



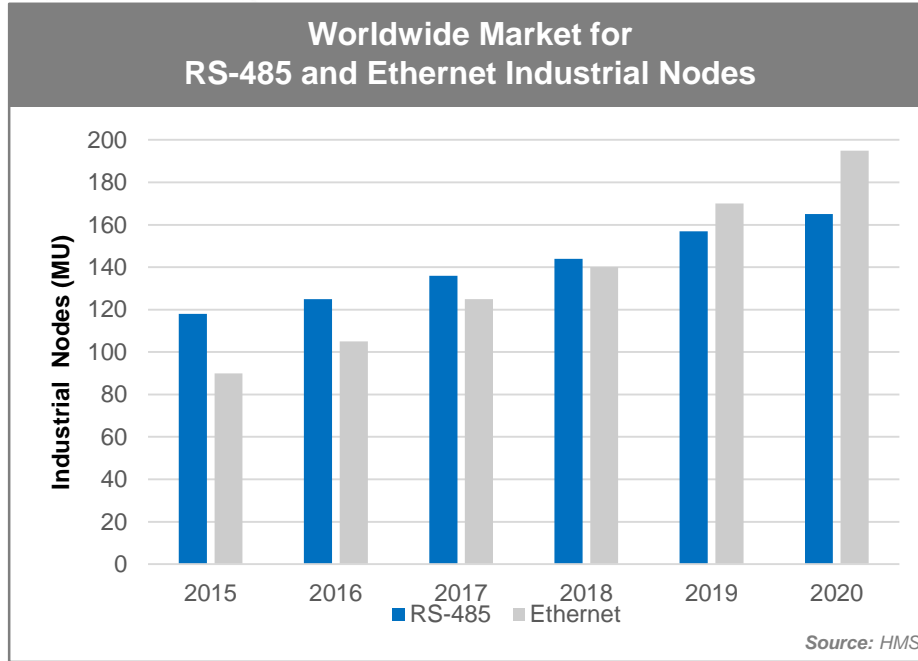
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# Industrial Communication and Control Protection: RS-485 and Ethernet

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Industry 4.0

# Over 330M industrial data nodes deployed, and growing



Key Feature	Industrial Ethernet	RS-485
Capable of driving Multiple Ports	Yes	Yes
Noise Immunity	Differential pair	Differential pair
Common Jack	RJ45	No
Fast Speed	100Mbps 1Gbps	10Mbps Max
Network Capability	Yes	NA
Power Delivery	PoE (15.4 W) PoE+ (30 W)	NA
Long Distance Transmission	100 meters	1500 meters

RS-485 has been historic standard but ethernet has grown due to data transfer capabilities

# Distance and data speed influence protocol selection



RS-485

Increased Distance



Remote I/O



Energy Meter



Factory Automation



Security System



Programmable Logic Controller



Wind Control



Human Machine Interface



Test Equipment



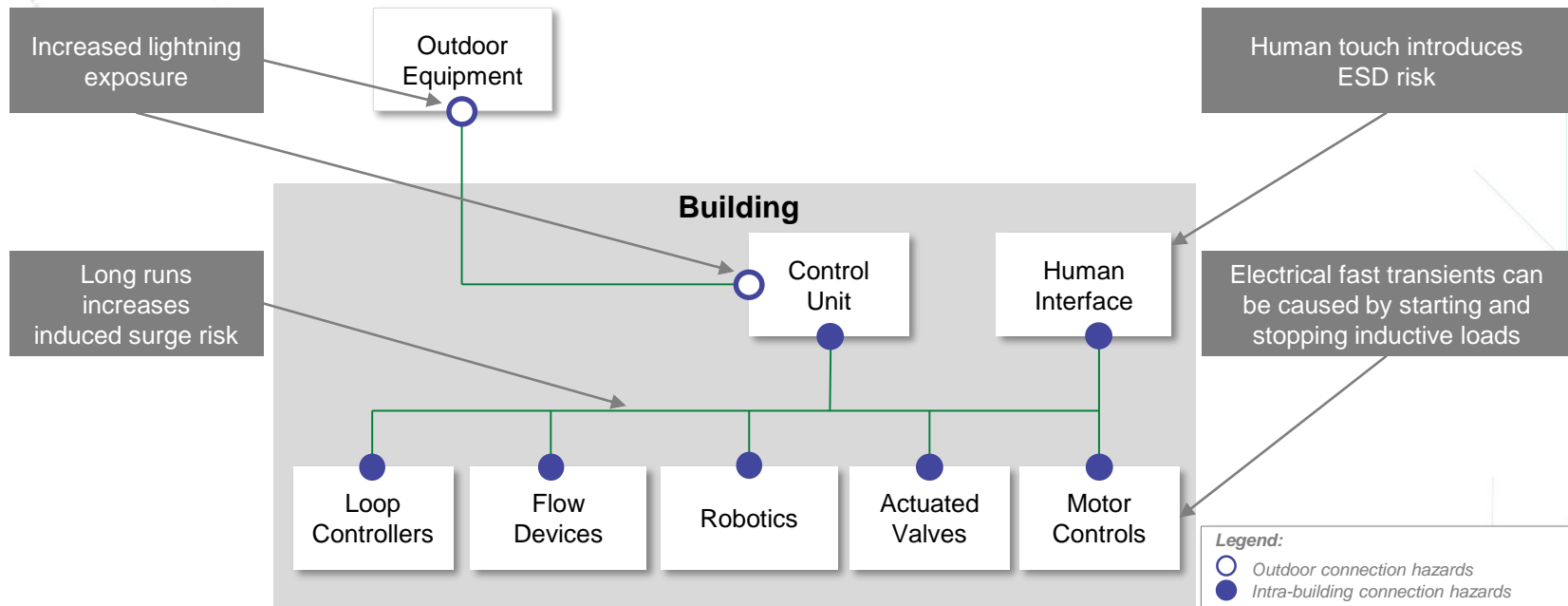
Machine Vision



Industrial Ethernet

Increased Data Speed

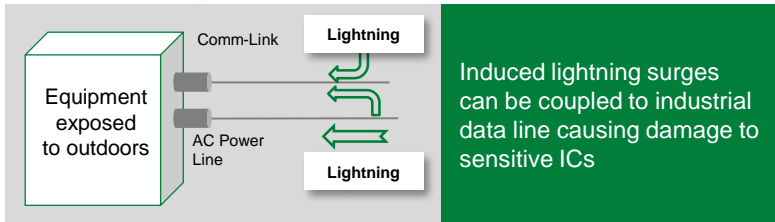
# Environment impacts protection needs



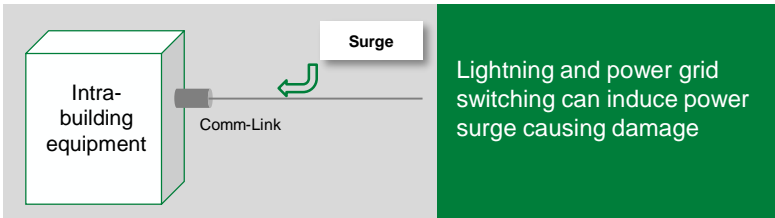
Each port requires protection from exposure to electrical hazards for long term reliability

# Electrical threats to RS-485 and ethernet

## Lightning surges



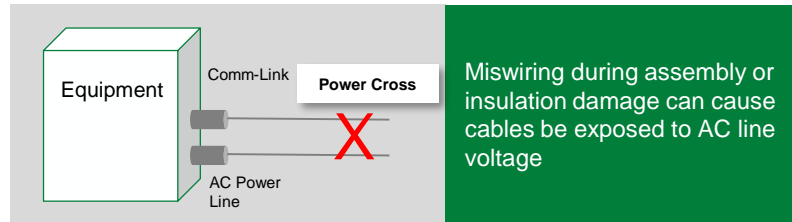
## Induced power surge



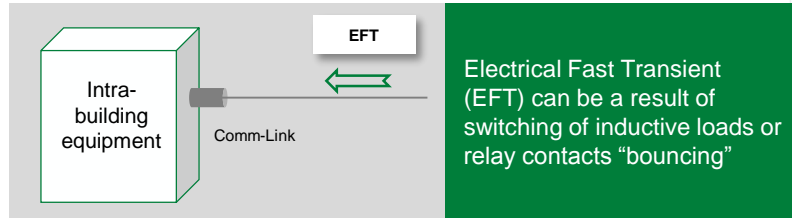
## Electrostatic discharge



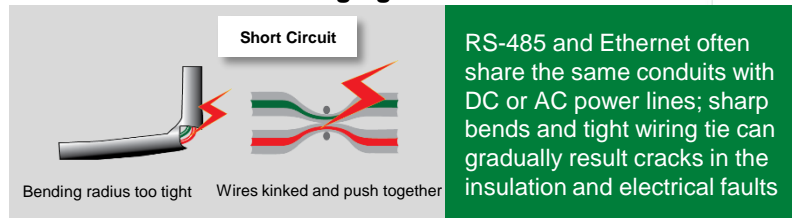
## Power cross



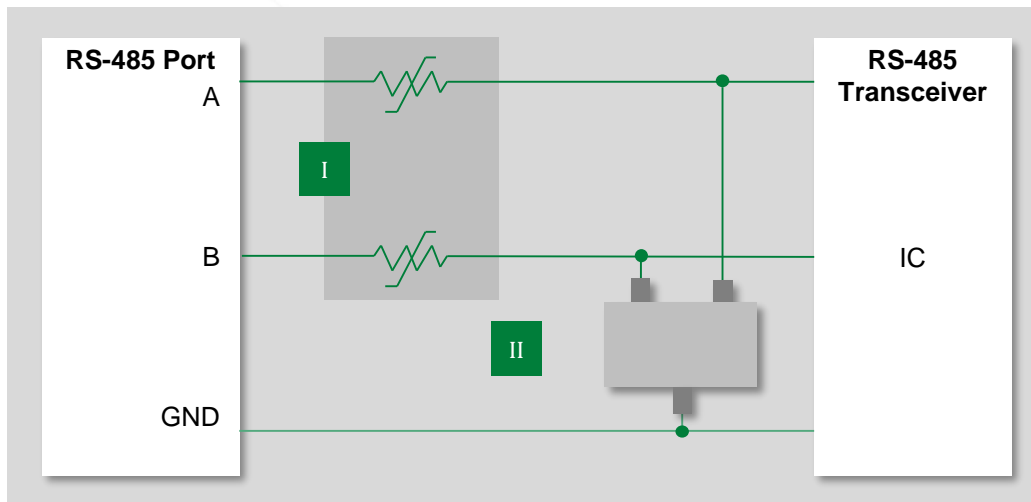
## Electrical fast transient



## Short circuit due to wire aging and installation



# Intra-building protection recommendations – RS-485



	Technology	Series
<b>I</b>	Resettable PPTC	<a href="#">TRF250/600</a> , <a href="#">TS250</a> , <a href="#">TSV250</a>
<b>II*</b>	TVS Diode	<a href="#">SM712</a>

**Note:**

\* Pulse-Guard ESD Suppressors type PGB/XGD are an alternative solution.

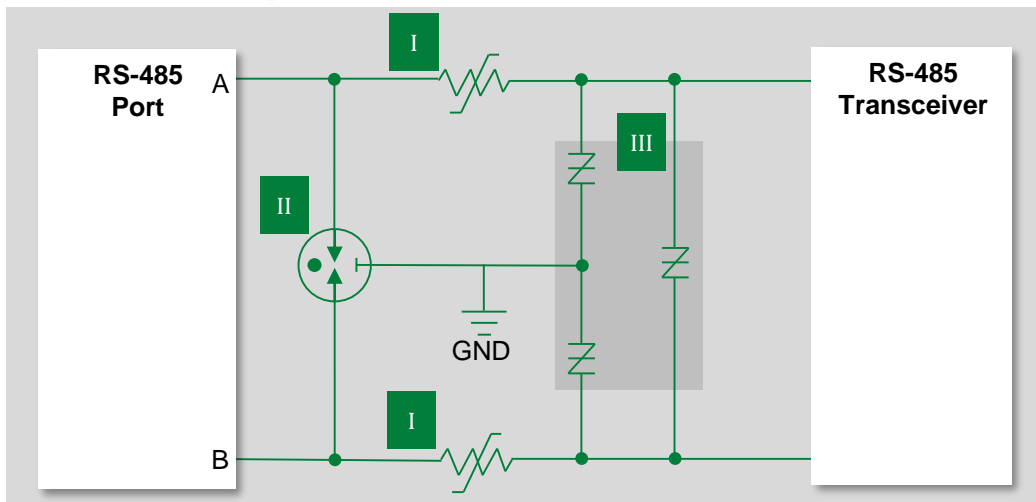
**Applicable Standards:**

- IEC 61000-4-2 (ESD)
- IEC 61000-4-4 (EFT)
- IEC 61000-4-5 (Lightning)
- ITU K.20 Internal Ports & YD/T 950-1998
- ITU K.21 Internal Ports & YD/T 950-1998
- GR 1089 Intra-Building (Type 2)
- UL 60950-1/IEC60950-1, EN60950-1

**I** Resettable PPTC can increase up-time by helping to protect equipment from short circuit and power cross event.

**II** TVS Diode Array, SM712, is specifically designed to help protect RS-485 applications from ESD, EFT, and lightning induced surges.

# Outdoor and harsh environments – RS-485



	Technology	Series
I	Resettable PPTC	<a href="#">TRF250/600</a> , <a href="#">TS250</a> , <a href="#">TSV250</a>
II	GDT	<a href="#">GTCxx</a>
III	SIDACTor	<a href="#">Pxxx0s</a>

#### Applicable Standards:

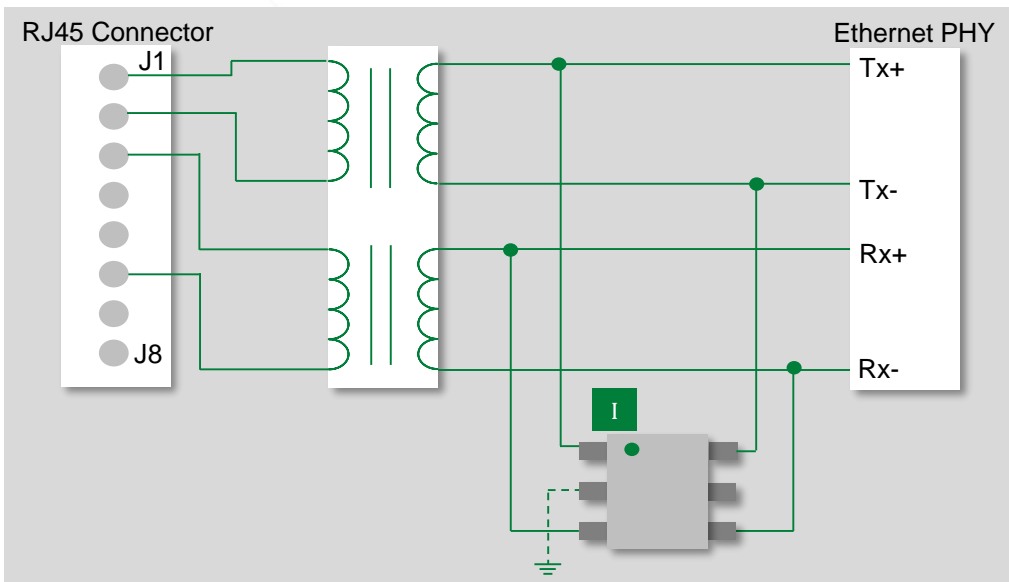
- IEC 61000-4-2 (ESD)
- IEC 61000-4-4 (EFT)
- IEC 61000-4-5 (Surge)
- ITU K.20 Internal Ports & YD/T 950-1998
- ITU K.21 Internal Ports & YD/T 950-1998
- GR 1089 Intra-Building (Type 2)
- UL 60950-1/IEC60950-1, EN60950-1

**I** Resettable PPTC can increase up-time by helping to protect equipment from short circuit and power cross event.

**II** Lightning protection utilizing a Gas Discharge Tube, GDT, with SIDACTor. When lightning occurs the SIDACTor will react first causing voltage to increase across PPTC until GDT fires. Resistance of PPTC must be selected carefully for proper coordination.

**III**

# Intra-building protection for Ethernet



Note: 1Gbps or greater will require an additional two twisted pair and the diode array solution should be replicated.

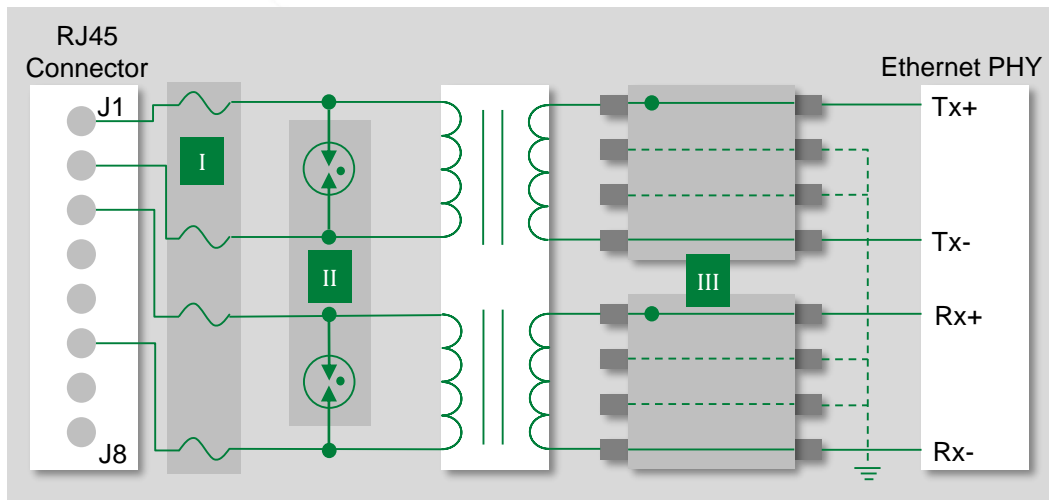
	Technology	Series
I	Diode Array	<a href="#">SRV05xx</a>

#### Applicable Standards:

- IEC 61000-4-2 (ESD)
- IEC 61000-4-4 (EFT)
- ITU (ESD Section)
- GR 1089 (ESD & EFT Sections)
- YD/T 950 & 1082
- UL 60950-1/IEC60950-1, EN60950-1

I Port protected from ESD and EFT. Lightning is not a concern in this application. Low capacitance diode array is needed for high data transmission speeds.

# Outdoor and harsh environment – Ethernet



	Technology	Series
I	Fuse	<a href="#">0461xxx</a>
II	GDT	<a href="#">SG</a> , <a href="#">CG6</a> , & <a href="#">CG5</a>
III	Diode Array	<a href="#">LC03xx</a> or <a href="#">SP40xx</a>

**Note:**

\* PPTC Devise such as T-Line (Telecom Line PPTC)

**Applicable Standards:**

- IEC 61000-4-2
- IEC 61000-4-4
- IEC 61000-4-5
- ITU K.20, K.21
- GR 1089
- UL 60950-1/IEC60950-1, EN60950-1

I

Telelink fuses can help protect power fault overcurrent. These fuses are designed specifically for high speed telecom applications. A single fuse per wire pair is sufficient.

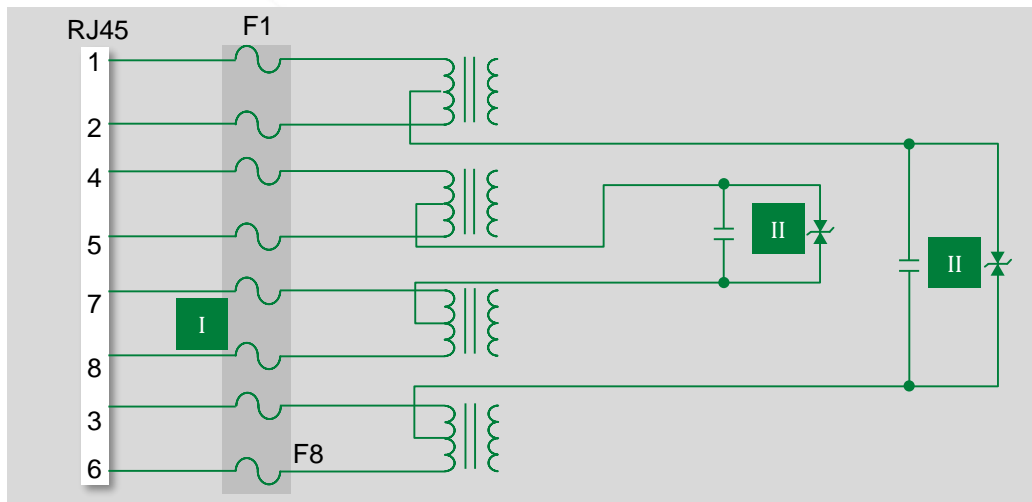
II

Lightning protection utilizes GDT with diode array to meet standard requirements. Class rating and external wiring configuration will determine

III

specific protection needed but an example would be (4kV/2kA, 1.2/50µs-8/20µs) .

# Lightning, ESD, and power fault protection – PoE



	Technology	Series
I*	Fuse	<a href="#">0461xxx</a>
II	TVS Diode	<a href="#">SMCJxxCA</a>

**Note:**

\* PPTC Devices such as T-Line (Telecom Line PPTC)

**Applicable Standards:**

- IEC 61000-4-2 (ESD)
- IEC 61000-4-4 (EFT)
- IEC 61000-4-5 (Class 0-4)
- ITU K.20 Internal Ports & YD/T 950-1998
- ITU K.21 Internal Ports & YD/T 950-1998
- GR 1089 Intra-Building (Type 2)
- UL 60950-1/IEC60950-1, EN60950-1

**I** Telelink fuses can help protect power fault overcurrent. These fuses are designed specifically for high speed telecom applications.

**II** A single TVS diode (bi-directional) across the center tap signal pair and second TVS diode across the center tap spare pair. The TVS diode can be chosen based surge requirements for 400W, 600W, 1500W or 3000W.

# Key links

- Ethernet Protection Design Guide:  
<https://www.digikey.com/en/pdf//littelfuse/littelfuse-ethernet-protection-guide>
- Fuseology Selection Guide:  
<https://www.digikey.com/en/pdf//littelfuse/fuseology-selection-guide>
- Electrostatic Discharge (ESD) Suppression Design Guide:  
<https://www.digikey.com/en/pdf//littelfuse/esd-protection-tvs-diode-arrays>
- Circuit Protection Solutions:  
<https://www.digikey.com/en/pdf//littelfuse/electronics-circuit-protection>
- General:  
[www.littelfuse.com](http://www.littelfuse.com)

# Reliability requires industrial communication protection

- RS-485 and ethernet nodes are projected to expand to 330 million by 2020
- RS-485 is generally used for longer-distance communication & control links
- Industrial Ethernet is most suitable where fast data transmission is needed
- Equipment environment and standards will determine required protection
- Lightning, ESD, EFT, inductive surges, and shorts are potential threats
- Fuses, PPTCs can be used for overcurrent protection and TVS diodes, GDTs, and SIDACtors can be used for overvoltage protection.



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