Engineering Guideline
01-2020

Fieldbus Equipment in Zone 2 Hazardous Areas

This engineering guideline explains concepts for fieldbus installations and explosion protection in Zone 2. For existing installations, it defines scenarios and provides actions of device replacement and small system expansions while retaining protection method Ex nL.

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Purpose

This engineering guideline contains a detailed description on the subject matter how to select, engineer or operate a plant based on Pepperl+Fuchs technology and products. It enables users to conduct planning or detail engineering in a self-guided fashion. This includes procedures, tips and tricks for best practices.

While this document reflects state of the art technology and has been researched to the best of our abilities, the ***information in this document is applied as is without any express or implied warranty***. It provides information based on international standards. Local rules and regulations apply placing more stringent demands that you must follow for installations in your area. Always exercise caution when operating plants with hazardous areas.

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Introduction

Pepperl+Fuchs fieldbus power hub system and various segment protector products may be installed in Zone 2 hazardous areas. The type of hazardous area protection required by the installation defines the selection of products that are applicable for operation in conformance with IEC standards.

This engineering guideline describes the installation choices possibilities based on relevant standards. It also addresses the major changes resulting from the 5th edition of the standard IEC 60079-11 and the introduction of the protection method Ex ic for Zone 2.

In 2006, the 5th edition of the international standard IEC 60079-11 introduced the type of protection “Ex ic”, intrinsic safety for live workable circuits in hazardous area Zone 2. The standard defining energy limited circuits Ex nL, IEC 60079-15 3rd edition, which also allows live work on electronic circuits, lost its validity in 2011.

For new plants and major turn arounds, the plant must be engineered according to type of protection, which is Ex ic for Zone 2 installations where the users demand live work on instrumentation without hot work permit. Existing installations may validate according to the standard Ex nL, if they have been originally built based on this standard and only for device replacement and for small system expansions.

Operators are required to clearly define in general the scope and size of what is to be considered a small system expansion. This is a primary condition, if operators wish to maintain Ex nL type of protection for their existing plant.

Fundamentally, the way how segments are designed remains the same. However intrinsic safety defines more stringent requirements on product design, for plant engineering, operations and upkeep. Type of protection intrinsic safety, Ex ic must be considered the “stronger” standard. By design all Ex ic-rated equipment can be applied as direct replacement to existing installations, that are engineered and operated under the now rated Ex nL.

Pepperl+Fuchs offers its portfolio of FieldConnex® fieldbus equipment for Zone 2, that meets the requirements for intrinsic safety to allow customers to engineer their plant according to the type of protection “Ex ic”. For product-specific details on the installation requirements, refer to the product data sheet and manuals of the individual products.

Chapter 2 provides an overview of applicable protection methods for fieldbus segments in Zone 2. This includes validation of intrinsic safety Ex ic. Chapter 3 explains rules for replacing aged or failed components in installations built in accordance with type of protection Ex nL. for replacing aged or failed components with and provides an overview list of actions to ensure and validate ignition protection. Chapter 4 covers scenarios for adding instruments, spur connection or entire segments under the rules of small system expansions.

Segment Design for Hazardous Area Zone 2

For fieldbus topologies today 2 different types of fieldbus designs are commonly used, depending on customer's requirements for live maintenance and the type of preferred fieldbus equipment.

For the following examples it is assumed that, in addition to a fieldbus power supply, segment protectors are employed. These represent a wiring interface between the fieldbus trunk and the spurs that the field devices are connected to. Each individual spur output is short-circuit proof (current limited) in a way that a short circuit at the spur level has no functional influence on the trunk and the adjacent spurs. Both, the power hub product range and the segment protectors may be installed in hazardous area Zone 2.

Pepperl+Fuchs offers the high-power trunk concept to be able to support the main customer requirements of a maximum number of devices at the same fieldbus trunk, while achieving maximum cable lengths. This concept is based on Pepperl+Fuchs standard power hub power supplies. Segment protectors are installed close to field devices and limit the energy at the spur. Therefore live maintenance at the field devices is permitted without the need for hot work permits.

FieldConnex products support the following fieldbus designs, which are described in detail below:

1. No live maintenance, trunk and spurs rated non arcing, Ex nA.
2. Live maintenance at the spur level (Entity Ex ic), trunk rated non arcing, Ex nA.

No Live Maintenance: Trunk, and Spurs Rated Non Arcing, Ex nA

In cases where no live maintenance is required, fieldbus power on the trunk and spurs is not limited. Live maintenance at the trunk or spur level is not allowed without hot work permit.

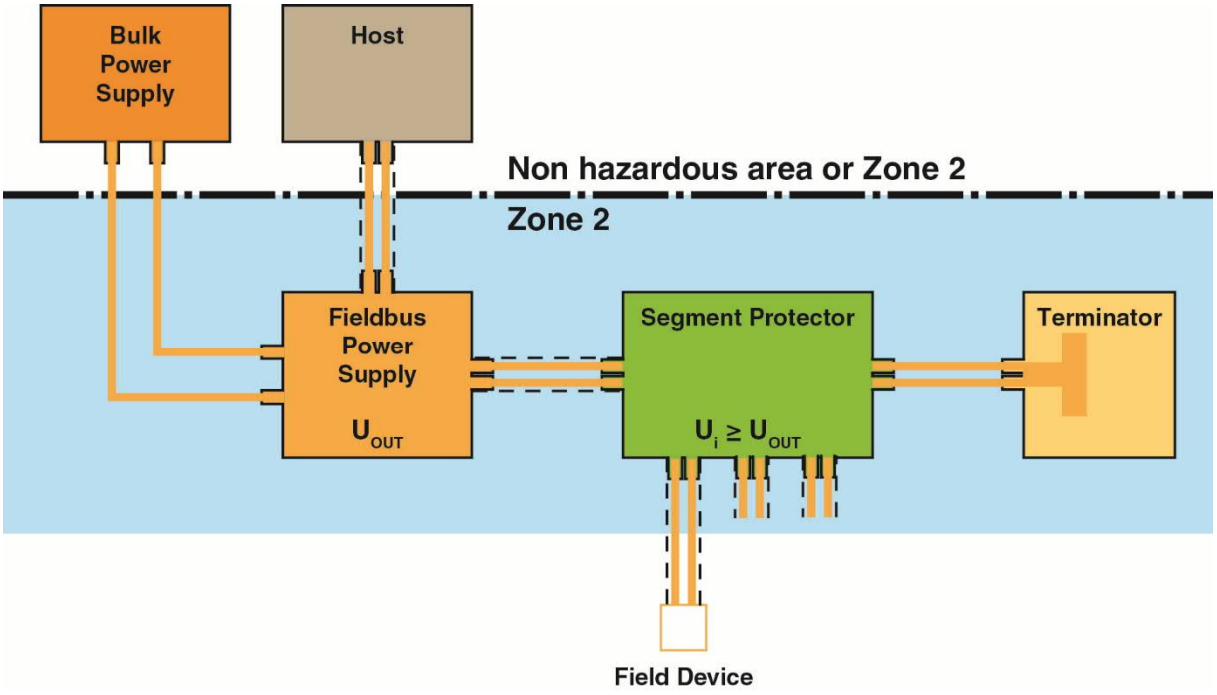
No special safety requirements exist for the host interface, provided the host itself is installed in the safe area. If the host interface is installed in Zone 2, a declaration of conformity must be provided.

Field devices and segment protectors are located in Zone 2 and therefore need to be (self-)certified for non-arcing apparatus. 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_{out}) that 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 (self-)certified for non-arcing apparatus equipment, energy-limited or intrinsically safe apparatus according to Entity or FISCO.

All existing power hub equipment, power supplies, and motherboards are suitable to be used according to this installation method.

For further information, consult data sheets and manuals of the specific power hub equipment.



Field device requirements	$U_i \geq U_{out}$	Ex ia/ib/ic
	$U_i \geq U_{out}$	Ex nA

Requirement and Value Overview

Live maintenance		
Trunk	No	
Spur/Device	No	
Mounting		
Host	Safe area or Zone 2	
Power supply	Safe area or Zone 2	
Segment protector	Zone 2	
Field devices	Zone 2	
Requirements / Approval		
Device group	Values	Certification / Declaration of Conformity required for
Host	n/a	No requirements in safe area, for Zone 2 installation a Declaration of Conformity
Power supply	$U_{0ut} \leq 32$ V	No requirements in safe area, for Zone 2 installation a Declaration of Conformity Ex nA
Segment protector	$U_i \geq U_{0ut}$	Ex nA
Field devices	$U_i \geq U_{0ut}$	Ex ia/ib/ic
	$U_i \geq U_{0ut}$	Ex nA

Live Maintenance at the Spur (Entity Ex ic), Trunk Rated Non Arcing, Ex nA

If live maintenance at the spur/device level is required, following the requirements for intrinsically safe limited circuits according to IEC 60079-11, edition 5, the type of fieldbus power supply defines the output rating of the intrinsically safe spurs.

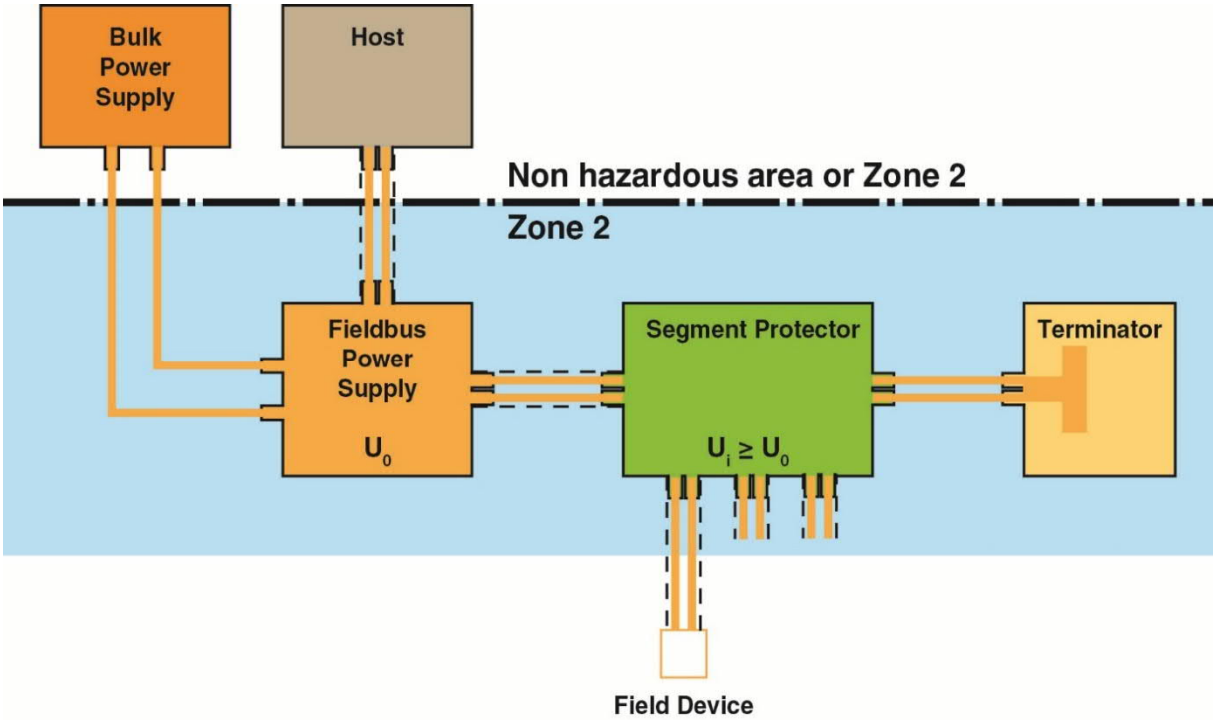
Due to the unlimited trunk energy, live work at the trunk is not permitted without hot work permit. However, live connection or disconnection at the output spurs of the segment protector is allowed, if the following Entity model safety evaluation/requirements for the field devices are followed:

$U_{O\ (power\ supply)} \leq U_{i\ field\ device}$
$I_{O\ (segment\ protector)} \leq I_{i\ field\ devices}$
$L_{O\ (segment\ protector)} \geq L_{spur\ cable} + \sum L_{i\ field\ devices}$
$C_{O\ (segment\ protector)} \geq C_{spur\ cable} + \sum C_{i\ field\ devices}$

In gas group IIC hazardous area the maximum output voltage is limited to U_O = 24 V.

The host interface must meet the requirements for SELV/PELV. The declaration of conformity must state the “passivity of any host interface”. That means that the host must not be an active current source. If the host interface is installed in Zone 2, a declaration of conformity must be provided in addition.

Field devices, certified Ex i (Entity or FISCO) are allowed to be connected to the outputs of the segment protector under an intrinsically safe Ex ic rating if the given safety values match to each other. The certified or declared safety values of the field devices have to match the safety values of the combination of fieldbus power supply and segment protector.



Field device requirements	$U_O \leq U_{i\ field\ device}$ $I_{O\ (segment\ protector)} \leq I_{i\ (field\ devices)}$[1] $P_{O\ (segment\ protector)} \leq P_{i\ (field\ devices)}$[1] $C_O \geq C_{i\ cable} + \sum C_{i\ field\ devices}$ $L_O \geq L_{i\ cable} + \sum L_{i\ field\ devices}$ [1] only applies if segment protectorecified for the field device	Ex ia/ib/ic (Entity or FISCO)

Requirement and Value Overview

Live Maintenance		
Trunk	No	
Spur/Device	Yes	
Mounting		
Host	Safe area or Zone 2	
Power supply	Safe area or Zone 2	
Segment protector	Zone 2	
Field devices	Zone 2	
Requirements / Approval		
Device group	Values	Certification / Declaration of Conformity
Host	n/a	SELV/PELV, declaration of conformity must state the passivity of the host interface. For installation in Zone 2 a declaration of conformity is required.
Power supply	$U_O \leq 24$ V for gas group IIC $U_O \leq 32$ V for gas group IIB	SELV/PELV, for Zone 2 installation a Declaration of Conformity Ex nA
Segment protector	$U_i \geq U_O$	Ex nA, Ex ic
Field devices	$U_O \leq U_{i\ \text{field device}}$ $I_{O\ \text{(segment protector)}} \leq I_{i\ \text{(field devices)}}$[1] $P_{O\ \text{(segment protector)}} \leq P_{i\ \text{(field devices)}}$[1] $C_O \geq C_{i\ \text{cable}} + \sum C_{i\ \text{field devices}}$ $L_O \geq L_{i\ \text{cable}} + \sum L_{i\ \text{field devices}}$ [1] only applies if specified for the field device	Ex ia/ib/ic (Entity or FISCO)

How to Select Fieldbus Equipment for Use in Hazardous Area Zone 2

Select your preferred fieldbus topology described in this paper.

Select the power supply following the requirements for the chosen Zone 2 topology with the help of the conformity matrix for FieldConnex® fieldbus power supplies, TDOCT-1908EENG. All FieldConnex power supplies are suitable to be used for Ex nA hazardous area use. The choice of power supplies is restricted if Ex ic hazardous area use is required.

Select the segment protector following the requirements for the chosen Zone 2 topology with the help of the conformity matrix for FieldConnex segment protectors. All FieldConnex segment protectors are suitable to be used for Ex nA hazardous area use. The choice of segment protectors is restricted if Ex ic hazardous area use is required.

Check if the host of your choice is following the requirements for the chosen Zone 2 topology.

Check if the field devices of your choice are following the requirements for the chosen Zone 2 topology.

Replacement of Ex nL Components

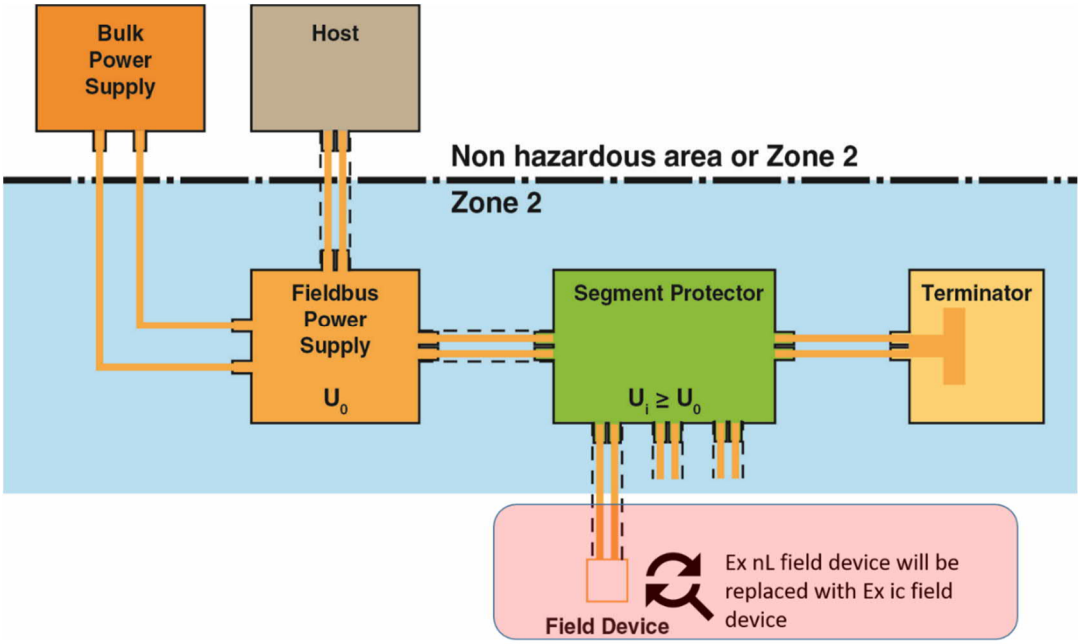
This chapter provides rules for replacing or upgrading individual instruments and infrastructure components. Spare parts today are typically rated Ex ic which is permitted as direct replacement. In general, the rated values for explosion protection according to Ex ic form the basis for validation and calculation of protection method Ex nL. ***The instrument or component, that is newly installed must be marked clearly as Ex nL. It is then no longer permitted to install the down-graded component in a circuit rated Ex ic.***

Always use caution during device replacement. Where in doubt, contact the vendor of the instrument or device for advice or confirmation.

Replacing of Ex nL with Ex ic-rated Field Device

Scenario

An existing Ex nL field device fails and shall be replaced with a new one. This is only available as Ex ic version and carries different certification values and a different certification number.



It is permitted to replace the field instrument. The loop remains Ex nL, if the user has conducted and documented the following actions:

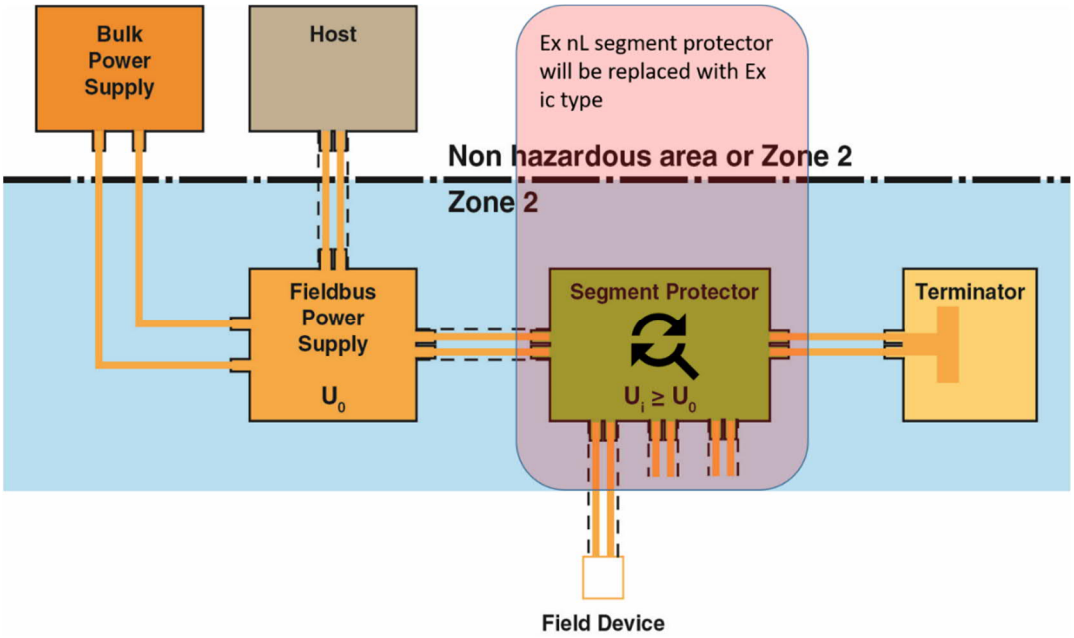
User Action

1. Validate intrinsic safety using the Ex ic parameters as Ex nL values.
2. Mark the field device as Ex nL instument.

Replacing of Ex nL- with Ex ic-rated Segment Protector in Existing Enclosure

Scenario

An existing Ex nL segment protector (e.g. R2-SP-N*) is to be replaced with a new Ex ic type (e.g. R2-SP-IC*). The existing nL voltage Source (e.g. HCD-FBPS-1.23.500) and field instruments shall remain in place, the certificate of R2-SP-IC* differs from the original R2-SP-N*.



It is permitted to replace the segment protector. Type of protection for the loops remain Ex nL, if the user has conducted and documented the following actions:

User Action

1. Set the DIP-switch on R2-SP-IC* to position 2.
2. Validate intrinsic safety using Ex ic parameters as Ex nL values.
3. Mark the loops as well as the field device as Ex nL.
4. For system solutions, e.g. completely assembled fieldbus junction boxes, contact the vendor to verify the certification of the solution.

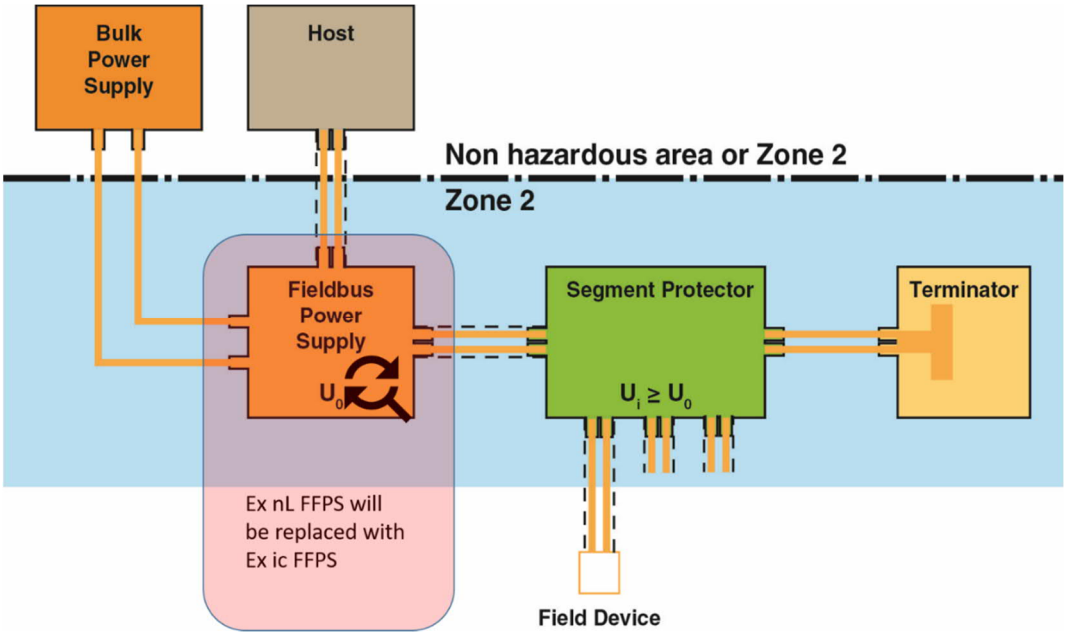
Pepperl+Fuchs issues a manufacturer declaration for most enclosure solutions. This states the conformity with the newly installed R2-SP-IC* segment protector.

Replacing of Ex nL with Ex ic-rated Fieldbus Power Supply

Scenario

A: A power supply used in an Ex nL application failed on a non-redundant setup.

B: A power supply used in an Ex nL application failed on a redundant setup.



It is permitted to replace the failed fieldbus power supply for both scenarios. They can be replaced and the loops will remain Ex nL, if the user has conducted and documented the following action:

User Action

1. Mark the power supply as Ex nL

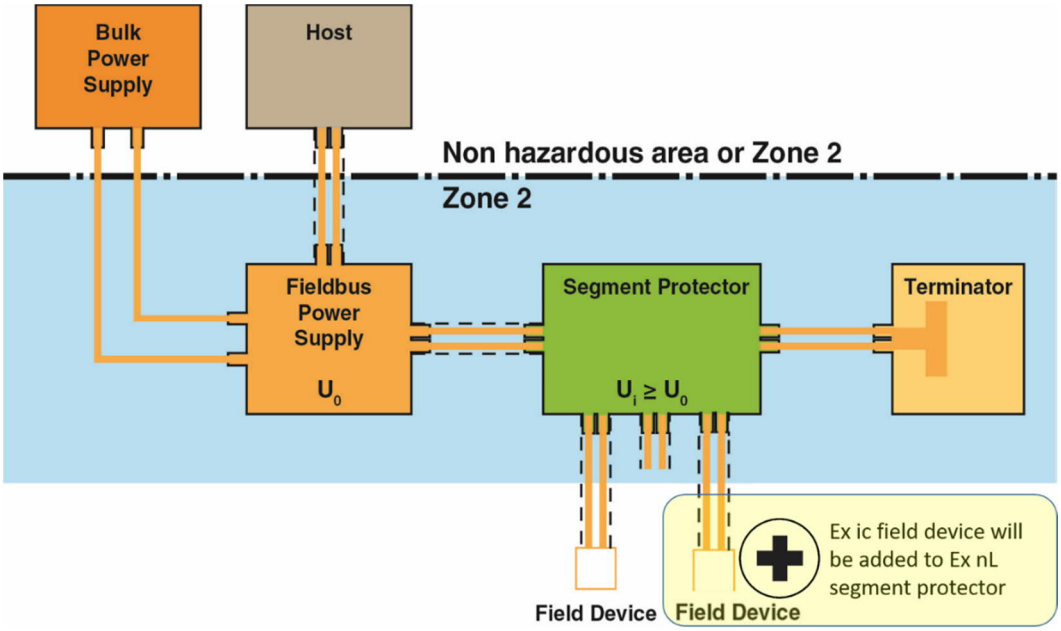
Small System Expansions utilizing Ex ic-rated Equipment

Upgrades, revamps, comprehensive modifications and new plants must be validated according to current standards utitlizing protection method Ex ic. The standards however permit operators to maintain Ex nL type of protection for small system expansions. For this rule to apply, requires that the user defines the scope of “small system expansions”. The following scenarios describe how to incorporate Ex ic-rated equipment in installations rated Ex nL.

Adding Ex ic Field Devices to an Ex nL certified Segment Protector

Scenario

One or more field devices shall be added to an existing Ex nL segment protector (e.g. R2-SP-N*).



Ex ic-rated field devices can be added to the topology and the type of protection remains Ex nL with the following user actions:

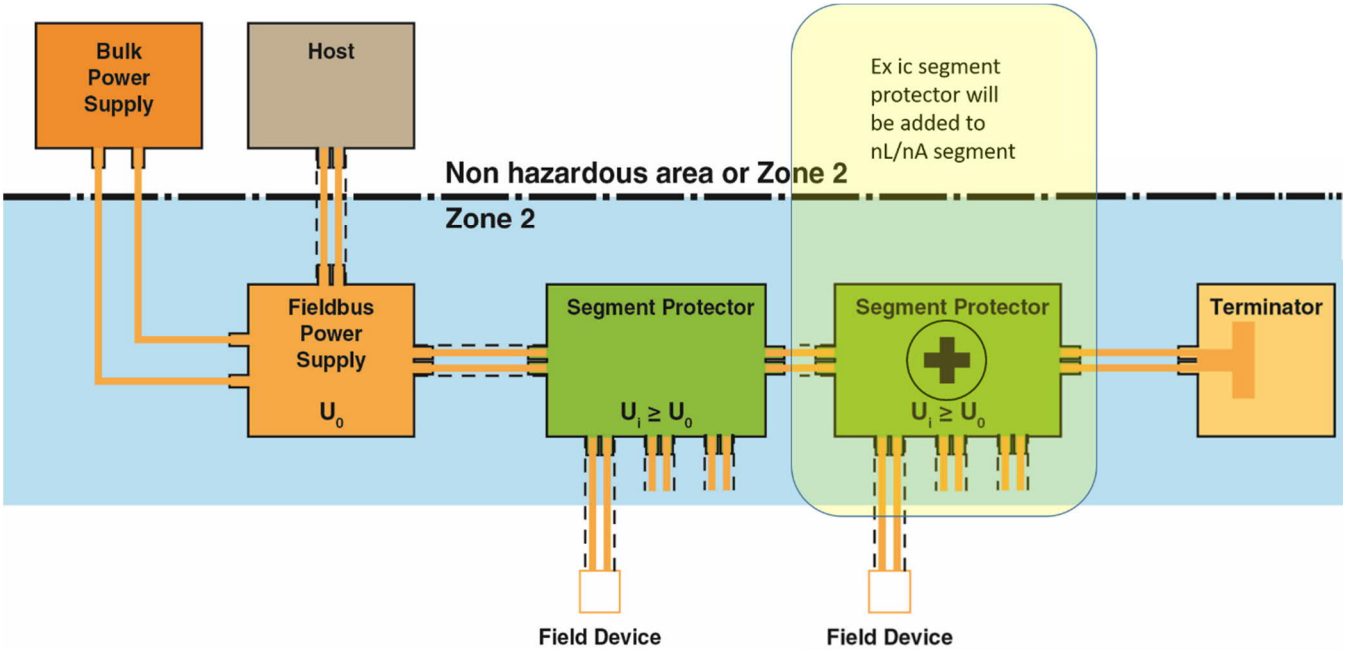
User Action

1. Define and document the scope of small system expansions.
2. Validate intrinsic safety using Ex ic parameters as Ex nL values.
3. Mark the loops as well as the field device as Ex nL.

Adding Ex ic Segment Protector to an Existing Ex nL/nA Segment

Scenario

An Ex ic-rated segment protector (e.g.R2-SP-IC*)in own enclosure shall be added to an existing Ex nL segment. The Ex nL voltage source HCD2-FBPS-1.23.500 or HD2-FBPS-1.23.500 remains in place.



Ex ic rated segment protectors can be added to the topology and the type of protection remains Ex nL with the following user actions:

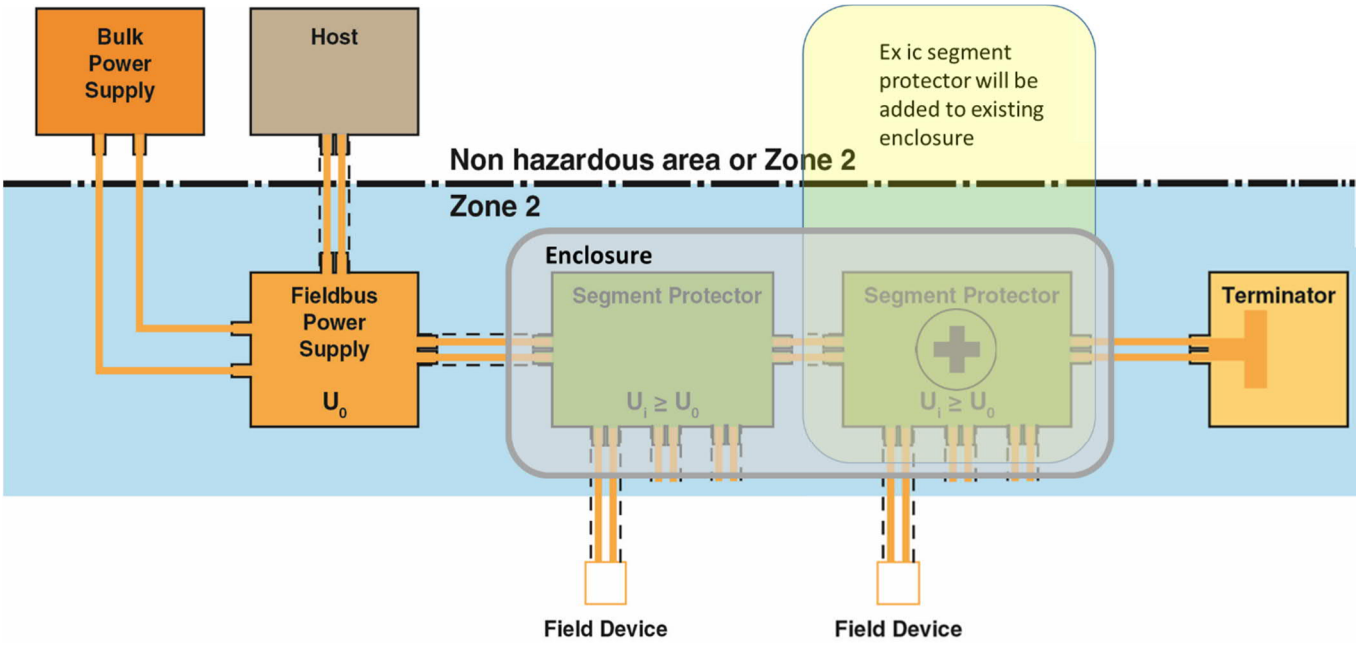
User Actions

1. Define and document the scope of small system expansions.
2. Mark the segment protector as Ex nL.
3. Set the DIP switch at the R2-SP-IC* to position 2.

Adding Ex ic Segment Protector to Field Junction box rated Ex nA/nL

Scenario

Segments are frequently planned with reserve space available inside an enclosure. An Ex ic segment protector (e.g. R2-SP-IC*) shall be added to an existing Ex nL segment. The Ex nL voltage source, e.g. power module HCD2-FBPS-1.23.500 or HD2-FBPS-1.23.500 remains in place.



Ex ic rated segment protectors can be added to the topology and the type of protection remains Ex nL with the following user actions:

User Action:

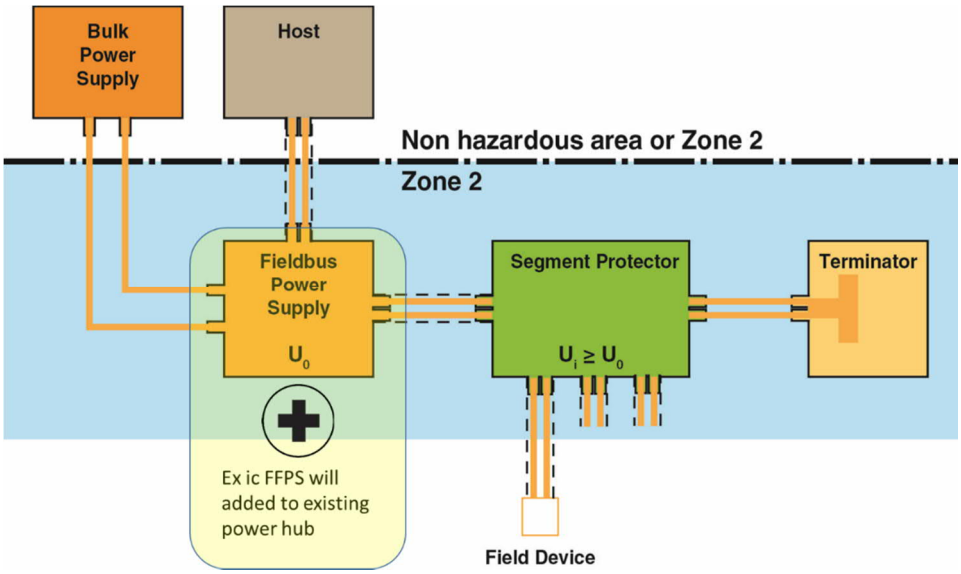
1. Define and document the scope of small system expansions
2. Contact the vendor of the junction box to verify the certification of the solution: Segment Protector and junction box.
3. Mark the segment protector as Ex nL.
4. Set the DIP switch at the R2-SP-IC to position 2.

Pepperl+Fuchs provides a manufacturer declaration for its engineered and manufactured junction boxes, stating the conformity with the newly installed R2-SP-IC* segment protector.

Adding Segments to Power Hub rated Ex nA/nL

Scenario

An existing fieldbus power hub with slots for spare segments should be extended. A new Ex nL/nA segment shall be installed.



Ex ic rated power supply modules can be added to the topology and the type of protection remains Ex nL with the following user actions:

User Action:

1. Define and document the scope of small system expansion
2. Validate intrinsic safety using Ex ic parameters as Ex nL valuesMark the power supply as Ex nL
3. Mark the segment protector as Ex nL
4. Mark the field devices as Ex nL

Ex ec Certification Coming latest by 2022

At the time of this writing Ex nA (in acc. to IEC 60079-15) is still allowed for presumption of conformity. A transition period is defined after which devices must be certified in accordance to Ex ec (in acc. to IEC 60079-7).This period ends on 19th April 2022.

In preparation for this, Pepperl+Fuchs is in preparation to provide fieldbus products and solutions in accordance with Ex ec. It is our intention to provide solutions and knowledge to engineering companies and end users with the objective of making this transition as easy as possible, similar to the transition from Ex nL to Ex ic.

Pepperl+Fuchs is committed to serving your needs for digital communications in any hazardous areas. Please contact us through your local representative or sales office.

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Explosion Protection

- Intrinsic Safety Barriers
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- Purge and Pressurization
- Industrial HMI
- Mobile Computing and Communications
- HART Interface Solutions
- Surge Protection
- Wireless Solutions
- Level Measurement

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- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
- Displays and Signal Processing
- Connectivity

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