

Fixing Loud Crackle/Static

An issue that commonly pops up in Hot Rods is the *Plate Load Problem*. These amps sometimes develop a loud intermitten crackle/static that's mainly caused by the 82K plate load resistor of the phase inverter (R57). Sometimes this resistor will come completely "open," or, in other words, it will internally break into two. This results in a dramatic loss of volume, as only one power tube is amplifying, and a terrible sounding break up even when the amp is supposed to be clean (i.e. severe crossover distortion). You can check for this by measuring the voltage on both sides of R57. If there's several hundred volts on one side, and zero volts on the other, then we've found the problem. If the resistor only partially fractures, then a crackle/static appears.

No need to worry if your amp is suffering from these problems, this fix is very inexpensive and simple. You'll need only to order the correct parts and replace them. Most techs go ahead and replace every plate load (R4, R11, R16, R22, R57, R58), which may be a good idea.

When asked about the problem a Fender representative said, "we had a vendor problem with these resistors. The problem would cause the resistors to eventually hair-line fracture and open under normal operating conditions. The vendor has since analyzed and corrected the problem with their process."

1. Before we can do anything, we must have the correct parts. You will need at least five (5) 1/2W 100K resistors and one (1) 1/2W 82K resistor. You can use any appropriate resistor rated for 1/2W or higher, and each resistor should be able to handle a working voltage of *at least* 350V and preferably 500V for longevity. A 1W resistor may be a little large, but it'll work. Do not use a 1/4W, but if you're in a severe pinch (e.g. playing for the pope) you can put two 1/4W resistors in parallel. Remember, two 1/4W 200K resistors in parallel will be the same as one 1/2W 100K resistor. A 1/4W 200K and a 1/4W 150K will give you a 1/2W 85.7K resistor, which is close enough.

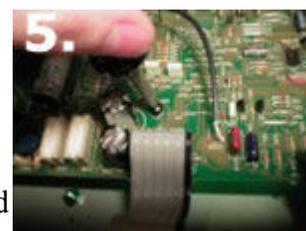
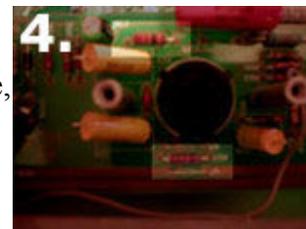
I used Xicon 5% 1/2W Carbon Composition resistors simply for the carbon comp "voodoo magic" ([30BJ500-100K](#), [30BJ500-82K](#)), which will increase nice sounding harmonic distortion. Others prefer Metal Film resistors for low noise and reliability. In this case you ought to try Vishay/Dale 1% 3/4W Metal Film flame-proof resistors. At Mouser their part number is [71-CCF60-100K](#), and [71-CCF60-82.5K](#). I recommend over-ordering! You'll never know when that extra part will come in handy—I've been thankful more than once. I've also ordered similar resistors from [Antique Electronic Supply](#) with good results.

2. DRAIN THE FILTER CAPS! Your life may depend on it. [Click here](#) to learn how.

3. Remove the smaller PCB which supports the tube sockets. The easiest way to do this is by removing the tubes, then removing the black screws which hold the sockets to the chassis. If you're wanting a headache try removing the silver screws which hold the sockets to the PCB. Trust me, I'll never do that again. You may also want to remove the really small PCB which supports V1. I used to leave it in, because I was lazy, but one of the two tiny green heater wires bridging the two tube PCBs broke, and it was very hard to spot.



4. Locate R57 and R58 on the tube PCB. They're right next to V3. My pictures will look different from the inside or your amp as I've replaced most the stock parts with high quality parts. Unsolder the two resistors and observe the location of R57. The name should be clearly printed on the PCB. R57 is the only plate load that requires an 82K Ω , the rest use 100K Ω resistors. (An explanation why is included at the end of this page.) I recommend removing the old solder with a solder sucker or extra component until you can clearly see two open holes. Bend the component's leads around a screwdriver so that they're at a 90 degree angle. Insert the new resistor's leads into the open holes and solder into place.



Removing excess solder will prevent us from damaging the fragile solder pads used by PCBs. (This occurs when you push a component into place before solder is hot enough. With a little force you can totally dislodge the solder pad, which is just a thin piece of foil glued to the PCB.) Damaged solder pads will need to be jumpered to the next location in the circuit. It's a good habit to check the continuity of corresponding traces with an ohm-meter after soldering in a new component. This will keep us from having to take the amp back apart if we plug in and find a new problem. 99% of the post-installation problems I've encountered were caused by damaged soldering pads.

5. Remove all chicken head knobs, washers, the black screws holding the PCB down, and the green ground wire behind the input jacks. Gently remove the main PCB so that you get under it to replace the remaining plate loads.

6. Locate R4, R11, R16, and R22. Unsolder and replace them.

7. Reconnect everything and enjoy your fixed amp.

Why 82K?

If you're reading this you may have noticed that the phase inverter's output seems like it must be "unbalanced." V3A's plate load is 82K, while V3B's plate load is 100K. You may or may not know that increasing the plate load increases output, and lowering the plate load decreases output. So it's often asked, "why's there an 82K on one side of the phase inverter, and a 100K on the other? Is this a mistake?" I've even heard a tech recommend that you switch the 82K to 100K so the output is "more symmetric," which somehow is supposed to sound better.

Observe a copy of the schematic. One leg of the phase inverter is hooked up to the negative feedback loop, and the other to the preamp. For a phase inverter of this type, V3A sees an input signal equivalent to the preamp's output minus the negative feedback coming from the cathode resistor (R56). The other half of the PI (V3B) sees the cathode feedback, which is slightly smaller—about 20% less. This makes the current swing in V3A about 20% larger. Since the current through the tube sections is relatively a function of the input, and independent of the plate resistors, the plate resistor values are adjusted so the the voltage swing in each section is approximately the same.

The unbalanced output effect of a phase inverter is greater with a small cathode feedback resistor. The Hot Rod's 6.8K resistor is very small. In Vox amps a 47K resistor is often used, so the cathode feedback is high enough to neglect the unbalance and two 100K resistors are used. So despite what some might tell you, simply increasing R57 to 100K will not give you a more symmetric output. Quite the opposite in fact.

By Justin Holton