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The Need for High-Performance Surge Protection for PoE Cameras

White Paper

The Need for High-Performance Surge Protection for PoE Cameras

Executive Summary

AXIS Communications is the global leader in the network camera and video encoder markets. AXIS customers deploy PoE-fed cameras in harsh outdoor environments. Designers, installers and end users must ensure signal integrity in these mission-critical applications. Robust, reliable surge protection devices (SPDs) help to do just this.

Transtector's 50-plus years in SPD design and deployment provides the expertise to properly evaluate SPD effectiveness with sensitive electronics such as AXIS cameras.

Typically, there are three threats to outdoor installed cameras:

1. Direct strike to a structure. A camera installed on the exterior of a building with an Ethernet line adjacent to a down conductor is exposed to surge energy that couples onto the cable, resulting in interruption.
2. A nearby lightning event induces energy onto the cable through the air.
3. A nearby event energizes the earth around the equipment. The camera and head-end equipment are on separate ground systems. The Ethernet cable now becomes a path for surge energy to cause interruption or damage.

To mitigate these threats, users should install SPDs on both ends of an outdoor Ethernet line.

Shielded cables, shielded receptacles, and dedicated shield-to-ground protection in the SPD will harden the signal line, helping to eliminate interruption.

Ethernet SPDs should have a low turn-on voltage and a solid protection performance over time. Repetitive protection capabilities are vital. Transtector’s hybrid silicon avalanche diode/gas discharge tube (SAD/GDT) protection circuit provides this level of protection.

To verify Transtector SPDs will protect AXIS cameras, Transtector performed testing to replicate the effects of lighting on a camera system. Surge energy was injected through an Ethernet cable to a camera on the opposite end protected by Transtector’s ALPUF140 SPD.

After repetitive surge events at extreme levels, the AXIS camera remained operational with no damage by the surge energy—even after multiple exposures.

This laboratory testing combined with customer experience in the field validates Transtector’s hybrid SAD/GDT Ethernet line SPDs will protect AXIS cameras from surge and transient events, ensuring power and signal integrity.

The application space and potential for Power-over-Ethernet (PoE) continues to expand in today's communications market. More network designers deploying cameras for surveillance, security and automation are adopting the technique for passing electrical power along with data over Ethernet cabling.

PoE technology in camera applications enables the collection, conversion and conveyance of data as quickly as possible, and without interruption. These benefits are crucial in outdoor camera applications as they result in less complicated, less expensive, and more efficient camera installations.

The new IEEE 802.3bt standard brings unprecedented robustness and efficiency to PoE, increasing the technology's potential usefulness in camera applications. However, the personnel installing outdoor cameras are often unaware of the proper techniques for protecting and grounding PoE when deployed outdoors. As a result of these challenges, installers choose to inefficiently run separate power feeds and/or simply eschew the most advanced cameras in order to avoid deployment and maintenance complexity.

Surge protection and grounding guidance helps installers properly deploy outdoor POE-fed cameras, ensuring the reliability of power and signal integrity throughout the lifetime of the installation. Transtector provides guidance and education backed by 50 years in the industry and best-in-class surge protection products.

AXIS Cameras being used for COVID-19 prevention.

Cameras are becoming common tools to aid in the mitigation of Coronavirus spread. AXIS Communications cameras are being used in supermarkets, casinos stadiums and many other venues to help improve the safety of those on site.

As the world begins to reopen amidst COVID-19, AXIS cameras can be used with a wide range of systems to provide Face Mask Detection, Physical Distance Measuring, Hand Sanitization Monitoring, and Occupancy Counting. These functions that require uninterrupted camera operation can enable organizations to meet public health requirements, while keeping employees, customers, and the general public safe.

Any PoE cameras installed in an outdoor environment to help prevent the spread of COVD-19 will incorporate Ethernet cables with the potential for exposure to surges or transient events. This creates the mission-critical requirements for a systematic approach to the design, installation and maintenance of a PoE camera on a pole, tower or structure.

Not All Ethernet SPDs are Built the Same

Today, low-cost surge protection devices (SPDs) are commonplace in outdoor Ethernet applications. Unfortunately, proponents of low-cost products seldom grasp the negative consequences of a poorly made Ethernet SPD on a system. Shortcuts in board-level design can lead to signal degradation. Less robust protection components let through high levels of damaging surge energy. Proper coordination of the surge components is vital to an SPD designed to last the life of the installation and ensure power and signal integrity.

To be clear, there is NO PERFECT surge protection technology.

Surge protection technology has come a long way since NASA first starting using gas tubes to protect launch controls in the 1970s. There are currently hundreds of surge protection manufacturers in the world working to design SPDs for the next generation of electronics.

Even with all of the advances made, there are still limitations. There simply is no single surge technology available with all three of the most desired characteristics: fast reaction time, high energy handling, and no degradation. Instead we have three basic components, each with their own unique characteristics.

- GDT: Gas discharge tube—very robust; degrades over time; highest turn-on voltage; slow to turn on.
- MOV: Metal oxide varistor—very robust; degrades much slower; lower turn-on voltage; turn on time better than GDT.
- SAD: Silicon avalanche diode—does not degrade; very low turn-on voltage; lower energy handling capability.

In the past, camera installers have mainly relied upon simple surge protection technologies primarily consisting of only one component—either gas tubes or metal oxide varistors.

The advanced technology used in AXIS cameras deployed in outdoor environments requires a more advanced approach to surge protection. Research over the past decade has led to a hybrid design that takes advantage of the best operating characteristics of voltage limiting and voltage switching devices, resulting in state-of-the-art two-stage protection products.

Two-stage SAD/GDT devices used for camera protection incorporate the latest generation of high surge capacity and fast-acting, non-degrading components. Transtector's hybrid circuit technology provides a robust, fast-acting diversion path designed to protect sensitive electronic equipment. In less than a few nanoseconds, Transtector's SAD SPDs immediately clamp the voltage spike that would otherwise damage the camera. These hybrid suppressors are capable of deflecting an extremely high amount of surge current while still maintaining low enough residual voltage throughout the surge event to sufficiently protect the equipment.

Another very important feature with the Transtector SPD is the dedicated shield-to-ground protection mode that is completely isolated from the copper pairs in the cable itself. This provides a dedicated path to ground and also keeps the shield isolated from the ground, ultimately protecting the integrity of the shield and preventing other grounding issues.

Status Quo is No Longer Acceptable

Designers, installers and operators of outdoor cameras must find a reliable method for evaluating SPDs used to protect Ethernet equipment. Currently, there isn't a recognized standard addressing best practices for grounding and protection of Ethernet-fed outdoor equipment. Several commercial and military standards address cable shield grounding; UL497/An addresses outdoor telephone lines and UL497B listings relate to the safety of those working on indoor data communications lines. But again, *there is no independent standard that describes best practices for grounding and protecting Ethernet-fed outdoor equipment to ensure power and signal integrity.*

The result is an industry based on low-cost, ineffective SPDs for Ethernet/PoE applications, leading to significant problems that greatly outweigh the cost savings. One bucket truck rollout to replace an SPD that has prematurely sacrificed, or worse, created signal problems due to degradation, is one too many. Properly designed SPDs are meant to be transparent to the signal, protect repetitively, and only sacrifice under extreme circumstances.

Transtector provides SPDs that deliver these desired performance characteristics, and partners with AXIS Communications to perform laboratory testing to verify performance as designed. Laboratory testing confirms what customers using Transtector to protect AXIS cameras already know—the hybrid SPD circuit by Transtector works reliably while delivering value-added features.

Transtector Laboratory Capabilities

Transtector designed its lab for standard and custom transient and surge immunity testing requirements. The test lab provides in-house verification using state-of-the-art equipment to clearly certify and demonstrate product capabilities, technology advantages, and transient damage. A wide range of customers have utilized the lab for OEM equipment surge immunity testing, including military, railroad, radio OEMs, and many others. In the lab, each systematically verifies the effects of surge energy on sensitive electronics with—and without—surge protection.

Lab equipment generates every recognized surge waveform and level necessary to validate surge protection performance. The lab can even create enough concentrated surge energy to shrink a quarter into a dime.

Developing a Test Plan

When Transtector became an AXIS Communications technology partner, the team developed a test plan that could be used to verify the Transtector protection system with an AXIS camera. At the time, Transtector had performed this type of testing with many other types of OEM equipment, but not cameras. Test engineers slightly modified a standard test method to incorporate a new path to confirm a successful test.

IEEE tells us that the best way to simulate lightning is to use an 8/20µs wave form. The test team sets the generator to produce the surge energy in the same microsecond time frame. The generator takes eight seconds to reach the peak of the energy level chosen, and then decreases quickly to less than 50% of the total energy (within 20 seconds).

In the next step, the test team determines how much surge current to expose the protection, and potentially the camera, in order to confirm the protection not only works, but is robust enough to handle extreme events.

The high impedance of the small copper wires in Ethernet cables limits the overall exposure level cameras can experience outdoors. Studies conducted in Florida, the unofficial lightning capitol of the USA, found the energy on copper pairs to reach 100 amps maximum. Note that 100 amps is more than enough surge energy to damage a camera. Transtector and AXIS chose to push the envelope and apply 1000 amps of surge energy to each pin, twice.

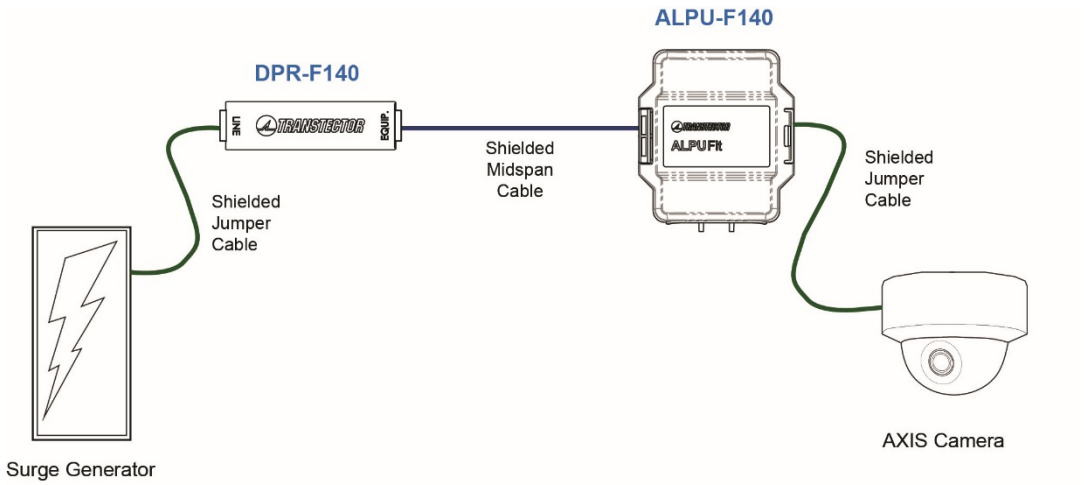
To simulate a real-world installation, engineers grounded all equipment to a single point, installing an indoor rated Transtector DPR-F140 SPD on one end of a midspan shielded CAT6A cable. (Shielded jacks, connectors and cables are best practice for outdoor Ethernet applications). The team injected a

surge through the DPR F-140 and the midspan Ethernet cable to the camera on the opposite end, with a Transtector ALPUF140 SPD protecting the camera.

After each event the team employed the unique validation method, then successfully shot a crystal-clear image using the AXIS camera software—indicating the surge had not damaged the camera and the L-G protection circuits provided a high level of protection.

A unique feature of the Transtector protection, and one that should be designed into all Ethernet SPDs, is a dedicated and isolated shield-to-ground protection circuit. After conducting the pin-to-ground (L-G) test, the team tested the shield-to-ground (S-G) circuit at 1kA, hitting it twice as well. The camera once again passed operational condition requirements after the S-G test.

A noteworthy result from the test is the operational condition of the SPD. After being subjected to *18 1kA surge events*, the Transtector SPDs were still transparent to the system and ready to protect the camera.



Conclusion

Rigorous testing demonstrates that Transtector surge protection safely protects AXIS cameras from surges, and will do so repetitively. Transtector SPDs will also remain transparent to the system after multiple surge events.

Outdoor camera installations face three major threats:

- First, a direct strike to a structure where the camera is installed on a building and the Ethernet line is adjacent to a down conductor. When the conductor brings energy to earth, surge energy can be coupled on the cable, resulting in interruption.
- Second, a localized lightning event induces energy onto the cable through the atmosphere.
- Third, a nearby event energizes the earth around the equipment. The camera and head end equipment are on separate ground systems and the Ethernet cable now becomes a path for surge energy to cause interruption or damage.

When facing these threats, it is important to install Ethernet SPDs on both ends of an outdoor Ethernet line. Shielded cables, shielded receptacles, and dedicated shield-to-ground protection in the SPD will harden the signal line. Ethernet SPDs should incorporate hybrid circuits that have a low turn-on voltage and a solid protection performance over time. Repetitive capabilities are vital to avoid maintenance tasks and signal interruption.

If these criteria are used in the SPD selection process it will most likely lead to the installation of Transtector solutions. This testing provides proof that selecting Transtector SPDs will lead to your AXIS cameras remaining operational even under extreme exposure.

For additional information on power and signal integrity applications visit our website at www.transtector.com or contact us directly at +1 208 635 6400.