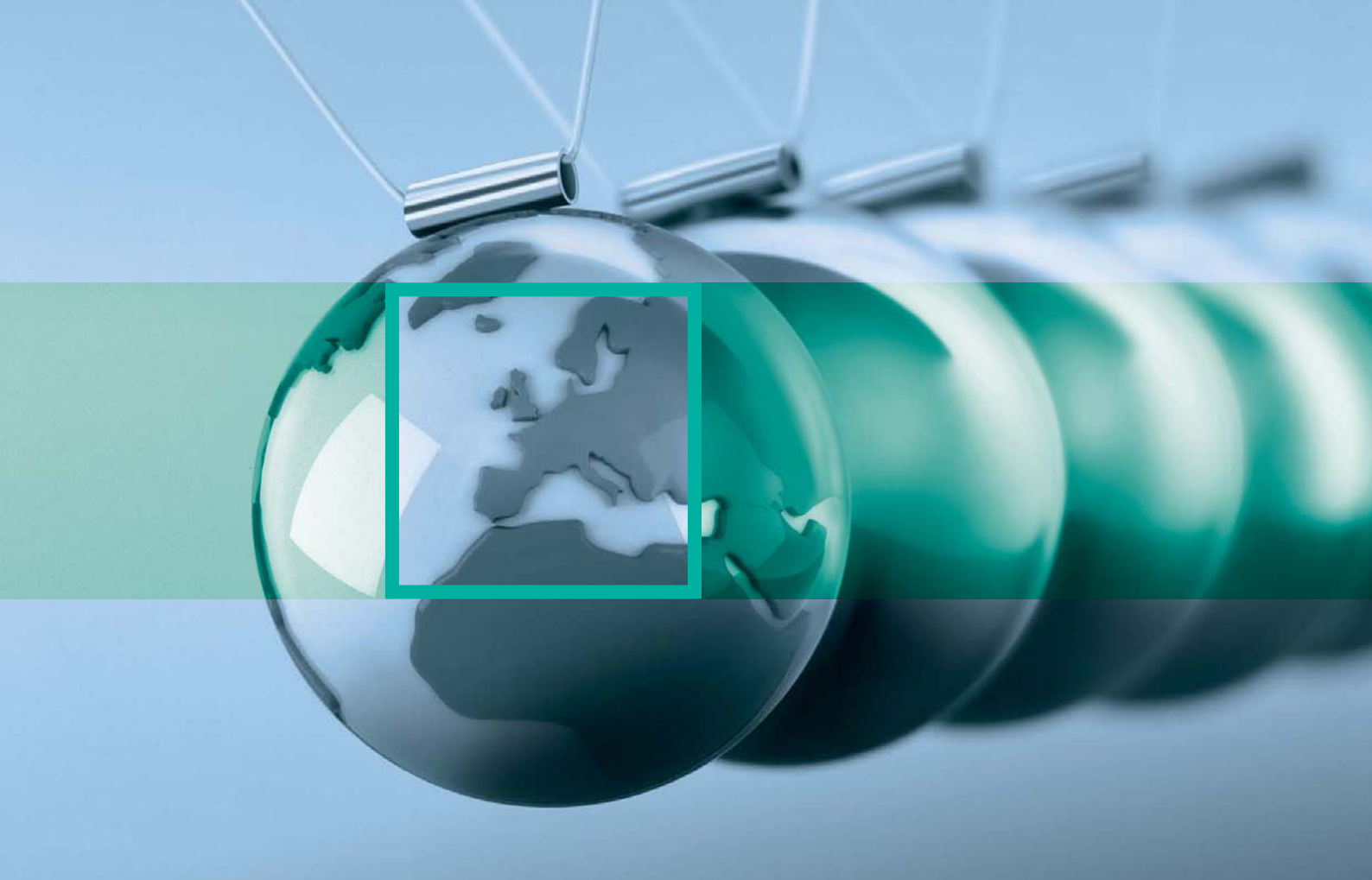


FIELD BUS

ENGINEER'S GUIDE





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Introduction 4

Technology 6



- Basic Principles
- Bus Systems for Process Automation
- Overview of Explosion Protection and Intrinsic Safety
- Best Working Practices
- Application Guideline

Fieldbus Infrastructure for Process Automation 102

FOUNDATION Fieldbus H1 104



- System Description
- Advanced Diagnostics
- Power Supplies
- Device Couplers
- Process Interfaces
- Accessories

PROFIBUS PA 300



- System Description
- Advanced Diagnostics
- Segment Couplers
- Device Couplers
- Process Interfaces
- Accessories

Ethernet 448



- System Description
- Products

Appendix 454



- Glossary
- Function Index
- General Notes
- Model Number Index

Introduction

The Engineer's Guide

This engineer's guide presents the FieldConnex® product portfolio of our Process Automation division and, compiled by our inhouse field experts, shares concise technical fieldbus knowledge based on years of substantiated fieldbus experience.

The engineer's guide consists of a technology section and a product section.

Technology Section

The technology section covers the following topics:

- Basic principles for understanding fieldbus for process automation
- Bus systems for process automation
- Overview of explosion protection and intrinsic safety
- Best working practices for planning and installing a segment
- Application guideline describing applications for different hazardous areas, listing applicable standards and general installation notes

Application Guideline:

Application Guide

Devices in Zone 2

For Zone 2, choices for explosion protection fulfill different types of requirements such as long cable runs or live maintenance at field instruments. It is important to know that in some cases, even the host interface connections must meet certain requirements for explosion protection. More details can be found in the Pepperl+Fuchs FieldConnex Application Guideline for Zone 2, which can be found as a free download on the Pepperl+Fuchs website. Please look for the datasheets on FieldConnex Segment Protectors.

Live Maintenance on Spurs (FISCO) Ex ic, High-Power Trunk

This method of explosion protection offers live maintenance at the spur/device level and the easiest validation process for intrinsic safety. The applicable standard for intrinsic safety FISCO Ex ic is IEC 60079-27 as of edition 2.

The fieldbus power supply limits the voltage to safe levels. The Segment Protector acts as the device coupler and wiring interface. It limits the current to safe levels. Due to the unlimited trunk energy, live work at the trunk requires a hot work permit. However, live connect or disconnect at the outputs of the Segment Protector is allowed.

Field devices according to FISCO are allowed to be connected to the outputs of the Segment Protector under an intrinsically safe Ex ic rating. The entity parameters of the cable shall be in the limits of the FISCO cable specification given in IEC 60079-27. Generally, fieldbus cable type 'A' fulfills the specifications according to FISCO.

The host interface shall meet the requirements for SELV/PELV. The declaration of conformity must state the "passivity of any host interface," meaning that the host shall not be an active power source. If the host interface is installed in Zone 2, a declaration of conformity must be provided in addition.

Figure 4 Live maintenance on spurs (FISCO) Ex ic, High-Power Trunk

1. Trunk: protected installation according to IEC 60079-14
2. Spurs: intrinsically safe Ex ic according to IEC 60079-27 (FISCO)

FieldConnex® Selection Example

	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	MBHD-FB1-4R + HD2-FBPS-1.17.500	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.17.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N ²	R2-SP-N ²
For a detailed selection go to page	26	38

¹ (R) denotes optional redundancy.
² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, IP ratings, and accessories.

Refer to General Notes Relating to Product Information.

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Product Section

The product section is divided in three main parts, FOUNDATION Fieldbus H1, PROFIBUS PA, and Ethernet. The table of contents of each part is followed by a system description and a comprehensive selection guideline that takes you through the process of selecting the components of the fieldbus infrastructure.

The selection tables summarize the technical data from the product pages to the key selection criteria, and serve as an important aid for factory planners and designers.

Selection Guideline:

FOUNDATION Fieldbus H1

Selection Guideline

High-Power Trunk with Spurs Ex ic (FISCO)

Special power modules are provided limiting the voltage to $U_0 \leq 17.5$ V.

Power Hub Motherboard or Power Supply

	N° of Segments	Redundant Power Supply	Redundant Host Connection	Slot for Advanced Diagnostics	Packing Density / Size	Power Dissipation per Segment	CREST	Terminators: Selectable / Fixed	Grounding Bar Available	HD2-FBPS-1.17.500
For Yokogawa AKB 306 system cable										
MBHD-FB1-4R.YO	4	■	■	■	■	■	■	F	■	■
MB-FB-4R.YO	4	■	■	■	■	■	■	S	■	■
MB-FB-4.YO	4	■	■	■	■	■	■	S	■	■
For Invenya Foboro FBM 208										
MB-FB-4R.GEN	4	■	■	■	■	■	■	S	■	■
MB-FB-4.GEN	4	■	■	■	■	■	■	S	■	■
For any host system										
MBHD-FB1-4R	4	■	■	■	■	■	■	F	■	■
MB-FB-1R	1	■	■	■	■	■	■	S	■	■
MB-FB-2R	2	■	■	■	■	■	■	S	■	■
MB-FB-4R	4	■	■	■	■	■	■	S	■	■
MB-FB-4R.GEN	4	■	■	■	■	■	■	S	■	■
MB-FB-4	4	■	■	■	■	■	■	S	■	■
MB-FB-4.GEN	4	■	■	■	■	■	■	S	■	■

+ ... +++ Indicates reduced space requirements.

- ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

Edition: 10/2006 (05/01.2007) (03/01.2007)

Refer to General Notes Relating to Product Information

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PEPPERL+FUCHS 131
RESPECTING YOUR PROCESS

FOUNDATION Fieldbus H1

Selection Guideline

Advanced Diagnostics

Power Supplies

Field Distribution

DART Fieldbus

Process Interfaces

Accessories

The selection guideline is followed by the product pages illustrating the features and technical data of each product.

The Website

For the most up-to-date and comprehensive product information, please visit our website:

www.pepperl-fuchs.com



On the website, you can narrow your search and find the product information you need in two different ways:

- Use the search function to find information about a specific product.
- Use the product selector to find a product based on specific features.

The Search Function

In the search field on our website, enter either of the following:

- Product name if known
- Part of the product name, e.g., from the catalog
- Part number, e.g., from the type label of a product you have already purchased

Note: The search function is not case sensitive. You can also carry out a wildcard search, using *.



Depending on the completeness of the product name or part number you entered, the search result displays a hit list with a short description of each product from which you can select the required product.

The Product Selector

Use the product selector to navigate to the required product group.

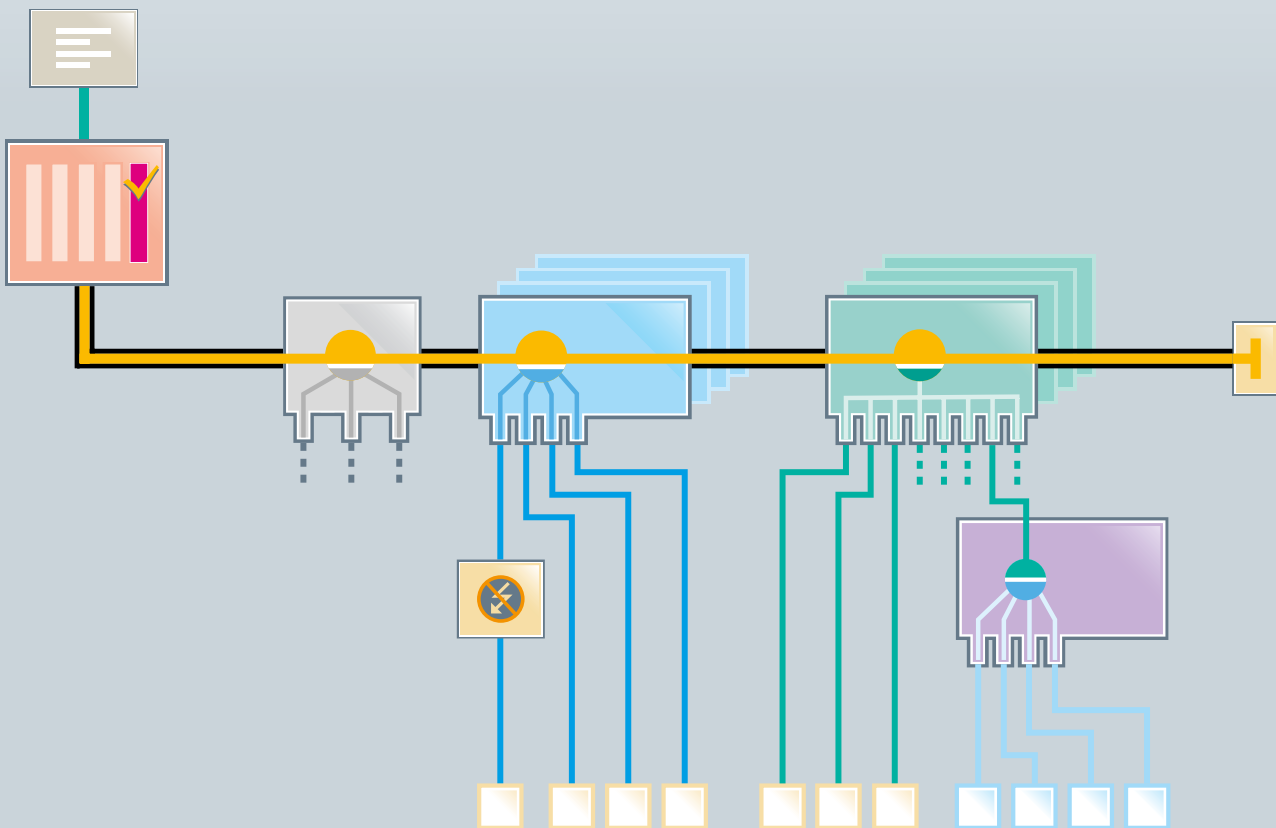
- [Isolated Barriers](#)
- [Zener Barriers](#)
- [Signal Conditioners](#)
- [Fieldbus Infrastructure](#)
 - [DART Fieldbus for Zone 1](#)
 - [Advanced Diagnostics](#)
 - [FOUNDATION Fieldbus H1](#)
 - [PROFIBUS PA](#)
 - [Ethernet](#)
- [Remote I/O Systems](#)
- [HART Interface Solutions](#)
- [Level Measurement](#)
- [Purge+Pressurization Systems](#)
- [Industrial Monitors+HMI Solutions](#)
- [Corrosion Monitoring](#)
- [Separator Alarm Systems](#)
- [Hazardous Area Enclosures+Equipment](#)
- [Power Supplies](#)
- [Software](#)

Here, you can choose a product from a list of products.

- [View All Products in Group](#)



Technology



Edition 912868 (US) / 220231 (EU) 05/2013

Basic Principles	9	Technology
Introduction	9	
Physical Layer	11	
Bus Systems for Process Automation	25	Technology
FOUNDATION Fieldbus H1	25	
PROFIBUS PA	29	
Safety for Bus Systems	33	
Overview of Explosion Protection and Intrinsic Safety	37	Basic Principles
Introduction	37	
Introduction to Intrinsic Safety	37	
Physical Fundamentals of Explosion Protection	38	Bus Systems
Classification of Hazardous Areas	40	
Types of Protection	43	
Labeling of Types of Protection	49	Explosion Protection
The Philosophy of Intrinsic Safety	50	
A New Dimension of Intrinsic Safety with DART	52	
Intrinsically Safe Systems	56	Best Working Practices
Explosion Protection for Segments	59	
Proof of Intrinsic Safety	59	
Installation of Intrinsically Safe and Associated Apparatus	61	Application Guideline
Legal Situation	63	
Testing and Maintaining of Intrinsically Safe Systems	65	
Additional Information	66	
Best Working Practices	71	
Planning a Segment	71	
Fieldbus in Hazardous Areas	77	
Installing Fieldbus	81	
Commissioning Fieldbus	82	
Operating and Maintaining	83	
Application Guideline	85	
Introduction	85	
General Purpose Area	87	

Devices in Zone 2	88
Devices in Zone 1 and 0	92
Devices in Class I, Division 2	97
Devices in Class I, Division 1	99

Basic Principles

Purpose, function, and the physical layer of fieldbus are described. This section particularly covers the fieldbus physical layer. Device connections to device couplers to power supply to diagnostic functions specific to fieldbus practices. The chapter lays the groundwork for understanding fieldbus for process automation.

Introduction

Definition of Fieldbus

Generally speaking, a fieldbus network refers to a control system that uses a digital, two-way, multidrop communication link among intelligent digital measurement and control devices. Fieldbus serves as a Local Area Network (LAN) for process control, remote I/O, and high-speed factory automation applications. Fieldbus systems encompass the physical wiring of the bus or network, voltage levels for communication, timing, and connections with each function defined by a protocol standard. These standards define the rules and vocabulary for the communication protocol.

While the communication protocol is different, FOUNDATION Fieldbus H1 and PROFIBUS PA share many similarities. FOUNDATION fieldbus and PROFIBUS PA are device-level communication protocols that transmit data and power. Transmission occurs through a single twisted-pair cable between the control system and digital field devices such as sensors, valve positioners, and transmitters in accordance with the IEC 61158-2 Standard. Each protocol can distribute control strategies and use "smart" instrumentation to transmit not only the process variables but also diagnostic information about communication quality and instrument health.

Fieldbus systems differ fundamentally from the traditional 4 ... 20 mA equipment of automation systems. In a classic 4 ... 20 mA system, individual measurement instruments link directly to the control system. In fieldbus systems, a number of transmitters are combined along a two-wire cable to form a group. This group, referred to as a network or segment, is connected to the control system as a whole unit. Each individual segment is considered a small network of devices.

Definition of a Segment

A simple definition of the segment is based on the critical physical characteristics: the segment is a piece of shielded cable with twisted lines and a terminating resistor at both ends. As an element of a network, the segment is the smallest unit of a fieldbus network that still has the characteristic of a network. Depending on how it is implemented in practice, the segment may contain between four and sixteen devices.

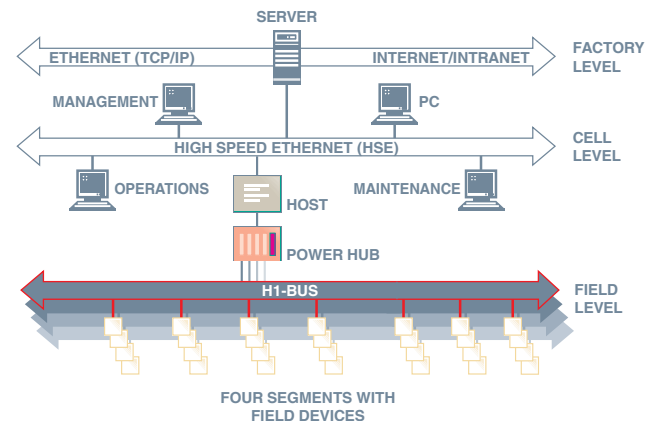


Figure 1 Example of a complete process control network with four segments

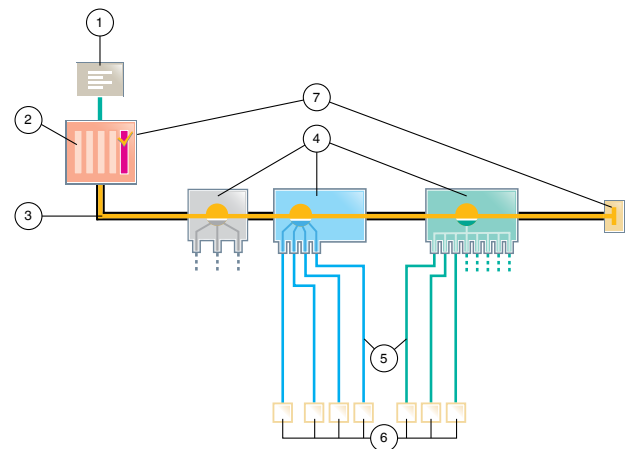


Figure 2 Typical segment, consisting of the following elements:
 1. DCS/PLC controller that houses the host
 2. Fieldbus power supply
 3. Trunk cable
 4. Junction boxes (Segment Protectors or FieldBarriers)
 5. Spur cable
 6. Field devices
 7. Two fieldbus terminators

In a FOUNDATION fieldbus application, the host includes the FOUNDATION Fieldbus H1 ports that connect directly to the segment through the fieldbus power supply.

In a PROFIBUS PA application, the host typically is a PROFIBUS DP interface card. To connect the high speed, non-powered DP physical layer to the bus-powered PA fieldbus, a Segment Coupler is needed. The segment coupler includes a PROFIBUS DP/PA gateway and PROFIBUS PA fieldbus power supplies.

Reasons to Use Fieldbus

Aging infrastructure, outdated technology, and inefficient maintenance practices are a crippling reality in many process plants around the world. Many plant managers are given the task to reduce construction and startup as well as continuing operation costs of the plant. Choosing an open, digital fieldbus system for either a greenfield or brownfield application allows end users to select best-in-class instrumentation for the given application, regardless of the manufacturer. Interoperability is guaranteed. The advantages are:

- Reduced wiring and control system hardware
- Hazardous area architectures with reduced design complexity and simplified verification
- Faster FAT/SAT
- Reduced downtime with predictive maintenance strategy
- Reduced maintenance with detailed device diagnostics

Fieldbus Applications

At this time, fieldbus technology has achieved industry standard status among process end users. Implementation of fieldbus system architectures is growing at a rapid pace in diverse industries around the world. Millions of fieldbus devices are already installed and have contributed to higher plant availability and reduced cost. Process control is a term commonly used to describe the monitoring and controlling of process variables such as temperature, pressure, level, and flow. Successful fieldbus installations can be found in industries such as petrochemical, refining, chemical, oil & gas, metals & mining, water & waste, pulp & paper, utilities, and food & beverage. In these industries, product creation is based on a continuous series of processes being applied to raw materials. A wide variety of instruments exists to accomplish specific types of process control.

Recent additions to the fieldbus specifications also include PROFIsafe and SIF (Safety Instrumented Functions), which make fieldbus technology suitable for SIS (Safety Instrumented Systems) applications.

Benefits of Digital over Analog

Analog communications are simple and robust. 4 ... 20 mA analog (point-to-point) communication networks, as simple as they may be, do have some limitations. Digital communications provide solutions to these limitations and offer increased benefits.

Immunity to Noise

One significant problem is signal interference. Noise induced on the 4 ... 20 mA signal can be interpreted as a change of the process value. To avoid common problems associated with a 4 ... 20 mA signal, it is best to convert the analog value into a digital value. Digital values are either on or off, there is no in between. Digital communications provide resistance to electrical interference and tend to be more fault tolerant. This fault tolerance is a clear advantage over analog 4 ... 20 mA communications.

Multiple Variables from One Device

Digital communication allows more process information to be transmitted by using encoding. A fieldbus protocol combines multiple process variables into a single transmission to the control system. Additionally, the microprocessors in the devices can calculate multiple process variables from a single probe.

Ease of Commissioning

Traditional 4 ... 20 mA devices must be physically addressed, configured and commissioned with a handheld configurator. This method is time-consuming and may require the wiring to be disrupted to connect the handheld device. Many times, this is difficult in hazardous locations. Fieldbus devices can be commissioned, configured, and scaled from the process control room, making maintenance and troubleshooting much easier.

Ease of Maintenance

Digital communication allows the quick transfer of diagnostic information about field devices and the physical layer. Since this diagnostic status is continuously transmitted to the controller and asset management system, predictive maintenance can be implemented, allowing for better planning and shorter plant outages.

Physical Layer

Components

The physical layer of both networks is identical and based on the IEC 61158-2 standard, clause 12. IEC 61158-2 identifies the components that create a complete segment as a host; fieldbus power supply, cable distribution, termination, and field devices.

The physical layer specification for FOUNDATION Fieldbus H1 and PROFIBUS PA networks is based on international standard IEC 61158-2 of the International Electrotechnical Commission and ISA S50.02-1992 of the International Society of Measurement. The specification states the requirements for fieldbus component parts. It also specifies the media and network configuration requirements necessary to ensure proper levels of data integrity before data-link layer error checking and interoperability between devices at the physical layer.

Host/Master

The first component of a segment is the control system interface module. For FOUNDATION fieldbus, the interface would be called the H1 host. For PROFIBUS applications, the controller interface would be a PROFIBUS DP master. These interfaces are responsible for control of the segment and ensuring communication. See Figure 3.

Trunk

The trunk is the main cable which runs along the entire segment. All other components for the segment connect to the trunk line. This is similar to a tree where the trunk supports all of the branches. See Figure 3.

Fieldbus Power Supply

FOUNDATION fieldbus and PROFIBUS PA offer the benefit of power and communication being on the same twisted pair of cables. This requires a fieldbus power supply, different from the standard bulk power supply, which provides a matching impedance to the segment. With the communication being a rectangular signal superimposed on the supply voltage, the matching impedance prevents this signal from being short circuited by the bulk power supply. The typical output ranges for fieldbus power supplies are 13 V DC ... 30 V DC and 110 mA ... 500 mA. Higher voltage supplies allow longer cable lengths. Higher current outputs allow for more devices to connect to a single segment.

Another important feature of the fieldbus power supply is the redundancy option. In the early years of fieldbus, this option was not available. As more installations used the new technology, the demand grew for increased reliability from the power supplies. See Figure 3.

Device Coupler

There must be some sort of junction point between the segment trunk and the field devices. The device coupler allows various numbers of devices to be parallel connected to the trunk. There are several types of junction boxes available on the market for this purpose.

The most basic option is a simple terminal block or tee connector. This option generally has connections for trunk in, trunk out, and one field spur. The connections can be terminals or quick disconnect. This option provides no short circuit current limitation and is generally the least expensive.

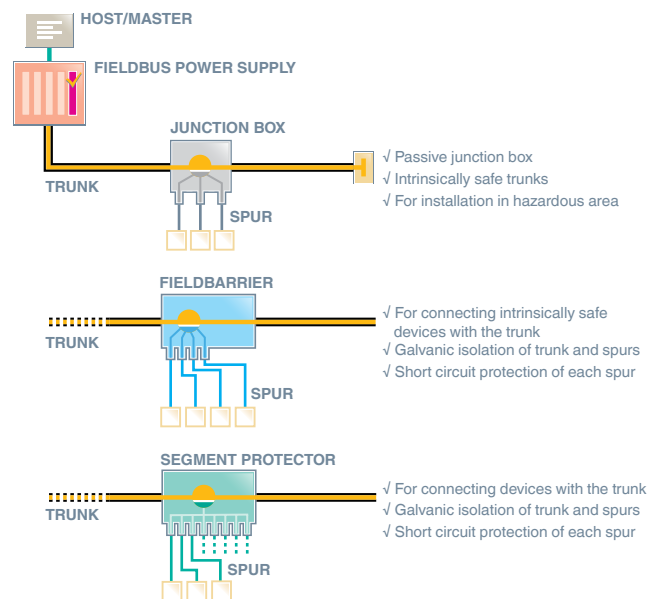


Figure 3 Different types of device couplers

The second option is a short circuit current limitation module often called a Segment Protector, device coupler, or brick. These modules are available with various spur numbers ranging from 4 to 12 spurs. Short circuit current limitation ensures that a short circuit on one spur does not affect communication for the entire segment. For this reason, short circuit current limitation modules should be used in every installation. This option provides the added benefit of feedback for the user. The Segment Protectors offer LEDs that indicate power, communication, and spur short circuits.

Most junction boxes of this type are Zone 2/Division 2 mountable and with proper device certification can be used for non-incendive, Ex ic installations. They may be DIN-rail-mounted devices, molded blocks, or mounted into small field enclosures. The connectors on the Segment Protectors come in various styles, with terminals and quick disconnects being the most common.

The FieldBarrier is a device coupler with galvanic isolation. It is the core component of the High-Power Trunk Concept. The purpose of the FieldBarrier is to place the intrinsic safety barrier as far as possible into the field and still provide the most power to the network. A FieldBarrier is typically a multi-channel device that can be daisy-chained on the segment. FieldBarriers provide short circuit current limitation and intrinsically safe outputs according to Entity or FISCO (Fieldbus Intrinsically Safe COnccept). Mounting options are similar to those for Segment Protectors. These devices are rated for Zone 1/Division 2 mounting with connections to devices in the Zone 0/Division 1 area.

Terminator

Every segment requires exactly two terminators to operate properly. The terminators are the equivalent of a $1\ \mu\text{F}$ capacitor and a $100\ \Omega$ resistor in series. The terminators are placed at the ends of the segment. Terminators serve as a shunt for the fieldbus current and protect against reflections.

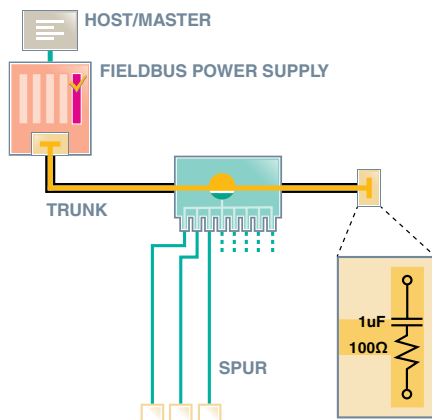


Figure 4 Two Fieldbus Terminators per Segment

The primary function of the terminator is to act as a current shunt for the control network. Fieldbus communication occurs when the field device modulates its current draw. The two $100\ \Omega$ loads in parallel create a $50\ \Omega$ equivalent load for the segment. Using Ohm's Law, we can see that the ideal signal level is $50\ \Omega \times \pm 10\ \text{mA} = 1\ \text{V}_{\text{pp}}$. Varying current is passed across the equivalent terminator load, resulting in a signal voltage level of $0.75 \dots 1\ \text{V}_{\text{pp}}$. Without the proper number of terminators, the signal level is out of specification and can disrupt the network.

Another function of the terminator is to reduce the impact of electrical reflections. Reflections on a control network are similar to waves in a pool. As a wave propagates through the water, the wave comes into contact with obstacles such as the side of the pool. When the wave hits the side of the pool, a small part of the wave bounces back towards the origin of the wave. In a fieldbus network, the communication signal is the wave. The side of the pool is represented by inconsistencies in the cabling. These reflected signals cause problems such as noise, jitter, and inaccurate data. Using a terminator at each end of the segment minimizes inconsistencies and reduces reflected signals.

Spur

A spur is the wire connecting each field device to the main trunk line. The length of the spur is limited based on the number of participants connected to the segment and the number of instruments per spur. We recommend that you connect only one field device per spur to maximize the short circuit current limitation of the coupler. See Figure 4.

Field Device

The field device is the end measuring instrument used in the process. The process variables collected by the field device are transmitted on the bus for use in controlling the overall process.

Cables and Cordsets

IEC 61158-2 offers cable recommendations on length, gauge, inductance, and capacitance. While the IEC standard does not specify the color, the de facto industry standard color is orange for general purpose and light blue for intrinsically safe applications.

Cables are divided into four types: A, B, C, and D.

Type	Description	Shield	Twisted	Cable Cross Section	Max. Trunk Length
A	Shielded twisted pair	Yes	Yes	$0.8\ \text{mm}^2$ (AWG 18)	1900 m (6200 ft)
B	Multiple twisted pair with shield	Yes	Yes	$0.32\ \text{mm}^2$ (AWG 22)	1200 m (3900 ft)
C	Multiple twisted pair without shield	No	Yes	$0.13\ \text{mm}^2$ (AWG 26)	400 m (1300 ft)
D	Multi-core, w/o twisted pairs and with overall shield	Yes	Yes	$1.25\ \text{mm}^2$ (AWG 16)	200 m (656 ft)

Table 1 Cable type and trunk length

Presently, quality fieldbus cables have an exposed run (ER) rating on them. This rating means the cable is crush resistant and is allowed to run outside of a cable tray or conduit for up to 50 ft. Therefore, this rating offers greater flexibility in the route design, resulting in reduced project costs.

The shielding makes the cable less sensitive to any electromagnetic interference that occurs in the area around the system. Laying fieldbus lines in their own cable tray further protects against false signals. The cables should be at least half of a meter away from any other lines containing electrical power that can be transmitted within the cycle time.

Many installations have begun using molded cordsets to make installation and replacement of devices easier, faster, and less prone to errors. Typically, FOUNDATION fieldbus users use 7/8" four pole connectors and PROFIBUS PA users have M12 four pole connectors. Connections to junction boxes can be hard-wired through cable glands or utilize molded connectors.

Topologies

A topology is how communication interfaces of individual bus devices are connected to each other on a segment.

When designing a segment, you need to consider the advantages and disadvantages of the various topologies. Since a single device failure can bring down an entire segment, short-circuit proof junction boxes are recommended for the distribution of the trunk to the spurs. Using a digital bus instead of conventional technology already saves on wiring and installation costs. The use of a mixed line and tree topology maximizes your savings.

Star

Star structure connects all devices directly to the control room without trunk or spurs. This structure is most often used when all of the field devices designated for the same segment are in close proximity to the control room cabinet. This structure requires the most cabling and is seldom applied in practice.

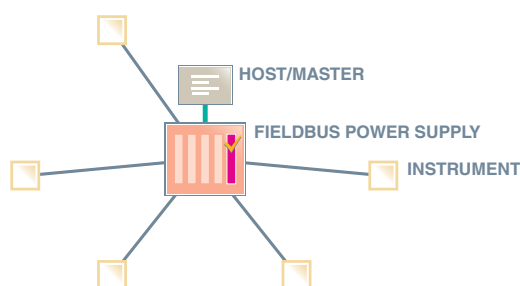


Figure 5 Star topology

Line

In a line structure topology, the network wiring is symbolized as a single line between the two devices. A twisted pair of wires connects all nodes with each other using a line. The line structure is often referred to as a bus topology, and it was already noted that this structure is frequently used in fieldbus-based systems. The devices are generally not connected in a daisy-chain with the cable leading from one device to the next, or with a junction box and using short spurs. Line/bus topology is used most frequently because it is clearly structured and costs less in wiring, as a general rule, than all the other topologies listed here. With everything connected in line, the exchange of a device will be disruptive to fieldbus communication.

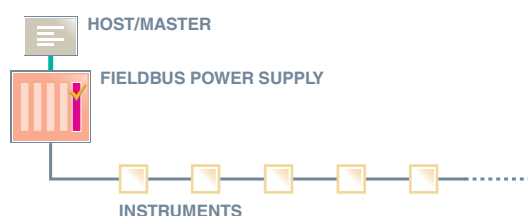


Figure 6 Line topology

Tree or Trunk and Spur Topology

Tree structure topology is built upon the line structure. The trunk line is run from the control room into the junction box located in the field. Each device is connected through the spur connections on the device coupler. By locating the distribution module at a central location near all the devices, this topology allows for maximum cable saving. There are different variations on the tree topology which are commonly used.

In a distributed architecture, a trunk line generally goes out to a single junction box. All spurs then branch out from this enclosure. The junction box may contain one or several device couplers to accommodate the desired number of spurs.

In a highly distributed architecture, the trunk is linked to multiple junction boxes. The boxes are smaller and placed closer to the field devices. Each box contains one Segment Protector or FieldBarrier.

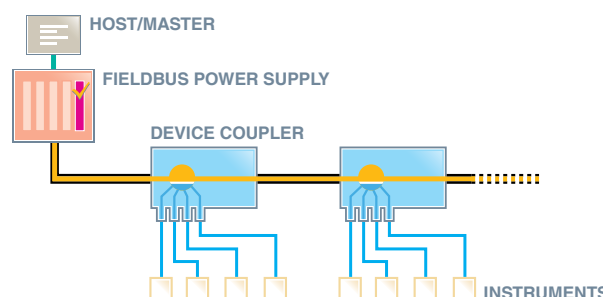


Figure 7 Tree or Trunk and Spur Topology

Communication

ISO/OSI Model

The International Standards Organization (ISO) has determined a general architecture of network specifications in their DIS 7498 model (applicable to most any digital network). These network specifications were developed as part of the Open Systems Interconnection (OSI) initiative to define the layering of communications in network protocol design. The OSI protocol stack is split into seven layers for modularity. All of the software layers work together, building and distributing the communications. Not all network protocols use every layer.

Digital fieldbus systems (FOUNDATION fieldbus and PROFIBUS PA) use three of the seven layers: 1, 2, and 7. This is because physical and logical layers are the same and there is no direct communication from one node to another across different segments.

	Data	Layer
Host Layers	→ Data	7. Application Network Process to Application
	Data	6. Presentation Data Representation and Encryption
	Data	5. Session Interhost Communication
Media Layers	Segments	4. Transport End-to-End Connections and Reliability
	Packets	3. Network Path Determination and IP (Logical Addressing)
	→ Frames	2. Data Link MAC and LLC (Physical Addressing)
	→ Bits	1. Physical Media, Signal, and Digital Transmission

Figure 8 OSI Model: FOUNDATION fieldbus and PROFIBUS PA use the layers 1, 2, and 7

The Layers in Detail

- **Level 1 – Physical Layer:** Defines the electrical and physical specifications for devices. In particular, the physical layer defines the relationship between a device and a physical medium. This relationship includes the layout of pins, voltages, and cable specifications.
- **Level 2 – Data Link Layer:** Is the protocol layer that transfers data between adjacent network nodes in a wide area network or between nodes on the same segment. The Data Link Layer provides the functional and procedural means to transfer data between network entities and provides the means for error detection and correcting events that occur in the physical layer.
- **Level 3 – Network Layer:** Establishes procedures for the encapsulation of data into "packets" for transmission and reception.
- **Level 4 – Transport Layer:** Defines how complete data files are handled over a network.
- **Level 5 – Session Layer:** Organizes data transfer in terms of the start and end of a specific transmission.
- **Level 6 – Presentation Layer:** Defines the character sets, terminal control, and graphics commands so that abstract data can be readily encoded and decoded between communicating devices.

- **Level 7 – Application Layer:** Refers to standards for generating and/or interpreting communicated data in its final form. In other words, the actual software programs used to communicate data.

Manchester Encoding

Current and Voltage

A rectangular alternating voltage is used for communication and is modulated onto the DC signal for the power supply of the device. The power supply provides a direct current with up to 31 V. Devices are required to operate with a minimum voltage of 9 V. Power must be available to all network stations. Message transfer is performed by an alternating current with a current intensity of 9 mA and a frequency of 31.25 kHz. The transfer rate of 31.25 kbps is slow compared to modern computer networks. However, this slow transfer rate results in reliable and stable communication that is suited for longer signal paths.

1s and 0s

Both FOUNDATION fieldbus and PROFIBUS PA use communication based on Manchester biphas encoding. This encoding defines the waveform that the devices on the network create by alternating the current of the segment. The transitions across the bit times zero line – that is, the DC supply voltage level – are analyzed in order to define a one or zero. A positive transition indicates a zero and a negative transition indicates a one. Each transition is expected at the midpoint of the bit time within a limited window for this change. If the crossing does not happen within this window, then the bit is lost. Manchester encoding is a synchronous serial signal, so the clocking of the network is contained in the communication waveform.

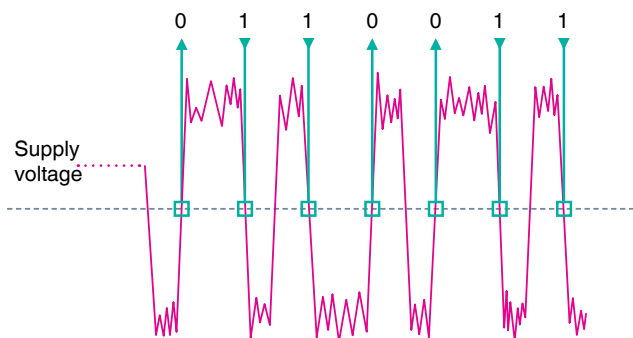


Figure 9 Sample Waveform

Signal Level

The voltage of the communication signal is $0.75 V_{pp} \dots 1.0 V_{pp}$ (peak-to-peak), at a resistance of 50Ω . A fieldbus terminator measured to correspond to the characteristic impedance of the cable (100Ω) is mounted to suppress signal reflections on both ends of the line. See Figure 9.

Noise

Any type of low-frequency or high-frequency disturbance is referred to as noise. Too much noise can be disturbing to communication. See Figure 9.

Jitter

Jitter is the difference between the expected and actual time of a bit. It is measured in milliseconds (ms). Jitter responds very sensitively to any type of change in the fieldbus physical layer. Any change in inductance, capacitance, or resistance will change jitter. It is thus an excellent measurement for physical layer quality: if jitter is OK, the installation is OK. See Figure 9.

Diagnostics

Introduction

Classic 4 ... 20 mA control and instrumentation systems have been the mainstay of countless production plants around the world for many decades. While the reliability of 4 ... 20 mA loops is acceptable, failures regularly occur. Many of the faults encountered on 4 ... 20 mA loops cannot be detected or are not discernible.

Traditionally, the attention given to the 4 ... 20 mA cable systems and instruments involves manually operated test equipment or loop testers. Testing is performed by highly qualified engineers in a reactionary way – if a fault is discovered, a repair is made. It would be advantageous if automatic test equipment, providing computer-generated sign-offs, could be attached to every 4 ... 20 mA loop and operated at the touch of a button. It would be even better if the same automatic test equipment could be left in place to continue monitoring the health of each 4 ... 20 mA loop during the plant's operational lifetime.

With the introduction of fieldbus, with its more robust digital communication when compared to 4 ... 20 mA, one fieldbus trunk cable services up to 32 fieldbus instruments. So, the option of attaching, and retaining, advanced automatic diagnostic test equipment on every trunk would be a feasible and cost effective consideration – it could actually reduce construction and commissioning expenditure (CAPEX), as well as operational expenditure (OPEX).

The cost reductions are apparent when you consider the key features offered by automatic diagnostic test equipment to each phase of the project life cycle:

- **Phase: Construction and Commissioning** – Rapidly and thoroughly test every network at the touch of a button. Print fully completed and accurate test reports as well as computer-generated sign-off sheets.
- **Phase: Construction, Commissioning, and Operation** – Test each trunk for conformity or continual conformity to the fieldbus standard IEC 61158-2. Automatically identify and report any failure or fault that could lead to a failure.
- **Phase: Operation** – Always stay connected and available with continuous automatic monitoring and reporting 24 hours a day, seven days a week, year after year.

To put the capital expenditure into perspective; the cost to install the new generation of advanced physical layer diagnostic systems that would be required to service 100 segments supporting approx. 1200 field devices, would equate to the cost of one skilled instrument and electrical engineer for only three months – not including the cost of the supporting test equipment expense.

Of course, fieldbus reduces the density of the field wiring, but if things go wrong, the control system can lose sight of multiple devices and many control loops in one instance. Thus, the design, construction, and proactive maintenance of a robust fieldbus network is an important consideration.

Physical Layer Diagnostics Tools

Many different versions of fieldbus test equipment are gradually being introduced to the market with varying degrees of price and performance.

The summary below describes the product range in basic terms:

Simple Handheld Devices

Handheld physical layer diagnostic testers for rudimentary failure troubleshooting and offline testing.

Basic Online Devices

Basic online physical layer diagnostic systems for rudimentary failure detection. These systems can be used for commissioning and kept in place for operational failure detection and alarm.

Mobile Advanced Devices

Mobile advanced physical layer diagnostic systems used for advanced testing where the control system and associated fieldbus power supplies have not yet been made available for commissioning or for detailed operational failure troubleshooting.

Advanced Online Devices

Online advanced devices are used for construction, commissioning and operational testing, fault finding, user-defined reporting/documentation, and early fault warning. Online systems are permanently connected to every segment and kept in place throughout the project life cycle.

Why Advanced Physical Layer Diagnostics is more Beneficial

You might think that physical layer diagnostics simply comprises a volt meter and a signal amplitude/noise analyzer connected to the trunk with an alarm warning feature. However, experience and extensive research has shown that the more measurement types taken and analyzed, the better the detection of a wider range of evolving faults is. For example, changes in noise levels or signal levels cannot disclose the effects of a power supply impedance drift or a terminator capacitor drift – instead, jitter measurement is used to detect the minute changes caused by such evolving failures. For more information, see "Importance of Jitter Measurement" in this section. Furthermore, a greater variety of diagnostic functions leads to a more comprehensive reporting structure and reveals potential issues which may arise during plant operation.

The Importance and Limitations of Online Advanced Physical Layer Diagnostics during Operation

For any system, downtime failures can affect production, product quality, and on rare occasions, lead to an environmental catastrophe or an unsafe situation. Therefore, early warning of a pending failure is essential for proactive maintenance and failure prevention. For fieldbus, failure prevention is an important task given the number of devices and control loops supported on one segment – and a task that can be done cost effectively.

The primary goal of the diagnostic system is to monitor and announce small changes or characteristics of a developing fault, long before the fault becomes destructive, so that the fault can be repaired or rectified while it is easily manageable. This goal includes physical layer compliance and continuing compliance with the appropriate standards. Applying online advanced physical layer diagnostics, combined with existing diagnostic capabilities, provides an indication of many developing faults. Being online, and on every line, means that a fault, intermittent or evolving, can be picked up immediately at any time and on any segment or part of the segment. The time stamp is important because many failures or propagating failures can be random or intermittent or linked to an external event.

Diagnostic systems alone do not guarantee high reliability. Obvious faults can occur where diagnostic warnings are of little preventative use. Common examples are a direct trunk short or open circuit caused by someone cutting through the trunk cable or a bad network design resulting in too little voltage getting through to the instruments. While these fault types are undesirable, there are protective measures that can be put in place to protect the network from such failures. With careful consideration of the common points of failure, that is, trunk cable and terminals, terminators, power supplies, then mechanical or electronic protection can be applied to those areas to great effect and therefore reduce the probability of these types of failure to a low level – or even eliminate the risk altogether.

The other significant advantage with online equipment is that at no time during monitoring, troubleshooting, testing, or validation would you need to do either of the following:

- Retrieve and refer to wiring diagrams
- Track down terminal connections to connect test or diagnostic equipment to
- Disturb control room cabinet wiring or patch cable
- Go on site and open up junction boxes until a specifically pinpointed repair is required

Therefore, the potential to introduce errors is minimized and the time taken for troubleshooting is dramatically reduced.

Diagnostic Information and Reporting

As stated earlier, a greater variety of diagnostic functions leads to a more comprehensive reporting structure. Although the measurement types may be complex in themselves, the information delivered must be tailored to the recipient skill level. An operator may observe a rudimentary diagnostic warning, and must be able to act upon it appropriately. From the information provided, the operator may decide to call the maintenance engineer for immediate attention, or the operator may decide to schedule the repair for the next shift, or even during a scheduled shutdown. On the other hand, the information provided is more detailed, designed for extensive troubleshooting by an expert maintenance engineer or even a remote expert engineer.

Good diagnostic measurements require good analytical software, which is too complex for handheld devices to implement. Furthermore, measurements sometimes have a relationship with other measurements, and to decode the relationship requires sophisticated software analysis.

The information generated by the advanced mobile and online diagnostic module software must be able to serve many user skill levels.

The Fieldbus Oscilloscope

The fieldbus oscilloscope bridges the gap between automatic diagnostics and manual troubleshooting. Competent engineers can assess in-depth information from an in-built dedicated digital storage oscilloscope with a vast selection of fieldbus-specific trigger point options.

An oscilloscope is by far the best tool for troubleshooting unusual or complex network faults, and integrating the oscilloscope within the diagnostic module has many advantages.

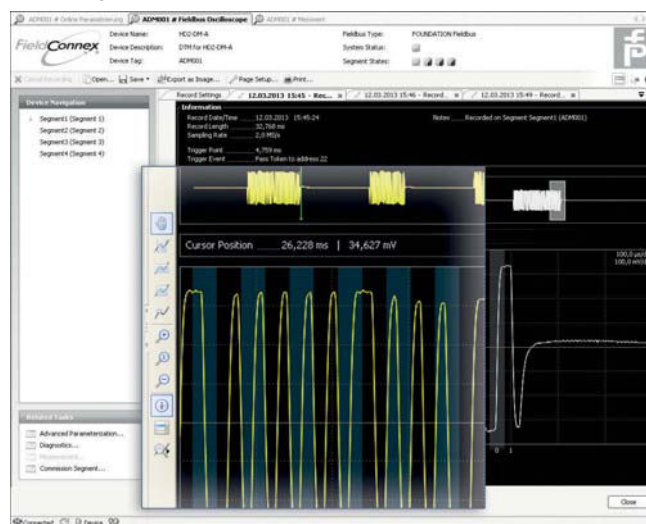


Figure 10 A fieldbus oscilloscope shows the signal as it is. This information helps the fieldbus expert draw additional conclusions.

Valuable Timesaving during Failure or Downtime

Integrating an oscilloscope into the diagnostic module can save a great deal of downtime – time spent finding and reading drawings, tracking down the correct terminals and connecting test probes to the terminal connections in the control room marshalling cabinets, and so on.

Eliminate Cable and Junction Box Disturbance

Disturbance to the control room marshalling cabinet cable network, patch bays, or having to open field junction boxes to connect oscilloscopes can lead to or add faults. Using an in-built online oscilloscope eliminates the need to disturb any hardware until a specific targeted repair is required.

A Record for Remote Use

Oscilloscope data can be recorded on the maintenance terminal. This way, a record exists. The information can be sent to a remote expert for additional troubleshooting, saving valuable time.

Advanced Diagnostics Infrastructure

The Integration of Advanced Physical Layer Diagnostics into Fieldbus Power Supplies

To decrease cost even further, one online physical layer diagnostic module should be able to monitor several segments at the same time. A good compromise between performance, device complexity, and hardware cost results in a single diagnostic module that manages four segments simultaneously. To minimize wiring efforts, the diagnostic module should be a part of the fieldbus power supply system or backplane.

Today's state-of-the-art fieldbus power supplies offer integrated Advanced Diagnostic Modules and single segment power supplies (with optional redundancy) grouped on a backplane to keep the wiring and maintenance simple and the cost low. This configuration is gaining a great deal of customer interest. In the near future, the majority of fieldbus power supplies will be supplied with advanced physical layer diagnostics by default.

Diagnostic Information – Integration into the System Backbone

The information from the diagnostic hardware can be transferred through a dedicated diagnostic network or through the fieldbus itself. But the most effective way is to use a separate or dedicated network, where several diagnostic modules can be connected through Ethernet to the system backbone. The operator station handles status information and the instrument management station provides full access.

Important Consideration

Transmitting diagnostic information through the segments means that the required additional host interfaces and power supplies significantly increase the control system cost.

Also, the availability of the diagnostic information depends on the availability of the segment through which the information is transferred. If a fatal error on a segment occurs, the diagnostic information cannot be sent to the host when it is needed the most.

Additionally, the communication bandwidth of an H1 fieldbus is not designed to send the amount of data necessary to analyze the physics of a segment adequately.

Therefore, routing diagnostic data through an autonomous digital cable is the only reliable, efficient, and cost effective approach to take.

Failure Cause, Effect, and Detection

Potential Causes of Failures and Their Effect

Without doubt, a well-designed and maintained segment operates without any problems for many years. Nevertheless, like any electronic system, failures are bound to occur on some segments at some point in their operational lifetime.

Fieldbus failures can develop or occur at any time without warning. Failures or faults can range from an insignificant change to a nuisance alarm or a fatal crash.

The next section covers the details of a wide range of failure types – not just the obvious textbook faults covered by basic fault finding. Remember that many of the failures covered below can also apply to classic 4 ... 20 mA systems.

Pole-to-Shield Faults (Unbalance)

A cable pole, either negative or positive, can directly create a low-resistance contact to the shield. This common fault is usually set up when cable ends are being drawn through the instrument housing, or when a cable is fractured during construction. However, not all faults are direct short circuits or low resistive contacts. Some faults may be capacitive or be of high resistance. For example, a cable may have unacceptable capacitive unbalance due to poor installation or manufacturing deficiencies, further compounded by device unbalance. Or, the cable may have water ingress and exhibit a low conductivity. Although these types of faults can be tolerated, a subsequent or compound fault normally leads to a failure. For example, one pole may have a capacitive short fault to ground and the other pole may be short circuited directly to the cable shield. Unbalance increases the sensitivity to noise and therefore increases the probability of communication errors.

Pole-to-Pole Faults

A pole-to-pole fault is another possible fault scenario. A direct low resistance short circuit on a trunk is a fault that cannot be tolerated, and the segment fails. Not all faults are direct short circuits. Some faults are resistive. For example, device filter capacitors or overvoltage protection semiconductors could be leaking, cable or junction boxes could be filled with water, and so on.

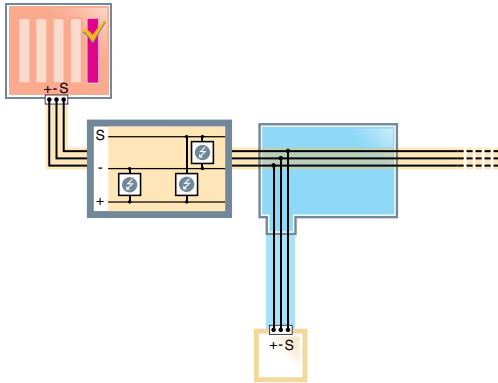


Figure 11 Pole-to-pole faults

Crosstalk, Noise, and Interference

Noise comes in many forms and can span the entire frequency spectrum. Noise can be picked up from nearby variable frequency drives, or the cable itself can be subject to vibration. Noise can also be induced by electromagnetic interference, or picked up from a neighboring cable as cross-talk.

Earth loops and earthbound noise are another form of low-and high-frequency noise. This noise can be transmitted through the cable shield and then be picked up by the trunk and spur cable. Earth faults are often the worst enemy of signal quality and the source of many problems.

The fieldbus standard sets limits to the permitted noise levels across the entire frequency spectrum from DC up to tens of MHz. The most destructive noise lies within the communication bandwidth where the levels are not allowed to exceed 75 mV peak-to-peak.

Terminator Faults

Simple terminators are common points of failure - even with redundant power supplies with so-called electronic redundant terminators, there is always a single or simplex terminator on the field side of the trunk.

Terminators fail due to the resistor breaking to an open circuit causing the loss of termination, or in some cases failing to a low resistance causing severe signal distortion. Capacitors can fail in a number of ways: Open circuit leading to loss of termination, short circuit leading to a fatal segment crash or component destruction or drift to a low capacitance, as well as failing to a resistive or conductive state, leading to gradual loss of the terminator.

Redundant electronic terminators and automatic terminators are prone to operation failure, due to their complex electronic sensing and switching components. Automatic terminators can deactivate at inconvenient points along a segment, leaving long lengths of free, unterminated trunks.

Note: Redundant terminators are not redundant in the strict sense, but any failure of a single component does not lead to a fatal crash, as compared to a simplex terminator. Instead, a single component failure causes a slight tolerable change in the network impedance. The Advanced Diagnostic Module picks up on this change, so that a repair can be made or scheduled.

Over-/Under-Termination

A system can tolerate a degree of over- or under-termination, depending on the network configuration and the initial signal quality. Other influencing factors include the quality of the fieldbus power supply/power conditioners and the device loading.

A failed or missing terminator at the end of a long trunk cable always leaves the cable open to signal reflections and creates signal distortion. Even though a laboratory test demonstrates that this distortion can be tolerated with short lengths of cable, in the field and in real life, it can be a different story.

Power Supply Drift or Impedance Failure

Passive impedance of fieldbus power supplies is set by fixed, robust, passive power inductors so impedance change is impossible. On the other hand, the impedance of active fieldbus power supplies depends on capacitors and transistors, and these components can drift over time or fail even when power supplies are arranged as a redundant pair.

Impedance drift or failure of active fieldbus power supplies do not always lead to signal attenuation. What usually happens is that the signal peaks droop or rise depending on whether it is too capacitive or too inductive.

Drooping or rising signals can lead to jitter errors at first, and then to multiple data retransmissions, before a fatal error occurs.

Water Ingress

Water ingress inside the cable or around terminals across two poles, caused by gland failure, junction box seal failures or split, fractured or porous cables, do not induce noise. Instead, it conducts electricity, resulting in a measurable increase or change in trunk current or earth leakage.

There is more to water ingress than just the conductive path it generates. By itself, water ingress presents no danger. Take condensation, for example. In its purest form, water has no conductivity. Only when conductive impurities are added or dissolved water does conduct electricity. As soon as conductivity is established, pole-to-pole faults immediately suffer from galvanic corrosion to the point where the terminals and cable can be dissolved within days.

Device Failures

Many devices have FDE – fault disconnection electronics. The idea behind FDE is that if destructive "jabber" is detected, then the device automatically disconnects from the segment. However, not all device failures can be prevented - the device impedance can drift to a destructive level long before a segment or spur protector can operate effectively. Many devices have a diode bridge network to allow bipolar connection to the trunk. These bridges can fail due to low impedance, or they can fail due to short circuit.

Transient Voltage Suppression (TVS) and Surge Arrestors

Surge arrestors or transient voltage suppressors are always used in power supplies, spur protection, and devices to prevent high-voltage surges from destroying or damaging sensitive internal electronic components.

Although surge arrestors or TVS (protection diodes) can prevent many high-voltage spikes from destroying devices or components, they are in fact a common point of failure themselves. The TVS diodes, which are connected directly across the trunk, can drift or leak, or they can fail to short circuit, which is the most common cause of failure for such devices. TVS diodes are inactive under no electrical or thermal stress during normal operation, and should last indefinitely. But they can be weakened after a high-voltage surge, and this often results in an increase in current leakage or a problematic impedance change.

Device Noise Filter Capacitors

Devices, power supplies, and protection circuits commonly use small capacitors for noise filtering. They are arranged across the poles, and from pole to shield.

Because there are many devices attached to a single segment, then the number of failure points is proportionally high (12 devices = 36 capacitors). The capacitors can fail open circuit, short circuit, and can drift to a lower capacitance with differing effects, where some can be destructive or, if left unattended, they could lead to a compound failure.

Signal Polarity Inversion

Many devices are bipolar, which means they can connect to a segment in any polarity. However, a few devices, power supplies, or repeaters are not bipolar, and they have the potential to be accidentally cross-wired. Cross-wiring inverts the data signal, which in some cases can be tolerated by the system, but intercommunication between devices fails. If devices are cross wired during construction and commissioning, many of the faults are not noticed until operation begins.

Power Supply Health and Failure

The fieldbus power output voltage can fall to unacceptable limits over time. Even with redundant power supplies, voltages can fall due to a combination of failures, that is, the OR diode fails short circuit, and one of the power supply outputs falls to a lower voltage, at a low impedance. For redundant power supplies, either one of the two power supplies can fail, requiring an urgent replacement.

Detection of Failures by the Advanced Measurement Techniques

Having considered the failure types, a vast range of measurement techniques is required for an early warning of any potential failure and for extensive fault detection.

The following section covers the measurement types and how they are used to assess a fault or more importantly, a propagating fault.

Importance of Jitter Measurement

Jitter measurement deviation is the most accurate indication of a developing fault. This finding has been agreed to by the Fieldbus Foundation Physical Layer working group (Chevron, Emerson, MTL, Pepperl+Fuchs, Relcom, and Yokogawa) concluding that jitter measurement is the only beneficial parameter to analyze when testing network impedance and power supply performance.

Jitter measurement is also the only parameter that can effectively be measured to verify the fieldbus power supply's conformance with IEC 61158-2 and compatibility with other devices. Passing jitter measurement testing gives the power supply the standard FF.831 tick mark. Continued jitter measurement verifies the power supply's continued compliance with FF.831 and its operational health.

Jitter analysis observes small changes that are not normally significant enough to cause data retransmissions or any other alarms. Jitter measurement ignores the singular effects of noise, attenuation, and distortion. For example, noise levels may be just within limits and the signal attenuation and distortion may also be just within limits so that no alarms go off, but collectively, they may cause data detection to fail. Jitter measurement detects the onset of failure, long before any other measurement parameter can react without a false alarm.

Deciding which Diagnostic Hardware/Software to Choose

Deciding which diagnostic module or system to purchase depends on the needs of the contractor, the needs of the purchaser and/or operator, or even project scheduling.

The choice should be based on features, performance, and cost. Although the cost difference is marginal between online systems, the cost must be weighed against the broader range of savings across the project life cycle.

In some cases, the control system and associated fieldbus power supplies are unavailable during construction or precommissioning. At that point, a portable mobile Advanced Diagnostic system and analytical software with portable mobile fieldbus power supplies are the only option. By ensuring that the control system, if not at least the fieldbus power supply hubs fitted with Advanced Diagnostic equipment, are installed at an early stage during the project life cycle, the project can realize significant cost and time saving benefits.

Case Study and Cost Comparison

Using Advanced Online or Mobile Physical Layer Diagnostics

Fieldbus is still relatively new. The manpower levels required for construction, commissioning, and operation of a fieldbus plant is often estimated according to the equivalent 4 ... 20 mA system. This next section will demonstrate the time and manpower savings seen with fieldbus technology as compared to 4 ... 20 mA technology, and more significantly, the savings seen when using advanced physical layer diagnostics.

Notes and Estimates

This case study considers the following points: Every project varies with regard to engineering staff levels and time schedules. Other factors such as the process or the product to be manufactured and the environment also play an important part in overall expenditure, so the estimates are general, but they do give an overview of the vast savings potential.

Some contractors allow a team up to 30 minutes for installation, precommissioning checks, and repair per instrument loop. The range seems to vary between 10 minutes per loop (a check), and up to 2 hours per loop (a check including repair work) depending on the project definition. For a 4 ... 20 mA system, 30 minutes per 4 ... 20 mA loop result in more than 2 ¼ months worth of qualified and experienced engineering, based on an eight-hour shift per day and a full work week. This case study considers a shorter time estimate.

Precommissioning can be grouped with construction, but for simplicity, precommissioning is grouped with commissioning, where the common aspect of control loop checking is ignored, as this is the same for any hardware model.

Instrument failures are in fact the same for any model, as a classic 4 ... 20 mA system has the same number of instruments as a fieldbus system. Based on an MTBF of 200 years per instrument, a failure of six instruments per year is anticipated for 1200 instruments, and with an MTTR of four hours, this means three days of repair time per year.

Equally, any cable or cable system repair work is the same for fieldbus with or without diagnostics. With the only difference being downtime – a repair to prevent a fault may take the same time as fixing a failure and therefore can be ignored.

Savings Summary

In summary, fieldbus, with its automatic device commissioning, online test equipment, and cable infrastructure reduces the amount of time needed for installation, commissioning, operation, testing, and maintenance. An analogy to support this claim is seen with automatic test equipment (ATE) when used to test the same circuit card repeatedly on a production line. The testing is fast, even though the circuit cards may have to be manually loaded. The fieldbus model demonstrates that there are many repeated circuits already connected in place; therefore, the time-saving benefits can easily be validated.

Conclusion

Fieldbus has made it truly cost-effective to use advanced automatic online diagnostics for every segment during the construction and commissioning phases, and to retain the same hardware/software for the operation phase. The same would not have been feasible or economic for an equivalent 4 ... 20 mA system.

From the information provided in this case study and cost comparison along with the data in Table 2, it is clear that the implementation of online advanced physical layer diagnostics will pay for itself in a short time frame, and will no doubt pay for itself after the first expected failure.

Online Advanced Diagnostics, with its greater variety of measurements, can provide early warning for many more propagating failures and so reduce downtime. The same results could not be achieved by using manually operated test equipment, handheld fieldbus diagnostic testers, or even systems supporting basic online physical layer diagnostic capability.

Task	Model		
	4 ... 20 mA	Fieldbus without diagnostics	Fieldbus with diagnostics
Constructional check – check each cable for: continuity, pole-to-pole and each pole-to-shield isolation and a test sheet completed. Allows for time to read the drawings and locate the terminals and connect the cable testers. Note: For fieldbus, additional line resistance and capacitance checks are required. For fieldbus with diagnostics, the cable can be checked at the same time as the precommissioning checks are performed.	5 minutes per cable	10 minutes per cable	Not required
	1 200 instrument cables: 1 200 x 6 000 minutes or 12 ½ days	100 segments: 100 x 10 = 1 000 minutes or 2 days	Not required
Construction failures – anticipated percentage of cable failures and the time taken to repair the fault based on a four hours 'meantime to repair' (MTTR) . Note: Fieldbus has the same number of spur cables as the 4 ... 20 mA model, plus an additional trunk cable.	1% predicted failure = 12, 4 ... 20 mA loops	1% predicted failure = 1 trunk, 12 spurs	Not required
	12 x 4 h = 6 days	13 x 4 h = 6 ½ days	Not required
Pre/commissioning instrument checks 4 ... 20 mA analog – test each instrument with a loop calibrator or handheld tester to ensure correct device polarity, operational voltage test, and loop current check for both analog inputs and analog outputs with a test sheet completed. Fieldbus – test each network to ensure correct device communication, signal-to-noise quality, tag number, and address validation, power supply voltage test with a test sheet completed. Note: The Advanced Diagnostic model tests many more physical layer parameters in a shorter time.	10 minutes per cable	60 minutes per segment	8 minutes per segment
	1 200 instrument cables: 1 200 x 10 = 1 200 minutes or 25 days	100 segments: 100 x 60 = 6 000 minutes or 12 ½ days	100 segments: 100 x 8 = 800 minutes or 1.6 days
Pre/commissioning failure – anticipated failures and the time taken to repair the fault based on a four hours 'meantime to repair' (MTTR) . Note: Fieldbus with diagnostics includes the predicted cable failures.	0.5 % predicted failure = 6, 4 ... 20 mA loops	0.5 % predicted failure = 1 segment	0.5 % predicted failure = 1 segment
	6 x 4 h = 3 days	1 x 4 h = ½ days	2 x 4 h = 1 day
Operational maintenance over a 1-year period – observing and inspecting every loop/segment for anomalies and to perform regular shutdown repair and maintenance tasks. Often, the maintenance shift reacts to failures passed on from the operating crew. Note: For fieldbus, additional communication checks need to be performed, using oscilloscopes and handheld analyzers. The diagnostic system tests many more physical layer parameters.	15 minutes per cable	60 minutes per segment	8 minutes per segment
	1 200 x 15 = 18 000 minutes or 37.5 days	100 x 60 = 6 000 minutes or 12 ½ days	100 segments: 100 x 8 = 800 minutes or 1.6 days
Construction and commissioning times	46.5 man-days	21.5 man-days	1.6 man-days
Operational maintenance times	37.5 man-days	12.5 man-days	1.6 man-days

Table 2 Comparing pre-commissioning and meantime-to-repair (MTTR) time and effort of the different signal models

Technology

Basic Principles

Bus Systems

Explosion Protection

Best Working Practices

Application Guideline

Grounding and Shielding

Grounding and shielding is important for immunity to noise of the segment. It is also an essential part for proper explosion protection. Choose a common method for fieldbus that matches the grounding and shielding philosophy of the plant. Great care should be taken to ensure proper grounding/shielding and this should be checked during planning.

Grounding the shield can be done through single-point, multi-point, or capacitive grounding techniques depending on the plant grounding procedures. As discussed earlier, the communication signal is read by the devices as a potential difference between the two leads (+/-). Thus, neither of the two leads should connect to ground or shield. Additional communications stability and protection from faults can be achieved by using galvanic isolation in the power supplies.

Single-Point

The bus shield is only grounded at one point on the segment. This is normally at the power conditioner or control room. The field devices housing and other components of the segment can connect to a local earth. Single-point grounding is the typical method for North American applications.

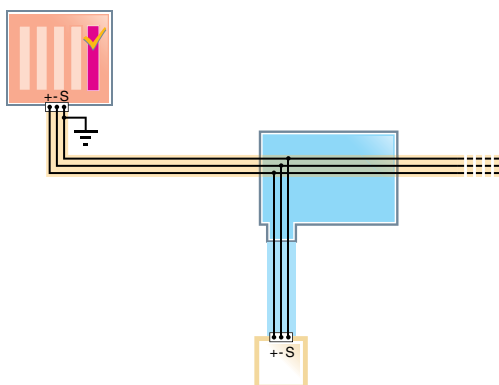


Figure 12 Single-point grounding at the power supply

Multi-Point

The different areas of a plant are separated grounded to a local earth point. These ground points are then tied together with a potential equalization line which runs through the entire plant. The devices and other components can all connect to local ground points.

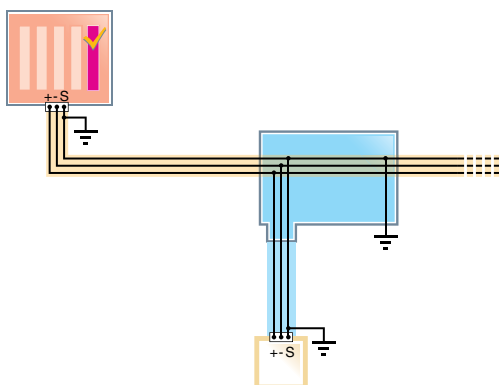


Figure 13 Multi-point grounding

Capacitive

Different areas of a plant can have different ground potentials. The bus shield is capacitively grounded at all devices and device couplers. This avoids currents on the shield.

Where FieldBarriers, device couplers with galvanic isolation, are used, the technique of capacitive grounding can be applied separately for trunk and spur lines. Shields on trunk and spurs are isolated from each other. The trunk is hard grounded at the power supply, capacitive grounding is applied at the FieldBarrier. Spur shields are connected to hard ground at the FieldBarrier, at the instrument, the shield is connected to ground via capacitor.

The devices and other components can connect to earth.

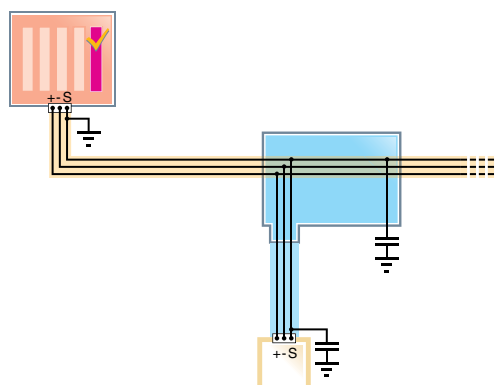


Figure 14 Hard grounding at the power supply, capacitive grounding on the device coupler and instrument.

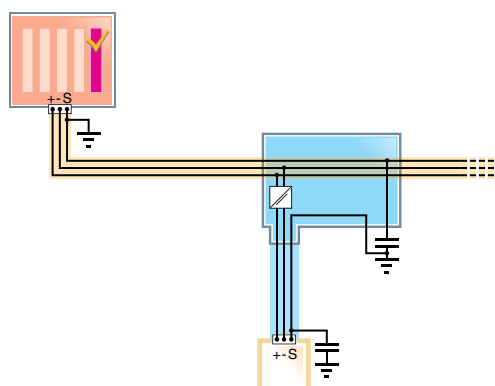


Figure 15 Shields of trunk and spur isolated. Capacitive grounding applied twice - only for FieldBarriers with galvanic isolation. Hard grounding on the housing side, capacitive grounding on all field devices.

Surge Protection

Definition

The effects of a lightning strike, even at a distance of 500 m, endangers electric equipment. A risk analysis based on the location of the fieldbus systems and system topology can help you decide whether to use surge protection.

The main purpose of the surge protection barrier is to limit induced transient voltage over sensitive electrical equipment and to divert the surge current safely to a controlled point to earth.

Surge Protector Design Details

The surge protection barrier provides line-to-line (differential mode) and line-to-earth (common mode) protection. This protection is achieved by integrating suitable switching elements into the surge protection device and guaranteeing a proper connection to earth.

The protection device must be able to respond quickly to high-impulse voltage and current. Since only one switching element is not able to fulfill this requirement, several switching stages are incorporated into the device. This is called hybrid circuit protection.

Gas discharge tubes (GDT) represent the first switching stage. These tubes can withstand high voltage and current, but their slow response times can still allow dangerously high energy levels to pass through. Therefore, a second switching element, a silicon avalanche transient voltage suppressor (TVS) diode, must be implemented to control the remaining energy levels. This diode type responds to low voltage and current levels quickly, clamping the voltage to nondamaging levels, and diverting the surge current reliably to earth. Both protection stages are decoupled via impedance. See Figure 16.

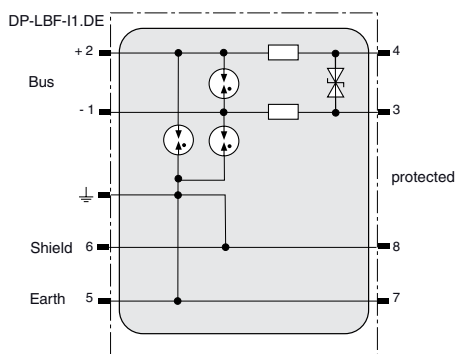


Figure 16 Internal components of a surge protection barrier. Gas Discharge Tubes on the left and the transient voltage suppressor diodes on the right

Surge protection barriers must be able to withstand test pulses as described in the international lightning standard IEC 60060-1.

IEC 60060-1 states that the trickle current pulse "has a shape increasing from zero to peak value in a short time, and then decreases to zero either exponentially or in the manner of a heavily damped sine curve." According to IEC standards, surge protection barriers should withstand exponential type current test pulses. See Figure 17.

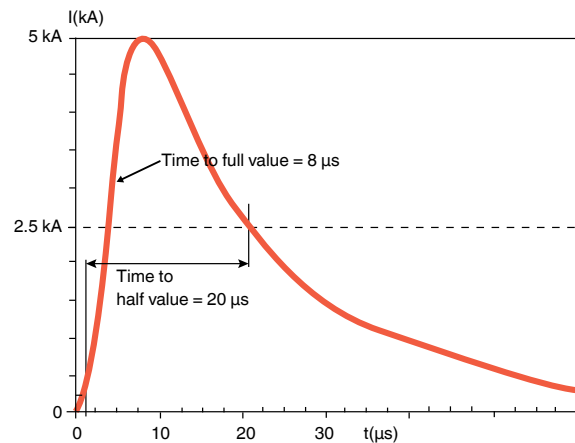


Figure 17 Diagram: Large induced surge

Following IEC 60060-1, SPBs for fieldbus signal lines must be able to divert at least 10 trickle current pulses of 10 kA (8/20 μs) safely to earth, without damaging the transition contacts to earth, the internal circuitry, and the SPB itself.

Pepperl+Fuchs SPBs are in accordance with IEC 60060-1 and CCITT with a nominal discharge current of 10 kA (8/20 μs) per lead.

Additional Features Required for Fieldbus Surge Protection

In addition to providing surge protection to the bus systems, these protection devices should have further characteristics to be in line with fieldbus applications.

Keeping In-line Resistance Low

Since FOUNDATION fieldbus and PROFIBUS PA carry both power supply and fieldbus communication signals on the same cable, any additional resistance on the bus has additional voltage drop, which may affect the trunk cable lengths. Therefore, it is essential to have low series resistance on the surge protection devices.

Higher Bandwidth

To ensure the fieldbus signals pass through the surge protection barriers without any distortions, the capacitance (line/line and line/earth) must be as low as possible (e.g., 1 nF), for the response time to be as fast as possible (e.g., < 1 ns line/line).

Pluggable Feature

It is preferable to have the fieldbus surge protection devices as fixed base units with pluggable surge protection modules to enable easy maintenance. Removing the pluggable surge protection module does not interrupt the fieldbus signal, and so does not affect the signal path if replacement of the protection module is required.

Surge Protection for the Fieldbus System

A surge that affects the fieldbus cables (e.g., trunk cable) travels either toward the control system or toward the field devices through the field junction box.

Or a surge can affect the spur cables and travel either toward the field devices or toward the control system through the field junction box.

Therefore, all these paths should be adequately protected by using a proper surge protection device to avoid any damage to the fieldbus system components.

Surge protection should be used at various stages to prevent damage to the system.

Surge protection in the control room protects the control system against surges that affect the trunk connection and come from the field.

- Surge protection at the trunk connection of the field junction box protects the field side against surges that occur between the control room and field junction box.
- Surge protection at the spur side of the field junction box protects the electronics against surges that occur between the junction box and the field devices.
- Surge protection at the field devices protects the field devices against surges that occur between field junction box and field device.

Surge Protection in Hazardous Areas

Surge protection is available for hazardous areas and general purpose areas. It can be engineered into many different explosion protection forms including intrinsic safety, purge and pressurization, and explosion-proof. There are options for signal interruption and different shield grounding options.

Bus Systems for Process Automation

The bus systems applied in process automation are FOUNDATION Fieldbus H1 and PROFIBUS PA. This chapter details how the protocols work.

FOUNDATION Fieldbus H1

Communication

Publisher/Subscriber

FOUNDATION fieldbus communication is based on the publisher/subscriber, also referred to as peer-to-peer, communication model. In this type of communication, only one node has authorization to transmit a signal on the bus at any given time. After the transmission is complete, the next node receives the token to transmit device communications. The token is passed in a circular pattern where each node is prompted one after another to send its data. This active device broadcasts the relevant process variable information to the entire network. This network publication enables all other interested devices to receive the process data simultaneously. These interested, listening devices are the subscribers on the network. This data transfer eliminates the need for the data to travel back to the controller and then out to the devices, although this type of communication is still possible.

The process for determining which network device is the publisher is accomplished with a defined schedule of communication in the DCS/PLC. The H1 host, which primarily contains the segment schedule, ensures that each device has a scheduled amount of time to transmit its data. The device is prompted to transmit necessary data when the host sends a specific signal to the device. This signal indicates that the receiving device is now the active publisher on the network.

Device Classes

There are three device classes for FOUNDATION Fieldbus H1. The three classes are basic, link master, and linking/ bridge. Basic is the device class that incorporates field instrumentation for the segment. The device can communicate on the network, but has no additional responsibilities. Linking or bridge devices allow the connection of the H1 network to other higher-level networks, such as High-Speed Ethernet (HSE). The link master device class contains Link Active Scheduler (LAS) capabilities. The LAS is the traffic officer of the H1 segment. Each segment requires only one LAS to be always active. The LAS is responsible for traffic monitoring on the segment and for keeping the communication on schedule.

LAS and Backup LAS

The LAS is responsible for probing every available address for new devices and ensuring known devices are still active. It compiles the execution schedule for the instruments process data transmission during scheduled communication. In building the schedule, the LAS verifies that data needed for function block execution is transmitted to the network before the function block executes, thus ensuring current process data. A Link Active Scheduler (LAS) device sends scheduled "Compel Data" (CD) commands to query devices on the network for time-critical information. Once a device has completed transmitting its information, it returns the token to the LAS.

The LAS probes for new devices on the fieldbus. This message is expected to produce a specific response message back to the LAS. The LAS is a node on the segment responsible for requesting data in cyclic mode and for monitoring transmission authorization in acyclic mode. This device ensures that the other devices transmit only during the time allotted and monitors the order in which individual devices transmit communications.

Typically, the LAS is a part of the DCS H1 card. LAS capabilities can be redundant or simplex. When using redundant LAS, it can be achieved by redundant H1 controllers in the DCS, or this function can be built into the operation of a field device. The redundant device is known as a backup LAS. The backup stores an identical schedule to the main LAS and monitors the health of the primary LAS. If the primary LAS fails, the backup LAS takes control and maintains the segment communications. It then performs all of the LAS functions, as well as transmits/receives process data. This is especially useful for applications utilizing Control in the Field.

Cycle Time

The macro cycle is the time required for a complete execution of scheduled and unscheduled communication. This user-defined cycle time is typically one second or less. Most of this time is spent on cyclic process data transfer and function block execution. Function blocks define and prepare the process data from each field instrument into a standard format, such as analog input. Some processes allow for longer macro cycle times where values do not change quickly, such as a segment that monitors only process temperatures. Most segments have other, more critical instrumentation. The control engineer may have to reduce the number of devices on a segment in order to reduce the macro cycle time. Each function block has a set amount of time for task completion. For example, analog inputs (level, pressure) take longer to transmit the required information than discrete inputs (valve, sensor blocks). These time durations can be found by using the device datasheet or manual and are usually limited to 70% of the macro cycle. The remaining 30% of the macro cycle is reserved for unscheduled communications.

Calculating the cycle time is easily accomplished by summing the function block execution and variable transmission times for each device on the segment. These times are normally included on the datasheets of the devices. It is also possible to extract the cycle time from the configuration software of the DCS/PLC.

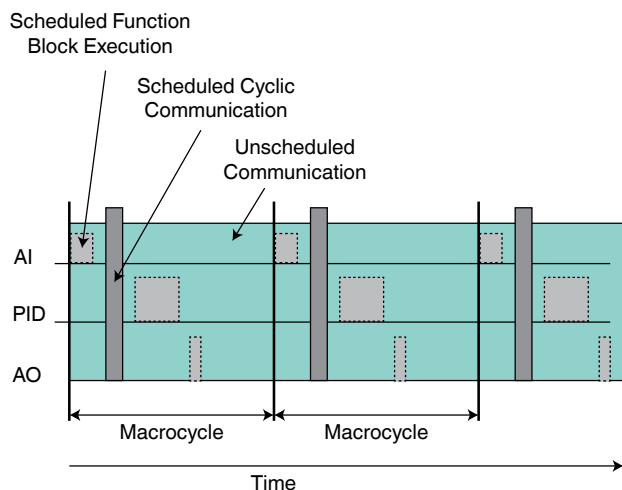


Figure 1 Macrocycle Diagram
 AI: analog input
 PID: proportional/integral/derivative control
 AO: analog output

Scheduled and Unscheduled Communication

FOUNDATION fieldbus has two modes of communication, scheduled and unscheduled. Each macro cycle is mainly comprised of scheduled communications with some "free time" for unscheduled communication. The scheduled communication period takes the highest priority for the segment. This is the time when all of the devices are transmitting process data and follow an exact schedule during each cycle. For a typical application, we recommend that the scheduled communication should not take more than 70 % of the macro cycle time.

The unscheduled communication is a period for asynchronous data to be transmitted to or received by individual devices. Asynchronous data is any communication that is not required on a regular interval for process control. One of the most commonly used forms of asynchronous data is diagnostic information from the device or configuration changes to the devices. During the unscheduled communication, the host transmits a pass token message. The device then has a predefined amount of time to communicate the additional information. If the amount of information is too large to transmit in the allotted time, then the remainder is transmitted during subsequent cycles.

Explicit transmission rights are assigned to facilitate acyclic processing of diagnostic and configuration data. This is referred to as token passing. A token passing protocol is when each device gets a turn to talk and then grants permission for the next node to talk when it has finished communicating. Permission to talk is passed around from node to node, as each one hands off the "token" to the next in sequential order. The token itself is not a physical item: it is a series of digital 1s and 0s broadcast on the network, carrying a specific address of the next node permitted to talk.

Determinism

Since these two modes of communication finish within fixed amounts of time, the FOUNDATION Fieldbus H1 network is deterministic. During every macro cycle, the field instrument function blocks are executed at the exact same point in time in the macro cycle. This exact timing makes the network predictable and repeatable. Network timing is crucial to maintaining this predictability and schedule. To ensure each device on the network is synchronized, the host transmits a time distribution message at regular intervals during unscheduled communication. If a device is lost due to a fault, it has several retry opportunities to transmit in subsequent cycles but still always at the same point in the cycle. This ensures that the cycle is always deterministic.

Addressing

Each H1 network can support a maximum of 32 devices including the host. The instruments are assigned unique addresses to differentiate them on the segment. The addresses range from 0 to 255. The address is automatically assigned to each instrument by the host system, eliminating the need for DIP switches and manual addressing. FOUNDATION fieldbus communication offers methods so that it can distinguish between the devices, by the device ID, and put them in communication without an address collision. The addresses assigned are defined by the host system. Each host system is different and therefore gives different addresses to the devices. Having automatic addresses increases network reliability since the chance of address repetition is removed.

If a device is replaced, it will appear in the host system as a spare device after it has been connected to the segment. Then the host system has an implemented function to assign it to a device which has been removed (due to replacement). The host sets all blocks into the same state of the successor device and puts it back in operation. Once again, this is handled by the host system and each system handles this in a different way.

Control in the Field

Function blocks can be configured for execution either in the controller or in the field devices. When executed in the field device, the result is control in the field. Control in the field is an advantage of FOUNDATION fieldbus since even if the host is lost, the process remains active and running. Second, control in the field provides a cycle time benefit by reducing the amount of data that must be transferred over the bus, thus decreasing the macro cycle. Since the process data is now processed in the field device, less controller memory and fewer resources are needed.

Configuration

DD/CFF

Every FOUNDATION fieldbus device is supplied with two files that work to define device capabilities and host limitations. These are the DD and CFF files. They are both created and distributed by the device manufacturer and allow the manufacturer to implement specialized or unique functions. The files assist the host in deciphering information from the device and instructing the host on how to display information to the user.

The DD file is the Device Description file, written in Device Description Language (DDL). This file describes all of the functionalities of the FOUNDATION fieldbus field instrument and explains to the host what each parameter in the device is intended for. Also included in the DD file are any available Methods. Methods allow for an easy step-by-step configuration of the device. Methods are similar to an install wizard you use for a new piece of computer hardware.

The CFF file is the capability file of the device. This file is written using the common file format programming language. The CFF file describes the number and operation of transducer and function blocks in the device.

The instrument manufacturers create these files based on standard formats and design criteria. The files are imported into the host system either before or after the device is connected to the network. Basing the files on standards allows complete interoperability for the network while still permitting manufacturers to implement distinguishing features.

EDDL

Electronic Device Description Language (EDDL) is a text file that is used to give a description of all of the accessible information found in FOUNDATION fieldbus, PROFIBUS, HART, and *WirelessHART* field devices. The EDDL files for the specific field device will give the parameters the device is capable of supporting, diagnostics on the device, and also information to assist with device calibration. In addition, the EDDL files allow the user to assign device tags and addresses to the field devices to simplify and speed up the commissioning process. To complement the basic functions of EDDL text files, a more advanced graphical EDDL technology is available for some devices, providing more in-depth visual tools to the user.

FDT/DTM

FDT is an interface specification utilizing software modules. Each device comes with a software module called DTM (Device Type Manager). The DTM describes datasets, function blocks, and a graphical user interface. It can include extra functions, such as elaborate analysis tools to enhance the device's physical functionality. A frame application named DTM frame is the host to the DTM.

The DTM frame typically resides in the operator or maintenance station. FDT/DTM technology can be compared to hardware with drivers to be installed on a computer operating system, such as Microsoft® Windows.

The FDT concept transfers this idea to the world of automation: each communicating field instrument has an electronic device description that can be integrated into the world of the system. That is, into the configuration and adjustment tools of a system environment, as well as into the stand-alone **PACTware™** tool.

Device Type Manager (DTM)

Like the printer driver in the office world, the field instrument brings its own driver, including the user interface, into the FDT world. This driver is called Device Type Manager, in short, DTM. It contains all the data and functions of the field instrument. A DTM can cover just one instrument type, or in some cases a complete family of instruments.

Frameworks

FDT frames are supplied by many vendors, with system suppliers offering their own. These frames are often used for testing or experimenting with FDT technology.

From the FDT frame, each individual instrument and communication component can be directly accessed to perform the following tasks:

- Adapt the configuration
- Modify individual parameters
- Simulate individual functions
- Get a detailed, meaningful diagnosis
- Prepare documentation

And all of this is manufacturer- and communication-independent. Subsequent modifications and extensions of the structure can be carried out at any time.

Device Models

FOUNDATION fieldbus communication is based on a set of blocks from field devices being linked together in the control system. There are three classes of blocks used in every fieldbus device. They are the resource, transducer, and function blocks.

Resource Block

Each FOUNDATION fieldbus device contains exactly one resource block. This block contains general device information including the manufacturer, device ID, and hardware and software revisions. It is also the controlling block for the device, so if it is set to "out of service" (OOS), then the entire device is out of service. Finally, the resource block is responsible for device diagnostics. It is not possible to link to any of the parameters contained in the resource block.

Transducer Block

The transducer block is the connection between the analog real world and the digital communication world. Each device has a different number of transducer blocks depending on how many inputs the device can interface with from the field. An eight input temperature multiplexer would have at least eight transducer blocks, while a flow meter might only have one or two transducer blocks. Transducer blocks allow the parameterization of each input channel including scaling and ranging. This block also contains diagnostic information about the physical sensor. Every transducer block links to a function block through the channel parameter of the function block. This link is the only parameter that links from the transducer block.

Function Block

FOUNDATION fieldbus function blocks are the basis for control of the FOUNDATION fieldbus communication protocol. The blocks represent abstract models of the measurement and control capabilities of a particular device. There are four classes of function blocks, including:

- Basic
- Advanced process
- Batch/discrete/hybrid
- Safety instrumented systems

The basic class of function blocks includes all standard blocks for control, such as DI, DO, AI, AO, and PID. It is possible to process multiple signals through one function block called a multiple function block, such as MDI, MDO, MAI, and MAO. The advanced process blocks include timer, splitter, alarm, and integrator blocks for advanced control.

- Proportional, integral, & derivative (PID) loop is where you have an element of a process that is being controlled by comparing a desired set point to the current state of the process. Depending on the difference between the two points, an output command is generated. In a PLC or DCS, the PID equation is part of a PID instruction entered into the process control program. This equation determines the output based on the difference between the set point and current state of the process.
- The batch/discrete/hybrid blocks are used for multi-variable devices and advanced applications, such as data acquisition and PLC sequencing.
- The SIS blocks are used to implement safety systems over the bus and are the newest class of blocks.

The Fieldbus Foundation defines and tests all classes of function blocks. This real-time monitoring helps ensure that each device manufacturer includes the same basic functions and parameters for similar device types.

In the host configuration tool, the control strategy is built using function blocks from the devices on the segment. The required function blocks are brought into a control window and linked together. The output of one block is connected to the input of another block. Controller systems vary but this is generally a simple-to-use graphic interface with the links visualized by lines drawn between the blocks.

Fieldbus Foundation

Source: www.fieldbus.org

"In late 1994, the path of fieldbus took a new, promising direction. Two parallel supplier consortiums – the Interoperable Systems Project (ISP) and WorldFIP North America – merged to form the Fieldbus Foundation. The new organization immediately brought critical mass to the effort to achieve an internationally acceptable fieldbus standard. The Foundation organized development programs, conducted field trials, and established the industry's most rigorous program for testing and registration of fieldbus devices.

Working arm-in-arm, manufacturers, end users, academic institutions and other interested parties became members of the Fieldbus Foundation and developed open, non-proprietary specifications known as FOUNDATION fieldbus. This advanced digital communication solution was designed from the ground-up to support mission-critical control applications where the proper transfer and handling of data is essential. FOUNDATION technology was created to replace incompatible networks and systems with an open, fully integrated architecture for information integration and distributed, real-time control across the enterprise.

With FOUNDATION technology, users gained the power to implement tightly integrated digital control based on a unified system architecture and a high-speed backbone for plant operations. This, in turn, removed the previously experienced constraints on device and subsystem interoperability.

Approval and support by key international industry bodies gave users the confidence that their investments ... were based on recognized global standards.

The International Electrotechnical Commission (IEC) voted to include the FOUNDATION H1 and FOUNDATION High-Speed Ethernet (HSE) specifications in the IEC 61158 international fieldbus standard. ... International end-user associations, such as NAMUR (Automation Systems Interest Group of the Process Industry, Germany) and JEMIMA (Electric Measuring Instruments Manufacturer's Association, Japan) have voiced support for FOUNDATION technology, and provided input from the end-user community that aided in specification development."

The Fieldbus Foundation continues to act as a watchdog for their technology, assuring device interoperability and maintaining protocol standards. They drive the technology forward to expand its capabilities and meet the needs of the process industry.

The Fieldbus Foundation has training and testing facilities around the globe. The organization offers free end-user fieldbus seminars to teach the fundamentals of their technology.

In addition to providing end-user training and promoting their technology, the Fieldbus Foundation continues to test fieldbus devices, issuing marks and assuring interoperability.

Pepperl+Fuchs has been a participating member in the organization since its inception. We have been involved in numerous working groups helping to shape and define the technologies and standards that form the basis of fieldbus organizations today. Over the years, Pepperl+Fuchs has successfully introduced many innovative and industry-first fieldbus products. Our commitment to support fieldbus technologies in the future remains strong.

PROFIBUS PA

PROFIBUS PA is a subset of a greater PROFIBUS family. Each PROFIBUS PA segment is connected to a PROFIBUS DP network. DP, a high-speed bus supporting baud rates up to 12 Mbps, is used for process and motion control applications. PA and DP share protocol and address range. PROFIBUS DP devices are not powered over the bus lines.

PROFIBUS PA is based on the physical layer as defined in IEC 61158-2.

Communication

Master/Slave Concept

PROFIBUS utilizes the master/slave concept for communication on the bus. The PLC/DCS acts as the master and cyclically interrogates each field device, the nodes, and requests the input data. At the time of the request, the master transmits all output data to the device. The polling of each device occurs in a sequential order. Each field device is polled once per cycle. The master is the central location for all data collection and transfer.

Master Classes

One device on the network is the master and authorizes all communication. PROFIBUS supports two types of network masters.

- Master Class I
- Master Class II

Master Class I is typically the PLC/DCS controller and is responsible for the cyclic communication of the network. It polls the field devices to gather input/output information.

Master Class II is usually an engineering station that acyclically communicates with field devices. This instrument is used for configuration or diagnostic information. Master Class II has a lower priority than Master Class I to ensure that the cyclic process variables are transmitted in a timely fashion.

Token Passing between Masters

Only one master can control the network at a time. Control passes between the masters using a token pass network, with Master Class I having a higher priority. After Master Class I polls each field device, it passes the token to Master Class II for a defined time. Once this time ends, the token returns to Master Class I. If all of the required asynchronous data cannot be transferred in this defined amount of time, the remainder of the data transfers in subsequent cycles.

The amount of information a device can transmit on the bus is 244 bytes of input data and 244 bytes of output data. Depending on how many variables the device is measuring, the number of bytes varies. For PROFIBUS PA, the typical number of bytes per variable is two for discrete variables and five for analog variables.

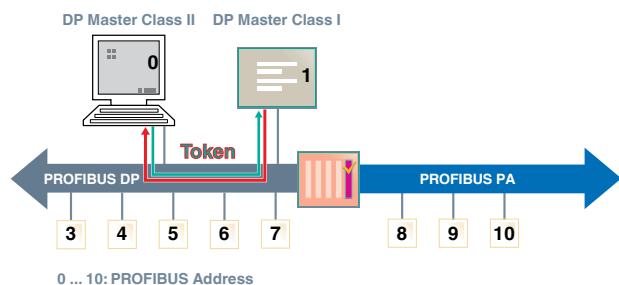


Figure 2 PROFIBUS DP token passing between masters

Cycle Time

The cycle time of the network is the time for all inputs and outputs to be fully updated one time. The cycle time is affected by several factors including:

- Number of devices
- Number of bytes being transmitted
- Network baud rate

The configuration tool available with the DCS system accurately calculates bus cycle time. Please refer to the DCS supplies manuals for exact cycle time.

Addressing

PROFIBUS supports an address range from 0 to 127. Address 127 is a broadcast message, which is not usable as a device address. Address 126 is the default address of every PROFIBUS PA device; therefore, to ensure an easy exchange with a PROFIBUS PA instrument, this address is not used for normal operation. Address 126 is reserved for adding PA instruments to the bus. Address 126 is the default setting for new PA devices. The PA instrument can be readdressed through the bus.

As a result, there are 126 addresses (address range 0–125) free for use. This includes all addresses for PROFIBUS DP Master (Master Class I and II). We recommend the use of address 0 for Master Class II (maintenance station) and addresses 1 and 2 for Master Class I. This address setting recommendation covers the case of a redundant Master Class I. The addresses of the (redundant) PROFIBUS PA Master must NOT be taken into account because these addresses are not visible on the PROFIBUS DP side.

Addressing of the PROFIBUS devices is done either through manual configuration of DIP switches on the device or through configuration software. The address programmed into the device must match the expected address in the Master.

Address	Function
0	PROFIBUS DP Master Class II
1	PROFIBUS DP Master Class I
2	PROFIBUS DP redundant Master Class I
3 through 125	PROFIBUS PA instrument addresses
126	Default address setting for new PROFIBUS PA devices added to the bus
127	Broadcast message. Not usable as a device address.

Table 1 PROFIBUS address range

PA Backbone – PROFIBUS DP

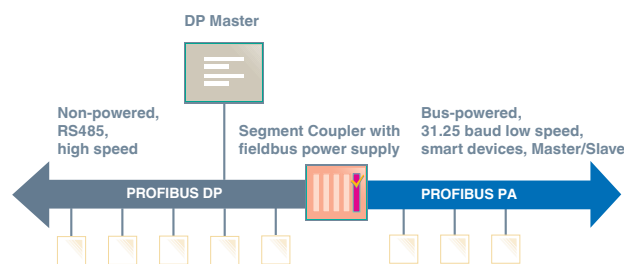


Figure 3 Integration of DP and PA

PROFIBUS DP, a high-speed bus, is used for process and motion control applications. PA and DP share the protocol and address range. Unlike PROFIBUS PA, PROFIBUS DP devices are not powered over the bus lines. PROFIBUS DP uses the RS485 physical layer and allows up to 32 devices per segment. For applications with more than 32 participants, repeaters are allowed. Each repeater starts a new network and refreshes and updates the signal. The use of repeaters results in more advantages relating to the dividing of process control into different segments and providing galvanic isolation between plant areas.

Communication speed selection affects several important issues, e.g., cycle time, cable length, and spur lines. Selecting the highest baud rate results in the shortest network length. Short network length introduces other side effects, such as increased vulnerability to EMC noise. Usually, a baud rate of 187 kbps or 500 kbps suffices for process control, leaving room for longer cable runs and less vulnerability to EMC. A secondary advantage of lower baud rates is the allowance of longer stub lines. General practice would be to avoid lengthy spur lines as much as possible. At 500 kbps, the total spur line length cannot exceed 20 meters. This length rapidly decreases with higher baud rates until they are not even allowed above 1.5 Mbps.

Speed (bits per second)	Distance (m)
9.6 K	1 200
19.2 K	1 200
45.45 K	1 200
93.75 K	1 200
187.5 K	1 200
500 K	400
1.5 M	200
3 M	100
6 M	100
12 M	100

Table 2 PROFIBUS DP baud rates and cable lengths

Connection between DP and PA

Linking the high-speed RS-485 of the DP network to the low-speed PA network requires a segment coupler. These devices contain DP slaves on one side and PA masters on the other side. The PA master collects data from the PA devices. The gateway portion of the segment coupler contains a slave simulation, which emulates all PA slaves connected to the segment coupler as a DP slave at its native address. Segment couplers can be either transparent or nontransparent to the master.

With transparent bus couplers, the PROFIBUS PA devices appear to the master to be PROFIBUS DP slaves and occupy a DP address in the master. Each device can be individually interrogated by Master Class I. Using a Master Class II provides full access to the diagnostics and configuration capabilities. The couplers can have an address on the DP network or not without losing communication transparency with PA slaves. When addressed, it is possible for the coupler to transmit diagnostic information back to the control system.

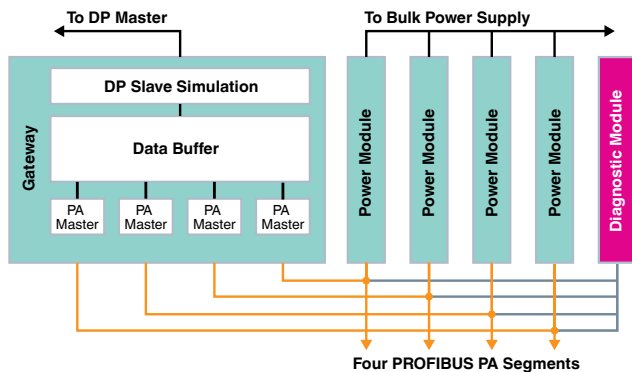


Figure 4 Segment Coupler 3 (SK3) block diagram

In nontransparent or DP/PA link systems, the segment coupler functions like a gateway. This segment coupler receives a PROFIBUS DP address, while the connected PA devices are invisible to the master and have no PROFIBUS DP address. All of the PA device data is communicated in one telegram. The function of this segment coupler is comparable to a remote I/O system, where PA devices are I/O modules. This setup requires mapping of the PA device variables into the coupler's memory and overall telegram. A PROFIBUS DP limitation is that the maximum amount of data per telegram is 244 bytes. If the segment coupler is nontransparent, the maximum amount of **all PA data together** is 244 bytes input + 244 bytes output. Example: A device requires up to 28 bytes input. In this case, you can handle max. eight devices behind a nontransparent segment coupler, which becomes expensive.

Configuration

GSD Files

A GSD file is an electronic data file that the master uses for the configuration of a PROFIBUS field device. The GSD file has the following properties:

- It describes the basic capabilities of a device
- It is specific to each fieldbus device
- It allows the configuration of input and output data to be transferred during cyclic communication
- It supports baud rates

GSD files have a standard format and follow guidelines defined by the PROFIBUS organization. The device vendor supplies this electronic file with the device. Alternatively, the file can be downloaded from the vendor's website. The GSD file is downloaded into the master class device and used for configuration and implementation.

Furthermore, the GSD file is used to configure and parameterize the PROFIBUS communication of a field device, e.g., the required number of I/O bytes, supported baud rates, amount of diagnostic bytes, timing information, etc. Configuring or parameterizing the instrument requires either a DD or a DTM, depending on the host system in use.

EDDL

Electronic Device Description Language (EDDL) is a text file that is used to give a description of all of the accessible information found in FOUNDATION fieldbus, PROFIBUS, HART, and *WirelessHART* field devices. The EDDL files for the specific field device will give the parameters the device is capable of supporting, diagnostics on the device, and also information to assist with device calibration. In addition, the EDDL files allow the user to assign device tags and addresses to the field devices to simplify and speed up the commissioning process. To complement the basic functions of EDDL text files, a more advanced graphical EDDL technology is available for some devices, providing more in-depth visual tools to the user.

FDT/DTM

FDT is an interface specification utilizing software modules. Each device comes with a software module called Device Type Manager (DTM). The DTM describes data sets, function blocks, and a graphical user. It can include more interface functions, such as elaborate analysis tools to enhance the device's physical functionality. A frame application named DTM frame is the host to the DTM. The DTM frame typically resides in the operator or maintenance station. FDT/DTM technology can be compared to hardware with drivers to be installed on a computer operating system, such as Microsoft® Windows.

Plug & Play in Automation

The FDT concept transfers this idea to the world of automation: each communicating field instrument has an electronic device description that can be integrated into the world of the system. That is, into the configuration and adjustment tools of a system environment, as well as into the stand-alone **PACTware™** tool.

Device Type Manager (DTM)

Like the printer driver in the office world, the field instrument brings its own driver, including the user interface, into the FDT world. This driver is called Device Type Manager, in short, DTM. It contains all the data and functions of the field instrument. A DTM can cover just one instrument type, or in some cases a complete family of instruments.

Frameworks

FDT frames are supplied by many vendors, with system suppliers offering their own. It is often used for testing or experimenting with FDT technology.

From the FDT frame, each individual instrument and communication component can be directly accessed to perform the following tasks:

- Adapt the configuration
- Modify individual parameters
- Simulate individual functions
- Get detailed, meaningful diagnostics
- Prepare documentation

And all of this is manufacturer- and communication-independent. Subsequent modifications and extensions of the structure can be carried out at any time.

Device Model

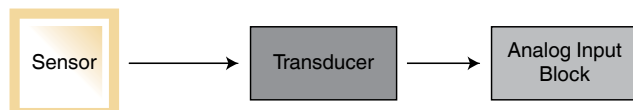
PROFIBUS PA devices can be described using models. One of these models is the block model which contains a physical block, transducer blocks, and function blocks.

The physical block describes the basic parameters and functionality of the apparatus itself or of the hardware (e.g., serial number, manufacturer identification, factory reset).

The function block contains one or more inputs or outputs that are transferred between the field device and the controller. The data is processed according to a predefined algorithm depending on the type of variable, such as analog input, discrete output, etc.

The transducer block contains parameters concerning the type of physical sensors, actuators, or switching elements attached to the transmitter. The function block uses these parameters in a device-independent way. The transducer block acts as a signal converter and contains functions such as calibration and linearization.

Sensor Connected Transducer Blocks



Actuator Connected Transducer Blocks

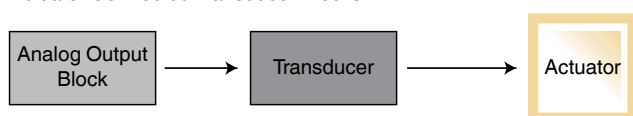


Figure 5 Diagram of block model

PROFIBUS International

Source: www.profibus.com

"Created in 1989 by a consortium of companies and institutions, PROFIBUS has become the world's most popular fieldbus in discrete manufacturing and process control. It is mature, proven technology that is ideal for supporting modern automation systems. With over 14 million installed devices, it is a significant driving force for the world's production plants. By continuously enhancing the technology, PROFIBUS International has ensured that PROFIBUS remains the dominant fieldbus solution. The ongoing commitment of the world's automation major suppliers ensures that investments today are fully protected for the lifetime of any plant. PROFIBUS is unique in offering a fully integrated solution for discrete and process applications, a major benefit in the process industries where upstream, mainstream and downstream processes have to work together. Industries using PROFIBUS range from critical petrochemical operations and high volume robotic manufacturing plants, right across the spectrum to food and drink, water/waste treatment plants."

PROFIBUS International continues to act as a watchdog for their technology, assuring device interoperability and maintaining protocol standards. They drive the technology forward to expand its capabilities and meet the needs of the process industry.

PROFIBUS International has training and testing facilities around the globe. The organization offers free end-user fieldbus seminars to teach the fundamentals of their technology.

In addition to providing end-user training and promoting their technology, PROFIBUS International continues to test fieldbus devices, issuing marks and assuring interoperability.

Pepperl+Fuchs has been a participating member in the organization since their inception. We have been involved in numerous working groups helping to shape and define the technologies and standards that form the basis of fieldbus organizations today. Over the years, Pepperl+Fuchs has successfully introduced many innovative and industry-first fieldbus products. Our commitment to support fieldbus technologies in the future remains strong.

Safety for Bus Systems

Safety Integrity Level (SIL)

Functional Safety and its Classification System

Technical safety means protection against dangers from the most varied, not immediately avoidable, system-inherent causes, such as faults and errors. Safety technology has to recognize the malfunction and transfer the system in danger to a safe state. Measures bring the risk of a potential error to an acceptably low level, resulting in increased safety for man, machine, and the environment while avoiding downtime for the system.

The SIL (Safety Integrity Level) class defines requirement profiles for the safety system. Development and structure of safety-relevant electronic components are covered in IEC 61508. Manufacturers allocate a SIL class to system components. To this end, considerations, such as an operational reliability analysis or failure modes, effects, and diagnostic analysis (FMEA), are used.

Safety in processing systems is defined in IEC 61511. From planning to decommissioning, this standard defines the organizational, structural, and technical requirements to achieve the system safety necessary. The minimum required SIL class for safety-related control corresponds to the danger potential of the production system. The SIL class of an entire system is composed of the safety evaluations of its individual components. Recurring function tests at set intervals are a prerequisite for maintaining the safety level.

In this context, the concepts of safety, availability, and reliability require particular differentiation.

The Safety Fieldbus

In the process industry, fieldbus communication is implemented with PROFIBUS or FOUNDATION Fieldbus H1 protocols, both defined in IEC 61158-2. It enables error detection in data transfer via safety mechanisms that recognize these errors and reject data. In standard protocol, a cyclic redundancy check is used that recognizes errors with high probability, but is insufficient for safety-related control.

The PROFIsafe and FF-SIF safe fieldbus systems use their respective native standard PROFIBUS and FOUNDATION Fieldbus H1 protocols as a transmission basis and secure the data in such a way that transmission errors are noted. Together with safety-relevant performance and control data, additional information is transmitted in the standard protocol data telegram, such as telegram numbers and a long cyclic redundancy check. One can also talk about a "telegram within a telegram." Additionally, the actuator is equipped with functions that bring the plant to a safe condition if communication is interrupted or fails.

Example: FOUNDATION Fieldbus Safety-Integrated Functions (FF-SIF)

FOUNDATION fieldbus uses function blocks (FB) to transfer data. The safe FF-SIF protects the data of an FB source from falsification during transfer via an additional safety layer. In the target FB, the safety layer checks consistency and only relays the data after passing all safety checks. Possible errors, such as data loss, falsification, delay, repetition, or wrong order are reliably detected.

Because safe FBs are based on the FOUNDATION Fieldbus H1 transfer standard, safety-related and standard process signals can be transferred over the same medium. The usual separation of safety technology and control technology can be eliminated. In addition to reliable data transfer, FF-SIF defines additional functions that increase the safety of the plant. These are:

- Self-diagnostics of the field devices. Intelligent devices independently and immediately report their status to the Process Control System. Maintenance required and device errors are frequently reported early and provide sufficient time for planned intervention into the system.
- Partial stroke tests for valves only check sporadically moved valves for jamming on process control grounds. The partial stroke tests can conveniently be carried out during operation from the control room and with test intervals that are not possible manually. The partial stroke test enables fewer or shorter downtimes for the plant.

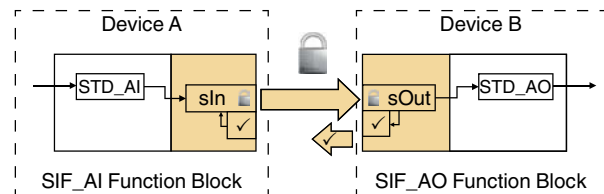


Figure 6 FF-SIF transmits additional safety checks along with the process value

Safe Data through the Protocol Alone

Through the additional mechanisms of data transfer alone, PROFIsafe and FF-SIF safety protocols enable safe data transfer, which has been certified by the official inspection authority TÜV as SIL3. The fieldbus infrastructure, such as power supply, installation components, and its accessories, is excluded from system safety consideration. This is known as the "black channel," derived from the "black box" concept.

So, it is much simpler for safety technology users to validate that the system is safe. When considering functional safety, only the value-added components are considered: sensors, actuators, and the controller. The fieldbus infrastructure is evaluated only for reliability and availability.

Process Control and Safety Components

The logic solver is the centerpiece of a safety-related process plant. It monitors the process and by default transfers the system in danger to a safe state. The logic solver is programmable, highly available, and replaces hard-wired relay circuits. The control logic consists of gates, such as OR, AND, NOR, and time relays. A logic solver for fieldbus differs from a solver for classic interface technology by including one or more fieldbus connections with a safety protocol for communication with safe fieldbus devices. The basic control has two tasks:

1. It adopts the classic task of a central process control with control system interface and
2. It regulates the access of the nodes in FOUNDATION fieldbus.

A basic control system is not fault tolerant and also not specially developed for safety, but together with process control, it adopts fundamental functions as the first link in the chain that deals with safety: it initially informs the control system via a process alarm about an abnormal state in the process. If the remedy to the problem does not succeed and the situation worsens, a trip level alarm is issued and the logic solver safely puts the system into a nonhazardous state.

The logic solver configuration platform allows programming of the logic coupler and the commissioning of the logic solver. During operation, it offers access to its diagnostic functions, such as operating statistics and error simulations. Today, the connection to the logic solver is made via an Ethernet network.

The plant asset management centrally manages the plant aspects during its life cycle. It is implemented through the consistent coordination and documentation of all activities around the apparatus down to each individual sensor in the field level. Tasks such as upkeep, maintenance, and troubleshooting are given priority with operative plant management. Strategic plant management looks after the organization and optimization of processes to increase efficiency and return.

The fieldbus diagnostic platform configures and visualizes the bus physical layer diagnostic functions integrated into the fieldbus power supply. A wizard automates the startup of the segment after its installation and correctly configures the monitoring of trip values. A report for plant documentation certifies that it is working correctly. Parts of the alarm management are integrated into the control system and reports are immediately available to the operator. The diagnostic platform indicates the error location and cause and also proposes troubleshooting measures. The platform can be operated separately from the management platform and permits direct setup in the plant. Trends, history, and conclusions regarding possible sources of errors can be tracked.

Only Availability is Relevant

For the end user, the main advantage is that only the safety of a few components is taken into account. In particular, safety-related consideration of the connected infrastructure is no longer necessary.

The safety protocol alone ensures the data integrity in the connected devices, i.e., the logic solver and the field device. The transfer channel, fieldbus infrastructure, is related to the safety aspect but otherwise separate and works as a kind of "black channel" in the fashion of a "black box" concept. That offers the planner and end user two significant advantages:

- Standard components for fieldbus infrastructure can be used.
- The proof of the safety function is much simpler due to the low number of components to be considered.

Planners and end users must, therefore, only focus on the availability and reliability of the fieldbus infrastructure, as this forms the basis for stable process control and efficient operation of the process plant.

The safety mechanisms of FF-SIF and PROFIsafe make fieldbus data transfer safe according to SIL3. Standard devices and safety-related devices can be used on a fieldbus at the same time and enable the use of the same infrastructure. Thus, safety-related consideration of the fieldbus infrastructure that connects the safety-related control and field devices is not necessary. Instead, only availability and reliability are of significance.

With careful planning, clean installation, and with diagnostics and components that fulfill the highest requirements for reliability, segments for control tasks already installed today can be used with safety-relevant systems. Software tools support planners with error-free design and diagnostics of the fieldbus architecture during operation until scheduled maintenance. Support for each phase in the life cycle of a fieldbus system today maximizes the reliability of the fieldbus and simplifies its management.

Safety Instrumented Functions (SIF)

FOUNDATION fieldbus Safety Instrumented Functions (FF-SIF) as defined by the technical specification, FF-008, allows the H1 network to operate as a control and safety system in one. FF-SIF enables a process to be rated up to SIL3 for human safety.

The safety information is transmitted on the same twisted pair as the process data using the "black channel" concept where safety-related messages have a higher priority on the bus. All safety-related devices are third-party certified to meet the IEC 61508 Safety System standard and Fieldbus Foundation registered to be compliant with the FF-008 specification. Since the same lines are used for process and safety information, the availability of the physical becomes important. It takes careful planning to ensure this availability is not compromised.

More information on FF-SIF can be found on the Fieldbus Foundation website and technical guides.

PROFIsafe

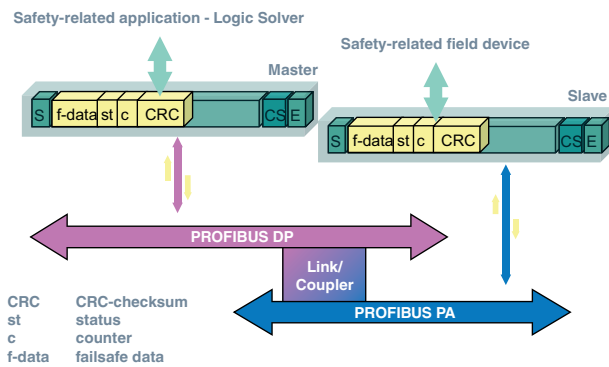


Figure 7 PROFIsafe embeds a complete telegram inside a regular PROFIBUS telegram.

PROFIsafe as defined by the technical specification IEC 61784-3-3, allows the PROFIBUS network to operate as a control and safety system in one. PROFIsafe enables a process to be rated up to SIL3 for human safety.

The safety information is transmitted on the same twisted pair as the process data using the "black channel" concept where safety-related messages have a higher priority on the bus. All safety-related devices are third-party certified to meet the IEC 61508 Safety System standard and PROFIBUS International registered to be compliant with the IEC 61784 3-3 specification. Since the same lines are used for process and safety information, the availability of the physical becomes important. It takes careful planning to ensure this availability is not compromised.

More information on PROFIsafe can be found on the PROFIBUS International website and in technical guides.

Overview of Explosion Protection and Intrinsic Safety

Introduction

This document deals with the physical principles and fundamentals of explosion protection and with the legal situation of the two-division model (North America) and the three-zone model (Europe and IEC countries) of hazardous (classified) locations. Regardless of the geographic location, the physical principles of explosion protection are identical. What differentiates one country from another are national deviations and varying requirements associated with the types of protection. In general terms, we can differentiate between the IEC concept and North American concept.

After World War II, the increased use of oil and its derivatives brought the construction of a great number of plants for extraction, refining, and transformation of the chemical substances needed for technological and industrial development.

The treatment of dangerous substances, with the resulting risk of explosion or fire caused by an electrical spark or hot surface, requires defined instrumentation located in a hazardous area. It also requires interfacing signals coming from a hazardous area to be unable to create the necessary conditions to ignite and propagate an explosion.

This risk of explosion or fire has been the limiting factor when using electrical instrumentation, because energy levels were such that the energy limitation to the hazardous area was difficult, if not impossible, to obtain. For this reason, those parts of the process that were considered risky were controlled with pneumatic instrumentation.

The introduction of semiconductor devices (transistors first and, subsequently, integrated circuits), along with the capability to reduce the working voltages and energy levels, made the energy-limitation protection technique, called "intrinsic safety," easier to apply when using electronic instrumentation in hazardous areas. Thus, a more economical and more efficient solution to the problem was created.

This publication has the following purposes:

- It explains the principles on which the types of protection against the danger of explosion are based
- It presents intrinsic safety and its application to anyone who faces problems related to design, installation, and maintenance

Introduction to Intrinsic Safety

In England, the 1913 methane gas explosion in a coal mine caused the loss of many lives. The inquiring commission in charge of the investigation debated at length whether the explosion was caused by the low-voltage signaling system that was used to advise the surface crew that coal cars were ready to be brought to the surface.

The signaling system, composed of a set of batteries and a bell, was activated by shorting, with a metallic tool or by hand, two bare conductors routed along the mine's galleries. See Figure 1. The system was considered safe because the low voltage and current level in the circuit were within recognized safety parameters.

The research that followed revealed that another important safety factor in determining the safety of an electrical circuit is the energy stored in the circuit. Without the use of proper limitation methods, the inductive energy stored in the bell and wiring produced energy levels that were sufficient to generate an electric arc that could ignite the dangerous air/gas mixture – causing the fatal explosion.

The type of protection called "intrinsic safety" was born.

The electrical apparatus and its associated circuits had to be designed in a way that would prevent the generation of arcs, sparks, or thermal effects that could ignite an explosive mixture, during both normal and fault conditions of the circuit.

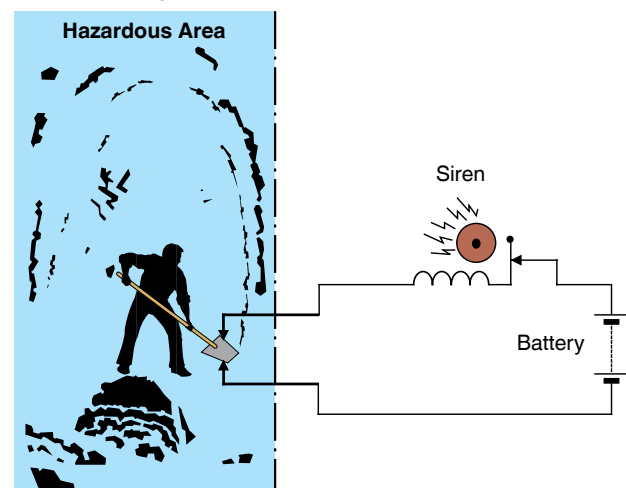


Figure 1 Mine signaling system erroneously considered safe causes an explosion

The first regulation for testing and certification of signaling systems for mines was issued. Subsequently, the study of the ignition process was expanded to include alternative current (AC) circuits and other dangerous gas mixtures.

The intrinsic safety concept was then applied to the surface industries, where potentially explosive atmospheres, that is, containing hydrogen or acetylene, are easier to ignite than the methane present in coal mines.

Physical Fundamentals of Explosion Protection

Ignition Triangle

From a chemical point of view, oxidation, combustion, and explosion are all exothermic reactions with different reaction speeds. For such reactions to take place, it is essential that the following three components be present simultaneously in a suitable ratio:

- Fuel: flammable vapors, liquids, or gases, or combustible dusts or fibers
- Oxidizer: generally air or oxygen
- Ignition energy: electrical or thermal

These three components are identified in the ignition triangle displayed in Figure 2.

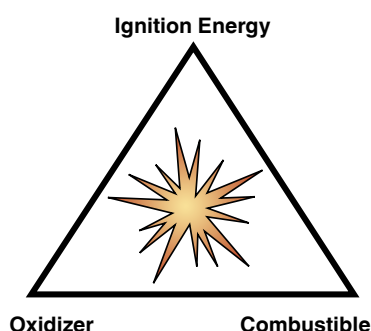


Figure 2 Ignition triangle

Once ignited, a controlled combustion, flame wave, or explosion can be caused, depending on how the exothermic energy is released.

All protection methods used today are based on eliminating one or more components of the ignition triangle in order to reduce the risk of explosion to an acceptable level. In a properly designed safety system, it is acceptable that two or more independent faults must occur, each one of low probability, before a potential explosion can occur.

There are materials that can explode spontaneously without energy supplied; however, this subject will not be addressed here. This publication deals with the prevention of explosions that can be caused through ignition.

Characteristics of Explosive Mixtures

The risk of an ignition of an air/gas mixture depends on the probability of the simultaneous presence of the following two conditions:

- Formation of flammable or explosive vapors, liquids, or gases, combustible dusts or fibers in an atmosphere or accumulation of explosive or flammable materials
- Presence of an energy source – electrical spark, arc, or surface temperature – that is capable of igniting the present explosive atmosphere

Each type of fuel has its own ignition characteristic. The characteristic curves of hydrogen and propane are illustrated in Figure 3. A **Minimum Ignition Energy (MIE)** exists for every fuel, representing the ideal ratio of fuel to air. At this ratio, the mixture is most easily ignited. Below the MIE, ignition is impossible for any concentration.

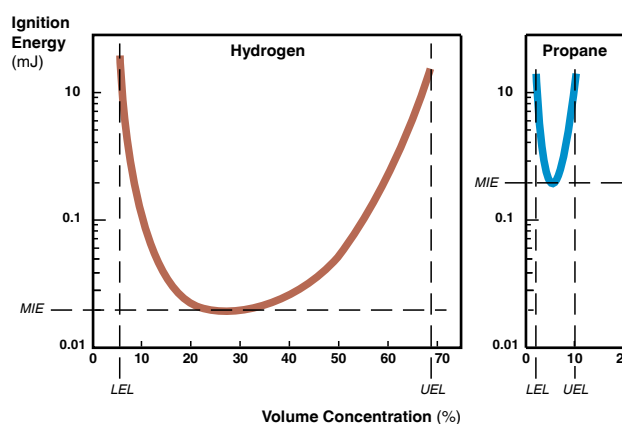


Figure 3 Ignition energy depending on hydrogen and propane air/gas concentration

For a concentration lower than the one corresponding to the MIE, the quantity of energy required to ignite the mixture increases, until a concentration value is reached below which the mixture cannot be ignited, due to the low quantity of fuel. This value is called the **Lower Explosive Limit (LEL)**. In the same way, when increasing the concentration the energy requirement increases, and a concentration value is identified, above which ignition cannot occur, due to the low quantity of an oxidizer. This value is called the **Upper Explosive Limit (UEL)**.

The following table lists the explosive characteristics of hydrogen and propane as examples.

	MIE	LEL	UEL
Hydrogen	20 μ J	4 %	75 %
Propane	180 μ J	2 %	9.5 %

Table 1 Explosive characteristics of hydrogen and propane

From a practical point of view, LEL is more important and significant than UEL because it defines the minimum quantity of gas in percentage needed to create an explosive mixture. This data is important when classifying hazardous areas.

The MIE (minimum energy required to ignite an air/gas mixture in the most favorable concentration) is the factor upon which the intrinsic safety technique is based. With this technique, the energy released by an electrical circuit, even under fault conditions, is limited to a value lower than the MIE.

Ignition Temperature

The ignition temperature of an air/gas mixture is the lowest temperature at which the potentially explosive atmosphere ignites without electrical energy being supplied.

This parameter is important because it establishes the maximum surface temperature allowed for devices located in a hazardous area, under both normal and fault conditions. The maximum surface temperature must always be lower than the ignition temperature of the gas present.

Flash Point Temperature

The flash point temperature is a characteristic of a volatile liquid, and it is defined as the lowest temperature at which the liquid releases sufficient vapors that can be ignited by an energy source.

Since a liquid above its flash point constitutes a source of danger, this parameter must be considered when classifying locations.

Evaluation of Explosion Risks

In any situation involving an explosive material, the risk of ignition must be taken into account. Generally, this evaluation involves industry specialists, safety, and mechanical engineers, as well as chemists and other critical facility personnel.

In addition to the nominal rating of materials under consideration, parameters related to the process involved are especially important in the evaluation. As an example, the risk of explosion may be caused by the evaporation of a liquid or by the presence of liquid sprayed under high pressure.

It is also important to know what atmospheric conditions are present normally and abnormally. The range of concentration between the explosion limits generally increases as the pressure and temperature of the mixture increases. The relationship between explosion limits and flash point for ethyl alcohol is illustrated in Figure 4.

Within the explosion limits the atmosphere is capable of exploding. This is shown as area B of the image. Area A is below the LEL; therefore, the mixture is no longer capable of ignition since it is too "lean". The mixture is also not capable of ignition in area C since it is too "rich" (that is, the oxygen content is too low for an explosion). If air is introduced, the mixture becomes flammable again.

In the area surrounding the vapor pressure curve (area D), mixtures are in equilibrium; therefore, a gas that is handled or stored within the critical temperature range of area B is explosive.

The flash point is generally a few degrees above the lower explosive limit. A liquid is considered flammable if its flash point is below 38 °C (100.4 °F) while it is considered combustible if its flash point is above 38 °C (100.4 °F).

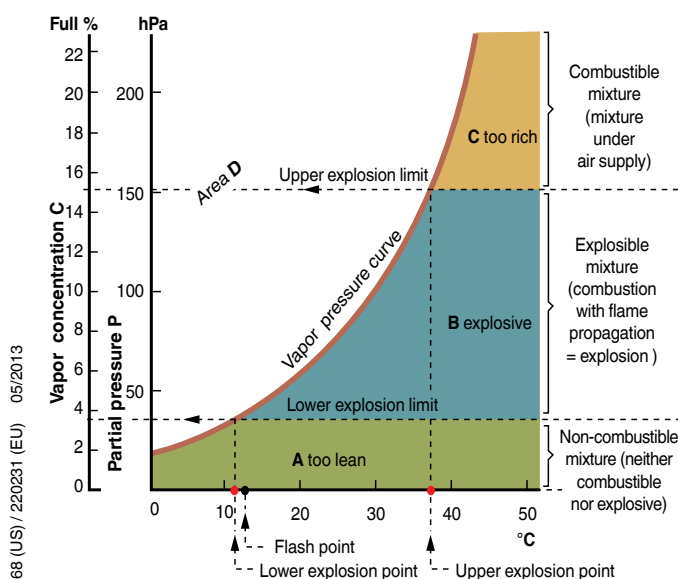


Figure 4 Graph representing the vapor pressure of ethyl alcohol

Classification of Hazardous Areas

Although the physical principles of explosion protection are the same worldwide and are not differentiated, the procedures determined by national legislation in the approximately 100-year history of explosion protection have resulted in various solutions.

Hazardous Areas and Apparatus

Determining hazardous areas in a plant is normally performed by experts of various disciplines. It may be necessary for chemists, process technologists, and mechanical engineers to cooperate with an explosion protection expert in order to evaluate all hazards. The possible presence of a potentially explosive atmosphere, as well as its properties and the duration of its occurrence must be established.

Hazardous areas are most frequently found in places where there is a possibility of an emission of flammable gas or dust. The hazardous area can occur in normal operation, in the event of a fault, or due to wear and tear of seals or other components.

A hazardous area ranges from the area of release to areas in which the affected substance is so diluted with air that ignition is no longer possible (LEL). The extent of the area is dependent on the type and quantity of released gases, degree of ventilation, or other similar conditions.

Many areas are designated as hazardous due to the presence of flammable gas. However the hazard associated with flammable dust is equally significant, since dispersed dust can also lead to explosions. An explosion hazard due to flammable dust can occur in various sectors of industry, for example, food products (e. g., confectionery, starch, flour, feed yeast), plastics, timber, rubber, furniture, textiles, pesticides, medicines, dyes, coal, metals (e. g., aluminum, chrome, iron, magnesium, and zinc), as well as in electricity generation from fossil fuels.

Today, expressed in rather simple terms, we can differentiate between the IEC concept and the North American concept. The differences lie in the categorization of hazardous areas, the design of apparatus, and the installation technology of electrical systems. The categorization of these areas is carried out in North America in accordance with the National Electrical Code NFPA 70, article 500 according to material groups (Class I: gases, vapors, and mist; Class II: dust; Class III: fibers and flyings) and a further categorization according to the probability of occurrence of these materials being present in a potentially hazardous quantity (Division 1 and Division 2).

Two Division Model

Hazardous areas are dependent on the type of flammable materials present and are divided into the following three categories:

Class I	Locations containing flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors
Class II	Locations containing combustible dusts
Class III	Locations containing fibers and flyings

Table 2

The probability of occurrence of these materials is considered through the classification into Divisions:

	Class I (Gases and Vapors) In accordance with NEC 500.5 and CEC J18-004	Class II (Flammable Dust or Powder) In accordance with NEC 500.6 and CEC 18-008	Class III (Flammable Fibers or Flyings) Divisions in accordance with NEC 500.7 and CEC 18-010
Division 1	Areas containing dangerous concentrations of flammable gases, vapors or mist continuously or occasionally under normal operating conditions.	Areas containing dangerous concentrations of flammable dusts continuously or occasionally under normal operating conditions.	Areas containing dangerous concentrations of flammable fibers or flyings continuously or occasionally under normal operating conditions.
Division 2	Areas probably not containing dangerous concentrations of flammable gases, vapors or mist under normal operating conditions.	Areas probably not containing dangerous concentrations of flammable dusts under normal operating conditions.	Areas probably not containing dangerous concentrations of flammable fibers or flyings under normal operating conditions.

Table 3

Classes of hazardous areas are divided into subgroups dependent on the type of flammable gas or vapor present:

Class I	Group A	Atmospheres containing acetylene
	Group B	Atmospheres containing hydrogen and flammable process gases with more than 30 % hydrogen by volume, or gases or vapors posing a similar risk level such as butadiene and ethylene oxide
	Group C	Atmospheres such as ether, ethylene or gases or vapors posing a similar risk level
	Group D	Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane methanol, methane, natural gas, naphtha, propane or gases or vapors posing a similar risk level
Class II	Group E	Atmosphere containing combustible metal dusts, including aluminum, magnesium, and their commercial alloys, or other combustible dusts whose particle size, abrasiveness and conductivity present similar hazards in the use of electronic equipment
	Group F	Atmospheres containing combustible carbonaceous dusts including carbon black, charcoal, coal, or coke dusts that have more than 8 percent total entrapped volatiles, or dusts that have been sensitized by other materials so that they present an explosion hazard
	Group G	Atmospheres containing combustible dusts not included in Group E or Group F, including fluorine, grain, wood, plastic, and chemicals

Table 4

The subgroups and the gases contained within each subgroup are based on the **Maximum Experimental Safe Gap** (MESG) or the **Minimum Ignition Current** (MIC).

Class III

- Class III hazardous locations are hazardous because of the presence of easily ignitable fibers or flyings. The probability is not high that such fibers or flyings are in the air in quantities sufficient to produce incandescence mixtures.
- Class III, Division 1 locations are those in which easily ignitable fibers or flyings are handled, manufactured, or used.
- Class III, Division 2 locations are those in which easily ignitable fibers or flyings are stored or handled.
- Locations belonging in this class usually include parts of textile mills, cotton gins, flax-processing plants, clothing manufacturing plants, woodworking plants, etc.
- Easily ignitable fibers and flyings include rayon, cotton, sisal, hemp, cocoa fiber, kapok, excelsior, etc.
- Class III locations are not further subdivided.

Figure 5 shows a gas tank with a fixed roof and vent as a typical example of a Class I hazardous location applicable in North America with categorization into Divisions 1 and 2.

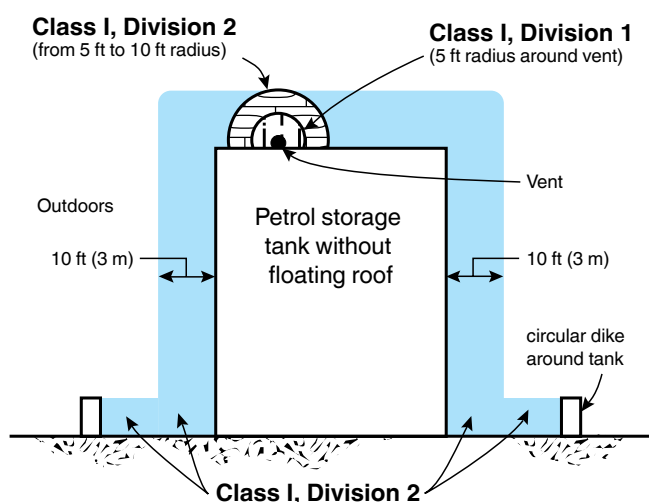


Figure 5 Schematic of a division-based area classification of a fuel tank with fixed lid and breather

Three Zone Model in North America and Canada

In 1988 in Canada, plants for Class I applications were transferred to the three-zone model of the IEC. For plants built after 1988, the three-zone model is mandatory (CEC, 1988 edition). In 1996 in North America, the NEC 505 section was introduced for Class I applications. Since the time of this addition to the NEC, area classification according to the IEC zones has been an option for companies.

Class I (Gases and Vapors)

Zones in accordance with NEC 505.5 and CEC 18-006:

Zone 0	Areas containing dangerous concentrations of flammable gases, vapors, or mist continuously or for long periods under normal operating conditions.
Zone 1	Areas containing dangerous concentrations of flammable gases, vapors, or mist during normal operating conditions, during repair or maintenance operations, or because of leakage.
Zone 2	Areas not likely to contain dangerous concentrations of flammable gases, vapors, or mist under normal operating conditions.

Table 5

However, in North America the traditional Division practice dominates and the possibility for zone classification is seen as secondary. As a comparison, the division practice in North America is compared to the zone practice in Europe in the following section.

Three Zone Model

The European zone practice is described in IEC/EN 60079-10. In accordance with this standard, any area in which there is a probability of a flammable gas or dispersed dust to exist must be classified into one of the following areas.

Zone 0	Areas in which a dangerous potentially explosive atmosphere of explosive air/gas mixture is continuously present or present for long periods.
Zone 1	Areas in which a dangerous potentially explosive atmosphere of explosive air/gas mixture is occasionally present in normal operation.
Zone 2	Areas in which a dangerous potentially explosive atmosphere of explosive air/gas mixture is rarely present but, if it is, only for short periods of time.
Zone 20	Areas in which a dangerous potentially explosive atmosphere of explosive air/dust mixture is continuously present or present for long periods.
Zone 21	Areas in which a dangerous potentially explosive atmosphere of explosive air/dust mixture is occasionally present for a short time.
Zone 22	An area in which a dangerous potentially explosive atmosphere of raised dust is unlikely to occur; but, if it does, only rarely and for short periods of time.

Table 6

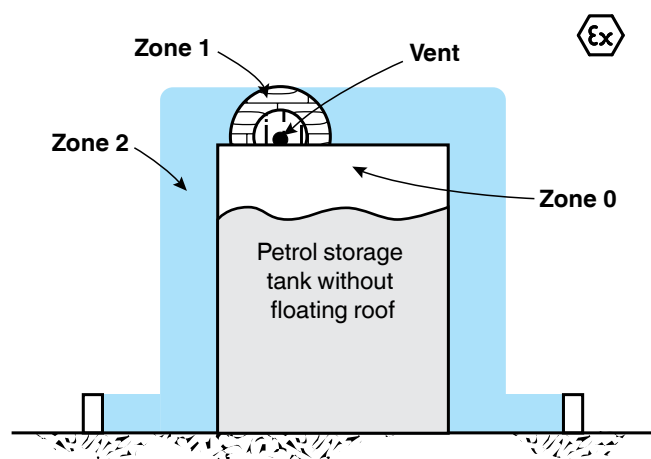


Figure 6 Schematic of a zone-based area classification of a fuel tank with fixed lid and breather

In practical implementation, relevant national regulations for zone classification, installation, and operation of a plant are to be observed. These may differ from the IEC regulations or concretize the IEC regulations.

Classification of Surface Temperature for Divisions and Zones

Apparatus installed directly in a hazardous area must be classified for the maximum surface temperature that the device produces under normal operation or in the event of a fault. The maximum surface temperature must be below the minimum ignition temperature of the gas present.

In the USA and Canada (as in Europe), six temperature classes are differentiated, T1 to T6. The classes T2, T3, and T4 are, however, divided into further subclasses, as indicated in the following table.

Maximum temperature		Temperature class in North America
°C	°F	
450	842	T1
300	572	T2
280	536	T2A
260	500	T2B
230	446	T2C
215	419	T2D
200	392	T3
180	356	T3A
165	329	T3B
160	320	T3C
135	275	T4
120	248	T4A
100	212	T5
85	185	T6

Table 7 Classification of surface temperature

Each gas is allocated to a temperature class according to its ignition temperature. Note that for all specific mixtures, there is no connection between ignition energy and ignition temperature.

Hydrogen for example has a minimum ignition energy of 20 µJ and an ignition temperature of 560 °C (1040 °F), whereas acetaldehyde has an ignition energy of over 180 µJ and an ignition temperature of 140 °C (284 °F).

An apparatus classified for a particular temperature class can be used in the presence of all gases, provided that its ignition temperature is above the temperature class rating of the particular device. For example, a T5 classified apparatus can be used with all gases, the ignition temperature of which is above 100 °C (212 °F).

Important: For all types of protection, a temperature classification is required with regard to all surfaces that could come into contact with a potentially explosive atmosphere.

Types of Protection

To reduce the risk of explosion, elimination of one or more of the components of the ignition triangle is necessary. For more information, see "Ignition Triangle" in the "Physical Fundamentals of Explosion Protection" section. There are three basic methods of protection – explosion containment, segregation, and prevention.

- **Explosion containment:** The only method that allows the explosion to occur but confines it to a well-defined area, thus avoiding the propagation to the surrounding atmosphere. The "flameproof" type of protection is based on this method.
- **Segregation between ignition source and potentially explosive atmosphere:** A method that attempts to create a spatial separation between potential ignition sources (electrical parts or hot surfaces) and the explosive mixture. The types of protection "pressurization," "powder filling," and "encapsulation" are based on this method.
- **Prevention of a potent ignition source:** A method that limits thermal effects such as hot surfaces and that either generally prevents electrical sparks (increased safety), or that limits the electrical energy – also under fault conditions – to safe levels as is the case for the "intrinsic safety" type of protection.

Selecting a Protection Method

First of all, the normal functioning of the apparatus must be considered. Secondly, eventual malfunctioning of the apparatus due to faulty components must be a consideration. Lastly, all those conditions that can accidentally occur, such as a short circuit, open circuit, grounding, and erroneous wiring of the connecting cables, must be evaluated.

The choice of a specific protection method depends on the degree of safety needed for the type of hazardous area, considered in such a way as to have the lowest probable degree of an eventual simultaneous presence of an adequate energy source and a dangerous concentration level of an air/gas mixture.

None of the protection methods can provide absolute certainty of preventing an explosion. Statistically, the probabilities are so low that not even one incident of an explosion has been verified when a standardized protection method has been properly installed and maintained.

The first precaution is to avoid placing electrical apparatus in hazardous areas. When designing a plant or factory, this factor needs to be considered. Only when there is no alternative should this application be allowed.

Other secondary, but important, factors for consideration are the size of the apparatus to be protected, the flexibility of the system, the possibility of performing maintenance, the installation cost, etc. Respective of these factors, intrinsic safety has many advantages; however, to understand these advantages better, it is necessary to know and understand the limitations of the other protection methods.

The purpose of this section is to present the different methods of protection briefly. In Europe, CENELEC and IEC standards refer to protection methods with symbols, such as Ex d for flameproof. These symbols are not used by the United States and Canada for Division rated products.

From the combination of code designations and symbols on each of the apparatus, the protection method can be instantly identified. The same is valid for North America and Canada, in cases where NEC 505 (American implementation of the IEC recommendation for gases and vapors) is applied.

Oil immersion	Ex o
Powder filling	Ex q
Encapsulation	Ex m
Pressurization	Ex p
Increased safety	Ex e
Flameproof	Ex d
Intrinsic safety	Ex i
Ignition protection n	Ex n
Intrinsically safe systems	Ex i
Apparatus with optical radiation	Ex op

Table 8 Code designation of protection methods for hazardous gas areas according to IEC 60079-X and NEC 505

The same types of protection exist in the North American zone, with methods as identified in the appropriate IEC 60079-X series standards.

Flameproof

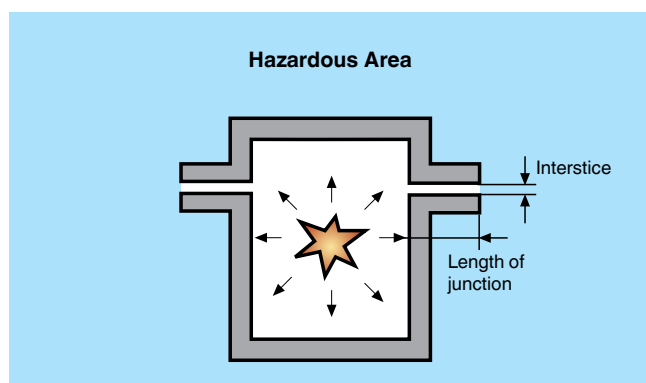


Figure 7 Schematic diagram of a flameproof enclosure (IEC 60079-1, EN 60079-1, FM 3615, UL 2279.P1)

This protection method is the only one based on the concept of preventing propagation of the explosion. In this case, the energy source is permitted to come in contact with the dangerous air/gas mixture. Consequently, the explosion is allowed to take place, but it must remain confined in an enclosure built to resist the excess pressure created by an internal explosion, thus impeding the propagation to the surrounding atmosphere.

The theory supporting this method is that the resultant gas jet coming from the enclosure is cooled rapidly through the enclosure's heat conduction and the expansion and dilution of the hot gas in the colder external atmosphere. This is only possible if the enclosure openings or interstices have sufficiently small dimensions.

Distinctions for Two Division Model

In North America, a flameproof enclosure (in accordance with IEC) is, as a rule, equated with the "flameproof" designation. In both considerations, the housing must be designed for a x1.5 explosion overpressure. The North American version "explosion-proof" (XP) must withstand a maximum explosion overpressure of x4.

Furthermore, in North America, the installation regulations (NEC 500) specify the use of a metal conduit for the field wiring installation. Here it is assumed that the air/gas mixture can be present within the conduit system. Therefore, the resulting explosion pressures must be considered. The conduit connections must be constructed according to specification and sealed (i. e., lead seals) with appropriate casting compound.

The housing is not constructed gas-tight but has a flameproof joint that serves as a pressure relief point. Escaping hot gases are cooled to the extent that they cannot ignite the potentially explosive atmosphere outside the housing. Ignition is prevented if the minimum ignition temperature and minimum ignition energy of the surrounding potentially explosive atmosphere is not reached. For this reason, apparatus of this type of protection are approved with different joint lengths and a maximum opening allowed, depending on the nature of the explosive mixture and on the design of the joint.

The classification of a flameproof enclosure is based on the gas group and the maximum surface temperature, which must be lower than the ignition temperature of the gas present.

Installation and Maintenance Problems of Explosion-Proof Enclosures

Explosion-proof enclosures often have installation and maintenance problems that can be summarized as follows:

- A medium-weight enclosure is heavy, and its installation creates mechanical and structural complications.
- Particularly corrosive atmospheric conditions that are often found in chemical plants, petrochemical plants, or oil platforms, require the use of materials such as stainless steel or bronze, which may cause dramatically higher costs.
- Cable entries require a particular arrangement (reductions, cable clamps, conduits, metal-clad cable, sealing) and, in some cases, such items may represent a cost higher than the enclosures themselves.
- In a humid atmosphere, condensation may cause problems inside the enclosure or conduit pipe.
- The safety of an explosion-proof enclosure is based entirely on its mechanical integrity; therefore, periodic inspections are important.
- Opening the enclosure is not permitted while the apparatus is functioning. This may complicate maintenance and inspection operations. Usually, the absence of a potentially explosive atmosphere must be determined and the process must be shut down in order to perform routine maintenance.
- It is difficult to remove the lid. In some cases, a special tool is required or sometimes 30–40 bolts must be unscrewed. After removing the lid, it is important to have the integrity of the joint ensured by experts before the system can be restarted.
- Changes to the system are difficult to implement.

The degree of safety of an explosion-proof enclosure, over time, depends on the correct use and maintenance by the plant personnel. Because of this vulnerability, the flameproof method is not always allowed, such as in the European Zone 0.

In the United States, not having a direct equivalent to Zone 0, there are particular restrictions in using explosion-proof enclosures in Division 1. Practically speaking, it is not allowed in any location that would be classified as Zone 0.

This protection method is one of the most widely used and is suitable for electrical apparatus located in hazardous areas where high levels of power are required, such as for motors, transformers, lamps, switches, solenoid valves, actuators, and for all parts that generate sparks. On the other hand, practical matters such as high maintenance and calibration costs make this method less cost-effective than intrinsic safety.

Purge and Pressurization Method

Purging or pressurization is a protection method based on the segregation concept. This method does not allow the dangerous air/gas mixture to penetrate the enclosure containing electrical parts that can generate sparks or dangerous temperatures. A protective gas – air or inert gas – is contained inside the enclosure with a slightly greater pressure than that of the external atmosphere. See Figure 8.

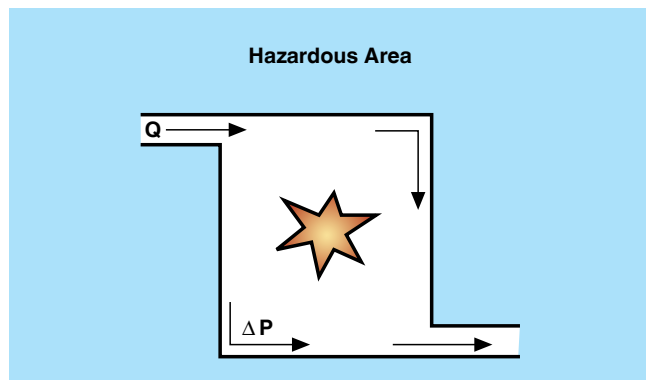


Figure 8 Schematic diagram of a pressurizing system (IEC 60079-2, EN 60079-2, FM 3620 and NFPA 496)

The internal overpressure remains constant with or without a continuous flow of the protective gas. The enclosure must have a certain degree of tightness; however, there are no particular mechanical requirements because the pressure supported is not high.

To avoid pressure loss, the protective gas supply must be able to compensate, during operation, for enclosure leakage and access by personnel where allowed. In general, the use of two interlocked doors is the classical solution.

Because it is possible for the explosive atmosphere to remain inside the enclosure after the purge and pressurization system has been turned off, it is necessary to expel the remaining gas by circulating a certain quantity of protective gas before restarting the electrical equipment.

The classification of the electrical apparatus must be based on the maximum external surface temperature of the enclosure, or the maximum surface temperature of the internal circuits that are protected with another protection method and that remain powered even when the protective gas supply is interrupted.

The purge and pressurization technique is not dependent upon the classification of the gas. Rather, the enclosure is maintained at a pressure higher than the dangerous external atmosphere, preventing the flammable mixture from coming in contact with the electrical components and hot surfaces inside.

Two Division Model

In the United States, the term "pressurization" is limited to Class II applications. Pressurization is the technique of supplying an enclosure with clean air or an inert gas, with or without continuous flow, at sufficient pressure to prevent the entrance of combustible dusts. Internationally, the term "pressurization" refers to a purging technique for Zones 1 and 2.

The two-division model of the purging protection method is based on the reduction of the classification inside the enclosure to a lower level. The following three types of protection (X, Y, and Z) are identified in relation to the hazardous-location classification and the nature of the apparatus.

Types of protection in relation to classification and nature of apparatus

- Type X: reduces the classification on the inside of the enclosure from Division 1 to a non-hazardous state that requires an automatic shutdown of the system in case of pressure loss.
- Type Y: reduces the classification on the inside of the enclosure from Division 1 to Division 2.
- Type Z: reduces the classification on the inside of the enclosure from Division 1 to a non-hazardous state; an alarm signal is required.

Three Zones Model

The European standard regarding this protection method, EN 60079-2, requires that particular safety systems function regardless of internal protective gas loss due to leakages, shutdowns, compressor breakdowns, or operator errors.

Pressurization is allowed as a method of protection in Zones 1 and 2. In the case of pressure loss, an automatic shutdown of the power supply can occur even with a slight delay for Zone 1, while a visual or audible signal is sufficient for Zone 2.

The European and the American practices are similar. In fact, The European standards have been revised to include three new protection methods of px, py, and pz. These methods are similar to the North American counterparts and show the level of harmonization taking place in the world. The safety devices (pressure transducers, flow meters, delay relays, etc.) needed to activate the alarm or the shutdown of the power supply must be either explosion-proof or intrinsically safe. The reason is that in general, these safety devices are in contact with the explosive atmosphere on the outside and on the inside of the enclosure during the purge phase or during pressure loss.

Sometimes the internal overpressure protection method is the only possible solution when no other method of protection is applicable. For example, in the case of large electrical apparatus or control panels where the dimensions and high energy levels make it impractical to use an explosion-proof enclosure or the application of the energy limitation method, the internal overpressure protection method is often the only answer.

The use of pressurization is limited to the protection of apparatus that do not contain the source of an inflammable mixture. For this type of apparatus, such as gas analyzers, the continuous-dilution technique must be used. This technique always keeps the protective gas – air or inert gas – in such a quantity that the flammable mixture concentration never exceeds 25 % of the lower explosive limit of the gas present.

Encapsulation

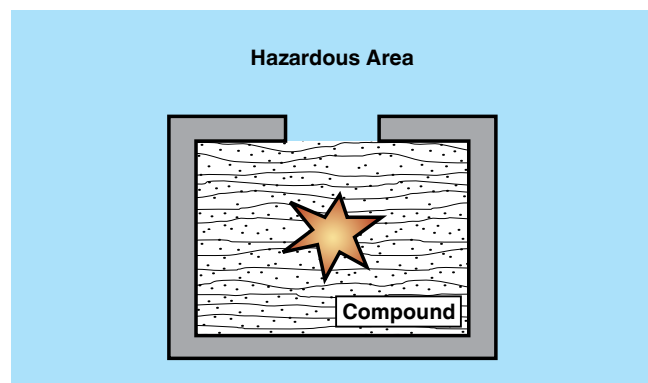


Figure 9 Schematic diagram of the cast enclosure (IEC 60079-18, EN 60079-18, UL 60079-18)

The encapsulation protection method is based on the spatial separation of all electrical parts that can cause the ignition of an explosive atmosphere in the presence of sparks or heating, by potting in compound that is resistant to the specific ambient conditions. See Figure 9.

Encapsulation ensures a good mechanical protection and is effective in preventing contact with an explosive mixture. Generally, it is used to protect electrical circuits that do not contain moving parts, unless these parts (e. g., reed relays) are already inside an enclosure that prevents the compound from entering. This technique is often used as a complement to other protection methods.

Oil Immersion Protection Method

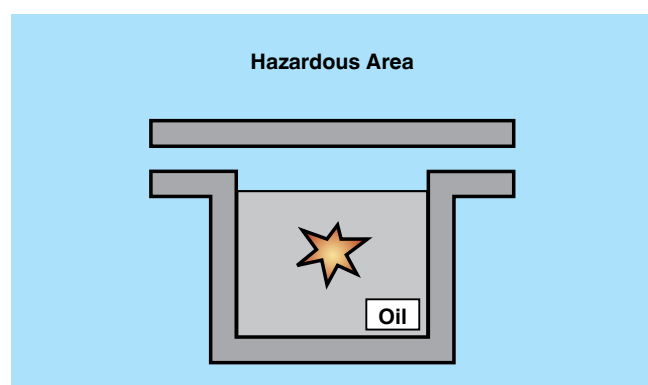


Figure 10 Schematic diagram of the oil enclosure (IEC 60079-6, EN 60079-6, UL 60079-6)

According to this protection method, all electrical parts are submersed in either nonflammable or low-flammability oil, which prevents the external atmosphere from contacting the electrical components. The oil often serves also as a coolant (refer to UL 698 and IEC 60079-6).

The most common application is for static electrical equipment, such as transformers, or where there are moving parts, such as transmitters.

This method is not suitable for process instrumentation or for apparatus that require frequent maintenance or inspections.

Powder Filling

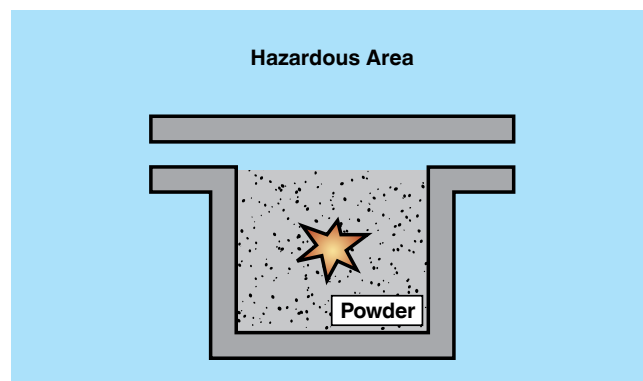


Figure 11 Schematic diagram of the powder filling "q" (IEC 60079-5, EN 60079-5, UL 60079-5)

This protection method is based on spatial separation of the ignition source and the potentially explosive atmosphere. Electrical components which could ignite a potentially explosive atmosphere via sparks or heating are fixed in position within a housing and surrounded by a filling. The potentially explosive mixture may permeate the housing. A possible explosion of this mixture inside the housing would be extinguished by the filling before it can ignite the potentially explosive atmosphere surrounding the device. The filling must be accomplished in a manner such that there are no cavities in the filling material.

Normally the filling is quartz sand (glass beads). The filling is subject to special legal requirements, as is the design of the housing.

The free space inside the sand-filled electrical apparatus or Ex component must be completely occupied by filling material. The external surfaces of the housing may not reach the relevant minimum ignition temperature at any point.

The housing may not be opened and the filling must not escape from the housing under normal operation or due to electric arcs or other processes within the powder filling "q".

Application: components giving rise to sparks or containing hot parts, the function of which is not influenced by fine-grained filling material. Capacitors or transformers are typical applications, but also complex electronic components, such as computers and monitors which are used for controlling, operating, and visualizing process data in hazardous areas. See Figure 11.

Increased Safety

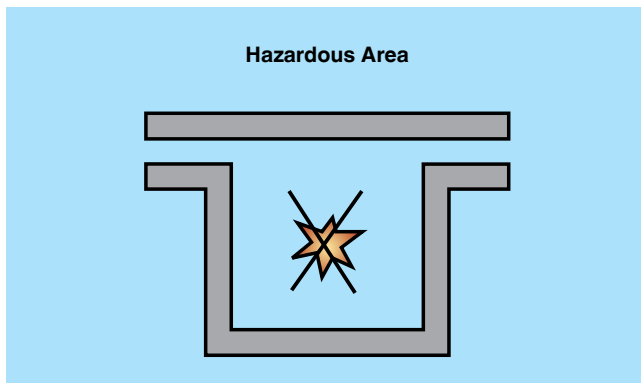


Figure 12 Schematic diagram of the "increased safety" type of protection (IEC 60079-7, EN 60079-7, UL 60079-7)

This protection method is based on the prevention of a potential ignition source (prevention concept). Measures must be applied to the electrical apparatus to prevent, with an elevated safety coefficient, the possibility of having excessive temperature or the generation of arcs or sparks inside and outside the apparatus during normal functioning. See Figure 12.

The "increased safety" type of protection is suitable for Zones 1 and 2. Under normal operation, an increased degree of safety is achieved by means of design parameters (increased air and creepage distances, IP degree of protection, tensile strength of terminal connections and cable glands, minimum cross sections, mechanical strengths, and isolation properties of the winding wire).

According to the standard, the prescribed means of construction must be made in such a way as to obtain an elevated safety coefficient during normal functioning. In the case of possibly allowed overloading, construction must comply to specific standards regarding connections, wiring, components, distances in air and on surfaces, isolators, mechanical impact and vibration resistance, degree of protection of the enclosure, etc. Particular attention must be given to those parts of the apparatus that could be sensitive to temperature changes, such as motor windings.

In the event of an overload, cage motors can be shut down promptly before the motor windings reach an impermissibly high temperature and become an ignition source.

Applications are junction boxes and connection boxes, connection spaces for heating, transformers, ballast resistors, and squirrel-cage induction motors, in combination with other ignition protection methods.

Intrinsic Safety

This type of protection is based on the principle of preventing a potential source of ignition (prevention concept). The electrical energy is kept below the minimum ignition energy required for each hazardous area.

The intrinsic safety level of an electrical circuit is achieved by limiting current, voltage, power, and temperature; therefore, intrinsic safety is limited to circuits that have relatively low levels of power. Of critical importance are the stored amounts of energy in circuits in the form of capacitance and inductance. These energy storage elements must be limited based on the voltage and current levels present in a particular circuit or make/break component.

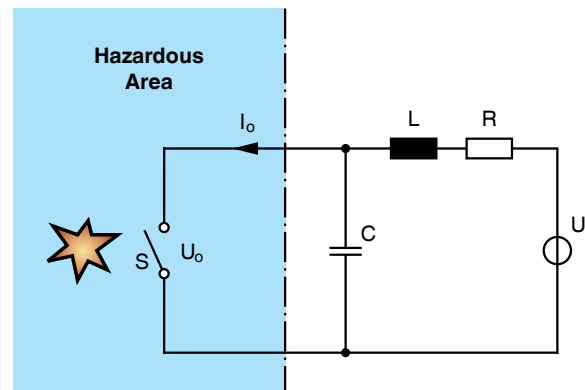


Figure 13 Schematic representation of an intrinsically safe circuit

In normal operation and in the event of a fault, no sparks or thermal effects may occur that could lead to the ignition of a potentially explosive atmosphere. Intrinsically safe circuits may therefore be connected and disconnected by experts during operation (even when live), as they are guaranteed to be safe in the event of a short circuit or disconnection. Intrinsic safety is the only type of protection that allows connectors to be opened and intrinsically safe apparatus to be removed and replaced by an equivalent device in a hazardous area. Because of the level of freedom this brings, intrinsic safety has become one of the most important methods of protection in the industrial automation industry.

Installation Costs

The "intrinsic safety" type of protection allows the installation of apparatus in a similar way to the practice used for standard apparatus. This factor alone lowers the cost of installation.

Explosion-proof enclosures, flameproof, and pressurized enclosures require special devices, such as metal-clad cables, conduits, cable clamps, and lead seals. Purging or pressurization requires a pipeline for the protective gas. These are the principle reasons for the higher installation cost when these protection methods are used rather than intrinsic safety.

Maintenance Costs

Relative to maintenance costs, intrinsic safety is the most advantageous because this method allows live maintenance with no need for plant shutdown. Intrinsic safety is also more reliable due to the use of infallible and derated components as prescribed by the standards.

Explosion-proof and flameproof enclosures require that particular attention is given to the integrity of the coupling joints and cable entrance, which adds to the cost of maintenance.

For pressurized enclosures, there is an added cost for the maintenance of the protective gas supply system and its related piping.

Conclusion

From the comparison of the three most widely used protection methods, it is evident that intrinsic safety, where applicable, is preferred for safety and reliability reasons. Intrinsic safety is also the most economical for installation and maintenance.

The use of intrinsic safety provides the best mix of an affordable system and safety requirements.

Special Types of Protection

Type of protection n, for use on electrical apparatus in Division 2 and Zone 2, includes a number of various degrees of protection, some of which can be seen as simplifications of intrinsic safety and other types of protection already presented.

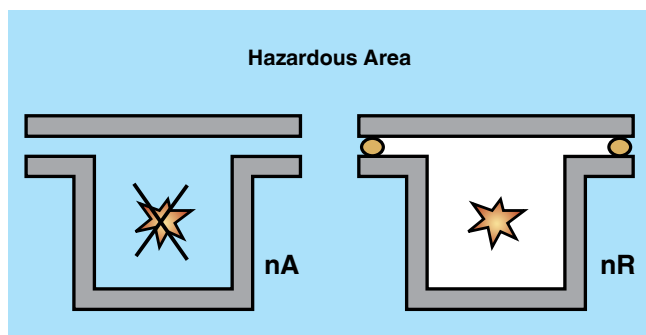


Figure 14 Schematic diagram of type of protection n (n = non-incendive) (IEC 60079-15, EN 60079-15, UL 60079-15)

Two Division Model

The concept of non-incendive circuitry is defined by the National Electrical Code, NFPA 70, as a circuit in which any arc or thermal effect produced, under intended operating conditions of the equipment, is not capable, under specified test conditions, of igniting the flammable gas, vapor, or dust-air mixture. To learn more on the entire non-incendive energy concept, refer to ANSI/ISA S12.12.01.

The non-incendive technique, when applied to electrical apparatus, makes the apparatus incapable of igniting a surrounding explosive atmosphere during normal functioning.

Non-incendive devices are not approved for Division 1.

Three Zone Model

The European standard EN 60079-15 describes the requirements for equipment to be used in Zone 2. These include:

- Non-sparking electrical equipment
- Equipment with parts or circuits that require light arcs, sparks, or hot surfaces (and that could, therefore, be capable of igniting a potentially explosive atmosphere if they are unprotected).

Possible protective principles of type of protection n are summarized in the table below:

Equipment n	Examples of protection methods	Marking
Non-sparking (simple "increased safety")	Electric motors (squirrel cage rotor), terminal box, fuses, lights, transformers, equipment with low power (monitoring and control technology), plug-in devices, cells, batteries, etc.	Ex nA
With protected contacts	Simple "flameproof enclosure" or simple "cast enclosure"	Ex nC *
Enclosed mechanism	Same	
Part not capable of igniting	Contact mechanism or housing designed to prevent ignition	
Hermetically sealed construction	Seal ensured by a melting process such as soft or hard soldering, welding, or melting glass into metal	
Sealed device	Designed so that it cannot be opened during normal operation	
Enclosed device	Completely embedded in an enclosing cast body	
Restricted breathing	Housing design limits penetration of gases and vapors. Only sparking equipment with an internal temperature ≤ 10 K compared to the ambient temperature of the housing can be installed.	Ex nR

Table 9 Possible protection principles of type of protection n
nL is now part of the protection method "intrinsic safety" ic (EN 60079-11).
* nC, if molded, is now part of the protection method "encapsulation" mc (EN 60079-18).

Mixed Protection Methods

In the process instrumentation field, the use of several protection methods applied to the same apparatus is a common practice. For example, circuits with intrinsically safe inputs can be mounted in pressurized or explosion-proof enclosures.

Generally, this mixed system does not present installation difficulty if each of the protection methods is appropriately used and is in compliance with the respective standards.

Summary of Protection Methods

This section has briefly presented the types of protection against fire and explosion. The concepts upon which these methods are based were introduced, and the general methods of construction and application were discussed.

The purpose of this section is not to exhaust the subject, but rather to offer an overview of the applicable protection methods for the electrical instrumentation used in that part of the plant classified as hazardous.

Intrinsic safety will be discussed in detail in the next section. For all other techniques, refer to the respective standards.

Labeling of Types of Protection

ATEX Labeling

With the introduction of ATEX requirements, a new labeling program came into force for the use of certain products in the EC.

The labeling requirements are aimed at uniformity. The CE conformity labeling on a product is an indication that all relevant directives (e. g., ATEX, low voltage directive 2006/95/EC, electromagnetic compatibility directive 2004/108/EC, machinery directive 2006/42/EC) have been adhered to and that the product is suitable for use according to the manufacturer's instructions.

For products used in hazardous areas, the following table is valid:

Device group	Device category	Type of atmosphere	Protection to be ensured	Hazardous area characteristics	Zone comparison
I (mining)	M1	–	Very high	Present continuously – equipment must not be de-energized	–
	M2	–	High	Present continuously – equipment can be de-energized	–
II (all areas except mining)	1	G (gases, vapors, mists) D (dust)	Very high	Present continuously, for long periods or frequently	Zone 0 Zone 20
	2	–	High	Likely to occur in normal operation and for short periods of time	Zone 1 Zone 21
	3	–	Normal	Not likely to occur in normal operation or infrequently	Zone 2 Zone 22

Table 10 ATEX labeling

In the following example, the key elements of device labeling are listed:

⊕ II (1)G [Ex ia] IIC PTB 00 ATEX 2080
⊕ II (1)D [Ex ia] IIIC

	⊕	Symbol identifies the product for hazardous areas
ATEX portion	II	Device group – non-mining application
	1	Device category – Can be used in Zone 0 and/or 20 – an (...) indicates the device meets the requirements of the category, but it must be installed outside the hazardous area
	G	Atmosphere type – can be used in areas with combustible gas
	D	Atmosphere type – can be used in areas with combustible dust
CENELEC/IEC portion	[...]	Associated apparatus that supplies safety into the hazardous area.
	Ex	Product type – explosion protection
	ia	Protection type – intrinsic safety
	IIC	Equipment group – IIC (gas) is most hazardous area
Certificate details	IIIC	Equipment group – IIIC (dust)
	PTB	Certifying test agency
	00	Test year (2000)
	ATEX	Compliance with Directive 94/9/EC
	2080	Registration number

Table 11 Device labeling

In the ATEX labeling, the Ex hexagon ⊕ indicates that this is a device for use in hazardous areas in the European market.

The EEx abbreviation stands for the CENELEC standard series EN 50*** and could be used until March 2007. Since December 2004, the Ex abbreviation has stood for CENELEC standard series EN 60079-**, which is based on harmonization with the IEC standard series of the same name.

Labeling according to Two Division Model

A label must be placed on the device that indicates the Approval Type, Class, Division, and Group used. On devices certified according to the two division model, reference to a control drawing or installation document is normally included on the product label.

Furthermore, using the NEC 505 three zone model, a similar IEC-based type of protection and marking (incorporating the "AEx" symbol) is permitted in USA. However, according to article 505 of the NEC, the installation methods and electrical connections employed for zones are similar to those used in article 500 of the NEC (i. e., conduit must be used). The exception to this requirement is when intrinsic safety is implemented.

NEC 500	Class I, Division 1, Groups A, B, C, D, T6
NEC 505	Class I, Zone 1, AEx de IIC T6
IEC	Ex de IIC T6 Gb
ATEX	⊕ II 2G EEx or Ex de IIC T6 Gb

Table 12 Differences in labeling for NEC 500, NEC 505, IEC, and ATEX

Labeling of Associated Apparatus

Two Division Model

A label is placed on the device that indicates the Approval Type, Class, Division, and Group used, and references a specific Control Drawing.

Example:

Associated apparatus for use in Class I, Division 2, Groups A,B,C,D hazardous locations provides intrinsically safe circuits for use in Class I, Division 1, Groups A,B,C,D hazardous locations when installed in accordance with Drawing No. ABC-1234.

Three Zone Model

Example 1: [Ex ia] IIC

Associated electrical apparatus located in a safe area

Example 2: Ex d [ia] IIC T4

Associated electrical apparatus in an explosion-proof enclosure located in a hazardous area

The marking between [] indicates that it is an associated electrical apparatus.

The Philosophy of Intrinsic Safety

In the previous section, the different methods that are used to reduce the danger of explosion or fire were presented. The protection methods, based on the containment and segregation concepts, are methods that contain the explosion in order for the energy source – electrical or thermal – to avoid coming in contact with the potentially explosive mixture. In both cases, the use of appropriate enclosures and specific wiring and installation systems are required. The intrinsic safety method prevents the ignition of the potentially explosive atmosphere, while simplifying the installation and use of the required apparatus that is connected to the electrical circuits directly located in a hazardous area.

The Intrinsically Safe Circuit

According to article 504 of the National Electrical Code, NFPA 70, and IEC/EN 60079-11, an intrinsically safe electrical circuit is defined as one in which no spark or thermal effect generated during normal functioning and/or during specific fault conditions is able to ignite a given explosive atmosphere.

An electrical circuit typically consists of a voltage U , resistance R , inductance L , capacitance C and switch S , connected as shown in Figure 15.

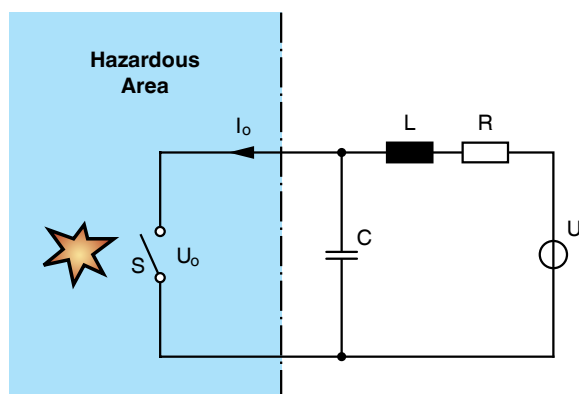


Figure 15 Schematic representation of an intrinsically safe circuit

To affirm that an electrical circuit is intrinsically safe, the parts of the circuit which are able to store energy, i. e., the inductor and the capacitor, must be considered. When the switch in the hazardous area is open, the capacitor accumulates energy that is discharged when the switch closes, causing an electrical spark. In the same way, when the contact is closed, the inductor stores energy that is released in the form of an electrical arc when the switch opens. The energy released by the circuit must be lower than the minimum ignition energy (MIE) of the air/gas mixture present in the hazardous area. Safety factors are applied to ensure that the values allowed are well below that required for ignition.

A theoretical estimation of the energy inherent to an electrical circuit is not always possible, especially when the energy provided by the current source is higher compared to the energy stored by the reactive components.

For this reason, the data normally used in considering intrinsic safety is presented in the form of the correlation between electrical parameters of the circuit, voltage, and current, and the minimum ignition energy level of the hazardous atmosphere.

An electrical circuit, no matter how complex, is sequentially examined as resistive, inductive, and capacitive. If the safety criteria are satisfied by the different types of circuits, the circuit can be considered intrinsically safe.

Resistive Circuits

A circuit is considered as resistive when the reactive part, inductance and capacitance, is zero or negligible.

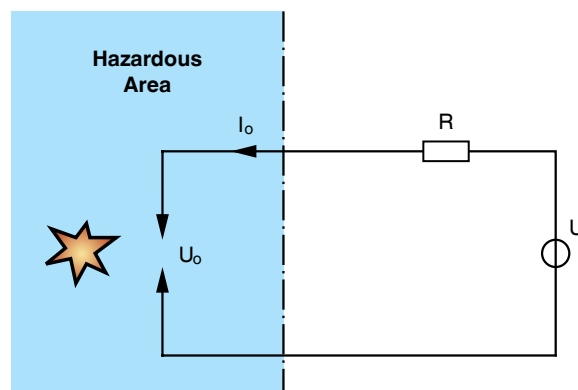


Figure 16 Schematic diagram of a resistive circuit

The energy released by this type of circuit depends essentially on the power supply source U and the current limitation due to the presence of resistor R .

The experimental tests on this type of circuit have demonstrated that the capacity for igniting an explosive atmosphere depends on the open-circuit voltage ($U_o = U$) and the short circuit current ($I_o = U / R$).

The ignition curve for resistive circuits relative to the group of gases that are considered by the standards is shown in Figure 17.

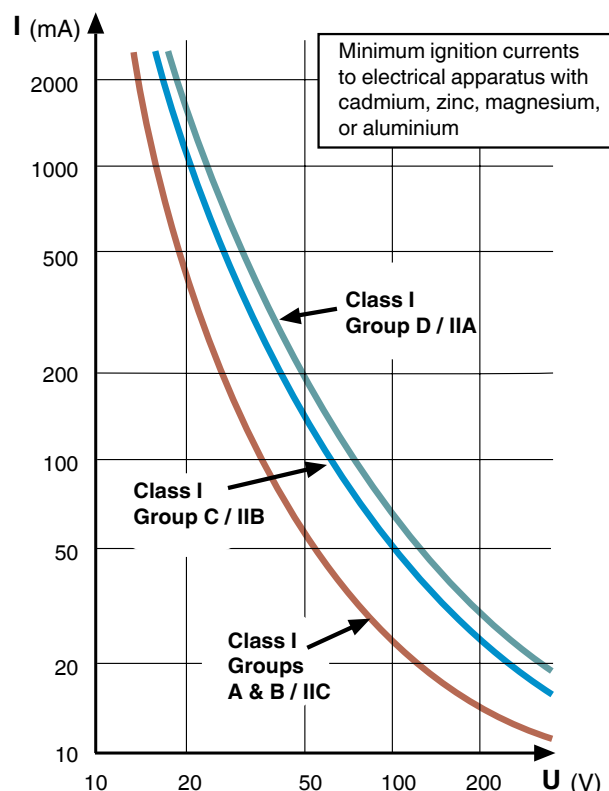


Figure 17 Ignition curve for a resistive circuit

By the trend of the curve, the lower the open-circuit voltage, the greater the amount of power that can be used safely. This characteristic allows process instrumentation that works with voltages on the order of 20 V to 30 V to be used efficiently in intrinsic safety applications.

For a more detailed ignition curve, refer to the appropriate standards.

Inductive Circuits

An electrical circuit is inductive when the reactive part, due to its inductance, is high with respect to the resistive part.

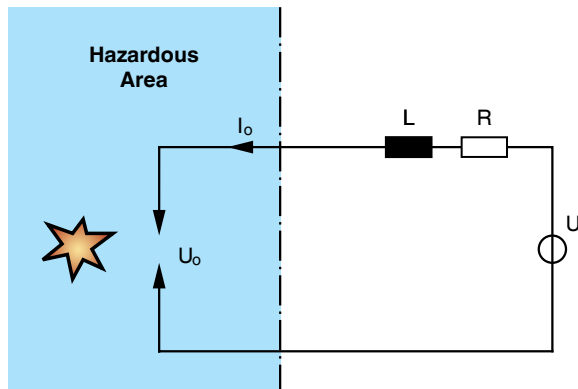


Figure 18 Schematic diagram of an inductive circuit

Closed Electrical Circuits

The maximum current that circulates in a closed circuit is:

$$I_o = U / R$$

The inductor L stores energy in the amount of:

$$E = \frac{1}{2} \times L \times I_o^2$$

Open Electrical Circuits

When the circuit is opened, a voltage ($U_{ind} = L \cdot di / dt$) is induced at the ends of the inductor that is added to voltage U. Therefore, the energy stored in the inductive magnetic fields, plus the energy coming from the current source, is released in the form of an electric arc at the point of the circuit's opening.

If the inductor's stored energy is the only cause of the spark, the minimum ignition current for a certain potentially explosive atmosphere is bound to the L value according to the following relationship:

$$E = \frac{1}{2} \times L \times I_o^2 = \text{constant}$$

Graphic representation on a logarithmic scale should present a rectilinear trend with an inclination of -2.

From the graph in Figure 19, note that the relationship can be verified except when the inductor value is lower than, or equal to, 1 mH.

This is due to the fact that, for high currents and low inductor values, the circuit becomes resistive. In this case, the power supply source becomes predominant as energy is released by the circuit.

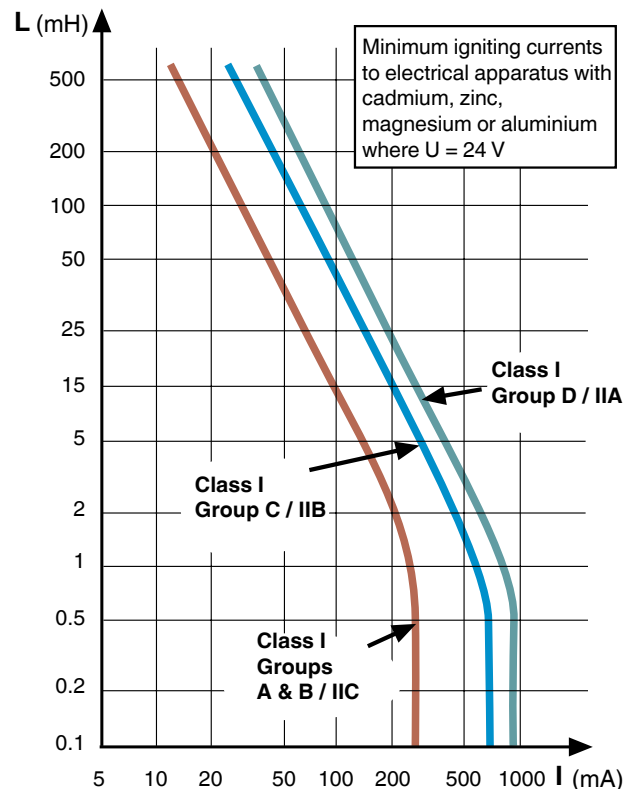


Figure 19 Ignition curve for an inductive circuit

For a more detailed ignition curve, refer to the appropriate standards.

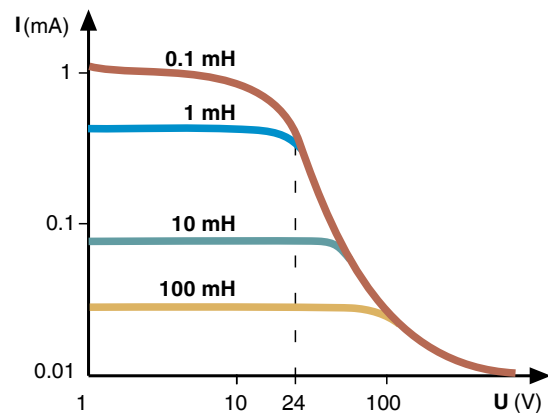


Figure 20 Minimum ignition current for inductive circuits in relation to voltage U

Capacitive Circuits

When a capacitive circuit (Figure 21) is open, the capacitor charges to a voltage U and accumulates an energy ($E = \frac{1}{2} \times C \times U^2$) that is released in the form of a spark at the point where the circuit closes. For an analogy with the inductive circuit with an inclination of -2 on the logarithmic scale, a relationship appears to exist between the capacitance value and the voltage source. However, experimental tests have demonstrated that this theoretical relationship does not exist and the ignition curves are as shown in Figure 22.

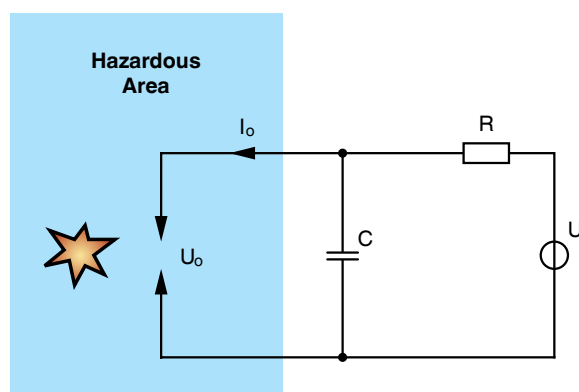


Figure 21 Schematic diagram of a capacitive circuit

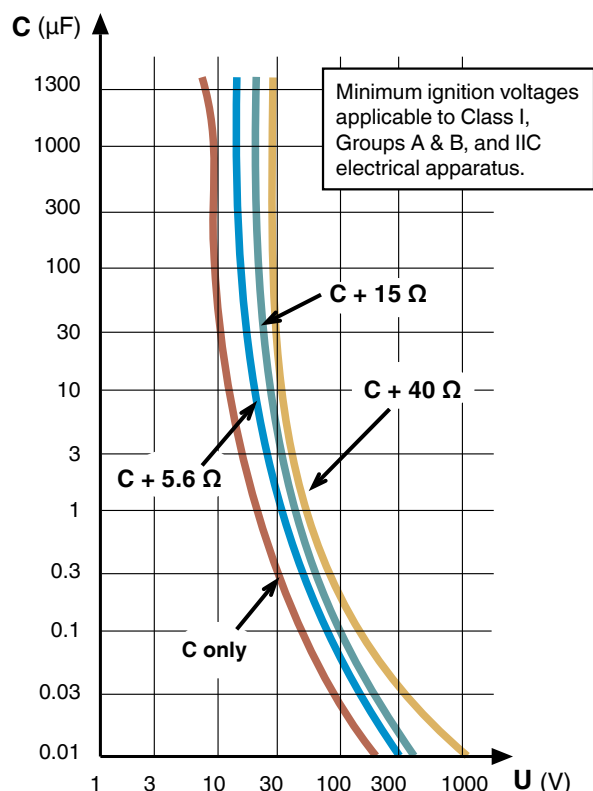


Figure 22 Ignition curve for a capacitive circuit

This discrepancy between the theoretical values and experimental data is due to the fact that the capacitor's discharge is not complete and instantaneous. Each resistor inserted in the capacitor's discharge circuit, besides increasing the discharge time constant, dissipates part of the accumulated energy, thus reducing the energy released at the point of contact.

A New Dimension of Intrinsic Safety with DART

Introduction

Intrinsic safety is a worldwide-accepted type of protection that offers many advantages over other types of ignition protection. It is based on the principle that the energy released within an electrical circuit through sparks, heat, or other normal and abnormal events is incapable of igniting a potentially explosive atmosphere.

Intrinsic safety is currently achieved by limiting the available power. This limitation of power – usually to less than 2 W – provides intrinsic safety (Ex i) and is therefore used in the area of control and instrumentation in the power supply to actuators and sensors with low connected loads.

A significantly higher direct power with the simultaneous safeguarding of all the positive characteristics of intrinsic safety offers the user a new and wider scope of application. These aims are achieved through the DART method (**D**ynamic **A**rc **R**ecognition and **T**ermination). DART is a technique of instantaneous tripping, which dynamically detects an undesired condition or a fault in the electrical system, precisely as it occurs and instigates an immediate transition to a safe condition before any safety-critical parameters are exceeded. DART is based on the detection of fault conditions and the characteristic rate of change of current.

Through the use of DART, systems can be operated at drastically increased direct power output compared to present intrinsic safety solutions. More available direct power opens the door to the use of intrinsic safety in many applications relevant to the process industry. To mention the following examples: analytic equipment, weighing equipment, lighting systems, valve control systems, and fieldbus systems, such as FOUNDATION Fieldbus H1 and PROFIBUS PA.

Basic Operating Principles

In the normal operating condition, the DART power supply feeds the full nominal power, which, depending on the application, can be greater by a factor of up to 25 (50 W) when compared to standards-related permissible values. At the instant of the onset of a fault incident, such as the opening of the circuit, DART detects the resulting change in current and immediately switches off the power supply. In this way, the energy from the electrical system is effectively limited in just a few microseconds. Thus, a spark capable of causing an ignition is prevented.

This procedure is possible due to a characteristic and easily detectable change in current (di/dt) during the onset of a fault condition. The reaction of the power supply takes place quickly – in approximately 1.4 μ s. On such a fast reacting system, an additional factor to be considered is the propagation time on the cable. The energy released is determined by the power converted at the point of the fault integrated over the time up to the effective disconnection. The following physical parameters are principally responsible for this:

- The power – determined by the supply voltage and the load current
- The time – comprising the signal propagation delay in the cable and the reaction time of the power supply
- The energy stored in the connection cable
- The load behavior

The energy released in the spark is determined by the power available, integrated over time. The relationships are explained below. Figure 23 shows the arrangement of the power supply, cable, and devices in the hazardous area.

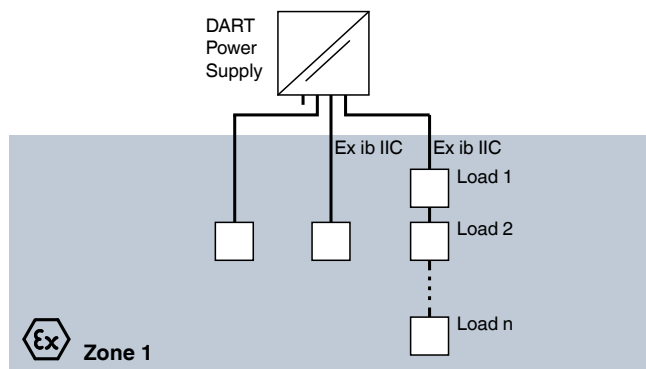


Figure 23 Arrangement of the power supply, cable, and devices in the hazardous area

Detecting a Spark Ignition

The determination of the intrinsically safe ignition limit values is made with the spark test apparatus specified in the standard IEC/EN 60079-11 – in which these values are subjected to a specified ignition probability. It is important to distinguish make sparks and break sparks. Only break sparks are considered in this context, as they represent the critical case.

A typical example of the behavior of the electrical parameters of a break spark is shown in Figure 24. A break spark commences with the voltage $U_F = 0$ V and usually ends on reaching the open circuit voltage at $U_F = U_o$, in which the steady increase of the spark voltage is directly associated with a reduction in the spark current I_F in a linear circuit. The period in between depends on the circuit and is referred to as the spark duration t_F .

Typical spark duration t_F : $5 \mu\text{s} < t_F < 2 \text{ ms}$.

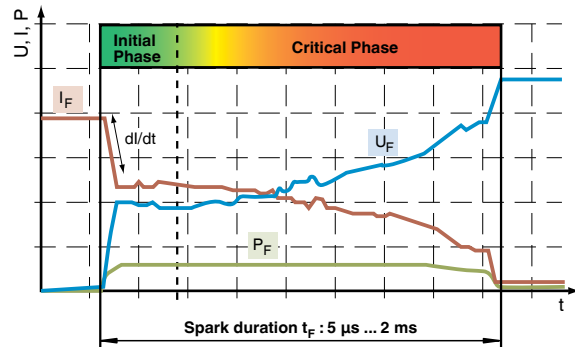


Figure 24 Variation with time of the spark current, voltage, and power of a linear limited break spark (non-IS)

At the start of a break spark, the spark voltage U_F jumps within a short time ($t \leq 1 \mu\text{s}$) from 0 V to $U_F \geq 10$ V. The voltage change is directly linked with a characteristic and easily evaluated sharp current change di/dt (see curve I_F). Directly after this change in current, the spark current and spark voltage remain relatively constant for approximately 1 ... 5 μs . During this period, there is definitively **no possibility of ignition** due to the low available spark energy W_F and it is referred to as the "initial phase." The time following this initial phase persists up to the end of the spark duration t_F . This range is the "critical phase" during which **an ignition can occur**. During this period, the spark draws the necessary ignition energy from the system, i. e., from the source, the cable, and the loads.

Based on the knowledge of these variations, it can be shown that the rapid detection of sparks in combination with a means for the rapid disconnection of the source can be used to prevent the ignition of an explosive mixture reliably. The task is principally to evaluate the current change (di/dt), while considering the characteristic safety values.

Figure 25 shows the time history of a spark interrupted by a DART power supply. The current change is clearly evident and is used to trigger the transition of the circuit into the safe condition. With DART, a fault condition is already detected and evaluated within the "initial phase," and leads to the disconnection of the power supply. The switch-off time available during this process depends on the system. A frequently used value based on the physics of the spark is 5 μs .

Due to the short rise times of current and voltage during the onset of a spark, the connecting cable between the power supply and the load acts as a wave guide, even when the cable lengths are short. The information that a spark is in existence propagates as a traveling wave or surge on the connecting cable. Thus, the power supply receives the information delayed – by up to one cable propagation delay period. The reaction of the power supply in turn becomes effective only after one cable propagation delay period and is based on the maximum cable length.

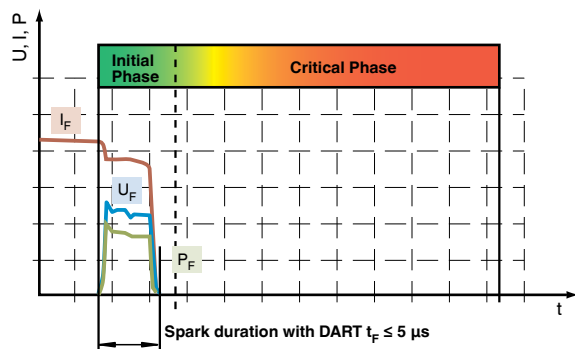


Figure 25 Time history of the spark current, voltage, and power of a break spark with DART interruption

This delay is an important safety parameter. In a typical cable used for instrumentation, electric waves travel at approx. half the speed of light or 160 000 km/s. Available power is approximately inversely proportional to the cable length. Further influencing factors to be considered are the stored energy in the connection cable and in the load.

Function of DART Components

A DART power system is comprised of three components – the power supply, the connecting cable/s, and one or more loads. A system consists of only one source, which can be provided in a redundant form for reasons of availability. The loads are connected to the power supply via a connecting cable with a defined surge impedance.

Power Supply

The output voltage is galvanically isolated from the station supply and limited by multiple redundant circuits. The DART-specific behavior is achieved through the functions represented in the block diagram in Figure 26.

Coordination of functions integrated in the DART power supply leads to output characteristics in which the output voltage U_{out} is represented against the output current I_{out} described below. In addition to the highest permitted safe values U_{lim} and I_{lim} , the characteristic is divided into the two operating ranges A and B:

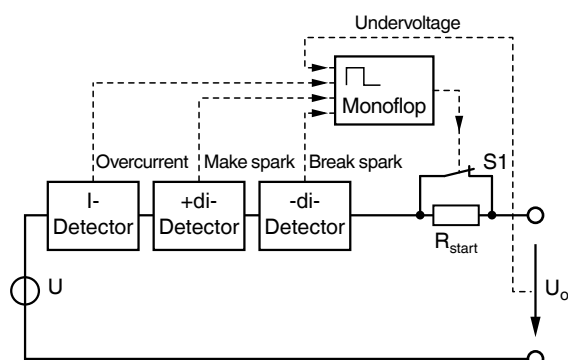


Figure 26 Block diagram of power supply

Safe Range A: Figure 27

This range, which is called the startup and fold-back range, represents the characteristic curve of a linear voltage source with safe values. After switching on the source, switch S1 is open (point 1). A low current of a few mA, the "trickle current" (point 2) begins to flow across the internal current limiting resistor R_{start} and to the load resistance. The comparator circuit monitors the output voltage and in effect the combination of cable and load resistances to ensure no fault is present ($R_{load} > R_{L1}$). When the output voltage reaches or exceeds a fixed threshold value U_{thre} (point 3) and after a necessary safety period of approx. 3 ms, the source switches to range B, the operating range. However, this is only possible if the current variation dI/dt due to the load lies below the prescribed detection threshold during the switch-on phase.

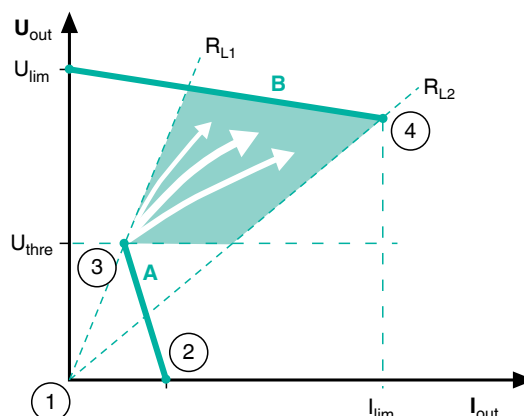


Figure 27 Output characteristic of a DART source with a representation of the transition from the safe range A to the optimum operating range B (schematic representation)

Normal – Operating Range B: Figure 28

Range B represents an almost ideal voltage source with an internal resistance $R_i \approx 0 \Omega$. In the operating range, the source can provide the optimum power to the load, by which means the maximum power conversion is possible at point 4 with $R_{load} = R_{L2}$. Any variations in the load condition – including that due to faults – are associated with an immediate current variation dI/dt . If the prescribed maximum value of the current variation is exceeded, the source switches off and the operating point returns immediately from range B to the safe fold-back range A. This likewise takes place if the maximum permissible load current I_{lim} is exceeded (point 4).

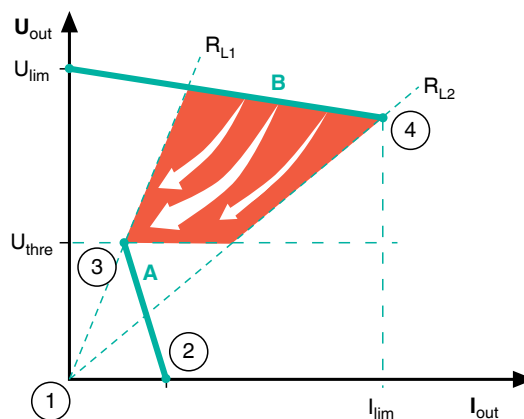


Figure 28 Behavior of the DART source in the event of a fault (schematic representation)

In summary, the dynamic control behavior of a DART source can be characterized as follows: a transition into the optimum operating range in the ms range and rapid turn-off to the safe fold-back range in the μ s range in the event of faults.

Loads

The following prerequisites have been taken into account in the DART concept with regard to the loads:

The spectrum of loads that can be used should be as comprehensive as possible.

- It should be as simple as possible to integrate the loads into the system.
- It should be possible to operate already existing components/loads (including the customary field devices) with this technology in the same manner as is possible with previously customary technologies – e. g., FISCO (protection of stocks).
- In order to keep the safety considerations straightforward, only a line topology is provided.
- The loads must not have a negative influence either on the functional or the safety capability of the DART source or other loads (including the cable).

The following particularly applies to the loads: They must not restrict or absorb the propagation of information on the formation of sparks. In this context, the load behavior must be accepted as not being exactly defined.

Decoupling Module

A decoupling module ensures a well-defined electrical behavior both from a functional as well as a safety perspective. It permits operation of practically any load with DART. A decoupling module is integrated into the explosion-proof housing of the load and connected in series with it. The decoupling module essentially fulfills the following tasks:

- Soft start-up of the load with limited current rise (di/dt)
- Well-defined, dynamic electrical behavior
- Optional disconnection in the case of faults through di/dt detection.

Summary and Outlook

Due to DART, high intrinsically safe power is available for new applications in the process industry, depending on the cable length. The maximum possible power output is strongly dependent on the delay times on the transfer cable. Solutions exist for two application areas: DART power for maximum power output and DART for fieldbus, optimized for fieldbus applications.

Safe Output Voltage	Cable Length	Output Current
Gas group IIC, max. 40 V, safety factor 1.5		
24 V	100 m	1 A
30 V	100 m	1 A
24 V	800 m	0.5 A
24 V	1000 m	0.36 A
Gas group IIB, safety factor 1.5		
24 V	100 m	2.5 A
24 V	500 m	1.5 A
30 V	500 m	1 A
40 V	500 m	1 A

Table 13 Maximum intrinsically safe output values of DART at typical cable length

Suitable test methods have been developed for an exact safety evaluation of the energy-limiting behavior of dynamically operating power supply concepts. Changes to the currently applicable standards have already been investigated.

DART enables the use of intrinsic safety in applications with power requirements, which today necessitate other, typically inflexible or expensive types of explosion protection. With DART, operating processes become simpler and complexity is reduced. Operating safety is increased.

Intrinsically Safe Systems

Intrinsically safe apparatus never stand alone (unless they are battery operated). Generally, it is part of a system in which the certified components are used to guarantee the safety of the system.

The simplified schematic of an intrinsically safe system (Figure 29) includes:

- Electrical apparatus (simple apparatus or intrinsically safe apparatus) located in a hazardous area
- Electrical apparatus located in a safe area (non-hazardous)
- The wiring between the two apparatus

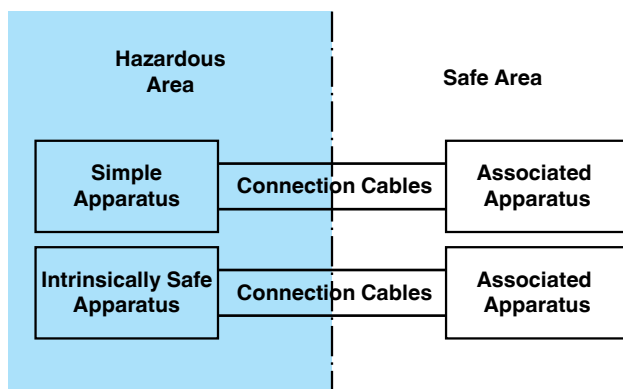


Figure 29 Simplified schematic of an intrinsically safe system

The analysis of an intrinsically safe system follows criteria that verify that the maximum energy, electrical and thermal, released in a hazardous area is lower than the ignition limit of the potentially explosive air/gas mixture, during normal or fault conditions.

Hazardous Area Apparatus

Apparatus that are certified for use in hazardous areas are of two types – simple apparatus and intrinsically safe apparatus.

Simple Apparatus

According to IEC 60079-11, the following shall be considered to be simple apparatus:

1. Passive components, for example switches, terminal boxes, resistors, and simple semiconductor devices
2. Sources of stored energy consisting of single components in simple circuits with well-defined parameters, for example capacitors or inductors, whose values shall be considered when determining the overall safety of the system
3. Sources of generated energy, for example thermocouples and photocells, which do not generate more than 1.5 V, 100 mA, and 25 mW

Intrinsically Safe Apparatus

The intrinsic safety of the apparatus must be guaranteed. This is accomplished by not permitting high energy levels, coming from connected apparatus or other circuits located in the same area, to be present in the hazardous area.

The certification exemption of simple apparatus cannot be applied to reactive circuits, due to their capability of storing energy. Inductive components, relay coils, or solenoid valves often can operate with energy levels much lower than the limits for intrinsic safety, but the energy released when the circuit is open can cause the ignition of the explosive atmosphere. In the same way, a capacitive circuit can cause ignition during discharge of the capacitor. Those types of apparatus must be equipped with components to reduce the released energy to safe levels.

There are many ways to make apparatus and circuits intrinsically safe. One such solution for making an inductive component safe is to parallel-connect a semiconductor diode to the coil so that released energy can be absorbed. For capacitive components, a resistor can be series-connected to reduce the discharged current to a safe level.

The standards permit the use of components such as diodes and resistors to be considered infallible where working conditions are concerned. Diodes must be duplicated and mounted so that a possible fault does not disconnect them from the coil. The resistor must be of metal film or wire-wound and of the necessary power rating. It must be wired so that it will not short circuit during fault status.

These are just a few methods used by designers to achieve the necessary protection for intrinsic safety apparatus.

Parameters of Intrinsically Safe Apparatus

Electrical apparatus for hazardous areas must be approved as intrinsically safe. Normally, an intrinsically safe apparatus has a manufacturer's documentation, certificate, or control drawing that specifies parameters for the selection of the associated apparatus. U_i and I_i parameters are assigned to each input. The associated apparatus connected to each input must not have a maximum output voltage U_o greater than U_i . Similarly, the associated apparatus must not have a maximum output current I_o greater than I_i .

U_i	maximum voltage applied to apparatus
I_i	maximum current applied to apparatus
C_i	internal unprotected capacitance
L_i	internal unprotected inductance

Table 14

Connection Cables

The length of cable connecting intrinsically safe equipment with associated equipment may be limited because of the energy-storing characteristics of the cable. The manufacturer's documentation, certificate, or control drawing provide guidance on determining the maximum allowed capacitance and inductance.

The electrical parameters of an associated apparatus determine the maximum allowed inductance and capacitance values of the connected circuit. Therefore, not only must the reactive part of the field devices be considered, but also the part related to the interconnecting cables. It is possible to limit or suppress the stored energy for field and safe area apparatus. However, because the total inductance and capacitance of the cable are distributed along its length, it is not possible to limit or suppress the stored energy for the connecting cable. See Figure 30.

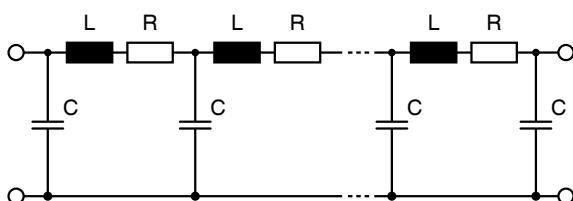


Figure 30 Equivalent schematic of a connecting cable

The capacitance, inductance, and resistance to length ratio parameters are usually supplied by the cable manufacturer and rarely cause a problem for the user. Particular attention must be given to the cable parameters because the manufacturer's data is not related to the possible fault situations covered by intrinsic safety. The fault combination that determines the worst condition must be verified.

For a 2-conductor cable, the manufacturer's data is sufficient. For shielded or multi-conductor cables, the analysis is more complex.

Safe Area Associated Apparatus

Associated electrical apparatus, which are located in a safe area, consists of electrical circuits related to intrinsic safety and can be designed to limit the energy toward the hazardous area to the required level.

Associated apparatus can be of the following three types:

- Apparatus receiving signals from the field
- Apparatus sending command signals to the field
- Intrinsically safe interfaces

Instrumentation devices that receive signals from a hazardous area do not supply power to the field devices during normal functioning. Intrinsic safety is accomplished by limiting the energy in the case of a fault.

Instruments that send signals are designed so that the dangerous energy level is never exceeded during normal operation or under fault conditions.

Intrinsically safe interfaces (e. g., safety barriers) prevent the transfer of dangerous energy coming from the uncertified instrumentation in safe areas.

Parameters of Associated Apparatus

Associated electrical apparatus must be certified as intrinsically safe, based on the maximum energy that can be transferred to the hazardous area, and have the following parameters:

U_o	maximum open-circuit voltage
I_o	maximum short circuit current
C_o	maximum allowed capacitance
L_o	maximum allowed inductance

Table 15

These parameters are important for the intrinsic safety of a system. If the parameters are respected, ignition of the explosive atmosphere is prevented, during normal operation or under fault conditions (i. e., accidental short circuiting, opening, or short circuit to ground of the connecting cable).

Protection Levels of Intrinsically Safe Systems

Zone Classification Protection Levels

Intrinsically safe electrical apparatus and the intrinsically safe part of the associated electrical apparatus are divided into three levels of protection – "ia", "ib", and "ic".

- Level ia: An electrical apparatus belonging to level of protection "ia" must not be able to ignite a potentially explosive atmosphere during normal functioning, during a single-fault condition, or during a combination of a two-fault condition with the following safety factors:
 - 1.5 during normal functioning
 - 1.5 during normal functioning with one fault
 - 1 with two faults
- Level ib: An electrical apparatus belonging to level of protection "ib" must not be able to ignite a potentially explosive atmosphere during normal functioning or during a single-fault condition with the following safety factors:
 - 1.5 during normal functioning
 - 1.5 during normal functioning with one fault
- Level ic: An electrical apparatus belonging to level of protection "ic" must not be able to ignite an explosive atmosphere during normal functioning

In conclusion, safety is guaranteed for the apparatus of level of protection "ia" during a two-fault condition; safety is guaranteed for the apparatus of level of protection "ib" during a single-fault condition. For both levels of protection, the safety factor during normal functioning with one fault is 1.5.

Levels "ia", "ib", and "ic" can be used for any group of gas; however, level of protection "ia" is the only category permitted for Zone 0. This is justified by the fact that, according to the safety concept, there must be at least two independent events, each one of low probability, before the ignition can occur. For more information, see "Ignition Triangle" in the "Physical Fundamentals of Explosion Protection" section.

For Zone 0, where danger is ever present, level "ia" allows up to two non-sequential events. For Zone 1, where danger is intermittent, the two events are the simultaneous presence of the dangerous gas and a single-fault condition in intrinsically safe apparatus. For Zone 2, the area is normally not hazardous.

It is evident that apparatus designed for Zone 0, level of protection "ia", can be used in Zones 1 and 2 with a greater margin of safety.

Division Classification Protection Levels

In the United States, the competent authority for the classification of hazardous locations is the National Fire Protection Association (NFPA). The NFPA is responsible for the National Electrical Code, NFPA 70, and the American standard for intrinsic safety is ANSI/ISA-60079-11 Explosive Atmospheres - Equipment protection by intrinsic safety "i".

Article 500 of the National Electrical Code stipulates the use of electrical apparatus in hazardous locations and classifies the areas, the groups of potentially hazardous materials, and the surface temperatures.

ANSI/ISA-60079-11 is related to intrinsic safety and is the authority on which the standards used by the testing labs are based (UL 913, FM 3610). The requirements contained in ANSI/ISA-60079-11 are based on IEC 60079-11 with national deviations. This results in significant harmonization of requirements between North America and the IEC.

A hazardous location of Division 1 includes the corresponding Zone 0 and Zone 1. Therefore, only one intrinsic safety category is allowed with the following safety factors:

- 1.5 considering the most unfavorable condition of a single fault
- 1 considering the most unfavorable condition of two faults

The North American standard is equivalent to the European standard for category ia.

The certification of apparatus, as it relates to the present danger – gas, dust, fiber – and surface temperature, follows the same concept as the European classification. The differences lie with the denomination of the groups and the subclasses of temperature.

The minimum ignition curves for the resistive, inductive, and capacitive circuits are identical to IEC 60079-11.

Safety Barriers for Protection of Intrinsically Safe Circuits in Fieldbus

Safety barriers are electronic control interfaces used to keep the energy to the field below the minimum ignition energy level of the potentially explosive atmosphere. To interface electrical apparatus located in a hazardous location with electrical apparatus located in a safe area, defined barriers must be used. In fieldbus technology, safety barriers are electronic circuits included with the respective component, providing the safe output voltage, current, and power.

Barriers can be of the following two types:

- Not galvanically isolated **safety barriers**
- Galvanically **isolated barriers**

Safety Barriers

Intrinsically safe safety barriers of this type follow a simple principle and are not complicated regarding the circuitry. See Figure 31.

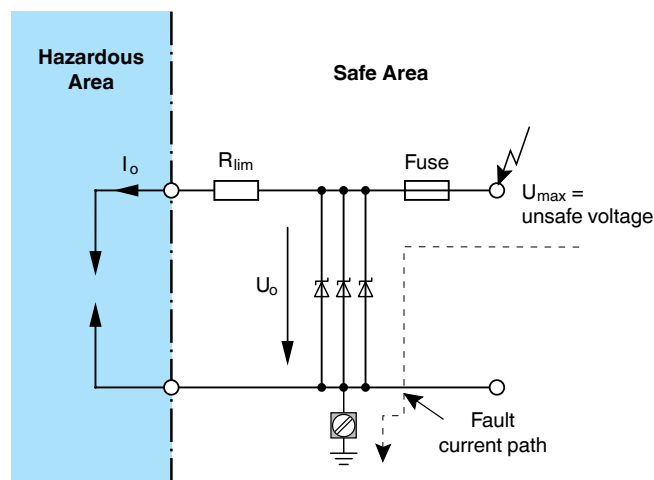


Figure 31 Schematic of a safety barrier

The functional principle of the safety barriers is based on the following: If a dangerous voltage that comes from the safe area is present, the safety diode limits the voltage and shunts the fault current toward earth until the fuse blows. This way a "safe" voltage (U_o) is maintained in an open circuit toward the hazardous area, while the maximum field short circuit current is defined by

$$I_o = U_o / R_{lim}$$

The safety parameters of safety barriers are defined in the following table:

U_o	maximum open circuit voltage
I_o	maximum short circuit current
C_o	maximum allowed capacitance
L_o	maximum allowed inductance

Table 16

The efficiency of safety barriers in limiting the maximum energy to the hazardous area essentially depends on the integrity of the barrier earth connection. Installation rules require that the earth connection resistance of the barrier must be lower than 1Ω .

Explosion Protection for Segments

The High-Power Trunk Concept

Intrinsic safety provides limited power for the application in fieldbus. However, the possibility of access to field devices without a hot work permit is highly desirable for any process automation system. The High-Power Trunk Concept solves this issue by using special safety barriers, such as FieldBarriers or Segment Protectors installed near field instrumentation.

FieldBarriers and Segment Protectors are device couplers that provide intrinsically safe outputs for spur connections. The trunk side is installed with increased safety, so that the trunk can be fed with higher power of up to 30 V/500 mA.

Work on the trunk requires a hot work permit. This is the small trade-off for connecting 16 or more devices to long trunks while hot work is still permitted on the instrument itself.

Intrinsic Safety for the Entire Segment

Two methods, Entity and FISCO, are defined in IEC 60079. They are commonly accepted and can essentially be applied in any hazardous area location.

DART Fieldbus is a recent innovation based on IEC 60079-11 for Zone classified hazardous areas. It provides four times more power compared to Entity or FISCO. This raises the limit on cable lengths and device counts, while at the same time maintaining intrinsic safety on the entire segment. Thus DART is often referred to as the intrinsically safe High-Power Trunk Concept.

Proof of Intrinsic Safety

Entity

Simple proof is the method prevalent in fieldbus. Note that the intrinsically safe output of any device feeding on unsafe power supplies is considered the current source in this chapter. This current source can either be the intrinsically safe fieldbus power supply or the output of the fieldbus junction box.

To verify the intrinsic safety between the associated apparatus and the field device in the hazardous area, the safety parameters (i. e., entity parameters) must match. The voltage, current, power, capacitance, and inductance must be verified regarding the following relations:

Safety/entity parameters				
Intrinsically safe apparatus		Cable/leads	Associated apparatus	
U_i			$\geq$	U_o
I_i			$\geq$	I_o
P_i			$\geq$	P_o
L_i	+	L_o	$\leq$	L_o
C_i	+	C_o	$\leq$	C_o

Table 17 Electrical parameters of a simple intrinsically safe circuit

Typically, if safety or Entity parameters are not available, a system certificate issued by a certification authority is necessary to attest the intrinsic safety of the equipment.

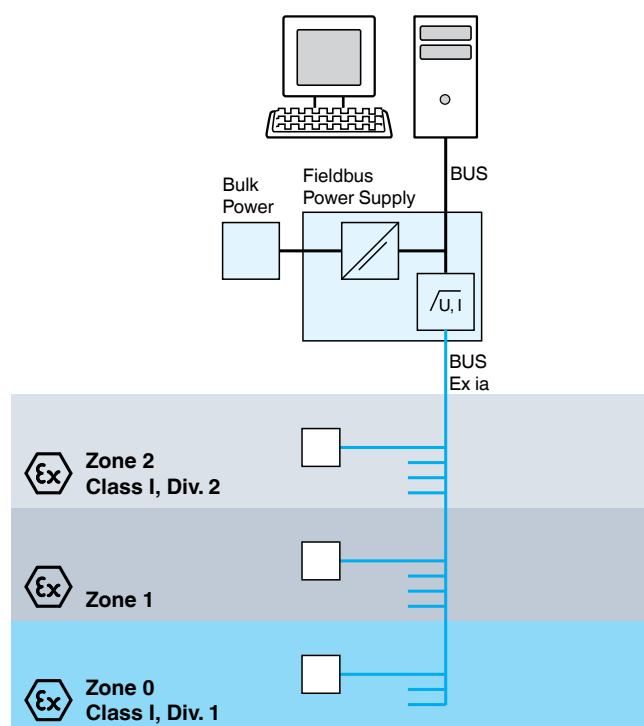


Figure 32 Intrinsically safe instrument connections with intrinsically safe fieldbus power supply

FISCO

FISCO stands for Fieldbus Intrinsically Safe Concept and is documented in IEC 60079-27. It is an expansion on Entity with slightly increased power availability and – more importantly – a significant simplification for the proof of intrinsic safety with multiple devices connected to a segment.

FISCO prescribes that only one power supply is permitted per segment and that all other devices are power drains with preventative measures in place against unintentional power feedback to the cable. FISCO places restrictions on cable and electric apparatus with regards to parasitic capacitance and inductance. Instruments and power supplies require certification through a notified body. Cables are documented through a declaration by the manufacturer.

Since 2002, FISCO even prescribes set limits for safe voltage, current, and power, as shown in table 18. Thus, power supplies and consumers can be connected without further calculations. The requirements for installation and validation are:

- Only one power supply per segment
- Maximum cable length on the trunk is 1000 m
- Maximum spur length is 60 m
- All connected apparatus is in compliance with FISCO

The user is required to document these points and intrinsic safety is proven.

FISCO Power Supply		FISCO Field Device
U_o is defined to ≤ 17.5 V	$\leq$	U_i is defined to ≥ 17.5 V
I_o is defined in acc. to IEC 60079-11 (ignition curves) but must not exceed 380 mA	$\leq$	I_i is defined to ≥ 380 mA
P_o is defined to ≤ 5.32 W	$\leq$	P_i is defined to ≥ 5.32 W

Table 18 Safe limits defined for FISCO-compliant electrical apparatus

DART Fieldbus

DART Fieldbus is in accordance with standard IEC 60079-11 and the first implementation of DART technology in actual products. It was developed by Pepperl+Fuchs. The entire segment is intrinsically safe. At the same time, the power supply provides 8 W of power to the trunk. Inspired by FISCO, proof of intrinsic safety is kept simple and without calculations. The requirements for installation and validation are:

- Trunk-and-spur topology is required
- Maximum trunk length is 1000 m. Spur length is up to 120 m
- Shielded twisted-pair cable type 'A' must be used
- Only components listed in the certificate are permitted on the trunk
- Up to four DART Segment Protectors can be installed anywhere on the trunk
- Any Entity conformant fieldbus instrument is permitted on a spur, one per spur

The user is required to document these points and intrinsic safety is proven. Further calculations are not required.

High-Power Trunk

The High-Power Trunk Concept is essentially a combination of methods of explosion protection, with the safety barrier placed inside the fieldbus junction box close to the device in order to achieve intrinsic safety. As a result, the spur outputs of the fieldbus junction boxes are intrinsically safe.

Proof of explosion protection is based on the rules stated above. For the purpose of validation, the output of the fieldbus junction box is considered the current source and the connected instrument is the only drain. This makes validation simple and efficient.

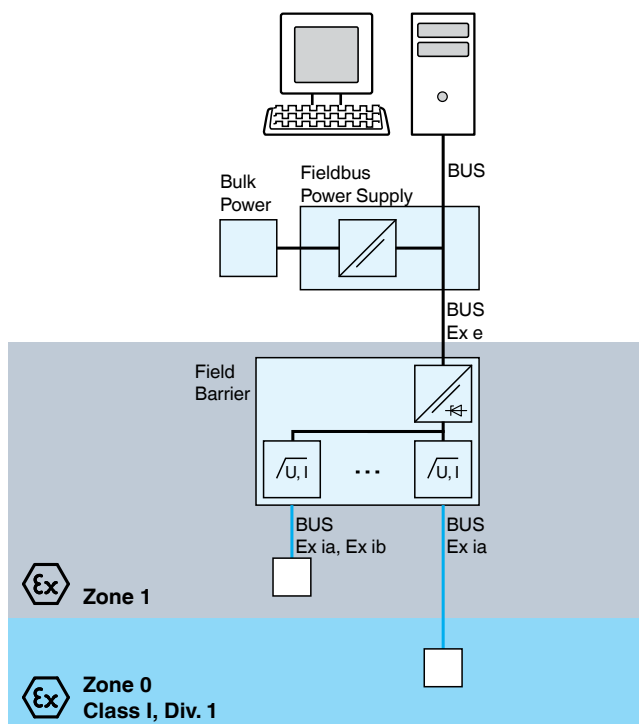


Figure 33 Intrinsically safe signal connections with High-Power Trunk Concept using FieldBarriers in Zone 0 to 1/Div. 1–2

Installation of Intrinsically Safe and Associated Apparatus

Installation of intrinsically safe and associated apparatus must conform to IEC 60079-14, Article 504 of the NEC, section 18 of the CEC, and other applicable standards. These standards require that intrinsically safe wiring is separated from non-intrinsically safe wiring, and that intrinsically safe wiring, terminals, and raceways be clearly labeled. Other considerations such as grounding and shielding requirements are also considered.

The installation of intrinsically safe and associated apparatus must be handled with particular care in order to prevent any impacts on the intrinsically safe circuits caused by apparatus and conductors that are not intrinsically safe circuits, if these impacts could reduce or eliminate the intrinsic safety of the system.

To achieve this, it is important to understand the concepts of segregation, separation, and clear identification of the intrinsically safe components. In particular:

1. The terminals of the intrinsically safe circuits must be placed at a distance of at least 50 mm (2 in) away from the terminals of the non-intrinsically safe circuits, or adequate separators (e. g., grounded metal partitions) must be used.
2. The different types of intrinsically safe circuits do not have to be electrically connected, unless such connection has been specified in the control drawing or the proof of intrinsic safety demands it.
3. When different types of intrinsically safe circuits end at the same marshaling terminal, it is advisable to maintain a distance between the terminals belonging to each other that is much greater than the 6 mm (0.24 in) required by the standard, unless it can be proven that the interconnection between the different types of circuits do not cause a dangerous energy situation.
4. The properties of intrinsically safe circuits are different in the following cases:
 - The circuits operate at different voltages or polarities
 - The circuits have different barrier grounding points
 - The circuits are certified for different categories or for different gas groups

For the intrinsically safe circuit, installation must be performed in a way that the maximum allowed value for current and voltage can never be exceeded because of external electric or magnetic fields. For example, proper installation in this case requires the use of cables that are adequately shielded and are separated from the cables of other circuits.

The connection elements – terminal block housing, protective enclosures for cables, the conduits for single conductors, and the wiring between intrinsically safe apparatus and associated apparatus – must be clearly marked and easily identified. If a color is used for this purpose, the color must be light blue.

For devices such as terminal blocks and switches, additional certification or specific marking is not required.

Degree of Protection for Enclosures

Indoor Enclosures

According to the standards for enclosures of intrinsically safe and associated apparatus, Type 1/IP20 is the minimum degree of protection for enclosures that are installed in indoor and/or protected areas. For more information, see "North American Degrees of Protection for Enclosures" and "Degrees of Protection for Enclosures (European Rating System)" in the "Additional Information" section.

Outdoor Enclosures

For outdoor enclosures, a degree of protection of Type 4 or 4X/IP54 is required. The degrees of protection of enclosures for intrinsically safe and associated apparatus have to be considered in the context of the overall functionality and safety of the plant.

Cable Capacitance and Inductance

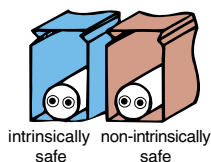
When designing and installing intrinsically safe systems, keep in mind that capacitance and inductance parameters of the connecting cables are important factors, even if they are not always determining factors.

The capacitance and inductance values of the cable (generally, given in pF/m and $\mu\text{H}/\text{m}$) should be easily available from the cable manufacturer. However, if there are difficulties in obtaining this data, the following values can be used (but only under exceptional circumstances), where the interconnection comprises two or three cores of a conventionally constructed cable (with or without shield): 200 pF/m (60 pF/ft) and either 1 $\mu\text{H}/\text{m}$ (0.2 $\mu\text{H}/\text{ft}$).

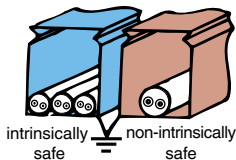
As an alternative to the inductance, another characteristic of the cable, the L/R ratio, can be used and is normally given in $\mu\text{H}/\Omega$. This parameter permits more flexibility in the cable installation process.

Refer to Figure 34 for examples of cable installation and to Figure 35 for examples of wiring in small enclosures containing associated apparatus.

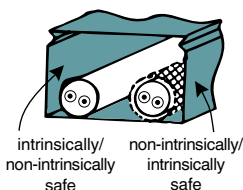
A The cables of the intrinsically safe and non-intrinsically safe circuits are installed in two separate, isolated conduits..



B The cables of the intrinsically safe and non-intrinsically safe circuits are installed in two separate, metallic, grounded conduits.



C The cables of the intrinsically safe and non-intrinsically safe circuits are installed in the same conduit. One of the cables is protected by a grounded shield to divert fault current to earth.



D Installation as above but the conduit must have an isolated divider.



E Installation as above but the conduit and divider must be made of metal and grounded.

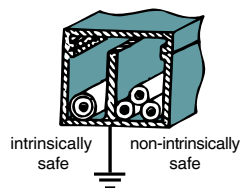
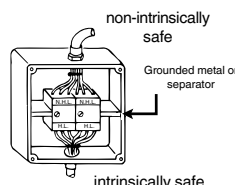
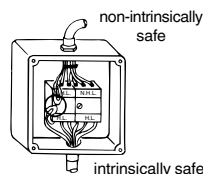


Figure 34 Examples of cable installation

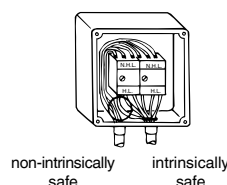
A **Correct:** When installing the wiring as shown, the minimum required distance between intrinsically safe and non-intrinsically safe conductors is guaranteed.



B **Incorrect:** Several conductors are of excessive length.



C **Incorrect:** A separation does not exist between intrinsically safe and non-intrinsically safe conductors.



D **Correct:** The maximum distance between the lid and the separator must be less than 1.5 mm. Otherwise the separator must ensure a clearance around the lid of at least 50 mm between the terminals of the intrinsically safe circuit and the non-intrinsically safe circuit.

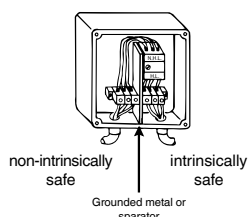


Figure 35 Examples of wiring in small enclosures containing associated apparatus

Grounding of Fieldbus Installations

Grounding and shielding of fieldbus installations is crucial from both a functional and explosion protection perspective. Most notable the main leads (+/-) are never connected to ground! Only the shield is connected to ground in certain locations. Because of the consequences of function, details are already described in the "Basic Principles" section.

Legal Situation

In industrial countries, explosion protection is regulated by law. Given any hazardous area installation, the plant operator is subject to the legal situation of the particular country. The following is a brief description of the North American situation followed by a more detailed situation for Europe.

Legal Situation in North America

The United States and Canada have a set of National Standards in force for apparatus used in hazardous locations. The Standards Council of Canada and the Occupational Health and Safety Administration in the US indicate that hazardous location apparatus shall be certified by designated, third-party agencies (Nationally Recognized Test Laboratories in the US) according to the appropriate standards of safety. Compliance to the standards are verified by the approval agencies. After successful completion of product evaluation, the testing agent will authorize the use of their mark on the product as a proof of meeting the required safety standard. Installation of the apparatus in the particular state or providence of use is covered by the appropriate installation standard (i. e., NEC and CEC) and verified by the **Authority Having Jurisdiction (AHJ)**.

Legal Situation in Europe

The European Union has issued the ATEX directives (Atmosphere Explosive) which require the use of type-examined explosion-proof apparatus.

ATEX consists of two parts: ATEX 95 (Directive 94/9/EC), which concentrates on the duties of the manufacturer; and ATEX 137(directive 1999/92/EC), which focuses on the end user's obligations.

ATEX 95 applies to electrical as well as mechanical apparatus and applies to gases, vapors, and dust atmospheres. Apparatus manufacturers apply the harmonized explosion protection standards applicable in Europe and request an EC-type examination. Following successful testing, the testing institute issues a corresponding certificate (EC-type examination certificate), which is a prerequisite for bringing the apparatus into circulation in the EC. Compliance with the ATEX directives means reinforced safety aspects – safer design, more demanding testing procedures, and specific quality assurance measures for the design as well as the manufacturing process.

With the signing of the Treaties of Rome (article 100: removal of technical barriers to trade), the foundation for harmonizing explosion protection on a European level was laid in 1957.

CENELEC (European Committee for Electrotechnical Standardization) emerged. With that, inside the EU and also beyond its borders (EFTA states and other countries), a unified legal basis for the manufacture and trade of electrical apparatus for use in hazardous areas was created. The requirements for their installation were and still continue to be subject to the legal and administrative regulations of each country of use.

CENELEC was originally composed of members of the European Economic Community. Today, CENELEC includes more than 30 countries and many partner members.

Furthermore, CENELEC has decided only to enact standards in parallel with the IEC. This means in practice that European standards in the area of electrical engineering will be based only on IEC standards as harmonized EN standards or be newly drafted.

For explosion protection of electrical apparatus, these are mainly standards of the series EN 60079 that in the future also cover the requirements of dust explosion protection.

The internationalization will be supported further by the introduction of the so-called IECEx system. The aim of the IECEx system is world-wide recognition, based only on a certificate and the associated test. In the future, manufacturers will not require further approvals for the entire global market. There is great interest in the implementation of this idea worldwide. More and more countries (already 31 in 2010) have declared their intention to participate and have begun to prepare legislative adaptations.

In recent years, two EU directives have fundamentally changed the European Ex-landscape:

- Directive 94/9/EC of the European Parliament and Council of 23 March 1994 for harmonization of the statutory provisions of member states for devices and protection systems for intended use in hazardous areas (ATEX 95).
- Directive 1999/92/EC of the European Parliament and Council of 16 December 1999 regarding minimum provisions to improve health protection and safety of employees who may be endangered by potentially explosive atmospheres (ATEX 137).

The ATEX 95 is mainly directed towards the manufacturers of electrical and non-electrical components and systems for hazardous areas and must literally be implemented in national law, while the ATEX 137 mainly applies to the safe operation of these plants. The minimum requirements of ATEX 137 had to be implemented in line with national law and each member state could largely implement its own workplace protection independently.

The goal of the EU is easy to recognize: on the one hand, to create equal competition for all suppliers in the EU single market and on the other hand, to create equivalent safety standards for all operators of installations and equipment within the EU.

The Directive 94/9/EC prescribes an EC-type examination with a corresponding verification certificate (Ex-type examination certificate) for electrical devices of categories 1 and 2. To obtain this certificate, the manufacturer submits all the necessary technical documentation and possibly a prototype to a notified body. On passing the examination, an EC-type examination certificate is issued, which contains all binding information and parameters for use in hazardous areas. This is the basis for the operation and installation of apparatus in Ex Zones 0 and 20, as well as 1 and 21.

For category 3 devices (operation in Zones 2 and 22), a CE declaration of conformity regarding compliance with the directive is sufficient.

The directive 1999/92/EC describes the "minimum requirements" for improving the health and safety of workers potentially at risk. It divides the hazardous atmosphere into zones and specifies which category of apparatus may be used in each zone.

The directive demands the analysis and description of the risks, the zone definitions, and the required practices with regard to site safety. The effects of any explosion must be minimized in such a way that workers are not put at risk. Essentially, the employer is required to take all reasonable measures to prevent the formation of an explosive atmosphere in the workplace. Where this is not possible, measures must be taken to avoid the ignition of any potentially explosive atmosphere. In addition, the effects of any explosion must be minimized in such a way that workers are not put at risk.

The main obligations on employers

- Prepare an **Explosion Protection Document (EPD)**
- Classify the workplace into zones where applicable
- Select ATEX 95 certified products (categories according to zone classification)
- Identify locations where potentially explosive atmospheres may occur (using warning signs)
- Train workers on hazardous area issues by the employer
- Special authorization must be given to each employee for carrying out works in hazardous areas.
- When equipment is to be repaired, the end user has the responsibility to select a qualified repair shop.

Corresponding installations and equipment are classified as installations subject to monitoring in accordance with directive 1999/92/EC and may be equipped only with approved devices. In addition, the plants must be tested before commissioning, after changes, and at regular intervals by approved institutions, companies, or by specially qualified personnel.

The responsibility for plant safety lies with the end user.

The safety of an installation in a hazardous area is the result of cooperation between the apparatus manufacturer, the installer, and the end user. According to ATEX, the only parties responsible for preventing accidents due to potentially explosive atmosphere are the apparatus manufacturer and the end user. For safe plant operation, the end user is obliged to follow the manufacturer's instructions, regarding installation, maintenance, and repair for each apparatus.

The proof of intrinsic safety can be used to establish the safely limited energy values to ensure intrinsic safety. This proof is an essential component part of the documentation (a requirement of the European directive 1999/92 EC), which must be issued before installation and kept up-to-date.

IEC/EN 60079-14 demands that – when proofing intrinsic safety – the mentioned requirements are adhered to if no system description exists for the overall intrinsically safe circuit. After establishing intrinsic safety, the installer must ensure that all required distances are adhered to and that separations between different circuits are implemented, especially regarding the circuits that have been properly marked in accordance with IEC/EN 60079-14.

Obtaining proof of intrinsic safety is possible using several processes and depends on the following:

- Number of associated (supply) apparatus (one or more)
- Shape of the output characteristic curve (linear or non-linear)
- Type of reactances (lumped or distributed)

The following table provides an overview of the possible procedures for obtaining proof.

Number of pieces of associated apparatus	Characteristic curve shape	L_i, C_i both $> 1\%$ L_o, C_o	Process
1	Linear	No	Simple proof
1	Linear	Yes	IEC/EN 60079-25 annex C or 50 % rule
1	Non-linear	Not relevant	IEC/EN 60079-25 annex C
> 1	All linear	No	Simple proof
> 1	All linear	Yes	IEC/EN 60079-25 annex C
> 1	> 1 non-linear	Not relevant	IEC/EN 60079-25 annex C

Table 19 Possible proof procedures according to IEC/EN 60079-14 and IEC/EN 60079-25

Only in the case of the "simple proof", the minimum ignition curves can be used according to IEC/EN 60079-11 to directly evaluate the intrinsically safe circuit and determine the maximum values for capacitance and inductance.

There are minimum ignition curves for resistive, capacitive, and inductive circuits.

Depending on which gas group an intrinsically safe circuit is being designed for, different minimum ignition curves are used that consider the minimum ignition energy for each gas group.

When both limits were pushed at the same time, laboratory tests confirmed that ignition could occur.

In the example, both lumped inductances and capacitances are shown. This has already been factored into the certification of the associated apparatus through reduced L_o and C_o values. If these reduced values are not provided in the authorization, then in the case of both lumped inductances and capacitances being present, the proof must be generated according to the IEC/EN 60079-25, Annex C. In "simple" systems (only one source, output curve is linear) the "50 % process" from IEC/EN 60079-11 suffices.

Testing and Maintaining of Intrinsically Safe Systems

No method of protection is completely safe and human-error proof. Proper maintenance that includes a rigorous initial inspection, verification, and subsequent periodic inspections and repairs is important for the safety and economical management of any instrumentation plant, and becomes fundamental in plants where the danger of fire or explosion exists.

To reduce the risk of catastrophic human errors, it is also important to permit only authorized and qualified personnel to repair explosion-proof apparatus. Powered plants must not be serviced. The following maintenance criteria are presented to give the reader a general understanding of what is involved in order to maintain an industrial facility relative to safety. This material is not intended to replace the applicable safety standards.

After the installation and completion of each plant, it is necessary to perform the following three types of inspection/maintenance activities:

- Initial inspection
- Scheduled maintenance (periodic inspections and repairs)
- Apparatus failure and repairs

To maintain safety of electrical systems in hazardous areas, regular maintenance is necessary.

The system operator is responsible for appropriate testing and maintenance cycles of their own system in accordance with the plant operator directive 1999/92 EC or other appropriate regulations.

For example, IEC/EN 60079-17 (testing and maintenance of electrical systems in hazardous areas) describes the procedure for electrical systems used in combination with explosion protection. The following applies in general:

Working on live electrical systems and apparatus in hazardous areas is strictly prohibited. As an exception to this rule, working on intrinsically safe systems is permitted.

Therefore, special requirements exist for the "intrinsic safety" type of protection:

- Maintenance work on live intrinsically safe systems may be carried out under certain conditions.
- The earth connections of safety barriers may not be removed before the circuits in the hazardous area are disconnected.

Work in hazardous areas is to be limited to the following:

- Disconnecting, removing, or changing parts
- Adjusting all settings required for calibration
- Removing or changing pluggable components
- Using testing instruments as set out in the documentation
- After testing, the intrinsically safe system/apparatus must fulfill all requirements of the system documentation

The documentation must contain the following:

- Proof of intrinsic safety
- Manufacturer, type of apparatus and certification number, category, apparatus group, temperature class
- Electrical parameters (inductance, capacitance, length, type and routing of cables, leads)
- Special requirements according to the component data sheet
- Installation location of each component within the system

In addition, check the following:

- Marking of intrinsically safe circuits easily identifiable
- Conformity of the actual installation with the documentation
- Separation of components into intrinsically safe and non-intrinsically safe circuits
- Cables and leads and their shielding
- Continuity of grounding of non-galvanically isolated circuits, earth connections to ensure intrinsic safety
- Grounding or electrical isolation of intrinsically safe circuits
- Adhering to specified minimum distances

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ANSI/NFPA 70	National Electrical Code, articles 500–505, Hazardous (Classified) Locations
ANSI/NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (Classified) Locations
ANSI/NFPA 497	Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
FM 3610	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous (Classified) Locations
FM 3615	Explosion-proof Electrical Equipment
ANSI/UL 698	Standard for Industrial Control Equipment for Use in Hazardous (Classified) Locations, Class I, Groups A, B, C and D and Class II, Groups E, F and G
ANSI/UL 913	Standard for Intrinsically Safe Electrical Circuits and Equipment for Use in Hazardous Locations (1971/11/30)
ANSI/UL 913	Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, Hazardous (Classified) Locations (2011/05/25)
UL60950-1	Information Technology Equipment – Safety – Part 1: General Requirements
ANSI/ISA-60079-0 12.00.01-2009	Electrical Apparatus for Use in Class I, Zones 0, 1, and 2 Hazardous Locations: General Information
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R2007

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R2012

C22.2-213-M1987
R2008

Electrical Apparatus for Use in Class I, Zones 0, 1, and 2 Hazardous Locations – Intrinsic Safety i

Recommendations for the Preparation, Content, and Organization of Intrinsic Safety Control Drawings

Pressurized Enclosures

Electrical Apparatus for Explosive Gas Atmospheres – Part 2: Pressurized Enclosures p

Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety

Non-incendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations

Electrical Apparatus for Use in Class I, Zone 2 Hazardous (Classified) Locations – Type of Protection n

Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

Canadian Electrical Code

Explosion-Proof Enclosures for Use in Class I Hazardous Locations

Intrinsically Safe and Non-incendive Equipment for Use in Hazardous Locations

Non-incendive Electrical for Equipment Use in Class I, Division 2 Hazardous Locations

International

IEC 60079-0	Explosive atmospheres – Part 0: Equipment – General requirements
IEC 60079-1	Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures 'd'
IEC 60079-2	Explosive atmospheres – Part 2: Equipment protection by pressurized enclosures 'p'
IEC 60079-4	Electrical apparatus for explosive gas atmospheres – Part 4: Method of test for ignition temperature
IEC 60079-5	Explosive atmospheres – Part 5: Equipment protection by powder filling 'q'
IEC 60079-6	Explosive atmospheres – Part 6: Equipment protection by oil immersion 'o'
IEC 60079-7	Explosive atmospheres: Equipment protection by increased safety 'e'
IEC 60079-10	Explosive atmospheres – Part 10: Classification of hazardous areas
IEC 60079-11	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety 'i'
IEC 60079-14	Explosive atmospheres – Part 14: Electrical installations design, selection and erection
IEC 60079-15	Explosive atmospheres – Part 15: Type of protection 'n'
IEC 60079-18	Explosive atmospheres – Part 18: Encapsulation 'm'
IEC 60079-25	Explosive atmospheres - Part 25: Intrinsically safe systems
IEC 60529	Degrees of Protection Provided by enclosures (IP code)
IEC 60950	Information technology equipment – Safety – Part 1: General requirements

Europe

DIN EN 60079-0	Explosive atmospheres – Part 0: Equipment – General requirements
DIN EN 60079-1	Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures 'd'
DIN EN 60079-2	Explosive atmospheres – Part 2: Equipment protection by pressurized enclosures 'p'
DIN EN 60079-4	Electrical apparatus for explosive gas atmospheres – Part 4: Method of test for ignition temperature
DIN EN 60079-5	Explosive atmospheres – Part 5: Equipment protection by powder filling 'q'
DIN EN 60079-6	Explosive atmospheres – Part 6: Equipment protection by oil immersion 'o'
DIN EN 60079-7	Explosive atmospheres: Equipment protection by increased safety 'e'
DIN EN 60079-10	Explosive atmospheres – Part 10: Classification of hazardous areas
DIN EN 60079-11	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety 'i'
DIN EN 60079-14	Explosive atmospheres – Part 14: Electrical installations design, selection and erection
DIN EN 60079-15	Explosive atmospheres – Part 15: Type of protection 'n'
DIN EN 60079-18	Explosive atmospheres – Part 18: Encapsulation 'm'
DIN EN 60079-25	Explosive atmospheres - Part 25: Intrinsically safe systems
DIN EN 60529	Degrees of Protection Provided by enclosures (IP code)
DIN EN 60950	Information technology equipment – Safety – Part 1: General requirements

Technology

Basic Principles

Bus Systems

Explosion
ProtectionBest Working
PracticesApplication
Guideline

Internet Resources

Instrumentation, Systems and Automation Association (ISA):	www.isa.org
American National Standards Institute (ANSI):	www.ansi.org
Environmental Protection Agency (EPA):	www.epa.gov
Occupational Safety and Health Association (OSHA):	www.osha.gov
Technischer Überwachungsverein (TÜV):	www.tuvps.com
Factory Mutual (FM):	www.fmaprovals.com
Underwriters Laboratory (UL):	www.ul.com
Canadian Standards Association (CSA):	www.csa-international.org
National Electrical Manufacturers Association (NEMA):	www.nema.org
National Fire Protection Association (NFPA):	www.nfpa.org
European Committee for Electromechanical Standardization (CENELEC):	www.cenelec.eu
International Electrotechnical Commission (IEC):	www.iec.ch

North American Degrees of Protection for Enclosures

Organizations such as NEMA, CSA, UL, IEC, and TÜV have developed rating systems for the identification of an enclosure's ability to withstand and repel the outside environment.

NEMA, CSA, and UL are the systems most often used in North America. The European rating system, developed by IEC and TÜV Rheinland, is similar to the North American system for safe area enclosures. But because, historically, the European system has been more deeply rooted in the concept of intrinsic safety, IEC 60529 has no equivalents to the NEMA hazardous location enclosure types 7, 8, 9, and 10. The North American system also includes a 4X rating that indicates resistance to corrosion.

The following tables show the enclosure types for safe areas and hazardous locations according to NEMA standards and European degree of protection systems.

Type	NEMA National Electrical Manufacturers Association (NEMA standard 250)
1	Constructed for use primarily to provide a degree of protection against limited amounts of falling dirt.
2	Similar to Type 1 but with addition of drip shields used where condensation may be severe.
3	Constructed for outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust, and damage from external ice formation.
3R	Constructed for outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.
3S	Constructed for outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust, and to provide for operation of external mechanisms when ice laden.
4	Constructed for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, hose-directed water, and damage from external ice formation.
4X	Constructed for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water, and damage from external ice formation.
6	Constructed for indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during occasional temporary submersion at a limited depth, and damage from external ice formation.
6P	Constructed for indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during prolonged submersion at a limited depth, and damage from external ice formation.
12	Constructed for indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping non-corrosive liquids.
12K	Type 12 with knock-outs.
13	Enclosures are constructed for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and non-corrosive coolant.

Table 20 Enclosure types for safe areas

Type	NEMA National Electrical Manufacturers Association (NEMA standard 250)
7	Constructed for indoor use in locations classified as Class I, Groups A, B, C, or D, as defined in the National Electrical Code.
8	Constructed for indoor or outdoor use in locations classified as Class I, Groups A, B, C, or D, as defined in the National Electrical Code.
9	Constructed for indoor use in locations classified as Class II, Groups E, F, or G, as defined in the National Electrical Code.
10	Constructed to meet the applicable requirements of the Mine Safety and Health Administration.

Table 21 Enclosure types for hazardous locations

Degrees of Protection for Enclosures (European Rating System)

IEC Definitions

The IEC 60529 standard defines degree of protection as a two-character code. The first character describes the degree of protection against contact with hazardous parts and the intrusion of solid objects. The second character designates the degree of protection against water. Refer to the appropriate sections of IEC 60529 for complete information regarding applications, features, and design checks.

Note:

If a code character is not required, it is to be substituted by the letter X.

Devices with 7 or 8 as second code character do not need to fulfill the requirements of the second code characters 5 or 6, unless they are explicitly marked as a double code character, e. g., IPX6/IPX7.

The conditions of Pepperl+Fuchs GmbH for IPX8 are:

- 1 m water column above the test subject
- 24 h operation under water with cyclical damping and amplification under rated load
- Cycle time 2 h
- Water temperature = room temperature $\pm 5^{\circ}\text{C}$ ($\pm 5\text{ K}$)

IP	X Protection against access to hazardous parts and ingress of solid foreign objects (first code character)	X Protection against ingress of liquids (second code character)
0	Non-protected	0 Non-protected
1	- Protected against intrusion of objects $\geq 50\text{ mm}$ - Protected against contact with back of hand (50 mm)	1 Protected against ingress of water dripping vertically
2	- Protected against intrusion of objects $\geq 12.5\text{ mm}$ - Protected against contact with jointed finger (12 x 80 mm)	2 Protected against ingress of water dripping, enclosure tilted up to 15°
3	- Protected against intrusion of objects $\geq 2.5\text{ mm}$ - Protected against intrusion with a tool (2.5 mm)	3 Protected against ingress of spraying water, up to 60° from vertical
4	- Protected against intrusion of objects $\geq 1\text{ mm}$ - Protected against intrusion with a wire (1.0 mm)	4 Protected against ingress of spraying water, any direction
5	- Dust protected - Protected against intrusion with a wire (1.0 mm)	4K Protected against splash water with increased pressure
6	- Dust tight - Protected against intrusion with a wire (1.0 mm)	5 Protected against ingress of jetting water, any direction
		6 Protected against ingress of powerful jetting water, any direction
		6K Protected against strong water jets
		7 Protected against ingress of water during temporary immersion
		8 Protected against ingress of water during continuous immersion
		9K Protected against water on high-pressure cleaning or vapor stream cleaning

Table 22 Degrees of protection for enclosures according to IEC/EN 60529

Best Working Practices

From planning to operation to plant upkeep, this chapter has the collected best working practices of 20 years of fieldbus in process automation and more than 10 years of experience collected from the people at Pepperl+Fuchs. Easy to follow step-by-step instructions guide the fieldbus novice to success with their first fieldbus project.

Planning a Segment

Chapter 12 of IEC 61158-2 describes all requirements that must be met for proper operation of a network for FOUNDATION Fieldbus H1 or PROFIBUS PA (MBP). Most requirements relate to interface design. Those details relevant for planning are described here for convenience with tips from practice for successful implementation of segments.

A carefully planned segment is the basis for reliable operation. Getting the segment design right the first time is an important step that allows significant time savings during commissioning compared to classic interface technology. The following extra steps described here save significant time in comparison to fixing issues later in the field.

If your total desired cable length is more than 1900 m (the sum of the trunk line and all spur lines), you must find other ways to design the fieldbus infrastructure to bring the total cable length to less than 1900 m. This may include running communications via fiber optics or by other means such as repeaters. This chapter focuses on H1 bus, bus-powered fieldbus infrastructure only, which is provided by FOUNDATION Fieldbus H1 and PROFIBUS PA (MBP).

The basic design steps are listed below and explained in greater detail in the next chapter:

- Specify environmental conditions
- Design typical loops for control and monitoring
- Calculate or specify the required bus cycle times
- Verify longest cable lengths
- Choose the segment topology
- Select the cable to be used
- Choose power supply and wiring interfaces
- Determine the number of devices connectable to the typical loops
- Verify that required trunk and spur length is possible based on number of devices connected

The good news first: After making some basic engineering decisions, software tools – most of them freeware – take care of calculating all electrical values and automate the process of validating the segment design on the fly, reassuring the planner that the actual design will work. Even change requests and red lining are easy to document with the help of these software tools.

Steps for Planning a Segment

Environmental Conditions

Ambient temperature is an important aspect for planning segments, as high temperatures can have a negative influence on achievable cable lengths. The following aspects influence component selection, however without influencing segment design:

- Shock/vibration
- Corrosion ratings/requirements
- Type of enclosure
- IP class and NEMA ratings of enclosures

Typical Loops

Because many variables are not yet known, planners design typical loops that fulfill the highest demands or constraints on the fieldbus infrastructure. The following table lists data to be considered for typical loops:

- Longest cable length from the control room into the field
- Current consumption of field devices used
- Maximum bus cycle time acceptable

There are two typical loops to be considered:

1. Control loops with a demand for shorter response times and thus shorter bus cycle time
2. Monitoring loops where a longer bus cycle is satisfactory

Bus Cycle Time

The bus cycle time of control and monitoring loops is an important ingredient in planning a segment because it influences the overall system responsiveness. Many factors that influence the bus cycle time are often determined with software available from DCS system vendors.

The bus cycle time is determined from the following aspects that influence the number of devices per segment and must be considered when planning a segment. We recommend that the bus cycle time be determined and the maximum number of devices calculated.

- Fieldbus system used (that is, FOUNDATION Fieldbus H1 or PROFIBUS PA)
- DCS system used
- Number of devices on the segment
- Amount of data to be transmitted
- Time required for asynchronous data exchange (e.g., configuration and diagnostic data)

The Topology

Next the planner chooses the topology. Though the planner is free to choose any topology, the trunk-and-spur and tree topologies are recommended as they fulfill the following demands:

- Usable for all segments of the plant
- Easy to understand and thus easy to work with and maintain
- Enable short circuit current limitation for the trunk, allowing live work on field devices

These topologies have been adopted as de facto standard in most process plants today; they are considered in the examples below. Typically the power supply is installed at one end of the trunk in a cabinet in the control room. The trunk is the longest part of the segment, it requires a fieldbus terminator installed at each end. See Figure 1.

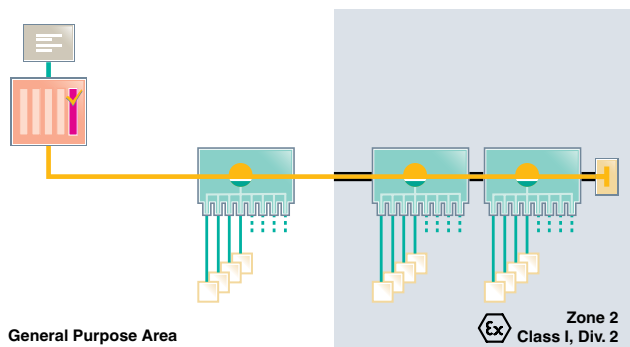


Figure 1 Trunk-and-spur topology. Easy to install and maintain. Also referred to as tree topology when all device couplers are mounted in one place.

Junction Boxes – Protecting the Trunk

For the safe area, distribution units with simple terminators and connectors are permissible. Simple junction boxes, also known as wiring bricks, or wiring blocks are installed near the field instruments with a layout following the selected topology. Good working practice then demands that the cable inside the junction box is detached first. Only then are the terminals inside the field instrument disconnected. However, this type of installation is seldom used in practice.

Live work on an instrument in the field almost always causes intermittent short circuits, which can cause the entire segment to fail. A wiring interface named Segment Protector features short circuit current limitation at each spur and protects the trunk from unintended faults caused when live work is performed on a field device. Since current-limiting wiring interfaces may have a non-linear behavior we recommend the use of a planning tool, where this load characteristic is considered and calculated.

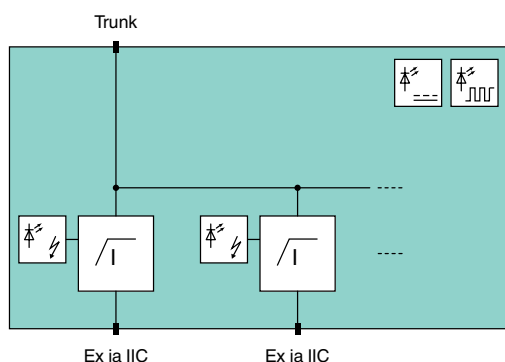


Figure 2 Segment Protector Principle Diagram: Each spur connection is equipped with short circuit current limitation. Operation of the segment remains undisturbed from live work on the field device

Considerations for Power Supply – Current and Voltage Reserves

The maximum current provided by the power supply determines the maximum number of field devices and wiring interfaces. The standard prescribes a minimum current consumption of 10 mA per field device. Current consumption of most devices is between 10 ... 20 mA.

A 20% current reserve minimum per segment is recommended for later additions and expansions. Additionally, the actual current consumption stated in the datasheets for the devices may differ from this standard. This reserve protects against mishaps that may be discovered late during commissioning and then cause a significant unexpected increase in cost to fix the issue in the field – for example, having to install extra segments.

At least one short circuit condition has to be considered when adding up current consumption. This is because live work on field instrumentation is a "normal" mode of operation and most likely causes intermittent short circuits.

Device libraries are available for SegmentChecker that detail load conditions for many field instruments of many manufacturers. Additionally, devices can be added to custom libraries manually, allowing exact planning of load conditions.

The maximum voltage of the power supply together with the load current determines maximum cable lengths, due to the voltage drop on the cable. This is influenced by the cable type, load, and topology. The standard prescribes a minimum voltage of 9 V available at the field device. Planners typically ask for 10% reserve or minimum of 10 V at every field device.

Finally: State-of-the-art power supplies provide galvanic isolation between the segment and the bulk power supply.

Cable Type – Trunk and Spur Lengths

According to IEC 61158-2, four cable types with respective values are defined for fieldbus use. They can be specified or purchased as type "A" ... "D". They include single twisted pair and multi-core versions. The type and wire gauge of the cable influences the maximum reachable cable length.

Table 1 shows the maximum achievable cable lengths by cable type at 25 °C. This is the sum of the trunk line and all spur lines. Longest cable lengths of 1900 m are reached when Type A cable is applied. Lower limits apply to the other types. Additionally, the achievable cable length depends on the ambient temperature and wire cross-section.

Cable Type	Preferred	Conductor Pairs	Twisted	Shielding	Total cable length
A	Yes	Single	Yes	Yes	1900 m
B	Yes	Multiple	Yes	Yes	1200 m
C	Less	Single or Multiple	Yes	No	400 m
D	Least	Multiple	No	Yes	200 m

Table 1 Maximum cable length, trunk, and all spurs by recommended cable types. Table compiled from source: IEC 61158-2 (Chapter 12.8.2, Annex B)

From these requirements, the planning software helps determine the maximum number of devices that can be connected to the segment for the desired cable lengths. The number of devices connected to a segment dictates the maximum permitted length of the spur as shown in Table 2.

Number of participants	Spur cable length
1-12	120 m
13-14	90 m
15-18	60 m
19-24	30 m
25-32	1 m

Table 2 Spur cable length by number of fieldbus participants according to IEC 61158-2

It becomes evident that the limitation in spur lengths is the reason why planners choose a number of participants of 24 or smaller. The number of participants includes the field instruments and the host system. The host system has a count of two where redundant hosts are used.

Note: Different limits apply for number of devices and spur length when hazardous locations are considered. These are discussed further below.

Calculating Electrical Values

All data collected from the considerations above is entered into a segment planning tool such as SegmentChecker, (www.segmentchecker.com) the fieldbus planning tool created by Pepperl+Fuchs. The planning tool helps calculate voltage drops and current consumption and verifies the validity of segment design immediately.

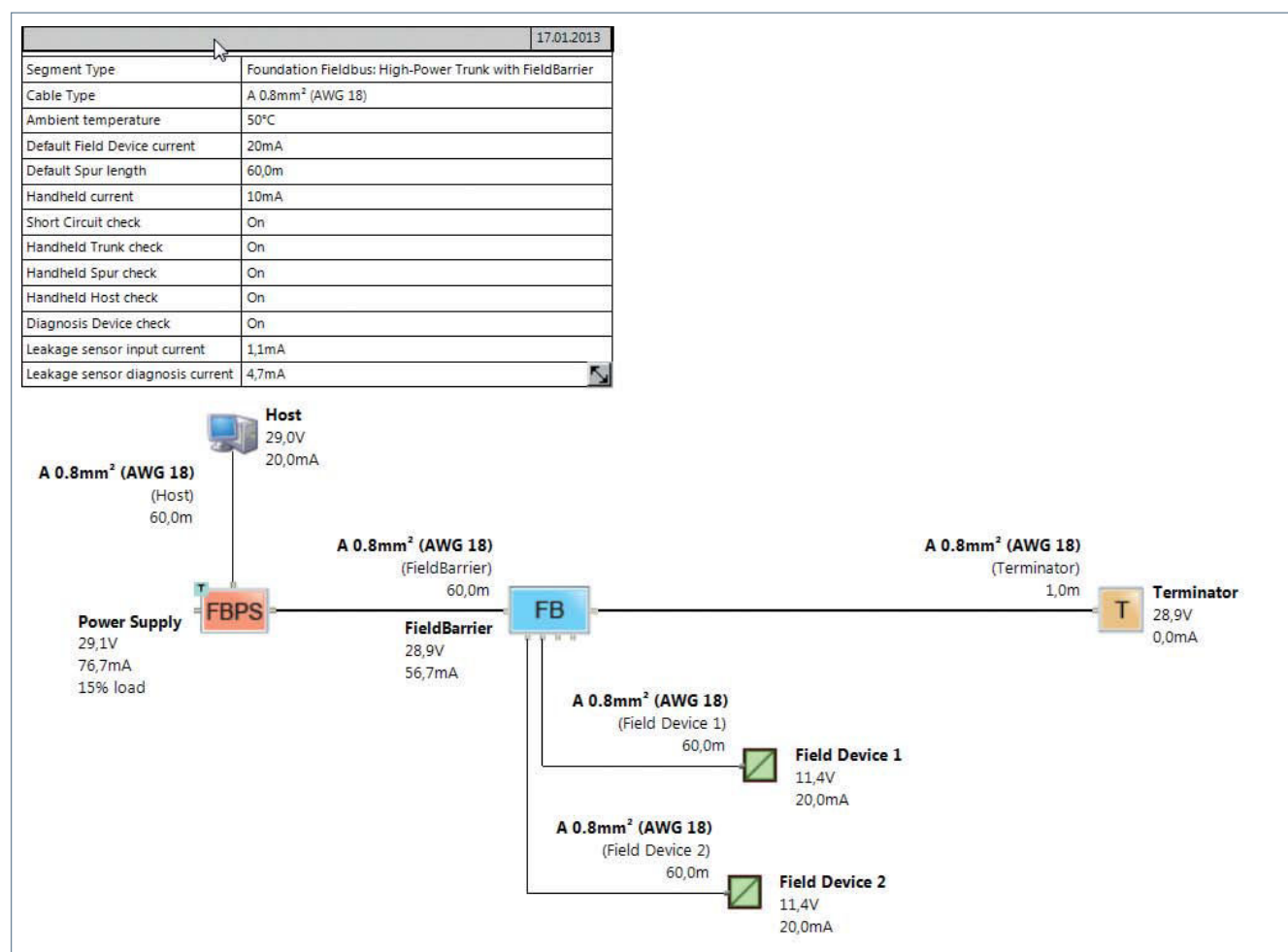


Figure 3 Planning a segment in SegmentChecker: Easy to use with the ability to drag and drop devices. The software immediately validates the configuration and highlights conditions that violate the minimum requirements.

SegmentChecker is a tool provided and maintained by Pepperl+Fuchs for the planning and design of fieldbus systems. SegmentChecker supports the layout and documentation of any fieldbus architecture, topology, and design. It compares the topology entered against specifications of the fieldbus standard IEC 61158-2 and highlights errors and potential problems with error messages and color-coding. Current consumption and voltage levels are shown at every point in the electrical system. A comprehensive set of libraries with field instruments can be easily loaded and a device editor allows simple addition of devices.

Documenting Segment Design

The planning software, SegmentChecker, has an export function including documentation text, lists, and graphic representation.

Drawing and engineering packages can be used to create connection diagrams. However, some planners reduce the amount of documentation to a simple spreadsheet that outlines the tag numbers of all equipment installed. This saves on documentation while simplifying all work steps with fieldbus.

Topology – A Case Study

Specification

The following requirements may constitute a real-life example based on the discussion above. Segment design must meet the specifications as follows:

Ambient temperature: 55 °C

Trunk length: min. 600 m

Topology: tree

Cable: cross-section 0.8 mm, AWG 18, 44 Ω/km

Current consumption per field device: 20 mA average: based on calculation of actual current consumption of devices planned to be used.

Short circuit current limitation: yes

Host-redundancy: yes

Host spur length: 5 m

Power supply load: 20% reserve

Field device spur length minimum: 70 m

Number of instruments per segment: 10

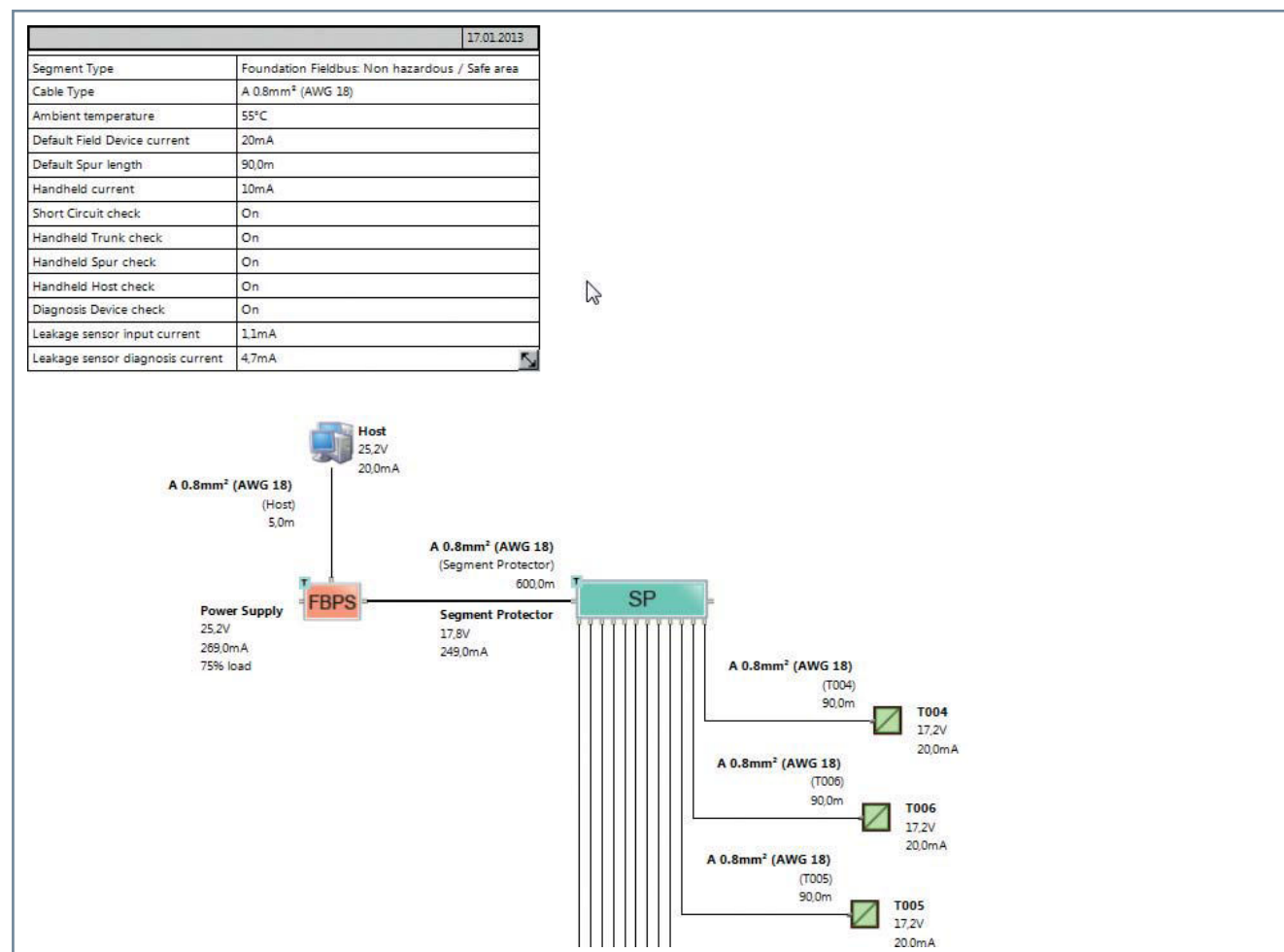


Figure 4 The topology as shown in SegmentChecker. Simple mouse clicks result in a fully validated structure.

Hardware Chosen for the Fieldbus Infrastructure

- Power Supply: 25 V / 360 mA, e.g., HD2-FBPS-1.25.360
- Segment Protector: R2-SP-N12. All field instruments are connected to one Segment Protector installed at the end of the trunk cable.
- Standard fieldbus cable, type A.

Validation and Results

This design is valid for implementation in the safe area. SegmentChecker automatically validates conformity of all data according to IEC 61158-2.

Parameter	Actual	Limit	Comment
Total cable length	1505 m	Min. 1900 m	Meets limit of IEC 61158-2
Spur length	70 m	Max. 90 m	Meets limit of IEC 61158-2 for up to 14 participants
Load of power supply	229 mA	Max. 288 mA	Meets 20% reserve of max. power supply current
Voltage at Segment Protector	19.1 V	9 ... 31 V	Meets limit of IEC 61158-2 including 10% reserve
Voltage at field instrument	18.5 V	Min. 9.9 V	Meets limit of IEC 61158-2 including 10% reserve

Table 3 Results of validation

This segment is a good design that follows all design rules and provides enough reserve for good function and future expansions. For showing the calculation steps to be carried out the example is validated "on foot" below:

Cable Length: Overall, Trunk and Spurs

Overall cable length is 1505 m, which is less than 1900 m according to IEC 61158-2. Calculation:

$$L_{\text{Tot}} = \sum L_{\text{Spur}} + L_{\text{Trunk}}$$

The formula calculates the total cable length from the sum of all spur lengths and the trunk length.

Spur length specified as 70 m is less than 90 m, the maximum according to IEC 61158-2. According to Table 2, a spur length of up to 90 m is permitted with up to 14 participants. In this segment, consisting of 10 field instruments plus 2 host connections, the spur length of 90 m is therefore OK. Two extra field instruments are permissible as reserve per segment while keeping the exact same planning.

Load Condition of the Power Supply

Load conditions at power supply are 229 mA, which is more than 20% less than 360 mA.

$$I_{\text{Seg}} = \sum I_{\text{Dev}} + \sum I_{\text{S.P.}} + I_{\text{Host}}$$

The formula calculates the total load of the power supply (I_{Seg}) from the sum of all device currents plus the load current of Segment Protectors and the host current.

Available Voltage at Segment Protector and Field Instruments

Additionally, the voltage available at wiring interfaces and field devices must meet minimum criteria:

$$R_{\text{Cable}} = R_{20} * (1 + \alpha_{20} (T - 20^{\circ}\text{C}))$$

$$U_{\text{SP}} = U_{\text{PS}} - I_{\text{Seg}} * R_{\text{Cable}}$$

$$U_{\text{Dev}} = U_{\text{SP}} - U_{\text{ASP}} - I_{\text{Dev}} * R_{\text{Cable}}$$

The formula calculates the resistance and voltage drop for the Segment Protector (SP) and the field device (DEV). Available voltage is lower with higher ambient temperature.

Voltage at the Segment Protector is 19.0 V and the voltage at the field instruments is 18.4 V, which are both larger than 9 V min according to IEC 61158-2 and within the range specified as 9 ... 31 V.

Calculations for Validation Example

Total cable length

Trunk length	1	600	600 m
+ Spur length	10	90	900 m
+ Host connection line length	1	5	5 m
= Total cable length			1505 m

Load current on trunk cable

Field instrument load current	10	20	200 mA
+ Segment Protector, load current	1	9	9 mA
= Load current on trunk cable			209 mA

Load of power supply

Load current on trunk cable			209 mA
+ Load current from host system	1	20	20 mA
+ Load of power supply			229 mA
= Maximum load of power supply	20%	360	288 mA

Line resistance calculations

Temperature coefficient			0.0039 Ω/mK
Difference to ambient temperature			35 K
=> Coefficient for temperature at 55 °C			1.1365
Line resistance at 20 °C			44 Ω/km
Line resistance at 55 °C			50.006 Ω/km
= Trunk length and resistance	600		30.0036 Ω
= Spur length and resistance	90		4.50054 Ω

Voltage drop on the trunk cable

Load current on trunk cable	209.0 mA
* Resistance of trunk cable	30.0 Ω
= Voltage drop on the trunk cable	6.3 V

Voltage at input of Segment Protector

Output voltage of power supply	25.3 V
- Voltage drop on the trunk cable	6.3 V
= Voltage at Segment Protector	19.0 V

Voltage drop on spur cable

Load current on spur cable	20.0 mA
* Resistance of spur cable	4.5 Ω
= Voltage drop on spur cable	0.1 V

Voltage at input of field instrument

Voltage at Segment Protector	19.0 V
- Voltage drop inside Segment Protector	0.5 V
- Voltage drop on spur cable	0.1 V
= Voltage at field instrument	18.4 V

More Considerations – Grounding, Shielding, Surge

Grounding and shielding are important for segment noise immunity. A common method should be chosen for fieldbus that matches the grounding and shielding philosophy of the plant. Great care should be taken to ensure proper grounding shielding; this should be checked during planning.

The potential difference between the two leads (+/-) carries the communication signal. Thus, neither of the two leads should be connected to earth or shield. Additional communication stability and protection from faults can be achieved through use of galvanic isolation in the power supplies.

Galvanic Isolation of the Power Supply

While in the past simple power conditioners only provided the required impedance matching and overload protection, they did not provide voltage regulation or galvanic isolation between the segments and the bulk power supply. Galvanic isolation in the fieldbus power supply protects the segment from signal distortion. Figure 4 shows a fault scenario with a ground fault. The system continues to run, however, distorted signals on segment 2 and unknown effects on segment 1 such as cross-talk are consequences of a single ground fault. Moreover, a second ground fault in another segment on the other lead (e.g., '+' lead) causes a short circuit on two segments.

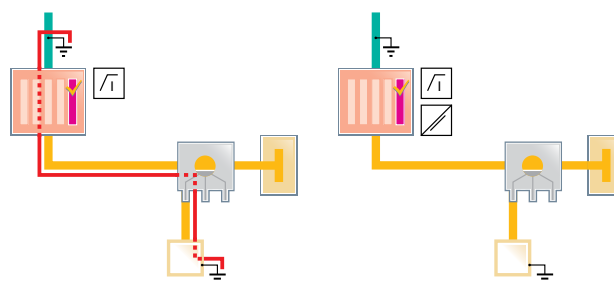


Figure 5 Without galvanic isolation, a short circuit to ground can cause a distortion in the segment with unknown effects such as crosstalk on other segments.

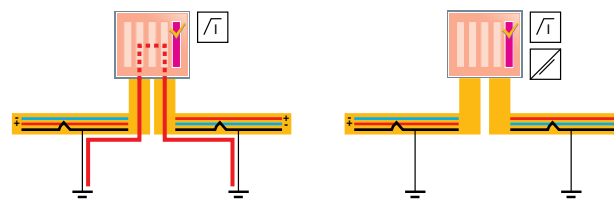


Figure 6 Without galvanic isolation, two ground faults can cause a distortion in the segment with unknown effects such as crosstalk on other segments.

Power conditioners without galvanic isolation should only be used where galvanic isolation is provided in the FieldBarrier or in the bulk power supply and when neither of the fieldbus leads is grounded. In principle, the fieldbus power supply should have galvanic isolation, which reflects state-of-the-art technology.

Surge Protection

The effects of a lightning strike, even at a distance of 500 m, can endanger electric equipment. A risk analysis based on the location of the fieldbus systems and its dimension and version decides on the use of surge protection. High-grade fieldbus components contain a protective diode between the pair of signal wires that already protects against surges and small amounts of energy. For high surges, external protection components are used. They permit the flow of large stray surge current against earth potential without being destroyed in the process.

Fieldbus in Hazardous Areas

All calculations and reasoning shown for fieldbus in safe areas are based on the fieldbus standard IEC 61158-2. This standard defines the maximum dimensions for a segment. In hazardous areas, additional constraints apply for explosion protection defined in IEC 60079. Here we show only the differences or extra work steps required to design and plan a segment in the hazardous area.

The same general steps for planning segments in safe areas apply to hazardous areas. The choice of topology is essentially the same as in safe areas. The only additions are the choice of explosion protection and its validation. A case study shows how achievable cable lengths and number of field devices per segment are influenced by the method of explosion protection. This case study is intended to serve as a guide for selection criteria.

The good news is: Solutions such as the High-Power Trunk Concept (HPTC) allow the same topology to be used in the hazardous area as in the safe area while preserving the ability to allow work on field devices without a hot work permit. For more information, see "High-Power Trunk Concept" in this section. The HPTC is implemented with energy-limiting device couplers (e.g., Segment Protector or FieldBarrier). Additionally, the HPTC actually simplifies the validation of explosion protection according to the way it is implemented. This chapter explains how.

More good news: SegmentChecker actually enables the selection of power supplies and wiring interfaces for any hazardous area with their respective input and output values in easy steps to ensure that the segment works as planned. SegmentChecker, however, only validates power, voltage, and current levels. It remains the responsibility of the segment designer to validate and document explosion protection parameters.

Types of Protection

This is a summary of types of protection and their impact on fieldbus planning, most importantly, the available power. This chapter is provided as a general reference leading to decision criteria for the method that best meets the demands of the process automation system.

Particularly when work on field devices must be possible without a hot work permit, energy-limiting types of protection, such as intrinsic safety (Ex i) and non-incendive (Ex nL) are preferred. However, these methods have the significant disadvantage that they place significant constraints on cable lengths and/or number of field devices.

Energy-limiting methods for explosion protection are used where live work on field instrumentation is specified without requiring a hot work permit. Where long distances must be bridged and higher power levels are required, mechanical methods of types of protection are applied. These are shown in Table 4 and Table 5.

Hazardous area	Explosion protection
Zone 0	Ex ia
Zone 1	Ex ib
Zone 2	Ex ic or Ex nL
Division 1	Ex ia
Division 2	Ex nL

Table 4 Energy-limiting methods for installation with explosion protection allowing live work without a hot work permit by hazardous area

Hazardous area	Explosion protection	Available power
Zone 0 / 1 / 2	Flameproof installation	Typically 30 V/500 mA from fieldbus power supplies on the trunk
	Protected wiring	
	Flameproof enclosures (Ex d)	
	Pressurized enclosures (Ex p)	
Div. 1 / Div. 2	Div. 2 wiring method	Power is not limited for explosion protection
	Explosion-proof installation	
	Armored cable	
	Purge for enclosures	

Table 5 Mechanical methods for installation with explosion protection allowing for maximum distances and devices.

Entity

The Entity model is defined in IEC 60079-11 and NEC 515. It is a method of validating an installation of intrinsically safe and associated apparatus by using intrinsically safe parameters. It is easy to use in a point-to-point connection; however, calculations become cumbersome when considering a network with multiple devices. In addition to the devices' parameters, the cable capacitance and inductance have to be considered. Simplifications for fieldbus were not considered within this specification and planners had no other option than to accept the complex and time-consuming calculation efforts to validate an installation.

The first initiative to define standardized IS parameters for fieldbus was started by the release of the FOUNDATION Fieldbus FF-816 Physical Layer Profile. Based on the conservative Entity model, this document recommended safety parameters of $U_0 = 24 \text{ V}$, $I_0 = 250 \text{ mA}$ and $P_0 = 1.2 \text{ W}$ for power supplies used for gas group IIC (group A,B) applications.

Gases of group IIB (group C) need more energy to ignite. In an attempt to overcome the 1.2-W limitation, one manufacturer introduced a IIB Entity power supply. Wiring blocks further limited the energy for IIC Entity field devices. Wiring had to be located in a IIB location even for IIC applications.

Applying the Entity model to fieldbus in practical applications is rather rare; only few power supplies conform to the Entity model available today. Typically, they provide 10 V ... 12 V and 70 mA ... 100 mA which is enough to operate 2 ... 3 field devices per segment (gas group IIC). In the end, Entity:

- Provides power for segments with up to 3 instruments
- Requires a significant calculation effort to validate intrinsic safety
- IIB solution offers more power; however, it is not suitable where many applications require group IIC
- Does not support redundant power

FISCO – Fieldbus Intrinsically Safe Concept

Initially published as an IEC technical specification created by the Physikalisch Technische Bundesanstalt (PTB), Germany FISCO is now defined in IEC 60079-27 for Ex ia, Ex ib, and Ex ic. Triggered by preliminary experiments conducted by PTB, the conservative approach of Entity with concentrated cable inductances and capacitances was reevaluated with the following objectives:

- Increase available power
- Standardize the installation parameters and limits
- Simplify system calculations, validation, and documentation

FISCO prescribes that only one power supply is permitted per segment and that all other devices are power drains with measures in place to prevent unintentional power feedback to the cable. For the first time, a standard defined actual restrictions on cable and electric apparatus with regards to parasitic capacitance and inductance. Instruments and power supplies require certification through a notified body. Cables are documented through a declaration by the manufacturer.

With the constraint of only a single power supply permitted per network, power supply redundancy is not possible. Available solutions are implemented as hot-standby redundancy.

Without requiring any calculations, FISCO offers the easiest method for validation of explosion protection, which explains its popularity. It shifts the bulk of the responsibility for sound electric design from the planner and operator of process plants to the equipment manufacturers. Under real-life conditions, it is suitable for small applications with short cable lengths and 4...8 devices per segment depending on the gas group.

High-Power Trunk Concept

The High-Power Trunk Concept (HPTC) removes the limitations with regards to segment length and number of devices. HPTC was developed and introduced by Pepperl+Fuchs in 2002.

The principle idea of the HPTC is to deliver unlimited energy on the fieldbus trunk with mechanical methods of explosion protection into the hazardous area. Within the hazardous area, it is distributed via energy-limiting wiring interfaces to its final destination, the field instrument. The trunk is installed utilizing protected installation and is, therefore, protected from mechanical damage and effects such as unintentional disconnect, corrosion, and so on. Standard power supplies are applied for the HPTC, which are much simpler by design and available at a lower price. For Zone 1/0 (Div. 1) applications the wiring interface, typically called FieldBarrier, is used and acts as distribution interface providing galvanically isolated outputs with intrinsically safe energy limitation (Ex ia IIC). Each output of the FieldBarrier acts as an independent FISCO or Entity power supply. Up to four FieldBarriers may be operated on one segment, allowing up to 16 intrinsically safe field devices and an overall maximum cable length of up to 1900 m.

The HPTC enables higher availability of the segment as the power supplies may be operated in redundant configuration. The same topology used in the safe area can be used for all hazardous areas: Zone 0, 1, and 2 and Class I / Divisions 1 and 2.

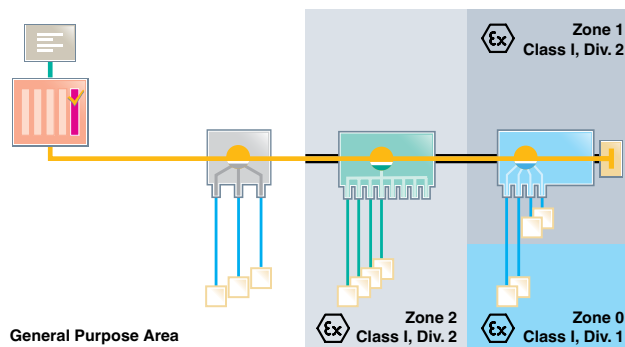


Figure 7 High-power trunk for any hazardous area Segment Protectors provide short circuit current limitation and non-incendive energy limitation (Ex nL) as well as intrinsic safety Ex ic. FieldBarriers provide intrinsic safety (Ex ia).

High-Power Trunk Concept with DART

Dynamic Arc Recognition and Termination (DART) is the latest advancement in energy limitation utilizing dynamically acting power supplies and equipment. A spark is detected as it occurs and shuts off before the energy released in the spark becomes incendive. DART features long cable lengths and many devices while removing the need for protected installation of the trunk cable. DART essentially realizes the intrinsically safe High-Power Trunk Concept.

Explosion-Proof Housing

Applicable in countries governed by NEC standards: As part of the NEC article 500, explosion-proof is a protection method that can be used in hazardous locations. An explosion-proof housing contains a spark and limits venting of the ionized gases in such a way that the energy released into the hazardous area cannot cause an explosion. An explosion-proof enclosure houses ordinary equipment. It requires the use of rigid metal conduit with poured seals at each end to run cabling from the hazardous area into the safe area. Explosion-proof is costly to install and maintain compared to other hazardous location protection methods and does not allow live work on any of the involved fieldbus components without a hot work permit. It is, therefore, not used for creating a fieldbus installation.

Flameproof Installation - Ex d-rated Wiring Interfaces

Although energy-limiting installation methods are used, there are exceptions where field instruments require higher energy levels and/or come with a flameproof housing. In such cases, the fieldbus infrastructure is installed using Segment Protectors with an Ex d rating. The rating of the wiring interface permits installation in any junction box in the field.

This method requires "protected installation" of all cables – trunk and spurs. Live work on field instruments requires a hot work permit. Any type of segment planning is done in accordance with that described above as energy is not limited for explosion protection.

Performance Comparison

The comparison shown in Table 6 highlights attributes qualitatively. Attributes are defined below and evaluated for their technical and business benefits as positive, neutral, or negative. The evaluation criteria shown in the table are:

Installation cost and effort:	The cost of parts and labor to install the fieldbus infrastructure.
Available power:	The amount of power available for instrument supply
Validation of explosion protection:	This is the number of calculations and work required to validate the installation for explosion protection. That is, with FISCO, even limiting voltages and currents are defined so that no calculations are required and validation is limited to documenting conformity of power supplies, instruments, and cable.
Power supply redundancy:	Option available to utilize power supply redundancy
Continuous physical layer diagnostics:	Option available to utilize continuous online physical layer diagnostics
Segment design mix:	Possibility to mix and match types of protection. This is often required where a need for a particular method of explosion protection determined based on the availability of field instruments for the method of choice.
Cabinet space requirement:	Foot print and heat dissipation leading to cabinet space requirements and cooling inside the cabinet. This may be a significant issue particularly where real estate comes at a significant price such as any type of marine application or underground installations.
Power supply initial cost:	The initial cost of intrinsically safe power supplies is typically higher due to higher demands on designs such as built-in redundancies and the requirements for certification.
Trunk live working:	Working on the trunk's electric circuits while the plant is in operation without requiring a hot work permit.
Spur live working:	Working on spurs' and field instruments' electric circuits while the plant is in operation without requiring a hot work permit.

Evaluation Criteria	Entity Ex I and Ex nL	FISCO (redundant) Ex i and Ex nL	High-Power Trunk	DART	Explosion/Flameproof
Installation cost and effort	o	o	+	o	-
Available power	-	o	+	+	+
Validation of explosion protection	-	+	+	+	o
Power supply redundancy	-	- (+)	+	+	+
Continuous physical layer diagnostics	-	-	+	+	+
Segment design mix	-	-	+	+	-
Cabinet space requirement	-	- (-)	+	+	o
Power supply initial cost	-	-	+	o	+
Trunk live working	+	+	-	+	-
Spur live working	+	+	+	+	-

Table 6 Qualitative comparison of types of protection for fieldbus
 + = positive attribute
 o = neutral attribute
 - = negative attribute

Case Study Showing Cable Lengths and Device Count

In this comparison, the primary goal is to maximize spur and trunk cable length and to derive from that the number of devices that can be connected. The results are based on calculations done with SegmentChecker.

It is important to note that all parameters specified in Table 7 are parameters for fieldbus design as necessitated by IEC 61158-2. Calculations with SegmentChecker lead to the resulting cable lengths with the reduced values from devices with explosion protection.

Parameter	Value
Ambient temperature	50 °C
Instrument average current consumption	20 mA
Minimum available voltage available to instrument 10% above IEC 61158-2	10 V
Current reserve for future extensions per segment	20%
Power supply load reserve for short circuit condition	20 mA
Current consumption per wiring interface, where used	5 mA
Cable specification	AWG 18, 50 Ω/km

Table 7 Basic values for case study calculation

Performance indicator	Entity		FISCO		High-Power Trunk	DART
	IIC	IIB	IIC	IIB		
Maximum output voltage	10.9 V	18.65 V	14 V	14.8 V	30 V	24 V
Output voltage under load	10.6 V	17 V	12.4 V	13.1 V	28.5 V	22 V
Maximum output current	100 mA	350 mA	120 mA	265 mA	500 mA	360 mA
Effectively available current	55 mA	255 mA	66 mA	177 mA	360 mA	248 mA
Real-life trunk length (theoretic trunk length)	180 m (1900 m)	700 m (1900 m)	570 m (1000 m)	290 m (1900 m)	668 m (1900 m)	670 m (1000 m)
Real-life spur length (theoretic spur length)	30 m (120 m)	60 m (120 m)	60 m (60 m)	60 m (60 m)	90 m (120 m)	100 m (120 m)
Max. number of field devices	2	8	4	8	12	12

Table 8 Values calculated for real-life application

Comparison of Actual Values

The comparison shown in Table 8 illustrates the significant differences in actual available cable length and the number of field instruments for each method of explosion protection. Primarily the voltage level is the constraint for the maximum achievable cable length, while the current value is the constraint for the number of field instruments that can be operated.

Calculation basis is the voltage level a power supply provides under load, which is 10 % ... 20 % less than the maximum voltage available without load. The effectively available current describes the current available for the field instruments. It is calculated utilizing the 20 % current reserve, the subtraction of 20 mA short circuit current and 5 mA multiplied by the number of distribution units in use.

Summary of Comparison

Cable length

Where longer cable lengths are required, a greater cable diameter can be used to counteract voltage drop. Another method would be to install repeaters in the field. Repeaters require an additional power supply. They refresh the signal received and repeat it while providing galvanic isolation between the two segments.

A repeater creates segments for both a fieldbus and a type of protection. A drawback is the high installation cost that requires a power cable and an explosion-proof housing installed in the field to host the repeater.

Energy Limitation for the Entire Segment

As can be expected, energy limitation applied to the entire segment based on Entity or FISCO places the tightest constraints on cable lengths and number of devices. These methods require the highest number of segments to lead into the field.

Spares installation requires extra trunk cabling that is typically accounted for during segment design. In practice, spares in many parts of the plant remain unused while there are not enough in other parts. This requires additional installation work while the plant is in operation.

High-Power Trunk Concept

The High-Power Trunk Concept has the longest cable lengths and enables the connection of the largest number of devices to one segment. It utilizes mechanical and energy-limiting methods of explosion protection. The trunk, installed with armored cable, Div. 2 wiring method, or protected installation is not limited for explosion protection and allows maximum cable lengths. Energy is limited at the wiring interface in the field. This enables live work in field instruments without requiring a hot work permit.

From the performance indicator values listed in Table 8, the conclusion can be drawn that the High-Power Trunk Concept enables the longest cable lengths and allows a satisfactory number of field devices. DART, however, has the potential to become the alternative once it has been generally accepted, as it provides an intrinsically safe solution with the same amount of power for the same number of devices and cable length.

General Considerations for Fieldbus in Hazardous Areas

All considerations for fieldbus in the safe area apply. This includes environmental conditions, required cable length, and so on.

Next the explosion protection concept is chosen. This includes the choice of field instruments, where the type of protection must be available. For this choice, qualitative aspects, attributes, and constraints of each method of explosion protection must be applied.

Then cable lengths and power levels are verified using the planning software (e.g., www.segmentchecker.com) and utilizing actual numbers and available component values for the explosion concept of choice.

The steps for validating explosion protection are done according to applicable standards. Applying fieldbus in hazardous areas is just that simple.

Installing Fieldbus

This installation guideline highlights the differences between conventional interface technologies and the fieldbus technology. It describes the main procedures for installing a fieldbus infrastructure. It is assumed that the reader has general knowledge of installation procedures.

Both FOUNDATION fieldbus and PROFIBUS PA are robust technologies. Except for installation in hazardous areas, only accepted rules for the installation of network wiring need to be observed.

To perform a fieldbus installation, follow these steps:

1. Installation of the trunk wiring
2. Installation of the spur wiring
3. Installation of a preconfigured junction box containing Segment Protectors or FieldBarriers and the fieldbus terminator
4. Connections inside the junction box
5. Connection of the instruments to the spur
6. Installation of the fieldbus power supply
7. Checking the correct location of the fieldbus terminators
8. Connection of the fieldbus power supply to the host, if the cabinet is not preconfigured

This represents only a typical installation procedure. The fieldbus installation process is so flexible that you can follow the steps in any order without negative consequences.

Good Practices

Cabling

- Sufficient spacing between signal and power cables

Note: Among all options, sufficient spacing is considered the best protection against electromagnetic interference.

Observance of legal regulations and industry-specific standards

- EMC resistance
- Installation guidelines

Note: Local guidelines and regulations always take precedence and interpret international standards and conventions for application in the country.

- Proper mounting of the cable glands to ensure tightness

Grounding

Sufficient EMC protection.

Proper grounding of the fieldbus shielding by either:

- Single-point grounding
- Multi-point grounding
- Hard grounding in the control room
- Capacitive grounding in the field

Note: Each of these concepts has pros and cons. The grounding concept needs to be decided on before installation and must be followed strictly throughout the complete network infrastructure. Mixing different grounding concepts is not recommended. For more information, see "Grounding and Shielding" in the "Physical Layer" section.

Termination

Proper termination including aspects such as:

- Protection of cable ends with a suitable sleeve
- Installation of cables with a cord grip

Commissioning Fieldbus

Commissioning Physical Layer

Walk Segment

The first step in commissioning the physical layer for FOUNDATION fieldbus or PROFIBUS PA is to walk the segment. During this step, the following should be verified:

- All devices are securely connected
- All shields are grounded according to the plant grounding scheme
- Exactly two terminators are installed at the farthest ends of each segment
- Device housings and conduit entrances are closed and sealed properly

Manual Processes

Commissioning and verification of a fully wired fieldbus infrastructure differs, depending on the availability of advanced physical layer diagnostics. The following procedure applies to commissioning a FOUNDATION fieldbus, without advanced physical layer diagnostics:

- Connect one device at a time
- Conduct test for device
- Disconnect after testing

Note: Commissioning a fieldbus infrastructure requires less than half of the time when compared to commissioning a conventional 4 mA ... 20 mA infrastructure.

The FOUNDATION™ Fieldbus System Engineering Guidelines AG-181, section 11 includes a detailed procedure for installing and commissioning segments. While this guide is relevant for fieldbus testing, the need remains for technically advanced manual testing, using sophisticated, manually operated test equipment and hand-completed test sheets.

Installation Guidelines Overview

The System Engineering Guidelines published by the Fieldbus Foundation include a detailed description of the fieldbus installation procedure (see the FOUNDATION™ Fieldbus System Engineering Guideline AG-181, section 11). While written by the Fieldbus Foundation, this procedure is equally applicable to PROFIBUS PA segments. For commissioning a new or modified system, these guidelines recommend the following set of testing equipment:

1. Digital multimeter for current, voltage, and resistance
2. Advanced capacitance meter capable of independent RC measurements
3. Digital oscilloscope with memory
4. Handheld fieldbus signal and data analyzer
5. Screwdrivers
6. Set of test sheets and pens

The verification procedure for commissioning a fieldbus network consists of testing each segment individually. Besides the testing equipment, this might require a set of adaptors or special terminals to connect to the various probes attached to the system. Provisions must be made to identify individual segment terminals. Since many terminals do not have exposed conductors for direct connection of the testing equipment, suitable eyelets must be used. After the testing procedure, these eyelets, as well as any other wiring with exposed conductors, must be removed to prevent unintentional short circuits.

Testing itself generally consists of the following steps:

1. Cable continuity and isolation tests
2. Line resistance and capacitance checks: pole to pole, pole to shield, capacitive unbalance, and grounding quality
3. Signal communication level analysis and limits
4. Noise level analysis and limits
5. Oscilloscope signal capture and detailed waveform analysis
6. Completion of system documentation

Such a test procedure requires considerably more time, expertise, and accuracy than verifying conventional 4 mA ... 20 mA wiring. It is therefore a task for highly skilled engineers. The engineers need to collect information from various devices and then be able to interpret the information derived from the resulting measurements correctly.

For example, manual testing in accordance with AG-181 requires electronic signal analysis using oscilloscopes and AC measuring/analyzing equipment. While oscilloscope data is useful for discovering many of the potential faults that exist in a particular system installation, it requires a skilled specialist to interpret the information correctly.

System implementation procedures fail to reveal many common problems such as in-band noise, power supply impedance, signal jitter errors, or inverted signals. Yet, such imperfections might lead to error conditions during loop checking or be responsible for hard to interpret problems down the line. Revealing all such potential faults right from the start requires considerable engineering skills and calls for the use of sophisticated test equipment. Testing procedures require the repeated disconnecting and reconnecting of wires. Interference with an already-installed and terminated network infrastructure can lead to potential failures if the terminals are not correctly reinstalled.

In addition, manually produced system documentation on paper is prone to errors, omissions, or even falsification. This is particularly the case if commissioning needs to be done under time pressure. As a result, sign-offs and hand-overs might be incomplete and measurements deviate from specifications. Eliminating such problems requires time-consuming troubleshooting. It also calls for considerable expert knowledge to interpret the measurements and oscilloscope display correctly, in order to discover the cause of the problem.

In other words: Commissioning a fieldbus infrastructure usually calls for costly specialists to take care of many unexpected problems.

Automated Tools

Automated diagnostic tools provide a simplified and time-saving way to verify a fieldbus infrastructure effectively. Using this technology, all that is needed is to run a test program on a PC, which automatically analyzes all segments on the system. Each segment is thoroughly tested for:

1. Compliance with AG-181 section 11
2. Compliance with IEC 61158-2 (fieldbus standard)
3. Compliance with FF-831, power supply impedance and compatibility
4. Correct operation and functionality of wiring, device communication, termination, and power supplies

Advanced physical layer diagnostics deviates from conventional manual procedures, offering the following advantages:

- Verification of address settings
- Recommendation of maintenance alarm values
- Shield checking
- Activation of communication
- Polarity testing
- Automation of verification procedures
- Comprehensive testing
- Automation of electronic documentation
- Verification of all devices at once
- Avoidance of interference with wiring
- Installation check of the actual system
- 85% reduction of precommissioning time

Commissioning Field Devices

Importing DD/GSD

To be able to communicate with a fieldbus device, the control system must have a file loaded into it, that describes the functionality of the device. These files have different formats but are available as Device Description (DD) or Generic Station Description (GSD). These text files are created by the device manufacturers to provide the controller with all pertinent variables, diagnostic codes, and revision information to allow the field device to participate in synchronous data exchange.

The DD/GSD files are normally found on the manufacturer's website, on a CD accompanying the device, and/or on the FOUNDATION fieldbus/PROFIBUS organization websites.

Addressing

Each device on a digital fieldbus must have a unique address to facilitate proper communication. For FOUNDATION fieldbus, the address is automatically assigned via the control system when a device is connected to the segment. It is possible to edit the address manually, but care must be taken not to duplicate addresses. PROFIBUS addressing is achieved either through manual setting of switches on the device or through software with a Master Class II.

Operating and Maintaining

Troubleshooting Tools

One of the main benefits of using a digital bus is the amount of diagnostic information that is automatically pushed to the asset management system. This data allows for a predictive maintenance schedule rather than a reactive or preventative schedule and keeps the plant running longer.

Diagnostics from Field Devices

Each field device can send diagnostic information back to the control system. The information can be related to the quality of the signal, warning messages, or failure messages. This diagnostic data can be logged by asset management software and tracked to obtain long term trending.

Handheld Tools

Several handheld tools are available that allow the user to complete tasks such as setting an address, monitoring variables, changing the device configuration, or reading diagnostic messages. These are helpful tools for analyzing information while in the field and eliminate the need for multiple older, bulky tools.

Adding Devices

Adding an instrument during ongoing plant operation is as easy as first-time installation. Provided the respective segment has spare terminals, the new device simply needs to connect to the fieldbus and is ready for operation.

Before adding to the segment, verify that the proper DD/GSD file and the address for the device have been loaded into the controller. Before installation, obtain all hot work permits and authorizations to ensure a safe work area.

Removing Devices

There are various procedures for the removal of a device during ongoing plant operation. Generally speaking, working on a live segment is not dangerous in any way and cannot cause any physical harm. However, fieldbus communication and its power supply need protection from any interruption in the flow of communication.

The greatest danger is a series of intermittent short circuits caused during the removal of a device. Short circuits result in the destruction of fieldbus telegrams and cause the system to repeat these lost telegrams automatically. Depending on the system settings, one or multiple repeats are usually tolerated before communication loss with a device is indicated. Depending on the function of this device, communication loss eventually leads to automatic plant shutdown.

Observing the following procedures prevents short circuits and other signal disturbances. These procedures ensure continued communication on the fieldbus during device disconnection or exchange:

Systems without short circuit current limitation

It is assumed that terminals inside the junction box are equipped with fixed plug-in connectors, while the instrument is wired to the spur cable. To disconnect the device, proceed as follows:

- Open the junction box that connects the instrument to the fieldbus trunk.
- Disconnect the instrument by quickly pulling off the plug.
- Open the field instrument and disconnect all wiring.

Systems with short circuit current limitation

Systems with short circuit current limitation by either Segment Protectors or FieldBarriers do not require removable terminals to connect field instruments. With such systems, any device can be disconnected during operation.

If the cable needs to be pulled through the cable gland for disconnecting a device, it is recommended to short circuit the communication wires. This action prevents open wires from coming in contact with any metal surface during transportation.

Application Guideline

Introduction

Pepperl+Fuchs products are used throughout the world. This chapter introduces installation rules for general purpose and hazardous areas. It describes applications per hazardous area, listing applicable standards as reference and general installation rules. For easy reading, each chapter contains the relevant information for the protection method described. Flip to the chapter listing applications for the hazardous area of your choice. Each application lists the respective selection guideline with complete choices.

In this context, "live maintenance" describes the fact that it is permissible to work or operate on electrical circuits or parts of electrical circuits such as the instruments or the spur connection in the hazardous area without legal requirements for permits such as a hot work permit, gas clearance, or other legal documentation. Company rules and guidelines for general safety may still apply.

Important Fieldbus Terms

Fieldbus systems in process automation provide power and communication on a single-shielded, **twisted-pair cable**. They are designed for application in demanding environments, long cable runs, and high device counts connected to the same cable. With fieldbus, you can reach all the way to the field device, allowing for full configuration, control, and communication of instruments from the safety of the control room.

A single electrical circuit with power supply, junction boxes, and instruments is called a **segment**. The typical topology for a segment is the **trunk-and-spur topology** with a main line or homerun cable – **the trunk** – installed from the control room into the field. One or more junction boxes mounted in the field provide connection outputs for field instruments and terminators. The connection cable is called a **spur**, as it is typically short in comparison to the trunk.

Instruments can be actors or sensors, analog or digital. The physical layer, power, communication, and connection are identical for all instruments. Fieldbus **power supplies** typically provide connections to the DCS and power the segment. A typical topology and most typical applications are shown below.

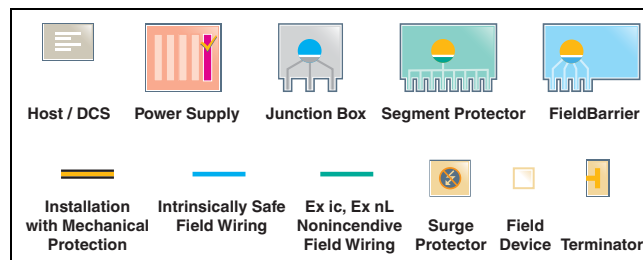


Figure 1 Symbol used in topology diagrams

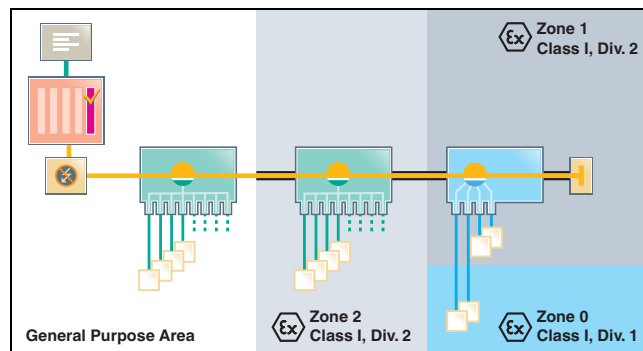


Figure 2 Trunk-and-spur topology for general purpose and hazardous areas showing components for the physical layer

Portfolio and Protection Methods

Live maintenance of spur connections and field instruments is easily achieved with FieldConnex® products in any hazardous area. The following table lists methods of protection offered with FieldConnex® components by hazardous area. While this application guide describes only the electronic components for DIN rail installation, Pepperl+Fuchs offers cabinets for the

control room with all DCS and FieldConnex® components installed and wired. Enclosures and fieldbus junction boxes are pre-engineered with selections, choices, and accessories fitting all protection methods described below. Prewired and factory tested, these solutions are easy to install on site and reduce installation time.

Method of protection	Live Maintenance on Trunk	Live Maintenance on Spurs	Device Coupler in ...	Page
General Purpose Area				87
Devices in Zone 2				88
Live Maintenance on Spurs (FISCO) Ex ic, High-Power Trunk		■	Zone 2	88
Live Maintenance on Spurs (Entity) Ex ic, High-Power Trunk		■	Zone 2	89
Live Maintenance on Spurs Ex nL, High-Power Trunk		■	Zone 2	90
Hot Work Permit Required, Spurs Ex nA, High-Power Trunk			Zone 2	91
Devices in Zone 1 and 0				92
Live Maintenance on Trunk and Spurs Ex ia	■	■	Zone 0 ... 1	92
Live Maintenance on Spurs Ex ia, High-Power Trunk		■	Zone 1	93
Live Maintenance on Trunk and Spurs Ex ib (Zone 1), High-Power Trunk	■	■	Zone 1	94
Hot Work Permit Required, Trunk and Spurs Ex d, Device Coupler in Zone 1			Zone 1	95
Hot Work Permit Required, Trunk and Spurs Ex d, Device Coupler in Zone 2			Zone 2	96
Devices in Class I, Division 2				97
Non-Incendive Field Wiring		■	Div. 2	97
Division 2 Wiring			Div. 2	98
Devices in Class I, Division 1				99
Class I, Division 2 Mounted FieldBarrier		■	Div. 2	99
Class I, Division 1 Mounted FieldBarrier in Purged Enclosure		■	Div. 1	100
Class I, Division 1 Mounted FieldBarrier in Explosion-Proof Enclosure		■	Div. 1	101

Note

The authors made every effort to provide accurate information. However, this information is provided “as is” without any explicit or implied warranty.

This chapter can list only general guidelines and rules. Local installation rules, electrical codes, or guidelines may apply. Refer to these rules. And always plan for safety in your process plant.

General Purpose Area

Since no hazardous materials are present, there are no safety restrictions on the power supplied to the field devices. The High-Power Trunk Concept was developed to offer the highest power to the field, which results in the longest cable runs and the most field devices per segment.

Recommended installation practices for optimal bus performance can be found in the "Wiring and Installation Guide" published by the Fieldbus Foundation™ or in the "PROFIBUS PA User and Installation Guideline" published by PROFIBUS International. Additional installation regulations should be followed according to local standards such as the NEC or VDE.

For a detailed selection of components, see the "Selection Guideline" in the FOUNDATION Fieldbus H1 or PROFIBUS PA sections.

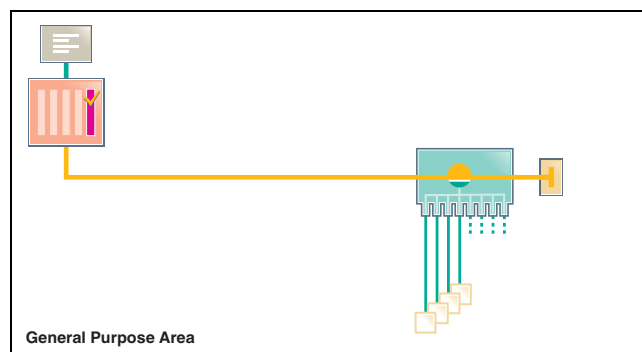


Figure 3 General Purpose Area

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply	MBHD-FB1-4R + HD2-FBPS-1.25.360	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N* ²	KT-MB-GTB-2PS R2-SP-N* ²

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Devices in Zone 2

For Zone 2, choices for explosion protection fulfill different types of requirements such as long cable runs or live maintenance at field instruments. It is important to know that in some cases, even the host interface connections must meet certain requirements for explosion protection. More details can be found in the Pepperl+Fuchs FieldConnex® Application Guideline for Zone 2, which can be found as a free download on the Pepperl+Fuchs website. Look for the datasheets on FieldConnex® Segment Protectors.

Live Maintenance on Spurs (FISCO) Ex ic, High-Power Trunk

This method of explosion protection offers live maintenance at the spur/device level and the easiest validation process for intrinsic safety. The applicable standard for intrinsic safety FISCO Ex ic is IEC 60079-27 as of edition 2.

The fieldbus power supply limits the voltage to safe levels. The Segment Protector acts as the device coupler and wiring interface. It limits the current to safe levels. Due to the unlimited trunk energy, live work at the trunk requires a hot work permit. However, live connect or disconnect at the outputs of the Segment Protector is allowed.

Field devices according to FISCO are allowed to be connected to the outputs of the Segment Protector under an intrinsically safe Ex ic rating. The Entity parameters of the cable must be in the limits of the FISCO cable specification given in IEC 60079-27. Generally, fieldbus cable type 'A' fulfills the specifications according to FISCO.

The host interface must meet the requirements for SELV/PELV. The declaration of conformity must state the "passivity of any host interface," meaning that the host must not be an active current source. If the host interface is installed in Zone 2, a declaration of conformity must be provided in addition.

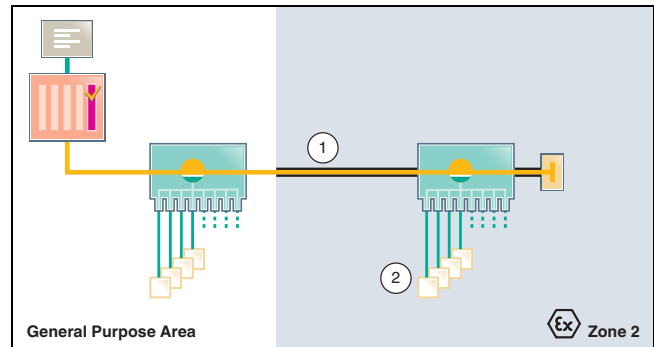


Figure 4 Live maintenance on spurs (FISCO) Ex ic, high-power trunk

1. Trunk: protected installation according to IEC 60079-14
2. Spurs: intrinsically safe Ex ic according to IEC 60079-27 (FISCO)

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	MBHD-FB1-4R + HD2-FBPS-1.17.500	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.17.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N* ²	R2-SP-N* ²
For a detailed selection go to page	132	326

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Live Maintenance on Spurs (Entity) Ex ic, High-Power Trunk

This method of protection offers live maintenance at the spur. Work on the trunk requires a hot work permit. In comparison to FISCO Ex ic, the voltage output is higher, providing a higher device count or longer cable runs. The applicable standard for intrinsic safety is IEC 60079-11 as of edition 5.

The fieldbus power supply defines and provides output ratings for the intrinsically safe spurs. In gas group IIC hazardous area, the maximum output voltage is limited to $U_0 = 24\text{ V}$. The Segment Protector acts as the device coupler and wiring interface. It limits the current to safe levels. Due to the unlimited trunk energy, live work at the trunk requires a hot work permit. However, live connect or disconnect at the outputs of the Segment Protector is allowed.

If the given safety values match, field devices, certified Ex ic Entity according to IEC 60079-11 are allowed to be connected to the outputs of the Segment Protector under an intrinsically safe Ex ic rating. The certified or declared safety values of the field devices have to match the safety values of the combination of fieldbus power supply and Segment Protector.

The host interface must meet the requirements for SELV/PELV. The declaration of conformity must state the "passivity of any host interface," meaning that the host must not be an active current source. If the host interface is installed in Zone 2, a declaration of conformity must be provided in addition.

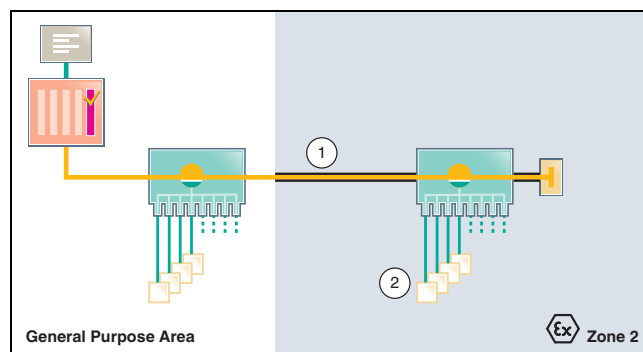


Figure 5 Live maintenance on spurs (Entity) Ex ic, high-power trunk

1. Trunk: protected installation according to IEC 60079-14
2. Spurs: intrinsically safe Ex ic according to IEC 60079-11

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	MBHD-FB1-4R + HD2-FBPS-1.23.500	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.23.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N* ²	R2-SP-N* ²
For a detailed selection go to page	134	327

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Live Maintenance on Spurs Ex nL, High-Power Trunk

This application is based on the now-expired standard IEC 60079-15 edition 3, which is applicable for installations and replacement components only. **It is no longer applicable for the manufacture of new components. The Ex nL standard has been replaced by the Ex ic standard, which guarantees backwards compatibility.** All components rated Ex ic can be applied as direct replacements.

The Ex nL standard offers live maintenance at the spur. Work on the trunk requires a hot work permit. The guiding standard for non-incendive energy limitation is IEC 60079-15 edition 3.

The fieldbus power supply defines the output rating of the energy-limited spurs. In the gas group IIC hazardous area, the maximum output voltage is limited to $U_0 = 24\text{ V}$. The Segment Protector acts as the wiring interface and can be installed in Zone 2. Live connect or disconnect at the outputs of the Segment Protector is allowed with proper validation of safety requirements according to the Entity concept.

The host interface requires a declaration of conformity, which declares the "passivity of any host interface," meaning that the host must not be an active current source. If the host interface is installed in Zone 2, a declaration of conformity for installation in Zone 2 must also be provided.

Field devices matching the output rating of the power supply and certified Ex nL or Ex ic (Entity) are allowed to be connected to the outputs of the Segment Protector under a Zone 2 energy-limited rating.

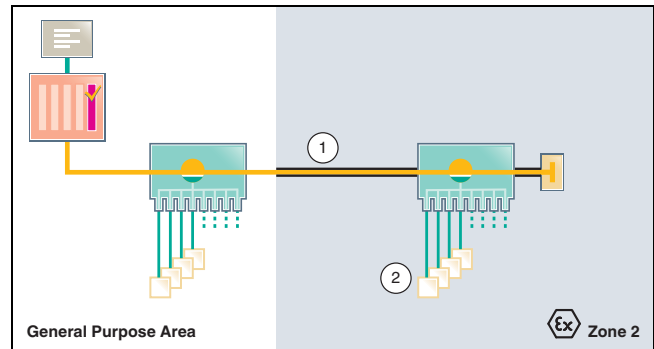


Figure 6 Live maintenance on spurs Ex nL, high-power trunk

1. Trunk: protected installation according to IEC 60079-14
2. Spurs: non-incendive Ex nL according to IEC 60079-15 (expired)

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	MBHD-FB1-4R + HD2-FBPS-1.25.360	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-2PS
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N* ²	R2-SP-N* ²
For a detailed selection go to page	136	328

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Hot Work Permit Required, Spurs Ex nA, High-Power Trunk

This application is suitable where live work on the trunk or spur is typically not required, and a hot work permit for such work is acceptable. All installation and cabling require "increased protection" according to IEC 60079-14.

The power supply can be rated for maximum cable lengths. Any FieldConnex[®] Segment Protector works as a device coupler and wiring interface. It can be installed in Zone 2. The output terminals of the Segment Protector are rated Ex nA. Electrical work on trunk and spurs always requires a hot work permit.

Field instruments are typically Ex d or Ex nA rated and installed in Zone 2. Only mechanical means of explosion protection apply to the installation.

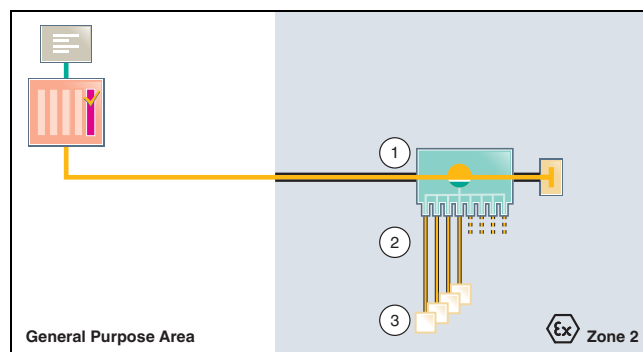


Figure 7 Hot work permit required, spurs Ex nA, high-power trunk

1. Trunk: protected installation according to IEC 60079-14
2. Spurs: protected installation according to IEC 60079-14
3. Field instruments: flameproof Ex d, protected installation

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	MBHD-FB1-4R + HD2-FBPS-1.25.360	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N* ²	KT-MB-GTB-2PS R2-SP-N* ²
For a detailed selection go to page	138	329

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Devices in Zone 1 and 0

Live Maintenance on Trunk and Spurs Ex ia

This application is applicable to both zones. Devices and junction boxes are installed either in Zone 0 or Zone 1. The junction boxes are associated simple apparatus. This application is based on IEC 60079-11 for intrinsic safety according to Entity and IEC 60079-27 for FISCO, the Fieldbus Intrinsically Safe Concept.

Live work on any part of the segment without a hot work permit is enabled through intrinsic safety at the power supply.

To validate intrinsic safety, the two concepts of Entity and FISCO are applicable. All wiring follows practices for intrinsic safety according to IEC 60079-14. Only intrinsically safe field instruments Ex ia (Zone 0 or Zone 1) or Ex ib (Zone 1 only) are permitted on the segment.

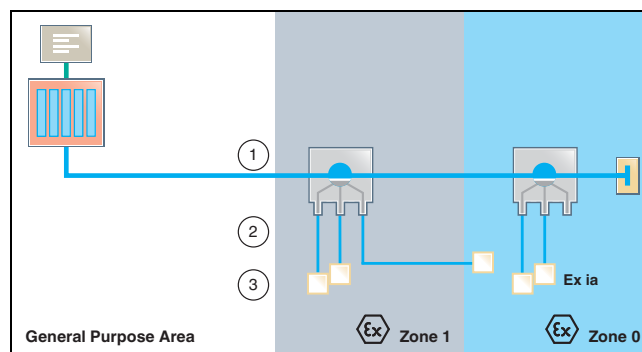


Figure 8 Live maintenance on trunk and spurs Ex ia

1. Trunk: intrinsically safe installation 'Ex ia' according to IEC 60079-11 or IEC 60079-27 (FISCO)
2. Spurs: intrinsically safe installation 'Ex ia' according to IEC 60079-11 or IEC 60079-27 (FISCO)
3. Field instruments: intrinsically safe instruments

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	Not available	KFD2-BR-Ex1.3PA.93
Fieldbus Junction Box selectable with 4, 6, 8 outputs	F2-JB-I#.*	F2-JB-I#.*
For a detailed selection go to page	Not available	322

Live Maintenance on Spurs Ex ia, High-Power Trunk

The High-Power Trunk Concept combines the benefits of intrinsic safety at the spur level with long cable runs and high device counts. This concept allows a flexible segment design. It offers a choice of validating intrinsic safety per spur according to IEC 60079-11 for intrinsic safety with Entity parameters or IEC 60079-27, which is the Fieldbus Intrinsically Safe Concept (FISCO). The trunk is installed, protected following the rules of IEC 60079-14.

The FieldBarrier is the device coupler and wiring interface. It can be installed in Zone 1. The outputs of the FieldBarrier are intrinsically safe (Ex ia). Electrical work on the trunk requires a hot work permit. Electrical work is permitted at the instrument and the spur without a hot work permit.

The trunk connections of the FieldBarrier are equipped with terminals rated Ex e (increased safety). The trunk requires installation with "increased mechanical protection" according to IEC 60079-14. Instruments can be rated Ex ia for Zone 0 or 1 or Ex ib for Zone 1 according to Entity and FISCO.

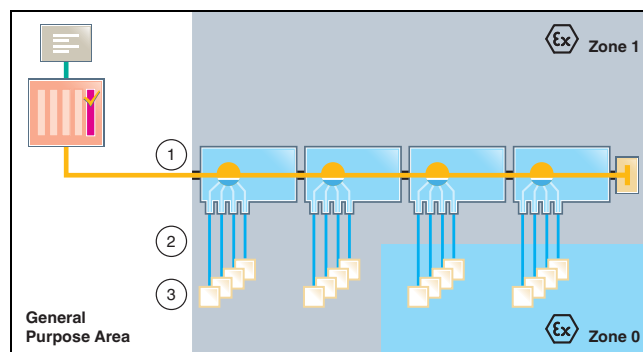


Figure 9 Live maintenance on spurs Ex ia, high-power trunk

1. Trunk: installation with mechanical protection according to IEC 60079-14
2. Spurs: one device per output FISCO or Entity: Ex ia IIC; intrinsically safe according to IEC 60079-11 or IEC 60079-27 (FISCO)
3. Field instruments: rated Ex ia for Zone 0 or 1 or Ex ib for Zone 1 according to Entity and FISCO

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	MBHD-FB1-4R + HD2-FBPS-1.500	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-2PS
FieldBarrier with 4 outputs	RD0-FB-Ex4 ²	RD0-FB-Ex4 ²
For a detailed selection go to page	127	323

¹ (R) denotes optional redundancy.

² FieldBarriers are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Live Maintenance on Trunk and Spurs Ex ib (Zone 1), High-Power Trunk

FieldConnex® DART Fieldbus provides intrinsically safe and high output power at the trunk through DART Technology (Dynamic Arc Recognition and Termination). In combination, the DART Power Hub and DART Segment Protector make the high-power trunk intrinsically safe for Zone 1. DART Fieldbus follows rules and certification according to IEC 60079-11.

A trunk-and-spur topology is mandatory. The DART Segment Protector is the device coupler and wiring interface certified for installation in Zone 1. Up to four DART Segment Protectors can be installed on one segment. A trunk length up to 1000 m is permitted. In all other design rules such as spur length, number of participants, etc., DART Fieldbus follows the fieldbus standard IEC 61158-2. The outputs of the DART Segment Protector are intrinsically safe (Ex ib) rated for existing intrinsically safe instruments (Ex ib, Entity). Electrical work on trunk and spurs is permitted without a hot work permit.

Both trunk and spurs follow installation rules for intrinsic safety as defined in IEC 60079-14. Any existing Entity-conformant field instrument rated Ex ib can be connected to a DART Segment Protector. The instrument is typically installed in Zone 1. In most cases, this is sufficient even for most field instruments rated for Zone 0, as they typically offer connections located in Zone 1.

For example, the instrument that is certified Ex ib [ia] is mounted on the wall of the tank with the sensor in Zone 0 and the connection terminals in Zone 1.

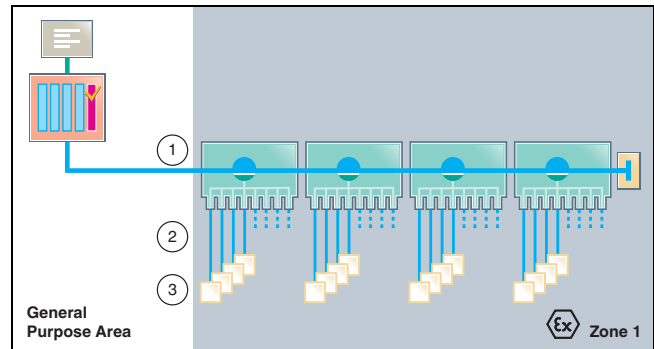


Figure 10 Live maintenance on trunk and spurs Ex ib (Zone 1), high-power trunk

1. Trunk: intrinsically safe installation Ex ib IIC according to IEC 60079-11
2. Spurs: intrinsically safe installation Ex ib IIC according to IEC 60079-11
3. Field instruments: rated Ex ib or intrinsically safe acc. to Entity

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	KT-MB-FB-D-4R (includes Power Modules)	KT-MB-FB-D-4R.GEN + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-D-2PS
Segment Protector with 12 outputs	R3-SP-IBD12 ²	R3-SP-IBD12 ²
For a detailed selection go to page	129	324

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Hot Work Permit Required, Trunk and Spurs Ex d, Device Coupler in Zone 1

This application is suitable where live work on the trunk or spur is typically not required and a hot work permit for such work is acceptable. All installations require “increased protection” according to IEC 60079-14. The power supply can be rated for maximum cable lengths.

The Segment Protector is the device coupler and wiring interface. It can be installed in Zone 1. Outputs provide short circuit current limitation only and enable connection of instruments rated Ex d for installation in Zone 1. Electrical work on trunk and spurs always requires a hot work permit.

Field instruments are typically rated Ex d and installed in Zone 1. Only mechanical means of explosion protection apply to the installation.

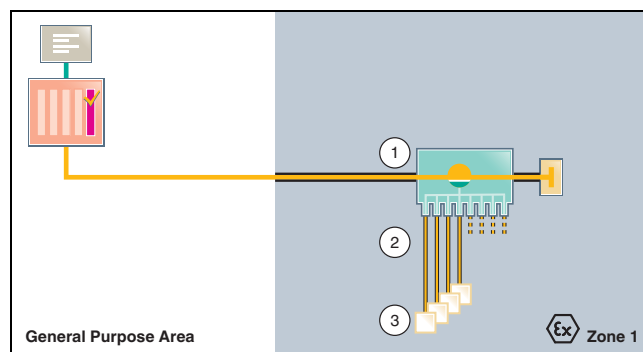


Figure 11 Hot work permit required, trunk and spurs Ex d, device coupler in Zone 1

1. Trunk: protected installation according to IEC 60079-14
2. Spurs: protected installation according to IEC 60079-14
3. Field instruments: flameproof Ex d, protected installation

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	MBHD-FB1-4R + HD2-FBPS-1.25.360	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-2PS
Segment Protector with 12 outputs	R-SP-E12 ²	R-SP-E12 ²
For a detailed selection go to page	130	325

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Hot Work Permit Required, Trunk and Spurs Ex d, Device Coupler in Zone 2

This application is suitable where live work on the trunk or spur is typically not required and a hot work permit for such work is acceptable. All installation requires “increased protection” according to IEC 60079-14. The power supply can be rated for maximum cable lengths.

The Segment Protector is the device coupler and wiring interface. It can be installed in Zone 2. Outputs provide short circuit current limitation only and enable connection of instruments rated Ex d for installation in Zone 1. Electrical work on trunk and spurs always requires a hot work permit.

Field instruments are typically rated Ex d and installed in Zone 1. Only mechanical means of explosion protection apply to the installation.

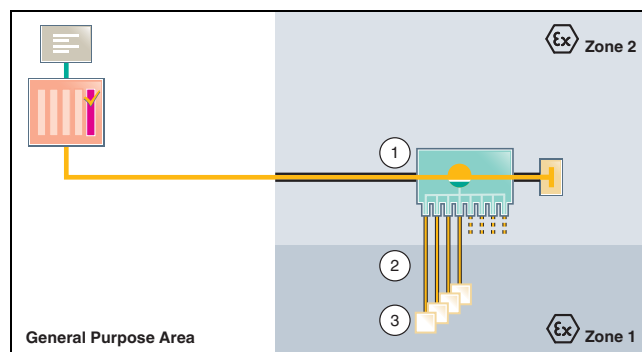


Figure 12 Hot work permit required, trunk and spurs Ex d, device coupler in Zone 2

1. Trunk: protected installation according to IEC 60079-14
2. Spurs: protected installation according to IEC 60079-14
3. Field instruments: flameproof Ex d, protected installation

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply or Segment Coupler	MBHD-FB1-4R + HD2-FBPS-1.25.360	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N* ²	KT-MB-GTB-2PS
For a detailed selection go to page	130	325

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Devices in Class I, Division 2

Non-Incendive Field Wiring

This application is suitable for live maintenance of spur connections in a Division 2 hazardous area. Utilizing the non-incendive Entity Concept as defined by the NEC500 allows devices with published Entity parameters to be coupled in a Division 2 area. These devices may be intrinsically safe devices or non-incendive field wiring devices.

The fieldbus junction box becomes the associated non-incendive field wiring apparatus and limits the voltage (V_{oc}), provided by the fieldbus power supply (V_{out}), and current to the field device. Live maintenance is allowed as long as the field device also known as the non-incendive field wiring apparatus or intrinsically safe device has a maximum Entity voltage (V_{max}) greater than the voltage provided by the power supply:

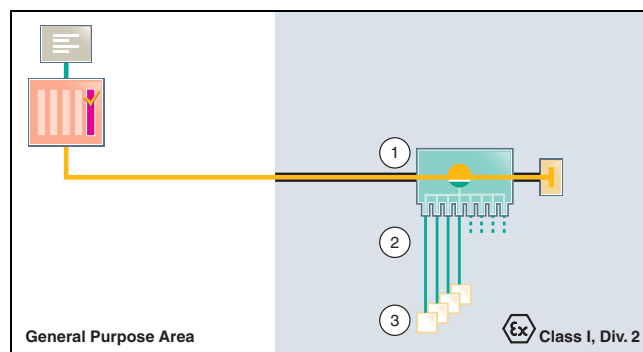
$$V_{max} \geq V_{oc} = V_{out}$$


Figure 13 Non-incendive field wiring

1. Trunk: Division 2 wiring methods as defined in NEC501, which relates to mechanical protections
2. Spurs: wiring in accordance with NEC501.10(3), which relates to standard wiring practices
3. Field instruments: manufacturer control drawing defines the installation

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply	MBHD-FB1-4R + HD2-FBPS-1.25.360	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-2PS
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N* ²	R2-SP-N* ²
For a detailed selection go to page	136	328

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Division 2 Wiring

Many fieldbus applications require the couplers and field devices to be installed in a Division 2 area. Using Division 2 certified field devices along with a FieldConnex® Segment Protector accommodates this application, but live maintenance is not allowed. A hot work permit must be obtained to ensure no hazardous materials are present.

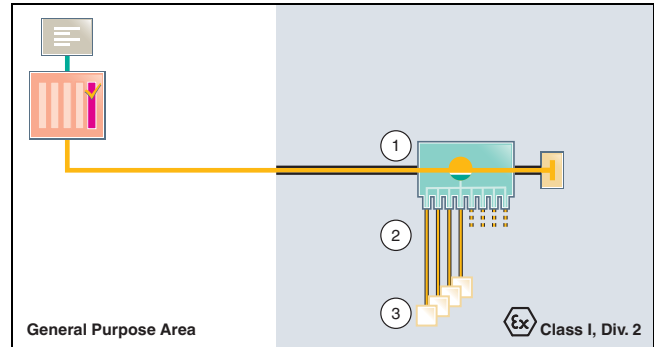


Figure 14 Division 2 wiring

1. Trunk: Division 2 wiring methods as defined in NEC501, which relates to mechanical protections
2. Spurs: Division 2 wiring methods as defined in NEC501, which relates to mechanical protections
3. Field instruments: manufacturer control drawing defines the installation

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply	MBHD-FB1-4R + HD2-FBPS-1.25.360	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-2PS
Segment Protector with a choice of 4, 6, 8, 10, 12 outputs	R2-SP-N* ²	R2-SP-N* ²
For a detailed selection go to page	130	325

¹ (R) denotes optional redundancy.

² Segment Protectors are available in enclosures as ready-to-install packages with a choice of housing materials, degrees of protection, and accessories.

Devices in Class I, Division 1

Division 1 applications using the FieldConnex® High-Power Trunk Concept all revolve around using the FieldConnex® FieldBarrier device coupler. The FieldBarrier provides four intrinsically safe outputs for wiring to Entity/FISCO rated field devices in a Division 1 area.

Class I, Division 2 Mounted FieldBarrier

The FieldBarrier is certified for Division 2 mounting with outputs extending into the Division 1 area. Field devices connected in this scenario are intrinsically safe certified devices with Entity or FISCO parameters.

Wiring for the trunk follows Division 2 wiring methods as defined in NEC501, which relates to mechanical protections. Spur wiring is in accordance with NEC504 and refers to intrinsically safe wiring practices.

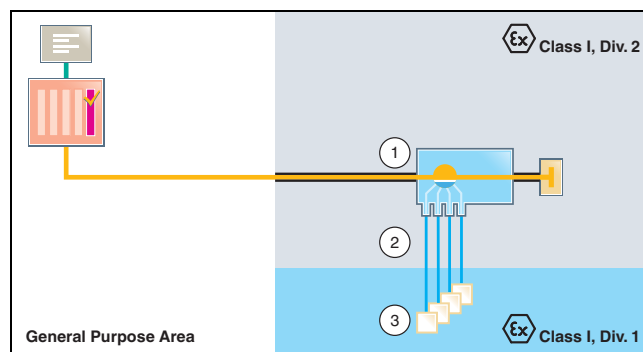


Figure 15 Class I, Division 2 mounted FieldBarrier

1. Trunk: Division 2 wiring method for high-power trunk per NEC: PLTC or ITC cable/wire tray, armored cable, or conduit
2. Spurs: intrinsically safe wiring according to NEC504
3. Field instruments: intrinsically safe instruments with Entity or FISCO parameters

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply	MBHD-FB1-4R + HD2-FBPS-1.500	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-2PS
FieldBarrier with 4 outputs	RD0-FB-Ex4	RD0-FB-Ex4
For a detailed selection go to page	127	323

¹ (R) denotes optional redundancy.

Class I, Division 1 Mounted FieldBarrier in Purged Enclosure

The FieldBarrier is certified for Division 2 mounting with outputs extending into the Division 1 area. Some applications require the FieldBarrier to be mounted in a Division 1 area, which can be realized by using a purged and pressurized enclosure. The certified purge system reduces the hazardous area classification inside the enclosure to Division 2, where the FieldBarrier can be mounted. Field devices connected in this scenario are intrinsically safe certified devices with Entity or FISCO parameters.

Wiring for the trunk follows Division 1 wiring methods, as defined in the NEC501.15, which describes explosion-proof conduit connections. Spur wiring is in accordance with NEC504 and refers to intrinsically safe wiring practices. Rules for the purge and pressurization system can be found in NFPA496.

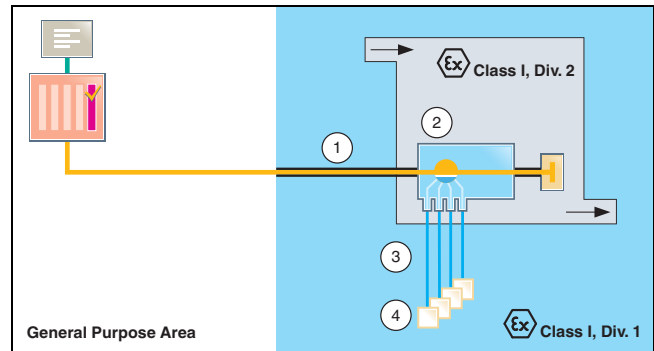


Figure 16 Class I, Division 1 mounted FieldBarrier in purged enclosure

1. Trunk: explosion-proof conduit with poured seals
2. FieldBarrier in purged enclosure
3. Spurs: intrinsically safe wiring according to NEC504
4. Field instruments: intrinsically safe instruments (live work permitted)

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply	MBHD-FB1-4R + HD2-FBPS-1.500	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-2PS
FieldBarrier with 4 outputs	RD0-FB-Ex4	RD0-FB-Ex4
Purge and Pressurization System	1000 series	1000 series
For a detailed selection go to page	127	323

¹ (R) denotes optional redundancy.

Class I, Division 1 Mounted FieldBarrier in Explosion-Proof Enclosure

The FieldBarrier is certified for Division 2 mounting with outputs extending into the Division 1 area, which is possible using an explosion-proof enclosure. The explosion-proof enclosure contains any explosion of hazardous materials. Field devices connected in this scenario are intrinsically safe certified devices with Entity or FISCO parameters.

Wiring for the trunk follows Division 1 wiring methods as defined in NEC501.15, which describes explosion-proof conduit connections. Spur wiring is in accordance with NEC504 and refers to intrinsically safe wiring practices.

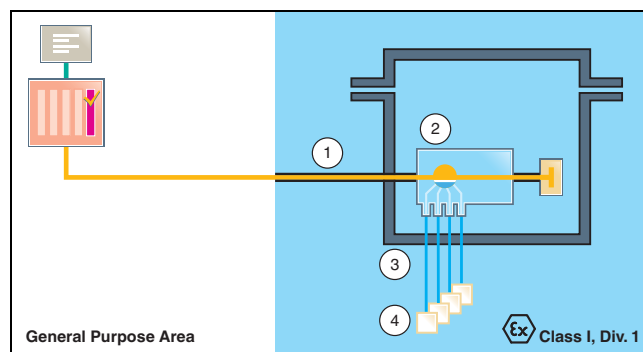


Figure 17 Class I, Division 1 mounted FieldBarrier in explosion-proof enclosure

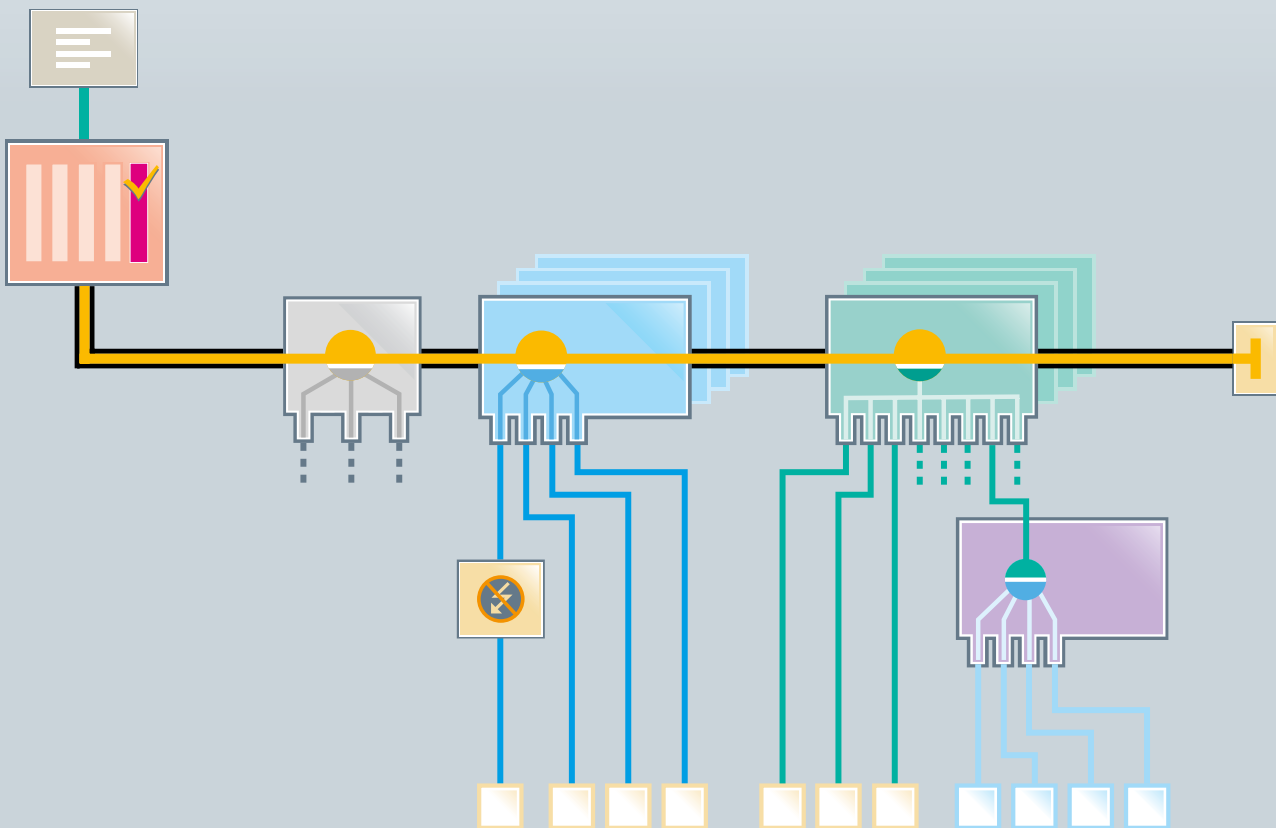
1. Trunk: explosion-proof conduit with poured seals
2. FieldBarrier in explosion-proof enclosure
3. Spurs: intrinsically safe wiring according to NEC504; explosion-proof seals are required within 18" of the enclosure
4. Field instruments: intrinsically safe instruments

Selection Example	FOUNDATION Fieldbus H1	PROFIBUS PA
Power Supply	MBHD-FB1-4R + HD2-FBPS-1.500	MB-FB-4(R).GEN ¹ + HD2-FBPS-1.500 + MB-FB-GT(R) ¹ + HD2-GTR-4PA KT-MB-GTB-2PS
FieldBarrier with 4 outputs	RD0-FB-Ex4	RD0-FB-Ex4
For a detailed selection go to page	127	323

¹ (R) denotes optional redundancy.



Fieldbus Infrastructure for Process Automation



FieldConnex® is the infrastructure and installation technology for connecting instrumentation of process automation to the respective DCS systems via fieldbus. Both, the DCS and instruments transmit measurement, control, configuration, and diagnostic data digitally for full integration of devices in higher-level management and control systems. FieldConnex® is available for hazardous and general purpose (non-hazardous) areas. In all cases, the respective statutory regulations and directives governing the application or intended use must be observed.

Operating Principle

Power and communication are transmitted via the same shielded twisted-pair cable. The power supply adds power to the communication and acts as the main connection to the DCS. Device couplers are wiring interfaces installed near the field instruments. Process interfaces enable conversion of simple digital or analog inputs and outputs to the fieldbus.

FieldConnex® supports two protocols that are prevalent in process automation: FOUNDATION Fieldbus H1 and PROFIBUS PA. They are both defined in IEC 61158-2 and operate according to the same physical layer definition. They satisfy the typical demands for long cable runs and explosion protection. A decision for a particular protocol in most cases is secondary to the decision for a particular DCS system. Galvanic isolation, a system of advanced physical layer diagnostics, and many other features are part of FieldConnex®.

- High standard for quality and long service life
- Redundancy of power supply
- Reliability with low heat dissipation
- Explosion protection for any hazardous area: Zones and Divisions
- Physical layer diagnostics for simplified commissioning, monitoring, troubleshooting
- Long running experience and technical expertise readily made available
- No need for maintenance

Turn to the page of your preferred fieldbus or communication system.

FOUNDATION Fieldbus H1

104



- Power Supplies
- Device Couplers
- Process Interfaces
- Advanced Diagnostics
- Accessories

PROFIBUS PA

300



- Segment Couplers
- Device Couplers
- Process Interfaces
- Advanced Diagnostics
- Accessories

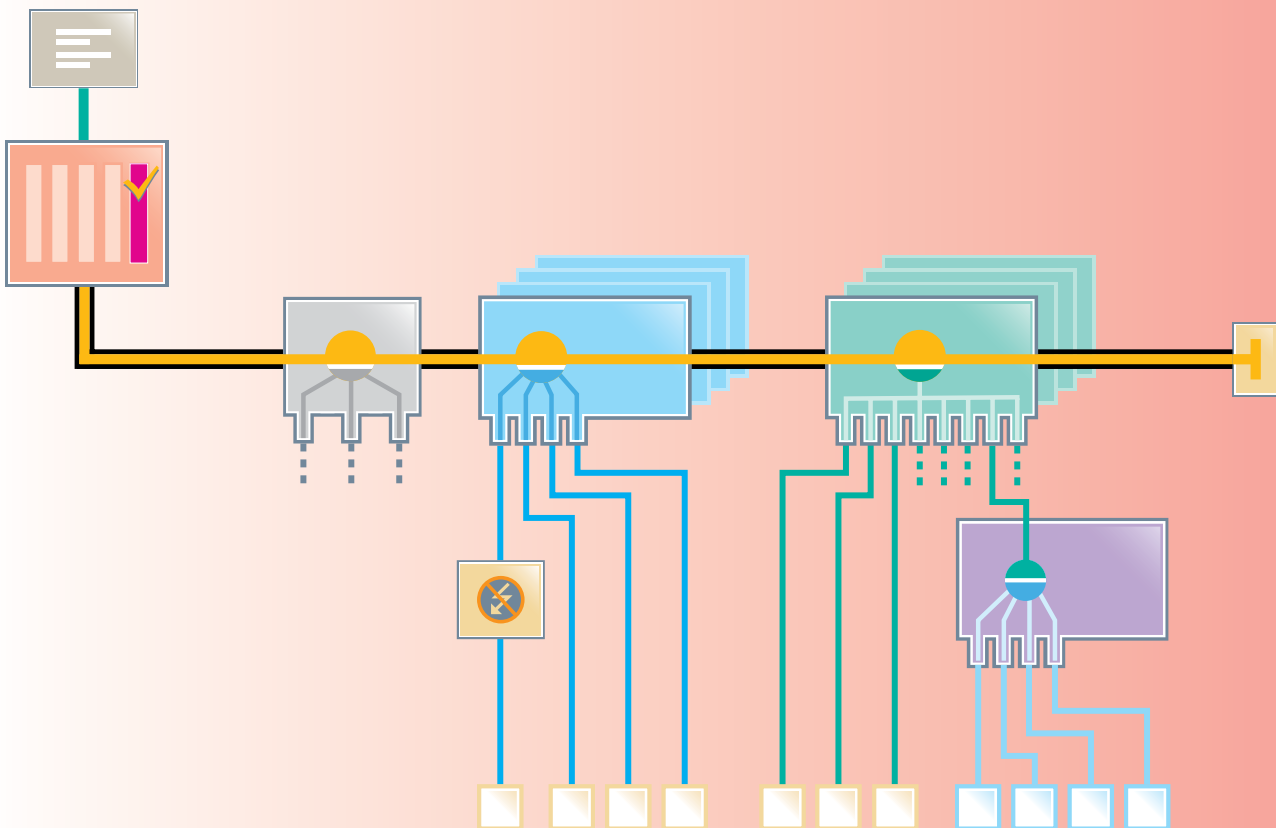
Ethernet

448





FOUNDATION Fieldbus H1



System Description	106
Selection Guideline	125
Products	
Advanced Diagnostics	140
Power Supplies	154
Field Distribution	216
DART Fieldbus	256
Process Interfaces	264
Accessories	278

Introduction

FieldConnex® is the infrastructure and connection technology for fieldbus in process automation. It supports FOUNDATION Fieldbus H1 based on IEC standard IEC 61158-2 and provides power and communication on the same cable. With quality components for your process automation system and demands in the field, our highly reliable and energy-efficient design enables you to easily design and implement segments that will keep running.

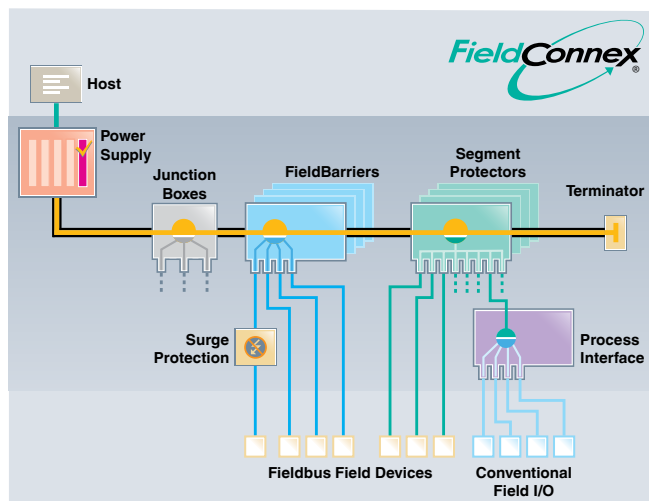


Figure 1 System diagram: Schematic connections between all components of the fieldbus infrastructure.

The color coding in the diagram above guides you through the process of selecting the right FieldConnex® components and options. Each chapter is clearly marked with the symbol for the component.

The following chapters describe all components – both hardware and software – that make up the FieldConnex® portfolio. This includes features, benefits, engineering concepts, and available options. Cross references to the "Technology" section, manuals, white papers, or other documents are provided for easy comprehension.

System Components

Diagrams show the context in which FieldConnex® components are applied in a segment. Symbols in the diagrams are defined for all product groups as follows:

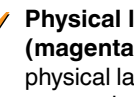
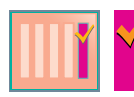


Fieldbus power supplies (orange) power the segment and provide connections to the DCS systems. Different versions and options suit all kinds of installations, starting from laboratory and test installations, to small-scale remote installations, up to large-scale process plants with 10 000 segments or more.



Device couplers (blue, green, or gray) provide the connection points for field

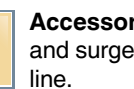
instruments. They come in enclosures ready to install in the field and are customized with accessories to fit the solution. Pepperl+Fuchs provides pre-engineered and pre-wired cabinets and housing solutions for plug and play.



Physical layer diagnostics (magenta) monitor the fieldbus physical layer and signals. This approach simplifies all practical aspects on handling the fieldbus.



Process Interfaces (purple) connect simple analog or digital I/O devices to the fieldbus. The process interface collects status, process data, and diagnostics and transmits the information via fieldbus to the DCS.



Accessories (yellow) such as terminators and surge protectors complete the product line.

Physical Layer Diagnostics

The quality of the installation itself can be monitored economically with FieldConnex® Advanced Diagnostics. Operator and maintenance staff can keep the physical layer from the power supply, junction boxes, and all connections between the DCS and the instrument in clear view. The system notifies the user when changes in the physical layer become critical issues during the operation of the automation system.

At the core is the Advanced Diagnostic Module (ADM), which is the first of its kind to monitor fieldbus signals for their quality. The system includes a software interface that allows the worker to analyze the installation from the safety of the control room.

A built-in expert system interprets a large number of measurements reported by the ADM. It provides information about possible causes and suggests courses of corrective action in plain text. Faults and possible causes are already known ahead of time for well-planned and necessary trips to the field. This way, unnecessary trips are avoided.

FieldConnex® Advanced Diagnostics reports alarms automatically to the DCS and plant asset management. This includes field-installed components with extra features to handle fault scenarios typical for fieldbus systems. This includes climate monitoring in the control cabinet, water ingress in junction boxes/instrument head, or wear of surge protectors. The alarm information reaches the DCS or maintenance station, traveling in parallel to normal fieldbus communication without requiring a fieldbus address or extra engineering.

FieldConnex® Advanced Diagnostics gives users the certainty that environmental conditions, manual intervention, or any other potentially unknown cause will not harm the quality of the installation. This increases the overall availability so that fieldbus can be applied even in safety-critical applications.

Explosion Protection

FieldConnex® can be implemented in any hazardous area (Zones and Divisions) with a large selection of explosion protection concepts. The concepts are designed to meet the needs of modern-day process automation systems for ease of application, system availability, and live maintenance.

To learn more about explosion protection concepts, see the "Application Guideline" in the "Technology" section.

In order to meet the requirements of your plant, both the power supply and device coupler must support the chosen explosion protection concept of your plant. The following aspects have a major impact on choosing the right power supply and device coupler:

- Type of hazardous area
- Preferred explosion protection concept
- Maximum cable length and device count per segment

For a complete selection of FieldConnex® components, see the "Selection Guideline" for FOUNDATION Fieldbus H1.

High reliability and availability of all FieldConnex® system components result from our long-lasting expertise and the quality of our manufacturing. This is possible because of a highly integrated value chain, from product design, to production and quality control through delivery and implementation in your plant.

Enclosure and Cabinet Solutions

Aside from superior power supply components and field installation, Pepperl+Fuchs offers complete solutions built at our factories and ready for installation on site. Pre-engineered fieldbus junction boxes are made from a range of materials and include all components and accessories pre-wired and tested.

Our engineering departments assist with control cabinets built to order. Factory acceptance testing is available at our many facilities around the world. With premium fieldbus components and our value in engineering, we look to reduce your cost and time required on site for installation, testing, and plant startup.

Power Supplies



FieldConnex® fieldbus power supplies come in two versions: modular Power Hubs with a motherboard as wiring interface and simplex all-in-one power supplies.



Figure 2

The FieldConnex® Power Hub with many choices and options to fit the specific need with regards to plant availability, wiring, and diagnostics.



Figure 3

All-in-one solutions work well in smaller applications and laboratory environments.

Detailed selection tables are located in the "Selection Guideline".

Common Attributes

Heat Dissipation

FieldConnex® power supplies are designed for low heat dissipation. This contributes to a longer service life and, more importantly, to reduced heat dissipation, enabling a higher packing density in the control room cabinet. In most cases, heat dissipation rather than the actual cabinet floor space is the limiting factor in cabinet detail engineering.

The actual heat dissipation depends on layout and load conditions. To assist the decision-making process, selection tables indicate low heat dissipation as follows '–', '––', '–––' where '–––' stands for the lowest heat dissipation and the best performance.



DIN Rail Installation

All power supplies mount firmly on the DIN rail for easy installation in the cabinet.

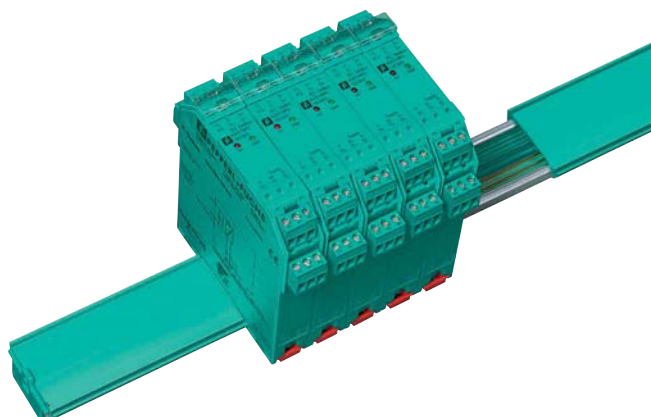


Figure 4 Simplex power supplies support the Pepperl+Fuchs Power Rail, reducing wiring.



Figure 5 DIN rail installation is standard for all FieldConnex® power supplies

Supply and Conditioner

A selection of output voltages allows for designs for general purpose areas and hazardous areas. Additionally, fieldbus power is available in two forms:

1. Power Supply Modules provide galvanic isolation, impedance matching, and a choice of controlled output voltages.
2. Galvanic isolation provides many long-term benefits for communication stability and plant availability.

Where device couplers without galvanic isolation are applied, galvanic isolation of the power supply increases overall availability because communication behaves much more robustly towards unwanted conditions such as ground faults. Therefore, we recommend power supplies with galvanic isolation as state-of-the-art.

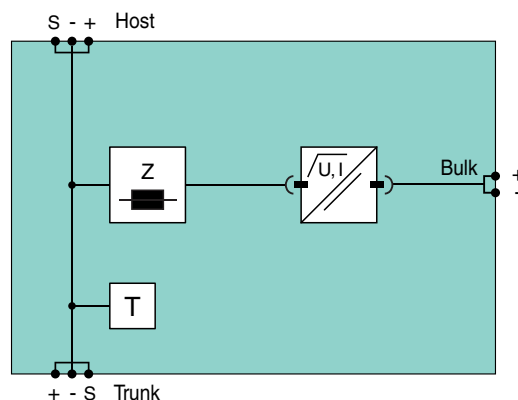


Figure 6 Schematic diagram of fieldbus power supply. Galvanic isolation and controlled voltage output detail of MBHD-FB1-4*

Power Conditioner Modules provide impedance matching and short circuit limitation. The output voltage closely follows the bulk power voltage. Power Conditioners do not have galvanic isolation. They contain fewer electronic components and because of that have low heat dissipation. However, in modern-day plants, galvanic isolation is specified. Power Conditioners are purchased mostly as replacement.

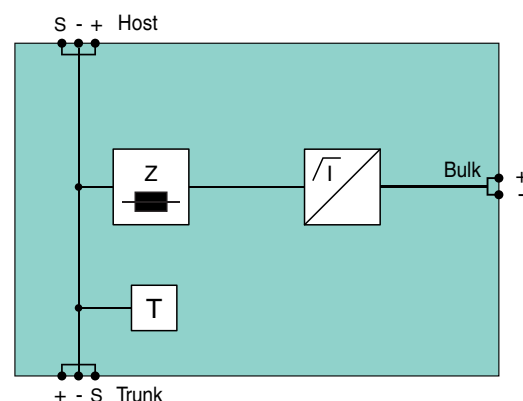


Figure 7 Schematic diagram of fieldbus Power Conditioner: Without galvanic isolation, follows the bulk power voltage

Applications for general purpose and safe areas with descriptions of explosion protection concepts are located in the "Application Guideline" of the "Technology" section.

Passive Impedance Matching

All FieldConnex® power supplies and Power Hubs feature passive impedance matching circuits. Passive components have a significantly lower heat dissipation compared to circuits using a series transistor.

Passive impedance matching is the only way to provide a perfectly balanced design. This contributes to a higher tolerance regarding grounding faults or module failures in redundant power supplies. A longer service life is guaranteed by using only resistors and inductances.

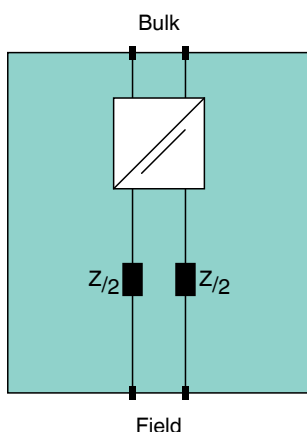


Figure 8 Impedance matching with purely passive design

For many of our products, we manufacture even the inductances. Thus we keep control over the quality of our manufacturing, components, and our circuit design.

Impedance Matching with CREST

Crosstalk and Resonance Suppression Technology (CREST) offers the best signal quality. In addition to the impedance matching circuits, filters ensure optimum signal quality. CREST provides additional impedance between segments in the case of ground faults on one or more segments, protecting the signal waveform from distortions.

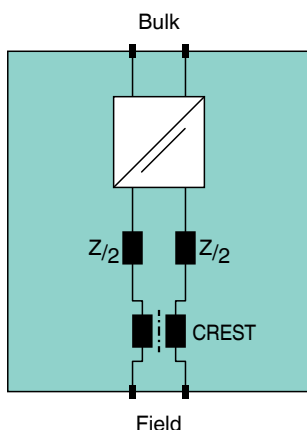


Figure 9 CREST cancels noise and other disturbances through current compensated inductances.

For a complete discussion of impedance matching and CREST, see the "Technology" section.

Power Hubs

The FieldConnex® Power Hub is a modular fieldbus power supply. It is comprised of a motherboard that serves as a wiring interface and plug-in modules for the power supply and diagnostics. In order to meet the different demands regarding options, economics, and availability, we offer three different versions as described below. All Power Hubs share the following attributes.

Redundancy

Power Supply Modules hold all electronic components. For high availability, motherboards can host two Power Supply Modules per segment acting as redundant pairs. This allows for:

- High segment availability
- Low number and cost of spares
- Low replacement cost through modularity

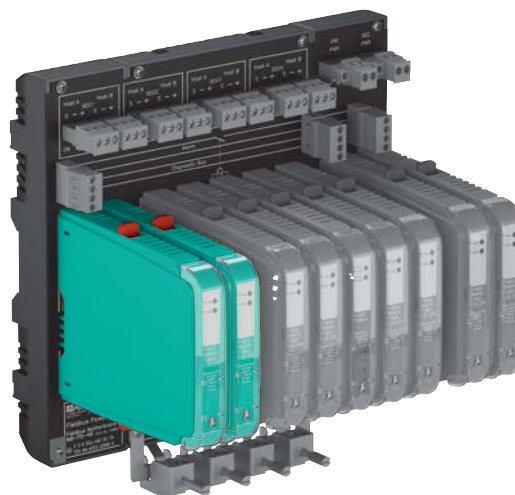


Figure 10 Each module feeds one segment. Two modules serve as redundancy pairs.

On most motherboards, the connection to bulk power is redundant: selected motherboards offer independent and redundant host connections with short circuit current limitation.

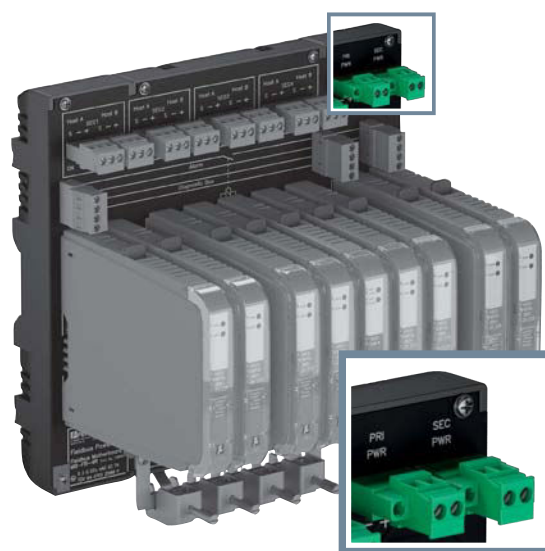


Figure 11 Redundant connections to bulk power (all Power Hubs)



Figure 12 Redundant host connections (selected Power Hubs)

Module Mounting without Tools

All plug-in modules lock securely onto the motherboard via Quick Lok Bars. Installation and replacement of modules is fast and easy without tools.

FieldConnex® Power Hubs provide a socket for the Advanced Diagnostic Module (ADM) for four segments each.

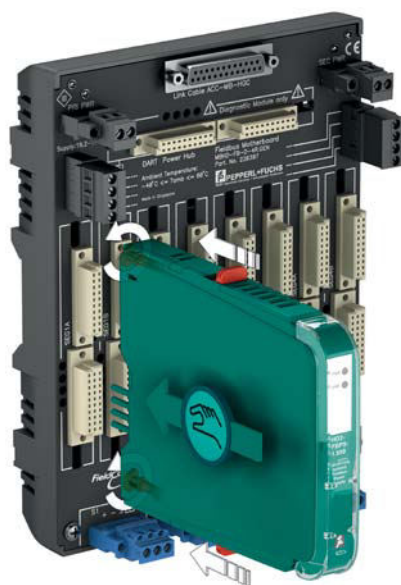


Figure 13 Installation of power and diagnostic modules works without tools

Passive Motherboard

The motherboard is the wiring interface installed in the control room cabinet. It consists of passive components only for a long, uninterrupted service life. The impedance matching circuits are located in the motherboard.

Compared to electronic versions located in the power module, the impedance is always properly matched. This contributes to good signal quality and better communication reliability.

Connection Options to the DCS

Motherboards or cable connectors are customized to match the DCS system of your choice. The following solutions are available:

- Custom cable connectors (Yokogawa)
- Plug-in sockets for fieldbus modules (Invensys)
- Side-by-side plug design matching connectors (Emerson and the like)
- Specially designed chassis to fit the installation rail (Honeywell)

Custom cables can be prepared for any other DCS configuration together with the generic DB-25 connector on selected motherboards. For this customization, contact your Pepperl+Fuchs representative.

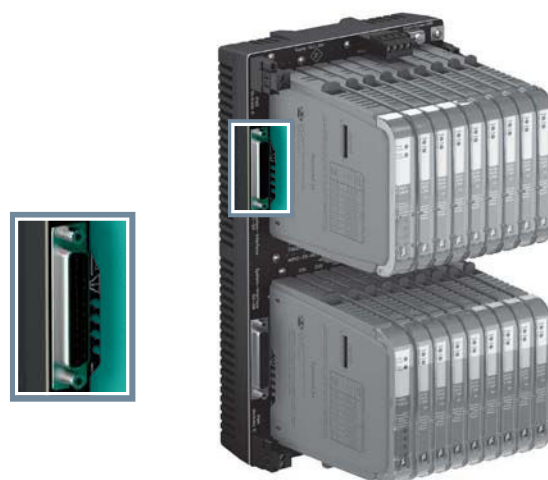


Figure 14 Host system connectors with cables to any DCS system for fast and error-free wiring of the control cabinet

Grounding Rail and Connectors with Retaining Screws

The motherboard can be fitted with a grounding rail for convenient and secure grounding of the cable shield. Typically, the shield is grounded centrally in the control room. Any type of grounding and shielding concept can be implemented.

All recent models feature plug-in connectors with retaining screws. The connection is long-lived and is designed to endure constant vibrations.

The fieldbus infrastructure does not require a SIL rating because the entire communication channel is already certified and approved for SIL 3 through the fieldbus protocol.

For a detailed discussion, see the "Technology" section.



Figure 15 Grounding rail installed on the motherboard. This simplifies installation and is one of the most popular options.

Available Types of Power Hubs

FieldConnex® offers three types of Power Hubs for different applications. Power Hubs are equipped with a slot for the Advanced Diagnostic Module. This enables monitoring of the fieldbus physical layer itself.

DART Fieldbus is available with selected Power Hubs. For details beyond mechanical attributes, see also the section below.

High-Density Power Hub/DART Power Hub:

Standard version with a good cost-benefit ratio. Provides all essential features for today's fieldbus-based process plant automation, including marine and offshore.

Compact Power Hub:

Small and durable version. Occupies the least amount of floor space per segment; is designed for a long service life and low heat dissipation

Universal Power Hub:

Universal version for extra signal reliability and redundancy. Provides the most options for best signal quality such as CREST redundant host connections.

Power Hub Type	Type Code of Motherboard	Compatible Power Module	No. of Segments	Power Supply Redundancy	Power Dissipation per Segment	CREST	Terminators: Selectable/Fixed
High-density	MBHD*	HD2*	4	S	++		F
Compact	MBHC*	HCD2*	8	S	+++		F
Universal	MB*	HD2*	4	O	+	X	S

Table 1 FieldConnex® Power Hub type by main attribute
For power supply redundancy: S = standard, O = option

Simplex Power Supply

All-in-one simplex power supplies provide power to one segment and connections to a single host via plug-in terminals. They come with an integrated terminator, and some can be powered via Power Rail. The simplex power supplies are configuration-free and preferably used in laboratory setups, skid mounts, and other compact applications.

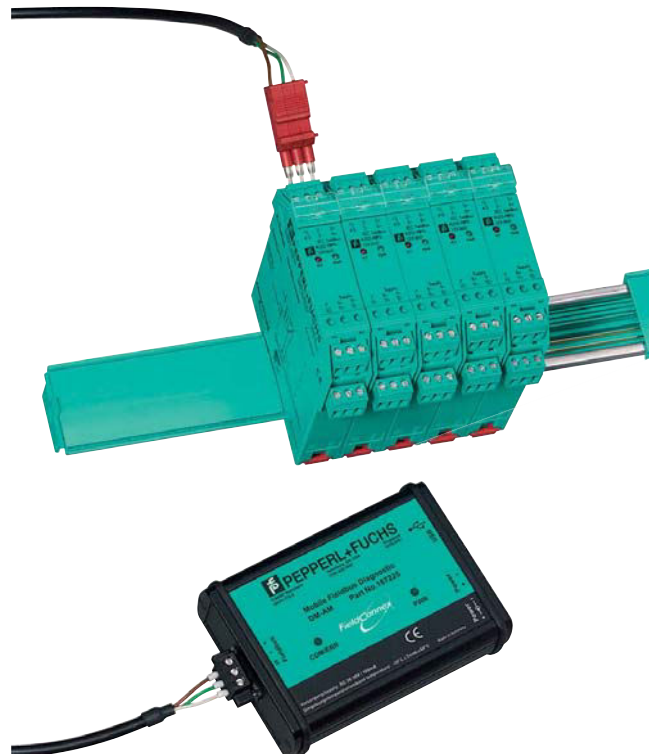


Figure 16 Five power supplies KLD2-FBPS-1.25.360 installed on a Power Rail: they are small in size and mount side by side on the DIN rail. Mobile Advanced Diagnostic Module connected in parallel.

Removable connectors provide receptacles for the connection with test equipment such as the mobile diagnostic module and measuring devices. Connection and disconnection are quick and the wiring remains undisturbed.

Current versions are only 20 mm wide and can be fitted on the DIN rail without requiring spacing for cooling purposes.

Type Codes	Types	Width (mm)	CREST	Terminators: Selectable/Fixed
KLD2-FBPS-1.25.360	Supply	20		F
KLD2-FBPS-1.12.220	Supply	20		F
KLD2-PC-1.1.IEC	Conditioner	20	X	F
KLD2-PR-1.IEC	Repeater	80	X	F

Table 2 Comparison of main attributes for simplex power supplies



Installation and Distribution



Fieldbus installation components, in general referred to as device couplers, are wiring interfaces with an enclosure that can be fitted for different demands of degree of protection and mechanical methods of explosion protection.

FieldConnex® device couplers combined with FieldConnex® power supplies provide protection methods that meet the demands of general purpose and all explosion hazardous areas. They come in three basic types:

- **FieldBarrier:** Comprises short circuit current limitation, galvanic isolation, and intrinsically safe power limitation at the spur. For hazardous area Zone 1 and Div. 2 with instruments in Zone 0 ... 1 and Div. 1 ... 2. The FieldBarrier is an innovation by Pepperl+Fuchs that has become a de facto standard for hazardous area applications requiring long cable lengths and high device counts. The FieldConnex® FieldBarrier has paved the way for fieldbus in process automation and has a large installation base in the market.
- **Segment Protector:** With short circuit current limitation. The recommended and economical choice for installations in general purpose and hazardous areas Zone 1 ... 2 and Div. 2.
- **Junction Box:** Simple, without short circuit current limitation. Is used when live access to a device is not critical, mainly for general-purpose applications or with intrinsically safe power supplies. Associated apparatus for hazardous areas Zone 1 ... 2 and Div. 2.

Short circuit current limitation

Short circuit current limitation for each spur protects the segment from faults at a spur. In case of a short circuit condition, the segment remains in operation as the device coupler limits the current. We strongly recommend applying device couplers with short circuit current limitation.

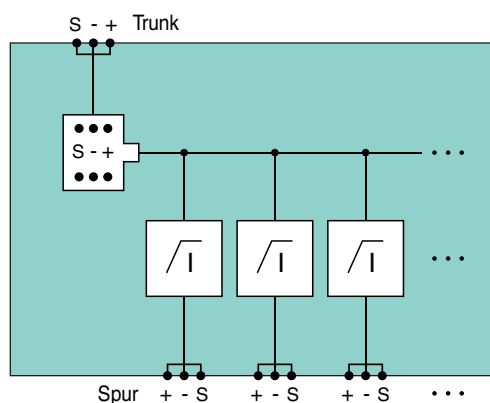


Figure 17 Short circuit current limitation at the spur enables live work on a field instrument while protecting the remainder of the segment.

FieldBarrier

Originally an innovation by Pepperl+Fuchs, the FieldConnex® FieldBarrier with galvanic isolation revolutionized the fieldbus industry. It is the fundamental building block of the High-Power Trunk Concept which is a de facto standard today allowing for long cable lengths and high device counts.

Typical Features

FieldBarriers comprise the following features:

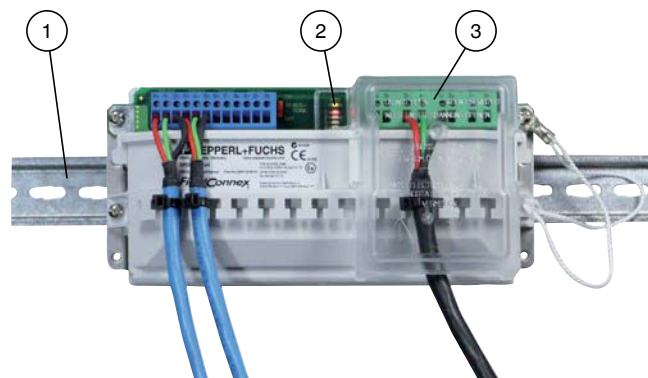


Figure 18 FieldBarrier on a DIN rail.

1. DIN rail installation: FieldBarriers are DIN rail mountable, typically without requiring tools.
2. LED indicators: LEDs provide indication for power and short circuit condition per spur. This supports installation and troubleshooting, and simplifies fault recognition.
3. Bus powering: The FieldBarrier draws the power required for indicators, power limitation, and short circuit current limitation from the fieldbus itself.

For a detailed discussion of explosion protection plans using FieldBarriers, see the "Application Guideline" in the "Technology" section.

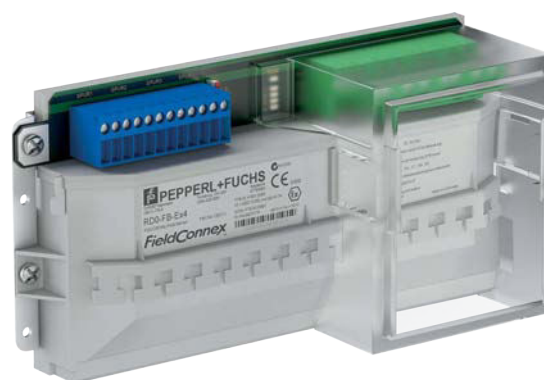


Figure 19 FieldBarrier: The additional translucent cover prevents an unintended disconnection of the trunk. Spurs are intrinsically safe.

The FieldBarrier acts as an intrinsically safe barrier between trunk and spurs with galvanic isolation. An important safety feature is the IP30 cover for the trunk connectors that protects against unintended opening of the trunk circuits.

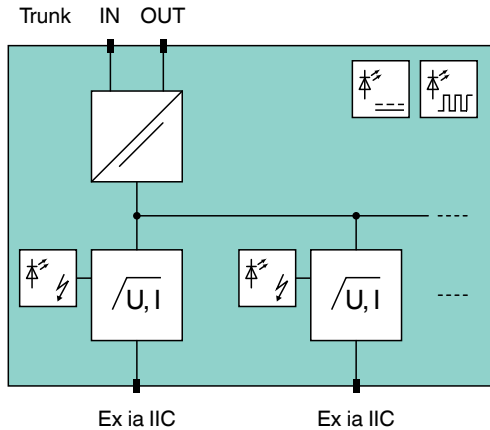


Figure 20 FieldConnex® FieldBarrier: Galvanic isolation between trunk and spurs, short circuit limitation, and intrinsically safe explosion protection at each spur.

Most devices installed in the hazardous area Zone 0/Class I, Div. 1 are connected to the fieldbus via a FieldConnex® FieldBarrier.

For enclosures with a degree of protection up to IP66 or equivalent Enclosure Type Rating, see "Fieldbus Junction Box Housing Solutions" in this section.

Segment Protectors

Segment Protectors are available for different applications. Their common attributes are short circuit current limitation and LED indicators.

Typical Features

Segment Protectors comprise the following features:

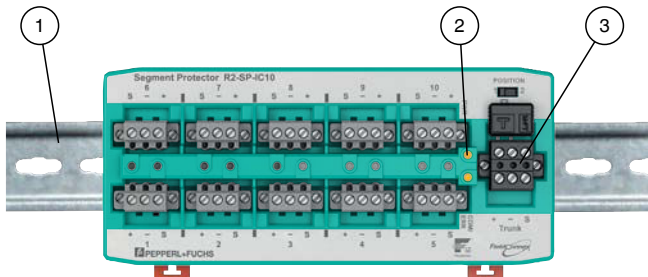


Figure 21 Segment Protector on a DIN rail. Number of spurs can be selected from 4 ... 12.

1. DIN rail installation: Segment Protectors are DIN rail mountable, typically without requiring tools.
2. LED indicators: LEDs provide indication for power, communication, and short circuit condition per spur. This supports installation and troubleshooting, and simplifies fault recognition.
3. Bus powering: The Segment Protector draws the power required for indicators, power limitation, and short circuit current limitation from the fieldbus itself.

R2-SP-N*:

Standard solution for the application in general purpose and Zone 2/Div. 2 areas. Supports latest standard for intrinsic safety 'Ex ic'. Comes with a choice 4 ... 12 outputs.

R2-SP-IC*:

Segment Protector with progressive short circuit current limitation. It detects faults typical for fieldbus installations, such as contact bounce. It detects these faults and sends an alarm via Advanced Diagnostics to the maintenance station indicating the affected spur.

RM-SP*:

Modular solution for equipment in confined space such as skid-mounted applications. Also for Zone 2/Div. 2. Trunk module with two spurs can be expanded with modules of four spurs each.

R-SP-E12:

For explosion-proof/flameproof enclosure protection in Zone 1/Div. 2.

R3-SP-IBD12:

The DART version for Zone 1 with trunk and spurs intrinsically safe Ex ib IIC.

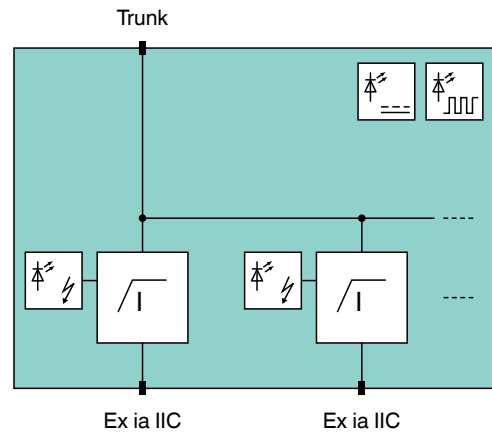


Figure 22 FieldConnex® Segment Protector: Short circuit limitation and intrinsically safe explosion protection at each spur.

For more details on DART Fieldbus, see "DART Fieldbus Components" as well as the "Application Guideline" in the "Technology" section, and the "Selection Guideline" for FOUNDATION Fieldbus H1.



Figure 23 Segment Protector in aluminum housing with LEDs visible from the outside

Receptacles for Test Connectors

Most Segment Protectors have a choice of trunk and spur connectors fitted with plugs or spring clamp terminals. More recent Segment Protectors feature removable terminals with retaining screws and test plug sockets.

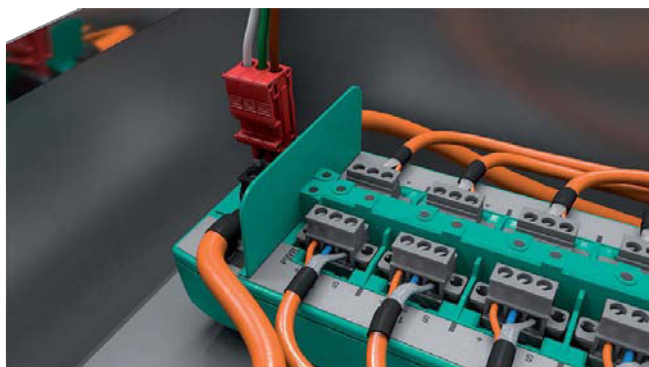


Figure 24 R2 Segment Protector: LED indicators, short circuit current limitation at each spur, removable terminals with retaining screws, and sockets for test plugs.

Trunk with T-Connector

Segment Protectors as of version R2-SP-N* feature a T-connector on the trunk line delivered with a terminator already in place. This is a simple, yet intuitive and reliable way of ensuring proper termination:

- When installed, the T-connector is attached to the trunk cable. The terminator is in place.
- When looping to the next Segment Protector in the same or another enclosure, the terminator has to be removed. The terminator on the next T-connector is already installed.

Even the Segment Protector itself can be exchanged without interfering with communication on the trunk.

Type	T-connector	Spring-Clamp Terminals	Plug-in Terminals	Plug-in Terminals with Retaining Screws	Explosion Protection	Installation in	Devices in
R2-SP-N*	X			X	Ex ic Ex nL	Zone 2 Div. 2	Zone 2 Div. 2
R2-SP-IC	X			X	Ex nAc	Zone 2 Div. 2	Zone 1 Div. 1
RM-SP*			X		Ex nL	Zone 2 Div. 2	Zone 2 Div. 2
R-SP-E12		X			Ex d	Zone 1	Zone 1
R3-SP-IBD12	X			X	Ex ib	Zone 1	Zone 1

Table 3 Attributes and selection criteria of Segment Protectors



Figure 25 The T-connector designed by Pepperl+Fuchs allows for easy and fault-free installation.

With its innovative design, the R2-SP-N* Segment Protector series is the result of more than a decade's experience of using fieldbus technology for superior availability.

For enclosures with a degree of protection up to IP66 or equivalent Enclosure Type Rating, see "Fieldbus Junction Box Housing Solutions" in this section.

Junction Box

Simple junction boxes are used for connections in fieldbus installations where manual intervention is typically only required offline, e.g., while the plant is set into service mode.



Figure 26 Simple junction box with IP67 for general purpose and intrinsically safe installation.

FieldConnex® junction boxes F2-JB-* come with our declaration as associated apparatus for hazardous area Zone 1 (Div. 2). They can be operated together with intrinsically safe fieldbus power supplies.

See description of aluminum housings for more information.

Fieldbus Junction Box Housing Solutions

Our wide range of FieldConnex® Fieldbus Junction Boxes are manufactured in-house to guarantee superior consistency and quality. Pre-engineered products are popular due to the many choices and options. They accommodate practically all requirements from the process industry. The FieldConnex® Fieldbus Junction Boxes are pre-wired and host device couplers and accessories. They are ready to install on site, reducing installation cost and time.

For hazardous areas, the Fieldbus Junction Box comes with a certificate for Zones 1/2/21/22 and Class I, Div. 2.

For special requirements, our engineering department is prepared to build custom-tailored solutions according to your needs.

Stainless Steel

Our stainless steel enclosures are the sturdiest and most impact-resistant on the market today. They are an ideal choice for environments requiring frequent washing of the equipment. They offer fully watertight seals and are the perfect choice for highly corrosive areas where standard enclosures would not remain tight. Stainless steel enclosures are available with degree of protection rating IP67 and Type 6.



Figure 27 Stainless steel enclosure with three FieldBarriers, a terminator, and pre-wired trunk connections.

Polyester

Glass fiber reinforced polyester (GRP) Fieldbus Junction Boxes are the perfect choice where low weight or costs are required. They represent an ideal solution for most installations that require a degree of protection rating of up to IP66 and Type 4X.



Figure 28 GRP enclosure with a pre-installed R2 Segment Protector

Aluminum

The FieldConnex® F2* Fieldbus Junction Boxes are compact, lightweight, and sturdy. For non-corrosive environments, aluminum enclosures are an even more economical choice. They are the best match for most installations that require degree of protection ratings IP67 and Type 4X.

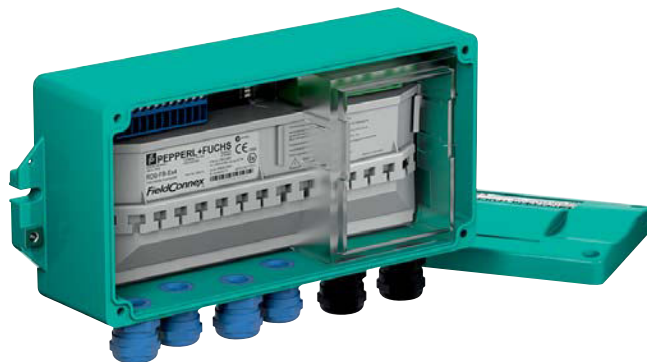


Figure 29 Very space-saving: FieldBarrier in an aluminum enclosure.

See the respective datasheets for complete choices of cable glands and options available.



DART Fieldbus Components



FieldConnex® DART Fieldbus implements the intrinsically safe High-Power Trunk Concept. It provides the power to drive long segments and supplies a high number of field instruments. At the same time, the trunk remains intrinsically safe. DART Fieldbus consists of DART Power Hubs and DART Segment Protectors.

For a complete description of DART technology and operation, see the "Technology" section.

Components for DART Fieldbus are certified Ex ib IIC allowing installation in Zone 1 and gas group IIC.

The DART Power Hub is based on the FieldConnex® High-density Power Hub. It provides power to the segment and features connections to the control system. Due to the DART technology, the Power Hub detects a spark before it occurs and switches it off.



Figure 30 DART Power Hub: redundant Power Supply Modules and intrinsically safe energy limitation.

The DART Segment Protector (type R3-SP*) has a similar design as the R2-SP* Segment Protector and provides the same features.

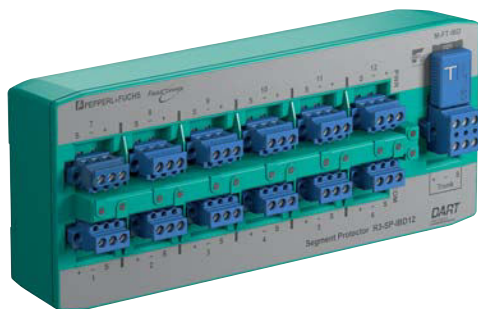
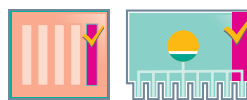


Figure 31 DART Segment Protector –Short circuit protection and Zone 1 certified terminator.

The segment retains its intrinsically safe rating when equipment is connected that is intrinsically safe (Ex ia), e.g., measurement tools. However, for DART to operate properly, only components listed in the certificate are permitted on the trunk.

Advanced Diagnostics



The fieldbus physical layer becomes a proactively manageable asset with the Advanced Diagnostic Module (ADM). The ADM automates

commissioning and documentation, monitors the segment online, and identifies even gradually occurring faults in real time.

Advanced Diagnostics is designed to support three practical tasks or use cases: commissioning, monitoring, and troubleshooting.

Three use cases for Advanced Diagnostics are described in the "Technology" section.

Modules and Hardware

The FieldConnex® Advanced Diagnostic Module (ADM) for the FieldConnex® Power Hub system provides real-time monitoring and local data storage of physical layer values for up to four segments. It automatically triggers alarm messages and communicates with the operator and maintenance station, enabling access for commissioning, monitoring, and troubleshooting.

Passive input circuits leave the physical layer unchanged, providing true, exact measurements. The ADM detects gradual or sudden changes and helps trace even intermittent malfunctions. It can be configured to monitor each segment closely.

Three versions are available for different types of applications and use cases:

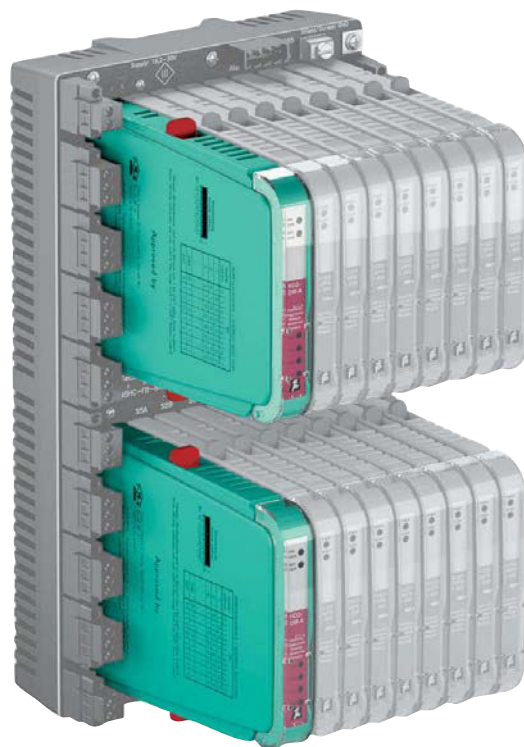


Figure 32 Stationary ADM (HD2-DM-*) plugs into the FieldConnex® Power Hub. It monitors up to four segments online and in real time.

Advanced Diagnostic Module

The Advanced Diagnostic Module plugs into the FieldConnex® Power Hub. Full measurement capabilities for four segments make this module the best choice for providing highest plant availability and the lowest commissioning and maintenance costs.

Advanced Diagnostic Module with Relay Output

Advanced Diagnostic Module with relay output only. Working without a software interface, physical layer monitoring starts by plugging in the module without any extra engineering. Optionally, the user can set warning thresholds via DIP switches. The module reports unwanted conditions via voltage-free contact. In combination with the mobile ADM, this is an economical tool for commissioning and troubleshooting.

Basic Diagnostic Module

The Basic Diagnostic Module monitors the fieldbus Power Hub health status only and issues warnings via a voltage-free contact.

Additional options and applications are the stand-alone motherboard and the mobile version of the ADM:



Figure 33 Stationary ADM on stand-alone motherboard for retrofitting any segment.

Stand-alone Advanced Diagnostics

In combination with a stand-alone motherboard, the HD2-DM-A provides full function diagnostics. It can be wired to any segment in parallel to the existing power supply and includes remote software support via the Diagnostic Manager. This is the ultimate choice for retrofitting any existing fieldbus installation.



Figure 34 Mobile ADM DM-AM-KIT for the traveling fieldbus professional.

Mobile Advanced Diagnostic Module

The mobile ADM is made for the traveling fieldbus practitioners. This full-fledged tool supports all working procedures throughout the complete lifecycle of a segment. Featuring a USB connection for power and communication with any laptop, the mobile ADM is intended for work in the field. Connected to any 24 V power supply, it can even be left unattended while monitoring a troubled segment.

Diagnostic Gateway

A gateway provides full access to up to 62 stationary ADMs via Ethernet and up to 16 ADMs via FF-node integration and EDDI. It connects the ADMs to higher-level control systems. Inside the control cabinet, a simple bus provides the bandwidth for physical layer diagnostic information. Thus, the bandwidth of the fieldbus itself remains untouched.



Figure 35 Gateway KT-MB-GT2AD to fieldbus diagnostic information

Optional inputs and outputs for analog and digital measurements and two high-power control outputs are designed for cabinet control. Even a humidity sensor is on board. The gateway can be configured as a local controller activating heaters, fans, or air-conditioning. Door contacts allow for alarming unauthorized access.

For a brief description of DCS integration, see below and the manual for full details.

Diagnostic Manager Software

The Diagnostic Manager, Professional Edition is the software program that displays the data of the ADM and runs the functions that make working with fieldbus quick and easy. The Diagnostic Manager automatically detects the Diagnostic Gateways and all Advanced Diagnostic Modules. The system is set up in minutes.

The Diagnostic Manager communicates simultaneously with all diagnostic modules. It runs on a PC in the safety of the control room. Multiple PCs running the Diagnostic Manager can access diagnostic information simultaneously, enabling a flexible distributed architecture.

Embedded in the Diagnostic Manager software is an expert system. This system learns and interprets the electrical values and behavior of each segment. A commissioning wizard documents a complete segment with only a few mouse clicks.

For fieldbus experts: The integrated oscilloscope triggers fieldbus-related events and stores up to ten consecutive shots. Working with fieldbus has never been easier.

A basic edition is available for free in the download section of www.pepperl-fuchs.com. It provides immediate access for reading and monitoring the physical layer for up to three ADMs simultaneously.

See the manual for full details on the Diagnostic Manager.

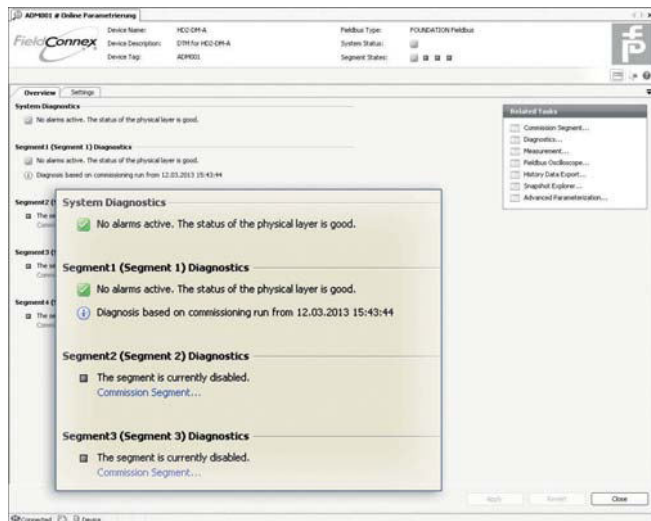


Figure 36 Summary views highlight enqueued tasks and issues with the fieldbus layer. They are easy to understand even for the installation and instrument professional with little fieldbus experience.

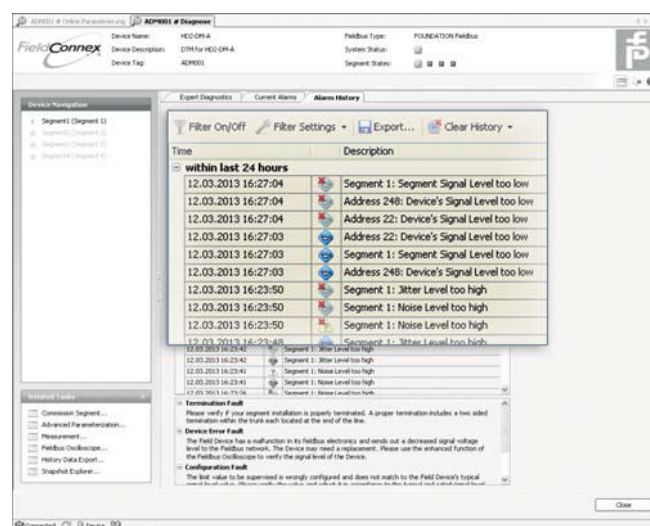


Figure 37 Alarm lists with time stamps and plain text messages provide insight into actual faults.

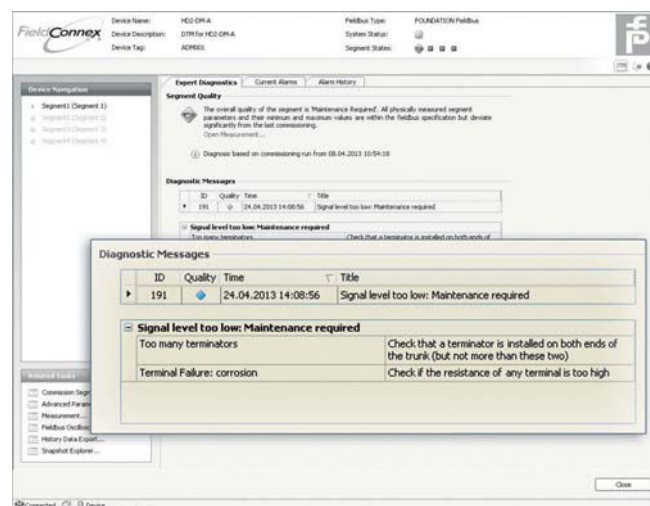


Figure 38 Clearly visible indicators guide the user. The expert system provides interpretation in easy-to-understand text.

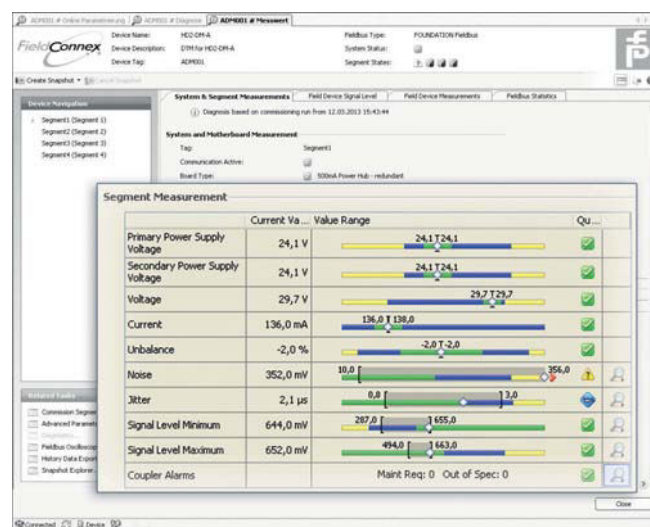


Figure 39 Live monitoring with clearly delineated boundaries shows the physical layer health per segment and per instrument.

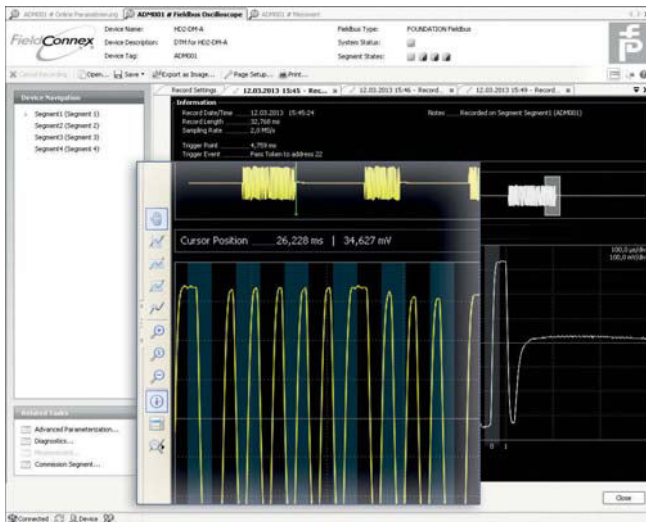


Figure 40 A fieldbus oscilloscope shows the signal as it is. This often helps the fieldbus expert to draw additional conclusions.

The Diagnostic Bus

FieldConnex® Advanced Diagnostics is equipped with a dedicated diagnostic bus. It provides the bandwidth for data transmission from the ADMs to the maintenance and operator station, without compromising the bandwidth of the respective segment. The diagnostic bus is the major prerequisite for any Advanced Diagnostics with value-added tools such as:

- Commissioning wizard
- Expert system
- Fieldbus oscilloscope
- Historian

The engineering and commissioning are quick and easy. FieldConnex® Power Hubs already include the dedicated diagnostic bus based on RS 485 hardware. Short linking cables (ACC-MB-HDC) connect adjacent motherboards. This is the economical and convenient way for engineering advanced physical layer diagnostics.

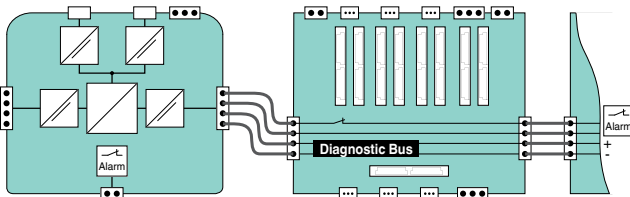


Figure 41 A dedicated, automatically configured diagnostic bus takes care of transmitting data to and from the ADMs.

Each cabinet is fitted with a Diagnostic Gateway (KT-MB-GT2AD) that can connect two diagnostic busses and alarm lines for the voltage-free common alarm contact. From here, it is connected to the existing Ethernet backbone.

System Integration into DCS

FieldConnex® Advanced Diagnostics includes DCS integration for major DCS vendors. Integration for further vendors is underway. Integration packages with automatic setup are currently available for free for:

- Yokogawa – PRM
- Emerson – AMS Suite
- Honeywell – Experion PKS ABB 800xA

The Diagnostic Manager is also tested and approved for popular DTM frames, for example:

- FieldCare (Endress+Hauser)
- FieldMate (Yokogawa)
- PACTware™

The Diagnostic Manager also provides an OPC interface for integration of common alarms into any DCS.

FF-H1 node integration of up to 16 ADMs / 64 segments is available with the Advanced Diagnostic Gateway.

For an up-to-date list, compatibility information, and free downloads go to the Pepperl+Fuchs website at <http://www.pepperl-fuchs.com>

Process Interfaces



The FieldConnex® process interfaces integrate simple conventional inputs and outputs into the DCS via fieldbus communication. On the fieldbus side, they act as transmitters. The output connections provide power for low-power valves, sensors, or conventional signals with no additional wiring required. Multiple I/Os are connected to the DCS via one fieldbus address. Types of sensors include:

- Proximity switches
- On/off low-power valves
- Digital inputs
- Temperature sensors
- Other simple I/Os

The process interface can be installed close to the sensors in Zone 1/Class I, Div. 2. The sensors themselves can be located in Zone 0/Class I, Div. 1.

Integration into the DCS is automated via standard EDDL or FDT/DTM technology. This is a simple and standardized way to keep engineering costs to a minimum. Using process interfaces is a cost-effective solution to bring simple I/O signals into the DCS. Choices of housing materials and types and custom-built cabinets enable an optimum application within the topology of your plant.

Valve Coupler

The valve coupler connects up to four low-power solenoid valves and positioning sensors to the DCS via a single fieldbus address. A detailed list of compatible valves can be found online on the respective datasheets. The valve coupler allows for remote operation of the valve and monitoring with two end-position sensors.

In addition, the valve coupler provides the following functions:

- Measuring and storing actual values for break-away and runtime per valve
- Storing maximum and minimum values
- Conducting partial stroke tests in either valve position

It generates alarm messages for preset limit values, lead breakage, or short circuits on the cable. Information is immediately accessible and allows for proactive user intervention to avoid unwanted conditions such as stuck valves.

The valve coupler is certified as intrinsically safe for installation in Zone 1. Inputs and outputs can be located in Zone 0.

The two end position sensors per valve can be accessed via one cable. The respective inputs of the valve coupler can be used as an eight-channel DI block.

Pre-configured solutions such as the FieldConnex® pneumatic interface combine multiple valve couplers, solenoid and amplifier valves, and a FieldBarrier in one convenient and easy-to-install housing. The pneumatic interface controls up to 32 valves via one fieldbus cable and pressurized air. Contact your Pepperl+Fuchs representative for details.

Selection Table

Type Code	Function	Inputs	Outputs	Terminals	Degree of protection	Installation in	I/O in
FD0-VC-Ex4.FF	Valve Coupler	8 DI	4 DO		IP65	Zone 1/Div. 2	Zone 0/Div. 1
F.VC0.P21.A04.*.*.*.*.*000	Valve Coupler Junction Box	8 DI	4 DO		IP66, NEMA 4X	Zone 1, Zone 21	Zone 0
F.VC0.S20.A04.*.*.*.*.*000	Valve Coupler Junction Box	8 DI	4 DO		IP66, NEMA 4X	Zone 1, Zone 21	Zone 0
RD0-TI-Ex8.FF.SC	Temperature Input	8 AI		Spring clamp	IP20	Zone 1/Div. 2	Zone 0/Div. 1
RD0-TI-Ex8.FF.ST	Temperature Input	8 AI		Screw terminal	IP20	Zone 1/Div. 2	Zone 0/Div. 1
F.TI0.P12.*08.F.0.*.*.*.*00	Temperature Interface Junction Box	8 AI		Screw terminal	IP66, NEMA 4X	Zone 1, Zone 2, Zone 21, Zone 22	Zone 0
F.TI0.S12.*08.F.0.*.*.*.*00	Temperature Interface Junction Box	8 AI		Screw terminal	IP66, NEMA 4X	Zone 1, Zone 2, Zone 21, Zone 22	Zone 0

Table 7 Type code selection table for process interfaces



Figure 42 FieldConnex® process interfaces: Connect simple digital and analog I/O to the DCS via fieldbus.

Temperature Multi-Input Device

The FieldConnex® Temperature Multi-Input Device (TMI) is a fieldbus communication and wiring interface for up to eight analog signals. It provides the necessary intrinsically safe power for the operation of sensors in hazardous area Zone 0/ Div 1.

Via a single fieldbus address, the TMI transmits all eight signals to the DCS system in an efficient and cost-effective way. It matches a wide variety of sensors. The following types of devices and signals can be connected:

- Resistive temperature sensors, includes 2-, 3-, and 4-wire versions
- Thermocouples
- Other resistance and millivolt signals

The following features are important for fieldbus integration and superior plant performance:

- Individual parameter sets per input
- Short update cycles
- Cold junction compensation
- Continuous monitoring of sensor and wire
- Transmission via up to eight AI or one MAI function blocks
- Input potential separation

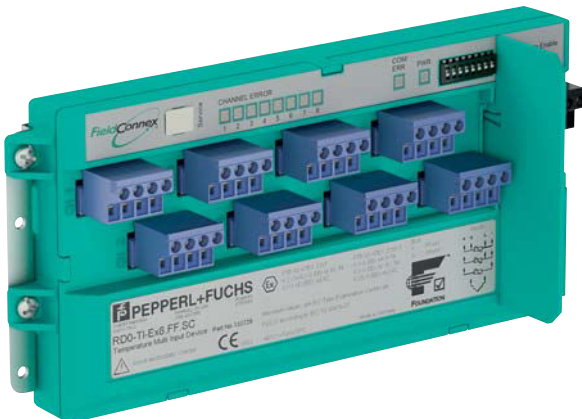


Figure 43 Temperature Multi-Input Device

Accessories



Accessories for FieldConnex® are terminators and surge protectors. They are available in two basic forms: IP20-proof DIN-rail-mountable and in an IP67-proof sturdy stainless steel housing.

Other products such as power supplies come with their own set of accessories (grounding rail, connector cables, ...). For more information on these products, refer to the respective data sheets at www.pepperl-fuchs.com.

Diagnostic-Enabled Accessories

Diagnostic-enabled accessories such as selected surge protectors and enclosure leakage sensors communicate alarm information to the DCS. Depending on their mounting position, diagnostic-enabled accessories can communicate with the affected spur, field device, or device coupler.

Data is transmitted to the DCS in parallel to regular fieldbus communication utilizing the existing Advanced Diagnostics infrastructure. The accessories do not require a fieldbus address. Implementation is plug-and-play and extra engineering or planning is not required.

Surge Protectors

FieldConnex® surge protection modules protect field instruments, control systems, and the fieldbus infrastructure from damage through overvoltage and power surges. Possible causes for power surges are: lightning strikes, surges, or cross-talk from power cables. The surge protector drains the power surge to the earth potential. The surge protector consists of multiple gas discharge tubes (GDT) and is connected to the fieldbus lead, optionally with a shield and earth potential. During normal operation, the GDT constitutes an open circuit. In case of a power surge, the GDT short circuits briefly, eliminating the power surge to earth potential.

Terminal Mounting

These surge protectors fit on Power Hubs and device couplers. They sense the impact of each lightning strike. The surge protectors indicate need for replacement via Advanced Diagnostics, superseding the demand for recurring manual inspection. This feature is available with no engineering required. Retrofit on existing installations is possible without the diagnostics option.

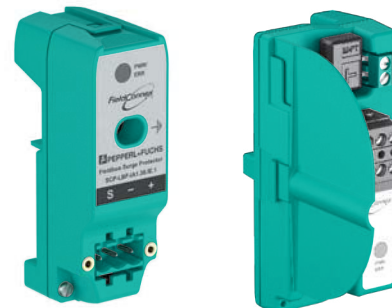


Figure 44 Surge protectors for trunk and spur. Hook on Power Hub or Segment Protector without extra wiring.

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

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Self Diagnostics for Surge Protector

Selected surge protectors monitor count and severity of overvoltage spikes endured over their lifetime. The results are then transmitted via Advanced Diagnostics to the maintenance station.

Replacement takes place only once the surge protector is worn out. This saves on replacement costs and otherwise necessary manual checks.

DIN Rail Mounting

FieldConnex® surge protectors enable the coordinated use in an EMC-oriented Lightning Protection Zones Concept in accordance with IEC 61312-1. They are in accordance with the fieldbus standard IEC 61158-2 and are certified as intrinsically safe according to IEC 60079-11 including DART Fieldbus.

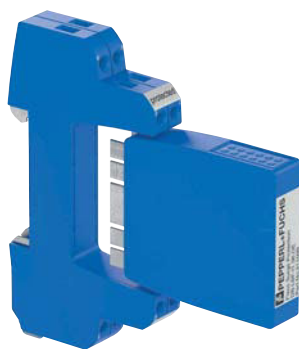


Figure 45 Surge protector for cabinet installation with click-to-latch plug-in design.

The surge protector for cabinet installation consists of a base and a plug-in unit. The base module is mounted on the DIN rail. It holds the plug-in module via an easy-to-operate locking mechanism. Firm contact increases the reliability of the unit and increases plant up-time. The base module comes in two versions, differing in the behavior upon removal of the plug-in module. Either the segment remains connected or it is disconnected.

The plug-in module contains the gas discharge tubes, and is available in two versions for different types of shielding and grounding:

1. Shield tied directly to earth. This module is applied where the central grounding point is located, typically in the cabinet. The module serves as the central grounding point for the segment. It is used in the field where multi-point grounding is applied.
2. Shield tied to earth via gas discharge tube (GDT). This version is used for field installation, where the shield has no direct connection to local earth. (that is, the shield is floating or capacitive grounding is used).

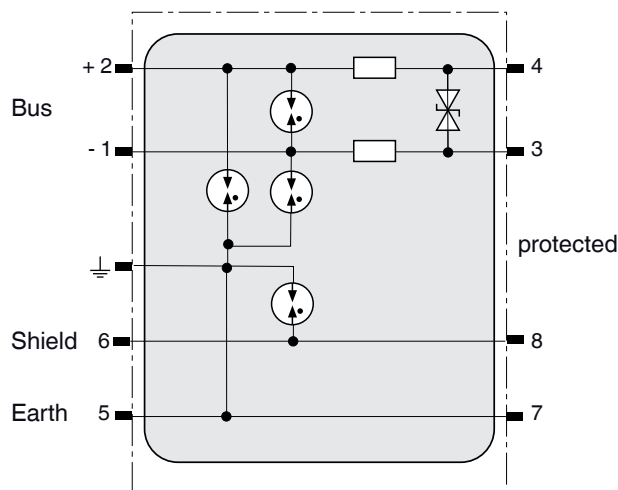


Figure 46 Typical schematic view of a surge protector with gas discharge tubes between +, -, shield, and earth.

The fieldbus planner decides which module fits the installation and maintenance requirements of the customer site best in each case.

Terminator

A fieldbus terminator is an electronic component with two basic functions:

1. It provides the impedance to suppress signal reflections.
2. It translates data signals that are transmitted as current change into a detectable voltage change as specified in the fieldbus standard IEC 61158-2.

One terminator is required at each end of the fieldbus trunk. FieldConnex® power supplies and device couplers carry integrated fieldbus terminators. If required, a separate "external" terminator can help to provide visibility to the installation and maintenance team, thus reducing the potential for human error.

See the description of Manchester bus-powered encoding in the "Technology" section for a thorough description.

FieldConnex® terminators feature a high-availability design with a resistor and multiple capacitors. Only a minor change in impedance results from the failure of a capacitor, leaving the basic function intact. This change in impedance is detected through online monitoring with the Advanced Diagnostic Module, allowing for corrective action before plant performance is jeopardized.

Sturdy Housings for Terminators or Surge Protectors

For field installation, stainless steel housings with IP67 degree of protection feature a choice of threads.

FieldConnex® includes devices in sturdy IP67 housings designed for installation of terminators or surge protectors in hazardous areas. These units come with a choice of threads and offer explosion protection.



Figure 47 Terminator or surge protector for field installation – the threading can be chosen.

Enclosure Leakage Sensor

Small amounts of water or liquid chemicals can be damaging to fieldbus installation materials such as connectors and electronic components. The enclosure leakage sensor detects water ingress and signals the affected spur. Users get a water indicator inside an enclosure directly and without extra engineering – all included with Advanced Diagnostics.

The alarm information reaches the DCS or maintenance station, traveling in parallel to normal fieldbus communication without requiring a fieldbus address. Engineering is all done with the purchase of the component and installing it in parallel to the segment. Getting control of installation issues should always be this simple.



Figure 48 Enclosure Leakage Sensor – small enough to fit into an instrument head.



Selection Tables

Surge Protectors	Explosion Protection	Connection Shield to Earth	Housing for Installation on	Degree of protection	Mount or Thread	Installation in
SCP-LBF-IA1.36.IE.1 ¹	Ex ia	Via GDT	Device coupler	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
SCP-LBF-IA1.36.IE.0	Ex ia	Via GDT	Device coupler	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
TCP-LBF-IA1.36.IE.1 ¹	Ex ia	Via GDT	Device coupler	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
TCP-LBF-IA1.36.IE.0	Ex ia	Via GDT	Device coupler	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
TPH-LBF-IA1.36.DE.1 ¹	Ex ia	Direct	Power Hub	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
TPH-LBF-IA1.36.DE.0	Ex ia	Direct	Power Hub	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
FS-LBF-D1.32	Ex d	None	Cable gland	IP67	M 20	Zone 1/Div. 2
FS-LBF-I1.32	Ex i	None	Cable gland	IP67	M 20	Zone 1/Div. 2
FN-LBF-D1.32	Ex d	None	Cable gland	IP67	½" NPT	Zone 1/Div. 2
FN-LBF-I1.32	Ex i	None	Cable gland	IP67	½" NPT	Zone 1/Div. 2

Table 4 Surge Protector selection table

¹ Requires device couplers with diagnostic function

Surge Protectors for DIN Rail installation	Explosion Protection for DIN Rail installation	Signal Connection	Connection Shield to Earth	Housing for Installation in	Degree of protection	Module Type (1 x base & 1 x plug in required)	Installation in
DB-LBF-I1	Ex i	Continuous		Cabinet	IP20	Base	Zone 1/Div. 2
DP-LBF-I1.36.DE			Direct			Plug-in	
DP-LBF-I.36.IE			Via GDT			Plug-in	
DB-LBF-I1.I	Ex i	Interrupted		Cabinet	IP20	Base	Zone 1/Div. 2
DP-LBF-I1.36.DE			Direct			Plug-in	
DP-LBF-I.36.IE			Via GDT			Plug-in	

Table 5 Surge Protector for DIN rail installation selection table

Continuous: Continuous fieldbus signal for uninterrupted operation during exchange of plug-in module

Interrupted: Interrupting the fieldbus signal. The segment is disconnected during exchange of the plug-in module.

Terminators	Explosion Protection	Housing for Installation on	Degree of protection	Mount or Thread	Installation in
KMD0-FT-Ex	Ex i	DIN Rail	IP67		Zone 1/Div. 2
FN-FT-Ex1.D.IEC	Ex d	Cable gland	IP67	½" NPT	Zone 1/Div. 2
FN-FT-Ex1.I.IEC	Ex i	Field	IP67	½" NPT	
FS-FT-Ex1.D.IEC	Ex d	Field	IP67	M 20	
FS-FT-Ex1.I.IEC	Ex i	Field	IP67	M 20	Zone 1/Div. 2
FP-FT-Ex1.D.IEC	Ex d	Field	IP67	PG 13.5	
FP-FT-Ex1.I.IEC	Ex i	Field	IP67	PG 13.5	Zone 1/Div. 2

Table 6 Terminator selection table

Selection Guideline

This selection guideline takes you through the process of selecting all components of the fieldbus infrastructure, power supply, device coupler, and accessories that are right for your process automation system. It allows selection of system attributes in this order:

- Fieldbus system
- Explosion protection if necessary
- DCS system connection
- Product attributes

Selecting Your FieldConnex® Infrastructure

First, select and verify that the chosen concept for explosion protection is applicable in the hazardous area. See table below.

Second, select the appropriate power supply. There are simplex power supplies and modular power hubs. With Power Hubs, a power supply module must also be selected. Choices for FieldConnex® Advanced Diagnostics are not included in

this part and are handled in separate planning steps. If you would like to apply FieldConnex® Advanced Diagnostics, it is sufficient to select a Power Hub with socket for an Advanced Diagnostic Module.

Decision criteria for a power supply are:

- DCS connections
- Redundancy
- Space requirements
- Attributes contributing to availability

Third, select the device coupler that is right for you. All FieldConnex® device couplers come fitted with housing, prewiring, and accessories. This section lists datasheets for enclosures in various protection ratings and materials.

Methods of Explosion Protection by Hazardous Area

Verify that the type of ignition protection is available for the hazardous area. The following table matches explosion protection applications with chapters from this selection guideline. Although other combinations are possible, the table contains only practical solutions.

Area in which the field devices are located	Intrinsically Safe Trunk and Spurs: Ex ia	High-Power Trunk with FieldBarrier: Spurs Ex ia	Trunk and Spurs Ex ib (DART)	High-Power Trunk with Mechanically Protected Trunk and Spurs Ex d/e	High-Power Trunk with Spurs Ex ic (FISCO)	High-Power Trunk with Spurs Ex ic (Entity)	High-Power Trunk with Spurs Ex nL/Non-Incendive Field Wiring	High-Power Trunk with Non-Incendive Spurs
General Purpose Area	■	■	■	■	■	■	■	■
Zone 2				■	■	■	■	■
Zone 1	■	■	■	■				
Zone 0	■	■						
Class I, Division 2				■	■	■	■	■
Class I, Division 1	■	■						
Page	126	127	129	130	132	134	136	138

General Selection Guidelines

We recommend a FieldConnex® Power Hub Motherboard to fit the DCS connections. This is easy to install as it reduces wiring in the control room cabinet with a design that integrates well with the DCS system.

The DB25 connector of the generic motherboard, *.GEN or *.HSC enables an easy and effective fit to any DCS. Custom cables for connection are provided upon request. Inquire with your local representative or sales office.

- **High-density motherboards MBHD-***
High-density motherboards are a cost-effective solution to fieldbus installations.
- **Compact motherboards MBHC-***
Compact motherboards offer the highest packing density in the cabinet with superior design and low heat dissipation.
- **Universal motherboards MB-***
Universal motherboards offer the largest choice of options, for example CREST. CREST is a passive filtering circuit allowing best transmission of fieldbus signal quality.

Important

In Zone 2/Div. 2 environments, it is vital to select the right combination of power supply and device coupler (Segment Protector). The power supply limits the voltage while the Segment Protector limits the current. On occasion, even the connection and protection of the host interface requires review and certification. Only then is explosion protection ensured at the spur.

Intrinsically Safe Trunk and Spurs: Ex ia

Intrinsically safe power supplies Ex ia are not available for FOUNDATION Fieldbus H1. Refer to Ex ib DART Fieldbus below for a complete solution of intrinsically safe fieldbus infrastructure.

High-Power Trunk with FieldBarrier: Spurs Ex ia

All FieldConnex® power supplies and power modules are applicable. The selection below shows reasonable choices.

Power Hub Motherboard or Power Supply	N° of Segments	Redundant Power Supply	Redundant Host Connection	Slot for Advanced Diagnostics	Packing Density/Size	Power Dissipation per Segment	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBCL-1.500	HD2-FBPS-1.25.360	HD2-FBPS-1.500	HCD2-FBPS-1.500
For Yokogawa AKB 336 system cable													
MBHD-FB1-4R.YO	4	■		■	++	--		F	■		■	■	
MB-FB-4R.YO	4	■	■	■	+	-	■	S	■	■	■	■	
MB-FB-4.YO	4			■	+	-	■	S	■	■	■	■	
MBHC-FB-8R.YO	8	■	■	■	+++	---		F	■				■
For Invensys Foxboro FBM 228													
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	■	■	
FBTA-228-BPFB-8	8				+	-	■	F		■	■	■	
FBTA-228-BPFB-R-4R	4	■	■		+	-	■	F		■	■	■	
FBTA-228-BPFB-R-8R	8	■	■	■	+++	---		F	■				■
For Honeywell C-Series													
MB-FB-4R.HO.SC	4	■	■	■	++	--		F			■	■ ¹	
For any host system													
MBHD-FB1-4R	4	■		■	++	--		F	■	■	■	■	
MB-FB-1R	1	■	■		+	-	■	S	■	■	■	■	
MB-FB-2R	2	■	■	■	+	-	■	S	■	■	■	■	
MB-FB-4R	4	■	■	■	+	-	■	S	■	■	■	■	
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	■	■	
MB-FB-4	4			■	+	-	■	S	■	■	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	■	■	
MBHC-FB-8R	8	■		■	+++	---		F	■				■
MBHC-FB-8R.HSC*	8	■		■	+++	---		F	■				■
MBHC-FB-8R.RH*	8	■	■	■	+++	---		F	■				■
Simplex power supply													
KLD2-FBPS-1.25.360	1				++	-		F		—	—	—	—
KLD2-PC-1.1.IEC	1				++	-		F		—	—	—	—
KLD2-PR-1.IEC (Repeater)	1				++	-		F		—	—	—	—

+ ... +++ Indicates reduced space requirements.

- ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

¹ Separate bulk power supply recommended for segments



Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Current Limitation	Installation in
RD0-FB-Ex4.*	None ¹	4	Ex ia	■	Zone 1/Div. 2
F2D0-FB-Ex4.* (Enclosure)	Aluminum	4	Ex ia	■	Zone 1/Div. 2
F.FB0.S**.A**.1.0.***.***.****	Stainless Steel	4, 8, 12	Ex ia	■	Zone 1/Div. 2
F.FB0.P**.A**.1.0.***.***.****	GRP	4, 8, 12	Ex ia	■	Zone 1/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.

Trunk and Spurs Ex ib (DART)

For DART Fieldbus, only one matching power supply is available.

Power Hub Motherboard or Power Supply	N° of Segments	Redundant Power Supply	Redundant Host Connection	Slot for Advanced Diagnostics	Packing Density/Size	Power Dissipation per Segment	Terminators: Selectable/Fixed	Grounding Bar Available
For Yokogawa AKB 336 system cable								
KT-MB-FB-D-4R.YO	4	■	■	■	++	-	F	■
For Invensys Foxboro FBM 228								
KT-MB-FB-D-4R.GEN	4	■		■	++	-	F	■
For any host system								
KT-MB-FB-D-4R.GEN	4	■		■	++	-	F	■
KT-MB-FB-D-4R	4	■		■	++	-	F	■

+ ... +++ Indicates reduced space requirements.

- ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

Only one device coupler matches this application.

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Current Limitation	Installation in
R3-SP-IBD12	None	12	Ex ib	■	Zone 1



FOUNDATION Fieldbus H1

Selection Guideline

Advanced Diagnostics

Power Supplies

Field Distribution

DART Fieldbus

Process Interfaces

Accessories



High-Power Trunk with Mechanically Protected Trunk and Spurs Ex d/e

All FieldConnex® power supplies and power modules are applicable. The selection below shows reasonable choices.

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Power Hub Motherboard or Power Supply	N° of Segments	Redundant Power Supply	Redundant Host Connection	Slot for Advanced Diagnostics	Packing Density/Size	Power Dissipation per Segment	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.25.360	HD2-FBPS-1.500	HCD2-FBPS-1.500
For Yokogawa AKB 336 system cable												
MBHD-FB1-4R.YO	4	■		■	++	--		F	■	■	■	
MB-FB-4R.YO	4	■	■	■	+	-	■	S	■	■	■	
MB-FB-4.YO	4			■	+	-	■	S	■	■	■	
MBHC-FB-8R.YO	8	■	■	■	+++	---		F	■			■
For Invensys Foxboro FBM 228												
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	■	
FBTA-228-BPFB-8	8				+	-	■	F		■	■	
FBTA-228-BPFB-R-4R	4	■	■		+	-	■	F		■	■	
FBTA-228-BPFB-R-8R	8	■	■	■	+++	---		F	■			■
For Honeywell C-Series												
MB-FB-4R.HO.SC	4	■	■	■	++	--		F		■	■	
For any host system												
MBHD-FB1-4R	4	■		■	++	--		F	■	■	■	
MB-FB-1R	1	■	■		+	-	■	S	■	■	■	
MB-FB-2R	2	■	■	■	+	-	■	S	■	■	■	
MB-FB-4R	4	■	■	■	+	-	■	S	■	■	■	
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	■	
MB-FB-4	4			■	+	-	■	S	■	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	■	
MBHC-FB-8R	8	■		■	+++	---		F	■			■
MBHC-FB-8R.HSC*	8	■		■	+++	---		F	■			■
MBHC-FB-8R.RH*	8	■	■	■	+++	---		F	■			■
Simplex power supply												
KLD2-FBPS-1.25.360	1				++	-		F		—	—	—
KLD2-PR-1.IEC (Repeater)	1				++	-		F		—	—	—

+ ... +++ Indicates reduced space requirements.
 - ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Current Limitation	Installation in
R-SP-E12	None ¹	12	—	■	Zone 1
F.SPE.S**.A**.1.0.***.***.****	Stainless Steel	12, 24	—	■	Zone 1
F.SPE.P**.A**.1.0.***.***.****	GRP	12, 24	—	■	Zone 1

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.



High-Power Trunk with Spurs Ex ic (FISCO)

Special power modules are provided limiting the voltage to $U_o = 17.5 \text{ V}$.

Power Hub Motherboard or Power Supply	N° of Segments	Redundant Power Supply	Redundant Host Connection	Slot for Advanced Diagnostics	Packing Density/Size	Power Dissipation per Segment	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.17.500
For Yokogawa AKB 336 system cable										
MBHD-FB1-4R.YO	4	■		■	++	--		F	■	■
MB-FB-4R.YO	4	■	■	■	+	-	■	S	■	■
MB-FB-4.YO	4			■	+	-	■	S	■	■
For Invensys Foxboro FBM 228										
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■
MB-FB-4.GEN	4			■	+	-	■	S	■	■
For any host system										
MBHD-FB1-4R	4	■		■	++	--		F	■	■
MB-FB-1R	1	■	■		+	-	■	S	■	■
MB-FB-2R	2	■	■	■	+	-	■	S	■	■
MB-FB-4R	4	■	■	■	+	-	■	S	■	■
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■
MB-FB-4	4			■	+	-	■	S	■	■
MB-FB-4.GEN	4			■	+	-	■	S	■	■

+ ... +++ Indicates reduced space requirements.

- ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Current Limitation	Installation in
R2-SP-N*	None ¹	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
F.SP4.S**.B**.1.0.***.***.***0	Stainless Steel	8...24	Ex ic	■	Zone 2/Div. 2
F.SP4.P**.B**.1.0.***.***.***0	GRP	8...24	Ex ic	■	Zone 2/Div. 2
SPJB-**-AL*.***	Aluminum	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-CS*.***	Carbon Steel	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-FB*.***	Fiberglass	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-PCW.***	Polycarbonate	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-SS*.***	Stainless Steel	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.



High-Power Trunk with Spurs Ex ic (Entity)

Special power modules are provided limiting the voltage $U_o = 24\text{ V}$.

Power Hub Motherboard or Power Supply	N° of Segments	Redundant Power Supply	Redundant Host Connection	Slot for Advanced Diagnostics	Packing Density/Size	Power Dissipation per Segment	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.23.500	HCD2-FBPS-1.23.500
For Yokogawa AKB 336 system cable											
MBHD-FB1-4R.YO	4	■		■	++	--		F	■	■	
MB-FB-4R.YO	4	■	■	■	+	-	■	S	■	■	
MB-FB-4.YO	4			■	+	-	■	S	■	■	
MBHC-FB-8R.YO	8	■	■	■	+++	---		F	■		■
For Invensys Foxboro FBM 228											
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	
For any host system											
MBHD-FB1-4R	4	■		■	++	--		F	■	■	
MB-FB-1R	1	■	■		+	-	■	S	■	■	
MB-FB-2R	2	■	■	■	+	-	■	S	■	■	
MB-FB-4R	4	■	■	■	+	-	■	S	■	■	
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	
MB-FB-4	4			■	+	-	■	S	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	
MBHC-FB-8R	8	■		■	+++	---		F	■		■
MBHC-FB-8R.HSC*	8	■		■	+++	---		F	■		■
MBHC-FB-8R.RH*	8	■	■	■	+++	---		F	■		■

+ ... +++ Indicates reduced space requirements.

- ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Current Limitation	Installation in
R2-SP-N*	None ¹	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
F.SP4.S**.B**.1.0.***.***.***0	Stainless Steel	8...24	Ex ic	■	Zone 2/Div. 2
F.SP4.P**.B**.1.0.***.***.***0	GRP	8...24	Ex ic	■	Zone 2/Div. 2
SPJB-**-AL*.***	Aluminum	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-CS*.***	Carbon Steel	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-FB*.***	Fiberglass	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-PCW.***	Polycarbonate	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-SS*.***	Stainless Steel	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.

High-Power Trunk with Spurs Ex nL/Non-Incendive Field Wiring

Special power modules are provided that limit the voltage. Match the voltage output to the respective input voltage of the field instrument.

Power Hub Motherboard or Power Supply	N° of Segments	Redundant Power Supply	Redundant Host Connection	Slot for Advanced Diagnostics	Packing Density/Size	Power Dissipation per Segment	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.17.500	HD2-FBPS-1.23.500	HCD2-FBPS-1.23.500
For Yokogawa AKB 336 system cable												
MBHD-FB1-4R.YO	4	■		■	++	--		F	■	■	■	
MB-FB-4R.YO	4	■	■	■	+	-	■	S	■	■	■	
MB-FB-4.YO	4			■	+	-	■	S	■	■	■	
MBHC-FB-8R.YO	8	■	■	■	+++	---		F	■			■
For Invensys Foxboro FBM 228												
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	■	
FBTA-228-BPFB-8	8				+	-	■	F		■	■	
FBTA-228-BPFB-R-4R	4	■	■		+	-	■	F		■	■	
FBTA-228-BPFB-R-8R	8	■	■	■	+++	---		F	■			■
For Honeywell C-Series												
MB-FB-4R.HO.SC	4	■	■	■	++	--		F		■	■	
For any host system												
MBHD-FB1-4R	4	■		■	++	--		F	■	■	■	
MB-FB-1R	1	■	■		+	-	■	S	■	■	■	
MB-FB-2R	2	■	■	■	+	-	■	S	■	■	■	
MB-FB-4R	4	■	■	■	+	-	■	S	■	■	■	
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	■	
MB-FB-4	4			■	+	-	■	S	■	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	■	
MBHC-FB-8R	8	■		■	+++	---		F	■			■
MBHC-FB-8R.HSC*	8	■		■	+++	---		F	■			■
MBHC-FB-8R.RH*	8	■	■	■	+++	---		F	■			■

+ ... +++ Indicates reduced space requirements.

- ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Current Limitation	Installation in
R2-SP-N*	None ¹	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F.SP4.S**.B**.1.0.***.***.***0	Stainless Steel	8...24	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F.SP4.P**.B**.1.0.***.***.***0	GRP	8...24	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-AL*.***	Aluminum	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-CS*.***	Carbon Steel	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-FB*.***	Fiberglass	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-PCW.***	Polycarbonate	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-SS*.***	Stainless Steel	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F2-JBSC-* (Aluminum Enclosure)	Aluminum	4, 6, 8	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
RM-SPTM-N2 (Trunk Module)	None ¹	2	Ex nL	■	Zone 2/Div. 2
RM-SPEM-N4 (Extension Module)	None ¹	4	Ex nL	■	Zone 2/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.



High-Power Trunk with Non-Incendive Spurs

All FieldConnex® power supplies and power modules are applicable. The selection below shows reasonable choices.

FOUNDATION Fieldbus H1

Selection Guideline

Advanced Diagnostics

Power Supplies

Field Distribution

DART Fieldbus

Process Interfaces

Accessories

Power Hub Motherboard or Power Supply	N° of Segments	Redundant Power Supply	Redundant Host Connection	Slot for Advanced Diagnostics	Packing Density/Size	Power Dissipation per Segment	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.25.360	HD2-FBPS-1.500	HCD2-FBPS-1.500
For Yokogawa AKB 336 system cable												
MBHD-FB1-4R.YO	4	■		■	++	--		F	■	■	■	
MB-FB-4R.YO	4	■	■	■	+	-	■	S	■	■	■	
MB-FB-4.YO	4			■	+	-	■	S	■	■	■	
MBHC-FB-8R.YO	8	■	■	■	+++	---		F	■			■
For Invensys Foxboro FBM 228												
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	■	
FBTA-228-BPFB-8	8				+	-	■	F		■	■	
FBTA-228-BPFB-R-4R	4	■	■		+	-	■	F		■	■	
FBTA-228-BPFB-R-8R	8	■	■	■	+++	---		F	■			■
For Honeywell C-Series												
MB-FB-4R.HO.SC	4	■	■	■	++	--		F		■	■	
For any host system												
MBHD-FB1-4R	4	■		■	++	--		F	■	■	■	
MB-FB-1R	1	■	■		+	-	■	S	■	■	■	
MB-FB-2R	2	■	■	■	+	-	■	S	■	■	■	
MB-FB-4R	4	■	■	■	+	-	■	S	■	■	■	
MB-FB-4R.GEN	4	■		■	+	-	■	S	■	■	■	
MB-FB-4	4			■	+	-	■	S	■	■	■	
MB-FB-4.GEN	4			■	+	-	■	S	■	■	■	
MBHC-FB-8R	8	■		■	+++	---		F	■			■
MBHC-FB-8R.HSC*	8	■		■	+++	---		F	■			■
MBHC-FB-8R.RH*	8	■	■	■	+++	---		F	■			■
Simplex power supply												
KLD2-FBPS-1.25.360	1				++	-		F		—	—	—
KLD2-PR-1.IEC (Repeater)	1				++	-		F		—	—	—

+ ... +++ Indicates reduced space requirements.

- ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Current Limitation	Installation in
R2-SP-N*	None ¹	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F.SP4.S**.B**.1.0.***.***.***0	Stainless Steel	8...24	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F.SP4.P**.B**.1.0.***.***.***0	GRP	8...24	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-AL*.***	Aluminum	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-CS*.***	Carbon Steel	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-FB*.***	Fiberglass	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-PCW.***	Polycarbonate	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-SS*.***	Stainless Steel	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F2-JBSC-* (Aluminum Enclosure)	Aluminum	4, 6, 8	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
RM-SPTM-N2 (Trunk Module)	None ¹	2	Ex nL	■	Zone 2/Div. 2
RM-SPEM-N4 (Extension Module)	None ¹	4	Ex nL	■	Zone 2/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.

Features

- Comprehensive diagnostics for fieldbus physical layer
- Mobile kit for the fieldbus professional
- Precise measurements through passive circuits
- For commissioning and troubleshooting
- Installation in Zone 2/Class I, Div. 2
- Connection to energy limited fieldbus segments Ex nL permissible
- USB interface for PC connection and power supply

Function

Designed for maintenance personnel and traveling fieldbus expert, the FieldConnex® Mobile Advanced Diagnostic Module (ADM) is a comprehensive measurement tool for single segments. It can be set up at any point on the segment. Its passive input circuits leave the physical layer untouched for exact data. The ADM detects gradual or sudden changes and helps trace even intermittent malfunctions.

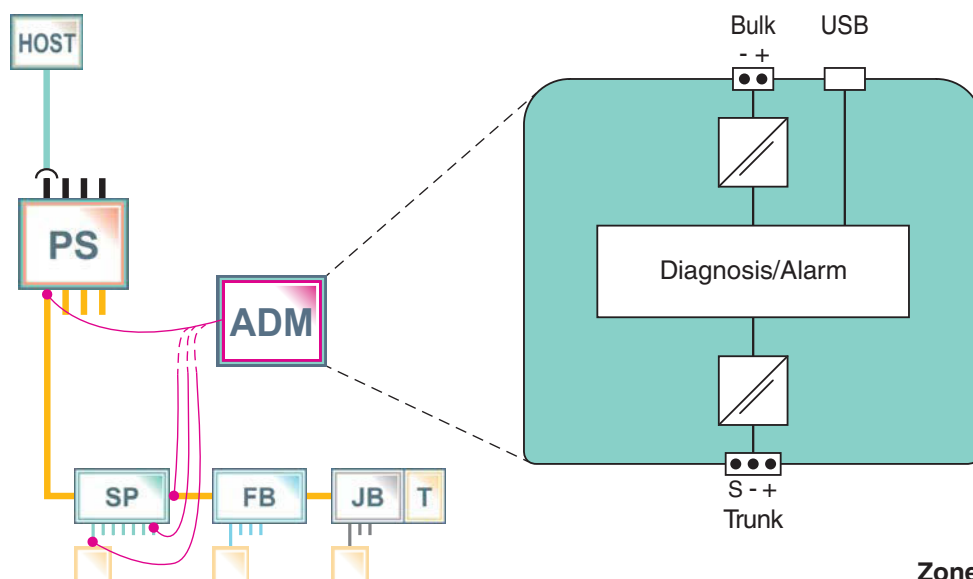
The Mobile ADM primarily supports commissioning and troubleshooting. It is powered via USB 2.0 full-speed port and communicates with any laptop or desktop. In addition, a mounting bracket and connection for an external power supply enable the installation in a cabinet for continuous monitoring without USB connection.

The Diagnostic Manager is the software for display and operation from the safety of the control room. The Professional Edition provides powerful functions and wizards simplifying and automating work procedures: an embedded expert system, a data historian, and a built-in oscilloscope (see datasheet DTM-FC.AD*).

Assembly



Connection



Zone 2/Div. 2

Technical data**Fieldbus interface**

Number of segments

1

Interface

Interface type

USB: square type B socket

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC 60529

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Mechanical specifications

Connection type

fieldbus: removable screw terminals with retaining screws
 external power: removable screw terminals with retaining screws
 USB: square type B socket

Core cross-section

2.5 mm²**Data for application in connection with Ex-areas**

Statement of conformity

TÜV 05 ATEX 2923 X

Group, category, type of protection, temperature class

Ⓔ II 3G Ex nA [nL] IIC T4

Directive conformity

Directive 94/9/EC

IEC 60079-15:2003

Functional Overview**Fieldbus voltage**

The segment voltage is measured in a range of 0 V ... 35 V.

Unbalance detection

A capacitive or resistive short between any fieldbus wire and shield is measured and given in a range between -100 % ... +100 %.
 (-100% = short against - wire, +100% = short against +wire)

Termination

Over- and Undertermination are detected and reported.

Communication level

Node specific communication levels are measured in a range of 0 V ... 2.5 V.

Jitter

Jitter is a measurement for the timing of each bit. Each component connected (power supply, field instrument, cable, ...) to the segment influences jitter. It is an excellent indicator for segment health. The jitter is either segment or device specific measured in a range of 0 µsec ... 8 µsec.

Signal polarity

For each node the polarity of the signal modulation is given.

Noise measurement

The noise is measured in a frequency range between 100 Hz ... 140 kHz. The noise measurement is node address specific to detect device specific noise emission.

Communication errors statistics

Segment-specific error counters e.g. for CRC errors and framing errors are displayed.

Features

- Comprehensive diagnostics for fieldbus physical layer and power supply
- Plug-in Module for the FieldConnex Power Hub
- Precise measurements through passive circuits
- For commissioning, online monitoring and troubleshooting
- Installation in Zone 2/Class I, Div. 2
- System state and fault indication via LEDs
- Display of data in the safety of the control room
- Automatic setup of diagnostic system
- Full software integration into DCS and PAM possible

Function

Designed as a plug-in module for the FieldConnex® Power Hub, this Advanced Diagnostic Module (ADM) is a comprehensive measurement tool for the physical layer of up to four fieldbus segments. Its passive input circuits leave the physical layer untouched for exact data. The ADM detects gradual or sudden changes and helps trace even intermittent malfunctions.

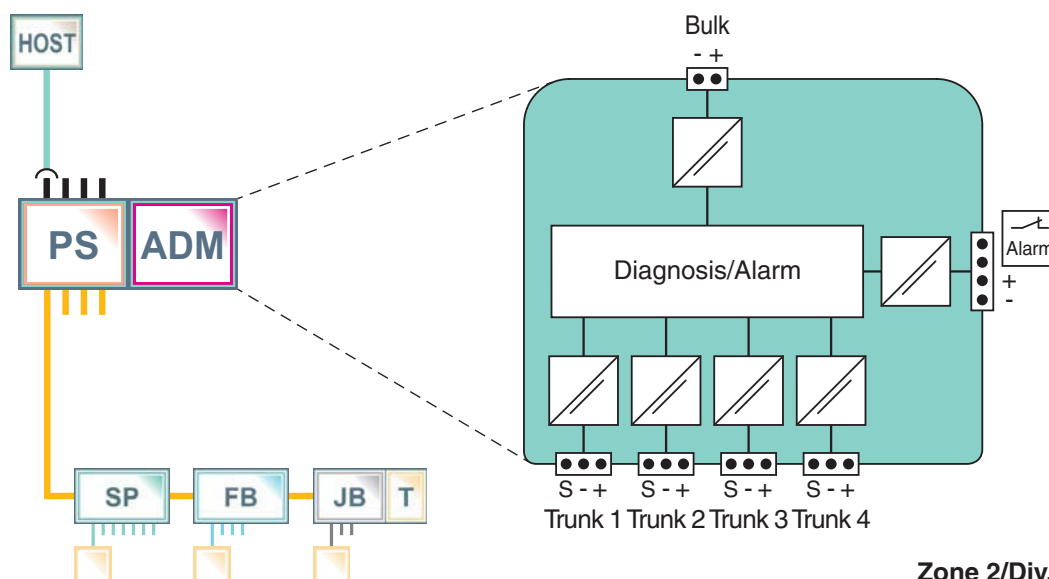
The ADM supports commissioning, online monitoring and troubleshooting. It can be integrated tightly into the DCS and PAM via a separate diagnostic bus, making the fieldbus physical layer itself a manageable asset. Configuration tools automate setup of the ADM and of selected DCS.

The Diagnostic Manager is the software for display and operation from the safety of the control room. The Professional Edition provides powerful functions and wizards simplifying and automating work procedures: Embedded expert system data historian and a built-in oscilloscope are included. (see datasheet DTM-FC.AD*).

Assembly



Connection



Zone 2/Div. 2

Technical data

Fieldbus interface	
Number of segments	4
Indicators/operating means	
Fault signal	VFC alarm 1 A, 50 V DC, normally closed
Interface	
Interface type	diagnostic bus: RS 485
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ambient conditions	
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Mechanical specifications	
Connection type	Motherboard specific
Core cross-section	Motherboard specific
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ⓔ II 3G EEx nA IIC T4
Directive conformity	
Directive 94/9/EC	EN 60079-15:2003
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Functional Overview

Expert system	Built-in expert system interprets behavior of each segment based on rules and gives pointed information in clear text. Precisely diagnosis causes and suggests remedies, which are easy to understand.
Supply input voltage	The supply voltage of the primary and secondary input is measured in a range of 0 V ... 40 V.
Segment power redundancy integrity	The health of the primary and backup fieldbus power supply is monitored. Mismatch of redundancy pairs is detected and causes an alarm.
Fieldbus voltage	The segment voltage is measured in a range of 0 V ... 35 V.
Fieldbus current	The current feed into a fieldbus segment is measured in a range of 0 A ... 1 A depending on the used power supply.
Unbalance detection	A capacitive or resistive short between any fieldbus wire and shield is measured and given in a range between -100% ... +100%. (-100% = short against - wire, +100% = short against +wire)
Termination	Over- and Undertermination are detected and reported.
Signal level	Node specific signal levels are measured in a range of 0 V ... 2.5 V.
Jitter	Jitter is a measurement for the timing of each bit. Each component connected (power supply, field instrument, cable, ...) to the segment influences jitter. It is an excellent indicator for segment health. The jitter is either segment- or device-specifically measured in a range of 0 µsec ... 8 µsec.
Signal polarity	For each node the polarity of the signal modulation is given.
Noise measurement	Noise is measured in a frequency range between 100 Hz ... 140 kHz. Noise measurement is node-address-specific in order to detect device-specific noise.
Oscilloscope function	The built-in oscilloscope is a powerful tool for signal voltage behavior analysis. It allows for analysis of specific frames and occurring communication errors. Trigger conditions, as e. g. different frame types, CRC errors, framing errors are either node-address-specific or unspecific. The frame contents detected in the sampled period are analyzed and shown.
Live list generation	A list of all connected devices and additional status information is generated. The ADM detects initial connection of a device to a segment in operation. A message reminds the user to re-run the commissioning wizard.
Alarm management	For all measured values, either segment- or node-specific, alarm limits exist. In addition, warning limits can be defined. When these limits are violated, alarms are generated.

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

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PROTECTING YOUR PROCESS

Features

- Diagnostics for fieldbus physical layer and power supply
- Plug-in Module for the FieldConnex Power Hub
- Plug and play - no engineering required
- For online monitoring
- Installation in Zone 2/Class I, Div. 2
- System state and fault indication via LEDs
- Alarm limits configurable via DIP switches
- Fault indication transmission by voltage free contact

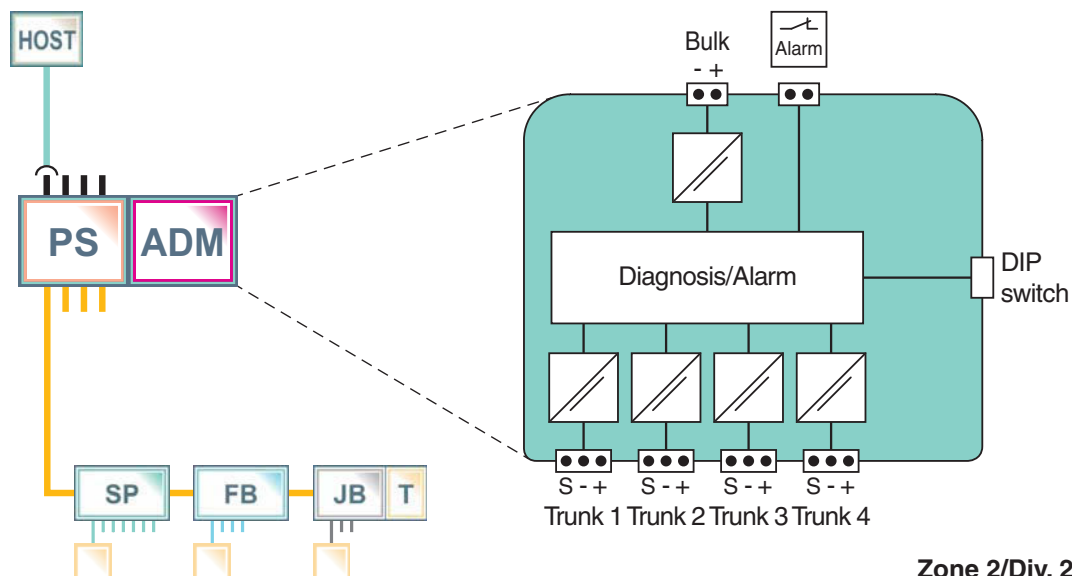
Function

Designed as a plug-in module for the FieldConnex® Power Hub, the Advanced Diagnostic Module (ADM) with relay output is a monitoring tool for the physical layer of up to four fieldbus segments. Passive input circuits leave the physical layer untouched, avoiding alteration of the signal. The ADM indicates unwanted conditions via voltage-free contact. It provides physical layer diagnostics "plug-and-play", without additional engineering. If desired, the values for maintenance and out-of-specification limit ranges are configurable via DIP switches. LED signals indicate that a limit has been exceeded. For commissioning and troubleshooting, a comprehensive diagnostic module such as the FieldConnex(R) mobile ADM (see DM-AM-KIT) is recommended.

Assembly



Connection



Zone 2/Div. 2

Technical data

Fieldbus interface

Number of segments 4

Indicators/operating means

Fault signal VFC alarm 1 A, 50 V DC, normally closed

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Ambient conditions

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Data for application in connection with Ex-areas

Statement of conformity TÜV 04 ATEX 2500 X

Group, category, type of protection, temperature class  II 3G EEx nA II T4

Directive conformity

Directive 94/9/EC IEC 60079-15

Monitored Values Overview

For each value maintenance and out-of-specification limit ranges are configurable via DIP switches.

Jitter

Jitter is a measurement for the timing of each bit. Each component connected (power supply, field instrument, cable, ...) to the segment influences jitter. It is an excellent indicator for segment health. The jitter is either segment- or device-specifically measured in a range of 1.6 µsec ... 4.8 µsec.

Signal Level

The voltage level of the communication signal, node specific measurement.

Noise

Unwanted disturbance. Often caused by overlay of a number of disturbances. Leads to signal deterioration.

Features

- Basic monitoring for power supply output and health
- Plug-in Module for the FieldConnex Power Hub
- Plug and play - no engineering required
- For online monitoring
- Installation in Zone 2/Class I, Div. 2
- System state and fault indication via LEDs

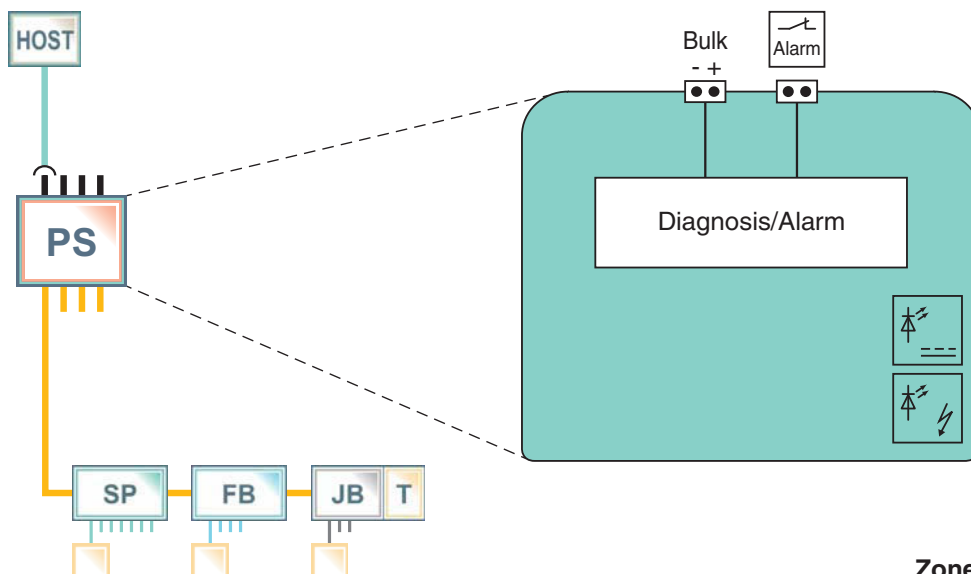
Function

Designed as a plug-in module for the FieldConnex® Power Hub, the Basic Diagnostic Module HD2-DM-B provides basic system diagnostics. It checks for proper operation of bulk power supplies and monitors the connected trunks for overload or short-circuit conditions. All Power Hub modules are checked for proper function. On redundant power modules it indicates mismatching pairs. The module indicates a fault condition via voltage-free contact. It provides monitoring "plug-and-play" without additional engineering. LED signals indicate a fault for easy detection.

Assembly



Connection



Zone 2/Div. 2

Technical data**Indicators/operating means**

Fault signal	VFC alarm 1 A, 50 V DC, normally closed

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC	EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NE 21:2006

Protection degree

IEC 60529

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Ambient conditions**Corrosion resistance**

acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications**Connection type**

Motherboard specific

Core cross-section

Motherboard specific

Data for application in connection with Ex-areas**Statement of conformity**

TÜV 04 ATEX 2500 X

Group, category, type of protection, temperature class

Ex II 3G EEx nA C IIC T4

Directive conformity

EN 60079-15:2003

Directive 94/9/EC**International approvals****FM approval**

CoC 3024816, CoC 3024816C

Approved for

Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nC IIC T4

Features

- Comprehensive diagnostics for fieldbus physical layer
- Module and motherboard for retrofit of any installation
- Precise measurements through passive circuits
- For commissioning, online monitoring and troubleshooting
- Installation in Zone 2/Class I, Div. 2
- System state and fault indication via LEDs
- Display of data in the safety of the control room
- Full software integration into DCS and PAM possible

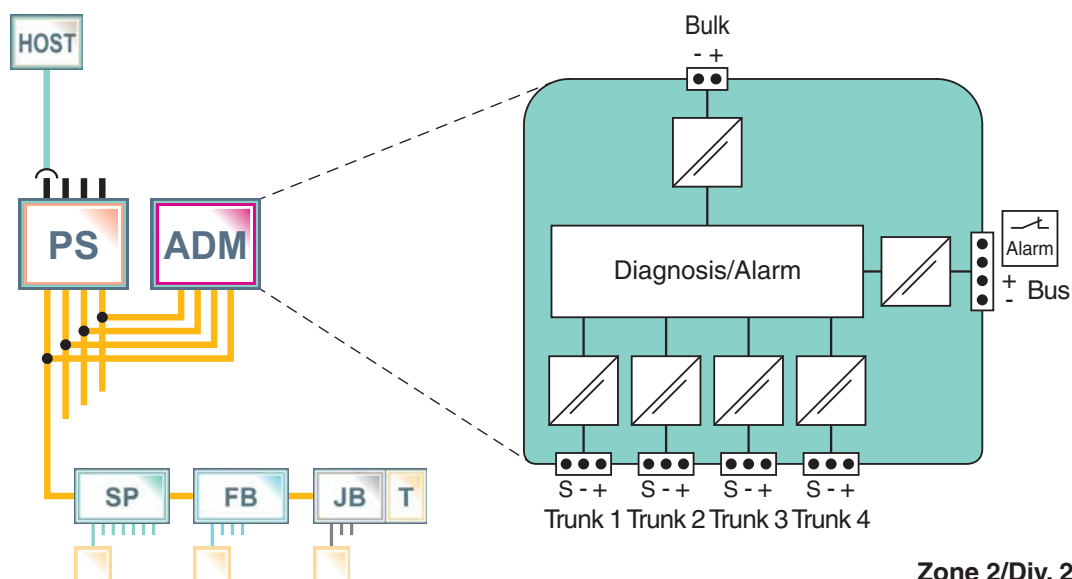
Function

The kit of FieldConnex® Advanced Diagnostic Module (ADM) and motherboard is a comprehensive measurement tool for the physical layer for retrofitting of up to four fieldbus segments. Its passive input circuits leave the physical layer untouched for exact data. The ADM detects gradual or sudden changes and helps trace even intermittent malfunctions. The ADM supports commissioning, online monitoring and troubleshooting. It can be integrated tightly into the DCS and PAM via a separate diagnostic bus, making the fieldbus physical layer itself a manageable asset. Configuration tools automate setup of the ADM and of selected DCS. The Diagnostic Manager is the software for display and operation from the safety of the control room. The Professional Edition provides powerful functions and wizards simplifying and automating work procedures: Embedded expert system data historian and a built-in oscilloscope are included. (see datasheet DTM-FC.AD*).

Assembly



Connection



Zone 2/Div. 2

Technical data**Fieldbus interface**

Number of segments 4

Indicators/operating means

Fault signal VFC alarm 1 A, 50 V DC, normally closed

Interface

Interface type diagnostic bus: RS 485

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Mechanical specifications

Connection type screw terminals

Core cross-section 2.5 mm²**International approvals**

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- System integration kit for Advanced Diagnostics
- DCS integration via Diagnostic Manager or device DTM
- Simple automatic setup of Advanced Diagnostics
- Summary alarm handling

Function

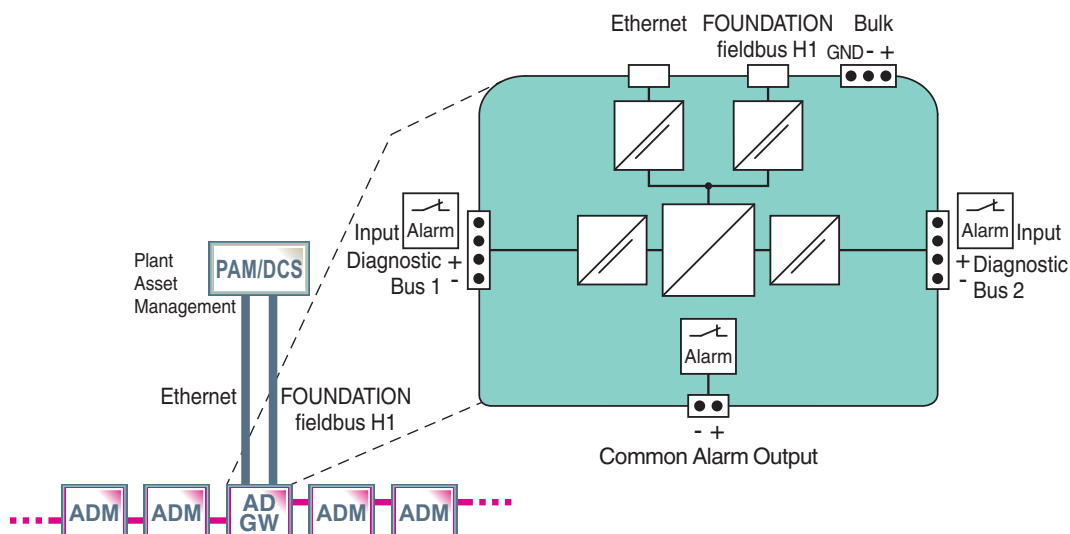
The FieldConnex[®] Diagnostic Gateway is the interface between stationary Advanced Diagnostic Modules (ADM) and the control system. It offers access to all ADM data in two ways: via Ethernet and the Diagnostic Manager software or via FOUNDATION Fieldbus H1 and DTM/EDD or both.

The gateway configures itself and automatically detects the ADMs. The Diagnostic Manager automatically finds gateways on the same subnet. The setup of the diagnostic bus and all connected modules is automatic. This significantly simplifies engineering of FieldConnex[®] Advanced Diagnostics.

Assembly



Connection



Zone 2/Div. 2

Technical data**Ethernet Interface**

Port	100 BASE-TX
Protocol	TCP/IP and UDP/IP
Services	ICMP, DHCP, AutolP, HTTP

Diagnostic Bus

Number of Diagnostic Bus Channels	2
Cable length/Channel	30 m

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Low voltage	
Directive 73/23/EEC	EN 61010

Standard conformity

Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21
Protection degree	IEC 60529
Climatic conditions	DIN IEC 721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ethernet	IEEE 802.3

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- System integration kit for Advanced Diagnostics
- DCS integration via Diagnostic Manager or device DTM
- Simple automatic setup of Advanced Diagnostics
- Alarm handling and integrated I/O for cabinet monitoring/control

Function

The FieldConnex[®] Diagnostic Gateway is the interface between stationary Advanced Diagnostic Modules (ADM) and the control system. It offers access to all ADM data in two ways: via Ethernet and the Diagnostic Manager software or via FOUNDATION Fieldbus H1 and DTM/EDD or both.

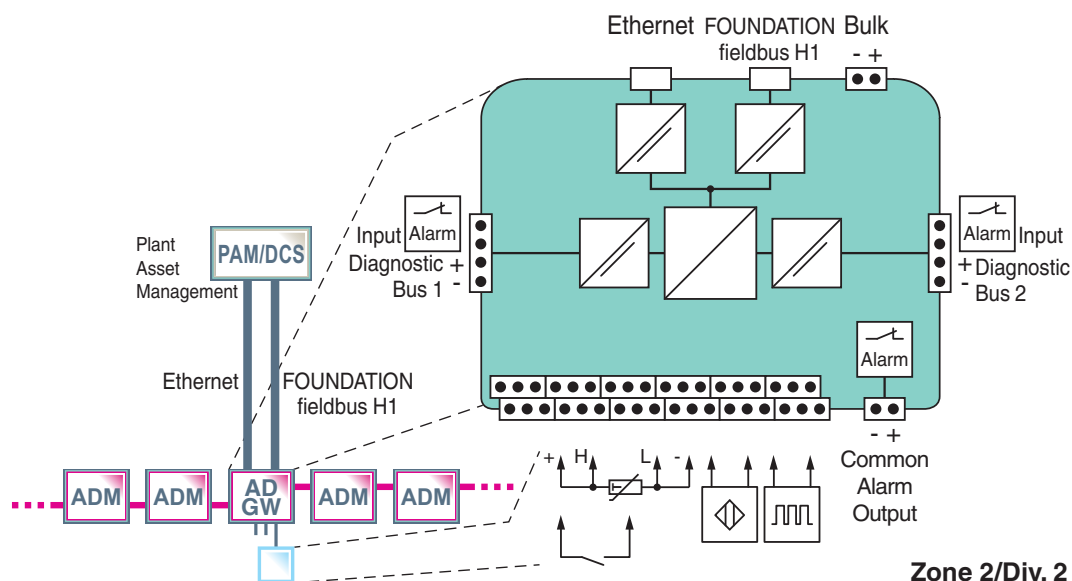
The gateway configures itself and automatically detects the ADMs. The Diagnostic Manager automatically finds gateways on the same subnet. The setup of the diagnostic bus and all connected modules is automatic. This significantly simplifies engineering of FieldConnex[®] Advanced Diagnostics.

Inputs for frequency, temperature, humidity, and NAMUR sensors and 2 relay contacts allow control of the control cabinet. The cabinet and physical layer diagnostics become easy-to-manage plant assets.

Assembly



Connection



Technical data**Ethernet Interface**

Port	100 BASE-TX
Protocol	TCP/IP and UDP/IP
Services	ICMP, DHCP, AutolP, HTTP

Diagnostic Bus

Number of Diagnostic Bus Channels	2
Cable length/Channel	30 m

Indicators/operating means

Fault signal	buzzer on

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Low voltage	
Directive 73/23/EEC	EN 61010

Standard conformity

Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21
Protection degree	IEC 60529
Climatic conditions	DIN IEC 721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ethernet	IEEE 802.3

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 1 segment, redundant
- Supports all PLC and DCS hosts
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

Function

The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

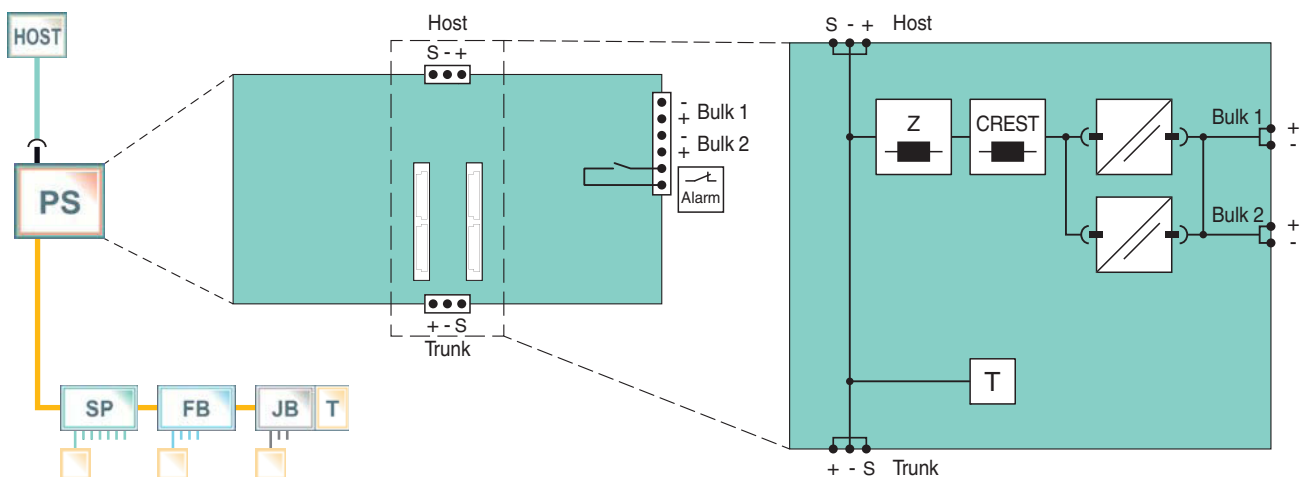
The motherboard is the wiring interface and mounting plate with common screw terminals for all DCS and PLC host systems. Sockets for all modules enable simple installation and replacement without tools. Certain motherboards enable power redundancy with seamless transfer. Pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Power loss	0.5 W

Fieldbus interface

Number of segments	
Redundant	1
Host-side	general purpose host
Terminating resistor	fixed 100 Ω

Indicators/operating means

Fault signal	VFC alarm 1 A, 50 V DC, normally closed

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Mechanical specifications

Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ⓔ II 3G EEx nA C IIC T4

Directive conformity

Directive 94/9/EC	IEC 60079-15:2003

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval	DNV A-10798

Compatible power modules

	HD2-FBPS-1.17.500		HD2-FBPS-1.23.500		HD2-FBPS-1.25.360		HD2-FBPS-1.500		HD2-FBCL-1.500

Power Output							
Voltage (V)		15 ... 17	21 ... 23	25 ... 28	28 ... 30	.. ¹	
Current (mA)		500	500	360	500	500	
Limit U ₀ (V)		17.5	24	-	-	-	
Device in ...	Type of Protection						Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia			■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia			■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d			■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■					Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■				Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	■		Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection			■	■	■	Segment Protector recommended

¹ follows bulk power supply

Features

- 2 segments, redundant, individual modules per segment
- Supports all PLC and DCS hosts
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

Function

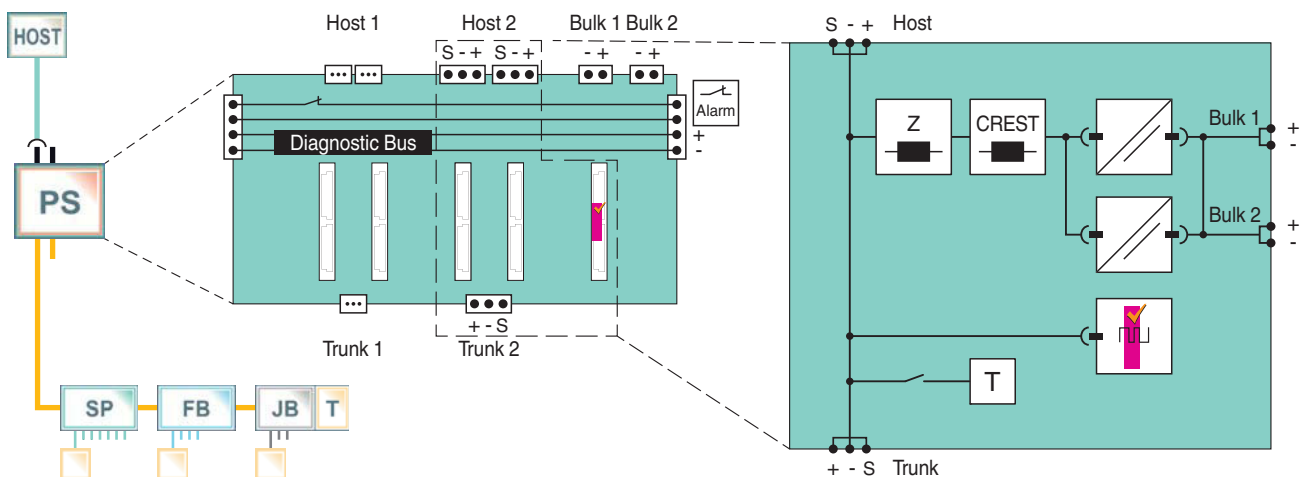
The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The motherboard is the wiring interface and mounting plate with common screw terminals for all DCS and PLC host systems. Sockets for all modules enable simple installation and replacement without tools. Certain motherboards enable power redundancy with seamless transfer. Pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Redundant	2
Host-side	redundant general purpose host
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA C IIC T4
Directive conformity	
Directive 94/9/EC	IEC 60079-15:2003
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4
Certificates and approvals	
Marine approval	DNV A-10798

Compatible power modules

HD2-FBPS-1.17.500	
HD2-FBPS-1.23.500	
HD2-FBPS-1.25.360	
HD2-FBPS-1.500	
HD2-FBCL-1.500	

Power Output						
Voltage (V)	15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)	500	500	360	500	500	
Limit U ₀ (V)	17.5	24	-	-	-	
Device in ...	Type of Protection					Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■				Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■			Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	■	■	Segment Protector recommended

¹ follows bulk power supply

912868 (US) / 220231 (EU) 05/2013

Edition

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

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pa-info@sg.pepperl-fuchs.com**PEPPERL+FUCHS** 157
PROTECTING YOUR PROCESS

Features

- 4 segments, individual modules per segment
- Supports all PLC and DCS hosts
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

Function

The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

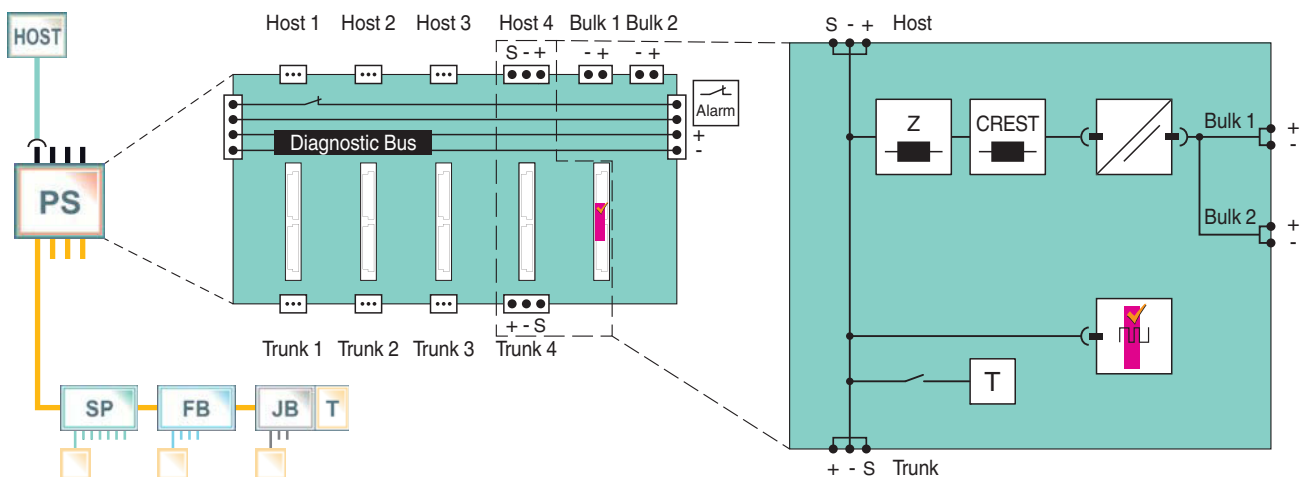
The motherboard is the wiring interface and mounting plate with common screw terminals for all DCS and PLC host systems. Sockets for all modules enable simple installation and replacement without tools. Certain motherboards enable power redundancy with seamless transfer. Pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Simplex	4
Host-side	general purpose host
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA C IIC T4
Directive conformity	
Directive 94/9/EC	IEC 60079-15:2003
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4
Certificates and approvals	
Marine approval	DNV A-10798

Compatible power modules

HD2-FBPS-1.17.500	
HD2-FBPS-1.23.500	
HD2-FBPS-1.25.360	
HD2-FBPS-1.500	
HD2-FBCL-1.500	

Power Output						
Voltage (V)	15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)	500	500	360	500	500	
Limit U ₀ (V)	17.5	24	-	-	-	
Device in ...	Type of Protection					Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■				Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■			Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	■	■	Segment Protector recommended

¹ follows bulk power supply

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Edition

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pa-info@sg.pepperl-fuchs.com**PEPPERL+FUCHS** 159
PROTECTING YOUR PROCESS

Features

- 4 segments, individual modules per segment
- Customizable for any host system
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

Function

The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

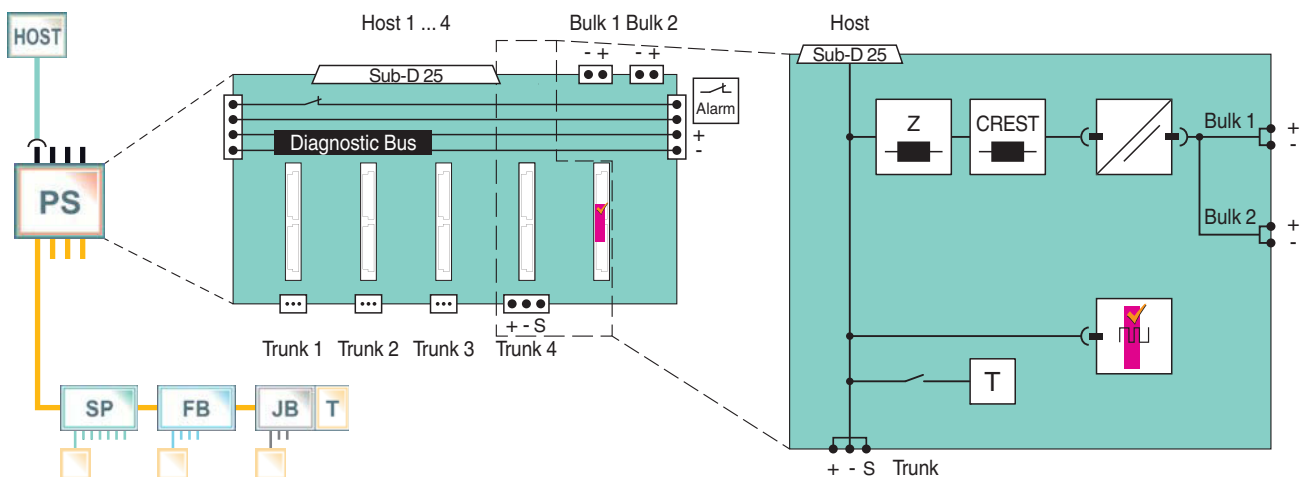
The motherboard is the wiring interface and mounting plate with a DB-25 connector for PROFIBUS PA gateway or customizable cable connections to any DCS. Sockets for individual power modules enable simple installation and can be replaced without tools. Certain motherboards enable power redundancy with seamless transfer. Pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Simplex	4
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA C IIC T4
Directive conformity	
Directive 94/9/EC	IEC 60079-15:2003

Compatible power modules

	HD2-FBPS-1.17.500	
	HD2-FBPS-1.23.500	
	HD2-FBPS-1.25.360	
	HD2-FBPS-1.500	
	HD2-FBCL-1.500	

Power Output						
Voltage (V)	15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)	500	500	360	500	500	
Limit U ₀ (V)	17.5	24	-	-	-	
Device in ...	Type of Protection					Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■				Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■			Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	■	■	Segment Protector recommended

¹ follows bulk power supply

Features

- 4 segments, individual modules per segment
- Customized for Yokogawa, ALF 111
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

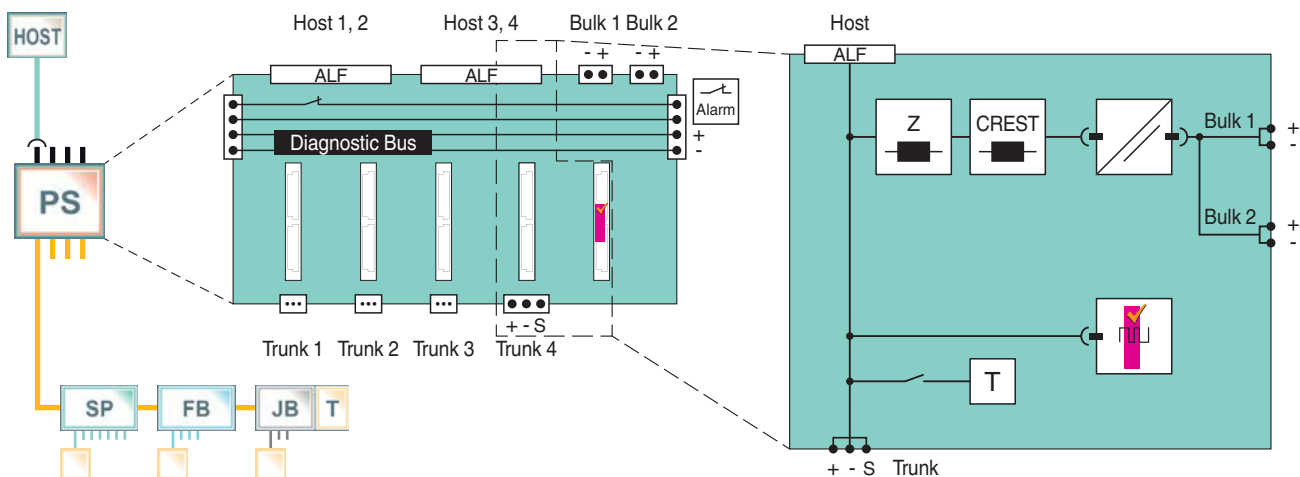
Function

The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The motherboard is the wiring interface with connectors for direct DCS hook-up via the AKB 336 system cable. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment. Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Simplex	4
Host-side	redundant Yokogawa ALF111 for AKB336 interface cable
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ex II 3 G Ex nA II T4
Declaration of conformity	PF 10 CERT 1569
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2005, EN 60079-27:2006
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4
Certificates and approvals	
Marine approval	DNV A-10798

Compatible power modules

		HD2-FBPS-1.17.500		HD2-FBPS-1.23.500		HD2-FBPS-1.25.360		HD2-FBPS-1.500		HD2-FBCL-1.500	
Power Output											
Voltage (V)		15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹					
Current (mA)		500	500	360	500	500					
Limit U ₀ (V)		17.5	24	-	-	-					
Device in ...	Type of Protection							Required Installation Components			
Zone 0/Div. 1	Intrinsically safe Ex ia			■	■	■		FieldBarrier			
Zone 1/Div. 1	Intrinsically safe Ex ia			■	■	■		FieldBarrier			
Zone 1/Div. 1	Flameproof Ex d			■	■	■		Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2			
Zone 2	Intrinsically safe Ex ic (FISCO)	■						Selected Segment Protectors			
Zone 2	Intrinsically safe Ex ic (Entity)		■					Selected Segment Protectors			
Div. 2	Non-incendive	■	■	■	■			Any Segment Protector; power module selection depends on voltage of field device			
Safe Area	No specific type of protection			■	■	■		Segment Protector recommended			

¹ follows bulk power supply

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

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pa-info@sg.pepperl-fuchs.com**PEPPERL+FUCHS** 163
PROTECTING YOUR PROCESS

Features

- **4 segments, redundant, individual modules per segment**
- **Supports all PLC and DCS hosts**
- **High-Power Trunk: Live work on devices in any hazardous area**
- **Features for best signal quality, low heat dissipation**
- **Optional Advanced Diagnostics**
- **Passive impedance and CREST technology for high reliability**
- **Supports Ex ic/nL voltage limitation**
- **Installation in Zone 2/Div. 2**

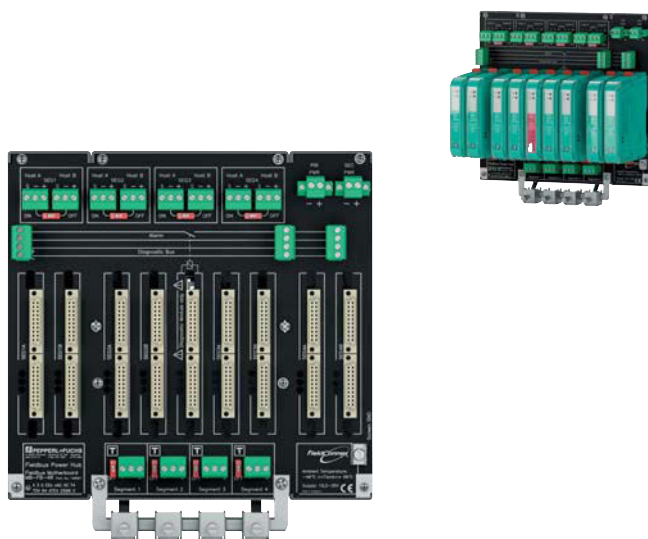
Function

The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

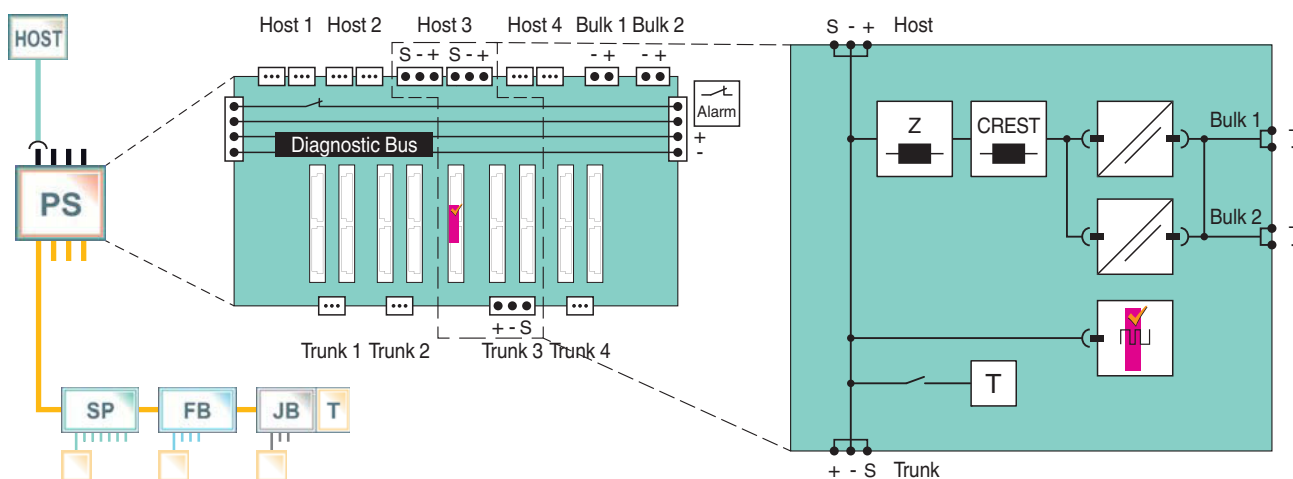
The motherboard is the wiring interface and mounting plate with common screw terminals for all DCS and PLC host systems. Sockets for all modules enable simple installation and replacement without tools. Certain motherboards enable power redundancy with seamless transfer. Pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Redundant	4
Host-side	redundant general purpose host
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA C IIC T4
Directive conformity	
Directive 94/9/EC	IEC 60079-15:2003
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4
Certificates and approvals	
Marine approval	DNV A-10798

Compatible power modules

HD2-FBPS-1.17.500	
HD2-FBPS-1.23.500	
HD2-FBPS-1.25.360	
HD2-FBPS-1.500	
HD2-FBCL-1.500	

Power Output						
Voltage (V)	15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)	500	500	360	500	500	
Limit U ₀ (V)	17.5	24	-	-	-	
Device in ...	Type of Protection					Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■				Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■			Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	■	■	Segment Protector recommended

¹ follows bulk power supply

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Edition

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

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pa-info@sg.pepperl-fuchs.com**PEPPERL+FUCHS** 165
PROTECTING YOUR PROCESS

Features

- 4 segments, redundant, individual modules per segment
- Customizable for any host system
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

Function

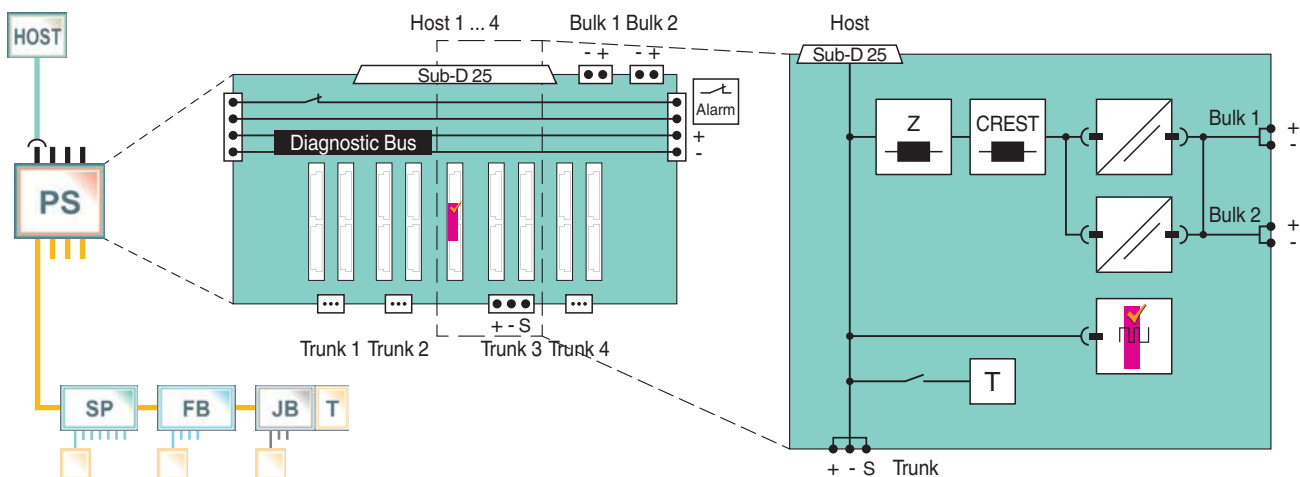
The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The motherboard is the wiring interface and mounting plate with a DB-25 connector for PROFIBUS PA gateway or customizable cable connections to any DCS. Sockets for individual power modules enable simple installation and can be replaced without tools. Certain motherboards enable power redundancy with seamless transfer. Pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Redundant	4
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA C IIC T4
Directive conformity	
Directive 94/9/EC	IEC 60079-15:2003

Compatible power modules

	HD2-FBPS-1.17.500	
	HD2-FBPS-1.23.500	
	HD2-FBPS-1.25.360	
	HD2-FBPS-1.500	
	HD2-FBCL-1.500	

Power Output						
Voltage (V)	15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)	500	500	360	500	500	
Limit U ₀ (V)	17.5	24	-	-	-	
Device in ...	Type of Protection					Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■				Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■			Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	■	■	Segment Protector recommended

¹ follows bulk power supply

Features

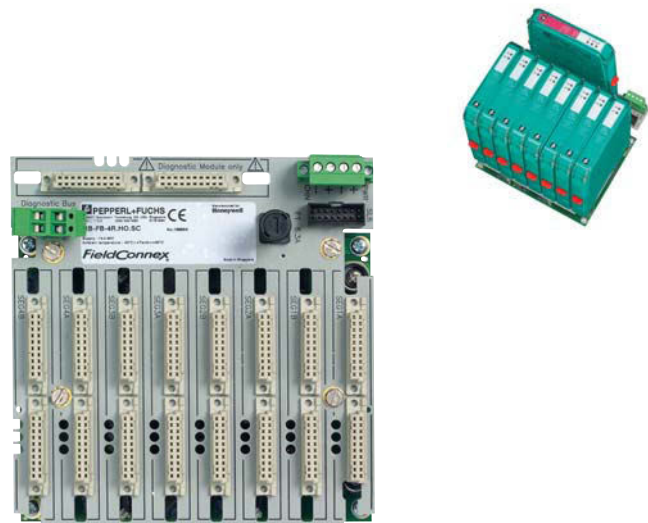
- **4 segments, redundant, individual modules per segment**
- **Customized for Honeywell, C-Series**
- **High-Power Trunk: Live work on devices in any hazardous area**
- **Optimized for size and quality, low heat dissipation**
- **Optional Advanced Diagnostics**
- **Passive impedance and CREST technology for high reliability**
- **Installation in Zone 2/Div. 2**

Function

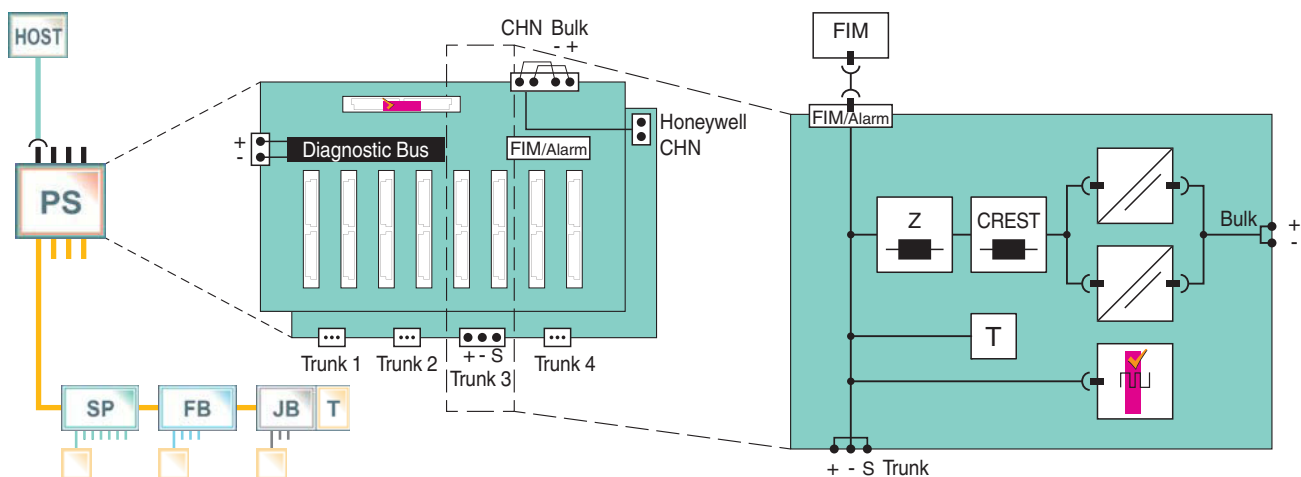
The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The motherboard is the mounting plate for installation in the Honeywell C-channel. It connects to existing bulk power, communication and fault indication. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply

Connection	Channel or external supply
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	6.3 A
Power loss	typ. 0.2 W per segment

Fieldbus interface

Number of segments	
Redundant	4
Host-side	Honeywell Series C 300 System connector
Terminating resistor	integrated 100 Ω

Indicators/operating means

Fault signal	to Honeywell C 300 System

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Mechanical specifications

Connection type	Honeywell channel or plug with screw flange
Core cross-section	2.5 mm ² if supplied via plug with screw flange
Mounting	Honeywell channel

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Compatible power modules

HD2-FBPS-1.17.500

HD2-FBPS-1.23.500

HD2-FBPS-1.25.360

HD2-FBPS-1.500

Power Output					
Voltage (V)	15 ... 17	21 ... 23	25 ... 28	28 ... 30	
Current (mA)	500	500	360	500	
Limit U ₀ (V)	17.5	24	-	-	
Device in ...	Type of Protection				Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia			■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia			■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d			■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■			Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■		Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection			■	Segment Protector recommended

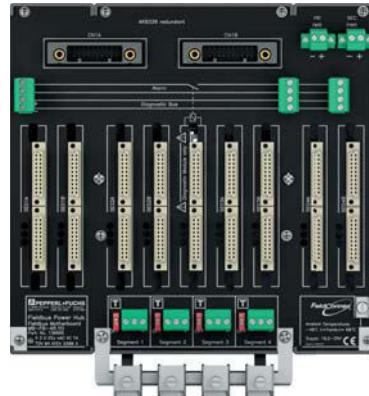
Features

- 4 segments, redundant, individual modules per segment
- Customized for Yokogawa, ALF 111
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

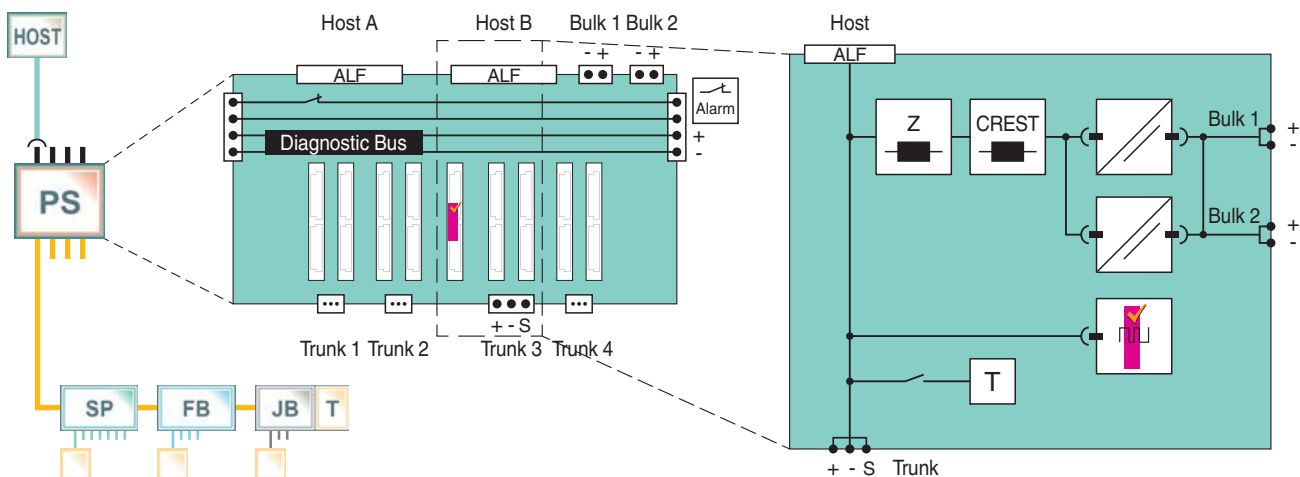
Function

The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The motherboard is the wiring interface with connectors for direct DCS hook-up via the AKB 336 system cable. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment. Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Redundant	4
Host-side	redundant Yokogawa ALF111 with AKB336 interface cables
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ex II 3 G Ex nA II T4
Declaration of conformity	PF 10 CERT 1569
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2005, EN 60079-27:2006
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4
Certificates and approvals	
Marine approval	DNV A-10798

Compatible power modules

		HD2-FBPS-1.17.500		HD2-FBPS-1.23.500		HD2-FBPS-1.25.360		HD2-FBPS-1.500		HD2-FBCL-1.500	
Power Output											
Voltage (V)		15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹					
Current (mA)		500	500	360	500	500					
Limit U ₀ (V)		17.5	24	-	-	-					
Device in ...	Type of Protection							Required Installation Components			
Zone 0/Div. 1	Intrinsically safe Ex ia			■	■	■		FieldBarrier			
Zone 1/Div. 1	Intrinsically safe Ex ia			■	■	■		FieldBarrier			
Zone 1/Div. 1	Flameproof Ex d			■	■	■		Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2			
Zone 2	Intrinsically safe Ex ic (FISCO)	■						Selected Segment Protectors			
Zone 2	Intrinsically safe Ex ic (Entity)		■					Selected Segment Protectors			
Div. 2	Non-incendive	■	■	■	■			Any Segment Protector; power module selection depends on voltage of field device			
Safe Area	No specific type of protection			■	■	■		Segment Protector recommended			

¹ follows bulk power supply

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

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PEPPERL+FUCHS 171
 PROTECTING YOUR PROCESS

Assembly

- **4 segments, redundant, individual modules per segment**
- **Supports all PLC and DCS hosts**
- **High-Power Trunk: Live work on devices in any hazardous area**
- **Optimized for size and quality, low heat dissipation**
- **Optional Advanced Diagnostics**
- **Passive impedance for high reliability**
- **Mountable in any direction**
- **Installation in Zone 2/Div. 2**
- **Supports Ex ic/nL voltage limitation**

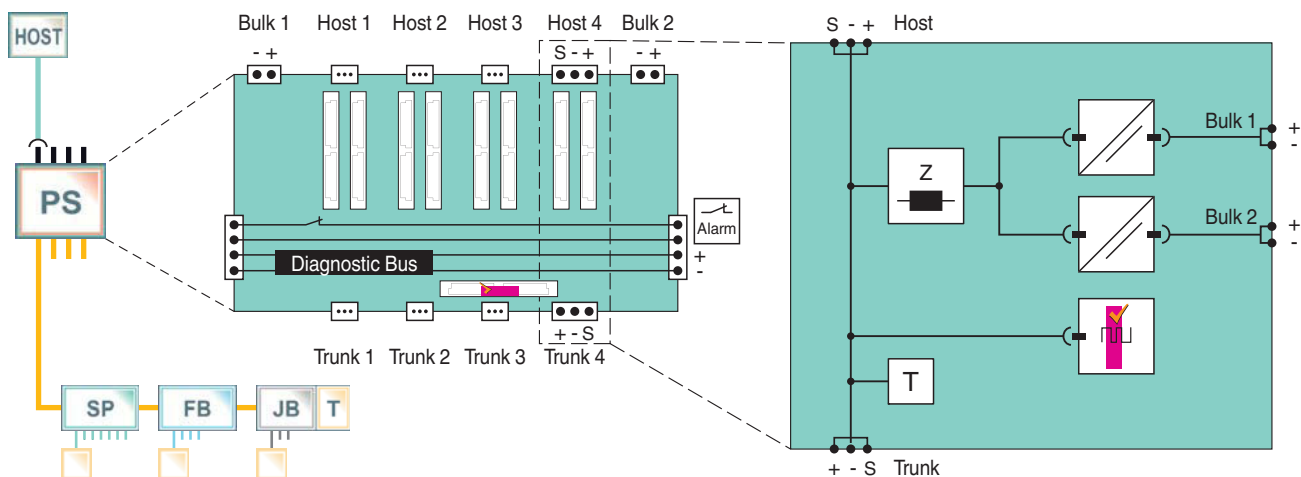
The FieldConnex® High-Density Power Hub is a modular fieldbus power supply for four segments, fulfilling the needs for all general applications. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

The motherboard is the wiring interface with connectors for all DCS and PLC host systems. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment.

Availability and a long service life is achieved through: only one passive impedance filter per segment, optimized design for low power dissipation, high-availability fieldbus termination and plug-in connectors with retaining screws. Any mounting direction allows optimized and space-saving cabinet layout.



Connection



Technical data

Supply

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Power loss	typ. 0.39 W per segment

Fieldbus interface

Number of segments	
Redundant	4
Host-side	redundant general purpose host
Terminating resistor	100 Ω integrated

Indicators/operating means

Fault signal	VFC alarm output via connectors

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity	TÜV 06 ATEX 553229 X
Group, category, type of protection, temperature class	⊕ II 3 G Ex nA II T4
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2006

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval	DNV A-10798

Compatible power modules

		HD2-FBPS-1.17.500		HD2-FBPS-1.23.500		HD2-FBPS-1.25.360		HD2-FBPS-1.500	
Power Output		15 ... 17		21 ... 23		25 ... 28		28 ... 30	
Voltage (V)		500		500		360		500	
Current (mA)		17.5		24		-		-	
Limit U ₀ (V)									
Device in ...	Type of Protection								
Zone 0/Div. 1	Intrinsically safe Ex ia					■	■		FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia					■	■		FieldBarrier
Zone 1/Div. 1	Flameproof Ex d					■	■		Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■							Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■						Selected Segment Protectors
Div. 2	Non-incendive	■	■			■	■		Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection					■	■		Segment Protector recommended



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 segments, redundant, individual modules per segment
- Customized for Yokogawa, ALF 111
- High-Power Trunk: Live work on devices in any hazardous area
- Optimized for size and quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance for high reliability
- Mountable in any direction
- Installation in Zone 2/Div. 2
- Supports Ex ic/nL voltage limitation

Function

The FieldConnex® High-Density Power Hub is a modular fieldbus power supply for four segments, fulfilling the needs for all general applications. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

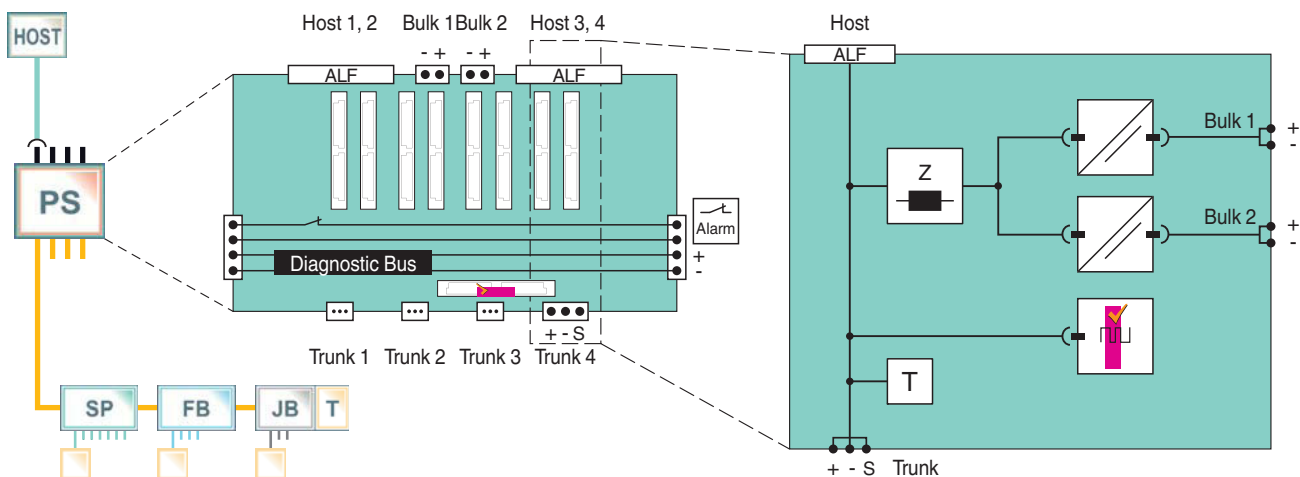
The motherboard is the wiring interface with connectors for direct DCS hook-up via the AKB 336 system cable. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment.

Availability and a long service life is achieved through: only one passive impedance filter per segment, optimized design for low power dissipation, high-availability fieldbus termination and plug-in connectors with retaining screws. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Power loss	typ. 0.39 W per segment

Fieldbus interface

Number of segments	
Redundant	4
Host-side	redundant Yokogawa ALF111 with AKB336 interface cables
Terminating resistor	100 Ω integrated

Indicators/operating means

Fault signal	VFC alarm output via connectors

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity	TÜV 06 ATEX 553229 X
Group, category, type of protection, temperature class	⊕ II 3 G Ex nA II T4
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2006
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4
Certificates and approvals	
Marine approval	DNV A-10798

Compatible power modules

		HD2-FBPS-1.17.500		HD2-FBPS-1.23.500		HD2-FBPS-1.25.360		HD2-FBPS-1.500	
Power Output		15 ... 17		21 ... 23		25 ... 28		28 ... 30	
Voltage (V)		500		500		360		500	
Current (mA)		17.5		24		-		-	
Limit U ₀ (V)									
Device in ...	Type of Protection								
Zone 0/Div. 1	Intrinsically safe Ex ia					■		■	
Zone 1/Div. 1	Intrinsically safe Ex ia					■		■	
Zone 1/Div. 1	Flameproof Ex d					■		■	
Zone 2	Intrinsically safe Ex ic (FISCO)	■							
Zone 2	Intrinsically safe Ex ic (Entity)			■					
Div. 2	Non-incendive	■		■		■		■	
Safe Area	No specific type of protection					■		■	
Required Installation Components									
FieldBarrier									
FieldBarrier									
Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2									
Selected Segment Protectors									
Selected Segment Protectors									
Any Segment Protector; power module selection depends on voltage of field device									
Segment Protector recommended									

Features

- **8 segments, redundant, individual modules per segment**
- **Supports all PLC and DCS hosts**
- **High-Power Trunk: Live work on devices in any hazardous area**
- **Best quality, smallest size and lowest heat dissipation**
- **Optional Advanced Diagnostics**
- **Passive impedance for high reliability**
- **Supports Ex ic voltage limitation**
- **Installation in Zone 2/Div. 2**

Function

The FieldConnex® Compact Power Hub is a modular fieldbus power supply for eight segments with lowest power dissipation and smallest foot print. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

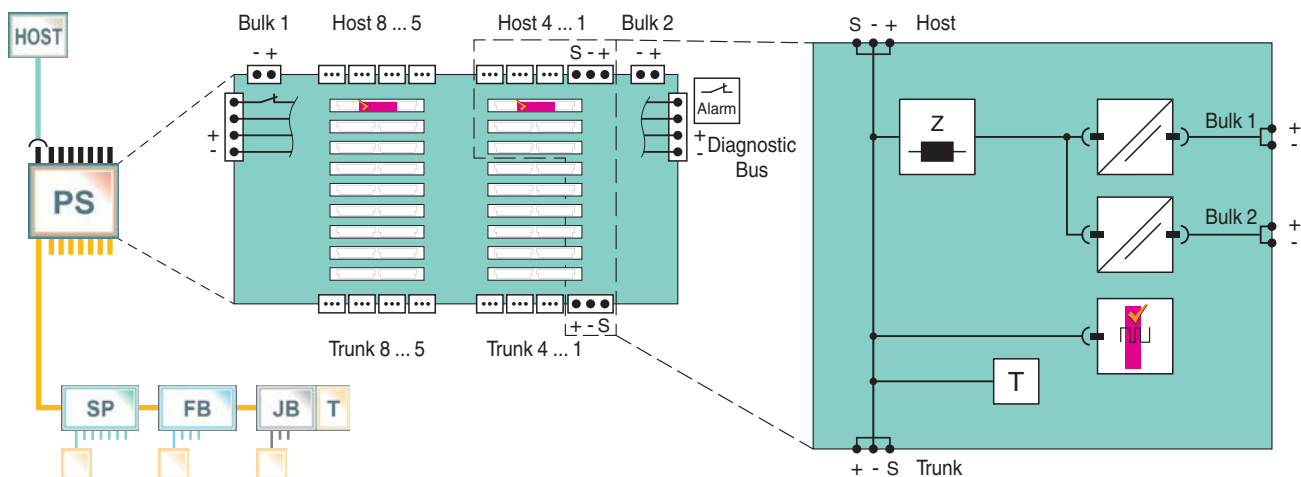
The motherboard is the wiring interface with connectors for all DCS and PLC host systems. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment.

This design allows the most compact cabinet layout for large scale projects. Excellent availability and a very long service life is achieved through: passive impedance filter per segment, high-availability fieldbus termination and plug-in connectors with retaining screws and electronics optimized for lowest power dissipation and compactness.

Assembly



Connection



Technical data

Supply

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Power loss	typ. 0.4 W per segment

Fieldbus interface

Number of segments	8 redundant
Host-side	general purpose host
Terminating resistor	100 Ω integrated

Indicators/operating means

Fault signal	VFC alarm 1 A, 50 V DC, normally closed

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity	TÜV 10 ATEX 555761X
Group, category, type of protection, temperature class	Ex II 3G Ex nA IIC T4 Gc

Directive conformity

Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010

Compatible power modules

		HCD2-FBPS-1.23.500	HCD2-FBPS-1.500	
Power Output				
Voltage (V)		21 ... 23	28 ... 29.5	
Current (mA)		500	500	
Limit U ₀ (V)		24	-	
Device in ...	Type of Protection			Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (Entity)	■		Selected Segment Protectors
Div. 2	Non-incendive	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	Segment Protector recommended

FOUNDATION Fieldbus H1

Selection Guideline

Advanced Diagnostics

Power Supplies

Field Distribution

DART Fieldbus

Process Interfaces

Accessories

Features

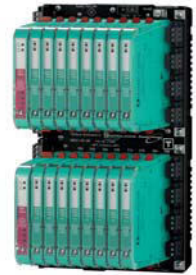
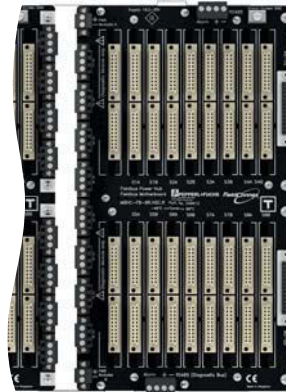
- 8 segments, redundant, individual modules per segment
- Customizable cable connections to any PLC and DCS hosts
- High-Power Trunk: Live work on devices in any hazardous area
- Best quality, smallest size and lowest heat dissipation
- Left/right version for optimized cabinet layout
- Optional Advanced Diagnostics
- Passive impedance for high reliability
- Supports Ex ic voltage limitation
- Installation in Zone 2/Div. 2

Function

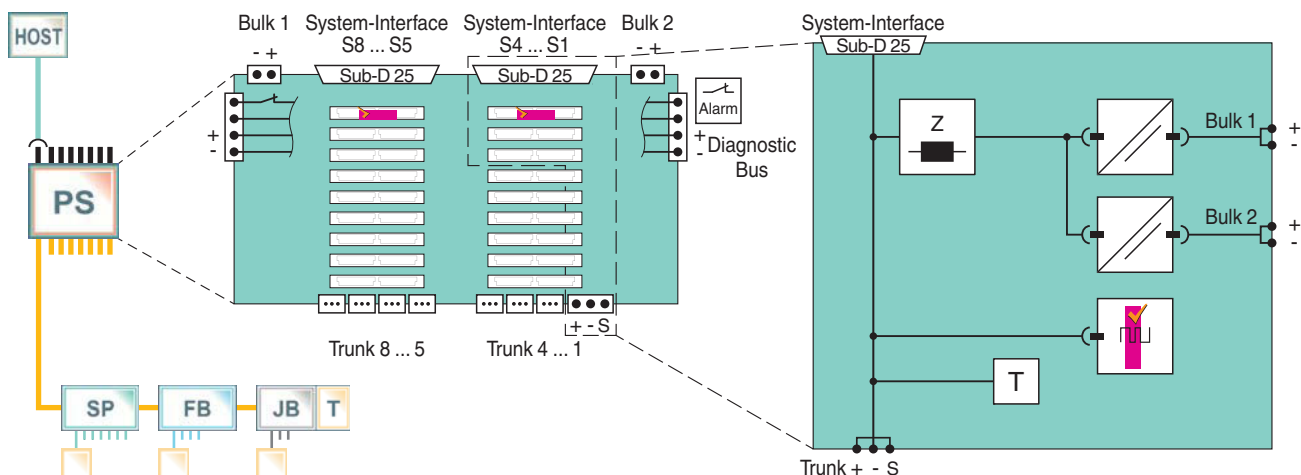
The FieldConnex® Compact Power Hub is a modular fieldbus power supply for eight segments with lowest power dissipation and smallest foot print. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

The motherboard is the wiring interface and mounting plate with system-specific cable connection for FOUNDATION fieldbus H1 hosts located on the left side of the motherboard. The version with type code extension ".R" has host connections on the right side for symmetrical cabinet layout. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment. This design allows the most compact cabinet layout for large scale projects. Excellent availability and a very long service life is achieved through: passive impedance filter per segment, high-availability fieldbus termination and plug-in connectors with retaining screws and electronics optimized for lowest power dissipation and compactness.

Assembly



Connection



Technical data

Supply

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Power loss	typ. 0.4 W per segment

Fieldbus interface

Number of segments	8 redundant
Host-side	system specific cable connection
Terminating resistor	100 Ω integrated

Indicators/operating means

Fault signal	VFC alarm 1 A, 30 V DC, normally closed

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity	TÜV 10 ATEX 555761X
Group, category, type of protection, temperature class	Ex II 3G Ex nA IIC T4 Gc

Directive conformity

Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010

Compatible power modules

		HCD2-FBPS-1.23.500	HCD2-FBPS-1.500	
Power Output				
Voltage (V)		21 ... 23	28 ... 29.5	
Current (mA)		500	500	
Limit U ₀ (V)		24	-	
Device in ...	Type of Protection			Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (Entity)	■		Selected Segment Protectors
Div. 2	Non-incendive	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	Segment Protector recommended

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

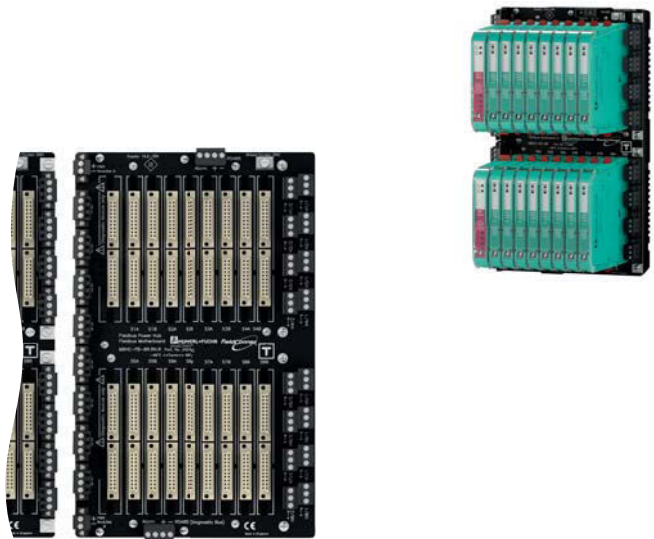
- 8 segments, redundant, individual modules per segment
- Supports all PLC and DCS hosts, redundant terminals
- High-Power Trunk: Live work on devices in any hazardous area
- Best quality, smallest size and lowest heat dissipation
- Left/right version for optimized cabinet layout
- Optional Advanced Diagnostics
- Passive impedance for high reliability
- Supports Ex ic voltage limitation
- Installation in Zone 2/Div. 2

Function

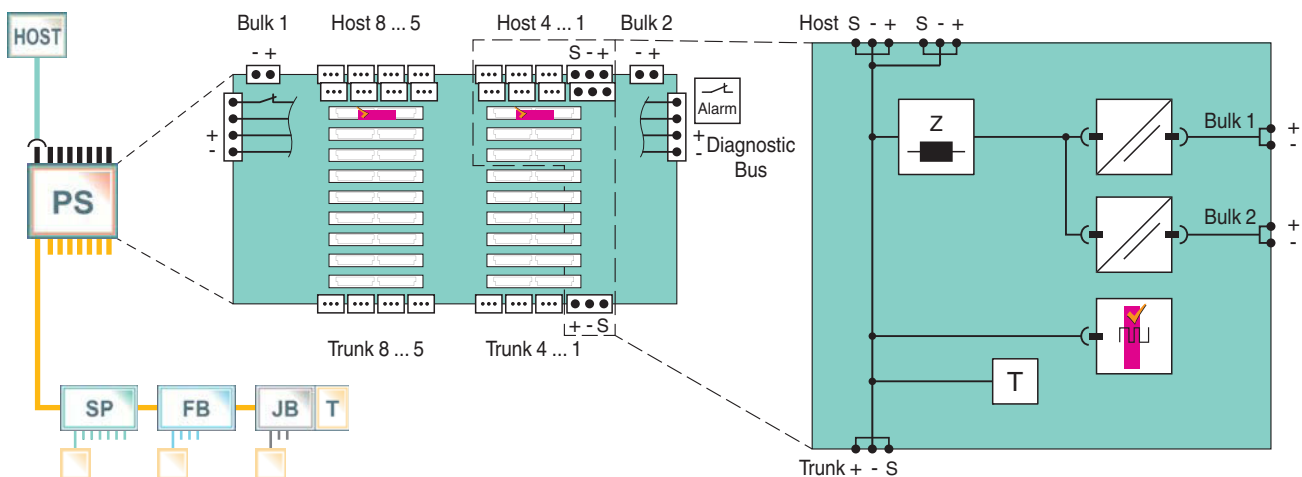
The FieldConnex® Compact Power Hub is a modular fieldbus power supply for eight segments with lowest power dissipation and smallest foot print. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

The motherboard is the wiring interface with redundant terminals for all DCS and PLC host systems on the left side of the motherboard. The version with type code extension ".R" has host connections on the right side for symmetrical cabinet layout. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment. This design allows the most compact cabinet layout for large scale projects. Excellent availability and a very long service life is achieved through: passive impedance filter per segment, high-availability fieldbus termination and plug-in connectors with retaining screws and electronics optimized for lowest power dissipation and compactness.

Assembly



Connection



Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

Technical data

Supply

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Power loss	typ. 0.4 W per segment

Fieldbus interface

Number of segments	8 redundant
Host-side	redundant general purpose host
Terminating resistor	100 Ω integrated

Indicators/operating means

Fault signal	VFC alarm 1 A, 50 V DC, normally closed

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity	TÜV 10 ATEX 555761X
Group, category, type of protection, temperature class	Ex II 3G Ex nA IIC T4 Gc

Directive conformity

Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010

Compatible power modules

		HCD2-FBPS-1.23.500	HCD2-FBPS-1.500	
Power Output				
Voltage (V)		21 ... 23	28 ... 29.5	
Current (mA)		500	500	
Limit U ₀ (V)		24	-	
Device in ...	Type of Protection			Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (Entity)	■		Selected Segment Protectors
Div. 2	Non-incendive	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	Segment Protector recommended

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- 8 segments, redundant, individual modules per segment
- Customized for Yokogawa, ALF 111
- High-Power Trunk: Live work on devices in any hazardous area
- Best quality, smallest size and lowest heat dissipation
- Optional Advanced Diagnostics
- Passive impedance for high reliability
- Supports Ex ic voltage limitation
- Installation in Zone 2/Div. 2

Function

The FieldConnex[®] Compact Power Hub is a modular fieldbus power supply for eight segments with lowest power dissipation and smallest foot print. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

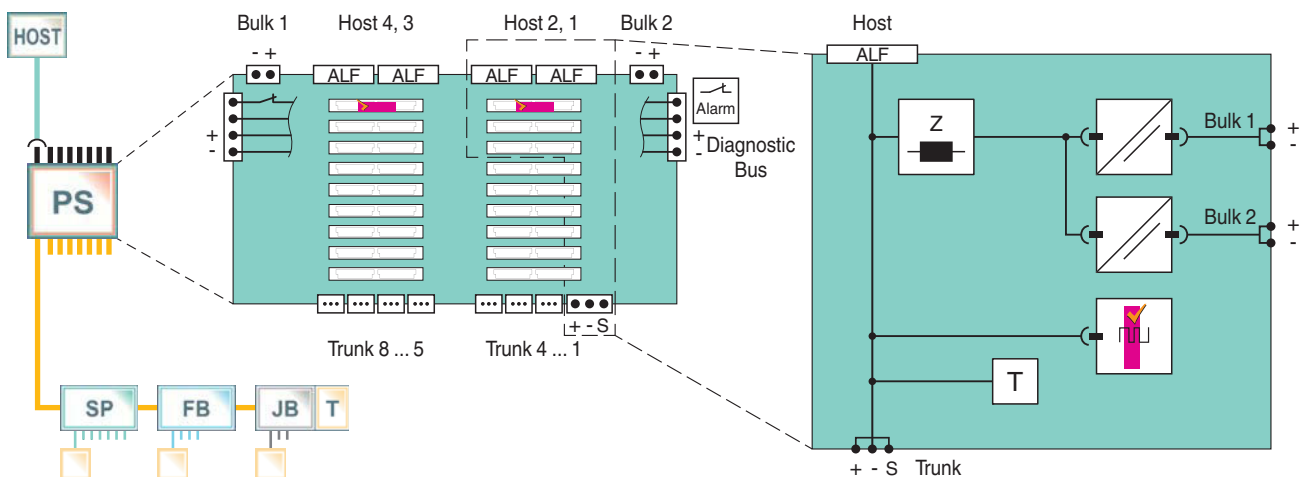
The motherboard is the wiring interface with connectors for direct DCS hook-up via the AKB 336 system cable. Sockets for all modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment.

This design allows the most compact cabinet layout for large scale projects. Excellent availability and a very long service life is achieved through: passive impedance filter per segment, high-availability fieldbus termination and plug-in connectors with retaining screws and electronics optimized for lowest power dissipation and compactness.

Assembly



Connection



Technical data

Supply

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Power loss	typ. 0.4 W per segment

Fieldbus interface

Number of segments	8 redundant
Host-side	redundant Yokogawa ALF111 with AKB336 interface cables
Terminating resistor	100 Ω integrated

Indicators/operating means

Fault signal	VFC alarm 1 A, 50 V DC, normally closed

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity	TÜV 10 ATEX 555761X
Group, category, type of protection, temperature class	Ex II 3G Ex nA IIC T4 Gc

Directive conformity

Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010

Compatible power modules

		HCD2-FBPS-1.23.500	HCD2-FBPS-1.500	
Power Output				
Voltage (V)		21 ... 23	28 ... 29.5	
Current (mA)		500	500	
Limit U ₀ (V)		24	-	
Device in ...	Type of Protection			Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (Entity)	■		Selected Segment Protectors
Div. 2	Non-incendive	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	Segment Protector recommended

FOUNDATION Fieldbus H1

Selection Guideline

Advanced Diagnostics

Power Supplies

Field Distribution

DART Fieldbus

Process Interfaces

Accessories

Features

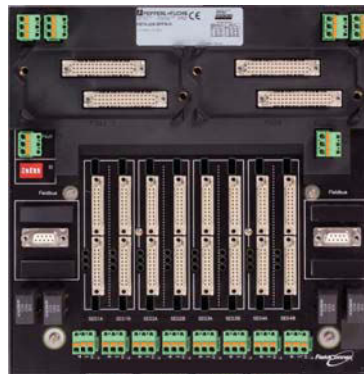
- 8 segments, individual modules per segment
- Supports all PLC and DCS hosts
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

Function

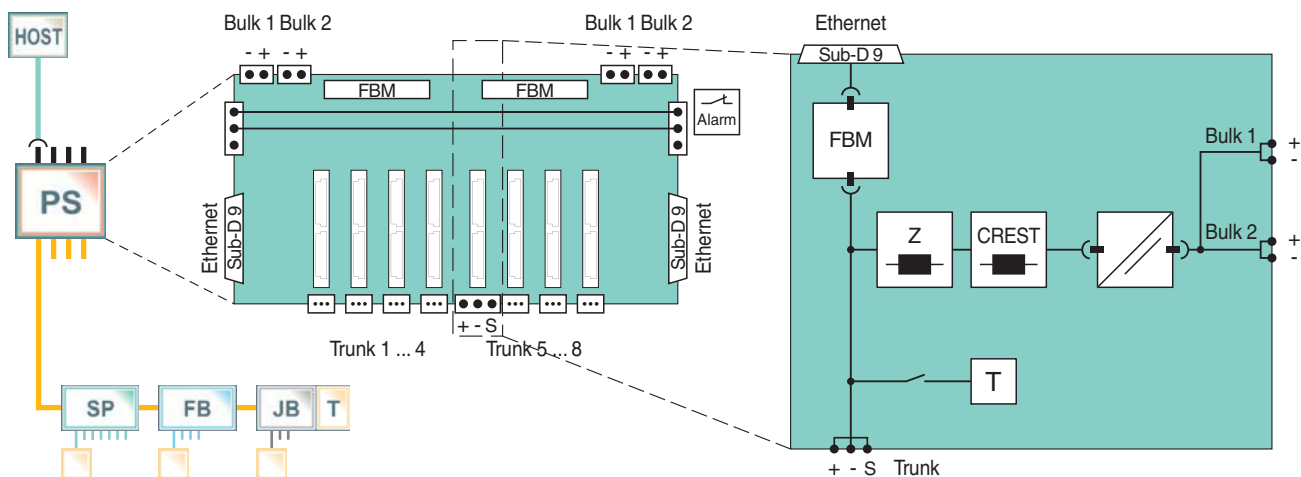
The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The motherboard is the wiring interface and mounting plate with sockets for FBM-228 host modules. Individual power modules enable simple installation and replacement without tools.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

Technical data

Supply

Connection	redundant
Rated voltage	21.6 ... 25.2 V
Rated current	16 A

Fieldbus interface

Number of segments	
Simplex	8
Host-side	Invensys FBM 228
Terminating resistor	fixed

Indicators/operating means

Fault signal	open collector, switched low

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Mechanical specifications

Connection type	Cage tension spring terminals
Core cross-section	≤ 2.5 mm ²
Mounting	DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity	TÜV 05 ATEX 2890 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA II T4
Directive conformity	
Directive 94/9/EC	EN 60079-15:2003

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Compatible power modules

HD2-FBPS-1.17.500

HD2-FBPS-1.23.500

HD2-FBPS-1.25.360

HD2-FBPS-1.500

HD2-FBCL-1.500

Power Output

Power Output	15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Voltage (V)	15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)	500	500	360	500	500	
Limit U ₀ (V)	17.5	24	-	-	-	
Device in ...	Type of Protection					Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Div. 2	Non-incendive	■	■	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	■	■	Segment Protector recommended

¹ follows bulk power supply

Features

- 4 segments, redundant, individual modules per segment
- Supports all PLC and DCS hosts
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

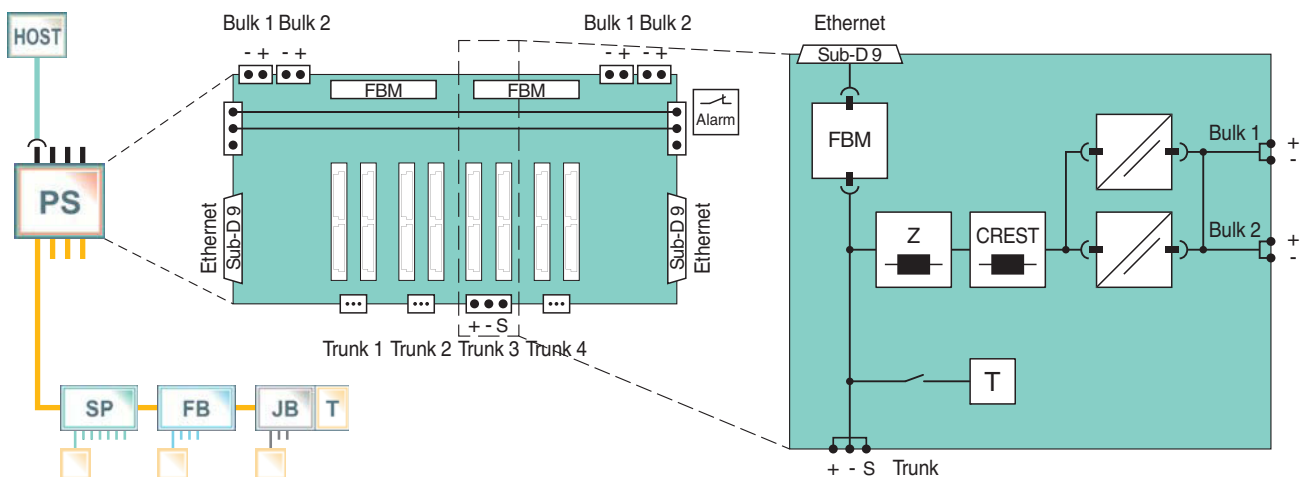
Function

The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The motherboard is the wiring interface and mounting plate with sockets for redundant FBM-228 host modules. Individual power modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment. Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	21.6 ... 25.2 V
Rated current	16 A
Fieldbus interface	
Number of segments	
Redundant	4
Host-side	redundant Invensys FBM 228
Terminating resistor	fixed
Indicators/operating means	
Fault signal	open collector, switched low
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Mechanical specifications	
Connection type	Cage tension spring terminals
Core cross-section	≤ 2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 05 ATEX 2890 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA II T4
Directive conformity	
Directive 94/9/EC	EN 60079-15:2003
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Compatible power modules

	HD2-FBPS-1.17.500	
	HD2-FBPS-1.23.500	
	HD2-FBPS-1.25.360	
	HD2-FBPS-1.500	
	HD2-FBCL-1.500	

Power Output						
Voltage (V)	15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)	500	500	360	500	500	
Limit U ₀ (V)	17.5	24	-	-	-	
Device in ...	Type of Protection					Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia		■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d		■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Div. 2	Non-incendive	■	■	■	■	Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection		■	■	■	Segment Protector recommended

¹ follows bulk power supply

Features

- 8 segments, redundant, individual modules per segment
- Customized for Invensys, FBM228
- High-Power Trunk: Live work on devices in any hazardous area
- Best quality, smallest size and lowest heat dissipation
- Optional Advanced Diagnostics
- Passive impedance for high reliability
- Dual, redundant bulk power connections

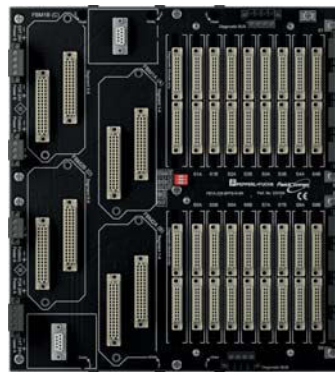
Function

The FieldConnex[®] Compact Power Hub is a modular fieldbus power supply for eight segments with lowest power dissipation and smallest foot print. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

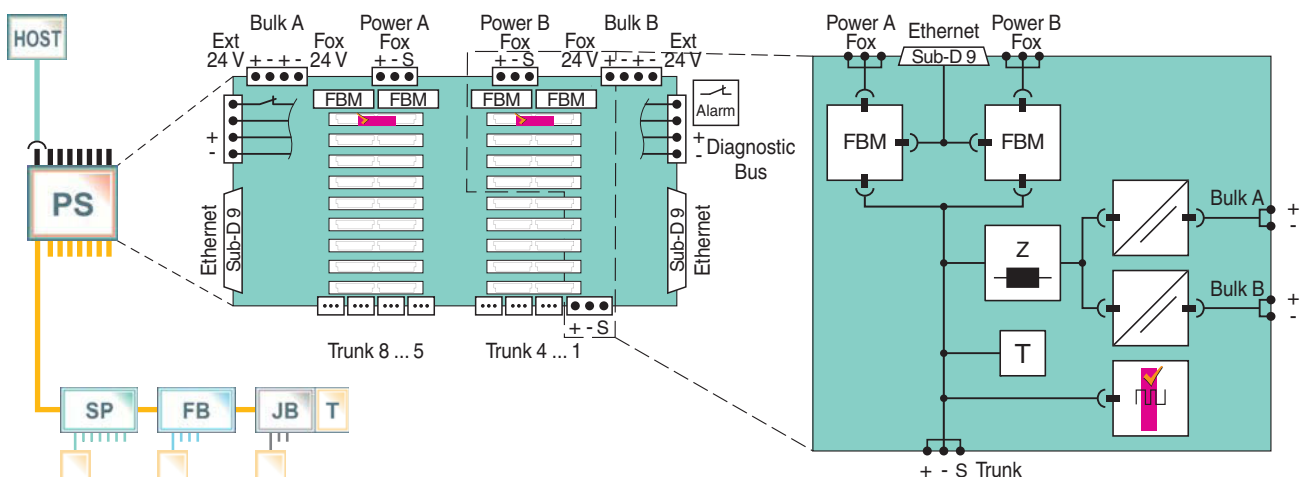
The motherboard is the wiring interface and mounting plate with sockets for redundant FBM-228 host modules. Individual power modules enable simple installation and replacement without tools. For power redundancy with seamless transfer, pairs of modules feed each segment. Dual, redundant bulk power connections are configurable. They permit common or separate supply to FBM and power modules via Invensys or external power source.

This design allows the most compact cabinet layout for large scale projects. Excellent availability and a very long service life is achieved through: passive impedance filter per segment, high-availability fieldbus termination and plug-in connectors with retaining screws and electronics optimized for lowest power dissipation and compactness.

Assembly



Connection



Technical data**Supply**

Connection	redundant
Rated voltage	21.6 ... 25.2 V Input for Power Hub selectable: Option 1: from regular Foxboro power supplies Option 2: one or two external bulk power supplies
Rated current	16 A
Power loss	typ. 0.4 W per segment

Fieldbus interface

Number of segments	
Redundant	8
Host-side	redundant Invensys FBM 228

Main cable (Trunk)

Rated current	≤ 500 mA per segment
Terminating resistor	100 Ω integrated

Indicators/operating means

Fault signal	VFC alarm output via connectors

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Mechanical specifications

Mounting	two DIN rails

Power module**HCD2-FBPS-1.500****Power Output**

Voltage (V)	28 ... 30	
Current (mA)	500	
Device in ...	Type of Protection	Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia	■ FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia	■ FieldBarrier
Zone 1/Div. 1	Flameproof Ex d	■ Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Safe Area	No specific type of protection	■ Segment Protector recommended

Features

- Output: 15 ... 17 V/500 mA
- Voltage limitation for FISCO ic, Entity ic, also FNICO and Ex nL
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- High efficiency, low heat dissipation for high packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

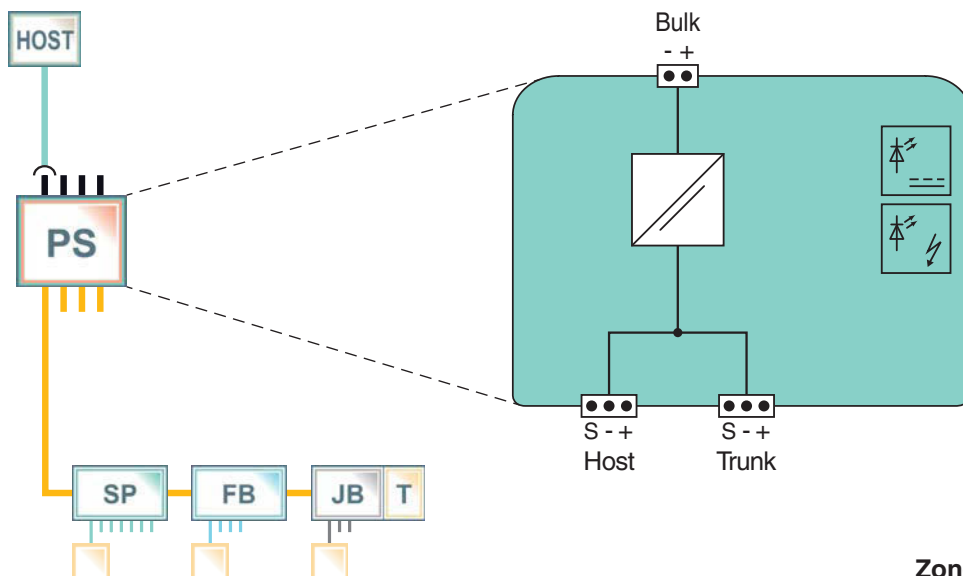
This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

The combination of this power supply, selected motherboards and R2 Segment Protectors provide outputs certified for explosion protection Ex ic according to FISCO or Entity. Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage	19.2 ... 35 V DC
Rated current	520 ... 290 mA
Power loss	typ. 1.3 W

Fieldbus interface

Rated voltage	15 ... 17 V
Rated current	500 ... 10 mA
Short-circuit current	550 mA
Terminating impedance	Motherboard specific

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	Motherboard specific
Core cross-section	Motherboard specific
Mounting	motherboard mounting

Data for application in connection with Ex-areas**Outputs**

Voltage U_o	17.5 V
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ex II 3 G Ex nA II T4

Directive conformity

Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2006

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval	DNV A-10798

Features

- Output: 21 ... 23 V/500 mA
- Voltage limitation for Entity ic and Ex nL
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- High efficiency, low heat dissipation for high packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

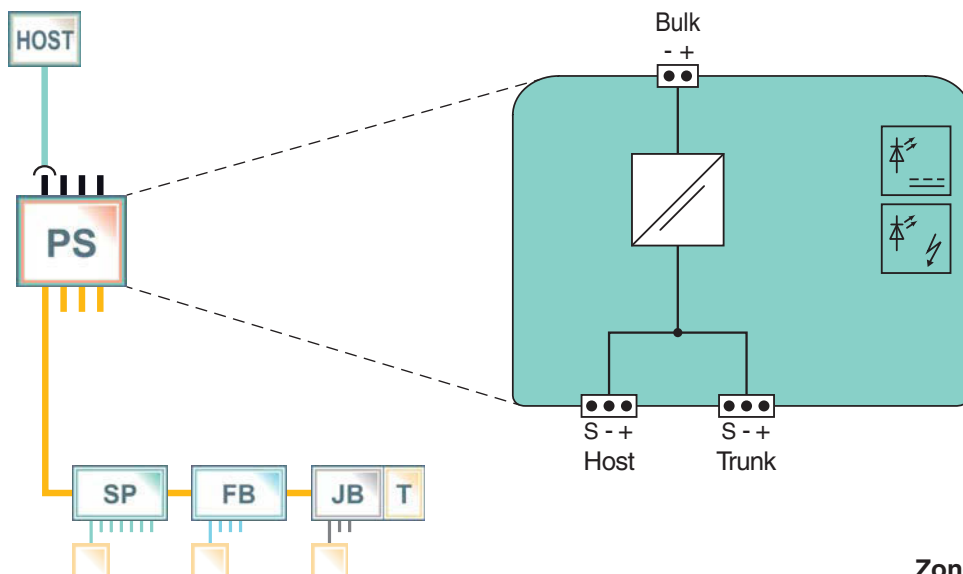
The combination of this power supply, selected motherboards and R2 Segment Protector provide outputs certified for explosion protection Entity Ex ic and Entity Ex nL.

Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage	19.2 ... 35 V DC
Rated current	700 ... 390 mA
Power loss	typ. 1.5 W

Fieldbus interface

Rated voltage	21 ... 23 V
Rated current	500 ... 10 mA
Short-circuit current	550 mA
Terminating impedance	Motherboard specific

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	Motherboard specific
Core cross-section	Motherboard specific
Mounting	motherboard mounting

Data for application in connection with Ex-areas**Outputs**

Voltage U_o	24 V
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3 G Ex nA II T4

Directive conformity

Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2006

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval	DNV A-10798

Features

- Output: 28 ... 30 V/500 mA
- High-Power Trunk for high device count and long cable runs
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- High efficiency, low heat dissipation for high packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

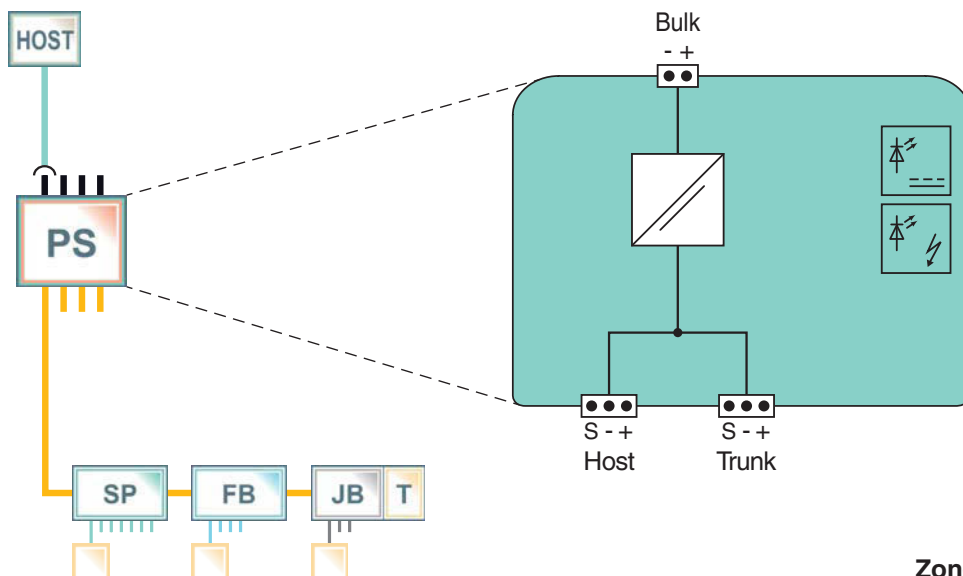
This power supply features the highest output power and allows for maximum cable lengths and highest number of devices in hazardous areas with the High-Power Trunk concept.

Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage	19.2 ... 35 V DC
Rated current	910 ... 490 mA
Power loss	typ. 1.8 W

Fieldbus interface

Rated voltage	28 ... 30 V
Rated current	500 ... 10 mA
Short-circuit current	550 mA
Terminating impedance	Motherboard specific

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	Motherboard specific
Core cross-section	Motherboard specific
Mounting	motherboard mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3 G Ex nA II T4
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2006

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval	DNV A-10798

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- Output: bulk power voltage 500 mA
- High-Power Trunk for high device count and long cable runs
- Without galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- Very low heat dissipation
- Hot swappable in redundant configuration
- Module exchange without tools during operation

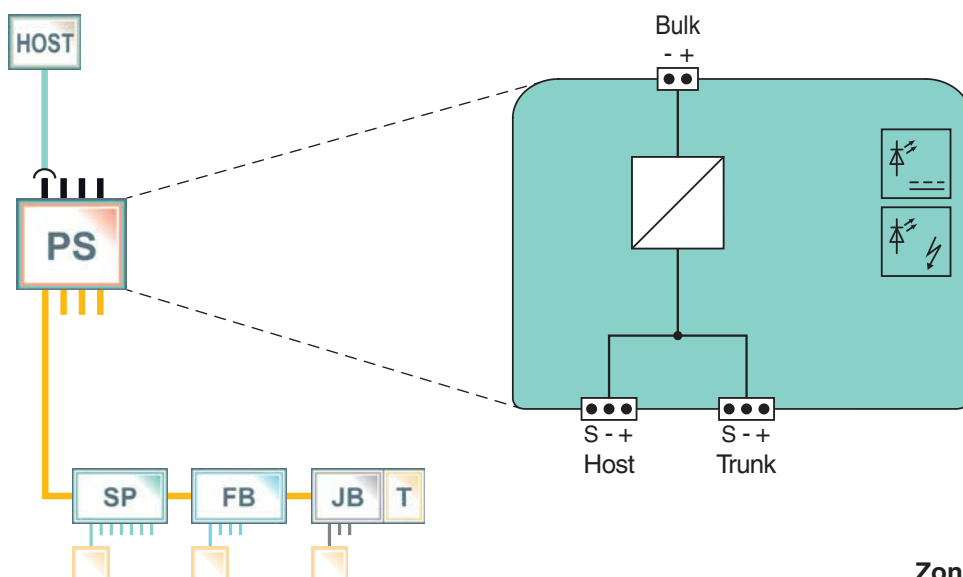
Function

The Power Conditioner Module is a system component for the FieldConnex® Power Hub and can be plugged into any universal motherboard (Type code: MB-FB*). It adapts the current for the supply of fieldbus segments and field devices. The power conditioner limits the current and provides the voltage levels from the bulk power to the network without galvanic isolation. It has the smallest number of components for a very long service life. It provides short-circuit limitation towards the segment and the host interfaces. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage	19.2 ... 32 V DC
Power loss	max. 0.8 W

Fieldbus interface

Rated voltage	supply voltage minus ≤ 2.5 V at full load
Rated current	0 ... 500 mA
Short-circuit current	600 mA
Host-rated current	0 ... 40 mA
Host short-circuit current	0 ... 55 mA
Terminating impedance	Motherboard specific

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Mechanical specifications

Connection type	Motherboard specific
Core cross-section	Motherboard specific
Mounting	motherboard mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA II T4

Directive conformity

Directive 94/9/EC	EN 60079-15:2003

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- Output: 25 ... 28 V/360 mA
- Universal power supply for most applications
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- High efficiency, low heat dissipation for high packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

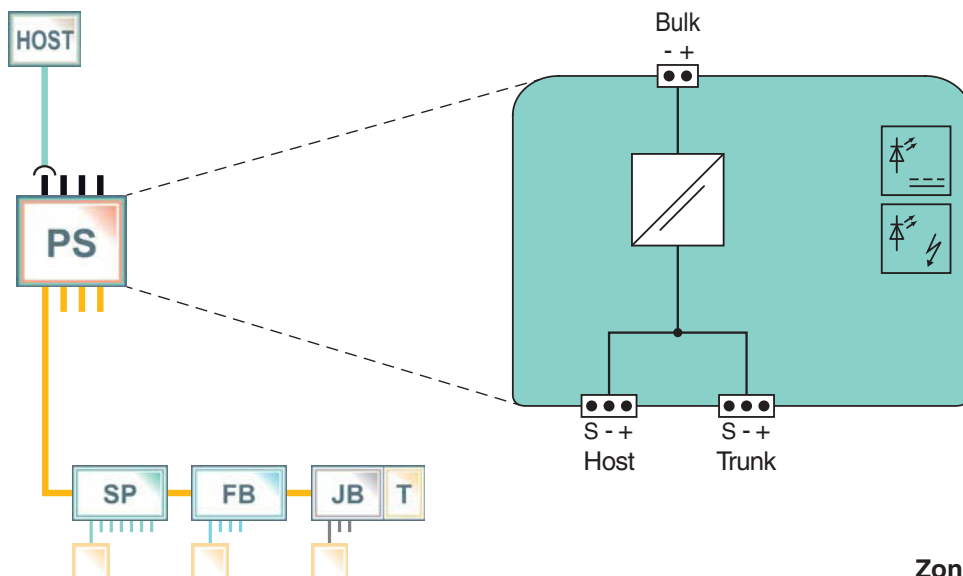
This power supply satisfies the needs of most fieldbus applications with regards to cable lengths and number of devices.

Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage 19.2 ... 35 V DC

Rated current 670 ... 360 mA

Power loss typ. 2 W

Fieldbus interface

Rated voltage 25 ... 28 V

Rated current 360 ... 10 mA

Short-circuit current typ. 400 mA

Terminating impedance Motherboard specific

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type Motherboard specific

Core cross-section Motherboard specific

Mounting motherboard mounting

Data for application in connection with Ex-areas

Statement of conformity TÜV 06 ATEX 553229 X

Group, category, type of protection, temperature class  II 3 G Ex nA II T4**Directive conformity**

Directive 94/9/EC EN 60079-15:2005, EN 60079-0:2004

International approvals

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval DNV A-10798

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- Output: 21 ... 23 V/500 mA
- Voltage limitation for Entity ic and Ex nL
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- Highest efficiency, lowest heat dissipation for highest packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

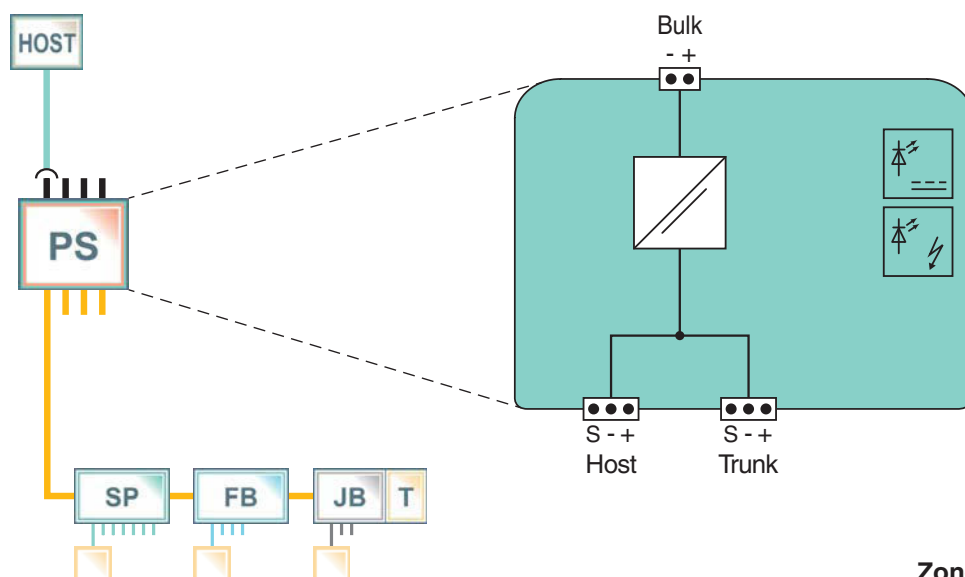
The combination of this power supply, selected motherboards and R2 Segment Protector provide outputs certified for explosion protection Entity Ex ic and Entity Ex nL.

Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage	19.2 ... 35 V DC
Power loss	typ. 1.2 W

Fieldbus interface

Rated voltage	21 ... 23 V
Rated current	500 ... 10 mA
Short-circuit current	550 mA
Terminating resistor	Motherboard specific

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	Motherboard specific
Core cross-section	Motherboard specific
Mounting	motherboard mounting

Data for application in connection with Ex-areas

Outputs	
Voltage U_o	24 V
Statement of conformity	TÜV 10 ATEX 555761X
Group, category, type of protection, temperature class	⊕ II 3G Ex nA IIC T4 Gc
Directive conformity	
Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010

Features

- Output: 28 ... 30 V/500 mA
- High-Power Trunk for high device count and long cable runs
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- Highest efficiency, lowest heat dissipation for highest packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

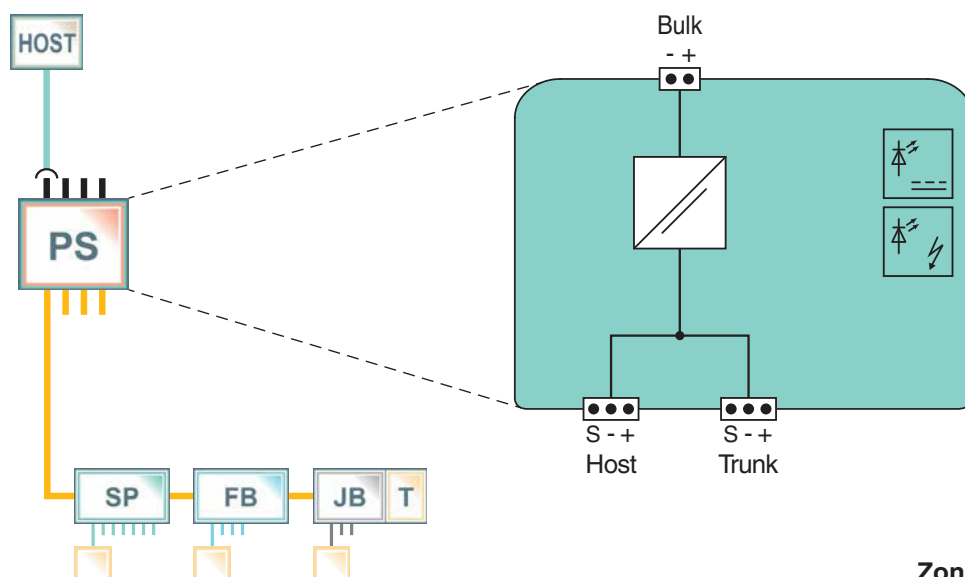
This power supply features the highest output power and allows for maximum cable lengths and highest number of devices in hazardous areas with the High-Power Trunk concept.

Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage	19.2 ... 35 V DC
Power loss	typ. 1.6 W

Fieldbus interface

Rated voltage	28 ... 29.5 V
Rated current	500 ... 10 mA
Short-circuit current	550 mA
Terminating resistor	Motherboard specific

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	Motherboard specific
Core cross-section	Motherboard specific
Mounting	motherboard mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 10 ATEX 555761X
Group, category, type of protection, temperature class	Ⓔ II 3G Ex nA IIC T4 Gc
Directive conformity	
Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010



FOUNDATION Fieldbus H1

Selection
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DistributionDART
FieldbusProcess
Interfaces

Accessories



Technical data**Supply**

Connection	Power Rail or terminals 8+, 11+; 9-, 12-
Rated voltage	10 ... 30 V DC
Efficiency	> 85 %
Rated current	350 ... 120 mA
Power loss	typ. ≤ 0.5 W

Fieldbus interface

Rated voltage	12 ... 13 V
Rated current	220 mA
Terminating impedance	100 Ω

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC/EN 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	Terminals
Core cross-section	up to 2.5 mm ²
Mounting	DIN rail mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 06 ATEX 553079 X
Group, category, type of protection, temperature class	⊕ II 3G Ex nAc IIC T4

Directive conformity

Directive 94/9/EC	EN 60079-15:2006, EN 60079-0:2009

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4



FOUNDATION Fieldbus H1

Selection
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FieldbusProcess
Interfaces

Accessories



Technical data**Supply**

Connection	Power Rail or terminals 8+, 11+; 9-, 12-
Rated voltage	19.2 ... 35 V DC
Rated current	630 ... 340 mA
Power loss	typ. 2,0 W

Fieldbus interface

Rated voltage	25 ... 27 V
Rated current	360 mA
Terminating impedance	100 Ω

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC/EN 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	Terminals
Core cross-section	up to 2.5 mm ²
Mounting	DIN rail mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 06 ATEX 553079 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA II T4
Directive conformity	
Directive 94/9/EC	EN 60079-15:2003

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval	DNV A-10798

Features

- Output: 14.7 ... 30.7 V/1 A
- For very high segment load
- High-Power Trunk for high device count and long cable runs
- Installation only in safe areas
- Selectable, high-availability terminator
- Low heat dissipation
- Supply via Power Rail

Function

The fieldbus power conditioner is an all-in-one module for single fieldbus segments. It provides short-circuit limitation (1 A) and impedance matching only. The output voltage depends on the bulk power voltage.

The device feeds high power to the trunk for maximum cable lengths and high device count in any hazardous area.

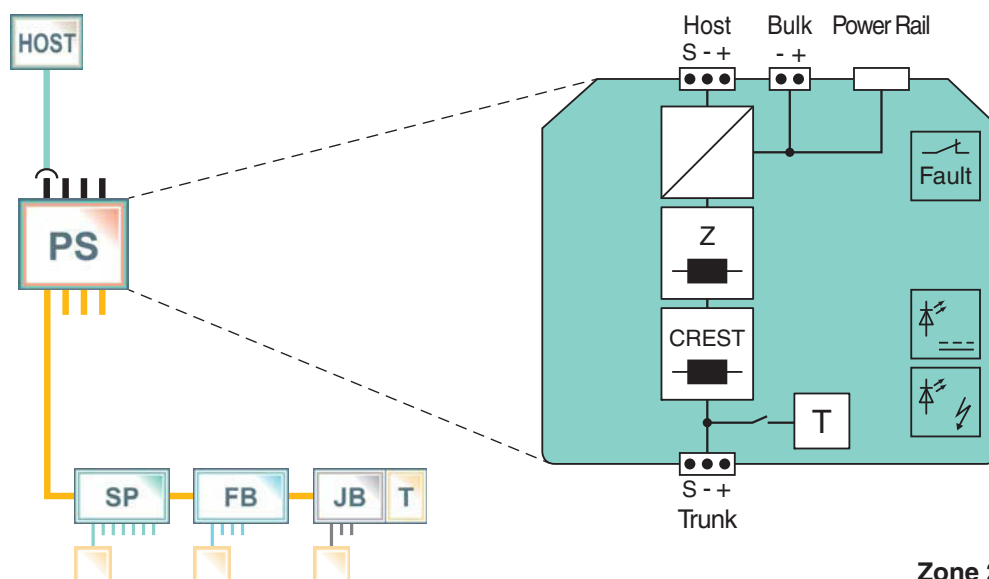
Fieldbus couplers provide explosion protection for live work at the spur.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Connection	Power Rail or terminals 8+, 11+; 9-, 12-
Rated voltage	16 ... 32 V DC
Rated current	1.02 A
Power loss	16 ... 32 V at 1 A: ≤ 1.86 W; typ. 1.6 W

Fieldbus interface

Field-side	
Rated voltage	14.7 ... 30.7 V DC
Rated current	1 A
Terminating impedance	100 Ω switchable off and on via rotary switch: 1 -> on; 0 -> off

Error message output

Connection	Power Rail or terminals 7, 10
Rated voltage	32 V DC
Rated current	10 mA
Voltage drop	1.2 V at 10 mA

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC/EN 60529
Climatic conditions	DIN IEC 721

Mechanical specifications

Connection type	Terminals
Core cross-section	up to 2.5 mm ²
Mounting	DIN rail mounting

International approvals

UL approval	UL E106378, CUL E106378
Approved for	Class I, Division 2, Groups A, B, C, D



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
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FieldbusProcess
Interfaces

Accessories



Features

- Output: 24 ... 26 V/400 mA
- For extension of fieldbus segments
- High-Power Trunk for high device count and long cable runs
- Installation in Zone 2/Class I, Div. 2
- Fixed, high-availability terminator
- High efficiency, low heat dissipation
- Supply via Power Rail

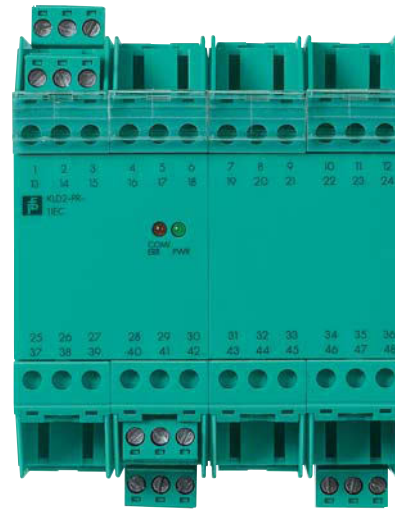
Function

The fieldbus power repeater is an all-in-one module with galvanic isolation for extending single fieldbus segments. It repeats the fieldbus signal thereby restoring waveform and signal level. The two segments interconnected are considered separate physical layers for extension of cable distance and device count.

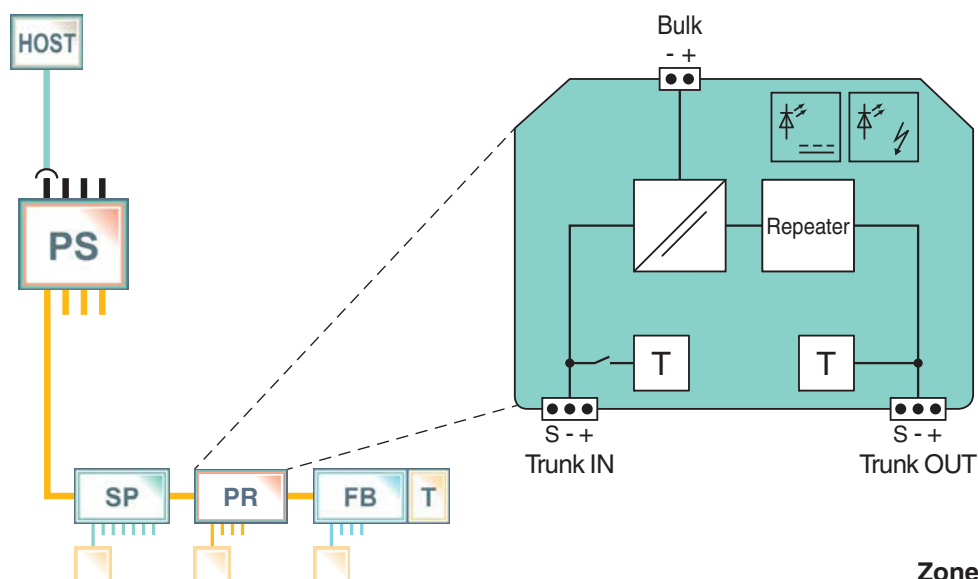
Power output is designed for long cable lengths and device counts suiting the needs of most fieldbus applications. Fieldbus couplers provide explosion protection for live work at the spur where needed.

Availability and a long service life are achieved through a passive impedance filter and an optimized design for low heat dissipation. Modules can be mounted with no spacing required in any direction for an optimized and space-saving cabinet layout.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Connection	Power Rail or terminals 47+, 48-
Rated voltage	20 ... 35 V DC
Ripple	≤ 10 %
Rated current	380 mA ... 760 mA

Fieldbus interface

Field-side

Rated voltage	24 ... 26 V DC
Rated current	≤ 400 mA
Terminating impedance	100 Ω, integrated

Host-side

Connection	Power Rail or terminals 28, 40+; 29, 41-
Rated voltage	9 ... 32 V DC (supplied switch S2 in pos. I) 0 V DC (not supplied switch S2 in pos. II)
Terminating impedance	100 Ω switchable off and on via rotary switch S1: 1 -> on; 0 -> off

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electrical isolation	EN 50178
Electromagnetic compatibility	NAMUR NE 21
Protection degree	IEC/EN 60529
Climatic conditions	DIN IEC 721

Mechanical specifications

Connection type	Terminals
Core cross-section	up to 2.5 mm ²
Mounting	DIN rail mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 01 ATEX 1788X
Group, category, type of protection, temperature class	⊕ 3G EEx nA II T4

Directive conformity

Directive 94/9/EC	EN 50021:1999

International approvals

FM approval	CoC 3015900
Approved for	Class I, Division 2, Groups A, B, C, D
CSA approval	CoC 1192739
Approved for	Class I, Division 2, Groups A, B, C, D



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
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DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Adjustable output 15 ... 30 V/max.1 A
- 8 hours operation at 500 mA without recharging
- IP 54 - Rain and splash proof
- Rugged housing for outdoor use
- Low battery and overload indication
- Output current meter
- Selectable terminators for creating any type of termination
- All in one - no additional components required

Function

Validation of device communication and fieldbus installation testing can be done even when the line voltage or DCS system is not available. This allows on-site personnel to verify the quality of the installation at early stages.

The fieldbus battery features a rugged housing for indoor/outdoor use during commissioning of fieldbus segments. The battery includes a fieldbus power conditioner. Its output voltage is adjustable to match the value of the later used fieldbus power supply. A battery charger is included.

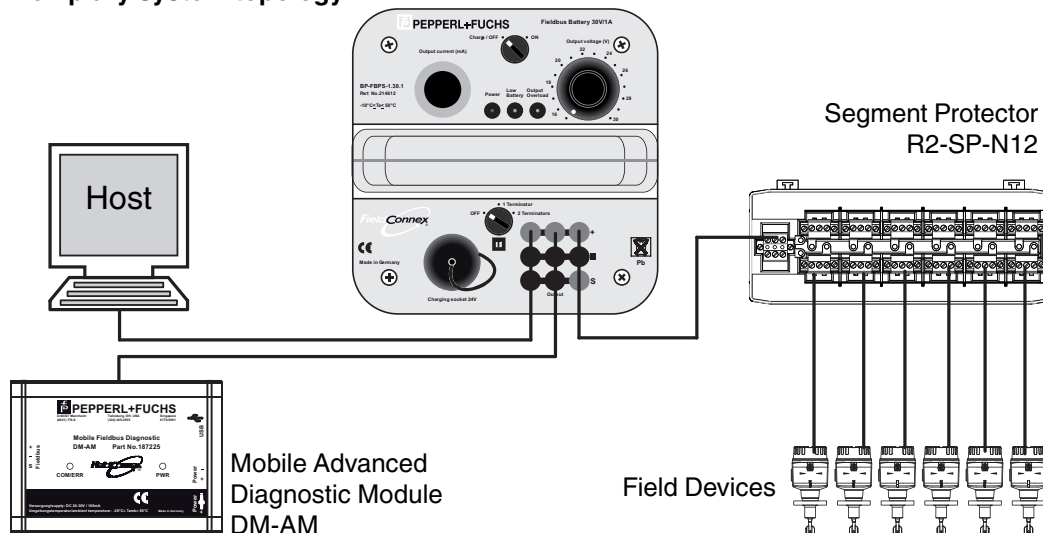
The fieldbus battery complements the FieldConnex Mobile Advanced Diagnostic Module or any other equipment available for testing any fieldbus installation.

Assembly



Connection

Exemplary system topology



Technical data**Supply**

Battery charger	110 ... 240 V AC, 50/60 Hz
Charging voltage	24 V DC

Connections

Battery charger	DC Round socket

Fieldbus interface

Rated voltage	15 ... 30 V DC, adjustable
Rated current	1 A
Host-side	banana socket 4 mm
Terminating resistor	2x 100 Ω on/off switchable via rotary switch
Diagnostic link	banana socket 4 mm

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Accumulator

Capacitance	7200 mAh
Charging time	8 ... 16 h



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Output: min. 11 V/45 mA
- For 1...2 devices/test setups
- In conjunction with NI PCMCIA-FBUS card
- Permitted for Zone 2 operation
- Windows XP/Vista/7 compatible
- USB 1.1/2.0 compatible

Function

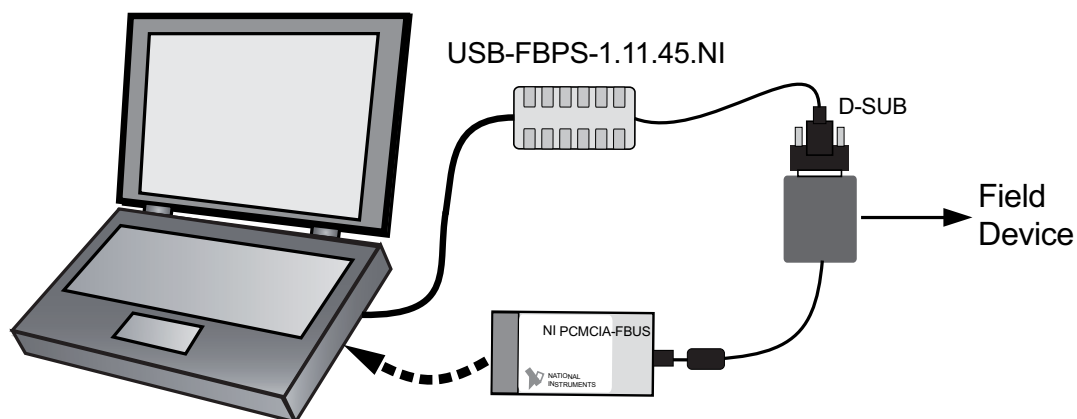
The USB-FBPS-1.11.45.NI fieldbus power supply powers one or two field devices. It connects via D-SUB female connector to the popular NI PCMCIA FBUS card by National Instruments.

This small unit is designed to enable commissioning and maintenance personnel to conduct single field device work typical during plant start-up or maintenance: device configuration download, functional test, and device tagging. The power supply provides the infrastructure from the convenience of a laptop or PC, or any other USB-port. This device complements the portfolio of FieldConnex® tools for the fieldbus practitioner on the go. It complements the mobile Diagnostic Module DM-AM for check-out, monitoring, and troubleshooting of single fieldbus segments.

Assembly



Connection



Technical data**Supply**

Connection	USB-Male Connector Typ A (Standard)
Rated voltage	typ. 5 V
Rated current	max. 350 mA
Power loss	typ. 250 mW

Fieldbus interface

Rated voltage	min. 11 V
Rated current	45 mA
Short-circuit current	typ. 60 mA
Terminating resistor	50 Ω

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Protection degree	IEC/EN 60529

Mechanical specifications

Connection type	USB-Male Connector Typ A (Standard)

Data for application in connection with Ex-areas

Outputs	
Voltage U_o	17.5 V
Declaration of conformity	PF 08 CERT 1303 X
Group, category, type of protection, temperature class	 II 3G Ex nA II T4
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006; EN 60079-15:2005; EN 60079-11:2007



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 ... 12 outputs Ex ic, Ex nL (FISCO or Entity) or non-incendive (Div 2)
- Short-circuit protection per output
- Segment Protector in Zone 2/Div. 2
- Instruments in Zone 2/Div. 2
- Power, Com, and Error LEDs
- T-connector for easy installation and maintenance
- Test points for easy troubleshooting

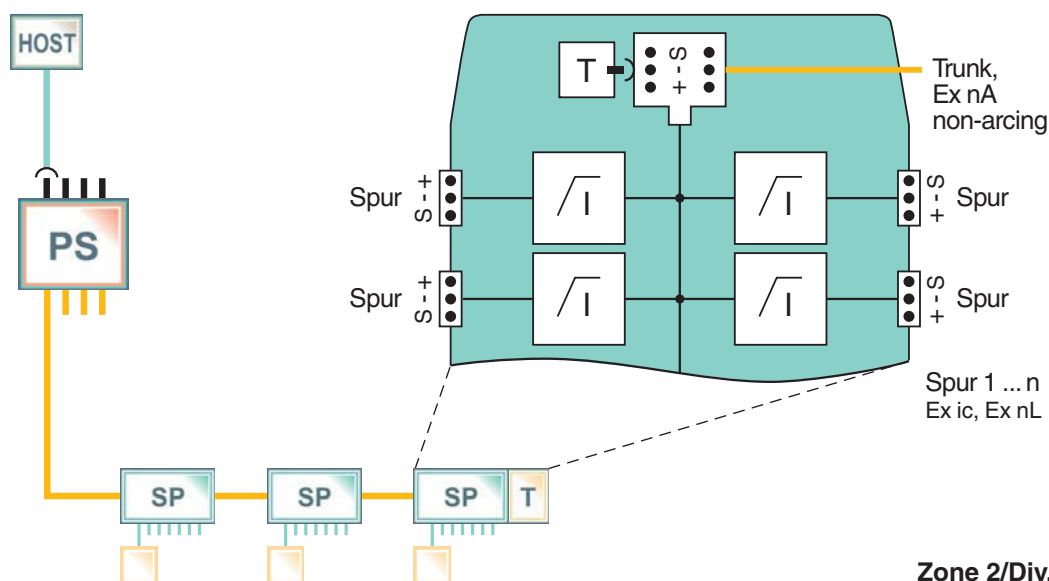
Function

The R2 Segment Protector, a fieldbus coupler for DIN-rail installation, connects 4 ... 12 instruments to the segment with intrinsic safety (Ex ic), energy limitation (Ex nL) and short circuit protection at each spur. This ensures proper operation of the segment during faults or hot work at the spur. The T-connector at the trunk allows for exchange of a Segment Protector with no effect on the remaining segment. The terminator is mounted at the 'T' and removed for network extensions always ensuring proper termination. All plugs feature retaining screws. LEDs and test access points simplify troubleshooting and help to decrease repair time. Any grounding and shielding concept is possible based on FieldConnex enclosure solutions.

Assembly



Connection



Technical data**Fieldbus interface****Main cable (Trunk)**

Rated voltage 9 ... 31 V DC

Rated current ≤ 4.5 A

Outputs

Rated voltage ≤ 31 V

Rated current ≤ 43 mA

Short-circuit current max. 58 mA

Quiescent current ≤ 8 mA (R2-SP-N4), ≤ 8 mA (R2-SP-N6), ≤ 8 mA (R2-SP-N8), ≤ 10 mA (R2-SP-N10), ≤ 10 mA (R2-SP-N12)

Voltage drop main cable/outputs ≤ 1.3 V

Voltage drop trunk In/Out 0 V

Terminating resistor external type M-FT 100 Ω +/- 10 %

Surge protection Trunk overvoltage protection if voltage exceeds typ. 39 V, max. 41 V

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NE 21:2006

Protection degree

IEC 60529

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Ambient conditions**Corrosion resistance**

acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications**Connection type**

removable screw terminals with retaining screws

Core cross-section≤ 2.5 mm²/AWG 12-24**Housing material**

Polycarbonate

Housing width

77 mm

Housing height

93 mm (R2-SP-N4), 121 mm (R2-SP-N6), 148 mm (R2-SP-N8), 177 mm (R2-SP-N10), 205 mm (R2-SP-N12)

Housing depth

42 mm

Protection degree

IP20

Mass

130 g (R2-SP-N4), 180 g (R2-SP-N6), 230 g (R2-SP-N8), 280 g (R2-SP-N10), 330 g (R2-SP-N12)

Mounting

DIN rail mounting

Data for application in connection with Ex-areas**Main cable (Trunk)**

Rated current see Statement of Conformity

OutputsVoltage U_o 24 V for IIC gas group, defined by trunk voltage

32 V for IIB gas group

Current I_o 65 mA for IIC and IIB gas groupsInductance L_o 0.25 mH for IIC and IIB gas groupsCapacitance C_o 60 nF for IIC and IIB gas groups**Statement of conformity**

TÜV 11 ATEX 081151 X

Group, category, type of protection, temperature class

Ex II 3G Ex nA [nL] [ic] IIC T4

Directive conformity

Directive 94/9/EC EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2005, EN 60079-27:2008

International approvals**FM approval**

CoC 3027877, CoC 3027877C

Control drawing

No. 116-0280

Approved for

Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, Ex nA [nL] IIC T4

UL approval

E106378

Approved for

Class I, Division 2, Groups A, B, C, D

IECEX approval

IECEX 11.0011 X

Approved for

Ex nA [nL] [ic] IIC T4

Certificates and approvals**Marine approval**

DNV A-10798

Features

- 4 ... 12 outputs Ex ic (FISCO or Entity) or non-incendive (Div 2)
- Advanced fault isolation at the spur
- Segment Protector in Zone 2/Div. 2
- Instruments in Zone 2/Div. 2 or Zone 1/Div. 1
- Advanced Diagnostics at the spur
- Power, Com, Diagnostics, and Error LEDs
- T-connector for easy installation and maintenance
- Test points for easy troubleshooting

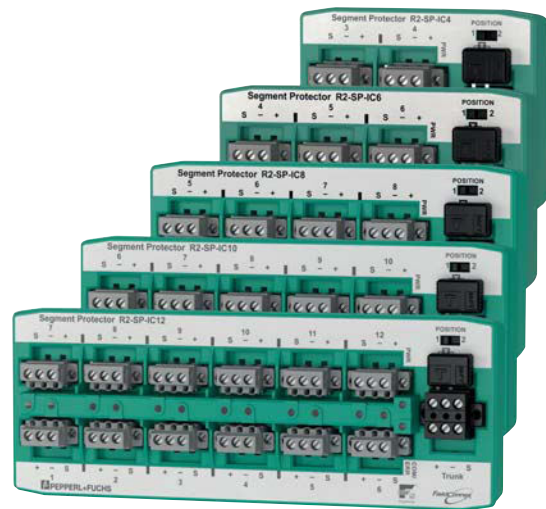
Function

The R2 Segment Protector with integrated diagnostics, a fieldbus coupler for DIN rail installation, connects 4 ... 12 instruments to the segment with intrinsic safety (Ex ic). Short-circuit, jabber, and bounce protection isolates most fault condition types from the segment. The short-circuit limit is adjustable for maximum load with Ex ic for gas groups IIB and IIC.

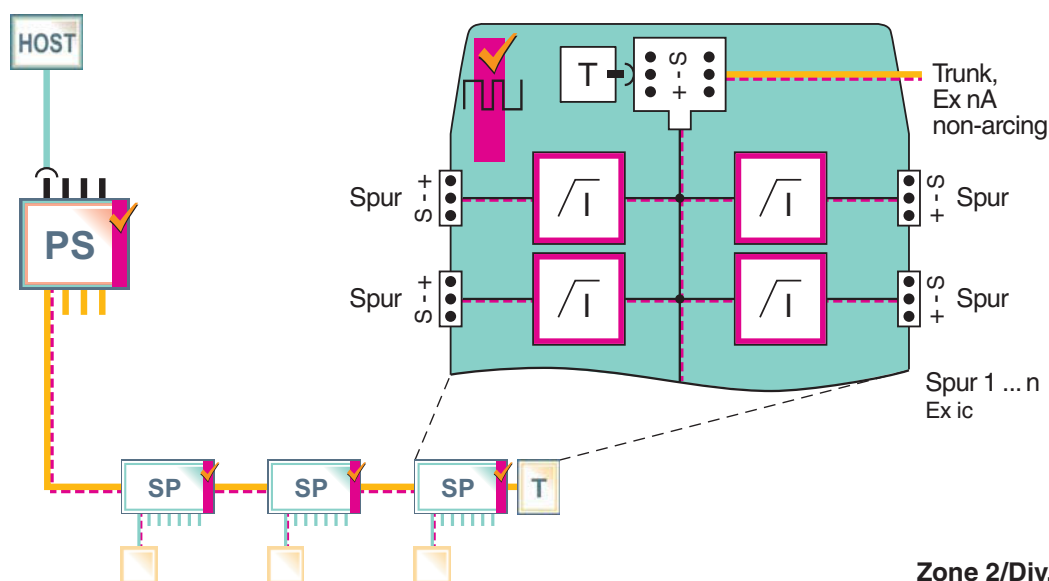
The T-connector at the trunk allows for exchange of a Segment Protector with no effect on the remaining segment. The terminator is mounted at the 'T' and removed for network extensions ensuring proper termination.

Segment Protectors with integrated diagnostics offer physical layer diagnostics at the spur. They are the basis for optional surge protectors with wear indication and enclosure leakage sensors all monitoring the quality of the installation for best availability.

Assembly



Connection



Technical data**Fieldbus interface****Main cable (Trunk)**

Rated voltage	9 ... 31 V DC 10.5 V DC minimum input voltage acc. to FF-846

Rated current	≤ 4.5 A

Outputs

Rated voltage	≤ 31 V

Rated current	≤ 32 mA switch 1, position 1 ≤ 43 mA switch 1, position 2

Short-circuit current	46 mA switch 1, position 1 65 mA switch 1, position 2

Quiescent current	≤ 15 mA (R2-SP-IC4), ≤ 17 mA (R2-SP-IC6), ≤ 17 mA (R2-SP-IC8), ≤ 19 mA (R2-SP-IC10), ≤ 19 mA (R2-SP-IC12)

Voltage drop main cable/outputs	≤ 1.2 V

Voltage drop trunk In/Out	0 V

Terminating resistor	external type M-FT 100 Ω +/- 10 %

Surge protection	Trunk overvoltage protection if voltage exceeds typ. 39 V, max. 41 V

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC	EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NE 21:2006	

Protection degree	IEC 60529

Climatic conditions	IEC 60721

Shock resistance	EN 60068-2-27

Vibration resistance	EN 60068-2-6

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	removable screw terminals with retaining screws

Core cross-section	≤ 2.5 mm ² /AWG 12-24

Housing material	Polycarbonate

Housing width	77 mm

Housing height	93 mm (R2-SP-IC4), 121 mm (R2-SP-IC6), 148 mm (R2-SP-IC8), 177 mm (R2-SP-IC10), 205 mm (R2-SP-IC12)

Housing depth	42 mm

Protection degree	IP20

Mass	130 g (R2-SP-IC4), 180 g (R2-SP-IC6), 230 g (R2-SP-IC8), 280 g (R2-SP-IC10), 330 g (R2-SP-IC12)

Mounting	DIN rail mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate	TÜV 12 ATEX 098651 X

Group, category, type of protection, temperature class	⊕ II 3 G Ex nAc [ic] IIC T4

Supply

Maximum safe voltage U _m	35 V

Outputs

Voltage U _o	32 V

Current I _o	46 mA switch 1, position 1 65 mA switch 1, position 2

Inductance L _o	0.25 mH switch 1, position 1 0.125 mH switch 1, position 2

Capacitance C _o	60 nF

Directive conformity

Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2012, EN 60079-15:2010

International approvals

IECEx approval	IECEx TUN 12.0015 X

Approved for	⊕ Ex nAc [ic] IIC T4

Certificates and approvals

Marine approval	pending

Features

- 2 outputs Ex nL, expandable to up to 26 with short-circuit protection
- High-Power Trunk for high device count and long cable runs
- Segment Protector in Zone 2/Div. 2
- Instruments in Zone 2/Div. 2
- Power, Com, and Error LEDs
- Integrated overvoltage protection

Function

The modular Segment Protector, a fieldbus coupler for DIN rail, connects instruments to the fieldbus segment. It features the most compact design and easily expandability for skid-mount applications.

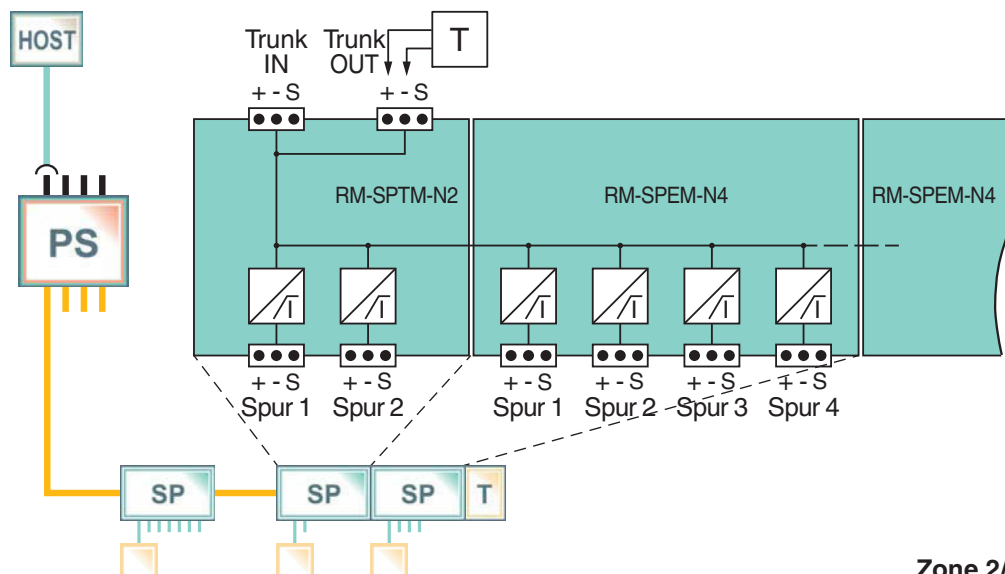
The trunk module connects the Segment Protector to the segment. Expansion modules snap side-by-side interconnected via a system plug. The high-availability terminator is mounted at the output. As it is removed for network extensions proper termination is always ensured. Short-circuit protection ensures proper operation of the segment in case of faults or hot work. Integrated LEDs simplify troubleshooting and help decrease repair time.

All connectors are plug-in type with receptacles for measuring tools, such as the mobile ADM. This leaves the wiring undisturbed. Any grounding and shielding concept is possible with FieldConnex enclosure solutions.

Assembly



Connection



Zone 2/Div. 2

Technical data**Fieldbus interface****Main cable (Trunk)**

Rated voltage 9 ... 31 V DC

Rated current ≤ 4.5 A

Outputs

Rated voltage ≤ 31 V

Rated current ≤ 43 mA

Short-circuit current max. 58 mA

Inherent current consumption

7 mA (RM-SPTM-N2), 3.5 mA (RM-SPEM-N4)

total current consumption = 7 mA + n * 3.5 mA with n = number of Extension Modules RM-SPEM-N4

Voltage drop main cable/outputs

≤ 1.3 V

Terminating resistor

100 Ω external

Surge protection

Trunk overvoltage protection if voltage exceeds typ. 39 V, max. 41 V

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NE 21:2006

Protection degree

IEC 60529

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Ambient conditions**Corrosion resistance**

acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications**Connection type**

screw terminals, removable

Core cross-section≤ 2.5 mm²/AWG 12-24**Housing material**

Polyamide PA 66

Housing width

17.5 mm per device

Housing height

94 mm

Housing depth

54 mm

Protection degree

IP20

Mass

75 g per device

Mounting

DIN rail mounting

Data for application in connection with Ex-areas**Main cable (Trunk)**

Rated current see Statement of Conformity

OutputsVoltage U_o 24 V for IIC gas group, defined by trunk voltage
32 V for IIB gas groupCurrent I_o 65 mA for IIC and IIB gas groupsInductance L_o 0.25 mH for IIC and IIB gas groupsCapacitance C_o 60 nF for IIC and IIB gas groups**Statement of conformity**

TÜV 11 ATEX 081152 X

Group, category, type of protection, temperature class  II 3G Ex nA [nL] IIC T4**Directive conformity**

Directive 94/9/EC EN 60079-15:2005, EN 60079-0:2006

International approvals**UL approval**

E106378

Approved for Class I, Division 2, Groups A, B, C, D

Certificates and approvals**Marine approval**

DNV A-10798

Features

- **4 ... 10 outputs Ex ic (FISCO or Entity) or non-incendive (Div 2)**
- **Advanced fault isolation at the spur**
- **Segment Protector in Zone 2/Div. 2**
- **Instruments in Zone 2/Div. 2 or Zone 1/Div. 1**
- **Advanced Diagnostics at the spur**
- **Power, Com, Terminator, Diagnostics, and Error LEDs**

Function

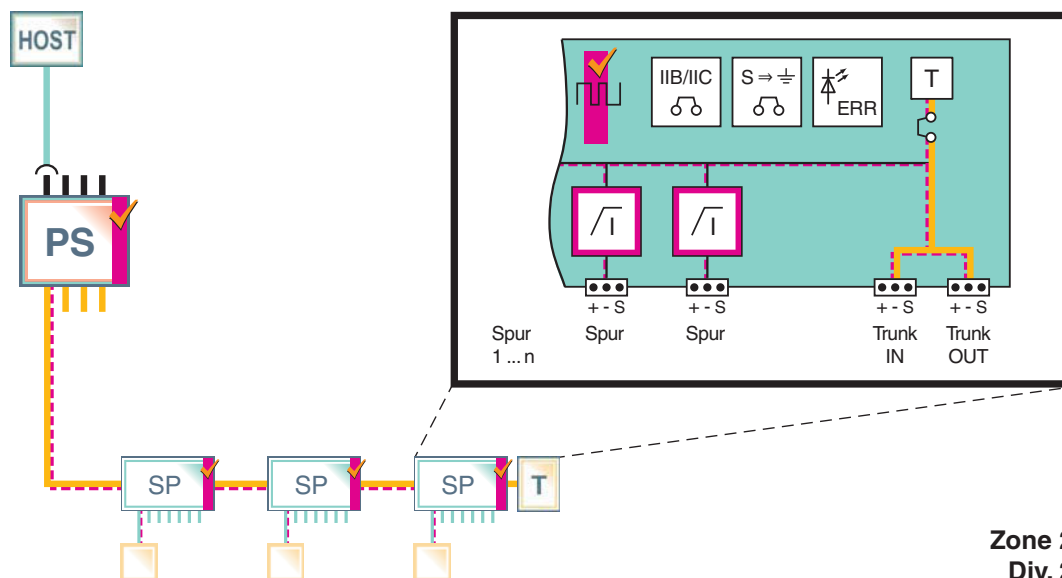
The F2 Segment Protector with integrated diagnostics, a device coupler in aluminum housing, connects 4 ... 10 instruments to the segment with intrinsic safety (Ex ic). Pre-engineering options are: cable glands in various materials; a choice of fixed or plug-in terminals with screw or spring-clamp connections. Short circuit, jabber, and bounce protection isolate most fault condition types from the segment. The short circuit current limitation is adjustable for maximum load with Ex ic for gas groups IIB and IIC. The shield can be connected hard-to-ground or floating. A terminator with LED indication is selectable via jumper.

Short circuit protection ensures proper operation of the segment in case of unwanted faults at the spur. Work on devices always requires a hot work permit. The integrated fieldbus terminator features a high-availability design and can be chosen via a jumper

Assembly



Connection



Zone 2
Div. 2

Technical data**Fieldbus interface****Main cable (Trunk)**

Rated voltage 9 ... 31 V DC, 10.5 V DC minimum input voltage acc. to FF-846

Rated current ≤ 4.5 A

Outputs

Rated voltage ≤ 31 V

Rated current ≤ 32 mA jumper 1, position 2
≤ 43 mA jumper 1, position 1Short-circuit current 46 mA jumper 1, position 2
65 mA jumper 1, position 1

Quiescent current ≤ 15 mA (F2-SP-IC04), ≤ 17 mA (F2-SP-IC06), ≤ 17 mA (F2-SP-IC08), ≤ 19 mA (F2-SP-IC10)

Voltage drop main cable/outputs ≤ 1.2 V

Voltage drop trunk In/Out 0 V

Terminating resistor selectable via Jumper 100 Ω +/- 10 %

Surge protection trunk, spurs overvoltage protected if voltage exceeds typ. 39 V, max. 41 V

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NE 21:2006

Protection degree IEC 60529

Climatic conditions IEC 60721

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Ambient conditions

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type removable screw terminal, removable spring terminal, screw terminal

Core cross-section ≤ 2.5 mm²/AWG 12-24

Cable entry cable gland, plug connection, and stopping plug options

Cable diameter 6 ... 13 mm (cable glands plastic), 7 ... 12 mm (cable glands nickel plated brass), 8.5 ... 13 mm (cable glands stainless steel), 8.5 ... 16 mm outside, 6 ... 12 mm inside, 0 ... 1.25 mm armor (cable glands nickel plated brass/stainless steel for armored cable)

Housing material ALSI12 (Cu) DIN1725 (Si 1.2 %), anodized

Housing width 120 mm (stopping plug plastic/stainless steel), 140 mm (cable glands plastic/nickel plated brass/stainless steel), 160 mm (cable glands nickel plated brass/stainless steel for armored cable), 135 mm (plug connection M12 nickel plated brass/stainless steel)

Housing height 258 mm

Housing depth 93 mm

Protection degree IP66

Mass max 2.6 kg, depending on model

Mounting panel mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate pending

Group, category, type of protection, temperature class Ex II 3 G Ex nAc [ic] IIC T4**Supply**Maximum safe voltage U_m 35 V**Outputs**Voltage U_o 32 VCurrent I_o 46 mA jumper 1, position 2

65 mA jumper 1, position 1

Inductance L_o 0.25 mH jumper 1, position 1

0.125 mH jumper 1, position 2

Capacitance C_o 60 nF**Directive conformity**

Directive 94/9/EC EN 60079-0:2009, EN 60079-11:2012, EN 60079-15:2010

International approvals

IECEx approval pending

Approved for pending

Certificates and approvals

Marine approval pending



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 ... 12 outputs Ex ic, Ex nL (FISCO or Entity)
- Glass fiber reinforced polyester, impact resistant, IP66
- Configurable cable entries for trunk and spurs
- International approvals
- Installation in Zone 2

Function

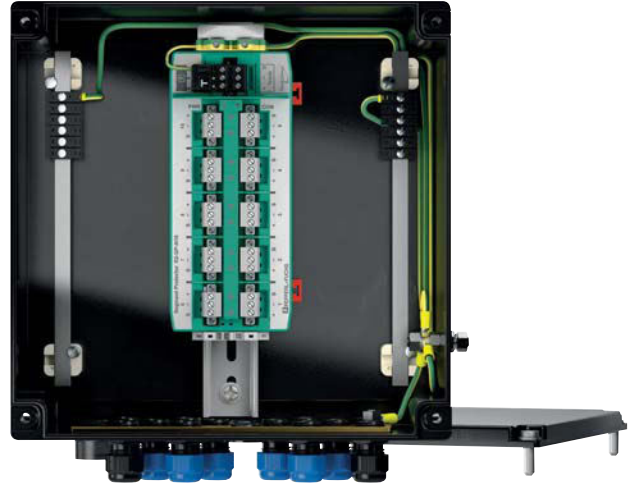
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2. Devices can be located in Zone 2. The number of outputs and size can be selected.

Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge.

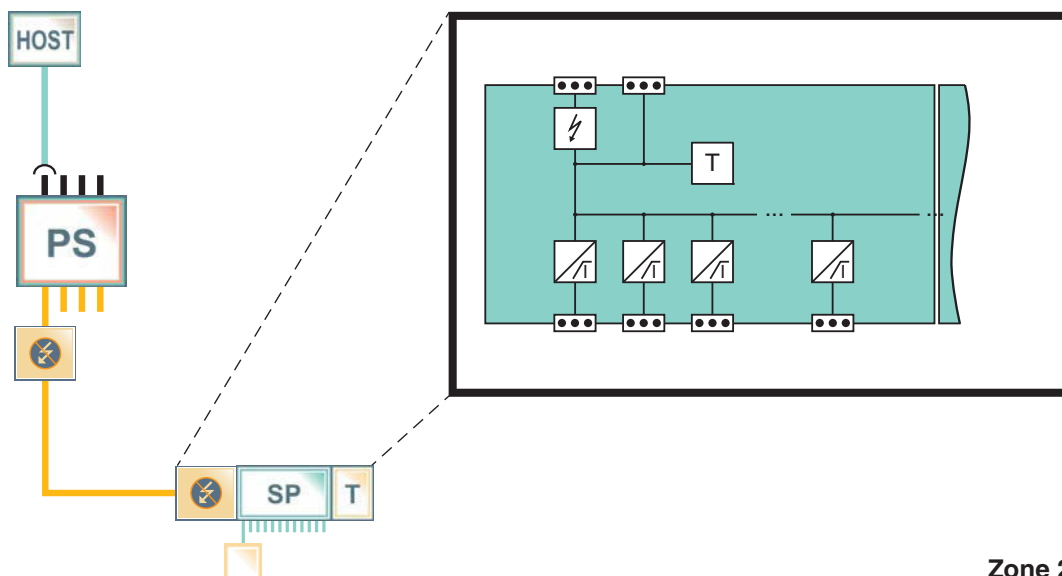
Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 2

Technical data**General specifications**

Installed components

Segment Protector R2-SP-N**

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable cover with retaining screws

Protection degree

IP66

Cable entry

cable gland and stopping plug options

Material

Housing

polyester, impact resistant, glass fiber reinforced

Surface

black molded finish (RAL 9005)

Surface resistance

< 10⁹ Ω

Water absorption

< 6 %

Seal

silicon, one piece

Grounding plate

brass

Material thickness

grounding plate: 3 mm

Dimensions

(W x H x D)

271 x 271 x 136 mm (1 x R2-SP-N**)

544 x 271 x 136 mm (2 x R2-SP-N**)

Mounting

thru-holes Ø6.5 mm

Grounding

grounding bolt M6, Stainless steel

Data for application in connection with Ex-areas

Statement of conformity

PF 08 CERT 1278 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ⓔ II 3G Ex nA [nL] [ic] IIC T4

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003, EN 60079-15:2005, EN 60079-11:2007

International approvals

IECEx approval

IECEx PTB 09.0016, suitable Junction Box on request

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- 4 ... 12 outputs Ex ic, Ex nL (FISCO or Entity)
- Stainless steel, electropolished, IP66
- Configurable cable entries for trunk and spurs
- International approvals
- Installation in Zone 2

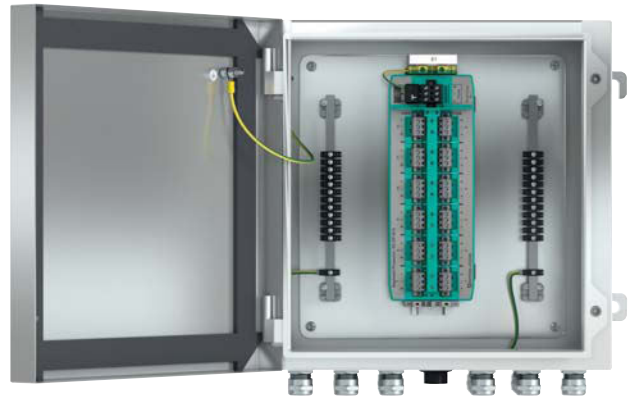
Function

This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2. Devices can be located in Zone 2. The number of outputs and size can be selected.

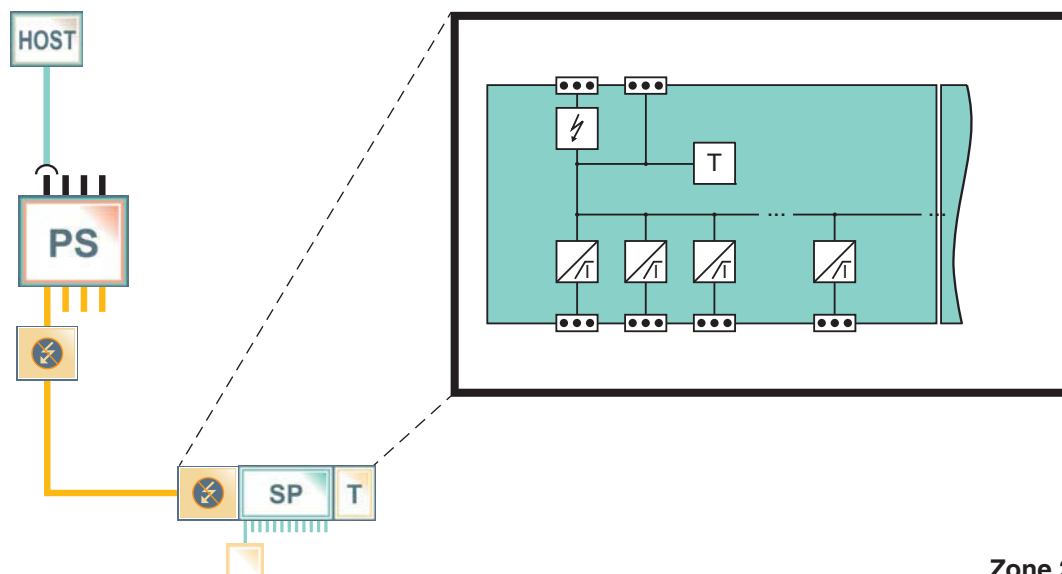
Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. The integrated rain channel prevents standing water from damaging the one-piece seal.

Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options. This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 2

Technical data**General specifications**

Installed components

Segment Protector R2-SP-N**

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable hinged door with captive retaining screws

Protection degree

IP66

Cable entry

cable gland and stopping plug options

Material

Housing

Stainless steel 1.4404/AISI 316L

Surface

electropolished

Seal

Neoprene, fire-resistant, one piece

Material thickness

enclosure body, enclosure cover, mounting plate: 1.5 mm
gland plate: 3.0 mm

Dimensions

(W x H x D)
306 x 306 x 165 mm (1 x R2-SP-N**)
380 x 380 x 175 mm (2 x R2-SP-N**)

Mounting

thru-holes Ø10 mm

Grounding

grounding bolt M10, brass

Data for application in connection with Ex-areas

Statement of conformity

PF 08 CERT 1278 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 3G Ex nA [nL] [ic] II C T4

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003, EN 60079-15:2005, EN 60079-11:2007

International approvals

IECEx approval

IECEx PTB 09.0016, suitable Junction Box on request

Features

- Intrinsically safe (Ex ic)/non-incendive outputs
- Anodized aluminum, IP67
- Configurable cable entries for trunk and spurs
- Packaged solution
- Installation in Class I, Division 2

Function

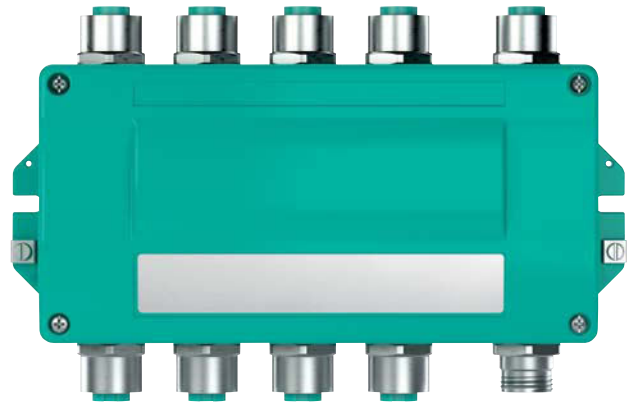
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Anodized aluminum provides corrosion resistance also to salt and impact resistance with lower weight compared to stainless steel. The compact housing offers convenient mounting flanges with external grounding lug.

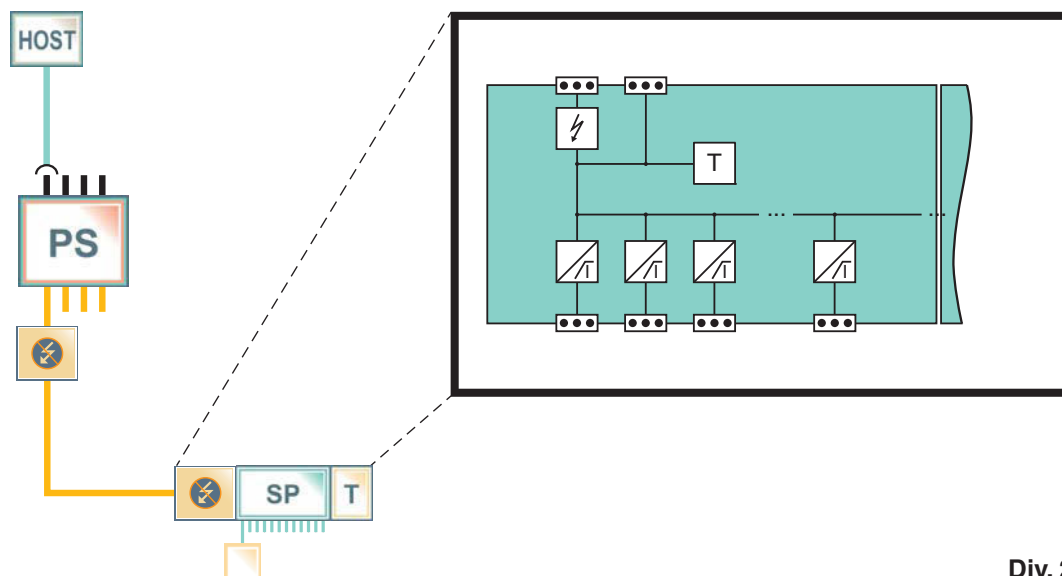
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components

Segment Protector R2-SP-N**

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Mechanical specifications

Enclosure cover

detachable cover with retaining screws

Protection degree

IP67

Cable entry

cable gland and stopping plug options

Material

Housing

aluminum

Surface

epoxy polyester paint

Seal

Polyurethane (PUR), one piece

Material thickness

enclosure body: 4 mm

enclosure cover: 3 mm

Dimensions

(W x H x D)

114 x 258 x 84 mm

Mounting

panel mount with M6 slots

Grounding

grounding bolt on enclosure body and enclosure cover

Features

- Intrinsically safe (Ex ic)/non-incendive outputs
- Carbon steel, NEMA 4
- Configurable cable entries for trunk and spurs
- Packaged solution
- Installation in Class I, Division 2

Function

This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Painted carbon steel provides good corrosion resistance. The optional window makes it easy to see the coupler's LEDs.

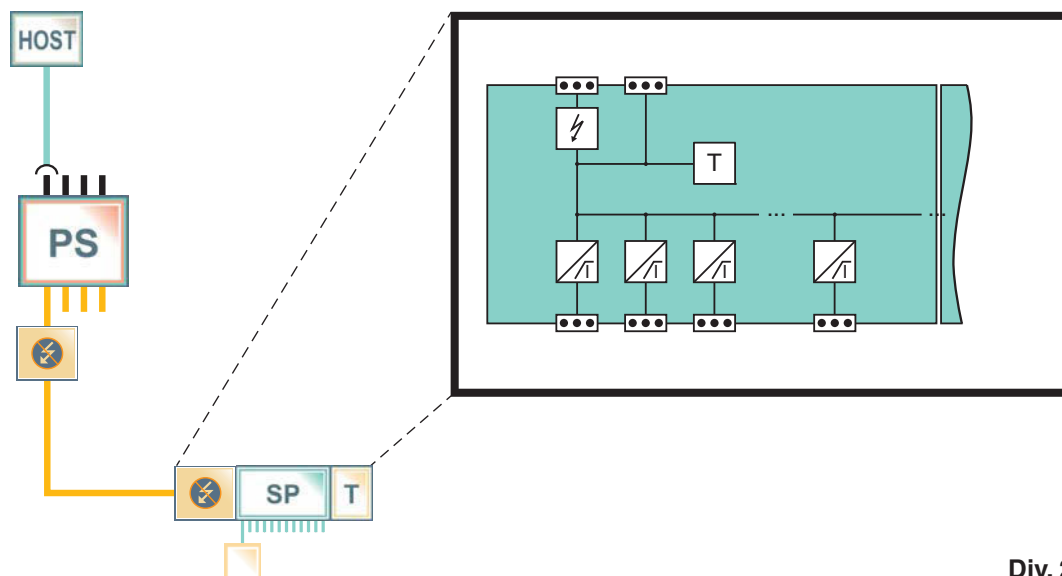
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components

Segment Protector R2-SP-N**

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Mechanical specifications

Enclosure cover

hinged door with cam lock

Protection degree

IP66, NEMA 4, NEMA 4X, NEMA 12

Cable entry

cable gland and stopping plug options

Material

Housing

Steel

Surface

gray paint

Seal

oil-resistant, one piece

Material thickness

enclosure body, enclosure cover: 1.6 mm
window: 6 mm

Dimensions

(W x H x D)

203 x 254 x 102 mm

window size: 197 x 95 mm

Mounting

thru-holes Ø6.4 mm

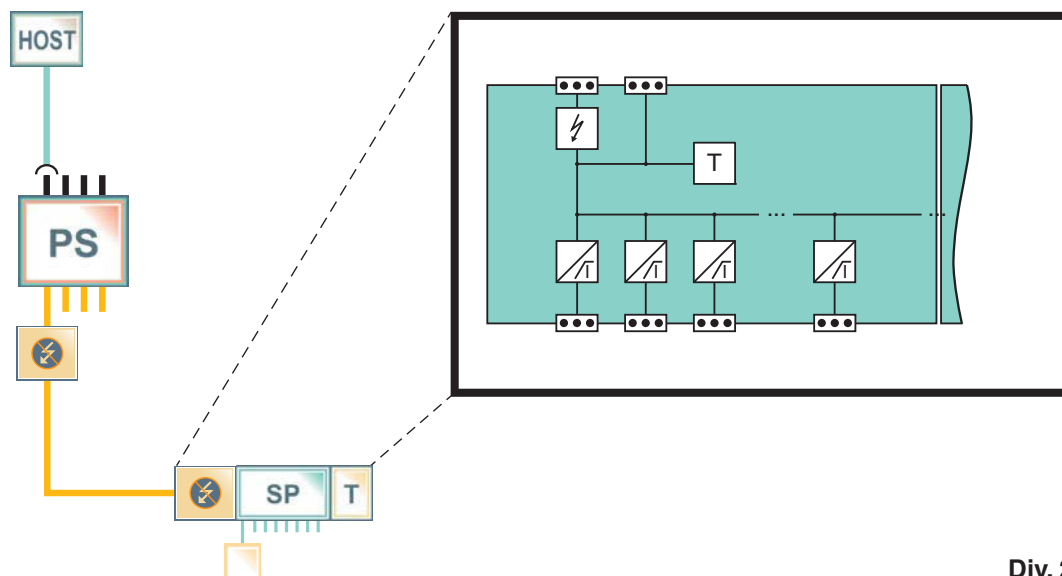
Grounding

grounding bolt on enclosure body and enclosure cover

- ## Function

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Connection



Div. 2

Technical data**General specifications**

Installed components	Segment Protector R2-SP-N** For technical data on installed electronic component see data sheet.

Mechanical specifications

Enclosure cover	detachable cover with stainless steel safety chain

Protection degree	NEMA 6P, NEMA 12

Cable entry	cable gland and stopping plug options

Material

Housing	polyester, impact resistant, glass fiber reinforced

Seal	Polyurethane (PUR), one piece

Material thickness	enclosure body: 4 mm enclosure cover: 3 mm

Dimensions	(W x H x D) 191 x 244 x 121 mm

Mounting	Flanged mounting Ø8 mm holes

Features

- Intrinsically safe (Ex ic)/non-incendive outputs
- Impact resistant polycarbonate, NEMA 4x
- Configurable cable entries for trunk and spurs
- Packaged solution
- Installation in Class I, Division 2

Function

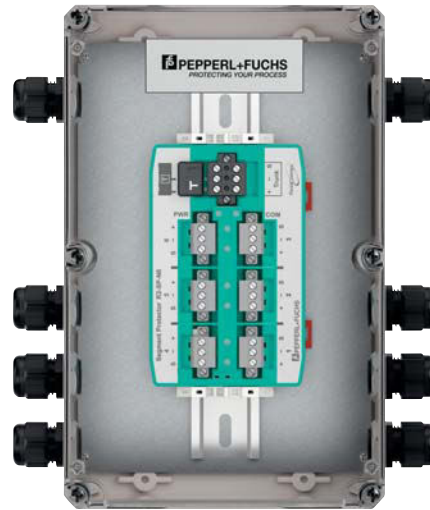
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Impact-resistant polycarbonate provides corrosion resistance. It is light weight and easy to modify. The clear cover makes it easy to see the coupler's LEDs.

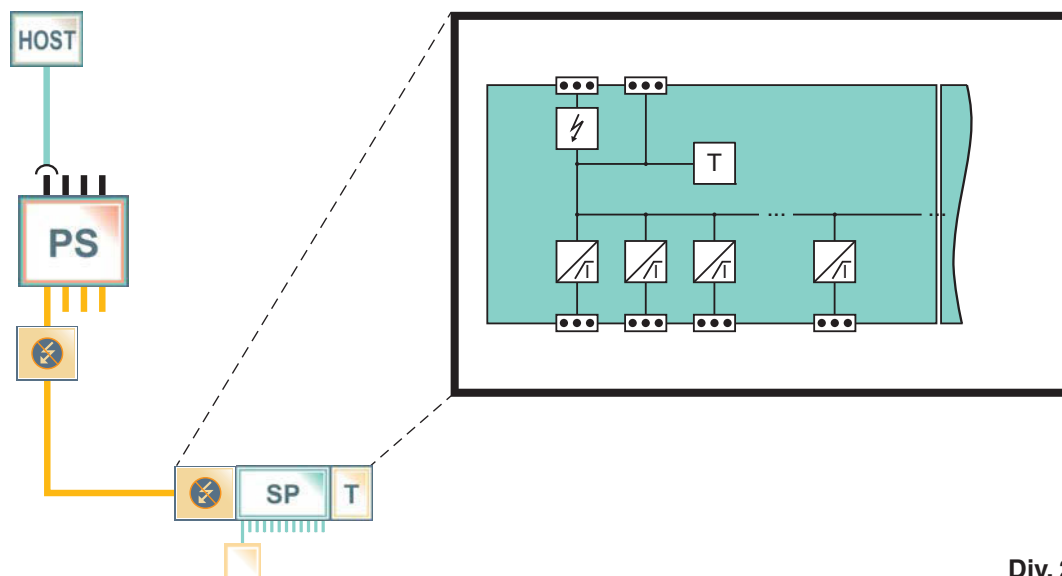
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components

Segment Protector R2-SP-N**

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Mechanical specifications

Enclosure cover

detachable cover with retaining screws

Protection degree

IP67, NEMA 4, NEMA 4X, NEMA 6, NEMA 12, NEMA 13

Cable entry

cable gland and stopping plug options

Material

Housing

polycarbonate, impact resistant

Seal

Polyurethane (PUR), one piece

Material thickness

enclosure body: 4 mm

enclosure cover: 3 mm

Dimensions

(W x H x D)

160 x 240 x 90 mm

Mounting

holes Ø4.5 mm

Features

- Intrinsically safe (Ex ic)/non-incendive outputs
- Stainless steel, brushed NEMA 4x
- Configurable cable entries for trunk and spurs
- Packaged solution
- Installation in Class I, Division 2

Function

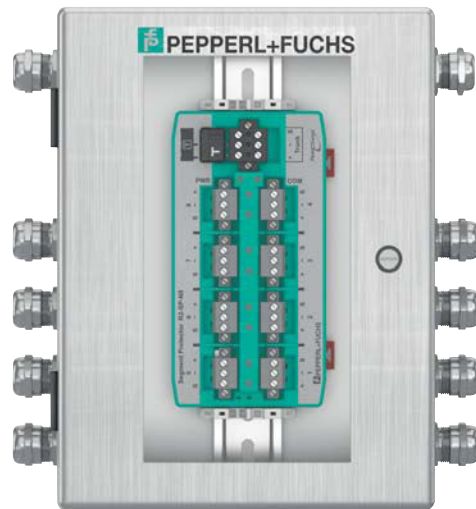
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. The flanged collar around the door prevents standing water from damaging the one-piece seal. The optional window makes it easy to see the coupler's LEDs.

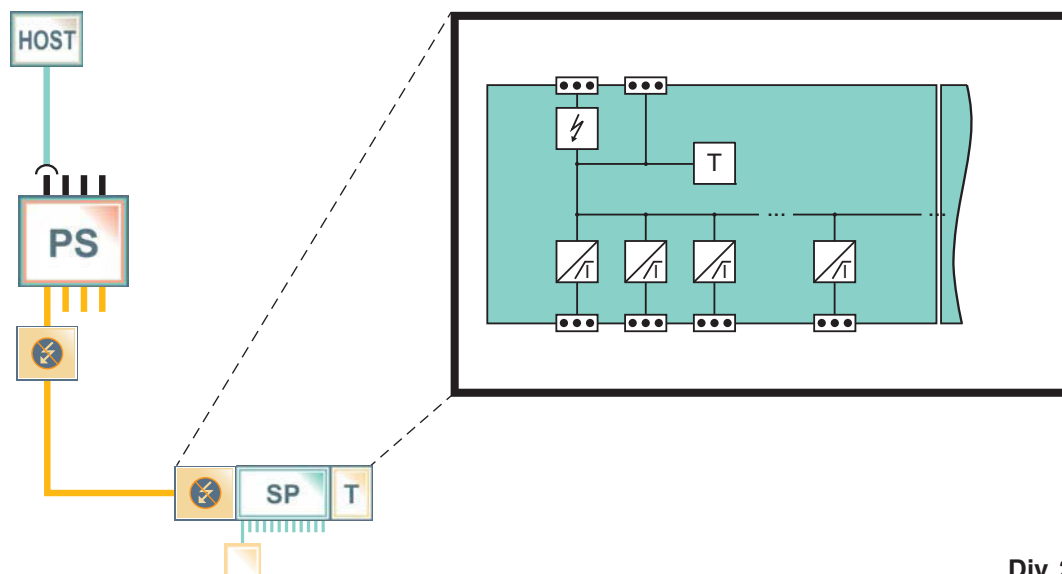
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components

Segment Protector R2-SP-N**

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Mechanical specifications

Enclosure cover

hinged door with cam lock

Protection degree

IP66, NEMA 4, NEMA 4X, NEMA 12

Cable entry

cable gland and stopping plug options

Material

Housing

Stainless steel 1.4404/AISI 316L

Surface

brushed finish

Seal

oil-resistant, one piece

Material thickness

enclosure body, enclosure cover: 1.6 mm
window: 6 mm

Dimensions

(W x H x D)

203 x 254 x 102 mm

window size: 197 x 95 mm

Mounting

thru-holes Ø6.4 mm

Grounding

grounding bolt on enclosure body and enclosure cover

Features

- 12 increased safety outputs (Ex e)
- Segment Protector in Zone 1/Div. 2
- Instruments in Zone 1/Div. 1
- Short-circuit protection per output
- High power on trunk and spurs

Function

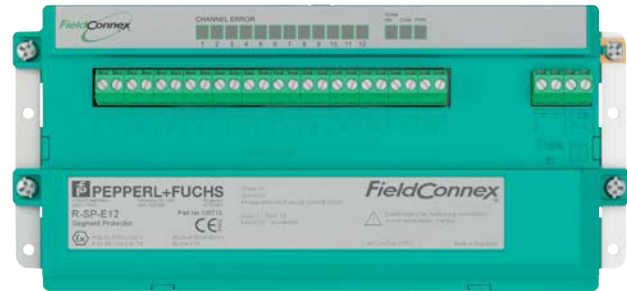
The R-SP-E12 Segment Protector is a fieldbus coupler that connects instruments to the fieldbus segment. Flameproof (Ex d) field devices are connected to the trunk line via one output each. Trunk and spurs are certified increased safety (Ex e).

Short-circuit protection ensures proper operation of the segment in case of unwanted faults at the spur. Work on devices always requires a hot work permit. The integrated fieldbus terminator features high-availability design and is selectable.

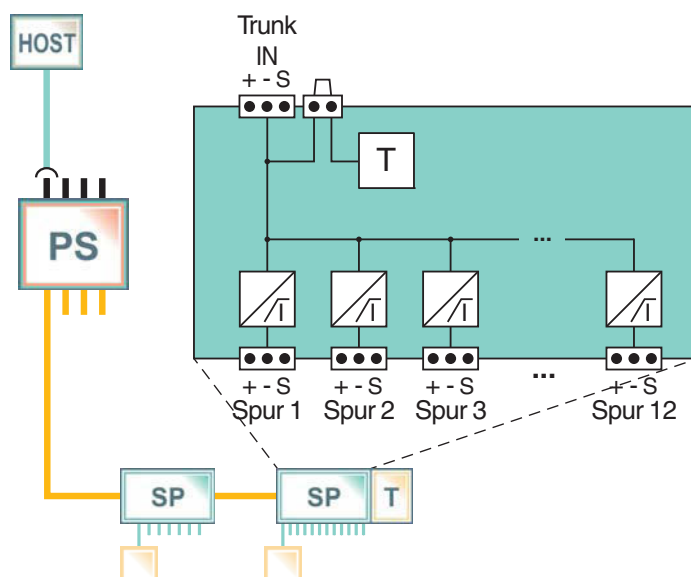
Connectors are fixed screw terminals. Any grounding and shielding concept is possible based on FieldConnex enclosure solutions.

Customizable housings host one or more Segment Protectors for different output counts.

Assembly



Connection



Zone 1/Div. 2

Technical data**Fieldbus interface****Main cable (Trunk)**

Rated voltage 9 ... 32 V DC

Outputs

Rated voltage ≤ 32 V

Rated current ≤ 40 mA

Short-circuit current max. 50 mA

Self current consumption

Voltage drop main cable/outputs ≤ 1.3 V

Terminating impedance

100 Ω integrated

Terminating resistor

selectable 100 Ω integrated

Surge protection

trunk, spurs overvoltage protected if voltage exceeds typ. 39 V, max. 41 V

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NE 21:2006

Protection degree

IEC 60529

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Mechanical specifications**Connection type**

screw fixing

Core cross-section≤ 2.5 mm²/AWG 12-24**Housing material**

Polycarbonate

Housing width

216 mm

Housing height

100 mm

Housing depth

50 mm

Protection degree

IP20

Mass

800 g

Mounting

DIN rail mounting

Data for application in connection with Ex-areas**EC-Type Examination Certificate**

PTB 04 ATEX 2100 X

Group, category, type of protection, temperature class

Ex II 2G EEx mb e IIC T4

Maximum values

Rated voltage ≤ 35 V

Prospective short-circuit current 100 A

Directive conformity

Directive 94/9/EC EN 50014:1997+A1+A2, EN 50019:2000, EN 60079-18:2004

International approvals**IECEx approval**

IECEx PTB 05.0010X

Approved for

Ex me II T4



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Connection of Ex d certified devices
- Glass fiber reinforced polyester, impact resistant, IP66
- Configurable cable entries for trunk and spurs
- International approvals
- Installation in Zone 1

Function

This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 1. Devices can be located in Zone 1. The number of outputs and size can be selected.

Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge.

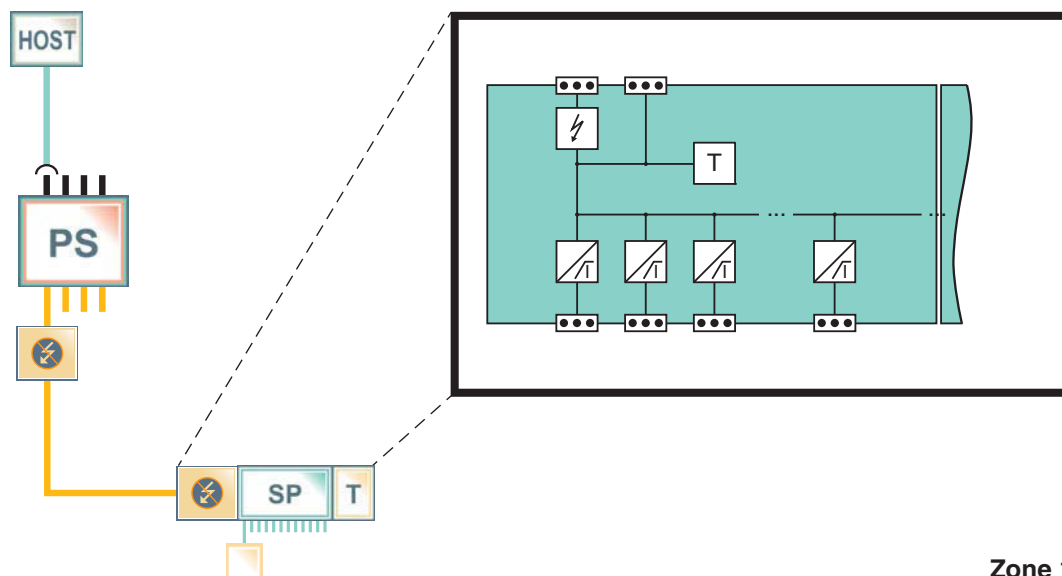
Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 1

Technical data	
General specifications	
Installed components	Segment Protector R-SP-E12 For technical data on installed electronic component see data sheet.
Conformity	
Protection degree	EN 60529
Impact resistance	EN 60079-0
Mechanical specifications	
Enclosure cover	detachable cover with retaining screws
Protection degree	IP66
Cable entry	cable gland and stopping plug options
Material	
Housing	polyester, impact resistant, glass fiber reinforced
Surface	black molded finish (RAL 9005)
Surface resistance	$< 10^9 \Omega$
Water absorption	$< 6 \%$
Seal	silicon, one piece
Grounding plate	brass
Material thickness	grounding plate: 3 mm
Dimensions	(W x H x D) 271 x 271 x 136 mm (1 x R2-SP-E12) 544 x 271 x 136 mm (2 x R2-SP-E12)
Mounting	thru-holes Ø6.5 mm
Grounding	grounding bolt M6, Stainless steel
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	Ex II 2G Ex e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***00) Ex II 2G Ex d e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***T) Ex II 2G Ex d e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***3*)
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 600079-14:2003
International approvals	
IECEX approval	IECEX PTB 07.0036, suitable Junction Box on request
INMETRO	2008EC02CP015, suitable Junction Box on request

Features

- Connection of Ex d certified devices
- Stainless steel, electropolished, IP66
- Configurable cable entries for trunk and spurs
- International approvals
- Installation in Zone 1

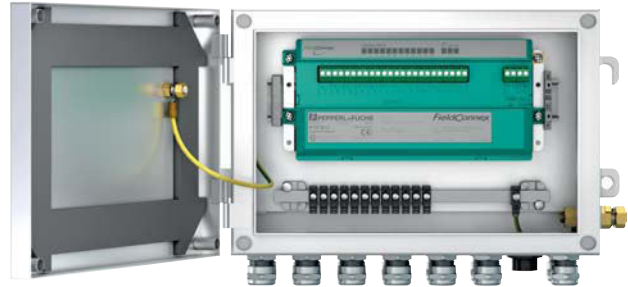
Function

This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 1. Devices can be located in Zone 1. The number of outputs and size can be selected.

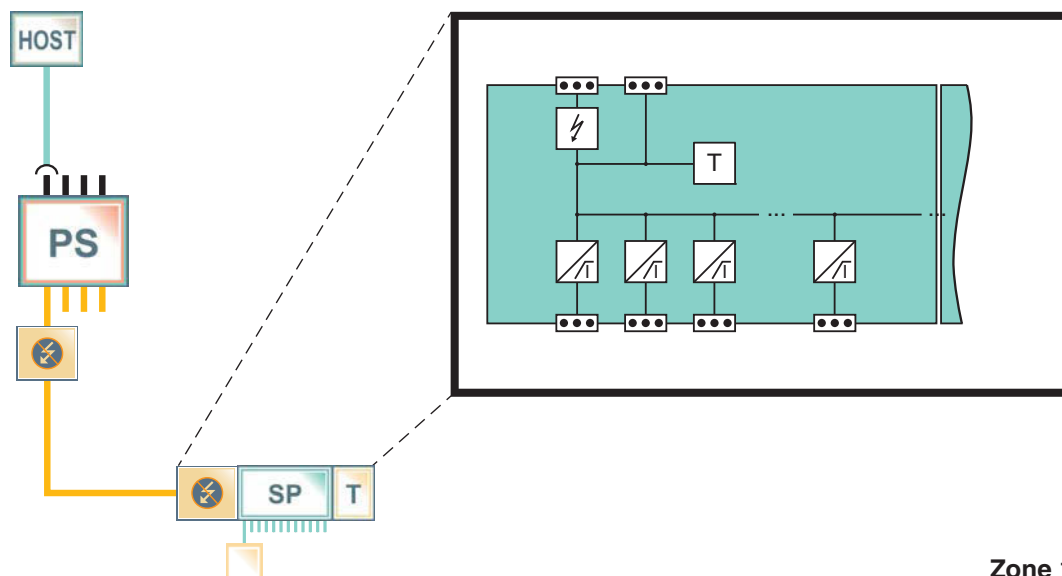
Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. Trunk and spur entries can be selected individually from a wide range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk are available as options.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Technical data**General specifications**

Installed components

Segment Protector R-SP-E12

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable hinged door with captive retaining screws

Protection degree

IP66

Cable entry

cable gland and stopping plug options

Material

Housing

Stainless steel 1.4404/AISI 316L

Surface

electropolished

Seal

Neoprene, fire-resistant, one piece

Material thickness

enclosure body, enclosure cover, mounting plate: 1.5 mm
gland plate: 3.0 mm

Dimensions

(W x H x D)
300 x 200 x 120 mm (1 x R-SP-E12)
480 x 400 x 175 mm (2 x R-SP-E12)

Mounting

thru-holes Ø10 mm

Grounding

grounding bolt M10, brass

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

⊕ II 2G Ex e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***00)

⊕ II 2G Ex d e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***T)

⊕ II 2G Ex d e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***3*)

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval

IECEx PTB 07.0036, suitable Junction Box on request

INMETRO

2008EC02CP015, suitable Junction Box on request

Features

- 4 outputs Ex ia IIC
- FieldBarrier in Zone 1/Div. 2
- Instruments in Zone 0...1/Div. 1
- Short-circuit protection per output
- Power, Com, and Error LEDs
- Supports FISCO and Entity
- Integrated cable tie-downs
- Supports all grounding methods

Function

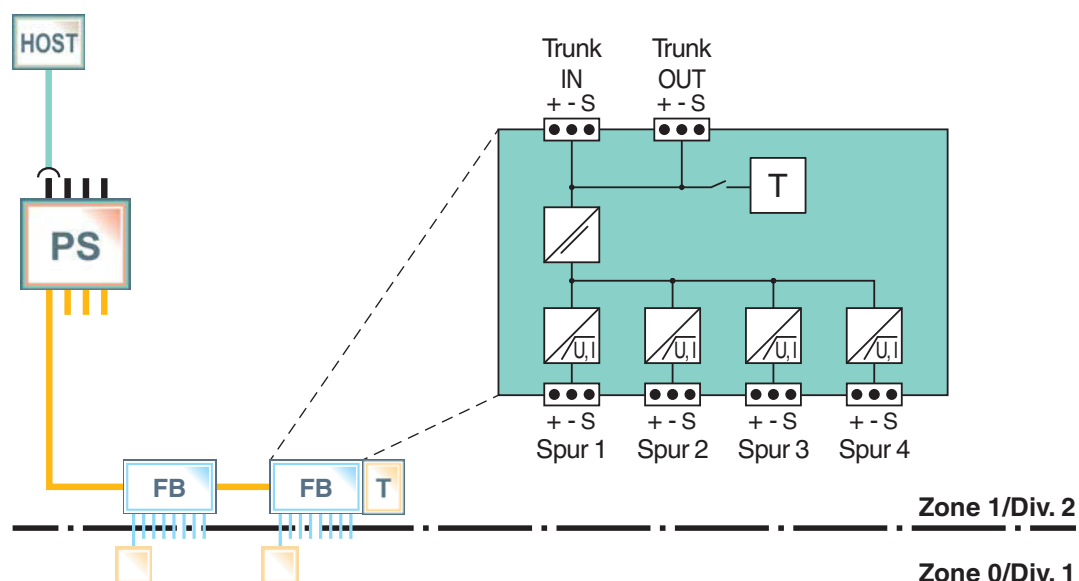
The FieldBarrier, a fieldbus coupler for DIN rail installation, connects four instruments with intrinsic safety (Ex ia/Ex ib) and short-circuit protection at each output. This ensures proper operation of the segment during faults or hot work at the spur.

High power on the trunk enables maximum cable lengths and device count in any hazardous area. The integrated fieldbus terminator features high-availability design and is selectable. Output terminals with a choice of fixed or spring clamp terminals connect one device each. LEDs simplify troubleshooting and help decrease repair time. Any grounding and shielding concept is possible based on FieldConnex enclosure solutions.

Assembly



Connection



Technical data**Fieldbus interface****Main cable (Trunk)**

Connection input (Trunk IN): terminals 3+, 4-, 5s
output (Trunk OUT): terminals 7-, 8+, 6s

Rated voltage 32 ... 16 V DC

Rated current 31 mA ... 26 mA (without load)
77 mA ... 115 mA (at 20 mA load per input)
120 mA ... 209 mA (at 40 mA load per input)
135 mA ... 241 mA (short-circuit on all outputs)

Outputs

Rated voltage 10 ... 13 V

Rated current ≤ 43 mA

Short-circuit current 50 mA

Terminating impedance 100 Ω switchable

Electrical isolation

Main wire/outputs isolation is not affected by interference according to EN 50020, voltage peak value 375 V

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NE 21:2006

Protection degree IEC/EN 60529

Climatic conditions DIN IEC 721

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type fixed terminals, plug-in terminals

Core cross-section up to 2.5 mm²

Housing material Polycarbonate

Housing width 100 mm

Housing height 217 mm

Housing depth 74 mm

Protection degree IP20

Mass 1050 g

Mounting mounting on DIN rail in cabinet

Data for application in connection with Ex-areas

EC-Type Examination Certificate PTB 02 ATEX 2086

Group, category, type of protection, temperature class  II 2(1G/D) G EEx me [ia] IIC T4

Main cable (Trunk)

Maximum safe voltage U_m 253 V AC

Outputs in accordance to IEC 60079-27

Voltage U_o 15.75 V

Current I_o 248 mA

Power P_o 975 mW

Declaration of conformity PF 08 CERT 0579 Valid for F2 housing solution without plug connectors

Group, category, type of protection, temperature class  II 3 D Ex tD A22 IP54 T135 °C (non-conductive dust)

Directive conformity

Directive 94/9/EC EN 50014:1997+A1+A2, EN 61241-0:2007, EN 61241-1:2007, EN 50020:1994, EN 50019:2000, EN 50028:1987

International approvals

FM approval CoC 3015728

Control drawing No. 116-0226

Approved for Class I, Division 2, Groups A, B, C, D/Class I, Zone 2, AEx nA [ia] IIC T4

CSA approval CoC 1592754

Control drawing 116-0266

Approved for Class I, Division 2, Groups A, B, C, D/Class I, Zone 2, Ex nA [ia] IIC T4

IECEx approval IECEx PTB 03.0003

Approved for Ex me [ia] IIC T4

Certificates and approvals

Marine approval DNV A-10798

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- 4 outputs Ex ia IIC
- FieldBarrier in Zone 1/Div. 2
- Instruments in Zone 0...1/Div. 1
- Short-circuit protection per output
- Power, Com, and Error LEDs
- Supports FISCO and Entity
- Integrated cable tie-downs

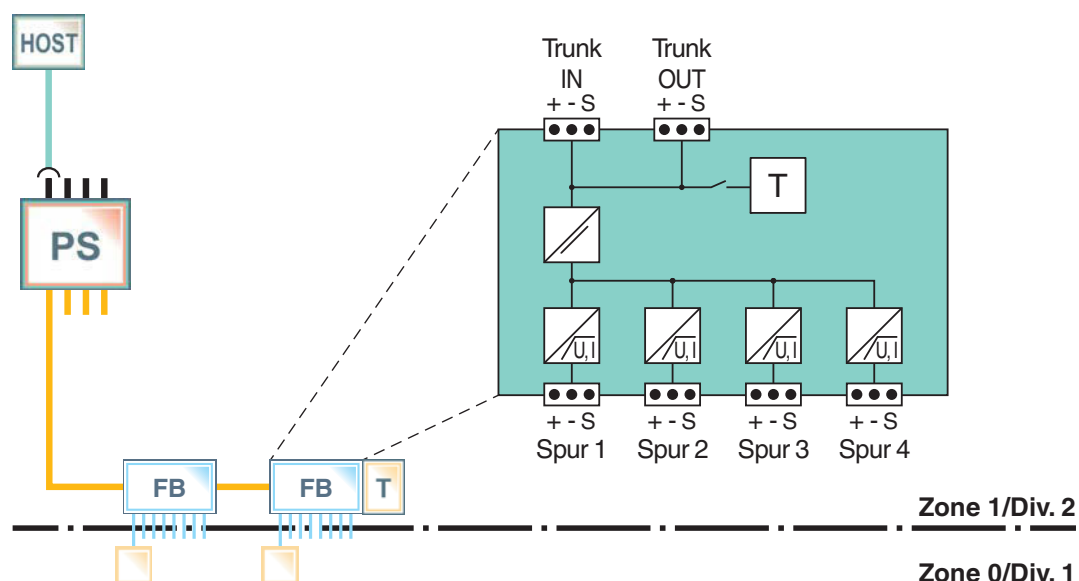
Function

The FieldBarrier, a fieldbus coupler in an aluminum housing, connects four instruments with intrinsic safety (Ex ia/Ex ib) and short-circuit protection at each output. This ensures proper operation of the segment during faults or hot work at the spur. The housing (Type F2) is made of sturdy cast aluminum for installation in rough environments. High power on the trunk enables maximum cable lengths and device count in any hazardous area. The integrated fieldbus terminator features high-availability design and is selectable. Output terminals with a choice of fixed or spring clamp terminals connect one device each. LEDs simplify troubleshooting and help decrease repair time. Hard and capacitive grounding and shielding concepts are selectable via jumper.

Assembly



Connection



Technical data**Fieldbus interface**

Main cable (Trunk)

Conformity

Protection degree EN 60529

Mechanical specifications

Enclosure cover detachable cover with retaining screws

Protection degree IP67

Cable entry cable gland and stopping plug options

Material

Housing ALSI12 (Cu) DIN1725 (Si 1.2 %), anodized

Surface painted green

Seal silicon, one piece

Housing width 140 mm (cable glands plastic/nickel plated brass/stainless steel),
160 mm (cable glands nickel plated brass for armored cable),
135 mm (plug connection M12 nickel plated brass/stainless steel, plug connection 7/8" stainless steel)

Housing height 258 mm

Housing depth 84 mm

Mass 3350 g

Mounting thru-holes Ø6.5 mm

Grounding M5 threading for grounding bolt

Data for application in connection with Ex-areas

EC-Type Examination Certificate PTB 02 ATEX 2086

Group, category, type of protection, temperature class  II 2(1G/D) G EEx me [ia] IIC T4

Declaration of conformity PF 08 CERT 0579 Valid for F2 housing solution without plug connectors

Group, category, type of protection, temperature class  II 3 D Ex tD A22 IP54 T135 °C (non-conductive dust)

Directive conformity

Directive 94/9/EC EN 50014:1997+A1+A2, EN 61241-0:2007, EN 61241-1:2007, EN 50020:1994, EN 50019:2000, EN 50028:1987

International approvals

FM approval CoC 3015728

Control drawing No. 116-0226

Approved for Class I, Division 2, Groups A, B, C, D/Class I, Zone 2, AEx nA [ia] IIC T4

CSA approval CoC 1592754

Control drawing 116-0266

Approved for Class I, Division 2, Groups A, B, C, D/Class I, Zone 2, Ex nA [ia] IIC T4

IECEx approval IECEx PTB 03.0003

Approved for Ex me [ia] IIC T4

Certificates and approvals

Marine approval DNV A-10798

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- 4, 8 or 12 outputs Ex ia
- Impact resistance enclosure, IP66
- Configurable cable entries for trunk and spurs
- Packaged certified solution
- Installation in Zone 1

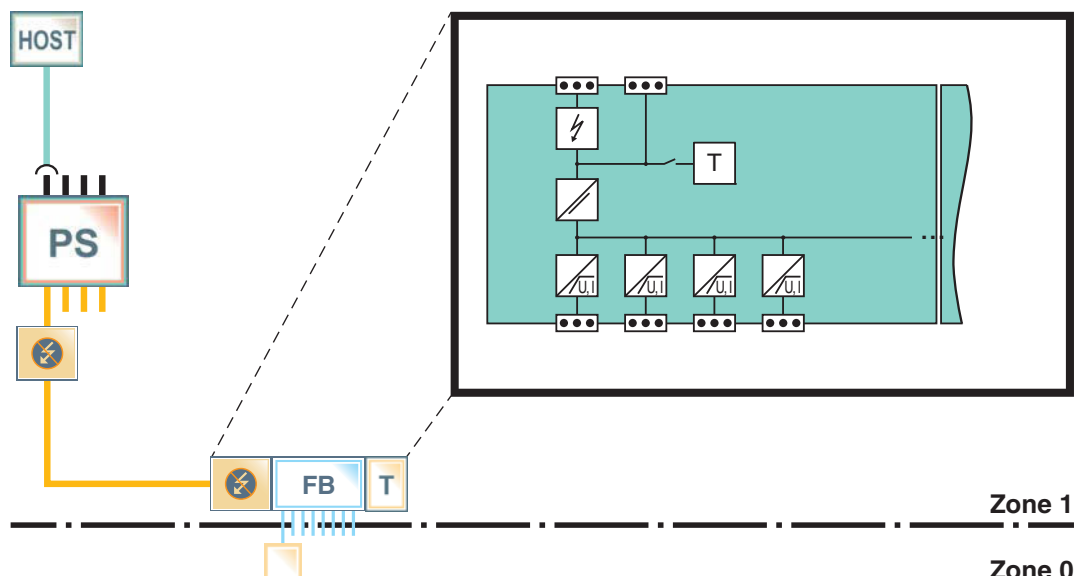
Function

This Junction Box is a device coupler with FieldConnex[®] FieldBarriers for Zone 1. Devices can be located in Zone 0. The number of outputs and size can be selected. Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge. Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options. This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Technical data**General specifications**

Installed components

FieldBarrier RD0-FB-Ex4.COM

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable cover with retaining screws

Protection degree

IP66

Cable entry

cable gland and stopping plug options

Material

Housing

polyester, impact resistant, glass fiber reinforced

Surface

black molded finish (RAL 9005)

Surface resistance

< 10⁹ Ω

Water absorption

< 6 %

Seal

silicon, one piece

Grounding plate

brass

Material thickness

grounding plate: 3 mm

Dimensions

(W x H x D)

271 x 271 x 136 mm (1 x RD0-FB-Ex4.COM)

544 x 271 x 136 mm (2 x RD0-FB-Ex4.COM)

544 x 544 x 136 mm (3 x RD0-FB-Ex4.COM)

Mounting

thru-holes Ø6.5 mm

Grounding

grounding bolt M6, Stainless steel

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 2(1)G Ex e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.00)

Ex II 2(1)G Ex d e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.***1)

Ex II 2(1)G Ex d e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.***3*)

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval

IECEx PTB 07.0036, suitable Junction Box on request

INMETRO

2008EC02CP015, suitable Junction Box on request

Features

- 4, 8 or 12 outputs Ex ia
- Electropolished enclosure, IP66
- Configurable cable entries for trunk and spurs
- Packaged certified solution
- Installation in Zone 1

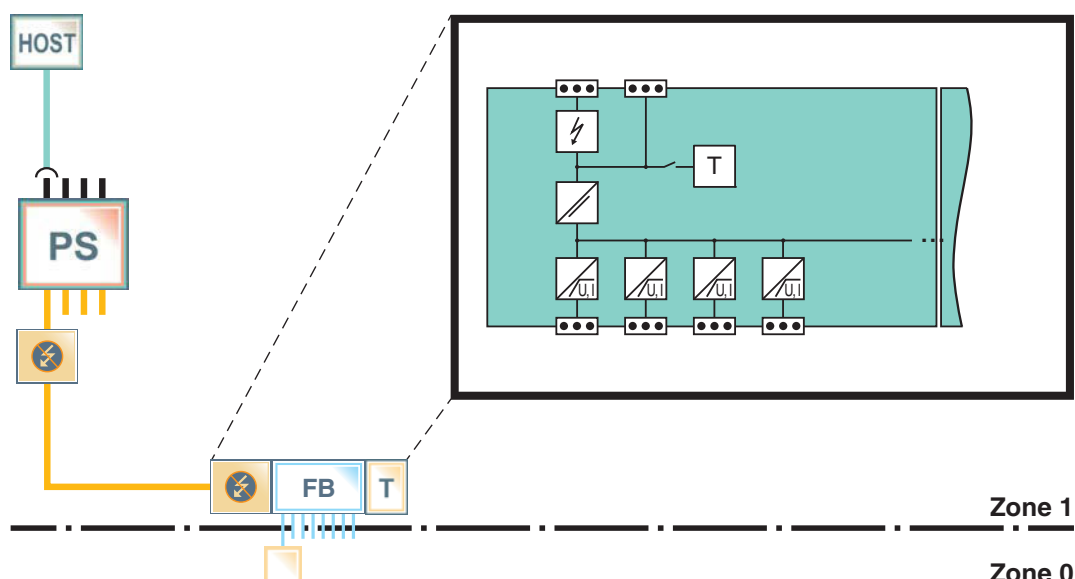
Function

This Junction Box is a device coupler with FieldConnex® FieldBarriers for Zone 1. Devices can be located in Zone 0. The number of outputs and size can be selected. Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options. This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Technical data**General specifications**

Installed components

FieldBarrier RD0-FB-Ex4.COM

For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable hinged door with captive retaining screws

Protection degree

IP66

Cable entry

cable gland and stopping plug options

Material

Housing

Stainless steel 1.4404/AISI 316L

Surface

electropolished

Seal

Neoprene, fire-resistant, one piece

Material thickness

enclosure body, enclosure cover, mounting plate: 1.5 mm
gland plate: 3.0 mm

Dimensions

(W x H x D)

300 x 200 x 120 mm (1 x RD0-FB-Ex4.COM)

380 x 380 x 175 mm (2 x RD0-FB-Ex4.COM)

480 x 400 x 175 mm (3 x RD0-FB-Ex4.COM)

Mounting

thru-holes Ø10 mm

Grounding

grounding bolt M10, brass

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 2(1)G Ex e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.00)

Ex II 2(1)G Ex d e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.1)

Ex II 2(1)G Ex d e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.3)

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval

IECEx PTB 07.0036, suitable Junction Box on request

INMETRO

2008EC02CP015, suitable Junction Box on request

Features

- 4 ... 8 outputs Ex ia, ib
- Installation in Zone 0/Div. 1
- Instruments in Zone 0...1/Div. 1
- Trunk and spurs intrinsically safe
- Supports FISCO and Entity

Function

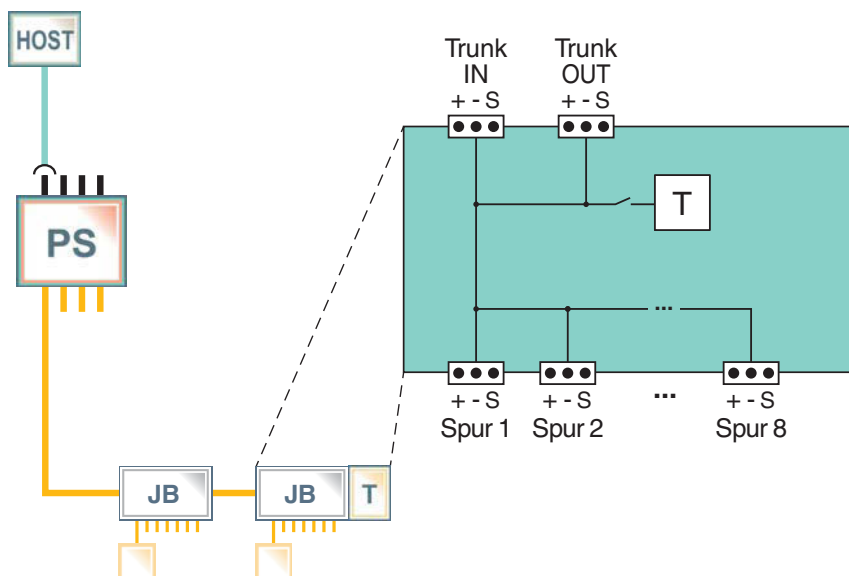
The Fieldbus Junction Box is a passive device coupler that connects instruments to intrinsically safe segments. The housing (Type F2) is made of sturdy aluminum for installation in rough environments Zone 1/Div. 2.

As an associated apparatus, the junction box is permitted for trunk and spur connections that are rated intrinsically safe (Ex ia, Ex ib) for instruments located in Zone 0 ... 1/Div. 2. A choice of fixed screw terminals or plug-in spring clamp connectors is available. Hard and capacitive grounding concepts are selectable via jumper.

Assembly



Connection



Technical data**Fieldbus interface****Main cable (Trunk)**

Connection input (Trunk IN): terminals 1+, 2-, 3s
output (Trunk OUT): terminals 4+, 5-, 6s

Rated voltage ≤ 35 V DC

Rated current 3 A DC at 70 °C, reduction 0.1A/K

Outputs

Rated voltage see main cable

Rated current see main cable

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NAMUR NE 21

Protection degree

IEC/EN 60529

Climatic conditions

DIN IEC 721

Mechanical specifications**Connection type**

Terminals

Core cross-section

up to 2.5 mm²

Housing

258 mm x 114 mm x 84 mm (without cable glands)

Protection degree

IP67

Mass

1800 g

Mounting

panel mounting

Features

- 4 ... 8 outputs Ex ia, ib
- Installation in Zone 0/Div. 1
- Instruments in Zone 0...1/Div. 1
- Trunk and spurs intrinsically safe
- Supports FISCO and Entity

Function

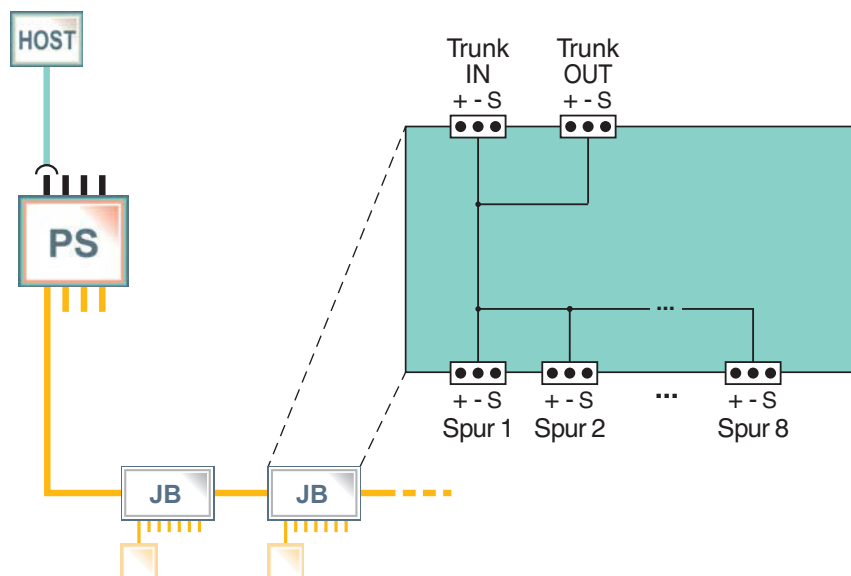
The Fieldbus Junction Box is a passive device coupler that connects instruments to intrinsically safe segments. The housing (Type F2) is made of sturdy aluminum for installation in rough environments Zone 1/Div. 2.

As an associated apparatus, the junction box is permitted for trunk and spur connections that are rated intrinsically safe (Ex ia, Ex ib) for instruments located in Zone 0 ... 1/Div. 2. A choice of fixed screw terminals or plug-in spring clamp connectors is available. Hard and capacitive grounding concepts are selectable via jumper.

Assembly



Connection



Zone 0

Technical data**Fieldbus interface****Main cable (Trunk)**

Connection input (Trunk IN): terminals 1+, 2-, 3s
output (Trunk OUT): terminals 4+, 5-, 6s

Rated voltage ≤ 35 V DC

Rated current 3 A DC

Outputs

Rated voltage see main cable

Rated current see main cable

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity**Electromagnetic compatibility**

NAMUR NE 21, EN 61326

Protection degree

IEC/EN 60529

Climatic conditions

DIN IEC 721

Mechanical specifications**Connection type**

Main cable (Trunk) Terminals

Core cross-section

up to 2.5 mm²

Cable diameter

Main cable (Trunk) 5 ... 10 mm

Housing

258 mm x 114 mm x 84 mm (without cable glands)

Protection degree

IP67

Mass

1800 g

Mounting

panel mounting

Data for application in connection with Ex-areas**Main cable (Trunk)**

only for connection to intrinsically safe fieldbus circuits

Maximum values

Voltage U_i ≤ 35 V

Current I_i ≤ 3 A

Directive conformity

standards

Directive 94/9/EC EN 50014, EN 50020, EN 50284

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- 4 segments, load-sharing redundancy
- Output: 22 ... 24 V/360 mA, Ex ib IIC
- DART for intrinsically safe, high-power segments
- Supports all PLC and DCS hosts
- Individual modules per segment
- Optimized for size and quality, low heat dissipation
- Passive impedance for high reliability
- Installation in Zone 2

Function

The FieldConnex® DART High-density Power Hub is a modular fieldbus power supply for four segments. It supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The kit comprises one motherboard and eight power supply modules (2 modules per segment).

DART (Dynamic Arc Recognition and Termination) enables the intrinsically safe High-Power Trunk Concept for a completely intrinsically safe segment certified acc. to IEC 60079-11.

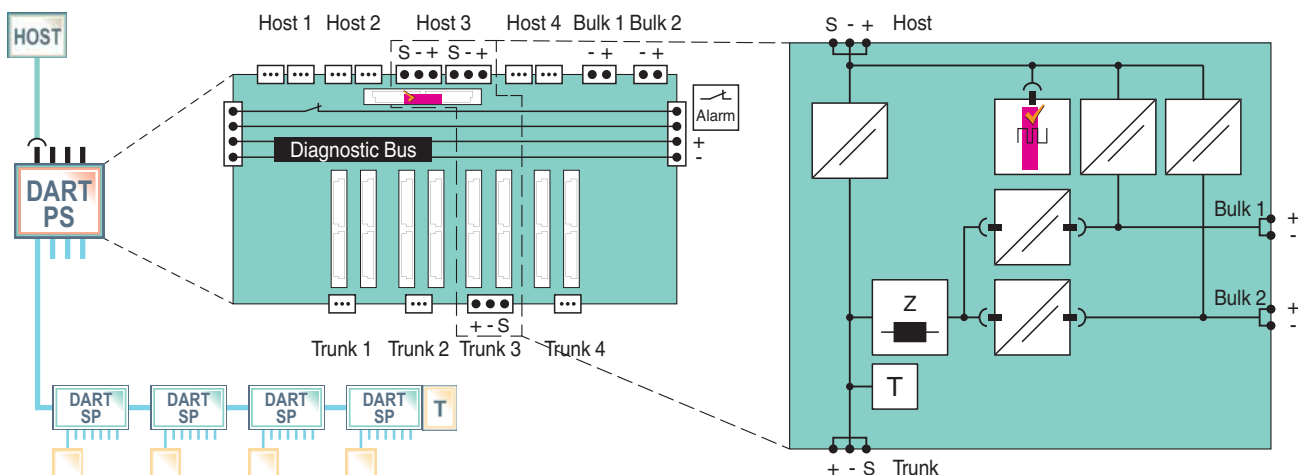
Connections and fieldbus power are provided for all DCS and PLC host systems. Sockets for all modules enable simple installation and replacement without tools. Power redundancy is load-sharing with either module supplying half of load current. Three-port isolation between segment, bulk power and host enhances system reliability.

Availability and a long service life is achieved through: only one passive impedance filter per segment, optimized design for low power dissipation, high-availability fieldbus termination and plug-in connectors with retaining screws.

Assembly



Connection



Technical data**Supply**

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	2730 ... 1540 mA

Fieldbus interface

Number of segments	
Redundant	4
Rated voltage	20.8 ... 22.3 V
Rated current	360 ... 10 mA
Short-circuit current	413 mA
Host-side	redundant general purpose host
Host-rated voltage	10.1 ... 11 V
Host-rated current	... 40 mA
Host short-circuit current	... 50 mA
Terminating resistor	100 Ω, integrated

Indicators/operating means

Fault signal	VFC alarm output via connectors

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug with screw flange
Core cross-section	2.5 mm ²

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 10 ATEX 2034, PTB 10 ATEX 2020 X, PTB 11 ATEX 2010 X
Group, category, type of protection, temperature class	⊕ II 2 G Ex ib IIC T4, ⊕ II (2) D [Ex ib] IIIC, ⊕ II 3(2) G Ex nAc [ib] IIC T4

Supply

Maximum safe voltage U _m	35 V

Host interface

Maximum safe voltage U _m	35 V

Alarm output

Maximum safe voltage U _m	35 V

Directive conformity

Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2007, EN 60079-15:2006, EN 60079-25:2010, EN 61241-11:2006

International approvals

IECEx approval	pending
Approved for	[Ex ib] IIC [Ex ib] IIIC Ex nAc II T4

Certificates and approvals

Marine approval	pending

Power module**HD2-FBPS-IBD-1.24.360****Power Output**

Voltage (V)	20.8 ... 22.3
Current (mA)	360

Device in ... Type of Protection Required Installation Components

Zone 1	Intrinsically safe Ex ib	■	Segment Protector R3-SP-IBD12

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 segments, load-sharing redundancy
- Output: 22 ... 24 V/360 mA, Ex ib IIC
- DART for intrinsically safe, high-power segments
- Redundant connection to PROFIBUS DP
- Customizable for any host system
- Individual modules per segment
- Optimized for size and quality, low heat dissipation
- Passive impedance for high reliability
- Installation in Zone 2

Function

The FieldConnex® DART High-density Power Hub is a modular fieldbus power supply for four segments. It supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The kit comprises one motherboard and eight power supply modules (2 modules per segment).

DART (Dynamic Arc Recognition and Termination) enables the intrinsically safe High-Power Trunk Concept for a completely intrinsically safe segment certified acc. to IEC 60079-11.

A Sub-D 25-pin connector with fieldbus power hooks up to the Segment Coupler for direct PROFIBUS DP connection.

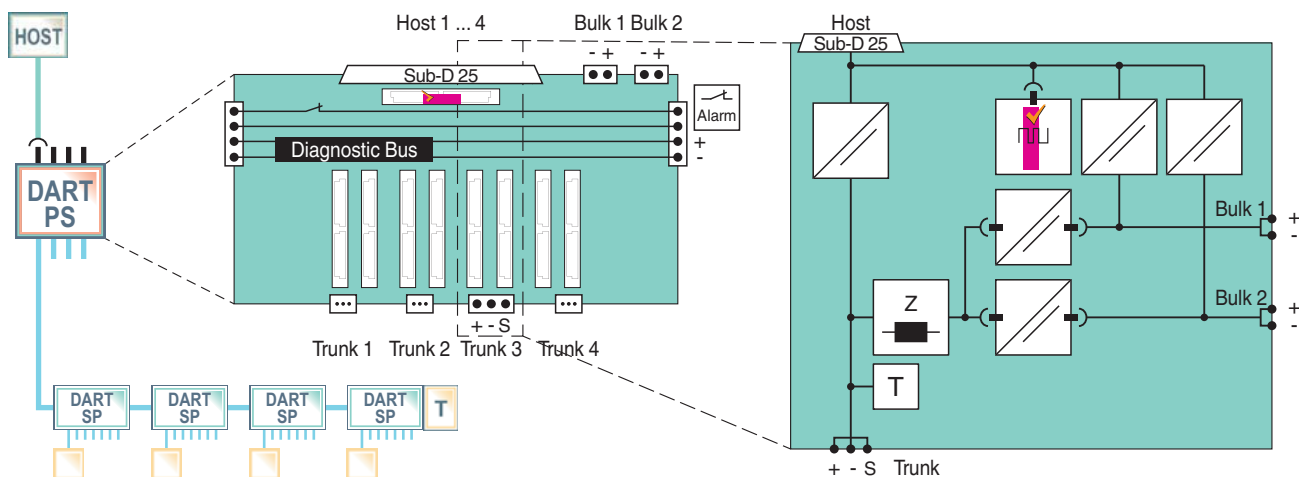
Through designed custom cables this power hub is easily adaptable to any FF-control system. Sockets for all modules enable simple installation and replacement without tools.

Power redundancy is load-sharing with either module supplying half of load current. Three-port isolation between segment, bulk power and host enhances system reliability. Availability and a long service life is achieved through: only one passive impedance filter per segment, optimized design for low power dissipation, high-availability fieldbus termination and plug-in connectors with retaining screws.

Assembly



Connection



Technical data**Supply**

Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	3230 ... 1820 mA

Fieldbus interface

Number of segments	
Redundant	4
Rated voltage	20.8 ... 22.3 V
Rated current	360 ... 10 mA
Short-circuit current	413 mA
Host-side	25-pin Sub-D socket
Host-rated voltage	10.1 ... 11 V
Host-rated current	... 40 mA
Host short-circuit current	... 50 mA
Terminating resistor	100 Ω, integrated

Indicators/operating means

Fault signal	VFC alarm output via connectors

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug with screw flange
Core cross-section	2.5 mm ²

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 10 ATEX 2034, PTB 10 ATEX 2020 X, PTB 11 ATEX 2010 X
Group, category, type of protection, temperature class	⊕ II 2 G Ex ib IIC T4, ⊕ II (2) D [Ex ib] IIIC, ⊕ II 3(2) G Ex nAc [ib] IIC T4

Supply

Maximum safe voltage U _m	35 V

Host interface

Maximum safe voltage U _m	35 V

Alarm output

Maximum safe voltage U _m	35 V

Directive conformity

Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2007, EN 60079-15:2006, EN 60079-25:2010, EN 61241-11:2006

International approvals

IECEx approval	pending
Approved for	[Ex ib] IIC [Ex ib] IIIC Ex nAc II T4

Certificates and approvals

Marine approval	pending

Power module**HD2-FBPS-IBD-1.24.360****Power Output**

Voltage (V)	20.8 ... 22.3
Current (mA)	360

Device in ... Type of Protection Required Installation Components

Zone 1	Intrinsically safe Ex ib	■	Segment Protector R3-SP-IBD12

Features

- 4 segments, load-sharing redundancy
- Output: 22 ... 24 V/360 mA, Ex ib IIC
- DART for intrinsically safe, high-power segments
- Customized for Yokogawa, ALF 111
- Individual modules per segment
- Optimized for size and quality, low heat dissipation
- Passive impedance for high reliability
- Installation in Zone 2

Function

The FieldConnex® DART High-density Power Hub is a modular fieldbus power supply for four segments. It supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The kit comprises one motherboard and eight power supply modules (2 modules per segment).

DART (Dynamic Arc Recognition and Termination) enables the intrinsically safe High-Power Trunk Concept for a completely intrinsically safe segment certified acc. to IEC 60079-11.

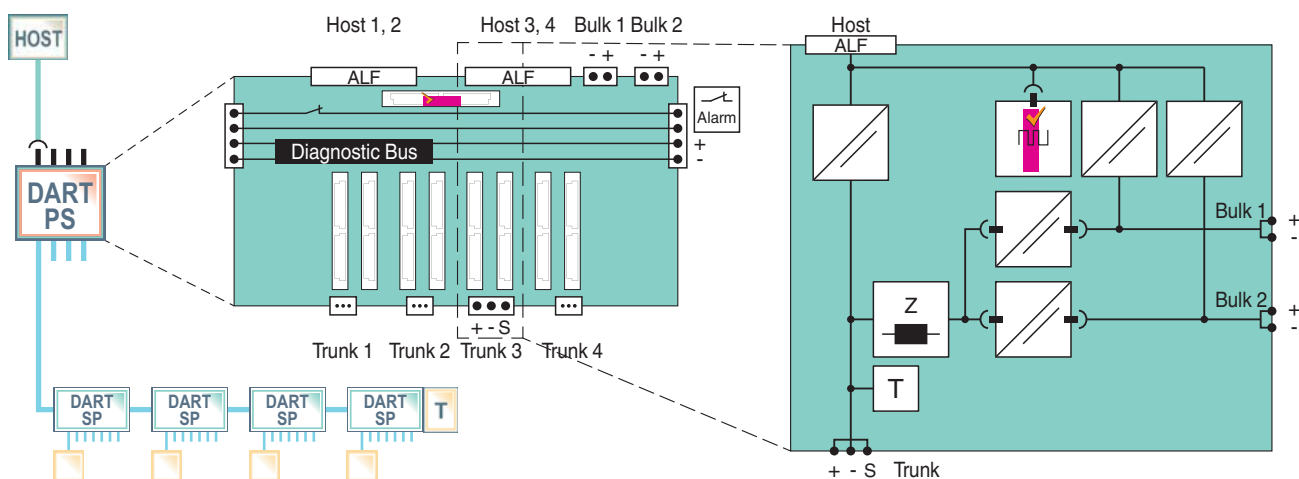
Connectors for the AKB 336 system cable allow for a direct hook-up. Sockets for all modules enable simple installation and replacement without tools. Power redundancy is load-sharing with either module supplying half of load current. Three-port isolation between segment, bulk power and host enhances system reliability.

Availability and a long service life is achieved through: only one passive impedance filter per segment, optimized design for low power dissipation, high-availability fieldbus termination and plug-in connectors with retaining screws.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A 2730 ... 1540 mA
Fieldbus interface	
Number of segments	
Redundant	4
Rated voltage	20.8 ... 22.3 V
Rated current	360 ... 10 mA
Short-circuit current	413 mA
Host-side	redundant Yokogawa ALF111 with AKB336 interface cables
Host-rated voltage	10.1 ... 11 V
Host-rated current	... 40 mA
Host short-circuit current	... 50 mA
Terminating resistor	100 Ω, integrated
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ambient conditions	
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Mechanical specifications	
Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	PTB 10 ATEX 2034, PTB 10 ATEX 2020 X, PTB 11 ATEX 2010 X
Group, category, type of protection, temperature class	⊕ II 2 G Ex ib IIC T4, ⊕ II (2) D [Ex ib] IIIC, ⊕ II 3(2) G Ex nAc [ib] IIC T4
Supply	
Maximum safe voltage U _m	35 V
Host interface	
Maximum safe voltage U _m	35 V
Alarm output	
Maximum safe voltage U _m	35 V
Directive conformity	
Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2007, EN 60079-15:2006, EN 60079-25:2010, EN 61241-11:2006
International approvals	
IECEx approval	pending
Approved for	[Ex ib] IIC [Ex ib] IIIC Ex nAc II T4
Certificates and approvals	
Marine approval	pending

Power module

HD2-FBPS-IBD-1.24.360			
Power Output			
Voltage (V)		20.8 ... 22.3	
Current (mA)		360	
Device in ...	Type of Protection	Required Installation Components	
Zone 1	Intrinsically safe Ex ib	■	Segment Protector R3-SP-IBD12

Features

- 12 outputs Ex ib IIC
- Segment Protector in Zone 1
- Instruments in Zone 1
- Short-circuit protection per output
- Power, Com, and Error LEDs
- T-connector for easy installation and maintenance
- Test points for easy troubleshooting

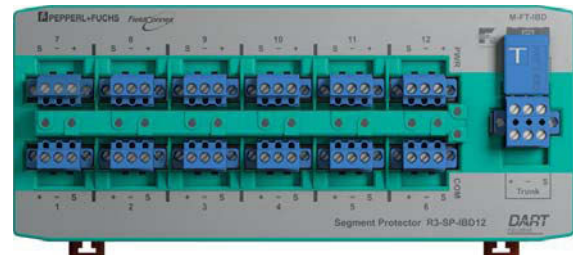
Function

The DART Segment Protector, a fieldbus coupler for DIN-rail installation, provides outputs for up to 12 intrinsically safe instruments (Ex ib IIC) to an intrinsically safe High-Power Trunk. It is equipped with short-circuit protection. This ensures proper operation of the segment during faults or hot work at the spur.

The T-connector at the trunk allows for exchange of a Segment Protector without effect on the remaining segment. The high-availability terminator is mounted at the 'T'. As it is removed for network extensions proper termination is always ensured.

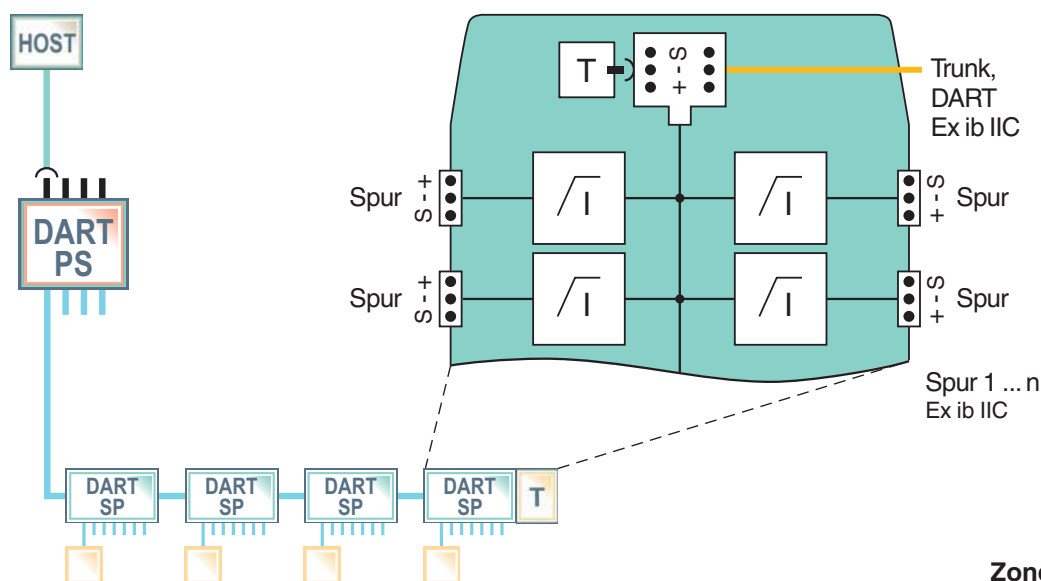
All plugs feature retaining screws. LEDs and test access points simplify troubleshooting and help to decrease repair time. Any grounding and shielding concept is possible based on FieldConnex enclosure solutions.

Assembly



DART
FIELDBUS

Connection



Zone 1

Technical data**Fieldbus interface****Main cable (Trunk)**

Rated voltage 14.5 ... 24 V DC

Rated current ≤ 4.5 A**Outputs**

Number of outputs 12

Number of devices per output 1

Rated voltage ≥ 10.5 V, ≤ 24 VRated current ≤ 34 mA

Short-circuit current max. 47 mA

Self current consumption typical 20 mA, ≤ 25 mAVoltage drop main cable/outputs ≤ 4 V

Voltage drop trunk In/Out 0 V

Terminating resistor external type M-FT-IBD 100 Ω +/- 10 %**Directive conformity****Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Ambient conditions

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type removable screw terminals with retaining screws

Core cross-section ≤ 2.5 mm²/AWG 12-24**Data for application in connection with Ex-areas**

EC-Type Examination Certificate PTB 10 ATEX 2034, PTB 10 ATEX 2018X

Group, category, type of protection, temperature class
 Ex II 2G Ex ib IIC T4,
 Ex II (2)D [Ex ib] IIIC

Main cable (Trunk) for connection to the DART Fieldbus System acc. to System Certificate PTB 10 ATEX 2034

Outputs Entity

Voltage U_o 23 VCurrent I_o 47 mAPower P_o 1.08 WInductance L_o gas group IIC 170 μ H
gas group IIB 1 mHCapacitance C_o gas group IIC 60 nF
gas group IIB 470 nF**Directive conformity**

Directive 94/9/EC EN 60079-0:2009, EN 60079-11:2007, EN 61241-11:2006

International approvals

IECEx approval pending

Approved for Ex ib IIC T4
[Ex ib] IIIC**Certificates and approvals**

Marine approval pending

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Technical data**Fieldbus interface**

Physical layer profile	profile type 511 (FISCO), profile type 111 (Entity)
ITK version	4.51
Implementation	resource block 1x RS function block 8x AI, 1x MAI transducer block 8x sensor TB, 1x concentrator TB
Execution time	AI, MAI 40 ms max.
Macro cycle	typical for one device 8xAI or 1xMAI ≤ 500 ms
Firmware update	via separate plug connection
FDE (Fault Disconnect Equipment)	6.7 mA
Rated voltage	9 ... 32 V
Rated current	≤ 23 mA

Input

Number	8
Grounding	grounding of thermoelements possible
Error detection	lead breakage, wiring error, hardware device error
Common mode voltage	Input to Input 600 V _{peak}

Transfer characteristics

Deviation	
Cold junction compensation	± 0.5 °C (32.9 °F)
Linearization	T/C input 0.1 °C RTD input 0.03 °C
Internal measurement cycle	for all sensor types ≤ 1 s

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electrical isolation	EN 60079-11
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug-in terminals
Core cross-section	
Bus	up to 2.5 mm ²
Inputs	up to 2.5 mm ²
Housing material	Polycarbonate
Protection degree	IP20
Mass	360 g
Mounting	mounting on DIN rail in cabinet

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 03 ATEX 2237
Group, category, type of protection, temperature class	⊕ II 2(1G/D) G Ex ia IIC T4, ⊕ II (1)GD [Ex ia] IIC
Bus	FISCO see EC-Type Examination Certificate
Statement of conformity	PTB 03 ATEX 2238 X
Group, category, type of protection, temperature class	⊕ II 3G Ex nA II T4, ⊕ II 3G Ex nL IIC T4, ⊕ II (3)G [Ex nL] IIC
Electrical isolation	
Bus	see Statement of Conformity
Input	see EC-Type Examination Certificate
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2005, EN 60079-27:2006

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- For eight temperature or analog sensors
- Installation in Zone 1...2/Div. 2, intrinsically safe
- Sensors in Zone 0/Div. 1
- Connection to fieldbus acc. to FISCO or Entity
- DCS integration via device description and function blocks
- Concentrator method for simplified configuration
- Monitors sensor condition
- For T/C, RTD 2-, 3-, 4-wire, voltage and resistance
- Cold junction compensation
- Removable terminals

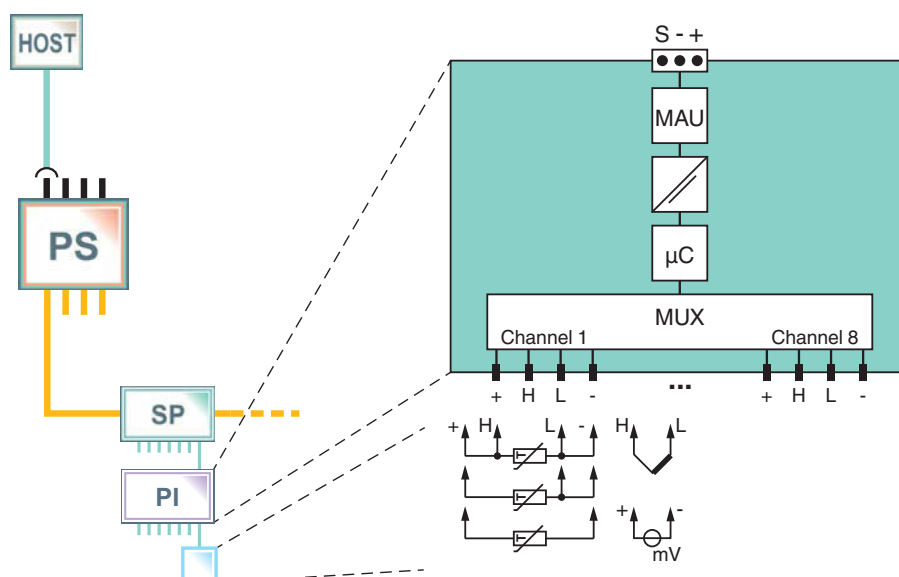
Function

The Temperature Multi-Input (TM-I) with aluminum housing connects up to 8 analog inputs to the DCS via fieldbus. Cable gland material is selectable. It is installed close to the sensors in the hazardous area. The TM-I is certified intrinsically safe and as associated apparatus: inputs are intrinsically safe even when the fieldbus connection is not. Analog inputs can be resistance temperature sensors with 2, 3, and 4 wires, measuring sensors, thermocouples, or millivolt signals. The TM-I communicates all data, configuration, and alarms via one fieldbus address and function blocks (8xAI or 1xMAI) to the DCS. For simplified configuration it supports the concentrator method: inputs can be configured all at once or individually. Fieldbus powers the sensors and the temperature interface itself, additional power or wiring is not required. Cold junction compensation for thermocouples is integrated. The TM-I detects and reports lead breakage and short circuit conditions.

Assembly



Connection



Zone 1

Technical data**Conformity**

Protection degree	EN 60529
Impact resistance	EN 60079-0

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type	plug-in terminals

Core cross-section

Bus	up to 2.5 mm ²
Inputs	up to 2.5 mm ²
Cable diameter	sensors: 5 ... 10 mm (cable glands plastic/nickel plated brass), 5 ... 9 mm (cable glands stainless steel) fieldbus: 5 ... 13 mm (cable glands plastic), 7 ... 12 mm (cable glands nickel plated brass/stainless steel)

Cable gland	sensor inputs M16, fieldbus M20

Housing material	ALSI12 (Cu) DIN1725 (Si 1.2 %), anodized

Protection degree	IP67

Mass	1800 g

Mounting	panel mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 03 ATEX 2237
Group, category, type of protection, temperature class	⊕ II 2(1G/D) G Ex ia IIC T4, ⊕ II (1)GD [Ex ia] IIC

Bus	FISCO see EC-Type Examination Certificate

Statement of conformity	PTB 03 ATEX 2238 X
Group, category, type of protection, temperature class	⊕ II 3G Ex nA II T4, ⊕ II 3G Ex nL IIC T4, ⊕ II (3)G [Ex nL] IIC

Electrical isolation

Bus	see Statement of Conformity
Input	see EC-Type Examination Certificate

Directive conformity

Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2005, EN 60079-27:2006

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- 8-channel universal temperature interface
- Glass fiber reinforced polyester, impact resistant, IP66
- Configurable cable entries for bus lines and field signal lines
- International approvals
- Installation in Zone 1 and Zone 2

Function

This Fieldbus Junction Box holds a Temperature Multi-Input Device for transferring signals from resistance temperature measuring sensors and thermocouples, as well as resistance and millivolt signals via FOUNDATION Fieldbus H1. The fieldbus junction box with eight inputs can be installed in Zone 1 with sensors located in Zone 0.

Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge.

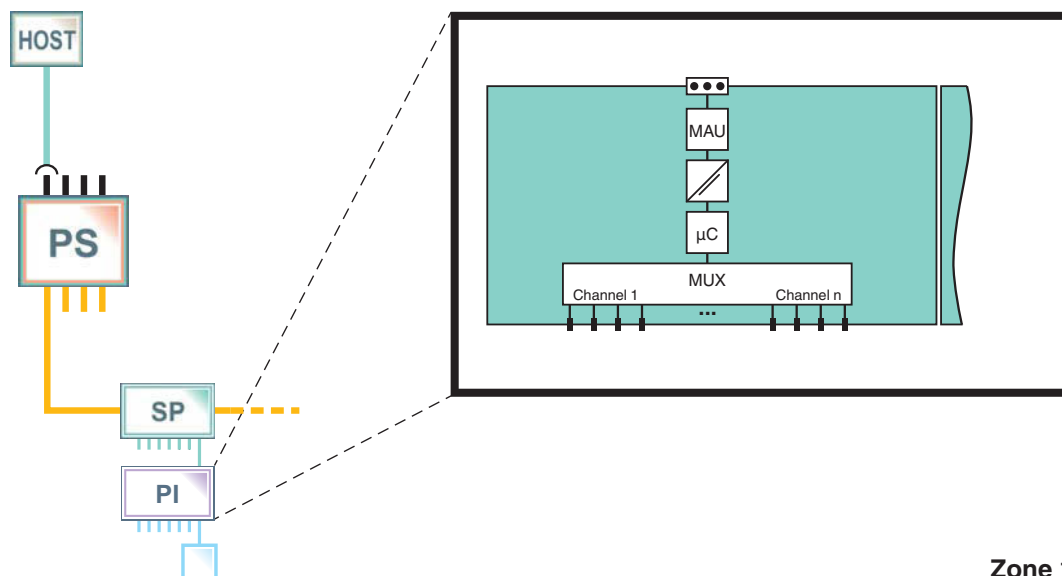
Bus and field signal line entries can be chosen individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate and grounding bar are available as options.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Technical data**General specifications**

Installed components

Fieldbus Temperature Interface RD0-TI-Ex8.FF.ST
For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable cover with retaining screws

Protection degree

IP66

Material

Housing

polyester, impact resistant, glass fiber reinforced

Surface

black molded finish (RAL 9005)

Surface resistance

< 10⁹ Ω

Water absorption

< 6 %

Seal

silicon, one piece

Grounding plate

brass

Material thickness

grounding plate: 3 mm

Dimensions

(W x H x D)
271 x 271 x 136 mm (1 x RD0-TI-Ex8.FF.ST)

Mounting

thru-holes Ø6.5 mm

Grounding

grounding bolt M6, Stainless steel

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 2(1)G Ex ia IIC T4 (F.TI0.S12.A08.F.0.***.***.**00)

Statement of conformity

PF 08 CERT 1278 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 3G Ex nL IIC T4 (F.TI0.S12.B08.F.0.***.***.**00)

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003, EN 60079-15:2005

International approvals

IECEx approval

IECEx PTB 07.0036, zone 1, suitable Junction Box on request
IECEx PTB 09.0016, Zone 2, suitable Junction Box on request

INMETRO

2008EC02CP015, suitable Junction Box on request

Features

- 8-channel universal temperature interface
- Stainless steel, electropolished, IP66
- Configurable cable entries for bus lines and field signal lines
- International approvals
- Installation in Zone 1 and Zone 2

Function

This Fieldbus Junction Box holds a Temperature Multi-Input Device for transferring signals from resistance temperature measuring sensors and thermocouples, as well as resistance and millivolt signals via FOUNDATION Fieldbus H1. The fieldbus junction box with eight inputs can be installed in Zone 1 with sensors located in Zone 0.

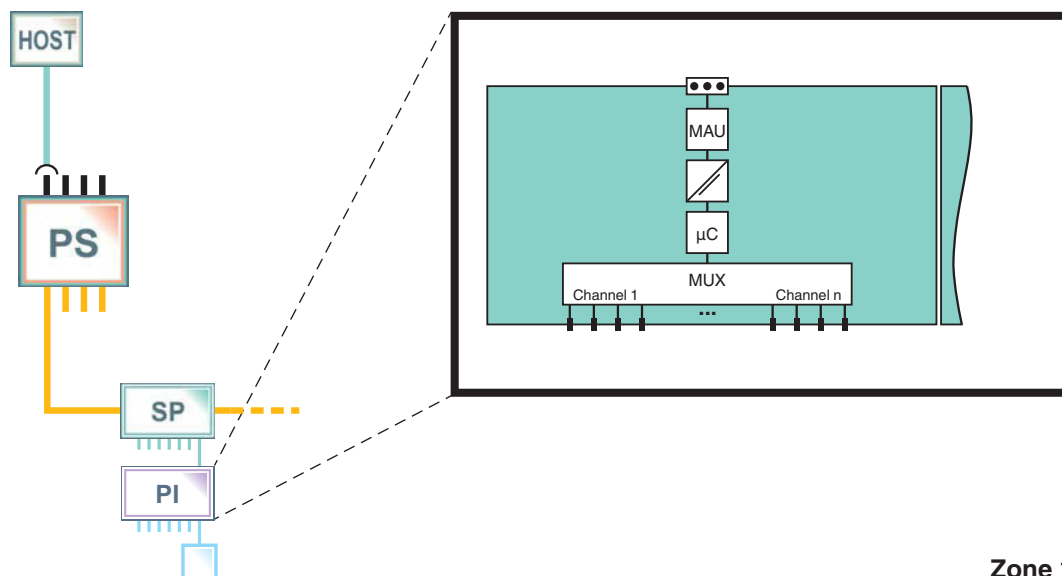
Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. Bus and field signal line entries can be chosen individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate and grounding bar are available as options.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 1

Technical data**General specifications**

Installed components

Fieldbus Temperature Interface RD0-TI-Ex8.FF.ST
For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable hinged door with captive retaining screws

Protection degree

IP66

Material

Housing

Stainless steel 1.4404/AISI 316L

Surface

electropolished

Seal

Neoprene, fire-resistant, one piece

Material thickness

enclosure body, enclosure cover, mounting plate: 1.5 mm
gland plate: 3.0 mm

Dimensions

(W x H x D)
300 x 200 x 120 mm (1 x RD0-TI-Ex8.FF.ST)

Mounting

thru-holes Ø10 mm

Grounding

grounding bolt M10, brass

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 2(1)G Ex ia IIC T4 (F.TI0.S12.A08.F.0.***.***.**00)

Statement of conformity

PF 08 CERT 1278 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 3G Ex nL IIC T4 (F.TI0.S12.B08.F.0.***.***.**00)

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003, EN 60079-15:2005

International approvals

IECEx approval

IECEx PTB 07.0036, zone 1, suitable Junction Box on request
IECEx PTB 09.0016, Zone 2, suitable Junction Box on request

INMETRO

2008EC02CP015, suitable Junction Box on request

Features

- For four intrinsically safe valves with position sensors
- Installation in Zone 1 and Zone 2
- Valves in Zone 0
- Connection to fieldbus acc. to FISCO or Entity
- DCS integration via device description and function blocks
- Monitors lead breakage and short circuits
- Valve monitoring and diagnostics integrated
- Conducts partial stroke testing

Function

The valve coupler (VC) for FOUNDATION fieldbus H1 connects up to four intrinsically safe low-power valves to the DCS via fieldbus. It is installed pre-wired in a field enclosure or directly outside close to the valves in the hazardous area. The VC drives four low-power auxiliary valves and gathers positioning information via pairs of inductive proximity switches.

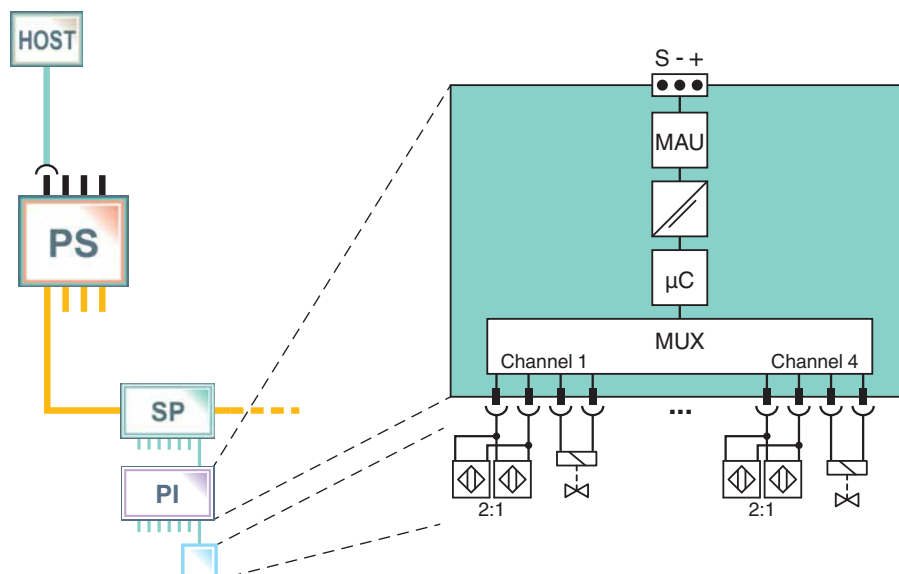
The VC communicates all data, configuration, and alarms via one fieldbus address to the DCS. It supports function blocks via device description. Fieldbus powers the actors, sensors and the valve coupler itself, additional power or wiring is not required.

The VC supports summary diagnostics according to NAMUR recommendations. It detects lead breakage and short circuit conditions. It monitors and reports runtime and breakaway time during each operation and can conduct partial stroke tests.

Assembly



Connection



Zone 1

Technical data**Fieldbus interface****FOUNDATION Fieldbus**

Connection	Connection +, -
Rated voltage	9 ... 32 V
Rated current	max. 23 mA
Baud rate	31.25 kBit/s
Protocol	IEC 61158-2

Field circuit**Inputs**

Sensor supply voltage	5 V
Sensor supply current	5 mA
Max. cycle time	≤ 160 ms

Outputs

Output voltage	6.4 ... 7.9 V
Output rated operating current	1.5 mA
Holding current	1 mA

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electrical isolation	EN 60079-11

Electromagnetic compatibility	NE 21:2006

Protection degree	IEC/EN 60529

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Core cross-section	Bus cable: Ø 5 mm ... 10 mm cable sensors/valve: Ø 4 mm ... 8 mm

Housing	187 mm x 129 mm x 46 mm

Protection degree	IP65

Installation position	Cable glands downwards

Mass	approx. 290 g

Mounting	panel mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 98 ATEX 2210

Group, category, type of protection, temperature class	Ex II 2G (1) Ex ia [ia Ga] IIC T4 Gb, Ex II (1D) [Ex ia Da] IIIC, Ex II 3G Ex ic IIC T4 Gc, Ex II (3D) [Ex ic Dc] IIIC

Field-side

Voltage	U_o	9 V
Current	I_o	44 mA
Power	P_o	99 mW

FOUNDATION Fieldbus

Voltage	U_i	24 V
Current	I_i	380 mA
Power	P_i	5.32 W
Rated voltage		9 ... 32 V
Rated current		23 mA
FDE (Fault Disconnect Equipment)		6.7 mA

Directive conformity

Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2012

International approvals

IECEx approval	IECEx TUN 04.0002
Approved for	Ex ia [ia Ga] IIC T4 Gb, [Ex ia Da] IIIC, Ex ic IIC T4 Gc, [Ex ic Dc] IIIC

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 valve control and 8 position feedback signals
- Glass fiber reinforced polyester, impact resistant, IP66
- Configurable cable entries for bus lines and field signal lines
- International approvals
- Installation in Zone 1

Function

This Fieldbus Junction Box holds valve couplers for connection to low-power solenoid valves. The fieldbus junction box can be installed in Zone 1, sensors in Zone 0. Four valves including two end position sensors can be connected.

Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge.

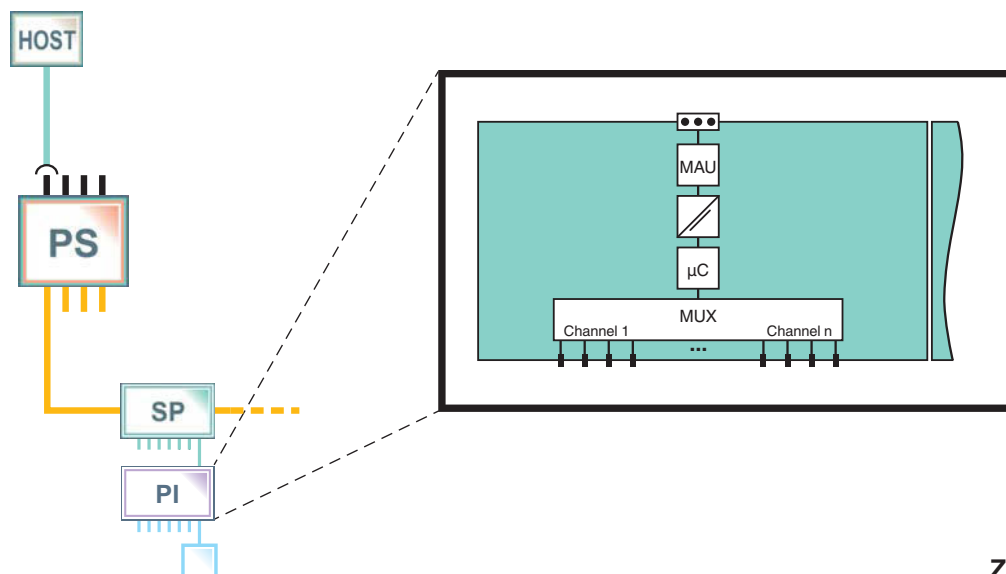
Bus and field signal line entries can be chosen individually from a range of cable glands and stopping plugs. A breather is included by default. A tag plate is available as option.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 1

Technical data**General specifications**

Installed components

Valve Coupler FD0-VC-Ex4.**
For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable cover with retaining screws

Protection degree

IP66

Material

Housing

polyester, impact resistant, glass fiber reinforced

Surface

black molded finish (RAL 9005)

Surface resistance

< 10⁹ Ω

Water absorption

< 6 %

Seal

silicon, one piece

Grounding plate

brass

Material thickness

grounding plate: 3 mm

Dimensions

(W x H x D)
271 x 544 x 136 mm (1 x FD0-VC-Ex4.**)

Mounting

thru-holes Ø6.5 mm

Grounding

grounding bolt M6, Stainless steel

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 2(1)G Ex ia IIC T4

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval

IECEx PTB 07.0036, suitable Junction Box on request

INMETRO

2008EC02CP015, suitable Junction Box on request

Features

- 4 valve control and 8 position feedback signals
- Stainless steel, electropolished, IP66
- Configurable cable entries for bus lines and field signal lines
- International approvals
- Installation in Zone 1

Function

This Fieldbus Junction Box holds valve couplers for connection to low-power solenoid valves. The fieldbus junction box can be installed in Zone 1, sensors in Zone 0. Four valves including two end position sensors can be connected.

Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. The integrated rain channel prevents standing water from damaging the one-piece seal.

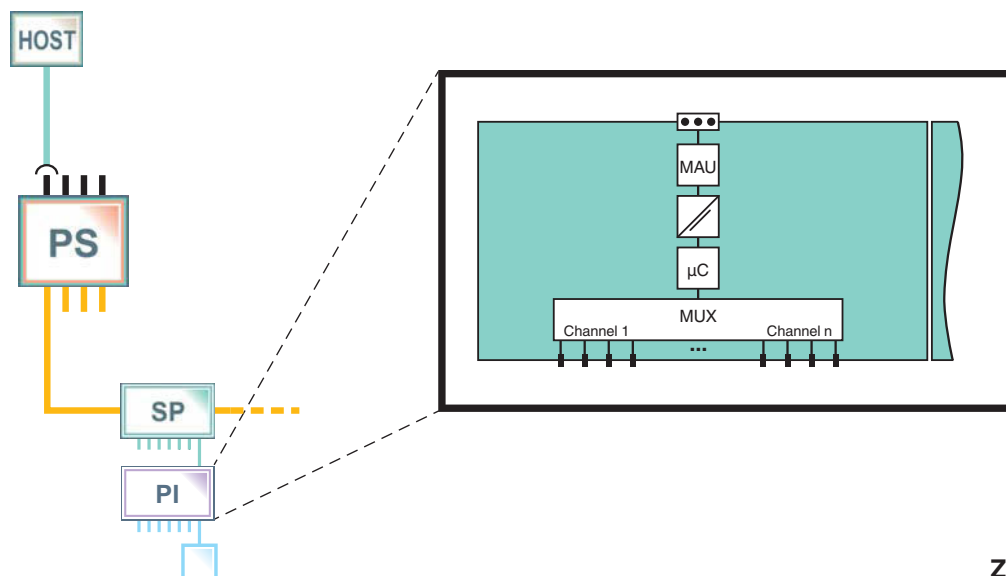
Bus and field signal line entries can be chosen individually from a range of cable glands and stopping plugs. A breather is included by default. A tag plate is available as option.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 1

Technical data**General specifications**

Installed components

Valve Coupler FD0-VC-Ex4.**
For technical data on installed electronic component see data sheet.

Conformity

Protection degree

EN 60529

Impact resistance

EN 60079-0

Mechanical specifications

Enclosure cover

detachable hinged door with captive retaining screws

Protection degree

IP66

Material

Housing

Stainless steel 1.4404/AISI 316L

Surface

electropolished

Seal

Neoprene, fire-resistant, one piece

Material thickness

enclosure body, enclosure cover, mounting plate: 1.5 mm
gland plate: 3.0 mm

Dimensions

(W x H x D)
380 x 380 x 175 mm (1 x FD0-VC-Ex4.**)

Mounting

thru-holes Ø10 mm

Grounding

grounding bolt M10, brass

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com

Group, category, type of protection

Ex II 2(1)G Ex ia IIC T4

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval

IECEx PTB 07.0036, suitable Junction Box on request

INMETRO

2008EC02CP015, suitable Junction Box on request

Features

- Terminator in stainless steel housing
- Flameproof enclosure (Ex d) protection
- Installation on open cable gland
- Choice of threads 20 mm, Pg 13.5 mm or 1/2" NPT

Function

F*-FT-Ex1.D.IEC are terminators for fieldbus and provide capacitance and resistance to terminate a fieldbus segment according to IEC 61158-2. Explosion protection is flameproof 'Ex d' for installation in Zone 1...2. A solid metal housing enables installation in rough environments. Housings are selectable with 20 mm ISO, PG 13.5 mm or 1/2" NPT connecting threads for easy installation on outdoor junction boxes or field instruments.

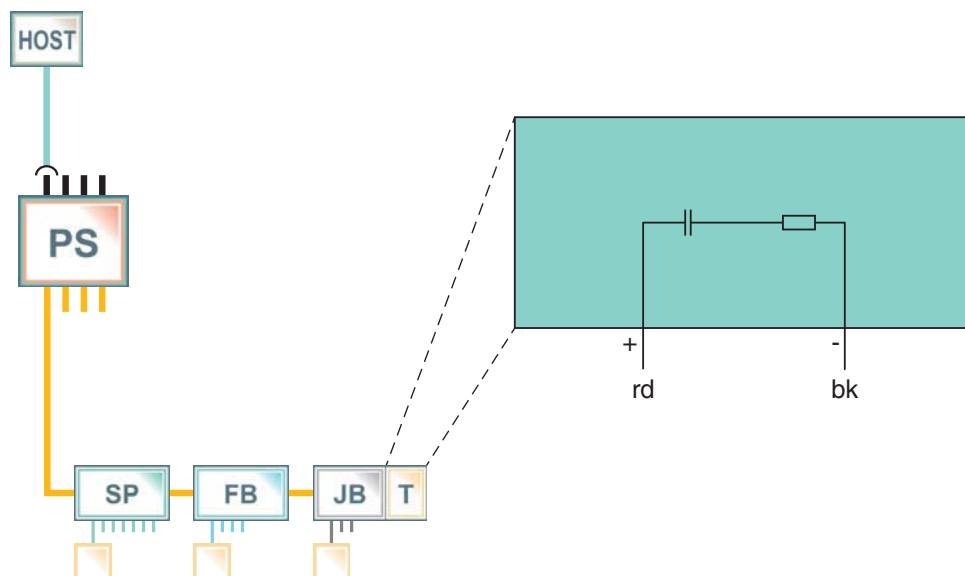
For increased availability the terminator features four capacitors in a network. If one capacitor should fail the basic functionality remains intact. This is detectable with the FieldConnex® Advanced Diagnostic Module allowing timely maintenance.

Fieldbus terminators are required at each end of the trunk line. They eliminate signal reflections at the end of the cable and convert the fieldbus signal transmitted as a current into a voltage, which is detectable by all devices.

Assembly



Connection



Zone 1

Technical data**Directive conformity**

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC/EN 60529

Ambient conditions

Ambient temperature

-50 ... 85 °C (-58 ... 185 °F)

Storage temperature

-50 ... 85 °C (-58 ... 185 °F)

Mechanical specifications

Core cross-section

0.75 mm²

Housing

77 mm x 22 mm

Protection degree

IP67

Mass

100 g

Mounting

20 mm ISO thread
PG13.5 thread
1/2 NPT thread**Data for application in connection with Ex-areas**

EC-Type Examination Certificate

DMT 01 ATEX 104 X

Group, category, type of protection,
temperature class

Ⓔ II 2G EEx d IIC T6

Temperature class

T6 for ambient temperature ≤ 60 °C
T5 for ambient temperature ≤ 75 °C
T4 for ambient temperature ≤ 85 °C

Maximum values

Rated voltage

< 253 V AC/125 V DC

Operating values

Rated voltage

≤ 32 V

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-1:2007, EN 60079-26:2007

International approvals

IECEx approval

IECEx BVS 10.0022X

Approved for

Ex d IIC T6 Gb

Features

- Terminator in stainless steel housing
- Intrinsically safe, FISCO or Entity
- Installation on open cable gland
- Choice of threads 20 mm, Pg 13.5 mm or 1/2" NPT

Function

F*-FT-Ex1.I.IEC are terminators and provide capacitance and resistance to terminate a fieldbus segment according to IEC 61158-2. Explosion protection is intrinsically safe 'Ex ia' for installation in Zone 0...2. A solid metal housing enables installation in rough environments. Housings are selectable with 20 mm ISO, PG 13.5 mm or 1/2" NPT connecting threads for easy installation on outdoor junction boxes or field instruments.

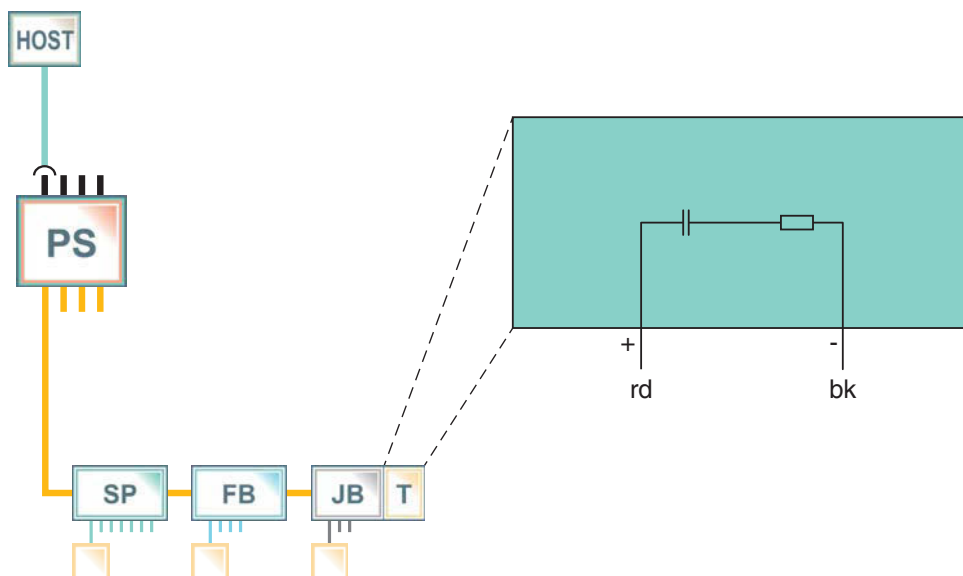
For increased availability the terminator features four capacitors in a network. If one capacitor should fail the basic functionality remains intact. This is detectable with the FieldConnex® Advanced Diagnostic Module allowing timely maintenance.

Fieldbus terminators are required at each end of the trunk line. They eliminate signal reflections at the end of the cable and convert the fieldbus signal transmitted as a current into a voltage, which is detectable by all devices.

Assembly



Connection



Zone 0

Technical data**Directive conformity**

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC/EN 60529

Ambient conditions

Ambient temperature

-50 ... 85 °C (-58 ... 185 °F)

Storage temperature

-50 ... 85 °C (-58 ... 185 °F)

Mechanical specifications

Core cross-section

0.75 mm²

Housing

77 mm x 22 mm

Protection degree

IP67

Mass

100 g

Mounting

20 mm ISO thread
PG13.5 thread
1/2 NPT thread**Data for application in connection with Ex-areas**

EC-Type Examination Certificate

DMT 01 ATEX 104 X

Group, category, type of protection,
temperature class

Ⓔ II 1G EEx ia IIC T6

Temperature class

T6 for ambient temperature ≤ 60 °C
T5 for ambient temperature ≤ 75 °C
T4 for ambient temperature ≤ 85 °C**Maximum values**Voltage U_i

≤ 30 V

Operating values

Rated voltage

≤ 30 V

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-11:2007, EN 60079-26:2007, IEC 60079-27:2008

International approvals

IECEx approval

IECEx BVS 10.0022X

Approved for

Ex ia IIC T6 Ga



FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Terminator in IP 20 housing
- Intrinsically safe, FISCO or Entity
- Installation on DIN rail in cabinet or field junction box

Function

The KMD0-FT-Ex is a terminator for fieldbus and provides capacitance and resistance to terminate a fieldbus segment according to IEC 61158-2. Explosion protection is intrinsically safe 'Ex ia' for installation in Zone 0...2. The housing is IP 20 for simple installation on the DIN rail for easy installation in control room cabinets or inside outdoor junction boxes.

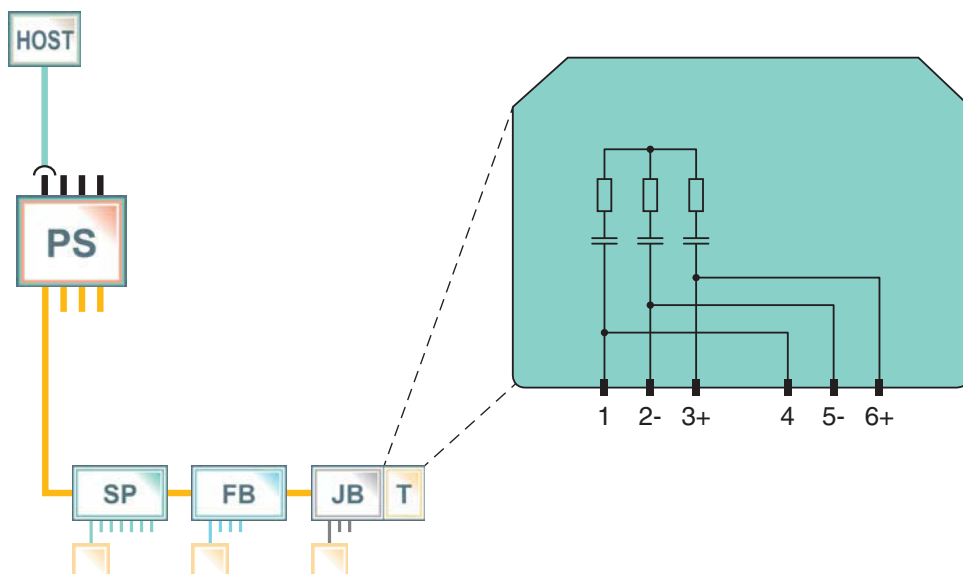
For increased availability the terminator features four capacitors in a network. If one capacitor should fail the basic functionality remains intact. This is detectable with the FieldConnex[®] Advanced Diagnostic Module allowing timely maintenance.

Fieldbus terminators are required at each end of the trunk line. They eliminate signal reflections at the end of the cable and convert the fieldbus signal transmitted as a current into a voltage, which is detectable by all devices.

Assembly



Connection



Technical data**Directive conformity**

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Ambient conditions

Ambient temperature

-20 ... 60 °C (-4 ... 140 °F)

Storage temperature

-40 ... 85 °C (-40 ... 185 °F)

Relative humidity

75 %

Mechanical specifications

Core cross-section

2.5 mm²

Housing width

20 mm

Protection degree

IP20

Mass

approx. 60 g

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 98 ATEX 2157

Group, category, type of protection, temperature class

Ⓔ II 2G EEx ia IIC T4

Voltage U_i

24 V

Current I_i

280 mA

Power P_i

1.93 W

Directive conformity

Directive 94/9/EC

EN 50014:1997

EN 50020:1994



Features

- Series voltage reducing module
- Removable terminals
- Polarity reversal protected
- Installation in cabinet on DIN mounting rail

Function

Pepperl+Fuchs Segment Protectors feature a safety switch off for explosion protection at typically 31.5 V.

In rare cases the tolerances in other manufacturers' power modules in combination with very short cable lengths with little or no voltage drop lead to a switch off of the Segment Protector.

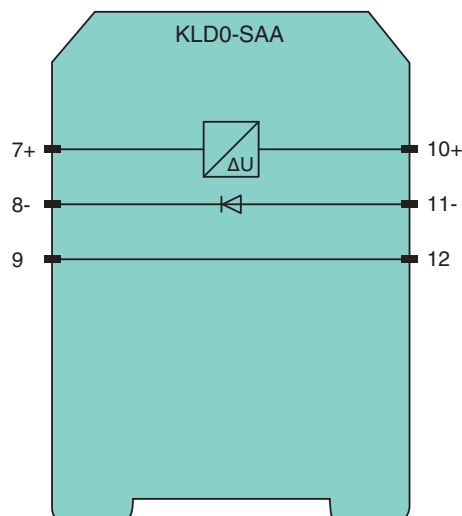
The KLD0-SAA is used to limit the voltage to uncritical values.

The KLD0-SAA is installed in close proximity to the power supply within the control cabinet.

Assembly



Connection



Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

Technical data**Directive conformity****Electromagnetic compatibility**

Directive 2004/108/EC

EN 61326-1:2006

Ambient conditions

Ambient temperature

-20 ... 60 °C (-4 ... 140 °F)

Storage temperature

-40 ... 85 °C (-40 ... 185 °F)

Relative humidity

< 75 %

Mechanical specifications

Connection type

Terminals

Core cross-section

up to 2.5 mm²

Housing

20 mm x 115 mm x 107 mm

Protection degree

IP20

Mass

approx. 100 g

Mounting

DIN rail mounting



Features

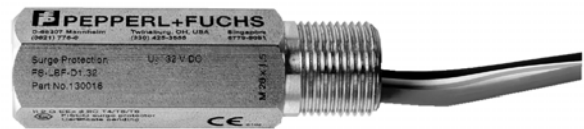
- Surge Protector in stainless steel housing
- Flameproof enclosure (Ex d) protection
- Surge protection for '+' and '-' fieldbus lead
- Choice of threads 20 mm or 1/2" NPT

Function

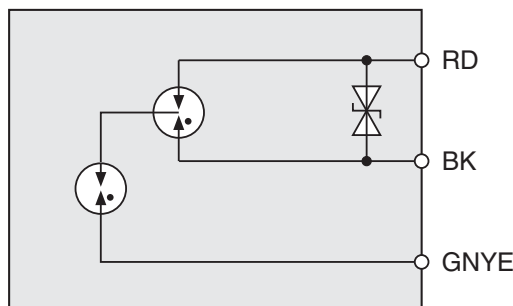
F*-LBF-D1.32 are surge protection devices for fieldbus installations. They direct power surges to earth via gas discharge tubes protecting field devices and control units from voltage surges and lightning strikes. They are in accordance with the fieldbus standard IEC 61158-2 and certified Ex d (flameproof enclosure) for Zone 1.

FieldConnex® surge protectors for field installation allow the coordinated use in a lightning protection zone concept in accordance with IEC 61312-1. Housings are selectable with 20 mm ISO or 1/2" NPT connecting threads for easy installation on outdoor junction boxes.

Assembly



Connection



Technical data**Electrical specifications**

Rated voltage	32 V
Surge Current (8/20) I_n	
per line	10 kA
total	10 kA
Max. surge current (8/20) I_{max}	10 kA
Voltage Protection Level at max. rated current	
Line/Line	58 V
Line/Earth	1700 V
Voltage Protection Level at 1 kV/ μ sec	
Line/Line	50 V
Line/Earth	1.2 kV
Reaction time t_A	
Line/Line	≤ 1 ns
Line/Earth	≤ 100 ns

Capacitance

Line/Line	25 pF
Line/Earth	15 pF

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC/EN 60529
Surge protection	IEC 61643-21

Ambient conditions

Ambient temperature	-50 ... 80 °C (-58 ... 176 °F)
Storage temperature	-50 ... 85 °C (-58 ... 185 °F)

Mechanical specifications

Core cross-section	1.3 mm ²
Housing material	Stainless steel 1.4401 (AISI 316) surface all over polished
Protection degree	IP00/IP67 if correctly installed
Mass	160 g
Mounting	screw mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate	KEMA 04 ATEX 2318 X
Group, category, type of protection, temperature class	Ex II 2G Ex d IIC T5/T6
Temperature class	T6 for ambient temperature ≤ 70 °C T5 for ambient temperature ≤ 80 °C

Maximum values

Rated voltage	32 V
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-1:2007

International approvals

IECEx approval	IECEx KEM 09.0067X
Approved for	Ex d IIC T5/T6 Gb

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

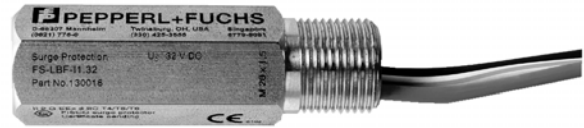
Features

- Surge Protector in stainless steel housing
- Intrinsically safe, FISCO or Entity
- Surge protection for '+' and '-' fieldbus lead
- Choice of threads 20 mm or 1/2" NPT

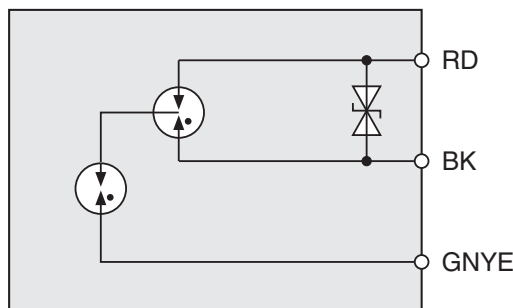
Function

F*-LBF-I1.32 are surge protection devices for fieldbus installations. They direct power surges to earth via gas discharge tubes protecting field devices and control units from voltage surges and lightning strikes. They are in accordance with the fieldbus standard IEC 61158-2 and certified intrinsically safe Ex ia for Zone 1, FISCO and Entity. FieldConnex® surge protectors for field installation allow the coordinated use in a lightning protection zone concept in accordance with IEC 61312-1. Housings are selectable with 20 mm ISO or 1/2" NPT connecting threads for easy installation on outdoor junction boxes.

Assembly



Connection



Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

Technical data**Electrical specifications**

Rated voltage 32 V

Rated current 550 mA

Surge Current (8/20) I_n

per line 10 kA

total 10 kA

Max. surge current (8/20) I_{max} 10 kA

Voltage Protection Level at max. rated current

Line/Line 58 V

Line/Earth 1700 V

Voltage Protection Level at 1 kV/ μ sec

Line/Line 50 V

Line/Earth 1.2 kV

Reaction time t_A Line/Line ≤ 1 nsLine/Earth ≤ 100 ns

Capacitance

Line/Line 25 pF

Line/Earth 15 pF

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC/EN 60529

Surge protection

IEC 61643-21

Ambient conditions

Ambient temperature -50 ... 80 °C (-58 ... 176 °F)

Storage temperature -50 ... 85 °C (-58 ... 185 °F)

Mechanical specificationsCore cross-section 1.3 mm²Housing material Stainless steel 1.4401 (AISI 316)
surface all over polished

Protection degree IP00/IP67 if correctly installed

Mass 160 g

Mounting screw mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate KEMA 04 ATEX 1317 X

Group, category, type of protection, temperature class $\text{Ex II 2(1)G Ex ia IIC T5/T6}$ Temperature class T6 for ambient temperature ≤ 70 °C
T5 for ambient temperature ≤ 80 °CVoltage U_i Entity 30 V, FISCO 17.5 VCurrent I_i Entity 550 mA, FISCO 380 mAPower P_i Entity 3 W, FISCO 5.32 WInternal capacitance C_i negligible 0 nFInternal inductance L_i negligible 0 μ H

Directive conformity

Directive 94/9/EC EN 60079-0:2006, EN 60079-11:2007, EN 60079-26:2007, EN 60079-27:2008

International approvals

IECEx approval IECEx KEM 09.0081X

Approved for Ex ia [ia Ga] IIC T5/T6 Gb

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

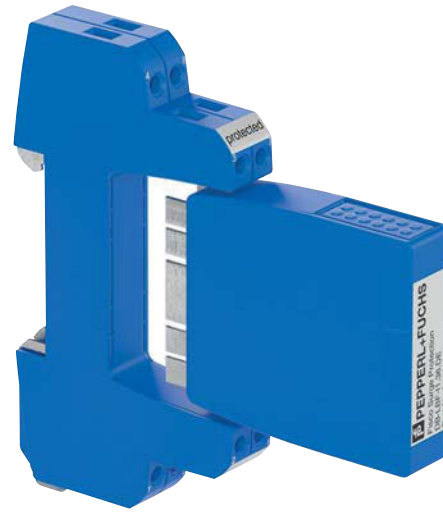
Features

- **Modular:** protection module easy to replace
- **Intrinsically safe (Ex ia), FISCO, Entity, DART Fieldbus,** or general-purpose
- **Protection module replaceable, interrupting or non-interrupting**
- **Grounding of shield direct or via gas-discharge tube**
- **Compact and space-saving design**
- **Installation on DIN rail in cabinet or field junction box**

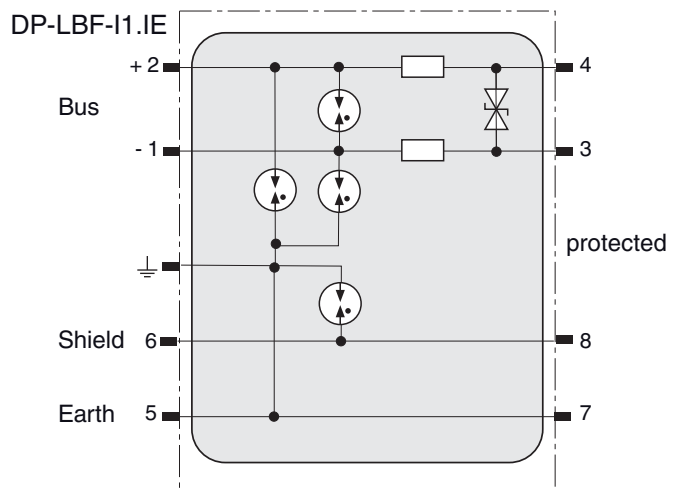
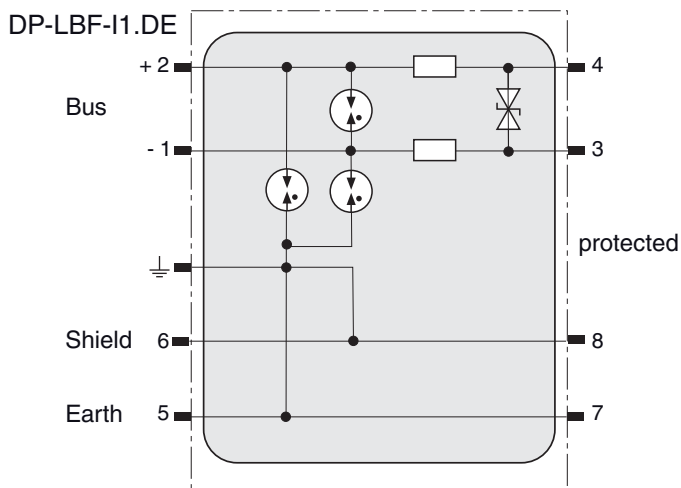
Function

The modular surge protector for fieldbus consists of a base (DB ...), and plug-in module (DP-LBF-I1.36*) and is in acc. with IEC 61158-2. It directs power surges to earth via gas discharge tubes protecting field devices. It is certified intrinsically safe for circuits in hazardous area Zone 0 ... 2/Div. 1 ... 2 and DART Fieldbus. The surge protector is installed in Zone 1 ... 2 or Div. 1 ... 2. Choices support all concepts: interrupting/non-interrupting module exchange and direct/indirect grounding of the shield. The plug-in module can be exchanged without tools. They support coordinated use in a lightning protection zone concept in acc. with IEC 61312-1. Installation in cabinet or junction box requires a minimum amount of wiring.

Assembly



Connection



Technical data**Electrical specifications**

Rated voltage	33 V
Rated current	500 mA
Voltage Protection Level U_p	
Line/Line	$\leq 58 \text{ V category C1/C2 } 8/20\mu\text{sec}, \leq 50 \text{ V category C3 } 1\text{kV}/\mu\text{sec}$ $\leq 51 \text{ V category B2 } 10/700\mu\text{sec}, \leq 55 \text{ V category D1 } 10/350\mu\text{sec}$
Line/Earth	$\leq 1400 \text{ V category C1/C2 } 8/20\mu\text{sec}, \leq 1100 \text{ V category C1/C2 } 1\text{kV}/\mu\text{sec}$ $\leq 1000 \text{ V category B2 } 10/700\mu\text{sec}, \leq 1300 \text{ V category D1 } 10/350\mu\text{sec}$
Screen/Shield directly grounded	$\leq 25 \text{ V category C1/C2 } 8/20\mu\text{sec}$ $\leq 20 \text{ V category D1 } 10/350\mu\text{sec}$
Screen/Shield indirectly grounded (via GDT)	$\leq 700 \text{ V category C1/C2 } 8/20\mu\text{sec}, \leq 600 \text{ V category C3 } 1\text{kV}/\mu\text{sec}$ $\leq 500 \text{ V category B2 } 10/700\mu\text{sec}, \leq 600 \text{ V category D1 } 10/350\mu\text{sec}$
Reaction time t_A	
Line/Line	$\leq 1 \text{ ns}$
Line/Earth	$\leq 100 \text{ ns}$
Screen/Shield-Earth	$\leq 100 \text{ ns}$
Overstressed fault mode	acc. IEC 61643-21 line inoperable mode 3 lines 1 and 2 at 15,5kA (8/20μsec) lines 3 and 4 at 30kA (8/20μsec)
Series resistance in line	1 Ω +/- 5 %
Impulse durability	
Per line	1 kA category D1 10/350μsec, 5 kA category C1/C2 8/20μsec
Screen/Shield directly grounded	5 kA category D1 10/350μsec
Screen/Shield indirectly grounded (via GDT)	4 kA category D1 10/350μsec, 10 kA category C1/C2 8/20μsec
AC durability	1 A, 50 Hz, 1 s category A2
Capacitance	
Line/Line	800 pF
Line/Earth	16 pF
Standard conformity	
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Surge protection	IEC 61643-21
Ambient conditions	
Ambient temperature	-50 ... 80 °C (-58 ... 176 °F)
Storage temperature	-50 ... 85 °C (-58 ... 185 °F)
Relative humidity	$\leq 95 \%$ non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g, 10 ... 150 Hz
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	KEMA 09 ATEX 0191 X
Group, category, type of protection, temperature class	Ⓔ II 2(1)G Ex ia IIC T4/T5/T6
Voltage U_i	30 V
Current I_i	500 mA
Internal capacitance C_i	negligible 0 nF
Internal inductance L_i	negligible 0 μH
Statement of conformity	KEMA 09 ATEX 0190 X
Group, category, type of protection, temperature class	Ⓔ II 3G Ex ic IIC T4/T5/T6, Ⓔ II 3G Ex nA II T4/T5/T6
Voltage U_i	33 V
Current I_i	500 mA
Internal capacitance C_i	negligible 0 nF
Ambient conditions	
Ambient temperature	-50 ... 80 °C (-58 ... 176 °F) T4, -50 ... 75 °C (-58 ... 167 °F) T5, -50 ... 50 °C (-58 ... 122 °F) T6
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2005, EN 60079-26:2007, EN 60079-27:2008
International approvals	
CSA approval	CSA 2437472
Control drawing	116-0361
IECEx approval	IECEx KEM 09.0088X
Approved for	Ex ia [ia Ga] IIC T4/T5/T6 Gb, Ex ic IIC T4/T5/T6 Gc, Ex nA IIC T4/T5/T6 Gc

Features

- Pluggable, mounts between Power Hub and trunk cable
- Intrinsically safe (Ex ia), FISCO, Entity, DART Fieldbus, or general-purpose
- Optional diagnostics for wear
- Grounding of shield direct
- Indication via LED and Advanced Diagnostics

Function

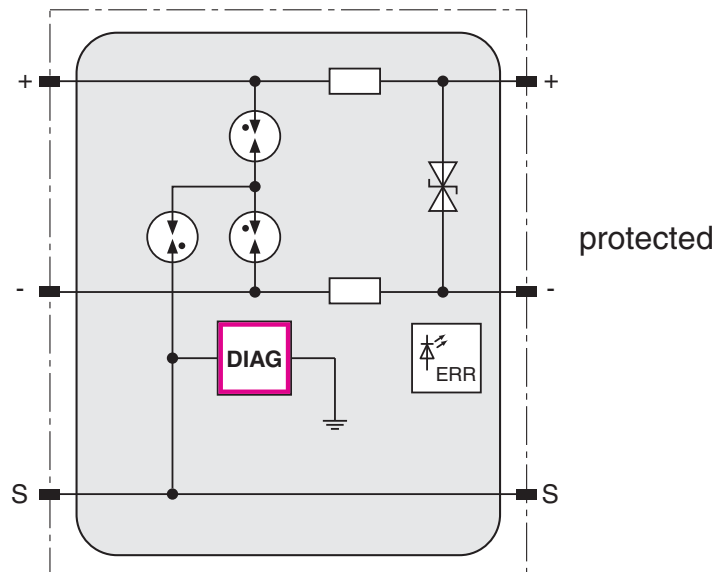
This fieldbus surge protector is in acc. with IEC 61158-2 and mounts on the trunk connector of FieldConnex® High-Density and Compact Power Hubs protecting them. It directs power surges to earth via gas discharge tubes. It is certified intrinsically safe for circuits in hazardous areas up to Zone 0/Div. 1 and DART Fieldbus. The surge protector is installed in Zone 1 ... 2 or Div. 1 ... 2.

Self-diagnostics (option) continuously monitor wear caused by surges. The end of the useful life is indicated via LED and in the control room via FieldConnex® Advanced Diagnostics for exchange.

Installation on the trunk connector is without additional wiring even as retrofit. A single grounding bar connects surge protectors mounted side by side to a common grounding point.



Connection



Technical data**Electrical specifications**

Rated voltage	36 V
Rated current	600 mA
Voltage Protection Level U_p	
Line/Line	≤ 50 V category B2 10/700 μ sec, 25 A ≤ 52 V category C1 8/20 μ sec, 300 A ≤ 55 V category C2 8/20 μ sec, 5 kA ≤ 46 V category C3 1kV/ μ sec, 10 A
Line/Earth	≤ 1060 V category B2 10/700 μ sec, 50 A per line ≤ 800 V category C1 8/20 μ sec, 300 A per line ≤ 1450 V category C2 8/20 μ sec, 5 kA per line ≤ 1300 V category C3 1kV/ μ sec, 50 A per line ≤ 1080 V category D1 10/350 μ sec, 500 A per line
Reaction time t_A	
Line/Line	≤ 1 ns
Line/Earth	≤ 100 ns
Overstressed fault mode	acc. IEC 61643-21 line inoperable mode 3
Series resistance in line	2 Ω +/- 5 %

Impulse durability	
Per line	5 kA category C2 8/20 μ sec

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NAMUR NE 21
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Surge protection	IEC 61643-21

Ambient conditions

Ambient temperature	-40 ... 70 °C (-40 ... 158 °F)
Storage temperature	-40 ... 85 °C (-40 ... 185 °F)
Relative humidity	≤ 95 % non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g, 10 ... 150 Hz

Data for application in connection with Ex-areas

EC-Type Examination Certificate	SIRA 12 ATEX 2128X
Group, category, type of protection, temperature class	Ex II 1G Ex ia IIC T4
Voltage U_i	24 V
Current I_i	500 mA
Internal capacitance C_i	2 nF
Internal inductance L_i	0.1 μ H
Statement of conformity	SIRA 12 ATEX 4176X
Group, category, type of protection, temperature class	Ex II 3G Ex nAc IIC T4, Ex II 3G Ex ic IIC T4
Voltage U_i	33 V
Current I_i	600 mA
Internal capacitance C_i	2 nF

Directive conformity

Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007

International approvals

IECEx approval	IECEx SIR 12.0051X
Approved for	Ex ia IIC T4

FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Features

- Pluggable, mounts between device coupler and trunk cable
- Intrinsically safe (Ex ia), FISCO, Entity, DART Fieldbus, or general-purpose
- Optional diagnostics for wear
- Grounding of shield via gas-discharge tube
- Indication via LED and Advanced Diagnostics

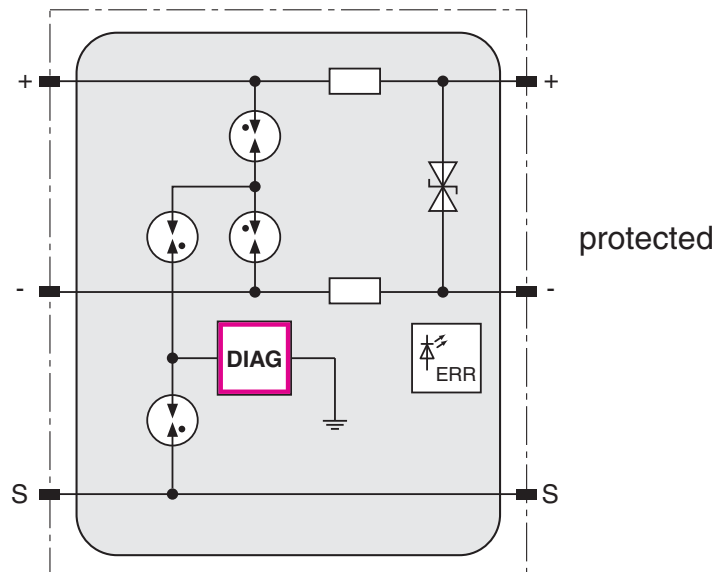
Function

This fieldbus surge protector is in acc. with IEC 61158-2 and mounts on the trunk connector of FieldConnex® device couplers protecting them. It directs power surges to earth via gas discharge tubes. It is certified intrinsically safe for circuits in hazardous areas up to Zone 0/Div. 1 and DART Fieldbus. The surge protector is installed in Zone 1 ... 2 or Div. 1 ... 2. Self-diagnostics (option) continuously monitor wear caused by surges. The end of the useful life is indicated via LED and in the control room via FieldConnex® Advanced Diagnostics for exchange. Installation on the trunk connector is without additional wiring even as retrofit.

Assembly



Connection



Technical data

Electrical specifications

Rated voltage	36 V
Rated current	600 mA
Voltage Protection Level U_p	
Line/Line	≤ 50 V category B2 10/700 μ sec, 25 A ≤ 50 V category C1 8/20 μ sec, 300 A ≤ 55 V category C2 8/20 μ sec, 5 kA ≤ 46 V category C3 1kV/ μ sec, 10 A
Line/Earth	≤ 1060 V category B2 10/700 μ sec, 50 A per line ≤ 800 V category C1 8/20 μ sec, 300 A per line ≤ 1.5 kV category C2 8/20 μ sec, 5 kA per line ≤ 1.3 kV category C3 1kV/ μ sec, 50 A per line ≤ 1080 V category D1 10/350 μ sec, 500 A per line
Screen/Shield indirectly grounded (via GDT)	≤ 500 V category B2 10/700 μ sec, 100 A ≤ 600 V category C1 8/20 μ sec, 500 A ≤ 720 V category C2 8/20 μ sec, 10 kA ≤ 550 V category C3 1kV/ μ sec, 100 A ≤ 570 V category D1 10/350 μ sec, 1 kA

Reaction time t_A

Line/Line	≤ 1 ns
Line/Earth	≤ 100 ns
Screen/Shield-Earth	≤ 100 ns
Overstressed fault mode	acc. IEC 61643-21 line inoperable mode 3
Series resistance in line	2 Ω +/- 5 %

Impulse durability

Per line	5 kA category C2 8/20 μ sec
Screen/Shield indirectly grounded (via GDT)	1 kA category D1 10/350 μ sec 10 kA category C2 8/20 μ sec

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NAMUR NE 21
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Surge protection	IEC 61643-21

Ambient conditions

Ambient temperature	-40 ... 70 °C (-40 ... 158 °F)
Storage temperature	-40 ... 85 °C (-40 ... 185 °F)
Relative humidity	≤ 95 % non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g, 10 ... 150 Hz

Data for application in connection with Ex-areas

EC-Type Examination Certificate	SIRA 12 ATEX 2128X
Group, category, type of protection, temperature class	Ex II 1G Ex ia IIC T4
Voltage U_i	24 V
Current I_i	500 mA
Internal capacitance C_i	2 nF
Internal inductance L_i	0.1 μ H
Statement of conformity	SIRA 12 ATEX 4176X
Group, category, type of protection, temperature class	Ex II 3G Ex nAc IIC T4, Ex II 3G Ex ic IIC T4
Voltage U_i	33 V
Current I_i	600 mA
Internal capacitance C_i	2 nF
Directive conformity	
Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007
International approvals	
IECEx approval	IECEx SIR 12.0051X
Approved for	Ex ia IIC T4

Features

- Pluggable, mounts between device coupler and spur cable
- Intrinsically safe (Ex ia), FISCO, Entity, DART Fieldbus, or general-purpose
- Optional diagnostics for wear
- Grounding of shield via gas-discharge tube
- Indication via LED and Advanced Diagnostics

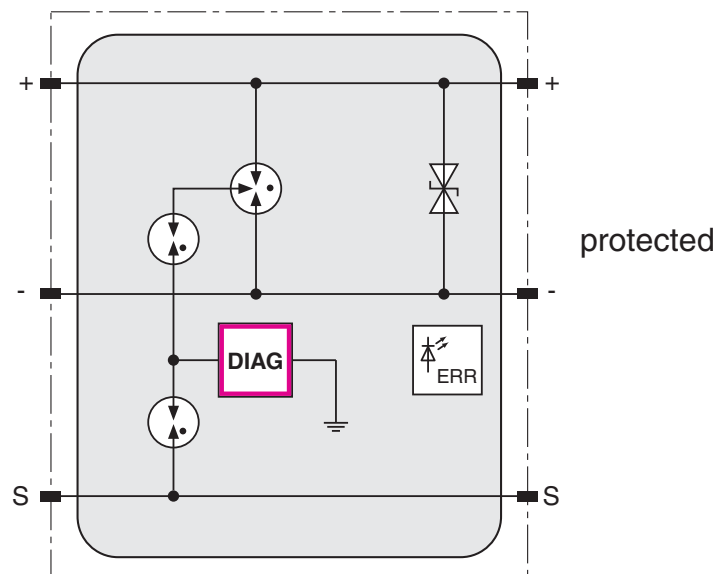
Function

This fieldbus surge protector is in acc. with IEC 61158-2 and mounts on the spur connector of FieldConnex® device couplers protecting them. It directs power surges to earth via gas discharge tubes. It is certified intrinsically safe for circuits in hazardous areas up to Zone 0/Div. 1 and DART Fieldbus. The surge protector is installed in Zone 1 ... 2 or Div. 1 ... 2. Self-diagnostics (option) continuously monitor wear caused by surges. The end of the useful life is indicated via LED and in the control room via FieldConnex® Advanced Diagnostics for exchange. Installation on the spur connector is without additional wiring even as retrofit. A single grounding bar connects surge protectors mounted side by side to a common grounding point.

Assembly



Connection



protected

Technical data

Electrical specifications

Rated voltage	36 V
Rated current	250 mA
Voltage Protection Level U_p	
Line/Line	≤ 50 V category B2 10/700 μ sec, 25 A ≤ 53 V category C1 8/20 μ sec, 150 A ≤ 55 V category C2 8/20 μ sec, 150 A ≤ 46 V category C3 1kV/ μ sec, 10 A
Line/Earth	≤ 980 V category B2 10/700 μ sec, 50 A per line ≤ 800 V category C1 8/20 μ sec, 50 A per line ≤ 1450 V category C2 8/20 μ sec, 5 kA per line ≤ 1200 V category C3 1kV/ μ sec, 50 A per line ≤ 980 V category D1 10/350 μ sec, 500 A per line
Screen/Shield indirectly grounded (via GDT)	≤ 500 V category B2 10/700 μ sec, 100 A ≤ 600 V category C1 8/20 μ sec, 500 A ≤ 700 V category C2 8/20 μ sec, 10 kA ≤ 550 V category C3 1kV/ μ sec, 100 A ≤ 570 V category D1 10/350 μ sec, 1 kA

Reaction time t_A

Line/Line	≤ 1 ns
Line/Earth	≤ 100 ns
Screen/Shield-Earth	≤ 100 ns
Overstressed fault mode	acc. IEC 61643-21 line inoperable mode 2
Impulse durability	
Per line	5 kA category C2 8/20 μ sec
Screen/Shield indirectly grounded (via GDT)	1 kA category D1 10/350 μ sec 10 kA category C2 8/20 μ sec

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NAMUR NE 21
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Surge protection	IEC 61643-21

Ambient conditions

Ambient temperature	-40 ... 70 °C (-40 ... 158 °F)
Storage temperature	-40 ... 85 °C (-40 ... 185 °F)
Relative humidity	≤ 95 % non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g, 10 ... 150 Hz

Data for application in connection with Ex-areas

EC-Type Examination Certificate	SIRA 12 ATEX 2128X
Group, category, type of protection, temperature class	Ex II 1G Ex ia IIC T4
Voltage U_i	24 V
Current I_i	500 mA
Internal capacitance C_i	2 nF
Internal inductance L_i	0.1 μ H
Statement of conformity	SIRA 12 ATEX 4176X
Group, category, type of protection, temperature class	Ex II 3G Ex nAc IIC T4, Ex II 3G Ex ic IIC T4
Voltage U_i	33 V
Current I_i	600 mA
Internal capacitance C_i	2 nF

Directive conformity

Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007

International approvals

IECEx approval	IECEx SIR 12.0051X
Approved for	Ex ia IIC T4

FOUNDATION Fieldbus H1

Selection
Guideline

Advanced
Diagnostics

Power
Supplies

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories

Features

- Indication via LED and Advanced Diagnostics
- Intrinsically safe, FISCO or Entity
- For instrument or device coupler
- Fits inside terminal compartment

Function

The enclosure leakage sensor senses water ingress in field device housings or junction boxes. It fits into the enclosure and sends alarms via the fieldbus network. It is certified intrinsically safe Ex ia for installation in Zone 0.

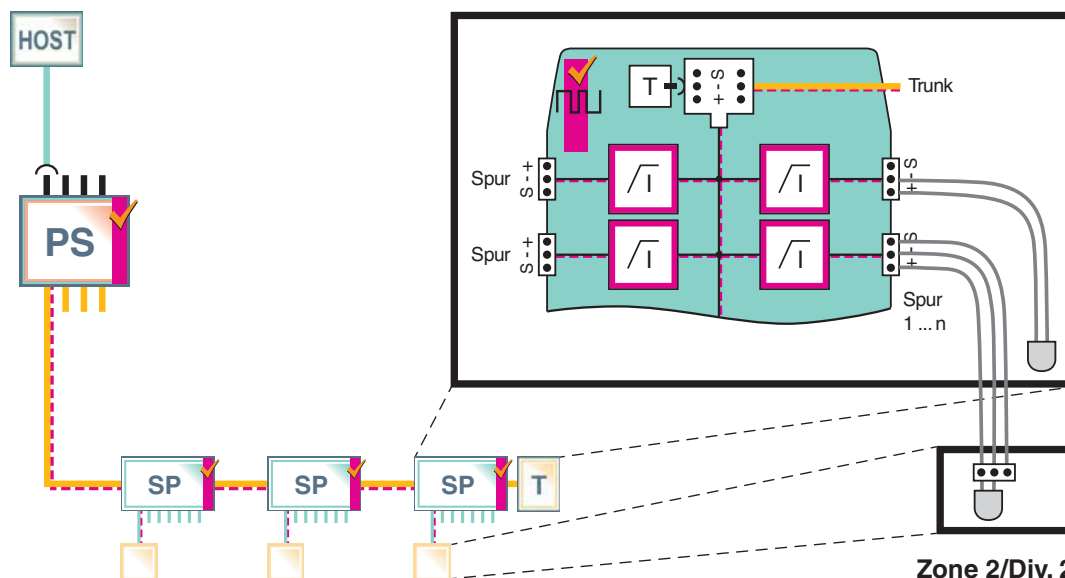
The alarm is indicated via LED and in the control room via FieldConnex® Advanced Diagnostics. Corrective actions can thus prevent effects from becoming irreversible or avoid conditions adverse to plant performance.

The ELS-1 connects in parallel to field instruments, trunk or spur connectors of compatible device coupler.

Assembly



Connection



Technical data**Directive conformity**

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC 60529

Climatic conditions

IEC 60721

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Ambient conditions

Ambient temperature

-40 ... 80 °C (-40 ... 176 °F)

Storage temperature

-40 ... 85 °C (-40 ... 185 °F)

Relative humidity

100 %

Shock resistance

15 g 11 ms

Vibration resistance

1 g, 10 ... 150 Hz

Mechanical specifications

Connection type

two strands, length 180 mm with cable ferrules, PVC insulation

Core cross-section

0.25 mm²

Housing material

Polycarbonate

Protection degree

Electronic component IP67
connection IP00

Mass

10 g

Data for application in connection with Ex-areas

EC-Type Examination Certificate

SIRA 12 ATEX 2129X

Group, category, type of protection,
temperature class

Ⓔ II 1G Ex ia IIC T4

Voltage U_i

24 V

Internal capacitance C_i

negligible 0 nF

Internal inductance L_i

negligible 0 μH

Statement of conformity

SIRA 12 ATEX 4154X

Group, category, type of protection,
temperature class

Ⓔ II 3G Ex nAc IIC T4, Ⓔ II 3G Ex ic IIC T4

Voltage U_i

33 V

Internal capacitance C_i

negligible 0 nF

Directive conformity

Directive 94/9/EC

IEC 60079-0:2011, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007

International approvals

IECEx approval

IECEx SIR 12.0052X

Approved for

Ex ia IIC T4, Ex ic IIC T4, Ex nAc IIC T4

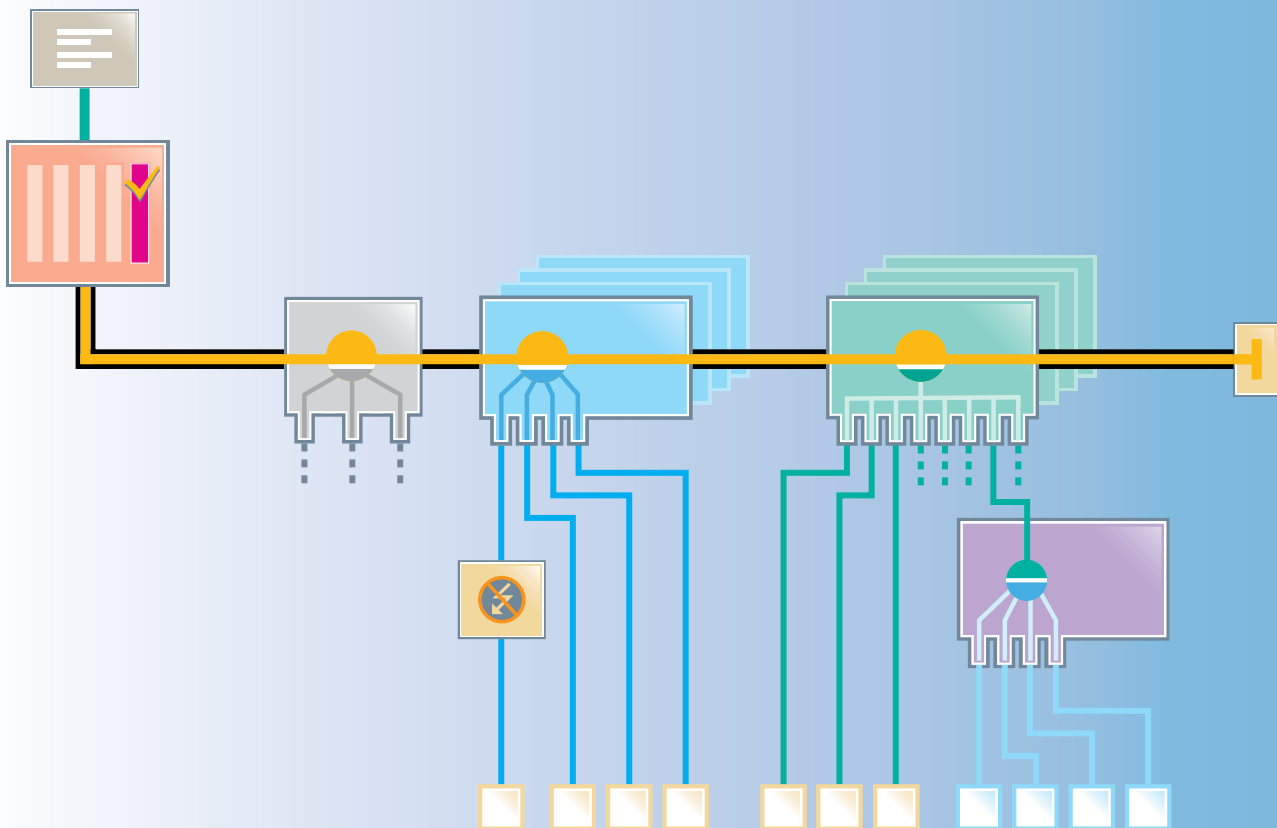
FOUNDATION Fieldbus H1

Selection
GuidelineAdvanced
DiagnosticsPower
SuppliesField
DistributionDART
FieldbusProcess
Interfaces

Accessories



PROFIBUS PA



Edition 912868 (US) / 220231 (EU) 04/2013

System Description	302
Selection Guideline	321
Products	
Advanced Diagnostics	330
Segment Couplers	344
Field Distribution	372
DART Fieldbus	412
Process Interfaces	418
Accessories	426



Introduction

FieldConnex® is the infrastructure and connection technology for fieldbus in process automation. It supports PROFIBUS PA based on IEC standard IEC 61158-2 and provides power and communication on the same cable. With quality components for your process automation system and demands in the field, our highly reliable and energy-efficient design enables you to easily design and implement segments that will keep running.

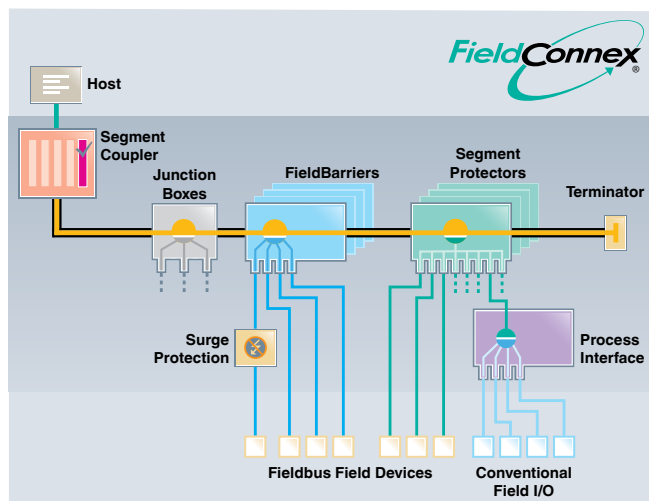


Figure 1 System diagram: Schematic connections between all components of the fieldbus infrastructure.

PROFIBUS PA is operated as a subnetwork to PROFIBUS DP. The Segment Coupler connects the two networks for data transmission and supplies power to the PROFIBUS PA segment.

The color coding in the diagram above guides you through the process of selecting the right FieldConnex® components and options. Each chapter is clearly marked with the symbol for the component.

The following chapters describe all components – both hardware and software – that make up the FieldConnex® portfolio. This includes features, benefits, engineering concepts, and available options. Cross references to the "Technology" section, manuals, white papers, or other documents are provided for easy comprehension.

System Components

Diagrams show the context in which FieldConnex® components are applied in a segment. Symbols in the diagrams are defined for all product groups as follows:

Segment Couplers (orange) power the segment and provide the connection to PROFIBUS DP. Different versions and options suit all kinds of installations, starting from laboratory and test installations, to small-scale remote installations, up to large-scale process plants with 10 000 segments or more.

Device couplers (blue, green, or gray) provide the connection points for field instruments. They come in enclosures ready to install in the field and are customized with accessories to fit the solution. Pepperl+Fuchs provides pre-engineered and pre-wired cabinets and housing solutions for plug and play.

Pepperl+Fuchs provides pre-engineered and pre-wired cabinets and housing solutions for plug and play.

Physical layer diagnostics (magenta) monitor the fieldbus physical layer and signals. This approach simplifies all practical aspects on handling the fieldbus.

Process Interfaces (purple) connect simple analog or digital I/O devices to the fieldbus. The process interface collects status, process data, and diagnostics and transmits the information via fieldbus to the DCS.

Accessories (yellow) such as terminators and surge protectors complete the product line.

Physical Layer Diagnostics

The quality of the installation itself can be monitored economically with FieldConnex® Advanced Diagnostics. Operator and maintenance staff can keep the physical layer from the power supply, junction boxes, and all connections between the DCS and the instrument in clear view. The system notifies the user when changes in the physical layer become critical issues during the operation of the automation system.

At the core is the Advanced Diagnostic Module (ADM), which is the first of its kind to monitor fieldbus signals for their quality. The system includes a software interface that allows the worker to analyze the installation from the safety of the control room.

A built-in expert system interprets a large number of measurements reported by the ADM. It provides information about possible causes and suggests courses of corrective action in plain text. Faults and possible causes are already known ahead of time for well-planned and necessary trips to the field. This way, unnecessary trips are avoided.

FieldConnex® Advanced Diagnostics reports alarms automatically to the DCS and plant asset management. This includes field-installed components with extra features to handle fault scenarios typical for fieldbus systems. This includes climate monitoring in the control cabinet, water ingress in junction boxes/instrument head, or wear of surge protectors. The alarm information reaches the DCS or maintenance station, traveling in parallel to normal fieldbus communication without requiring a fieldbus address or extra engineering.

FieldConnex® Advanced Diagnostics gives users the certainty that environmental conditions, manual intervention or any other potentially unknown cause will not harm the quality of the installation. This increases the overall availability so that fieldbus can be applied even in safety-critical applications.

Explosion Protection

FieldConnex® can be implemented in any hazardous area (Zones and Divisions) with a large selection of explosion protection concepts. The concepts are designed to meet the needs of modern-day process automation systems for ease of application, system availability, and live maintenance.

To learn more about explosion protection concepts, see the "Application Guideline" in the "Technology" section.

In order to meet the requirements of your plant, both the power supply and device coupler must support the chosen explosion protection concept of your plant. The following aspects have a major impact on choosing the right power supply and device coupler:

- Type of hazardous area
- Preferred explosion protection concept
- Maximum cable length and device count per segment

For a complete selection of FieldConnex® components, see the "Selection Guideline" for PROFIBUS PA.

High reliability and availability of all FieldConnex® system components result from our long-lasting expertise and the quality of our manufacturing. This is possible because of a highly integrated value chain, from product design, to production and quality control through delivery and implementation in your plant.

Enclosure and Cabinet Solutions

Aside from superior power supply components and field installation, Pepperl+Fuchs offers complete solutions built at our factories and ready for installation on site. Pre-engineered fieldbus junction boxes are made from a range of materials and include all components and accessories pre-wired and tested.

Our engineering departments assist with control cabinets built to order. Factory acceptance testing is available at our many facilities around the world. With premium fieldbus components and our value in engineering, we look to reduce your cost and time required on site for installation, testing, and plant startup.

PROFIBUS PA Segment Coupler



FieldConnex® Segment Couplers connect PROFIBUS DP to PROFIBUS PA and provide power to the instruments. They come in two versions: simplex "all-in-one" power supplies and modular Power Hubs with a motherboard as wiring interface. The Segment Coupler consists of a PROFIBUS DP/PA gateway and fieldbus power supplies. The gateway provides a transparent connection between PROFIBUS DP and PROFIBUS PA. Viewed from the PLC, all slaves appear as PROFIBUS DP slaves.

Details on the principle function of transparent coupling and Segment Couplers can be found below and in the "Technology" section.

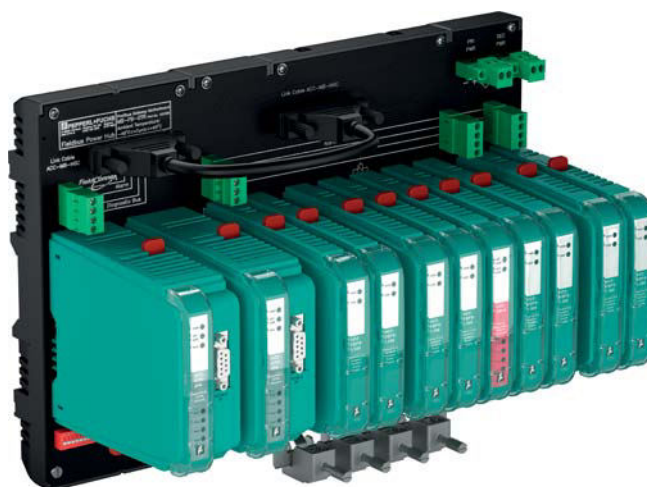


Figure 2 The FieldConnex® PROFIBUS Power Hub Segment Coupler 3 (SK3) with optional simplex and redundant power supply and gateways. See Figure 2.

Choices and options of the Power Hub are tailored to specific needs regarding plant availability, wiring, and diagnostics.

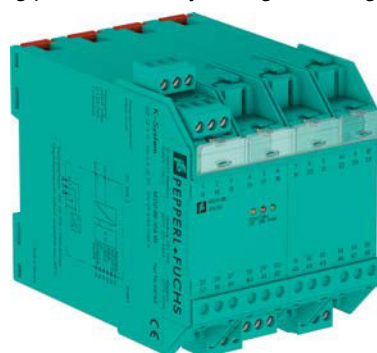


Figure 3 The Segment Coupler (SK1) is the all-in-one solution and works well in smaller applications and laboratory environments.

Detailed selection tables are located in the "Selection Guideline".



PROFIBUS PA

Selection
Guideline

Advanced
Diagnostics

Segment
Coupler

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories

Common Attributes

PROFIBUS Power Hub Gateway – Transparent Behavior

The gateway of the Segment Coupler provides a transparent connection so that all PA slaves appear to be connected to the PROFIBUS DP segment. This is true for all aspects of communication: Synchronous data exchange, field device configuration, and status information.

PROFIBUS Power Hub Gateways are equipped with a standard DB9 connector for easy connection to the DP segment.

Each segment comes with its own PA master. This allows for high speed on the PA side, as all segments operate independently and in parallel.

During idle time, the PA master detects the devices connected to it on the PA side. It also detects and sends alerts about abnormal conditions such as duplicate addressing.

When the DP master initiates communication, the gateway reads device data requested by the master and configures itself. It then assumes the communication role of all PA instruments connected to it.

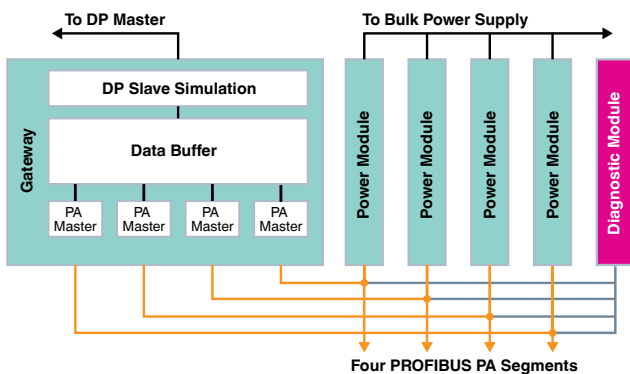


Figure 4 Schematic diagram of FieldConnex® PROFIBUS Power Hub – each segment is equipped with its own PA master for high communication speed

In the PLC or DCS system field instruments are configured and operated, based on their native GSD files.

Transparent behavior removes complexity in segment design, engineering, operation and maintenance – and the Segment Coupler remains configuration-free.

Heat Dissipation

FieldConnex® power supplies are designed for low heat dissipation. This contributes to a longer service life and, more importantly, to reduced heat dissipation, enabling a higher packing density in the control room cabinet. In most cases, heat dissipation rather than the actual cabinet floor space is the limiting factor in cabinet detail engineering.

The actual heat dissipation depends on layout and load conditions. To assist the decision-making process, selection tables indicate low heat dissipation as follows ‘-’, ‘--’, ‘---’ where ‘---’ stands for the lowest heat dissipation and the best performance.

DIN Rail Installation

All power supplies mount firmly on the DIN rail for easy installation in the cabinet.

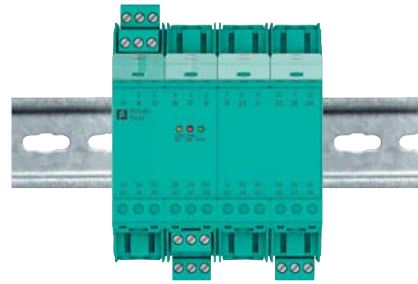


Figure 5 Segment Coupler mounted on DIN rail.



Figure 6 DIN rail installation is standard for all FieldConnex® Segment Couplers.

Supply and Conditioner

A selection of output voltages allows for designs for general purpose areas and hazardous areas. Additionally, fieldbus power is available in two forms:

1. Power Supply Modules provide galvanic isolation, impedance matching, and a choice of controlled output voltages.
2. Galvanic isolation provides many long-term benefits for communication stability and plant availability.

Where device couplers without galvanic isolation are applied, galvanic isolation of the power supply increases overall availability because communication behaves much more robustly towards unwanted conditions such as ground faults. Therefore, we recommend power supplies with galvanic isolation as state-of-the-art.

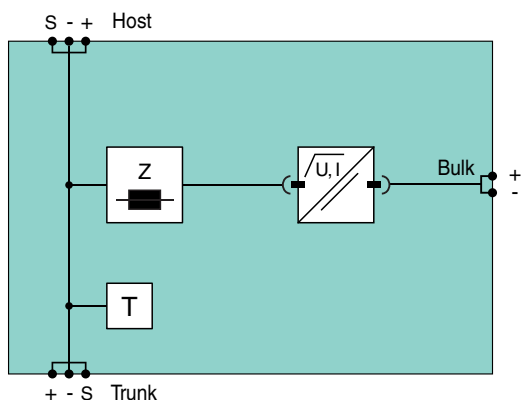


Figure 7 Schematic diagram of fieldbus power supply. Galvanic isolation and controlled voltage output detail of MBHD-FB1-4*

Power Conditioner Modules provide impedance matching and short circuit limitation. The output voltage closely follows the bulk power voltage. Power Conditioners do not have galvanic isolation. They contain fewer electronic components and because of that have low heat dissipation. However, in modern-day plants, galvanic isolation is specified. Power Conditioners are purchased mostly as replacement.

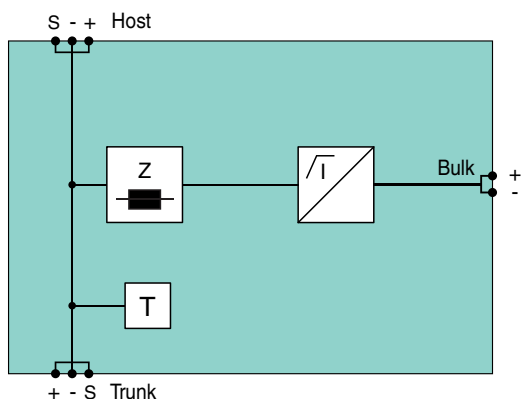


Figure 8 Schematic diagram of fieldbus Power Conditioner: Without galvanic isolation, follows the bulk power voltage

Applications for general purpose and safe areas with descriptions of explosion protection concepts are located in the "Application Guideline" of the "Technology" section.

Passive Impedance Matching

All FieldConnex® power supplies and Power Hubs feature passive impedance matching circuits. Passive components have a significantly lower heat dissipation compared to circuits using a series transistor.

Passive impedance matching is the only way to provide a perfectly balanced design. This contributes to a higher tolerance regarding grounding faults or module failures in redundant power supplies. A longer service life is guaranteed by using only resistors and inductances.

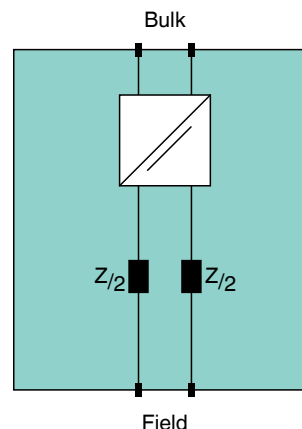


Figure 9 Impedance matching with purely passive design

For many of our products, we manufacture even the inductances. Thus we keep control over the quality of our manufacturing, components, and our circuit design.

Impedance Matching with CREST

Crosstalk and Resonance Suppression Technology (CREST) offers the best signal quality. In addition to the impedance matching circuits, filters ensure optimum signal quality. CREST provides additional impedance between segments in the case of ground faults on one or more segments, protecting the signal waveform from distortions.

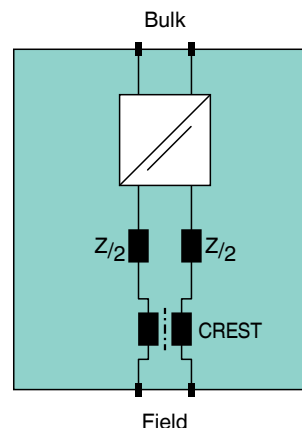


Figure 10 CREST cancels noise and other disturbances through current compensated inductances.

For a complete discussion of impedance matching and CREST, see the "Technology" section.



Power Hub – Segment Coupler 3

The FieldConnex® PROFIBUS Power Hub is a modular fieldbus power supply. It is comprised of a motherboard that serves as a wiring interface and plug-in modules for the power supply and diagnostics. In order to meet the different demands regarding options, economics, and availability, we offer three different versions as described below. The following attributes characterize the PROFIBUS Power Hub:

Redundancy

Power Supply Modules hold all electronic components. For high availability, motherboards can host two Power Supply Modules per segment acting as redundant pairs. This enables:

- High segment availability
- Low number and cost of spares
- Low replacement cost through modularity

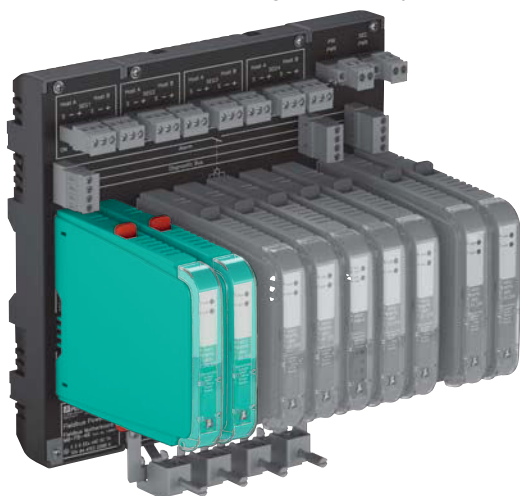


Figure 11 Each module feeds one segment. Two modules serve as redundancy pairs.

The connection to bulk power is redundant.



Figure 12 Redundant host connections (selected Power Hubs)

Module Mounting without Tools

All plug-in modules lock securely onto the motherboard via Quick Lok Bars. Installation and replacement of modules is fast and easy without tools.

FieldConnex® Power Hubs provide a socket for the Advanced Diagnostic Module (ADM) for four segments each.



Figure 13 Installation of power and diagnostic modules works without tools

Passive Motherboard

The motherboard is the wiring interface installed in the control room cabinet. It consists of passive components only for a long, uninterrupted service life. The impedance matching circuits are located in the motherboard.

Compared to electronic versions located in the power module, the impedance is always properly matched. This contributes to good signal quality and better communication reliability.

Grounding Rail and Connectors with Retaining Screws

The motherboard can be fitted with a grounding rail for convenient and secure grounding of the cable shield. Typically, the shield is grounded centrally in the control room. Any type of grounding and shielding concept can be implemented.

Selected models feature plug-in connectors with retaining screws. The connection is long-lived and is designed to endure constant vibrations.

The fieldbus infrastructure does not require a SIL rating because the entire communication channel is already certified and approved for SIL 3 through the fieldbus protocol.

For a detailed discussion, see the "Technology" section.

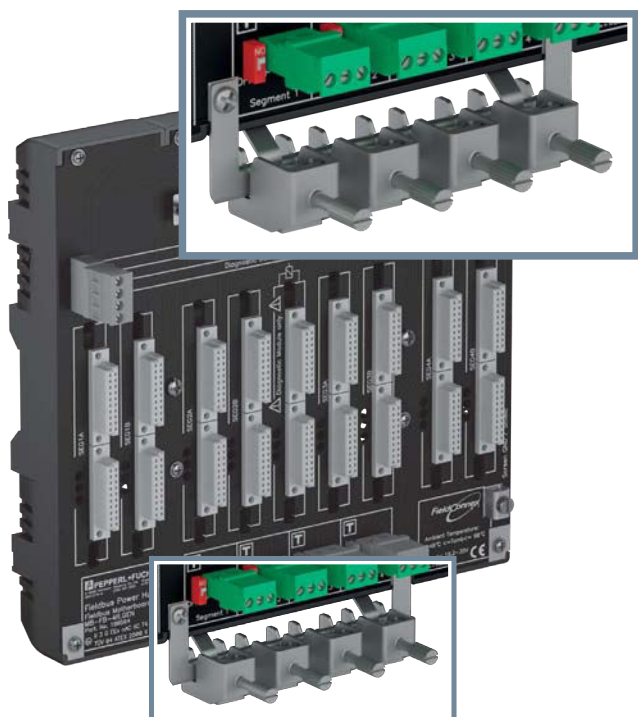


Figure 14 Grounding rail installed on the motherboard. This simplifies installation and is one of the most popular options.

Segment Coupler (SK1)

The Segment Coupler SK1 is an all-in-one simplex power supply and DP gateway. It provides power to one segment and connections to a DP master via terminals. The SK1 comes with an integrated terminator and can be powered via Power Rail. It is configuration-free and preferably applied in smaller applications or laboratory setups. The transmission speed on the DP side is constant 93.75 kBit/s.

Versions are available with high output for general purpose areas and the High-Power Trunk Concept, and with intrinsically safe outputs for a completely intrinsically safe installation according to FISCO or Entity explosion protection concepts.

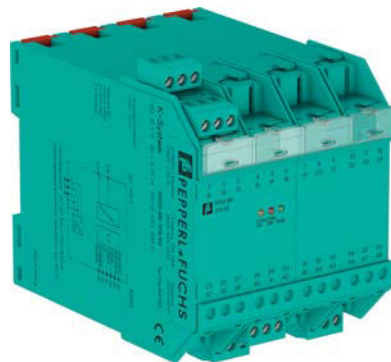


Figure 15 Segment Coupler SK1: a compact single unit

Current versions are only 20 mm wide and can be fitted on the DIN rail without requiring spacing for cooling purposes.

Type Codes	Types	Width (mm)	CREST	Terminators: Selectable/Fixed
KFD2-BR-Ex1.3PA.93	Supply			
KFD2-BR-1.PA.93	Supply			

Table 1 Comparison of main attributes for Segment Coupler SK1

Installation and Distribution



Fieldbus installation components, in general referred to as device couplers, are wiring interfaces with an enclosure that can be fitted for different demands of degree of protection and mechanical methods of explosion protection.

FieldConnex® device couplers combined with FieldConnex® power supplies provide protection methods that meet the demands of general purpose and all explosion hazardous areas. They come in three basic types:

- **FieldBarrier:** Comprises short circuit current limitation, galvanic isolation, and intrinsically safe power limitation at the spur. For hazardous area Zone 1 and Div. 2 with instruments in Zone 0 ... 1 and Div. 1 ... 2. The FieldBarrier is an innovation by Pepperl+Fuchs that has become a de facto standard for hazardous area applications requiring long cable lengths and high device counts. The FieldConnex® FieldBarrier has paved the way for fieldbus in process automation and has a very large installation base in the market.
- **Segment Protector:** With short circuit current limitation. The recommended and economical choice for installations in general purpose and hazardous areas Zone 1 ... 2 and Div. 2.
- **Junction Box:** Simple, without short circuit current limitation. Is used when live access to a device is not critical, mainly for general-purpose applications or with intrinsically safe power supplies. Associated apparatus for hazardous areas Zone 1 ... 2 and Div. 2.

Short circuit current limitation

Short circuit current limitation for each spur protects the segment from faults at a spur. In case of a short circuit condition, the segment remains in operation as the device coupler limits the current. We strongly recommend applying device couplers with short circuit current limitation.

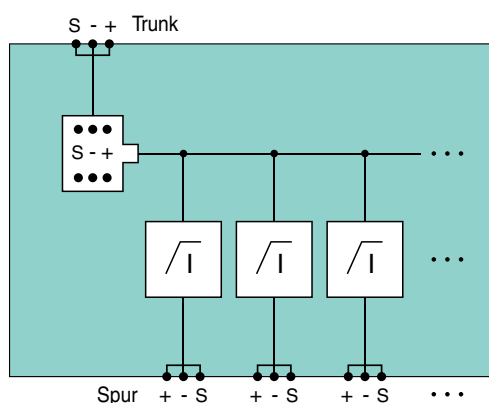


Figure 16 Short circuit current limitation at the spur enables live work on a field instrument while protecting the remainder of the segment.

FieldBarrier

Originally an innovation by Pepperl+Fuchs, the FieldConnex® FieldBarrier with galvanic isolation revolutionized the fieldbus industry. It is the fundamental building block of the High-Power Trunk Concept which is a de facto standard today allowing for long cable lengths and high device counts.

Typical Features

FieldBarriers comprise the following features:

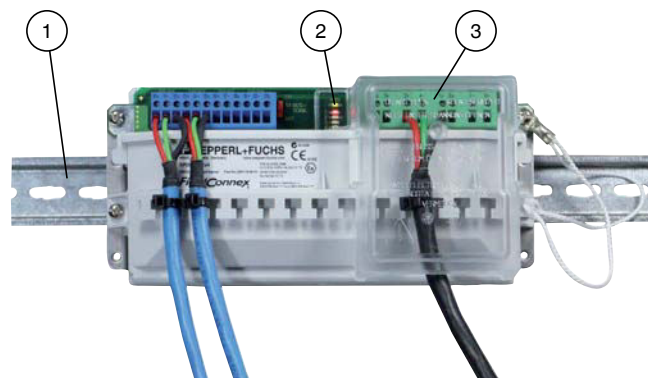


Figure 17 FieldBarrier on a DIN rail.

1. DIN rail installation: FieldBarriers are DIN rail mountable, typically without requiring tools.
2. LED indicators: LEDs provide indication for power and short circuit condition per spur. This supports installation and troubleshooting, and simplifies fault recognition.
3. Bus powering: The FieldBarrier draws the power required for indicators, power limitation, and short circuit current limitation from the fieldbus itself.

For a detailed discussion of explosion protection plans using FieldBarriers, see the "Application Guideline" in the "Technology" section.

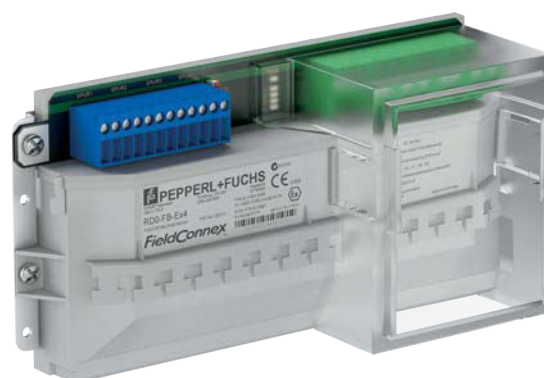


Figure 18 FieldBarrier: The additional translucent cover prevents an unintended disconnection of the trunk. Spurs are intrinsically safe.

The FieldBarrier acts as an intrinsically safe barrier between trunk and spurs with galvanic isolation. An important safety feature is the IP30 cover for the trunk connectors that protects against unintended opening of the trunk circuits.

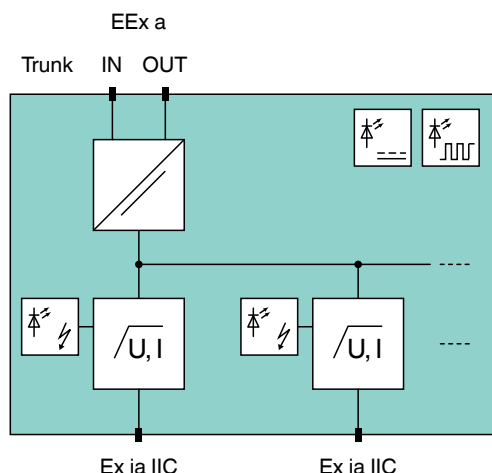


Figure 19 FieldConnex® FieldBarrier: Galvanic isolation between trunk and spurs, short circuit limitation, and intrinsically safe explosion protection at each spur.

The majority of devices installed in the hazardous area Zone 0/Class I, Div. 1 are connected to the fieldbus via a FieldConnex® FieldBarrier.

For enclosures with a degree of protection up to IP66 or equivalent Enclosure Type Rating, see "Fieldbus Junction Box Housing Solutions" in this section.

Segment Protectors

Segment Protectors are available for different applications. Their common attributes are short circuit current limitation and LED indicators.

Typical Features

Segment Protectors comprise the following features:

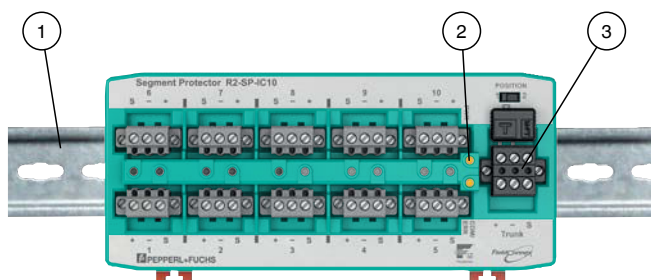


Figure 20 Segment Protector on a DIN rail. Number of spurs can be selected from 4 ... 12.

1. DIN rail installation: Segment Protectors are DIN rail mountable, typically without requiring tools.
2. LED indicators: LEDs provide indication for power, communication, and short circuit condition per spur. This supports installation and troubleshooting, and simplifies fault recognition.
3. Bus powering: The Segment Protector draws the power required for indicators, power limitation, and short circuit current limitation from the fieldbus itself.

R2-SP-N*:

Standard solution for the application in general purpose and Zone 2/Div. 2 areas. Supports latest standard for intrinsic safety 'Ex ic'. Comes with a choice 4 ... 12 outputs.

R2-SP-IC*:

Segment Protector with progressive short circuit current limitation. It detects faults typical for fieldbus installations, such as contact bounce. It detects these faults and sends an alarm via Advanced Diagnostics to the maintenance station indicating the affected spur.

RM-SP*:

Modular solution for equipment in confined space such as skid-mounted applications. Also for Zone 2/Div. 2. Trunk module with two spurs can be expanded with modules of four spurs each.

R-SP-E12:

For explosion-proof/flameproof enclosure protection in Zone 1/Div. 2.

R3-SP-IBD12:

The DART version for Zone 1 with trunk and spurs intrinsically safe Ex ib IIC.

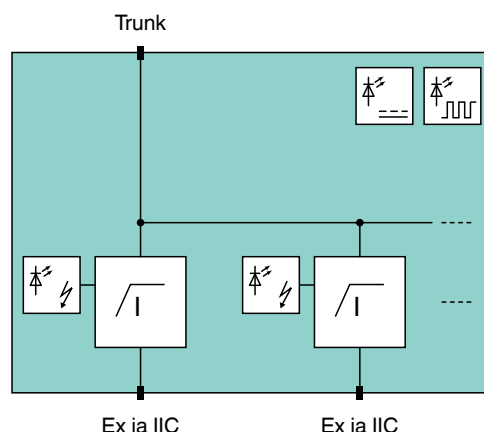


Figure 21 FieldConnex® Segment Protector: Short circuit limitation and intrinsically safe explosion protection at each spur.

For more details on DART Fieldbus, see "DART Fieldbus Components" as well as the "Application Guideline" in the "Technology" section, and the "Selection Guideline" for PROFIBUS PA.



Figure 22 Segment Protector in aluminum housing with LEDs visible from the outside

Receptacles for Test Connectors

Most Segment Protectors have a choice of trunk and spur connectors fitted with plugs or spring clamp terminal connections. More recent Segment Protectors feature removable terminals with retaining screws and test plug sockets.

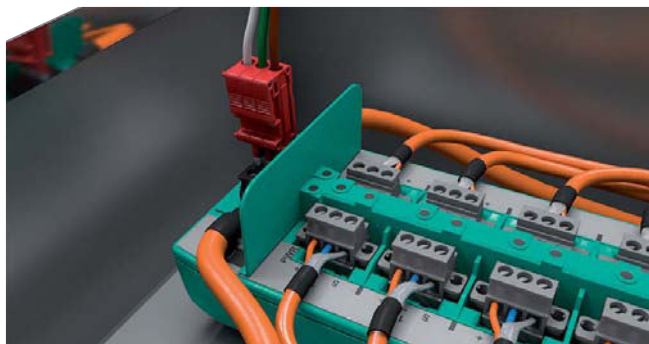


Figure 23 R2 Segment Protector: LED indicators, short circuit current limitation at each spur, removable terminals with retaining screws, and sockets for test plugs.

Trunk with T-Connector

Segment Protectors as of version R2-SP-N* feature a T-connector on the trunk line delivered with a terminator already in place. This is a simple, yet intuitive and reliable way of ensuring proper termination:

- When installed, the T-connector is attached to the trunk cable. The terminator is in place.
- When looping to the next Segment Protector in the same or another enclosure, the terminator has to be removed. The terminator on the next T-connector is already installed.

Even the Segment Protector itself can be exchanged without interfering with communication on the trunk.

Type	T-connector	Spring-Clamp Terminals	Plug-in Terminals	Plug-in Terminals with Retaining Screws	Explosion Protection	Installation in	Devices in
R2-SP-N*	X			X	Ex ic Ex nL Ex d	Zone 2 Div. 2 Zone 2	Zone 2 Div. 2 Zone 1
R2-SP-IC	X			X	Ex nAc	Zone 2 Div. 2	Zone 1 Div. 1
RM-SP*			X		Ex nL	Zone 2 Div. 2	Zone 2 Div. 2
R-SP-E12		X			Ex d	Zone 1	Zone 1
R3-SP-IBD12	X			X	Ex ib	Zone 1	Zone 1

Table 2 Attributes and selection criteria of Segment Protectors

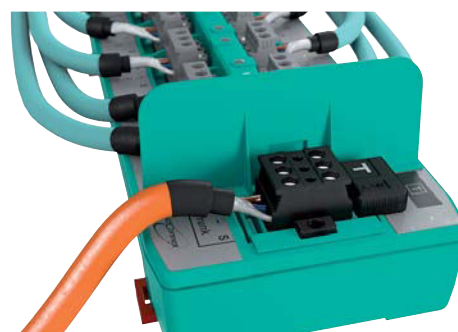


Figure 24 The T-connector designed by Pepperl+Fuchs allows for easy and fault-free installation.

With its innovative design, the R2-SP-N* Segment Protector series is the result of more than a decade's experience of using fieldbus technology for superior availability.

For enclosures with a degree of protection up to IP66 or equivalent Enclosure Type Rating, see "Fieldbus Junction Box Housing Solutions" in this section.

Junction Box

Simple junction boxes are used for connections in fieldbus installations where manual intervention is typically only required offline, e.g., while the plant is set into service mode.



Figure 25 Simple junction box with IP67 for general purpose and intrinsically safe installation.

FieldConnex® junction boxes F2-JB-* come with our declaration as associated apparatus for hazardous area Zone 1 (Div. 2). They can be operated together with intrinsically safe fieldbus power supplies.

Please see description of aluminum housings for more information.

Fieldbus Junction Box Housing Solutions

Our wide range of FieldConnex® Fieldbus Junction Boxes are manufactured in-house to guarantee superior consistency and quality. Pre-engineered products are very popular due to the many choices and options. They accommodate practically all requirements from the process industry. The FieldConnex® Fieldbus Junction Boxes are pre-wired and host device couplers and accessories. They are ready to install on site, reducing installation cost and time.

For hazardous areas, the Fieldbus Junction Box comes with a certificate for Zones 1/2/21/22 and Class I, Div. 2.

For special requirements, our engineering department is prepared to build custom-tailored solutions according to your needs.

Stainless Steel

Our stainless steel enclosures are the sturdiest and most impact-resistant on the market today. They are an ideal choice for environments requiring frequent washing of the equipment. They offer fully watertight seals and are the perfect choice for highly corrosive areas where standard enclosures would not remain tight. Stainless steel enclosures are available with degree of protection rating IP67 and Type 6.



Figure 26 Stainless steel enclosure with three FieldBarriers, a terminator, and pre-wired trunk connections.

Polyester

Glass fiber reinforced polyester (GRP) Fieldbus Junction Boxes are the perfect choice where low weight or costs are required. They represent an ideal solution for most installations that require a degree of protection rating of up to IP66 and Type 4X.



Figure 27 GRP enclosure with a pre-installed R2 Segment Protector

Aluminum

The FieldConnex® F2* Fieldbus Junction Boxes are very compact, lightweight, and sturdy. For non-corrosive environments, aluminum enclosures are an even more economical choice. They are the best match for most installations that require degree of protection ratings IP67 and Type 4X.

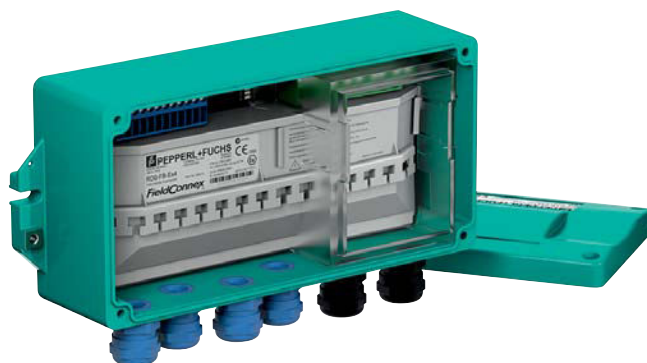


Figure 28 Very space-saving: FieldBarrier in an aluminum enclosure.

See the respective datasheets for complete choices of cable glands and options available.



DART Fieldbus Components



FieldConnex® DART Fieldbus implements the intrinsically safe High-Power Trunk Concept. It provides the power to drive long segments and supplies a high number of field instruments. At the same time, the trunk remains intrinsically safe. DART Fieldbus consists of DART Power Hubs and DART Segment Protectors.

For a complete description of DART technology and operation, see the "Technology" section.

Components for DART Fieldbus are certified Ex ib IIC allowing installation in Zone 1 and gas group IIC. The Segment Coupler can reside in Zone 2.

The DART Power Hub is based on the FieldConnex® High-density Power Hub. It provides power to the segment and features connections to the control system. Due to the DART technology, the Power Hub detects a spark before it occurs and switches it off.



Figure 29 DART Power Hub for PROFIBUS PA: redundant Power Supply Modules and intrinsically safe energy limitation.

The DART Segment Protector (type R3-SP*) has a similar design as the R2-SP* Segment Protector and provides the same features.

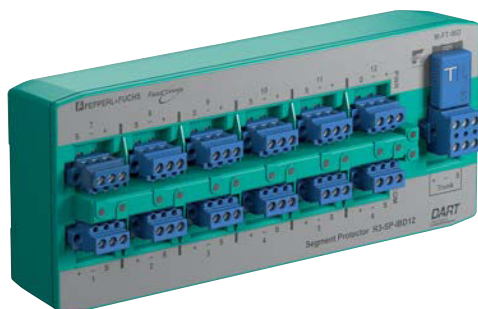


Figure 30 DART Segment Protector –Short circuit protection and Zone 1 certified terminator.

The segment retains its intrinsically safe rating when equipment is connected that is intrinsically safe (Ex ia), e.g., measurement tools. However, for DART to operate properly, only components listed in the certificate are permitted on the trunk.

Advanced Diagnostics



The fieldbus physical layer becomes a proactively manageable asset with the Advanced Diagnostic Module (ADM). The ADM automates

commissioning and documentation, monitors the segment online, and identifies even gradually occurring faults in real time.

Advanced Diagnostics is designed to support three practical tasks or use cases: commissioning, monitoring, and troubleshooting.

Three use cases for Advanced Diagnostics are described in the "Technology" section.

Modules and Hardware

The FieldConnex® Advanced Diagnostic Module (ADM) for the FieldConnex® Power Hub system provides real-time monitoring and local data storage of physical layer values for up to four segments. It automatically triggers alarm messages and communicates with the operator and maintenance station, enabling access for commissioning, monitoring, and troubleshooting.

Passive input circuits leave the physical layer unchanged, providing true, exact measurements. The ADM detects gradual or sudden changes and helps trace even intermittent malfunctions. It can be configured to monitor each segment closely.

Three versions are available for different types of applications and use cases:

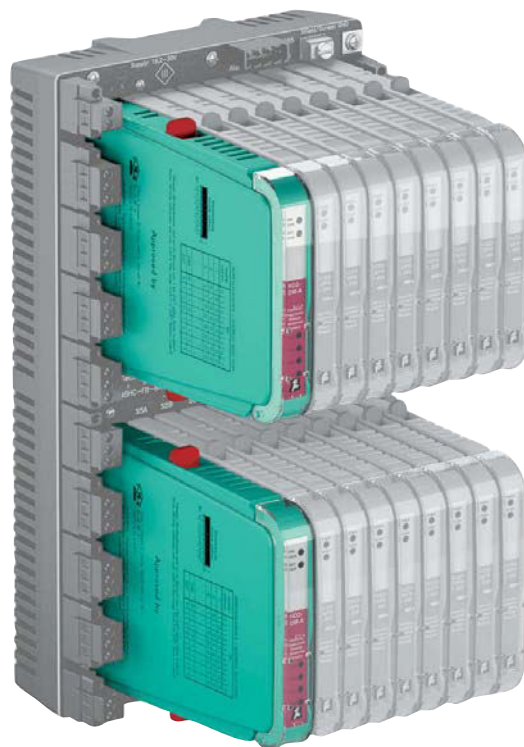


Figure 31 Stationary ADM (HD2-DM-*) plugs into the FieldConnex® Power Hub. It monitors up to four segments online and in real time.

Advanced Diagnostic Module

The Advanced Diagnostic Module plugs into the FieldConnex® Power Hub. Full measurement capabilities for four segments make this module the best choice for providing highest plant availability and the lowest commissioning and maintenance costs.

Advanced Diagnostic Module with Relay Output

Advanced Diagnostic Module with relay output only. Working without a software interface, physical layer monitoring starts by plugging in the module without any extra engineering. Optionally, the user can set warning thresholds via DIP switches. The module reports unwanted conditions via voltage-free contact. In combination with the mobile ADM, this is an economical tool for commissioning and troubleshooting.

Basic Diagnostic Module

The Basic Diagnostic Module monitors the fieldbus Power Hub health status only and issues warnings via a voltage-free contact.

Additional options and applications are the stand-alone motherboard and the mobile version of the ADM:



Figure 32 Stationary ADM on stand-alone motherboard for retrofitting any segment.

Stand-alone Advanced Diagnostics

In combination with a stand-alone motherboard, the HD2-DM-A provides full function diagnostics. It can be wired to any segment in parallel to the existing power supply and includes remote software support via the Diagnostic Manager. This is the ultimate choice for retrofitting any existing fieldbus installation.



Figure 33 Mobile ADM DM-AM-KIT for the traveling fieldbus professional.

Mobile Advanced Diagnostic Module

The mobile ADM is made for the traveling fieldbus practitioners. This full-fledged tool supports all working procedures throughout the complete lifecycle of a segment. Featuring a USB connection for power and communication with any laptop, the mobile ADM is intended for work in the field. Connected to any 24 V power supply, it can even be left unattended while monitoring a troubled segment.

Integration into plant asset management or engineering stations can be accomplished in either of the following ways:

1. Integration via PROFIBUS DP: PROFIBUS Power Hub gateways can access the Advanced Diagnostic Module. The communication packages for the gateway and ADM include all drivers for easy setup with self-configuration. This is a very effective integration without requiring additional hardware.
2. Integration via Ethernet: An additional gateway provides full access to up to 62 stationary ADMs. It connects all ADMs to higher-level controls through Ethernet. Inside the control cabinet, a simple bus provides the bandwidth for physical layer diagnostic information. Thus, the bandwidth of the fieldbus itself remains untouched. This method is used when applying the Advanced Diagnostic Module to networks with Segment Coupler 2 (SK2) or without FieldConnex® power supplies.



Figure 34 PROFIBUS Power Hub Gateway KT-MB-GT2AD to fieldbus diagnostic information

Optional inputs and outputs for analog and digital measurements and two high-power control outputs are designed for cabinet control. Even a humidity sensor is on board. The gateway can be configured as a local controller activating heaters, fans, or air-conditioning. Door contacts allow for alarming unauthorized access.

For a brief description of DCS integration, see below and the manual for full details.

Diagnostic Manager Software

The Diagnostic Manager, Professional Edition is the software program that displays the data of the ADM and runs the functions that make working with fieldbus quick and easy. The Diagnostic Manager automatically detects the diagnostic gateways and all Advanced Diagnostic Modules. The system is set up in minutes.

The Diagnostic Manager communicates simultaneously with all diagnostic modules. It runs on a PC in the safety of the control room. Multiple PCs running the Diagnostic Manager can access diagnostic information simultaneously, enabling a flexible distributed architecture.

Embedded in the Diagnostic Manager software is an expert system. This system learns and interprets the electrical values and behavior of each segment. A commissioning wizard documents a complete segment with only a few mouse clicks.

For fieldbus experts: The integrated oscilloscope triggers fieldbus-related events and stores up to ten consecutive shots. Working with fieldbus has never been easier.

A basic edition is available for free in the download section of www.pepperl-fuchs.com. It provides immediate access for reading and monitoring the physical layer for up to three ADMs simultaneously.

See the manual for full details on the Diagnostic Manager.

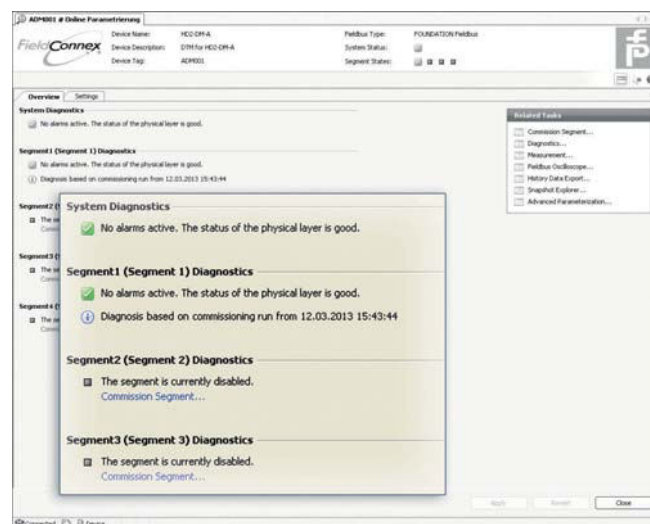


Figure 35 Summary views highlight enqueued tasks and issues with the fieldbus layer. They are easy to understand even for the installation and instrument professional with little fieldbus experience.

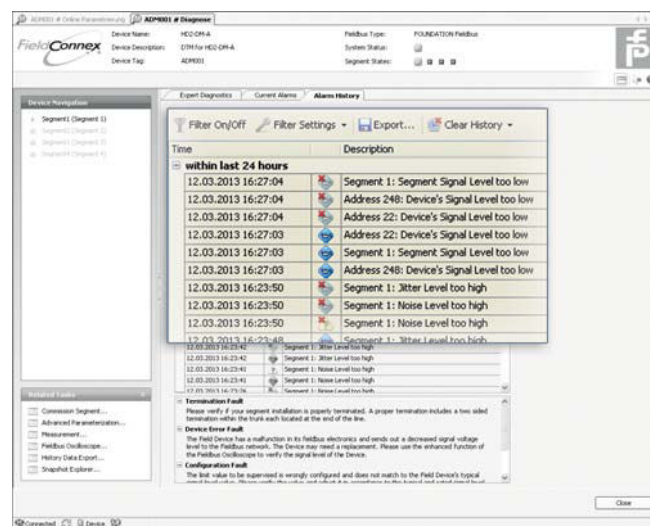


Figure 36 Alarm lists with time stamps and plain text messages provide insight into actual faults.

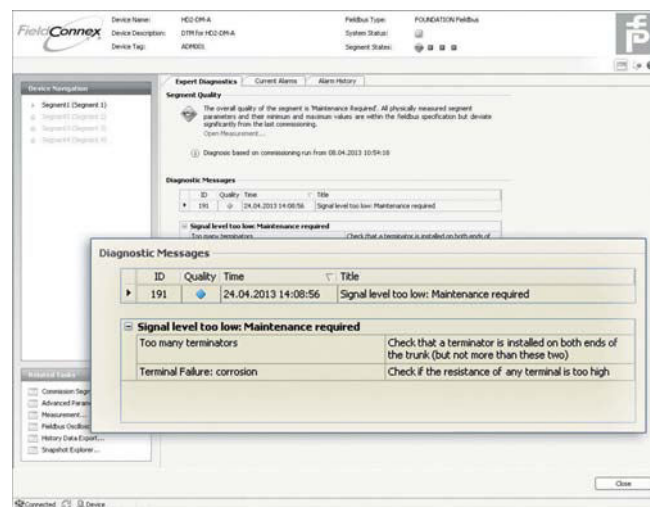


Figure 37 Clearly visible indicators guide the user. The expert system provides interpretation in easy-to-understand text.

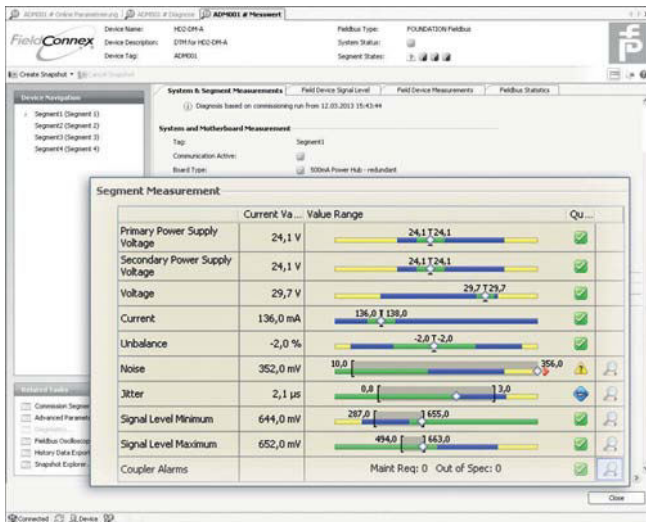


Figure 38 Live monitoring with clearly delineated boundaries shows the physical layer health per segment and per instrument.

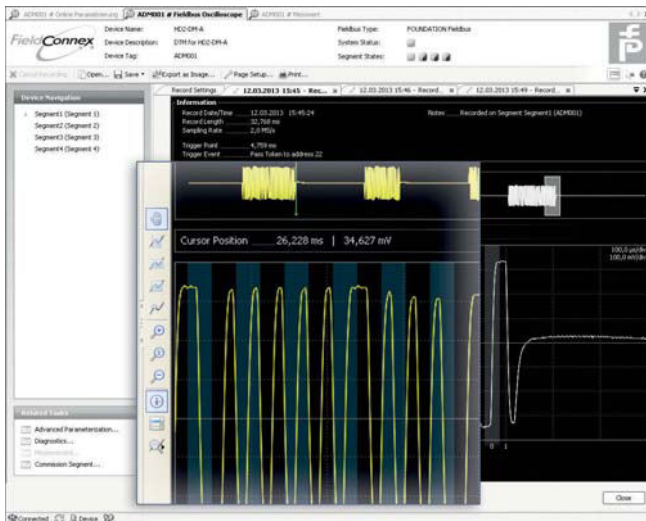


Figure 39 A fieldbus oscilloscope shows the signal as it is. This often helps the fieldbus expert to draw additional conclusions.

The Diagnostic Bus

With Segment Coupler 3 the easiest integration is via PROFIBUS DP and direct access through Segment Coupler 3. The diagnostic bus is internally wired connecting the Advanced Diagnostic Module directly to the PROFIBUS DP Gateway. See Figure 40. For all other power supplies or linking devices the diagnostic bus and Diagnostic Gateway is the proper choice.

FieldConnex® Advanced Diagnostics is equipped with a dedicated diagnostic bus. It provides the bandwidth for data transmission from the ADMs to the maintenance and operator station, without compromising the bandwidth of the respective segment. The diagnostic bus is the major prerequisite for any Advanced Diagnostics with value-added tools such as:

- Commissioning wizard
- Expert system
- Fieldbus oscilloscope
- Historian

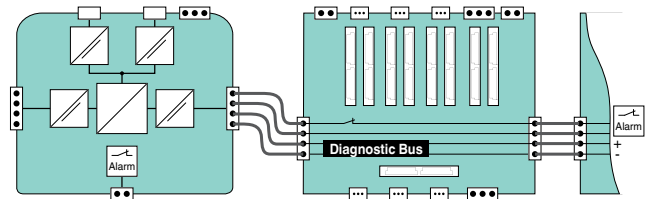


Figure 40 A dedicated, automatically configured diagnostic bus takes care of transmitting data to and from the ADMs.

In retrofit installations for any power supply or DP/PA coupler each cabinet is fitted with a diagnostic gateway (KT-MB-GT2AD*) that can connect two diagnostic busses and alarm lines for the voltage-free common alarm contact. From here, it is connected to the existing Ethernet backbone.



Process Interfaces



The FieldConnex® process interface integrates simple conventional inputs and outputs into the DCS via fieldbus communication. On the fieldbus side, it acts as a transmitter. The output connections provide power for low-power valves and digital sensors with no additional wiring required. Multiple I/Os are connected to the DCS via one fieldbus address. Types of sensors include:

- Proximity switches
- On/off low-power valves
- Digital inputs

The process interface can be installed close to the sensors in Zone 1. The sensors themselves can be located in Zone 0. Integration into the DCS is automated via standard EDDL or FDT/DTM technology. This is a simple and standardized way to keep engineering costs to a minimum. Using process interfaces is a cost-effective solution to bring simple I/O signals into the DCS.

Choices of housing materials and types and custom built cabinets enable an optimum application within the topology of your plant.

Valve Coupler

The valve coupler connects up to four low-power solenoid valves and positioning sensors to the DCS via a single fieldbus address. A detailed list of compatible valves can be found online on the respective datasheets. The valve coupler allows for remote operation of the valve and monitoring with two end-position sensors.

In addition, the valve coupler provides the following functions:

- Measuring and storing actual values for break-away and runtime per valve
- Storing maximum and minimum values
- Conducting partial stroke tests in either valve position

It generates alarm messages for preset limit values, lead breakage, or short circuits on the cable. Information is immediately accessible and allows for proactive user intervention to avoid unwanted conditions such as stuck valves.

The valve coupler is certified as intrinsically safe for installation in Zone 1. Inputs and outputs can be located in Zone 0.

The two end position sensors per valve can be accessed via one cable. The respective inputs of the valve coupler can be used as an eight-channel DI block.

Selection Table

Type Code	Function	Inputs	Outputs	Terminals	Degree of protection	Installation in	I/O in
FD0-VC-Ex4.PA	Valve Coupler	8 DI	4 DO		IP65	Zone 1	Zone 0
FD0-BI-EX12.PA	Sensor Interface	12 DI	4 DO		IP65	Zone 1	Zone 0
F.VC0.P21.A04.*.*.*.*.*.*000	Valve Coupler Junction Box	8 DI	4 DO		IP66, NEMA 4X	Zone 1, Zone 21	Zone 0
F.VC0.S20.A04.*.*.*.*.*.*000	Valve Coupler Junction Box	8 DI	4 DO		IP66, NEMA 4X	Zone 1, Zone 21	Zone 0

Table 6 Type code selection table for process interfaces

Pre-configured solutions such as the FieldConnex® pneumatic interface combine multiple valve couplers, solenoid and amplifier valves, and a FieldBarrier in one convenient and easy-to-install housing. The pneumatic interface controls up to 32 valves via one fieldbus cable and pressurized air. Contact your Pepperl+Fuchs representative for details.



Figure 41 FieldConnex® process interfaces: Connect simple digital and analog I/O to the DCS via fieldbus.

Sensor Interface

For the transmission of the status from up to 12 electrical contacts or intrinsically safe NAMUR sensors, the Sensor Interface is a solution with a very small foot print. The unit takes power from the segment and provides all information on one fieldbus address. It is certified intrinsically safe for installation in Zone 1.

Accessories



Accessories for FieldConnex® are terminators and surge protectors. They are available in two basic forms: IP20-proof DIN-rail-mountable and in an IP67-proof sturdy stainless steel housing.

Other products such as power supplies come with their own set of accessories (grounding rail, connector cables, ...). For more information on these products, refer to the respective data sheets at www.pepperl-fuchs.com.

Diagnostic-Enabled Accessories

Diagnostic-enabled accessories such as selected surge protectors and enclosure leakage sensors communicate alarm information to the DCS. Depending on their mounting position, diagnostic-enabled accessories can communicate with the affected spur, field device, or device coupler.

Data is transmitted to the DCS in parallel to regular fieldbus communication utilizing the existing Advanced Diagnostics infrastructure. The accessories do not require a fieldbus address. Implementation is plug-and-play and additional engineering or planning is not required.

Surge Protectors

FieldConnex® surge protection modules protect field instruments, control systems, and the fieldbus infrastructure from damage through overvoltage and power surges. Possible causes for power surges are: lightning strikes, surges, or cross-talk from power cables. The surge protector drains the power surge to the earth potential. The surge protector consists of multiple gas discharge tubes (GDT) and is connected to the fieldbus lead, optionally with a shield and earth potential. During normal operation, the GDT constitutes an open circuit. In case of a power surge, the GDT short circuits briefly, eliminating the power surge to earth potential.

Terminal Mounting

These surge protectors fit on Power Hubs and device couplers. They sense the impact of each lightning strike. The surge protectors indicate need for replacement via Advanced Diagnostics, superseding the demand for recurring manual inspection. This feature is available with no engineering required. Retrofit on existing installations is possible without the diagnostics option.



Figure 42 Surge protectors for trunk and spur. Hook on Power Hub or Segment Protector without extra wiring.



Self Diagnostics for Surge Protector

Selected surge protectors monitor count and severity of overvoltage spikes endured over their lifetime. The results are then transmitted via Advanced Diagnostics to the maintenance station.

Replacement takes place only once the surge protector is worn out. This saves on replacement costs and otherwise necessary manual checks.

DIN Rail Mounting

FieldConnex® surge protectors enable the coordinated use in an EMC-oriented Lightning Protection Zones Concept in accordance with IEC 61312-1. They are in accordance with the fieldbus standard IEC 61158-2 and are certified as intrinsically safe according to IEC 60079-11 including DART Fieldbus.

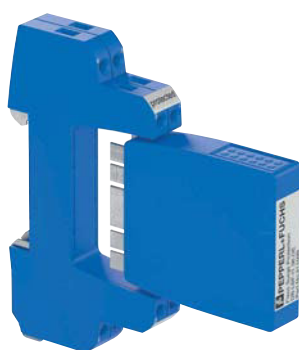


Figure 43 Surge protector for cabinet installation with click-to-latch plug-in design.

The surge protector for cabinet installation consists of a base and a plug-in unit. The base module is mounted on the DIN rail. It holds the plug-in module via an easy-to-operate locking mechanism. Firm contact increases the reliability of the unit and increases plant up-time. The base module comes in two versions, differing in the behavior upon removal of the plug-in module. Either the segment remains connected or it is disconnected.

The plug-in module contains the gas discharge tubes, and is available in two versions for different types of shielding and grounding:

1. Shield tied directly to earth. This module is applied where the central grounding point is located, typically in the cabinet. The module serves as the central grounding point for the segment. It is used in the field where multi-point grounding is applied.
2. Shield tied to earth via gas discharge tube (GDT). This version is used for field installation, where the shield has no direct connection to local earth. (that is, the shield is floating or capacitive grounding is used).

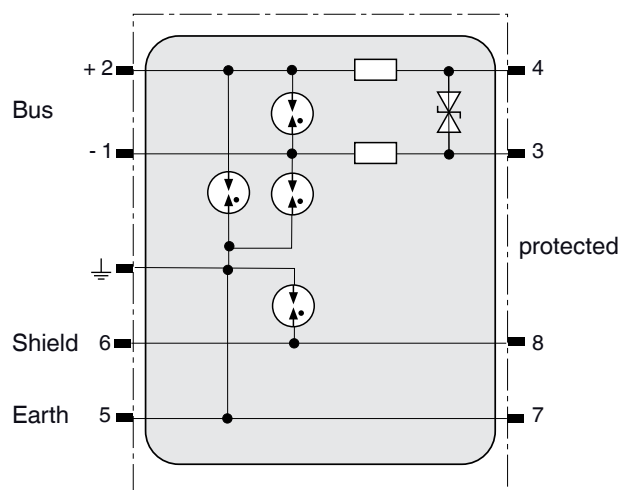


Figure 44 Typical schematic view of a surge protector with gas discharge tubes between +, -, shield, and earth.

The fieldbus planner decides which module fits the installation and maintenance requirements of the customer site best in each case.

Terminator

A fieldbus terminator is an electronic component with two basic functions:

1. It provides the impedance to suppress signal reflections.
2. It translates data signals that are transmitted as current change into a detectable voltage change as specified in the fieldbus standard IEC 61158-2.

One terminator is required at each end of the fieldbus trunk. FieldConnex® power supplies and device couplers carry integrated fieldbus terminators. If required, a separate "external" terminator can help to provide visibility to the installation and maintenance team, thus reducing the potential for human error.

Please see the description of Manchester bus-powered encoding in the "Technology" section for a thorough description.

FieldConnex® terminators feature a high-availability design by means of a resistor and multiple capacitors. Only a minor change in impedance results from the failure of a capacitor, leaving the basic function intact. This change in impedance is detected through online monitoring with the Advanced Diagnostic Module, allowing for corrective action before plant performance is jeopardized.

Sturdy Housings for Terminators or Surge Protectors

For field installation, stainless steel housings with IP67 degree of protection feature a choice of threads.

FieldConnex® includes devices in sturdy IP67 housings designed for installation of terminators or surge protectors in hazardous areas. These units come with a choice of threads and offer explosion protection.



Figure 45 Terminator or surge protector for field installation – the threading can be chosen.

Enclosure Leakage Sensor

Small amounts of water or liquid chemicals can be damaging to fieldbus installation materials such as connectors and electronic components. The enclosure leakage sensor detects water ingress and signals the affected spur. Users get a water indicator inside an enclosure directly and without additional engineering – all included with Advanced Diagnostics.

The alarm information reaches the DCS or maintenance station, traveling in parallel to normal fieldbus communication without requiring a fieldbus address. Engineering is all done with the purchase of the component and installing it in parallel to the segment. Getting control of installation issues should always be this simple.



Figure 46 Enclosure Leakage Sensor – small enough to fit into an instrument head.



Selection Tables

PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Surge Protectors	Explosion Protection	Connection Shield to Earth	Housing for Installation on	Degree of protection	Mount or Thread	Installation in
SCP-LBF-IA1.36.IE.1 ¹	Ex ia	Via GDT	Device coupler	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
SCP-LBF-IA1.36.IE.0	Ex ia	Via GDT	Device coupler	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
TCP-LBF-IA1.36.IE.1 ¹	Ex ia	Via GDT	Device coupler	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
TCP-LBF-IA1.36.IE.0	Ex ia	Via GDT	Device coupler	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
TPH-LBF-IA1.36.DE.1 ¹	Ex ia	Direct	Power Hub	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
TPH-LBF-IA1.36.DE.0	Ex ia	Direct	Power Hub	IP20	No additional wiring	Zone 1 ... 2 Div. 1 ... 2
FS-LBF-D1.32	Ex d	None	Cable gland	IP67	M 20	Zone 1/Div. 2
FS-LBF-I1.32	Ex i	None	Cable gland	IP67	M 20	Zone 1/Div. 2
FN-LBF-D1.32	Ex d	None	Cable gland	IP67	½" NPT	Zone 1/Div. 2
FN-LBF-I1.32	Ex i	None	Cable gland	IP67	½" NPT	Zone 1/Div. 2

Table 3 Surge Protector selection table

¹ Requires device couplers with diagnostic function

Surge Protectors for DIN Rail installation	Explosion Protection for DIN Rail installation	Signal Connection	Connection Shield to Earth	Housing for Installation in	Degree of protection	Module Type (1 x base & 1 x plug in required)	Installation in
DB-LBF-I1	Ex i	Continuous		Cabinet	IP20	Base	Zone 1/Div. 2
DP-LBF-I1.36.DE			Direct			Plug-in	
DP-LBF-I.36.IE			Via GDT			Plug-in	
DB-LBF-I1.I	Ex i	Interrupted		Cabinet	IP20	Base	Zone 1/Div. 2
DP-LBF-I1.36.DE			Direct			Plug-in	
DP-LBF-I.36.IE			Via GDT			Plug-in	

Table 4 Surge Protector for DIN rail installation selection table

Continuous: Continuous fieldbus signal for uninterrupted operation during exchange of plug-in module

Interrupted: Interrupting the fieldbus signal. The segment is disconnected during exchange of the plug-in module.

Terminators	Explosion Protection	Housing for Installation on	Degree of protection	Mount or Thread	Installation in
KMD0-FT-Ex	Ex i	DIN Rail	IP67		Zone 1/Div. 2
FN-FT-Ex1.D.IEC	Ex d	Cable gland	IP67	½" NPT	Zone 1/Div. 2
FN-FT-Ex1.I.IEC	Ex i	Field	IP67	½" NPT	
FS-FT-Ex1.D.IEC	Ex d	Field	IP67	M 20	
FS-FT-Ex1.I.IEC	Ex i	Field	IP67	M 20	Zone 1/Div. 2
FP-FT-Ex1.D.IEC	Ex d	Field	IP67	PG 13.5	
FP-FT-Ex1.I.IEC	Ex i	Field	IP67	PG 13.5	Zone 1/Div. 2

Table 5 Terminator selection table

Selection Guideline

This selection guideline takes you through the process of selecting all components of the fieldbus infrastructure, power supply, device coupler, and accessories that are right for your process automation system. It allows selection of system attributes in this order:

- Fieldbus system
- Explosion protection if required
- DCS system connection
- Product attributes

Selecting Your FieldConnex® Infrastructure

First, select and verify that the chosen concept for explosion protection is applicable in the hazardous area. See table below.

Second, select the appropriate power supply. There are simplex power supplies and modular power hubs. With power hubs, a power supply module must also be selected. Choices for FieldConnex® Advanced Diagnostics are not included in

this part and are handled in separate planning steps. If you would like to apply FieldConnex® Advanced Diagnostics, it is sufficient at this point to select a Power Hub with socket for an advanced diagnostic module.

Decision criteria for a power supply are:

- DCS connections
- Redundancy
- Space requirements
- Attributes contributing to availability

Third, select the device coupler that is right for you. All FieldConnex® device couplers come fitted with housing, prewiring, and accessories. This section lists datasheets for enclosures in various protection ratings and materials.

Methods of Explosion Protection by Hazardous Area

Verify that the type of ignition protection is available for the hazardous area. The following table matches explosion protection applications with chapters from this selection guideline. Note that although other combinations are possible, the table contains only practical solutions.

Area in which the field devices are located	Intrinsically Safe Trunk and Spurs: Ex ia	High-Power Trunk with FieldBarrier: Spurs Ex ia	Trunk and Spurs Ex ib (DART)	High-Power Trunk with Mechanically Protected Trunk and Spurs Ex d/e	High-Power Trunk with Spurs Ex ic (FISCO)	High-Power Trunk with Spurs Ex ic (Entity)	High-Power Trunk with Spurs Ex nL/Non-Incendive Field Wiring	High-Power Trunk with Non-Incendive Spurs
General Purpose Area	■	■	■	■	■	■	■	■
Zone 2				■	■	■	■	■
Zone 1	■	■	■	■				
Zone 0	■	■						
Class I, Division 2				■	■	■	■	■
Class I, Division 1	■	■						
Page	322	323	324	325	326	327	328	329

General Selection Guidelines

Segment Couplers SK3 and SK1 are equipped with DB9 connectors for PROFIBUS DP. The Segment Coupler SK3 consists of two motherboards for power supplies and gateways respectively. It thus requires selection for both motherboards and plug-in modules. FieldConnex Advanced Diagnostics is always available as an option.

The exception is the compact Segment Coupler, which is provided as one complete kit with motherboard, power and gateway modules.

For more information, see: KT-MB-GTB-2PS or KT-MB-GTB-D-2PS. For Advanced Diagnostics the stand-alone version can be used if required.

Segment Coupler 1 is an all in one solution based on the K-System housing.

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

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Intrinsically Safe Trunk and Spurs: Ex ia

PROFIBUS PA

Power Hub Motherboard or
SK1 Power Supply

N° of Segments

Redundant Power Supply

Slot for Advanced Diagnostics

PROFIBUS DP Speed

DP Speed Auto Adjust

CREST

Terminators: Selectable/Fixed

Grounding Bar Available

Segment Coupler 1

KFD2-BR-Ex1.3PA.93

1

93.75 kbps

F

Selection
GuidelineAdvanced
Diagnostics

Device Coupler

Enclosure Material

No. of Outputs

Output Protection Rating

Spur Short Circuit Protection

Installation in

F2-JB-I#. * (Aluminum Enclosure)

Aluminum

4, 6, 8

Ex ia

Zone 0...1

Segment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Please consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

High-Power Trunk with FieldBarrier: Spurs Ex ia

Select the Power Hub motherboard of the Segment Coupler 3 (SK3) with or without redundancy. In addition, a gateway motherboard and gateway modules are required, again available with and without redundancy.

Power Hub Motherboard for SK3 or SK 1 Power Supply	N° of Segments	Redundant Power Supply	Slot for Advanced Diagnostics	PROFIBUS DP Speed	DP Speed Auto Adjust	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBCL-1.500	HD2-FBPS-1.25.360	HD2-FBPS-1.500
Universal Motherboards for Segment Coupler 3											
MB-FB-4R.GEN	4	■	■	45.45 kBps	■	■	S	■	■	■	■
MB-FB-4.GEN	4		■	...	■	■	S	■	■	■	■
KT-MB-GTB-2PS (includes gateway module)	2			12 MBps	■		F			■	
Segment Coupler 1											
KFD2-BR-1.PA.93	1			93.75 kBps			F		—	—	—

For MB-FB* motherboards, the following components are required for the PROFIBUS DP to PA gateway:

Gateway Components of SK3	Description
MB-FB-GT	Motherboard for single gateway
MB-FB-GTR	Motherboard for two gateways in redundant configuration with redundant connection to DP master
HD2-GTR-4.PA	Gateway module

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Protection	Installation in
RD0-FB-Ex4.*	None ¹	4	Ex ia	■	Zone 1/Div. 2
F2D0-FB-Ex4.* (Enclosure)	Aluminum	4	Ex ia	■	Zone 1/Div. 2
F.FB0.S**.A**.1.0.***.***.***	Stainless Steel	4, 8, 12	Ex ia	■	Zone 1/Div. 2
F.FB0.P**.A**.1.0.***.***.***	GRP	4, 8, 12	Ex ia	■	Zone 1/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Please consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.



Trunk and Spurs Ex ib (DART)

Select the Power Hub motherboard of the Segment Coupler 3 (SK3) with or without redundancy. In addition, a gateway motherboard and gateway modules are required, again available with and without redundancy.

Power Hub Motherboard for SK3		N° of Segments	Redundant Power Supply	Slot for Advanced Diagnostics	Packing Density/Size	Power Dissipation per Segment	CREST	Terminators: Selectable/Fixed	Grounding Bar Available
High-density Motherboard and Power Supply for Segment Coupler 3									
KT-MB-FB-D-4R.GEN		4	■	■	++	-		F	■
KT-MB-GTB-D-2PS (includes gateway module)		2		■	+	-		F	

+ ... +++ Indicates reduced space requirements.

- ... --- Indicates low to lowest heat dissipation. Lower is better for cabinet density.

For KT-MB-FB-D-4R.GEN, the following components are required for the PROFIBUS DP to PA gateway:

Gateway Components of SK3	Description
MB-FB-GT	Motherboard for single gateway
MB-FB-GTR	Motherboard for two gateways in redundant configuration with redundant connection to DP master
HD2-GTR-4.PA	Gateway module

Only one device coupler fits this application:

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Protection	Installation in
R3-SP-IBD-N12 ¹	None	12	Ex ib	■	Zone 1

¹ Pre-engineered and preconfigured enclosures available; contact your Pepperl+Fuchs representative for availability of your choices.

High-Power Trunk with Mechanically Protected Trunk and Spurs Ex d/e

Select the Power Hub motherboard of the Segment Coupler 3 (SK3) with or without redundancy. In addition, a gateway motherboard and gateway modules are required, again available with and without redundancy.

Power Hub Motherboard for SK3 or SK 1 Power Supply	N° of Segments	Redundant Power Supply	Slot for Advanced Diagnostics	PROFIBUS DP Speed	DP Speed Auto Adjust	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.25.360	HD2-FBPS-1.500
Universal Motherboards for Segment Coupler 3										
MB-FB-4R.GEN	4			45,45 kBps ... 12 MBps			S			
MB-FB-4.GEN	4						S			
KT-MB-GTB-2PS (includes gateway module)	2						F			
Segment Coupler 1										
KFD2-BR-1.PA.93	1			93,75 kBps			F		—	—

For MB-FB* motherboards, the following components are required for the PROFIBUS DP to PA gateway:

Gateway Components of SK3	Description
MB-FB-GT	Motherboard for single gateway
MB-FB-GTR	Motherboard for two gateways in redundant configuration with redundant connection to DP master
HD2-GTR-4.PA	Gateway module

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Protection	Installation in
R-SP-E12	None ¹	12	—	■	Zone 1
F.SPE.S**.A**.1.0.**.***.****	Stainless Steel	12, 24	—	■	Zone 1
F.SPE.P**.A**.1.0.**.***.****	GRP	12, 24	—	■	Zone 1

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Please consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.



High-Power Trunk with Spurs Ex ic (FISCO)

Select the Power Hub motherboard of the Segment Coupler 3 (SK3) with or without redundancy. In addition, a gateway motherboard and gateway modules are required, again available with and without redundancy.

Special power modules are provided limiting the voltage $U_0 = 17.5 \text{ V}$.

Power Hub Motherboard for SK3	N° of Segments	Redundant Power Supply	Slot for Advanced Diagnostics	PROFIBUS DP Speed	DP Speed Auto Adjust	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.17.500
Universal Motherboards for Segment Coupler 3									
MB-FB-4R.GEN	4	■	■	45.45 kBps	■	■	S	■	■
MB-FB-4.GEN	4		■	... 12 MBps	■	■	S	■	■

Components for PROFIBUS DP to PA gateway:

Gateway Components of SK3	Description
MB-FB-GT	Motherboard for single gateway
MB-FB-GTR	Motherboard for two gateways in redundant configuration with redundant
HD2-GTR-4.PA	Gateway module

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Protection	Installation in
R2-SP-N*	None ¹	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
F.SP4.S**.B**.1.0.***.***.***0	Stainless Steel	8...24	Ex ic	■	Zone 2/Div. 2
F.SP4.P**.B**.1.0.***.***.***0	GRP	8...24	Ex ic	■	Zone 2/Div. 2
SPJB-**-AL*.***	Aluminum	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-CS*.***	Carbon Steel	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-FB*.***	Fiberglass	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-PCW.***	Polycarbonate	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-SS*.***	Stainless Steel	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Please consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.

High-Power Trunk with Spurs Ex ic (Entity)

Select the Power Hub motherboard of the Segment Coupler 3 (SK3) with or without redundancy. In addition, a gateway motherboard and gateway modules are required, again available with and without redundancy.

Special power modules are provided limiting the voltage $U_o = 24 \text{ V}$.

Power Hub Motherboard for SK3	N° of Segments	Redundant Power Supply	Slot for Advanced Diagnostics	PROFIBUS DP Speed	DP Speed Auto Adjust	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.23.500
Universal Motherboards for Segment Coupler 3									
MB-FB-4R.GEN	4	■	■	45.45 kBps	■	■	S	■	■
MB-FB-4.GEN	4		■	12 MBps	■	■	S	■	■

Components for PROFIBUS DP to PA gateway:

Gateway Components of SK3	Description
MB-FB-GT	Motherboard for single gateway
MB-FB-GTR	Motherboard for two gateways in redundant configuration with redundant connection to DP master
HD2-GTR-4.PA	Gateway module

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Protection	Installation in
R2-SP-N*	None ¹	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
F.SP4.S**.B**.1.0.***.***.***0	Stainless Steel	8...24	Ex ic	■	Zone 2/Div. 2
F.SP4.P**.B**.1.0.***.***.***0	GRP	8...24	Ex ic	■	Zone 2/Div. 2
SPJB-**-AL*.***	Aluminum	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-CS*.***	Carbon Steel	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-FB*.***	Fiberglass	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-PCW*.***	Polycarbonate	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2
SPJB-**-SS*.***	Stainless Steel	4, 6, 8, 10, 12	Ex ic	■	Zone 2/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Please consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.

High-Power Trunk with Spurs Ex nL/Non-Incendive Field Wiring

Select the Power Hub motherboard of the Segment Coupler 3 (SK3) with or without redundancy. In addition, a gateway motherboard and gateway modules are required, again available with and without redundancy.

Special power modules are provided limiting the voltage. Just match the voltage output to the respective input voltage of the field instrument.

Power Hub Motherboard for SK3	N° of Segments	Redundant Power Supply	Slot for Advanced Diagnostics	PROFIBUS DP Speed	DP Speed Auto Adjust	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBPS-1.17.500	HD2-FBPS-1.23.500
Universal Motherboards for Segment Coupler 3										
MB-FB-4R.GEN	4	■	■	45.45 kBps	■	■	S	■	■	■
MB-FB-4.GEN	4		■	... 12 MBps	■	■	S	■	■	■

Components for PROFIBUS DP to PA gateway:

Gateway Components of SK3	Description
MB-FB-GT	Motherboard for single gateway
MB-FB-GTR	Motherboard for two gateways in redundant configuration with redundant connection to DP master
HD2-GTR-4.PA	Gateway module

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Protection	Installation in
R2-SP-N*	None ¹	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F.SP4.S**.B**.1.0.***.***.***0	Stainless Steel	8...24	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F.SP4.P**.B**.1.0.***.***.***0	GRP	8...24	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-AL*.***	Aluminum	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-CS*.***	Carbon Steel	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-FB*.***	Fiberglass	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-PCW.***	Polycarbonate	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-SS*.***	Stainless Steel	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F2-JBSC-*(Aluminum Enclosure)	Aluminum	4, 6, 8	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
RM-SPTM-N2 (Trunk Module)	None ¹	2	Ex nL	■	Zone 2/Div. 2
RM-SPEM-N4 (Extension Module)	None ¹	4	Ex nL	■	Zone 2/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Please consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.

High-Power Trunk with Non-Incendive Spurs

Select the Power Hub motherboard of the Segment Coupler 3 (SK3) with or without redundancy. In addition, a gateway motherboard and gateway modules are required, again available with and without redundancy.

All FieldConnex power supplies and power modules are applicable. The selection below shows reasonable choices.

Power Hub Motherboard for SK3 or SK 1 Power Supply	N° of Segments	Redundant Power Supply	Slot for Advanced Diagnostics	PROFIBUS DP Speed	DP Speed Auto Adjust	CREST	Terminators: Selectable/Fixed	Grounding Bar Available	HD2-FBCL-1.500	HD2-FBPS-1.25.360	HD2-FBPS-1.500
Universal Motherboards for Segment Coupler 3											
MB-FB-4R.GEN	4			45.45 kBps ... 12 MBps			S				
MB-FB-4.GEN	4						S				
KT-MB-GTB-2PS (includes gateway module)	2						F				
Segment Coupler 1											
KFD2-BR-1.PA.93	1			93.75 kBps			F		—	—	—

For MB-FB* motherboards, the following components are required for the PROFIBUS DP to PA gateway:

Gateway Components of SK3	Description
MB-FB-GT	Motherboard for single gateway
MB-FB-GTR	Motherboard for two gateways in redundant configuration with redundant connection to DP master

Device Coupler	Enclosure Material	No. of Outputs	Output Protection Rating	Spur Short Circuit Protection	Installation in
R2-SP-N*	None ¹	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F.SP4.S**.B**.1.0.***.***.***0	Stainless Steel	8...24	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F.SP4.P**.B**.1.0.***.***.***0	GRP	8...24	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-AL*.***	Aluminum	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-CS*.***	Carbon Steel	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-FB*.***	Fiberglass	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-PCW.***	Polycarbonate	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
SPJB-**-SS*.***	Stainless Steel	4, 6, 8, 10, 12	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
F2-JBSC-* (Aluminum Enclosure)	Aluminum	4, 6, 8	Ex nL/Non-Incendive Field Wiring	■	Zone 2/Div. 2
RM-SPTM-N2 (Trunk Module)	None ¹	2	Ex nL	■	Zone 2/Div. 2
RM-SPEM-N4 (Extension Module)	None ¹	4	Ex nL	■	Zone 2/Div. 2

Wildcards (*) denote number of spurs or other options such as selections for cable glands and accessories. Please consult the respective data sheet for ordering details or ask your Pepperl+Fuchs sales engineer or representative for availability of your choices.

¹ Denotes wiring interface for DIN rail installation, IP20.

Features

- **Comprehensive diagnostics for fieldbus physical layer**
- **Mobile kit for the fieldbus professional**
- **Precise measurements through passive circuits**
- **For commissioning and troubleshooting**
- **Installation in Zone 2/Class I, Div. 2**
- **Connection to energy limited fieldbus segments Ex nL permissible**
- **USB interface for PC connection and power supply**

Function

Designed for maintenance personnel and traveling fieldbus expert, the FieldConnex[®] Mobile Advanced Diagnostic Module (ADM) is a comprehensive measurement tool for single segments. It can be set up at any point on the segment. Its passive input circuits leave the physical layer untouched for exact data. The ADM detects gradual or sudden changes and helps trace even intermittent malfunctions.

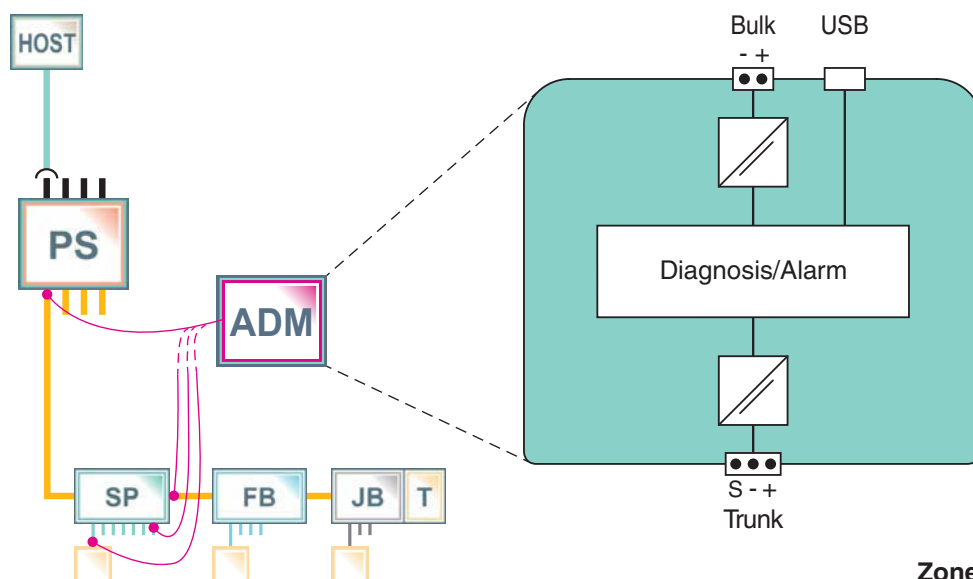
The Mobile ADM primarily supports commissioning and troubleshooting. It is powered via USB 2.0 full-speed port and communicates with any laptop or desktop. In addition, a mounting bracket and connection for an external power supply enable the installation in a cabinet for continuous monitoring without USB connection.

The Diagnostic Manager is the software for display and operation from the safety of the control room. The Professional Edition provides powerful functions and wizards simplifying and automating work procedures: an embedded expert system, a data historian, and a built-in oscilloscope (see datasheet DTM-FC.AD*).

Assembly



Connection



Zone 2/Div. 2

Technical data

Fieldbus interface

Number of segments 1

Interface

Interface type USB: square type B socket

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC 60529

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Mechanical specifications

Connection type

fieldbus: removable screw terminals with retaining screws
 external power: removable screw terminals with retaining screws
 USB: square type B socket

Core cross-section

2.5 mm²

Data for application in connection with Ex-areas

Statement of conformity

TÜV 05 ATEX 2923 X

Group, category, type of protection, temperature class

Ex II 3G Ex nA [nL] IIC T4

Directive conformity

Directive 94/9/EC IEC 60079-15:2003

Functional Overview

Fieldbus voltage

The segment voltage is measured in a range of 0 V ... 35 V.

Unbalance detection

A capacitive or resistive short between any fieldbus wire and shield is measured and given in a range between -100 % ... +100 %.
 (-100% = short against - wire, +100% = short against +wire)

Termination

Over- and Undertermination are detected and reported.

Communication level

Node specific communication levels are measured in a range of 0 V ... 2.5 V.

Jitter

Jitter is a measurement for the timing of each bit. Each component connected (power supply, field instrument, cable, ...) to the segment influences jitter. It is an excellent indicator for segment health. The jitter is either segment or device specific measured in a range of 0 µsec ... 8 µsec.

Signal polarity

For each node the polarity of the signal modulation is given.

Noise measurement

The noise is measured in a frequency range between 100 Hz ... 140 kHz. The noise measurement is node address specific to detect device specific noise emission.

Communication errors statistics

Segment-specific error counters e.g. for CRC errors and framing errors are displayed.



PROFIBUS PA

Selection Guideline

Advanced Diagnostics

Segment Coupler

Field Distribution

DART Fieldbus

Process Interfaces

Accessories





Features

- Comprehensive diagnostics for fieldbus physical layer and power supply
- Plug-in Module for the FieldConnex Power Hub
- Precise measurements through passive circuits
- For commissioning, online monitoring and troubleshooting
- Installation in Zone 2/Class I, Div. 2
- System state and fault indication via LEDs
- Display of data in the safety of the control room
- Automatic setup of diagnostic system
- Full software integration into DCS and PAM possible

Function

Designed as a plug-in module for the FieldConnex® Power Hub, this Advanced Diagnostic Module (ADM) is a comprehensive measurement tool for the physical layer of up to four fieldbus segments. Its passive input circuits leave the physical layer untouched for exact data. The ADM detects gradual or sudden changes and helps trace even intermittent malfunctions.

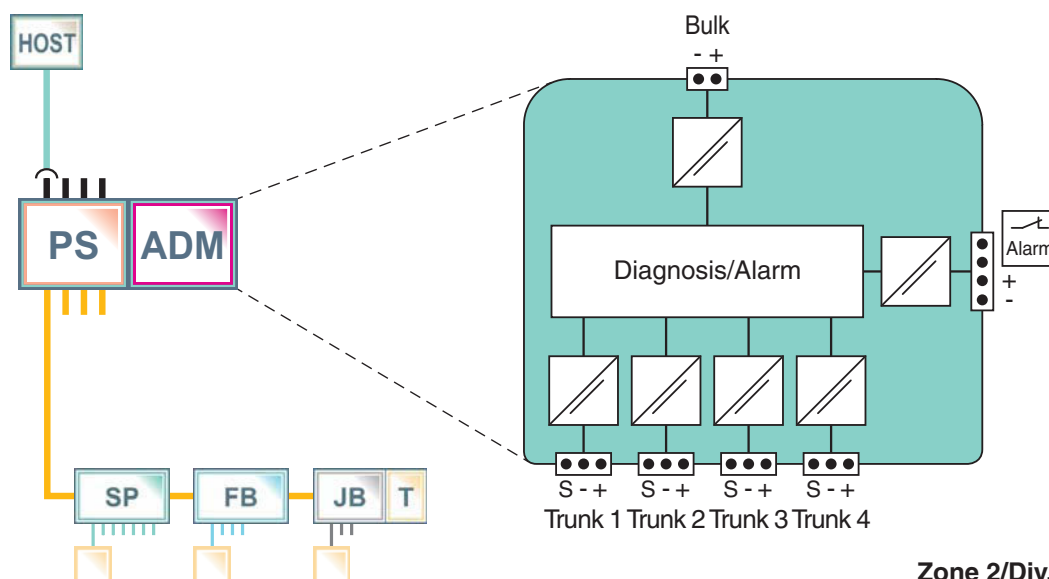
The ADM supports commissioning, online monitoring and troubleshooting. It can be integrated tightly into the DCS and PAM via a separate diagnostic bus, making the fieldbus physical layer itself a manageable asset. Configuration tools automate setup of the ADM and of selected DCS.

The Diagnostic Manager is the software for display and operation from the safety of the control room. The Professional Edition provides powerful functions and wizards simplifying and automating work procedures: Embedded expert system data historian and a built-in oscilloscope are included. (see datasheet DTM-FC.AD*).

Assembly



Connection



Technical data

Fieldbus interface	
Number of segments	4
Indicators/operating means	
Fault signal	VFC alarm 1 A, 50 V DC, normally closed
Interface	
Interface type	diagnostic bus: RS 485
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ambient conditions	
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Mechanical specifications	
Connection type	Motherboard specific
Core cross-section	Motherboard specific
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ⓔ II 3G EEx nA IIC T4
Directive conformity	
Directive 94/9/EC	EN 60079-15:2003
International approvals	
FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories

Functional Overview

Expert system	Built-in expert system interprets behavior of each segment based on rules and gives pointed information in clear text. Precisely diagnosis causes and suggests remedies, which are easy to understand.
Supply input voltage	The supply voltage of the primary and secondary input is measured in a range of 0 V ... 40 V.
Segment power redundancy integrity	The health of the primary and backup fieldbus power supply is monitored. Mismatch of redundancy pairs is detected and causes an alarm.
Fieldbus voltage	The segment voltage is measured in a range of 0 V ... 35 V.
Fieldbus current	The current feed into a fieldbus segment is measured in a range of 0 A ... 1 A depending on the used power supply.
Unbalance detection	A capacitive or resistive short between any fieldbus wire and shield is measured and given in a range between -100% ... +100%. (-100% = short against - wire, +100% = short against +wire)
Termination	Over- and Undertermination are detected and reported.
Signal level	Node specific signal levels are measured in a range of 0 V ... 2.5 V.
Jitter	Jitter is a measurement for the timing of each bit. Each component connected (power supply, field instrument, cable, ...) to the segment influences jitter. It is an excellent indicator for segment health. The jitter is either segment- or device-specifically measured in a range of 0 µsec ... 8 µsec.
Signal polarity	For each node the polarity of the signal modulation is given.
Noise measurement	Noise is measured in a frequency range between 100 Hz ... 140 kHz. Noise measurement is node-address-specific in order to detect device-specific noise.
Oscilloscope function	The built-in oscilloscope is a powerful tool for signal voltage behavior analysis. It allows for analysis of specific frames and occurring communication errors. Trigger conditions, as e. g. different frame types, CRC errors, framing errors are either node-address-specific or unspecific. The frame contents detected in the sampled period are analyzed and shown.
Live list generation	A list of all connected devices and additional status information is generated. The ADM detects initial connection of a device to a segment in operation. A message reminds the user to re-run the commissioning wizard.
Alarm management	For all measured values, either segment- or node-specific, alarm limits exist. In addition, warning limits can be defined. When these limits are violated, alarms are generated.

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

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PROTECTING YOUR PROCESS



Features

- Diagnostics for fieldbus physical layer and power supply
- Plug-in Module for the FieldConnex Power Hub
- Plug and play - no engineering required
- For online monitoring
- Installation in Zone 2/Class I, Div. 2
- System state and fault indication via LEDs
- Alarm limits configurable via DIP switches
- Fault indication transmission by voltage free contact

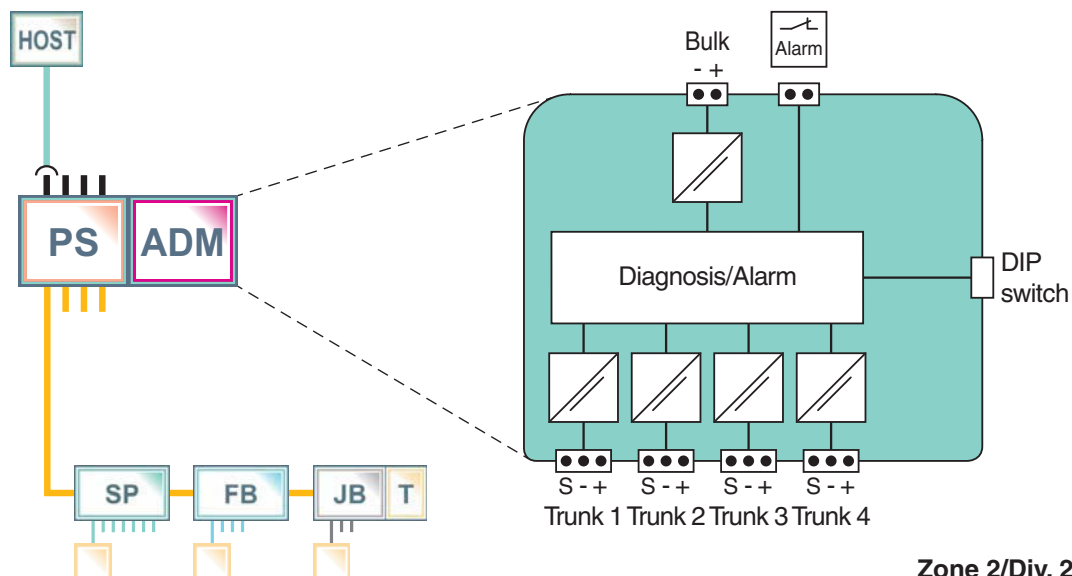
Function

Designed as a plug-in module for the FieldConnex® Power Hub, the Advanced Diagnostic Module (ADM) with relay output is a monitoring tool for the physical layer of up to four fieldbus segments. Passive input circuits leave the physical layer untouched, avoiding alteration of the signal. The ADM indicates unwanted conditions via voltage-free contact. It provides physical layer diagnostics "plug-and-play", without additional engineering. If desired, the values for maintenance and out-of-specification limit ranges are configurable via DIP switches. LED signals indicate that a limit has been exceeded. For commissioning and troubleshooting, a comprehensive diagnostic module such as the FieldConnex(R) mobile ADM (see DM-AM-KIT) is recommended.

Assembly



Connection



Zone 2/Div. 2

Technical data

Fieldbus interface	
Number of segments	4
Indicators/operating means	
Fault signal	VFC alarm 1 A, 50 V DC, normally closed
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ambient conditions	
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ex II 3G EEx nA II T4
Directive conformity	
Directive 94/9/EC	IEC 60079-15

Monitored Values Overview

For each value maintenance and out-of-specification limit ranges are configurable via DIP switches.

Jitter	Jitter is a measurement for the timing of each bit. Each component connected (power supply, field instrument, cable, ...) to the segment influences jitter. It is an excellent indicator for segment health. The jitter is either segment- or device-specifically measured in a range of 1.6 µsec ... 4.8 µsec.
Signal Level	The voltage level of the communication signal, node specific measurement.
Noise	Unwanted disturbance. Often caused by overlay of a number of disturbances. Leads to signal deterioration.



PROFIBUS PA

Selection
Guideline

Advanced
Diagnostics

Segment
Coupler

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories





Features

- Basic monitoring for power supply output and health
- Plug-in Module for the FieldConnex Power Hub
- Plug and play - no engineering required
- For online monitoring
- Installation in Zone 2/Class I, Div. 2
- System state and fault indication via LEDs

Function

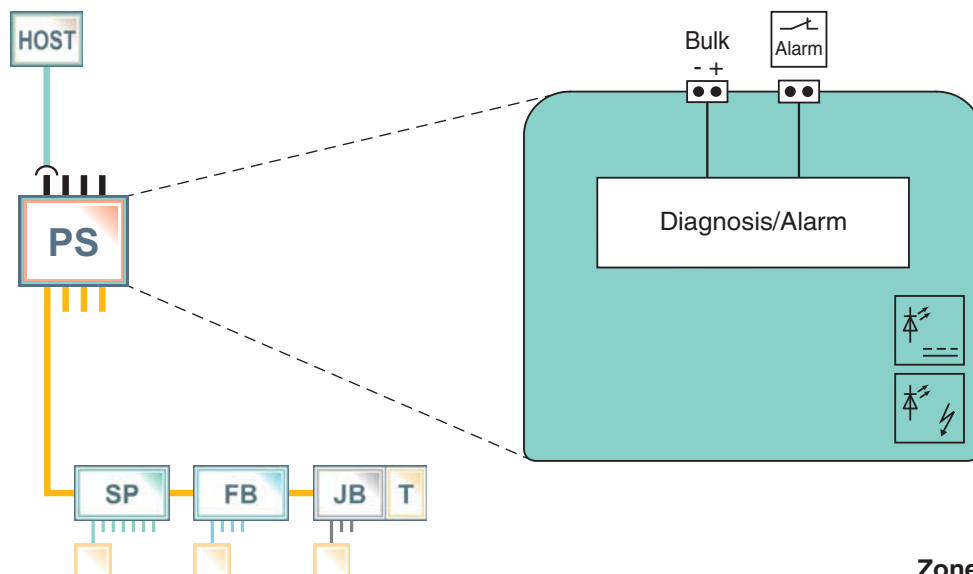
Designed as a plug-in module for the FieldConnex® Power Hub, the Basic Diagnostic Module HD2-DM-B provides basic system diagnostics. It checks for proper operation of bulk power supplies and monitors the connected trunks for overload or short-circuit conditions. All Power Hub modules are checked for proper function. On redundant power modules it indicates mismatching pairs.

The module indicates a fault condition via voltage-free contact. It provides monitoring "plug-and-play" without additional engineering. LED signals indicate a fault for easy detection.

Assembly



Connection



Zone 2/Div. 2

Technical data**Indicators/operating means**

Fault signal VFC alarm 1 A, 50 V DC, normally closed

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC 60529

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Ambient conditions

Corrosion resistance

acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type

Motherboard specific

Core cross-section

Motherboard specific

Data for application in connection with Ex-areas

Statement of conformity

TÜV 04 ATEX 2500 X

Group, category, type of protection, temperature class

⊕ II 3G EEx nA C IIC T4

Directive conformity

Directive 94/9/EC EN 60079-15:2003

International approvals

FM approval

CoC 3024816, CoC 3024816C

Approved for

Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nC IIC T4



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- **Comprehensive diagnostics for fieldbus physical layer**
- **Module and motherboard for retrofit of any installation**
- **Precise measurements through passive circuits**
- **For commissioning, online monitoring and troubleshooting**
- **Installation in Zone 2/Class I, Div. 2**
- **System state and fault indication via LEDs**
- **Display of data in the safety of the control room**
- **Full software integration into DCS and PAM possible**

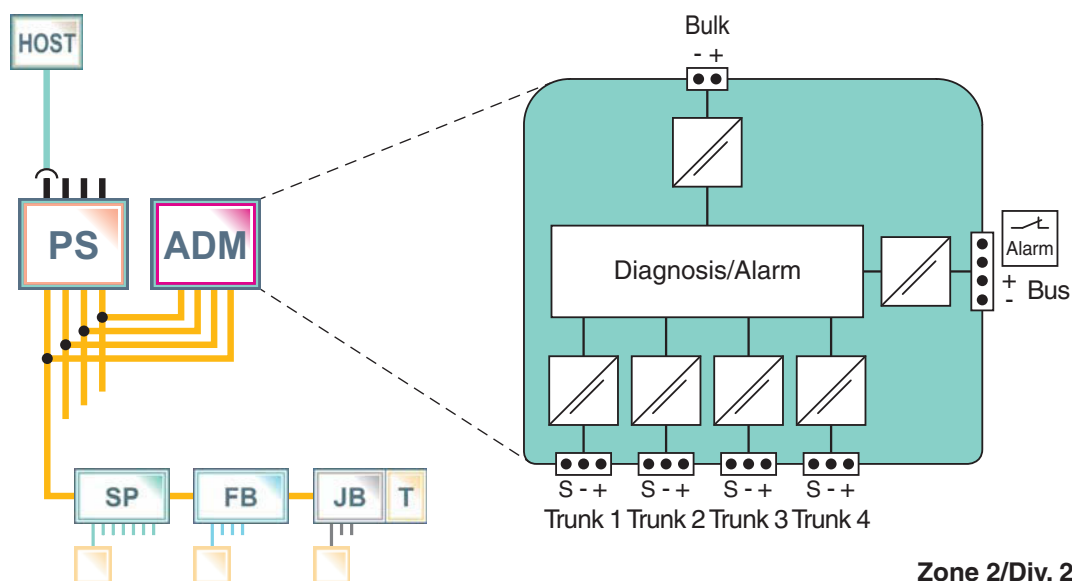
Function

The kit of FieldConnex® Advanced Diagnostic Module (ADM) and motherboard is a comprehensive measurement tool for the physical layer for retrofitting of up to four fieldbus segments. Its passive input circuits leave the physical layer untouched for exact data. The ADM detects gradual or sudden changes and helps trace even intermittent malfunctions. The ADM supports commissioning, online monitoring and troubleshooting. It can be integrated tightly into the DCS and PAM via a separate diagnostic bus, making the fieldbus physical layer itself a manageable asset. Configuration tools automate setup of the ADM and of selected DCS. The Diagnostic Manager is the software for display and operation from the safety of the control room. The Professional Edition provides powerful functions and wizards simplifying and automating work procedures: Embedded expert system data historian and a built-in oscilloscope are included. (see datasheet DTM-FC.AD*).

Assembly



Connection



Zone 2/Div. 2

Technical data**Fieldbus interface**

Number of segments 4

Indicators/operating means

Fault signal VFC alarm 1 A, 50 V DC, normally closed

Interface

Interface type diagnostic bus: RS 485

Directive conformity**Electromagnetic compatibility**

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Mechanical specifications

Connection type screw terminals

Core cross-section 2.5 mm²**International approvals**

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- System integration kit for Advanced Diagnostics
- DCS integration via Diagnostic Manager or device DTM
- Simple automatic setup of Advanced Diagnostics
- Summary alarm handling

Function

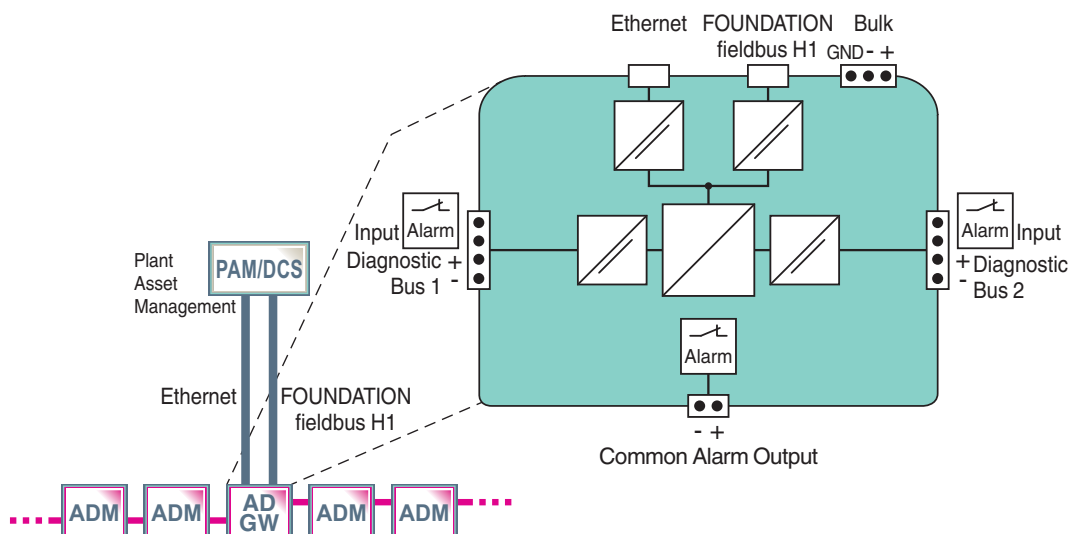
The FieldConnex[®] Diagnostic Gateway is the interface between stationary Advanced Diagnostic Modules (ADM) and the control system. It offers access to all ADM data in two ways: via Ethernet and the Diagnostic Manager software or via FOUNDATION Fieldbus H1 and DTM/EDD or both.

The gateway configures itself and automatically detects the ADMs. The Diagnostic Manager automatically finds gateways on the same subnet. The setup of the diagnostic bus and all connected modules is automatic. This significantly simplifies engineering of FieldConnex[®] Advanced Diagnostics.

Assembly



Connection



Zone 2/Div. 2

Technical data**Ethernet Interface**

Port	100 BASE-TX
Protocol	TCP/IP and UDP/IP
Services	ICMP, DHCP, AutoIP, HTTP

Diagnostic Bus

Number of Diagnostic Bus Channels	2
Cable length/Channel	30 m

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Low voltage	
Directive 73/23/EEC	EN 61010

Standard conformity

Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21
Protection degree	IEC 60529
Climatic conditions	DIN IEC 721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ethernet	IEEE 802.3

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- System integration kit for Advanced Diagnostics
- DCS integration via Diagnostic Manager or device DTM
- Simple automatic setup of Advanced Diagnostics
- Alarm handling and integrated I/O for cabinet monitoring/control

Function

The FieldConnex[®] Diagnostic Gateway is the interface between stationary Advanced Diagnostic Modules (ADM) and the control system. It offers access to all ADM data in two ways: via Ethernet and the Diagnostic Manager software or via FOUNDATION Fieldbus H1 and DTM/EDD or both.

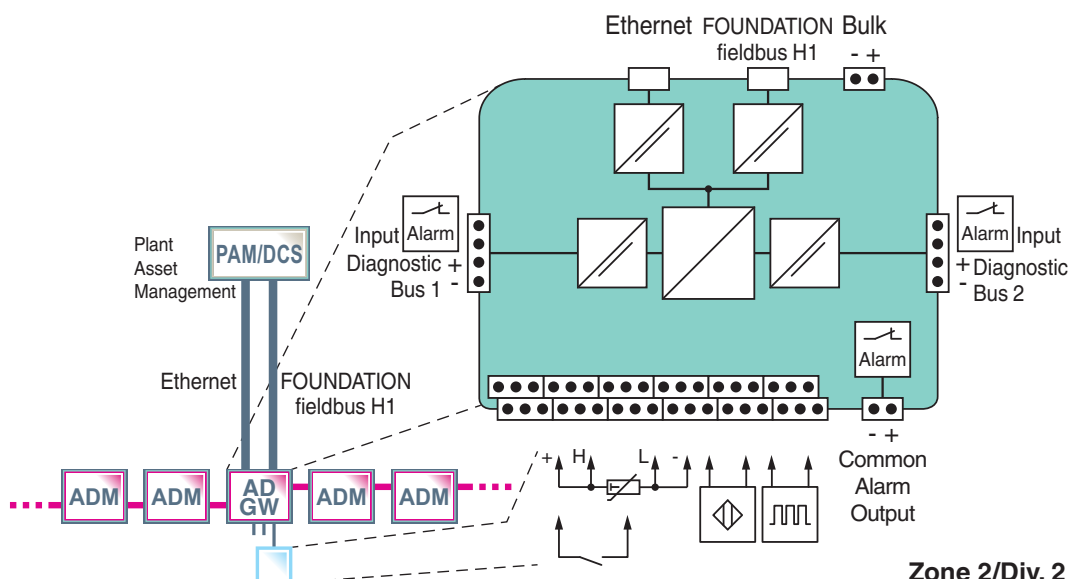
The gateway configures itself and automatically detects the ADMs. The Diagnostic Manager automatically finds gateways on the same subnet. The setup of the diagnostic bus and all connected modules is automatic. This significantly simplifies engineering of FieldConnex[®] Advanced Diagnostics.

Inputs for frequency, temperature, humidity, and NAMUR sensors and 2 relay contacts allow control of the control cabinet. The cabinet and physical layer diagnostics become easy-to-manage plant assets.

Assembly



Connection



Technical data

Ethernet Interface

Port	100 BASE-TX
Protocol	TCP/IP and UDP/IP
Services	ICMP, DHCP, AutoIP, HTTP

Diagnostic Bus

Number of Diagnostic Bus Channels	2
Cable length/Channel	30 m

Indicators/operating means

Fault signal	buzzer on

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Low voltage	
Directive 73/23/EEC	EN 61010

Standard conformity

Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21
Protection degree	IEC 60529
Climatic conditions	DIN IEC 721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ethernet	IEEE 802.3

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3


PROFIBUS PA
**Selection
Guideline**
**Advanced
Diagnostics**
**Segment
Coupler**
**Field
Distribution**
**DART
Fieldbus**
**Process
Interfaces**
Accessories


Features

- **2 segments, simplex, individual modules per segment**
- **High-Power Trunk: Live work on devices in any hazardous area**
- **Connection to PROFIBUS DP**
- **Transparent, configuration free**
- **Optimized for size and quality, low heat dissipation**
- **Automatically adapts speed on DP - up to 12 Mbit/s**

Function

The FieldConnex® PROFIBUS Compact Power Hub is a modular fieldbus power supply. It consists of one motherboard, which is the mounting plate and wiring interface, two power modules - one per segment, and a gateway module for connection to PROFIBUS DP.

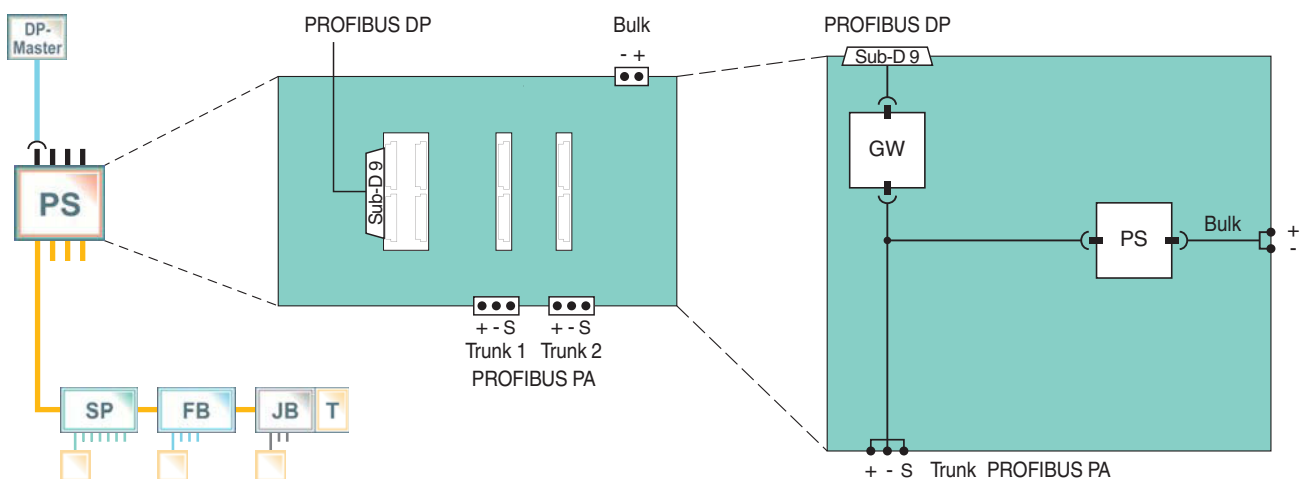
Communication is transparent between DP and PA: The gateway segment coupler makes each PA device appear as if it was connected to DP. This includes cyclic/acyclic data exchange and transmission speed. Segment design is clear and easy to understand without sub-networks; the gateway module itself is configuration free - all reducing engineering work.

Availability and a long service life is achieved through: only one passive impedance filter per segment, optimized design for low power dissipation, high-availability fieldbus termination and plug-in connectors with retaining screws.

Assembly



Connection



Technical data**Supply**

Rated voltage	19.2 ... 35 V DC
Rated current	1.46 ... 0.77 A
Power loss	typ. 6.7 W

Fieldbus interface

Number of segments	
Simplex	2
Rated voltage	25 ... 28 V
Rated current	360 ... 10 mA
Short-circuit current	typ. 400 mA
PROFIBUS DP	
Connection	9-pin Sub-D socket
Protocol	PROFIBUS DP/DP V1
Terminating resistor	100 Ω integrated

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Low voltage	
Directive 73/23/EEC	EN 50178 (identical to EN 62103)

Standard conformity

Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Mounting	DIN rail, system M36

Power module**HD2-FBPS-1.25.360****Power Output**

Voltage (V)	25 ... 28	
Current (mA)	360	
Limit U_0 (V)	-	
Device in ...	Type of Protection	Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Safe Area	No specific type of protection	Segment Protector recommended



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4 segments, individual modules per segment
- Customizable for any host system
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

Function

The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring.

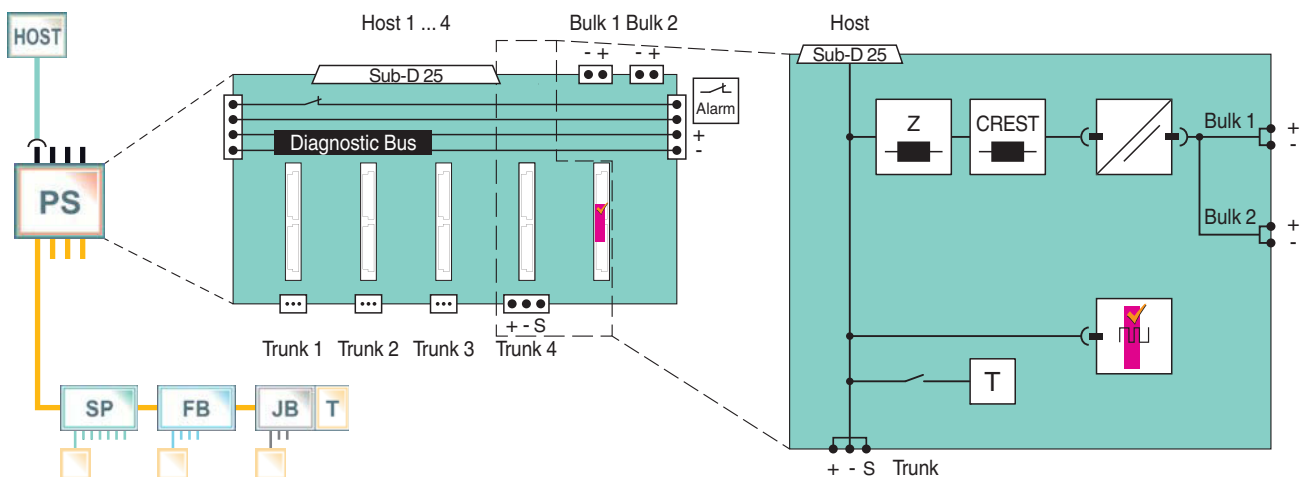
The motherboard is the wiring interface and mounting plate with a DB-25 connector for PROFIBUS PA gateway or customizable cable connections to any DCS. Sockets for individual power modules enable simple installation and can be replaced without tools. Certain motherboards enable power redundancy with seamless transfer. Pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Simplex	4
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ⓔ II 3G EEx nA C IIC T4
Directive conformity	
Directive 94/9/EC	IEC 60079-15:2003

Compatible power modules

		HD2-FBPS-1.17.500					
			HD2-FBPS-1.23.500				
				HD2-FBPS-1.25.360			
					HD2-FBPS-1.500		
					HD2-FBCL-1.500		
Power Output							
Voltage (V)		15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)		500	500	360	500	500	
Limit U ₀ (V)		17.5	24	-	-	-	
Device in ...	Type of Protection						Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia			■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia			■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d			■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■					Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■				Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	■		Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection			■	■	■	Segment Protector recommended

¹ follows bulk power supply



Features

- 4 segments, redundant, individual modules per segment
- Customizable for any host system
- High-Power Trunk: Live work on devices in any hazardous area
- Features for best signal quality, low heat dissipation
- Optional Advanced Diagnostics
- Passive impedance and CREST technology for high reliability
- Supports Ex ic/nL voltage limitation
- Installation in Zone 2/Div. 2

Function

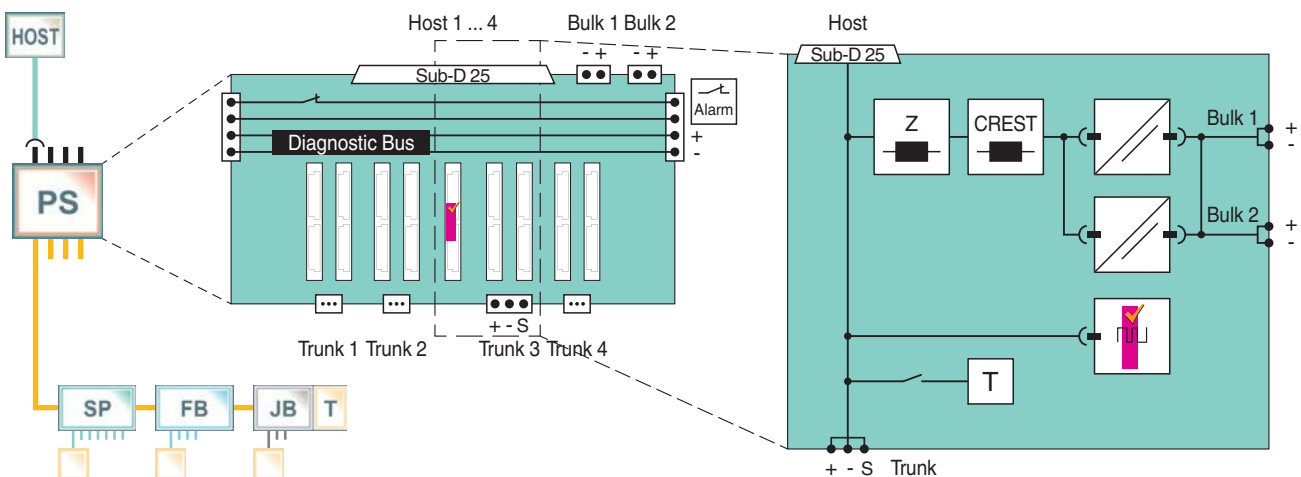
The FieldConnex® Universal Power Hub is a modular fieldbus power supply, providing the most options for most reliable communication. It supports explosion protection e.g. the High-Power Trunk for longest cable run and highest device count. The Power Hub supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The motherboard is the wiring interface and mounting plate with a DB-25 connector for PROFIBUS PA gateway or customizable cable connections to any DCS. Sockets for individual power modules enable simple installation and can be replaced without tools. Certain motherboards enable power redundancy with seamless transfer. Pairs of modules feed each segment.

Availability and a long service life are achieved through: only one passive impedance filter per segment with CREST for superior signal transmission, optimized design for low power dissipation and high-availability fieldbus termination. Any mounting direction allows optimized and space-saving cabinet layout.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	16 A
Fieldbus interface	
Number of segments	
Redundant	4
Terminating resistor	selectable 100 Ω
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Mechanical specifications	
Connection type	screw terminals
Core cross-section	2.5 mm ²
Mounting	DIN mounting rail
Data for application in connection with Ex-areas	
Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	⊕ II 3G EEx nA C IIC T4
Directive conformity	
Directive 94/9/EC	IEC 60079-15:2003

Compatible power modules

		HD2-FBPS-1.17.500					
			HD2-FBPS-1.23.500				
				HD2-FBPS-1.25.360			
					HD2-FBPS-1.500		
						HD2-FBCL-1.500	
Power Output							
Voltage (V)		15 ... 17	21 ... 23	25 ... 28	28 ... 30	- ¹	
Current (mA)		500	500	360	500	500	
Limit U ₀ (V)		17.5	24	-	-	-	
Device in ...	Type of Protection						Required Installation Components
Zone 0/Div. 1	Intrinsically safe Ex ia			■	■	■	FieldBarrier
Zone 1/Div. 1	Intrinsically safe Ex ia			■	■	■	FieldBarrier
Zone 1/Div. 1	Flameproof Ex d			■	■	■	Segment Protector R-SP-E12 or any Segment Protector installed in Zone 2
Zone 2	Intrinsically safe Ex ic (FISCO)	■					Selected Segment Protectors
Zone 2	Intrinsically safe Ex ic (Entity)		■				Selected Segment Protectors
Div. 2	Non-incendive	■	■	■	■		Any Segment Protector; power module selection depends on voltage of field device
Safe Area	No specific type of protection			■	■	■	Segment Protector recommended

¹ follows bulk power supply



Features

- Output: 15 ... 17 V/500 mA
- Voltage limitation for FISCO ic, Entity ic, also FNICO and Ex nL
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- High efficiency, low heat dissipation for high packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

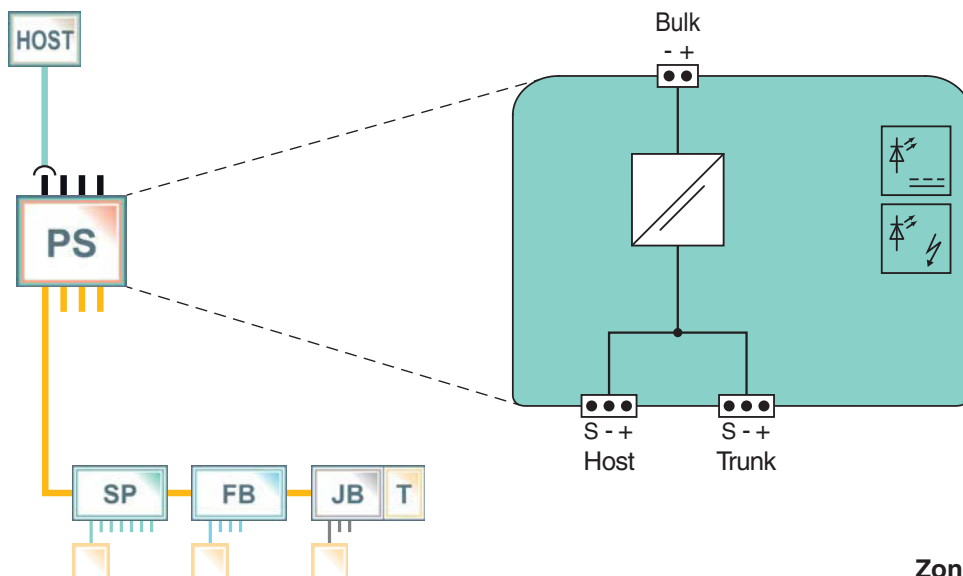
This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

The combination of this power supply, selected motherboards and R2 Segment Protectors provide outputs certified for explosion protection Ex ic according to FISCO or Entity. Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage 19.2 ... 35 V DC

Rated current 520 ... 290 mA

Power loss typ. 1.3 W

Fieldbus interface

Rated voltage 15 ... 17 V

Rated current 500 ... 10 mA

Short-circuit current 550 mA

Terminating impedance Motherboard specific

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type Motherboard specific

Core cross-section Motherboard specific

Mounting motherboard mounting

Data for application in connection with Ex-areas**Outputs**Voltage U_o 17.5 V

Statement of conformity TÜV 04 ATEX 2500 X

Group, category, type of protection, temperature class Ex II 3 G Ex nA II T4**Directive conformity**

Directive 94/9/EC EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2006

International approvals

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval DNV A-10798



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- Output: 21 ... 23 V/500 mA
- Voltage limitation for Entity ic and Ex nL
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- High efficiency, low heat dissipation for high packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

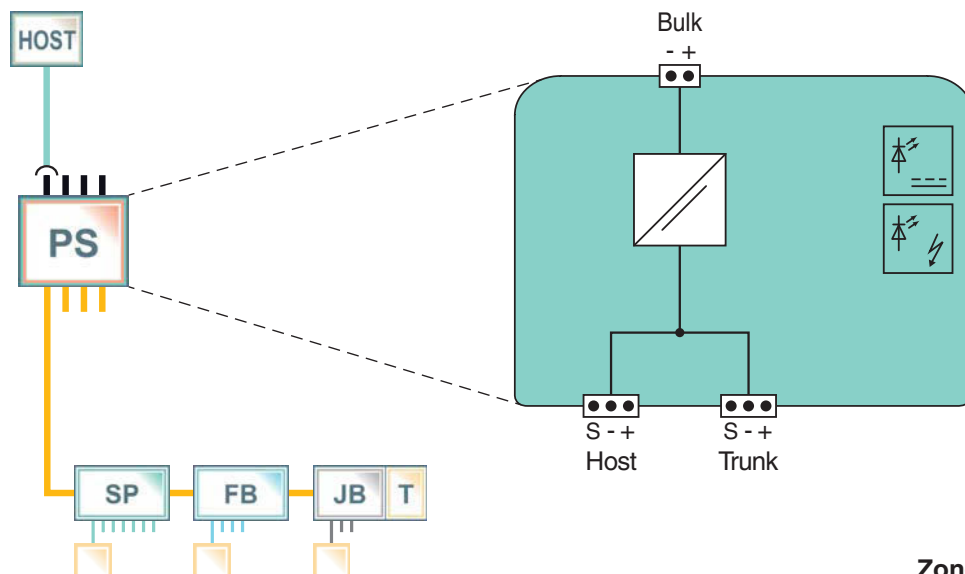
The combination of this power supply, selected motherboards and R2 Segment Protector provide outputs certified for explosion protection Entity Ex ic and Entity Ex nL.

Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage 19.2 ... 35 V DC

Rated current 700 ... 390 mA

Power loss typ. 1.5 W

Fieldbus interface

Rated voltage 21 ... 23 V

Rated current 500 ... 10 mA

Short-circuit current 550 mA

Terminating impedance Motherboard specific

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type Motherboard specific

Core cross-section Motherboard specific

Mounting motherboard mounting

Data for application in connection with Ex-areas**Outputs**Voltage U_o 24 V

Statement of conformity TÜV 04 ATEX 2500 X

Group, category, type of protection, temperature class Ex II 3 G Ex nA II T4**Directive conformity**

Directive 94/9/EC EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2006

International approvals

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval DNV A-10798



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- Output: 28 ... 30 V/500 mA
- High-Power Trunk for high device count and long cable runs
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- High efficiency, low heat dissipation for high packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

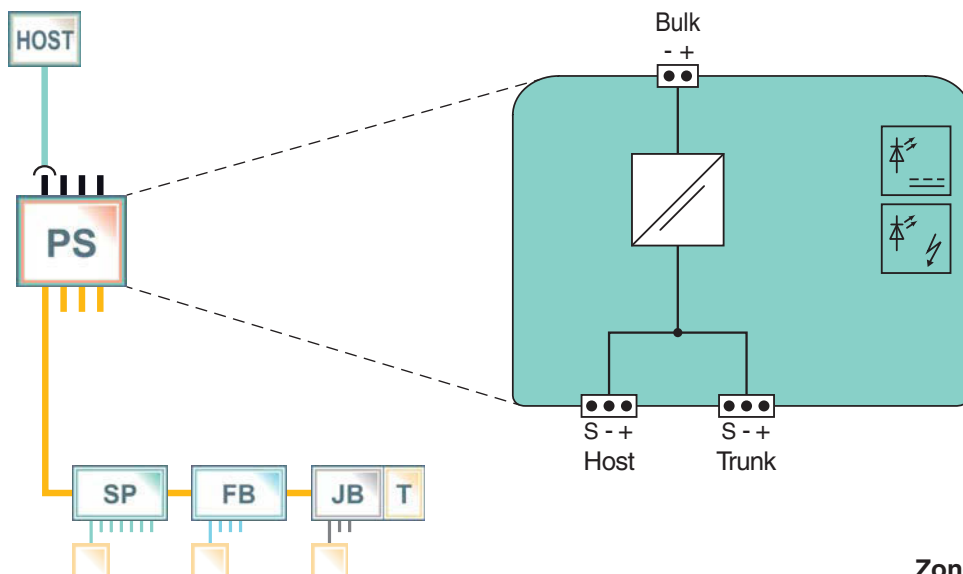
This power supply features the highest output power and allows for maximum cable lengths and highest number of devices in hazardous areas with the High-Power Trunk concept.

Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage 19.2 ... 35 V DC

Rated current 910 ... 490 mA

Power loss typ. 1.8 W

Fieldbus interface

Rated voltage 28 ... 30 V

Rated current 500 ... 10 mA

Short-circuit current 550 mA

Terminating impedance Motherboard specific

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type Motherboard specific

Core cross-section Motherboard specific

Mounting motherboard mounting

Data for application in connection with Ex-areas

Statement of conformity TÜV 04 ATEX 2500 X

Group, category, type of protection, temperature class  II 3 G Ex nA II T4**Directive conformity**

Directive 94/9/EC EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2006

International approvals

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval DNV A-10798



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- Output: bulk power voltage 500 mA
- High-Power Trunk for high device count and long cable runs
- Without galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- Very low heat dissipation
- Hot swappable in redundant configuration
- Module exchange without tools during operation

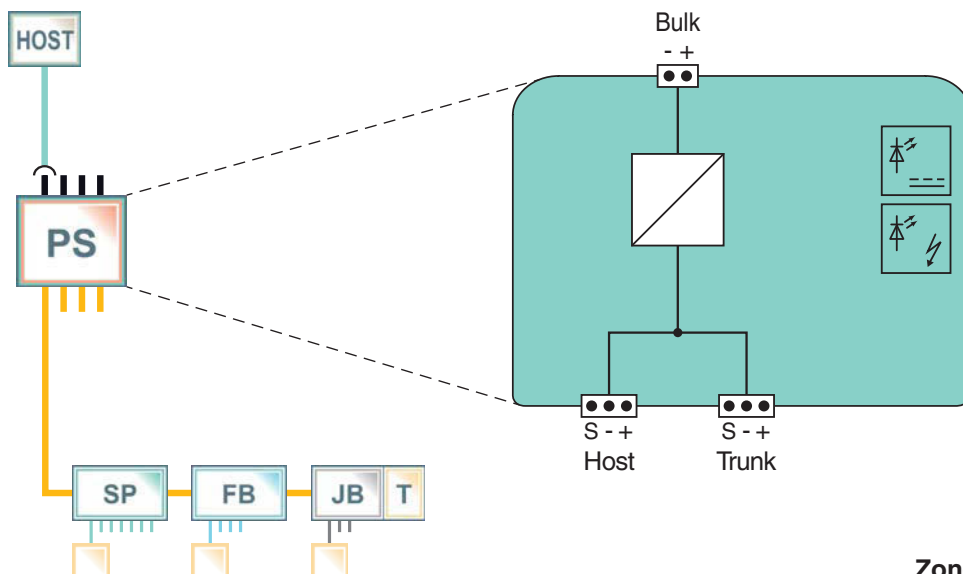
Function

The Power Conditioner Module is a system component for the FieldConnex® Power Hub and can be plugged into any universal motherboard (Type code: MB-FB*). It adapts the current for the supply of fieldbus segments and field devices. The power conditioner limits the current and provides the voltage levels from the bulk power to the network without galvanic isolation. It has the smallest number of components for a very long service life. It provides short-circuit limitation towards the segment and the host interfaces. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage	19.2 ... 32 V DC
Power loss	max. 0.8 W

Fieldbus interface

Rated voltage	supply voltage minus ≤ 2.5 V at full load
Rated current	0 ... 500 mA
Short-circuit current	600 mA
Host-rated current	0 ... 40 mA
Host short-circuit current	0 ... 55 mA
Terminating impedance	Motherboard specific

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Mechanical specifications

Connection type	Motherboard specific
Core cross-section	Motherboard specific
Mounting	motherboard mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ⓔ II 3G EEx nA II T4

Directive conformity

Directive 94/9/EC	EN 60079-15:2003

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- Output: 25 ... 28 V/360 mA
- Universal power supply for most applications
- With galvanic isolation
- Installation in Zone 2/Class I, Div. 2
- High efficiency, low heat dissipation for high packing density
- Hot swappable in redundant configuration
- Module exchange without tools during operation

Function

This Power Supply Module is a system component for the FieldConnex® Power Hub and can be plugged into the motherboard. It adapts current and voltage for the supply of fieldbus segments and field devices.

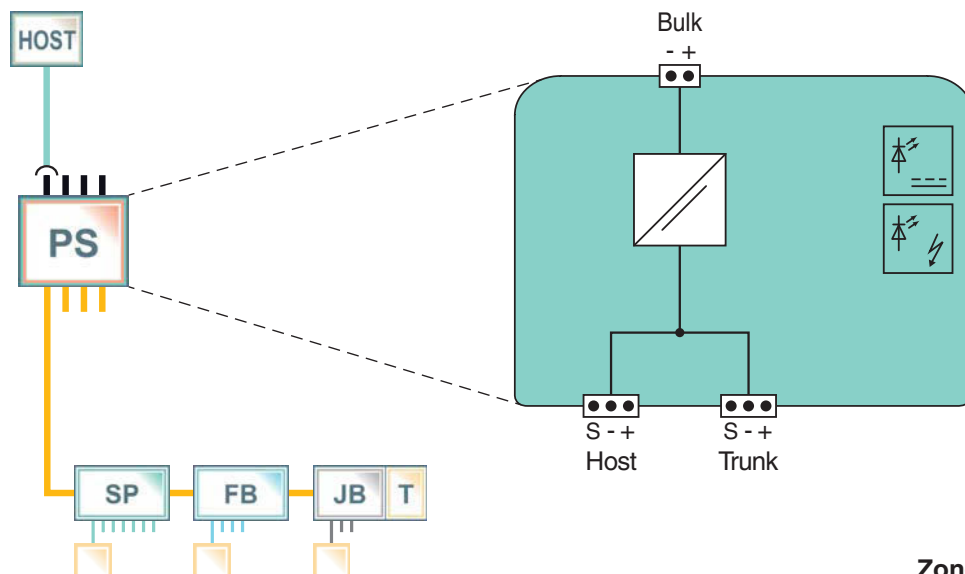
This power supply satisfies the needs of most fieldbus applications with regards to cable lengths and number of devices.

Reliability of communication is enhanced through galvanic isolation between segment and bulk power supply. Two LEDs indicate power and status. In redundant configuration two modules are connected in parallel via simple circuits ensuring seamless operation.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage 19.2 ... 35 V DC

Rated current 670 ... 360 mA

Power loss typ. 2 W

Fieldbus interface

Rated voltage 25 ... 28 V

Rated current 360 ... 10 mA

Short-circuit current typ. 400 mA

Terminating impedance Motherboard specific

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type Motherboard specific

Core cross-section Motherboard specific

Mounting motherboard mounting

Data for application in connection with Ex-areas

Statement of conformity TÜV 06 ATEX 553229 X

Group, category, type of protection, temperature class  II 3 G Ex nA II T4**Directive conformity**

Directive 94/9/EC EN 60079-15:2005, EN 60079-0:2004

International approvals

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

Certificates and approvals

Marine approval DNV A-10798



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- **For one PROFIBUS Gateway Module**
- **Connection to PROFIBUS DP**
- **Part of Segment Coupler 3**

Function

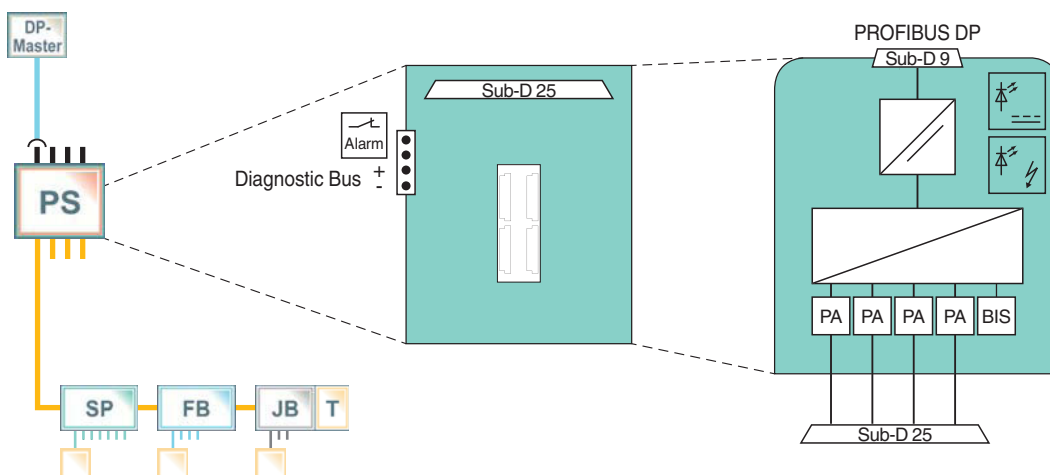
The PROFIBUS Gateway Motherboard is a system component of the FieldConnex[®] PROFIBUS Universal Power Hub system. Gateway, power supply and respective motherboards combined are named PROFIBUS Segment Coupler 3 (SK3).

The motherboard is the mounting plate and wiring interface for one PROFIBUS Gateway Module. It connects to any *.GEN Power Supply Motherboard via system cable (included). Communication is transparent between DP and PA: The gateway segment coupler makes each PA device appear as if it was connected to DP. This includes cyclic/acyclic data exchange and transmission speed. Segment design is clear and easy to understand without sub-networks; the gateway module itself is configuration free - all reducing engineering work.

Assembly



Connection



Technical data**Supply**

Rated voltage 19.2 ... 35 V SELV/PELV

Rated current 2 ... 3 A

Indicators/operating means

Fault signal VFC alarm output via connectors

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electrical isolation IEC 62103

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Mechanical specifications

Mounting DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity TÜV 04 ATEX 2500 X

Group, category, type of protection, temperature class  II 3G EEx nA IIC T4**Directive conformity**

Directive 94/9/EC IEC 60079-15:2003

International approvals

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

PROFIBUS Power Hub Gateway Module

Type code	Description
HD2-GTR-4PA	PROFIBUS DP/PA Gateway Module



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- For two PROFIBUS Gateway Modules
- Redundant configuration
- Connection to PROFIBUS DP
- Part of Segment Coupler 3

Function

The PROFIBUS Gateway Motherboard is a system component of the FieldConnex® PROFIBUS Universal Power Hub system. Gateway, power supply and respective motherboards combined are named PROFIBUS Segment Coupler 3 (SK3).

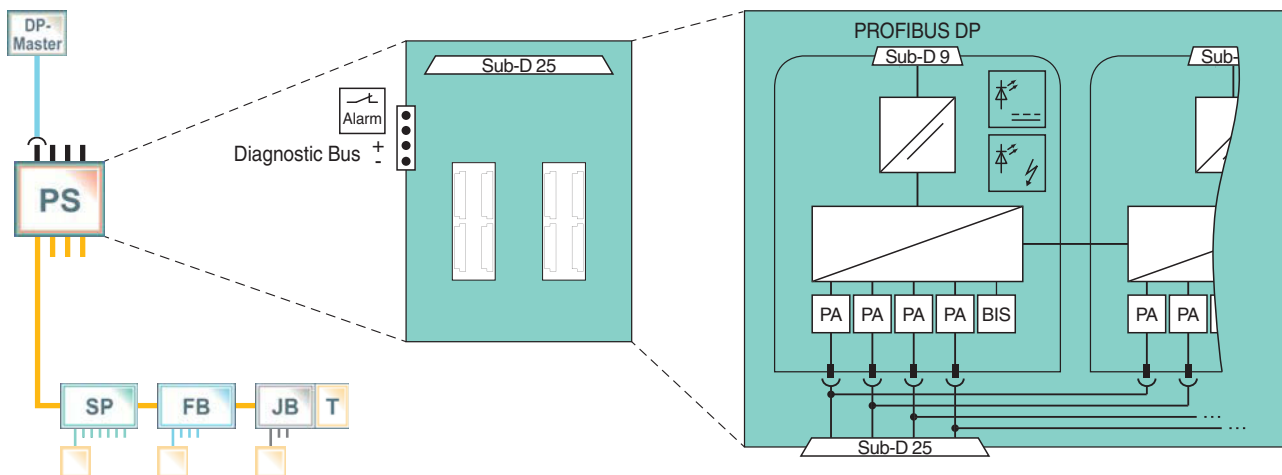
The motherboard is the mounting plate and wiring interface for two PROFIBUS Gateway Modules. It connects to any *.GEN Power Supply Motherboard via system cable (included). Communication is transparent between DP and PA: The gateway segment coupler makes each PA device appear as if it was connected to DP. This includes cyclic/acyclic data exchange and transmission speed. Segment design is clear and easy to understand without sub-networks; the gateway module itself is configuration free - all reducing engineering work.

Gateway modules operate in redundant configuration with handshaking between each communication. During redundancy transfer between modules communication is seamless for DP-Master und field devices ensuring continued operation. Gateways indicate their internal status via voltage-free contact and via diagnostic telegram on PROFIBUS DP.

Assembly



Connection



Technical data

Supply

Rated voltage 19.2 ... 35 V SELV/PELV

Rated current 2 ... 3 A

Indicators/operating means

Fault signal VFC alarm output via connectors

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electrical isolation IEC 62103

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Mechanical specifications

Mounting DIN mounting rail

Data for application in connection with Ex-areas

Statement of conformity TÜV 04 ATEX 2500 X

Group, category, type of protection, temperature class  II 3G EEx nA IIC T4

Directive conformity

Directive 94/9/EC IEC 60079-15:2003

International approvals

FM approval CoC 3024816, CoC 3024816C

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4

PROFIBUS Power Hub Gateway Module

Type code	Description
HD2-GTR-4PA	PROFIBUS DP/PA Gateway Module



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- PROFIBUS DP V1/For 4 segments PA
- Connects PA transparently to PROFIBUS DP
- Optional redundant configuration
- Installation in Zone 2/Class I, Div. 2
- Up to 12 Mbit/s, auto adapting
- For redundant and non-redundant masters
- Supports Flying Redundancy (FR)
- Cyclic/acyclic data exchange

Function

The fieldbus gateway is a system component of the FieldConnex[®] PROFIBUS Power Hub (Segment Coupler 3/SK3) and plugs into the gateway motherboard. It transparently connects PROFIBUS DP with up to four PROFIBUS PA segments. It operates in conjunction with power supply modules connected to a separate motherboard (*.GEN).

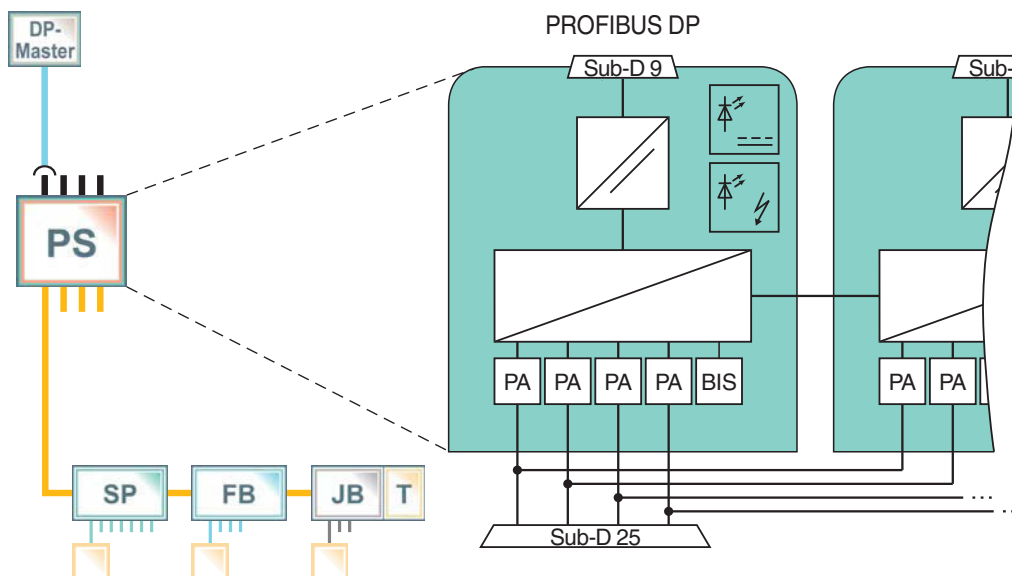
Transparent coupling means that each PA slave is directly addressed and configured from the PROFIBUS DP master. The gateway itself is configuration free. A DTM enables setup of communication and offers several status and diagnostic functionalities.

Used in connection with the corresponding motherboard, two gateways provide redundant coupling. The HD2-GTR-4PA supports PROFIBUS Flying Redundancy (FR) and all non-redundant master.

Assembly



Connection



Technical data

Supply

Rated voltage	19.2 ... 35 V DC
Rated current	160 ... 90 mA
Power loss	3 W

Fieldbus interface

PROFIBUS DP

Connection	9-pin Sub-D socket
Protocol	PROFIBUS DP V1

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC	EN 61326-1:2006

Low voltage

Directive 73/23/EEC	EN 50178 (identical to EN 62103)

Standard conformity

Electrical isolation	IEC 62103
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Mounting	motherboard mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 04 ATEX 2500 X
Group, category, type of protection, temperature class	Ex II 3G EEx nA II T4

Directive conformity

Directive 94/9/EC	EN 60079-15:2003

International approvals

FM approval	CoC 3024816, CoC 3024816C
Approved for	Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, AEx/Ex nA IIC T4



PROFIBUS PA

Selection
Guideline

Advanced
Diagnostics

Segment
Coupler

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories





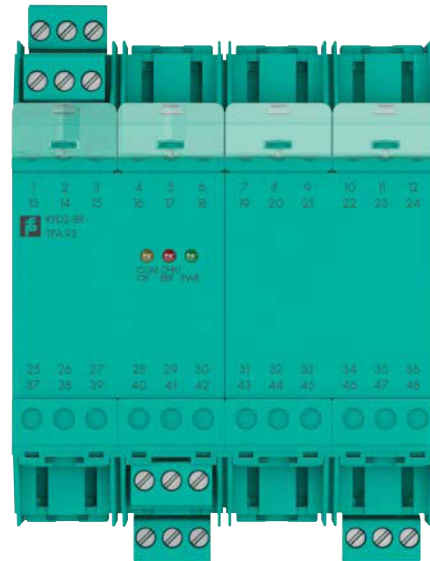
Features

- Output: 24 ... 26 V/400 mA
- Connects PA transparently to PROFIBUS DP
- Intrinsically safe, Ex ia (FISCO or Entity)
- Installation in Zone 2/Class I, Div. 2
- Fixed, high-availability terminator
- For all non-redundant masters
- Cyclic/acyclic data exchange

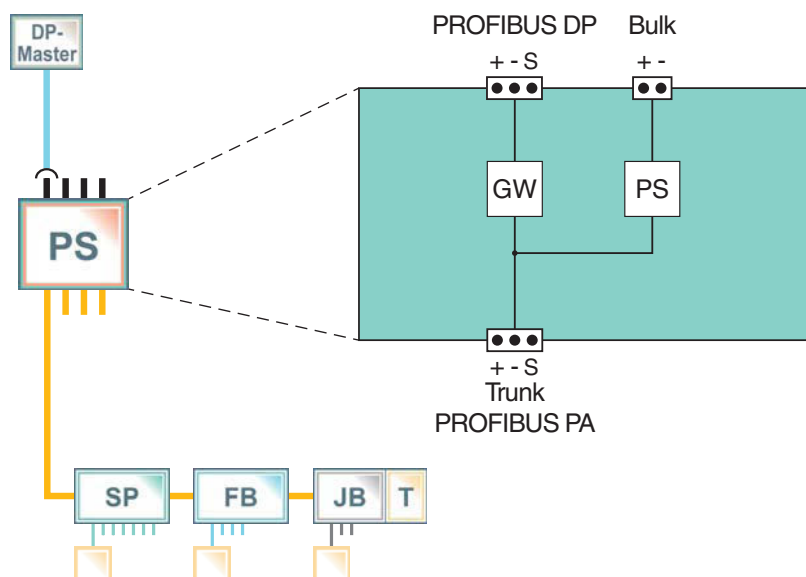
Function

This "Segment Coupler 1" or SK1 is an all-in-one gateway and fieldbus power supply for connecting PROFIBUS PA to PROFIBUS DP transparently. It powers a single PROFIBUS PA segment adapting current and voltage. Power output is designed for long cable lengths and device counts suiting the needs of most fieldbus applications. Fieldbus couplers provide explosion protection for live work at the spur where needed. Transparent coupling means that each PA slave is directly addressed and configured from the PROFIBUS DP master. The gateway itself is configuration free. A DTM enables setup of communication and offers several status and diagnostic functionalities. SK1 supports any DP master at a fixed transmission speed of 93.75 kbps.

Assembly



Connection



Technical data**Supply**

Connection	Power Rail or terminals 47 (L+), 48 (L-)
Rated voltage	20 ... 35 V DC
Ripple	≤ 10 %
Rated current	790 mA ... 400 mA

Fieldbus interface**PROFIBUS PA**

Connection	terminals 3, 15+; 2, 14-
Rated voltage	24 ... 26 V
Rated current	≤ 400 mA
Terminating impedance	100 Ω, integrated

PROFIBUS DP PROFIBUS with RS 485 transmission technique

Connection	terminals 28 RxD/TxD-P, 29 RxD/TxD-N, 30 shield/FE, 40 DGND, 41 CNTR-P, 42 VP
Baud rate	93.75 kBit/s
Terminating impedance	with rotary switch (S1) switchable: 1 = on; 0 = off

Directive conformity

Electromagnetic compatibility	
Directive 89/336/EEC	EN 61326, EN 50081-2

Standard conformity

Electrical isolation	EN 50178
Electromagnetic compatibility	NAMUR NE 21
Protection degree	IEC/EN 60529
Climatic conditions	DIN IEC 721

Mechanical specifications

Connection type	Terminals
Core cross-section	up to 2.5 mm ²
Mounting	DIN rail mounting

Data for application in connection with Ex-areas

Statement of conformity	TÜV 01 ATEX 1788X
Group, category, type of protection, temperature class	⊕ 3G EEx nA II T4
Directive conformity	
Directive 94/9/EC	EN 50021:1999



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- Output: 12.6 ... 13.4 V/100 mA
- Connects PA transparently to PROFIBUS DP
- High-Power Trunk for high device count and long cable runs
- Installation in Zone 2/Class I, Div. 2
- Fixed, high-availability terminator
- For all non-redundant masters
- Cyclic/acyclic data exchange

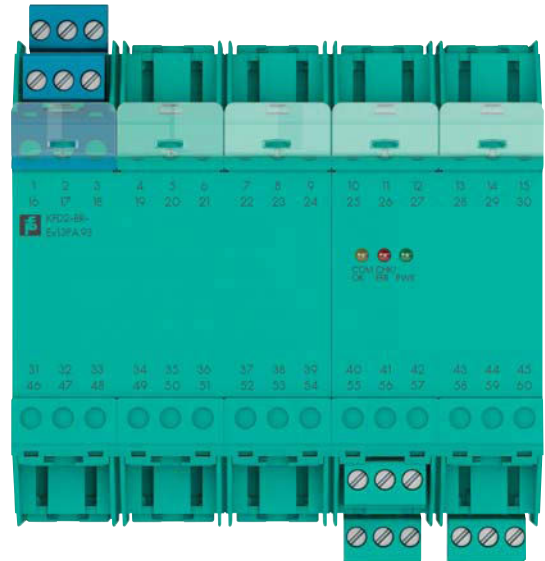
Function

This "Segment Coupler 1" or SK1 is an all-in-one gateway and fieldbus power supply for connecting PROFIBUS PA to PROFIBUS DP transparently. It powers a single PROFIBUS PA segment adapting current and voltage. The output is rated intrinsically safe Ex ia IIC according to FISCO and Entity. The complete segment can be installed intrinsically safe.

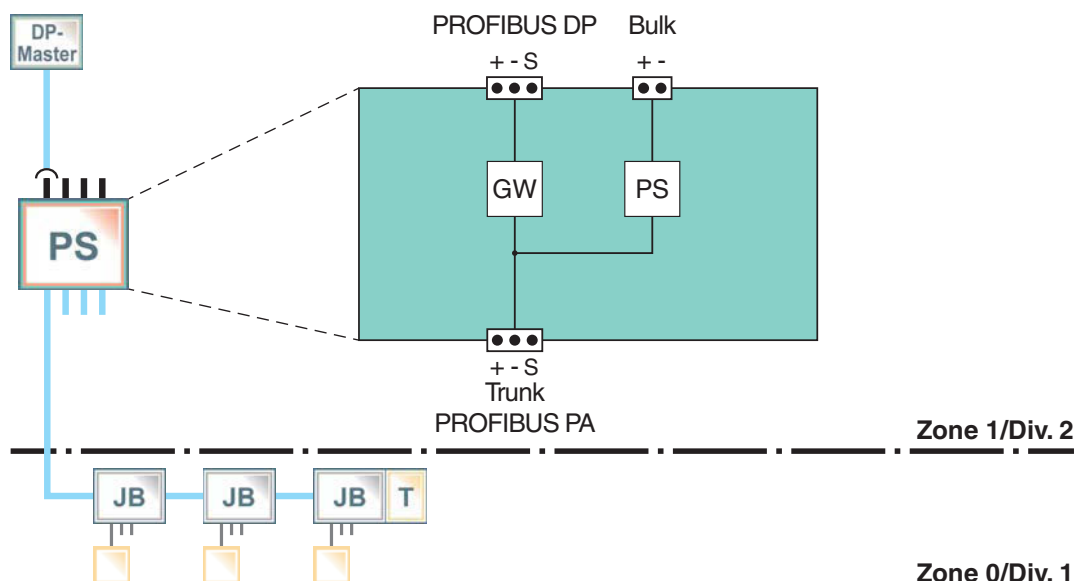
Transparent coupling means that each PA slave is directly addressed and configured from the PROFIBUS DP master. The gateway itself is configuration free. A DTM enables setup of communication and offers several status and diagnostic functionalities.

SK1 supports any DP master at a fixed transmission speed of 93.75 kbps.

Assembly



Connection



Technical data

Supply	
Connection	Power Rail or terminals 59+, 60-, 58 FE
Rated voltage	20 ... 35 V DC
Ripple	≤ 10 %
Rated current	190 mA ... 430 mA
Fieldbus interface	
PROFIBUS PA	
Connection	terminals 3, 18+; 2, 17-
Rated voltage	12.6 ... 13.4 V
Rated current	≤ 100 mA
Terminating impedance	100 Ω, integrated
PROFIBUS DP	
Connection	PROFIBUS with RS 485 transmission technique
Connection	Terminals 40 RxD/TxD-P, 41 RxD/TxD-N, 42 screen/FE, 55 DGND, 56 CNTR-P, 57 VP
Baud rate	93.75 kBit/s
Terminating impedance	with rotary switch (S1) switchable: 1 = on; 0 = off
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electrical isolation	EN 50178
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Mechanical specifications	
Connection type	Terminals
Core cross-section	up to 2.5 mm ²
Mounting	DIN rail mounting
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	PTB 99 ATEX 2142, for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection, temperature class	⊕ II (1)GD [EEx ia] IIC
Supply	
Maximum safe voltage U _m	253 V AC/125 V DC (Attention! U _m is no rated voltage.)
PROFIBUS PA	
Voltage U _o	15 V
Current I _o	207.2 mA
Power P _o	1.93 W
Maximum safe voltage U _m	60 V
Statement of conformity	
Statement of conformity	TÜV 00 ATEX 1531 X, observe statement of conformity
Group, category, type of protection, temperature class	⊕ II 3G EEx nA II T4
Directive conformity	
Directive 94/9/EC	EN 50014:1997 EN 50020:1994



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Adjustable output 15 ... 30 V/max.1 A
- 8 hours operation at 500 mA without recharging
- IP 54 - Rain and splash proof
- Rugged housing for outdoor use
- Low battery and overload indication
- Output current meter
- Selectable terminators for creating any type of termination
- All in one - no additional components required

Function

Validation of device communication and fieldbus installation testing can be done even when the line voltage or DCS system is not available. This allows on-site personnel to verify the quality of the installation at early stages.

The fieldbus battery features a rugged housing for indoor/outdoor use during commissioning of fieldbus segments. The battery includes a fieldbus power conditioner. Its output voltage is adjustable to match the value of the later used fieldbus power supply. A battery charger is included.

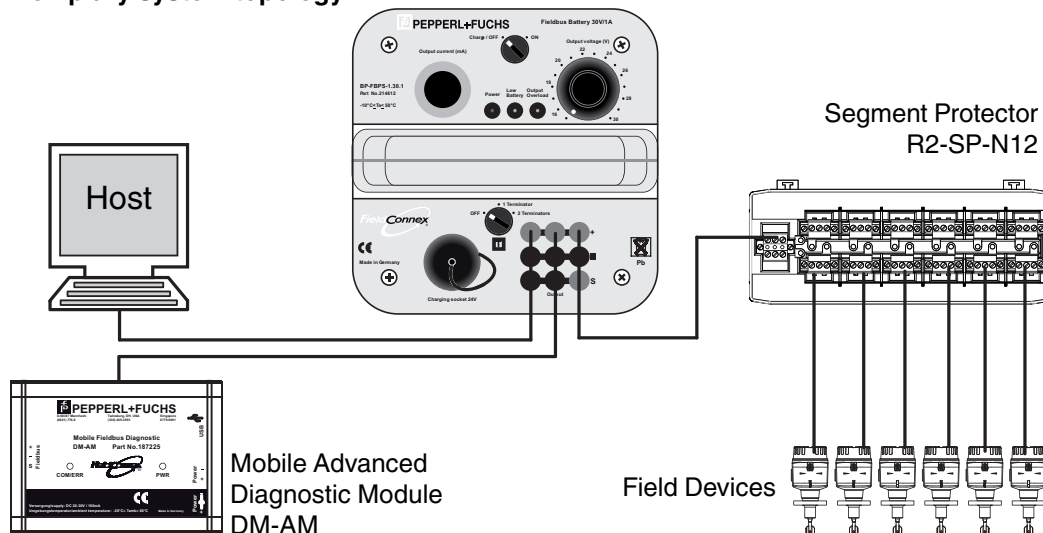
The fieldbus battery complements the FieldConnex Mobile Advanced Diagnostic Module or any other equipment available for testing any fieldbus installation.

Assembly



Connection

Exemplary system topology



Technical data**Supply**

Battery charger	110 ... 240 V AC, 50/60 Hz
Charging voltage	24 V DC

Connections

Battery charger	DC Round socket

Fieldbus interface

Rated voltage	15 ... 30 V DC, adjustable
Rated current	1 A
Host-side	banana socket 4 mm
Terminating resistor	2x 100 Ω on/off switchable via rotary switch
Diagnostic link	banana socket 4 mm

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Accumulator

Capacitance	7200 mAh
Charging time	8 ... 16 h



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 ... 12 outputs Ex ic, Ex nL (FISCO or Entity) or non-incendive (Div 2)
- Short-circuit protection per output
- Segment Protector in Zone 2/Div. 2
- Instruments in Zone 2/Div. 2
- Power, Com, and Error LEDs
- T-connector for easy installation and maintenance
- Test points for easy troubleshooting

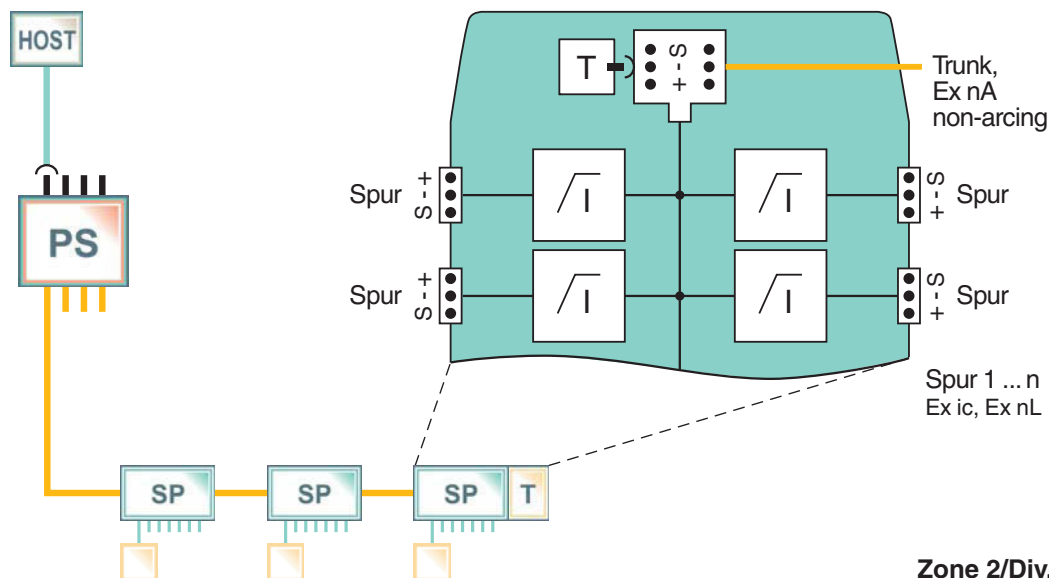
Function

The R2 Segment Protector, a fieldbus coupler for DIN-rail installation, connects 4 ... 12 instruments to the segment with intrinsic safety (Ex ic), energy limitation (Ex nL) and short circuit protection at each spur. This ensures proper operation of the segment during faults or hot work at the spur. The T-connector at the trunk allows for exchange of a Segment Protector with no effect on the remaining segment. The terminator is mounted at the 'T' and removed for network extensions always ensuring proper termination. All plugs feature retaining screws. LEDs and test access points simplify troubleshooting and help to decrease repair time. Any grounding and shielding concept is possible based on FieldConnex enclosure solutions.

Assembly



Connection



Technical data**Fieldbus interface**

Main cable (Trunk)

Rated voltage 9 ... 31 V DC

Rated current ≤ 4.5 A

Outputs

Rated voltage ≤ 31 V

Rated current ≤ 43 mA

Short-circuit current max. 58 mA

Quiescent current ≤ 8 mA (R2-SP-N4), ≤ 8 mA (R2-SP-N6), ≤ 8 mA (R2-SP-N8), ≤ 10 mA (R2-SP-N10), ≤ 10 mA (R2-SP-N12)

Voltage drop main cable/outputs ≤ 1.3 V

Voltage drop trunk In/Out 0 V

Terminating resistor external type M-FT 100 Ω +/- 10 %

Surge protection Trunk overvoltage protection if voltage exceeds typ. 39 V, max. 41 V

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Ambient conditions

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type removable screw terminals with retaining screws

Core cross-section ≤ 2.5 mm²/AWG 12-24

Housing material Polycarbonate

Housing width 77 mm

Housing height 93 mm (R2-SP-N4), 121 mm (R2-SP-N6), 148 mm (R2-SP-N8), 177 mm (R2-SP-N10), 205 mm (R2-SP-N12)

Housing depth 42 mm

Protection degree IP20

Mass 130 g (R2-SP-N4), 180 g (R2-SP-N6), 230 g (R2-SP-N8), 280 g (R2-SP-N10), 330 g (R2-SP-N12)

Mounting DIN rail mounting

Data for application in connection with Ex-areas

Main cable (Trunk)

Rated current see Statement of Conformity

Outputs

Voltage U_o 24 V for IIC gas group, defined by trunk voltage
32 V for IIB gas groupCurrent I_o 65 mA for IIC and IIB gas groupsInductance L_o 0.25 mH for IIC and IIB gas groupsCapacitance C_o 60 nF for IIC and IIB gas groups

Statement of conformity TÜV 11 ATEX 081151 X

Group, category, type of protection, temperature class  II 3G Ex nA [nL] [ic] IIC T4

Directive conformity

Directive 94/9/EC EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2005, EN 60079-27:2008

International approvals

FM approval CoC 3027877, CoC 3027877C

Control drawing No. 116-0280

Approved for Class I, Division 2, Groups A, B, C, D, T4/Class I, Zone 2, Ex nA [nL] IIC T4

UL approval E106378

Approved for Class I, Division 2, Groups A, B, C, D

IECEx approval IECEx 11.0011 X

Approved for  Ex nA [nL] [ic] IIC T4**Certificates and approvals**

Marine approval DNV A-10798



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4 ... 12 outputs Ex ic (FISCO or Entity) or non-incendive (Div 2)
- Advanced fault isolation at the spur
- Segment Protector in Zone 2/Div. 2
- Instruments in Zone 2/Div. 2 or Zone 1/Div. 1
- Advanced Diagnostics at the spur
- Power, Com, Diagnostics, and Error LEDs
- T-connector for easy installation and maintenance
- Test points for easy troubleshooting

Function

The R2 Segment Protector with integrated diagnostics, a fieldbus coupler for DIN rail installation, connects 4 ... 12 instruments to the segment with intrinsic safety (Ex ic). Short-circuit, jabber, and bounce protection isolates most fault condition types from the segment. The short-circuit limit is adjustable for maximum load with Ex ic for gas groups IIB and IIC.

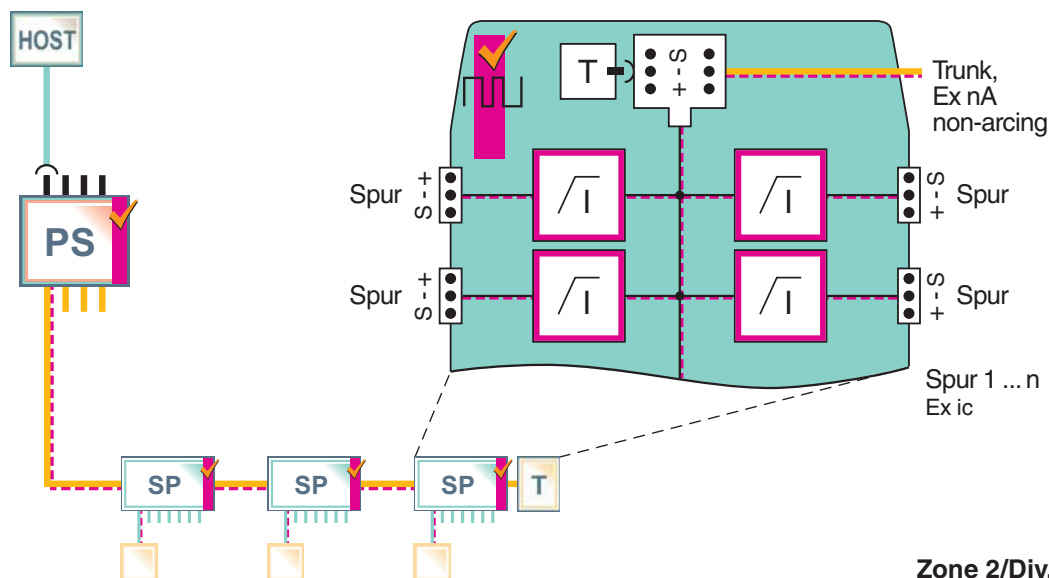
The T-connector at the trunk allows for exchange of a Segment Protector with no effect on the remaining segment. The terminator is mounted at the 'T' and removed for network extensions ensuring proper termination.

Segment Protectors with integrated diagnostics offer physical layer diagnostics at the spur. They are the basis for optional surge protectors with wear indication and enclosure leakage sensors all monitoring the quality of the installation for best availability.

Assembly



Connection



Zone 2/Div. 2

Technical data

Fieldbus interface

Main cable (Trunk)

Rated voltage 9 ... 31 V DC
10.5 V DC minimum input voltage acc. to FF-846

Rated current ≤ 4.5 A

Outputs

Rated voltage ≤ 31 V

Rated current ≤ 32 mA switch 1, position 1
≤ 43 mA switch 1, position 2

Short-circuit current 46 mA switch 1, position 1
65 mA switch 1, position 2

Quiescent current ≤ 15 mA (R2-SP-IC4), ≤ 17 mA (R2-SP-IC6), ≤ 17 mA (R2-SP-IC8), ≤ 19 mA (R2-SP-IC10),
≤ 19 mA (R2-SP-IC12)

Voltage drop main cable/outputs ≤ 1.2 V

Voltage drop trunk In/Out 0 V

Terminating resistor external type M-FT 100 Ω +/- 10 %

Surge protection Trunk overvoltage protection if voltage exceeds typ. 39 V, max. 41 V

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Climatic conditions IEC 60721

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Ambient conditions

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type removable screw terminals with retaining screws

Core cross-section ≤ 2.5 mm²/AWG 12-24

Housing material Polycarbonate

Housing width 77 mm

Housing height 93 mm (R2-SP-IC4), 121 mm (R2-SP-IC6), 148 mm (R2-SP-IC8), 177 mm (R2-SP-IC10),
205 mm (R2-SP-IC12)

Housing depth 42 mm

Protection degree IP20

Mass 130 g (R2-SP-IC4), 180 g (R2-SP-IC6), 230 g (R2-SP-IC8), 280 g (R2-SP-IC10), 330 g (R2-SP-IC12)

Mounting DIN rail mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate TÜV 12 ATEX 098651 X

Group, category, type of protection, temperature class  II 3 G Ex nAc [ic] IIC T4

Supply

Maximum safe voltage U_m 35 V

Outputs

Voltage U_o 32 V

Current I_o 46 mA switch 1, position 1
65 mA switch 1, position 2

Inductance L_o 0.25 mH switch 1, position 1
0.125 mH switch 1, position 2

Capacitance C_o 60 nF

Directive conformity

Directive 94/9/EC EN 60079-0:2009,
EN 60079-11:2012,
EN 60079-15:2010

International approvals

IECEx approval IECEx TUN 12.0015 X

Approved for  Ex nAc [ic] IIC T4

Certificates and approvals

Marine approval pending



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 2 outputs Ex nL, expandable up to 26 with short-circuit protection
- High-Power Trunk for high device count and long cable runs
- Segment Protector in Zone 2/Div. 2
- Instruments in Zone 2/Div. 2
- Power, Com, and Error LEDs
- Integrated overvoltage protection

Function

The modular Segment Protector, a fieldbus coupler for DIN rail, connects instruments to the fieldbus segment. It features the most compact design and easily expandability for skid-mount applications.

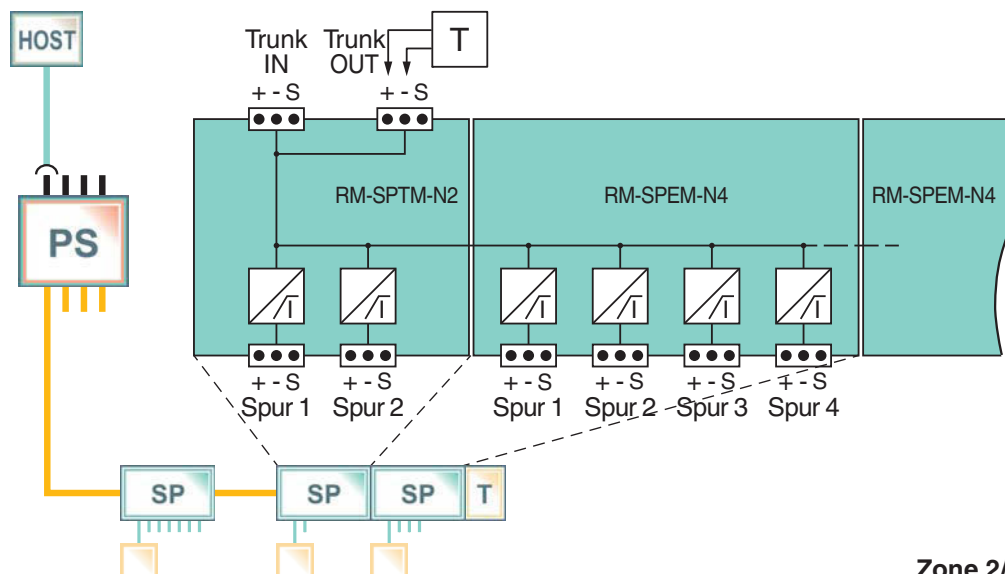
The trunk module connects the Segment Protector to the segment. Expansion modules snap side-by-side interconnected via a system plug. The high-availability terminator is mounted at the output. As it is removed for network extensions proper termination is always ensured. Short-circuit protection ensures proper operation of the segment in case of faults or hot work. Integrated LEDs simplify troubleshooting and help decrease repair time.

All connectors are plug-in type with receptacles for measuring tools, such as the mobile ADM. This leaves the wiring undisturbed. Any grounding and shielding concept is possible with FieldConnex enclosure solutions.

Assembly



Connection



Zone 2/Div. 2

Technical data

Fieldbus interface	
Main cable (Trunk)	
Rated voltage	9 ... 31 V DC
Rated current	≤ 4.5 A
Outputs	
Rated voltage	≤ 31 V
Rated current	≤ 43 mA
Short-circuit current	max. 58 mA
Inherent current consumption	7 mA (RM-SPTM-N2), 3.5 mA (RM-SPEM-N4), total current consumption = 7 mA + n * 3.5 mA with n = number of Extension Modules RM-SPEM-N4
Voltage drop main cable/outputs	≤ 1.3 V
Terminating resistor	100 Ω external
Surge protection	Trunk overvoltage protection if voltage exceeds typ. 39 V, max. 41 V
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	
NE 21:2006	
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ambient conditions	
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Mechanical specifications	
Connection type	screw terminals, removable
Core cross-section	≤ 2.5 mm ² /AWG 12-24
Housing material	Polyamide PA 66
Housing width	17.5 mm per device
Housing height	94 mm
Housing depth	54 mm
Protection degree	IP20
Mass	75 g per device
Mounting	DIN rail mounting
Data for application in connection with Ex-areas	
Main cable (Trunk)	
Rated current	see Statement of Conformity
Outputs	
Voltage U _o	24 V for IIC gas group, defined by trunk voltage 32 V for IIB gas group
Current I _o	65 mA for IIC and IIB gas groups
Inductance L _o	0.25 mH for IIC and IIB gas groups
Capacitance C _o	60 nF for IIC and IIB gas groups
Statement of conformity	TÜV 11 ATEX 081152 X
Group, category, type of protection, temperature class	⊕ II 3G Ex nA [nL] IIC T4
Directive conformity	
Directive 94/9/EC	EN 60079-15:2005, EN 60079-0:2006
International approvals	
UL approval	E106378
Approved for	Class I, Division 2, Groups A, B, C, D
Certificates and approvals	
Marine approval	DNV A-10798



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4 ... 10 outputs Ex ic (FISCO or Entity) or non-incendive (Div 2)
- Advanced fault isolation at the spur
- Segment Protector in Zone 2/Div. 2
- Instruments in Zone 2/Div. 2 or Zone 1/Div. 1
- Advanced Diagnostics at the spur
- Power, Com, Terminator, Diagnostics, and Error LEDs

Function

The F2 Segment Protector with integrated diagnostics, a device coupler in aluminum housing, connects 4 ... 10 instruments to the segment with intrinsic safety (Ex ic). Pre-engineering options are: cable glands in various materials; a choice of fixed or plug-in terminals with screw or spring-clamp connections. Short circuit, jabber, and bounce protection isolate most fault condition types from the segment.

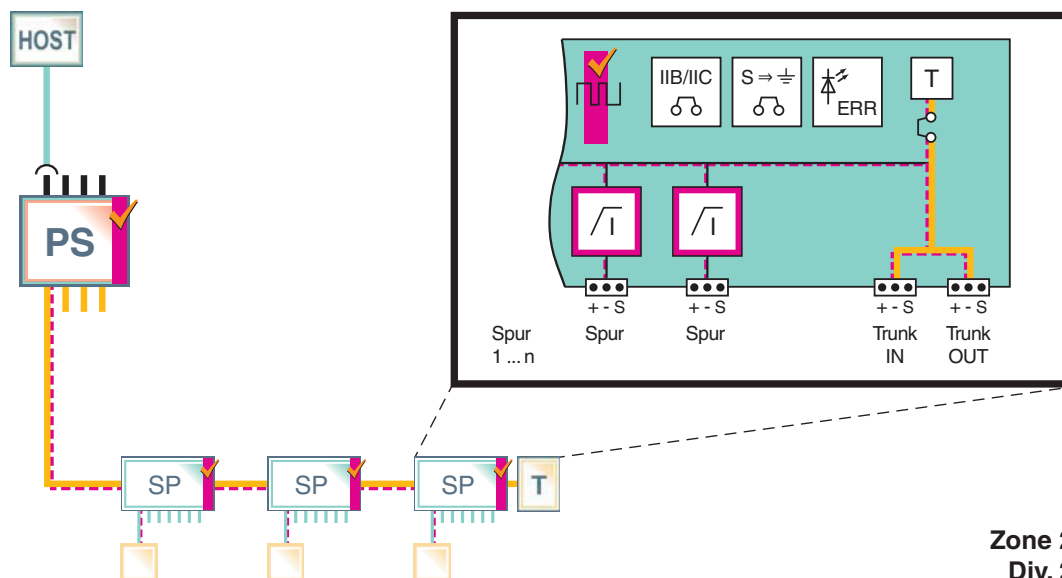
The short circuit current limitation is adjustable for maximum load with Ex ic for gas groups IIB and IIC. The shield can be connected hard-to-ground or floating. A terminator with LED indication is selectable via jumper.

Short circuit protection ensures proper operation of the segment in case of unwanted faults at the spur. Work on devices always requires a hot work permit. The integrated fieldbus terminator features a high-availability design and can be chosen via a jumper

Assembly



Connection



Zone 2
Div. 2

Technical data

Fieldbus interface

Main cable (Trunk)

Rated voltage 9 ... 31 V DC, 10.5 V DC minimum input voltage acc. to FF-846

Rated current ≤ 4.5 A

Outputs

Rated voltage ≤ 31 V

Rated current ≤ 32 mA jumper 1, position 2
≤ 43 mA jumper 1, position 1

Short-circuit current 46 mA jumper 1, position 2
65 mA jumper 1, position 1

Quiescent current ≤ 15 mA (F2-SP-IC04), ≤ 17 mA (F2-SP-IC06), ≤ 17 mA (F2-SP-IC08), ≤ 19 mA (F2-SP-IC10)

Voltage drop main cable/outputs ≤ 1.2 V

Voltage drop trunk In/Out 0 V

Terminating resistor selectable via Jumper 100 Ω +/- 10 %

Surge protection trunk, spurs overvoltage protected if voltage exceeds typ. 39 V, max. 41 V

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree IEC 60529

Climatic conditions IEC 60721

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Ambient conditions

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type removable screw terminal, removable spring terminal, screw terminal

Core cross-section ≤ 2.5 mm²/AWG 12-24

Cable entry cable gland, plug connection, and stopping plug options

Cable diameter 6 ... 13 mm (cable glands plastic), 7 ... 12 mm (cable glands nickel plated brass), 8.5 ... 13 mm (cable glands stainless steel), 8.5 ... 16 mm outside, 6 ... 12 mm inside, 0 ... 1.25 mm armor (cable glands nickel plated brass/stainless steel for armored cable)

Housing material ALSI12 (Cu) DIN1725 (Si 1.2 %), anodized

Housing width 120 mm (stopping plug plastic/stainless steel), 140 mm (cable glands plastic/nickel plated brass/stainless steel), 160 mm (cable glands nickel plated brass/stainless steel for armored cable), 135 mm (plug connection M12 nickel plated brass/stainless steel)

Housing height 258 mm

Housing depth 93 mm

Protection degree IP66

Mass max 2.6 kg, depending on model

Mounting panel mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate pending

Group, category, type of protection, temperature class  II 3 G Ex nAc [ic] IIC T4

Supply

Maximum safe voltage U_m 35 V

Outputs

Voltage U_o 32 V

Current I_o 46 mA jumper 1, position 2
65 mA jumper 1, position 1

Inductance L_o 0.25 mH jumper 1, position 1
0.125 mH jumper 1, position 2

Capacitance C_o 60 nF

Directive conformity

Directive 94/9/EC EN 60079-0:2009, EN 60079-11:2012, EN 60079-15:2010

International approvals

IECEx approval pending

Approved for pending

Certificates and approvals

Marine approval pending



PROFIBUS PA

Selection
Guideline

Advanced
Diagnostics

Segment
Coupler

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories





Features

- 4 ... 12 outputs Ex ic, Ex nL (FISCO or Entity)
- Glass fiber reinforced polyester, impact resistant, IP66
- Configurable cable entries for trunk and spurs
- International approvals
- Installation in Zone 2

Function

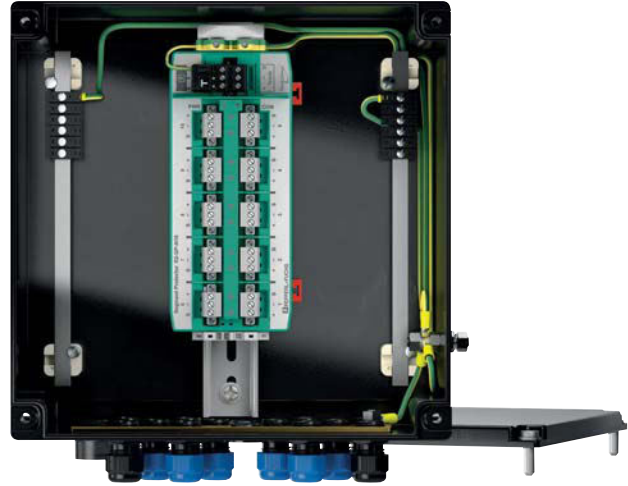
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2. Devices can be located in Zone 2. The number of outputs and size can be selected.

Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge.

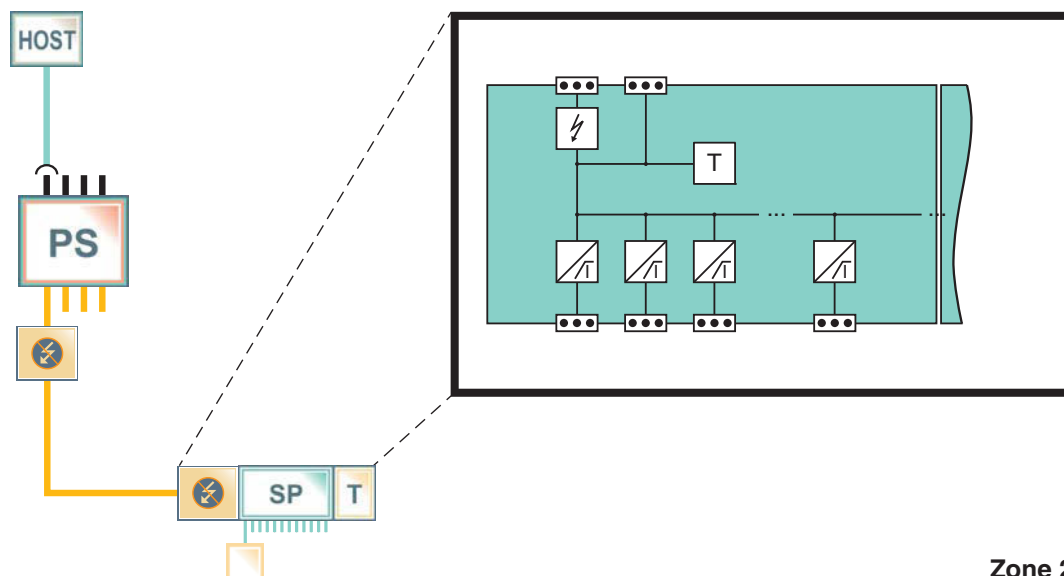
Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 2

Technical data**General specifications**

Installed components	Segment Protector R2-SP-N** For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529
Impact resistance	EN 60079-0

Mechanical specifications

Enclosure cover	detachable cover with retaining screws
Protection degree	IP66
Cable entry	cable gland and stopping plug options
Material	
Housing	polyester, impact resistant, glass fiber reinforced
Surface	black molded finish (RAL 9005)
Surface resistance	< 10 ⁹ Ω
Water absorption	< 6 %
Seal	silicon, one piece
Grounding plate	brass
Material thickness	grounding plate: 3 mm

Dimensions	(W x H x D) 271 x 271 x 136 mm (1 x R2-SP-N**) 544 x 271 x 136 mm (2 x R2-SP-N**)

Mounting	thru-holes Ø6.5 mm
Grounding	grounding bolt M6, Stainless steel

Data for application in connection with Ex-areas

Statement of conformity	PF 08 CERT 1278 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	⊕ II 3G Ex nA [nL] [ic] IIC T4
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-14:2003, EN 60079-15:2005, EN 60079-11:2007

International approvals

IECEx approval	IECEx PTB 09.0016, suitable Junction Box on request



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4 ... 12 outputs Ex ic, Ex nL (FISCO or Entity)
- Stainless steel, electropolished, IP66
- Configurable cable entries for trunk and spurs
- International approvals
- Installation in Zone 2

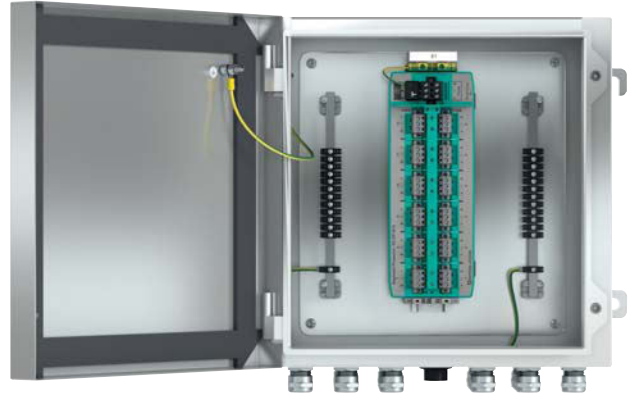
Function

This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2. Devices can be located in Zone 2. The number of outputs and size can be selected.

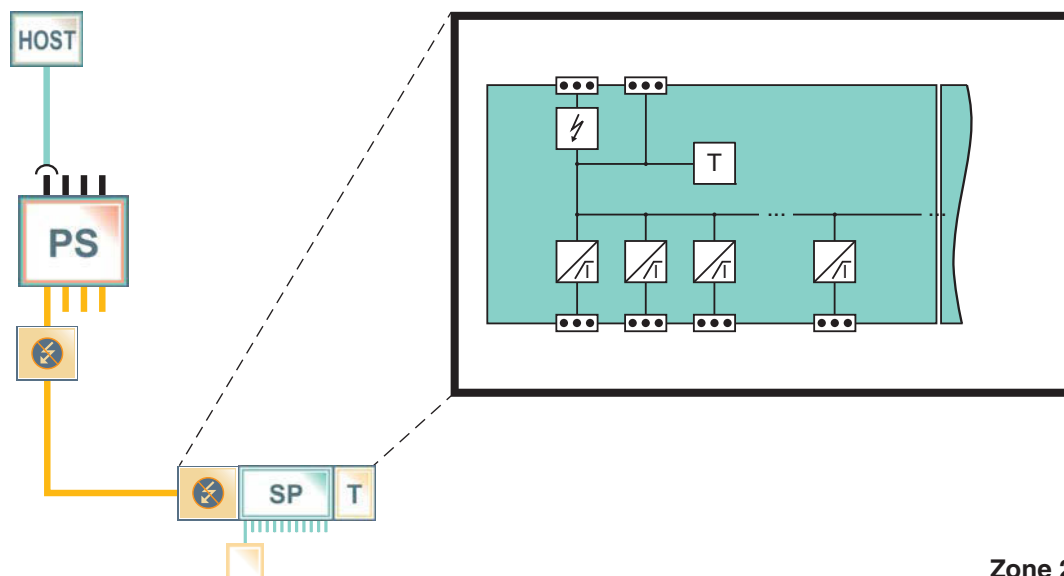
Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. The integrated rain channel prevents standing water from damaging the one-piece seal.

Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options. This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 2

Technical data**General specifications**

Installed components	Segment Protector R2-SP-N** For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529
Impact resistance	EN 60079-0

Mechanical specifications

Enclosure cover	detachable hinged door with captive retaining screws
Protection degree	IP66
Cable entry	cable gland and stopping plug options
Material	
Housing	Stainless steel 1.4404/AISI 316L
Surface	electropolished
Seal	Neoprene, fire-resistant, one piece
Material thickness	enclosure body, enclosure cover, mounting plate: 1.5 mm gland plate: 3.0 mm
Dimensions	(W x H x D) 306 x 306 x 165 mm (1 x R2-SP-N**) 380 x 380 x 175 mm (2 x R2-SP-N**)
Mounting	thru-holes Ø10 mm
Grounding	grounding bolt M10, brass

Data for application in connection with Ex-areas

Statement of conformity	PF 08 CERT 1278 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	Ⓔ II 3G Ex nA [nL] [ic] II C T4
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 600079-14:2003, EN 60079-15:2005, EN 60079-11:2007
International approvals	
IECEx approval	IECEx PTB 09.0016, suitable Junction Box on request



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Intrinsically safe (Ex ic)/non-incendive outputs
- Anodized aluminum, IP67
- Configurable cable entries for trunk and spurs
- Packaged solution
- Installation in Class I, Division 2

Function

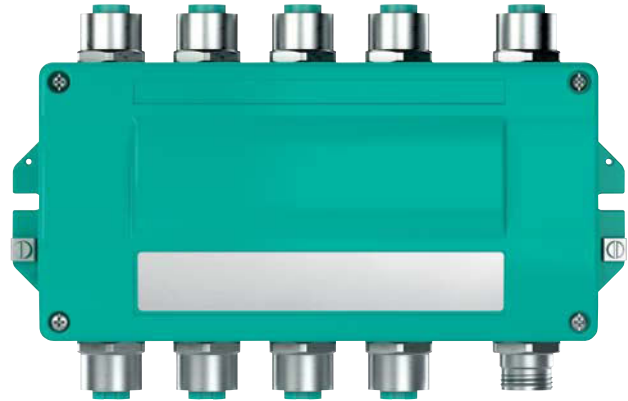
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Anodized aluminum provides corrosion resistance also to salt and impact resistance with lower weight compared to stainless steel. The compact housing offers convenient mounting flanges with external grounding lug.

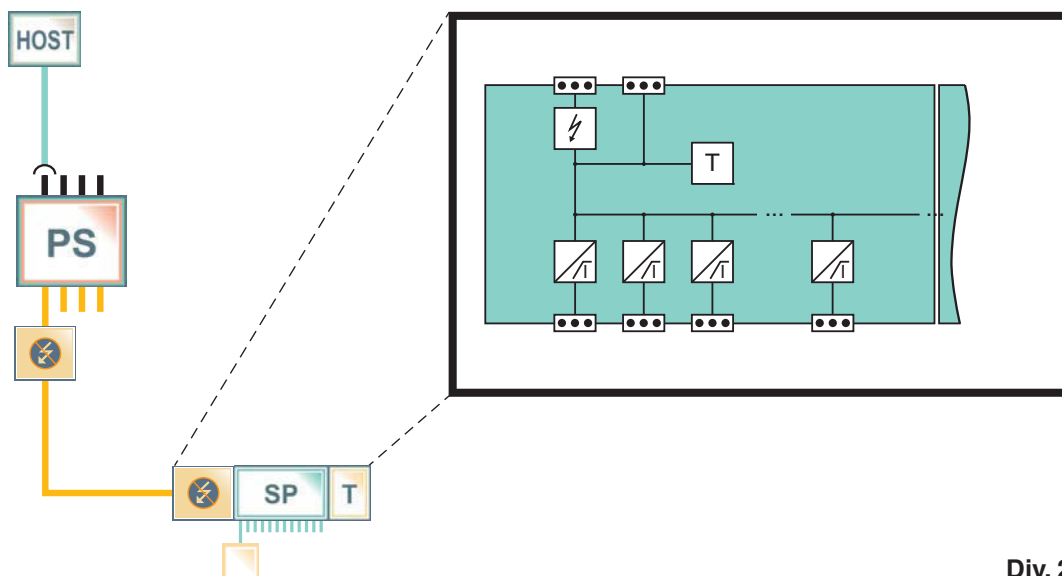
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components	Segment Protector R2-SP-N** For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529

Mechanical specifications

Enclosure cover	detachable cover with retaining screws

Protection degree	IP67

Cable entry	cable gland and stopping plug options

Material

Housing	aluminum

Surface	epoxy polyester paint

Seal	Polyurethane (PUR), one piece

Material thickness	enclosure body: 4 mm enclosure cover: 3 mm

Dimensions	(W x H x D) 114 x 258 x 84 mm

Mounting	panel mount with M6 slots

Grounding	grounding bolt on enclosure body and enclosure cover



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Intrinsically safe (Ex ic)/non-incendive outputs
- Carbon steel, NEMA 4
- Configurable cable entries for trunk and spurs
- Packaged solution
- Installation in Class I, Division 2

Function

This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Painted carbon steel provides good corrosion resistance. The optional window makes it easy to see the coupler's LEDs.

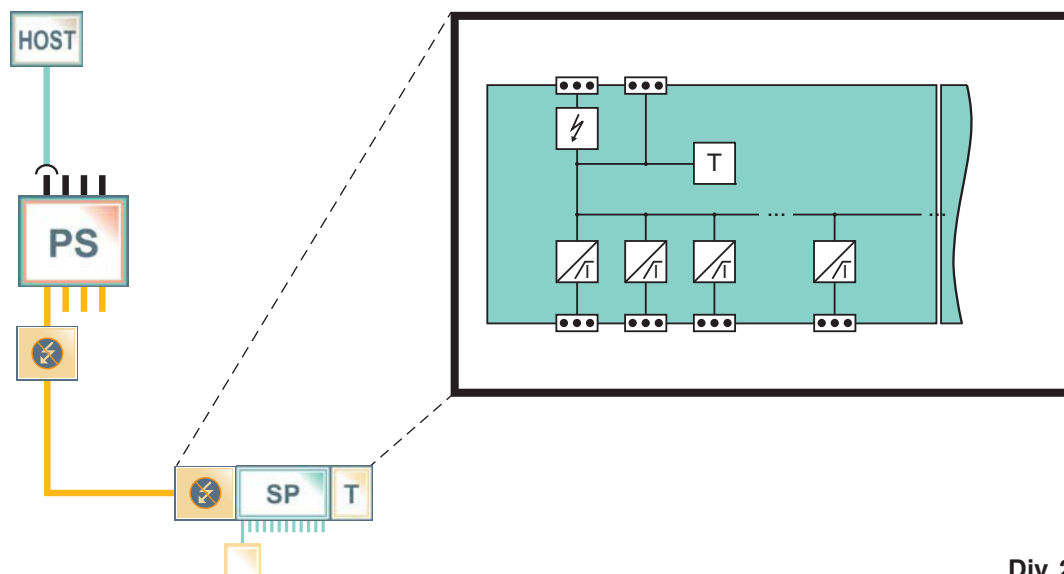
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components	Segment Protector R2-SP-N** For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529

Mechanical specifications

Enclosure cover	hinged door with cam lock
Protection degree	IP66, NEMA 4, NEMA 4X, NEMA 12
Cable entry	cable gland and stopping plug options
Material	
Housing	Steel
Surface	gray paint
Seal	oil-resistant, one piece
Material thickness	enclosure body, enclosure cover: 1.6 mm window: 6 mm

Dimensions

(W x H x D)
203 x 254 x 102 mm
window size: 197 x 95 mm

Mounting	thru-holes Ø6.4 mm

Grounding	grounding bolt on enclosure body and enclosure cover



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Intrinsically safe (Ex ic)/non-incendive outputs
- Glass fiber reinforced polyester, NEMA 4x
- Configurable cable entries for trunk and spurs
- Packaged solution
- Installation in Class I, Division 2

Function

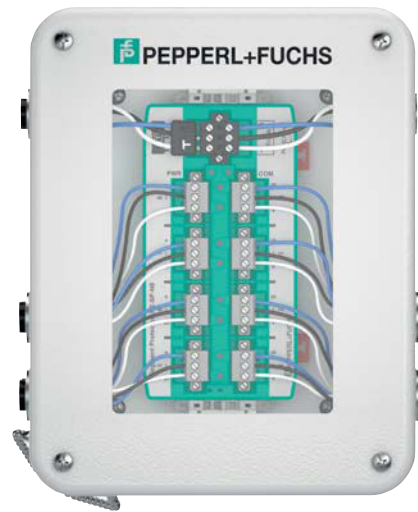
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge.

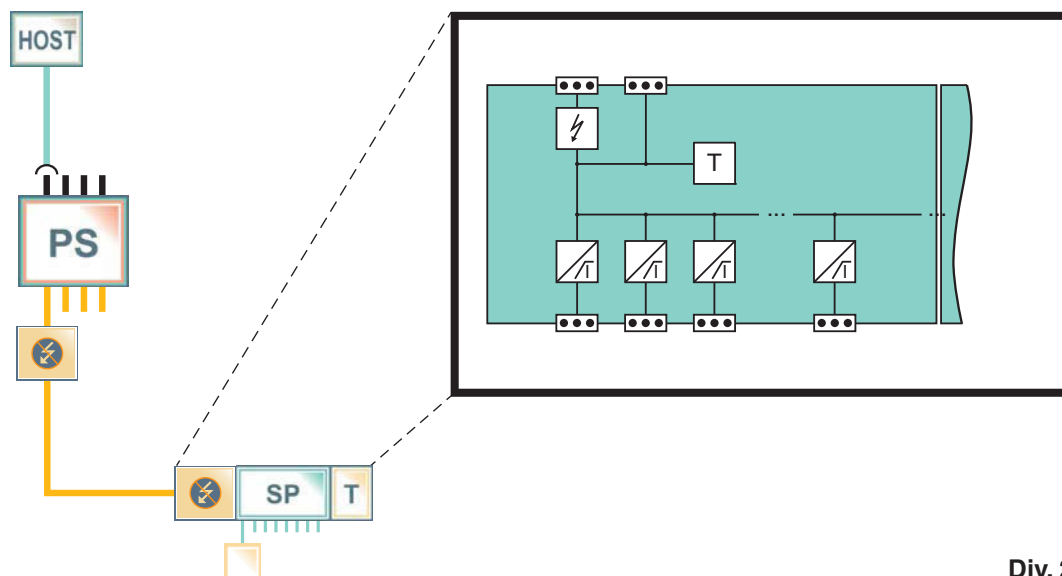
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components	Segment Protector R2-SP-N** For technical data on installed electronic component see data sheet.

Mechanical specifications

Enclosure cover	detachable cover with stainless steel safety chain
Protection degree	NEMA 6P, NEMA 12
Cable entry	cable gland and stopping plug options
Material	
Housing	polyester, impact resistant, glass fiber reinforced
Seal	Polyurethane (PUR), one piece
Material thickness	enclosure body: 4 mm enclosure cover: 3 mm
Dimensions	(W x H x D) 191 x 244 x 121 mm
Mounting	Flanged mounting Ø8 mm holes



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Intrinsically safe (Ex ic)/non-incendive outputs
- Impact resistant polycarbonate, NEMA 4x
- Configurable cable entries for trunk and spurs
- Packaged solution
- Installation in Class I, Division 2

Function

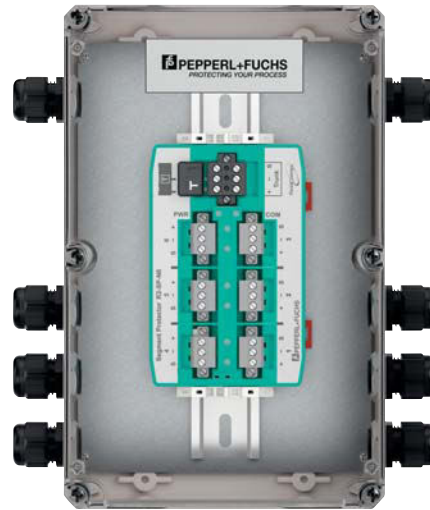
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Impact-resistant polycarbonate provides corrosion resistance. It is light weight and easy to modify. The clear cover makes it easy to see the coupler's LEDs.

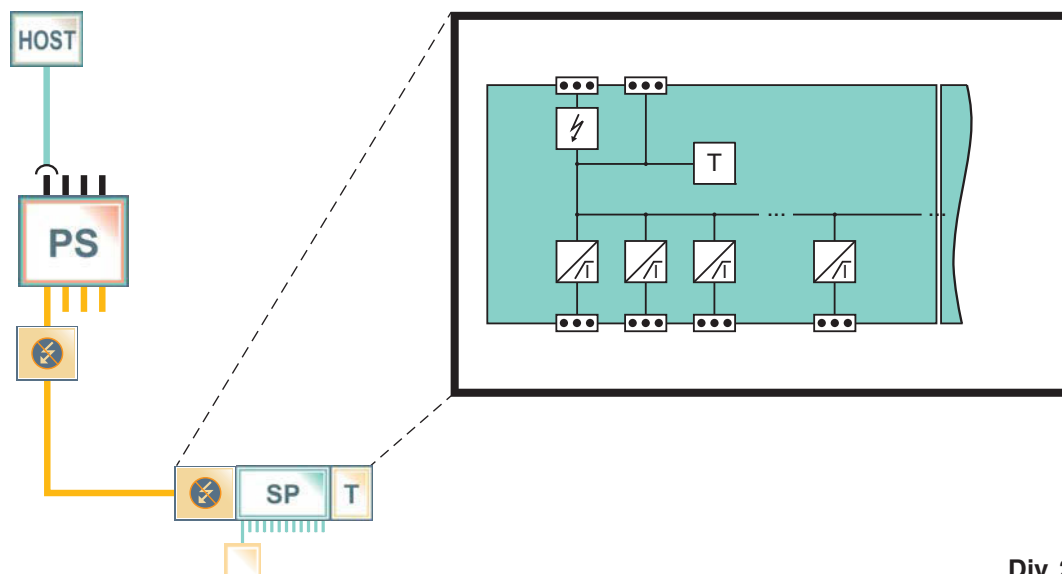
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components	Segment Protector R2-SP-N** For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529

Mechanical specifications

Enclosure cover	detachable cover with retaining screws
Protection degree	IP67, NEMA 4, NEMA 4X, NEMA 6, NEMA 12, NEMA 13
Cable entry	cable gland and stopping plug options
Material	
Housing	polycarbonate, impact resistant
Seal	Polyurethane (PUR), one piece
Material thickness	enclosure body: 4 mm enclosure cover: 3 mm
Dimensions	(W x H x D) 160 x 240 x 90 mm
Mounting	holes Ø4.5 mm



Features

- **Intrinsically safe (Ex ic)/non-incendive outputs**
- **Stainless steel, brushed NEMA 4x**
- **Configurable cable entries for trunk and spurs**
- **Packaged solution**
- **Installation in Class I, Division 2**

Function

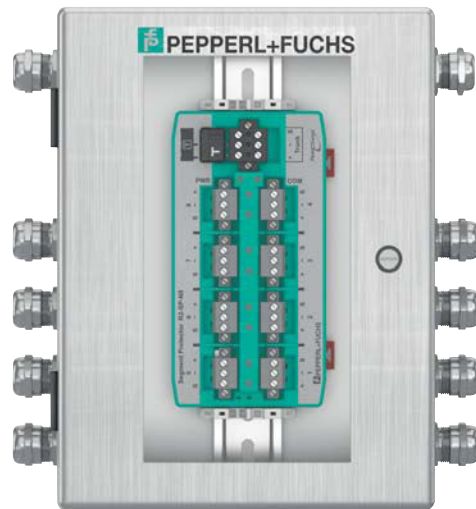
This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 2/Div 2. Devices can be located in Zone 2/Div 2. The number of outputs and size can be selected.

Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. The flanged collar around the door prevents standing water from damaging the one-piece seal. The optional window makes it easy to see the coupler's LEDs.

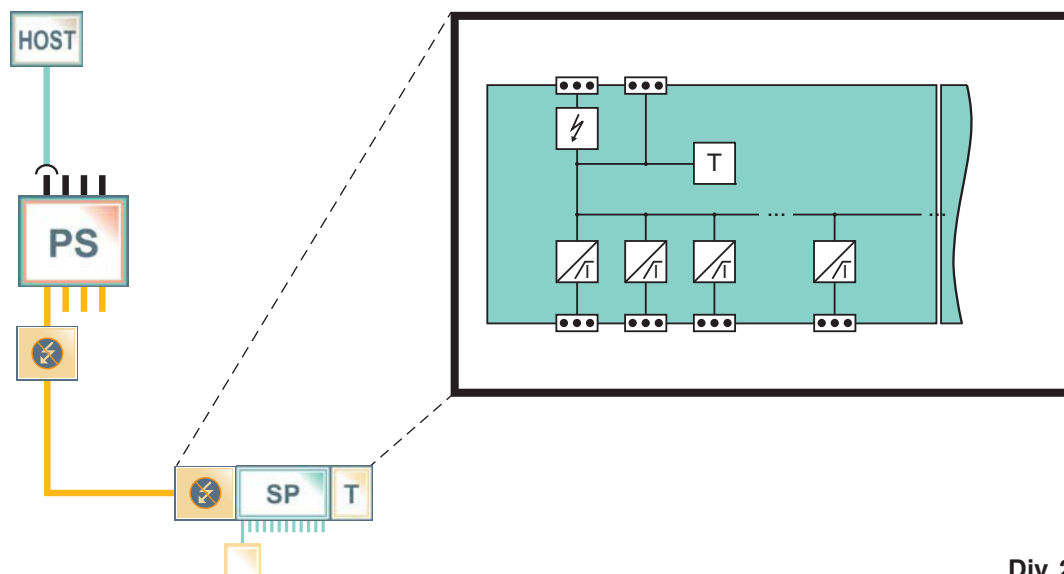
Trunk and spur entries can be selected individually from a range of cable glands and quick disconnects.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Div. 2

Technical data**General specifications**

Installed components	Segment Protector R2-SP-N** For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529

Mechanical specifications

Enclosure cover	hinged door with cam lock
Protection degree	IP66, NEMA 4, NEMA 4X, NEMA 12
Cable entry	cable gland and stopping plug options
Material	
Housing	Stainless steel 1.4404/AISI 316L
Surface	brushed finish
Seal	oil-resistant, one piece
Material thickness	enclosure body, enclosure cover: 1.6 mm window: 6 mm

Dimensions	(W x H x D) 203 x 254 x 102 mm window size: 197 x 95 mm

Mounting	thru-holes Ø6.4 mm

Grounding	grounding bolt on enclosure body and enclosure cover



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 12 increased safety outputs (Ex e)
- Segment Protector in Zone 1/Div. 2
- Instruments in Zone 1/Div. 1
- Short-circuit protection per output
- High power on trunk and spurs

Function

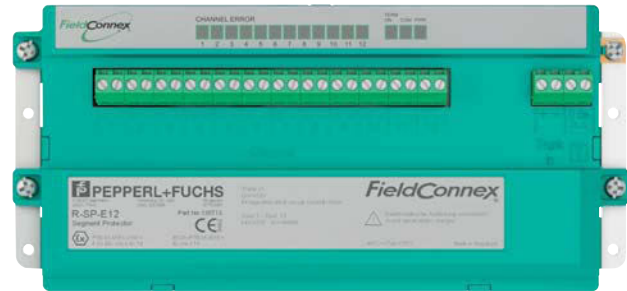
The R-SP-E12 Segment Protector is a fieldbus coupler that connects instruments to the fieldbus segment. Flameproof (Ex d) field devices are connected to the trunk line via one output each. Trunk and spurs are certified increased safety (Ex e).

Short-circuit protection ensures proper operation of the segment in case of unwanted faults at the spur. Work on devices always requires a hot work permit. The integrated fieldbus terminator features high-availability design and is selectable.

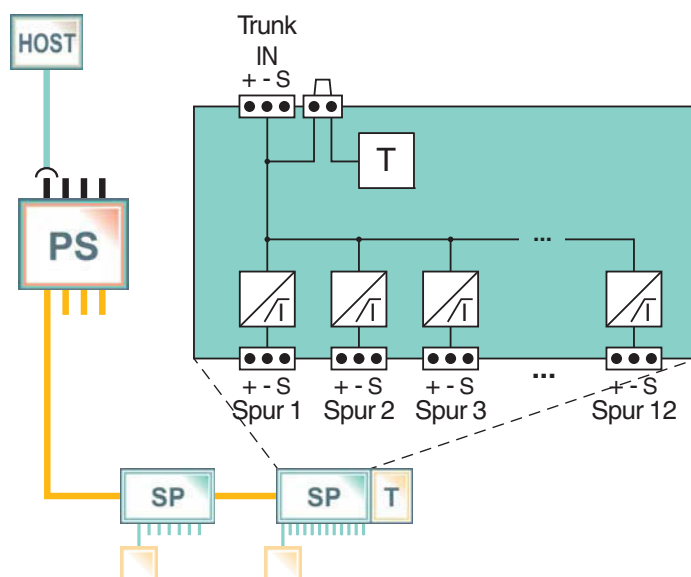
Connectors are fixed screw terminals. Any grounding and shielding concept is possible based on FieldConnex enclosure solutions.

Customizable housings host one or more Segment Protectors for different output counts.

Assembly



Connection



Zone 1/Div. 2

Technical data

Fieldbus interface

Main cable (Trunk)

Rated voltage 9 ... 32 V DC

Outputs

Rated voltage ≤ 32 VRated current ≤ 40 mA

Short-circuit current max. 50 mA

Self current consumption

 ≤ 9 mA

Voltage drop main cable/outputs

 ≤ 1.3 V

Terminating impedance

100 Ω integrated

Terminating resistor

selectable 100 Ω integrated

Surge protection

trunk, spurs overvoltage protected if voltage exceeds typ. 39 V, max. 41 V

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC 60529

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Mechanical specifications

Connection type

screw fixing

Core cross-section

 ≤ 2.5 mm²/AWG 12-24

Housing material

Polycarbonate

Housing width

216 mm

Housing height

100 mm

Housing depth

50 mm

Protection degree

IP20

Mass

800 g

Mounting

DIN rail mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 04 ATEX 2100 X

Group, category, type of protection, temperature class  II 2G EEx mb e IIC T4

Maximum values

Rated voltage ≤ 35 V

Prospective short-circuit current 100 A

Directive conformity

Directive 94/9/EC EN 50014:1997+A1+A2, EN 50019:2000, EN 60079-18:2004

International approvals

IECEx approval

IECEx PTB 05.0010X

Approved for Ex me II T4



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Connection of Ex d certified devices
- Glass fiber reinforced polyester, impact resistant, IP66
- Configurable cable entries for trunk and spurs
- International approvals
- Installation in Zone 1

Function

This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 1. Devices can be located in Zone 1. The number of outputs and size can be selected.

Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge.

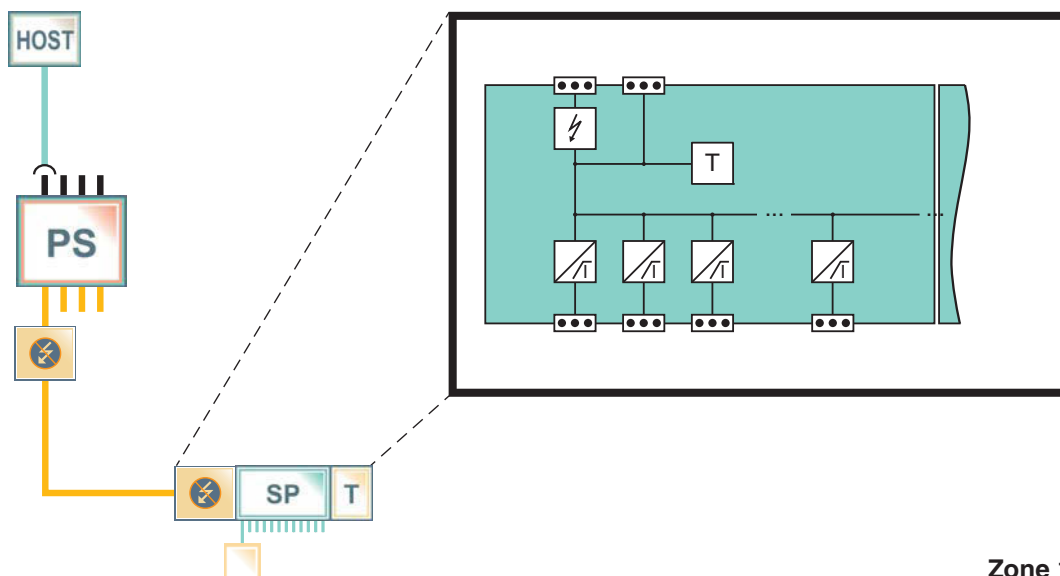
Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 1

Technical data

General specifications

Installed components	Segment Protector R-SP-E12 For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529
Impact resistance	EN 60079-0

Mechanical specifications

Enclosure cover	detachable cover with retaining screws
Protection degree	IP66
Cable entry	cable gland and stopping plug options
Material	
Housing	polyester, impact resistant, glass fiber reinforced
Surface	black molded finish (RAL 9005)
Surface resistance	$< 10^9 \Omega$
Water absorption	$< 6 \%$
Seal	silicon, one piece
Grounding plate	brass
Material thickness	grounding plate: 3 mm

Dimensions	(W x H x D) 271 x 271 x 136 mm (1 x R2-SP-E12) 544 x 271 x 136 mm (2 x R2-SP-E12)

Mounting	thru-holes Ø6.5 mm
Grounding	grounding bolt M6, Stainless steel

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	Ex II 2G Ex e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***00) Ex II 2G Ex d e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***T) Ex II 2G Ex d e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***3*)

Directive conformity

Directive 94/9/EC	EN 60079-0:2006, EN 600079-14:2003

International approvals

IECEx approval	IECEx PTB 07.0036, suitable Junction Box on request
INMETRO	2008EC02CP015, suitable Junction Box on request



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- Connection of Ex d certified devices
- Stainless steel, electropolished, IP66
- Configurable cable entries for trunk and spurs
- International approvals
- Installation in Zone 1

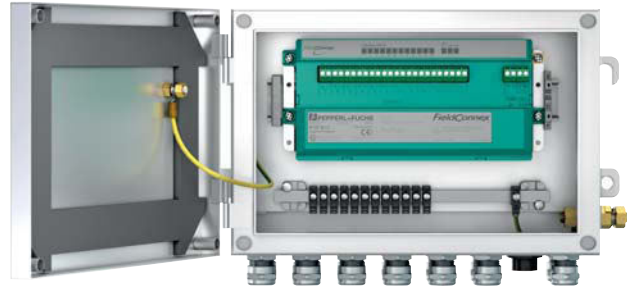
Function

This Segment Protector Junction Box is a device coupler with FieldConnex® Segment Protectors for Zone 1. Devices can be located in Zone 1. The number of outputs and size can be selected.

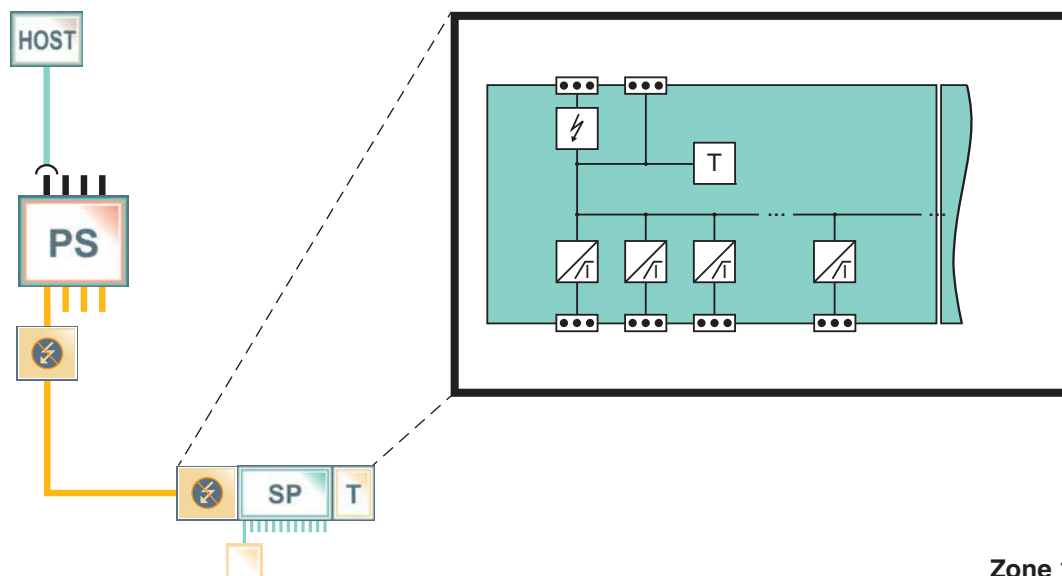
Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. Trunk and spur entries can be selected individually from a wide range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk are available as options.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 1

Technical data**General specifications**

Installed components	Segment Protector R-SP-E12 For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529
Impact resistance	EN 60079-0

Mechanical specifications

Enclosure cover	detachable hinged door with captive retaining screws
Protection degree	IP66
Cable entry	cable gland and stopping plug options
Material	
Housing	Stainless steel 1.4404/AISI 316L
Surface	electropolished
Seal	Neoprene, fire-resistant, one piece
Material thickness	enclosure body, enclosure cover, mounting plate: 1.5 mm gland plate: 3.0 mm
Dimensions	(W x H x D) 300 x 200 x 120 mm (1 x R-SP-E12) 480 x 400 x 175 mm (2 x R-SP-E12)
Mounting	thru-holes Ø10 mm
Grounding	grounding bolt M10, brass

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	Ex II 2G Ex e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***00) Ex II 2G Ex d e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***T) Ex II 2G Ex d e mb IIC T4 (F.SPE.S**.A**.1.0.***.***.***3*)
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-14:2003
International approvals	
IECEx approval	IECEx PTB 07.0036, suitable Junction Box on request
INMETRO	2008EC02CP015, suitable Junction Box on request



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4 outputs Ex ia IIC
- FieldBarrier in Zone 1/Div. 2
- Instruments in Zone 0...1/Div. 1
- Short-circuit protection per output
- Power, Com, and Error LEDs
- Supports FISCO and Entity
- Integrated cable tie-downs
- Supports all grounding methods

Function

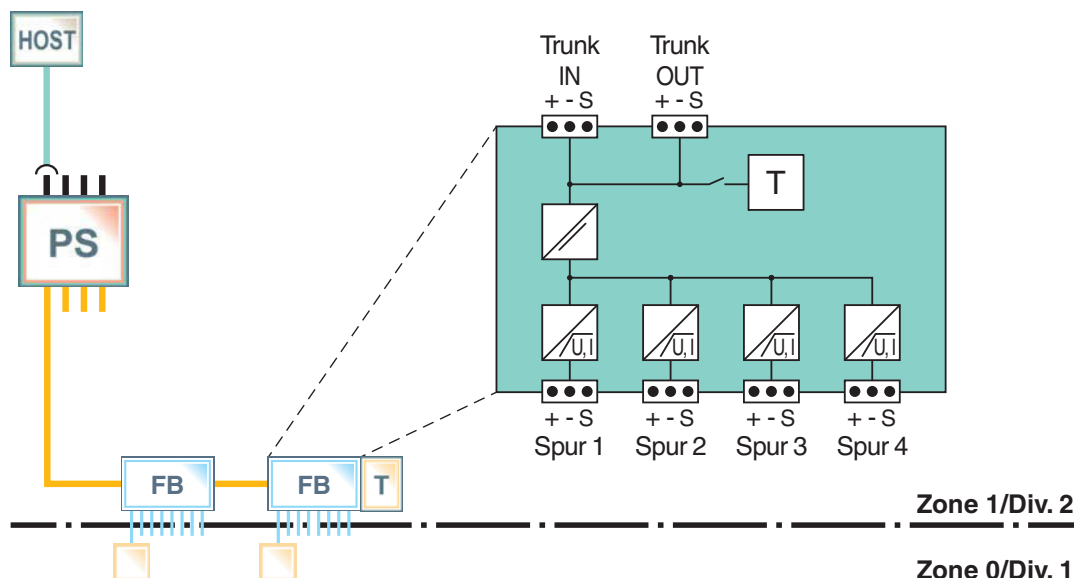
The FieldBarrier, a fieldbus coupler for DIN rail installation, connects four instruments with intrinsic safety (Ex ia/Ex ib) and short-circuit protection at each output. This ensures proper operation of the segment during faults or hot work at the spur.

High power on the trunk enables maximum cable lengths and device count in any hazardous area. The integrated fieldbus terminator features high-availability design and is selectable. Output terminals with a choice of fixed or spring clamp terminals connect one device each. LEDs simplify troubleshooting and help decrease repair time. Any grounding and shielding concept is possible based on FieldConnex enclosure solutions.

Assembly



Connection



Technical data

Fieldbus interface

Main cable (Trunk)

Connection	input (Trunk IN): terminals 3+, 4-, 5s output (Trunk OUT): terminals 7-, 8+, 6s
Rated voltage	32 ... 16 V DC
Rated current	31 mA ... 26 mA (without load) 77 mA ... 115 mA (at 20 mA load per input) 120 mA ... 209 mA (at 40 mA load per input) 135 mA ... 241 mA (short-circuit on all outputs)

Outputs

Rated voltage	10 ... 13 V
Rated current	≤ 43 mA
Short-circuit current	50 mA

Terminating impedance

100 Ω switchable

Electrical isolation

Main wire/outputs

isolation is not affected by interference according to EN 50020, voltage peak value 375 V

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC/EN 60529

Climatic conditions

DIN IEC 721

Corrosion resistance

acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type

fixed terminals, plug-in terminals

Core cross-section

up to 2.5 mm²

Housing material

Polycarbonate

Housing width

100 mm

Housing height

217 mm

Housing depth

74 mm

Protection degree

IP20

Mass

1050 g

Mounting

mounting on DIN rail in cabinet

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 02 ATEX 2086

Group, category, type of protection, temperature class

Ⓔ II 2(1G/D) G EEx me [ia] IIC T4

Main cable (Trunk)

Maximum safe voltage U_m

253 V AC

Outputs

in accordance to IEC 60079-27

Voltage U_o

15.75 V

Current I_o

248 mA

Power P_o

975 mW

Declaration of conformity

PF 08 CERT 0579 Valid for F2 housing solution without plug connectors

Group, category, type of protection, temperature class

Ⓔ II 3 D Ex tD A22 IP54 T135 °C (non-conductive dust)

Directive conformity

Directive 94/9/EC

EN 50014:1997+A1+A2, EN 61241-0:2007, EN 61241-1:2007, EN 50020:1994, EN 50019:2000, EN 50028:1987

International approvals

FM approval

CoC 3015728

Control drawing

No. 116-0226

Approved for

Class I, Division 2, Groups A, B, C, D/Class I, Zone 2, AEx nA [ia] IIC T4

CSA approval

CoC 1592754

Control drawing

116-0266

Approved for

Class I, Division 2, Groups A, B, C, D/Class I, Zone 2, Ex nA [ia] IIC T4

IECEx approval

IECEx PTB 03.0003

Approved for

Ex me [ia] IIC T4

Certificates and approvals

Marine approval

DNV A-10798



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4 outputs Ex ia IIC
- FieldBarrier in Zone 1/Div. 2
- Instruments in Zone 0...1/Div. 1
- Short-circuit protection per output
- Power, Com, and Error LEDs
- Supports FISCO and Entity
- Integrated cable tie-downs

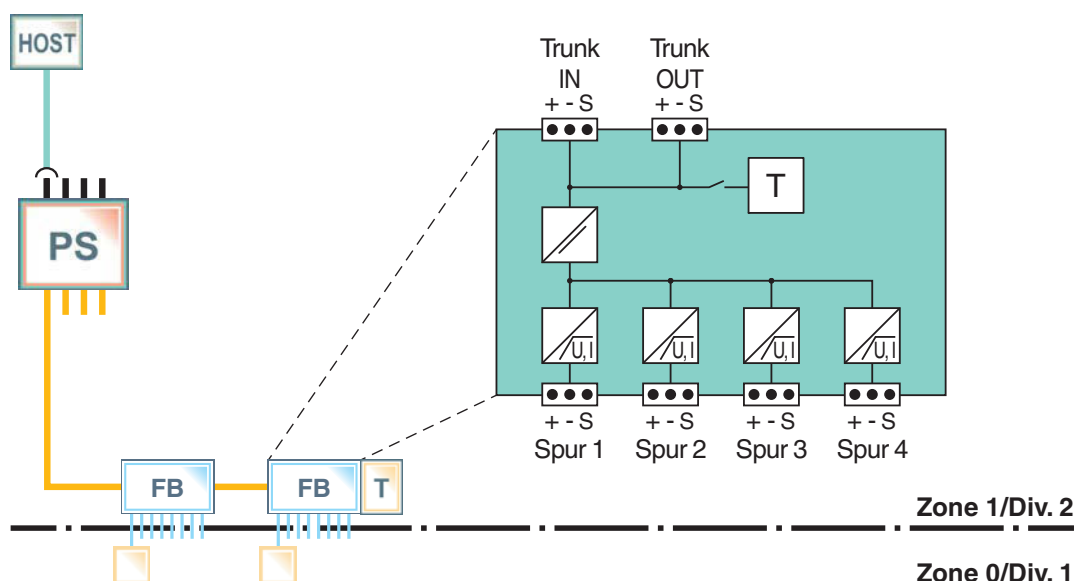
Function

The FieldBarrier, a fieldbus coupler in an aluminum housing, connects four instruments with intrinsic safety (Ex ia/Ex ib) and short-circuit protection at each output. This ensures proper operation of the segment during faults or hot work at the spur. The housing (Type F2) is made of sturdy cast aluminum for installation in rough environments. High power on the trunk enables maximum cable lengths and device count in any hazardous area. The integrated fieldbus terminator features high-availability design and is selectable. Output terminals with a choice of fixed or spring clamp terminals connect one device each. LEDs simplify troubleshooting and help decrease repair time. Hard and capacitive grounding and shielding concepts are selectable via jumper.

Assembly



Connection



Technical data

Fieldbus interface	
Main cable (Trunk)	
Conformity	
Protection degree	EN 60529
Mechanical specifications	
Enclosure cover	detachable cover with retaining screws
Protection degree	IP67
Cable entry	cable gland and stopping plug options
Material	
Housing	ALSI12 (Cu) DIN1725 (Si 1.2 %), anodized
Surface	painted green
Seal	silicon, one piece
Housing width	140 mm (cable glands plastic/nickel plated brass/stainless steel), 160 mm (cable glands nickel plated brass for armored cable), 135 mm (plug connection M12 nickel plated brass/stainless steel, plug connection 7/8" stainless steel)
Housing height	258 mm
Housing depth	84 mm
Mass	3350 g
Mounting	thru-holes Ø6.5 mm
Grounding	M5 threading for grounding bolt
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	PTB 02 ATEX 2086
Group, category, type of protection, temperature class	Ex II 2(1G/D) G EEx me [ia] IIC T4
Declaration of conformity	PF 08 CERT 0579 Valid for F2 housing solution without plug connectors
Group, category, type of protection, temperature class	Ex II 3 D Ex tD A22 IP54 T135 °C (non-conductive dust)
Directive conformity	
Directive 94/9/EC	EN 50014:1997+A1+A2, EN 61241-0:2007, EN 61241-1:2007, EN 50020:1994, EN 50019:2000, EN 50028:1987
International approvals	
FM approval	CoC 3015728
Control drawing	No. 116-0226
Approved for	Class I, Division 2, Groups A, B, C, D/Class I, Zone 2, AEx nA [ia] IIC T4
CSA approval	CoC 1592754
Control drawing	116-0266
Approved for	Class I, Division 2, Groups A, B, C, D/Class I, Zone 2, Ex nA [ia] IIC T4
IECEx approval	IECEx PTB 03.0003
Approved for	Ex me [ia] IIC T4
Certificates and approvals	
Marine approval	DNV A-10798



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4, 8 or 12 outputs Ex ia
- Impact resistance enclosure, IP66
- Configurable cable entries for trunk and spurs
- Packaged certified solution
- Installation in Zone 1

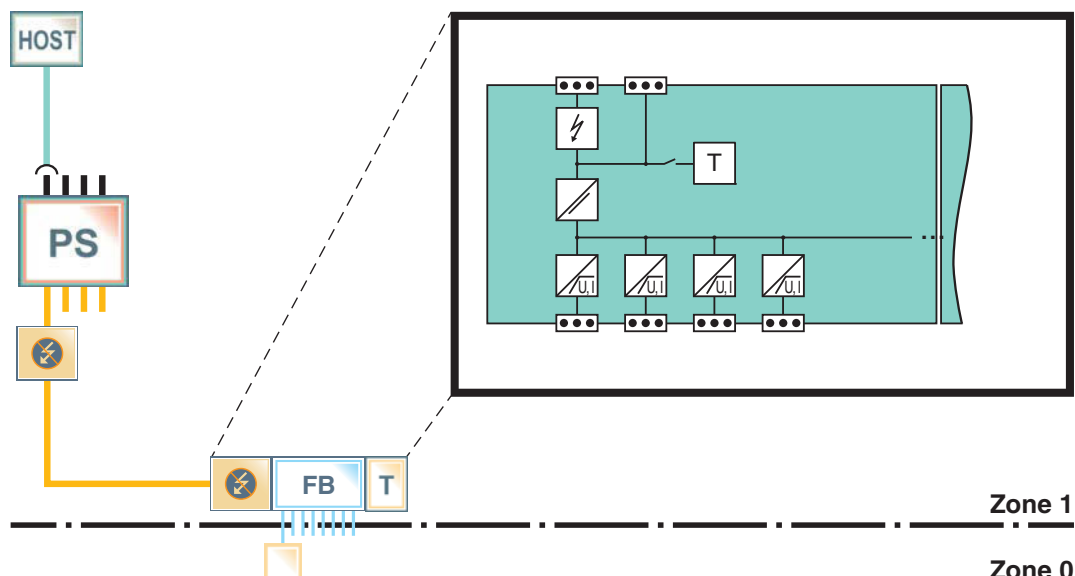
Function

This Junction Box is a device coupler with FieldConnex[®] FieldBarriers for Zone 1. Devices can be located in Zone 0. The number of outputs and size can be selected. Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge. Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options. This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Technical data**General specifications**

Installed components	FieldBarrier RD0-FB-Ex4.COM For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529
Impact resistance	EN 60079-0

Mechanical specifications

Enclosure cover	detachable cover with retaining screws
Protection degree	IP66
Cable entry	cable gland and stopping plug options
Material	
Housing	polyester, impact resistant, glass fiber reinforced
Surface	black molded finish (RAL 9005)
Surface resistance	< 10 ⁹ Ω
Water absorption	< 6 %
Seal	silicon, one piece
Grounding plate	brass
Material thickness	grounding plate: 3 mm

Dimensions	(W x H x D) 271 x 271 x 136 mm (1 x RD0-FB-Ex4.COM) 544 x 271 x 136 mm (2 x RD0-FB-Ex4.COM) 544 x 544 x 136 mm (3 x RD0-FB-Ex4.COM)

Mounting	thru-holes Ø6.5 mm
Grounding	grounding bolt M6, Stainless steel

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	Ex II 2(1)G Ex e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.***00) Ex II 2(1)G Ex d e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.***1) Ex II 2(1)G Ex d e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.***3*)

Directive conformity

Directive 94/9/EC	EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval	IECEx PTB 07.0036, suitable Junction Box on request
INMETRO	2008EC02CP015, suitable Junction Box on request



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4, 8 or 12 outputs Ex ia
- Electropolished enclosure, IP66
- Configurable cable entries for trunk and spurs
- Packaged certified solution
- Installation in Zone 1

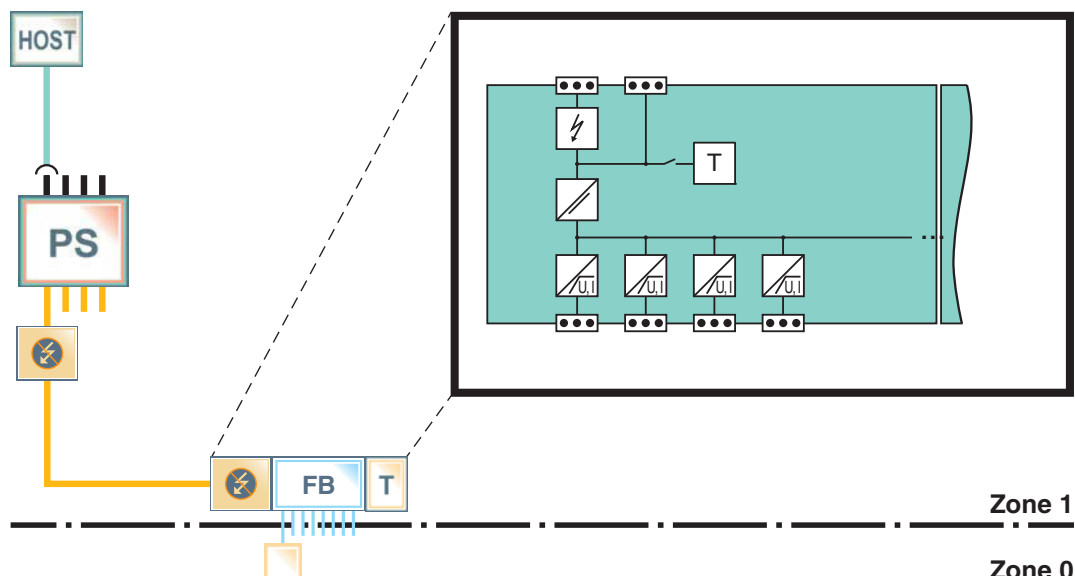
Function

This Junction Box is a device coupler with FieldConnex[®] FieldBarriers for Zone 1. Devices can be located in Zone 0. The number of outputs and size can be selected. Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. Trunk and spur entries can be selected individually from a range of cable glands and stopping plugs. A breather is included by default. Tag plate, grounding bar, surge protection for the trunk, and bus termination are available as options. This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Technical data**General specifications**

Installed components	FieldBarrier RD0-FB-Ex4.COM For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529
Impact resistance	EN 60079-0

Mechanical specifications

Enclosure cover	detachable hinged door with captive retaining screws
Protection degree	IP66
Cable entry	cable gland and stopping plug options
Material	
Housing	Stainless steel 1.4404/AISI 316L
Surface	electropolished
Seal	Neoprene, fire-resistant, one piece
Material thickness	enclosure body, enclosure cover, mounting plate: 1.5 mm gland plate: 3.0 mm

Dimensions	(W x H x D) 300 x 200 x 120 mm (1 x RD0-FB-Ex4.COM) 380 x 380 x 175 mm (2 x RD0-FB-Ex4.COM) 480 x 400 x 175 mm (3 x RD0-FB-Ex4.COM)

Mounting	thru-holes Ø10 mm
Grounding	grounding bolt M10, brass

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	Ex II 2(1)G Ex e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.***00) Ex II 2(1)G Ex d e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.***1) Ex II 2(1)G Ex d e mb [ia] IIC T4 (F.FB0.***.A**.1.0.***.***.***3*)

Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval	IECEx PTB 07.0036, suitable Junction Box on request
INMETRO	2008EC02CP015, suitable Junction Box on request



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 ... 8 outputs Ex ia, ib
- Installation in Zone 0/Div. 1
- Instruments in Zone 0...1/Div. 1
- Trunk and spurs intrinsically safe
- Supports FISCO and Entity

Function

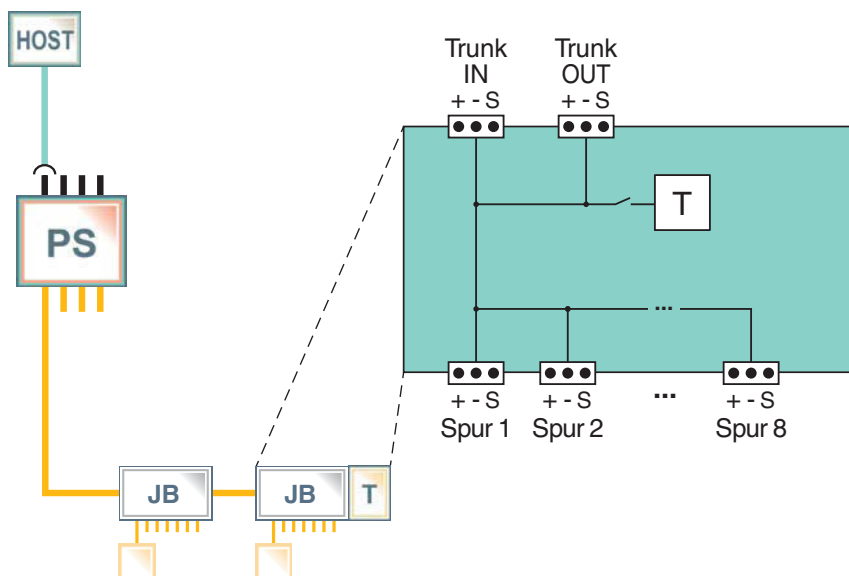
The Fieldbus Junction Box is a passive device coupler that connects instruments to intrinsically safe segments. The housing (Type F2) is made of sturdy aluminum for installation in rough environments Zone 1/Div. 2.

As an associated apparatus, the junction box is permitted for trunk and spur connections that are rated intrinsically safe (Ex ia, Ex ib) for instruments located in Zone 0 ... 1/Div. 2. A choice of fixed screw terminals or plug-in spring clamp connectors is available. Hard and capacitive grounding concepts are selectable via jumper.

Assembly



Connection



Technical data

Fieldbus interface

Main cable (Trunk)

Connection input (Trunk IN): terminals 1+, 2-, 3s
output (Trunk OUT): terminals 4+, 5-, 6s

Rated voltage ≤ 35 V DC

Rated current 3 A DC at 70 °C, reduction 0.1A/K

Outputs

Rated voltage see main cable

Rated current see main cable

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NAMUR NE 21

Protection degree

IEC/EN 60529

Climatic conditions

DIN IEC 721

Mechanical specifications

Connection type

Terminals

Core cross-section

up to 2.5 mm²

Housing

258 mm x 114 mm x 84 mm (without cable glands)

Protection degree

IP67

Mass

1800 g

Mounting

panel mounting



PROFIBUS PA

Selection
Guideline

Advanced
Diagnostics

Segment
Coupler

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories





Features

- 4 ... 8 outputs Ex ia, ib
- Installation in Zone 0/Div. 1
- Instruments in Zone 0...1/Div. 1
- Trunk and spurs intrinsically safe
- Supports FISCO and Entity

Function

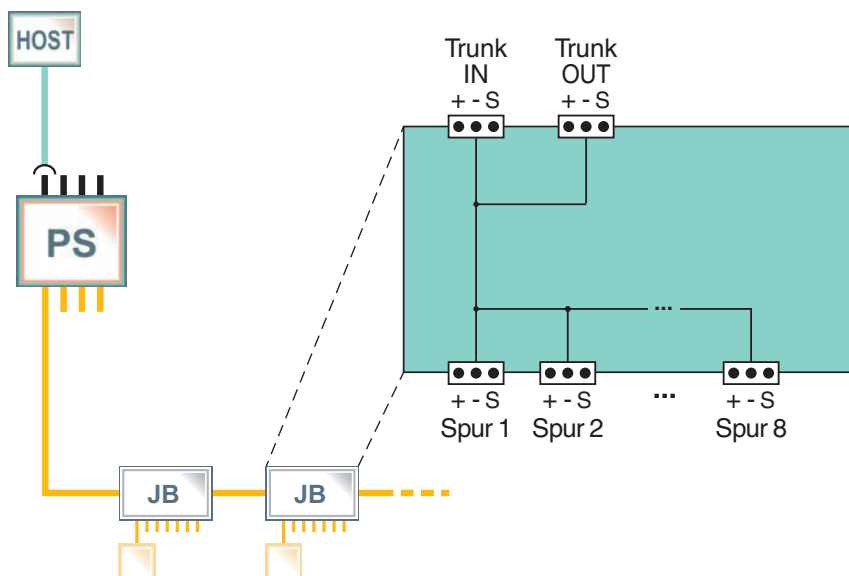
The Fieldbus Junction Box is a passive device coupler that connects instruments to intrinsically safe segments. The housing (Type F2) is made of sturdy aluminum for installation in rough environments Zone 1/Div. 2.

As an associated apparatus, the junction box is permitted for trunk and spur connections that are rated intrinsically safe (Ex ia, Ex ib) for instruments located in Zone 0 ... 1/Div. 2. A choice of fixed screw terminals or plug-in spring clamp connectors is available. Hard and capacitive grounding concepts are selectable via jumper.

Assembly



Connection



Zone 0

Technical data

Fieldbus interface

Main cable (Trunk)

Connection input (Trunk IN): terminals 1+, 2-, 3s
output (Trunk OUT): terminals 4+, 5-, 6s

Rated voltage ≤ 35 V DC

Rated current 3 A DC

Outputs

Rated voltage see main cable

Rated current see main cable

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NAMUR NE 21, EN 61326

Protection degree

IEC/EN 60529

Climatic conditions

DIN IEC 721

Mechanical specifications

Connection type

Main cable (Trunk)

Terminals

Core cross-section

up to 2.5 mm²

Cable diameter

Main cable (Trunk) 5 ... 10 mm

Housing

258 mm x 114 mm x 84 mm (without cable glands)

Protection degree

IP67

Mass

1800 g

Mounting

panel mounting

Data for application in connection with Ex-areas

Main cable (Trunk)

only for connection to intrinsically safe fieldbus circuits

Maximum values

Voltage $U_i \leq 35$ V

Current $I_i \leq 3$ A

Directive conformity

standards

Directive 94/9/EC EN 50014, EN 50020, EN 50284



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 2 segments, simplex, individual modules per segment
- Output: 22 ... 24 V/360 mA, Ex ib IIC
- DART for intrinsically safe, high-power segments
- Connection to PROFIBUS DP
- Transparent, configuration free
- Optimized for size and quality, low heat dissipation
- Passive impedance for high reliability

Function

The FieldConnex® DART PROFIBUS Compact Power Hub is a modular fieldbus power supply. It consists of one motherboard, which is the mounting plate and wiring interface, two power modules - one per segment, and a gateway module for connection to PROFIBUS DP.

DART (Dynamic Arc Recognition and Termination) enables the intrinsically safe High-Power Trunk Concept for a completely intrinsically safe segment certified acc. to IEC 60079-11.

This Power Hub kit is ready to install. Sockets for all modules enable simple installation and replacement without tools. Three-port isolation between segment, bulk power and host enhances system reliability.

Communication is transparent between DP and PA: The gateway segment coupler makes each PA device appear as if it was connected to DP. This includes cyclic/acyclic data exchange and transmission speed. Segment design is clear and easy to understand without sub-networks; the gateway module itself is configuration free - all reducing engineering work.

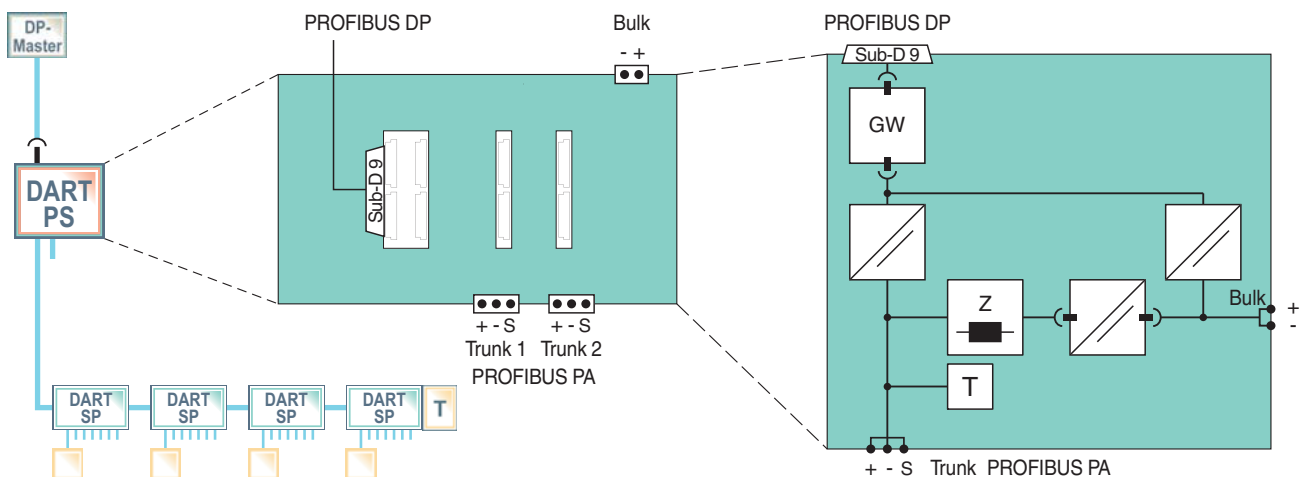
Availability and a long service life is achieved through: only one passive impedance filter per segment, optimized design for low power dissipation, high-availability fieldbus termination and plug-in connectors with retaining screws.

Assembly



DART
FIELDBUS

Connection



Technical data

Supply	
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	1330 ... 745 mA
Fieldbus interface	
Number of segments	
Simplex	2
Rated voltage	20.8 ... 22.3 V
Rated current	360 ... 10 mA
Short-circuit current	413 mA
PROFIBUS DP	
Connection	9-pin Sub-D socket
Protocol	PROFIBUS DP/DP V1
Terminating resistor	100 Ω, integrated
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Low voltage	
Directive 73/23/EEC	EN 50178 (identical to EN 62103)
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ambient conditions	
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Mechanical specifications	
Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	PTB 10 ATEX 2034, PTB 10 ATEX 2020 X, PTB 11 ATEX 2010 X
Group, category, type of protection, temperature class	Ⓔ II 2 G Ex ib IIC T4, Ⓔ II (2) D [Ex ib] IIIC, Ⓔ II 3(2) G Ex nAc [ib] IIC T4
Supply	
Maximum safe voltage U _m	35 V
Directive conformity	
Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2007, EN 60079-15:2006, EN 60079-25:2010, EN 61241-11:2006
International approvals	
IECEX approval	pending
Approved for	[Ex ib] IIC [Ex ib] IIIC Ex nAc II T4
Certificates and approvals	
Marine approval	pending

Power module

HD2-FBPS-IBD-1.24.360			
Power Output			
Voltage (V)		20.8 ... 22.3	
Current (mA)		360	
Device in ...	Type of Protection	Required Installation Components	
Zone 1	Intrinsically safe Ex ib	■	Segment Protector R3-SP-IBD12



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- 4 segments, load-sharing redundancy
- Output: 22 ... 24 V/360 mA, Ex ib IIC
- DART for intrinsically safe, high-power segments
- Redundant connection to PROFIBUS DP
- Customizable for any host system
- Individual modules per segment
- Optimized for size and quality, low heat dissipation
- Passive impedance for high reliability
- Installation in Zone 2

Function

The FieldConnex® DART High-density Power Hub is a modular fieldbus power supply for four segments. It supports optional Advanced Diagnostics for fast fieldbus commissioning and online monitoring. The kit comprises one motherboard and eight power supply modules (2 modules per segment).

DART (Dynamic Arc Recognition and Termination) enables the intrinsically safe High-Power Trunk Concept for a completely intrinsically safe segment certified acc. to IEC 60079-11.

A Sub-D 25-pin connector with fieldbus power hooks up to the Segment Coupler for direct PROFIBUS DP connection.

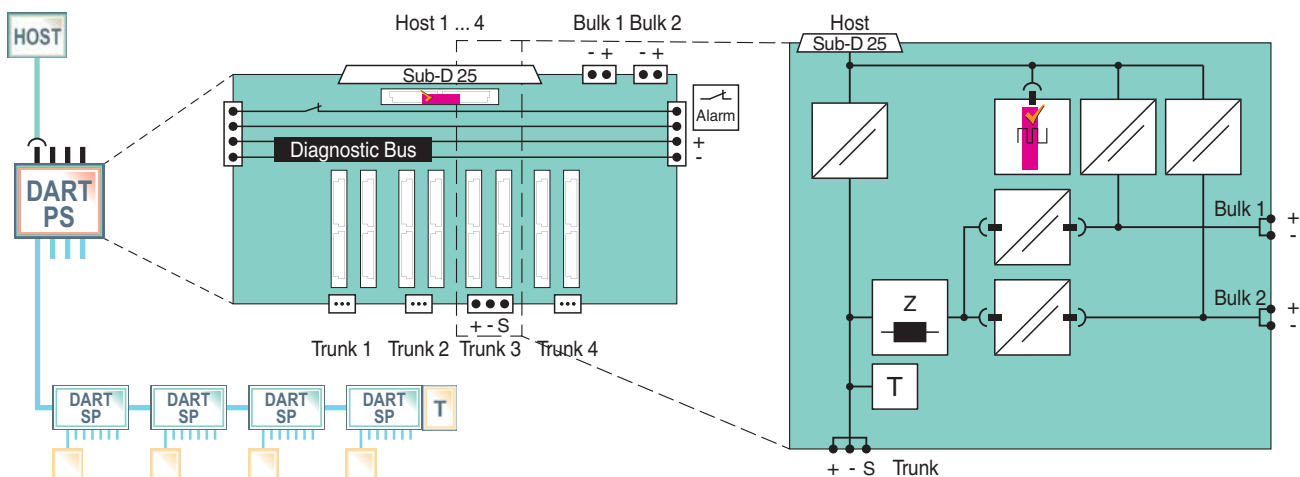
Through designed custom cables this power hub is easily adaptable to any FF-control system. Sockets for all modules enable simple installation and replacement without tools.

Power redundancy is load-sharing with either module supplying half of load current. Three-port isolation between segment, bulk power and host enhances system reliability. Availability and a long service life is achieved through: only one passive impedance filter per segment, optimized design for low power dissipation, high-availability fieldbus termination and plug-in connectors with retaining screws.

Assembly



Connection



Technical data

Supply	
Connection	redundant
Rated voltage	19.2 ... 35 V SELV/PELV
Rated current	3230 ... 1820 mA
Fieldbus interface	
Number of segments	
Redundant	4
Rated voltage	20.8 ... 22.3 V
Rated current	360 ... 10 mA
Short-circuit current	413 mA
Host-side	25-pin Sub-D socket
Host-rated voltage	10.1 ... 11 V
Host-rated current	... 40 mA
Host short-circuit current	... 50 mA
Terminating resistor	100 Ω, integrated
Indicators/operating means	
Fault signal	VFC alarm output via connectors
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ambient conditions	
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Mechanical specifications	
Connection type	plug with screw flange
Core cross-section	2.5 mm ²
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	PTB 10 ATEX 2034, PTB 10 ATEX 2020 X, PTB 11 ATEX 2010 X
Group, category, type of protection, temperature class	Ⓔ II 2 G Ex ib IIC T4, Ⓔ II (2) D [Ex ib] IIIC, Ⓔ II 3(2) G Ex nAc [ib] IIC T4
Supply	
Maximum safe voltage U _m	35 V
Host interface	
Maximum safe voltage U _m	35 V
Alarm output	
Maximum safe voltage U _m	35 V
Directive conformity	
Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2007, EN 60079-15:2006, EN 60079-25:2010, EN 61241-11:2006
International approvals	
IECEx approval	pending
Approved for	[Ex ib] IIC [Ex ib] IIIC Ex nAc II T4
Certificates and approvals	
Marine approval	pending

Power module

HD2-FBPS-IBD-1.24.360			
Power Output			
Voltage (V)		20.8 ... 22.3	
Current (mA)		360	
Device in ...	Type of Protection	Required Installation Components	
Zone 1	Intrinsically safe Ex ib	■	Segment Protector R3-SP-IBD12



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 12 outputs Ex ib IIC
- Segment Protector in Zone 1
- Instruments in Zone 1
- Short-circuit protection per output
- Power, Com, and Error LEDs
- T-connector for easy installation and maintenance
- Test points for easy troubleshooting

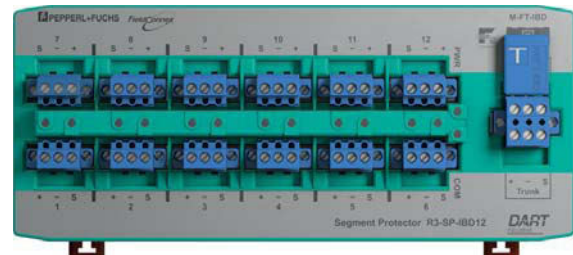
Function

The DART Segment Protector, a fieldbus coupler for DIN-rail installation, provides outputs for up to 12 intrinsically safe instruments (Ex ib IIC) to an intrinsically safe High-Power Trunk. It is equipped with short-circuit protection. This ensures proper operation of the segment during faults or hot work at the spur.

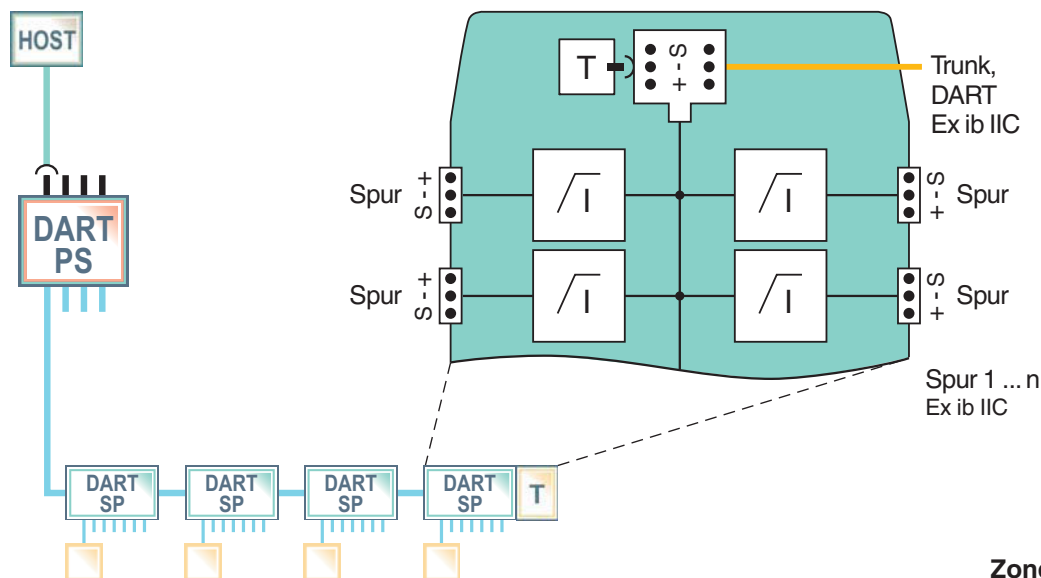
The T-connector at the trunk allows for exchange of a Segment Protector without effect on the remaining segment. The high-availability terminator is mounted at the 'T'. As it is removed for network extensions proper termination is always ensured.

All plugs feature retaining screws. LEDs and test access points simplify troubleshooting and help to decrease repair time. Any grounding and shielding concept is possible based on FieldConnex enclosure solutions.

Assembly



Connection



Zone 1

Technical data

Fieldbus interface

Main cable (Trunk)

Rated voltage 14.5 ... 24 V DC

Rated current ≤ 4.5 A

Outputs

Number of outputs 12

Number of devices per output 1

Rated voltage ≥ 10.5 V, ≤ 24 VRated current ≤ 34 mA

Short-circuit current max. 47 mA

Self current consumption typical 20 mA, ≤ 25 mAVoltage drop main cable/outputs ≤ 4 V

Voltage drop trunk In/Out 0 V

Terminating resistor external type M-FT-IBD 100 Ω +/- 10 %

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility NE 21:2006

Protection degree IEC 60529

Shock resistance EN 60068-2-27

Vibration resistance EN 60068-2-6

Ambient conditions

Corrosion resistance acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Connection type removable screw terminals with retaining screws

Core cross-section ≤ 2.5 mm²/AWG 12-24

Data for application in connection with Ex-areas

EC-Type Examination Certificate PTB 10 ATEX 2034, PTB 10 ATEX 2018X

Group, category, type of protection, temperature class Ex II 2G Ex ib IIC T4, Ex II (2)D [Ex ib] IIIC

Main cable (Trunk) for connection to the DART Fieldbus System acc. to System Certificate PTB 10 ATEX 2034

Outputs Entity

Voltage U_o 23 VCurrent I_o 47 mAPower P_o 1.08 WInductance L_o gas group IIC 170 μ H
gas group IIB 1 mHCapacitance C_o gas group IIC 60 nF
gas group IIB 470 nF

Directive conformity

Directive 94/9/EC EN 60079-0:2009, EN 60079-11:2007, EN 61241-11:2006

International approvals

IECEx approval pending

Approved for Ex ib IIC T4
[Ex ib] IIIC

Certificates and approvals

Marine approval pending



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

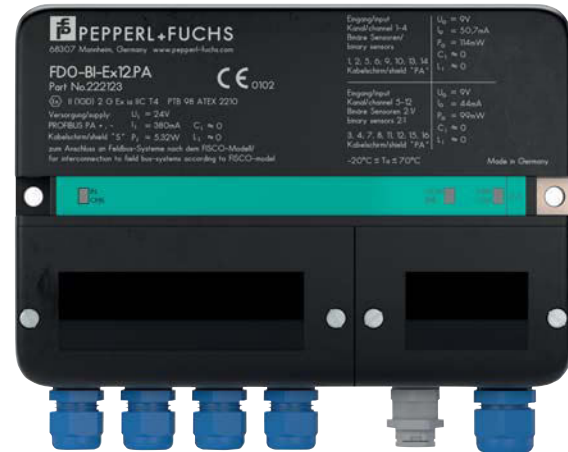
- For 12 intrinsically safe binary inputs
- Installation in Zone 1 and Zone 2
- Sensors in Zone 0
- Connection to fieldbus acc. to FISCO or Entity
- Galvanic separation between bus and sensors
- EMC acc. to NAMUR NE 21

Function

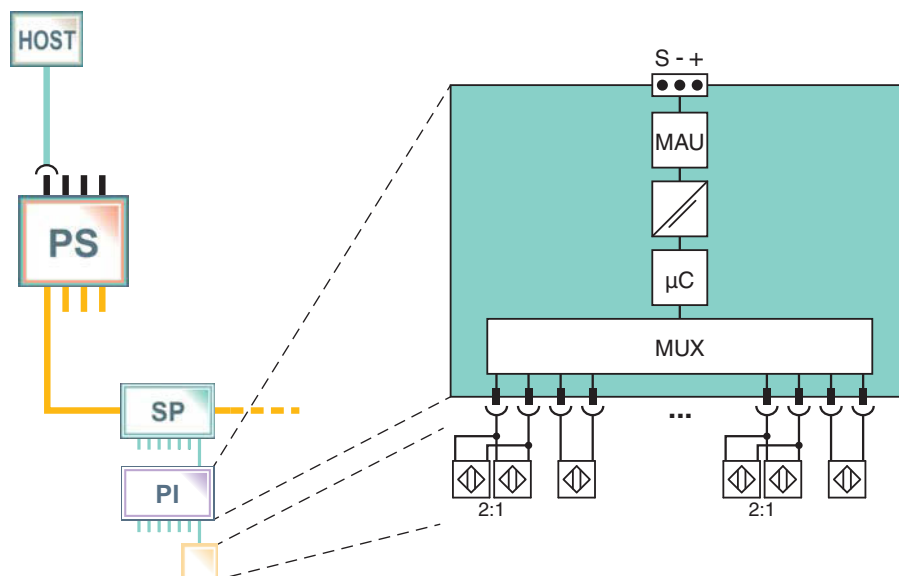
The binary input (BI) for outside installation connects up to twelve digital inputs to the DCS via fieldbus. It is installed close to the sensors in the hazardous area. Inputs include intrinsically safe NAMUR sensors or mechanical contacts. The BI communicates all data, configuration, and alarms via one fieldbus address to the DCS. System integration is possible through GSD files. Fieldbus powers the sensors and the binary interface itself, additional power or wiring is not required.

Four inputs are connected directly, eight inputs are connected via 2:1 technology. See the list with compatible sensors online. The binary input monitors the sensors for proper function.

Assembly



Connection



Zone 1

Technical data

Fieldbus interface

PROFIBUS PA

Connection	Connection +, -
Rated voltage	9 ... 32 V
Rated current	≤ 23 mA
Baud rate	31.25 kBit/s
Protocol	PROFIBUS DP V1

Field circuit

Inputs

Sensor supply voltage	4, for binary sensors: 5.5 V 8, for binary sensors: 5 V
Sensor supply current	4, for binary sensors: 4.5 mA 8, for binary sensors: ≤ 5 mA
Max. cycle time	for binary 4 sensors, 4 x 1 s = 4 s for 8 binary sensors, 8 x 12.5 ms = 100 ms

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electrical isolation	EN 60079-11
Electromagnetic compatibility	NE 21:2006
Protection degree	IEC/EN 60529

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Core cross-section	Bus cable: Ø 5 mm ... 10 mm cable sensors: Ø 4 mm ... 8 mm
Housing	187 mm x 129 mm x 46 mm
Protection degree	IP65
Installation position	Cable glands downwards
Mass	approx. 290 g
Mounting	panel mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 98 ATEX 2210
Group, category, type of protection, temperature class	Ex II 2G (1) Ex ia [ia Ga] IIC T4 Gb, Ex II (1D) [Ex ia Da] IIIC, Ex II 3G Ex ic IIC T4 Gc, Ex II (3D) [Ex ic Dc] IIIC

Field-side

Voltage	U _o	9 V
Current	I _o	44 mA
Power	P _o	99 mW

PROFIBUS PA

Voltage U _i	24 V
Current I _i	380 mA
Power P _i	5.32 W
Rated voltage	9 ... 32 V
Rated current	23 mA
FDE (Fault Disconnect Equipment)	6.7 mA

Directive conformity

Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2012

International approvals

IECEx approval	IECEx TUN 04.0002
Approved for	Ex ia [ia Ga] IIC T4 Gb, [Ex ia Da] IIIC, Ex ic IIC T4 Gc, [Ex ic Dc] IIIC



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- For four intrinsically safe valves with position sensors
- Installation in Zone 1 and Zone 2
- Valves in Zone 0
- Connection to fieldbus acc. to FISCO or Entity
- DCS integration with FDT/DTM technology
- Monitors lead breakage and short circuits
- Valve monitoring and diagnostics integrated
- Conducts partial stroke testing
- Conforms to PROFIBUS PA profile

Function

The valve coupler (VC) for PROFIBUS PA connects up to four intrinsically safe low-power valves to the DCS via fieldbus. It is installed pre-wired in a field enclosure or directly outside close to the valves in the hazardous area. The VC drives four low-power auxiliary valves and gathers positioning information via pairs of inductive proximity switches.

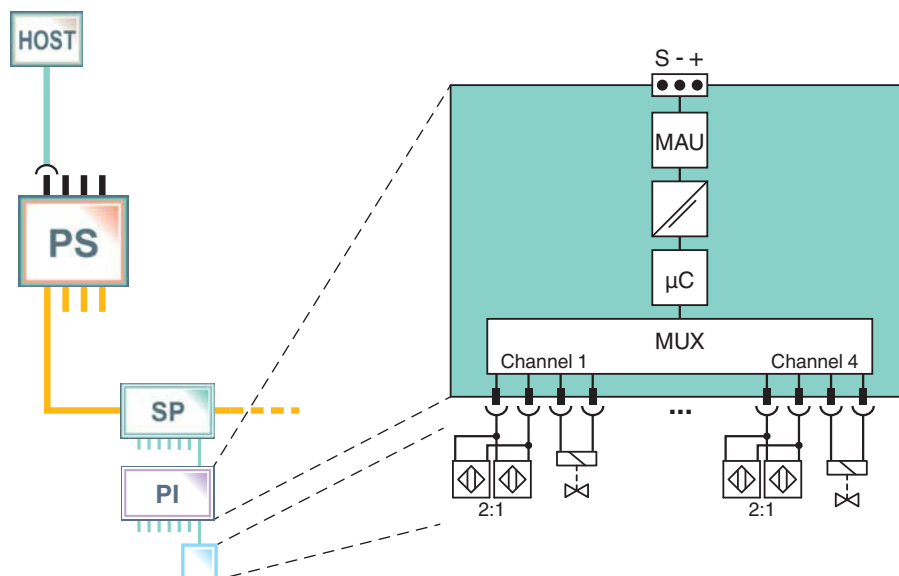
The VC communicates all data, configuration, and alarms via one fieldbus address to the DCS. It supports DCS integration through GSD file and FDT/DTM technology. Fieldbus powers the actors, sensors and the valve coupler itself, additional power or wiring is not required.

The VC supports the PROFIBUS PA profile for easy integration with summary diagnostics according to NAMUR recommendations. It detects lead breakage and short circuit conditions. It monitors and reports runtime and breakaway time during each operation and can conduct partial stroke tests.

Assembly



Connection



Zone 1

Technical data

Fieldbus interface

PROFIBUS PA

Connection	Connection +, -
Rated voltage	9 ... 32 V
Rated current	≤ 23 mA
Baud rate	31.25 kBit/s
Protocol	IEC 61158-2

Field circuit

Inputs

Sensor supply voltage	5 V
Sensor supply current	5 mA
Max. cycle time	≤ 160 ms

Outputs

Output voltage	6.4 ... 7.9 V
Output rated operating current	1.5 mA
Holding current	1 mA

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electrical isolation	EN 60079-11

Electromagnetic compatibility

Protection degree	NE 21:2006

Ambient conditions

Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3

Mechanical specifications

Core cross-section	Bus cable: Ø 5 mm ... 10 mm Cable sensors/valve: Ø 4 mm ... 8 mm

Housing	187 mm x 129 mm x 46 mm

Protection degree	IP65

Installation position	Cable glands downwards

Mass	approx. 290 g

Mounting	panel mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 98 ATEX 2210

Group, category, type of protection, temperature class	Ex II 2G (1) Ex ia [ia Ga] IIC T4 Gb, Ex II (1D) [Ex ia Da] IIIC, Ex II 3G Ex ic IIC T4 Gc, Ex II (3D) [Ex ic Dc] IIIC

PROFIBUS PA

Voltage U_i	24 V
Current I_i	380 mA
Power P_i	5.32 W
Rated voltage	9 ... 32 V
Rated current	23 mA
FDE (Fault Disconnect Equipment)	6.7 mA

Directive conformity

Directive 94/9/EC	EN 60079-0:2009, EN 60079-11:2012

International approvals

IECEx approval	IECEx TUN 04.0002

Approved for	Ex ia [ia Ga] IIC T4 Gb, [Ex ia Da] IIIC, Ex ic IIC T4 Gc, [Ex ic Dc] IIIC



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 valve control and 8 position feedback signals
- Glass fiber reinforced polyester, impact resistant, IP66
- Configurable cable entries for bus lines and field signal lines
- International approvals
- Installation in Zone 1

Function

This Fieldbus Junction Box holds valve couplers for connection to low-power solenoid valves. The fieldbus junction box can be installed in Zone 1, sensors in Zone 0. Four valves including two end position sensors can be connected.

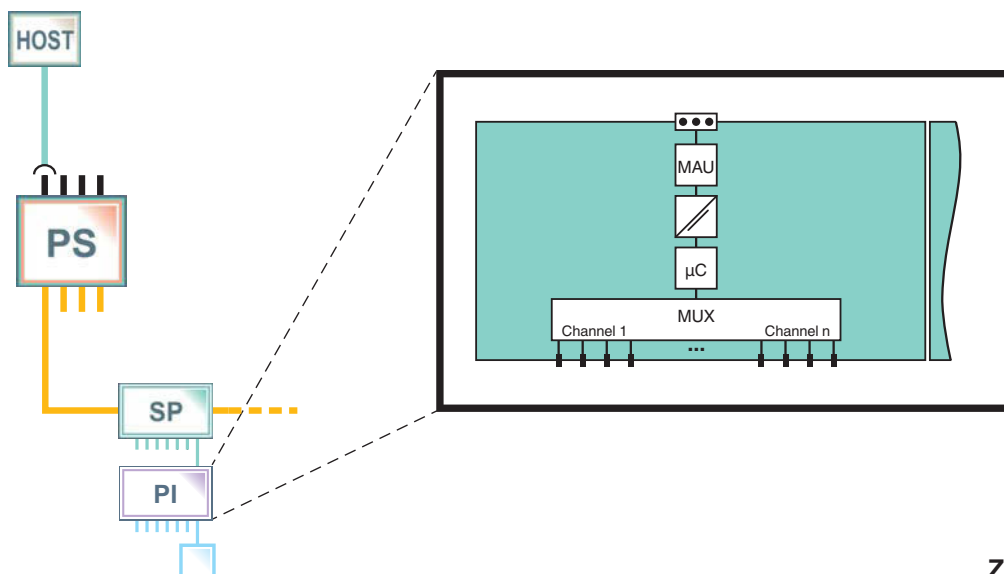
Glass fiber reinforced polyester provides corrosion resistance and is light weight. The surface resistance avoids electrostatic charge.

Bus and field signal line entries can be chosen individually from a range of cable glands and stopping plugs. A breather is included by default. A tag plate is available as option. This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 1

Technical data**General specifications**

Installed components	Valve Coupler FD0-VC-Ex4.** For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529
Impact resistance	EN 60079-0

Mechanical specifications

Enclosure cover	detachable cover with retaining screws
Protection degree	IP66
Material	
Housing	polyester, impact resistant, glass fiber reinforced
Surface	black molded finish (RAL 9005)
Surface resistance	< 10 ⁹ Ω
Water absorption	< 6 %
Seal	silicon, one piece
Grounding plate	brass
Material thickness	grounding plate: 3 mm
Dimensions	(W x H x D) 271 x 544 x 136 mm (1 x FD0-VC-Ex4.**)
Mounting	thru-holes Ø6.5 mm
Grounding	grounding bolt M6, Stainless steel

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	Ex II 2(1)G Ex ia IIC T4
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval	IECEx PTB 07.0036, suitable Junction Box on request
INMETRO	2008EC02CP015, suitable Junction Box on request



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- 4 valve control and 8 position feedback signals
- Stainless steel, electropolished, IP66
- Configurable cable entries for bus lines and field signal lines
- International approvals
- Installation in Zone 1

Function

This Fieldbus Junction Box holds valve couplers for connection to low-power solenoid valves. The fieldbus junction box can be installed in Zone 1, sensors in Zone 0. Four valves including two end position sensors can be connected.

Electropolished stainless steel 316L provides high corrosion and impact resistance at a very wide temperature range. The integrated rain channel prevents standing water from damaging the one-piece seal.

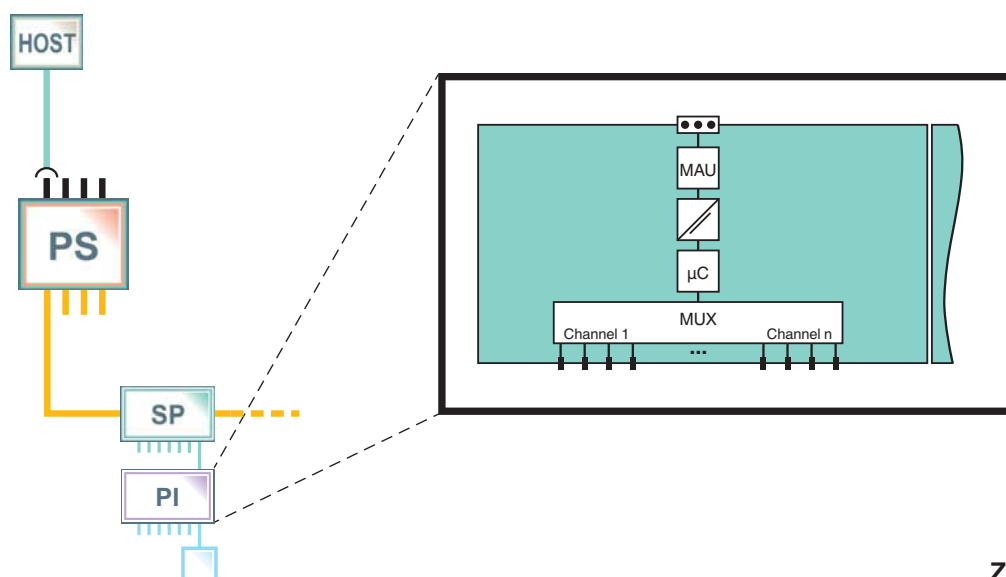
Bus and field signal line entries can be chosen individually from a range of cable glands and stopping plugs. A breather is included by default. A tag plate is available as option.

This junction box is available pre-wired, with all accessories, for fast ordering, delivery, site installation, and commissioning.

Assembly



Connection



Zone 1

Technical data**General specifications**

Installed components	Valve Coupler FD0-VC-Ex4.** For technical data on installed electronic component see data sheet.

Conformity

Protection degree	EN 60529
Impact resistance	EN 60079-0

Mechanical specifications

Enclosure cover	detachable hinged door with captive retaining screws
Protection degree	IP66
Material	
Housing	Stainless steel 1.4404/AISI 316L
Surface	electropolished
Seal	Neoprene, fire-resistant, one piece
Material thickness	enclosure body, enclosure cover, mounting plate: 1.5 mm gland plate: 3.0 mm

Dimensions	(W x H x D) 380 x 380 x 175 mm (1 x FD0-VC-Ex4.**)

Mounting	thru-holes Ø10 mm
Grounding	grounding bolt M10, brass

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 07 ATEX 1061 (assembled Junction Box), for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	Ex II 2(1)G Ex ia IIC T4

Directive conformity

Directive 94/9/EC	EN 60079-0:2006, EN 60079-14:2003

International approvals

IECEx approval	IECEx PTB 07.0036, suitable Junction Box on request
INMETRO	2008EC02CP015, suitable Junction Box on request



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Terminator in stainless steel housing
- Flameproof enclosure (Ex d) protection
- Installation on open cable gland
- Choice of threads 20 mm, Pg 13.5 mm or 1/2" NPT

Function

F*-FT-Ex1.D.IEC are terminators for fieldbus and provide capacitance and resistance to terminate a fieldbus segment according to IEC 61158-2. Explosion protection is flameproof 'Ex d' for installation in Zone 1...2. A solid metal housing enables installation in rough environments. Housings are selectable with 20 mm ISO, PG 13.5 mm or 1/2" NPT connecting threads for easy installation on outdoor junction boxes or field instruments.

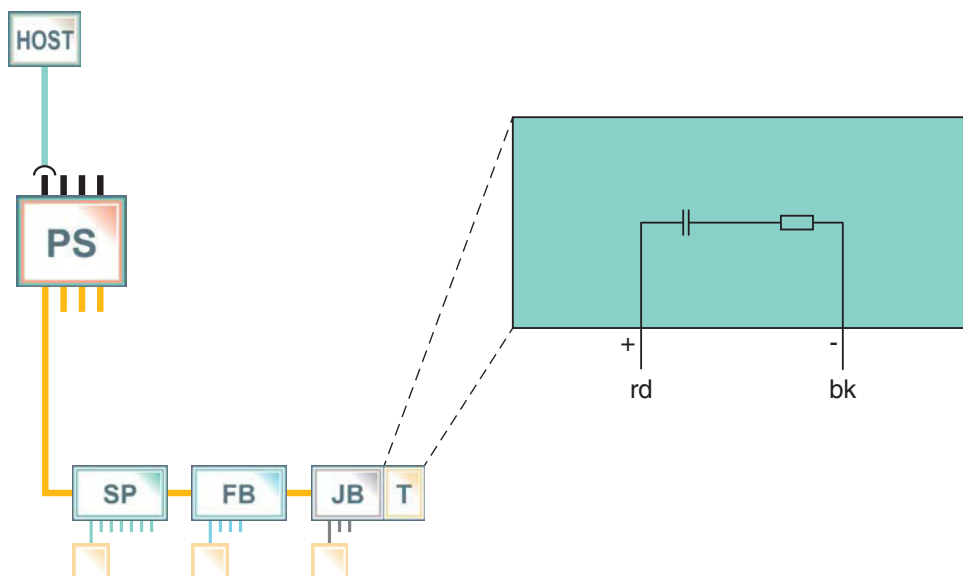
For increased availability the terminator features four capacitors in a network. If one capacitor should fail the basic functionality remains intact. This is detectable with the FieldConnex[®] Advanced Diagnostic Module allowing timely maintenance.

Fieldbus terminators are required at each end of the trunk line. They eliminate signal reflections at the end of the cable and convert the fieldbus signal transmitted as a current into a voltage, which is detectable by all devices.

Assembly



Connection



Zone 1

Technical data**Directive conformity**

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC/EN 60529

Ambient conditions

Ambient temperature

-50 ... 85 °C (-58 ... 185 °F)

Storage temperature

-50 ... 85 °C (-58 ... 185 °F)

Mechanical specifications

Core cross-section

0.75 mm²

Housing

77 mm x 22 mm

Protection degree

IP67

Mass

100 g

Mounting

20 mm ISO thread
PG13.5 thread
1/2 NPT thread**Data for application in connection with Ex-areas**

EC-Type Examination Certificate

DMT 01 ATEX 104 X

Group, category, type of protection, temperature class

Ⓔ II 2G EEx d IIC T6

Temperature class

T6 for ambient temperature ≤ 60 °C
T5 for ambient temperature ≤ 75 °C
T4 for ambient temperature ≤ 85 °C

Maximum values

Rated voltage

< 253 V AC/125 V DC

Operating values

Rated voltage

≤ 32 V

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-1:2007, EN 60079-26:2007

International approvals

IECEx approval

IECEx BVS 10.0022X

Approved for

Ex d IIC T6 Gb



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Terminator in stainless steel housing
- Intrinsically safe, FISCO or Entity
- Installation on open cable gland
- Choice of threads 20 mm, Pg 13.5 mm or 1/2" NPT

Function

F*-FT-Ex1.I.IEC are terminators and provide capacitance and resistance to terminate a fieldbus segment according to IEC 61158-2. Explosion protection is intrinsically safe 'Ex ia' for installation in Zone 0...2. A solid metal housing enables installation in rough environments. Housings are selectable with 20 mm ISO, PG 13.5 mm or 1/2" NPT connecting threads for easy installation on outdoor junction boxes or field instruments.

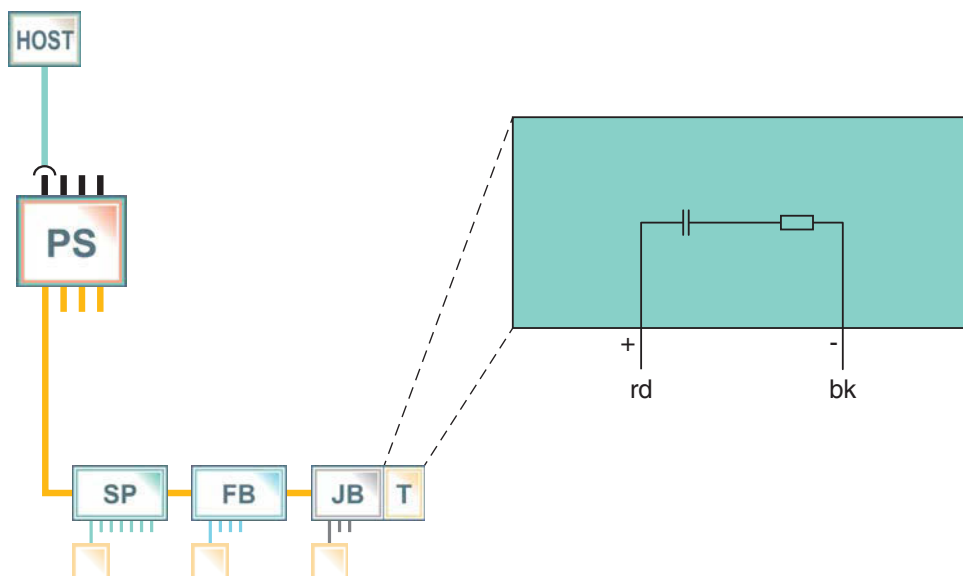
For increased availability the terminator features four capacitors in a network. If one capacitor should fail the basic functionality remains intact. This is detectable with the FieldConnex[®] Advanced Diagnostic Module allowing timely maintenance.

Fieldbus terminators are required at each end of the trunk line. They eliminate signal reflections at the end of the cable and convert the fieldbus signal transmitted as a current into a voltage, which is detectable by all devices.

Assembly



Connection



Zone 0

Technical data**Directive conformity**

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC/EN 60529

Ambient conditions

Ambient temperature

-50 ... 85 °C (-58 ... 185 °F)

Storage temperature

-50 ... 85 °C (-58 ... 185 °F)

Mechanical specifications

Core cross-section

0.75 mm²

Housing

77 mm x 22 mm

Protection degree

IP67

Mass

100 g

Mounting

20 mm ISO thread
PG13.5 thread
1/2 NPT thread**Data for application in connection with Ex-areas**

EC-Type Examination Certificate

DMT 01 ATEX 104 X

Group, category, type of protection,
temperature class

Ⓔ II 1G EEx ia IIC T6

Temperature class

T6 for ambient temperature ≤ 60 °C
T5 for ambient temperature ≤ 75 °C
T4 for ambient temperature ≤ 85 °C**Maximum values**Voltage U_i

≤ 30 V

Operating values

Rated voltage

≤ 30 V

Directive conformity

Directive 94/9/EC

EN 60079-0:2006, EN 60079-11:2007, EN 60079-26:2007, IEC 60079-27:2008

International approvals

IECEx approval

IECEx BVS 10.0022X

Approved for

Ex ia IIC T6 Ga



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- Terminator in IP 20 housing
- Intrinsically safe, FISCO or Entity
- Installation on DIN rail in cabinet or field junction box

Function

The KMD0-FT-Ex is a terminator for fieldbus and provides capacitance and resistance to terminate a fieldbus segment according to IEC 61158-2. Explosion protection is intrinsically safe 'Ex ia' for installation in Zone 0...2. The housing is IP 20 for simple installation on the DIN rail for easy installation in control room cabinets or inside outdoor junction boxes.

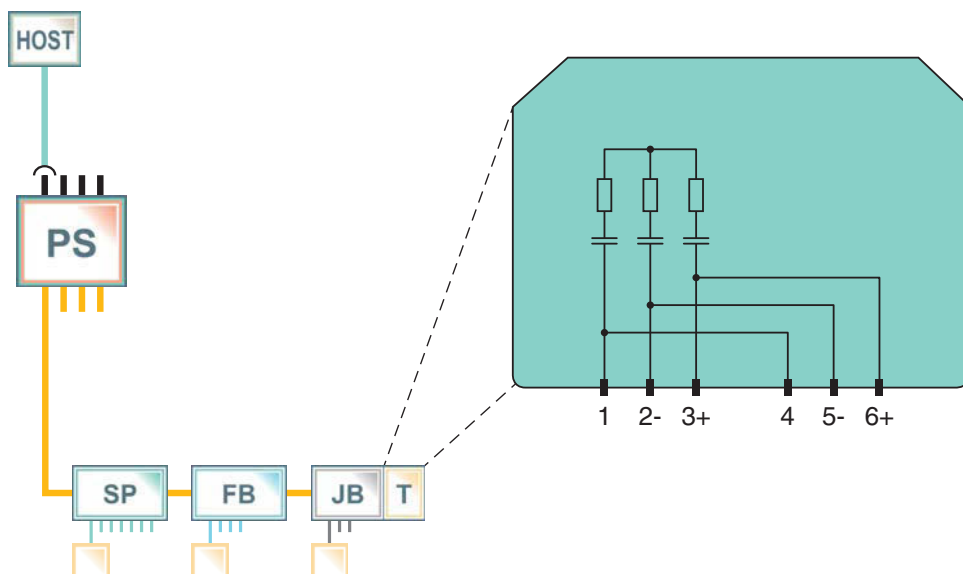
For increased availability the terminator features four capacitors in a network. If one capacitor should fail the basic functionality remains intact. This is detectable with the FieldConnex[®] Advanced Diagnostic Module allowing timely maintenance.

Fieldbus terminators are required at each end of the trunk line. They eliminate signal reflections at the end of the cable and convert the fieldbus signal transmitted as a current into a voltage, which is detectable by all devices.

Assembly



Connection



Technical data**Directive conformity**

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Ambient conditions

Ambient temperature

-20 ... 60 °C (-4 ... 140 °F)

Storage temperature

-40 ... 85 °C (-40 ... 185 °F)

Relative humidity

75 %

Mechanical specifications

Core cross-section

2.5 mm²

Housing width

20 mm

Protection degree

IP20

Mass

approx. 60 g

Data for application in connection with Ex-areas

EC-Type Examination Certificate

PTB 98 ATEX 2157

Group, category, type of protection, temperature class

Ⓔ II 2G EEx ia IIC T4

Voltage U_i

24 V

Current I_i

280 mA

Power P_i

1.93 W

Directive conformity

Directive 94/9/EC

EN 50014:1997

EN 50020:1994



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Features

- Series voltage reducing module
- Removable terminals
- Polarity reversal protected
- Installation in cabinet on DIN mounting rail

Function

Pepperl+Fuchs Segment Protectors feature a safety switch off for explosion protection at typically 31.5 V.

In rare cases the tolerances in other manufacturers' power modules in combination with very short cable lengths with little or no voltage drop lead to a switch off of the Segment Protector.

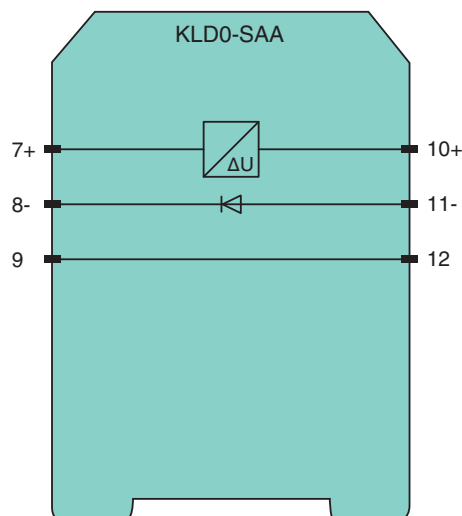
The KLD0-SAA is used to limit the voltage to uncritical values.

The KLD0-SAA is installed in close proximity to the power supply within the control cabinet.

Assembly



Connection



Technical data**Directive conformity****Electromagnetic compatibility**

Directive 2004/108/EC

EN 61326-1:2006

Ambient conditions

Ambient temperature

-20 ... 60 °C (-4 ... 140 °F)

Storage temperature

-40 ... 85 °C (-40 ... 185 °F)

Relative humidity

< 75 %

Mechanical specifications

Connection type

Terminals

Core cross-section

up to 2.5 mm²

Housing

20 mm x 115 mm x 107 mm

Protection degree

IP20

Mass

approx. 100 g

Mounting

DIN rail mounting



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

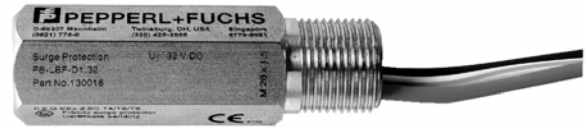
- Surge Protector in stainless steel housing
- Flameproof enclosure (Ex d) protection
- Surge protection for '+' and '-' fieldbus lead
- Choice of threads 20 mm or 1/2" NPT

Function

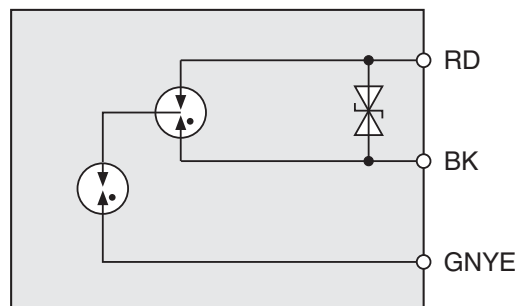
F*-LBF-D1.32 are surge protection devices for fieldbus installations. They direct power surges to earth via gas discharge tubes protecting field devices and control units from voltage surges and lightning strikes. They are in accordance with the fieldbus standard IEC 61158-2 and certified Ex d (flameproof enclosure) for Zone 1.

FieldConnex® surge protectors for field installation allow the coordinated use in a lightning protection zone concept in accordance with IEC 61312-1. Housings are selectable with 20 mm ISO or 1/2" NPT connecting threads for easy installation on outdoor junction boxes.

Assembly



Connection



Technical data

Electrical specifications

Rated voltage 32 V

Surge Current (8/20) I_n

per line 10 kA

total 10 kA

Max. surge current (8/20) I_{max} 10 kA

Voltage Protection Level at max. rated current

Line/Line 58 V

Line/Earth 1700 V

Voltage Protection Level at 1 kV/ μ sec

Line/Line 50 V

Line/Earth 1.2 kV

Reaction time t_A

Line/Line ≤ 1 ns

Line/Earth ≤ 100 ns

Capacitance

Line/Line 25 pF

Line/Earth 15 pF

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC/EN 60529

Surge protection

IEC 61643-21

Ambient conditions

Ambient temperature -50 ... 80 °C (-58 ... 176 °F)

Storage temperature -50 ... 85 °C (-58 ... 185 °F)

Mechanical specifications

Core cross-section 1.3 mm²

Housing material Stainless steel 1.4401 (AISI 316)
surface all over polished

Protection degree IP00/IP67 if correctly installed

Mass 160 g

Mounting screw mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate KEMA 04 ATEX 2318 X

Group, category, type of protection, temperature class Ex II 2G Ex d IIC T5/T6

Temperature class T6 for ambient temperature ≤ 70 °C
T5 for ambient temperature ≤ 80 °C

Maximum values

Rated voltage 32 V

Directive conformity

Directive 94/9/EC EN 60079-0:2006, EN 60079-1:2007

International approvals

IECEx approval IECEx KEM 09.0067X

Approved for Ex d IIC T5/T6 Gb



PROFIBUS PA

Selection
Guideline

Advanced
Diagnostics

Segment
Coupler

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories





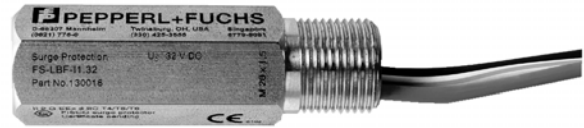
Features

- Surge Protector in stainless steel housing
- Intrinsically safe, FISCO or Entity
- Surge protection for '+' and '-' fieldbus lead
- Choice of threads 20 mm or 1/2" NPT

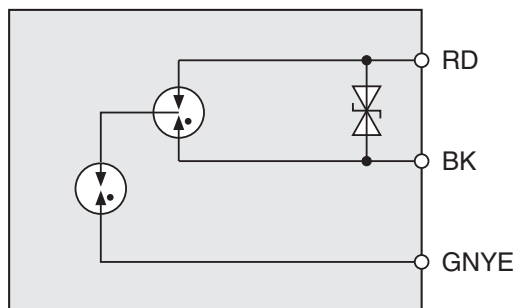
Function

F*-LBF-I1.32 are surge protection devices for fieldbus installations. They direct power surges to earth via gas discharge tubes protecting field devices and control units from voltage surges and lightning strikes. They are in accordance with the fieldbus standard IEC 61158-2 and certified intrinsically safe Ex ia for Zone 1, FISCO and Entity. FieldConnex® surge protectors for field installation allow the coordinated use in a lightning protection zone concept in accordance with IEC 61312-1. Housings are selectable with 20 mm ISO or 1/2" NPT connecting threads for easy installation on outdoor junction boxes.

Assembly



Connection



Technical data**Electrical specifications**

Rated voltage 32 V

Rated current 550 mA

Surge Current (8/20) I_n

per line 10 kA

total 10 kA

Max. surge current (8/20) I_{max} 10 kA

Voltage Protection Level at max. rated current

Line/Line 58 V

Line/Earth 1700 V

Voltage Protection Level at 1 kV/ μ sec

Line/Line 50 V

Line/Earth 1.2 kV

Reaction time t_A Line/Line ≤ 1 nsLine/Earth ≤ 100 ns

Capacitance

Line/Line 25 pF

Line/Earth 15 pF

Directive conformity

Electromagnetic compatibility

Directive 2004/108/EC EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC/EN 60529

Surge protection

IEC 61643-21

Ambient conditions

Ambient temperature

-50 ... 80 °C (-58 ... 176 °F)

Storage temperature

-50 ... 85 °C (-58 ... 185 °F)

Mechanical specifications

Core cross-section

1.3 mm²

Housing material

Stainless steel 1.4401 (AISI 316)
surface all over polished

Protection degree

IP00/IP67 if correctly installed

Mass

160 g

Mounting

screw mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate

KEMA 04 ATEX 1317 X

Group, category, type of protection, temperature class

Ex II 2(1)G Ex ia IIC T5/T6

Temperature class

T6 for ambient temperature ≤ 70 °C
T5 for ambient temperature ≤ 80 °CVoltage U_i Entity 30 V, FISCO 17.5 VCurrent I_i Entity 550 mA, FISCO 380 mAPower P_i Entity 3 W, FISCO 5.32 WInternal capacitance C_i negligible 0 nFInternal inductance L_i negligible 0 μ H

Directive conformity

Directive 94/9/EC EN 60079-0:2006, EN 60079-11:2007, EN 60079-26:2007, EN 60079-27:2008

International approvals

IECEx approval

IECEx KEM 09.0081X

Approved for

Ex ia [ia Ga] IIC T5/T6 Gb



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





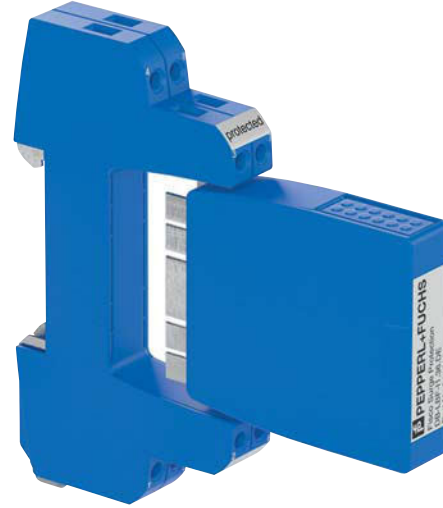
Features

- **Modular:** protection module easy to replace
- **Intrinsically safe (Ex ia), FISCO, Entity, DART Fieldbus,** or general-purpose
- **Protection module replaceable, interrupting or non-interrupting**
- **Grounding of shield direct or via gas-discharge tube**
- **Compact and space-saving design**
- **Installation on DIN rail in cabinet or field junction box**

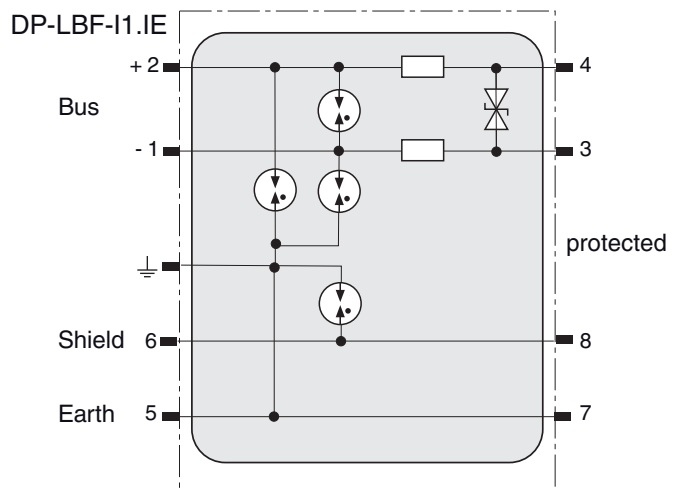
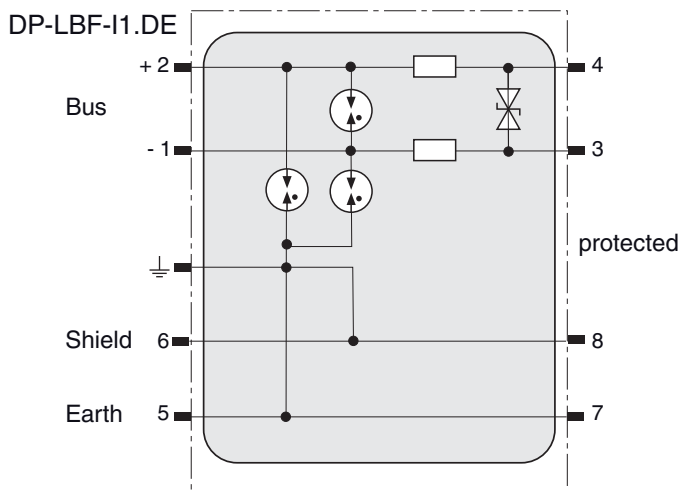
Function

The modular surge protector for fieldbus consists of a base (DB ...), and plug-in module (DP-LBF-I1.36*) and is in acc. with IEC 61158-2. It directs power surges to earth via gas discharge tubes protecting field devices. It is certified intrinsically safe for circuits in hazardous area Zone 0 ... 2/Div. 1 ... 2 and DART Fieldbus. The surge protector is installed in Zone 1 ... 2 or Div. 1 ... 2. Choices support all concepts: interrupting/non-interrupting module exchange and direct/indirect grounding of the shield. The plug-in module can be exchanged without tools. They support coordinated use in a lightning protection zone concept in acc. with IEC 61312-1. Installation in cabinet or junction box requires a minimum amount of wiring.

Assembly



Connection



Technical data

Electrical specifications

Rated voltage	33 V
Rated current	500 mA
Voltage Protection Level U_p	
Line/Line	$\leq 58 \text{ V category C1/C2 } 8/20\mu\text{sec}, \leq 50 \text{ V category C3 } 1\text{kV}/\mu\text{sec}$ $\leq 51 \text{ V category B2 } 10/700\mu\text{sec}, \leq 55 \text{ V category D1 } 10/350\mu\text{sec}$
Line/Earth	$\leq 1400 \text{ V category C1/C2 } 8/20\mu\text{sec}, \leq 1100 \text{ V category C1/C2 } 1\text{kV}/\mu\text{sec}$ $\leq 1000 \text{ V category B2 } 10/700\mu\text{sec}, \leq 1300 \text{ V category D1 } 10/350\mu\text{sec}$
Screen/Shield directly grounded	$\leq 25 \text{ V category C1/C2 } 8/20\mu\text{sec}, \leq 20 \text{ V category D1 } 10/350\mu\text{sec}$
Screen/Shield indirectly grounded (via GDT)	$\leq 700 \text{ V category C1/C2 } 8/20\mu\text{sec}, \leq 600 \text{ V category C3 } 1\text{kV}/\mu\text{sec}$ $\leq 500 \text{ V category B2 } 10/700\mu\text{sec}, \leq 600 \text{ V category D1 } 10/350\mu\text{sec}$
Reaction time t_A	
Line/Line	$\leq 1 \text{ ns}$
Line/Earth	$\leq 100 \text{ ns}$
Screen/Shield-Earth	$\leq 100 \text{ ns}$
Overstressed fault mode	acc. IEC 61643-21 line inoperable mode 3 lines 1 and 2 at 15,5kA (8/20μsec) lines 3 and 4 at 30kA (8/20μsec)
Series resistance in line	1 Ω +/- 5 %
Impulse durability	
Per line	1 kA category D1 10/350μsec, 5 kA category C1/C2 8/20μsec
Screen/Shield directly grounded	5 kA category D1 10/350μsec
Screen/Shield indirectly grounded (via GDT)	4 kA category D1 10/350μsec, 10 kA category C1/C2 8/20μsec
AC durability	1 A, 50 Hz, 1 s category A2
Capacitance	
Line/Line	800 pF
Line/Earth	16 pF
Standard conformity	
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Surge protection	IEC 61643-21
Ambient conditions	
Ambient temperature	-50 ... 80 °C (-58 ... 176 °F)
Storage temperature	-50 ... 85 °C (-58 ... 185 °F)
Relative humidity	$\leq 95 \%$ non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g, 10 ... 150 Hz
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	KEMA 09 ATEX 0191 X
Group, category, type of protection, temperature class	Ex II 2(1)G Ex ia IIC T4/T5/T6
Voltage U_i	30 V
Current I_i	500 mA
Internal capacitance C_i	negligible 0 nF
Internal inductance L_i	negligible 0 μH
Statement of conformity	KEMA 09 ATEX 0190 X
Group, category, type of protection, temperature class	Ex II 3G Ex ic IIC T4/T5/T6, Ex II 3G Ex na II T4/T5/T6
Voltage U_i	33 V
Current I_i	500 mA
Internal capacitance C_i	negligible 0 nF
Ambient conditions	
Ambient temperature	-50 ... 80 °C (-58 ... 176 °F) T4, -50 ... 75 °C (-58 ... 167 °F) T5, -50 ... 50 °C (-58 ... 122 °F) T6
Directive conformity	
Directive 94/9/EC	EN 60079-0:2006, EN 60079-11:2007, EN 60079-15:2005, EN 60079-26:2007, EN 60079-27:2008
International approvals	
CSA approval	CSA 2437472
Control drawing	116-0361
IECEx approval	IECEx KEM 09.0088X
Approved for	Ex ia [ia Ga] IIC T4/T5/T6 Gb, Ex ic IIC T4/T5/T6 Gc, Ex na IIC T4/T5/T6 Gc



PROFIBUS PA

Selection
Guideline

Advanced
Diagnostics

Segment
Coupler

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories



Features

- Pluggable, mounts between Power Hub and trunk cable
- Intrinsically safe (Ex ia), FISCO, Entity, DART Fieldbus, or general-purpose
- Optional diagnostics for wear
- Grounding of shield direct
- Indication via LED and Advanced Diagnostics

Function

This fieldbus surge protector is in acc. with IEC 61158-2 and mounts on the trunk connector of FieldConnex® High-Density and Compact Power Hubs protecting them. It directs power surges to earth via gas discharge tubes. It is certified intrinsically safe for circuits in hazardous areas up to Zone 0/Div. 1 and DART Fieldbus. The surge protector is installed in Zone 1 ... 2 or Div. 1 ... 2.

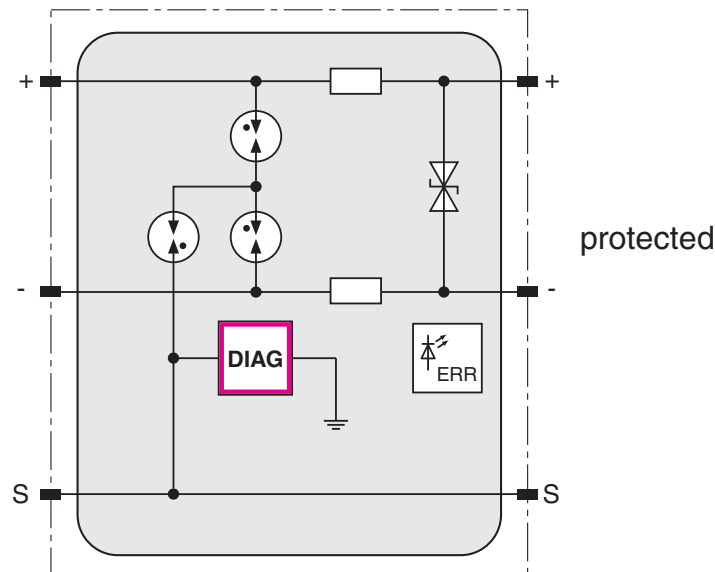
Self-diagnostics (option) continuously monitor wear caused by surges. The end of the useful life is indicated via LED and in the control room via FieldConnex® Advanced Diagnostics for exchange.

Installation on the trunk connector is without additional wiring even as retrofit. A single grounding bar connects surge protectors mounted side by side to a common grounding point.

Assembly



Connection



Technical data**Electrical specifications**

Rated voltage	36 V
Rated current	600 mA
Voltage Protection Level U_p	
Line/Line	≤ 50 V category B2 10/700 μ sec, 25 A ≤ 52 V category C1 8/20 μ sec, 300 A ≤ 55 V category C2 8/20 μ sec, 5 kA ≤ 46 V category C3 1kV/ μ sec, 10 A
Line/Earth	≤ 1060 V category B2 10/700 μ sec, 50 A per line ≤ 800 V category C1 8/20 μ sec, 300 A per line ≤ 1450 V category C2 8/20 μ sec, 5 kA per line ≤ 1300 V category C3 1kV/ μ sec, 50 A per line ≤ 1080 V category D1 10/350 μ sec, 500 A per line

Reaction time t_A

Line/Line	≤ 1 ns
Line/Earth	≤ 100 ns
Overstressed fault mode	acc. IEC 61643-21 line inoperable mode 3
Series resistance in line	2 Ω +/- 5 %

Impulse durability

Per line	5 kA category C2 8/20 μ sec

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NAMUR NE 21
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Surge protection	IEC 61643-21

Ambient conditions

Ambient temperature	-40 ... 70 °C (-40 ... 158 °F)
Storage temperature	-40 ... 85 °C (-40 ... 185 °F)
Relative humidity	≤ 95 % non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g, 10 ... 150 Hz

Data for application in connection with Ex-areas

EC-Type Examination Certificate	SIRA 12 ATEX 2128X
Group, category, type of protection, temperature class	Ex II 1G Ex ia IIC T4
Voltage U_i	24 V
Current I_i	500 mA
Internal capacitance C_i	2 nF
Internal inductance L_i	0.1 μ H
Statement of conformity	SIRA 12 ATEX 4176X
Group, category, type of protection, temperature class	Ex II 3G Ex nAc IIC T4, Ex II 3G Ex ic IIC T4
Voltage U_i	33 V
Current I_i	600 mA
Internal capacitance C_i	2 nF

Directive conformity

Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007

International approvals

IECEx approval	IECEx SIR 12.0051X
Approved for	Ex ia IIC T4



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Pluggable, mounts between device coupler and trunk cable
- Intrinsically safe (Ex ia), FISCO, Entity, DART Fieldbus, or general-purpose
- Optional diagnostics for wear
- Grounding of shield via gas-discharge tube
- Indication via LED and Advanced Diagnostics

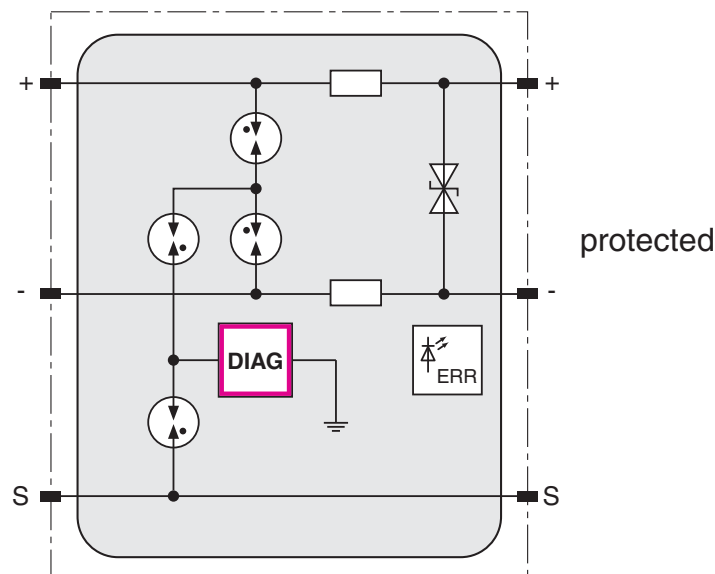
Function

This fieldbus surge protector is in acc. with IEC 61158-2 and mounts on the trunk connector of FieldConnex® device couplers protecting them. It directs power surges to earth via gas discharge tubes. It is certified intrinsically safe for circuits in hazardous areas up to Zone 0/Div. 1 and DART Fieldbus. The surge protector is installed in Zone 1 ... 2 or Div. 1 ... 2. Self-diagnostics (option) continuously monitor wear caused by surges. The end of the useful life is indicated via LED and in the control room via FieldConnex® Advanced Diagnostics for exchange. Installation on the trunk connector is without additional wiring even as retrofit.

Assembly



Connection



Technical data

Electrical specifications

Rated voltage	36 V
Rated current	600 mA
Voltage Protection Level U_p	
Line/Line	≤ 50 V category B2 10/700 μ sec, 25 A ≤ 50 V category C1 8/20 μ sec, 300 A ≤ 55 V category C2 8/20 μ sec, 5 kA ≤ 46 V category C3 1kV/ μ sec, 10 A
Line/Earth	≤ 1060 V category B2 10/700 μ sec, 50 A per line ≤ 800 V category C1 8/20 μ sec, 300 A per line ≤ 1.5 kV category C2 8/20 μ sec, 5 kA per line ≤ 1.3 kV category C3 1kV/ μ sec, 50 A per line ≤ 1080 V category D1 10/350 μ sec, 500 A per line
Screen/Shield indirectly grounded (via GDT)	≤ 500 V category B2 10/700 μ sec, 100 A ≤ 600 V category C1 8/20 μ sec, 500 A ≤ 720 V category C2 8/20 μ sec, 10 kA ≤ 550 V category C3 1kV/ μ sec, 100 A ≤ 570 V category D1 10/350 μ sec, 1 kA

Reaction time t_A

Line/Line	≤ 1 ns
Line/Earth	≤ 100 ns
Screen/Shield-Earth	≤ 100 ns
Overstressed fault mode	acc. IEC 61643-21 line inoperable mode 3
Series resistance in line	2 Ω +/- 5 %

Impulse durability

Per line	5 kA category C2 8/20 μ sec
Screen/Shield indirectly grounded (via GDT)	1 kA category D1 10/350 μ sec 10 kA category C2 8/20 μ sec

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NAMUR NE 21
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Surge protection	IEC 61643-21

Ambient conditions

Ambient temperature	-40 ... 70 °C (-40 ... 158 °F)
Storage temperature	-40 ... 85 °C (-40 ... 185 °F)
Relative humidity	≤ 95 % non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g, 10 ... 150 Hz

Data for application in connection with Ex-areas

EC-Type Examination Certificate	SIRA 12 ATEX 2128X
Group, category, type of protection, temperature class	Ex II 1G Ex ia IIC T4
Voltage U_i	24 V
Current I_i	500 mA
Internal capacitance C_i	2 nF
Internal inductance L_i	0.1 μ H
Statement of conformity	SIRA 12 ATEX 4176X
Group, category, type of protection, temperature class	Ex II 3G Ex nAc IIC T4, Ex II 3G Ex ic IIC T4
Voltage U_i	33 V
Current I_i	600 mA
Internal capacitance C_i	2 nF
Directive conformity	
Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007
International approvals	
IECEx approval	IECEx SIR 12.0051X
Approved for	Ex ia IIC T4



PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories



Features

- Pluggable, mounts between device coupler and spur cable
- Intrinsically safe (Ex ia), FISCO, Entity, DART Fieldbus, or general-purpose
- Optional diagnostics for wear
- Grounding of shield via gas-discharge tube
- Indication via LED and Advanced Diagnostics

Function

This fieldbus surge protector is in acc. with IEC 61158-2 and mounts on the spur connector of FieldConnex® device couplers protecting them. It directs power surges to earth via gas discharge tubes. It is certified intrinsically safe for circuits in hazardous areas up to Zone 0/Div. 1 and DART Fieldbus.

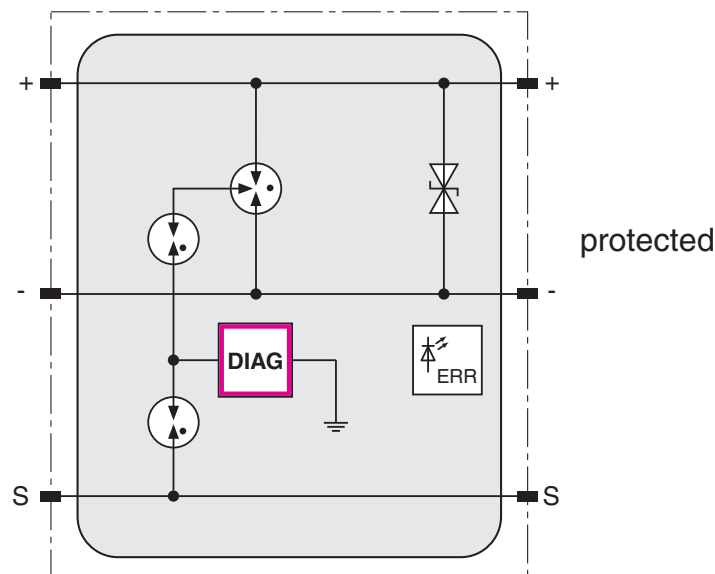
The surge protector is installed in Zone 1 ... 2 or Div. 1 ... 2. Self-diagnostics (option) continuously monitor wear caused by surges. The end of the useful life is indicated via LED and in the control room via FieldConnex® Advanced Diagnostics for exchange.

Installation on the spur connector is without additional wiring even as retrofit. A single grounding bar connects surge protectors mounted side by side to a common grounding point.

Assembly



Connection



Technical data

Electrical specifications

Rated voltage	36 V
Rated current	250 mA
Voltage Protection Level U_p	
Line/Line	≤ 50 V category B2 10/700 μ sec, 25 A ≤ 53 V category C1 8/20 μ sec, 150 A ≤ 55 V category C2 8/20 μ sec, 150 A ≤ 46 V category C3 1kV/ μ sec, 10 A
Line/Earth	≤ 980 V category B2 10/700 μ sec, 50 A per line ≤ 800 V category C1 8/20 μ sec, 50 A per line ≤ 1450 V category C2 8/20 μ sec, 5 kA per line ≤ 1200 V category C3 1kV/ μ sec, 50 A per line ≤ 980 V category D1 10/350 μ sec, 500 A per line
Screen/Shield indirectly grounded (via GDT)	≤ 500 V category B2 10/700 μ sec, 100 A ≤ 600 V category C1 8/20 μ sec, 500 A ≤ 700 V category C2 8/20 μ sec, 10 kA ≤ 550 V category C3 1kV/ μ sec, 100 A ≤ 570 V category D1 10/350 μ sec, 1 kA

Reaction time t_A

Line/Line	≤ 1 ns
Line/Earth	≤ 100 ns
Screen/Shield-Earth	≤ 100 ns
Overstressed fault mode	acc. IEC 61643-21 line inoperable mode 2
Impulse durability	
Per line	5 kA category C2 8/20 μ sec
Screen/Shield indirectly grounded (via GDT)	1 kA category D1 10/350 μ sec 10 kA category C2 8/20 μ sec

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electromagnetic compatibility	NAMUR NE 21
Protection degree	IEC 60529
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Surge protection	IEC 61643-21

Ambient conditions

Ambient temperature	-40 ... 70 °C (-40 ... 158 °F)
Storage temperature	-40 ... 85 °C (-40 ... 185 °F)
Relative humidity	≤ 95 % non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g, 10 ... 150 Hz

Data for application in connection with Ex-areas

EC-Type Examination Certificate	SIRA 12 ATEX 2128X
Group, category, type of protection, temperature class	Ex II 1G Ex ia IIC T4
Voltage U_i	24 V
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Internal capacitance C_i	2 nF
Internal inductance L_i	0.1 μ H
Statement of conformity	SIRA 12 ATEX 4176X
Group, category, type of protection, temperature class	Ex II 3G Ex nAc IIC T4, Ex II 3G Ex ic IIC T4
Voltage U_i	33 V
Current I_i	600 mA
Internal capacitance C_i	2 nF
Directive conformity	
Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007
International approvals	
IECEx approval	IECEx SIR 12.0051X
Approved for	Ex ia IIC T4



PROFIBUS PA

Selection
Guideline

Advanced
Diagnostics

Segment
Coupler

Field
Distribution

DART
Fieldbus

Process
Interfaces

Accessories





Features

- Indication via LED and Advanced Diagnostics
- Intrinsically safe, FISCO or Entity
- For instrument or device coupler
- Fits inside terminal compartment

Function

The enclosure leakage sensor senses water ingress in field device housings or junction boxes. It fits into the enclosure and sends alarms via the fieldbus network. It is certified intrinsically safe Ex ia for installation in Zone 0.

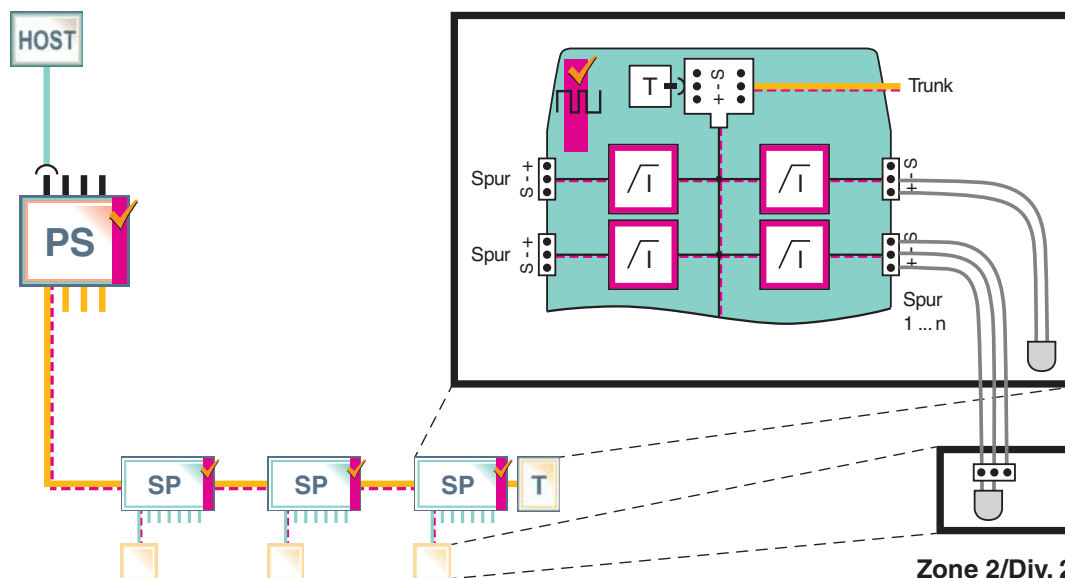
The alarm is indicated via LED and in the control room via FieldConnex® Advanced Diagnostics. Corrective actions can thus prevent effects from becoming irreversible or avoid conditions adverse to plant performance.

The ELS-1 connects in parallel to field instruments, trunk or spur connectors of compatible device coupler.

Assembly



Connection



Technical data**Directive conformity**

Electromagnetic compatibility

Directive 2004/108/EC

EN 61326-1:2006

Standard conformity

Electromagnetic compatibility

NE 21:2006

Protection degree

IEC 60529

Climatic conditions

IEC 60721

Shock resistance

EN 60068-2-27

Vibration resistance

EN 60068-2-6

Ambient conditions

Ambient temperature

-40 ... 80 °C (-40 ... 176 °F)

Storage temperature

-40 ... 85 °C (-40 ... 185 °F)

Relative humidity

100 %

Shock resistance

15 g 11 ms

Vibration resistance

1 g, 10 ... 150 Hz

Mechanical specifications

Connection type

two strands, length 180 mm with cable ferrules, PVC insulation

Core cross-section

0.25 mm²

Housing material

Polycarbonate

Protection degree

Electronic component IP67
connection IP00

Mass

10 g

Data for application in connection with Ex-areas

EC-Type Examination Certificate

SIRA 12 ATEX 2129X

Group, category, type of protection, temperature class

Ⓔ II 1G Ex ia IIC T4

Voltage U_i

24 V

Internal capacitance C_i

negligible 0 nF

Internal inductance L_i

negligible 0 μH

Statement of conformity

SIRA 12 ATEX 4154X

Group, category, type of protection, temperature class

Ⓔ II 3G Ex nAc IIC T4, Ⓔ II 3G Ex ic IIC T4

Voltage U_i

33 V

Internal capacitance C_i

negligible 0 nF

Directive conformity

Directive 94/9/EC

IEC 60079-0:2011, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007

International approvals

IECEx approval

IECEx SIR 12.0052X

Approved for

Ex ia IIC T4, Ex ic IIC T4, Ex nAc IIC T4

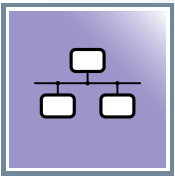


PROFIBUS PA

Selection
GuidelineAdvanced
DiagnosticsSegment
CouplerField
DistributionDART
FieldbusProcess
Interfaces

Accessories





Ethernet

System Description	450
Products	452

Introduction

Where faster communication speeds are required, for example, for transmission of large amounts of data, Ethernet is the physical media of choice. For hazardous areas, solutions with explosion protection are required. Open standards such as PROFINET and FOUNDATION Fieldbus HSE may well become the base for manufacturers to develop and offer solutions.

Combining proven and well-known technologies, intrinsically safe Ethernet offers an alternative solution for network topologies in the hazardous area.

The benefits of Ethernet in this environment are manifold:

- Easy to apply without special knowledge
- No configuration necessary
- Cost-effective because standard technology keeps the costs low
- Can be installed quickly and flexibly, e.g., for temporary installations or maintenance tasks

To provide our customers with intrinsically safe Ethernet according to proven Pepperl+Fuchs quality standards, we have designed a handy, intrinsically safe solution: the FieldConnex® Ethernet Isolator.

For Intrinsically Safe Ethernet: Ethernet Isolator

The FieldConnex® Ethernet Isolator is a compact device that combines intrinsically safe energy limitation and galvanic isolation into one product, making Ethernet connections plug-and-play in Zone 0.

Galvanic isolation eliminates the need for equipotential bonding and solid grounding between the safe area and the connection point in the hazardous area. Intrinsically safe energy limitation and galvanic isolation are possible at 100 Mbit/sec. For installation, flexible Ethernet cable can be used, which is simple to install, cost-effective, and plug-and-play.

As an important component of fieldbus infrastructure for an open and integrated architecture, the Ethernet Isolator offers all the benefits for long-lasting and reliable process plants regarding planning, installation, operation, and asset management.

Based on cost-effective standard components, the Ethernet Isolator can be applied "flexibly" in the hazardous area. System designers, installation teams, and maintenance personnel can use the Ethernet Isolator without the need for special knowledge on Ethernet technology.

This way, construction and operation of temporary installations become easy, as does the operation of mobile apparatus. For example, machinery and equipment can be frequently connected and disconnected during normal operation or can be installed on a temporary basis.

With the Ethernet Isolator, costly and inflexible installation is a thing of the past. The energy-efficient design produces low heat dissipation, a definite advantage when cabinet space is tight and costly.

Long lasting performance is ensured through the superior electric circuitry – a fundamental benefit of all Pepperl+Fuchs products and a basic requirement for any process plant today.

Pepperl+Fuchs is an expert in fieldbus infrastructure and explosion protection. Working with OEMs, our knowledge enables the integration of our intrinsically safe Ethernet Isolator technology into virtually any component requiring Ethernet as physical layer.

The Ethernet Isolator can also be applied in non-hazardous locations where a galvanic isolation is required, for example, between two sites.

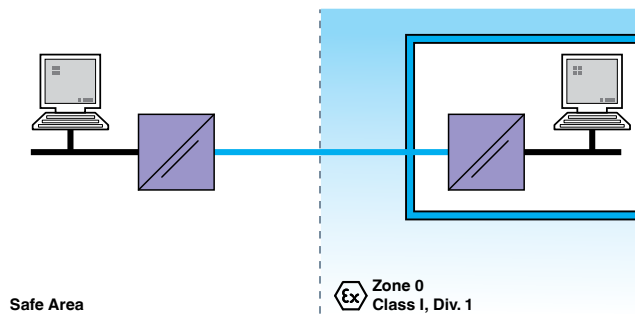


Figure 1 Application options for the intrinsically safe Ethernet Isolator in the fieldbus topology

Features

- Galvanic Isolation I.S. to non-I.S. Port
- 10/100 MBit/s according to IEEE 802.3/3u
- Installation in Zone 2, Ethernet in Zone 1 or Zone 0
- Standard Ethernet patch or crossover cable
- DIN-Rail mounted and OEM Version

Function

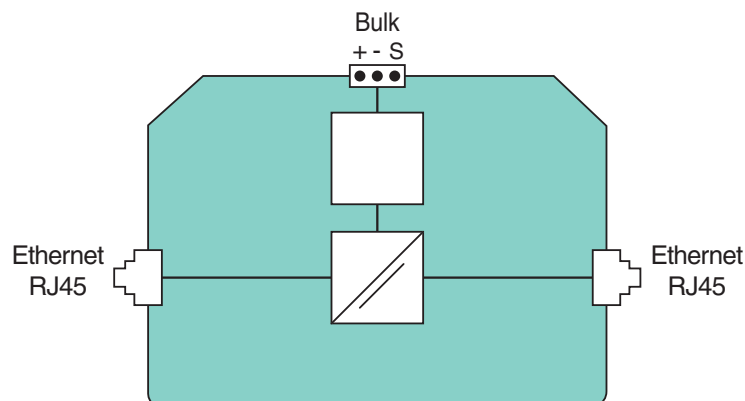
The Ethernet Isolator is an intrinsically safe isolated barrier. It enables cost effective and simple installation in hazardous areas up to Zone 0. It supports high-speed Ethernet and can be mounted in Zone 2.

At each end of the trunk, an Ethernet Isolator is installed. In combination, they provide the intrinsically safe energy limitation. The Ethernet Isolator offers a wire-based alternative to wireless LAN, fiber optic solutions, and Ex e installations. In safe area applications, a single Ethernet Isolator can be used for galvanic isolation. The Ethernet Isolator is compatible with all IEEE standards. It provides high noise immunity and low heat dissipation in a compact housing.

Assembly



Connection



Zone 2/Div. 2

Technical data**Supply**

Rated voltage	19.2 ... 35 V DC
Rated current	150 ... 100 mA
Power loss	3 W

Ethernet Interface

Intrinsically safe port	10 BASE-T/100 BASE-TX
Non-intrinsically safe port	10 BASE-T/100 BASE-TX
Connection type	2 x RJ-45, IEC 60603-7
Connector pinout	female connector; TIA/EIA-568-B
Transfer rate	10/100 Mbit/s, Auto-Negotiation
Operating mode	Half/Full Duplex
Cable type	CAT5e S/FTP AWG 24, Installation cable, L/R ratio max. 10 µH/Ω of all strand combinations
I.S. cable length	typ. 100 m/20 °C
Total cable length	typ. 200 m/20 °C
Number of isolators	≤ 2 in series connection

Directive conformity

Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006

Standard conformity

Electrical isolation	EN 50020
Protection degree	IEC 60529
Climatic conditions	DIN IEC 721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ethernet	IEEE 802.3, IEEE 802.3u

Ambient conditions

Ambient temperature	-40 ... 60 °C (-40 ... 140 °F)
Storage temperature	-40 ... 85 °C (-40 ... 185 °F)
Relative humidity	≤ 95 % non-condensing
Shock resistance	15 g 11 ms
Vibration resistance	1 g 10 ... 150 Hz
Pollution Degree	max. 2, according to IEC 60664

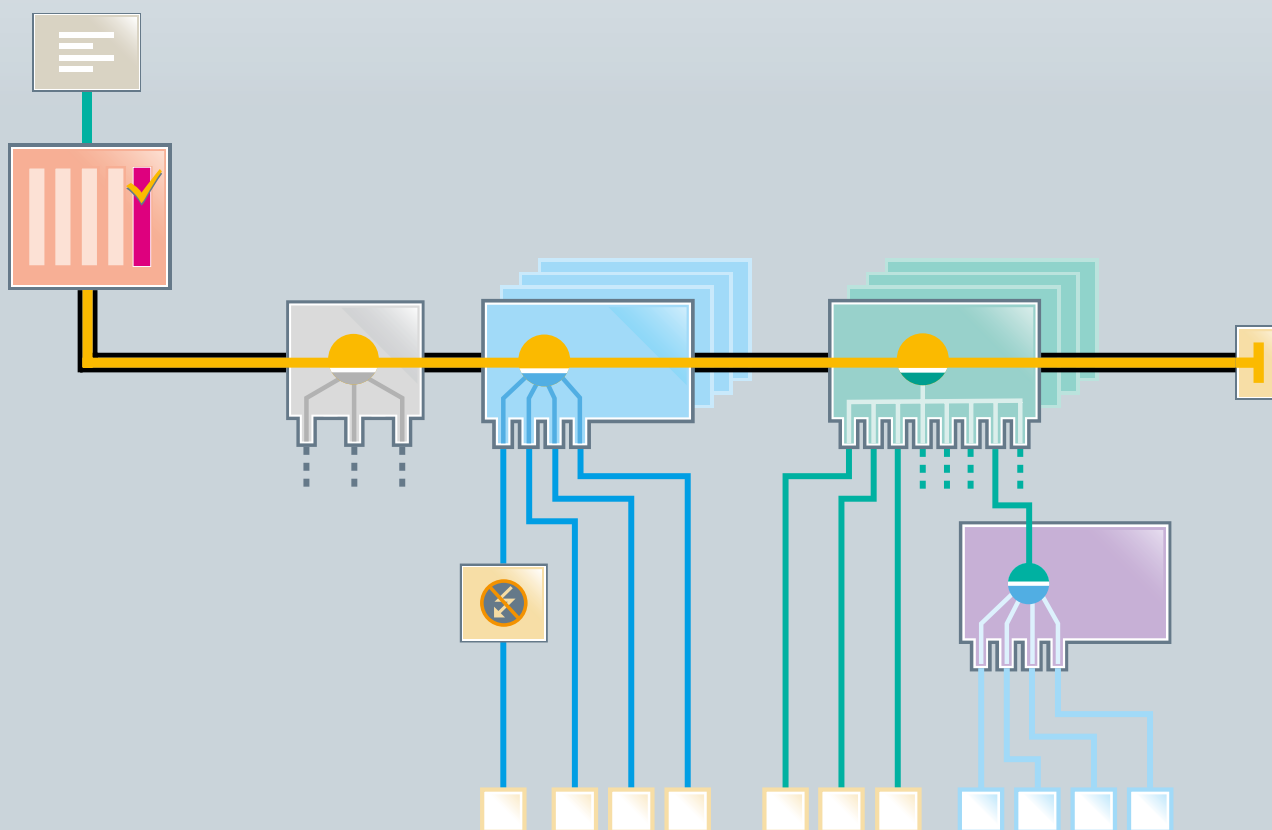
Mechanical specifications

Connection type	Terminals
Core cross-section	up to 2.5 mm ²
Housing material	Polyamide PA 66
Protection degree	IP20 according to EN 60529
Mass	195 g
Mounting	DIN rail mounting

Data for application in connection with Ex-areas

EC-Type Examination Certificate	PTB 07 ATEX 2025 X
Group, category, type of protection, temperature class	⊕ II (1) GD [Ex ia] IIB, ⊕ II 3 (1GD) G Ex nA [ia IIB] II T4, ⊕ I (M1) [Ex ia] I
Supply	
Maximum safe voltage U _m	253 V AC
Directive conformity	
Directive 94/9/EC	EN 60079-0:2004+Corr.2004, EN 60079-11:2007, EN 60079-15:2005

Appendix



Edition 912868 (US) / 220231 (EU) 04/2013

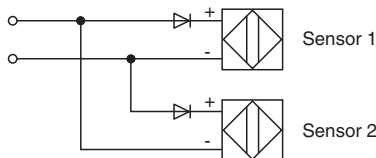
Glossary	456
General Notes	469
Model Number Index	471

0 ... 9

2:1 Procedure

The 2:1 procedure enables the transfer of two independent digital signals on a single wire pair without a bus system. To do this, the two sensors (or mechanical switches) are controlled and evaluated antiparallel in time multiplex mode. Due to the condition of time multiplex mode, not all proximity switches can be operated using the 2:1 procedure.

Some sensor types can be connected with additional external Polarity Reversal Protection.

Polarity Reversal Protection**A****Advanced Diagnostic Module**

Diagnostic module to plug into the Power Hub Motherboard. The Advanced Diagnostic Module is returning advanced Physical Layer Diagnostics, such as jitter and noise levels.

Advanced Diagnostics

Components and system for FieldConnex® advanced physical layer diagnostics. In general, this is comprised of one or more Advanced Diagnostic Modules and infrastructure, such as the Diagnostic Manager software, which is operated in the control room.

ANSI

Abbreviation for "American National Standards Institute." Non-profit organization for the development and harmonization of standards.

Approved

Acceptable to the authority having jurisdiction.

⇒ Authority Having Jurisdiction

Arcing Device

A device, such as make/break component, that under normal conditions produces an arc with energy sufficient to cause ignition of an ignitable mixture.

Asset Management

Asset management functionality often includes the monitoring of devices like flow meters, analyzers, actuators, and control valves. It detects faults and sometimes even recommends corrective actions.

Associated Apparatus

Apparatus in which the circuits are not necessarily intrinsically safe themselves, but which affect the energy in the intrinsically safe circuits and are relied upon to maintain intrinsic safety.

Associated electrical apparatus may be either of the following:

1. Electrical apparatus that have an alternative type of protection, for use in the appropriate hazardous (classified) location
2. Electrical apparatus that are not protected and therefore cannot be used within a hazardous (classified) location

Associated Non-Incendive Field Wiring Apparatus

Apparatus in which the circuits are not necessarily non-incendive themselves, but that affect the energy in non-incendive field wiring circuits and are relied upon to maintain non-incendive energy levels.

Associated Safe-Location Equipment

Equipment designed to form part of an intrinsically safe system. The equipment has properties that can affect the safety of the intrinsically safe system of which it forms a part. These are:

- not all its circuits are supplied by an intrinsically safe system
- not all its circuits are intrinsically safe

Examples of associated safe-location equipment are:

1. A line-connected power unit supplying power to intrinsically safe equipment in a hazardous location
2. A recorder in a safe location actuated by a transducer situated in a hazardous location

Asynchronous Data Exchange

Event-driven communication to adjust devices and to read diagnostic data. Includes reading and writing of device parameters and diagnostic data into or out of a fieldbus device. Normally field devices are parameterized per asynchronous data exchange. Then a synchronous data exchange follows.

Authority Having Jurisdiction

The organization, office, or individual that has the responsibility and authority for approving equipment, installations, or procedures.

Autoignition Temperature

⇒ Ignition Temperature

B

BASEEFA

Abbreviation for "British Approvals Service for Electrical Equipment in Flammable Atmospheres." A governmental body in the United Kingdom that has the authority to accept or reject the design of an electrical apparatus based on recognized safety standards.

Basic Diagnostic Module

Diagnostic module to plug into the Power Hub Motherboard. It monitors the power supply for internal health and proper operation, such as proper supply voltage range and monitoring trunks for overload and short circuit conditions.

BSI

Abbreviation for "British Standards Institute."

Bulk Power

Output (current and voltage) generated by the bulk power supply.

Bulk Power Supply

The bulk power supply provides power to multiple devices wired into an installation, for example, a control cabinet, a control room, or even larger industrial areas. It converts the supply voltage, which is typically higher in ratings (230 V, 400 V, or more) into a voltage and current that is usable by instrumentation technology, such as barriers, power supplies, and field devices.

Bus Technology

Various bus technologies are employed throughout the industry. Examples are PROFIBUS, MODBUS, FOUNDATION Fieldbus, and Ethernet.

C

Cable, Shielded, Twisted-Pair

⇒ Wire, Shielded, Twisted-Pair

CENELEC

Abbreviation for "European Electrotechnical Committee for Standardization." The standard for the European Economic Community (EEC) nations and the European Free Trade Association. Legally, certification to the CENELEC standard is sufficient to permit sale in any European country. If IEC standards are available, CENELEC tries to utilize them, because the European community has already adopted these standards.

Certified Equipment

Equipment that has been evaluated by a recognized testing agency and confirmed to be in compliance with the applicable standards.

Class I Location

A location in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

⇒ Class I, Division 1 Location

⇒ Class I, Division 2 Location

Class I, Division 1 Location

A location (1) in which ignitable concentrations of flammable gases or vapors can exist under normal operating conditions; (2) in which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or (3) in which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors and might also cause simultaneous failure of electrical equipment that could act as a source of ignition.

Class I, Division 2 Location

A location (1) in which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; (2) in which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation and might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) that is adjacent to a Class I, Division 1 location and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. If the outside of the conduit and enclosures is a non-hazardous (unclassified) location, electrical conduits and their associated enclosures separated from process fluids by a single seal or barrier are classified as a Class I, Division 2 location.

Class II Location

A location that is hazardous because of the presence of combustible dust.

⇒ Class II, Division 1 Location

⇒ Class II, Division 2 Location



Class II, Division 1 Location

A location (1) in which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures; (2) in which mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced and might also provide a source of ignition through simultaneous (the word "simultaneous" is not included in the Canadian definition) failure of electric equipment, operation of protection devices, or from other causes; or (3) in which combustible dusts of an electrically conductive nature may be present in hazardous quantities.

Class II, Division 2 Location

A location in which combustible dust is not normally in the air in quantities sufficient to produce explosive or ignitable mixtures and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but combustible dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment and where combustible dust accumulations on, in, or in the vicinity of the electrical equipment or may be ignitable by abnormal operation or failure of electrical equipment.

Class III Location

A location that is hazardous because of the presence of easily ignitable fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.

⇒ Class III, Division 1 Location

⇒ Class III, Division 2 Location

Class III, Division 1 Location

A location in which easily ignitable fibers or materials producing flyings are handled, manufactured, or used.

Class III, Division 2 Location

A location in which easily ignitable fibers are stored or handled (except in the process of manufacture).

Code of Practice

An international term referring to a document that describes basic safety features and methods of protection and recommends the selection, installation, and maintenance procedures that should be followed to ensure the safe use of electrical apparatus.

Common Interface

Term at the end of a Power Hub product name, which describes how the Power Hub is connected to the DCS.

Concentrator Method

A function block defined by the Fieldbus Foundation defining a method to configure multiple similar variables at one time.

Control Drawing

A drawing or other document provided by the manufacturer of the intrinsically safe or associated apparatus that details the allowed interconnections between the intrinsically safe and associated apparatus.

Corrective Maintenance

⇒ Maintenance, Corrective

Countable Fault

⇒ Fault

CSA

Abbreviation for "Canadian Standards Association." A third-party certification agency headquartered in Canada and recognized by OSHA as a Nationally Recognized Test Laboratory in the United States. The presence of CSA, UL, or FM certification marks on equipment is normally sufficient for the local inspector to declare that the product is designed to recognized safety standards.

D

DCS

⇒ PCS

Declaration of Conformity

As opposed to the statement of conformity, the declaration of conformity of a product is issued by the manufacturer. The manufacturer attests that the product is in conformity with the European guidelines. The declaration of conformity is necessary for the CE marking of the product.

Device Coupler

Most generic term for wiring interface installed in the field for connection of instruments to the segment. For FieldConnex® these are:

- Junction Box
- Segment Protector
- FieldBarrier

Diagnostic Bus

Multiple Advanced Diagnostic Modules are mounted on a FieldConnex® Power Hub or a stand-alone motherboard. The diagnostic bus connects these modules each other and with the Diagnostic Gateway.

Diagnostic Manager

The Diagnostic Manager displays measurements of Advanced Diagnostic Modules of a production plant in the control room. It configures the modules for online real-time monitoring and continuously monitors fieldbus communications. Operations and maintenance personnel stays informed and receives alarms when communications quality decays. Maintenance or repair work can be scheduled proactively, thus pre-empting system failure and increasing plant availability.

⇒ Advanced Diagnostic Module

⇒ Basic Diagnostic Module

DTM

Abbreviation for "Device Type Manager." Software component for easy access to all functions of a field device by a graphical user interface, for parameterizing the device, for diagnostics and maintenance, and for integration into an Asset Management or a Process Control System.

Dust-Ignition Proof

A term used in the United States to describe an enclosure that excludes ignitable amounts of dusts that might affect performance or rating and that, when installed and protected in accordance with the original design intent, do not permit arcs, sparks, or heat otherwise generated or liberated inside the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specified dust.

Dust-Protected Enclosure

An international term describing an enclosure in which the ingress of dust is not totally prevented, but dust does not enter in sufficient quantity to interfere with the safe operation of the equipment or accumulate in a position within the enclosure where it is possible to cause an ignition hazard.

E

EC-Type Examination Certificate

The manufacturer certifies that the product meets the fundamental safety requirements under EC regulations by the application of a registration number to this product.

The following regulations apply to Pepperl+Fuchs products:

73/23/EWG Low Voltage Directive

89/336/EWG EMC Directive

89/392/EWG Machine Directive

94/9/EG Devices and Safety Systems for Hazardous Areas

Encapsulation

An international term describing a type of protection in which the parts that could ignite an explosive atmosphere by either sparking or heating are enclosed in an encapsulant in such a way that this explosive atmosphere cannot be ignited. This type of protection is referred to by CENELEC as Ex m in Standard EN 60079-18.

Enclosure Leakage Sensor

Product name for an accessory of the FieldConnex® fieldbus portfolio. The Enclosure Leakage Sensor is small and fits into a junction box or instrument housing. The alarm is annunciated to higher-level systems such as the DCS via process fieldbus.

Entity

The Entity concept provides more flexibility in selecting equipment to form an intrinsically safe system. The Entity concept allows the user to identify acceptable combinations of intrinsically safe apparatus and associated apparatus that have not been examined as a system.

Ethernet

High-speed bus that lends itself to various protocols. Most commonly used protocols are MODBUS/TCP and EtherNet/IP. Redundancy solutions are in place. Slaves are often connected to the bus via switches.

Ex d

Designation for the flameproof (explosion containment) type of protection.

⇒ Flameproof Enclosure

Ex e

Designation for the increased safety (prevention) type of protection.

Ex i

Designation for the intrinsic safety (prevention) type of protection. This method consists of two categories: ia and ib.

Ex ia

This intrinsic safety category is limited to low-power circuits and is suitable for process instrumentation. Up to two faults are allowed and can be used in Zones 0, 1, and 2.

Ex ib

This intrinsic safety category is similar to the Ex ia type of protection, except that category ib allows only one fault and can only be used in Zones 1 and 2.

Ex ic

This intrinsic safety category permits devices to be used in Zone 2. Prerequisites that must be fulfilled are proof of intrinsic safety, galvanic isolation, and clear marking of Ex ic circuits.

Ex m

Designation for the encapsulation (segregation) type of protection.

Ex n

Designation for the simplified (prevention) type of protection.

Ex o

Designation for the oil immersion (segregation) type of protection.

Ex p

Designation for the pressurization (segregation) type of protection.

Ex q

Designation for the powder-filling (segregation) type of protection.

Ex s

Designation for the special (special protection) type of protection. This type is standardized only in Great Britain and Germany.

Explosion-Proof Apparatus

⇒ Explosion-Proof Equipment

Explosion-Proof Enclosure

An enclosure that withstands an explosion of a gas or vapor within it and prevents the ignition of an explosive gas or vapor surrounding it, and that operates at such an external temperature that a surrounding explosive gas or vapor does not get ignited. This type of enclosure is similar to a flameproof enclosure.

Explosion-Proof Equipment

Equipment or apparatus enclosed in an explosion-proof enclosure.

F**FAT**

Abbreviation for "factory acceptance tests."

Fault

A defect or electrical breakdown of any component, spacing, or insulation that alone or in combination with other faults may adversely affect the electrical or thermal characteristics of the intrinsically safe circuit. If a defect or breakdown leads to defects or breakdowns in other components, the primary and subsequent defects and breakdowns are considered to be a single fault.

Countable Fault

A fault that is applied to a part of the electrical apparatus that meets the constructional requirements of this standard.

Uncountable Fault

A fault that is applied to areas of the electrical apparatus that do not meet the constructional requirements of this standard. If application of a countable fault leads to subsequent defects and breakdowns, they are considered to be uncountable faults.

Fibers and Flyings, Easily Ignitable

Fibers and flyings that are easily ignitable, including rayon, cotton (including cotton linters and cotton waste), sisal or henequen, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, and other materials of similar nature.

FieldBarrier

The FieldBarrier is used in hazardous area location fieldbus applications to connect intrinsically safe fieldbus instruments to a main non-intrinsically safe fieldbus trunk. With non-intrinsically safe fieldbus trunk connections, FieldBarriers can connect up to 16 intrinsically safe field devices to a controller located in the safe area.

⇒ Device Coupler

Fieldbus

An industrial network system for real-time distributed control, more precisely a digital, two-way, multi-drop communication link among intelligent measurement and control devices. It serves as a Local Area Network (LAN) for advanced process control, remote input/output, and high-speed factory automation applications.

Fieldbus Infrastructure

Comprises all components belonging to the fieldbus technology, for example, the components to connect the control system with the field devices.

Fieldbus Power Supply

A power supply designed for fieldbus applications where power and data is transmitted via a single shielded twisted-pair cable. Most notably, a fieldbus power supply features an impedance matching circuit that prevents the low internal resistance of the power supply causing a short circuit in the data signal.

Fieldbus Topology

The fieldbus topology defines the physical specifications and the features of the fieldbus networks. It specifies the hierarchy between the devices as to how they are physically connected to each other.

FieldConnex®

FieldConnex® is a Pepperl+Fuchs brand name and comprises a comprehensive fieldbus infrastructure that connects the control system to intelligent field instruments and at the same time powers instruments via a two-wire bus. It is designed for the fieldbus protocols FOUNDATION Fieldbus H1 and PROFIBUS PA.

Flameproof Enclosure

An international term for an enclosure that withstands the pressure developed during an internal explosion of an explosive mixture and that prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure, and that operates at such an external temperature that a surrounding explosive gas or vapor will not be ignited. This enclosure is similar to an explosion-proof enclosure. This type of protection is referred to by IEC as Ex d.

⇒ Ex d

FM (Approval)

Abbreviation for "Factory Mutual" Approvals, a third-party certification agency recognized by OSHA as a Nationally Recognized Testing Laboratory in the United States. It is a division of Factory Mutual Global, which specializes in property insurance. For marketing in the U.S., FM, CSA, and UL provide testing, listing, and labeling services for industrial and safety products. Generally, certifications by FM, CSA, and UL are recognized in most jurisdictions; however, there are exceptions.

FOUNDATION Fieldbus

FOUNDATION Fieldbus is a family of fieldbus systems for the process industry. They are governed by the Fieldbus Foundation. Main classifications are H1 and HSE.

G

Galvanic Isolation

A form of isolation that meets stringent standards for intrinsically safe circuits.

Generic Interface

Term at the end of a Power Hub product name that describes how the Power Hub is connected to the DCS.

Grounding Device

A device with a defined internal impedance used to connect conductors of an electric system to ground for directing current or voltages to earth. Or a device with no internal impedance defined and used to ground conductors temporarily for worker safety. The grounding device may consist of a grounding transformer or a neutral grounding device, or a combination of these. Protective devices such as surge protectors may be a part of the device.

Ground Fault

⇒ Unbalance

Group

A classification of flammable materials of similar hazard. Consists of Groups A, B, C, D, E, F, and G to NEC and CEC standards and Groups I, IIA, IIB, and IIC to IEC standards.

H

Hard Grounding

When both ends of a fieldbus cable shield are connected to the same electrical potential.

Hazardous (Classified) Location

A location where fire or explosion hazards may exist due to the presence of flammable gases or vapors, flammable liquids, combustible dust, or easily ignitable fibers or flyings.

Hazardous Materials

Gases, vapors, combustible dusts, fibers, or flyings that are explosive under certain conditions.

High-Power Trunk Concept

A trunk that makes high power available in the field. High-Power Trunk Concepts are according to renowned users the breakthrough in fieldbus connection technology.

I

I.S.

Abbreviation for "intrinsic safety."

IEC

Abbreviation for "International Electrotechnical Commission." An international commission of which most nations are members. IEC standards directly affect equipment for sale internationally. The benefit of participation in the IEC is that costly differences in plant or equipment design can be avoided by designing equipment consistent with IEC documents where feasible.

Ignitable Gas Mixture

A gas-air mixture that can be easily ignited by an open flame, arc or spark, or high temperature.

Ignition Temperature

The minimum uniform temperature required to initiate or cause self-sustained combustion of a solid, liquid, or gaseous substance (independent of any other ignition source).

Increased Safety

An international term that describes a type of protection in which various measures are applied to reduce the probability of excessive temperatures and the occurrence of arcs or sparks in the interior and on the external parts of electrical apparatus that do not produce them in normal service. This type of protection is referred to by IEC as Ex e.

⇒ Ex e

Inductance

The property of an electric circuit by virtue of which a varying current induces an electromotive force in that circuit or in a neighboring circuit. The practical difference between capacitance and inductance in an intrinsically safe circuit is minimal. Both store energy, but an inductor releases energy when a circuit is broken, and a capacitor releases energy when the circuit is made.

Insulator

A material that conducts electrons slowly. The importance to intrinsic safety is that air (a spatial distance) is often an insulator.

Internal Wiring

Wiring and electrical connections that are made within the apparatus by the manufacturer. Within racks or panels, interconnections between separate pieces of apparatus made in accordance with detailed instructions from the apparatus manufacturer are considered to be internal wiring.

Intrinsic Safety

A type of protection in which a portion of the electrical system contains only intrinsically safe equipment (apparatus, circuits, and wiring) that is incapable of causing ignition in the surrounding atmosphere. No single device or wiring is intrinsically safe by itself, unless it is an intrinsically safe designed, battery-operated self-contained apparatus (e. g., portable pagers, transceivers, gas detectors, etc.). In all other instances, a device is intrinsically safe only when employed in a properly designed intrinsically safe system. This type of protection is referred to by IEC as Ex i.

Intrinsic Safety Ground Bus

A grounding system that has a dedicated conductor that is independent of the power system. The conductor prevents ground currents from flowing and is reliably connected to a ground electrode (e. g., in accordance with Article 250 of NEC, ANSI/NFPA 70, or Section 10 of CEC Part I, CSA C22.1).

Intrinsically Safe Apparatus

⇒ Intrinsically Safe Equipment

Intrinsically Safe Circuit

A circuit in which any spark or thermal effect, produced either normally or in specified fault conditions, is incapable, under the prescribed test conditions, of causing ignition of a mixture of flammable or combustible material in air in the most easily ignited concentration of this mixture.

Intrinsically Safe Equipment

Equipment that may be installed in a hazardous location, in which all the circuits are intrinsically safe, or that is designed to form part of an intrinsically safe system.

Intrinsically Safe Ground

A clearly identified conductor of not less than 12 AWG/4 mm² cross-sectional area with a total impedance from barrier ground bus bar to main power system earth of not more than 1 Ω.

Intrinsically Safe System

An assembly of interconnected intrinsically safe apparatus, associated apparatus, and interconnecting cables in which those parts of the system that may be used in hazardous (classified) locations are intrinsically safe circuits.

ISA

Abbreviation for the "Instrumentation, Systems and Automation Society." ISA Committee SP12, established in 1949, has been influential in establishing the recognition of intrinsic safety and non-incendive circuits in the NEC.

J

Junction Box

Junction boxes come in two different versions: Short-circuit proof junction boxes (Segment Protectors) and passive junction boxes. Junction boxes come in 1, 2, 4, 6, and 8 spur versions for general purpose and I.S. applications.

⇒ Device Coupler

K

Knock-Out

A portion of the wall of an enclosure so fashioned that it may be removed readily with a hammer, screwdriver, and pliers at the time of installation, to provide a hole for the attachment of an auxiliary device or raceway, cable, or fitting.

L

Labeled Equipment

Equipment or materials, to which has been attached a label, symbol, or other identifying mark of an organization concerned with product evaluation, that may maintain periodic inspection of the production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Leakage Sensor

A leakage sensor is a device that detects water ingress and indicates this through a visible and/or audible alarm. In automation systems, the leakage sensor may send this alarm to the control system or plant asset management system through digital fieldbus protocols.

⇒ Enclosure Leakage Sensor

LEL

Abbreviation for "lower explosive limit" (lower flammable limit).

M**Maintenance, Corrective**

Any maintenance activity that is not normal in the operation of the equipment and requires access to the interior of the equipment. Such activities are expected to be performed by qualified personnel who are aware of the hazards involved. Such activities typically include locating causes of faulty performance, replacement of defective components, adjustment of internal controls, and the like.

Maintenance, Operational

Any maintenance activity, excluding corrective maintenance, intended to be performed by the operator and required in order for the equipment to serve its intended purpose. Such activities typically include the correcting of "zero" on a panel instrument, changing charts, record keeping, adding ink, and the like.

Maintenance, Preventative

Activities scheduled at regular intervals to prevent a system from failing.

Maintenance, Proactive

Activities executed not at regular intervals but on a demand basis, typically indicated through asset management systems indicating wear on a device or instrument. Proactive maintenance is typically the most cost-effective concept, as maintenance and repair is only performed on demand.

Maximum External Capacitance (C_o , C_a)

Maximum capacitance in an intrinsically safe circuit that can be connected to the connection facilities of the apparatus without invalidating intrinsic safety.

Maximum External Inductance (L_o , L_a)

Maximum value of inductance in an intrinsically safe circuit that can be connected to the connection facilities of the apparatus without invalidating intrinsic safety.

Maximum External Inductance to Resistance Ratio (L_o/R_o)

Ratio of inductance (L_o) to resistance (R_o) of any external circuit that can be connected to the connection facilities of the electrical apparatus without invalidating intrinsic safety.

Maximum Input Current (I_i , I_{max})

Maximum current (peak AC or DC) that can be applied to the connection facilities for intrinsically safe circuits without invalidating intrinsic safety.

Maximum Input Power (P_i)

The maximum power that can be applied to the terminals of an intrinsically safe device without invalidating the intrinsic safety of the device.

Maximum Input Voltage (U_i , V_{max})

Maximum voltage (peak AC or DC) that can be applied to the connection facilities for intrinsically safe circuits without invalidating intrinsic safety.

Maximum Internal Capacitance (C_i)

The total unprotected internal capacitance of the intrinsically safe apparatus that must be considered as appearing across the terminals of the intrinsically safe apparatus.

Maximum Internal Inductance (L_i)

The total unprotected internal inductance of the intrinsically safe apparatus that must be considered as appearing across the terminals of the intrinsically safe apparatus.

Maximum Internal Inductance to Resistance Ratio (L_i/R_i)

Ratio of inductance (L_i) to resistance (R_i) which is considered as appearing at the external connection facilities of the electrical apparatus.

Maximum Output Current (I_o , I_{sc})

Maximum current (peak AC or DC) in an intrinsically safe circuit that can be taken from the connection facilities of the apparatus.

Maximum Output Power (P_o)

Maximum electrical power in an intrinsically safe circuit that can be taken from the apparatus.

Maximum Output Voltage (U_o , V_{oc})

Maximum output voltage (peak AC or DC) in an intrinsically safe circuit that can appear under open circuit conditions at the connection facilities of the apparatus at any applied voltage up to the maximum voltage, including U_m and U_i .

Maximum Surface Temperature

The highest temperature attained by a surface accessible to flammable gases, vapors, or combustible dusts under conditions of operation within the ratings of the apparatus (including recognized overloads and defined fault conditions).

MESG

Abbreviation for "maximum experimental safe gap." The maximum clearance between two parallel metal surfaces that has been found, under specified test conditions, to prevent an explosion in a test chamber from being propagated to a secondary chamber containing the same gas or vapor at the same concentration.

MIC

Abbreviation for "minimum ignition current."

MIE

Abbreviation for "minimum ignition energy." The smallest amount of energy that can ignite the most easily ignitable mixture of a specific gas or vapor-in-air mixture or dust-in-air mixture.

Minimum Igniting Voltage

Minimum voltage of capacitive circuits that causes the ignition of the explosive test mixture in the spark-test apparatus.

N**NEMA**

Abbreviation for "National Electrical Manufacturers Association." Provides a rating system to identify the ability of an enclosure to repel the outside environment. Unlike organizations such as UL, FM, and CSA, NEMA does not require independent testing and leaves compliance to its rating system up to the manufacturer.

NFPA

Abbreviation for "National Fire Protection Association." The NFPA has acted as a sponsor and publisher of the National Electrical Code since 1911. Most of the NFPA standards tend to emphasize recommendations for the safe use of electrical apparatus, area classification, fire protection, and hazards of materials.

Non-Incendive Circuit

A circuit in which any arc or thermal effect produced under normal operating conditions of the equipment is not capable, under prescribed conditions, of igniting the specified flammable gas, vapor-in-air mixture, combustible dusts, or ignitable fibers or flyings.

Non-Incendive Component

A component having contacts for making or breaking a specified incendive circuit in which the contacting mechanism is constructed so that the component is not capable of igniting the specified flammable gas or vapor-in-air mixture when tested as specified by an appropriate test procedure. The housing of a non-incendive component is not intended to exclude the flammable atmosphere or contain an explosion.

Non-Incendive Equipment

Equipment having electrical/electronic circuitry and components that are incapable under normal conditions of causing ignition of a specified flammable gas or vapor-in-air mixture due to arcing or thermal effect.

Non-Incendive Field Wiring

Wiring that enters or leaves an equipment enclosure and, under normal operating conditions of the equipment, is not capable, due to arcing or thermal effects, of igniting a specified flammable gas or vapor-in-air mixture or combustible dust-in-air mixture. Normal operation includes opening, shorting, or grounding the field wiring.

Non-Incendive Field Wiring Apparatus

Apparatus intended to be connected to non-incendive field wiring.

Normal Operation Conditions

Conditions that conform electrically and mechanically with the design specifications and that are within the limits specified by the manufacturer.

NRTL

Abbreviation for "Nationally Recognized Testing Laboratory." This recognition indicates that the Occupational Safety & Health Administration has accredited certain organizations to evaluate products according to consensus-based safety standards.

O**Operational Maintenance**

⇒ Maintenance, Operational

OSHA

Abbreviation for "Occupational Safety and Health Administration." The U.S. Congress passed the OSHA Act in 1971. Part 1910 of the OSHA regulations adopted the 1968 NEC and defined "approved" to mean "listed by UL or FM." "Approved" was redefined in 1972, providing exceptions to FM or UL listing; however, in practice the emphasis on listing remained unchanged. Listing requirements increased interest in developing standards for certain categories of apparatus, such as process control instrumentation. Third-party approval agencies (e.g., UL, FM, CSA) for electrical equipment must be accredited by OSHA.

Overvoltage Category

The assignment of an electrical apparatus in accordance with the expected overvoltage.

Rated operating voltage (V) for alternating voltage systems in accordance with DIN IEC 38	Rated surge voltages (V) for overvoltage category			
	I	II	III	IV
230/400/277/480 ¹⁾	1500	2500	4000	6000
400/690	2500	4000	6000	8000
1000	4000	6000	8000	12000

¹⁾ Rated operating voltage of 500 V is set.

Table 3 The assignment of rated operating voltages to the rated surge voltages

P

PCS

Abbreviation for "Process Control System." In the fieldbus context, Process Control Systems or distributed control systems (DCS) use fieldbuses to connect transducers and actuators. In general, a control system comprises a process monitoring system. Whenever necessary, operators may intervene manually, e.g., in case of faults.

Plant Asset Management

⇒ Asset Management

Power Conditioner Module

Power Conditioner Modules are Power Modules which provide current limiting capability without galvanic isolation.

Power Hub

Power Hub is a FieldConnex[®] solution for the control cabinet. It is made up of the Power Hub Motherboard onto which, depending on the number of segments and the redundancy concept, a number of Power Supply Modules and/or Power Conditioner Modules can be plugged. Additionally, the Basic Diagnostic Module or the Advanced Diagnostic Module can be mounted. The task of the Power Hub is to supply several segments.

⇒ Fieldbus Power Supply

Power Module

A Power Module supplies a segment. There are two kinds of Power Modules:

- Power Supply Modules: modules with galvanic isolation
- Power Conditioner Modules: modules without galvanic isolation

Power Supply

⇒ Fieldbus Power Supply

Power Supply Module

A Power Supply Module is a Power Module with galvanic isolation.

Preventative Maintenance

⇒ Maintenance, Preventative

Proactive Maintenance

⇒ Maintenance, Proactive

Process Interface

Fieldbus Process Interfaces integrate conventional, non-digital sensors and actuators into fieldbus communication.

PROFIBUS DP

Widely popular master/slave bus protocol based on RS485 hardware architecture. Offers fast and deterministic data exchange. Standard also covers redundancy. Slaves are connected to the bus in parallel.

PROFIBUS Power Hub

⇒ Segment Coupler

PROFIBUS Power Hub Gateway

The PROFIBUS Power Hub Gateway is part of the PROFIBUS Power Hub and is responsible for coupling from PROFIBUS DP to PROFIBUS PA. It is comprised of either one or two PROFIBUS Power Hub Gateway Modules and one Gateway Motherboard. The PROFIBUS Power Hub is also referred to as Segment Coupler 3, SK3.

⇒ Segment Coupler

Protective (Infallible) Component or Assembly

A component or assembly which is so unlikely to become defective in a manner that lowers the intrinsic safety of the circuit, it may be considered not subject to fault when analysis or tests for intrinsic safety are made.

PTB

Abbreviation for "Physikalisch-Technische Bundesanstalt." An approval agency in Germany that has the authority to accept or reject the design of an electrical apparatus based on recognized safety standards.

R

Redundancy

A means to increase availability of an automation system by doubling hosts, transmission media (cables), and/or slaves. Redundancy ensures that a segment can continue to work even when there is a fault. Redundancy may be a pre-requisite to achieve functional safety. Within PROFIBUS DP, only slave redundancy is standardized.

S

Safe Area

A non-hazardous location.

Seal, Cable, Explosion-Proof

A cable terminator filled with compound and designed to contain an explosion in the enclosure to which it is attached or to minimize passage of flammable gases or vapors from one location to another. A conduit seal may also be used as a cable seal. This method differs from the international practice, which requires cable glands.

Seal, Conduit, Explosion-Proof

A sealed fitting, poured with a cement-like potting compound, designed to contain an explosion in the enclosure to which it is attached and to minimize passage of flammable gases or vapors from one location to another.

Segment

A segment is an electrical circuit for fieldbus, connecting instruments and sensors to the Process Control System. The bus line between two terminators forms a segment. A segment for FOUNDATION Fieldbus H1 or PROFIBUS PA contains up to 32 nodes.

SegmentChecker

Software from Pepperl+Fuchs that allows virtual engineering of a segment.

Segment Coupler

A fieldbus power supply for PROFIBUS PA, including a gateway for transparent connection between PROFIBUS DP and PROFIBUS PA. A Segment Coupler is typically configuration-free.

⇒ PROFIBUS Power Hub Gateway

Segment Protector

A device coupler with short circuit current limitation for connection of fieldbus devices to the segment.

⇒ Device Coupler

Shielded, Twisted-Pair Wire

⇒ Wire, Shielded, Twisted-Pair

Short Circuit Current Limitation

The ability of the solid-state output to withstand a direct short circuit without damage to itself.

Simple Apparatus

An electrical component or combination of components of simple construction with well-defined electrical parameters that is compatible with the intrinsic safety of the circuit in which it is used. A device that does not generate or store more than 1.5 V, 0.1 A, and 25 mW. Examples are switches, thermocouples (TCs), light-emitting diodes (LEDs), and resistance temperature devices (RTDs).

Spur

A spur is a branch line connecting a sub segment to the main segment of MBP-based networks. Only one slave must be connected to the end of the sub segment.

⇒ Trunk

Surge Protector

A device that protects electric and electronic devices from voltage peaks caused by lightning strike, but also by capacitive or inductive coupling.

T

Temperature Classification

⇒ Temperature Code

Temperature Code

A system of classification by which one of 14 temperature identification numbers (internationally, six temperature classes) is allocated to an electrical apparatus. The temperature code represents the maximum surface temperature of any component that may come in contact with the flammable gas or vapor mixture.

Temperature Multi-Input Device

Fieldbus device to transmit signals from resistance thermometers and thermocouples over the fieldbus.

Terminator

Electrical signals can be reflected at the end of a cable, which can lead to interferences. A terminator is a terminating resistor that is placed at the end of a cable to avoid signal reflections.

Test Plug Socket

Special plug with openings where diagnostic tools for test purpose can be plugged in.

Topology

⇒ Fieldbus Topology

Trunk

The trunk is the main communication line of a fieldbus network. From the trunk, the spurs go off which connect the field devices to the fieldbus.

⇒ Spur

U

UEL

Abbreviation for "upper explosive limit" (upper flammable limit).

UL

Abbreviation for "Underwriters Laboratories, Inc.," a third-party certification agency that is an independent, self-supporting, nonprofit testing laboratory and standards developer. It is recognized by OSHA as a Nationally Recognized Testing Laboratory in the United States. The presence of UL, CSA, or FM certification labels on equipment is normally sufficient evidence to the local inspector that the product is designed to meet recognized safety standards.

Unbalance

A capacitive or resistive short circuit between a fieldbus wire and shield leads to unbalance. This is also referred to as ground fault.

Uncountable Fault

⇒ Fault

W

Wire, Shielded, Twisted-Pair

A wire with isolation against EMI (electromagnetic interference), suited for fieldbus installations.

Z

Zone

The international method of specifying the probability that a location is made hazardous by the presence, or potential presence, of flammable concentrations of gases and vapors. The term Division is used in the United States and Canada.

Zone 0

An area in which an explosive gas-air mixture is continuously present or present for long periods. Equal to a Class I, Division 1 hazardous location.

Zone 1

An area in which an explosive gas-air mixture is likely to occur in normal operation. Equal to a Class I, Division 1 hazardous location.

Zone 2

An area in which an explosive gas-air mixture is not likely to occur and if it does occur, only exists for a short time. Equal to a Class I, Division 2 hazardous location.

Zone 20

An area in which a combustible dust cloud is part of the air permanently, over long periods of time or frequently. Equal to a Class II, Division 1 hazardous location.

Zone 21

An area in which a combustible dust cloud in air is likely to occur in normal operation. Equal to a Class II, Division 1 hazardous location.

Zone 22

An area in which a combustible dust cloud in air may occur briefly or during abnormal operation. Equal to a Class II, Division 2 hazardous location.

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Ethernet

E

EI-0D2-10Y-10B..... 452

FOUNDATION Fieldbus H1

B

BP-FBPS-1.30.1..... 212

D

DM-AM-KIT 140

DP-LBF-I1.36.*..... 290

E

ELS-1 298

F

F*-FT-Ex1.D.IEC 278

F*-FT-Ex1.I.IEC 280

F*-LBF-D1.32..... 286

F*-LBF-I1.32..... 288

F.FB0.P**.A**.1.0.*** **

F.FB0.S**.A**.1.0.*** **

F.SP4.P**.B**.1.0.*** **0

F.SP4.S**.B**.1.0.*** **0

F.SPE.P**.A**.1.0.*** **

F.SPE.S**.A**.1.0.*** **

F.TI0.P12.*08.F.0.*** **00

F.TI0.S12.*08.F.0.*** **00

F.VC0.P21.A04.*.*** **000

F.VC0.S20.A04.*.*** **000

F2D0-FB-Ex4.*..... 246

F2D0-TI-Ex8.FF.*..... 266

F2-JB-#.*..... 252

F2-JB-I#.*..... 254

F2-SP-IC*..... 222

FBTA-228-BPFB-8..... 184

FBTA-228-BPFB-R-4R..... 186

FBTA-228-BPFB-R-8R..... 188

FD0-VC-Ex4.FF (REV 2013)..... 272

H

HCD2-FBPS-1.23.500..... 200

HCD2-FBPS-1.500..... 202

HD2-DM-A..... 142

HD2-DM-A.RO..... 144

HD2-DM-B..... 146

HD2-FBCL-1.500..... 196

HD2-FBPS-1.17.500..... 190

HD2-FBPS-1.23.500..... 192

HD2-FBPS-1.25.360..... 198

HD2-FBPS-1.500..... 194

K

KLD0-SAA..... 284

KLD2-FBPS-1.12.220..... 204

KLD2-FBPS-1.25.360..... 206

KLD2-PC-1.1.IEC..... 208

KLD2-PR-1.IEC..... 210

KMD0-FT-Ex..... 282

KT-MB-DMA..... 148

KT-MB-FB-D-4R..... 256

KT-MB-FB-D-4R.GEN..... 258

KT-MB-FB-D-4R.YO..... 260

KT-MB-GT2AD.FF..... 150

KT-MB-GT2AD.FF.IO..... 152

M

MB-FB-1R..... 154

MB-FB-2R..... 156

MB-FB-4..... 158

MB-FB-4.GEN..... 160

MB-FB-4.YO..... 162

MB-FB-4R..... 164

MB-FB-4R.GEN..... 166

MB-FB-4R.HO.SC..... 168

MB-FB-4R.YO..... 170

MBHC-FB-8R..... 176

MBHC-FB-8R.HSC*..... 178

MBHC-FB-8R.RH*..... 180

MBHC-FB-8R.YO..... 182

MBHD-FB1-4R..... 172

MBHD-FB1-4R.YO..... 174

R

R-SP-E12..... 238

R2-SP-IC*..... 218

R2-SP-N* (Ex ic)..... 216

R3-SP-IBD12..... 262

RD0-FB-Ex4.*..... 244

RD0-TI-Ex8.FF.*..... 264

RM-SP*..... 220

S

SCP-LBF-IA1.36.IE*..... 296

SPJB-**-AL*.***..... 228

SPJB-**-CS*.***..... 230

SPJB-**-FB*.***..... 232

SPJB-**-PCW*.***..... 234

SPJB-**-SS*.***..... 236

T

TCP-LBF-IA1.36.IE*	294
TPH-LBF-IA1.36.DE*	292

U

USB-FBPS-1.11.45.NI	214

PROFIBUS PA**B**

BP-FBPS-1.30.1	370

D

DM-AM-KIT	330
DP-LBF-I1.36.*	438

E

ELS-1	446

F

F*-FT-Ex1.D.IEC	426
F*-FT-Ex1.I.IEC	428
F*-LBF-D1.32	434
F*-LBF-I1.32	436
F.FB0.P**.A**.1.0.***.***.***	404
F.FB0.S**.A**.1.0.***.***.***	406
F.SP4.P**.B**.1.0.***.***.***0	380
F.SP4.S**.B**.1.0.***.***.***0	382
F.SPE.P**.A**.1.0.***.***.***	396
F.SPE.S**.A**.1.0.***.***.***	398
F.VC0.P21.A04.*.***.***.***000	422
F.VC0.S20.A04.*.***.***.***000	424
F2D0-FB-Ex4.*	402
F2-JB-#.*	408
F2-JB-I#.*	410
F2-SP-IC*	378
FD0-BI-Ex12.PA (REV 2013)	418
FD0-VC-Ex4.PA (REV 2013)	420

H

HD2-DM-A	332
HD2-DM-A.RO	334
HD2-DM-B	336
HD2-FBCL-1.500	356
HD2-FBPS-1.17.500	350
HD2-FBPS-1.23.500	352
HD2-FBPS-1.25.360	358
HD2-FBPS-1.500	354
HD2-GTR-4PA	364

K

KFD2-BR-1.PA.93	366
KFD2-BR-Ex1.3PA.93	368
KLD0-SAA	432
KMD0-FT-Ex	430
KT-MB-DMA	338
KT-MB-FB-D-4R.GEN	414
KT-MB-GT2AD.FF	340
KT-MB-GT2AD.FF.IO	342
KT-MB-GTB-2PS	344
KT-MB-GTB-D-2PS	412

M

MB-FB-4.GEN	346
MB-FB-4R.GEN	348
MB-FB-GT	360
MB-FB-GTR	362

R

R-SP-E12	394
R2-SP-IC*	374
R2-SP-N* (Ex ic)	372
R3-SP-IBD12	416
RD0-FB-Ex4.*	400
RM-SP*	376

S

SCP-LBF-IA1.36.IE*	444
SPJB-**-AL*.***	384
SPJB-**-CS*.***	386
SPJB-**-FB*.***	388
SPJB-**-PCW*.***	390
SPJB-**-SS*.***	392

T

TCP-LBF-IA1.36.IE*	442
TPH-LBF-IA1.36.DE*	440

YOUR APPLICATION. OUR CHALLENGE.

PROCESS INTERFACES

- Intrinsically safe barriers
- Signal conditioners
- Fieldbus infrastructure
- Remote I/O systems
- HART interface solutions
- Level measurement
- Purge and pressurization systems
- Industrial monitors and HMI solutions
- Explosion protection equipment
- Wireless solutions
- Solutions for process interfaces

INDUSTRIAL SENSORS

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic sensors
- Rotary Encoders
- Positioning Systems
- Inclination and acceleration sensors
- AS-Interface
- Identification systems
- Logic control units



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