

## TVI, CATVI and VCRI

*Ed Hare, KA1CV, ARRL Laboratory Supervisor, chats with his friend, Joe Hamm. Once again, the subject is interference. It seems as though Joe is inflicting some grief on the guy next door. This time it's a double whammy: he's trashing two television sets at once!—WB8IMY*

**Q:** Hello, again, Mr EMI-Fix-It. It's me, Joe Hamm. I really appreciate the advice you have given me about my other EMI problems. It seems I can't win, though. My new neighbor, Bruce, just came to talk to me about some interference problems he's having with his TVs (TVI). It seems that when I transmit on HF, I'm getting into his VCR and both of his TV sets. One is hooked up to cable, the other is hooked up to a "rabbit-ear" antenna. When I transmit on 2 meters, I'm tearing up channel 18 on the cable TV. I heard that TVI is the fault of the transmitter. Should I buy a new transmitter?

**A:** Don't buy a new transmitter just yet, unless you're looking for a good excuse to spend your money. First, I'm going to send you back in time to the February and March 1992 issues of *QST*. Those important issues will refresh your memory about the technical and interpersonal basics that are part of any EMI problem. Reprints are available from ARRL Headquarters along with a pamphlet for your neighbor and a list of companies that sell filters and other helpful products. This compilation is the Technical Information Service "EMI/RFI Package."<sup>1</sup> I also suggest that you buy the book *Radio Frequency Interference—How to Find It and Fix It* to get a more complete picture. Contact your ham-radio dealer or refer to the ARRL Publications Catalog elsewhere in this issue.

Let's see what we can do right now, though.

Interference can result from several different causes—electrical noise (such as a vacuum-cleaner motor), spurious signals from your transmitter, or the inability of the TV set to "tune out" a strong local signal. As an analogy to the last point, if you were to tune a TV set to channel 3, and saw channel 13 instead, you would probably conclude that the TV was broken. If you tune your TV to channel 3, and see a local HF transmitter instead, you could reach the same conclusion. That is, the TV is "broken" in the sense that it needs additional filtering or shielding to work near a strong RF source.

If you can demonstrate to Bruce (and

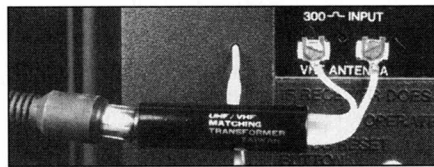


Figure 1—This is the proper way to install a high-pass filter using 75-Ω coax with a 300-Ω TV antenna input.

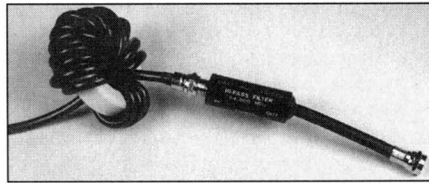


Figure 2—A 75-Ω high-pass filter installed with a common-mode choke.

yourself) that you are not interfering with an antenna-connected TV at your house, your transmitter will be off the hook. (It would still be a neighborly thing to offer your help to find a solution, however.)

**Q:** Well, when I transmit on HF, I interfere with the TV in our den. It is connected to an outside antenna, located about 30 feet from my beam. Does this mean the interference is all my fault?

**A:** Not necessarily. Let's run through the things you can do to find out. Start by installing a low-pass filter on your transmitter. This should be installed near the transmitter or amplifier output.

**Q:** I installed the filter and it helped quite a bit. I still see some interference on the video and I hear myself in the sound. Should I add another low-pass filter?

**A:** Most interference problems have multiple causes. The fact that you made things better by installing a low-pass filter tells you that you probably *did* have a problem with spurious signals from your transmitter. The next thing you can do is to look at your station ground. If you have no ground, add one. Grounding is not a cure-all for EMI problems, but under some circumstances, it can help.

I suggest that you install a low-pass filter permanently—whether you need one or not! You can always point to it with pride, explaining that you have installed a filter on your end. If the FCC is ever involved with your EMI problem, they will ask you lots of questions about your low-pass filter and station ground.

**Q:** I added a good ground and it didn't seem to make any difference. What's next?

**A:** It sounds as if we're dealing with a TV that is susceptible to overload from your fundamental signal. It's time to try the appropriate filters for the TV.

For an antenna-connected TV, the first filter to try is a high-pass filter. These are available from Radio Shack (catalog no. 15-579 or 15-582). Several other sources are listed in the "EMI/RFI Package." Buy one and install it as close as possible to the TV antenna input, as shown in Figure 1.

**Q:** Wow! The picture is clear as a bell, but I'm still getting into the sound. What gives?

**A:** A high-pass filter will attenuate the HF signal that's picked up by the antenna and sent to the TV *inside* the TV's feed line. But you can also pick up a lot of signal on the *outside* of the feed line. The signal that is not inside the feed line is called a *common-mode* signal.

You can filter the common-mode signal with a common-mode choke. Obtain an FT-240-43 ferrite core.<sup>2</sup> (Don't use unknown material; it may not work; see the Technical Correspondence on "Toroidal-Core Color Codes" in this issue.) Wrap about 10 turns of the feed line (either coax cable or twin-lead) onto the ferrite core, installing it just before the antenna input to the TV. The "EMI/RFI Package" also has a list of commercial suppliers of common-mode chokes. A home-brew common-mode choke is shown in Figure 2.

In some cases, you may also need to install a common-mode choke on the TV's a/c line cord. If necessary, you can also try an a/c line filter, available from Radio Shack (catalog no. 15-1111).

**Q:** Hooray! It worked. My TV is clean as a whistle, except for interference to that real weak channel we get from about 150 miles away. Can I fix that one, too?

**A:** Probably not. The FCC rules do *not* protect fringe-area reception. If you are outside that station's coverage area, you will just not get enough TV signal to be usable. If you, or your neighbors, are having problems receiving that station, it is not surprising.

**Q:** Well, I am ready to help Bruce. Any other words of wisdom before I go over there?

**A:** Don't forget that you do *not* want to service your neighbor's equipment. Once you have determined that the problem is

<sup>1</sup>Notes appear on page 83.

not your radio station, you want to be a good neighbor. We're a *locator* of solutions, not a *provider*. If you take the back off the TV, you may be blamed years later when the 25-year old clunker gives up the ghost.

There are a few other things you should watch out for. Make sure the TV is getting a good picture. An old, rusted TV antenna or feed line can be a direct cause of an interference problem by generating harmonics of your signal right there at the TV! A bad installation will result in a weak, snowy picture that's much more prone to interference. Fix these things first.

**Q:** *I'm over at my neighbor's house while my buddy operates my transmitter and Bruce is right—things are a real mess. Where should I start?*

**A:** Well, you just fixed the antenna-connected TV in your house, didn't you? Start doing the same things with your neighbor's TV, in the same order.

**Q:** *You're right. We finally fixed it. Should I install the high-pass filter on the VCR and cable TV installation?*

**A:** No. If the cable TV system is not leaking severely, there will not be any HF signal inside the cable to be filtered. Most of the time, cable TV is virtually immune to HF interference problems. If there is a problem with cable-television interference (CATVI) from HF signals, it is usually caused by a common-mode signal on the outside of the coaxial cable. If you tell your neighbor to buy a high-pass filter, and then go back and tell him that you specified the wrong filter, he may be a little upset!

Start by disconnecting the VCR. If you still have interference, add the common-mode choke. Install the choke where the cable attaches to either the set-top cable converter or to the back of a cable-ready TV. If this still doesn't cure the interference, you can try a common-mode choke and/or ac line filter on the TV and/or the converter. If this doesn't do it, you could try a high-pass filter as a last resort.

Once you fix the cable interference problem, apply the same cures to the VCR. VCRs can be a bit harder to fix, primarily because the video and sound signals inside the VCR are in the HF range.

A cable-ready TV or VCR that doesn't respond to any of the above treatments is subject to direct-pickup interference. In this case, the only recourse your neighbor has is to contact the equipment manufacturer in writing. He could also call the Electronic Industries Association<sup>3</sup> to get the appropriate contact persons for the manufacturer.

If you are able to determine that the converter box is subject to direct pickup, or that a cable leak exists, contact the cable company for assistance. Often the cable repair personnel are *not* familiar with all of the technical issues surrounding a CATVI problem. If that's the case, you can call the

cable company and discuss the problem with the repair supervisor or the system engineer. The ARRL has written a two-part article about CATVI that was published in *Communications Technology*, the journal of the Society of Cable Television Engineers. The cable company will recognize this publication! A copy is also available in the "EMI/RFI—CATVI" package from the ARRL Technical Information Service Secretary.<sup>1</sup>

**Q:** *Well, it took quite a combination of filters, but I managed to fix most of Bruce's problem. The only thing that's left is my 2-meter interference to cable channel 18. Why is that problem still there?*

**A:** In a nutshell, cable television makes use of frequencies allocated to over-the-air services. Cable channel 18, or channel "E" in CATV parlance, is from 144 to 150 MHz. The amateur 2-meter band falls within that channel. Your 2-meter signal is clearly leaking into the system. The hard part is finding out where.

Start by determining if the signal is also leaking out. In most systems, the cable video carrier will be on either 144.00 or 145.25, plus or minus 25 kHz. If you hear a *strong* carrier on that frequency, the cable system is probably leaking. The cable company will appreciate your calling this to their attention. This type of leakage can be very expensive if they fail their cumulative leakage tests or if they're cited for violations of FCC rules. If their signal is leaking out, you can be sure your signal is leaking in. In the case of cable-plant leaks, it is the cable company's responsibility to cure the problem.

Even if the leak from the cable system is below the FCC leakage requirements, the interference could still be caused by a leak in the cable system. An interfering signal that's more than 40 dB below the video carrier level can still cause interference! If the leak is not severe, the cable company may try to tell you that they don't have to fix it. Don't be fooled. The cable company must adhere to several regulations about picture quality. FCC regulation 76.605(a) states, among other things, that the carrier-to-noise ratio must be at least 40 dB and the carrier-to-coherent disturbances ratio must be at least 47 dB. These regulations, and the ARRL CATVI package, will help your cable operators understand their responsibilities.

Unfortunately, it is not all black and white! The leak could be in the cable system, the cable company's set-top converter, or a customer-owned cable-ready TV or VCR. The cable company is responsible for the first two, but cannot be held responsible for the design of the TV. If the TV leaks, Bruce will have to contact the manufacturer.

Sometimes, a common-mode choke does help. Try one on the incoming cable, just before it contacts the first piece of elec-

tronic equipment. Try a common-mode choke on the ac line connected to each piece of equipment, too. Other than that, there is no filtering you can do. If you filter the 2-meter signal, you will be filtering cable channel 18, too!

The manufacturer and cable company can get involved in a real finger-pointing contest in some situations! There is an easy way to determine if the cable operator is "off the hook." Ask the cable operator to demonstrate good performance on channel 18 using a set-top converter supplied by the cable company. If they can do that, the leak is clearly in the cable-ready TV. If they can't show that their system is working well, they have a bit more work to do. Suggest that they buy the ARRL RFI book and contact the ARRL "RFI Desk" (that's me!) here at Headquarters.

**Q:** *Thanks for all your help. Bruce is happy now. His dog Bucky even likes me again! Is it always this easy?*

**A:** Unfortunately, no. The proper application of personal diplomacy and technical solutions sure make it a lot easier, though!

#### Notes

<sup>1</sup>Send a 9x12-inch self-addressed, stamped envelope with 4 units of First-Class postage for each package to the ARRL Technical Information Service Secretary, 225 Main St, Newington, CT 06111. Include a specific request for the "EMI/RFI package" and/or the "EMI/RFI—CATVI" information packages.

<sup>2</sup>Ocean State Electronics, 6 Industrial Dr, Westerly, RI 02891, tel 401-596-3080. Catalog no. FT240-43 (\$8). Add \$4.50 for shipping and handling. Visa, MasterCard or COD accepted.

<sup>3</sup>Electronic Industries Association, 2001 Pennsylvania Ave., Washington, DC 20006 202-457-4977



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## Strays

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### QRP WALLPAPER

◊ Keeping your station's output power down to the minimum necessary is the law, and it's always a good operating procedure. Earth Friendly Technologies (EFT) has created an additional incentive to turn down the juice: Any amateur who can confirm a two-way contact of more than 100 km (63 mi) on any ham band using any authorized mode with less than one watt of power output may apply for the QRPp Low Power Award. Its purpose is to promote the enjoyment of low-power operating, while demonstrating its usefulness and practicality. EFT states that encouraging low-power operations will increase the number of skilled and competent operators in the art, hobby and professions associated with RF communications; reduce interference (QRM and RFI); and place less pressure on the earth's resources. For a copy of the complete rules and information on how to apply for the award, which may be framed and displayed in your shack, send a self-addressed, stamped envelope to EFT, PO Box 460101, Aurora, CO 80046-0101. Application fee is \$4 (\$5 foreign).—Roger Wendell, WB0JNR, Aurora, Colorado