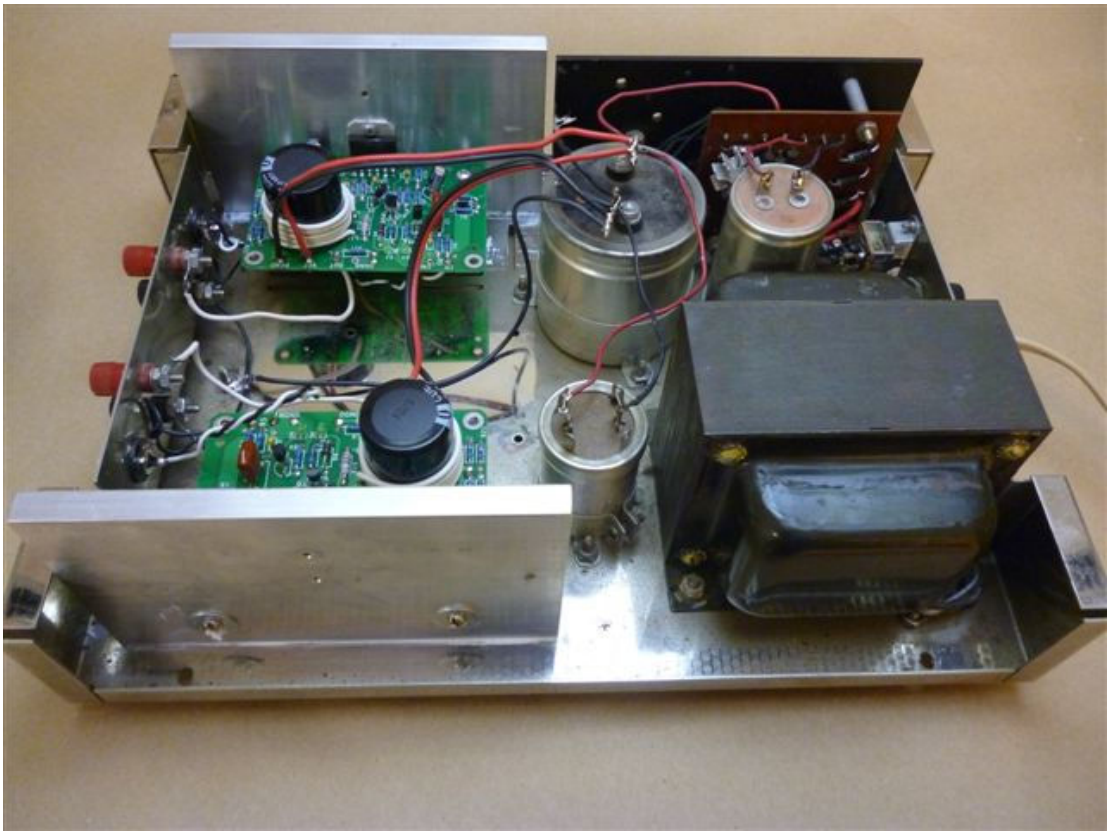
UPDATING THE DYNACO STEREO 120 SOLID STATE POWER AMPLIFIER: SUPER HEATSINK VERSION



Revision 1.19: February 16, 2012

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Section 1: About This Manual

This manual gives you all the information you need to bring your Solid State Dynaco Stereo 120 Power Amplifier up to date using UpdateMyDynaco replacement modules and UpdateMyDynaco Super Heat Sinks. These heat sinks offer these advantages compared to recycling the original Dynaco heat sinks:

1. The Super Heat Sinks let you deliver 60 Watts Per Channel into 8 Ohms with much less temperature rise than the original heat sinks. It even allows the delivery of significant 4 Ohm power, limited mainly by the power supply regulator's designed-in fold-back.
2. The amount of disassembly and reassembly is much less when you use the Super Heat Sinks. You preserve the old Dynaco amplifier modules, and the job of updating your Dynaco will probably take about an hour less time.
3. A secondary market for original Dynaco Stereo 120 amplifier modules might develop on EBay. Perhaps you could offset the cost of the UpdateMyDynaco kit by selling the original modules.

The only part of your Stereo 120 that really needs to work is the power supply. With this kit, you'll build good sounding, highly reliable amplifiers to replace the original amplifier modules.

Check www.updatemydynaco.com for "Hints for Kit Builders" before you begin assembly

Who Should Attempt this Project?

You can build this kit and update your Dynaco Stereo 120 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

Tools You'll Need

You'll need the following tools to update your Stereo 120:

1. flat blade screwdriver for #6 screws
2. Phillips screwdriver (#2)
3. pliers or nut drivers suitable for #6 hardware (5/16" nut driver or hex wrench)
4. needle nose pliers (helpful, but not strictly necessary)
5. pencil type soldering iron of 25 to 50 Watts (no huge honking soldering guns or blowtorches)
6. wire cutters and strippers
7. multi-meter (helpful, but not strictly necessary)
8. magnifying glass, to verify identification codes on the 3 COG capacitors

Project Overview

The project consists of the following steps:

1. Checking out the old Dynaco Stereo 120 power supply.
2. Removing the old amplifier modules, output capacitors, and a few associated bits, while saving some parts for re-use.
3. Assembling the updated amplifier module PC Boards.
4. Mounting the updated amplifier modules to the super heat sinks.
5. Mechanical installation and wiring in the updated amplifier modules.

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: Checking the Stereo 120 Power Supply

The only part of your old Stereo 120 that really needs to work is the power supply. In this section, we show how to check your power supply. If your amplifier modules haven't been badly damaged, this is the simplest method of assuring your power supply is ok. If the amplifier modules have been damaged, then you'll have to use the procedure in Section 4: Troubleshooting the Stereo 120 Power Supply to troubleshoot, separating amplifier module problems from power supply problems.

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 1).

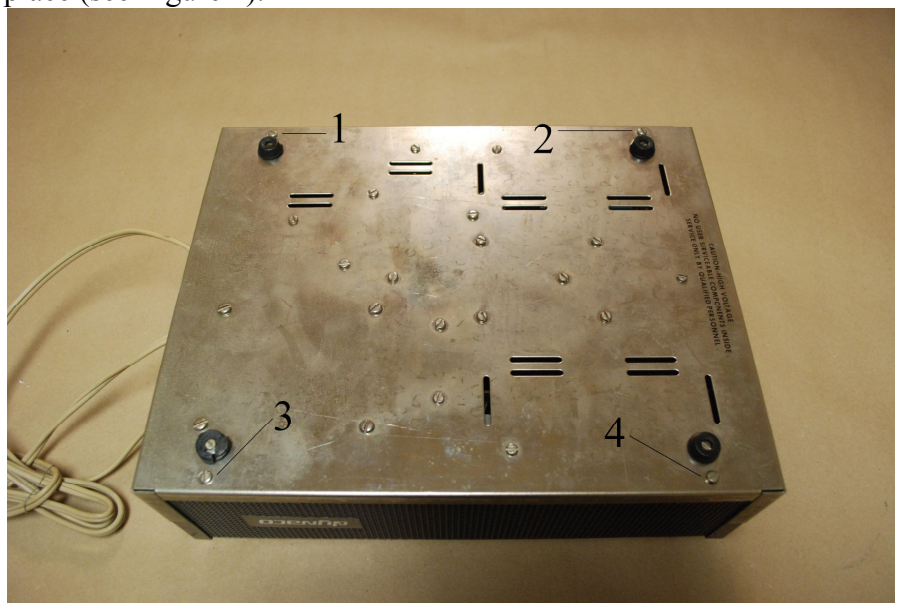


Figure 1-Location of the four screws that hold the cover to the base

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

Check the Power Supply Voltages

At this point:

1. The perforated metal top is off the amplifier.
2. AC power, inputs, and outputs, are disconnected.
3. You can see into the amplifier, as shown in Figure 2.
4. You have a voltmeter ready, set to a scale that allows measuring the nominal output voltage, 72 Volts DC.

Now:

1. Make sure that the power switch is off.

2. Plug the amplifier into the AC wall socket.
3. Standing off to one side, turn the power switch on. Observe the amp for about a minute to make sure no smoke is curling out of any of the modules.
4. If all seems calm, measure the voltage on C12 (see Figure 2). Write down the number here:

   The voltage on C12 was _____Volts DC.

- If this number is between 66 and 78 Volts, then your power supply is good.
- If this number is outside this range, your power supply has a problem.

Section 3: Saving the Stuff that Should Be Saved

Cutting the wires on the old amplifier modules

Refer to Figure 2. It shows where the wires must be cut to remove the old amplifier modules. Those cuts are detailed in the text below. Each cut is marked by an X.

Removing the LEFT channel module

1. To remove the LEFT channel module, cut the following wires close to the end that connects to the LEFT channel PC-14 module. Make only one cut per wire, leaving the wire attached at the end farthest from the LEFT PC-14 module.
   a. Eyelets 8, 9, 10, 11, 12, and 13
2. Cut the wire that attaches to Eyelet 5 of the PC-15 power supply circuit board close to the PC-15 circuit board.
3. Loosen the two screws that hold the left channel heat sink in place (note that one of the screws holds a mounting foot[1]). Save the hardware for later re-use.
4. Cut the red wire that connects to Q5's collector, close to the lug. Although there are multiple wires on the collector, only cut the wire that connects to C12.
5. Cut the black wire that connects to Q6's emitter, near the emitter. There are two wires on the emitter...you need only cut the wire that runs to the black left speaker binding post.

Save the LEFT module and mounting hardware. Perhaps you can sell it on E-bay. The Super Heat Sink version of the kit doesn't use the old module or heat sink, but you should save the 2 6-32x1/2" screws and the rubber foot as they will be re-used to mount the left channel super heat sink module amplifier.

Removing the RIGHT channel module

6. To remove the RIGHT channel module, cut the following wires close to the end that connects to the RIGHT channel PC-14 module. Make only one cut per wire, leaving the wire attached at the end farthest from the RIGHT PC-14 module.
   a. Eyelets 8, 9, 10, 11, 12, and 13
7. Loosen the two screws that hold the RIGHT channel heat sink in place (note that one of the screws holds a mounting foot[2]). Save the hardware for later re-use.

[1] If your mounting feet are falling apart, you can order a replacement set from updatemydynaco.com.
[2] If your mounting feet are falling apart, you can order a replacement set from updatemydynaco.com.

8. Cut the red wire that connects to Q5's collector, close to the lug. Although there are multiple wires on the collector, only cut the wire that connects to C12.
9. Cut the black wire that connects to Q6's emitter, near the emitter. There are two wires on the emitter...you need only cut the wire that runs to the black RIGHT speaker binding post.

Save the RIGHT module and mounting hardware. Perhaps you can sell it on E-bay. The Super Heat Sink version of the kit doesn't use the old module or heat sink, but you should save the 2 6-32x1/2" screws and the rubber foot as they will be re-used to mount the RIGHT channel super heat sink module amplifier.

Removing C7 RIGHT

1. Remove and save the 3 sets of #6 hardware that hold C7 RIGHT to the bottom of the chassis.
2. Unroll one foot of the wire that's wrapped around C7 RIGHT and connects to the RIGHT RED Binding post.
3. Cut this wire near C7 RIGHT so that about 1 foot of wire remains connected to the RIGHT RED Binding post. The rest of the wire wrapped around the capacitor will be used to make the new inductor on the UpdateMyDynaco modules.

Removing C7 LEFT

4. Remove and save the 3 sets of #6 hardware that hold C7 LEFT to the bottom of the chassis.
5. Unroll one foot of the wire that's wrapped around C7 LEFT and connects to the LEFT RED Binding post.
6. Cut this wire near C7 LEFT so that about 1 foot of wire remains connected to the LEFT RED Binding post. The rest of the wire wrapped around the capacitor will be used to make the new inductor on the UpdateMyDynaco modules.

Removing the Output Zobel Networks

1. Clip the lead of the 0.1 uF capacitor that connects to the RIGHT RED binding post, near the RIGHT RED Binding post.
2. Clip the lead of the 4.7 Ohm resistor that connects to the RIGHT BLACK binding post, near the RIGHT BLACK binding post.
3. Clip the lead of the 0.1 uF capacitor that connects to the LEFT RED binding post, near the LEFT RED Binding post.
4. Clip the lead of the 4.7 Ohm resistor that connects to the LEFT BLACK binding post, near the LEFT BLACK binding post.
5. Remove the terminal strip and the two attached resistors and capacitors.

Note that the new circuit boards include a Zobel network that takes the place of the components on the terminal strips. Figure 4 shows what the amplifier should look like when you've completed this step.

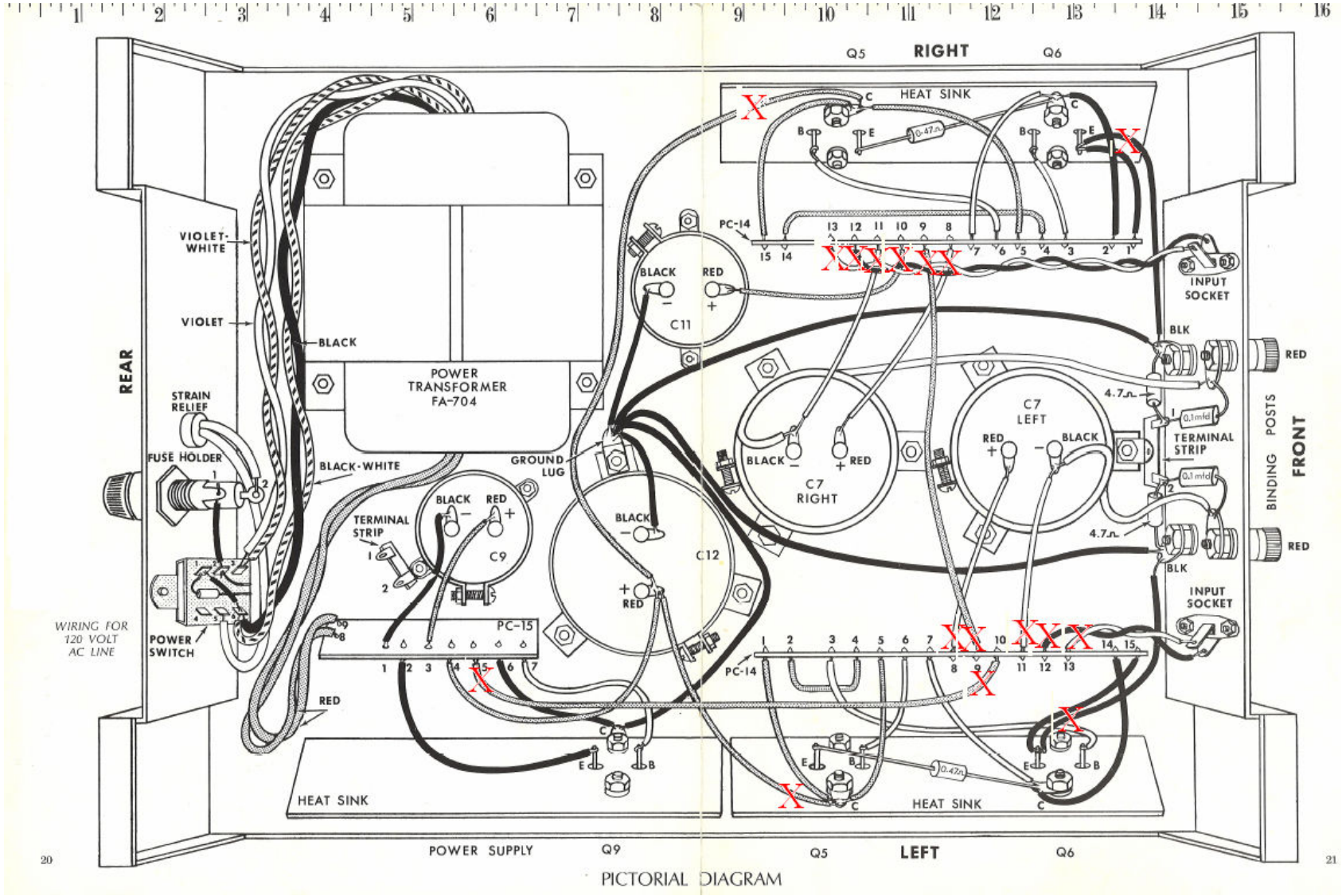


Figure 2-Location diagram for cutting wires

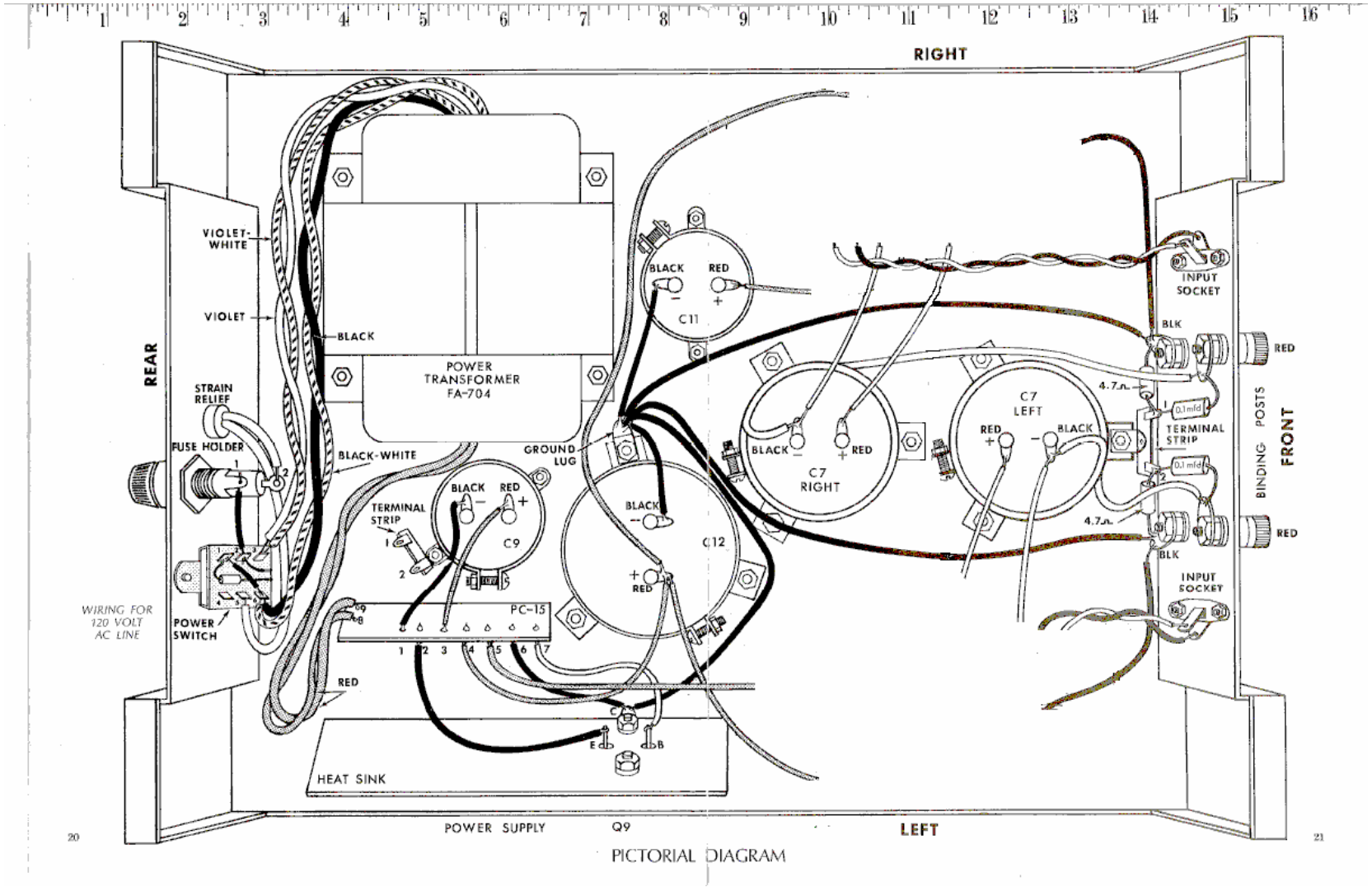


Figure 3-After the Amplifier Modules have been removed

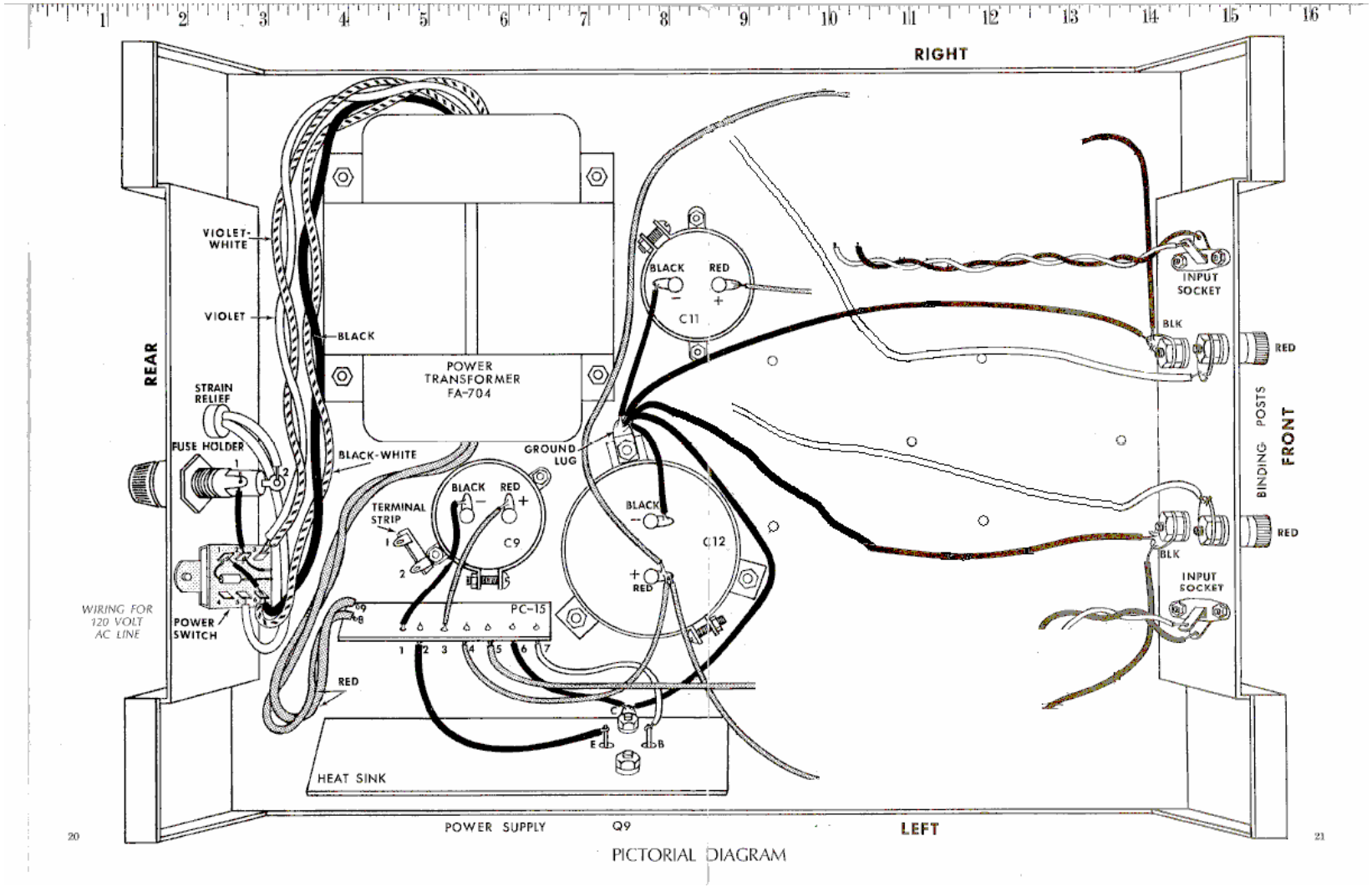


Figure 4- Removal of components is completed

Section 4: Troubleshooting the Stereo 120 Power Supply

This section only applies if your power supply didn't pass the test outlined in Section 2: Checking the Stereo 120 Power Supply. If your power supply did pass that test, move on to Section 5: Building the Updated Circuit Boards. This section describes how to verify proper operation of the power supply, separating power supply troubles from amplifier module troubles.

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

Prepare and Connect the Test Load

We'll recycle parts of the amplifier boards to make a test load resistor for the power supply. If you know that your power supply and regulator are working correctly, you may skip ahead to Section 5: Building the Updated Circuit Boards.

1. Keeping the leads as long as possible, remove two 300 Ohm power resistors from one of the PC-14 circuit boards. If you have any doubts about the resistors, check them with an ohm-meter.
2. Connect the two resistors in series, twisting and soldering.
3. Connect the series resistors across C12. Figure 5 shows how the test circuit will look. The ground side connection is a bit round-about, but it's there none the less.

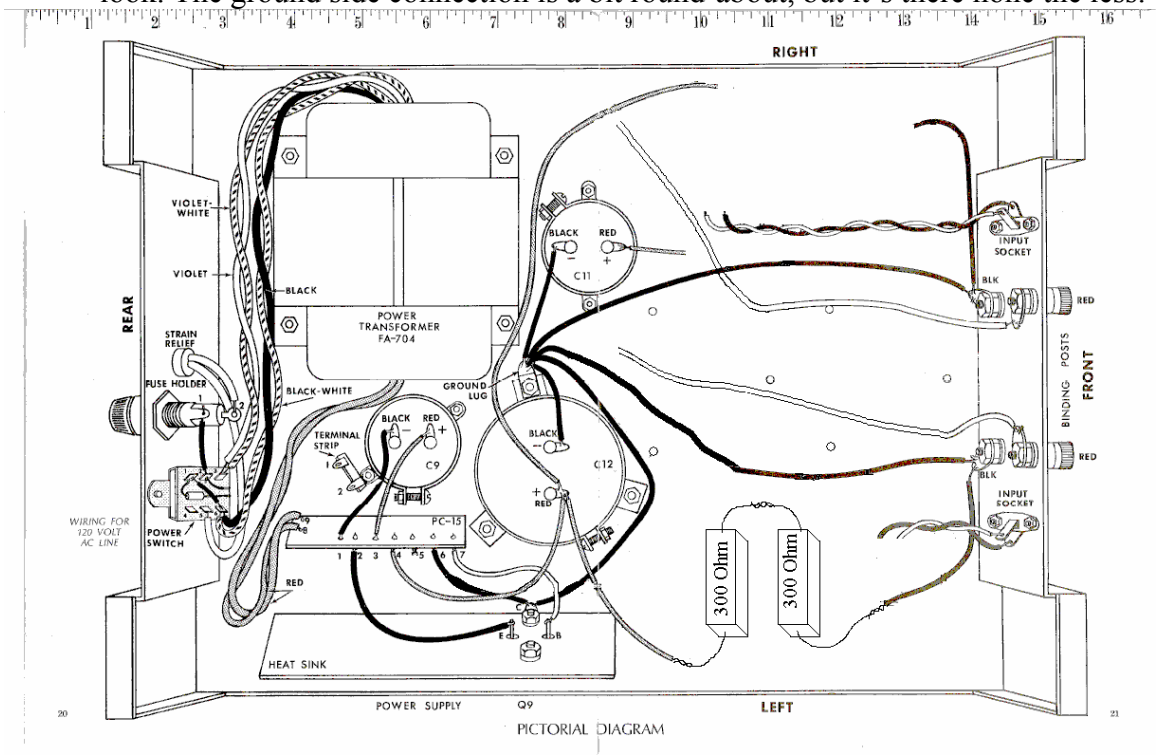


Figure 5-Connecting a test load to the power supply

Test the Power Supply

1. Make sure that neither the resistors nor their connections rest on the chassis. This is important.

2. Make sure that none of the other dangling wires is making contact with anything else.
3. When everyone is clear of the amplifier, plug it in, and turn it on.
4. Measure the DC voltage on the terminals of C12.
5. The voltage should be between 68 and 76 Volts, with a nominal voltage of 72 Volts. If it falls in this range, your power supply checks out. Remove the load resistors and move onto Section 5: Building the Updated Circuit Boards.

Just In Case – Trouble Shooting

The Voltage is Much More than 78 volts

Most likely the pass transistor (Q9 on the power supply heat sink) is shorted. However, repairing the power supply module is beyond the scope of this manual. You can complete Section 5: Building the Updated Circuit Boards, but don't move on to Section 6: Wiring In the Updated Amplifier Modules until you have repaired the power supply module. Check www.updatemydynaco.com , the Power Supply Circuit Description, for more information.

The Voltage is Much Less than 66 volts

Most likely the pass transistor is open. However, repairing the power supply pass module is beyond the scope of this manual. Don't continue until you have repaired the module. Check www.updatemydynaco.com , the Power Supply Circuit Description, for more information.

There's No Voltage at All

Check:

1. Is the AC socket powered?
2. Is the amp plugged in?
3. Is the power turned on?

Remove the power, check and replace the fuse with a properly rated fuse. Sometimes, fuses just get tired. Sometimes they blow to prevent a disaster. At this point, we're not sure what the case is here.

Maintaining a respectful distance, power the amp again, and observe if the fuse blows. If it blows quickly, unplug the amp, and go to www.updatemydynaco.com , the Power Supply Circuit Description, for more information. The FAQs at the end of the document may be especially helpful.

At this point, if you're scared, confused, or nervous, find someone who knows what they're doing to help you. Above all, be safe!

Section 5: Building the Updated Circuit Boards

This section details the process of building the circuit boards. 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 toward the taller components. You will:

1. Install the resistors
2. Install the small capacitors
3. Install the diodes
4. Install the LEDs
5. Install the medium size capacitors
6. Install the transistors
7. Install the big capacitor
8. Wind and install the output inductor.
9. Install the LM3886.

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.

We recommend the following procedure:

1. Insert all the resistors of the same value, e.g. R14, R19, R20, and R21.
2. Bend the leads as described above.
3. Solder the leads on the back of the board.
4. clip the leads.

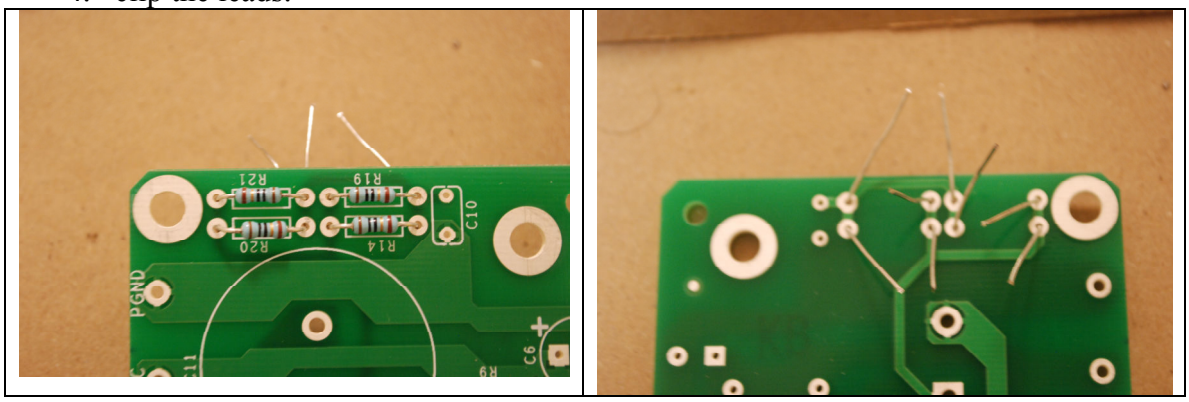


Figure 6-The first four resistors are installed with leads bent on the back side, but not yet soldered.

Turn the page for specific directions about each resistor.

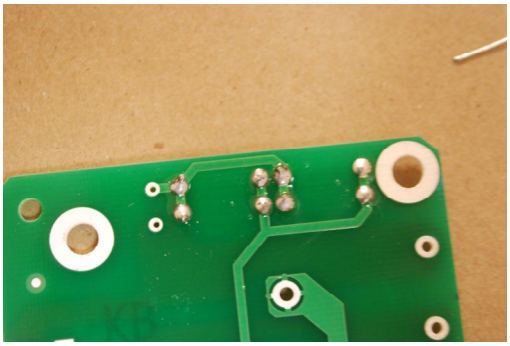


Figure 7-leads soldered and clipped

When you have completed this section, there will only be one empty resistor slot, R16, a no-load, which will remain empty.

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 code[3]. 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.

Designation	Value	Color Code	Done?
R14	10	Brown, Black, Black, Gold, Brown	
R19	10	Brown, Black, Black, Gold, Brown	
R20	10	Brown, Black, Black, Gold, Brown	
R21	10	Brown, Black, Black, Gold, Brown	
R13	100	Brown, Black, Black, Black, Brown	
R1	100K	Brown, Black, Black, Orange, Brown	
R2	100K	Brown, Black, Black, Orange, Brown	
R3	100K	Brown, Black, Black, Orange, Brown	
R5	100K	Brown, Black, Black, Orange, Brown	
R7	100K	Brown, Black, Black, Orange, Brown	
R8	100K	Brown, Black, Black, Orange, Brown	
R4	1K	Brown, Black, Black, Brown, Brown	
R6	1K	Brown, Black, Black, Brown, Brown	
R9	1K	Brown, Black, Black, Brown, Brown	
R10	1K	Brown, Black, Black, Brown, Brown	
R18	1K	Brown, Black, Black, Brown, Brown	
R11	20K	Red, Black, Black, Red, Brown	
R12	20K	Red, Black, Black, Red, Brown	
R17	2K87	Red, Gray, Violet, Brown, Brown	
R15	10 (1 Watt)	Brown, Black, Black, Gold, Brown. This resistor body is larger than the others.	
R16		This Location Remains Empty	

Note: R8 and R18 are near each other on the board. Be careful...don't mix them up!

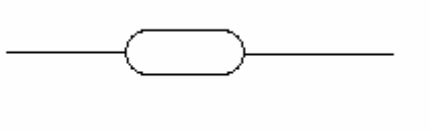
[3] See "Resistor Color Code" on page 31 to see how to read resistor color codes.

Install the Small Capacitors and the Diodes

Now we'll install the following small capacitors:

Designation	Value	Marking	Done?
C3	220 pF	221	
C4	220 pF	221	
C9	47 pF	470	

Here's what these three caps look like (not to scale):



Next we install diodes D1 and D4.

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	Done?
D1	1N4004	4004	
D4	1N4004	4004	

Here's what the diodes look like (not to scale):

Next we install LEDs D2 and D3 (Light Emitting Diodes – note that in normal operation, these diodes will be dark. However, in a fully darkened room, you'll see a dull green glow from the powered LEDs.)

Be careful! Light Emitting Diodes have a polarity, also! Read carefully to make sure you're putting the diodes in the right way! The cathode of the LED is indicated by a bar (negative sign) molded into the package. On some packages, there is no bar, but seen from the top, the circular outline with have a flat side. That flat side is the cathode. Finally, if the leads are uncut, the shorter of the two leads will be the cathode.			
Designation	Value	Marking	Done?
D2	T1 style	none	
D3	T1 style	none	

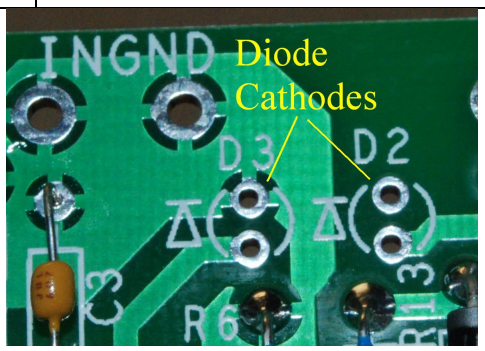


Figure 8-showing LED cathode orientation

Last Capacitors and the Transistors

Now, the medium tall polarized electrolytic capacitors:

C1 and C6 are polarized. Make sure the negative sign on the capacitors faces away from the positive sign on the silk screen!			
Designation	Value	Marking	Done?
C1	47 µF, 63 V	47 µF, 63 V, and minus sign for polarity	
C6	47 µF, 100 V	47 µF, 100 V, and minus sign for polarity	

And the non-polarized capacitors:

Designation	Value	Marking	Done?
C2	1 µF, 63 V or 100V	1 uF, 63 V or 100V (box shaped mylar capacitor)	
C5	0.1 µF, 100V	104	
C8	0.1 µF, 100V	104	
C10	0.1 µF, 100V	104	

Install the transistors. 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 ½" 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	Value	Marking	Done?
Q1	2N5551, NPN	2N5551	
Q2	2N5551, NPN	2N5551	
Q3	2N5551, NPN	2N5551	

Now install the speaker coupling capacitor:

Watch the polarity! Make sure the minus sign faces away from the plus sign on the silk screen. That puts the minus side of the cap along the outer edge of the circuit board.			
Designation	Value	Marking	Done?
C11	3300 uF 63V	3300 uF, 63 WVDC	

The speaker coupling capacitor will either snap or push into place. Verify once more that you have polarity correct, and then solder both speaker terminals to the circuit board. This will probably take more heat, time, and solder than anything you have soldered up to now.

Winding the Output Inductor

This step takes just a bit of finesse, but if you've come this far, you have nothing to worry about. If you're a bit frazzled, take a break before proceeding.

There...feel better? OK, let's go. Just follow these steps, ***measuring the wire length carefully if you want to succeed on the first shot***.

1. Cut a 21 1/2" length of 16 AWG solid wire from the output inductors wound around the old Dynaco output capacitors.
2. Strip back 3/8" of insulation from both ends of the wire. Be careful not to nick the conductors.
3. From the component side, place one stripped end of the wire into the L1A terminal. Route it around the output capacitor as shown in (see Figure 9) Solder the wire into the L1A hole.
4. Wind 5 turns of wire, closely spaced, so it looks like Figure 10. When you get to the end of the coil, fold the end across the existing turns, toward the L1B hole.
5. Pull the end of the wire through the L1B hole, and solder it on the back of the board.

Figure 9-Starting to wind the output inductor

Figure 10-finishing step for the output inductor

Solder the LM3886 into the Board

This is the last step in stuffing the circuit board. By now, you are pretty good at soldering. Your skill will help you with this step. Just follow the instructions calmly and carefully, and you'll do just fine.

You'll use the heat sink and hardware to accurately locate the LM3886 on the board. These steps refer to Figure 11.

1. Use two #6-3/8" Phillips head screws (they may or may not have captive lock-washers) to fasten two brackets to the solder side of the amplifier PC board.

2. Set the LM3886 into the board, but don't solder it in place. Temporarily complete the mechanical assembly as shown in Figure 11 using the following hardware:
    a. 4-40 screw (callout 4 in Figure 11). No nut is needed owing to the tapped hole in the super heat sink.
    b. Qty 2 of #6 fender washers, and Qty 2 of #6-32x5/8" pan-head screws with captive lock-washers(callouts 6 and 7 in Figure 11).

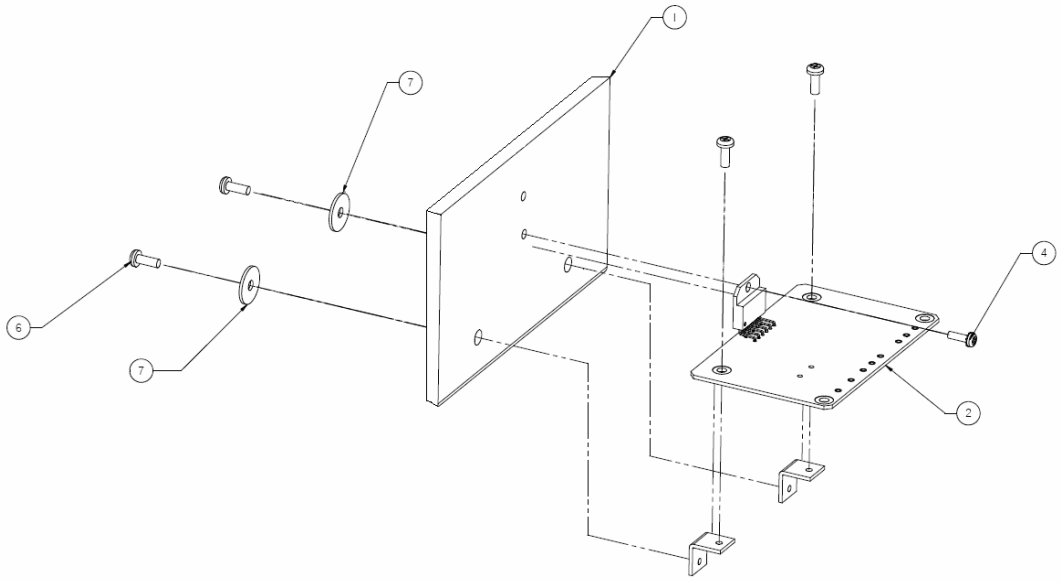


Figure 11-Assembling the circuit board to the heat sink

3. Look carefully at the board, the LM3886, and the heat sink. True and center everything before you tighten down any of the screws.
4. Solder just the corner pins of the LM3886, as shown in Figure 12. Make sure that the LM3886 is straight and level above the board as shown in Figure 13. Your set up won't look exactly like this because the kit is now supplied with the metal tab LM3886, and you will not have placed thermal compound on the LM3886 at this point.

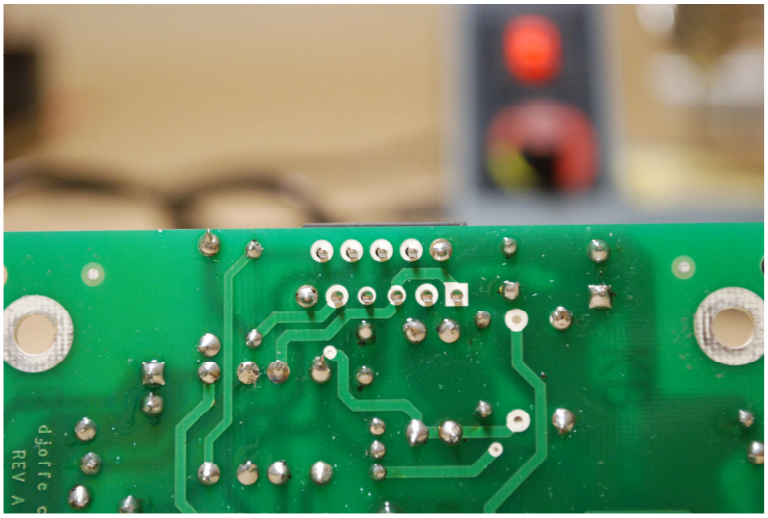


Figure 12-LM3886 installation step three, just the corner pins are soldered

5. If something has moved, just reheat the corner pins and pull the LM3886 in or out as needed. If you miss a right angle by a little, don't worry. Since you've only soldered two pins down, it's easy enough to reheat those two pins, and move the LM3886 up and down a bit until it sits at the right height.
6. Check your work. The LM3886 body should sit up off the board to avoid short circuits between the rows of pins (See Figure 13).
7. Remove the 4-40 screw that holds in the LM3886 and the two 6-32x5/8" that hold the brackets to the heat sink. Separate the heat sink from the pcb and bracket assembly.
8. Solder all the remaining pins of the LM3886 to the PCB.

Carefully inspect your soldering. Make sure that all pins of the LM3886 are soldered, and that there are no solder bridges between pins. Inspect the board from both the top and the bottom!

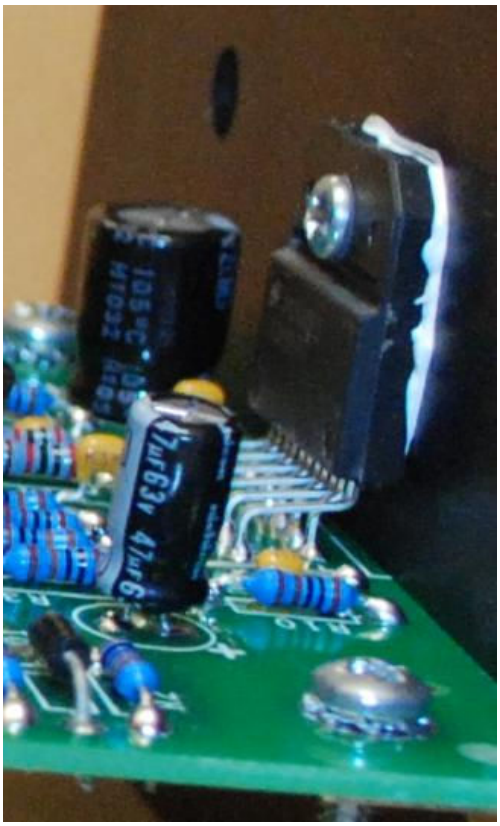


Figure 13-The LM3886 sits up off the board to avoid shorts between the front and back rows of pins.

Final Inspection of the Circuit Board

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

1. polarity (banded end) of D1 and D4 matching the banded end on the silk screen.
2. polarity (flat end, or molded bar end) of LEDS D2 and D3, placed toward the outside edge of the board.
3. polarity of C1 (minus sign away from the indicated plus sign on the silk screen).

4. polarity of C6 (minus sign away from the indicated plus sign on the silk screen).
5. polarity of C7 (minus sign close to the edge of the board).

If you get one of these polarities wrong, there is a good chance that the amplifier 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.

Mounting the Updated Amplifier Board to the Super Heat Sink

1. Cut a corner of the 4-gram packet of thermal compound. If you use it appropriately, that's enough to do everything you need. Place a line of thermal compound onto the back of the LM3886. Use your finger to smear the line into a thin film covering on the back of the LM3886. Save the rest of the thermal compound for other steps in the assembly.
2. Now that the LM3886 is completely soldered in place and thermal compound is applied, assemble the LM3886 and circuit board to the heat-sink plate as you did once previously, as shown in Figure 11:
    a. 4-40 through the LM3886 mounting hole into the tapped heat sink hole
    b. 6-32x5/8" screws and fender washers through the heat sink into the brackets.
3. Square up the assembly of the circuit board to the heat sink, and use the #6 screws and fender washers to fasten the brackets to the heat sink. The #6 screws and fender washers leave enough wiggle room to make assembly fairly non-critical. Just make everything finger tight at first to make sure it all looks even and fits well without strain.
4. When everything looks good, progressively tighten all the hardware.
5. Tighten the #4 screw that holds the LM3886 to the heat sink. Both the tab and heat sink are metal, so you can tighten it firmly.
6. Repeat the process to build the amplifier module for the second channel.

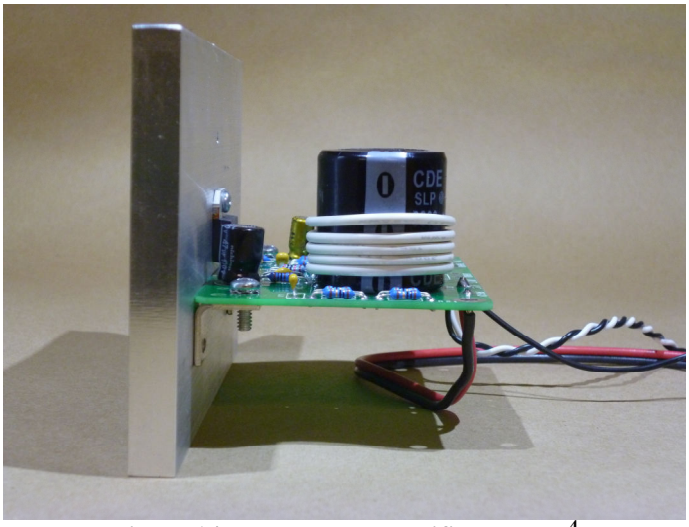


Figure 14-a completed amplifier module[4]

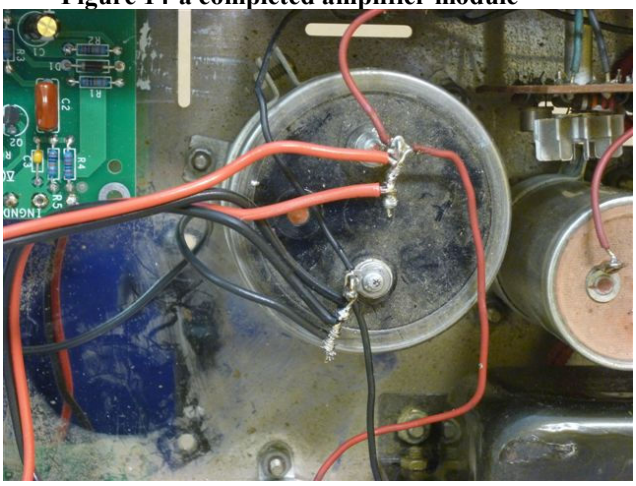


Figure 15-Showing Detail of wiring to C12

Figure 16-Showing the Final Wiring (shown with isolated, rather than original input jacks)

[4] Kits built per assembly manual revision 1.17 and above will show another 1/8" of protrusion of the screws that hold the mounting brackets to the super heatsink.

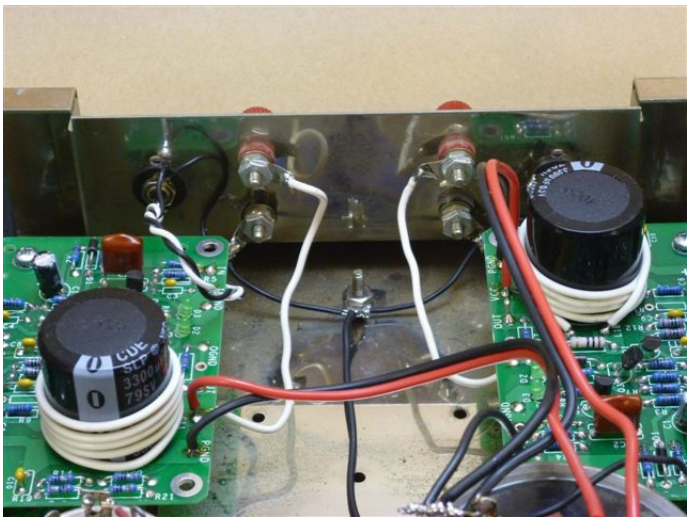


Figure 17-Final wiring, input panel detail (isolated input jacks versus standard non-isolated jacks)

Section 6: Wiring In the Updated Amplifier Modules

This section gives the steps needed to wire the new modules into your old amplifier. Here's the plan:

1. Revise the grounding system
2. Revise the power system
3. Complete the grounding system
4. Replace the left and right channel input wiring.
5. Connect all the wires to the amplifier modules.
6. Fasten the amplifier modules in place.

Revise the Grounding System

We're revising the grounding system for two reasons. First, after a number of years, some of the connections may need to be refreshed to make good contact. Second, these changes can reduce the hum to very low levels.

Figure 3 shows the way the wiring was. Figure 19 shows the way things will look at the completion of the next two sub-sections, Revise the Grounding System and Revise the Power System.

1. Remove the nut and bolt that hold the ground lug to the chassis. It is located between C12 and the transformer (Refer to Figure 3).
2. Cut the 5 wires that connect to the ground lug, close to the ground lug. Leave the other end of these 5 wires attached.
3. Set the ground lug aside. It will not be re-used. Re-install the nut and bolt removed in step 1, without the ground lug, to fasten the leg of C12 to the chassis.
4. Cut the black wire that connects to C12's negative terminal to a length of 1 inch. Slide the insulation off, leaving 1" of bare wire connected to the terminal.
5. Connect the black wire from Q9's collector on the power supply to C12's negative terminal. C12's negative terminal now has two wires, the wire from Q9's collector, and a 1" long bare wire.

6. Connect the wire from C11's negative terminal to the bare wire on C12's negative terminal, at the end closest to the terminal.

Revise the Power System

1. There are three red wires connected to C12's positive terminal:
    a. From PC-11 eyelet 4
    b. A long unconnected wire that used to go to the right channel
    c. A shorter unconnected wire that used to go to the left channel
2. Cut the shorter wire to 1" length and remove the insulation.
3. Remove the wire dangling from C11's positive terminal. Connect the longer wire from C12's positive terminal to C11's positive terminal.
4. Cut the supplied 24" length of red-black wire into two 12" lengths.
5. For the first 12" piece, remove ½" of insulation from the red and black wires at one end.
6. Repeat this for the second 12" piece of red and black wire.
7. Wrap the red wire of the first red-black wire around the bare wire that connects to C12's positive terminal, closest to the terminal.
8. Wrap the red wire of the second red-black wire around the bare wire that connects to C12's positive terminal, next to the previous wire.
9. Wrap the black wire of the first red-black wire around the bare wire that connects to C12's negative terminal, closest to the terminal.
10. Wrap the black wire of the second red-black wire around the bare wire that connects to C12's negative terminal, next to the previous wire.
11. Strip ½" of insulation from one end of the 18 AWG stranded wire supplied with the kit. Wrap this around the bare wire that connects to C12's negative terminal, next to the previous wire.
12. Solder all the wires on C12.

Complete the Ground System

Please refer to Figure 19. It shows how the completed wiring will look.

1. Locate the centrally located hole in the chassis nearest the input/output panel. It previously was used for an output capacitor mounting bracket. We will locate a star-ground lug in that hole, fastened with a 6-32 screw and nut. Don't screw the lug down at this time.
2. Connect these three wires to the ground lug. Cut their lengths to fit comfortably.
    a. The black wire from C12's negative terminal.
    b. The shorter black wire from the right channel speaker binding post.
    c. The shorter black wire from the left channel speaker binding post.

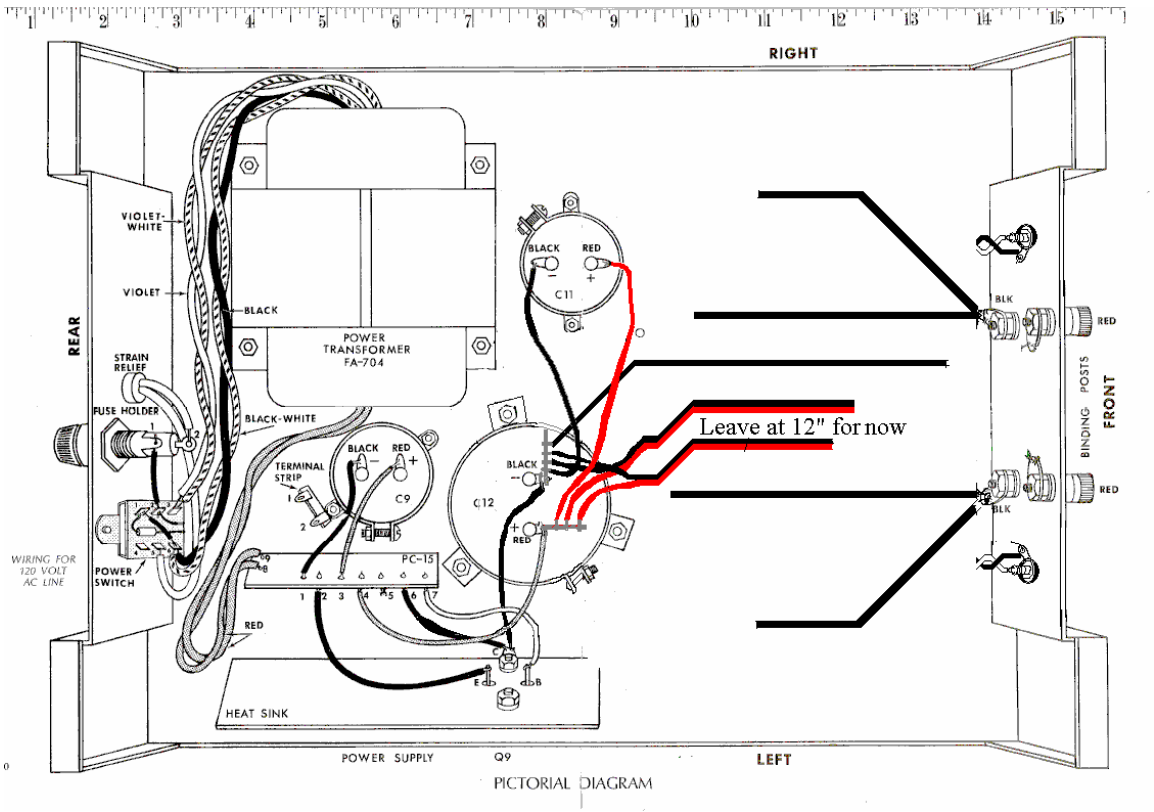


Figure 18-Rewiring the power and half the grounds

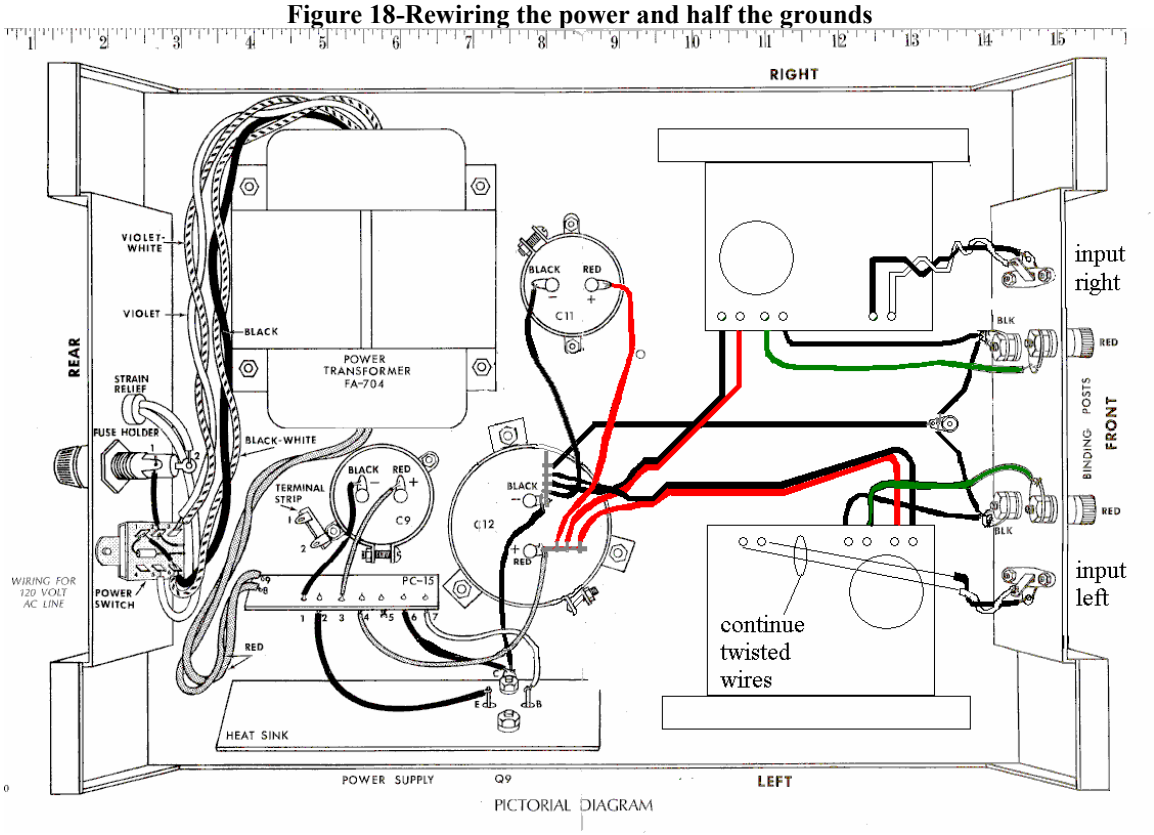


Figure 19-completed wiring

Wiring the Inputs

1. Right Channel – Remove the old wires from the input connector.
    a. Take one black-white twisted pair and cut it to a 4" length[5].
    b. Strip ¼" of insulation off both sides of the two wires.
2. Connect the black/white twisted pair to the right channel input jack.
    a. Solder the black wire to the shorter terminal (ground).
    b. Solder the white wire to the longer terminal
3. Left Channel – Remove the old wires from the input connector.
    a. Cut the second black-white twisted pair to a 5.5" length.
    b. Strip ¼" of insulation off both sides of the two wires.
4. Connect the black/white twisted pair to the Left channel input jack.
    a. Black wire to the shorter terminal (ground)
    b. White wire to the longer terminal

Wiring the Outputs

Both red speaker output terminals should have 16 AWG white wires still connected. (For clarity, this is shown in green in Figure 19)

1. Form the left channel wire toward the place where the left channel amplifier module will sit.
2. Form the right channel wire toward the place where the right channel amplifier module will sit.

Connecting the Left Channel Amplifier Module

1. Set the left channel amplifier board and heat sink assembly in place. Don't mount it to the chassis yet. Note that the new PCB should face the center of the amplifier chassis.
2. Select one red-black pair connected to C12 to power the left channel board:
    a. From the solder side of the board, insert the left channel red wire through the left channel VCC eyelet and solder it on the component side.
    b. From the solder side of the board, insert the left channel black wire through the left channel PGND eyelet and solder it on the component side.
3. For the black and white twisted pair that brings signal to the left channel board:
    a. From the component side of the board, insert the left channel black wire through the left channel INGND eyelet and solder it on the solder side.
    b. From the component side of the board, insert the left channel white wire through the left channel INPUT eyelet and solder it on the solder side.
4. Dress the remaining black wire coming from the left channel black speaker binding post to one of the OGND terminals of the left channel amplifier. Cut it to length and remove ¼" of insulation. Insert it into the OGND terminal from the solder side of the board, and solder it on the component side of the board.

[5] This may seem a bit long to you, but lets you position the modules for inspection or re-work without unsoldering the input wires. Feel free to make these wires shorter once you are comfortable with the amplifier's performance.

5. Dress the white wire from the left channel red speaker binding post to the OUT eyelet of the left channel amplifier. Remove ¼" of insulation, and insert the wire from the solder side. Solder on the component side.
6. Check your work. One The following eyelets on the PCB should each have a wire:
    a. VCC (red wire of the red-black pair)
    b. PGND (black wire of the red-black pair)
    c. IGND (black wire of the black-white twisted pair)
    d. INPUT (white wire of the black-white twisted pair)
    e. OGND (black white from the left channel black speaker binding post)
    f. OUTPUT (wire from the left channel red speaker binding post).
7. Make sure that the bottom lip of the heat sink is clean, and also the place where it mounts to the chassis. Place a line of thermal compound along the bottom of the short part of the heat sink. Smear it into a thin film using a finger.
8. Mount the heat sink to the chassis using salvaged 6-32x1/2" hardware. Remember that the outside mounting screw also carries a mounting foot.

Connecting the Right Channel Amplifier Module

9. Set the right channel amplifier board and heat sink assembly in place. Don't mount it to the chassis yet. Note that the new PCB should face the center of the amplifier chassis.
10. Select one red-black pair connected to C12 to power the right channel board:
    a. From the solder side of the board, insert the right channel red wire through the right channel VCC eyelet and solder it on the component side.
    b. From the solder side of the board, insert the right channel black wire through the right channel PGND eyelet and solder it on the component side.
11. For the black and white twisted pair that brings signal to the right channel board:
    a. From the component side of the board, insert the right channel black wire through the right channel INGND eyelet and solder it on the solder side.
    b. From the component side of the board, insert the right channel white wire through the right channel INPUT eyelet and solder it on the solder side.
12. Dress the remaining black wire coming from the right channel black speaker binding post to one of the OGND terminals of the right channel amplifier. Cut it to length and remove ¼" of insulation. Insert it into the OGND terminal from the solder side of the board, and solder it on the component side of the board.
13. Dress the white wire from the right channel red speaker binding post to the OUT eyelet of the right channel amplifier. Remove ¼" of insulation, and insert the wire from the solder side. Solder on the component side.
14. Check your work. One The following eyelets on the PCB should each have a wire:
    a. VCC (red wire of the red-black pair)
    b. PGND (black wire of the red-black pair)
    c. IGND (black wire of the black-white twisted pair)
    d. INPUT (white wire of the black-white twisted pair)
    e. OGND (black white from the right channel black speaker binding post)

    f. OUTPUT (wire from the right channel red speaker binding post).
15. Make sure that the bottom lip of the heat sink is clean, and also the place where it mounts to the chassis. Place a line of thermal compound along the bottom of the short part of the heat sink. Smear it into a thin film using a finger.
16. Mount the heat sink to the chassis using salvaged 6-32x1/2" hardware. Remember that the outside mounting screw also carries a mounting foot.

Making the Speaker Binding Posts User Friendly

The speaker binding posts have holes for the speaker wire. These holes should be oriented from side to side, not up and down, to allow easy connection of the speaker wires. If your binding posts are already correctly oriented, skip this step. If not, here's the procedure that should be applied to whichever of the 4 binding posts don't have the correct orientation:

1. Loosen the binding post (red or black plastic part) until you can see the hole in the mounting stud.
2. Loosen and remove the nut that holds the speaker connection wires. Remove the speaker wire lugs, noting their locations so that they may be correctly returned.
3. Loosen the remaining nut just enough to be able to spin the binding post to the correct orientation. Keep the binding post from turning as you tighten it with a nail (or stout toothpick) through the wire hole.
4. Replace the solder lugs with the speaker connection wires.
5. Replace and tighten the nuts that hold those lugs in place.

Section 7: Testing the Completed Amplifier

It's best to test the completed amplifier one step at a time. In that manner, if you have something wrong, you may damage the amplifier module, but you won't damage your speakers.

Test #1

1. Disconnect signal inputs and speakers from the amplifier.
2. Turn the power switch off.
3. Plug in the amplifier.
4. Turn the power switch on.
5. Observe the amplifier for a minute.
    a. It will make a "bong" sound when you turn on the power, but after that you should hear only a soft humming sound from the power transformer.
    b. Watch for smoke. There should be no smoke. If you see smoke, turn off the amplifier immediately, take a few deep breaths, and refer to the troubleshooting section.
    c. Feel the heat-sinks. There should be no appreciable heating.
6. In all but a very dark room, the LED soft glow should be invisible. If the LEDs glow brightly in a well lit room, you have probably mis-loaded some resistors.

If there is neither smoke nor excess heating, leave the power on and move on to Test #2.

Test #2

1. If you have a DC voltmeter, check the voltage on the speaker outputs.
    a. Left channel red to black binding post should show a DC voltage of less than 100 mV if the amp has been on for about 1 minute[6]. The longer the amp is on, the lower the DC output voltage will be.
    b. Repeat this test for the Right channel speaker binding posts.

If this result is ok, go on to test 3. If this result is not correct (e.g. speaker binding posts have a few volts of DC after the amp has been on for more than 1 minute), then re-check:

- Polarity of C7
- R17 is installed and has the correct value (2870 Ohms)
- That one of the OGND terminals has a ground wire installed.

Test #3

1. Hook speakers up to the binding posts. There may be a very soft click as you hook up the speaker.
2. The speakers should be rather quiet at this point, perhaps with barely audible hiss or hum if you place your ear near sensitive speakers. Any more noise than this probably indicates either an assembly error or a power supply problem.

Test #4

1. Turn off the amplifier power.
2. Connect your preamp output to the power amplifier input.
3. Turn down the preamp volume.
4. Turn on the amplifier power. You may hear a soft click or thump from your speakers.
5. After about 15 seconds, turn up you preamp volume to the desired listening level, and enjoy your amplifier.

The amplifier has special slow turn-on features that diminish pops and clicks in the speakers at turn-on without the need for relays. The DC bias voltages in the amplifier will thus take 30 seconds or so to reach steady state. During that time, you may hear some distortion. Don't worry, it will clear up perfectly in 30 seconds unless you are over-driving the amp, or something is wrong. Think of it like a tube amp...it takes 30 seconds to warm up.

[6] The DC voltage will drop to very nearly zero in 15 seconds if a speaker is connected.

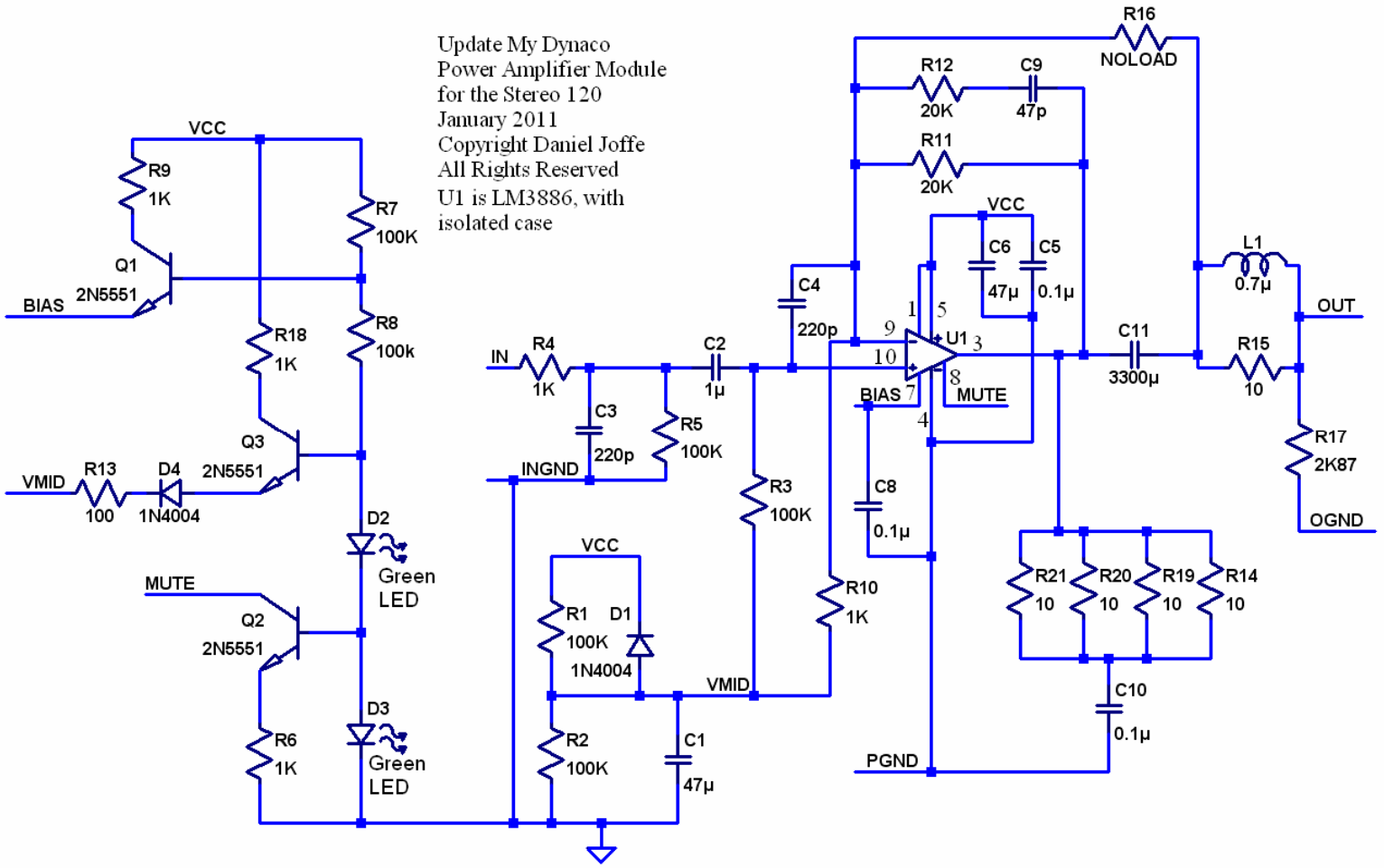


Figure 20-Schematic of amplifier module

Resistor Color Code

Figure 21-demonstrating the resistor color code

Here's an extreme close-up of a ¼ 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: • Band 4 is gold => multiply by 0.1 • Band 4 is silver=> multiply by 0.01
Yellow	Tolerance: • Brown =>1% • Red => 2% • Gold=> 5% • Silver=>10% • No band=>20%