Lightning Protection and Grounding Check List

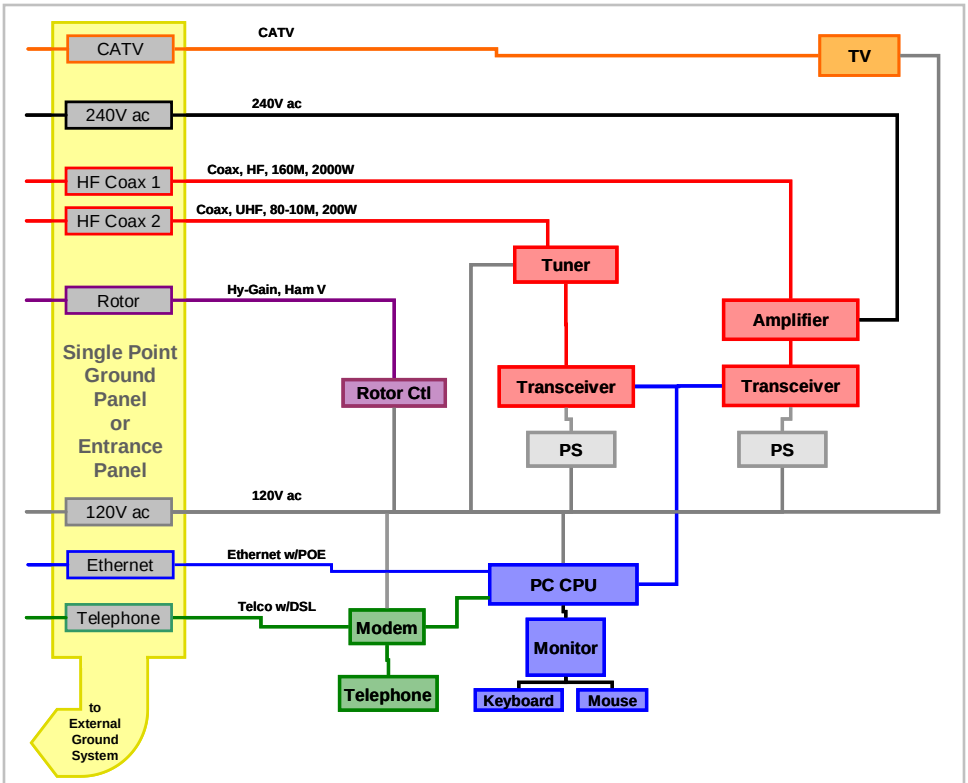
by Ron Block, NR2B

To protect your amateur radio station from lightning damage, you need to do the following.

Inside the radio room:

Identify what equipment is to be protected by creating a high-level schematic similar to the drawing at the right:

- Include all items that are electrically interconnected with the radio equipment, either directly or indirectly. There are no options here; if it is electrically connected it must be included.
- Include any nearby metallic items even though they are not electrically connected; then include all indirectly electrically connected components.
- Identify all of the input and output connections associated with the equipment to be protected.
- Identify the electrical characteristics of each input and output connection.
- Aggregate the power circuits by voltage.



High-level schematic with protectors on the SPGP.

Identify a protector for each input and output:

Coax	Frequency range, maximum power, dc-blocked or pass-through peak voltage and current, connector family, mount type (flange or bulkhead)
CATV	Frequency range, connector family, mount type (flange or bulkhead)
Rotor	Peak voltage and current for each line.
Telco	Number of lines
Power	Voltage (120 or 240), maximum current (15A or 20A)
Ethernet	Speed (10, 100, 1000 MHz), optional Power Over Ethernet (POE)
Other	Peak voltage, dc-blocked or pass-through peak voltage and current, highest frequency, connection type (coax, twisted pair)

Create a Single Point Ground Panel (SPGP) or Entrance Panel:

- Design and layout the SPGP to have a clean and natural cable flow with a one to two foot separation between the protected and un-protected cabling.
- Mount each of the input and output protectors on the SPGP or Entrance Panel.
- Ground all equipment chassis to the SPGP or Entrance Panel with a short, wide (copper strap or braid) and straight (minimal gradual bends ≥12-inches) conductor.
- Ground the SPGP or Entrance Panel to an **external ground system** using wide copper strap. In general, there should be more copper surface area leaving the panel than arriving form all cables. The connection should be as direct and straight as possible.
- The SPGP or Entrance Panel **must be the only ground** for the protected equipment.
- The shape and thickness (≥ 26 AWG) of the SPGP doesn't matter. Use wide (≥ 3-inches) copper or aluminum for minimal inductance.
- Mount the SPGP on an interior wall approximately mid-way between the coax cable entrance and the radio equipment. In general the total distance between the SPGP or Entrance Panel and the radio should not exceed ten feet.

Cabling:

- Maintain 1 to 2-foot separation between protected and unprotected cabling. Where practical, use EMT for long runs (≥4-feet) of protected and unprotected cabling for magnetic shielding purposes. Ground EMT to SPGP or Entrance Panel and use as a chassis ground connection.
- Cut to size and re-dress all interconnect cabling.
- Watch out for unprotected cabling within the wall(s).
- If EMT conduit is used to house coax cabling coming to the SPGP, ground the EMT only at the SPGP end.
- If coax cabling must travel some distance (≥ 15-feet) through the structure (house) to get to the SPGP, call for additional guidance and precautions.

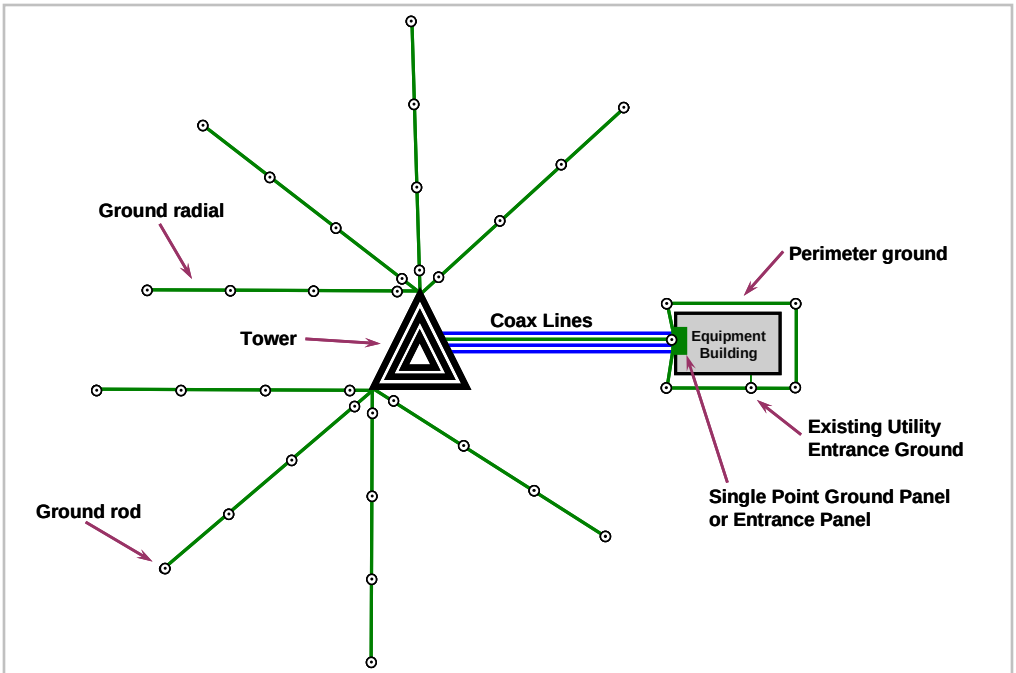
Outside electronics:

- External electronics such as coaxial switches, antenna mounted preamplifiers, and 802.11 access points should be individually treated in the same way as the radio station. That is, create a high-level schematic to identify all of the input and output connections, identify each connection's electrical characteristics (peak voltage and current), and identify the appropriate protector.
- Mount the electronic device and it's protectors on a common electrical surface (equivalent to a Single Point Ground Panel), and ground the SPGP to the tower or mounting post.

Do not operate the radio station during potential periods of lightning activity. You could be the conductive link between the protected but elevated radio equipment and a path to ground.

Outside the radio room:

The **external ground system** consists of the following elements.



Typical tower grounding.

Perimeter ground:

- Should go all the way around the house. Part of the way around is better than nothing.
- At a minimum, it **must** interconnect the utility ground, SPGP or Entrance Panel, and the tower.
- Use the same material, placement, and bonding as radials.

Radials:

- Bare copper strap (1½-inches wide by 26 AWG) or wire (#2/0) buried 6 or more inches below grade radiating away from inhabited structures.
- Minimum length is 10 feet; maximum effective length is about 80 feet. Gradual (≥ 1 foot) bends in radials are permissible.
- Bond to all metallic items within four feet of the radial's travel to prevent flashover and add to the overall ground system.

Ground rods:

- Copper clad steel (industrial series), 5/8-inch diameter, and 8 to 10 feet long.
- Space the ground rods approximately 2-times the length of one rod apart in normal (grassy) soil, about half the distance in sandy soil.
- Must be driven into the ground; do not drill and back-fill.
- Should be exothermically bonded to the radial. Use ERICO mold CRC 16002 for 1½-inch copper strap to 5/8-inch ground rod.
- Mechanical connections require joint compound, a conductive grease fill (Jet-Lube, SS-30; CopperShield), and annual inspection.

Dissimilar metals:

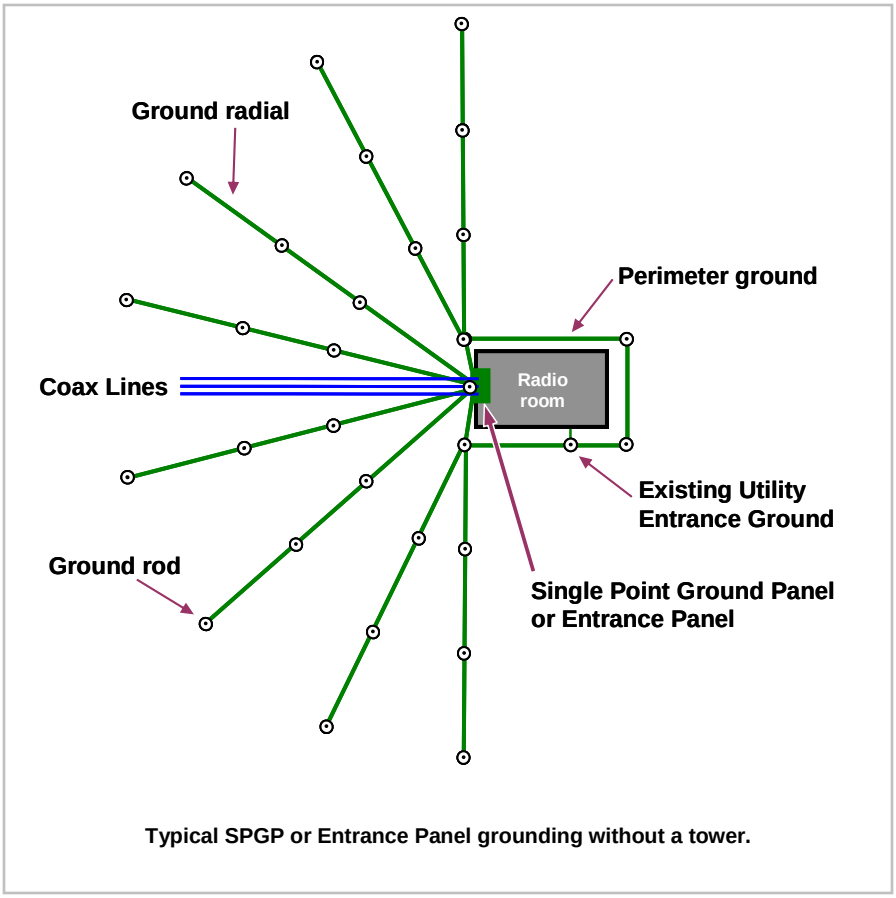
- Copper should never come in direct contact with galvanized (Zinc) surfaces. Use stainless steel as a buffer material covered with joint compound. Inspect annually.

Tower:

- Place 20-feet or more away from any inhabited structure to minimize the effects of magnetic energy during a lightning strike.
- Apply a ground-kit to each coax at the top, every 75 feet down the tower (to help protect the coax cables), and at the take-off point.
- Coax take-off point should be at the lowest practical point on the tower; the lower the better.

Maintenance:

- Measure soil pH and correct to 7 (neutral) or higher, then the optimum system life is approximately 30-years.
- Measure and inspect the ground system annually, use the *fall of potential method*. A highly effective ground system should be ≤5 Ohms.
- Ground system effectiveness can be improved through doping with Epsom salts (2-pounds per linear 10-feet of radial plus 1-pound additional for each ground rod). Lightly water into the ground; reapply each spring.



Typical SPGP or Entrance Panel grounding without a tower.

- It is acceptable to drip-irrigate a ground system to maintain the ions necessary to support energy dissipation into the earth.

Reference: **Lightning Protection for the Amateur Radio Station**, Ron Block, KB2UYT (now NR2B), ***QST*** June, July, and August 2002
This document was edited by **Roger Block**, KD7UT, founder of PolyPhaser Corporation