



THE PERCOLATOR COMBO

Assembly Instructions

2 WATT AMPLIFIER KIT



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THE PERCOLATOR

2 Watt Tube Amp / 1x8 Combo Kit Assembly Instructions

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INTRODUCTION

Thanks for buying the Percolator single-tube, 2-watt guitar combo kit from Zeppelin Design Labs! We hope you will have fun assembling this kit, followed by many years of musical enjoyment. We think we've produced a pretty nice product, and we'd love to hear your feedback. Send an email, or post on the ZDL forum.

Note there is a serial number sticker on the chassis. Reference this serial number when and if you ever need to contact us for assistance.

Please read this manual ALL THE WAY THROUGH BEFORE STARTING! I know that's a lot to ask, but you will discover a number of issues concerning timing or sequencing that you might not realize if you just start out.

The Percolator was designed around a single tube developed by GE in the early 1960's under the brand name "Compactron." Compactron tubes have multiple amplifier sections in one bottle. The tube in the Percolator has two triodes and one sharp cut-off pentode. That's the same topology as the Fender Champ, but in one bottle! This tube was never intended to be used in an audio circuit (it was originally designed for use in various parts of a TV circuit), but it works and sounds great in a guitar amplifier. Since this tube is rarely, if ever, seen in guitar amps, it offers a rather unique tone.

Compactrons were developed in a time of fast technological growth. In the early 1960's transistors were becoming more stable and practical for use in more demanding circuits. They also were much smaller and didn't require as much power (via heating filaments). The tube market was being challenged and threatened by this new solid state competitor. The GE corporation (which was one of, if not the most prolific tube developers in the world at the time) was well invested in their miniature tube line and wasn't too interested in making the transition to transistor development. So to compete with transistors and give tubes a few more years in the market, the engineers at GE developed the Compactron that could take the place of several tubes with just one bottle. It was the tube equivalent to the integrated circuit. They were mostly designed for use in the color TV market, but some of them did find their way into radios and hifi amps. Ampeg even used a Compactron in some of their preamp circuits. GE made a big push to promote and use these tubes in their products, but eventually transistors did win the technology battle and tubes were altogether replaced in televisions, leaving large stockpiles of unused Compactrons in warehouses. The last Compactrons were made in the early 1990's and are still readily available today as "new old stock" (NOS) items. The Percolator, with its single Compactron tube, gives us a chance to re-purpose a piece of tube history, while offering unique tonality in this modern market.

CAUTIONS, WARNINGS, DANGERS

This is not a beginner's electronics project! If you have not worked with line/high voltage electricity before do not attempt this project without qualified help. **THIS THING CAN KILL YOU** if you don't know what you are doing. We expect that you know how to safely and properly solder electronics. If you have never soldered a circuit board before, you **MUST** practice on something simpler and safer! If you lack experience, build this kit with a qualified friend. Use common sense when soldering. Use safety glasses and don't burn yourself or anything else. We also expect you to know how to use a digital

multimeter (DMM). If you are not comfortable with using a DMM, either have an experienced friend help you, or learn how by watching some YouTube videos on using a multimeter.

The Percolator is available wired for either 115-120VAC / 60hz OR for 230-235VAC / 50hz. You must use the model appropriate to your region. If the power cord furnished with the Percolator has the wrong plug for the type of receptacle used in your area, you must go to the hardware or electronics store and obtain the appropriate GROUNDED adapter! Never defeat the grounding of the power cord.

Amplifiers handle HIGH VOLTAGES, higher than what comes out of the wall outlet. If you do not know what you are doing or you screw up this project, you could expose yourself or others to DEADLY HIGH VOLTAGE! Amplifiers have devices in them called capacitors. Capacitors (or caps) store high-voltage electricity for a long time, hours after the unit is turned off. If you do not know what you are doing, and you handle the capacitors recklessly, YOU COULD KILL YOURSELF OR THE GUY NEXT TO YOU!

Zeppelin Design Labs LLC takes no responsibility for any harm that may come to anyone or anything through this product.

This instruction guide is full of **CAUTIONS**, **WARNINGS**, and **DANGERS**. These are actually three distinct things:

1. **CAUTION** indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury, like cutting or burning your finger.
2. **WARNING** indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury, like shocking yourself at a wall receptacle.
3. **DANGER** indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. This word is limited to use in the most extreme situations.

Once your amp is complete and safely installed in its cabinet, it is no more dangerous than a toaster. There is a warning label on the chassis reminding you and others of the hazards typical to any electric appliance; but while under construction, with the chassis open and the components exposed, this manual contains the warnings you need to stay safe!

BUILDING THE AMPLIFIER

WHAT YOU WILL NEED

Your Combo consists of three major assemblies: the Amplifier, the Cabinet, and the Baffle Board. Following is a complete list of all the tools and supplies you will need to build the three assemblies. Note that there are a variety of ways to build and finish a simple wood cabinet. These instructions will show you how to build the cabinet the way we do it here in the Lab. If you prefer a different method, go for it. Thus, the tools and supplies you end up using may be slightly different from what we show here.

TOOLS

1. Digital Multimeter, able to measure DC voltage, AC voltage, and Resistance
2. Screw Drivers (a cordless screw gun is handy but will not always be appropriate; you will need these hand tools)
 - i. #1 Phillips
 - ii. #2 Phillips
 - iii. Small Straight
3. 12" Ruler
4. A small awl, or metal poking probe
5. Small hammer
6. Soldering Iron (not a soldering gun, or a "cold heat" iron), good quality, 15-50 watt, with a good medium or small sized tip, conical or "screwdriver" shape. One with a temperature control and a stand is best.
7. Wet sponge or dry solder-cleaning pad
8. Wire stripper, to strip 16-, 18- and 20-gauge wire
9. Flush cutters or small diagonal cutters
10. Needle-nose pliers
11. X-Acto knife, razor blade, or scissors
12. Some sort of clamp or fixture to hold the printed circuit board and other parts while soldering (optional, but it's nice to work with).
13. Solder sucker or solder braid – optional, but very handy if you have to remove / repair any components!
14. Drill: cordless, corded, or drill press
15. Drill bits: 5/64", 9/64", 3/16", 7/32"
16. Orbital Sander (optional) or sanding block
17. Small router and 3/16" radius roundover bit, or other small detail bit (optional)
18. Countersink (see also text below)
19. Staple gun. We prefer electric or pneumatic, but manual will work fine.
20. Sharp pencil
21. Bar clamps, minimum 12" opening, two of them
22. Speed square
23. Heat gun, or very hot hair dryer

SUPPLIES

1. Solder, 60/40 rosin core, the smaller diameter the better (we prefer .032" diameter). Make sure it's good quality; we prefer Kester brand, but the Radio Shack brand will work fine.
2. Isopropyl alcohol, denatured alcohol, or rubbing alcohol
3. Mineral spirits, for cleanup
4. Good quality wood glue such as TiteBond II or III
5. Good quality wood filler such as DAP Plastic Wood (optional)
6. Masking tape
7. Sandpaper, either discs for your orbital, or sheets for your block: 60, 120, 220, 320
8. Very small can of MinWax Dark Walnut Wood Finish #2716 (oil-based stain) or equal
9. Small can of MinWax Wipe-On Poly clear satin
10. A small amount of flat black paint, spray or can.
11. Clean rags

WHAT'S IN THE BOX

Table 1: Percolator Combo Bill Of Materials (BOM) is a complete parts list of everything that should be present in your kit, followed by photos of each part. Print the BOM and carefully go through the kit, identifying every part. Note that some of the components are difficult to tell apart. Compare them carefully with the photos.

Besides verifying that nothing is missing, this will acquaint you with the parts and their names. If ANYTHING is missing, first double-check: we double-checked before sealing the box at our lab! If

it's still missing, EMAIL US right away at support@zeppelinlabs.com. Include your serial number (given via a sticker on the chassis) in your email. If we are reasonably convinced that we goofed and shorted your kit, we will get replacement parts in the mail to you as soon as possible. If you lose or damage anything, we will be glad to sell you replacements. The unusual or custom components can be ordered directly from us (contact support@zeppelinlabs.com). For more common parts, like resistors, caps, or screws, you may just want to go to a local electronics or hardware store.

TIP: Empty the parts of the kit onto a cookie sheet or into a big fruit bowl, NOT onto the cluttered workbench, or onto the living room carpet! This will protect you from losing tiny parts.

Figure 1: What's In The Box?

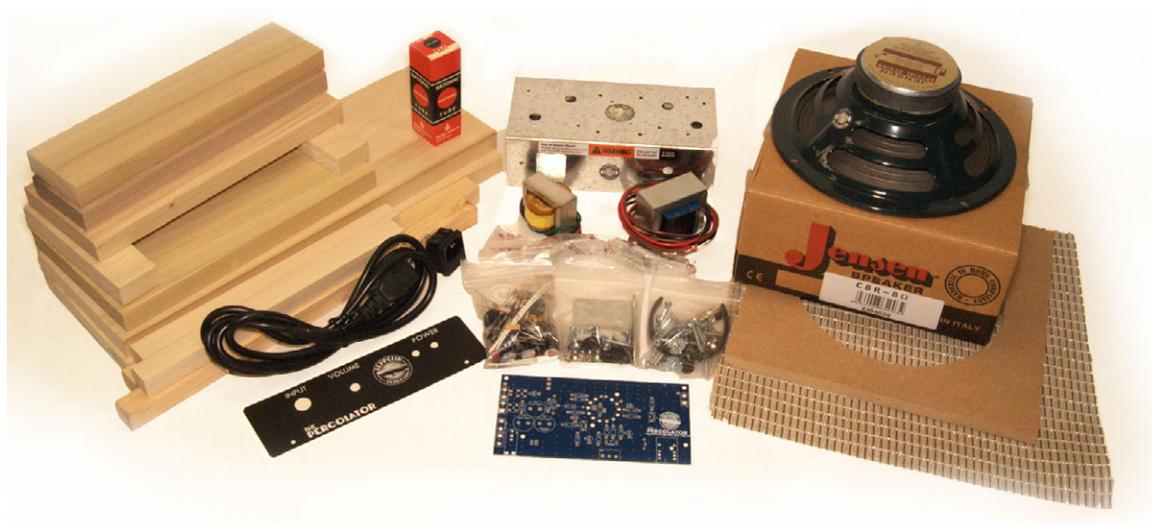


Table 1: Percolator Combo Bill Of Materials

Loose in the box:

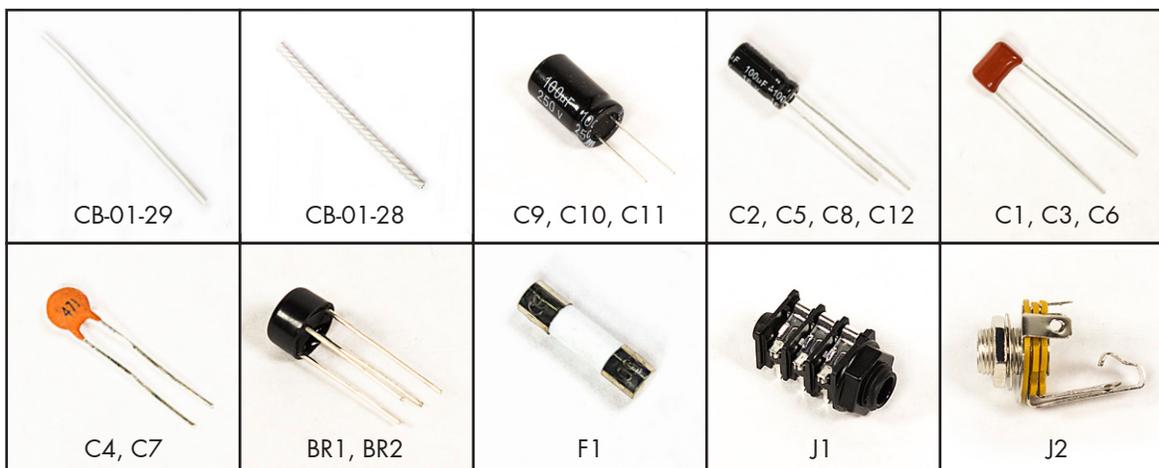
Part #	Description	Notes	Qty
CA-40-08	Baffle Board for 8" Speaker		1
CA-51-03	Cabinet Top	Has a big notch	1
CA-50-01	Cabinet Bottom		1
CA-55-03	Cabinet Sides		2
CA-60-01	Cabinet Front		1
CA-70-01	Cabinet Cleat - Rear	Shorter parts	2
CA-70-02	Cabinet Cleat - Front	Longer parts	2

CA-65-01	Cabinet Port		2
CB-10-01	Power Cable	IEC 6'	1
CH-10-20	Chassis Top		1
CH-10-21	Chassis Base Plate		1
TX-10-21	Grill Cloth Black/Silver/Beige	12" x 12"	1
HD-30-13	Handle		1
LS-30-08	Loudspeaker 8"	8 ohm	1
PC-03-01	PCB	Printed Circuit Board	1
PL-10-03	Percolator Face Label		1
J3	Power Receptacle		1
T1	Power Transformer	120V Primary	1
T2	Output Transformer	4W	1
DC-04-10	Paper Templates		4
V1	Vacuum Tube	NOS Compactron	1



In the Components bag:

Part #	Description	Notes	Qty
CB-01-29	10" (25cm) (total length) Hookup Wire 20/1	One or more pieces	1-2
CB-01-28	4" (10.5cm) twisted pair Hookup Wire 20/1	Heater voltage	1
C9, C10, C11	Electrolytic Capacitor 100uF/250V		3
C2, C5, C8, C12	Electrolytic Capacitor 100uF/16V		4
C1, C3, C6	Film Capacitor 0.022uF/250V		3
C4, C7	Ceramic Disc Capacitor 470pF/50V		2
BR1, BR2	Bridge Rectifier 2A/1000V		2
F1	Fuse 1A 250V		1
J1	¼" Stereo Jack (w/ plastic nut)	Input (Plastic barrel)	1
J2	¼" Mono Jack (w/ metal nut and washer)	Output (Metal barrel)	1
HD-32-03	Knob		1
D1	Red LED 5mm		1
VR1	Potentiometer 100KA		1
R1, R6, R11	Resistor 22K	Red, Red, Orange, Gold	3
R5, R9, R10	Resistor 220K	Red, Red, Yellow, Gold	3
R3, R8	Resistor 47K	Yellow, Violet, Orange, Gold	2
R4	Resistor 820R	Gray, Red, Brown, Gold	1
R7, R14, R17	Resistor 1.5K (or 1K5)	Brown, Green, Red, Gold	3
R16	Resistor 4.7K (or 4K7)	Yellow, Violet, Red, Gold	1
R2	Resistor 1M	Brown, Black, Green, Gold	1
R15, R12	Metal Film Resistor 120R 1%	Brown, Red, Black, Black, Brown	2
R13	Metal Film Resistor 2.2K (or 2K2) 1%	Red, Red, Black, Brown, Brown	1
HD-70-35	Panel Mount LED Bezel		1
HD-70-42	12 Pin Tube Socket		1
S1	SPDT Toggle Switch	PCB Mount	1



 HD-32-03	 D1	 VR1	 R1, R6, R11	 R5, R9, R10
 R3, R8	 R4	 R7, R14, R17	 R16	 R2
 R15, R12	 R13	 HD-70-35	 HD-70-42	 S1

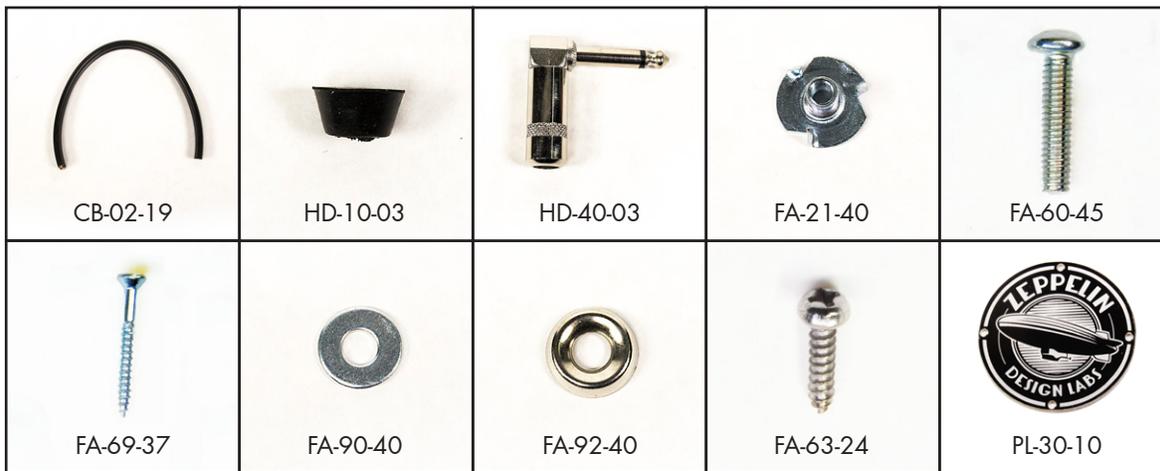
In Hardware bag #1:

Part #	Description	Notes	Qty
HD-50-01	Solder Lug		1
CH-10-25	Isolation Fin		2
HD-20-02	Rubber Grommet		4
FA-22-21	Keys Lock Nut M3		5
FA-60-37	Philips Machine Screw – Pan head M3x6		17
FA-63-33	Philips Sheet Metal Screw - Pan head 6x3/8"	Chassis, Fins, Feet	12
FA-63-37	Philips Sheet Metal Screw - Flat head 6x1-1/4"	Installing the chassis in the cabinet	4
ST-10-23	Nylon Hex Standoff M3x12		6
FA-91-30	Lock Washer M3		6

 HD-50-01	 CH-10-25	 HD-20-02	 FA-22-21	 FA-60-37
 FA-63-33	 FA-63-37	 ST-10-23	 FA-91-30	

In Hardware bag #2:

Part #	Description	Notes	Qty
CB-02-19	Zip Wire multi-stranded 16 awg	6" (15cm)	1
HD-10-03	Foot	1/2"x1/4" (7x14mm)	4
HD-40-03	1/4" Phono Jack - Male	Speaker cable	1
FA-21-40	T - Nut #8-32"	Baffle	4
FA-60-45	Philips Machine Screw – Pan head #8-32x3/4"	Speaker	4
FA-69-37	Philips Wood Screw - Flat head #6x1-1/4"	Cabinet	30
FA-90-40	Flat Washer #8	Speaker	4
FA-92-40	Countersunk Washer #8	Baffle	8
FA-63-24	Phillips Wood Screw - Pan head #4x1/2"	Badge	4
PL-30-10	ZDL Badge		1



POPULATING THE PRINTED CIRCUIT BOARD

Your workspace should be well-lit, well-ventilated, and disposable; that is, don't work on the nice dining room table! Work on a utility surface that you can burn, drill and scratch. A piece of ¼" tempered masonite, or a chunk of MDF, makes an excellent cover if you don't have a utility work bench.

CAUTION: Solder fumes are not healthy for you. The fumes consist of vaporized flux, which can irritate your nose, lungs, and even your skin. You **MUST** work in a space where the air drifts away from you as you work, so fumes do not rise straight onto your face.

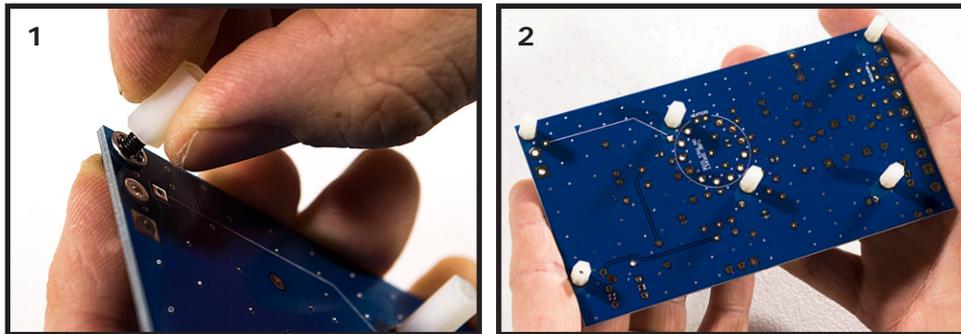
CAUTION: Solder residue usually contains lead, which is poisonous if you ingest it. Do not breathe the fumes, do not eat the supplies, wash your hands after you handle solder, and sweep and wipe up your work space after EVERY USE.

The printed circuit board (PCB) holds most of the components in this amp. Nearly all of the components will be installed on the "component side" of the board, which is the side that has the Zeppelin Design Labs logo on it. The other side of the board is called the "solder side", which, as the name implies, is the side on which the legs of the components are soldered to the board. Proper technique for installing and soldering components to a circuit board is demonstrated in our assembly reference video, but there are several other great resources on YouTube under the search "soldering tutorial." The general procedure consists of the following:

1. Install the part on the "component side" of the board, by threading the wire leads through the appropriate holes in the board. For your convenience, the board has silk screen outlines indicating where the components should be placed, along with text indicating the part number and often times the component value.
2. Hold the component in place with your finger and turn the board over.
3. Gently bend the leads out at about 45 degrees to keep the component from falling out of its holes.
4. Install all of one type of component, bending each of the leads as they are installed.
5. Flip the board over solder-side-up, and solder all of the components in one pass.
6. Clip the leads off (with small diagonal cutters) right at the solder joint.

Let's begin!

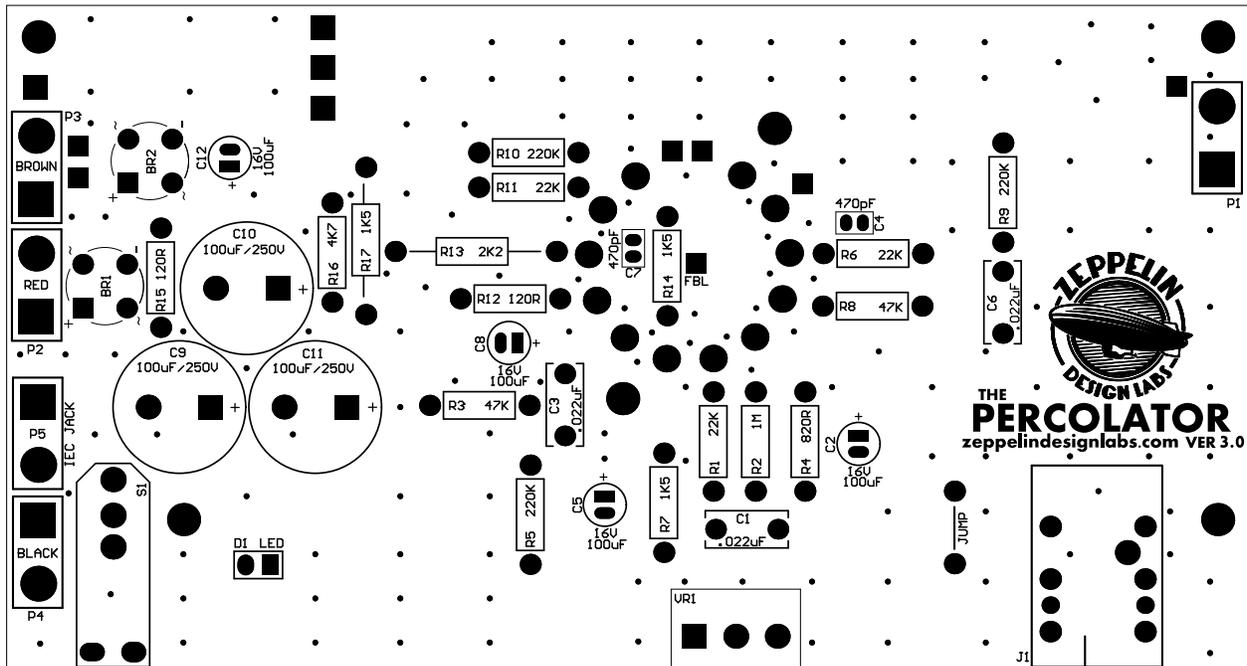
1. Standoffs (Part # ST-10-23): Use 6 standoffs, 6 M3 screws (Part # FA-60-37), and 6 lock washers (Part # FA-91-30). The plastic standoffs are installed on the solder side of the board, which means they are screwed in from the component side. The lock washer goes between the PCB and the standoff (not between the screw head and the PCB)¹. Place the 6 standoffs in the locations indicated below².



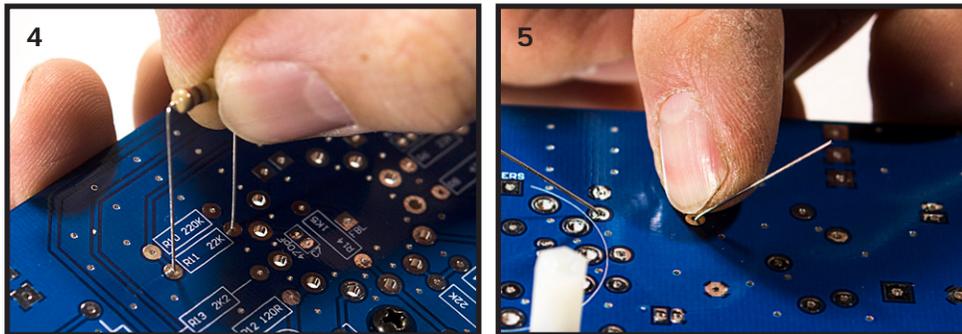
2. Resistors: The value of resistors are given by a series of colored stripes on their body. There are several tutorials on line describing how to decode these stripes, but we will identify each resistor for you by simply naming the stripe colors, and giving you the value and the part number. Figure 2: Component Values and Locations on the next page is a handy reference. If you are color blind or can't see the stripes clearly, then you must use your digital multimeter to measure the resistance of each resistor.
3. The hole spacing of most of the resistors on the circuit board allows the leads to be (gently) bent 90 degrees at the body of the resistor³. This allows most resistors to slip into their holes very easily. Resistors R13 & R17 are exceptions to the normal hole spacing, so for those two components you'll have to estimate where to bend the leads.



Figure 2: Component Values and Locations

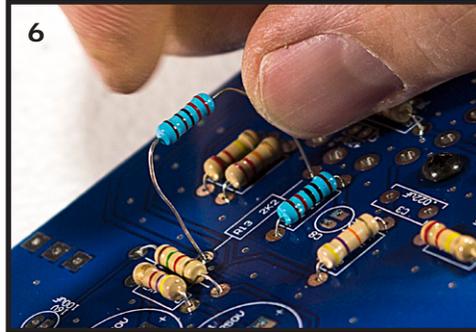


- a. Start with the 22K resistors (R1, R6, R11), labeled RED, RED, ORANGE, GOLD. Compare to its picture in the BOM. Find their locations on the circuit board and install and bend the leads as described above^{4,5}. Don't solder any of them until all 17 resistors are installed; just bend the leads to keep them in their place.

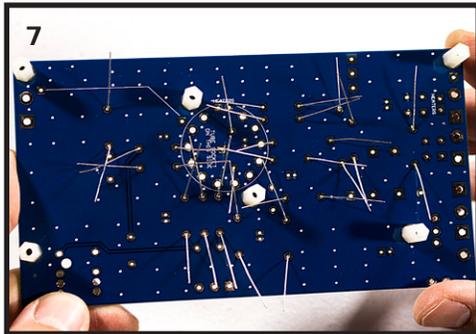


- b. Continue with the 220K resistors (R5, R9, R10), labeled RED, RED, YELLOW, GOLD.
- c. Continue with the 1.5K (or 1K5) resistors (R7, R14, R17), labeled BROWN, GREEN, RED, GOLD. R17 has a larger lead spacing than most of the other resistors so estimate where to bend the leads.
- d. Continue with the 47K resistors (R3, R8), labeled YELLOW, VIOLET, ORANGE, GOLD.
- e. Continue with the 120 ohm (or 120R) resistors (R12, R15), which are blue in color and are labeled BROWN, RED, BLACK, BLACK, BROWN.

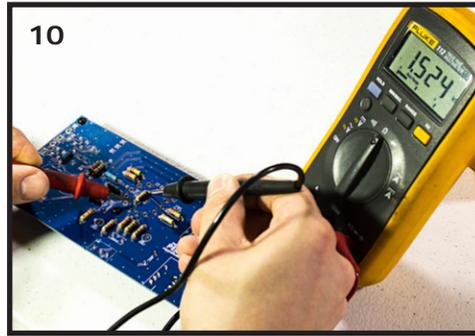
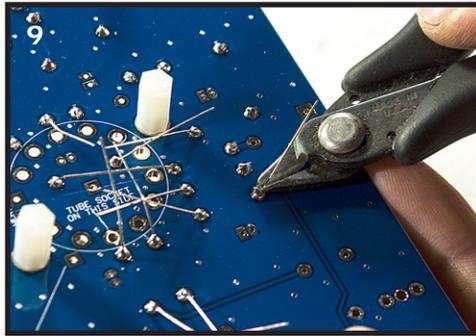
- f. Continue with the 2.2K (or 2K2) resistor (R13), which is also blue in color and is labeled RED, RED, BLACK, BROWN, BROWN. The lead spacing on R13 is also abnormal, so bend the leads the proper length to fit into their holes.⁶



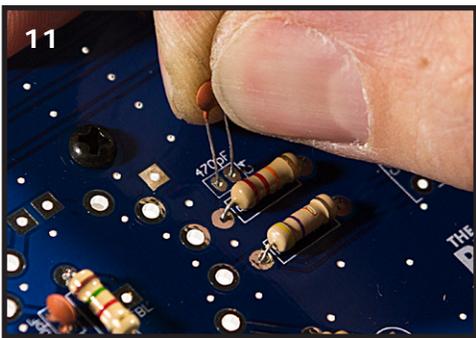
- g. Continue with the 1M resistor (R2), labeled BROWN, BLACK, GREEN, GOLD.
h. Continue with the 820 ohm (or 820R) resistor (R4), labeled GRAY, RED, BROWN, GOLD.
i. Last, install the 4.7K (or 4K7) resistor (R16), labeled YELLOW, VIOLET, RED, GOLD.
j. You should have a whole forest of bent leads coming out the solder side of the board.⁷ Now you can turn the board solder-side-up and solder each one to the board.⁸



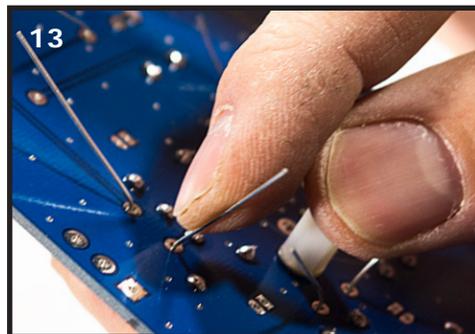
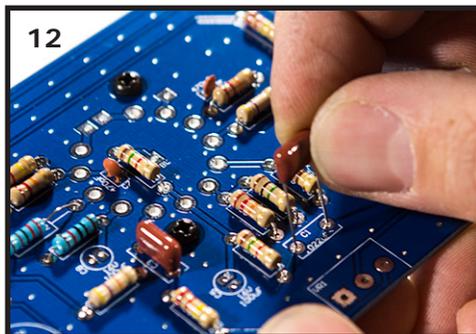
- k. Now clip each lead with your flush cutters at the solder joint.⁹
l. Before installing any more components on the circuit board, double check the resistance values of each of the installed resistors. Set your digital multimeter to the "ohms" or "resistance" setting, and measure across all of the resistors. Compare the measured value to the listed value in Figure 2 on the previous page.¹⁰ Make sure they are all correct (within 5%) before moving on!
4. Capacitors: The Percolator uses 3 different types of capacitors: Film capacitors, tiny ceramic disc capacitors, and electrolytic capacitors. Film and ceramic caps can be installed in either direction on the circuit board (the legs can be reversed in their holes). But electrolytic caps are polarized, meaning they will only work when they are installed in the correct orientation.



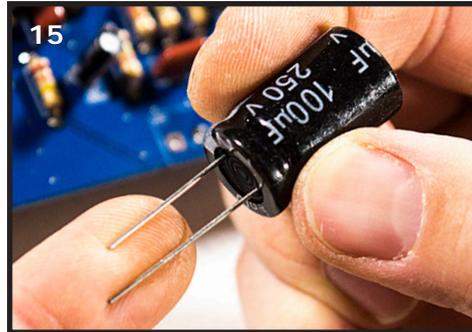
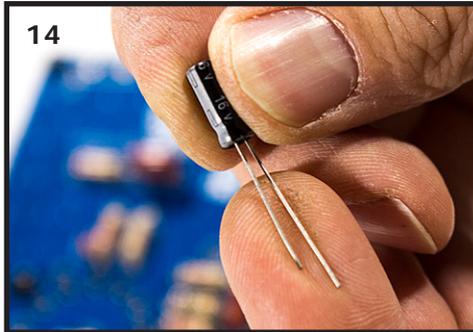
a. Let's start with the two tiny ceramic caps (C4 ,C7).¹¹ Install, solder and clip the leads.



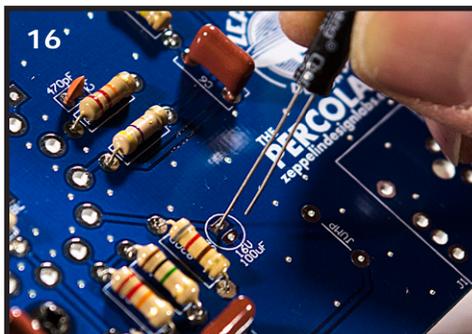
b. Continue with the three film caps (C1 ,C3 ,C6).¹² Install¹³, solder and clip the leads.



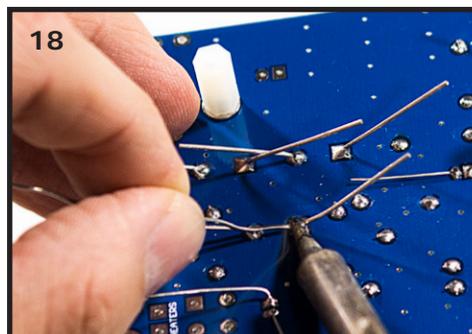
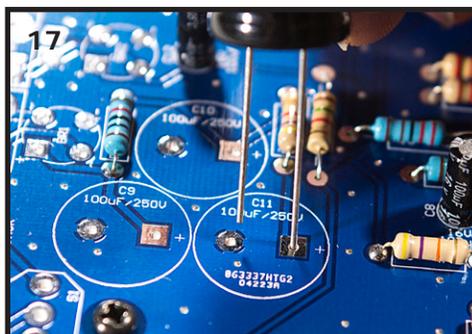
- c. Now for the tricky electrolytic caps. Note all the electrolytic capacitors have one leg that is longer than the other.^{14, 15} The longer leg is the positive side of the cap. The positive leg (the longer leg) goes in the square pad. PAY CLOSE ATTENTION TO THIS WHEN YOU ARE INSTALLING THESE CAPS! It is very easy to install one or more electrolytic caps backwards! If you do, the amp won't work correctly! Double check Figure 2 for reference. Figure 2 also has "+" signs where the positive (longer) lead goes. The negative side of the caps have white stripes pointing to the negative lead.



- d. Install all of the smaller electrolytic caps (C2 ,C5 ,C8 ,C12). Solder and clip the leads.¹⁶

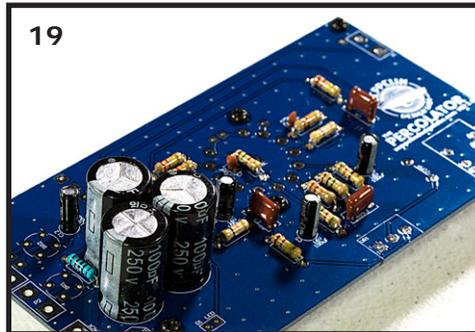


- e. Now install the three big electrolytic caps (C9 ,C10 ,C11).¹⁷ Solder and clip the leads¹⁸, but put one of these clipped leads aside for use in the next step.

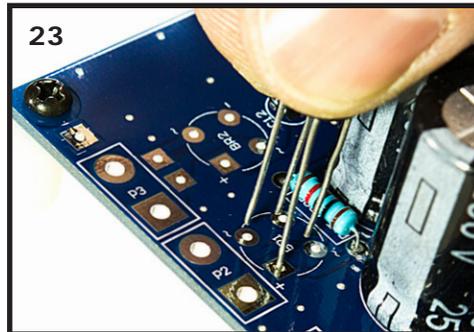
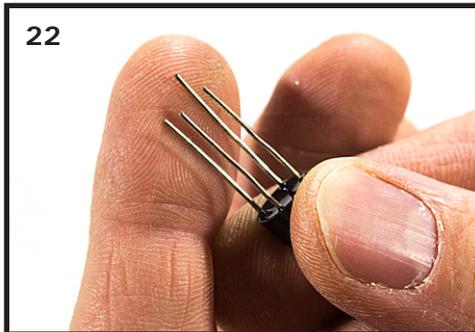


WARNING: The big electrolytic caps (C9 ,C10 ,C11) are likely to explode if they are installed backwards, which could result in personal injury. Install in STRICT CONFORMANCE with these instructions!

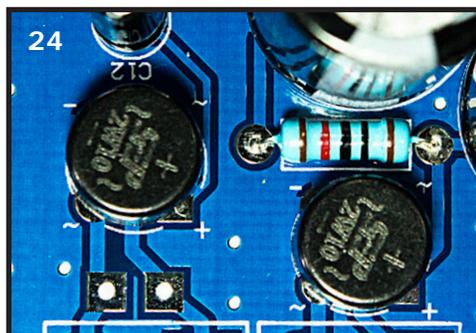
- f. Before moving on, double check the orientation of each of the electrolytic caps. Make sure the stripe on each electrolytic cap is in the same direction as each cap in the picture.¹⁹



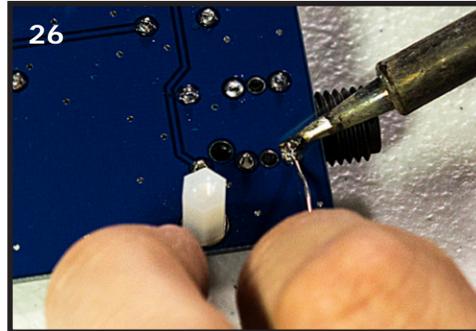
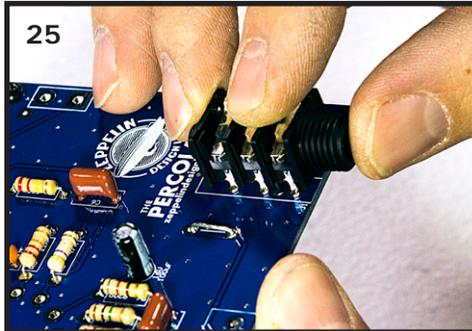
5. Jumper wire: Use one of the leads that you just clipped off of the big electrolytic capacitors (C9, C10, or C11) as this jumper. Use your needle nose pliers to bend the lead in the shape of a staple.²⁰ Install the jumper in the holes and solder the leads.²¹
6. Bridge rectifiers (Part # BR1, BR2): Bridge rectifiers have 4 leads and it is very important to make sure each lead goes in the correct hole. The only indication on the circuit board of how the rectifiers should be oriented is a square pad. The positive lead (the longest lead²², labeled with a "+") goes in the square hole²³. The other leads should line up properly with the other holes.



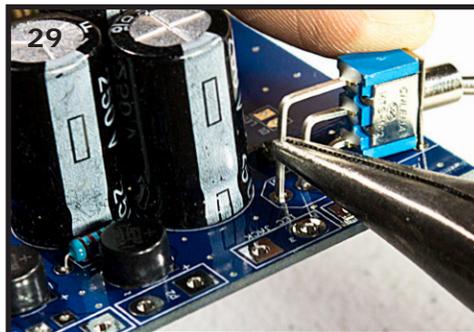
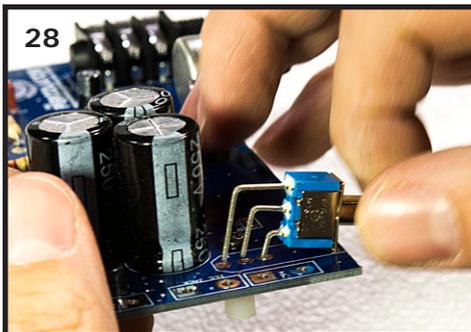
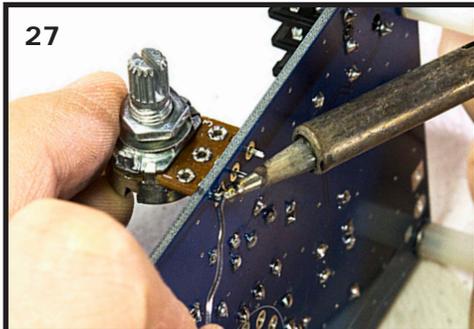
- a. Install both BR1 and BR2 with this orientation. Solder and clip the leads.
- b. Before moving on, double check the orientation of the bridge rectifiers. Make sure the "+" and "-" printed on the component are in the same orientation as the "+" and "-" on the circuit board.²⁴



7. Input jack (Part # J1): Remove the plastic nut from the input jack and put it aside until the next section. Snap the input jack into its holes on the circuit board.²⁵ Make sure you solder the leads well.²⁶ The leads are too short to cut on this component so don't bother.



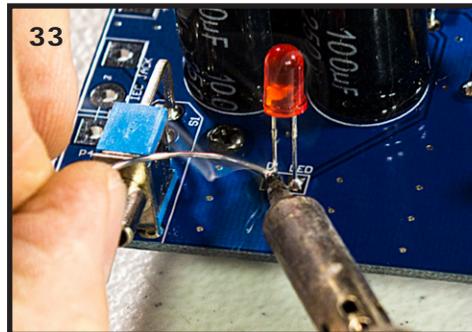
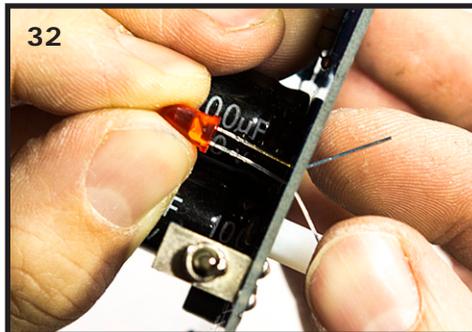
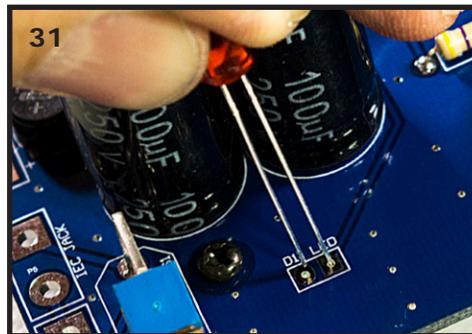
8. Potentiometer (Part # VR1): Remove the nut and washer from the shaft of the pot and put them aside until the next section. Install the potentiometer ("pot" for short) with the shaft facing away from the board. The leads are too short to bend out, so you just have to hold the pot while you solder at least one lead.²⁷ It is very important to make sure all the leads are completely seated in their holes before soldering, otherwise the board won't fit into the chassis properly. The leads are too short to cut on this component too.



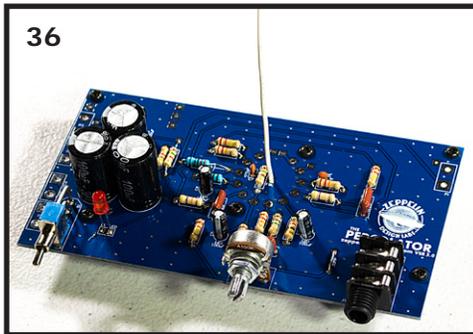
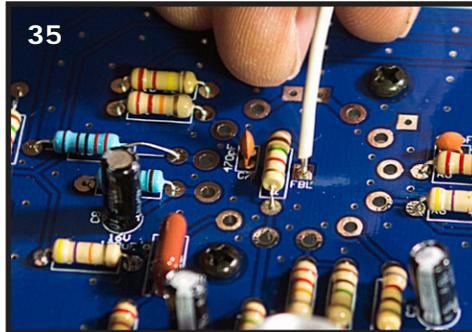
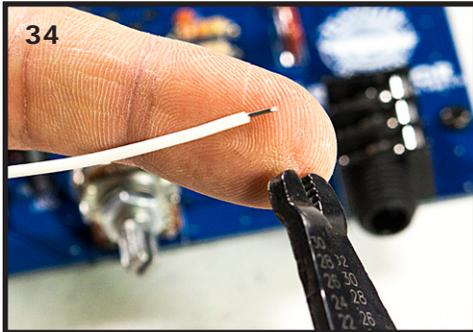
9. Power switch (Part # S1): Carefully install the power switch on the PCB.²⁸ If all the leads don't line up right away, very gently guide them into the holes with your needle-nose pliers.²⁹ When you solder the switch, it is very important to make sure all the leads are making good connections with the board because this component is switching high voltage. The front two pins just act as anchors for the switch and are connected to the large piece of metal on the front of the component. Extra heat may be needed to secure these pins properly because the large piece of metal tends to act as a heat sink.

Once you have soldered all the leads, check the rigidity of the solder joints by flipping the switch several times. Make sure it feels secure.

10. LED (Part # D1): The LED (light emitting diode) is a polarized component, meaning that it matters which way it goes into the holes. Following the standard of all the polarized components on this board, the long lead goes into the square hole.^{30, 31} If you do not install the LED in the correct orientation the "on light" will not work. Install the LED in the holes so that the top of the LED stands about 7/8" (23mm) off the surface of the board.³² Solder the LED on the component side of the board (it will be easier to switch later if you get it backwards).³³ Clip the leads on the solder side of the board.

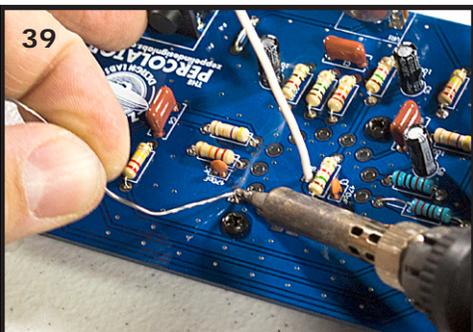
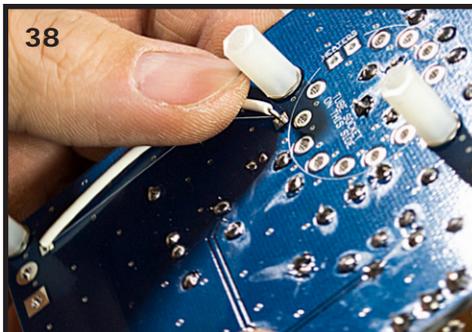
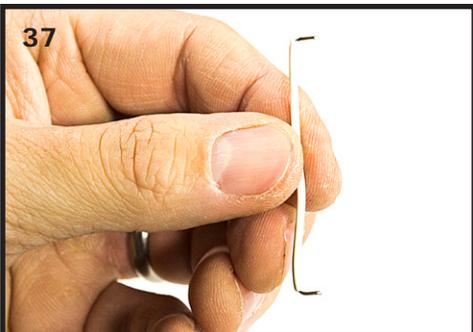


11. Feedback loop wire: Cut a 4-1/8" (10.5cm) length from the hookup wire (Part # CB-01-29) and strip about 1/4" (6mm) of insulation from each end.³⁴ Solder one end of this wire to the FBL hole so the wire is emerging from the component side of the board.^{35, 36} The other end of the wire will be attached in the next section.

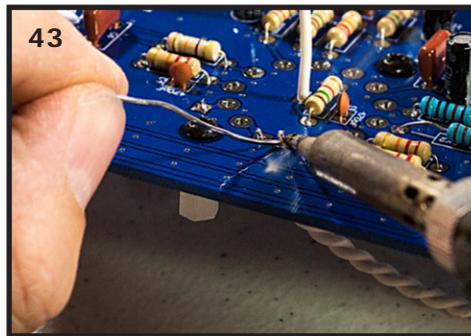
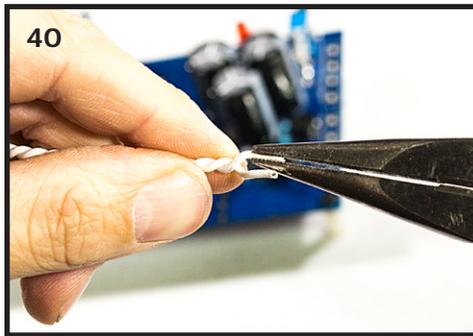


12. 6cm Hookup wire: Cut a 2-3/8" (6cm) length from the hookup wire (Part # CB-01-29) and strip about 1/4" (6mm) of insulation from each end. With your pliers bend both ends at a right angle.³⁷ This wire goes on the solder side of the board, so flip the board over and install the wire where it goes (note the picture³⁸). Solder it on the component side of the board.³⁹

Now bend the wire along the surface of the board to make it follow the line printed on the board.



13. 10.5cm Twisted pair hookup wire (Part # CB-01-28): This wire is used to transmit the 6.3V heating filament voltage to the tube. Untwist about 1/4" (6-7mm) of each end of the twisted pair and straighten the ends out with your pliers.⁴⁰ Strip off about 1/8" (3-4mm) insulation from each end of the two wires.⁴¹ On the solder side of the board, install the four stripped ends in the holes marked "HEATERS".⁴² It doesn't matter which wire goes into which of the two holes. Solder each of the four ends on the component side of the board.^{43, 44}

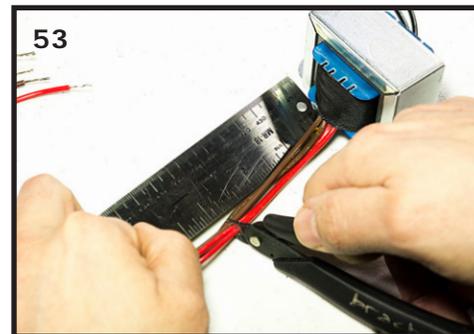
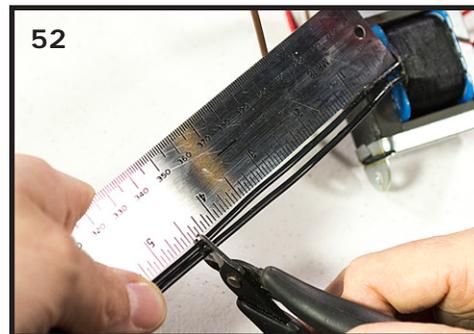
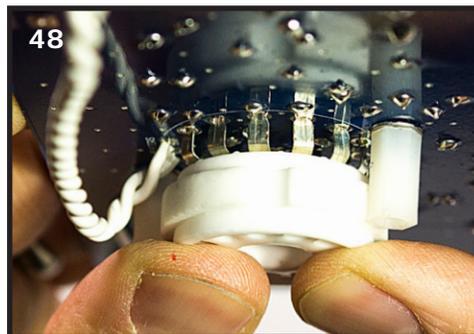
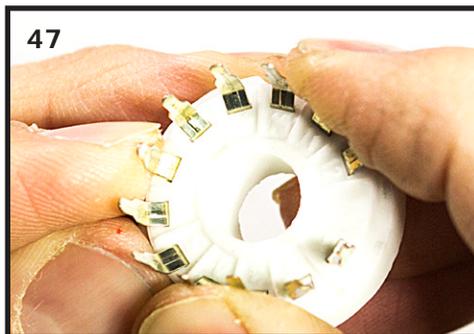


14. Tube socket (Part # HD-70-42):

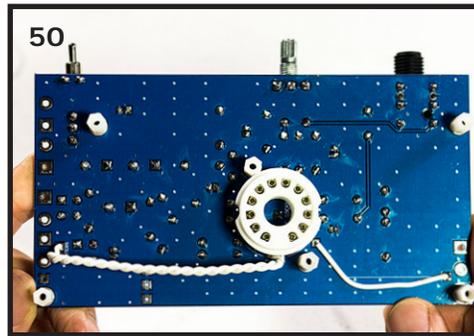
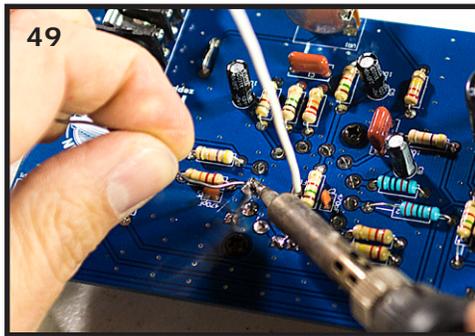
- a. Before installing the tube socket, we need to help prepare it to easily seat the tube. These sockets come a little tight from the factory, so it is helpful to loosen up the place where the tube pins fit in.⁴⁵ Very gently use your awl to slightly widen each of the 12 pin sockets.⁴⁶



- b. The tube socket is installed on the solder side of the board. The leads may need to be pressed in slightly for it to fit in the holes.⁴⁷ Make sure all the leads are seated firmly and that the socket is pushed in as close to the board as possible.⁴⁸ Double check to make sure that the top of the socket is parallel to the surface of the board.



c. Solder the leads of tube socket on the component side of the board.^{49, 50}



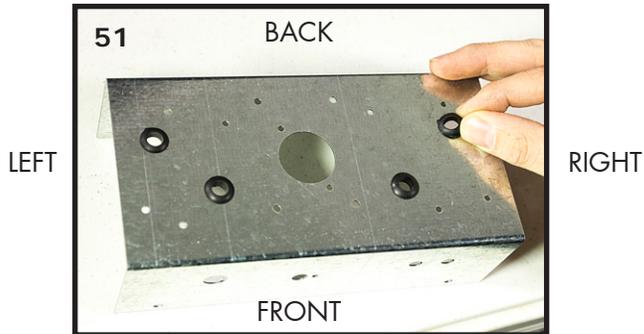
The circuit board is now complete!

Double check all your solder joints and make sure everything is well soldered and making good connections. If anything looks at all sketchy, touch-up each solder joint. It's much easier to fix a problem with the board now than once it is installed in the chassis. Once you are satisfied with the PCB, put it aside in a safe spot until the next section when it is installed in the chassis.

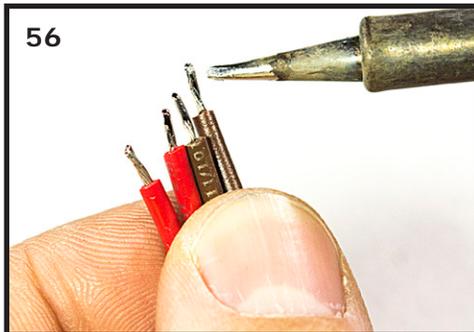
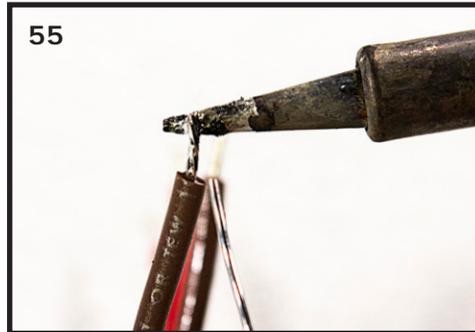
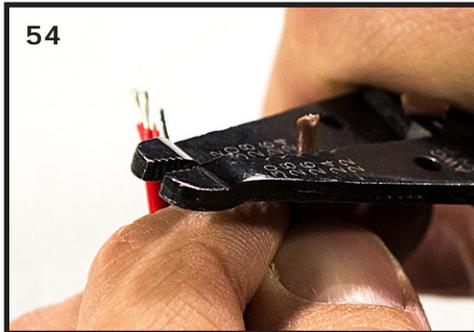
LOADING THE CHASSIS

Note the chassis face with the big square hole is the BACK of the amp! Generally, hold the chassis with the back AWAY from you unless told otherwise! This will help avoid building the thing backwards.

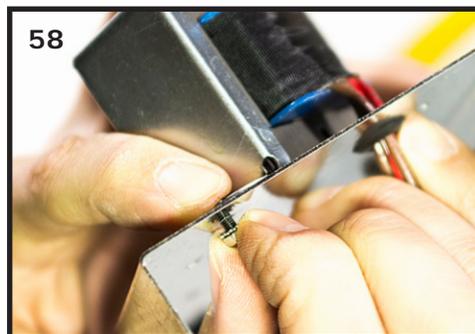
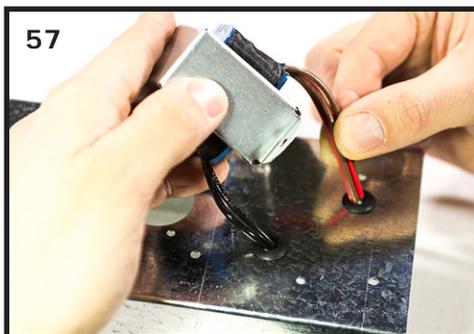
1. Grommets: Pop the 4 rubber grommets (Part # HD-20-02) into the holes on top of the chassis as shown.⁵¹



2. Power Transformer (Part # T1):
 - a. Cut the black wires coming from the power transformer to 4-5/16" (11cm).⁵² Put the black wires that you just cut aside because you will use them later. Cut the brown and red wires to 2-3/4" (7cm).⁵³ Strip off about 3/16" (4-5mm) of insulation from each of the 6 wires.⁵⁴ Twist together the tiny strands of wire on each of the stripped ends. Then "tin" the stripped part of each wire.^{55, 56} "Tinning" is the process of coating or filling a wire or connector contact with solder to make it easier to attach. It also helps to keep the tiny strands of wire from fraying out while you try to solder them. When you tin the transformer wires, make sure you do not use too much solder; otherwise the wire will be too thick to fit into the PCB holes later.



- b. The power transformer goes on the RIGHT side of the chassis (with the back of the chassis AWAY from you). Pass the red and brown wires through the rear-right grommet, and the black wires through the front-right grommet.⁵⁷ Align the transformer mounting holes with the holes in the chassis. Notice there are two holes to choose from near the front-right corner. If you ordered the 115VAC model, use the hole that is furthest in from the corner. If you ordered the 220VAC model, use the hole closest to the corner. Use two M3x6 machine screws (Part # FA-60-37) and two M3 keps lock nuts (Part # FA-22-21) to mount the transformer.⁵⁸ Screw down tight.⁵⁹

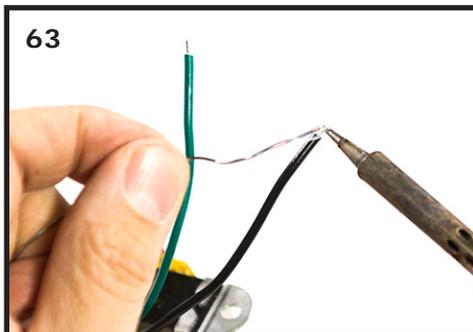
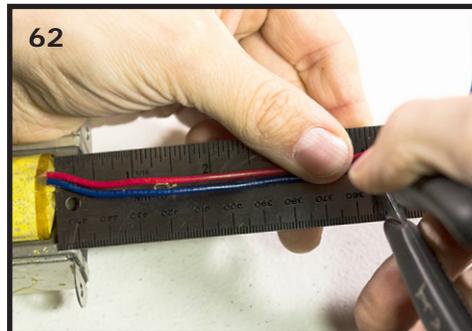
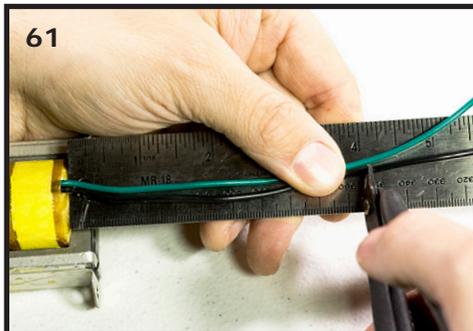


- c. Now you need to twist the wires. Twist the black wires together somewhat tightly, but do not over twist the wires near where they emerge from the transformer. You do not want to stress the wires near the transformer coil, because they can easily break on the inside of the transformer, and that would be very bad. Also twist the red wires together and the brown wires together in the same way (not too tight near the coil).⁶⁰

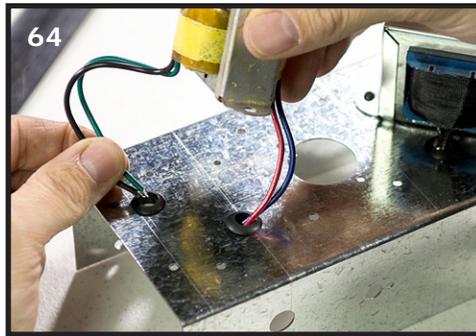


3. Output Transformer (Part # T2):

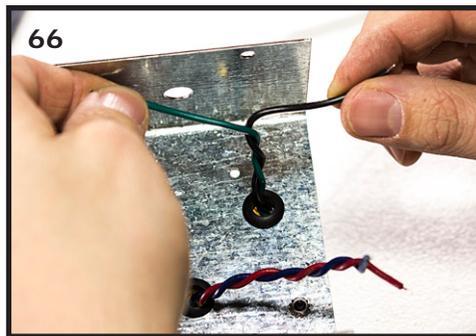
- a. Cut all of the wires coming from the output transformer to 4" (10cm).^{61, 62} Strip off about 3/16" (4-5mm) of insulation from each of the four wires. Twist together the tiny strands of wire on each of the stripped ends and tin the stripped part of each wire.⁶³ Don't make the tinned wire too fat.



- b. The output transformer goes on the LEFT side of the chassis. Pass the green and black wires through the left-rear grommet, and the blue and red wires through the front-left grommet.⁶⁴ Screw the transformer down to the chassis, just like the power transformer, with two M3x6 machine screws (Part # FA-60-37) and two M3 keps lock nuts (Part # FA-22-21).⁶⁵



- c. Twist the green and black wires together, and twist the red and blue wires together, in the same way as the power transformer wires.⁶⁶ Once again, be mindful not to over twist the wires close to the coil.



4. Fins (Part # CH-10-25) (2 pcs): These flank the tube socket and shield the tube from the magnetic fields from the transformers. Place them as shown, careful that they face the right way. If you put them in backwards, the tube won't fit later. If the fins look like the letter L, then the base of the L points towards the tube opening. Use four # 6x3/8" sheet metal screws (Part # FA-63-33) to attach the fins.⁶⁷ DO NOT OVER-TIGHTEN THESE SCREWS! Just drive them in snug. If you over-tighten, they will strip out the chassis.

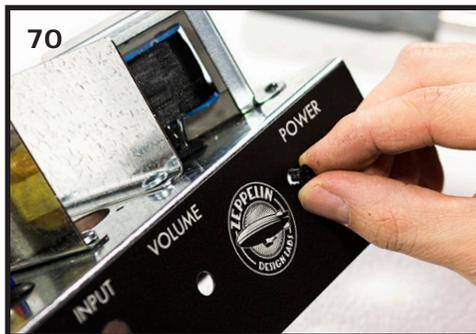


5. Label (Part # PL-10-03): Clean the front of the chassis with a clean rag moistened with isopropyl alcohol, denatured alcohol, or rubbing alcohol.⁶⁸ Clean it thoroughly, and allow any liquid to dry completely. Be careful NOT TO TOUCH the face AT ALL after cleaning. The oil on your fingertips will leave prints that will interfere with the bond of the label. Test fit the label, then peel off the back and carefully set it in place.⁶⁹ GET IT RIGHT THE FIRST TIME! YOU WILL NOT BE ABLE TO RE-POSITION THIS LABEL! Line up the bottom edge of the label with the bottom edge of the chassis; then align some of the chassis holes, drop it in place, and rub it down firmly over the entire surface.

TIP: If the label is slightly misaligned over one of the edges or holes use a razor blade or xacto knife to trim off the excess.

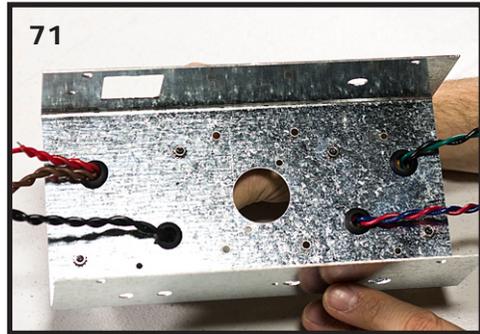


6. LED bezel (Part # HD-70-35): Install the plastic LED bezel into its hole on the front of the chassis (through the label).⁷⁰ It goes in the hole to the right of the ZDL logo. It should easily snap into place.



7. Install the PCB (Part # PC-03-01):

- a. Flip the chassis over so the fins and transformers are resting on the table top, and the front of the chassis is facing you. Bend all the transformer wires to the outside of the chassis so that they don't get in the way of the placement of the PCB.⁷¹



- b. Carefully place the circuit board in the chassis with the standoffs down (the standoffs resting on the top of the chassis) and the component side of the board up. The input jack side of the board should be closest to you. Slide the PCB forward as the input jack, pot, and switch fit through the holes on the front of the chassis and the tube socket is seated in its chassis hole.⁷² You may have to hold the board at an angle while sliding it forward to get everything to fit properly. Make sure all the transformer wires are between the front and back standoffs. The standoffs should line up with the screw holes on top of the chassis.



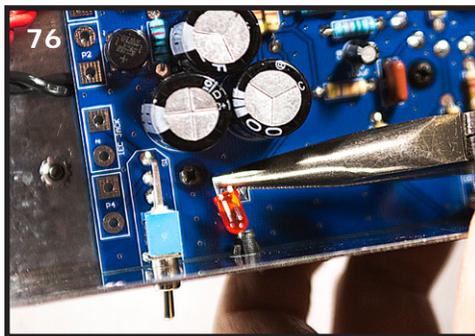
- c. Affix the PCB to the chassis with six machine screws (Part # FA-60-37) placed through the chassis holes into the standoffs.⁷³ Don't over tighten or cross-thread these screws.



- d. Place the washer and nut back on the pot, and snug down with your pliers.⁷⁴ Place the plastic nut back on the input jack,⁷⁵ and snug it down with your pliers. Do not over-tighten this nut or the label could start warping.



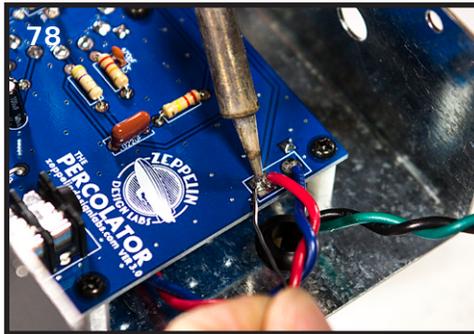
- e. Use your needle nose pliers to bend the LED over to fit inside of the LED bezel on the front of the chassis.⁷⁶ Be sure not to twist the LED or the leads might touch and short out against each other. Push the LED through the bezel until it snaps into place.



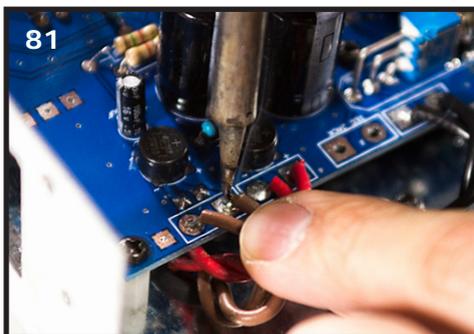
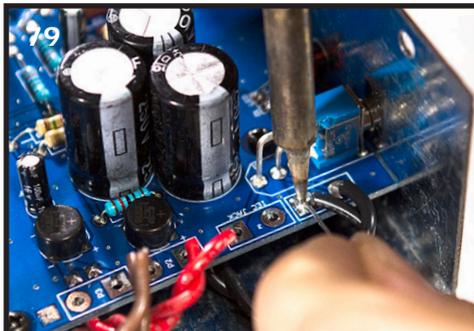
8. Knob (Part # HD-32-03): Turn the pot all the way counter clockwise. Place the knob on the pot and align the white line on the knob to the position where you want the volume to be off (usually between 1:00 & 2:00, when the amp is upside down). Use a small flat screwdriver to tighten the set screw until the knob is tight.⁷⁷ Now turn the knob all the way right and left through its travel. The line should be between 10:00 & 11:00 at the maximum clockwise position. The goal in setting the knob is to make the 6:00 position of the knob (when the amp is upside down) be the half way point of the pot turn, in other words, the turning distance either side of middle should be equal. If it's not right, loosen the screw, adjust the knob, and re-tighten. It may take a few times of re-adjustment to get the knob/pot position where you want it.



9. Wiring the PCB: Once the PCB is affixed to the chassis you can attach the transformer wires. All of the wires will pass around the side of the PCB, and you will solder them on the component side of the board.
- a. Output transformer: Place the red wire into the square hole of P1, and then the blue wire to the round hole of P1. Solder both connections.⁷⁸

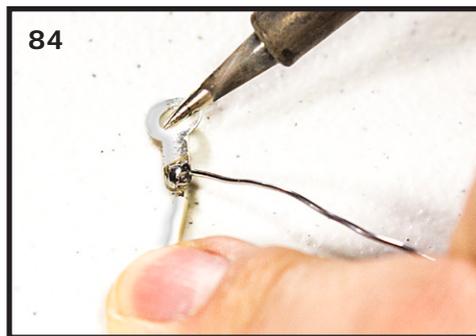
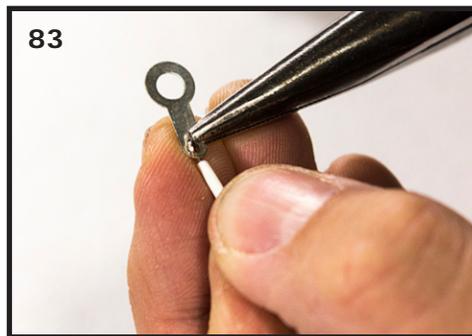
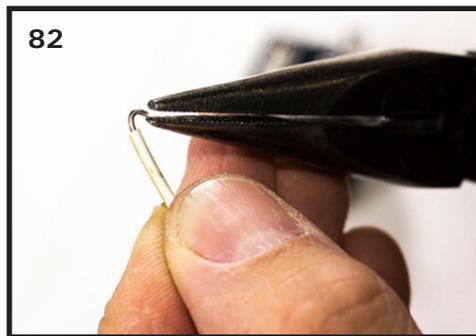


- b. Power transformer: Place the black wires into the holes of P4; it doesn't matter which wire goes in which hole.⁷⁹ Place the red wires into the holes of P2⁸⁰, and then place the brown wires into the holes of P3.⁸¹ In each pair, it does not matter which wire goes in which hole, but **MAKE SURE YOU MATCH THE COLOR TO THE CORRECT NUMBER!** Solder all the wires in their respective holes.



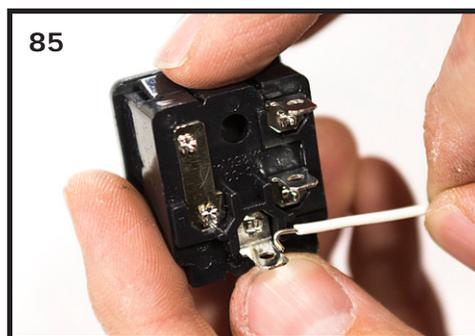
10. Grounding Wire: Cut off a 1.5" (4cm) length from the hookup wire (Part # CB-01-29) and strip about 1/4" (6mm) of insulation off both ends. Using your needle nose pliers, bend a small hook in one stripped end of the wire.⁸² Thread the hook through the small hole on the grounding lug (Part # HD-50-01) and crimp it tight with your pliers.⁸³ Solder that connection.⁸⁴

Put this assembly aside until next step.

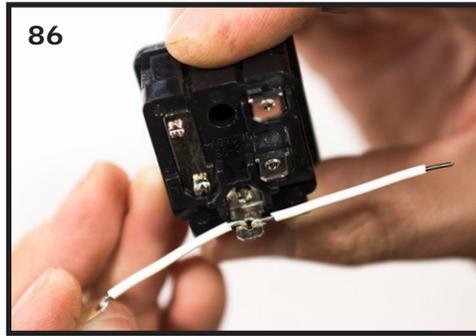


11. IEC Power Receptacle (Part # J3):

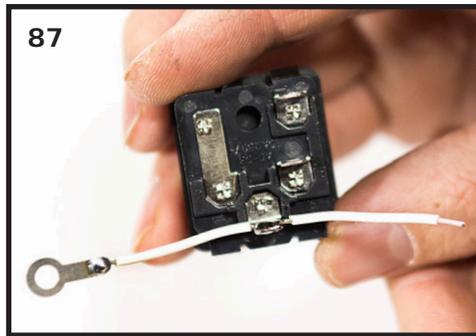
- a. Cut off another 1.5" (4cm) length from the hookup wire (Part # CB-01-29) and strip about 1/4" (6mm) of insulation off the ends.⁸⁵ Attach the wire to the power receptacle lug as shown, with the wire pointing to the left away from the power receptacle (study the picture carefully). Use the same hook and crimp technique that you used in the previous step, but don't solder it yet. **MAKE SURE YOU ATTACH THE WIRE TO THE CORRECT POWER RECEPTACLE LUG.**



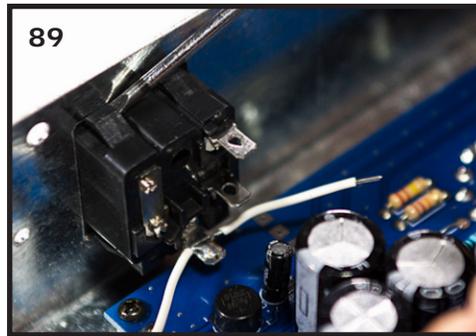
- b. Now attach the other 4cm wire (the end opposite the ground lug) to the same power receptacle lug. Attach it so the ground lug is pointing to the right, away from the power receptacle (study the picture carefully).⁸⁶



- c. Now solder the wires to the lug. Be careful not to use too much heat or the lug could start melting out of the plastic.⁸⁷



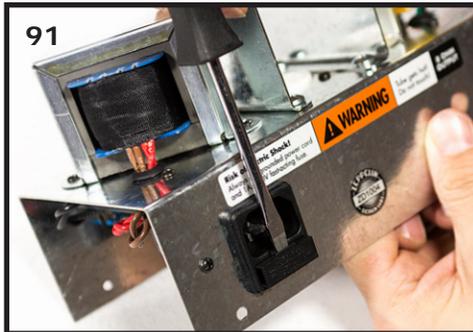
- d. Bend both wires slightly forward and push the power receptacle through the chassis. **BE SURE TO INSTALL IT WITH THE CORRECT SIDE UP** (look at the picture).⁸⁸ It may be a tight fit; it could take some wrenching to get it to seat. Once it is seated properly, you can very gently bend the four retaining tabs of the power receptacle up if you want to ensure a tighter fit.⁸⁹



- e. Place the wire coming from the right side of the power receptacle (the wire without the ground lug on it) in one of the 3 square ground pads on the PCB next to the power receptacle. Solder this wire in place on the component side of the board.⁹⁰



- f. Use your flat screwdriver to pry the fuse holder from the power receptacle.⁹¹ Place the fuse (Part # F1) in the holder⁹² and slide it back into the power receptacle.⁹³



12. Grounding Wire Revisited: Use a M3x6 machine screw (Part # FA-60-37) and one M3 Lock Nut, (Part # FA-22-21) to attach the grounding lug to the back of the chassis as shown.⁹⁴ Screw it down tight!



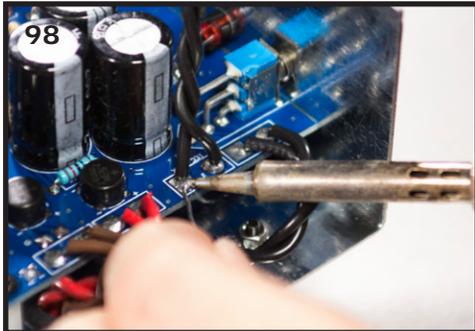
13. Wiring the IEC power receptacle:

WARNING: If you make a mistake here, you could expose yourself or others to electric shock. Double check all your connections.

- a. Retrieve the lengths of wire that you cut off the power transformer earlier. Cut each of the two black wires to 4-1/4" (10.5cm) long.⁹⁵ Strip about 3/16" (4-5mm) of insulation from each end of both wires.⁹⁶ Tin each end (don't use too much solder).



-
- b. Now twist the two wires together, to within about 3/8" of each end.⁹⁷ Solder one end of the pair to the holes labeled P5, IEC jack.⁹⁸

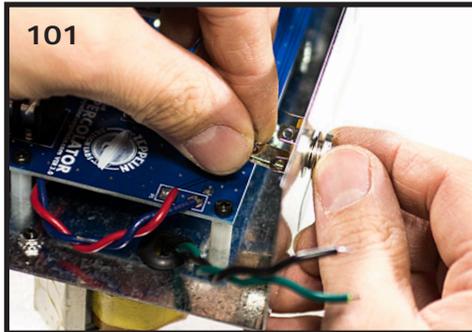


-
-
- c. Solder the end of the wires to the IEC power receptacle, to the two lugs shown in the picture.⁹⁹ It doesn't matter which wire goes to which lug, JUST MAKE SURE YOU SOLDER THEM TO THE CORRECT TWO LUGS! Mind the picture.¹⁰⁰

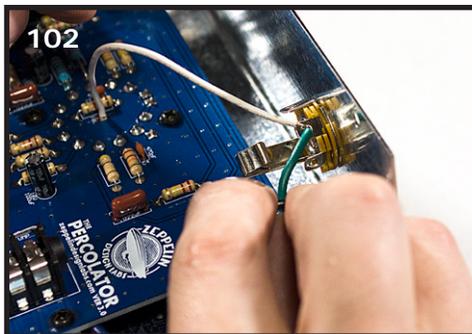


14. Output jack (Part # J2):

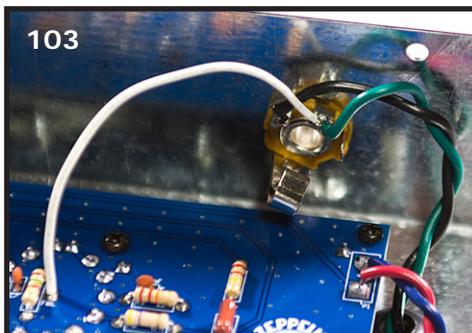
- a. Remove the nut and washer from the output jack and install it on the back of the chassis.¹⁰¹ Orient the jack so the lugs are facing up, as in the picture. The washer goes on the outside of the jack, between the nut and the chassis.



- b. With your needle nose pliers make a small hook in the stripped section of the feedback loop wire (the long wire attached to the middle of the circuit board, in the FBL hole). Hook the FBL wire on the "tip" lug of the output jack (note the picture below¹⁰², if you are not sure which is the correct lug).
- c. Next attach the green wire from the output transformer to the same lug (the "tip" lug) as the FBL wire.¹⁰² Solder both wires to the lug.



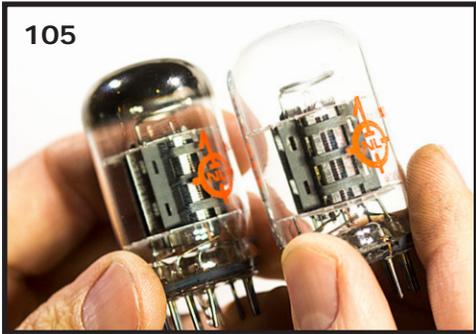
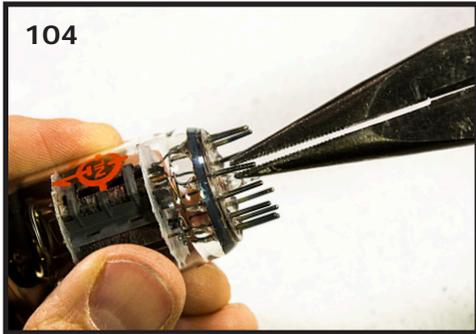
- d. Next, attach the black wire from the output transformer to the ground lug (note the picture if you are not sure which lug is the ground).¹⁰³ Solder the black wire to the lug.



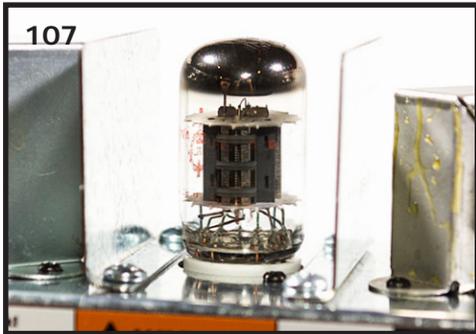
15. Tube (Part # V1):

- a. Take the tube out of its box and closely look at the pins. Sometimes a few of the pins get bent in the handling or shipping process from the factory. If any of the pins are bent, very gently use your needle nose pliers to straighten them out.¹⁰⁴ Do this step very carefully and do not put too much torque on the pin at the point where it comes out of the glass. If you do, the glass could easily crack and allow the vacuum in the tube to be compromised, which would mean we'd have to sell you a new tube.

TIP: You can tell if the vacuum is bad in your tube because the "getter flash" (the shiny metallic section on the inside of the glass) will turn white or clear.¹⁰⁵



- b. Now flip the amp right-side-up again and install the tube in its socket. It can only go in one way. Line up the pins and then gently rock the tube,¹⁰⁶ pressing gently but firmly down on the top, until it is completely seated in the socket.¹⁰⁷ If it has a hard time fitting into the socket make sure all the tube pins line up with the socket pins properly. If you still have trouble, you might need to use your awl again to loosen the tube socket pins.

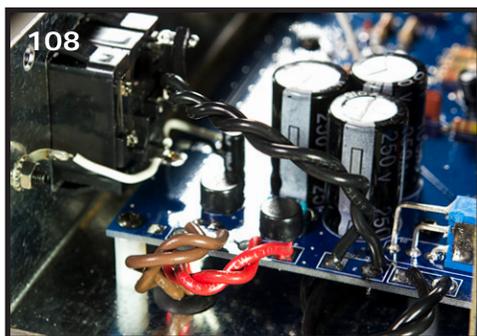


TESTING THE AMP

The testing process is done with the Percolator upside down. The transformers and fins should be resting on the bench top. Make sure none of the weight of the amp is resting on the glass bottle of the tube. If it is, put some blocks of wood under the transformers to jack the amp up a little bit.

A schematic of the amplifier is printed on the template sheet that came with the kit. This schematic is for reference in troubleshooting, should you have problems with the amp. DC test voltages are labeled in red on "Figure 3: Voltage Reference" on page 41. The test procedure will consist of systematically measuring these voltages to ensure that your amp is within spec. Print this diagram and write your measurements directly on it. You don't have to know how to read a schematic to test these voltages, but you do need to know how to use your digital multimeter.

1. WITH THE AMP UNPLUGGED, double check all your wiring. Look closely at the pictures and make sure the wires on your amp are correctly positioned.^{108,109}

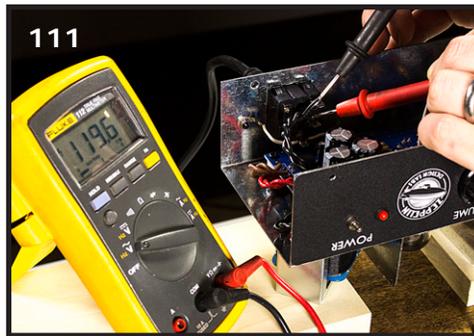


2. WITH THE AMP UNPLUGGED from the wall, double check your solder joints. Closely examine every joint on the PCB and make sure they are good, solid connections.
3. Using a 1/4" speaker cable, plug the Percolator's output jack into an 8 ohm speaker cabinet. ONLY USE AN 8 OHM CABINET WITH THIS AMPLIFIER. WHENEVER YOU APPLY POWER TO THIS AMP, MAKE SURE IT IS FIRST PLUGGED IN TO AN 8 OHM LOAD. You can make the speaker cable provided (page 69) and attach it to the speaker (page 82) and plug this into the amp.
4. Make sure the Percolator's power switch is in the off position (when the amp is upside down, the switch should be up).¹¹⁰ Plug the IEC power cable into the IEC power receptacle on the amp. Make sure NOTHING is touching any part of the amplifier that shouldn't be, and then plug the power cable into the wall outlet.



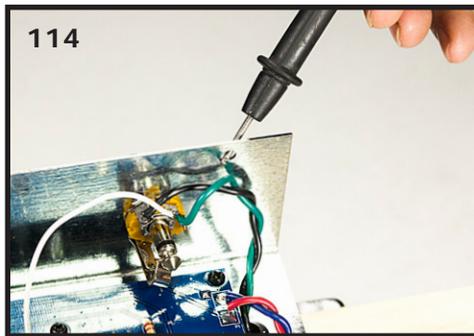
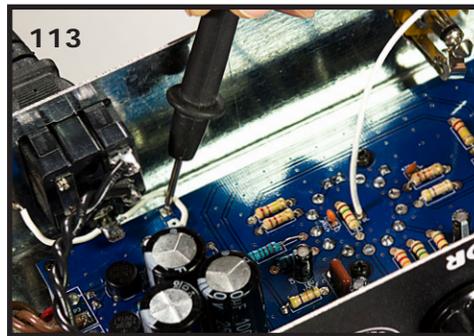
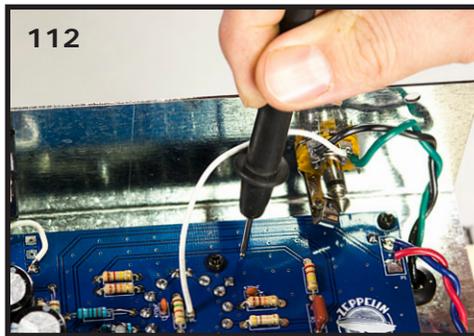
WARNING! As soon as you plug in the Percolator, there is LINE VOLTAGE across some parts of the exposed circuit board. Touching the board could shock, injure, or kill you! NEVER TOUCH ANY PART OF THE CIRCUIT BOARD WHEN THE AMP IS PLUGGED INTO THE WALL!

Before you turn the power switch on, set your multimeter to test AC voltage. Measure the AC voltage across the IEC power receptacle as shown.¹¹¹ Depending on several (mostly uncontrollable) factors, you should measure between 115VAC and 120VAC (or between 220VAC and 240VAC if you got the international power transformer). The amplifier was designed to use 118VAC from the wall outlet (230VAC for the international transformer), so the voltages listed in the test procedure are based on that. If your AC voltage reading is different than 118VAC (or 230VAC), then the voltage readings in the next few steps will be off proportionally. Theoretically, if the input voltage from the wall outlet is off by a certain percentage then all of the rest of the voltages in the amp will be off by the same percentage. The tolerances of the tube and the rest of the components can easily vary by 5%, so that could cause a bit of voltage fluctuation as well.



5. Set your digital multimeter to read DC voltage. In this amp, all DC voltages are measured with respect to ground, so the black probe of your multimeter should be held at ground potential. This amp has several places at ground potential that are good to put your black probe. Any of the vias (the tiny holes throughout the PCB) should work.¹¹² Any one of the 3 square pads on the PCB under the IEC power receptacle will work.¹¹³ You could also use any place on the chassis, assuming the ground lug is making good contact with the chassis.¹¹⁴ Keep the black probe on any of those places while making DC voltage measurements.

TIP: Use a test lead (a wire with small alligator clips on both ends) to clip the negative (black) lead of your multimeter to the grounded chassis. That will free up one hand.



6. Turn on the power switch.

WARNING! As soon as you turn on the Perculator, there is HIGH VOLTAGE across several parts of the exposed circuit board. Touching the board could shock, injure or kill you! NEVER TOUCH ANY PART OF THE CIRCUIT BOARD WHEN THE AMP IS PLUGGED INTO THE WALL!

The red LED should immediately turn on¹¹⁵ (if it does, skip to the next step). If it doesn't, then measure the junction of C12 and R17 (TP2 in "Figure 3: Voltage Reference" on page 41). It should read around 6.5VDC. If it does, it means you either installed the LED backwards, or you installed the wrong resistor in R17. Switch off the amp, unplug the power cable and fix the problem. If TP2 does not read around 6.5VDC (by a large percentage) double check C12 and/or BR2 to make sure they are in the proper orientation.

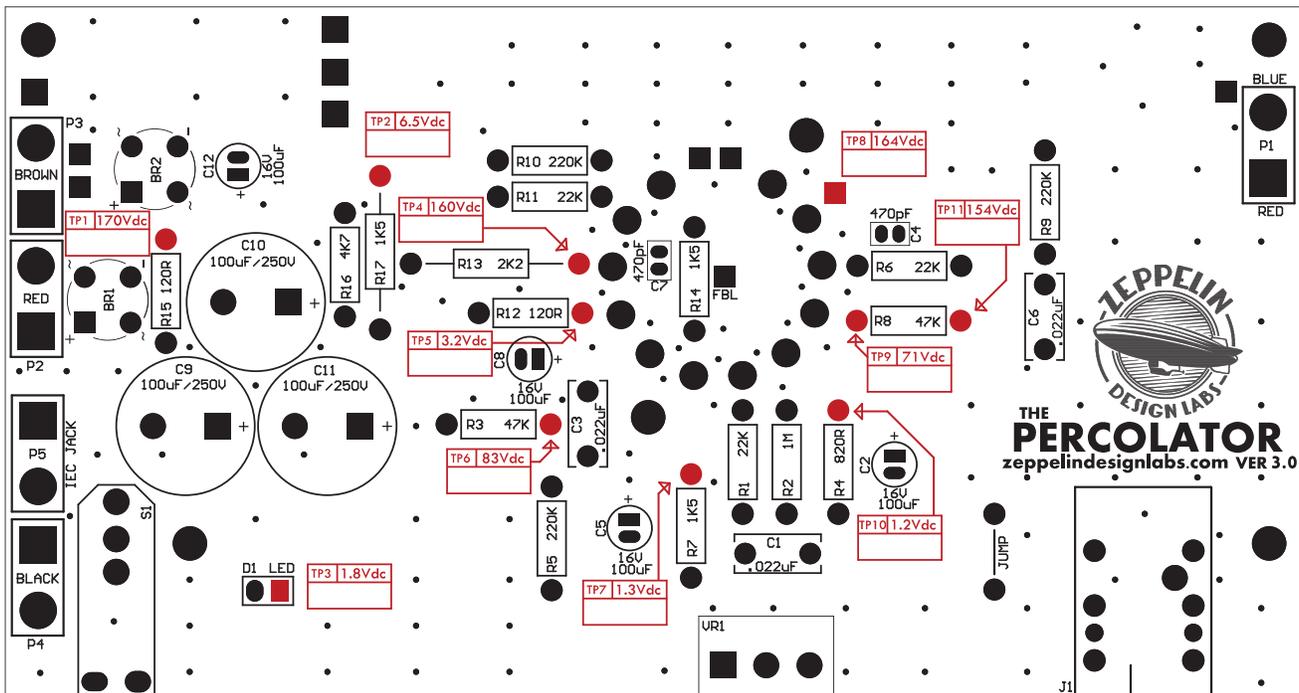


WARNING: Capacitors contain high-voltage electricity hours after the amp is unplugged! Handling the capacitor could shock or burn you! If you must remove or re-solder a capacitor, either let it sit unplugged overnight, or safely discharge it as described in the tip below.

- Figure 3 has 11 DC test voltages (in red) with arrows pointing to the place on the circuit board where these voltages should be found. The points are numbered TP1 through TP11 ("TP" stands for "test point"). In the figure next to each voltage is a box for you to write down the voltage that you actually measure. Remember, you are measuring from ground (with the black probe) to the red point (with the red probe).¹¹⁶ Start on the left side of the board and work your way from point to point, writing down each voltage as you measure it. All the voltages should be fairly close to the printed value, but if the line voltage (from the wall outlet) is above or below 118 VAC (230VAC for the international version), then these voltages will be off by the same percentage. If any of these voltages are significantly off beyond this line voltage percentage, then it is very likely that one or more of the components are installed in the wrong place. Triple check the resistors, capacitors, and bridge rectifiers by visually inspecting each one. If they are all correct, then triple check each solder joint. If you make any changes, use your multimeter to re-test the voltages that were incorrect. If you have to get to the solder side of the board, you'll have to unsolder all the transformer wires from the board, and remove the IEC receptacle, as well as unscrew the front panel components and stand off screws from the chassis.

TIP: To safely discharge a capacitor: Get a 1k-10k ohm, 2w resistor and solder or clip test leads to the resistor legs. Clip one of the leads to the chassis, and clip the other lead to the positive side of the high-voltage cap. The cap will discharge in a few seconds.

Figure 3: Voltage Reference





TIP: If it turns out that you need to re-solder any of the resistors, don't bother removing the board from the chassis to get to the solder side, just solder them on the component side of the board.

8. Once the voltages are all within spec, carefully plug your guitar (or harp mic) into the input jack, taking care not to touch the exposed circuit board. Make some noise.¹¹⁷ Turn up the volume. It should sound great!

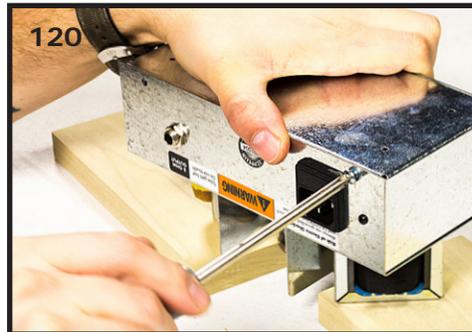


ASSEMBLING THE CHASSIS

1. Turn the power switch off. Unplug any cables that are plugged in to the amp (power, speaker, instrument). Carefully seat the chassis base plate (Part # CH-10-21) onto the inverted chassis.¹¹⁸ It is a snug fit.



2. Use four sheet metal screws, pan head Philips #6x3/8 (Part # FA-63-33), two in front¹¹⁹, two in back¹²⁰, to secure the chassis to the base plate. Use a #2 Philips screw driver (not a screw gun) and turn just until seated. DO NOT OVERTIGHTEN or you could warp the label, or even worse, strip out the screw hole.



That's it!

The electronics part of your amp is done. Good job.

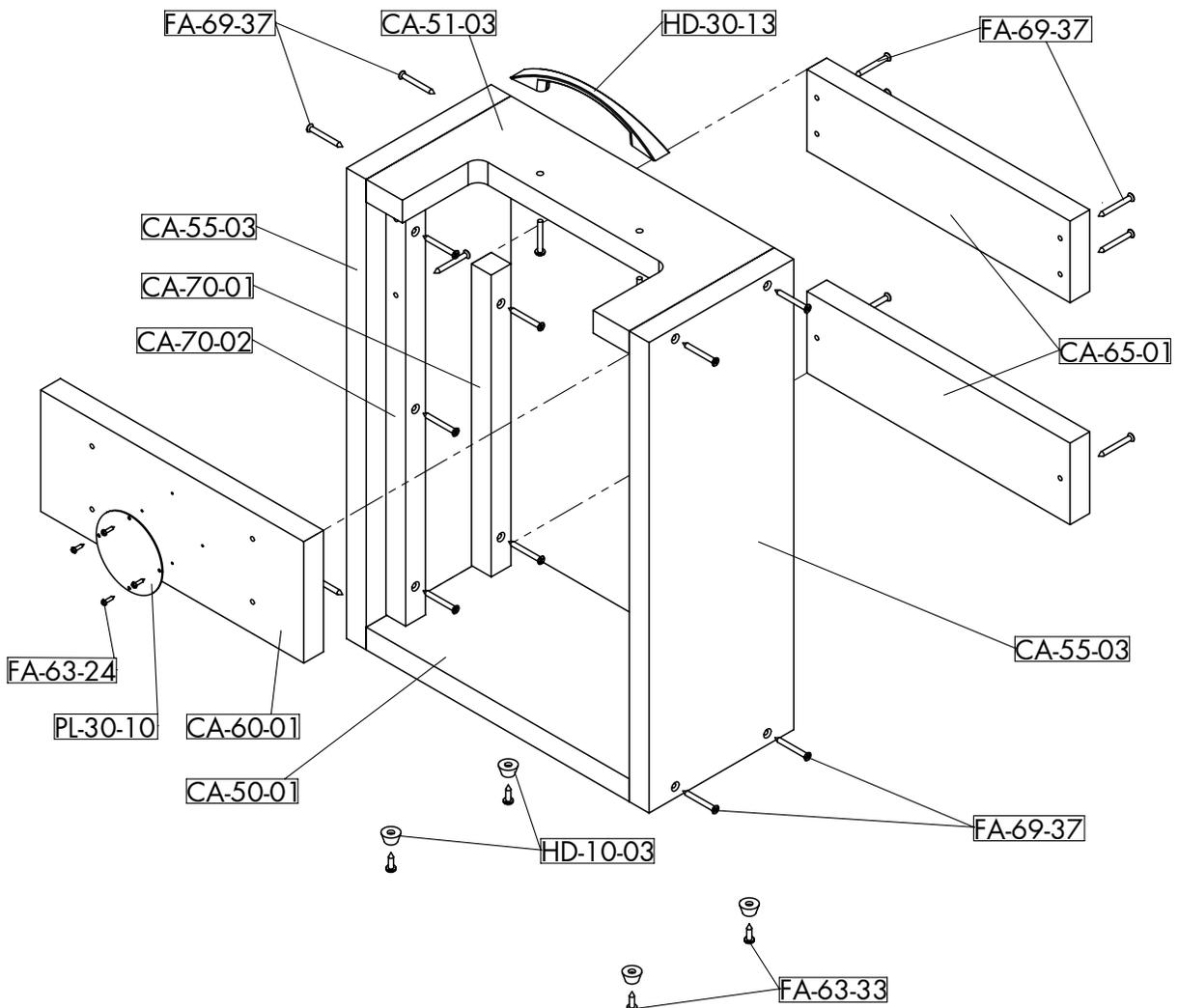
BUILDING THE CABINET

Building the cabinet isn't much trickier than building the amp, but does involve a different skill set. While the amp can be built in an hour or two, it takes several hours over several days to complete the cabinet! Take your time, be careful, and you should produce a lovely solid wood cabinet to be proud of.

We are going to show you how we make the pre-finished Percolator Combo here in our lab. There are as many carpentry and finishing techniques as there are carpenters and finishers. If you prefer to do something differently, go for it. If you have an experienced friend to work on this with you, take his or her advice over ours.

Following is a parts diagram of the cabinet. The part numbers are keyed to Table 1: Combo Bill Of Materials on page 6

. Figure 4: Combo Cabinet Exploded Parts Diagram



A WORD ON COUNTERSINKS

The overall success of this project depends somewhat on your ability to accurately countersink the wood screws, so that the heads lie just below the surface of the wood, but no deeper. There are several ways to do this:

- buy a #6 pilot bit (9/64") with matching fluted countersink and stop collar, or an all-in-one #6 pilot / counterbore / countersink tool
- buy a countersink bit
- Use a 1/4" drill bit in a drill press



The first (shown to the left) is our favorite: very accurate and easy to use. The second, a countersink bit (shown to the right), is next best. If you don't do a lot of wood working, you may not want to invest in these tools. This leaves using a 1/4" drill bit in a press. To do this, first drill through with the 9/64" bit, then countersink with the 1/4" bit, carefully and gradually adjusting the depth of plunge until the full diameter of the bit just barely cuts into the wood. The screw should then pull the head down into the wood and just below the surrounding surface. Practice setting the depth on a scrap of pine until you like the results.

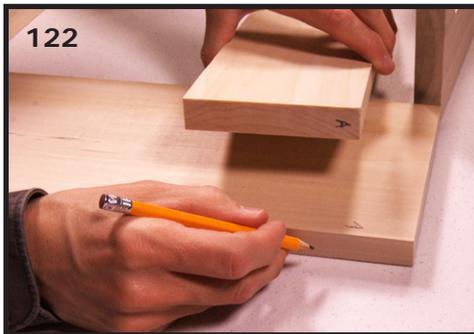
ALWAYS provide a 5/64" pilot in the holding piece of wood, and keep the clutch on your screw gun set low when driving, or the screws provided are likely to spin out or break.

ASSEMBLING THE BOX

1. Fitting the Wood Parts (Part # CA-51-03, CA-50-01, CA-55-03, CA-60-01): Arrange the five large pieces of wood as shown in Figure 4: Combo Cabinet Exploded Parts Diagram on page 44. If you have a preference for the appearance of grain, color, knots, etc, flip the parts around this way and that until you like the way they look.¹²¹ **NOTE:** The cabinet TOP is FRAGILE until glued in place! Handle with care. Should either of the "ears" break off, glue them back on.



2. With the pencil, label the parts where it won't show so you can easily fit them together again later. Put the labels all towards the front.¹²²

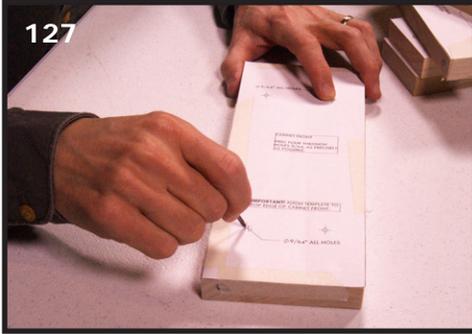


3. With scissors or blade and ruler, cut out the templates provided with your kit.¹²³ Tape the templates to the outside face of the various cabinet parts: the Top, Bottom, Front, one Side, and the Upper and Lower Ports.¹²⁴ Don't mess with the Cleats for now. In case the templates do not match the wood size PERFECTLY (it happens), there's a note on some of the templates showing which edge of the wood to line it up with. If there is no note, the alignment is not super-critical; just center the template.



4. With the awl, or a nail and small hammer, carefully poke a hole into the wood at the center of each cross hair.¹²⁵ Save the Front for last. Mark the other parts first, then remove the template from the first Side, tape it to the other Side, and mark those holes too.¹²⁶ Finally, now that you are good at it, mark the Front as accurately as you can.¹²⁷ Remove all templates and tape. Keep the templates handy for reference.¹²⁸

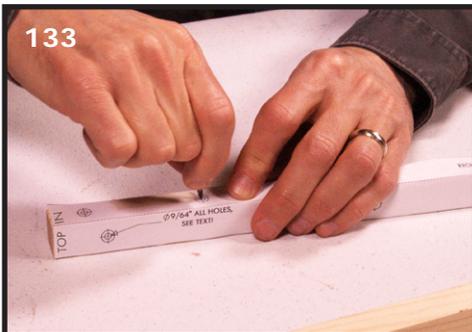
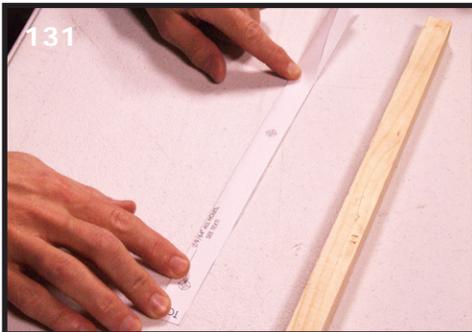




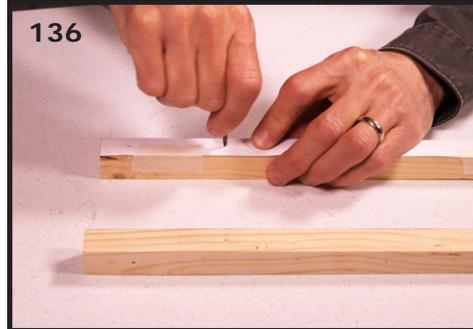
5. Rear Cleats (Part # CA-70-01): Tape the shorter template to the cleat, centering it along the length of the wood.¹²⁹ Poke two holes in one side of each Rear Cleat.¹³⁰



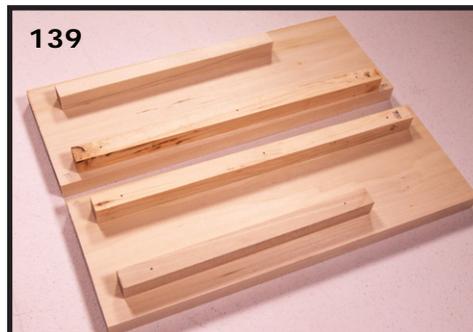
6. Front Cleats (Part # CA-70-02): Fold the longer template along its length and wrap it around one of the longer cleats.¹³¹ Tape down the template.¹³² Mark the holes on two sides.¹³³ Do you see in the photos where the template is labeled "IN" and "TOP"? Peel back the template and write those words on the wood.¹³⁴



7. Now remove the tape, fold the same template the other way,¹³⁵ wrap it around the other long cleat, and mark the five holes.¹³⁶ Peel back the template and mark "TOP" and "IN" as you did before.¹³⁷ NOTE: you are making a PAIR of Front Cleats, not two identical ones!



8. Laying out the Cleats (Part # CA-70-01, CA-70-02): Place the Sides face down on your work table, with the front edges facing each other. Lay out the four cleats, with the long Front Cleats toward the middle and the shorter Rear Cleats toward the left and right. Compare the "TOP" and "IN" labels to the photo.¹³⁸ Each long cleat should have three marks and the word "TOP" facing the ceiling; two marks and the word "IN" should be facing across over the tops of the shorter Rear Cleats.¹³⁹ Triple-check that you have the cleats oriented correctly to create a pair of mirror-image cabinet sides! Many people find this difficult to visualize, even when the parts are right there, so if you are unsure, grab the nearest person and ask him or her to check your work.



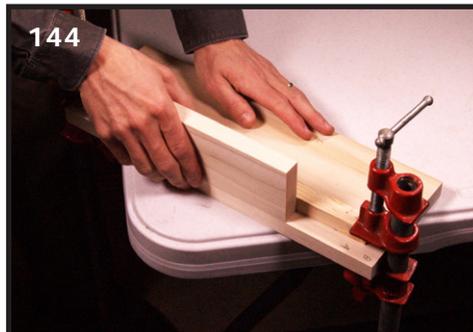
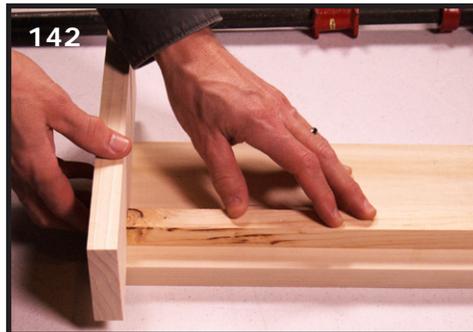
9. With the pencil, carefully label each cleat and each side, in a spot where it will not show, so you can easily put each cleat back in its correct spot.¹⁴⁰



10. Now pick one of the long Front Cleats, and use one of the Port pieces (Part # CA-65-01) on edge as a spacer to space the cleat in from the front edge,¹⁴¹ and to center it in from the top and bottom edges.^{142,143} Note the cleat is cut a little short, so check it at both ends and center it on the cabinet side. This is much easier than it sounds. Finally, check the offset from the front edge once more: it's better to place the cleat a hair too far in than too far out! Use one or both of your clamps to hold the cleat securely in place.¹⁴⁴

NOTE: Take your time on this step! The overall neatness of the front of your combo depends on placing this cleat accurately.

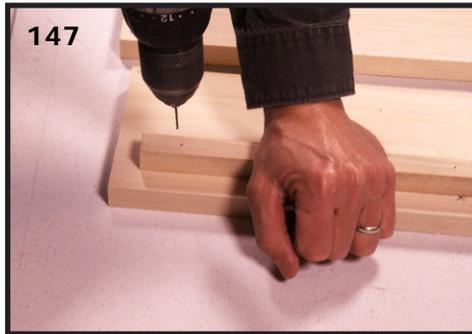
TIP: See our online video "1x8 Speaker Cabinet Assembly"(3:03) for a demonstration of how easy this is.



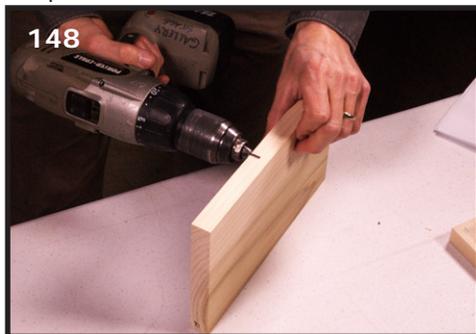
11. Grab your drill with the 5/64" bit set to stick out about 1-1/8", and drill three pilot holes at the upward-facing marks, through the Cleat and into the Side.¹⁴⁵ Remove the clamps and set this cleat aside.



12. Repeat steps 10 - 11 for the other Front Cleat.
13. The process for the two short Rear Cleats is similar, but note you use the Port piece to space them up from the bottom and in from the back edge.¹⁴⁶ Be SURE to space these cleats in a little far from the back edge! You can usually hold the rear cleats firmly in place with one hand while drilling the pilot holes with the other; clamping should not be necessary.¹⁴⁷

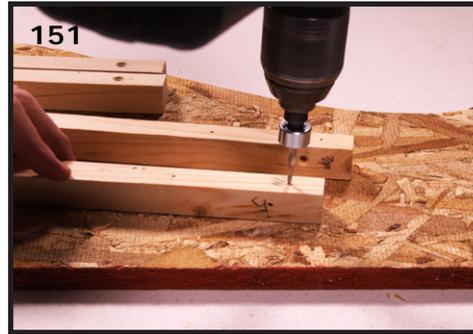
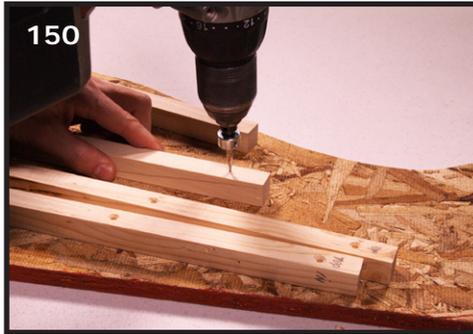


14. While you have that 5/64" bit in place, drill four blind holes in the cabinet Bottom, about 1/2" deep.^{148,149}

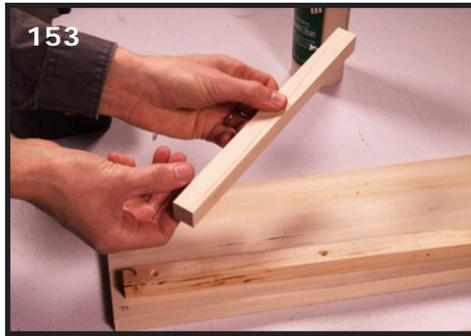


15. Now with the 9/64" bit, re-drill all the pilot holes in all the Cleats. You should find ten of them.¹⁵⁰ Further, drill through-holes at the other two marks near the "IN" labels – four more holes.¹⁵¹

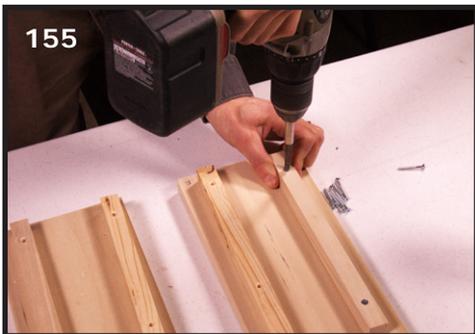
TIP: You will get cleaner holes on the inside face of the cleat if you can go straight through into a piece of plywood or block of pine.



16. Carefully drill four 9/64" through holes in the cabinet Front. These holes in the Front need to be as accurate as possible for the amp to fit nicely into the cabinet, so be sure to hold the drill perpendicular to the surface of the wood – or use a drill press. NOTE: These holes do not get countersunk.
17. Countersinks: In this build, we used a countersink with stop collar on the 9/64" bit, so we drilled and countersunk the cleats in one step. If you are countersinking in a separate step, go back now and countersink all the holes in the Cleats, using your chosen method.
- NOTE:** Be sure to countersink the last pair of holes on the long Cleats on the side marked "IN", so as to make a PAIR of cleats, not two identical cleats!
18. Install the Cleats: Run a bead of glue down the back of one cleat. Spread it out into a uniform, thin layer with a screw.¹⁵² Place two (or three) of the #6x1-1/4" wood screws (Part # FA-69-37) into the countersunk holes until they just protrude through the glue.¹⁵³ TRIPLE-CHECK YOUR LABELS TO ASSURE THAT YOU ARE PUTTING THE CLEAT IN THE CORRECT SPOT! THIS IS VITAL TO A DECENT OUTCOME! Place the screw tips into the mating pilot holes in the cabinet side.¹⁵⁴



19. Grab your screw gun (fitted with a NEW #2 Philips driver and the clutch down low), press down hard and drive the screws home.¹⁵⁵ If the clutch spins out early, increase it ONE STEP AT A TIME just until the cleat goes down firm to the cabinet side. DO NOT OVERTIGHTEN as the screw will either spin out or break.



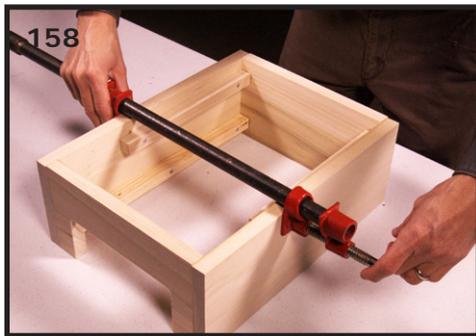
20. Repeat steps 18 - 19 for the other three cleats.¹⁵⁶ No need to allow dry time before continuing.



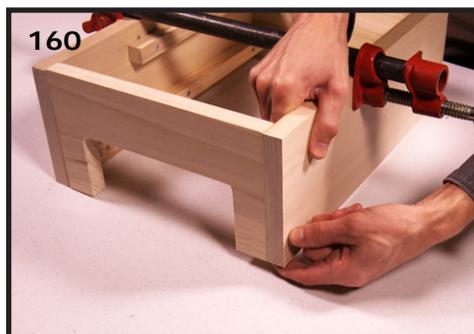
21. Dry fit the cabinet together, on its back, with the Front in place.¹⁵⁷ Look at those two little vertical edges on the cabinet Top, at either side of the amp cutout. If you want to apply an edge detail to this spot, like a roundover, but you want to leave the edge of the Front square, then YOU MUST APPLY THAT DETAIL TO THE TOP NOW! You will have the dickens of a time detailing it later without also messing up the Front, unless you are a crafty craftsman indeed. See also Step 48 below. Here in the Lab, we roundover the cabinet later, and we roll right across that front edge as well, so we skip this step.



22. Now stand up the Top, Sides and Bottom on their FRONT edges on your clean, smooth, flat work surface. Dry-fit them together. Use a bar clamp to snug the pieces together as shown.¹⁵⁸ Hopefully your clamps have plastic pads on the bearing surfaces. If not, DO NOT OVERTIGHTEN the clamps or you will mar the wood. It just needs to be snug.

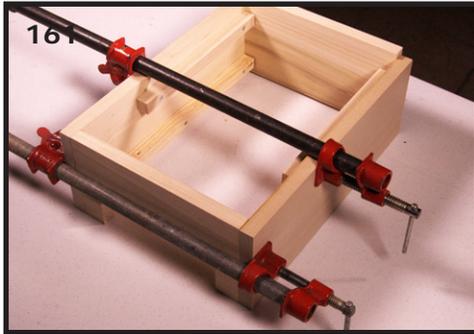


23. Pick one corner and line up the pieces of wood as carefully and accurately as you can.¹⁵⁹ Be sure the faces (the sides touching the table) are flush to each other at the joint. If the parts are a tiny bit uneven on the back face (that is, the side facing you), that's okay; don't worry about it – it's the back.¹⁶⁰

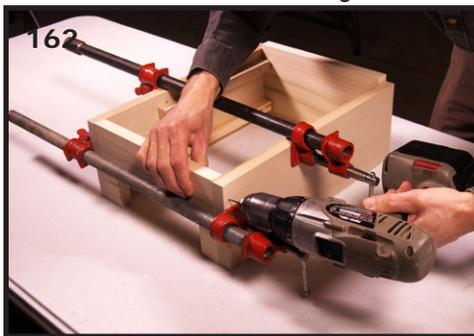


24. When you are satisfied with the alignment of the corner, add the second clamp as shown and tighten both clamps moderately to securely hold that joint in place for drilling.¹⁶¹

NOTE: Take your time with this step. The overall neatness of your cabinet depends on getting this step right.



25. Fit your drill with the 5/64" bit, sticking out about 1-1/8". At the corner you lined up, drill two holes at the nail marks, through the side, and into the mated wood piece.¹⁶²



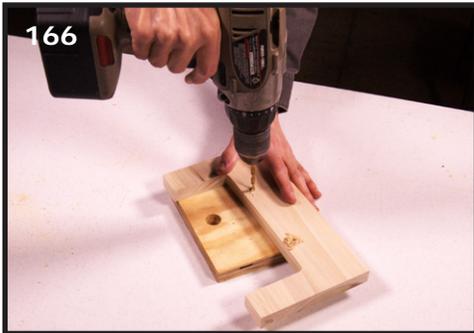
26. Continue to the other three corners, loosening the clamps and lining up the corners one by one. Drill a total of 8 holes.^{163,164}



27. Disassemble the four pieces. With the 9/64" bit, re-drill the eight small holes you drilled in the sides, and countersink them. You will get cleaner holes if you can drill straight through and into a piece of plywood or a board.¹⁶⁵ Also, at this time, use the 9/64" bit to drill the 4 chassis mounting screw holes in the front of the cabinet. With a 5/64" bit drill the 4 badge mounting holes in the front as well.



28. Change to a 3/16" bit and drill the two holes for the handle in the cabinet Top.¹⁶⁶



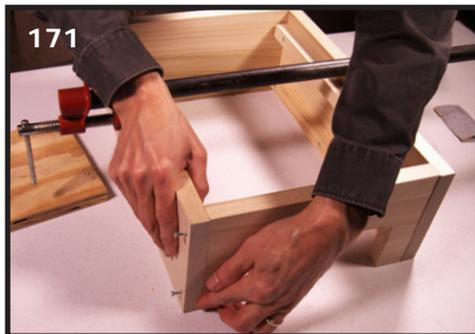
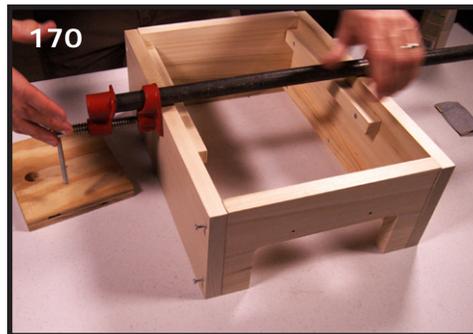
29. Inspect the inside faces of the wood pieces for splinters or "blowout": bits of wood standing above the surrounding surface. Clean these off with a bit of 120-grit sandpaper.¹⁶⁷



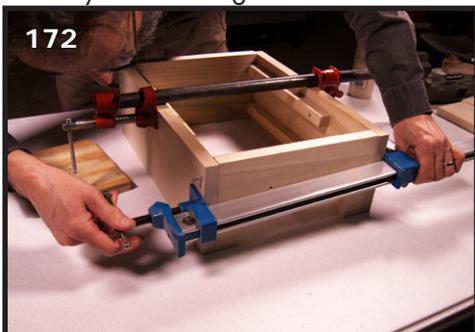
30. Dry-fit the four sides as before, with the front edges down on the table. Apply some wood glue to one end of the TOP. Smooth the glue with a screw until it uniformly coats the end.¹⁶⁸



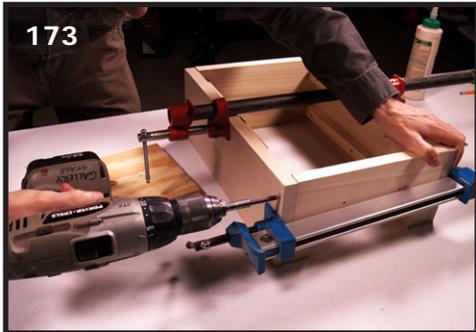
31. Fit two wood screws into the appropriate two holes of the mating SIDE piece.¹⁶⁹ Guide the tips into the little pilot holes in the TOP piece. Set a clamp across the box as shown, barely snug.¹⁷⁰ Carefully line up the joint as before.¹⁷¹



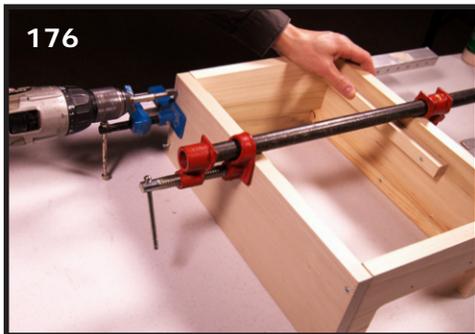
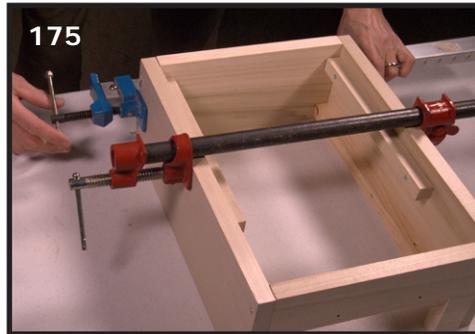
32. Add the second clamp right across the joint and apply moderate pressure to hold the joint securely for screwing.¹⁷²



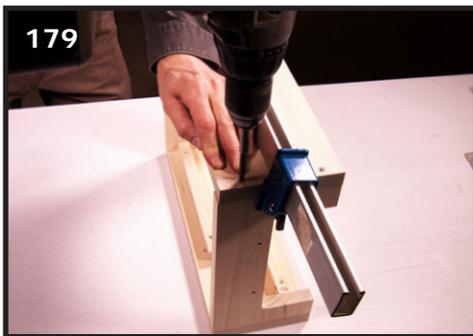
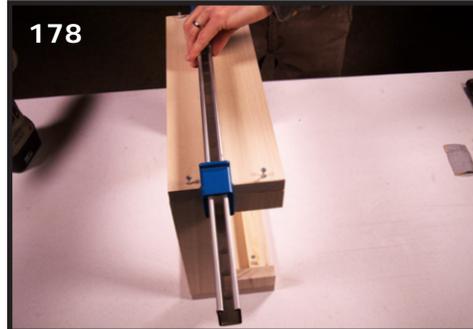
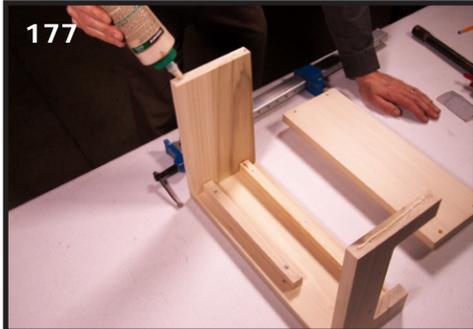
33. With a #2 Philips screwdriver, or cordless screw gun with the clutch at its LOWEST SETTING, press in hard and drive the two screws barely snug. You will tighten these later.¹⁷³



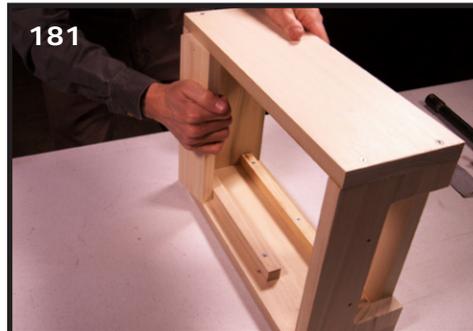
34. Now attach the BOTTOM to the same SIDE, holding the joint secure with a clamp while driving the screws barely snug.^{174,175,176}



35. Now apply glue to the remaining exposed ends of both the TOP and BOTTOM.¹⁷⁷ Fit four screws into the remaining SIDE and maneuver them into all four little pilot holes. Align, clamp and screw the joints (barely snug) one at a time.^{178,179}



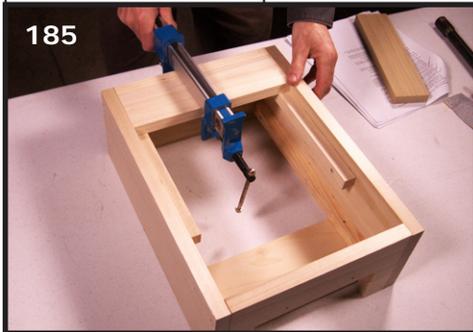
36. Dry fit into place the Front and the lower Port (that's the Port with one hole-mark at each end). They will probably be a snug fit.^{180,181,182}



37. Check the box for overall squareness: Set the cabinet on its back and drop the baffle board into place. Does the opening seem reasonably square? If not, clamp the baffle board into the acute corner as shown.¹⁸³ (We demonstrate this here on a 1x8 speaker cabinet shell.) This will pull the whole box into perfect square. Now tighten all eight cabinet screws.¹⁸⁴ If necessary, use the other clamp to hold the joints tight as you drive the screws home. Do not over-tighten! You will only sink them too deep into the side, or spin them out, or worst, break off the head. Proceed carefully with a screw driver, or a cordless screw gun with the clutch set low (1, 2 or 3).



38. Move the bar clamp to the lower Port and clamp it tightly to the Bottom.¹⁸⁵ Fit the upper Port in place, flush with the tops of the rear cleats or a hair higher.¹⁸⁶



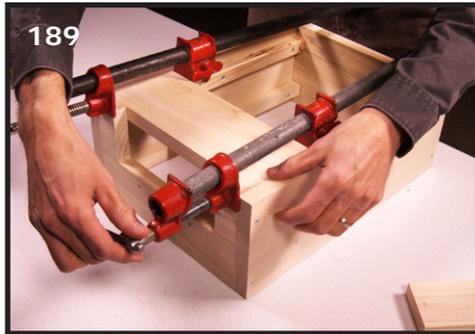
39. Drill six holes $5/64$ " x $1-1/8$ " deep through the ports where marked and into the cleats.¹⁸⁷



40. Remove the Ports. Label them so you can easily put them back in the same orientation!¹⁸⁸



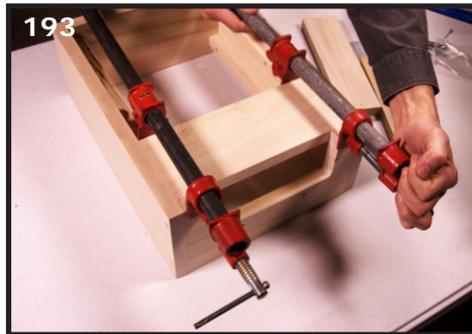
41. Installing the Front: Use both clamps to squeeze the Front tight against the cabinet Top.¹⁸⁹ From the rear, run a wood screw in through the cleat and spin it a few times with a Philips screw driver to mark the Front.¹⁹⁰ Repeat for all four cleat holes.



42. Remove the Front and drill four pilot holes $5/64$ " x $1/2$ " deep in the back side of the Front.¹⁹¹



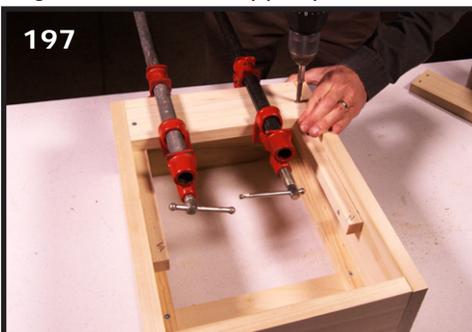
43. Apply glue to the cleats and the underside of the Top, where the Front will touch them.¹⁹² Fit the Front back into place, clamping it to the Top as before.¹⁹³ Using a screw driver or cordless screw gun, run four wood screws #6x1-1/4" through the cleats and into the Front.¹⁹⁴



44. Re-drill the six little holes in the Ports with the 9/64" bit and countersink them.¹⁹⁵



Glue the LOWER PORT ONLY into place. Apply glue to the cabinet bottom and to the cleats just where the lower Port will touch them. Fit the lower port back into the cabinet, being careful to match up your markings.¹⁹⁶ Clamp the lower port tight to the cabinet bottom, and screw it tight to the cleats with two wood screws.¹⁹⁷ Do NOT glue or install the upper port!



45. Remove the clamps from the port, set the cabinet on its back, and check the front for square again. If the cabinet is not square, clamp the baffle tightly into the acute corner again. This will pull the whole box perfectly square. Leave the whole thing alone for at least four hours!
46. After the glue is completely cured, remove the baffle and inspect the joints. If any joints are poorly mated (for example, the Ports stick out of the cabinet, or the Front is not flush with the cabinet), grind them flush with 60 or 80 grit sandpaper.¹⁹⁸



Edge Detail: If you want to apply a router detail, now's the time. There's only room for a small chamfer or roundover. (If you don't want to use a router, you can achieve a similar look simply with a lot of hand-sanding.) We use a 3/16" roundover bit with a bearing at the bottom.¹⁹⁹



NOTE: As you route each edge, be careful to orient the router so that you do not run the bearing across the screw heads. This will result in blemishes that can ruin the cabinet!

Round over all the outside edges except the four back edges. Detailing the top front edge is optional and up to you. We like to run the router all along that edge as well,²⁰⁰ which leaves sharp little inside corners to be dressed up with some hand sanding.^{201,202}

DANGER! Routers are dangerous, tricky machines that can do you serious harm if misused. If you are unfamiliar with routers, get a friend to help you!



47. Remove the dust with a vacuum or compressed air and inspect all the seams. If there are any gaps you cannot live with, fill them with wood dough. Pack it in tight, leave some extra on the surface, and then leave it alone for at least four hours to harden thoroughly.²⁰³



That's it! Congratulations.

Take a break, or go work on the baffle, or take a bike ride, and when you are ready we'll sand and finish the box.

FINISHING THE BOX

There are lots of ways to apply a beautiful, durable finish to a solid wood box. Following is how we finish our cabinets here at the Lab. You may finish your cab any way you like. Please send us photos of your completed project for our gallery!

Your cabinet is made of top-grade solid poplar. This is a dense, very finely grained softwood. It is harder, more stable and more durable than pine. It is the wood of choice for all fine millwork that is destined to be painted, but properly prepared it stains nicely too.

We illustrate some of the following procedures on a 1x8 speaker cabinet. The process is identical on the Combo cabinet.

1. Do not sand the interior of the cabinet at all. Sand the whole exterior twice, using 120 and 220 grit sandpapers.
 - a. If you routed a detail, carefully sand out any burn marks, and be careful you do not obliterate your detail with the orbital sander.^{204,205}



- b. "Ease" the square edges; that is, strike off the sharp square edge the mill applied to the wood. Your finish ingredients cannot accumulate on a sharp edge. Don't use the orbital for this, at least not for the inside edges; sand the square edges by hand only. The orbital is likely to chew up the inside corners.²⁰⁶

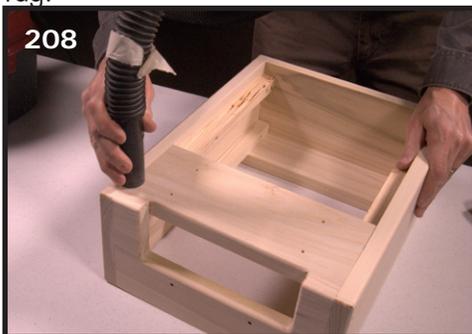


- c. Sand the three exposed faces of the upper Port and ease the edges.
- d. Carefully and thoroughly hand-sand the inside corners around the cutout in the cabinet top.²⁰⁷

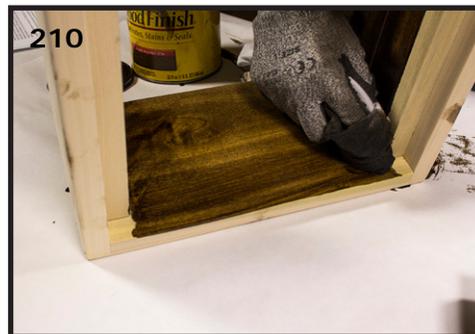


Be thorough! The better job you do here will strongly influence how uniform your stain turns out later.

2. Remove the dust: blast it with compressed air, draw it off with a shop-vac, or wipe with a clean rag.²⁰⁸



3. With a clean rag, apply a liberal coat of MinWax Dark Walnut Wood Finish #2716. This is an oil-based stain, one of the easiest to use. Coat the entire cabinet interior, paying attention to the inside corners.^{209,210,211,212}





4. Now wipe the stain off again with a large clean rag.²¹³ Rub it out thoroughly and carefully, leaving no fingerprints or streaks.²¹⁴



5. Now repeat for the exterior.²¹⁵ Set the cabinet down on its back, propped up on a few pencils, or chopsticks, or triangular strips of wood.²¹⁶ Let it dry for at least 4 hours!



6. Use a clean rag to apply a coat of MinWax Wipe-On Poly Clear Satin.²¹⁷ This is a remarkable product that is thin enough to soak straight into the wood but thick enough to provide a decent finish without running or dripping. Pour a little product into a disposable metal cup, like the bottom inch cut from a soda can. Dip your rag and apply a generous coat to the whole cabinet, starting with the interior and working around to the exterior. Be careful to "flood" those inside corners.²¹⁸ Do NOT apply poly to the ENDS of the Port! They will get along fine without it, but if you do poly them, the port will have a hard time fitting back in to the cabinet.²¹⁹ Set the cabinet back down on its back to dry THOROUGHLY, such as, overnight.²²⁰



7. When dry, very lightly hand-sand the exterior of the cabinet with 320 grit sandpaper. Ignore the interior; it's done. Precisely where the border lies between interior and exterior is up to you. The finish is thin, so be careful you do not remove the poly and damage the stained wood underneath. You are trying to strike off the fuzzy grain raised by the finishing process so far. This sanding should produce a fine white powder that feels soft as velvet to the touch.²²¹ Wipe it off with a clean cloth.



8. Clean up your work space as best you can. Remove all the dust from the cabinet and the work table. It is dust in the air that affects the final finish.

9. Apply a second coat of Wipe-On Poly to the exterior. Ignore the interior; it's done. Allow to dry thoroughly.²²²



10. At this point, if the box is beautiful and satiny-smooth, you are done. If it is still a little fuzzy or uneven, sand very lightly with 320 grit sandpaper and apply a third light coat. Allow to dry thoroughly.

That's it! Look at that gorgeous thing you made! You're some kind of genius.²²³



ASSEMBLING THE CABINET

1. Stand the cabinet on its top and install the four little feet (Part # HD-10-03) with four #6x3/8" screws (Part # FA-63-33). Do not over-tighten.²²⁴



2. Use a screw driver to install the handle, using the screws that came with it.^{225,226} Your combo probably shipped with a different handle than the one shown here.

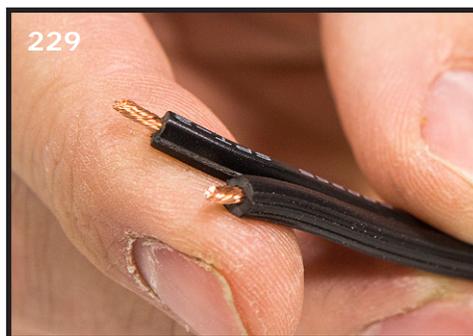


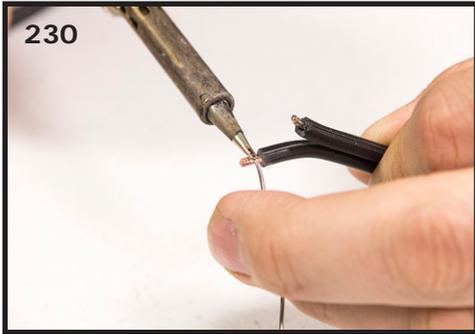
*The cabinet is done!*²²⁷



MAKING THE SPEAKER CABLE

1. Take the 6" zip wire (Part # CB-02-19) and split the ends about 1/2" (13mm). Now use your flush or diagonal cutters and cut off about 3/16" (4-5 mm) from ONE END of the RIBBED wire.²²⁸ Cut 3/16" (4-5 mm) insulation off all four ends. Twist the exposed stranded wire ends,²²⁹ and then tin them with the soldering iron.²³⁰





CAUTION: Solder fumes are not healthy for you. The fumes consist of vaporized flux, which can irritate your nose, lungs, and even your skin. You **MUST** work in a space where the air drifts away from you as you work, so fumes do not rise straight onto your face.

CAUTION: Solder residue usually contains lead, which is poisonous if you ingest it. Do not breathe the fumes, do not eat the supplies, wash your hands after you handle solder, and sweep and wipe up your work space after EVERY USE.

2. Open the male ¼" phono jack (Part # HD-40-03) by unscrewing the barrel. Note there is a clear plastic sleeve over the contacts. Remove this.²³¹



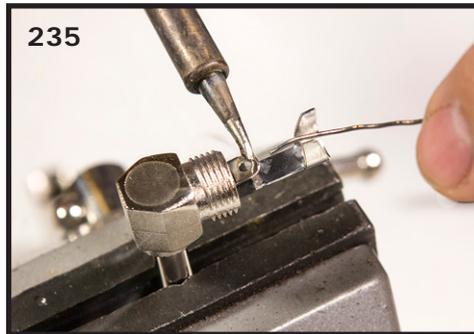
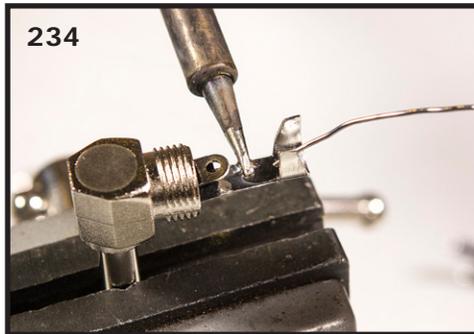
3. With the needle-nose pliers, carefully open the crimp ring at the rear of the jack.²³²



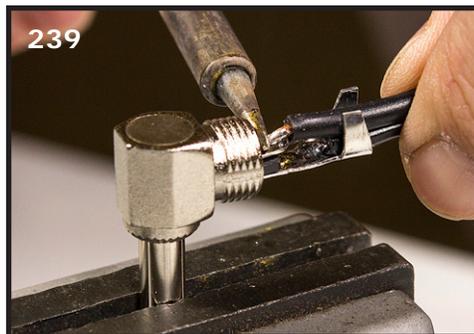
4. Mount the jack in some sort of clamp, vise or fixture, with the solder terminals exposed.²³³



5. Tin the two contact points on the jack as shown.^{234,235}



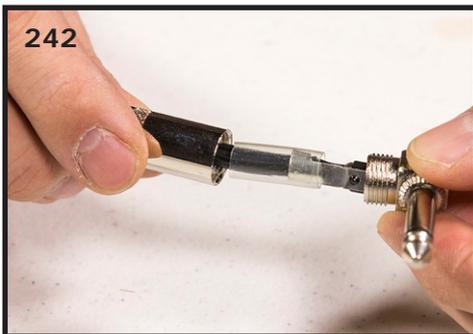
6. Solder the slightly-shorter ribbed wire to the negative lug as shown.²³⁶ Now solder the other wire (with writing on it) to the positive lug.^{237,238,239}



7. After the lugs have adequately cooled, carefully squeeze the crimp rings back down onto the wire.²⁴⁰ This should be snug enough to hold the wire in place, but not so tight that you damage or cut through the insulation!²⁴¹



8. Carefully slide the plastic sleeve along the wire and over the contacts.²⁴²



9. Slide the jack barrel along the wire and over the jack. Screw it on tight.²⁴³ Take the jack out of the clamp or vise and this baby is done.^{243b}



10. Test the continuity of the cable with your multimeter. Set your meter to the continuity setting (or Resistance setting).
- Test for continuity from the jack tip (the positive point) to the end of the wire with writing. A continuity tester will beep; a resistance meter should show very low resistance, like, less than one ohm.

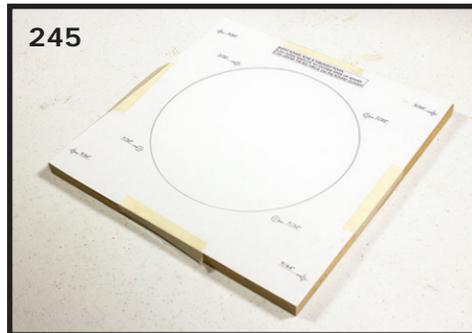
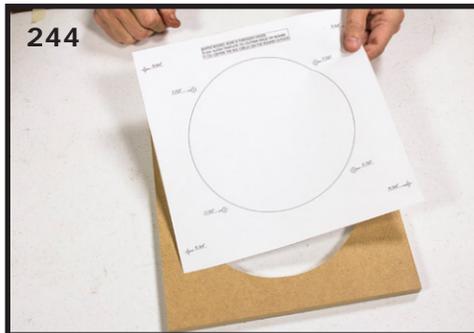
- b. Next test for continuity from the jack shaft (the negative point) to the end of the ribbed wire.
- c. Now, test for infinite resistance from the positive tip to the negative ribbed wire.

That's it!

You have just built a quality speaker cable for your cabinet! This cable is the impedance delivery device for your amplifier. It's what connects the load (the speaker) to your amp. Most amplifiers, especially tube amps, are very particular about what kind of load they are powering, so it is very important that this cable is functioning properly. If there's ever a problem with your cable, you'll know how to fix it. Disassemble the jack and look for bad solder joints, stray wires or damage to the insulation or the plastic sleeve. Repair or replace as necessary. Heat shrink can be used to replace a damaged sleeve.

BUILDING THE BAFFLE BOARD

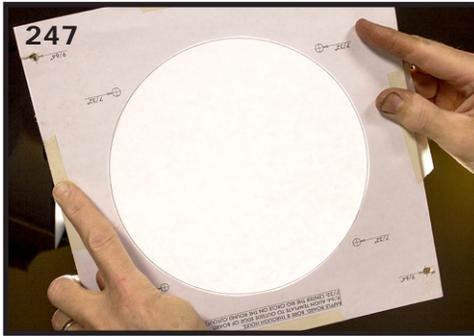
1. Cut out the paper template of the baffle board and tape it to the baffle board (Part # CA-40-08) with masking tape.²⁴⁴ Line up the outside edges as best you can.²⁴⁵



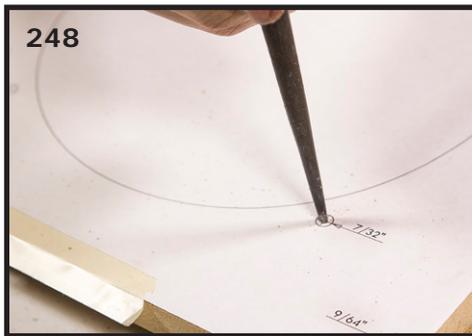
2. Use the awl, or hammer and nail, to mark the locations of the four $9/64$ " holes near the corners of the board.²⁴⁶



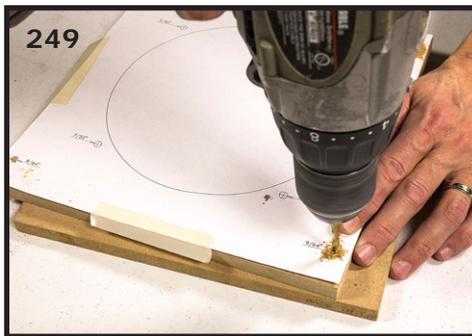
3. If necessary, re-position the template to align the big circle with the big cutout in the board.²⁴⁷



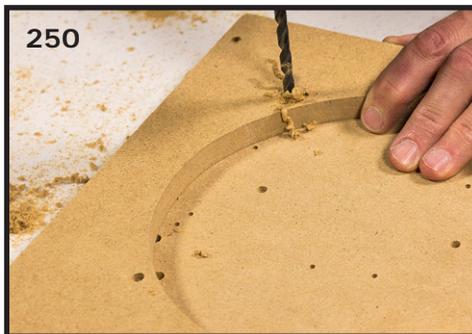
4. Use the hammer and awl or nail to mark the locations of the four $7/32$ " holes near the edge of the round cutout. Remove the template.²⁴⁸



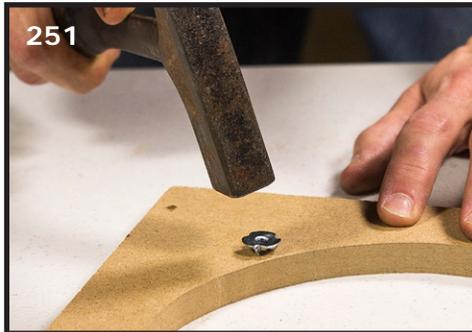
5. Use the drill and the $9/64$ " bit to drill the four holes in the corners of the board. If you have a drill press, use it. Otherwise, take care to hold the drill as straight-up as you can. Hold the baffle firmly down against a piece of plywood or a smooth work surface that you can drill into. This will give you a cleaner hole on the bottom side of the board.²⁴⁹



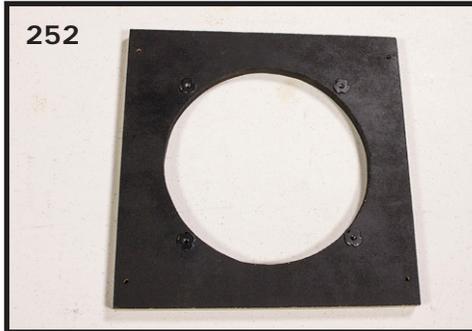
6. Change to a $7/32$ " bit and drill the four holes near the cutout.²⁵⁰



7. Use the hammer to tap the four t-nuts (Part # FA-21-40) into the four holes near the round cutout. Keep tapping until the t-nuts are flat against the board.²⁵¹



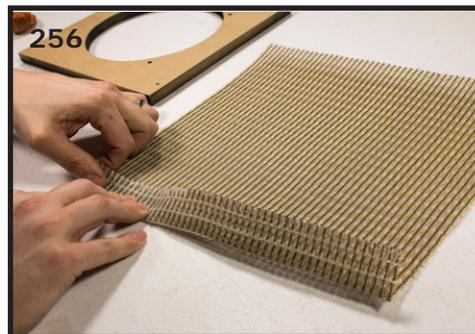
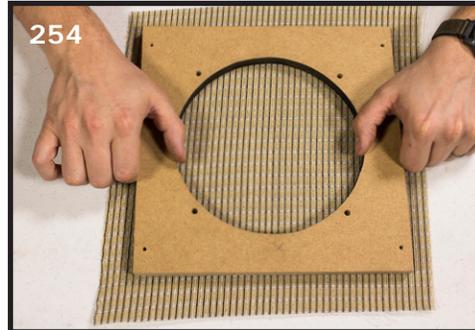
8. Paint the side of the baffle board with the t-nuts and the inside surface of the round cutout flat black. No other sides need to be painted.²⁵² Allow to dry thoroughly! Go work on the cabinet while you are waiting.



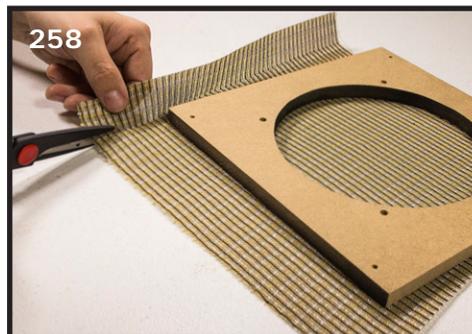
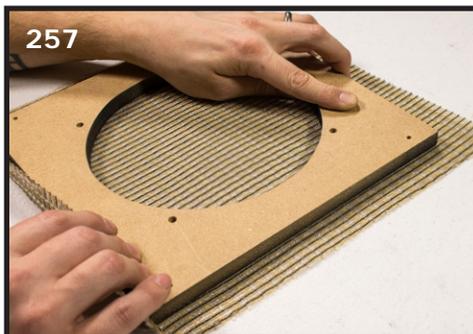
9. Now it is time to put on the grill cloth. Attaching grill cloth in a way that looks nice is not an easy task. There are two goals to keep in mind in working with grill cloth: 1) keep the lines straight; and 2) make the grill cloth tight. There are several different techniques for accomplishing these two goals, but the process described here has worked well for us. If you aren't confident about doing this step, call your local upholstery shop and they might be able to help you out.

The first part of putting on grill cloth consists of folding the four sides while carefully following straight lines.

- a. Set the grill cloth face-down on the table. The face is the side with a distinct grid pattern and broken black lines.²⁵³ Set the baffle board black-side-down neatly centered on the grill cloth. Align one of the edges of the baffle board with one of the silver lines about an inch from the edge of the grill cloth.²⁵⁴ Remove the baffle board and fold the cloth over on that silver line and crease it the entire length of the grill cloth. The bent edge should be at a 90 degree angle.^{255,256}

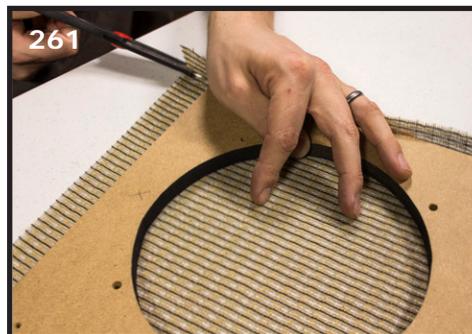
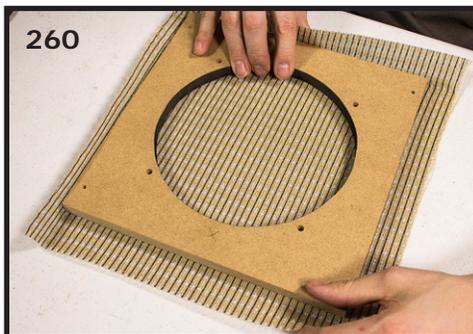


- b. Place the baffle board back on the grill cloth (with the edge against the fold) and center the board on the cloth.²⁵⁷ Now pick out a black line closest to one of the adjacent edges. Remove the baffle board, and use scissors or a razor to cut the grill cloth along the folded crease to the chosen black line.²⁵⁸ DO NOT OVER CUT THIS LINE. Fold over the grill cloth at the black line and crease it to 90 degrees along the entire length of the cloth.²⁵⁹

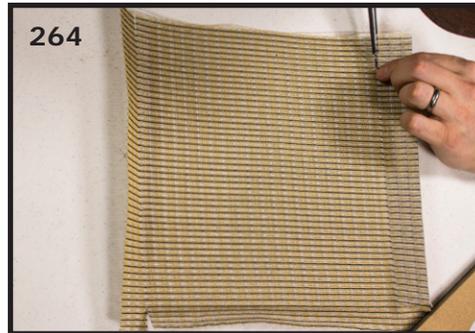
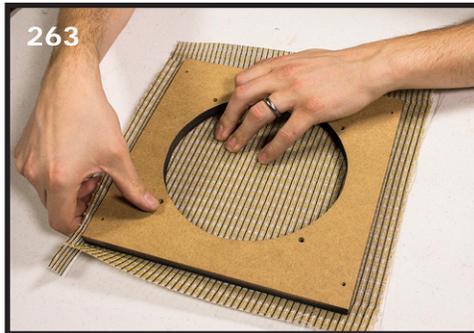




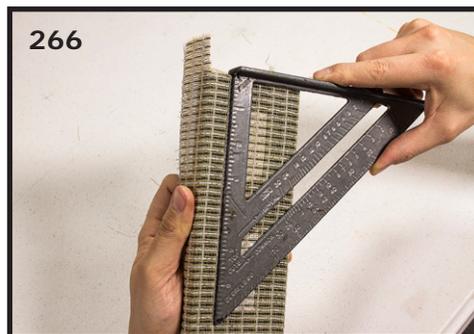
- c. Place the baffle board back on the cloth with the edges against the two folds.²⁶⁰ Now find the line on the grill cloth (one of the threads) that is parallel and closest to the the other side of the baffle, opposite the first fold. Remove the baffle board and cut the grill cloth along the previously folded crease to this new parallel line.²⁶¹ Once again, DO NOT OVER CUT THIS LINE. Fold and crease the grill cloth on the new parallel line the entire length of the grill cloth.²⁶²



- d. With the baffle board resting between the three folds, find the line that is parallel and closest to the remaining side of the baffle board.²⁶³ Remove the baffle board and cut the grill cloth on each of the folds crossing this new line.²⁶⁴ ONCE AGAIN, DON'T OVER CUT. Fold and crease along this line.²⁶⁵



10. Make sure that the baffle board is rotated so that the black lines on the grill cloth will be vertical when it is installed on the cabinet (notice the orientation of the baffle board mounting holes). Alternatively, if you own a Percolator 2 Watt Tube Amplifier by Zeppelin Design Labs, orient the cloth to match the pattern on the amp grill. While holding the baffle board (black side and t-nuts down) onto the grill cloth, flip the assembly over and look at the front. The edges of the grill cloth should wrap tightly around the baffle board, and all the lines on the cloth should be parallel or perpendicular to the baffle board sides. Check the straightness of the lines (in both directions) with your speed square and make sure the back of the grill cloth is flat against the front of the baffle board. The process is illustrated with a grill cloth frame from the Percolator amp head.²⁶⁶



11. Place the assembly face down on the table. While holding the grill cloth in its proper place, use your staple gun to put one staple into the edge of the baffle board in the middle of each side. Make sure the staple is right in the middle of the baffle board in both directions (up/down and left/right).²⁶⁷



12. Re-examine the assembly to make sure the grill cloth lines are still straight (use your speed square) and check to make sure the back of the grill cloth is still flat against the front of the baffle board. If so, proceed with placing staples around the edges. Start in the middle of each side and move to the corners.²⁶⁸ Alternate sides with each staple. Put the staples in at a 45 degree angle, so that all the staples aren't lined up in the middle of the edge.²⁶⁹ If any staples aren't seated properly you can use your hammer to tap them in. Periodically use your speed square to check that the lines are remaining straight (in both directions). Don't worry about getting the grill cloth tight on this step, just concern yourself with getting the lines straight. If you notice some of the lines are going crooked, pull out the necessary staples and start over. Take your time and you will be pleased with the results.



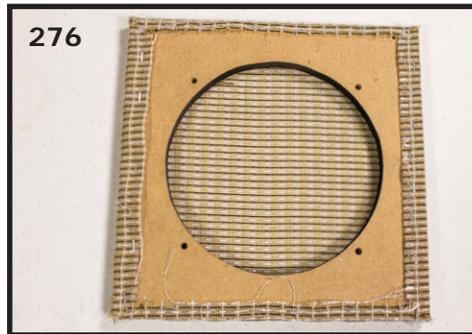
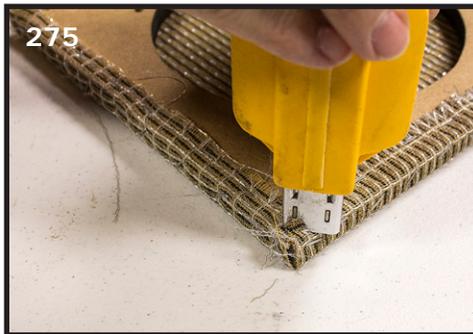
13. When you are done stapling and the lines are all straight, cut the long lengths of the grill cloth from the corners of the baffle board.²⁷⁰



14. Fold the remaining grill cloth over to the back of the baffle board and staple it down. Leave about 1/2" from the corners without any staples.^{271, 272}



15. At one corner of the baffle board, hold both corners of the grill cloth down, one of top of the other. Use your razor to cut a 45 degree line through both layers of cloth, from the corner of the baffle board. Remove both corners of cloth that were cut off. Use one staple to hold down the grill cloth in the corner. Do this for the other three corners.²⁷³⁻²⁷⁶

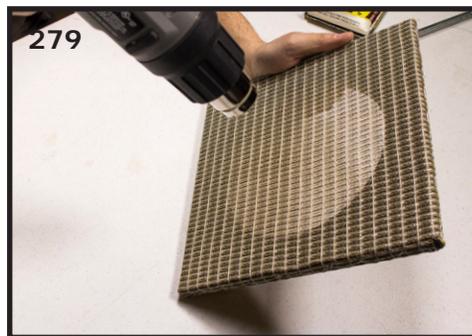
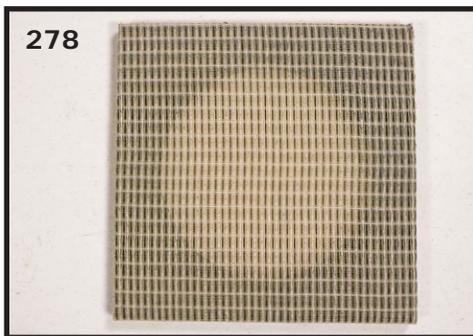


16. Use a lighter to singe loose threads at the corners.²⁷⁷



WARNING: The grill cloth is flammable! Be extremely careful to only singe the tips of loose fibers without setting your baffle board on fire.

17. If the grill cloth seems looser than you are comfortable with then you can use your heat gun to tighten it up.^{278,279} This is a tricky process to apply just enough heat to tighten it up, but not enough to cause the lines to warp and go crooked. We suggest you practice on some of the scraps you just cut from the baffle assembly. This will give you an idea of how easily the grill cloth is affected by your heat gun. Start with the heat gun on the lowest setting and if that isn't hot enough, you can move up from there. Also, start with the heat gun at least 12" away from the grill cloth; move closer if necessary. Move from the center of the baffle outward, in ever-bigger circles. You are trying to warm the whole cloth uniformly, from the center outwards. Be patient and take your time, and you should be pleased with the results.



18. Take the speaker (Part # LS-30-08) out of its box and place it face down on the back of the baffle board, lining up its mounting holes with the t-nut holes. The speaker should be rotated so that the connection terminals will be at the top of the baffle, closest to the input jack.²⁸⁰



19. Place a #8 Flat Washer (Part # FA-90-40) on the shaft of a #8x3/4" machine screw (Part # FA-60-45)²⁸¹ and run it through the speaker rim and into one of the t-nuts.²⁸² Be careful not to cross-thread the nut and screw; it should screw in easily. Also, be careful not to press down too hard on the screw as you tighten it, otherwise it might push out the t-nut from baffle board. Leave it slightly loose.



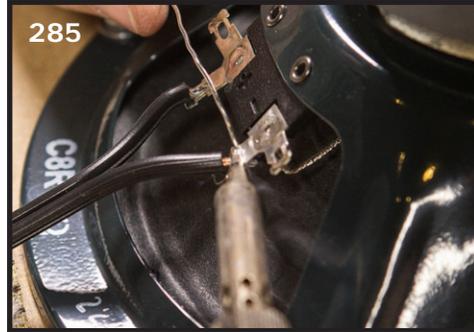
20. Repeat for the remaining three screws and washers. Now tighten them all down securely.²⁸³



21. Now tin the terminals on the speaker and solder your previously-fabricated speaker cable to the speaker terminals.²⁸⁴ Be careful to solder the ribbed wire to the negative terminal (the one marked with a "-").²⁸⁵ Solder the wire with writing on it to the positive terminal (marked with "+").²⁸⁶ Also be careful not to drip molten solder onto the speaker cone!

CAUTION: Solder fumes are not healthy for you. The fumes consist of vaporized flux, which can irritate your nose, lungs, and even your skin. You **MUST** work in a space where the air drifts away from you as you work, so fumes do not rise straight onto your face.

CAUTION: Solder residue usually contains lead, which is poisonous if you ingest it. Do not breathe the fumes, do not eat the supplies, wash your hands after you handle solder, and sweep and wipe up your work space after EVERY USE.



That's it!

The baffle board is done. Set it aside until the cabinet is complete.

COMPLETING THE COMBO

INSTALLING THE AMP



1. Place the cabinet upside down on the table, propping it up on a couple of books or something so the handle doesn't touch the table. Carefully set the amp in place, with the black label facing down.²⁸⁸ Press the bottom of the amp flat against the cabinet front.

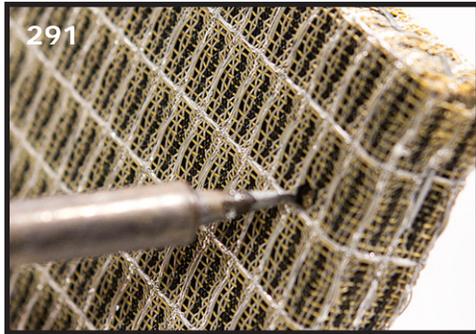


2. Place a finish washer (Part # FA-92-40) around the shaft of a #6x1-1/4" sheet metal screw (Part # FA-63-37). Run the screw through one of the holes in the cabinet face. Use a #2 Philips driver, NOT a screw gun! If we all did our jobs well, the screw will line up perfectly with the hole in the chassis and will dig right in. Just start the screw, then repeat for the other three screws.²⁸⁹ Now hold the amp tight to the cabinet and drive the screws in until you feel them pull the amp tight. DO NOT OVERTIGHTEN THESE SCREWS or they will strip out the chassis.²⁹⁰



INSTALLING THE BAFFLE BOARD

1. Use a hot soldering iron to melt a little hole through the grill cloth over the four mounting holes near the corners of the baffle board.²⁹¹



2. Place the cabinet on its back and drop the completed baffle into the front. Orient the baffle so that the cable is facing toward the amp.^{292,293}



3. Poke a #6x1-1/4" wood screw (Part # FA-69-37) through one of the holes and use a screw driver to turn it a few times, just enough to mark the cleat.²⁹⁴ Repeat for all four corners.

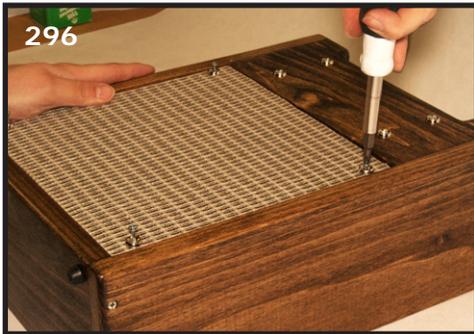


4. Remove the baffle and use the 5/64" bit to drill four pilot holes about 1/2" deep into the cleats.²⁹⁵



5. Drop the baffle back into place, careful to place it in the same orientation as previously.

Place a #8 Finish Washer (Part # FA-92-40) over the end of a #6x1-1/4" wood screw (Part # FA-69-37) and drive it through one of the holes and into the cleat. Leave it a little loose.²⁹⁶



6. Repeat for the other three corners, then go back and tighten all four screws.²⁹⁷



7. Flip the cabinet over face-down. Plug the speaker cable into the amplifier output jack. Plug the IEC cable (the power cord, Part # CB-10-01) into the amplifier.²⁹⁸



8. Place the Upper Port in place, careful to put it in the same orientation as when you drilled the holes; look for your mark under that dark finish! Tap it tightly into place against the cleats.²⁹⁹ Run the last four wood screws through the Port and tight into the Cleats.³⁰⁰



9. Use the 4 #4x1/2" (part # FA-63-24) to screw the badge onto the cabinet front. Do not over tighten these screws!³⁰¹



Congratulations! Your Percolator 1x8 Combo is done!

Go show it off to your spouse / parent / child / pet / band mate / neighbor. Get them to love it before you plug it in.



USING YOUR NEW COMBO

Please obtain the "Percolator 1x8 Combo Owner's Manual" online from the same place you found this manual. Go to www.zepherindesinglabs.com. Navigate to the product page for the Combo, either DIY Kit or Assembled Ready-to-Play. On the "Documentation" tab you will find all the latest manuals for download.

Have fun! Rock out! Don't stay up too late if it's a school or work night. Give yourself at least an hour or two of sleep.

