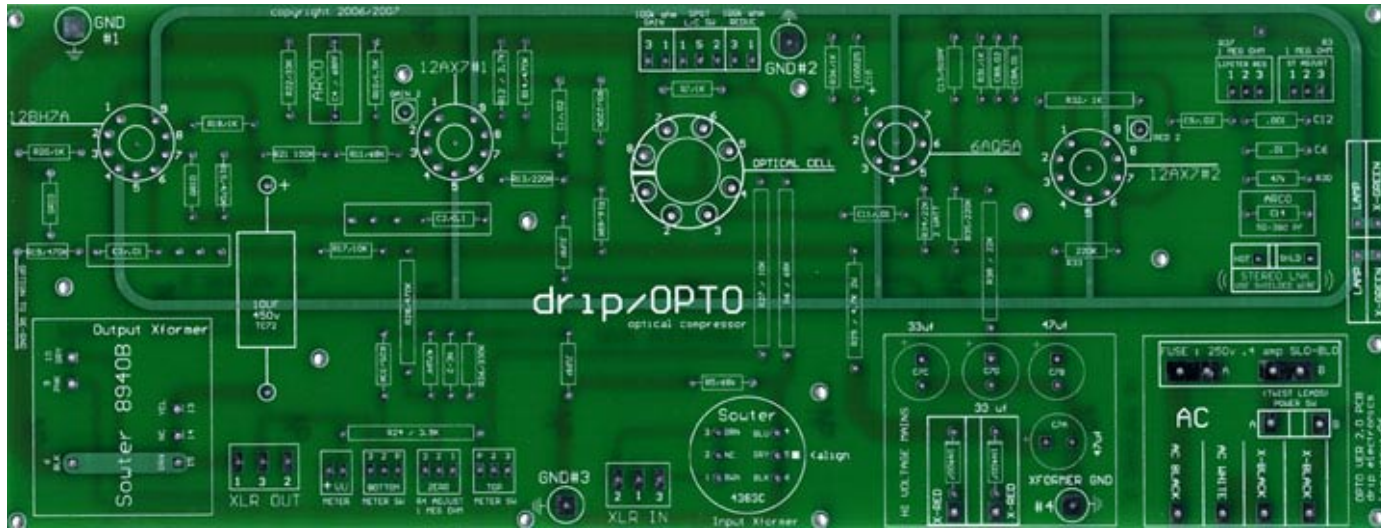




opto|compressor



Drip opto compressor limiter pcb ver 2.0 | build manual | parts and materials



Introduction :

Thank you for your interest in the drip 'opto' pcb. A bit of time has past since the design of ver 1.0 and I am happy to present the latest design .

This board is a completely new design and layout .

Some of the advantages of the ver 2 design :

1. Larger board size , allowing for good separation between most all power and signal traces.
2. Heavier copper weight, the board uses 3oz copper, 3 times the thickness of the ver 1 board.
3. Most crucial connections are at least 2mm wide (14 times the needed copper for the rated amperage needed)
4. Thicker pcb board , .93" almost double in thickness of the ver 1 board . The benefits of this are :
 - A.) More dielectric between the top and bottom layers of the board.
 - B.) Better heat dissipation
 - C.) Less flexibility and vibration.
5. pcb mount Sowter input/output transformers, Making build time much faster , and more consistent. Also eliminating the need to deal with mounting problems. (Most leaded transformers including the ha-100x and a-24 work very well.)
6. Tube heaters are now on the pcb , eliminating the need to wire them, resulting in more consistent results.
7. Fuse is now pcb mountable
8. Curved tracks inspired off of vintage designs
9. Improved grounding scheme true to the original design.
10. Designed based upon UPC specs (pcb design codes and standards)

Attention|disclaimer

This project is presented as artwork, and is solely intended

As such.

Although this board can be assembled and

Built into a functioning optical compressor.

Due to the high voltages and possibilities of

Human error , drip electronics | gregory lomayesva

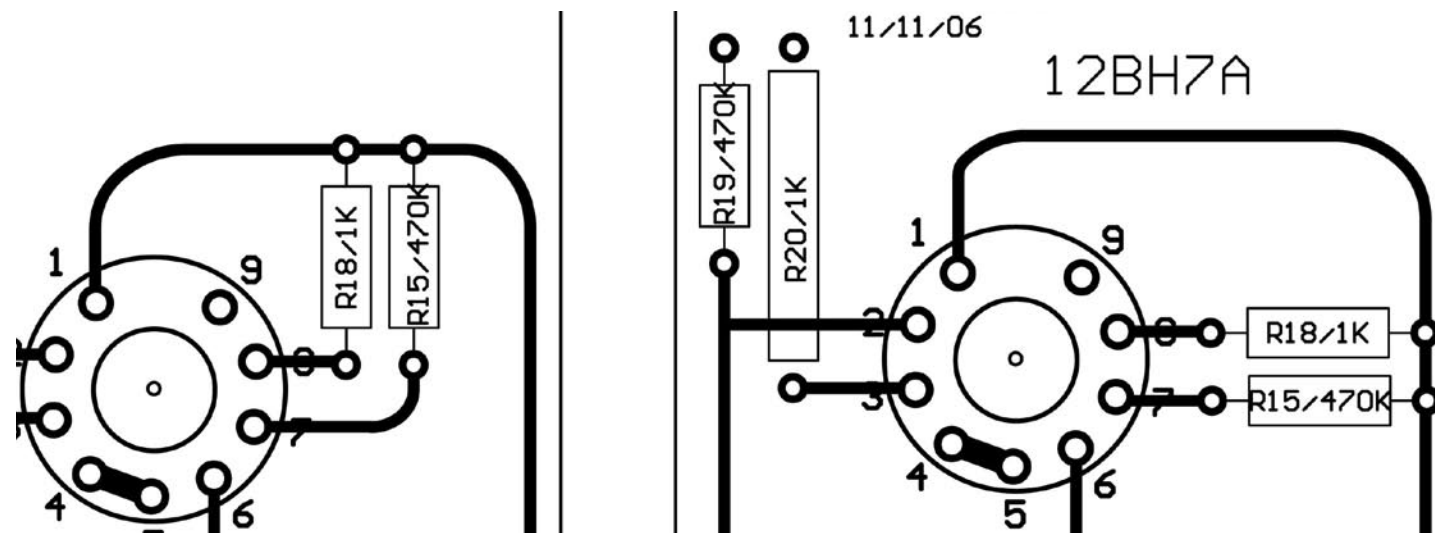
Hereby assumes no liability for injury/damage/loss

which might unintentionally occur.

This manual is intended for information purposes only.

Proceed at your own risk.





Design notes and history:

The goal of this project was to duplicate the sound of a point to point optical compressor circa 1969.

It was started long before the re-issue came out when the prices for a vintage unit could reach upwards of five thousand dollars.

Having built many p2p optical compressors I found that with every one there were

so many variables that could effect the sound-hum-noise and performance of the unit.

At a certain point I memorized the circuit and was able to begin seeing alternatives in wiring layout , some often improving performance and signal path.

The ver 2 circuit board has more similarities with an actual point to point unit , more so then with the turret board version. (even in the process of using only two dimensions) simply put , the signal path is shorter and more 'direct' then the turret board style in most instances.



This in it's self does not necessarily make it 'better',

It does however ,promote a lesser chance for noise and hum due to excessive wire runs.

The pcb 'is' the identical circuit ,based off of schematics and the dissection of vintage units.

The whole process of design had taken probably over several hundred different layouts before the ver 1 pcb was released.

For some odd reason I decided I would keep ver 1 a one sided board.

Since I hated the idea of using 'jumps' in the circuit board , (Simply it felt like cheating)

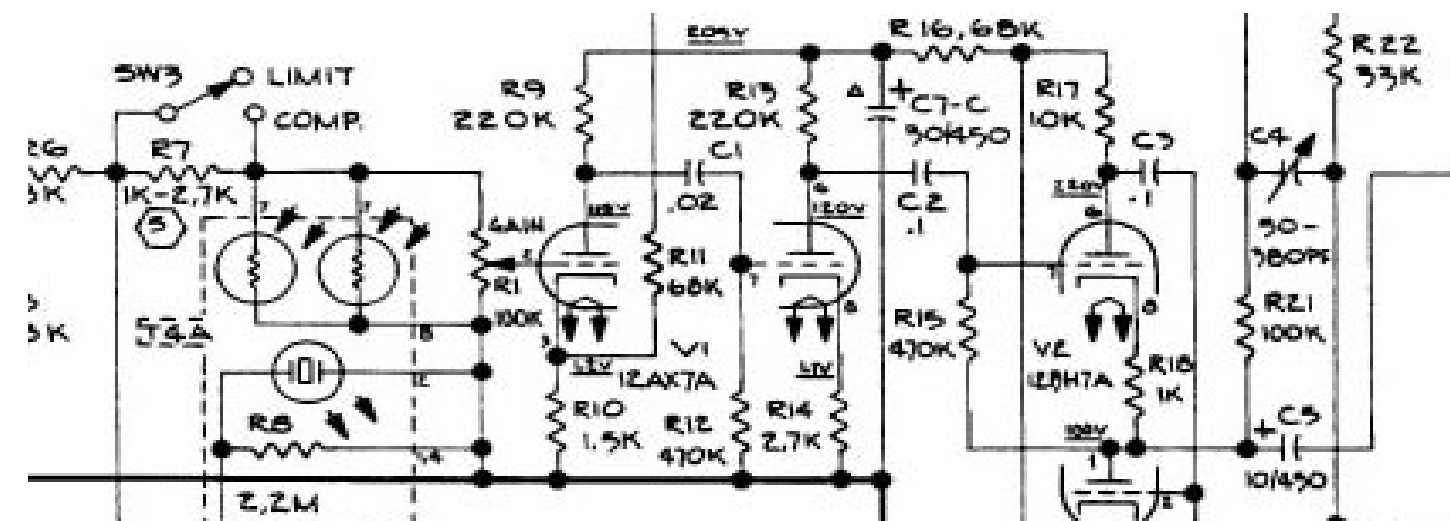
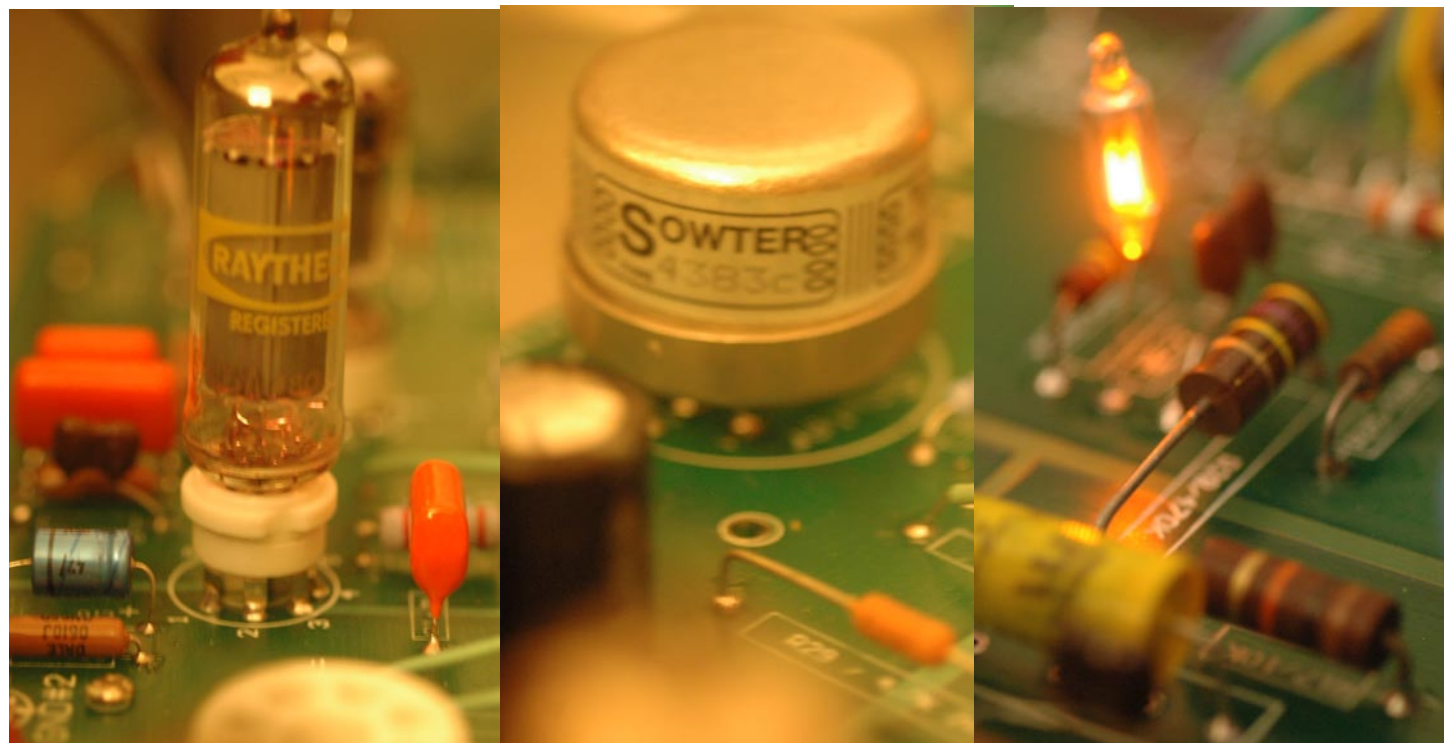
this made the process even more complicated , for every move of a component , another fell out of place .

Only at a certain point was a complete balance achieved.

(With only a few 'jumps' used :()

I think the most important part of the ver 2 board , is that it remains true to my original design , yet adds a lot more space with in its layout , helping in keeping 'crosstalk' to a minimum.





errata|caution 

I wanted to design a board that helped even the amateur with the experience of DIY with minimal complications.

Some will say that the idea of PCB's negates the 'purity' of a vintage design like the optical compressor , yet it is important to understand that when based upon a good design and layout, a pcb can achieve great and often exacting results. (over and over).

Instead of making hundreds of connections , you will only need to make less than 50. There is room for error , but many are a lot more predictable and correctable.

This new design has proven reliable, quiet, and accurate.

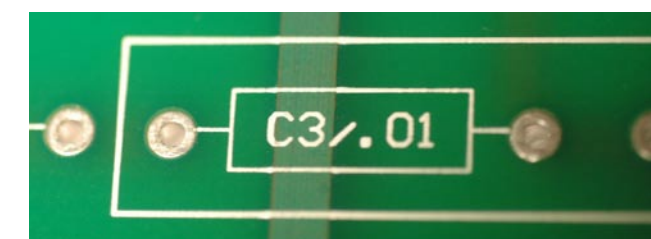
I selected sowter transformers for this project , simply because I have a hard time telling the difference between the a-24/ha100x combo and the sowters.

Please enjoy the process of DIY and this build.

best .

g.

C3 IS MISLABLED AS A .01
IT IS A .1 CAPACITOR



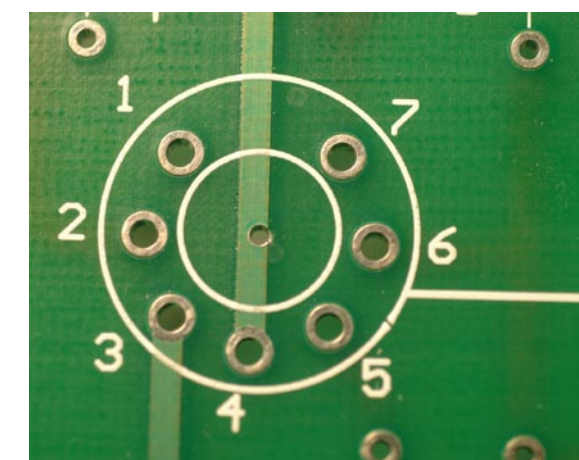
left behind alignment holes :

in the center of the 12ax7a#2 foot print and in the center of the 6aq5a foot print you will find a via (hole) in the center of them ,

please heat and fill with solder.

they were simply holes to align the tubes , and were left in during production.

they will not harm the design if filled or left unfilled.

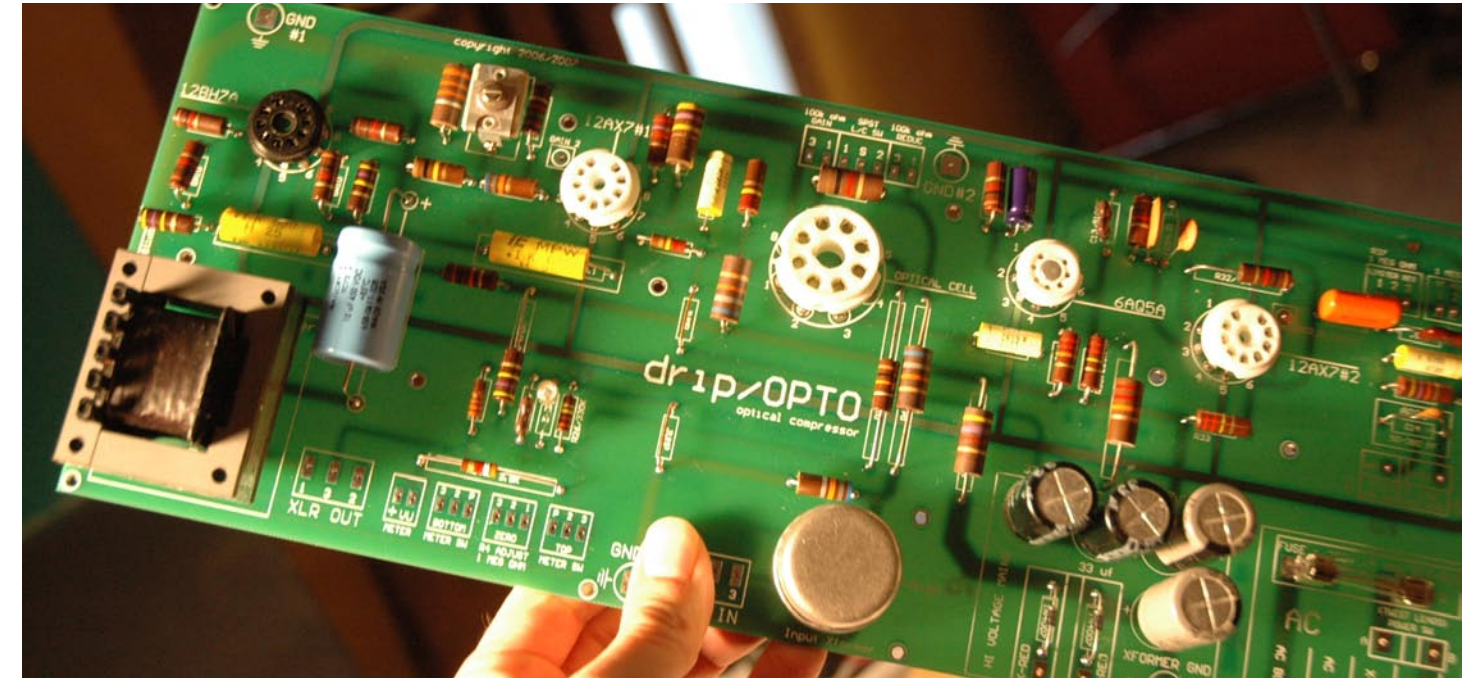


Warnings|caution



It is important to cover a few safety tips and cautions before you begin.

1. This project has high voltages, at some places on a live board voltages can be upwards of +300v @ 380 mA. It is not a terrible amount of current/voltage, and I have been shocked many times for foolish mistakes such as forgetting the unit was powered on while servicing it etc. It's enough voltage to remind you to never make that mistake again.
For someone with a heart condition this voltage can be lethal.
2. Once the unit has been powered up, the filtering electrolytic capacitors (c7a-c7d) will remain with charge in them for a period after the power has been switched off. I found that a shock also is still possible for a few moments. (It seems the NE-2 neon light helps dissipate charge after power off.)
3. Never 'lift' or remove the safety ground (chassis ground from AC cord).
The board with proper wiring and ground layout will have minimal noise and hum, solving a hum problem by lifting the safety ground is wrong, often illegal and dangerous to you and others.
4. Work off of an ac plug that is grounded to earth.
5. If the fuse pops on the pcb or a circuit breaker, there IS something wrong, stop, recheck all connections and review your work. the fuse will only pop if there is a short or a miswired connection.
6. Do not rush through the project with out reviewing your work several times. beware of solder bridges. sloppy work or impatience is dangerous to you and others.
7. Be neat in your connections and wire runs, don't use more wire than is needed for each connection.
if you can't be 'neat', don't bother with this project.
'Neatness promotes accuracy'
8. If the electrolytic capacitors are mounted in reverse, they can explode violently. REMEMBER THIS. CHECK EACH ELECTROLYTIC !.
9. if you do not understand something fully that is not covered in this manual or are unsure about something. STOP. and ask a question either in the forum or through email. you will be helped.
10. This unit is intended as a mono unit, and was not designed for anything but the 'rated' power transformer.
11. The use of a 'vented' case IS necessary.



info|build order

- 1.) install resistors and jumpers
- 2.) install capacitors
- 3.) install tube sockets / octal sockets
- 4.) install transformers if using pcb mount.
- 5.) install _fuse clips and fuse
- 6.) connect ground leads and solder tags
- 7.) connect pots
- 8.) connect switches
- 9.) connect XLR's
- 10.) connect ac section
- 11.) connect vu meter
- 12.) power up / power down
- 13.) install tubes
- 14.) pass audio test
- 15.) troubleshoot
- 16.) install t4



Parts|capacitors|info

non electrolytic capacitors

Choosing capacitors for your project can be daunting , there are so many choices available . most radial and axial leaded caps will fit.

On the original unit all .01 and .02 capacitors are ceramic . (z5u rated , most seem in the 2 kilovolt range , although caps rated for 500v will do fine) there is nothing special about ceramics , they are low grade standard duty capacitors.

The .1 caps are polyester rated for 400v (this is a great place for audiophile or vintage caps)

The .001 cap is usually mica (300-500v is fine).

NOTE :there is no polarity with these caps , so they can be soldered in any direction , only with the electrolytics is there a need for proper polarity alignment.

The use of vintage capacitors can really have a cool effect on the tone of the project , but you will need to check them for consistency.



Some of the component footprints on the version 2 board have been enlarged to Accommodate larger modern and vintage caps.

I tend to use ceramic caps for the 6aq5a and the 12ax7#2 section.

Saving the more expensive caps for the gain amplifier section . (12bh7a/12ax7#1)

One approach is to build the pcb using quality and reliable modern parts , then after all Troubleshooting has been completed and the unit is working well ,

then replace the modern caps with various vintage styles. this approach might save time and headaches due to faulty parts.



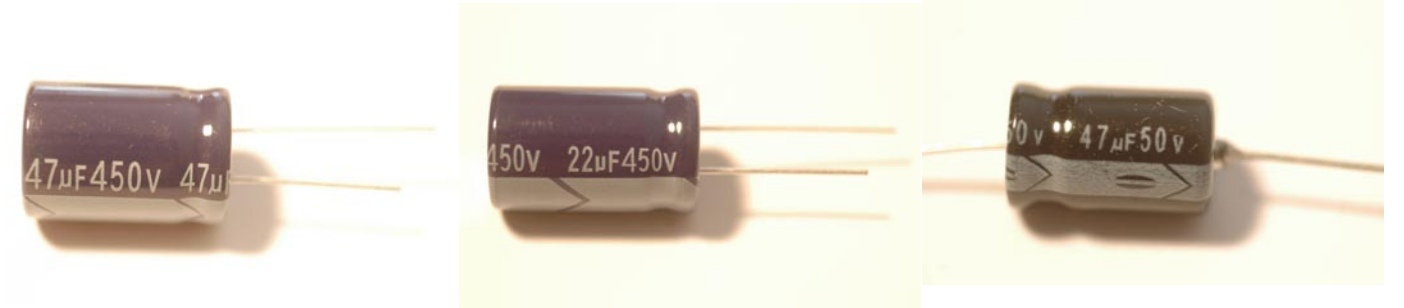
Many people use the 'orange drop' Variety of caps, either the 716 or the 715 series. They are reliable polypropylene capacitors often used in guitar amps, and the 'sound' of them is liked. they will need to be the 600v range.

The codes to identify them are :

- 102J : .001 cap
- 103j : .01 cap
- 104j : .1 cap
- 223j : .022 cap (.022 replaces the .02)

Electrolytic capacitors :

NOTE :electrolytic caps must be aligned properly. there is a 'positive' and a 'negative' lead. on the pcb , the positive side is marked with a plus '+' symbol. electrolytic caps can explode if placed in reverse.



The pcb uses 6 electrolytic capacitors :

- c5 : 10uf @450v (axial mount)
- c7a : 47uf @450v (radial mount)
- c7b : 47uf @450v (radial mount)
- c7c : 22uf@450v (radial mount)
- c7d : 22uf@450v (radial mount)
- c10 : 47uf@25v (axial mount)

(The foot print for c7c and c7d are marked 33uf , but I have had great results by replacing them with 22uf caps. both will work fine.)



NOTE : the electrolytic cap has an arrow and 'minus' symbol to denote that the lead on that side of the radial cap is NEGATIVE.



C5 :

The c5 capacitor (10 uF@450v) plays an important part in the signal path. It is the last stop before the audio hits the output transformer.

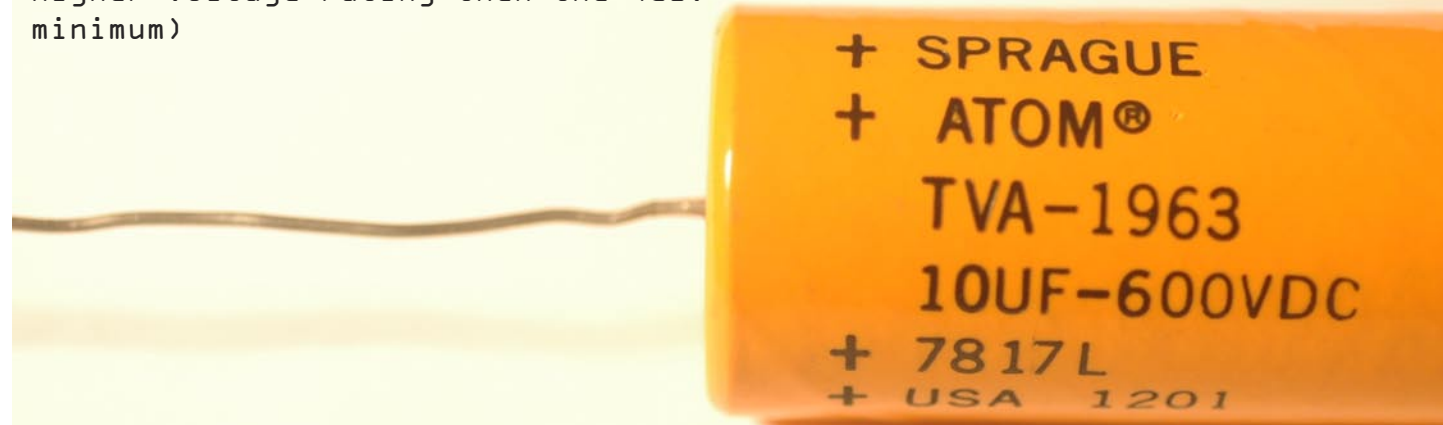
Interestingly enough, this cap can have a subtle effect on the audio. However small, it is enough to be heard.

For the most part I would recommend the CDE mallory TC72 cap as pictured above.

It has a slightly dark feel to it and is very smooth sounding.

Most of these caps are relatively inexpensive, so I would encourage you to experiment with different brands.

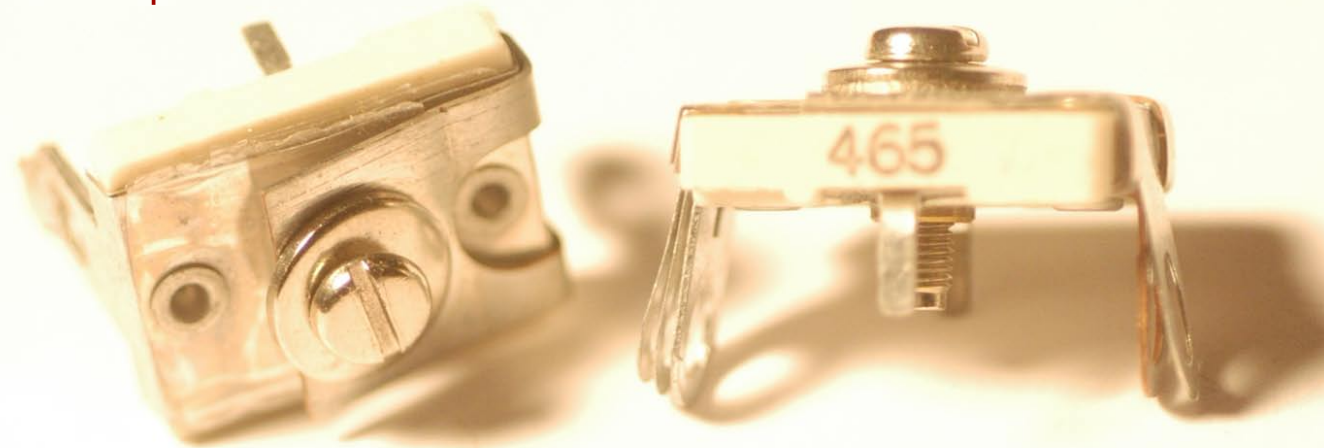
(For c5 you can use capacitors with a higher voltage rating than the 450v minimum)



+ SPRAGUE
+ ATOM®
TVA-1963
10UF-600VDC
+ 7817L
+ USA 1201

NOTE : it is important to elevate some of the capacitors giving them space between their body and the pcb. especially the capacitors that cross over the heater traces on the top side of the board. hum or noise could possibly be introduced by these capacitors if they rest upon these traces. adding extra height to the caps can give an extra level of security (aprox 1/8" to 1/4") The use of heat shrink tubing on longer capacitor spans will also help with insulating the leads from short circuits and accidental shocks.

Variable capacitors :

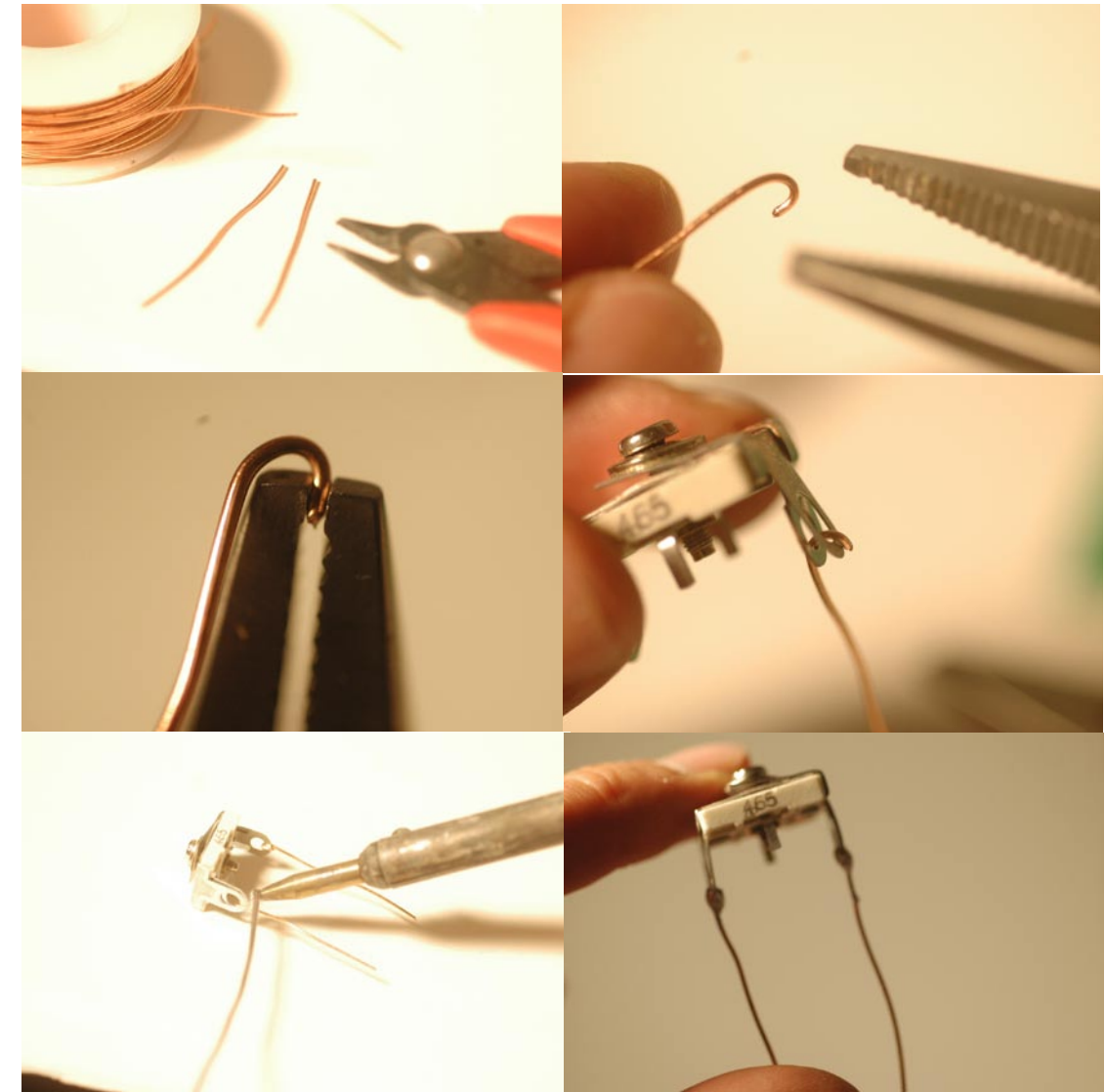


The original caps for c4 and c14 are the arco 465 variable mica trimming capacitors rated at 175 volts and are adjustable from 75pf to 380 pf.

You can use a fixed value cap in place of using the arco's.
150 pf ceramic for c4 (rated for 300v)
300 pf ceramic for c14 (rated for 300v)
(Using fixed values can help for the tuning of stereo linked units)

C4 is used to adjust the frequency response of the compressor.
A higher capacitance makes for a brighter response.
The original units all seem to land around 120-150 pf.
It is best to use a digital multi meter to measure and set the Capacitance before adding leads and soldering it to the pcb.
using a small screwdriver dial in the wanted capacitance while observing the multimeter, the tighter the screw , the more capacitance.

(In most cases just use an arco for c4
and use a fixed cap for c14)

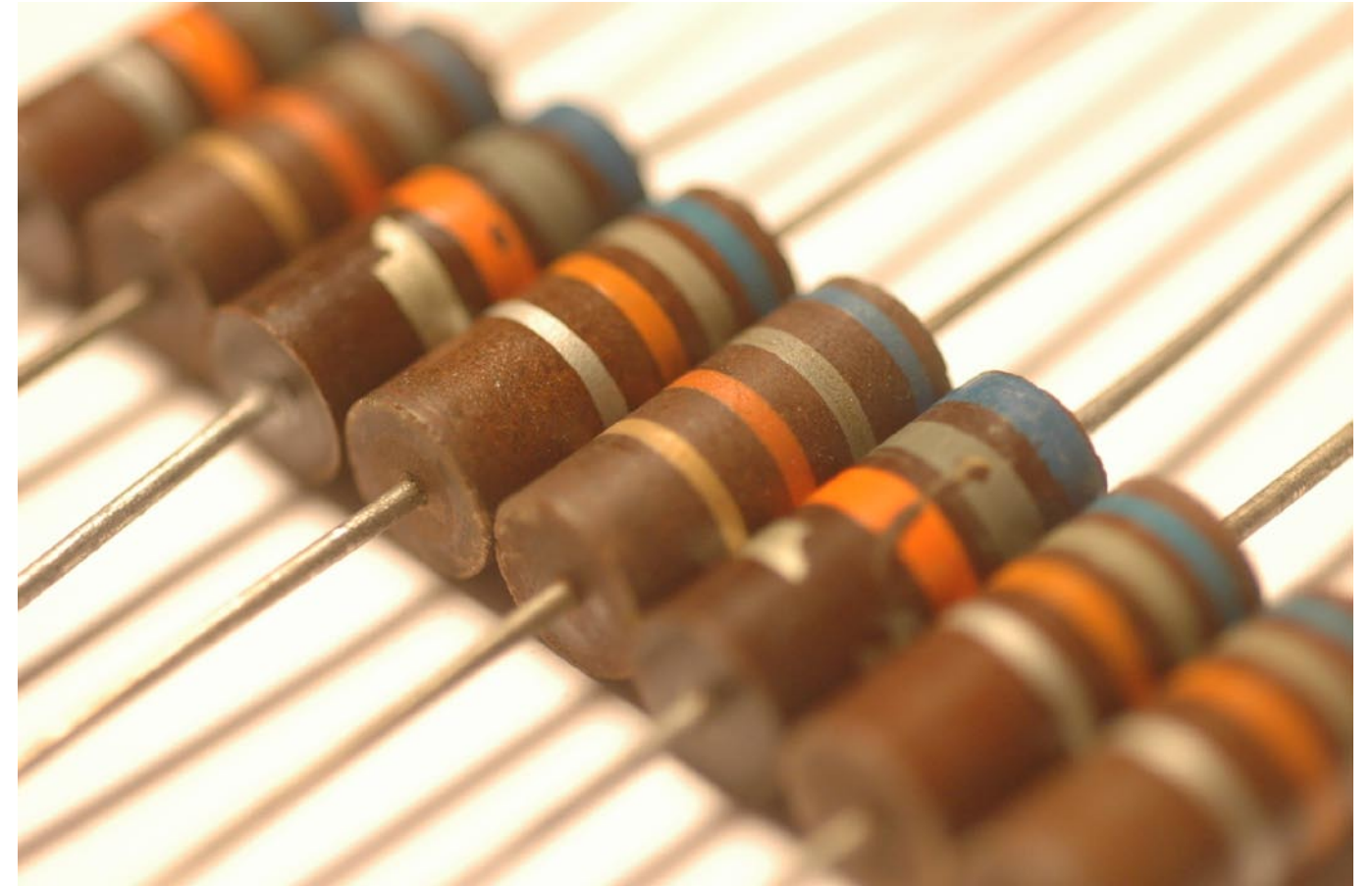


Once the cap has been adjusted for value , you will need to add leads to it for mounting onto the pcb.
Using 24-20 gauge wire simply cut two pieces to a 1" length and solder to each leg of the arco.





parts|resistors|info



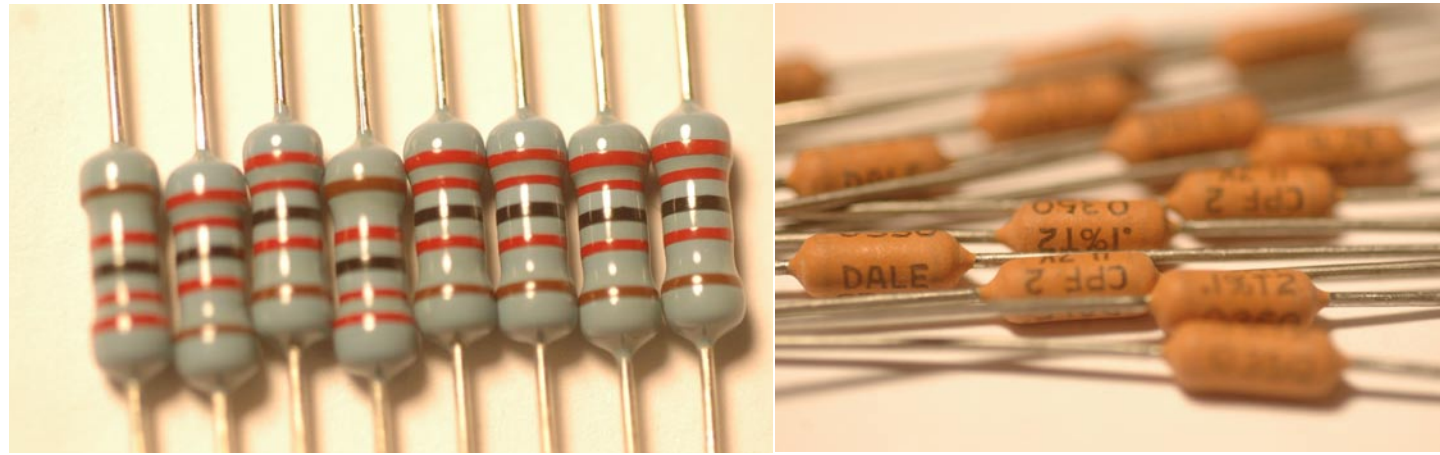
The original resistors in a vintage unit are carbon composition allen bradley 1/2 watt +/- 10-20%. Carbon comp resistors are believed to have a 'warmer' sound than metal film resistors. Yet often at a price of more noise and less reliability, there are alternatives to consider in your selection, a company called ohmite has a new carbon comp resistor brand called 'Little Demon'.

As for metal film resistors, some brands are state of the art with tolerances down to '0.01%'. Metal resistors are quiet, accurate and reliable. The sound of metal film resistors can be more preferred than carbon. The capacitors and transformers can make up for any short falls of that 'metal sound'.

Avoid metal oxide resistors for anything but the power distribution resistors, (the resistors that 'feed' off of the main power rail).

r29(2watt)/r33/r35/r34(2watt)/r16/r28/r17

Often I use 1-2 watt resistors for these sections.



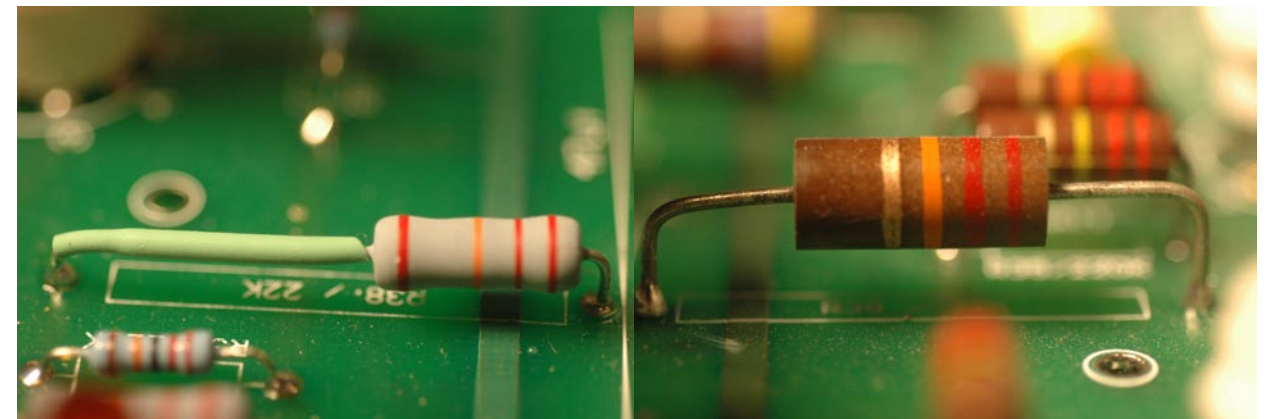
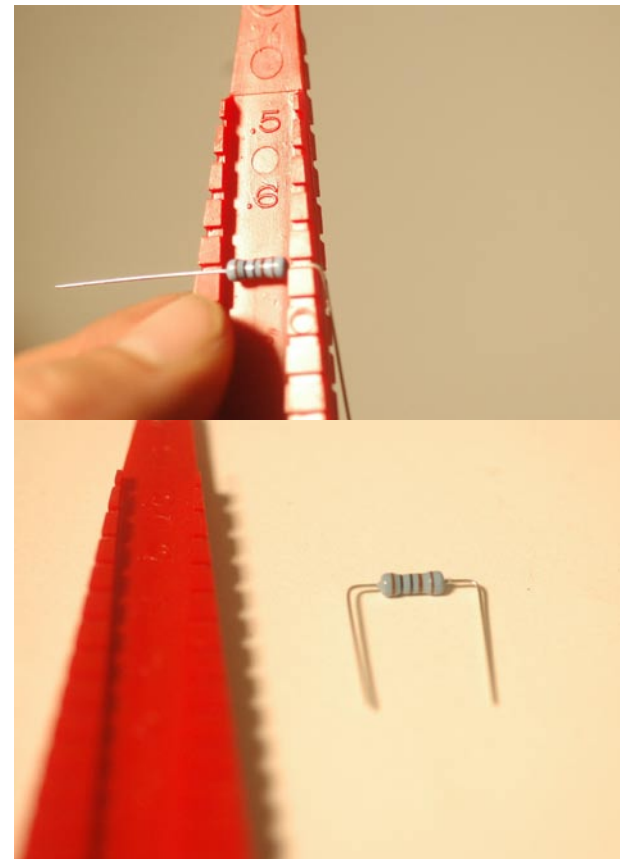
Most all the resistors that you use will be 1/2 watt except for r29 4.7k and r34 22k these will be 2 watt resistors (metal oxide).

In different camps of thought , some say higher wattage resistors have less noise , feel free to experiment with this.

NOTE :DO NOT USE 1/4 watt resistors!
however tempting this might be .
the voltage in some places on the
circuit near or overlap the operating
range of them.

NOTE : it is important to elevate some of the resistors
giving them space between their body and the pcb.
Especially the resistors that cross over the heater
traces on the top side of the board.
hum or noise could possibly be introduced by these
resistors if they rest upon these traces.
Adding extra height to the resistors can give an extra
level of security (aprox 1/8" to 1/4")
The use of heat shrink tubing on longer resistor spans
will also help with insulating the resistor leads
from short circuits and accidental shocks.

Installing the resistors is easy ,
I recommend a resistor bending
tool, this will speed up the process
and keep the resistors looking neat and
straight.
Most of the resistor bends will all be
the same size.





jumps :

there are 2 jumps on the board , with these you will simply bend a piece of 24 GA wire like a resistor and solder them into position.

a standard 0.7" jumper will work also.

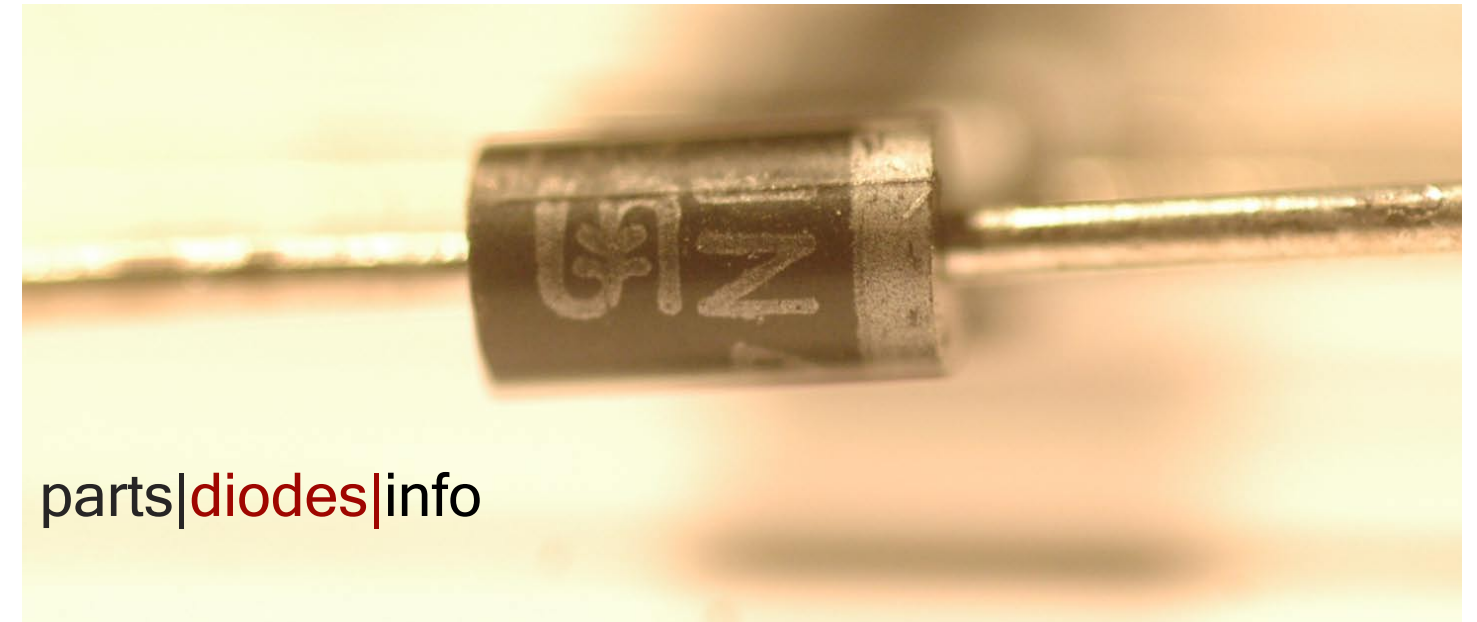
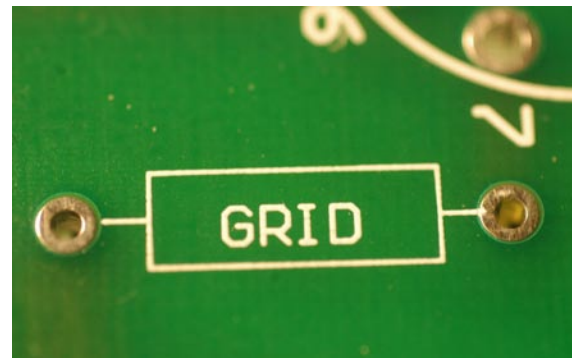
Grid resistors :

Near the 12bh7a tube socket you will find 2 resistor footprints marked 'GRID'

On point to point units people often encounter oscillations when using sower transformers. Normally a 1k resistor would be used in these positions. However , they were only added as a precaution.

I have built many using both with and without and found no noticeable impact on the performance.

On the modern units only the pin#2 of the 12bh7a uses this grid resistor. DIY models often use another grid on 12bh7 pin 7.



parts|diodes|info

NOTE : the diodes are one way devices , they must be placed in the proper direction or damage to other components may occur. Diodes are very sensitive to electrostatic charges.

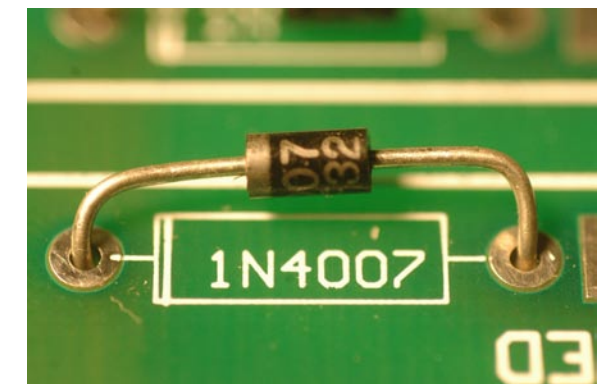
The circuit uses standard 1n4007 diodes , they are rated for 1A @ 1000V . These diodes are of a economical _ grade. They can be replaced with 'fast recovery epitaxial diodes' , also known as FRED's.

"The effect is, that you get all the punch, smooth and equally brilliant top end, better responsiveness that you would get with fully tube-featured rectifier "

(It is important to remember when using FREDs that the metal plate on back is also a cathode, it is best to encase the fred in some large heat shrink tubing once installed to avoid shorts)

The cathode on a 1N4007 is designated by a white band on the diode body, This line must be aligned with the foot print on the pcb.

Illustrated here is the footprint on the pcb , notice the extra line



NOTE : when powered ,some of the highest voltages and amps occur at this area on the pcb.



parts|potentiometers|info



The original compressor used mil spec 2 watt carbon pots (allen bradley). for this project you will use 2) 100k ohm taper (logarithmic) pots , 1 for gain and the other for gain reduction.

NOTE : it is ok to use linear taper pots for the gain and reduction control , they will be much quicker in their response meaning the gain and reduction will be a bit sensitive or touchy. (1/4 watt pots seem to work here also instead of 2 watt rated)

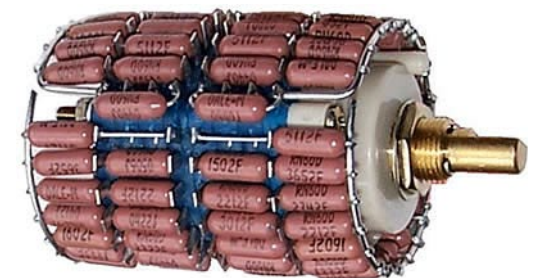
You will also use 3) 1 meg ohm linear taper pots for the following :
Stereo adjust/ limiter response / zero adjust

There are many brands of pots from the modern conductive plastic, wire wound , and the carbon variety. You can also use Vishay pcb mount Spectrol Potentiometers for the stereo adjust and limiter response pots , the pads for these two match the pin out of the spectrols. (use only for mono units because You will need access to them for stereo operation)

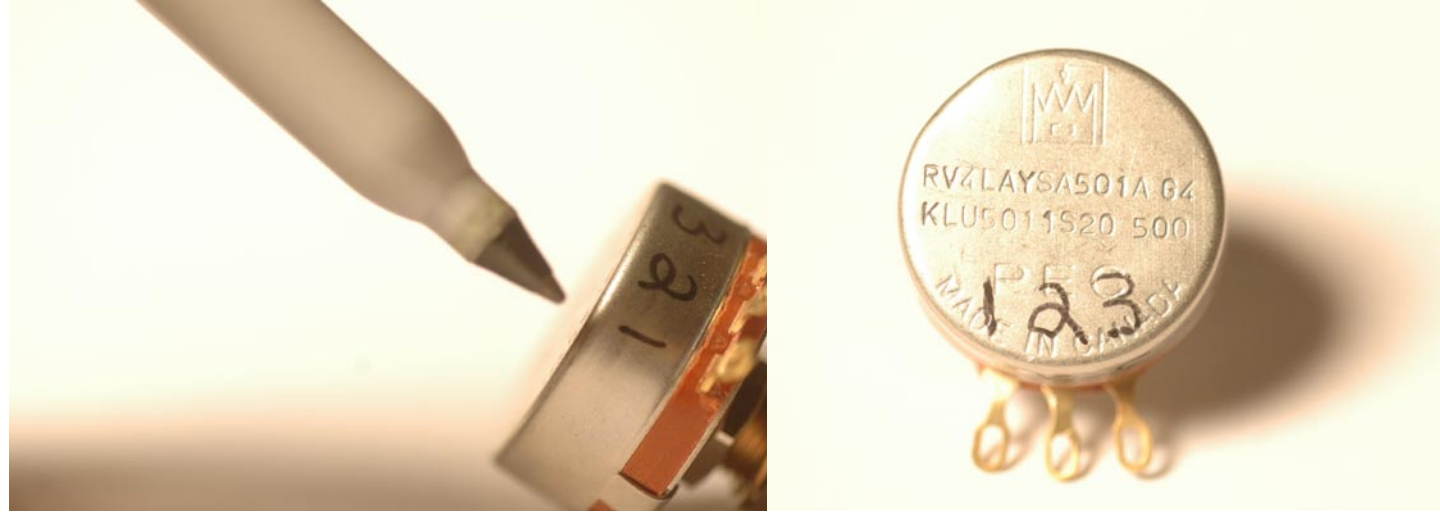
The 100k pots are a very important part of the signal path. For they pass audio to the amplifier section and to the gain reduction circuit. It would be better to spend money on good 100k pots and use cheaper Choices on the 1 meg ohm pots.

The pec carbon are of very good quality and are used on the modern compressor. Alphas may seem very cheap , but are tried and true . Lots of people prefer the tone and feel of these underdogs. Conductive plastic like the Alps 'blue velvet' can be a vast improvement to your unit, audiophiles stand by these pots for their silky sound and perfect glide.

For the super upgrade, you can use a 'stepped attenuator', often these are the holy grail of volume control. Using individual resistors for each step in audio volume. For the most part these can achieve the highest level of transparency in the signal path.



parts|potentiometers|hookup

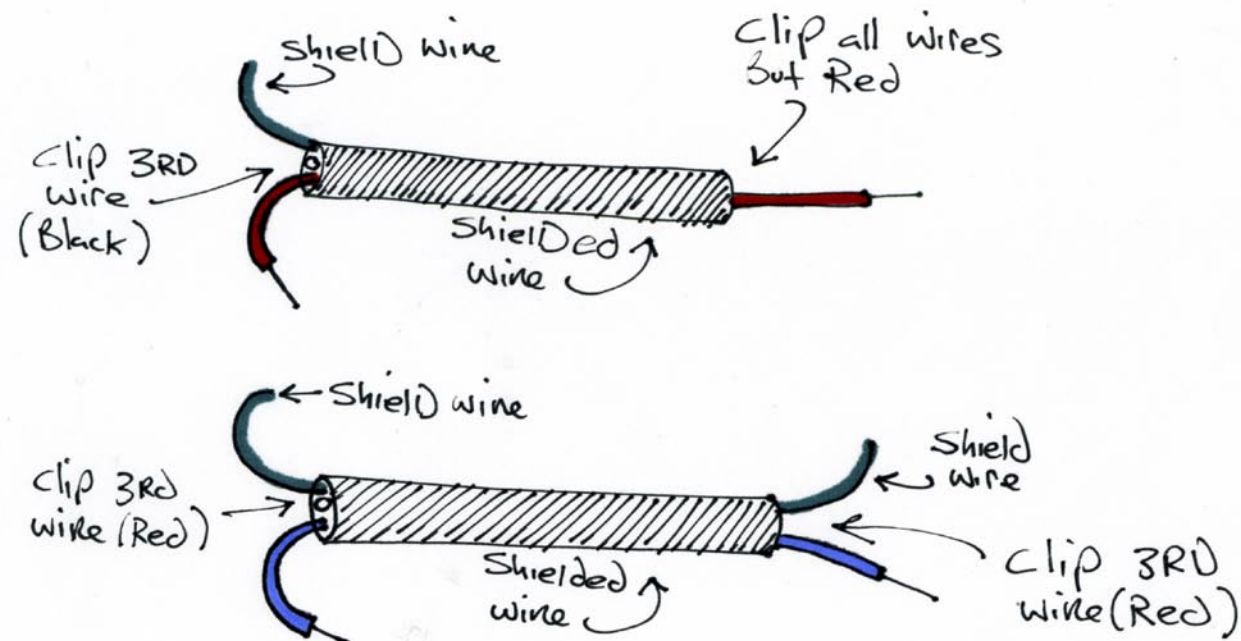


for most pots , any easy method is to use a marker and label them as pictured above.

looking at the back of the pot , usually the pin on the left will be pin '1' the middle pin of the pot will always be pin 2 also known as 'the wiper' . pin 3 will be on the right.

NOTE : if your gain control or reduction works in reverse, you will need to reverse the pin 1 and pin 3.

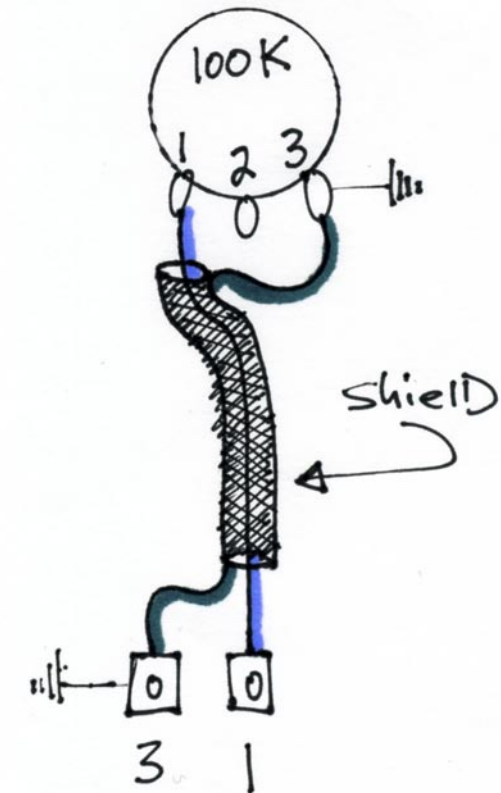
for the gain and reduction pots you will need a pair of shielded wires cut in the configuration as shown in the illustration, clipping the unused wires.



gain potentiometer (100k)

here is an illustration of how the gain pot is hooked up .

- 1.)solder the shield wire to pin 3 on the pot .
- 2.)now connect the other end of the shield wire to the pcb 'gain' pad #3 (wich is a ground)
- 3.)solder the next lead to pot pin#1 .
- 4.)solder the other end to pcb 'gain' pad#1



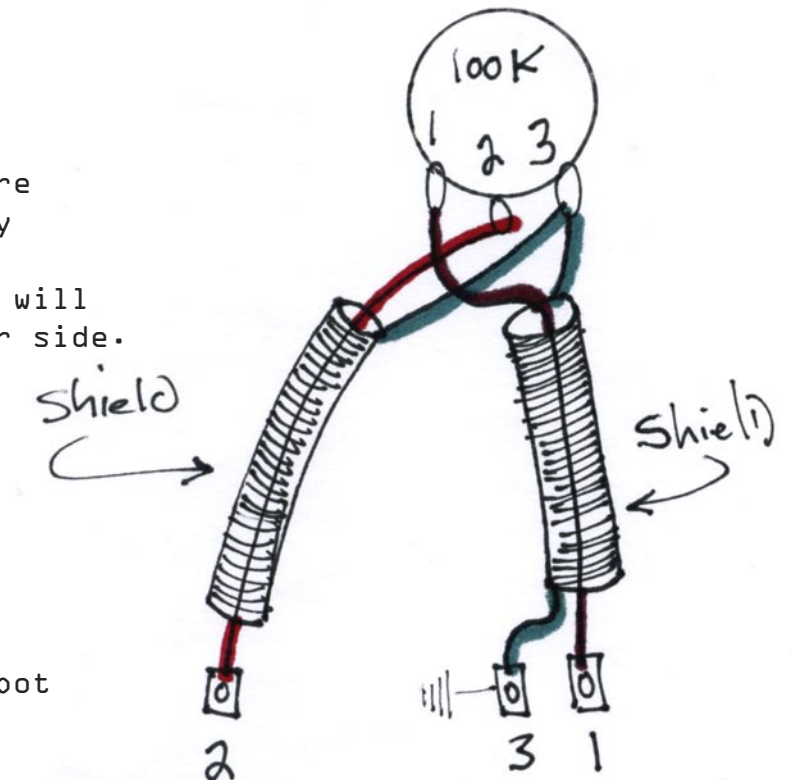
step #2

using a piece of shielded cable strip both ends of the cable , on one side cut both the shield wire and one of the leads , leaving only one wire (shown as red here). on the other side of the cable you will also cut the same lead on the other side.

solder that solo wire to pcb pad 'gain #2' located next to the 12ax7#1 tube socket.

solder the other end of that lead to the pot pin #2

now solder the shield wire to the pot pin#3.

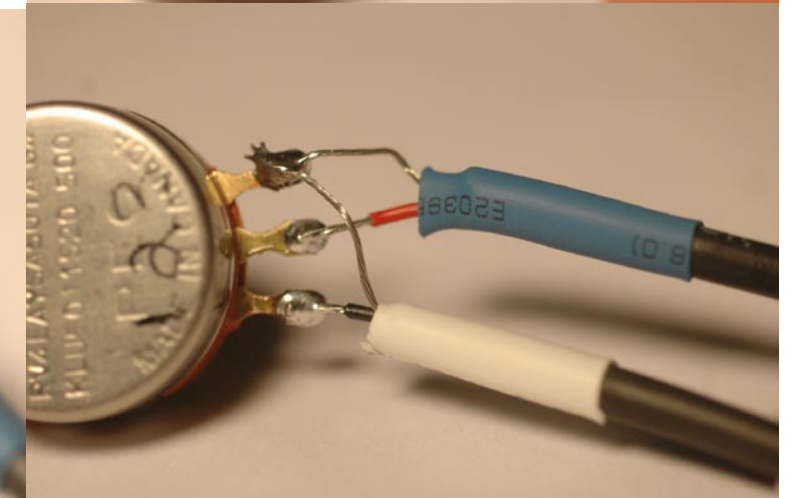
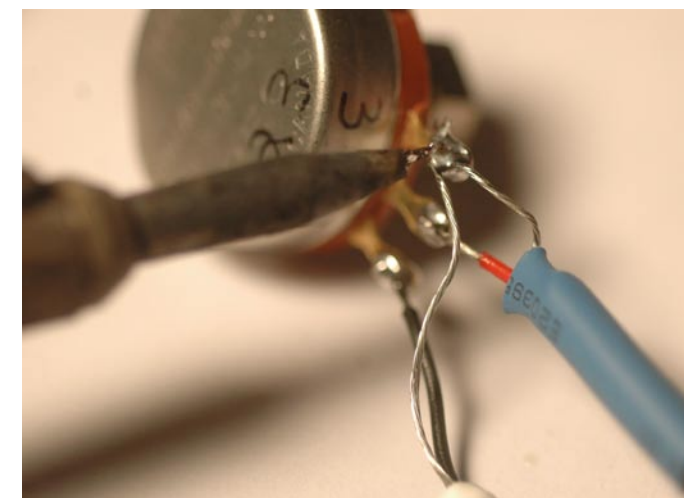
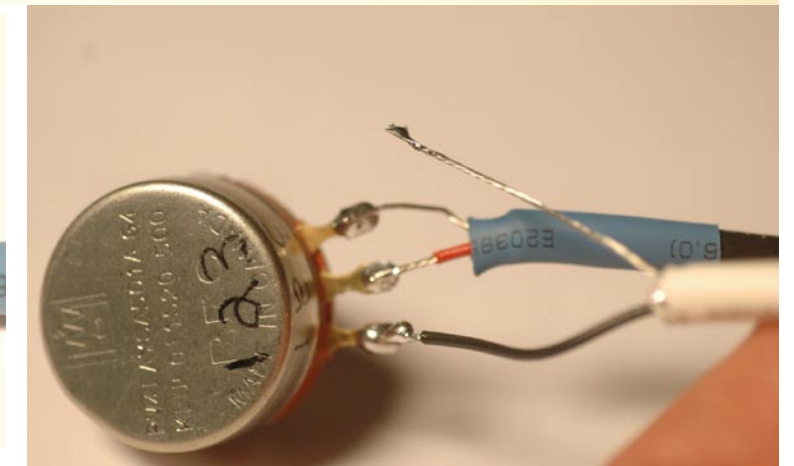
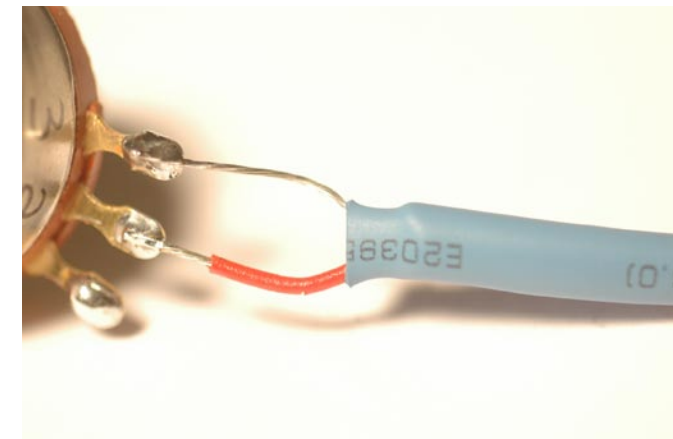
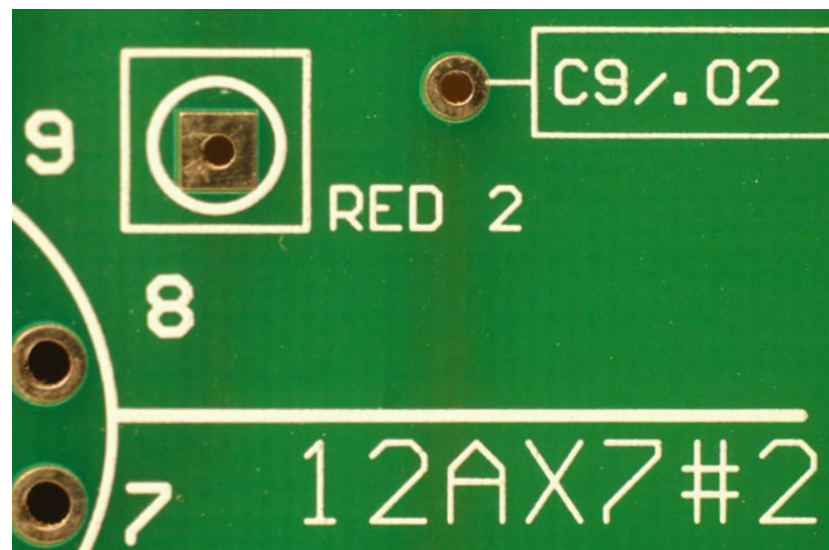
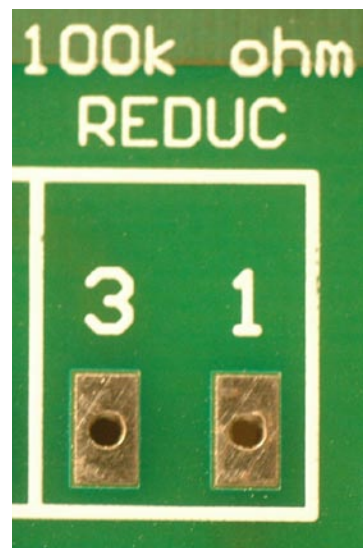
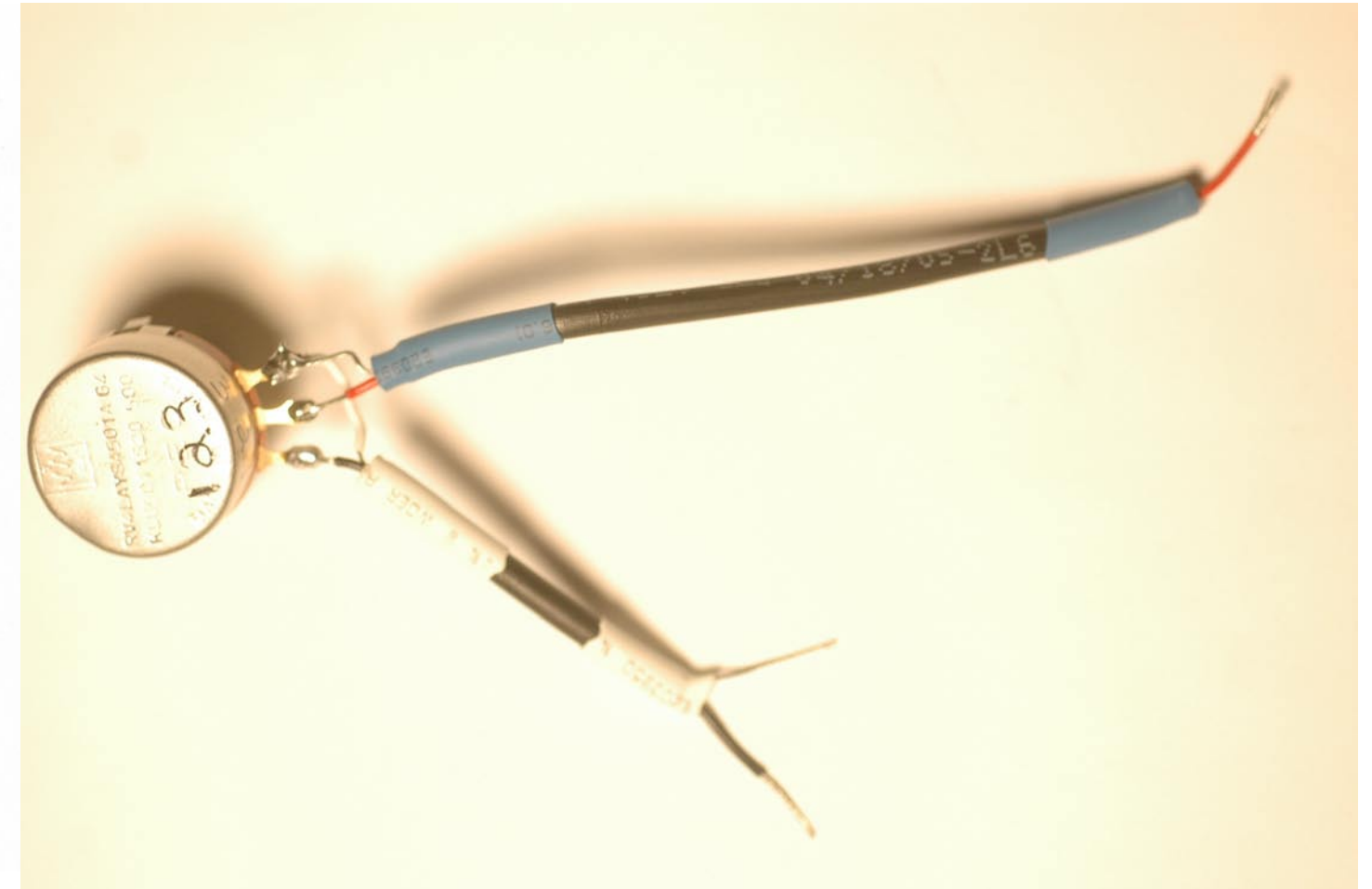
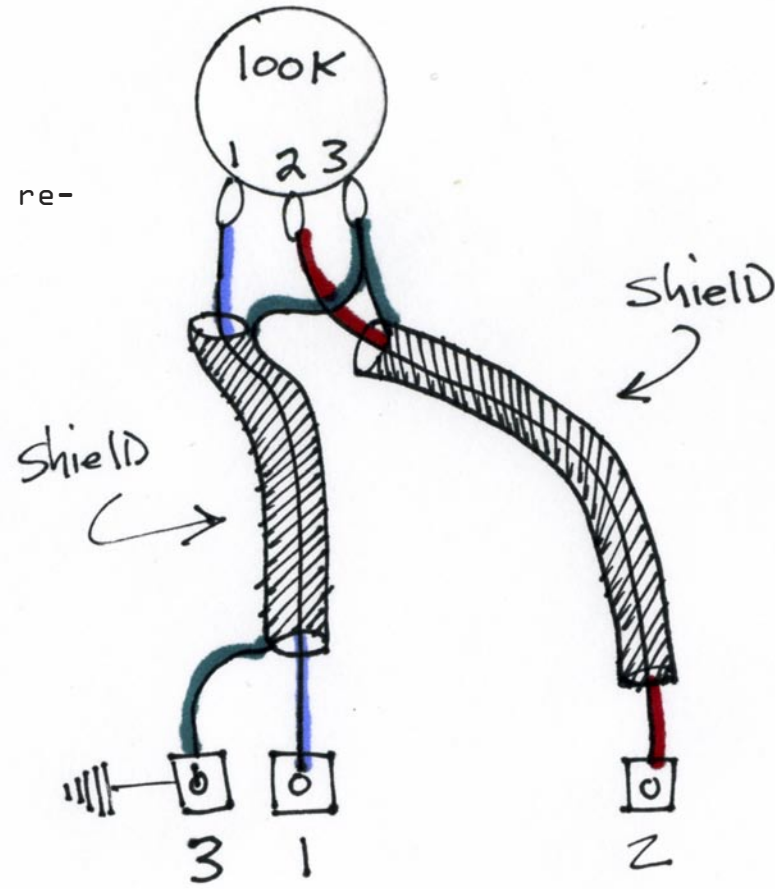


reduction potentiometer (100k)

connect to pcb pads marked '100k ohm reduce'

here is an illustration of how the reduction pot is hooked up .

it is connected in the same manner as the gain pot.
once again the connection to pcb pad#2 is using a piece of shielded wire only connected on one side.
reduction pad 2 is located near the 12ax7#2 socket marked as 'reduc 2'



limiter response / stereo adjust potentiometers (1meg)

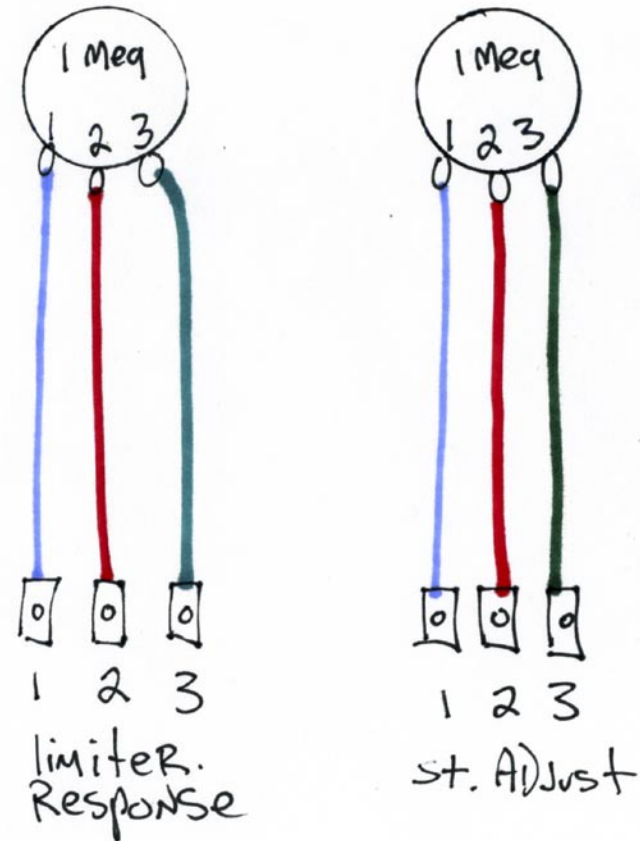
connection of these pots is pretty straight forward.

you will hook them up as illustrated here.

you can use shielded wire for this connection .

there is a lone pad above the limiter response foot print that is a ground for the shield wire.

you will only connect the shield on one side , clipping the other side.

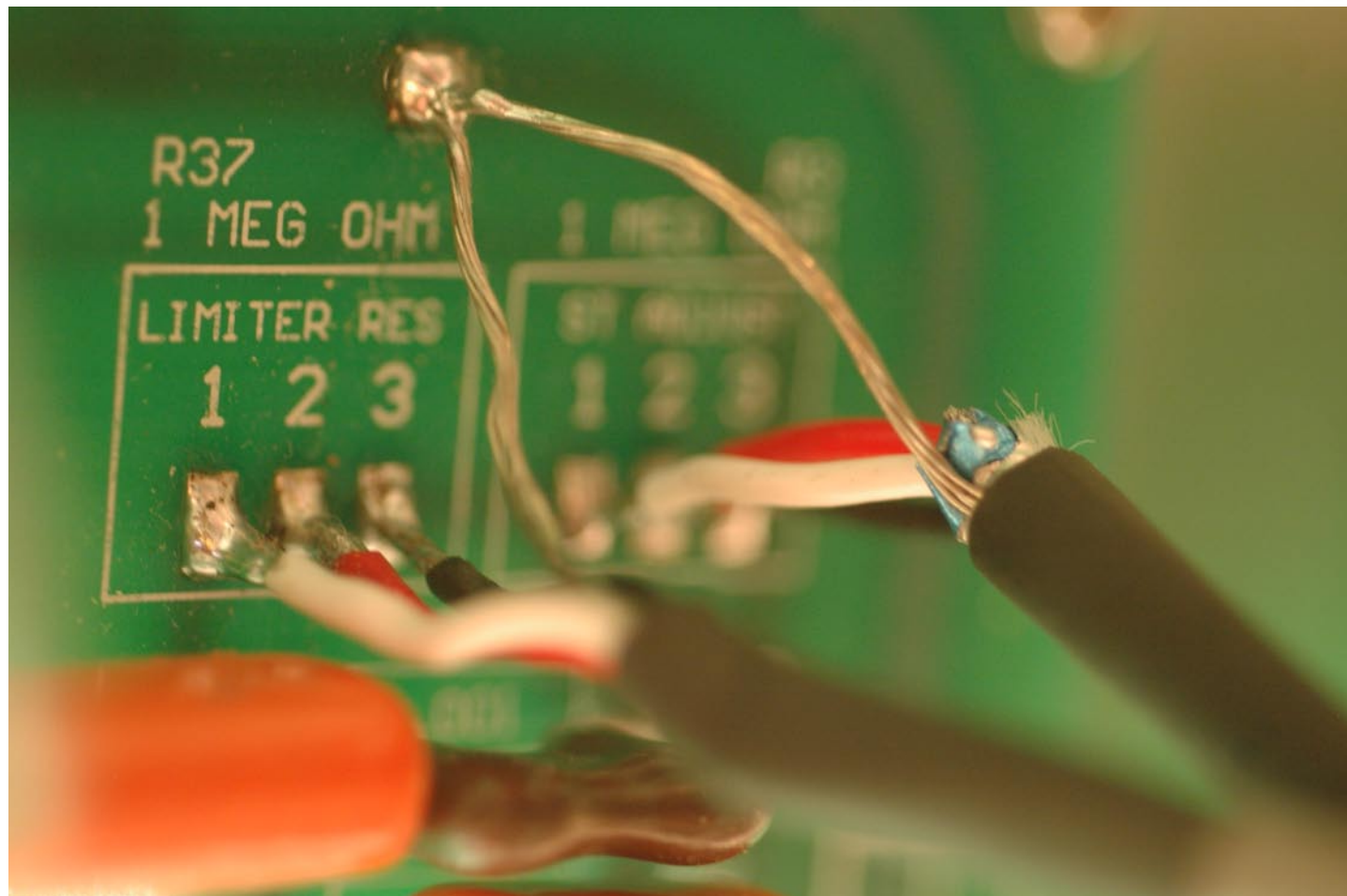


zero adjust potentiometer (1meg)

another straight forward pot , most layouts include this pot on the front panel of the unit.

shielded wire is not needed.

connect as illustrated.





parts|tube|info



The compressor uses 4 vacuum tubes :

- 2) 12ax7a High-Mu Twin Triode
- 1) 12bh7a Medium-Mu Twin Triode
- 1) 6aq5a Beam Power Pentode

There are many brands of tubes to choose from , new old stock (nos) and also newly manufactured brands. The compressor works well with just standard issue tubes of no fancy nature.

Yet as with so many things you can explore the highly prized vintage tubes like telefunken,rca,and amperex.

Tubes do have a 'sound' to them and you can experiment with Different tubes in the gain section (12ax7#1 and 12bh7a) as with the capacitors you can also reserve the more expensive tubes for this area , and use the more affordable tubes for the reduction circuit (6aq5a and 12ax7#2)

The 6aq5a is the only tube that is not currently manufactured, but there seems to be no shortage on the supply of them.

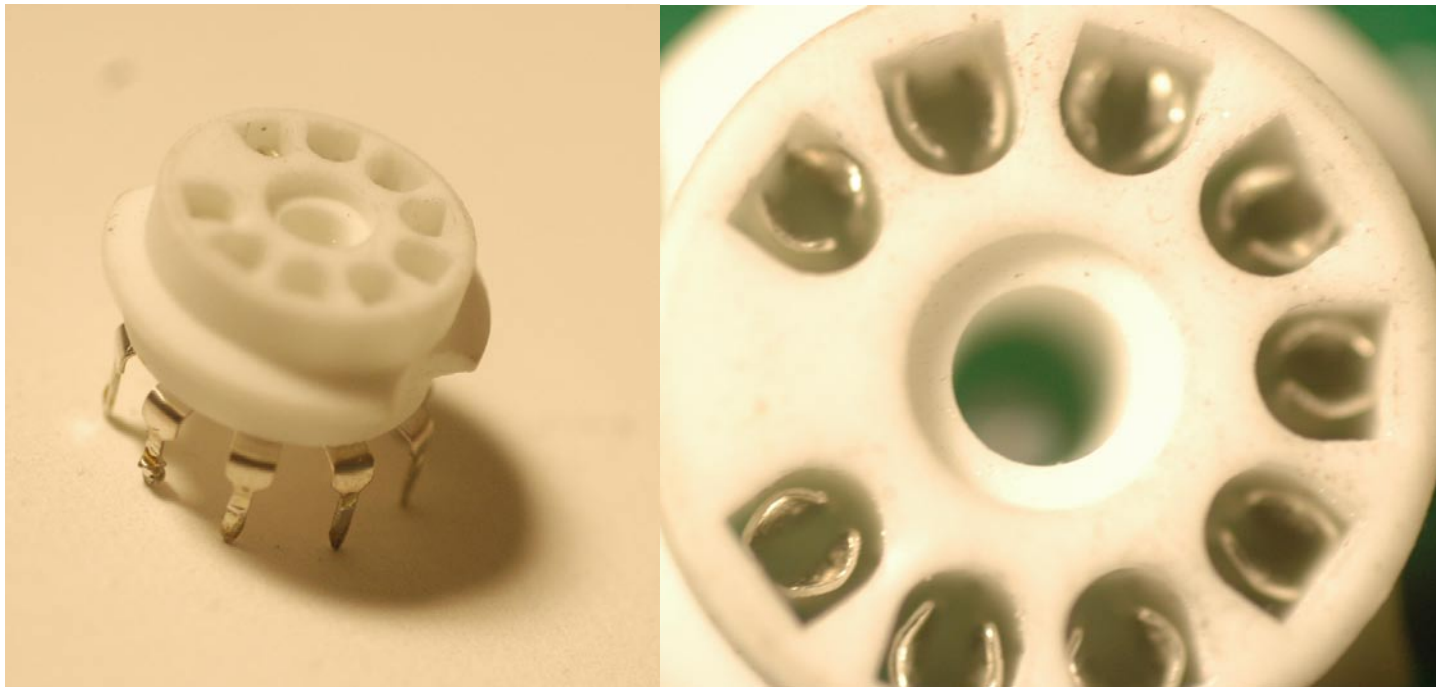
When you purchase your tubes it is important to have them tested. (I've dismantled a unit to pieces trying to find the source of hum and oscillations , only to find that it was a bad tube)

parts|tube.socket|info

The tube sockets are a very important part of the project.
Try to use hi quality ceramic pcb mount sockets.
molded plastic will work , but often have poor contact
with the tubes.
Sometimes compressing the metal contact in the socket itself
will help insure a good connection.

You will need three 9 pin sockets (12ax7 size)

And one 7 pin miniature socket (6aq5a size)



TRANSFORMER
SPECS :

Input primary impedance : 600 ohm
Secondary impedance : 50k split
Frequency response : 20-20khz
max. mW : 30
max Dbm : +15

output primary impedance : 15k ohm
split
secondary impedance: 600 ohm
frequency response : 20-40 kHz
max dBm : +15
max mW : 30

(split winding is not required)



parts|transformers|info

Audio input and output transformers :

The pcb was designed to use pcb mount sowter input and output Transformers.

The board is also marked for the use of leaded type sowters.

For pcb mount use :

Input part # : 4383 C

Output part# : 8940 B

These transformers are state of the art and at the same time have a very close sound to the vintage utc transformers. Their shielding is outstanding and has allowed for a more compact layout.

By having the transformers pcb mount a higher level of consistency and reliability can be achieved.(many complications in building The ver1 pcb happened in this area.)

In comparison to the utc transformers , the sowters sound ever so similar , the utc's have a subtle darker feel to them .

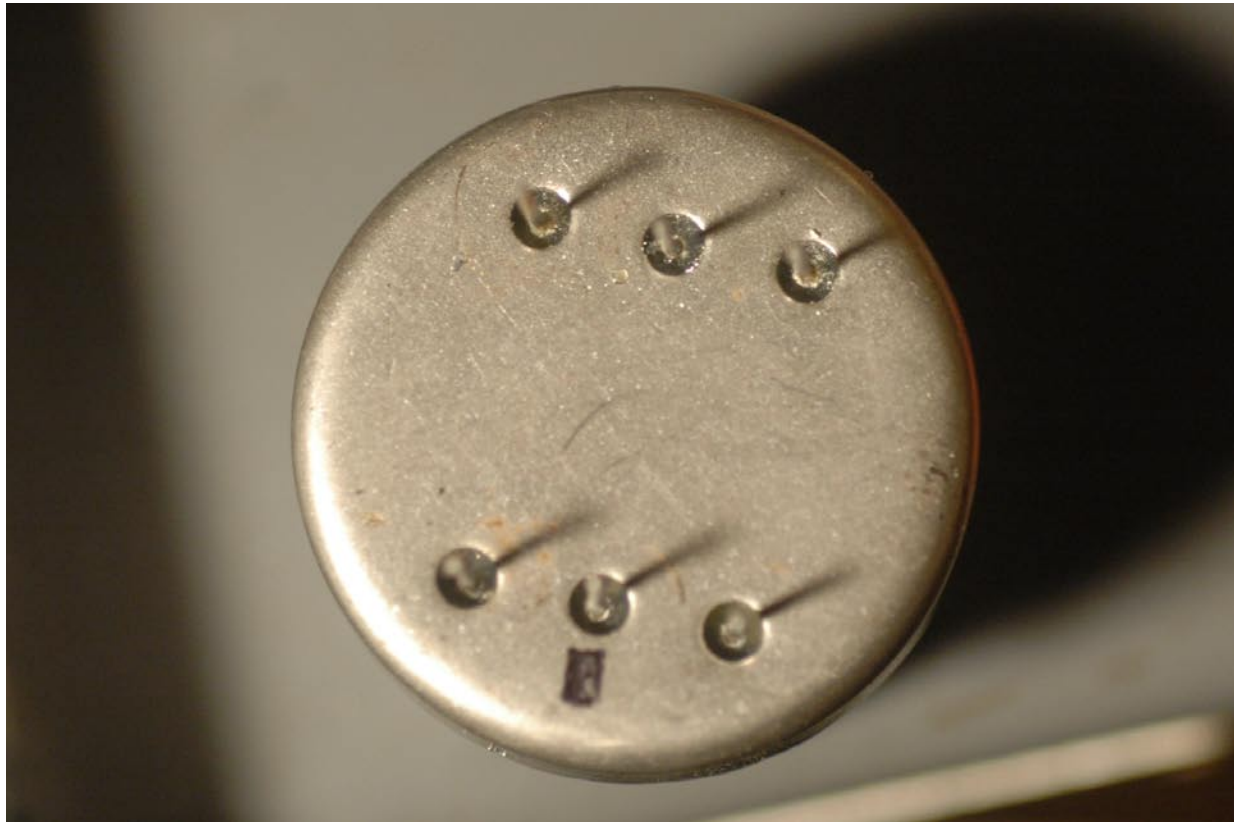
Most all transformers will work with this board including the UTC ha-100x or a-10 input transformers and the a-24 output transformer.

You can use leaded transformers as well , adding an extra level of shielding by mounting out side the case.

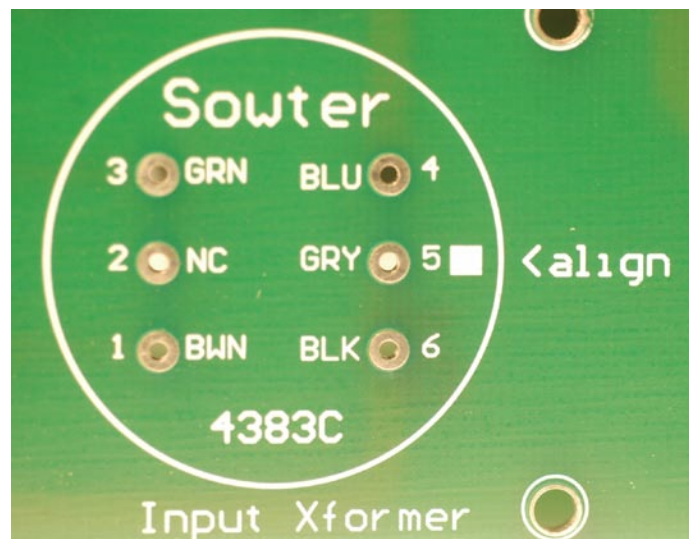


parts|transformers|hook.up

Audio input and output transformers :



when installing the input transformer , you will need to take note of a small mark that the company has placed near one of the middle pins , it is important to align this side with the corresponding mark on the footprint of the pcb 'align'.



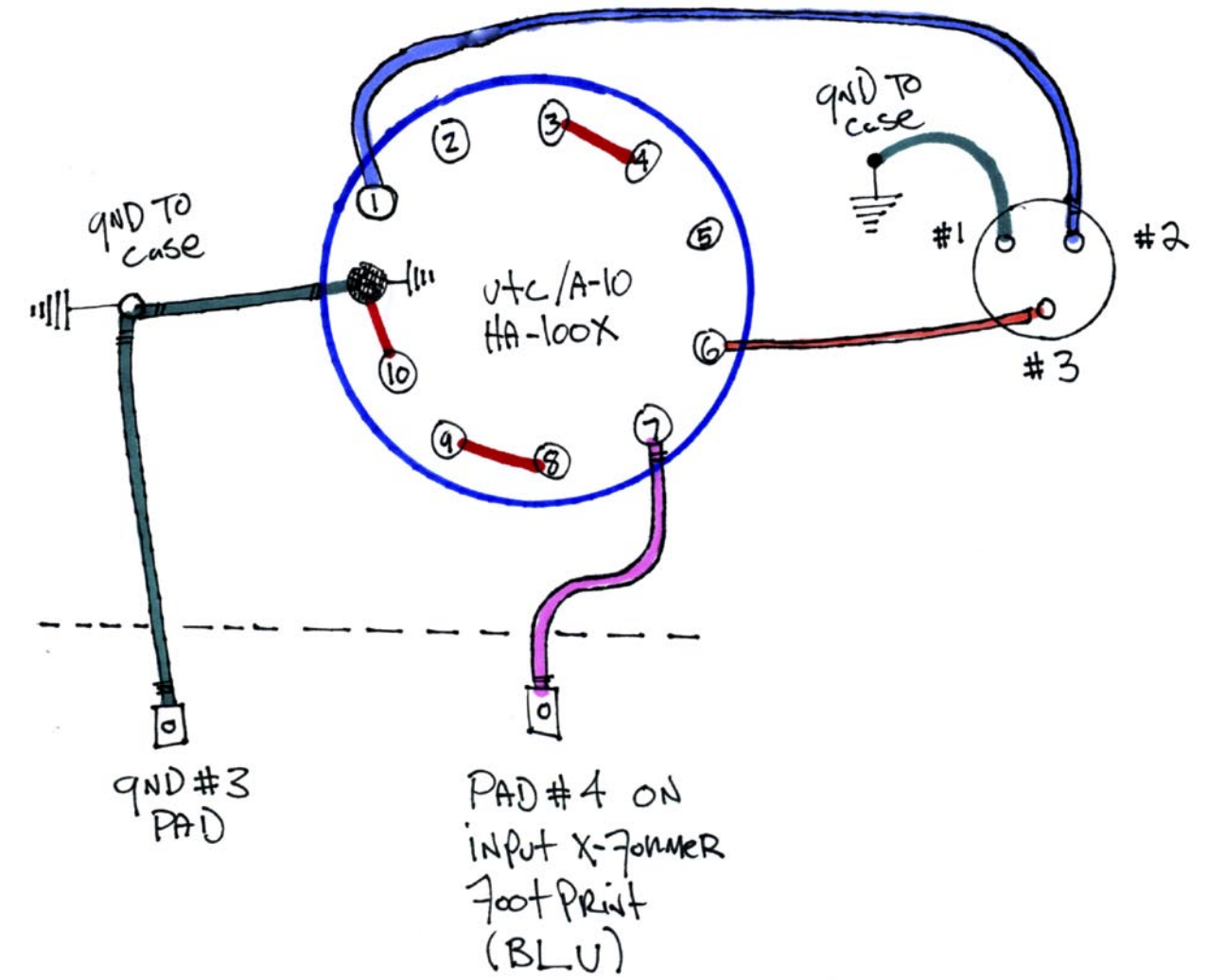
it is important to elevate the input transformer at least a 1/16 or 1/8 of an inch off the board , this will prevent the pads on the pcb from shorting out on the case of the x-former.

when soldering , be careful as not to apply too much solder because it can travel through the pad and puddle up at the base of the pin on the other side and possibly short the pin to the transformer case.

the output transformer will only fit in the correct position . simply place and solder into place.



if using leaded sowter transformers , just match the wires to the corresponding color marked on the pcb footprint for both.



utc a-10 or ha-100x hook up

once you have mounted the transformer to the case , use the above diagram to hook the transformer to the pcb.

you will not use the xlr pads on the pcb , and instead just directly wire the input xlr socket to the transformer. I have had good luck with using the hax ground as a good place to ground pin #3 on the xlr socket. traditionally the input xlr is grounded seperatly to the case.

it is important to also solder the bridges between the trans former pins as shown in red.

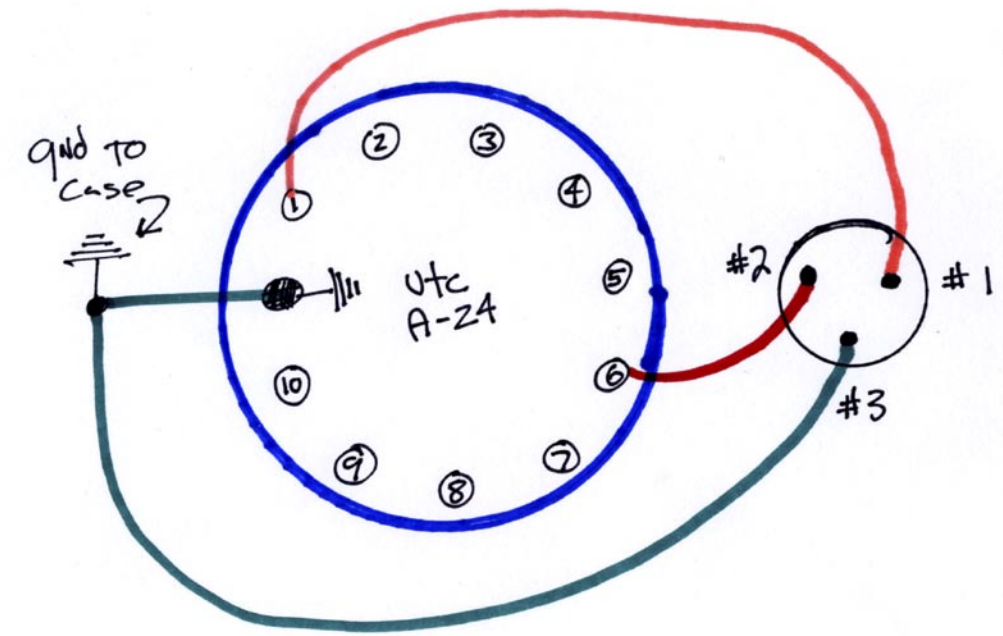
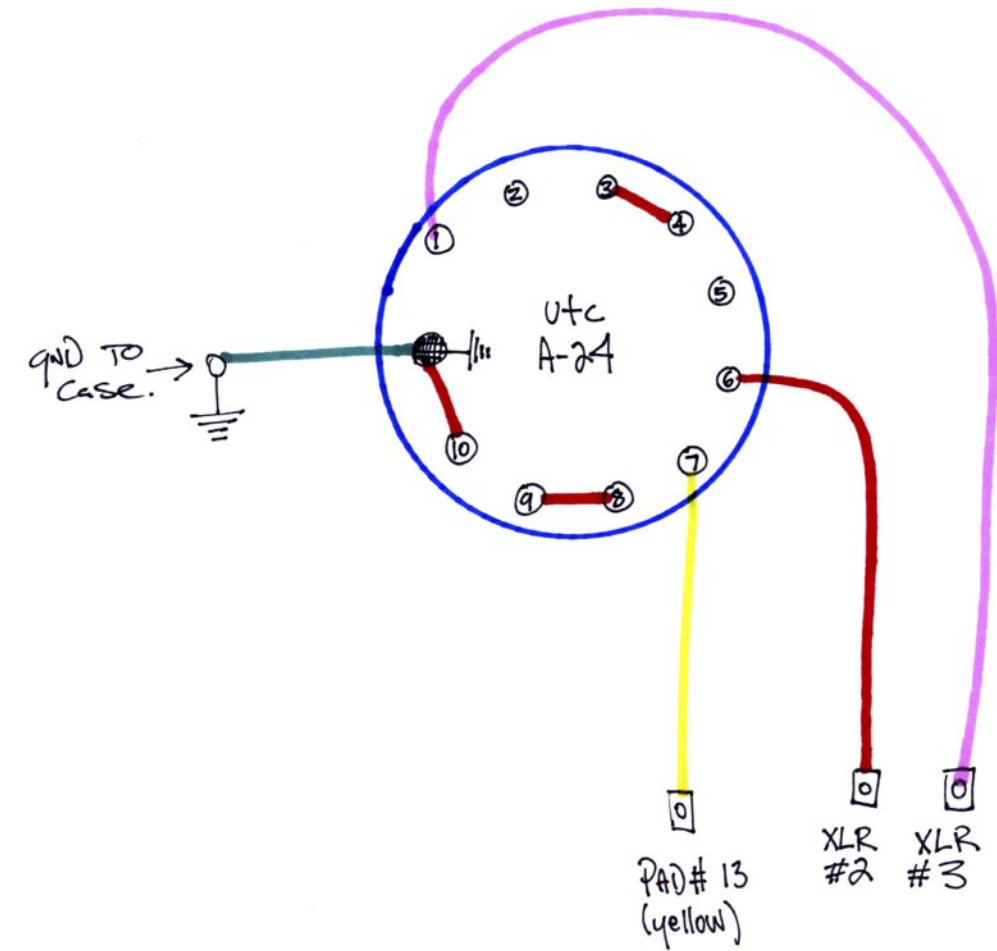
utc a-24

the a-24 input transformer installation is shown in the illustrations .
it is important to solder bridges as shown in red on the top illustration.

pad# 13 is located on the pcb footprint for the output transformer.

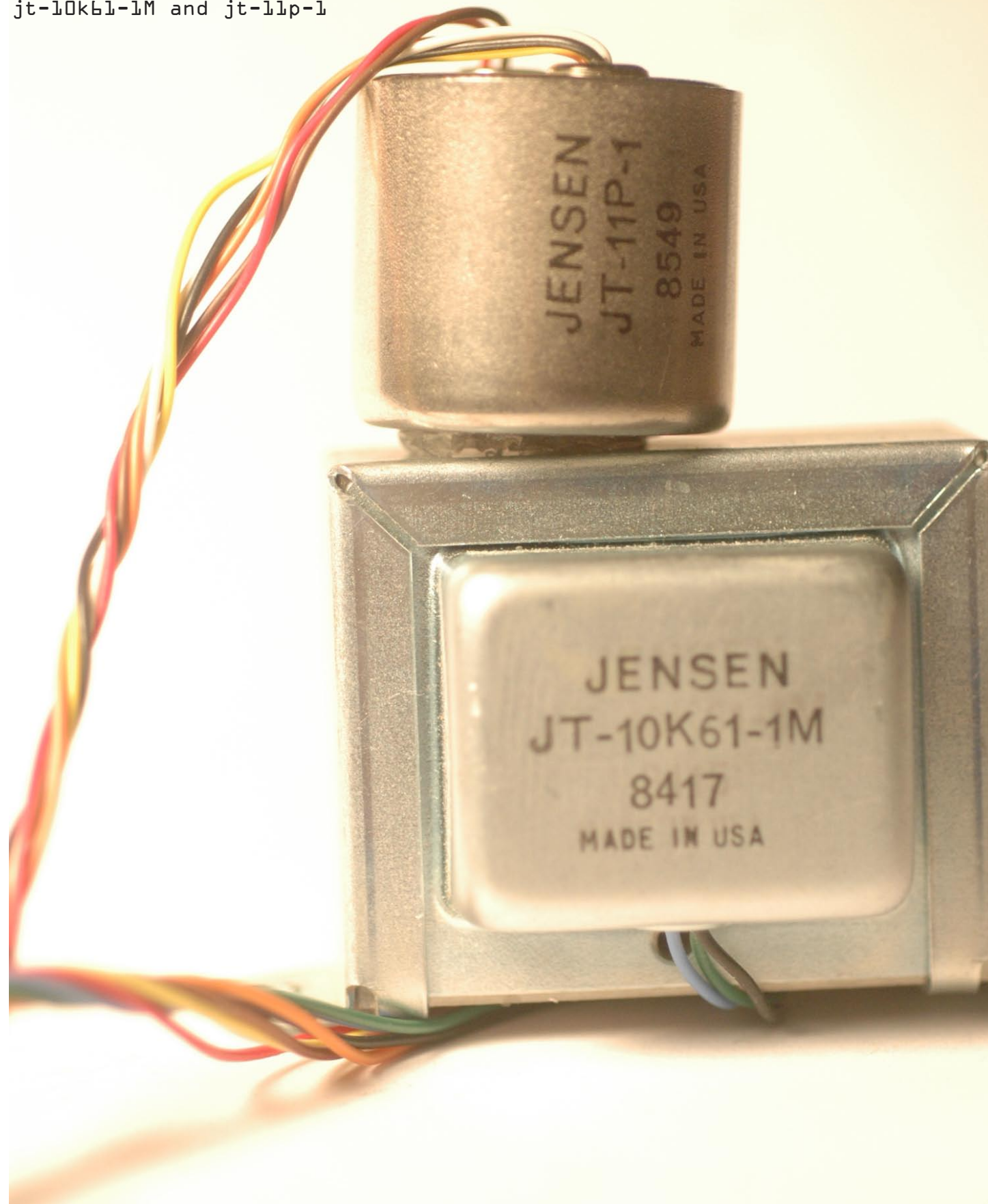
you will also connect the xlr socket directly to the transformer using the bottom diagram.
the connections to the xlr output pads are only for the metering section.

as for the xlr pin#3 (gnd) I have had great luck in grounding it to the ground located next to the a-24.
(as shown in the illustration)



For jensen transformers
use part numbers :

jt-10k61-1M and jt-11p-1



parts|[vu.meter](#)|info

It is often asked 'who would use anything other than their ears when using the compressor to control the gain and reduction?'

It is possible to use an off the shelf economy model VU meter, but the compressor is hyper finicky about the vu meters it likes.

A brand called SIFAM makes modern vintage looking meters with true VU standards.

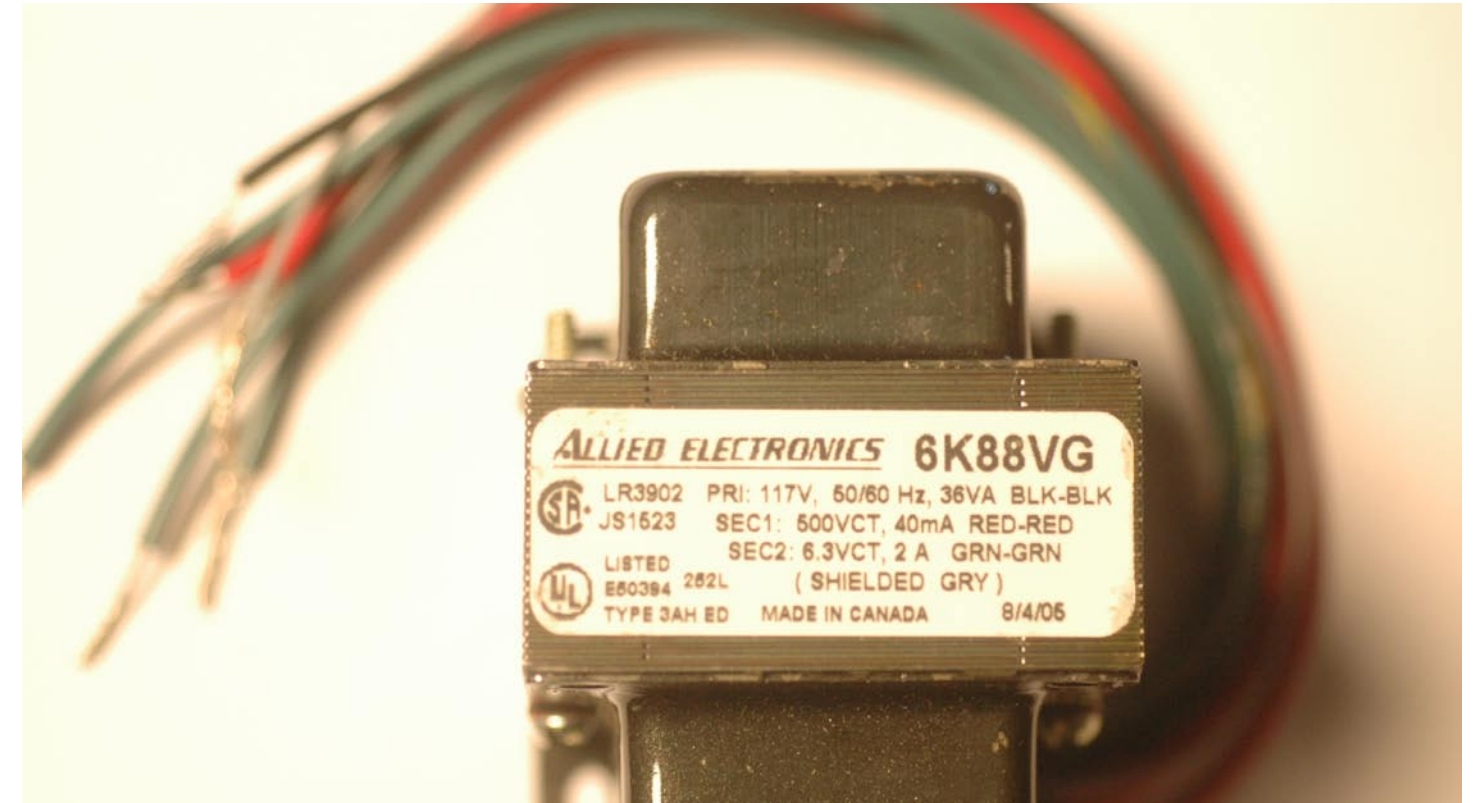
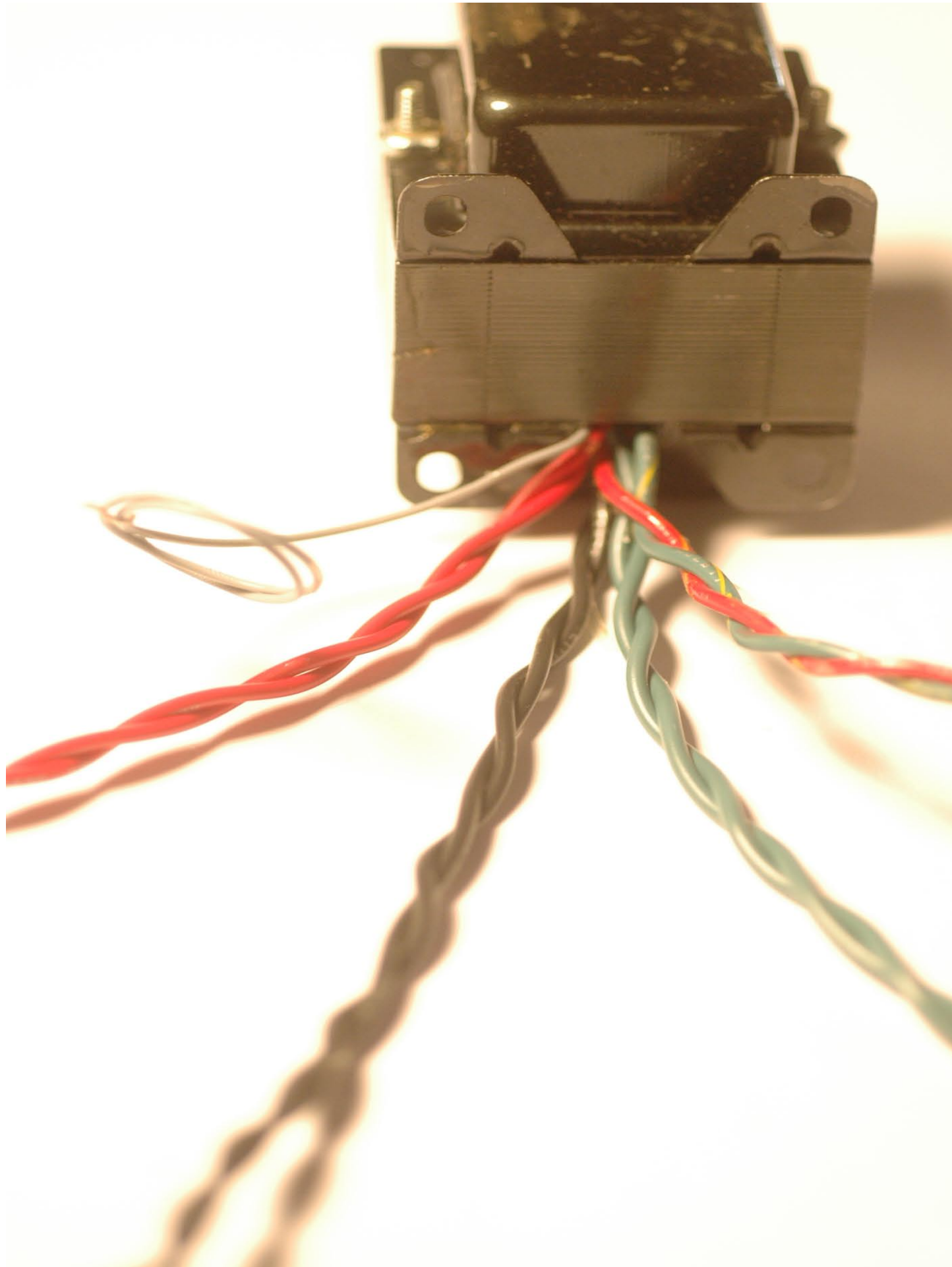
When it comes to meters , sifam is the way to go hands down.

You can also use vintage meters available on most auction web sites.

NOTE :

With some styles and brands other than sifam , you might have to build a recifier circuit for your meter to work properly. You will know this because your meter will work in reverse.





parts|transformers|info

Power transformer :



The traditional power transformer for the circuit requires a transformer of 250-0-250 volts center tapped @ 40 milliamperes and a secondary of 6.3 volts center tapped @ 2 amps.

The primary can be the USA 110v or the European 240v

The allied electronics 6k88vg transformer works very well for USA builds ,

It is center-tapped and has minimal noise and hum.

Another alternative is the hammond 269jx

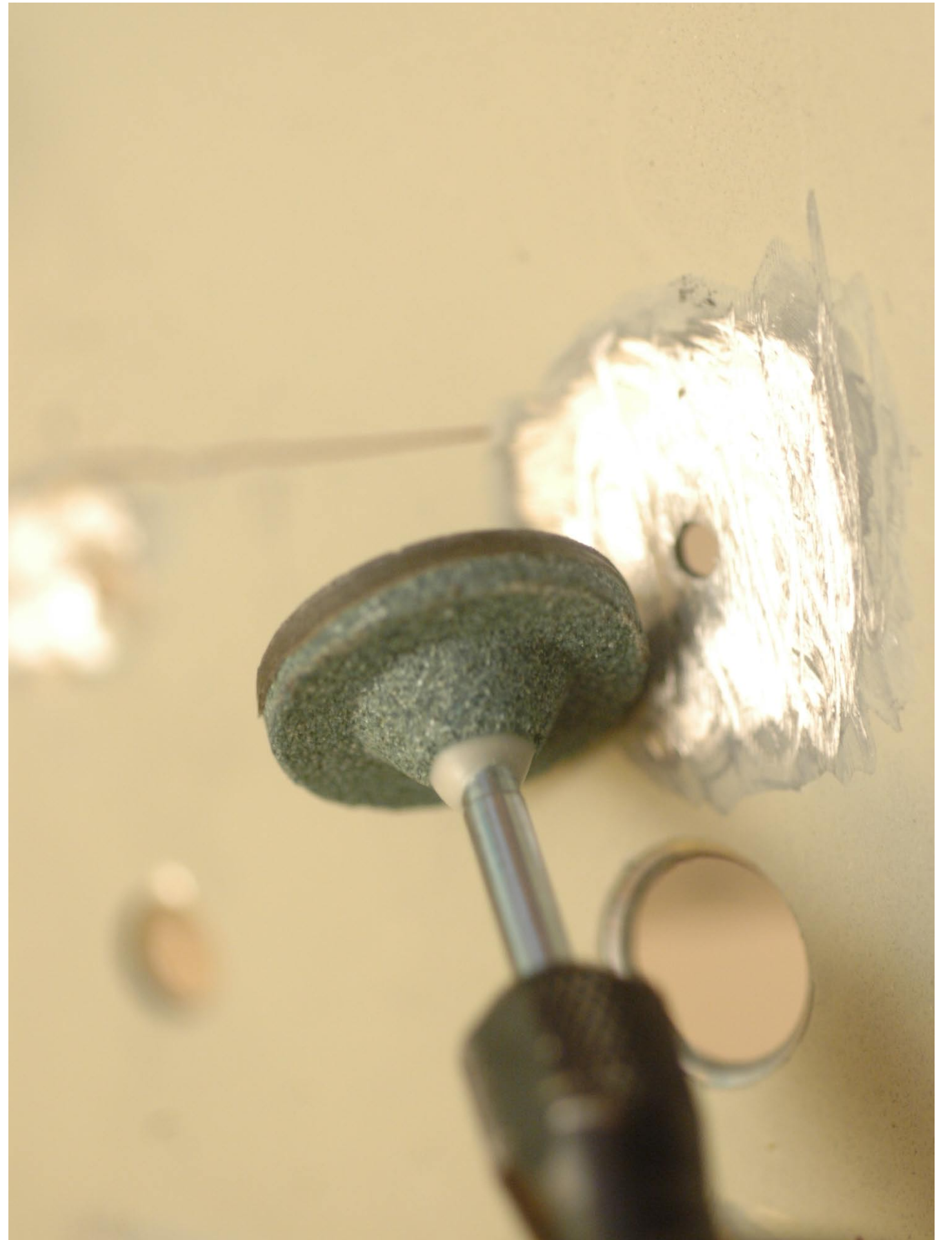
It does not have a center tap and could

be prone to hum or noise , but this is

often solvable with the use of a 'false' center tap, where a 100-250 ohm resistor is soldered to each lead of the 6.3v filament wire and the other side of each resistor is soldered to a ground.

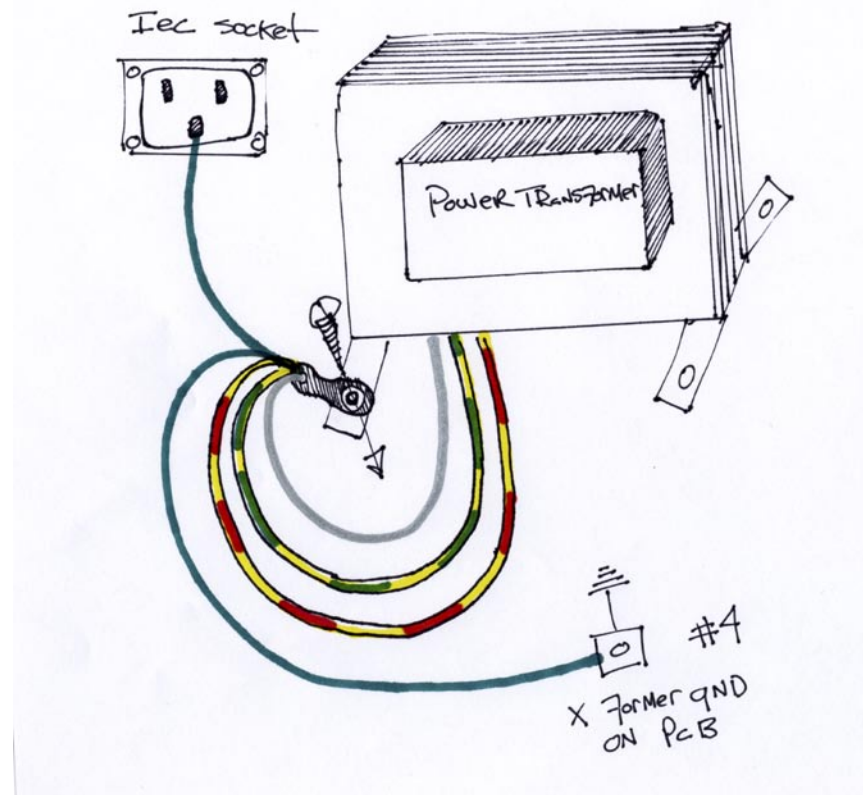


sowter however makes a more expensive power transformer for both USA and European voltages. I'm sure this is a fantastic transformer built to the highest standards. it is electrostatically shielded and I would recommend this over the allied and hammond versions.



parts|power transformers|hookup

star ground layout :



To create the transformer star ground , first it is a good idea to use a dremel and clean one of the transformers 'legs' so you can make a solid contact with the case and this ground point.

next you will bolt the transformer to the case and attach a solder tag or two to this bolt.

this is the begining of the star ground.

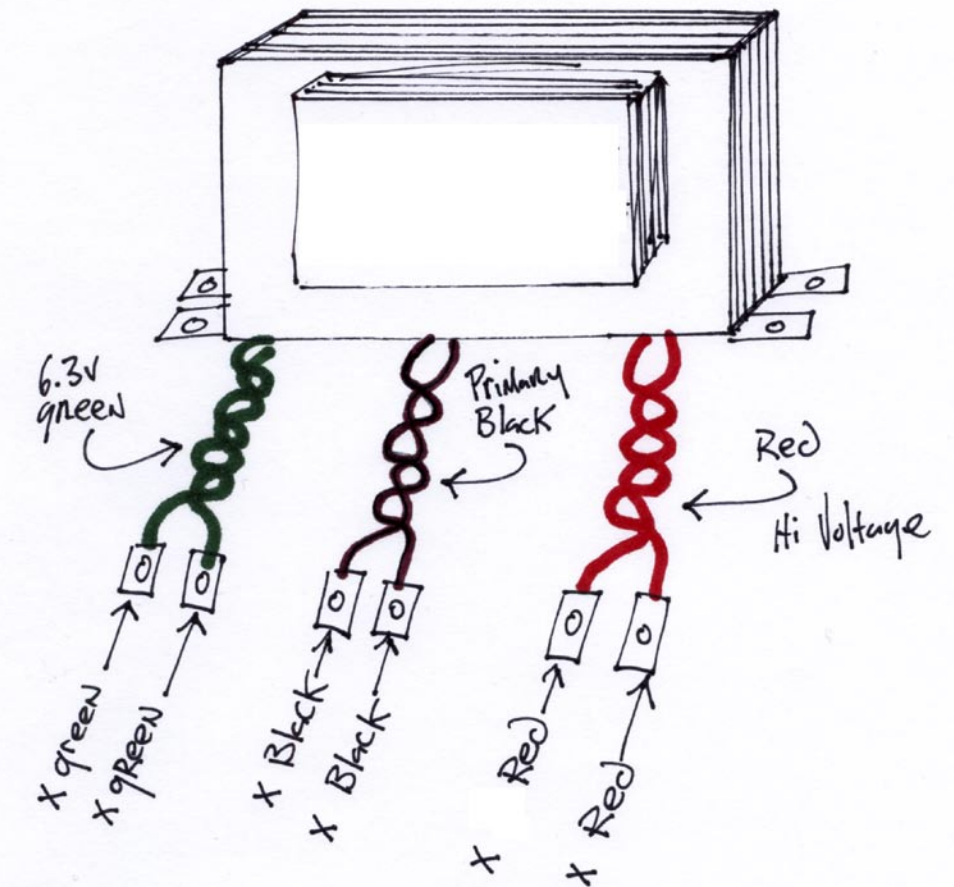
now you will solder the grey wire(transformer shield) coming out of the transformer base to one of these solder tags.

next you will solder the green/yellow (6.3v filament center tap) and the red yellow (high voltage center tap) to this ground also.

as in the illustration you will also use a piece of 22-20 gauge wire to connect ground pad #4 (marked as 'xformer GND') on the pcb to the star ground also.

and last you will use a piece of 22-20 gauge wire to connect the ground from the IEC socket to this point.

transformer connections :



now you will begin to hook up the various transformer leads to their corresponding pad on the pcb.

it is often a custom that builders twist the pairs of wire as illustrated in an attempt to help reduce noise or hum associated with overlapping wires of different voltages.

only with the two filament (solid green) wires is this neccicary. as for the other two pairs black/black and red/red it is ok to do this also or not.

as in the diagram , it is clearly marked on the pcb where each of these wires go , I.e 'x-black' means 'transformer-black'

there is no polarity issue here , so either lead of corresponding color can be placed on the pad named for it.



NOTE :

please pay attention to the instructions in this area. incorrect wiring of this section can highly damage the components on the pcb, as with possible electrocution and injury to you.

IEC power socket (type c14 chassis inlet)

For your power cord , you will use the IEC style inlet , since the fuse is mounted on the pcb , you will not need the fused version .



NOTE :

DO NOT USE POWER CORDS DIRECTLY WIRED TO THE PCB!
This practice is dangerous and under no circumstances should you do this.

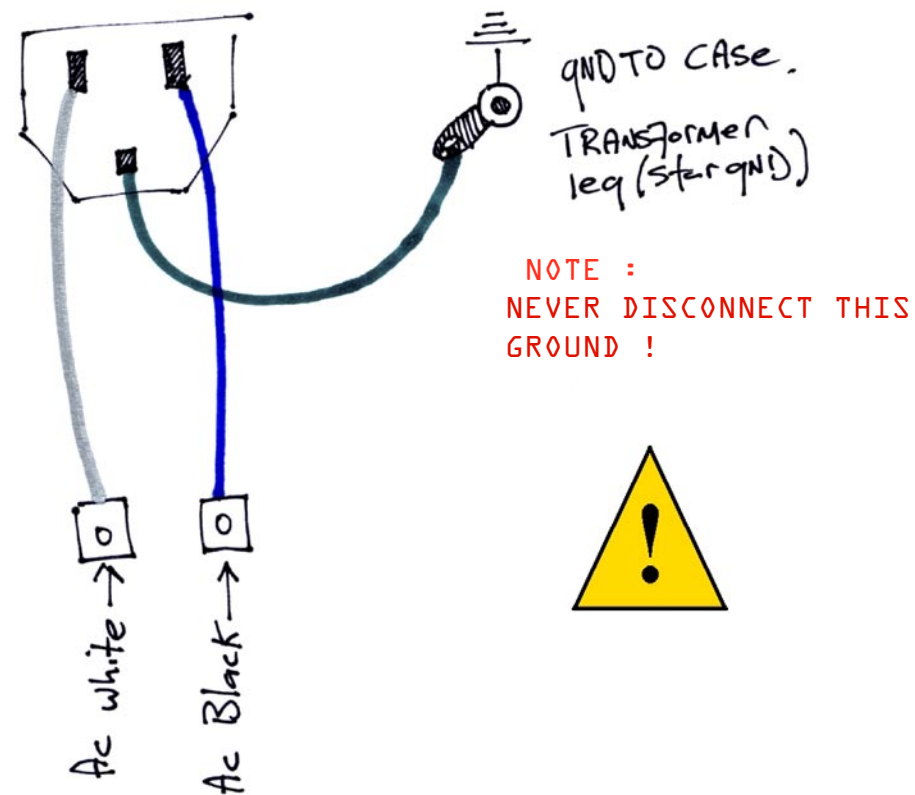
wiring :

if looking at the IEC socket from the back as shown in the illustration , you will always connect the pcb pad marked 'AC black' to the pin on the right. this is very important.

the bottom pin is connected to the star ground at the transformer leg.

this ground is know as the 'safety ground'

never 'lift' or disconnect this ground under any circumstances.



parts|shielded.wire|info

NOTE :

For this project I recommend using at least 22 gauge wire for most connections

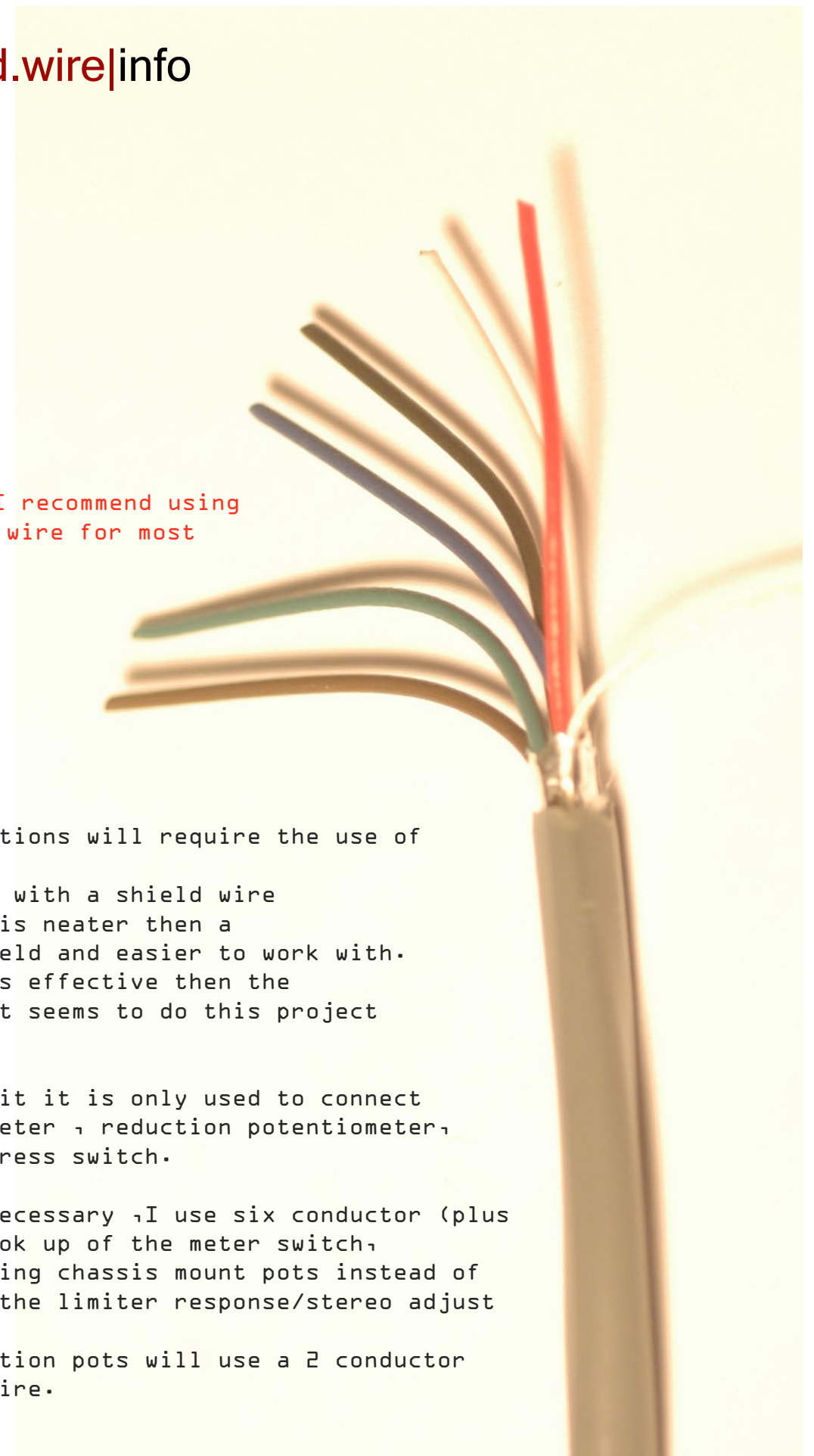
Some of the connections will require the use of Shielded wire.

A foil type shield with a shield wire is preferred , it is neater than a braided copper shield and easier to work with. Although it is less effective than the Braided copper , it seems to do this project just fine.

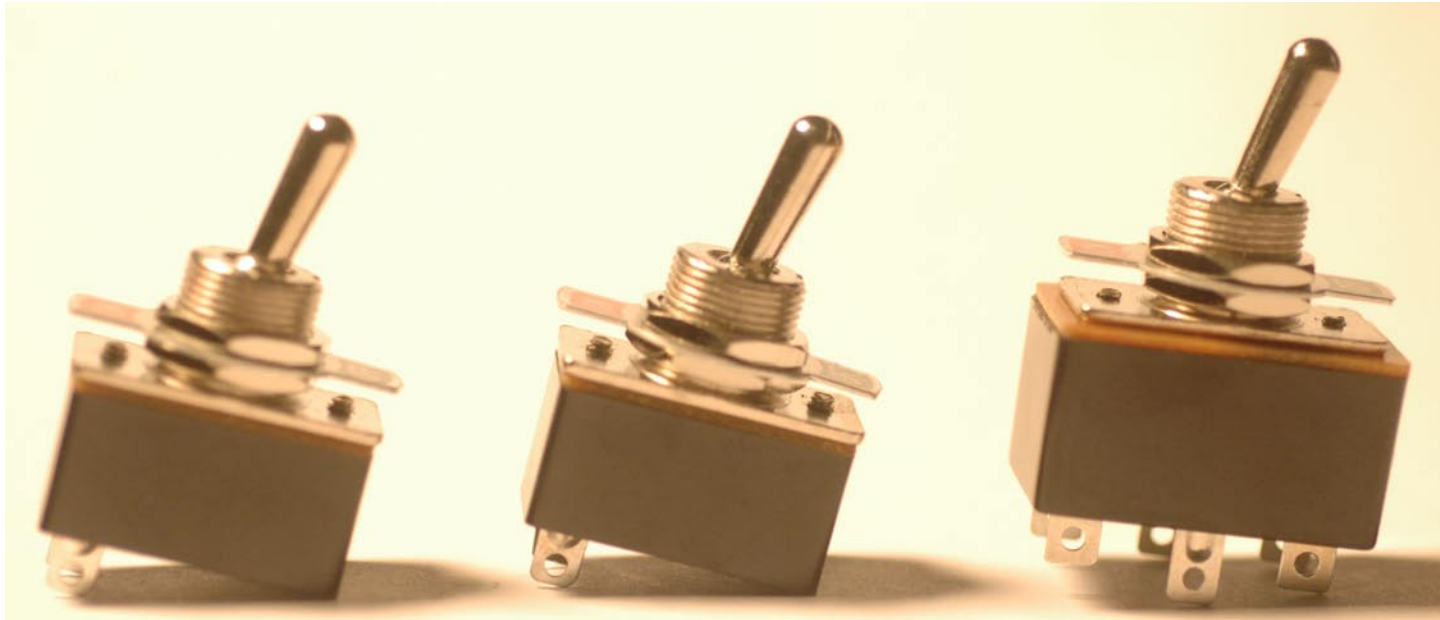
On the original unit it is only used to connect the gain potentiometer , reduction potentiometer , and the limit compress switch.

Although it is unnecessary , I use six conductor (plus shield) for the hook up of the meter switch , and also if I'm using chassis mount pots instead of the spectrols for the limiter response/stereo adjust pots .

The gain and reduction pots will use a 2 conductor plus shield type wire.



parts|switches|info



You will use 3 toggle switches for the build :

- 2) spst (single pole single throw) switches
one for the power switch and one for the
limit/compress selection switch.
- 1) dpdt (double pole double throw) switch
for the meter selection switch.

For the power switch use at least a 6 amp rated
switch.

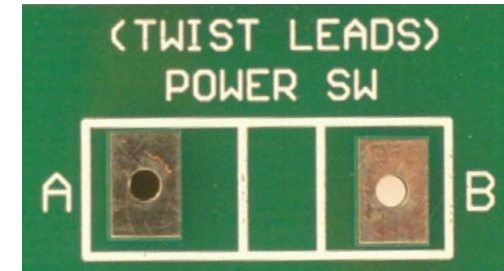
For the other switches very low volts/current go
through them so a standard duty toggle is fine.

(Radio shack has a nice bag that has the above switch-
es - perfect for this build)

NOTE : the dpdt switch must be the on/on type
with only two toggle positions.
Switches with a middle toggle position
On-off-on seem not to work.

parts|switches|hookup

power switch (spst) 6amp rated :



power toggle switch with rc snubber
network.(anti-pop)

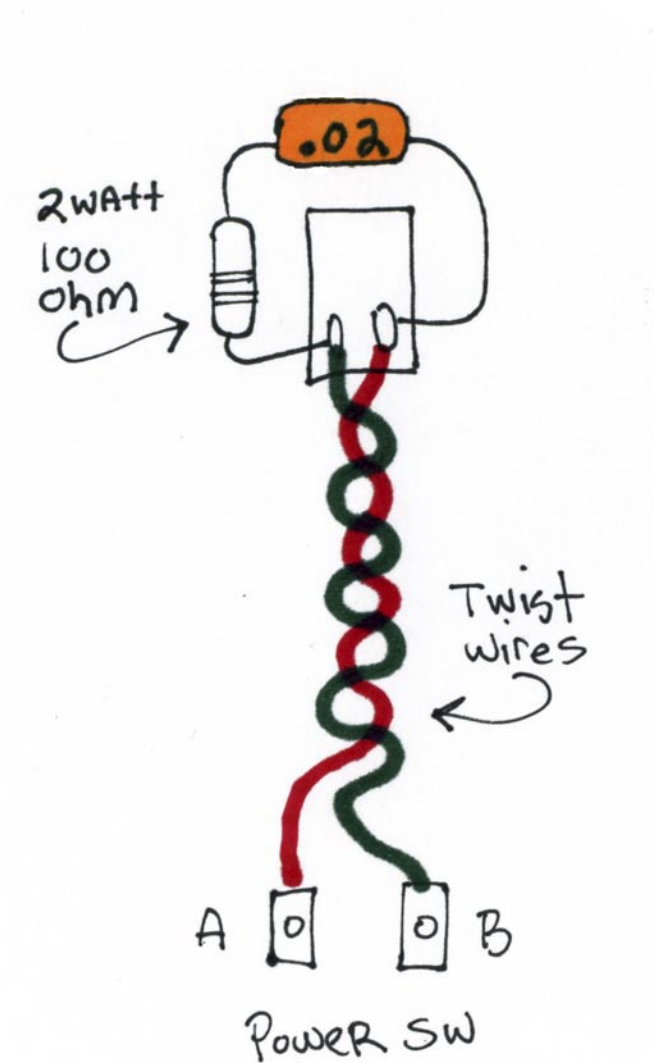
you will use two pieces of 22 gauge
wire in a twisted pair configuration,
as shown in the illustration.

simply connect one end of the wires to
the pcb pads marked 'power SW'

and the other ends to the spst switch.

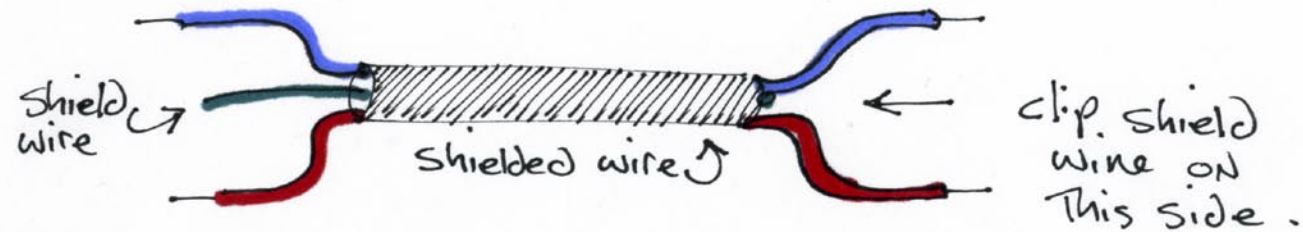
use the diagram to solder a 110 ohm
resistor in series with a 600v .022
'orangdrop' between the switch contacts
to create an anti pop
snubber network.

this will eliminate any popping noise
on shutdown.

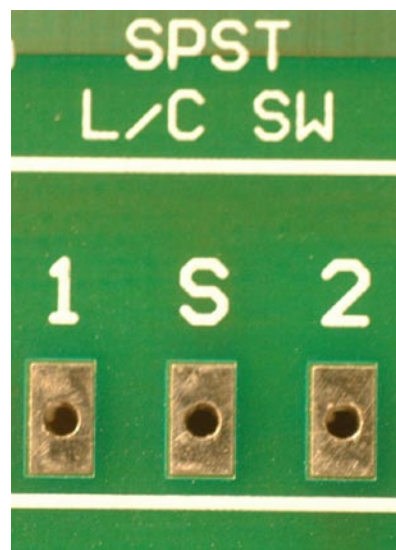
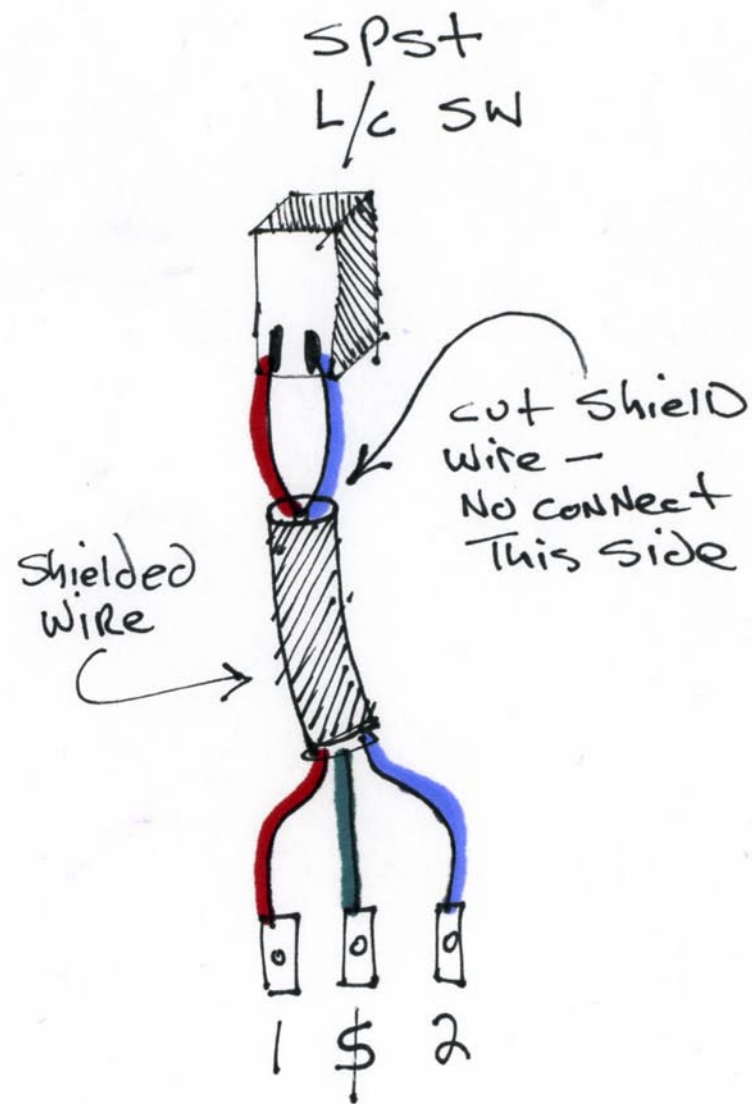


parts|switches|hookup

limit/compression switch (spst) :



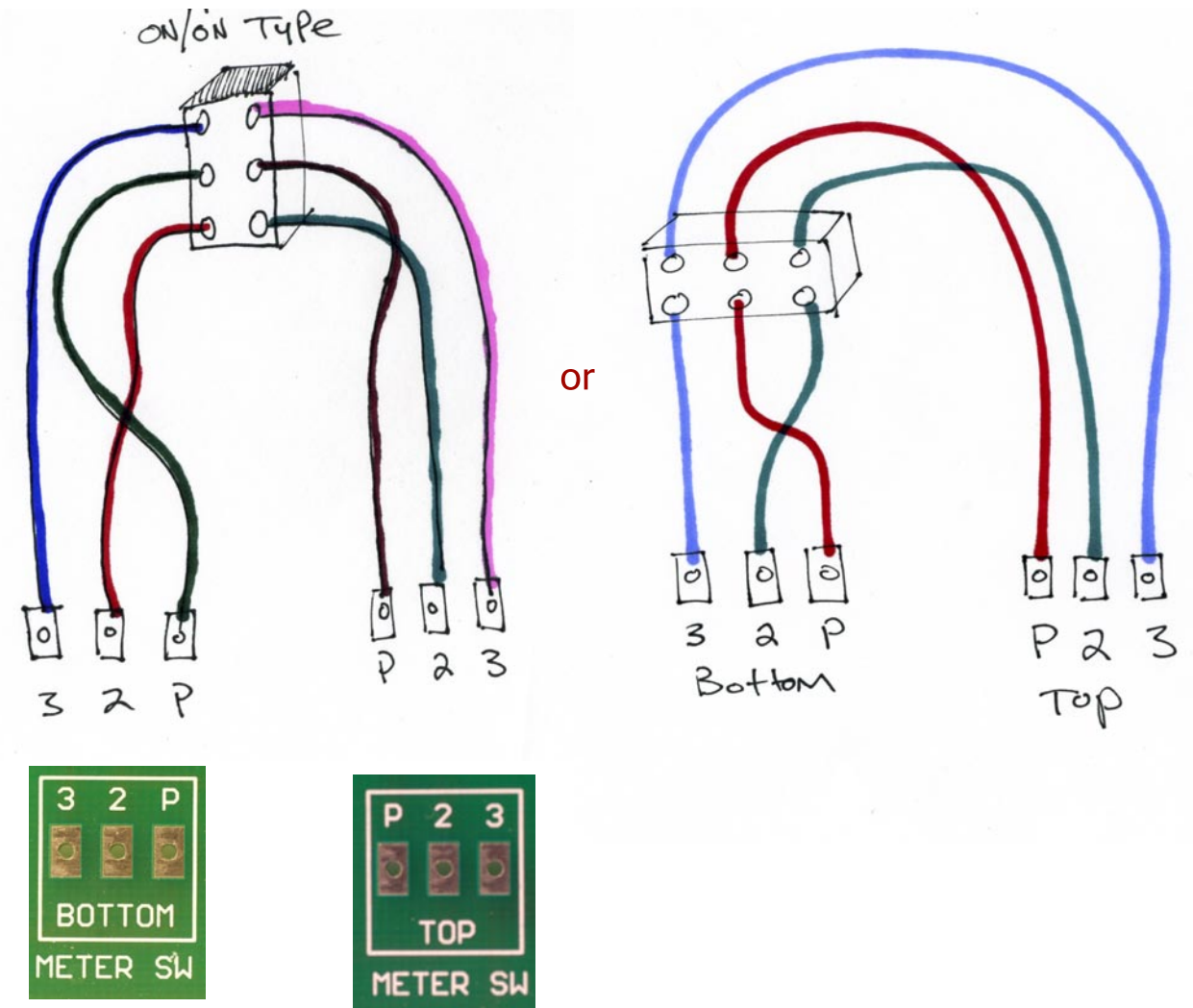
you will need to cut one piece of shielded 2 conductor wire as shown in the illustration. connect to pads on pcb marked SPST L/C SW. use the below illustration as an example.



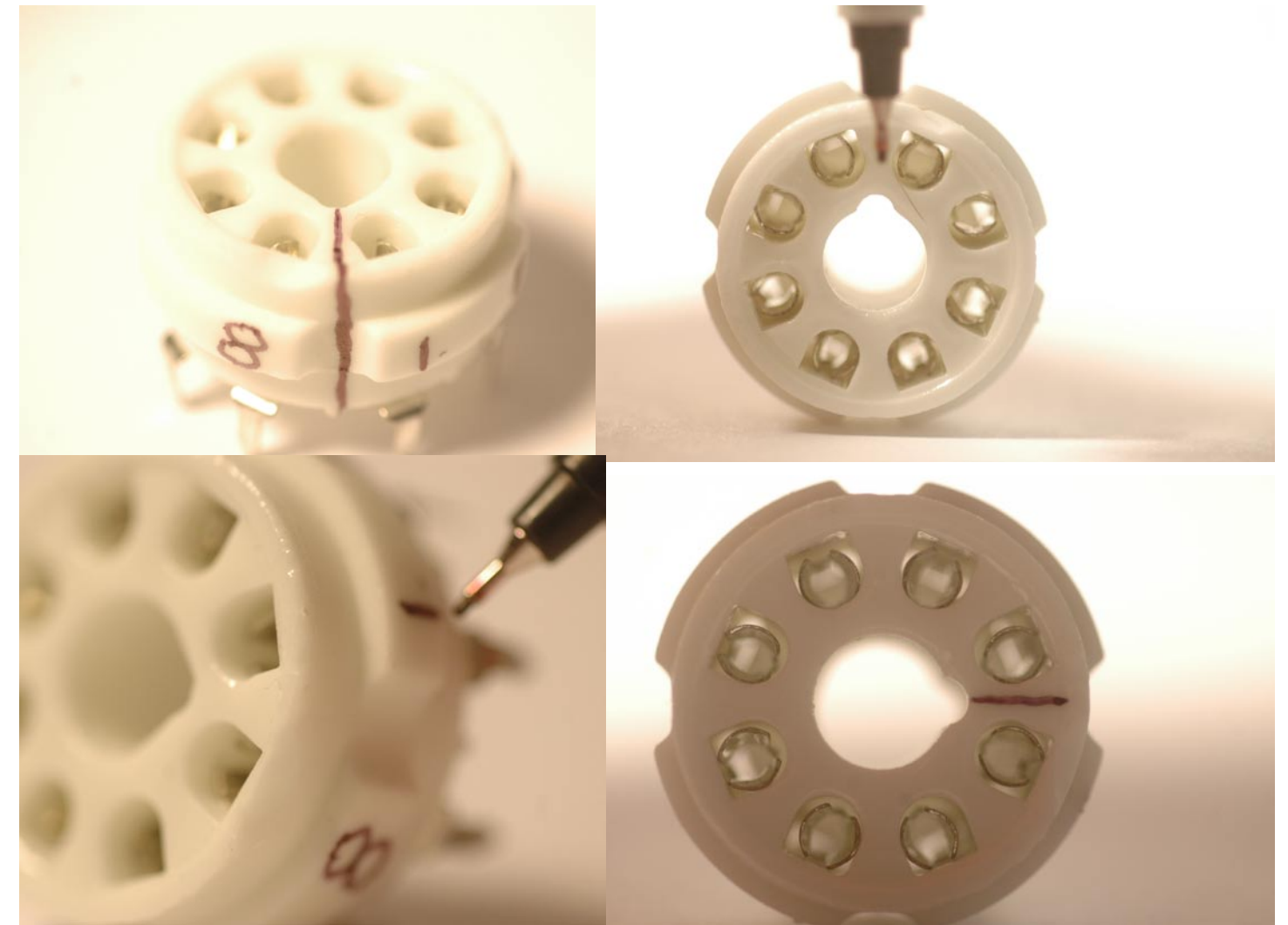
parts|switches|hookup

meter selection switch (dpdt on/on) :

this switch is used to change the vu meter from monitoring the output of audio to the monitoring of reduction



this connection is actually very easy . the two sections marked 'meter SW' are also labeled 'top' and 'bottom' these were added just to clarify one side of the switch from the other. you could just as well say 'right' or 'left' as in this illustration. you will notice how both the pads marked 'p' go to the center of the switch , that is because 'p' stand for 'pole' and will always go to the center pins. it doesnt mater what sides the numbered pads connect to , aslong as they are paired with their correspondind number on the same side of the switch.



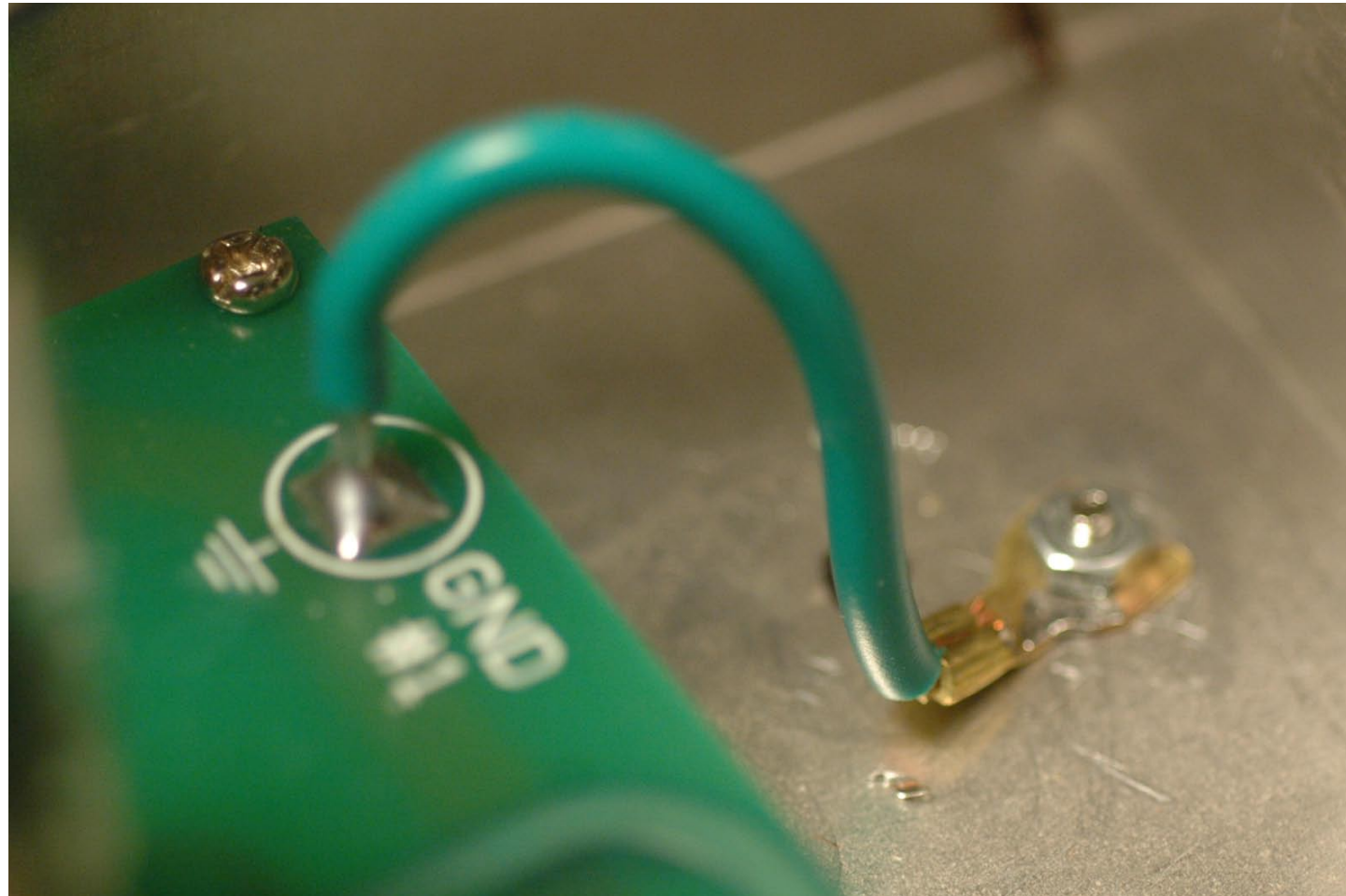
parts|[octal.socket](#)|info

For attaching the t4b optical cell to the pcb , you will use a 8 pin pcb mount octal socket. ceramic works best for this.

It is important to note that it is essential to align this properly.
In the above photo you will see how the socket is numbered.
Take notice of the inner circle and small indent .
The number 8 pin is to the left of the dent and the number 1 pin is to the right.
These numbers will correspond to the footprint on the pcb.

NOTE : you can severely damage the expensive t4b if you misalign the octal socket.
Take your time and double check placement before Soldering.

parts|ground|info



the pcb has 4 grounds that you will need to connect to the chasis.

in the above photo , you can see how this is done .
for best results do not make the lead wire coming off the gnd pad longer then it needs to be .

this ground structure corresponds to the ground structure of the original vintage units as with the modern version.

if there is poor contact in these grounds , the unit will not function correctly.

it is better to have these grounds as seprate and induvidual points.
star grounding these connections does not seem to improve performance in subjective tests.

ive had good luck using 12 gauge wire with a spade fork crimped on as in the photo, or a traditional solder tag is ok too.

parts|misc|info

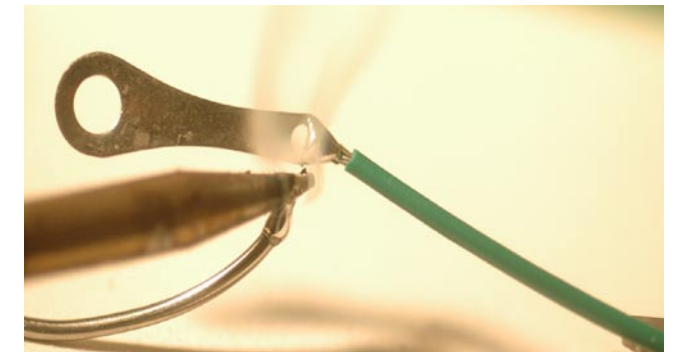
solder tags :

This project will require the use of solder tags for very important Connections like the individual grounds and the transformer star ground.

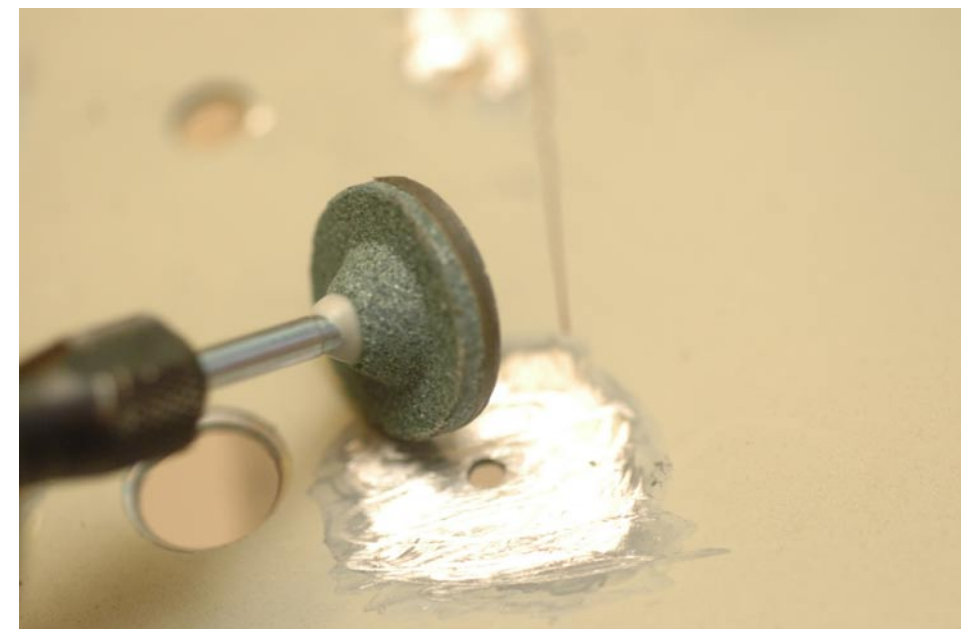
Please use these or something comparable.

These connections are some of the most important of the project .

pre-bent solder tags with an added lock washer teeth are best, they help insure a solid contact.



NOTE : if your case is painted , you will have to dremel or sand away a small area to attach the solder tags, clean solid contact to metal is important.



parts|chasis|info

There are many different styles of cases that you can choose for your project, from steel to aluminium, both seem to work well. Aluminium will be easier to drill and cut for things like the IEC socket.

NOTE : it is very important that the case is vented to allow the heat from the tubes to dissipate. All of the parts that will be inside the case can handle a good amount of heat but venting is Necessary as a safety precaution and a step to preserve the life span of the internal components.



The required size for the pcb build is a case at least 5" high by 17" wide and 10" deep. The pcb's dimensions are 15.75"x6" , but you will need a little room inside the case for the connections to switches and the solder tags that will receive the ground connections.

A solid constructed case with a lid is preferred over the cases that come in 6 pieces (top,bottom,side,side,rear and front.) It seems that these cases have a harder time with maintaining a solid ground Connection especially if they are painted.

If you do choose a 6 piece case , one option is to add one Wire from the transformer star ground to the bottom of the case to ensure solid grounding.

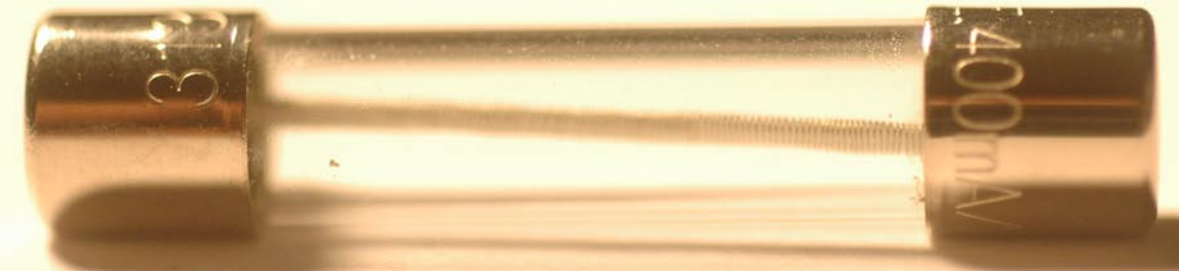
Bad grounding can cause noise and hum.

If you are using a multi sided case , a good solution is to

make all ground points to the bottom of the case.

This will make it so the ground connections do not have to travel through the bolts causing ground loops and other problems.

parts|fuse|info

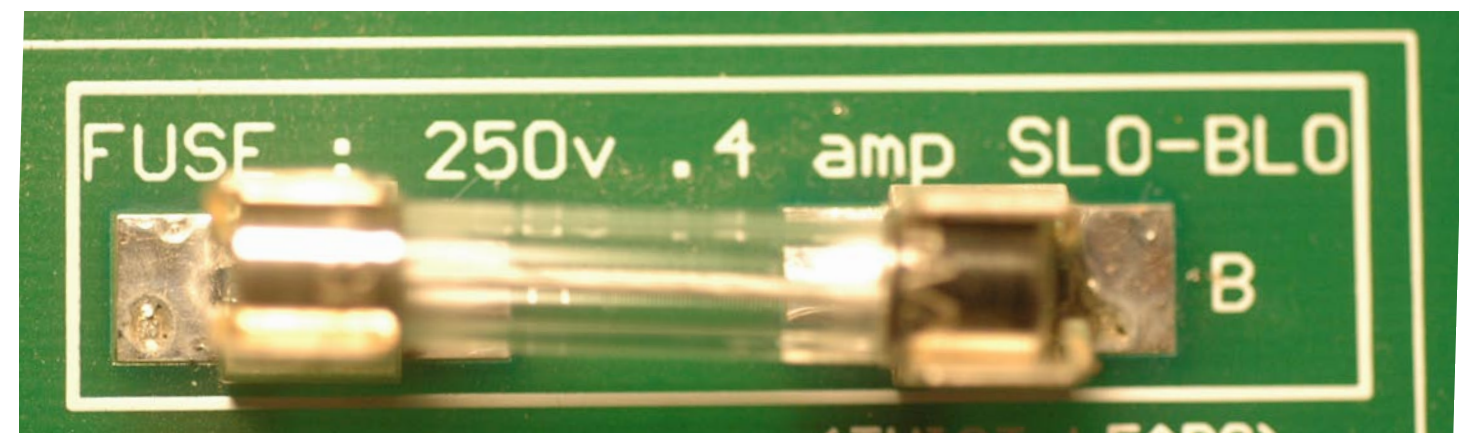


The fuse is a 250v 400mA(.4 amp) SLO BLO mouser no# 576-0313.400HXP



The clips used to attach the fuse to the pcb are littel fuse : 3AG PC clip

mouser number 576-01220083h



parts|NE-2.neon|info

The ne-2 neon is used to regulate voltage in the metering section.
There is no polarity for it , so hook it up in any position.

The zero adjust pot will effect the brightness of this light as it adjusts the vu meter in gain reduction mode.
In some positions it will turn it off completely.

NOTE : another helpful job this bulb does is to remind you the unit is powered and ON.
It has saved me countless times from accidental shock.
It seems that the ne-2 also bleeds off some of the stored charge in the filtering caps once the unit has been turned off.
but I would be careful around the c7 caps regardless.

lamp/power indicator light

You will use a 6v AC lamp that can handle 2 amps.
You can also get a lamp/holder assembly that comes as one piece.

You will connect this to the pads next
The heater connections marked 'lamp'



Knobs

Depending on the type of potentiometers you use , you will need to purchase 5 knobs for :

- 1: gain
- 2: reduction
- 3: stereo adjust
- 4: limiter response
- 5: meter zero adjust

You can select these on basis of your personal aesthetic, molded plastic works great here.

NOTE :

Knobs often have shaft size requirements , so be sure to check this to match your pots.

Wire

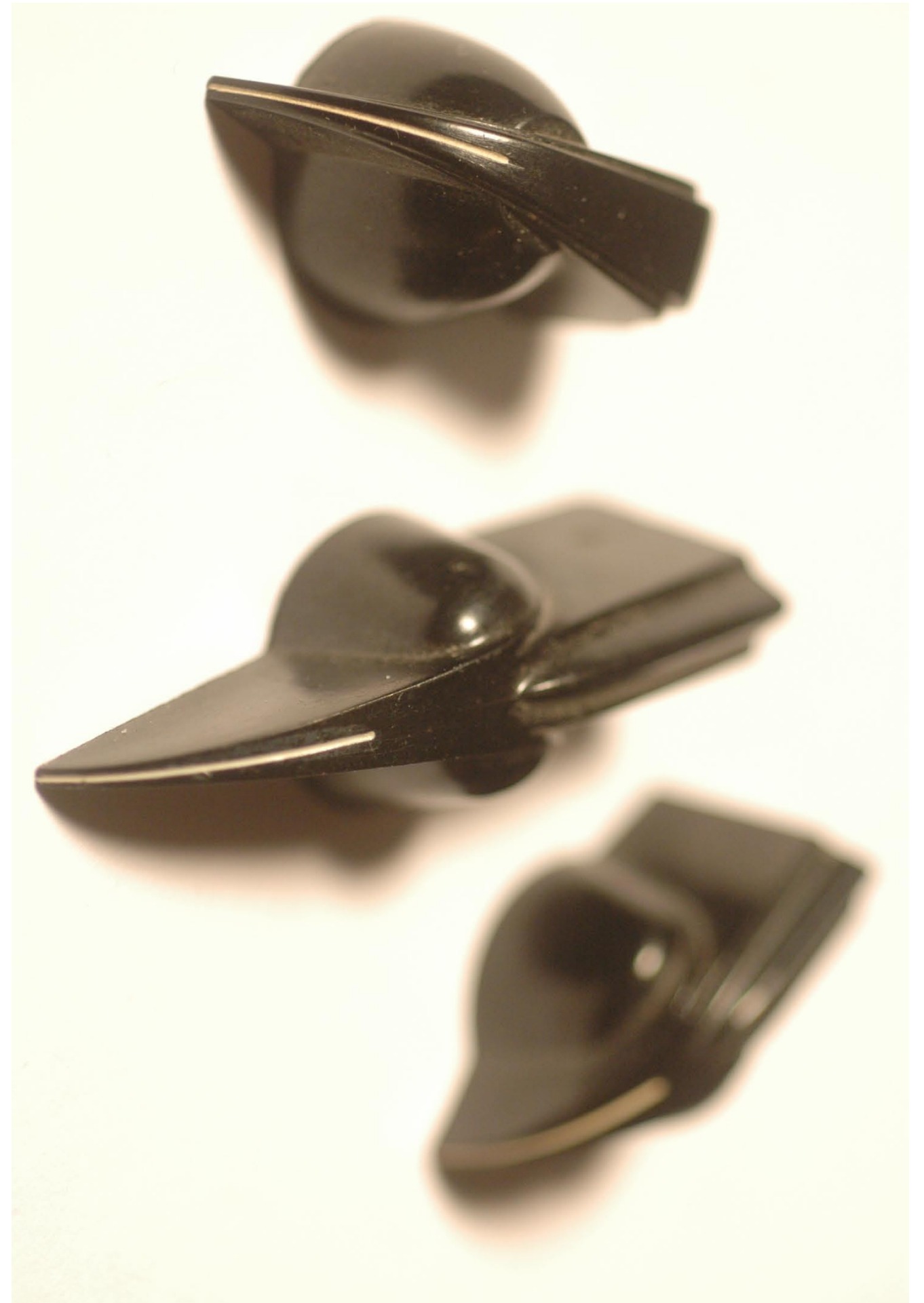
Please use at least 22 gauge wire for the Various connections used in this project.
(24 gauge would be the minimum allowed)

Standoffs

8 standoffs are needed to elevate the pcb above the case floor.

a minimum of 1/4 inch is required.

(20mm standoffs with #40 screws seem to work very well here)

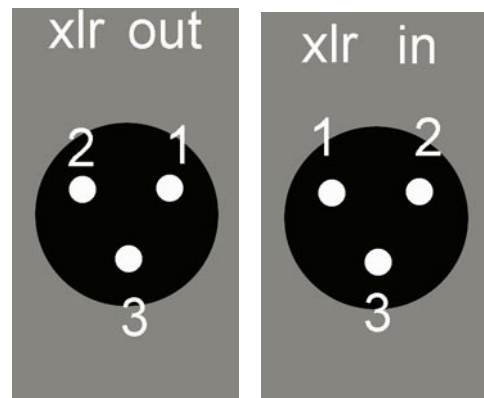


xlr connectors



You will use 2 chassis mount xlr sockets. One female which you will use for input and one male which you will use for output. (In the photo , male is on the left)

There are many degrees of quality that you can get for these , try to buy the best you can afford . The audio circuit of the unit begins and ends here. (switchcraft and neutrik are some good brands to consider)



illustrated here are the pinouts for the xlr sockets if viewed from the rear (solder side)

DO NOT USE 'XLR OUT PAD # 1' ON THE PCB FOR CONNECTING TO THE XLR OUT SOCKET'S PIN1 .

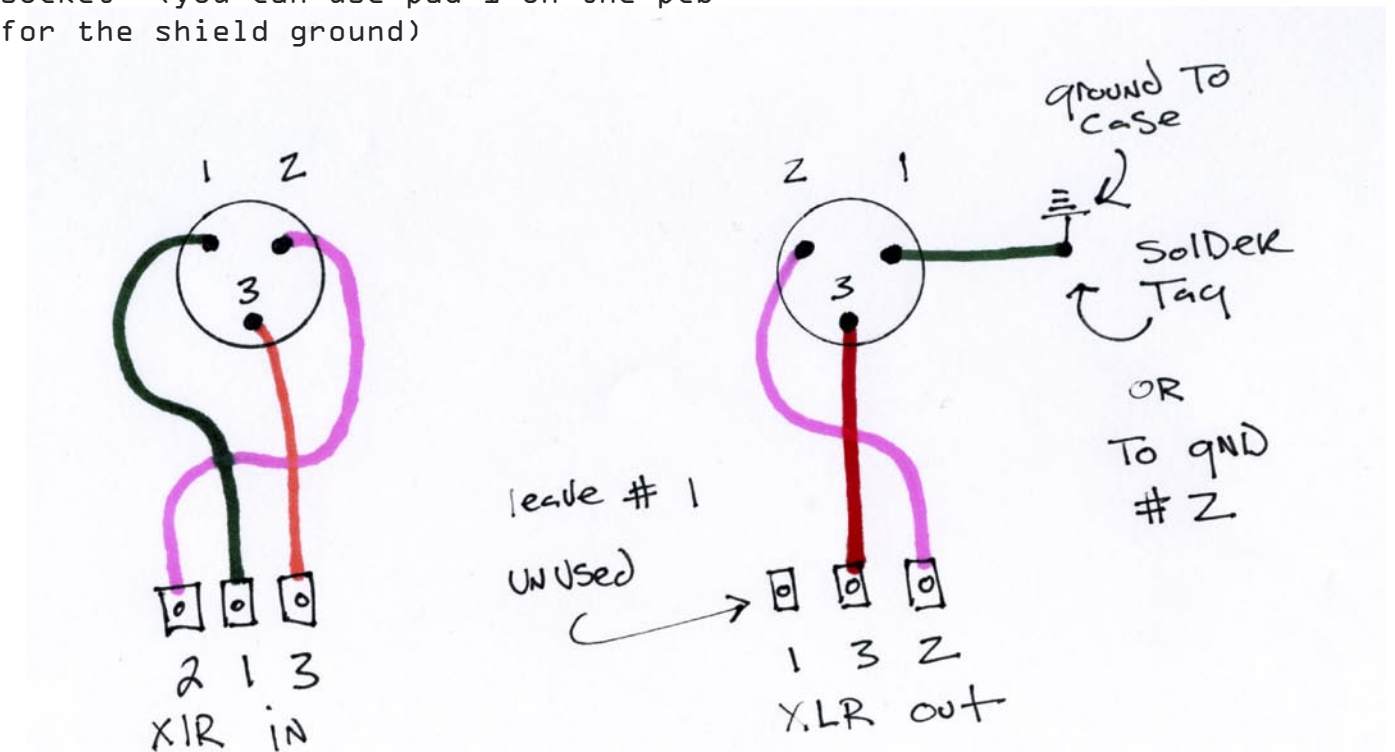
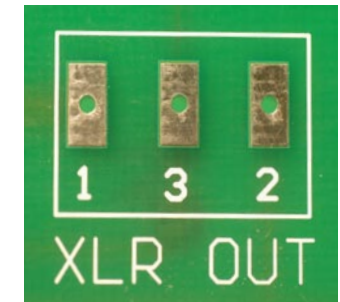
it works fine in some instances , but ive had greater results in eliminating noise by using an alternate ground.

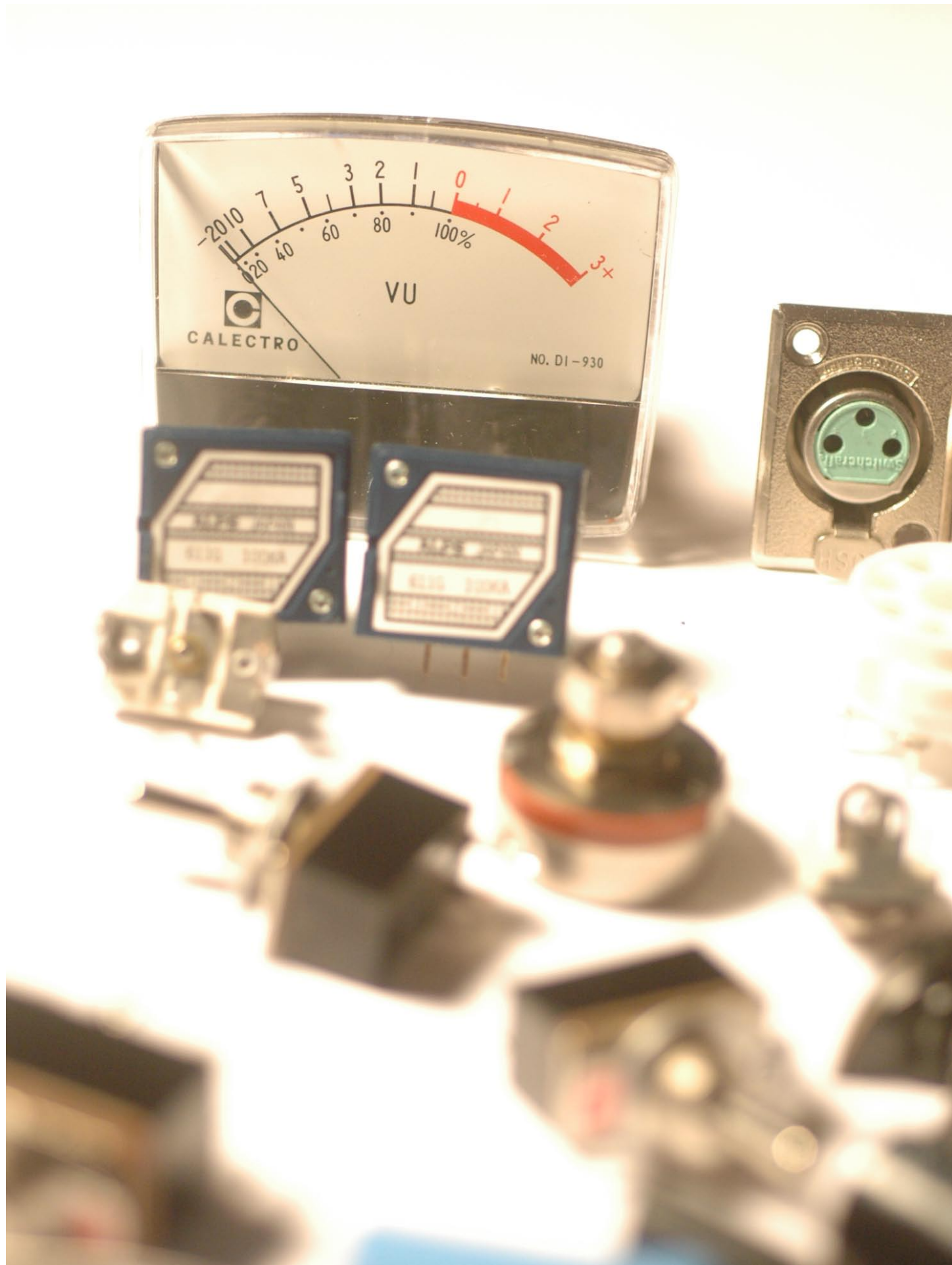
traditionally the xlr out socket's pin 1 is grounded to GND#2 on the PCB, but I have had great results by using a solder tag 1"-2" away from the xlr out socket for this.

you can use shielded wire for these connections , although it is not neccicary.

on the input xlr use the shield wire for the pin#1 connection..

for the xlr out , you can have it connected at one end only since you will be using a solder tag to ground the socket. (you can use pad#1 on the pcb for the shield ground)





parts|bill of materials

this is a standard list of materials and supplies.
you can use this list to refrence items to better suit your
budget and your preffered brands of components.

some of the parts were arbitrairily
selected , there are other brands you may prefer.

on certain things like the case,meter and tubes
you will have to choose to fit your own needs and price points.

with some items there are multiple inventory numbers or
distributers , this is to provide you with more options in your
selection ,

parts|bill of materials

capacitors

- 1 **10uf@v450v** electrolytic (cde mallory tc72)
Allied Stk#: 852-9089 (cde mallory tc72)
Allied Stk#: 507-0192 (atom TVA 1705 450V)

- 2 **.1 @ 400v** (normally polyester , polyprop works great) a good place for hi grade caps) 400v min.
mouser# 75-715P400V0.1 (orange drop)

- 3 **.01 @ 450v** (1 kilovolt ceramic z5u) or use polypro cap
mouser# 75-715P600V0.01 (orange drop)

- 4 **.02 @ 450v** (1 kilovolt ceramic z5u) or use polypro cap
mouser# 75-715P600V0.022 (orange drop)

- 1 **.001 @ 450v** mica caps work well here or use polypro
mouser# 75-715P600V0.001 (orange drop)

- 1 **500pf @ 450v** mica or ceramic
mouser#5982-15-500V500 (mica)

- 1 **470pf @ 500v** mica or ceramic
mouser#5982-15-500V470 (mica)

- 2 **47uf @ 450v** electrolytic (for power section)
mouser#140-XRL450V47-RC

- 2 **22uf @ 450v** electrolytic (for power sec)(use in place of 33uf)
mouser#140-XRL450V22-RC

- 1 **150pf @ 500v** mica (use for c4) or use arco 465
mouser#5982-15-500V150 (mica)
surplus sales of newbraska #(CTM) 465

- 1 **330pf @ 500v** ceramic (use for c14) or use arco 465
mouser#5982-15-500V330 (mica)
surplus sales of newbraska #(CTM) 465

- 1 **47UF @ 25V** electrolytic
mouser#75-516D476M025-E3

- 2 **1n4007** general purpose rectifier (diode)
mouser#512-1N4007
-

- 1 **.4 amp slo blow fuse** (standard size)
mouser part#576-0313.400HXP
-

- 2 **fuse clips** for mounting fuse to pcb
mouser : P/N 01220083H ldesc : 3ag pc clip
(littel fuse , fuse clips)
-

- 1 **IEC power plug** IEC C14
mouser#161-R30148
-

- 1 **Ne-2** (neon light)
Mouser#36NE002
-

- 1 **VU meter** sifam
meterdistributor.com or sifam.com
-

tube sockets :

- 3 **nine pin** (12ax7 size) ceramic pcb mount tube sockets
triodeelectronics part#:9pinpcgold
tubedepot.com part#:SK-9PINPCG
 - 1 **seven pin** (6aq5a size) ceramic pcb mount tube socket
triodeelectronics part#:7pinpccr
tubedepot.com part#:SK-7PINPC
 - 1 **eight pin** (relay size) 'octal' ceramic pcb mount socket. (for t4b)
triodeelectronics part#: octal-pccergold
tubedepot.com part#:SK-8PINPCG
-

tubes :

- 2 **12ax7a** (ecc83)
triodeelectronics part#:12ax7tesla
tubedepot.com part#:JJ-ECC83
 - 1 **12bh7a**
triodeelectronics part#:12bh7eh
tubedepot.com part#:EH-12BH7
 - 1 **6aq5a**
triodeelectronics part#:6aq5e190
tubedepot.com part#:NOS-6AQ5A
-

resistors :

3 **100 ohm metal oxide power resistors** (1 watt or 2 watt)
(will use one for power switch 'pop' control (aka rc network snubber)
(might need other 2 for center tap replacement for hum control)

mouser#282-100-RC

Half watt resistors

xicon 1/2 metal film resistors

8 **1k** mouser# 273-1k-rc
1 **1.5k** mouser# 273-1.5k-rc
1 **2.7k** mouser# 273-2.7k-rc
1 **3.9k** mouser# 273-3.9k-rc
1 **6.8k** mouser# 273-6.8k-rc
2 **10k** mouser# 273-10k-rc
1 **22k** mouser# 273-22k-rc
2 **33k** mouser# 273-33k-rc
1 **47k** mouser# 273-47k-rc
4 **68k** mouser# 273-68k-rc
1 **100k** mouser# 273-100k-rc
3 **220k** mouser# 273-220k-rc
1 **330k** mouser# 273-330k-rc
4 **470k** mouser# 273-470k-rc

2 watt resistors (use metal oxide power resistors)

1 **4.7k** mouser#282-4.7K-RC
1 **22k** mouser#282-22K-RC

POTS :

2 **100k AUDIO TAPER** (for gain control and reduction)
PEC 2 WATT CARBON :Digi-Key Part Number KA1041S28-ND

3 **1MEG LIN TAPER** (for st adj, limiter response and zero adj.)
PEC 2 WATT CARBON :Digi-Key Part Number RV4L105C-ND

KNOBBS :

5 **knobs** choose to your aesthetic and to match your pot shaft.
alliedelec.com or mouser.com or radioshack.com

switches :

2 **spst toggle** switches mouser # 691-110-73
1 **dpdt toggle** on/on switch TBA

radioshack.com

3-Pack Toggle Switch Kit

Model: 275-322 | Catalog #: 275-322

Includes one DPDT and two SPST toggle switches. Rated 3 amps at 125VAC

XLR sockets

1 **xlr in socket** (chassis mount) mouser :mouser# 568-NC3FP-1
1 **xlr out socket** (chassis mount)mouser :mouser# 568-NC3MP

wire :

aprox 2 feet of foil shielded 2 conductor (plus ground) wire 22GA
aprox 3 feet of foil shielded 3 conductor (plus ground) wire 22GA
aprox 3 feet of foil shielded 6 conductor (plus ground) wire 22GA

aprox 3 feet of 24-22 gauge hook up wire for the assorted connections.

1 assorted pack of shrink tubing (will use some 1/16 for the longer resistor leads) also keeps the shielded wire ends looking good and not ratty.

1 **resistor bending tool** 'speedy bend lead former'
mouser#5166-901

audio transformers

↓ **SOWTER 4383c** ('c' is for pcb pins)(INPUT) request PCB mount ver
(leaded transformers will work too)
<http://www.sowter.co.uk/> or <http://www.prodigy-pro.com>

↓ **SOWTER 8940b** ('B' is for pcb pins)(output) request pcb mount ver
(leaded transformers will work too)
<http://www.sowter.co.uk/> or <http://www.prodigy-pro.com>

power transformer :

usa build :
allied transformer 6k88vg (250-0250 40Ma CT / 6.3v 2a CT)
allied part #: 227-0113
sowter part #: 0295 (for Teletronix)

euopean build :
sowter part #: 0208 (for Teletronix)

T4b optical cell :

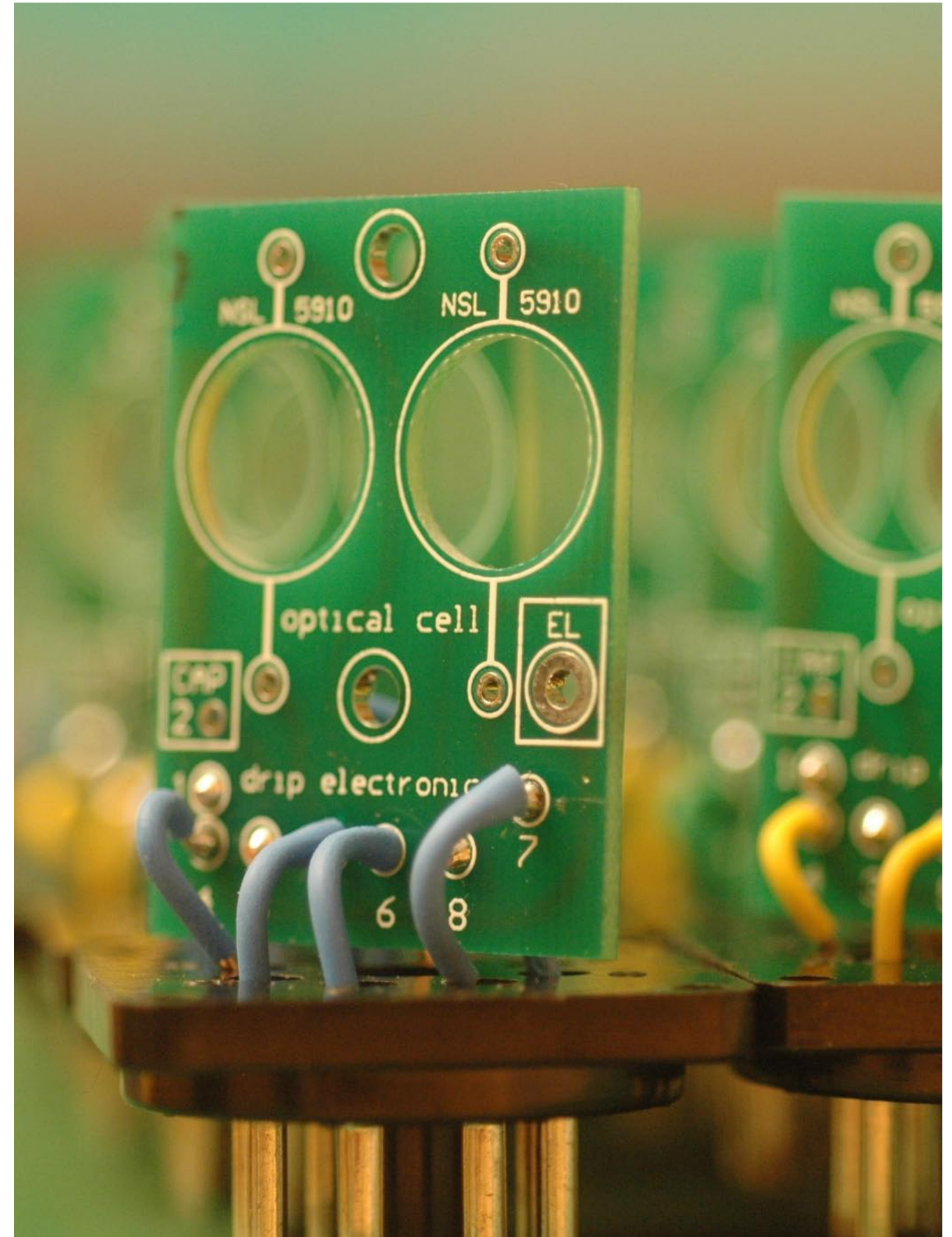
jbl : (818) 894 8850 urei parts dept
they carry the original urei model for aprox 250\$
ebay : often has the originals purchased from the jbl tent sale
price usually is at 165-200\$
Universal audio : Uaudio.com (support)
ADL : anthonyadl@aol.com (845 255-4695)

drip electronics will be fully manufacturing the t4bs in the near future.

enclosure :

the pcb is 15.75"x6" wide , you will need a case at least 5" high to fit the tubes
a vented case is required (can also drill some large holes on the top if your case is not vented)

aluminum or steel works well , **DO NOT USE PLASTIC**



assorted :

↳ 1/4-1/2" stand offs with screws.

radio shack # 276-195 20.6 mm (13/16")

↳ solder tags (lugs) Terminals 'LUG LOCKING TINNED#4'

mouser#534-7311 (for #4 screw size)

mouser#534-7330 (for #8 screw size)

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