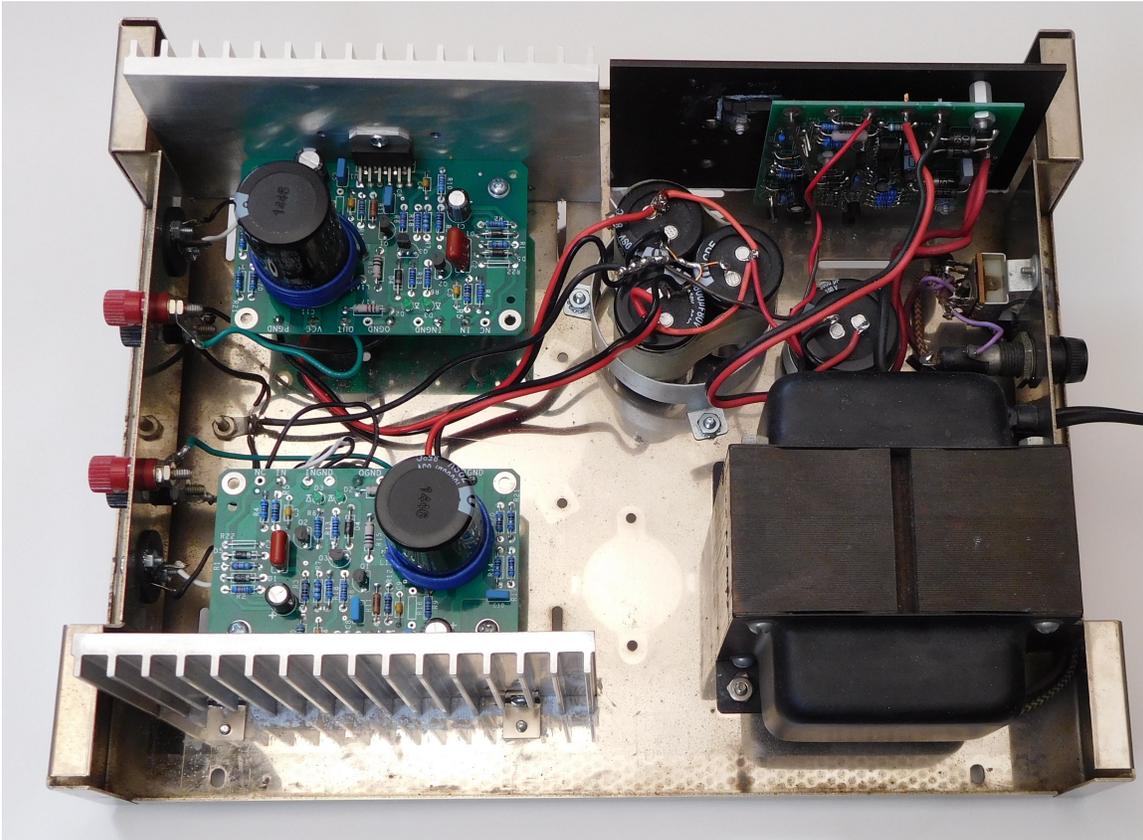


DYNACO STEREO 120 COMPLETE REBUILD KIT



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Revision 1p05
May 9, 2017

Table of Contents

Table of Figures	3
Section 1: About this Manual	5
Who Should Attempt this Project?	5
Tools You'll Need.....	5
Project Overview	5
Important Safety Notes	6
About Components	6
Recommended Solder	6
Section 2: Removing the Modules and Caps	7
Opening the Amplifier	7
Remove the old amplifier modules	7
Remove the Capacitors	7
C7 RIGHT.....	7
C7 LEFT	8
C9, C11, and C12.....	8
Removing the Output Zobel Networks	8
Remove the Ground Lug and Wires	8
Section 3: Removing the Stereo 120 Power Supply	12
Clean up the chassis.....	12
Section 4: Assembling and Testing the Power Supply	13
Component Order.....	13
Install the Resistors	13
Install the Diodes	15
Identifying the glass body diodes	15
Install the Capacitors.....	16
Install the Transistors.....	17
Install the Integrated Circuits.....	17
Final Inspection of the Circuit Board.....	17
Final Assembly	18
Installing the Completed Power Supply and New Capacitors	20
Installing C9.....	21
Build the C12 Dynamite Capacitor.....	21
Installing the New C12 Dynamite Capacitor Configuration.....	22
Connect the Transformer to the Power Supply.....	24
Test the Power Supply	24
Section 5: Assembling the Amplifier Circuit Boards	24
Install the Resistors	25
Install the Small Capacitors and the Diodes	27
Last Capacitors and the Transistors	28
Winding the Output Inductor.....	29
Final Amplifier Module Assembly and LM3886 Installation	30
Mounting the PCB to the Super-duper Heatsinks.....	30
Final Inspection of the Circuit Board.....	32
Section 5: Wiring in the Updated Amplifier Modules.....	32

Revise the Grounding System.....	33
Revise the Power System.....	33
Wiring the Inputs	34
Wiring the Outputs.....	35
Connecting the Left Channel Amplifier Module	35
Connecting the Right Channel Amplifier Module.....	36
Making the Speaker Binding Posts User Friendly.....	37
Section 6: Testing the Completed Amplifier	37
Test #1.....	37
Test #2.....	38
Test #3.....	38
Test #4.....	38
Resistor Color Code.....	42

Table of Figures

Figure 1-Location of the four screws that hold the cover to the base.....	7
Figure 2-Component Identification, and where to cut	9
Figure 3-Amp modules removed	10
Figure 4-Amp and Power Supply Modules Removed	11
Figure 5-Power supply bare PCB	13
Figure 6-Installing resistors	14
Figure 7-Completed Circuit Board (to this point).....	18
Figure 8-Installing the stand-offs. Picture on left shows location, picture on right shows side view of assembly detail	18
Figure 9-forming Q5's leads	19
Figure 10-Apply heat sink compound to metal tab side of Q5	19
Figure 11-fasten Q5 to the heat sink as shown	19
Figure 12-installing the PC board on the heat sink.....	20
Figure 13-install and tighten the nuts.....	20
Figure 14-3 30 mm diameter capacitors take the space of one 2.5" diameter capacitor ..	21
Figure 15-Ground Harness Configuration	22
Figure 16-Power Supply Installation completed.....	23
Figure 17-Empty the amplifier components into a soup bowl.....	25
Figure 18-Closeup of Completed Amplifier board (your big cap may look a bit different)	25
Figure 19-First four resistors are installed, leads bent on the back side, soldered, then clipped.....	26
Figure 20-Zero Ohm R22 installation detail.....	27
Figure 21-showing LED cathode orientation.....	28
Figure 22-Starting to wind the output inductor.....	30
Figure 23-finishing step for the output inductor	30
Figure 24-Assembling the circuit board to the super duper heat sink	31
Figure 25-The LM3886 sits up off the board to avoid shorts between the front and back rows of pins. The body should be at right angles to the circuit board	31
Figure 26-completed amplifier module mounted on the heatsink	32

Figure 27-Rewiring Half the Grounds	33
Figure 28-completed wiring.....	35
Figure 29-Schematic of amplifier module	39
Figure 30-Optional Input Ground Wires are shown in blue	40
Figure 31-Power Supply Schematic.....	41
Figure 32-demonstrating the resistor color code	42

Section 1: About this Manual

This manual gives you all the information you need to completely rebuild your Dynaco Stereo 120 Solid State Power Amplifier using UpdateMyDynaco replacement module kits and components. You will:

- Replace all the old electrolytic capacitors
- Replace the power supply regulator board
- Replace the amplifier modules
- Increase the energy available from the power supply while improving its regulation and reducing its noise
- Reduce the distortion in the amplifier channels
- Make your Stereo 120 sound better than new!

The only part of your Stereo 120 that really needs to work is the power transformer, line cord, fuse-holder, and power switch.

Who Should Attempt this Project?

You can rebuild 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 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 (strongly recommended to cross-check resistor values against color codes)
8. magnifying glass, to verify identification codes on small components

Project Overview

The project consists of the following steps:

1. Removing the old amplifier modules (circuit board and heat-sink).
2. Removing the old power supply module.
3. Removing the old electrolytic capacitors.

4. Cleaning up the chassis.
5. Building the new power supply module.
6. Installing and wiring the new capacitors and checking out the new power supply.
7. Building the new amplifier modules.
8. Connecting everything together.
9. Checking everything out.
10. Listening to great sounding music!

Important Safety Notes

By purchasing 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.

About Components

We reserve the right to make design/or component changes at any time without prior notification.

Recommended Solder

The kit must be assembled with 60/40 Rosin Core solder. The recommended diameter is 0.032 inches. Among many such sources of solder, I have used Radio Shack part number 64-009. It contains 8 oz. of solder, which is much more than you'll need to assemble the kit.

Section 2: Removing the Modules and Caps

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).

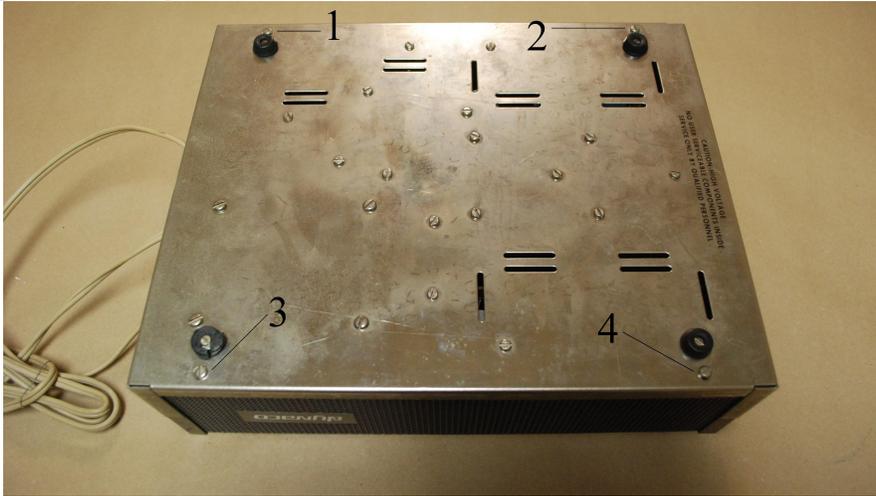


Figure 1-Location of the four screws that hold the cover to the base

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

Remove the old amplifier modules

The following discussion refers to Figure 2.

We'll keep this simple. The amplifier modules (PC-14's and the associated heat sinks) are held in by two sets of 6-32 screws and nuts that go through the foot of the heatsink and into the chassis. Remove those two screws from each amplifier module. Then:

1. Cut all the wires that hold the amplifier modules into the chassis. You can use the X's in Figure 2 for hints on where to cut the amplifier module wires.
2. Lift out the two amplifier modules.
3. Set the module asides. We will not re-use any part of either amplifier module.
4. Save only the mounting screws for later re-use.

Remove the Capacitors

C7 RIGHT

1. Remove 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.

C7 LEFT

4. Remove 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.

C9, C11, and C12

You'll now remove C9, C11, and C12. Disconnect the wires as needed to make them easy to remove.

1. Remove the 3 sets of #6 hardware that hold C9 to the bottom of the chassis.
2. Remove the 3 sets of #6 hardware that hold C11 to the bottom of the chassis.
3. Remove the 3 sets of #6 hardware that hold C12 to the bottom of the chassis.
4. Loosen the mounting clamp hardware for C9 and remove C9 from its clamp.
5. Loosen the mounting clamp hardware for C12 and remove C12 from its clamp.
6. Neither C11 nor its mounting clamp will be re-used in the re-build.

Removing the Output Zobel Networks

Refer to Figure 2 as you:

1. Clip the lead of the 0.1 μ F 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 μ F 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.

Remove the Ground Lug and Wires

1. Remove the nut and bolt that hold the ground lug to the chassis. It is located between C12 and the transformer. Cut the wires near the lug. See Figure 3.

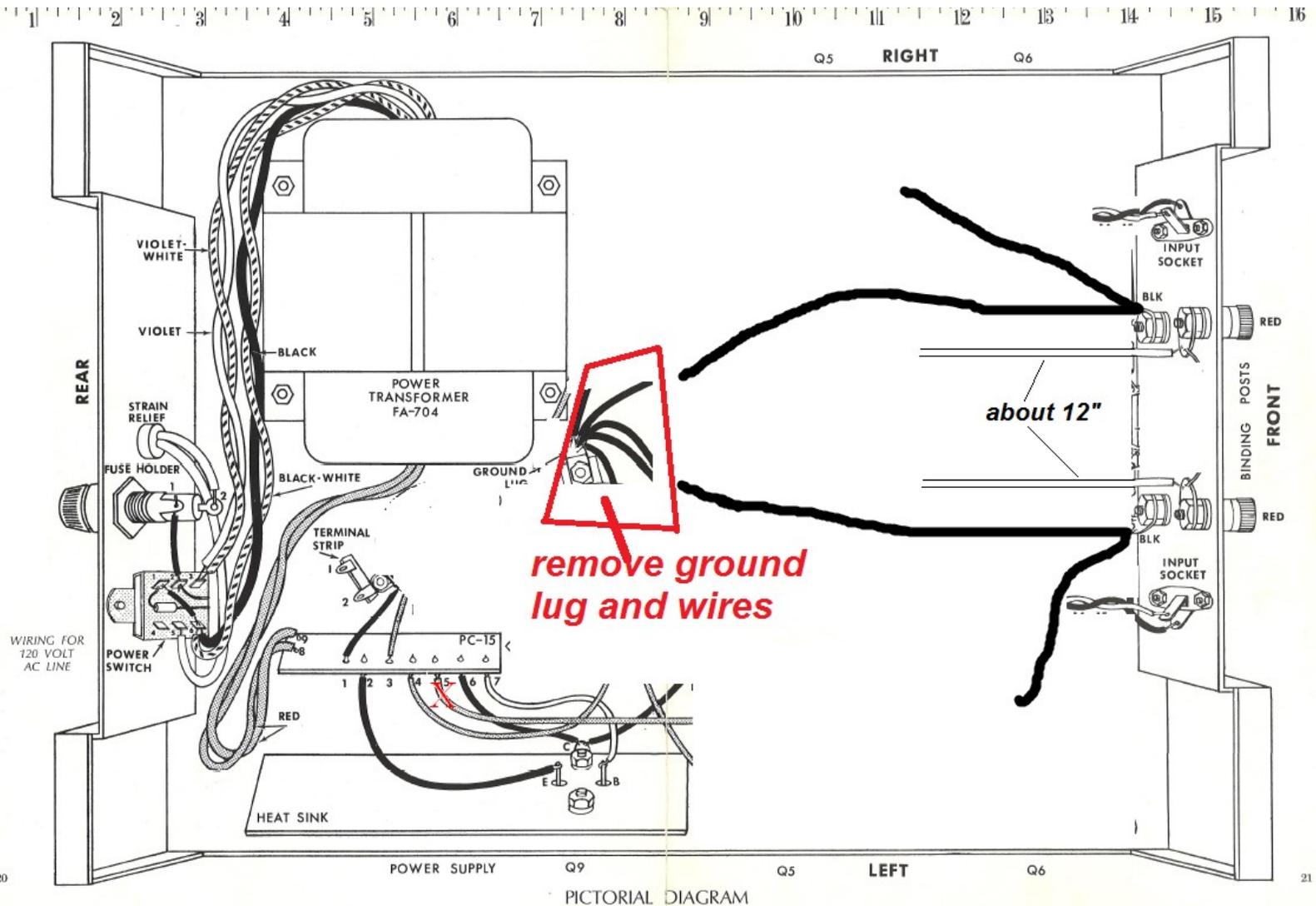


Figure 3-Amp modules removed

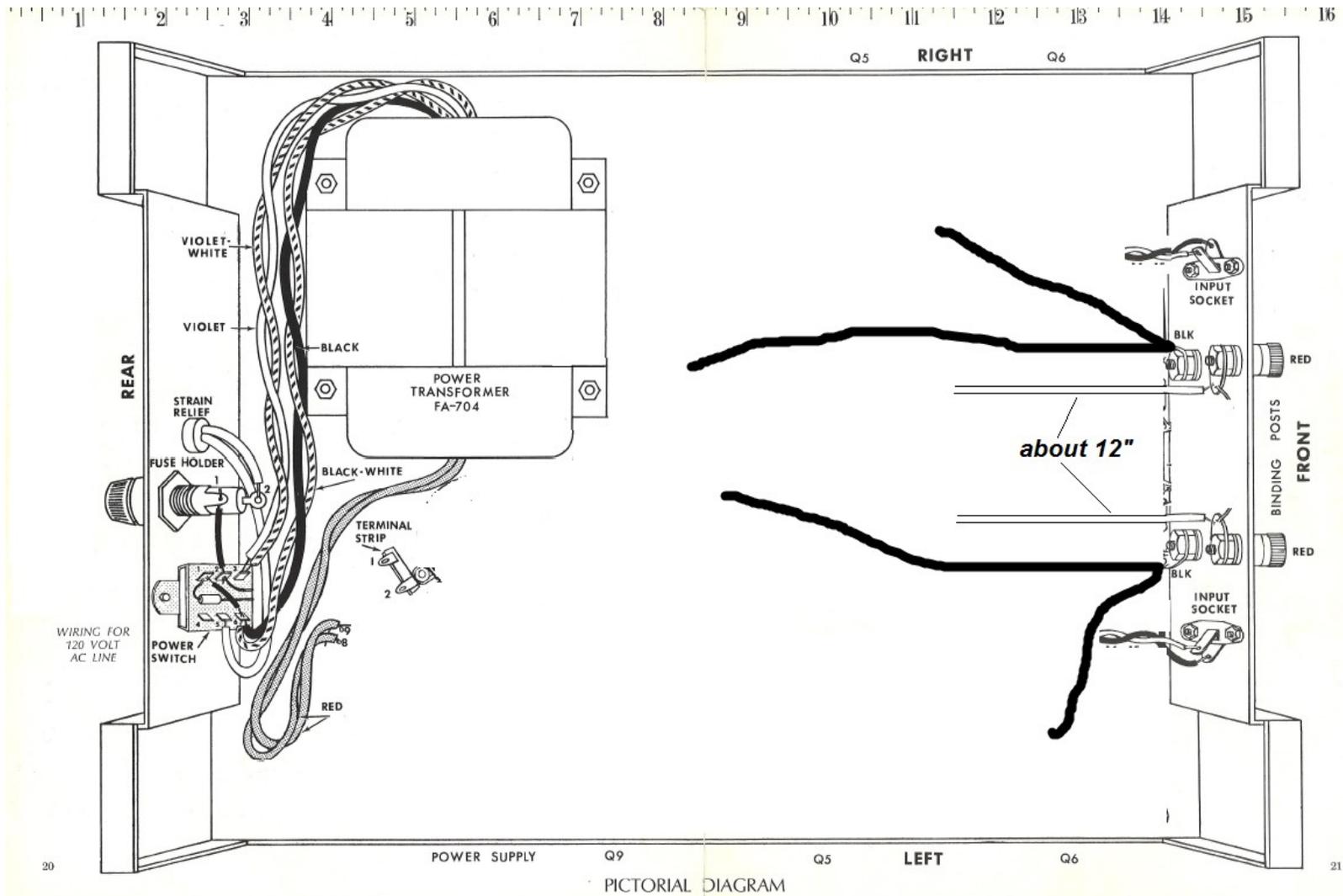


Figure 4-Amp and Power Supply Modules Removed

Section 3: Removing the Stereo 120 Power Supply

Please refer to Figure 3 and Figure 4. After you've completed the previous section, only the power supply (PC-15 and the related heatsink) remains in the chassis. Our goal here is to remove the power supply, leave the transformer wires long, and harvest the *power-supply* heat-sink for re-use.

1. Remove the two screws that hold the power supply heatsink to the bottom of the chassis.
2. De-solder the two red wires that run from the power transformer to eyelets 8 and 9 of the power supply PCB. If this is awkward, you could cut the wires quite close to the regulator PCB. Still, try to leave these wires as long as possible.
3. Cut the rest of the wires that hold the power supply PCB to the chassis, cutting them close to the PCB.
4. Disassemble the PCB from the heat-sink.
5. Remove the large power transistor from the heat-sink. Cut whatever wires join the large power transistor to the PCB to facilitate its removal.
 - a. Remove the mica washer. You may have to peel it off. Sometime the easiest way is to scrape it off carefully with a single-edged razor.
 - b. Clean up and remove the old white thermal compound using isopropyl alcohol and paper towels. The 90% version works better than the usual 70% stuff. *Be careful, the combination of paper towels and isopropyl alcohol is quite flammable!*
6. Save the power supply heatsink and the chassis mounting hardware for later use.

Clean up the chassis

Remove the rest of the wires and hardware until your amp looks like Figure 4. As shown, all the wiring from the power cord through to the secondary wiring of the transformer will remain intact. The only other wires that will be hanging on are:

1. 12 inch pieces of white wire, on attached to each red speaker binding posts.
2. 4 black wires, two on each black binding post.
3. Twisted pairs hanging onto the RCA jacks.

This is the perfect time to clean up the chassis. Use whatever combinations of cleaners and metal polishes you feel comfortable using. At this point, some people will strip the rest of the parts off the chassis, and run the chassis through the dishwasher before multiple rounds of metal polish.

There's a youtube that details a hard-core version of the cleaning and stripping process:

<https://www.youtube.com/watch?v=o8jEKVTD0BU>

Note that some of the details will differ, but it should give you a general idea of the process, especially if your plan is to take things to the nth degree.

It's up to you how much of a project you'd like to make of the cleanup. When you're finished with your chosen amount of cleanup, then turn the page, and we'll start re-building your Stereo 120.

Section 4: Assembling and Testing the Power Supply

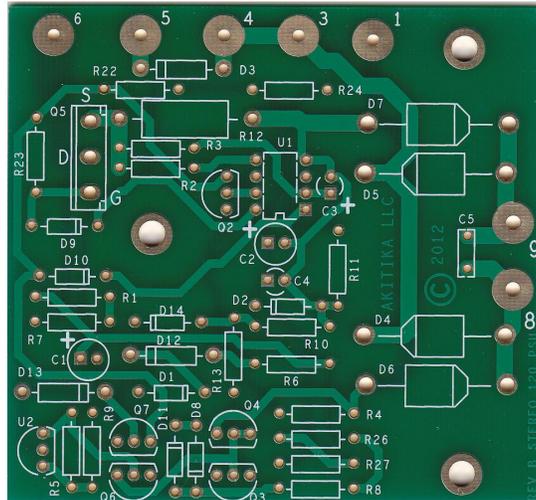


Figure 5-Power supply bare PCB

This section details the process of building the power supply 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. Empty the contents of the PSUG envelope into a flat soup bowl. This keeps the parts from getting lost, and makes them easy to find.
2. Install the resistors
3. Install the diodes
4. Install the capacitors
5. Install the transistors
6. Install the integrated circuits.
7. 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.

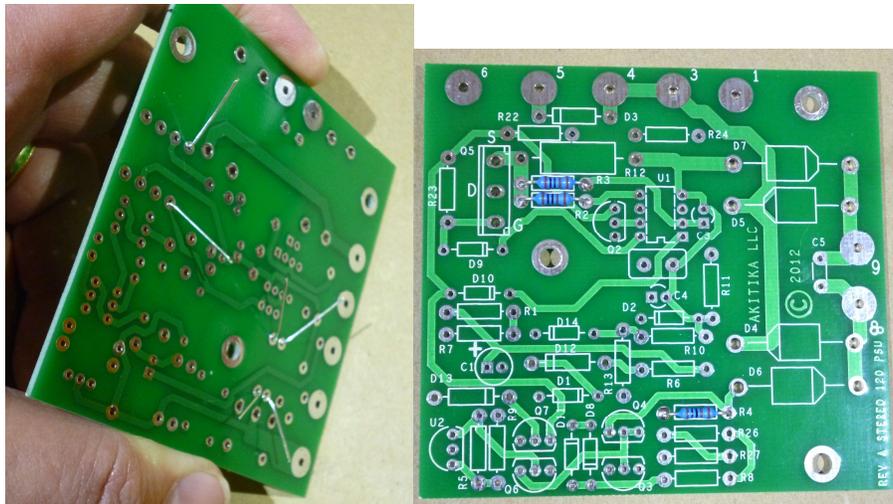


Figure 6-Installing resistors

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	

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

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

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.

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.

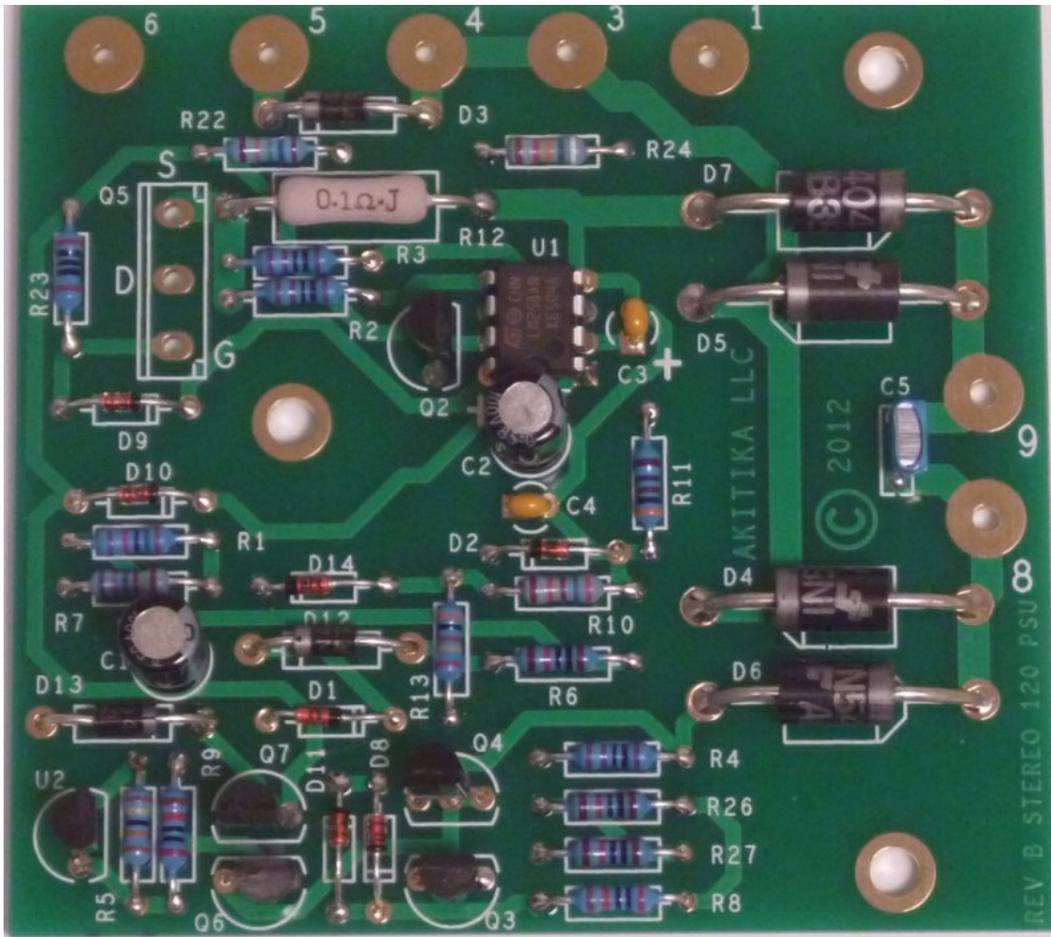


Figure 7-Completed Circuit Board (to this point)

Final Assembly

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

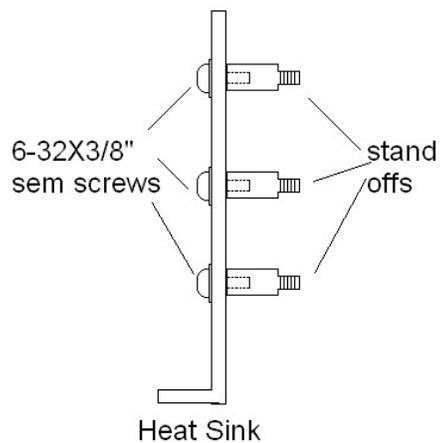
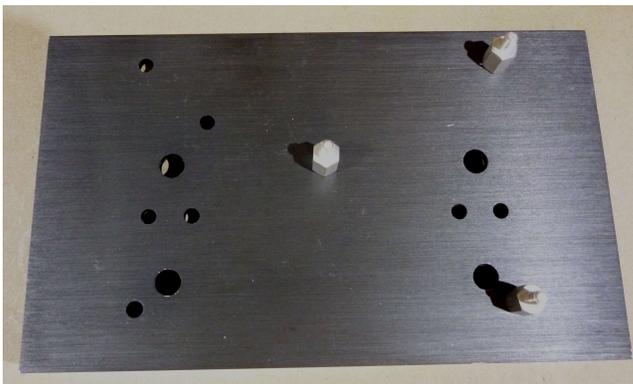


Figure 8-Installing the stand-offs. Picture on left shows location, picture on right shows side view of assembly detail

Form the leads of Q5 as shown in Figure 9.

Q5	IRFP250N, TO-247	N-Ch MOSFET, 200 V @ 30 A
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Figure 9-forming Q5's leads

Smear a thin film of heat sink compound to the metal tab side of Q5 as shown in Figure 10.

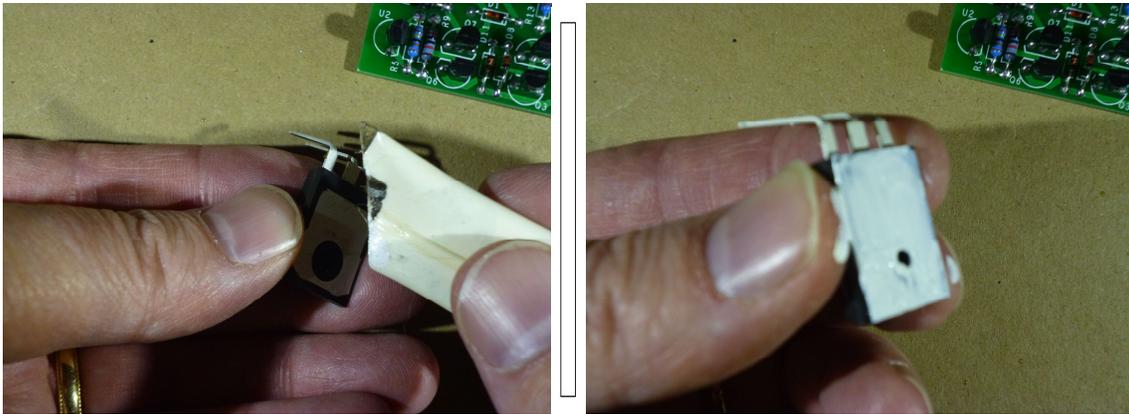


Figure 10-Apply heat sink compound to metal tab side of Q5

Use a 6-32x1/2" SEM screw and a 6-32 PEM nut to fasten Q5 to the heatsink as shown in Figure 11. For now, leave the screw and nut a bit loose.

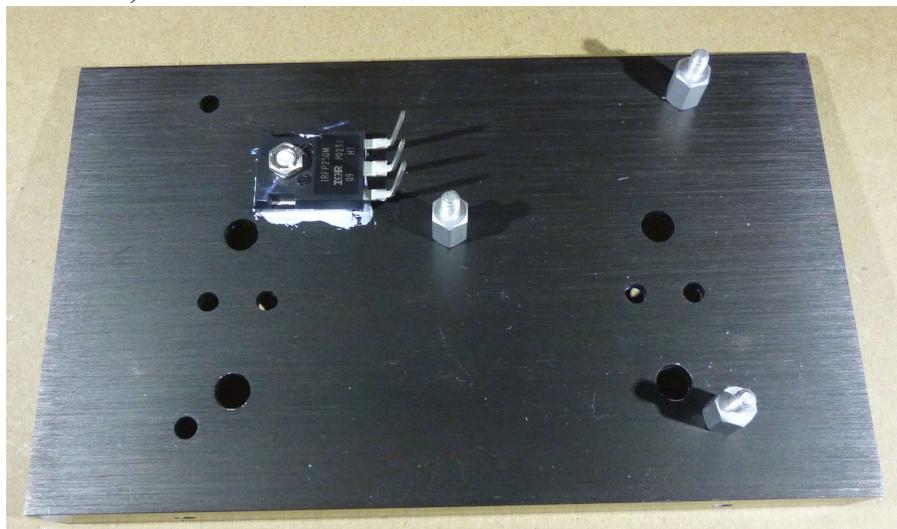


Figure 11-fasten Q5 to the heat sink as shown

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.

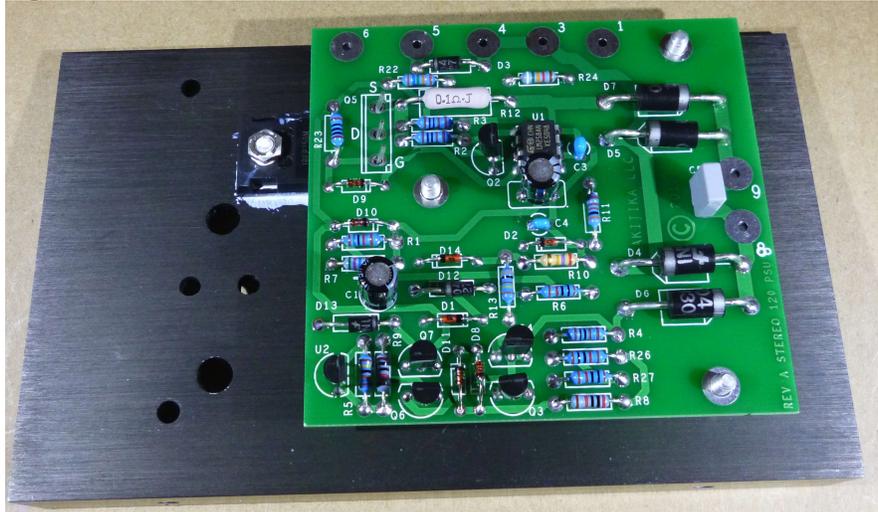


Figure 12-installing the PC board on the heat sink

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 $\frac{1}{8}$ to $\frac{1}{4}$ inch above the PCB.

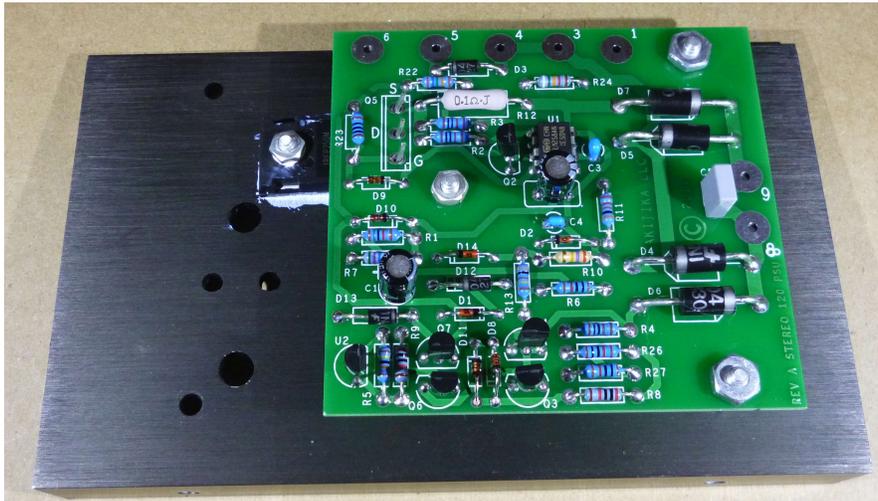


Figure 13-install and tighten the nuts

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!

Installing the Completed Power Supply and New Capacitors

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

Installing C9

1. Install C9's replacement, a 3900 μ F 100 Volt capacitor, into the bracket that previously held the old C9 (1000 μ F 100 Volts). Use the same screw that previously held the capacitor snugly in the clamp. Use the same screws and hardware to fasten the clamp to the chassis. Refer to Figure 2 for the preferred orientation of the plus and negative terminals of C9. You'll find a Red-Blue twisted pair made from 18 AWG solid wire.
 2. Cut a 5 1/2" length of the Red-Blue twisted pair, and strip about 1/4" from the 4 ends.
 - Solder the blue wire from C9's negative terminal to eyelet 1 of the PCB.
 - Solder the red wire from C9's positive terminal to eyelet 3 of the PCB.

Double check the last two connections to make sure the polarity is correct!

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

Build the C12 Dynamite Capacitor

1. You'll replace C12, a single 2.5" diameter capacitor with three 30 mm diameter capacitors, as shown in Figure 14.

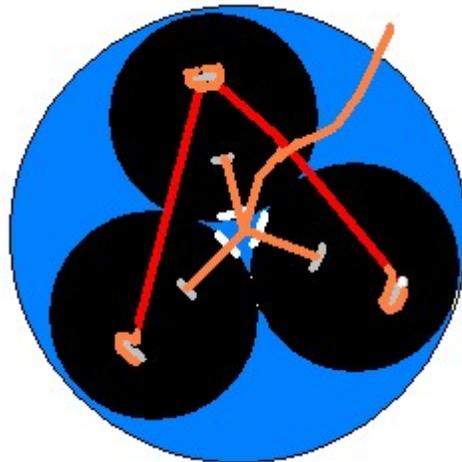


Figure 14-3 30 mm diameter capacitors take the space of one 2.5" diameter capacitor

2. Orient the three capacitors with the **negative** leads in the center of the grouping.
3. Place a piece of masking tape around the outside of the three capacitors to hold them together. This will make it easier to install the ground and positive wire harnesses.
4. Construct the ground harness for the caps:
 - a. Remove 4" of insulation from the supplied 20 AWG wire.
 - b. Cut the resulting bare wire into two 2" long pieces.
 - c. Twist and shape the wires as shown in Figure 15.

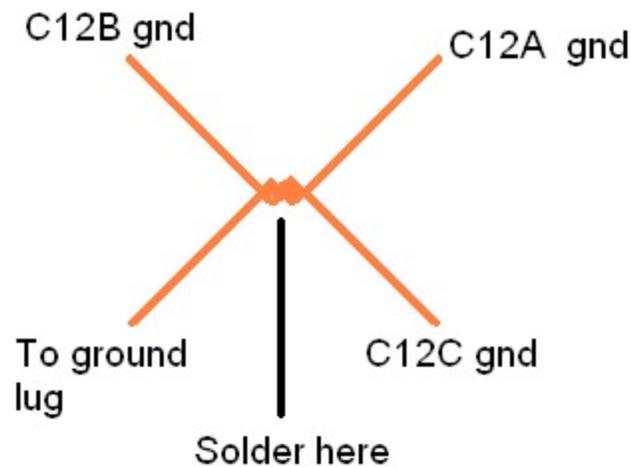


Figure 15-Ground Harness Configuration

5. Solder the center section as indicated. Place the soldered portion of the jumper in the center of the dynamite capacitor configuration. Hook the ends of three of the four wires to the three negative terminals of the capacitors. Solder the wires to the negative terminals.
6. Form the remaining wire upward, away from the caps. You'll attach it to the amplifier ground connections in a later step.
7. Prepare the Positive Wire Harness as follows (see Figure 14):
 - a. Cut two pieces of red 20 AWG wire, each to a length of 2 ½".
 - b. Remove ¼" of insulation from the ends of the wires (4 places).
 - c. Form the bare ends into hooks. Crimp the hooks around the positive terminals of the capacitor as shown in Figure 14. Solder the connections, making sure to leave room for additional wires added in later steps.

Installing the New C12 Dynamite Capacitor Configuration

Now it's time to install the new capacitor arrangement and reconnect the wires. Use Figure 16 to guide the re-wiring of the C12 replacement capacitor.

1. Fit the new dynamite capacitor configuration into the original C12 mounting clamp.
2. When the orientation agrees with Figure 16, snug up the capacitor clamp band. Do not over-tighten it.
3. Remove the masking tape that held the capacitor configuration together.
4. Locate the shorter piece of 18 AWG stranded red/black pair (zip cord). Cut a 5" length, then strip ¼" from the four ends. Tightly twist and tin the four ends.
5. Solder the red wire from C12's positive bus to eyelet 4 of the PCB.
6. Solder the black wire from C12's ground bus to eyelet 6 of the PCB. Place the C12 end of this wire close to the end of the ground wire tail that connects to the capacitor grounds.
7. Inspect your work carefully. Make sure that there is no possible way for wires connected to the positive and negative terminals of the new C12 configuration to come into contact.

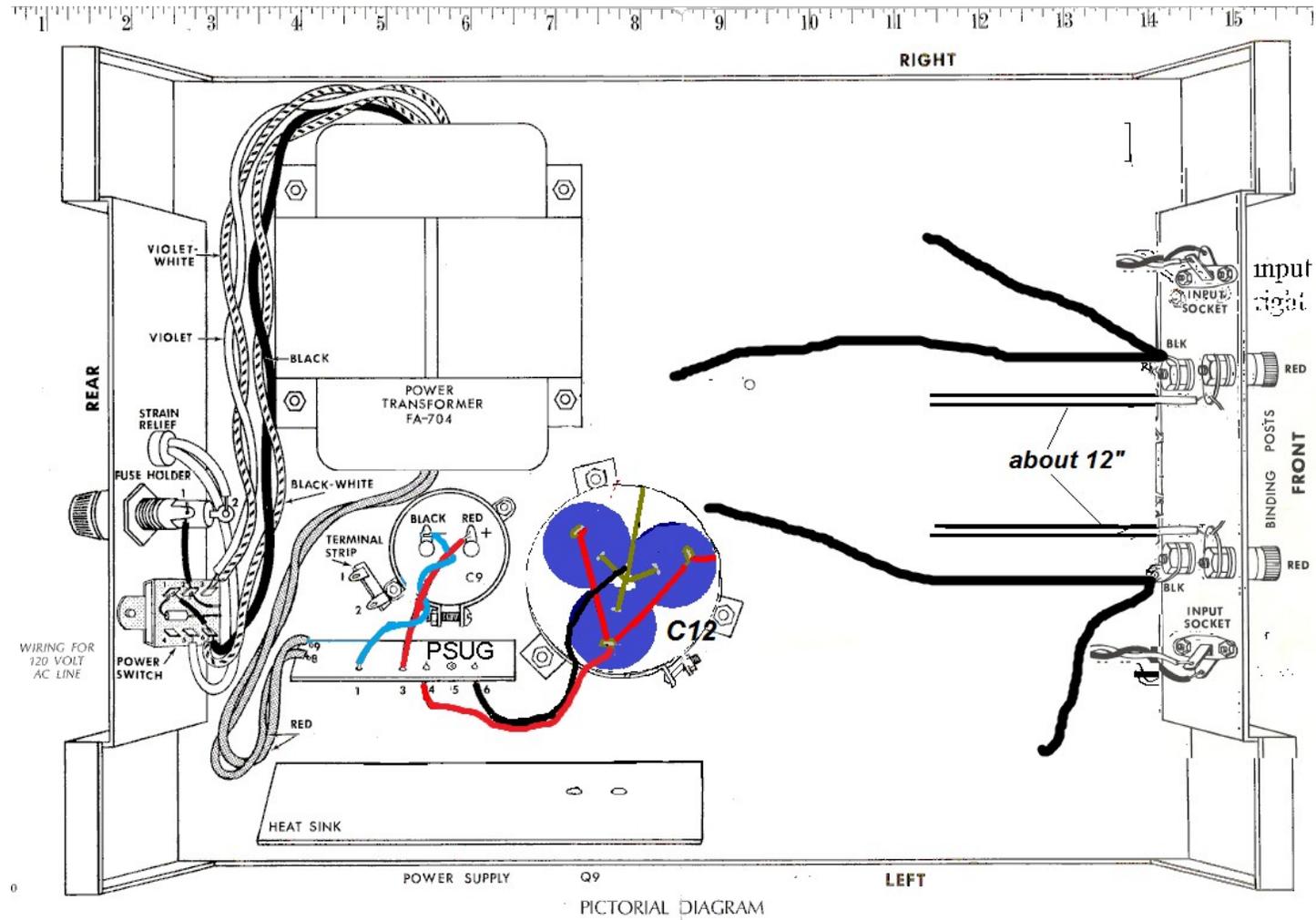


Figure 16-Power Supply Installation completed

Connect the Transformer to the Power Supply

Make sure that the AC power cord is not plugged in.

Here are the wiring steps:

1. Place the power supply heatsink and PCB assembly roughly in position in the amplifier. Don't install the mounting screws that hold the assembly to the chassis.
2. Twist the two transformer red wires together to minimize hum.
3. Solder one red wire from the transformer to eyelet 8 of the PCB.
4. Solder the other red wire from the transformer to eyelet 9 of the PCB.
5. Now, tighten the screws that go through the foot of the heatsink, holding the power supply heatsink and PCB assembly in place.

Test the Power Supply

Before you begin, make sure to compare your assembly to Figure 16. Double check the polarity of capacitors C9 and C12.

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 \pm 2 volts. If this is the case, unplug the power cord and go on. If the output voltage is wrong, stop and check your work. Please heed the warnings below:

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

- *Anything outside of the range of 69-75 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!*

Section 5: Assembling the Amplifier Circuit Boards

This section details the process of building the amplifier module circuit boards. We start with an overview on this page. There are two amplifier modules, one each for the right and left channels. You'll build the first channel, then go back to this page to build the second channel.

Begin by carefully emptying the contents of *one* of the envelopes marked "GT-101 Amplifier Module" into a broad soup bowl, as shown in Figure 17.

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.



Figure 17-Empty the amplifier components into a soup bowl

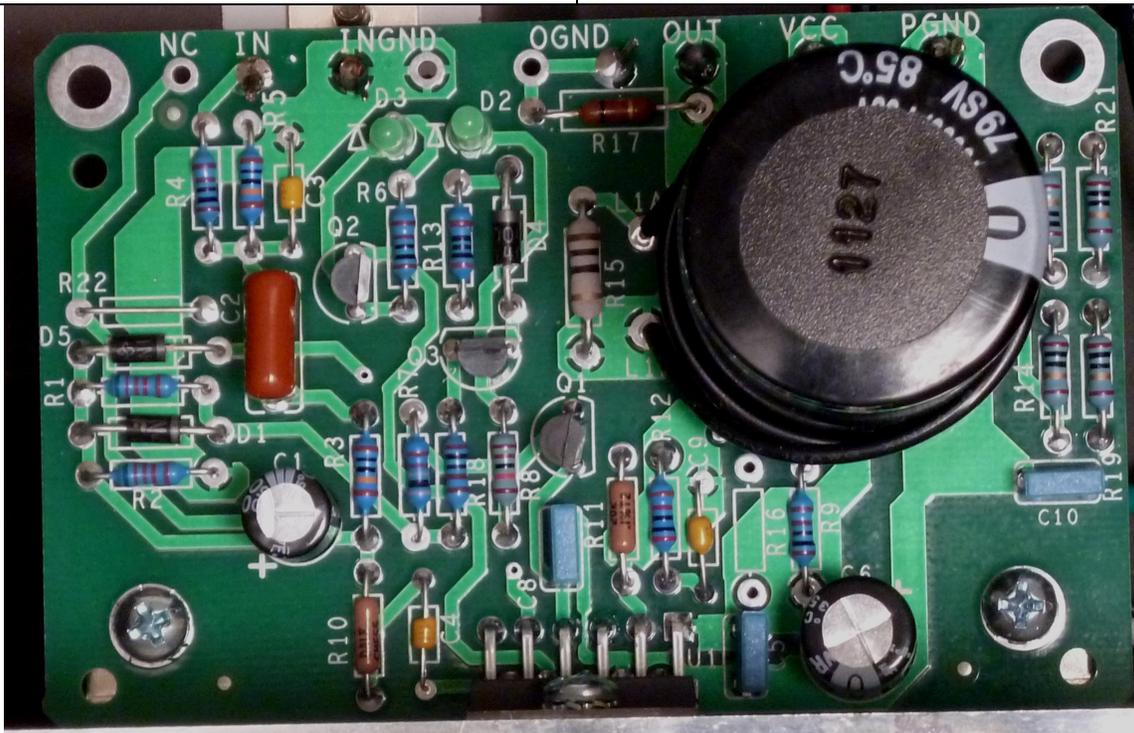


Figure 18-Closeup of Completed Amplifier board (your big cap may look a bit different)

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 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:

5. Insert all the resistors of the same value, e.g. R14, R19, R20, and R21.
6. Bend the leads as described above.
7. Solder the leads on the back of the board.
8. clip the leads.

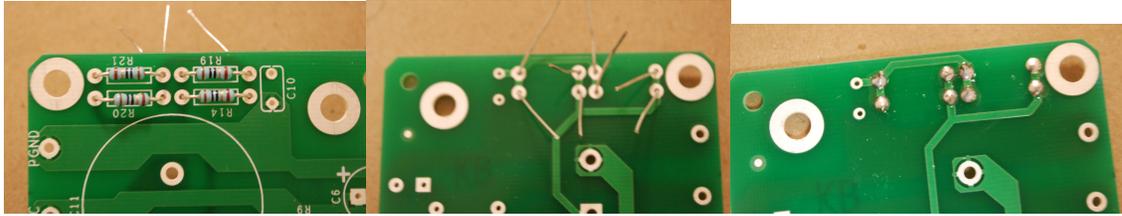


Figure 19-First four resistors are installed, leads bent on the back side, soldered, then clipped. When you have completed this section, there will only be one empty resistor slot, R16, a no-load, which will remain empty.

Keep track of your progress by placing a check-mark in the done column as every resistor is installed. The resistor values can be checked with a meter, or by reading the color code². 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.

You will build two identical channels. We've provided two Done columns, Done1 for the first channel you build, and Done2 for the second channel. We recommend that you build the channels one at a time, completing the first channel, then returning to this point to build the second channel.

Designation	Value	Color Code	Done 1	Done 2
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	46K4	Yellow, Blue, Yellow, Red, Brown		
R2	51K1	Green, Brown, Brown, Red, Brown		
R3	100K	Brown, Black, Black, Orange, Brown		
R5	100K	Brown, Black, Black, Orange, Brown		
R7	9K09	White, Black, White, Brown, Brown		
R8	11K	Brown, Brown, Black, Red, Brown		
R12	20K	Red, Black, Black, Red, Brown		
R4	1K	Brown, Black, Black, Brown, Brown		
R6	1K	Brown, Black, Black, Brown, Brown		
R9	1K	Brown, Black, Black, Brown, Brown		
R18	1K	Brown, Black, Black, Brown, Brown		
R10	1K, 0.1%	Brown, Black, Black, Brown, Violet; In some kits, the resistor may have the numbers: 1K 0.1% on a brown body		
R11	20K, 0.1%	Red, Black, Black, Red, Violet In some kits, the resistor may have the numbers: 20K 0.1% on a brown body.		

² See "Resistor Color Code" on page 32 to see how to read resistor color codes.

R17	1K (1 Watt) 5%	Brown, Black, Red, Gold (there are less stripes on a 5% resistor) ³		
R15	10 (1 Watt) 5%	Brown, Black, Black, Gold (there are less stripes on a 5% resistor). This resistor has a larger body.		
R16		This Location Remains Empty		
R22	0 Ohms	Use one of the cut resistor leads from a previous step to span the R22 mounting holes, making a 0 Ohm resistor.		
Note: R8 and R18 are near each other on the board. Be careful not to mix them up!				

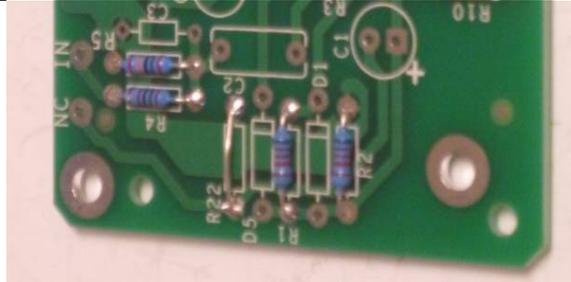


Figure 20-Zero Ohm R22 installation detail

Install the Small Capacitors and the Diodes

Now we'll install the following small capacitors:

Designation	Value	Marking	Done 1	Done 2
C3	220 pF	221		
C4	220 pF	221		
C9	47 pF	470 (some may be marked 47J)		

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



Next we install diodes D1, D4 and D5.

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	Done1	Done2
D1	1N4004	4004		
D4	1N4004	4004		
D5	1N4004	4004		

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



Next we install LEDs D2 and D3 (Light Emitting Diodes – the green light from these LEDs will be of medium brightness, and thus visible in a normally lit room.

³ The resistor body of this “1 Watt” resistor seems small to me, but the manufacturer’s data sheet swears that it’s a 1 Watt resistor. In most cases, it will be called on to dissipate considerably less.

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 will 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	Done1	Done2
D2	T1 style	none		
D3	T1 style	none		

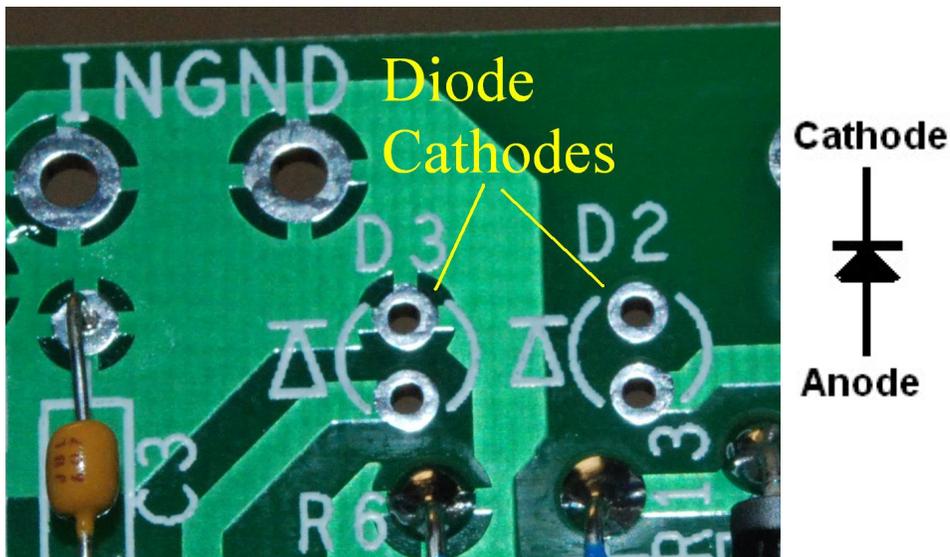


Figure 21-showing LED cathode orientation

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 1	Done 2
C1	100 μ F, 50 V	100 μ F, 50 V, and minus sign for polarity		
C6	47 μ F, 100 V	47 μ F, 100 V, and minus sign for polarity		

And the non-polarized capacitors:

Designation	Value	Marking	Done 1	Done 2
C2	1 μ F, 63 V or 100V	105K, 63 V or 100V (pillow shaped mylar capacitor)		
C5	0.1 μ F, 100V	μ 1J100, small blue box shape		
C8	0.1 μ F, 100V	μ 1J100, small blue box shape		
C10	0.1 μ F, 100V	μ 1J100, small blue box shape		

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 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	Value	Marking	Done 1	Done 2
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 1	Done 2
C11	3300 μ F 63V	3300 μ F, 63 WVDC		

C11 will be 10000 μ F @ 63V if you have purchased the 10K μ F upgrade. The 10 K μ F upgrade produces a bit more bass with lower distortion.

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 the on first shot.***

1. Locate the 30" piece of 18 AWG solid wire supplied in each kit. Straighten it out in preparation for a precise measurement. Hint: An easy way to straighten the wire is to essentially play "tug-of-war" with the wire. Two people, and two pairs of pliers works well. One person, a bench vise, and a pair of pliers also works well. The wire will actually lengthen a little as you tug it. Don't stretch it more than about 1/4".
2. Cut a 24 3/8" length of the straightened 18 AWG solid wire. The length supplied with be about 30", so you'll have to carefully measure and cut the wire.
3. Strip back 3/8" of insulation from both ends of the wire. Be careful not to nick the conductors.
4. 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 22) Solder the wire into the L1A hole.
5. Wind 6 turns of wire, closely spaced, so it looks like Figure 23. When you get to the end of the coil, fold the end across the existing turns, toward the L1B hole.
6. Pull the end of the wire through the L1B hole, and solder it on the back of the board.

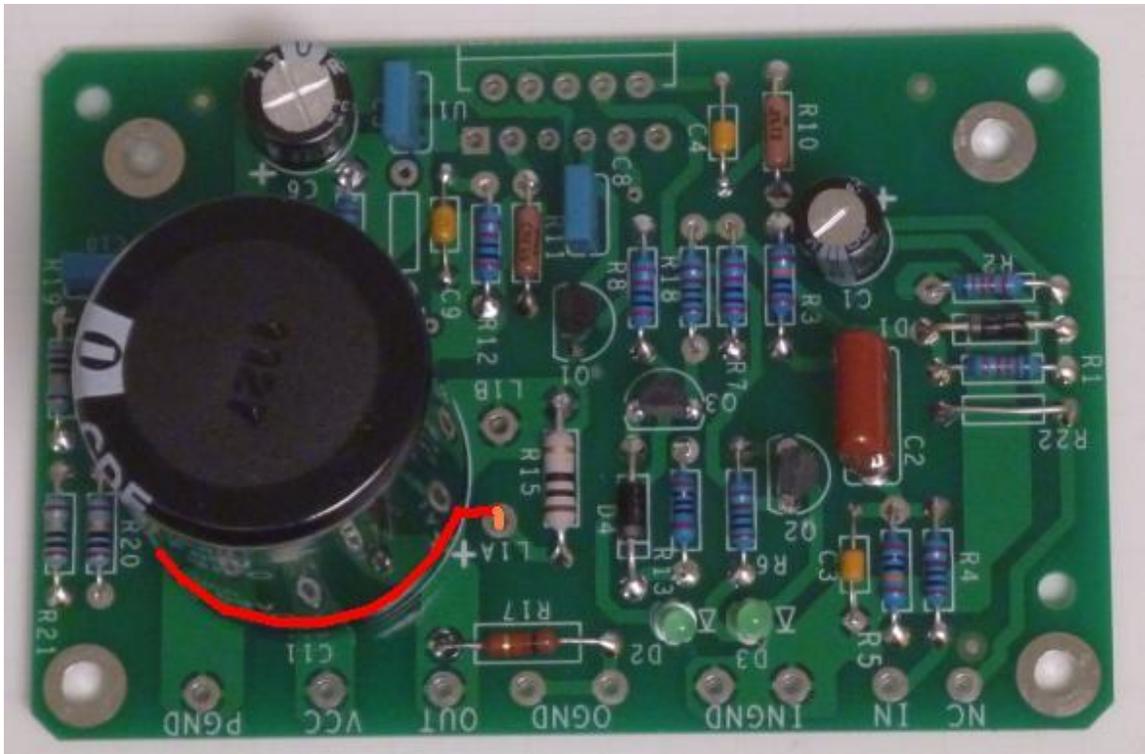


Figure 22-Starting to wind the output inductor



Figure 23-finishing step for the output inductor

Final Amplifier Module Assembly and LM3886 Installation

Mounting the PCB to the Super-duper Heatsinks

These are the last steps in building the circuit. Refer to Figure 24. You'll first mount the PCB to the heatsink, then install the LM3886.

1. Fasten the brackets to the PCB using 6-32x1/4" screws.
2. Square up the PCB/bracket assembly to the heat sink. Use the #6-32x3/8" screws to fasten the brackets to the heat sink. Note that the hole in the bracket that adjoins the heatsink is a clearance hole.

3. Cut a corner of the thermal compound packet. 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.
4. Insert the LM3886 into the PCB and against the heat sink using a 6-32x3/8" screw (Figure 24).
5. Make sure that the LM3886 leads sit evenly above the board. There should be some daylight between the bottom row of pins and the board (Figure 25), and the pins should protrude evenly on the solder side.
6. When the LM3886 looks square tighten all the screws, especially the screw that holds the LM3886 to the heat sink. Both the tab and heat sink are metal, so you can tighten it firmly.
7. Solder just the corner pins, and recheck the assembly for squareness and pin protrusion.
8. When everything looks good, solder the rest of the LM3886 pins.
9. Use 6-32x3/8" screws to attach the two mounting foot brackets to the cleared spaces on the finned side of the heat sink. Note that the screw passes through a clearance hole in the bracket. The remaining bracket hole is tapped to accept a 6-32 screw that will be installed at a later step.
10. Repeat the process to build the amplifier module for the second channel.

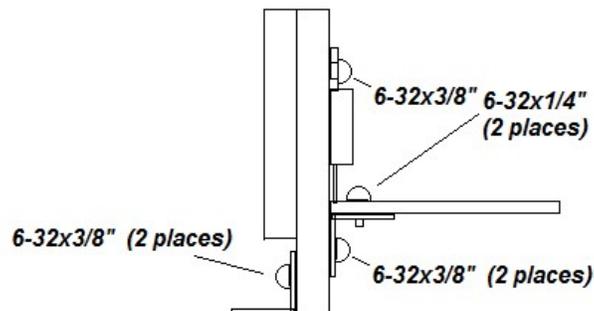


Figure 24-Assembling the circuit board to the super duper heat sink



Figure 25-The LM3886 sits up off the board to avoid shorts between the front and back rows of pins. The body should be at right angles to the circuit board

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!

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 C11 (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.

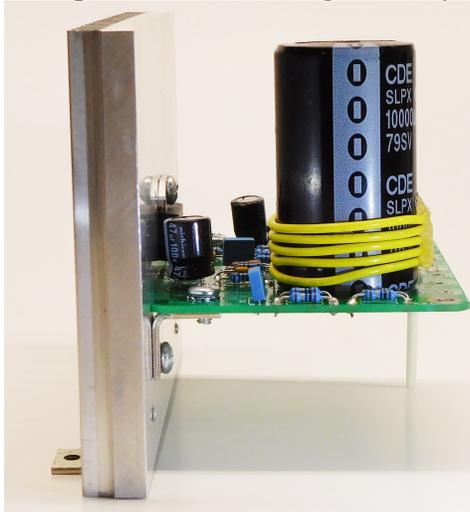


Figure 26-completed amplifier module mounted on the heatsink

Section 5: 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. Connect the power
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. Please refer to Figure 27.

Use one of the supplied #6 lugs to create the new grounding arrangement. Make the following three connections to the lug prior to installing it into the chassis.

1. Connect the short black wire from the left black binding post.
2. Connect the short black wire from the right black binding post.
3. Cut a piece of the supplied 18 AWG stranded black wire to run from the lug to the ground connection of C12.

Solder all three wires to the lug, then use a recovered 6-32 nut and bolt to fasten the lug to the chassis as shown in Figure 27. The two remaining black wires that connect to the binding posts will be used in a later step.

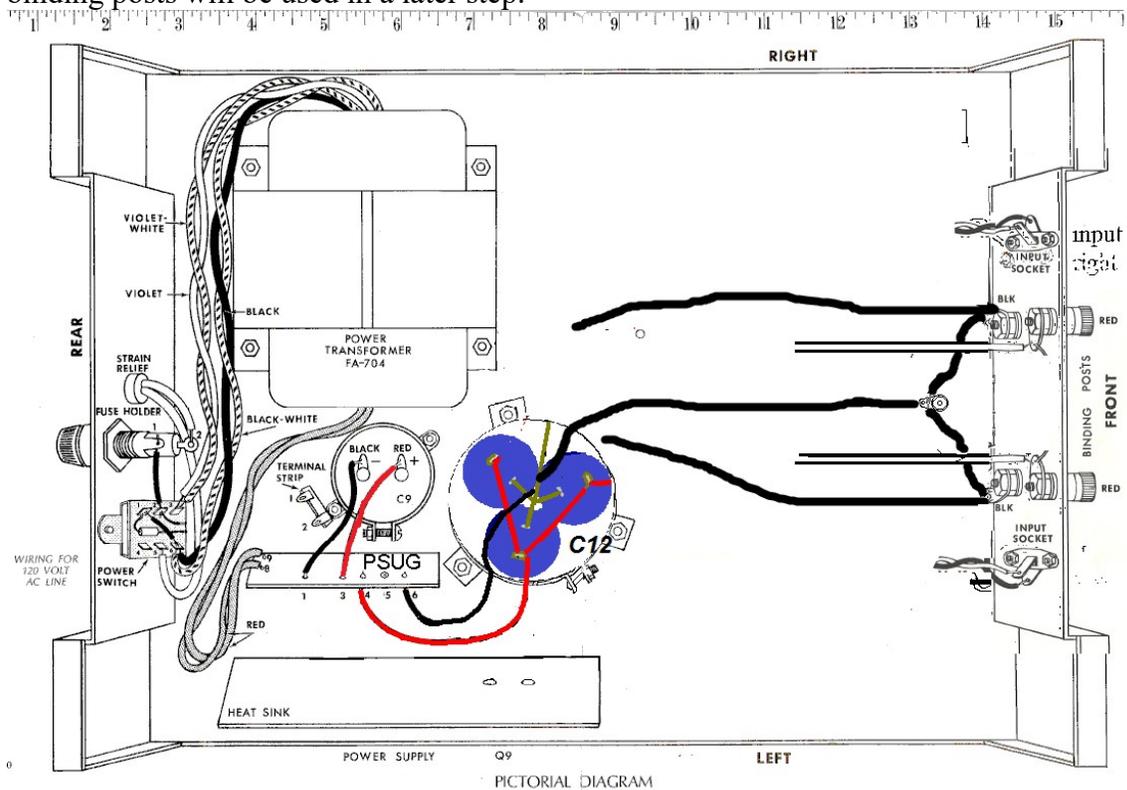


Figure 27-Rewiring Half the Grounds

Revise the Power System

Please refer to Figure 28.

Warning: Do not connect power to the amplifier modules unless you are sure that the power supply output voltage is less than 76 Volts!

1. Cut the supplied 24" length of red-black wire into two 12" lengths.
2. For the first 12" piece, remove 1/4" of insulation from the red and black wires at one end.
3. Repeat this for the second 12" piece of red and black wire.

4. Wrap the red wire of the first red-black wire around one of the C12 terminals as shown in Figure 28.
5. Wrap the red wire of the second red-black wire around the other of the C12 terminals as shown in Figure 28.
6. Wrap the black wire of the first red-black wire around the bare wire that connects to C12's negative terminal, closest to the already-connected ground wire from the Power Supply.
7. 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.

Wiring the Inputs

Note: These directions assume that you are using the original, non-isolated RCA jacks. These jacks make a ground connection to the chassis. If you are using isolated RCA jacks, or if your RCA jacks are original jacks held in with rivets and the rivets are loose, then you must add the two wires shown in Figure 30.

1. Right Channel – Remove the old wires from the input connector.
 - a. Take one black-white twisted pair and cut it to a 4" length⁴.
 - 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

⁴ 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.

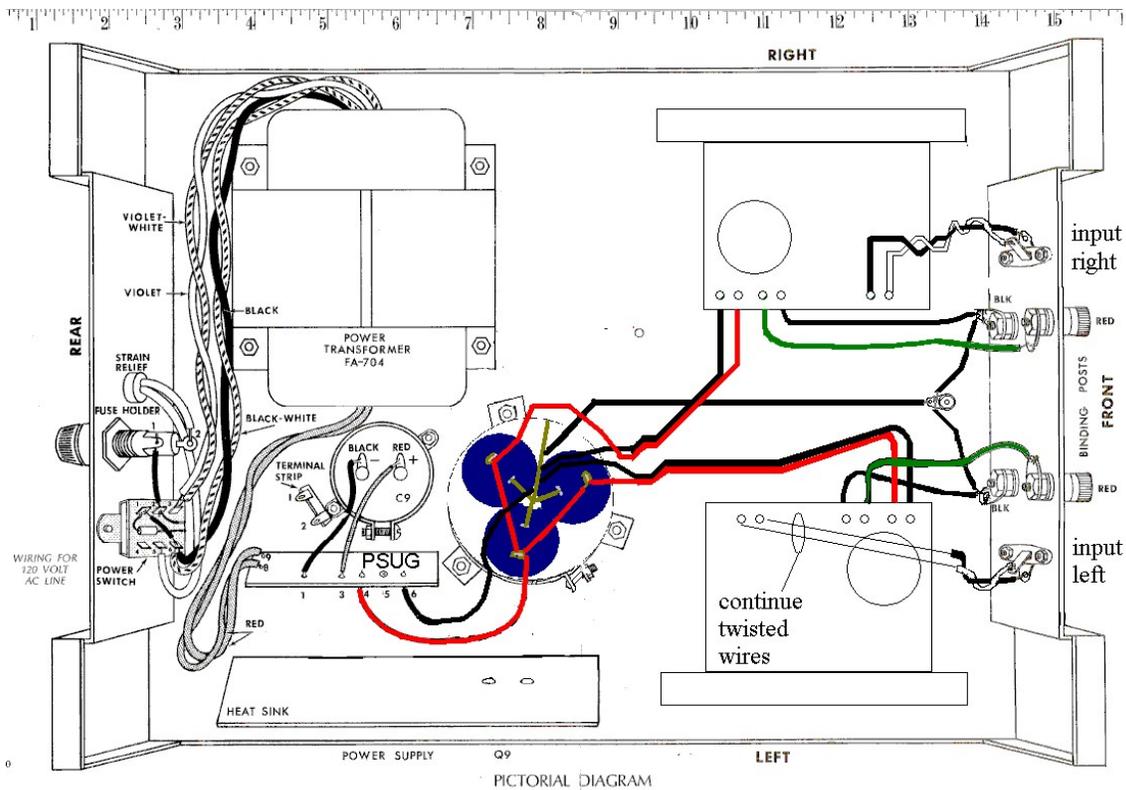


Figure 28-completed wiring

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 28.)

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. 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. 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 wire 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

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. Check your work. 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 wire from the right channel black speaker binding post)
 - f. OUTPUT (wire from the right 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.

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 6: 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 switch, but after that about all you should hear is 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 a normally lit room, you should see that both LEDs are on.

If this all goes well, (no smoke or 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 minute⁵. 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 (1000 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 the preamp volume to the desired listening level, and enjoy your amplifier.

The amplifier has special slow turn-on features that avoid 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.

⁵ The DC voltage will drop to very nearly zero in 15 seconds if a speaker is connected.

All resistors 1/4W, 1% unless otherwise noted

GT-101 Amplifier Module
 As configured for use in TCK amplifier
 modules for the Dynaco Stereo 120
 Copyright 2012-2017
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 U1 is LM3886 with
 non-isolated case

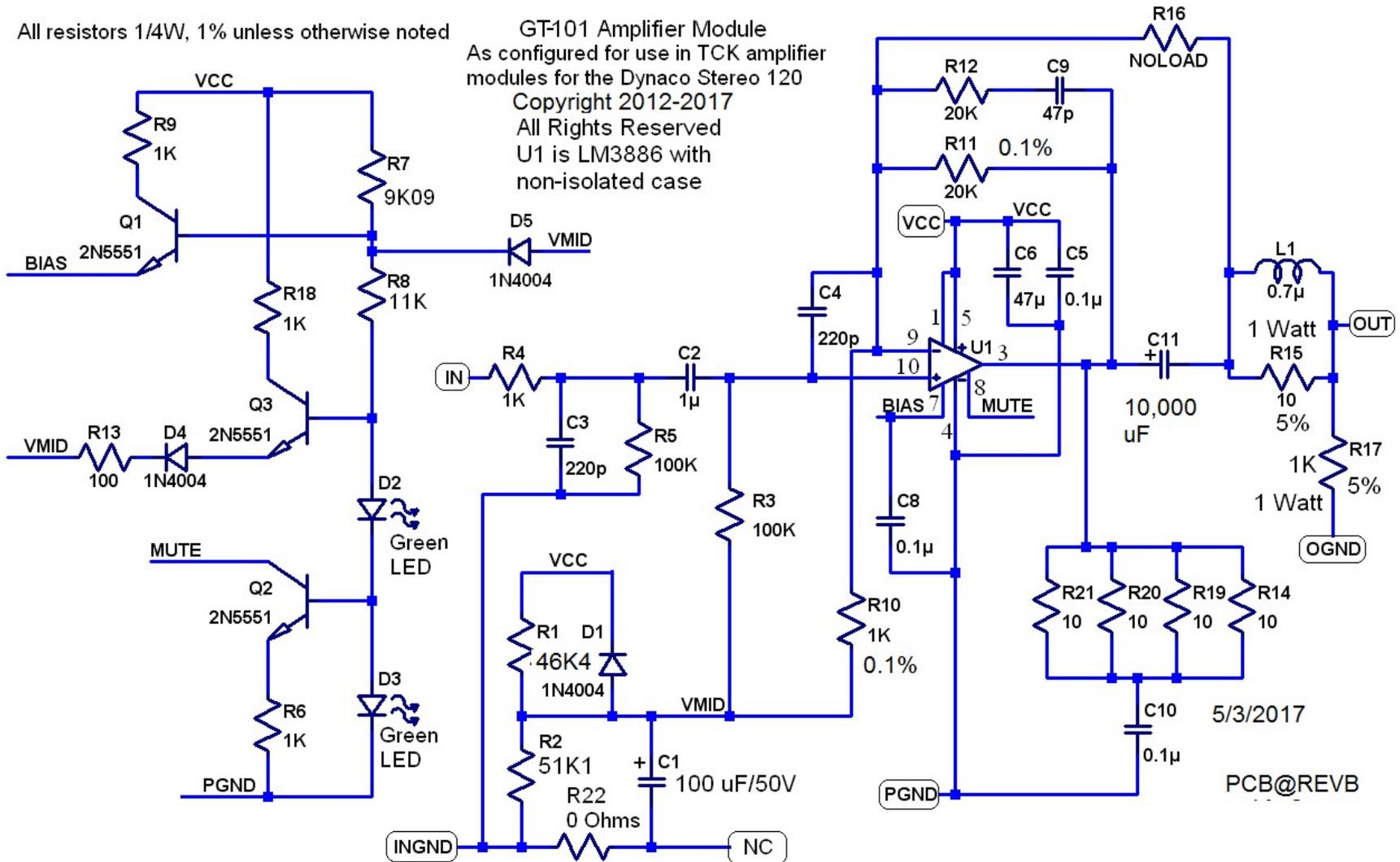
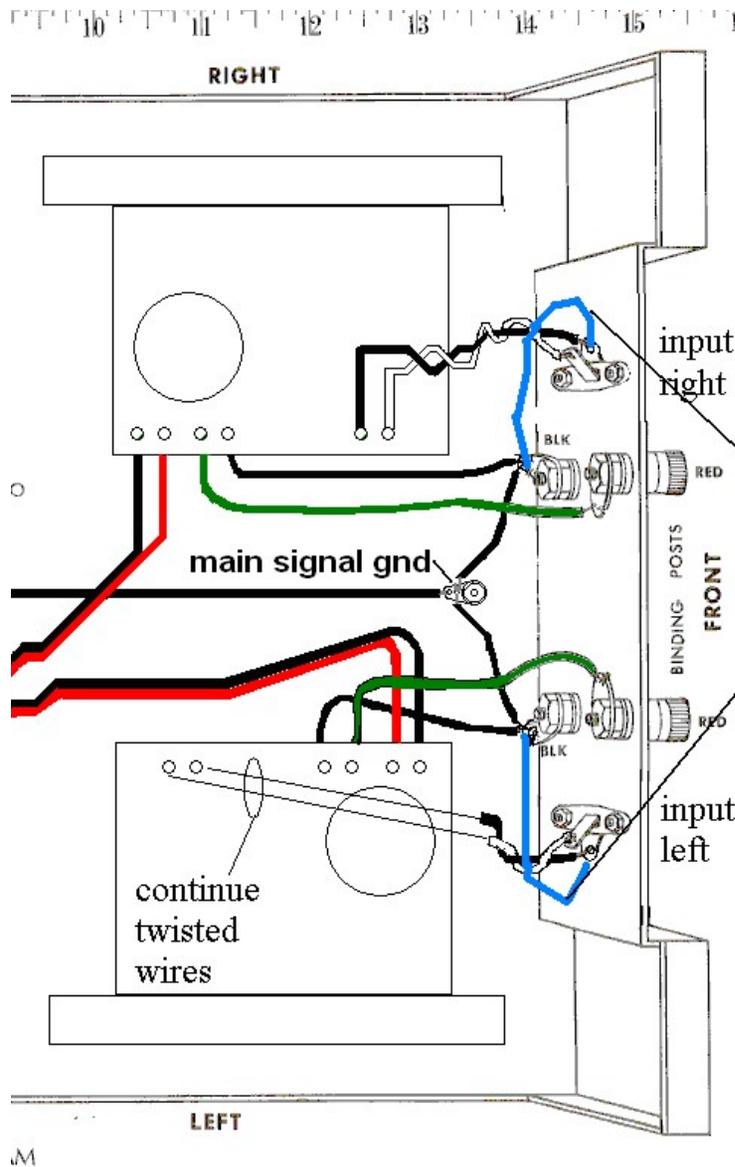


Figure 29-Schematic of amplifier module



add these ground wires if:

1. you're using insulated ground RCA jacks, or
2. you have original jacks retained by rivets, and the rivets are loose, or
3. you have any doubt about the quality of the connection of the RCA connectors to the main signal ground.

Figure 30-Optional Input Ground Wires are shown in blue

Resistor Color Code



Figure 32-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 (5-band, 1 % resistors):

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
5	Tolerance: <ul style="list-style-type: none"> • Violet (purple) =>0.1% • Brown =>1% • Red => 2% • Gold=> 5% • Silver=>10% • No band=>20%