Design Guideline

Exchange and Replacement for Segment Couplers 1, 2 and 3

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The design guideline

The design guideline provides information relating to the application and usage of Pepperl+Fuchs products. This information is typically cross-system and goes beyond the contents of the operating instructions or the manual. We provide this design guideline to support you in applying our technology and products. Experts located all around the world are on hand to provide individual support. Please feel free to contact us.

Contents

Abbreviations used in this document:

Abbreviation	Definition
DART	Dynamic Arc Recognition and Termination
DB9	Connector type for connecting a serial bus
DCS	Distributed control system
SK, SK1, SK2, SK3	Segment coupler, model series 1, 2, or 3
FLTR	From left to right

1 Overview

The current generation of PROFIBUS segment couplers replaces all previous segment couplers. This document describes compatible products and constraints that must be taken into account for replacements or conversions.

Pepperl+Fuchs recommends using segment coupler 3 (SK3) to equip two or more segments, and particularly for plant modernization.

Chapter 1 describes the new products and provides an overview in table format of the compatibility between currently installed solutions and new solutions. The chapter summarizes general information about conversions and ends with tables that provide the type codes of all new products listed by solution.

Chapter 2 describes the solutions in detail and provides instructions for each solution based on issues that must be considered.

Chapter 3 describes the field changes required when replacing intrinsically safe power link modules with the SK3. The upgrade to the high-power trunk concept or the intrinsically safe high-power trunk concept is independent of the conversion of the control cabinet.

Procedure:

1. Chapter 1 provides an overview of the solutions.
2. Select a solution based on Table 1.
3. Check the decision criteria and constraints for implementation in the subsection of the selected solution in Chapter 2.
4. Plan the field installation according to the instructions of the associated subsection in Chapter 3.

1.1 PROFIBUS Power Hub, Segment Coupler 3 (SK3)

The PROFIBUS Power Hub consists of one or two motherboards and snap-on modules for the gateway, the power supply and advanced physical layer diagnostics (Advanced Diagnostics). The SK3 offers the largest selection of functions and maximum flexibility for control technology integration. The functions are compatible with the SK1 and SK2 models. The SK3 can be equipped with redundant gateway modules and redundant power supply modules.

Communication to the control system (DCS) can be converted to PROFINET by replacing the gateway module during the update, or it can be completed at a later date.

PROFIBUS Power Hub, SK3 for intrinsically safe installation throughout with DART

The DART Power Hub uses the same logical structure as the SK 3. The power supply feeds the segment with intrinsically safe high power. Special segment protectors are used in the field, which limit the available energy to classic intrinsic safety.

1.2 Basic Segment Coupler (BSK) or Segment Coupler 1

The FieldConnex® basic segment coupler is a combined gateway and fieldbus power supply for transparently connecting PROFIBUS PA to PROFIBUS DP. The BSK is ideal for use in small plants or replacing the connection to a single segment or segment coupler 1.

The BSK automatically adjusts the transfer rate of the PROFIBUS DP communication to up to 1.5 MBit/s. The data is buffered so that the full transfer rate is available on the DP segment.

The BSK can be used for small installations or for replacing individual power links.

1.3 General information on replacing segment couplers 1, 2 and 3

In general, the space requirements of the above solutions are less than those for the installed products. In each case, this applies when replacing a Power Hub with another Power Hub, or replacing the segment coupler 1 (SK1) and 2 (SK2) with the basic segment coupler (BSK). ***However, control cabinet modifications may be required for different form factors if SK1 or SK2 is to be replaced by the SK3.***

In modern-day cabinet layout DIN rails are typically mounted vertically. Thus the design of segment coupler 3 is changed to place modules in the same direction as the DIN-rail.

The maximum permissible ambient temperature for all components of the SK3 exceeds that of the components that are being replaced, regardless of the installation location. The SK3 can therefore be used as a replacement for all temperature ranges in existing applications.

Due to the generally higher output voltage of the replacement solutions, the power consumption per segment may be higher. The parameters of the station power supply must be verified.

Table 1 relates currently installed components to available solutions. Table 2 shows the type codes for setting up the solutions described in Chapter 2.

Table 1: Compatibility of installation and replacement solution for segment couplers 1...3

Original \ Replacement	SK3 simplex	SK3 redundant	SK3 with DART *)	BSK	SK1 Intrinsically Safe
SK1	X			X	
SK1 Intrinsically Safe	X **)		X	X **)	X
SK2	X			X	
SK2 intrinsically safe	X **)		X		
SK2 line redundancy		X	X		
SK3	X				
SK3 redundant		X			
Compact SK3	X			X	

***) The field installation must be replaced by DART Segment Protector R3-SP-IB*. The intrinsic safety of the installation must be verified. The field devices must be Entity in accordance with IEC 60079-11.**

****) Requires the replacement of the field installation with FieldBarrier or a Segment Protector. The trunk must be mechanically protected according to IEC 60079-14, and installed in accordance with local guidelines.**

Table 2: List of segment coupler 3 components for one to four segments

Type Codes	Quantity	Description	Comments
Segment Coupler 3, Simplex			
MBHC-FB-4.GT	1	Motherboard for gateway, power and diagnostics module	
HD2-GTR-4.PA	1	Gateway module	
HCD2-FBPS-1.500	1…4	Power supply module	
HCD2-FBPS-1.23.500	1…4	Power supply module	Alternatively with reduced voltage
HD2-DM-A	1	Advanced diagnostic module	Optional
Segment Coupler 3, Redundant			
MB-FB-GTR1	1	Motherboard for redundant gateways	
HD2-GTR-4.PA	2	Gateway module	
MBHC-FB-4R.HSC	1	Motherboard for redundant power supply modules	
HCD2-FBPS-1.500	2…8	Power supply module	Two per segment
HCD2-FBPS-1.23.500	2…8	Power supply module	Alternatively with reduced voltage
HD2-DM-A	1	Advanced diagnostic module	Optional
Segment Coupler 3, Redundant for the Intrinsically Safe High-Power Trunk			
MB-FB-GTR1	1	Motherboard for redundant gateways	
HD2-GTR-4.PA	2	Gateway module	
KT-MB-FB-D- 4R.GEN	1	DART Power Hub	Power Hub consisting completely of motherboard and power modules
HD2-DM-A	1	Advanced diagnostic module	Optional
Base Segment Coupler for one Segment			
KFD2-BR-1.PA.1500	1	Segment coupler	
KFD2-BR-Ex1.3PA.93	1	Segment coupler with intrinsically safe power supply	

2 Control Cabinet

The segment coupler is typically installed in the control cabinet. The subsections in this chapter describe each of the alternative solutions, starting with a list of the components for which this solution is suitable as a replacement. They describe the solutions in detail and list the type codes. Additionally, tips are given for every issue that must be considered and, where necessary, procedures for replacement.

2.1 Segment Coupler 3 (PROFIBUS Power Hub)

Suitable as a replacement for
SK1, SK1 intrinsically safe,
SK2, SK2 intrinsically safe,
SK3, SK3 compact for two segments

Decision Criteria

An SK3 powers up to four segments and connects these with the control system via PROFIBUS DP. This is the recommended replacement solution. It is used if at least one of the following statements is true:

Table 3: Criteria for use

Criterion	Value
The control technology is modernized or replaced.	Yes
Number of segments to be replaced	> 1
SK2: number of power links per gateway	> 1
PROFIBUS DP bit rate	> 1.5 MBit/s
Possible distance between two cable ducts	> 150 mm

Additional Properties

- PROFIBUS DP communication is configurable.
- The segment can be equipped with advanced diagnostics.
- A redundant design is possible (see next section).

Constraints / Comments

1. One segment coupler 3 with its own PROFIBUS DP connection must be configured for every four segments.
2. A conversion is necessary at a distance of less than 150 mm between the cable ducts. Figure 1 shows a size comparison.
3. The plug must be changed for the PROFIBUS PA segment connection. The plug is included in the delivery.
4. If the power links are intrinsically safe, the information in Chapter 3.1 also applies.
5. When replacing SK1, one DB9 plug must be provided on the PROFIBUS DP side.

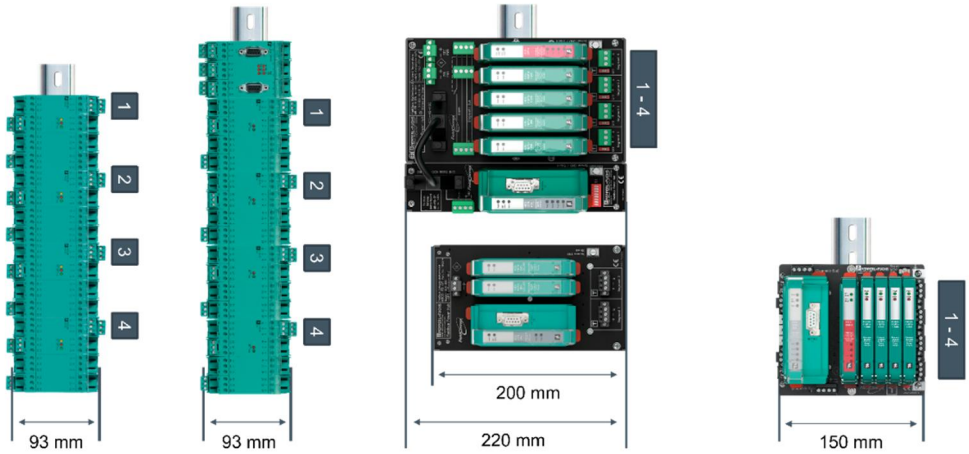

Figure 1: Comparison of the space requirements for four segments with the same orientation of the DIN rail (example). The numbering refers to the segment connections. FLTR: 4 x SK1, SK2 for 4 segments; SK3 based on MB-FB and SK3 compact; far right: SK3 based on MBHC-FB

Table 4: List of segment coupler 3 components for one to four segments

Type Codes	Quantity	Description	Comments
MBHC-FB-4.GT	1	Motherboard for gateway, power and diagnostics module	
HD2-GTR-4.PA	1	Gateway module	
HCD2-FBPS-1.500	1…4	Power supply module	
HCD2-FBPS-1.23.500	1…4	Power supply module	Alternatively with reduced voltage
HD2-DM-A	1	Advanced diagnostic module	Optional

The older segment coupler 3 product family can be replaced one to one. Table 5 assigns each replacement component to the components to be replaced.

Table 5: Compatibility and replacement of components by type code

Old Type Code	QTY	New Type Code	Comments
All Power Hubs			
MB-FB-4.GEN	1	MBHC-FB-4.HSC	
MB-FB-4.GEN + MB-FB-GT	1	MBHC-FB-4.GT	Combined motherboard for gateway, diagnostic and power supply modules
MB-FB-4R.GEN	1	MBHC-FB-4R.HSC	
MBHD-FB			
Gateway Motherboards			
MB-FB-GT + MB-FB-4.GEN	1	MBHC-FB-4.GT	Combined motherboard for gateway, diagnostic and power supply modules
MB-FB-GTR	1	MB-FB-GTR1	
Compact SK3			
KT-MB-GTB-2PS	1	MBHC-FB-4.GT	Combined motherboard for gateway, diagnostic and power supply modules. Different form factor!
KT-MB-GTB-2PS	2	KFD2-BR-1.PA.1500	Alternative: Segment couplers for DIN rail mounting

2.2 Redundant Segment Coupler 3 (PROFIBUS Power Hub)

Suitable as a replacement for

SK2 with line redundancy
SK2 intrinsically safe with line redundancy
SK3 redundant

Description and Decision-Making Criteria

An SK3 with redundant power supply and redundant gateway modules feeds up to four segments each and connects these with the control system via PROFIBUS DP. This solution is used when at least one of the following statements is true:

Table 6: Criteria for use

Criterion	Value
The control technology is modernized.	Yes
Number of segments to be replaced	> 1
SK2: number of power links per gateway	> 1
PROFIBUS DP bit rate	> 1.5 MBit/s
Possible distance between two cable ducts	> 190 mm
DP coupling	Line redundancy
PROFIBUS DP gateways	Redundant
Field device supply	Redundant

Additional Properties

§ PROFIBUS DP communication is configurable.
§ The installation can be equipped with advanced diagnostics.

Constraints / Comments

1. One redundant segment coupler 3 with its own PROFIBUS DP connection must be configured for every four segments.
2. A conversion in the control room cabinet is required if the distance between cable ducts is less than 190 mm. Figure 2 shows a size comparison.
3. The plug connector of the PROFIBUS PA segment must be replaced. The plug is included.
4. If the power links are intrinsically safe, the information in Chapter 3.1 also applies.

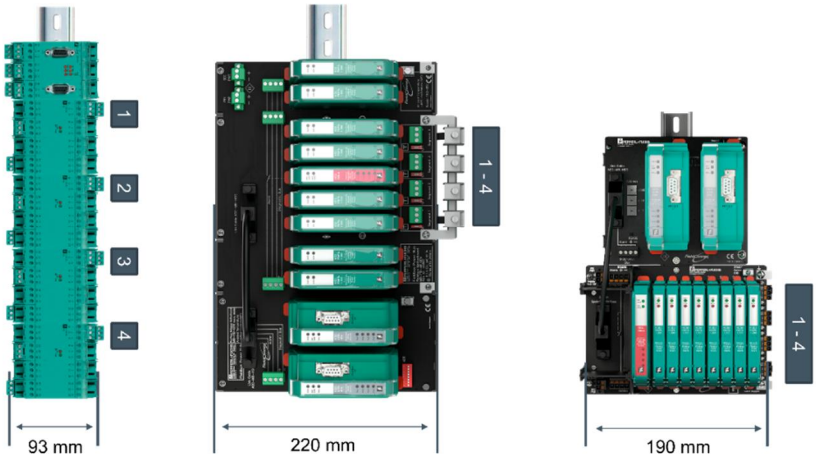

Figure 2: Comparison of space requirements for four segments with redundant segment coupler 3. The numbering refers to the segment connections. FLTR: SK2 with line redundancy for four segments; SK3 based on MB-FB; SK3 based on MBHC**

Table 7: List of redundant segment coupler 3 components for one to four segments

Type Codes	Quantity	Description	Comments
MB-FB-GTR1	1	Motherboard for redundant gateways	
HD2-GTR-4.PA	2	Gateway module	
MBHC-FB-4R.HSC	1	Motherboard for power supply modules	
HCD2-FBPS-1.500	2…8	Power supply module	
HCD2-FBPS-1.23.500	2…8	Power supply module	Alternatively with voltage limitation Ex ic
HD2-DM-A	1	Advanced diagnostic module	Optional

The segment coupler 3 product family based on motherboards MB-FB* can be replaced one to one . Table 5 in Chapter 2.1 assigns each replacement component to the components to be replaced.

2.3 Segment Coupler 3 with Intrinsically Safe High-Power Trunk

Suitable as a replacement for

SK1 intrinsically safe
SK2 intrinsically safe
SK2 intrinsically safe with line redundancy

Description and Decision-Making Criteria

An SK3 with redundant power supply and redundant gateway modules feeds up to four segments with high, intrinsically safe power and connects these with the control system via PROFIBUS DP. This solution is used when at least one of the following statements is true:

Table 8: Criteria for use

Criterion	Value
The control technology is modernized.	Yes
Number of segments to be replaced	> 1
SK2: number of power links per gateway	> 1
PROFIBUS DP bit rate	> 1.5 MBit/s
Possible distance between two cable ducts	> 200 mm
DP coupling	Line redundancy
PROFIBUS DP gateways	Redundant
Field device supply	Redundant
Trunk installation layout	Intrinsically safe

Additional Properties

- PROFIBUS DP communication is configurable.
- The segment can be equipped with advanced diagnostics.

Constraints / Comments

1. One redundant segment coupler 3 with its own PROFIBUS DP connection must be configured for every four segments.
2. A conversion in the control room cabinet is required if the distance between cable ducts is less than 200 mm. Figure 3 shows a size comparison.
3. The plug must be changed for the PROFIBUS PA segment connection. The plug is included in the delivery.
4. When replacing SK1, a DB9 plug must be provided on the DP side. Not included!
5. The junction boxes in the field must be replaced by DART segment protectors. Pre-wired housing solutions for fast on-site replacement are available from Pepperl+Fuchs. Details are described in Chapter 3.2

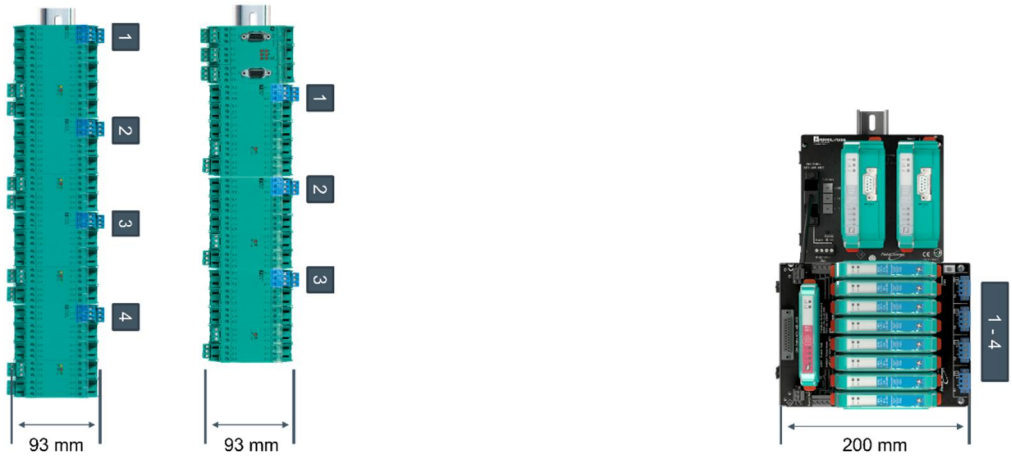

Figure 3: Comparison of the space requirements for three to four segments with redundant segment coupler 3. The numbering refers to the segment connections. FLTR: four SK1; SK2 for three segments; SK3 for the intrinsically safe high-power trunk.

Table 9: Segment coupler 3 component list, redundant for the intrinsically safe high-power trunk

Type Codes	Quantity	Description	Comments
MB-FB-GTR1	1	Motherboard for redundant gateways	
HD2-GTR-4.PA	2	Gateway module	
KT-MB-FB-D- 4R.GEN	1	DART Power Hub	Power Hub consisting completely of motherboard and power modules
HD2-DM-A	1	Advanced diagnostic module	Optional

2.4 Basic Segment Coupler (BSK)

Suitable as a replacement for:
SK1, SK1 intrinsically safe,
SK2, SK2 intrinsically safe
SK3 compact

Description and Decision-Making Criteria

The FieldConnex basic segment coupler is a combined gateway and fieldbus power supply for transparently connecting PROFIBUS PA to PROFIBUS DP. The BSK is ideal for use in small plants or for replacing individual segment coupler 1 or 2. This solution is used when at least one of the following statements is true:

Table 10: Criteria for use

Criterion	Value
Individual segments should be replaced.	Yes
Number of segments to be replaced	small, e.g. < 4
SK2: number of power links per gateway	= 1
PROFIBUS DP bit rate	≤ 1.5 MBit/s (BSK) ≤ 93.75 kBit/s (SK1)

Constraints / Comments

1. One BSK must be planned per power link or SK1.
2. SK2 and compact SK3: The DB9 plug must be adapted to plug connectors.
3. PROFIBUS DP: When replacing SK2 with BSK, the number of PROFIBUS DP nodes will likely increase. The DP-side installation must be checked to ensure conformity with regard to cable distance, topology, transmission rate and number of nodes.
4. Compact SK3: The plug must be changed for the PROFIBUS PA segment connection. The plug is included in the delivery.
5. If the power links are intrinsically safe, the information in Chapter 3.1 also applies.

Table 11: Compatibility and replacement of SK1 by type code

Old Type Code	QTY	New Type Code	Comments
KFD2-BR-1.PA.93	1	KFD2-BR-1.PA.1500	One-to-one replacement
KFD2-BR-Ex1.3PA.93	1	KFD2-BR-Ex1.3PA.93	One-to-one replacement

3 Conversion in the Field

When choosing a different type of protection and the associated power supply, conversion in the field may be necessary. This typically affects the trunk and the junction box. With FieldConnex, three solutions are available for the intrinsically safe type of protection.

Pepperl+Fuchs offers preconfigured, ready-to-install, pre-wired housing solutions for field installation.

3.1 SK3 or BSK with High-Power Trunk

The power supply for the high-power trunk delivers a power output of up to 30 V and 500 mA. The trunk cable must be installed with mechanical protection according to IEC 60079-14 and local guidelines.

FieldBarriers or Segment Protectors are installed in the junction boxes.

Constraints / Comments

1. FieldBarrier for field devices with Zone 0 / Div. 1, Ex ia rating
   Segment Protector for field devices in Zone 2 / Div. 2, Ex ic rating
2. Junction box installed in Zone 1…2 / Div. 1...2.
3. Fieldbus cable type ‘A’ is recommended.
4. The total length of the segment, trunk and all spurs can be up to 1900 m.
5. Parameters of field devices must be checked and validated according to FISCO or Entity. Validating the intrinsic safety of the field devices is simple, and is possible without any calculations.

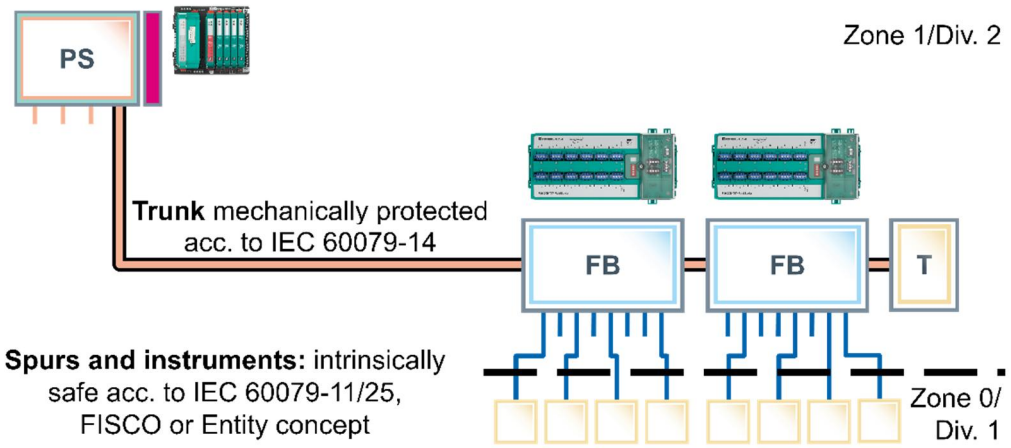

Figure 4: High-power trunk concept with FieldBarrier

3.2 SK3 with Intrinsically Safe High-Power Trunk

The power supply for the intrinsically safe high-power trunk provides 24 V and 360 mA. Ignition protection type intrinsic safety of the trunk is achieved with DART, Dynamic Arc Recognition and Termination. The DART fieldbus is certified in accordance with IEC 60079-11 IECEx and the ATEX directive, and can be used in many countries.

SK1 or SK2 is replaced with SK3 with DART power modules. DART segment protectors are used as the junction boxes.

Constraints / Comments

1. Junction box and field device connection in Zone 1, Ex ib
2. Fieldbus cables must be cable type ‘A’.
3. Parameters of field devices must be checked and validated according to Entity. Validating intrinsic safety is simple, and accomplished without any calculations.
4. The length of the trunk cable must not exceed 1000 m.

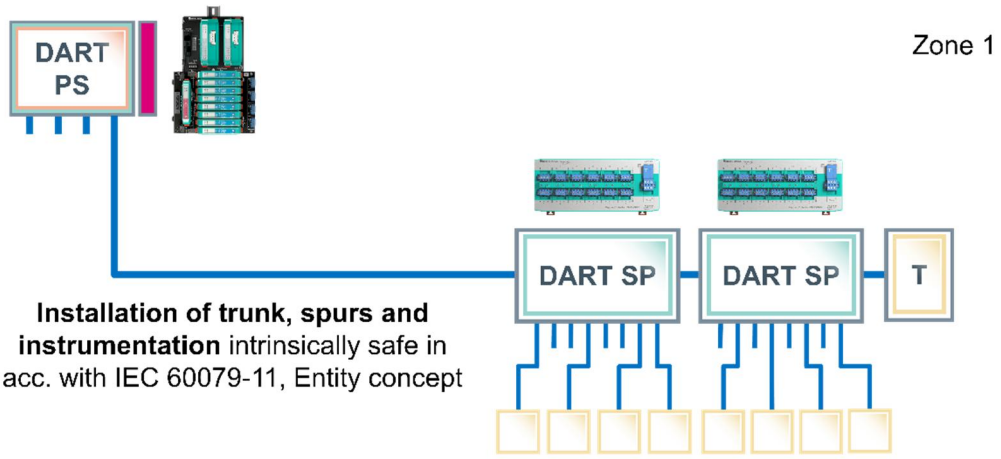

Figure 5: Segment with intrinsically safe high-power trunk

3.3 SK1 Intrinsically Safe

The intrinsically safe segment coupler 1 type: KFD2-BR-Ex1.3PA.93 remains available as a spare part. Changes to the field installation are not necessary.

4 Summary

This document describes the replacement of segment couplers 1 to 3 with devices of the current generation. Pepperl+Fuchs employees and its representatives are glad to assist in the practical implementation. To find a contact in your area, visit our website: http://www.pepperl-fuchs.com.

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- Intrinsically safe barriers
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- Explosion protection equipment
- Solutions with explosion protection

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