The Trinity Amps
Tweed
Amp Builder's Guide

Dec. 11 , 2021 Version 21.5

www.trinityamps.com

Table of Contents

Introduction

This guide has been prepared for builders of Trinity Amps Kits. It is always being improved and we would appreciate your feedback and comments to: stephen@trinityamps.com

Accordingly, content and specifications are subject to change without notice.

We do try to make it as accurate as possible, but it is sometimes hard to keep up with the changes. Therefore, if you do find an error, please let us know about it and we will correct it. Suggestions are welcome so if you have one, please get in touch with us.

Sources of help.

Forums: Please use the various forums to get help. They are an excellent resource and can be found at trinityamps.com Fender forum.

The Fender Amp Field Guide is a terrific resource for all amps Fender

Email: We can't help with every problem but if you cannot get your problem resolved, email us and we'll do our best to help.

Phone Call: If your problem can't be solved, email for a phone appointment.

Acknowledgements

Much of the content in this document is original. Rather than reinvent content, some parts are based on content from other excellent sources and are hereby acknowledged.

R.G. Keen's site www.geofex.com - Tube Amp FAQ, Tube Amp Debugging
AX84.com site www.AX84.com - Gary Anwyl's P1 construction guide version 1.0
GM Arts website http://users.chariot.net.au/~gmarts/index.html - Guitar Amp Basics
Aron from diystompboxes.com

WARNING

Please Read this Information Carefully

The projects described in these pages utilize **POTENTIALLY FATAL HIGH VOLTAGES.** If you are in any way unfamiliar with high voltage circuits or are uncomfortable working around high voltages, **PLEASE DO NOT RISK YOUR LIFE BY BUILDING THEM.** Seek help from a competent technician before building any unfamiliar electronics circuit. While efforts are made to ensure accuracy of these circuits, no guarantee is provided, of any kind!

USE AT YOUR OWN RISK: TRINITY AMPS EXPRESSLY DISCLAIM ALL LIABILITY FOR INJURY OR PROPERTY DAMAGE RESULTING FROM THIS INFORMATION! ALL INFORMATION IS PROVIDED 'AS-IS' AND WITHOUT WARRANTY OF ANY KIND.

REMEMBER: NEVER OPERATE YOUR AMP WITHOUT A LOAD. YOU WILL RUIN YOUR OUTPUT TRASNFORMER!

Version Control

Version	Date	Change
21.1	12Feb21	First Issue
21.2	19Jul21	Board Mounting Clarified
21.3	28Aug21	Updated per I Elliott feedback
21.4	9Dec21	Addendum for 120V PT
21.5	11Dec	Addendum for 8 Ohm Only OT

Builders Guide General Theory

For a discussion on Guitar Amp Basics and Tube Amp Theory, please refer to our support page document **Builders Guide General Theory**

Circuit Description

Below is a brief description of the original Fender 5E3 circuit and function of each stage.

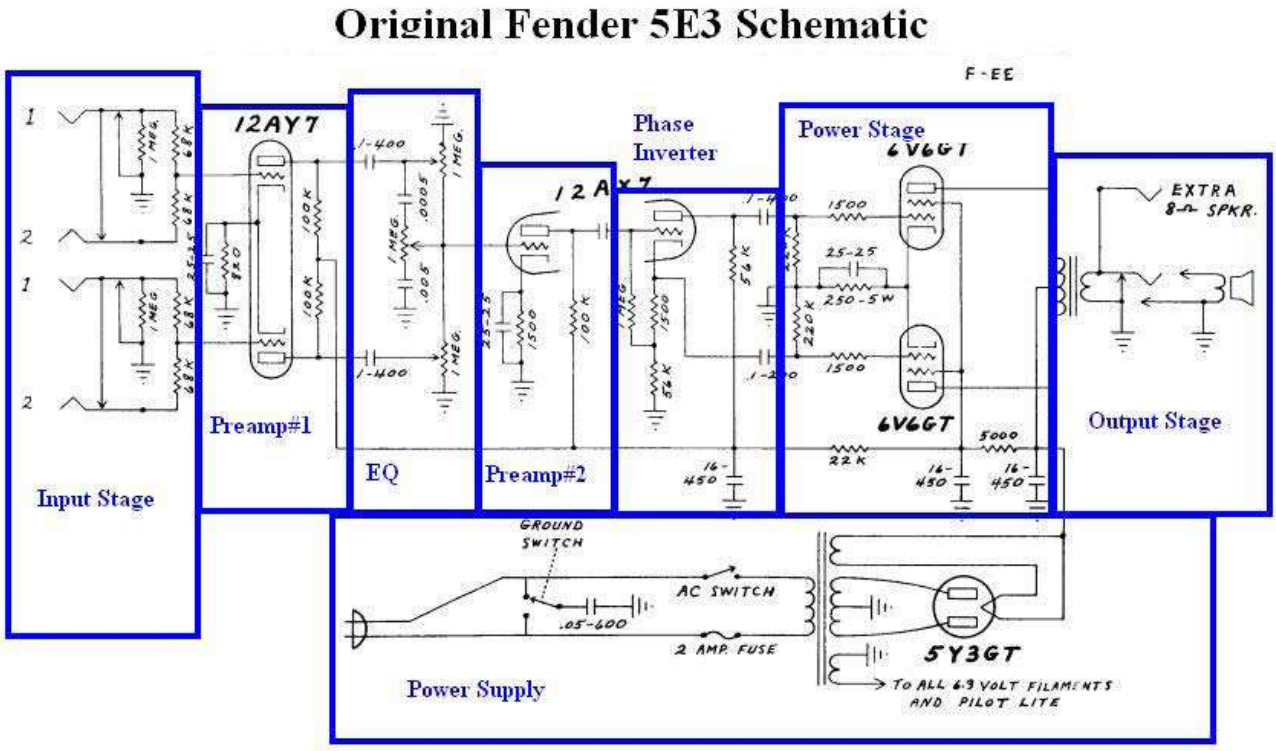
Power Supply
This circuit takes in the AC line voltage, steps it up with a power transformer and uses 3 pairs of secondary tap locations to power the circuit, heat the tube filaments, and drive the rectifying tube. The rectifying tube contains a pair of vacuum diodes and the following capacitors help to rectify the signal close to DC voltage to drive the circuit. In the original amp, there was no true earth ground in the two-prong plug. The ground polarity switch (which we took out because we used a 3-pronged plug) in conjunction with the unpolarized AC 2-prong plug and .05uF/500V capacitor to the chassis provided a quasi-ground for the chassis. This was a safety hazard for musicians because of the dangerous static discharge.
Input Stage
This circuit receives the incoming guitar signal and sends the signal into the first preamp.
First/Second Preamp Stage
The filtered input signal at the grid of the triode is amplified by a factor determined by the behavioral properties of the triode and the situational bias. This amplified signal is present at the plate (anode) and is 180 degrees out of phase with the input signal.
Equalization
This is the location of the "Volume" and "Tone" knobs (potentiometers). The Volume potentiometer determines the amplitude of the signal coming from the plate of the first preamp. In effect, it controls the gain of that triode. The Tone potentiometer controls the frequency response of the signal, determining whether high frequencies or low frequencies are to be attenuated. When the potentiometer is at 0Ω, high frequencies are shunted to ground. When the pot is at 1MΩ, the high frequencies are passed through and the frequencies below the 3dB point of the filter are taken to ground.
This single tone control acts a treble roll off as it is rotated counter clockwise, and a high treble "boost", similar to a bright switch, as it gets towards its most clockwise position.
The .0047 uF cap is the treble cut cap, and the 500pf cap on the other end of the tone control is the "bright" shunt cap. When the wiper is fully clockwise, the 500pf cap is essentially connected between the wiper and the high side of the volume control. High frequencies bypass the resistance of the volume control. It's acting as a high pass filter at this point.
What Makes the Bright Channel Bright? The Bright channel's signal cap feeds into the "bright" shunt capacitor (500pF) that is part of the tone control design. This circumvents the Bright Volume potentiometer. To obtain a more distinctive Bright channel, you can replace the 0.1uF coupling cap with a 0.047uF or 0.022uF value.
Phase Inverter
The triode is biased such that the voltage amplification is only unity. The result is ideally a signal present at the plate with an equal magnitude as the grid voltage but out of phase by 180 degrees. The cathode of the triode will ideally be a clone of the grid signal. The output of the phase inverter is ideally two equal magnitude signals out of phase with one another by 180 degrees.

Power Stage

The power stage is composed of two pentodes and their respective bias circuitry. Each of the two out of-phase signals coming from the phase inverter are fed into their own pentode to be further amplified. The two amplified signals are output at the pentode plates. This circuit uses a Push-Pull Class A power tube arrangement where the current flows in each tube at all times but out of phase by 180 degrees.

Output Stage

Each of the two power stage output signals flow into a lead on the primary of the center-tapped output transformer. The transformer steps down the high voltage and steps up the low magnitude current. An 8-ohm speaker is connected to the transformer secondary to output the sound.



Original Circuit with outlined stages

Tweed Specifications

The 5E3 Tweed is about 15 watts cathode bias 6v6, concertina phase inverter simple tweed preamp with very strange and interactive volume and tone controls for each channel, this amp was used by Neil Young.

Year: 1955-1960

Model: Tweed Deluxe ; Cricuit: 5E3

Configuration: Combo

Control Panel: Chrome top facing w/ white screened labels, controls numbered 1-12

Control Layout: Ground Switch, Fuse (2A), Power Switch, Pilot Lamp, Bright Volume, Normal Volume, Tone, Bright Input (X2), Normal Input (X2)

Knobs: Black pointer

Cabinet: 55: Narrow panel, 16.5;" x 18" x 8.75;" (41.9 x 45.7 x 22.2 cm)

55-60: 16.75;" x 20" x 9.5;" (42.5 x 50.8 x 24.1 cm)

Cab Covering: Diagonal tweed

Cab Hardware: Leather Handle, glides

Grille: Dark brown linen (55) or brown grille cloth

Weight: 25 lbs. (11.3 Kg)

Speakers/Load: 1 x 12"/8 ohms

Speaker Model: Recommended Tone Tubby Alnico [Jensen P12R or Jensen P12Q]

Output: 15 Watts

Preamp: 12AY7, 1/2 12AX7

Power: 2 x 6V6GT

Bias: Cathode Biased

Rectifier: 5Y3GT

Phase Inverter: 1/2 12AX7 (split load)

Comments: A speaker jack and external speaker jack are located under the chassis.

Fender amps own the blues …

No discussion of blues guitar amps would not include Fender amps. They own the blues, any amp maker today has to compete with or try and pry these old jewels from the guitar players hands. Favorites are the early tweed Deluxe and the AB763 versions of all the amps.

Each era of Fender amps produced many very useful guitar amps The most heavily "cloned amps are the 5E3 Fender Deluxe of course the tweed champ 5F1 and the mother of all guitar amps the 1959 tweed Bassman 5F6A, The AB763 is the most heavily cloned topology for clean channels in many guitar amps made today. This circuit first appeared in the blackface twins.


Trinity
AMPS


GROUND
FUSE
ON
TONE
VOLUME
VOLUME
BRIGHT
NORMAL

Building an Amp

Warning: Do not attempt to build a guitar amp unless you know how to work safely with the dangerous voltages present in a tube amp. These voltages can exceed 700 volts.

Introduction

If you have purchased your Trinity Amp as a kit, this guide will help you build a tube guitar amplifier. It is oriented towards someone who knows a little about electronics but is new to do-it-yourself amps. It outlines a simple path to getting a quality amp build.

Switches and wire

Use standard UL approved switches with a 125V/3A rating for the Power and Standby switches. Use 22 or 20 gauge insulated solid wire with a 600V rating. It is good to get a variety of colors so you can color code your wiring.

Use 18 Gauge stranded for mains wiring.

Physical layout

Make sure the jacks, sockets and pots mounted along the edge won't interfere with parts mounted on the underside of the chassis. Imagine how chassis will be mounted in the cabinet and make sure there is enough clearance for the speaker and mounting brackets. Trinity amp chassis are laid out with serviceability and neatness in mind.

Grounding

It is recommended that you follow the layout provided with your Trinity Amp. It has been tested and has proven reliable. If you choose to deviate, consider the following information.

Amps traditionally use the chassis for signal ground. This is not the best choice since it can create ground loops and bad ground connections may develop over time. It is better to use star grounding in which all of the local grounds are collected at a single 'star ground' point. With star grounding there is only one connection between the chassis and signal ground.

Here are some rules for laying out a star ground. More information on grounding can be found in the Tube Amp FAQ and the Tech Info page of Aiken Amplification.

(1) Connect the power transformer center tap directly to the negative terminal of the first power supply filter capacitor (cap) then run a separate wire from the negative terminal to the star ground point.
(2) Collect the ground points of each tube and its associated resistors and capacitors to a local ground point that is not connected to the chassis. Run one wire to the star ground point from each collection.
(3) Run exactly one wire from the star ground point to chassis.
(4) Rarely but sometimes necessary, insulate the input and output jacks from the chassis.
The safety ground wire from the mains is separate from the signal ground. Run a wire from the AC ground to the chassis near where the AC power enters the chassis.

Insulated jacks

To insulate the input and output jacks either use plastic insulated jacks or metal jacks with insulating washers. Some people prefer the increased durability of metal jacks. Insulating a metal jack requires a shoulder washer with a 3/8 in. internal hole that fits a ½ in. panel hole.

Minimizing transformer interference

To minimize coupling between the power transformer and output transformer orient them so their plates are at right angles. If possible, place them at opposite ends of the chassis.
Keep the input stage wiring short and away from the output stages. This minimizes the possibility of oscillations caused by coupling of the output signal into the input.
Mount the grid resistors as physically close to the grid pins as possible.
Use a twisted pair of wires for the tube filament wiring. Route it away from AC lines and close to the chassis.

Wiring

The traditional method of constructing amps involved mounting the components on tag board or fiberboard. This is the technique that is used for Trinity Amplifiers and is the recommended approach for service and reliability.

Assembling the amp

Before You Begin

When you first receive your kit, remove all of the parts from the shipping box and place them on a well-lit, clean surface. Check all of the parts against the parts list and verify that you have everything before you begin. Contact us at once if you are missing anything, or if something appears to be damaged**.**

Tools

* 25 Watt, pencil tip soldering iron
* 60/40 rosin core solder (.032" dia)
* wire stripper
* wire cutter
* needle nose pliers
* screwdrivers (Philips, slot)
* multi-meter with minimum 500V range

Use a stand for the soldering iron, a sponge to keep the tip clean, de-soldering wick material and clip leads. You should also have a multi-meter with at least 500V range, preferably 1000V and an audible continuity checker. Try to get a multi-meter that measures capacitance. This lets you verify the value of your components before you install them.

Soldering

Soldering is accomplished by heating the components to be soldered and allowing the molten solder to flow onto them. Do not try to melt solder on the tip of the iron and transfer it to the solder joint. It doesn't work.

Follow these steps when soldering:

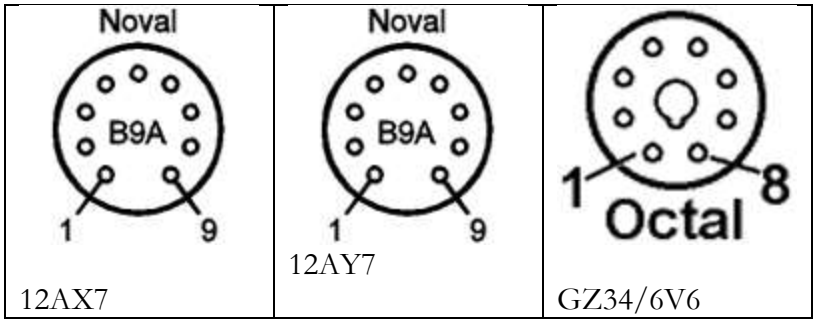
- Use 60/40 rosin-core solder.
- Keep the tip of the soldering iron clean. If it's dirty, wipe it on a damp sponge to clean it.
- Set the temperature of your soldering iron to about 700F.
- Melt some solder on the tip of the iron. The molten solder helps to efficiently transfer heat from the soldering iron to the component leads.
- Make a good mechanical connection first, and then make a good solder joint.
- Heat the leads to be soldered by touching it with the tip of the iron.
- Touch the solder to the leads. The solder should flow onto the leads. Avoid breathing the fumes.
- Remove the soldering iron and allow the solder joint to cool.
- Note: Do not apply the tip of the soldering iron to the eyelet board any longer than it takes for the solder to flow.

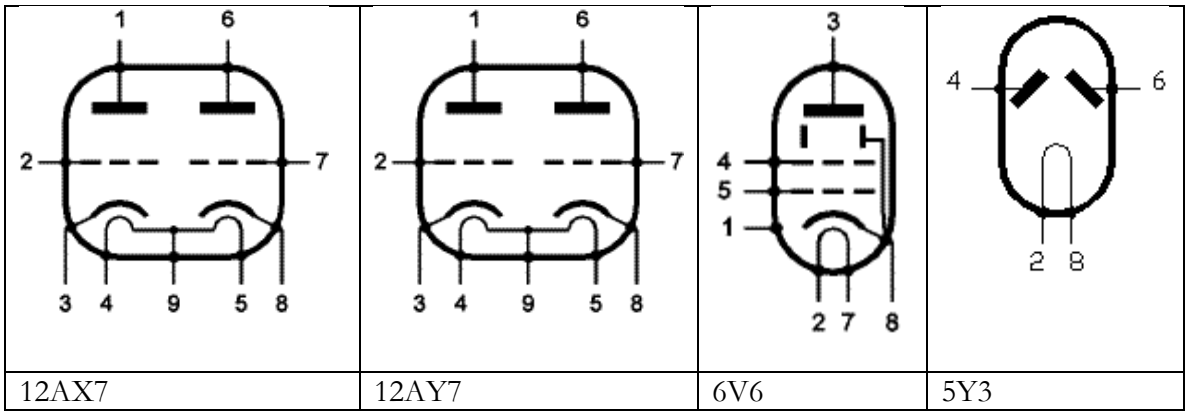
The solder joint should be clean and shiny. If it is dull looking it may be a 'cold solder joint' which is not a good electrical connection. If a solder joint is suspect, heat it with the iron to reflow the solder.

Tube Pin Numbering

- V1 and V2 are the preamp tubes. 12AY7 and 12AX7 respectively
- V3 and V4 are the 6V6 power tubes
- V5 is the 5Y3 rectifier

The pins on a 9-pin tube socket are numbered 1 to 9 in a clockwise direction when viewed from the bottom. Note that there is a gap between pins 1 and 9.
The pins on an 8-pin tube socket are numbered 1 to 8 in a clockwise direction when viewed from the bottom. Note that there is a gap between pins 1 and 8.

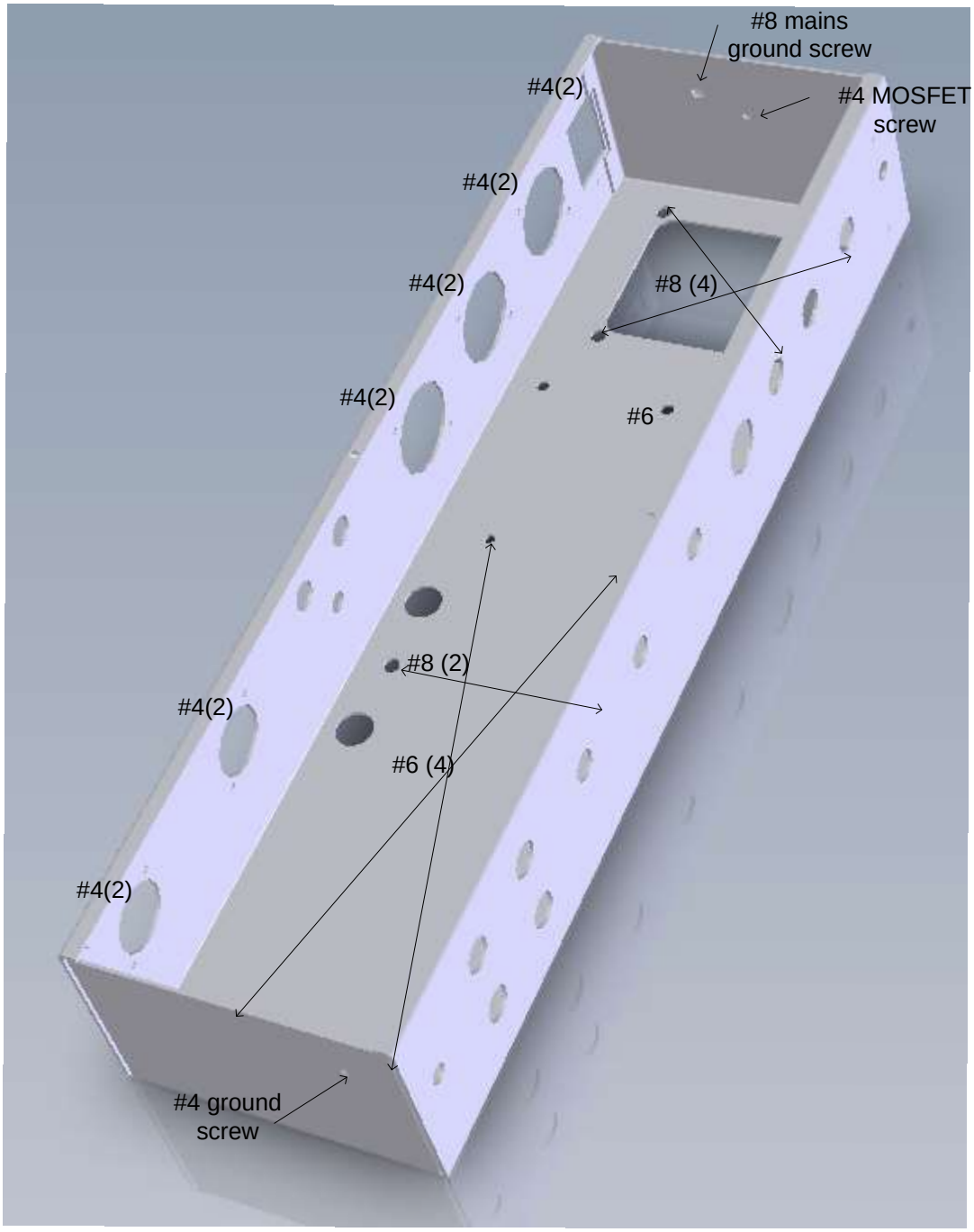




The pins on the potentiometers are numbered 1 to 3 from left to right when the shaft is facing towards you and the pins are at the top.

Assembly Steps Summary

1. Install hardware on the Chassis.
2. Wire up the heater wires; connect to the pilot light.
3. Install Power Transformer and wire the Power Supply.
4. Install the Output Transformer and Wire to the B+, output tube sockets and jacks
5. Assemble the eyelet board
6. Install the eyelet board.
7. Connect the eyelet board wires to power, sockets, and controls.
8. Wire and install input jacks. Connect to board.
9. Check components, wiring and connections.
10. Follow Start-Up procedure.



Mounting Hardware Locations

Install Hardware

Install all the hardware on the chassis to make sure it all fits properly. Don't install the transformers yet.

The classic Fender layout was followed with some changes. We use 1/2" stand-offs for mounting the circuit board to the chassis and also two ground connections (power & per-amp). We also insulate the input jacks from the chassis.

Install all the tube sockets. The sockets with the shields are for V1 to V2. The other 8 pin sockets and clip retainers are for the 6V6 or 5Y3 tubes.
The orientation of the sockets is as follows. Locate pin 1 of V1 & V2 socket and orient it so that pin 1 points towards you. Fasten in place with screws into the 4-40 threaded hole in the chassis using #4 screws. Locate pin 1 of V3, V4, and V5 socket and orient it so that pin 1 points away from you. Fasten in place with screws into the 4-40 threaded hole in the chassis using #4 screws. This orientation is done to slightly minimize the heater wiring and make connections to the board and transformer a little more convenient. See layout diagram.

Note: Some people prefer to wire up the rectifier socket before installing the fuse holder.

Insert 2 grommets for wire leads passing through the chassis from the output transformer.

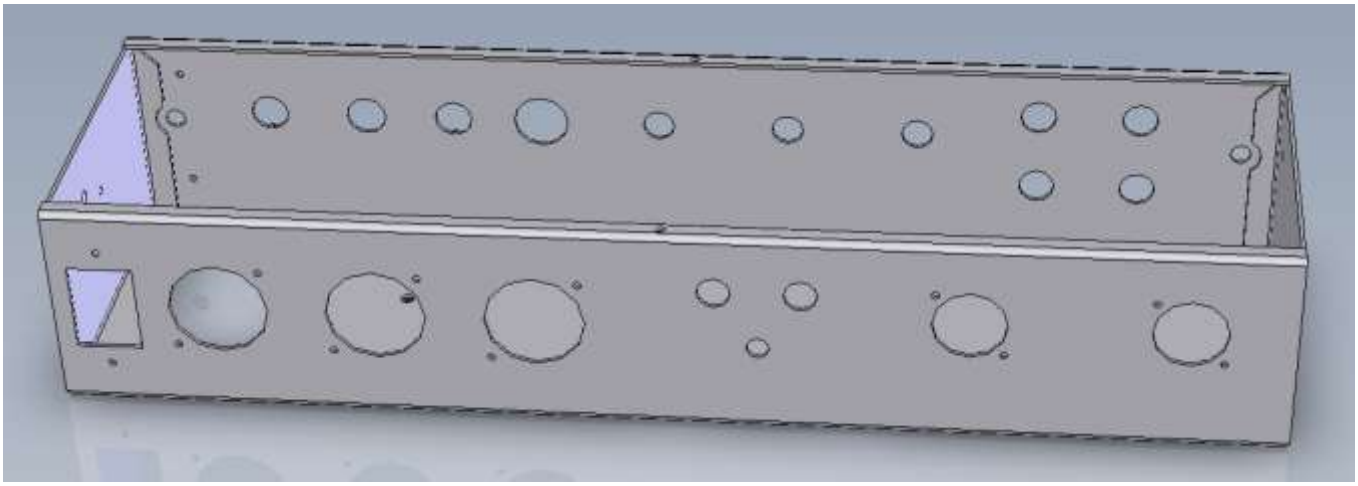
Ensure the potentiometers are located in the correct positions according their values and the layout. Cut off the locating tabs on the potentiometers in order to flush mount them. Use a washer on the outside, under the nt.
For the jacks you will need to use fibre washer pair to isolate them from the chassis. More on that later.

Trinity Tweed Front View

When you mount the fuse holder (washer on outside)), switch, and pilot light make sure that these components are tight and that if they come loose in the future they can't 'windmill' into each other and short out! The pots and input/output jacks must also be tight.
In the original Tweed design, they were grounded to the rest of the circuit this way so the speaker output jacks depend on a tight mechanical connection for grounding and proper operation.

Install the IEC Socket for the power cord into the large rectangle hole mounting with two #4 screws. Point the single ground lug towards the end of the chassis.

Install the DPDT Impedance Switch into the ¼ inch hole located between the two output jack holes. Use a nut, then lock-washer, then the tang washer (tang facing outwards or cut off) then last nut.



Trinity Tweed Chassis Rear View

Wiring

The original design was not grounded to the AC line, since most homes in the '50s only had two wire outlets. We've chosen to ground the amp for safety. We did deviate slightly from the original design in that a mains ground is used. Power and preamp star grounding is used and the mains ground is bolted to the chassis. We run the individual pre-amp grounds directly to a separate star instead of 'bussing' them as on the original. This was done to reduce the background noise.

Here is a guideline for wiring the kits with the supplied wire:

- Use 22 gauge 600V solid for hook up to tubes
- Use 22 gauge 600V solid/stranded for hook up to pots/front panel
- Use 20-22 gauge 600V pre-twisted wire for tube heater wiring
- use 20-18 Gauge, stranded or solid, 600v for power supply hook up - to transformers, rectifier, standby etc.
- Re-use stranded cut offs from the transformers.

Wire Up Heater Wires
Install the pilot lamp socket if you haven't already.

It is important to wire the tube filaments carefully. Use the Red-Black pre-twisted wire to do this. If you need to make up some heater wire, tightly twist two long lengths of wire tightly together. This will help to minimize any hum.

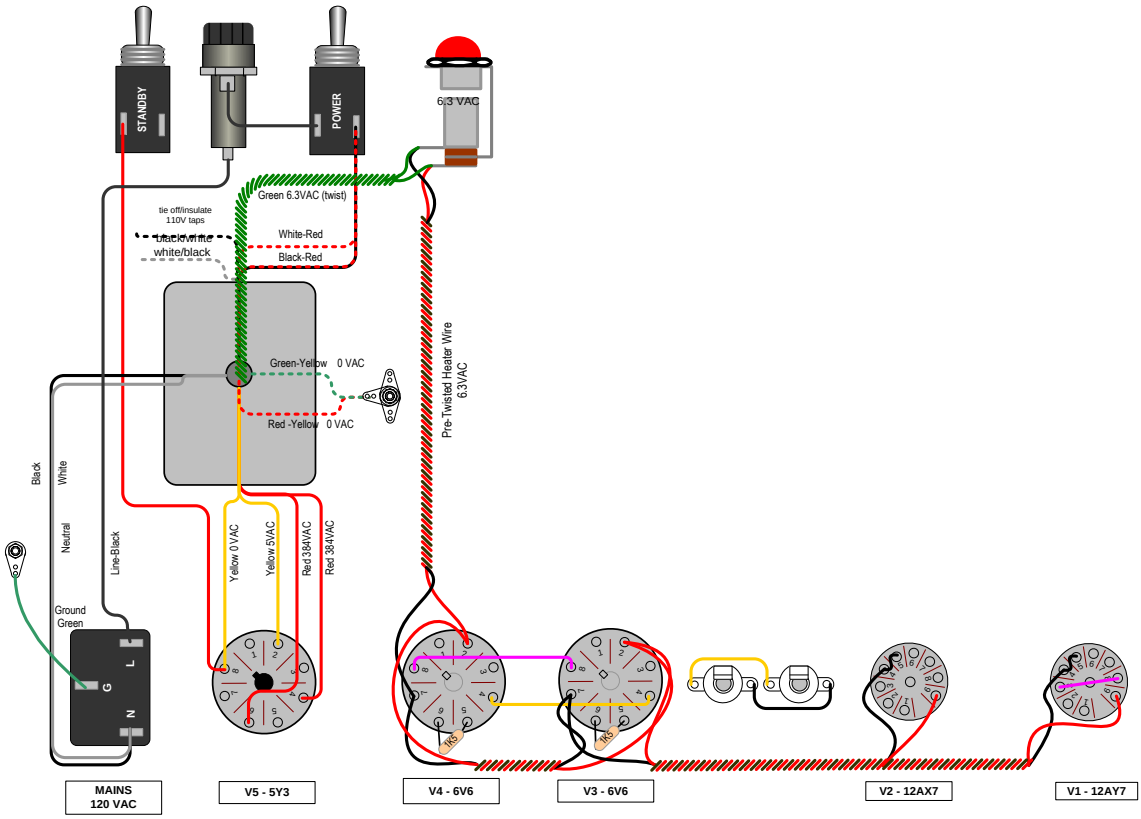
Solder each wire to the indicator socket.

It is imperative that where possible, the signal wires run close to the chassis, while the heater wires run as far away from the signal wires as possible. Make sure the signal wires hug the chassis and the heaters have a tight twist on them. For the 12AX7 and 12AY7, we have had success running the connection wires to them from as shown in the layout.

Note: Don't substitute smaller gauge heater wires than provided. The wires need to be big enough to carry the current back to ground and keep hum low.

One wire comes from the indicator socket to the first 6V6 Power Tube to pin 7, the other wire to same 6V6 Power Tube but pin 2. Then these go to pins 7 and 2 respectively of the second Power Tube. From there, the wires daisy chain across the preamp tubes. Run the heater wires for the preamp as far away from the board as possible, along the inside of the chassis edge. One wire connects to both pins 4 and 5 of each preamp tube and the other wire to pin 9. Connect the same color heater wire to the same pin(s) as you progress from tube to tube e.g. Black on pin 7 of both 6V6 and Red on pins 2. Do the preamps tubes using the same process. Black on pins 4 & 5 tied together and Red on pins 9. Don't switch the heater wire polarity.

Once soldered, in place at each tube socket, press it flat, tight against the chassis.



Heater Wiring Layout
Showing Power Transformer in Place

Install Power Transformer

Locate the hole for the transformer with the 4 #8 bolts/studs holding the transformer plates and bell covers together. Put the transformer in place and hold in place with the #8 nuts with washers as supplied. Tighten up the nuts.

Note: Leave the original nuts in place so as to provide a gap between the transformer and chassis. This provides some heat and electrical isolation to the chassis.

Now, wire up the 2- 3.15VAC (6.3 VAC total) from the power transformer and solder to the indicator socket lugs with the heater wires to the tubes.

Connect the Green-Yellow 0V 6.3V center tapped wire to the "Power" ground made of 3 #6 lugs connected to the chassis.

Then connect the Red-Yellow 0V center tapped wire to the "Power" ground.

Solder the grounds in place.

Wiring the Tweed Rectifier Socket

Connect the Yellow 5 V Rectifier heater wires from the transformer to pins 2 and 8 of the 5Y3 rectifier socket.

Connect the Red high voltage wires to pins 4 and 6 of the 5Y3. Connect the Red-Yellow center tap of the high voltage from the transformer, and ground it at the power ground point.

Trinity Tweed Grounding Scheme

Our amps use a two-point grounding scheme where the power side of the amp is connected to a single common ground point, and the pre amp part is connected to another point on the chassis that is located immediately beside the input jacks.

Note: For grounding these amps, we strongly recommend that you follow the layout provided. We don't recommend that you deviate but if you do, use a collected one-point star grounding scheme. Everything connected together and marked with the 'earth' symbol on the schematic is connected together locally, and then that local common is connected to the star point.

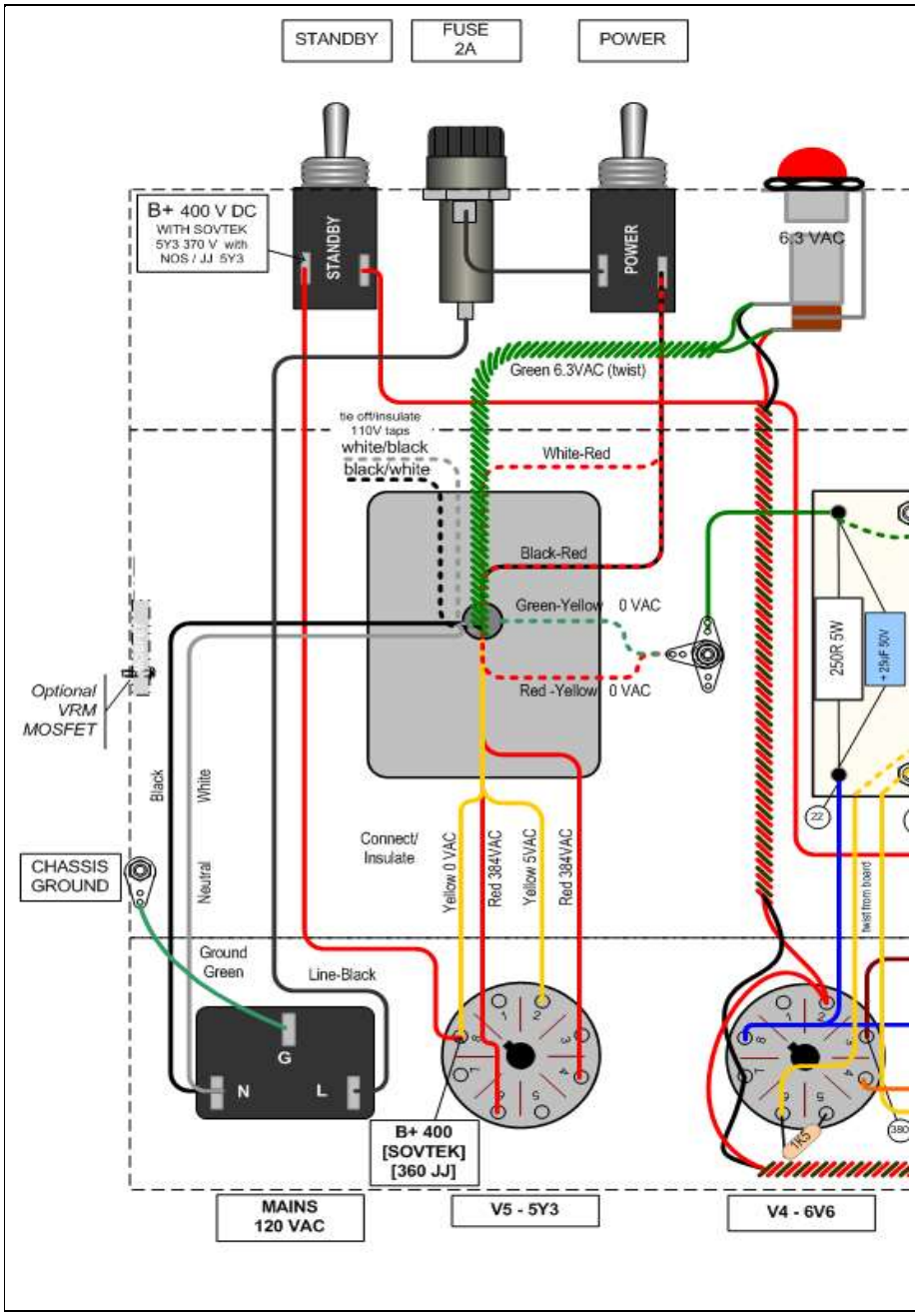
Power Amp Side Ground

Pre-Amp Side Ground

Mains Power Connection

Wire up the rest of the main power supply.

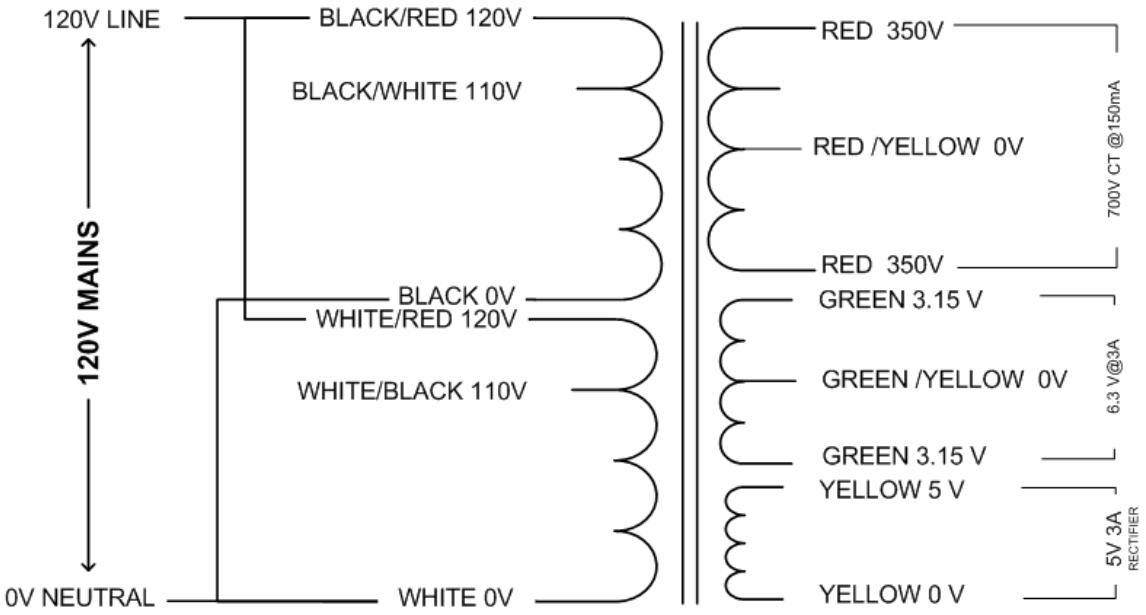
Start at the mains IEC Socket. Attach the ground lug to the chassis immediately beside the socket and ensure it is grounded well. Tighten as much as possible with the #8 KEPS lock nut..



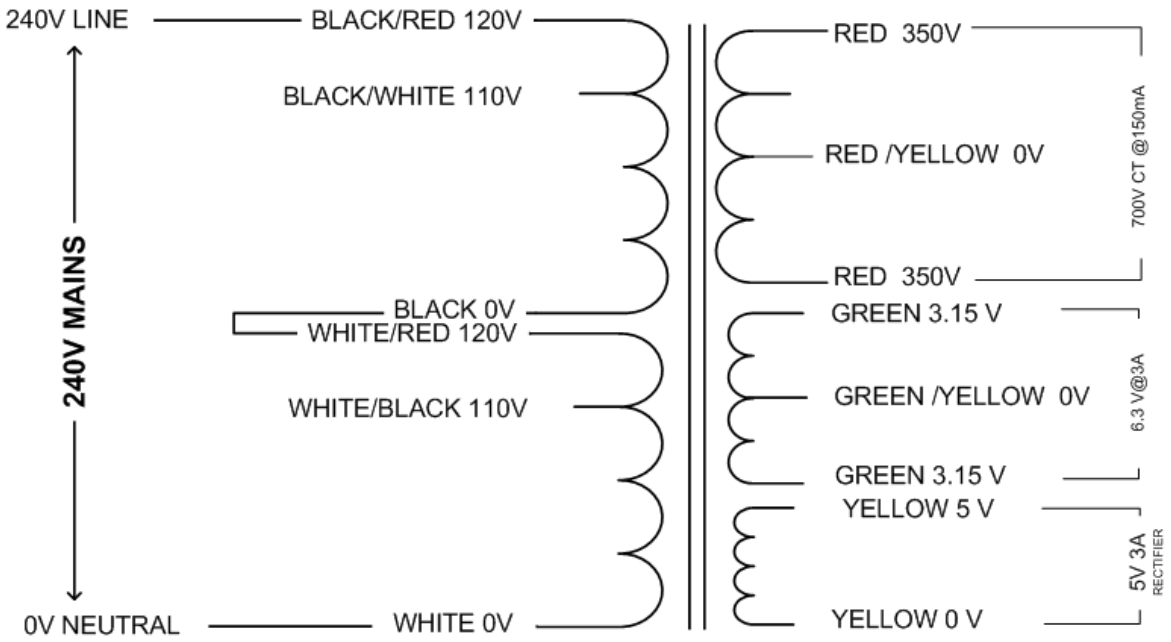
Connect a Black/Hot line from the IEC Line lug to the fuse holder. Run a wire from the lug on the side of the fuse holder and from the end of the holder to the power switch. Make sure the switch is in the desired on position, the connection is 'made'. The switch may have the option of being 'On' in either 'Up' or 'Down' position. From the other side of the switch, connect to the transformer Black/Red – White/Red pair (120V input).

The other side of the IEC is connected to the Black – White pair ('Common' side) of the power transformer. Tie off any unused taps that are not required for the Tweed build. Tie it off by cutting off the exposed wire and then put heat-shrink over the end and then tuck it away as it is not used.

Tweed 120V HI CAPACITY Power Transformer Connection Schematic



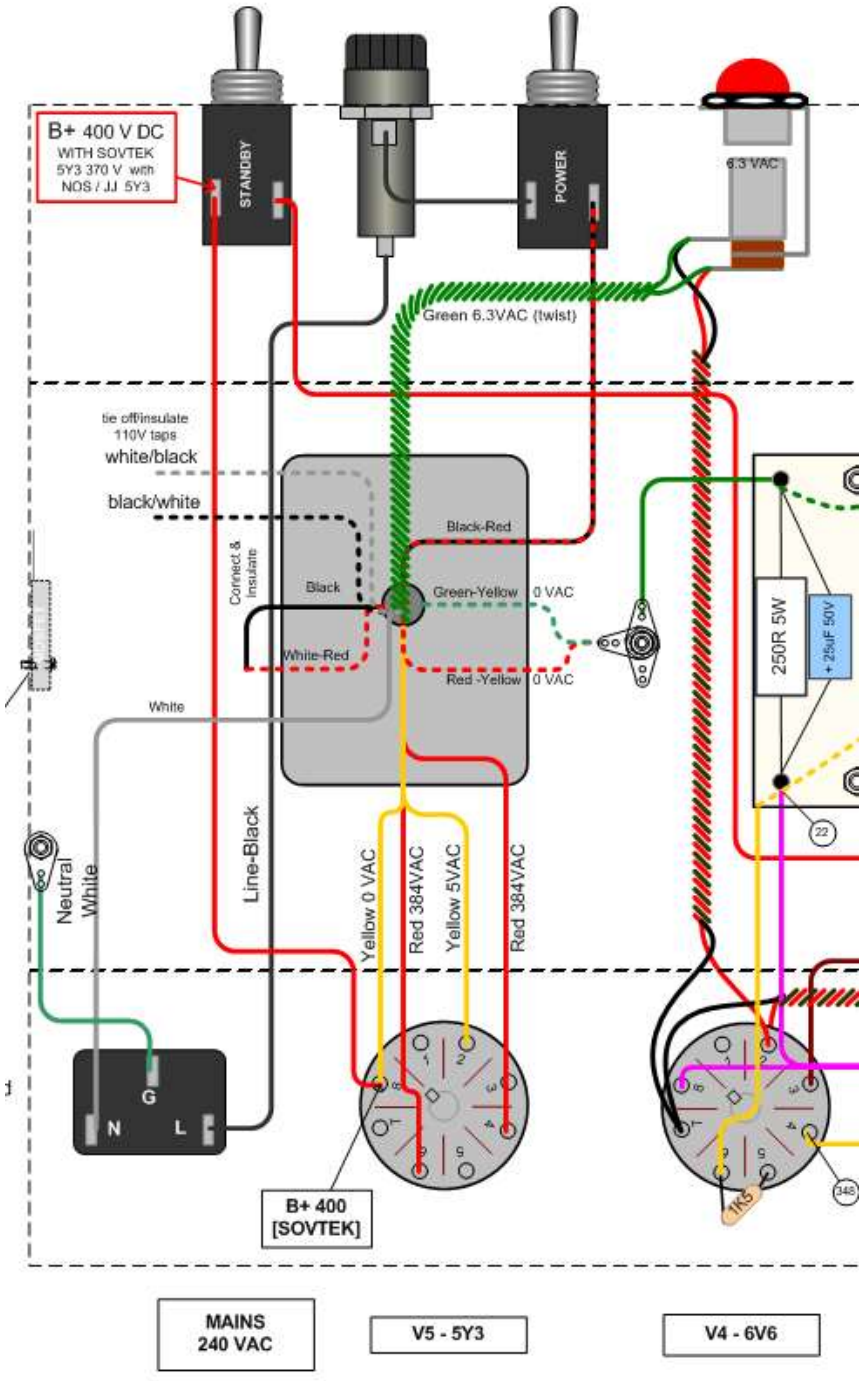
Tweed 240V HI CAPACITY Power Transformer Connection Schematic



120V - use the primary in parallel hooking Black/Red to White/Red and Black to White. Connect 120 mains to Black/Red and White

240V - use the primary in series hooking Black to White/Red. Connect 240 mains to Black/Red and White.

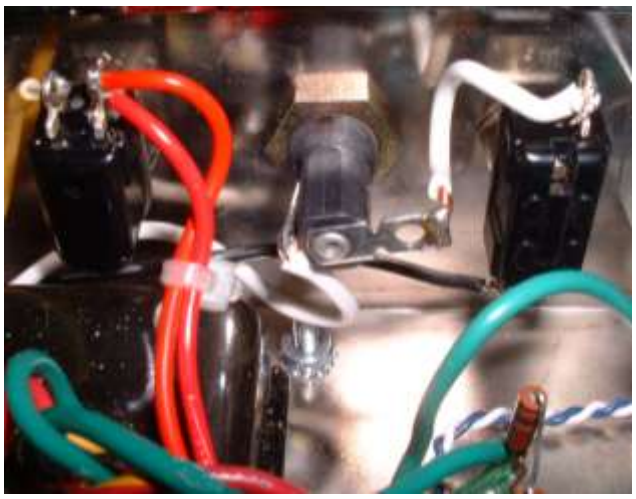
Tweed 240V HI CAPACITY Power Transformer Connection Schematic



Connect a Black/Hot line from the IEC Line lug to the fuse holder. Run a wire from the lug on the side of the fuse holder and from the end of the holder to the power switch. Make sure the switch is in the desired on position, the connection is 'made'. The switch may have the option of being 'On' in either 'Up' or 'Down' position. From the other side of the switch, connect to the transformer Black/Red lead (240V input).

The other side of the IEC is connected to the White lead ('Common' side) of the power transformer.
Connect the Black and White/Red, solder and insulate with some shrink tubing.
Tie off the unused taps (110V) that are not required for the Tweed build. Tie it off by cutting off the exposed wire and then put heat-shrink over the end and then tuck it away as it is not used.

The original Deluxe did not have a standby switch but one is included in this design and fits in the original 'Ground Switch' position. Another improvement.



Connect a wire from pin 8 of the rectifier tube to one side of the standby switch. Attach a wire to the other side of the standby switch that is long enough to route neatly and reach the first capacitor on the eyelet board, per the layout diagram. Give yourself an extra few inches.

Connect to the center tap of the Output Transformer to the same side of the stand by switch. For proper voltage mains connections, refer to the Power Transformer schematic.

Once you have wired up the transformer, fuse, stand-by and pilot light socket, it is a good time to check that the Power transformer is working properly.

Testing the Power Transformer

Install the appropriate fuse. Double check that the wiring is as per layout and that the transformer is wired correctly for your Mains Voltage.

DO NOT INSERT ANY TUBES. Carefully apply power to the circuit (use Variac if possible, or current limiting light bulb) and check that the AC voltages are within range of the spec. ***Note that they will be higher with NO tubes plugged in***.

- Carefully measure the AC MAINS VOLTAGE
- Carefully measure the AC VOLTAGE across the INDICATOR lugs. You should measure around 6.3VAC
- Carefully measure the AC VOLTAGE across Pins 2-8 of the RECTIFIER SOCKET. You should measure around 5.0VAC
- Carefully measure the AC VOLTAGE across Pins 4-6 of the RECTIFIER SOCKET. You should measure over 700VAC.

If everything measures correctly, then move on to the next step. If not, this is the time to resolve the issue. If voltages are half what was expected, check the PRIMARY WIRING matches your local MAINS voltage. If voltages are very low, check that there are no shorts circuits to ground.

Install the Output Transformer - Output Jacks

Orient the Output Transformer so that the Yellow and Black output (secondary wires) are closest to the output jacks and Blue, Red and Brown (primary wires) closest to the Power tubes.. Feed all the leads

through the previously installed plastic chassis grommets. Bolt the Output Transformer in place with two #8 bolts & nuts with lock washers. Tighten.

If not already installed, install the output jacks 'connected' or grounded to the chassis. No fibre washers are used. Refer to the Output Transformer schematic. Twist the output leads from the transformer to the output tubes. Leave enough transformer lead length to reverse the leads from one 6V6 to the other if necessary to eliminate amplifier squealing.

Start by soldering the Brown output lead to V4 pin 3 and the Blue lead to V3 pin 3. Refer to the Output Transformer schematic below and wire up the 2 output jacks in parallel paying particular attention to the Yellow and Black colored leads.

Impedance Switch

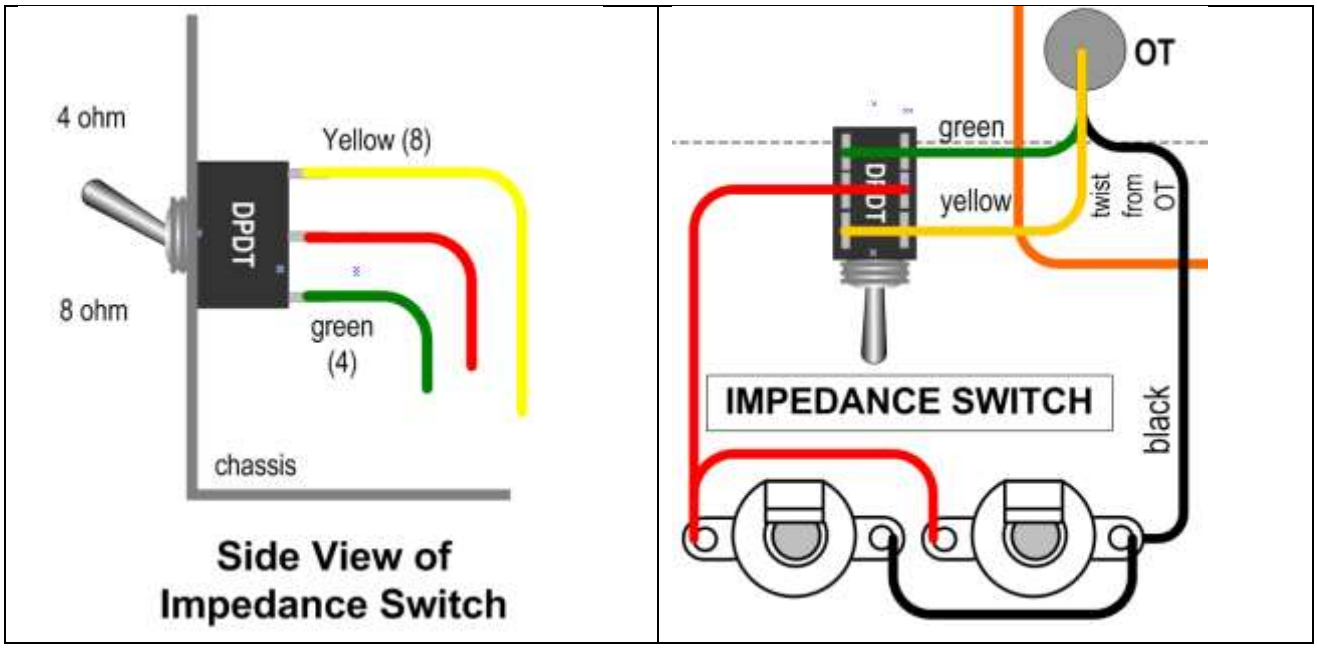
The Primary leads from the transformer should be twisted together and the secondarys braided and both fed through the two chassis grommets.

Cut a wire long enough to route from the Impedance switch center pole terminals to the closest output jack. Hook a wire into the two center poles of the switch and solder it in place. Solder the other end two the closest output jack. Connect the other output jack with another piece of wire making sure they're connected to the same jack terminals. In this case, the positive or "Tip" end.

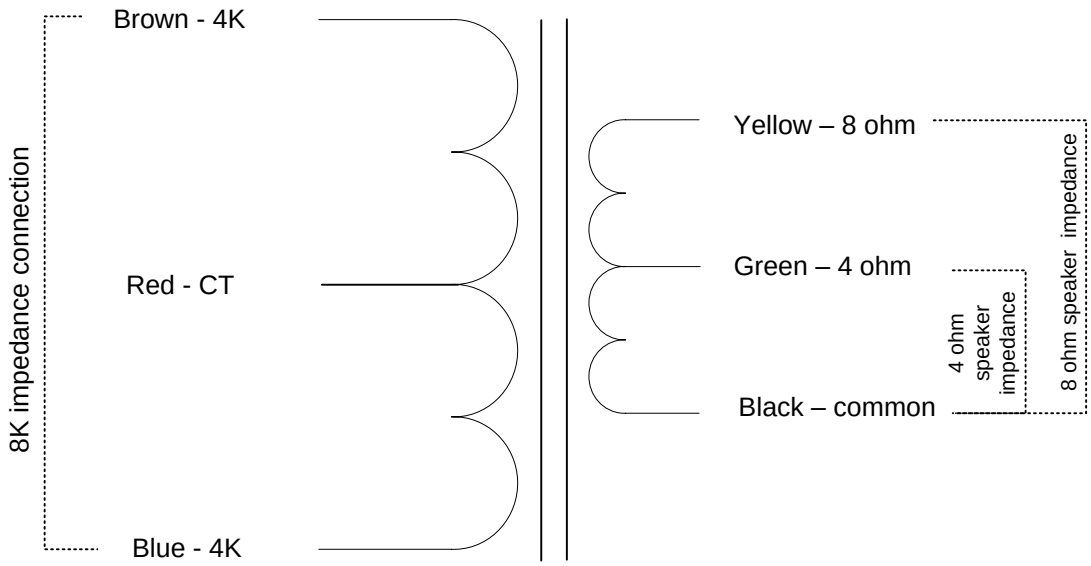
Neatly route and solder in place the 4 ohm, Green lead, to one side of the DPDT Switch, both terminals. Neatly route and solder in place the 8 ohm, Yellow lead, to the other pole of the switch.

Connect the black Output Transformer lead to the other speaker jack. Connect the other output jack with another piece of wire making sure they're connected to the same jack terminals. In this case, the negative or "Ring" end.

Note: You may choose to only wire the 8 ohm, as per traditional Tweed wiring. If the 4 ohm is not to be used, omit the impedance switch and hard wire the 8 ohm to the speaker jacks and then the put some shrink tubing over the end of the GREEN lead.



TWEED 8/4 OHM OUTPUT TRANSFORMER



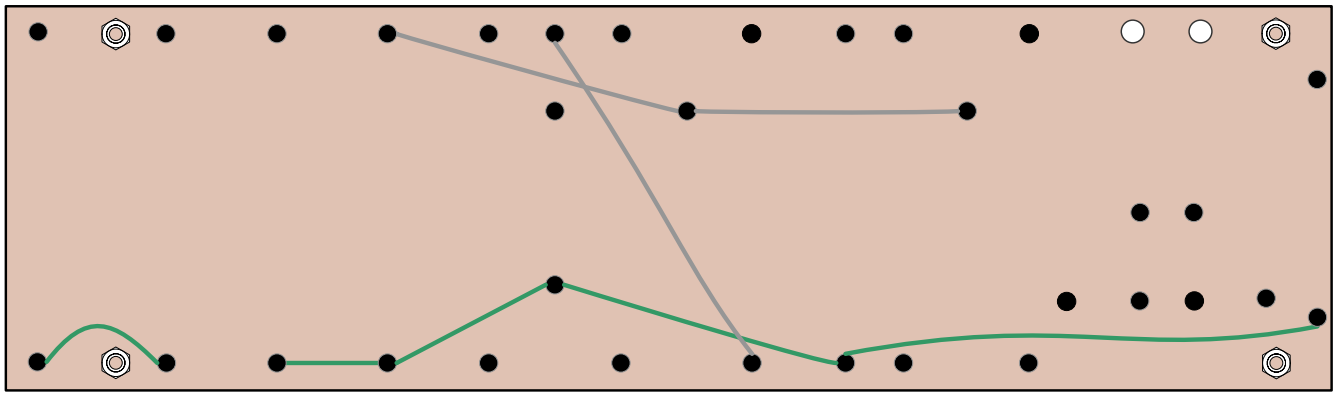
TWEED 8/4 OHM CONNECTION

Assemble the Eyelet Board

Except for the location of the Phase Inverter resistor network, the layout is based on the original Fender 5E3 Deluxe. If you do not have a pre-built Trinity amps eyelet board, now is the time to build it.

Install the Jumpers – Install the jumper wires on the underside of the board. Some leads go under the board (these are the dashed lines on the supplied layout diagram). Follow the pictures below and the layout. Do not solder in place yet.

Some builders prefer to run the jumpers on the Top side of the board for ease of future service. You will have to transpose the layout if you prefer this technique.



Trinity Tweed Board Underside Layout – Jumpers Only

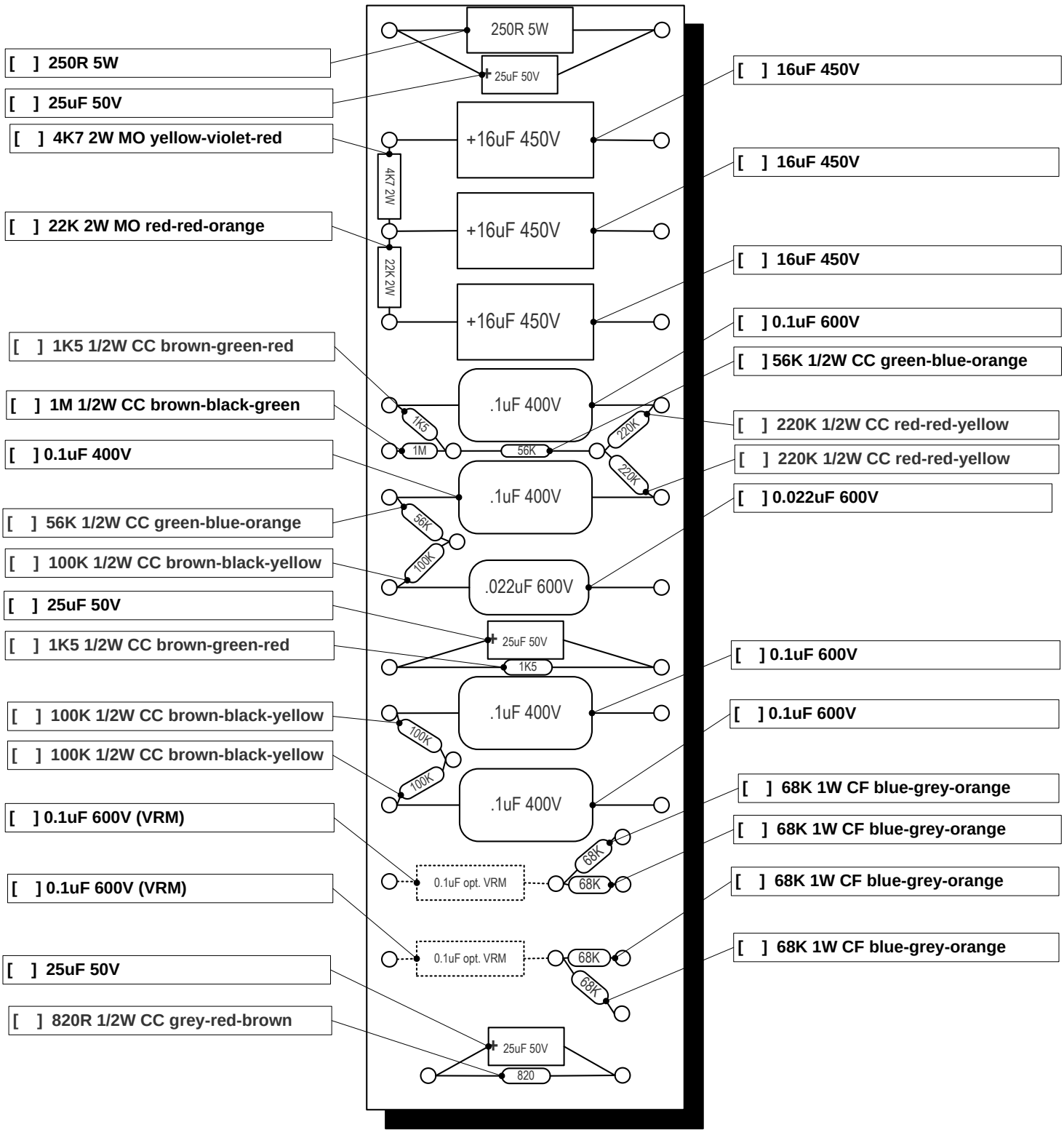
Install the Eyelet Board Components - Align the board according to the layout diagram and follow the diagram closely as you build the board.

Carefully identify all the board components and their values. **Measure those that you can to confirm the values.** See the section on how to read Resistor and Capacitor codes.

When installing Electrolytic Capacitors (power supply, bypass caps), ensure that they are aligned with the correct polarity on the board. There may be a '+' sign, or indentation to identify the positive end of the capacitor or arrows pointing to the negative (ground) end of an electrolytic capacitor. Usually, capacitors with values less than 1 uF have no polarity requirements or markings.

Install the components on the board by following the layout from left to right.

Start with the bigger parts on the power supply side of the board. Then, work your way over to the signal components. Make all of your connections as neatly as possible. At each eyelet, mount and solder ALL of the components including the flying leads that belong in each eyelet and solder once.



Crimp all wires tightly at the connection point before soldering. Remember, if your solder joints are not bright and shiny; do them over until they shine like jewels. Double check all of your connections for shorts against adjoining components or terminal posts.

Flying leads are also installed at this time. Cut connecting wires in various colors and about 6" (rear) -8" (front) long each. Following the layout, install the connecting wires to the bottom of the board leaving plenty of extra length, wire is not expensive and it'll save aggravation later

Start with the 250 ohm 5Watt / 25uF capacitor pair. Note: Make sure the cathode pair are well separated as this resistor emits considerable heat. Install flying leads and solder in place.

Move on to the 3 - 16uF 500V filter capacitors and power supply resistors.

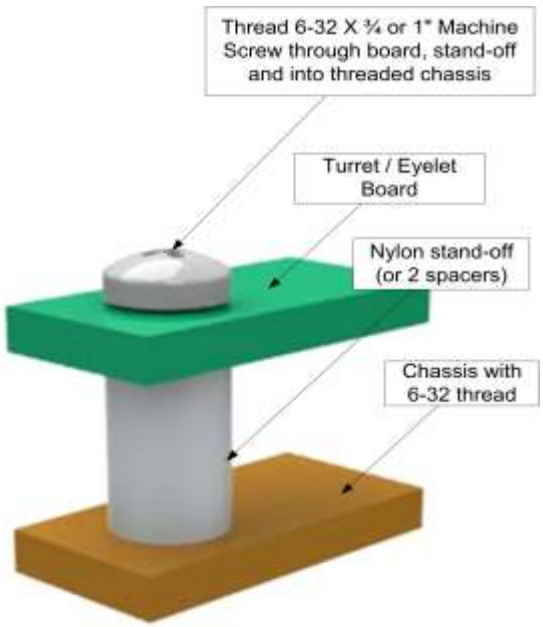
Continue with the remaining parts, following the layout provided.

Note: For multiple component leads that must fit into one eyelet or eyelet, insert them first and solder once when they are all in place. Bend each component lead at 90 degrees so that it fits into the eyelet squarely and neatly. Solder each eyelet once all component leads that connect to it, jumpers and flying leads are in place.

Tip: Circle each "eyelet" on a printed copy of the layout as you complete each connection to that point to track progress and confirm that all parts are in the correct orientation and position. It's well worth the time to re-check the eyelet board layout before installing it in the chassis.

The old style 'point to point' wired eyelet board used in this project is mounted on stand-offs to the chassis. This is an improvement over the original design which allowed the board to 'float'.

For convenience, the holes for the #6 standoff bolts are threaded in the chassis so screw the bolts into place from the outside then put the standoffs on these. Install the eyelet board followed by the nuts to hold the board in place. You can also do the reverse and screw the bolt through the board, stand-off and finally into the chassis without the need for a nut.



The chassis is tapped to receive 6-32 machine screws. To mount the board, align the board mounting hole, stand-off and tapped hole and then thread a 6-32 X ¾ / 1" machine screw through board, stand-off and into threaded chassis. Tighten to keep it in place and repeat for each corner. Use #6 lock washers under the screw head.
TIP: Use some hot glue to hold stand-offs in place on board or chassis.

Connecting the Board

Now is the time to make the connections from the eyelet board to the tubes and potentiometers.

Tip: On a copy of the layout, highlight the connections as you complete them to make sure they are done correctly.

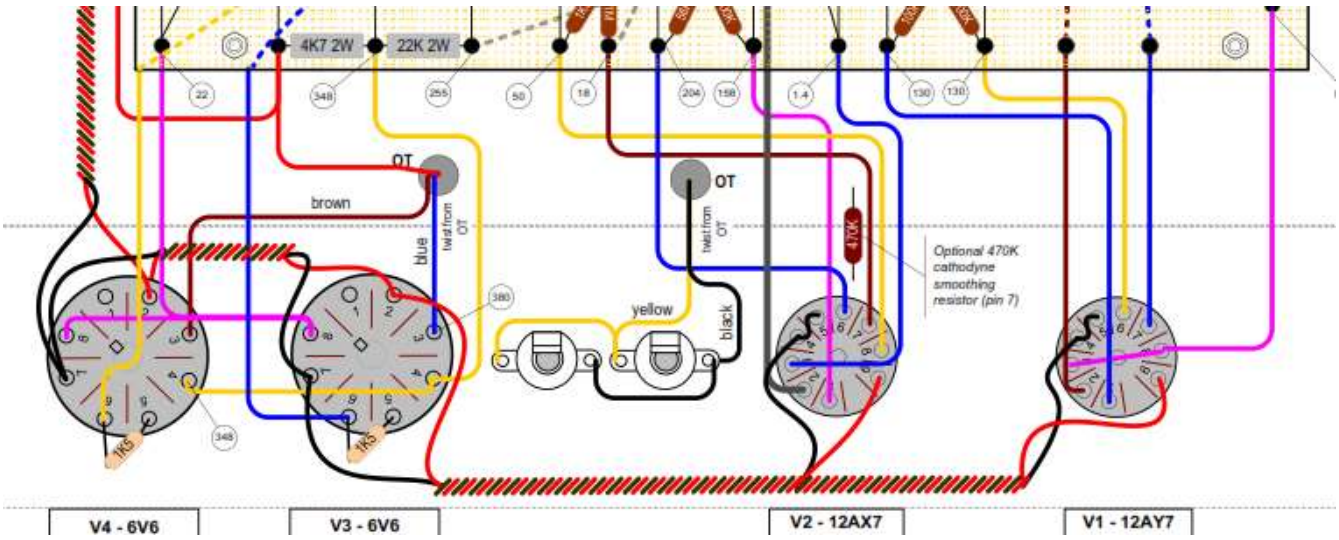
1. Connect and solder the power wire from the standby switch to the board.

2. Connect and solder the Output Transformer Red centre tap to the B+ on the board (optionally route it back to the stand-by switch).

3. Connect and solder the ground wire from the ground side of the 250 ohm /25uF power tube cathode resistor pair to the Power Ground.

4. Connect and solder the ground wire from the ground side of the 820 ohm /25uF preamp tube cathode resistor pair to the Pre-Amp Ground.

Then start at one end of the board and work your way sequentially around the board doing the point-to-point wiring with the flying leads to tube sockets. Board to tube pin; board to tube pin etc. Start at V1, pin 1 and move to the far end of the board to V4.



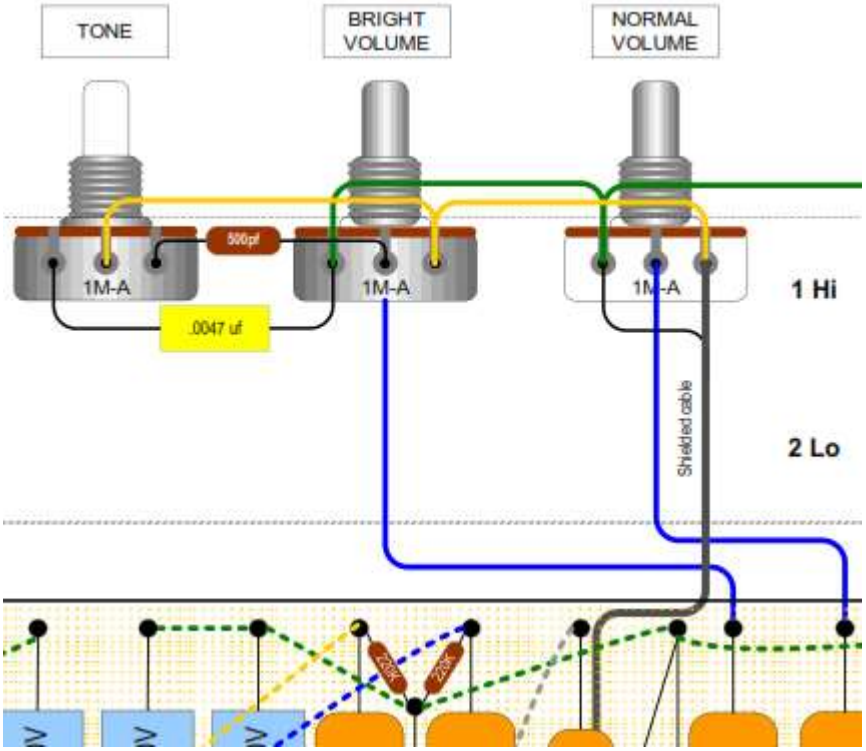
Connect Board to Potentiometers

The easiest way to wire these correctly is to carefully follow the layout, and do one terminal connection at a time.

Install the jumpers first but do not solder as some of the terminals require more than one wire connection, so again, arrange accordingly and solder once.

Locate the 500pf capacitor and pre form it to fit between the Tone and Bright channel Volume pots. Use some heat shrink tubing make ensure it does not touch the other tone capacitor . Attach the flying lead

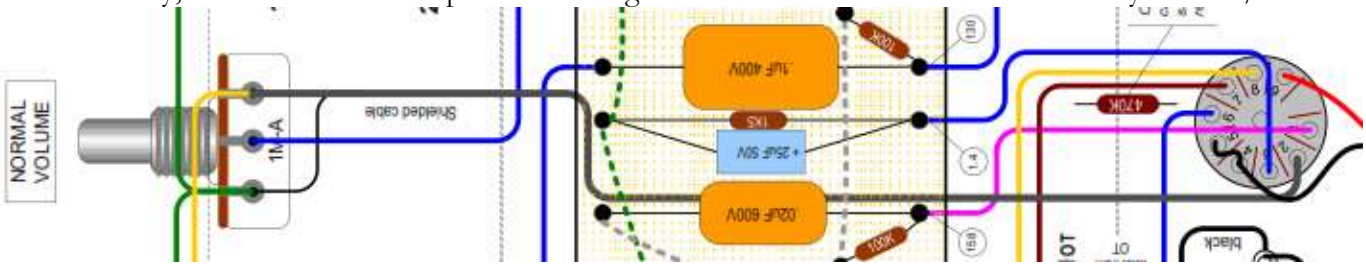
from the bright channel and solder in place. Locate the .0047uF capacitor and pre form it to fit between the Tone and Bright channel Volume pots. Again, use some heat shrink tubing make ensure it does not touch the other tone capacitor. Solder it in place with the ground on the volume pot..



Co-Axial Cable to Volume Control

This is an improvement to reduce noise. To prepare the co-axial cable for connections:

1. Cut back the outside plastic covering at both ends by about 5/8" to reveal the braided shield.
2. At one end, pull back the shield and cut it off at the 5/8" mark. Put some heat shrink around the end covering the area where it was cut off.
3. At the other end, pull back the shield but poke a very fine screwdriver or pick into the shield and work out a 'hole'. Fish the inside conductor through this hole and pull it through.
4. Twist the braid together.
5. Finally, cut back the outside plastic covering on the inside conductor at both ends by about 1/4"



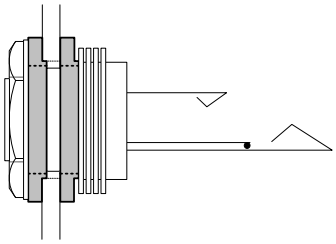
Follow the layout provided and connect the centre of the co-ax cable to the right side potentiometer lug and the co-ax shield to Ground, left side. Be sure to ground only at this end of the cable.
Connect the centre of the other end of the co-ax cable to V2, pin 2.

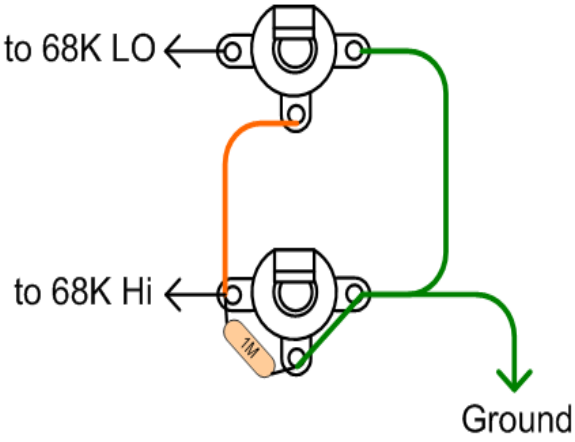
Input Jacks

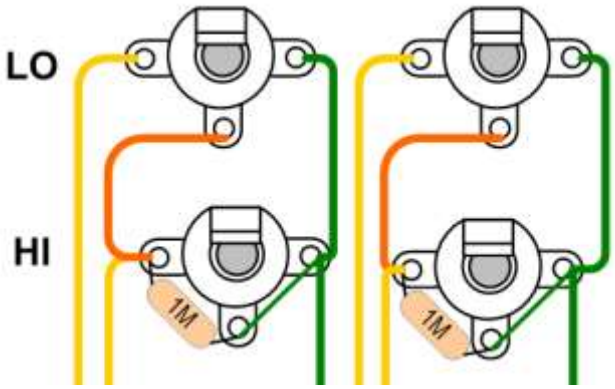
To wire up the input jacks, it is easiest to remove the jacks from the chassis, set the spacing per channel pair correctly to match the chassis, wire them with the 1M Carbon Film resistors and jumpers and then reinstall them. Leave enough wire flying lead for the ground wires on the input jacks go to the pre-amp ground and about 6" to reach the board from each jack. The ground wire and insulated jacks are another improvement over the original design. Use wire from the input jacks to the eyelet board

Install the Switchcraft switched input jacks. Use the supplied black shoulder washers to insulate the jack from the chassis. This is an improvement in design for noise reduction. Refer to the diagram and install the washers with the shoulder of the outside inserted **into** the chassis. The rear washer has no shoulder while the front one does. They are sandwiched in place by the jack and mounting nut. Tighten securely. Once installed, test to confirm that there is no electrical connection from the jack to chassis.

Then connect and solder the leads to ground tag and input leads to the 4-68K input grid resistors on the board.







Final checkout

When you finish assembling the amp, double-check the wiring and the components. Trace or highlight the connections on a copy of the layout provided with the amp to ensure the amp is wired correctly. Check everything at least once!

Measure the resistance from each part that has a ground connection to the chassis. Put your probe on the parts lead. All readings should be less than 1 ohm, typically 0.5 ohms.

Make sure the Mains ground at the chassis is **very** tight.

Power Up

SAFETY WARNING READ THIS FIRST!!!!!

Working Inside A Tube Amplifier Safely

Working inside a tube amplifier can be dangerous if you don't know the basic safety practices. If you aren't prepared to take the time to learn and apply the right precautions to keep yourself safe, don't work on your own amp. You can seriously injure yourself or get yourself killed.

Unplug Pretty self-explanatory. Do not, ever, ever, leave the equipment plugged in and start work on it. Leaving it plugged in guarantees that you will have hazardous voltages inside the chassis where you are about to work.

Sit If the amp has been turned on recently, the caps will still have some high voltage left in them after the switch is turned off. Let it sit for five minutes after you turn it off.

Drain When you open up an amp, you need to find a way to drain off any residual high voltage. A handy way to do this is to connect a shorting jumper between the plate of a preamp tube and chassis ground. This jumper will drain any high voltage to ground through the 50k to 100K 2W plate resistor on the tube. To do this successfully, you will need to know which pins are the plate pins. Look it up for the amp you're going to be working on. You'll need to know this for the work anyway. Leave the jumper in place while you do your work. Remember to remove it when you finish your work. You can also permanently install a 220K 2W resistor on the B+ line to chassis ground to do this.

Test Take your multimeter and ground the negative, black lead to the chassis. With the positive, red lead, probe the high voltage cap terminals or leads and be sure the voltage across them is low. Preferably to less than 10V.

Close First take the shorting jumper out. Put the chassis back in the cabinet, making sure all of your tools, stray bits of solder, wire, etc. are out of it. You don't have to actually put all the screws and so forth back in if you believe more work might be needed, but make sure that the chassis is sitting stably in the cabinet and won't fall out.

First note that most meters have three input jacks (some have four) one is marked COM, the BLACK lead goes there. Another jack is marked V, ohm, mA, the RED lead goes there for most measurements. The third jack is a high current jack usually marked 10ADC (sometimes it is 20 or some other number). This jack is used only for high current measurements. The four jack models use separate jacks for current measurements, this makes accidentally setting the meter to a current mode harder, but it still can be set to resistance. For vacuum tube electronics we can usually ignore the high current mode. Put your test leads into the COM and V(ohm)mA jacks and leave them there.

Making a Voltage Measurement

Before attempting to make a voltage measurement, think about the anticipated result.

- Is this a DC or AC voltage?
- How much voltage will be present?
- If things are not working correctly what is the highest voltage that I might find?

A voltage is ALWAYS measured between TWO points. Is one of those points CHASSIS GROUND? This is the most common case. If not, can you make a different measurement such that one of the measurement points IS GROUND? If your measurements are all referenced to CHASSIS GROUND, you can then connect the black lead (Negative or Common) to the CHASSIS with a clip and probe the other test point with the RED (Positive) lead.

1. Set the selector switch on the meter to the range that is higher than the maximum anticipated voltage of the appropriate type (DC or AC). If the maximum anticipated voltage is not known, set the meter to the highest range available.
2. Wherever possible connect the meter into the circuit when the circuit is OFF, then power up the circuit without touching anything.
3. Read the meter. If the reading is lower than the next available lower range on the meter you may set the meter to a lower range while the circuit is on. When doing this touch ONLY the meter with ONE hand, and be careful to only lower the meter one range, allow the readings to stabilize (2 or 3 seconds) before proceeding further.

Note: Accidentally setting the meter to a current or resistance range can damage the meter, and the circuit it is connected to. If the circuit has sufficient power the meter can explode or burst into flames. I know from experience that this will happen if you try to measure the resistance of the wall outlet. Most modern meters are "fuse and diode protected" this is to prevent fireworks, but will not usually save the meter from an overload of this magnitude.

Discharging the Power Supply

If you need to service the amp after having it on, you must “discharge” the power supply capacitors. This is done by unplugging the amp, turning the power and standby to the on position and letting it sit for 30 seconds or so. If you do not have a standby switch, you will need to short the capacitor positive leads to ground with a 220K 2W resistor on a lead with an insulated wire. You hear a small pop when this is done. This is just the cap discharging itself. Always use a multimeter to check the residual B+ voltage in the large filter capacitors to make sure it is fully discharged.

REMEMBER: DO NOT OPERATE YOUR AMP WITHOUT A LOAD

Install a 2 AMP SLO BLO fuse.

Note: If you see or smell smoke when you turn on the amp, turn it off immediately and re-check the connections.

1. **With no rectifier in place**, apply power and test the High voltage AC and ensure that it is on the correct pins of the rectifier (pins 4 & 6) and in the correct voltage range (greater than 350 Volts AC). Between pins 4 & 6 should read in the order or 760 V AC. From pin 4 or 6 to ground, should be about half of that.
2. Test the filament voltages and ensure they are on the correct pins for all tubes.
3. 5 VAC across pins 2 and 8 or V5, 5Y3 Rectifier.
4. 6.3 VAC across pins 2 and 7 on V4, V3 6V6 Power Tubes
5. 6.3 VAC across pins 4-5 pair and 9 on V2 12AX7 and V1 12AY7 Pre-Amp Tubes

6. If all is OK, then shut off, **install the rectifier and apply power without the preamp or power tubes installed.** Turn on the Stand-By switch on the Tweed. Check the plate voltages on the tube sockets. The plate voltages will be higher than the voltages listed on the schematic because there is no load provided by the tubes. It will be in excess of 400 Volts DC.
7. If everything is okay, power off the amp, install the 12AX7/AY7 and two power tubes (6V6), connect a speaker and power on again.
8. Measure the DC voltages from tube pin to chassis ground and compare to the layout, schematic or Trinity Tweed Voltage Chart.

Tube	Plate Pin(s)	Cathode Pin(s)	Heater (pins)
V1 - 12AX7 V2 -12AY7	1,6	3,8	4+5, 9
V3, V4 - 6V6	3	8	2, 7
V5 – 5Y3			2, 8

9. If the voltages seem close to the chart, then with volume setting at minimum and NO instrument plugged in, power up again. Listen for sounds that may indicate a problem. Loud transformer vibrations or humming or other crackling sounds. Observe if any of the components besides the tubes are getting hot – check the power resistors. Carefully check and make note of the voltages on all the tubes.

10. If all seems in order, and the fuse has not blown, turn the volume up a bit. If everything seems fine, plug in a cable, and touch one end. You should get a loud hum, this is a good sign. If you get this far, it's time to plug in your guitar and take the amp for a test run.

11. Hopefully, there are no problems but if you think there are e.g. hum, squeal etc., then move on to the troubleshooting section of this manual.

General Amplifier Operation

Some DO NOTS

- Never, Never, Never run the amp without a speaker plugged in. This can cause major Output Transformer damage.
- Do not flip the power switch off, and then back on rapidly. This can cause power supply damage.
- Never replace a burned out fuse with a bigger-amperage one. Remember - there was a reason the first one burned out, usually protecting something more expensive. Putting a bigger fuse in will just ratchet up the power level until something really vital burns out. If the second equal-rating fuse pops, turn it off and get a tech to look at it.
- Never ignore signs of high heat inside - a wisp of smoke or a burning smell is **NOT** normal.
- Your amp produces lots of heat, and will continue to do so even if you block the fresh air vents. Blocking the vents will overheat the amp and you may have to get some very expensive repairs done.
- Never ignore a red glow other than the small orange ends of the filaments. A red glow over a large part of the internal plates of the output tubes means they're about to melt. If you notice this, shut it down and get a tech to help you find out what it wrong.
-

Some DOs

- Add another speaker into the "external speaker" jack; a mismatched speaker load won't kill it, while an open circuit (disconnected speakers) may do so.

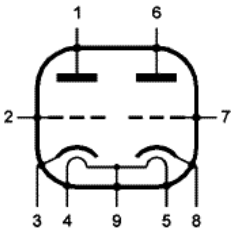
Note that in the long term, unless you have an impedance switch, the impedances should be matched to the OT , as in this case of the Tweed , 8 ohms, or 2 16s in parallel.

- Overdrive the stuFfing out of it. Tubes are very forgiving of massive overdrives, unlike solid state stuff. As long as they tubes don't overheat or stay overdriven for long periods, it's not fatal.
- Overdrive the stuffing out of it. Tubes are very forgiving of massive overdrives, unlike solid state stuff. As long as they tubes don't overheat or stay overdriven for long periods, it's not fatal.

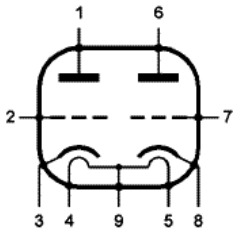
Trinity Tweed Voltage Chart

Use to record your measured voltages

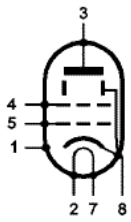
AC Mains Voltage	120 VAC
B+ No tubes installed	400 VDC
B+ All tubes installed	367 VDC WITH JJ 5Y3 (in brackets)



12AX7



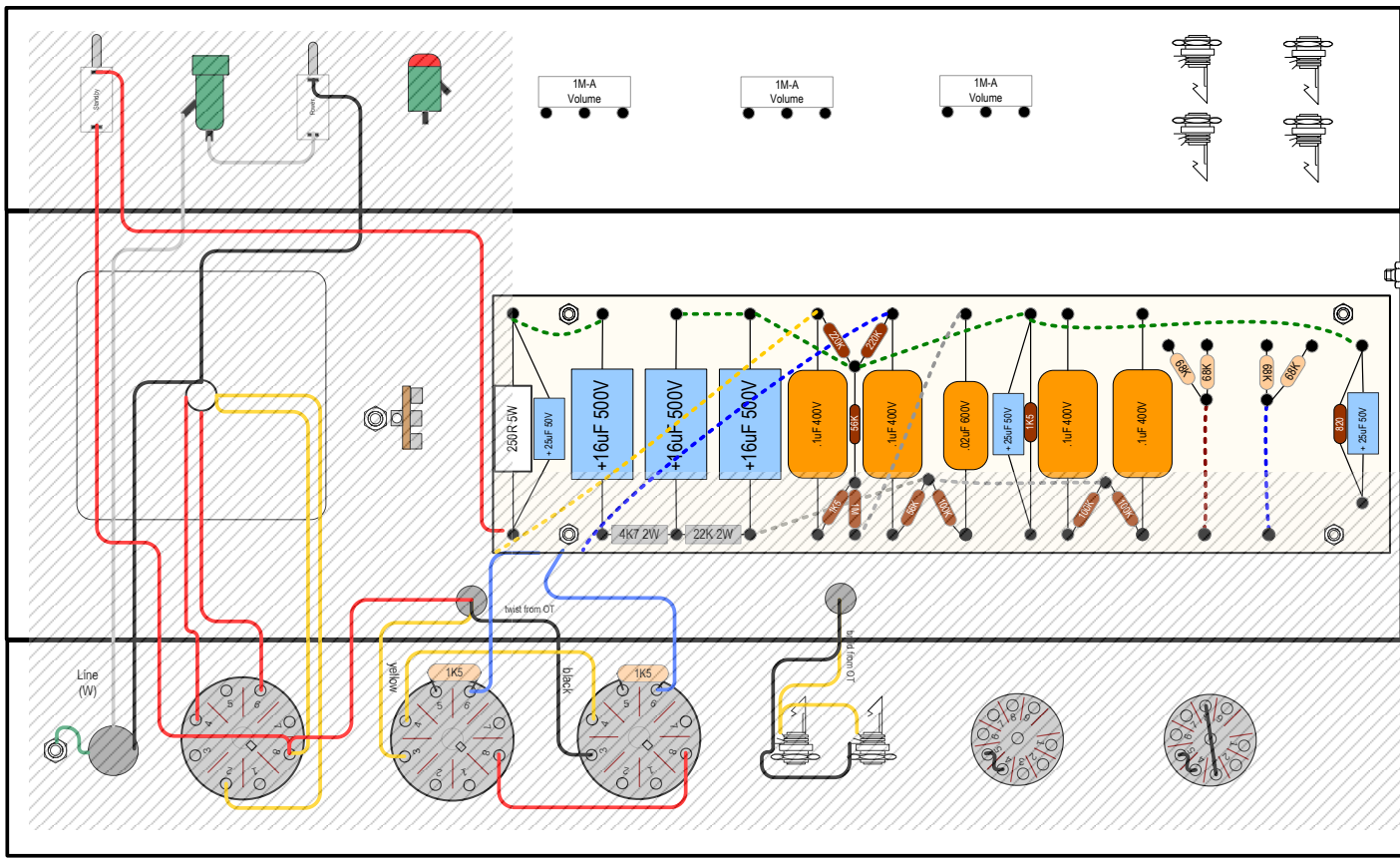
12AY7



6V6

TUBE	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1 12AY7	130 (120)	--	2.0 (1.8)	--	--	133 (120)	--	2.0 (1.3)	--
V2 12AX7	158 (148)	--	1.4 (1.3)	--	--	204 (191)	18 (17)	50 (45)	--
V3 6V6			380 (356)	348 (326)				22 (20)	
V4 6V6			380 (356)	348 (326)				22 (20)	

THE ABOVE DC VOLTAGES ARE MEASURED FROM TUBE PIN TO CHASSIS GROUND



The above layout above indicates areas of the Trinity Tweed where you should take extreme caution. There are voltages in this area in excess of 400 VDC.

WARNING

Please Read this Information Carefully

The projects described in these pages utilize **POTENTIALLY FATAL HIGH VOLTAGES.** If you are in any way unfamiliar with high voltage circuits or are uncomfortable working around high voltages, **PLEASE DO NOT RISK YOUR LIFE BY BUILDING THEM.** Seek help from a competent technician before building any unfamiliar electronics circuit. While efforts are made to ensure accuracy of these circuits, no guarantee is provided, of any kind!

USE AT YOUR OWN RISK: TRINITY AMPS EXPRESSLY DISCLAIM ALL LIABILITY FOR INJURY OR PROPERTY DAMAGE RESULTING FROM THIS INFORMATION! ALL INFORMATION IS PROVIDED 'AS-IS' AND WITHOUT WARRANTY OF ANY KIND.

Builders Guide General Troubleshooting

For a discussion on Guitar Amp Troubleshooting, please refer to our support page document **Builders Guide General Troubleshooting**

Tone Tweaking

Below are some modifications you might choose to implement in order to change the tone and response of your Trinity Tweed. There are several Fender interest groups on the Internet who can provide some direction.

Reducing Low End Response

Change the 1st two coupling caps from .1uF to .022uF to reduce the low end response [boominess].

Reduce the value of just the coupling cap on the bright channel from 0.1uF to 0.022uF to brighten it up a little bit and to increase the difference in tone between the two channels.

You can reduce the 0.1uF coupling caps between the PI and the power tubes from 0.1uF to 0.047uF or 0.022uF.

Increase Headroom

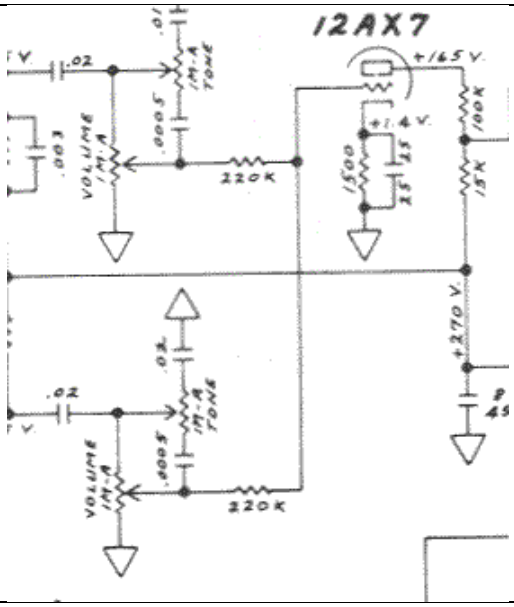
Remove or add a switch to toggle the value of the 2nd stage cathode capacitor: either 25uF (stock value) or 0.68uF (less bass, brighter overall tone) or remove this bypass capacitor completely. This would be effective for reducing the woofiness of a humbucker for example and also less break-up at higher volumes. Distortion wont start until volume is closer to 5 instead of 3.

Smoothen Distortion

Add a try 470K to pin 7 of V2 feeding the phase invertor to smoothen out the break-up, and minimize any 'blatting', 'swirling' or 'grainy' sounds sometimes heard in amps using the Tweed cathodyne kind of phase inverter. Make sure the resistor goes right on the pin as it is acting as a 'grid=stopper'.

Use the same Volume and Tone circuit as the 6G3 Brownface Deluxe.

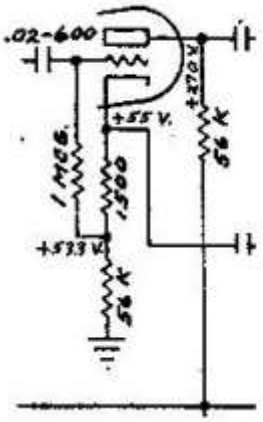
Rewire the pots to mix the 2 channels with a pair of 220K resistors. The reason for installing this mod is that the standard Tweed ramps up fast and breaks up very soon with reduced range in the volume pots. The tone/volume mod fixes that and at the same time smoothes out the response and volume curve. Plus it reduces the dark muddy tones as you play louder. After this mod is installed both channels are a little brighter and cleaner. The normal channel is more useable and the bright channel is special with better highs and note definition, while the amp doesn't crank out until the volume pots are around 4.5-7 instead of 1.5 to 3.

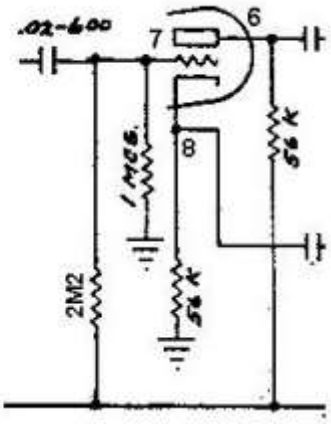


Feedback Switch - Add a modification that allows you to switch in a [56K from 8 ohm output] negative feedback loop to reduce overall volume and tighten and brighten up the sound a little bit and flatten out the frequency response (reduce bass response) when tone control is centered. Connect the feedback to pin 3 of V2. NOTE: You may need to reverse the BLUE and BROWN plate leads at the power tubes.

Put a .0022 cap in the tone control instead of .005 uF to reduce Bass control response curve.

DC-bias the phase inverter. The result is a slightly smoother breakup at higher volumes and slight increase in headroom (though not much).





More Tips for fine tuning your amp

Reprinted with permission from Aron from diystompboxes.com

These are very simplistic modifications you can do to your amp, let your ears be your guide:

- Change coupling caps; changing to smaller values reduces bass, changing to larger values adds more bass. Reducing the value of coupling caps can help eliminate "flabby" bass syndrome.
- Change cathode bypass caps. Adding a cathode bypass cap to a stage that doesn't have one will let the stage have more gain. Just like coupling caps, making the value larger adds bass - generally 25uF allows almost all bass through, .68uF are used in some Marshalls for a more midrange boost and 1uF and 5uF are used in some high end fusion type amps. Again, smaller values can help reduce "flabby" bass.
- Change cathode resistors - larger values reduce gain, smaller values give more gain. A "trick" is to connect a 5K+pot wired as a variable resistor instead of the standard cathode resistor - now you can turn the pot and dial in the perfect tone. After dialing the sound, remove the resistor and pot and measure it. Substitute the nearest standard value resistor in place of the pot plus a resistor.
- Add grid stopping resistors to help tame oscillation. If you have oscillation with your amp, you can sometimes help it by installing grid stopping resistors. The grid stoppers can also subtly roll off high end as well.
- Add high frequency roll off caps in parallel with the plate resistor. This is sometimes used to "mellow" out a stage (reduces highs).
- Adjust the grid leak resistor. Reduce the value to attenuate the signal into the stage to control the gain.
- Use a shielded cable from your input jack to the first gain stage. This can reduce RF, buzz and general reduce noise.
- Replace all plate resistors with metal film types. This can help reduce hiss..

Running 6L6 Output Tubes

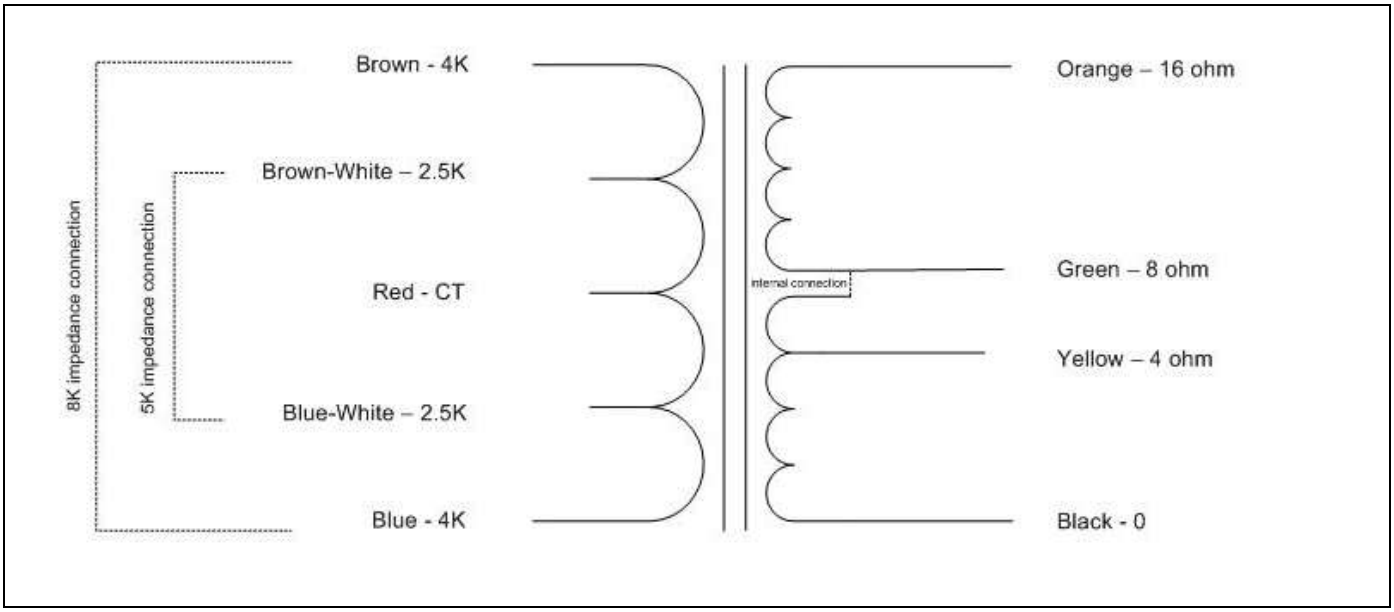
1. Replace the 5W 6V6 250R cathode resistor with a 10W to enable use of 6L6GT output tubes.
2. Replace the first two 16uF 450V Filter caps with 33uF 450V caps to manage sag with 6L6GT
3. Replace the OT with our optional Heyboer OT that has 5K & 8K impedance leads and hook up the 5K leads (BROWN-WHITE / BLUE-WHITE) to the 6L6GT plates, pins 3. Tie off the 8K leads, they can be used for 6V6 in the future if desired.
4. Use an 5AR4 or SOVTEK 5Y3 tube rectifier to increase B+ to approx. 400-380VDC when running 6L6 tubes.
5. Install a 470R 3W screen resistor on pin 4 (anchor on unused pin 1).
6. Connect the leads from the 2nd 16uF filter cap to pins 1 on V3 & V4

This mod will deliver about 25 watts output power and the amp will be noticeably louder while retaining the Classic Tweed tone.
NOTE: Our stock Tweed Output Transformer is NOT guaranteed with this modification. Do not use the stock OT in this configuration.
You should be familiar with Tube Amps before attempting this.

6L6 Tweed BOM

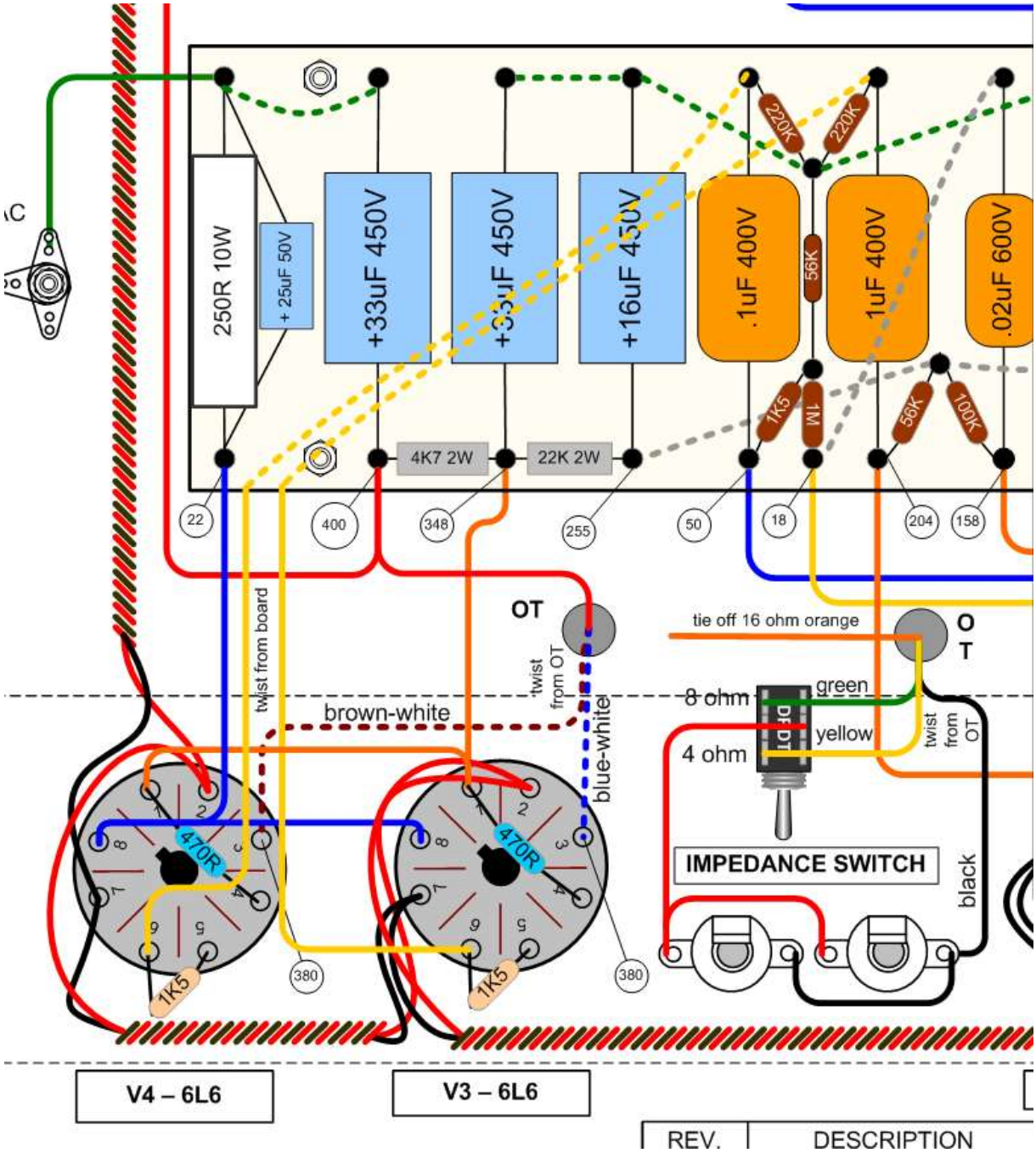
1 10W 250R 10W Wirewound Cement Resistor	1 5AR4 or SOVTEK 5Y3 tube rectifier
2 33uF 4550V Capacitor	2 470R 3W metal oxide resistor
1 Heyboer OT with 5K & 8K impedance	2 6L6 Power Tubes

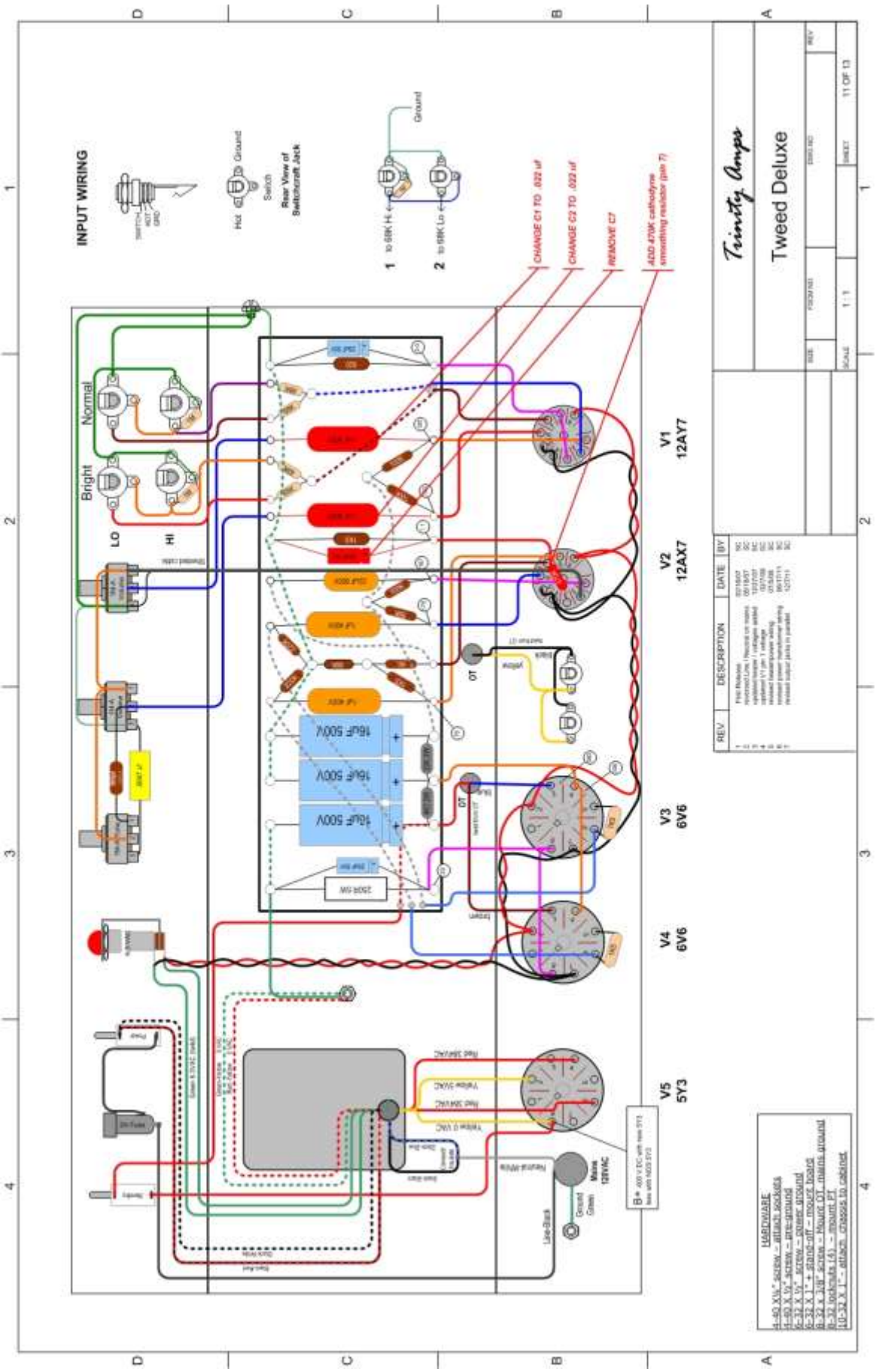
Upgraded OT for 6L6 Power Tubes



HEYBOER OT for TWEED 6L6 CONVERSION

Tweed 6L6 Layout




INPUT WIRING
Rear View of Switchcraft Jack
Switch
Hot
Ground
1 to 68K Hi
2 to 68K Lo
CHANGE C1 TO .022 uf
CHANGE C2 TO .022 uf
REMOVE C7
ADD 470K cathodyne
Normal
Bright
LO
HI
V1 12AY7
V2 12AX7
V3 6V6
V4 6V6
V5 5Y3
16uF 500V
16uF 500V
16uF 500V
OT
Trinity Amps
Tweed Deluxe
REV
DESCRIPTION
DATE
BY
HARDWARE
4-40 X¼" screw – attach sockets
6-32 X ¼" screw – pre-ground
6-32 X ½" screw – chassis ground
6-32 X 1" + stand-off – mount board
8-32 X 3/4" screw – Mount PT, mains ground
8-32 locknuts (4) – mount PT
10-24 X 1" – attach chassis to cabinet

Tube Substitutions

12AX7 - ECC83, 7025, ECC803, E83CC, 6681, 12AX7R, CV10319, CV492, 12AX7A, 12AX7S, 12AX7WA, 5751, 5751WA, 6057, 6681, 6L13, 7025, 7382, 7494, 7729, B339, CK5751, CV4004, CV4017, CV8156, CV8222, CV8312, E2164, E83CC, ECC803, ECC803S, ECC863, M8137, QB339

12AY7 – 6072, CV2650, CV3650, 6072, 6072A

The 12AX7 family of dual-triode preamp tubes consists of the 12AX7, 5751, 12AT7, 12AY7, 12AV7 & 12AU7. These are all pin compatible with one another, the only differences being the gain factor of each tube. A common substitution is to replace a 12AX7 with a 5751 or a 12AT7 to tame a preamp that tends to overdrive too easily, allowing you to get a better 'clean' sound out of your amp.

Tube	Gain	Acceptable Substitutes					
12AX7	100		5751	12AT7	12AY7		
5751	70	12AX7		12AT7	12AY7		
12AT7	60		5751		12AY7		
12AY7	45		5751	12AT7		12AV7	
12AV7	41				12AY7		12AU7
12AU7	19						

The above is not carved in stone and any of these tubes can be substituted for any other. You can always replace a higher-gain tube with a lower-gain tube, using your ears to tell you whether this was good idea or not. As example, the Fender Pro Junior amp came stock with two 12AX7 tubes - one for the preamp and one for the inverter. If you re-tube it with a 12AU7 in the preamp stage and a 12AT7 for the inverter the 12AU7 in the preamp will provide a nice clean sound, and the 12AT7 inverter helps prevent overdriving the power amp.

How to read Resistor Color Codes

First the code

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

How to read the Color Code

First find the tolerance band, it will typically be gold (5%) and sometimes silver (10%).

Starting from the other end, identify the first band - write down the number associated with that color; in this case Blue is 6.

Now 'read' the next color, here it is red so write down a '2' next to the six. (you should have '62' so far.)

Now read the third or 'multiplier' band and write down that number of zeros.

In this example it is two so we get '6200' or '6,200'. If the 'multiplier' band is Black (for zero) don't write any zeros down.

If the 'multiplier' band is Gold move the decimal point one to the left. If the 'multiplier' band is Silver move the decimal point two places to the left. If the resistor has one more band past the tolerance band it is a quality band.

Read the number as the '% Failure rate per 1000 hour'. This is rated assuming full wattage being applied to the resistors. (To get better failure rates, resistors are typically specified to have twice the needed wattage dissipation that the circuit produces.) 1% resistors have three bands to read digits to the left of the multiplier. They have a different temperature coefficient in order to provide the 1% tolerance. At 1%, most error is in the temperature coefficient - i.e. 20ppm.

How to read Capacitor Codes

Large capacitor have the value printed plainly on them, such as 10.uF (Ten Micro Farads) but smaller disk types along with plastic film types often have just 2 or three numbers on them?

First, most will have three numbers, but sometimes there are just two numbers. These are read as Pico-Farads. An example: 47 printed on a small disk can be assumed to be 47 Pico-Farads (or 47 puFf as some like to say)

Now, what about the three numbers? It is somewhat similar to the resistor code. The first two are the 1st and 2nd significant digits and the third is a multiplier code. Most of the time the last digit tells you how many zeros to write after the first two digits, but the standard (EIA standard RS-198) has a couple of curves that you probably will never see. But just to be complete here it is in a table.

milli, micro, nano, pico

1 mili Farad (or any other unit) is 1/1,000th or .001 times the unit. (10^{-3})

1 micro = 1/1,000,000 or 0.000 001 times the unit (10^{-6})

1 nano = 1/1,000,000,000 or 0.000 000 001 times the unit (10^{-9})

1 pico = 1/1,000,000,000,000 or 0.000 000 000 001 times the unit (10^{-12})

Table 1 Digit multipliers	
Third digit	Multiplier (this times the first two digits gives you the value in Pico-Farads)
0	1
1	10
2	100
3	1,000
4	10,000
5	100,000
6 not used	
7 not used	
8	.01
9	.1

Now for an example: A capacitor marked 104 is 10 with 4 more zeros or 100,000pF which is otherwise referred to as a 0.1 μF capacitor.

Most kit builders don't need to go further but there is sometimes a tolerance code given by a single letter.

So a 103J is a 10,000 pF with +/-5% tolerance

Typical Capacitor Markings

Code	pf	nf	uF
510	51	0.051	0.0000510
181	180	0.18	0.00018
501	500	0.5	0.0005
472	4700	4.7	0.0047
103	10000	10	0.01
123	12000	12	0.012
203	20000	20	0.02
223	22000	22	0.022
104	100000	100	0.1
684	680000	680	0.68

Table 2 Letter tolerance code	
Letter symbol	Tolerance of capacitor
B +/	0.10%
C +/	0.25%
D +/	0.5%
E +/	0.5%
F +/	1%
G +/	2%
H +/	3%
J +/	5%
K +/	10%
M +/	20%
N +/	0.05%
P +100%	0%
Z +80%	20%

FAQ

NOTE: B+ stands Battery Plus == B+ and came from the old days of tubes. B+ is measured at the intersection of the rectifier DC output and the first filter cap.

Q: The pictures show the power and standby switches as "top and bottom" on the back of the switch, the layout shows them as "front and back" and I have back mounted "left and right". Does it make a difference as to what orientation I choose to make sure the switch operate correctly, i.e. on is on and off is off?
A: It does make a difference as to what orientation you choose to make sure the switches operate correctly. Put a switch in any position and measure the resistance across two terminals. "ON" is where resistance is zero. Then rotate the switch so that DOWN is ON (UK style).

Q: I assume that the shield is only attached to the pot; it is NOT connected to the tube socket?
A: Yes. Do not connect the shield at both ends on the volume pot OR input cables.

Q: The wire looks to be two basic sizes, "thin" and "thick". From the pictures, it looks like the "thin" is used for the pot wiring and the "thick" is for the tube sockets. Is this correct?
A:
Use 22 gauge solid for hook up to tubes;
Use 20-22 gauge, twisted tightly for tube heater wiring;
Use 20-22 gauge solid/stranded for hook up to pots/front panel; and
Use 18 gauge, stranded, 600v for power supply hook up - to transformers, rectifier, standby etc.
Tip: Re-use cut-offs from the transformers for power supply hook up.

Q: What should I use for the jumper wires on the back of the eyelet board?
A: Use the provided solid 22 ga or the stranded supplied for jumpers, it is not critical.

Q: For the input jacks:
a): I should be using the shielded wire which is the thick gray/black wire that you supplied about 3' of. Does the shield braid from both lines go to the common tip lug on the lower jack while the core line goes to the individual tip lugs on both jacks? I want to make sure I am interpreting the drawing correctly.
b). The other end of the shield does NOT get connected to the tag strip at V1, correct?
c). Each pair of input jacks gets only one resistor, correct? Can I lace one lead of the resistor through both jacks for the connection?
A: Take a look at the drawing of the input jacks. That should help you out. Use the shielded wire which is the heavy grey/black wire. The core goes to the hot. At the other end, the shield does NOT get connected to the tag strip at V1.

Q: Do you need use both of the fiber shoulder washers when mounting the input jacks?
A: Yes, we recommend that you do. Not required for the output jacks

Q: Is there hardware provided for the grounding? Screws, star washers, nuts, etc.?
A: Yes, these should be in the kit.
Note: The power grounds should not go the transformer mount as there is a separate hole to mount the grounding points.

Q: Is it easier to wire the pots up outside of the chassis on a cardboard with the pots spaced correctly, or can it be done easily in the chassis?
A: You can wire them in place, it's not too difficult, but I would wire the input jacks outside of the chassis with the approximate spacing to fit the panel.

TIP: It is easy to solder up the input jacks by putting them "inside out". Use a set of jack locations to the right of the normal channel and mount the jacks in their final orientation, but mounted outside of the chassis with the mounting screw inside the chassis. This keeps the orientation and spacing correct and gives you me a lot of room to solder the resistor, jumpers grounding wire and shielded wires. Then, when done, remove the completed jacks, mount them correctly inside the chassis and tighten up the mounting screws and solder up the other end of the shielded wires to the tag strips at V1.

TIP: More, larger format, colour pictures and the schematic & layout that are helpful in the build are posted on the Trinity Forum & 18 Watt forum. Right click on them to download if you want print in large, colour format.

Schematic**: trinityamps.com Forum Index -> Resources ->** Trinity Tweed Deluxe Docs

TIP: Flatten or remove the locating tabs on the pots so that they tighten properly on the chassis.

TIP: Sometimes carbon comp resistors are hard to decode the colours. It is a good idea to check the resistances of these parts before assembly.

TIP: Use insulation tubes from the wiring on the resistor / cap leads around the tubes and pots by using longer pieces of insulation stripped from the supplied 22 or 20 ga wire.

TIP: There is no bleed resistor in the Deluxe. You don't need to worry about this unless you are going to poke around inside immediately after it's shutdown.
For safety, unplug the amp, then turn on the stand-by switch for a minute to help drain the caps. If you want to check them, measure B+ after you've done that. If there is still high voltage there, drain it again.

TIP: Heater Wires: Stranded wire is very hard to twist tightly. Stranded or solid doesn't make much difference. Solid wire stays in place better once it's positioned and a bit easier to feed through holes. If they aren't well twisted make sure they are tight against the chassis. You can use 22 ga solid for heaters. It is rated for more than 5A anyway.

TWEED Bill of Materials (BOM)

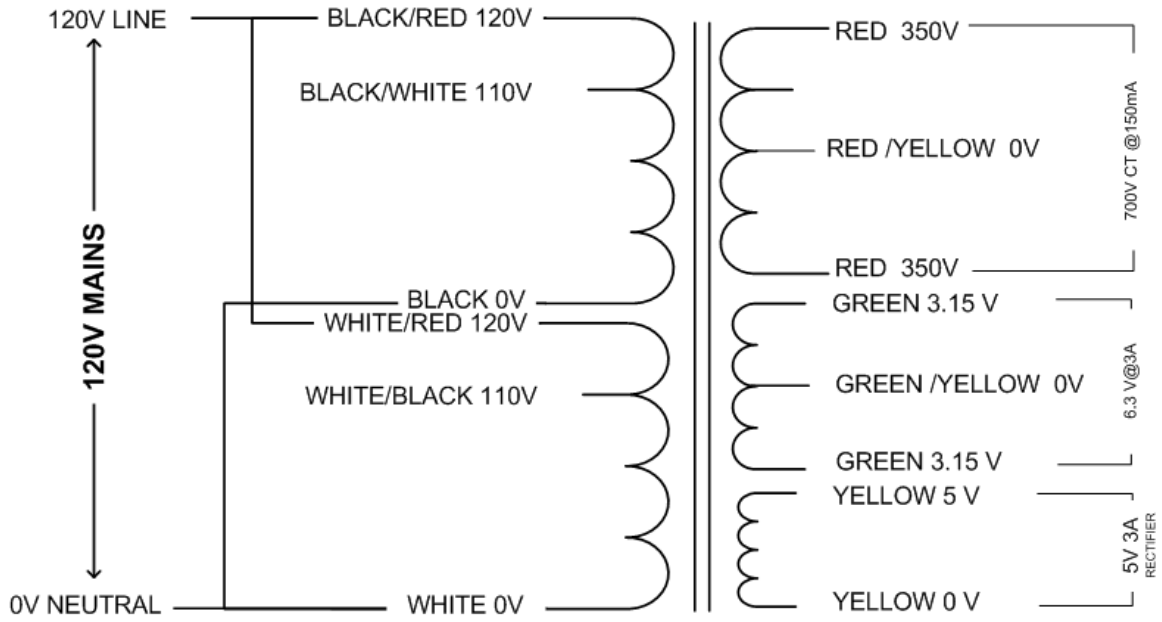
DESCRIPTION	QTY	CHECK
TWEED KIT WITH TRANSFORMER SET, CHASSIS, TUBES		
TWEED RESISTORS	**1**	
WIREWOUND RESISTORS - THROUGH HOLE 250 OHMS 5% TOL	1	
METAL OXIDE RESISTORS 470 OHMS 5% TOL	1	
CARBON COMPOSITION RESISTORS 820 OHM 5%	1	
CARBON COMPOSITION RESISTORS 1.5 K OHMS 1/2W 350V	2	
CARBON FILM RESISTORS- THROUGH HOLE 1.5K OHMS 0.05	2	
METAL OXIDE RESISTORS 4.7KOHMS 05% TOL	1	
METAL OXIDE RESISTORS 22K OHMS 5% TOL	1	
CARBON COMPOSITION RESISTORS 56K OHM 5%	2	
CARBON FILM RESISTORS- THROUGH HOLE 68K OHMS 0.05	4	
CARBON COMPOSITION RESISTORS 100K OHM 5%	3	
CARBON COMPOSITION RESISTORS 220K OHM 5%	2	
CARBON FILM RESISTORS- THROUGH HOLE 470K OHMS 0.05	1	
RESISTORS - 0.5 WATT CARBON COMPOSITION 1MO	1	
CARBON FILM RESISTORS- THROUGH HOLE 1M OHMS 5%	2	
TWEED CAPACITORS	**1**	
CAPACITOR - 500V SILVER MICA ± 5% CAPACITANCE: 500 PF	1	
CAPACITOR - MALLORY 630V 150S AXIAL LEAD CAPACITANCE: .0047 UF	1	
CAPACITOR - 600V 716P SERIES POLYPROPYLENE CAPACITANCE: .022 UF	1	
CAPACITOR - 600V 716P SERIES POLYPROPYLENE CAPACITANCE: .1 UF	4	
CAPACITOR - 475V AXIAL LEAD ELECTROLYTIC CAPACITANCE: 16 UF	3	
CAPACITOR - 50V AXIAL LEAD ELECTROLYTIC 25 µF	3	
TWEED POTENTIOMETERS	**1**	
KNOB - CHICKEN HEAD SET SCREW COLOR: BLACK	3	
POTENTIOMETER - ALPHA AUDIO 3/8" BUSHING RESISTANCE: 1 MOHM	3	
TWEED CHASSIS HARDWARE	**1**	
IEC RECEPTACLE - FOR POWER CORD	1	
FUSE HOLDER - 3AG-TYPE BAYONET TYPE HIGH QUALITY	1	
FUSE - SLOW-BLOW 250V 3AG 0.25" X 1.25" AMPERAGE: 2 AMPS	1	
LAMP - FENDER STYLE PREMIUM PILOT ASSEMBLY	1	
JEWEL - FENDER STYLE COLOR: RED	1	
DIAL LAMP - #47 T-3-1/4 6.3V 0.15A BAYONET BASE	1	
SWITCH - CARLING TOGGLE SPST ON-OFF SIDE SOLDER LUGS	2	
SWITCH - CARLING MINI TOGGLE SPDT 2 POSITION	1	
GROMMETS & BUSHINGS GROMMETS & BUSHINGS SB 500-6 BLK	2	
TWEED SOCKET	**1**	
TUBE SHIELD - FOR 9-PIN MINIATURE ALUMINUM	2	
SOCKET - BELTON 9 PIN MINIATURE TOP MOUNT	2	
SOCKET - BELTON MICALEX 8 PIN OCTAL MIP	3	
TUBE CLIP - BELTON FOR OCTAL SOLD INDIVIDUALLY	3	

TWEED JACKS	1	
JACK - SWITCHCRAFT 1/4" MONO 2-CONDUCTOR SHUNT TIP	4	
JACK - SWITCHCRAFT ¼" MONO 2-CONDUCTOR OPEN CIRCUIT	2	
SCREWS & FASTENERS SHOULDER WASHER 3/8"	4	
SCREWS & FASTENERS WSHR FBR 3/8".625"	4	
TWEED FASTNERS	**1**	
MACHINE SCREW PHILLIPS PAN HEAD 4-40X5/16 L	13	
HEX NUT EXT TOOTH LOCKWASHER 4-40	1	
TERMINALS TERMINALS LUG LOCKING MATTE TINNED#4	2	
MACHINE SCREW PHILLIPS PAN HEAD 6-32X3/4 L	4	
MACHINE SCREW PHILLIPS PAN HEAD 6-32X3/8 L	1	
HEX NUT EXT TOOTH LOCKWASHER 6-32	1	
INTERNAL TOOTH LOCK WASHER #6 CHROME	4	
TERMINALS TERMINALS LUG LOCKING MATTE TINNED#6	3	
STANDOFFS & SPACERS .375 STD SPACER	4	
MACHINE SCREW PHILLIPS PAN HEAD 8-32X3/8 L	3	
HEX NUT EXT TOOTH LOCKWASHER 8-32	7	
TERMINALS TERMINALS LUG LOCKING MATTE TINNED#8	1	
MACHINE SCREW PHILLIPS TRUSS HEAD 10-32X1-1/4 L	2	
HEX NUT EXT TOOTH LOCKWASHER 10-32	2	
SAE FLAT WASHER #10	2	
TWEED WIRE	**1**	
22 GAUGE SOLID CORE WIRE (VARIOUS COLOURS)	10	
22 GAUGE TWISTED PAIR RED/BLACK	3	
BELDEN RG174/U COAXIAL CABLE	1	
18 GAUGE STRANDED WIRE BLACK	1.5	
18 GAUGE STRANDED WIRE WHITE	1.5	
HEAT SHRINK TUBING 1MM	4	
HEAT SHRINK TUBING 3MM	4	
HEAT SHRINK TUBING 6MM	4	
CABLE TIE 4 IN BLACK 18 LBS	6	
TWEED VACUUM TUBE SET	**1**	
VACUUM TUBE - 6V6 JJ ELECTRONICS	2	
12AX7/ECC83 - JJ ELECTRONICS PIN TYPE: REGULAR	1	
12AY7/6072A - ELECTRO-HARMONIX	1	
VACUUM TUBE - 5Y3 S JJ ELECTRONICS RECTIFIER	1	
TWEED EYELET BOARD	1	
CHASSIS TWEED CHROME PRINTED	1	
CORD - POWER 18 AWG 3 CONDUCTOR DETACHABLE BLACK IEC LENGTH: 8 FEET	1	
TRANSFORMER POWER TWEED NO. 6452 MOD	1	
TRANSFORMER OUTPUT DELUXE NO. 108	1	

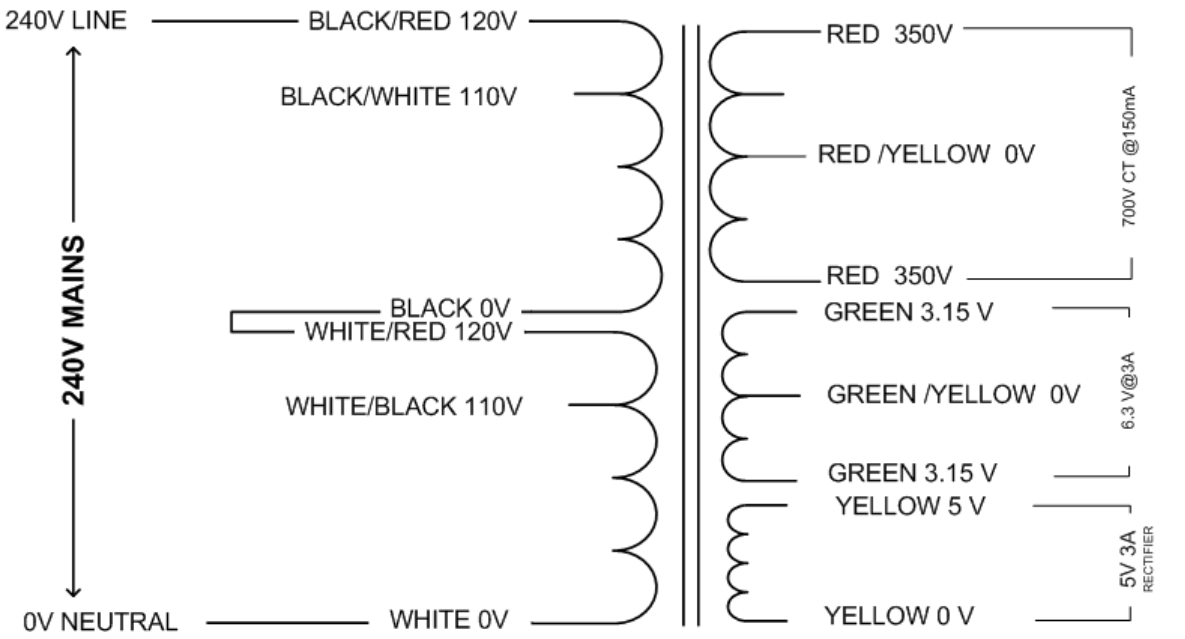
*Note - Some hardware may be used to ship transformers in place.

Some of the parts contained in this kit are subject to availability. Trinity Amps reserves the right to substitute any part without notification. Substitutions are guaranteed not to affect the integrity or operation of your amplifier kit.

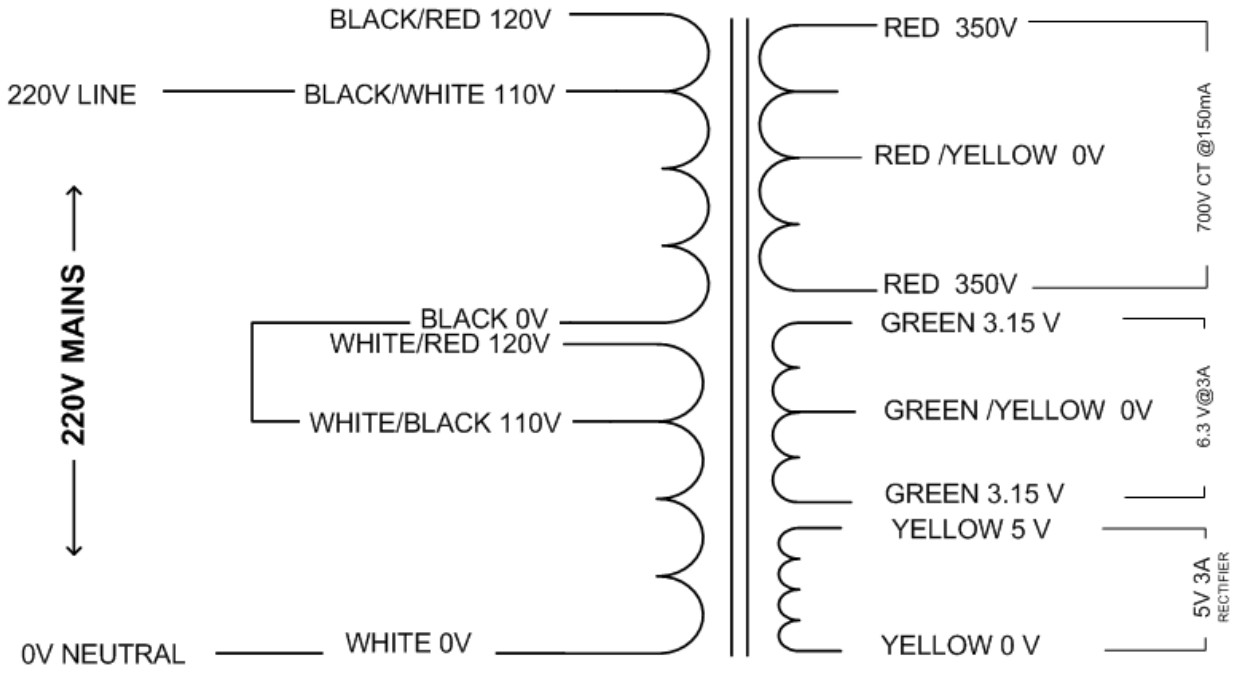
Power Transformer Hook-Ups



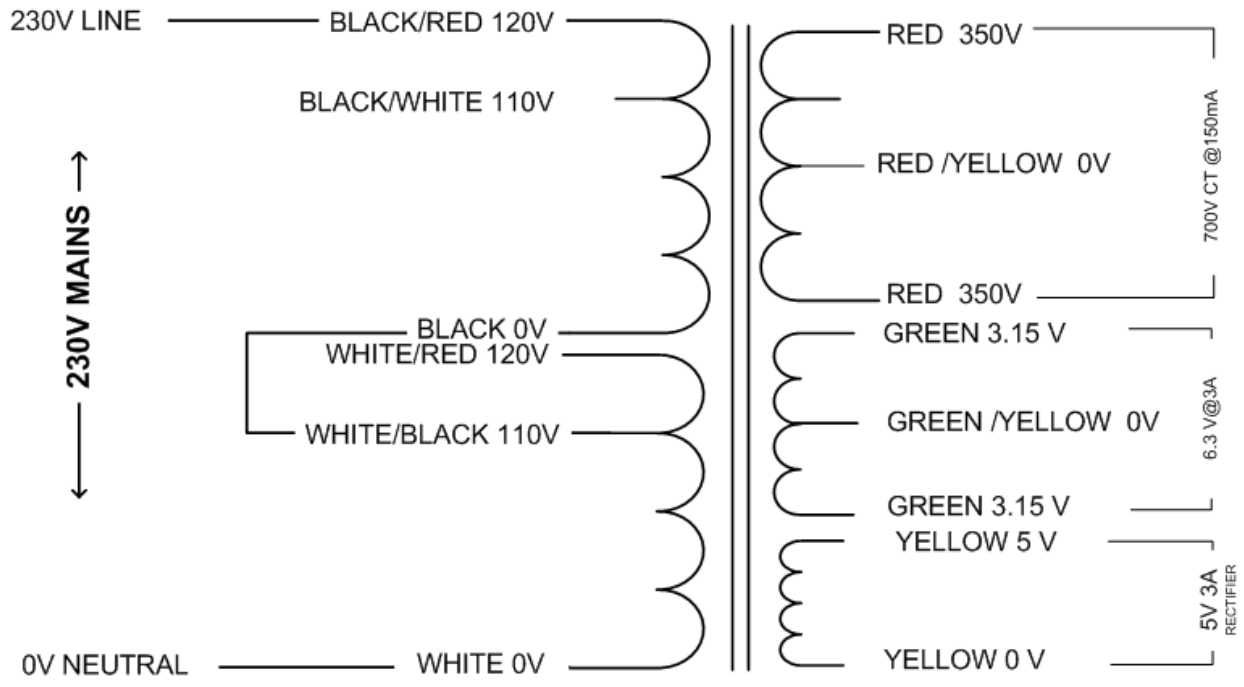
Trinity Amps 9114-2-EX Power Transformer 120V HOOK-UP



Trinity Amps 9114-2-EX Power Transformer 240V HOOK-UP



Trinity Amps 9114-2-EX Power Transformer 220V HOOK-UP



Trinity Amps 9114-2-EX Power Transformer 230V HOOK-UP

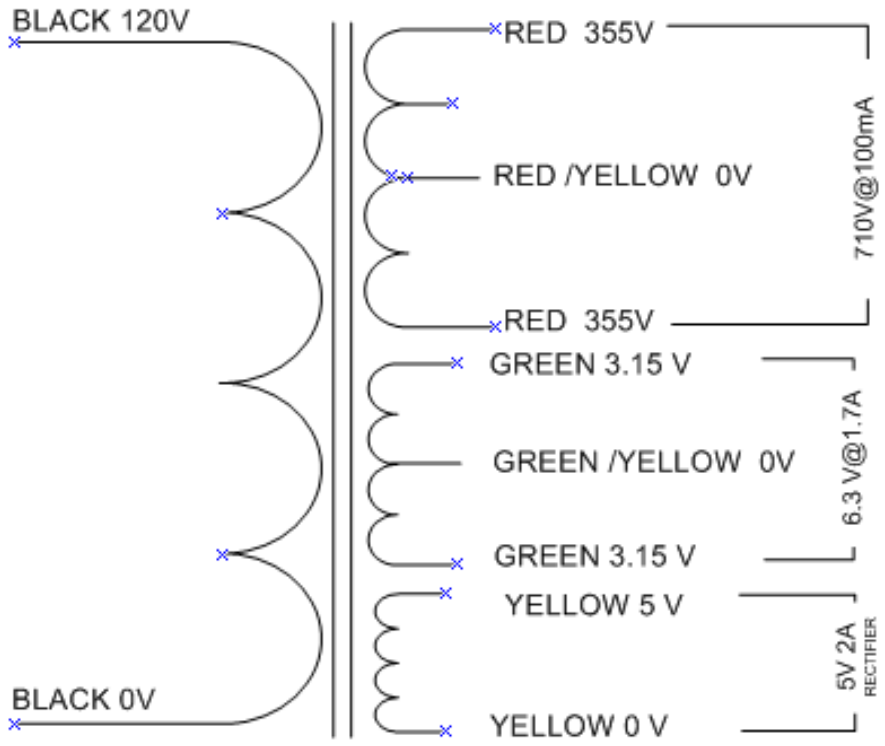
ADDENDUM 120V Power Transformer

Due to supply constraints, your Tweed Kit may be supplied with a Heyboer 120V North American Power Transformer (PT) rather than an International version. If so, the following apply.

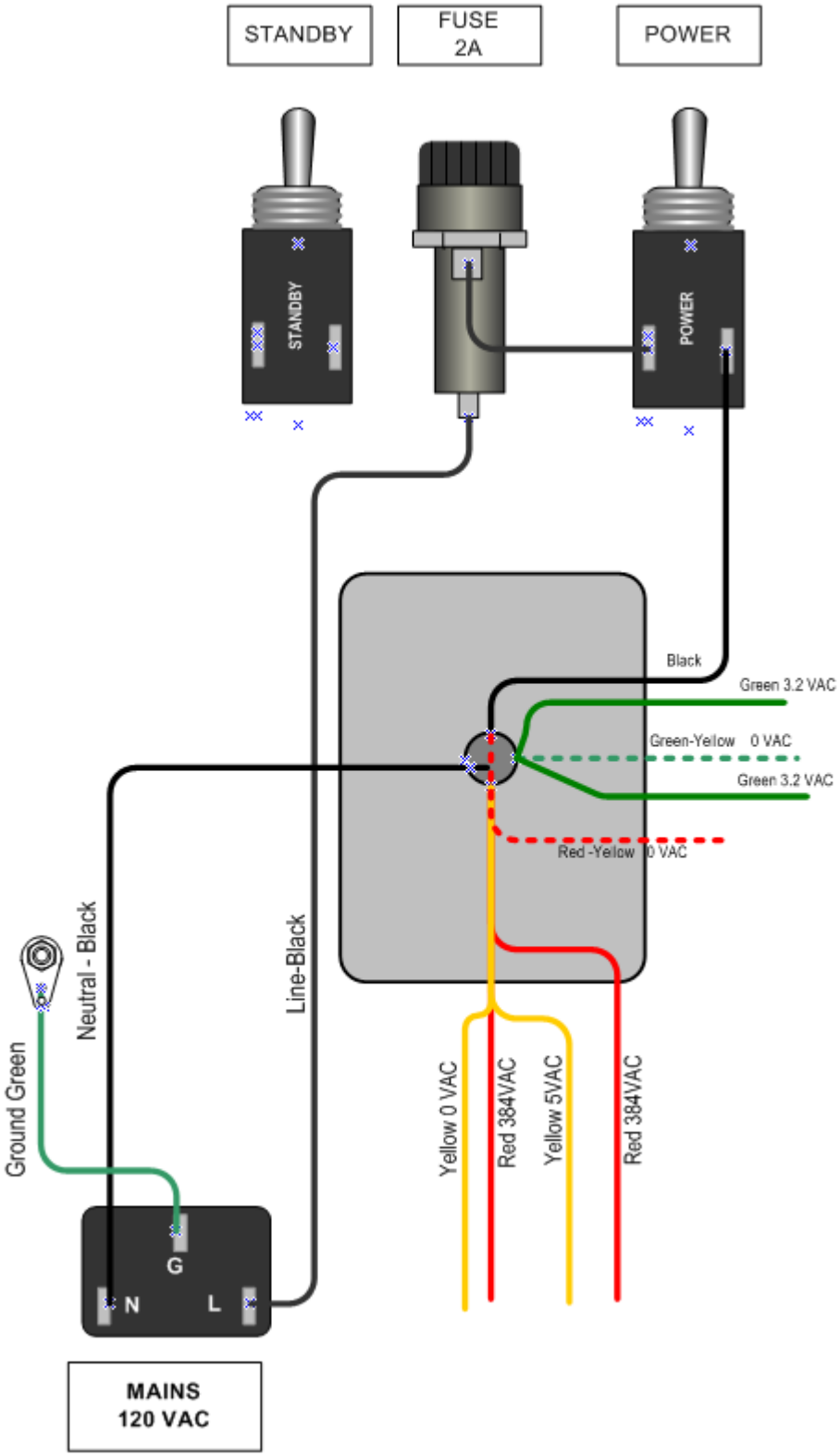
This is a simpler connection. Follow the ADDENDUM Layout.

- Connect one BLACK PT primary lead to the IEC socket, NEUTRAL (N).
- Connect an 18Ga stranded wire from the IEC Line (L) terminal, to the FUSE holder, end tab.
- Connect the FUSE holder side tab to the closest POWER switch tab.
- Connect the other PT Primary to the other tab of the POWER switch.

The remainder of the chassis wiring remains the same.



HEYBOER - TWEED 120V Power Transformer


STANDBY
FUSE
2A
POWER
STANDBY
POWER
Black
Green 3.2 VAC
Green-Yellow 0 VAC
Green 3.2 VAC
Red -Yellow 0 VAC
Neutral - Black
Line-Black
Ground Green
Yellow 0 VAC
Red 384VAC
Yellow 5VAC
Red 384VAC
G
N
L
MAINS
120 VAC

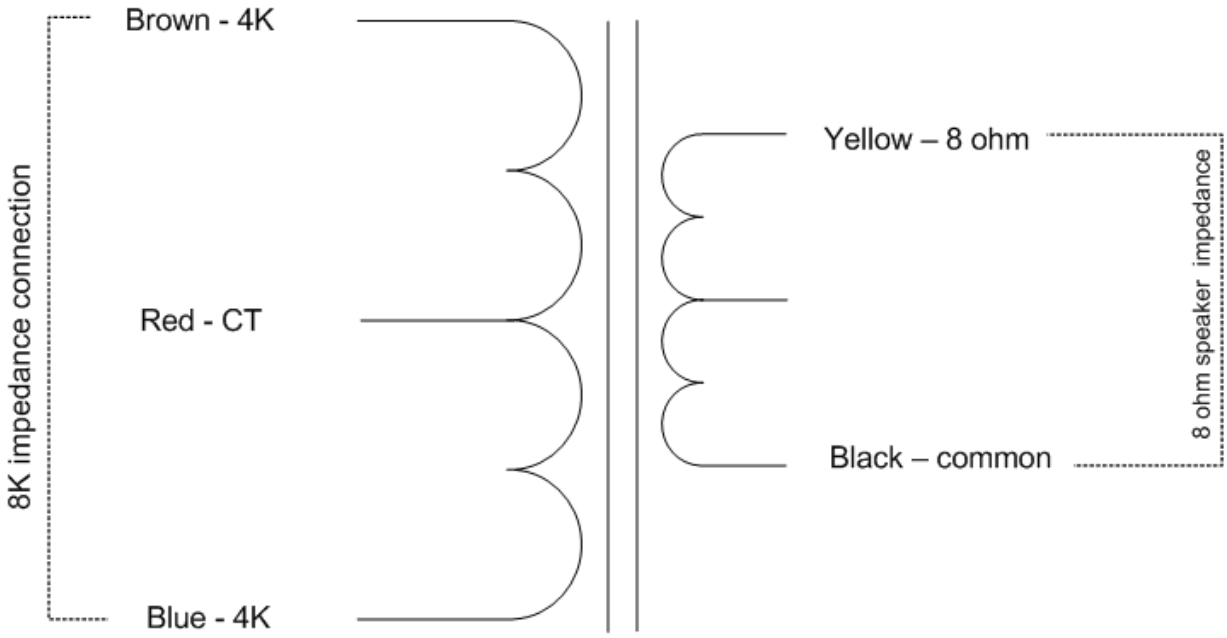
ADDENDUM 8 Ohm Only Output Transformer

Due to supply constraints, your Tweed Kit may be supplied with a Heyboer 8 ohm only Output Transformer (OT). If so, the following apply.

This is a simpler connection. Follow the ADDENDUM Layout.

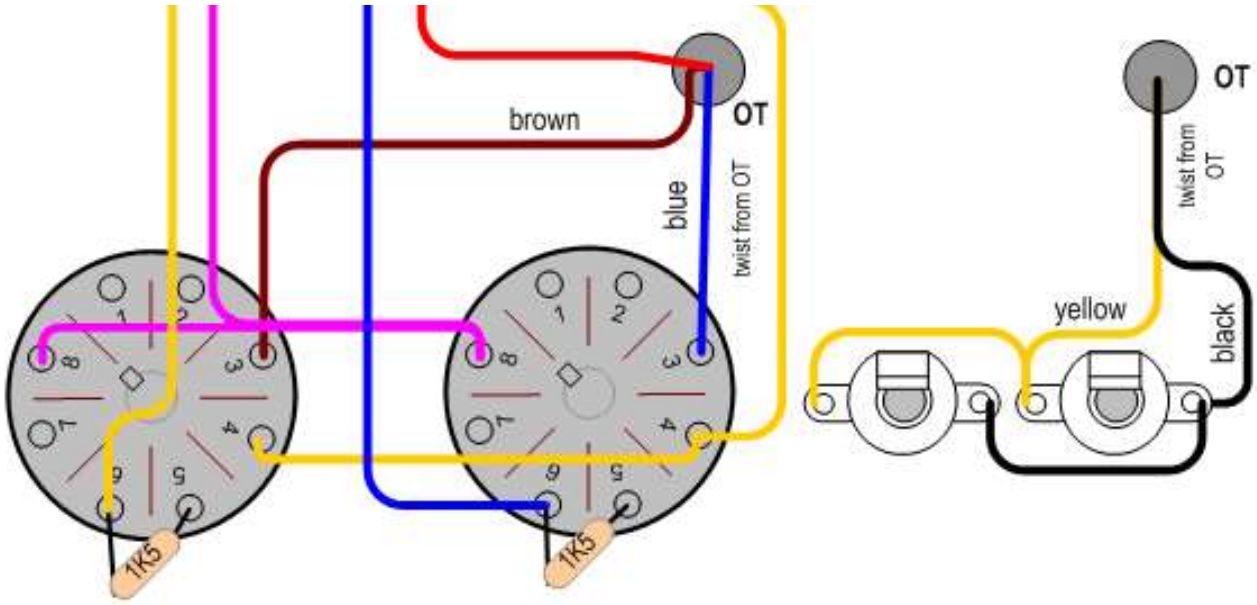
- Connect the BLACK OT secondary lead to the Output Jack Ring Lug. (chassis connection)
- Connect the YELLOW OT secondary lead to the Output Jack Tip Lug.
- Connect a jumper from one Output Jack Tip Lug to the other jack Tip Lug
- Connect a jumper from one Output Jack Ring Lug to the other jack Ring lug. (optional)
- NO DPDT Impedance Switch is required

The remainder of the chassis wiring remains the same.



Tweed Output Transformer – 108 OT HTS-5039

8 Ohm Only Tweed OT Layout



Trinity Amps Schematics and Layouts