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Assembly Manual

Tweed Champ 5F1A



Instructions for Assembling with the:

- Printed Circuit Board (PCB)

with additional modification suggestions and recommended amp settings

version 11.0
March 09, 2011

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Memphis, TN

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Special thanks to:
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Caleb Kim
Henry Lum
Brian Overstreet
Doug Sims
Rex Cuizon

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Short History of the Tweed Fender™ Champ

With just 4 watts, the first incarnation of the Fender™ Champ was introduced in 1948 and was called the “Champion 800”. It had one 6SJ7 preamp tube, a single 6V6 power tube, and a 5Y3 rectifier tube. Along with an 8” speaker, it was covered in two toned brown and tan vinyl and was beautiful to behold. In 1953 the name changed to “Champion 600™” with a 6” speaker replacing the original 8”. The two toned vinyl remains, however some of the later Champion 600's are covered in the new transition tweed covering. By 1953, all Champion amps were covered in tweed and all still sounded great! These early Champions were the perfect complement to the new Telecaster™ family of guitars. But all is not finished yet ...

The biggest improvements were brewing. In 1955, the “Champ” is born with the introduction of the new 12AX7A as the preamplifier tube (replacing the 6SJ7). This brings the output to 5 watts into a 6” speaker. But there is one more big improvement coming. In 1958, along with a slight component change, the 8” speaker is reintroduced. With this final change, the “mother of tone” is born. It is as if the planets aligned and whispered to Leo Fender what the near perfect amp should sound like. He was listening because here it is.

It is this last, near perfect incarnation that we provide for you here.

The tweed champ is one of my favorite amps. Inside its diminutive size rests the heart of an entire world of music. From blues, to rock-a-billy; from rock-n-roll to soul; from country to jazz, this amp is capable of holding its own across a wide swath of musical history and genres. From humble consideration as a “beginner amp”, this amp has become a standard bearer for what is cool about music.

Therefore imagine my excitement in designing a kit where you can build an incredible amp on which to put your musical mark on the world. Wow ... this is going to be fun!

Thank you for purchasing this great kit. You should be able to easily put this kit together in an evening or two ... whether you have any prior amp building experience or not. I designed this kit for you to enjoy both building and playing this amp. And once finished, this kit will allow you to make the best music you can ... to make your world mark.

Now, let's have some building and playing fun.

Robert Hull
Director of Technical Services
TubeDepot.com

!!! Read these safety precautions before continuing !!!

ALL tube amplifiers contain **LETHAL VOLTAGES**, often several hundred volts which **WILL** leave burnt entrance and exit wounds in skin. These voltages have the potential to cause **permanent physical damage and death**. These voltages are present when the amp is turned on and also for some time after the amp has been turned off. **You can still get shocked with a tube amp turned off and disconnected from AC power.**

The above statement is a bit scary, but we want to stress that every piece of electronic equipment must be treated with respect. When AC power is applied, there is always a chance for injury or death. With tube amps, even when the AC power is not applied there is still danger. Being shocked with high voltage is very painful and we do not want anyone finding out the hard way.

When building this kit, we want your experiences to be both enjoyable and safe. There are more kits to assemble and we want you to enjoy building and playing them all.

- DISCLAIMER -

TubeDepot.com, it's employees, officers, shareholders, investors and subsidiaries accept no liability for any damage(s), injury(s) or death incurred from or while building or using this kit.

TubeDepot.com reserves the right to make changes to this manual as new construction methods are found to be more efficient and/or safer. When a particular procedure in this assembly manual differs from the assembly video, our recommendation is to follow this manual to insure the best construction possible.

Throughout this manual at key points in the construction, we have annotated important steps with the below alerts. For your safety and to improve construction quality, It is important that you become familiar with each of these alerts and adhere to their recommendations when they appear.

Explanation of Alerts

WARNING

- Used when identifying an action that may cause physical injury or death.

CAUTION

- Used when identifying an action that may cause damage to components and/or equipment.

NOTE

- Used when identifying general points of interest.

As with any construction project, there are certain tools and supplies that are recommended to complete the project. These are tools and supplies not provided with the kit and are instead provided by the builder.

The following is our recommended list:

Phillips screwdriver, #1 and #2
Slip joint pliers
Needle nose pliers
Wire cutters, diagonal
Wire strippers, for 18 and 20 awg wire
Electric Drill
Drill bit, 3/16" - Chassis mounting in the cabinet
Drill bit, 5/32" - PCB and turret board chassis mounting
Drill bit, 1/8" - Fiberboard mounting
Masking tape, 2"
Ruler or scale, 12" w/ 1/16" markings
Permanent marker, fine tip

Soldering iron, 25W – 40W (35W recommended)
Solder, electronics safe (60/40 w/ rosin core recommended)
Flux, electronic – liquid or paste (must be safe for electronic work)
De-soldering pump extractor
Solder wick
Sponge

The following are really nice to have:

Soldering station w/ temperature control
Multimeter w/ DC range of at least 500V
Variable AC supply (Variat[®] style)
Current Limiting AC source (build directions in this manual)
Needle nose pliers – small size, for electronics work
Wire cutters, diagonal – small size, for electronics work
Center punch
Nutdrivers - 5/16", 11/32", 7/16", 1/2"
Square, 9"
Scratch Awl
heat shrink, 1/8" x 6"
De-burring tool
Fingernail polish (for holding nuts and screws in place)

***TubeDepot.com
part number***

[TL-VTSCRSET8](#)

[TL-VT33](#)

[TL-VT33](#)

[TL-VT5021](#)

[TL-WP35](#)

[TS-24-6040-0027](#)

[TS-83-1000-0186](#)

[TS-384-1000](#)

[TS-1817-10F](#)

[TL-WTCPT](#)

[TL-DVM850BL](#)

[TL-NN7776](#)

[TL-170M](#)

[TS-HS-ASST-7](#)

It is important to review all the parts that came with your kit. The list below is what you should have received to complete your kit. If you find anything missing, contact us:

Qty	Description	Application	TubeDepot.com 1686 Barcrest Dr. Memphis, TN 38134 (877) 289-7994 info@tubedepot.com	
1	speaker, 8" Jensen MOD, 8 Ω (4 Ω available)	speaker		
1	chassis, steel chrome plated champ 5E1/5F1	chassis		
1	cabinet, tweed champ 5E1/5F1	cabinet		
1	PCB board, 5E1/5F1	printed circuit board		
transformers				
1	transformer, power tweed champ	power transformer		
1	transformer, output tweed champ 4 & 8 ohm tap	output transformer		
tubes				
1	5Y3 rectifier tube	rectifier tube		
1	6V6GT beam power tetrode	power tube		
1	12AX7 dual triode	preamp tube		
panel hardware				
1	knob, vintage pointer	knob		
1	fuse holder, conical cap, vintage Fender style	fuse holder		
1	fuse, 3AG 2A slow-blow	fuse		
1	lamp holder	lamp holder		
1	jewel, red	lamp jewel		
1	lamp, #47, 6.3 V	lamp		
2	jack, 12A, shorting, Switchcraft ¼"	input jack		
1	jack, 11A, open, Switchcraft ¼"	speaker jack		
3	washer, lock 3/8"	jack lock washer		
1	plug, Switchcraft ¼"	speaker plug		
power cord hardware				
1	power cord, grounded three prong, 12'	power cord		
1	strain relief, Heyco	power cord strain relief		
1	nylon cable clamp	power cord clamp		
1	screw, zinc plated #8 x 5/8", phillips flat head	cord clamp mounting		
tube sockets				
1	socket, tube, miniature 9pin	preamp tube		
2	socket, tube, octal	rectifier / power tube		
hardware				
2	grommets, rubber 3/8" hole	grommets		
2	bolt, 1 1/2" 10x32 truss screw	chassis mounting		
2	nuts, KEPS 10x32	chassis mounting		
6	screw, zinc plated 6-32 x 1/4", phillips pan head	tube socket mounting		
9	nuts, KEPS 6x32	tube socket / PCB mounting		
1	nuts, 6x32	tube socket w/ solder tab mounting		
4	nuts, KEPS 8x32	power / output transformer mounting		
2	nuts, 8x32	power transformer w/ solder tab mounting		
4	screw, zinc plated 6-32 x 7/8" phillips pan head	PCB mounting		
4	standoff, nylon; L = .5"; id = .140"; od = .250"	PCB mounting		
2	screw, zinc plated 8-32 x 1/4", phillips pan head	output transformer mounting		
2	solder lug, locking, #8 screw	grounding at power transformer		
1	solder lug, locking, #6 screw	grounding at preamp tube socket		
electronic, resistors				
2	100, 1/2w carbon film	filament pseudo center tap		
2	68K, 1/2w carbon film	input resistors		
1	1M, 1/2w carbon film	input biasing resistor		
2	100K, 1/2w carbon film	preamp tube plate resistors		
2	1.5K, 1/2w carbon film	preamp tube cathode resistors		

- 1 [22K, 1/2w carbon film](#)
- 1 [220K, 1/2w carbon film](#)
- 1 [470, 3w metal oxide](#)
- 1 [10K, 2w metal oxide](#)
- 1 [22K, 1w metal oxide](#)

electronic, capacitors

- 2 [.022ufd / 630v](#)
- 2 [22ufd / 50V](#)
- 1 [22ufd / 450V](#)
- 2 [10ufd / 450V](#)

electronic, potentiometers

- 1 [1M pot w/ on-off switch \(Alpha \)](#)
- 1 [100K trim pot, horizontal mount](#)

wire

- 3 wire, 20 awg, stranded, hi-temp PVC – yellow
- 2 wire, 20 awg, stranded, hi-temp PVC – red
- 2 wire, 20 awg, stranded, hi-temp PVC – black
- 3 wire, 18 awg, stranded, hi-temp PVC – green
- 2 wire, 18 awg, stranded, hi-temp PVC – black
- 2 wire, 18 awg, stranded, hi-temp PVC – white

shielding

- 3" aluminum tape, 3" width, 10" length, self adhesive

heat shrink

- 1 heat shrink, 1/4" - black, 6" piece

- feedback resistor
- biasing resistor
- cathode resistor
- B+ resistor
- B+ resistor

- coupling caps
- cathode bypass caps
- power supply filter cap
- power supply filter caps

- volume / power switch
- feedback adjustment

- board, general wiring
- board, signal / B+ wiring
- board, ground wiring
- filament wire
- speaker wire, -
- speaker wire, +

- electrical and heat shielding

- wire dressing / capping

4 Cabinet Preparation

This chapter deals with preparing the cabinet for installation of the completed chassis. But first, we need to take inventory of the parts that came installed on the cabinet.

1. **Handle w/ mounting hardware** – There should be a single flat brown leather handle with two metal securing ends all fastened to the cabinet with four screws.
2. **Feet, chrome metal glide** – There should be four metal feet attached with screws to the underside of the cabinet.
3. **Back panels, upper and lower with screws** – There should be two back panels. The top back panel should be secured with four panel screws, the bottom panel should be secured with two panel screws.
4. **Baffle bolts with nuts** – There should be four bronze plated bolts attaching the baffle to the cabinet. The baffle is secured with four KEPS nuts, one on each of these bolts.
5. **Speaker bolts with nuts** – There should be four black oxide coated bolts for securing the speaker to the baffle board. Additionally, there should be four KEPS nuts, one on each of these bolts to be used when mounting the speaker.



photo 4.1a

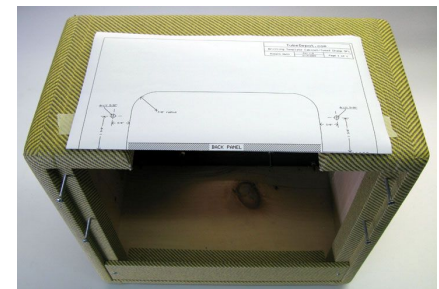


photo 4.1b

4.1 Drilling for the Two Chassis Mounting Bolts

Step 1 – Remove the amp handle from the top of cabinet

Step 2 – Remove the top back panel (place a small mark on the inside of the panel to indicate which edge is up)

Step 3 – Apply masking tape on each side of cabinet opening (photo 4.1a).

Step 4 – Remove template page from manual (appendix D1) and fold on indicated line.

CAUTION

Some printers may automatically reduce the size of the template when printed. Therefore, prior to use, always physically measure the printed template to insure proper scale is maintained.

Step 5 – Place template on top of cabinet, properly centered over the opening (photo 4.1b).

CAUTION

Be certain of template placement before drilling. The rounded edges of the cabinet can skew measurements and cause improper placement. Always measure several times before drilling.

Step 6 – With a pointed tool, make a mark through the template at the cross hair points marked “drill 3/16” (photo 4.1c). Press lightly into the tape and cabinet. This doesn't have to be a deep mark, just enough to see the mark on the masking tape underneath.

Step 7 – Remove the template. With a ruler or scale, check and verify that the marks are properly aligned on the cabinet top as referenced to the measurements on the template.

Step 8 – If the marks are verified correct, drill the two 3/16” holes, one at each of these two marks all the way through the top of the tweed cabinet.

Step 9 – Remove the masking tape and clean up any loose splinters and / or tweed from the holes and test fit the chassis mounting bolts.

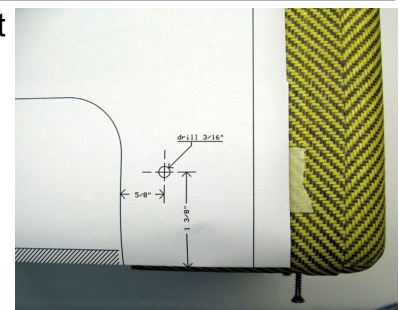


photo 4.1c

Step 11 – With the chassis mounting bolts in the cabinet, test fit the chassis onto the bolts

Step 12 – Remove chassis and reinstall handle, leaving chassis mounting bolts installed.

Proceed to 4.2

4.2 Installing the Speaker

Step 1 – Remove the four nuts from the speaker mounting bolts inside the cabinet.

Step 2 – Remove the speaker from its shipping box. With speaker in hand, carefully align the speaker mounting holes to the baffle bolts. I recommend installing the speaker with connecting terminals on top.

Step 3 – Slowly press the speaker onto these bolts, being certain that the bolts are proceeding through the mounting holes of the speaker equally (photos 4.2a, b, & c).

CAUTION

Alignment of all holes during speaker installation is very important. Otherwise, one or more of the bolts may puncture the speaker cone by accident.



photo 4.2a



photo 4.2b

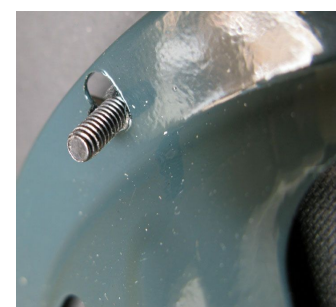


photo 4.2c

Step 4 – Once the speaker is installed on the bolts, install and tighten the KEPS nuts.

Proceed to steps 4.3

4.3 Wiring the Speaker

Step 1 – Twist the two lengths of black and white wire together (photo 4.3a).

Step 2 – At one end, strip the insulation back ½ ” from both wires and tin these two wires (photo 4.3b).

Step 3 – Unscrew the barrel of the ¼ ” phone plug.

NOTE

The ¼” phone plug was invented for use in telephone switchboards in 1878. Although it is no longer used for telephone switching, this great plug has become the standard connection type between musical instruments and outboard equipment.

Step 4 – Solder the two tinned wires to the plug; white to center and black to shield (photo 4.3c). Reinstall plug barrel.

Step 5 – At the opposite end of the twisted wire pair, strip back the insulation ¼ ” and tin these two wires.

photo 4.3a



photo 4.3b

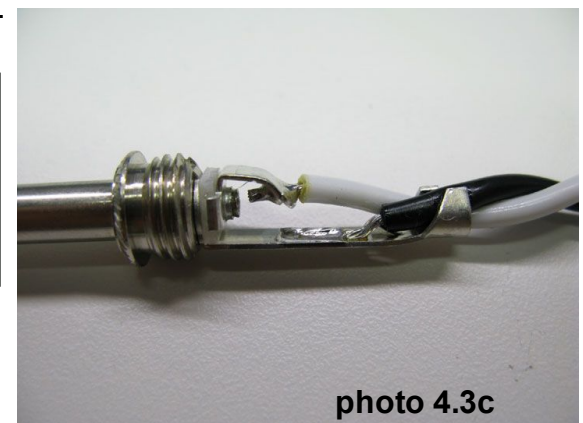
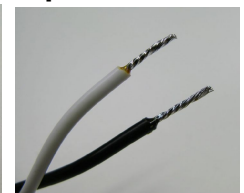


photo 4.3c

Step 6 – Solder these wires to the solder terminals of the speaker; the white wire to the “+” terminal and the black wire to the “-” terminal (photo 4.3e).

Proceed to 4.4

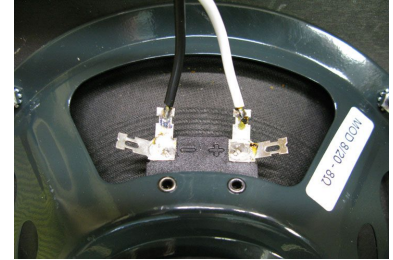


photo 4.3e

4.4 Installing the Shielding Tape

Step 1 – Place the removed back panel with the tweed side toward the desk and the wood side facing up.

Step 2 – Cut the 30” aluminum shielding tape strip into three equal lengths of 10”

Step 3 – Remove the backing from the first of the three shielding tape strips.

CAUTION

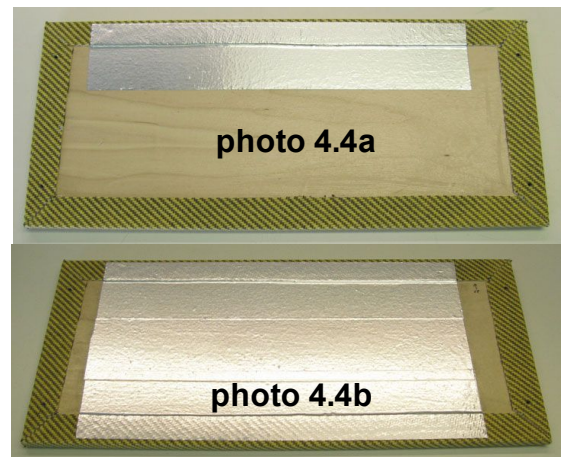
Once the backing is removed from the aluminum tape, the tape will have a tendency to curl. Be sure to keep the tape straight to avoid having the tape stick permanently to itself.

Step 4 – Apply the aluminum tape to the back of the panel. Leave 1/8th of an inch space at the top of the panel and centered the strip between the two panel edges (photo 4.4a).

Step 5 – Remove the backing from the second shielding tape strip and apply the tape to the back of the panel similar to the first strip. Place it just below the first strip, over lapping by 1/8th of an inch and centered on the panel.

Step 6 – Remove the backing from the final shielding tape strip and apply the tape to the back of the panel similar to the previous two strips. Align the edge of the tape along the bottom edge of the panel, offset by 1/8th of an inch from the bottom edge of the panel and overlapping the second strip (photo 4.4b).

Proceed to chapter 5



Here is where good soldering skills and attention to detail will pay off. By following these directions, you should have no trouble in completing the circuit assembly quickly and without errors.

I encourage you to first read all the steps to familiarize yourself with not only the installation flow, but also the components to be used. Appendix A has explanations on how to read the value codes found on both the resistors and capacitors. Appendix B has helpful hints on improving soldering skills.

5.1 Printed Circuit Board (PCB) Assembly

This PCB was designed to sound great and to maximize your customizing ability in a compact, easy to assemble package. This PCB layout closely follows the original point-to-point layout in order to duplicate any tone shaping created by component and wiring proximity interactions. With over-sized traces and through-hole plating, this board will provide years of trouble free life.

Step 1 – Gather all components necessary to complete the PCB. Separate the components by type; the resistors in one pile, the capacitors in another, the trim pot in a third. The resistors will be installed first. They have no polarity and can therefore be installed in either direction.

NOTE

For great hints on improved soldering skills, review Appendix B at the end of this manual. Additionally, visit: <http://www.youtube.com/user/TubeDepotTV> and watch "How To Solder".

Step 2 – Install a 1.5K / ½ watt resistor (brown, green, red, gold) in R6 position.

Step 3 – Install two 68K / ½ watt resistors (blue, gray, orange, gold) in positions R1 & R2.

Step 4 – Install two 100K / ½ watt resistors (brown, black, yellow, gold) in positions R4 & R5.

Step 5 – Install a 22K / ½ watt resistor (red, red, orange, gold) in position R8.

Step 6 – Install a 220K / ½ watt resistor (red, red, yellow, gold) in position R9.

Step 7 – Install a 1.5K / ½ watt resistor (brown, green, red, gold) in position R7.

Step 8 – Install a 470 / 3 watt resistor (yellow, violet, brown, gold) in position R10. The PC board says 2 watt but I upgraded to a larger resistor.

Step 9 – Install a 22K / 1 watt resistor (red, red, orange, gold) in position R12.

Step 10 – Install a 10K / 2 watt resistor (brown, black, orange, gold) in position R11. The PC board says 1 watt but I upgraded to a larger resistor.

CAUTION

Electrolytic capacitors DO have a polarity and must be installed into the circuit according to the markings on the component and the PC board.

Step 11 – Install a 22ufd/50V electrolytic capacitor in position C3. This component has a polarity, therefore it must be installed according to case and board markings (photo 5.1a).

Step 12 – Install a 22ufd/50V electrolytic capacitor in position C4. This component has a polarity, therefore it must be installed according to case and board markings.

Step 13 – Install the 100K trimmer pot.

Step 14 – Install the two .022 ufd coupling capacitors in positions C1 & C2. These capacitors do not have a polarity and can be installed in either direction.

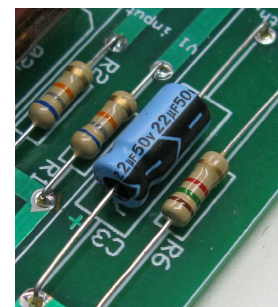


photo 5.1a

Step 15 – Install the two 10ufd / 450V electrolytic filter capacitors in positions C8 & C7. These components have a polarity, therefore they must be installed according to case and board markings (photo 5.1b).

CAUTION

If using the 16ufd/475V Sprague Atoms in the C6 position, the positive end of the capacitor must be mounted as close toward R11 as possible. In this way, the negative end of the Sprague Atom 16ufd/475V cap will clear the pilot lamp assembly without shorting out.

Step 16 – Install the 22ufd / 450V filter capacitor in position C6. This component has a polarity, therefore it must be installed according to case and board markings (photo 5.1b).

Proceed to 5.2

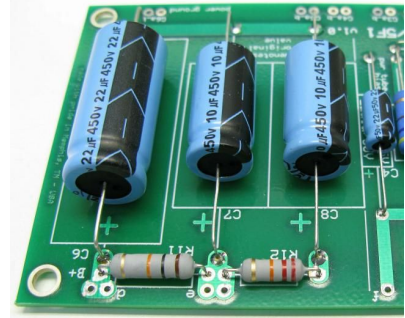


photo 5.1b

5.2 Installing the Wires to the Board

Black Wires (Grounding)

Step 1 - Strip back the insulation from the end of the black wire 1/8" and tin the end of the exposed strands. Insert the tinned end of this wire into the pad labeled "G1a" and solder. Measure and cut this wire to a length of 3" from pad G1a (photo 5.2a).

Step 2 – Repeat above for pad G2a & G2b.

Step 3 – Repeat above for pad G3a except extend to 4" length.

Step 4 – Repeat above for pad G4a (4" length).

Step 5 – Repeat above for pad G6a (3" length).

Red Wires (Circuit B+ and Preamp Tube Inputs)

Step 5 - Strip back the insulation from the end of the red wire 1/8" and tin the end of the exposed strands. Insert the tinned end of this wire into the pad labeled "d" and solder. Measure and cut this wire to a length of 3" from pad d.

Step 6 – Repeat above for pad e.

Step 7 – Repeat above for pad m.

Yellow Wires (General Signal Routing)

Step 8 - Strip back the insulation from the end of the yellow wire 1/8" and tin the end of the exposed strands. Insert the tinned end of this wire into the pad labeled "a" and solder. Measure and cut this wire to a length of 3" from pad a.

Step 9 – Repeat above for pads b.

Step 10 – Repeat above for pad c except extend wire to 4".

Step 11 – Repeat above for pads f through k.

Step 12 – Repeat above for pad n (photo 5.2a).

Proceed to Chapter 6

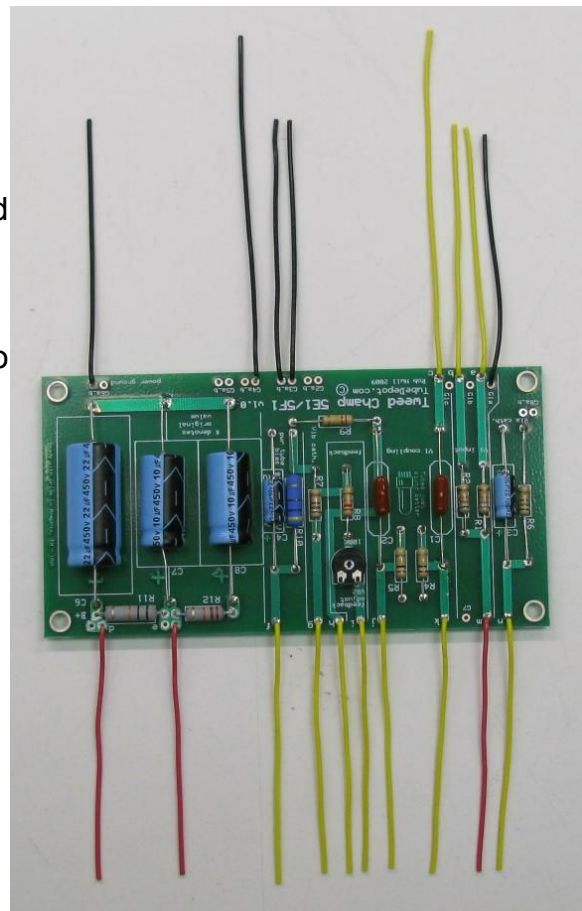


photo 5.2a

6 Chassis Preparation

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6.1 Drilling Mounting Holes for the Printed Circuit Board (PCB)

Step 1 – Locate the template “drilling template chassis/5F1” in Appendix D1A.

CAUTION

Some printers may automatically reduce the size of the template when printing. Therefore, prior to use, always physically measure the printed template to insure proper scale is maintained.

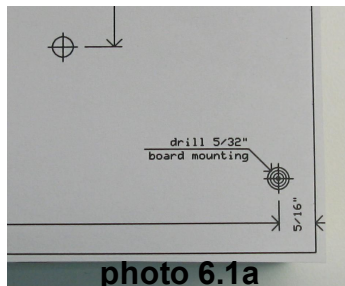


photo 6.1a

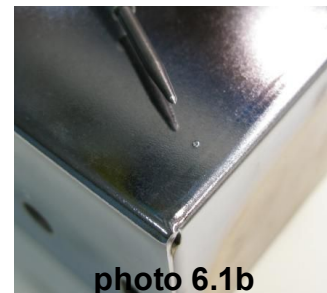


photo 6.1b

Step 2 – Situate the chassis with the large chrome side facing up and the printed control panel facing toward you and place the template onto the chassis. Make sure the template markings line up with the actual chassis cutouts.

Step 3 – On the template, locate the four concentric circular drill indicators (photo 6.1a).

Step 4 – With a sharp, hardened tool (center punch is great), make a mark at the center of these drilling indicators, leaving an identifiable indentation / mark on the chassis (photo 6.1b).

NOTE

A sharp, large nail and hammer make a great make-shift center punch. By placing the nail on the template mark and firmly tapping the head of the nail with the hammer, the resultant mark in the metal is great for accurately guiding the drill bit into the chassis.

Step 5 – Utilizing the printed measurements from the template, verify that these marks are correctly situated on the chassis.

Step 6 – Once verified, drill four, 5/32” holes, one hole at each of these marked spots.

NOTE

Use a new drill bit when drilling this chassis. Go slowly through the steel at a low rotational speed. A little drop of light oil at each drilling point helps too. These practices will allow the metal to be cut cleanly with minimal formation of burrs.

Step 7 – Remove any burrs around holes. A deburring tool is very helpful here.

Proceed to 6.2

6.2 Installing the Power Transformer

Step 1 – Loosely twist all power transformer wires together and slowly guide the wire bundle through chassis opening.

Step 2 – Situate the transformer so that the primary wires (black wires) will be nearest the fuse holder and the secondary wires (reds, yellows, greens) will be nearest the rectifier tube socket.

Step 4 – Install and tighten two #8 KEPS nuts on the transformer mounting bolts nearest the edge side of the chassis (photo 6.2a).

Step 5 – Bend the two #8 solder tabs at a slight angle (photo 6.2b).

Step 6 – Install these tabs on the remaining two transformer bolts, oriented at angles toward the chassis edges (photo 6.2a).

Step 7 – Install the two #8 standard nuts on these two bolts with the solder tabs (photo 6.2a).

Proceed to 6.3

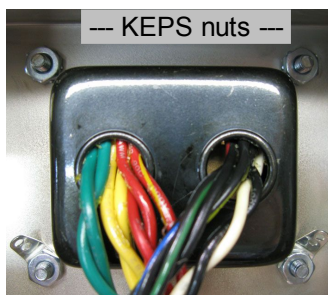


photo 6.2a



Photo 6.2b

6.3 Installing the Rubber Grommets

Step 1 – locate the two rubber grommets and the two corresponding holes on the chassis.

Step 2 – Insert the two rubber grommets in the chassis holes (photos 6.3a and 6.3b).

Proceed to 6.4

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photo 6.3a



photo 6.3b



6.4 Installing the Output Transformer

NOTE

The new upgraded output transformer has an additional brown primary wire which is not seen in the video or photos in this manual. This brown wire is NOT used in this build. We recommend running this wire into the chassis and sealing its end with insulation tape or heatshrink. It will NOT be connected to anything.

Step 1 – Twist the red, blue and brown primary wires together.

Step 2 – Twist the yellow, green, and black secondary wires together.

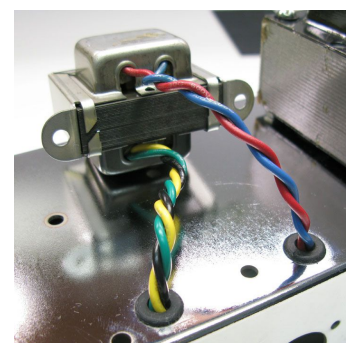
Step 3 – Feed the two wire sets into the grommets (photo 6.4a). The red, blue, and brown wires go into the grommet nearest the power transformer.

Step 4 – Pull the two wire bundles tightly through the grommets leaving the transformer flush on the chassis.

Step 5 – Secure the output transformer to the chassis with two #8 KEPS nuts and the two #8 x 1/4" screws. The two KEPS nuts should be mounted on the inside of the chassis.

Proceed to 6.5

photo 6.4a



This photo does not show the brown wire (see above note)

6.5 Installing the Octal Tube Sockets

Step 1 – Prior to mounting, slightly bend the solder terminals on the back of the socket outward (photo 6.5A).

CAUTION

The terminals of these sockets will break if bent too far. It is recommended to use needle nose pliers for better control when bending these terminals.

Step 2 – Insert the socket from the outside of the chassis. Rotate both sockets so that Pin 2 is closest to the chassis edge. (photo 6.5b).

Step 3 – Secure the socket to the chassis with two #6 x 1/4" screws and two #6 KEPS nuts per socket.

Proceed to 6.6



Photo 6.5a

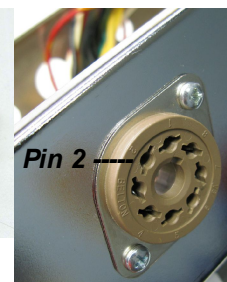


Photo 6.5b

6.6 Installing the 9 pin Tube Socket

Step 1 – Prior to mounting, slightly bend the solder terminals 1 - 3 and 6 - 9 on the back of the socket outward, leaving pins 4 and 5 alone for now.

CAUTION

The terminals of these sockets will break if bent too far. It is recommended to use the needle nose pliers for better control when bending these terminals.

Step 2 – Using a pair of needle nose pliers, carefully bend terminals 4 and 5 together. The holes of each of these terminals should meet flush against each other (photo 6.6a).



Photo 6.6a

Step 3 – To provide a flush mounting surface for the screws, use a pair of needle nose pliers to carefully bend the edges of the shield near the screw mounting holes in toward the socket (photo 6.6b, 6.6c, and 6.6d).

Step 4 – Insert the tube socket from the outside of the chassis and rotate the socket so that pin 8 of the tube is closest to the chassis edge (photo 6.6e).

Step 5 – With a #6 x 1/4" screw and #6 KEPS nut, secure the tube socket to the chassis with the outside hole (photo 6.6e).

Step 6 – Now bend the #6 solder tabs at a slight angle.

Step 7 – Insert a #6 x 1/4" screw into the remaining chassis hole.

Step 8 – Install the #6 solder terminal onto the screw on the inside of the chassis. Secure with the #6 standard nut. Locate the solder end of the #6 solder terminal away from the socket (photo 6.6e).

Proceed to 6.7



photo 6.6b

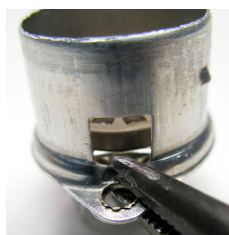


photo 6.6c

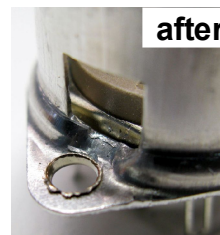
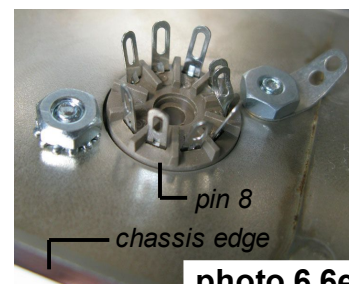


photo 6.6d



6.7 Installing the Electronics Assembly

Step 1 – Install the four #6 x 7/8" bolts into the drilled mounting holes.

Step 2 – With masking tape, tape down the heads of these screws to the chassis to hold them in place while completing the following steps.

Step 3 – Install the four 1/2" nylon standoffs onto the four #6 x 7/8" bolts.

Step 4 – Mount the electronics assembly onto the four #6 X 7/8" bolts and standoffs, each hole of the board corresponding to a bolt.

Step 5 – Apply four #6 KEPS nuts on the remaining exposed four #6 x 7/8" bolts and tighten them all down finger tight. The assembly can be centered as needed.

Step 6 – Remove the masking tape and finish tightening the nuts down tightly to the board.

Proceed to 6.8



6.8 Installing and Wiring the Input Jacks

Step 1 – With the 1M resistor (brown, black, green, gold), bend both leads and insert this resistor between the "tip" and the shorting contact terminals of jack 1. Situate resistor on the inside of the jack (photo 6.8a).

Step 2 – Run the component lead coming from the shorting contract terminal over to the neighboring "sleeve" or ground terminal (photo 6.8b).

Step 3 – Thread the remaining component lead coming from the "tip" terminal over to the second jack's "shorting switch" terminal (photo 6.8b).

Step 4 – Solder the two terminals of these jacks together (photo 6.8c).



NOTE

The two input holes on the outside of the chassis can be used as a temporary holding place and spacing template while working with the input jacks. In this way, the proper spacing is guaranteed when soldering the jacks together (photo 6.8c).

Step 5 – From inside the chassis, install this dual jack assembly into the appropriate chassis holes. The jack with the 1M resistor goes into input 1. The lock washers (the washers with the teeth) go on the inside of the chassis. The flat washer goes on the outside. Tighten down the assembly (photo 6.8d).

Step 6 – Strip and tin the end of the 3" black wire coming from pad "G1a" and connect the wire to the sleeve / ground terminal of the input 2 jack.

Step 7 – Strip and tin the end of the 3" yellow wire coming from pad "a" and connect this wire to the "tip" terminal of the input 2 jack (photo 6.8d).

Step 8 – Strip and tin the end of the 3" yellow wire coming from pad "b" and connect this wire to the point where the two jacks are soldered together.

Step 9 – Strip and tin the end of the 3" black wire coming from pad "G2b" and connect the wire to the sleeve / ground terminal of the input 1 jack (photo 6.8d).

Proceed to 6.9



photo 6.8d

6.9 Installing and Wiring the Volume Control

Step 1 – Feed a red wire 8" in length starting from the volume control, behind the electronics assembly board, coming out somewhere between the preamp tube and the speaker output jack.

Step 2 – Strip and tin the preamp tube end of this red wire and connect the wire to pin 7 of the preamp tube.

Step 3 – Cut the alignment tab off of the volume control (photo 6.9a) and install control into the chassis as indicated (photo 6.9b).

Step 4 – Strip and tin the volume control end of this red wire and connect the wire to the middle lug of the volume control (photo 6.9b).

remove this tab

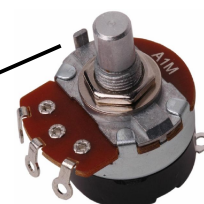


photo 6.9a

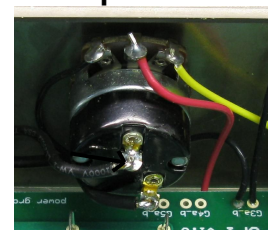


photo 6.9b

CAUTION

When wiring the volume control, the terminals to use are the three in line terminals at the edge of the control. The two terminals on the rear of the control are for the power switch.

Step 5 - Strip and tin the end of the 4" yellow wire coming from pad "c" on the electronics assembly and connect it to the volume control far right terminal (photo 6.9b).

Step 6 – Strip and tin the end of the 3" black wire coming from pad "G2a" on the electronics assembly and connect it to the volume control right far left terminal (photo 6.9b).

Proceed to 6.10

6.10 Wiring the Power Grounds from the PCB

Step 1 – Locate the black grounding wire coming from pad G6a. Trim this wire to 2" length. Strip the insulation 1/4" from the end of the wire and tin the exposed strands.

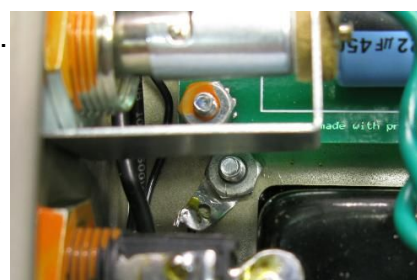
Step 2 – Bend a small hook in the stripped and tinned end and connect this wire (do not solder just yet) to the nearby terminal lug attached to the power transformer mounting bolt nearest the fuse holder (photo 6.10a).

Step 3 – Locate the next black grounding wire coming from pad G4a. Strip the insulation 1/4" from the end of the wire and tin the exposed strands.

Step 4 – Repeat the same for the wire coming from pad G3a.

Step 5 – Bend a small hook in these stripped and tinned ends and

photo 6.10a

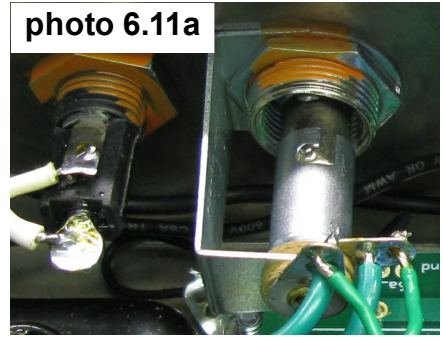


connect these two wires to the nearby terminal lug attached to the power transformer mounting bolt nearest the fuse holder (photo 6.10a).

Step 6 – Solder these three black wires to this lug.

Proceed to 6.11

photo 6.11a



6.11 Installing the Indicator Lamp

Step 1 – Remove the nut from the bezel holder.

Step 2 – With the nut removed, remove the lamp frame.

Step 3 – Place the bezel holder in opening in the chassis.

Step 4 – Install the lamp holder on the threaded end of the bezel holder.

CAUTION

When installing the indicator lamp, be certain that no part of C6 on the electronics assembly touches any part of the lamp holder. This may require repositioning C6 on the board.

Step 5 – Thread the nut onto the threaded end of the bezel holder.

Step 6 – Position the indicator lamp with the frame toward the fuse holder (photo 6.11a).

Step 7 – Tighten the nut to firmly secure the assembly to the chassis.

NOTE

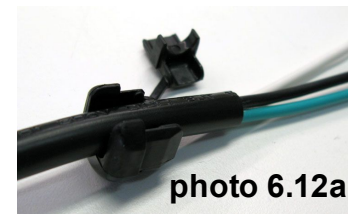
The nut that secures the lamp assembly can be firmly tightened by placing the point of a center punch on one of the corners of the nut. Firmly tap the center punch to tighten the nut.

Step 8 – Secure the nut by painting the exposed threads with fingernail polish (photo 6.11a).

Proceed to 6.12

6.12 Installing the AC Power Cord

Step 1 – locate the cut end of the power cord and strip off the outer black PVC insulation approximately 7 1/2" from this cut end.



CAUTION

The black PVC jacket of the power cord is thin and very easily cut. Be very careful not to cut so deep as to accidentally cut the insulation of the inside wires.

Step 2 – With the three wires (white, green and black) exposed, trim the white wire to a length of 5", the green wire to 4" and leave the black wire at 7 1/2" length.

Step 3 – Wrap the strain relief around the black PVC jacket of the power cord approximately 1" from where the stripped jacket begins. Note alignment of the strain relief (photo 6.12a).

Step 4 – With a pair of slip joint pliers, firmly squeeze the strain relief around the power cord. Grasp the strain relief and feed the stripped end of the power cord wires into the corresponding hole in the chassis.

Step 5 – While still grasping the strain relief with the pliers, guide the strain relief into the chassis hole. By firmly pressing the compressed strain relief into the hole, the strain relief should slide into place (photo 6.12b).



NOTE

There is a specific tool that makes installing strain reliefs simple. If you find yourself installing strain reliefs on a regular basis, this tool is worth owning. See TubeDepot.com p/n TL-R-29

Proceed to 6.13

6.13 Installing and Wiring the Fuse Holder

Step 1 – Remove the nut from the fuse holder and insert the fuse holder into the appropriate chassis opening. The rubber gasket should be situated on the outside of the chassis.

Step 2 – Reinstall the threaded nut on the fuse holder and tighten it against the chassis. Lock the nut down by painting the exposed threads with fingernail polish.

Step 3 – Locate the “HOT” wire of the AC power cord (the black wire in the USA). Solder this wire to the end of the fuse holder.

WARNING

By wiring the fuse holder as recommended, shock hazards associated with changing a fuse are reduced because the source AC is at the far end of the fuse holder and not at the cap end.

NOTE

The original amp had a .05 ufd cap between the fuse holder and ground. Commonly referred to as the “safety” cap, this cap can be eliminated when using a 3 wire grounded power cord instead of a 2 wire power cord. The grounding wire of the power cord is connected to chassis and thereby providing the safe reference to ground instead of the old .05ufd cap.

Step 4 – Cut a 5” piece of 18awg black wire. Strip and tin each end.

Step 5 – Solder one end of this wire to the remaining solder terminal of the fuse holder.

Step 6 – Solder the other end of this wire to the bottom solder terminal of the rear mounted switch on the back of the volume potentiometer (photo 6.13a).

Proceed to 6.14

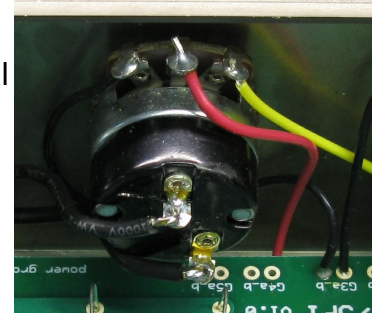


Photo 6.13a

6.14 Wiring the Power Switch and AC ground

Step 1 – Locate the appropriate power transformer's wire #1 primary wire (see box below) and solder it to the top solder terminal of the rear mounted switch on the back of the volume potentiometer (photo 6.13a). Use the white wire in the USA.

CAUTION

It is important to choose the correct primary wires based on the mains voltage appropriate for your location in the world. Incorrect wiring can lead to power transformer damage and/or fire hazards.

CAUTION

The correct wire choices as per the mains voltages are as follows:

If your mains

then the wires to use are ...

voltage is ...

wire #1 (to power switch)

wire #2 (to AC pwr cord))

100

black with blue stripe

black

117/120

white

black

220

black with yellow stripe

black

230

black with green stripe

black

240

black with red stripe

black

Step 2 – Locate the “NEUTRAL” wire of the AC power cord (the white wire in the USA).

Step 3 - Strip and tin the end of this wire.

Step 4 – Locate the solid black wire from the power transformer and strip and tin the end.

Step 5 – Wrap the end of the “NEUTRAL” wire from the AC power cord with the end of the black wire from the power transformer and solder together.

Step 6 – Fully insulate this connection with either a wire nut or with heat shrink (preferred).

Step 7 – Solder the green wire from the AC power cord to the solder terminal mounted to the power transformer nearest the rectifier tube socket (photo 6.16a).

Proceed to 6.15

6.15 Installing and Wiring the Speaker Jack

Step 1 – Install the 1/4" Switchcraft 11A jack into the appropriate speaker jack chassis hole. Place the lock washer (the washer with the teeth) on the inside of the chassis.

Step 2 – Trim the black wire from the output transformer to the edge of the chassis. Strip and tin the end of this wire and solder it to the "sleeve" terminal of speaker jack (photo 6.15a).

Step 3 – Strip and tin the end of the 3" yellow wire coming from pad "i" on the electronics assembly. Connect it but don't yet solder it to the "tip" terminal of the speaker jack (photo 6.15a).

Step 4 – Check impedance of speaker and select appropriate matching output transformer tap (see below caution).

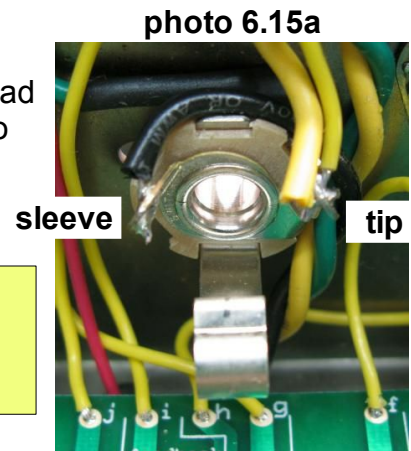
CAUTION

For 8 ohm impedances, use the green wire. For 4 ohm impedances, use the yellow wire. Running this amp into an incorrect load can damage the output transformer and the power tubes.

Step 5 – Trim, strip and tin the end of this wire and solder it, along with the previously mounted yellow wire to the "tip" end of the jack.

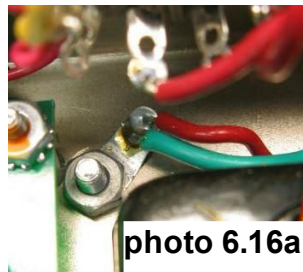
Step 6 – Cap off the end of the unused output transformer tap with a small piece of electrical tape or heat shrink tubing (photo 6.15b).

Proceed to 6.16



6.16 Wiring the Rectifier Tube Socket

Step 1 – Strip and tin the end of the red wire with the yellow line on it coming from the power transformer. Solder this wire to the solder terminal nearest the rectifier socket. This same terminal has the green wire from the power cord connected to it (photo 6.16a).



Step 2 – Strip and tin the two solid red wires from the power transformer. Solder these to pins 4 and 6 of the rectifier tube socket (photo 6.16b).

Step 3 – Strip and tin the two yellow wires from the power transformer. Connect these two wires to pins 8 and 2 of the rectifier tube socket. Apply solder to pin 2 but do not yet apply solder to pin 8 (photo 6.16b).

Step 4 – Trim the red wire from pad "d". Strip and tin this wire and connect it to pin 8 of the rectifier tube socket. Do not solder just yet (photo 6.16b).

Step 5 – Trim the red wire from the output transformer to the edge of the chassis. Strip, tin and solder to pin 8 of the rectifier tube socket (photo 6.16b). These three wires should all be soldered.

Step 6 - The remaining black wires (which are the unused multi-voltage taps) of the power transformer should be trimmed and capped off with either electrical tape or preferably heat shrink tubing (photo 6.16c). Do not trim the green wires yet.

Proceed to 6.17

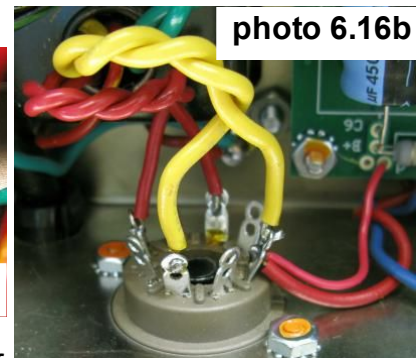


photo 6.16c

6.17 Wiring the Power Output Tube Socket

NOTE

The new upgraded output transformer has an additional brown primary wire which is not seen in the video or photos in this manual. This brown wire is NOT used in this build. We recommend running this wire into the chassis and sealing its end with insulation tape or heatshrink. It will NOT be connected to anything.

Step 1 – Trim, strip and tin the blue wire from the output transformer. Solder this wire to pin 3 of the output tube socket (photo 6.17a).

Step 2 – Trim, strip and tin the red wire from pad “e”. Solder this wire to pin 4 of the output tube socket (photo 6.17a).

Step 3 - Trim, strip and tin the yellow wire from pad “f”. Solder this wire to pin 8 of the output tube socket (photo 6.17a).

Step 4 – Trim, strip and tin the yellow wire from pad “h”. Solder this wire to pin 5 of the output tube socket (photo 6.17a).

Step 5 – The brown wire from the output transformer will NOT be used for this construction.

Step 6 – Neatly organize all wires tightly against the chassis.

Proceed to 6.18

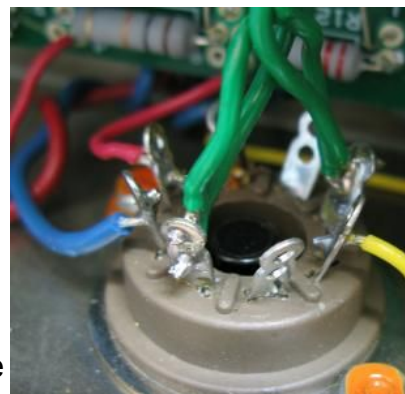


photo 6.17a

6.18 Wiring the Preamp Tube Socket

Step 1 - Trim, strip and tin the yellow wire from pad “g”. Solder this wire to pin 8 of the preamp tube socket (photo 6.18a).

Step 2 – Verify that the red wire that runs from the center (wiper) contact of the volume control is soldered to pin 7 of the preamp tube socket (photo 6.18a).

Step 3 – Trim, strip and tin the yellow wire from pad “j”. Solder this wire to pin 6 of the preamp tube socket (photo 6.18a).

Step 4 – Trim, strip and tin the yellow wire from pad “k”. Solder this wire to pin 1 of the preamp tube socket (photo 6.18a).

Step 5 – Trim, strip and tin the red wire from pad “m”. Solder this wire to pin 2 of the preamp tube socket.

Step 6 – Trim, strip and tin the yellow wire from pad “n”. Solder this wire to pin 3 of the preamp tube socket (photo 6.18a).

Step 7 – Neatly organize all wires tightly against the chassis.

Proceed to 6.19



photo 6.18a

6.19 Installing and Wiring the Filaments

Step 1 – Trim, strip and tin the two green wires from the power transformer. Solder these wires on the two terminals of the installed indicator lamp. Use the inside mounting holes of the terminals (photo 6.19a).

Step 2 – Take the green 18awg stranded wire and fold it in half. Tightly twist together the two cut ends and chuck this into an electric drill (photo 6.19b).

Step 3 – Wrap the other end around a screwdriver and pull the wire tightly between the drill and screwdriver (photo 6.19c).



photo 6.19a

Step 4 – Slowly engage the drill, twisting the wire tightly and evenly together (photo 6.19d).

Step 5 – Unwind about 1" of the cut ends of the twisted wire. Strip and tin these ends and solder them to the indicator lamp terminals (photo 6.19a).

Step 6 – Measure approximately 4" of the twisted wire from the indicator lamp and cut. Unwind about 1" from the cut ends of this twisted wire. Strip and tin these ends and connect to pins 2 and 7 of the power tube socket. Do not solder just yet.

Step 7 – Unwind about 1" of the cut ends of the remaining twisted wire. Strip and tin these ends and connect them to pins 2 and 7 of the power tube socket. Apply solder to pins 2 and 7 of the power tube socket (photo 6.19e).

Step 8 - Measure approximately 6" of this twisted wire from the power tube socket and cut. Unwind about 1" from the cut ends of this twisted wire. Strip and tin these ends and connect to pins 9 and 4/5 of the preamp tube socket. Do not solder just yet.

Step 9 – Take the two 100 ohm resistors and twist the two leads together (6.19f).

Step 10 – Bend the end of the other two opposite leads of the resistors away from each other (6.19f).

Step 11 – Connect these two bent resistor ends to pins 9 and 4/5.

Step 12 – Apply solder to pins 9 and 4/5 (photo 6.19g).

Step 13 – Trim the twisted ends of the resistors to half length. Bend a small loop in the twisted ends.

Step 14 – Cut a 3" length of black wire. Strip and tin both ends.

Step 15 – Solder one end of this black wire to the loop of the two resistors (photo 6.19g).

Step 16 – Solder the other end of this black wire to the solder tab mounted to the screw of the preamp tube (photo 6.19g).

Proceed to Chapter 7

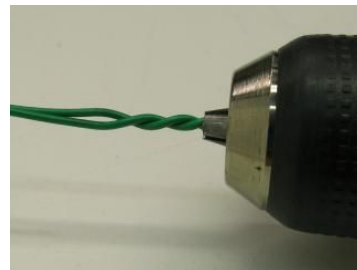


photo 6.19b

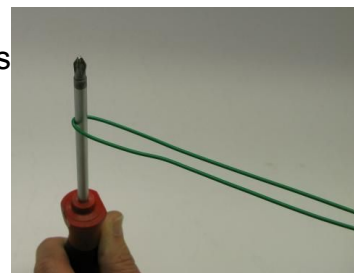


photo 6.19c

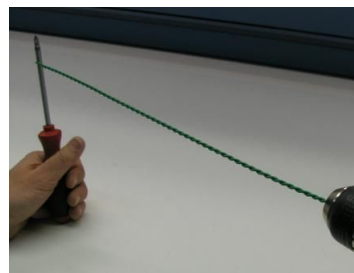


photo 6.19d



photo 6.19f



photo 6.19g



photo 6.19e

7 Final Assembly

7.1 Installing the Volume Control Knob

Step 1 – Prior to mounting chassis into cabinet, turn the volume control full counter clockwise

Step 2 – With the knob in hand, back the set screw of the knob fully counter clockwise (but not to the point it is falling out).

Step 3 – Place the knob on the shaft of the chassis mounted volume control.

Step 4 – Orient knob with pointer toward the printed number “1” on the chassis.

Step 5 – lift knob slightly from being fully flush against chassis so as to keep knob from dragging on mounting nut of the control when turned.

Step 6 – Tighten the set screw of the knob firmly against the control shaft.

Step 7 – Confirm smooth operation

Proceed to 7.2

7.2 Installing the Chassis Mounting Bolts and Chassis

Step 1 – Press the two truss bolts into the cabinet holes (if not already installed).

Step 2 – Mount the chassis onto these bolts, holding the chassis against the cabinet top.

Step 3 – Install the two #10 KEPS nuts, one on each bolt, and loosely tighten chassis against top of cabinet.

Step 4 – Slide chassis to rear of cabinet, away from speaker.

Step 5 – Press back panel into position, pushing the chassis against the panel. This will properly align the chassis with in the cabinet and provide good contact with the shielding foil.

NOTE

Proper alignment of chassis within cabinet is when the chassis contacts the back panel shielding tape without distorting the back panel.

Step 6 – Place the back panel to the side and firmly tighten chassis into the cabinet.

Proceed to 7.3

7.3 Installing AC Power Cord Clamp

Step 1 – Properly align the 5/16” nylon cable clamp around power cord (photo 7.2a).

Step 2 – With a #8 x 5/8” screw, secure the cable clamp and power cord to the inside cabinet wall. (photo 7.2b)

Proceed to Chapter 8



photo 7.2a

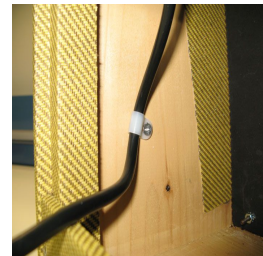


photo 7.2b

8 Testing

8.1 You are almost finished. And although the first temptation is to plug up the amp and turn it on, I want to caution you to instead take the time and review all your connections. This will be time well spent as it ties together all the construction steps. Any errors are more likely to stand out at this time. It is not uncommon to find two or three errors.

After verifying all of the above connections are correct, read through all of the following steps before completing any of them. Once you have finished reading these steps, it is time to begin.

Step 1 - Install a 2A, fast blow fuse into the fuse holder.

WARNING

When changing or installing a fuse, always remove the AC source by unplugging the amp. Never use fingers to remove or insert a fuse into a fuse holder. Instead, use the fuse cap to hold the fuse when removing or inserting into the holder.

CAUTION

Use of any fuse larger than 2A is not recommended and could cause severe and costly equipment damage in case of an internal component failure.

Step 2 – With the amp unplugged and no tubes installed, turn on the amplifier's power switch. The power switch will remain on until all tests are finished.

Step 3 – Plug the amp's AC power cord into AC power at the wall.

NOTE

I personally recommend using a variable AC with separate current and voltage meters. This allows bringing the voltages up very slowly and provides more accurate monitoring capabilities.

NOTE

If you are uncomfortable with just turning on the amp and watching for smoke, I recommend building an inexpensive Dim-Bulb tester to monitor and control current flow into the amp. A quick internet search on "Dim Bulb tester" will give several diagrams and plans.

CAUTION

It is good practice to use a power strip with a circuit breaker and an on/off switch between the wall power and the amplifier power cord as an improved electrical safety measure.

WARNING

In case of any troubles, quickly disconnecting the power cord from the wall (or turn off the power strip). You should not touch the amp or the amp's power switch until the amplifier's power cord is no longer connected to AC wall power.

Step 4 – The panel indicator should illuminate. Monitor for any unusually smoke or smells or a blown fuse or hot power transformer. If anything unusual occurs, disconnect power immediately and review connections.

Step 5 – If there is nothing unusual after a couple of minutes, remove AC power by disconnecting the AC power cord from the AC source. Leave the amp's power switch "on".

Step 6 – With the amp disconnected from power, install the rectifier tube.

Step 7 – Plug the amplifier's AC power cord into the AC power source at the wall.

Step 8 – The panel indicator should illuminate. Visually verify that the filament inside the rectifier tube is glowing. Monitor amplifier for any unusual smoke or smells or blown fuse. If anything unusual occurs, disconnect power immediately and review connections.

NOTE

Within a minute or two, the rectifier will have heated up and provided a slowly increasing high voltage to the power supply. This voltage will have properly formed the high voltage filter caps.

Step 9 – With your multimeter on the 500 volt range, carefully connect the meter's black lead to chassis ground and the red lead to the positive end of C6 (B+). The voltage here should be something close to +470 +/- 15 volts (photo 8.1a). The voltage at this point will be 20V lower when the power tubes have been installed.

WARNING

Whenever testing voltages, it is recommended to keep your free hand off of the chassis. In this way, there isn't a path for significant current to flow through the body to ground in case the measuring hand accidentally comes in contact with high voltages.

NOTE

These voltages are being measured without tubes installed. These values will decrease with the added load of the tubes bringing the voltages within acceptable tolerances of the caps.

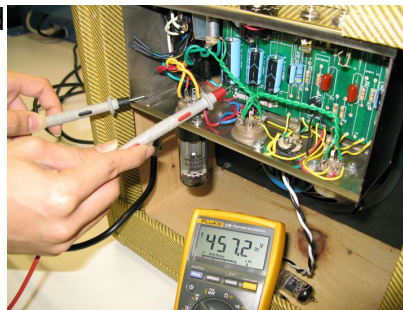
Step 10 – Remove AC power by disconnecting the AC power cord from the AC source.

Step 11 – Install the preamp tube.

Step 12 – Plug the amplifier's AC power cord into the AC power source at the wall.

Step 13 - The panel indicator should illuminate. Monitor for any unusual smoke or smells or blown fuse. If anything unusual occurs, disconnect power immediately and review connections.

Step 14 – Let the amplifier warm up for 2 minutes. With a multimeter on the 20 volt range, carefully connect the meter's black lead to chassis ground and the red lead to the positive side of C3. If C3 is not installed, the red lead can be connected to pad "n" instead. The voltage here should be close to +1.8 +/- .5 volts (photo 8.1b).



NOTE

The presence of voltages at steps 14 & 15 indicates that the two halves of V1 are correctly sourcing current.

Step 15 – Move the red lead to the positive side R7 (pad "g"). The voltage here should be close to +1.8 +/- .5 volts.

Step 16 – If these measurements are correct, remove the AC power by disconnecting the AC power cord from the AC source.

Step 17 – Install the power tube.

Step 18 – Connect speaker to output jack.

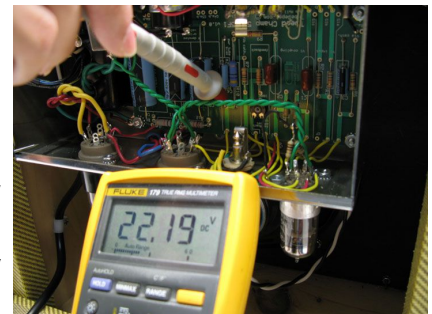
Step 19 – Turn volume to minimum position, leaving the amplifier power switch to "on".

Step 20 – Plug the amplifier's AC power cord into the AC power source at the wall.

Step 21 – The panel indicator should illuminate. Monitor for any unusual smoke or smells or blown fuse. If anything unusual occurs, disconnect power immediately and review connections.

Step 22 – Let the amplifier warm for 2 minutes.

With a multimeter on the 200 volt range, carefully connect the meter's black lead to chassis ground and the red lead to the positive side of C4. The voltage here should read close to +22 +/- 3 volts (photo 8.1c).



NOTE

The presence of voltage at step 22 indicates that V2 is correctly sourcing current.

Step 23 – If all these measurements are within specifications, and the speaker is connected, and with no signal source connected to either input, turn up the volume control and listen for a low level hiss from the speaker. There will be a slight hum, but anything drastic indicates wiring troubles.

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Step 24 – If the above hiss is heard, turn the volume control back to minimum and connect a signal source into input 1.

NOTE

A signal source can be a guitar or high impedance microphone or even a low level CD or MP3 player. A speaker output from another amp is not recommended.

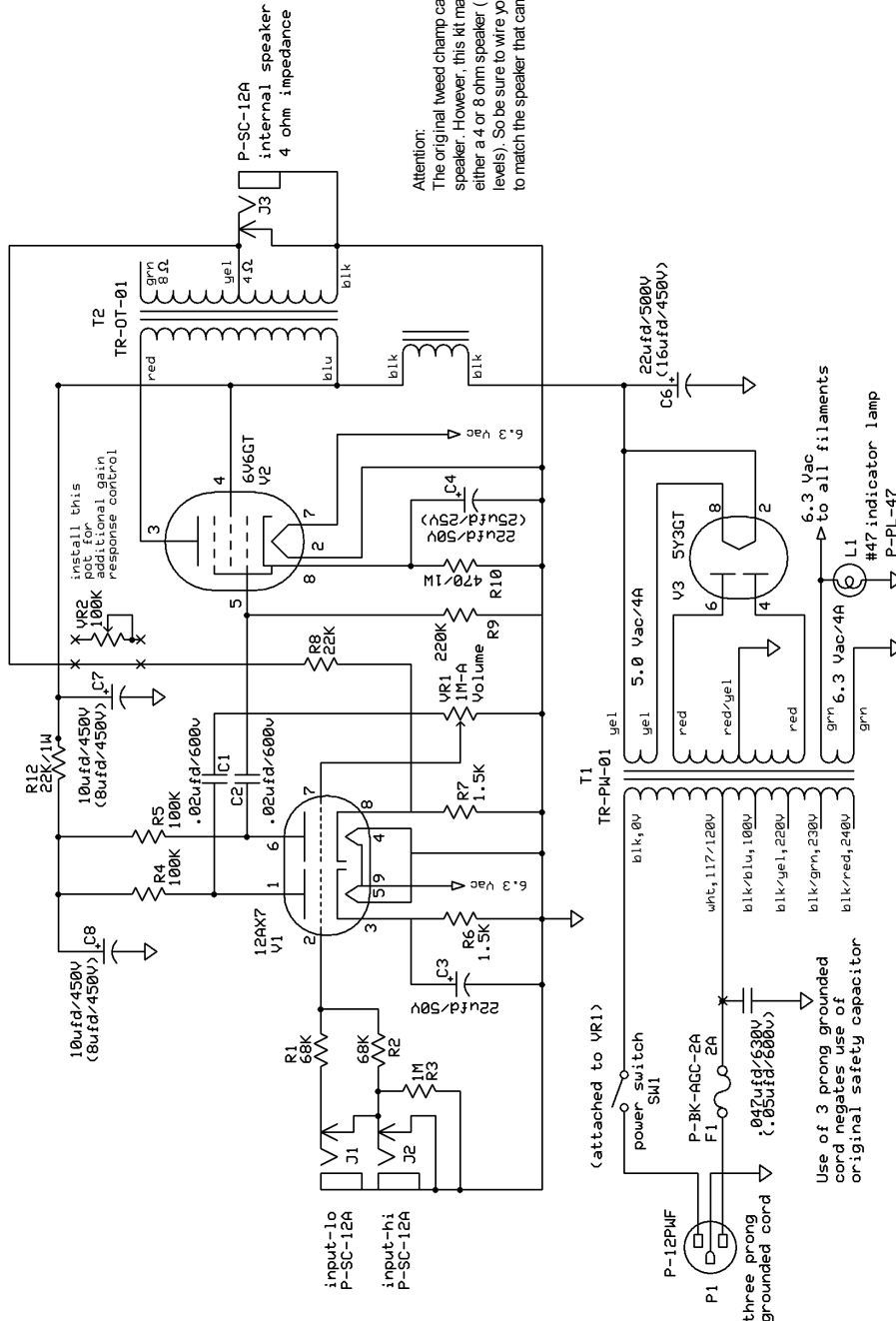
Step 25 – Turn up the volume on the amp and the signal source (most likely a guitar or harmonica microphone) and verify that the signal is coming from the speaker.

Step 26 – If everything checks good, turn off amp and install the back panel.

Step 27 – Now the time has come to rock out ... your amp is done!

End

Note: the upgraded output transformers have an additional brown wire on the primary that is not used with this kit.



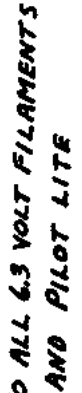
- Notes:
1. values in parenthesis are original values
 2. part numbers are TubeDepot.com stock numbers
 3. unless otherwise stated, resistors are 1/2W
 4. ground connections are to the chassis

TubeDepot.com

Tweed Champ 5E1 - Schematic

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33-X

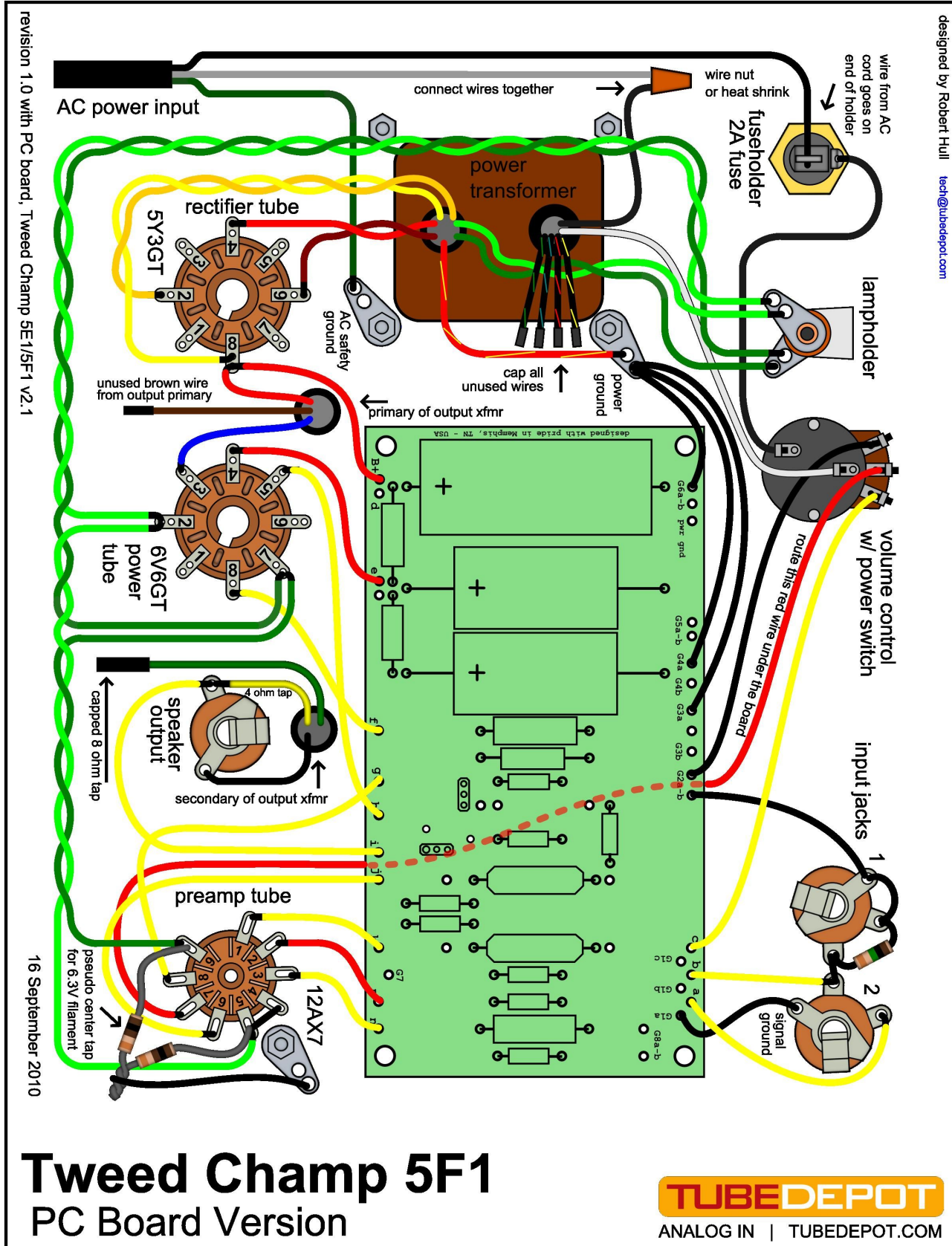


Wiring Layout with PC Board

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designed by Robert Hull tech@tubedepot.com



10 Cool Modifications

Once you have the amp working and sounding good, here are a few ideas to “shape” the tone to suite your tastes.

1. Change both C1 and C2 to .01ufd or .0047ufd to reduce low frequency response at high gain settings. Gives the amp the ability to “cut through” better.
2. Install 22ufd/450v caps in C8 and C9 positions - tightens power supply and provides quicker dynamics.
3. Experiment with 22ufd/50v cap in C3 position - increases gain with it installed.
4. Change out 6V6 for an EL84 by fabricating your own cover plate adapter and installing a 9 pin tube socket – allows installing EL84s vs. 6V6.
5. Change out 6V6 for 6AQ5/6005 by fabricating your own cover plate adapter and installing a 7 pin socket – allows installation of 6AQ5s vs. 6V6.
6. Change out 6V6 with 5881. It is recommended to remove the rectifier tube and use a solid state rectifier instead. In this way, the power transformer is not providing filament current to a rectifier tube. This additional power transformer over head is needed for the increased 6.3V filament requirements of the 5881. Additionally, the filter caps will have to be upgraded to +500V.
7. Install solid state rectifier in place of tube rectifier – tightens up dynamics and power output. Filter caps must be upgraded to +500V types.
8. Run this amp without negative feedback altogether by disconnecting the feedback line from speaker output jack – provides much more overall gain and distortion with the volume up. The Gibson GA5 is a nearly identical circuit to this tweed champ without the feedback.
9. Install a miniature toggle switch, SPDT between the speaker jack and the preamp tube socket. This miniature switch can then be wired as an impedance selector for the 4 and 8 ohm taps from the output transformer. In this way, more cabinet choices become available.

Resistor and Capacitor Codes

Most electronic components are so small that printing the actual values, ratings and tolerances on the individual component is nearly impossible. Therefore, codes were invented early in electronic history and printed on the components to describe what they were. Many of these codes are still in use today.

Below I've listed some of the more common codes that you are likely to come across while building this project.

How to Identify Power Ratings and Resistor Value Color Codes.

This project uses different types of resistors. The diagrams below will assist you in locating and identifying resistor values, tolerances and ratings for the various circuit requirements for your project.

Resistor Power Ratings

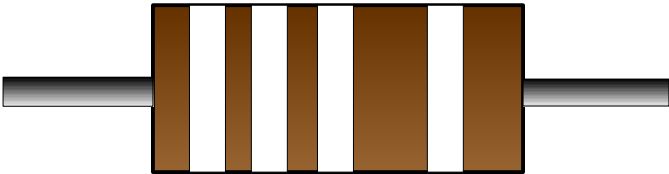
Not only are resistors graded by their values but also by their power ratings. Power ratings are determined by how much heat (power) can be safely dissipated by the resistor. Higher ratings are usually indicated by larger sizes.

Below are photos and descriptions of the various resistors used in this project.



Resistor Types

Carbon Film
Metal Oxide
Carbon Composition



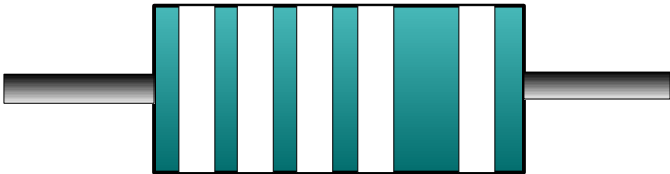
1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Color	Digit
3rd Digit	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Multiplier	
Color	Multiplier
Black	1
Brown	10
Red	100
Orange	1,000
Yellow	10,000
Green	100,000
Blue	1,000,000
Silver	.01
Gold	.1

Tolerance	
Color	Tolerance
None	+/- 20%
Silver	+/- 10%
Gold	+/- 5%
Red	+/- 2%
Brown	+/- 1%



Metal Film (1%)

How to Read Capacitor Value Codes

This project uses several different kinds of capacitors. Some of these capacitors have their values and voltage ratings printed on them, others use numerical codes. The diagrams below will assist you in locating and identifying capacitor values, tolerances, and voltage ratings for the various circuit requirements for your project.



Cornell-Dubilier Silver Mica – high quality / high accuracy picofarad cap

1st line: 250 +/- %5 = direct value in pfd (250pfd); tolerance 5%
2nd line: 500V SM = voltage rating (500V); batch code



Sprague "Orange Drop" 715 series – Vintage style rolled film & foil polypropylene capacitor, radial leads.

1st line: 715P600V = 715 series; rated at 600V
2nd line: 104J 0821 = value in pfd (104 = 10 and 4 zeros pfd); tolerance (J = +/- 5%); batch code

104 = .1ufd
103 = .01ufd 223 = .022ufd 473 = .047ufd
102 = .001ufd 222 = .0022ufd 472 = .0047ufd



Xicon MPP – Warm tone, small size, metalized polypropylene capacitor. Similar construction style to Orange Drop 716 series capacitors.

1st line: F104K d = value in pfd (104 = 10 and 4 zeros pfd); tolerance (K = +/- 10%)
2nd line: 630MPP 1 = voltage rating (630V); construction (MPP = metalized polypropylene)

104 = .1ufd
103 = .01ufd 223 = .022ufd 473 = .047ufd
102 = .001ufd 222 = .0022ufd 472 = .0047ufd



Sozo Film and Foil – Vintage style rolled film & foil polypropylene capacitor, axial leads.

1st line: 684K = value in pfd (684 = 68 and 4 zeros pfd); tolerance (K = +/- 10%)
2nd line: 160V = voltage rating (160V)
3rd line: 0834R = batch / date code



104 = .1ufd 684 = .68ufd
103 = .01ufd 223 = .022ufd 473 = .047ufd
102 = .001ufd 222 = .0022ufd 472 = .0047ufd

Soldering Hints

Anyone working in electronics should learn how to solder well. Thankfully it isn't hard, it just takes practice and having the proper tools. Once you are able to solder well, your projects will be more professional and more reliable.

Refer to our video "How To Solder" for detailed explanations.

http://www.youtube.com/watch?v=cIDydYIVTqU&feature=channel_page

But before you get started, here are a few safety tips that should be followed:

- Fumes from soldering can be harmful therefore it is important to always have adequate ventilation.
- Wear appropriate clothing when working around hot, molten solder. Never wear shorts or open toes shoes.
- protect hands and equipment from burns by using a soldering iron holder. An improperly stored soldering iron is a fire hazard
- Do not eat, drink, or smoke while you are soldering. Limit exposure to lead.
- Wash hands often when soldering.
- Wear safety glasses when soldering.

Purpose of Soldering

Soldering is used to bond two or more metals together. By applying heat to a connection and feeding solder into this connection, the solder will melt and flow around the metals. A small surface amount of each of the metals will additionally melt and inter-mix with the liquid solder forming an alloy. This connection is called an intermetallic bond and the two metals, when properly soldered together, act as if it they were one solid piece.

Importance of Proper Soldering

Proper soldering is the basis for faithful equipment operation. A good solder connection is physically strong and electrically reliable. A poorly soldered connection will have intermittent operation which can cause electrical damage to neighboring components. At the very least, a bad solder connection will create an unpleasant audible experience. Therefore the importance of good soldering skills cannot be over emphasized. Your sound will rely on it.

Basic Soldering Rules

The following are some basic soldering rules that if followed, will result in a reliably soldered connection every time:

1. Make sure the surfaces to be soldered are clean and free of corrosion. A dirty, greasy, or oxidized surface will not accept solder properly, creating an intermittent solder connection.
2. Establish a firm mechanical connection of the components prior to soldering. Solder should only be used to develop an electrical connection and not a mechanical one.

3. Insure that the soldering tip is clean prior to any soldering. A clean solder tip is one wiped lightly across a damp sponge to remove oxides prior to use. It is essential for maximum heat transfer that there are few contaminants on the tip.
4. When applying the soldering iron to a connection to be made, it is important to lay the tip in such a position that the maximum surface area of the tip is presented to the connection. In this way, the maximum heat is transferred to the connection in the minimal amount of time.
5. Apply solder to the work and not the iron. In this way, a properly heated connection will readily accept the solder, further reducing the chances for unreliability.
6. Use only clean, good quality, rosin core solder. Poor quality or dirty solder will not melt smoothly and will deposit contaminants into the connection, making it weak.
7. Use only the amount of solder needed to complete the connection. Use too little solder and the connections is compromised where as too much solder runs the risk of accidentally contacting neighboring connections.
8. Finish the connection by removing the soldering iron quickly. It is important to apply heat only for as long as it needed to properly flow the solder. Any additional heat runs the risk of overheating the parts being soldered.
9. Do not move the parts of the connection while the solder is hardening. It is important that everything stays totally still until the solder has fully set because any movement in the parts while the solder is in a plastic state will result in a weak, unreliable, and cracked connection.
10. Clean any rosin residues from freshly made connections. Rosin residues can trap dirt and dust that could weaken a connection and possibly create arcing conditions. Isopropyl or ethel alcohol and a stiff bristled brush are good for this.

Sequence of Events to Make a Good Connection

1. Establish a good mechanical connection of the components prior to soldering.
2. Place the tip of the iron firmly against the connection to be soldered.
3. Let connection reach soldering temperature (usually within 1 to 2 seconds).
4. Feed solder into the point where the soldering iron tip meets the connection, not on to the tip of the soldering iron.
5. Feed an adequate amount of solder into the connection for the solder to flow around the components to be joined.
6. When adequate amount has been reached, remove solder and iron simultaneously.
7. Do not move connection or components until solder has solidified.
8. Clip off any excess wire lead(s).

Amplifier Care, Feeding, and Applications

Now that the amp is together here are a few good hints to keep it up and running and you safe and happy:

- Only plug this amp into properly grounded (three prong) AC receptacles.
- Do not cut off the third prong of the power cord plug thus defeating its safety feature.

WARNING

Keith Relf of "The Yardbirds", Leslie Harvey of "Stone the Crows", and John Rostill of "The Shadows" all died of electrocution while playing their guitars (Leslie Harvey while on stage). Proper grounding is more than just important ... it can be life or death!

- Only plug this amp into the properly wired AC voltages.
- Do not expose this amp to high levels of moisture such as rain or spilled liquids.
- Avoid placing any beverages on the cabinet.
- Whenever changing tubes or cleaning this amp, disconnect the amp from the AC power source and allow the amp to cool for 10 min. before beginning.
- It is recommended that the amp is only plugged to AC power when the amp is being used. Otherwise, it should be left unplugged from AC voltages.
- Avoid exposing this amp to elevated temperatures such as heaters or hot cars or garages. The expansion and contractions of these temperatures will put undo stress on all the solder connections, possibly damaging them.
- Always provide adequate ventilation for the tubes and amplifier. An air space of 6" or more is recommended between the amp and any other object(s), especially around the rear of the amp. It is a good idea to keep the amp as cool as possible.

Amplifier Feeding

As with any tube amp, the choice of tubes will affect the overall tone of the amp. And of course, some tube choices are more dramatic than others. Therefore, I encourage everyone to shape the tone of this amp to suit their tastes through the use of different tubes. Below is a short list of tubes that can be used for adjusting tone performance without modifying the amp.

Preamp tubes:

- 12AX7A / ECC83 / ECC803 / 7025; (high gain – amplification factor = 100)
- 12AD7; (high gain – amplification factor = 100)
- 12AT7 / ECC81; (high gain – amplification factor = 70)
- 12AY7; (med gain – amplification factor = 40)
- 12AU7 / 5814 / 6189 / 5963 / ECC82; (low gain – amplification factor = 17)
- 12AZ7; (med gain – amplification factor = 60)
- 12DW7; (mixed gain – amplification factor, first triode = 100; second triode = 17)
- 5751; (high gain – amplification factor = 70)

Power tubes:

- 6V6GT - 5871 - 7408 - 7184

Rectifier tubes:

- 5Y3GT - 5AX4 - 5CG4 - 5R4 - 5T4
- 5V4 - 5Z4 - 5AR4 - GZ30 - 6106

Applications

The laboratory environment is nice, but life experiences better determine success levels. Therefore the true test of a good amp is how well it performs “in the field”. The following are some of my favorite field proven gigging and recording hints.

- Run this amp wide open! Let it breath, let it sing. It wants to be heard.
- With the amp wide open, control the level of distortion with the guitar's volume control.
- Try recording this amp by putting a microphone in front, slightly off axis of the speaker to get a crunchy, bluesy tone. Relocate the microphone to directly in front to get an upfront rock tone.
- Instead of one, try recording with two microphones, one in front (straight phase) and another in back (reverse the phase). This will make the amp sound huge when recorded!
- Run the amp into a different cabinet (ie 2x12, 4x12, 4x10). It is surprising how different speaker set ups will respond to 5W. Just set microphones to taste and enjoy.
- Record the amp in the bathroom close to the tub. Tubs ring wonderfully when excited.
- A little slap back echo goes along way so try a delay pedal between the guitar and amp.
- A vibrato or tremolo pedal in front is perfect for soulful coolness.
- Run an overdrive pedal set clean in front of the amp. Now crank up the pedal's output and hit the amp hard with this signal. I love this arrangement!
- Harp players can get control of feedback (as well as tone shaping) by putting an EQ pedal between the harp microphone and the amp.
- Guitar players can benefit from an EQ pedal in front as well. Just a little more shaping can make everyone happy.
- The low end response can be maximized by situating the amp's cabinet as firmly against the floor as possible.
- Run your guitar / harp microphone into the #1 input and then come out of the #2 input of this amp and go into the front end of a different amp. This way you can run two amps at the same time. The sound of this amp mixed with another is very good.
- Connect the output of this amp to a speaker load box with a line out and this amp becomes a great preamp in which to drive another amp or straight to the board.
- Run a vocal microphone (through the appropriate impedance matching devices) and record the most deliciously distorted vocals ever. No modeling can touch this sound.
- Install a solid state rectifier and get an extra watt of power and an animated dynamics in tone.
- Exchange the 6V6 with a 5881 for a more expansive sound scape. It is best to only run the 5881 when using the solid state rectifier.
-

Appendix D

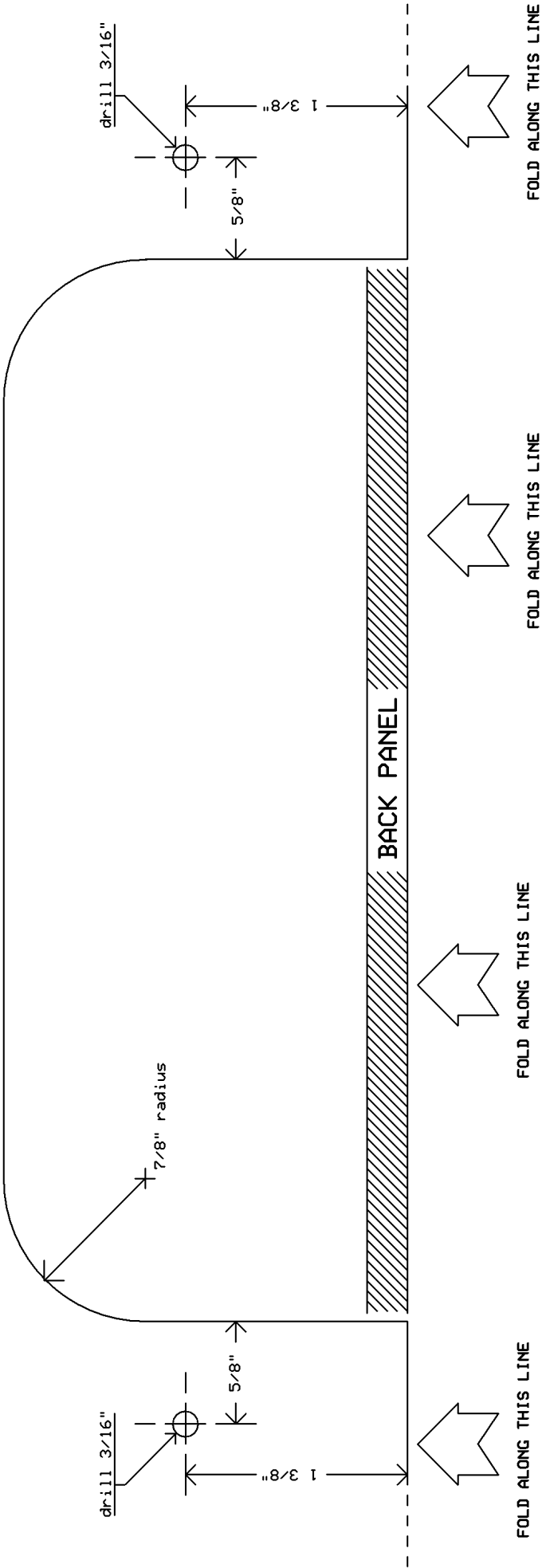
Templates

Appendix D1 is the cabinet drilling template

Appendix D2 is the chassis drilling template – PCB and Turret Boards

APPENDIX D-1

CAUTION: Because some printers may compress this template when printing, always insure accuracy of this template before drilling by measuring the cabinet and template first. It is always better to measure twice and drill once. For once a hole is drilled, it cannot be un-drilled.



TubeDepot.com

Drilling Template Cabinet/Tweed Champ SF1

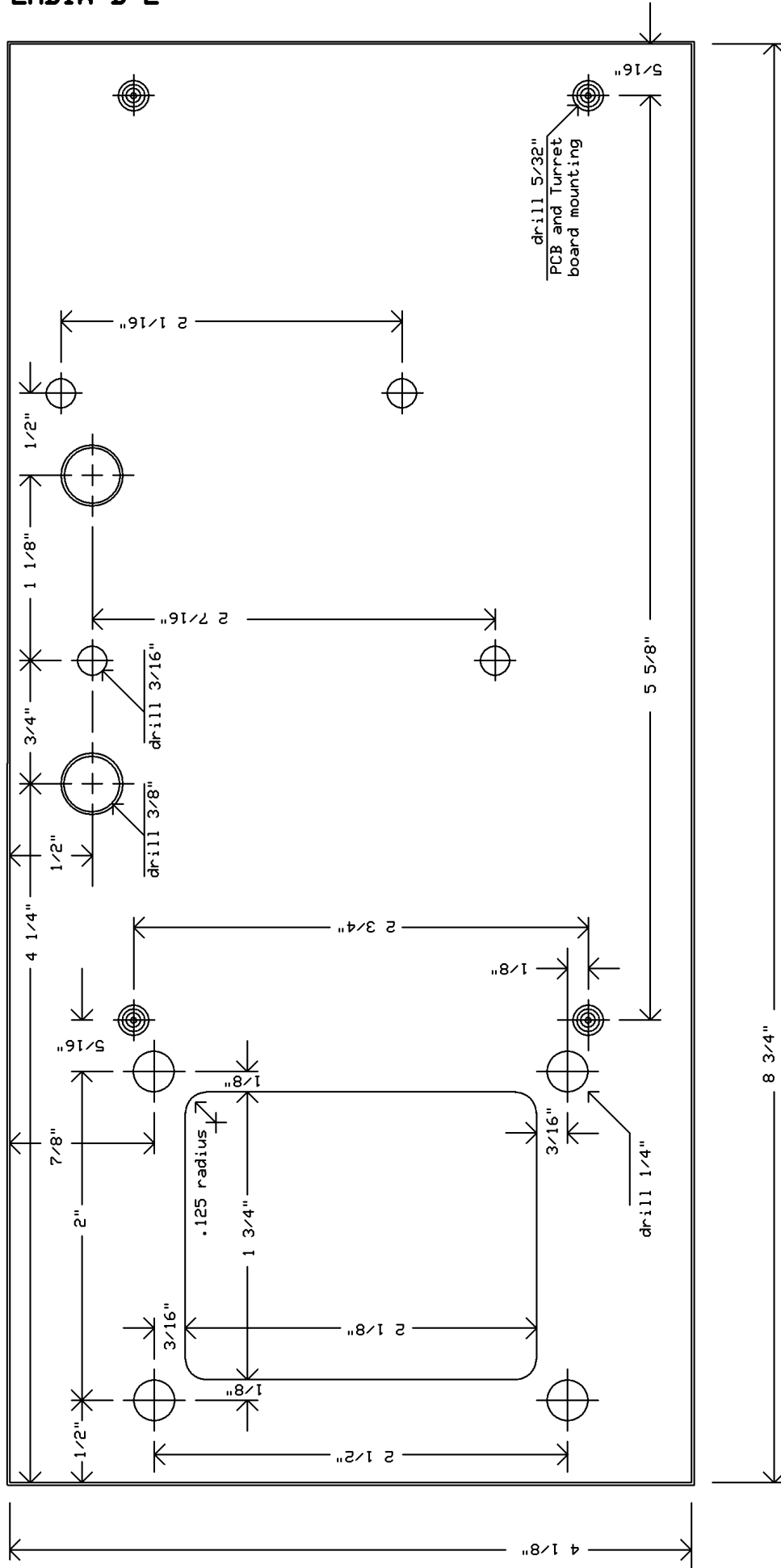
Rev 1.0
3/19/2009

Robert Hull

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APPENDIX D-2

↑
tube sockets on this side



↑
printed control panel on this side