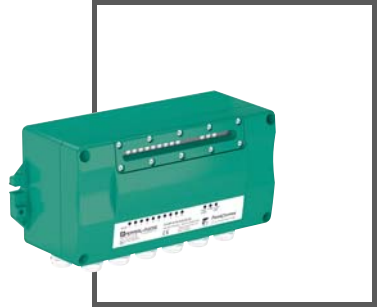


MANUAL

F2-SP-IC* Segment Protector



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

The chapter "Safety" is valid as instruction manual.

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

1.2 Symbols used

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

Safety-relevant symbols



Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.



Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.



Caution!

This symbol indicates a possible fault.

Non-observance could interrupt devices and any connected facilities or systems, or result in their complete failure.

Informative symbols



Note!

This symbol brings important information to your attention.



Action

This symbol indicates a paragraph with instructions.

1.3 System Operator and Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismantling lies with the system operator.

Mounting, installation, commissioning, operation, maintenance and disassembly of any devices may only be carried out by trained, qualified personnel. The instruction manual must be read and understood.

1.4 Pertinent Laws, Standards, Directives, and further Documentation



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

The corresponding data sheets, declarations of conformity, EC-type-examination certificates, certificates and Control Drawings if applicable (see data sheet) are an integral part of this document. You can find this information under www.pepperl-fuchs.com.

Due to constant revisions, documentation is subject to permanent change. Please refer only to the most up-to-date version, which can be found under www.pepperl-fuchs.com.

1.5 Marking

The Segment Protectors are marked with:

Pepperl+Fuchs GmbH
Lilienthalstrasse 200, 68307 Mannheim, Germany
F2-SP-IC*
TÜV 13 ATEX 107689 X
 II 3 G Ex nAc [ic] IIC T4 ,  II 2(3) D Ex tb [ic] IIIC T130°C (for cable gland version only)
IECEX TUN 13.0004X
Ex nAc [ic] IIC T4 , Ex tb [ic] IIIC T130°C (for cable gland version only)

The stars replace a combination of characters, depending on the product.

Electrical data see EC-type-examination certificate or datasheet.

1.6 Intended Use

F2-SP-IC* Segment Protectors are fieldbus device couplers that connect field devices, through spurs, to the trunk of a segment in accordance with IEC61158-2. Each spur individually limits or isolates the current during a spur failure, ensuring that the remaining segment is not affected.

The device is designed for use in intrinsically safe fieldbus systems according to FISCO or Entity.

F2-SP-IC* Segment Protectors are intended for panel mounting. For mounting, use two screws with a diameter of 6 mm. Choose the mounting material to fit the nature of the sub-surface (the wall). When choosing the mounting material, ensure that it can be fastened securely.

If devices have already been operated in general electrical systems, they may subsequently no longer be installed in electrical systems used in combination with hazardous areas.

Mounting, installation, commissioning, operation, maintenance and disassembly of any devices may only be carried out by trained, qualified personnel. The instruction manual must be read and understood.

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

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 (non-condensing) specified.

1.7

Mounting and Installation

The installation instructions in accordance with IEC/EN 60079-14 must be observed.

The installation instructions in accordance with IEC/EN 60079-25 must be observed.

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

Do not install damaged or polluted devices.

If devices have already been operated in general electrical systems, they may subsequently no longer be installed in electrical systems used in combination with hazardous areas.

The use of the jumper "P" to change I_0 and the jumper "T" to activate the terminator as well as the connection and disconnection of energized non intrinsically safe circuits is only permitted if no explosive atmosphere exists.

Cables must be securely fixed.

To ensure the IP degree of protection:

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

Do not connect the signal wires to ground or to the cable shield.

Trunk and spur connectors are only allowed to be manipulated at ambient temperatures between -5 °C and +70 °C.

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

1.7.1 Intrinsically Safe Circuits

All separation distances between two adjacent intrinsically safe circuits need to be observed in accordance with IEC/EN 60079-14.

Intrinsically safe circuits of associated apparatus (installed in safe areas) can be led into hazardous areas, whereby special attention must be paid to maintain separation distances to all non-intrinsically safe circuits according to the requirements in IEC/EN 60079-14.

If "Ex ic" protected circuits are operated with non-intrinsically safe circuits, they must no longer be used as "Ex ic" protected circuits.

The respective peak values of the field device and the associated apparatus with regard to explosion protection should be considered when connecting intrinsically safe field devices with intrinsically safe circuits of associated apparatus (verification of intrinsic safety). Make sure to observe IEC/EN 60079-14 and IEC/EN 60079-25.

1.7.2 Zone 22

Devices with external pluggable connectors for non-intrinsically safe circuits must not be installed in Zone 22.

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

The housing must not be opened when the device is connected to the supply voltage if there is a risk of dust explosion.

All dust deposits must be removed before the housing is opened.

1.7.3 Zone 21

Devices with external pluggable connectors must not be installed in Zone 21.

Connection or disconnection of any energized circuits is only permitted in the absence of a hazardous atmosphere.

Ex ic protected circuits meet equipment protection level Dc only.

The housing must not be opened when the device is connected to the supply voltage.

All dust deposits must be removed before the housing is opened.

1.8 Repair and Maintenance

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

1.9 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 and dry environment. The permitted storage temperature (see data sheet) must be considered.

1.10 Disposal

Disposing of devices, packaging material, and possibly contained batteries must be in compliance with the applicable laws and guidelines of the respective country.

2 Product Specifications

2.1 Overview and Application

The F2-SP-IC* Segment Protectors are part of a new family of bus powered, fault tolerant fieldbus device couplers used for the connection of field instruments to segments.

The Segment Protectors are designed for fieldbus systems in accordance with IEC 61158-2 (FOUNDATION Fieldbus H1 or PROFIBUS PA) and in accordance with the FOUNDATION fieldbus device coupler test specification FF-846.

Communication and power distribution share the same two-wire cable using Manchester Bus Powered (MBP) coding.

Mounting of F2-SP-IC* Segment Protectors

The Segment Protector is placed in an aluminum housing for wall mounting.

The F2-SP-IC* Segment Protector family offers different trunk cable entry options and spur cable entry options for the most required applications and types of protection. For the different cable entry options, → see image on page 13.

For spur wiring, different types of terminals are available depending on the maintenance requirements of the plant. For the terminal options, → see image on page 13.

Connection layout

Spurs: Each field device is connected to 1 output or spur, and 1 or more Segment Protector(s) are connected to the segment or trunk. F2-SP-IC* offers the choice from 4-10 spur connections.

Trunk: Featuring 2 cable glands and terminals for Trunk IN and Trunk OUT, the Segment Protector can be installed at any point in the trunk line.

Type of protection

The Segment Protector is certified for installation in Zone 2. Using Pepperl+Fuchs Segment Protectors in combination with Pepperl+Fuchs Fieldbus Power Supplies allows you to perform live maintenance at the field device level in Zone 2 because the outputs are either classified Entity Ex ic or FISCO ic.

Monitoring and diagnostic options

The F2-SP-IC* Segment Protector series are the first to offer device level integrated Physical Layer Diagnostics as a standard. Most important physical layer parameters, such as communication signal levels and signal jitter for each participating field instrument are monitored and compared to limit values that are mainly derived from the IEC 61158-2 physical layer specification or from empirical data.

A fault summary status alarm is shown on the Segment Protector through an LED indicator and can be issued in detail, i.e. via specific field instrument diagnosis using an Advanced Diagnostic Module, positioned in the specific working environment of a control system.

Failure condition handling (short circuit limitation and beyond)

The design of the F2-SP-IC* Segment Protector series focuses on fault tolerance towards failure conditions on the spur/field device level threatening the entire segment to fail.

Each spur is equipped with short circuit current limitation with unique features:

- **Spur Contact Bounce Protection:** Protects the segment from continuous or intermittent current changes due to poorly attached, fractured, or loose fieldbus wires at a spur. When under vibration, wires can keep connecting and disconnecting to the attached field device load. The Pepperl+Fuchs Spur Contact Bounce Protection protects the fieldbus communication from permanent disturbances, and safeguards the segment against failure.
- **Progressive Spur Short Circuit Protection:** Avoids segment failure in situations where the spur current progressively rises, e.g. if water ingresses in the terminal arrangement, leading to increasing conductivity between the fieldbus wires and causing the current limiting electronics to dampen the communication signals due to increasing impedance. The Pepperl+Fuchs Segment Protector safely isolates any affected spur in order to prevent a total segment failure.
- **Device Jabber Protection:** Specific software or hardware failures can cause the field instrument to communicate continuously (Jabber). The Pepperl+Fuchs Segment Protector has an integrated device jabber inhibitor that first detects faults caused by device jabber, and then immediately isolates the faulty device from the segment.

If a spur has a short circuit or failure, the fieldbus trunk and all other field devices remain in operation. When the fault is repaired, the Segment Protector automatically resumes normal operation of the spur.

These features, combined with overvoltage protection at 39 V, make segments reliable.

Surge protection for F2-SP-IC* Segment Protectors

As an option Segment Protectors are delivered with a trunk surge protection device to protect safely against damages caused by voltage surges and lightning strikes. The FS-LBF-11.32 is installed in one of the trunk cable glands. Therefore, this option is only available when a single Segment Protector is connected to the segment.

Fieldbus termination for F2-SP-IC* Segment Protectors

By default, a jumper for fieldbus termination is included. A field terminator is mounted at the very end of the segment or trunk. The last Segment Protector on the segment is terminated by a mechanical jumper. This design increases fieldbus availability in two ways:

1. the connection is secured by screws
2. overtermination resulting in reduced signal levels is avoided: the termination is clearly visible for installation personnel and can only be connected at the end of the trunk line

Shielding/Grounding

The Segment Protector offers an optional grounding terminal jumper to connect all shields to the external grounding clamp of the Segment Protector housing. If shielded cables are used, the terminal jumper should be stored in the defined parking position.

Gas Group Selection

The maximum short circuit current must be determined depending on the gas group IIC or IIB. The F2-SP-IC* includes a short circuit current jumper to adjust the Segment Protector to the individual requirements.

Indicators for Monitoring and Diagnosis

The Segment Protectors contain externally visible LED indicators for easy communication monitoring and diagnosis. The LEDs indicate:

- bus communication activity
- physical layer diagnostic status
- power on the trunk
- a short circuit condition or fault at any connected spur (each spur is equipped with an individual LED)
- Trunk voltage > 10 V and Terminator activated

2.2

Type Codes

2.2.1

F2-SP-IC* Segment Protector Type Code

Type Code/Order Designation									
Type of housing									
F2	Field housing, aluminum, IP65								
Function									
SP	Segment Protector								
Explosion protection method									
IC	Ex ic, non-incandive field wiring rated spur outputs								
Number of outputs									
04	4 spurs								
06	6 spurs								
08	8 spurs								
10	10 spurs								
Terminal options									
0	Screw terminal, non-pluggable								
1	Screw terminal, pluggable								
2	Spring terminal								
Trunk cable entry options ³									
00	M20 stopping plug, plastic								
01	M20 stopping plug, stainless steel								
02	M20 cable gland, plastic								
03	M20 cable gland, nickel plated brass								
04	M20 cable gland, stainless steel								
05	M20 cable gland, nickel plated brass for armored cable								
06	M20 cable gland, stainless steel for armored cable								
09	M12 plug connection, nickel plated brass FOUNDATION Fieldbus ²								
10	M12 plug connection, nickel plated brass PROFIBUS PA ²								
11	M12 plug connection, stainless steel FOUNDATION Fieldbus ¹								
12	M12 plug connection, stainless steel PROFIBUS PA ¹								
Spur cable entry options ³									
00	M20 stopping plug, plastic								
01	M20 stopping plug, stainless steel								
02	M20 cable gland, plastic								
03	M20 cable gland, nickel plated brass								
04	M20 cable gland, stainless steel								
05	M20 cable gland, nickel plated brass for armored cable								
06	M20 cable gland, stainless steel for armored cable								
09	M12 plug connection, nickel plated brass FOUNDATION Fieldbus								
10	M12 plug connection, nickel plated brass PROFIBUS PA								
11	M12 plug connection, stainless steel FOUNDATION Fieldbus								
12	M12 plug connection, stainless steel PROFIBUS PA								
Accessory options									
0	No tag plate								
1	Tag plate stainless steel incl. printing								
2	Tag plate stainless steel excl. printing								
0	No trunk surge protector								
1	Trunk surge protector								
F2	-	SP	-	IC
A	-	B	-	C	D	E	F	G	H I

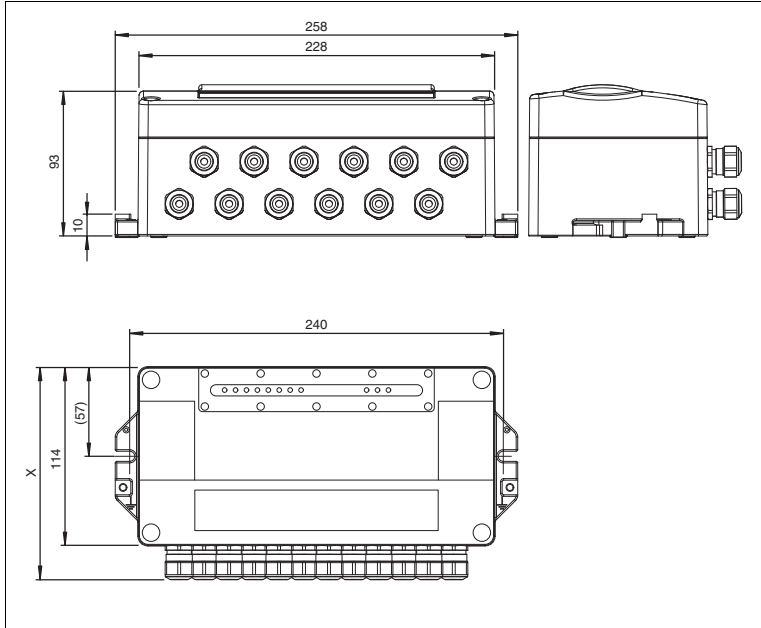
- 1 If no surge protector is selected, one trunk entry is closed with a stainless steel stopping plug.
- 2 If no surge protector is selected, one trunk entry is closed with a plastic stopping plug.
- 3 Only options with cable glands are permitted for dust hazardous areas.

Contact your Pepperl+Fuchs representative to check the availability of individual variants.

2.3 Component Dimensions and Overview

The following section shows the dimensions, the inside connections, and the options of the Segment Protector.

Component dimensions



X For the housing height, please see see table "Variants of Cable Connections, Housing Types, and Temperature Ranges" on page 18.

Component overview

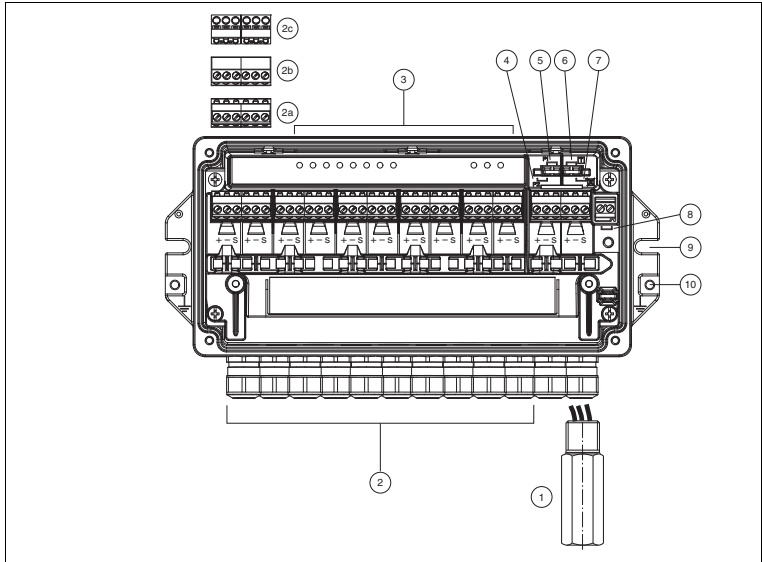


Figure 2.1 F2-SP-IC*: Segment Protector with housing cover removed.

- 1 Surge Protector: The option connects to the cable entry of the Trunk OUT line (preconfigured as selected).
→ see image on page 33
- 2 Spur terminals: 4-10 spurs can be connected to the Segment Protector. The Segment Protector features either of the 3 types of terminals shown (preconfigured as selected):
2a Screw terminal
2b Removable screw terminal
2c Removable spring terminal
- 3 Status LEDs for spurs, trunk power, communication, and terminator
See chapter 5.1
- 4 Trunk IN terminal: Connects the incoming trunk line to the Segment Protector
- 5 Jumper for protection type
→ see Figure 4.2 on page 28
- 6 Jumper for termination
→ see Figure 4.1 on page 26
- 7 Trunk OUT terminal: Connects the outgoing trunk line to the Segment Protector
- 8 Shield/screen grounding jumper (optional)
→ see Figure 4.4 on page 30
- 9 Notch for fixing the Segment Protector housing with screw M6
- 10 Grounding point for connecting the Segment Protector to earth with M4 screw.
See chapter 4.4

2.4

Technical Data

Technical Data	
Fieldbus interface	
Main cable (Trunk)	
Rated voltage	9 ... 31 V DC 10.5 V DC minimum input voltage acc. to FF-846
Rated current	max. 4.5 A
Outputs	
Number of outputs	see table Technical data depending on model
Number of devices per output	1
Rated voltage	max. 31 V
Rated current	max. 32 mA jumper 1, position 2 max. 43 mA jumper 1, position 1
Short-circuit current	46 mA jumper 1, position 2 65 mA jumper 1, position 1
Self current consumption	see table Technical data depending on model
Voltage drop main cable/outputs	max. 1.2 V
Voltage drop trunk In/Out	0 V
Terminating resistor	selectable via Jumper 100 Ω +/- 10 %
Surge protection	trunk, spurs overvoltage protected if voltage exceeds typ. 39 V, max. 41 V
Directive conformity	
Electromagnetic compatibility	
Directive 2004/108/EC	EN 61326-1:2006
Standard conformity	
Electromagnetic compatibility	NE 21:2011
Protection degree	IEC 60529
Fieldbus standard	IEC 61158-2
Climatic conditions	IEC 60721
Shock resistance	EN 60068-2-27
Vibration resistance	EN 60068-2-6
Ambient conditions	
Ambient temperature	see table 2
Storage temperature	-40 ... 85 °C (-40 ... 185 °F)
Relative humidity	< 95 % non-condensing
Shock resistance	15 g , 11 ms

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
Technical Data	
Vibration resistance	5 g , 10 ... 150 Hz
Corrosion resistance	acc. to ISA-S71.04-1985, severity level G3
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	TÜV 13 ATEX 107689 X
Group, category, type of protection, temperature class	 II 3 G Ex nAc [ic] IIC T4 ,  II 2(3) D Ex tb [ic] IIIC T130°C (for cable gland version only)
Supply	
Maximum safe voltage	35 V
Outputs	
Voltage	32 V
Current	46 mA jumper 1, position 2 65 mA jumper 1, position 1
Inductance	0.25 mH jumper 1, position 1 0.125 mH jumper 1, position 2
Capacitance	60 nF
Directive conformity	
Directive 94/9/EC	EN 60079-0:2012 , EN 60079-11:2012 , EN 60079-15:2010 , EN 60079-31:2009
International approvals	
IECEx approval	IECEx TUN 13.0004X
Approved for	Ex nAc [ic] IIC T4 , Ex tb [ic] IIIC T130°C (for cable gland version only)
Certificates and approvals	
Marine approval	pending

Table 2.1 F2-SP-IC*: Technical data

Technical Data Depending on Model

Number of outputs	4	6	8	10
Quiescent current	max. 15 mA	max. 17 mA	max. 17 mA	max. 19 mA
470 mW**	530 mW**	530 mW**	530 mW**	590 mW**

Table 2.2 Technical data depending on model
** + 10 mW per spur at 20 mA load

Variants of Cable Connections, Housing Types, and Temperature Ranges

Type of connection		Number of outputs				Fixed screw	Pluggable screw	Pluggable spring terminal	Housing height "X" ^{**} (mm)	AF (mm)	Temperature range (C°)
		4	6	8	10						
00	Stopping plug plastic	x	x	x	x	x	x	120	8	-40...+70	
01	Stopping plug stainless steel	x	x	x	x	x	x	120	10	-40...+70	
02	Cable glands plastic	x	x	x	x	x	x	150	24	-40...+70	
03	Cable glands nickel plated brass	x	x	x	x	x	x	140	24	-40...+70	
04	Cable glands stainless steel	x	x	x	x	x	x	140	24	-40...+70	
05	Cable glands nickel plated brass for armored cable	x	x	x	x	x	x	160	24	-40...+70	
06	Cable glands stainless steel for armored cable	x	x	x	x	x	x	160	24	-40...+70	
09, 10	Plug connection M12 nickel plated brass	x	x	x	n/a	n/a	n/a	135	n/a	-25...+70	
11, 12	Plug connection M12 stainless steel	x	x	x	n/a	n/a	n/a	135	n/a	-25...+70	

Table 2.3 Variants of cable connections, housing types, and temperature ranges

** Housing height including trunk surge protection: 170 mm; available for all variants.

3 Hazardous Area Installation and Use

3.1 Installation in Zone 2, no Live Maintenance at Trunk and Spurs (Ex nAc)

For non-intrinsically safe Zone 2 circuits, live maintenance on the trunk or spurs must only be carried out with hot work permit.

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, a declaration of conformity must be provided.

Field devices and Segment Protectors are located in Zone 2 and therefore need to be certified for non-arcing protection (Ex nAc). If the fieldbus power supplies are also located in hazardous area Zone 2, the same requirements apply.

The evaluation of a non-arcing circuit is limited to the maximum voltage of the fieldbus power supply (U_o) which has to be less than or equal to the maximum rated input voltage U_i of the Segment Protector and field devices. Field devices and Segment Protectors following this requirement could be either certified for non-arcing apparatus equipment or intrinsically safe apparatus according to Entity or FISCO.

For the requirements for typical fieldbus products for use in Zone 2 installations refer to the manual: 'Using Pepperl+Fuchs fieldbus equipment in Zone 2 hazardous area environment'. This document is supplied separately and can be obtained from the Pepperl+Fuchs Internet product data base.

3.2 Installation in Zone 2 with Live Maintenance at the Spurs (Ex ic, FISCO ic)

For applications requiring certified output voltages at the spurs in accordance with IEC 60079–25 (rated as Ex ic or FISCO ic), two solutions are available:

1. The use of dedicated fieldbus power supply modules which safely limit the output voltage in accordance with IEC 60079–25, using a maximum output voltage level of $U_o \leq 24$ V. The current is limited by the Segment Protector.
2. To take into account the Segment Protector internal voltage limitation, in accordance with IEC 60079–25, using a maximum output voltage level of $U_o \leq 32$ V. The current is limited by the Segment Protector.

3.2.1 Spur Voltage Limited by the External Fieldbus Power Supply $U_o \leq 24$ V, Entity Examination

When using intrinsically safe fieldbus power supplies to directly limit the spur output safety voltage, it is necessary to pay particular attention to the type of fieldbus power supply selected for use with the Segment Protector. This determines the type of Zone 2 or Div. 2 installations and the certified field instruments that can be connected, in the Zone 2 or Div. 2 area, to the spurs of the Segment Protector.

A check must be performed to ensure that the correct type of power supply module is used for the required safety output parameters. For example, the output voltage must be equal to, or less than the maximum voltage of the connected field devices.

When a power supply with $U_o \leq 24 \text{ V}$ is used, the resulting allowed safety output values for gas groups IIC, IIB, IIA at the spurs are:

F2-SP-IC* allowed safety output values:

- $U_o = 24 \text{ V}$, $I_o = 65 \text{ mA}$, $L_o = 0.25 \text{ mH}$, $C_o = 60 \text{ nF}$
(jumper "P" in position "P2")

→ see Figure 4.2 on page 28

The safety evaluation follows the Entity concept defined in EN 60079-11.

Requirements for typical fieldbus products for use in Zone 2 installations are summarized in the manual: 'Using Pepperl+Fuchs fieldbus equipment in Zone 2 hazardous area environment'. This document is supplied separately and can be obtained from Pepperl+Fuchs Internet product data base.

3.2.2

Spur Voltage Limited by the Segment Protector

The fieldbus trunk is rated as non-arcing Ex nAc. Live maintenance at the trunk is only permitted when gas clearance has been assured. The Segment Protector includes an internal voltage limitation in accordance with IEC 60079-25, using a maximum output voltage level of $U_o \leq 32 \text{ V}$. If the internal voltage limitation of $U_o \leq 32 \text{ V}$ is used, it is required to determine the hazardous location related to the gas group in which the Segment Protector will be installed.

The jumper "P" determines the setting of two different maximum short circuit currents, one for gas group IIC, and one for gas group IIB. The spur outputs are rated as intrinsically safe Ex ic.

Max. voltage U_o	Gas groups	Short circuit current I_o	Capacitance C_o	Inductance L_o	Jumper "P"
32 V, internal limitation	IIC	46 mA	60 nF	0.125 mH	Position 2 "P2"
32 V, internal limitation	IIB/IIA	65 mA	60 nF	0.25 mH	Position 1 "P1"
$\leq 24 \text{ V}$, trunk voltage limitation	IIC/IIB/IIA	65 mA	60 nF	0.25 mH	Position 1 "P1"

Table 3.1 Jumper positions to meet short circuit current limits for different gas groups as specified by protection type

The requirements for typical fieldbus products for use in Zone 2 installations are summarized in the manual: 'Using Pepperl+Fuchs fieldbus equipment in Zone 2 hazardous area environment'. This document is supplied separately and can be obtained from Pepperl+Fuchs Internet product data base.

3.2.3 Spur Voltage Limited by the External Fieldbus Power Supply, FISCO Examination

When using intrinsically safe fieldbus power supplies to directly limit the spur output safety voltage, it is necessary to choose a suitable fieldbus power supply for use with the Segment Protector. The power supply used determines the type of Zone 2 or Division 2 installations and the certified field instruments that can be connected to the spurs of the Segment Protector in the Zone 2 or Division 2 area.

A check must be performed to ensure that the correct type of Power Supply Module is used for the required safety output parameters. For example, the output voltage must be equal to or less than the maximum voltage of the connected field devices.

In case a power supply with $U_o \leq 17.5 \text{ V}$ is used, the resulting safety output values for gas groups IIC, IIB, IIA at the spurs that are permitted, are:

- $U_o = 17.5 \text{ V}$, $I_o = 65 \text{ mA}$, $L_o = 0.25 \text{ mH}$, $C_o = 60 \text{ nF}$ (jumper "P" in position "P2")

→ see Figure 4.2 on page 28

The safety evaluation follows the FISCO concept defined in EN 60079-11.

The parameters of the cable used must be within the following ranges:

- $R' = 15 \dots 150 \text{ Ohm/km}$ (loop resistance)
- $L' = 0.4 \dots 1 \text{ mH/km}$
- $C' = 45 \dots 200 \text{ nF/km}$ (incl. a possibly existing shield)
- $C' = C'_{\text{wire/wire}} + 0.5 * C'_{\text{wire/shield}}$ (with floating field apparatus)
- $C' = C'_{\text{wire/wire}} + C'_{\text{wire/shield}}$ (if the shield is connected to one pole of the fieldbus devices supply circuit)

From the safety point of view, the maximum length of the Segment Protector spur cable is 1000 m for IIC and 5000 m for IIB, as each spur output is specified as an independent FISCO source.

Requirements for typical fieldbus products for use in Zone 2 installations are summarized in the manual: 'Using Pepperl+Fuchs fieldbus equipment in Zone 2 hazardous area environment'. This document is supplied separately and can be obtained from Pepperl+Fuchs Internet product data base.

4 Installation and Commissioning

In the following section you find information on how to install and commission the Segment Protector in your fieldbus topology.



Note!

Before performing any work: Read the section on Safety, see chapter 1, especially all sections that are relevant for your application.

4.1 Mounting and Dismounting

The following section explains how to mount the F2-SP-IC Segment Protector.

The following steps are described in order of mounting:

1. Mounting the housing
2. Suitable trunk and spur cable sizes
3. Mounting cable glands / Mounting plug connectors



To mount the aluminum housing

1. To wall-mount the aluminum housing: Use 2 screws.
Diameter: 6 mm.
2. Connect trunk and spur lines according to the information given below.
Pay special attention to the torques for the cable glands/plug connectors!
3. After mounting/wiring: Screw tight the aluminum housing cover.
Required tightening torque: 2.5 Nm.

Suitable trunk and spur cable diameters

The following cable sizes can be connected to the Segment Protector:

Type of connection		Cable diameter (mm)
00	Stopping plug plastic	
01	Stopping plug stainless steel	
02	Cable glands plastic	6 ... 13
03	Cable glands nickel plated brass	7 ... 12
04	Cable glands stainless steel	7 ... 12
05	Cable glands nickel plated brass for armored cable	10 ... 16 outside 7 ... 12 inside 0 ... 1.25 armored
06	Cable glands stainless steel for armored cable	10 ... 16 outside 7 ... 12 inside 0 ... 1.25 armored
09, 10	Plug connection M12 nickel plated brass	
11, 12	Plug connection M12 stainless steel	

Table 4.1 F2-SP-IC* cable diameter depending on cable gland/plug connection

For information on the wrench size (AF), see table "Variants of Cable Connections, Housing Types, and Temperature Ranges" on page 18.



To install cable glands



Danger!

Explosion hazard

If the cable glands are not fitted correctly, the IP degree of protection cannot be ensured and the electronic components can be exposed to an explosive atmosphere.

Check cable glands:

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

Screw each cable gland onto the respective socket for each spur and each trunk at the Segment Protector.

Refer to the following table for the tightening torque required to ensure the protection type/degree of protection.

Tightening torques for cable glands (approx.)

Cable entry type: Cable gland	Trunk: Nm (approx.)	Spurs: Nm (approx.)
M20 stopping plug, plastic	-	-
M20 stopping plug, stainless steel	-	-
M20 plastic	max. 3.75 Nm	max. 3.75 Nm
M20 nickel plated brass	max. 10 Nm	max. 10 Nm
M20 stainless steel	max. 10 Nm	max. 10 Nm
M20 nickel plated brass for armored cable	max. 20 Nm	max. 20 Nm
M20 stainless steel for armored cable	max. 20 Nm	max. 20 Nm

Table 4.2 F2-SP-IC* tightening torques for different types of cable glands



To install plug connections



Danger!

Explosion hazard

If the the plug connections are not installed correctly or unused connections are not secured sufficiently, the IP degree of protection cannot be ensured and the electronic components can be exposed to an explosive atmosphere.

Check plug connections:

- all connections must be installed correctly and fit tightly
- all unused connections must be secured safely

To install each plug connection: Screw the sockets into the respective cable entry of the Segment Protector for each spur and trunk in use. Observe the torque required for it!

Refer to the following table for the tightening torque required to ensure the protection type/degree of protection.

Plug connections are available for size M12 cable entries.



M12 x 1

The pin assignment of the plug connection depends on the fieldbus technology used.

Pin assignment of plug connections

Pin	PROFIBUS PA	FOUNDATION Fieldbus H1
1	PA+	Data-
2	n.c. (GND)	Data+
3	PA-	Shield
4	Shield	n.c. (GND)

Table 4.3 Pin assignment of plug connections
Note: Outputs are always sockets (female).

4.2 Segment Protector Connection Layout of the Trunk

Cable and Connection Information

- Permissible cross core section: 0.2-2.5 mm²
- Insulation stripping length: 7 mm
- If stranded conductors are used: Protect strand ends with end splices.
- Ensure that connectors are mechanically locked.
- Torque required for tightening terminal screws: 0.4-0.5 Nm

The Segment Protector can be installed in the segment in 2 ways:

1. Trunk IN and surge protection: With an incoming trunk line and a Surge Protector that uses the housing entry of the Trunk OUT cable.
2. Trunk IN and Trunk OUT: with an incoming and with an outgoing trunk line.



Note!

Restrictions for Applications with M12 Plug Connections

In order to maintain intrinsic safety, for applications that use M12 plug connections, the Segment Protector can be used in the following ways:

- Trunk IN and surge protection: With an incoming trunk line and a Surge Protector that uses the housing entry of the Trunk OUT cable.
- Trunk IN and stopping plug: With an incoming trunk line and a stopping plug that closes the housing entry of the Trunk OUT cable.
If no surge protection is selected, the Segment Protector is preconfigured with the suitable stopping plug in order to ensure intrinsic safety.



To connect the trunk to the Segment Protector (as single unit or in serial connection)

1. Connect the trunk wires to the designated Trunk IN terminal.
2. For serial connection: Use the Trunk OUT terminal to connect the outgoing trunk line to it.



To terminate the Segment Protector

If the Segment Protector is installed physically at the end of the fieldbus trunk, the trunk needs to be terminated by activating the integrated fieldbus terminator.

Attention: In a segment only 2 terminators are allowed to be activated altogether: one on either physical end of the trunk.

1. Loosen the right screw at the terminal that holds the right jumper "T" in parking position and unplug the jumper.

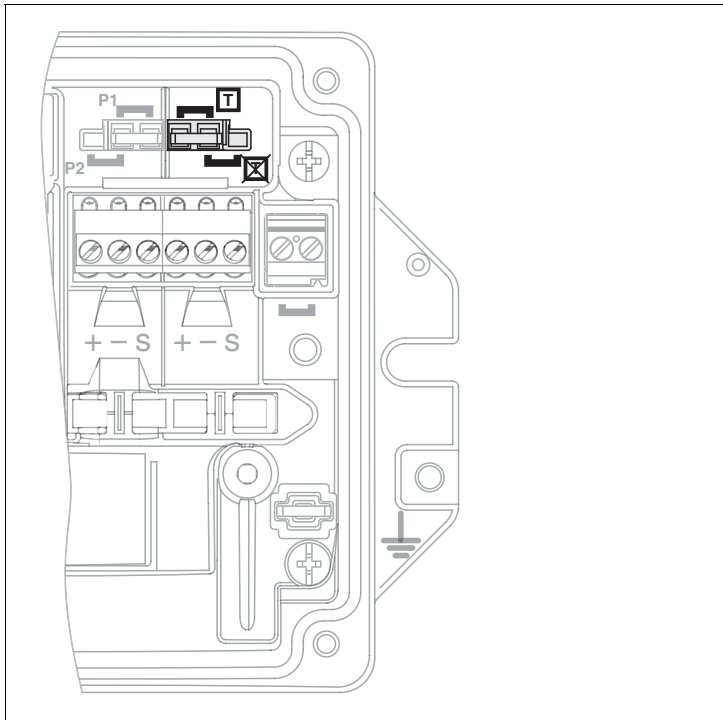


Figure 4.1 F2-SP-IC*: Disclosed housing with focus on right side of the separation wall, position(s) of the termination jumper.

2. In order to activate termination of the Segment Protector: Shift the jumper to the left.
3. Tighten the terminal screws to hold the jumper in position.

↳ The trunk line is terminated.

4.3

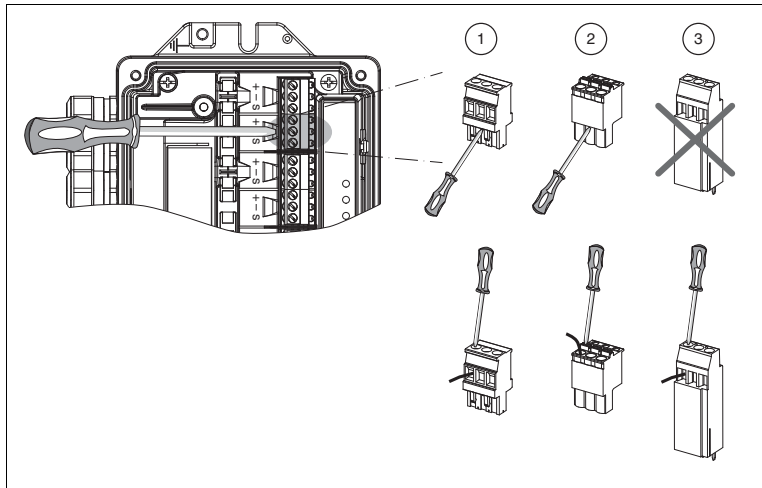
Segment Protector Connection Layout of the Spurs

Cable and Connection Information

- Permissible cross core section: 0.2-2.5 mm²
- Insulation stripping length: 7 mm
- If stranded conductors are used: Protect strand ends with end splices.
- Ensure that connectors are mechanically locked.
- Torque required for tightening terminal screws: 0.4-0.5 Nm

Depending on the type of maintenance requirements of the plant, the spurs can be connected using one out of three different kinds of terminals:

Connection Types of Spur Terminals



Action	1 Spring terminal	2 Removable screw terminal	3 Screw terminal
Dismounting	Lever out with suitable tool	Lever out with suitable tool	n/a
Wiring	Push down clamp with suitable tool	Undo clamp screw	Undo clamp screw

Gas group selection

The F2-SP-IC* enables you to determine the type of protection required for your plant. Using the jumper for short circuit limitation, you can change its position so it either delivers the type of protection IIC or IIB.

For further information see chapter 3.2.2.



To apply the jumper for short circuit current limitation



Danger!

Explosion hazard

Failure to apply the short circuit current limitation in hazardous environments can result in an explosive atmosphere exposed to too much short circuit current.

Ensure to adjust the Segment Protector according to the type of protection required at your plant.

1. To achieve the type of protection IIC, the jumper for short circuit current must be set to position "P2".
Loosen the left screw at the first terminal connector that holds the left jumper "P1" in parking position and unplug the jumper.

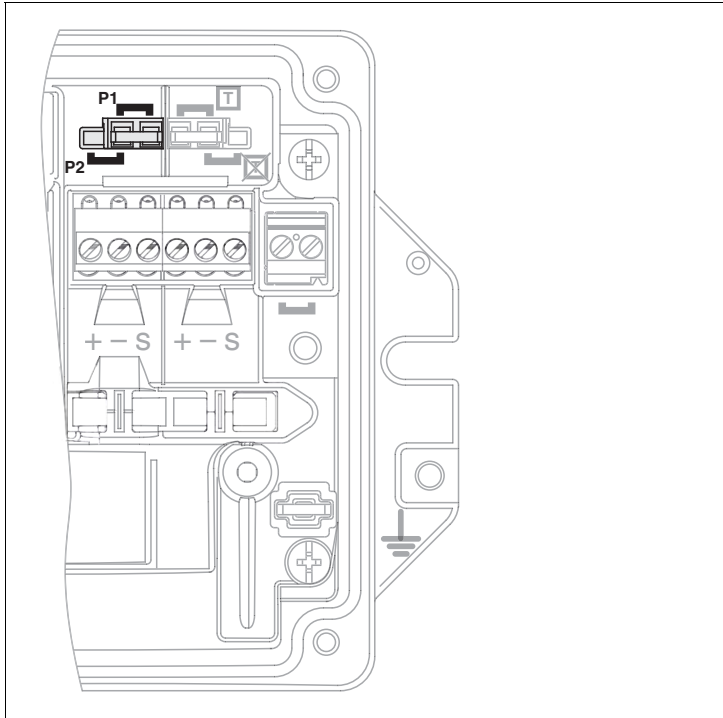


Figure 4.2 F2-SP-IC*: Disclosed housing with focus on right side of the separation wall, position(s) of the protection type jumper.

2. In order to change to Gas Group IIC: Shift the jumper to the right in position "P2".
3. After you have plugged in the jumper: Tighten the screws to hold it in position.

↳ The Segment Protector is now ready to be operated in Gas Group IIC.

4.4

Grounding / Shielding the Segment Protector and the Fieldbus Cables

Grounding the Housing

The Segment Protector aluminum housing must be connected to local earth when installed in an hazardous area. The external M4 earth clamp provides a low impedance path to earth. To connect the Segment Protector housing to the local plant earth, use a connection with a minimum cross core section of $\geq 4 \text{ mm}^2$.

Required torque for the grounding screw: 3.5 Nm

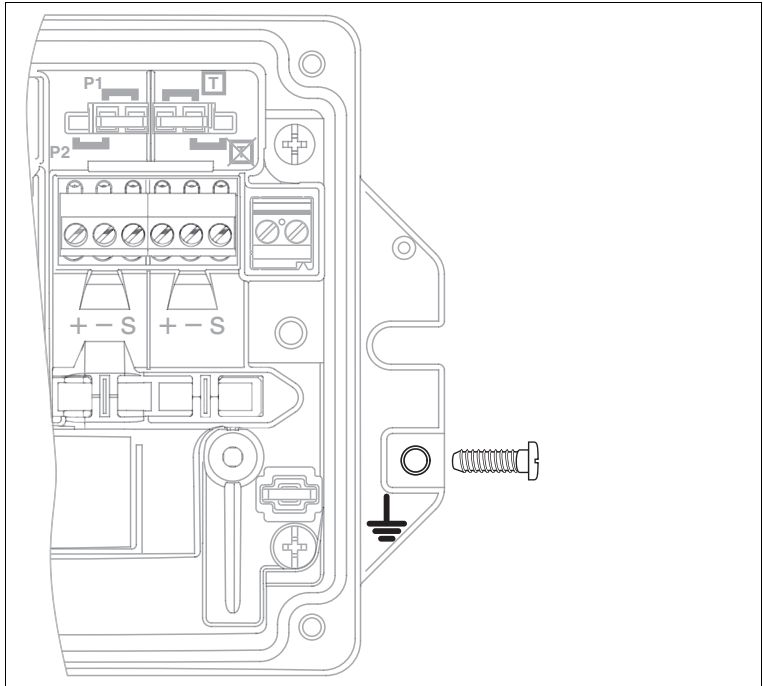


Figure 4.3 F2-SP-IC*: Disclosed housing with focus on right side of the separation wall, and the clamp to use for grounding the housing.

Fieldbus Cable Shielding

Fieldbus supports several methods for cable shield grounding in order to accommodate differing plant topologies (cf. Foundation Fieldbus "System and Engineering Guideline" AG-181). The most common topology uses a single point for grounding, where the cable shield is connected directly to a clean earth at the control room, while all other shields throughout the segment are left floating. Other topologies connect the cable shield to earth at multiple points throughout the segment, in order to maximize protection against EMC disturbance.

The F2-SP-IC* Segment Protector offers the option to leave all shields floating or to connect them all to the external earth clamp of the Segment Protector housing.



Grounding Jumper in Grounding Position

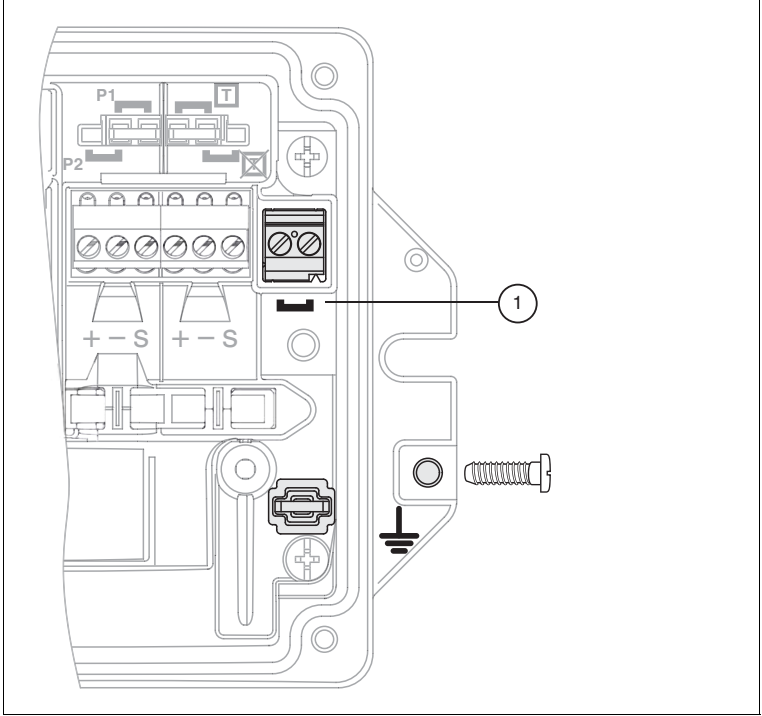


Figure 4.4 F2-SP-IC*: Disclosed housing with focus on right side of the separation wall, and the jumper in position for connecting the shield to earth.

- 1. Grounding position

Grounding Jumper in Parking Position

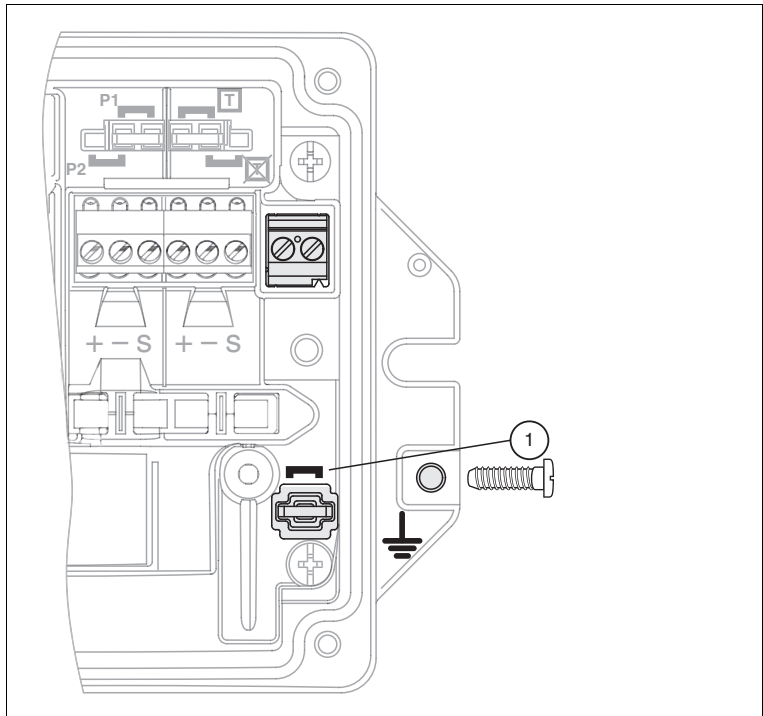


Figure 4.5 F2-SP-IC*: Disclosed housing with focus on right side of the separation wall, and the jumper for grounding the shield in parking position.

1. Parking position



Warning!

Dangerous atmospheres and plant damages due to communication loss

Connecting signal leads of the spur lines to the earth potential or the cable shield during plant operation can cause communication loss with the segment. Serious plant damages or dangerous atmospheres can be the result.

Do not connect any signal leads of spur lines to earth potential or cable shield. After maintenance activities, always ensure that all the wirings have been reattached properly.

If EMC requires you to ground the shield of the trunk or of the spurs of a fieldbus transmission line, closely adhere to the information valid for this situation. For details refer to EN 60079-14 and to the corresponding information of the respective fieldbus type in use. Information on the fieldbus type is found in the PROFIBUS PA User and Installation Guideline or FOUNDATION Fieldbus H1 Application Guides.

4.5 Option: Tag Plate

According to the identifying requirements of your plant, your Segment Protector is optionally equipped with a tag plate containing unique ID information on the Segment Protector that you have defined. The embossed stainless steel tag plate is fixed and lead-sealed to the spur side of the Segment Protector.

4.6 Option: Surge Protection with FS-LBF-I1.32

If required, the F2-SP-IC* Segment Protector can be equipped with an optional Pepperl+Fuchs FS-LBF-I1.32 Surge Protector of the F*-LBF-I1.32 product line.

F*-LBF-I1.32 are surge protection devices for fieldbus installations. They direct power surges to earth via gas discharge tubes, protecting field devices and control units from voltage surges and lightning strikes. They are in accordance with the fieldbus standard IEC 61158-2 and are certified intrinsically safe Ex ia for Zone 1, FISCO, and Entity.

Upon delivery, the Surge Protector is mounted on the cable entry for the Trunk OUT line.

For further information on the Surge Protector, refer to the Instruction Manual "Fieldbus Surge Protector F*-LF-I1.32.

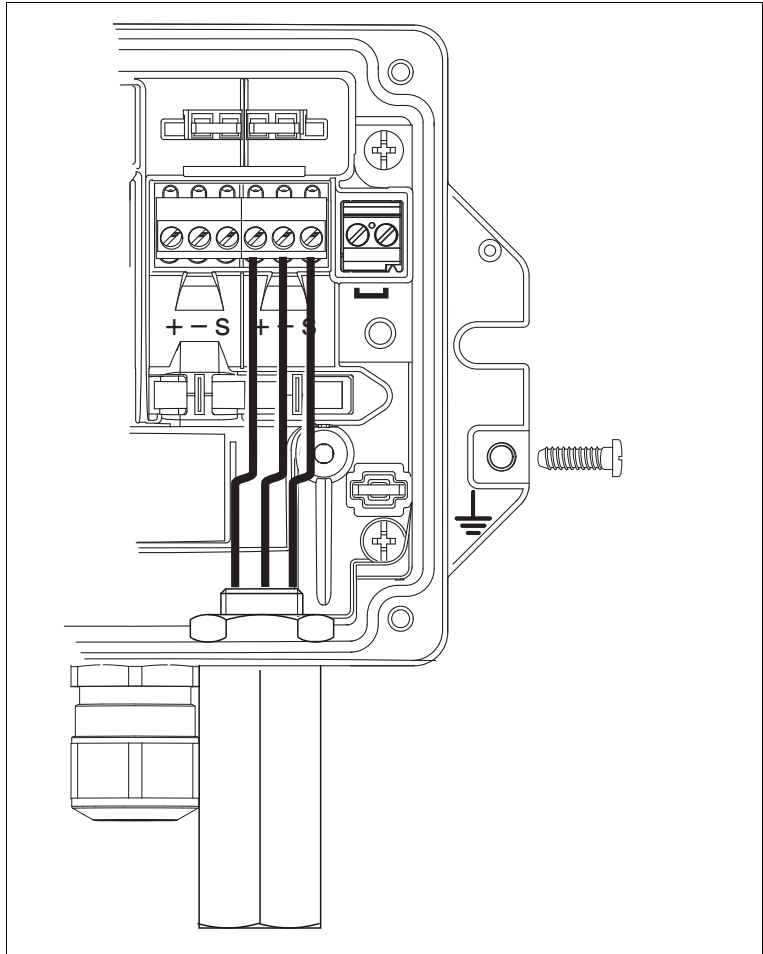
4.6.1 Servicing the FS-LBF-I1.32 in the Segment Protector

Installation and commissioning of all devices must be performed by a trained professional only.

The installation instructions in accordance with IEC/EN 60079-14 must be observed.

The dielectric strength of the insulation must be at least 500 V according to IEC/EN 60079-14.

Installation of FS-LBF-I1.32 in the Segment Protector



Ensuring the degree of protection and the type of protection

When servicing the Surge Protector, e.g., to change the seals, observe the following:

- Number of thread turns: 5 turns
- To prevent the threading from loosening and to ensure the degree of protection:
 - Use lock nuts with seals
 - Use Loctite® medium-strong adhesive in threaded holes

Segment Protector Version	LED Indication
F2-SP-IC8*	<p>SPUR 1 2 3 4 5 6 7 8 PWR/TERM PWR COM/ERR</p>
F2-SP-IC10*	<p>SPUR 1 2 3 4 5 6 7 8 9 10 PWR/TERM PWR COM/ERR</p>

Terminator power LED PWR/TERM:

If the fieldbus trunk voltage exceeds 10 V and the Terminator is activated, the LED is ON.

5.2 Fault Detection, Physical Layer Diagnostics

The device coupler can monitor the important physical layer parameters for each participating field device, e. g., communication signal levels and signal jitter. The monitored values are compared to fixed-limit values derived from the IEC 61158-2 physical layer specification or from empirical data.

After a fault or deviation has been detected, a single yellow LED serves as fault indicator at the respective device coupler. For more information see chapter 5.1

Using Pepperl+Fuchs “Advanced Physical Layer” solutions, e. g., the diagnostic module HD2-DM-A, show the diagnostic state of the individual device in the specific working environment of the control system. For more information, consult the documentation of the respective diagnostic product.

5.2.1 Device Signal Level

In order to detect the following kind of faults or problems, device signal level monitoring and diagnosis are important:

- Incorrect segment termination
- Improper trunk or spur wiring
- Loose wires
- Water ingress in the device coupler or field instrument housing

The monitoring alarm setpoints are:

Signal level 'Maintenance required':	$U_{pp} \leq 300 \text{ mV}$ or $U_{pp} \geq 1200 \text{ mV}$
Signal level 'Out of Specification':	$U_{pp} \leq 200 \text{ mV}$ or $U_{pp} \geq 1300 \text{ mV}$

Where **U_{pp}** is the peak-to-peak signal level

5.2.2 Device Signal Jitter

The device signal jitter is the deviation from the ideal timing of the communication signal. In fieldbus technology, jitter is the deviation of the ideal zero crossing point of the transmitted signal curve during the nominal bit duration. This deviation is measured in relation to the previous zero crossing, i. e., the reference event.

The device signal jitter is the most important parameter to monitor where the noise can influence the signal.

The monitoring alarm setpoints are:

Jitter level "Maintenance required":	$t \geq 3.5 \mu\text{sec}$ and $t \leq 5 \mu\text{sec}$
Jitter level "Out of Specification":	$t \geq 5 \mu\text{sec}$

Where t is the jitter error in time

5.3 Fault Isolation

5.3.1 Short Circuit Current Limitation (Static Fault Protection)

The spur short circuit current limitation is designed to protect the entire segment from failing by limiting the spur current from a direct short circuit (static protection). If the short circuit current condition exceeds a specified period, the spur is automatically isolated from the trunk, i. e., it does no longer receive any current.

5.3.2 Spur Contact Bounce Protection (Dynamic Fault Protection)

Periodic or intermittent changes in the current drawn throughout a segment can cause continuous communication failures up to a point where the segment fails. Changes in the spur current can occur during connection and disconnection of the spur wires or due to fractured or loose wires under vibration.

Conventional spur protection is only designed to protect the segment by limiting the spur current from a direct short circuit (static protection). It does not protect the segment from periodic or intermittent low-level changes in the segment current (dynamic protection).

Under vibration, insufficiently attached, fractured, or loose fieldbus wires keep connecting and disconnecting to the attached field device load. Because the spur is connected to one field device, the current does normally not increase to a value that exceeds the short circuit current. Such intermittent current disturbances are converted into corresponding voltage effects on the trunk. This could cause a temporary or total loss of communication, even leading to the loss of the segment.

The Pepperl+Fuchs Spur Contact Bounce Protection isolates a faulty spur from the segment to prevent segment failures caused by intermittent faults that are not detected by conventional spur protection device couplers.

5.3.3 Progressive Spur Short Circuit Current Limitation (Creeping Fault Protection)

Conventional spur protection circuits are designed to prevent segment failures during fast current changes above the rated short circuit current (direct short circuits).

Failure situations, where the spur current progressively increases, cause the current limiting electronics to dampen the communication signals due to its increasing impedance. A typical failure situation is water in the terminal arrangement with increasing conductivity between the fieldbus wires.

Oscillation sometimes occurs when a fault current is marginally above the current limiting setpoint and the electronic circuit is just operating. At this point, the voltage to the fault decreases with a resulting decrease in current that turns off the current limiting circuit. This cycle continues quite rapidly and can be amplified when a device is transmitting at the same time. The reaction during this narrow transition point is unpredictable because not every fault behaves in a repeatable way. For example, the impedance of water vs. voltage or current can be very non-linear, with the impedance further varying due to the possible impact of temperature and conductivity.

The following example shows the criticality of such a fault scenario:

A field instrument with an active backup – a Link Active Scheduler (LAS) – loses communication to a host in the control room. This situation is due to the low communication signal during a progressing fault condition. The backup LAS now activates while the host LAS remains active. At this point, field instruments at normally operating spurs still 'see' the backup LAS which is nearby, as well as the host.

With 2 active LAS on the segment, communication clashes and the segment fails.

Pepperl+Fuchs offers the Progressive Spur Short Circuit Current Limitation that detects slowly increasing spur current and isolates the faulty spur from the segment to prevent segment failures.

5.3.4 Device Jabber Protection

Specific software or hardware failures can cause a field instrument to communicate continuously (Jabber). In this event, the device should disconnect itself from the segment immediately.

The international fieldbus standard IEC61158-2 requires that a field instrument contains a 'Jabber Inhibit' circuit or 'watchdog'. Up to this point, not all currently available instruments support or contain the 'Jabber Inhibit' 'watchdog'.

The Pepperl+Fuchs device couplers have a spur dependent 'Jabber Inhibit' feature to isolate a faulty field instrument from the segment in such events.

5.4 Accessory: Enclosure Leakage Sensor ELS-1

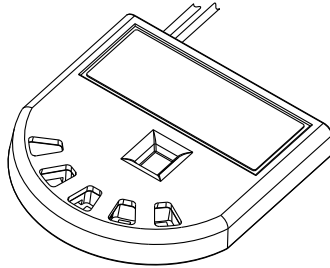
The FieldConnex[®] enclosure leakage sensor ELS-1 contains a diagnostic function to detect water ingress breaches inside housings early. ELS-1 warns of water ingress before it can adversely affect fieldbus communication, demand high current levels or cause galvanic corrosion damage to electronics. Compactly designed ELS-1 fits into most of today's existing field device housings.

The sensor is designed for use in fieldbus communication topologies according to IEC 61158-2. ELS-1 conforms to the intrinsically safe FISCO and Entity concepts and to IEC 60079-11. As an associated apparatus, ELS-1 can be attached to any fieldbus trunk or spur that is intrinsically safe certified.

ELS-1 can be connected in parallel to the spur output cables of Pepperl+Fuchs device couplers types R2-SP-IC*, F2-SP-IC*, and R4D0-FB*. Powered by the spur, ELS-1 requires less than 6 mA for operation.

Once water is detected, the diagnostic function inside ELS-1 issues an alarm to the Pepperl+Fuchs Advanced Diagnostics infrastructure. The alarm is transmitted to the Pepperl+Fuchs 'Advanced Diagnostic Manager' software running on the systems maintenance or operator workstation.

Additionally, ELS-1 issues a visual alarm to help identify the affected device/housing or validate the error.



5.5 Using Device Couplers in PROFIBUS PA Installations

You need to take special precautions for installations operating under the following conditions:

- With a high level of environmental impact
- With vibration or shock
- With field devices connecting or disconnecting regularly during operational conditions

The following precautions are necessary to decrease consecutive failures that cause a PROFIBUS PA segment to fail:

- Regularly check that the terminal connections of the device coupler are tightened correctly
- Increase the RETRY LIMIT parameter of the PROFIBUS master to a minimum of 4

Note: When using the Pepperl+Fuchs Segment Coupler HD2-GT* series, the default value of the RETRY LIMIT is already set to 4.

- In order to disconnect a field device, ensure to adhere to the following sequence:
 1. Unplug the corresponding connector at the device coupler
 2. Unscrew the fieldbus wires at the field device

5.6 Using Device Couplers in FOUNDATION Fieldbus H1 Installations

You need to take special precautions for installations operating under the following conditions:

- With a high level of environmental impact
- With vibration or shock
- With field devices connecting or disconnecting regularly during operational conditions

The following precautions are necessary to decrease consecutive failures that cause a FOUNDATION Fieldbus H1 segment to fail:

- Regularly check that the terminal connections of the device coupler are tightened correctly
- Increase the STALE_COUNT_LIMIT parameter of the FOUNDATION Fieldbus LAS or host used to a minimum of 2
- In order to disconnect a field device, ensure to adhere to the following sequence:
 1. Unplug the corresponding connector at the device coupler
 2. Unscrew the fieldbus wires at the field device

6 Appendix

6.1 Spare Parts, Options, and Accessories

Name	Description
FS-LBF-I1.32	Surge protection for voltages \geq typ. 39 V, max. 41 V: Protects trunk and spurs against overvoltage
ELS-1	Enclosure Leakage Sensor for water detection

6.2 Electromagnetic Compatibility Verification in Accordance with EC Council Legislation Directive 2004/108/EC

Compatibility in Accordance with 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 EN 61326. 3 different performance criteria are distinguished in this standard:

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 NE 21 recommendation, are partly higher compared to the test levels and failure criteria defined in EN 61326-1. For the product qualification, failure criteria and test levels have been selected, always representing the worst case conditions.

EN 61000-4, as a generic standard, defines the test setups for the specific required test for EN 61326-1 and NE 21.

Applied standards:

- CE-Conformity 2004/108/EC
- EN 61000-4, July 2007
- EN 61326-1, October 2006
- EN 55011, March 2007
- NE 21, May 2011

Conducted EMC tests:

Immunity

Standard	Type	Test Level	Category
EN 61000-4-2	Electrostatic discharge, direct contact	6 kV	A
	Electrostatic discharge, indirect, air	8 kV	A
EN 61000-4-3	Electromagnetic field radiated, radio frequency	10 V/m	A
EN 61000-4-4	Fast transients burst on signal lines	1 kV	A
	Fast transients burst on power lines	2 kV	A
EN 61000-4-5	Slow transient surge on signal lines	1 kV	B
	Slow transient surge on shielded lines	2 kV	B
EN 61000-4-6	Conducted immunity, radio frequency	10 V	A
EN 55011	RF conducted emission	Class A	–
	RF radiated emission	Class A	–

6.3

Referenced Documents

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

PROCESS AUTOMATION – PROTECTING YOUR PROCESS



Worldwide Headquarters

Pepperl+Fuchs GmbH
68307 Mannheim · Germany
Tel. +49 621 776-0
E-mail: info@de.pepperl-fuchs.com

For the Pepperl+Fuchs representative
closest to you check www.pepperl-fuchs.com/contact

www.pepperl-fuchs.com

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