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KNOWLEDGE

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Lightning Protection

The following article explains the proper installation techniques to use for protection of outdoor cameras that may be exposed to lightning strikes.

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Lightning Protection

Reference Guide

Pole-mounted dome cameras in open areas can be susceptible to lightning strikes. Reference this document for information on how to protect video equipment from direct lightning strikes.

Note: There is no perfect solution for lightning protection. Therefore, hire a certified professional engineer experienced in lightning and surge suppression technology to make educated choices of cost versus protection.

Note: No camera equipment manufacturer can claim their equipment can withstand direct lightning strikes.

Note: Most video equipment can withstand secondary induced voltages. Many of the dome's protection devices are tied to and referenced to the frame ground signal supplied with the 24Vac power lines to the dome. Although the dome enclosure is well insulated with plastic and the frame ground is not required for safety, the frame ground is required for the dome's internal surge protection to function.

American Dynamics dome cameras can withstand surges specified in the following national and international standards:

- EN50130-4 Immunity Requirements for Components of Fire, Intruder, and Social Alarm Systems
- EN50130-4 Mains Supply Voltage Variations
- IEC1000-4-11 Mains Supply Voltage Dips and Shorts
- IEC1000-4-2 ESD
- IEC1000-4-3 Radiated Field
- ENV50141 Conducted Disturbances
- IEC1000-4-4 Electrical Fast Transient Burst Immunity (Lightning induced surges)
- IEC1000-4-5 Slow High Energy Voltage Surge

Generally Accepted Facts about Lightning

The following information is from the National Fire Protection Association (NFPA 780), European International ElectroTechnical Commission (IEC 61024) and National Lightning Safety Institute.

Lightning Facts

- Hundreds of millions of volts can be at the point of impact.
- Current can be 400,000 amps with the average strike being 25,000 amps. Three percent of the strikes are above 100,000 amps.
- A lightning protection system with an earth resistance of 10 ohms can still allow a buildup of over a million volts.
- When lightning hits the ground, it is estimated that only 15% of it penetrates the earth and the rest travels across the surface. The surface gradient can exceed 10,000 volts per foot.
- Most energy in a lightning stroke is 10kHz or below. Therefore the resistance (versus reactance) of a connection will be most significant.

Grounding

Grounding methods vary from site to site depending on soil conditions and ground elevation at the system component location. When choosing a method, consider the following:

- **Use an array of ground conductors.**

  An array of buried, radial, ground conductors to spread the charge is recommended.

- **Use a buried loop ground conductor around buildings and protective enclosures.**

  This conductor will distribute the charge and limit the potential across the building (#2/0 or #4/0 AWG bare copper wires have typically been used).

- **Use lightning air terminals.**

  If mounting electronic equipment such as a dome camera outside of a protected structure, a lightning air terminal with an independent down conductor (or other suitable means) can be used to carry the discharge to an adequate ground grid away from the equipment.

- **Reduce the possibility of corrosion.**
  To reduce the resistance and slow the degradation due to corrosion, weld or exothermically bond the buried grounding systems. Avoid using mechanical connections.
- **Note sandy or dry soil areas.**
  These areas may require extra ground rods and a more elaborate ground mat system to achieve a low resistance ground to earth.

  Design the grid so that at any point the strike cannot generate enough heat to turn sand into glass insulators around ground rods and buried conductors.

Running Cables

Even if each structure has its own lightning protection system, potential between the two structures can be in the millions of volts. When running cables, consider the following:

- **When low power signal cables are routed between two structures:**
  - Bond together the ground systems of the two structures with low enough impedance to limit the potential to a level that protects the electronic equipment attached.
  - If bonding the structures together is not practical, then consider converting the electrical signals to a different electrical isolation means such as optical fiber or RF.
- **Isolate cables:**
  - Do not run signal cables near lightning conductors, especially in parallel runs.
  - Keep unprotected conductors at least two meters from conductors in the lightning protection system.
  - Cables running from the electronics cabinet to the dome mounted at the top of the pole should have at least 1000V of isolation from the pole over the entire run using an isolation or insulation method.
  - Do not rest exposed connectors such as video BNC connectors against the inside of the pole. Otherwise the level of isolation from lightning will be compromised.
- Use an equal potential bonding plate tied to the nearby grounding system to reference electrical as well as the plumbing systems entering the structure.

Example Installation

One of the most susceptible installations is when a dome is mounted on pole in an open area, such as the case of highway traffic cameras.

A well-protected system is shown on page 4. Although a two-wire SensorNet interface provides more protection against surges and interference than RS-422 due to transformer isolation, this example describes RS-422 communication to the dome as this is one of the most common protocols. This example employs the following features:

1. **Control and video signals are connected to remote control equipment over a fiber optic cable.**

   The composite video and RS-422 to fiber converter should be housed in the electronics cabinet in or near the base of the pole.

   Running the digitized signal over fiber optic cable will simplify protection against lighting surges and allow very long runs with little loss in video quality.

2. **The cabinet has an isolation transformer to supply 120Vac.**

   The transformer has primary and secondary surge and lightning protection.

   A primary disconnect/breaker contains over-current protection and provides a means to power down the complete local system for upgrades or repair.

   The secondary side of the isolation transformer is referenced to the local cabinet ground rod.

3. **Low voltage surge arrestors.**

   Use low voltage surge arrestors, referenced to the cabinet ground, to provide further protection to power, RS-422, and video lines that go to the pole.

4. **Extend the lightning air terminal above the pole to attract nearby lightning strikes.**

   Route a heavy down conductor along the outside of the pole to the grounding network at the bottom of the pole.

   Ground the shell of the pole at the base so it is not used to carry the direct lightning discharge.

   Note: Large diameter welded rebar systems can be engineered to carry the discharge current from the air terminal. This requires a certified professional engineer experienced in lightning protection.

   Note: Current agency recommendations are to run buried radial conductors out away from the pole to help dissipate the charge. Since the cabinet is near the pole, they could share the same ground rod and radial conductor system. The shared ground rod should be as close to the bottom of the pole as possible.

   Tie the ground of the cabinet to the pole ground with a #4/0 AWG bare copper wire. This wire limits the extreme potential between the pole and the electronics cabinet and can be considered a portion of the radial conductors installed for safety.

   If the cabinet is more than three meters away, the pole and cabinet should have their own ground rods and the two ground rods should be tied together with a #4/0 AWG bare copper wire. For distances over ten meters, the protection system should be designed by a certified professional engineer experienced in lightning protection.

   Note: Installations shielded from direct lightning strikes by nearby taller structures will not need a lightning air terminal.

   For instance, 80-foot light poles having proper lightning discharge systems that surround a 50-foot video pole should attract direct lightning hits, preventing a direct strike to the video pole.

   IMPORTANT! Other factors may eliminate the need for a lightning air terminal. However, the determination should be made by a professional engineer experienced in lightning protection. If an air terminal is not installed, it is still important to ensure there is very low resistance from the top of the pole to the buried ground system at its base.

5. **Wiring junction box.**

   Poles with a wiring junction box at their top can be extremely vulnerable. To improve isolation, spliced connections should be well insulated (1kV+) and kept away from the cap that covers the box.

6. **Ground conductor routed with 24Vac to the dome.**

   This conductor is used as the discharge path for the surge protectors located in the dome electronics. It is vital that the ground conductor be a #12 AWG bare copper wire or larger.

7. **Additional surge suppression.**

   Additional surge suppression at the top of the pole is also recommended. These surge suppressors should be isolated from the pole with their reference tied to the 24Vac ground. For cable distances over 10 meters, the protection system should be designed by a certified professional engineer experienced in lightning protection.

8. **Pole mount lifting mechanisms.**

   For mechanisms that cannot accommodate a coax cable for video, a conductor pair can be used for a short run in the arm at the top of the pole.

   To reduce susceptibility to induced noise and to limit the degradation of picture quality, twist the pair of individual conductors together and keep them separate from those used for power or communications.

   Note: Blending coax and twisted pair lines may affect video quality. Always employ proper impedance matching techniques to minimize problems.

Camera Pole Installation with Lightning Suppression