Focus

A Leap Forward in Protecting "Ground," the Heart of Electronic Products and Electrical Systems

Establishing and maintaining a high-quality grounding system is the foundation of all good electronic designs and power systems.

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The concept of "ground" permeates practically everything about how well we utilize our modern electronics; our home and commercial electrical systems; our IT infrastructures and their supporting networks; our communications systems, security and alarm systems, entertainment and audio systems; and our military machinery.

Ground is pervasive and multifunctional. It serves as a zero-voltage-level reference in buss systems and network signaling as well as in AC and DC electrical systems of all types. It is also the fault safety path in most modern electrical systems to prevent human electrocution through inadvertent contact with metallic surfaces carrying abnormal voltage and current potentials due to power fault conditions. Ground is also used to divert excess energy back to earth to drain off circuit noise transients, and ground is used as a "dumping ground" by UPS systems, power conditioners, AC power strip protectors, signal line port protectors, and the like to divert damaging energy waveforms in order to protect sensitive equipment circuitry.

So an appropriate grounding system certainly has a tremendous job to perform. Establishing and maintaining a high-quality grounding system is the foundation of all good electronic designs and their associated power systems and topologies. In fact, it has been repeatedly demonstrated that old or faulty grounding systems are directly responsible for a great majority of power problems that consumers and companies face around the world. The key to solving unexplained power problems, equipment glitches, and equipment damage begins here. Once a solid grounding system foundation has been established, you need to build upon that foundation by adding the necessary UPS systems, backup generators, power conditioners, LAN network protectors, Telecom protectors, data signal protectors, and ground line transient protectors. All of these require a genuine grounding system in order to execute to their best performance.

Indeed, securing and maintaining the integrity of ground has long been an endeavor of component and electrical design engineers as well as system integration and construction engineering professionals as they strive to eke out more functionality and higher performance in tighter spaces. For example, as integrated circuit designs become more complex and densely populated and voltage levels become smaller and tighter, it's clear that ground as a zero-voltage-level reference from which AC and DC levels transition needs to be reliable for best performance, accuracy, and efficiency. However, ground integrity at the circuit design level is directly associated with and derived from the power source's grounding and grid systems under actual operation. Typically, these power sources range from the simple single-phase 120/240 VAC systems that control our homes to the more complex multi-phase and multi-voltage, transformer-distributed commercial building power grid systems. The sheer explosion that's happening in home network intelligence and converging electronics systems is trending toward mimicking the sophistication of the outside commercial and corporate world. Thus, there is the increasing need to tightly control grounding principles and to protect and secure a good, clean ground reference to support these expansive capabilities. Fire and burglar alarm controllers, audio systems, and complete home entertainment systems are good examples of equipment that is particularly sensitive to voltage and current fluctuations, so ground integrity is paramount.

Well-established are the methods and procedures for lightning rod grounding systems to divert lightning off a building to earth. And grounding bed systems and various soil treatments establish more suitable ground system impedances. Likewise, there are various methods of achieving proper equipment ground bonding throughout a facility to tie back to the system neutral and ultimately divert current back to earth.

However, the ground system is really intended to be an earth-sinking mechanism for carrying off threatening transient energy and fault leakage current in a forward direction away from the equipment frame/chassis ground. It is not intended to be an open conduit for damaging energy to travel back up the ground line paths, back into your equipment, and across your power supplies, printed circuit board ground planes, and copper IT network cabling or be otherwise induced into sensitive equipment circuitry . The reality and irony is that there is a physical copper or aluminum grounding equipment conductor (wire) as well as a complex and continuous web of metallic grid running a pathway throughout a building's grounding system, presenting many opportunities for a bidirectional backflow of energy targeted right into your equipment and data networks.

A leap forward technologically that could potentially become the basis for a sound electrical system and electronic design would be a component approach wherein the component could be placed on the equipment appliance ground line connection in series. This component would only allow the desired voltages, current, and frequencies to traverse the line in the correct direction toward earth, all without violating the strict impedance grounding rules devised by various safety and electrical standards bodies and codes such as Underwriters Laboratories, Inc. (UL) and the National Electric Code (NEC). The ideal component technology should be transparent in the forward "to earth" direction yet act as a blocking check valve in the reverse "to equipment" direction, preventing abnormal frequencies (beyond 50/60 Hz), noise, induced lightning, saturated ground-level elevations, and other damaging transients from contaminating the ground reference. The ideal technology would be passive yet stable under environmental changes without degradation over time or during the process of performing its repetitive duties. Today's UPS systems, power conditioners, and power strips are unable to protect anything other than the hot and neutral lines and merely dump excess energy to the ground line. This deficiency leaves existing power systems, electronic equipment and IT data networks very vulnerable.

A Leap Forward Has Arrived

Various ground line protection innovations have begun popping up in the power quality landscape, offering a better-protected and more secure power environment. The most notable offerings include a range of ground line transient filter solutions that come in a hardwired mountable component module format as well as inline universal power cord versions. Footprints are available for PCB mounting, system level mounting, and plug-and-play power cord styles that allow for easy insertion on UPS systems, PC servers, pluggable controllers, and other equipment. These in-series ground line protectors are UL/CSA- and ETL-recognized components that have essentially no degradation factor under changing environmental conditions, and they don't wear out under repeated usage, having no moving parts or solid state circuitry. Using innovative materials processing and inductor fine tuning, this core technology is being applied successfully in fire alarm panels, in cellular radio towers, in gas pipeline applications, in audio systems, in manufacturing equipment, in remote metering devices, and in intelligent controller applications, to name a few. Further technological growth and spin-off application models are in development that protect all relevant AC lines (hot, neutral, and ground).

A sound engineering design and system implementation requires strict attention to all the facets of achieving a fine-tuned grounding system that allows optimal equipment performance, optimal safety, and optimal security of data and operations. Now, components are available that can go directly in series on the ground line in close proximity to almost any appliance, system, or controller imaginable. This breakthrough technology prevents virtually any "sneakthrough" intrusion of abnormal voltages, current, or frequencies into your equipment on the ground line.

Business operations are becoming much more sophisticated and intertwined than ever before, and they rely on IT professionals and the expansive equipment networks IT professionals oversee. No longer can we afford to ignore the unprotected ground line that reaches into the heart of our important business and security systems. Fortunately, there are emerging products designed to serve as a firewall by closing this open door of trouble. For IT professionals and other support professionals, the economic benefits are realized through higher network performance, less equipment and personnel downtime, fewer emergency field visits, and a higher level of data security. Quite possibly, in the same sense that it's hard to imagine any business operating today without at least some form of surge protection and backup system, we may someday see that electrical systems and their attached equipment appliances have mandatory ground line transient protection.

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