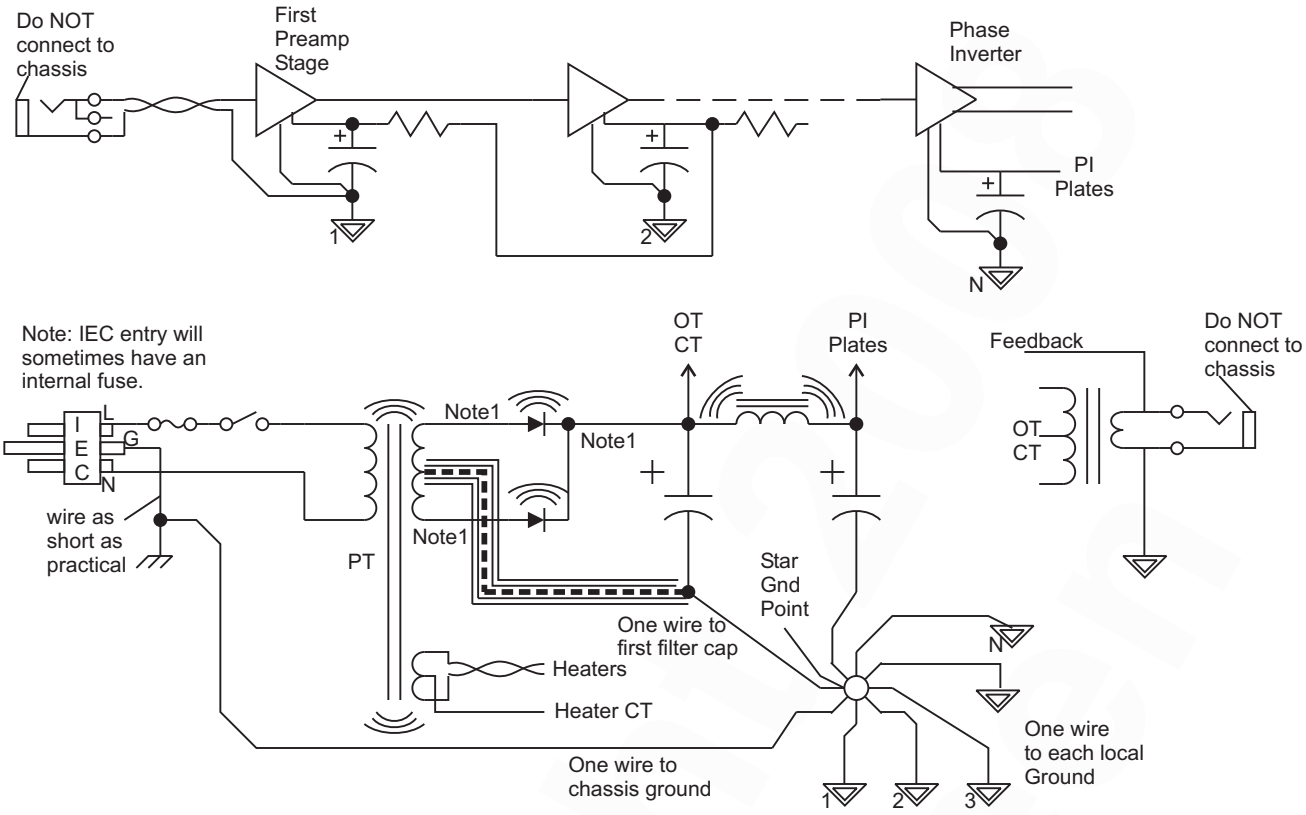

Other sources of hum

1. Some tubes simply hum on their own. Always try replacing the tubes FIRST.
2. Remnants of old “line reverse switch” must be totally removed; no cap from the AC line to chassis, either side.
3. Heater CT:
   a. If it’s left open you WILL get hum. It has to be connected to some voltage.
   b. Ordinary connection is to ground. This works most times.
   c. Two 100R 3W 1% resistors make a more accurate CT than most transformers.
   d. Fender used a 200R pot with the wiper grounded. This not only let you balance the two sides, you could null out hum from elsewhere. It works, but it’s a pain.
   e. In hard cases where the heater CT is known to be the problem, it can be tied to a voltage 5V - 50V positive with respect to signal ground. This will not help the balance issues much.
4. Heater wires should be twisted as shown. For super quiet performance, use shielded twisted pair and ground the shield to star ground point.
5. PT, Inductor, and OT can radiate to each other and to sensitive wires.
6. SS rectifiers which are standard rectifiers (i.e. not fast and soft recovery) can cause R F ringing at 2x line frequency. This is a buzzy sounding “hum” like fluorescent light hum.
7. Note the PT center tap. Because of the high pulse currents in it, this wire will cause 2x power line frequency hum if it’s not hooked ONLY to the first filter cap minus.
8. It helps some if the PT CT and the other two PT secondary leads on the HV are all three twisted together, as the CT and one of the others will be carrying balanced currents as the current pulses alternate between the two secondary leads.
9. Switch and control knob bushings are “grounded” by connection to chassis. Use a star washer to bite into the bushing and the chassis for firm connection. Do not solder a bus wire to the backs of the pots and ground signals to it.

To those who’ve seen a contradictory instance of this setup on an amp without hum: Yes, I know that various amps violate various ones of these items and don’t hum. This is not the only possible way to not get hum. But it is the only way which is known ahead of time to prevent hum. Every amp is a special case and may get away with any one of these issues violated, maybe several. But you can’t know that until you find out that amp’s special cases.

R.G. Keen July 2008