

**Call them phantoms, ghosts, or just plain interference—those unwanted signals sneaking into your receiver can be downright infuriating. But these simple steps can chase your ghosts back into the grave.**

by John E. Shepler

**D**o you have ghosts in your audio equipment? Perhaps you have heard them—faint little voices in intercom or PA speakers, or maybe strange music coming from your stereo long after the turntable has stopped.

Most likely, these are not contacts from the spirit world but simply a condition known as radio frequency interference or RFI. The voices or music may be originating from a local radio broadcaster or perhaps even a ham or CB operator. RFI is actually an overload condition whereby normally well-behaved audio circuits begin to act like radio receivers.

Very sensitive circuits like microphone or phono preamps are particularly susceptible. The presence of strong rf signals can drive semiconductors out of their linear operating ranges. The transistor or integrated circuit junctions will then act like diode detectors much the same as in a crystal set. Once the radio signals are detected, they will be amplified right along with the normal audio.

What can you do to exorcise these ghosts from your equipment? There are really only two effective methods: shielding and bypassing.

Shielding means putting a metal case around vulnerable circuits so that they are never exposed to outside radio waves. The higher the offending frequency, the tighter the metal shield must be. The reason is that higher frequencies with their shorter wavelengths can sneak into cracks and holes that lower frequencies cannot penetrate.

If the equipment is not entirely self-contained, any cables entering the cabinet will also have to be shielded or bypassed. In stereo phonographs, shielded audio cable is a must between the tonearm and preamp. You should also make sure that the phono connectors are making good contact at both ends and that there is no corrosion where the metal parts touch.

If shielding is not possible or doesn't seem to do the job, the most effective approach is to bypass the offending signal before it can do any damage. Bypassing is really not very difficult, but must be done with caution. One potential problem is that tinkering with the circuitry may void any new equipment warranty. Also, if done improperly, some higher audio frequencies may get bypassed along with the rf.

If you are still not afraid of ghosts, the

next step is to isolate the affected stage. In a stereo receiver, the tuner and tape input circuits might be perfectly ok, but a local radio station may be heard faintly in the phono position. In a public address amplifier, the problem may only exist when the microphone level is increased.

Once you have narrowed the rf problem down to a particular stage, check the schematic diagram to see what components might be acting as detectors. Transistors, diodes, and integrated circuits are all likely suspects.

### **Bypass capacitors**

In the case of transistor amplifiers, solder a small value ceramic bypass capacitor directly across the base and emitter connections. 50 to 100 pf units are usually very effective and will not affect audio frequencies. Keep the leads of the capacitor as short as possible and solder directly to the printed circuit foil.

For integrated circuits, you will need to locate the inverting and non-inverting inputs on each IC. Note that some integrated circuits have more than one amplifier in a package. Solder 50 pf capacitors to the pins that go to these inputs.

Diodes can be particularly troublesome if they are located in an automatic gain control stage as they are in many popular cassette recorders and two-way radio gear. Bypass each signal diode with a 50 pf capacitor connected from anode to cathode.

If the rf problem is very severe, you may have to bypass more than one stage. You may also have to put bypass capacitors across the inputs and outputs. Grounding the chassis and bypassing the power cord with 0.01 uf/600V capacitors from each side of the line to the chassis may also be needed. These techniques, though, should be needed only in only the most stubborn cases.

One final thought about amplifiers with very long wires to remote loudspeakers—if nothing else works, try using an audio isolation transformer with a 1:1 turns ratio. This may stop your speaker wires from acting like a super-efficient antenna.

Once you have gotten the feel of RFI shielding and bypassing, you may want to offer your services in the neighborhood. Chances are, others are having the same problems and would really appreciate having someone eliminate the radio ghosts that are haunting their hi-fi's. 

