

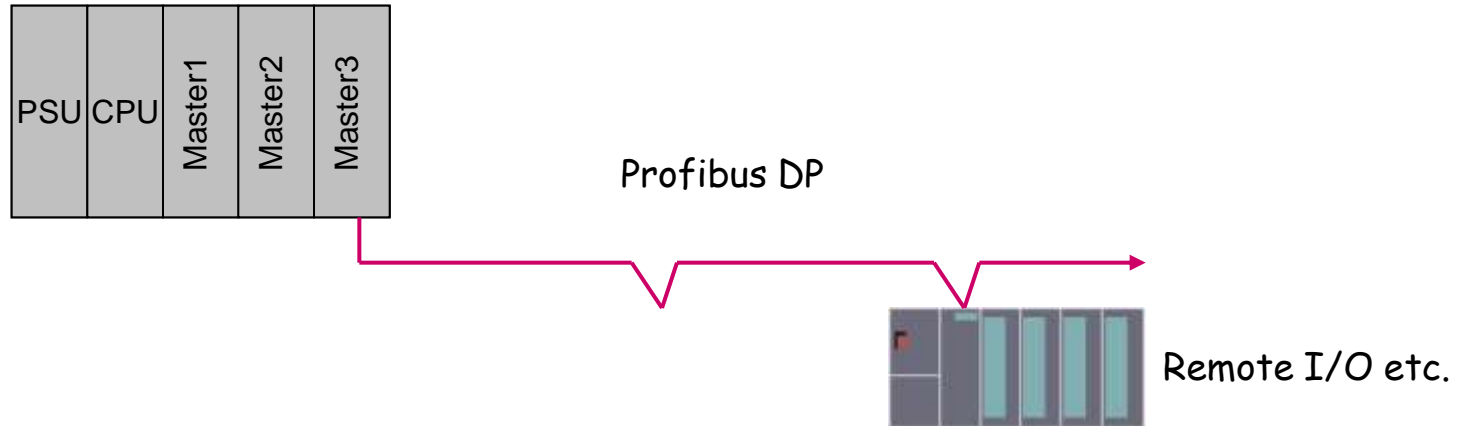
**Practical  
aspects of  
Profibus in  
Process**

Endress &  
Hauser  
Manchester  
October 2010

## **Component Selection**

- What components there are available
- What components to use and where
- Minimum configuration
- Into the real world
- Hazardous area
- Some rules

# Basic configuration



Basic configuration normally uses Profibus DP

## Master slave communications

*The Master controls all cyclic communications*

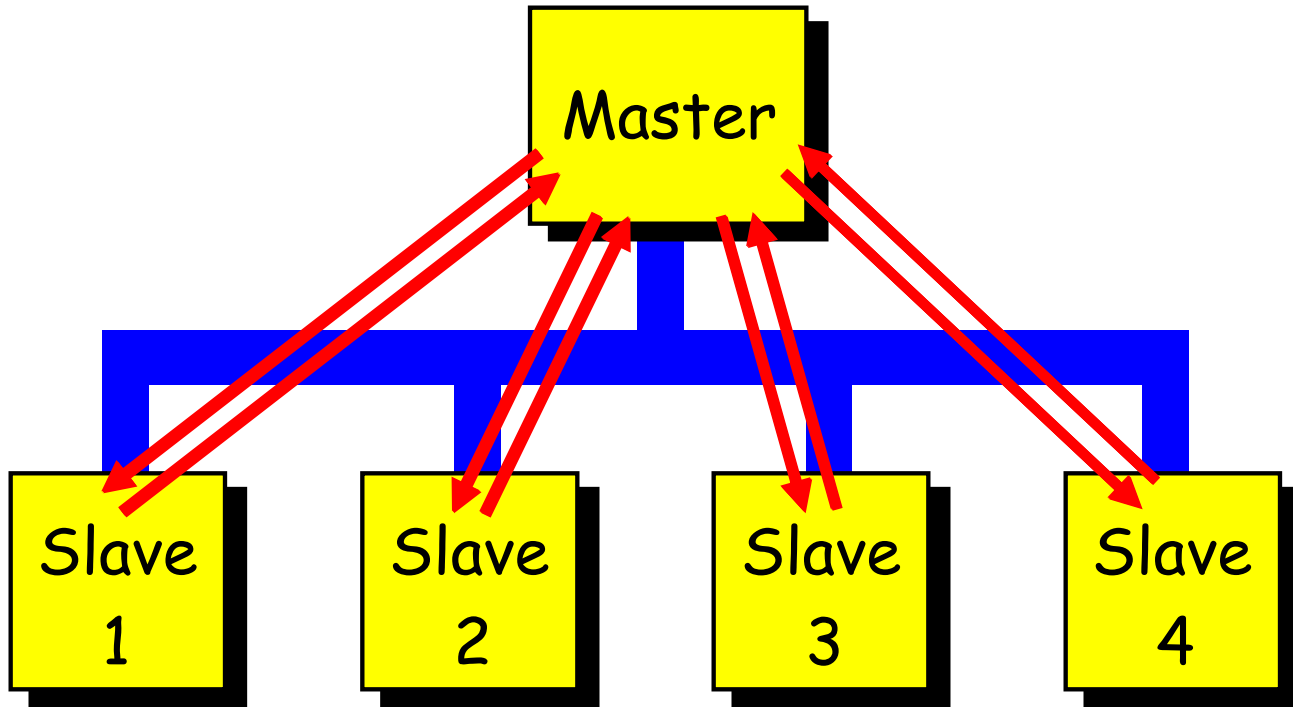
*The Master is configured using a software tool for your PLC/DCS*

*Use a .gsd file as the common interface between all devices and the master*

*You can have more than one master on a network*

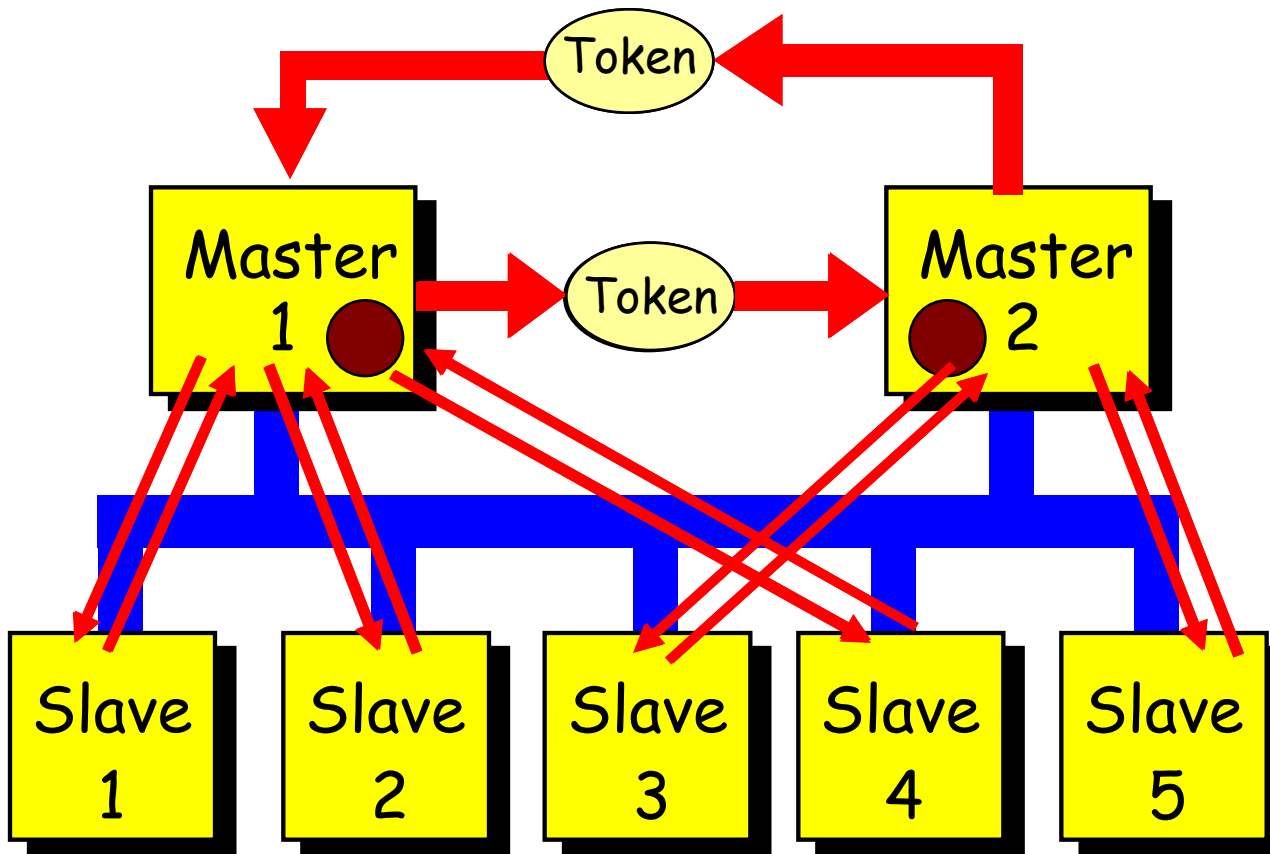
*A slave is locked to a cyclic master*

## Single master system



Cyclic operation:  
 $M \rightarrow S1, S1 \rightarrow M$   
 $M \rightarrow S2, S2 \rightarrow M$   
 $M \rightarrow S3, S3 \rightarrow M$   
 $M \rightarrow S4, S4 \rightarrow M$   
 $M \rightarrow S1, S1 \rightarrow M$   
 $M \rightarrow S2, S2 \rightarrow M$   
etc.

## Dual master system



Cyclic operation:  
 $M1 \rightarrow S1, S1 \rightarrow M1$   
 $M1 \rightarrow S2, S2 \rightarrow M1$   
 $M1 \rightarrow S4, S4 \rightarrow M1$   
 $M1 \rightarrow \text{token} \rightarrow M2$   
 $M2 \rightarrow S3, S3 \rightarrow M2$   
 $M2 \rightarrow S5, S5 \rightarrow M2$   
 $M2 \rightarrow \text{token} \rightarrow M1$   
 $M1 \rightarrow S1, S1 \rightarrow M1$   
 $M1 \rightarrow S2, S2 \rightarrow M1$   
 etc.

## DP to PA

*For Process Automation devices you need a converter between DP & PA*

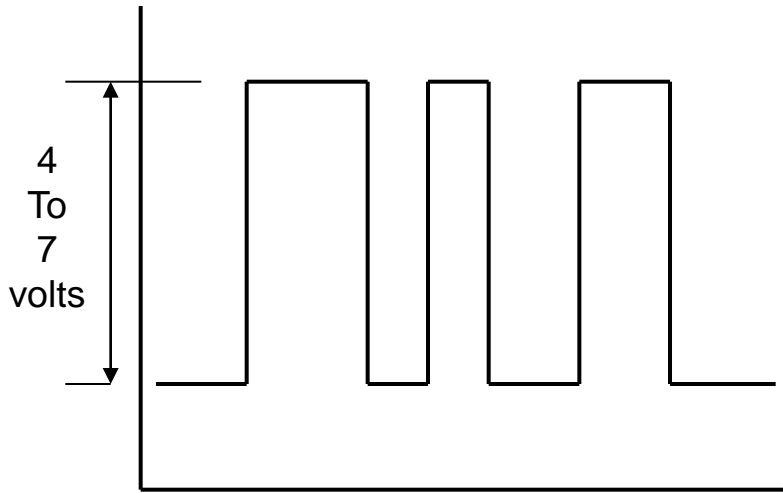
*DP uses RS485*

*PA uses Manchester Bus Power*

*Different converters exist. Simple couplers or link modules*

*Each has its areas of use, benefits and disadvantages*

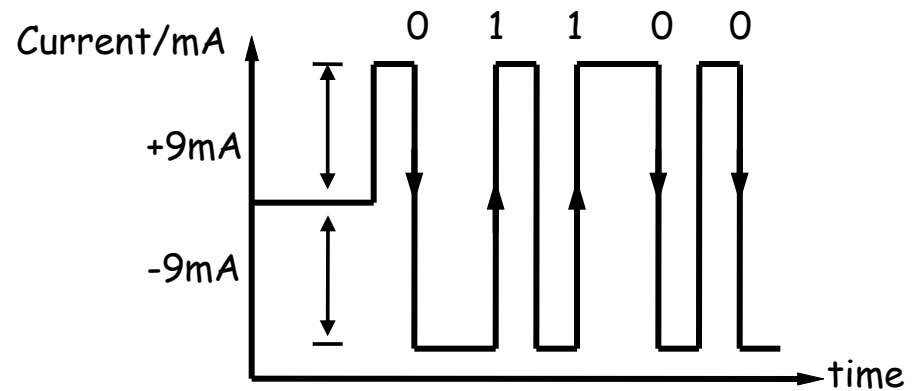
# Conversion from RS485 to Manchester Bus (PA)



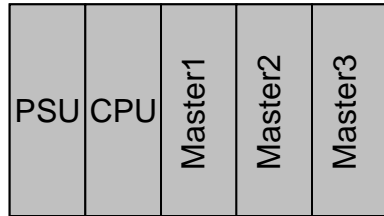
Profibus DP  
RS485 multi-drop

Coupler or link module

Profibus PA Manchester  
Bus Powered multi-drop



# DP to PA couplers



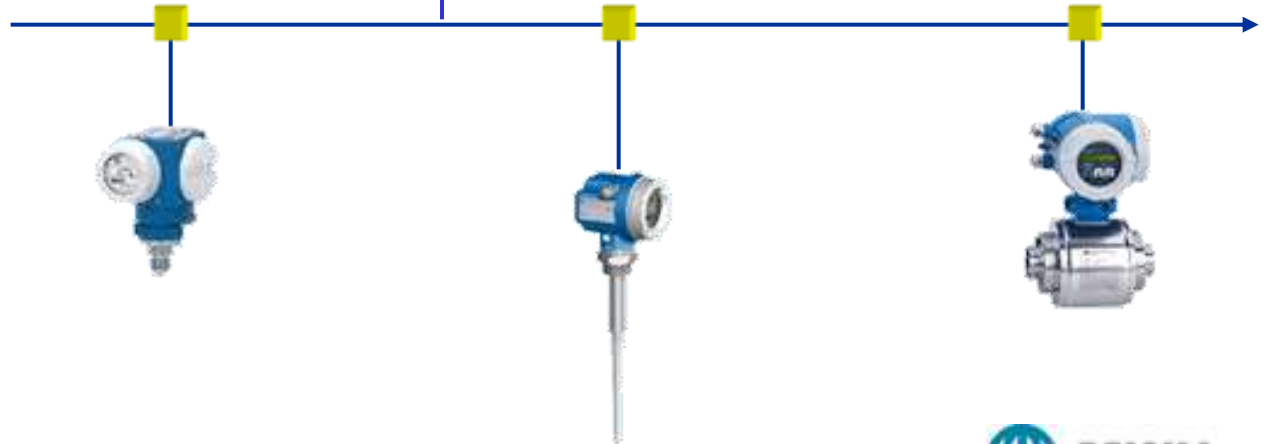
Powered termination.



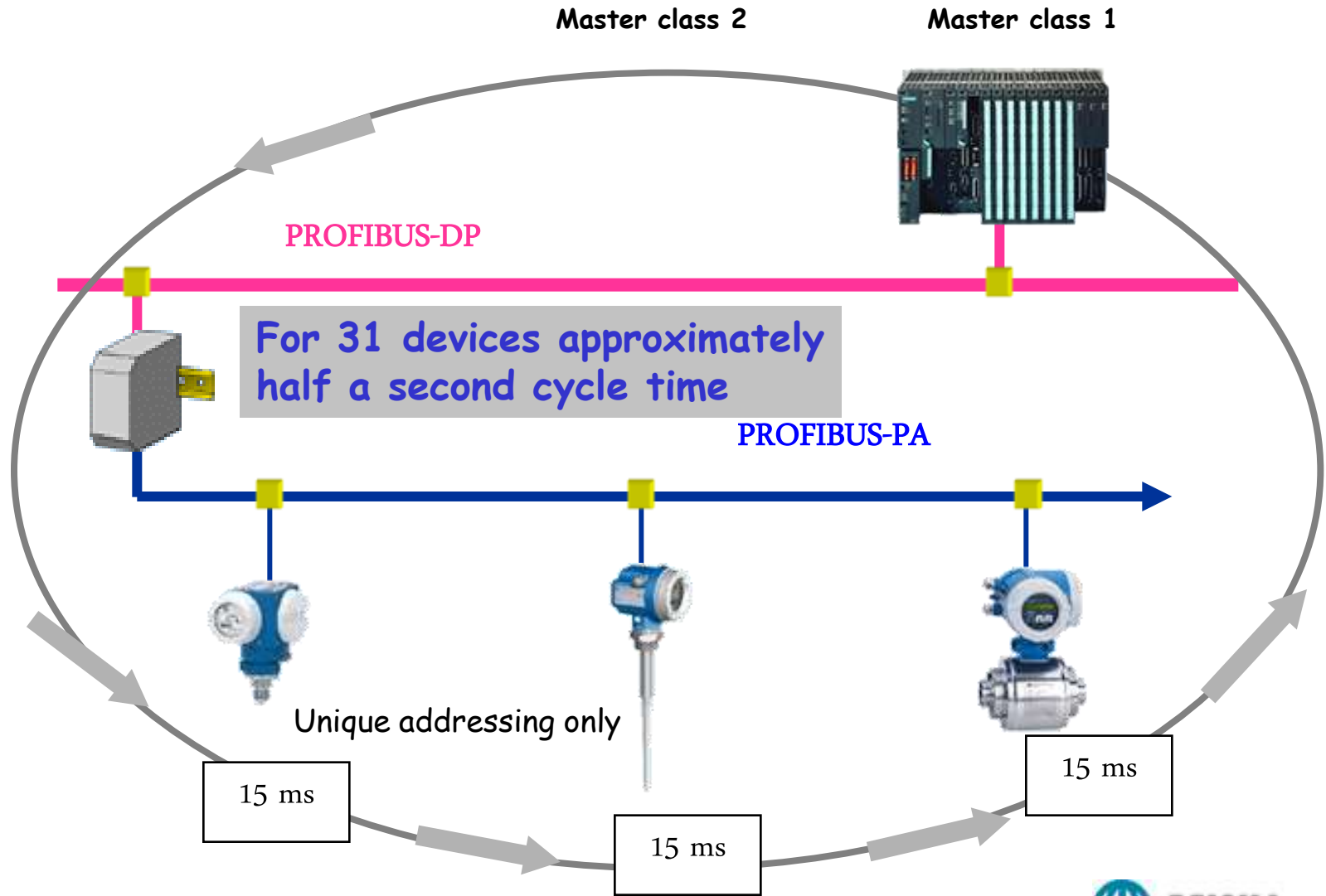
Remote I/O etc.

PROFIBUS-PA

Slack module allows non-coupler uses unique addressing, no address on the bus for all PA devices and allows full baud rate available



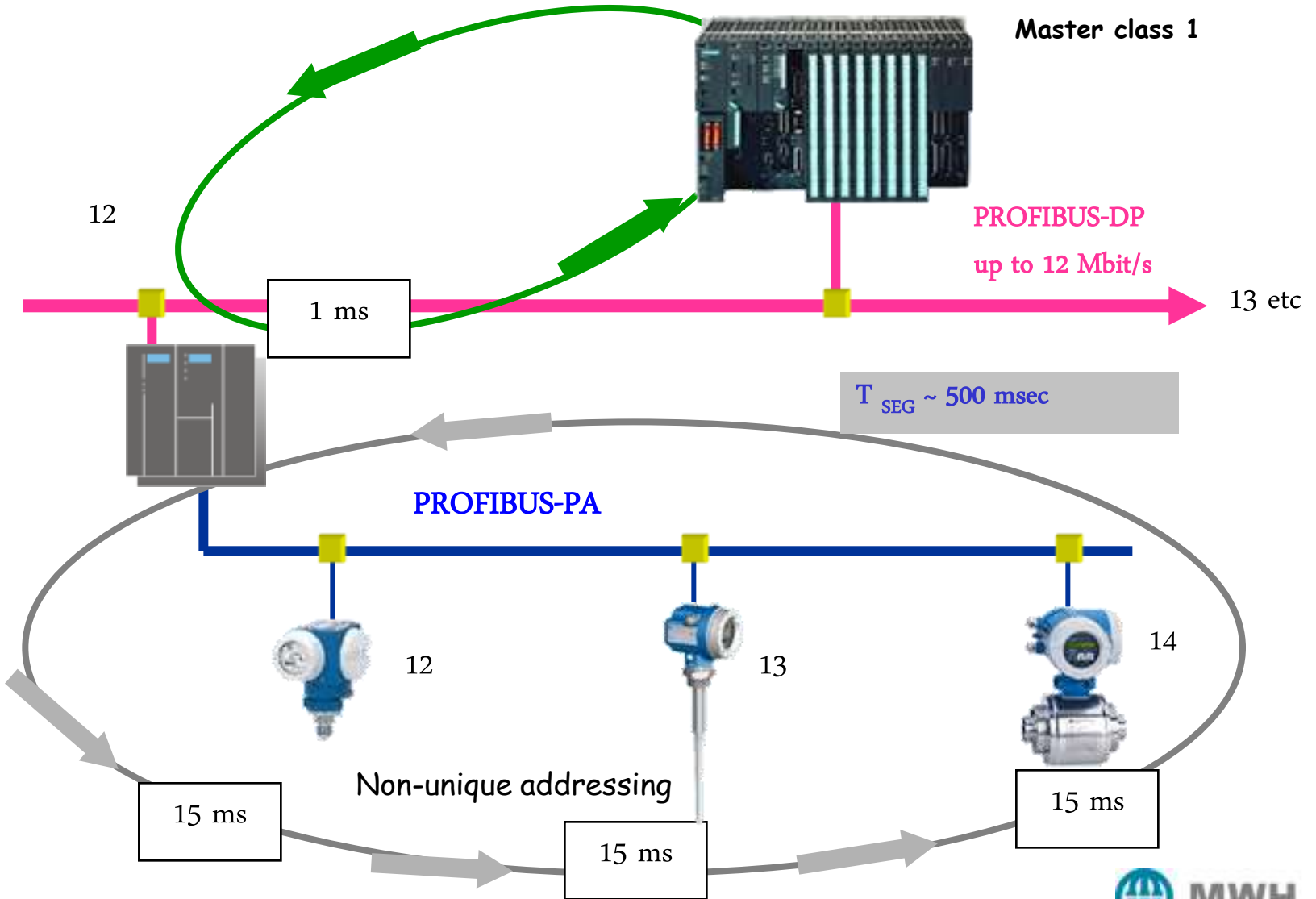
# DP to PA-Simple coupler (Siemens/P&F)



## DP to PA-Simple coupler (cont)

- Two variants of the DP/PA Coupler: Ex and Non-Ex
- Converts the signals from DP (RS 485) to PA (IEC 61158-2)
- Transparent to master and slave
- No configuration necessary
- Fixed baud rate of 45.45 or 93.75 kBit/s on DP network
- Contains termination (one end) for the Profibus PA bus
- Powers the PA field devices

# DP to PA-Link Module (Siemens)



## DP to PA-Link Module

- The LINK contains at least one IM157 module and one DP/PA coupler
  - the Link acts as a DP-Slave to the DP-Master
  - the Link acts as a master to the PA-Slaves
  - max. I/O range for all PA devices:
    - 244 Byte Input + 244 Byte Output
- Address range on PROFIBUS-DP between 0-125
- Address range for slaves on PROFIBUS-PA from 3-125
- Up to 5 DP/PA couplers can be connected to one IM157 module
- Remember the 244 byte limit
- 9.6 kBit/s to 12 Mbit/s (standard bus parameters)
- GSD generator required when used outside a Siemens environment

# DP to PA-Link Module

IM 157

1..5 DP/PA Coupler(s)



*Where now?*

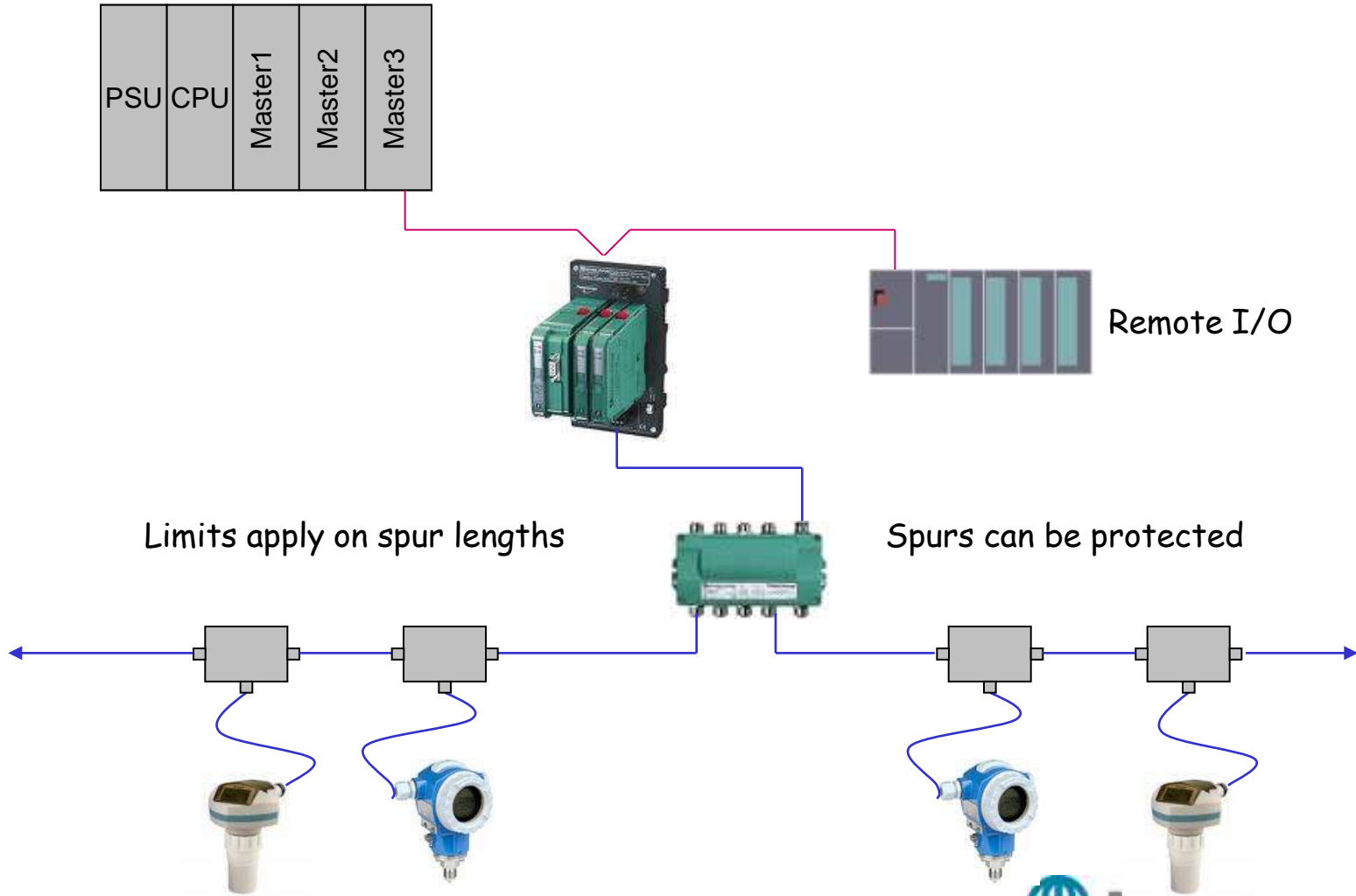
*Profibus PA can go 1900 metres in the field with up to 31 slaves*

*Junction boxes are often used to distribute PA around the plant*

*Current limiting devices can be employed to protect segments*

*This enables a highly flexible system to be created*

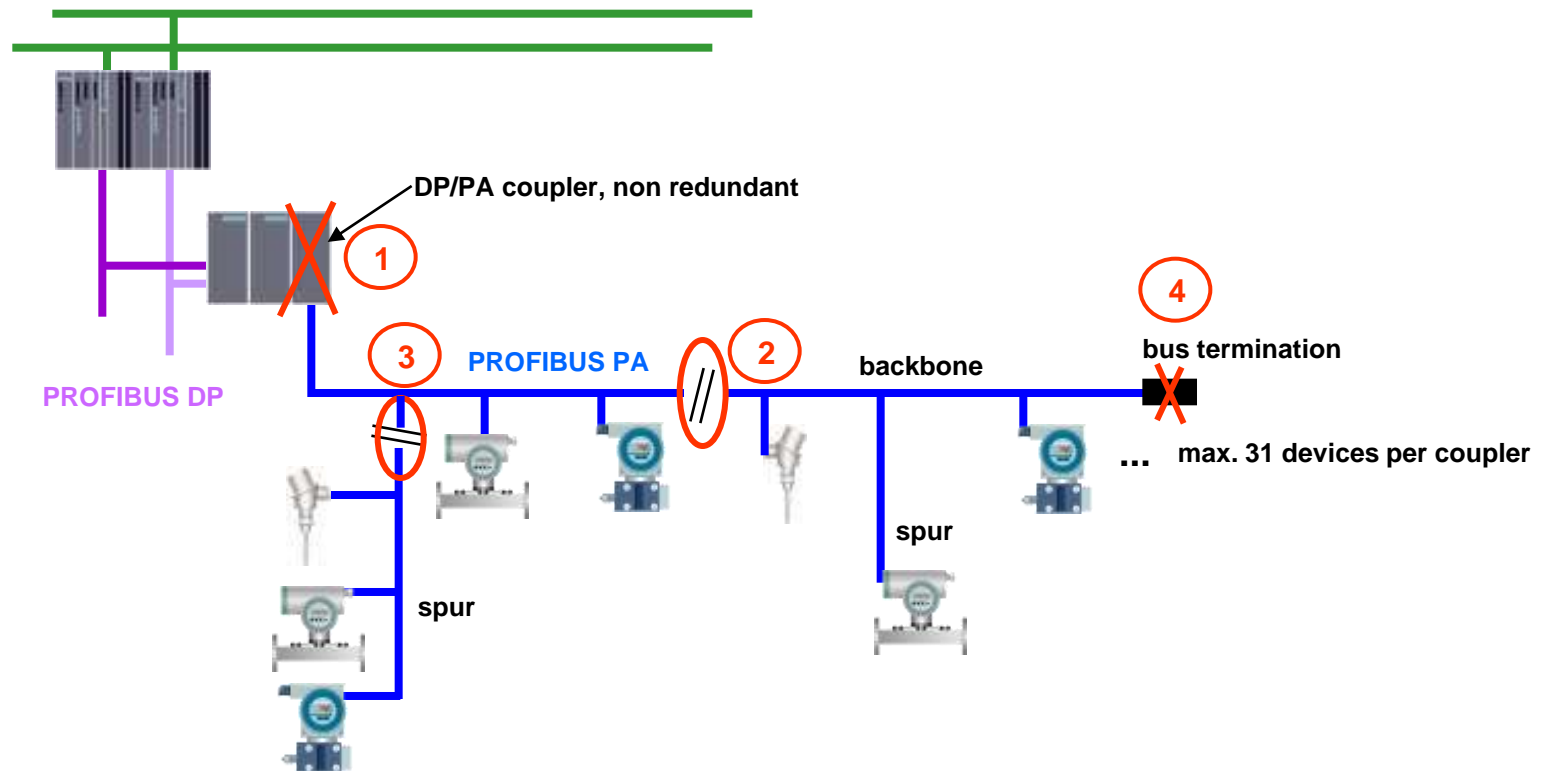
# PA field components



## What can go wrong?

- Field equipment is more prone to damage
- Often instruments are connected via a plug/socket
- Moisture can intrude causing a breakdown
- Seals on junction boxes may be damaged letting in water
- Physical damage may occur

# Possible faults on a PA segment



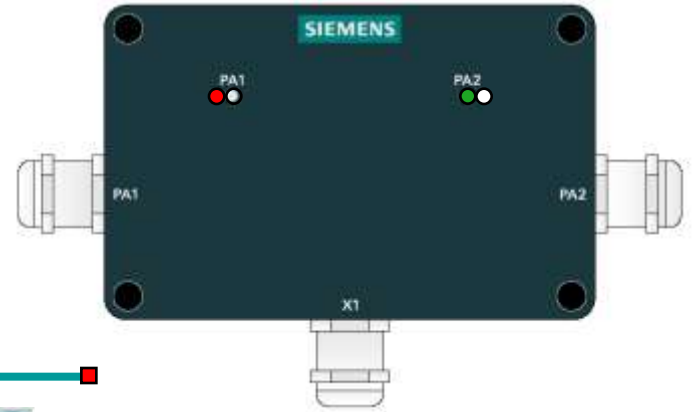
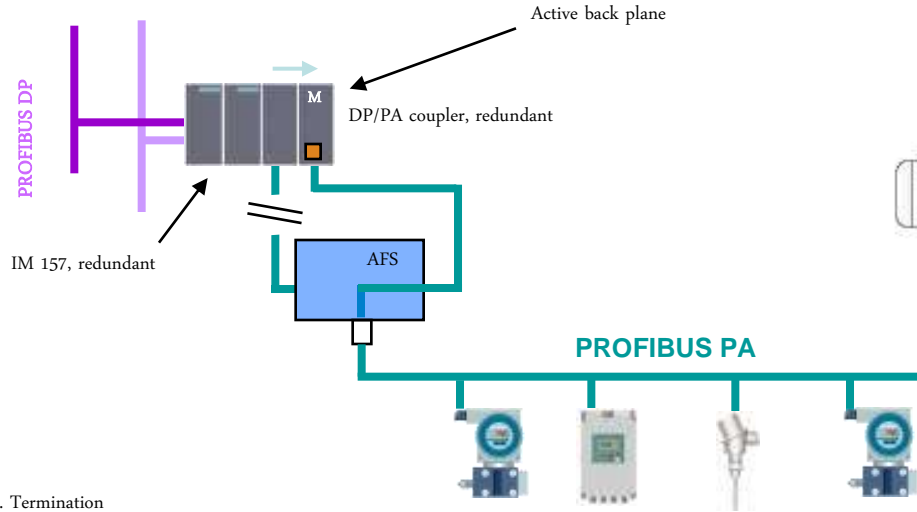
	failure	effect	estim. of harm
1	breakdown of PA Coupler	breakdown of up to 31 devices	
2	short-circuit / wire break on backbone	breakdown of up to 31 devices	
3	short-circuit / wire break on spur	breakdown of typ. 1-4 devices	
4	missing bus termination	disturbance of communication	

## Redundant systems

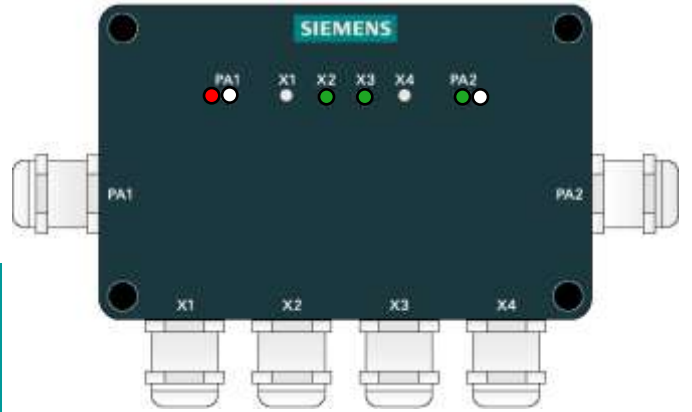
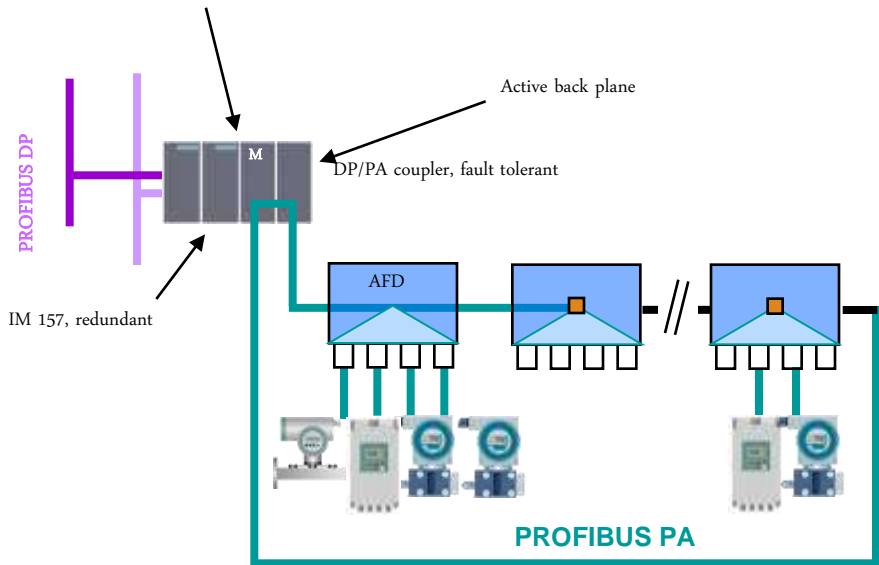
*Using special devices the PA segment can be maintained even under fault conditions*

*Offers a safe and reliable system for critical equipment ensuring plant up-time*

# Fault tolerant systems



Normally in a ring. Termination on backplane



*Very easy to do - you can self-certify*

*FISCO, FINCO, ENTITY all supported*

*Hazardous area components available*

*Allows a flexible approach as in a safe area*

*Far less documentation needed*

## FISCO rules overview

- Max 1000 metres (EEx ia) with type 'A' cable
- Max 9-10 devices (current limited)
- Max 60 metre spur lengths
- Max 110 mA link module supply

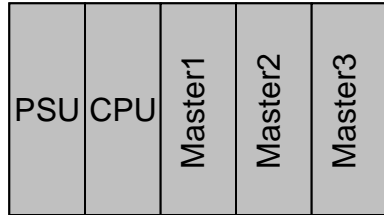
- $V_o < V_i$
  - $I_o < I_i$
  - $P_o < P_i$
- } FISCO parameters  
(Fieldbus Intrinsically safe COnccept)

Limitation of device capacitance and inductance:  $C_i < 5 \text{ nF}$ ,  $L_i < 10 \mu\text{H}$

- One source of power (i.e. device is a passive current sink)
- Must use FISCO approved devices.

Power supply cannot deliver more energy into the field than the device can safely operate with

# FISCO system



Using FISCO rules you need a special coupler or link module



EEXia output

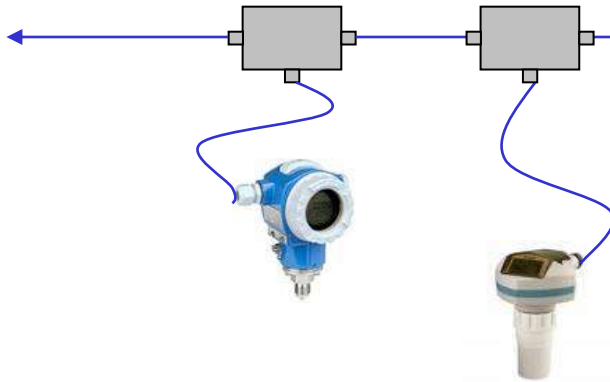


Remote I/O

Safe area

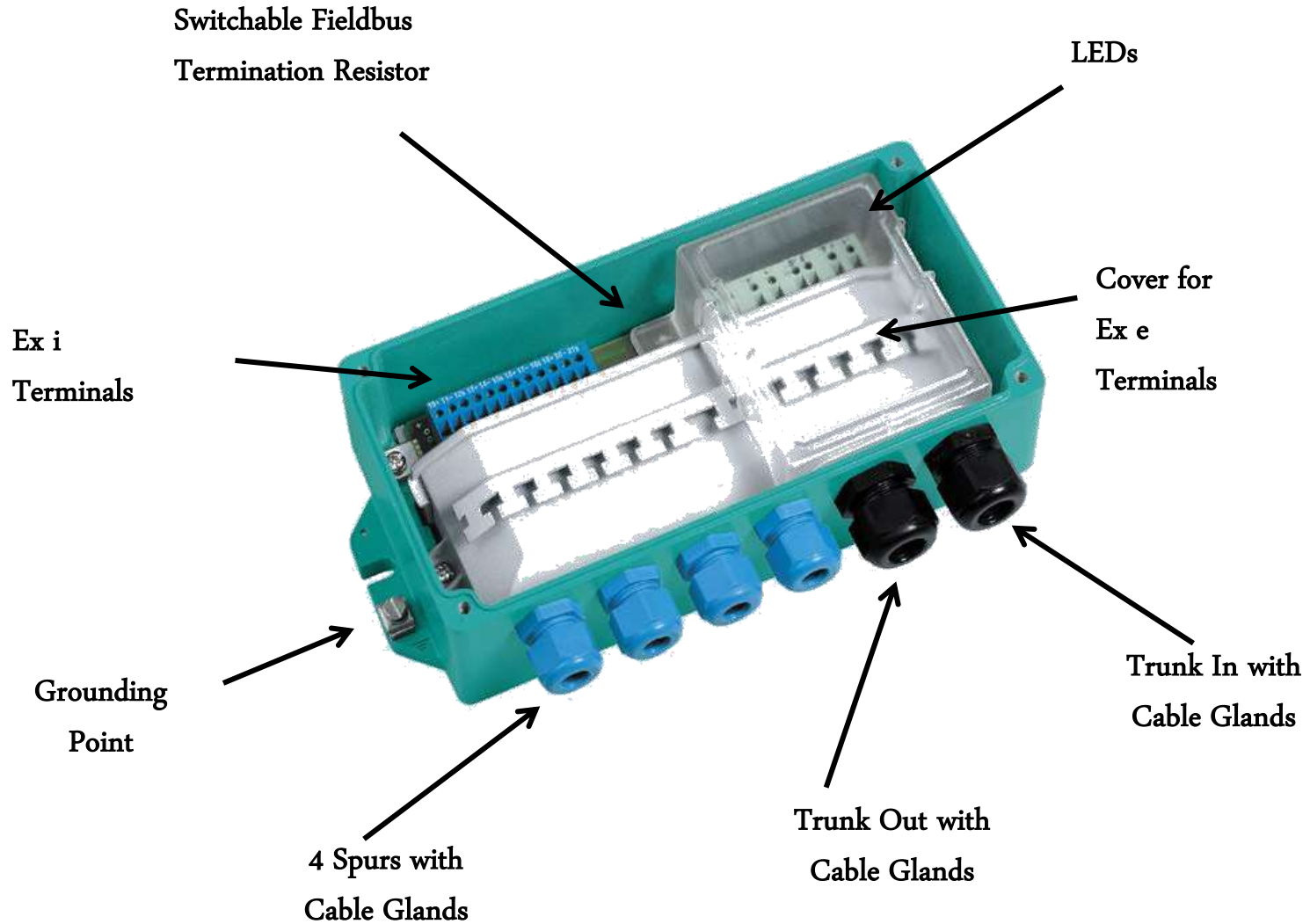
Hazardous area

Maximum of 8 to 9 devices

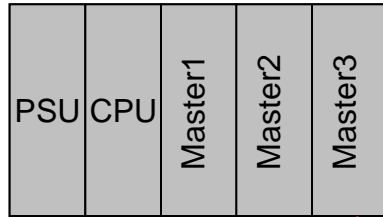


Maximum of 1000 metres using type 'A' cable

# Hazardous area with high power bus



# Hazardous area with high power bus



Using a field barrier means you do not need a hazardous area coupler so can have the full 400mA available



Remote I/O

EEXe

Safe area



Field Barrier  
Zone 1-2

Hazardous area

Limit on the number of devices on a segment is normally 1-2 devices)

EEX ia



# Cabling rules

Number of spurs	Non-I.S	I.S
24-32	1m	1m
19-24	30m	60m
15-18	60m	60m
13-14	90m	60m
1-12	120m	60m

PA (PROCESS Automation)  
Networks

Safe area PA segment length is 1900 metres including spurs

## Maximum segment lengths achievable with copper wire

Baud rate	Maximum segment length
9.6 kbit/s	1 000m
19.2 kbit/s	1 000m
45.45 kbit/s	1 000m
93.75 kbit/s	1 000m
187.5 kbit/s	1 000m
500.0 kbit/s	400m
1.5 Mbit/s	200m
3.0 Mbit/s	100m
6.0 Mbit/s	100m
12.0 Mbit/s	100m

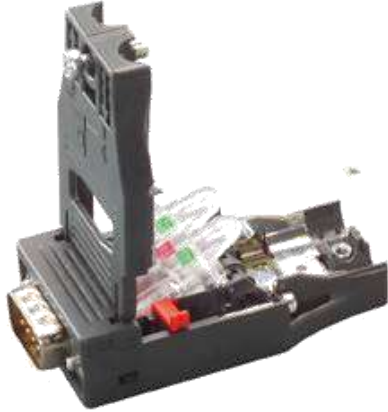
DP  
(Decentralised Peripheral)  
Networks

DP is distance limited  
PA tends to be current limited

# Other field devices-connectors



## Other field devices-connectors



- Wide choice of Cable to suit each application.
  - 9-pin DIN is standard way to connect Profibus DP devices together.
  - Outdoor equipment generally cable-glanded and hard-wired.
    - DP has 5 pin and PA 4 pin M12 plugs and sockets

# Spur devices (PA)



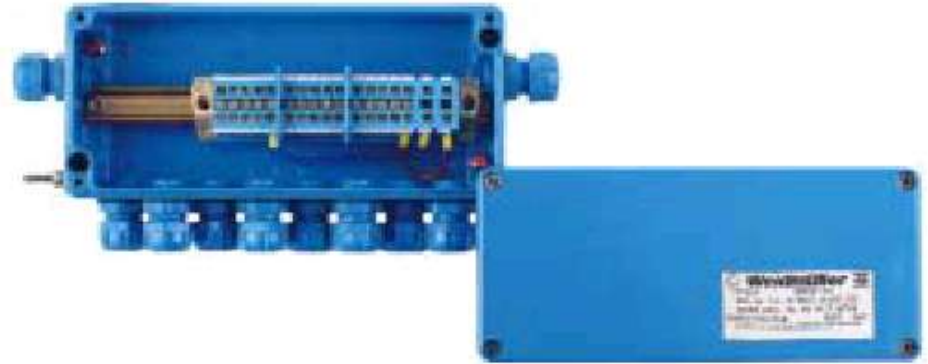
# Field junction boxes

Weidmüller PROFIBUS PA



# Field connectors and junction boxes

## Weidmüller PROFIBUS PA



## Siemens PROFIBUS PA



# Over-voltage (lightning) protection

Dehn+Söhne



Ensure 360 screen connection

# Diagnostics - Power hub

- Power Hub based Diagnostic Module
- Upgrade option for existing installations
- Monitors Power Hub related functions and Physical Layer health
- Supports 4 Fieldbus Segments
- Summary Alarm Relay Output
- Status LED's for
  - Bulk power health
  - Segment health
  - Communication activity

- Segment health  
- Communication activity

Bulk power health



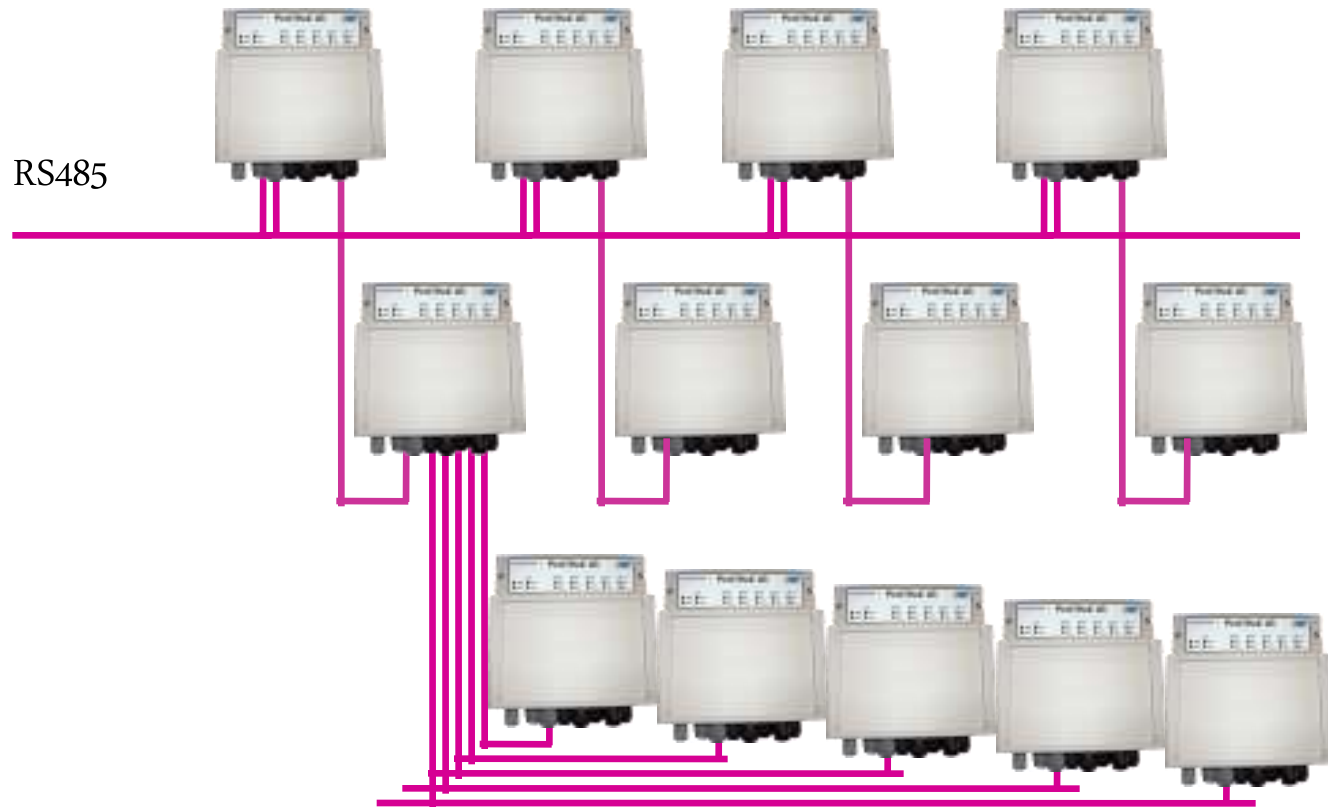
## DP field components - repeaters

- 5 Galvanic isolated channels (segments).
- Suitable for RS 485 based networks (PROFIBUS DP, DP-V1, DP-V2 and MPI).
- Transmission speeds: 9,6 Kbit/s ...12 Mbit/s.
- Each channel complies to the DP - RS 485 specification.
- Integrated termination facility for each channel and trunk line.
- IP 65 classification.
- Each channel can serve 1 up to 31 devices.
- No limit in serial placement or cascading of ProfiHubs.



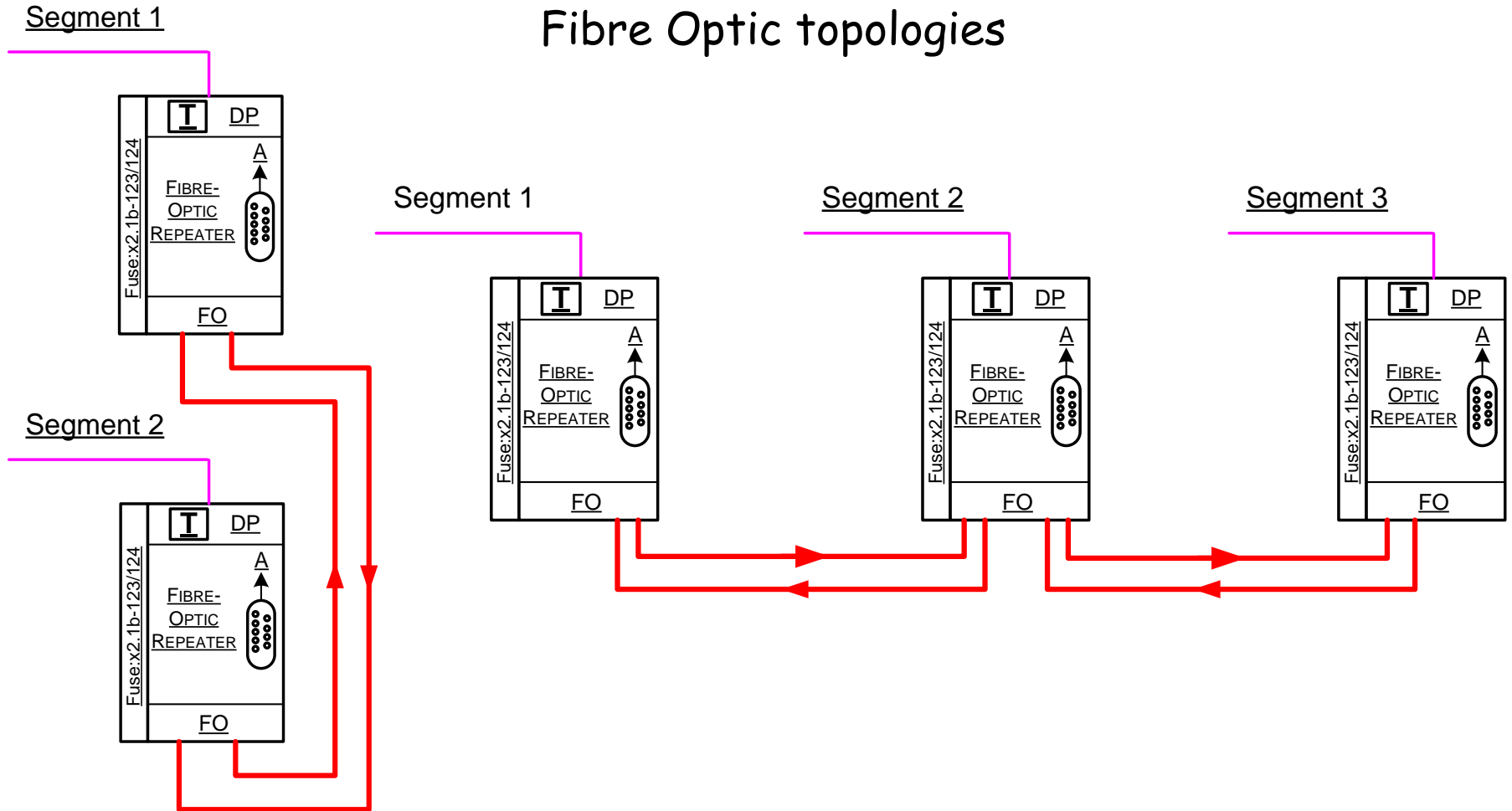
## DP field components - repeaters

- Large networks with star and tree topology
- No **limit** in the cascading of ProfiHubs



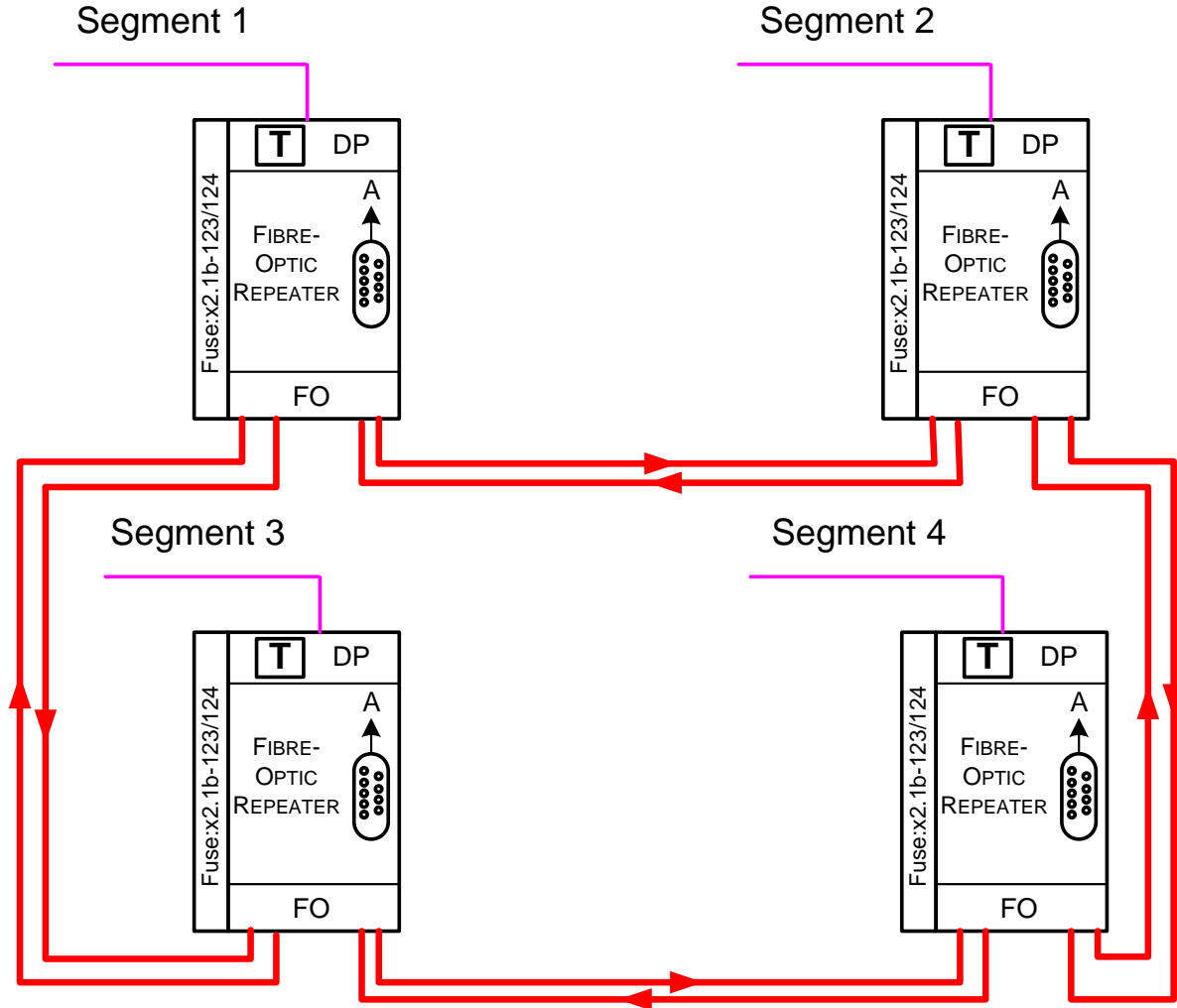
# DP field components- Fibre optic

## Fibre Optic topologies



# DP field components- Fibre optic

## Fibre Optic topologies



# Questions?