Grounding & Lightning Protection for the Ham Shack and Communications Site

Digital Communication applications associated with, HAM radio and related hobbies.

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"The RF Integrity and performance of an Amateur (HAM) radio system is based upon good antenna and good ground combinations."

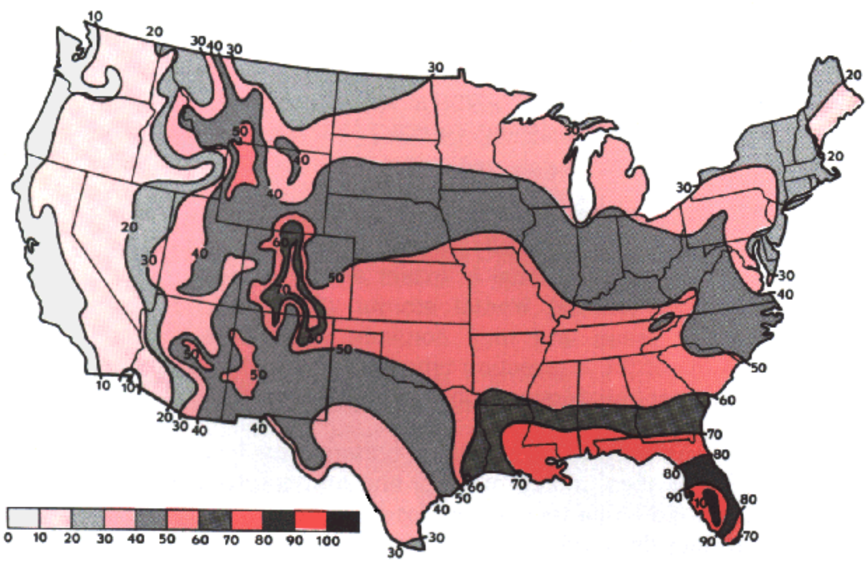
Primary protection considerations for HAM radio communication systems are:

- Protection for operating and visiting personnel.
- Protection of the transceivers, radio, and other equipment.
- Providing fault and lightning current paths to allow over-current and protection of equipment.
- Providing low impedance paths for noise signals and RF to drain away.
- Overall, HAM shack protection.

Noise is the enemy of *Amateur Radio, Data, and Digital Communications*.
In addition to providing Equipment and Personnel Protection from lightning,
a good ground system will reduce noise in your Packet Station,
or your mountain-top communications site.

G. E. "Buck" Rogers Sr.

If you follow these Lightning Protection & Grounding procedures;
You're Grounded !



The numbers shown on this map correspond to the color bands and indicate the number of lightning and thunderstorms per year in the indicated area or color band.
NOTE: that the largest numbers of lightning storms occur in Florida and in the Midwest.

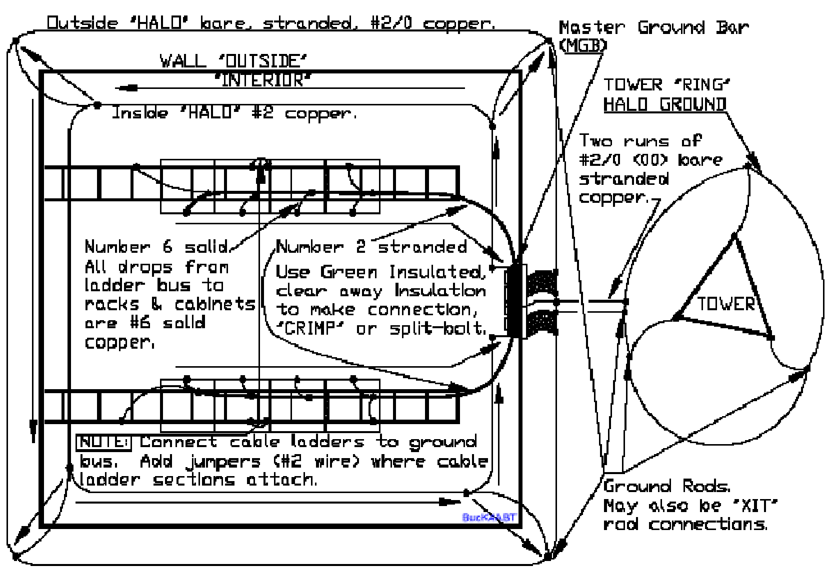
ANTENNAS AND SUPPORTING STRUCTURES

Metal antenna structures that are anchored into the ground are inherently self-protected. Some radio systems antennas and beams may be damaged by direct lightning strokes. In any case, they should be bonded to metal supporting structures to eliminate arcing.
If the ability of an antenna to withstand direct lightning strokes is doubtful, Lightning rods atop the tower or supporting structure, to intercept lightning strokes should be provided where the transmission pattern permits.

Lightning rods may be attached directly to a metallic supporting structure and should protrude sufficiently above vulnerable elements to provide an adequate "*cone of protection*". Top lighting fixtures may also be subject to damage if they are not properly shielded. Metallic antenna towers, either guyed or self-supporting, provide an excellent conducting path for stroke currents but the footings, base, and guy anchors of such structures must be properly connected to suitable grounding cables and earth electrodes.

When wood poles are used to support antennas a lightning rod should be provided at the top of the pole to intercept strokes. This lightning rod should have a large size ground wire attached (cadwelded) to it and routed to a good earth ground system. This will give protection against pole splitting and possible antenna damage. In a common arrangement, a ground rod is attached to the pole with one end protruding sufficiently above the top of the pole to provide a suitable *cone of protection*. A #6 AWG (or larger), solid, bare copper, down conductor is connected to the rod and stapled directly to the pole on the side ***opposite*** *the coax or transmission line* to the antenna. All pole-top hardware, the antenna, and any supporting guys should be bonded to this grounding conductor.

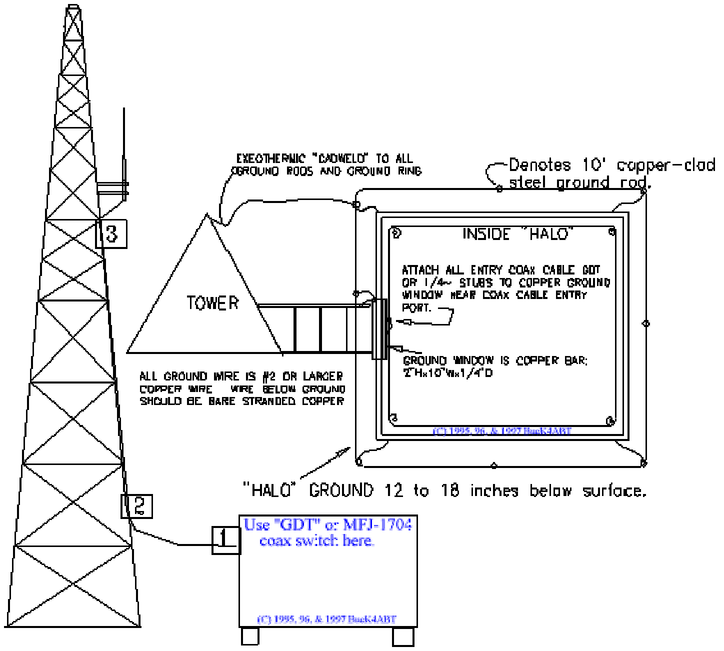
At the base of the pole the shields of lines, equipment cabinets, and any other conducting objects should be bonded to the down lead which then must be connected to the common area ground system similar to that shown below.



An overview of how a communications site is grounded.

Your site should not contain an independent ground(s). ALL grounds should be connected together as shown in the illustration above. A single point (common) ground is noted by the **Master Ground Bar** or MGB, as shown. Ground rods are chemical rod systems that are used in areas where grounds are hard to achieve.

ANOTHER METHOD FOR HAMSHACK GROUNDING



1 Attach ground at entry point to building.

2 Attach ground to shield when coax begins vertical run upwards.

3 Attach ground to coax shield at top of vertical run before coax bends away from tower. Keep all bends smooth, NO SHARP BENDS, this also applies to ground leads.

The ideal hamshack ground system. Preserve the integrity of all grounds, connect "ALL" grounds together at the ground "window."

NOTE: The coax shield grounds at points 1, 2, & 3 are weather tight (sealed).

Antenna Grounds and Counterpoise Designs

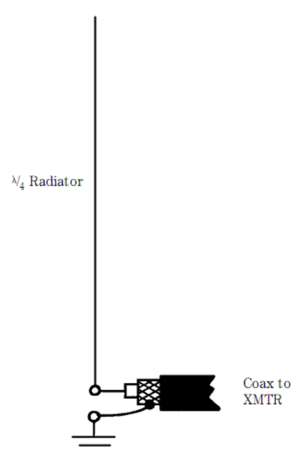
Ground refers to the chassis side of the electrical system, usually negative or minus in DC polarity, but most important the return path is also for AC signals. In our discussion, ground means the ground relative to the antenna being discussed.

Picture a "vertical" antenna a quarter wavelength long. No matter how high you attach it's base, the antenna must have a RELATIVE and/or EARTH "GROUND." The *"nominal" feedpoint impedance of a vertical antenna is* 30 to 48 ohms IF everything is according to the "textbook." If fed with 50 ohm coax, the MINIMUM SWR is 50:30 - 1.7 to 1, with PERFECT RELATIVE GROUND and mounted in FREE SPACE.

The AIR between the "antenna" and the feedpoint which is attached to the RELATIVE GROUND is part of our antenna system.

1/4 WAVE VERTICAL ANTENNAS

An example of a simple vertical antenna:



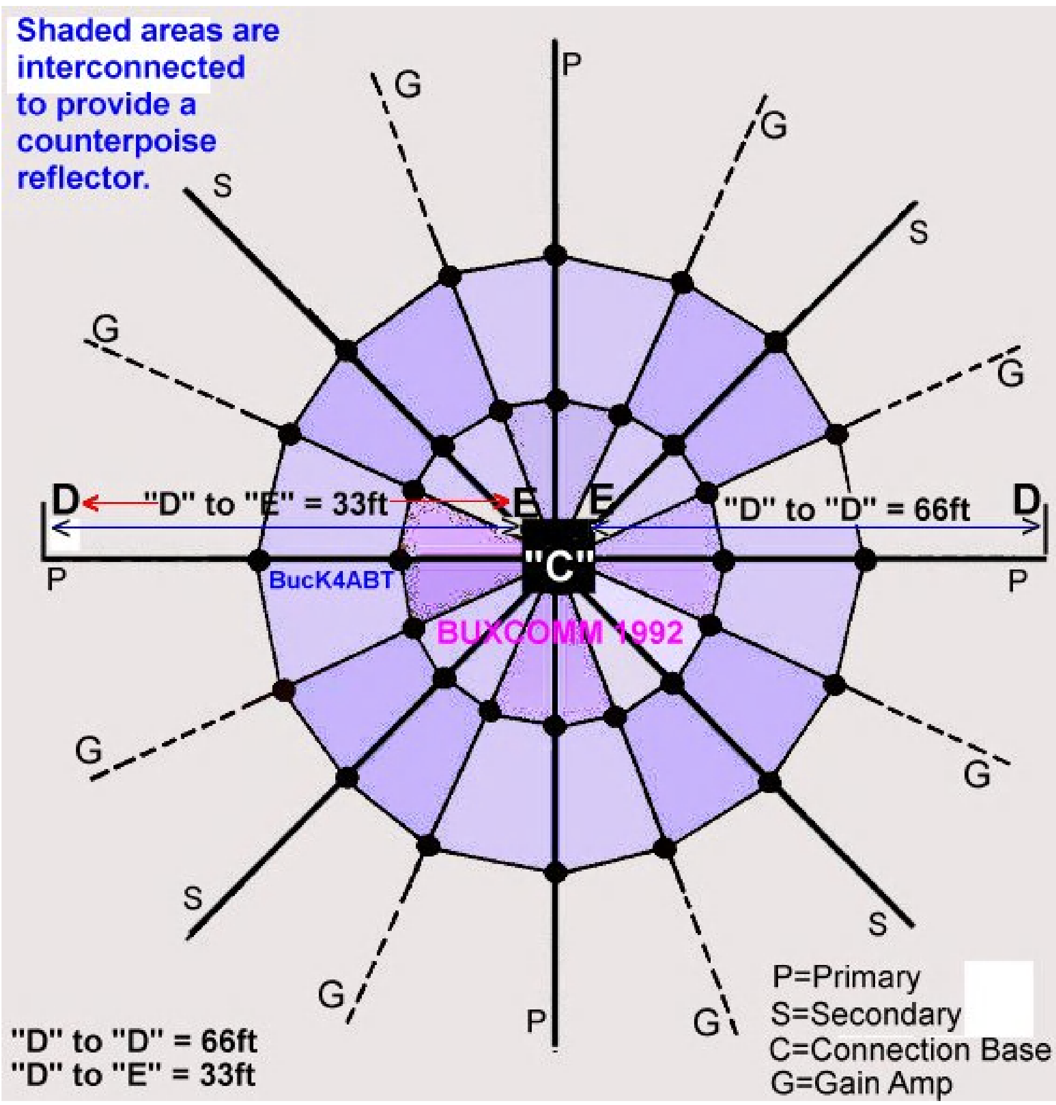
Vertical Antenna Ground Systems:

Earth alone is not an efficient ground, therefore we need to enhance our ground system with a metal (copper) ground system. By adding this ground (radial) system, we can improve both the gain and bandwidth factor of our vertical antenna. This addition can enhance performance of our vertical, almost doubling its gain. So you can readily see this is an addition that becomes a essential part of our antenna system.

Shown below I've drawn a ground radial system similar to the one I use around my 40 ft vertical. The wire I use is AWG# 14 Flex Weave (BUXCOMM.com item# 14 FLEX-WEAVE), bare copper, buried a few (3 to 5 inches) below the soil surface.

> IThe *counterpoise reflectors are optional* and may hamper the burial of each radial extension. 16 wires approximately 33 feet long spread evenly around the feedpoint of a vertical antenna is adequate.
> Of course more wires (radials) are better and longer wires are even better.

I don't dig a trench with a pick and shovel, I simply use an old axe to slice the soil, and then I use a wooden stick with a notch on the end to push the bare copper, # 14 FLEX-WEAVE into the narrow slit in the soil. After the Flex Weave is pressed into the soil, the earth can easily be moved together making the radial trench almost invisible.



At each end I leave enough wire to connect, or solder, to the antenna ground/base-plate and at the opposite end, I connect to a short copper-clad ground rod (BUXCOMM item# GROUNDROD) cut into 3 short pieces. I use item# G10701 or G4401.
If you have a butane torch and accessories, you might use it to solder the radials. Use extreme caution if you attempt the latter connecting process.

Long wire antennas can also benefit by using a radial running the length of the long wire antenna. A long wire radial is a number 10, 12, or 14 bare copper (FlexWeave) buried below the soil surface, running the same direction, directly below the long wire antenna.

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