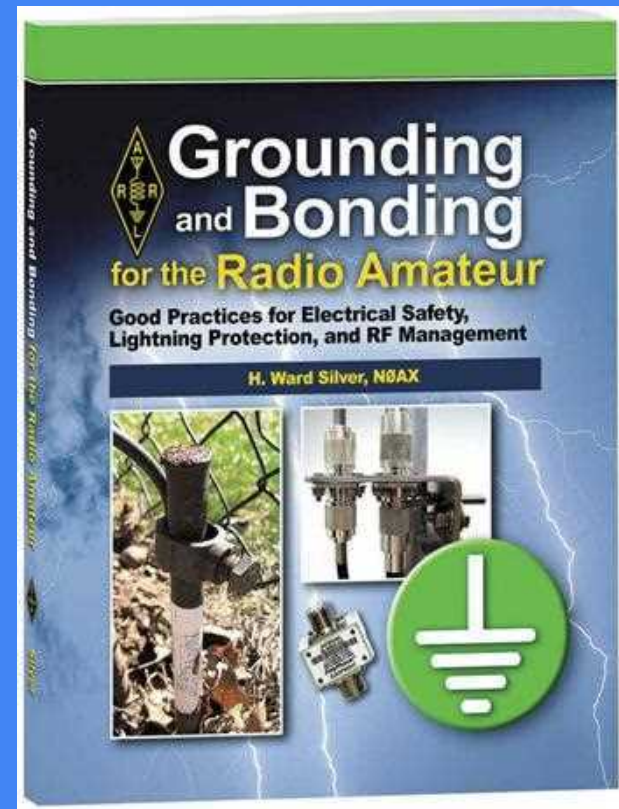


Grounding and Bonding

What YOU need to know!

John Thurmond K5JBT - Feb 2024



What we'll cover today...

- What is grounding and bonding?
- Why is it important?
 - Safety - for your equipment, your house, your family...
 - RFI - Poor grounding creates problems
- Practical advice
 - Lightning protection
 - Single Point Grounds



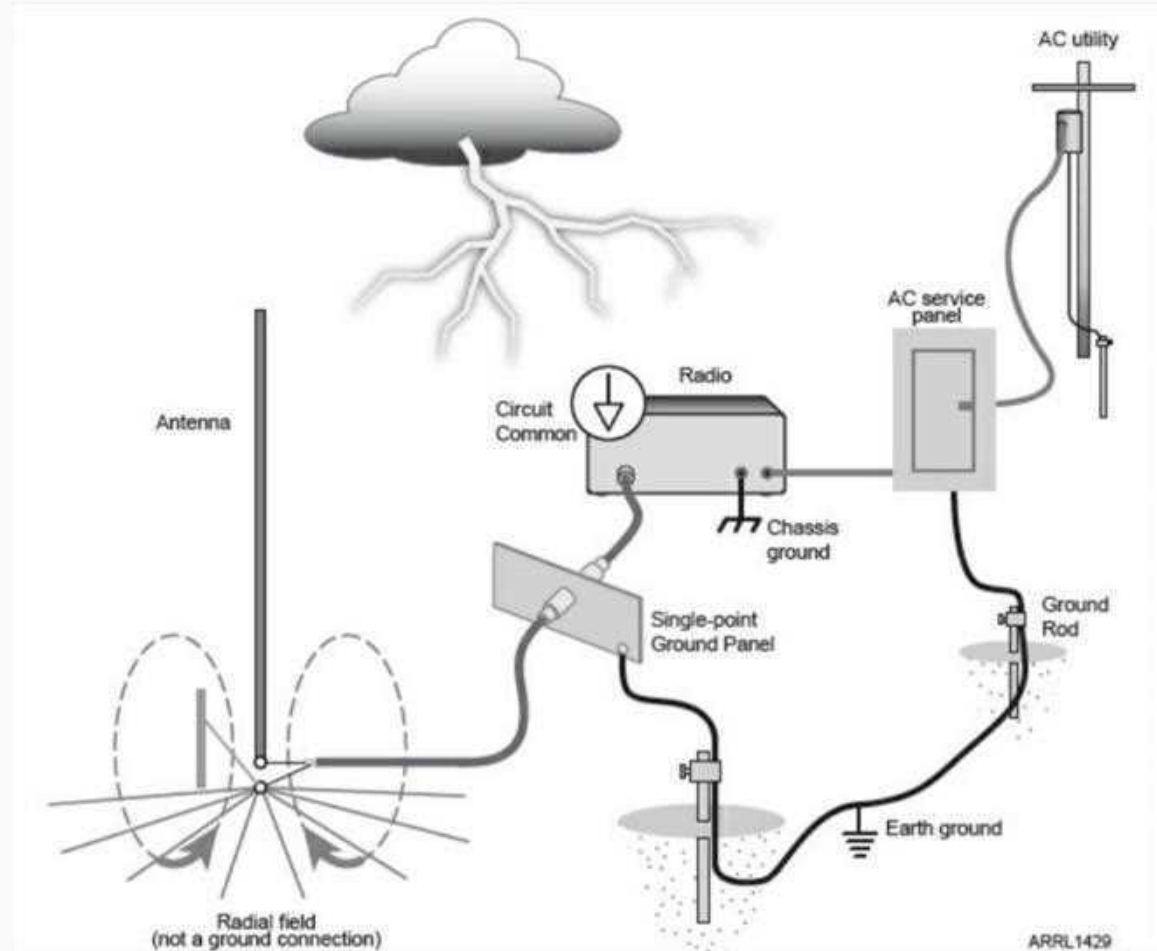
Why Ground?

- **AC Safety**
Protect against shock hazards
- **Lightning Protection**
Route transients away from equipment
- **RF Management**
Prevent RFI in equipment

Grounding is a complicated term!

We use "grounding" to describe many things:

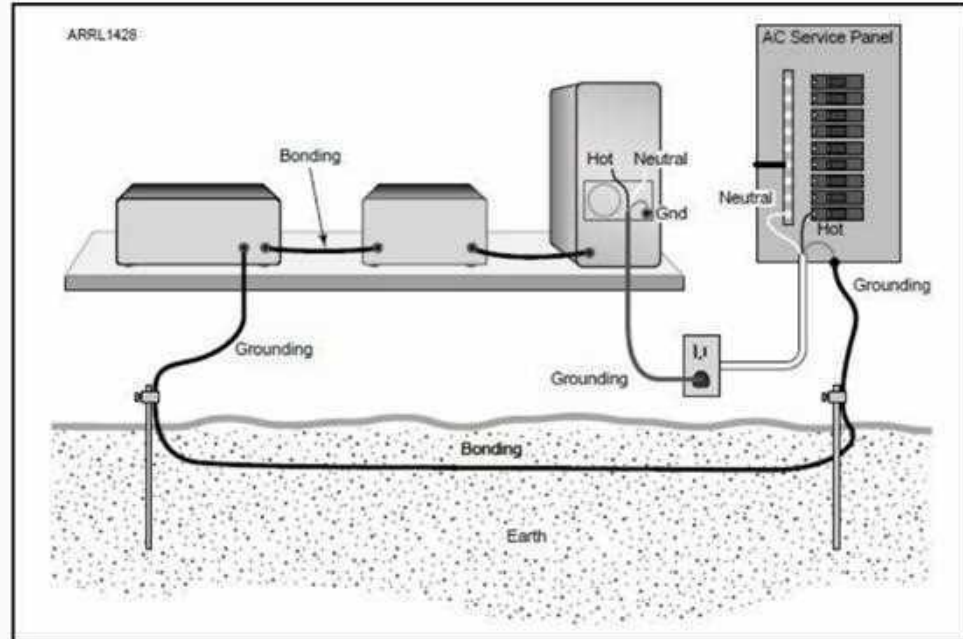
- Chassis grounds
- Antenna grounds
- Earth grounds
- Circuit grounds (common voltage)



Grounding and Bonding

Grounding = To make a connection to the Earth

Bonding = Connecting equipment or connections together to minimize voltage between them



AC Safety Ground

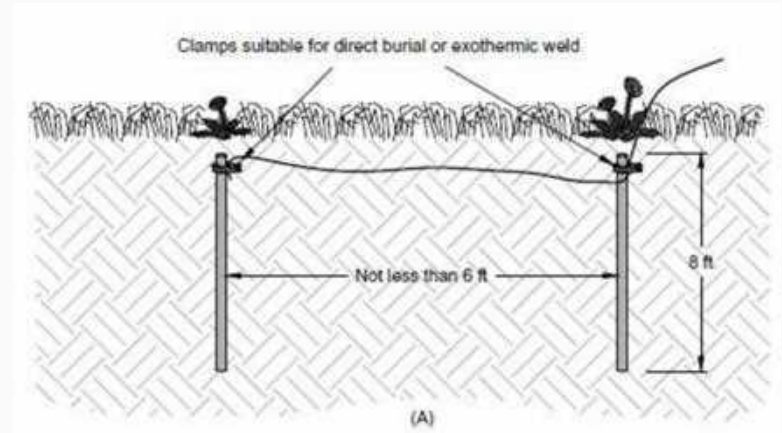
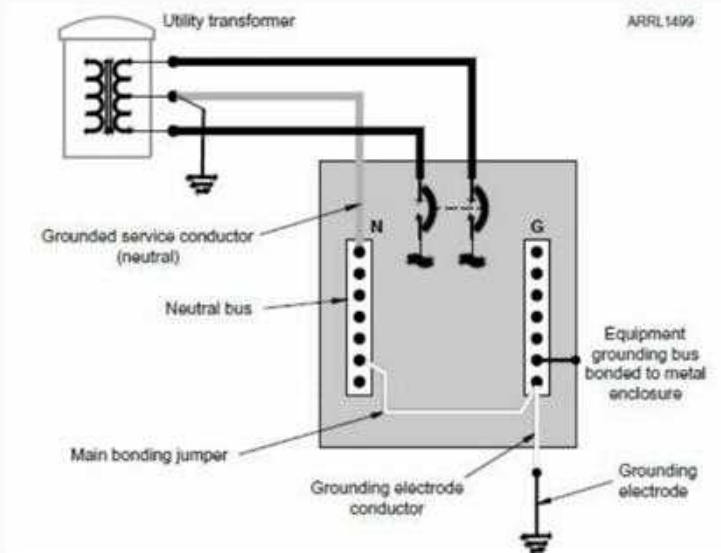
Governed by National Electrical Code (NEC)

All houses (should) have this!

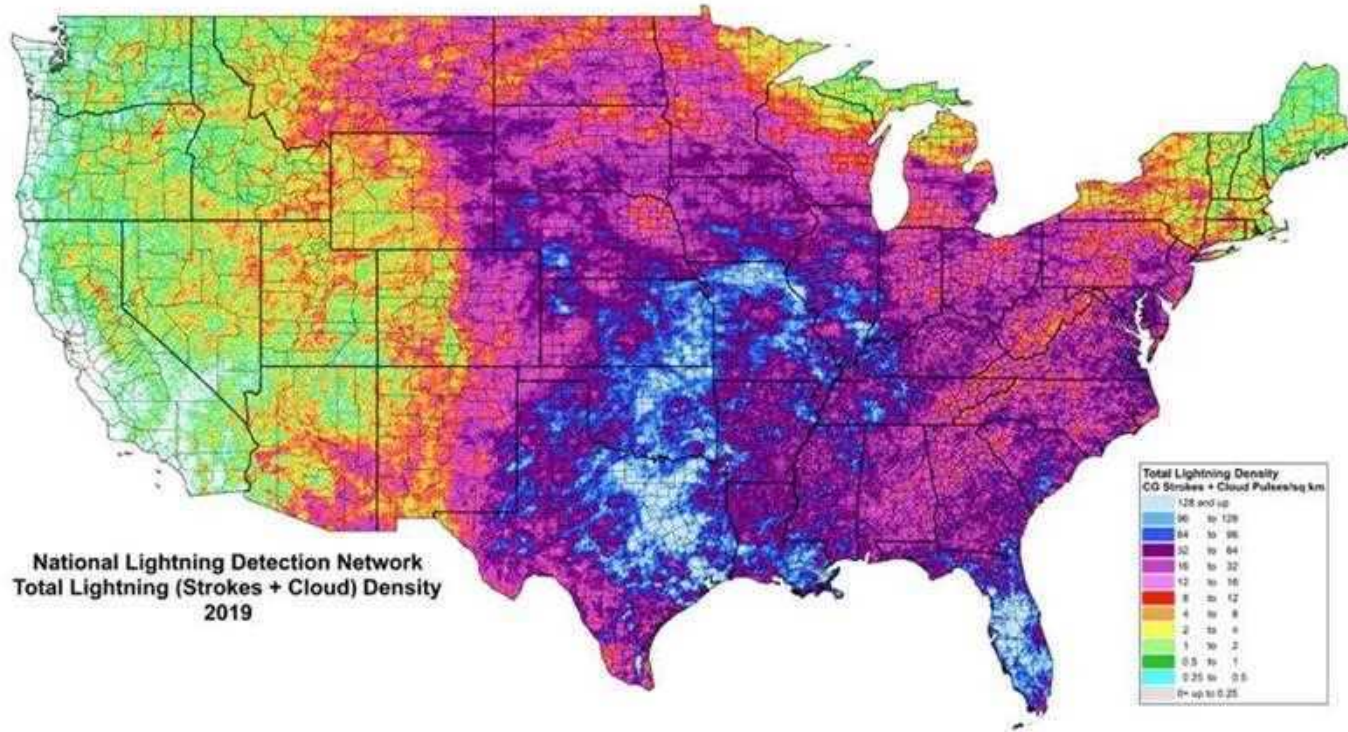
Have you ever checked yours?

Have you checked how things are bonded to your ground? (Cable, telephone...)

Most electricians know the code, but not the 'why'! (or anything about antenna lightning protection)



Who cares about lightning? You should!



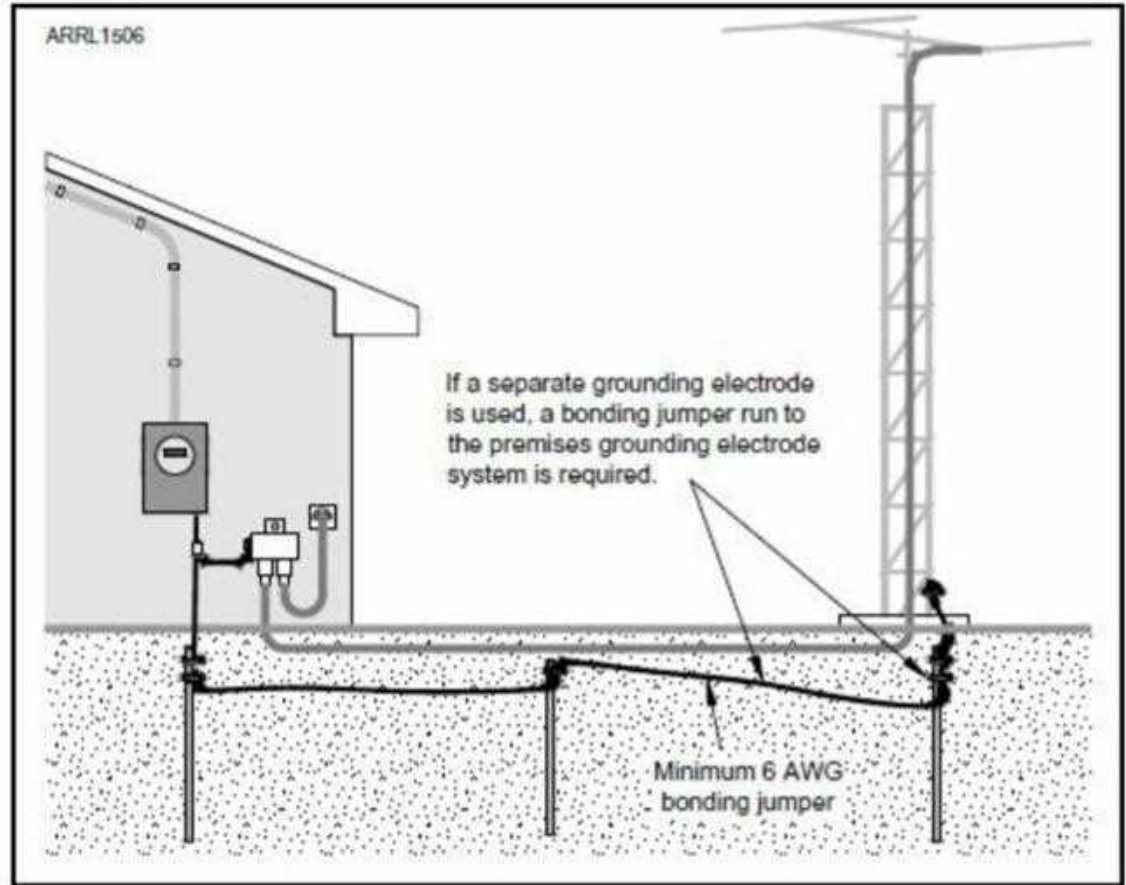
NEC 810.20 – Each feed line or lead-in conductor from an outdoor antenna **must be provided with a listed antenna discharge unit.** (Attic or other indoor antennas are not required to have an antenna discharge unit.) The antenna discharge unit **must be located nearest the point of entrance to the building,** but not near combustible material. The antenna discharge unit **must be grounded.**

AC Safety and Lightning Grounds

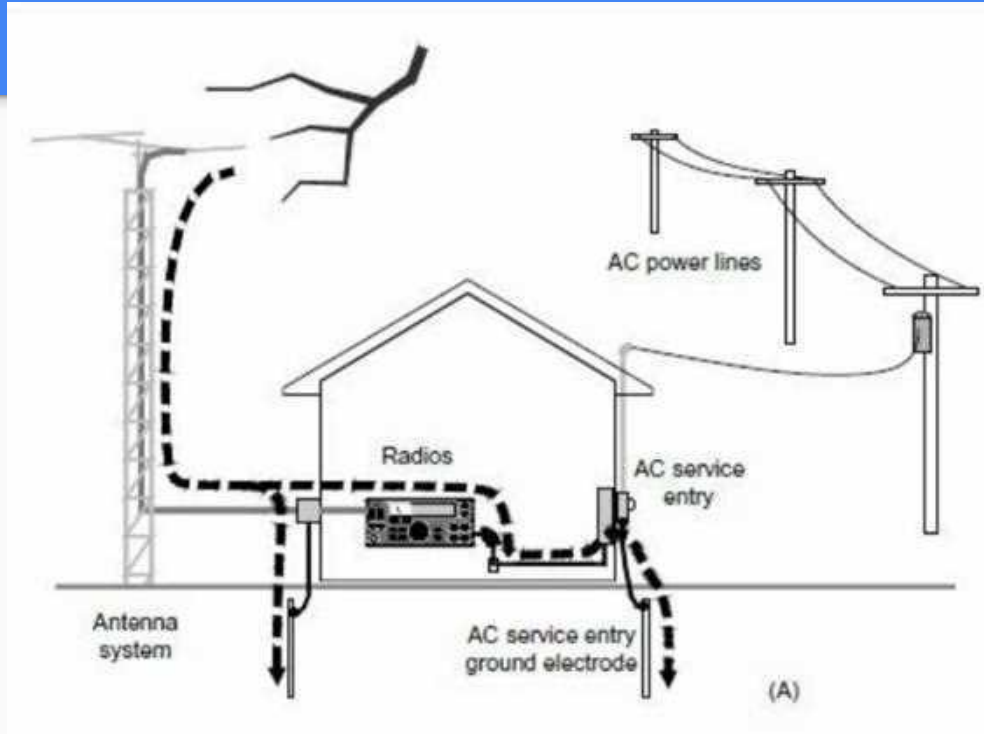
As long as **all** of the ground electrodes of both AC and Lightning grounds are bonded together, they do not interfere with each other and can even provide additional safe current paths.

They **must** be bonded together at their common points — **the ground electrodes**.

You cannot rely on the lightning protection system alone to provide ac safety and vice versa.



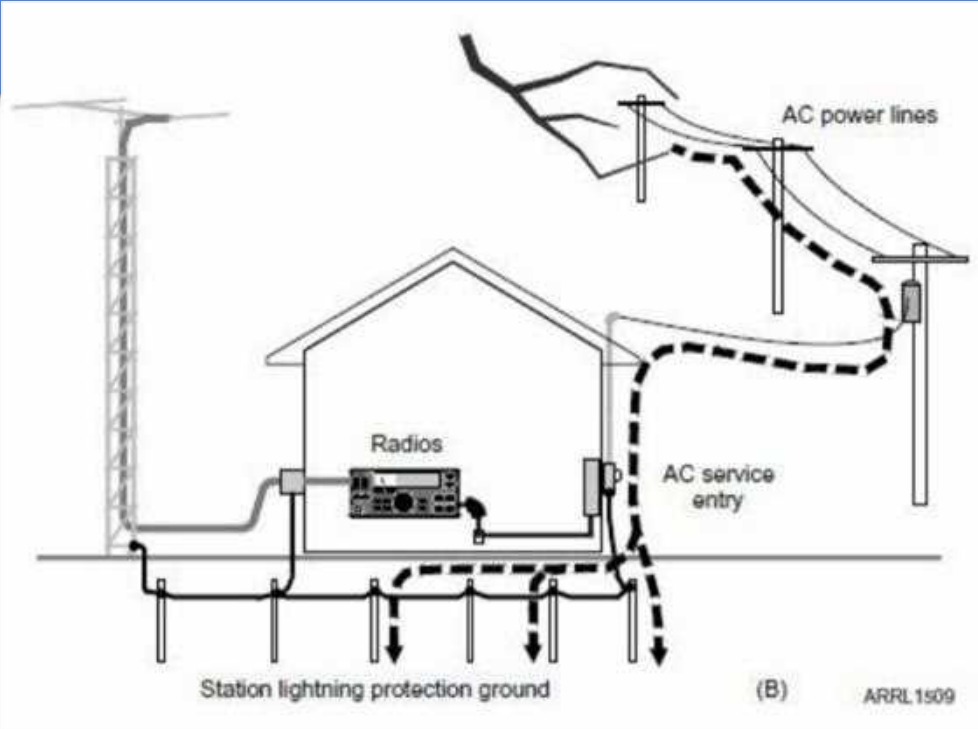
Common - and WRONG



Why this isn't OK

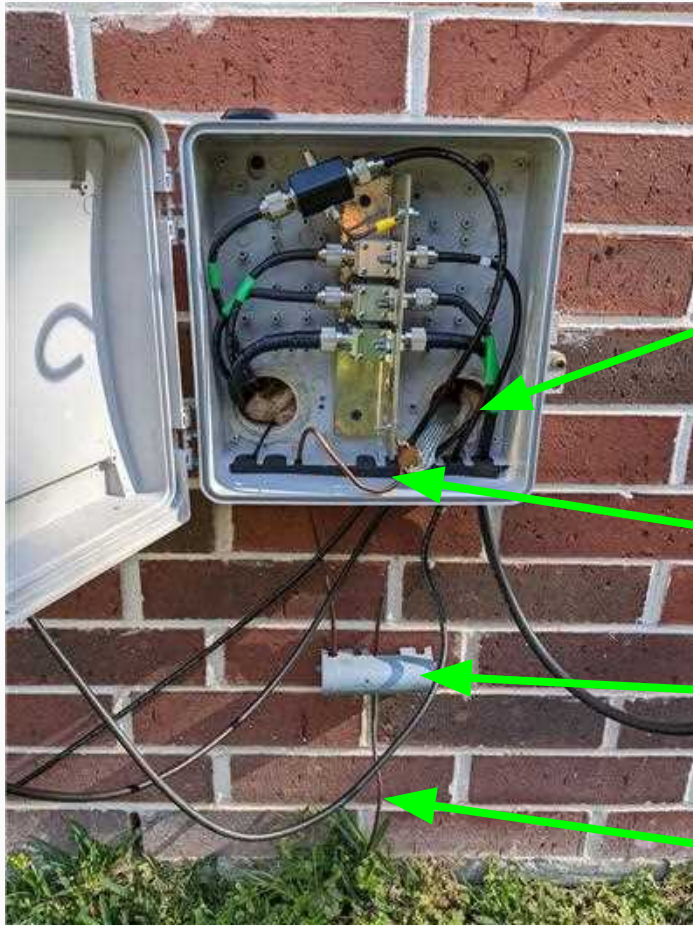
- Not up to NEC code
- Lightning will start fires/destroy equipment
- Insurance won't pay out!

Correct - Even if 'inconvenient'



Always Bond Ground Rods!

- Keep lightning currents *outside your house*
- Bond with #6 AWG solid copper
- Bond *correctly*



2" Copper Braid to SPG in Shack - overkill!
(*\$12/ft GA Copper - 1.25" is \$4/ft - ABR has 1" braid*)

6 AWG solid copper wire from ground bar to bridge

"Bonding Bridge" (*\$15 Lowes*)

6 AWG Uninsulated copper wire to house ground



*Diamond SP1000
\$37 Amazon / \$32 DXE*



*Polyphaser IS-50UX ~\$75
DXEngineering*



*Ground Bar - \$68
Georgia Copper*



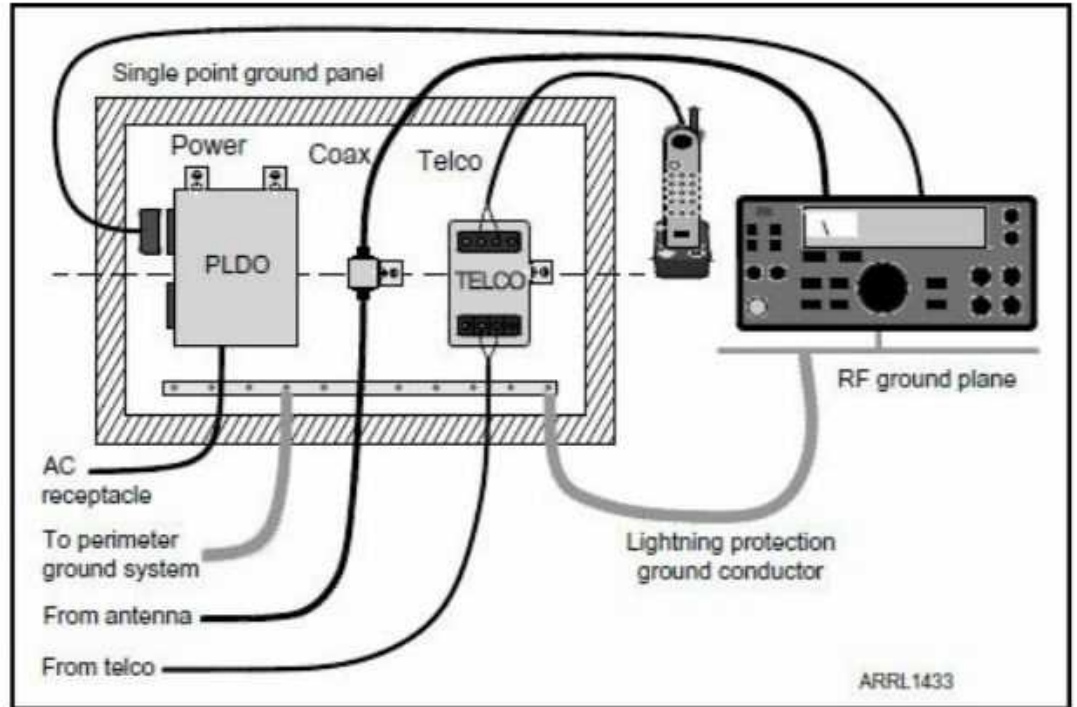
*Demarc Box - \$36
Amazon*

In your shack...

Build a Single Point Ground - Just a sheet of copper nailed on a board

Ensure *everything* in your shack is grounded there - all incoming lines! cable, internet, phone...

Bond to ground with 6 AWG solid copper wire - the biggest thing you can manage (braid is ideal indoors)





1" Braid to radios on desk (ABR)

All incoming antenna lines grounded (again) through switches (overkill)

AC Line Surge protector (for all equipment)

Ethernet grounded surge protector (unused - \$12 Amazon)

2" Copper braid to antenna entry

Where does a lightning surge go?

Please take
grounding
seriously - **it could**
save your life!

Goal of grounding system = low ground impedance!

Hard to measure, need specialized tools

Not hard to achieve in Houston (harder in deserts/stony ground)

Lightning will always seek the lowest-impedance path - give it what it wants!



Bonding with exothermic welding

The **best** and **most fun** way to bond
wires to ground rods...



<https://photos.app.goo.gl/sMnPr1YvxPVtES6E8>

Thanks!

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Grounding bar for coax shield (no surge suppressor)

Bonded (?) to screw on outside of meter

A bonding bridge is easy to install, and makes it easier to bond multiple grounds to your ground rod



RFI Concerns

You will **always** have 'ground loops', which are effectively antennas for local RFI.

Minimize Inductance!

Keep cables short, bundle them together.

Wider wires (or braid, or strap) have lower inductance than thinner wires

Bends add inductance!

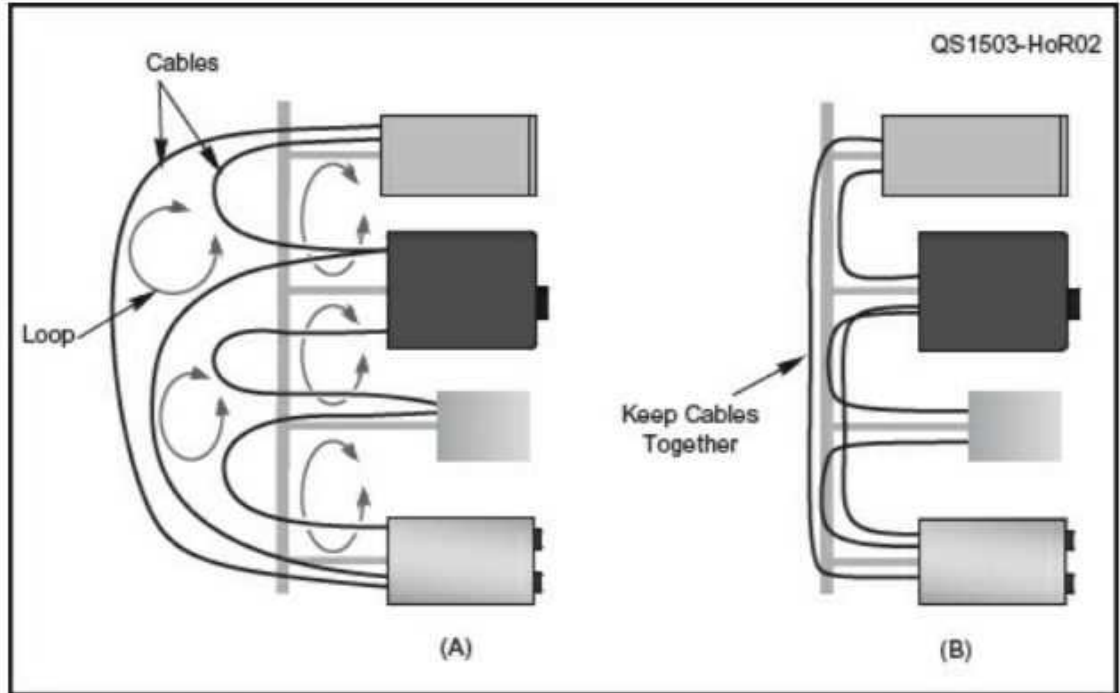


Figure 5.8 — Each conductive path through enclosures and cables creates a loop (A) that can pick up and radiate signals. Minimizing cable length and loop area by keeping cables together as at (B) can reduce RF pickup.



Most wires are short or bundled (not always well)

Equipment with well-designed grounds (e.g. USB hub)

No “wall warts” here!

A good ground and good equipment will eliminate most “RF in the shack” problems

Ferrites and isolation (ground loop breakers) can help extreme cases. Ask for help!

Ask for help!