

Tube Guitar Amp Troubleshooting

Here's my technique for troubleshooting a tube guitar amplifier. Many of these techniques apply to solid state amps too.

If you are turning on a new build amp for the first time I recommend you use a [light bulb current limiter](#) and follow the [Paul Ruby First Power Up Procedure](#). Following it will minimize damage due to a miswired amp.

The more you know about [how tube amps work](#) the easier they are to troubleshoot, so keep learning.

You can do a lot of troubleshooting using just spare tubes and a multimeter. **Always suspect a bad tube as they are the most common failure point in a tube amplifier. Having a spare set of tubes to swap into the amp is a must for gigging tube amp users.**

Preliminary Troubleshooting

If the amp is blowing fuses at power up replace the fuse and plug the amp into a [light bulb current limiter](#) and power it up.

Here is Gerald Weber's light bulb current limiter guidance:

The purpose of the light-bulb is to allow you to keep the amp on - without blowing a fuse - long enough to troubleshoot it. I suggest using a 100 watt incandescent bulb. [If you can't find a 100 watt a 150 is the next best thing. You can not use an LED or fluorescent bulb.]

Plug the amp in to the light-bulb limiter, turn the amp on in 'standby' mode (if available).

Switch standby to 'play'. If the lamp lights brightly this indicates a short somewhere in the amp.

Remove power tubes, one at a time. If the light stays bright, that tube can be put back into the amp. If the light dims, the tube you just removed is shorted. If none of the tubes appears to be shorted, go to the next step.

Remove all power tubes together. If the light dims, the problem is probably in the bias supply. If the light remains bright, the problem is (probably) a bad rectifier, shorted power transformer, or shorted filter cap - see next step.

Now switch the amp to standby mode. If the light goes out, the problem is in the filter caps. If the light keeps shining bright, the problem is in the transformer or the rectifier - see next step.

Remove the rectifier (or disconnect the diodes if it's a hard-wired solid-state rectifier). If the light dims, the rectifier is bad. If the light stays bright, the problem is probably in the power transformer.

If the amp is not blowing fuses:

Try another guitar and guitar cable.

Some amps have multiple master volumes so make sure they are turned up.

When testing an amp **try all the input jacks** and make sure all the volume and gain knobs are off zero.

If the amp has an effects loop **try plugging the guitar into the FX loop Return jack**. That will bypass

the gain stages and circuitry upstream. If that works you know the problem is upstream of the Return jack.

If an amp is completely dead take a look at the tubes to see if they have any heater glow. Dimming the room lights can help see the glow. Most amp pilot lights are powered by the heater circuit, but not all so don't assume a lit pilot light means the tubes have heat.

If the amp still looks completely dead check the mains fuse. Most older amps have a mains fuse holder on the control panel or on the back of the amp chassis while many newer amps have the fuse built into the power cord socket. You have to pry open a little cover to get to the fuse. **Check the fuse for continuity with your multimeter.** They can look good but still be blown.

Check the speaker and speaker cable. A speaker cable with a break in it can fry the output transformer. **Make sure the speaker is plugged into the correct speaker jack.** Many Fender amps ground out the signal if you plug only one speaker into the Aux speaker jack.

Play another amp through the speaker to verify its tone and function. You can also **connect another speaker to the problem amp**, if the amp sounds good you know you have a bad speaker.

If the amp powers up but is quiet or sounds bad **you should always suspect a bad tube.** You should have a spare set of tubes on hand so **swap out all the tubes one at a time** and see if that fixes your problem.

Going Inside the Chassis

WARNING

*Amplifiers have large capacitors that store enough electricity to **kill even when the amplifier is unplugged.** If you open an amplifier you **MUST** verify no voltage remains in the capacitors before working inside it.*

Look for internal fuses. Many amps have several fuses inside the chassis, both in-line and circuit board mounted to protect the power transformer and other circuitry.

Dirty or loose tube sockets can cause everything from no signal at all to intermittent static, pops and hum. If wiggling the tubes causes noise then put some contact cleaner on the tube's pins and insert them into the socket. You can also [re-tension loose sockets](#) for solid pin contact.

My next step is to **take DC voltage readings** starting at the filter caps (B+1, B+2, B+3). It's good to have a baseline voltage chart for your amps so you know what voltage to expect. A higher than normal B+ reading can be caused by a non-functional tube that's not drawing current from the power supply. A lower than normal reading can be caused by a tube that is pulling too much current which can be caused by a bias problem.

Octal Tube Socket Numbers

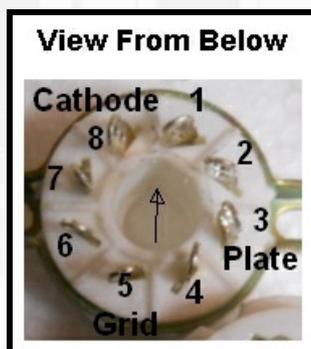


Plate is pin 3, Screen pin 4, Grid pin 5 and Cathode is pin 8. Arrow points to the insertion index notch.

Next is the power tube closest to the power transformer. For octal power tubes (8 pins) I look for 5.7 to 6.9v **AC** heater voltage between socket pins 2 and 7. Tube socket pins are normally numbered from the socket index (slot or pin gap) clockwise. 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 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. **If you don't hear a pop when probing the grid (pin 5) then you have a problem somewhere between that power tube and speaker. The first thing to try is to replace the tube.**

Blown power tube screen resistors are a common cause of weak or nasty sounding output. When a power tube blows it can short the tube's plate to the screen and blow the 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 the blown tube but still not sound good due the huge output imbalance between the good tube and the tube with no screen voltage. Measure the resistance from both ends of the screen resistor and subtract the difference to get the actual screen resistor resistance. You need to measure this way because the resistor is connected to the power supply on one end.

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.

If the first power tube checks out OK 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. **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. Nine pin power tubes like the EL84 have different pin functions so Google their data sheet to see their pin functions.

If you have unexpected voltage on a tube's grid you may have a leaky coupling capacitor upstream allowing DC through to the grid.

"Chop Sticking" the Amp

You can use a non-conducting wooden chop stick to move wires around with the amp operating to identify lead dress problems. On my first amp build I had the V1A plate and grid wires laying on top of one another which created a moderate hum. Simply moving those wires apart made the amp almost silent. A chop stick can also be used to apply pressure to components and solder joints to identify weak components and joints.

Freeze Spray for Intermittent Problems

Intermittent problems are sometimes caused by a weak component or bad solder joint that is affected by

heat as the amplifier warms up. You can sometimes identify the issue by waiting for the problem to occur then carefully spray [freeze spray](#) to cool amp components. If spraying a part or solder joint causes the issue to go away you've located the problem.

Break Out the Oscilloscope

If I haven't found the problem after checking all the tube voltages and hearing a grid pop I **break out the tone generator** and inject a 1000Hz 100 milliamp signal at the input jack and **trace it through the amp with an oscilloscope** by probing the tubes' grids. Start at the input jack and work towards the speaker and watch for the wave shape to disappear or change shape. There are tone generator apps for your phone you can use but you will need an adapter with a 1/4" mono TS plug.

I also use a dummy load when doing this test so I don't have to listen to the damn tone coming through the amp's speaker. **Be careful with your oscilloscope probes because the very high voltage on the tube plates can damage it** unless you use a high voltage rated probe. The grids normally have zero or low DC voltage so I take my signal sample from the grids.

For more reading take a look at Jack Darr's [Electric Guitar Amplifier Handbook](#). It has a pretty good amp troubleshooting and repair section with good info on both tubes and transistors.

By Rob Robinette

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