Lightning / Surge Protection for RadioRA 2 and HomeWorks Devices

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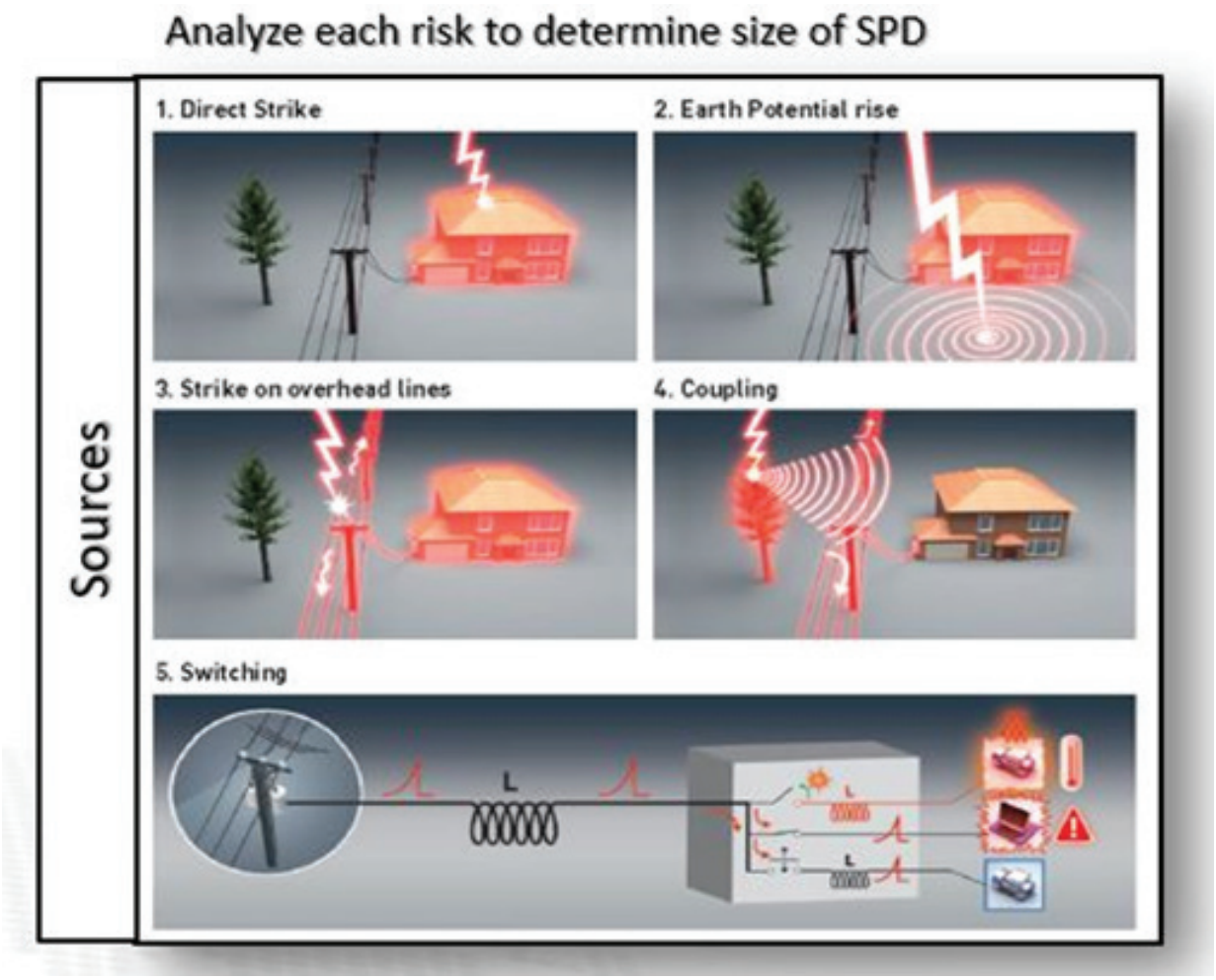
Overview

Lightning strikes may cause permanent damage to household electrical equipment, including Lutron System components. Lightning strike-damaged equipment is not covered by the Lutron Warranty and should be reported to the homeowner's insurance company.

All Lutron products are designed with integrated surge suppression devices. (Lutron follows the IEEE C62.41-1991 recommended practice on Surge Voltages in Low Voltage AC Power Circuits.) These integrated suppression devices are effective for preventing damage in most installations. Despite this fact, high-risk homes that are located in lightning-prone locations may experience surge levels that are capable of damaging Lutron devices, particularly in the case of a direct lightning strike on the property. (For additional information on lightning-prone areas of the U.S. and abroad, see the maps at the end of this application note.) Although this type of damage is typically covered by the homeowner's insurance, there is inconvenience involved in getting equipment replaced and/or having non-functional products. Many installers and homeowners are interested in adding additional protection hardware to their systems to minimize the risk of this sort of disruption. This application note was written to address these interests. Some threats other than direct strike are external and internal switching transients, loading and unloading of circuits, indirect lightning strikes, and electromagnet coupling. The image below illustrates these threats.



Overview *(continued)*

The devices recommended in this document are some of the most rugged and cost-effective protection devices available. Although installing these devices will provide an added degree of protection, in the most extreme circumstances damage is still a possibility. The likelihood of damage occurring will be greatly reduced when surge protection is used. This application note covers surge protection of low voltage links and the high voltage side of the installation with use of AC panel mount surge suppression with filtering. This may require additional solutions including: lightning rods, grounding methods, and local (near to a component) surge suppression, etc. High voltage surge suppression requires expertise (consider consultants if this is not internal to your organization) and up-front planning/design. An easy way to visualize a complete well-coordinated surge protection system is to consider your facility as a box. This box has multiple wires entering and exiting it, and all of these wires must be protected to completely protect the facility.

Our customers often ask why Lutron doesn't integrate the surge protection provided by the external devices directly into our products. The primary reason is that over time (many surges) or given a surge with sufficient energy the suppression devices can/will fail. When they fail they tend to fail "shorted" to ground. This failure mode is "good" in the respect that it continues to protect the Lutron equipment, although communications on the link will no longer work. External surge protection devices can be replaced easily, at low cost, with no reprogramming. If the devices were built into the Lutron product, the entire product would have to be replaced. We may have delayed the product replacement but we haven't prevented it.

Other benefits of external protection are:

- For maximum protection, it is best to have surge energy shunted away before it gets into the Lutron equipment
- The physical space required is impractical to implement in many products
- Not every customer needs to "pay" (in terms of size or cost) for this protection (for example, per the lightning strike maps, someone in the Northwest with a single building install, no integration connected,...)

Note: Refer to the surge protection company's website for specification information and installation instructions of a specific surge suppressor.

Recommendations

Installation Based Recommendations

- Protect all electrical breaker panels feeding dimmers, processors, and dimming panels. A panel mounted surge suppression unit with enhanced filtering will protect equipment from catastrophic events, clean the power, and suppress internally generated transients that can lockup electronics, necessitate reprogramming of controls, and gradually deteriorate sensitive electronics. See Section 3.4.3, IEEE Std.1100-2005.
- Protect all RS-232 ports with permanently connected third party equipment (typically other processors that are part of integration systems). While RS-232 communication wire runs are themselves short, all of the equipment and wire runs that are connected to the third-party equipment provide an electrical path to conduct damaging surges. Damage most often occurs because the ground referencing between the two systems can become separated during a surge. This creates high voltages that damage the RS-232 ports, and is the most common type of port failure.
- Protect any link or bus that travels between buildings regardless of geographical location. Again damage may occur because the ground referencing between buildings can become separated during a lightning strike. Lutron recommends using fiber optic communication between buildings. Using fiber cable breaks the electrical connection (by using light rather than current carrying conductors) and will minimize damage if one building gets struck. Refer to "**RS-485 Communication Using Fiber Optics Modem FAQ**" on the HomeWorks Resource Website.
- Protect Links/Busses that have wire runs over 500 ft (152.4 m) long even if they are contained within a single building. A long wire run is susceptible to high levels of capacitively coupled surge energy as it travels alongside other wires and through the structure and mechanicals of the building.

Geographical Based Recommendations

Refer to the lightning strike maps at the end of this document.

- Protect all breaker panels feeding lighting system from internal and external surges.
- Protect 120 V~ outputs from dimming modules which go outside (such as to landscape lighting) in areas that are determined to be at high risk, such as those at high elevations, and those in close proximity to water.
- Protect **all** links/busses for installations in **orange** and **red** areas. In the US, for example, this would include Florida, the Southeast, and portions of the Midwest.
- Protect **all** links/busses for installations in areas that are determined to be at high risk, such as those at high elevations, and those in close proximity to water.

Note: The lightning strike maps in this application note are best viewed in color. Please view on a computer or print out in color.

Surge Protection Equipment

The following surge protection equipment may be used to protect lighting panels and all dimming controls. The following suppression units will protect the electrical system from external transients entering the system through the power lines. The filtering part of the units will clean the power, and suppress internally generated transients that can lockup electronics, necessitate reprogramming of controls, and gradually deteriorate sensitive electronics. See Section 3.4.3, IEEE Std.1100-2005.

Breaker Panel Protection

1. Manufacturer: Citel, Inc.
   Model Number: M50-120T-A
   120/240~ Split (Single) Phase
   Website: www.citel.us

Photograph courtesy of Citel Inc.

2. Manufacturer: Citel, Inc.
   Model Number: M100-1201
   120/240~ Split (Single) Phase
   Website: www.citel.us

Photograph courtesy of Citel Inc.

3. Manufacturer: Transient Protection Design
   Model Number: TK-TTLP-1S240-FL
   120/240~ Split (Single) Phase
   Website: https://transientprotectiondesign.com

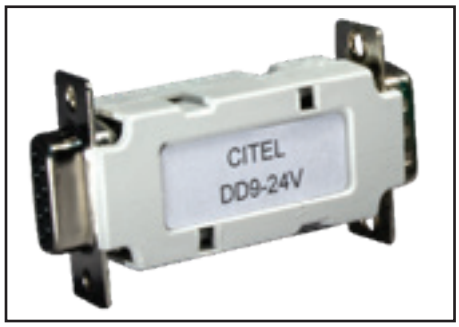

Photograph courtesy of Transient Protection Design

Surface Protection Equipment *(continued)*

RS-232 Surge Protection

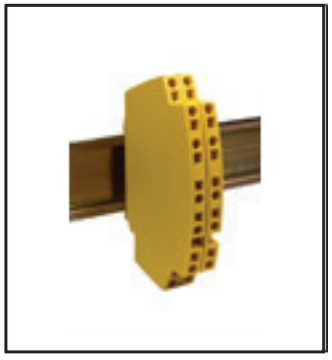
The following surge protection equipment may be used to protect RS-232 ports

1. Manufacturer: Citel, Inc.
   Model Number: DD9-24V
   Website: www.citel.us



Photograph courtesy of Citel Inc.

2. Manufacturer: Citel, Inc.
   Model Number: DLA-12D3 (1 Pair)
   DLA-12D3 (1 Pair Compact)
   Website: www.citel.us



Photographs courtesy of Citel Inc.

3. Manufacturer: Total Protection Solutions, LLC
   Model Number: TK-CT2-DB9-DIN2
   Website: www.TPSsurge.com

Photograph courtesy of Total Protection Solutions

4. Manufacturer: Transient Protection Design, LLC
   Model Number: TPD-DB9
   Website: https://transientprotectiondesign.com

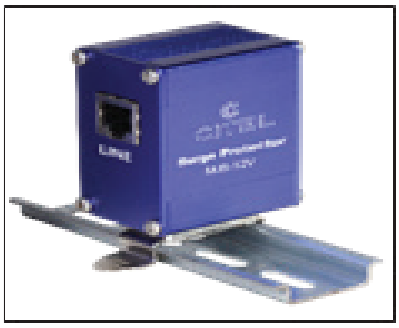
Photograph courtesy of Transient Protection Design, LLC

Surge Protection Equipment *(continued)*

Ethernet Surge Protection

The following surge protection equipment may be used to protect Ethernet ports (Cat 6/5e/5 non-PoE/non-Power over Ethernet applications only).

1. Manufacturer: Citel, Inc.
   Model Number: MJ8-CAT6S
   Website: www.citel.us



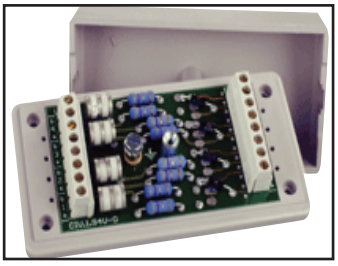
Photograph courtesy of Citel Inc.

RS-485 Protection and H48/D48 dimming Protection (HomeWorks and HomeWorks QS Only)

The surge protection equipment listed below may be used to protect the RS-485 links and H48/D48 links.

1. Manufacturer: Citel, Inc.
   Model Number: B280-48D3 (2 pair)
   Model Number: B480-48D3 (4 pair)
   Website: www.citel.us

B280-48D3 (2 pair)



B480-48D3 (4 pair)

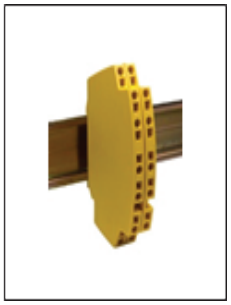
Photographs courtesy of Citel, Inc.

Note: Both 4-terminal (2-pair) and 8-terminal (4-pair) devices are available. Choose model based on the number of links to be protected.

2. Manufacturer: Citel, Inc.
   Model Number: DLA-48D3 (1 Pair)
   Model Number: DLA-48D3 (Two Pair)
   Model Number: DLC-48D3 (One Pair Compact)
   Website: www.citel.us

DLA-48D3 (1 pair)

DLA2-48D3 (2 pairs)



DLC-48D3 (1 pair)

Photographs courtesy of Citel Inc.

Note: Choose model based on the number of links to be protected.

Surge Protection Equipment *(continued)*

3. Manufacturer: Total Protection Solutions, LLC.
Model Number: TK-CT2-36LIT24 (24 terminals/12 pair)
Model Number: TK-CT2-36LIT12 (12 terminals/6 pair)
Model Number: TK-CT2-36LIT4 (4 terminal/2 pair)
Website: www.TPSsurge.com

TK-CT2-36LIT24 (12 pair)

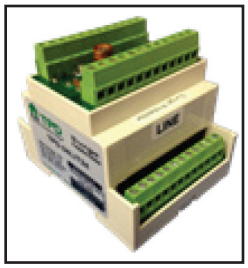
TK-CT2-36LIT12 (6 pair)

TK-CT2-36LIT4 (2 pair)

Photographs courtesy of Total Protection Solutions

Note: 24-Terminal (12-pair), 12-terminal (6-pair), and 4-terminal (2-pair) devices are available. Choose model based on the number of RS-485 links and H48/D48 dimming busses to be protected. Same unit can be used for both dimming busses and links.

4. Manufacturer: Transient Protection Design, LLC.
Model Number: TK-CT2-36LIT24 (24 terminals/12 pair)
Model Number: TK-CT2-36LIT12 (12 terminals/6 pair)
Model Number: TK-CT2-36LIT4 (4 terminal/2 pair)
Website: www.transientprotectiondesign.com



TPD-36LIT24 (12 pair)

TK-CT2-36LIT12 (6 pair)


TK-CT2-36LIT4 (2 pair)

Photographs courtesy of Transient Protection Design, LLC

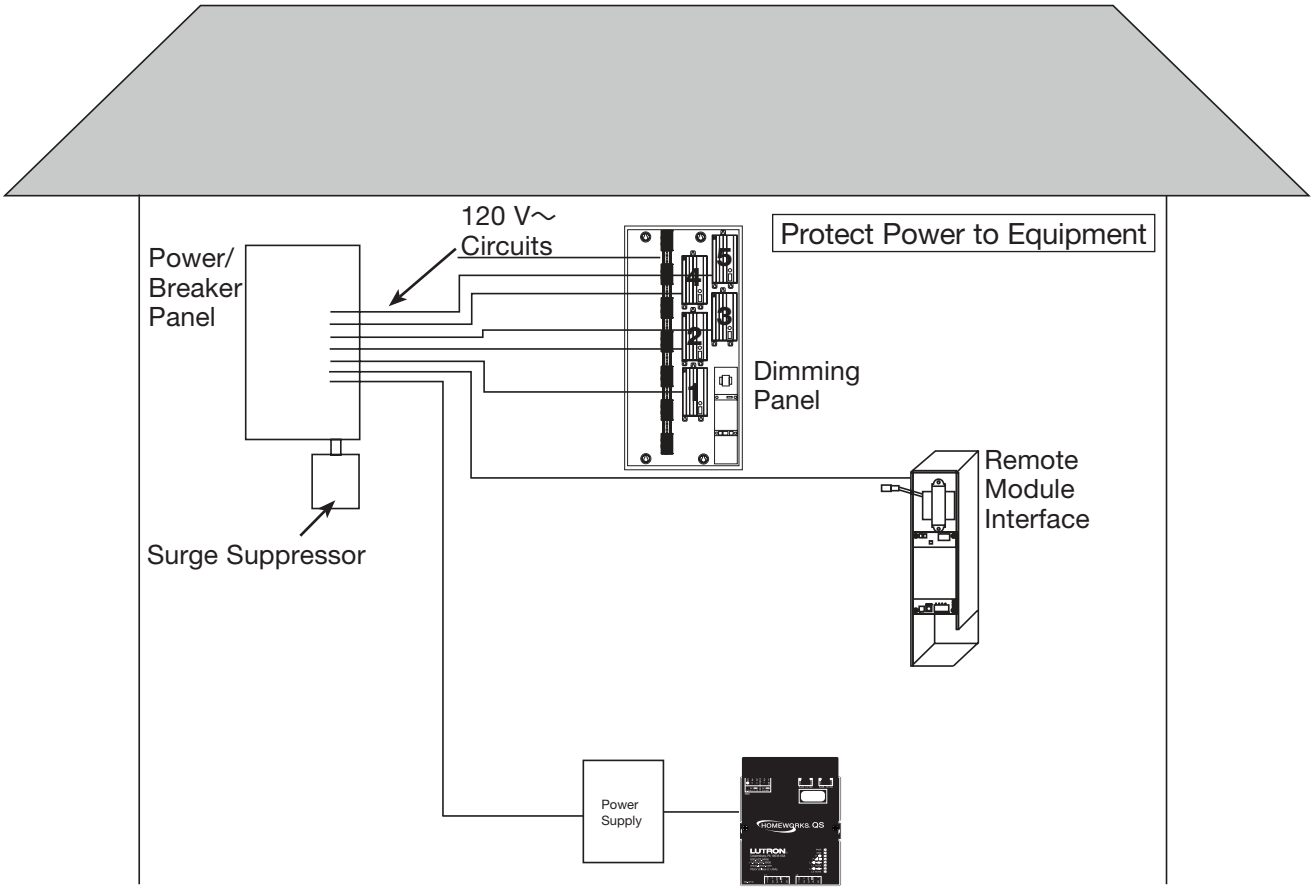
Note: 24-Terminal (12-pair), 12-terminal (6-pair), and 4-terminal (2-pair) devices are available. Choose model based on the number of RS-485 links and H48/D48 dimming busses to be protected. Same unit can be used for both dimming busses and links.

Line Voltage Protection

Breaker Panel Equipment Placement

Example: Connection to breaker panel.

Locate and install one surge suppressor at each breaker panel feeding HomeWorks QS processors, dimming modules, and remote module interface.

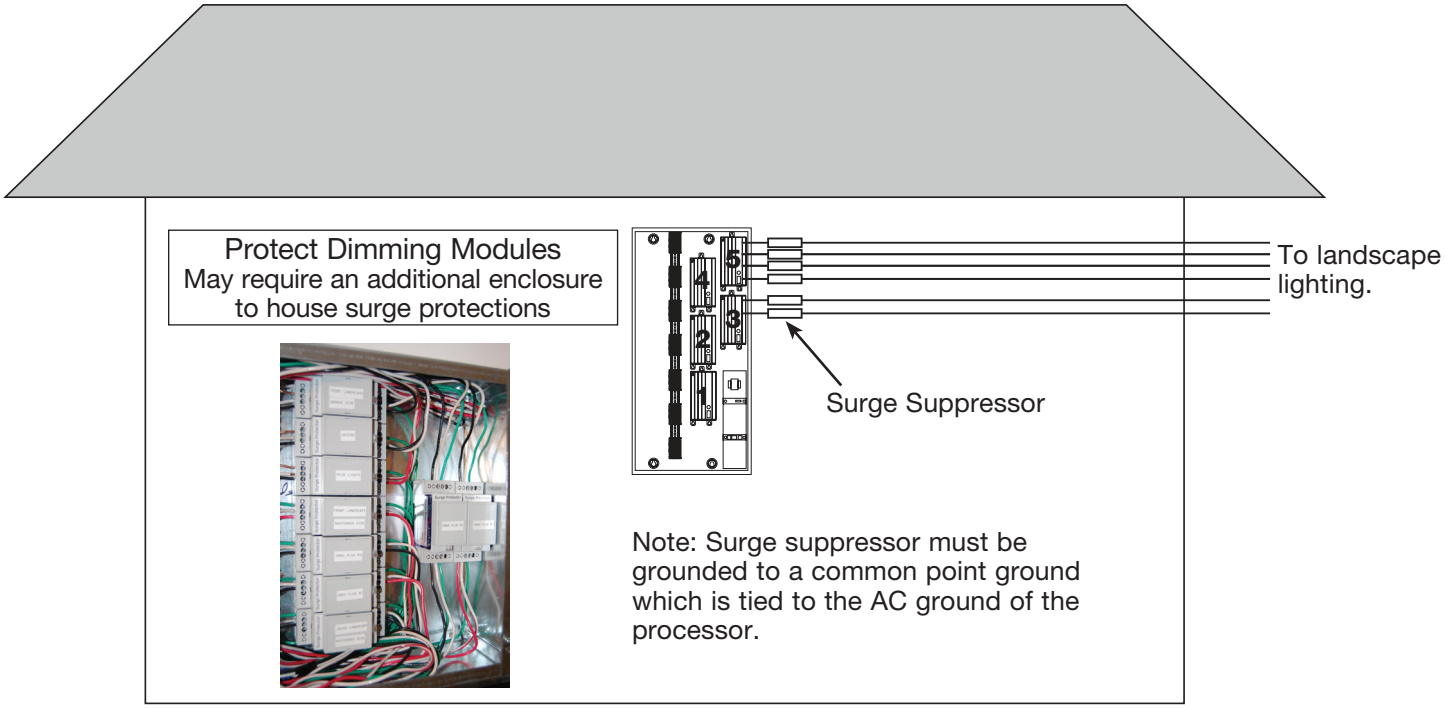


HomeWorks QS Power Supply and Processor

Line Voltage Protection

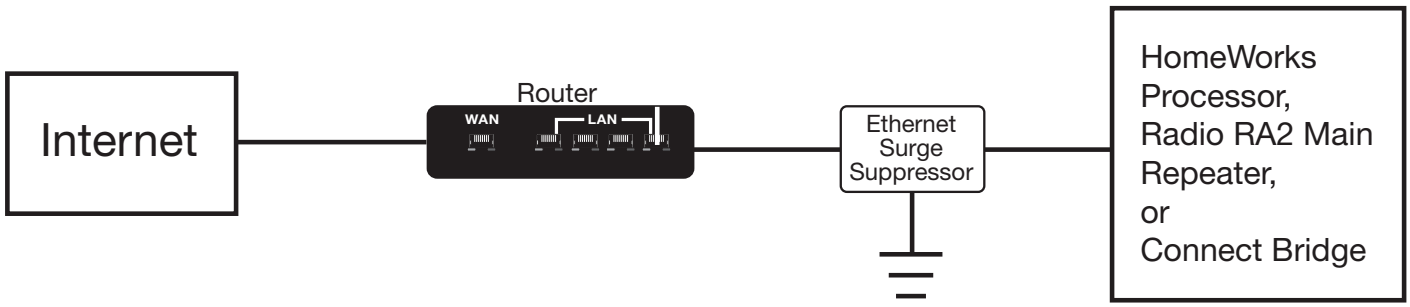
Dimming Module Equipment Placement

Example: Connection to 120 V~ landscape lighting or other exterior circuits.

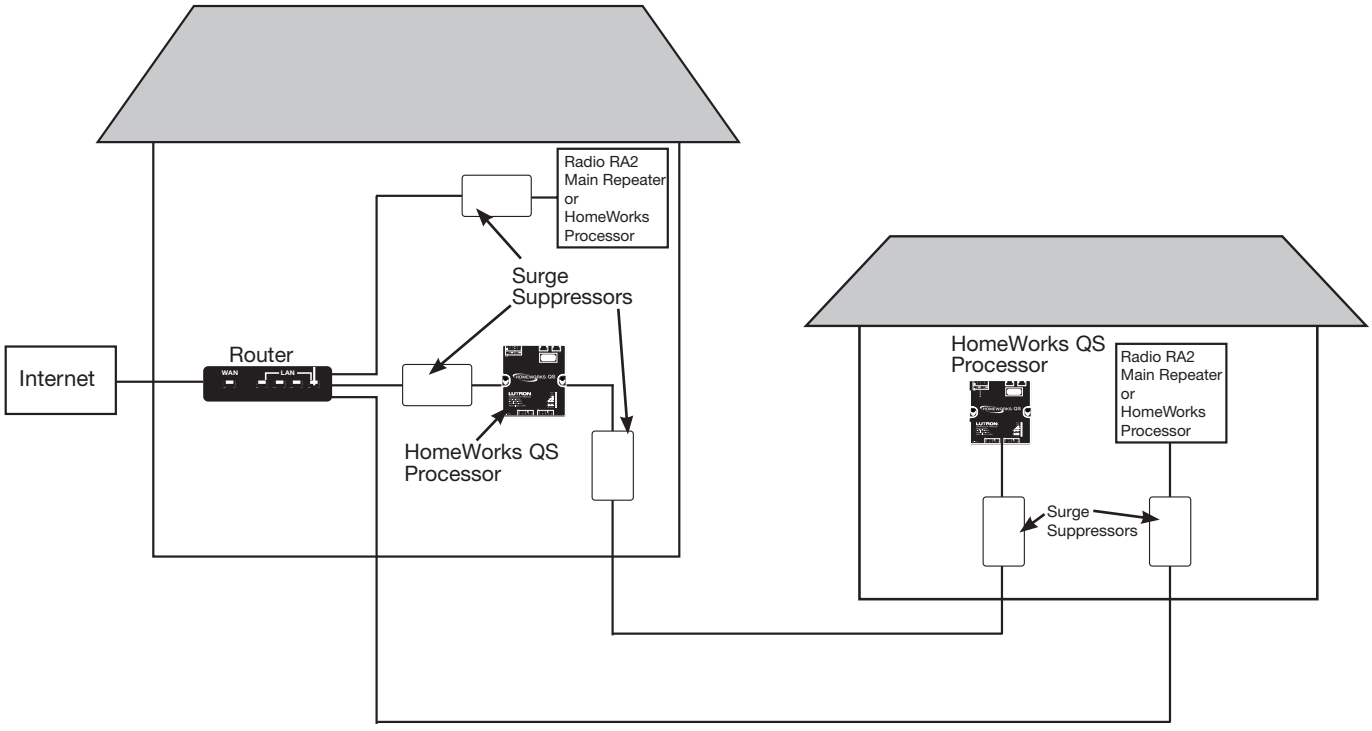


Ethernet Protection

Ethernet Equipment Placement - Single Building



Ethernet Equipment Placement - Multiple Buildings

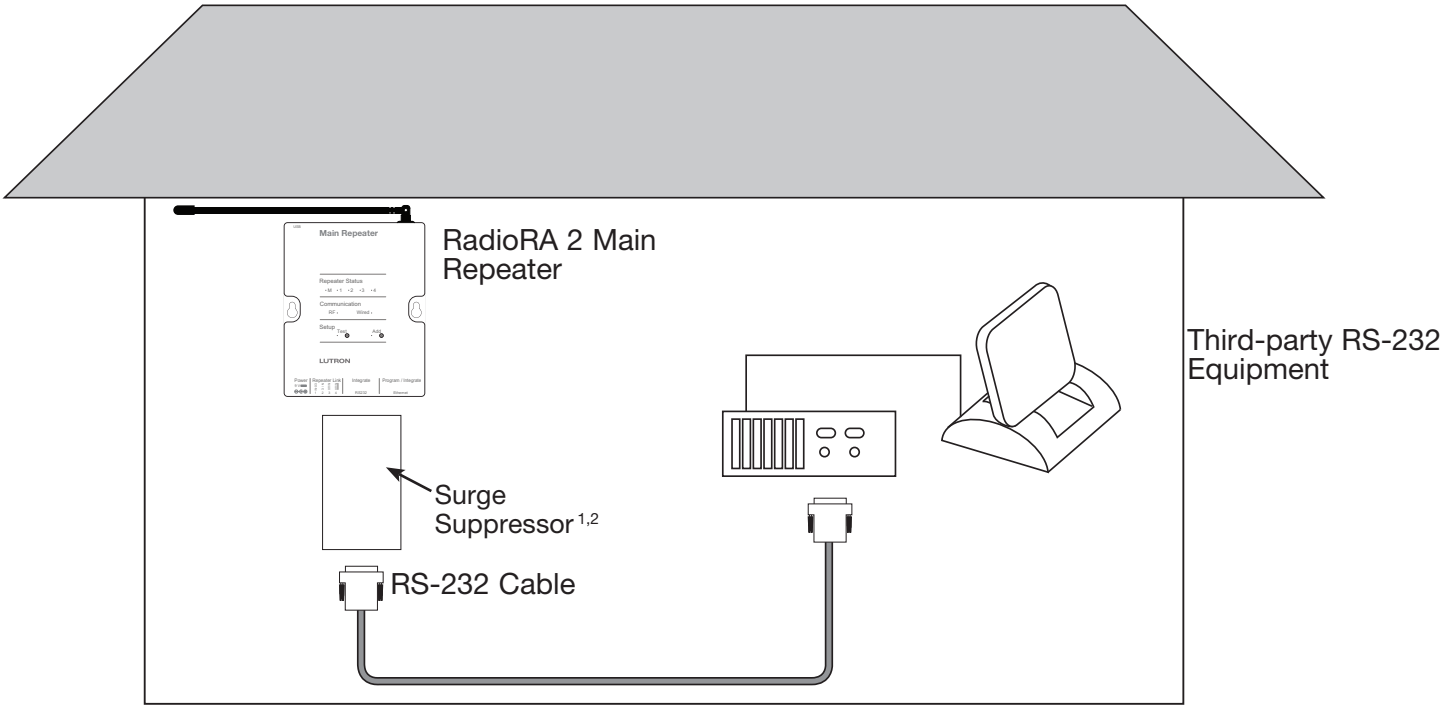


Notes:
A short, straight, common earth ground using a chassis or busbar connection MUST be made.
An adapter or additional cable may be needed for processors installed in certain enclosures.

RadioRA 2

RS-232 Equipment Placement

Example: Connection to third-party RS-232 equipment.



Notes:

[1] Surge suppressor must be grounded to a common point ground which is tied to the AC ground of the processor.

[2] An adapter cable may be required for some surge suppressors. The length of the adapter cable depends on the enclosure being used and where the suppressor is being located.

The following RS-232 surge arrestors install (plug in) in-line with DB-9 connectors:

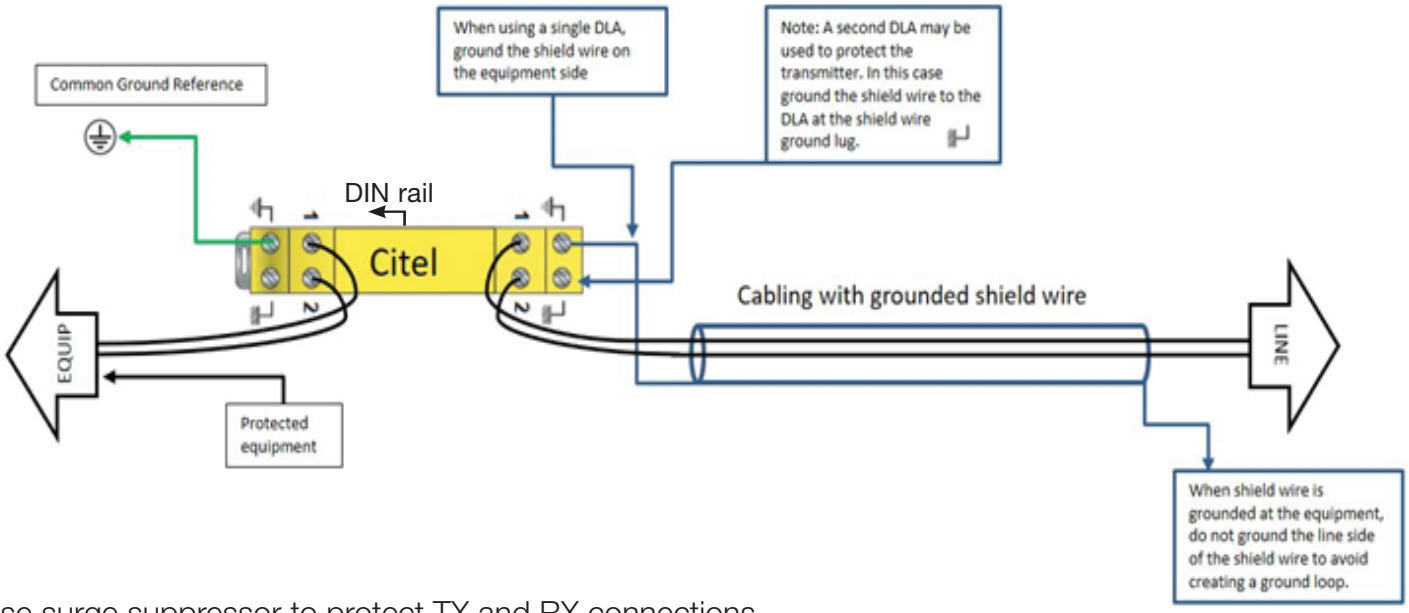
1. Manufacturer: Citel, Inc.
   Model Number: DD9-24V

2. Manufacturer: Total Protection Solutions, Inc.
   Model Number: TK-CT2-DB9-DIN2

3. Manufacturer: Transient Protection Design, Inc.
   Model Number: TPD-DB9

RadioRA 2 *(continued)*

Example: Using grounded shield RS-232 wire.

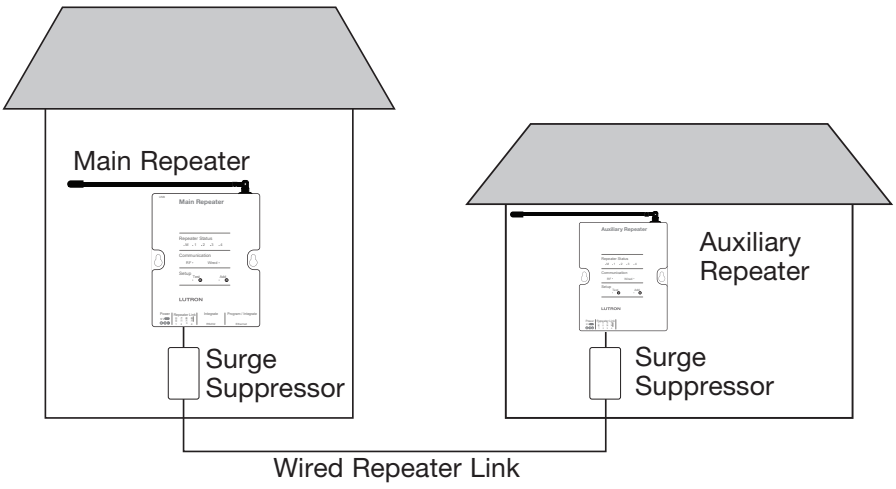


Use surge suppressor to protect TX and RX connections.

Manufacturer: Citel, Inc.
Model Number: DLA-12D3 (1 Pair)
DLC-12D3 (1 Pair Compact)

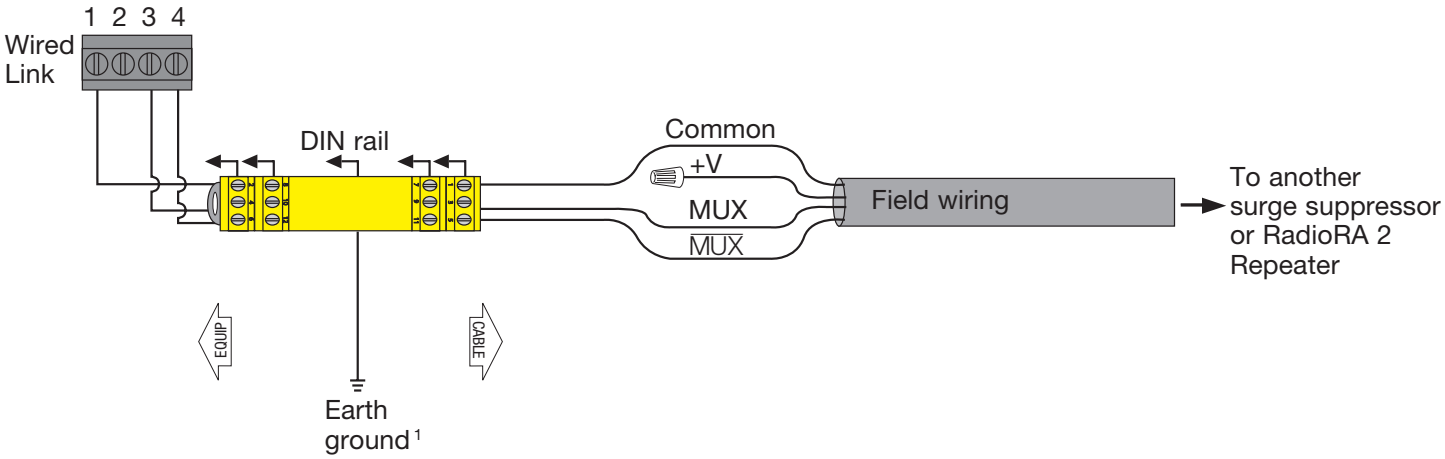
RS-485 Equipment Placement

Example: RadioRA 2 systems with low-voltage wire runs outside or between buildings.



RadioRA 2 *(continued)*

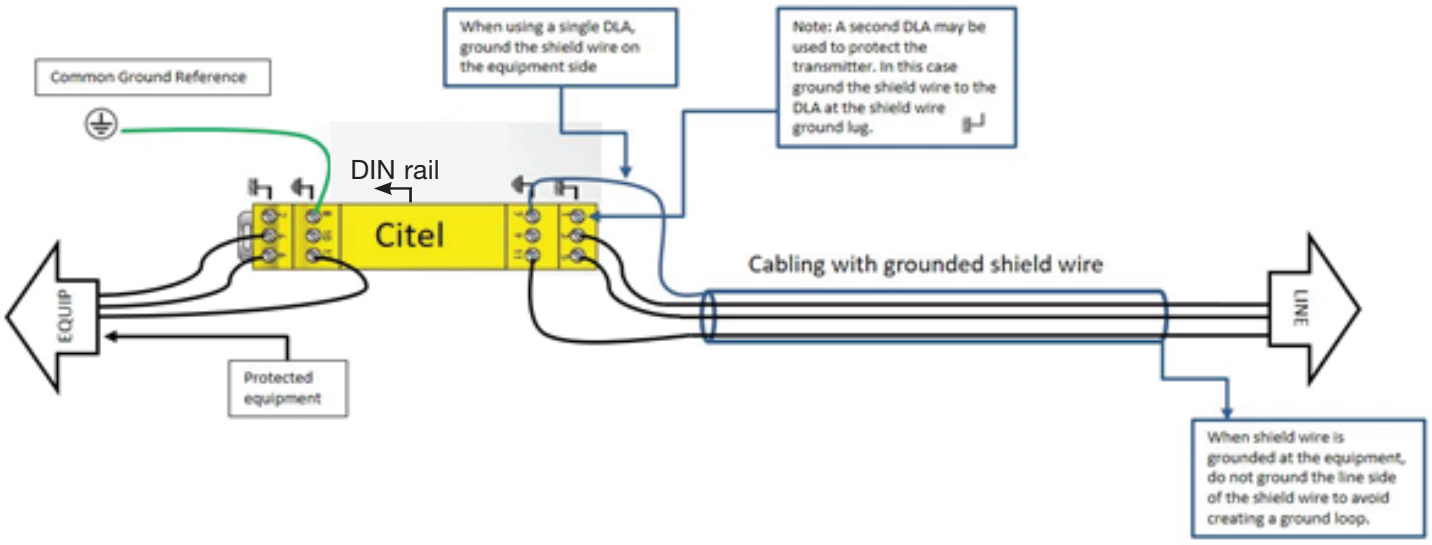
RS-485 Component Wiring Detail



Two pair surge suppressor shown. Connect 3-mux and 4-mux using connections for first pair. Connect 1-com to one terminal of second pair. Do not connect to terminal 2 on repeater. Cap off/insulate unused wire (shown as +V) from cable.

1 A short, straight, common earth ground using a chassis or busbar connection MUST be made.

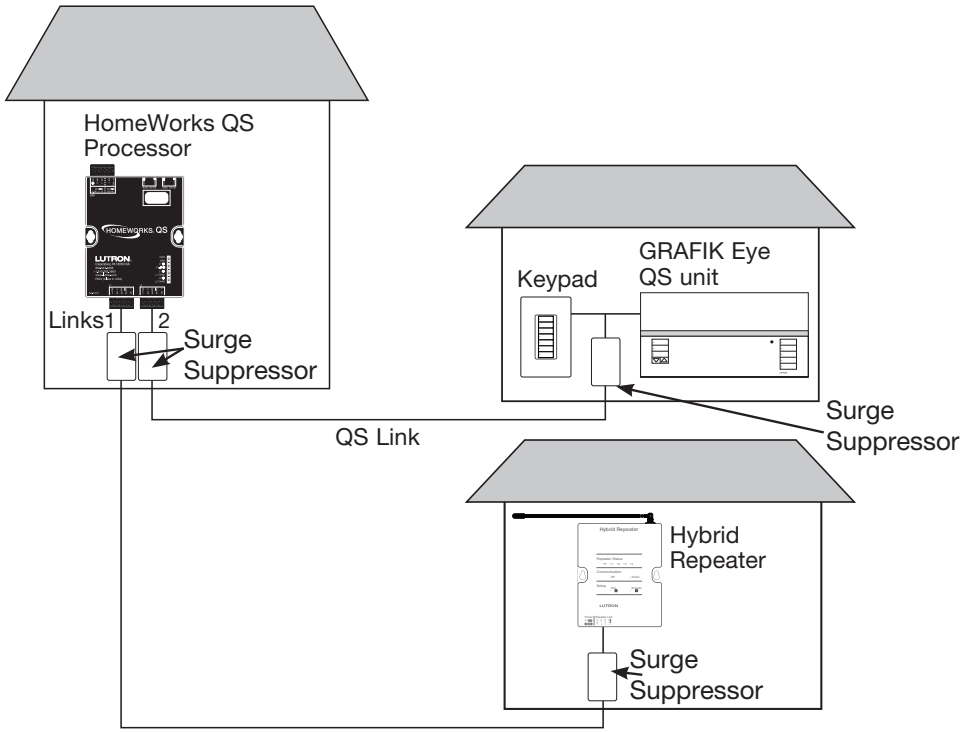
Example: Using grounded shield RS-485 wire.



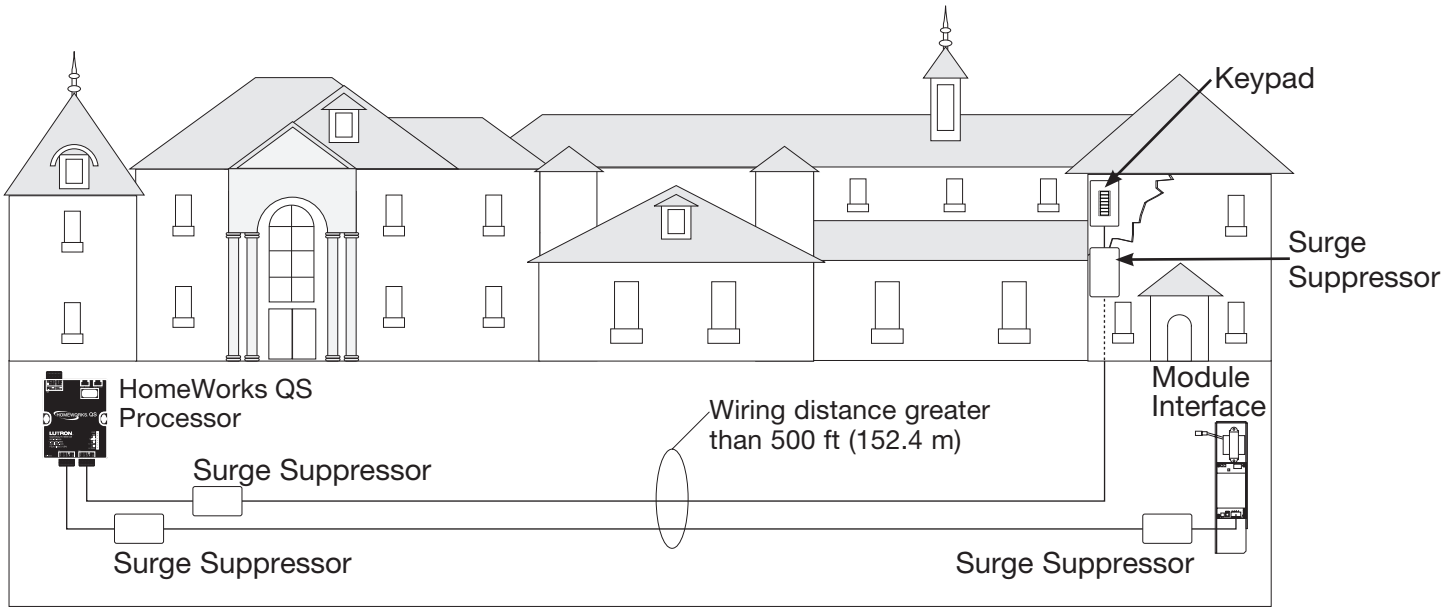
HomeWorks QS

RS-485 Equipment Placement

Example: HomeWorks QS systems with low-voltage wire runs outside or between buildings.



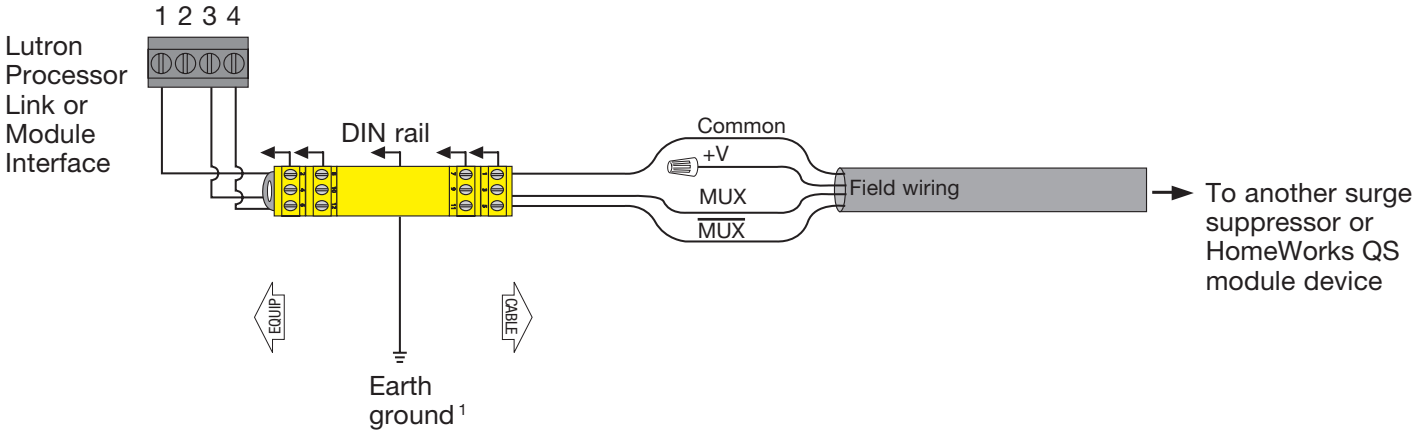
Example: System components that are wired greater than 500 ft (152.4 m) from the processor.



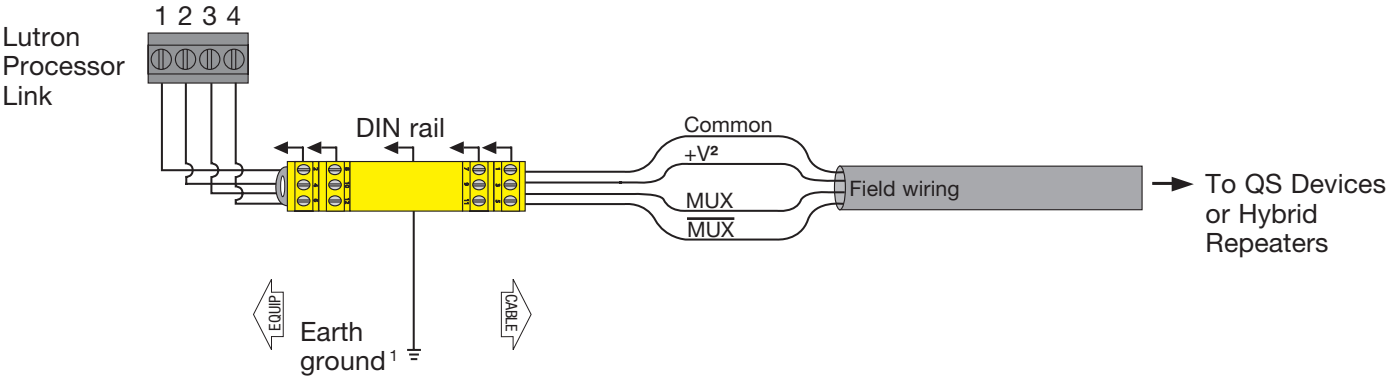
HomeWorks QS *(continued)*

RS-485 Component Wiring Detail

Example: Module Interface Link not powered by the processor. Do not connect +V, tape back/insulate this lead.



Example: QS Link or Hybrid Repeater Link.



Notes:

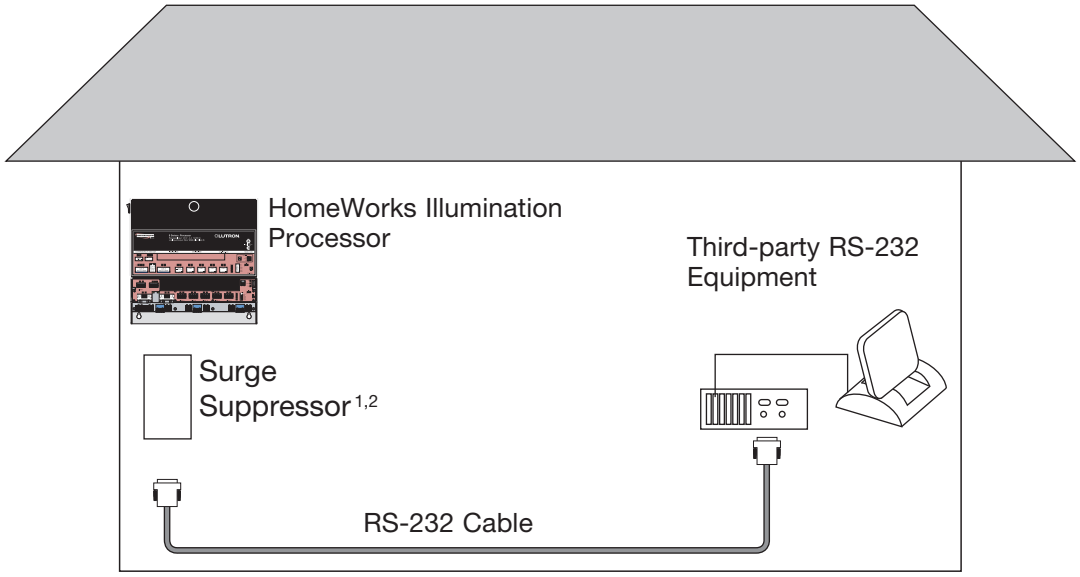
[1] A short, straight, common earth ground using a chassis or busbar connection MUST be made.

[2] Connect +V terminal only if the QS devices or Hybrid Repeater are being powered from the link and not from an external power supply or local transformer.

HomeWorks Illumination

RS-232 Equipment Placement

Example: Connection to third-party RS-232 equipment.



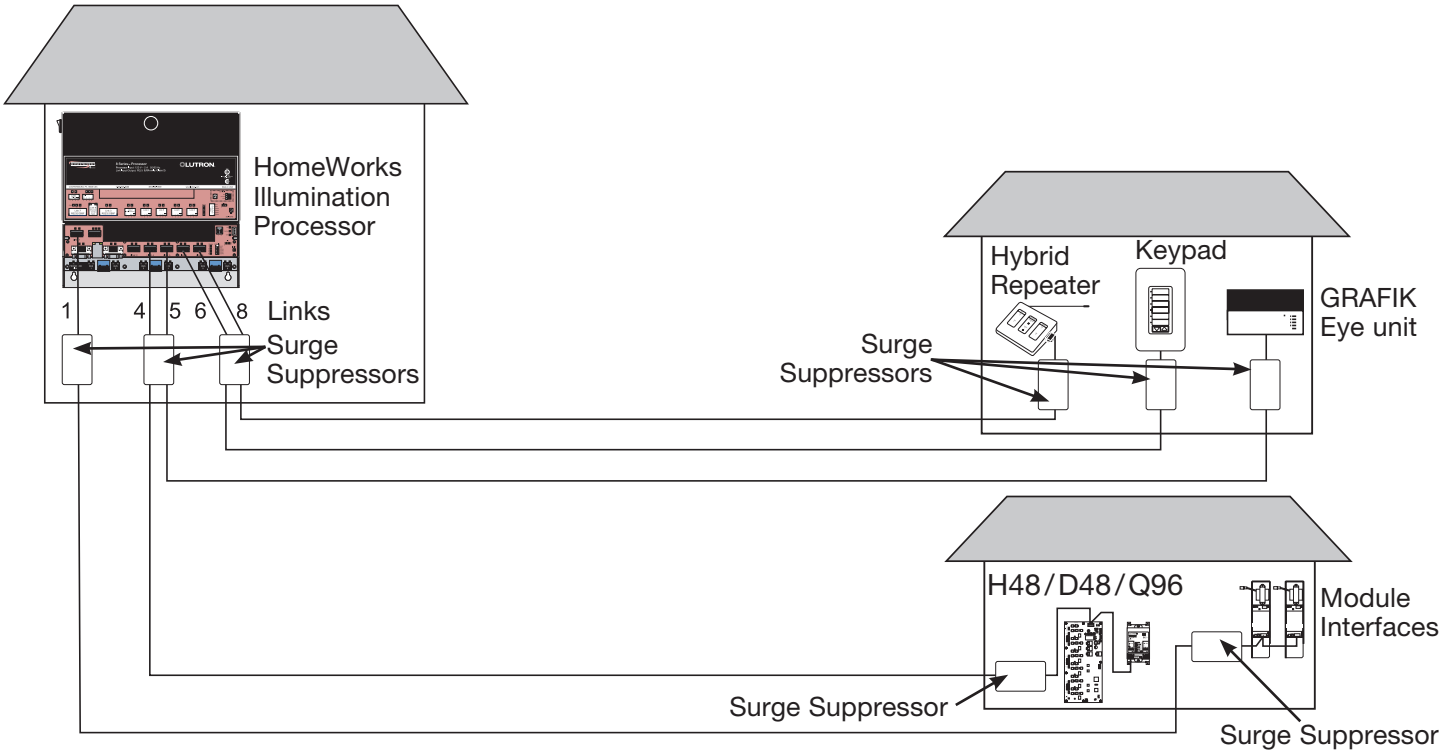
Notes:

[1] A short, straight, common earth ground using a chassis or busbar connection MUST be made.

[2] An adapter or additional cable may be needed for processors installed in certain enclosures.

RS-485 Equipment Placement

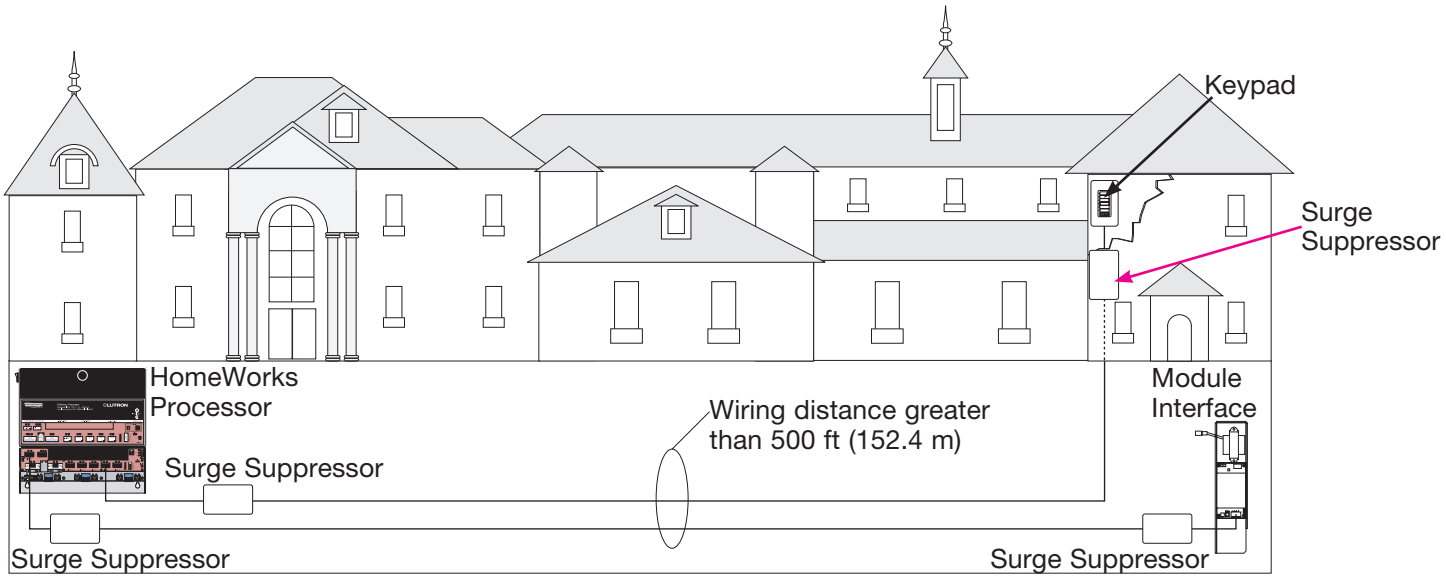
Example: HomeWorks Illumination systems with low-voltage wire runs outside or between buildings.



HomeWorks Illumination *(continued)*

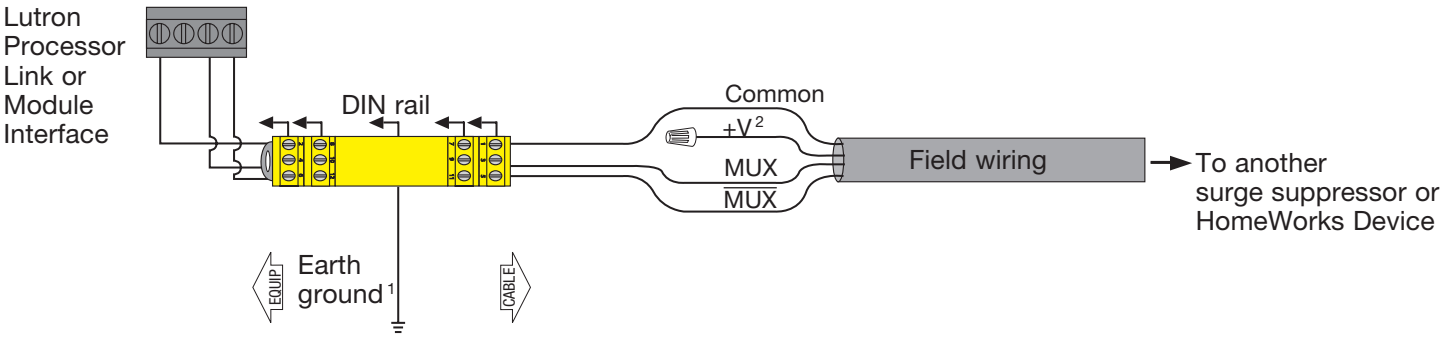
RS-485 Equipment Placement *(continued)*

Example: System components that are wired greater than 500 ft (152.4 m) from the processor.

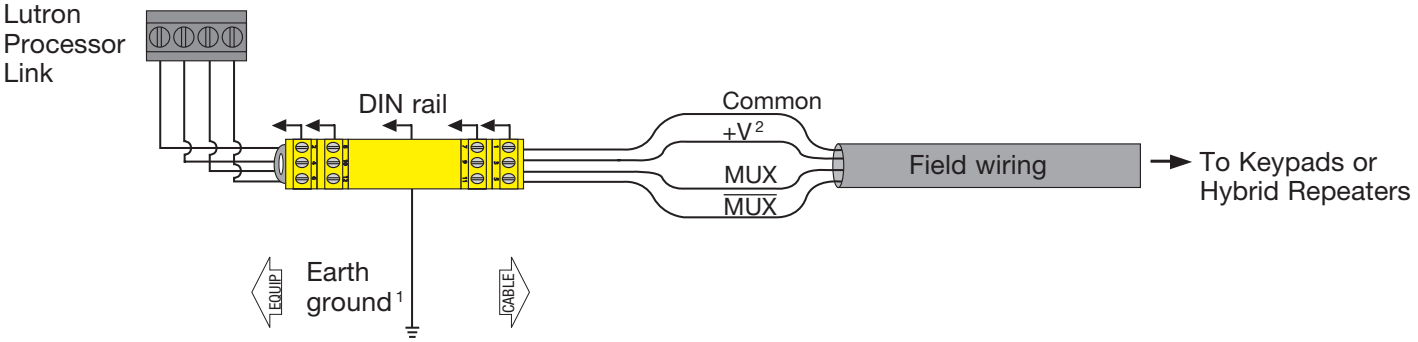


RS-485 Component Wiring Detail

Example: Inter-Processor Link, Module Interface Link, GRAFIK Eye Link, Shade Interface, Dimmer Interface not powered by processor. Do not connect +V, tape back/insulate this lead.



Example: Keypad Link, Hybrid Repeater Link.



Notes:

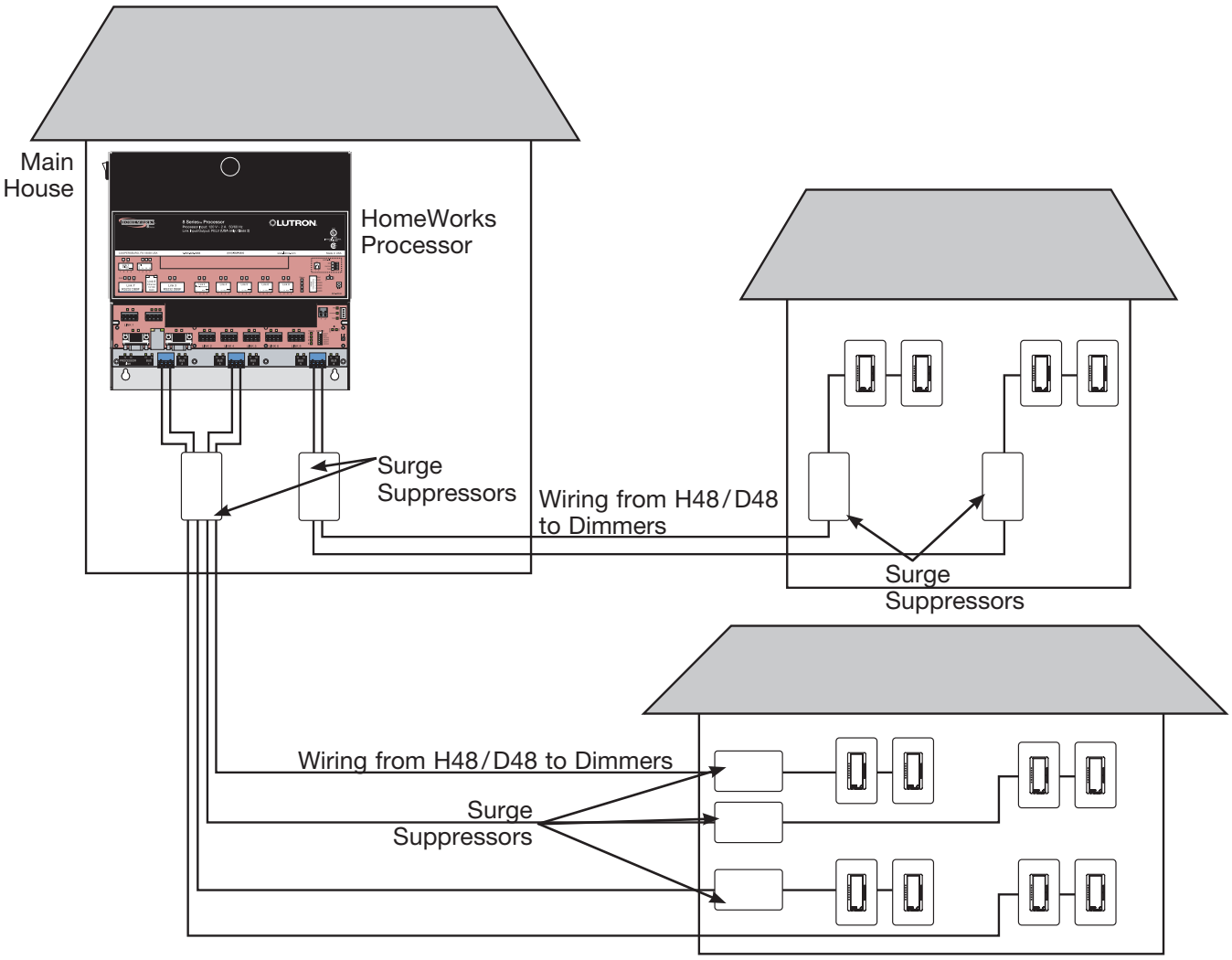
[1] A short, straight, common earth ground using a chassis or busbar connection MUST be made.

[2] Connect +V terminal only if the Keypads or Hybrid Repeater is being powered from the link and not from an external power supply or local transformer.

HomeWorks Illumination *(continued)*

H48/D48 Equipment Placement

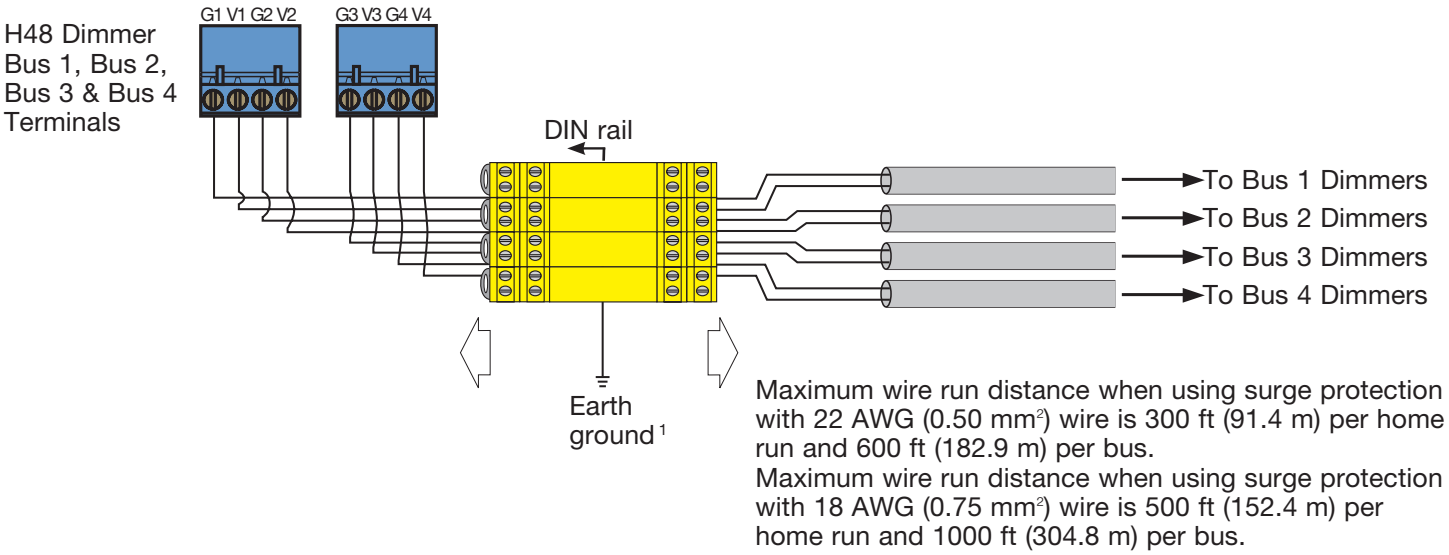
Example: Systems with HomeWorks Wired Dimmers located in other buildings.



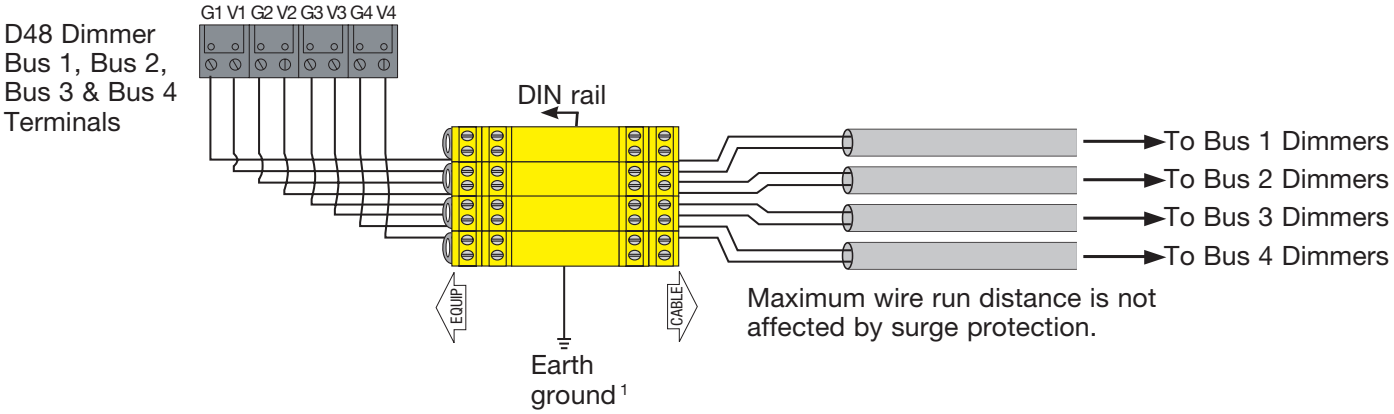
HomeWorks Illumination *(continued)*

H48/D48 Component Wiring Detail

Example: H48 Dimmer Busses.



Example: D48 Dimmer Busses.



Notes:

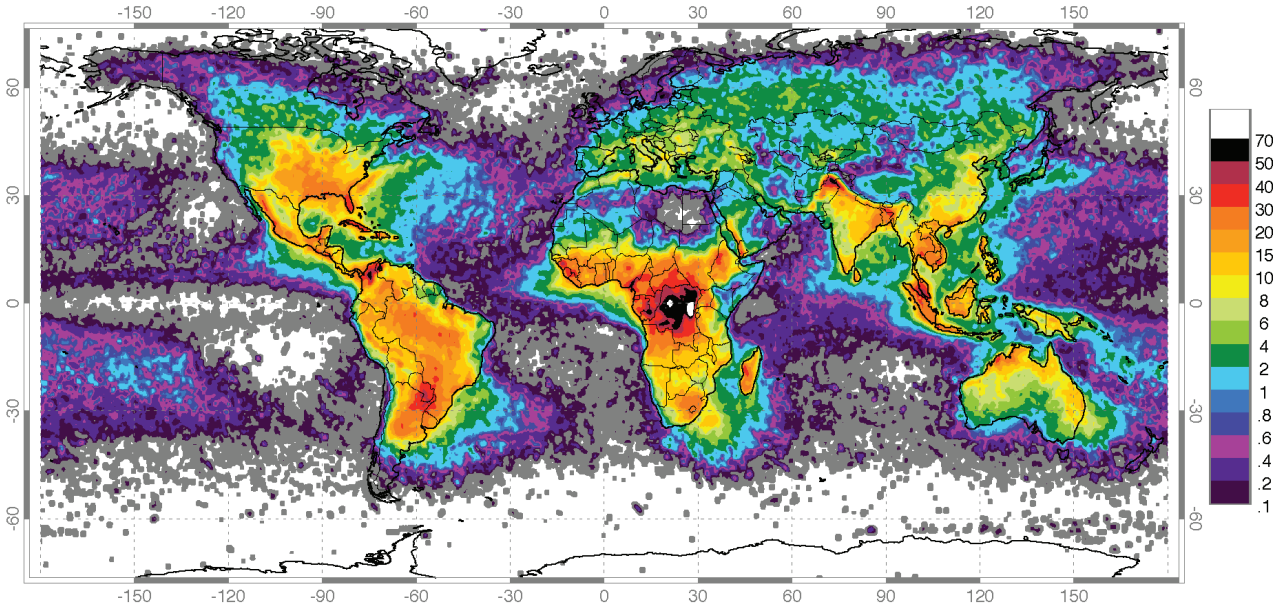
[1] A short, straight, common earth ground using a chassis or busbar connection MUST be made.

Lightning Strike Information

Lightning Protection Resources:

National Lightning Safety Institute: www.lightningsafety.com | Lightning Protection Institute: www.lightning.org

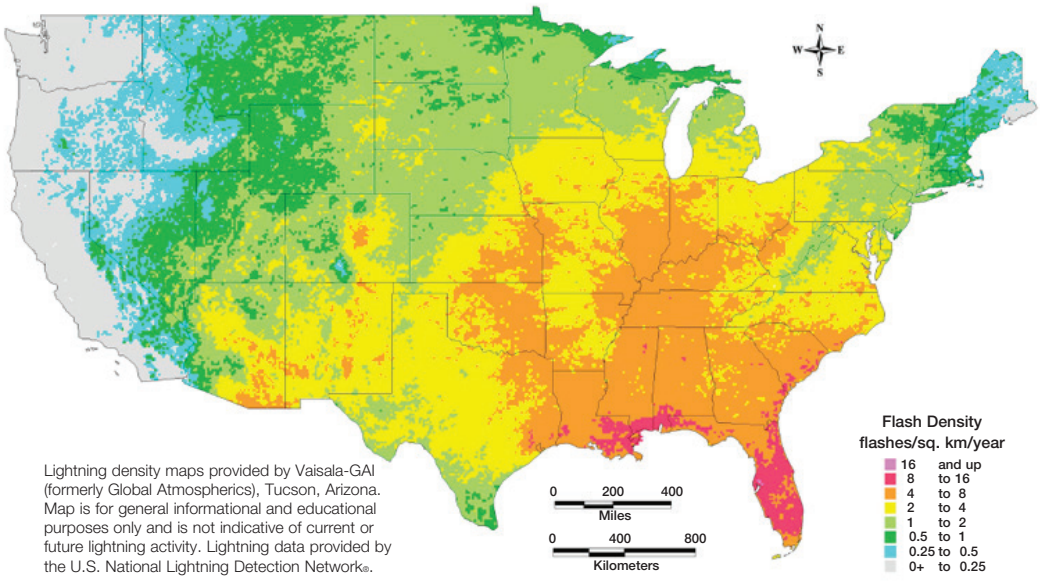
Global lightning distribution map

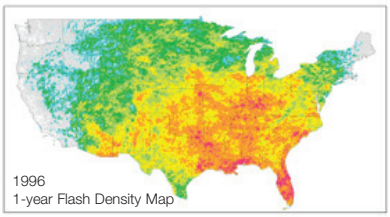


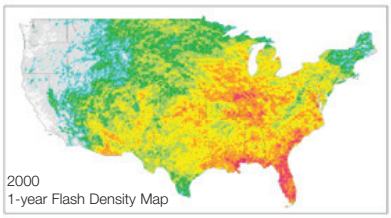
Low Resolution Full Climatology Annual Flash Rate

Global distribution of lightning April 1995 - February 2003 from combined observations of the NASA OTD (4/95-3/00) and LIS (1/98-2/03) instuments

U.S. lightning distribution map







The 5-year Flash Density Map shows the average amount of lightning recorded in 1996-2000. The average amount of lightning that occurs in any given area varies significantly from year to year, as shown in the annual maps for 1996 and 2000.

Contact Information

Citel, Inc.

10108 USA Today Way
Miramar, FL 33025 USA
Phone: +1.800.248.3548
Fax: +1.954.430.7785
Web: www.citel.us
Sales Email: sales@citel.us
Technical Support Email: engineering@citel.us

Citel, Inc. Parts List

Breaker Panel Protection
M50-120T-A
M100-120T

RS-232 Protection
DD9-24V RS-232 DB9 Protection
DLA-12D3 (1 Pair)
DLC-12D3 (1 Pair Compact)

RS-485 and H48/D48 Protection
B280-48D3 (2 Pair)
B480-48D3 (4 Pair)
DLA-48D3 (1 Pair)
DLA2-48D3 (2 Pair)
DLC-48D3 (1 Pair Compact)

Ethernet Protection
MJ8-CAT6S (CAT6/5e/5 non-PoE)

Transient Protection Design, LLC.

4311 William Penn HWY
Mifflintown, PA 17059
Phone: +1.888.281.7856
Fax: +1.717.436.8675
Web: https://transientprotectiondesign.com
Technical Support and Sales Email:
sales@TPDsurge.com

Transient Protection Design, LLC. Parts List

Breaker Panel Protection
TK-TTLP-1S240-FL Unlimited Amperage

Dimming Module Protection
TPD-DM120-20A Max 20 A Circuit
TPD-DM120-15A Max 15 A Circuit

RS232 Protection
TPD-DB9 RS232 DB9 Connection

RS-485 & H48/D48 Protection
TPD-36LIT24 (24 terminal/12 pair)
TPD-36LIT12 (12 terminal/6 pair)
TPD-36LIT4 (4 terminal/2 pair)

Total Protection Solutions, LLC

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Web: www.TPSsurge.com
Sales Email: Maureen@TPSsurge.com
Technical Support: Bob@TPSsurge.com

Total Protection Solutions, LLC Parts List

Breaker Panel Protection
TK-TTLP-1S240-FL Unlimited Amperage

Dimming Module Protection
TK-LT120-20A-DIN2 Max 20 A Circuit
TK-LT120-15A-DIN2 Max 15 A Circuit

RS232 Protection
TK-CT2-DB9-DIN2 RS232 DB9 Connection

RS-485 & H48/D48 Protection
TK-CT2-36LIT24 (24 terminal/12 pair)
TK-CT2-36LIT12 (12 terminal/6 pair)
TK-CT2-36LIT4 (4 terminal/2 pair)

Lutron Contact Numbers

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