Real People
Make Up Life Safety

Surge Protection
Fire Alarm Inspector Course

David Taylor
Field Sales Engineer
Ditek
INTRODUCTION TO SURGE PROTECTION
Course Outline

About DITEK Corporation

What are Surges and Spikes?
- Causes
- Effects
- Terminology

How Surge Protection Works

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- Silicon Avalanche Diode
- Metal Oxide Varistor
- Gas Discharge Tube
Course Outline

How to Select the Correct Surge Protection

- Fire Alarm
- NFPA Code References
- UL Scopes

Installation Rules

Proper Grounding

Conclusion
DITEK CORPORATION continues to lead the industry in the design and manufacturing of electrical and low-voltage surge protection devices. Founded in 1988 and located in Largo, Florida, DITEK manufactures more than 300 different product solutions offering unparalleled protection options for the commercial, industrial and residential markets.
What are Surges and Spikes?

**Surges and Spikes** are unexpected, temporary and uncontrolled increases in current or voltage in an electrical circuit.

- They can be present on any metallic conductor.
- They can damage, degrade and even destroy electrical and electronic equipment. Surges are the most common cause of equipment damage and destruction.
What Causes Surges and Spikes?

**EXTERNAL CAUSE**

- **Lightning** – a direct hit, usually catastrophic
- **Proximity Strikes** – lightning strikes several miles away causing large voltage surges along transmission lines
- **Utility Grid Switching** – utility companies switching transmission lines from one supply system to another
- **Brownouts / Blackouts** – under voltage or voltage sag followed by a surge or spike

**INTERNAL CAUSE**

- **Inductive Loads** – the switching on and off of electric motors inside or outside a facility, such as HVAC systems, refrigeration equipment, pumps, CNC machines, copiers and printers
- **Mechanical Failures** – components of the electrical distribution system failing
- **Human Error** – accidental induction of AC power on low voltage system circuits
What Causes Surges and Spikes?

Vaisala's National Lightning Detection Network® (NLDN®)

Average Flash Density  
fl/sq mi/yr

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What Causes Surges and Spikes?
# Effects of Surges and Spikes

| DEGRADATION          | Gradual deterioration of internal circuitry  
|                      | • Premature equipment failure |
| DESTRUCTION          | Instantaneous loss of expensive equipment  
|                      | • Electronics, motors, controllers, etc. |
| DOWNTIME             | Loss of productivity and revenue  
|                      | • Loss of critical data and information |
Surge Protection Terminology

- **Maximum Continuous Operating Voltage (MCOV)** – the highest amount of voltage the device will allow to pass through continuously.

- **Clamping Level** – used to describe the *voltage level* which causes the surge protection device to “turn on” and start diverting the surge energy away from your connected equipment.

- **Response Time** – refers to the *amount of time* it takes for the surge protection device to “turn on” and start diverting energy. Surge protection components are typically 100 to 1000 times faster than any available surge energy.

- **Let-through Voltage** – the sum of the effective clamping voltage minus peak service voltage.
How Surge Protection Works

Initial Surge

Surge Protective Device

Surge Clamped

Normal Service Voltage
DC/AC
Metal Oxide Varistor (MOV)

Comprised typically of zinc oxide that conducts when it is exposed to an overvoltage that exceeds its rating. MOVs have a finite life expectancy and degrade when exposed to a few large transients, or many more smaller transients, and will eventually short to ground creating an end of life scenario. This condition will cause a circuit breaker to trip or a fused link to open. Larger transients may cause the component to open, thus bringing about a more violent end to the component itself. This component is typically used to suppress transients found in AC power circuits.
Silicon Avalanche Diode (SAD)

Comprised of silicon or other semiconductor materials. These components provide faster reaction times and better voltage clamping compared to other technologies, but they have much lower current handling capabilities. Unlike MOV’s, they do not degrade over time when used within their ratings. When component ratings are exceeded, the device will short creating a ground fault. These are typically used to suppress transients found in low voltage communication and data circuits.
Gas Discharge Tube (GDT)

Uses a sealed tube with 2 electrodes and an inert gas trapped inside. These components can typically conduct more current than other surge components. Like MOVs, they will also degrade over time and service and will create a short to ground while in conduction mode. It also reacts much slower compared to other surge technologies. This component is typically used in conjunction with other surge protection components as a hybrid protection circuit to take the leading edge or large energy hit. The most common use for this component is telecommunications equipment.
DITEK manufactures a complete line of surge protection products to meet the needs of our target markets:

- IP Video / CCTV Systems
- Fire Alarm Systems
- Networking & Voice Communications
- Access Control & Intrusion Systems
- Commercial, Industrial & Residential AC Power
Fire Alarm Systems

Is downtime an option in your life safety installations?
Fire Alarm Code References

NFPA 72 - 2013, Chapter 12 – Circuits and Pathways

12.2.4.2 All non-power-limited and power-limited signaling system circuits entering a building shall be provided with transient protection.

NFPA 70 National Electrical Code – 2014

Article 760.32 Non-power-limited fire alarm circuits and power-limited fire alarm circuits that extend beyond one building and run outdoors shall meet the installation requirements of Parts II, III and IV of Article 800 and shall meet the installation requirements of Part I of Article 300.

Informational Note: An example of a protective device suitable to provide protection is a device tested to the requirements of ANSI/UL 497B, Protectors for Data Communications.
NFPA 70 Requirements

NFPA 70, the National Electrical Code, Article 285.6

Article 285.6 requires all SPDs to be marked with a short circuit current rating (SCCR). This rating must be equal or greater than the available fault current present at the point where the SPD is installed on the system. For example, if a protector is to be installed at a location where the available fault current is 10,000 symmetrical amperes, then the SPD needs to be rated and carry a SCCR of 10kA or greater. This rating is derived from actual UL testing.

Verify that the SCCR rating of your 120V SPD equals or exceeds the AIC rating of the circuit breaker feeding the Fire Alarm Control equipment!
NFPA 70 *National Electrical Code* - 2017

**Article 695.14** A listed surge protection device shall be installed in or on the fire pump controller
**Surge Protection UL Scopes**

**UL 1449 4th Edition – Surge Protective Devices**

These requirements cover Surge Protective Devices (SPDs) designed for repeated limiting of transient voltage surges as specified in the standard on 50 or 60 Hz power circuits not exceeding 1000 V.

- **Type 1** - Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, and intended to be installed without an external overcurrent protective device.

- **Type 2** - Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device.

- **Type 3** - Point of utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, for example cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected.
Surge Protection UL Scopes

**UL 497 – Primary Protectors for Communication Circuits**
- These requirements cover protectors for paired-conductor communications circuits to be used in accordance with Article 800 of the National Electrical Code, NFPA 70.

**UL 497A – Secondary Protectors for Communication Circuits**
- These requirements cover secondary protectors for use in single or multiple-pair type communications circuits that are intended to be installed in accordance with Article 800 of the National Electrical Code ANSI/NFPA 70.

**UL 497B – Isolated Loop Circuit Protectors**
- These requirements cover protectors for data communications and fire alarm circuits
Fire Alarm Surge Protection

- SLC (Shorts to Ground)
- 2MHLPF-WB (Opens Circuit)
- IDC/PIV
- NAC
- 2MHLPG-BW
- 2MHLPB-BW

- External Antenna Kit
- VSPN
- PHONE LINES
- Cellular Communicator
- (Hardwired) 2MHTPW or MRJ31XSCPWP (one per line)
- (Modular) 2MHLPG-BW
- DF12OS1 (Series Connection)
- 120HWLOK (Parallel Connection)
- Electrical Service
Deflector DTK-DF120S1

- Protects 120VAC 20A circuits
- Audible alarm sounds when compromised
- Rapid-Replacement module
- Dry contact for remote notification
- Separate enclosure **not** required
- ¾” NPT Rigid or Flex conduit
- UL1449 4th Edition Listed
- UL1283 EMI/RFI Filtering
DKT-VSPN

- Specifically designed for wireless radio antenna protection
- N-type Female to Female connection
- 0 – 6 GHz Frequency range
Kit includes a NFPA 72 2013 10.6.5.2 compatible lockout kit to prevent accidental disconnect of the fire alarm system.
DTK-120HW

ALARM PANEL/CONTROL PANEL INSTALLATION DIAGRAM #1

120 VAC Power In

Connection Point

3’ Conductor Length #12 AWG Minimum

Circuit Board

Battery

Battery

DTK-120HW
ELECTRICAL PANEL/DISCONNECT INSTALLATION DIAGRAM #2

- DTK-120HW
- White Wire
- Neutral Bus
- Black Wire
- DTK-120HW
- Green Wire
- Ground Bus

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JUNCTION BOX INSTALLATION DIAGRAM #3

120 VAC Power In

3’ Conduit Length To Alarm Panel
2MHLP-F vs. 2MHLP-B

- Opens Circuit when compromised
- Shorts to Ground when compromised
DTK-TSS Series
Installation Photos
Best Practices

It is imperative that surge protection is installed per the guidelines set forth by the manufacturer. Improperly installed devices will not perform as intended and consequently, will not protect the equipment.
Installation Rule #1

The conductor length between the surge protective device (SPD) and the equipment being protected should be a minimum of 3 feet in length to allow enough time for the SPD to react. The conductors can be greater than 3 feet as long as they are isolated and are not subjected or directly exposed to internally- or externally-generated transient voltage spikes and/or surges.
Example - Incorrect
Example - Correct
Installation Rule #2

The use of a grounding bus bar is strongly recommended as a means of terminating SPD ground wires to existing electrical grounding leads. This will ensure a solid mechanical connection of all grounding wires. The use of twist-on wire connectors (aka "wire nuts") is not recommended for termination of SPD ground wires to existing electrical grounding leads. Twist-on wire connectors can add resistance, may become loose and/or corroded over time, and can also unnecessarily extend the length of the grounding conductor. This would degrade the performance of the SPD due to the lack of a short, low impedance ground path.
Example - Incorrect
Example - Correct
When installing multiple SPD’s and terminating to a common ground, a dedicated ground wire ran from each individual SPD to a common grounding bus bar is strongly recommended. “Daisy-chaining” multiple SPD ground wires together via the SPD grounding terminals or by using twist-on wire connectors is not recommended as this increases the resistance and extends the length of the ground path.
Example - Incorrect
Example - Correct
Installation Rule #4

Always make sure that the field wiring (unprotected wires) and the protected wiring occupy separate conduit feeds. When unprotected and protected wires occupy the same conduit, surge energy can be induced on to the protected wiring and completely bypass the surge protective device.
Example - Incorrect
Example - Correct
Installation Rule #5

Whenever possible, Surge Protective Devices should not be installed inside of the Fire Alarm Control Panel. A catastrophic failure of the SPD could result in residual physical damage to the circuit board and/or wiring inside the FACP.

**This is a recommendation, not a requirement**
Example - Incorrect
Ground resistance should be 25 Ohms or less. 5 Ohms or less is recommended for optimal performance.
Measuring Ground Resistance

Ideal 61-920

Ground Resistance Clamp Meter

Megger DET3TC

Digital Three Pole Earth Testing Kit
Grounding Reference

- Electrical Service Ground
- Grounded Building Steel
- Local Electrical Ground
- Dedicated Ground Rod

Do not reference metallic water pipes. PVC is used when repairing or replacing pipes and since it is non-conductive, ground reference will be lost.
Inspecting Surge Protection

Preventative maintenance inspections should be conducted monthly and immediately following local lightning strikes.

For AC power surge protectors, inspection involves verifying that all LEDs are lit. If an LED is out, the unit is compromised or has self-sacrificed, and needs to be replaced.

For low voltage surge protectors, the device will either short to ground or open the circuit, depending on the specific model, when it has self-sacrificed.
Web Portal

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- CAD Drawings Available as PDF and DWG
- Technical White Papers
- Application Diagrams
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