This month’s story begins with a *clank* — a rather loud sound emanating from somewhere inside our gas cooking stove. I’d just put up a 105 foot dipole about 30 feet above the kitchen. Operating on 20 and 15 meters was no problem but when I dropped to 30 or 40 meters — *clank*. The oven door latch solenoid was activating whenever a dot or dash was sent, holding for a few seconds after the RF stopped and — *clank* releasing, only to — *clank* activate again on the next transmission. Ellen is tolerant but not so tolerant that I could ignore it, and so the story begins.

General Approach to RFI

Let’s back up a little bit. Solving RFI problems requires a somewhat organized approach — without it you’ll chase your tail forever or until you give up and go off the air entirely. We can start by dividing RFI into two categories: RFI caused by your ham radio equipment and RFI to your ham radio equipment. This was clearly in the former category.

In the cases for which your transmissions are causing RFI, there are a series of cases to evaluate. First, is the victim device experiencing the RFI designed to receive a radio signal as part of its normal operation — such as a TV or cordless phone? If so, the first thing you must do — even according to the FCC rules — is to determine or ensure that your station is not generating a spurious signal on the frequencies intended to be received by the victim. For example, in the case of RFI to a weather radio, your station should not be generating any signals on the frequencies of the weather alert transmissions. If it is, go no further and either fix the transmitter or add the necessary transmit filters.

Assuming that the device is a receiver of some sort and your transmissions are *clean* (free of spurious emissions), determine whether or not it is simply the strength of your signal causing the problem. For example, a commercial broadcast FM receiver’s front end circuitry could be overwhelmed by a strong 2 meter FM signal from your nearby mobile rig. This is called *fundamental overload* and is a symptom of a receiver being overwhelmed by a strong signal via its normal receive path. The usual fix here is a filter in the receive signal path to the receiver (such as in the antenna feed line). Obviously, the stove was not designed to receive RF signals so it was on to the final case.

This final case is the most common form of RFI from ham transmissions now that most TV reception is not via over-the-air analog signals. In this case, the signal from your station is being picked up as *common-mode current* by external cables or wires attached to the victim device. (See Hands-On Radio experiment #91, “The Common-Mode Choke,” for a discussion of common and differential mode signals.) Those currents are then conducted into the device where they disturb its normal operation in some way. If you can block those signals from getting into the device — usually by using some kind of common-mode choke or shielding — you can solve the problem. That’s what I expected would solve my problem with the stove.

There is one additional frequent RFI case — *direct pickup* — in which the wiring inside the device picks up the signal without any external cables or wires. This is often the case for battery powered devices and can be very difficult to solve. Guess which mine turned out to be?

Let’s Get Cooking

The stove is made of heavy sheet metal and, as with every other appliance these days, has a microprocessor that controls its functions. The only external wiring is the ac line cord. As Figure 1 shows, the stove sits directly under the antenna. Testing showed that the RFI only occurred at power levels greater than 25 W and only on the bands at and below 10 MHz. With the antenna so close, the stove was clearly in enough V/m of field strength to cause interference.

My first — and only — candidate for picking up common-mode signals was the ac line cord to a socket directly in back of the stove. Opening up my shack notebook and starting a troubleshooting log for recording each step, I grabbed some ferrite split cores (the common variety available at RadioShack) and snapped them on the ac power line where it entered the back of the stove through a hole in the sheet metal.

[While the split core type of ferrite bead is]
The control board was covered by a single piece of sheet metal and mounted behind the display panel at the top of the range. Along with the hot and neutral ac line wires (safety ground was connected where the line cord entered the stove) there was a bundle of individual wires connected to the control board that carried sensor, switch and control signals. With the external ac filter and cores still on the external line cord, I added two more cores to the ac line and control bundle — no effect on the RFI. Note that I left all of the attempted fixes in place while I continued to work since the fix can be cumulative — there might not be a “magic bullet” that solves the problem by itself.

At the lowest power at which the RFI occurred, the cores had no effect on the RFI. At the lowest power at which the RFI occurred, the cores had no effect on the RFI. I have since obtained cores made of #31 material, optimized for RFI suppression below 10 MHz. See K9YC’s online tutorial about RFI and ferrite, the RF Interference chapter of The ARRL Handbook or The ARRL RFI Book. The next step was to increase the internal wiring diagram showing the wiring for the sensors, power and switches, summarized by Figure 2. I was getting warmer, so to speak.

Safety Check
Before we go any further, it’s important to remember some basic safety guidelines. When dealing with an ac line powered appliance, any component that you attach to the ac line must be rated for ac line use. Capacitors should be rated for at least 600 V ac, and both capacitors and inductors should use flame retardant insulating materials. This is not the place for components intended for use in low voltage electronics. If you insert any components in series with the ac line, be sure the connections are well insulated with sleeve or heat-shrink tubing. Use cable clamps or small enclosures so that the components and connections can’t touch the body of the appliance and aren’t subjected to vibration. Appliances often have elevated internal temperatures (particularly stoves) so the components and materials must be adequately rated for high temperature use, as well. And never work on energized equipment.

I’m Going In!
The point of this RFI travelogue is not to teach you how to get rid of RFI in a specific type of gas stove. The description of the journey is its own reward in that it is an example of how to whittle the problem down one step at a time and then solve it in an orderly manner. A deliberate, documented approach may seem like plodding overkill but in my experience, this type of tortoise beats the rabbit more often than not!
Figure 3 — The controller board with bypass capacitors and a ferrite clamp-on core installed after testing was completed. The controller board is covered with a sheet metal shield in normal operation.
Hands on the Radio. Chris Garneau. Album El Radio. Hands on the radio We left too soon We left you in the afternoon. I hurt somebody I love you too I love you underneath the moon I love you underneath the moon. With hands on the radio, we'll get there soon We'll get there in the afternoon Fans in the stadium, they leave too soon They always leave in the afternoon They always leave in the afternoon. This town is my favorite and I promise I'll come back Girls, I promise you Boys, I promise you too.