Torres Engineering -Amp Basics for Tube Amp Kits
Vacuum Tube Amplifiers and Guitars

1630 Palm Avenue San Mateo CA 94402 http://www.torresengineering.com
revised Jun 17, 2003 Phone (650) 571 6887

Full Kits ---------- Version 1

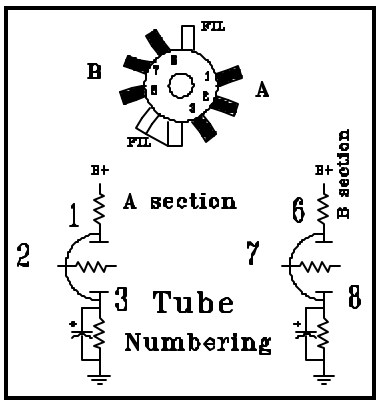
Amp and Guitar BASIC information/instructions - Read this first. For all Torres Kits.
Read the entire kit over and this flyer completely before starting any work of kind.
Kits are intended as do-it-yourself projects. It is not cost-effective to purchase kits and take them to a tech for installation. Torres in-shop installation will always be cheaper, even including shipping, unless, of course, you are outside the continental United States.

A few basics to start. I have to assume you can get the amp out of the cabinet. You always work looking at the amp **from the back**. You always orient pots with the tabs pointing up, you are looking at them from the bottom of the pot, with the shaft away from you. All drawings are oriented as if you were looking at the amp from the back.

The amp stores dangerous amounts of electricity in its filter capacitors. This is **not discharged** when you unplug (of course you always work on the amp UNPLUGGED! **Never plugged in!!**) Don't ignore this warning at risk to your own life.

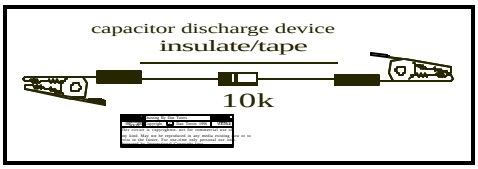
You **MUST** discharge the filter caps by shorting the stored current to ground. The safer and recommended method is to connect a 10k two watt resistor to a pair of insulated alligator clips. Tape it all up so there is no exposed metal except the ends of the clips. Attach one clip to the + (plus) side of each filter capacitor (under the amp on Fenders, in a long metal can) and touch the other **insulated** alligator clip to ground on the amp chassis. Be sure you aren't touching the metal of the alligator clips **or the amp chassis**. This will discharge slower, safer and with less fireworks.

Amps will discharge themselves over time. Small amps will discharge in about four hours (to be safe) but big powerful amps may have power supplies that do not have "discharge circuits," and can take 12 hrs or more before they are safe.



Warnings and disclaimer
Tube Amplifiers, all components and related products are electrical products with extremely high voltages that if mishandled or if used carelessly or for improper purposes, can cause life hazards and serious personal injuries. Such equipment is dangerous even when turned off or unplugged.
Please read the following.

1. Please observe and have all members of your family and other users observe all precautions recommended by the manufacturer.
2. Do not allow young people to work on this equipment without being supervised by a responsible and knowledgeable adult.
3. Do not take apart equipment, kits or components without specific instructions recommending such modification and without complying with every element of such instructions.
4. Please be advised that this book, kit or article does not, nor is it intended to, list the precautions necessary to prevent personal injury, death, damages to the amplifier or other components, other property damage, malfunctions or electronic damage. By buying this book, kit or article you agree that the author of the book, kit or article shall have no responsibility for safety precautions for your tube amplifier or related components or equipment, nor shall the author have any liability whatever for any injury, death, damage to the amplifier or the components, such other property damage, malfunctions or any economic damage.
5. You agree that the safety aspects of all recommendations, suggestions and other information in this book, kit or article are to be verified by you, with your manufacturer's representative, or other product source. Therefore, no recommendation, suggestion or other information contained in this book, kit or article shall create or be used as a basis for any claim of responsibility or liability of the author, Torres Engineering, Torres Amps and Guitars, or any person or firm affiliated with them or either of them.



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7. Your purchase of a book, kit or components of tube amplifiers or electric guitars constitutes your verification that you are personally responsible for possessing all necessary electronic knowledge and skill.
8. In view of the dangers involved, do not attempt any project if you are not comfortable with all elements of the project, if you do not have the necessary skills and knowledge, or if you do not understand the instructions.
9. Projects, kits articles, books, and any suggestions, written or oral are provided for entertainment only. No guarantee of results is implied or made in any way.

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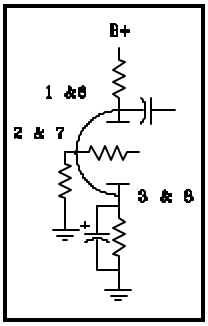
Kits are packed by hand individually. ***Parts may be substituted in some cases****. Replacement parts will be of the same or better specifications.* ***Review your kit in full before doing any work to be sure you have all the parts needed for your particular kit. Some kits include extra parts****.*

CIRCUIT MOD KITS (Not EZ kits)



Almost all of the work you will do will be on the preamp stages of the amplifier. Fender, Boogie, Traynor, Marshall, most all amps, use 12AX7-7025-ECC83 and 12AT7 -ECC81 preamp tubes.
Each tube is divided into two circuits (they are "dual triodes.")
The "A section" is made up of pins one, (output) two, (input) & three (cathode.) The "B section" is pins six, (output), seven (input), & eight (cathode.) See the drawing.

They are referred to as: V1A and V1B. The tubes are numbered starting on the RIGHT (looking from the back) as V1 through V whatever.

WORDS OF CAUTION.

As we develop kits for more and more different amplifiers, the working conditions become more varied. If your amp has a printed circuit board, not a fiberboard circuit board (like Fenders, early Ampegs, Traynors and early Marshalls) you have to observe some "printed circuit board rules." Pretty simple stuff, but really important.

Also, some additional cautions for everyone.

Remember that there is danger **under** the circuit board. If you are replacing a part, and inserting it into the same holes the old one came out of, be careful you don't go **too far**. It is very easy to go through and down to the chassis, shorting the part and the circuit to ground. This can be dangerous and damaging.

Don't overheat the circuit board. Traces are delicate things. Heat the board as little as possible. If a trace lifts or is damaged you are going to be into major work to fix it. Be careful.

Don't flex the board. Some are real flexible. There is a strong urge to flex it up and unsolder parts from the bottom. If it breaks you are in deep s___! Just don't do it.

An old craftsman's saying applies here; "Measure twice, then measure again." Check everything, every part, the entire project at least twice. You aren't in any race here. **If you put a 1k resistor in place of a 1 meg resistor you won't be able to figure out why it doesn't work.**

Be sure you understand what you are doing.

Follow the instructions. Test between stages as you are supposed to. **99% of the trouble with kits** is not following instructions.

Do a neat job. Trim wire and component leads to an **exact** fit. Use a common sense and take a look at how Fender/Marshall etc. did the job in the past. Parts fit **perfectly**, and there are no messy leads, excess wire lengths, sloppy solder circuits, "jury rigged" parts etc. The instructions often tell you to take some parts out **first**. This is to **make room for the new parts**. Put them on the circuit board if at all possible.

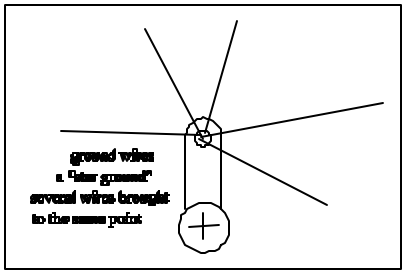
If critical wires appear to be too long, and are crossing over each other frequently, you may have your circuit board in backward. All drawings show the board installed looking at the back of the amp or preamp.

Shielded cables have to have the internal braided shield CONNECTED TO GROUND or they aren't shielded. Connect it at one end only. **The braided shield does not have to go to the circuit's "star ground" it can be grounded at any convenient place.**

These tube circuits are all fairly similar. Look at the "Basic circuit" drawing. Just about every circuit has these common characteristics.

They have a plate load resistor at pins one or six. They all have a cathode circuit, with or without a capacitor at pins three and eight. Input is always pins two or seven and there **has to be** a resistor in front of the input circuit. They have a capacitor at the output at pins one, or six. Marshalls and some Fenders have the output at pins three or eight on some circuits.

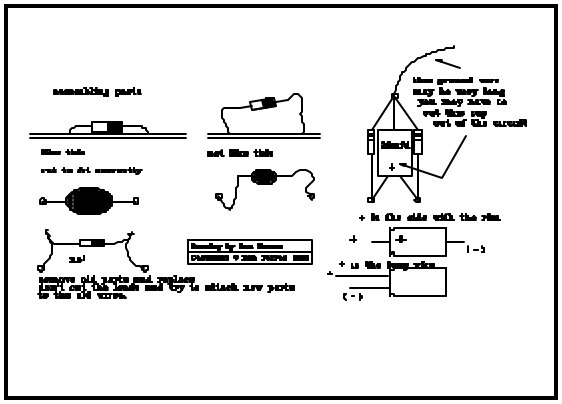
Follow the rules and it will always come out for you first time.



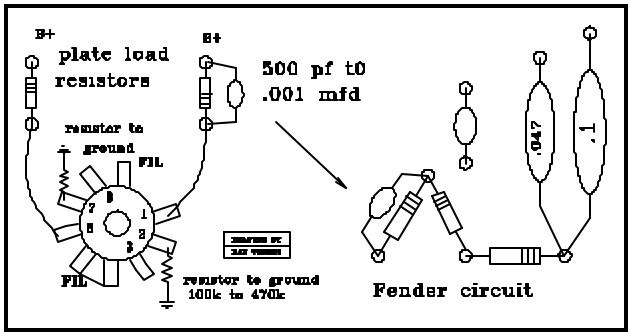
Capacitor ID Numbers - Important

Capacitors have all kinds of ID codes. Not all are marked clearly with their values. Here are the code numbers to identify the Capacitors used in the kits.
Dark Green caps. All start with **2G**. The KT isn't necessary

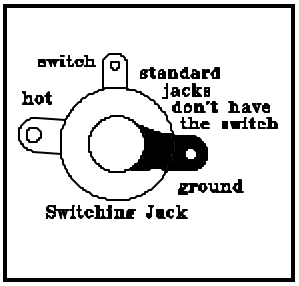
2G102KT .001 mfd or 1000 pf
2G222KT .0022 mfd or 2200 pf
2G472KT .005 mfd or 5000 pf
2G103KT .01 mfd
2G223KT .02 mfd
2G203KT .02 mfd also
2G303KT .03 mfd
2G333KT .03 mfd also
2G339KT .039 mfd
2G503KT .05 mfd
2G104K .1 mfd



Disk caps. Most are in Pico Farads (PF.)
47 or 47m 47 pf
101 100 pf
151 150 pf
251 250 pf
471 470 pf replaces 500 pf
501 500 pf
751 750 pf
502 5000 pf or .005



Bright Blue or Brown Metalized Poly caps
They have the values on them
.02, .047, .68 etc.



Orange Drop Caps
Our custom made capacitors have “Torres” and the value right on the cap.
418P series.
Long numbers such as 715P47356JD3
Ok, 715P is the type. Ignore that
56JD3 is the voltage indicator, Ignore that. It leaves 473 in this case. This is confusing industrial electronic terminology. So:
102 .001
472 .005 (.0047 actually)
222 .0022 (.002 is the same)
332 .003
103 .01
223 or 203 .02
473 .047
104 .1

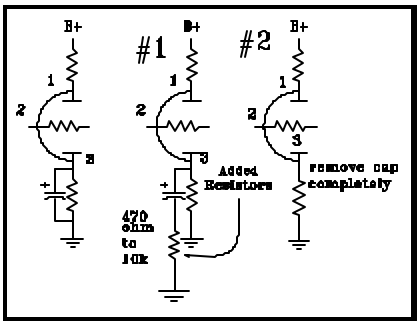
These industrial numbers are found on all the caps. Look at 2G103KT. Obviously 2G is the type, and KT is a voltage indicator. Leaving 103. 103 is .01 mfd..

Common substitutions.
.0047 sub for .005 (.0050)
.002 sub for .0022
.02 substituted for .022
.03 sub for .033
.047 sub for .05
470 pf sub for 500 pf. We use the 470 pf because it has a much higher voltage rating

These don't make any difference in the circuits we are building

Resistor Codes.
This is the standard electronics class chart of the color codes.

Look at the colored bands on the resistors. One side has the bands closer to the end. That's where you start.
The first two bands determine **numbers.** Lets say you find red and yellow. That's 2 and 4 - or 24.
The next band is how many zeros to add. Assume band #3 is blue. That's six zeros.
So your resistor is 24,000,000 ohms. Twenty four million ohms.
Common electronics language calls a million a "meg." So red/yellow/blue is 24 megs.
More language, 1000 is labeled "K" so 24,000 is 24k (which is red/yellow/orange.)



FINE TUNING YOUR AMPLIFIER MODIFICATION

(*Before fine tuning, be sure you have done all the testing included here, have all your grounds in the right places [star ground] have shielded cables all prepared correctly, and have triple checked all parts. Fine Tuning is not repair work. It is for minor problems. Test everything first.*)

Often amplifier modifications that work for us may need some fine tuning of the gain to work for you. This is due to the basic fact that every tube amp is different from every other tube amp in existence.

Throw in the impossible to control factors of different tube manufacturers, and the obvious difference in a tube's output and micro phonic qualities over its life, and you have a need for these fine-tuning tricks.

TORRES high gain amplifier modifications have these circuits (as well as commercial amplifiers.)

The most common problem is too much treble. We work really hard to raise the high frequency of the amplifier to get the increased treble response needed for modern guitar technique. Sometimes it can be too much. Turning the treble control up may cause the amp to squeal.

Most commonly this is from micro phonic preamp tubes. Tap them with a pencil (when the amp is on) and see if they ring. If they ring a lot, replace them. Tube testers won't show micro phonic tubes.

If you have checked your preamp tubes and determined that they are not micro phonic, or you want to stay with the tubes you already have, see the first drawing.

The amplifier will have this circuit all the time. It is the basic B+ Plate load resistor. It is connected to pins one and six of the preamp tubes.

The trick is to add a small value capacitor (rated for 500 volts) in parallel with the plate load resistor (usually 47k to 330k - most commonly 100k and 220k.) This cap will effectively shut the squeal off. It will also roll off a bit of the highs. Once you have the squeal conquered, experiment with smaller values of capacitors until you get the happy medium. I like 750 pf for very high gain circuits, but your tone is up to you.

The squeal you get may come from too much gain also. A tube's gain can vary ON A BRAND-NEW TUBE from 48 to about 62. When you multiply this by 50 with a boost stage, you end up with a gain range, from the same design, of 700. That is a lot of difference to be aware of.

Looking at the same first drawing you will find resistors going to ground on pins two and seven. Grid load resistors. You already have some in there (in case you didn't know it.) You can cut some of the excess gain by adding additional grid load resistors. Start with 220k and go up and/or down until you get the proper gain from the stages. It shorts some of the output of the previous stage to ground before it reaches the next stage. The lower its value the more gain goes to ground.

I normally use one meg or 470k for the standard resistor value. Lowering it to 220k will reduce the gain of the stage, and therefore eliminate the squeal from too much gain. It’s an easy change and doesn't affect much else other than gain.

Other times the gain will be WAY, WAY too much. The amp will go into "cutoff" wherein the notes at full overdrive will seem to turn the amp off with no sustain. Everything will act weird at max overdrive and the amp will seem to be unusable. This is rare as the designs are tested quite a bit before being shipped out. But it can happen, especially with Marshalls and small Fenders (Princeton etc.) It is again, easy to fix.

See the drawing of several tube circuits. Note the changes in the cathode circuit. The first change is to install a resistor from 470 ohms to 10k in series with the cathode bypass capacitor.

A lot of gain comes from that capacitor. The resistor cuts it down easily. This is one of the most effective, efficient ways to fine tune an amplifier. It doesn't affect the frequency response and with different resistor values on the first two or three stages of the amplifier you can tune it to perfection.

Diagram #two shows a more drastic effect. Just remove the cathode bypass capacitor entirely. It’s very easy and very effective. You may just love the sound without it. (More and more modern designs are using the un bypassed cathode resistor circuit for its great "punch" and lack of raspiness.)

Using any or all of these techniques you should be able to get that amp under full control and produce just exactly the sound you want

"Do I have a prayer?" Easy Tech amp troubleshooting

There are lots of books and materials on testing amplifiers with a battery of expensive test equipment. However, checking their work on a tube amplifier may be hard for hobbyists and musicians on a tight budget. The expense of an oscilloscope and related test equipment may be just too prohibitive to consider. (Note: buying such equipment used takes **a lot** of knowledge - getting burned is very easy.)

I will provide some ways to verify and troubleshoot your work with just a simple VOM meter. None of these easy checks are as informative and complete as using an oscilloscope, a distortion analyzer, ammeters, etc. but they may, often, get a standard amp working and find simple wiring or construction faults.

This is an easy series of checks you can do with a VOM (Voltage Ohm Meter) to see if your amp has a **chance** of working.

We have found a very high percentage of "dead amps" to be simple grounding problems.

Tube cathodes and grids should have some kind of measurable resistance to ground (a "load") to operate.

These checks are done with the amp **off and unplugged**. Turn all the volume controls to 10, including master volumes.

Cathodes. The common preamp tubes have cathodes at pins three and eight. (12AX7, 12AT7, 12AU7, 5751 etc.) Connect one lead of your meter to ground - the amp chassis is fine. Set the meter on ohms at 10, 20k or so. Check a tube manual or substitution book for the cathode pinout on other - odd tubes.

Read each cathode pin (three and eight.) Generally you will see between 470 ohms and 10k. Most Fenders, Boogies, Torres "Super Texans" and "Reverb Kings," and other Blackface Fender-based amps will read between 820 ohms and 2.7k (2700 ohms.)

Some earlier amps may have the cathodes of preamp tubes grounded directly to the chassis (some Supros and others.)

Exception. Marshalls, Tweed Fenders, Vox, Torres "Dual Marshalls" "Torres British Invasion" - all amps with a 1 + 1 cascade circuit may have one or two cathodes reading between 56k and 100k, a "cathode follower circuit."

If you get one cathode that appears to read "open" with the meter set at 20k, switch it to 100k or 200k and see if it reads a higher resistance.

Driver tube cathodes are usually connected in parallel and may read from 12k to about 24k.

resistor color codes (ohms)			
Band color	1st and 2nd band	multiplier (3rd band)	tolerance (4th band)
Black	0	1	0.01
Brown	1	10	0.02
Red	2	100	0.03
Orange	3	1000	0.04
Yellow	4	10000	
Green	5	100000	
Blue	6	1000000	
Violet	7	10000000	
Gray	8	100000000	

Why not start at 100k or so? Then you get inaccurate, uninformative readings on the rest of the amp.

If you get one or more cathodes reading infinity, or open circuits, track them down and fix the ground. Disconnecting a cathode from ground will turn the amp completely off.

We are finding more old, original ground connections that were soldered to the chassis broken - fatigued. They may be laying there, looking perfect but broken loose. Age, the flexing of the chassis, and low heat (cold solder joints) at the time of manufacture may be the problem.

If one of these connections is broken, you may find it difficult to resolder to the chassis with normal soldering tools. A terminal lug and screw would be a better repair.

Power tubes. The normal guitar amp tubes 6L6, 6V6, EL34, 6550, 5881, 6CA7, 7027, KT88, KT66 all have a cathode at pin eight. (Some have pins one and eight grounded, but all have pin eight connected to ground.)

EL84/6BQ5 has a cathode at pin three.

Power tube cathodes are also connected to ground. Either directly or via a "cathode bias resistor." In any case, all the power tube cathodes should read either zero ohms or some low resistance (250 ohms to 1000 ohms) value to ground.

Set your meter on 1k to 3k to check power tube cathodes. Most cathode biased amps will read 150 to 800 ohms so 1k should catch them all.

Amps with "half power" switches or "50 - 100 watt" switches usually accomplish the power reduction by disconnecting the cathodes of half the tubes from ground. Be sure you have these switches set to the high power setting before testing.

Tricky note: Some silver faced fixed bias Fenders also have power tube cathode resistors. These are most commonly 150 ohms, but

we have seen 120 and 130 ohm resistors.

Check all of the cathode circuits to be sure they are grounded. After fixing any ground problems you should check to see that they all have the correct value according to the schematic (if you have one.)

Often preamp and cathode biased power tube cathode resistors are bypassed with a capacitor. The amp will work without these capacitors but may not work well. Unfortunately VOM meters do not read capacitors. You will need a capacitance meter for that. Some modern VOM meters do have basic capacitor reading functions. Check your manual.

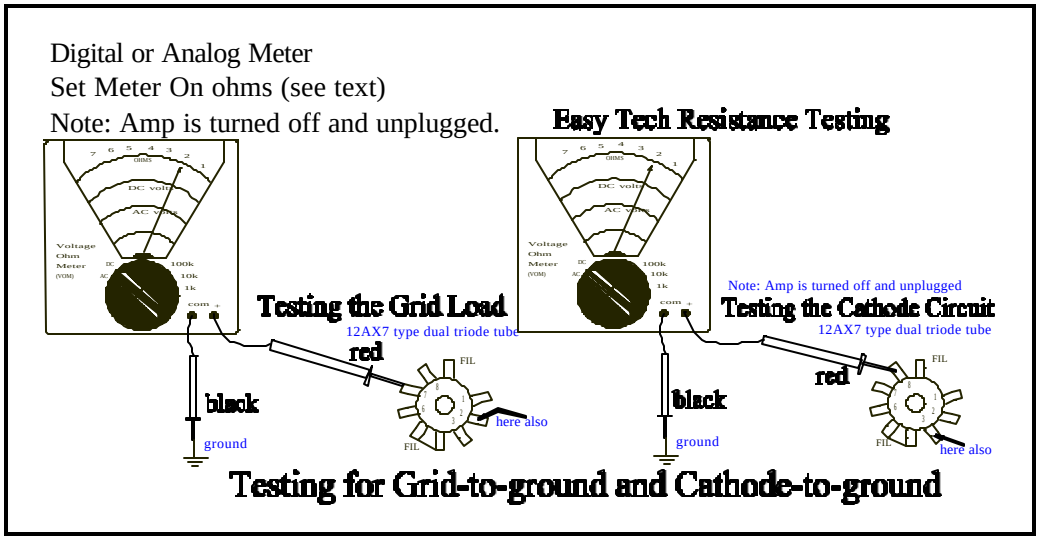
Grids. Tubes receive their input signal at the "control grid," one of the elements of the tube. A somewhat vague, but important fact is that the grid has to "see" a load in order to operate. There has to be a resistance to ground at the grid of a tube. It can't be "fed" directly from a capacitor, a resistance is needed or it doesn't work correctly (in the common guitar amp circuits we are discussing here - don't get over technical in an "Easy Tech" article.)

The preamp tubes (12AX7, 12AT7, 12AU7, 12AY7, 12AZ7, 5751 etc.) Have two grids. Pin two (2) and pin seven (7).

The common power tubes (6L6, 6V6, EL34, 6550, KT66, KT88, KT100, 6CA7, 5881, KT77, 7027 etc.) All have pin five as the control grid. 6BQ5/EL84 has pin two as the control grid.

Check a tube manual for the grids of other tubes. Power tubes will be labeled "G1" for the control grid.

So, for the amp to work correctly you should be able to read a resistance at these pins.



Broken "grid load resistors" are **very common** in guitar amps. If they are broken or disconnected from ground the amp will make sounds, but the sound will appear to cut off. That is, it will sound "crunchy" or distorted for a few seconds then cut off, it will seem to turn off. It may also turn off and come back on for two or three second intervals. If you hear sounds like this, look for the missing grid load resistor.

Pots such as volume controls are grid load resistors (a potentiometer is a variable resistor.)

Your volume pots have one tab connected to ground so the pot acts as a resistance to ground.

This is important to know because Fender and others at various times in their development would ground the pot in different ways. Earlier amps have the easy - to - see tabs bent over and soldered to the pot.

Later as they become conscious of ground loops a wire may run from the pot to a central or semi-central ground point (See "grounded in reality" Available as a reprint from **Torres Engineering.**)

Again, why know this? Because in rebuilding or modifying an amp, it is easy to disconnect this wire, therefore disconnecting the volume pot from ground, therefore disconnecting the grid load resistor. Look out for it.

Ok, time for some ohm meter checks.

These checks are done with the amp **off and unplugged**. Turn all the volume controls to 10, including master volumes.

Attach the black lead from your meter to ground. Set the meter on ohms at a scale capable of reading one meg or more (1000K, 2000K, 3000K whatever the meter allows.)

Check each grid pin on the tubes. For example, tube V1 on a Twin reverb type amp. Without a guitar plugged in pin two reads about 34k ohms. Pin seven reads somewhere between 200k and one meg (the volume control with the tone circuit.) About the highest you would get would be a Marshall Super Lead or a Torres "Dual Marshall" with pin two of V2 reading 1.470 meg (the one meg volume control and the 470k resistor in series after it.)

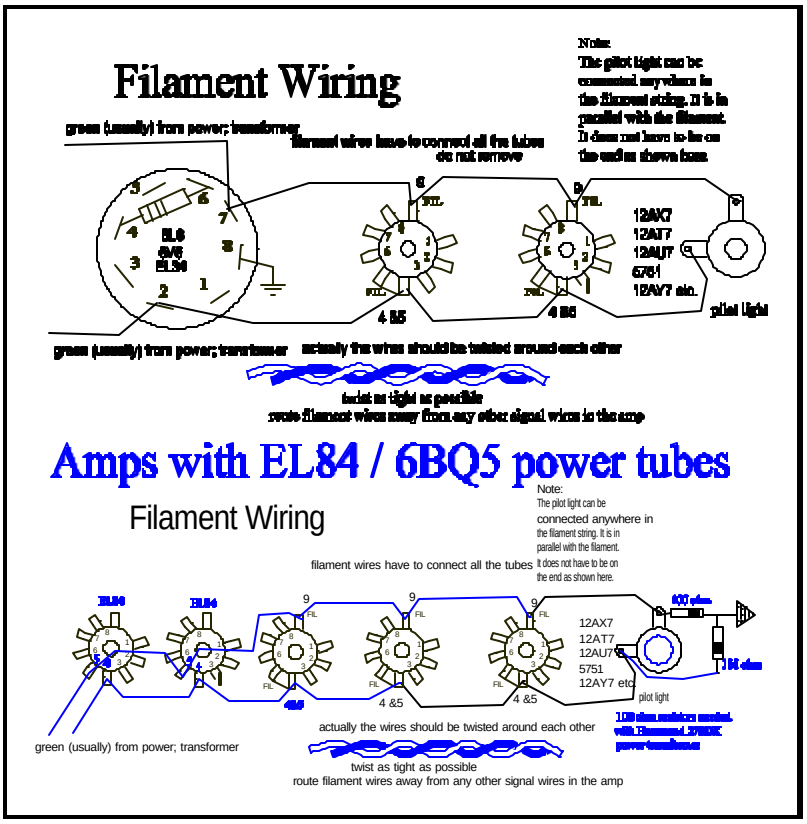
Grid loads can be very low also. As low as 1k. Common effects loop stages are around 2.2k, 6.8k up to 100k. In any case, since we are looking for simple repairs, with simple techniques, all you really want to determine is that there is **some kind of resistance** at the grids of the tubes. If the reading is very low, you may want to switch the meter to lower settings to get an accurate idea of the grid load. You could compare them to the schematic if you have one.

Power tubes. It looks like the control grids aren't attached to ground. But the "grid stopper" resistors connect to the load resistors, usually 100k or 220k. The load resistors join at the bias supply which is a pot or a resistor connected to ground. Look for values from about 50k (correctly loaded 6550 tubes) to around 240k for 6L6 tubes. About the same for EL84's (240k.)

Cathode biased amps will read the grid stopper resistor plus the grid load resistors. Around 221.5k for 6L6 tubes. Again, you are just looking for some kind of value. You should see pretty close to the same load on all power tubes. Balance controls can make them vary a little bit, but it shouldn't be much.

This next series of tests requires the amplifier to be on. You have to know what you are doing and you must be qualified to work with a "hot" high voltage electronic device. The voltages involved will certainly hurt you, and they can kill you.

Don't have an amp tech do this work in a rush, and at all times, be extra careful. This information is provided for qualified technicians only.



"Click Tests." This is an old technique mentioned in the famous **Jack Darr Amplifier Handbook** (out of print for years) and found in other older texts also. It involves a **side effect** of checking the plate voltages of an amplifier and will help you find a dead circuit very quickly.

With your amp on and your technical skills up to par, set the VOM meter on 1000 volts **DC** and clip the black lead to the amp chassis (ground.) Turn the amp volume controls on, maybe half way.

Take a look at the schematic (it's a sample Tweed Bassman) and see where the arrows are. These points are the plates of the preamp tubes. Each of those plates will have a DC voltage on it.

The Process. Starting at the **end** of the preamp, the driver circuit, check the voltage at the tube plates, Pins one and six. Besides reading the DC plate voltage, the meter will make a clicking noise when you touch the red lead to the tube pin or plate load resistor - this is the "click test."

If the circuit is live and delivering a signal to the following stage there will be a "click," Sometimes loud, sometimes not so loud.

Jack Darr's suggestion is to proceed **backwards** in the preamp listening for the click. When you find the stage where it **doesn't click**, you have found the dead circuit.

Not at least you know what parts are working and can center in on where there might be a problem

It is suggested to test at the circuit board and not the tube pins. There is too much of a chance of shorting a plate to ground trying to test at the pins.

Is it amplifying? AC signal tests.

This is a quick easy way to see if the circuit is working, amplifying your guitar.

The basic knowledge here is that the audio signal in the amp is an AC signal. The coupling capacitors block the DC and allow the "music" audio AC signal to proceed from stage to stage.

Therefore, you can test for an AC signal after each stage's coupling capacitor.

The Process. Have your amp tech do this.

Clip the black lead of the VOM to the chassis (ground.) Set the meter at 1 - 5 volts AC.

Plug your guitar in - it is the signal generator. Turn the amp on, turn on the volume control(s).

Take a look at the AC Test schematic. It shows the points to test for an audio signal.

Clip your meter's red lead to one of the test points. They will be after a coupling capacitor in the amp circuit.

Twang your guitar and watch the meter. Does the AC signal rise, then fade out? If so, that stage is amplifying. Go on to the next stage. You will have to set the meter to higher settings as you proceed through the preamp circuit. Each time, hit a string on the guitar and watch the meter.

When you find the point where there is **no AC signal,** you have found the problem area.

This is also good for tracking down hum and audio noise. Without playing the guitar, test at various points until you find a steady AC signal - that is where the hum exists or starts.

An example is a Marshall with a bad hum that seemed to exist in the preamp.

Checking with the VOM on AC, finds the hum existed only in the driver circuit - somewhat unusual. There was no visible signal at any other preamp stages. But when testing the output of the push pull driver one side had a bad hum while the other side was quiet - again strange. It was a bad tube with only one side of the dual triode creating noise. This took about two minutes.

You can do this with an oscilloscope and get far more accurate results, but you may not have a scope and these tests are **very fast**.

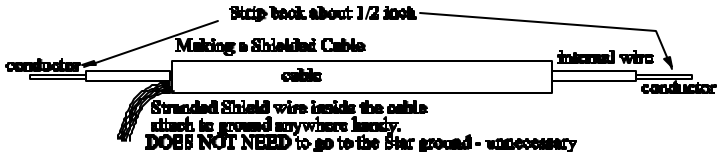
If you have a very sensitive meter you can get an AC signal from the guitar at the input (set at the lowest possible AC setting.)

Again, these are intended to be easy, fast methods to track down a dead circuit in an amp you are trying to repair and/or get working. They don't substitute for more extensive testing and won't find complex problems.

Some of the hot repair guys can fix the amp as fast as they can take it out of the cabinet. Tricks like these and others help quite a bit.

More Amp assembly details.

Some kits have a small transformer used to power the channel switching relays. It will have a connection to the 110 - 115 volt AC power for the whole amp.



Route the wires from the small channel switching transformer **outside** of the amp chassis as much as possible. - Running 110 volt AC inside the amp, near the preamp tubes causes a hum.

Also route the five volt DC to the relays outside of the amp chassis as much as possible, again to reduce noise.

AC wires should be twisted around each other to reduce capacitance and their tendency to act as antennas. (This also applies to Stratocaster and Telecaster pickup wires.)

The tone control wires (usually three wires) should be twisted tightly together from the circuit board to the pots. It may require new wires for enough length to twist them.

Wires to tube grids (pins two and seven of the preamp tubes, pin five of power tubes), should be shielded if possible, and as short as possible. If they are unshielded, route them away from plate wires, AC wires, and next to the amp chassis.

All wiring should be as neat as possible - don't rush. Replace a wire if you cut it too short. Don't try to stretch it.

It isn't necessary to use our color code, although it will make the kit much easier to build, but do take the time to get at least three colors of wire so you can tell where things go. Buying just one spool/color of wire leads to making a confusing amplifier.

Warnings and disclaimer

Tube Amplifiers, all components and related products are electrical products with extremely high voltages that if mishandled or if used carelessly or for improper purposes, can cause life hazards and serious personal injuries. Such equipment is dangerous even when turned off or unplugged.

You shouldn't be working inside the amp unless you know what you are doing.

Don't work on an amp plugged in.

Always discharge the filter capacitors before starting work. If you don't know how, contact us for a reprint on how to do it ("What the Hell are filter caps?")

Solder neatly, and use the smallest amount of solder you can.

Be careful, but have fun.

General instructions for guitar amplifiers.

How do all these knobs work? "

As we enter the 21st century, knowledge from the 50s and 60's becomes more distant and obscure. Often we don't know exactly how things such as tube amplifiers were designed to work, causing a bit of confusion in both terms and function. Maybe this simple page will make it clearer.

Volume Controls. The volume control isn't a gas pedal the numbers are not a measurement of how much power is being used. That is, on a 100-watt amp, 5 is **not 50 watts.**

In general, Fender and Marshall amps all begin to "break up" or distort just above four. The amp is putting out its full clean power at about three and a half. Early catalogs will bear this fact out.

Why have the knob go to 10 then? Owners were expected to know about amplifiers and be aware that you couldn't turn it all the way up and expect a clean sound. The instructions given were *if you notice distortion turn the volume* down. The other reason for the wide range on the volume control was because guitars have an extremely wide range of output levels. A Les Paul has about four times the output of a Telecaster and about six times the output of a Rickenbacker. The manufacturers wanted to have their amp put out the full RMS power with any guitar.

Master Volume Controls. Again, these are not gas pedals and not calibrated (five isn't half power.)

Master volumes were added to the amp designs in the mid to late 60's. The idea was to be able to turn the preamp (the regular volume) up causing distortion, and then turn the actual volume of the amplifier down with the **master volume** so the distorted tones were available at a reasonable overall volume.

But master volumes don't work exactly like that as they are still within the amplifier's preamp circuit (and aren't controlling the final sound to the speakers.) Turning the master volume down causes some degree of distortion, no matter where the regular volume is set. If you want your amp to be clean as possible, turn the master volume all the way up

For clean tone - Turn the master all the way up, turn the regular volume down.

For distorted tones - Turn the master down, turn the regular volume up.

There are hundreds of combinations of master volume and regular volume.

Tone control circuits. Fender and Marshall amps share the same basic tone circuit. This is not an active circuit and the controls are not "notch filters." That is, they are not really tone controls that select a specific frequency response and boost or cut it. The treble control is more of a "mixer" between high frequencies and low frequencies than a treble control, and it has a great deal of gain available. Midrange controls are actually tone circuit gain controls that, within the circuit design, **appear** to boost midrange.

The amps can become muddy sounding with all the tone controls at 10. It's a good idea to evaluate the tone of the amp as you hear it instead of trying to duplicate some settings you've read in a magazine. Any list of "settings" is very vague and inaccurate and would only apply to one person's playing technique with one particular guitar, plugged into a specific amplifier, with an individual speaker, in the same exact room - as you can see - pretty inaccurate to your playing conditions.

Boost Circuits on Torres Amps.

Midrange boost. It increases gain, midrange and sustain. It works best with the **treble control** turned up to six or higher and is not active at all with the treble below four.

Gain Boost. It increases gain, bass and overdrive. It gets its effect by deactivating part of the tone control circuit. When the gain boost is on, the tone controls are not as effective.

Bright switch. The standard guitar amp's bright switch works if the volume is turned down a bit. If the volume is at 10, the bright switch is out of the circuit.

Information for all tube amps.

Most of the used tube amps we are playing today were built quite a long while ago, 15 to 30 years. At that time everyone knew a bit about tubes because everything used them. Now, we are pretty much in the dark about the whole thing, and the Guitar Magazine's "Tube Secrets" articles don't help much.

Tube amplifiers need to have a speaker connected all the time. This goes for any tube amp, anytime. Even if your amp has a line-out, you still need speakers connected. Otherwise it will burn up the tubes and destroy the output transformer.

Some very small tube amps have a headphone jack built in. Usually these amps have a speaker load resistor switched in by plugging into the jack. Read the amp instructions. Note: without very expensive parts, this isn't practical at power levels above 6 - 8 watts.

Tubes are made of Glass. Sure, no problem, but we forget sometimes and toss the amps around in the truck or back of the car. Its amazing how much they can stand, but you should be aware - **glass breaks**. And once a tube is broken, it loses its vacuum and won't work anymore. Usually the tube will turn white when it loses the vacuum. Discard "white tubes," they will never be any good.

If your new or modified amp has a sound problem, the first thing to suspect is tubes. Even the highest quality premium tubes can be damaged in shipping. Try one-at-a time replacement before assuming the entire amplifier is bad. Contact us for some help if you need it.

If we have had to use older tubes in your amp modification the amp has been adjusted for them, but problems can arise in shipping and just luck with old power tubes. An amp may work perfectly with the tubes in one arrangement and not work with them

rearranged. Without new power tubes we can't always be sure the amp will operate when returned to you.

Tubes Don't live forever. One of the main reasons the "mainstream" world left tubes behind is the fact that they are temperamental. A brand-new tube can last 20 years or 20 minutes and paying a high price for them doesn't eliminate this. It is a good idea to have spare tubes on hand. Buying matched power tubes will ensure that they have been tested and are good tubes, but it doesn't provide any kind of "any and all conditions" warranty.

New Old Stock (NOS) tubes, made in America **can be** very good, but are subject to the same Temperamental nature of any item made of glass. We don't make guitar amp tubes, no one in America makes tubes for guitar amps, all the tubes come from Russia, China and Eastern Europe. The old folk-type statement "*I just got them so they have to be good"* is not valid no matter what brand or whom you got the tubes from.

The tubes being "lit up" does not absolutely mean they are good - and tubes NOT lit up, or not showing as much light does not mean they are bad. New designs in tubes "hide" the glowing filament, but the tube is still totally functional.

A giant misunderstanding we are hearing lately is that tube circuits are "go - no go" That is, they have to be perfect to work. This is entirely wrong, and leads to very big misunderstandings. A tube circuit can tolerate all kinds of incorrect things, or broken and missing parts, and still produce sound. It is incorrect to assume that if the amp makes sounds, it is 100% correct. That may not be so at all. - it should SOUND RIGHT. Amps don't buzz, cut out, hum or squeal when they are all correct, but they may operate with buzz, cut out, hum and squeal mistakes.

12AX7 tubes. Many tubes had different names in the past. The distinctions have evaporated and some tubes with several names are all the same tubes now. Most common is the standard 12AX7 preamp tube. It has quite a few names. 7025 (industrial equivalent) and ECC83 (British part number.) They used to be different, now they are the same tube. 50s and 60's Fenders specify a mix of 12AX7 and 7025 tubes. You can replace them all with 12AX7 or ECC83 tubes.

What's a "standby switch?" Fenders, Marshals, Traynor, Boogie's all have one. Its purpose is to put the amp on idle while you take a break. The tubes have a filament that has to be heated up in order for the tube to work. Heating the filament is why the amp has to "warm up." The standby switch **leaves the filament** heated up, and turns off the power and preamp stages. You can flip the standby switch off after a break and play right away. This extends tube life, as the filament doesn't have to be reheated every 45 minutes.

For a short break in the bar or club, put it on standby. But, if you and the other guys in the band are going away - turn all the amps **completely off.** A tube can go bad at any time. If the amp is on standby when the tube shorts out, you may have some damage. Only use the Standby switch when you are still around the amp.

When you first turn the amp on, turn on the **on-off** switch, but leave it on standby for about two minutes. This allows the filaments to heat up and be working right before you start playing.

"What's bias?" Well, I won't go into all the voltage potential, reverse grid bias etc. mumbo jumbo. But be aware that the amp has an adjustment that has to be made with different tubes, and as tubes wear out. **Anytime** you change the power tubes the bias should be adjusted or at least looked at. Again, no matter what brand.

The **Bias** is a negative voltage fed to the tubes. It makes them work right, and sound right. If it is off - underbias (too little voltage) the tubes will glow red hot, the amp will hum and sound lousy. If there is too much bias (overbias,) you will be low on power, and tone will suffer. We have **"bias instructions** ($5.00") to help you set the bias yourself. It's not terribly hard, learn to do it and keep your amp working perfectly **for years**.

Ground Switches. Ground switches no longer meet federal safety standards. We will begin omitting them from custom amplifiers on 4/1/98

Reverb cables. The reverb unit has polarity. If they reverb cables are reversed, it will not work. If your reverb does not work, reverse the cables plugged into the amp. If we did not have your reverb springs here to test, we have tested the circuit with a good reverb spring unit on our workbenches.