# The Trinity Amps
# Amp Troubleshooting Guide

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# Version Control

| Version | Date | Change |
| --- | --- | --- |
| 22.1 | 12Feb21 | First issue |
| 22.2 | 25Jul21 | Added No Sound section, reference techniques and Light Bulb Current Limiting Device |
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# WARNING

**Read this Information Carefully**

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

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# Troubleshooting

When debugging a newly built amp the first things to do are check the wiring, make sure the correct components are installed, and look for bad solder joints.

Use a voltmeter to check voltages and compare them with the voltages listed on the schematic. Remember that you can calculate current by measuring the voltage drop across a resistor and dividing by the resistance.

An incorrect voltage or unusual current may give you a clue to the source of the problem. A low voltage often indicates that something is drawing more current than the power supply can handle and dragging down the voltage.

Probing with a non-conductive object such as a chopstick while the amp is powered on is a good way to find bad connections or problems with the way the wiring is laid out.

Remember that dangerous voltages are present when the amp is powered on. Always drain the filter caps and disconnect the mains before working on the amp. To learn how to do this safely, see the following 'Faulty power supply filter caps' discussion.

Never operate the amp without a load or you will damage the output transformer. You can use an 8 ohm 15 watt power resistor as a dummy load in place of a speaker.

## *No sound*

This technique assumes that the voltages at all the tubes are within spec.

Confirm the speaker cable is OK.

Confirm the impedance switch is wired correctly.

Plug-in a guitar cable and measure the resistance from the tip of the guitar cable to the grid input of the first tube. It should be 68K in the low position and 33K in the high position. If it is not, confirm the input switches are wired correctly.

Confirm that any coax cable core is not shorting to the shield ie input shorted to ground. This can happen during the build process if you apply too much heat and it melts the core insulator.

Using the schematic diagram and lay out diagram, trace the signal path from the first tube on through to the power tubes and make sure it is wired correctly. Do continuity checks on the wire from component to component.

If that all checks out then turn the amp on, turn the volume & master volume up a bit . Can you hear hum or hiss in the speaker? Does it change with volume settings? Do the Treble and Bass controls affect the tone?

Plug in a guitar cable and touch the tip of the guitar cable with your thumb and see if you can hear a hum.

If you can't hear a hum then use your multi-meter probes and very carefully touch the input grids to the power tube. This must be after the phase inverter coupling caps or you will have high-voltage on your screwdriver so be very careful! The safest way to do this is to locate where that wire connects on the circuit board and touch it at that location rather than on the tube itself. You should hear a pop or a click when you do that and that indicates that that part of the amplifier is reproducing sound.

If you hear a pop at the power tube section then move to the input grids to the phase inverter and repeat the same test. Work your way back towards the first preamp tube until you find a location where touching the input grid of the tube does not produce a pop or a hum. This is most likely the area where there's a problem of a cold solder joint or a broken wire or something else.

## *More Techniques*

The power tube pins 3 (plate) and 4 (screen) should have high voltage DC and pin 5 (grid) should pop when probed with the meter. For fixed bias amps the grid should show a negative voltage but cathode biased amps will indicate near 0 volts on the grid. Pin 8 (cathode) will show 0 volts in fixed bias amps or show voltage between 10 to 25 volts DC in cathode biased amps. Nine pin power tubes like the EL84 have different pin functions so Google their data sheet to see their pin functions. With all the volumes turned up you should always hear a pop when probing the grid of any tube in the signal chain. Tubes that run the reverb or tremolo may not pop when probed.

If you get no grid pop then you have a problem somewhere between that tube and the last tube that popped. The first thing to try is to replace the tube. Next measure the voltage at every pin of the troubled tube's socket for clues to the problem.

Higher than normal voltage on the plates can be caused by no electron flow through the tube. This can be caused by no heater voltage or a disconnect between the tube cathode, the cathode resistor (if used) and ground. High voltage on the plates can also be caused by a higher value cathode resistor like using a 15k resistor instead of the specified 1.5k.

Lower than normal voltage on the plates is caused by too much current flow through the tube. This can be caused by an incorrect bias voltage on the grid. A leaking coupling cap can let DC voltage through to the grid and heat up the bias current. A lower value cathode resistor can also allow too much current to flow through a tube.

Cathode biased power and preamp tubes should show the bias voltage on the tube's cathode pin. If there is voltage on the plate but the cathode is zero this can be caused by a bad cathode resistor connection or no heater voltage. With the amp off measure the resistance from the cathode pin to ground. It should equal the cathode resistor value.

Fixed bias power tubes should show the cathode as connected to ground and show a negative voltage on the grid, usually between -30 to -50 volts DC. An incorrect grid bias voltage can make an amp sound bad.

Unwanted Grid Voltage Most preamp tubes should show no voltage on their grids (12A*7 tubes' pins 2 & 7) except tubes that function as phase inverters or cathode followers where voltage on the grid is normal. If the preamp tube's grid leak resistor is tied directly to ground it should not have any voltage on it. If there is voltage on the grid it's usually caused by a leaky upstream coupling cap (that must be replaced) or grid current. To verify the source of grid voltage you can pull the tube and see if the voltage on the tube socket grid pin goes away. If the grid voltage is still present then it's coming from a leaking capacitor or a wiring mistake. No voltage on the grid pin means the unwanted grid voltage was being generated by grid current. Try another tube and look for incorrect component values or wiring mistakes associated with that tube circuit.

Blown power tube screen resistors are a common cause of weak or nasty sounding output. When a power tube blows it often shorts the tube's plate to the screen which results in a blown screen resistor. A blown screen resistor will normally fail open with infinite resistance. The amp can operate with one power tube but it will sound weak and funky. When you replace the blown tube it will still function poorly because the blown screen resistor will not allow any voltage to the screens so the amp will sound different than with a blown tube but still not sound good due the huge output imbalance between the good tube and the tube with no screen voltage. Verify the screen voltage and the resistance across the screen resistor.

If the first power tube checks out then move to the next tube up the circuit which will be another power tube for push-pull circuits or the driver tube for single ended amps. Make sure all the volumes, gains and master volumes are turned up a little when you check the preamp tubes so you can listen for a pop when probing the preamp tubes' grid.

Again, listen for a pop when probing the grid and plate pins and look for voltage anomalies. The pop should get louder as you test each tube up the amplification chain toward the input. Continue moving toward the first preamp tube. If you don't get a pop, or a weaker pop than expected when probing a tube's grid then you have found a problem area. Carefully check the voltages of that tube to find clues to why it's not working.

For 9 pin preamp tubes verify 5.7 to 6.9v AC between the heater pins 4 and 9, and 5 and 9 and verify you have DC voltage on pins 1 and 6 (plates), 3 and 8 (cathodes). You should hear a pop when probing the grids, pins 2 and 7. Nine pin tubes should have 0 volts on their grids unless the triode is being used as a phase inverter, cathode follower or uses grid bias.

If you have unexpected voltage on a tube's grid you may have a leaky coupling capacitor upstream allowing DC voltage through to the grid or a bad tube generating grid current. ~*Rob Robinette* ~

## *Hum*

Hum is the most common problem and is usually caused by AC line noise leaking into the filament wiring or input stages and getting amplified. Here we provide a comprehensive step-by-step troubleshooting guide.

First, measure the resistance from each parts ground connection to the chassis. All readings should be less than 1 ohm, typically 0.5 ohms.

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

## *Volume Test*

A good way to troubleshoot is to divide and conquer by turning the volume control(s). If the hum changes levels as you do this, then the source of the hum is something that affects the stages of the amp before the volume control. A faulty, humming preamp tube can be isolated this way very quickly. Conversely, if the volume control does not affect the hum, the cause is somewhere after the volume control.

### *Faulty tube*

Tubes sometimes develop internal hum. Do some tube swapping to locate the problem. Use the volume control test.

### *Severely unmatched output tubes in a push pull amplifier*

Push pull amplifiers get by with less power supply filtering because they're supposed to cancel this ripple in the output transformer. The cancellation can be upset by output tubes that use different amounts of bias current, allowing the hum to be heard.

### *Faulty power supply filter caps*

There are a limited number of ways for the power supply filter capacitors to be bad. All of the tests on power filter capacitors must be considered hazardous since they may store lethal amounts of voltage and charge even with the amplifier unplugged.

Any time you suspect power filter capacitors, do the following: With the amplifier unplugged and the chassis open, connect one end of a clip lead to the metallic chassis. Clip the other end of the lead to a 10K 1/2W or larger resistor. Holding the resistor with an insulating piece of material, touch the free end of the resistor to each section of the power filter capacitors for at least 30 seconds. This will safely discharge the filter capacitors.

Then:

Visually inspect the capacitor(s) for any signs of bulging, leaking, dents and other mechanical damage. If you have any of these, replace the capacitor. Also note the condition of any series dropping resistors connected to the capacitors to see if they have been damaged by heat. Replace them if they have.

Use an ohmmeter to measure the resistance from the (+) terminal of each capacitor to the (-). This should be over 15K ohms (**Ω**), preferably much over that. If you get less than that on any capacitor, unsolder that capacitor and re-measure just the capacitor. Less than 15K**Ω** indicates a dead or dying capacitor; replace it. If the resistance is now much higher with the cap unsoldered, there is a low resistance load pulling current, not a faulty capacitor. Always check all of the power filter capacitors while you're in there. If one is bad, consider replacing them all.

If there is no obvious mechanical problem and the resistance seems high enough, temporarily solder a new, known good capacitor of at least as high a capacitance and voltage across the suspected capacitor or section, then plug in and try the amplifier again. If this fixes the problem, turn the amplifier off, unplug it, drain the filter capacitors again, and replace at least the bad section if not all of the filter capacitors.

If you are replacing a multi-section can capacitor, get a replacement can with multiple sections matching the original before you remove the original capacitor. Once you get it, make yourself a note of the symbol on each terminal of the old capacitor, such as square □=1uF/450V, triangle Δ=20uF 450V, etc. and then clip the old terminal with the symbol off the old can. Remove the old can, mount the new one, and use the symbol chart and lugs still on the leads to make sure you connect the right sections up in the new capacitor.

### *Faulty bias supply in fixed bias amplifiers*

A bias supply with excessive ripple injects hum directly into the grids of the output tubes. Check that the bias supply diode is not shorted or leaky, and then bridge the bias capacitor with another one of equal value to see if the hum goes away.

### *Unbalanced or not-ground-referenced filament winding*

The filament power must be referenced to the DC in the tubes in some way, otherwise you may get a lot of hum. The filaments are usually a center tapped 6.3VAC winding, with the CT grounded for the necessary reference.

If the winding is not grounded and balanced around ground, it will cause hum. Measure the voltage from each side of the 6.3V to ground; it should be pretty much exactly half the AC voltage at either end. If it is unbalanced to ground, tweak the pot or change the resistors to get it to be.

**Note**: If you have grounded center tap style supply that is not centered on ground, this indicates a faulty power transformer.

**TIP:** If your heater wires did not have a center tap to connect to ground, then put a 100 **Ω** anti-hum resistor to ground from each side of the heater wires to the common ground point. This will add a ground reference to the heater voltages and help to reduce hum.

Other methods are low value pot (200-500 **Ω**) across the whole 6.3V with the wiper grounded.

### *Defective input jack*

If the input jack is not making good contact to the guitar cord shield, it will hum. Likewise, if the jack has a broken or poorly soldered ground wire, or not-very-good connection to the grounded chassis, it will cause hum. If messing with the jack changes the hum, suspect this.

**TIP:** If hum or noise exists when the input plug is removed, try re-soldering the connections to the Input jacks.

### *Poor AC grounding*

In amps with two wire cords, defects of the 'ground reverse' switch and/or capacitor can cause hum. A leaky power transformer can also cause this.

### *Induced hum*

Placement of the amplifier near other equipment can sometimes cause it to pick up radiated hum from other equipment. Suspect this if the hum changes loudness or tone when you move or turn the amp. There is usually nothing you can do about this except move the amp to where the hum is less.

### *Poor internal wire routing*

If the signal leads inside the amp are routed too near the AC power wires or transformer, or alongside the high-current filament supply wires, they can hum. Sometimes using shielded cable for signal runs inside the cabinet can help. It is hazardous to do, but you can open the amp up and use a wooden chopstick (NOT A PENCIL) to move the wires around inside to see if the hum changes. This is hard to do well and conclusively, since the amp may well hum more just because it is open. BE VERY CAREFUL NOT TO SHORT THINGS INSIDE THE AMP.

### *Poor AC Chassis Ground at Power Transformer*

A common problem is the main ground point to the chassis. The green wire ground to the chassis, the 'line reverse' cap, the CT on the filament windings, the CT on the high voltage windings, and other things associated with power or RF shield grounding are often tied to lugs held under one of the power transformer mounting bolts. If this bolt becomes loose, or if there is corrosion or dirt under the lugs, you can get an assortment of hum problems.

### *Defective internal grounding*

There are potentially lots of places that must be tied to ground in the internal wiring. This varies a lot from amp to amp. If one is broken loose or has a poor solder joint or poor mechanical connection, it can show up as hum. Note that modified amplifiers are particularly susceptible to this problem, as the grounding scheme that the manufacturer came up with may well have been modified, sometimes unintentionally. With the amp unplugged, open and the filter capacitors drained, carefully examine the wires for signs of breakage.

### *Hiss*

Some noise or hiss is normal. These amps are supplied with Carbon Composition resistors similar to the original. This style of resistor has inherent noise. If this amount of hiss is bothersome, you will need to replace the resistors in the signal chain with Metal Film resistors.

### *Metal Film Resistor Substitutions*

If you really want to eliminate hiss, use metal film resistors where the signal level is small and the following amplification is high - a classical description of an input stage. The input to an amp should probably have a metal film plate resistor to minimize noise.

Substitute them on the grid resistors in all but output stages because the signal level is typically too low.

Substitute them on the Cathode resistors. They typically only have a few volts across them, and they're often decoupled with a capacitor, both of which would minimize the carbon composition resistor distortion (carbon comp "Mojo").

The best place to use CC's is where there's big signal - plate resistors, and ideally the stage just before the phase inverter. The phase inverter would otherwise be ideal, with plate resistors carrying the highest signal voltage in the amp, but phase inverters are often enclosed in a feedback loop. The feedback minimizes the distortion the resistor generates.

### *Squealing/Feedback*

Squealing usually occurs when there is coupling between the input and output stages. The positive feedback causes the amp to become an oscillator. Vary the volume and tone controls to see if it affects the oscillation.

That will tell you if the coupling is occurring before or after the control. Sometimes the problem can be solved by minor changes to the wiring (moving output wires away from input wires, shortening excessively long wires, etc.).

Use shielded wire on the input jack to help a hum or squealing problem.

Ensure the shielded wire goes on top of the board, not underneath it.

If you've built a TMB-MV 18, you may have a squeal when you turn up the Volume & Master Volume together. Try the following to eliminate it.

1. Move all  Grid Stopper resistors to attach directly to pins.

2. Use shielded wire from the Volume pot wiper to the resistor.

4.  If all that doesn't work reverse the output transformer leads on pin 7 on V4, V5.

Explanation: One of the primary leads is in phase with one of the secondary taps. In a high gain amp, this phase relationship needs to be maintained.

In extreme cases, you may need to ground the output jacks to the chassis.

### *Radio Interference*

If you are picking up radio stations on your amp:

1. Try a .01 uF  or 47 pf capacitor on very short leads between the 'ground' side of the input jack and chassis.
2. Make sure the chassis is fully enclosed electrically. Install a piece of thin Aluminum sheet metal or HVAC Aluminum tape sandwiched between the chassis & cabinet and make sure it makes contact with the chassis.
3. Make sure the 68K grid blocking resistors are located at/on the V1 tube socket.
4. Use shielded wire between the input jack and the 68K grid blocking resistor.
5. Place ferrite beads over the shielded input cable.
6. Try grounding the shield of the shielded input cable to the chassis instead of the preamp ground.

Other useful measures to take in extreme circumstances:

1. Use a filtered IEC connector for your mains power connection.
2. Put a 100pf across the V1 Plate and cathode pins 1&3

### *Scratchy Sounds on Potentiometer(s)*

If you are hearing scratch sounds on a pot when you rotate it, measure the DC voltage from the terminals to ground. A leaky coupling capacitor or tone stack can cause this to happen.

## Amp Triage

Does a volume, tone or master volume control affect the noise? When a control affects the noise it usually indicates the noise is entering the amp before that control. Is the input jack the source of the issue?

Always suspect a bad tube as they are the most common failure point in a tube amplifier. A bad tube can cause lots of different symptoms including everything from complete signal loss, hum, hiss or static. Power tubes usually wear out quicker than preamp. Don't forget the rectifier tube-- they can cause all kinds of problems including weird noises. Reverb driver tubes often have over 400 volts on their plates and die quicker than preamp tubes.

Loose or dirty tube socket pins can cause all kinds of hard to diagnose intermittent problems including complete loss of signal, red plating due to loss of bias voltage, weird noises, static, crackle & pop, weakening or thinning of signal output, loss of tube heat, higher than normal plate voltage, zero voltage on the cathode of a cathode biased amp--almost anything. Sometimes you can gently wiggle a tube and listen for noise. You can clean the socket by spraying contact cleaner on a tube's pins and inserting it into the socket a couple of times.

Power and output transformers are the least likely cause of amp problems.

Always try another guitar, guitar cable, speaker and speaker cable.

Make sure a speaker or dummy load is connected to the amp every time it is powered up.

## Measure Voltages

Specially on a brand new built amp, take voltage readings of your tubes in case someone needs to see those readings.

Voltage readings are like heart beat and blood pressure readings that your doctor uses to diagnose your health issues.

The tubes need to be in the amp, the amp needs to be on and the power tubes biased properly to get any sort of meaningful voltage reading.

For the most part, an amp is basic triode gain stages put together in different sequences.

The checklist below doesn't cover everything but it is something to always bear in mind, whether you're fixing an existing amp or troubleshooting your own build.

## Voltage Readings

With tubes installed, measure and record all the voltages and compare them to whatever documentation you have. High plate voltages or low cathode voltages indicate the tube is not conducting properly. Could be a bad plate or cathode resistor, poor ground, bad bypass capacitor or vacuum tube.

## Tubes

Tubes are the number one suspect. A good first step is to substitute known good tube(s) and see if the voltages return to normal and problems go away.

## Process

Pull preamp tube 1, turn on amp and see if problem has gone. If so, focus in this area. If not resolved, pull tube 2 and repeat. This will help isolate the location of preamp issues. If the problem goes away, try replacing that tube.

Once you narrow it down to a single triode or maybe two possible triodes, here's a checklist of things a triode needs to function, aside from making sure it's not just a bad tube:

1) Plate resistor. Correct Value? Soldered correctly?

2) Cathode resistor. Bypassed or not. The bypass cap is always suspect.

3) Grid leak resistance. This may be a volume pot, a fixed resistor, or a tone stack. No matter how it's accomplished, the grid must have a connection to ground for current to flow. And ensure the grid leak is always there, even if a switch connected to the grid is engaged ("It pops when I change channels")

Confirm that these are connected and measure ok with an ohmmeter.

4) In AC coupled triode stages (the vast majority) make sure no DC is leaking from the previous stage to the grid of the next. Measure DC voltage on the grid of the triode with a voltmeter.

Measure voltages at plates and cathodes. If there isn't a big voltage drop across the plate resistor, the tube isn't conducting. One of the four issues above is the cause. Even if they all check ok as far as measured resistance goes when the amp is off, something isn't passing current. For example, it could be a bad ground connection not allowing current to flow so voltages are way off, such as very high plate voltages.

With no HT voltage (completely discharged safely), all anode resistors need checking and cathode capacitors (25uF 50V etc.) might require replacing.

## Troubleshooting Tools

Use FX loops if present to isolate a problem to preamp or PI/output. Then is the noise affected by a MV? Tone stack? Channel volumes?

## Ground Connections

Ground connections are very, very important. Check all ground connections to ensure they are solid, clean and conductive. Measure resistance <1 ohm.

## Solder Joints

A bad solder joint can cause noise, weak signal and poor grounding. Applying pressure with a chopstick and hearing noise can identify a bad joint. Freeze spray can also help identify bad solder joints. Reheat the joint with a small amount of solder added.

## Noise or crackling

Noise or cracking could be caused by any resistor. Grounding grids or pulling tubes lets you find the stage where the crackle is.

First track down where the crackle is coming from. Either by grounding grids or pulling preamp tubes, working from input to PI. Pull tubes starting with the first preamp tube until the noise goes away. That narrows down the problematic area. Try replacing the tube first before diving in.

Then it's a combination of the above list, the way the amp was constructed, and materials used. In eyelet/turret/tag/terminal builds, solder joints are pretty easy to inspect.

- Touch up suspect solder joints by reheating and adding a little solder.
- Look for discolored components. Smell things.
- Measure any voltage from the board material itself to ground!

## Hum and Lead Dress

Lead dress is a major cause of noise and hum.
Try to maintain a linear path for audio. Think of the signal levels in each wire as you route them. Keep inputs or low-level signals away from high-level wires. When in doubt, use shielded wire.

***Twist heater wires***. What is really important is the distance of the heaters to the input grid wires. You can fly the heater wires in the air & away from the chassis and place the the grid wires against the chassis. Or if you wish to go the other way fly the grid wires in the air & away from the chassis and place the heater wires against the chassis in the corner.

Don't have your ***OT's input and output wires*** run parallel to each other in close proximity for anything more than is unavoidable. And the reason is RF interference via induction. Twist the input and output side for common mode noise rejection. Even a few turns will help quite a bit.
The closer together they are, and the longer the run that they are together, especially with no twist, will lead to noise.

If you must cross a signal wire with another wire try and ***cross signal wires at 90-degrees*** to minimize inductive interference.

***Keep high level signal lines (PI, Speaker out) away from low level signal lines (preamp-grid etc.)***. If you must cross them, do it at 90 deg. Every lead has a magnetic field. If you have an alternating current in one it can induce a current in an adjacent wire. Parallel lines make this worse, 90 deg should minimize it. Same as the transformers; they're nearly always 90 degrees out (on their cores).

Identify which leads carry AC and which DC and keep AC runs short and let DC runs be longer. Audio signal is AC.

***Use Co-Axial cable*** - RG-174U if possible, for low level signals or long-run lengths. For example, Input jacks to grid stopper resistors; preamp controls to tubes; MV or Treble to tube grids. Ground only one end of the cable, insulating the shield from the core with shrink-tubing.
***Twist AC wires*** if possible, for as much of the length they run as possible; even a few turns cuts down RF noise (common-mode-suppression). These are Power leads, rectifier and heater leads and remember: your OT wiring is AC as is any wiring running to, or from, a transformer, and that includes the choke.

Typical amp has short DC path from tube to tone-stack components then three long AC paths to the pots. If you have the components right by the pots then you have a single longer DC path from the tube and short AC paths.

Note - **Measuring "continuity"** is NOT a guarantee of determining a short. The "continuity" setting on a multimeter typically generates a tone when the measured resistance is 199 ohms and less. That last statement is very, very important to understand. As an example, if you are measuring the continuity of a wire or switch contact or ground connection and a tone is created, this indicates that the resistance between the leads is somewhere between 0 ohms and 199 ohms. That is potentially NOT a short. For an accurate determination of a short, you'll have to switch to a resistance setting and measure the actual resistance.

# Blocking Distortion

Blocking Distortion happens when the time constant of the high-pass filter formed by the (220K) grid leak resistors and (0 .1uF) coupling caps before the power tubes, is too high. When presented with a constant signal with a significant duty cycle (i.e. clipping), the power tube grids have no time to recover and begin to charge positive, the result being some really nasty, alien-like distortion. This is something you won't notice until you drive the amp hard.

A Tone control at max may be allowing more signal content through exacerbating the issue.

You could try this: Lower the RC time constant of the high-pass filter, either by lowering the cap value, resistor value or both. Drop the value to .056 or .068, possibly even .047 or .02, depending on your requirements. Or, you can drop the value of the grid leak resistors. Or you can reduce BOTH slightly. Either way works. The trick is to reduce the values only enough to reduce blocking distortion, while still maintaining good bass reproduction.

# Parasitic Oscillation

With the Bright volume on max and tone at 0 (bass), no input, listen to the amp through a speaker, you should hear hiss. Slowly turn the tone towards bright and see if you hear a click at high treble levels. If you do, you may have Power Tube parasitic oscillation. If you were playing the amp, it would cut out or get quiet at high treble levels. If so, check that the wires to the grid resistors are connected correctly. You can also increase the grid resistor to the power tubes.

### *Amp Buzz or Rattle When Installed in Cabinet*

If you get a buzz in an amp when it's installed in a cabinet, it could be due to any one or a combination of the following things. Start with the easy things and work your way through the tests.

First, is it a metallic buzz? Is it a tube (ringing) buzz? Is it a softer buzz (wooden/plastic sound?)

Try using an external speaker, isolated from the amp to see if it goes away. This should tell you it's related to the cabinet mechanics or not.

Testing Cabinet Mechanics

- Are the Speaker mountings tight?
- Are the cabinet construction screws tight?
- Are the Vents loose? Use more fasteners; Rubber gasket between vent and chassis; hard rubber washers to hold vent assembly on
- Does the power transformer touch the mounting boards ? Check for a gap and then separate the power transformer from the mounting board.
- Is the Speaker cable rattling against back of chassis? Hold it & listen. Tie it down if necessary.

Loosen the chassis from the cabinet and see if the buzz goes away. This will isolate the chassis as the problem. If it does go away, Test the chassis mechanics.

Testing Chassis Mechanics

- Are all the nuts fastening parts to the chassis tight? (sockets, transformers, tag strips etc.).

- Are there Shields on pre-amp tubes? Remove & listen.
- Are there Spring retainers on power and rectifier tubes? Remove them or temporarily tie them down somehow & listen. Cover in heat resistant tubing if necessary to isolate them from the tubes; or remove them; or you can retain tubes with a small amount of silicone.
- Are the tubes mechanically rattling? Hold them and see if the rattle goes away. Replace if necessary.
- Are the Controls loose? (toggles/mounting rings etc.)
- Is the Chassis loose? - tighten & listen
- Is the Chassis loose against backboard? - Remove backboard & listen
- Is the Chassis pushed up hard against cabinet? Tighten; Use Rubber gasket (neoprene 3/8' X 1/8' window/door sealer) around where the chassis touches the cabinet
- Is there a gap between panels/chassis & cabinet? Tighten it up, use rubber gasket where the faceplate meets cabinet. Rubber gasket (neoprene 3/8' X 1/8' window/door sealer) between panel and cabinet
- Is the Chassis vibrating around backboard? Remove the backboard and listen. Use a Vibration damping strip or rubber gasket between chassis and backboard.
- Is the Chassis vibrating around the tranny? Hold tranny & listen; Are there washers between tranny & chassis. Flush mounting (i.e. no washers) could cause rattle. Use rubber gasket between transformer or use washers
- Is the Circuit board mounted tightly against chassis? Tighten mounting screws - check standoffs.
- Are there components touching the turret board? Use a chopstick to prod some of the larger ones first, then space them off the board; You can even silicone the rattling parts to board if necessary (especially larger caps).
- Are there Components touching each other? Use a chopstick to prod some of the larger ones first, then separate them; Silicone the rattling parts to separate them (especially larger caps)

Other Tests

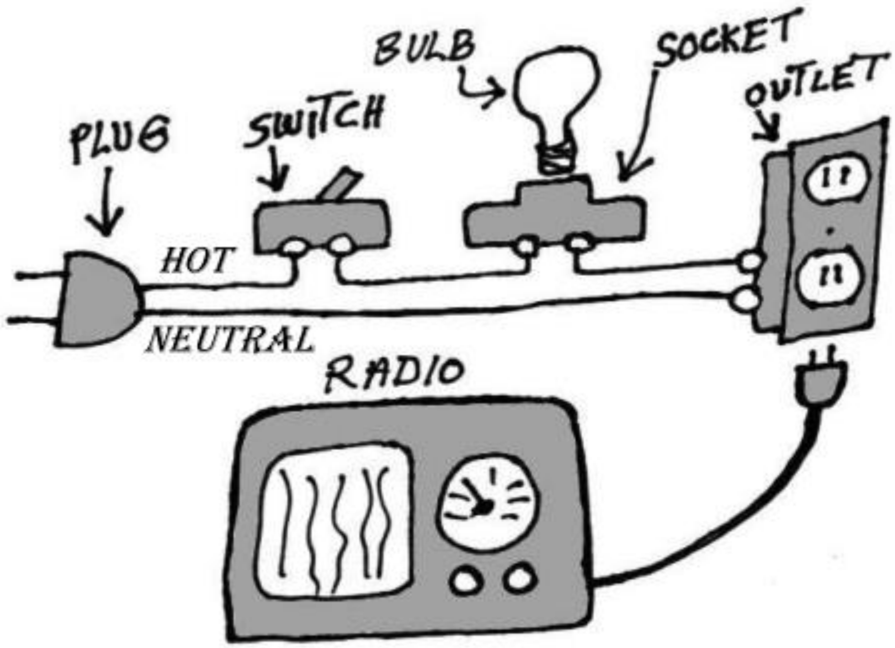
- Try different tubes - if it is coming from both channels, try output tubes first. Tap them when removed from the amp to see if you can hear any rattles.
- Input/Output jacks - try plugging a spare 1/4' jack into the other jack(s) when playing or the end of a chopstick. Replace the noisy jack.
- Speaker - vibration between alnico magnet & bell cover; or voice coil rub. Try a different speaker; Replace speaker if necessary
- If you have a signal generator you can sweep from a low frequency noting where any rattles occur. Then leave the frequency generator at that position while you prod around looking for the source of the problem. Fix it and move on to the next one. If you don't have a signal generator, then you'll need to pluck certain strings of your guitar in sequence and see what excites the rattles.

At three separate and different frequencies you might find:

- Components vibrating against the board;
- Chassis rattling against the cabinet; and
- Mechanically noisy tubes (V1 for example).

Make sure all the components are away from the board and not touching, and put neoprene 3/8' X 1/8' window sealer with one adhesive side, between chassis and wherever it touches the cabinet.

# Light Bulb Current Limiting Device




A useful tool to construct is a Current Limiting Device. This is simply a 25-50 watt light bulb wired in series with the main, hot line.

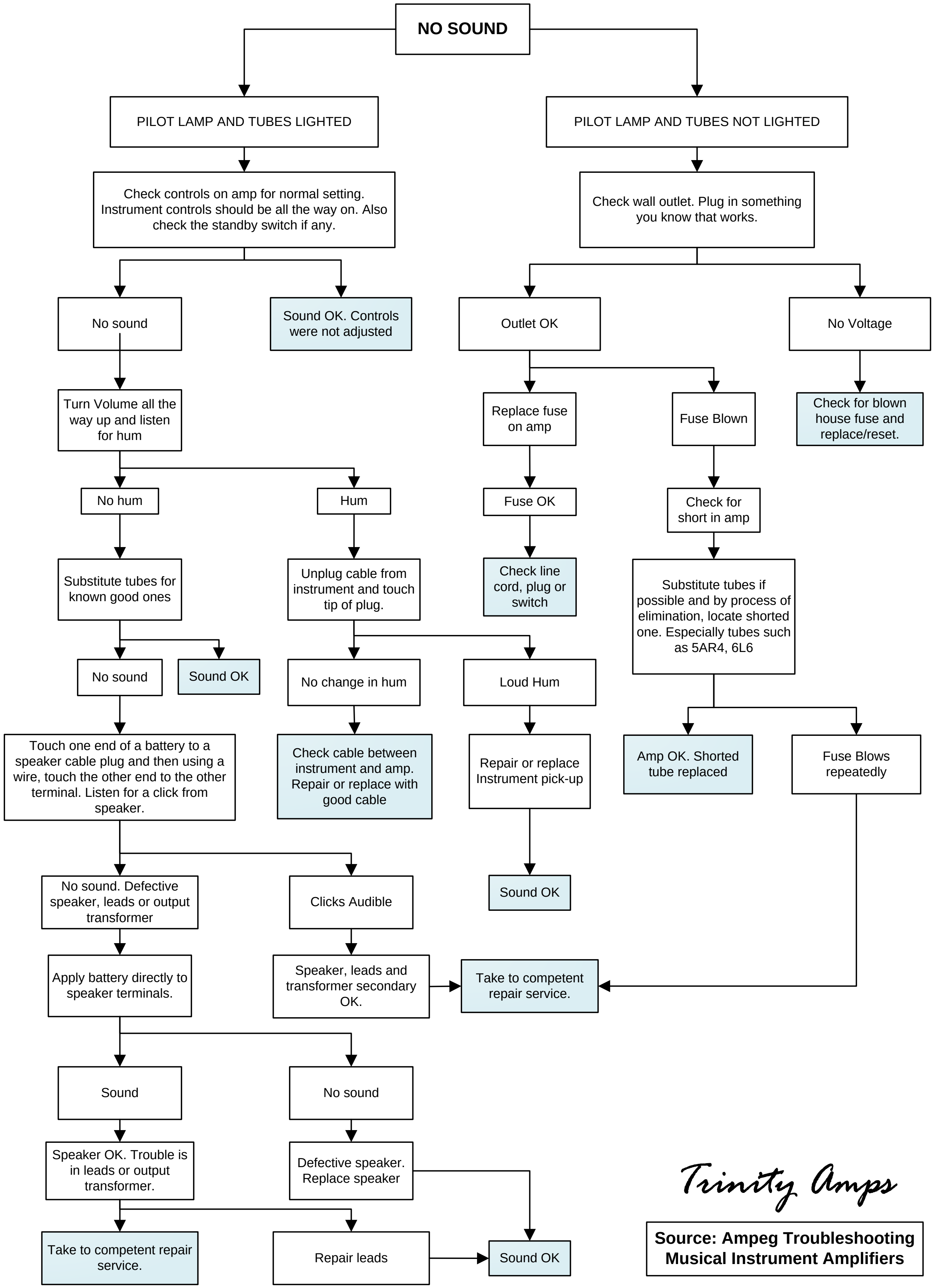
The idea behind this circuit is to use a light bulb in series with the outlets you are trying to protect. Simply wire one of the outlets on a light socket, in series with the outlet you want to protect.

**Theory**: If the current draw on the protected outlets gets high, the light bulb will light, indicating a high current draw. Light s are current limiters. They will get to their maximum brightness and then the bulb filament resistance will increase, limiting the circuit current.

**Practice** - If the light goes bright, you most likely have an issue that needs to be resolved.

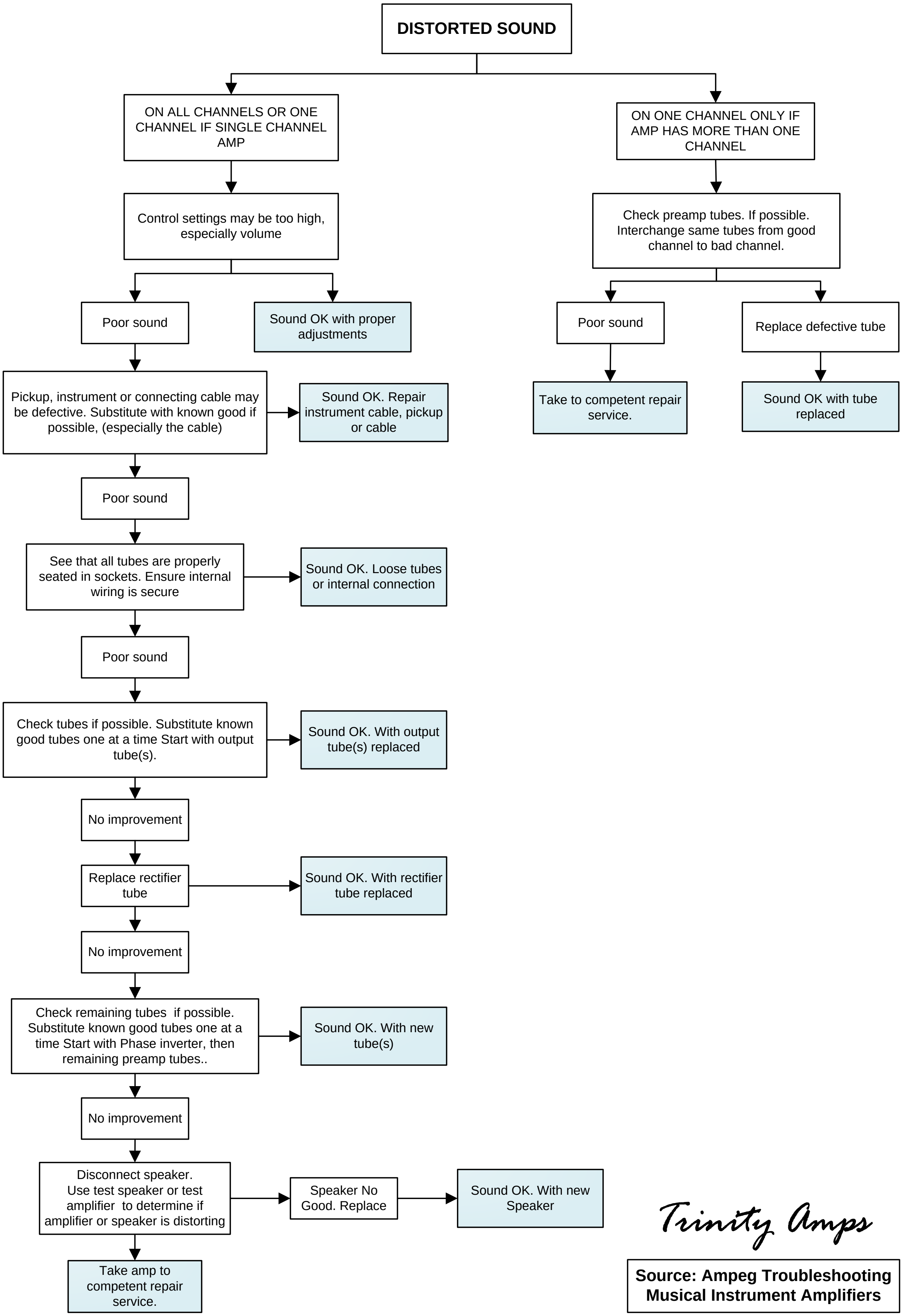
Once the issue is resolved and the amp seems safe to operate without the device, remove it from the circuit to do your voltage tests.

# Troubleshooting Flow Charts




Trinity Amps

**Source: Ampeg Troubleshooting Musical Instrument Amplifiers**


DISTORTED SOUND
ON ALL CHANNELS OR ONE CHANNEL IF SINGLE CHANNEL AMP
ON ONE CHANNEL ONLY IF AMP HAS MORE THAN ONE CHANNEL
Control settings may be too high, especially volume
Check preamp tubes. If possible. Interchange same tubes from good channel to bad channel.
Poor sound
Sound OK with proper adjustments
Poor sound
Replace defective tube
Pickup, instrument or connecting cable may be defective. Substitute with known good if possible, (especially the cable)
Sound OK. Repair instrument cable, pickup or cable
Take to competent repair service.
Sound OK with tube replaced
Poor sound
See that all tubes are properly seated in sockets. Ensure internal wiring is secure
Sound OK. Loose tubes or internal connection
Poor sound
Check tubes if possible. Substitute known good tubes one at a time Start with output tube(s).
Sound OK. With output tube(s) replaced
No improvement
Replace rectifier tube
Sound OK. With rectifier tube replaced
No improvement
Check remaining tubes if possible. Substitute known good tubes one at a time Start with Phase inverter, then remaining preamp tubes..
Sound OK. With new tube(s)
No improvement
Disconnect speaker. Use test speaker or test amplifier to determine if amplifier or speaker is distorting
Speaker No Good. Replace
Sound OK. With new Speaker
Take amp to competent repair service.
Trinity Amps
Source: Ampeg Troubleshooting Musical Instrument Amplifiers