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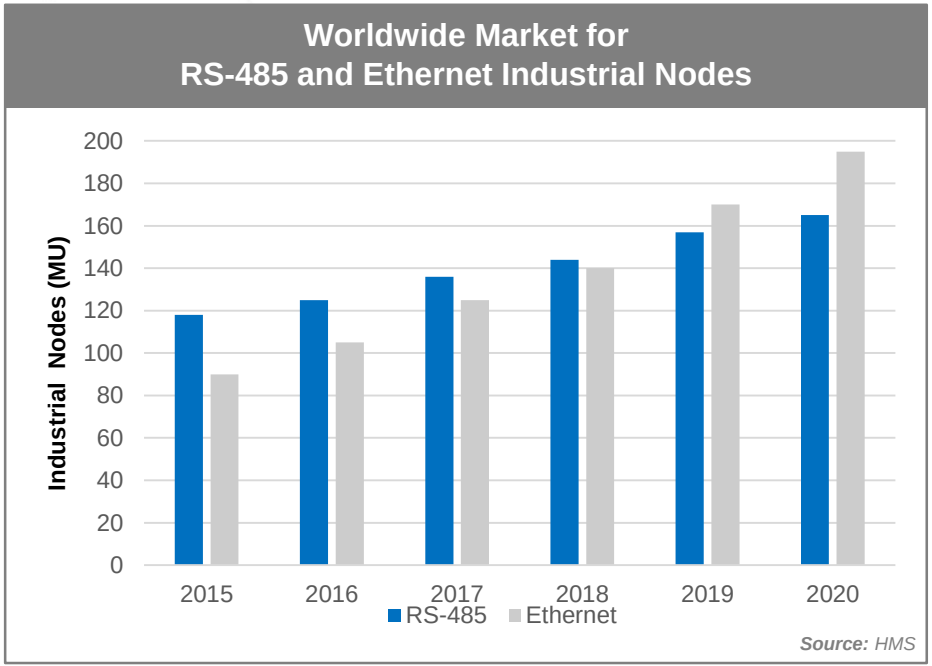
Industrial Communication and Control Protection: RS-485 and Ethernet

Industry 4.0

REV0319

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

Remote I/O

Energy Meter

Factory Automation

Security System

Programmable
Logic Controller

Wind Control

Human Machine
Interface

Test Equipment

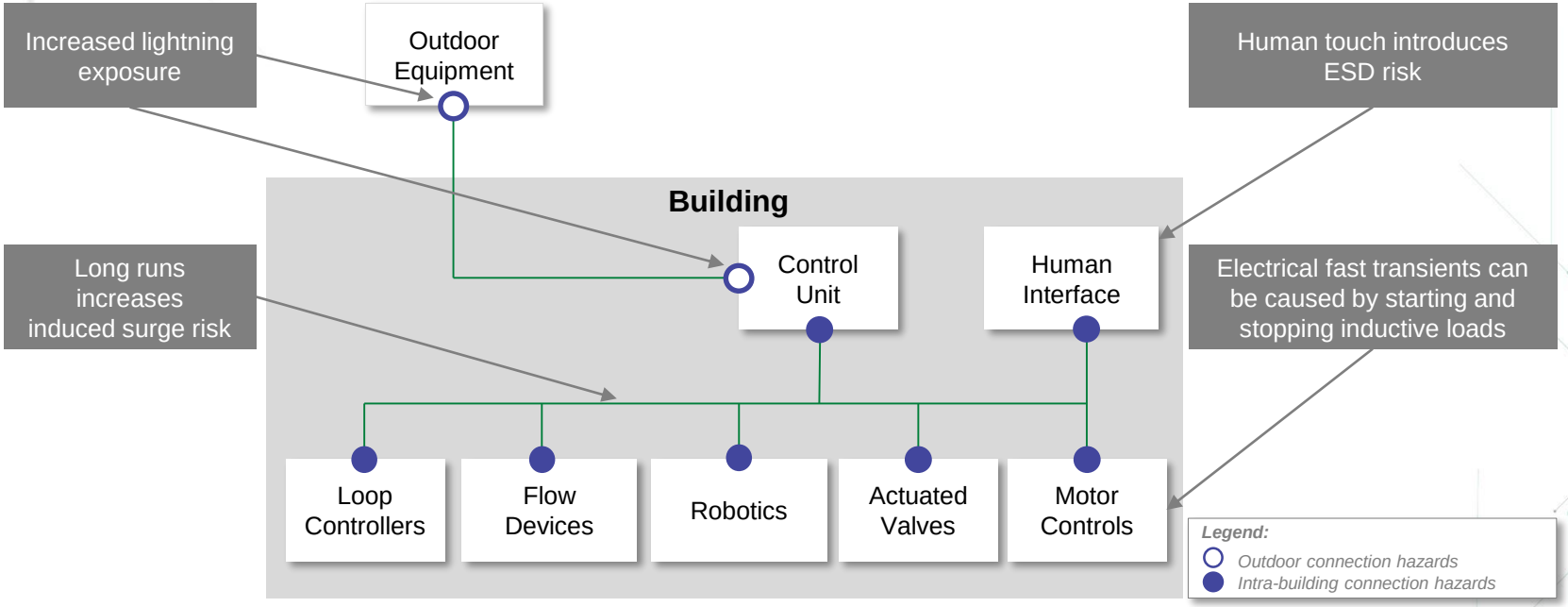
Machine Vision

Industrial Ethernet

Increased Distance

Increased Data Speed

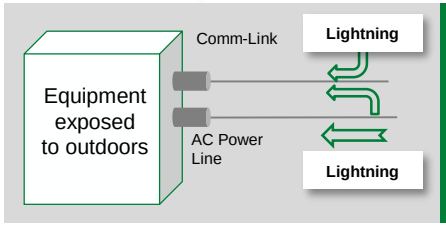
Environment impacts protection needs



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

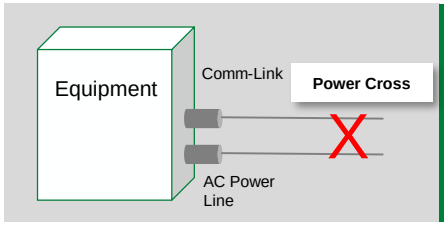
Electrical threats to RS-485 and ethernet

Lightning surges



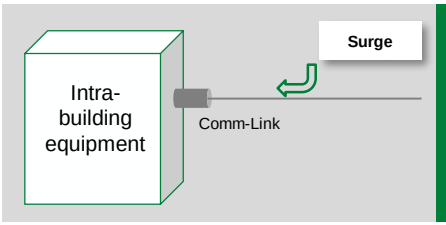
Induced lightning surges can be coupled to industrial data line causing damage to sensitive ICs

Power cross



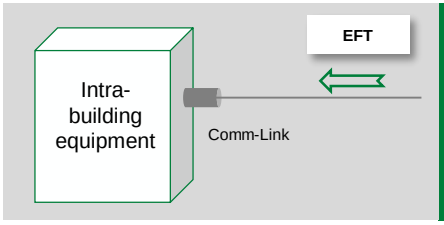
Miswiring during assembly or insulation damage can cause cables be exposed to AC line voltage

Induced power surge



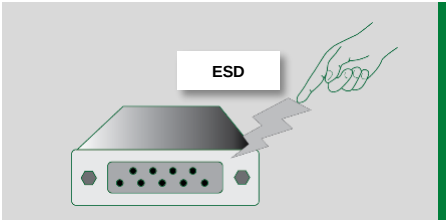
Lightning and power grid switching can induce power surge causing damage

Electrical fast transient



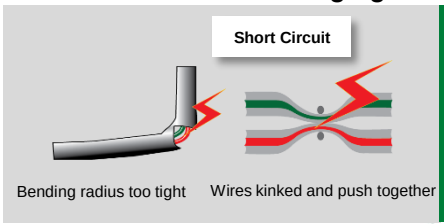
Electrical Fast Transient (EFT) can be a result of switching of inductive loads or relay contacts “bouncing”

Electrostatic discharge



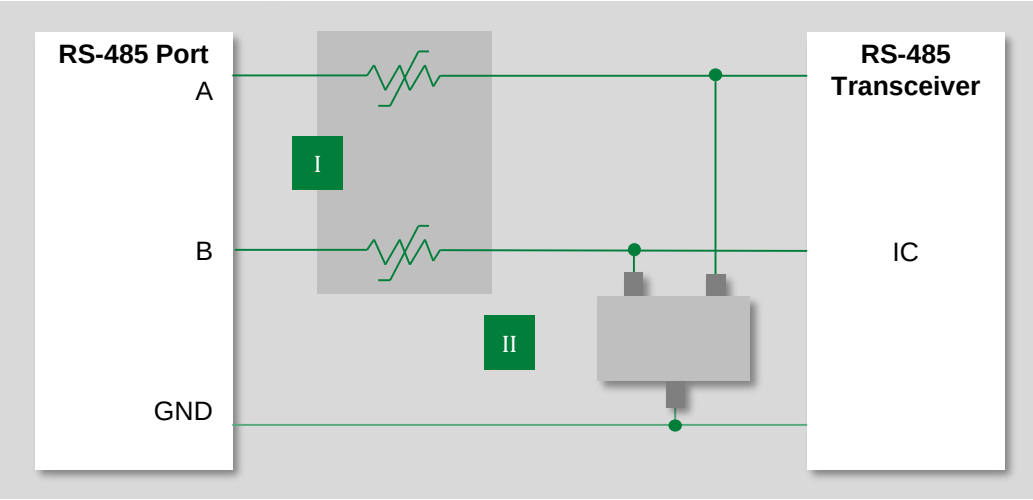
ESD passing through connecter can cause damage to ICs

Short circuit due to wire aging and installation



RS-485 and Ethernet often share the same conduits with DC or AC power lines; sharp bends and tight wiring tie can gradually result cracks in the insulation and electrical faults

Intra-building protection recommendations – RS-485



	Technology	Series
I	Resettable PPTC	TRF250/600, TS250, TSV250
II*	TVS Diode	SM712

Note:

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

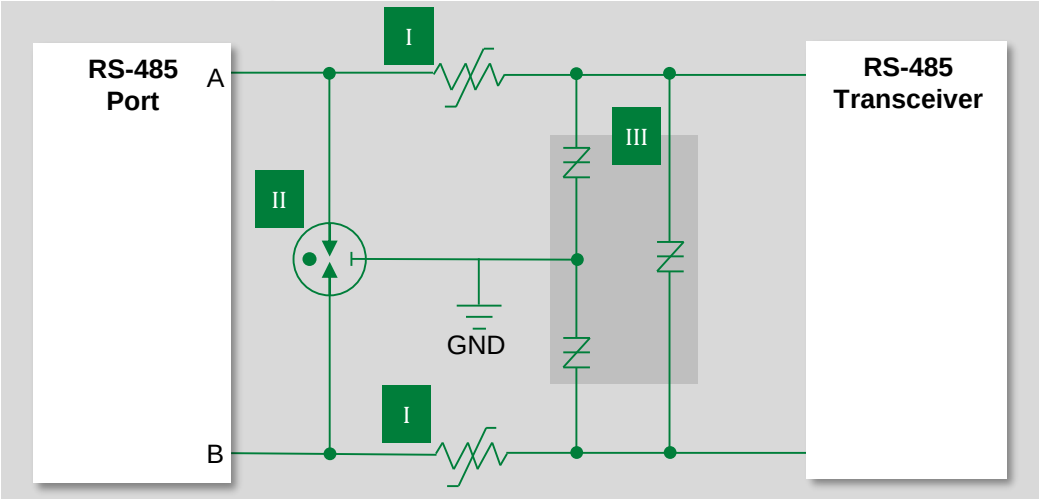
Applicable Standards:

- *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	TRF250/600, TS250, TSV250
II	GDT	GTCxx
III	SIDACtor	Pxxx0s

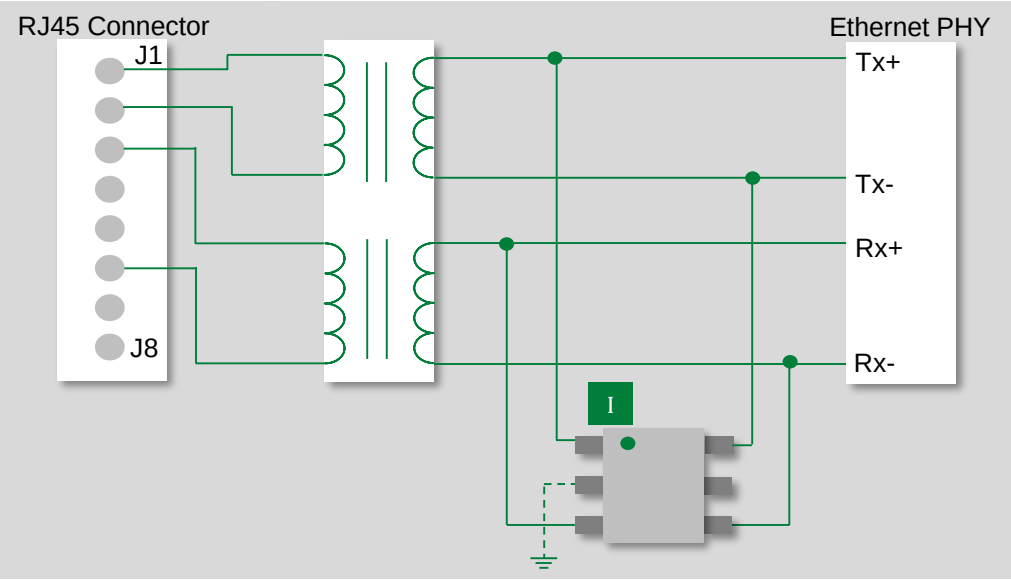
Applicable Standards:

- *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 **III** 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.

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	SRV05xx

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.

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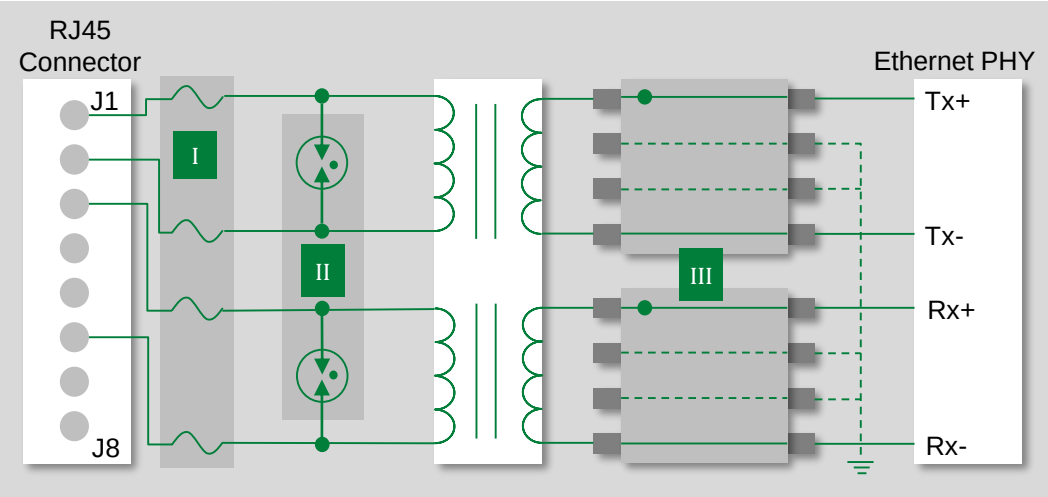
Outdoor and harsh environment – Ethernet



	Technology	Series
I	Fuse	0461xxx
II	GDT	SG, CG6, & CG5
III	Diode Array	LC03xx or SP40xx

Note:

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

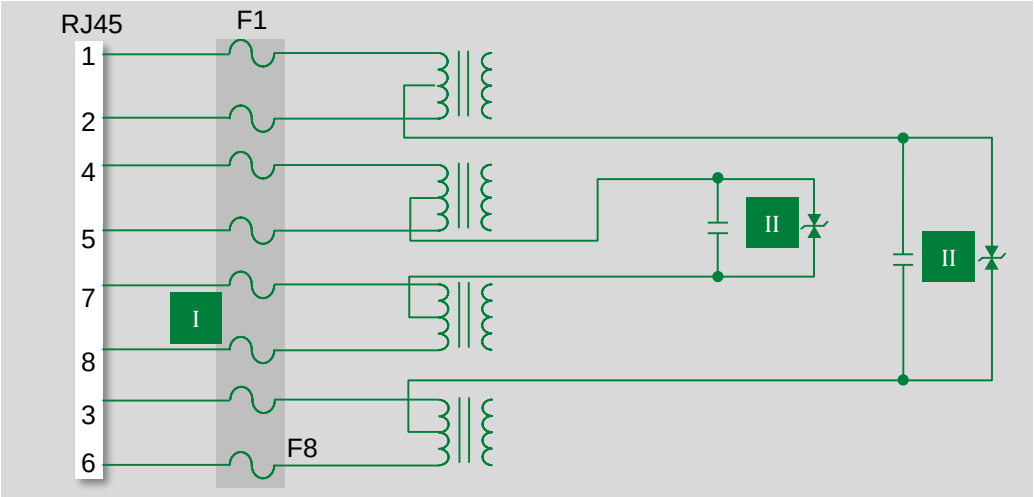
Applicable Standards:

- *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 **III** Lightning protection utilizes GDT with diode array to meet standard requirements. Class rating and external wiring configuration will determine 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	0461xxx
II	TVS Diode	SMCJxxCA

Note:
** PPTC Devise 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.littelfuse.com/~/media/electronics/design_guides/esd/littelfuse_ethernet_protection_design_guide.pdf.pdf

- Fuseology Selection Guide:
https://www.littelfuse.com/~/media/electronics/product_catalogs/littelfuse_fuseology_selection_guide.pdf.pdf

- Electrostatic Discharge (ESD) Suppression Design Guide:
https://www.littelfuse.com/~/media/electronics/design_guides/esd/littelfuse_esd_suppression_design_guide.pdf.pdf

- Electronic Discharge (ESD) Protection Design Guide:
https://www.littelfuse.com/~/media/electronics/design_guides/esd/littelfuse_esd_protection_design_guide.pdf.pdf

- Circuit Protection Solutions:
https://www.littelfuse.com/~/media/electronics/product_catalogs/littelfuse_product_selection_guide.pdf.pdf

- General
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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