A Simple and Effective Approach to Station Grounding

Every station needs a grounding plan — here's one approach.

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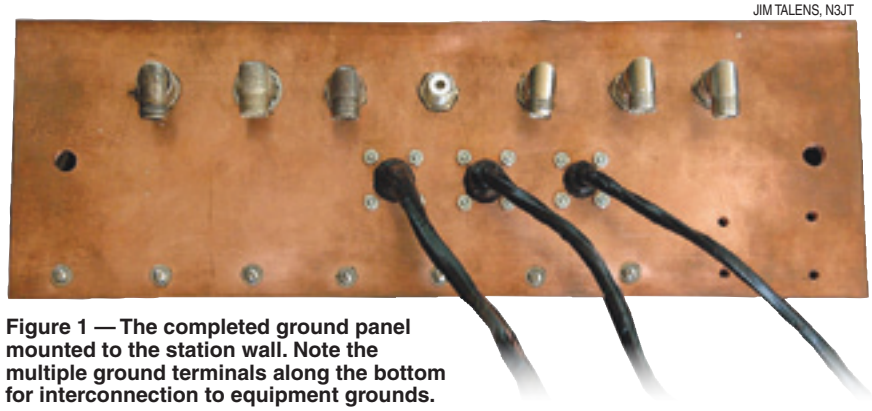

Figure 1 — The completed ground panel mounted to the station wall. Note the multiple ground terminals along the bottom for interconnection to equipment grounds.

One morning in early summer I entered the shack to check 20 meters and my e-mail but neither the radio nor the PC would turn on. A check in the garage revealed a tripped circuit breaker for the shack. I reset it and returned to the shack only to find the 35 A power supply for the HF rig had no output, the PC would not turn on, the external hard-drive did not work, the laser printer showed gibberish, the telephone company equipment for Internet and television service, including the router, was nonfunctional and an assortment of low voltage equipment produced no output. Nothing else in the house was damaged. I later found the HF transceiver's liquid crystal display was scrambled, and it had other problems. The list had grown to include everything in the shack except the HF amplifier, rotator controller and desk lamp. What had happened?

In anticipation of a predicted thunderstorm the night before, I had disconnected coaxial cables, rotator cable and other lines leading from outside into the shack. Except for the amplifier, everything remained plugged into the ac mains. During the night there had been plenty of atmospheric activity but nothing sounded particularly close.

Unplugging Antennas Isn't Enough

Inspection of the equipment revealed a sizeable weld mark on the side of the 35 A power supply where its case touched the 2 meter transceiver, which was similarly scorched. The Ethernet cable from router to PC displayed a clear connector at one end and a blackened mess at the other. It appears that a voltage surge entered the shack on a coaxial cable and had found a low resistance route to ground through my equipment and the branch ac circuit.

Recovery and Inspiration

Many computers use a logic stage on the motherboard to activate the power up procedure. A voltage spike there can easily lead to a new computer purchase, which I fortunately had been considering before events forced an early decision. The 35 A power supply was repaired by replacing all its transistors and the voltage regulator; the telephone company replaced the router and its optical network terminal, the HF radio needed factory attention and was repaired by replacing a minor printed circuit board. The overall damage tally could have easily been worse. It was clear, though, that the shack needed a single point ground system to eliminate different ground potentials for the radio gear and the remainder of the house.

Setting the Stage

A single point ground system basically assures the ground potential everywhere in the station is the same. That means linking the grounds from the radio devices, electrical system, tower and cable grounds with low impedance interconnections. First, I ran a length of #8 AWG copper wire from the basement cold water pipe to the base of the tower. Then I planted a new 8 foot ground rod outside the shack window and ran a 2 inch wide #24 AWG copper strap into the shack. A cable to the tower also connects to that ground rod.

The house electrical ground is connected at the ac entry location by connection to a house copper cold water pipe, the typical practice at the time my house was constructed. That pipe is bonded to the tower and the tower is bonded to the shack ground rods. Those rods in turn are bonded to my new copper panel, with additional connections to the grounds in the shack wall sockets (as described below). So the whole system is interconnected using the shortest possible paths.

Following professional engineering standards, I could have run a heavy copper cable around the house with multiple ground rods or even installed a screen of wires and ground rods, but there is no way to do this without laying cable under a paved driveway. The key to achieving my more practical approach involves constructing a grounding plate in the shack that provides a single-point radio ground connection along with means to quickly disconnect the radio gear from outside cables.

Panel Construction

I chose a solid piece of copper plate measuring ¼ × 6 × 18 inches as the foundation for the single point ground panel.[1] This provides sufficient surface area to accommodate a number of coaxial and other cables as well as ground connection points for

[1]Notes appear on page 41.

shack equipment and the copper strap to the ground rod outside.

I drilled holes for double female coaxial cable bulkhead connectors and holes for other connectors (rotator cable, tower antenna relays, and others). I then drilled a series of equally spaced holes along the bottom for bolts to tie equipment ground wires to the panel, as well as holes for fastening the copper strap. Even with a new carbide bit, it was a challenge to drill those large holes! [A step drill bit might work better. — *Ed.*] For the rotator and other connectors, I used the same drill bit but then used a file bit to enlarge the holes as necessary. At all connection points I used an antioxidant to prevent contact deterioration.

You can see from Figure 1 what this plate looks like. It is mounted to the wall behind the PC monitor but toward one side of the operating desk so that it is not obvious, yet remains readily accessible. It takes only a few seconds to disconnect all the gear from the antenna and other outside cables.

Preventing Bumps on Your Head

To connect the main electrical circuit in the shack to this system I ran an extension cord from the 120 V ac outlet to a metal enclosed receptacle box screwed to the top rear edge of the operating desk adjacent to the copper plate. A #12 AWG wire connects the box and plate. At the other end of the desk, near the amplifier, I did the same for the 240 V ac outlet, though there I connected the metal box with #12 AWG wire to the copper strap because the strap was close by. Another reason for mounting the outlets on the desk surface is to prevent thumping your head when crawling under the operating desk to disconnect ac plugs. Now all disconnects are done above the desk and, importantly, there is less reluctance to disconnect because there is no need to climb under the desk.

Some Parts Suggestions

Make sure you're sitting down when you shop for connectors. They are quite costly but I have identified a company that produces sturdy, round connectors that are perfect for this kind of project. They're only a few dollars each, even with the gold plated pins. See the parts list and supplier list on the QST-In-Depth Web site.[2] As noted earlier, it's not easy to drill through ¼ inch copper plate, let alone fashion square holes, so stick to round connectors. Even if you use thinner copper, use round connectors. Also, when installing pins in a connector body make sure you don't do it backwards as I did on one occasion. They are not easy to remove.

Worthwhile Finishing Touches

I now use a wireless computer-to-router and computer-to-printer systems and thus have eliminated some of the cable exposure in the shack, but there are still power cords, Ethernet and telephone cables across the house to the telephone equipment. These cables now route through high quality surge protectors.

Few hams would install the extensive and costly grounding networks needed to prevent damage from a direct lightning hit, but the probability of such a strike is very low in most parts of the country, according to IEEE reports.[3] The more common risk of induced voltage surges like the one that destroyed much of my equipment can be reduced significantly by creating a single point ground system and disconnecting cables when dangerous weather approaches. In the shack I also use high quality surge protectors for devices that remain connected to ac at all times, such as printer and router. I also use a UPS for the PC, which contains a similar surge protector. Lightning arrestors should also be installed at the coax cable entrance panel.

The Future

So will all this protect me from a future lightning strike? Your guess is as good as mine, but I am confident that the kind of arc and resulting damage I experienced recently will not happen again!

Notes

[1]I chose ¼ inch thickness because I had planned on more holes and was concerned about rigidity over time, but ⅛ or 3⁄16 inches would be more than adequate and less costly. Also, many panel mounting connectors specify a thickness limit, though for the connectors I used that was unimportant because I mounted the connectors atop the panel rather than recessed.

[2]**www.arrl.org/qst-in-depth**

[3]R. Cohen, et al, "How to Protect Your House and Its Contents from Lightning, IEEE Guide for Surge Protection of Equipment Connected to ac Power and Communication Circuits," Standards Information Network, IEEE Press, ISBN 0-7381-4634-X (2005).

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When he is not watching out for thunderstorms, Jim keeps busy as a telecom consultant and counsel for broadcast, wireless and satellite clients. He is also a Realtor. Jim has operated from a number of locations during international contests, winning the ARRL DX Contest CW single operator category as HKØ/N3JT in 1991. He lives in McLean, Virginia and operates 97% CW. Jim has a Web site at **www.n3jt.com** *and can be reached at 6017 Woodley Rd, McLean, VA 22101 or via e-mail at* **n3jt@arrl.net**. QST