

# Troubleshooting 101: RF Mayhem

**Part of an occasional series on common troubleshooting techniques. In this installment, we're grappling with interference to a home theater audio system, although the same techniques can help suppress other interference issues.**

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There's nothing like a relaxing evening on the radio. You fire up your transceiver and slowly browse the bands, tuning through the conversations until you hear the familiar sound of a station calling CQ. Reaching for the microphone, you settle back into your chair, squeeze the push-to-talk switch, and unleash your response.

"Hey!" comes the sudden shout from downstairs.

You clench your teeth and groan because the next utterance is as certain as the sunrise.

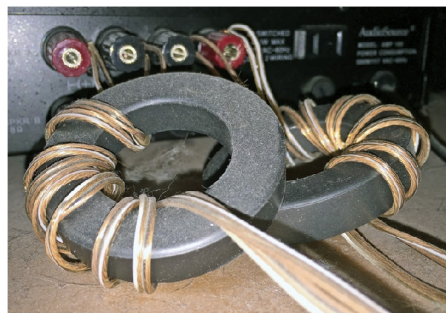
"You're coming through the TV again!"

"I'm not 'coming through the TV,'" you mutter to no one. "I'm coming through the audio amplifier that's connected to the TV."

It's a problem your spouse has been complaining about for what seems like an eternity, but the thought of fixing it has filled you with an almost existential dread. It is long past time to bite the bullet and do what must be done, but where does one begin?

## A Process of Elimination

A simplified diagram of a home theater audio system is shown in Figure 1. It usually consists of a television receiver that is connected to an external audio amplifier, the output of which is applied to various speakers. The RF from your transceiver is getting into the system somewhere, and threatening the



An example of common-mode chokes applied to speaker wires at the output of a home theater audio amplifier.

sanity of everyone in the room. You're lucky they don't show up in your station with torches and pitchforks.

Fortunately, finding the RF entry point (or points) is merely a process of elimination. See the flow chart in Figure 2, and begin at the top with the box labeled START HERE. Follow the paths, and eventually, you'll find the culprit. In nearly all cases, either the speaker wires are picking up your signals, or

RF is making its way into the audio amplifier on the cable from the TV or another connected device.

## The Cure

Once you determine how your signal is getting into the audio system, you need to apply the cure. The antibiotic for wayward RF energy is typically the *common-mode choke*. You can create effective chokes for HF applications by wrapping 8 to 10 turns of the offending wire or cable through what is known as a *ferrite toroid core*. You can purchase ferrite cores from vendors such as Palomar Engineers ([palomar-engineers.com/ferrite-products/ferrite-cores](http://palomar-engineers.com/ferrite-products/ferrite-cores)), but take care to order the proper ones. You will need cores with inside diameters sufficient to allow you to wind the wires through. And just as importantly, the cores you purchase must have the proper ferrite composition to suppress the signals that are bedeviling your

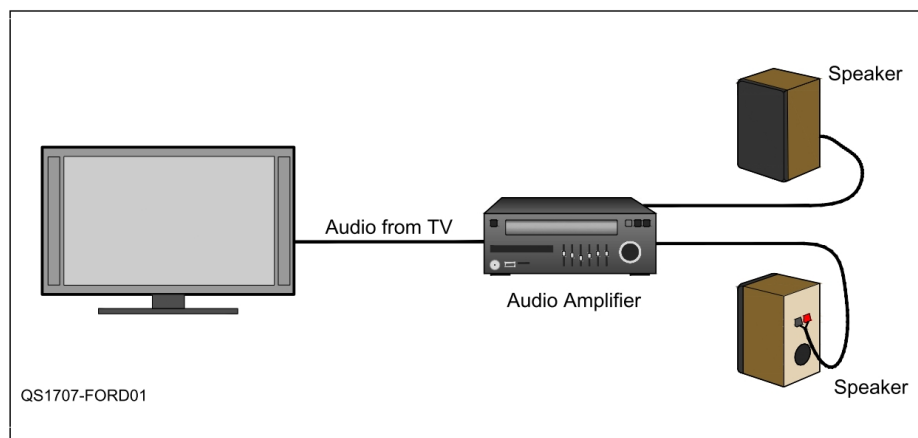


Figure 1 — A simplified home theater system consisting of a TV, audio amplifier, and speakers.

family. Type 31, or so-called “Mix 31,” cores are your best choices for signals from 1 to 30 MHz. Another effective core for this frequency range is the Type 43.

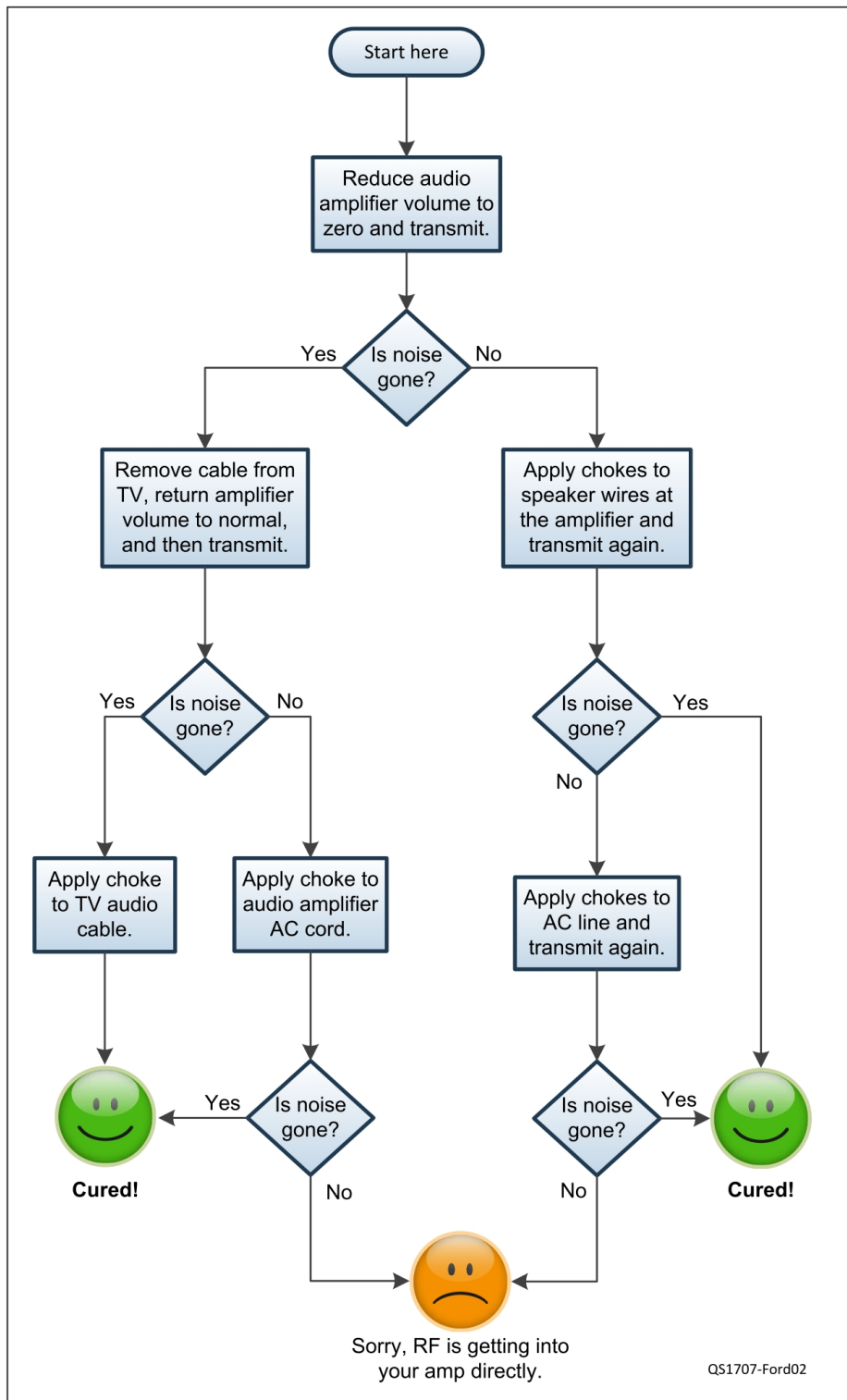
Beware of cores you might encounter at hamfest fleamarkets. The signs on the tables may advertise cores as being “Type 31,” but are they the real deal? You have no way to know.

Also, avoid using snap-on ferrites for problems caused by HF signals. They may seem convenient, but they rarely work well at HF. Overall, it is best to stick with the circular “donut” cores; you’ll be much happier with the results.

With core in hand, wind the wires through the center, around the outside, and back through the center again, keeping the turns evenly spaced. Do not overlap turns. Your goal is to leave the one end of the wire or cable a couple of inches outside the core, so that the choke is as close to the amplifier input as possible. A particularly stubborn case may require cores at the amplifier input *and* speaker output.

In most instances, well-placed, properly wound cores will eliminate the problem. In extreme cases, you may find that you must apply these chokes to every cable or wire that connects to the audio amplifier, including the ac line cord. The worst possible outcome is interference that seems impervious to even the best common-mode chokes. That’s usually caused by a poorly designed amplifier that is picking up your transmissions directly within its own circuitry. The only cure may be to purchase a better audio amplifier, reduce your transceiver output power, or simply operate when your loved ones are out of the house!

*Troubleshooting questions or comments? Contact the ARRL Laboratory*



**Figure 2** — A process flow chart to help you track down interference to a home theater audio system. Begin at START HERE and follow the steps.

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