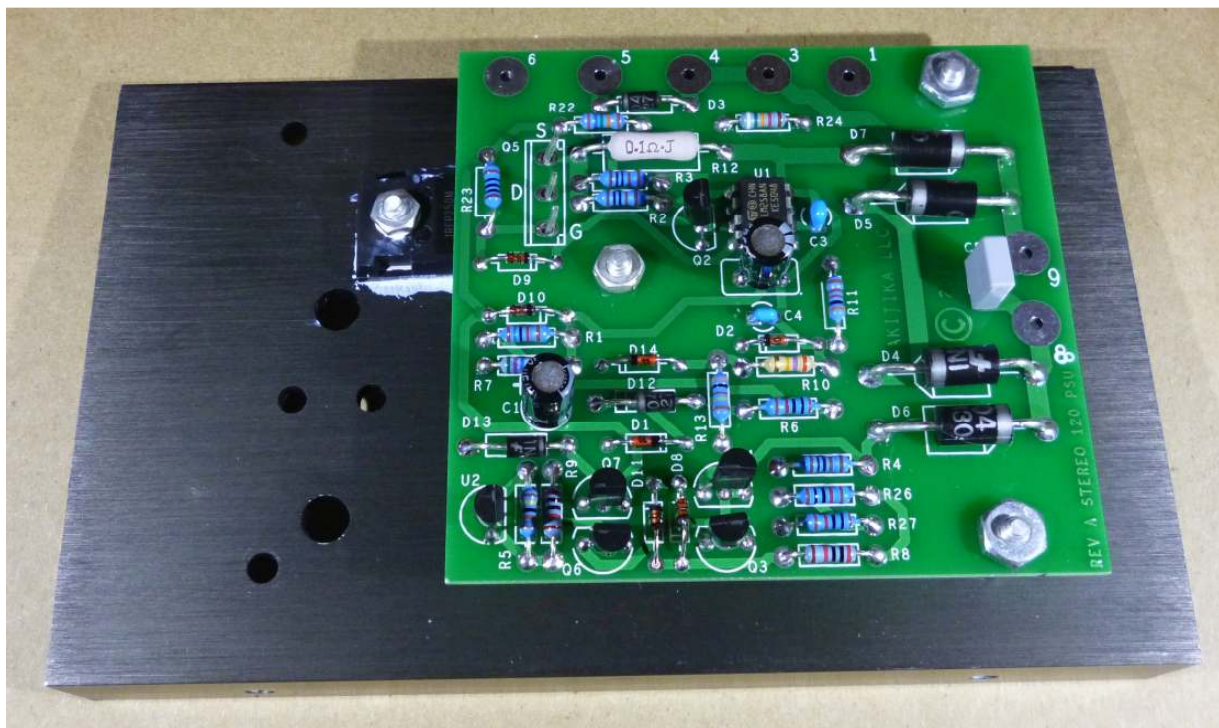


POWER SUPPLY REPLACEMENT KIT FOR THE DYNACO STEREO 120 SOLID STATE POWER AMPLIFIER



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Section 1: About This Manual

This manual gives the information you need to build and install an updated power supply regulator for Dynaco's Stereo 120 Power Amplifier. The kit can be used in a number of different ways, all of which re-use the existing power transformer and heat sink.

1. It's a drop-in replacement for the original Stereo 120 power supply regulator board and pass transistor (PC-15 and Q9), even if you maintain the stock (original) amplifier modules.
2. It works with updatemydynaco updated amplifier modules.
3. It can be used with PSRC, the power supply replacement capacitor kit and updatemydynaco updated amplifier modules.

Compared to the original power supply regulator, it has the following improvements:

- Much tighter tolerance on output voltage
- Much less thermal drift of the output voltage
- Output current limiting is independent of discrete device parameters (in the Dynaco design it depended heavily on transistor gain and temperature)
- Short-circuit proof (sometimes true of the original design, but not always)
- Lower output impedance and lower noise

Who Should Attempt this Project?

You can build this kit and update your Dynaco Stereo 120's power supply 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 to update your Stereo 120's power supply:

1. ***Multi-meter – required to measure output voltage***, useful for verifying resistor values.

2. flat blade screwdriver for #6 screws
3. Phillips screwdriver (#2)
4. pliers or nut drivers suitable for #6 hardware (5/16" nut driver or hex wrench)
5. needle nose pliers (helpful, but not strictly necessary)
6. pencil type soldering iron of 25 to 50 Watts (no huge honking soldering guns or blowtorches)
7. wire cutters and strippers
8. magnifying glass, if you're over 42!

Project Overview

The project consists of the following steps:

1. Building the new power supply regulator board.
2. Removing the old power supply regulator and a few associated bits, while saving some parts for re-use.
3. Joining the re-cycled heatsink and the new power supply regulator board.
4. Testing the power supply.
5. Final assembly

Important Safety Notes

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 New Power Supply PCB

This section details the process of building the circuit board. We start with an overview on this page. The specifics you need to start building begin on the next page.

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

1. Install the resistors
2. Install the diodes
3. Install the capacitors
4. Install the transistors
5. Install the integrated circuits.
6. DO NOT INSTALL THE LARGE PASS TRANSISTOR (Q5) AT THIS TIME!

Component Order

You'll notice that the component designations in the directions don't go exactly in order. We have grouped them so that all components with the same value appear together. This makes assembly easier. You'll find in the parts kit that similar parts, e.g. 3 1K resistors, are typically (though not always) taped together.

Install the Resistors

In general, you install the resistors by placing the body on 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 your solder them in place. Try to bend the leads in a direction that won't lead to solder bridges between traces that should remain disconnected.

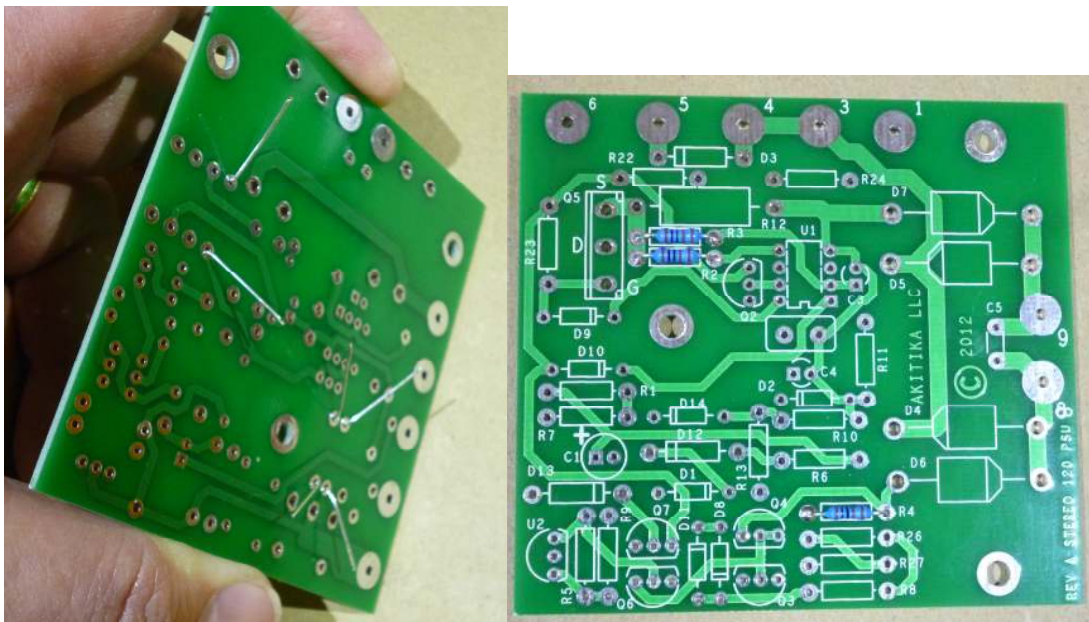


Figure 1-Installing resistors

We recommend the following procedure:

1. Insert all the resistors of the same value, e.g. R2, R3, and R4.
2. Bend the leads as described above.
3. Solder the leads on the back of the board.
4. Clip the leads.

Track your progress by placing a check-mark in the done column as you install each resistor. Check resistor values with a meter, or by reading the color code¹. Orient the resistor with the fat brown band on the right, then you can read both the Color Code column and the resistor from left to right.

| ¼ Watt, 1% resistors | | | |
|----------------------|----------|-------------------------------------|-----------|
| Designation | Value | Color code | Done? (✓) |
| R2 | 1K | Brown, Black, Black, Brown, Brown | |
| R3 | 1K | Brown, Black, Black, Brown, Brown | |
| R4 | 1K | Brown, Black, Black, Brown, Brown | |
| R6 | 10K | Brown, Black, Black, Red, Brown | |
| R26 | 10K | Brown, Black, Black, Red, Brown | |
| R27 | 10K | Brown, Black, Black, Red, Brown | |
| R8 | 20K | Red, Black, Black, Red, Brown | |
| R9 | 20K | Red, Black, Black, Red, Brown | |
| R1 | 15K | Brown, Green, Black, Red, Brown | |
| R5 | 140K | Brown, Yellow, Black, Orange, Brown | |
| R7 | 5K76 | Green, Violet, Blue Brown, Brown | |
| R10 | 26K1 | Red, Blue, Brown, Red, Brown | |
| R11 | 3K01 | Orange, Black, Brown, Brown, Brown | |
| R13 | 3.01 Meg | Orange, Black, Brown, Yellow, Brown | |
| R22 | 165K | Brown, Blue, Green, Orange, Brown | |
| R23 | 100 | Brown, Black, Black, Black, Brown | |
| R24 | 95K3 | White, Green, Orange, Red, Brown | |

| 2 Watt, 5% resistor | | | |
|---------------------|-------|---------|-----------|
| Designation | Value | Marking | Done? (✓) |
| R12 | 0.1 | 0.1 | |

¹ See “Resistor Color Code” on page 24 to see how to read resistor color codes.

Install the Diodes

Now install the diodes. Be careful to observe the polarity markings on the diodes. You'll notice that one end of the diodes has a band. Match the banded end of the diode with the banded end of the silk screen.

| Designation | Type, Package | Description | Done? (✓) |
|-------------|------------------|---------------------------------|-----------|
| D1 | BZX55B33, DO-35 | 33 Volt 2% zener diode | |
| D14 | BZX55B33, DO-35 | 33 Volt 2% zener diode | |
| D2 | BZX79-B10, DO-35 | 10 Volt 2% zener diode | |
| D8 | 1N4148, DO-35 | 0.2 A, 100 PIV, switching diode | |
| D9 | 1N4148, DO-35 | 0.2 A, 100 PIV, switching diode | |
| D10 | 1N4148, DO-35 | 0.2 A, 100 PIV, switching diode | |
| D11 | 1N4148, DO-35 | 0.2 A, 100 PIV, switching diode | |
| D3 | 1N4004, DO-41 | 1A, 400 PIV, rectifier diode | |
| D12 | 1N4004, DO-41 | 1A, 400 PIV, rectifier diode | |
| D13 | 1N4004, DO-41 | 1A, 400 PIV, rectifier diode | |
| D4 | 1N5404, DO-201AD | 3A, 400 PIV, rectifier diode | |
| D5 | 1N5404, DO-201AD | 3A, 400 PIV, rectifier diode | |
| D6 | 1N5404, DO-201AD | 3A, 400 PIV, rectifier diode | |
| D7 | 1N5404, DO-201AD | 3A, 400 PIV, rectifier diode | |

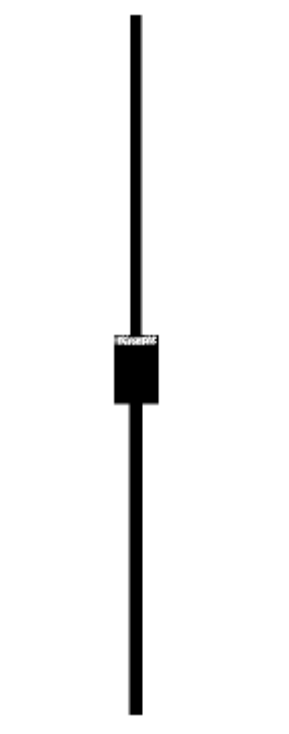
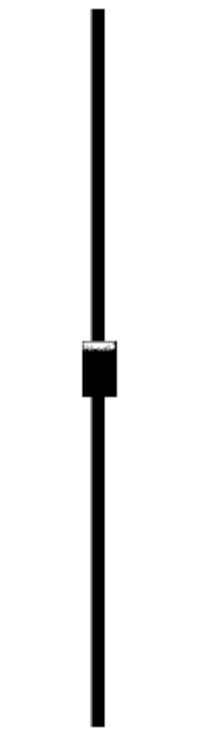
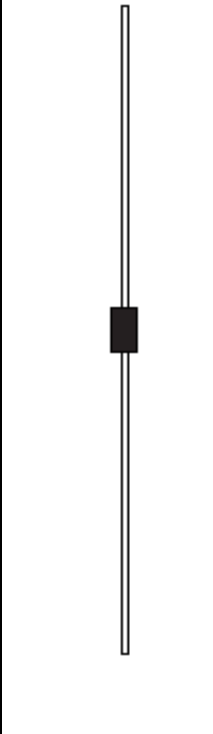
Identifying the glass body diodes

The glass body diodes have the following identifying marks. If your vision is like mine, you may need good light and a magnifying glass.

- 1N4148, D8-D11, has the number 48 visible
- BZX55B33B, D1 and D14, has the number 33 visible
- BZX79-B10, D2, has the number 10 visible

Also, typically when these diodes are packed, you can preliminarily identify the types because:

- The 4 1N4148 diodes will typically be taped together
- The 2 BZX55B33B diodes will typically be taped together
- The 1 BZX79-B10 diode will be by itself

| | | |
|---|---|--|
|  |  |  |
| D4-D7, DO-201AD opaque black plastic package | D3, D12, D13, DO-41, opaque black plastic package | D1, D1, D8- D11, D14, DO-35 glass package |

Install the Capacitors

Now install the capacitors:

| Designation | Value | Description | Done? (✓) |
|-------------|------------|--|-----------|
| C1 | 10 μ F | 100V electrolytic (polarized), cylindrical shape | |
| C2 | 10 μ F | 100V electrolytic (polarized), cylindrical shape | |
| C3 | 100 nF | 50V, Z5U, +/- 20%, marked 104 | |
| C4 | 100 nF | 50V, Z5U, +/- 20%, marked 104 | |
| C5 | 10 nF | 400V, film, 20%, box shaped | |

Notes:

1. C1 is polarized, showing a minus sign (-) on the negative end of the capacitor. Make sure that the minus sign faces away from the plus sign (+) marked on the silk screen for C1.
2. C2 is also polarized.
 - a. The Rev A PCB's have a silk screen error in the drawing for C2. The shape is shown as a rectangle; there is no "C2" designation, and no polarity designation. Use Figure 2 to locate and properly install C2. The bottom of C2 should be about $\frac{1}{4}$ " above the PCB to assure no connection to the trace that runs between its terminals.
 - b. The Rev B PCB has correct shape and polarity marking for C2 (Figure 3).

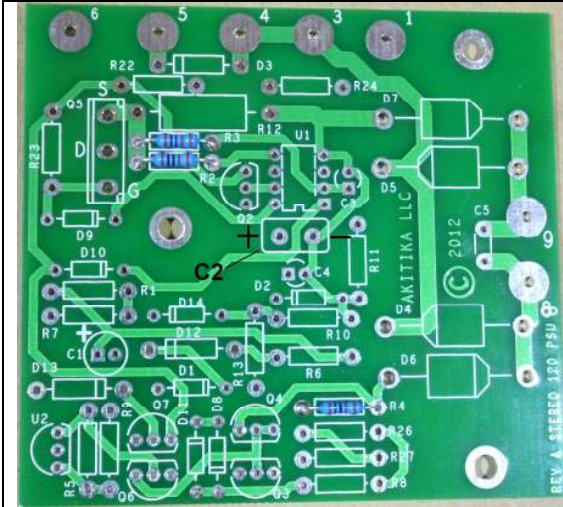


Figure 2-C2 location and polarity is missing in Rev A boards. Shape is also misleading.

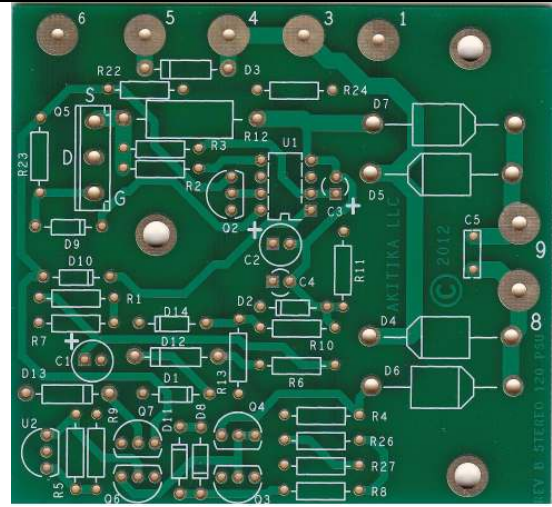


Figure 3-C2 shape and polarity marking is correct on Rev B boards

Install the Transistors

Spread the outside leads a bit to make it easier to insert them into the board. Do not install Q5 now. It will be installed later.

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? (✓) |
|-------------|---------------|------------------------------|-----------|
| Q2 | 2N3904, TO-92 | 60 V NPN bipolar transistor | |
| Q3 | 2N3904, TO-92 | 60 V NPN bipolar transistor | |
| Q4 | 2N3904, TO-92 | 60 V NPN bipolar transistor | |
| Q6 | 2N5401, TO-92 | 150 V PNP bipolar transistor | |
| Q7 | 2N5401, TO-92 | 150 V PNP bipolar transistor | |

Don't confuse U2 and Q2. They have the same shape, but operate very differently. Get a loupe, and a light, and make sure you haven't put one or the other in the wrong place!

Install the Integrated Circuits

Install the integrated circuits.

Orient U1 so that pin 1 on the chip matches pin 1 on the silk screen.

Orient U2 to match the silk screen outline.

| Designation | Type | Description | Done? (✓) |
|-------------|----------------|------------------------------|-----------|
| U1 | LM258 or LM358 | 8 Pin DIP | |
| U2 | TL431, TO-92 | Programmable shunt regulator | |

Final Inspection of the Circuit Board

After you've taken a break, look over your completed circuit board one more time. Looking on the component side, double check:

1. polarity (banded end) of diodes matching the banded end on the silk screen.
2. polarity of C1 (minus sign away from the indicated plus sign on the silk screen).
3. polarity of C2 (per the indicated drawing).

If you get one of these polarities wrong, there is a good chance that the power supply won't work, or there will be damage when you power it up.

Look at the solder side of the board. Make sure that:

1. All component leads are soldered (it's easy to forget one or two, and that will cause either unreliable operation, or no operation at all!)
2. There are no solder bridges between pads which should be isolated. Solder bridges may stop the amplifier from working correctly.

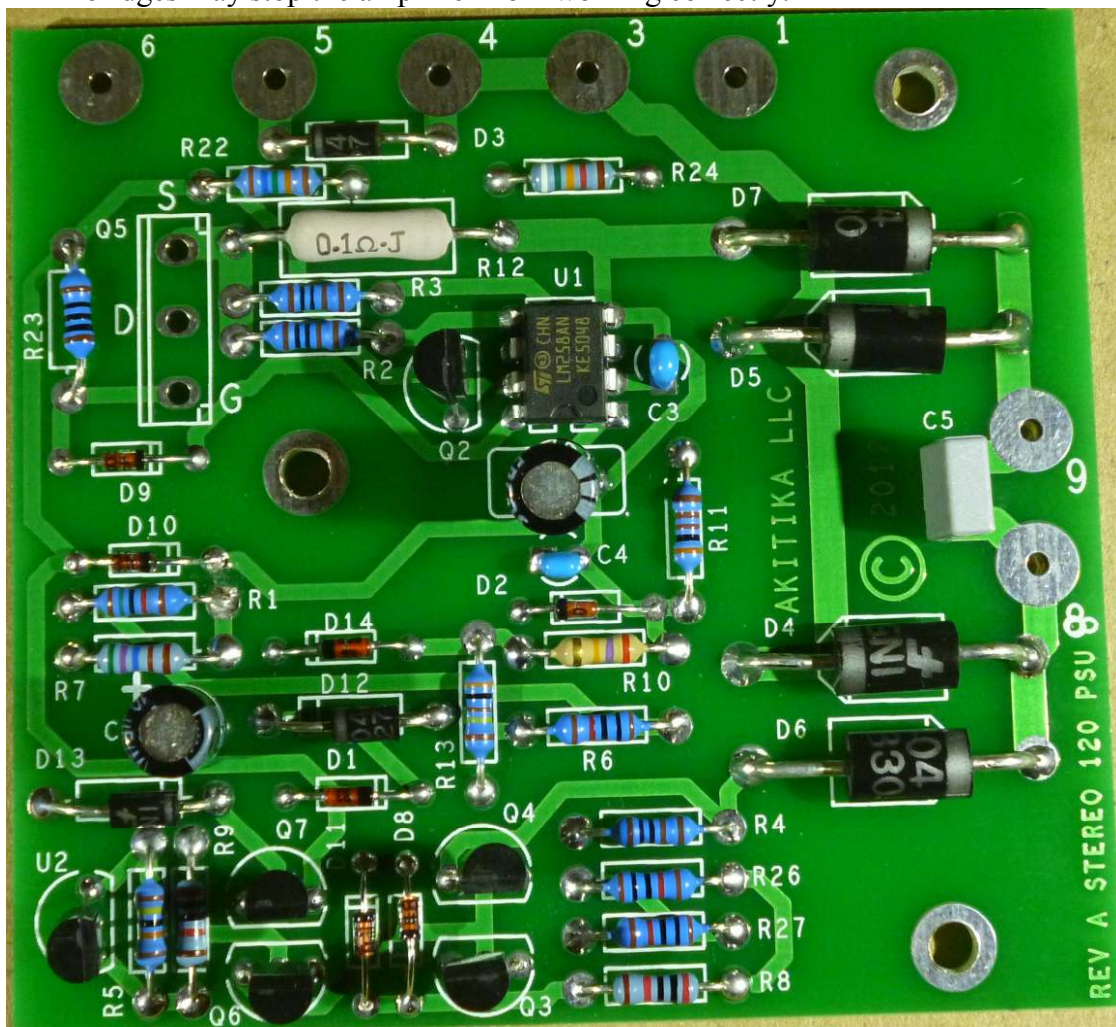


Figure 4-Completed Rev A Circuit Board (to this point). Your R10 will look different. You can see a Rev B board at a similar state of assembly in Figure 16.

Section 3: Removing the Old Power Supply

Make sure that the power cord is out, and has been out for at least 1 minute before starting this section.

Opening the Amplifier

1. *Make sure the amplifier is unplugged. If it was recently powered, allow the amp to sit for one full minute before proceeding.*
2. Remove the four screws along the outside edge of the bottom that hold the cover in place (see Figure 5).

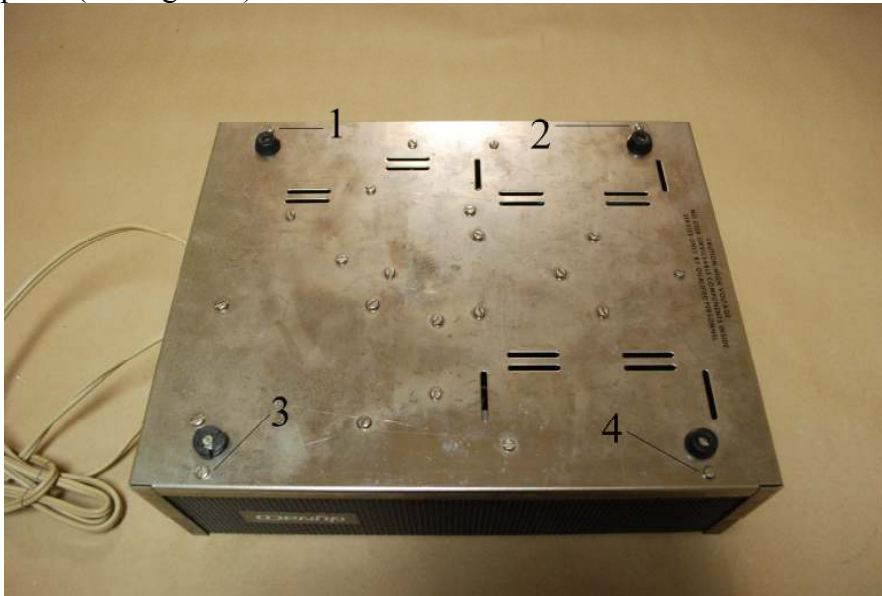


Figure 5-Location of the four screws that hold the cover to the base

3. Holding both the top and bottom of the amplifier, flip it over.
4. Lift the perforated metal top off of the amplifier.

Removing the Old Power Supply Board and Heat Sink

The power supply heat sink is bolted to the chassis with a pair of 6-32 nuts, bolts, and lock washers, one of which also holds one of the feet. Loosen, remove, and save these items. At this point, the power supply is held in by certain wires which we will remove in the next section.

Remove these wires from power supply board (PC-15)

Refer to Figure 6. De-solder or cut the following 6 wires from their PC-15 circuit board eyelets. Using masking tape, label each wire with the eyelet number to which it was attached.

1. eyelet 1 – black wire to negative terminal of C9
2. eyelet 3 – red wire to positive terminal of C9
3. eyelet 4 – red wire to positive terminal of C12
4. eyelet 5 – red wire to eyelet 10 of LEFT PC-14 (only applies to Stereo 120's with original Dynaco amplifier modules).
5. eyelet 8 – red wire to power transformer
6. eyelet 9 – red wire to power transformer

Cut or de-solder the black wire that runs from the lug on the collector of Q9 to the ground lug.

Prepare the Heat Sink for Re-use

These directions tell you how to recover the heat sink for re-use with the new power supply board.

1. The power supply assembly (heatsink with Q9 and PC-15) should now be loose. Remove it from the chassis.
2. Remove the three long screws and stand-offs that hold the PC-15 to the heat sink.
3. Clip or de-solder Q9's emitter and base wires near Q9.
4. Remove the nuts and bolts that hold Q9 in place.
5. Remove Q9 from the heat sink. If there is an insulator attached, remove it also.
6. Use isopropyl alcohol to clean old heat sink compound off the heat sink.
7. The heat sink is now ready for re-use.

Final Assembly

Attach three standoffs to the heat sink as shown in Figure 7 using 6-32x3/8" SEM screws.

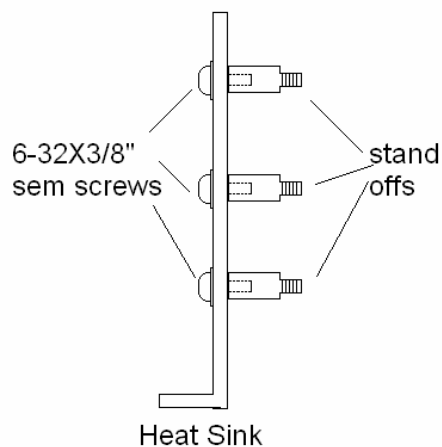
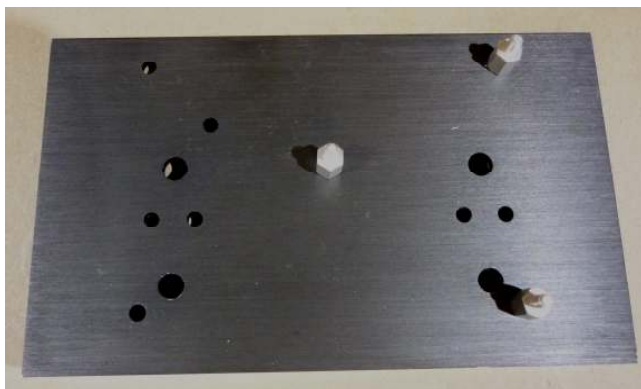


Figure 7-Installing the stand-offs. Picture on left shows location, picture on right shows side view of assembly detail

Form the leads of Q5 as shown in Figure 8.

| | | |
|----|------------------|---------------------------|
| Q5 | IRFP250N, TO-247 | N-Ch MOSFET, 200 V @ 30 A |
|----|------------------|---------------------------|



Figure 8-forming Q5's leads

Smear a thin film of heat sink compound to the metal tab side of Q5 as shown in Figure 9.

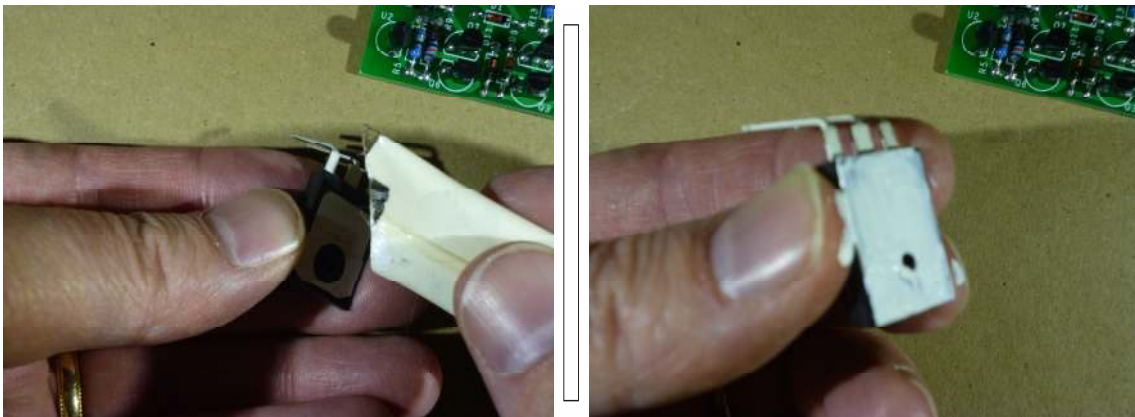


Figure 9-Apply heat sink compound to metal tab side of Q5

Use a 6-32x1/2" SEM screw and a 6-32 PEM nut to fasten Q5 to the heatsink as shown in Figure 10. For now, leave the screw and nut a bit loose.

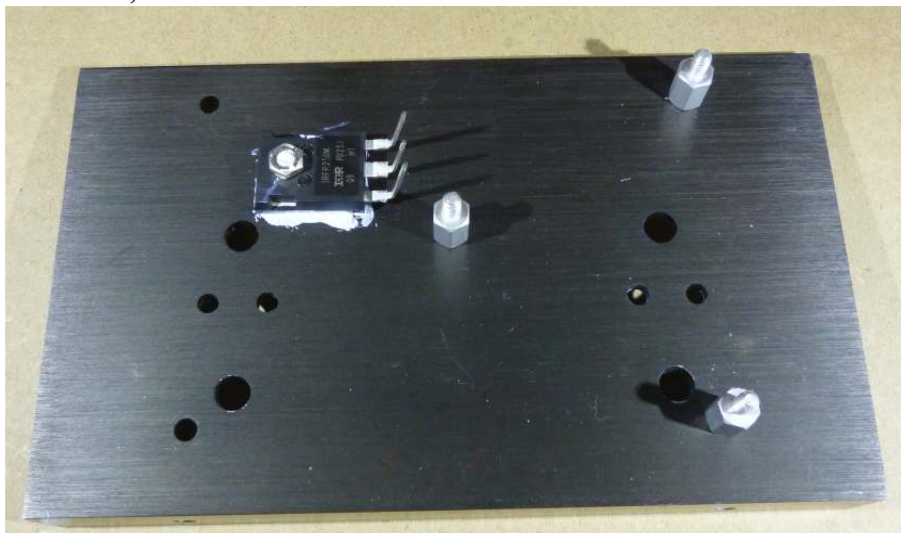


Figure 10-fasten Q5 to the heat sink as shown

Fit the assembled circuit board over the leads of Q5, passing the three leads through the holes marked S, G, and D. Wiggle the board so the threaded parts of the standoffs engage the mounting holes on the PC board.



Figure 11-installing the PC board on the heat sink

Install and tighten the 3 PEM nuts that hold the PCB to the standoffs. Tighten the screw that holds Q5 to the heat sink. Wiggle it a bit and form its leads to make sure that it lies flat along the heat sink. Solder the source, drain, and gate leads of Q5. Clip the leads about 1/8 to 1/4 inch above the PCB.

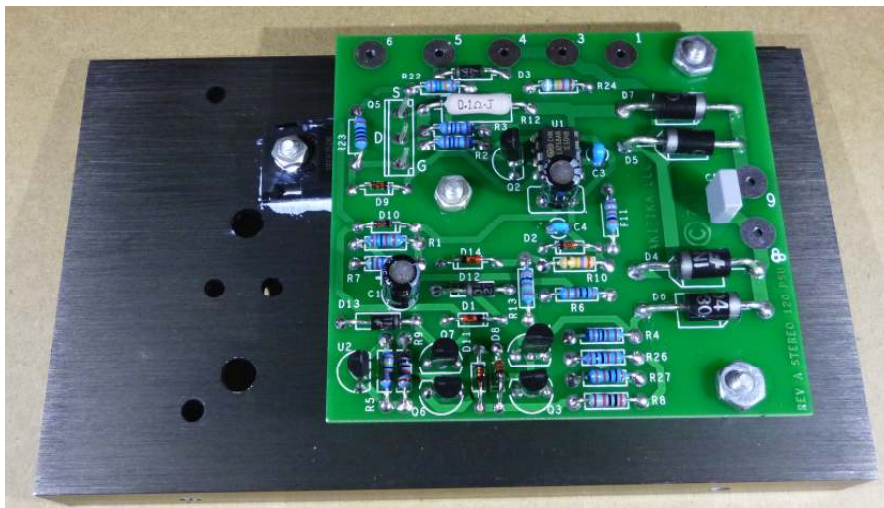


Figure 12-install and tighten the nuts

Examine the chassis where the heat sink was installed. If there is old thermal compound present, remove it with Isopropyl alcohol and a paper towel.

Be careful...Isopropyl alcohol and paper towels are a potentially flammable combination!

Section 4: Testing the Completed Power Supply

In this section, we'll test the power supply by itself. That limits collateral damage in the case of assembly errors or component problems.

Make sure that the power cord is out, and has been out for at least 1 minute before starting this section.

Here are the wiring steps, and 2 unwiring steps that will save your amplifiers from grief if there is a power supply problem.

1. Place the heatsink and PCB assembly roughly in position in the amplifier. Don't install the mounting screws that hold the assembly to the chassis.
2. Solder one red wire from the transformer to eyelet 8 of the PCB.
3. Solder the other red wire from the transformer to eyelet 9 of the PCB.
4. Solder the black wire from C9's negative terminal to eyelet 1 of the PCB.
5. Solder the red wire from C9's positive terminal to eyelet 3 of the PCB.
6. Solder the red wire from C12's positive terminal to eyelet 4 of the PCB.
7. Solder the black wire from the ground lug to eyelet 6 of the PCB.

Install the 6-32 hardware and foot that hold the power supply heat sink in place. Tighten the hardware finger tight for now.

At this point, there are different instructions depending upon which version of the amplifier you have:

- An original Stereo 120
- A Stereo 120 with Updatemydynaco amplifier modules
- A Stereo 120 with Updatemydynaco amplifier modules and the PSRC (power supply replacement capacitor) Kit

The intention of any of these instructions is to test the power supply without applying voltage to the power amplifiers. Thus all of these instructions call for C12 (and C11 in some of the cases, as noted) to be connected, but power to the amplifiers to be disconnected.

Follow the section that corresponds to your situation.

For Original Dynaco Stereo 120's

Refer to Figure 13:

8. Disconnect the red wire from C12 to the collector of Q5 PC-14 RIGHT.
9. Disconnect the red wire from C12 to the collector of Q5 PC-14 LEFT.

Make sure that the AC power cord is not plugged in. Turn the power switch on. Now, standing well away from the chassis, plug in the AC power cord. There may be a small "bong" sound when you plug the amplifier in, and perhaps a small arc at the wall socket, but there should be no smoke or drama coming from the amplifier chassis.

If after a minute everything seems calm, measure the output voltage. A DC voltmeter connected across C12 should show 72+/-2 volts. If this is the case, unplug the power cord and go on. If the output voltage is wrong, see the Troubleshooting section.

If the voltage across C12 is out of tolerance, pull the plug and STOP!

- *Anything outside of the range of 68-76 Volts is considered bad!*
- *More than 76 volts could be hazardous to your amplifier modules!*
- *More than 84 volts will be fatal to your amplifier modules!!!*
- *If you don't have a DC voltmeter...GET ONE! This is not the time to play amplifier roulette!*

Make sure that the power cord is out, and has been out for at least 3 FULL MINUTES before starting this section. There's a lot of capacitance, and not much loading to discharge the caps in this configuration (without the amps attached). Alternatively, you could measure the voltage on C12 until it drops below 10 Volts.

10. Re-connect the red wire from C12 to the collector of Q5 PC-14 RIGHT.
11. Re-connect the red wire from C12 to the collector of Q5 PC-14 LEFT.
12. Solder the wire from LEFT PC-14 eyelet 10 to eyelet 5 of the PCB.

For Stereo 120's with Update My Dynaco Amplifier Modules

Refer to Figure 14.

The power wires that feed the amplifier modules connect to wire busses on C12. On those wire bus bars:

8. Disconnect the red wire of the red/black pair from C12 that goes to the to the VCC eyelet of the RIGHT channel amplifier.
9. Disconnect the red wire of the red/black pair from C12 that goes to the to the VCC eyelet of the LEFT channel amplifier.

Make sure that the AC power cord is not plugged in. Turn the power switch on. Now, standing well away from the chassis, plug in the AC power cord. There may be a small "bong" sound when you plug the amplifier in, and perhaps a small arc at the wall socket, but there should be no smoke or drama coming from the amplifier chassis.

If after a minute everything seems calm, measure the output voltage. A DC voltmeter connected across C12 should show 72+/-2 volts. If this is the case, unplug the power cord and go on. If the output voltage is wrong, see the Troubleshooting section.

Make sure that the power cord is out, and has been out for at least 3 FULL MINUTES before starting this section. There's a lot of capacitance, and not much loading to discharge the caps in this configuration (without the amps attached). Alternatively, you could measure the voltage on C12 until it drops below 10 Volts.

10. Reconnect the red wire of the LEFT channel red/black pair to the C12 bus-wire on the positive terminal of C12.
11. Reconnect the red wire of the RIGHT channel red/black pair to the C12 bus-wire on the positive terminal of C12.
12. Note that eyelet 5 of the PCB will have no wire connected.

For Stereo 120's with Update My Dynaco Amplifier Modules and PSRC (Power Supply Replacement Capacitors)

Refer to Figure 15.

The power wires that feed the amplifier modules connect to wire busses on C12. On those wire busses:

8. Disconnect the red wire of the red/black pair from C12 that goes to the to the VCC eyelet of the RIGHT channel amplifier.
9. Disconnect the red wire of the red/black pair from C12 that goes to the to the VCC eyelet of the LEFT channel amplifier.

Make sure that the AC power cord is not plugged in. Turn the power switch on. Now, standing well away from the chassis, plug in the AC power cord. There may be a small “bong” sound when you plug the amplifier in, and perhaps a small arc at the wall socket, but there should be no smoke or drama coming from the amplifier chassis.

If after a minute everything seems calm, measure the output voltage. A DC voltmeter connected across C12 should show 72+/-2 volts. If this is the case, unplug the power cord and go on. If the output voltage is wrong, see the Troubleshooting section.

Make sure that the power cord is out, and has been out for at least 3 FULL MINUTES before starting this section. There’s a lot of capacitance, and not much loading to discharge the caps in this configuration (without the amps attached). Alternatively, you could measure the voltage on C12 until it drops below 10 Volts.

10. Reconnect the red wire of the LEFT channel red/black pair to the C12 bus-wire on the positive terminal of C12.
11. Reconnect the red wire of the RIGHT channel red/black pair to the C12 bus-wire on the positive terminal of C12.
12. Note that eyelet 5 of the PCB will have no wire connected.

Section 5: Final Assembly for All Amplifiers

Remove the 6-32 hardware that holds the heat sink to the chassis. Smear a film of thermal compound on the mounting surface of the heat sink. Re-attach the heat sink to the chassis using the 6-32 hardware (remember to install the foot) and tighten the hardware.

Reinstall the top, then install and tighten the four screws that hold the top in place.

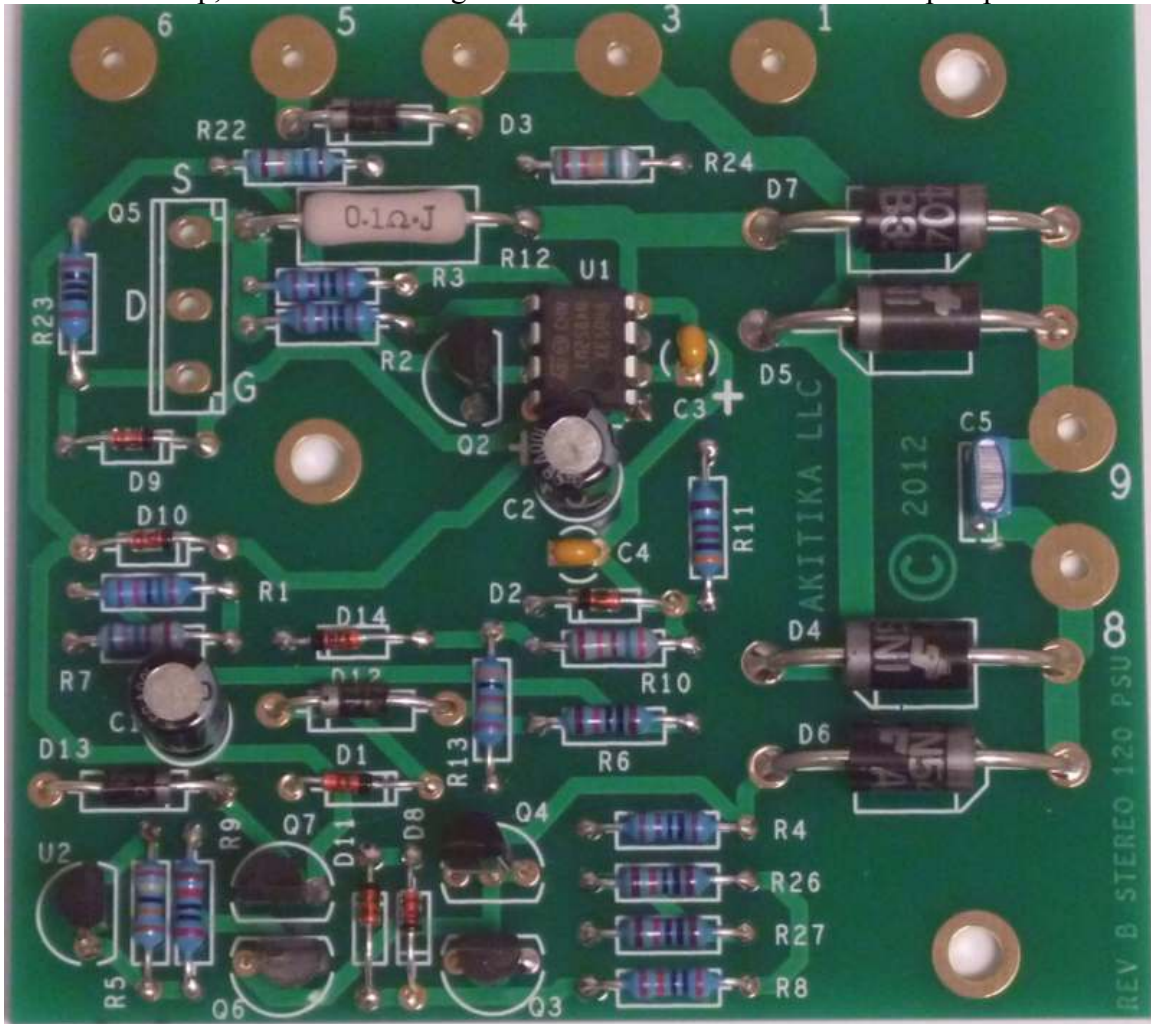


Figure 16-Assembled Rev B board, power mosfet Q5 not installed

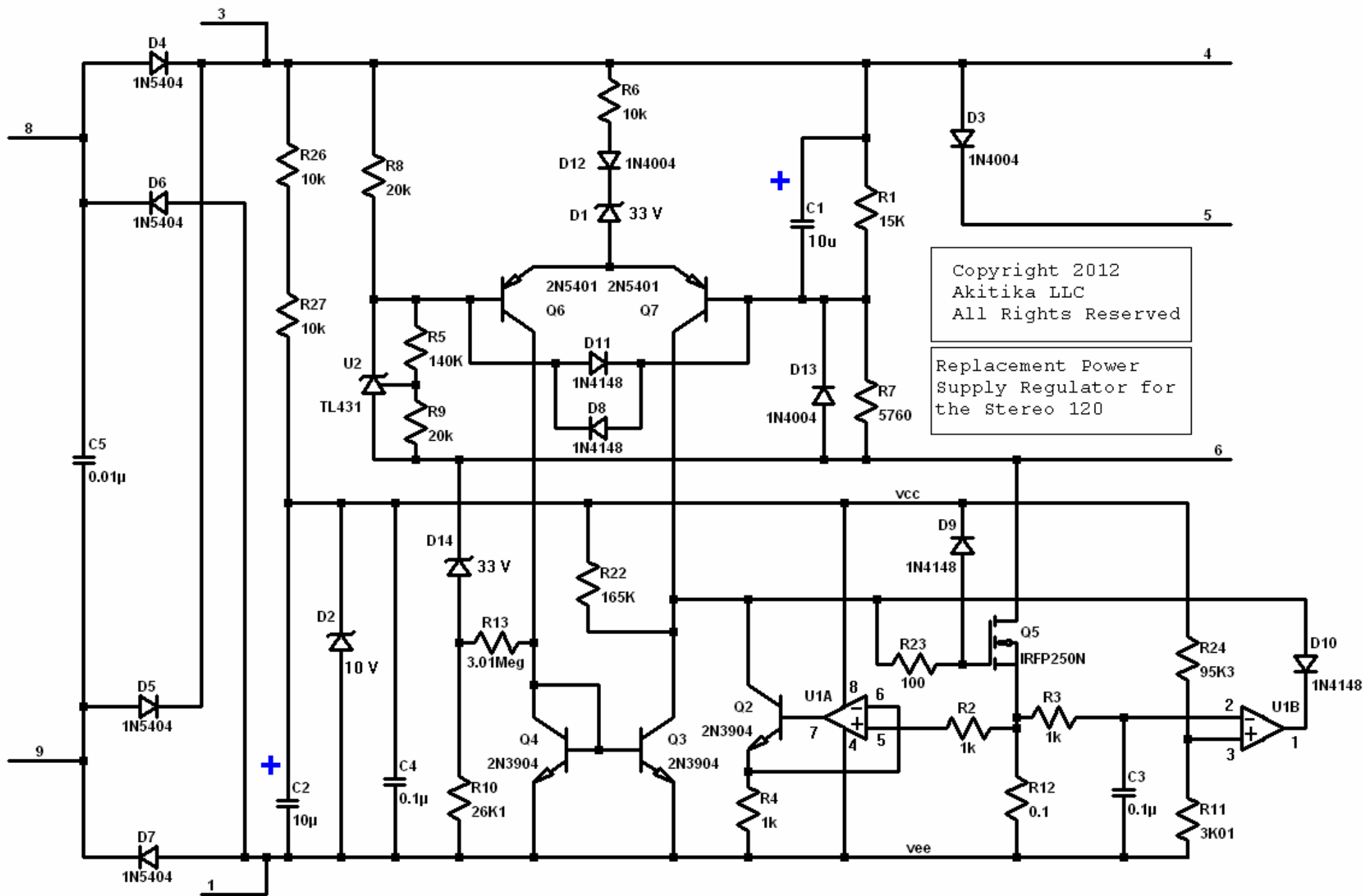


Figure 17-Schematic of power supply

Resistor Color Code



Figure 18-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% |