8 Simple & Significant

Electronics Loss Prevention (ELP) Concepts

The 90/10 Rule of Electronics Loss Prevention.

Generally speaking *about* 90% of electrical anomalies (which are usually low energy surges and transients, etc.) can be managed by traditional grounding.

But the other 10% of these events are problematic, particularly for electronic equipment. Damage to, or failure of electronic equipment is far too common due to the significant limitations of traditional grounding methods for managing higher energy faults. Hence, in that electronic circuitry is now the heart of every mechanical, industrial, or communications device we use throughout the world, protective techniques that can fully protect this electronic heartbeat are essential: *Broadband electronic loss prevention* systems, designs, and products that can properly dissipate this troublesome 10% are now entirely necessary.

HEHF Current and Loss Prevention for Electronics

High energy, high frequency (HEHF) fault events are bad news for electronics.

Traditional grounding standards were designed specifically for analog equipment and lower frequency (50-60Hz) faults. Lightning-grade faults exceed 250**M**Hz. Most configurations of traditional grounding lose effectiveness rapidly when they face frequencies exceeding 100MHz. Charge "reflection" (that is, the reversal of current flow to go "backwards" and **into** presumably protected assets) becomes a real possibility, thus jeopardizing equipment.

A typical lightning strike can easily convey over 250kV at or above 30,000 Amps. That is roughly 7.5GW of energy! (Doc's 1.21 gigawatt strike in *Back to the Future* was kids play!)

Combining this level of energy with high frequencies common in lightning-originated faults (even at substantial distances from a given site) creates a lethal cocktail for electronics unless this HEHF current is intercepted and dissipated. The ability of traditional grounding strategies to do this is extremely limited.

90-Year-Old Assumptions Are Tenuous at Best

Throughout the history of published codes, industry standards, and accepted specifications for grounding, (as early as the 1923 National Electric Code), one finds the consistent _assumption_ that traditional ground rods can fully dissipate any intensity of charge, at any frequency, in soils with impedances many millions of times greater than copper. (All soils – globally - are *hundreds of millions of* times more resistive than copper.) Simply designing and installing a grounding system with a calculated number of ground rods of a certain length, regardless of soil conditions, continues to be viewed by code and standards writers as sufficient to ensure protection of assets of any type.

Unfortunately, this is dangerously incorrect. While such an approach to grounding might have been applicable in the analog era many decades ago, it is often dangerously inappropriate in the electronic era. Because electronic devices and circuitry are massively more sensitive to faults of any type than their analog predecessors, loss prevention strategies that can dissipate HEHF current flows *and* overcome substantial soil impedance mismatches is now absolutely necessary. Further, this must all happen generally in less than 8 *micro*seconds. That's eight-*millionths* of a second. Common rod-based grounding is not up to this task.

As the world becomes constantly more dependent on electronic devices that are truly critical in an untold variety of applications, it becomes reasonable to ask why traditional grounding is still seen as proper and sufficient protection — *when empirical data clearly show it is not*.

Continued Use of Traditional Methods is Amplifying Losses

Every year in the United States, about $2 billion in **insured** lightning damage claims are paid. A major portion of this is for losses of electronic devices. *This amount is increasing annually*. Uninsured losses, especially in high-lightning-event areas (like Florida in the United States), are likely to be several times greater than insured losses.

Because traditional grounding has not kept up with our dependence on electronics throughout society, losses will continue to increase – unless we adopt a more thorough and capable approach to electrical grounding.

Your Inbound Electric Supply Can Carry Trouble

In our experience, over 2 out of 3 cases of equipment loss and damage originate on inbound electric supply lines and NOT via lightning strikes to towers or structures. Only about one third of loss events come from tower/structure strikes.

This being the case, not having a highly capable interception and dissipation strategy for over-voltages and other power quality problems on electric supply lines is simply asking for trouble. A ground rod or two, connected by lighter gauge wire just isn't going to cut it. This is NOT effective loss prevention.

Surge Suppressors Need a Helping Hand

When Surge Suppression Devices (SSDs) intercept trouble-making currents and voltages, they must have a place to harmlessly dispose of this energy. If the repository for this energy is traditional ground rods and the offending flow is at HEHF levels, the suppression will not be successful. Additionally, SSDs are only connected to the inbound “phase” or “hot” lines, **not** the neutral line. Current will and does flow “backwards” on neutral lines. Hence, faults on neutral lines are particularly dangerous.

If a protection strategy depends on any degree of surge suppression, it needs the benefit of a far more robust dissipation network to dispose of intercepted faults AND provide equally capable protection on neutral lines to prevent damage to local electronics and the suppressor itself.

Interestingly, Faraday Cages used for protection against electromagnetic pulses and other harmful charges cascading upon data centers and other critical structures and assets, must also have a “place to put” the energy they intercept. Just as with SSDs, if this energy is at HEHF levels, traditional grounding techniques are not likely to be fully effective. Additionally, if Faraday-based protection is bonded to single-point grounding scheme which includes inbound electric service grounding, any energy not dissipated by grounding may and likely will flow “upstream”….and into the very structure and assets the cage was meant to protect. Rethinking grounding and electronics loss prevention for Faraday applications is certainly called for.

Always Give Electricity a Great Superhighway Escape Route

The first rule of effective electronics loss prevention is stopping faults from entering your facilities. The best way to do this is to give the charge a **reason to stay away**: Give it a super-low resistance *escape path* to a great dissipation network. With that in place, the surge has no incentive to come inside. It *wants* to go to ground….so make sure it has *millions* of opportunities to do so.

No entry…. no damage.

Don’t Chase Unrealistic Resistance Measurements

Many commercial grounding standards specify achieving a so-called *resistance-to-ground* reading of 5 Ohms or less at a single reading.

Succinctly put, *don’t waste your time*. Any grounding contractor claiming your network has achieved this level is not telling the whole story. **ALL** accepted measurement methods are only suitable as **relative** numbers for a given site on a given day. Claiming a super low resistance level as a fixed and absolute data point for any grounding strategy at a particular site is grossly inappropriate and inaccurate.

But far more importantly, widely applied and fully accepted measurement techniques used to presumably gauge resistance-to-ground do not do that. Instead, they are actually **ground resistance** meters. *That is, they measure the resistance of the ground surrounding a grounding system, <u>NOT the performance of the grounding system</u>.* A simple review of where these meters “inject” test current and at what location this current is measured will make this point clear. Configured correctly (and not on a grounding loop), the results of ground resistance testing only tell the researcher the “level of challenge" a grounding system is facing at a given time. No data whatsoever is reported with respect to the ability of a grounding system to dissipate current, and particularly HEHF current. Therefore, beware of system verification data based entirely on so-called resistance-to-ground figures, especially where the resistance data are unrealistically low.