Troubleshooting Your Radio Equipment

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NEW HAM COMPANION

You awake one Saturday morning, eager to check into your favorite net. But when you turn on the radio, nothing happens. This is the moment that all hams dread. Your equipment doesn't work, and you have visions of expensive repair bills and several weeks or months off the air. You desperately hope that nothing serious is wrong. But, remembering that terrific thunderstorm last Thursday evening, it becomes clear that your radio has been hit by lightning. All those sensitive integrated circuits must be blown up. "Great," you think. "I can't hear anything even with the volume turned all the way up. My receiver is blown for sure."

When this happened to me, I was certain that my $1000 solid-state radio was badly damaged. However, by using basic troubleshooting methods, I determined that the problem was a short in the microphone connector that had locked the radio in transmit mode. The problem was easily fixed at no cost!

Something like this is going to happen to you. It's inevitable. When it does, you need to apply sound principles of equipment troubleshooting before you decide to turn your rig over to a radio shop. Most equipment problems are caused by operator error, and defective cables and connectors. When equipment is sent to the shop for repair, the technician may not be able to fix it *because the failure was not in the equipment.*

At the first sign of trouble, do the following:

❑ Check the positions of all the operating controls.

❑ Check all of the mode indications and verify the mode.

❑ Check all the cables and connections of your equipment.

Eliminate the Operator First

Most problems can be easily solved by examining the controls. For example, you turn on your radio, but don't hear audio. Check the audio-gain control. Is it turned down? Is the squelch turned up so that the audio output is muted? Don't laugh! When this happened to me the first time, I was stumped—until I took a look at the squelch setting.

Another common operator error involves transmitting CW with the transceiver set to the *SSB* mode. When you try to transmit, nothing happens. This problem is easily identified by referring to the mode indicator. Sometimes, the source of this problem is not obvious. For example, some radios have a *control-lock* button that disables the front panel controls. If this button is pressed by mistake, the radio appears to be unresponsive to any commands—because it *is*!

When checking your control settings, be sure to include your cables and accessories. Suppose you turn on your transceiver and tune across the band without hearing a single signal. Is the band dead? Tuning to another band, you discover that it's dead also. This makes you suspicious, and you begin to think that your receiver has failed. Well, maybe not.

Troubleshooting your radio equipment is easier than you think. If you follow these troubleshooting techniques, you'll be able to solve most problems yourself without the cost of expensive repairs.

First, verify that the antenna is connected. If this doesn't reveal the problem, check all your cables and connectors to make sure they're hooked up correctly. If you have an antenna switch, is it in the correct position? If you have an antenna tuner, check to see that it's tuned to the correct band. A tuner acts like a filter. If your transceiver is tuned to 10 meters, but your tuner is set for 80 meters, your tuner attenuates the 10-meter signals. Finally, be sure to check the attenuator setting on your rig. I operated during a contest once with my 20-dB attenuator switched on. I couldn't understand why the band conditions were so poor. By the time I discovered my error, the contest was over!

When operating VHF FM via a repeater, verify that your controls are set properly before transmitting. If you fail to access a repeater when using an H-T, low battery voltage may be the culprit. (Most H-Ts provide a low-battery indicator. Check this first.) If the repeater requires a CTCSS tone to activate, is your CTCSS function switched on? Is the correct tone selected? Make sure the repeater offset is set to the proper value. This is a *very* common problem. If the repeater is listening 600 kHz *below* the output frequency, you can't activate it with your offset switched to 600 kHz *above*!

Always Check Your Cables and Connectors

Seasoned hams know that the most failures occur in the cable and connectors. Connectors are especially vulnerable because they're constantly being connected and disconnected. The first step after verifying your control settings is to check that the connectors are screwed in tightly. When you encounter a high SWR or a low output-power indication, look for a loose connector first.

After you have checked for loose connectors, look for *shorted* or *opened* cables. Shorts are often caused by poorly soldered connectors or crushed cables. Open cables are usually caused by broken wires at the connector. Use a VOM (volt-ohm meter) to check your cables. Disconnect both ends of the cable and remove it from the equipment. (Don't assume that the cable is not connected to a short circuit. Remove the cable.) Switch the meter to the resistance scale (2000 ohms full-scale or less) and measure the resistance between the center pin of the coaxial connector and the shield. If a short circuit is present, the resistance will be nearly zero (see Fig 1).

If the cable isn't shorted, you're not out of the woods yet. You need to check for an opened cable. Connect your VOM between the center pins of both connectors. Then connect your VOM between the outer shells of both connectors. The resistance should be zero in both cases. If it isn't, you have a break in the cable.

If you've followed all these steps and you still haven't discovered the problem, it's time to get out your equipment manual and review the troubleshooting section. This section gives possible causes for common symptoms. It is important that you read and study it before you decide to open up your radio.

Use All Your Senses

Don't be deterred by the difficulty of performing repairs on your own equipment. Some problems that seem impossible to solve turn out to be simple to fix. When the

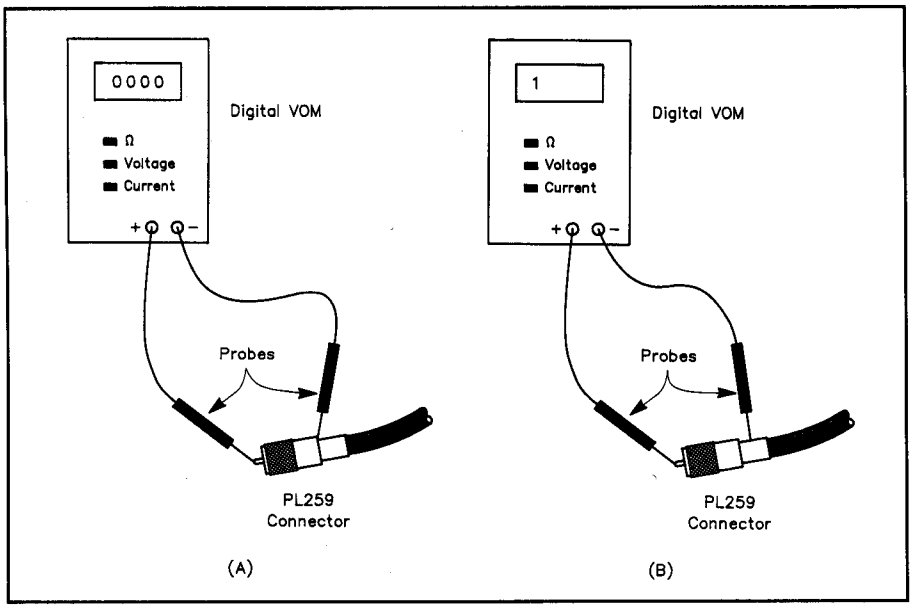

Fig 1—A volt-ohm meter (VOM) can be used to check for defective cables. A reading of zero resistance indicates a short (A). An infinite resistance reading indicates an open circuit (B). With this particular meter, a 1 on the far left side of the display indicates infinite resistance. When measuring from the center conductor to the shield, a good coaxial cable should show infinite resistance (open). If the meter indicates a short, check the connector.

controls of my 2-meter hand-held stopped working, I was prepared for an expensive repair bill. The radio failed to respond to the controls. I couldn't enter frequency or change the mode. Surely the microprocessor had failed.

I opened the radio to determine if I could replace the chip. While inspecting the circuit board, I noticed that a small metallic particle was shorting two of the printed circuit traces. When I removed it, the radio worked perfectly!

The moral of the story is: Carefully inspect your radio. After you open the case, look for short circuits, loose or broken connections, and burned components. Smell is as important as sight. Smell your radio for burned components. Look for burned spots or evidence of arcing. Take your time. You never know what you may find.

To Fix or Not to Fix

Once you've completed your inspection, you need to decide whether to take your radio to a repair shop. At this stage you should read the troubleshooting section of the *ARRL Handbook*. It will give you ideas on how to troubleshoot your equipment. Call the manufacturer's service department or a repair shop that specializes in your brand of radio and see if they have a simple cure. Some problems can be diagnosed over the phone! Ask if this is a problem that occurs frequently because of a design deficiency in the transceiver. If the technician thinks that the problem can be fixed, be sure to get a cost estimate. As an additional precaution, get a second opinion. Call another repair shop and compare the results of the two estimates.

After you obtain the repair estimates, consider the following: Were the technicians confident that the problem could be fixed for a reasonable cost? Were the technicians familiar with a similar problem that they had successfully repaired? Finally, consider if the problem is something simple that you can fix yourself. If the repair estimate is high, consider troubleshooting it yourself—at least to the point where you can verify that the problem is not a simple, low-cost repair. But if you don't have a good grasp of electronics, and you don't know someone who does, send the radio to the shop.

Three Ironies of Troubleshooting

Troubleshooting is a process of eliminating the possible failures, one-by-one. It is ironic because, most of the time, the culprit is not what you expect.

The First Irony: Whenever you are absolutely certain that you have correctly guessed the cause of a failure, you will be wrong.

This is my primary rule for troubleshooting. When you've deduced the cause of failure, you also need to think about the cost of being wrong!

The Second Irony: Whenever you believe that an expensive, hard-to-find component is the cause of your failure, you will be wrong.

In other words, you should check and replace the inexpensive components *first*, before you attempt to replace the expensive parts.

The Third Irony: The amount of effort required to replace a component is inversely proportional to the probability that it has failed.

Putting it another way, don't go after the hard-to-replace components until you eliminate all other possibilities.

If you decide to fix the equipment yourself, make the simple, low-cost repairs first and the high-cost repairs last. For example, if your tube-type radio has low output power, it's reasonable to suspect the final amplifier tubes. Don't rush to buy new ones, though. Arrange to have a friend lend you his tubes and see if that fixes the problem. Check the suspect tubes on a tube tester. Be sure to check the driver tube, too. Once you've *verified* that you need new tubes, *then* it's time to get out your checkbook.

Clear Thinking is Important

It is very easy to get into trouble when attempting to repair your own equipment. *Clear thinking is the most important troubleshooting tool you have.* Don't hurry to fix the problem. This is always disastrous. Hurry causes panic, which prevents clear thinking. Before you dig into the problem, plan a course of action. Read your equipment manual and the troubleshooting section of the *ARRL Handbook* to refresh your memory. The following story shows how panic can magnify a small problem into a big problem.

I connected my 2-meter all-mode transceiver to a power supply with the wrong polarity. Of course, the radio didn't work. Discovering my mistake, I corrected the polarity, but the radio still didn't work. Swearing at myself for gross stupidity, I was sure that I had destroyed my expensive radio. Panic and anxiety took over. I desperately needed to fix the problem.

I visually checked the fuse, and it looked good. Because I was in a panic, I proceeded to make a series of blunders. Opening up the case, I began looking for damaged components. Using my VOM, I discovered a short circuit between the power supply terminals of the radio. I tried to test the power supply protection diode. It indicated a short to ground. Convinced that the diode was bad, I attempted to remove it from the circuit. During this process I broke the diode. After an hour I managed to remove the broken diode and install a replacement. I reconnected the radio and it *still* didn't work!

I had missed something, but what? Stopping to think for the first time, I decided to recheck the fuse. It was bad! Even though the fuse *looked* good, a resistance check with my VOM showed an open circuit. The broken fuse wire was hidden by the cap at the end of the fuse. A new fuse solved the problem.

The problem was simple—a blown fuse. I violated my own troubleshooting rules by thinking that the failure was in the radio—and I was wrong. However, my primary error was not stopping to think clearly. I just assumed that the fuse was good because it *looked* good! But, panic clouded my judgment and I magnified a simple blown fuse into a major repair operation.

Harry Ricker, KC3MX, became a ham at age 15. Amateur Radio was the inspiration that led to an electrical engineering career in satellite communications. Harry holds an Extra Class license and is an active operator on HF QRP and 6 meters. He teaches Amateur Radio license classes sponsored by the Montgomery Country Amateur Radio Club. QST