

## How Lightning Causes Damage

Secura Key's Access Control equipment includes onboard surge or transient suppressors, designed to prevent damage to circuit components due to power spikes generated by building power, process equipment, elevators, HVAC units and other transient sources in the facility or on the power grid.

However, all Access Control equipment is susceptible to damage from lightning, especially when components are installed outdoors or buried data cables exit the building or connect between buildings. There are several ways lightning damage can occur:

- 1. Line Surge** – A lightning strike enters the facility through the power utility that supplies the site. This can happen through a local strike, or a more distant strike at a power substation. Sometimes power is interrupted and restored. The result is a large power surge or spike, which can damage PC's, monitors, printers, and access control panels.
- 2. Ground Potential Rise** – A nearby or direct lightning strike sends an electrical surge through the ground causing momentary ground voltages of up to 7500 volts. Depending on the intensity, a ground potential rise can actually cause surge suppressors to feed high current into "protected" devices, and it can cause physical damage to electronics and personnel inside the facility.
- 3. Direct Strike** – A direct hit to the facility or to incoming utility lines induces very large voltages and currents on all electrical wiring in the facility, damaging or destroying wiring, and electronic equipment, whether it is indoors or outdoors. Integrated circuits are burned or vaporized, and components are literally blown off circuit boards. If a direct strike hits a buried cable run, devices on both ends of the cable will be destroyed.

## How to Protect Your System

Lightning protection can be targeted to a specific problem area at relatively low cost, or it can be applied to an entire facility and every device in the system at a substantial cost. How much you spend will depend on the frequency of lightning in your area, and on how critical your access control system is to your operation. It may be cheaper to replace a controller board once a year, than it would be to protect your system end-to-end. On the other hand, if you are also losing process control equipment, HVAC, IT systems, cameras and other devices, you may want to go the whole nine yards and hire a lightning protection consultant.

Here are some steps you can take to protect your access control system.

## 1. Line Surge Protection

- a. Install AC Surge Protection at your main service panel, and at all sub-panels. This should be done by a licensed electrician. <sup>1</sup>
- b. Install a UPS with surge protection for your system PC, Monitor, and Printer. <sup>2</sup>
- c. Install plug-in surge protectors at each DC power supply that powers the access control panel or standalone access control unit, readers and locking devices. <sup>3</sup>
- d. Install Gate Controller surge protectors. <sup>4</sup>
- e. Properly ground all surge protectors. Make sure all surge protectors are connected to a good earth ground according to the installation instructions provided with each device. Check ground continuity and resistance to ensure that the ground connection is good.



Left to right: Industrial AC Mains and Sub Panel Surge Arrestors, UPS, plug-in surge protector, gate controller surge suppressor.

## 2. Data Line Protection

- a. Buried cable should be in non-metallic PVC conduit. Make sure that the conduit is completely sealed against water or moisture. This will reduce the cable's attractiveness to lightning strikes.
- b. Install surge suppressors on reader cable runs. Secura Key offers the DTK-CR to protect Wiegand-output card readers, including data, reader power, LED control lines and strike power. See Applications Bulletin 19 for connection diagram. This unit can also be used to protect standalone readers, such as RK65K, RK600, 26SA, and 28SA- Plus. For best performance, surge suppressors should be installed at both ends of each cable run.
- c. Install surge suppressors on data cable runs. Secura Key offers the DTK-XR to protect the SK-ACP access control panel, including a Telco modem connection, 24VDC power supply, and RS-485 communications lines. See Applications Bulletin 20 for connection diagram. Again, for best performance, surge suppressors should be installed at both ends of each cable run.

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1. Residential and Industrial AC surge protectors or surge arrestors are available from companies such as Ditek (ditekcpr.com), Citel (citelprotection.com), and Joslyn division, Thomas & Betts (joslynsurge.com).  
2. There are many UPS vendors, with APC the most widely known (apc.com)  
3. These are widely available from vendors such as Ditek, APC, and Belkin.  
4. These are available from Ditek.

For RS485 or RS232 cables, 3-stage surge suppressors provide a higher degree of protection by combining gas discharge tubes with high-speed solid-state suppressors such as MOV's, transorbs, varistors, and avalanche diodes.<sup>5</sup>

- d. Install opto-isolators on data cable runs. Opto-isolators use an LED emitter and a light sensor to convert data into light, thus breaking the electrical path provided by a copper wire data cable. Isolators prevent transient and surges from being conducted into readers or controllers, and they also eliminate the effects of Ground Potential Rise, and ground differentials between system components. Triple-isolated units are the best. Opto-isolators should be installed on a non-conducting surface in a non-conducting enclosure, and for best results, they should be installed at both ends of the cable.<sup>6</sup>
- e. Combine surge suppressors with opto-isolators. This is the most thorough approach you can take to protect copper wire cable runs. Install opto-isolators closest to the protected equipment, and then install surge suppressors nearby to protect the isolated data line, as well as the opto-isolators. For best performance, install both devices at both ends of the cable.



Left to right: DTK-CR card reader surge protector, DTK-XR data line surge protector, Three-stage RS-485 surge suppressor, RS-485 opto-isolator.

### 3. Extreme Cases

We get calls about long cable runs that get direct or proximate lightning hits annually, destroying controller boards and readers at either end. The following solutions will cost more than surge suppression and isolation, but they will solve the problem.

- a. Install Fiber Optic Cable. RS-485 or RS-232-to-fiber converters are available. Select a burial type cable with a NON-METALLIC protective sheath, or run standard fiber through PVC conduit to prevent rodent damage. There are different types of fiber-optic cable, so be sure to use one that is compatible with your converter. Also note that splicing the fiber optic cable to end-connectors is difficult for the inexperienced – you can order a cable to length, prefitted with connectors, or you can hire an experienced technician to do the job.<sup>7</sup>
- b. Install an RF Link. RS232, RS485, USB and TCP/IP can be converted to 900 MHz or 2.45GHz RF by using wireless modems.<sup>8</sup> A specialized unit is available for access control which duplicates the reader and strike/gate connections from an access control panel over a 900 MHz or 2.45GHz RF Link.<sup>9</sup>

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5. These are available from B&B Electronics ([bb-elec.com](http://bb-elec.com)), Citel ([www.citel.us](http://www.citel.us)), and Telebyte ([telebyteusa.com](http://telebyteusa.com)).

6. Opto-isolators are available as RS-485 repeaters, RS-232 repeaters, or as RS-232-to-RS-485 converters, from many suppliers including B&B Electronics ([www.BB-elec.com](http://www.BB-elec.com)).

7. B&B Electronics ([www.bb-elec.com](http://www.bb-elec.com))

8. Available from suppliers such as Digi, B&B Electronics and many others

9. Available from Cypress Computer Systems ([www.cypressworld.com](http://www.cypressworld.com))

## 4. Facility Protection

- a. If your facility is frequently hit by lightning, there are many techniques which can be used to protect equipment and personnel, including installation of lightning rods, buried grounding grids or ground rings (also called a counterpoise), copper ground stakes, Faraday cages, down conductors, bonding of all metal conductors entering the structure (utilities, HVAC ducts, etc), and connection to a single-point grounding system. Contact the National Lightning Safety Institute ([www.lightningsafety.com](http://www.lightningsafety.com)) to locate a qualified lightning prevention consultant in your area.

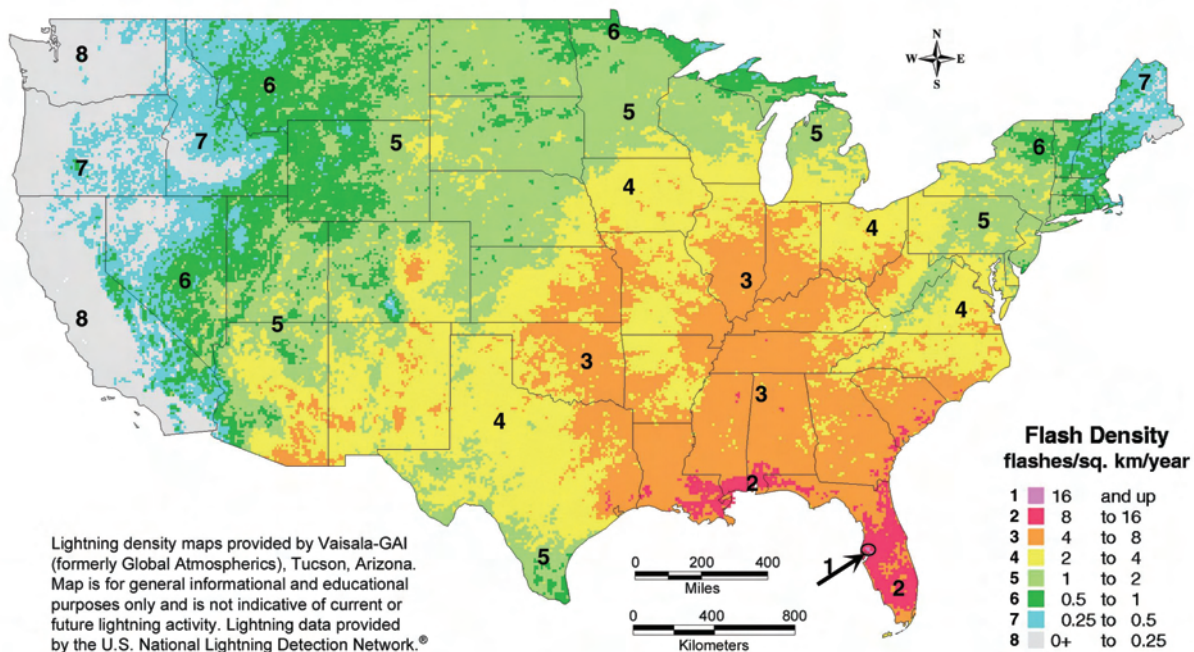


Left to right: RS-485-to-Fiber Optic converter, RS485-to-900 MHz RF converter/transmitter, 2-reader interface to 900 MHz RF converter (transmitter and receiver).

## Lightning Density Map

Lightning damage is one of the biggest reasons for warranty (and non-warranty) repairs in the low voltage equipment market (access control, alarms, CCTV).

This map will tell you if you are in an area with a high lightning flash density. While lightning can strike anywhere in the world, you may need to take more serious lightning protection measures if you are located in the orange, red, or pink areas on the map.



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DATE: 9/9/009  
REV.: --  
AF#: 7332

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