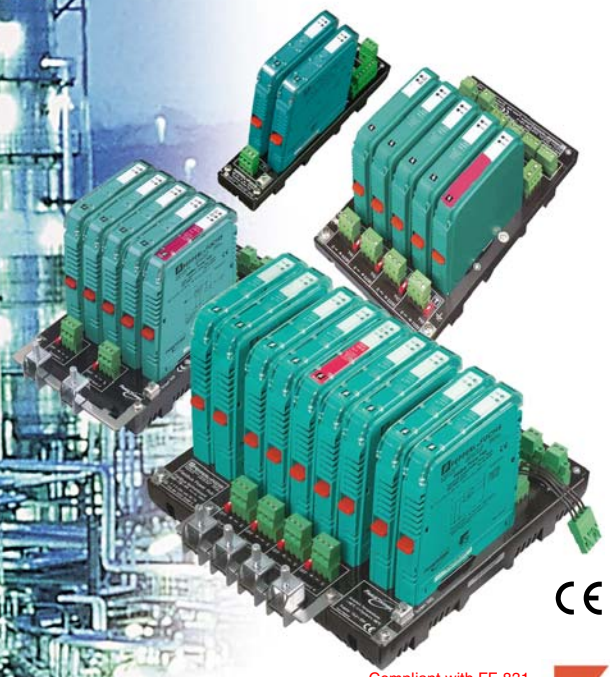
PROCESS AUTOMATION

System Manual

Fieldbus Power Hub

A family of advanced high performance simplex or redundant balanced Fieldbus Power Supplies and Power Conditioners:

SAFE AREA
ZONE 2 / Div. 2



CE

Compliant with FF-831
The latest FF power supply test specification

FF-831

Crosstalk & Resonance suppression technology **CREST**

PEPPERL+FUCHS
FieldConnex™

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1 Quick acting reference list

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2 Explanation of symbols

2.1 Safety-relevant Symbols

Warning

This symbol indicates a warning about a possible danger.
In the event the warning is ignored, the consequences may range from personal injury to death or from damage to equipment to destruction.

Attention

This symbol warns of a possible fault. Failure to observe the instructions given in this warning may result in the device and any connected facilities or systems to it develop a fault or fail completely.

2.2 Informative Symbols

Note

This symbol brings important information to your attention.

This symbol marks an acting paragraph.

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3 Introduction

This manual describes the Pepperl+Fuchs Fieldbus Power Hub System which consists of different products:

Product	Specification
MB-FB-1R	Motherboard 1x redundant Fieldbus segment (Basic Diagnostic module function integrated)
MB-FB-2R	Motherboard 2x redundant Fieldbus segments (4x Power Supplies + 1x Diagnostic module)
MB-FB-4	Motherboard 4x simplex Fieldbus segments (4x Power Supplies + 1x Diagnostic module)
MB-FB-4R	Motherboard 4x redundant Fieldbus segments (8x Power Supplies + 1x Diagnostic module)
HD2-FBPS-1.500	Isolated Fieldbus Power Supply, 28 - 30 V, 500 mA output
HD2-FBPS-1.23.500	Isolated Fieldbus Power Supply, 21 - 23 V, 500 mA output
HD2-FBPS-1.17.500	Isolated Fieldbus Power Supply for FNICO installations, 15 - 17 V, 500 mA output
HD2-FBCL-1.500	Fieldbus Power Conditioner, 500 mA output
HD2-DM-B	Common Basic Fieldbus Diagnostic module
HD2-DM-A	Advanced Diagnostic module (general description only, see corresponding manual and data sheet)

The described solution is intended for use with FOUNDATION Fieldbus Host systems with generic Host interface connector. For other Fieldbus host specific solutions please contact Pepperl+Fuchs.

It is assumed the user has technical knowledge of and experience in the areas of FOUNDATION Fieldbus, explosion protection, as well as planning and installing FOUNDATION Fieldbus systems. The manual does not provide an introduction to FOUNDATION Fieldbus or explosion protection for inexperienced users.

The Declaration of Conformity, Certificate of Compliance and data sheets are an integral part of this manual. The data sheets contain the electrical data of the Declaration of Confirmity and the Certificate of Compliance.

For further information please refer to the Pepperl+Fuchs "Wiring and Installation Guide".

The documents are available on the internet at www.fieldconnex.info or contact your local Pepperl+Fuchs representative.

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4 Instructions

4.1 Intended use

The Fieldbus Power Hub product range is intended to power up to four FOUNDATION Fieldbus H1 segments either in simplex or redundant mode according to IEC 61158-2.

The Fieldbus Power Hub product range may be installed in Zone 2 or Class I Division 2 hazardous areas. Type of protection is EEx nA (non-arcing) for Zone 2 Gas Groups IIC, IIB, IIA, and non-incendive for use in Class I Division 2 Gas Groups A, B, C and D.

Laws and/or regulations governing the use or intended use must be observed. The Fieldbus Power Hub products are only approved for proper professional use in accordance with the intended purposes. Improper handling will void any claim made under the warranty as well as any manufacturer's liability.

The Fieldbus Power Hub system must only be operated by trained professionals in accordance with this instruction manual.

Warning

Protection of operating personnel and the system is not ensured, if the module is not used in accordance with its intended purpose.

Warning

The operator of the system is responsible in terms of planning, mounting, commissioning, operating and maintenance.

Warning

If devices are operated in general electrical systems, they must not thereafter be operated in electrical systems that are connected with hazardous areas.

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4.2 Marking

The Fieldbus Power Hub product range is product specific marked with:

Motherboard	Power Supply Modul	Basic Diagnostic Modul	Advanced Diagnostic Modul
Pepperl+Fuchs GmbH	Pepperl+Fuchs GmbH	Pepperl+Fuchs GmbH	Pepperl+Fuchs GmbH
Fieldbus Power Hub	Fieldbus Power Hub	Fieldbus Power Hub	Fieldbus Power Hub
MB-FB-****	HD2-FB****	HD2-DM-B	HD2-DM-A
TÜV 04 ATEX 2500 X	TÜV 04 ATEX 2500 X	TÜV 04 ATEX 2500 X	TÜV 04 ATEX 2500 X
			
II 3 G EEx nA C IIC T4	II 3 G EEx nA II T4	II 3 G EEx nA C IIC T4	II 3 G EEx nA II T4

Note

The stars replace a combination of characters depending on the version.

4.3 Mounting and dismounting

Warning

Installation and commissioning of the Fieldbus Power Hub must be performed by a trained person.

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Instructions

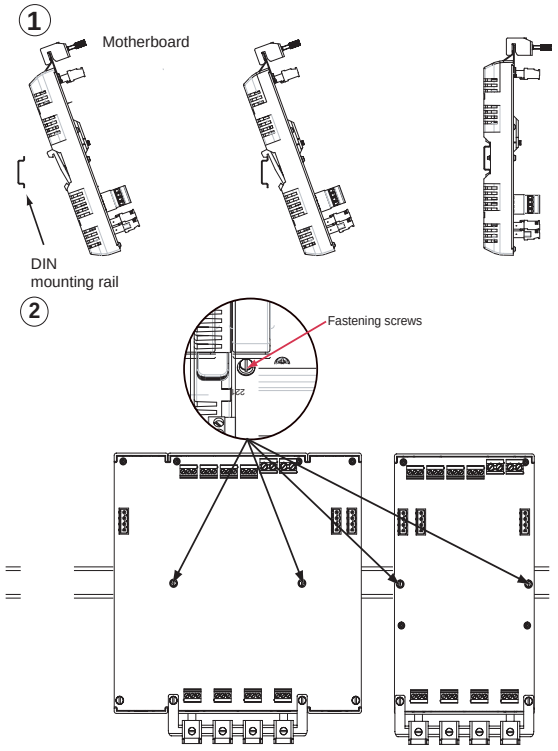
Mounting of Fieldbus Power Hub motherboards MB-FB-*

The Power Hub motherboards are designed for protection class IP 00 in accordance with EN 60529 and must accordingly be protected against adverse ambient conditions such as water splashing or dirt. They are intended for DIN rail mounting.

To mount a motherboard proceed as follows:

1. Place the motherboard on the DIN rail.
2. Tighten the two fastening screws to attach the motherboard to the DIN rail.

The motherboard is mounted.



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Mounting of HD2*-Modules on the motherboard

Attention

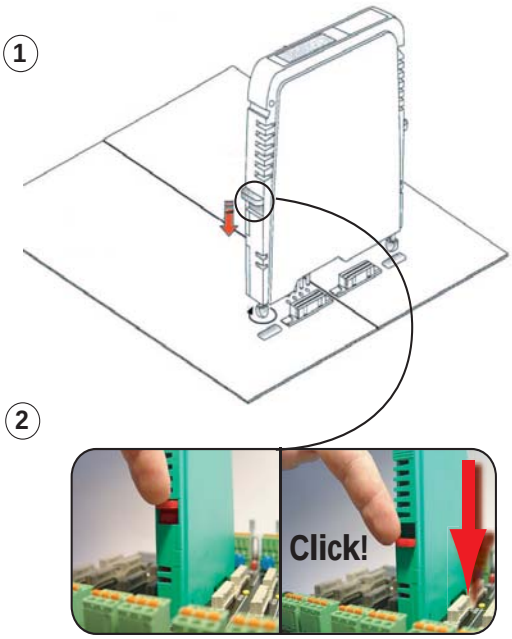
There is a special connection slot for the diagnostic modules HD2-DM** on the Power Hub motherboard, which is labeled “Diagnostic Module only“. Do not try to plug other modules into this connection slot. Other modules may be damaged.

The housing of HD2-*-Modules meets the degree of protection class IP 20. It is intended for mounting on the Fieldbus Power Hub motherboards MB-FB-*.

To install a new module on the board proceed as follows:

1. Carefully center the polarisation holes and mate the two connectors, then gently press down the module.
2. Push down the red “Quick-LOK“ tabs on each side of the module to attach it to the panel (no tools required).

The new module is installed.



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Dismounting of HD2*-Modules

To remove the modules proceed as follows:

Push the red “Quick-LOK“ tabs upwards and lift off the entire module gently.

The module is removed.

4.4 Repair and maintenance

Warning

Devices being operated in connection with hazardous areas may not be changed or manipulated.

Warning

In case of defect, the device must be removed and replaced with a new one.

Warning

Fieldbus Power Hub products which are operated in conjunction with hazardous areas must not be modified. If there is a defect, the product must always be replaced by an original part.

If the motherboard is defective, it can be removed from a chain of Power Hubs by linking the two adjacent motherboards by means of a relief connection. The replacement of any part of the Fieldbus Power Hub may be done under live conditions.

Tasks for eleminating malfunctions must only be performed by specialists who are specially trained and authorized for the task.

4.5 Disposal

Disposal of devices and their packaging material must be performed in compliance with the applicable laws and guidelines of the corresponding country.

The devices do not contain batteries which need to be disposed of separately from the products.

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5 Specification

5.1 Overview

The FieldConnex Power Hub for Foundation Fieldbus is a fully balanced, high-performance platform for communication and power supply to field devices via a single shielded cable. The Power Hub design is in accordance with IEC 61158-2 Fieldbus specifications. Communication with a host system is established by modulating the data signal onto the power stream utilizing the Manchester Bus Protocol (MBP).

A Power Hub System consists of one motherboard and one or more plug-in modules for power supply and diagnostic functions. Power Modules exist in two forms: Power Supply Modules provide full galvanic isolation; Power Conditioner Modules provide current limiting capability without galvanic isolation.

The Power Hub System is designed around the High Power Trunk Concept, allowing the main trunk to reach into Zone 1/Div. 1 by using increased safety and non-incendive behavior to field devices connected via spurs. Maximum cable length and maximum number of field devices are thus achieved.

The following table shows the main features of the Power Hub system and their benefits.

Features		User benefit
Low full load heat dissipation (per segment)	< 2 W	long life expectation
Hot swap capability	YES	increased segment availability
Host fault isolation (short circuit protection)	YES Conditioner only	increased segment availability
Redundant or simplex configuration	YES	flexible segment design
Fully balanced (electrically)	YES	excellent Fieldbus signal quality, increased robustness
Ultra-high integrity passive power conditioners	YES	excellent Fieldbus signal quality, increased robustness

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Specification

Features		User benefit
Fieldbus diagnostic	YES	proactive maintenance will increase reliability and reduces costs
Local and remote alarm annunciation	YES	easy maintenance
High RF and in-band interference isolation	YES	increased robustness
Segment inrush tolerance	YES	tolerant to field device misbehavior
Full current span operation (10 mA to 500 mA)	YES	flexible segment design
Current load share	YES	interruption free communication in case of a module failure
Redundant current sensing	YES Conditioner only	less bulk Power Supply necessary

5.2 Power Supply to field devices

Field devices are supplied by Power Modules, which are plugged into the sockets of the Power Hub Motherboard. A simplex motherboard will hold 4 Power Modules, a redundant motherboard will hold up to 8 Power Modules. Bus cables connect each segment to the motherboard.

A simplex supply is achieved using one Power Module per segment, a redundant supply uses 2 Power Modules per segment. Either galvanically isolated Power Supply Modules or non-galvanically isolated Power Conditioner Modules can be used.

Note

Do not mix a galvanically isolated Power Supply Module and a non-galvanically isolated Power Conditioner Module on the same segment. This will trigger an error if a Diagnostic Module is connected to the Motherboard.

The Power Modules allow for basic diagnostics via integrated LEDs which indicate availability of the module and correct supply voltage. An additional LED indicates a failure of the module (see below).

If fitted with two Power Modules per segment, the Power Hub supplies the segments redundantly.

All in all, the power supply achieves the following tasks:

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- Supply of field devices: POWER + communication signal
- Redundant supply for high availability
- Basic diagnostics via LEDs
- Advanced Physical Layer Diagnostics using the Advanced Diagnostic Module HD2-DM-A and the FDT/DTM software packet

5.3 System components

5.3.1 Motherboards

Motherboards are available for one, two or four fieldbus segments. Motherboards are typically mounted on DIN rails inside a wiring or marshalling cabinet. Wiring connectors exist on board for two independent bulk power supplies, fieldbus segments, fault and diagnostics signalling.

MB-FB-1R

The motherboard MB-FB-1R is a system component of the FieldConnex Power Hub. It allows redundant supply for one fieldbus segment as well as the connection of the FOUNDATION Fieldbus H1 host system. Two sockets will hold the power supply modules which operate in redundancy. The modules are available for different explosion protection concepts and with various isolation levels. Basic system diagnostic features are integrated and visualized by LED. All modules are checked for proper function and integrity. The bulk power supplies are checked for working in the proper voltage range and the connected trunk is monitored for overload and short-circuit.

MB-FB-2R

The motherboard MB-FB-2R is a system component of the FieldConnex Power Hub. It allows the redundant supply of two fieldbus segments and a redundant connection of the FOUNDATION Fieldbus H1 Host system, switchable with one or two connection cables. Four sockets will hold the power supply modules, two each are in redundancy per segment. The modules are available for different explosion protection concepts and with various isolation levels. The extra socket will hold a diagnostics module.

MB-FB-4

The motherboard MB-FB-4 is a system component of the FieldConnex Power Hub. It allows the supply of four fieldbus segments and the connection of the FOUNDATION Fieldbus H1 host system. The four sockets will hold the power supply modules. The power modules are available for different explosion protection concepts and with various isolation levels. The extra socket will hold a diagnostics module.

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Specification

MB-FB-4R

The motherboard MB-FB-4R is a system component of the FieldConnex Power Hub. It allows the redundant supply of four fieldbus segments and the redundant connection of the FOUNDATION Fieldbus H1 Host system, switchable with one or two connection cables. The eight sockets will hold the power supply modules, two each are in redundancy per segment. The extra socket will hold a diagnostics module.

5.3.2 Modules

Power Modules are connected to the motherboard via sockets. Replacement under live conditions (hot-swap) and load sharing capability in redundant configuration enable interruption-free communication. The modules are available in different explosion protection concepts and with various isolation levels.

Power Modules

- Power Supply Modules
  Modules providing full galvanic isolation between bulk power supply and fieldbus segments are called “Power Supply Modules“. They provide optimal system reliability for applications where cabling and wiring are routed through critical or harsh electrical environments, i.e. where superior protection from electromagnetic interference (EMI) is mandatory.
  Different Power Supply Modules exist with voltage regulated and limited energy levels according to the specifications of FNICO, Entity and FISCO standards. A maximum output current of 500 mA is available to power field devices.
- Power Conditioner Modules
  Modules with current limiting circuits between bulk power supply and fieldbus segment and without galvanic isolation are called “Power Conditioner Modules“. Power Conditioner Modules carry passive components only and can be used where ’good wiring practice’ is followed and reduced safety requirements exist such as protection type n or increased safety. Power Conditioner Modules utilize CREST technology thereby creating high impedance for common mode noise and network resonance effects.

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5.3.3 Schematic Overview

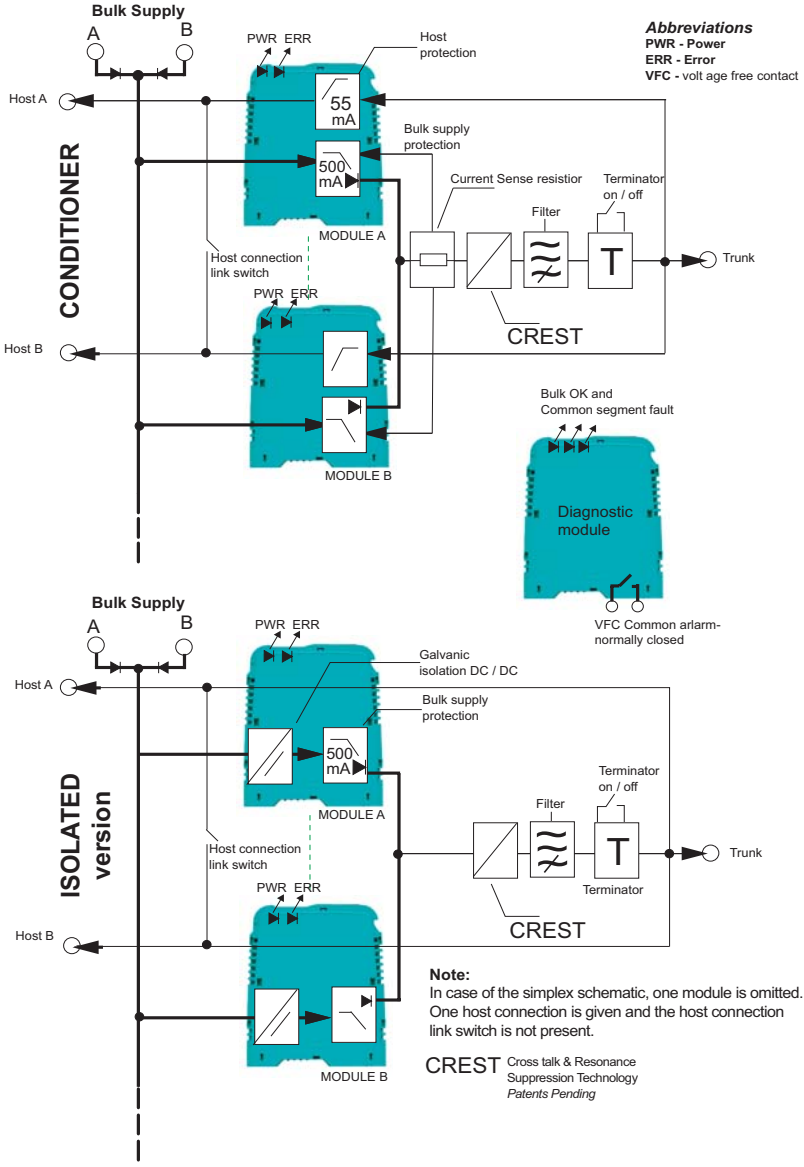

Bild 5.1: Schematic Overview

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Specification

5.3.4 Diagnostic Modules

- Basic Diagnostic Module
  The Diagnostic Module HD2-DM-B is a system component of the FieldConnex Power Hub. It provides basic system diagnostics. It checks if the bulk power supplies are working in the proper voltage range and monitors the connected trunks for overload or shortcircuit. Each Power Hub Module is checked for proper function, in case of redundant versions a system integrity check is performed.
  Malfunctions are indicated by LEDs and can be transmitted by voltage free contact connection. The module can be plugged onto the different motherboards in combination with various other modules.
- Advanced Diagnostic Module
  The Advanced Diagnostic Module HD2-DM-A is part of the FieldConnex Power Hub product range. In conjunction with the FDT/DTM based PC software package it provides critical analysis of signal and segment parameters e.g. bulk power or short circuit, as well as detailed measurement of specific system and node physical layer values e. g. noise or jitter levels and unbalance detection. The integrated powerful oscilloscope function visualizes the communication at each segment. Continuous monitoring of all relevant physical layer parameters proactively detects degradation before the segment communication fails.

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5.4 Fieldbus Power Hub Basic Diagnostics

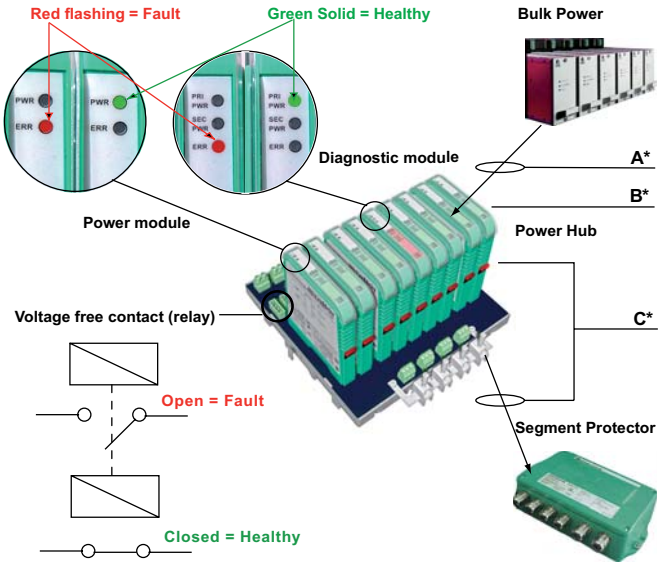
Self-supervision functions consist of circuitry located in the motherboard, the Power Modules and an optional Diagnostics Module. Basic Diagnostics monitor the Power Hub System for the following conditions:

- Availability of bulk power supplies
- Output voltage and overload or short circuit conditions per segment
- Module failure

In redundant configurations, a system integrity check is performed annunciating mismatching types of Power Modules and the availability of only one Power Module.

Visual alarm notification, which meets the requirements of NAMUR BE44, is provided by the Power and Diagnostic Modules. Green LEDs and a normally closed, potential-free contact indicate normal system operation. If an abnormal system condition is detected, a red LED starts flashing. Simultaneously, the relay contact opens.

The following figure illustrates the locations of the LEDs on the Modules. The table in chapter “Basic diagnostic information” on page 16 details possible system conditions and respective indication at the Power Hub.



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5.5 Basic diagnostic information

Fault	Relay Contact	Diagnostic Module[a]	Power Module
A: Supply Under/Over Voltage Detection			
> 18.5 V DC +/- 4 % < 35.8 V DC +/- 4 %		PRI PWR SEC PWR ERR	PWR ERR
< 17.5 V DC +/- 4 % > 36.8 V DC +/- 4 %[b]		PRI PWR SEC PWR ERR	PWR ERR
B: Power Module compatibility (redundant system)			
All modules are compatible (either isolated or conditioner type at each segment[c])		PRI PWR SEC PWR ERR	PWR ERR
An isolated module has been mismatched or paired with a conditioner module for one or more segments		PRI PWR SEC PWR ERR	PWR ERR
C: Power Module or load status			
Power Module failure		PRI PWR SEC PWR ERR	PWR ERR
Output overload or trunk short circuit		PRI PWR SEC PWR ERR	PWR ERR
All Power Modules fixed and healthy		PRI PWR SEC PWR ERR	PWR ERR
For redundant mother-boards only: Only one Power Module is fitted to a segment		PRI PWR SEC PWR ERR	PWR ERR

a. At the single redundant segment motherboard version LED „ERR“ is labeled as LED „ERR/Alarm“
b. For the Diagnostic Module, the power (PWR) indicator will show the status of each bulk power connection. **Example:** If the primary supply fails, the Primary Bulk Power LED (PRI PWR) will go out and the ERR LED will flash. The Secondary Bulk Power LED (SEC PWR) will continue to show green.
c. A motherboard may contain a mixture of isolated and non-isolated (Conditioner) Power Modules, but not for the same segment

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5.6 Mobile Advanced Diagnostic Solution

In addition to the Advanced Diagnostic Module HD2-DM-A described in chapter 5.3.4, the FieldConnex® system offers a solution for mobile diagnosis.

5.6.1 The Mobile Advanced Diagnostic Module DM-AM

The Mobile Advanced Diagnostic Module DM-AM is a USB powered universal tool to analyze the Physical Layer parameters of a fieldbus segment. The integrated USB 2.0 fullspeed interface permits a simple handling and the necessary convenient portability in the field: It can be connected anywhere on the Fieldbus network.

Used in conjunction with the FDT/DTM based PC software package it provides basic analysis of signal and segment parameters e. g. measurement of specific system and node physical layer values e. g. increasing noise or jitter levels and unbalance detection. The integrated powerful oscilloscope function enables to visualize the communication at a segment. The continuous monitoring of all relevant physical layer parameters allows to detect proactive degradations before the segment communication fails.
As a part of the PACT*ware*™ FieldConnex ® DTM collection, a DTM is offered which supports e. g. alarming, trending, report generation and oscilloscope function.

Note

You can find a complete overview of the Advanced Diagnostic Solutions on the individual instruction manuals and data sheets of the two devices. They can be downloaded from www.pepperl-fuchs.com.

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Specification

5.7 Technical data

System specification		
Ambient conditions		MB-FB-1R
Ambient temperature	-40..60 °C	
Storage temperature	-40..85 °C	
Shock resistance	15 g 11 ms	
Vibration resistance	1 g, 58 to 150 Hz	
Humidity	<95 % non condensing	MB-FB-2R
Mechanical specification		
Connection type for external wiring	Plug in screw	
Cross core section	Up to 2.5 mm²	
Protection degree	IP 20 acc. to EN 60529	MB-FB-4
Motherboard mounting	DIN rail 35 mm	
Standards		
Shock resistance	DIN EN 60068-2-27	
Vibration resistance	DIN EN 60068-2-6	
EMC	Namur NE 21 EN 61326 IEC 61158-2	MB-FB-4R
Fieldbus	IEC 61158-2	
Hazardous area classification		
Approvals	Zone 2 II 3 G EEx nA II T4 Class I Division 2 Gas Groups A-D	

Motherboard types MB-FB-2R, MB-FB-4, MB-FB-4R		
Input/Output		
Rated input voltage	21.6 to 25.2 V DC	
Rated input current	16 A	
Fieldbus terminator	Switchable, per segment	
Screen/shield earthing	Trunk, Host: on screen/ ground connection clamp. Optionally on earth bar with cable clamps.	

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Motherboard type MB-FB-1R	
Input/Output	
Rated input voltage and current	19.2 to 35 V DC
Rated input current	16 A
Power Dissipation	Max 0.5 W
Fieldbus terminator	Fixed integrated
Screen/shield earthing	Trunk, Host: on screen/ ground connection clamp
LED indication	
Primary and secondary input power	Green, if the input power is >18.5 V
Error/Alarm	Red (flashing 2 Hz), if the output of at least one Power Module is in short circuit, overload or under voltage condition. Basic diagnostic functionality is built in.

Isolated Power Supply Module type HD2-FBPS-1.500	
Input/Output	
Rated input voltage	19.2 to 35 V DC
Rated output voltage	28 to 30 V DC from full load to zero
Rated output current	500...10 mA
Power dissipation	Typ. 2.5 W
Supply input to galvanically isolated Fieldbus output	Functional insulation acc. to DIN EN 50178, rated insulation voltage 50 V_{eff} AC
LED indication	
Output power (PWR)	Green, if the output voltage is >28 V
Error (ERR)	Red (flashing 2 Hz), if the output is in short circuit, overload or under voltage condition

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Specification

Isolated Power Supply Module type HD2-FBPS-1.23.500	
Input/Output	
Rated input voltage	19.2 to 35 V DC
Rated output voltage	21 to 23 V DC from full load to zero
Rated output current	500...10 mA
Power dissipation	Typ. 1.8 W
Supply input to galvanically isolated Fieldbus output	Functional insulation acc. to DIN EN 50178, rated insulation voltage 50 V_{eff} AC
LED indication	
Output power (PWR)	Green, if the output voltage is >21 V
Error (ERR)	Red (flashing 2 Hz), if the output is in short circuit, overload or under voltage condition

Isolated FNICO Power Supply Module type HD2-FBPS-1.17.500	
Input/Output	
Rated input voltage	19.2 to 35 V DC
Rated output voltage	15 to 17 V DC from full load to zero
Rated output current	500...10 mA
Power dissipation	Typ. 1.6 W
Supply input to galvanically isolated Fieldbus output	Functional insulation acc. to DIN EN 50178, rated insulation voltage 50 V_{eff} AC
LED indication	
Output Power (PWR)	Green, if the output voltage is >15 V
Error (ERR)	Red (flashing 2 Hz), if the output is in short circuit, overload or under voltage condition

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Power Conditioner non-isolated type HD2-FBCL-1.500	
Input/Output	
Rated input voltage	19.2 to 32 V DC
Output voltage	Input voltage minus 2.5 V at full load
Rated output current	500 mA
Power dissipation	Max. 0.8 W
Nominal host output current	40 mA
Host short circuit current	Typ. 55 mA
LED indication	
Output Power (PWR)	Green, if output voltage is >16 V
Error (ERR)	Red (flashing 2 Hz), if the output is in short circuit, overload or under voltage condition

Basic Diagnostic Module type HD2-DM-B	
Supply	
Rated voltage	19.2 to 35 V DC
Rated current	20 mA
Power dissipation	Max. 0.5 W
Indicators/operating means	
LED Pri Power	Green: primary input power connected
LED Sec Power	Green: secondary input power connected
LED Err	red: 2 Hz flashing, power supply fault (short circuit, undervoltage), redundancy fault
Fault Signal	VFC alarm 1 A, 50 V AC, normally closed

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Specification

Advanced Diagnostic Module type HD2-DM-A	
Supply	
Rated voltage	19.2 to 35 V
Rated current	110 to 30 mA
Power dissipation	max. 2 W
Fieldbus interface	
Number of segments	4
Rated Voltage	9 to 32 V
Indicators/operating means	
LED Pri Power	Green: primary input power connected
LED Sec Power	Green: secondary input power connected
LED 1-4	Yellow: Bus activity. Red (flashing with 2 Hz): Alarm. Red: Hardware Error
Fault Signal	VFC alarm 1 A, 50 V AC, normally closed
DIP Switch	Diagnostic Address 1 to 247, binary coded

Connector/Terminal Configurator	
Trunk terminals	2.5 mm², screw type x 3, connector
Host terminals	2.5 mm², screw type x 3, connector
Alarm terminals	2.5 mm², screw type x 4, connector

Accessories			
Description	**Part No.**	**Components**	
Screening/ earthing kit	ACC-MB-HSK	Including earth bar, 4x cable clamps	
Diagnostic link cable	ACC-MB-HDC	Coupling of diagnostic bus between two motherboards, length 6 cm	

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5.8 Ordering information

Power Hub system ordering summary	
HD2-FBPS-1.500	Isolated Fieldbus Power Supply Module with 28 to 30 V DC and 500 mA output.
HD2-FBPS-1.23.500	Isolated Fieldbus Power Supply Module with 21 to 23 V DC and 500 mA output.
HD2-FBPS-1.17.500	Isolated FNICO Power Supply Module with 15 to 17 V DC and 500 mA output.
HD2-FBCL-1.500	Fieldbus Power Conditioner (non-isolated) Module with load share and host fault isolation (short circuit protection) 500 mA.
HD2-DM-B	Basic Diagnostic Module with LED indication and common relay fault output.
HD2-DM-A	The Advanced Diagnostic Module allows, in conjunction with the FDT/DTM based PC software package, to analyze signal and segment parameters as well as measurement of specific system and node physical layer values.
MB-FB-1R	General purpose 1x redundant segment Fieldbus motherboard with redundant bulk power feed, all connectors screw terminal type. Basic Diagnostic Module function integrated.
MB-FB-2R	General purpose 2x redundant segment Fieldbus motherboard with redundant bulk power feed and diagnostic interface, all connectors screw terminal type.
MB-FB-4	General purpose 4x segment Fieldbus motherboard with redundant bulk power feed and diagnostic interface, all connectors screw terminal type.
MB-FB-4R	General purpose 4x redundant segment Fieldbus motherboard with redundant bulk power feed and diagnostic interface, all connectors screw terminal type.
ACC-MB-HSK	Screening/earthing kit for trunk cable screen/ shield.
ACC-MB-HDC	Diagnostic link cable for daisy chaining of motherboards.

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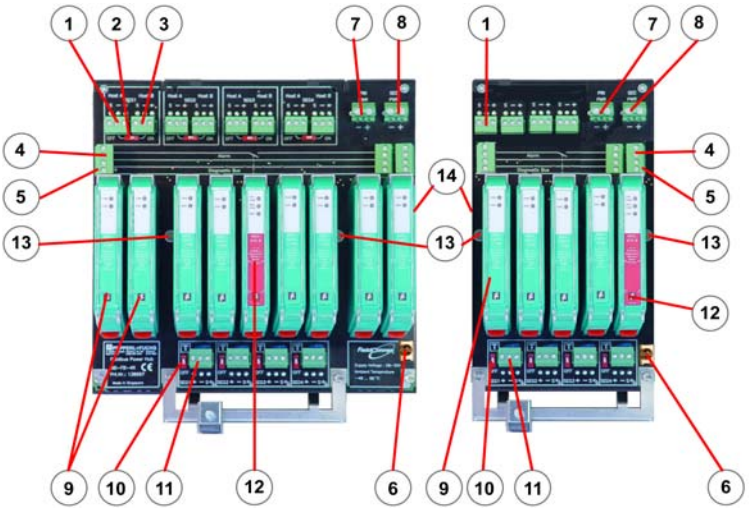
5.9 Component Identity

MB-FB-4R	MB-FB-2R, MB-FB-4



1	Host connection A (segment 1)	8	Secondary power connection
2	Host connection Link switch (segment 1)	9	Power module(s) (segment 1)
3	Host connection B (segment 1)	10	Terminator switch (segment 1)
4	Common alarm voltage free contact	11	Trunk connection (segment 1)
5	Diagnostic bus connection	12	Diagnostic module
6	Screen/ground connection clamp	13	Motherboard fastening screw
7	Primary power connection	14	DIN rail slot

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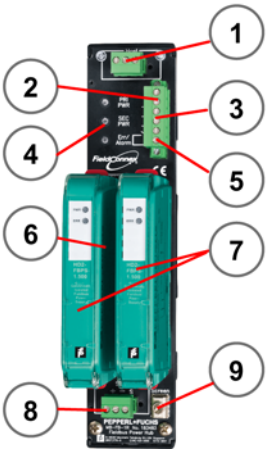
5.10 Component identity MB-FB-1R



1 Host connection
2 Primary power connection
3 Secondary power connection
4 LED indication from integrated Diagnostic module
5 Alarm output
6 Motherboard fastening screw
7 Power modules
8 Segment trunk connection
9 Screen/ground connection clamp

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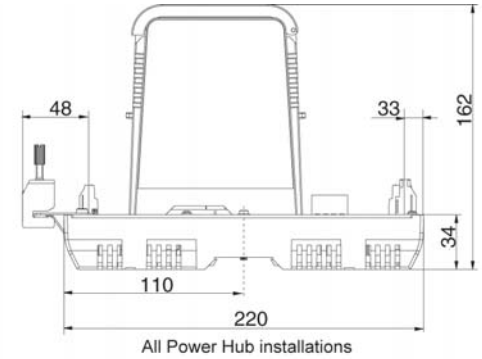
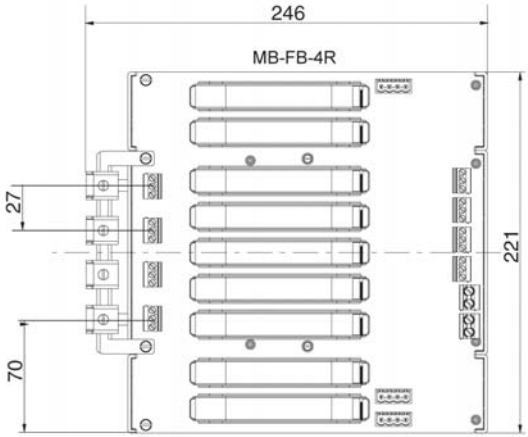
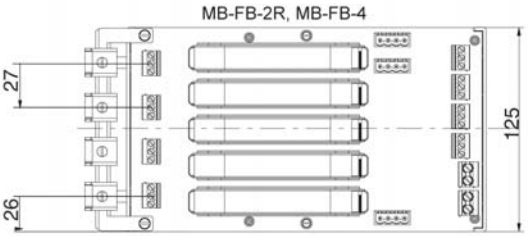
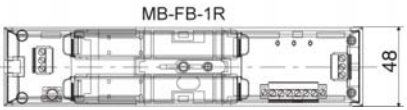
5.11 Dimensional Drawings



All Power Hub installations







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5.12 System engineering

5.12.1 Redundant Power Supply for one Fieldbus Segment

For one redundant Fieldbus segment, use the following components:

- Motherboard MB-FB-1R
- 2 x Power Modules (Power Supply Modules or Power Conditioner Modules)
- Diagnostic Module (Basic or Advanced)

5.12.2 Redundant Power Supply for two Fieldbus Segments

For two redundant Fieldbus segments, use the following components:

- Motherboard MB-FB-2R
- 4 x Power Modules (Power Supply Modules or Power Conditioner Modules)
- Diagnostic Module (Basic or Advanced)

5.12.3 Simplex Power Supply for four Fieldbus Segments

For four simplex Fieldbus segments, use the following components:

- Motherboard MB-FB-4
- 4 x Power Modules (Power Supply Modules or Power Conditioner Modules)
- Diagnostic Module (Basic or Advanced)

5.12.4 Redundant Power Supply for four Fieldbus Segments

For four redundant Fieldbus segments, use the following components:

- Motherboard MB-FB-4R
- 8 x Power Modules (Power Supply Modules or Power Conditioner Modules)
- Diagnostic Module (Basic or Advanced)

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6 Installation and commissioning

6.1 Selection and installation check list

Choosing redundant or simplex.	A simplex system will mean low segment cost, but also a substantial reduction in segment integrity.
Choosing for a Zone 1/ Div. 1 hazardous area installation.	Use Pepperl+Fuchs FieldBarrier™ in conjunction with any Power Supply Module. Consider Conditioner Module due to low risk of wiring faults with Ex technology.
Choosing for a Zone 2/Div. 2 hazardous area installation.	Implement FNICO (Fieldbus Non-Incendive Concept) using HD2-FBPS-1.17.500 Power Modules and Segment Protectors.
Choosing isolated or conditioner version.	The onditioner version will mean lower segment cost but with the added risk of segment loss through extreme cable mishandling – considerably low risk with Ex technology.
Consider your earthing/ grounding requirements.	Good earthing/grounding practice will eliminate noise issues.
Choosing basic or advanced diagnostic capabilities	Advanced Physical Layer diagnostic enables proactive maintenance to increase segment availibility
Watch out for terminator allocation.	Too many or too few? Segment failure can be attributed to the terminators.
Redundant H1 input/output?	Some redundant host systems may have one high integrity connection (cable) where others may have two.
Primary and secondary connections made to the supply input?	Redundant bulk power supplies will connect the motherboard discretely.
Diagnostic links connected? Watch out for the last motherboard link, too.	Missing links will cause only diagnostic problems and not lead to any segment failure.

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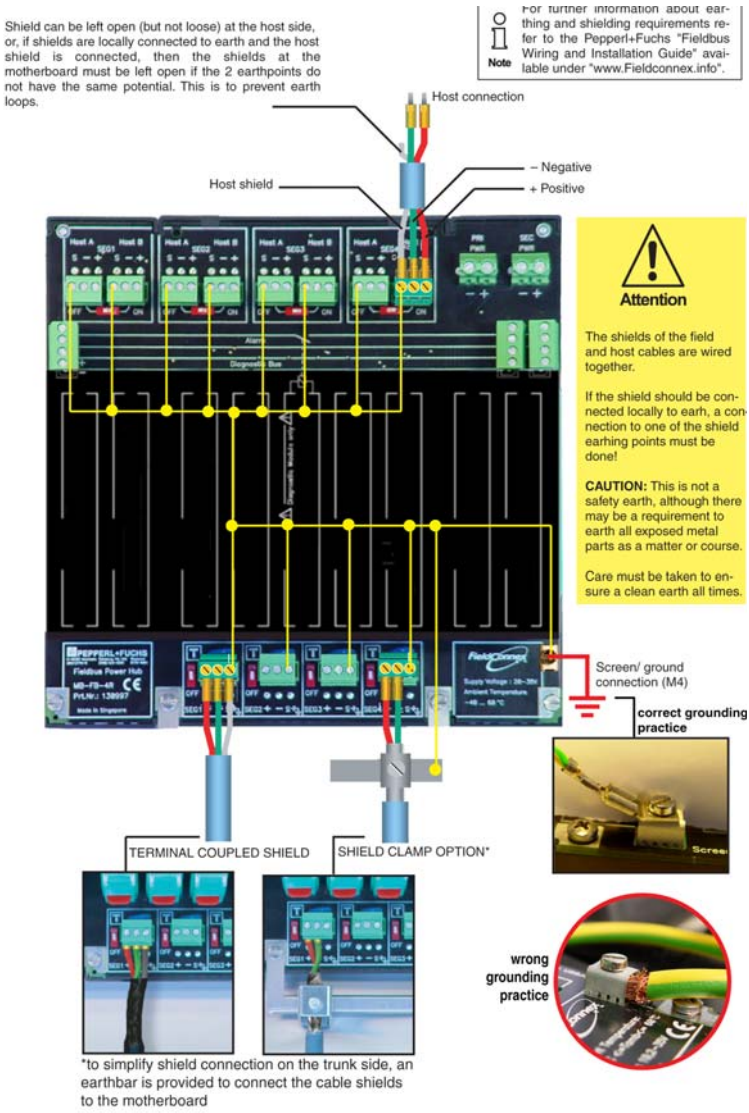
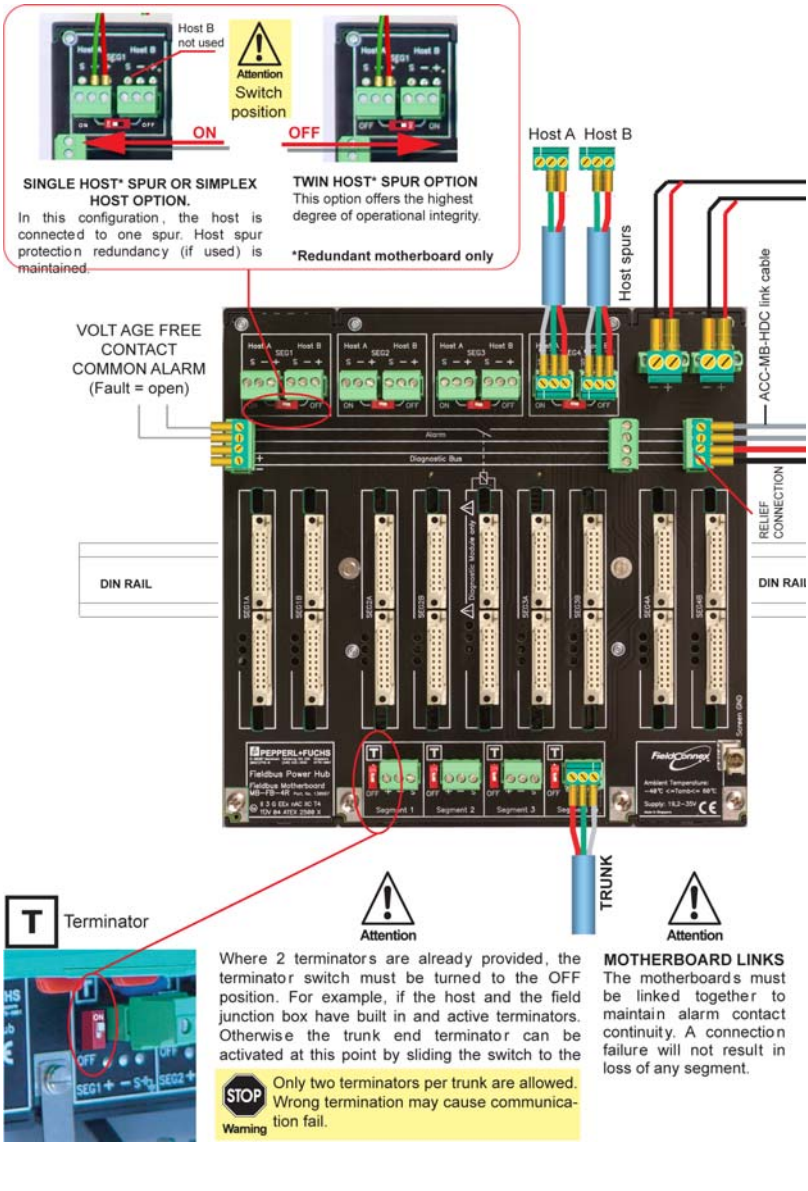
6.2 Screen/ground connection



The earth/ground and shield connection concept for the simplex and the single redundant segment motherboard is the same.

Installation and commissioning

6.3 Host and terminator connection detail



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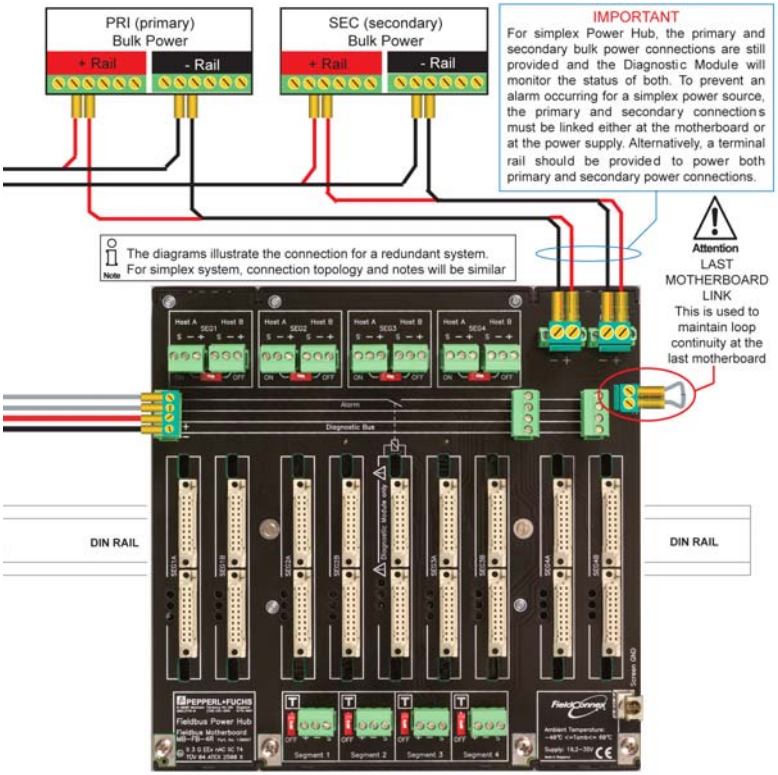
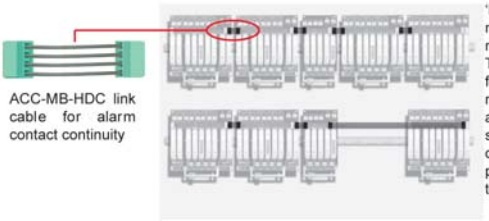
6.4 Power and diagnostic connection detail





ACC-MB-HDC link cable for alarm contact continuity

'Daisy chaining' a series of motherboards using the motherboard links.
To remove a motherboard for maintenance or replacement, first the two adjacent motherboards should be relief-connected, thus by-passing the motherboard to be removed.

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7 Installation in hazardous areas

Installation of the Power Hub within Zone 2 or Class I Division 2 area

The Fieldbus Power Hub system may be installed in Zone 2 and Class I Division 2 hazardous areas. The type of protection is EEx nA (non-arcing) for Zone 2 Gas Groups IIC, IIB, IIA, and non-incendive for use in Class I, Division 2 Gas Groups A, B, C and D. Depending on the type of Fieldbus Power Supply used in the Power Hub, different topologies and types of Zone 2/Div. 2 installations are possible.

The Fieldbus trunk is always rated EEx nA (non-arcing) for Zone 2 applications. Furthermore, the Fieldbus trunk can be placed within a Division 2 area as long as it is installed according to a Division 2 wiring method. The Power Hub, used in conjunction with the Pepperl+Fuchs Segment Protectors (SP), allows the user to 'hot swap' field devices within Zone 2 or Division 2 environment.

The maximum output current of the SPs is limited to 45 mA while the maximum voltage is based on the type of Fieldbus Power Supply used in the Power Hub. The selected Power Supply will dictate the safety parameters for the connected field instruments.

The following table summarizes the safety parameters for typical field instruments suitable for Zone 2 energy limited or Class I Div. 2 non-incendive field wiring applications:

Type of protection	Saftey relevant parameters
EEx nL Entity	Ui $\leq$ 32 V, Li $\leq$ 20 µH, Ci $\leq$ 5 nF
EEx nL FNICO	Ui $\leq$ 17.5 V, Li $\leq$ 20 µH, Ci $\leq$ 5 nF
EEx i Entity	Ui $\leq$ 24 V, Ii $\leq$ 250 mA, Li $\leq$ 20 µH, Ci $\leq$ 5 nF
EEx i FISCO	Ui $\leq$ 17.5 V, Ii $\leq$ 380 mA, Li $\leq$ 10 µH, Ci $\leq$ 5 nF

In summary, it is necessary to pay particular attention to the type of Fieldbus Power Supply selected for use on the Power Hub. This determines the type of certified field instruments that can be connected in Zone 2 or Div. 2 area. In all of the following examples, the use of Pepperl+Fuchs Segment Protectors is critical to the Zone 2/Div. 2 topology.

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Warning

For further information about the installation in Division 2 hazardous areas, please refer to the control drawing (control drawing number on the respective data sheet).

7.1 Safety Instructions

Warning

The Declaration of Conformity and Certificate of Compliance of all parts belonging to the Fieldbus Power Hub system must be observed. It is especially important to pay attention to any special conditions for safe use that are indicated.

Warning

The Fieldbus Power Hub should be installed in a protection class IP 54 or better enclosure in accordance with EN 60529.

Warning

Only devices which are suitable for operation in hazardous areas Zone 2/ Div. 2 and the conditions present at the place of operation (see Declaration of Conformity or Certificate of Compliance), shall be connected to non-energy limited circuits in Zone 2, resp. Class I, Div. 2.

Warning

Field devices which are directly connected to the segment trunk connections must be suitable for use in hazardous areas, category 3G (Zone 2) or Class I Div. 2.

Warning

In a Zone 2 installation, connection or disconnection of energized non-energy limited circuits on the trunk is only permitted during installation, maintenance or for repair purposes since the presence of an explosive atmosphere during the short period of installation, maintenance or repair is considered as improbable. This also applies to the switch components on the motherboard of the Power Hub.

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Installation in hazardous areas

Warning

In a Div. 2 installation, connection or disconnection of the equipment at the power connections or changes at the switch components on the motherboard are only allowed if the area is known to be non-hazardous.

Warning

Special care must be taken if Power Supplies are to be used in conjunction with Pepperl+Fuchs Segment Protectors for energy limited, non-incendive field wiring. A check must be made to ensure that the correct Power Supply type is used in relation to its output values. For example, the output voltage must be equal or less than the maximum voltage of the connected field devices.

Warning

If devices are operated in general electrical systems, they must not thereafter be operated in electrical systems that are connected with hazardous areas.

Warning

The temporary coexistence of potentionally explosive atmosphere and installation, maintenance and repair work is considered improbable in Zone 2.

Warning

Isolated and Non-isolated Power Modules can be connected to the motherboard. However, each segment on a redundant motherboard must only be fitted with two modules of the same type (i.e. either two Power Supply Modules or two Power Conditioner Modules).

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7.2 Fieldbus Power Supply HD2-FBPS-1.500

7.2.1 Energy limited, non-incendive field wiring for field devices using the Fieldbus Power Supply HD2-FBPS-1.500

If the general purpose Fieldbus Power Supply HD2-FBPS-1.500 is used in conjunction with Pepperl+Fuchs Segment Protectors (SPs), the outputs of the SP will be classified EEx nL (energy limited) or non-incendive field wiring.

Due to the unlimited trunk energy, live work at the trunk is not permitted without gas clearance. However, live connect or disconnect at the output spurs of the SP is allowed, if the following Entity Concept safety evaluation/requirements for the field devices are followed:

32 V M Ui (field device)

Li field device + L cable M 0.25 mH

Ci field device + C cable M 100 nF

No special safety requirements exist for the host interface, provided the host itself is installed in the safe area. If the host interface is installed in Zone 2 or Div. 2, a Declaration of Conformity or a Certificate of Compliance for EEx nA, non-incendive equipment must be provided.

Field devices with a voltage of Ui N 32 V, certified EEx nL or EEx i are allowed to be connected to the outputs of the SP under a Zone 2 energy limited, Div. 2 non-incendive field wiring rating.

Today only a small quantity of field devices certified for EEx nL or EEx i with Ui N 32 V are available. Traditionally, the majority of EEx i field devices are certified according to the Entity concept with Ui = 24 V or according to FISCO with Ui = 17.5 V.

7.2.2 Advantages of the concept

High power is made available for the field devices due to the high voltage and current of the feeding Fieldbus Power Supply. From a topology point of view, this will always offer a superior load capability.

7.2.3 Disadvantages of the concept

- Only a few field devices match the parameters required for this application.
- No hot work is permitted at the trunk.
- Safety calculations are required to be performed.

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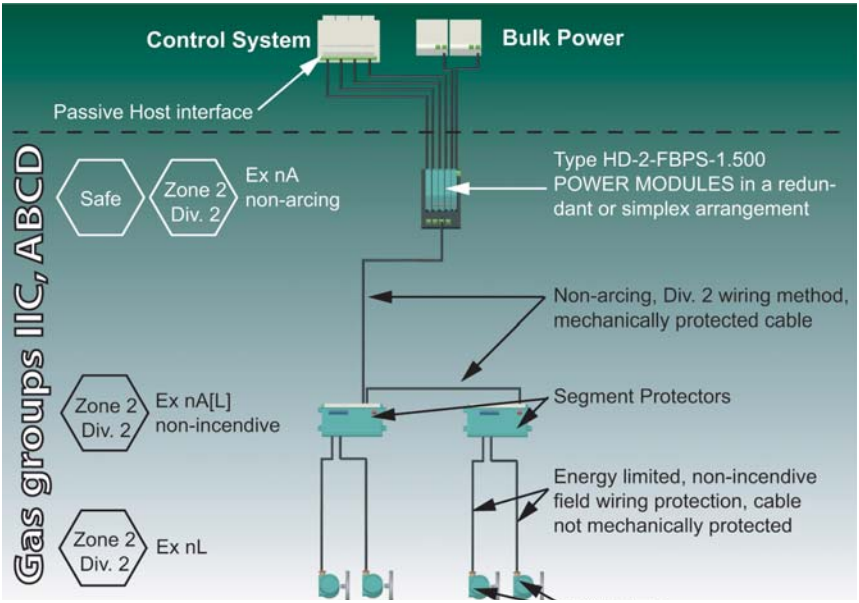
Installation in hazardous areas



The codes:	
Ex n	Type n or Zone 2
Ex nA	non-sparking
Ex nL	energy limited
Ex nAL	non sparkling and energy limited

For detail information, please refer to appendix 1

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7.3 Fieldbus Power Supply HD2-FBPS-1.23.500

7.3.1 Energy limited, non-incendive field wiring for field devices using the Fieldbus Power Supply HD2-FBPS-1.23.500

If the general purpose Fieldbus Power Supply HD2-FBPS-1.23.500 is used in conjunction with Pepperl+Fuchs Segment Protectors (SPs), the outputs of the SP will be classified EEx nL (energy limited) or non-incendive field wiring.

Due to the unlimited trunk energy, live work at the trunk is not permitted without gas clearance. However, live connect or disconnect at the output of the SP is allowed, if the following Entity Concept safety evaluation/requirements for the field devices are followed:

24 V M Ui (field device)

Li field device + L cable M 0.25 mH

Ci field device + C cable M 100 nF

Similar to the topology shown in the previous chapter, the voltage is not limited by the Segment Protector. Instead the voltage is limited by the Fieldbus Power Supply HD2-FBPS-1.23.500 to a maximum voltage of 24 V. In conjunction with the current limitation of the Segment Protector, the outputs of the SP are rated energy limited, non-incendive field wiring. The Zone 2/Div. 2 Segment Protectors supply an energy limited current to each spur (i. e. EEx nL / non-incendive), which allows the cable and devices the benefits normally only given in intrinsically safe systems. Instruments are treated exactly the same as intrinsically safe instruments, thus they can be live connected or disconnected without the risk of ignition. Another advantage is that the spur cables are exempt from mandatory mechanical protection, saving both weight and cost. As needed in a standard intrinsically safe configuration, Entity parameters must be calculated and compared for the instruments and the cables of the individual spurs.

The Declaration of Conformity or Certificate of Compliance must also state the "passivity" of any host interface. In other words, the host must not be an active power source or it must be certified energy limited with Uo M 24 V.

Field devices with a voltage of Ui N 24 V certified EEx nL or EEx i are permitted to be connected to the outputs of the SP under a Zone 2 energy limited, Div. 2 non-incendive field wiring rating.

The majority of field devices with Ui N 24 V are Ex i devices certified according to the Entity Concept.

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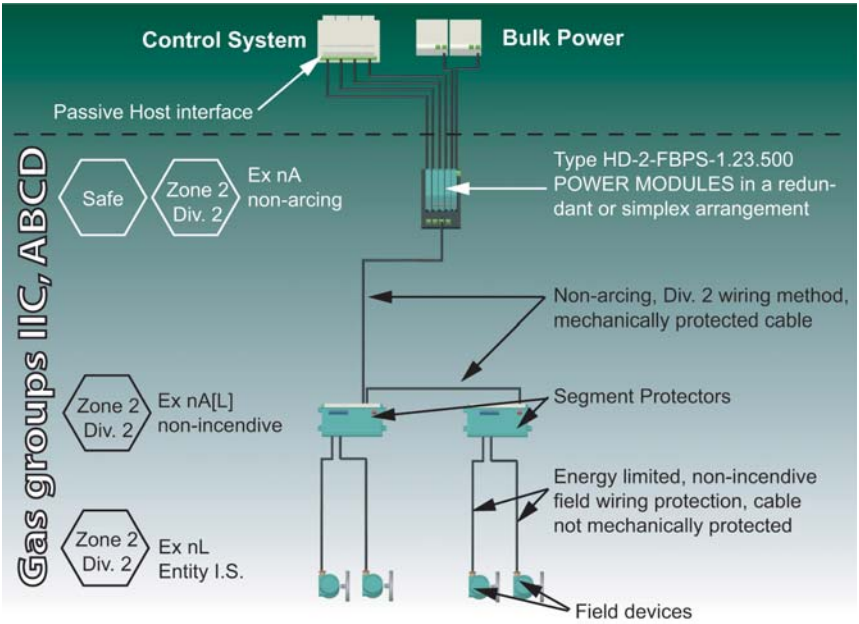
Installation in hazardous areas

7.3.2 Advantages of the concept

- High power is made available for the field devices due to the high voltage and current of the feeding Fieldbus Power Supply. From a topology point of view, this will always offer a superior load capability.
- The majority of Ex nL or intrinsically safe field devices, match the safety parameters required for this application.

7.3.3 Disadvantages of the concept

- No hot work is permitted at the trunk.
- Safety calculations needed.



The codes:	
Ex n	Type n or Zone 2
Ex nA	non-sparking
Ex nL	energy limited
Ex nAL	non sparkling and energy limited

For detail information, please refer to appendix 1

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7.4 Fieldbus Power Supply HD2-FBPS-1.17.500

7.4.1 Energy limited, non-incendive field wiring according to FNICO for field devices using the Fieldbus Power Supply HD2-FBPS-1.17.500

During later developments of intrinsically safe Fieldbus, Pepperl+Fuchs considered an energy limited, non-incendive field wiring concept equivalent to FISCO (Fieldbus Intrinsically Safe COncept) and derived FNICO (Fieldbus Non-Incendive COncept). This energy limited, non-incendive version of FISCO, uses fewer safety components, but offers a notable performance advantage due to reduction in safety factor or margin for Zone 2 and Div. 2 equipment.

FNICO works by limiting the supply voltage to 17.5 V maximum (so that FISCO instruments may be used) and limiting the output short circuit current to non-incendive levels. This satisfies both non-incendive and Zone 2 installations for Gas Group IIC (Group A, B) or IIB (Group C) or IIA (Group D) environments. The FNICO ignition curve was empirically derived, then published in IEC 60079-27, and can be used by any Fieldbus Power Supply manufacturer in its present form:

Supply Voltage Uo	Current mA Gas Group IIC	Current mA Gas Group IIB
14 V	247	513
15 V	179	478
16 V	139	389
17 V	109	324
17.5 V	101	287

The current limit dictated by this table is still restrictive, particularly for a trunk in Gas Group IIC or Group A/B. A deviation from the concept used by Pepperl+Fuchs addresses the restriction by allowing the main trunk to be maintained at a Zone 2/Div. 2 level using a non arcing EEx nA rating or Div. 2 wiring methods. This allows unrestricted current from the Power Supply. The Zone 2/Div. 2 Segment Protectors supply an energy limited current to each spur (i. e. EEx nL/non-incendive), which allows the cable and devices the benefits normally only given to intrinsically safe systems.

Because FNICO is essentially an intrinsically safe system, instruments are treated exactly the same as intrinsically safe instruments, thus they can be live connected or disconnected without the risk of ignition. Another advantage is that the spur cables are exempt from mandatory mechanical protection, saving both weight and cost.

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Note

For FNICO applications, the FNICO Power Supply type HD2-FBPS-1.17.500 must be used.

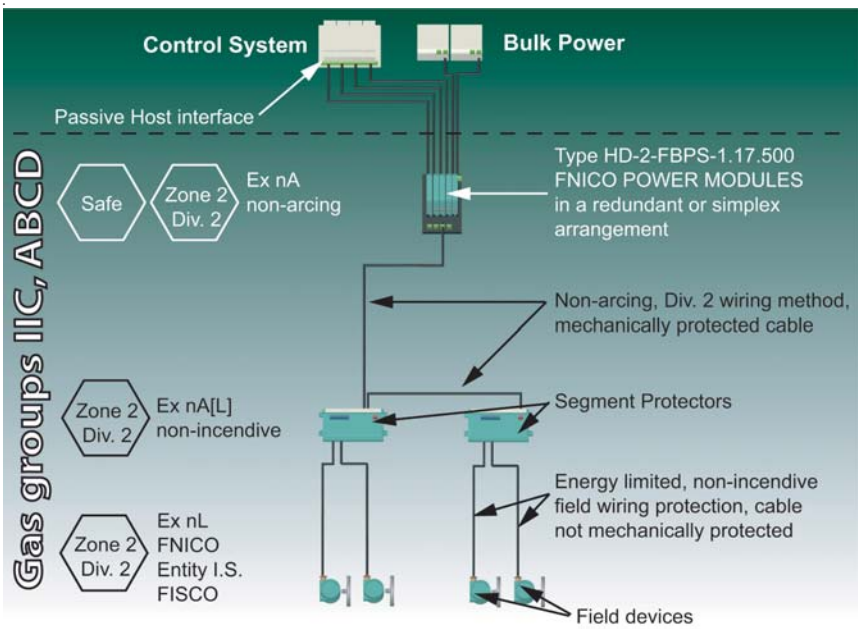
The Declaration of Conformity or Certificate of Compliance must also state the "passivity" of any host interface. In other words, the host must not be an active power source or it must be certified energy limited with Uo M 17.5 V.

7.4.2 Advantages of the concept

- High current for the field devices due to the high current of the Fieldbus Power Supply.
- All of today's existing field devices certified for EEx nL, FISCO, Entity or FNICO may be used.
- No loop assessment needed due to FNICO conform outputs.

7.4.3 Disadvantages of the concept

- No hot work is permitted at the trunk.
- Restrictions on the topology due to limited output voltage.



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The codes:	
Ex n	Type n or Zone 2
Ex nA	non-sparking
Ex nL	energy limited
Ex nAL	non sparkling and energy limited

For detail information, please refer to appendix 1

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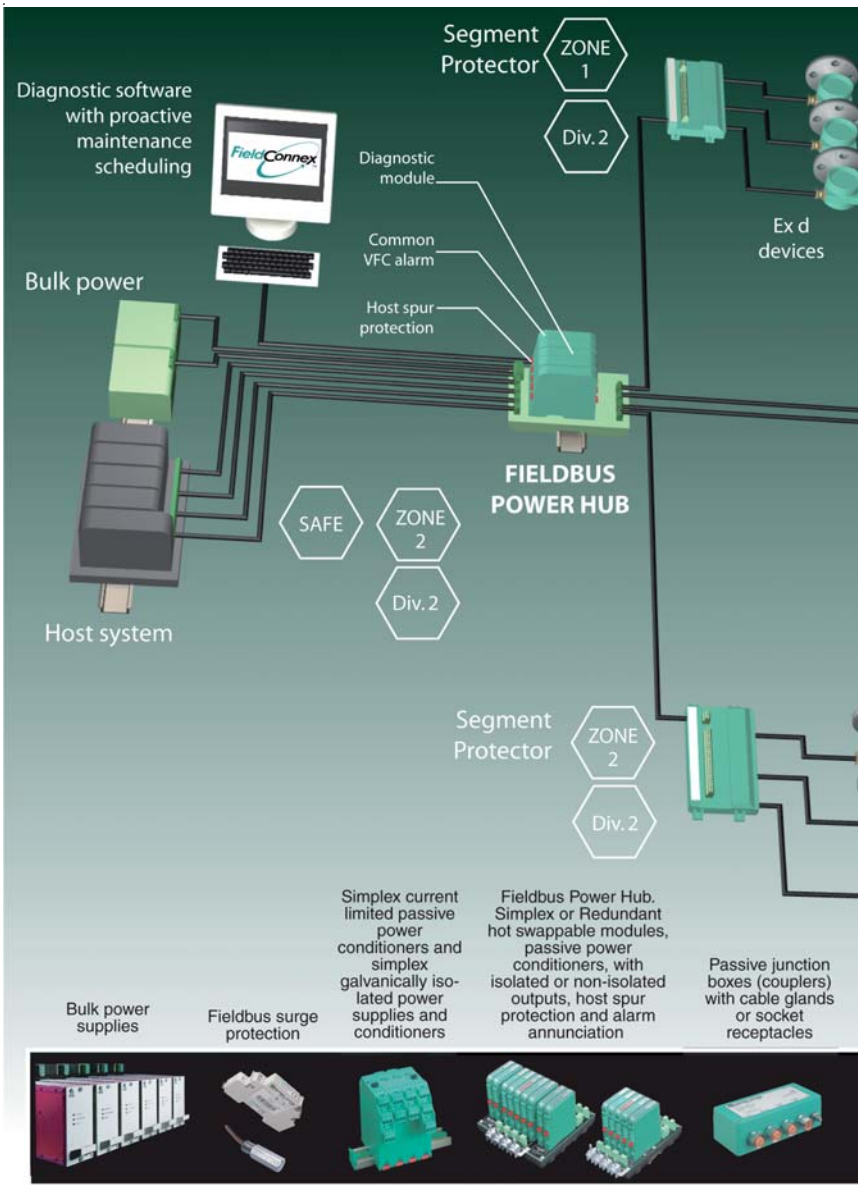
8 Product portfolio



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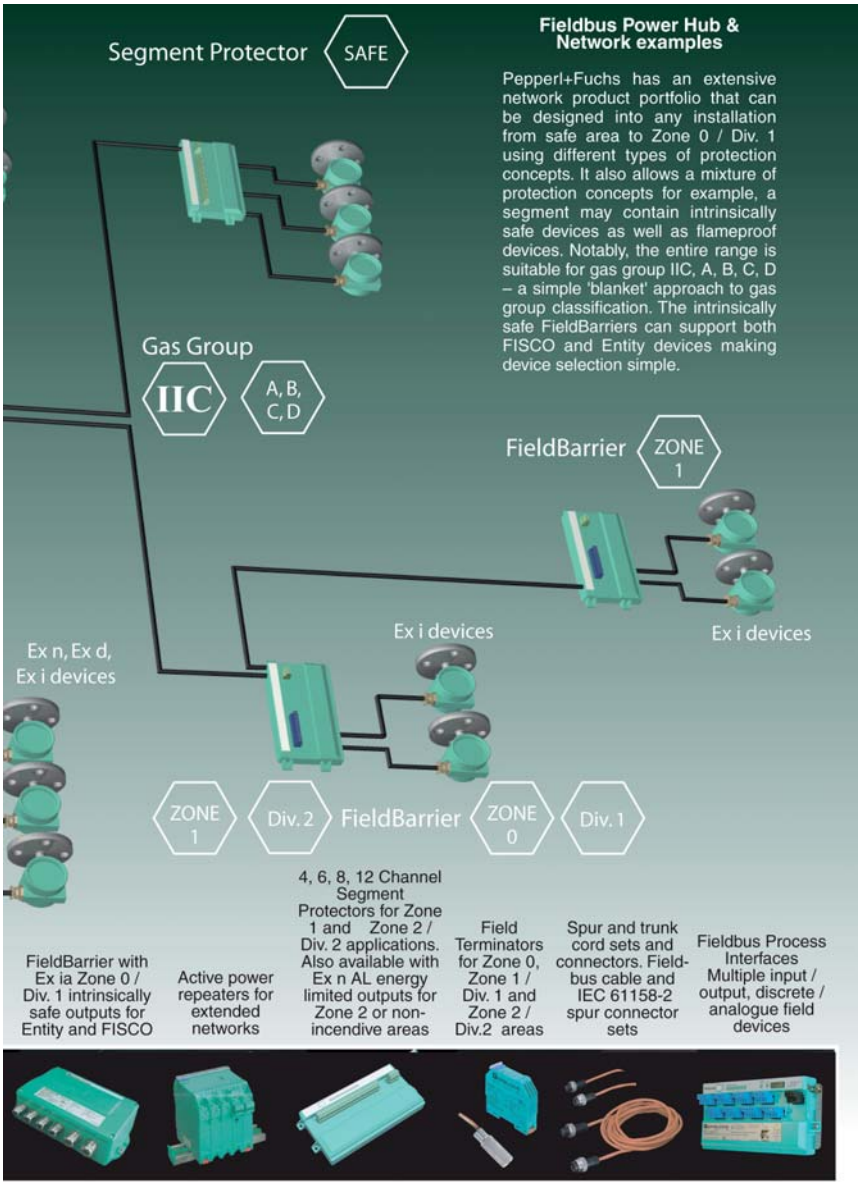

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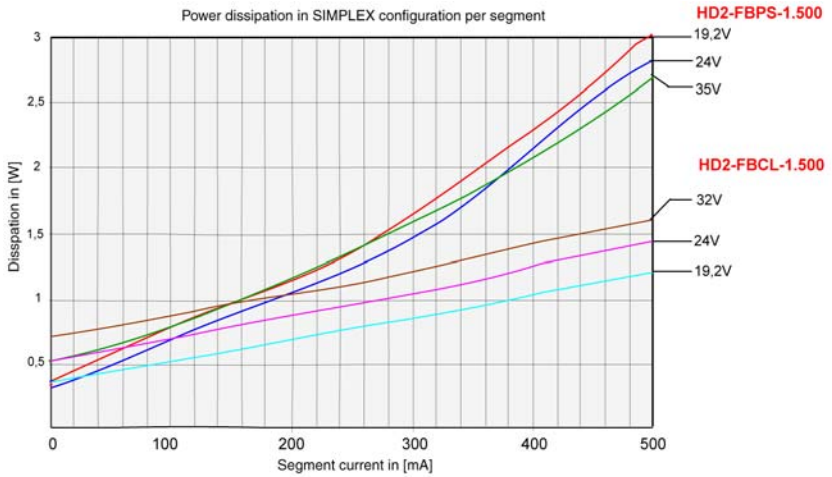
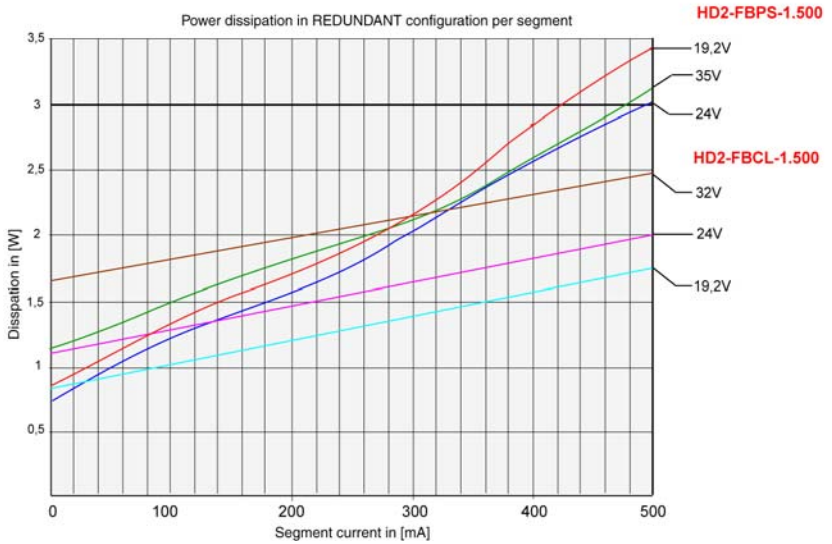
9 Thermal dissipation

Each Fieldbus Power Supply will dissipate, i. e. lose energy in form of heat. The graphs below illustrate typical power dissipation values in Watts for each segment including motherboard power losses, for given output currents and supply voltages.

Thermal dissipation of HD2-FBPS-1.500 and HD2-FBCL-1.500





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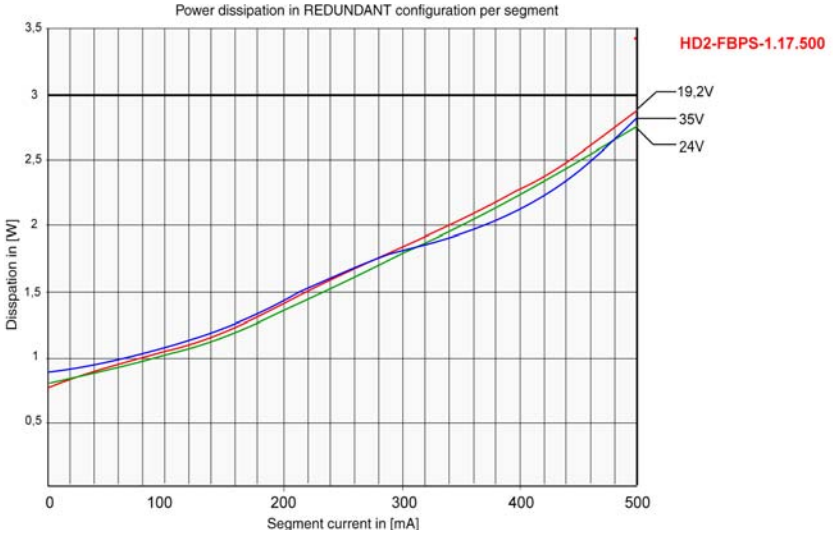
Thermal dissipation of HD2-FBPS-1.17.500



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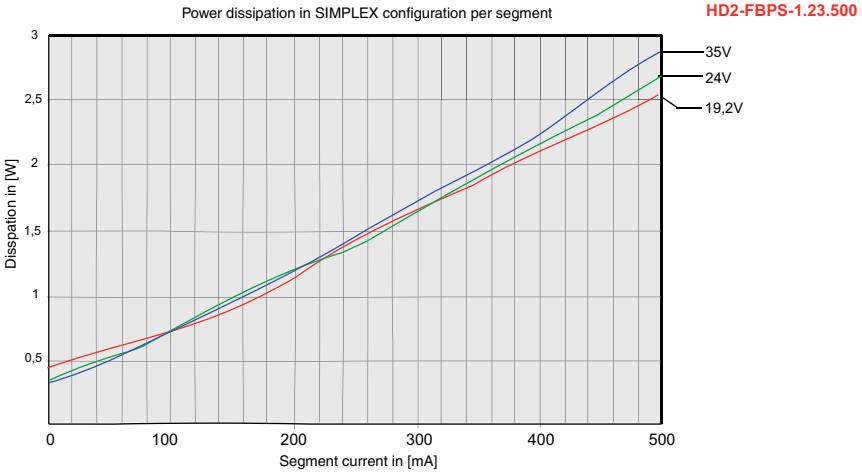
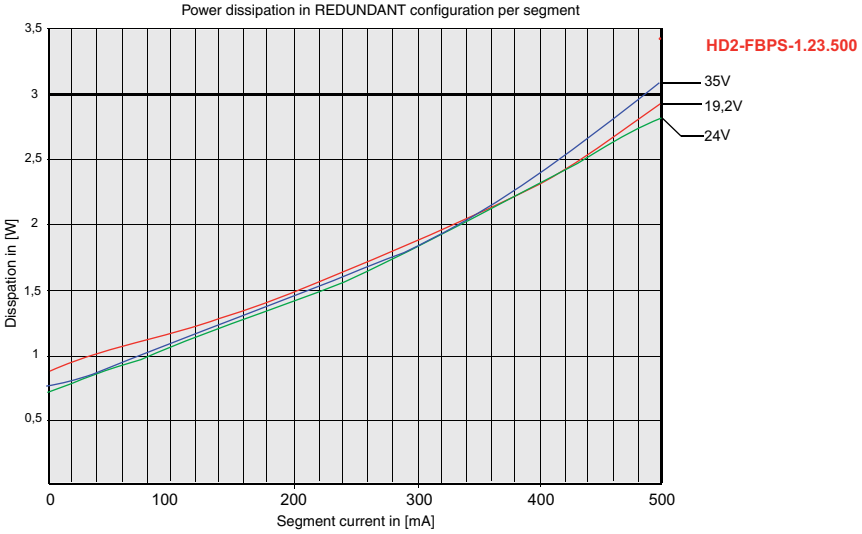
Thermal dissipation

Thermal dissipation of HD2-FBPS-1.23.500





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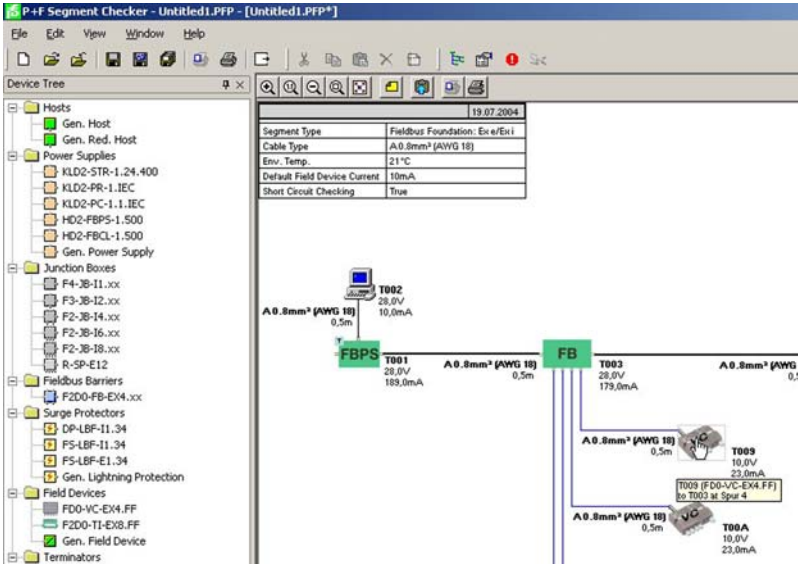
10 Segment planning consideration

Pepperl+Fuchs offers a Microsoft Windows® compatible software tool, called SegmentChecker, designed to design, evaluate and document FOUNDATION Fieldbus or PROFIBUS PA based Fieldbus segments. The desogned segment will be automatically checked against the design rules for a physical Fieldbus segment as defined in the international Fieldbus standard IEC 61158-2.

Power Supplies, wiring components and field devices are provided in a device library. Configuration dependent values for power supply load, voltage levels at each Fieldbus node and termination will be checked. Environmental influences such as ambient working temperature on the cable resistance or fault conditions such as short circuits at a Segment Protector output are considered. Field devices not included can be defined and added to the library.

For each designed segment a document will be created which includes detailed information about the devices used and the calculation results. Error conditions are highlighted. For each segment, the segment graphic can be exported.

Segment Checker software is available for download from:
www.segmentchecker.com



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11 FF-831 – Fieldbus Power Supply functional test and validation

Until now, Fieldbus Power Supplies and Fieldbus Power Conditioners have only been validated against IEC 61158-2, clause 12 (formerly clause 22), which comprises a performance criterion rather than an in-depth formal test procedure. The criterion could not eliminate any potential problems in real world applications and therefore, many suppliers have performed their own in-house validation using additional test requirements based on the criterion laid out in IEC 61158-2, clause 12.

To unify manufacturers (in a quest to produce a common and accepted test procedure), the Fieldbus Foundation formed a committee (made up of all relevant member manufacturers and technically driven by Pepperl+Fuchs) to co-operatively formulate a definitive technical test specification and test procedure that will guarantee a product's compliance with IEC 61158-2, clause 12, with additional testing to ensure that the Fieldbus signal (H1) quality and accuracy is maintained under all operational conditions.

The FF-831 tick mark is universally recognized and applied to Fieldbus Power Supplies which are approved for use with any participating control system or device.

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12 Appendix 1

12.1 IEC 60079 Codes

Code	Description
Ex n	Type of protection "n", applied to electrical apparatus such that in normal operation and on certain specified abnormal conditions it is not capable of igniting a surrounding explosive atmosphere. Equivalent US/NEC classification = "non-incendive equipment", apparatus having electrical circuitry that is incapable, under normal operation conditions, of causing ignition of a specified flammable gas-air mixture due to arcing of thermal means.
Ex nA	Non-sparking classified circuits are not allowed to be worked on in life situation if energized, but will under normal conditions not be able of causing ignition of the specified explosive atmosphere. Equivalent US/NEC classification = "non-incendive circuits", a circuit, other than field wiring, in which any arc or thermal effect produced under intended operating conditions of the equipment is not capable, under specified test conditions, of igniting a flammable gas-air, vapor-air or dust-air mixture.
Ex nL	Energy limited circuits which are allowed to be opened and shorted under energized condition. Equivalent US/NEC classification = "non-incendive field wiring", a circuit which under normal conditions of the equipment, is not capable, due to arcing or thermal effects, of igniting a flammable gas-air, vapor-air or dust-air mixture. Normal operation includes opening, shorting or grounding the circuit.

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Appendix 1

Code	Description
Ex na[L] Ex nA[nL]	Associated energy limited apparatus, energy limited circuits could be opened and shorted in life situation, e. g. Segment Protector outputs, non-energy limited circuits could be only opened and shorted with gas clearance e. g. Segment Protector trunk. Equivalent US/NEC classification = "associated non-incendive field wiring apparatus", apparatus in which the circuits are not necessarily non-incendive, but affect the energy in non-incendive field wiring circuits and are relied upon to maintain non-incendive energy levels. Associated non-incendive field wiring apparatus may be either of the following: • Electrical apparatus that has an alternative type of protection for use in the appropriate hazardous (classified) location. • Electrical apparatus not so protected that shall not be used in a hazardous (classified) location. Associated non-incendive field wiring apparatus has designated associated non-incendive field wiring apparatus connections for non-incendive field wiring apparatus and may also have connections for other electrical apparatus.

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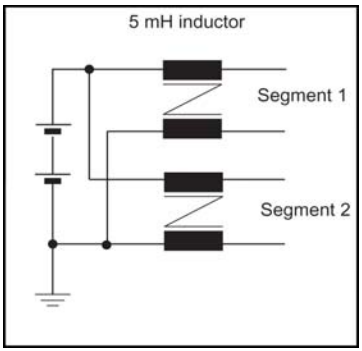
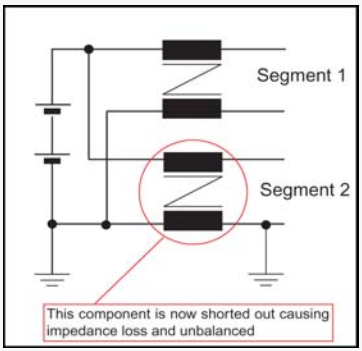
13 Appendix 2

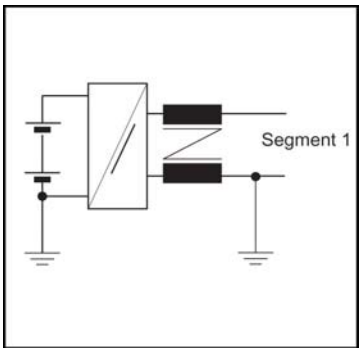
13.1 How CREST works



The original specification draft for Fieldbus (SP 50) suggested the use of simple passive conditioners and a common grounded bulk power supply.



The grounded earth eliminated problems of cross-talk and noise, but introduced other problems, such as impedance loss and/or unbalance, if a pole of a segment was shorted to ground.



To combat this potential problem, galvanic isolation was introduced to each segment in the form of a DC-to-DC converter.

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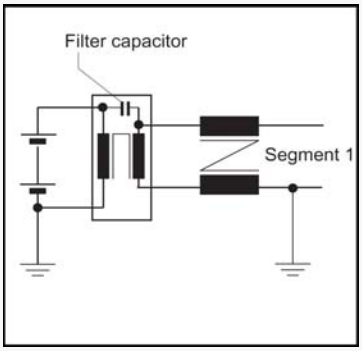
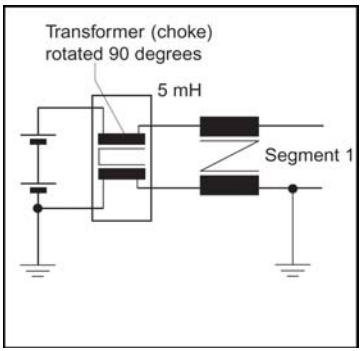
Appendix 2



With segment isolation, cross-talk is reduced, and grounded segments will not cause impedance problems.
Unfortunately, often a EMC filter capacitor is used across the galvanic isolation to reduce EMI/RFI emissions and output ripple, effectively offering a low impedance path for high frequency signals.



The engineers at Pepperl+Fuchs studied the model and realized that if the supply isolation was turned by 90 degrees, then galvanic isolation could be emulated while creating a high impedance common mode and differential noise filter.

This led to the use of a current compensated choke to simulate AC or signal isolation. Crosstalk is reduced to acceptable levels and **CREST** can realize a significant reduction in segment cost when using non-isolated segments. This method has also been applied to isolated Fieldbus Power Supplies to significantly reduce the effect of EMI/RFI emissions/ receptions as well as the effects of network unbalance and harmonic or natural resonance.

'Pure or ideal isolation' is never attained in modern-day switching-mode power supplies as they usually have a high voltage capacitor across the galvanic isolation barrier. By reducing output ripple and EMI/RFI emissions, this prevents them from achieving 'ideal' isolation. The figure be-

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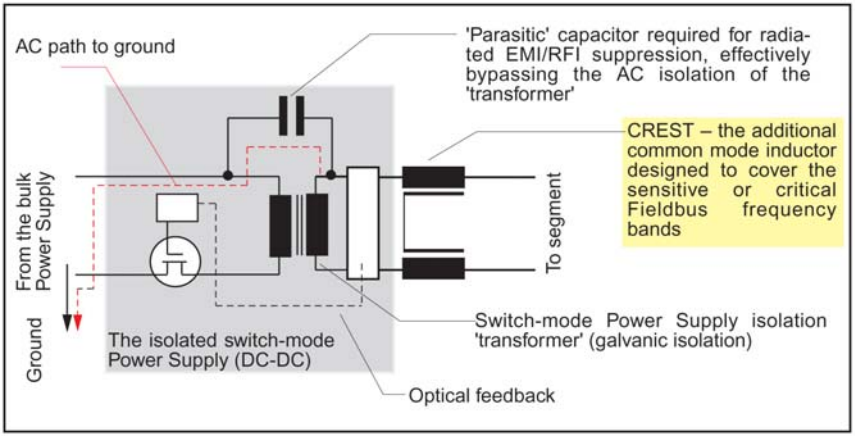
low shows the capacitor, used on switching-mode power supplies to reduce radiated noise.



The parasitic filter capacitor bypasses the 'effect' of AC isolation, making the segment isolation less than ideal. Compensation for the loss of isolation is achieved by using a common mode inductor (**CREST**).

The common mode inductor converts differential mode noise into common mode noise, which is not affecting bus communication any more.

The common mode inductor is specially designed to operate within the frequency range specific to Fieldbus. Although there are small common mode inductors used at the input stages within DC-DC converters, they are only sized for frequencies beyond those that are important to Fieldbus.

The common mode inductor is also used for high impedance isolation within the Fieldbus frequency spectrum. This effectively isolates any potential resonance effect or influence that may be caused by the bulk power supply. This type of resonance could otherwise distort the communication signal and lead to communication failure.

13.2 NON-ISOLATION with CREST – the definitive solution?

Although this appears to be an ideal solution, the current compensated choke can easily be saturated if one pole or one segment is shorted to

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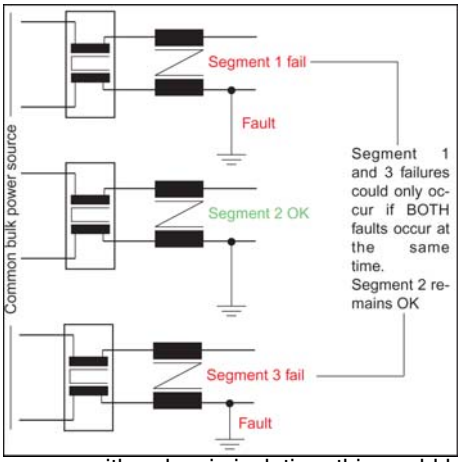
earth and, at the same time, another pole on another segment (sharing the same bulk power supply) is shorted to earth.



Of course, even with galvanic isolation, this could happen with a pole-to-pole fault on two segments – i. e. a similar two-fault situation.

Increased safety = increased integrity

With good wiring practice and use of high integrity components found in increased safety and type n installations, a pole-to-pole fault and pole-to-shield fault are very unlikely to occur. Fieldbus segments are usually connected in a trunk configuration whereby the trunk is connected to a Segment Protector or a FieldBarrier to increase the integrity while maintaining field devices. Maintenance to the trunk wiring will most likely never occur, making any dual pole-to-pole or pole-to-ground fault very unlikely.

With routine maintenance, as requested by all Fieldbus component suppliers and safety authorities, non-isolation with **CREST** can provide a very robust low cost alternative to galvanically isolated segments.

For high integrity networks, where cabling is not controlled or adequately maintained, isolated Fieldbus Power Supplies should be considered as an alternative to non-isolated Power Conditioners.

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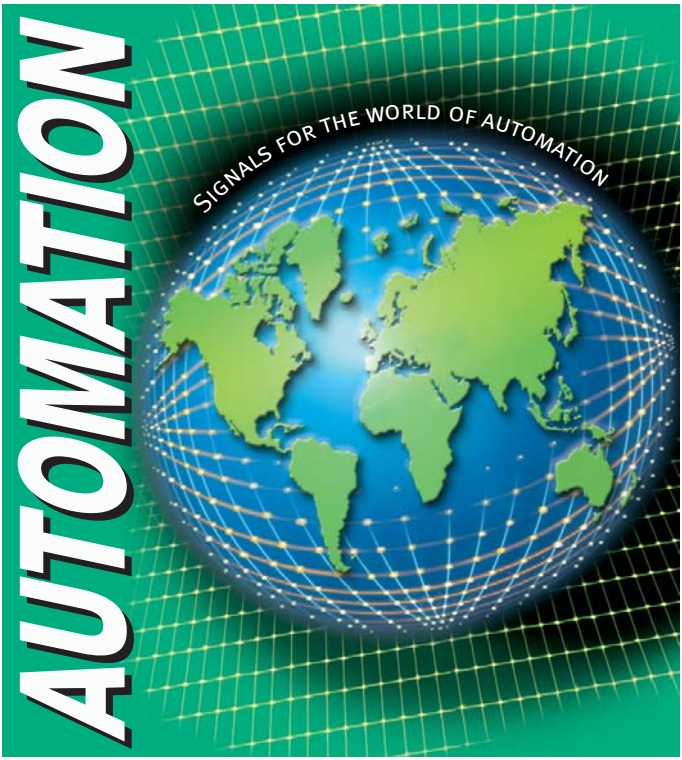

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