

September 2010

Description

The TRUNKSAFE Fault-Tolerant Fieldbus System provides a cost-effective, yet highly reliable, strategy to maintain continuous communications between field devices and a host system in the event of any single point failure (such as any open single wire) on a FOUNDATION fieldbus™ H1 or PROFIBUS PA segment.

Delivers “High-Availability” Fieldbus Segments

Designed for important and plant-critical fieldbus segments, TRUNKSAFE utilizes two trunk cables (or “legs”) for physical layer redundancy to ensure no single point of failure will shut down the network.

Under normal operation, the fieldbus segment is terminated at each end of the segment at the TRUNKSAFE Redundant Power Conditioners. TRUNKSAFE maintains fieldbus communications throughout the entire segment until a fault (open- or short-circuit) is detected. Upon fault detection, the TRUNKSAFE Device Coupler initiates its automatic segment termination so that the healthy leg is properly terminated. This patented*, automatic system for fault detection and termination allows uninterrupted fieldbus communications throughout the segment (see Figure 1). The host is informed about the fault via a contact closure output.

TRUNKSAFE is fully compliant with FOUNDATION fieldbus FF831-1 (the technical specification for fieldbus power supplies) and FF846-1 (the technical specification for device couplers).

Fault-Tolerant Protection Against All Physical Layer Faults

One difficulty still remains with fieldbus technology: all segment communications and power integrity are vulnerable to a single broken twisted wire cable. Until now, the only ways to protect plant-critical segments were expensive duplication of an entire segment's hardware, complex software voting schemes and restricting the number of devices per segment. With TRUNKSAFE, critical process loops can use fieldbus technology without worrying about cable failures. This allows full access to advanced diagnostics and uninterrupted measurement and control communications that can be realized using fieldbus technology.

* United States Patent Numbers 7,454,252 and 7,505,819

All product names are registered trademarks of their respective companies.



TRUNKSAFE Fieldbus Device Couplers and Power Conditioners install on a DIN-style rail. Device couplers can be ordered in rugged field-mount enclosures with cable glands.



Features

- **Complete redundant fieldbus physical layer.** TRUNKSAFE is comprised of a Host Interface, two redundant fieldbus DC Power Conditioners and a specially-engineered Device Coupler that, in combination, maintain continuous segment communications even in the event of a cable break (open- or short-circuit) or failures to a TRUNKSAFE Power Conditioner.
- **Compatible with FOUNDATION Fieldbus H1 and PROFIBUS PA networks.** Completely compliant with fieldbus physical layer standard IEC 61158-2; no modification is required to fieldbus devices or to DCS-level software.
- **Advanced Fieldbus physical layer diagnostics.** TRUNKSAFE Diagnostic Modules offer simple hardware-based alarm LEDs and voltage free relay for DC power status, segment noise, power conditioners and network status.

Certifications



Factory Mutual (cFMus) US/Canada
File No. 3032513C
Non-Incendive - Class I, Division 2,
Groups A, B, C, D; T4A Ta=70°C



(ATEX) Zone 2
Certificate No. FM08ATEX0050X
II 3 G Ex nA nC [nL] IIC T4
Ta: -40°C to +70°C

(IECEx)

Certificate No. FMG 08.0007X
Ex nA nC [nL] IIC T4

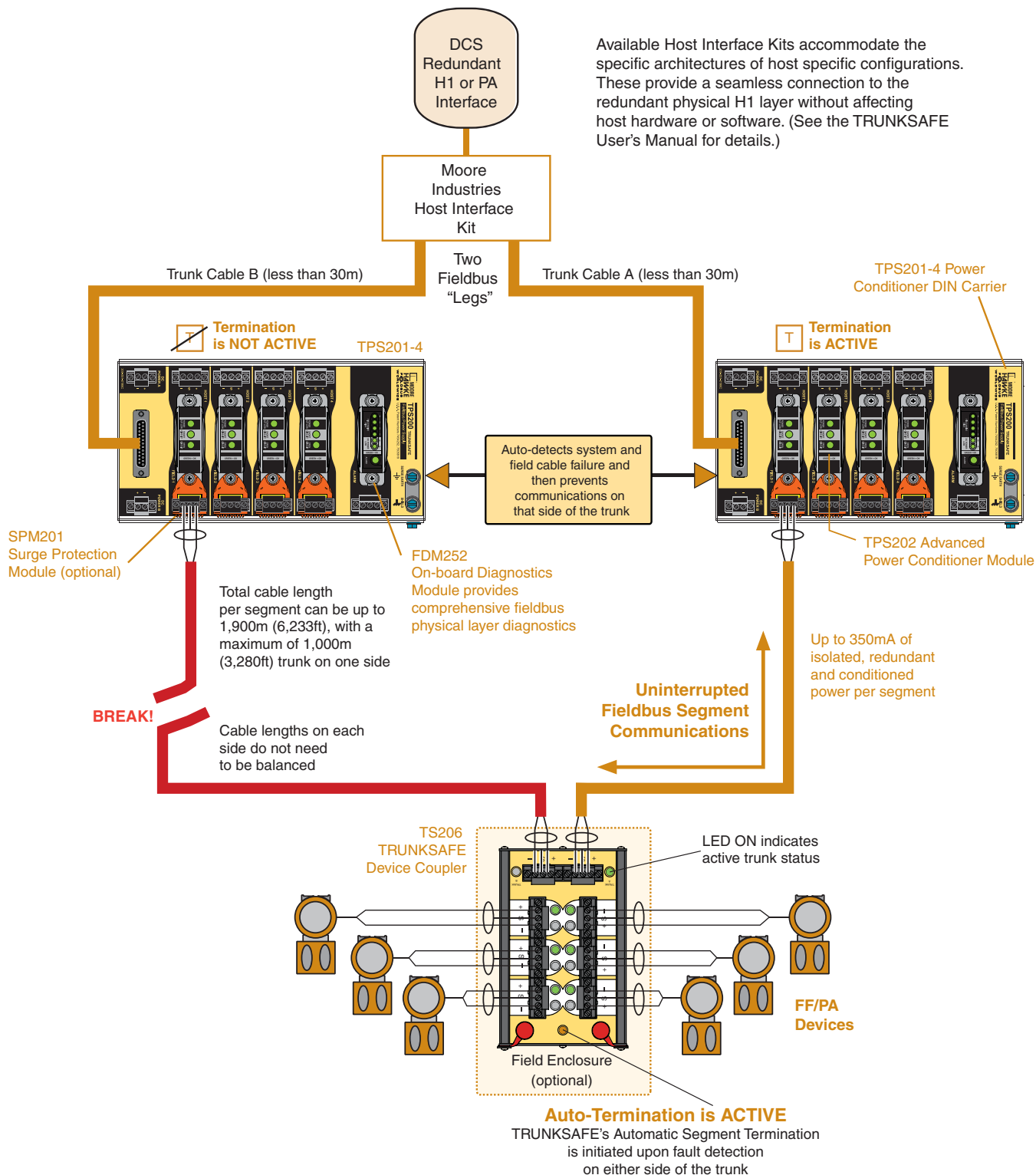


CE Conformant — EMC Directive 2004/108/EC EN 61326

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Figure 1. TRUNKSAFE maintains continuous segment communications between field devices and a host system in the event of any single point failure, such as an open- or short-circuit.



Simple, Yet Secure, Redundancy

The TRUNKSAFE Fault-tolerant Fieldbus System is comprised of three main sections: a Host Interface Kit (with Fieldbus Redundancy Adaptors), two fieldbus DC Power Conditioners, and a single field-based Device Coupler (Figure 1). TRUNKSAFE's major advantage is that no single point of failure will cause the loss of fieldbus communications with the host system.

TRUNKSAFE's Host Interfaces are unique to each host system, since each supplier has their own method of supporting redundant H1 cards or a PA coupler. The TRUNKSAFE concept is to convert these single H1 or PA trunk outputs into two trunk outputs that will be carried all the way to the Device Coupler in the field. Typically this is done with Fieldbus Redundancy Adaptors connected on the host H1 cards or terminal board (See the TRUNKSAFE User's Manual for details). Additional Fieldbus Redundancy Adaptors (when needed) ensure that active modules can be replaced without shutting down H1 or PA communications.

The resultant two trunk outputs begin the redundant H1 segment, and are then wired to separate TRUNKSAFE Power Conditioner DIN Carriers (TPS201). In most cases this is accomplished with a plug-to-plug cable connector carrying four segments. Each segment has two trunks, and each trunk is connected to a separate Fieldbus Power Conditioner DIN Carrier Board. Each Carrier Board supports four trunks with an individual Power Conditioning Module (TPS202) for each trunk. The segment has redundant Power Conditioner Modules (one on each DIN Carrier Board) providing conditioned power to the trunk and field-based Device Coupler. The Device Coupler receives power and communications from each trunk. In normal operation, integral fieldbus terminators are provided at each Power Conditioner Module.

Completely compliant with IEC 61158-2, the system will support a total cable length including the redundant leg and spurs of up to 1,900 meters (6,233 feet).

Reaction to Cable Fault Detection

TRUNKSAFE provides industry-first secure communications for a fieldbus network.

Advanced Redundant Power Conditioners—Both of TRUNKSAFE's Power Conditioners continuously monitor its segment cable leg. In the event of a field cable (open-circuit, short-circuit or broken wire) or host failure, the Power Conditioner immediately detects, reports and isolates the faulty leg. System communications will continue over the remaining leg.

Device Couplers with Fully-Automatic Segment Terminator—The TRUNKSAFE Device Coupler simultaneously detects the absence of DC power on the incoming trunk as a cable fault on one leg, and activates its terminator. This maintains normal fieldbus communications on the healthy leg. Internal blocking circuitry prevents current flow out of the device coupler so that a trunk short-circuit on one side cannot affect the trunk on the

other side. The TRUNKSAFE Device Coupler automatically resets when cable integrity is restored. This functionality allows TRUNKSAFE to maintain all fieldbus communication functions in spite of any single system fault, and provide for automatic reset once the faults are removed.

TRUNKSAFE Advanced Fieldbus Power Conditioner

The TRUNKSAFE Power Conditioner is composed of a TRUNKSAFE DIN Carrier (Model TPS201) populated with up to four TRUNKSAFE Advanced Power Conditioner Modules (Model TPS202). Each Power Conditioner provides up to 350mA of isolated and conditioned DC power for FOUNDATION fieldbus H1 or PROFIBUS PA segments. The system's power conditioner pairs are fully load-sharing in normal operation. Each also incorporates a hard-wired segment terminator that is always ON.

Physical Layer Diagnostics—The TRUNKSAFE system incorporates a diagnostics module which maintains overall system "high-availability" by giving advance notice of cable faults as well as potential failures (See Page 6 for additional information).

TRUNKSAFE Fieldbus Device Coupler

Available in 6- and 12-spur configurations, TS200 Device Couplers have designed in redundancy and feature:

Automatic Segment Termination—TRUNKSAFE delivers the unique advantage of being able to identify a open- or short-circuit, isolate the faulty leg, and automatically terminate the leg of the TRUNKSAFE system that continues operating normally.

Short Circuit Protection—TRUNKSAFE Device Couplers provide electronic and fully auto-resetting spur short-circuit protection that prevents segment failure caused by single device faults. Utilizing a "FoldBack" technique, any spur that attempts to draw more than 48mA is automatically switched off and not permitted any current flow until the fault is removed. This is a significant advantage over "current-limiting" designs on competing units which hold a fault permanently on the segment at a higher than normal current level. This often results in segment failure by overloading the segment power supply. With removal of the short, the TRUNKSAFE Device Coupler automatically reconnects the spur to the fieldbus segment.

Diagnostic LEDs and hand-held connections—Diagnostic LEDs positively indicate status of each incoming trunk, power status on each spur, spur short circuits and status of auto termination. The front panel features convenient connections for a fieldbus hand-held configurator (see Page 6).

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Specifications

TRUNKSAFE Advanced Fieldbus Power Conditioner

TPS201-4 Power Conditioner DIN Carrier Performance Number of Segments: 4 Supply Voltage: 19.2 to 32Vdc, reverse polarity protected Terminals Type: Removable terminals with screw-clamp retaining screws Wire Size: Handles 0.8-2.5mm²/12-24AWG cable sizes TPS202 Power Conditioner Module Performance Output Capacity: 350mA per segment; up to 25.5V (no load) Power Requirements: 13.5VA @350mA per segment Power Dissipation: 5.5W @350mA per segment Terminator: 100 ohms/1microFarad per segment DC/DC Isolation: 500Vdc (segment to power supply) Indicators LED (Power): GREEN, normal; ORANGE, Output Voltage <18V LED (Short): GREEN, normal; RED, Cable Short LED (Open): GREEN, normal; RED, Cable Open	FDM252 Fieldbus Diagnostics Module Performance Power Dissipation: 0.5W maximum LED Indicators LED Type: GREEN, Normal; RED, Fault LED A: DC "A" Input Voltage Low (<18V) LED B: DC "B" Input Voltage Low (<18V) LED 1: Segment #1 Noise High (>75mV p/p) LED 2: Segment #2 Noise High (>75mV p/p) LED 3: Segment #3 Noise High (>75mV p/p) LED 4: Segment #4 Noise High (>75mV p/p) Alarm Relay Output Type: Relay (failsafe, open on alarm) Contact Rating: 5A @250Vac 50/60Hz or 24Vdc, non-inductive load	SPM201 Surge Protection Module Performance Complies with: -IEC 61158-2, for 31.25kB/s and testing according to -IEC 61643-21 Maximum Surge Current Isn: 20kA (8/20µsec) Nominal Discharge Current Isn: 3kA(8/20µsec) Nominal Rated Current In: 650mA Maximum Continuous Operating Voltage (MCOV): 35V Peak Common Mode: 230V Limiting Voltage Vlim: 50V @3kA (8/20µsec) Nominal Voltage Vn: 32V Line Attenuation: Rs: 1 ohm capacitance:1nF IP Rating: IP20 Ambient Conditions (All Components and Options) Operating Range: -20°C to +60°C (-4°F to +140°F) Storage Range: -40°C to +85°C (-40°F to +185°F) Relative Humidity: 0-95%, non-condensing RFI/EMI Immunity: 10V/m @80-1000MHz, 1kHz AM when tested according to IEC61326
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TRUNKSAFE Fieldbus Device Coupler (TS200)

Communications FOUNDATION Fieldbus™ H1 or PROFIBUS PA Performance Maximum Quiescent Current: TS206: 13.5mA TS20W: 25mA Maximum Spur Output Current: $I_{lim} = 48mA$ Spur Short Circuit Load: I_{ssc} 2mA (typical)/6mA max. Spur Voltage Drop: 0.5V @20mA spur current (typical), 1V maximum Maximum Spur Voltage: 24V max. no load	LED Indicators Trunk: GREEN (Active); OFF (Inactive) Spur: GREEN (Normal); RED (Fault) Auto-Terminator: YELLOW (Terminator On); OFF (Terminator Off) Terminals Type: Removable terminals with screw-clamp retaining screws Wire Size: Handles sizes between 0.8-2.5mm²/12-24AWG Enclosures (Optional) Type: Aluminum IP66; Stainless Steel 316 IP66; GRP (Glass Reinforced Polyester) IP66	Cable Gland (Device Couplers with Enclosures) Type: Armored/Unarmored Material: Nickel-plated brass Ambient Conditions Operating Range: -40°C to +70°C (-40°F to +158°F) Storage Range: -40°C to +85°C (-40°F to +185°F) Relative Humidity: 0-95%, non-condensing RFI/EMI Immunity: 10V/m @80-1000MHz, 1kHz AM when tested according to IEC61326
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Ordering Information

TRUNKSAFE Advanced Fieldbus Power Conditioner and Associated Accessories

Description	Model Number
TRUNKSAFE Advanced Power Conditioner DIN Carrier (Handles up to 4 TPS202 Advanced Power Conditioners)	TPS201-4
TRUNKSAFE Advanced Power Conditioner Modules (Specify up to 4 per TPS201-4 DIN Carrier)	TPS202
TRUNKSAFE Fieldbus Diagnostics Module (One module per TPS201-4 DIN Carrier)	FDM252
TRUNKSAFE Surge Protection Module (Optional, one per active segment requiring protection)	SPM201

TRUNKSAFE Fieldbus Device Coupler

Unit	Mounting/Enclosure Type	Number of Spurs	Gland/Connector Type	Gland Entry Size
TS2 TRUNKSAFE Fault-Tolerant Fieldbus System (General Purpose and Non-Incendive Applications)	0 DIN-Rail Mount (No enclosure; for installation in another manufacturer's enclosure; IP54 protection is recommended)	6 Fieldbus Spurs W 12 Fieldbus Spurs	Not Applicable	-DIN (No cable glands) Universal DIN-style enclosure mounts on 32mm (EN50035) G-type and 35mm (EN50022) Top Hat DIN-rails
	5 Standard Aluminum, Solid Cover, IP66 Enclosure 6 Standard Aluminum, Clear Cover, IP66 Enclosure 4 Stainless Steel 316, IP66 Enclosure with E-Z vertically removable lid and bottom entry cable gland plate	6 Fieldbus Spurs W 12 Fieldbus Spurs	-A Unarmored Cable Glands (standard) -B Armored Cable Glands -C Compound Seal Cable Glands -D No Cable Glands -E M12 Turck Eurofast™ Sockets -F 7/8-in. Turck Minifast™ Sockets	GLAND ENTRY SIZE FOR: -O (standard) Unarmored Cable (7.5-11.9mm O.D.); Armored Cable (9.5-16.0mm O.D.)
	3 GRP (Glass Reinforced Polyester), IP66 Enclosure	6 Fieldbus Spurs	NOTES: 1. Gland/connector selection is for all entry ports. 2. Choices "-E" and "-F" have male sockets for "Trunk In" and female sockets for "Trunk Out" and "Spurs". 3. Weatherproof seals are provided for all glands, but not sockets. 4. Compound seal glands are epoxy filled on installation and prevent gas transmission into enclosures; no seal pot required from Division 1 to Division 2.	-S Unarmored Cable (3.0-8.0mm O.D.); Armored cable (5.5-12.0mm O.D.)

When ordering, specify: Unit • Mounting or Enclosure Type • Number of Spurs -Gland/Connector Type -Gland Entry Size
Model number example: TS256-A-0
 (6-Spur Device Coupler in Aluminum Enclosure with Cable Glands for Unarmored Cable)

Typical TRUNKSAFE Bill of Materials (for single segment TRUNKSAFE network):

1 ea. Host Interface Kit	Host Interface Kit (See the TRUNKSAFE User's Manual for Details)
2 ea. TPS201-4	4-Position TRUNKSAFE Advanced Power Conditioner DIN Carrier
2 ea. TPS202	TRUNKSAFE Power Conditioner Module
2 ea. FDM252	TRUNKSAFE Fieldbus Diagnostics Module
2 ea. SPM201	TRUNKSAFE Surge Protection Module
1 ea. TS256-A-0	6-Spur TRUNKSAFE Device Coupler in Aluminum Enclosure with Cable Glands for Unarmored Cable

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Intelligent Physical Layer Diagnostics

The TRUNKSAFE Redundant Fieldbus System delivers comprehensive diagnostic capabilities at every level.

Power Supply Diagnostics

LEDs on the TRUNKSAFE Power Conditioner Modules alert users to potential problems:

- Host or field cable open-circuit
- Host and field cable short-circuit
- High field current ($>350\text{mA}$)
- Low Power Conditioner output voltage ($<18\text{V}$)

The TRUNKSAFE Diagnostic Module provides additional information on vital parameters influencing the physical layer. A volt-free contact closure can be wired as a general alarm, with individual LEDs on the Diagnostic Module reporting the following faults:

- DC Input Voltage #1 Low ($<18\text{V}$) or Loss of Input Supply
- DC Input Voltage #2 Low ($<18\text{V}$) or Loss of Input Supply
- Segment #1 Noise High ($>75\text{mVpp}$)
- Segment #2 Noise High ($>75\text{mVpp}$)
- Segment #3 Noise High ($>75\text{mVpp}$)
- Segment #4 Noise High ($>75\text{mVpp}$)

NOTE: Advanced Diagnostics

Advanced physical layer diagnostic modules with communications to a host are available from several vendors. We suggest selective use of this capability tied to control or critical segments. Third-party DIN-rail mounted Advanced Diagnostic Modules can easily be attached to any MooreHawke segment. Consult the factory for details.

Device Coupler Diagnostics

LEDs on the TRUNKSAFE's Device Couplers provide instant indication of:

- Power status each TRUNK
- Power status per SPUR
- Short-circuit status per SPUR
- Auto-termination ON/OFF

NOTE: The TRUNKSAFE system provides complete fault tolerant segment communications independent of the TRUNKSAFE Diagnostics Module. However, all advanced diagnostics and all alarms require the Diagnostics Module to be specified with the system.

Fieldbus Redundancy Adaptor

A TRUNKSAFE host-specific Fieldbus Redundancy Adaptor installs between the H1/PA interface card(s) and the TRUNKSAFE Power Conditioner DIN Carrier Board, and routes the fieldbus signal to both trunks of the TRUNKSAFE network. The Fieldbus Redundancy Adaptor and Interface Adaptor (if necessary) has no effect on the operation or performance of the H1/PA cards, and is typically mounted in close proximity to the H1/PA card or module.

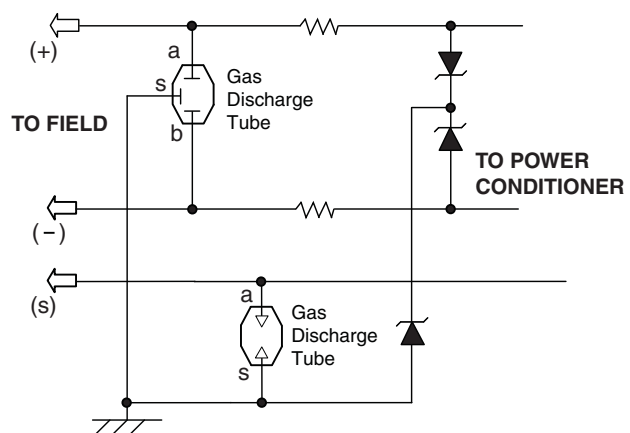
TRUNKSAFE Fieldbus Host Interface Kits are available to accommodate the architectures of the major host manufacturers including ABB, Emerson Process Management, Honeywell, Invensys, Siemens and Yokogawa. A generic redundancy adaptor is also available to accommodate other host suppliers or when a single H1 Card or PA Coupler is used in a host system.

Surge Protection Module

The SPM201 Surge Protection Module prevents surges and over voltage spikes occurring directly on the main trunk from causing damage to the TRUNKSAFE Power Conditioner Modules, as well as the host system.

Inserted onto the field side pluggable terminal position, the SPM201 is fitted with a combination of solid state electronics and a gas discharge tube to withstand a surge of up to 20kA . It diverts surges to a safe earth connection, with no effect on the performance of the TRUNKSAFE Power Conditioner. All TRUNKSAFE Power Conditioner Carriers (TPS201-4) fitted with SPM201 Modules must have a secure low-impedance ($<0.1\text{ ohm}$) connection to the main local ground.

Figure 2. SPM201 schematic.



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Figure 2. TPS201/202 Advanced Power Conditioner with DIN-Rail Mounting Installation Dimensions.

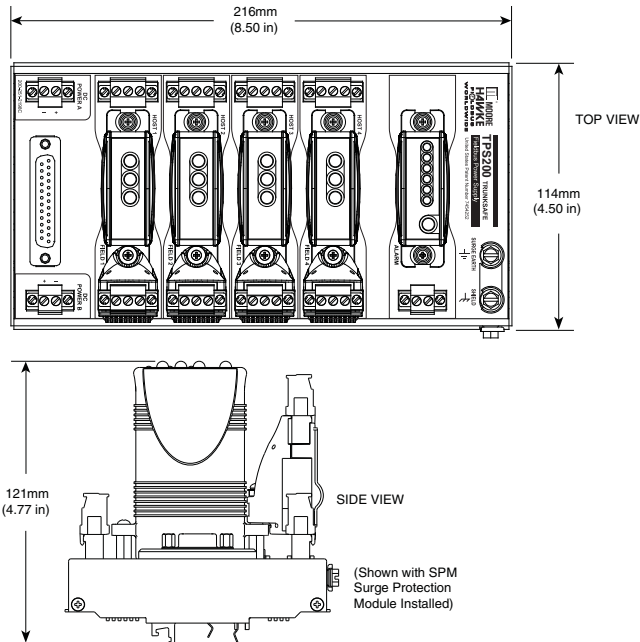


Figure 3. TS200 Device Coupler DIN-Rail Mounting Installation Dimensions (Base Unit).

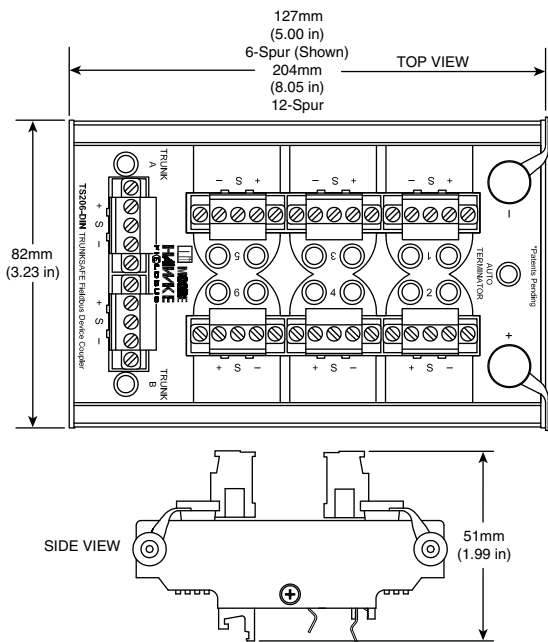
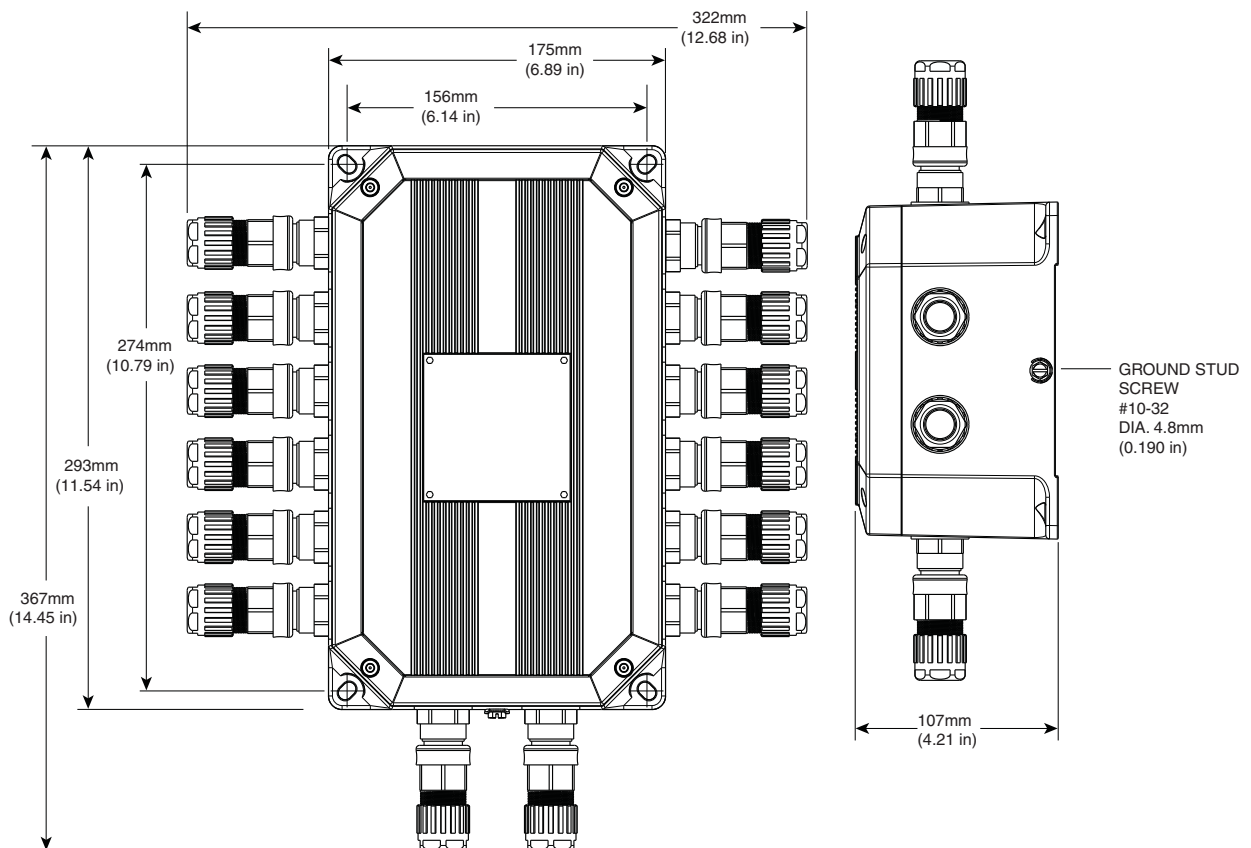


Figure 4. Standard Aluminum Enclosure Installation Dimensions for 6-Spur (TS256) and 12-Spur (TS25W) Models.



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Figure 5. Stainless Steel 316 with E-Z Vertically Removable Lid and Bottom Entry Cable Gland Plate 12-Spur Models (TS24W).

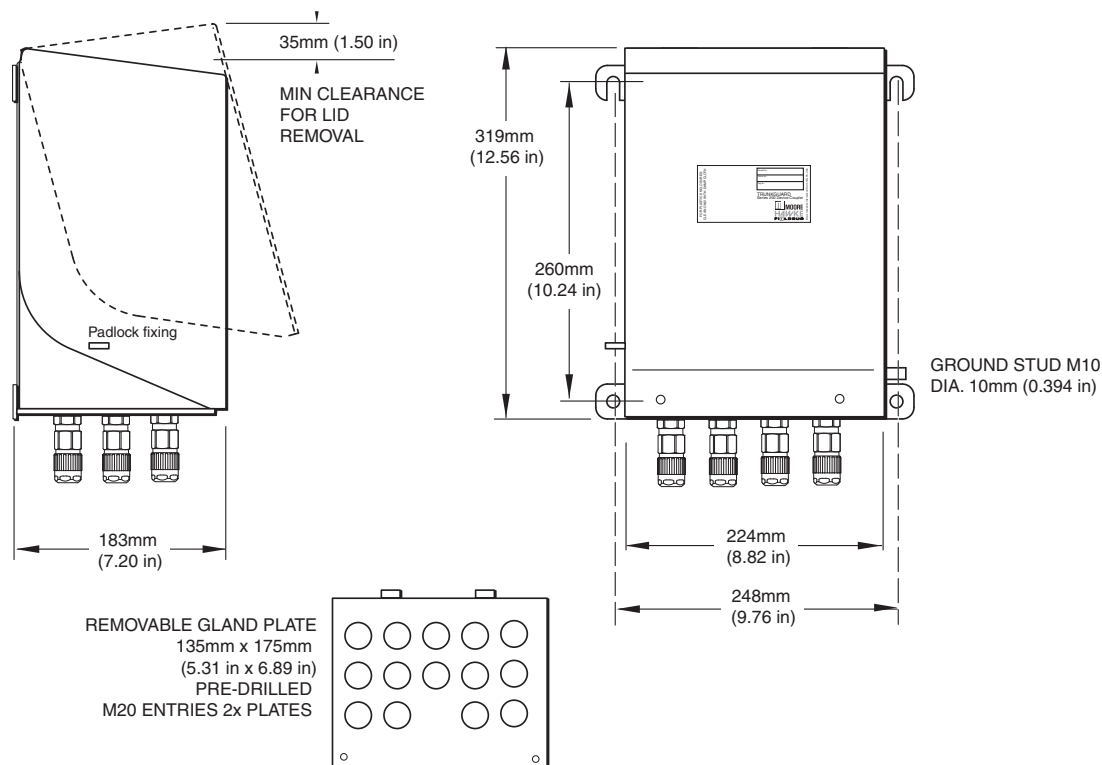


Figure 6. GRP (Glass Reinforced Polyester) Enclosure Installation Dimensions for 6-Spur (TS236) Models.

