

Strays – Lightning protection

Lightning is a beautiful, alarming, deadly, and widely misunderstood natural phenomenon. In spite of its awesome display of force, are there measures you can take to protect your equipment and yourself against its effects?

What is lightning?

Lightning is a sudden and massive static electrical discharge that results in a super-heated display of energy. Although it's electricity, it's neither AC (alternating current) nor DC (direct current), but a **transient** (surge) transfer of power (voltage and current, or energy per unit time).

It starts as a collection of “free” electrons, the result of ionization in the clouds likely due to the **triboelectric effect** from particle friction. When the electric field strength of the imbalance between the cloud and ground exceeds the **dielectric strength of the air** for the given distance, it triggers a series of events. The air between the cloud and the ground ionizes, forming a stepped electrical path to allow current flow in an attempt to equalize the potential difference. This gives rise to a brilliant **spark** that's accompanied by an acoustic shock wave known as thunder.

Lightning behavior

The seemingly unpredictable behavior of lightning can appear to many that it doesn't follow the rules of nature like we humans might expect. Rest assured that lightning follows the laws of physics like everything else, but because of its high-energy nature, it requires some understanding that often fall outside daily mortal experience.

Because lightning is a transient, its signal (voltage and current) rises and falls quickly. So quickly that it can be characterized by a (**Taylor**) sum of many high-frequency components. These high-frequency harmonics, in turn, create electrical eddy currents within an electrical conductor for a short period of time, resulting in a greater portion of the signal to flow near the outside of the conductor, a behavior known as **skin effect**.

One side effect of the skin effect is an increase of conductor impedance as a function of frequency, giving most conductors an inductive appearance. When lightning current encounters this high conductor impedance, yet is within reasonable electric field prox-



imity of another conductor exhibiting a greater electric field difference, the current can arc over to the other conductor through the air, a seeming contradiction.

How to minimize the effects of lightning

Lightning is so powerful that it seems like there's little you can do to keep your equipment safe from its harm. Even if you as an amateur take every precaution, your gear can still be subject to that big, bad bolt. Here are a few things you can do toward *your best effort*:

- Drive a ground rod into the dirt below each rooftop antenna, and connect solid bare 4 AWG copper wire between each ground rod and its antenna mast.
- Drive one more ground rod into the dirt just outside your shack (radio room), unless one of the above rods is already there.
- Install a ground panel in your shack.
- Connect all your ground rods, your shack ground panel, and your electrical service panel ground together with solid bare 4 AWG copper wire.
- Install a surge protector (“lightning arrester”) on your ground rod and route your coax from your rooftop antenna through the protector.

Unplug or leave plugged in?

Whenever a lightning storm approaches, do you picture the repeater owner rushing up the mountain to disconnect the coax from the radio gear? Neither do I. But his repeater equipment is ham radio gear like yours, so shouldn't he be worried enough to unplug the coax? The repeater owner might indeed be a little concerned about lightning; I mean, repeater towers **do** get struck.

At the risk of over-simplifying the remedy, here's my

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recommendation: *If you've routed your coax through a surge protector as I've described, then whether or not you unplug won't make much difference. But if your coax isn't routed through a surge protector, then unplugging is more dangerous than leaving it plugged in.*

With your grounding properly installed as outlined, you're as protected against lightning damage as you reasonably can be, whether or not you leave your cable plugged in. If you don't route your coax through a surge protector, do you believe that a few feet of separation is enough to stop lightning after it's already traveled a half mile to your antenna? In fact, the spark gap you provide by unplugging it presents an attractive path for the high-potential electric field to establish a low-impedance streamer between your equipment and the coax, even if you've placed your coax connector in a glass jar.

Popular lightning myths

- ***Lightning takes the path of least resistance.***

Lightning, like all electricity, takes all connected paths, inversely proportional to path impedance.

- ***Grounding an object will make it more attractive to lightning.***

Grounding will not make one object any more "attractive" to lightning than another.

- ***If it's not raining, or you don't see clouds, lightning won't form.***

Clouds are necessary, but its discharge can originate from far away, even out-of-sight.

- ***Lightning only strikes the tallest objects.***

Lightning can discharge through any conductive object that possesses lower electric potential compared with that of the source.

- ***Lightning victims can become "electrified" and carry a residual charge that can hurt somebody else.***

It's perfectly safe to come in contact with a lightning victim if you both are in a safe place.

Protecting yourself from lightning

- As it says, ***When thunder roars, go indoors.***

- Don't stand under or near a tree during a lightning storm; stay away from open water, hilltops, and mountain ridges when lightning is within a few miles.



- Don't seek shelter in open structures, such as baseball dugouts, gazebos, pavilions, carports, or your front porch.
- Don't bathe, shower, or stand near plugged-in electrical appliances during a lightning storm.
- Don't stand outside near utility poles, towers, guy wires, or tall buildings, even though they might seem "professionally" grounded.



- Avoid close proximity to conductive objects, such as barbed wire, chain-linked fences, swing sets, and street signs during a storm.
- Bring your pets indoors when a storm approaches.

You can read a brief but more comprehensive discussion about lightning [on my website](#).

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