



MANUAL

**FIELD BUS POWER HUB  
YOKOGAWA  
ADVANCED HIGH  
PERFORMANCE POWER  
SUPPLIES AND  
CONDITIONER**





With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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# 1 Safety

## 1.1 Validity

Specific process and instructions in this document require special precautions to guarantee the safety of personnel.

## 1.2 Symbols used

This document contains information that you must read for your own personal safety and to avoid property damage. The warning signs are displayed in descending order depending on the hazard category, as follows:

### Safety-relevant symbols



**Danger!**

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.



**Warning!**

This symbol indicates a warning about a possible fault or danger.

In the event the warning is ignored, the consequences may course personal injury or heaviest property damage.



**Caution!**

This symbol warns of a possible fault.

Failure to observe the instructions given in this warning may result in the devices and any connected facilities or systems develop a fault or fail completely.

### Informative symbols



**Note!**

This symbol brings important information to your attention.



**Action**

This symbol marks an acting paragraph.

## 1.3 System Operator and Personnel

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

Assembly, commissioning, operation, maintenance and dismantling of any devices may only be carried out by trained, qualified personnel who have read and understood the instruction manual.

### 1.4 Pertinent Laws, Standards, Directives, and further Documentation

Laws, standards, or directives applicable to the intended use must be observed. In relation to explosive areas, Directive 1999/92/EC must be observed.

The corresponding data sheets, the declaration of conformity, the EC-type-examination certificate and applicable certificates (see data sheet) are an integral part of this document. You can find this information under [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com).

### 1.5 Delivery, Transport and Storage

Check the packaging and contents for damage.

Check if you have received every item and if the items received are the ones you ordered.

Keep the original packaging. Always store and transport the device in the original packaging.

Always store the device in a clean, dry environment. Note the permitted storage temperature (see data sheet).

### 1.6 Marking

#### Motherboards

MB-FB-4\*.YO

Pepperl+Fuchs GmbH

Fieldbus Power Hub

TÜV 04 ATEX 2500 X



II 3 G Ex nA II T4

PF 10 CERT 1569

#### Modules

HD2-FBPS-\*.500

Pepperl+Fuchs GmbH

Fieldbus Power Hub

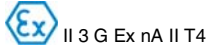
TÜV 04 ATEX 2500 X



II 3 G Ex nA II T4

### HD2-FBPS-1.25.360

Pepperl+Fuchs GmbH  
 Fieldbus Power Hub  
 TÜV 06 ATEX 553229 X



### HD2-DM-A

Pepperl+Fuchs GmbH  
 Fieldbus Power Hub  
 TÜV 04 ATEX 2500 X



### HD2-DM-A.RO

Pepperl+Fuchs GmbH  
 Fieldbus Power Hub  
 TÜV 04 ATEX 2500 X



### HD2-DM-B

Pepperl+Fuchs GmbH  
 Fieldbus Power Hub  
 TÜV 04 ATEX 2500 X



## 1.7 Intended use

The Fieldbus Power Hub product range is intended to power fieldbus 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. Types of protection are Ex 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.

Dedicated power supply modules limit the output voltage safely acc. to IEC 60079-11. In combination with Pepperl+Fuchs Segment Protectors the outputs are specified Ex nl or Ex ic (except HD2-FBPS-1.23.500 modules with part number 180995). Thus live maintenance at the field device level is permitted.

The solution is intended for use with YOKOGAWA FOUNDATION Fieldbus interface module ALF 111. The motherboards provide YOKOGAWA specific system connectors and allows the redundant connection of the ALF 111 by means of AKB 336 interface cables.

For further information about hazardous area installation refer to referenced documents see chapter 7.2.

The devices are only approved for appropriate and intended use. Ignoring these instructions will void any warranty and absolve the manufacturer from any liability.

The device must only be operated in the ambient temperature range and at the relative humidity (noncondensing) specified.

## 1.8 Mounting and installation

Prior to mounting, installation, and commissioning of the device you should make yourself familiar with the device and carefully read the instruction manual.

The devices may be installed in a corrosive location acc. to ISA-S71.04-1985, severity level G3.

### 1.8.1 Mounting instructions for HD2\* modules

The modules are intended for mounting on an appropriate Fieldbus Power Hub motherboard.

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.

#### Instruction for redundant systems

Each segment on a redundant motherboard must only be fitted with two power modules of the same type.

### 1.8.2 Zone 2 and Div. 2

Connection or disconnection of energized non-intrinsically-safe circuits is only permitted in the absence of a hazardous area.

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 Zone 2/Div. 2 installations and certified field instruments that can be connected in Zone 2 or Div. 2 area.

Special care must be taken if power supply modules are to be used in conjunction with Pepperl+Fuchs segment protectors for energy limited Ex nL, intrinsically safe Ex ic and non-incendive field wiring.

A check must be made to ensure that the correct type of power supply module 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.

Requirements for all used fieldbus products in Zone 2 installations are summarized in the manual: "Using Pepperl+Fuchs fieldbus equipment in Zone 2 hazardous area environment". This document is available separately.



### 1.8.3 Ex ic

The intrinsically safe circuits of the associated apparatus may lead into hazardous areas. Make sure to observe all relevant distances (creepage distances, clearances) to all non-intrinsically safe circuits (e.g. clearance) in accordance with IEC/EN 60079-14.

Circuits in ignition protection class "Ex ic" which have been operated with circuits of other ignition protection classes may not be used as "Ex ic" circuits afterwards.

When connecting intrinsically safe field devices to intrinsically safe circuits on the associated apparatus, observe the relevant maximum values of the field devices and associated apparatus specified in the explosion protection documentation (certificate of intrinsic safety). Make sure to observe IEC/EN 60079-14 and IEC/EN 60079-25.

The devices should be installed at least in an environment according pollution degree 2.

### 1.8.4 Ex nL

Current circuits with ignition protection class " Ex nL" (limited energy) that are operated with current circuits with different ignition protection classes may subsequently no longer be operated as current circuits with ignition protection class "Ex nL".

## 1.9 Housing

If additional housings are needed for installation in hazardous areas, the following points must be considered / evaluated:

- Degree of protection as per IEC/EN 60529
- Light resistance as per IEC/EN 60079-0
- Impact strength as per IEC/EN 60079-0
- Chemical resistance as per IEC/EN 60079-0
- Heat resistance as per IEC/EN 60079-0
- Electrostatics as per IEC/EN 60079-0

To ensure the IP degree of protection:

- all seals must be undamaged and have been correctly fitted
- all screws of the housing / housing cover must have been tightened with the appropriate torque
- only cable of the appropriate size must be used in the cable glands
- all cable glands must have been tightened with the appropriate torque
- all empty cable glands must have been sealed with sealing plugs

### 1.10 Repair and Maintenance

The devices may not be repaired, changed or manipulated. If there is a defect, the product must always be replaced with an original part.

### 1.11 Disposal

Devices, packaging material, and possibly contained batteries must be disposed of in compliance with the applicable laws and guidelines of the corresponding country.

## 2 Specification

### 2.1 Overview

The FieldConnex® Power Hub is a high-performance power supply for FOUNDATION Fieldbus. It consists of a motherboard with sockets for plug-in modules an one or two power modules (redundant configuration) per segment and a diagnostic module. The Power Hub is designed for use with fieldbus systems in accordance with IEC 61158-2. This standard specifies how power and communication are transmitted sharing one shielded twisted-pair cable. Communication between field devices and a host system is established by modulating the data signal onto the power stream utilizing Manchester Bus Powered (MBP) transmission.

All FieldConnex® Power Hubs feature superior design elements. The main design points are redundancy, passive impedance generation, well balanced circuitry and low heat dissipation.

All active electronic components are located in the plug-in modules. Each module holds the electronic components for only one segment and two modules build a redundant configuration. When an exchange becomes necessary only the smallest amount of electronic components is exchanged compared to block configurations for power supplies. Modules can be exchanged while the system is energized without the use of tools, thus ensuring very high system availability.

Impedance generation prevents the data signal from being short circuited by the power supply's low internal resistance. This impedance generation is designed with passive components such as inductances and resistors with very long durability.

A fully balanced circuit and segment design is important for undisturbed fieldbus operation. An external disturbance through EMI impacts both leads of the shielded twisted-pair cable symmetrically. The data signal is thus undisturbed. Low heat dissipation allows highest packing density inside the cabinet and a very long service life.

The Power Hub feeds fieldbus segments following the High-Power Trunk concept for explosion protection. High energy level on the trunk line is fed to the field instrument via couplers as FieldBarriers or Segment Protectors.

Using Segment Protectors allows you to do live maintenance at the field device level in Zone 2 as outputs are either classified for Ex nL, Ex ic, Entity, FNICO or FISCO ic. Using FieldBarriers allows to do live maintenance in Zone 1 as outputs are classified Ex ia. Thus limitations for explosion protection are overcome enabling maximum cable lengths and highest number of devices in any explosive area.

A plug-in Advanced Diagnostic Module for fieldbus is available. This module monitors the physical layer online and in real time enabling detection of degradation and faults during operation. Measurement data and alarms are transmitted to the control room thus bringing visibility to the fieldbus physical layer, which can now be treated as active component in Plant Asset Management systems. Operators are enabled to decide on proactive measures to avoid unwanted situations and while the plant is running smoothly.

The following table summarizes the main features and benefits of the Power Hub:

Features	User benefit
Low heat dissipation of less than 2 W per segment under full load condition.	Long service life. Very high packing density and reduced cooling requirements.
Exchange of modules while the system is energized and load share between power modules.	Increased segment availability
Full balance of electric circuitry with high isolation against RF and in-band interference	High resistance to external disturbance such as EMI.
High-integrity passive power conditioners	Long service life.
Local and remote alarm annunciation	Easy maintenance and troubleshooting
Tolerance against inrush currents during segment start	Long-term, robust operation with tolerance towards field device misbehavior
Full current span operation from 10...500 mA	Flexible segment design and tolerance against live working on field devices
Advanced Diagnostic Module for physical layer fieldbus diagnostics	Improved and known quality of fieldbus installation. Live supervision for preventive and pro-active maintenance. Professional Tools for easy fieldbus troubleshooting

## 2.2 System Components

### 2.2.1 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.

All motherboards contain the unique, patented CREST technology thereby creating high impedance for common mode noise and network resonance effects. see chapter 6

#### MB-FB-4.YO

The motherboard allows the supply of four fieldbus segments as well as the redundant connection of the Yokogawa ALF 111 by means of AKB336 system cables. The four sockets will hold the power supply modules. The extra socket will hold a diagnostics module.

#### MB-FB-4R.YO

The motherboard allows the redundant supply of four fieldbus segments as well as the redundant connection of the Yokogawa ALF 111 by means of AKB336 system cables. Eighth sockets will hold the power supply modules, two each are in redundancy per segment. The extra socket will hold a diagnostics module.

### 2.2.2 Power Supply Modules HD2-FBPS-\*

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.

Power Modules are connected to the motherboards via sockets. They can be exchanged while the system is in operation. In redundant configuration load is shared between two power modules.

For different application requirements special Power Supply Modules are available:

Designation	Application
HD2-FBPS-1.500	general purpose
HD2-FBPS-1.23.500	Ex ic, Ex nL
HD2-FBPS-1.17.500	FISCO ic, FNICO
HD2-FBPS-1.25.360	general purpose

**2.2.3 Power Conditioner Modules HD2-FBCL-\***

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.

Power Modules are connected to the motherboards via sockets. They can be exchanged while the system is in operation. In redundant configuration load is shared between two power modules.

Designation	Application
HD2-FBCL-1.500	general purpose

**2.2.4 Diagnostic Modules**

**Basic Diagnostic Module**

The Basic Diagnostic Module provides basic system diagnostics. It monitors the input voltage of the bulk power supply and each segment for overload and short-circuit conditions. Each Power Supply Module is checked for proper function. Power Modules operating in redundant configuration are checked for compatibility. Status and faults are indicated by LEDs and can be transmitted via dry contact.

**Advanced Diagnostic Module**

The Advanced Diagnostic Module is a comprehensive measurement tool for the fieldbus physical layer. It is well suited for commissioning, online monitoring and maintenance. The module provides the exact segment and individual device data needed for detection of changes in the fieldbus physical layer. Segment measurements include fieldbus voltage and load current; device specific measurements are: signal level, noise and jitter. All data is transmitted to the control room via Ethernet. The Diagnostic Manager – Basic Edition shows all data on easy to use displays.

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The Diagnostic Manager - Professional Edition offers additional functionality: the Commissioning Wizard generates automated reports; the software displays clear-text messages for troubleshooting of out-of spec behavior. The OPC server transmits user-selectable summary alarms to the DCS.

For further information please refer to the manual Advanced Diagnostic Module HD2-DM-A.

### Advanced Diagnostic Module, Relay Output

The Advanced Diagnostic Module, Relay Output is a tool to permanently monitor the fieldbus physical layer. For each physical layer parameter monitored, limit ranges can be configured using DIP switches.

The module distinguishes between two alarm types:

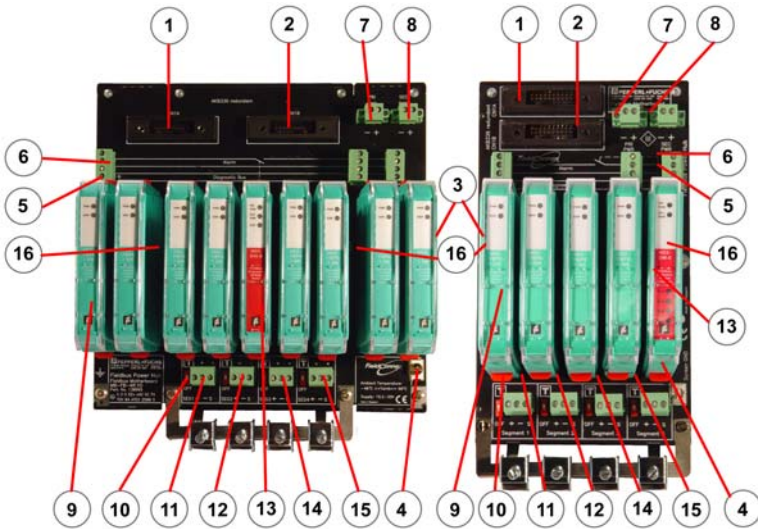
- A Maintenance Required alarm
- An Out Of Specification alarm

The Maintenance Required alarm serves to make proactive diagnosis possible. If a value violates the limit, a relay contact will open and the respective segment LED will start flashing yellow. By means of this proactive diagnosis, changes within the fieldbus installation will be detected early on and fault sources can be found before communication fails.

If an Out Of Specification alarm appears (LED flashing red), one of the physical layer parameters monitored has rapidly declined and moved out of the range of the Maintenance Required alarm. A fast examination of the segment affected is crucial to prevent a total dropout of this segment in the near future.

To set up appropriate limit values for your fieldbus installation, a comprehensive diagnostic solution such as the Pepperl+Fuchs Mobile Advanced Diagnostic Module is required during commissioning to derive the DIP switches positions.

2.3 Component Identity MB-FB-4\*.YO



- 1 Host connection CN1A
- 2 Host connection CN1B
- 3 DIN rail slot
- 4 Screen/ground connection clamp
- 5 Diagnostic bus connection
- 6 Common alarm voltage free contact
- 7 Primary power connection
- 8 Secondary power connection
- 9 Power module(s) (segment 1)
- 10 Terminator switch (segment 1)
- 11 Trunk connection (segment 1)
- 12 Trunk connection (segment 2)
- 13 Diagnostic module
- 14 Trunk connection (segment 3)
- 15 Trunk connection (segment 4)
- 16 Motherboard fastening screw

2.4 Technical Data

System Specification

**Ambient conditions**

Ambient temperature	-40 ... 60 °C
Storage temperature	-40 ... 85 °C
Shock resistance	15 g , 11 ms
Vibration resistance	1 g , 10 ... 150 Hz
Relative humidity	< 95 % non-condensing

**Mechanical specifications**

Connection type	screw terminals
Core cross-section	2.5 mm <sup>2</sup>
Protection degree	IP20

**Standard conformity**

Electromagnetic compatibility	NE 21:2006
Protection degree	IEC 60529
Fieldbus standard	IEC 61158-2
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6

Motherboard Types MB-FB-4\*

**Supply**

Rated voltage	19.2 ... 35 V
Rated current	16 A
Terminating resistor	selectable 100 Ω

Isolated Power Supply Module Type HD2-FBPS-1500

**Supply**

Rated voltage	19.2 ... 35 V DC
Power loss	typ. 1.8 W

**Fieldbus interface**

Rated voltage	28 ... 30 V
Rated current	500 ... 10 mA
Short-circuit current	550 mA

**Indicators/operating means**

LED ERR	red flashing: short-circuit or undervoltage at output
LED PWR	green if U <sub>out</sub> > 28 V

### Isolated Power Supply Module Type HD2-FBPS-1.23.500

#### Supply

Rated voltage	19.2 ... 35 V DC
Power loss	typ. 1.5 W

#### Fieldbus interface

Rated voltage	21 ... 23 V
Rated current	500 ... 10 mA
Short-circuit current	550 mA

#### Indicators/operating means

LED ERR	red flashing: short-circuit or undervoltage at output
LED PWR	green if $U_{out} > 21$ V

### Isolated Power Supply Module Type HD2-FBPS-1.17.500

#### Supply

Rated voltage	19.2 ... 35 V DC
Power loss	typ. 1.3 W

#### Fieldbus interface

Rated voltage	15 ... 17 V
Rated current	500 ... 10 mA
Short-circuit current	550 mA

#### Indicators/operating means

LED ERR	red flashing: short-circuit or undervoltage at output
LED PWR	green if $U_{out} > 15$ V

### Power Conditioner Non-Isolated Type HD2-FBCL-1.500

#### Supply

Rated voltage	19.2 ... 35 V DC
Power loss	typ. 1.3 W

#### Fieldbus interface

Rated voltage	supply voltage minus max. 2.5 V at full load
Rated current	500 ... 10 mA
Short-circuit current	600 mA
Host-rated current	0 ... 40 mA
Host short-circuit current	0 ... 55 mA

#### Indicators/operating means



### Power Conditioner Non-Isolated Type HD2-FBCL-1.500

LED ERR	red flashing: short-circuit or undervoltage at output
LED PWR	green if $U_{out} > 16\text{ V}$

### Basic Diagnostic Module Type HD2-DM-B

#### Supply

Rated voltage	Rated current	19.2 ... 35 V
Rated current		20 mA
Power loss		Max. 0.5 W

#### Indicators/operating means

LED PRI PWR	green: on, primary bulk power supply connected
LED SEC PWR	green: on, secondary bulk power supply connected
LED ERR	red: 2 Hz flashing, power supply fault (short-circuit, undervoltage), redundancy fault
Fault signal	VFC alarm 1 A, 50 V DC, normally closed

### Advanced Diagnostic Module Type HD2-DM-A

#### Supply

Rated voltage	19.2 ... 35 V
Rated current	110 ... 30 mA
Power loss	max. 2 W

#### Fieldbus interface

Number of segments	4
Rated voltage	9 ... 32 V

#### Indicators/operating means

LED PRI PWR	green: on, primary bulk power supply connected
LED SEC PWR	green: on, secondary bulk power supply connected
LED Seg 1...4	yellow: bus activity; red 2 Hz flashing: alarm; red: hardware error
Fault signal	VFC alarm 1 A, 50 V DC, normally closed
DIP-switch	diagnostic address 1...247, binary coded

### Advanced Diagnostic Module Type HD2-DM-A.RO

#### Supply

Rated voltage	19.2 ... 35 V
Rated current	40 ... 25 mA
Power loss	max. 1 W

#### Fieldbus interface

Number of segments	4
Rated voltage	9 ... 32 V

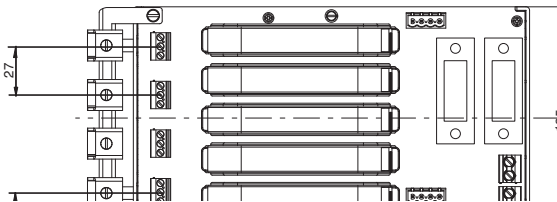
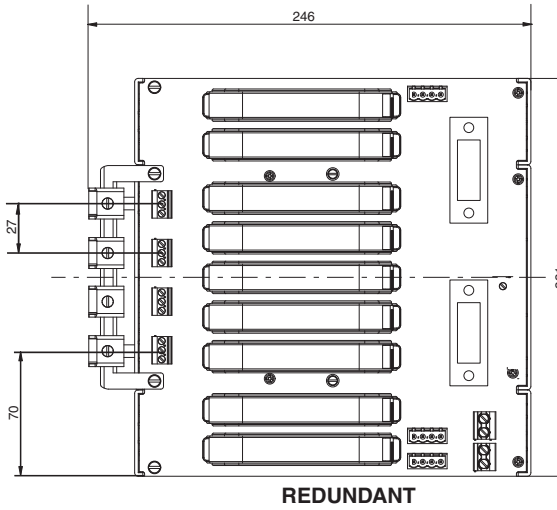
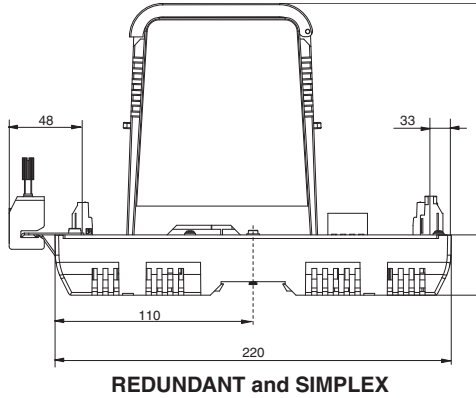
#### Indicators/operating means

LED PRI PWR	green: on, primary bulk power supply connected
LED SEC PWR	green: on, secondary bulk power supply connected
LED Seg 1...4	yellow: bus activity; yellow 2 Hz flashing: Maintenance required; red 2 Hz flashing: specification limit violated; red: hardware error
Fault signal	VFC alarm 1 A, 50 V DC, normally closed
DIP-switch	fieldbus type , redundant supply , Signal level , Noise level , Jitter

#### Accessories

Description	Order code	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

2.5 Dimensional Drawings



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### 3 Installation and Commissioning

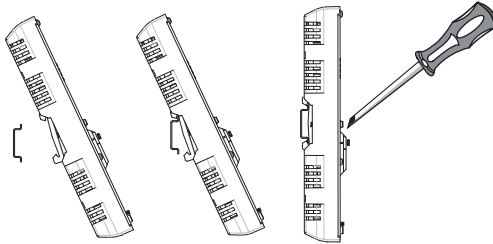
#### 3.1 Mounting and Dismounting



##### Mounting of Fieldbus Motherboards on DIN mounting rail

To mount a motherboard on a DIN mounting rail, proceed as follows:

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



The motherboard has been mounted.



##### Mounting of Modules on the motherboard



**Caution!**

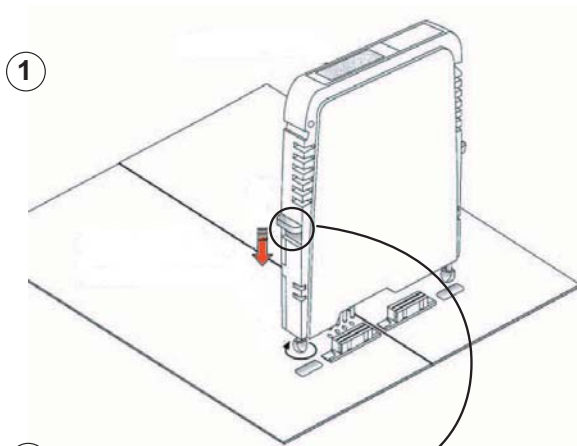
**Hardware Damage**

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.

To install a new module on the motherboard, 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 bars on each side of the module to fix it to the panel (no tools required).



2



The new module has been installed.



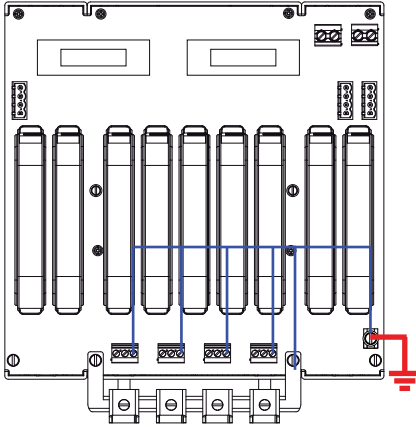
### Dismounting of Modules from the Motherboard

To dismount a module from the motherboard, proceed as follows:

Push the red Quick LOK bars upwards and lift off the entire module gently.

The module has been removed from the motherboard.

### 3.2 Shield and Ground Connection



#### Trunk Shield Connection with ACC-MB-HSK Kit

To simplify shield connection on the trunk side, an earth bar is provided for cable shield connection.



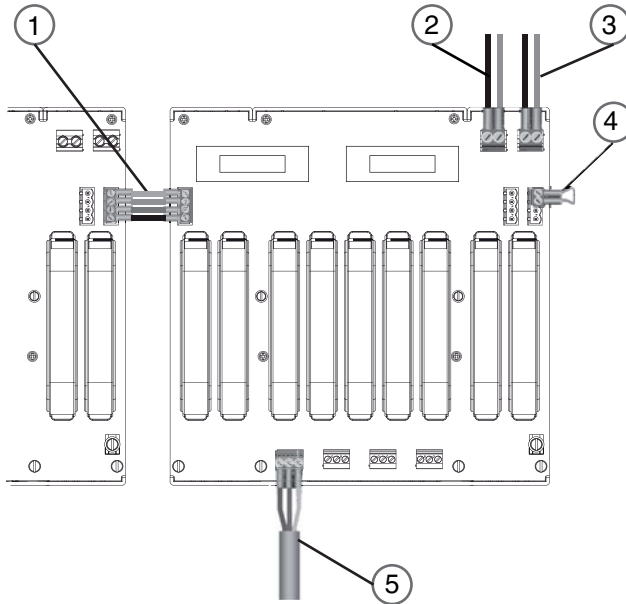
**Caution!**

This is not a safety earth, although there may be a requirement to earth all exposed metal parts as a matter of course.

Care must be taken to ensure a clean earth at all times.

The grounding/shielding concept of the other MB-FB\* motherboards is equal.

### 3.3 Connections



- 1 Diagnostic link cable AAC-B
- 2 Primary bulk power connection
- 3 Secondary bulk power connection
- 4 Final motherboard link (the alarm contact has to be looped at the last motherboard)
- 5 Fieldbus trunk connection

#### Motherboard Series Connection

To maintain the alarm contact continuity the motherboards must be linked by ACC-MB-HDC link cable.

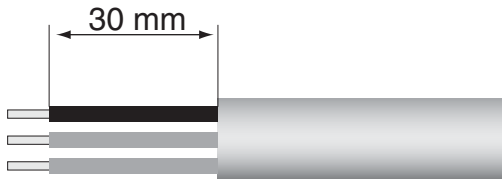
A connection loss at the alarm link does not have any negative influence on the fieldbus segments.

#### 3.3.1 Installation requirements for Ex ic installations

If the Fieldbus Power Hub should be used within an intrinsically safe installation (Ex ic) the following installation requirements have to be executed:

##### Preparing trunk, alarm and diagnostic bus cable for Ex ic installations

To guarantee the prescribed clearance distance the trunk cables, the alarm voltage-free contact and diagnostic bus cable have to be prepared as following (unnecessary if ACC-MB-HDC diagnostic cable is been used).



No more than 30 mm of the single leads of the trunk and diagnostic bus cables may stick out of the cable jacket. Respectively the single leads of the trunk and diagnostic bus cable have to be band together with a tie-wrap or a shrink hose after 30 mm see chapter 3.

### 3.4 Segment Termination

Motherboards got integrated terminators for each fieldbus segment. see chapter 2.3

**Caution!**

Communication Problems

Wrong termination may cause communication problems or a total communication loss.

- Make sure that there are two terminators activated on each trunk line.
- One terminator should be located on each end of the trunk line.



## 4 Fieldbus Power Hub Basic Diagnostics

The Fieldbus Power Hub System provides integrated self-supervision functionality located within the Power Modules and the Motherboards. Additionally, a Basic Diagnostic Module is available to monitor bulk power supply status and compatibility of the mounted Power Modules in redundant systems. The following conditions are monitored:

- Availability of the bulk power supply
- Output voltage per segment
- Overload or short circuit per segment
- Power Module failure

The status of the Power Hub is shown by LED indication and by a normally closed, voltage-free contact. Normal operating conditions are shown by green LEDs, the voltage-free contact is closed. See table below for detail diagnostic information.

Fault	Relay Contact	Diagnostic Module	Power Module
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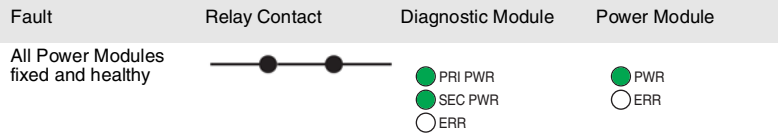
**A: Supply Under/Over Voltage Detection**



**B: Power Module compatibility** redundant system only



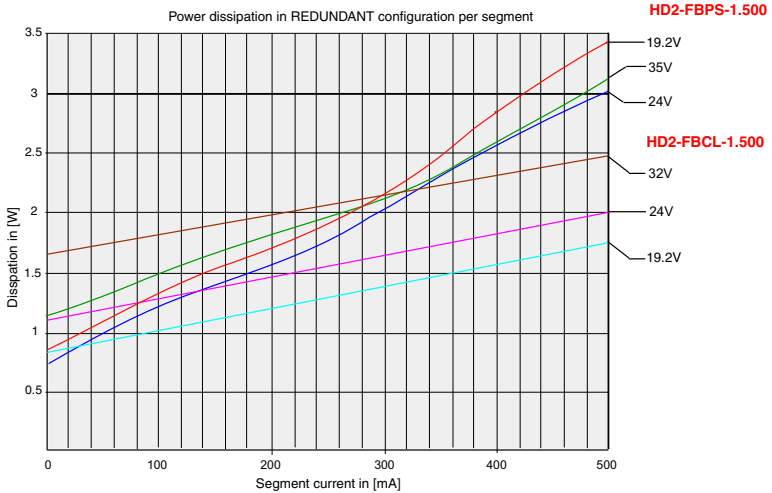
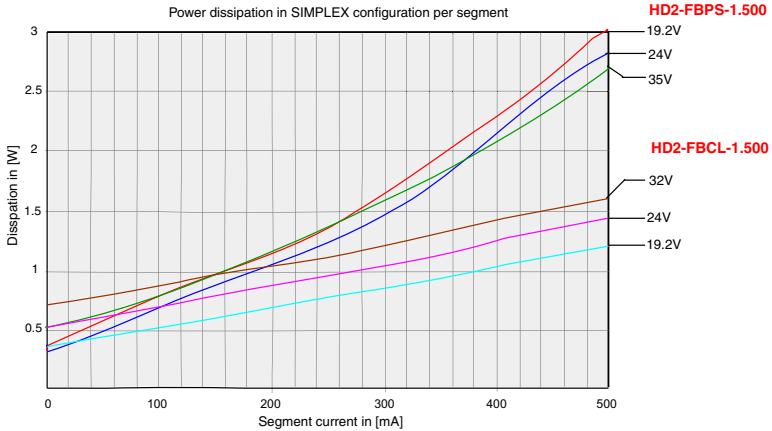
Fault	Relay Contact	Diagnostic Module	Power Module
All modules have intact redundancy partner		<ul style="list-style-type: none"> <li><span style="color: green;">●</span> PRI PWR</li> <li><span style="color: green;">●</span> SEC PWR</li> <li><span style="border: 1px solid black; border-radius: 50%; display: inline-block; width: 10px; height: 10px; vertical-align: middle;"></span> ERR</li> </ul>	<ul style="list-style-type: none"> <li><span style="color: green;">●</span> PWR</li> <li><span style="border: 1px solid black; border-radius: 50%; display: inline-block; width: 10px; height: 10px; vertical-align: middle;"></span> ERR</li> </ul>
Only one Power Module is fitted to a segment		<ul style="list-style-type: none"> <li><span style="color: green;">●</span> PRI PWR</li> <li><span style="color: green;">●</span> SEC PWR</li> <li><span style="color: red;">●</span> ERR</li> </ul>	<ul style="list-style-type: none"> <li><span style="color: green;">●</span> PWR</li> <li><span style="border: 1px solid black; border-radius: 50%; display: inline-block; width: 10px; height: 10px; vertical-align: middle;"></span> ERR</li> </ul>
<b>C: Power Module or load status</b>			
Power Module failure		<ul style="list-style-type: none"> <li><span style="color: green;">●</span> PRI PWR</li> <li><span style="color: green;">●</span> SEC PWR</li> <li><span style="color: red;">●</span> ERR</li> </ul>	<ul style="list-style-type: none"> <li><span style="border: 1px solid black; border-radius: 50%; display: inline-block; width: 10px; height: 10px; vertical-align: middle;"></span> PWR</li> <li><span style="color: red;">●</span> ERR</li> </ul>
Output overload or trunk short circuit		<ul style="list-style-type: none"> <li><span style="color: green;">●</span> PRI PWR</li> <li><span style="color: green;">●</span> SEC PWR</li> <li><span style="color: red;">●</span> ERR</li> </ul>	<ul style="list-style-type: none"> <li><span style="border: 1px solid black; border-radius: 50%; display: inline-block; width: 10px; height: 10px; vertical-align: middle;"></span> PWR</li> <li><span style="color: red;">●</span> ERR</li> </ul>



## 5 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 one segment including motherboard power losses, for given output currents and supply voltages.

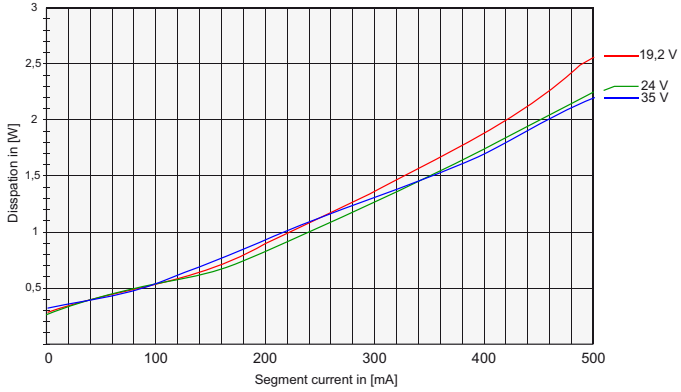
### Thermal Dissipation of HD2-FBPS-1.500 and HD2-FBCL-1.500



**Thermal Dissipation of HD2-FBPS-1.17.500**

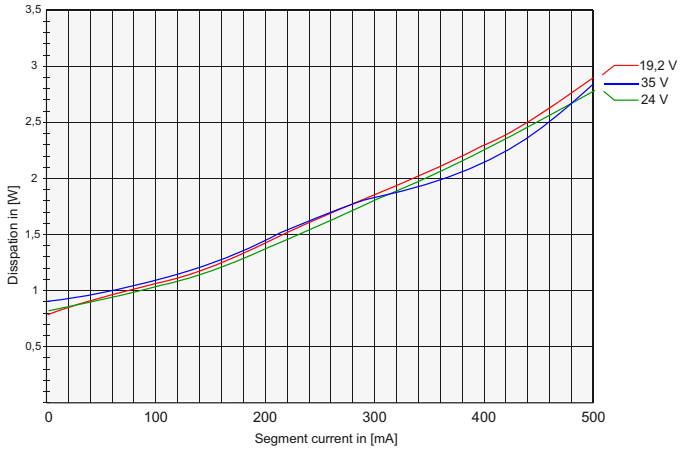
Power dissipation in SIMPLEX configuration per segment

**HD2-FBPS-1.17.500**



Power dissipation in REDUNDANT configuration per segment

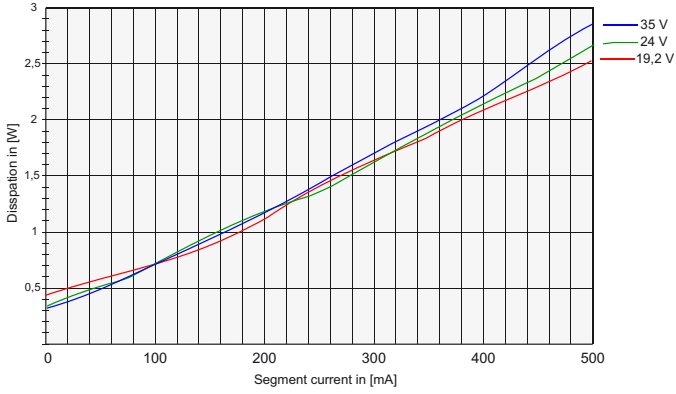
**HD2-FBPS-1.17.500**



**Thermal Dissipation of HD2-FBPS-1.23.500**

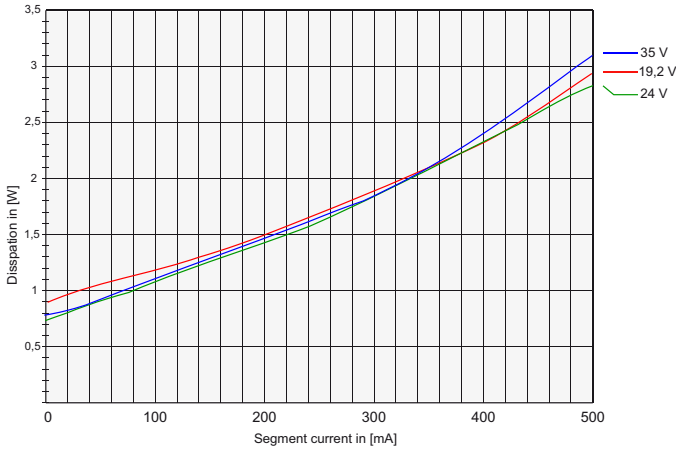
Power dissipation in SIMPLEX configuration per segment

**HD2-FBPS-1.23.500**



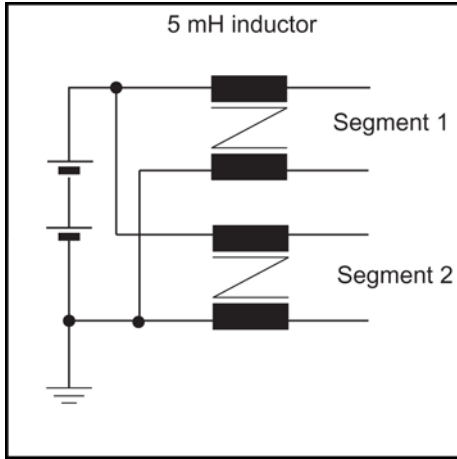
Power dissipation in REDUNDANT configuration per segment

**HD2-FBPS-1.23.500**

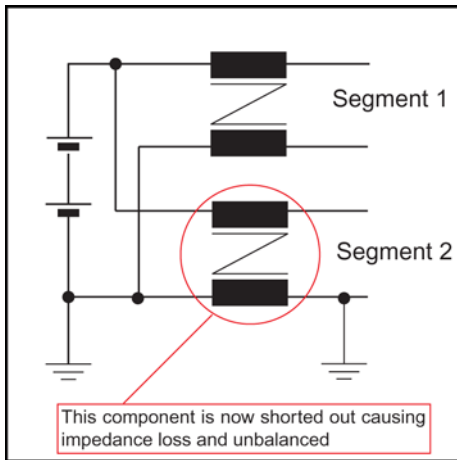


## 6 How CREST works

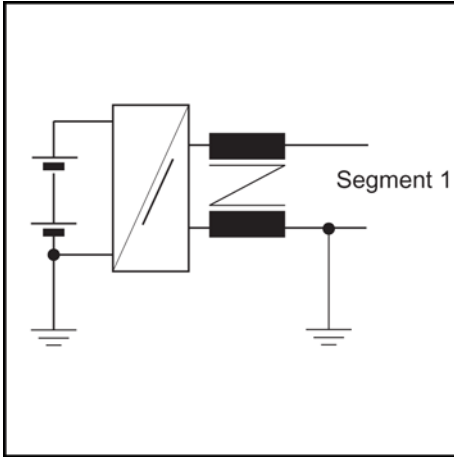
The original specification draft for Fieldbus (SP 50) suggested the use of simple passive conditioners and a common grounded bulk power supply.



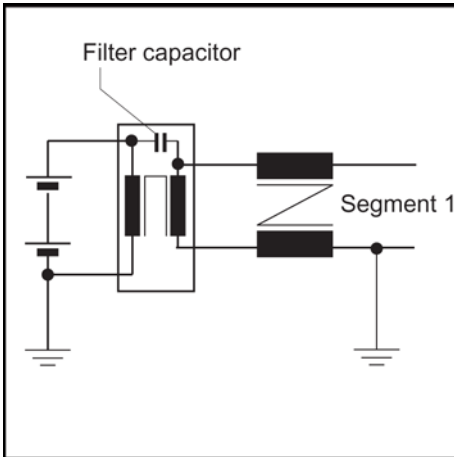
The grounded earth eliminated problems of cross-talk and noise, but introduced other problems, such as impedance loss and/or unbalance, if a pole of a segment was shorted to ground.



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

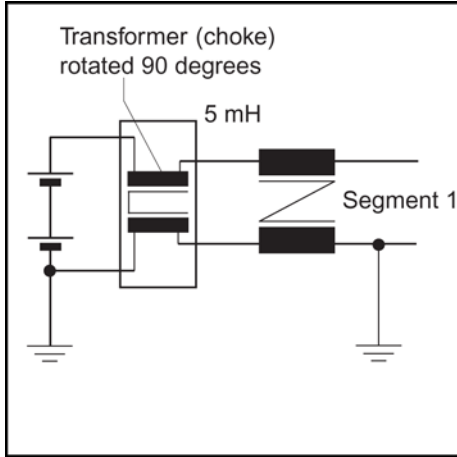


With segment isolation, cross-talk is reduced, and grounded segments will not cause impedance problems. Unfortunately, often an EMC filter capacitor is used across the galvanic isolation to reduce EMI/RFI emissions and output ripple, effectively offering a low impedance path for high frequency signals.



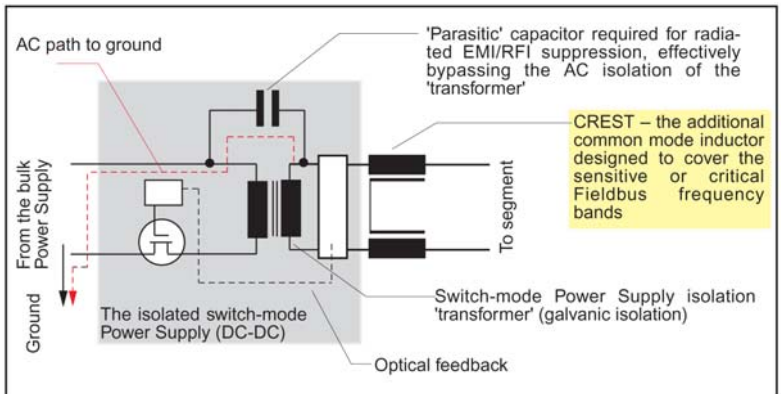
The engineers at Pepper+Fuchs studied the model and realized that if the supply isolation was turned by 90 degrees, then galvanic isolation could be emulated while creating a high impedance common mode and differential noise filter.





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 below 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).

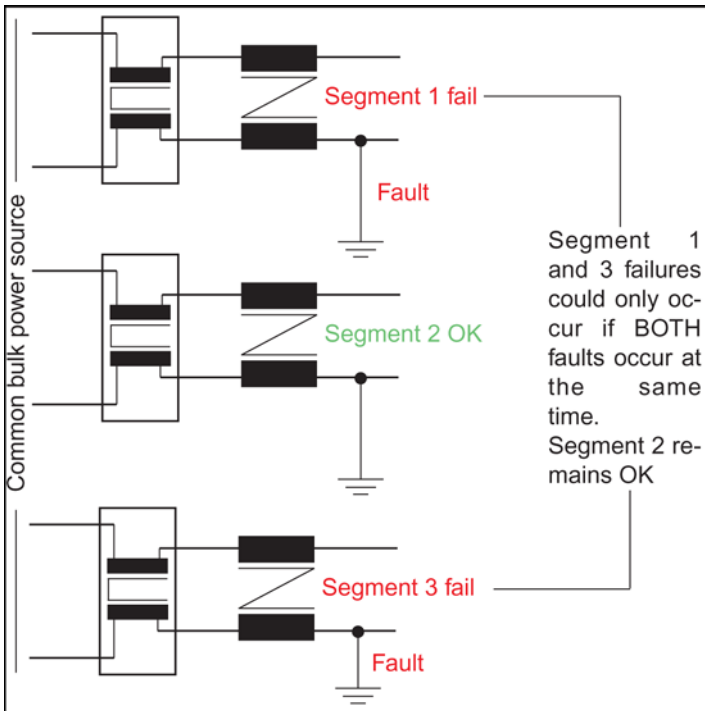
The common mode inductor converts differential mode noise into commonmode noise, which is not affecting bus communication any more.

The common mode inductor is specially designed to operate within the frequency range specific to Fieldbus. Although there are small commonmode 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.

### 6.1 Non-Isolation with CREST

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 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.

## 7 Appendix

### 7.1 Ordering Information

Designation	Description
HD2-FBPS-1.500	Isolated Fieldbus Power Supply Module with 28 ... 30 V DC and 500 mA output.
HD2-FBPS-1.23.500	Isolated Fieldbus Power Supply Module with 21 ... 23 V DC and 500 mA output.
HD2-FBPS-1.17.500	Isolated FNICO Power Supply Module with 15 ... 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-FBPS-1.25.360	General purpose isolated Fieldbus Power Supply Module with 25 ... 28 V DC and 360 mA output.
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.
HD2-DM-A.RO	The Advanced Diagnostic Module, Relay Output, permanently monitors the physical layer. If a predefined limit value is exceeded, a built-in contact opens to alarm the operator by means of a system alarm input.
MB-FB-4.YO	General purpose 4x segment Fieldbus motherboard with redundant bulk power feed and diagnostic interface, all connectors screw terminal type.
MB-FB-4R.YO	General purpose 4x redundant segment Fieldbus motherboard with redundant bulk power feed and diagnostic interface, all connectors screw terminal type.
Accessories	
ACC-MB-HDC	Diagnostic link cable, length 6 cm
ACC-MB-HSK	Screening/earthing kit.

### 7.2 Referenced Documents

- Manual: "Using Pepperl+Fuchs fieldbus equipment in Zone 2 hazardous area environment"
- Selection table: Conformity of FieldConnex® Power Hub power modules and motherboards to Ex ic

### 7.3 Electromagnetic Compatibility in Accordance with EC Council Legislation Directive 2004/108/EC

**Compatibility in accordance with IEC/EN 61326-1:2006 and Namur NE 21:2006 recommendation.**

The electromagnetic compatibility – EMC – requirements applicable for electrical equipment for measurement, control and laboratory use in general are anchored in the European Standard IEC/EN 61326-1. Three different categories of device performances are distinguished:

A category **A** device – operates as intended during the test. This device can withstand the immunity tests without any noticeable performance degradations within the specification limits of the manufacturer.

A category **B** device – operates as intended after the test. The device shows temporary degradation or loss of function of performance during the test but self-recovers from that state when the exposures are ceased.

A category **C** device – has loss of function, may need manual restoration. During the test a temporary loss of function is allowed as long as an operator can restore the device back to operation.

The requirements of the association for standard and control and regulations of the German chemical industries, defined in the NE21 recommendation, are partly higher compared to the test levels and failure criterion defines in IEC/EN 61326-1. For the product qualification, failure criterions and test levels have been selected, representing always the worst case conditions.

IEC/EN 61000-4, as a generic standard, defines the test setups for the specific required test for IEC/EN 61326-1 and NE21.

**Applied standards:**

- CE-Conformity 2004/108/EC
- IEC/EN 61000-4
- IEC/EN 61326-1:2006
- IEC/EN 55011:2007
- NE 21:2006

Standard	Test	Test Level	Failure Criterion
IEC/EN 61000-4-2	Electrostatic discharge direct contact Electrostatic discharge indirect air	6 kV	A
		8 kV	A
IEC/EN 61000-4-3	Electromagnetic field radiated, radio frequency	10 V/m	A
IEC/EN 61000-4-4	Fast transients Burst on signal lines Fast transients Burst on power lines	1 kV	A
		2 kV	A

Standard	Test	Test Level	Failure Criterion
IEC/EN 61000-4-5	Slow transient Surge on signal lines Slow transient Surge on shielded lines	1 kV 2 kV	B B
IEC/EN 61000-4-6	Conducted immunity, radio frequency	10 V	A
IEC/EN 55011	RF conducted emission RF radiated emission	Class A Class A	-- --

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