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Subject: Fused cathode mod for Audio Note Kit 2

Posted by [Wayne Parham](#) on Sun, 19 Jul 2009 19:32:05 GMT

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I've been the happy owner of an Audio Note Kit 2 for several years now. I use it for several hours every day so it sees a lot of service. It's a reliable amplifier, in general, but it has one achilles heel. After some time, the output tubes usually develop a condition that increases quiescent current, which in turn causes the cathode resistors to get hot enough to melt solder. This can damage the resistors and/or output transformer or power transformer. I've replaced power transformers and cathode resistors more than once. You can read some of my history with this amp in the links below:

Audio Note power transformer

KT88 and 6550 - Operational shifts You may notice from the "power transformer" thread that my first failure was a power transformer. This was actually caused by bad coupling caps - One of the output tubes was biased hard into conduction because DC was passing through the coupling capacitor. This has the exact same symptoms as the mysterious "grid short" I'm talking about now, excessively high quiescent current from high voltage on the grid. It was enough to stress the power supply. But in this first case, the problem was leaky coupling caps, so replacing them fixed the problem. Naturally, when the same symptoms appeared later, I expected to find bad caps but they were fine. The problem was the output tubes, and I've gone through three more just like that over the years.

and a 470 $\mu$ F bypass capacitor across that. The normal voltage across them is about 25v, which is around 90mA. When the tube starts to go south, the quiescent current rises steadily until you reach what I would consider a failure point of 200mA. At this point, the voltage across the cathode resistors and bypass capacitor has reached 56v, which exceeds the breakdown voltage of the capacitor. The current through the resistors is just under their 12 watt limit, making enough heat to melt the solder on the leads. Even if you were to increase the power limits of the cathode resistors and the voltage rating of the bypass cap, all this excessive current is passing through the output transformer so I'm not sure we want to do that.

It occurs to me that a simple solution presents itself. Just put a fuse in the circuit. This will protect not only the cathode resistors and bypass cap, but also the output and power transformers. Instead of melting the solder off the resistors, you'll just blow a fuse when the tube starts to go bad. To me, this is a much better way to go.

The Kit 2 has a barrier strip mounted inside the chassis between the two output tubes. See the photo below:

For reference, see the Kit 2 output circuit schematic. Cathode resistors R28 (left) and R29 (right) and bypass capacitors C21 (left) and C22 (right) are mounted on this barrier strip. One side of each goes to ground, and there are two ground connections for each one. Black wires to W16 and W17 on the power supply are the "source" of the ground connection, and these are passed through to the transformer by way of a connection to the cathode resistor, a jumper to the ground side of the output tube filament (pin 2 on the right, 7 on the left) and onto the filament winding on

the power transformer.

The bottom line is the mod to add a fuse is very easy to make. You'll notice there are two unused tabs on the barrier strip that can be used to open the ground connection to each cathode circuit. Move the W16 and W17 wires to open tabs, and move the filament ground jumper connection (pin 2 on the RH output tube, pin 7 on the LH tube) to the other side of the tab. This retains the ground connections between the transformer filament winding, the tube filament and the power supply PCB. It isolates the cathode resistor though, allowing you to install a fuse in the cathode circuit. When the fuse opens, it lifts the ground.

I have chosen 0.125A fuses, which blow when the cathode resistor voltage rises to 35v. I think this is probably a safe point, but not so low that it might blow prematurely. I considered a 0.1A fuse, but I think that's too low. Probably 0.15A would be fine too, blowing around 42v across the cathode resistor. These aren't values you'll find at your local Radio Shack, but they are available. Just be sure to get fast blow fuses between 0.1A and 0.15A.

So far, I have about 20 hours playing time with the fuse installed. There is no difference I can tell, no extra noise or anything like that. The fuse is installed in the ground line, right where the lines would be run even without the fuses installed. So there's no real difference except the resistance

downside to this mod, the only thing done is protection from grid shorts. Now I feel a lot more comfortable that I won't have to replace output transformers in the future, even if a tube goes bad.