulated voltage. This provides a nicer alternative to the way this was done in Rev B, where a wire was tacked to the cathode of a diode. These eyelets have two possible functions as of this writing:
  - Supplies the “Power Good” Signal used in the PAT4RENEW kit.
  - Supplies power to the PAT4 Selector Upgrade kit.
- The power supply has had some minor design changes that afford a bit more available output power and a lower dropout voltage.
- The highest regulated output voltage can be set to either 35V or 38V with a resistor change, so that output is currently listed as 35VL and 35VR.

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 (BLUE)
- Line Amp Distortion Reducer (DRD4)
- Tone Control Switch (TCS)
- Preamp Renewal Kit (PAT4RENEW) supplies left and right channel boards for both phono and line stage functions.
- Toroidal transformer to reduce hum (PAT4X).

The DRD4 Line Amp Distortion Reducer drops the distortion of the original 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 DRD4 is not needed if you install the PAT4RENEW kit.*

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.

The PAT4RENEW board replaces the original line stage and phono boards with a new design, new parts, and new PCB's. It has lower noise, lower distortion, and a more accurate phono section. This is really the best way to go if you are upgrading both the power supply and the audio sections of your PAT-4 Preamp.

### ***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!
6. Rosin core solder, 0.031" diameter is recommended, either 60/40 tin/lead or 63/37 tin/lead will do a good job. I typically use Kester solder.

## ***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.

### ***There are two ways to build this kit***

There are two ways to build this power supply:

1. To use with stock channel circuit boards.
2. To use with PAT4RENEW circuit boards.

When built for the stock channel circuit boards, the supply produces:

- +38 Volts DC for the line stages
- +17.5 Volt DC for the phono preamp
- -17.5 Volt DC, not used with stock boards, but used with some Updatemydynaco enhancements.

When built for the PAT4RENEW circuit boards, the supply produces:

- +35 Volts DC for the line stages and the phono stage.
- The +17.5 Volt DC supply is disabled by not installing R20 and R21.
- The -17.5 Volt DC power supply is used by the PAT4RENEW circuit boards.

We'll call out those modifications in the course of the manual.

### ***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. R11 and R12.
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.

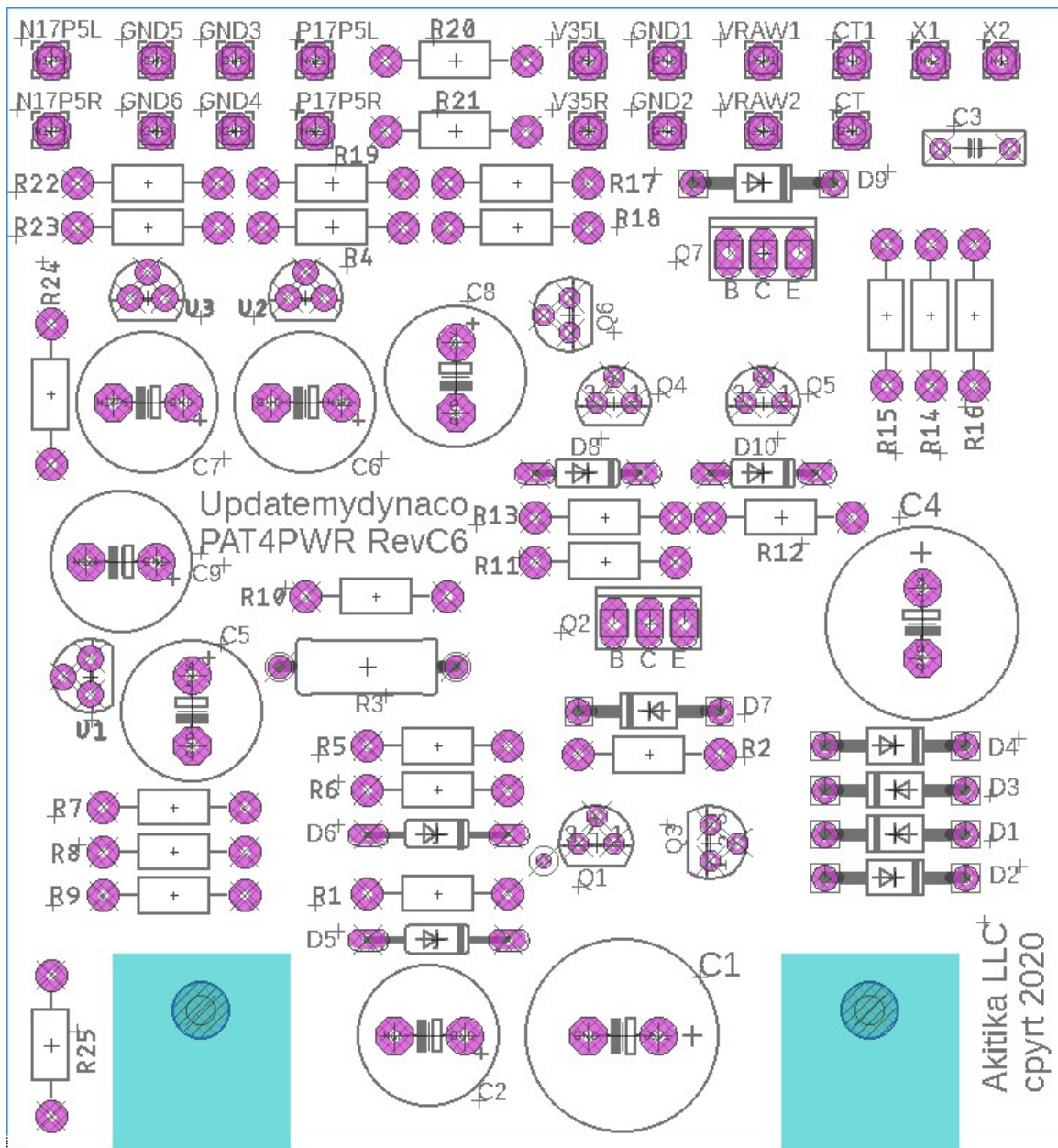


Figure 1-Component Locating Guide

Designation	Value	Color Code	Done(✓)
R1	4K99	Yellow, White, White, Brown, Brown	
R6	49K9	Yellow, White, White, Red, Brown	

OK...If you're paying attention:

R1 is 4990 Ohms, and you verified it with your DMM

R6 is 49,900 Ohms, and you also verified that with your DMM!

Carry on!

R11	100	Brown, Black, Black, Black, Brown	
R12	100	Brown, Black, Black, Black, Brown	
R9	10K	Brown, Black, Black, Red, Brown	
R10	10K	Brown, Black, Black, Red, Brown	
R19	10K	Brown, Black, Black, Red, Brown	
R23	10K	Brown, Black, Black, Red, Brown	
R13	16K2	Brown, Blue, Red, Red, Brown	
R24	3240	Orange, Red, Yellow, Brown, Brown	
R25	3240	Orange, Red, Yellow, Brown, Brown	
R2	1K	Brown, Black, Black, Brown, Brown	
R5	1K	Brown, Black, Black, Brown, Brown	
R15	1K	Brown, Black, Black, Brown, Brown	
R16	2.2	Red, Red, Black, Silver, Brown	
R7	20K	Red, Black, Black, Red, Brown	
R18	20K	Red, Black, Black, Red, Brown	

### R17 Can Have Two Possible values

If you're building a PAT4PWR to use with original Dynaco PAT4 Preamp PCBs, then use the supplied 23K2 resistor in the PAT4PWR kit for R17. Doing so makes the nominal output voltage 38 Volts DC.

R17	23K2	Red, Orange, Red, Red, Brown	
-----	------	------------------------------	--

If instead you're building a PAT4PWR to use with the PAT4RENEW Preamp PCB's, then get the 20K resistor supplied with that kit. Install that 20K resistor into the R17 location.

R17	20K0	Red, Black, Black, Red, Brown	
-----	------	-------------------------------	--

That makes the nominal output voltage 35 volts DC. In this case, the 23K2 resistor should be placed in your spares cupboard.

R14	2K	Red, Black, Black, Brown, Brown	
R4	60K4	Blue, Black, Yellow, Red, Brown	
R8	60K4	Blue, Black, Yellow, Red, Brown	
R22	60K4	Blue, Black, Yellow, Red, Brown	

### R20 and R21 Might not be installed

If you're using the original preamp circuit boards, then install R20 and R21. Doing so makes the +17.5 Volt supply that the original circuit boards require for their phono section.



If you're upgrading to PAT4RENEW circuit boards, then Don't Install R20 and R21. The PAT4RENEW circuit boards run their phono preamp from 35 volts, and thus don't need the 17.5 Volts. Removing these two resistors makes more power available for the 35 Volt output.

R20	4420	Yellow, Yellow, Red, Brown, Brown	
R21	4420	Yellow, Yellow, Red, Brown, Brown	

### Resistor Notes

- All the resistors in the table shown above are ¼ W, 1%, Metal Film. A larger resistor will be installed in the next section.
- 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.
- We strongly recommend that you use a DMM (digital multi-meter) to confirm the resistor values before installation.

### Install the 1-Watt Resistor

Designation	Value	Color Code	Done(✓)
R3	3.3	Orange, Orange, Gold	

### Install the Diodes

<i>Be careful! Diodes have a polarity. Make sure the band on the diode aligns with the banded end of the silk screen!</i>			
Designation	Value	Marking, type	Done(✓)
D1	1N4004	4004, 400 PIV 1 Amp	
D2	1N4004	4004	
D3	1N4004	4004	
D4	1N4004	4004	
D7	1N4004	4004	
D9	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:



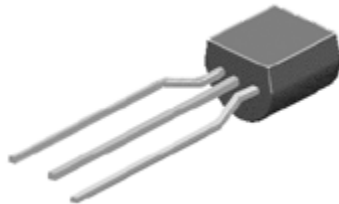
<i>Be careful! Diodes have a polarity. Make sure the band on the diode aligns with the banded end of the silk screen!</i>			
Designation	Value	Marking, Type	Done(✓)
D5	BZX55C43	The number 43 is visible, 43 volt zener	
D6	BZX79-B10	B10 is visible, 10 volt zener	
D8	1N4148	The number 48 is visible, 75 PIV, 100 mA	
D10	1N4148	The number 48 is visible, 75 PIV, 100 mA	

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



## 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	
Q3	2N5551, TO-92	150 V NPN bipolar transistor	
Q4	2N5551, TO-92	150 V NPN bipolar transistor	
Q5	2N5551, TO-92	150 V NPN bipolar transistor	
Q6	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.*

## 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 regulator so its body shape matches the silk-screen outline. Leave the top of the regulator about 1/2" off the board! The lead length prevents stress on the body and keeps the regulator 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 regulator integrated circuit leads. This is one place where the spacing is close enough that extra solder might cause short circuit between two leads on the device.*

## Install the TO-220 Power Transistors with Heatsinks

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



Install a heat sink on both Q2 and Q7, the power transistors, before you solder them into the board. Use a 6-32x1/4" sems-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.

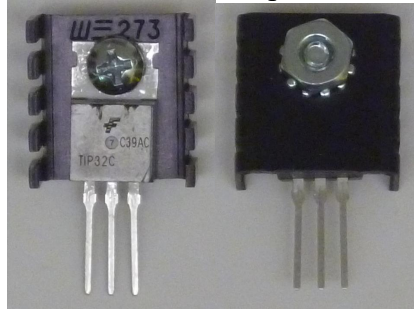


Figure 2-Front and Back views of Q7 mounted on heat sink. Prepare Q2 similarly with its own heatsink

*Orient the transistors so the position of the metal tab matches the silk-screen outline. Solder the outside leads first and assure that the transistors are straight, then solder the center lead. Let the shoulders of the transistors leads set their height above the board.*

Designation	Type	Description	Done? (✓)
Q2	TIP31C	NPN transistor, 100 V (with heatsink)	
Q7	TIP32C	PNP transistor, 100 V (with heatsink)	

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

## Install the Capacitors

Install the polarized electrolytic capacitors. Note that + sign on the silk-screen shows where the positive side of the capacitor should go. However, the markings on the caps prominently show the negative side. Make sure that the *non-negative side of the cap connects to the hole indicated by the positive sign on the silk screen.*

Designation	Value	Marking	Done? (✓)
C1	470 $\mu$ F, 63 V	470 $\mu$ F, 63 V, and minus sign for polarity	
C4	470 $\mu$ F, 63 V	470 $\mu$ F, 63 V, and minus sign for polarity	
C8	220 $\mu$ F, 63 V	220 $\mu$ F, 63 V, and minus sign for polarity	
C5	100 $\mu$ F, 63 V	100 $\mu$ F, 63 V, and minus sign for polarity	
C6	100 $\mu$ F, 63 V	100 $\mu$ F, 63 V, and minus sign for polarity	
C7	100 $\mu$ F, 63 V	100 $\mu$ F, 63 V, and minus sign for polarity	
C9	100 $\mu$ F, 63 V	100 $\mu$ F, 63 V, and minus sign for polarity	
C2	100 $\mu$ F, 80 V	100 $\mu$ F, 80 V, and minus sign for polarity	



And the non-polarized capacitor:

Designation	Value	Marking	Done? (✓)
C3	10 nF, 250V	10nk 250	

## 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 3. 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  $\Delta$  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 (see Figure 3). 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.

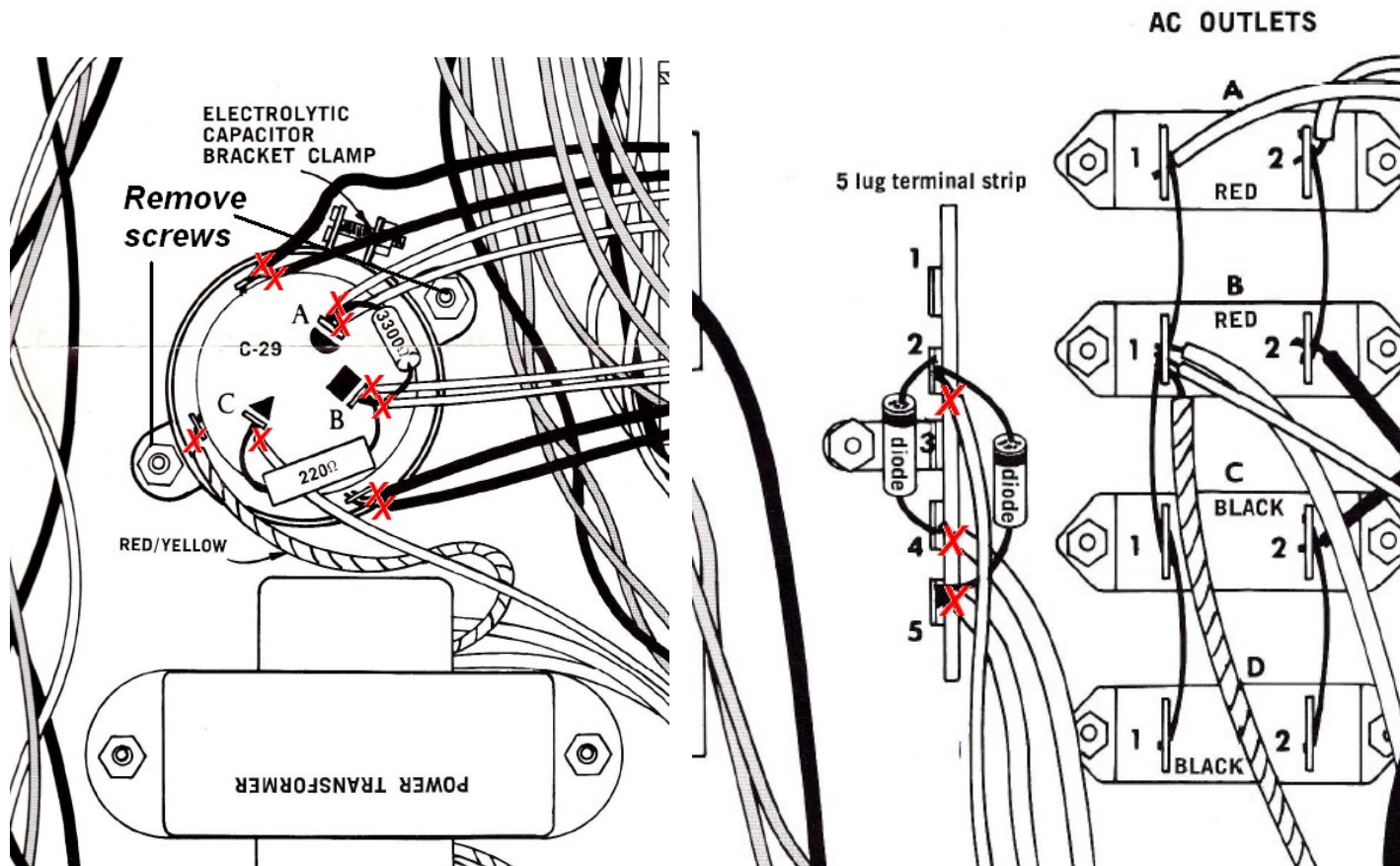
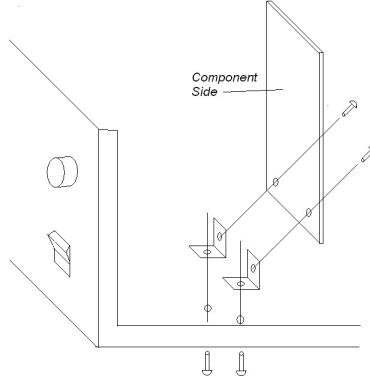


Figure 3-Showing wires to cut and screws to remove

## 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 4-Mounting the power supply to the PAT-4**

2. Use the old mounting holes from C29 to fasten the brackets to the chassis. Figure 5, on the next page, may also clarify this bit of the assembly. Use the provided pair of 6-32x1/4" sems screws.

## 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.

The connections listed here cover connection of stock preamplifier boards to the new power supply. Connections to the PAT4RENEW board are slightly different. Refer to the PAT4RENEW manual for those connections.

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	
Front PC-16 eyelet 12	38V	V35R Eyelet	
Rear PC-16 eyelet 12	38V	V35L Eyelet	
Front PC-16 short gnd wire (eyelet 11)	none	GND2 Eyelet	
Rear PC-16 short gnd wire (eyelet 11)	none	GND1 Eyelet	
Rear PC-16 eyelet 4	P17P5	Bottom eyelet P17P5R	
Front PC-16 eyelet 4	P17P5	Top eyelet P17P5L	
Rear PC-16 long gnd wire (eyelet 3)	none	Bottom gnd, next to P17P5R	
Front PC-16 long gnd wire (eyelet 3)	none	Top gnd, next to P17P5L	

Note that on a stock Dynaco circuit board the N17PV eyelets and the grounds to the left of them will be unused. They are however used for the P4LSRC, PAT4LP, PAT4PPR, and PAT4RENEW upgrades.

## ***Final Test and Assembly***

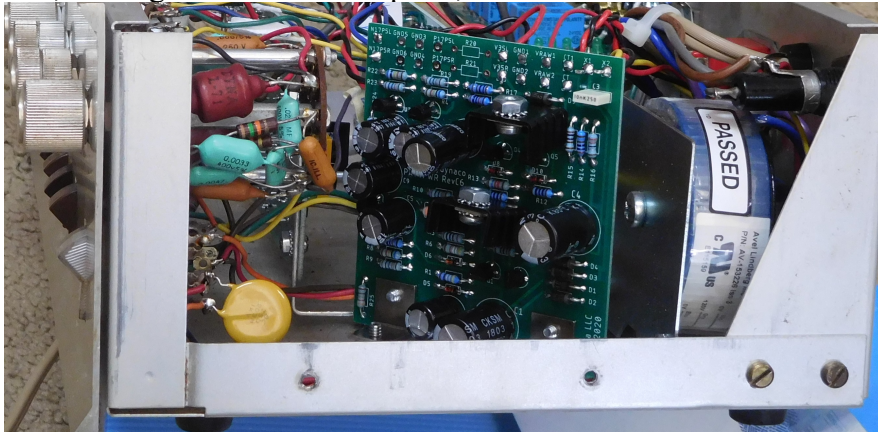
Inspect your work:

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. V35L and V35R should be between 37 and 39 Volts<sup>1</sup>
2. P17P5 should be between 17 and 18 Volts
3. N17P5, although not used at this point, should be between -17 and -18 volts<sup>2</sup>.



**Figure 5-New Power Supply Installed in PAT-4 (this PAT-4 has PAT4X, PAT4SEL, and PAT4RENEW)**

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

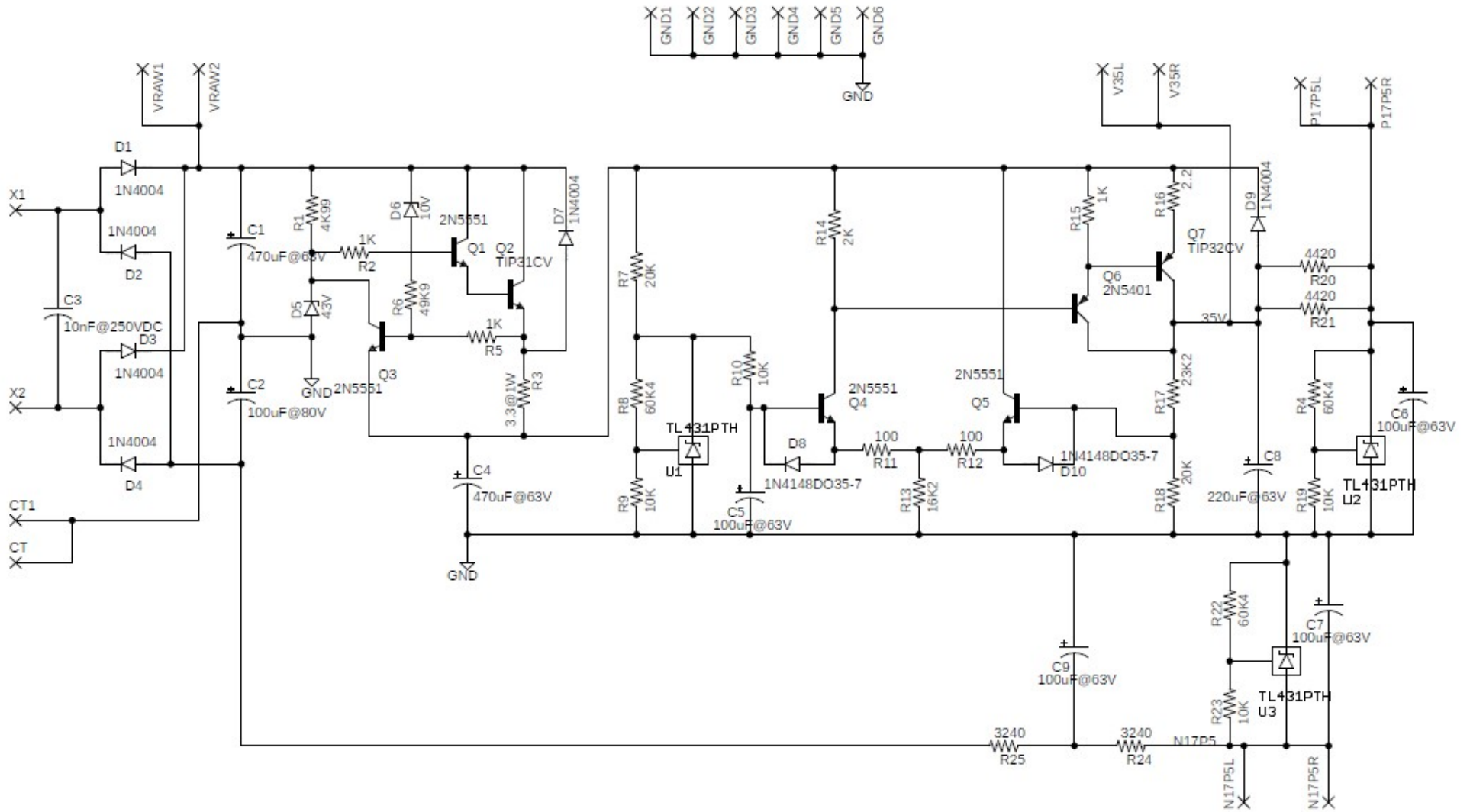
1. Remove the AC plug from the wall outlet.
2. Wait one minute to allow the caps to discharge.
3. Put the top back on and re-install the four (or five) screws that hold it in place.
4. Reinstall the PAT-4 to your music system.

---

<sup>1</sup> If you've installed the PAT4RENEW board, then you adjusted R17 on the power supply from 23K2 to 20K to produce a nominal output voltage of 35 volts. Notice also with the PAT4RENEW board that R20 and R21 are not installed as PAT4RENEW doesn't use plus 17.5 Volts.

<sup>2</sup> The PAT-4 with stock boards doesn't use the negative 17.5 Volt outputs. Newer upgrades for the circuit boards, however, do use the negative 17.5 volt outputs.

# Schematic



**Figure 6-Schematic of PAT-4 Electronically Regulated Power Supply (Rev C6)**

Note that R17 might be 20K0, producing 35 Volts of output, if you are mating your PAT-4 with the PAT4 PRENEW boards.



## Resistor Color Code



Figure 7-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"> <li>• Band 4 is gold =&gt; multiply by 0.1</li> <li>• Band 4 is silver=&gt; multiply by 0.01</li> </ul>
**Yellow	Tolerance: <ul style="list-style-type: none"> <li>• Brown =&gt;1%</li> <li>• Red =&gt; 2%</li> <li>• Gold=&gt; 5%</li> <li>• Silver=&gt;10%</li> <li>• No band=&gt;20%</li> </ul>