SEA-310, Assembly and Test Instructions

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INTRODUCTION

Congratulations on your purchase of the Seagull Electronics SEA-310 Guitar Amplifier Kit. All the parts in this kit cannot wait for you to turn them into an excellent amplifier that will play its heart out for you. You are about to build something that will give you musical enjoyment and maybe guide you towards a hobby or a career. This document will guide you through the process of assembling and testing the SEA-310.

These instructions use terms that may be unfamiliar to you. These terms will either be described in the instructions themselves or you can look them up in the Glossary (Table 7). The figures showing the kit contents (Figure 55 through Figure 59) show the names of the parts.

Is it hard to build the SEA-310? Yes and No. If you have never done electronic assembly, you will learn many new skills and lots of new terminology. If you are familiar with electronic assembly, it might be quite easy. As a beginner, the single most important way to ensure success is to make sure to read and use these instructions. They are written for beginners and will guide you through the process. The second most important way to ensure success is to have a helper available when you perform Step 4 – "Wiring the SEA-310." If you find the kit difficult to assemble, then you will just learn more by building it. If you make mistakes and must redo a few steps, you'll learn even more!

How long will it take to assemble the SEA-310? It depends on your level of experience. If you are new to electronic assembly, plan on about 16 to 20 hours to paint, assemble, and test your kit. We don't recommend working on the kit for more than several hours at a time. Work carefully, take breaks, build it with a friend or loved one – enjoy the process. As you build and test, think about the music it will eventually provide, and how every electron will flow through paths that you soldered and wired with your own hands.

Remember, the SEA-310 is not about making a masterpiece. It's about making YOU into a practical and skilled craftsperson and giving you something you'll enjoy for years. If your SEA-310 ends up covered in war wounds from experimenting, tweaking, use, and abuse, but rocks you with beautiful music – if you enjoy looking at the circuitry through the plexiglass back as much as you enjoy looking at the faceplate, then your SEA-310 has fully served its purpose.

HOW TO USE THESE INSTRUCTIONS

1) Use the Glossary (Page 55) to help identify electronic terms you may not be familiar with.
2) Use Figures Figure 55 to Figure 59 to find the names of all the parts.
3) Print these instructions and place them in a three-ring binder. This will allow you to remove frequently-used pages such as the Case Wiring Diagram and the Component Location (Zone) Table when you need them.
4) Words written in *italics* are terms from the electronics industry. Look them up on the Internet to see what they mean
5) Pay particular attention to text that is enclosed in blue lines as shown below.

When connecting the wires to the pilot light, it is extremely important that the red wire is soldered to the connection on the back of the pilot light as shown in Figure 24

TOOLS NEEDED TO BUILD AND TEST THE SEA-310

Soldering Kit

Soldering kits like the one shown in Figure 1 contain a soldering iron, solder, a de-soldering tool, solder wick, and several hand tools that will make soldering easier. There are many on the market. The kit shown in Figure 1 is sold by Plusivo, costs about $15.00 and works great.

Figure 1 - Soldering kit

Needle-Nose Pliers, Diagonal Cutters, and Wire Stripper

The needle-nosed pliers and the diagonal cutters shown Figure 2, are necessary for inserting the components into the PCB and then trimming the leads. The wire stripper is used for case wiring. A good wire stripper has numbers that represent the wire gauge being stripped. Your stripper should be able to strip stranded wire gauges from #18 to #24.

Figure 2 - Needle-nose pliers, diagonal cutters, and wire stripper. The quarter is shown so you can see the size of these tools. The numbers on the wire stripper show where to put different stranded or solid wire sizes so they'll be stripped correctly. Make sure your stripper can strip stranded wire gauges from #18 to #24. Find a video to show you how to use the wire stripper.

Digital Multimeter

A multimeter, such as the one shown in Figure 3 is used for testing the SEA-310 after assembly and can also be used to help identify the components in the parts bag. The ETEKCITY MSR-A600 shown in Figure 3 costs about $19.00 and works great. If you are shopping for an inexpensive multimeter, the most important specification is whether it can measure AC voltage as low as 10 mV at frequencies between about 30 and 1000 Hz.

Figure 3 - Multimeter

Blue Painter's Tape

Blue painter's tape will be as useful as any other tool used for the SEA-310. Painter's tape works best because it sticks well and then can be easily removed without leaving residue. You'll use it to tape the components to the inventory sheets while sorting components, insulate all the controls from each other during test, and be your "third hand" during assembly. Painter's tape is available in the paint section of any home improvement store.

"Third Hand" Tool

If you are building the SEA-310 alone, you may want to consider a "third hand" tool such as the one shown in Figure 4 which costs about $9.00 and is available here.

Figure 4 - "Third hand" tool

Other Stuff You Will Need

You'll use these for wiring the controls and assembling the case. One of your BEST TOOLS is additional hands in the form of a helper. That second set of hands will make the assembly process much easier. More importantly, you'll share the experience with a friend or a loved one. At a minimum you'll need:

- Medium Phillips screwdriver
- Small Phillips screwdriver
- Pliers
- Adjustable wrench suitable for 13/16" nut
- X-Acto razor knife
- One sheet of #600 grit sandpaper
- Scissors
- Ruler or tape measure
- Fine tip Felt tip marker for marking the grille cloth for cutting
- Magnifying glass, …or young eyes
- Three-ring binder to hold instructions during assembly
- Box wrenches or deep socket wrenches: 7 mm, 10 mm, 13 mm, and 1/2" (you can also use a small adjustable wrench.)

Audio Signal Generator App

An audio signal generator is needed for feeding test signals into the Guitar and AUX inputs of the SEA-310. The audio signal generator will play pure tones (also called sinusoidal signals) into the SEA-310 at exact amplitudes and frequencies. You can use your phone as the audio signal generator. The audio generator from Keuwlsoft is available for Android phones. The audio signal generator from Media Punk Studios is available for the iPhone. (Note that your iPhone 7 or later will need the "Lightning to 3.5 mm Headphone Jack" adapter which came with your phone)

Lightning to 3.5 mm Headphone Jack Adapter

This is needed ONLY if you will use an iPhone 7 or newer model for the test procedure. The adapter is included with some iPhones.

Figure 5 - Lightning to 3.5 mm Headphone Jack Adapter. You will need this if you test your SEA-310 with an iPhone 7 or newer.

Audio Cable

Figure 6 shows the audio cable you will need for testing the SEA-310. This is a standard 3.5 to 3.5 mm stereo cable with male connectors on both ends. These are commonly available at any consumer electronics store, but chances are there are a few lying around your home.

Figure 6 - Standard 3.5 mm to 3.5 mm stereo cable with male connectors on both ends.

Audio Headphones with a 3.5 mm Jack.

These are simple headphones like the ones shown in the figure. You should be able to find a pair of these in that junk drawer in your house.

Figure 7 - Audio Headphones

Power Cord

The power cord shown in Figure 8 is used to connect the SEA-310's external power supply to a wall outlet. It's the same power cord that is used for nearly all consumer computer equipment and is not included in the kit. There are probably a few unused power cords lying around your house. If you are outside the US, please note that the SEA-310 External Power Supply works with line voltages from 100 to 240 VAC.

Figure 8 – Power cord

Primer, Paint, and Sandpaper

Pick the color you want for your SEA-310. A single can of spray primer and a can of color coat will do perfectly. A sheet of 600 grit sandpaper will help to smooth the surface before painting and between coats.

12 Volt Adapter

You only need a 12 Volt adapter if you plan to operate your SEA-310 from your car. It is not included in the kit. The MPD ZA5073 from Memory Protection Devices is recommended because it has an internal fuse, and a 2.1 mm center positive jack. The 12 Volt Adapter should be able to supply 4 Amps.

Figure 9 - 12 Volt Adapter

STEP 1 – PAINTING THE SEA-310

If you plan to paint your SEA-310, it should be the first step because it is shipped with no metal parts attached to the case.

For best results, a primer must be applied to the surface. If this step is neglected, the wood will soak up the color coat and you won't get the smooth finish you want. The easiest way to paint is to spray a coat of primer and then spray two coats of your chosen color. You can buy the paint at any home improvement store. A single can of primer and a single can of color is sufficient.

Since you will have to wait for the paint to dry between coats, you can get started with Step 2, Identifying and Sorting the Components, while you are waiting.

Instructions for Painting the SEA-310

Painting the SEA-310 will require multiple coats. Read the instructions on the can to find how long the paint must dry between coats.

1) Read the instructions included with the paint and follow all safety instructions.

2) Make sure to paint in a well-ventilated area. Paint fumes are toxic.

3) For best results, sand the cabinet with 600 grit sandpaper before painting. Then lightly sand and wipe the dust off between coats.

4) Your paint color will look good on the SEA-310, but not necessarily on the garage floor. Place newspaper or other protection to catch overspray.

5) Roll some of the tape backwards so it is sticky on the outside. Press it into the PCB Mounting Channel and PCB Wiring Channel as shown in Figure 10 to prevent paint from getting in the channel.

6) When painting, raise the cabinet slightly above the ground to prevent the paint from sticking to the newspaper. Cut eight 1-inch sections of the 18 AWG red wire and use them as spacers that separate the case and Front Bezel from the newspaper as shown in Figure 10.

7) Watch a YouTube video on spray painting basics. Gain experience with spray painting by holding a piece of cardboard and spraying it. Don't worry about wasting paint. One can will paint a few SEA-310s.

8) Spray the inside of the cabinet. Let the paint dry as specified by the instructions. Turn the SEA-310 over, place it on the spacers, and paint the outside.

9) Don't forget to paint the face and sides of the Front Bezel.

10) If you want to make your SEA-310 look even better, paint the edges of the plexiglass as shown in Figure 12.

Place rolled up tape in the PCB Mounting Channel and PCB Wiring Channel.

Cut 1 inch pieces of #18 AWG red wire to use as spacers.

Place the spacers so they elevate the Cabinet and Front Bezel slightly.

Figure 10 - Preparing the SEA-310 for painting

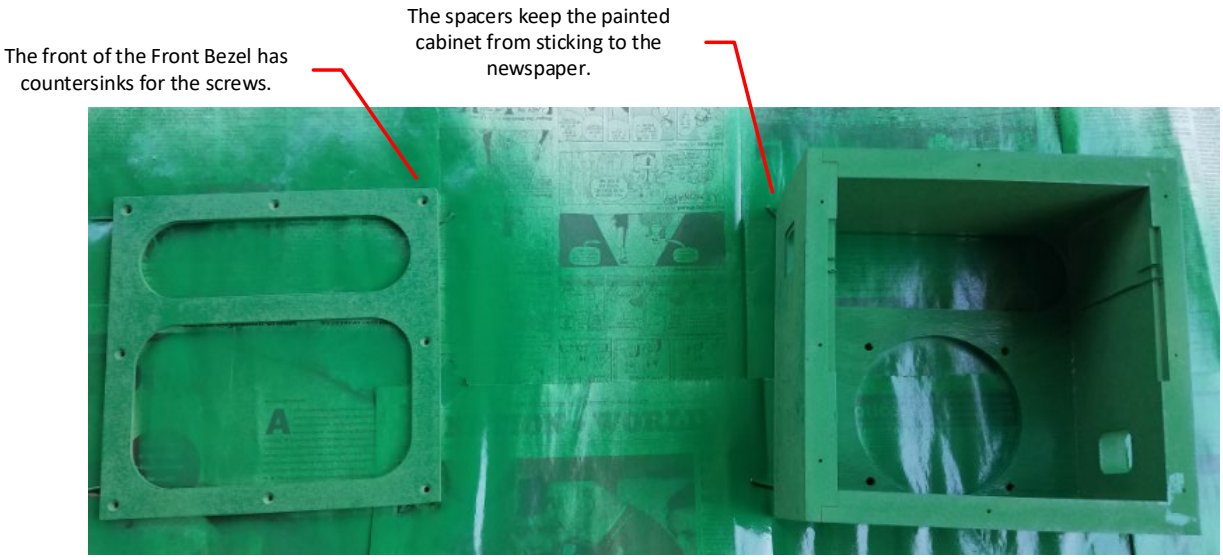
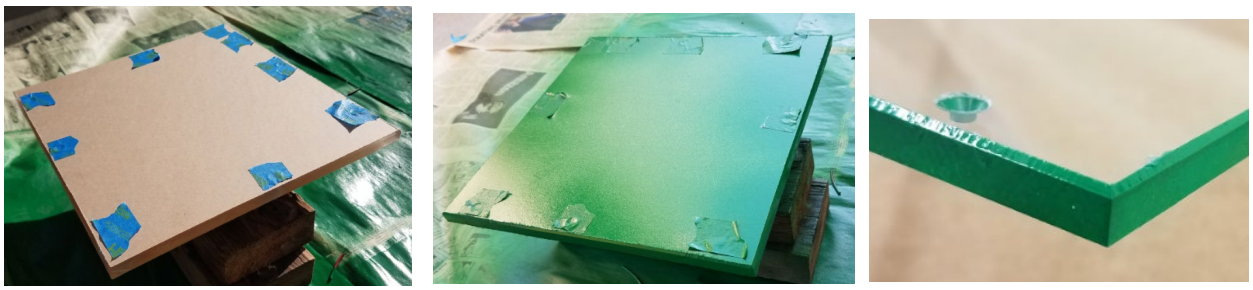


Figure 11 - Painting the Cabinet and Front Bezel. Use multiple coats and sand between coats to get the best finish.



(a) (b) (c)

Figure 12 - Painting the Plexiglass edges (a) The protective backing keeps the paint away from the front and the back. Tape is used to keep paint out of the screw holes. (b) Paint away! (c) After the paint dries, remove the backing.

STEP 2 – IDENTIFYING AND SORTING THE ELECTRONIC COMPONENTS

Your SEA-310 can only give peak performance if all components are placed in their correct locations. If components are placed in the wrong locations, the SEA-310 may still amplify your guitar, but won't give you the booming sound that all those parts are waiting to provide. You will find that many of the parts look the same but are actually different. This section will help you sort the bag of parts (Figure 59) so you'll know exactly where to put them on the PCB.

Here is a simple and foolproof way to make sure you put each component in the right place:

1) Remove the Inventory Sheets (Figure 47 through Figure 53) from the three-ring binder.
2) Locate each part from the bag and tape it to the Inventory Sheet next to its description as shown in Figure 13.

With the components taped to the Inventory Sheets, stuffing the board will be easier because the reference designators (see the next section) for the components are written on the Inventory Sheets. Also, you will stuff the components on the board in the order they appear on the Inventory Sheets.

The components are in the bag of components (Figure 59). Some parts are used in multiple places in the SEA-310 and have been placed in small bags. Other parts are loose in the bag of components and you need to sort them and tape them to their place on the Inventory Sheet. The next section contains information that will help you sort the components.

Component Values/Types and Reference Designators

Every part on the PCB has a *component value* and *component type*. For example, the resistors (the things with colored bands and bare wires coming out each end) have *component type* "resistor," and their *component value* is their resistance value measured in Ohms (Ω). The capacitors (the small yellow things with two bare leads coming out the bottom and the big round things) have a *component value* measured in Microfarads (µF)). The transistors are the small black things with three leads. As you sort the parts, you will see that some parts (especially those small black transistors!) look identical and you must sort them by carefully reading the component type from the parts.

Every part on the PCB has its own *reference designator.* Reference designators show where each component from the schematic diagram is located on the PCB. Reference designators are shown on the schematic diagram next to each component. They are also shown in white writing (*the silkscreen*) on the top, or *component side*, of the PCB. Resistors typically have reference designators starting with "R" such as R1, R2, R3, … Capacitors are C1, C2, C3. Transistors are Q1, Q2, Q3, … For example, locate C1 on the upper left of the schematic diagram (Figure 60). You can see that its value is 0.22 µF and one end of it is connected to the Guitar input J1 and the other end is connected to resistor R1. Now find C1 on the PCB (it is at the top right in Zone A7). Looking at the component side of the PCB you will see holes for C1, but it doesn't appear that C1 is connected to anything. Now turn the board over and you will see small *copper traces* connecting one side of C1 to J1 and the other side to R1 as shown in the schematic. So, when all the components are placed in the correct locations on the PCB they will be wired exactly as shown on the schematic diagram. It's important to understand that schematic diagrams are drawn to show the signal

flow (typically left to right) through the PCB, and reference designators are typically ordered left to right on the schematic. The PCB matches the wiring on the schematic, but it is designed so connectors are in the right places and other physical constraints are met. To help you find the components on the PCB, the PCB is divided into zones, and Table 8 provides a zone reference for each component.

Preventing Damage from Static Electricity

There are three components on the SEA-310 PCB that can be damaged by static electricity and should be handled with care. They are in a special silver bag. For now, just leave them in the bag. When you stuff the board, you'll learn how to place the components in the board without damaging them.

Identifying Components

The electronic components in the parts bag are all housed in industry-standard packages. For example, the small resistors (the things with colored bands and bare wires coming out each end) all use the same package, but they all have different values. This means that you must read the values based on markings on the component. The markings are coded so they take up less space on the component, and you'll have to use those codes.

The easiest way to identify each the component is with the Inventory Sheets. For each component you will find a picture, and a description of the marking.

If you want to become an expert, you can read the resistance from the colored bands on the resistors by learning the color code. Search the Internet for "*Resistor Color Code*." You can also learn the numeric code for the capacitors by searching the Internet for "*Capacitance Value Code*." If you are not sure of the value of a component, you can use the multimeter to measure it.

Using the Inventory Sheets

Now that you know about component values, markings, and reference designators, you're ready to dig into that parts bag. Grab the Inventory Sheets and the painter's tape and maybe a magnifying glass. Tape the specified number of components to the sheet as shown in Figure 13. Do not block the writing on the Inventory Sheet because the reference designators will tell you where to place the components on the board in Step 3.

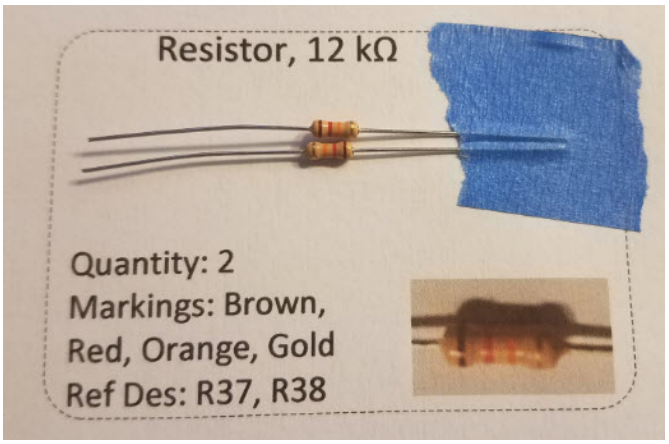


Figure 13 - Tape the components to the inventory sheets using painter's tape. Don't block the text because you'll need to see it when you stuff the board. Use Table 8 on Page 64 to determine where to put these parts on the PCB.

STEP 3 – SOLDERING COMPONENTS TO THE PRINTED CIRCUIT BOARD (PCB)

Congratulations for sorting all those components! At this point, all the components (except for the static sensitive components in the silver bag) should be taped to the Inventory Sheets. You should double-check to make sure the components are sorted correctly. If they aren't, your SEA-310 won't provide peak performance, and may not work at all.

Determining Where the Components are Located on the PCB

The reference designators are ordered from left to right on the schematic diagram, but not on the PCB. This can make it difficult to see where to install them. The letters and numbers around the edges of the PCB divide it into rectangular zones, and Table 8 on Page 64 shows the zone for each component based on its reference designator. After looking up the zone in the table, look at the PCB and you will see exactly where to place the component.

Soldering Components on the PCB

Place the SEA-310 cabinet on its face and place the board in the PCB Assembly Tray on the back of the cabinet with the silkscreen (the white writing) facing you as shown in Figure 14.

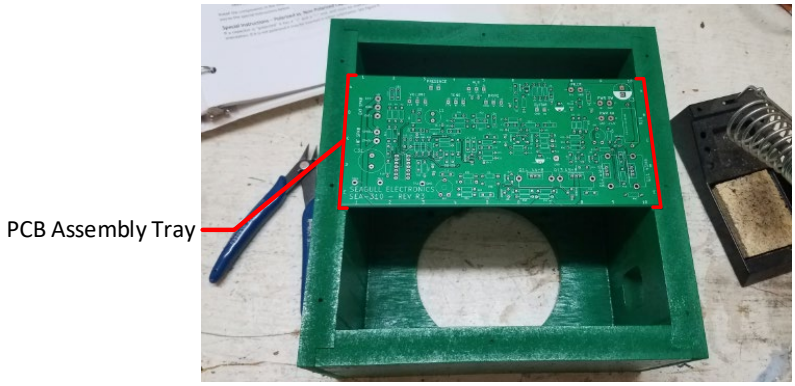


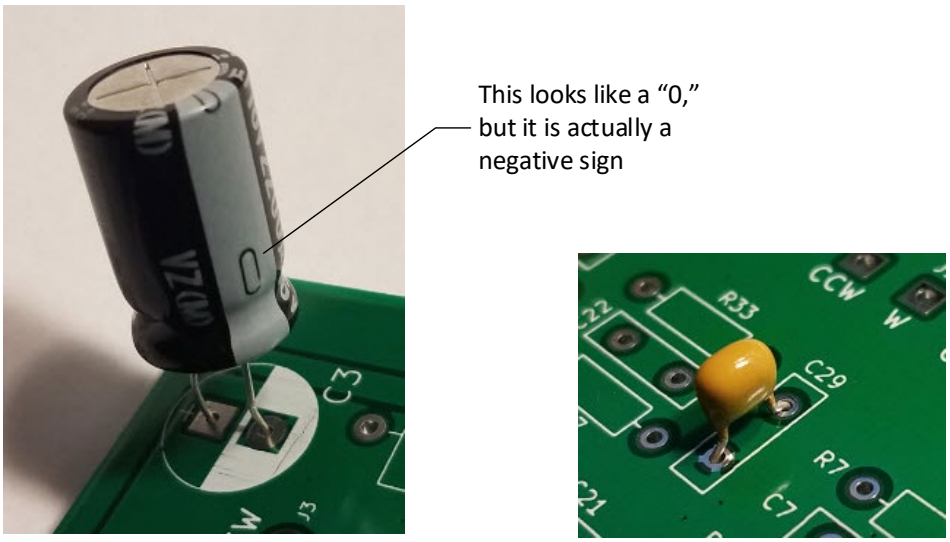
Figure 14 - Secure the PCB in the PCB Assembly Tray while installing components

Search the Internet for a "How to Solder Through-Hole Components" and you'll see how easy it is! Remove the Zone map (Table 8, Page 64) from the three-ring binder and have it in front of you. Grab the solder from the bag with the wire (Figure 58) and get started.

Before you begin soldering components, note the Special Instructions shown below. These instructions provide tips and tricks for installing some of the parts. The Inventory Sheets will refer to the Special Instructions.

Special Instructions – Polarized vs. Non-Polarized Capacitors

If a capacitor is "polarized" it has a "+" and a "–" end, and must be inserted in the PCB in the correct orientation. If it is not polarized it may be inserted in either orientation. See Figure 15.



The polarized capacitor has a white stripe and a "-" sign showing its negative end. The PCB has a white area showing where the "-" end goes.

The non-polarized capacitor has no polarity markings. It may be inserted into the PCB in either orientation.

Figure 15 - Capacitors may be polarized or non-polarized. if a capacitor is polarized, the PCB shows the correct orientation.

Special Instructions – Adjustable Resistors, RV1 and RV2

These components have short leads and will fall out of the PCB when you flip the board to solder them. Figure 16 shows a trick for soldering them.

Solder one lead before turning the PCB over

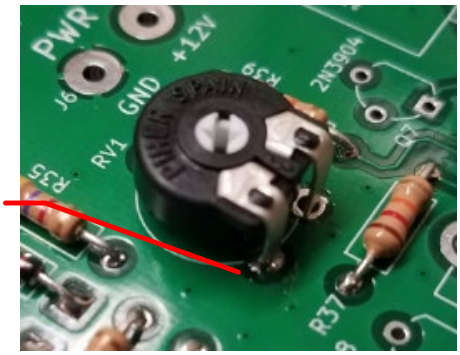
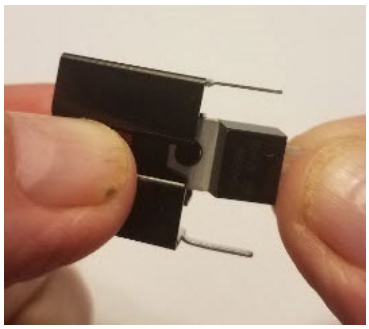


Figure 16 - Secure RV1 and RV2 by soldering one lead from the top of the board. Then turn the board over and solder the other two leads. Finally, re-solder the first lead. Note that you can also secure the parts with painter's tape.

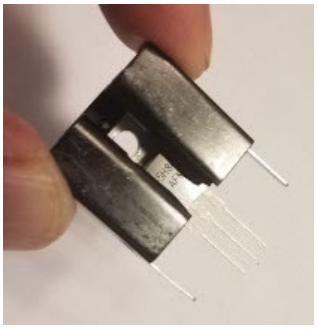
Special Instructions – Power Transistors and Heat Sinks (Q11, Q12, Q13, Q14)

These four components have the job of supplying the audio power to the speaker. Before you install them look at the PCB traces between the power transistors and the speaker connections. They are wide because they must carry lots of electrical current! When doing their job, the power transistors generate heat, so we protect them with *heat sinks* to help them stay cool. Note that the transistors have a metal surface on the back. When that metal surface is pressed against the heat sink, heat is transferred from the transistor into the heat sink and the transistor stays cool. Once your SEA-310 is working, place your fingers on the heat sinks while playing loudly – you'll feel the heat!

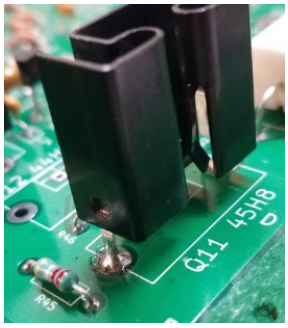
The transistors and heat are held together by the springiness in the heat sink. Then they are installed into the PCB as a unit as shown in Figure 17.



(a)



(b)



(c)

Figure 17 – (a) Use your thumb to <u>slightly</u> spread the heat sink as you press the transistor into it. (b) Press the transistor into the heat sink until the holes in the heat sink and transistor line up. (c) Insert the transistor and heat sink into the PCB so the transistor leads and heat sink tabs fit easily into the PCB. Then make one solder joint on the top of the board to keep the component from falling out. Finally, turn the board over and solder the rest of the leads and the heat sink tabs

Special Instructions – Static Sensitive Parts

When sorting the components, you left the MOSFET (Q15), voltage regulator, U1, and integrated circuit (U2) in their anti-static bag. In dry environments static electricity is the reason for that spark when you touch a doorknob. In damp environments it's not a big issue. Before opening the bag and handling these parts, touch your hand to a grounded metal surface such as a lamp, or your computer.

Special Instructions – Integrated Circuit (U2)

When installing this Integrated Circuit (IC) on the PCB, the notch on the case (at the left in the photo below) must align with the notch marked on the silkscreen. The rows of pins on the IC are slightly wider than the holes in the PCB. Press one side of the IC very gently against a flat surface to bend the row of pins in slightly. After the IC has been pressed in the holes, solder one pin from the top of the PCB so it won't fall out when the board is turned over. Then solder all the pins.

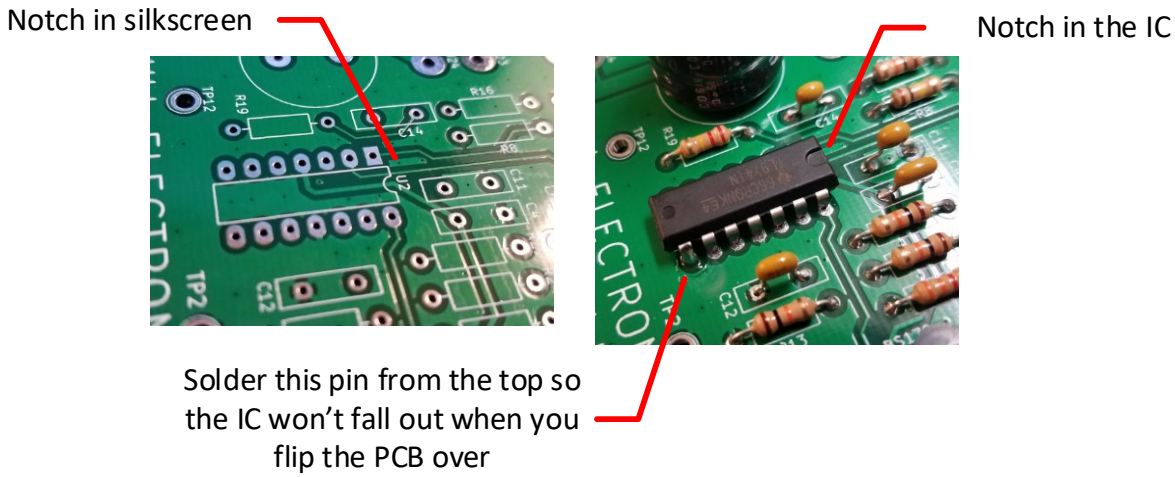


Figure 18 – Details for soldering the IC

Install each component in the PCB using the steps below:

1) Place the SEA-310 cabinet on its face and place the board in the PCB Assembly Tray on the back of the cabinet with the silkscreen (the white writing) facing you.
2) Remove the component from the Inventory Sheet.
3) Refer to Table 8 to find the zone where the component is located on the PCB.
4) Find the exact location of the component by finding its reference designator on the PCB.
5) If necessary, bend the component leads with the needle-nose pliers so you can place it through the holes on the board.
6) Insert the component through the holes on the PCB.
7) Bend the leads slightly so the component will stay in the PCB when the PCB is turned over. Do not bend the leads excessively because that makes it hard to remove the component if you want to change it in the future.
8) Turn the PCB over to expose the *solder side* and solder the component to the PCB.
9) Trim the excess leads with the diagonal cutters.

10) Save five or ten of the excess leads you cut off because they'll be needed when you wire the cabinet.

Install the components in the order they appear on the inventory sheet. The Inventory sheets will refer you to the special instructions below.

Help! – I soldered a component in the wrong place

I do this all the time. Your soldering kit should have the tools needed for this. Search the Internet for "De-soldering a through-hole component." It's not fun, but you can do it!

STEP 4 – WIRING THE SEA-310

At this point all the components should be installed on the SEA-310 PCB. Now you need to connect the PCB to the Electromechanical Components (jacks, potentiometers, switches, speaker) on the cabinet. This requires two skills that you can learn by searching the Internet:

- Use the wire stripper to remove or *strip* the insulation from the end of a wire.
- Solder a wire to a terminal

If you are new to soldering, this is a great time to have a helper who can hold the wires while you solder them. If you are a beginner and working alone, consider using the "third hand" tool shown in Figure 4

1. Use the front panel to secure jacks and connectors as you solder wires to them. Remove the Case Wiring Diagram (Figure 35) from the three-ring binder and have it in front of you as you wire the SEA-310.
2. Place the cabinet face-down on the workbench. Place the front panel in the Assembly Tray with the printing facing down as shown in Figure 19. The front panel will hold the components while you solder wires to them.
3. Place one of the pots through the front panel so its solder terminals are exposed. Secure it hand-tight to the front panel with its nut and washer.
4. Cut a 3.0" piece of the 24 AWG blue wire.
5. Use the wire stripper to remove about 1/8" of insulation from the wire. Make sure to place the wire in the hole marked '24" on the "Stranded" side of the stripper as shown in Figure 19.
6. Form a hook in the bare part of the wire and place it through one of the terminals on the pot.
7. Solder the wire to the terminal so it comes straight out as shown in Figure 19.

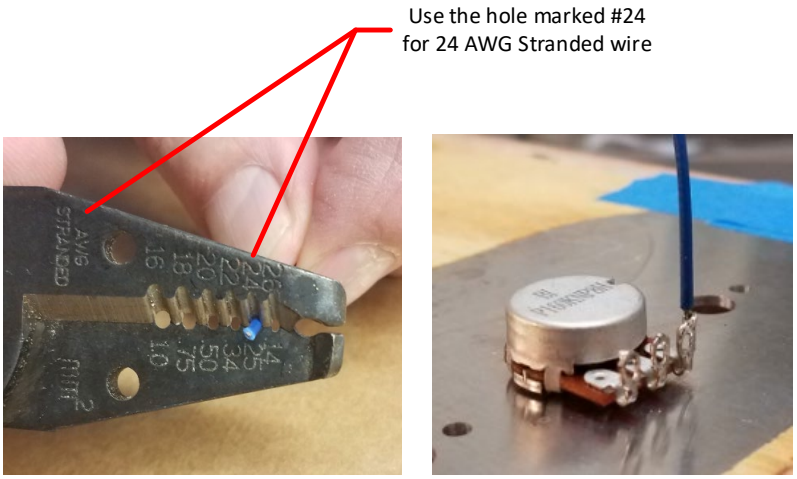


Figure 19 – Use the hole marked "24" when stripping 24 AWG wire. When soldering the wires to the terminals of the pot make sure they come straight out as shown. Having a helper hold the wire while you solder it makes it MUCH easier to solder the wires.

8. Cut two more 3.0" blue wires and solder them to the other two terminals of the pot.
9. After soldering wires to the pot remove it from the panel and set it aside.

10. Repeat the same process for the other two pots.
11. Secure the Presence Switch hand-tight to the panel. Note that the flat spot on the switch bushing must align with the flat spot in the hole in the panel.
12. Cut a 2.5” section of 24 AWG black wire. Cut a 2.5” section of AWG 24 orange wire.
13. Strip the wires and solder them to the switch terminals as shown in Figure 20.

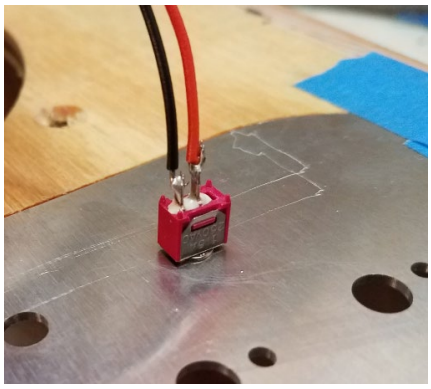


Figure 20 - Presence switch wiring. Don’t worry about feeding the wire through the tiny terminals on this switch prior to soldering. Laying the bare part of the wire flat against the terminal and soldering it is fine.

14. Find the AUX Jack and secure it hand-tight into the panel.
15. Find the AUX jack on the Case Wiring Diagram. Note that one corner of the AUX jack is different than the others. Orient the AUX Jack with the symbol on the Case Wiring Diagram as shown in Figure 21.
16. Note that the Case Wiring Diagram shows a connection between pins 1 and 5 and another connection between pins 1 and 2 of the AUX jack. Use extra component leads you saved when stuffing the PCB to make these connections as shown in Figure 21.
17. Cut a 2.5” section of 24 AWG black wire. Cut two 2.5” sections of AWG 24 orange wire.
18. Solder the black wire and the two orange wires to the AUX jack as shown in Figure 21.

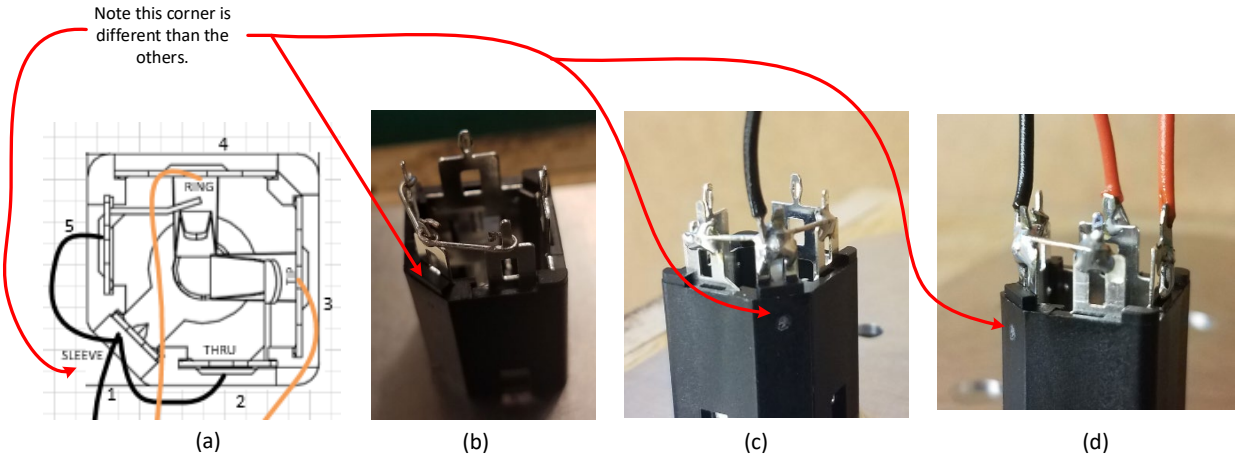


Figure 21 – (a) Orient the AUX jack as shown in the Case Wiring Diagram. Note that one corner is different than the others. (b) Use extra component leads to make the connections on the jack by securing them to the top of the terminals. (c) Solder the component leads. Then *tin*[1] the black lead, lay it next to the terminal and solder it. (d) Finally, solder the orange wires.

19. Find the Guitar Jack (it's the same jack is used for the guitar input and external speaker) Place it in the panel. Orient it as shown in Figure 22.
20. Use one of the cut off component leads to make the connection on the jack shown in Figure 22.
21. Cut a 2.5" section of 24 AWG black wire and a 2.5" section of 24 AWG orange wire. Connect to the Guitar jack as shown in Figure 22.

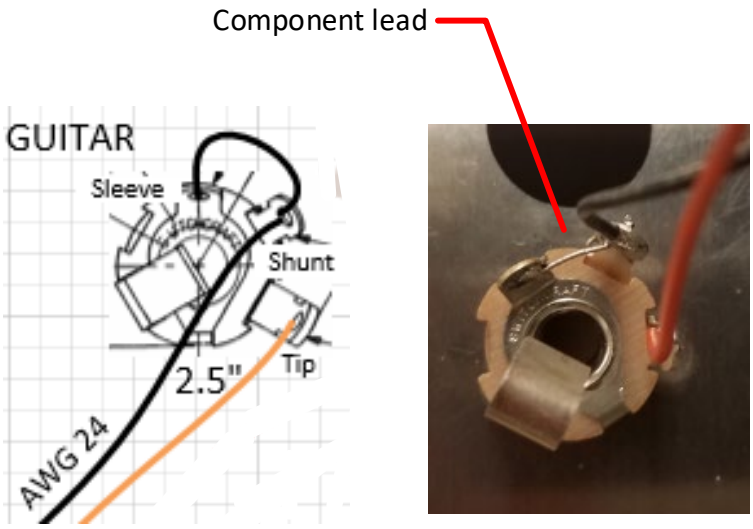


Figure 22 - Solder the component lead between the shunt and sleeve connections of the Guitar Jack and then solder the orange and black wires

[1] This refers to applying solder to a wire prior to soldering it to a terminal. Learn this skill by searching for it on the Internet. Tinning makes soldering to a terminal easier.

22. Find the EXT SPKR jack and place it hand-tight in the Front Panel (it fits in the hole for the Guitar jack). Find the EXT SPKR jack on the wiring diagram. Cut 3” sections of yellow, violet, and white 18 AWG wire. When you strip the wires make sure to use the setting for #18 AWG on the stripper (Figure 19). Solder the wires to the jack as shown in Figure 23.

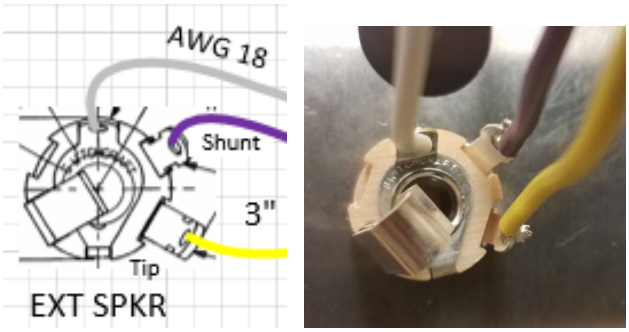


Figure 23 - Wiring for EXT SPKR Jack

23. Your collection of wired Electromechanical Components should look as shown in Figure 24.

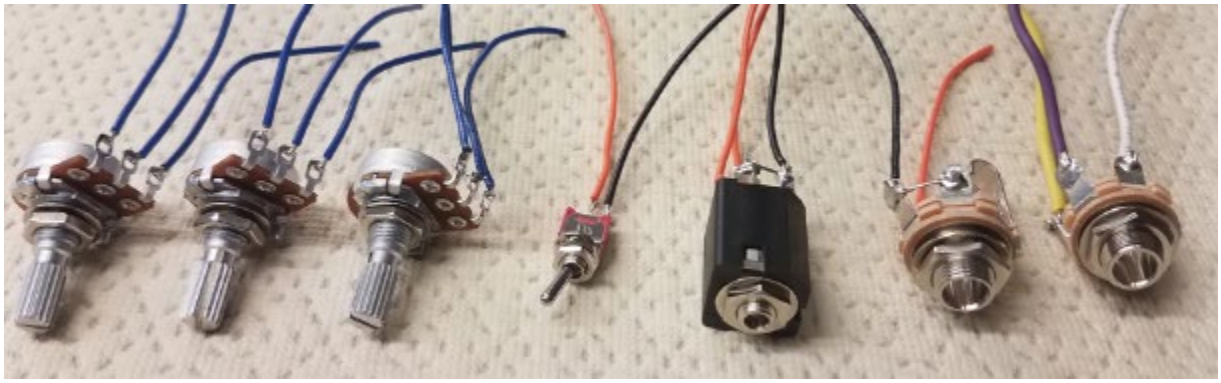


Figure 24 - Electromechanical Components with wires attached

24. Find the pilot light assembly and refer to Figure 25 for details of how it attaches to the Front Panel.

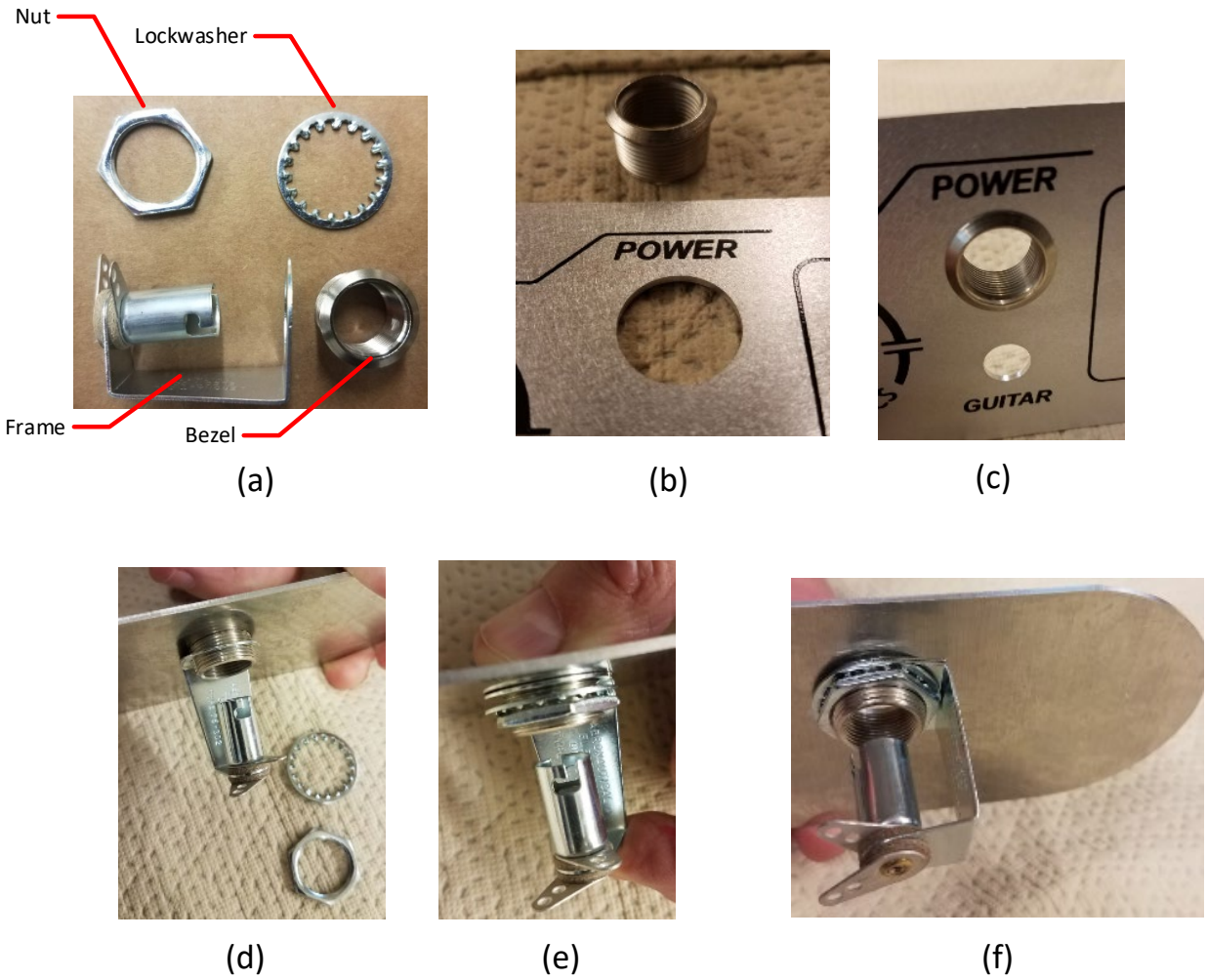


Figure 25 – Details for installing the Pilot Light in the Front Panel. (a) Pilot light hardware. (b) Locate the Front Panel and the Bezel. (c) Insert the Bezel into the Front Panel so the threads come out the back of the Panel. (d) Place the Frame over the Bezel. (e) Insert the Lockwasher and then thread the nut on the Bezel. (f) Orient the Frame so that the flat side faces the closest edge of the Front Panel. You will tighten the nut in the next step.

25. Secure the pilot light assembly to the Front Panel so the wire terminals face away from the panel edge as shown in Figure 26. Fully tighten the nut with a 13/16” (or adjustable) wrench while gently holding the side of the housing with pliers.

26. Cut 6” red and black 18 AWG wires and solder to the correct terminals on the pilot light as shown in Figure 26.

When connecting the wires to the pilot light, it is extremely important that the red wire is soldered to the connection on the back of the pilot light as shown in Figure 28*(b). If the light is wired incorrectly the pilot light will not work and R20 on the PCB will get very hot.*

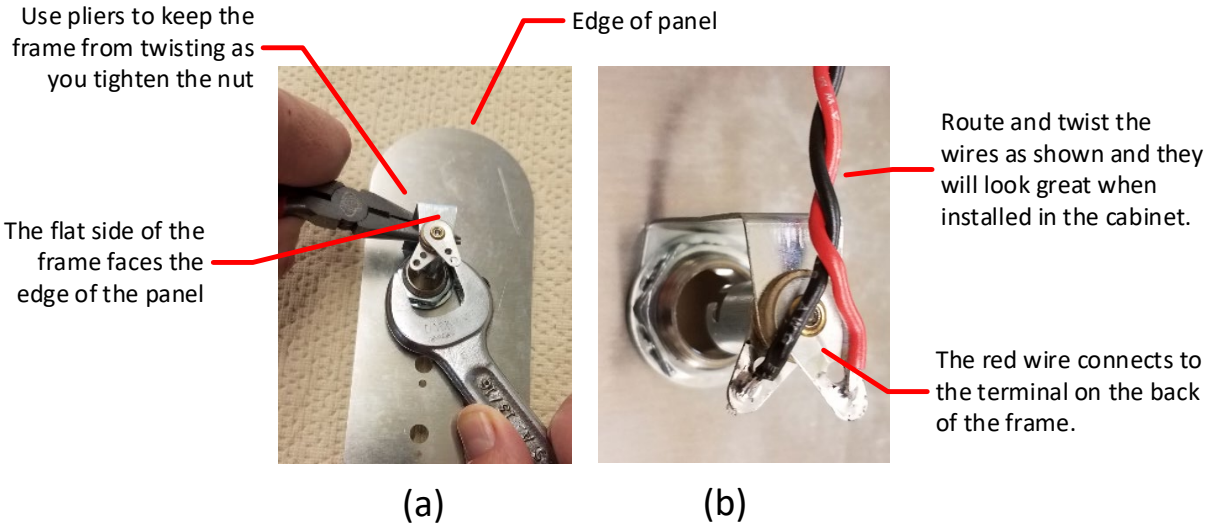


Figure 26 – (a) Tighten the pilot light housing with the wrench while securing it with a pair of pliers. You must fully tighten the pilot light at this step because it will not be possible later in the procedure. (b) Solder the wires to the terminals and twist with about two twists per inch.

27. Find the Power Connector Panel and the Power Input Jack (Figure 56). Remove the nut and washer from the Power Input Jack.
28. Push the Power Input Jack into the plate so the solder terminals are on the side with no writing.
29. Place the washer on the Power Input Jack as shown in Figure 27 and thread the nut. Fully tighten the nut with a 13 mm wrench (or a pair of pliers). Hold the Power Connector Panel with a towel while you tighten so you won't cut yourself.
30. Note that the center terminal of the Power Input Jack has a "solder cup" instead of a terminal. Search the Internet for a video on soldering a wire to a solder cup.
31. Cut 9" red and black 18 AWG wires for the Power Input Jack. Tape the Power Connector Panel into the indentation in the cabinet to secure it. Solder the red wire to the center terminal and the black wire to the outer terminal as shown in Figure 27.

It is extremely important that you solder the red and black wires to the correct locations on the Power Input Jack as well as on the PCB (later in the procedure.) If these wires are reversed, the power supply polarity will be reversed, and the PCB will be damaged.

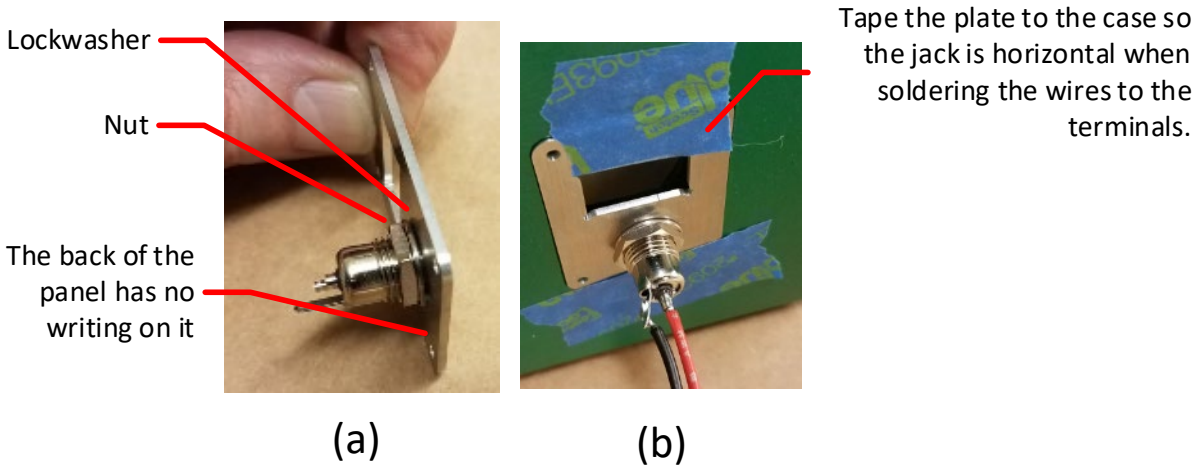
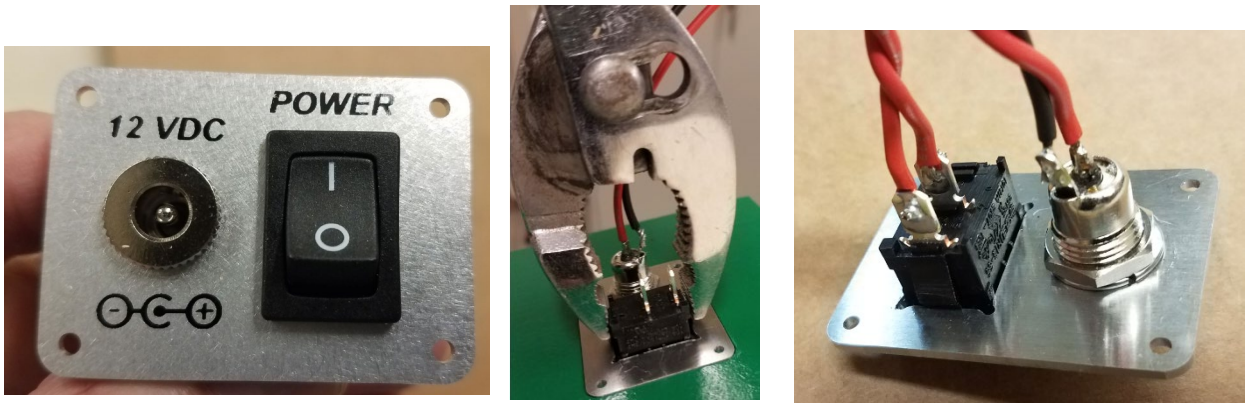


Figure 27 – (a) Hardware stack-up for the Power Input Jack. (b) Make sure the jack is facing sideways when you solder to the center terminal. If the center terminal is vertical, the solder will flow into the jack and can damage it

32. Find the Power Switch (Figure 56). Press the Power Switch through the front of the Power Connector Panel as shown in Figure 28.
33. Cut two 9” red 18 AWG wires for the Power Switch and solder to the switch terminals.
34. Twist the wires from the Power Switch, Power Input Jack, and Pilot Light with approximately two twists per inch as shown in Figure 28



(a) (b) (c)

Figure 28 – (a) Press the Power Switch through the front of the Power Connector Panel with the "1" next to the word "Power." (b) Squeezing the tabs on the Power Switch with pliers makes it easier to press in. (c) Solder the wires to the terminals and twist with about two twists per inch.

Congratulations! At this point you have prepared all the Electromechanical assemblies and you are ready to begin connecting the wires to the PCB.

Next you will connect all the Electromechanical Components to the PCB.

1. Get one of the pots with the 2.5" 24 AWG blue wires attached. Strip approximately 1/8" of the insulation from each wire. When pulling insulation off, hold the wire with your fingers so you don't stress the solder connection at the pot.
2. Remove the Case Wiring Diagram (Figure 35) from the three-ring binder and have it in front of you as you solder the wires to the PCB.
3. Solder the wires for the VOLUME pot to the PCB as shown in Figure 29.

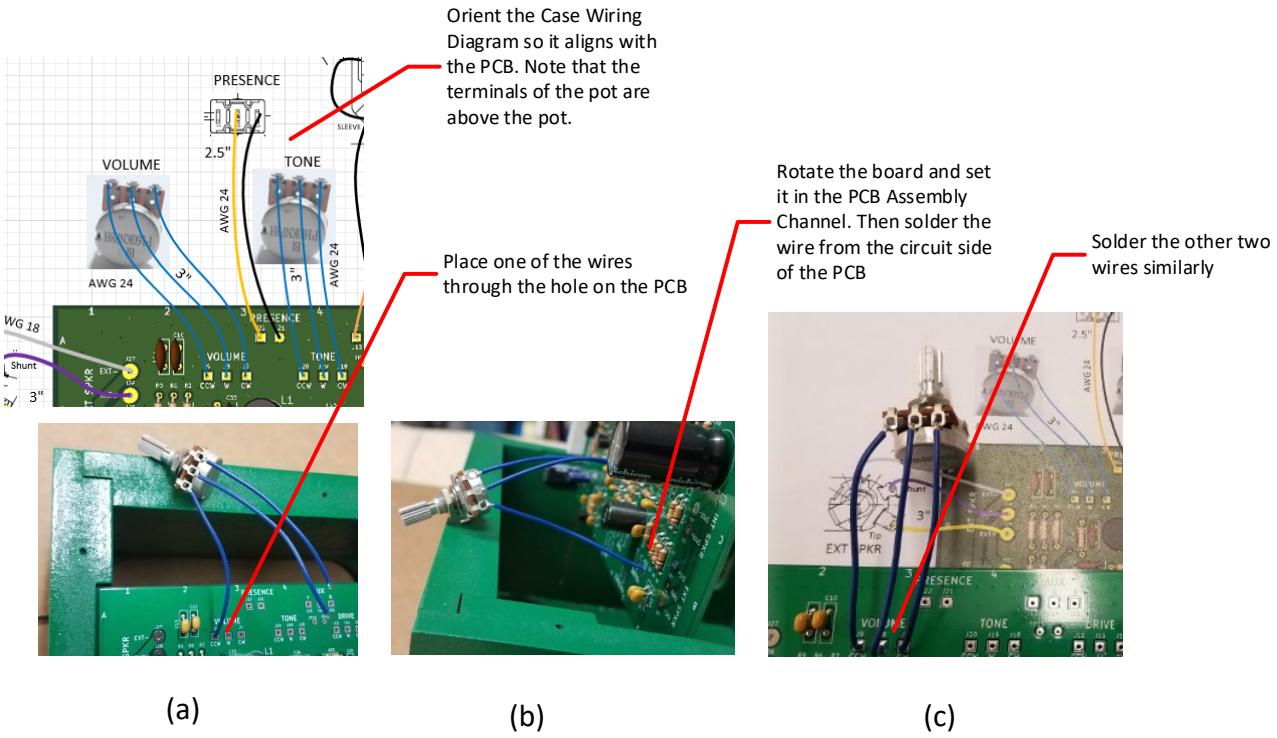


Figure 29 – Follow these steps to solder the wires from the pots to the PCB. Make sure that the pots are oriented with the terminals above them as shown.

4. Solder the wires for the TONE and DRIVE pots to the PCB.
5. Get the AUX jack with the three 24 AWG wires soldered to it. Remove about 1/8” of insulation from each wire. Solder the AUX jack to the PCB as shown in the Case Wiring Diagram. Twist the wires so there are about two twists per inch.
6. Solder the wires for the Presence Switch to the PCB as shown in the Case Wiring Diagram. Twist the wires so there are about two twists per inch.
7. Solder the wires for the Guitar jack to the PCB as shown in the Case Wiring Diagram. Twist the wires on the Guitar jack so there are about two twists per inch.
8. Solder the wires for the EXT SPKR jack to the PCB as shown in the Case Wiring Diagram. Twist the wires so there are about two twists per inch.
9. Remove the PCB from the Assembly Channel and set it aside.

The PCB should now look as shown in Figure 30.

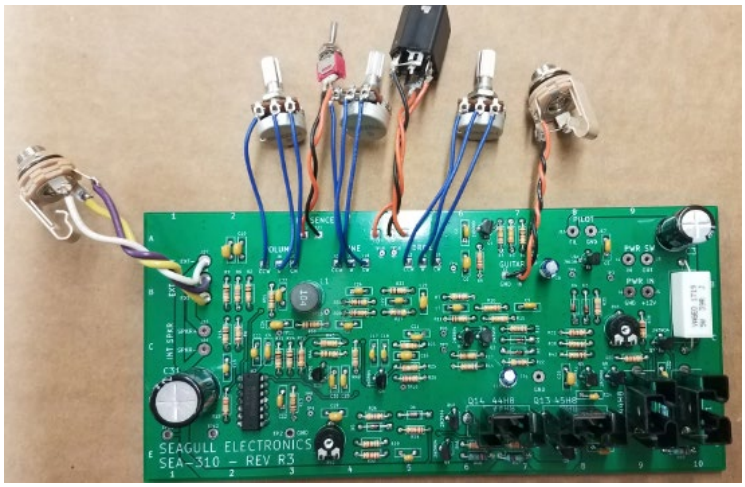


Figure 30 - PCB with Electromechanical Components attached

Next, Connect the Electromechanical Components to the Cabinet.

1. To prevent the Cabinet from sliding on the workbench as you install the speaker, install the four rubber feet (Figure 56) to the bottom of the cabinet with four #6 x ¾ flathead screws (Figure 57) as shown in Figure 31.

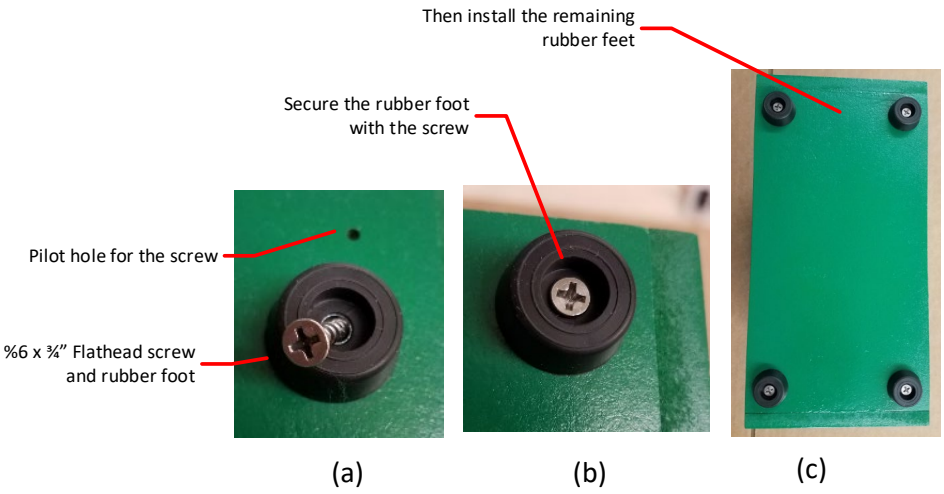


Figure 31 - Rubber feet - installation details

You are about to install the speaker in the cabinet with screws and locknuts. The locknuts "lock" because they have a small amount of plastic in them. You have to twist the screwdriver fairly hard to get the screw through the locknut. Be very careful with the screwdriver – if it slips it could damage the paper cone of the speaker.

2. Find the speaker (Figure 55), four 10-32 x ¾ inch flat head Philips screws, and the four locknuts (Figure 57.) Secure the speaker in the Cabinet so the terminals face the top of the Cabinet and tighten the screws as shown in Figure 32.

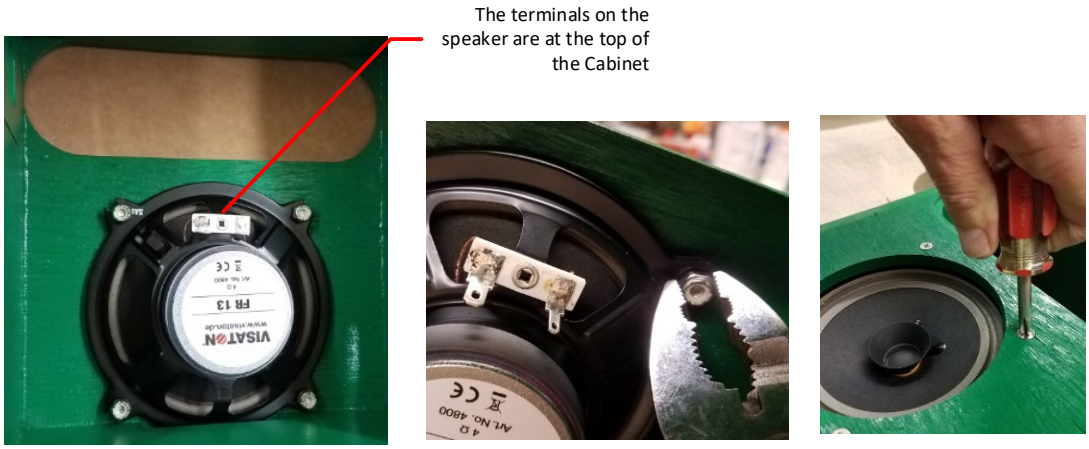


Figure 32 - (a) Orient the speaker so the terminals face the top of the cabinet and then install the screws and locknuts so they are hand tight. (b) Place the Cabinet on the workbench so the rubber feet keep it from slipping. Hold the locknut with a 3/8" wrench or a pair of pliers while you tighten each screw. (c) Tighten the screw until it stops turning. Don't let that screwdriver slip!

3. Secure the EXT SPKR Connector Panel to the case with four #2 x 3/8" round head screws (Figure 57) as shown in Figure 33.
4. Secure the Power Connector Panel to the case with four #2 x 3/8" round head screws (Figure 57) as shown in Figure 33.

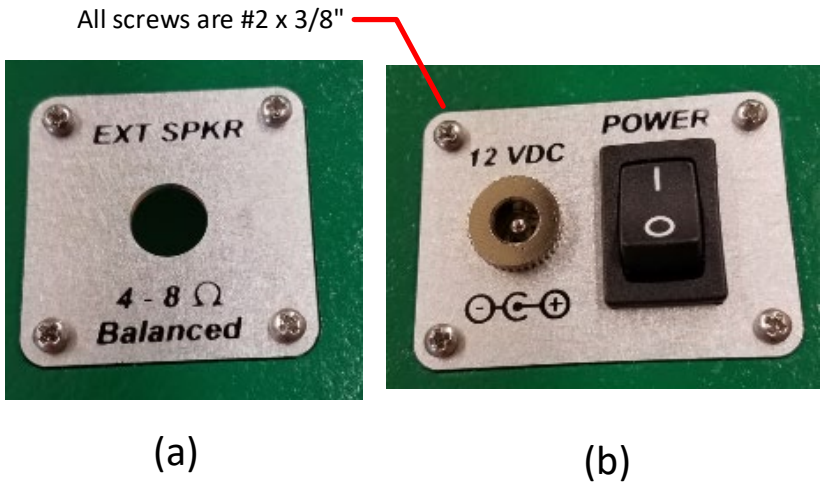


Figure 33 – EXT SPKR Connector Panel and Power Connector Panels installed to the Cabinet.

5. Examine the free ends of the wires you soldered to the Power Input Jack, Power Switch, and Pilot Light. If their lengths are slightly unequal, trim the longer wire.

6. Strip about 1/8” of insulation from the wires on the Power Input Jack, Power Switch, and Pilot Light. Hold the wires as you strip them so you don’t stress the terminals they are soldered to.

It is extremely important that you solder the red and black wires from the Power Input Jack to the proper locations on the PCB. If these wires are reversed, the power supply polarity will be reversed, and the PCB will be damaged.

---

7. Set the PCB in the Assembly Channel as shown in Figure 34 and connect the wires you just stripped to the PCB as shown on the Case Wiring Diagram. Note that the red wire from the Power Input Jack MUST connect to the +12 V connection on the PCB (Zone B9) as shown in Figure 34. The black wire from the Power Input Jack MUST solder to GND (Zone B9). If these wires are reversed, the PCB will be damaged when power is applied.

8. Solder the red wires from the Power Switch to the PWR SW connection on the PCB (Zone B9) as shown in Figure 34. It does not matter which wire goes to which connection on the PCB.

9. Locate the Front Panel which should have the pilot light securely mounted to it. Solder the pilot light wires to the PCB as shown in Figure 34. Make sure the red wire connects to FIL(ament) on the PCB (Zone A8) and the black wire connects to GND (Zone A8). If the light is wired incorrectly the pilot light will not work and R20 on the PCB will get very hot.

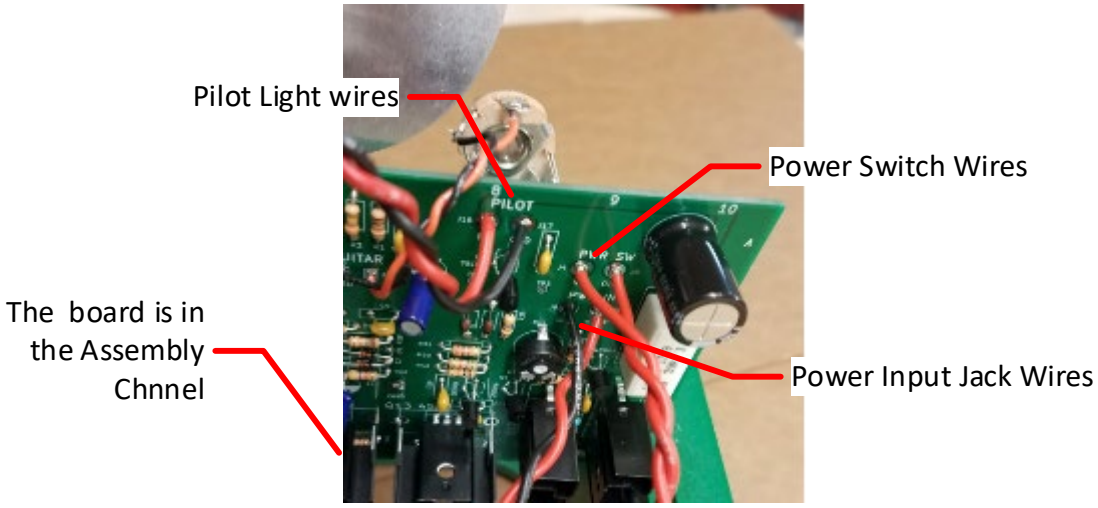


Figure 34 - Connections from the Power Connector Panel to the PCB

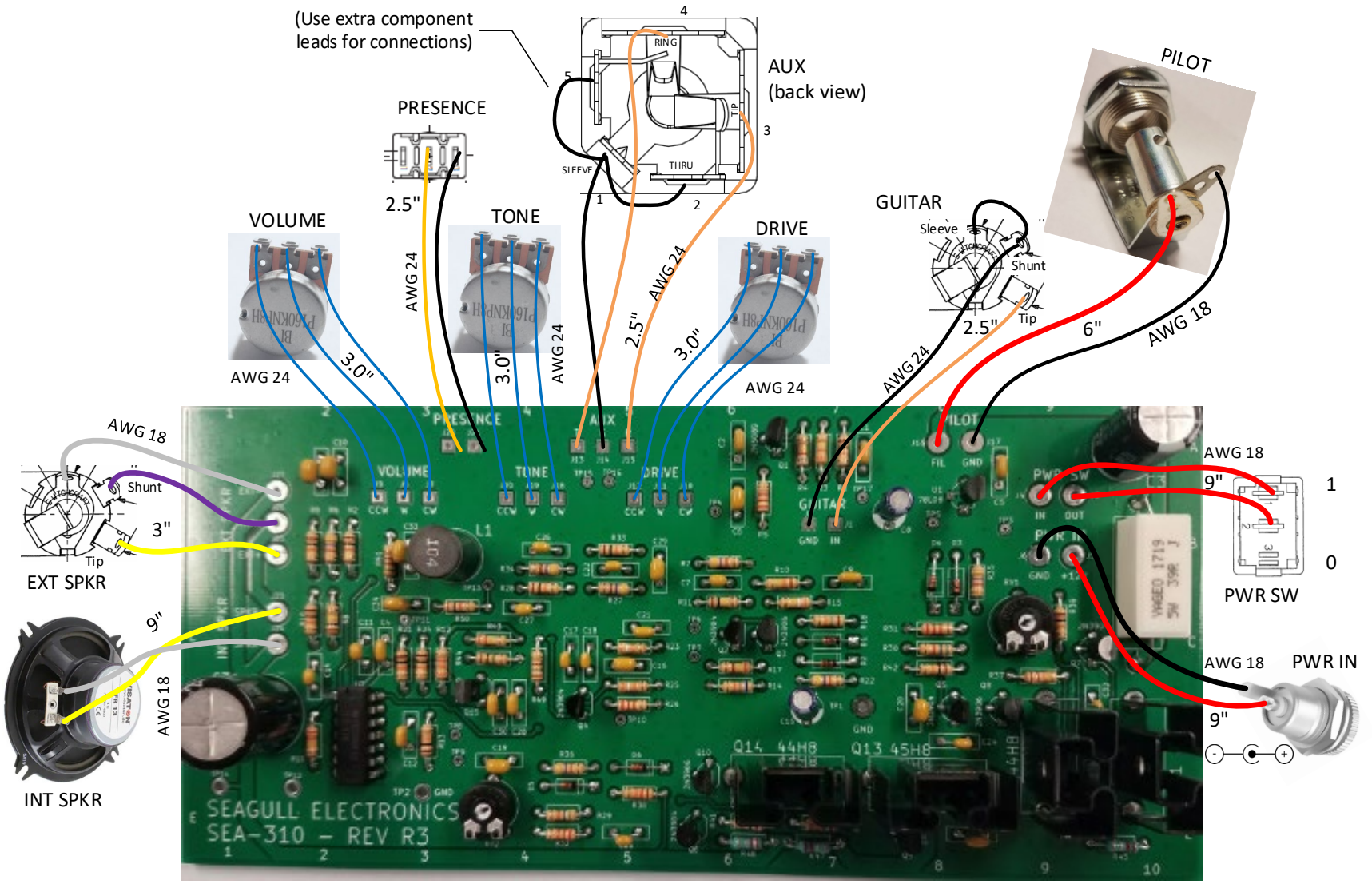


Figure 35 - Case Wiring Diagram

STEP 5 – TESTING THE SEA-310

You are now ready to apply power to the SEA-310 and make sure it is properly assembled and ready to provide the best possible performance. This is important because if there are assembly errors, your SEA-310 may work – but won't give you the best sound it's capable of. If one of the tests below fails, it is typically the result of an assembly error. These tests will help you find and fix any issues.

Prepare the SEA-310 for Electrical Testing

Place the SEA-310 face down with the PCB component side up in the PCB Assembly Tray. Wrap painter's tape around the electromechanical components that are connected by wires to the PCB to insulate them so they will not "short" to each other if they touch. Make sure to leave an opening in the tape so you can turn the pots, move the Presence switch, and plug cables into the jacks.

Note that there are holes on the PCB with markings like TP1 (Zone D7), TP2 (Zone E2), etc. These are called test points and you'll see that they are also shown on the schematic diagram. The test points provide a convenient place to place the multimeter probe during testing. Some of the test points are small, and you must hold the multimeter test lead on them as you make measurements. The more commonly used test points are larger so you can push the test leads through the test point and leave it there while you make measurements.

Do not connect any cables to the SEA-310. Figure 36 shows the SEA-310 ready for testing.

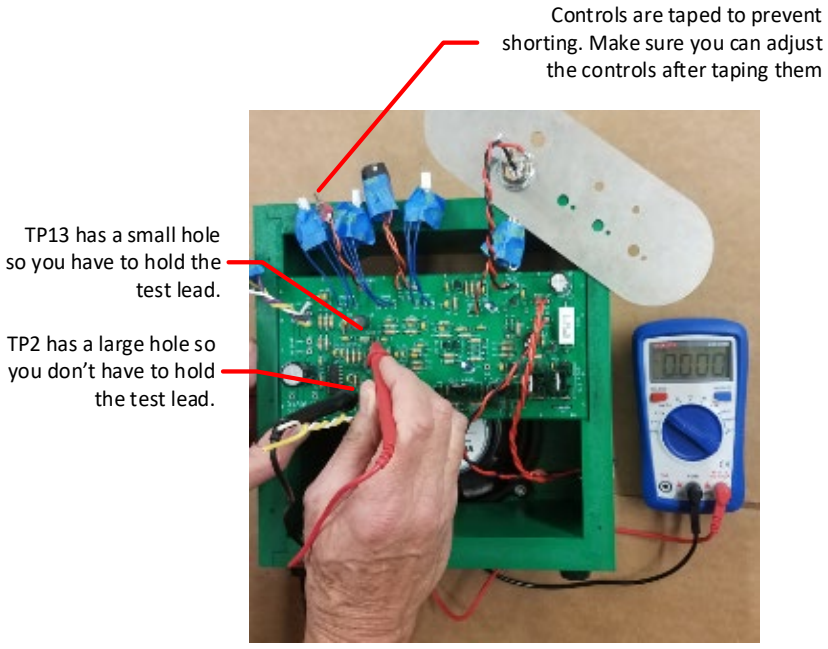
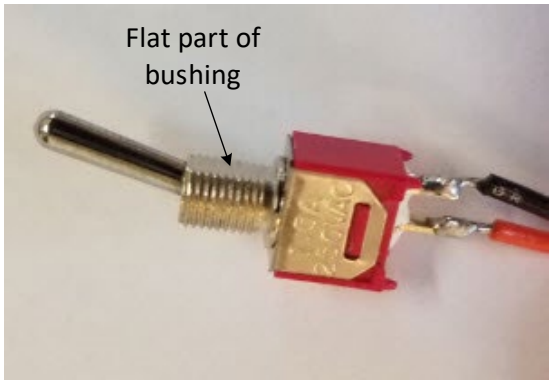


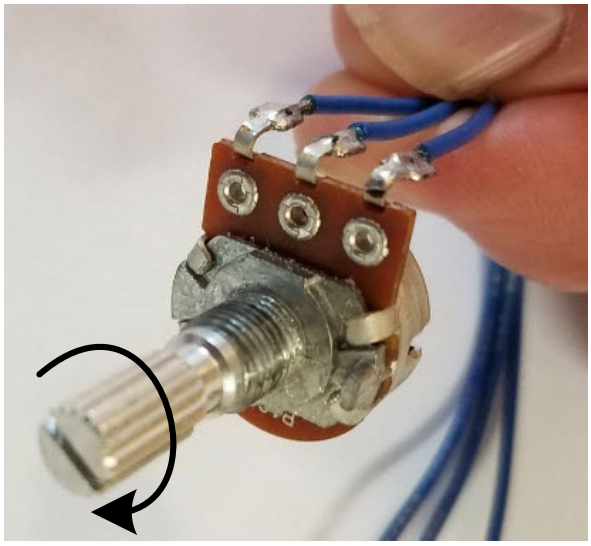
Figure 36 – The PCB is placed in the PCB Assembly Tray and ready for testing. Note the tape around the Electromechanical Components that keeps them from shorting to each other. The black lead of the multimeter is connected to ground by placing it through TP2. The red lead is held on TP13.

Setting Controls During Testing

During testing you will adjust the potentiometers (Drive, Tone, and Volume) and the Presence switch. Figure 37 shows how to set them.



Presence is off when the switch handle is next to the flat side of the bushing.



The arrow shows the clockwise (CW) direction for the pot. Note that you are looking directly at the shaft.

Figure 37 - Details for setting the SEA-310 controls during testing.

Smoke Test!

The term “Smoke test is commonly used in industry. Simply put, it involves applying power and checking for smoke. Engineers and technicians know it is bad to “let the smoke out” of the components.

The worst assembly error you can make with the SEA-310 is reversing the polarity of the plus and minus connections from the power supply. Double check your wiring as shown below.

Before doing the smoke test make sure that:

1) The center terminal of the Power Input Jack on the side of the Cabinet is connected to the red wire, and the side terminal of the Power Input Jack is connected to the black wire (Figure 28).

2) The red wire from the Power Input Jack connects to J5 (PWR IN “+12 V”, Zone B9) on the PCB (Figure 34).

3) The black wire from the power jack connects to J6 (PWR IN “GND”, Zone B9) on the PCB.

4) The power switch on the case has two red wires that connect to J3 and J4 on the PCB (Zone B9). They are marked “PWR SW,” and connect to the power switch. It does not matter which of these wires go to which connection on the switch (Figure 34).

5) The pilot light wires are connected as shown in Figure 26.

6) The red wire from the pilot light connects to FIL(ament) on the PCB (Zone A8) and the black wire connects to GND (Zone A8) (Figure 34).

Next, make sure that the polarity of the External Power Supply polarity is correct. Connect the Power Cord to the External Power Supply and plug the cord into a wall outlet. This will illuminate a small green light on the External Power Supply. Set the multimeter to DC Volts and place the red lead in the center of the output jack and the black lead on the outside of the jack as shown in Figure 38. If there is a negative sign in front of the voltage reading, the power supply is incorrectly configured, and should not be connected to the SEA-310.

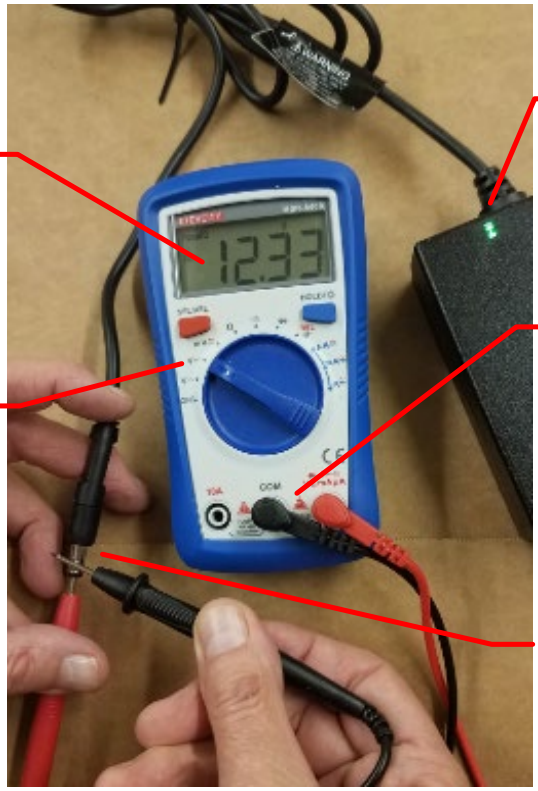


Figure 38 - With the multimeter set to measure DC Volts and the red lead in the center of the connector and the black lead on the outside, you should read about 12 Volts.

Set the Power Switch to the “0" position (Off). Plug the External Power Supply into a wall outlet and connect the External Power Supply to the Power Input Jack on the SEA-310. Turn the Power Switch on and check for smoke. Insert the light bulb in the pilot light housing by pushing it in the socket and then turning about 1/8 turn and make sure it glows brightly. Run your hand over the components of the PCB and feel for hot components. R20 (Zone B10) is the only component that should be warm. If the ICs, U1 (Zone A8)

or U2, (Zone D3) get hot, then either the plus and minus connections on the PCB are reversed or the IC was inserted upside down. In either case, the IC is ruined, and you'll need a new one. Incorrectly installed transistors may get hot also and will need to be replaced. Contact us if you need replacement components.

DC Bias Tests and Adjustments

Before playing sound through the SEA-310, voltages in the circuit will be measured when there is nothing connected to the Guitar and AUX inputs. The measurements are called Direct Current (DC) bias voltages, and they verify that many of the resistors and transistors are installed correctly. Experienced electronic technicians know that most circuit problems can be found quickly and efficiently by measuring DC bias voltages. After measuring voltages, variable resistors RV1 and RV2 will be adjusted.

Table 1 guides you through the DC Bias tests. The table columns are:

1. Column 1 – "Measurement Location" Specifies the test point on the PCB where you place the red lead of the multimeter when making the measurement. The zone on the PCB is also shown so you can find the test point on the PCB.

2. Column 2 – "Measured Voltage" Write the measured voltage here. You may need the measurement later if you experiment with the SEA-310.

3. Column 3 – "Measurement Limits" These are the test limits for the measurement. If the measurement falls between these values the test is a success. If it is outside the range, it is a fail and the problem will have to be diagnosed

4. Column 4 – "Components" This column shows the components that affect the measurement. If the measurement is a success, then it is very likely that these components are correctly installed. If the measurement fails, check each of these components against the inventory sheet to make sure they are correct. Also visually inspect the solder joints between these components and the PCB.

For all measurements, the Power Switch should be on. Remove any Guitar or AUX input cables. Turn Drive, Tone, and Volume pots fully CW and set Presence off as shown in Figure 37. Place the black multimeter lead through the GND test point (TP2, Zone E3) and set the multimeter to measure DC voltage. (you will see a "DC" at the upper-left side of its screen)

Take the measurements shown in Table 1. If a measurement value is outside the measurement limits, visually inspect the components shown in the Components column of Table 1 and make sure they match the components shown on the Inventory Sheets.

Measurement location (zone)	Measured voltage (V)	Measurement limits (V)	Components
TP3 (B9)		11.5 – 12.5 V	External power supply, Power wiring and switch.
TP5 (B8)		7.9 – 8.1 V	U1, C3, C5, R12
TP8 (D3)		5.85 – 6.15 V	R12, R13, C12, U2

Measurement location (zone)	Measured voltage (V)	Measurement limits (V)	Components
TP4 (A6)		4.2 – 4.6 V	R1, R3, R4, Q1, R5, C6
TP7 (C6)		2.7 – 3.0 V	C7, R10, R11, Q2, R17, C15
TP6 (C6)		5.7 – 6.3 V	R15, Q3, R18, D1, D2, R22, C17, C18.
TP10 (D5)		3.1 – 3.6 V	R23, R25, Q4, R26, R27, R28, R34, C26
TP13 (C4)		3.6 – 4.0 V	C27, R43, R44, R49, R50, R51, L1, Q15, wiring of presence switch.
TP9 (D3)		5.8 – 6.0 V	R2, R6, R8, R9, R16, R19, R21, C10, C11, C13, C14, U2.
TP11 (C3)		6.1 - 6.3 V	R21, R24.

Table 1 – DC Bias Data

Place the red multimeter lead on TP12 (Zone E2) and leave the black lead connected to TP2 (GND, Zone E3). While reading the voltage, adjust RV1 (Zone C9) with a very small screwdriver so that the multimeter reads between 5.95 and 6.05 V. The components associated with this measurement are (R30, RV1, R31, R35, R39, R37, R42, R45, R46, Q5, Q7, Q8, Q11, Q12, C31, D3, D4

Place the red multimeter lead on TP14 (Zone E1) and leave the black lead connected to TP2 (GND, Zone E3). While reading the voltage, adjust RV2 (Zone E4) so that the multimeter reads between 5.95 and 6.05 V. The components associated with this measurement are (R29, RV2, R32, R36, R40, R38, R41, R47, R48, Q6, Q9, Q10, Q13, Q14, C31, D5, D6, and the EXT SPKR jack wiring.

Configure the Audio Signal Generator

With the DC Bias Tests successfully completed, the SEA-310 is ready to be tested with audio input signals. Make sure the yellow and white speaker wires are not connected because the tones are loud and can damage your hearing.

For these tests, you will need an audio signal generator app for either your phone or your computer such as the ones described below.

If you have an iPhone, install the Media Punk Tone Generator on your phone and use as shown in Figure 39.

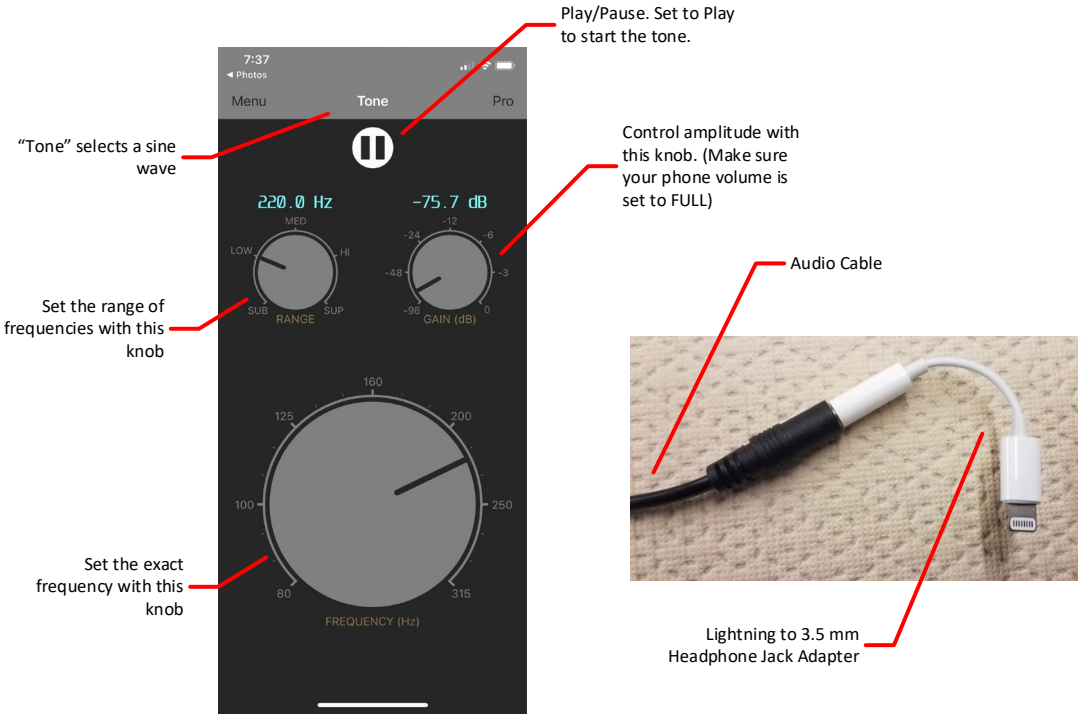


Figure 39 – Using the Media Punk Tone Generator. (a) Control screen. (b) For iPhones 7 and later you will need the Lightning to 3.5 mm Headphone Jack Adapter between your phone and the Audio Cable.

If you have an Android phone, install the Keuwlsoft Tone Generator on your phone. Use it as shown in Figure 40.

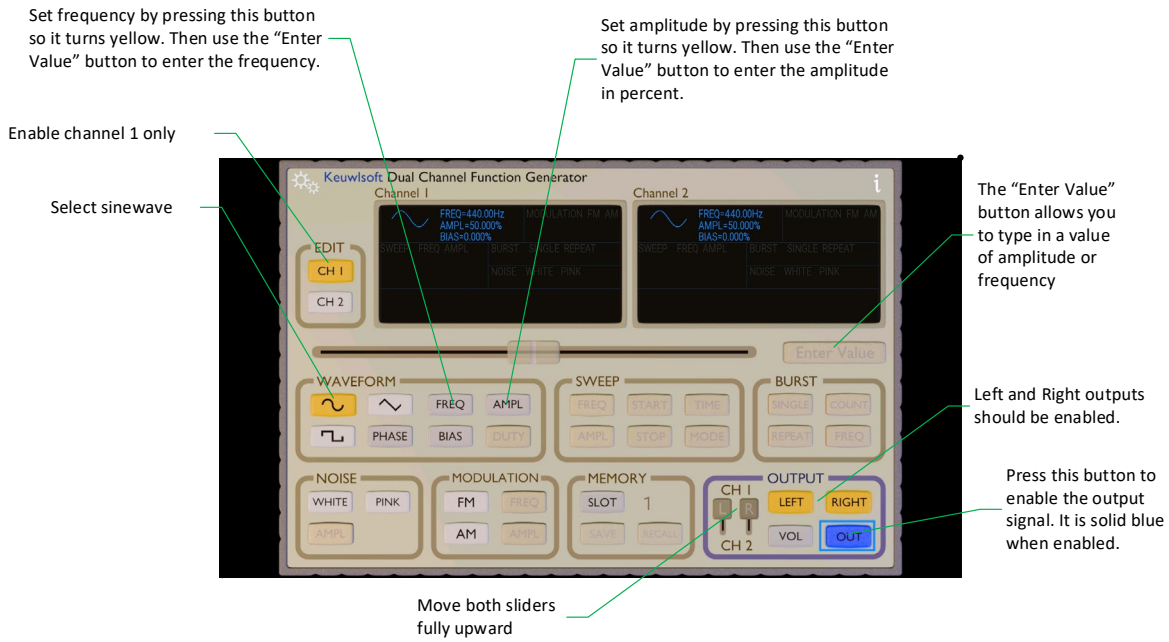


Figure 40 - Control screen for the Keuwlsoft signal generator app

Set the Test Input Level

Set your phone volume to full for these tests. Turn the Drive and Volume knobs on the SEA-310 CW. Turn the Tone knob CCW. Turn Presence off (switch handle on flat side of switch). Turn power on. Locate the Audio Adapter (Figure 56) and plug it into the Guitar input jack on the SEA-310. Connect the Audio Cable between your phone or computer and the Audio Adapter as shown in Figure 41.

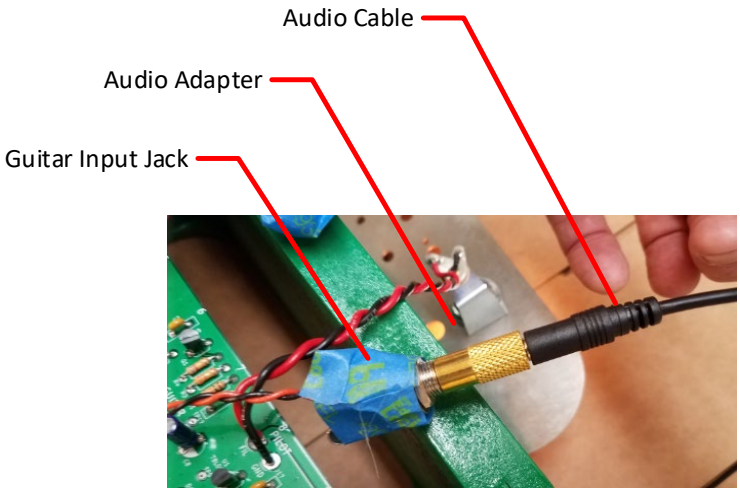


Figure 41 - Connect the Audio Cable to the Guitar Input using the Audio Adapter. Connect the other end of the Audio Cable to your phone or computer.

Some phones will automatically lower their volume from FULL when the audio cable is taken out and reinserted. This is a great safety feature for headphones, but it will change the signal level into the SEA-310 and corrupt your measurements. Whenever you disconnect the audio cable, make sure to reset the phone volume to full.

Set the frequency of the Audio Signal Generator to 220 Hz (that's one octave above the A string on your guitar) and set the volume control on your phone to full. Set the multimeter to read AC Volts (you will see "AC" on the left of its screen). Place the black multimeter lead through TP2 (GND, Zone E3) Place the red multimeter lead on TP17 (Zone A7). Adjust the signal generator's AMPL[2] control until the multimeter reads 5 mV. The AMPL setting from the audio signal generator will be used throughout this test and is called the "Test Input Level." Remember that the voltage from your phone is set by the AMPL setting on the signal generator AND the volume control on your phone so make sure the volume on your phone is set to full when you use the Audio Signal Generator. Note the AMPL setting and volume control below.

AMPL Control for Test Input Level _____

Phone Volume Control for Test Input level (should be "full"): _____

Gain Test

This test verifies that your SEA-310 will properly amplify the tiny signals from your guitar strings into a booming sound at the speaker. We will measure voltage gain, which is the ratio of one voltage to another. For example, if a 5 mV sinewave is fed into the Guitar input of the SEA-310 and a 5 Volt sinewave is measured at the output, then the gain from input to output is[3]:

$$Gain = \frac{V_{Out}}{V_{In}} = \frac{5}{0.005} = 1000$$

Equation 1

[2] Note that you are entering amplitude in percent or dB and not Volts. The reason for this is that the signal generator app can be used on different phones that have different circuitry and the signal generator app does not know how its output is converted to voltage. Therefore, the app shows percentage or dB. The purpose of this step is to establish a 5 mV level from your phone or computer.

3 Audio engineers express gain in dB using the equation and example below:

$$Gain_{dB} = 20 \cdot log_{10}\left(\frac{V_{Out}}{V_{In}}\right) = 20 \cdot log_{10}\left(\frac{5}{0.005}\right) = 60.0\ dB$$

When the Drive or Volume controls are adjusted, they change the gain through the SEA-310. This is why measurements are made with these controls set to known (CW) positions. For our testing we will feed the Guitar input with the 5 mV Test Input level and then check the voltages in different places in the SEA-310. If the SEA-310 has the correct gain, the measured voltages will be within the high and low test limits. If the measurements are outside the limits, the test fails, and you will need to make sure the associated components match the Inventory sheets and they are soldered properly to the PCB..

Set the Drive and Volume controls fully CW. Set Tone CCW. Set Presence off. Set the frequency of the Audio Signal Generator for 220 Hz and its amplitude to the Test Input Level. Connect the Audio Signal Generator to the Guitar input as you did in the last step. Set the multimeter to measure AC Volts and place the black lead of the multimeter through TP2. Place the red multimeter lead at TP4 (Zone A6) and make sure you read the Test Input Level of 5 mV. If you don't read 5 mV, you will have to reconfigure the Audio Signal Generator. Take AC voltage measurements at the test points shown in the rows of Table 2. Verify that the voltages are within the measurement limits. If a test fails, then check the values of the components in the right-hand column.

Measurement location (zone)	Measured voltage (V)	Measurement limits (V)	Components
TP4 (A6)		0.048 – 0.052 V	C1, R1, R3, R4, Q1
TP6 (C6)		0.085 – 0.095 V	C6, C7, wiring of Drive pot
TP10 (D5)		0.084 – 0.094 V	C16, C17, C18
TP13 (B4)		0.066 – 0.072 V	R27, R28, R33, R34, C22, C26, C29, C27
TP9 (D3)		1.3 – 1.4 V	R50, C34, R2, R6, R8, R9, R16, R19, C10, C11, c13, C14, U2
TP11 (B3)		1.3 – 1.4 V	U2
TP12 (E2)		2.5 – 2.7 V	R30, C20, C24
TP14 (E1)		2.5 – 2.7 V	R29, C19, C25

Table 2 - AC gain measurements. Make sure the Multimeter is set to read AC Volts.

The measurements in Table 2 were all taken with the black multimeter lead connected to ground. In industry we would say the "measurements were taken with respect to ground." To check the speaker drivers, measure the voltage difference between TP12 and TP14.

Place the red multimeter lead through TP12 and the black lead through TP14. The AC voltage should be between 5.2 and 5.3 V. Write the voltage reading in Table 3 because it will be needed for later tests. Leave the system set in this configuration because it will be used for the next test.

Measurement location (zone)	Measured voltage (V)
TP12 to TP14	

Table 3 Voltage measurement between TP12 and TP14

Test the Wiring of Drive and Volume Pots

Increasing either the Drive or Volume pots should increase the voltage and therefore the sound level the speaker. If you wired a pot incorrectly, turning it clockwise would *decrease* the sound at the speaker. With the system configured for the previous test you should see between 5.4 and 6.0 V between TP12 and TP14. Turn the Drive pot counterclockwise and the multimeter reading should decrease. If it increases, the pot is wired backwards. Return the Drive pot to the CW position and perform the same test with the Volume pot. If this test fails, check the pot wiring against the Case Wiring Diagram.

Low Frequency Response Test

This test will make sure that the low frequency from your guitar's low E string (88 Hz) is faithfully amplified by the SEA-310. In the last step of the Gain Test, you wrote the measurement between TP12 and TP14 in Table 3 (it should have been about 5.3 V). Multiply that voltage by 0.707 and enter it in Table 4. For example, if the voltage was 5.4 V, the result of the multiplication would be 3.74 V. Turn the Drive and Volume pots CW and the tone CCW. Turn Presence off. Set the frequency of the Audio Signal Generator to 220 Hz. Measure between TP12 and TP14. Now lower the frequency of the audio generator until the multimeter reads the value you just computed (around 3.74 V). This test passes if the frequency is below 95 Hz. If this test fails, check C1, R1, C5, C6, C17, C26, C27, C34, R2, C11, R8, C21, R30, C20, R29.

Measurement location (zone)	Voltage from Table 3	Voltage from Table 3 multiplied by 0.707.	Measured Frequency
TP12 to TP14			

Table 4 – Low Frequency Test Results. The frequency in the last column is called the "Lower 3 dB Frequency."

Tone Control Tests

These two tests verify that the TONE pot is wired correctly and the components in the tone control circuits are correct.

Tone Control Test 1

Turn the Drive and Volume pots CW and the tone CCW. Set Presence off. Set the amplitude of the Audio Signal Generator to the Test Input Level and the frequency to 220 Hz. Measure the AC voltage between TP12 and TP14 and enter this voltage in the "Initial Voltage" column of Table 5. Multiply this value by 0.28 to get the lower test limit for the test and by 0.38 to get the upper limit and enter the limits in Table 5. Now turn the tone control CW and verify the measured voltage is between the test limits. If the test fails, check components R27, R28, R33, R34, C22, C26, and C29.

Tone Control Test 2

Turn the Drive, Tone, and Volume knobs CW. Set Presence off. Set the amplitude of the Audio Signal Generator to the Test Input Level and the frequency to 1000 Hz. Measure the AC voltage between TP12 and TP14 and enter this voltage in the "Initial Voltage" column of Table 5. Multiply this value by 0.66 to get the lower test limit for the test and by 0.76 to get the upper limit and enter the limits in Table 5. Now

turn the tone control CCW and verify the measured voltage is between the test limits. If the test fails, check components R27, R28, R33, R34, C22, C26, and C29.

Tone Control Test	Initial Voltage	Lower Test Limit Voltage	Upper Test Limit Voltage	Measured Voltage
Test 1				
Test 2				

Table 5 – Tone Control Test Results

Presence Switch Test

Turning the Presence switch on reduces the amplifier gain at 680 Hz by a gain factor of 0.35 resulting in a sound that many musicians like. In industry, we say that R50, R51, C33, and L3 create a *notch filter* because they create a dip or notch in the frequency response. Set Drive, Tone, and Volume pots CW. Set Presence off. Set the frequency of the Audio Signal Generator to 680 Hz and its amplitude to the Test Input Level. Measure AC voltage between TP12 and TP14 and write it in the "Initial Voltage" column of Table 6. Multiply this voltage by 0.35 to get the lower test limit for the test and by 0.45 to get the upper limit. Now turn the Presence switch on and verify the measured voltage is between the test limits you just computed. If the test fails, check components R50, R51, C33, L1 and the wiring to the Presence switch.

Initial Voltage	Lower Test Limit Voltage	Upper Test Limit Voltage	Measured Voltage

Table 6 – Presence Switch Test Results

Connect the Speaker

You are about to connect the speaker to the SEA-310 PCB. The speaker can make a HUGE sound and you don't want it to damage your hearing. Follow the safety precautions below and wear those earplugs!

Before connecting the speaker, remember that it's important to protect your hearing and maintain healthy relationships with your parents, roommates, and neighbors. The SEA-310 makes a huge sound, and prolonged exposure to loud sounds can damage your hearing. In addition, others may not appreciate screaming tones as much as you do. Here are two suggestions:

1) Even with the speaker connected to the PCB, you can always disable it by plugging an electric guitar cable into the EXT SPKR connection on the side of the cabinet. Do not connect the other end of the cable to anything. This breaks the path between the SEA-310 and the internal speaker and you'll get silence. You can also plug the Audio Adapter into the EXT SPKR jack to

disable the internal speaker.

2) Wear the earplugs provided in the kit when testing the SEA-310 with the speaker wires connected.

Wire the Speaker as shown below:

1. Turn the Power Switch off and disconnect the power cable from the Power Input Jack.

2. Cut a 9” length of yellow 18 AWG wire and a 9” length of white 18 AWG wire.

3. Strip ¼” from one end of each wire and solder to the Speaker as shown in Figure 42.

4. Twist the wires so there are about two twists per inch and solder the wires to the PCB as shown in the Case Wiring Diagram.

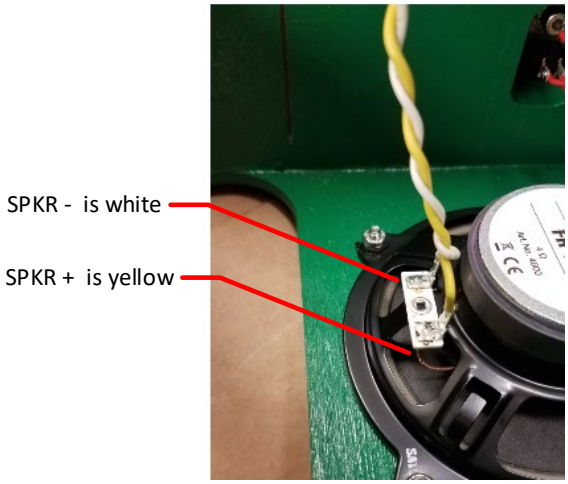


Figure 42 - Strip 1/4" from the wires and solder to the terminals on the speaker as shown. Note the “+” and “-“ terminals on the Speaker.

High Frequency Test

With the Tone pot CW, the SEA-310 will pass frequencies up to about 5000 Hz. If you are using an inexpensive AC multimeter you cannot test the high frequency response because the multimeter is not capable of making accurate measurements at these frequencies. So instead of making a scientifically accurate measurement, we’ll do the next best thing:[4]

1) Double-check the components on the PCB to make sure the components that affect frequency response are correct. The critical components for high frequency response are C14, C17, and C18. Use the Inventory Sheets to verify that the correct components are installed.

[4] If you have access to an oscilloscope or a multimeter with sufficient frequency response, the upper 3 dB cutoff frequency should be about 5000 Hz with the tone control CW.

2) Feed high frequencies through the SEA-310 and make sure you hear them from the speaker as described below.

If you are lucky enough to be testing the SEA-310 with a parent, grandparent, or, uh, … someone older than you, offer to be the designated listener. The reason for this is that as we age (or are exposed to prolonged loud sounds) it is harder to hear high frequencies. Therefore, the older team member might think the SEA-310 is not producing high frequencies when the problem is just their hearing. As older folks, we always like to tell stories about the rock concerts that undoubtedly damaged our hearing. This might be a good time to take a break, swap stories, and then commit yourself to preventing hearing loss.

Now we'll do the test that requires hearing. Turn the Drive and Volume pots CCW. Set Tone CW. Presence off. Connect the Audio Signal Generator to the Guitar input using the Audio Adapter. Set the frequency of the Audio Signal Generator to 1000 Hz. Set the Audio Signal Generator to the Test Input Level.

1. Increase the Drive pot to about 25% of the way from CCW to CW and adjust the Volume pot until the sound from the speaker is at a comfortable listening level. It does not need to be loud.
2. Raise the frequency of the Audio Signal Generator from 1000 Hz to 2000 Hz and you will hear an octave jump in the frequency, but the level from the speaker should not change.
3. Return the frequency of the Audio Signal Generator to 1000 Hz and listen to the level from the speaker. Raise the frequency to 4000 Hz and you will hear a two-octave jump, but the level from the speaker should not change.
4. Return the frequency to 1000 Hz and listen to the speaker. Raise the frequency of the audio generator to 8000 Hz and you will hear a three-octave jump, and the level should be much lower.

Aux Input Test

Now we will make sure the SEA-310 can play your backing tracks from the AUX input. Remove the Audio Cable and Audio Adapter from the Guitar input. Plug the Audio Adapter into the EXT SPKR jack to disable the speaker. Connect the Audio Cable between the Audio Signal Generator and the AUX input. Set Drive, Tone, and Volume pots CCW. Presence off. (the controls affect the Guitar input path only) Set the frequency of the audio generator to 1000 Hz. Measure the AC voltage between TP12 and TP14. Set the amplitude of the Audio Generator until the multimeter reads 4.0 V.

Place the black multimeter lead through TP2 (GND). Place the red multimeter lead at TP15 (Zone A5) and measure the voltage. Then measure the AC voltage at TP16 (Zone A5). These voltages should be between 20 mV and 25 mV. If they are not, check components R9, R16, C10, C13.

Reconnect the multimeter between TP12 and TP14 and make sure the voltage is still 4.0 V. Lower the frequency of the signal generator until the voltage drops to 2.8 V. The resulting frequency should be less than 42 Hz. If it is not, check components R9, R16, C10, C13.

Output Power Test

This last test makes sure the SEA-310 can deliver FULL power to the speaker. There is no way to do this test quietly so:

1) Wear hearing protection.
2) Be considerate of your roommates and neighbors.

Time for the team to use hearing protection!

Set the Drive, Tone, and Volume pots CCW. Presence off. Enable the speaker by removing the Audio Adapter from the EXT SPKR jack. Connect the Audio cable between the Audio Signal Generator and the AUX input. Set the frequency of the Audio Signal Generator to 1000 Hz. Measure the AC voltage between TP12 and TP14. Adjust the amplitude of the signal generator until the meter reads 6.3 V. The SEA-310 should be screaming. If the multimeter reads at least 6.34 V, your SEA-310 is producing 10 Watts of output power and this test was a success.

Just for fun, let the SEA-310 scream for a minute and then place your hand on the heat sinks for power transistors Q11, Q12, Q13, and Q14. Feel the heat? At 10 Watts output power they are working!

EXT SPKR Jack Test

Set the Drive, Tone, and Volume pots CCW. Presence off. Connect the Audio cable between the Audio Signal Generator and the AUX input. Set the frequency of the Audio Signal Generator to 1000 Hz. Insert the Audio Adapter into the EXT SPKR Jack and the sound from the speaker should stop. Reduce the level from the audio signal generator so the voltage between TP12 and TP14 is 1 V. Plug the Audio Headphones into the Audio Adapter and you should hear the tone from one of the earbud channels.

STEP 6 – FINAL ASSEMBLY

At this point the PCB and the case wiring of the SEA-310 are perfect, but the controls and connections are loose and flopping around. In this step, you will slide the PCB into the PCB Mounting Channel, secure the Electromechanical Components on the front panel and secure the EXT SPKR jack to the side of the case. Finally, you'll mount the clear Plexiglass Back Panel to the cabinet and your SEA-310 will be complete.

1. Turn the power off. Unplug the External Power Supply from the SEA-310, and disconnect any cables from the Guitar input, AUX input, and the EXT SPKR.

2. Remove the painter's tape from the controls.

3. Remove the bulb from the pilot light so it won't get damaged during assembly.

4. Route the Speaker, Power Input, and Power Switch wires around the front of the PCB (between the Front Panel and the PCB) as shown in Figure 43.

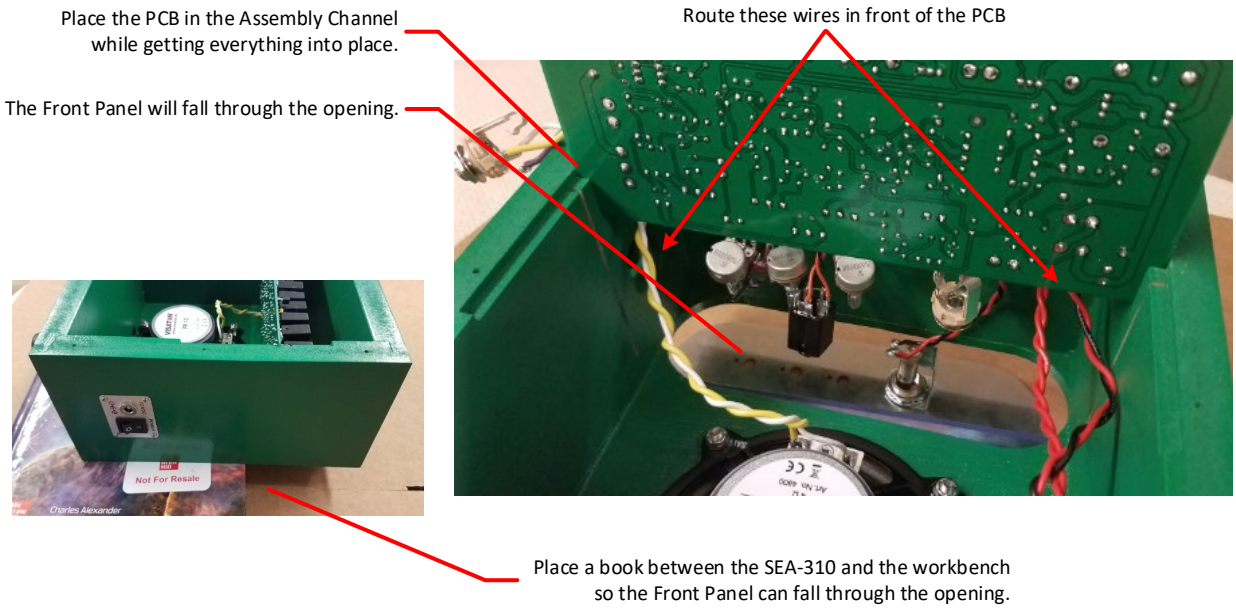


Figure 43 - Route the wires as shown prior to inserting the PCB in the PCB Mounting Channel

5. Remove the nut and washer from the EXT SPKR Jack and set them aside.

6. Move the PCB to the PCB Mounting Channel and press it down fully as shown in Figure 44. When the PCB is partway in the channel, insert the EXT SPKR Jack through the hole in the EXT SPKR Connector Panel.

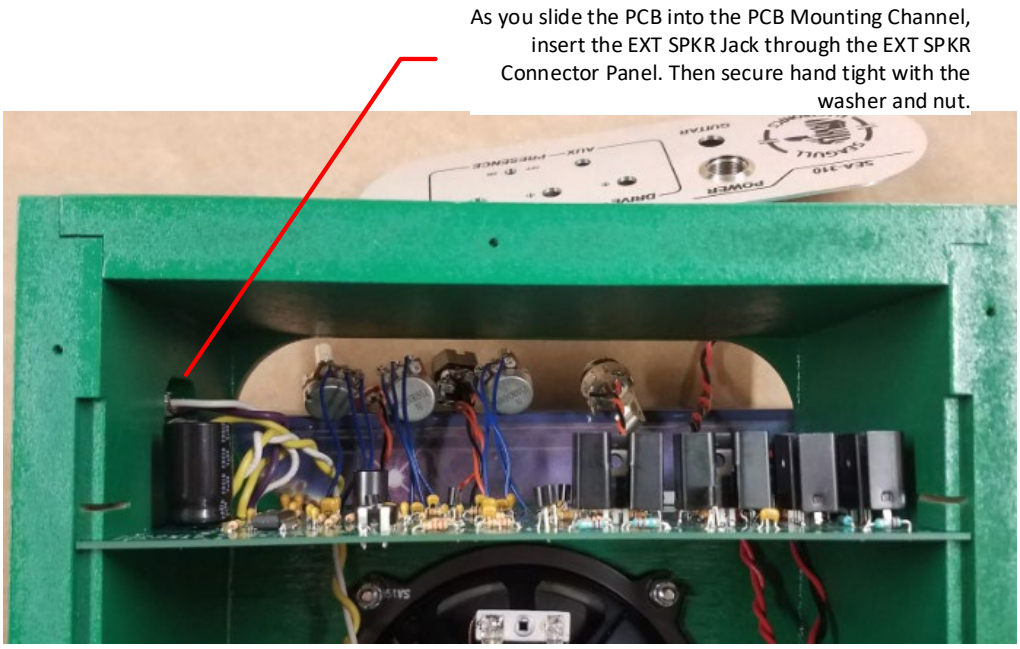


Figure 44 - The PCB slides into the PCB Mounting Channel

7. Note that each of the Electromechanical Components (pots, switch, jacks) comes with a nut and washer. Identify the nut and washer for each control, separate them from their component, and place them where you can access them easily.

8. Press the Drive, Tone, and Volume pots through the Front Panel. Note that they have a tab on them that goes through the small hole in the Front Panel. Install the washer and thread the nut hand tight.

9. Note that the threaded bushing on the Presence switch has a flat side as shown in Figure 37, and its hole on the Front Panel has a flat side also. When the flat side of the bushing lines up with the flat side of the hole, the switch will go in the hole. This orientation ensures that when Presence is switched to the ON position, …the switch will be on. The switch has two nuts. Thread the first nut fully on the bushing, push the switch through the Front Panel, and then install the washer and outer nut hand tight.

10. Install the AUX jack hand tight.

11. Install the Guitar jack and hand tight.

12. Print Page 65 of these instructions on 8 ½" x 11" paper and then measure the template to make sure that its dimensions match those on the figure. Cut out Figure 54 carefully. Using a Sharpie or other marker, transfer the pattern to the grille cloth. Then cut the grille cloth with a pair of scissors as shown. Trim the grille cloth very carefully so it just fits in the channel in the Front Bezel. Tape the grille cloth into the cutout in the backside of the Front Bezel to it to hold it in

place as shown. You will leave the tape on when you secure the Front Bezel. It's part of your SEA-310!

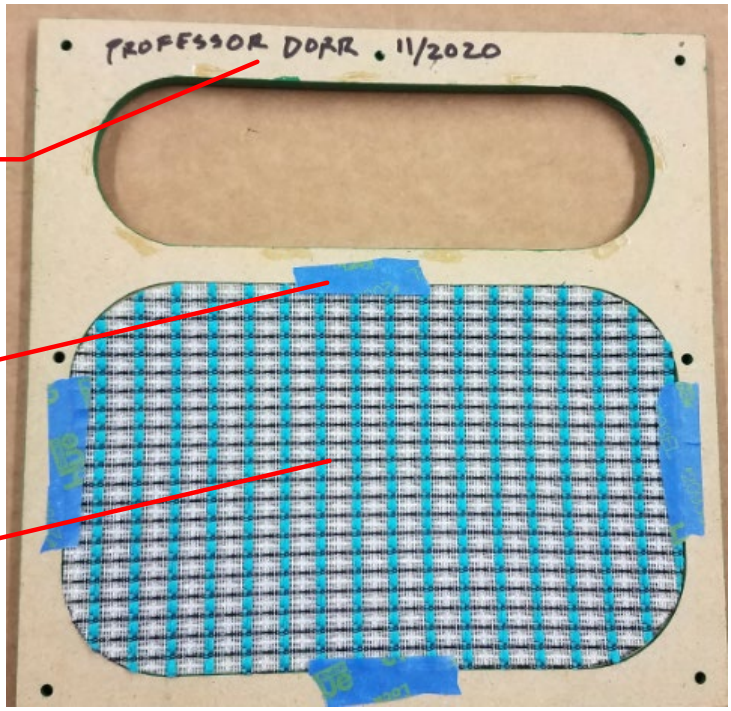


Figure 45 – Showing the back (cabinet side) of the Front Bezel with the trimmed Grille cloth taped in the channel. The tape holds the grille cloth when you turn the Front Bezel over and mount it to the cabinet

13. Locate 8 of the #6 x 1" flathead screws (these are the longer ones) (Figure 57). Use your fingers to make sure the Front Panel stays in the cutout in the Hold the Front Panel as you install the screws to secure the Front Bezel.

14. You are now ready to tighten the nuts on the Electromechanical Components with a wrench or pair of pliers. If you tighten the nuts too tightly you can damage the components (bad!). If they are not tight enough, they may eventually work themselves loose and you'll have to re-tighten them (no big deal!) If you are building the SEA-310 with an experienced helper have them show you how much to tighten them. If not tighten them about a quarter to a half turn past hand tight. Here are the wrench sizes you'll need: Pots and AUX: 10 mm, Presence switch: 7 mm, Guitar and EXT SPKR: ½". Hold your wrench carefully and try not to scratch the front panel of the SEA-310.[5]

15. Use a ½" wrench to tighten the nut on the EXT SPR jack. While tightening, place your fingers behind the jack and prevent it from twisting and damaging the wired connections.

[5] Did you scratch the panel? I've scratched a few! Don't worry about it – it's a learning experience. If the scratch bugs you go to the Internet and learn how to remove a scratch from an aluminum panel. You are a craftsperson now, and you can do it!

16. Use a ½" wrench to tighten the nut on the Guitar jack. Make sure the washer is between the nut and the Front Panel. While tightening, place your fingers behind the jack and prevent it from twisting and damaging the wired connections.

17. Make sure the tabs on the pots are pressed into the holes on the front panel. If they aren't, loosen the nuts a bit and rotate the pots. When the tab goes in the hole, you'll feel a small click. Look at the back of the amp and the terminals on the pot will be at the top. You can also see the tab through the small hole on the Front Panel. The tab will keep the pots from twisting as you tighten them. Tighten the nuts with a 10 mm wrench.

18. Place your fingers behind the AUX jack to prevent it from twisting. Tighten the nut with a 10 mm wrench.

19. Tighten the nut on the Presence switch with a 7 mm wrench. Note that the flat side of the switch will prevent it from turning as it is tightened.

20. Install the handle with two #6 x 3/4" countersunk flathead screws (Figure 46.) Note the pilot holes. After tightening the screws snap the plastic covers in place.

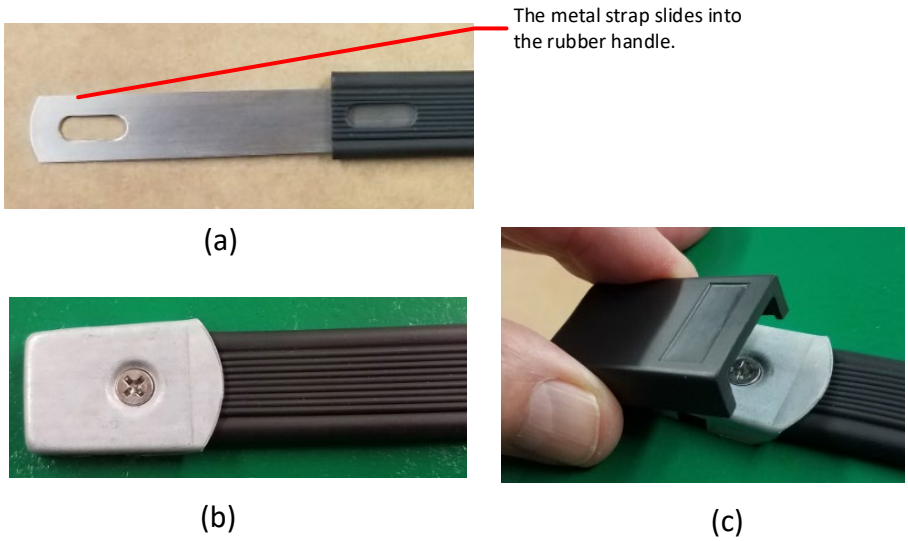


Figure 46 – Installing the handle. (a) Insert the metal stiffener into the rubber handle. (b) The screw goes through the openings in the rubber handle and the stiffener. Then screw it into the pilot hole. Do the same on the other end. (c) Finally, snap the plastic caps into place.

21. Place the SEA-310 on a book or similar object so that it is not resting on the pots as shown in Figure 43. Set the Plexiglass Back Panel on the back of the SEA-310 with the countersink holes facing up. Rotate the plexiglass so that its holes align with the pilot holes.[6] Secure the Plexiglass

[6] We staggered the holes so you can take your SEA-310 apart lots of times. If the holes on the Cabinet ever strip, just rotate the Plexiglass Back Panel 90° and drill new pilot holes!

back with eight #6 x ¾" countersunk flathead screws (Figure 46.)

22. The final assembly step is to place the plastic knobs on the pots and install the bulb and colored lens on the pilot light. Set the pots CCW. Press the knobs on the pots so that the line on the knob points at about seven o'clock[7]. Turn the pots fully CW and the line should point to about five o'clock.

23. Finally, reinstall the bulb in the pilot light and screw the colored pilot light lens into the pilot light.

STEP 7 – FINAL TEST PROCEDURE

Your SEA-310 is fully assembled. Do this final test to make sure nothing got damaged during final assembly.

Connect power to the SEA-310. Turn the power switch on. Make sure you get a nice glow from the colored pilot light.

Turn Drive, Tone, Volume CCW, Presence off. Connect your phone to the AUX input and play some good music. Note that the controls on the SEA-310 do not affect the signal from the AUX input. Use your phone to set the volume. Verify that huge SEA-310 sound!

Connect your guitar to the Guitar Input and play. You can also connect your phone to the Guitar Input through the Audio Adapter. Make sure the Drive knob changes the output level. Make sure the Tone knob changes the tone. Make sure the Volume knob changes the output level. Switch Presence on and off. The tone will change a bit and the sound will be a bit softer with Presence on. Connect your earphones into the adapter and plug into EXT SPKR. Make sure the speaker gets quiet and the sound is heard through your headphones.

Congratulations, you have finished all the procedures in this document!

[7] If you don't like the Marshall knobs, you can order Fender knobs, chicken heads, or, ... The pot shaft size is 6 mm

ARE YOU DONE? – NEVER!

Congratulations. You turned that huge mess of parts into a working SEA-310!

- You learned about different electronic components and learned to identify them by their markings.
- You learned how to install components in a PCB based on their reference designators.
- You learned how to solder components into a PCB.
- You (surely) learned how to unsolder an incorrectly installed part from a PCB or terminal.
- You learned how to measure, cut, strip, and solder wire.
- You learned how to make measurements with a multimeter.
- You learned how to do things with two hands when you first thought you would need three hands.
- You made mistakes and had to disassemble parts of the SEA-310 so you could re-do them correctly.
- You learned a bunch of Electronic Industry terms.

OK, so those are the details. What's really important?

- You are now a Craftsperson with the knowledge and confidence to use your hands to build and fix stuff with tools.
- You experienced what it is like to be an electronic engineer/technician. Did you dig it? If so aim yourself in this direction. It is a fun and rewarding career.

Is the SEA-310 really done? This is up to you. Go to our website www.seagullelectronickits.com and you'll learn how it works and how to change components to tailor the sound to your tastes. Whether you're in middle school, college, or anywhere between, you'll find cool stuff that will teach you about electronics, acoustics, and music. Hopefully when you read it, you'll remove that Plexiglass back, remove the PCB and begin your journey. Don't worry about damaging the SEA-310. It is made from high-quality materials and you can assemble and disassemble it as many times as you wish.

GLOSSARY OF TERMS

Term	Definition
Assembly Channel	Shorter slot that the PCB slides into while wiring Electromechanical Components. See Figure 43.
Audio Signal Generator	Phone or computer App used to generate tones during testing. See Figure 39 or Figure 40.
Case	Refers to the wooden Cabinet. The terms Case and Cabinet are used interchangeably in these instructions.
Case Wiring Diagram	Drawing that shows how the PCB is connected to the controls, and jacks on the Cabinet. See Figure 35.
Circuit Side (of PCB)	The side of the PCB where the components are soldered.
Component Side (of PCB)	The side of the PCB where the components are located. The silkscreen (white writing) is located on the component side of the PCB.
Countersink	A V-shaped indentation in a surface that matches the angle on a screw head.
CW, CCW	Clockwise and Counter-Clockwise. Refers to the angular position of the pots. When specified, it means that the pot shaft should be turned until it stops. See Figure 37.
Electromechanical Components	All pots, jacks, and connectors located on the Cabinet and wired to the PCB.
Flathead	Refers to a screw head with a flat face and an angled head. Flathead screws mate with countersunk holes.
Inventory Sheet	Pages in these instructions that show a picture of each component and where it goes on the PCB. The inventory sheets are used for stuffing the PCB.
PCB	Printed Circuit Board. During assembly you solder components into it.
PCB Assembly Tray	Shallow cutout on the back of the Cabinet. The PCB lies flat in this cutout so you can easily stuff components and solder them in. (See Figure 10)
PCB Mounting Channel	Slot cut into the Cabinet that the PCB slides in to. (See Figure 10)
PCB Wiring Channel	Short slot cut into the cabinet next to the PCB Mounting Channel. Use this channel to hold the board while you connect the wires to it.
Pilot holes	Holes drilled in Cabinet that are slightly smaller than the screws. They help guide the screws in.
Polarized	If a component is polarized, it must be installed in a specific direction on the PCB, and the silkscreen on the PCB will show the correct orientation. Resistors are not polarized and can be installed in either direction. See Figure 15 for polarized and non-polarized capacitors.
Pot/ Potentiometer	Refers to the Drive, Tone, and Volume Potentiometers mounted on the Front Panel. Plastic knobs on the Potentiometers make them easy to turn.
Reference Designator	Reference designators show where each component from the schematic diagram fits in the PCB.
Schematic	Drawing showing the connections between all components on the PCB. See Page 69.
Silkscreen	The white writing on the Component Side of the PCB. It shows reference designators, test points, and other useful information.

Term	Definition
Stuffing the PCB	Refers to the process of placing components on the PCB and soldering them in.
Test Input Level	Setting of the Audio Signal Generator that provides 10 mV AC voltage when the phone or computer volume is set to full. See Page 41.
TP1, TP2, …	Refers to Test Points on the PCB. The multimeter leads are placed on the Test Points when testing the PCB. See Figure 36.
Voltage Gain	The ratio of one voltage to another. The gain of an audio amplifier is the output voltage at the speaker divided by the input voltage. If you want to express voltage gain in dB like the pros, see Footnote 3 on Page 42.
Zone	The silkscreened letters and numbers around the edges of the PCB divide it into rectangular zones, and Table 8 on Page 64 shows the zone for each component based on its reference designator.

Table 7 - Glossary of Terms

INVENTORY SHEETS

These capacitors can be installed in either direction on the PCB. In other words, they are "non-polarized."

Capacitor: 0.22 µF

Quantity: 11
Markings: 224K
Ref Des: C1, C2, C4, C5, C9, C12, C21, C23, C28, C30, C32

Capacitor: 1.0 µF

Quantity: 8
Markings: 105K
Ref Des: C6, C10, C13, C16, C19, C20, C29, C34

Capacitor: 56 nF

Quantity: 3
Markings: 563K
Ref Des: C7, C11, C27

Capacitor: 27 nF

Quantity: 2
Markings: 273K
Ref Des: C22, C26

Capacitor: 1.0 nF

Quantity: 4
Markings: 102
Ref Des: C17, C18, C24, C25

Capacitor: 100 pF

Quantity: 1
Markings: 101
Ref Des: C14

Capacitor: 470 nF

Quantity: 1
Markings: 474
Ref Des: C33

Figure 47 - Inventory Sheet #1

All resistors can be installed in either direction on the PCB. In other words, they are "non-polarized."

Resistor 10 kΩ

Quantity: 13
Markings: Brown, Black, Orange, Gold
Ref Des: R1, R2, R9, R13, R16, R21, R24, R28, R33, R39, R40, R41, R42

Resistor 4.7 kΩ

Quantity: 5
Markings: Yellow, Violet, Red, Gold
Ref Des: R6, R7, R22, R35, R36

Resistor 2.2 kΩ

Quantity: 4
Markings: Red, Red, Red, Gold
Ref Des: R5, R26, R31, R32

Resistor, 0.22 Ω

Quantity: 4
Markings: Red, Red, Silver, Gold
Ref Des: R45, R46, R47, R48

Resistor, 220 kΩ

Quantity: 2
Markings: Red, Red, Yellow, Gold
Ref Des: R19, R43

Resistor, 39 kΩ

Quantity: 2
Markings: Orange, White, Orange, Gold
Ref Des: R23, R25

Resistor, 470 Ω

Quantity: 2
Markings: Yellow, Violet, Brown, Gold
Ref Des: R27, R34

Figure 48 -Inventory Sheet #2

Resistor, 5.6 kΩ

Quantity: 2
Markings: Green, Blue, Red, Gold
Ref Des: R29, R30

Resistor, 12 kΩ

Quantity: 2
Markings: Brown, Red, Orange, Gold
Ref Des: R37, R38

Resistor, 330 kΩ

Quantity: 1
Markings: Orange, Orange, Yellow, Gold
Ref Des: R3

Resistor, 820 kΩ

Quantity: 1
Markings: Grey, Red, Yellow, Gold
Ref Des: R4

Resistor, 18 kΩ

Quantity: 1
Markings: Brown, Grey, Orange, Gold
Ref Des: R18

Resistor, 130 kΩ

Quantity: 1
Markings: Brown, Orange, Yellow, Gold
Ref Des: R10

Resistor, 100 kΩ

Quantity: 2
Markings: Brown, Black, Yellow, Gold
Ref Des: R8, R11

Resistor, 68 kΩ

Quantity: 1
Markings: Blue, Grey, Orange, Gold
Ref Des: R14

Figure 49 - Inventory Sheet #3

Resistor, 390 kΩ

Quantity: 1
Markings: Orange, White, Yellow, Gold
Ref Des: R15

Resistor, 3.3 kΩ

Quantity: 1
Markings: Orange, Orange, Red, Gold
Ref Des: R12

Resistor, 240 Ω

Quantity: 1
Markings: Red, Yellow, Brown, Gold
Ref Des: R17

Resistor, 1 Meg Ω

Quantity: 1
Markings: Brown, Black, Green, Gold
Ref Des: R44

Resistor, 180 Ω

Quantity: 1
Markings: Brown, Grey, Brown, Gold
Ref Des: R49

Resistor, 1000 Ω

Quantity: 1
Markings: Brown, Black, Red, Gold
Ref Des: R50

Resistor, 510 Ω

Quantity: 1
Markings: Green, Brown, Brown, Gold
Ref Des: R51

Figure 50- Inventory Sheet #4

When installing diodes in the PCB, the black band on the diode must align with the white stripe shown on the PCB

See special instructions for soldering this component.

Diodes

Quantity: 6
Markings: See photo
Ref Des: D1, D2, D3, D4, D5, D6

Adjustable Resistors

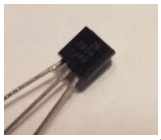
Quantity: 2
Markings: See photo
Ref Des: RV1, RV2

Be extra careful when identifying the remaining parts on this sheet. They all use the same TO-92 package and look identical. You must read the markings to identify them.
When installing these components on the PCB, the component case must align with the white marking on the PCB.

Use the needle-nosed pliers to separate the leads a bit. Then bend the center lead back toward the round side. Use this trick for all of these small transistors

Transistor – 2N3904

Quantity: 6
Markings: 2N3904
Ref Des: Q2, Q4, Q5, Q6, Q7, Q9



Transistor – 2N3906

Quantity: 3
Markings: 2N3906
Ref Des: Q3, Q8, Q10

Transistor – 2N5089

Quantity: 1
Markings: 2N5089
Ref Des: Q1

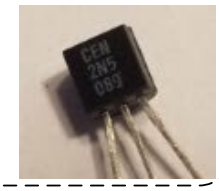
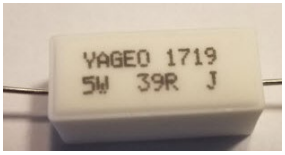


Figure 51 - Inventory Sheet #5

Turn the board over and set on a table to hold this component in place during soldering

Power Resistor, 39 Ω

Quantity: 1
Markings: 39R
Ref Des: R20

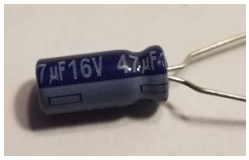


Inductor – 1 mH

Quantity: 1
Markings: See photo
Ref Des: L1

47 uF Capacitor - Polarized

Quantity: 2
Markings: 47 uF, 16 V
Ref Des: C8, C15



See special instructions for polarized capacitors

The two capacitors below have the same value (2200 µF) but they are very different. Note that the one on the left below (C3) has a white stripe and it is also smaller than the one on the right (C31).

2200 uF Capacitor - Polarized

Quantity: 1
Markings:
2200 uF 16 V
Ref Des: C3

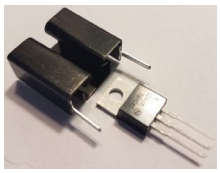
2200 uF Capacitor
– Non-polarized

Quantity: 1
Markings:
2200 uF 10 V
Ref Des: C31

Figure 52- Inventory Sheet #6

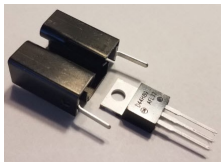
When installing the power transistors shown below on the PCB, the heat sinks and transistors are fitted together and then soldered into the PCB. See the special instructions for these parts.

PNP Power Transistor – D45H8 and Heat Sink



Quantity: 2
Markings: 45H8G
Ref Des: Q11, Q13

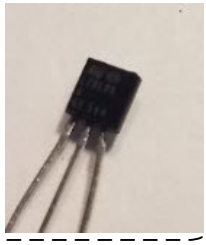
NPN Power Transistor – D44H8 and Heat Sink



Quantity: 2
Markings: 44H8G
Ref Des: Q12, Q14

The three static sensitive components below are located in the silver bag. Do not remove them from the bag until you are ready to solder them in the PCB. See the special instructions for these parts.

Voltage Regulator

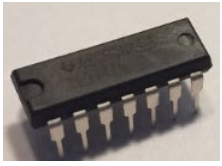


Quantity: 1
Markings: 78L08
Ref Des: U1

MOSFET – BS170

Quantity: 1
Markings: BS170
Ref Des: Q15

Integrated Circuit – Operational Amplifier



Quantity: 1
Markings: TL974IN
Ref Des: U2

When installing this Integrated Circuit on the PCB, the notch on the case (at the left in the photo below) must align with the notch marked in white on the PCB.

Figure 53 - Inventory Sheet #7

PCB COMPONENT LOCATION (ZONE) TABLE

Ref Des	Zone
C1	A7
C2	A6
C3	A10
C4	C3
C5	A9
C6	A6
C7	B6
C8	B8
C9	B7
C10	A2
C11	C2
C12	D3
C13	A2
C14	C2
C15	D7
C16	C5
C17	C4
C18	C5
C19	D4
C20	D8
C21	C5
C22	B5
C23	E8
C24	D8
C25	E5
C26	B4
C27	C4
C28	D4
C29	B5

Ref Des	Zone
C30	D4
C31	D1
C32	D9
C33	B3
C34	C3
D1	C7
D2	C7
D3	B8
D4	B8
D5	E4
D6	E5
L1	B3
Q1	A6
Q2	C6
Q3	C6
Q4	D5
Q5	D8
Q6	E6
Q7	C9
Q8	D9
Q9	E8
Q10	D6
Q11	D10
Q12	D9
Q13	D8
Q14	D7
Q15	D4
R1	A7
R2	B2

Ref Des	Zone
R3	A7
R4	A7
R5	B6
R6	B2
R7	B6
R8	C2
R9	B2
R10	B7
R11	C6
R12	C3
R13	D3
R14	C6
R15	C7
R16	C2
R17	C6
R18	C7
R19	D2
R20	B10
R21	C3
R22	C7
R23	C5
R24	C3
R25	D5
R26	D5
R27	B5
R28	B4
R29	E4
R30	C8
R31	C8

Ref Des	Zone
R32	E4
R33	B5
R34	B4
R35	B8
R36	D4
R37	C9
R38	E5
R39	C9
R40	E7
R41	E6
R42	C8
R43	C4
R44	C4
R45	E10
R46	D9
R47	E7
R48	E6
R49	C4
R50	C3
R51	B3
RV1	C9
RV2	E4
U1	A8
U2	D2

Table 8 - Location of components on the PCB based on their Reference Designators. The "Zone" refers to the letters and numbers on the edges of the PCB.

GRILLE CLOTH TEMPLATE

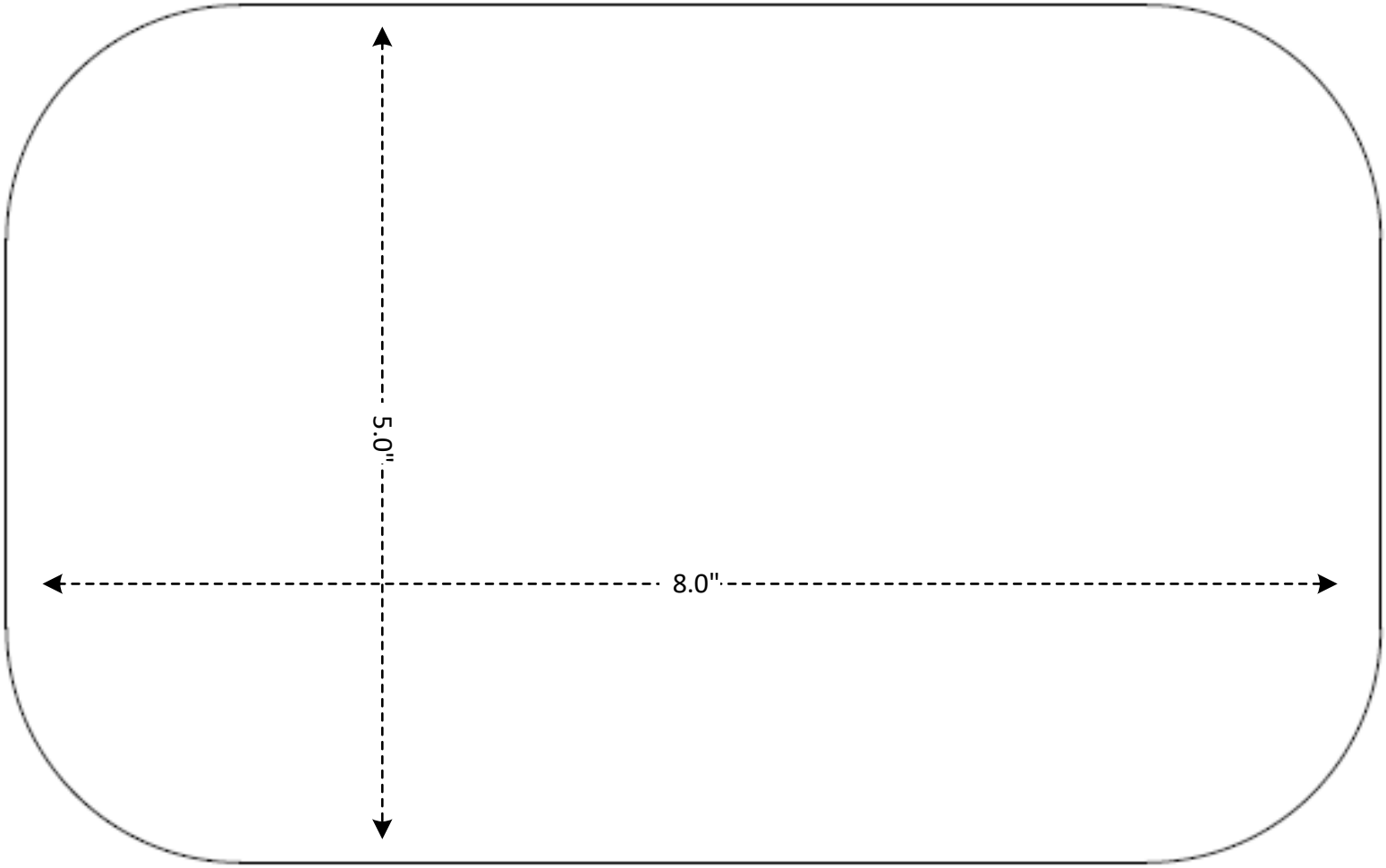


Figure 54 - Template for cutting grille cloth. Print this Page on 8 ½ X 11" paper and then use scissors to cut on the solid line. Before cutting the grille cloth, use a ruler or tape measure to make sure the cutout has the dimensions shown on the drawing.

SEA-310 KIT CONTENTS

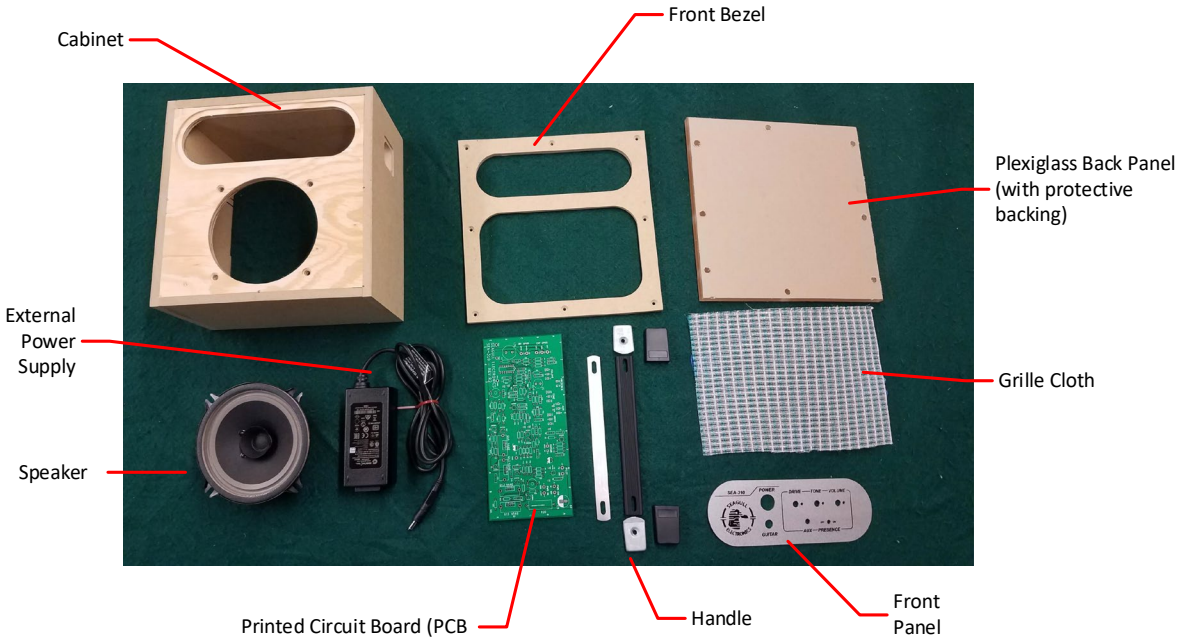


Figure 55 – Pieces shipped loosely in kit

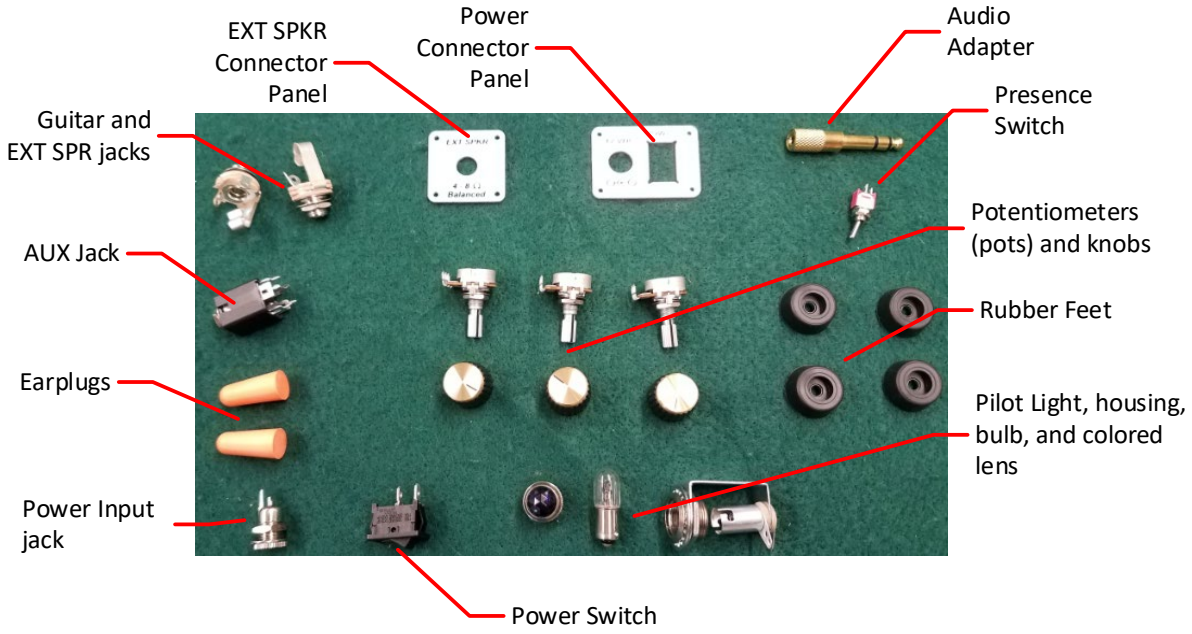


Figure 56 - Electromechanical Components and Earplugs

Figure 57 – Fasteners

Figure 58 - Wire and Solder

Figure 59 - Bag containing PCB Components

SCHEMATIC DIAGRAM

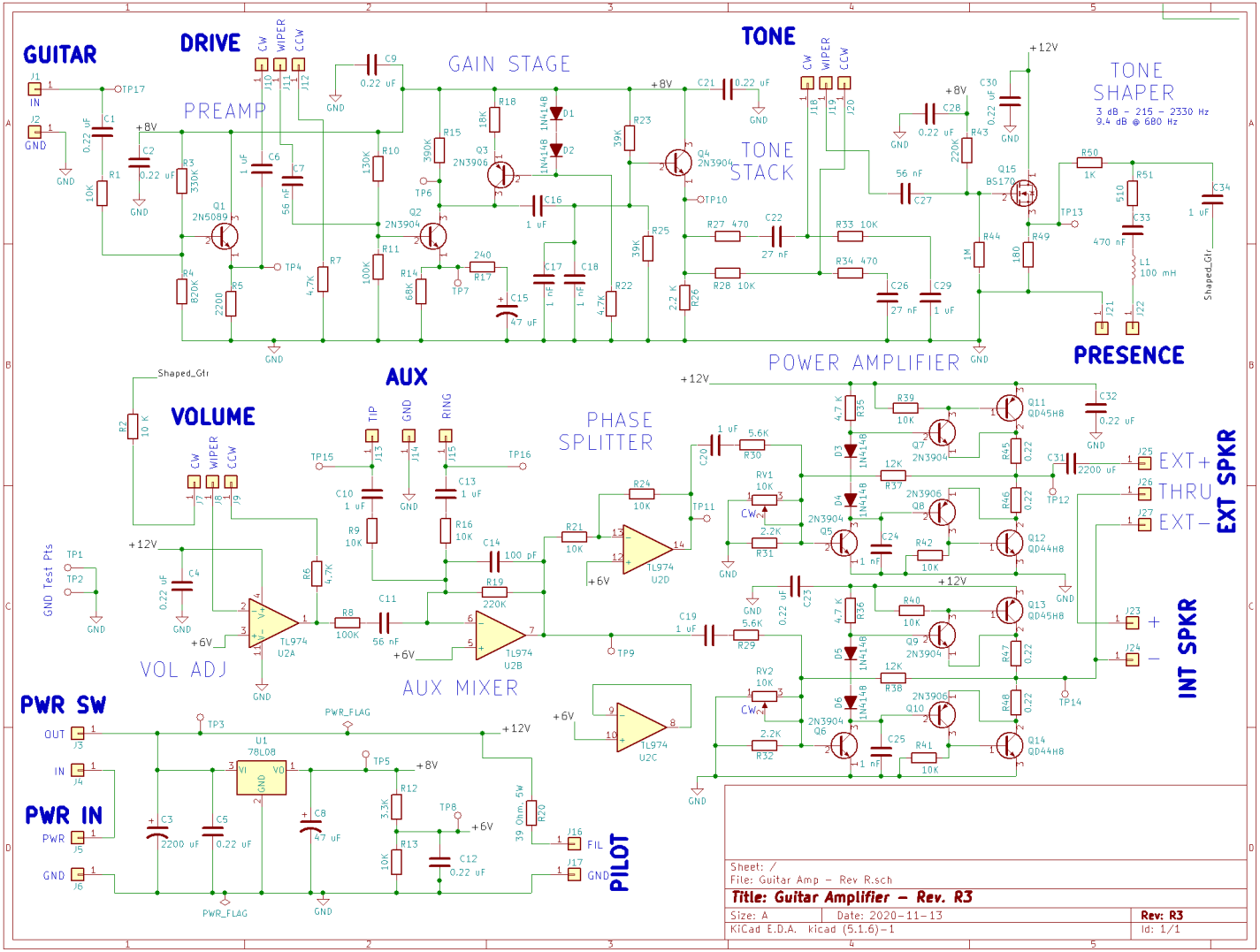


Figure 60 - Schematic Diagram