10 Mb/s Single Twisted Pair Ethernet
Daisy Chain Powered Trunk

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Overview

- Current Fieldbus Segment Planning
- Fieldbus Power Distribution
- Comparison 10SPE and Fieldbus Powering
- Daisy-Chain Trunk Topology
- Simplified Power Decoupling Circuit
- Additional Remarks

Current Fieldbus Segment Planning

- Currently in fieldbus applications the segment layout is preplanned, so that it is guaranteed that the overall installation works over the intended temperature range with enough headroom for a stable installation.
- One open tool for planning fieldbus segments is shown below (www.segmentchecker.com).

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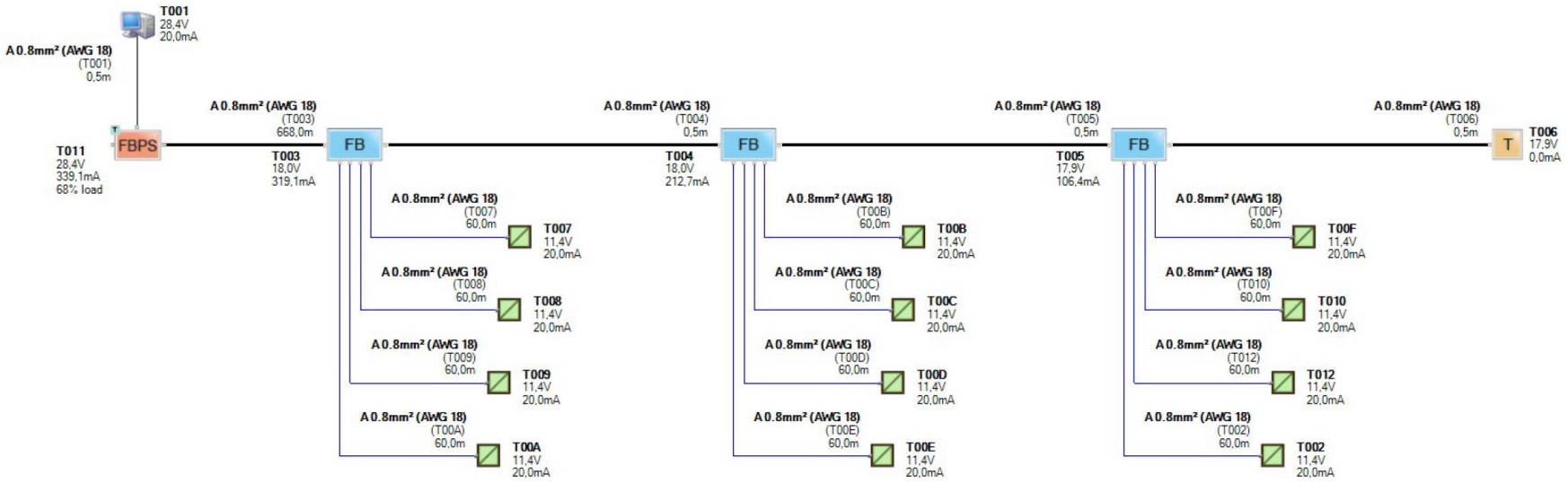
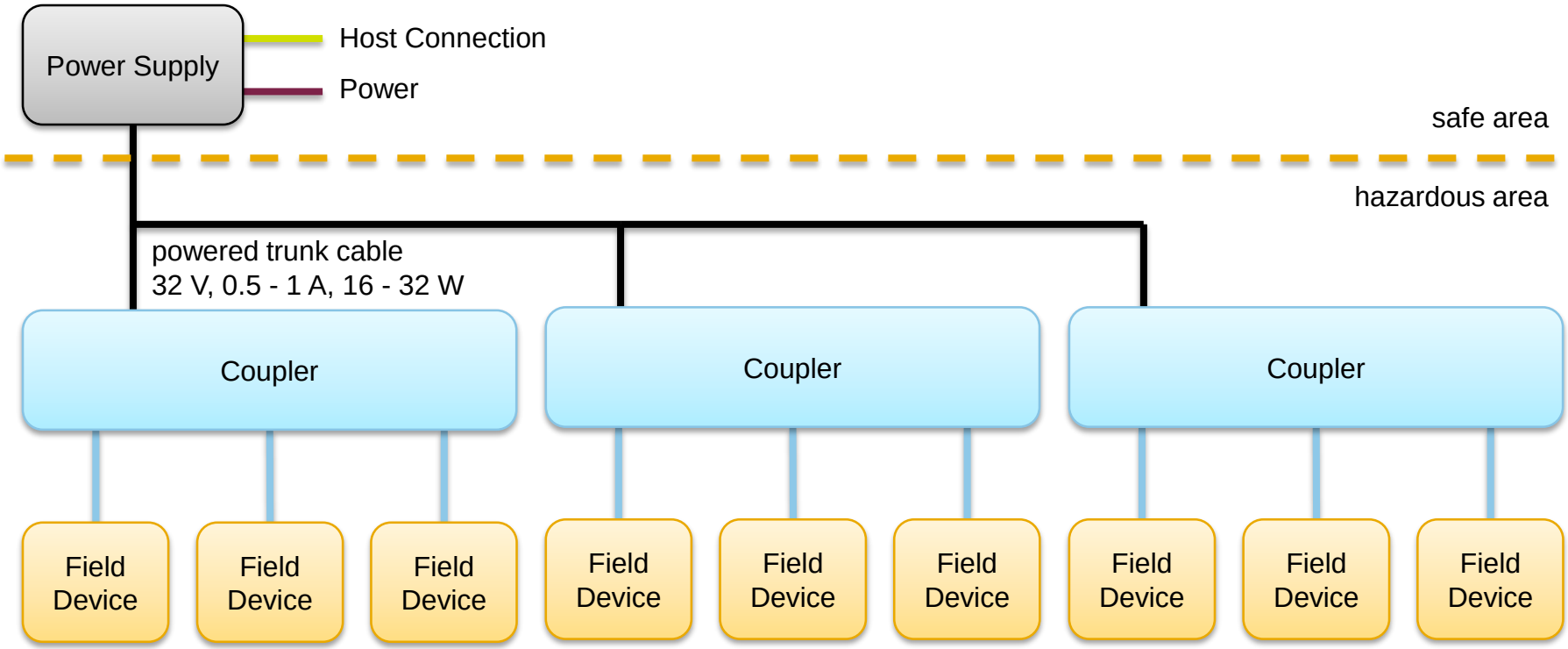
Segment Type	Fieldbus Foundation: High-Power Trunk with FieldBarrier
Cable Type	A 0.8mm² (AWG 18)
Env. Temp.	50°C
Default Field Device Current	20mA
Default Spur Length	60m
Short Circuit Checking	On



Fieldbus Power Distribution

- In current fieldbus installations a supply voltage of up to 32 V at a supply current of up to 1 A is being used. Therefore a total power of about 32 W can be supplied.
- All couplers are connected to the same trunk cable.
- Within the couplers the power is inductively decoupled and the communication is coupled to the bus using a transformer or capacitive coupling.

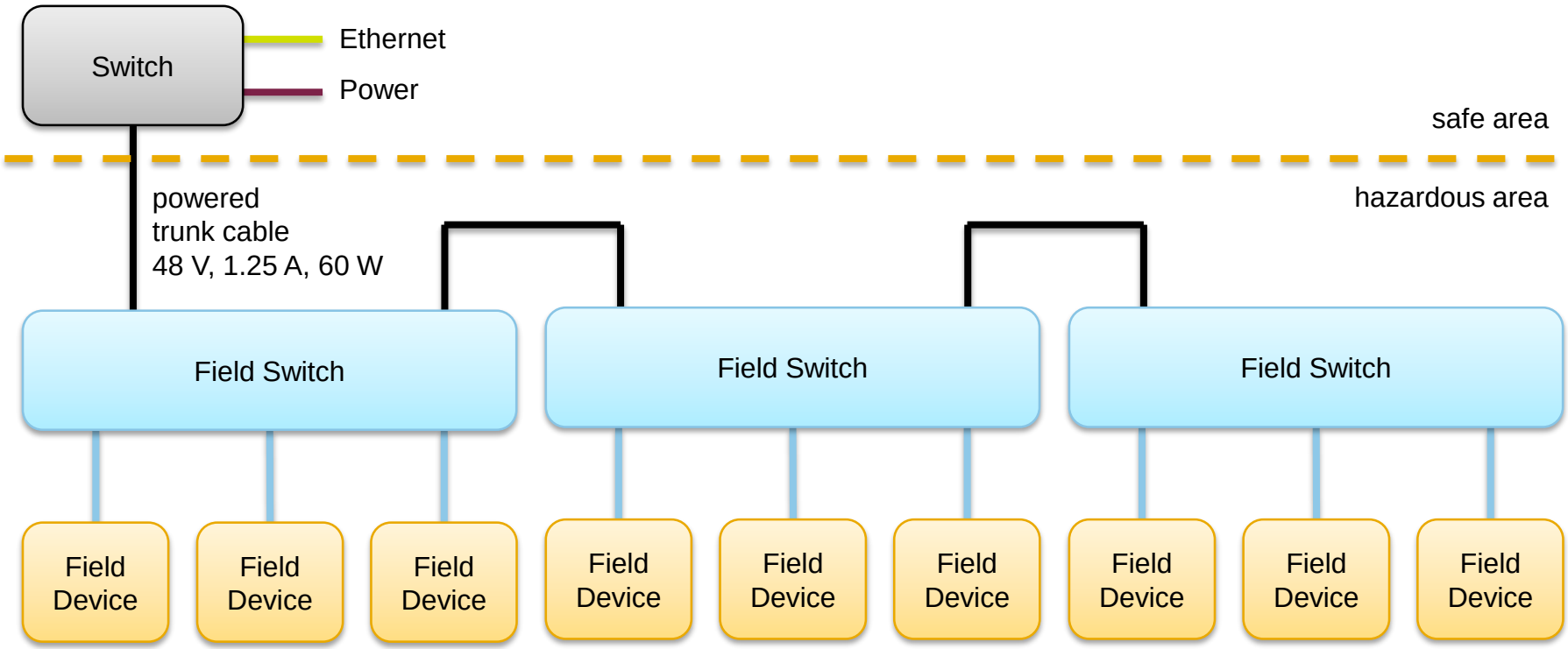


Comparison 10SPE and Fieldbus Powering

- Fieldbus power distribution is very similar to the suggested power distribution for 10SPE.
  - 48 V supply voltage for 10SPE compared to 32 V supply voltage for fieldbus installations.
  - 1.25 A supply current for 10 SPE compared to 0.5 A to 1 A supply current for fieldbus installations.
  - 60 W of supply power is also in a similar region compared to 32 W supply power for fieldbus installations.
  - Fieldbus devices typically have a constant current consumption, alternatively a constant power consumption is also defined.
  - Due to the integrated switch mode power supply, fieldbus couplers have a constant power consumption.
  - The current fieldbus standard (IEC61158-2) is implemented in the same way for Profibus PA as well as for Foundation Fieldbus and exists already for more than 20 years.
- Practically the only difference between a fieldbus trunk and a 10SPE trunk would be, that fieldbus uses a multi-drop bus structure and that 10SPE is intended to use a daisy chain topology.
- Using a daisy chain topology allows the implementation of point-to-point full duplex communication at the PHY level, without the need for implementing changes at the MAC layer as it would be necessary for a bus topology, which should be prevented.
- A daisy chain structure needs to be implemented in a way, that the energy losses within each node are minimized to improve the overall efficiency of the system.

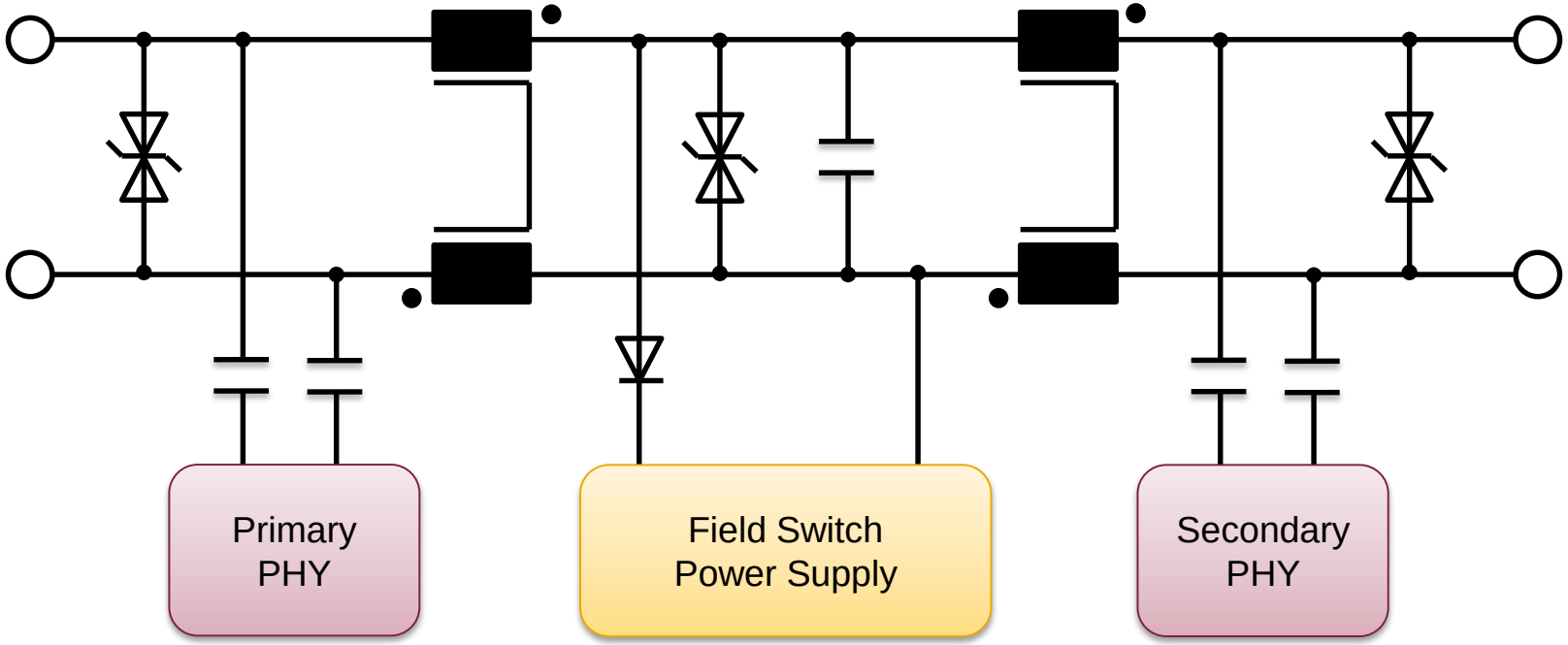
Daisy Chain Trunk Topology

- Depending on the overall available power and the power consumption for process automation applications several Field Switches need to be connected in a daisy chain topology.
- Total trunk cable length is up to 1000 m.
- Total supply power at the beginning of the trunk is about 60 W (48 V, 1.25 A).



Simplified Power Decoupling Circuit

- The following diagram shows a principle circuit allowing a daisy chain structure of the field switches with minimum power losses.
- The first inductor is used to decouple the power from the first trunk segment.
- The second inductor is used to create a new trunk segment.
- The capacitor in between the two inductors is used to block the communication signal.



Additional Remarks

- To reduce the overall power losses, the daisy chain path does not contain any reverse polarity protection or current limiting elements.
- All components have to be chosen, so that they can withstand the maximum positive or negative supply voltage, including the inductance voltage, which is clamped by the bipolar suppressor diodes.
- The field switch power supply needs to provide a slow start up with a maximum allowed ramp rate, also the capacitors on the primary and secondary side of the field switch power supply need to be charged slowly. This is important to reduce the overall disturbances on the powered trunk.
- In steady state operation the field switch and also the connected field devices must provide a constant current consumption or preferably a constant power consumption.
- As also valid for current fieldbus applications during the (de-)attachment of a field switch or a field device, the communication may shortly be interrupted.
- Nevertheless the interruption must be short enough, so that the upper layer protocols will be able to handle this situation without dropping a field devices‘ communication.
- After a disturbance of the signal of up to about 20 ms the PHY needs to be able to recover operation in less than about 50 ms.

Thank You