Grounding Issues

For Amateur Radio Stations

by Bob - K4TAX

As a result of several recent discussions passed around on the various Internet sites, I thought I'd share a few thoughts on the subject. I profess to be "no expert" on the subject, but recalling my formal education and projects professionally on "Lightening Protection for Remote Radio Systems" and "Grounding for Broadcast Applications" lends a lot of experience and knowledge.

There are three types of ground systems to be considered as associated with amateur stations:

(1) Safety Ground - This ground is simply the AC power neutral system, formed by a single driven ground, and used for most all residential installations. Some electrical codes still do allow and will accept connection to a cold water pipe. This seems to be going out of style with the installation of PVC or other "non-conductive" carriers of water. By all means, do not chop off or isolate the 3rd pin ground on any power supply or other equipment. It is there to keep you alive in case some component fails.

(2) Lightning Ground - This ground is associated with radio towers, buildings and other "taller than local terrain" structures. Here again, we &Mac222;nd several ground rods are driven and spaced equally around the base of the tower. I prefer the 1/2" or 5/8" x 8 foot copper clad rods. If one has to drive them in at an angle to avoid rock under the soil, it is better at an angle than not buried completely. These rods must be connected to each other as well as the tower in the form of a ring or circle. Suggested spacing is about 8 -10 feet. All conductors must be attached using the lowest possible resistance connection system (crimp, clamp and cad-weld…..no soft solder!) and conductors of massive surface area must be used. (I use a length of 3/4" soft copper water line, &Mac223;attened out so as to make a heavy, easily workable copper strap.) The preferred method of attachment to ground rods is a "CAD Weld" method, basically a thermo weld, one time shot system. Keep in mind that a single lightning stroke carries a lot of energy and

should be dispersed to as large an area as possible.

(3) RF Ground - This ground is the toughest of all. Any RF frequency can be de&Mac222;ned by its wavelength. Over this wavelength, one will &Mac222;nd that the voltage reaches both maximum and minimum values. The distance between a minimum and a maximum is 1/4 wavelength. Therefore as one moves away from a ground point to a distance of 1/4 wavelength the potential goes from zero volts (theoretically) to maximum voltage. On 20 meters, this is a distance of around 17 feet. On 10 meters this distance is about 9 feet. So where is ground? Basic advice - keep ground connecting systems, away from 1/4 wave multiples on bands you choose to operate. Keep conductors as large as possible, the more surface area the better hence the lower inductance. (A discussion on ground impedance is outside the scope of this article.)

Practical Application - In most cases, an RF ground is not needed at your station. In some cases, it actually may be causing you more harm than good. Unless you are running an antenna system that is “unbalanced against ground” (e.g. long wire or off-center fed antenna). Due to the nature of coax fed dipoles and beams, as well as, balanced fed dipoles, a ground is not needed for RF purposes. Do pay heed to lightning protection however. (Balanced fed antennas and the use of baluns is another topic of discussion. FYI - I believe in both.)

So how does RF get into my shack? Most likely, RF is being picked up by the house wiring from a nearby, low antenna, (one that is located over the house, or attached to one end of the house) fed back via the 3rd pin AC ground and to the rig. SWR on feedlines is also a contributing factor but not as much as one is often led to believe. No amount of &Mac222;ltering, shielding or added grounding will correct a RF radiation problem of this type. Move the antenna or move the radio to gain more distance. I frequently operate a 75M coax fed dipole on 10M and 20M (using a tuner to keep the transmitter happy) and have no RF in the shack. The SWR on the coax feed line is often 10:1. There is no RF ground in use either. How does this work? Well, the antenna is some 100 feet from the shack, 70 feet in the air, and does not cross over the house.

If possible, one can take advantage of a good RF ground (staying away from the 1/4 wave numbers) and improve the situation. A simple, single, short conductor from the operating

position to a driven ground may help. A word of caution about adding driven grounds. It is little understood, and most often overlooked, but most important, all driven grounds must be bonded together. Yes, the tower ground, the radio ground the residential AC ground, the telephone and cable grounds must be bonded or connected together. For details on this subject, locate the National Lightening Safety Institute web page and read the real truth and facts for yourself. What they have is current practice and should be taken seriously.

Regarding bonding of all grounds, I've been told that connecting the tower lightning ground system to the house ground system will cause the house to “burn up” because of a lightning strike. Poo poo on this. Keep in mind that during a nearby lightening strike the energy is dispersed over a wide area (several thousand feet in all directions). Should there be two driven grounds in the area, a “step voltage” is produced and these grounds are not at the same potential. Look at your system. Is your radio equipment connected to two different grounds? If so the difference in potential will &Mac222;nd the path of least resistance, typically through the radio equipment. **Please bond all grounds**. Should your system, tower or house take a direct lightning strike, nothing short of the &Mac222;re department can help. Maybe they can arrive in time to save the lot.

If you have questions, agreement or disagreements, please respond via email. Let's all be safe out there!

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