AC4TV™ Studio-Pro

Mercury Upgrade Kit

Assembly Manual

VERSION 061411

Written & produced by the staff of

The Heart & Soul of Your Amp
Mercury MAGNETICS™

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Circuitry design by Alan Cyr
(www.Amp-Exchange.com)

If you do not know how to read a schematic, we strongly recommend that you take this project to a qualified technician for installation.

All ***Mercury Magnetics*** products are 100% handmade by us in California, USA.

Mercury Magnetics products are UL (Underwriters Laboratories Inc.) recognized components for the USA and Canada. OBJY2 component systems, electrical insulation, E120568. UL Recognition, class 130(b) – Class 200(n). OBJY8 component systems, electrical insulation, certified for Canada, class 130(b) – Class 200(n).

Mercury Magnetics transformers and other products are in compliance with the European Union RoHS Directive 2020/95/EC with respect to the following substances: lead (Pb), mercury (Hg), cadmium (Cd, hexavalent chromium (CR (VI)), polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE).

Attention: Modifying your VOX AC4TV amp voids the VOX warranty!

Introduction to the VOX AC4tv *Studio-Pro Upgrade Kit*

Congratulations! And thank you for investing in the ***Mercury Studio-Pro Upgrade Kit*** for your **VOX AC4tv**. You're going to love the ***Tone*** of your ***Upgraded*** amp.

About *Upgrading* your AC4tv

Don't let your **VOX AC4tv** amp's compact size and price fool you. Aside from amazing ***tone***, your ***Upgraded*** **AC4tv** will run both *studio-quiet* and *pedal-friendly*.

Mercury is well connected with both pro and studio players, and long before the ***Upgraded*** little amp was ready for prime-time the prototypes were making the rounds here in Los Angeles. Consider that these players have the choice of any gear they want – but they're running with the ***Upgraded*** **AC4tv** because they love the way it sounds and responds. They know it's best tool for the job!

You'll find that your ***Upgraded*** **AC4tv** may be one of the most *pedal-friendly* little amps you'll ever own. So go ahead, *un*mothball those stomp boxes, experiment and discover what new directions you can take your sound.

Upgrade transformers and your *tone*

Savvy guitarists and amp techs know that tube amp design begins with *quality transformers*. The *transformers* you use determine your amp's ***tone***. When you get the *transformers* right you're on the road to a great-sounding amp.

However, these days amp manufacturers are often forced into a balancing act of compromises in order to meet the low budget demands of the market. First on the hatchet list is the *transformers*. And sadly, low-bidder *transformers* only give you low-bidder ***tone***. Manufacturers may be stuck with this dilemma but you don't have to be. ***Mercury*** has THE solution with our no compromise ***Upgrade*** *transformer* designs. The same you'll find in the best pro and studio amps all over the world.

The bottom line is that no matter how an amp plays, it cannot achieve its full sonic potential without following the time-tested recipes of properly engineered *transformers*.

Quality *transformers* are a good investment because you're getting so much more ***tone*** (and amp reliability) for your money. Usually making the difference between an amp you love and are inspired to play *vs.* one that's orphaned in your closet.

Why's that?

One of the most significant (and not so obvious) reasons we don't like the sound of some amps is a phenomenon known as "ear fatigue."

In nature all sounds are composed of layers of frequencies producing all sorts of harmonics and distortion. *Ear fatigue* is caused by information commingling with non-musical, unnatural noise that beat up your internal mechanisms – some of which we "feel" more than hear. These mechanisms end up working overtime trying to separate the desirable from the less desirable sounds. That's how *fatigue* happens.

A popular misconception is that vacuum tubes were designed to distort. We only enjoy the benefits of distortion by the influence of the amp's *transformers* – *not its tubes*. When it's done right you hear ***tone*** that's more musical, appealing, and *less fatiguing*. ***Tone*** that takes you in, invites and inspires

Continued on next page ➔

more playing. ***Tone*** that gives you an emotional experience. It's all about musicality that's virtually impossible without the right *transformers*.

Kick-starting your *tone*

There's no short-cut to building quality *transformers*. That's why ***Mercury*** plays such an important role in your music. We provide you with the key components in the chain between your guitar and the ear. But, we can only get there with uncompromising engineering expertise, the uncommonly high quality of our materials, our unique and proprietary "recipes," and craftsmanship unlike anywhere else in the world.

It costs a lot more to produce zero-compromise *transformers*. But the result is that musicians everywhere tell us how much they *love* our products. We believe that when you've heard how ***Mercury*** *transformers* can improve your sound, you'll be hooked, too.

Using this *Upgrade Kit*

Be sure to read through this entire manual before beginning to modify your amp. If you are not comfortable or unsure in any way, we recommend that you take your ***Kit*** and amp to a qualified ***Mercury*** installer. For an amp tech near you, please call, *Skype (a popular web-based telephone service)*, write or email us for a referral (worldwide).

Working on any electronic device is potentially hazardous. To perform this ***Upgrade*** you should have at least completed a basic electronics assembly class, or know someone who can safely guide you.

It's easy to damage your amp. While most things are repairable the "learning experience" could cost you.

That said, we've attempted to break this manual down into a series of easy-to-follow, sequential steps – almost "paint-by-number." We're aware that this style may put off someone with old-school training, but our intention is to help the broadest possible spectrum of those wishing to make the ***Upgrade***. The photos and illustrations in this manual will minimize guesswork or interpretation issues.

There's a lot to be said about rolling your own, but if you have a case of *tinkeritus* we recommend that you install the ***Upgrade*** as documented here – do it ***first*** – before considering or experimenting with any other modification. In this way you'll have a good ***tonal*** reference for other mods you may choose to make.

The ***Upgrade*** requires a radical modification of your amp's main PCB (printed circuit board), replacing the *power* and *output transformers*, with the addition of a ***Mercury*** "Mini-Choke." Our *Mini-Choke* replaces a resistor on the original PCB and adds a noticeable amount of ***dynamic headroom*** (WOW! factor) to the circuit.

Note that all amps of this type are divided into three sections: power supply, preamp and power amp. Learning about and understanding these fundamental principles, along with how the amp's *transformers* and *choke* interact, will take you a long way to wringing the most from any tube-based amp.

Your feedback

Would you like to help us make even better ***Upgrade Kits*** in the future? Or, would you like to share your ideas, experiences or perhaps a sound clip or Youtube? Your friends at ***Mercury*** care about what you have to say, and welcome your feedback and contributions to this project.

Send comments, suggestions, video, relevant links, photos and sound samples to:

Kits@MercuryMagnetics.com
or call us at **(818) 998-7791**

On behalf of the staff of ***Mercury Magnetics***, thank you again for putting your trust in us.

You've made the *Mercury Upgrade* – *now* you're ready to play!

Table of Contents

CAUTION! The voltages in your amplifier can be dangerous. Transformers and chokes are not user servicable parts. Installation of these components should always be performed by an experienced technician. The simple ability to use a soldering iron is not enough to qualify a "do-it-yourself person." Those who are inexperienced in working with electronic circuits should never attempt to service their amplifiers. Household line currents can be deadly!! Transformers, chokes and large filter capacitors can store dangerous charges for several days, or longer, after the amplifier has been unplugged. Never touch the terminals of these components without being certain of their charge status. Risk of shock and damage to equipment may result from mishandling and/or improper use of these components. Please use common sense and always think safety first. After all, great tone is most enjoyed when you are alive to hear it.

SOLDERING NOTE: ***VOX's AC4tv*** is assembled using *RoHS* compliant, lead-free solder. Working with lead-free solder is different than standard solder. Generally a hotter iron is necessary. For more information we recommend doing a web-earch for "lead-free soldering techniques."

PULL TEST: After reassembly, make sure that all of the clip connectors from the transformers to other amp components are secure. To be sure, give the clips a tug with a set of needlenose pliers. If a clip slips off relatively easily, you'll need to reshape or crimp it so that it'll hold securely.

DO NOT POWER UP THE AMP WITHOUT TUBES!

CAPACITOR DISCHARGE WARNING: Safe discharging of *filter* capacitors matters. It is essential for your safety and to prevent damage to the amp's circuitry, that large or high voltage capacitors be fully discharged before measurements are made, soldering is attempted, or the circuitry is touched in any way. For information on how to do this, web-search "capacitor discharging." Also see the appendix for additional information.

CAPACITOR POLARITY: Note that many capacitors have positive and negative polarity, and are stamped accordingly. Be sure that their polarity is correct when soldering to a PCB.

BRAIDING, TWISTING AND COILING LEADS: Do not braid, twist or coil the power transformer's B+ lead wire. Check our reference illustrations and photos to see which leads are twisted together. Typically only the filament leads of the power transformer. Other positioning of leads may be necessary to minimize amp noise. Follow are diagrams and instructs for optimal performance.

TRIMMING TRANSFORMER LEADS: To minimize noise, measure and trim the solderable lead lengths of the transformers and ***Mini-Choke***™. Route all wires cleaning around the tubes, chassis, *etc.*

CLIPPING *vs.* UNSOLDERING PCB COMPONENTS: To make this ***Upgrade*** it will be necessary to remove several components from the Main PCB of the amp. Due to quality issues with modern off-shore PCB manufacturing, it can be difficult to unsolder an item without creating other problems, the most typical of which is an eyelet detaching from the PCB. Therefore we've indicated which components should be clipped vs. unsoldered. To unsolder heat your iron to 800ºF, then very quickly heating up one side of the existing solder connection while pulling it through on the other. If the iron is not hot enough, or you linger too long, the eyelet will get damaged (or fall off). If this happens you'll have to fabricate a repair, or created a jumper to a trace. See this manual's appendices for tips.

POWERING UP A GUITAR AMP: After making any modifications to an amp's circuit (e.g. this ***Upgrade***) use a *Variac* along with an current meter (some have both) to slowly apply power to the amp while checking for warning signs of circuitry errors or shorts. See the section on "Using a Variac" at the end of this manual.

LOADING OUTPUT TRANSFORMERS: You must connect a speaker or speaker cab to your amp before powering it up. Without a load the output transformer will blow.

MINI-CHOKE FACTOID: A ***Mercury Mini-Choke***™ replaces a resistor and adds a disernable amount of tonal dimension to the circuit.

TRANSFORMER BREAK IN PERIOD: As a general rule, transformers require approximately 30 hours of ***playing time*** to be fully broken in. Please refer to ***Mercury's*** website for more information.

BE SAFE! ALWAYS USE PROTECTIVE EYEWEAR!

Parts List

Transformers:

- **Mercury Axiom** 120V power transformer (part #: VXP-AC4-RE REV. 3) or 1
- **Mercury Axiom** 240V power transformer (part #: VXP-AC4-RE-240) 1
- **Mercury Axiom** output transformer (part #: VXO-AC4-95) 1
- **Mercury Axiom *Mini-Choke*™** (part #: VXO-AC4-CH) 1

Power Diodes:

- IN4007 (black with white band) 2

Capacitors:

- 47μF (electrolytic / radial / 35V 85°C) 1
- 10μF (electrolytic / radial / 50V 85°C) 1
- 10μF (electrolytic / radial / 350V 85°C) 1
- 47μF (electrolytic / radial / 350V 85°C) 1
- 22μF (electrolytic / radial / 350V 85°C) 1
- 22μF (electrolytic / radial / 25V 85°C) 1
- 47ρF (silver mica / 500V) 1
- 680ρF (silver mica / 500V) 1
- 0.047μF (mylar / 400V) 1

Resistors:

- 2.7KΩ (1 watt / metal oxide (flame-proof) / color code: red, violet, red) 1
- 47KΩ (.5 watt / carbon film / color code: yellow, violet, orange) 1
- 470Ω (.5 watt / carbon film / color code: yellow, violet, brown) 1
- 470KΩ (.5 watt / carbon film / color code: yellow, violet, yellow) 1
- 3.9KΩ (.5 watt / carbon film / color code: orange, white, red) 1
- 15KΩ (.5 watt / carbon film / color code: brown, green, orange) 1
- 2.2KΩ (.5 watt / carbon film / color code: red, red, red) 1
- 68KΩ (.5 watt / carbon film / color code: blue, grey, orange) 1
- 100KΩ (.5 watt / carbon film / color code: brown, black, yellow) 1
- 22KΩ (.25 watt / carbon comp / color code: red, black, orange) 1

Misc. Components:

- Audio taper potentiometer (A1M) replacement for “Volume” control 1
- Coil of shielded filament wire 20 gauge . . . . . ~12"
- Coil of clear insulation tubing spaghetti . . . . . ~12"
- Coil of unshielded filament wire for jumpers . . . . . ~12"
- Stand-off assembly 1
- Cable ties – 6" 5
- No. 8 – 1/2" wood screws (to mount ***Mini-Choke***) 2
- Instructional CD-ROM 1
- **Mercury** metal badge 1
- **Mercury** guitar case sticker 1

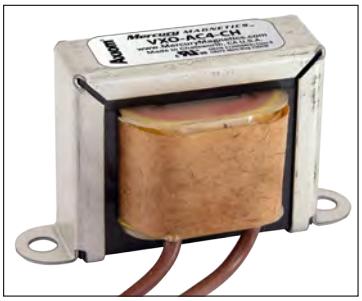
Recommended tools for this project:

- Good quality solder iron (capable of temps at > 800ºF)
- Electronics grade solder
- Solder sucker and/or wick
- *Dremel Tool* with 1/16" bit, reamer and small grinder*
- Set of screw drivers (Philips)
- *Exacto* knife for cutting and scraping PCB traces*
- Small needle-nose plyers
- Wire strippers
- *Loctite 290* (green)
- Pure isopropyl alcohol and Q-tips
- *Variac* and current meter

**Dremel Tool* can be used to cut traces and drill holes in PCB.

AXIOM® Power Transformer
VXP-AC4-RE REV. 3 (120V) or
VXP-AC4-RE-240 (240V)

AXIOM® Output Transformer
VXO-AC4-95



AXIOM® Mini-Choke™
VXO-AC4-CH

RESISTORS (carbon film)

1x 470Ω 1/2W (yellow/violet/brown/gold)
1x 47KΩ 1/2W (yellow/violet/orange/gold)
1x 470KΩ 1/2W (yellow/violet/yellow/gold)
1x 2.2KΩ 1/2W (red/red/red/gold)
1x 3.9KΩ 1/2W (orange/white/red/gold)
1x 15KΩ 1/2W (brown/green/orange/gold)
1x 68KΩ 1/2W (blue/grey/orange/gold)
1x 100KΩ 1/2W (brown/black/yellow/gold)

RESISTORS (carbon composition)

1x 20KΩ 1/4W (red/black/orange/gold)

RESISTOR (metal oxide / flame proof)

1x 2.7KΩ 1W (red/violet/red/gold)

POWER DIODE

2x IN4007 (black with white band)

CAPACITORS (silver mica)

680±5% 500V SM — 1x 680pF 500V
47±5% 500V SM — 1x 47pF 500V

CAPACITOR (mylar)

Suntan 2G473K — 1x .047µF 400V

CAPACITORS (electrolytic)

1x 10µF 350V 85°C — 10µF 350V 85°C
1x 22µF 350V 85°C — 22µF 350V 85°C
1x 47µF 350V 85°C — 47µF 350V 85°C
1x 47µF 35V 85°C — 47µF 35V 85°C
1x 22µF 25V 85°C — 22µF = 25V 85°C
1x 10µF 50V 85°C — 10µF = 50V 85°C

Note that electroyltic capacitors have polarity. Be sure to study the schematics for the correct directions when ***Upgrading*** your amp.

1x Stand-off kit

2x #8 – 1/2" wood screws

1x 1M audio taper potentiometer with nut and washer

Instructional CD ROM

5x Cable ties (6 in.)

EQUIPPED WITH The Heart & Soul of Your Amp Mercury MAGNETICS California, USA www.MercuryMagnetics.com

Mercury metal nameplate

The Heart & Soul of Your Amp Mercury MAGNETICS

Mercury guitar case sticker

~12 in. coil — 20 gauge shielded wire

~12 in. coil — Insulated wire "spaghetti"

~12 in. coil — Unshielded filament wire

Version: 02-24-11

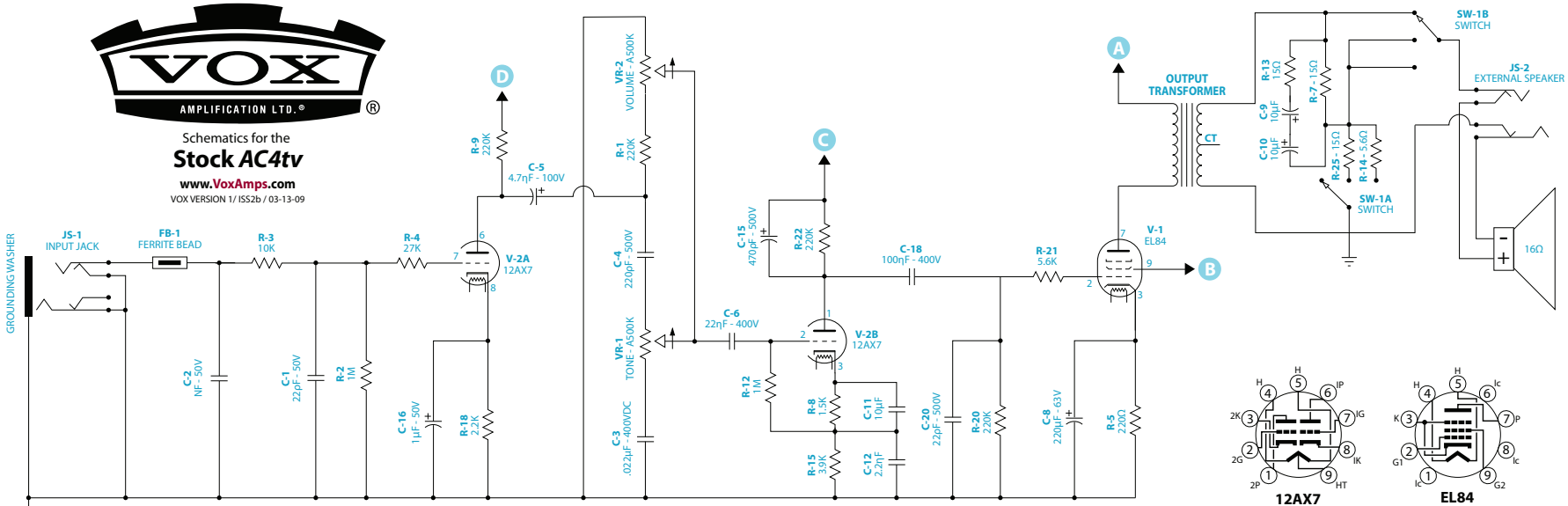
VOX AMPLIFICATION LTD.®

Schematics for the

Stock *AC4tv*

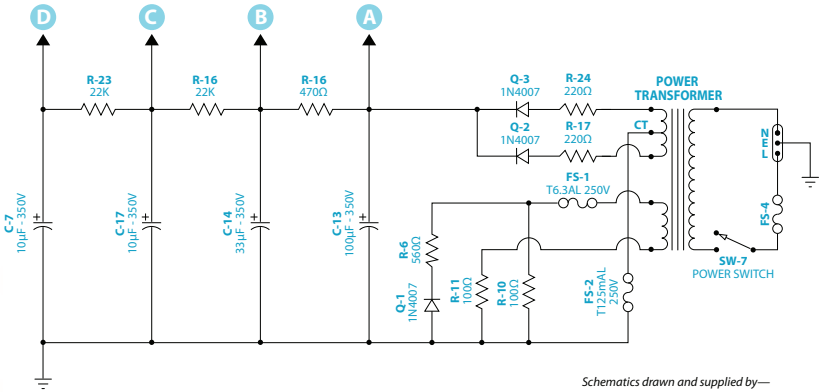
www.VoxAmps.com

VOX VERSION 1/ ISS2b / 03-13-09



AC4TV Combo

AC4TVH (Head)
with
V112TV
Speaker Cabinet



Schematics drawn and supplied by—

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Mercury MAGNETICS

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VERSION: 05-13-10

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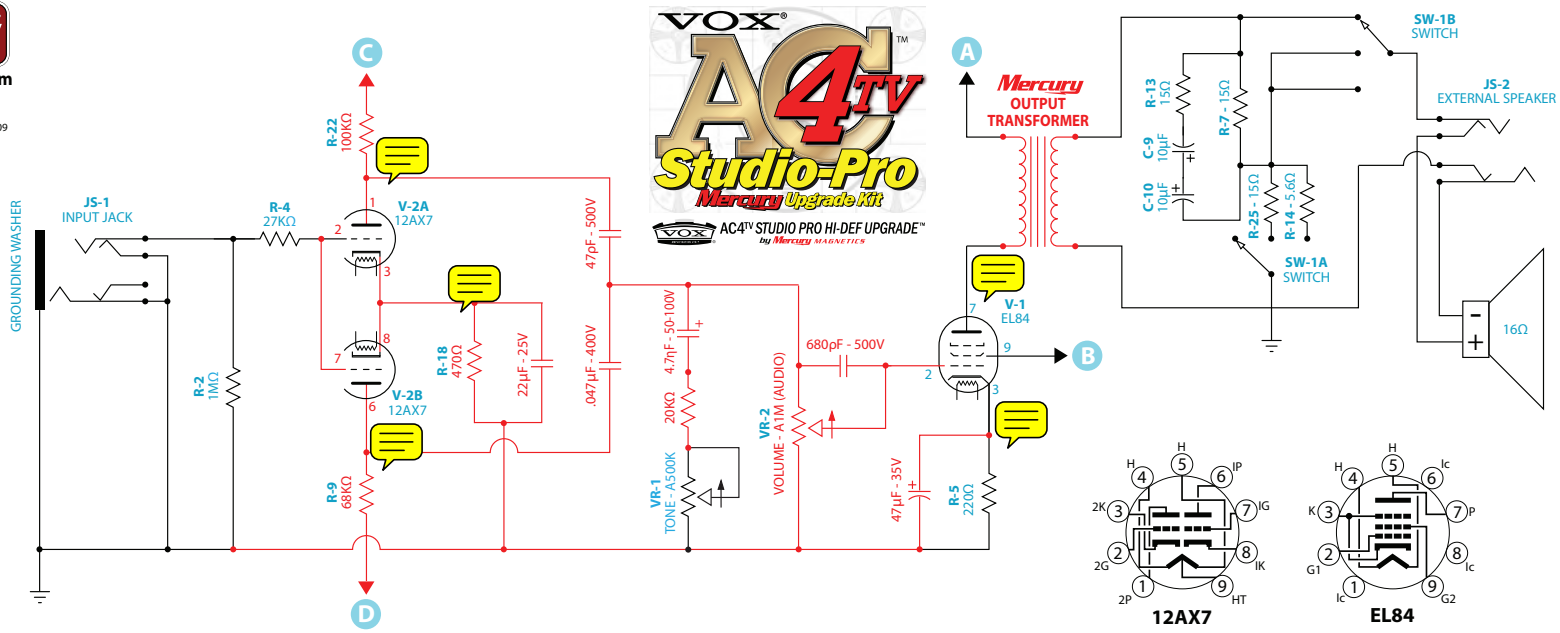
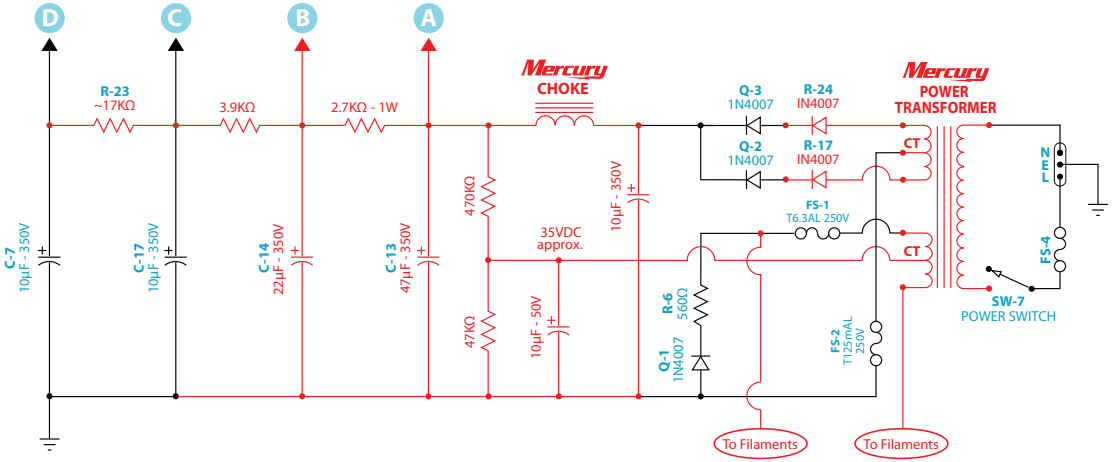
For the VOX AC4tv PCB version 1 / ISS2b / 03-13-09
Mercury versions: 09-10-09 (original), 02-21-11 (current)

Notes:
1. Unless otherwise stated all resistors are carbon film .5 (1/2) watt.
2. RED indicates modifications to the original PCB circuit.
3. See accompanying parts list for a more detailed specifications of the new components.



Axiom®
Next-generation guitar amplifier transformers Mercury MAGNETICS



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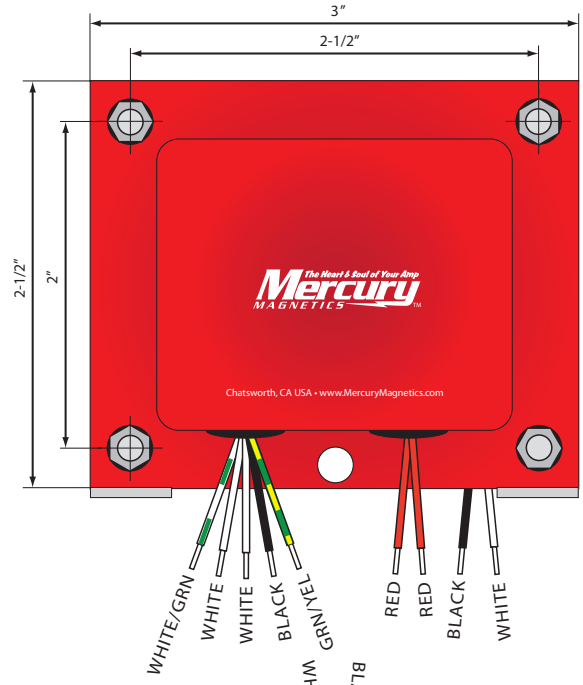
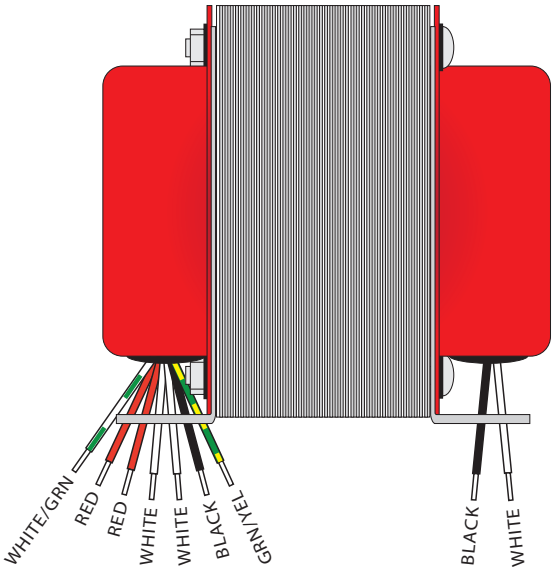
VXP-AC4-RE
REV. 3

120V Version





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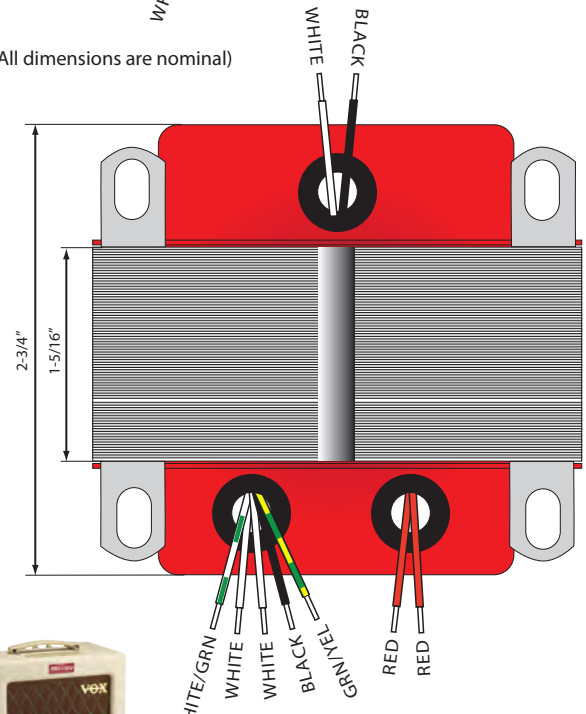
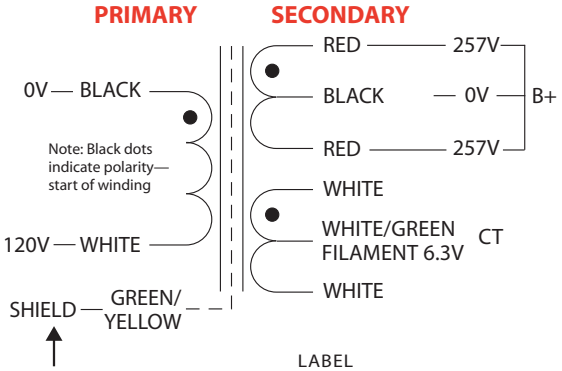
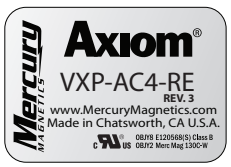




Note: Grounding of the *Faraday Shield* is optional. It may reduce noise depending upon the source of the ground.

LABEL



For upgrading the ***VOX AC4tv*** combo or ***AC4tvH*** head

TYPE: Power Transformer
MOUNTING: Horizontal Mount
CLASS: Axiom®

PART NO.: VXP-AC4-RE
ORIGINAL VOX PART NO.: 076-AC4U
DATE: 01-27-11 (Rev. 3)

VXP-AC4-RE REV. 3

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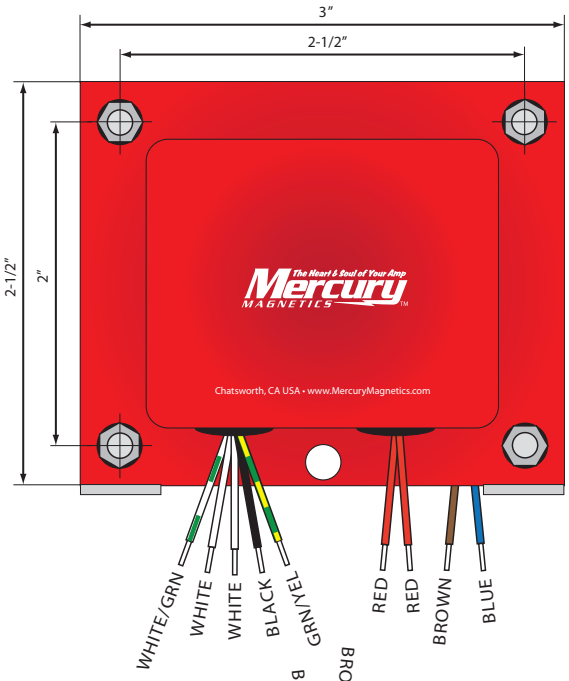
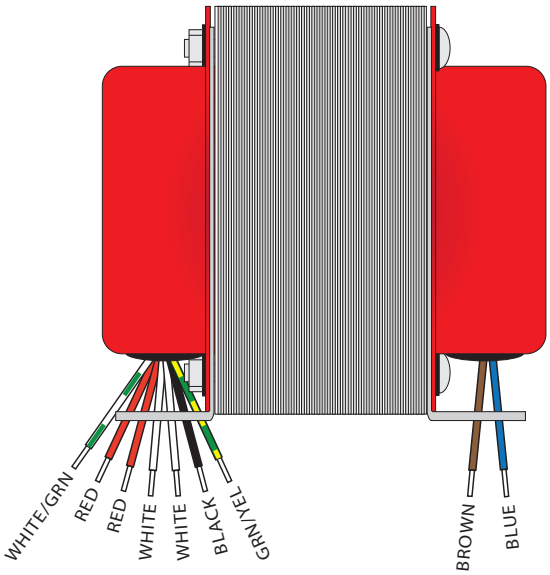
VXP-AC4-RE-240

240V Version





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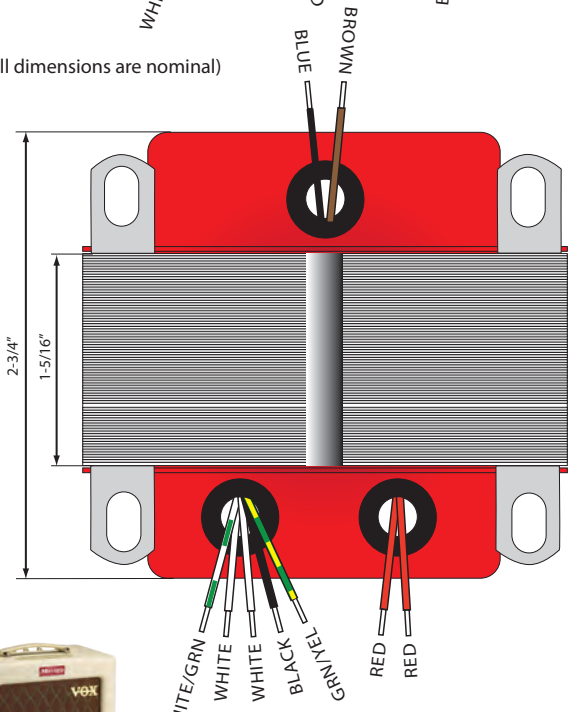

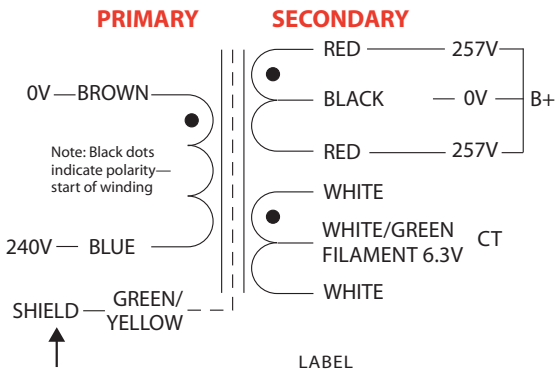

Note: Grounding of the *Faraday Shield* is optional. It may reduce noise depending upon the source of the ground.

LABEL

For upgrading the ***VOX AC4tv*** combo or ***AC4tvH*** head

TYPE: Power Transformer
MOUNTING: Horizontal Mount
CLASS: Axiom®

PART NO.: VXP-AC4-RE-240
ORIGINAL VOX PART NO.: 076-AC4U
DATE: 02-22-11

VXP-AC4-RE-240

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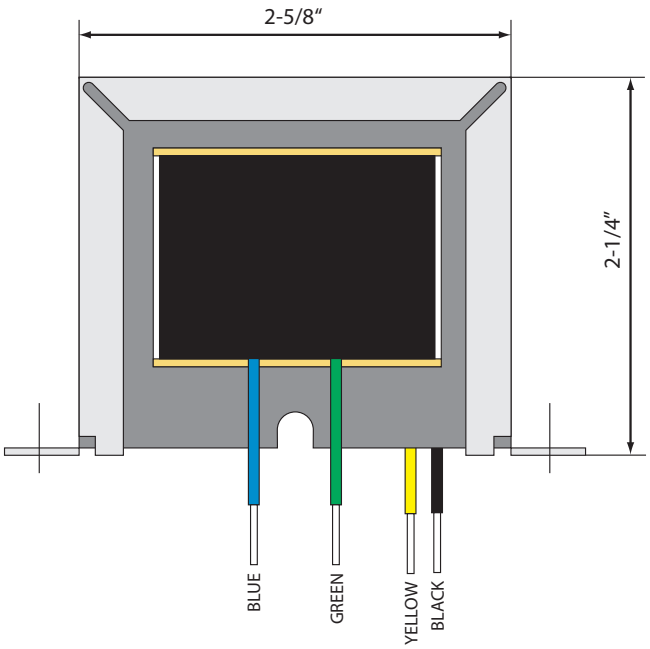
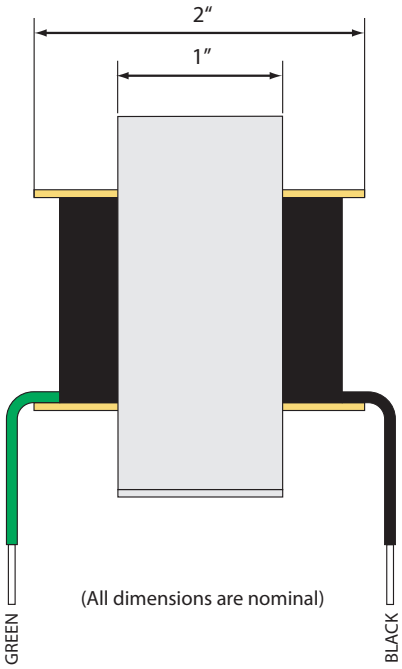
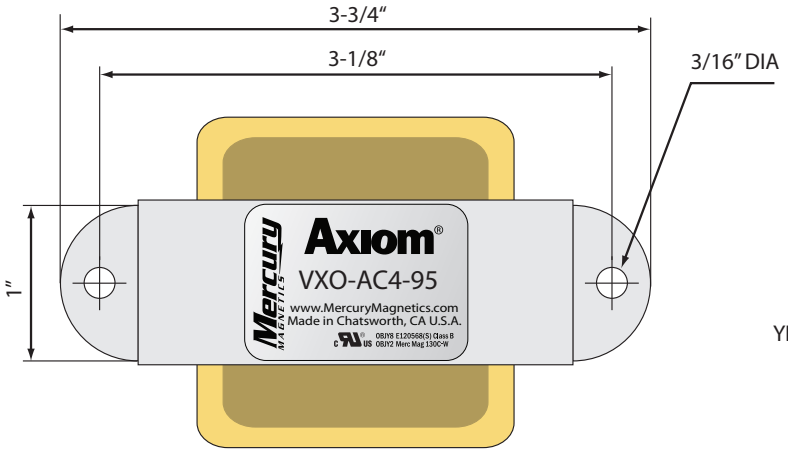
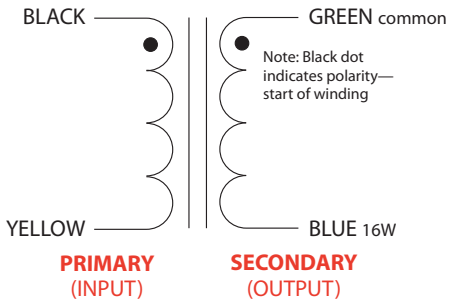
VXO-AC4-95









VOX AC4TV Studio-Pro Mercury Upgrade Kit

For upgrading the ***VOX AC4tv*** combo or ***AC4tvH*** head

MOUNTING: Horizontal A-Frame
POWER RANGE: Our OTs are rated to handle up to 50% more power than the original manufacturer spec.
CLASS: Axiom®
TYPE: Single-ended output transformer
PART NO.: VXO-AC4-95
ORIGINAL VOX PART NO.: 066-AC4 OPT
DATE: 01-27-11

VXO-AC4-95

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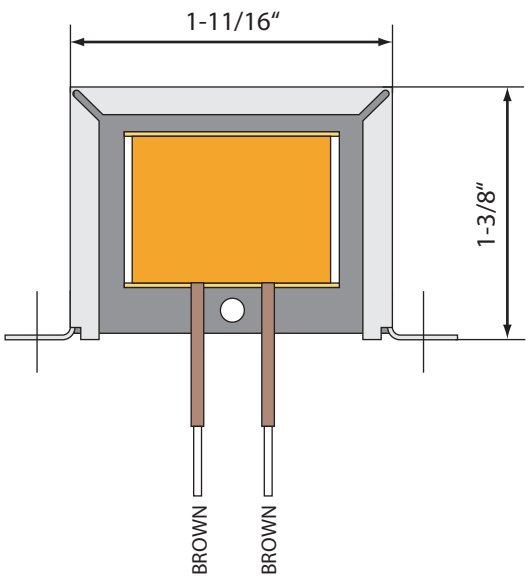
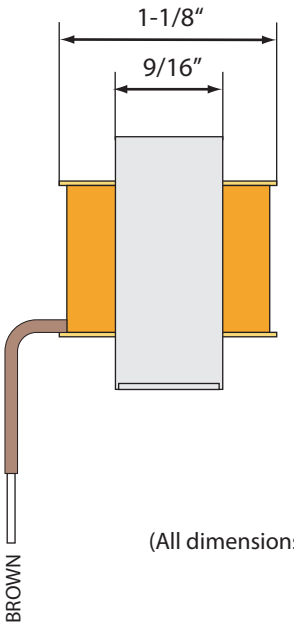
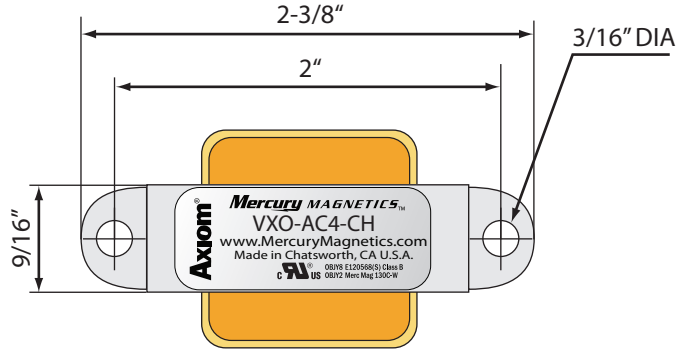
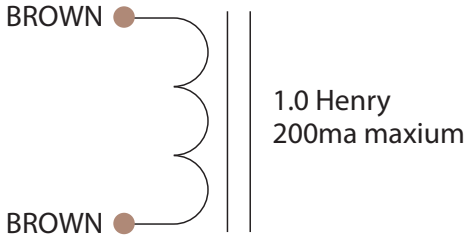
VXO-AC4-CH





(All dimensions are nominal)





VOX AC4TV Studio-Pro Mercury Upgrade Kit

For upgrading the ***VOX AC4tv*** combo or ***AC4tvH*** head

MOUNTING: Horizontal A-Frame
POWER RANGE: 1 Henry / 200ma max.
CLASS: Axiom®
TYPE: Mini-Choke™
PART NO.: VXO-AC4-CH
ORIGINAL VOX PART NO.: N/A

DATE: 11-17-09
REVISION: N/A

VXO-AC4-CH

Step-by-Step

An Overview of the *Upgrading* Process

The following outlines the sequence you'll follow to apply the ***Mercury Upgrade Kit*** to your ***VOX AC4tv's*** chassis. Both the head and combo have identical chassis, therefore all instructions, other than the direct speaker connection for the combo versions, is exactly the same. Also be sure to read through the various appendices for helpful hints and tips.

1st SEQUENCE

You're about to strip your stock ***VOX AC4tv*** and prepare it for the ***Mercury Upgrade***. It's good practice to place all of the components you remove into holding containers so they are easy to locate and won't get lost. Most of the components you are stripping will not be used again. But hold onto everything for now until your ***Upgraded*** amp is up and running.

Let's get started:

1. Unplug the amp from the power source (AC).
2. Remove all chassis retaining screws from the back and the two on the top of the amp.
3. Remove the chassis from the amp – if you have a combo, disconnect the two speaker wires first.
4. Discharge the capacitors.
5. Remove the following from the Main PCB:
   a. Tubes
   b. Transformer clips (TAG1, 2, 4, 6, 7, 8 and 10)
   c. Pull the Tone and Volume "chicken head" knobs, and remove their retaining nuts/ washers.
   d. Remove the Input jack's retaining nut and washer.
6. Remove the two Main PCB retaining screws/ washers.
7. Carefuly pull the Main PCB out of the chassis and unsolder the red & black LED wires.
8. Unsolder the blue wire going from the Output Transformer to the OP LEVEL switch's PCB.
9. Unclip or unscrew any remaining wires attaching the transformers to the chassis, then unbolt and remove the Power and Output transformers.

2nd SEQUENCE

With the Main PCB removed and completely disconnected from the chassis, the next step is to strip and prepare the board for the ***Upgrade***. Use Figures 1 & 2 for reference.

You will be clipping some components, and unsoldering others. The difference is mainly for speed. Clipped components and their locations will not be re-used*. Whereas unsoldered components, or their locations, will be.

*It is a good idea to not unsolder the components we've recommended to clip (even if you want to). The idea is to save the PCB from unnecessary stress. The Main PCB is made in Asia and not designed to withstand a lot of punishment. As you will see as the ***Upgrade*** progresses, there will be mainy times when it is necessary to make repairs or workarounds to hold the PCB together. Don't be intimidated, though. They're easy to do.

Special note: The solder used in these amps is *RoHS* compliant – a term for a new industry standard that basically means the solder is

lead-free. This also means that you'll need to use a good quality iron running hotter than traditional solder melting temperatures (set it for about 800° F). Although *RoHS* compliant solder melts at higher temps than the original soldering alloys it's likely you'll be using regular electronics solder for this project. You may also want to do a web search to study up on working with *RoHS* solder.

For drilling or resizing holes we recommend that you use a *Dremel Tool* with a 1/16" bit and a hole reamer bit. A hole reaming bit will come in handy to enlarge existing holes. And a small grinding head will serve as a trace-cutter. A sharp pocket knife or *Exacto* is recommended for carefully scraping away PCB insulation to reveal traces.

See appendixes for special instructions regarding trace cutting, trace revealing, and adding jumpers.

1. Use the illustrations on the following two pages to strip the board in this order:
   e. Clip items
   f. Unsolder items
   g. Hole drilling and enlarging
   h. Cut traces
   i. Reveal traces
   j. Add jumpers
2. Carefully compare your stripped and modified Main PCB so that it matches the illustrations in this sequence. A missed step or mistake will bite you later on. Take your time to do a methodical and thorough approach.

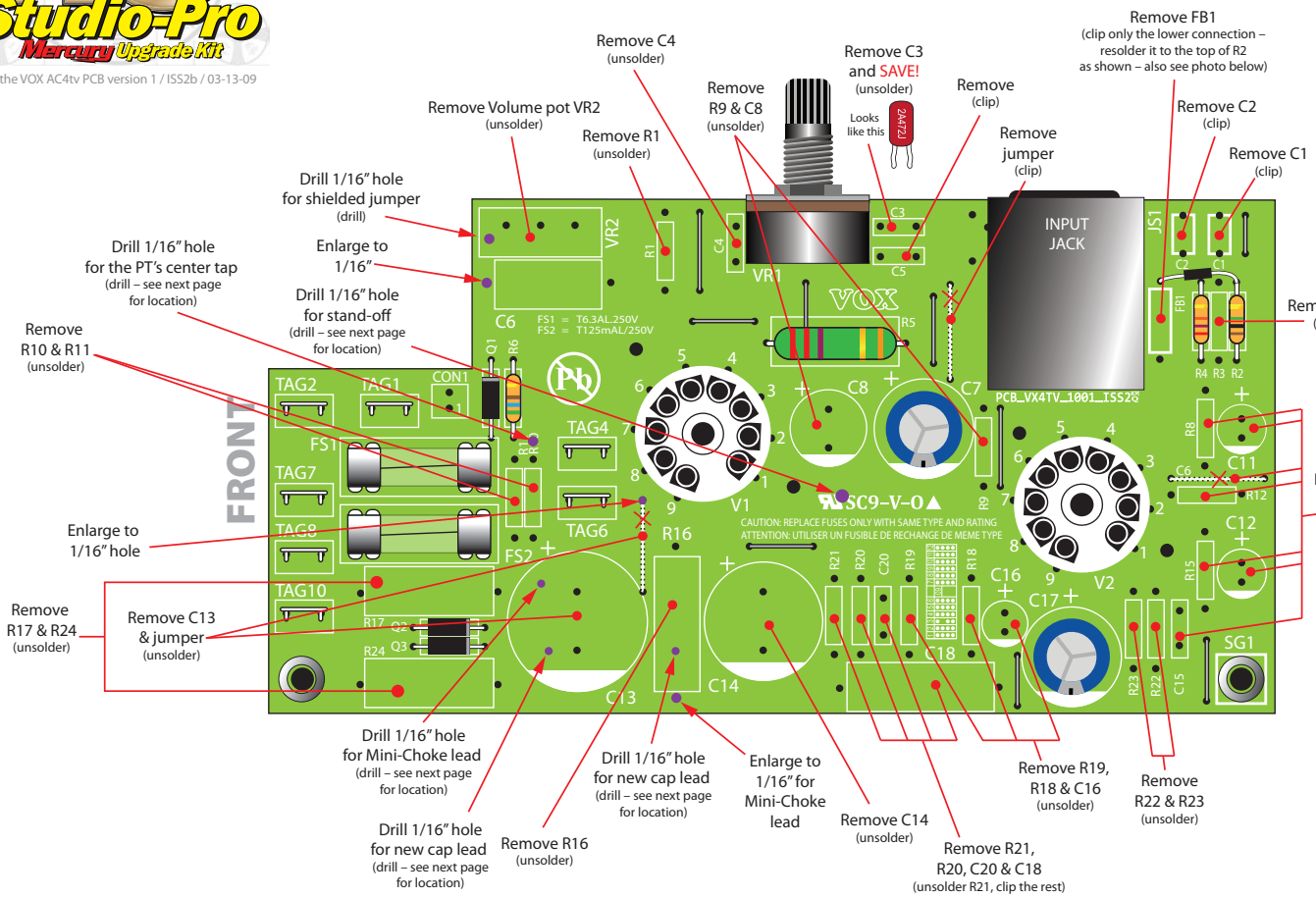
VOX AC4TV Studio-Pro Mercury Upgrade Kit

For the VOX AC4tv PCB version 1 / ISS2b / 03-13-09

Figure 1

STRIPPING & PREPPING THE MAIN PCB

NOTE: THESE DIAGRAMS ARE NOT PRECISELY TO SCALE



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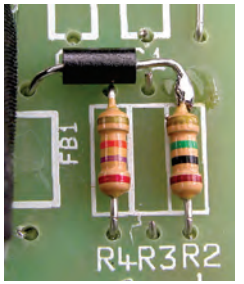
VOX AC4TV PCB version 1/ ISS2b / 03-13-09



Detail of FB1 modification

Description: In preparation for the *Mercury Upgrade Kit* follow the diagrams on this and the next page to strip and prep the Main PCB. We've indicated the components that should be clipped *vs*. unsoldered. See appendices for special instructions on what to do if one of the PCB's eyelets is accidentally detached. Do not fully remove FB1 (ferrite bead) – instead, reconnect to R2 as shown. Also, carefully remove C3 (4.7ηF cap) – because you're going to be re-use it in another location of the tone circuit.

The next page shows the underside of the PCB and gives the locations of trace cuts and trace reveals. Also, where to add jumpers. To learn about these techniques, see the appendixes of this manual. Note that you'll need to drill several holes in the PCB – use a 1/16" drill bit in a *Dremel Tool* for best results.

Schematics drawn and supplied by—
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Version: 06-14-11

VOX AC4TV Studio-Pro Mercury Upgrade Kit

For the VOX AC4tv PCB version 1 / ISS2b / 03-13-09

Figure 2

STRIPPING & PREPPING THE MAIN PCB

NOTE: THESE DIAGRAMS ARE NOT PRECISELY TO SCALE

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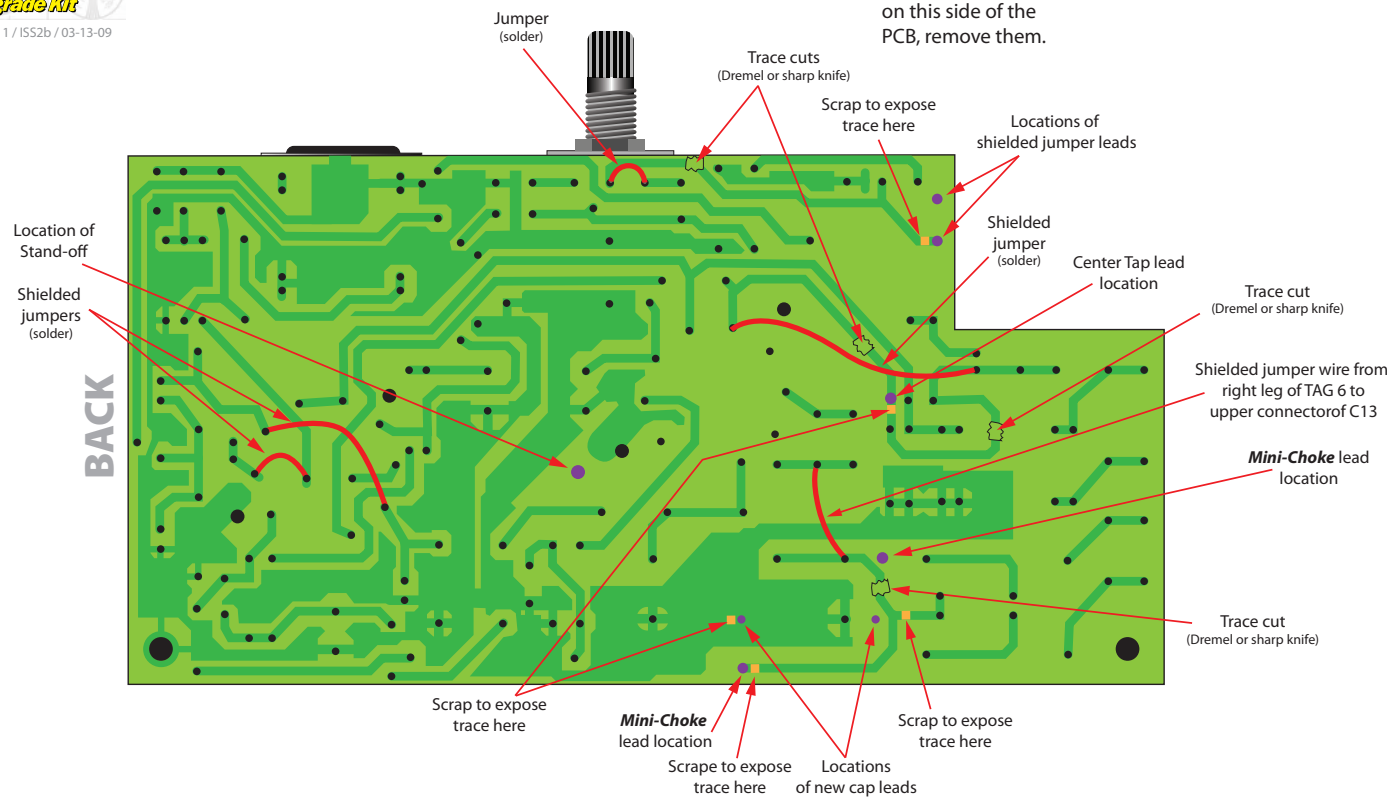

Description: The dark green areas on the back of the PCB represent "traces." Traces are literally flat copper alloy strips that serve the same function as wire. The traces are covered with a thin insulation film. It is sometimes necessary to scrape the film away to "reveal" the trace for soldering wires or making trace repairs. Likewise, you can cut completely through a trace to interrupt a circuit. Not represented on this illustration (in order to make it easier to follow the traces) are the various blobs of solder used to make connections between the various components of the circuit. Holes in the traces intended to pass through components have conductive "eyelets" built into them. And these eyelets, unfortunately, are easily damaged by the high heat of the soldering iron when you work on these Asian-made PCBs. So, don't worry if this happens, even the old pros experience these problems, and there are several workarounds to fix things.

Also note that when you are soldering jumpers or component leads, wires, *etc.*, it will often be necessary to scrape the insulation from a trace in order to have a reliable surface to solder to. Likewise, if there is another terminal on the same trace you may solder to that instead of trying to work with a damaged or missing eyelet. The manual's appendices show several photographic examples that will help make this easier to understand.

Note that holes for pass-through wires, such as the ***Mini-Choke*** or insulated jumpers, will need to be enlarged. If this is necessary, we recommend that you use a *Dremel Tool* with a reaming bit when needed.

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3rd SEQUENCE

In this sequence you'll be adding components to the Main PCB. We've broken down what you'll need to do into a logical set of steps to make it easier. The next few pages of illustrations (Figures 3 thru 8) will guide you through.

Notes:

- Polarity on the electrolytic caps is important (narrow stripe is the negative/ground side).
- Some existing holes may have to be enlarged for some connections. Use a *Dremel Tool* with a reaming bit.
- The PCB's traces and especially the soldering eyelets are easily damaged. See this manual's appendices for trace and jumper damage and repair tips. Eyelets are pass-through holes used to solder components onto the PCB. They join and make contact from one side of the board to the other. Typically an eyelet is made of thin copper or similar conductive metal. If an eyelet is badly damaged there won't be a connection. Please be sure to understand this concept.

For the VOX AC4tv PCB version 1 / ISS2b / 03-13-09

Figure 3

UPGRADING THE MAIN PCB

NOTE: THESE DIAGRAMS ARE NOT PRECISELY TO SCALE

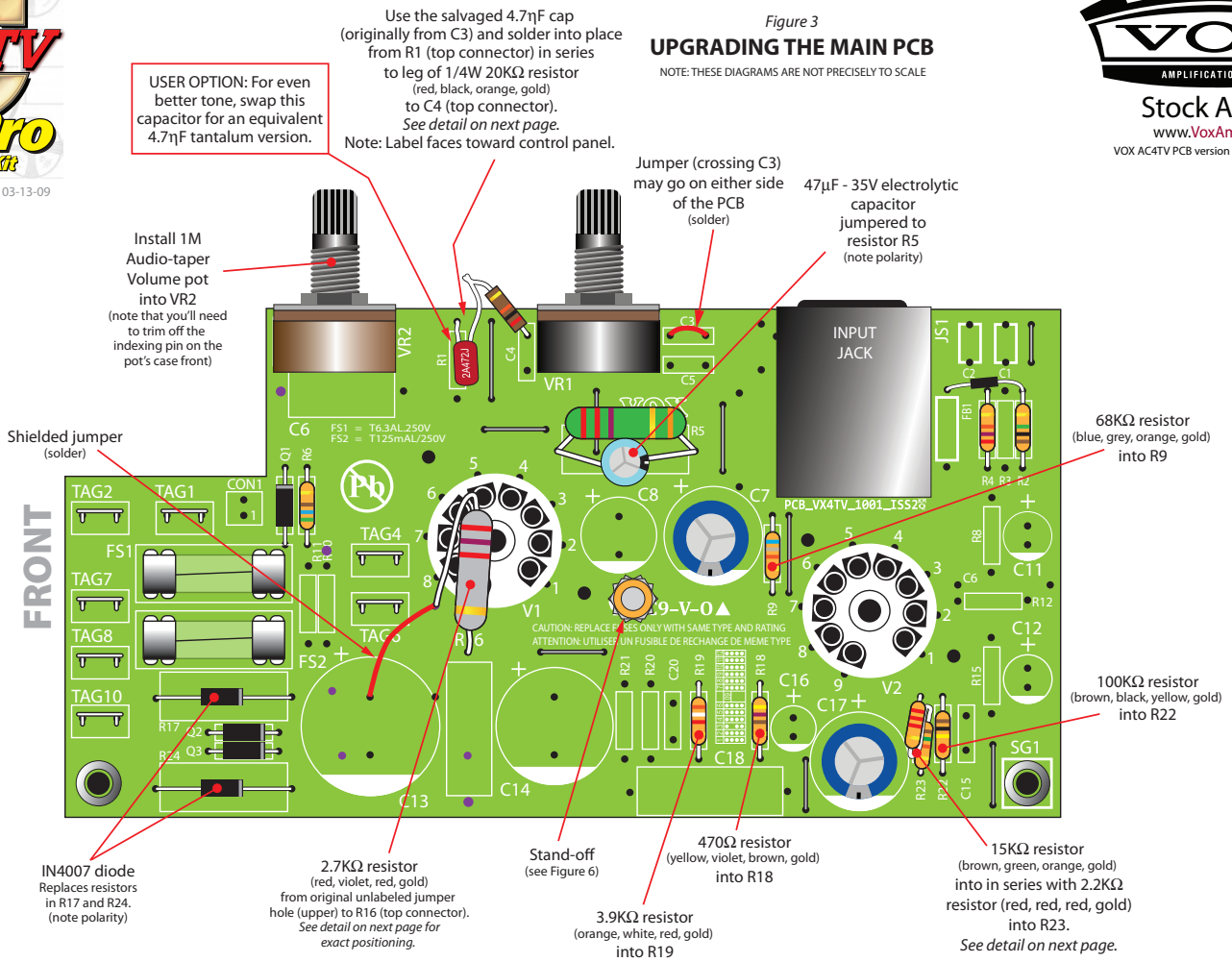

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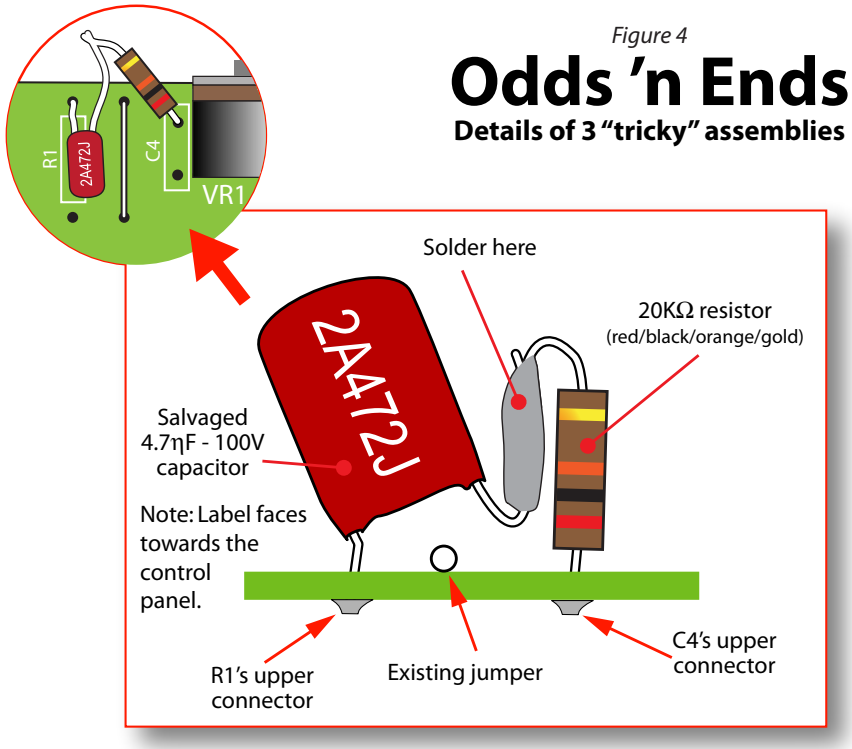
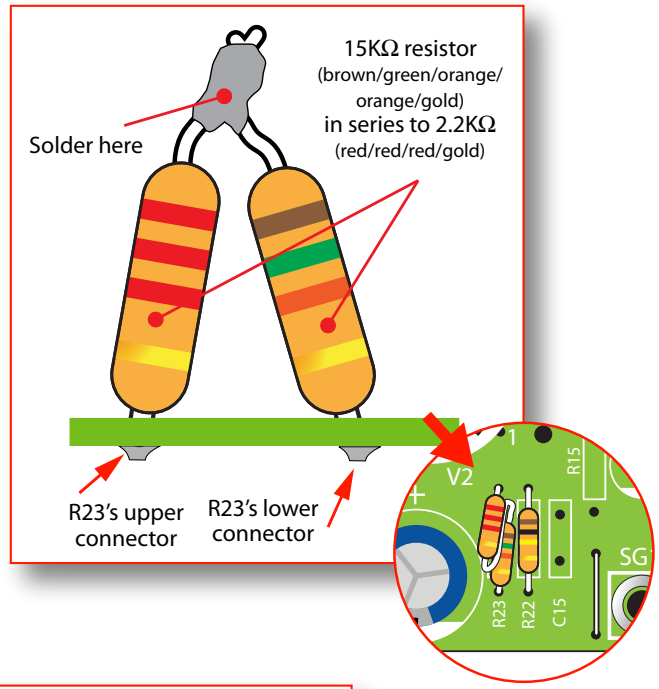
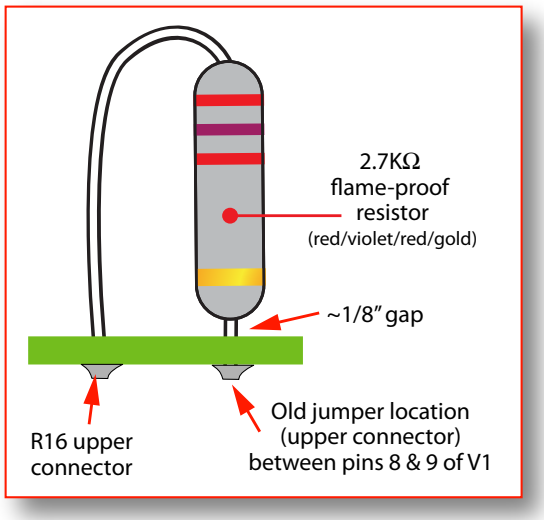
Figure 4

Odds 'n Ends

Details of 3 "tricky" assemblies







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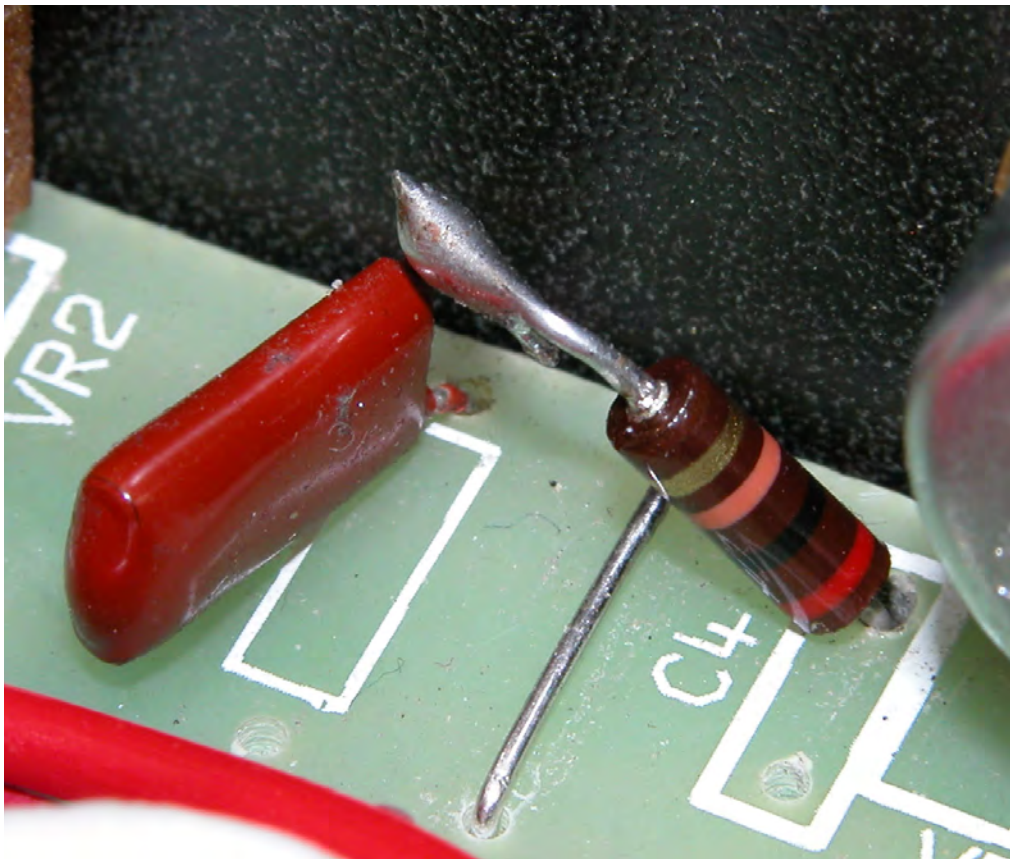
Detail of the 15KΩ resistor in series with the 2.2KΩ resistor as they appear in the ***Upgraded*** amp in location R23.



Detail of the 4.7ηF capacitor in series with the 20KΩ carbon comp resistor as they appear in the ***Upgraded*** amp to the left of the tone potentiometer.

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For the VOX AC4tv PCB version 1 / ISS2b / 03-13-09

Figure 5

UPGRADING THE MAIN PCB

NOTE: THESE DIAGRAMS ARE NOT PRECISELY TO SCALE

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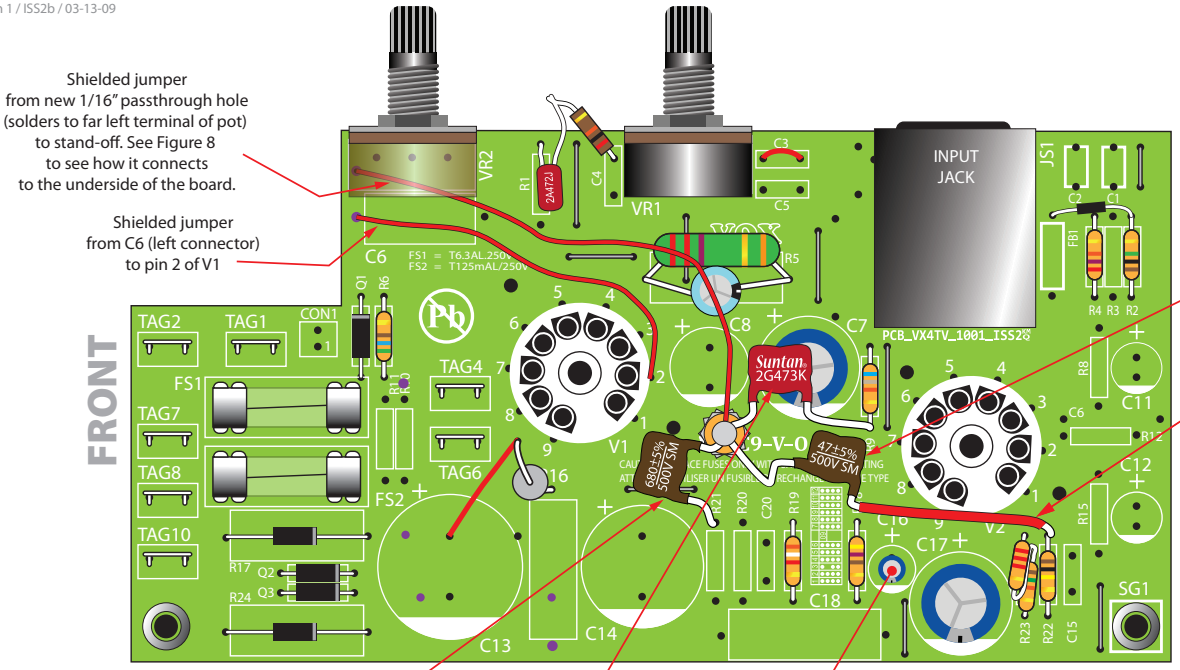

Shielded jumper from new 1/16" passthrough hole (solders to far left terminal of pot) to stand-off. See Figure 8 to see how it connects to the underside of the board.

Shielded jumper from C6 (left connector) to pin 2 of V1

47pF - 500V silver mica coupling capacitor from stand-off to R22 (upper leg)
Note added shielding
(see *Figure 6* for layout)

680pF - 500V silver mica coupling capacitor from stand-off to R21 (upper hole)
(see *Figure 6* for layout)

.047µF - 400V mylar coupling capacitor from stand-off to R9 (lower leg)
(see *Figure 6* for layout)

22µF - 25V electrolytic capacitor into C16
(note polarity)

Description: See the next page for more detailed instructions on how the components connect to the Stand-Off.

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Figure 6

"Stand-off" Connections Detail

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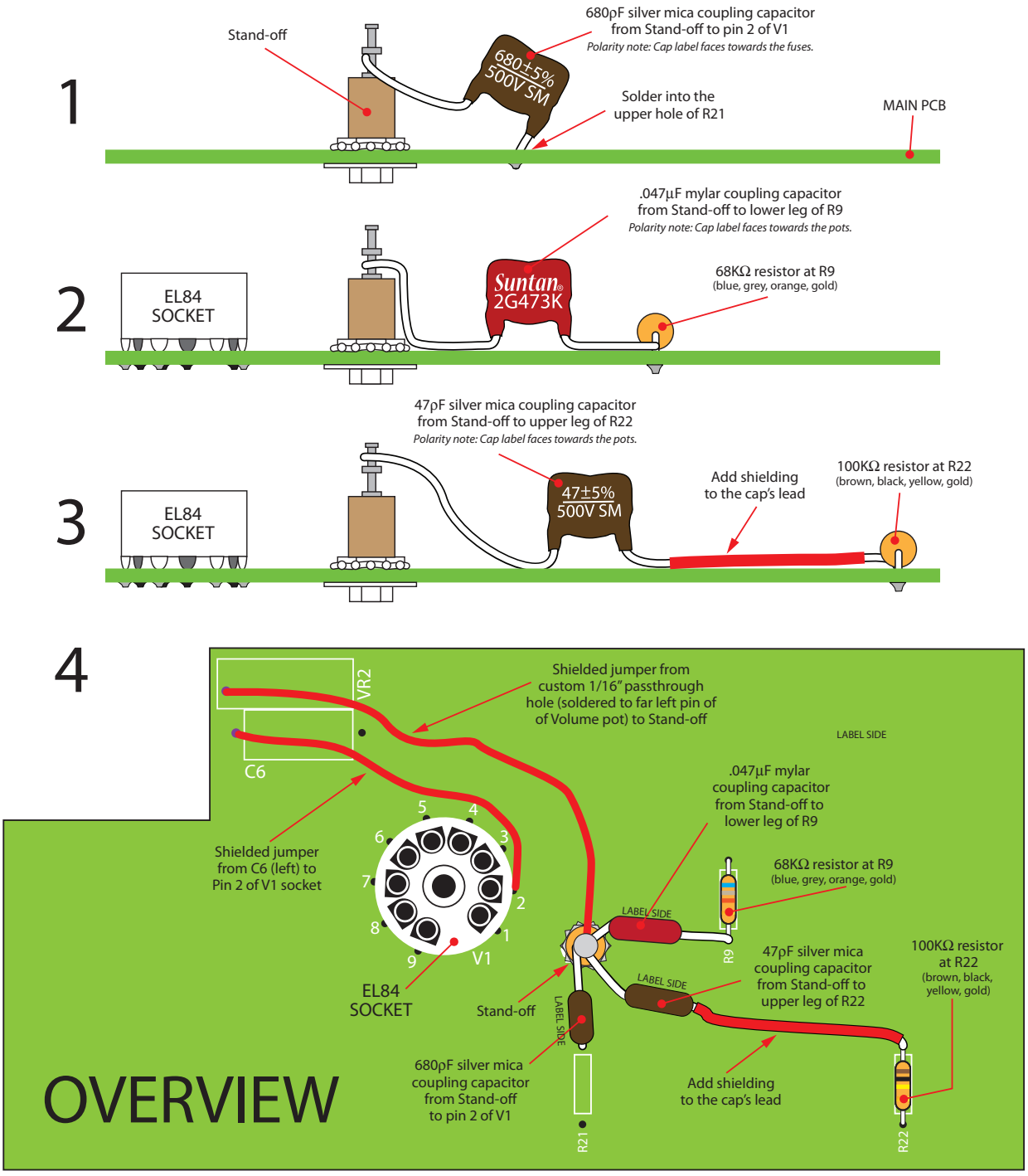
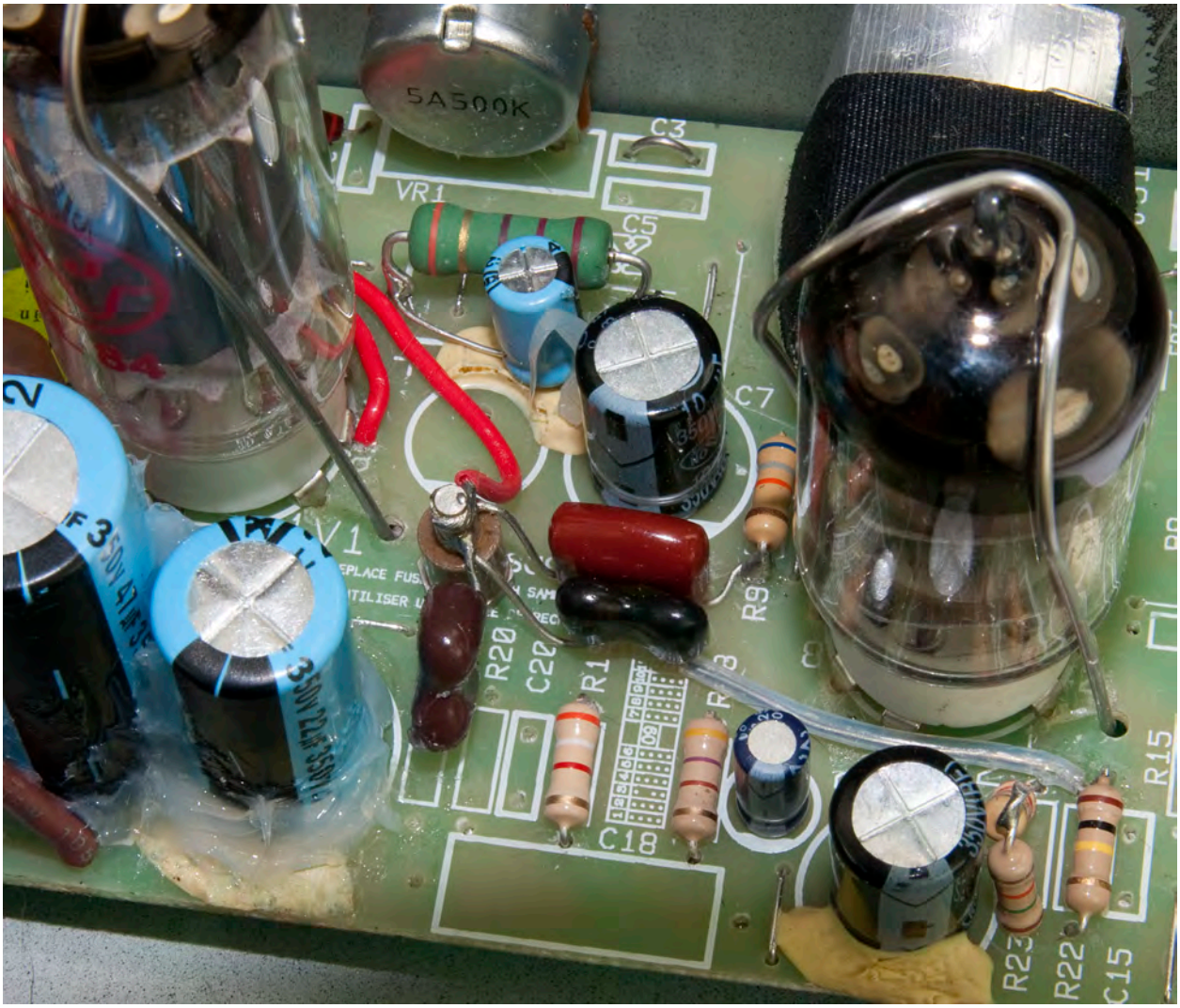


Use the illustrations on this page as a guide to building the connections to the Stand-off. Steps 1–3 are cross-sectional giving the ideal layouts of the three capacitors. Step 4 shows you an isolated overview of the Main PCB with ONLY the related connections to the Stand-off on the Main PCB.



Detail of the Stand-off component cluster on the ***Upgraded*** amp.

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Figure 7

UPGRADING THE MAIN PCB

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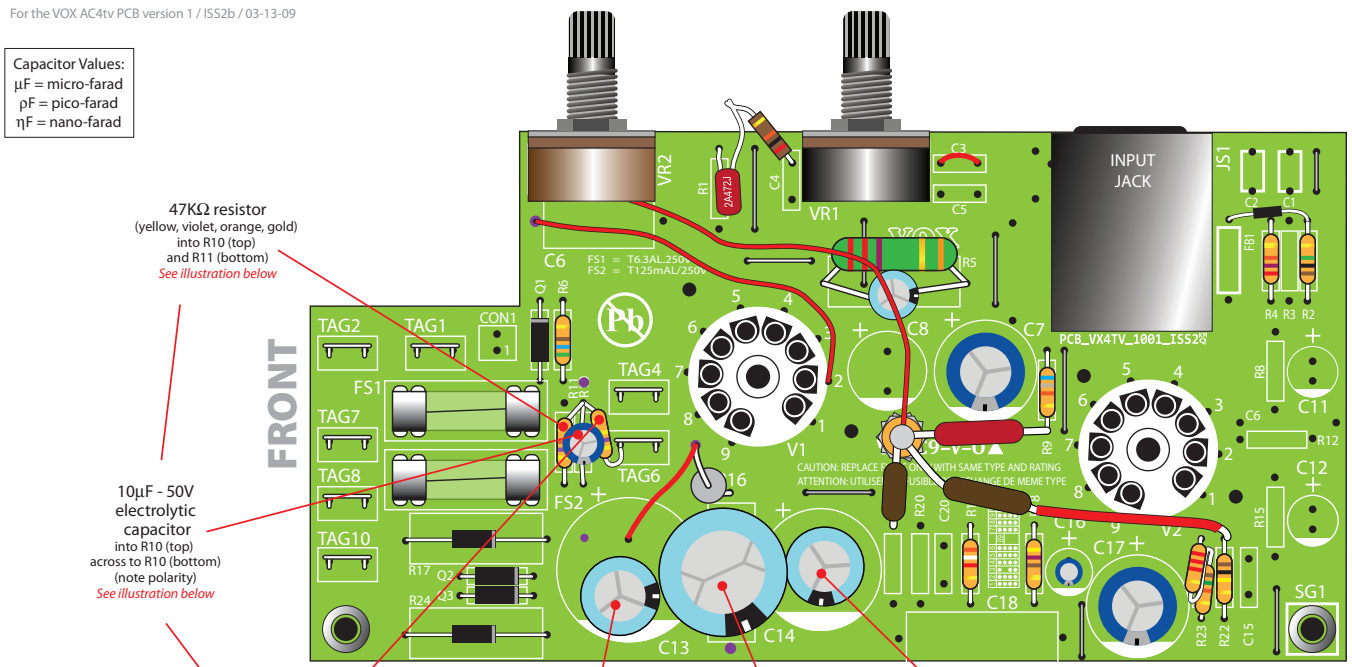
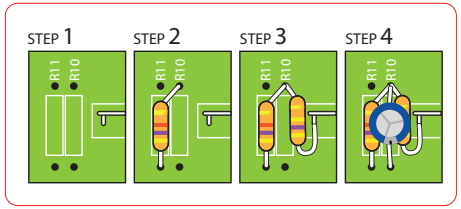
Capacitor Values:
µF = micro-farad
ρF = pico-farad
ηF = nano-farad





Description: Note the polarity of these capacitors. See the next page for how these capacitors connect to the underside of the Main PCB.

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Figure 8

UPGRADING THE MAIN PCB

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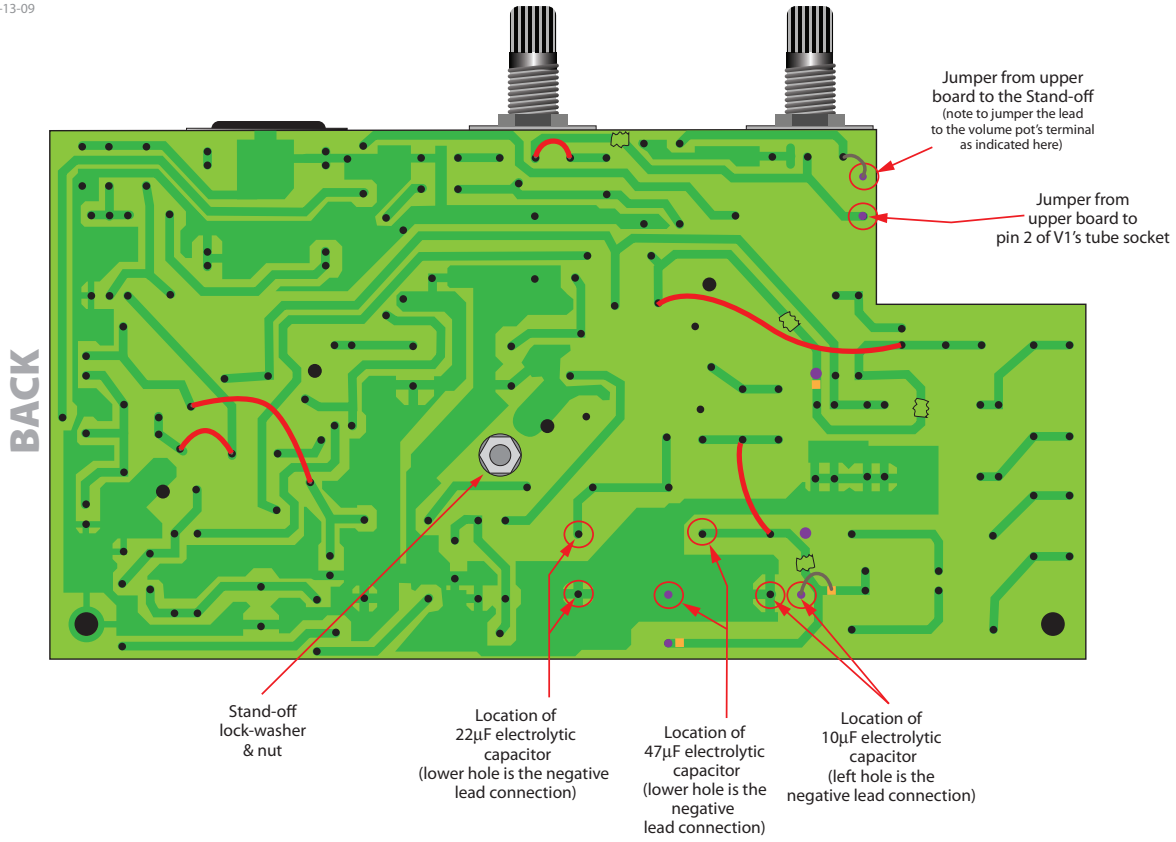

Note: You may need to make trace repairs, or extend leads by soldering them onto revealed traces, *etc*. See appendices for tips and tricks for working with traces.

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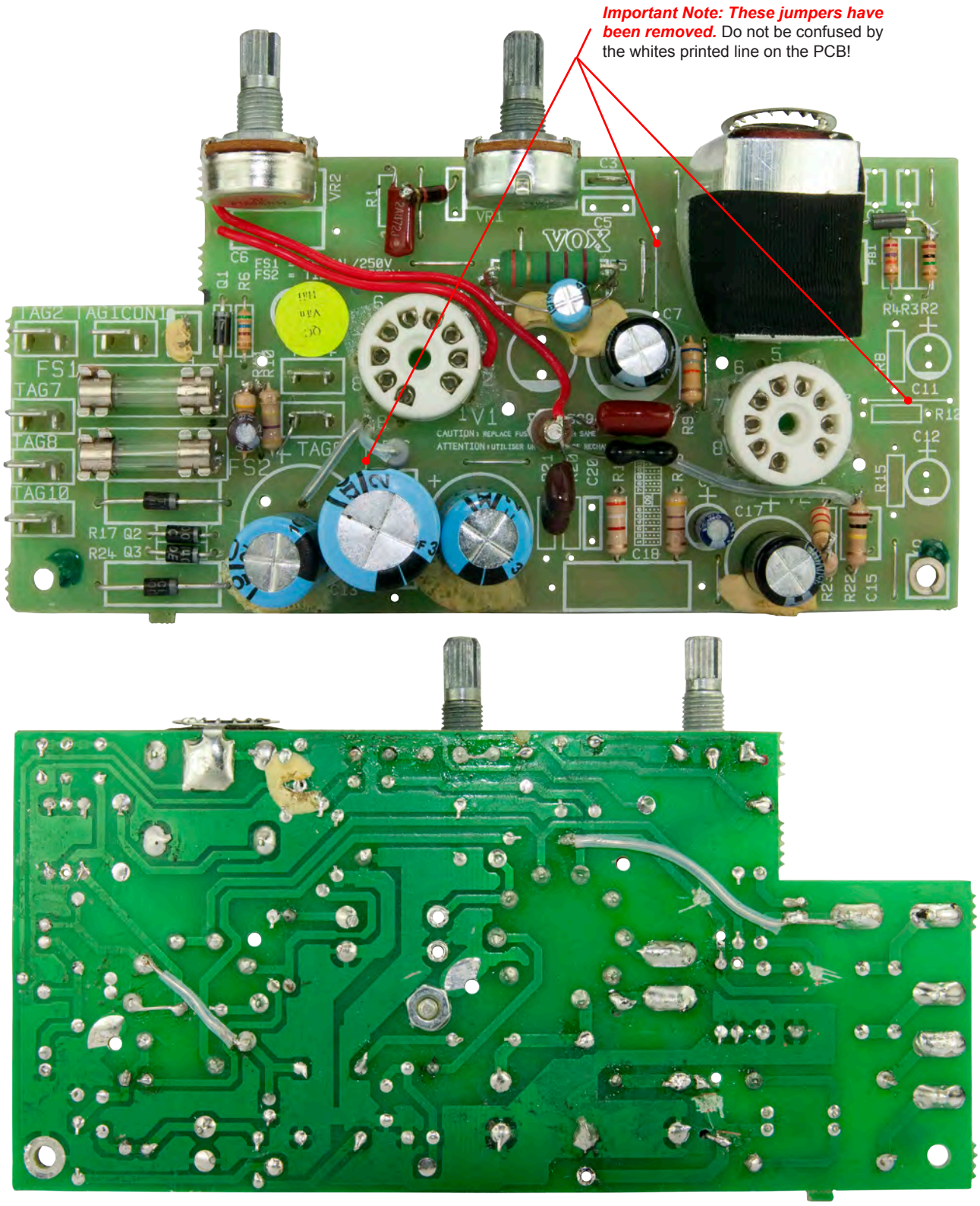

Reference photos: Shows front and back of a Main PCB with the completed upgrade, ready to reinstall in the AC4tv chassis.

4th SEQUENCE

In the final sequence (Figures 9 thru 13) you'll be reassembling your amp. Use the illustrations and notes to guide you through the procedure.

Here's an overview of the steps:

Triple-check your modifications. If you have any questions the time to get them answered is now. Call ***Mercury*** if you are in doubt about *anything*.

First, bolt in the transformers and the ***Mini-Choke***. Bolt down the grounding leads. Solder the output transformer's blue lead to the *OP Level Switch PCB* (as shown). Apply *Loctite 290* (green) to the retaining nut heads of the transformers, ***Mini-Choke*** and the chassis grounds.

Now, solder the two brown ***Mini-Choke*** leads into place on the Main PCB so that they pass over all the other components. Then, pass the LED's leads between the ON/OFF switch terminals and under the *OP Level Switch PCB's wires*, soldering its leads into place onto the Main PCB.

The Main PCB is now bolted onto the chassis (do not use Loctite, yet) until the amp has been tested (you may have to pull the board to make adjustments or repairs). Use the retaining nuts to temporarily bolt on the Volume, Tone and Input Jack.

Clip the following leads to the Main PCB –

1. Output transformer's yellow & black leads.
2. Power transformer's red & black leads, being sure to tightly twist the twin white leads before connecting. Twisting these wires substantially reduces amp noise.

Position all leads as high off the Main PCB and as close to the power transformer as possible.

Inspect the illustrations to ensure that all other connections from the power transformer and the I.E.C. (AC cord) are in place.

Replace the tubes and attach the tube retainers.

If you have a combo amp, connect the speaker leads. If you have a head, connect a 16Ω speaker.

DO NOT BYPASS THIS STEP!

After triple-checking your assembly, connect the amp's power to a *Variac*, or even better, a variable AC power supply, and with a current metter ready follow the testing/start-up proceedure as outlined in this manual's appendix.

Debug if necessary and repeat this process until you are satisfied that the ***Upgraded*** amp is working correctly.

When the amp is working to your satisfaction use the cable ties (supplied) to group and hold the various wires away from the Main PCB (especially the tubes – they'll melt the leads!). In particular, gather up the red, black, double-white and blue leads tying them as close to the Power transformer as possible. See final photographs for examples.

Apply *Loctite 290* (green) to the two retaining bolts and screws of the Main PCB.

Reassemble the chassis into the case. If you own a combo, attach the black speaker wire to the unmarked negative terminal and the white speaker wire to the "+" (positive) terminal on the speaker.

Apply the ***Mercury*** metal place to properly I.D. your ***Mercury Upgraded VOX AC4tv***. And you are done!

Figure 9

Re-assembly – Part 1: Preparation for the final assembly. Ensure that these leads are in place. Your chassis should look like this.

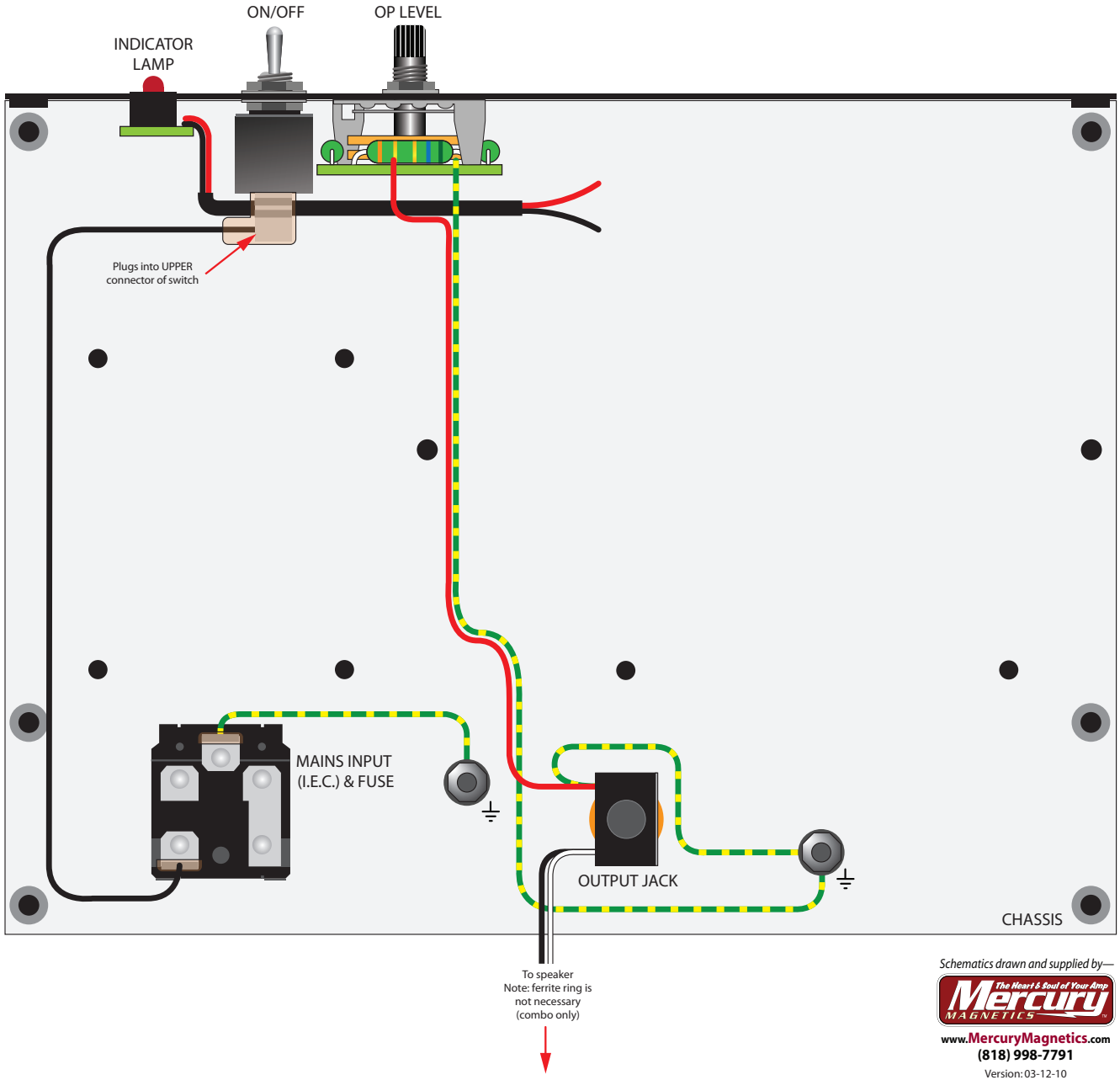

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Figure 10a

Re-assembly – Part 2: Start by installing the power transformer. It's a little trickier to bolt down than the output. Install the output transformer and choke as shown. Connect the indicated ground leads. And solder the output's blue lead into "TAG3" of the *OP Level Switch* PCB.

See the next page for a detail of the *OP Level Switch PCB*.

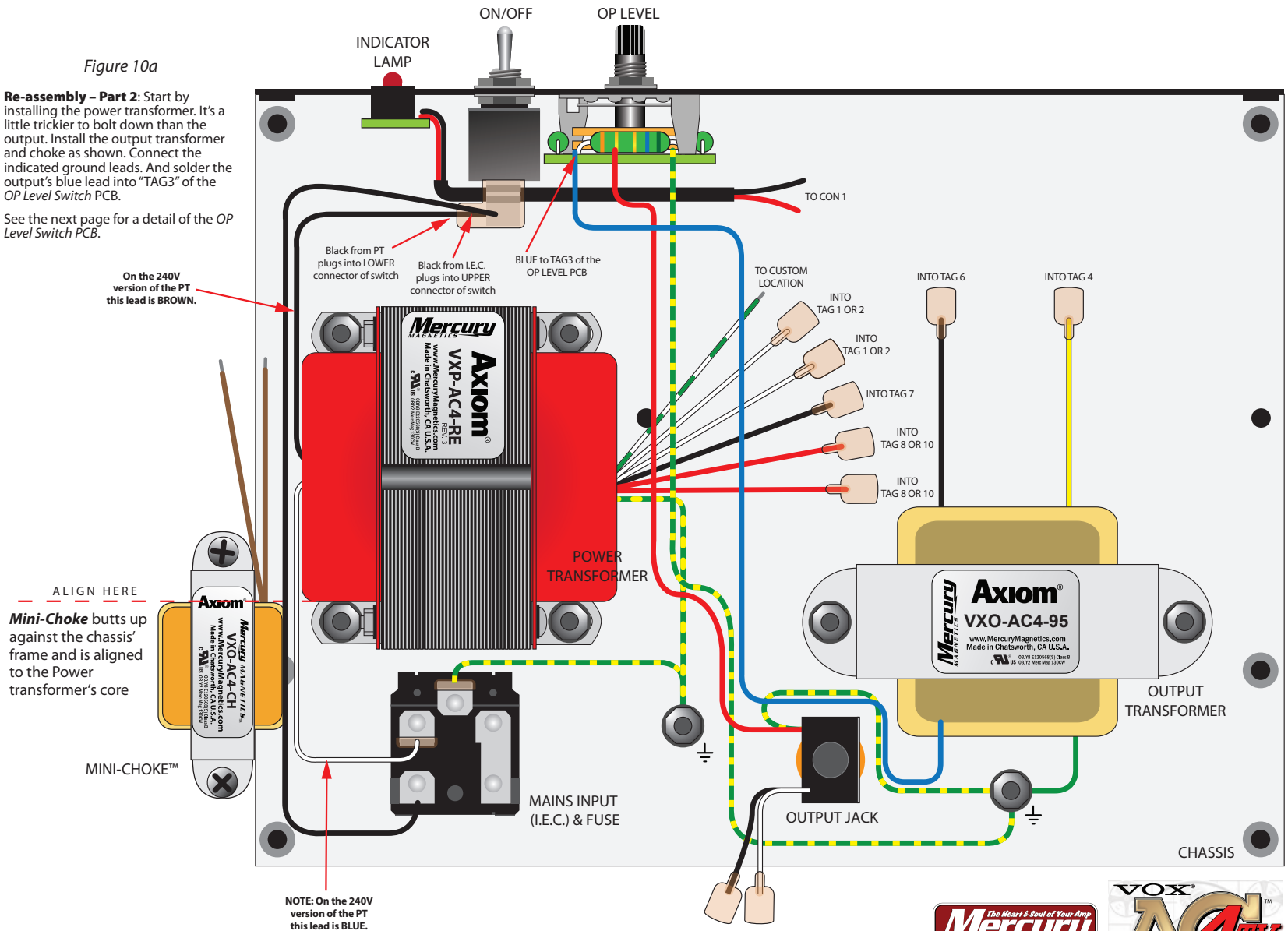

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Figure 10b

The OP LEVEL Switch PCB

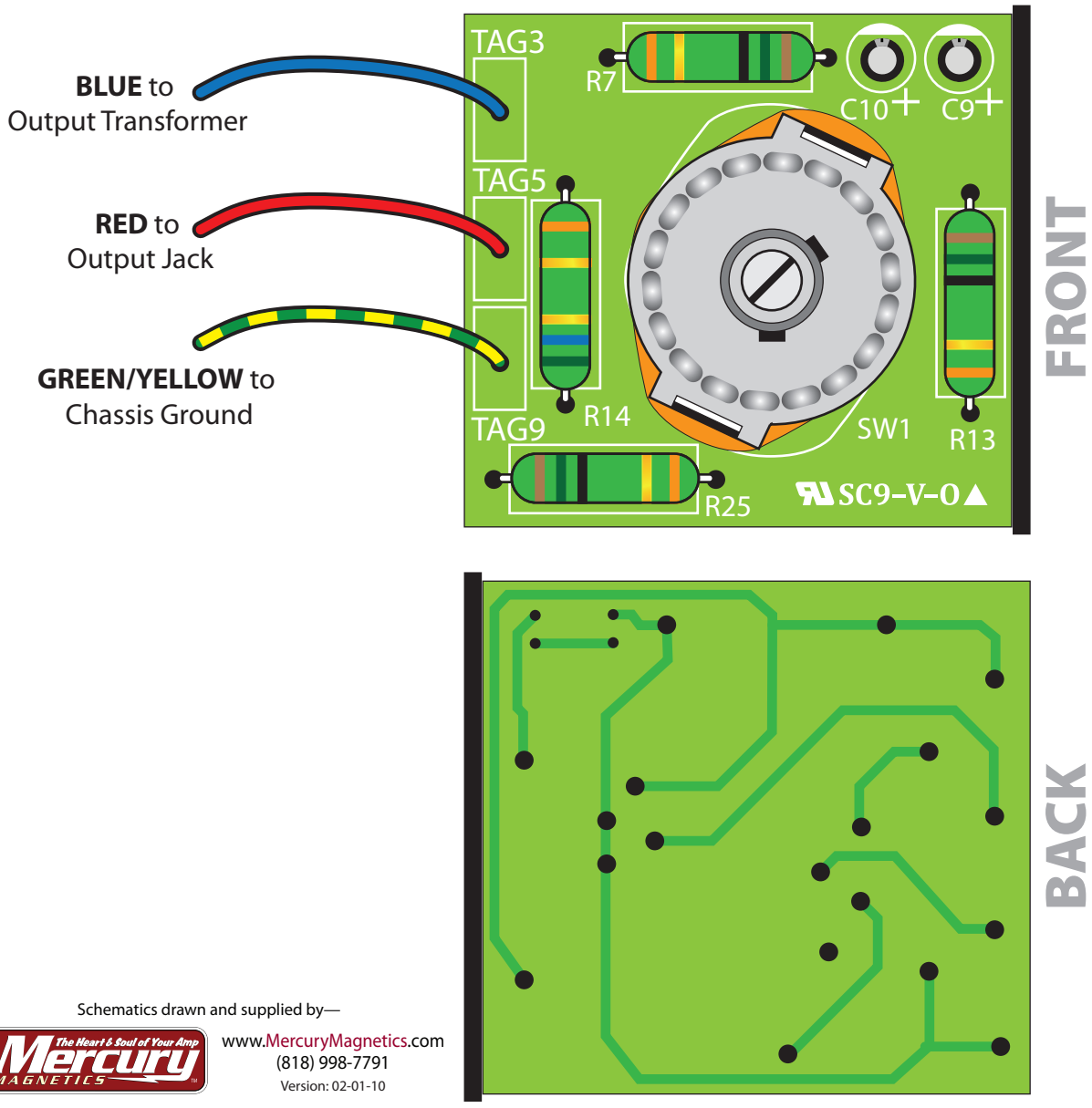

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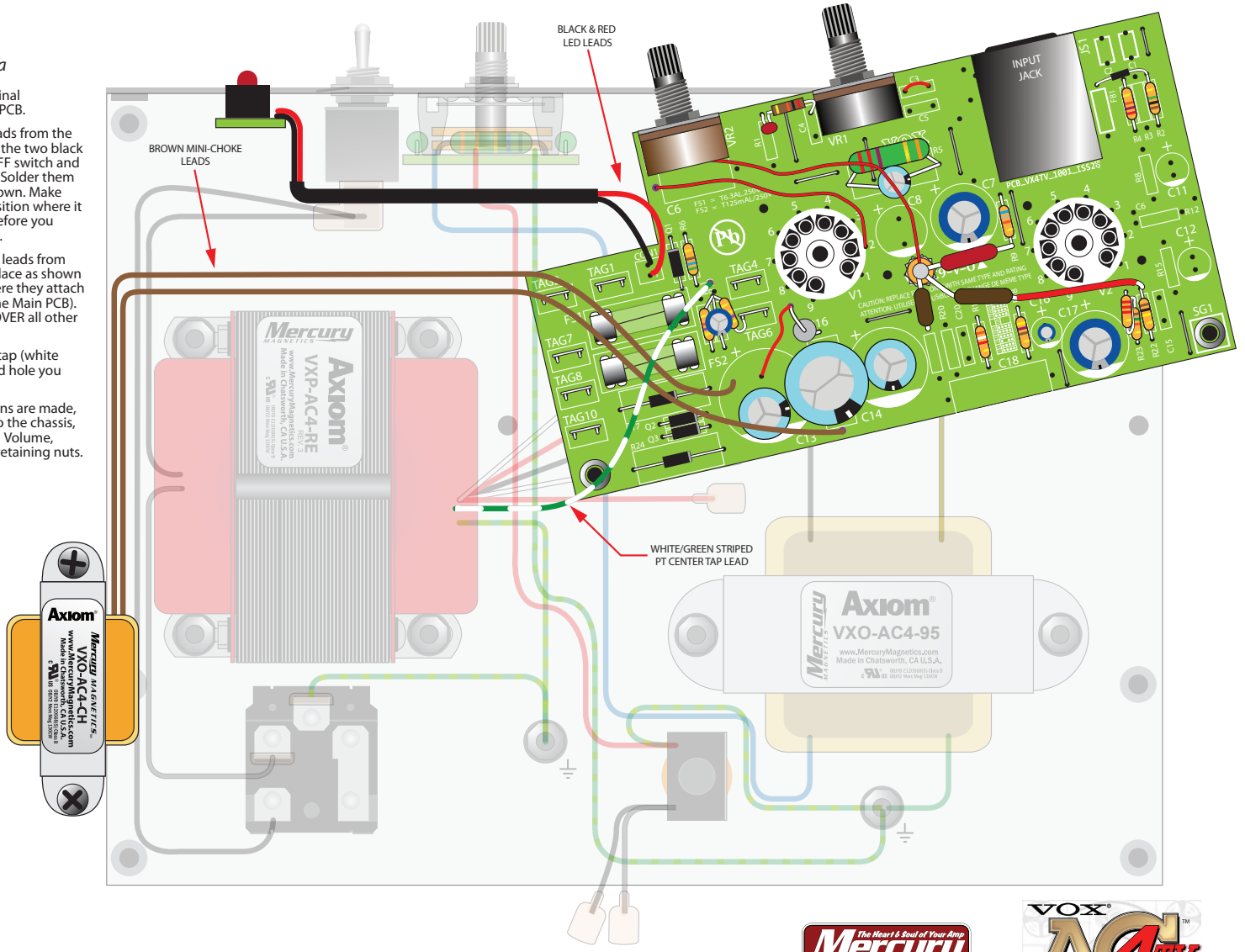
Figure 11a

Re-assembly – Part 3: Final connections to the Main PCB.

1. Pass the red & black leads from the panel's L.E.D. between the two black terminals of the ON/OFF switch and under the other leads. Solder them directly to CON1 as shown. Make sure the PCB is in a position where it can be bolted down before you attach these two leads.
2. Solder the twin brown leads from the ***Mini-Choke*** into place as shown (see next page for where they attach on the under side of the Main PCB). Run the brown leads OVER all other amp components.
3. Solder the PT's center tap (white with green stripes) lead hole you made above R10.
4. When these connections are made, bolt the Main PCB onto the chassis, and finger-tighten the Volume, Tone and Input Jack's retaining nuts.



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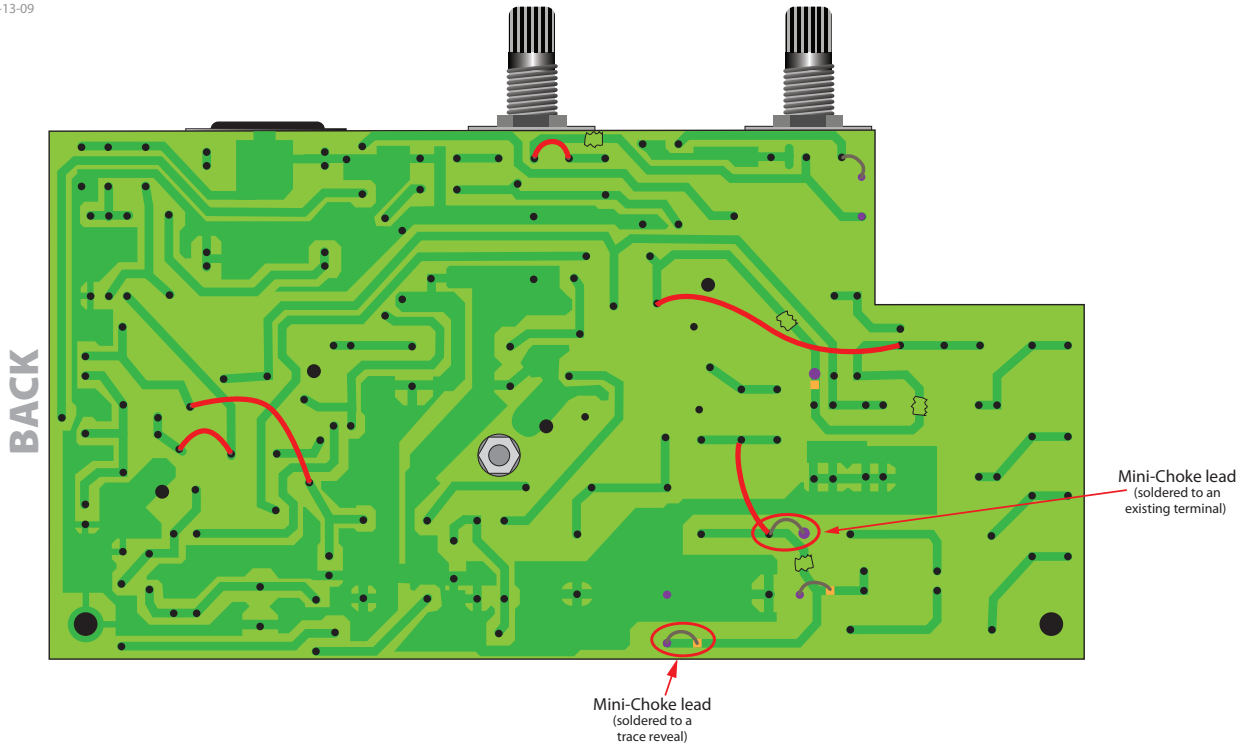
VOX AC4TV Studio-Pro Mercury Upgrade Kit

For the VOX AC4tv PCB version 1 / ISS2b / 03-13-09

Figure 11b

UPGRADING THE MAIN PCB

NOTE: THESE DIAGRAMS ARE NOT PRECISELY TO SCALE



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VOX AC4TV PCB version 1/ ISS2b / 03-13-09

Description: Shows where the ***Mini-Choke*** leads come through the Main PCB and where they are soldered. One lead is soldered onto the revealed trace, the other lead onto an existing soldered terminal. Note that there is no polarity of the ***Mini-Choke's*** leads.

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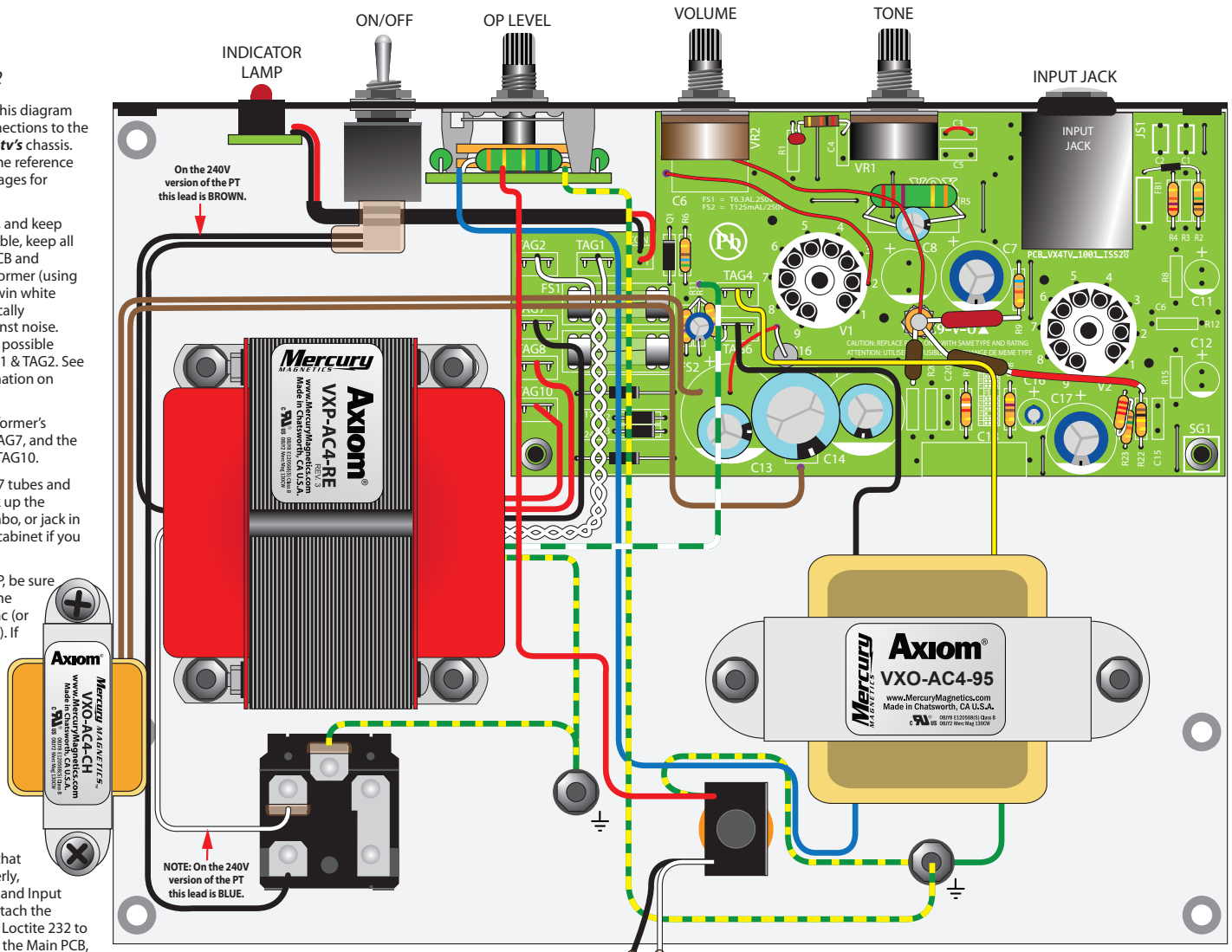
Version: 06-14-10

Figure 12



Re-assembly – Part 4: This diagram shows all of the final connections to the ***Mercury Upgrade AC4tv's*** chassis. Be sure to also examine the reference photos on the next few pages for suggested positioning.

Note to reduce amp hum, and keep amp noise as low as possible, keep all leads high off the Main PCB and towards the power transformer (using cable ties). Twisting the twin white filament leads is also critically important in the war against noise. Make the twist as tight as possible before connecting to TAG1 & TAG2. See appendix for more information on filament leads.

Connect the power transformer's remaining black lead to TAG7, and the twin red leads to TAG8 & TAG10.

Insert the EL84 and 12AX7 tubes and their retaining clips. Hook up the speaker if you have a combo, or jack in an external 12Ω speaker cabinet if you don't.

BEFORE TESTING THE AMP, be sure to read and understand the appendix on using a Variac (or variable AC power supply). If there's an error you run the risk of damaging the amp and/or hurting yourself. Firing up the amp with the proper equipment is the safe way to do it and can easily save you a lot of expense if something goes wrong.

* * *

After you've determined that the amp is working properly, tighten the Volume, Tone and Input Jack's retaining nuts. Reattach the chicken head dials. Apply Loctite 232 to the two retaining bolts of the Main PCB, and the grounding lugs. Then close everything up by bolting the back of the cab back onto the case. Finish by attaching the ***Mercury Magnetics*** nameplate to the cab and you are done.

Note that new transformers require approximately 30 hours of *playing* to "break in." Your amp will actually sound even better at by the end of this period.

Thank you again – ENJOY your new amp!

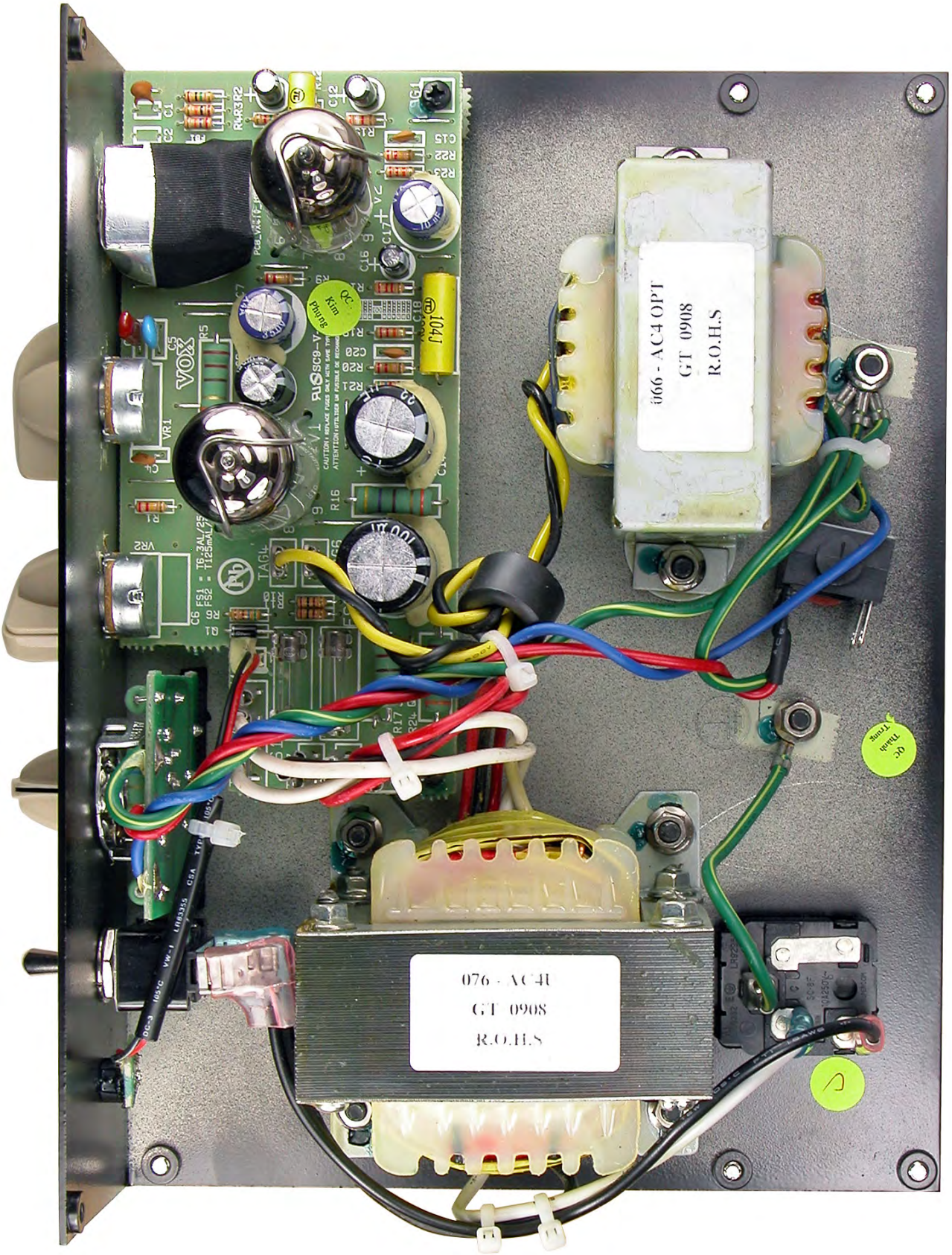
NOTE: For optimum tone ***Mercury*** recommends swapping the stock speaker for a 10" ***Celeston Gold***. See www.Celestion.com for more information.

Speaker wires (for Combo only) Note: White goes to positive (+) terminal on speaker

WARNING: DO NOT POWER UP THE AMP WITHOUT CONNECTING THE SPEAKER (OR SPEAKER CAB). DO NOT POWER UP THE AMP WITHOUT THE USE OF A VARIAC!

www.MercuryMagnetics.com
(818) 998-7791

Version: 02-21-11



Reference photo: A bone stock ***VOX AC4tv*** chassis (version 1).

Reference photo: a completed ***Mercury VOX AC4tv Studio-Pro Upgrade***.

Note: The PT in this photo is the 240V version. The 120V appears identical except the leads coming from the primary are black (brown on the 240V) and white (blue on the 240V).

BE FOREWARNED!

IF YOU BYPASS THIS STEP THERE IS A VERY REAL POSSIBILITY THAT YOU WILL CAUSE DAMAGE TO THE AMP AND/OR SERIOUS HARM TO YOURSELF!

Using a Variac & Current Meter

Don't power-up your amp without 'em!

NOTE: IF YOU ARE NOT A QUALIFIED AMP TECH, DO NOT ATTEMPT TO POWER UP YOUR MODIFIED AMPLIFER, YET. INSTEAD, ***Mercury*** RECOMMENDS THAT IT BE INSPECTED BY A QUALIFIED TECHNICIAN. AN AMP TECH WILL GO OVER YOUR WORK AND VERIFY THAT IT IS SAFE TO POWER IT UP.

After modifying your amp, the next step is to power it up using a *variac* and current meter.

The *Variac* and current meter allows you to slowly add voltage while checking the indicators to make sure that your handiwork is correct. Without a *variac* you run the *extreme* risk of frying your amp or some of its components, getting hurt, electrocuted, *etc*.

A *Variac* is a standard amp tech tool. No amp tech should be without one. They are available from many electronic stores or online, eBay, *etc*. Prices start at about $50 and go up from there. The better units (such as the *Tenma* isolated variable AC power supply shown in these photos) include output current metering. Consider that the cost of a *Variac* is free, because a single error without one can easily cost more than the *Variac* itself!

As the following instructions show, you'll need to monitor the output current while increasing power to the amp with the *Variac*. If your *Variac* doesn't have a self-contained current meter this can also be done with a separate amperes meter connected to the fuse-holder of the amp (with the fuse removed).

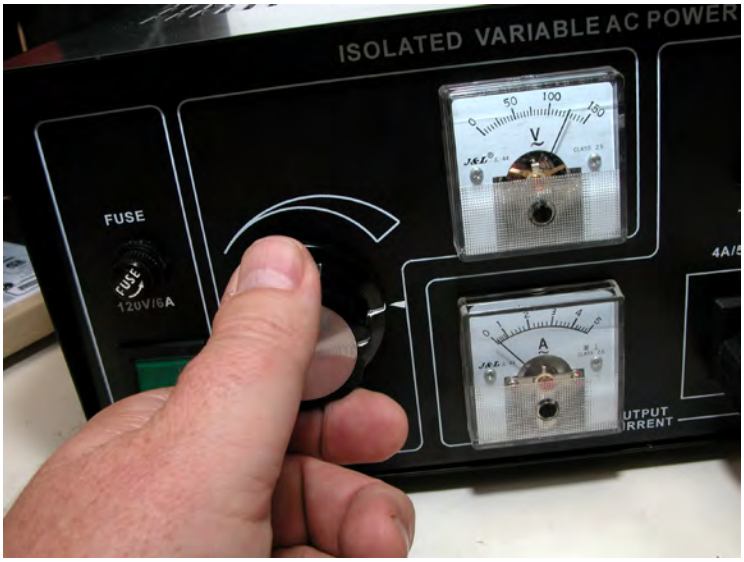
Specific instructions for how to use *Variacs* and current meters are beyond the scope of this manual. Check the web or owner manuals of the devices for specific methods.

STEP A: Make sure that your amp is OFF. Plug it into the *Variac*. The *Variac* is OFF with the output voltage knob set to zero (0). Turn on the *Variac's* power. Then, turn on the amp's power.

Variac: A variable transformer used to vary AC voltages. Also the tradename for a brand of variable AC transformer. There are other brands, but the term is generically used to describe all of them. A *variac* allows adjustment of the incoming AC mains voltage. The better quality units have meters for voltage and current, or both, and fuses for protection. *Variacs* come in many shapes and sizes. But their function is basically the same. If your *variac* does not have an amperes (current) meter, you'll need to use a separate meter.

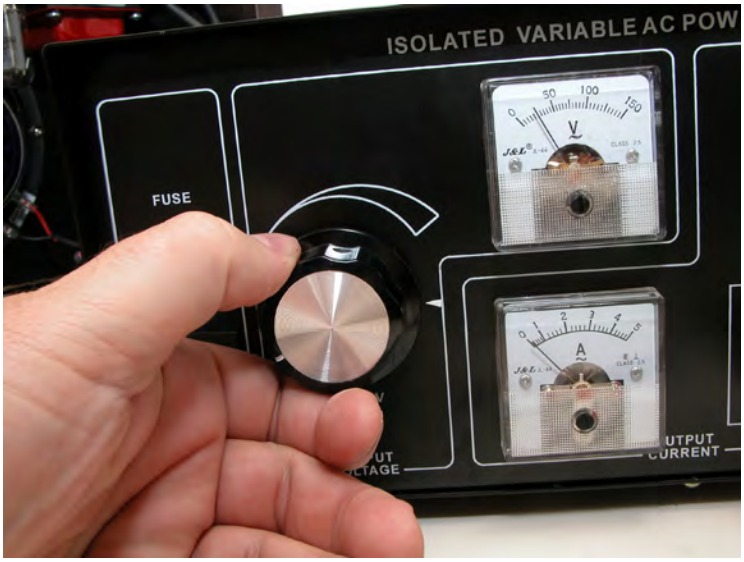
NOTE: The *Variac* in the photo to the left does not have an amperes meter whereas the *Tenma* model does.

STEP B: Turn on the amp's power.



STEP C: While watching the current (amp) meter, slowly roll on the *Variac's* output voltage knob. The amp should turn on at about 45 volts.

When you get to about 60 volts you don't want to see more than a few hundred milliamps. If the current meter reaches anywhere above half an amp, roll the *Variac* back to zero, shut everything down, discharge the caps, and look for the error, short or bad component. Correct the problem and repeat until this test passes.



STEP D: Once you can reach 120 volts drawing less than half an amp, you are in good shape.

NOTE: If you don't have a current meter on your *Variac*, remove the fuse from the amp, and with an amp meter across the empty fuse holder socket, turn on the amp and perform the test above.

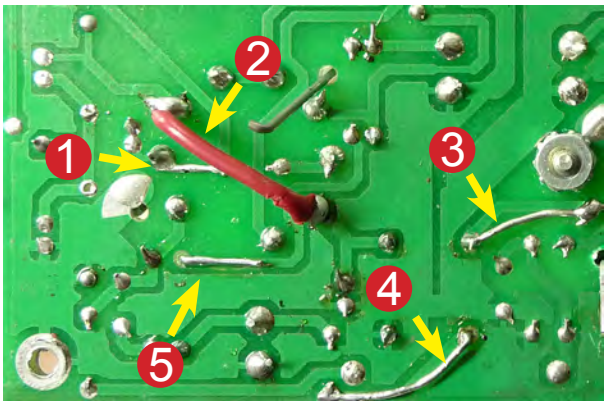
Tips 'n Tricks for
Working on PCBs

A PCB (printed circuit board) begins life as a solid sheet of thin copper foil across a backing material made of epoxy resin. Then, using a photographic process, a circuit is imprinted onto the foil and all unnecessary copper is etched away. What's left are copper foil "traces" that take the place of wires. To prevent shorts, PCBs are laminated with a colored insulating material (green for the ***AC4tv***) that functions just like the shielding around insulated wire. Although PCBs may be many layers thick, the PCB used in the ***VOX AC4tv*** is single-layered, which makes it easier to work on or modify.

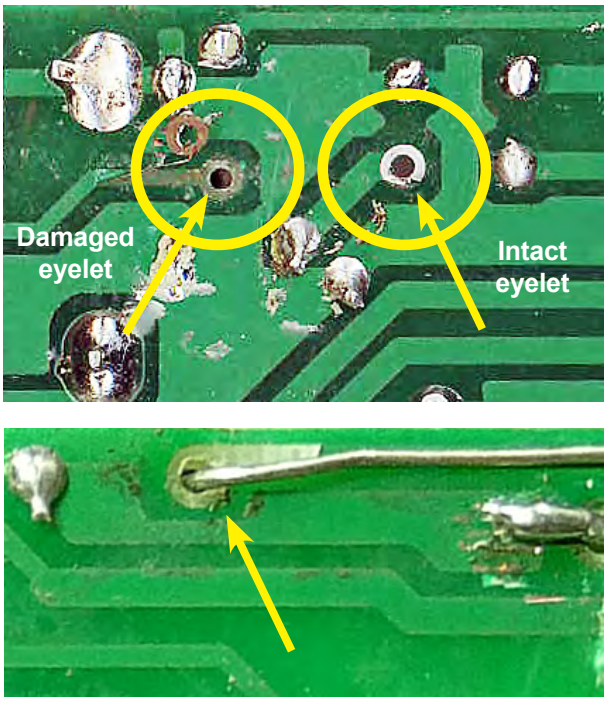
PCBs cost substantially less to produce than their predecessors, i.e. *point-to-point* circuit boards. And are used by amp manufacturers to maintain affordable prices for consumers.

On a PCB components are often attached to the top of the board and then soldered from the back via pass-through conductive "eyelets" where they follow the traces that make up the circuit.

Asian-made PCBs are typically not as resilient as those made in the west. Therefore they're likely to require patching and repair work as you make the ***Upgrade***. This is normal, and easy to do – as long as you know a few tricks.



Various examples: 1. Jumper. 2. Jumper. 3. Trace repair (jumper soldered from terminal to terminal on same trace). 4. Trace repair (ditto). 5. Damaged eyelet repair (lead is soldered to a revealed trace).



Repair to a damaged eyelet: The lead from component bypasses the damaged eyelet and is soldered to either a revealed trace or another terminal on the same trace (as in this example).

Revealing a Trace: Sometimes we need to "reveal" traces so that the PCB can be modified or repaired. An easy way to do this is to take a sharp knife or *Exacto* and carefully scrape away the lamination to "reveal" the copper foil under it. Use high-grade (99%) Isopropyl alcohol and a Q-tip to clean these new contacts before soldering to them.

How to Repair Damaged Eyelets: The PCB's conductive eyelets are easily damaged and

Continued on next page ➔

often just fall off in the process of making repairs and modifications. If this happens the easiest workaround is to reveal about 1/8” of trace material (near the eyelet hole on the same circuit) and solder the component’s lead connection directly to that.

Or, if there’s a nearby soldered connection on the same trace, you can use the component’s lead to jumper directly to the terminal.

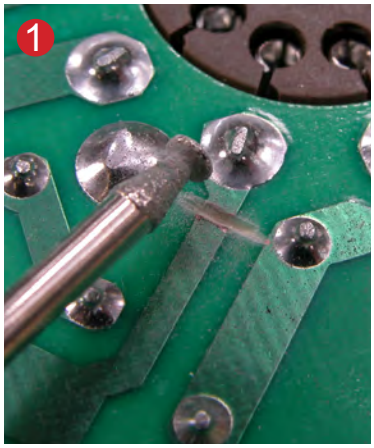
If an eyelet is damaged or missing or the trace material around it is very thin, then you may consider soldering a reinforcement jumper across it.

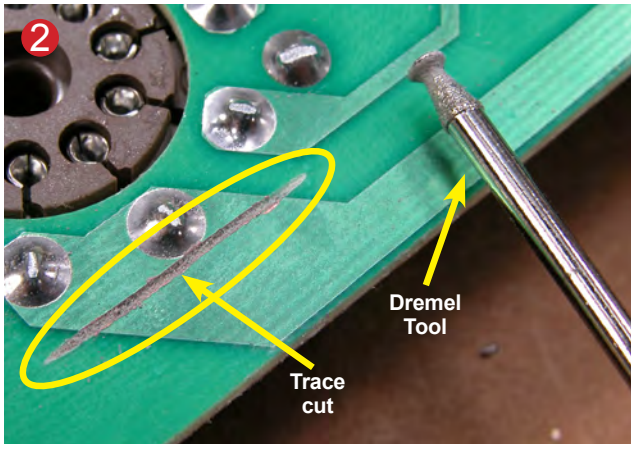
How to Cut a Trace: A “trace” is the conductive strip (foil) on a printed circuit board. It has a very thin laminate or lacquer layer over it. Cutting a trace is like clipping a wire. Use a box knife, *Exacto* knife or a *Dremel Tool* with a cutting or grinding edge attachment to make the cuts.

Various examples: This photo shows a cut trace, and a component lead jumpered and soldered to a revealed trace. It’s best to not drill a hole directly into a trace. Instead make the hole off to the side of the trace and then, as in this example, solder the component’s leg to the trace.

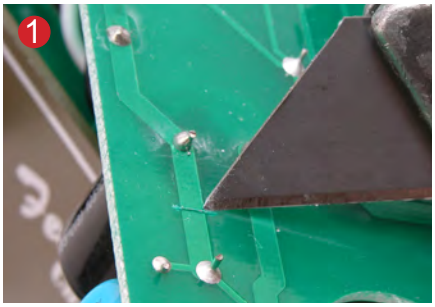
A *trace cut* severes the embedded metal laminent on a PCB. The purpose of a *trace cut* is to modify or re-route the electrical flow of the circuit.

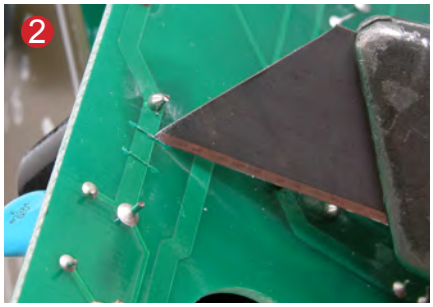
Here’s two different ways to cut a trace:

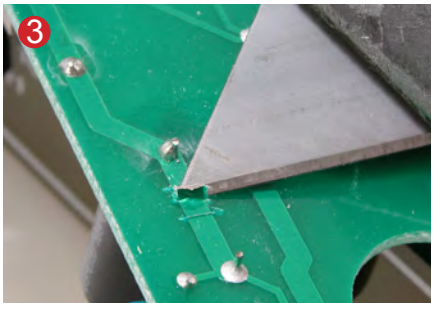


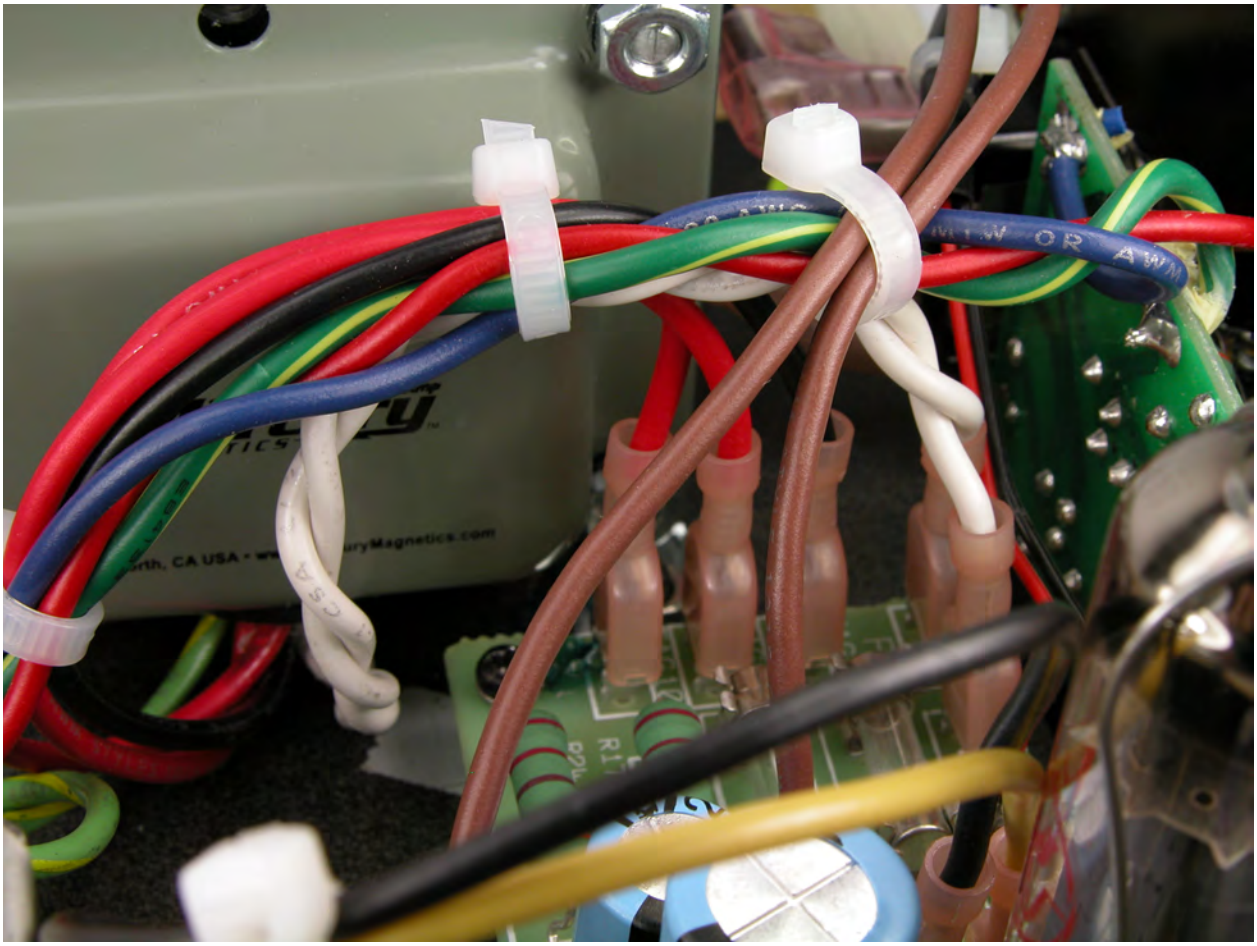


OR









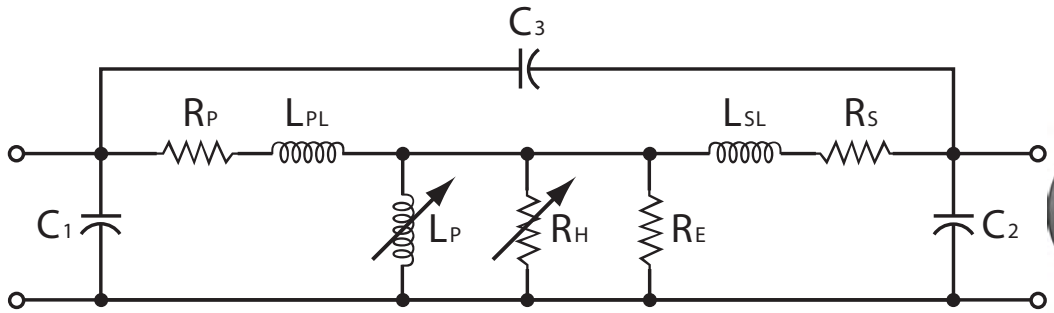
About the Filament Supply Leads

The PT (power transformer) with the ***Mercury Upgrade Kit*** for the ***AC4tv*** has two white leads (wires) coming from the *secondary* side (but NOT the single white lead coming from the *primary*) of the casing. See the power transformer's diagram at the front of this manual for clarification. The two white *secondary* leads are the "filament supply leads." The ***filament supply leads*** are the *only* wires that must be twisted together.

This photograph shows a twisting pattern that you should aim for. Consistent, even twisting is important. Ideally about 10 twists per inch. Cable tie these leads as high off the Main PCB as possible, and as close as possible to both the power transformer. This will minimize amp noise and hum.

The Output Transformer Circuit

Mercury's circuit equivalent of an Output Transformer



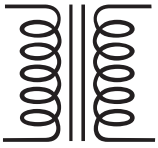
C_1	Primary Self Capacitance	L_P	Primary Inductance
C_2	Secondary Self Capacitance	R_P	Primary Resistance
C_3	Interwinding Capacitance	R_S	Secondary Resistance
L_{PL}	Primary Leakage Inductance	R_E	Core Eddy Current Losses
L_{SL}	Secondary Leakage Inductance	R_H	Core Hysteresis Losses

"Blessed are the Tone Makers"

The above circuit reveals the properties of an audio *output transformer*. The transformer is a *reactive* component—its values change depending upon the information feeding it. Transformers for tube-based electric guitar amps are designed to *intentionally provoke* the tubes into distortion—the polar-opposite of demands of *hi-fi*. The best guitar tone comes from harnessing and *manipulating* the inherent flaws of the imperfect transformer. This is where art meets science in our pursuit of great guitar tone.

—Sergio Hamernik

Consider the above *vs.* this typical dummied-down transformer symbol



DANGER! READ ME!

DISCHARGE THOSE FILTER CAPS!!!!!

The following is a collection of notes on discharging Filter Capacitors

Compiled by the staff at ***Mercury Magnetics***

DISCHARGING CAPACITORS – The filter capacitors in an amp will retain a charge for quite some time after the amp is shut off and unplugged. It is a good idea to make sure your amp is safe to work on. One way is to take a wire with an INSULATED alligator clip on each end, clip one end to a good ground point, and the other to one of the plate leads for the first stage preamp tube. Another method would be to put a 100K, 5W or more resistor in line of these two clips by attaching one end to ground (first), then the other to the filter caps themselves. NEVER SHORT THEM OUT DIRECTLY!

BE THE ONE-ARMED TECHNICIAN – There will come a time when you have to work on a chassis that is running. When doing so, if possible clip one of your meter's test leads to ground, and use only one hand to probe the circuit, keeping the other in your pocket, *etc.* That way if you DO take a shock, your heart is not in line of the path of least resistance – in one arm and out the other. When you ABSOLUTELY must use two hands, be EXTREMELY CAREFUL, and use common sense, but PLEASE try to avoid these situations!

* * *

"Filter" caps can store ***fatal*** amounts of electrical current. The caps are connected near the rectifier and are part of the power supply, and aid in converting AC to DC. In fact, they are a standard component in any power supply.

If you're completely lost, and don't understand this, DON'T MODIFY YOUR AMP. You haven't enough knowledge to work on high voltage/current circuits safely.

Several ways to discharge caps:

FIRST, UNPLUG THE AMP! (But that doesn't make it safe!)

THEN, take a screwdriver or a jumper and short the capacitors leads.

– OR jumper the power amp tube plate pin to ground for a minute or so (Class A, single power tube only)
– OR jumper the positive (+) lead of each large cap to ground for several seconds. A jumper with a built-in resistor (10K or so) will help prevent sparks here.

Some or all of these methods may result in a spark. Obviously, your flesh can act as a jumper also.

It's NEVER a good idea to touch amp circuitry when it's switched on. And don't work on amps in bare feet, or on a damp basement floor.

* * *

Letting the capacitors discharge slowly is preferable to having them do it all at once through your body while you're poking around inside the amp. Having the supplies you need on hand makes the job go faster.

You'll want screwdrivers, contact cleaner (you can use *Gunk* brand choke and carburetor cleaner or *WD-40*), a toothbrush and – unless you own an air compressor – an aerosol can of compressed air – soldering supplies and a volt/ohm meter (learn how to use them!).

Start by unplugging the amp from the wall, the speakers from the amp, and removing the amp chassis from the case. For Fender amps, removing the chassis involves unscrewing the upper back case panel, then unscrewing the chassis from the top of the case. Put the screws, nuts, and lock washers where they won't get lost.

With the chassis out of the case, you can locate the filter capacitors you'll want to avoid touching as you perform the tune-up. These will be cardboard cylinders (usually orange or tan or vintage Fenders) with "+" printed near one terminal. It's also a good idea to steer clear of wiring connected to the power transformer because it's a discharge path for the filter capacitors.

If you haven't given the capacitors a couple of days to discharge – or if you just want to be cautious – you can use a short length of insulated wire with alligator clips on the ends to discharge them. First, make certain that the amp is unplugged. Attach one alligator clip to a capacitor's positive (+) lead, then touch the other clip to the amp chassis several times. Repeat the procedure for each capacitor marked with a voltage (VDC) rating higher than 25. The time spent on this precaution can spare you from a numbing electric shock that you'll remember long after the amp is back together.

How to Discharge a Power Capacitor in Tube Amp

by Kevin Krause
eHow contributing writer

To be able to properly test and troubleshoot your tube amplifier with a multimeter it is important to discharge the capacitors located in the amp's power section to avoid false readings. Capacitors act as short-term batteries, storing a charge that can be called on by other components. This charge will remain in the capacitor even after the amp has been powered off, and can produce misleading voltage readings along circuit paths. Because of the high level of the stored power in the capacitor, safe discharging is a must.

Things you'll need:

1. High wattage resistor
2. Alligator clip
3. Copper wire
4. PVC tube or dowel rod
5. Soldering iron
6. Solder
7. Multimeter

Instructions

Level of difficulty: Moderate

Step 1: Strip about 1/4 inch of insulation off each end of a 2-foot length of insulated copper wire, and solder one end of the wire to one of the leads of a high wattage resistor. The resistance required can be determined by adding 5 to 50 ohms per volt of the capacitor's rating. For instance, a 100V capacitor would require a resistor rated anywhere from 500 to 5k ohms.

Step 2: Attach the other end of the wire to an alligator clip.

Step 3: Solder the free lead of the resistor to a short piece of bare copper wire.

Step 4: Tape the resistor and bare copper wire to one end of a length of non-conductive material, such as PVC tubing or a dowel rod. Make sure enough of the copper wire is exposed to act as a contact point.

Step 5: Attach the alligator clip to one of the capacitor's leads. Be sure the amplifier is completely powered off before doing so.

Step 6: Touch the bare wire end of the PVC tube or dowel rod to the other lead of the capacitor. It is very important to not touch any of the exposed leads or wires at this time. Hold the bare wire on the lead for at least several seconds to fully discharge the capacitor.

Step 7: Test the capacitor with a multimeter to be sure all voltage has been safely removed.

Discharging Capacitors in a Guitar Tube Amp

Take pride in how safe you can be.
You can't play guitar or build amps if you're dead.

You may have heard various horror stories about things inside amps that can store a charge that can kill you. Well, it's true! However, those dangerous voltages can be easily drained in just a few minutes, so take your time and don't rush.

It is absolutely vital that we drain the filter capacitors in the DC power supply before working on any guitar amplifier. These often hold a charge of several hundred volts, which is potentially deadly. Capacitors can hold their charge for a long time, even with the power off and the amp unplugged. It's very important that we learn to properly "drain" this residual voltage so that we may safely work on the inside of our amplifiers.

What You'll Need:

Filter Capacitor Discharge Tool

1. **Safety glasses.** Always use safety glasses. If you wire a capacitor in backwards there is a very good chance that it will explode in your face.

2. **Digital multi-meter.** Capable of reading 500 volts DC.
3. **Capacitor discharge tool.** A jumper wire consisting of alligator clips on the ends, with a resistor in series in the middle of the jumper.
4. **Needle nose pliers.** With very good insulation on the handles for holding the alligator clips of the capacitor discharge tool.

Always make sure your tools are in good condition. If there's any question, replace them. Cracked insulation is one of the first things to check, and check often.

Turn the power switch OFF, and place the standby switch in the ON position. This isn't the same as having your amp "on standby."

Always unplug the amp from the wall. Unplugging from the wall will not drain the filter capacitors completely, but again this is for our own safety. Unplugging is the equivalent to "locking out" before working on a downed machine.

Because filter caps are almost always of the electrolytic type, they're "polarized" and therefore have a positive and negative end. We can identify the positive or negative ends by looking for the "polarity indicator" printed on the cap's side.

Our first objective is to check for residual voltage with a multi-meter. In some cases most of the voltage may have already been drained. Many amplifiers will incorporate "bleeder" resistors, which will drain the capacitor charge automatically in a few minutes after the amp is turned off. Don't depend on this resistor to do the job. Never assume the caps have been drained to a safe level without checking with a reliable multi-meter.

Here's a couple of ways to measure the residual voltage contained in the filter capacitors. Note that these are also equally valid for draining the caps:

1. **Across the capacitor**.
2. **From the positive side of the cap to the chassis**. This is essentially the same as draining "across" the caps since the negative side is at the same electrical potential as the chassis.
3. **From the chassis to a tube pin**. This can be done at pin 3 of any power tube, or pins 1 or 6 of any preamp tube. By shorting the chassis to the correct pin the caps will be forced to drain through the plate load of that tube. This prevents sparking from high current.

IMPORTANT NOTE, HOW NOT TO DO IT: In old electronics books they tell you to use a screw driver with an insulated handle to short out the caps. "Shorting" with a screwdriver will almost instantly drain the caps to zero volts, causing sparks from high current. This is not acceptable. If there are several hundred volts stored in the caps, be prepared for a nice sized spark. It will most likely leave a black mark on the chassis, and in extreme cases, partially weld the screwdriver to the chassis.

Now we're ready to start testing and discharging

Set your multi-meter to read DC voltage. Adjust the meter's range so that it's above 500 volts. Clip the black lead of your multi-meter to the chassis. Using only one hand, with the other hand far from the chassis (preferably in your pocket or behind your back), measure the DC voltage across one of the filter capacitors. You can adjust the meter's range down if you can't get a clear reading. Any DC voltage readings less than 5 volts are harmless, so the amp can be safely worked on, but do a double check of all the caps just to make sure. If not we must drain off the residual voltage with a resistor until it is safe.

Use a resistor value somewhere between 10K and 100K, with a power rating of 5W or so (a high power rating is not really necessary for heat dissipation reasons, but mainly because the higher power resistors are physically more robust and won't tend to break). The larger the resistor value, the longer it will take to discharge. If your capacitors do not have a dangerously high voltage, say around 30 volts, feel free to use a smaller 1K 1 Watt resistor.

Now take your capacitor discharge tool and clip one side to the chassis. Always clip to the chassis ground first before connecting to the circuit. If you clip to the circuit first you will have a hot wire hanging out of your amp, which is very dangerous. Once you have one side clipped to the chassis, take your needle nose pliers with good insulation on the handles and hold the alligator clip that will go to the circuit with the needle nose pliers.

Clip this to pin 1 or 6 of the first preamp tube. This seems to be the safest way of discharging the capacitors. If you're working on the first preamp tube socket, then clip your discharge tool to pin 1 or 6 of the second preamp tube. Wait a few minutes (about 5 minutes, if the amp has bleeder resistors this time will be shorter) then, while the discharge tool is still in place recheck all the capacitors with your multi-meter and keep that other hand behind you. Keep checking until the voltage has reached a safe level. Note: This procedure must be done every time you turn the amp on then off.

> Remember to remove the discharge tool before powering on the amp. Make it a bright color like

yellow and maybe put a piece of shiny tape on it to make it more visible. You can even put a fuse in series with the resistor on the discharge tool in case you forget to remove it.

Filter capacitors are wired in parallel, so draining one should drain them all, but never assume. Always recheck for residual voltage in every filter capacitor until there's absolutely no doubt in your mind that all are drained.

Less than 5 volts is safe, but I prefer to drain mine to 1 volt for peace of mind. Don't be surprised if you find the capacitors slowly recharging themselves. This phenomenon is known as dielectric absorption and is quite normal in electrolytic capacitors. The filter caps shouldn't recharge to a lethal level, but leave the discharge tool in place while working on the amp.

A few final notes:

1. Never work on an amp if you're tired, fatigued, frustrated or intoxicated.
2. Never work while distracted.
3. Never work on an amp around small children. There are just too many dangers involved to take that chance.
4. Try to have a plan in case something does go wrong. You might consider asking someone in your household to take a CPR class.
5. Take your time and don't rush.
6. Use common sense.

http://tubenewbie.com/discharge_capacitors.html

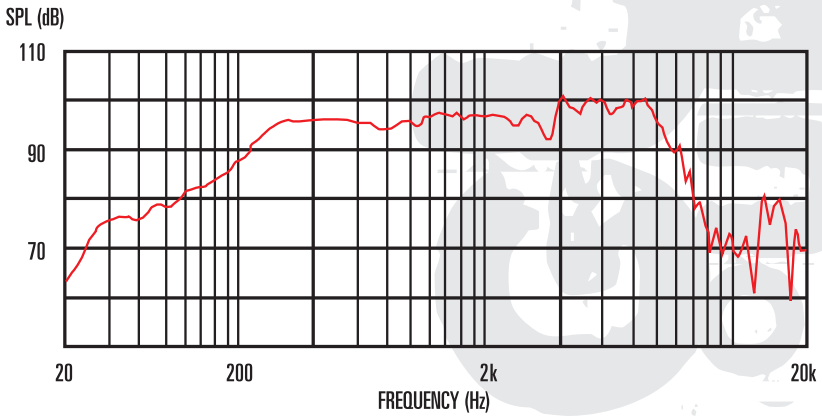
CELESTION GUITAR LOUDSPEAKERS

G10 GOLD

Following the great reviews we received for the Gold 12", we realised there was also a need for a speaker that conveyed the Alnico mellowness of the original Blue, with the speed and response of a 10" driver.

The G10 Gold is the ultimate 10" speaker, blending unmistakable Alnico class with a rich low-end, creamy mid-range and vintage chiming top-end. Springy, warm, revealing and highly expressive, it can be used singly or in pairs to add a classy sheen to any amp, or in a 4x10 configuration for higher volume depth, warmth and shimmer, with less of the boom associated with 4x12 cabinets.

8 FREQUENCY RESPONSE



GENERAL SPECIFICATIONS

Nominal diameter	10", 254mm
Power rating	40W
Nominal impedance	8 Ω & 1 5 Ω
Sensitivity	98dB
Chassis type	Pressed steel
Voice coil diameter	1.75", 44.5mm
Voice coil material	Round copper
Magnet type	Alnico
Frequency range	80-6000Hz
Resonance frequency, Fs	80Hz

MOUNTING INFORMATION

Diameter	10.1", 256mm
Overall depth	5.3", 135mm
Magnet structure diameter	4.7", 119mm
Cut-out diameter	9.0", 229mm
Mounting slot dimensions	0.25 x 0.43", 6.5 x 11mm
Number of mounting slot	8
Mounting slot PCD	9.6", 244mm
Unit weight	5.9lb, 2.7kg

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