SIEMENS

SIMATIC NET

PROFIBUS Network Manual

System Manual

Edition 04/2009

C79000-G8976-C124-03

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Proper use of Siemens products

Note the following:

⚠WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be adhered to. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of the Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG
GERMANY

℗ 04/2009

Table of contents

1 PROFIBUS networks

1.1 Local area networks in manufacturing and process automation

1.1.1 General introduction

Communications systems

The performance of control systems is no longer simply determined by the programmable logic controllers, but also to a great extent by the environment in which they are located. Apart from plant visualization, operating and monitoring, this also means a highperformance communication system.

Distributed systems

Distributed automation systems are being used increasingly in manufacturing and process automation. This means that a complex control task is divided into smaller "handier" subtasks with distributed control systems. There are therefore exacting requirements for communication between the distributed systems. Such structures have, for example, the following advantages:

- Independent and simultaneous startup of individual sections of plant/system
- Smaller, clearer programs
- Parallel processing by distributed automation systems
  This results in the following:
  - Shorter reaction times
  - Reduced load on the individual processing units.
- Systemwide structures for handling additional diagnostic and logging functions
- Increased plant/system availability since the rest of the system can continue to operate if a substation fails.

A powerful and comprehensive communication system is indispensable to a distributed plant structure.

SIMATIC NET

With SIMATIC NET, Siemens provides an open, heterogeneous communication system with local area networks graded by performance for the various levels of manufacturing and process automation in an industrial environment. The SIMATIC NET communication systems are based on national and international standards according to the ISO/OSI reference model.

The basis of such communication systems is provided by local area networks (LANs) that can be implemented in one of the following ways depending on certain conditions:

- Electrically
- Optically
- Wireless
- Combined electrical/optical/wireless
- Electrically, intrinsically safe

1.1.2 Overview of the SIMATIC NET system

SIMATIC NET

SIMATIC NET is the name of the communication networks connecting SIEMENS programmable controllers, host computers, work stations and personal computers.

SIMATIC NET includes the following:

- The communication network consisting of the transmission medium, the corresponding connection and transmission components, and the corresponding transmission methods
- Protocols and services used to transfer data between the devices listed above
- The modules of the automation system or computer that provide the connection to the LAN (communications processors "CPs" or "interface modules").

To handle a variety of tasks in automation engineering, SIMATIC NET provides different communication networks to suit the particular situation.

The topology of rooms, buildings, factories, and complete company complexes and the prevalent environmental conditions mean different requirements. The networked automation components also make different demands on the communication system.

To meet these various requirements, SIMATIC NET provides the following communication networks complying with national and international standards:

1.1.3 Bus systems for industrial use

Overview

The following graphic shows the connection of the various automation systems to the standardized networks.

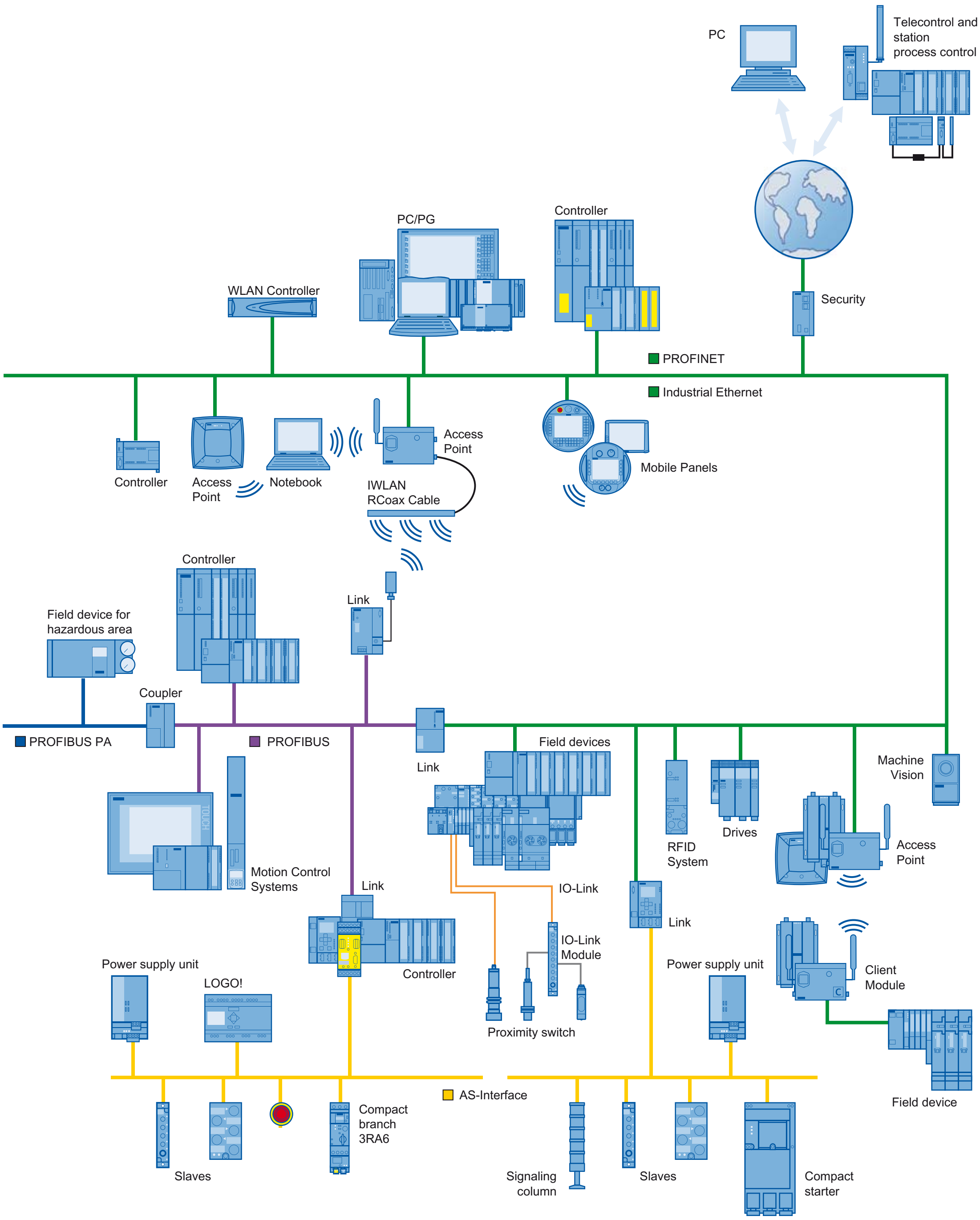


Figure 1-1 Industrial bus systems

Gateways are implemented via controllers or links.
Configuration and diagnostics can be performed from any point in the plant.

Standardization

PROFINET / Industrial Ethernet	
• Industrial Ethernet (IEEE 802.3) • PROFINET (IEC 61158/61784) • Industrial Wireless LAN (IEEE 802.11)	• Industrial standard based on the international Ethernet standard • Open Industrial Ethernet standard for automation • Industrial standard for wireless communication based on the international standard
PROFIBUS	
• PROFIBUS (IEC 61158/61784)	• International standard for the field area (market leader in fieldbuses worldwide)
AS-Interface (AS-i)	
• AS-Interface (IEC 62026-2/EN 50295)	• International standard that, as an economical alternative to the cable harness, links sensors and actuators over a two-wire cable
IO Link	
• IO Link	• Standard for intelligent interfacing of sensors and actuators to the control level using a cost-effective point-to-point link

Use of the communication systems

	Ind. Ethernet	PROFINET	PROFIBUS DP	AS-i	IO Link
Enterprise Resource Planning (ERP) (for example PC)	●	○	-	-	-
Control (for example SIMATIC S7-300)	●	●	●	●	-
Motion Control (for example SIMOTION)	○	●	●	○	-
Intelligent field devices (for example ET 200S/CPU)	-	●	●	○	●
Simple field devices (for example ET 200)	-	●	●	●	-
Sensor / actuator	-	●	●	●	●
Drives (for example SINAMICS)	○	●	●	-	-
SIRIUS motor starter	-	●	●	●	○
SINUMERIK	○	●	●	○	-
Safety-oriented communication	-	●	●	●	-

- not suitable
○ suitable
● well suited

Industrial Ethernet

Communications network for the LAN and cell area in with baseband transmission technology according to IEEE 802.3.

Characteristics:

- High transmission performance
  - Fast Ethernet (100 Mbps)
  - Gigabit Ethernet (1000 Mbps)
- Scalability and practically unlimited network spans with switching technology
- Three transmission technologies are available:
  - Electrical cable (twisted pair)
  - Fiber-optic cable
  - Wireless LAN
- Security modules protect from unauthorized access
- Industrial Ethernet provides expansions specifically for an industrial environment:
  - Network components and cabling technology suitable for industry
  - High availability due to redundancy functionality (for example ring redundancy) and redundant power supply

IWLAN

Industrial wireless communication stands for the industrial mobile communication products for wireless communication.

These are based on global wireless standards such as IEEE 802.11, GSM, GPRS or UMTS.

Industrial Wireless LAN (IWLAN) technology represents an extension to the IEEE 802.11 standard that is particularly suited to demanding industrial applications with real-time and redundancy requirements.

Characteristics:

- Operation in the frequency bands 2.4 and 5 GHz
- Support of most IEEE 802.11 standards
- High spatial flexibility: Communication independent of hard-wired cabling (for example no trailing cable is required with overhead monorails)
- Straightforward interfacing with cable Ethernet
- High availability
  - Due to device-related and application-related monitoring of the wireless connection
  - Due to numerous security technologies (for example RADIUS server, WEP, AES, TKIP)
- Suitability for industry with Industrial Wireless LAN (IWLAN)
  - Data reservation
  - "Rapid roaming" for extremely fast handover of mobile nodes between different wireless cells

PROFINET IO

PROFINET allows the integration of distributed field devices (IO devices, for example signal modules) directly in Industrial Ethernet. The user data is transferred by means of TCP/IP or IT standards. The simple engineering for PROFINET, field-proven with PROFIBUS, was adopted here.

By retaining the device model of PROFIBUS, the same diagnostics information is available on PROFINET.

From the viewpoint of programming with STEP 7, there is no difference between PROFIBUS and PROFINET when accessing a distributed field device.

PROFINET based on the network technology of Industrial Ethernet, however, provides enhancements that are extremely important for industrial applications and that are absent in Ethernet.

PROFIBUS

Communications network for the cell and field area complying with IEC 61158-2 / EN 61158-2 with the hybrid medium access technique token bus and master slave. Networking is on twisted-pair or fiberoptic cable.

Transmission media: PROFIBUS networks can be implemented with the following:

- Shielded, twisted-pair cables (characteristic impedance 150 Ω)
- Fiberoptic cables

The various communication networks can be used independently or, if required, can also be combined with each other.

PROFIBUS PA

PROFIBUS PA is the PROFIBUS for process automation (PA). It connects the PROFIBUS DP communications protocol using the MBP transmission technique in compliance with IEC 61158-2.

Transmission media: PROFIBUS PA networks can be created with intrinsic safety based on shielded, twisted-pair cables (with PROFIBUS PA).

AS-Interface (AS-i)

The actuator sensor interface (ASi) is a communications network for automation at the lowest level for connecting binary or analog actuators and sensors (also safety-oriented) to programmable logic controllers via the ASi bus cable.

Transmission media: The flat yellow cable typical for AS-i transfers the network communication and supplies the field devices with power.

IO Link

Communications standard below the fieldbus level. This allows central fault diagnostics and location as far as the sensor/actuator level and simplifies commissioning and maintenance by allowing parameter data to be modified dynamically, directly from within the automation system.

1.2 Basics of the PROFIBUS network

1.2.1 Attachable systems

IEC 61158-2 / EN 61158-2

SIMATIC NET PROFIBUS products and the networks created with them comply with the PROFIBUS standard IEC 61158-2 / EN 61158-2. The SIMATIC NET PROFIBUS components can also be used with SIMATIC S7 to create a SIMATIC MPI subnet (MPI = Multipoint Interface).

1.2.2 Standards

Standards for SIMATIC NET PROFIBUS

SIMATIC NET PROFIBUS is based on the following standards and directives:

- IEC 61158 2 to 6: 1993/2000 / EN 61158-2

  Digital data communications for measurement and control - fieldbus for use in industrial control systems
- EIA RS 485: 1983

  Standard for electrical characteristics of generators and receivers for use in balanced digital multipoint systems

Standards for SIMATIC NET PROFIBUS PA

SIMATIC NET PROFIBUS PA is based on the following standards and directives:

- IEC 61158 2: 1993

  Fieldbus standard for use in industrial control systems Part 2: Physical layer specification and service definition
- EN 61158 2: 1994

  Fieldbus standard for use in industrial control systems Part 2: Physical layer specification and service definition
- PTB Report W 53: 1993

  Investigations into intrinsic safety of fieldbus systems, March 1993
- PNO guideline: 1996

  PROFIBUS PA Installation Guideline (technical guidance for use of IEC 61158 2 with PROFIBUS, No. 2.091)

1.2.3 Access mechanism

TOKEN BUS/masterslave method

Network access on PROFIBUS corresponds to the method specified in IEC 61158-2 / EN 61158-2, "Token Bus" for active and "masterslave" for passive stations.

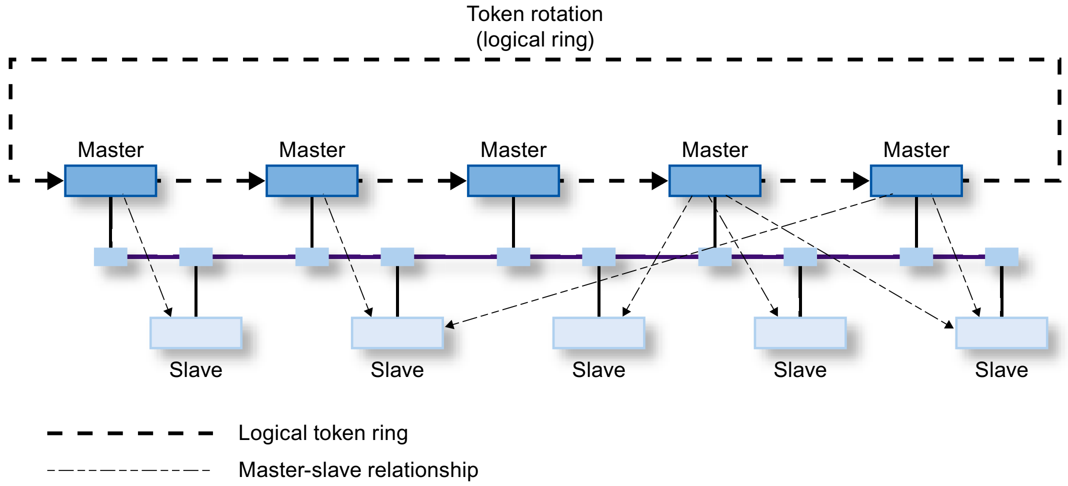


Figure 1-2 Principle of the PROFIBUS medium access technique

Active and Passive Nodes

This access procedure is independent of the transmission medium. Figure 1-1 "Principle of the PROFIBUS medium access technique" shows the hybrid technique with active and passive nodes. This is explained briefly below:

- All active nodes (masters) form the logical token ring in a fixed order and each active node knows the other active nodes and their order in the logical ring (the order does not depend on the topological arrangement of the active nodes on the bus).
- The right to access the medium, the "token", is passed from active node to active node in the order of the logical ring.
- If a node has received the token (addressed to it), it can send frames. The time in which it is allowed to send frames is specified by the token holding time. Once this has expired, the node is only allowed to send one high priority message. If the node does not have a message to send, it passes the token directly to the next node in the logical ring. The token timers from which the maximum token holding time is calculated are configured for all active nodes.
- If an active node has the token and if it has connections configured to passive nodes (masterslave connections), the passive nodes are polled (for example values read out) or data is sent to the slaves (for example setpoints).
- Passive nodes never receive the token.

This access technique allows nodes to enter or leave the ring during operation.

1.2.4 Protocols for PROFIBUS

Potential applications for PROFIBUS DP

PROFIBUS DP (distributed I/O) is used for controlling sensors and actuators using a central controller in production engineering. Here, particular emphasis is on the many standard diagnostics options. Other potential uses include the connection of "distributed intelligence", in other words the internetworking of several controllers (similar to PROFIBUS FMS). Data rates of up to 12 Mbps are possible on twisted-pair cables and/or fiber-optic cables.

Since there is no difference at layer 2 for PROFIBUS protocols, all protocols can be operated side-by-side in a PROFIBUS network.

Potential applications of PROFIBUS PA

PROFIBUS PA (process automation) is used for the control of measuring devices by a process control system in process engineering. This version of PROFIBUS is suitable for hazardous areas (Ex zones 0 and 1). Here, only a weak current flows through an intrinsically safe circuit in the bus cables, so that sparks capable of causing an explosion are not produced even if a fault occurs. The maximum data transmission rate is 31.25 kbps.

Position in the ISO-OSI reference model

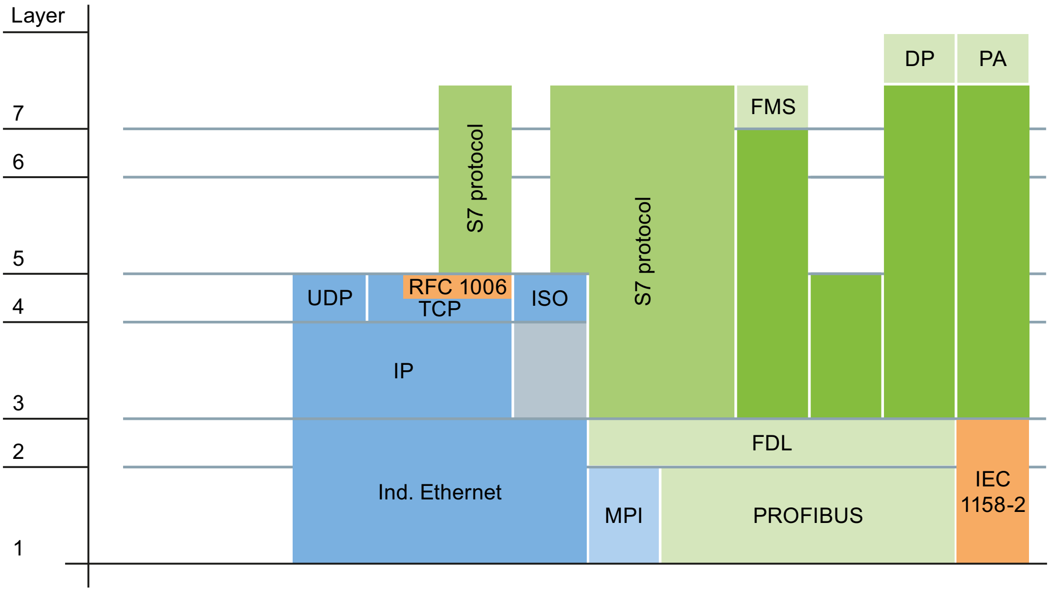


Figure 1-3 ISO-OSI reference model

Layer 2 in PROFIBUS is known as the FDL layer (Fieldbus Data Link).

Above layer 2, there is a specific interface that can be assigned to layer 4.

The other layers of the OSI reference model are not implemented.

The frame formats of PROFIBUS layer 2 allow considerable transmission reliability for FDL communication (Hamming distance HD=4). Frames in which errors are detected are repeated automatically.

DP protocol

At the field level, protocols for PROFIBUS with large numbers of services or complicated data processing are unsuitable because the required bus cycle time and reaction time cannot be achieved.

To be able to cover the field level within the automation hierarchy, PROFIBUS DP (distributed peripheral I/O) was developed. The essential characteristic of PROFIBUS DP is that the user data is represented in the form of a cyclic data image. Here, object-oriented interfaces as used in FMS or the S7 protocol are completely avoided. The principle of PROFIBUS DP communication is a master-slave system. A master polls one or more slaves cyclically.

Instead of the normal user interface, at layer 7 (ISO-OSI reference model) of the DP protocol, there is a user interface in the form of a standard application that along with the DDLM (Direct Data Link Mapper) interfaces directly with layer 2 (ISO-OSI reference model), in other words with FDL.

There are two types of DP masters:

- Class 1 master: Controls the process cyclically
- Class 2 master: Device parameter assignment and diagnostics

Benefits:

- Very fast communications protocol because very hardware oriented
- Can be used with third-party systems

FMS protocol

In the original form of the PROFIBUS specification, not only the FDL protocol but also the FMS protocol was specified. The aim of this protocol was to be able to include more complex hierarchical systems alongside the field devices.

To achieve this, part of the MMS (Manufacturing Message Specification) that originated from the MAP communications model was met in addition to field device interfacing. The complete model resulted in the Fieldbus Message Specification (FMS).

Within PROFIBUS, levels 3 to 6 are not implemented. The user layer is layer 2; for layer 7, the Lower Layer Interface (LLI) was developed for the FMS protocol. Functions of the non-existent layers such as connection establishment and termination and connection monitoring are implemented in this LLI for the FMS protocol.

The FMS protocol is object-oriented. All transferred data is transferred in the form of non-proprietary, standardized communications objects. Each object is accessed via its index or name.

Benefits:

- Acknowledged data transfer
- Can be used flexibly with third-party systems
- Access to individual variables or structure elements is possible
- Linking to slaves and masters possible

S7 protocol

All SIMATIC S7 and C7 controllers have integrated S7 communication services that allow the user program to read or write data. The S7-400 controllers use SFBs, the S7-300 or C7 controllers use FBs. These functions are available regardless of the bus system used, so that you can use S7 communication via Industrial Ethernet, PROFIBUS or MPI.

Benefits:

The S7 protocol is supported by all available S7 controllers and communications processors. PC systems with suitable hardware and software also support communication with the S7 protocol.

- Not dependent on the bus medium (PROFIBUS, Industrial Ethernet (ISO-on-TCP), MPI)
- Can be used with all S7 data areas
- Transfer of up to 64 kbytes in one job
- Layer 7 protocol handles acknowledgment of data records automatically
- Low processor and bus load when transferring larger amounts of data because it is optimized for SIMATIC communication

1.2.5 Transmission mode

1.2.5.1 Physical transmission techniques

Physical transmission techniques

The physical transmission techniques used depend on the SIMATIC NET PROFIBUS transmission medium:

- RS485 for electrical networks on shielded, twisted-pair cables
- Optical techniques according to IEC 61158-2 Section 23 on fiber-optic cables
- MBT transmission technique complying with IEC 61158-2 for intrinsically safe and non-intrinsically safe electrical networks in process control (PROFIBUS PA) based on shielded, twisted-pair cables.

1.2.5.2 Transmission techniques according to EIA standard RS485

EIA standard RS-485

The RS485 transmission technique corresponds to balanced data transmission as specified in the EIA standard RS485 (Page 337). This transmission technique is mandatory in IEC 61158-2 / EN 61158-2 for data transmission on twisted-pair cables.

The medium is a shielded, twisted pair cable.

The bus cable is terminated at both ends with the characteristic impedance. Such a bus cable terminated at both ends is known as a segment.

The attachment of the node to the bus is via a bus terminal with a spur line or a bus connector (maximum 32 nodes per segment). The individual segments are connected via repeaters.

The maximum length of a segment depends on the following:

- The transmission speed
- The type of cable being used

Benefits:

- Flexible bus or tree structure with repeaters, bus terminals, and bus connectors for attaching PROFIBUS nodes
- Purely passive forwarding of signals allows nodes to be deactivated without affecting the network (except for the nodes that supply power to the terminating resistors)
- Simple installation of the bus cable without specialized experience.

Restrictions:

- Distance covered reduces as the transmission rate increases
- Requires additional lightning protection measures when installed outdoors

Properties of the RS485 transmission technique

The RS485 transmission technique in PROFIBUS has the following physical characteristics:

Physical characteristics of the RS485 transmission technique

Network topology:	Bus, tree structure with the use of repeaters
Medium:	Shielded, twisted-pair cable
Achievable segment lengths: (depending on the cable type see Segments for transmission speeds up to a maximum of 500 kbps (Page 42))	1,000 m For transmission speeds up to 187.5 kbps 400 m For transmission speed up to 500 kbps 200 m For a transmission speed of 1.5 Mbps 100 m For transmission speeds 3, 6 and 12 Mbps
Number of repeaters connected in series:	Max. 9
Number of nodes:	Maximum 32 on one bus segment Maximum 127 per network when using repeaters
Transmission rates:	9.6 kbps, 19.2 kbps, 45.45 kbps, 93.75 kbps, 187.5 kbps, 500 kbps, 1.5 Mbps, 3 Mbps, 6 Mbps, 12 Mbps

Note

The properties listed in the table above assume a bus cable of type A and a bus terminator according to the PROFIBUS standard IEC 61158-2 / EN 61158-2. The SIMATIC NET PROFIBUS cables and bus connectors meet this specification. If reductions in the segment length are necessary when using special versions of the bus cable with increased loop resistance, this is pointed out in the sections on "Configuration" and "SIMATIC NET PROFIBUS cables".

1.2.5.3 Transmission techniques for optical components

The IEC 61158-2 / EN 61158-2 guideline

The optical transmission technique complies with IEC 61158-2 / EN 61158-2.

Integrated optical interfaces, OBT, OLM

The optical version of SIMATIC NET PROFIBUS is implemented with integrated, optical ports, optical bus terminals (OBT) and optical link modules (OLM).

Duplex fiberoptic cables are used as the medium made of glass, PCF or plastic fibers. Duplex fiberoptic cables consist of 2 conducting fibers surrounded by a common jacket to form a cable.

Modules with integrated optical ports and optical bus terminals (OBTs) can be interconnected to form optical networks only with a bus structure.

Using OLMs, optical networks can be installed using a bus, star and ring structure. The ring structure provides a redundant signal transmission path and represents the basis for networks with high availability.

Benefits:

- Regardless of the transmission rate, large distances can be covered between two end devices (connections between OLM and OLM up to 15,000 m)
- Electrical isolation between nodes and transmission medium
- When plant components at different ground potential are connected, there are no shield currents
- No electromagnetic interference
- No additional lightning protection elements are required
- Simple laying of fiberoptic cables
- High availability of the LAN due to the use of a ring topology
- Extremely simple attachment technique using plastic fiberoptic cables over shorter distances

Restrictions:

- Frame throughput times are increased compared with an electrical network
- The assembly of glass fiberoptic cables with connectors requires specialist experience and tools
- The absence of a power supply at the signal coupling points (node attachments, OLMs, OBTs) stops the signal flow

Characteristics of the optical transmission technique

The optical transmission technique has the following characteristics:

Network topology:	Bus structure with integrated optical ports and OBT; bus, star or ring structure with OLMs
Medium:	Fiberoptic cables with glass, PCF or plastic fibers
Maximum link length: (point-to-point)	With glass fibers up to 15,000 m dependent on the fiber and OLM type With plastic fibers: OLM: 0 m to 80 m OBT: 1 m to 50 m
Transmission speed:	9.6 kbps, 19.2 kbps, 45.45 kbps, 93.75 kbps, 187.5 kbps, 500 kbps, 1.5 Mbps, 3 Mbps*, 6 Mbps*, 12 Mbps
Number of nodes:	Maximum of 127 per network (126 with ring structure with OLMs)

* not with integrated optical ports and OBT

Note

The optical ports of the OLMs are optimized for greater distances. The direct coupling of the optical ports of an OLM with an OBT or integrated optical ports is not possible due to differences in the technical specifications.

1.2.5.4 Transmission techniques for PROFIBUS PA

IEC 611582 standard

The transmission technique corresponds to the MBP transmission technique complying with the IEC 611582 standard (identical to EN 611582).

The transmission medium is a shielded, twisted pair cable. The signal is transmitted Manchester-coded at 31.25 kbps. In general, the data line is normally also used to supply power to the field devices.

Benefits:

- Simple cabling with twisted pair
- Remote power supply via the signal cores

- Intrinsically safe operation possible (for hazardous areas)
- Bus and tree topology
- Up to 31 field devices (+ master) per line segment

Restrictions:

- Transmission speed: 31.25 kbps

Properties of the MBP transmission technique according to IEC 61158-2

The main characteristics of the MBP transmission technique according to IEC 61158-2 are as follows:

Network topology:	Bus, star and tree topology
Medium:	Shielded, twisted pair cable
Achievable segment lengths:	1900 m
Transmission speed:	31.25 kbps
Number of field devices per PA segment:	Max. 31

Topologies of SIMATIC NET PROFIBUS networks 2

2.1 Topologies of RS485 networks

2.1.1 Overview

Transmission speed

When operating SIMATIC NET PROFIBUS in the RS485 transmission technique, the user can select one of the transmission rates below:

9.6 kbps, 19.2 kbps, 45.45 kbps, 93.75 kbps, 187.5 kbps, 500 kbps,

1.5 Mbps, 3 Mbps, 6 Mbps or 12 Mbps

Depending on the transmission rate, transmission medium, and network components different segment lengths and therefore different network spans can be implemented.

The bus attachment components can be divided into two groups:

- Components for transmission rates from 9.6 kbps to a maximum of 1.5 Mbps
- Components for transmission rates from 9.6 kbps to a maximum of 12 Mbps

Bus cable

The transmission media used are the SIMATIC NET PROFIBUS cables described in Chapter 4. The technical information below applies only to networks implemented with these cables and SIMATIC NET PROFIBUS components.

Node attachment

The nodes are attached to the bus cables via bus connectors, bus terminals or RS485 repeaters.

Terminator

Each bus segment must be terminated at both ends with its characteristic impedance. This cable terminator is integrated in the RS485 repeaters, the bus terminals and the bus connectors and can be activated if required.

This line terminator can only be effective if the relevant connection element is supplied with power. With the bus terminals and the bus connectors, this power is supplied by the connected end device, whereas the RS485 repeater and the terminator have their own power supply.

The RS485 transmission technique allows the attachment of a maximum of 32 devices (end devices and repeaters) per bus segment. The maximum permitted cable length of a segment depends on the transmission rate and the bus cable used.

Connecting segments using RS485 repeaters

By using RS485 repeaters, segments can be interconnected. The RS485 repeater amplifies the data signals on the bus cables. You require an RS485 repeater when you want to attach more than 32 nodes to a network or when the permitted segment length is exceeded. A maximum of 9 repeaters can be used between any two nodes. Both bus and tree structures can be implemented.

The following figure shows a typical topology using RS485 technology with 3 segments and 2 repeaters.

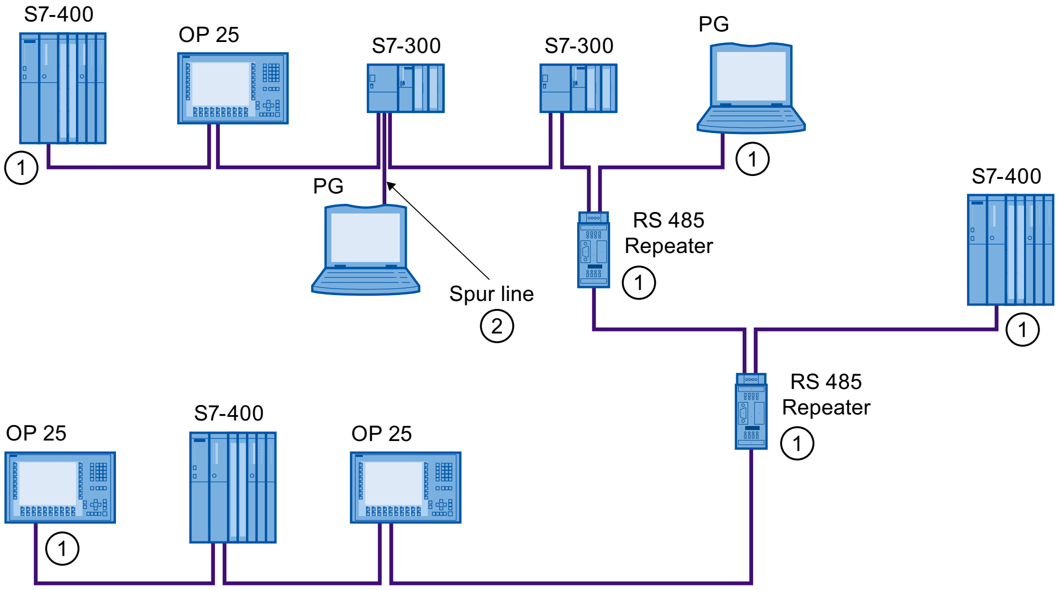


Figure 2-1 Topology with RS-485 technology
① Terminating resistor activated
② PG connected for maintenance via spur line (6ES7 901-4BD00-0XA0)

Increasing the overall span of a network by using repeaters can lead to longer transmission times that may need to be taken into account when configuring the network (Page 41).

2.1.2 Components for transmission speeds up to 1.5 Mbps

All SIMATIC NET bus attachment components can be used for transmission speeds up to 1.5 Mbps.

2.1.3 Components for transmission speeds up to 12 Mbps

The following bus attachment components can be used for transmission speeds up to 12 Mbps:

Table 2- 1 Bus attachment components for transmission speeds up to 12 Mbps

	Order no.
PROFIBUS bus connector with axial cable outlet	6GK1 500-0EA02
PROFIBUS FastConnect bus connector RS-485 Plug 180 with 180° cable outlet	6GK1 500-0FC10
RS-485 bus connector with vertical cable outlet • Without PG interface • With PG interface	 6ES7 972-0BA12-0XA0 6ES7 972-0BB12-0XA0
PROFIBUS FastConnect bus connector RS-485 with 90° cable outlet and cable piercing technique Max. transmission speed 12 Mbps • Without PG interface • With PG interface	 6ES7 972-0BA51-0XA0 6ES7 972-0BB51-0XA0
PROFIBUS FastConnect bus connector 180° cable outlet, insulation piercing technique Max. transmission speed 12 Mbps • Without PG interface • With PG interface	 6ES7 972-0BA60-0XA0 6ES7 972-0BB60-0XA0
RS-485 bus connector with 35° cable outlet • Without PG interface • With PG interface	 6ES7 972-0BA41-0XA0 6ES7 972-0BB41-0XA0
SIMATIC NET 830 1T connecting cable, preassembled, fitted with terminating resistors, as link between electrical interface of an OLM or OBT and the PROFIBUS interface of a PROFIBUS node. • 1.5 m • 3 m	 6XV1 830-1CH15 6XV1 830-1CH30
SIMATIC NET 8302 connecting cable for PROFIBUS, preassembled cable with two D-sub, 9pin male connectors, terminating resistors can be activated. • 3 m • 5 m • 10 m	 6XV1 830-2AH30 6XV1 830-2AH50 6XV1 830-2AN10
SIMATIC S5/S7 PROFIBUS connecting cable for connecting programming devices up to 12 Mbps preassembled with 2 D-sub 9-pin connectors, length 3 m	6ES7 901-4BD00-0XA0
RS485 repeater for PROFIBUS up to 12 Mbps, 24 V DC, casing to IP20	6ES7 972-0AA01-0XA0
PROFIBUS bus terminal 12M	6GK1 500-0AA10
Optical Link Module OLM Vx	6GK1 50x xCx00
Optical Bus Terminal OBT	6GK1 500-3AA0
Active RS-485 PROFIBUS terminator	6ES7 972-0DA00-0AA0

2.2 Topologies of optical networks

2.2.1 Electrical - optical gateway

Electrical/optical conversion

If you want to cover larger distances with the fieldbus regardless of the transmission rate or if the data traffic on the bus is threatened by extreme levels of external noise, you should use fiberoptic cables instead of copper cable.

To interface electrical cables with fiberoptic cables, you have the following possibilities:

- PROFIBUS nodes with a PROFIBUS-DP interface (RS-485) are connected to the optical network via an Optical Bus Terminal (OBT) or via an Optical Link Module (OLM).
- PROFIBUS nodes with an integrated fiber-optic cable interface (for example the ET 200M (IM 153-2 FO), S7-400 (IM 467 FO)) can be directly integrated in an optical network with a bus topology.
- Optical networks with a larger network span or structured as redundant rings should be implemented using OLMs.

The structure of optical networks using optical link modules (OLMs) is described in detail in later chapters in this manual.

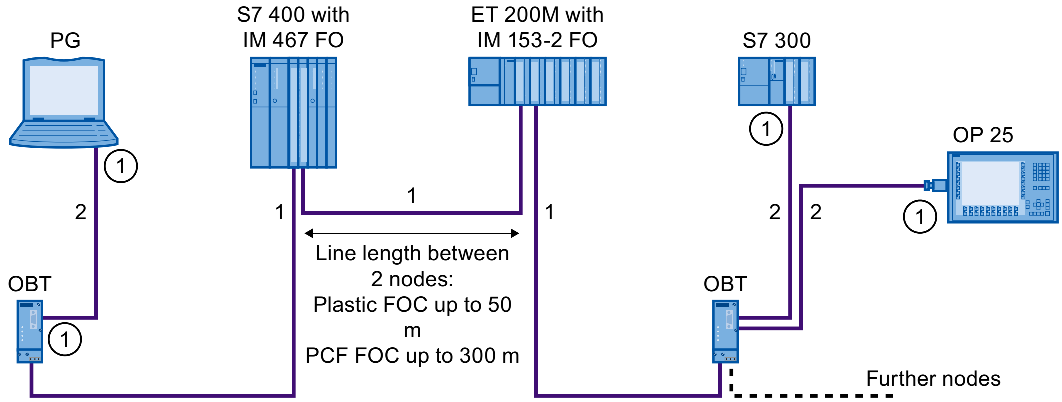
For information about the structure of an optical PROFIBUS network with PROFIBUS nodes having an integrated FO interface, refer also to the manual Distributed I/O System ET 200" (http://support.automation.siemens.com/WW/view/en/114247).

2.2.2 Topology with integrated optical interfaces

Bus topology

The optical PROFIBUS network with nodes that have an integrated fiber-optic cable interface has a linear (bus) topology. The PROFIBUS nodes are interconnected in pairs over duplex fiber-optic cables.

Up to 32 PROFIBUS nodes with integrated FO interfaces can be connected in series in an optical PROFIBUS network. If a PROFIBUS node fails, the linear topology means that none of the downstream DP slaves can be accessed by the DP master.



① Terminating resistor activated

1 Fiber-optic cables

2 PROFIBUS bus cable

Figure 2-2 PROFIBUS DP network - nodes with integrated FO interfaces

For short distances, the preassembled 8301T or 8302 connecting cables can be used as an alternative to the PROFIBUS cable.

Transmission speed

An optical PROFIBUS network with a bus topology can be operated at the following transmission speeds:

9.6 kbps, 19.2 kbps, 45.45 kbps, 93.75 kbps, 187.5 kbps, 500 kbps, 1.5 Mbps and 12 Mbps

PROFIBUS Optical Bus Terminal (OBT)

Using a PROFIBUS optical bus terminal (OBT), an individual PROFIBUS node without an integrated FO port or a PROFIBUS RS485 segment can be attached to the optical PROFIBUS network (see Figure 2-2).

The attachment is made to the RS485 interface of the OBT using a PROFIBUS cable or a preassembled connecting cable. The OBT is included in the optical PROFIBUS bus via the FO interface.

2.2.3 Topologies with OLMs

OLMs

The OLMs have a floating electrical channel (similar to the channels on a repeater) and depending on the version, they have one or two optical channels.

The OLMs are suitable for transmission rates of 9.6 kbps to 12 Mbps. The transmission rate is detected automatically.

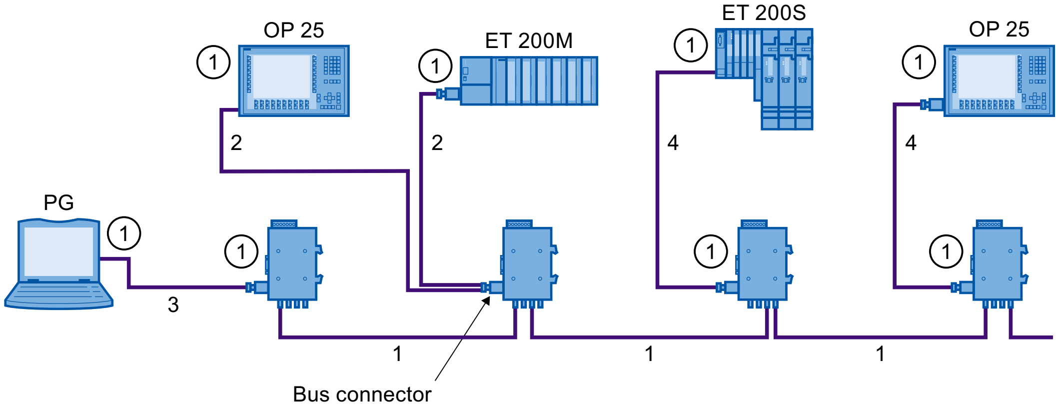
Linear bus topologies

Figure 2-3 shows a typical example of a bus topology

In a bus structure, the individual SIMATIC NET PROFIBUS OLMs are connected together in pairs by duplex fiberoptic cables.

At the start and end of a bus, OLMs with one optical channel are adequate, in between, OLMs with two optical channels are required.

The end devices are attached to the electrical interfaces of the OLMs. Either an individual end device or a complete PROFIBUS segment with a maximum of 31 nodes can be connected to the RS485 interface.

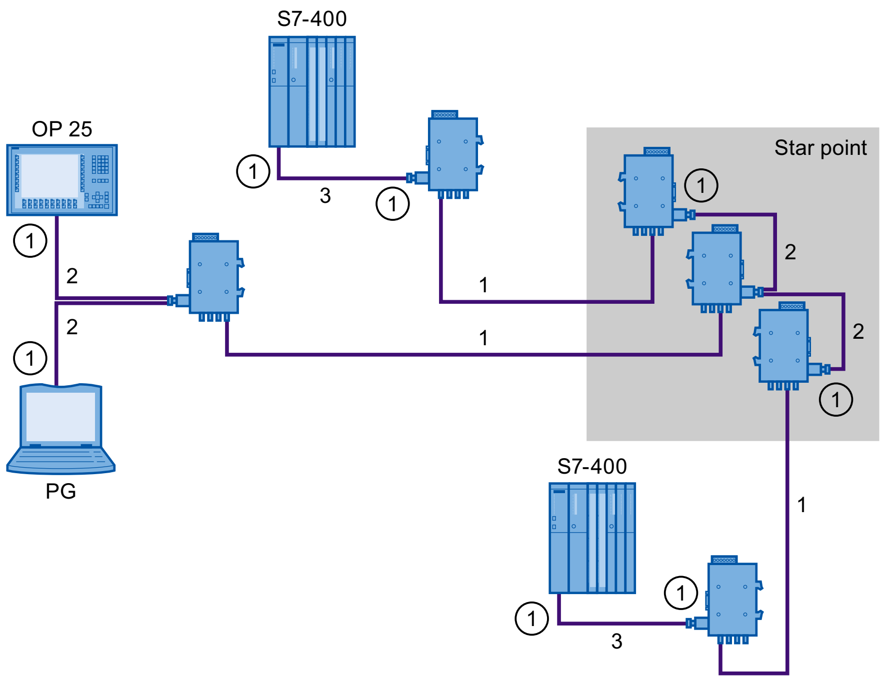


①	Terminating resistor activated
1	Fiber-optic cables
2	PROFIBUS bus cable
3	PROFIBUS connecting cable 830-1T
4	PROFIBUS connecting cable 830-2

Figure 2-3 Example of a bus topology with OLMs

Star topologies with OLMs

Several optical link modules are grouped together to form a star coupler via a bus connection of the RS485 interfaces. This RS485 connection allows the attachment of further end devices until the maximum permitted number of 32 bus attachments per segment is reached.



① Terminating resistor activated
1 Fiber-optic cables
2 PROFIBUS bus cable
3 PROFIBUS connecting cable 830-2

Figure 2-4 Example of a star topology with OLMs

Optical channels

The OLMs are connected to the star coupler by duplex fiberoptic cables.

Both end devices and electrical bus segments can be connected to the OLMs attached by the duplex fiberoptic cables. Depending on the requirements and the distance, the duplex cables can be implemented with plastic, PCF or glass (OLM only) fibers.

Monitoring FO links

Using the echo function, the connected OLMs can monitor the fiberoptic sections. A break on a link is indicated by a display LED and by the signaling contact responding.

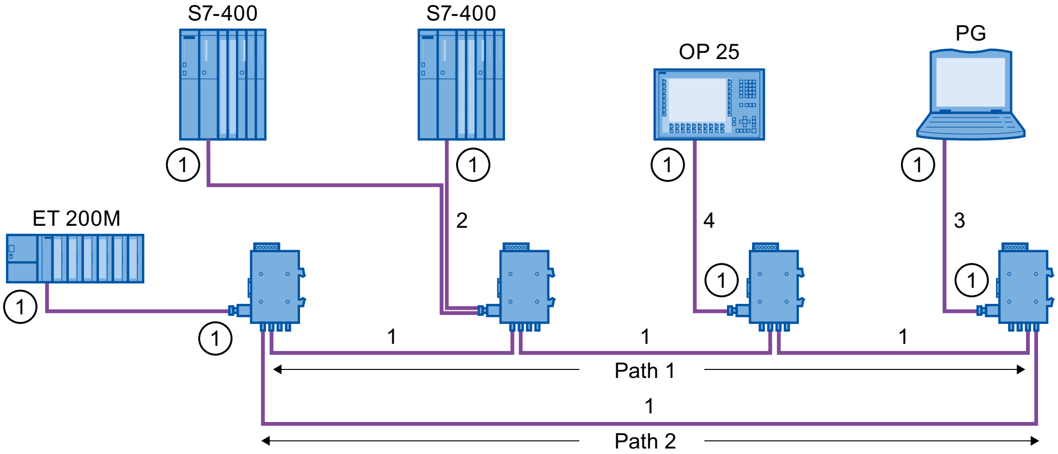
Even if only one transmission direction is lost, the segmentation triggered by the monitoring function leads to safe disconnection of the OLM from the star coupler. The remaining network can continue to work without problems.

Mixed structure

The star coupler can be made up with combinations of OLM/P, OLM/G and OLM/G1300 modules and at the RS485 end with all types.

Redundant Optical Rings using OLMs

Redundant optical rings are a special form of bus topology. By closing the optical bus to form a ring, a high degree of operational reliability is achieved.



① Terminating resistor activated
1 Fiber-optic cables
2 PROFIBUS bus cable
3 PROFIBUS connecting cable 830-1T
4 PROFIBUS connecting cable 830-2

Figure 2-5 Network structure in a redundant, optical, twofiber ring topology

A break on a fiberoptic cable between two modules is detected by the modules and the network is reconfigured to form an optical bus. The entire network remains operational.

If a module fails, only the end devices or electrical segments attached to the module are separated from the ring; the remaining network remains operational as a bus.

The problem is indicated by LEDs on the modules involved and by their signaling contacts.

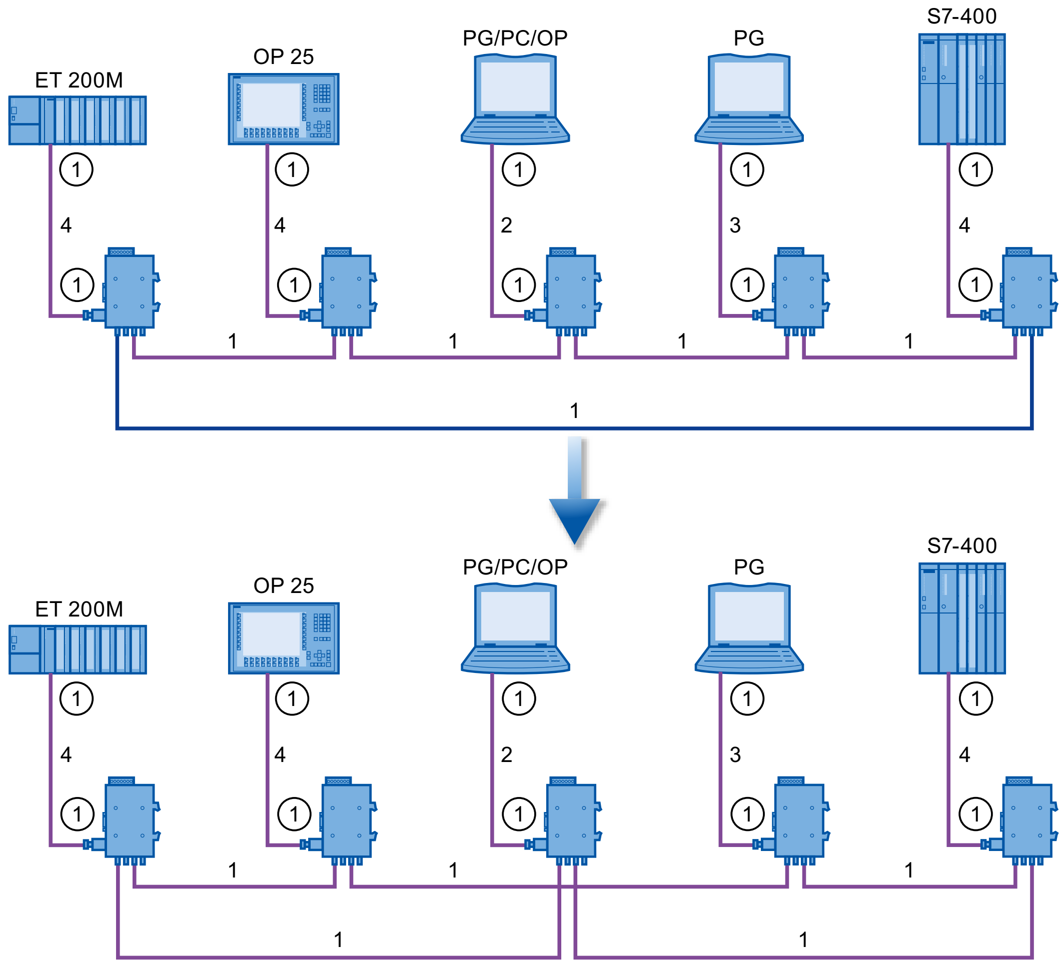
After the problem is eliminated, the modules involved cancel the segmentation automatically. and the bus is once again closed to form a ring.

Note

To increase the availability, the duplex cables for the outgoing and incoming paths in the ring should be laid separately.

Alternative cabling strategy

If the distance between two OLMs turns out to be too long, a structure as shown in the figure below can be implemented.



① Terminating resistor activated
1 Fiber-optic cables
2 PROFIBUS bus cable
3 PROFIBUS connecting cable 830-1T
4 PROFIBUS connecting cable 830-2

Figure 2-6 Alternative cabling of a network structure in an optical twofiber ring topology

2.2.4 Combination of integrated optical interfaces and OLMs

Options for combinations with OLM

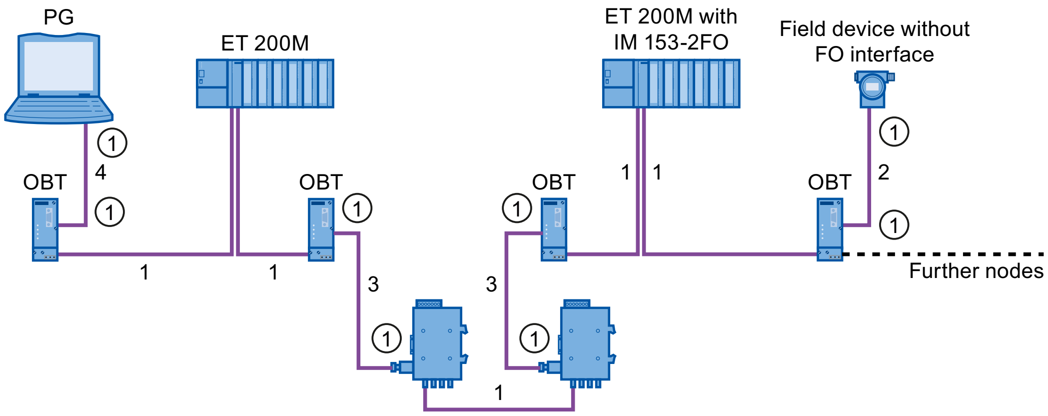
Note

You will find information on combinations with OLMs in the operating manual of the OLM on the Internet (http://support.automation.siemens.com/WW/view/en/24164176).

Attaching glass FO cables to buses made up of integrated optical interfaces

The operating wavelength of the integrated optical interfaces and the OBT is optimized for the use of plastic or PCF fibers. The direct attachment of glass FO cables is not possible.

If a link with glass FO cable is required, for example to span distances of more than 300 m, this link must be implemented with OLMs. The attachment of glass links to the optical bus made up of integrated optical interfaces is via the RS485 interface of an OBT. The following schematic shows an example of an application.



① Terminating resistor activated
1 Fiber-optic cables
2 PROFIBUS bus cable
3 PROFIBUS connecting cable 830-1T
4 PROFIBUS connecting cable 830-2

Figure 2-7 Attachment of an optical glass link to an optical bus made up of integrated optical interfaces

2.3 Topologies of wireless networks

Overview

Siemens supports communication with a whole family of networks. The various networks meet the widest possible range of performance and application requirements.

They can exchange data at various levels, between various parts of a plant or between various automation stations. Since PROFIBUS itself does not provide any wireless transmission technology, Industrial Wireless Communication with SCALANCE W in conjunction with the IWLAN/PB Link PN IO takes on a special importance.

Industrial wireless communication stands for the industrial mobile communication products for wireless communication. These are based on global wireless standards such as IEEE 802.11, GSM, GPRS or UMTS.

The wireless components are equipped with uniform system interfaces and are designed for perfect interaction with each other. Supplementing the conventional wired solutions, wireless communication is making greater inroads into industry. Siemens offers products for data transmission over local networks, intranet, Internet or wireless networks.

SCALANCE W

The products of SCALANCE W offer the unique combination of reliability, ruggedness and security in one product:

- For implementation at industrial and automation customer sites
- For outdoor environments with demanding climatic requirements
- For low-cost integration in the control cabinet or in devices

The Industrial Wireless LAN (IWLAN) technology provides an extension to the IEEE 802.11 standard that is particularly suited to demanding industrial applications with real-time and redundancy requirements.

For the first time customers have a single wireless network both for data critical to the process, for example alarm signaling, (IWLAN) as well as for non-critical communication (WLAN), for example for service and diagnostics. Some of the main features of SCALANCE W products are the reliability of the wireless channel and their rugged design with high standards of mechanical durability for which SIMATIC is known. To protect against unauthorized access, the products provide modern standard mechanisms for user identification (authentication) and encryption of data, but can also be easily integrated into existing security concepts.

Wireless integration of PROFIBUS lines

An existing Ethernet network can be expanded by a mobile network without increased overheads.

An existing PROFIBUS network can, for example, be connected using an access point and the IWLAN/PB Link PN IO (see schematic below).

The wireless connection is established to the mobile stations by connecting a SCALANCE W access point to the Ethernet network. The mobile stations are connected over wireless with a client module, for example the SCALANCE W746-1PRO client module to which the mobile station is connected by a cable.

Access to the existing controllers or processes is possible without additional wiring.

Use of a wireless link and the roaming function means that operators can move freely within the range of the Industrial Wireless LAN network and monitor the process from different locations.

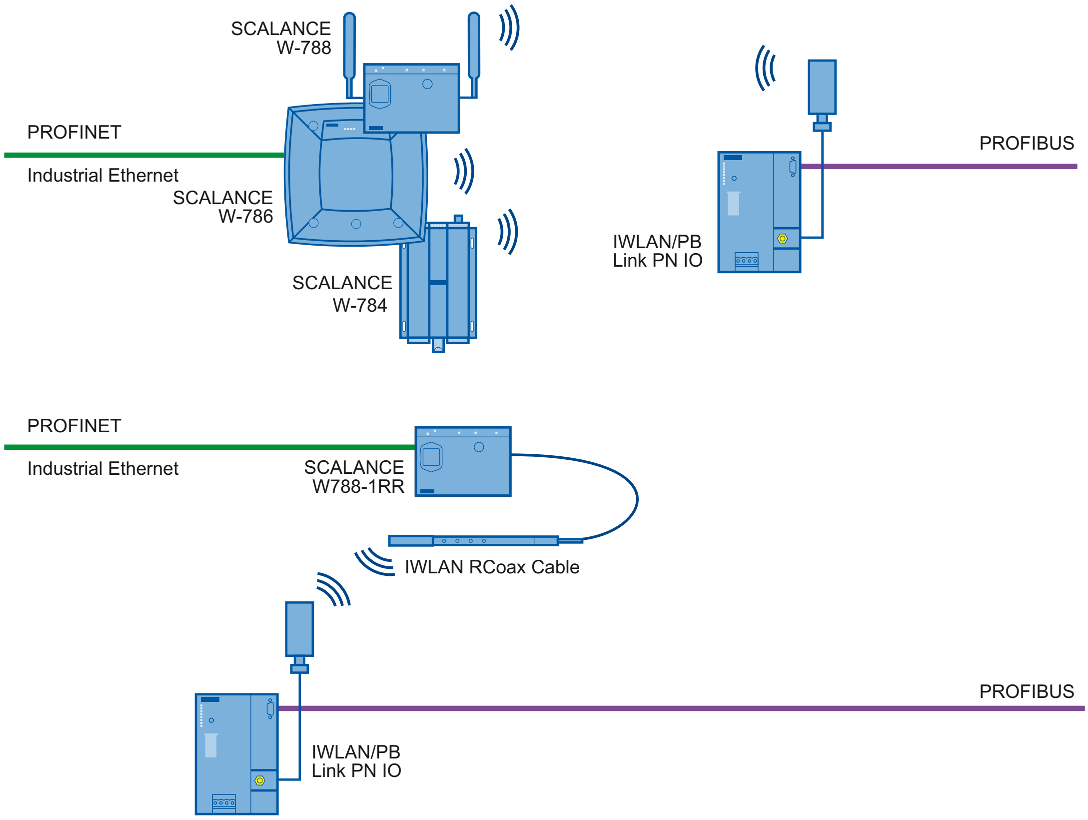


Figure 2-8 Topologies of wireless networks with PROFIBUS

2.4 Topologies with PROFIBUS PA

Bus and star topology

The topology of PROFIBUS PA may be in linear or stellar form.

SpliTConnect system

The SpliTConnect tap (T tap) allows a bus segment to be set up with end device connection points. The SpliTConnect tap can also be cascaded with the SpliTConnect coupler to form connection distributors. Using the SpliTConnect terminator, the tap can be expanded to form the segment terminator.

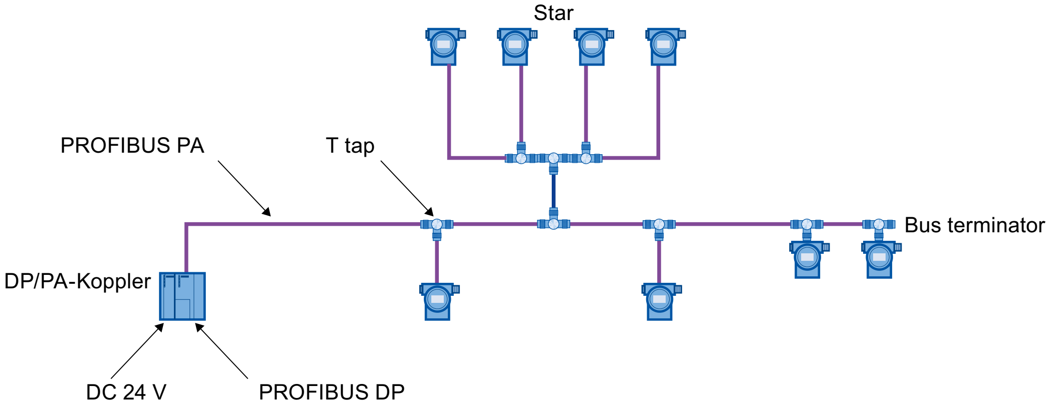


Figure 2-9 Bus and star topology

Field distributors AFD/AFS

For more information on expanding the PA line, refer to section "Field distributors AFD/AFS (Page 97)"

Field device supply via PROFIBUS PA

When using the DP/PA bus coupler, the power for the field devices is supplied via the data line of PROFIBUS PA.

Design

The total current of all the field devices must not exceed the maximum current of the DP/PA coupler. The maximum output power therefore limits the number of field devices that can be connected to PROFIBUS PA.

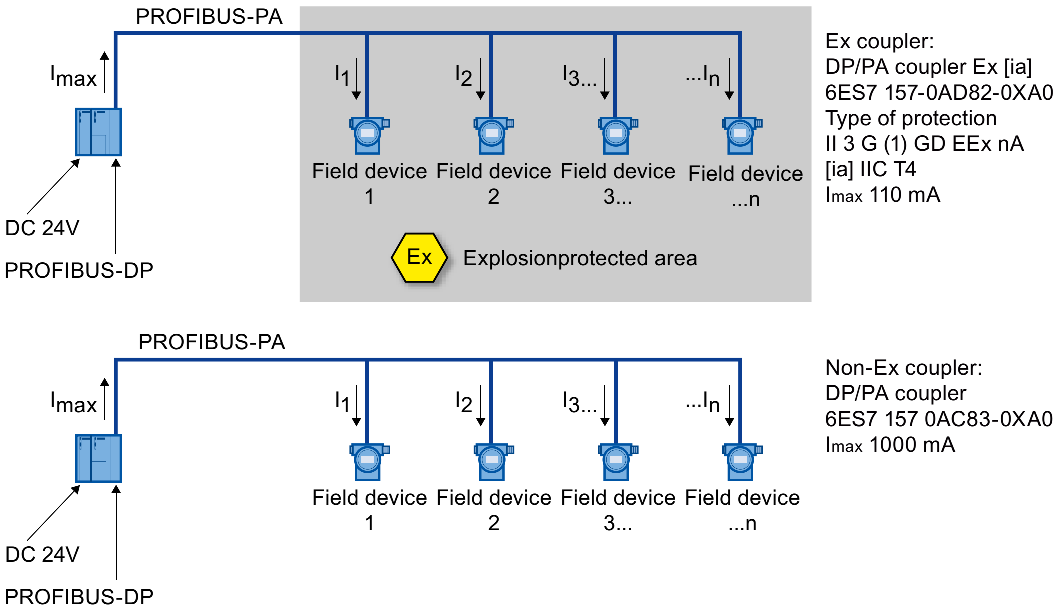


Figure 2-10 Remote power supply for field devices in the hazardous and nonhazardous area

Expansion

If the maximum output current of the DP/PA coupler is exceeded, you will need to include a further DP/PA coupler.

Total cable length

The total cable length is the sum of the main cable and all the spur lines.

With a standard PROFIBUS PA cable with a cross-section of 0.8 mm², the maximum length of the cable in total is

- 470 m (with the full configuration at the cable end) up to 1900 m for DP/PA coupler (6ES7 157-0AC83-0XA0)
- 920 m to 1000 m for DP/PA coupler Ex [ia] (6ES7 157-0AD82-0XA0)

Spur line

The maximum permitted length for spur lines can be found in the table below. You should also remember the maximum length of the total cable (see above).

Number of spur lines	Maximum length of the spur line	
	DP/PA coupler	DP/PA coupler Ex [ia]
1 to 12	Max. 120 m	Max. 30 m
13 to 14	Max. 90 m	Max. 30 m
15 to 18	Max. 60 m	Max. 30 m
19 to 24	Max. 30 m	Max. 30 m
25 to 32	< 1 m	< 1 m

3 Network configuration

3.1 Configuring electrical networks

3.1.1 Overview

PROFIBUS networks

PROFIBUS networks were specially designed for use in an industrial environment and one of their main features is their degree of immunity to electromagnetic interference resulting in high data integrity. To achieve this degree of immunity, certain guidelines must be adhered to when configuring electrical networks.

Parameter

The following parameters must be taken into account when planning an electrical network:

- The transmission speed required for the task (within a network, only one uniform transmission speed can be used)
- The required number of nodes
- The type of network components required (bus terminals, bus connectors, connecting cables)
- The bus cables to be used
- The required segment lengths
- The electromagnetic and mechanical environment of the cabling (for example surge voltage protection, cable trays)
- The number of RS485 repeaters between any two end devices is limited to a maximum of 9
- Increasing the overall span of a network by using several repeaters can lead to longer transmission times that may need to be taken into account when configuring the network, see section Frame transmission time (Page 58).

Terminator

All segments must be terminated at both ends regardless of the transmission speed. For this purpose, the cable terminator made up of a combination of resistors must be activated in the relevant connection elements. There must be no further cable sections after an activated terminator.

For a cable terminator to work it must be supplied with power. This means that the relevant end device or RS-485 repeater must be supplied with power. As an alternative, the PROFIBUS terminator can be used as permanent cable terminator.

Note

The power supply to terminating resistors must not be interrupted by turning off the end device or repeater or by unplugging the bus connector or spur line. If uninterrupted power supply to the terminating resistors cannot be guaranteed, the PROFIBUS terminator with its own power supply must be used.

3.1.2 Segments for transmission speeds up to a maximum of 500 kbps

Transmission speeds up to a maximum of 500 kbps

The following maximum segment lengths can be implemented with the SIMATIC NET PROFIBUS cables:

Table 3- 1 Possible segment lengths

Transmission speed in kbps	Segment length for cable type	
	- FC standard cable - FC standard cable IS GP - FC robust cable - FC FRNC cable - FC food cable - FC underground cable - SIENOPYR-FR marine cable	- FC trailing cable - PROFIBUS flexible cable - PROFIBUS festoon cable - PROFIBUS torsion cable
9.6	1000 m	900 m
19.2	1000 m	900 m
45.45	1000 m	900 m
93.75	1000 m	900 m
187.5	1000 m	700 m
500	400 m	400 m
The maximum permitted number of bus attachments (end devices, repeaters, OLMs, BT12 M,...) to one segment is 32.		

Length of the spur lines

If you do not fit the bus cable directly at the bus connector (for example, when using a PROFIBUS-DP bus terminal), you must take into account the maximum possible spur line length.

The table below shows the maximum permitted lengths of spur lines per segment:

Table 3- 2 Length of spur lines per segment

Transmission speed	Max. length of spur lines per segment	Number of nodes with spur line length of ...	
		1.5 m or 1.6 m	3 m
9.6 to 93.75 kbps	96 m	32	32
187.5 kbps	75 m	32	25
500 kbps	30 m	20	10

3.1.3 Segments for a transmission speed of 1.5 Mbps

Transmission speed 1.5 Mbps

The following maximum segment length can be implemented with the SIMATIC NET PROFIBUS cable:

Table 3- 3 Possible segment lengths

Transmission speed in kbps	Segment length for cable type	
	- FC standard cable - FC standard cable IS GP - FC robust cable - FC FRNC cable - FC food cable - FC underground cable - SIENOPYR-FR marine cable	- FC trailing cable - PROFIBUS flexible cable - PROFIBUS festoon cable - PROFIBUS torsion cable
1,500	200 m	200 m

Node attachments at 1.5 Mbps

Each attachment of a node to the bus cable represents a capacitive mismatch that has no effect at lower transmission speeds. At a transmission speed of 1.5 Mbps, however, problems can arise due to these mismatches if the following guidelines in terms of type, number and distribution of node attachments are not adhered to.

Weighting factors

To be able to define permitted configurations, a method is necessary with which the attached components can be evaluated in terms of their capacitive bus load. This is achieved by assigning weighting factors to the components (see table below).

PROFIBUS interfaces implemented as 9pin D-sub female connectors (CPs, OLMs...), do not have their own weighting factors. These are already taken into account in the values listed in the table.

Table 3- 4 Weighting for segments at 1.5 Mbps

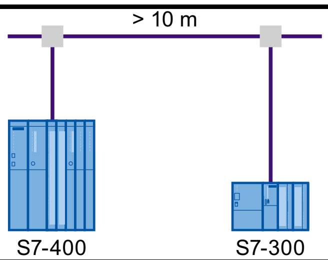
Product name	
RS-485 bus terminal with 3.0 m long spur line (order no. 6GK1 5000BA00, version 2)	1.5
RS-485 bus terminal with 1.5 m long spur line, with PG interface (order no. 6GK1 500 0AD00 , version 2)	1.5
Bus connector with axial cable outlet (order no.: 6GK1 500-0EA02) Bus connector with axial cable outlet for FastConnect system (order no.: 6GK1 500-0FC10) Bus connector with 90° cable outlet (order no.: 6ES7 972-0BA12-0XA0) Bus connector with 90° cable outlet with PG interface (order no.: 6ES7 972-0BB12-0XA0) Bus connector with 90° cable outlet for FastConnect system (order no.: 6ES7 972-0BA51-0XA0) Bus connector with 90° cable outlet with PG interface (order no.: 6ES7 972-0BB51-0XA0) Bus connector with 35° cable outlet (order no.: 6ES7 972-0BA41-0XA0) Bus connector with 35° cable outlet with PG interface (order no.: 6ES7 972-0BB41-0XA0)	0.1
Bus terminal 12M (order no. 6GK1 500-0AA10)	0.1
RS485 repeater (attachment of bus segments) (order no. 6ES7 972-0AA01-0XA0)	0.1
Active RS-485 PROFIBUS terminator (order no. 6ES7 972-0DA00-0AA0)	0.1
SIMATIC S5/S7 connecting cable for 12 Mbps PG attachment to PROFIBUS DP (order no.: 6ES7 901-4BD00- 0XA0)	0.5

Rules

At a transmission speed of 1.5 Mbps, the following rules apply to the permitted number of nodes and their distribution/arrangement in a SIMATIC NET PROFIBUS segment:

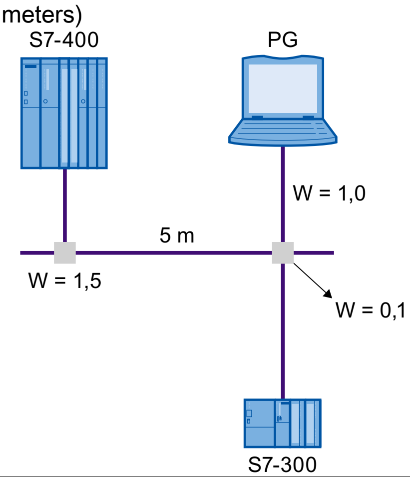
- The maximum permitted number of nodes in any segment is 32.
- The sum of the weightings of all the connection elements in a segment must be ≤ 25.
- The rules for the distances between adjacent connection elements are as follows (distance in this case is the length of the bus cable):
  - If the distance between adjacent connection elements is greater than 10 m, the weighting of the connection elements can be ignored.
  - If the distance between adjacent connections elements is greater than the sum of the two weighting values of the elements in meters, the arrangement is not critical and no additional conditions need to be taken into account. The weighting value of the PG connecting cable, SIMATIC S5/S7 connecting cable 12 Mbaud must be added to the value of the corresponding connection element.
  - If the minimum clearance described above is not kept to, a group is formed and the following additional conditions must be adhered to:
    Attachment elements can be arranged as close to each other as required providing the sum of their weighting values does not exceed the value 5.
    The distance in meters between two adjacent groups must be at least as large as the sum of the weighting values of the two groups.

Table 3- 5 Examples illustrating the configuration rules

<table>
<tr><th></th><th></th></tr>
<tr><td>No special conditions if the length of the bus cable between two end devices > 10 m</td><td>
</td></tr>
<tr><td>No special conditions if the length of the bus cables between two end devices is greater than the sum of the weighting values of both end devices.

If a bus terminal or a bus connector has a PG interface, a connected PG cable must be taken into account when calculating the weighting values.</td><td>Bus cable, for example 5 m

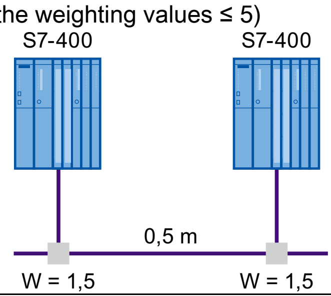
WV = 1.5 + 1.0 + 0.1 = 2.6

5 m > 2.5 m (sum of the weighting values in meters)

</td></tr>
<tr><td>Take the weighting values of a group into account if the sum of the weighting values is greater than the bus cable between the end devices.

Elements can then be as close to each other as necessary.

The total weighting value of a group must not, however, exceed 5.</td><td>Bus cable, for example 0.5 m group

WV = 1.5 + 1.5

0.5 m < 3 m ⇒ group formation ⇒ sum of the weighting values ≤ 5)

</td></tr>
</table>

3.1.4 Segments for transmission speeds up to a maximum of 12 Mbps

Transmission speeds up to a maximum of 12 Mbps

The following maximum segment length can be implemented with the SIMATIC NET PROFIBUS cable:

Table 3- 6 Possible segment lengths

Transmission speed in Mbps	Segment length for cable type	
	- FC standard cable - FC standard cable IS GP - FC robust cable - FC FRNC cable - FC food cable - FC underground cable - SIENOPYR-FR marine cable	- FC trailing cable - PROFIBUS flexible cable - PROFIBUS festoon cable - PROFIBUS torsion cable
3	100 m	100 m
6	100 m	100 m
12	100 m	100 m

When planning segments for transmission speeds from 3 Mbps to a maximum of 12 Mbps, the following factors must be taken into account:

- The maximum length of a segment must not exceed 100 m.
- The maximum number of bus attachments (nodes, OLMs, RS485 repeaters,...) in one segment is restricted to 32.
- The use of passive spur lines is not allowed.
- To attach end devices to bus segments, only the bus connectors permitted for 12 Mbps or the BT12M bus terminal can be used.
- To attach a programming device or PC via a spur line, only the "SIMATIC S5/S7 connecting cable, 12 Mbps, order no. 6ES7 901-4BD00-0XA0" can be used.

Note

If several bus connectors are used at short electrical intervals (in other words, the cable length between adjacent connectors is less than 1 m, for example several slaves in one cabinet), you should avoid the situation where several bus connectors are disconnected at the same time for a longer period. Disconnecting more than one bus connector does not necessarily mean errors but may well reduce the reliability (immunity to noise) of a segment.

3.1.5 Configuring electrical networks with RS-485 repeaters

RS-485 repeater

To increase the number of nodes (>32) in a network or to extend the cable length between two nodes, segments can be connected together using RS485 repeaters to form a network. The following figure shows a possible combination of several segments using repeaters to form a network.

The RS-485 repeaters support all transmission speeds from 9.6 kbps to 12 Mbps.

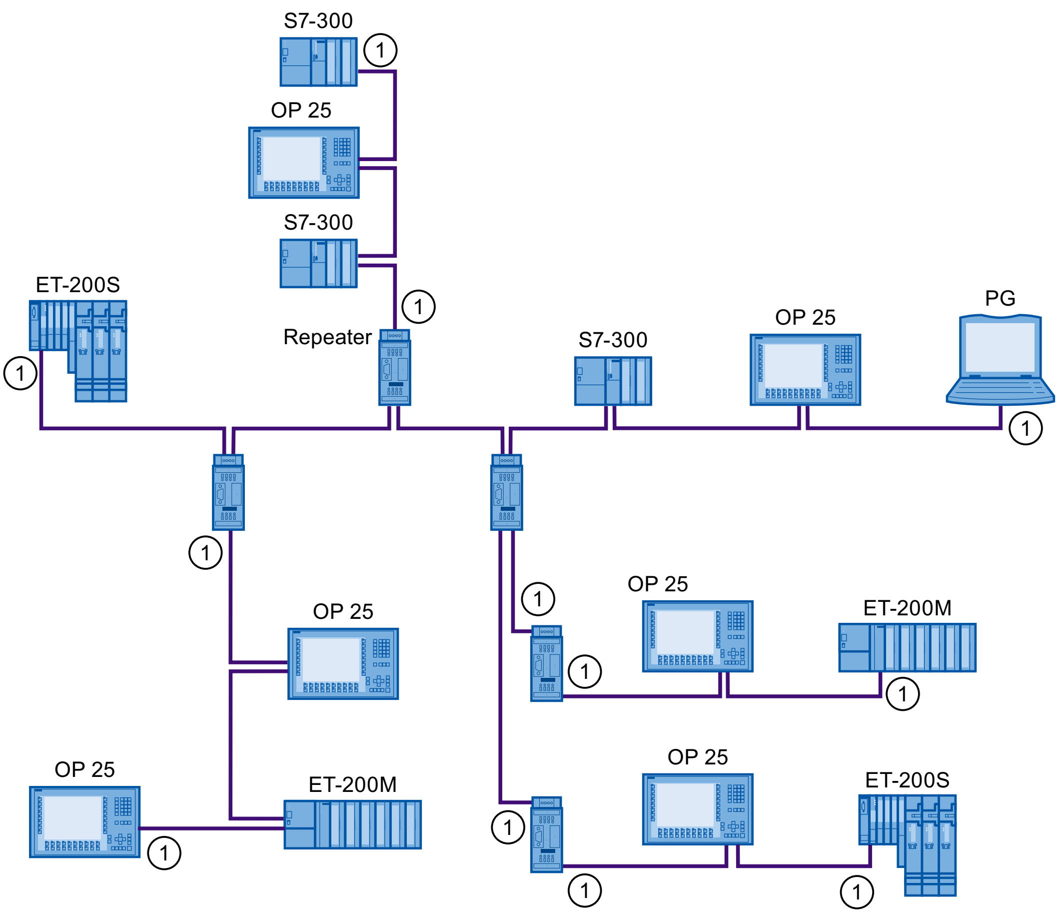


Figure 3-1 Structure of an electrical PROFIBUS network using RS485 repeaters
① terminating resistor on

Configuration

When configuring an electrical network with RS485 repeaters, the following conditions must be taken into account:

- The maximum segment length for a transmission speed must be adhered to (see section Segments for transmission speeds up to a maximum of 500 kbps (Page 42), section Segments for a transmission speed of 1.5 Mbps (Page 43), section Segments for transmission speeds up to a maximum of 12 Mbps (Page 46)).
- The maximum number of bus attachments (stations, RS-485 repeaters, OLM) per segment is limited to 32. There may be further restrictions at transmission speeds of 1.5 Mbps or higher (see section Segments for a transmission speed of 1.5 Mbps (Page 43)).
- The maximum number of nodes in a network is limited to 127.
- A maximum of 9 RS485 repeaters can be installed between two nodes.

3.2 Configuring optical networks

3.2.1 Overview

Configuration parameters for optical networks

When configuring optical PROFIBUS networks, the following parameters must be taken into account:

- Using fiberoptic cables, only pointtopoint links can be established.
- The maximum signal attenuation of the transmission path (the power budget) must be within the permitted values.
- The minimum or maximum permitted transmission speeds of the components (only one uniform transmission speed can be used in a network).
- The cascading rules for the components used.
- The maximum permitted number of nodes in a network.
- In largespan networks, the transmission delay time.

3.2.2 How a fiberoptic cable transmission system works

Introduction

This section describes the structure and functions of an optical transmission system. The information here will help you to understand the rules for calculating the optical power budget in the next section.

Transmission link

An optical transmission path consists of a transmitter, the optical fiber, and a receiver.

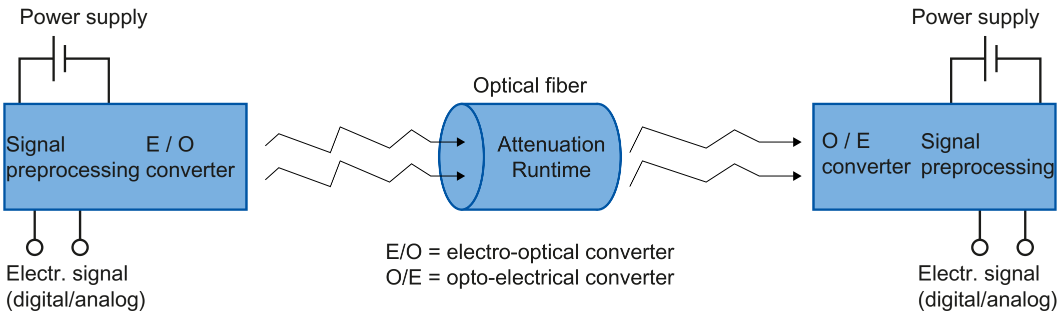


Figure 3-2 Structure of a link

Transmitter

The transmitter in an optical digital transmission system consists of a signal converter that converts the digital signals from the electronics into a pulse type suitable for the electro-optical converter, and an electrooptical converter (E/O converter) that converts the electric pulses to optical signals. In SIMATIC NET PROFIBUS, LEDs (LED = Light Emitting Diode) are used as E/O converters. Generally, the LEDs are specially adapted to the various transmission media.

Transmission media

The following types of fiber-optic cable are used as the transmission media SIMATIC NET PROFIBUS:

- Plastic fiber-optic cables
- PCF fiberoptic cables (polymer cladded fiber)
- Glass fiber-optic cables

For more detailed information about the various fiberoptic cables for SIMATIC NET PROFIBUS, refer to section "Passive components for optical networks (Page 189)".

Receiver

The receiver of a digital optical transmission system consists of an optoelectric converter (a photodiode), that converts the optical signals to electrical signals and a signal converter that converts the electrical pulses received from the diode into signals compatible with the connected electronics.

Attenuation

The attenuation of the transmission path is determined by the following factors:

- The choice of optical fiber
- The wavelength of the transmit diodes
- The type of connector

- With glass optical fibers, the number of splices (including repair splices)
- The length of the optical fiber (cable length)
- The link power margin on the link (for example for aging and temperature dependency of the LEDs and photodiodes).

3.2.3 Optical power budget of a fiberoptic transmission system

Optical power budget

The transmitted optical power Pout and the received optical power Prec are specified in dBm, the attenuation caused by connectors and the fiber is specified in dB.

dBm is a reference unit and describes the logarithmic ratio of the power level to the reference power P0 = 1mW.

The following formula applies:

Px [in dBm] = 10*log(Px [in mW] / P0)

Table 3- 7 Examples

Transmit power Px	Transmit power as logarithmic power ratio Px to Po
10 mW	+ 10 dBm
1 mW	0 dBm
1 µW	- 30 dBm

Transmitter

Depending on the fiber being used, the minimum and maximum optical power that can be coupled into a fiber is specified. This power is reduced by the attenuation of the connected transmission path resulting from the fiber itself (length, absorption, scattering, wavelength) and the connectors used.

Receiver

The receiver is characterized by its optical sensitivity and its dynamic range. When configuring an optical link, you should make sure that the power reaching the receiver does not exceed its dynamic range. If the power falls below the minimum, this increases the bit error rate (BER) due to the signaltonoise ratio of the receiver. If the maximum received power is exceeded, saturation and overload effects increase pulse distortion and therefore also increase the bit error rate.

Power budget

The power budget of an optical link not only takes into account the attenuation in the fiber itself, temperature and aging effects but also the attenuation values of the connectors and splices and therefore provides exact information about whether or not an optical link can be implemented. The starting point for calculating the maximum transmission path length is the minimum transmit power that can be coupled into the fiber type. To simplify matters, the budget is calculated in dBm and dB.

The following is subtracted from the minimum transmit power:

- The attenuation of fiber a_{FOC} [in dB/km or dB/m] (see manufacturer's data)
- The input power required at the receiver

The coupling losses at the send and receive diodes are already taken into account in the information about the transmit power and receiver sensitivity.

Plastic and PCF fiber-optic cables

Plastic and PCF fiber-optic cables can only be used on short distances due to their relatively high fiber attenuation. They are installed in one piece. Fiberoptic connections with couplers or splices should not be considered since they further reduce the distance that can be covered.

Refer to the maximum permitted cable lengths in the tables in the section "Optical power budget" or in section "Cable lengths for plastic and PCF FO links (Page 52)".

Glass FOC

Glass FO cables can span distances in the kilometer range. It is often not possible to install cables over such distances in one piece. The fiberoptic link must then be put together in several cable sections.

The junctions of these sections in the form of couplers or splices always involve certain attenuation losses.

With transmission paths using glass fiber-optic cables, the following aspects must also be taken into account:

- The loss caused by splices
- The loss caused by connectors
- When calculating the power budget, a link power margin of at least 3 dB (at a wavelength of 860 nm) or at least 2 dB (at a wavelength of 1300 nm) must be maintained.

Splices

Along with the splices, future repair splices must also be taken into account. Depending on the route of the cables and the risk of mechanical damage, one or more future repairs (approximately 1 per 500 m) should also be included in the budget. A repair always means two splices since a new section of cable must be inserted (the length depending on the accuracy of the test equipment).

System reserve

When calculating the power budget, a link power margin of at least 3 dB (at a wavelength of 860 nm) or at least 2 dB (at a wavelength of 1300 nm) must be maintained.

If the calculated link power margin is lower, the transmission path will not be reliable long-term in its currently planned form. This means that the transmission path may well function when it is first started up since components are normally better than their rated performance (particularly when brand new) but due to aging, replacement of components as a result of repairs and changing environmental conditions, the bit error rate will tend to rise to an unreliable level the longer the equipment is in use.

Note

To avoid possible errors during the installation of the transmission link, when installing glass fibers, the installed sections must be tested prior to commissioning and the measured values logged (see Section A2 "Testing fiber-optic cable").

Form

Section "Calculating the signal loss on glass fiber-optic links with OLMs (Page 54)" of this manual contains a work sheet for calculating the power budget of glass fiberoptical links.

3.2.4 Cable lengths for plastic and PCF FO links

Cable lengths

The transmission distance over fiberoptic cables is not dependent on the transmission speed.

Each node on the optical PROFIBUS network has repeater functionality so that the following distance information relates to the distance between two adjacent, interconnected PROFIBUS nodes.

The maximum cable length between two PROFIBUS nodes depends on the type of fiberoptic cable used and the optical network components.

Table 3- 8 Permitted cable lengths with integrated optical interfaces or OBT

Fiber-optic cables SIMATIC NET PROFIBUS	Maximum cable lengths between two nodes (in m)	Projected for 1 network (= 32 nodes) (in m)
Plastic fiberoptic, duplex cord	50	1550
Plastic fiberoptic, standard cable	50	1550
PCF fiberoptic, standard cable	300	9300

Table 3- 9 Permitted cable lengths in an OLM network

Fiber-optic cables SIMATIC NET PROFIBUS	Maximum cable lengths between two nodes (in m)	Projected for 1 network (= 32 nodes) (in m)
Plastic fiberoptic, duplex cord	50	1550
Plastic fiberoptic, standard cable	80	2480
PCF fiberoptic, standard cable	400	12400

Note

An optical bus can contain a maximum of 32 integrated optical interfaces in series.

Several buses of up to 32 integrated optical interfaces can only be linked via OBTs (optical repeaters).

In optical networks (bus, star, ring) containing only OLMs, the number of OLMs is limited to 122.

The number of all optical components (integrated interfaces, OBTs, OLMs) in the optical PROFIBUS network must be specified in the configuration tool as the "Number of OLM, OBT" parameter (see Section Frame transmission time (Page 58)). This number must not exceed 122.

Mixing plastic fiberoptic and PCF fiberoptic

To make the best use of the different cable lengths, the plastic fiberoptic cables and PCF fiberoptic cables can be mixed.

For example, you can use plastic fiber-optic cable for local connections between distributed DP slaves (distance < 50 m) and PCF fiber-optic cable for the connection between the DP master and the first DP slave in the bus topology (distance > 50 m).

3.2.5 Calculating the signal loss on glass fiber-optic links with OLMs

Calculation examples

The following work sheets show typical calculations of the power budget for SIMATIC NET PROFIBUS glass optical fibers, one with OLM/G11, OLM/G12 at a wavelength of 860 nm and one with OLM/G111300 and OLM/G121300 at a wavelength of 1300 nm.

Note

Please note that the information on fiber attenuation in the data sheets and type specifications of fiberoptic cables is based on measurements with narrowband laser light sources precisely adapted to the wavelengths.

The LED transmission elements used in practice produce a wider band spectrum whose mid frequency deviates slightly from the measured wavelength.

You should therefore use the following attenuation values on all connections with SIMATIC NET multimode glass fiberoptic cable between SIMATIC NET PROFIBUS components:

3.5 dB/km at 860 nm

1.0 dB/km at 1310 nm

Note

The following distances between 2 OLMs must not be exceeded regardless of the optical power budget:

OLM/P11, OLM/P12 400 m

OLM/G11, OLM/G12, OLM/G12-EEC 3 km

OLM/G11-1300, OLM/G12-1300 15 km

Power budget for OLM/G11, G12 for a pointtopoint link with the wavelength λ= 860 nm

Attenuation on the cable

Fiber Type	Attenuation a(FOC)	Cable length L
62.5/125 µm	3.5 dB/km	2.85 km

L * a(FOC) = 10.0 dB

+

Attenuation for connectors

a(conn)	Amount
0.4 dB	1

+

Number * a(conn) 0.4 dB

+

Attenuation caused by splices

a(spl)	Amount
0.2 dB	3

Number * a(spl) 0.6 dB

Attenuation of the transmission path

a(path) = 11.0 dB

Characteristic data of the OLM/G11, G12
maximum power coupled into 62.5/125 µm fiber

P(a, min)
-13 dBm

Receiver sensitivity

P(e, min)
-28 dBm

Maximum permitted attenuation

a(max) = P(a, min) - P(e, min) = 15.0 dB

System reserve

a(max) - a(path) = 4.0 dB

The transmission path can be implemented as planned.

Power budget for OLM G111300, G121300 for one pointtopoint link at wavelength l = 1310 nm

Attenuation on the cable

Fiber Type	Attenuation a (FOC)	Cable length L
62.5/125 µm	1.0 dB/km	9 km

L * a(FOC) = 9.0 dB

+

Attenuation for connectors

a(conn)	Amount
1 dB	0

+

Number * a(conn) 0 dB

+

Attenuation caused by splices

a(spl)	Amount
0.2 dB	5

Number * a(spl) 1.0 dB

Attenuation of the transmission path

a(path) = 10.0 dB

Characteristic data of the OLM/G11-1300, G12-1300
maximum power coupled into 62.5/125 µm fiber

P(a, min)
-17 dBm

Receiver sensitivity

P(e, min)
-29 dBm

Maximum permitted attenuation: a(max) = P(a, min) - P(e, min) = 12.0 dB

System reserve: a(max) - a(path) = 2.0 dB

The transmission path can be implemented as planned.

Note

The maximum length of fiberoptic cable that can be supplied in one piece depends on the cable type but is approximately 3 km per drum. Longer links must therefore be put together using more than one piece of cable. To connect the sections of cable, coupling elements or splices must be used reducing the maximum possible cable length due to their attenuation.

Sheet for a power budget calculation using OLMs

Attenuation for the OLM/G11, G12, G11-1300 or G12-1300 for one pointtopoint link with wavelength λ =

Attenuation on the cable

Fiber type in µm	Attenuation a(FOC) in dB/km	Cable length L in km

L * a(FOC) = dB

+

Attenuation for connectors

a(conn) in dB	Amount

+

Number * a(conn) dB

+

Attenuation caused by splices

a(spl) in dB	Amount

Number * a(spl) dB

Attenuation of the transmission path

a(path) = dB

Characteristic data of the OLM/G11-1300, G12-1300
maximum power coupled into 62.5/125 µm fiber

P(a, min) in dBm

Receiver sensitivity

P(e, min) in dBm

Maximum permitted attenuation

a(max) = P(a, min) - P(e, min) = dB

System reserve

a(max) - a(path) = dB

3.3 Frame transmission time

3.3.1 Overview

Dependency of the system reaction time

The system reaction time of a PROFIBUS network depends on the following:

- The type of system being used (single or multiple master system)
- The maximum reaction time of the individual nodes
- The amount of data to be transmitted
- The bus configuration (topology, cable lengths, active network components)

The setting of the bus parameters (configuration) to the particular PROFIBUS network using configuration software such as COM PROFIBUS or STEP 7.

Using optical link modules, extremely large PROFIBUS networks can be created. These allow the use of long optical fiber links and the cascading of large numbers of components. Each time the data packet passes through an OLM there is a delay.

Due to the delays caused by cables and network components and the monitoring mechanisms in the network components, the PROFIBUS network parameter "Slot Time" must be adapted to the network span, the network topology and the transmission speed.

3.3.2 Configuring optical buses and star topologies with OLMs

Creating a system overview

You configure the PROFIBUS network, for example with SIMATIC STEP 7. The busspecific configuration begins with the creation of the system overview in the hardware configuration dialog "HW Config" of STEP 7.

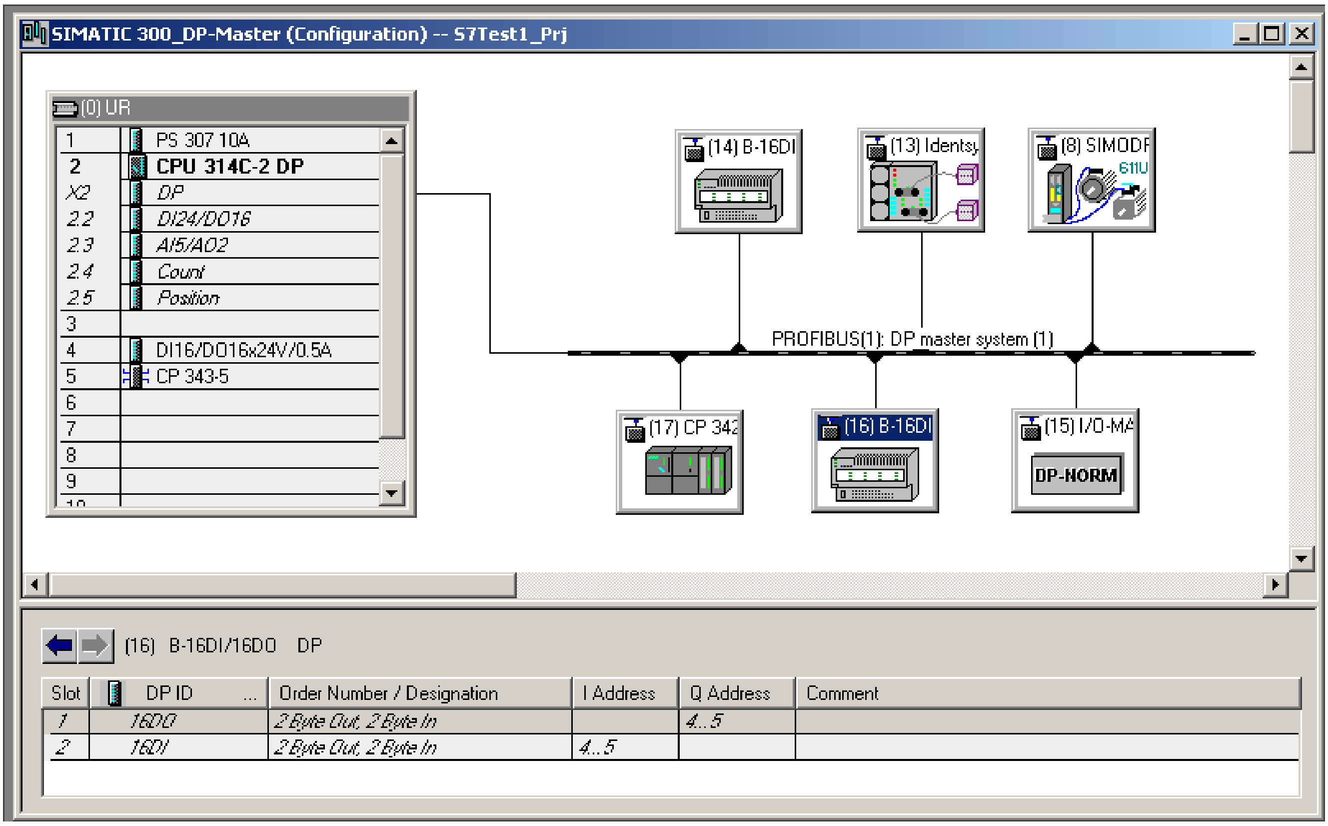


Figure 3-3 "HW Config" dialog in STEP 7

Setting the PROFIBUS properties

In the "Properties - PROFIBUS" dialog, you can set the highest station address (HSA), the transmission speed and the bus profile.

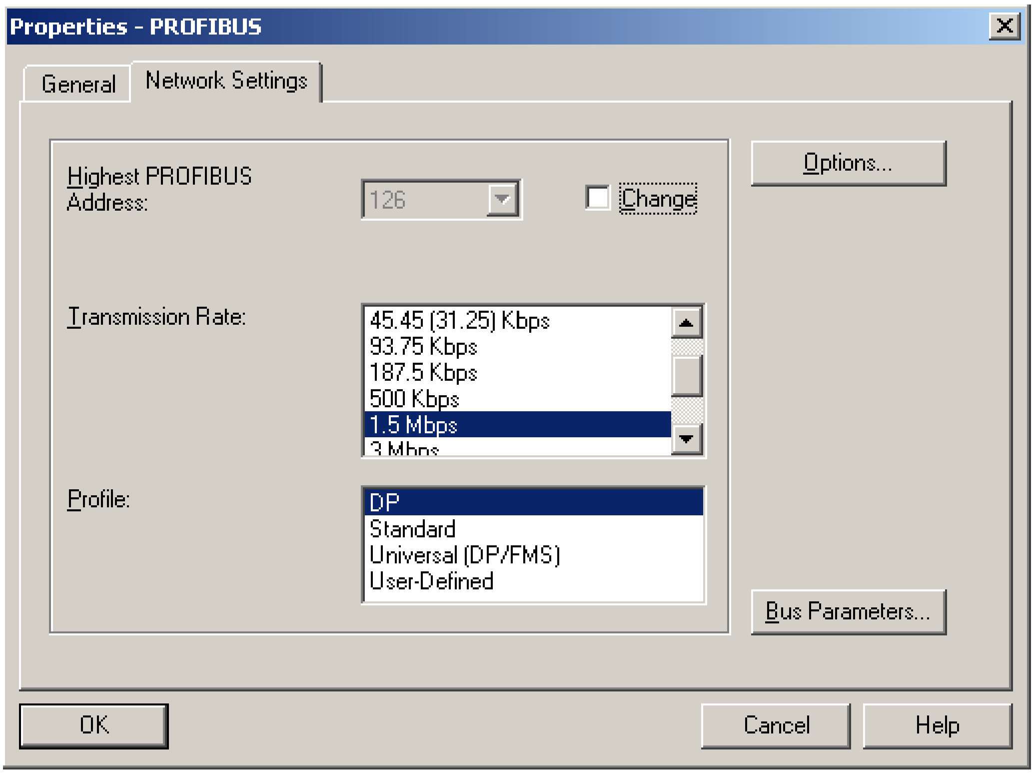


Figure 3-4 "Properties - PROFIBUS" dialog

Entering the cabling configuration

You can make the settings for the cabling configuration (number of OLMs, cable length) in "Options" → "Cables".

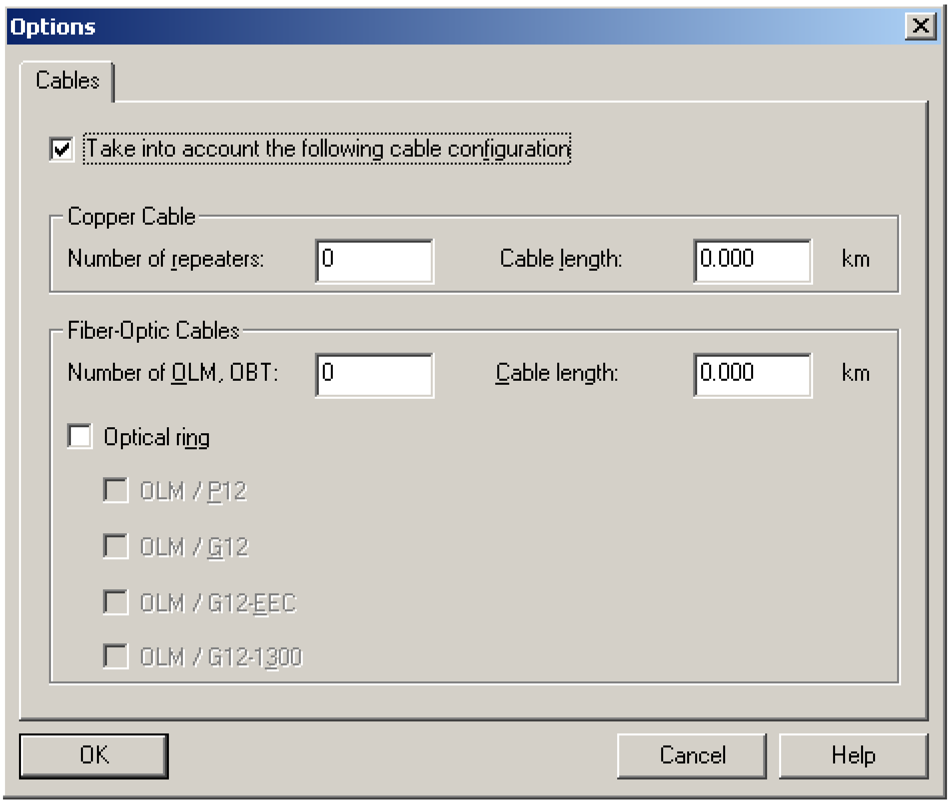


Figure 3-5 "Options" → "Cables" input dialog

Checking the bus parameters

Based on the entries made, the configuration tool can check whether the slot time is feasible in the selected communication profile. If the additional delays of OLM and FO cables mean that the system would exceed the value, the parameters are adapted. The newly calculated bus parameters are displayed in the "Bus Parameters" dialog.

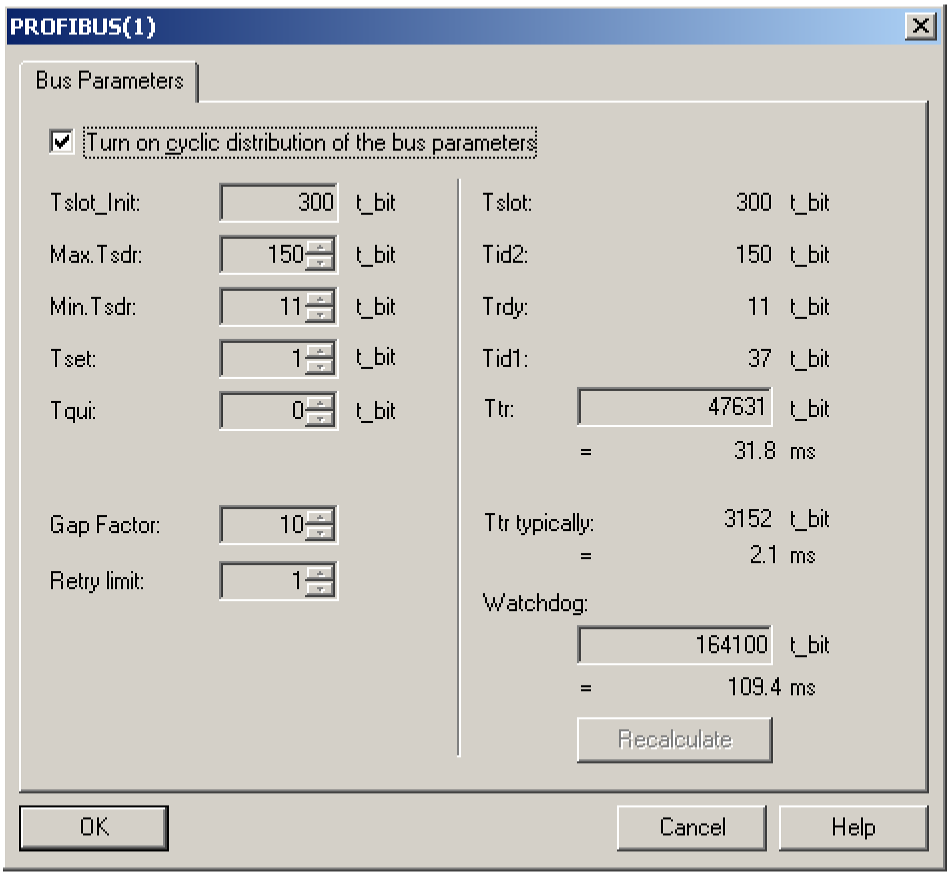


Figure 3-6 Bus parameters adapted to the system

3.3.3 Configuring redundant optical rings with OLMs

Configuring redundant optical rings with OLMs

The following configuration conditions must be satisfied in redundant optical rings:

- An unused address lower than the HSA (Highest Station Address)
- Increased retry value to at least the value 3
- Checked and adapted slot time

To set the parameters in 2. and 3., use the user-specific profile of the configuration tool. There is an example of applying the bus parameters in STEP 7 at the end of this section.

An unused address lower than the HSA

The value of the HSA (Highest Station Address) parameter must be set on all end devices so that there is at least one address in the network between bus address 0 and the value of HSA that is not used by a node; in other words, there is an address gap. You can create this address gap simply by increasing the value of the HSA parameter to one higher than the highest node address in the network.

Note

If this condition is not or is no longer satisfied, the optical bus will no longer close to form a redundant optical ring following segmentation. The fault message (LED and signaling contact) of the two OLMs affected is not canceled even after the fault has been eliminated.

Increased retry value to at least the value 3

If a fault occurs requiring a failover (for example a wire break), there is a failover time during which correct data transmission is not possible. To ensure a "bumpless" failover for the application, it is advisable to set the number of frame retries on the PROFIBUS master to at least 3.

Checked and adapted slot time

To allow a “bumpless" return from the optical bus to the optical ring after the fault has been eliminated, there must be no frame on the network at the failback time. The network is briefly free of frames when a master addresses a device whose address is configured but does not actually exist.

The master waits for a response until the configured slot time has elapsed. The OLM recognizes this frame-free state and closes the optical bus in the middle of this polling sequence to form the optical ring again.

The slot time must be set to approximately twice the value it would be in a non-redundant network.

Calculate the slot time according to the following formula:

Slot time = a + (b x length of FOC) + (c x number of OLMs)

Slot time is the monitoring time in bit times

Length of FOC is the sum of all FO cables (segment lengths) in the network. The lengths must be specified in km.

Number of OLMs is the number of PROFIBUS OLMs in the network

The factors a, b and c depend on the transmission speed and can be found in the following tables.

Table 3- 10 Constants for calculating the slot time with the DP standard (redundant optical ring)

Transmission speed	a	b	c
12 Mbps	1651	240	28
6 Mbps	951	120	24
3 Mbps	551	60	24

Transmission speed	a	b	c
1.5 Mbps	351	30	24
500 kbps	251	10	24
187.5 kbps	171	3.75	24
93.75 kbps	171	1.875	24
45.45 kbps	851	0.909	24
19.2 kbps	171	0.384	24
9.6 kbps	171	0.192	24

Table 3- 11 Constants for calculating the slot time with DP/FMS ("Universal") and DP with S5-95U (redundant optical ring)

Transmission speed	a	b	c
12 Mbps	1651	240	28
6 Mbps	951	120	24
3 Mbps	551	60	24
1.5 Mbps	2011	30	24
500 kbps	771	10	24
187.5 kbps	771	3.75	24
93.75 kbps	451	1.875	24
45.45 kbps	851	0.909	24
19.2 kbps	181	0.384	24
9.6 kbps	171	0.192	24

Note

The slot time calculation takes into account only the optical network and the attachment of nodes to the OLM in each case via a maximum 20 m long RS485 bus segment. Longer RS-485 bus segments must be included by adding them to the length of FOC.

With the OLM/G111300 and OLM/G121300, the minimum slot times shown in the following table must be maintained at transmission speeds of 12 Mbps, 6 Mbps, 3 Mbps and 1.5 Mbps.

Table 3- 12 Minimum slot time for OLM/G111300 and OLM/G121300

Transmission speed	Minimum slot time
12 Mbps	3800 t_{Bit}
6 Mbps	2000 t_{Bit}
3 Mbps	1000 t_{Bit}
1.5 Mbps	530 t_{Bit}

If the slot time is lower than the minimum slot time, use the minimum slot time according the table above for the slot time you are configuring.

Note

If the slot time is configured with a value that is too low, this can lead to malfunctions and error displays on the OLM. The system LED flashes red/green.

3.3.4 Example of configuring the bus parameters in STEP 7

Structure of the network example

The example assumes a redundant optical ring with the following structure:

- 20 OLM G12 modules in the redundant optical ring
- 20 km total ring length
- Transmission speed 1.5 Mbps
- Nodes attached directly to OLMs
- "PROFIBUSDP" bus protocol

Calculating the slot time

For the transmission speed of 1.5 Mbps selected in the example, Section "Cable lengths for plastic and PCF FO links (Page 52)" lists the following values

a = 351

b = 30

c = 24

From this, the slot time is calculated as follows:

Slot time = 351 + (30 x 20) + (24 x 20) = 1431

Entering the bus parameters

This means that the following 3 bus parameters must be entered for the example:

Slot time (T_slot_Init) = 1431

Number of retries (Retry_Limit) = 3

Highest station address (HSA) = 126 (default setting)

These values are entered in STEP 7 in the "Bus Parameters" dialog for the "UserDefined" bus profile.

You must then trigger the recalculation of the bus parameters with the "Recalculate" button.

Note

Since the formula includes the delays of all fiberoptic and RS485 cables, the "Consider cable configuration" check box must not be activated in the "Options" -> "Cables" dialog.

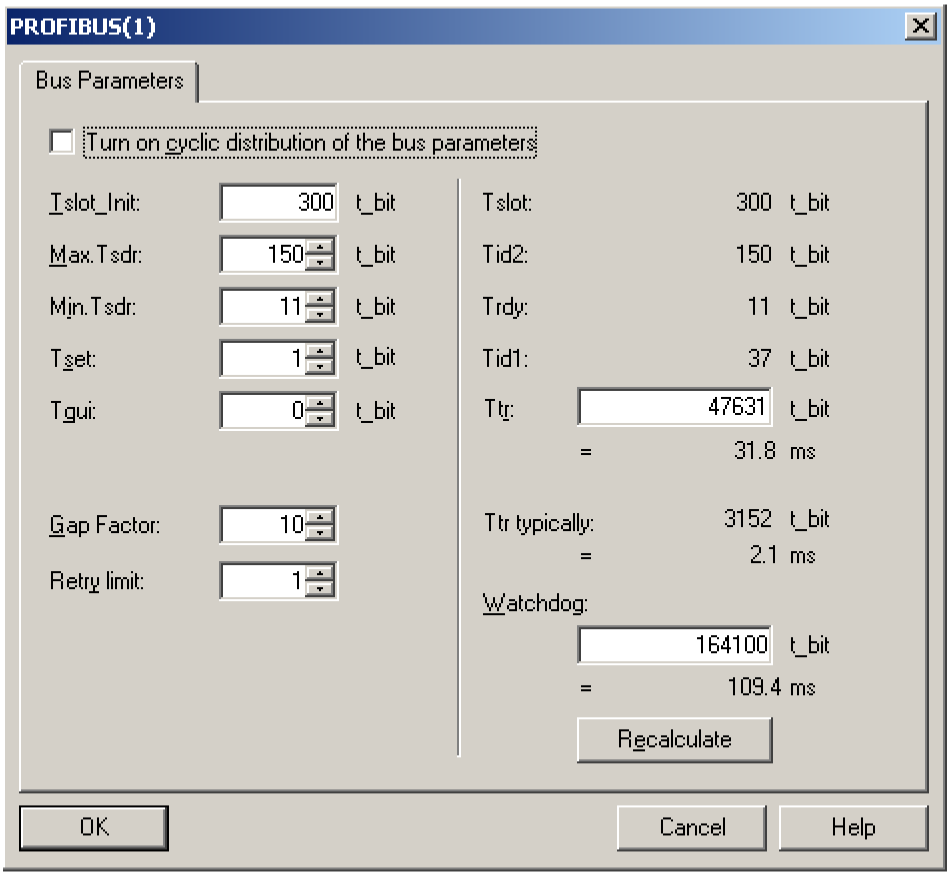


Figure 3-7 "Bus Parameters/UserDefined" dialog in STEP 7

4 Active components

4.1 Active components for RS485 networks

4.1.1 485 repeater

4.1.1.1 Functions and properties of the RS-485 repeater

What is an RS485 repeater?

The RS 485 repeater amplifies data signals on bus lines and couples bus segments.

Use of the RS-485 repeater (6ES7 972-0AA01-0XA0)

The RS-485 IP 20 repeater connects two PROFIBUS or MPI bus segments using RS-485 technology with a maximum of 32 nodes. It allows transmission rates from 9.6 kbps to 12 Mbps.

You require an RS-485 repeater when:

- There are more than 32 stations (maximum 127, including repeaters) connected to the bus
- Bus segments are operated ungrounded on the bus (electrical isolation of segments), or
- The maximum cable length of a segment is exceeded

- Help is required during commissioning
  - Switch for disconnecting segments
  - Display of bus activity
  - Disconnecting a segment when the terminator is incorrectly activated
- The signal amplitude and time need to be regenerated

Figure 4-1 RS-485 repeater

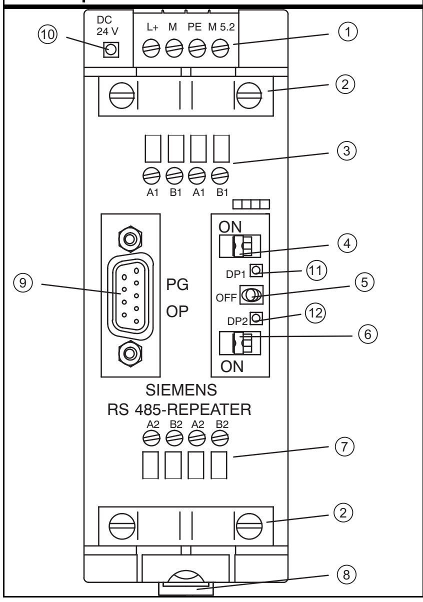
Please note that there is also a diagnostics repeater that in addition to the normal repeater functionality provides extensive diagnostics functions for troubleshooting the physical cable, see Section Diagnostics repeater for PROFIBUS DP (Page 77)

Rule

If you want to install a PROFIBUS network with RS485 repeaters, you can connect a maximum of nine RS485 repeaters in series.

Design of the RS-485 repeater

Table 4- 1 Description and functions of the RS-485 repeater

Description and functions of the RS 485 repeater	No.	Function
	1	Connection for the RS-485 repeater power supply (pin "M5.2" is the ground reference, if you want to measure the voltage difference between terminals "A2" and "B2").
	2	Shielding clamp for strain relief and grounding of the bus cable of bus segments 1 or 2
	3	Terminals for the bus cable of bus segment 1
	4	Terminating resistor for bus segment 1)[1]
	5	Switch for OFF state (= Disconnect bus segments 1 and 2, for example, during commissioning)
	6	Terminating resistor for bus segment 2)[1]
	7	Terminals for the bus cable of bus segment 2
	8	Slide for mounting and removing the RS-485 repeater on a DIN rail
	9	Interface for PG/OP on bus segment 1
	10	LED 24V power supply
	11	LED indicating bus activity on segment 1
	12	LED indicating bus activity on segment 2

)[1] If the terminating resistor is activated, the right-hand bus terminals are disconnected

Note

Pin M5.2 of the power supply is used as the ground reference for signal measurements if problems occur and must not be connected up.

Technical specifications

Table 4- 2 Technical specifications of the RS-485 repeater

Power supply	
Rated voltage	24 V DC
Ripple (static limit)	20.4 V DC to 28.8 V DC
Current consumption at rated voltage	
Without load on PG/OP socket	200 mA
Load on PG/OP socket (5 V/90 mA)	230 mA
Load on PG/OP socket (24 V/100 mA)	300 mA
Connectors	
• Bus cables	2 terminal blocks
• Power supply	Terminal block

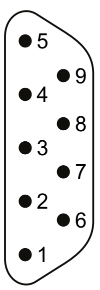
Galvanic isolation	Yes, 500 V AC
Transmission spped (detected automatically by repeater)	9.6 kbps, 19.2 kbps, 45.45 kbps, 93.75 kbps, 187.5 kbps, 500 kbps, 1.5 Mbps, 3 Mbps, 6 Mbps, 12 Mbps
Operating temperature	0 °C to 60 °C
Storage temperature	40 °C to 70 °C
Relative humidity (operation)	95% at 25 °C
Type of protection	IP20
Dimensions W x H x D (mm)	45 x 128 x 67
Weight (including packaging)	350 g

Table 4- 3 Relationship between transmission rate and maximum segment length

Transmission rate	Segment length
9.6 kbps	1000 m
19.2 kbps	1000 m
45.45 kbps	1000 m
93.75 kbps	1000 m
187.5 kbps	1000 m
500 kbps	400 m
1,500 kbps	200 m
3,000 kbps	100 m
6,000 kbps	100 m
12,000 kbps	100 m

Pin assignment of the D-sub connector (PG/OP socket)

Table 4- 4 Pin assignment of the 9-pin D-sub connector (PG/OP socket)

View	Pin no.	Signal name	Description
	1	-	-
	2	M24V	24 V ground
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference potential (station)
	6	P5V2	Supply plus (station)
	7	P24V	24 V
	8	RxD/TxD-N	Data line A
	9	-	-

Block diagram

The following figure shows a diagram of the RS-485 repeater:

- Bus segments 1 and 2 are electrically isolated.
- Bus segment 2 and the PG/OP socket are electrically isolated from each other.
- Signals are amplified
  - Between bus segments 1 and 2
  - Between PG/OP socket and bus segment 2

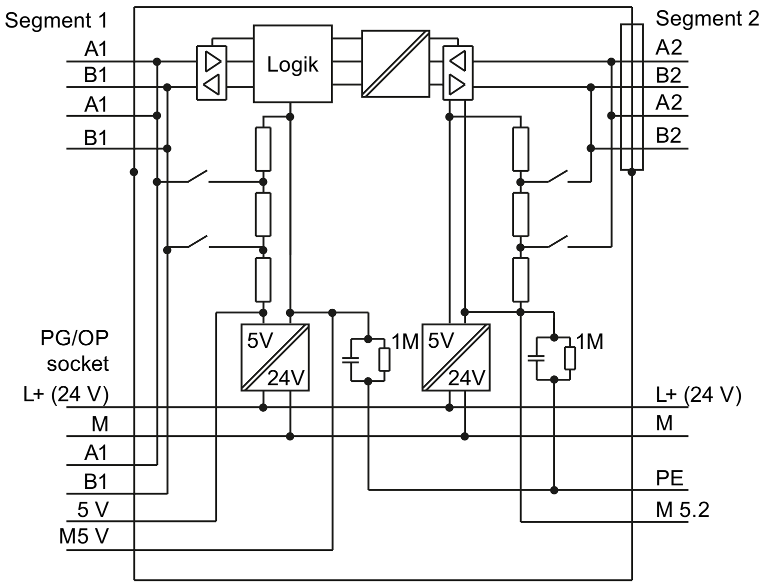


Figure 4-2 Diagram of the RS-485 repeater

4.1.1.2 Configuration options with the RS-485 repeater

Overview

The following section explains the configurations in which you can use the RS485 repeater:

- Segment 1 and segment 2 terminated on RS-485 repeater
- Segment 1 terminated on RS-485 repeater and segment 2 looped through on RS-485 repeater

and

- Segment 1 and segment 2 looped through on RS-485 repeater

Terminating resistor on/off

the following figure shows the setting for the terminating resistor:

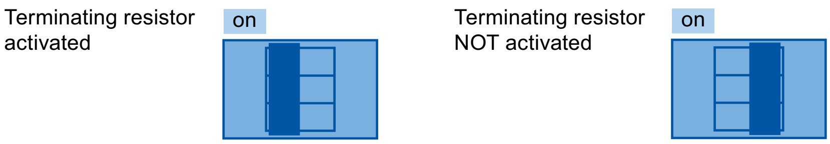


Figure 4-3 Setting of the terminating resistor

Segments 1 and 2 terminated

The following figure shows how to connect the RS485 repeater to the ends between two segments:

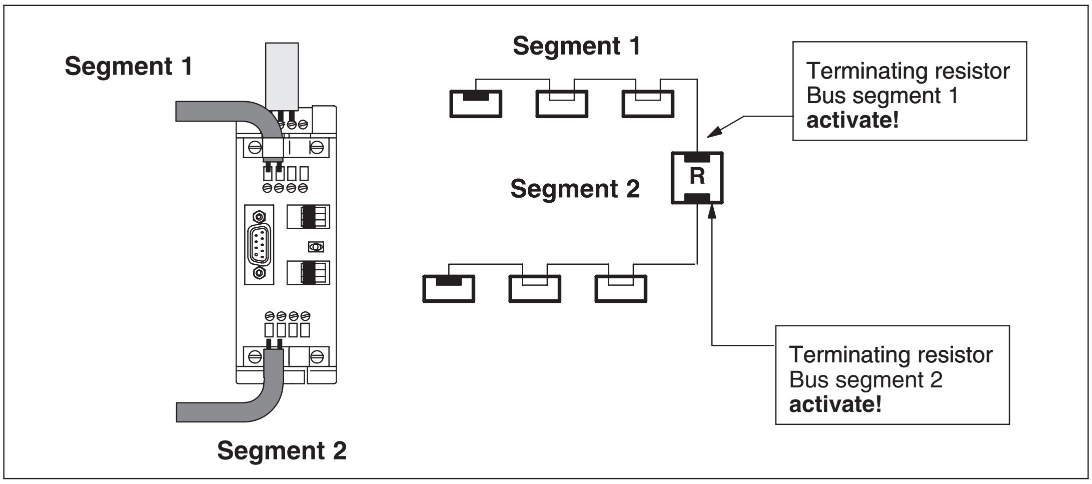


Figure 4-4 Connection of two bus segments with an RS-485 repeater

Segment 1 terminated, segment 2 connected through

The following figure shows the connection between two segments via an RS485 repeater with one segment connected through:

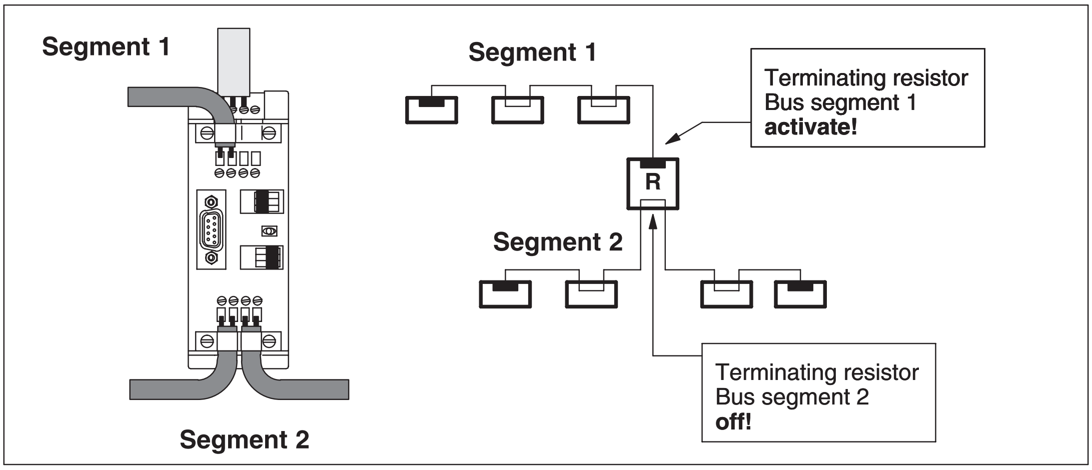


Figure 4-5 Connection of two bus segments with an RS-485 repeater

Segments 1 and 2 connected through

The following figure shows the connection between two segments via an RS485 repeater with each bus cable connected through:

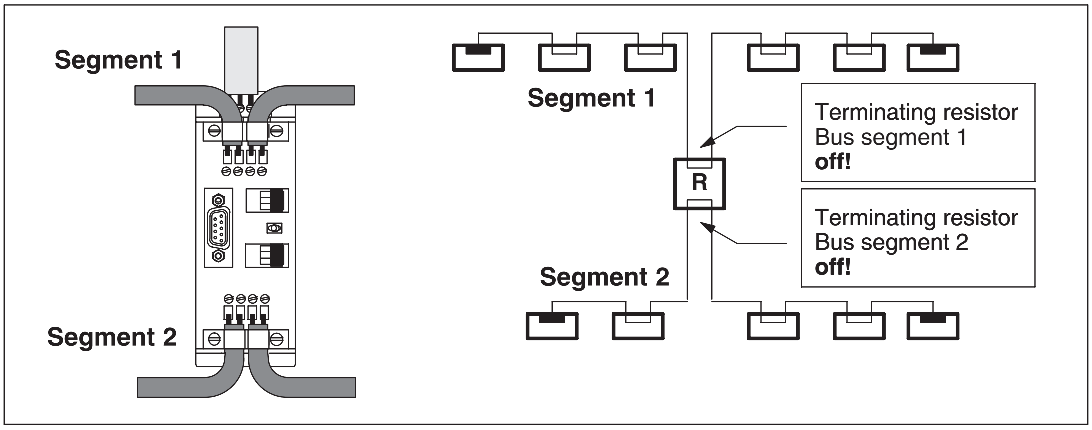


Figure 4-6 Connection of two bus segments with an RS-485 repeater

Note

If you turn off the power supply of a complete segment, the terminating resistors of the connected nodes are also without power supply. This can lead to disruptions or undefined signal states in this segment that are not recognized by the repeater and can then lead to problems in the other segment.

Whenever possible, we recommend the following procedure:

- Alternative 1:
  Disconnect the two segments before turning off the power supply using switch 5 (Table "Description and functions of the RS485 repeater") on the repeater (set to "OFF").
- Alternative 2:
  Connect the repeater to the power supply of the segment to be turned off so that the repeater is also turned off. In this case, make sure that the repeater is not at the end of the previous segment, since the repeater then acts as the terminator which has no effect if there is no power supply. If this solution is required, use a PROFIBUS terminator with a permanent power supply after the repeater.
- Alternative 3:
  If you want the repeater to retain its power supply, use PROFIBUS terminators to terminate the segment you want to turn off since these also require a permanent power supply. You require 1 terminator if the bus segment to be turned off ends at the repeater, otherwise you require 2 terminators.

4.1.1.3 Installing and uninstalling the RS-485 repeater

Overview

You can install the RS-485 repeater as follows:

- On an S7300 rail

or

- On a standard rail (order number 6ES5 7108MA..)

Installation on an S7-300 rail

To install the RS485 repeater on an S7300 rail, the catch on the rear of the RS485 repeater must first be removed (see Figure 5-6):

- Insert a screwdriver below the tongue of the catch (1) and
- Push the screwdriver towards the rear of the module (2). Hold the screwdriver in this position!

  Result: The catch of the RS-485 repeater is released.
- With your free hand lift the catch up as far as it will go and then remove the catch (3).

  Result: The catch is removed from the RS-485 repeater.
- Fit the RS485 repeater onto the S7300 rail (4).

- Push it towards the back as far as it will go (5).
- Tighten the securing screw with a torque of 80 to 110 Ncm (6).

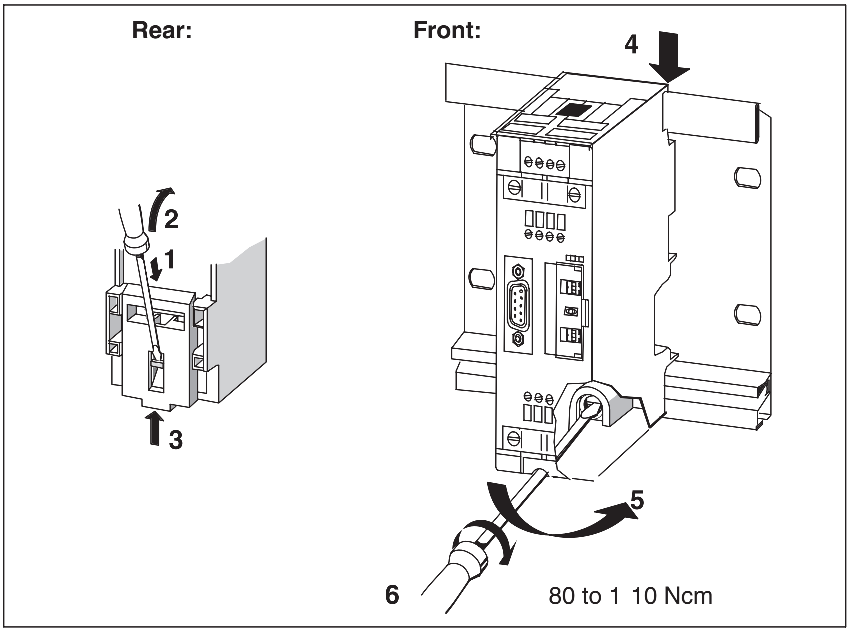


Figure 4-7 Installing the RS-485 repeater on an S7-300 rail

Removing the repeater from an S7300 rail

To remove the RS485 repeater from the S7300 rail:

- Loosen the securing screw of the RS-485 repeater (1) and
- Pull the RS485 repeater out and up (2).

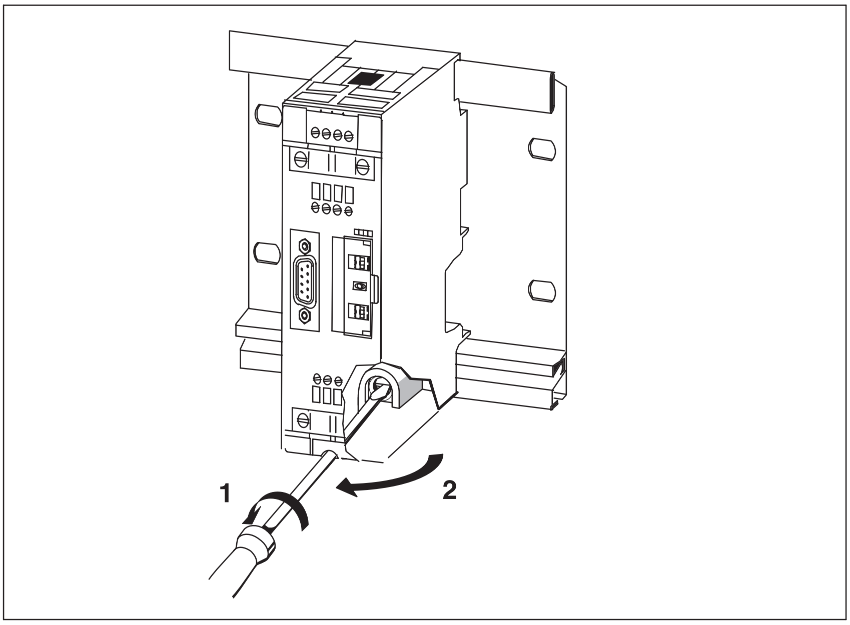


Figure 4-8 Removing the RS-485 repeater from the S7-300 rail

Installation on a standard rail

To be able to install the repeater on a standard rail, the catch must be present on the back of the RS485 repeater:

- Fit the RS485 repeater onto the standard rail from above and
- Push it towards the back until the catch locks it in place.

Removal from the standard rail

To remove the RS-485 repeater from the standard rail:

- Press down the catch on the bottom of the RS485 repeater using a screwdriver and
- Pull the RS485 repeater out and upwards to remove it from the standard rail.

4.1.1.4 Ungrounded operation of the RS-485 repeater

Ungrounded operation

Ungrounded operation means that chassis and PE are not connected.

Ungrounded operation of the RS485 repeater allows you to operate electrically isolated bus segments.

The figure shows the change in the voltage relationships resulting from using the RS-485 repeater.

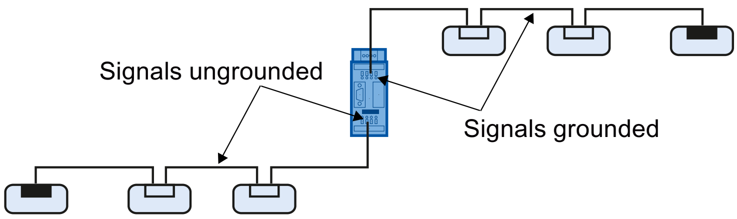


Figure 4-9 Ungrounded operation of bus segments

4.1.1.5 Connecting the power supply

Cable type

To connect the 24 V DC power supply, use flexible cables with a cross section of 0.25 mm^2 to 2.5 mm^2 (AWG 26 to 14).

Connecting the power supply

To connect the power supply of the RS-485 repeater:

- Strip the insulation from the cable for the 24 V DC power supply.
- Connect the cable to terminals "L+", "M" and "PE".

4.1.1.6 Connecting the bus cable

All the bus cables described in Chapter 4 are suitable for connection to the RS485 repeater.

Connecting the PROFIBUS cable

Connect the PROFIBUS cable to the RS485 repeater, as follows:

- Cut the PROFIBUS cable to the required length.
- Strip the insulation from the PROFIBUS cable as shown the figure.

The braid shield must be folded back on to the cable. Only then can the shield clamp serve as strain relief and as the shield contact.

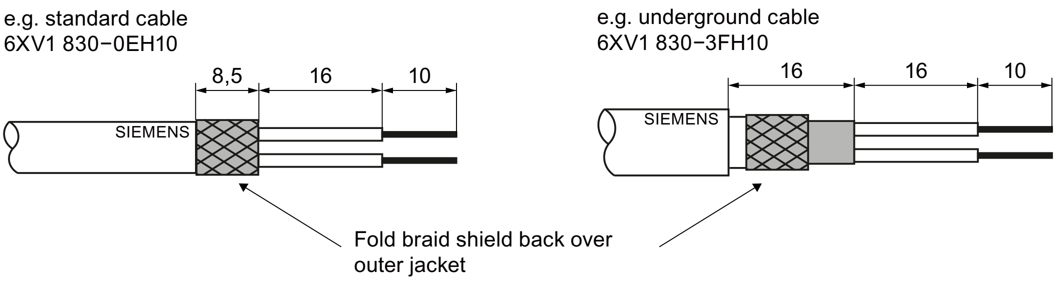


Figure 4-10 Stripping length for connecting to the RS-485 repeater

- Connect the PROFIBUS cable to the RS-485 repeater:
  Connect the same wires (green/red for the PROFIBUS cable) to the same terminal A or B (in other words always connect terminal A with a green wire and terminal B with a red wire or vice versa).
- Tighten the shield clamps so that the shield makes good contact with the clamp.

4.1.2 Diagnostics repeater for PROFIBUS DP

What is a diagnostic repeater?

A diagnostic repeater is a repeater capable of monitoring the segment of an RS-485 PROFIBUS subnet (copper cable) during normal operation and report line faults in a diagnostic frame to the DP master. Using STEP 7, COM PROFIBUS and with HMI devices (SIMATIC HMI), the location of the problem and the cause can be displayed in plain language.

The diagnostic repeater allows cable faults to be detected, located and visualized early by means of cable diagnostics during normal operation. This means that problems in the system can be detected in good time and downtimes minimized.

Properties of the diagnostic repeater

The diagnostic repeater performs the following tasks:

- Diagnostic function for two PROFIBUS segments (DP2 and DP3):

  The diagnostic function supplies the location and cause of cable problems such as wire breaks or missing terminating resistors. The location of the problem is specified relative to the existing nodes, for example "short circuit of signal line A to shield between node 12 and 13".
- Repeater function for three PROFIBUS segments (DP1, DP2, DP3):

  The diagnostic repeater amplifies data signals on bus cables and connects individual RS-485 segments.
- Support when reading out the stored topology table and visualization of the bus topology with STEP 7.
- Support when reading out the stored diagnostic and statistical information.
- Provides a clock that can be set and read be the user program.
- Provides monitoring functions of PROFIBUS in isochronous mode.
- Provides identification data.
- PG interface electrically isolated from the other bus segments, removing/inserting the PG connecting cable does not cause disturbances on the other PROFIBUS DP segments even at high transmission speeds.
- The diagnostic repeater is a DP slave with degree of protection *IP20.

Application of the diagnostic repeater

A diagnostic repeater is necessary for the following:

- Cable diagnostics of a PROFIBUS network during ongoing operation
- Attachment of more than 32 nodes on the bus
- Implementation of branches
- Electrical isolation of two segments
- Ungrounded operation of bus segments
- Visualization of bus topology with STEP 7 as of V5.2.

Order no.

6ES7 972-0AB01-0XA0

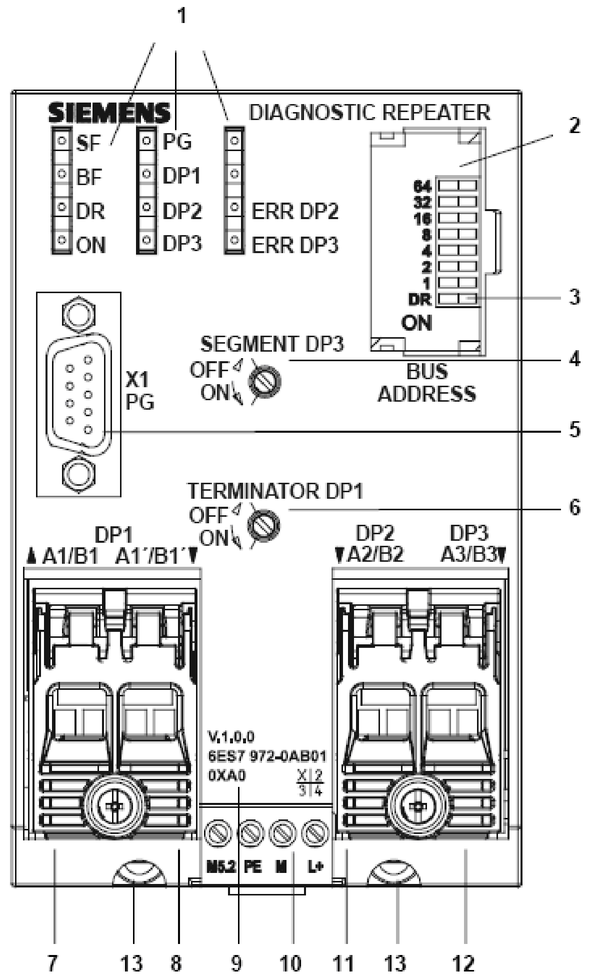
Design of the diagnostic repeater

Figure 4-11 Diagnostic repeater

The diagnostic repeater is integrated into the bus system as a PROFIBUS DP standard slave. It allows the following:

- Monitoring of 2 PROFIBUS DP segments
- Max. 31 stations per segment (max. 62 stations per diagnostics repeater)
- Maximum segment length of each segment 100 m
- Configuration of up to 9 diagnostic repeaters in series

Use only approved bus connectors on the segments capable of diagnostics



1 Status and fault LEDs

2 Switch for setting the PROFIBUS address

3 Switch for enabling the repeater function

4 Rotary switch for disconnecting the DP3 segment

5 Interface for PG with integrated terminating resistor

6 Rotary switch for temptation resistor for the DP1 segment

7 Terminal A1/B1 for the incoming bus cable of segment DP1

8 Terminal A1'/B1' for the outgoing bus cable of segment DP1

9 Version of the firmware and order number

10 Power supply connector

11 Terminal A2/B2 for the bus cable of segment DP2, with measuring circuit for line diagnostics

12 Terminal A3/B3 for the bus cable of segment DP3, with measuring circuit for line diagnostics

13 Securing screws for installation on S7-300 rail

Technical specifications

Table 4- 5 Technical specifications of the diagnostic repeater

Power supply Rated voltage Ripple (static limit)	 24 V DC 20.4 V DC to 28.8 V DC
Connectors Bus cables Power supply	 FastConnect insulation-piercing technique, 10 piercing cycles possible Terminal block
Transmission speed	9.6 kbps to 12 Mbps
Permissible ambient temperature	0° C to 60° C
Storage temperature	-40 to +70 °C
Relative humidity (operation)	95 % at 25° C
Type of protection	IP20
Dimensions W x H x D (mm)	80 x 125 x 67.5
Weight	300 g

4.1.3 PROFIBUS terminator (active RS485 terminator)

What is a PROFIBUS terminator?

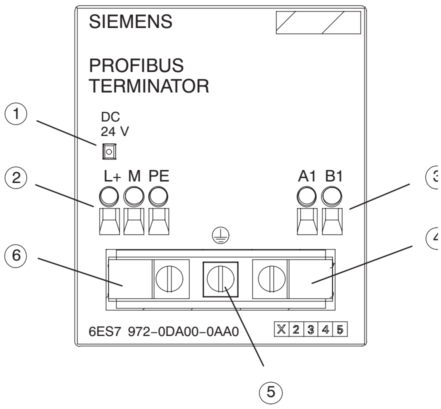
The PROFIBUS terminator provides active termination for the bus. The main advantage of this is that bus nodes can be switched off, removed or replaced without impacting data transfer. This applies in particular to the nodes at both ends of the bus cable on which the terminating resistors normally have to activated and supplied with power. The PROFIBUS terminator can be installed on a standard rail.

Order no.

6ES7 972-0DA00-0AA0

Design of the PROFIBUS terminator

Design of the PROFIBUS terminator



No.	Function
1	LED 24 V power supply
2	Connection for 24 V DC power supply
3	PROFIBUS connection
4	Shield clamp to ground the braid shield and for strain relief of the bus cable
5	Grounding screw
6	Cable clamp for strain relief of the power supply cable

Technical specifications

Table 4- 6 Technical specifications of the PROFIBUS terminator

Power supply S Rated voltage S Ripple (static limit)	 24 V DC 20.4 V DC to 28.8 V DC
Current consumption at rated voltage	Max. 25 mA
Isolation	yes, 600 V DC
Transmission speed	9.6 kbps to 12 Mbps
Type of protection	IP20
Permissible ambient temperature	0° C to 60° C
Storage temperature	-40 to +70 °C
Connectable cables; power supply Flexible cables with end sleeve without end sleeve Solid conductors	Screw mechanism; 0.25 mm² to 1.5 mm² 0.14 mm² to 2.5 mm² 0.14 mm² to 2.5 mm²
Connectable cables; PROFIBUS	Screw mechanism; all SIMATIC NET PROFIBUS cables

Dimensions W x H x D (mm)	60 x 70 x 43
Weight (including packaging)	95 g

Connecting the PROFIBUS cable

Connect the PROFIBUS cable to the PROFIBUS terminator, as follows:

- Cut the PROFIBUS cable to the required length.
- Strip the insulation from the PROFIBUS cable as shown in Figure 5-10.
  The braid shield must be folded back on to the cable. Only then can the shield clamp serve as strain relief and as the shield contact.

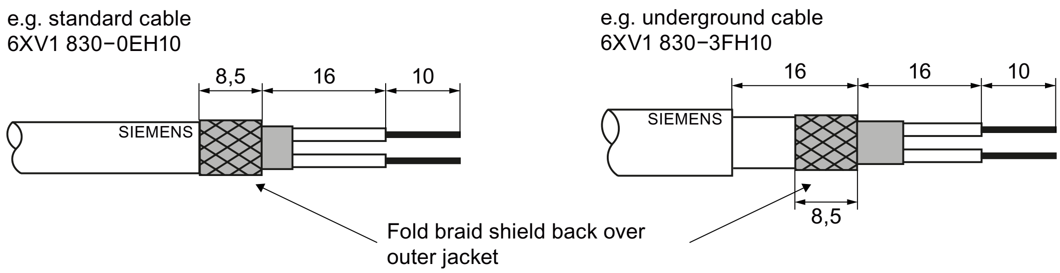


Figure 4-12 Stripping length for connecting to the PROFIBUS terminator

- Connect the PROFIBUS cable to the PROFIBUS terminator:
  Connect the same wires (green/red for the PROFIBUS cable) to the same terminal A or B (in other words always connect terminal A with a green wire and terminal B with a red wire or vice versa).
- Tighten the shield clamps so that the shield makes good contact with the clamp.

Note

When installing the segment, make sure that no terminating resistor is activated on the bus connectors if the two PROFIBUS terminators are included in the PROFIBUS segment.

4.2 Active components for optical networks

4.2.1 Optical bus terminal OBT

Figure 4-13 Optical bus terminal (OBT)

Area of application

The OBT (Optical Bus Terminal) is used to attach a single PROFIBUS node without an integrated optical interface or a PROFIBUS RS485 segment with up to 31 nodes to the optical PROFIBUS. The OBT therefore provides the advantages of optical data transmission for existing DP devices.

The RS-485 interface of an individual PROFIBUS DP node is connected via a cable terminated at both ends (for example connecting cable 830-1T) to the RS-485 interface of the OBT. The OBT is integrated into the optical line using two optical interfaces.

The following optical transmission media can be connected to the OBT:

- Plastic fiber-optic cables can be used up to an individual segment length of 50 m. They can be assembled easily on site by fitting 2 x 2 simplex connectors.
- PCF fiberoptic cables can be used for distances up to 300 m. These cables are preassembled.

Design

The OBT has a compact plastic housing. It is suitable for mounting on a DIN rail or for wall mounting using two holes drilled through it.

The OBT has the following connectors:

- 9pin D-sub female connector for connection of a PROFIBUS RS485 segment with nodes such as programming devices (PG), PCs, operator panels (OP) or nodes without an integrated optical interface, for example an ET 200B or DP components of other manufacturers
- Two optical interfaces for attaching plastic and PCF fiberoptic cables with simplex connectors (connection to CP 3425 FO, IM 467 FO or ET 200 with an integrated optical interface)
- 24 V DC connector for power supply

Functions

- Attachment of a PROFIBUS RS485 segment
- Provides an electrical attachment to the optical PROFIBUS (for example a PG attachment for commissioning and diagnostics)
- Supports all PROFIBUS transmission speeds from 9.6 kbps to 1.5 Mbps and 12 Mbps
- Regeneration of the signals in amplitude and time
- Cascading depth when using user-defined bus parameters up to 126 nodes
- Electrical isolation of the DP node via fiberoptic cable
- Simple diagnostics via LED display for operating voltage and for receipt of data CH1, CH2 and CH3.

Table 4- 7 Ordering data

Ordering data	Order no.
PROFIBUS OBT Optical bus terminal for attachment of a PROFIBUS RS485 segment to an optical bus without simplex connector	6GK1 500-3AA00

4.2.2 Optical Link Module OLM

Figure 4-14 Optical Link Module (OLM)

Area of application

With the PROFIBUS OLM (Optical Link Module), Version 4, PROFIBUS networks can be implemented as bus, star and redundant ring structures.

The transmission rate of a fiberoptic path is not dependent on the distance and can range from 9.6 kbps to 12 Mbps.

OLMs can be used in system buses based on PROFIBUS, interbuilding networks with glass fiberoptic cables, mixed networks with electrical and optical segments, largespan networks (road tunnel, traffic control systems), networks in which high availability is required (redundant ring networks) etc.

Design

OLMs are available with one or two fiberoptic interfaces for different types of fiberoptic cable:

- Plastic fiber-optic cables (980/1000 µm) can be used for single lengths of up to 80 m. They can be fitted with BFOC connectors on site.
- PCF fiber-optic cables (200/230 µm) can be used for single lengths of up to 400 m. They are offered preassembled with four BFOC plugs and an insertion tool.
- Glass fiber multimode fiber-optic cables (62.5/125 µm) such as the SIMATIC NET fiber-optic cables can be used for long distances of up to 3000 m. They must be ordered preassembled with 4 BFOC connectors and are tested before they are supplied.
- Single mode fiberoptic cables (10/125 µm fibers) can be used for extremely long distances of up to 15 km. These are available on request.

OLMs can be combined via an RS485 interface and individual nodes or entire electrical segments can be included in the PROFIBUS network.

Version 4 OLMs support all PROFIBUS transmission speeds up to 12 Mbps.

They have a compact metal casing. They are suitable for installation on a DIN rail or for fixed mounting. When installed vertically, OLMs can be placed sidebyside needing gaps between them.

Functions

Automatic detection of all PROFIBUS data rates: 9.6 kbps to 12 Mbps including 45.45 kbps (PROFIBUS PA)

- Setup of the following network topologies:
  Bus, star, redundant ring
- High availability due to media redundancy. Distance between two OLMs in the redundant ring limited only by the maximum optical distance.
- Attachment to different types of fiberoptic transmission media (one or two optical interfaces, BFOC connectors)
- Isolated RS485 interface with segment capability (D-sub female connector)
- Unrestricted multi-master operation:
  Expanded segmentation functions for localization of faults on fiber-optic and RS-485 segments
- Fast localization of faults:
  - Indication of module status by floating signaling contact
  - Checking the fiber-optic cable link quality Measurement output for optical receiver for logging and checking of the fiber optic signal quality with a voltmeter
- High cascading depth:
  Line and redundant ring up to 122 OLMs (only limited by monitoring times)
- 24 V DC power supply with redundant power supply option
- Line quality display with multicolor LEDs per optical channel

Note

The optical ports of the OLMs are optimized for greater distances. The direct coupling of the optical ports of an OLM with an OBT or integrated optical ports is not possible due to differences in the technical specifications.

Table 4- 8 Ordering data

Ordering data	Order no.
PROFIBUS OLM/P11 Optical Link Module with 1 x RS485 and 1 x plastic FO interface, with signaling contact and measurement output	6GK1 503-2CA00
PROFIBUS OLM/P12 Optical Link Module with 1 x RS485 and 2 x plastic FO interfaces, with signaling contact and measurement output	6GK1 503-3CA00
PROFIBUS OLM/G11 Optical Link Module with 1 x RS485 and 1 x glass FO interface, for standard distances, with signaling contact and measurement output	6GK1 503-2CB00
PROFIBUS OLM/G12 Optical Link Module with 1 x RS485 and 2 x glass FO interface, for standard distances, with signaling contact and measurement output	6GK1 503-3CB00

Ordering data	Order no.
PROFIBUS OLM/G12 EEC Optical link module with 1 x RS 485 and 2 x glass fiber-optic interface (4 BFOC sockets), for standard distances up to 3,000 m, for extended temperature range –20 °C to +60 °C, with signaling contact and measuring output	6GK1 503-3CD00
PROFIBUS OLM/G11-1300 Optical Link Module with 1 x RS485 and 1 x glass FO interface, for long distances, with signaling contact and measurement output	6GK1 503-2CC00
PROFIBUS OLM/G12-1300 Optical Link Module with 1 x RS485 and 2 x glass FO interface, for long distances, with signaling contact and measurement output	6GK1 503-3CC00

Compatibility with predecessor versions

In mixed operation with SINEC L2 Optical Link Modules SINEC L2FO OLM/P3, OLM/P4, OLM/S3, OLM/S4, OLM/S3-1300 and OLM/S4-1300 with OLM V4.0, the functional compatibility must be enabled on the OLM V4.0 (DIL switch).

Enable functional compatibility only when the OLM V4.0 is used as a replacement or expansion device in existing networks with SINEC L2FO OLMs and a direct optical link is required. To interconnect OLM V3 and OLM V4.0, the functional compatibility must be disabled because these devices are compatible with each other.

Further information

You will find more detailed information on the OLM in the IK PI catalog and on the Internet (http://support.automation.siemens.com/WW/view/en/24164176).

4.3 Active components for connecting two PROFIBUS networks

4.3.1 DP/DP coupler

Area of application

The PROFIBUS DP/DP coupler is used to link two PROFIBUS DP networks together. Data (0 to 244 bytes) is transmitted from the DP master of a first network to the DP master of another network and viceversa.

This principle corresponds to the hardwiring of inputs and outputs. The coupler has two independent DP interfaces via which the connection to the two DP networks is established.

The DP/DP coupler represents a slave in each DP network. Data is exchanged between the two DP networks by copying internally in the coupler.

Figure 4-15 DP/DP coupler

Design

The DP/DP coupler is installed in a compact, 40 mm wide housing.

The module can be installed (vertically when possible) on a standard rail with no gaps being necessary.

The coupler is connected to PROFIBUS DP networks via an integrated 9-pin D-sub connector.

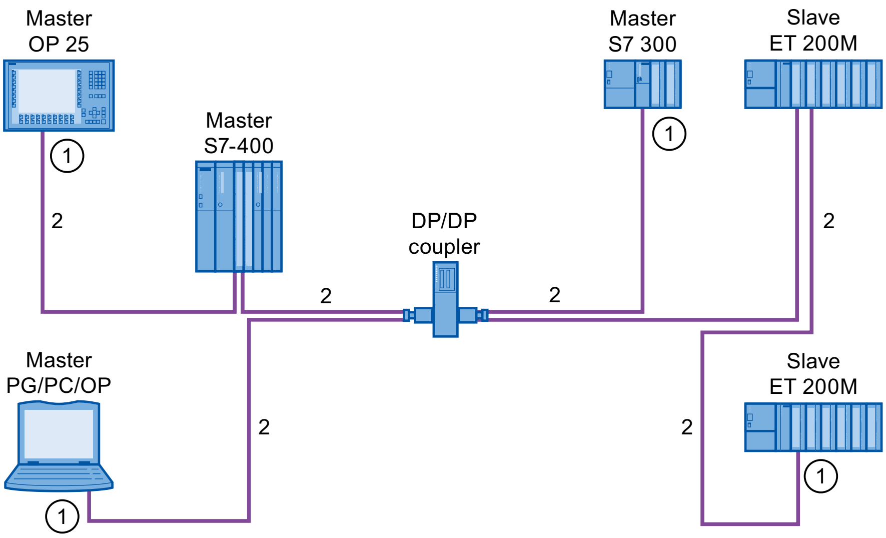


Figure 4-16 Example of a configuration with the DP/DP coupler
① Terminator activated
2 PROFIBUS bus cable

Function

The DP/DP coupler continuously copies the output data of one network to the input data of the other network (and vice versa).

- Exchange of a maximum of 244 bytes of input and output data, in each case with up to 128 bytes consistent
- Maximum of 16 input/output ranges for the exchange of data
- If one side fails, the outputs of the other side are held at the last value
- Support of DPV1 with full diagnostics
- The DP/DP coupler can be set either using switches or with STEP 7
- Different baud rate settings are possible
- Electrical isolation between the two DP networks
- Two-way power supply

Parameter assignment

The PROFIBUS DP addresses are set by using two DIL switches on the top of the device. The configuration is set using the GSD file and the configuration tool of the attached PROFIBUS DP master. The data length is set with the relevant configuration tool.

Ordering data

Ordering data	Order no.
DP/DP coupler To connect two PROFIBUS DP networks.	6ES7 158-0AD01-0XA0

4.4 Active components for interfacing to PROFIBUS PA

4.4.1 Connecting to PROFIBUSPA

DP/PA bus coupler

The DP/PA bus coupler is the link between PROFIBUS DP and PROFIBUS PA. This means that it connects the process control systems with the field devices of process automation (PA).

The following modules are available for the DP/PA bus coupling:

- DP/PA coupler Ex [ia] (6ES7 157-0AD82-0XA0)
- DP/PA coupler FDC 157-0 (6ES7 157-0AC83-0XA0)
- Interface module IM 153-2 (6ES7 153 2BA82-0XB0) for setting up a DP/PA link

To set up a DP/PA link in redundant operation (including coupler and PA ring redundancy), you also require the following:

- Bus module BM IM 153 for 2 x IM 157 (6ES7 195-7HD80 0XA06)
- Bus module BM DP/PA coupler for 2 DP/PA couplers (6ES7 195 7HG80-0XA0)
- 1 field splitter AFS for coupler redundancy (6ES7 157-0AF81-0XA0)
- 1 to 8 field distributors AFD for ring redundancy (6ES7 157-0AF82-0XA0)

4.4.2 DP/PA coupler

Area of application

The DP/PA coupler (stand-alone) is used for small quantity frameworks and low timing requirements.

When using the DP/PA coupler, the data rate on PROFIBUS DP must be fixed at 45.45 kbps. The configuration limits are determined either by the maximum number of addressable slaves (field devices) or the maximum cycle time.

When using the DP/PA coupler, the field devices are addressed directly by the PLC/automation system; the DP/PA coupler is transparent. It is not necessary to configure the DP/PA coupler.

Figure 4-17 DP/PA coupler

The figure below illustrates the logical integration of the DP/PA couplers in the system.

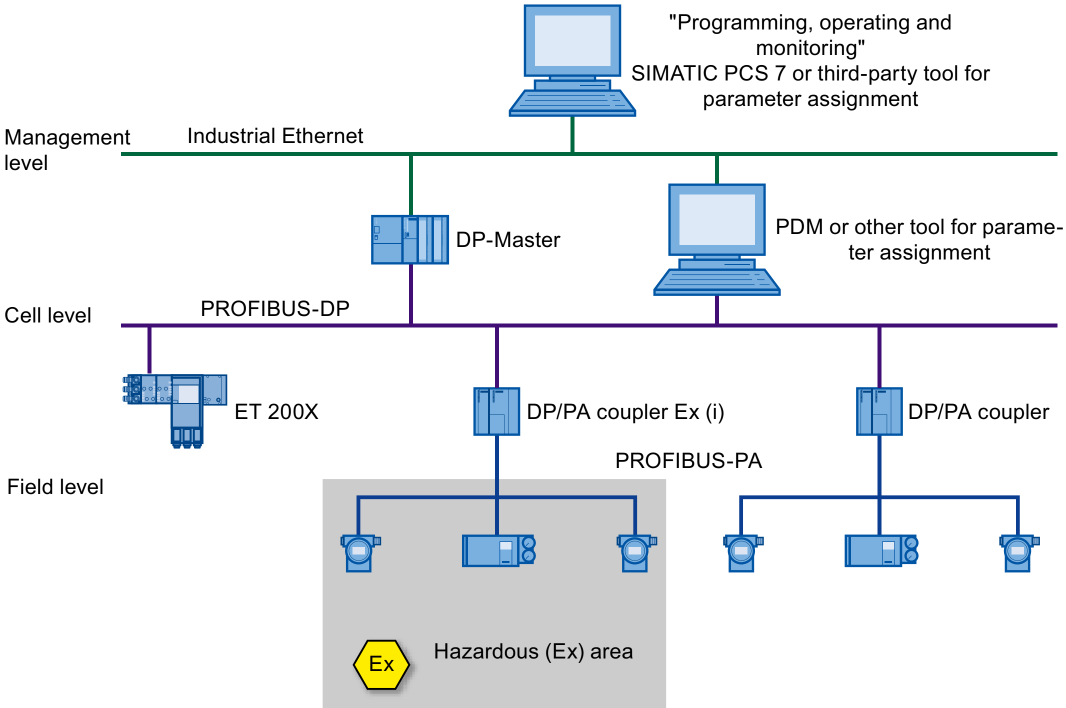


Figure 4-18 Logical integration of DP/PA couplers into the system

For more information on expanding the PA line, refer to section "Field distributors AFD/AFS (Page 97)"

Areas of application of the DP/PA coupler

The DP/PA coupler is available in two versions:

- DP/PA coupler Ex [ia]: You can attach all field devices that are certified for PROFIBUS PA and that are inside the hazardous area.
- DP/PA coupler FDC 157-0: You can attach all field devices that are certified for PROFIBUS PA and that are outside the hazardous area.

The DP/PA coupler is "related equipment" in compliance with EN 50014 or EN 50020.

Properties of the DP/PA coupler (general)

The DP/PA coupler FDC 157-0 (6ES7 157-0AC83-0XA0) has the following characteristics:

- Electrical isolation between PROFIBUS DP and PROFIBUS PA
- Conversion of the physical transmission properties between RS485 and IEC 611582
- Diagnostics using LEDs
- Transmission speed on PROFIBUS DP 45.45 kbps
- Transmission speed on PROFIBUSPA 31.25 kbps
- Integrated power supply unit

Properties of the DP/PA coupler Ex [ia]

The DP/PA coupler Ex Ex [ia] (6ES7 157-0AD82-0XA0) has the following additional characteristics:

- Type of protection EEx [ia] IIC T4
- Intrinsic safety
- Integrated, intrinsically safe power supply unit and integrated barrier

Configuring the DP/PA coupler

- The DP/PA coupler can be used in SIMATIC S5 and S7 and with all DP masters that support 45.45 kbps.
- For the DP/PA coupler, you only need to set the transmission speed of 45.45 kbps for the relevant DP network during configuration.
  You then configure the PA field devices just as normal DP slaves using the DP configuration tool and the appropriate GSD file. You can configure the PA field devices with SIMATIC PDM or with any other vendorspecific software configuration tool.
- Configuration of the DP/PA coupler FDC 157-0 as a DP slave is necessary in the following situations:
  - If the diagnostic functions will be effective.
  - If you want to operate the DP/PA couplers with ring redundancy or coupler redundancy.

Further information

Operating instructions *DP/PA Coupler, DP/PA Link and Y Link Bus Couplers* (Bus links (http://support.automation.siemens.com/WW/view/en/1142696))

4.4.3 DP/PA link

Area of application

The DP/PA link is used for large quantity frameworks and high timing requirements.

The DP/PA link is a slave on the PROFIBUS DP and a master on the PROFIBUS PA. The PLC/automation system addresses the field devices over the DP/PA link like a modular slave whose modules are the PA devices.

Configuration of the DP/PA link is integrated extremely conveniently in the STEP 7 configuration software (V4.02 and higher). The DP/PA link can be operated on PROFIBUS DP standard masters.

The GSD file required for operation on PROFIBUS DP standard masters can be downloaded from the Internet (you will find more detailed information on the Internet (http://support.automation.siemens.com/WW/view/en/26562190)).

Definition

The DP/PA link consists of the IM 153-2 and up to a maximum of five DP/PA couplers. The DP/PA link is a DP slave at the PROFIBUS DP end and a PA master at the PROFIBUS PA end.

Application

With the DP/PA link, you have a decoupled interface from PROFIBUS PA to PROFIBUS DP with transmission speeds of 9.6 kbps to 12 Mbps.

The following figure shows where the DP/PA Link fits in.

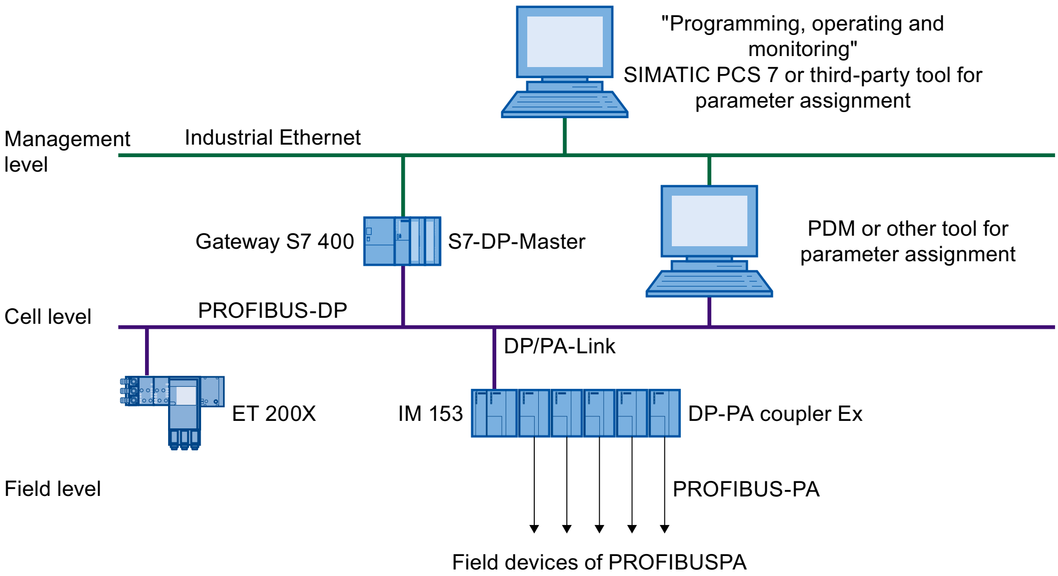


Figure 4-19 Integration of the DP/PA Link

The DP/PA Link is configured with STEP 7, Version 4.02 or higher.

Properties

The DP/PA Link has the following characteristics:

- Diagnostics with LEDs and the user program
- DP slave and PA master
- Can be operated at all transmission speeds (9.6 kbps to 12 Mbps)

Mode of operation

The following figure shows how the DP/PA Link functions with the IM 153-2 (6ES7 153-2BA82-0XB0) and the DP/PA couplers.

- The DP/PA Link maps the underlying PROFIBUS PA system on a DP slave.
- With the DP/PA Link, PROFIBUS DP is completely decoupled from PROFIBUS PA.

- The PA master and PA slaves form a separate, underlying bus system.
- Increasing the number of DP/PA couplers simply serves to increase availability. All DP/PA couplers along with the attached PA field devices form one common PROFIBUS PA bus system.

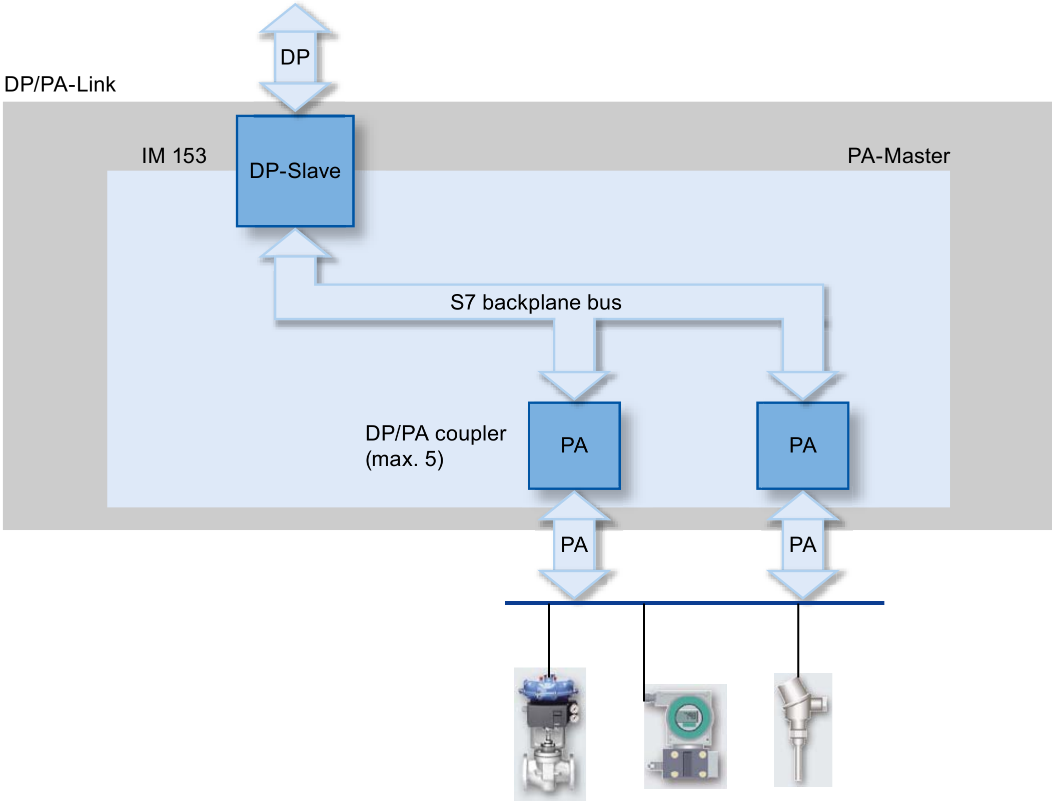


Figure 4-20 How the DP/PA Link works with DP/PA couplers

Rules

The following rules apply when configuring PROFIBUS PA:

- There can be a maximum of 31 PA field devices in a PROFIBUS PA system
- Only one device supplying power (=DP/PA coupler) may be connected in a physical PROFIBUS PA segment.
- A maximum of 31 PA field devices can be attached to a DP/PA Link. The maximum number of attachable PA field devices per physical PROFIBUS PA segment or per DP/PA coupler is limited by the maximum output current of the DP/PA coupler and the I/O data to be transferred.

Further information

Operating instructions *DP/PA Coupler, DP/PA Link and Y Link* (Bus couplers (http://support.automation.siemens.com/WW/view/en/1142696))

4.5 Active components for the link from PROFIBUS DP to RS-232C

4.5.1 DP/RS232C Link

Design

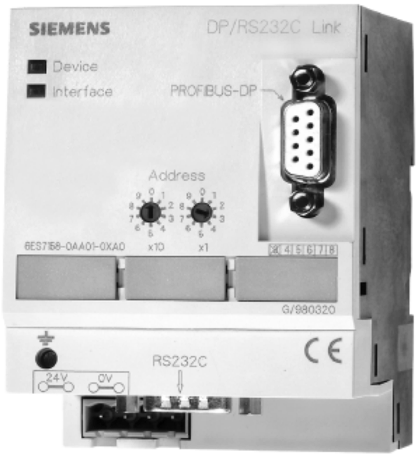


Figure 4-21 DP/RS232C Link for PROFIBUS DP

The DP/RS232C Link (6ES7 158-0AA01-0XA0) consists of a compact 70 mm housing for DIN rail mounting. Ideally the module should be installed vertically. The modules can be inserted one beside the other without gaps being necessary. The system is connected to PROFIBUS DP via a 9-pin D-sub socket. The RS232C interface is implemented as a 9pin D-sub connector.

Area of application

The PROFIBUS DP/RS232C Link is a converter between an RS232C (V.24) interface and PROFIBUS DP. Devices with an RS232C interface can be linked to PROFIBUSDP with the DP/RS232C Link. The DP/RS232C Link supports the procedures 3964 R and free ASCII protocol.

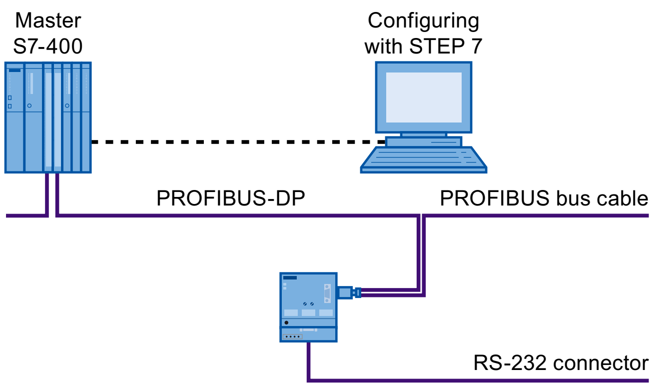


Figure 4-22 Example of a configuration with the DP/RS232C Link

How it works

The PROFIBUS-DP/RS-232C Link is connected to the device over a point-to-point link. Conversion to the PROFIBUSDP protocol takes place on the PROFIBUSDP/RS232C Link. The data is transferred consistently in both directions. Up to 224 bytes of user data can be transferred per frame.

Parameter assignment

The PROFIBUSDP address can be set using two rotary switches on the front panel. The device is configured using the GSD file and the configuration tool of the connected device, for example STEP 7.

4.5.2 Field distributors AFD/AFS

Overview

The active field distributors (AFD) and active field splitters (AFS) allow two variants of redundant operation on a PA line:

- Ring redundancy with up to 8 AFDs
- Coupler redundancy with AFS

Figure 4-23 Field distributors AFD/AFS

Area of application

- Active Field Distributor AFD

  PA field devices, for example measuring instruments, sensors and actuators can be connected to the active field distributor (AFD).

  In conjunction with 2 DP/PA couplers (FDC 157-0), the active field distributor (AFD) allows operation with ring redundancy. In this case, a maximum of 8 active field distributors (AFD) connect 2 DP/PA couplers with the PA field devices. You can connect up to 4 PA field devices to one active field distributor (AFD). The total number of PA field devices on the PA line is 31 devices and this is limited by 1 A maximum current.

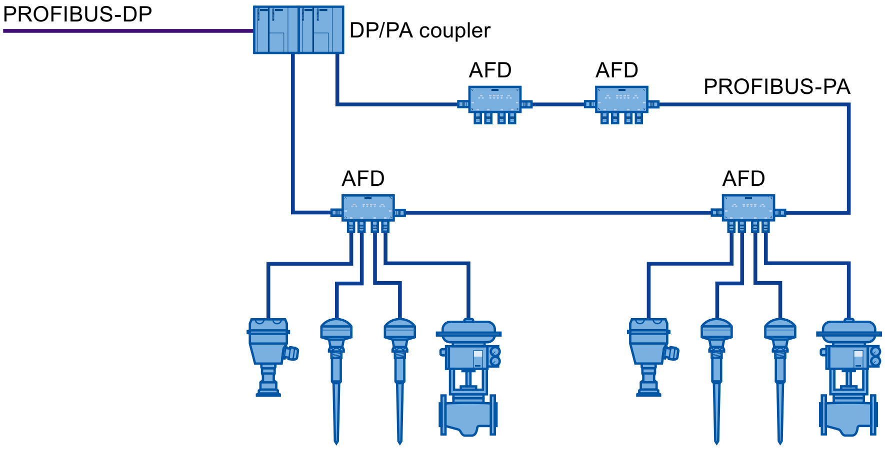


Figure 4-24 DP/PA coupler in redundant mode

- AFS (Active Field Splitter)

  The active field splitter (AFS) connects 2 DP/PA couplers (FDC 157-0) with the field devices of a PROFIBUS PA line. It therefore allows coupler redundancy on the PA line. The total number of PA field devices on the PA line is 31 devices and this is limited by 1 A maximum current.

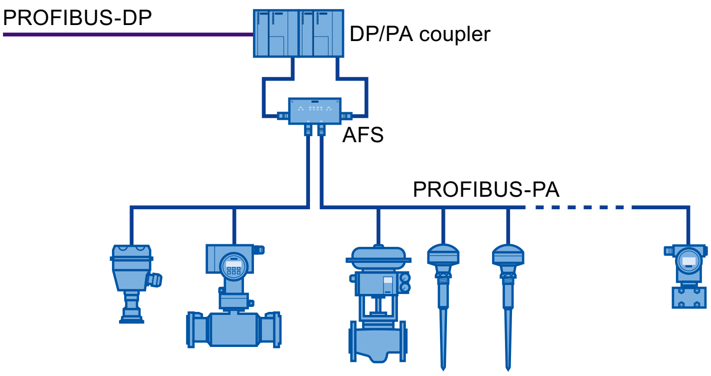


Figure 4-25 Coupler redundancy with active field splitter (AFS)

	AFD	AFS
Functions	• Connection of field devices for PROFIBUS PA • Automatic bus termination • Isolation of defective PA segments • Reconnection of isolated PA segments after eliminating the problem • Extending a PA segment during ongoing operation	• Automatic switchover of the PA main line to the active DP/PA coupler
Properties	• 2 cable glands for the PA main line • 4 cable glands for 4 PA field devices • Connection of the PROFIBUS PA trunk line and the PA spur lines using the spring clamp method • Reverse polarity protection connections • Diagnostics using LEDs • Power supply via the PA bus • Screw gland on substrate or mount with adapter on mounting rail • Degree of protection IP66 • Grounding terminal outside	• 2 cable glands for the PA main line • 1 cable gland for the PROFIBUS PA line • Optional: Center feed via a cable bushing • Connection of the PROFIBUS PA trunk lines with spring clamps • Reverse polarity protection connections • Connection of maximum 31 PA field devices • Diagnostics using LEDs • Power supply via the PA bus • Screw gland on substrate or mount with adapter on mounting rail • Degree of protection IP66 • Grounding terminal outside

Ordering data

Ordering data	Order no.
SIMATIC DP, active field distributor AFD	6ES7 157-0AF81-0XA0
SIMATIC DP, active field splitter AFS	6ES7 157-0AF82-0XA0

Further information

Operating instructions *DP/PA Coupler, DP/PA Link and Y Link Bus Couplers* (Bus links (http://support.automation.siemens.com/WW/view/en/1142696))

4.6 Active components for connecting a PROFIBUS segment to an Industrial Ethernet network

4.6.1 IE/PB Link PN IO

Area of application

As a separate component, the IE/PB PN IO link provides a seamless transition between Industrial Ethernet and PROFIBUS.

Figure 4-26 IE/PB Link PN IO

Using the IE/PB Link PN IO as a proxy, you can continue to use existing PROFIBUS devices and integrate them in a PROFINET application.

Design

The IE/PB Link PN IO has all the advantages of the SIMATIC design:

- Compact construction; the rugged plastic housing has the following on the front panel:
  - An RJ-45 interface for connection to Industrial Ethernet.
  - A 9-pin D-sub socket for connection to PROFIBUS
  - A 2-pin terminal strip for connecting the external power supply of 24 V DC.
  - Diagnostic LEDs
- Connection is by means of the IE FC RJ-45 Plug 180 with 180° cable outlet using a standard patch cable
- Simple mounting; the IE/PB Link PN IO is mounted on an S7-300 rail
- Can be operated without a fan
- Fast device replacement in the event of a fault by using the optional C-PLUG exchangeable medium (not supplied with the device)

Function

- PROFINET

PROFINET IO PROXY; interfacing of PROFIBUS DP slaves to PROFINET IO controller with real-time communication (RT) according to PROFINET standard additional functionality for vertical integration:

- S7 routing
  - permits cross-network PG communication, in other words, all S7 stations on Industrial Ethernet or PROFIBUS can be programmed remotely using the programming device.
  - permits access to visualization data of S7 stations on PROFIBUS from HMI stations on Industrial Ethernet.
- Data record routing (PROFIBUS DP)

  Using this function, the IE/PB Link PN IO can be used as a router for data records that are intended for field devices (DP slaves). SIMATIC PDM (Process Device Manager) is a tool that creates data records of this type for parameter assignment and diagnostics of field devices.

  It is possible, for example, to use SIMATIC PDM (on the PC) on Industrial Ethernet to set parameters and run diagnostics for PROFIBUS PA field device over the IE/PB Link PN IO and DP/PA coupler.

  The additional functions for vertical integration can also be used in an existing PROFIBUS application without PROFINET for connection to a higher-level Industrial Ethernet.

  In this case, the IE/PB Link PN IO is used as an additional DP master class 2 on a PROFIBUS segment to link to Industrial Ethernet and provides the above functions.

Ordering data

Ordering data	Order no.
IE/PB Link PN IO Link between Industrial Ethernet and PROFIBUS with PROFINET IO functionality, TCP/IP, S7 routing and data record routing	6GK1 411-5AB00

4.7 Active components for linking between Industrial Wireless LAN and PROFIBUS

4.7.1 IWLAN/PB Link PN IO

Area of application

Figure 4-27 IWLAN/PB Link PN IO

The IWLAN/PB Link PN IO supports the use of IWLAN and WLAN antennas for wireless or contact-free data transmission, for example in monorail overhead conveyors or storage and retrieval systems. Support of PROFINET means that the wide variety of PROFIBUS system services, such as diagnostics over the bus, can still be utilized.

- Overhead monorail conveyors

  Vehicle controllers for suspended monorails can be implemented economically on the basis of SIMATIC components. High availability, short response times and easy expansion can be achieved by using distributed controllers, such as SIMATIC ET 200S IM 151/CPU. With the aid of the IWLAN/PB Link PN IO, the vehicle controllers can continue to be used without change. The user can also program them remotely with STEP 7 over IWLAN.

- Storage and retrieval systems

  In storage and retrieval systems, data light barriers requiring intensive maintenance can be replaced by an IWLAN solution. This increases plant availability.

Design

The IWLAN/PB Link PN IO is snapped onto a standard mounting rail. The external dimensions are the same as those of the power rail boosten housing. An antenna for an IWLAN RF field is attached using a connector. The IP20 degree of protection ensures that the IWLAN/PB Link PN IO is suitable for installation in the control cabinet.

- Compact design;

  the front panel of the rugged plastic enclosure includes:

  – An R-SMA interface for connecting antennae

  – A 9-pin D-sub socket for connection to PROFIBUS

  – A 4-pin terminal block for connecting the external power supply of 24 V DC

  – Diagnostic LEDs
- Can be operated without a fan
- Fast device replacement in the event of a fault by using the optional C-PLUG exchangeable medium (not supplied with the device)

Function

- PROFINET

  PROFINET IO PROXY; wireless connection of PROFIBUS DP slaves to PROFINET IO controller using real-time communication (RT) according to PROFINET standard

Ordering data

Ordering data	Order no.
IWLAN/PB Link PN IO Link between Industrial Wireless LAN and PROFIBUS with PROFINET IO functionality	
National approvals for operation outside the USA	6GK1 417-5AB00
National approvals for operation in the USA	6GK1 417-5AB01

4.8 Active components for the link between PROFIBUS (DP slave) and AS-Interface

4.8.1 DP/AS-i LINK Advanced

Area of application

Figure 4-28 DP/AS-i Link Advanced - single master / double master

The DP/AS-i LINK Advanced is a PROFIBUS DPV1 slave (according to IEC 61158-2 / EN 61158-2) and an AS-Interface master (according to AS-Interface specification V3.0 to EN 50 295) and it allows transparent data access to the AS-Interface from PROFIBUS DP.

PROFIBUS DP masters can exchange I/O data with the AS-Interface cyclically. DP masters with acyclic services can also carry out AS-Interface master calls. DP/AS-i LINK Advanced is, therefore, suitable for distributed configurations and for integrating a lower-level AS-Interface network.

The AS-Interface single master version of DP/AS-i LINK Advanced is suitable for applications with typical volumes of data.

The AS-Interface double master version of DP/AS-i LINK Advanced is suitable for applications with large volumes of data. In this case, the double data volumes can be processed on two separate AS-Interface lines.

Design

The DP/AS-i LINK Advanced comprises a stable housing for DIN rail mounting with degree of protection IP20 and it can be operated without a battery or fan.

In the event of a fault, the DP/AS-i LINK Advanced allows fast device replacement with the optional C-PLUG exchangeable medium (not supplied with the device).

The DP/AS-i LINK Advanced has a compact design and features the following:

- A display on the front panel for detailed indication of the mode and the functional readiness of all connected and activated AS-Interface slaves
- 6 buttons for startup and testing of the AS-Interface line directly on the DP/AS-i LINK Advanced
- LED displays of the mode of the PROFIBUS DP and AS-Interface

- Integrated Ethernet port (RJ-45 jack) for convenient startup, diagnostics and testing of the DP/AS-i LINK Advanced via a Web interface with a standard browser
- Power supplied via the AS-Interface profile cable or alternatively with 24 V DC
- Low mounting depth due to recessed connector assembly

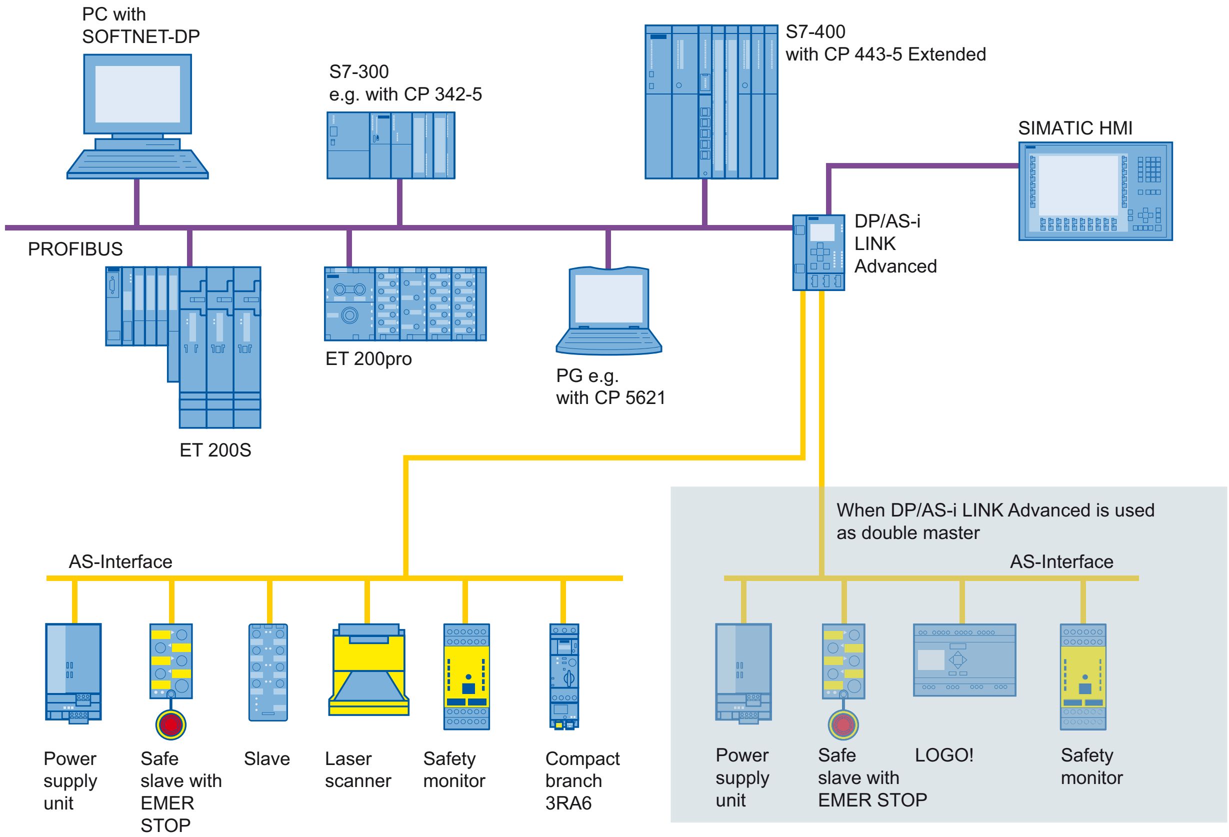


Figure 4-29 Example of a configuration with the DP/AS-i LINK Advanced

Function

The DP/AS-i LINK Advanced allows a PROFIBUS DP master cyclic access to the I/O data of all slaves of a lower-level AS-Interface segment. In line with the expanded AS-Interface specification (V3.0), a maximum of 62 slaves - each with 4 digital inputs and 4 digital outputs - as well as analog slaves, can be connected per AS-Interface line. The extended slave types according to the AS-i Specification V3.0 with higher I/O data volumes are also supported.

The DP/AS-i LINK Advanced normally occupies 32 input bytes and 32 output bytes on the DP master, in which the I/O data of the connected digital AS-Interface slaves of an AS-i line are stored. The double master occupies twice the number of bytes. The size of the input/output buffer can be compressed so that only the I/O memory actually required is used on the DP master system.

Integrated evaluation of analog signals is just as simple as access to digital values; it is unnecessary to call communications blocks.

PROFIBUS DP V1 masters can also trigger AS-Interface master calls using the acyclic PROFIBUS services (for example: write parameters, change addresses, read diagnostic values).

An operator display on the AS-i Link allows you to commission the lower-level AS-Interface line completely. The DP/AS-i LINK Advanced is equipped with an additional Ethernet port that permits use of the integrated Web server further increasing the user-friendliness of the operator display already described. Firmware updates are also available.

The optional C-PLUG supports module replacement without input of connection parameters (PROFIBUS address etc.), ensuring that downtimes in the event of a fault are reduced to a minimum.

Diagnostics

Comprehensive diagnostic functions are available via LEDs, displays, control buttons, Web interface, or STEP 7. These include:

- Operating status of the Link
- Status of the Link as a PROFIBUS DP slave
- Diagnostics of the AS-Interface network
- Frame statistics
- Standard diagnostics pages for fast diagnostic access using a standard browser.

Configuration

The DP/AS-i LINK Advanced can be configured using STEP 7 as of version V5.4 or simply by adopting the actual configuration of the AS-Interface on the display.

Alternatively, the DP/AS-i LINK Advanced can be integrated in the engineering tool by means of the PROFIBUS GSD file:

- STEP 7 versions earlier than V5.4
- Engineering tools from other vendors

If STEP 7 is used for configuration, the AS-Interface configuration can be uploaded to STEP 7 as of V5.4. Siemens AS-Interface slaves can also be conveniently configured in HW Config (slave selection dialog).

Ordering data

Ordering data	Order no.
Single master with display	6GK1 415-2BA10
Dual master with display	6GK1 415-2BA20

Further information

Manual "DP/AS-Interface Link Advanced (http://support.automation.siemens.com/WW/view/en/22502958/133300)"

4.8.2 DP/AS-Interface Link 20E

Area of application

Figure 4-30 DP/AS-Interface Link 20E

The DP/AS-Interface Link 20E is a PROFIBUS DP slave (to EN 50 170) and AS-Interface master (according to the AS-Interface specification V3.0 to EN 50 295) and permits the AS-Interface to be operated on PROFIBUS DP.

Simple PROFIBUS masters can exchange I/O data with the AS-Interface cyclically. Masters with acyclic services can exchange I/O data and carry out master calls.

Design

The DP/ASinterface link 20E consists of a compact housing with degree of protection IP20.

The LEDs on the front panel indicate the operating status and functional readiness of all connected and activated slaves. The DP/AS-Interface Link 20E also has other LED displays for the PROFIBUS DP slave address, DP bus faults and diagnostics.

The DP/AS-Interface Link 20E has two buttons for changing the operating mode and for adopting the current actual configuration as the desired configuration.

The PROFIBUS DP address can be set using buttons.

The power is supplied via the AS-Interface profile cable

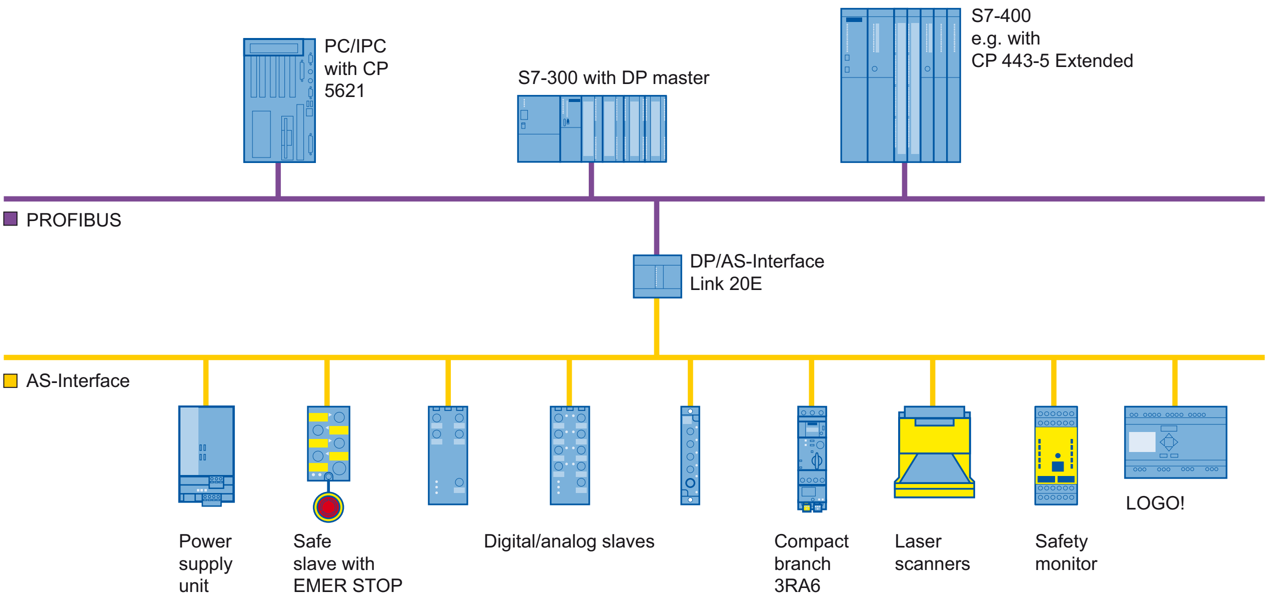


Figure 4-31 Example of a configuration with the DP/AS-Interface Link 20E

Function

DP/AS-Interface Link 20E allows a DP master to access all the slaves in an AS-Interface segment. In line with the extended specification (V3.0), up to a maximum of 62 slaves each with four digital inputs and four digital outputs as well as analog slaves can now be connected.

The DP/AS-Interface Link 20E is normally assigned 32 bytes of input data and 32 bytes of output data on the DP master on which the I/O data for the connected AS-Interface slaves is stored. The size of the input/output buffer can be compressed so that only the memory actually required on the DP master is used.

PROFIBUS DP masters can also trigger AS-Interface master calls using the acyclic PROFIBUS services (for example: write parameters, change addresses, read diagnostic values).

Configuration

DP/AS-Interface Link 20E can be configured on PROFIBUS with STEP 7.

The GSD file is also supplied with the manual, which means that configuration can even be carried out for versions in which DP/AS-Interface Link 20E is not yet normally available.

The AS-Interface segment can be configured with STEP 7 or simply by adopting the actual configuration. Commissioning is also possible without PROFIBUS.

If STEP 7 is used for the configuration, the AS-Interface configuration can be uploaded to STEP 7 as of version V5.2.

Ordering data

Ordering data	Order no.
DP/AS-Interface Link 20E Link between PROFIBUS DP and AS-Interface with degree of protection IP20	6GK1 415-2AA10

Further information

Manual "DP/AS–Interface Link 20E (http://support.automation.siemens.com/WW/view/en/33563718)"

4.8.3 DP/AS-i F-Link

Area of application

Figure 4-32 DP/AS-i F-Link

The DP/AS-i F-Link is a PROFIBUS DP-V1 slave (to EN 50170) and AS-i master (to EN 50295 according to the AS-Interface Specification V3.0) and allows transparent data access to the AS-Interface from PROFIBUS DP. DP/AS-i F-Link is also the only AS-i master with which safety-oriented input data can be transferred from ASIsafe slaves to a failsafe CPU with the PROFIBUS DP master using the PROFIsafe protocol. Additional safety-oriented cabling or monitoring is not required (in particular, there is no need for an AS-Interface safety monitor). Binary or analog values can be transferred depending on the slave type. All slaves that comply with AS-Interface Specification V2.0, V2.1 or V3.0 can be operated as AS-i slaves.

As a fully-fledged AS-i master according to Specification V3.0, the configuration limits in the AS-i network are significantly extended (496 inputs and 496 outputs, up to 62 digital or analog slaves).

Design

The DP/AS-i F Link consists of a compact housing with degree of protection IP20.

The LEDs on the front panel of the DP/AS-i F Link indicate the current status and error messages (device status, AS-i power/status, bus faults (PROFIBUS DP), group errors).

The DP/AS-i F Link three buttons for changing the mode, confirming a menu entry and resetting to the factory settings.

Power is supplied via a 24 V DC power unit (PELV).

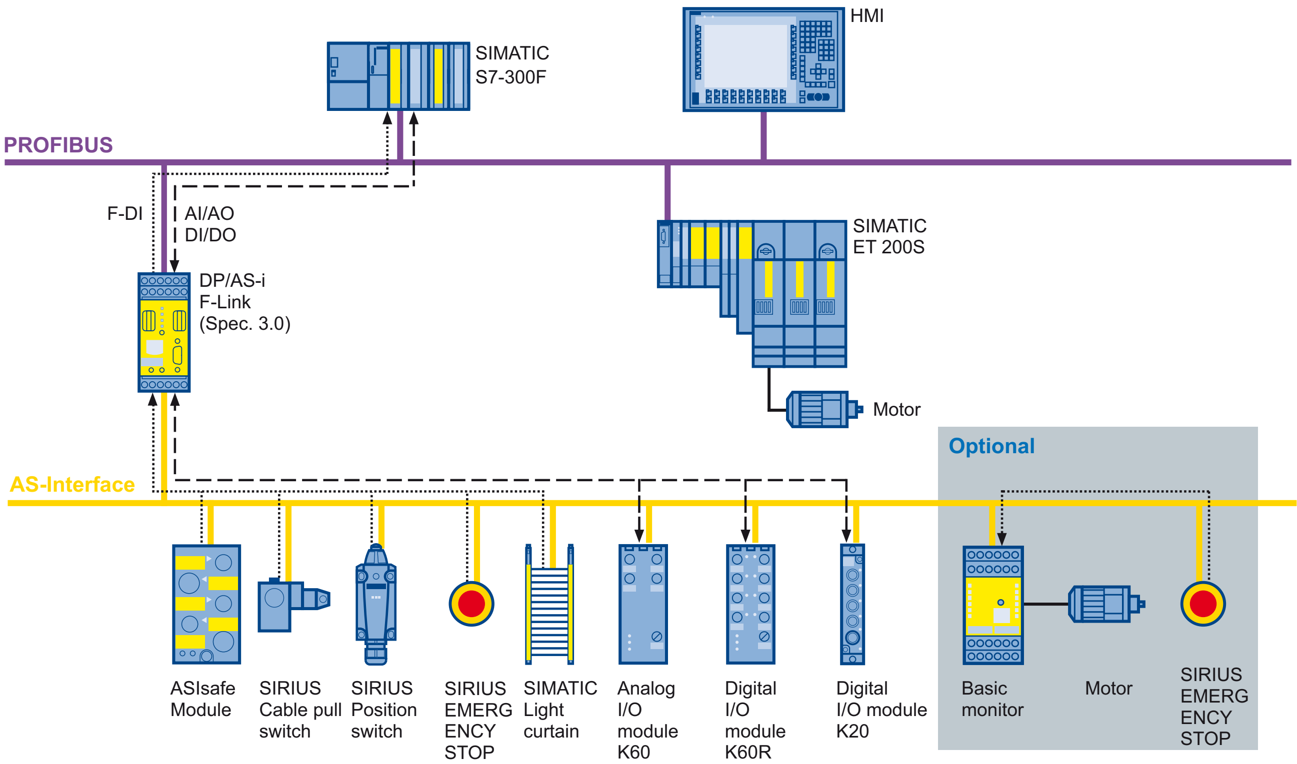


Figure 4-33 Example of configuration with the DP/AS-i F Link

Function

PROFIBUS DP masters to DP-V0 or DP-V1 can exchange I/O data with lower-level AS-i slaves cyclically.

PROFIBUS DP master with acyclic services complying with DP-V1 can also executed AS-i command calls (fore example, read/write AS-i configuration during ongoing operation).

Apart from the digital I/O data, analog data is also stored quickly in the cyclic I/O area of a failsafe S7-300/S7-416 F-CPU.

In configuration mode, DP/AS-i F-Link reads the configuration data of the I/O devices on the AS-Interface. Slave addresses can be set and code sequences of secure AS-i slaves taught in via the display and operator input keys.

During operation, four LEDs and the display provide detailed diagnostic information which, if necessary, can be used to localize faults immediately. A user program allows diagnostic data records to be read and made available to a higher-level operator control and monitoring system (for example WinCC).

Configuration

The DP/AS-i F Link can be configured with STEP 7 as of version V5.4 SP1. All AS-Interface slaves from Siemens can be configured conveniently in HW Config (slave selection catalog) and safety parameter settings made.

It is also possible to upload the AS-Interface configuration to STEP 7 and to adopt the actual configuration directly on the device (commissioning aid).

Alternatively, the DP/AS-i F Link can be integrated in the engineering tool using the PROFIBUS GSD file.

Unlike the AS-Interface safety monitor, DP/AS-i F-Link is simply a gateway with no separate safety logic. The safety function is programmed at the level of the higher-level failsafe controller, for example:

- With Distributed Safety as of version V5.4 SP1 for SIMATIC S7-300F/416F
- With SAFETY INTEGRATED "SI-Basic" or "SI-COMFORT" NCU software for SINUMERIK 840D pl/sl.

Note

To configure with STEP 7 / HW Config, the F Link object manager must be installed.

You can download the object manager from the Internet (http://support.automation.siemens.com/WW/view/en/24724923) free of charge.

Ordering data

Ordering data	Order no.
DP/AS-i F-Link Link between PROFIBUS DP and AS-Interface for safety-oriented data transmission from ASIsafe to PROFIBUS DP – PROFIsafe. Master profile M4 complying with expanded AS-i Specification 3.0. Degree of protection IP20	
Screw-type terminals	3RK3 141-1CD10
Spring-loaded terminals	3RK3 141-2CD10

Further information

"DP/AS-i F Link (http://support.automation.siemens.com/WW/view/en/24196041)" manual

5 Cables for PROFIBUS RS485 networks

5.1 RS-485 cables

PROFIBUS cables

Various SIMATIC NET PROFIBUS cables are available allowing optimum adaptation to different environments.

All the information about segment lengths and transmission rates refer only to these cables and can only be guaranteed for these cables.

The following applies for all PROFIBUS cables:

- Due to the double shielding, they are particularly suitable for laying in industrial environments subject to electromagnetic interference.
- A consistent grounding concept can be implemented via the outer jacket and the ground terminals of the bus terminal.
- The meter markers printed on the cable make it easier to identify the length. (Serve as orientation; accuracy ±5 %.)

Notes on installing RS485 bus cables

Bus cables are impaired by mechanical damage. How to install bus cables correctly is described in detail in Appendix "Installing bus cables (Page 259)".

To make it easier to measure the length of cables, they have a marker every meter.

Overview

The table below is an overview of the bus cables for PROFIBUS showing their mechanical and electrical characteristics.

If you require a cable with characteristics that are not covered by the range of products described here, please contact your local SIEMENS office.

Ordering special cables, accessories, and tools

Special cables and special lengths of all SIMATIC NET bus cables as well as accessories, tools and measuring equipment can be obtained from:

I IA SE IP S BD 1
Jürgen Hertlein
Tel.: +49 (911) 750-4465
Fax: +49 (911) 750-9991
juergen.hertlein@siemens.com (mailto:juergen.hertlein@siemens.com)

Table 5- 1 Bus cables for PROFIBUS (1)

Technical specifications 1) Cable type	FC standard cable GP	FC standard cab le IS GP	FC FRNC cable GP	FC food cable	FC robust cable
Order no.	6XV1 830-0EH10 0EU10	6XV1 831-2A	6XV1 830-0LH10	6XV1 830-0GH10	6XV1 830-0JH10
Attenuation at 16 MHz at 4 MHz at 38.4 kHz at 9.6 kHz	 42 dB/km 22 dB/km 4 dB/km 2.5 dB/km	 42 dB/km 22 dB/km 4 dB/km 2.5 dB/km	 42 dB/km 22 dB/km 4 dB/km 2.5 dB/km	 42 dB/km 22 dB/km 4 dB/km 2.5 dB/km	 42 dB/km 22 dB/km 4 dB/km 2.5 dB/km
Surge impedance at 9.6 kHz at 31.25 kHz at 38.4 kHz at 3 to 20 MHz Rated value	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω
Loop resistance	110 Ω/km	110 Ω/km	110 Ω/km	110 Ω/km	110 Ω/km
Shield resistance	9.5 Ω/km	9.5 Ω/km	9.5 Ω/km	9.5 Ω/km	9.5 Ω/km
Effective capacitance at 1 kHz	28.5 nF/km	28.5 nF/km	29 nF/km	28.5 nF/km	28.5 nF/km
Operating voltage (rms value)	100 V	100 V	100 V	100 V	100 V
Cable type Standard code	02YSY(ST)CY 1x2x0.64/2.55 150 KF 40 FR	02YSY(ST)CY 1×2×06.5/2.56 BL KF40 FR	02YSH(ST)CH 1x2x0.64/2.55 -150 VI KF25 FRNC	02YSY(ST)C2Y 1x2x0.64/2.55 -150 KF40	02YSY(ST)C11Y 1x2x0.64/2.55 -150 KF40 FR VI
Jacket Material Color Diameter	 PVC violet 8.0 ± 0.4 mm	 PVC blue 8 mm ± 0.4 mm	 FRNC light violet 8.0 ± 0.4 mm	 PE black 8.0 ± 0.4 mm	 PUR violet 8.0 ± 0.4 mm
Perm. ambient conditions -Operating temperature -Transportation/storage temperature -Installation temperature	 -40°C + 75°C -40°C + 75°C -40°C + 75°C	 -40°C + 75°C -40°C + 75°C -40°C + 75°C	 -25°C + 80°C -25°C + 80°C -25°C + 80°C	 -40°C + 60°C -40°C + 60°C -40°C + 60°C	 -40°C + 60°C -40°C + 60°C -40°C + 60°C
Bending radiuses Single bend Multiple bends	 150 mm 300 mm	 150 mm 300 mm	 60 mm 80 mm	 30 mm 60 mm	 75 mm 150 mm
Max. tensile load	100 N	100 N	100 N	100 N	100 N
Approx. weight	80 kg/km	80 kg/km	72 kg/km	67 kg/km	71 kg/km

Technical specifications 1) Cable type	FC standard cable GP	FC standard cab le IS GP	FC FRNC cable GP	FC food cable	FC robust cable
Resistance to fire	Flame retardant to IEC 60332-3-24 Category C	Flame retardant to IEC 60332-3-24 Category C	Flame retardant to IEC 60332-3-24 Category C IEC 60332-3-22 Category A	Flammable	Flame retardant to IEC 60332-1
Resistance to oil	Conditionally resistant to mineral oils and fats	Conditionally resistant to mineral oils and fats	-	Conditionally resistant to mineral oils and fats	Resistant to mineral oils and grease
UV resistance	Resistant	Resistant	Resistant	Resistant	Resistant
Product property Halogen-free Silicone-free ROHS-compliant	 No Yes Yes	 No Yes Yes	 Yes Yes Yes	 No Yes Yes	 No Yes Yes
UL listing at 300 V rating UL style at 600 V rating	Yes/CMG/CL3/ Sun Res Yes	Yes/CMG/CL3/ Sun Res Yes	Yes/CMG/CL3/ Sun Res Yes	No No	Yes / CMX No
1) Electrical characteristics at 20 °C, tests according to DIN 47250 Part 4 or DIN VDE 0472 2) Trailing cables for the following requirements: - Min. 3 million bending cycles for the specified bending radius and an acceleration of max. 4 m/s^2 3) Outer diameter >8 mm; bus connectors can only be connected after the outer jacket has been stripped 4) Not suitable for connection to insulation piercing bus connectors (6ES7 972 0BA30 0XA0) 5) At 800 Hz 6) Restricted segment lengths 7) Transmission rate 31.25 kbps 8) Cable suitable for applications involving torsion: min. 5 million torsion movements on 1 m Cable length (±180°)					

Table 5- 2 Bus cables for PROFIBUS (2)

Technical specifications 1) Cable type	FC ground cable	FC trailing cable 6) 4)	FC trailing cable 6) 4)	Festoon cable 6) 4)	Torsion cable 6) 4) 8)
Order no.	6XV1 830 - 3FH10	6XV1 830 -3EH10	6XV1 831-2L	6XV1 830 -3GH10	6XV1 830 -0PH10
Attenuation at 16 MHz at 4 MHz at 38.4 kHz at 9.6 kHz	 42 dB/km 22 dB/km 4 dB/km 2.5 dB/km	 49 dB/km 25 dB/km 4 dB/km 3 dB/km	 49 dB/km 25 dB/km 4 dB/km 3 dB/km	 49 dB/km 25 dB/km 4 dB/km 3 dB/km	 49 dB/km 25 dB/km 3 dB/km 2.5 dB/km

Technical specifications 1) Cable type	FC ground cable	FC trailing cable 6) 4)	FC trailing cable 6) 4)	Festoon cable 6) 4)	Torsion cable 6) 4) 8)
Surge impedance at 9.6 kHz at 31.25 kHz at 38.4 kHz at 3 to 20 MHz Rated value	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω
Loop resistance	110 Ω/km	133 Ω/km	133 Ω/km	133 Ω/km	98 Ω/km
Shield resistance	9.5 Ω/km	14 Ω/km	14 Ω/km	19 Ω/km	14 Ω/km
Effective capacitance at 1 kHz	28.5 nF/km	28 nF/km	28 nF/km	28 nF/km	29 nF/km
Operating voltage (rms value)	100 V	100 V	100 V	100 V	100 V
Cable type Standard code	02YSY(ST)CY2Y 1x2x0.64/2.55 -150 KF 40 SW	02YY(ST)C11Y 1x2x0.64/2.55-150 KF LI 40 FR petrol	02YY(ST)C11Y 1x2x0.64/2.55 150 KF LI 40 FR	02Y(ST)CY 1x2x0.65/2.56 -LI petrol FR	02Y(ST)C11Y 1x2x0.65/2.56 -150 LI FR VI
Jacket Material Color Diameter	 PE/PVC black 10.8 ± 0.5 mm 3)	 PUR petrol 8.0 ± 0.4 mm	 PUR violet 8.0 ± 0.4 mm	 PVC petrol 8.0 ± 0.3 mm	 PUR violet 8.0 ± 0.4 mm
Perm. ambient conditions -Operating temperature -Transportation/storage temperature -Cable installation temperature	 -40°C + 60°C -40°C + 60°C -40°C + 60°C	 -40°C + 60°C -40°C + 60°C -40°C + 60°C	 -40°C + 60°C -40°C + 60°C -40°C + 60°C	 -40°C + 80°C -40°C + 80°C -40°C + 80°C	 -25°C + 75°C -40°C + 80°C -25°C + 75°C
Bending radiuses Single bend Multiple bends	 40 mm 80 mm	 40 mm 60 mm 2)	 40 mm 120 mm 2)	 30 mm 70 mm 2)	 40 mm 80 mm 2)
Max. tensile load	100 N	100 N	100 N	80 N	100 N
Approx. weight	117 kg/km	70 kg/km	77 kg/km	64 kg/km	65 kg/km
Resistance to fire	Flammable	Flame retardant to IEC 60332-1-2	Flame retardant to IEC 60332-1-2	Flame retardant to IEC 60332-3-24 (Cat. C)	Flame retardant to IEC 60332-1-2
Resistance to oil	Conditionally resistant to mineral oils and fats	Resistant to mineral oils and grease	Resistant to mineral oils and grease	Resistant to mineral oils and grease	Resistant to mineral oils and grease
UV resistance	Resistant	Resistant	Resistant	Resistant	Resistant
Product property Halogen-free Silicone-free ROHS-compliant	 No Yes Yes	 No Yes Yes	 No Yes Yes	 No Yes Yes	 No Yes Yes

Technical specifications 1) Cable type	FC ground cable	FC trailing cable 6) 4)	FC trailing cable 6) 4)	Festoon cable 6) 4)	Torsion cable 6) 4) 8)
UL listing at 300 V rating UL style at 600 V rating	No No	Yes / CMX No	Yes / CMX No	Yes/CM/CMG/ PLTC/SunRes/ OilRes Yes	Yes / CMX No

1) Electrical characteristics at 20 °C, tests according to DIN 47250 Part 4 or DIN VDE 0472
2) Trailing cables for the following requirements:
- Min. 3 million bending cycles for the specified bending radius and an acceleration of max. 4 m/s²
3) Outer diameter >8 mm; bus connectors can only be connected after the outer jacket has been stripped
4) Not suitable for connection to insulation piercing bus connectors (6ES7 972-0BA30-0XA0)
5) At 800 Hz
6) Restricted segment lengths
7) Transmission rate 31.25 kbps.
8) Cable suitable for applications involving torsion: min. 5 million torsion movements on 1 m Cable length (±180°)

Table 5- 3 Bus cables for PROFIBUS (3)

Technical specifications 1) Cable type	FC flexible cable 6) 4)	Hybrid standard cable	Hybrid robust cable	SIENOPYR FR marine cable
Order no.	6XV1 831-2K	6XV1 860-2R	6XV1 860-2S	6XV1830 -0MH10
Attenuation at 16 MHz at 4 MHz at 38.4 kHz at 9.6 kHz	 < 49 dB/km < 25 dB/km < 4 dB/km < 3 dB/km	 49 dB/km 25 dB/km 4 dB/km 3 dB/km	 49 dB/km 25 dB/km 4 dB/km 3 dB/km	 45 dB/km 22 dB/km 5 dB/km 3 dB/km
Surge impedance at 9.6 kHz at 31.25 kHz at 38.4 kHz at 3 to 20 MHz Rated value	 270 ± 10 % - 185 ± 10 % 150 ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 270 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω	 250 Ω ± 10 % - 185 Ω ± 10 % 150 Ω ± 10 % 150 Ω
Loop resistance	≤ 133 Ω/km	138 Ω/km	138 Ω/km	110 Ω/km
Shield resistance	≤ 14 Ω/km	10 Ω/km	10 Ω/km	6.5 Ω/km
Effective capacitance at 1 kHz	approx. 28.5 nF/km	30 nF/km	30 nF/km	-
Operating voltage (rms)	≤ 100 V	300 V	300 V	100 V
Continuous current of the power wires at 25 °C	-	7.5 A	7.5 A	-

Technical specifications [1] Cable type	FC flexible cable [6) 4)]	Hybrid standard cable	Hybrid robust cable	SIENOPYR FR marine cable
Cable type Standard code	02YH(ST)C11Y 1x2x0.65/2.56 150 LI K40 VI FRNC	02Y(ST)C 1x2x0.65/2.56 150 LI LIY-Z Y 2x1x1.5 VI	02Y(ST)C 1x2x0.65/2.56 150 LI LIH-Z 11Y 2x1x1.5 VI FRNC	M-02Y(ST)CHX 1x2x0.35 100V
Jacket Material Color Diameter	 PUR violet 8.0 ± 0.4 mm	 PVC violet 11 ± 0.5 mm	 PUR violet 11 ± 0.5 mm	 Polymer [3)] black 10.3 ± 0.5 mm
Power cores Conductor cross section Color of the wire insulation	 - -	 1.5 mm2 black	 1.5 mm2 black	 - -
Perm. ambient conditions -Operating temperature -Transportation/storage temperature -Installation temperature	 -20°C + 60°C -40°C + 60°C -40°C + 60°C	 -40°C + 75°C -40°C + 75°C -40°C + 75°C	 -40°C + 75°C -40°C + 75°C -40°C + 75°C	 -40°C + 80°C -40°C + 80°C -10°C + 50°C
Bending radiuses Single bend Multiple bends	 40 mm ≥ 120 mm [8)]	 44 mm 125 mm	 44 mm 125 mm	 108 mm 216 mm
Max. tensile load	100 N	450 N	450 N	100 N
Approx. weight	70 kg/km	140 kg/km	135 kg/km	109 kg/km
Resistance to fire	Flame retardant to IEC 60332-1-2	Flame retardant to IEC 60332-1-2	Flame retardant to IEC 60332-1-2	Flame retardant to IEC 60332-3-24
Resistance to oil	Conditionally resistant to mineral oils and fats	Resistant to mineral oils and grease	Resistant to mineral oils and grease	Resistant to mineral oils and grease
UV resistance	Resistant	No	Yes	Resistant
Product property Halogen-free Silicone-free ROHS-compliant	 Yes Yes Yes	 No Yes Yes	 Yes Yes Yes	 Yes Yes Yes

Technical specifications [1] Cable type	FC flexible cable [6] [4]	Hybrid standard cable	Hybrid robust cable	SIENOPYR FR marine cable
UL listing at 300 V rating	Yes	Yes / CMG	Yes / CMX	No
UL style at 600 V rating		No	No	No

1) Electrical characteristics at 20 °C, tests according to DIN 47250 Part 4 or DIN VDE 0472

2) Trailing cables for the following requirements:
- Min. 3 million bending cycles for the specified bending radius and an acceleration of max. 4 m/s2

3) Outer diameter > 8 mm; bus connectors can only be connected after the outer jacket has been stripped

4) Not suitable for connection to insulation piercing bus connectors (6ES7 972 0BA30 0XA0)

5) At 800 Hz

6) Restricted segment lengths

7) Transmission rate 31.25 kbps.

8) Cable suitable for applications involving torsion: min. 5 million torsion movements on 1 m
Cable length (±180°)

5.2 FC standard cable GP

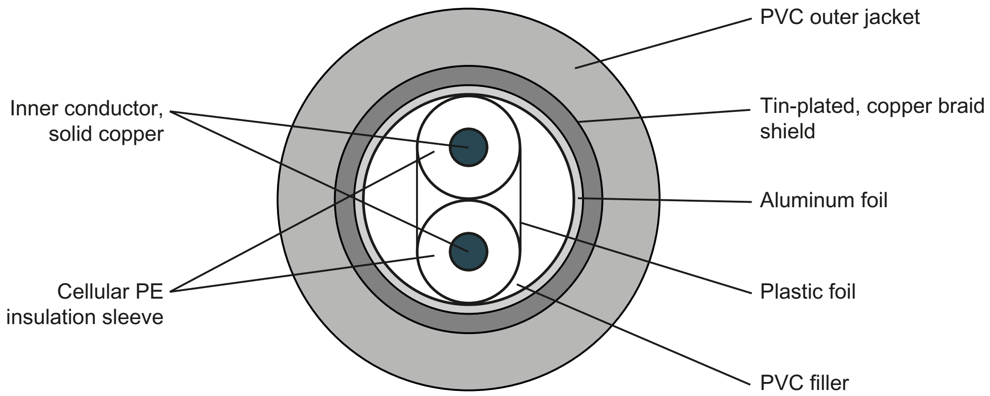


Figure 5-1 Structure of the FC standard cable

FC standard cable 6XV1 830-0EH10

The bus cable 6XV1 8300EH10 is the FastConnect standard bus cable for PROFIBUS networks. It meets the requirements of IEC 61158-2 / EN 61158-2, cable type A, with solid copper cores (AWG 22).

The combination of twisted wires, foil shield and braid shield make the cable particularly suitable for industrial environments subject to electromagnetic interference. The design of the cable also guarantees stable electrical and mechanical data after the cable has been installed.

The FastConnect bus cable 6XV1 830-0EH10 is UL listed.

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the cable, see Section Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138).

Properties

Due to the composition of the jacket material, the bus cable has the following characteristics:

- Flameretardant
- Selfextinguishing in case of fire
- Conditionally resistant to mineral oils and fats
- Sheath material not free of halogens

Use

The bus cable is intended for fixed installation in buildings (inhouse cabling).

5.3 PROFIBUS FC standard cable IS GP

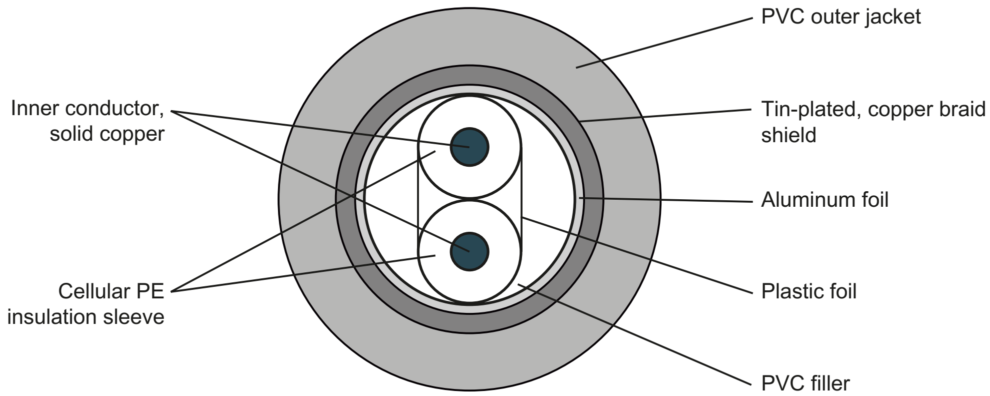


Figure 5-2 Structure of the FC standard cable

FC standard cable 6XV1 831-2A

Bus cable 6XV1 831-2A (IS = Intrinsically Safe) with its blue outer jacket is the FastConnect standard bus cable for intrinsically safe PROFIBUS RS-485 IS networks. It meets the requirements of IEC 61784-5-3. The cable with solid copper cores (AWG 22) is intended for fixed installation.

The combination of twisted wires, foil shield and braid shield make the cable particularly suitable for industrial environments subject to electromagnetic interference. The design of the cable also guarantees stable electrical and mechanical data after the cable has been installed.

The FastConnect bus cable 6XV1 831-2A is UL listed.

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the cable (see Section Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138))

Properties

PROFIBUS FC standard cable with blue outer jacket for use in hazardous areas with ET 200iSP.

Due to the composition of the jacket material, the bus cable has the following characteristics:

- Flameretardant
- Selfextinguishing in case of fire
- Conditionally resistant to mineral oils and fats
- Sheath material not free of halogens

Use

The bus cable is intended for fixed installation in buildings (inhouse cabling).

5.4 FCFRNC cable (bus cable with halogenfree outer jacket)

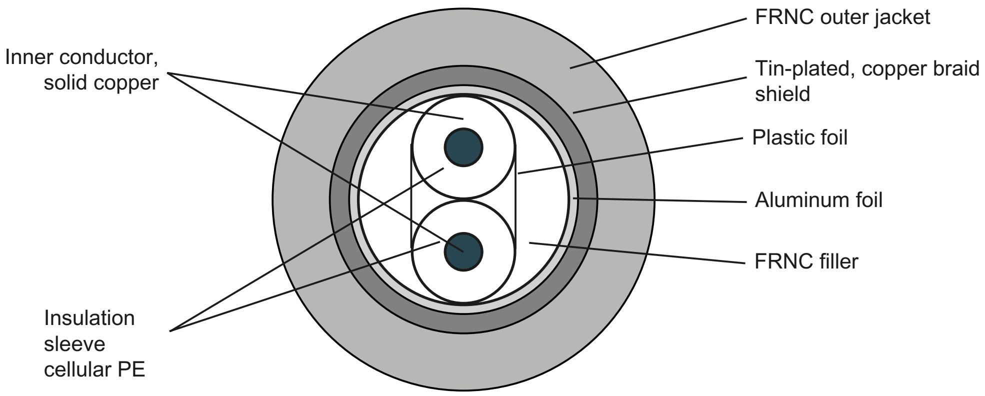


Figure 5-3 Structure of the bus cable with halogenfree outer jacket

Bus cable with halogenfree outer jacket 6XV1 830-0LH10

The bus cable with a halogenfree outer jacket 6XV1 8300LH10 complies with the specification IEC 61158-2 / EN 61158-2, cable type A, with solid copper cores (AWG 22).

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the PROFIBUS cable, see Section Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138).

Properties

The characteristics of the jacket material differ from those of the standard bus cable as follows:

- The material is free of halogens
- Not resistant to UV radiation
- The jacket material is flame resistant

Use

The bus cable with the halogen-free outer jacket is particularly suitable for use inside buildings.

5.5 FC food cable (PE jacket)

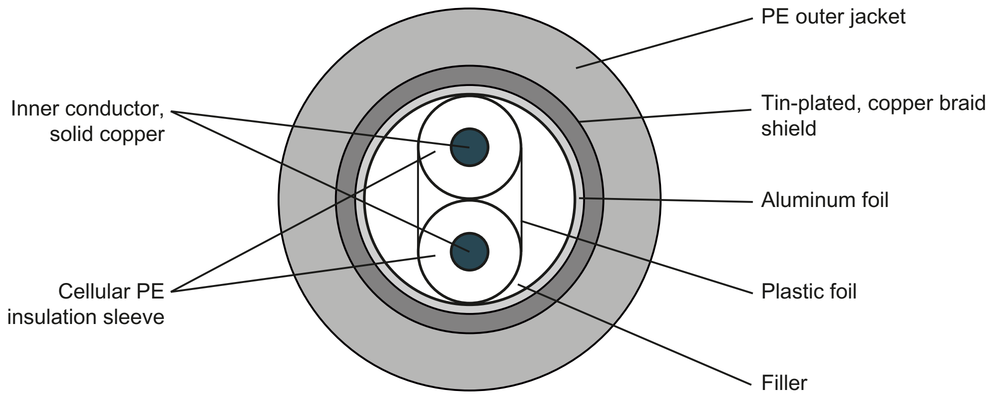


Figure 5-4 Structure of the bus cable with PE jacket

FC bus cable with PE jacket 6XV1 830-0GH10

The FC bus cable with a PE jacket 6XV1 830-0GH10 complies with the specification IEC 61158-2 / EN 61158-2, cable type A, with solid copper cores (AWG 22). The inner structure of the cable (cores, filler, shielding) is identical to that of the standard cable.

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the PROFIBUS cable, see Section Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138).

Properties

The properties of the polyethylene (PE) jacket differ from those of the standard bus cable as follows:

- Improved resistance to abrasion
- Improved resistance to oil and lubricants
- Resistant to UV radiation

- Resistant to water and steam
- The jacket material is flammable

Use

The bus cable with the PE jacket is particularly suited for use in the food, beverages and tobacco industry. It is designed for fixed installation within buildings (inhouse cabling).

5.6 FC robust cable (with PUR jacket)

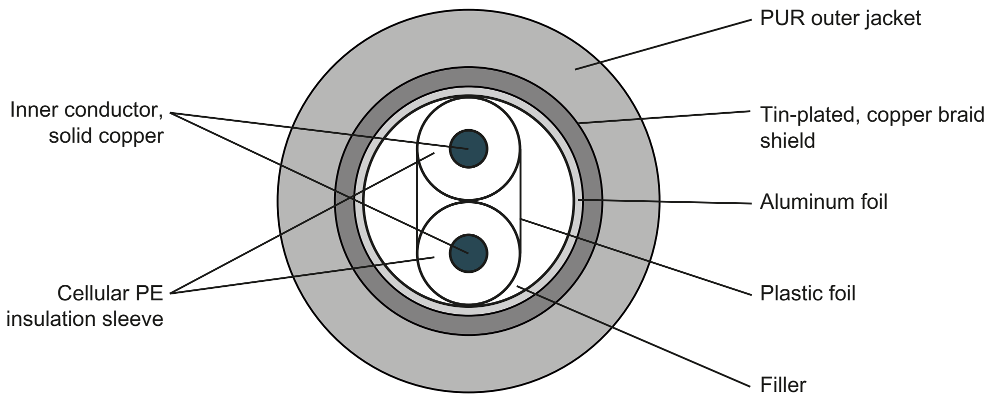


Figure 5-5 Structure of the bus cable with PUR jacket

FC bus cable with PUR jacket 6XV1 830-0JH10

The FC bus cable with a PUR jacket 6XV1 830-0JH10 complies with the specification IEC 61158-2 / EN 61158-2, cable type A, with solid copper cores (AWG 22). The inner structure of the cable (cores, filler, shielding) is identical to that of the standard cable.

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the cable, see Section Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138).

Properties

The characteristics of the PUR jacket material differ from those of the standard bus cable as follows:

- Improved resistance to abrasion
- Improved resistance to oil and lubricants
- Resistant to UV radiation
- The jacket material is flame resistant

Use

The FC robust cable with its PUR jacket is particularly suitable for use in areas where it is exposed to chemicals and mechanical strain. It is designed for fixed installation within buildings (inhouse cabling).

5.7 FC ground cable

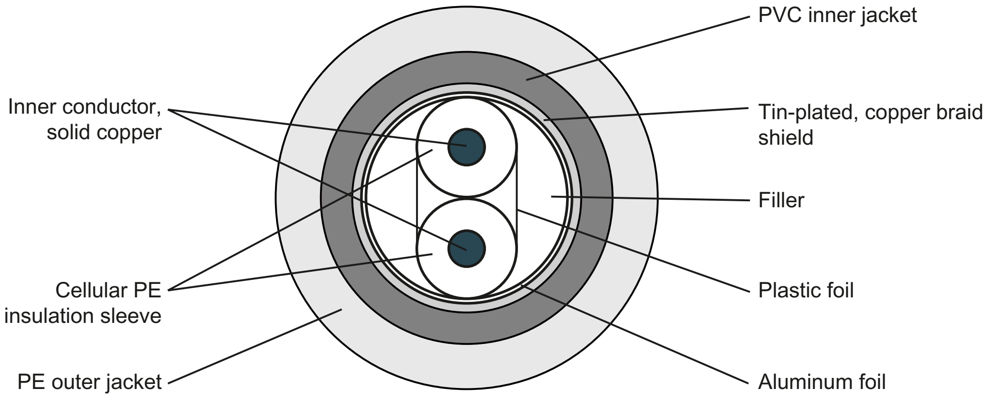


Figure 5-6 Structure of the ground cable

FC ground cable 6GK1 830-3FH10

The FC ground cable 6GK1 830-3FH10 meets the requirements of IEC 61158-2 / EN 61158-2, cable type A, with solid copper cores (AWG 22). The internal structure of the cable corresponds to that of the standard bus cable, the electrical characteristics are identical. The cable has an additional PE outer jacket. The outer and inner jackets are bonded together so that the FC ground cable can be fitted with all SIMATIC NET PROFIBUS connectors after removing the outer jacket.

After removing the outer jacket, the structure of the cable also allows use of the FastConnect (FC) stripping tool for fast stripping of the inner cable (see Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138)).

Properties

The characteristics of the ground cable differ from those of the standard bus cable as follows:

- Improved resistance to abrasion
- Improved resistance to oil and grease complying with VDE 0472, Part 803, Test Type B
- Resistant to UV radiation
- Larger outer diameter and heavier
- The jacket material is flammable
- Resistant to water and steam

Use

Due to its additional outer PE jacket, this cable is suitable for underground cabling (campus cabling).

5.8 FC trailing cable

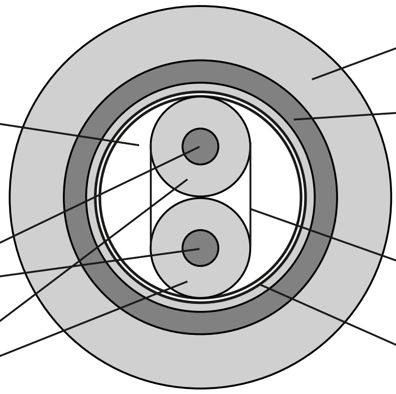


Figure 5-7 Structure of the trailing cable

Trailing cable 6XV1 830-3EH10

The trailing cable 6XV1 8303EH10 corresponds to the specification IEC 61158-2 / EN 61158-2, cable type A, with stranded copper cores (approximately AWG 24 19/36) with the exception of the higher d.c.loop resistance.

This difference means a reduced segment length; refer to the tables in Section "Network configuration (Page 41)".

In contrast to the standard bus cable, the cores of the trailing cable are of stranded copper. In conjunction with the special combination of braid shield, foil shield, and the jacket material of polyurethane, the cable is extremely flexible while retaining highly constant electrical characteristics.

If you connect to screw terminals, the stranded cores must be fitted with wireend ferrules (0.25 mm^2 complying with DIN 46228).

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the outer jacket, see Section "Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138)".

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

Properties

The characteristics of the trailing cable differ from those of the standard bus cable as follows:

- Extremely good resistance to abrasion
- Resistance to mineral oils and fats
- Extremely good resistance to UV radiation

- Small bending radii for installation and operation
- Due to the smaller Cu crosssection, the d.c. loop resistance and the HF attenuation are higher which means a reduced segment length.
- The jacket material is flame resistant

Use

The trailing cable is designed for a minimum of 4 million bending cycles at the specified bending radius and a maximum acceleration of 4 m/s^2 and is therefore particularly suitable for installation in drag chains.

Note

During installation and operation, all mechanical requirements for the cable such as bending radii, tensile strain etc. must be kept to.

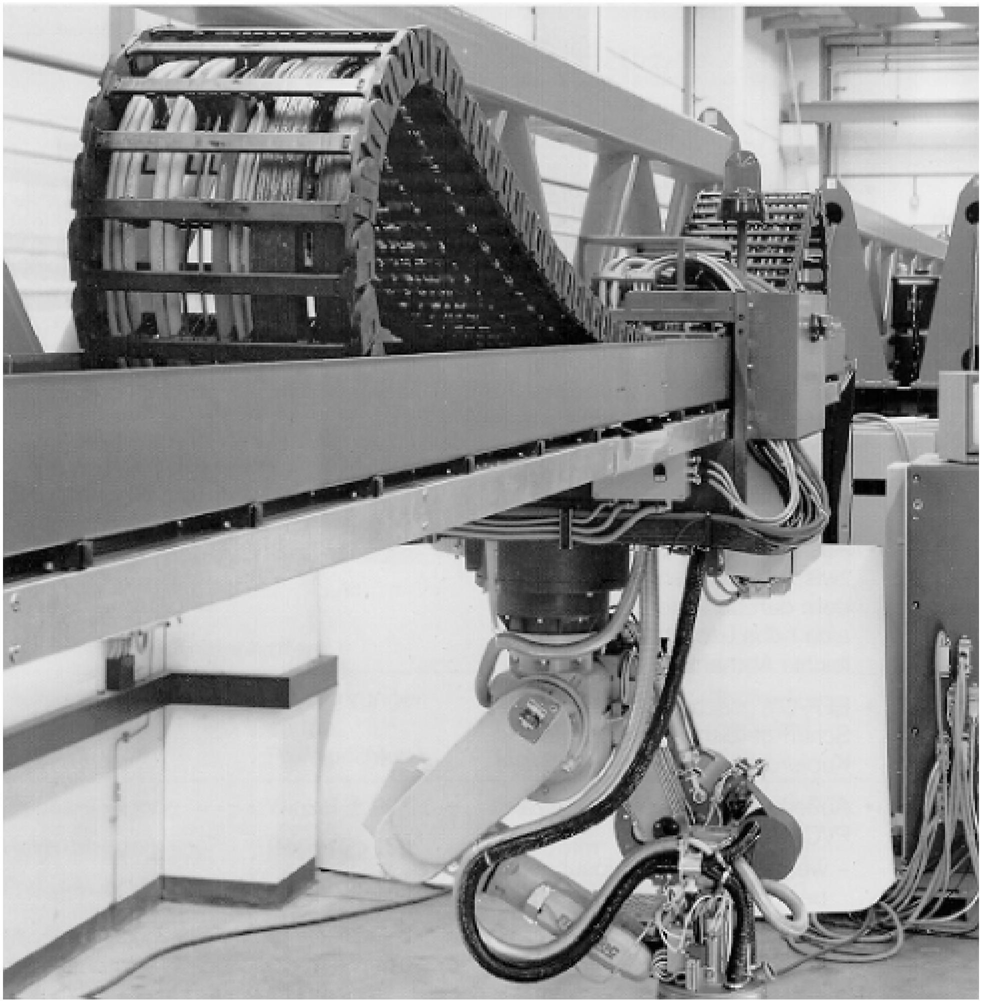


Figure 5-8 Example of using the PROFIBUS trailing cable in a drag chain

Segment lengths

Due to the increased loop resistance, somewhat shorter segment lengths are permitted at low transmission speeds, see Section "Network configuration (Page 41)". For transmission speeds ≤ 500 kbps, the trailing cable has the same values as the standard bus cable.

Note

If you connect to screw terminals, the stranded cores must be fitted with wireend ferrules (0.25 mm^2 complying with DIN 46228). Use only wireend ferrules made of materials with permanently stable contact properties, for example copper with a tinplated surface (not aluminum).

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

5.9 PROFIBUS FC trailing cable

The FC trailing cable 6XV1 831-2L is the same as the PB FC trailing cable (6XV1 830 3EH10) but has a violet outer jacket.

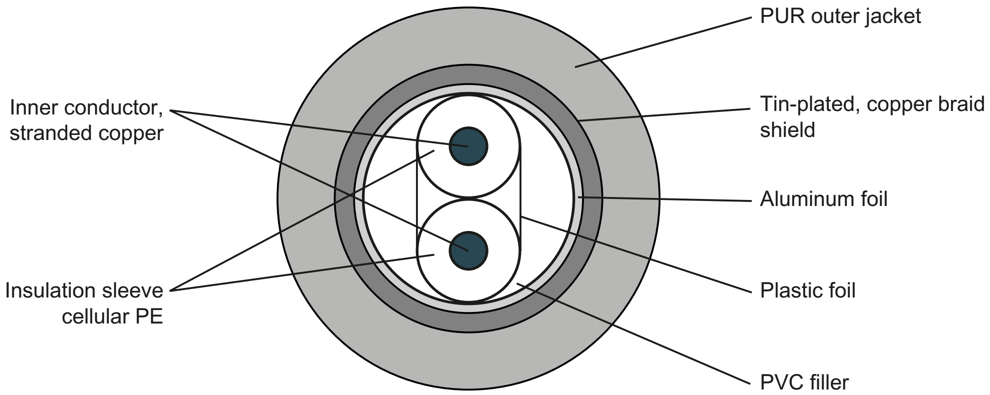


Figure 5-9 Structure of the FC trailing cable

Trailing cable 6XV1 831-2L

The trailing cable 6XV1 831-2L corresponds to the specification IEC 61158-2 / EN 61158-2, cable type A, with stranded copper cores (approximately AWG 24 19/36) with the exception of the higher loop resistance.

This difference means a reduced segment length; refer to the tables in Section Network configuration (Page 41).

In contrast to the standard bus cable, the cores of the trailing cable are of stranded copper. In conjunction with the special combination of braid shield, foil shield, and the jacket material of polyurethane, the cable is extremely flexible while retaining highly constant electrical characteristics.

If you connect to screw terminals, the stranded cores must be fitted with wireend ferrules (0.25 mm^2 complying with DIN 46228).

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the outer jacket, see Section Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138).

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

Properties

The characteristics of the trailing cable differ from those of the standard bus cable as follows:

- Extremely good resistance to abrasion
- Resistance to mineral oils and fats
- Extremely good resistance to UV radiation
- Small bending radii for installation and operation
- Due to the smaller Cu crosssection, the d.c. loop resistance and the HF attenuation are higher which means a reduced segment length.
- The jacket material is flame resistant

Use

The trailing cable is designed for a minimum of 4 million bending cycles at the specified bending radius and a maximum acceleration of 4 m/s^2 and is therefore particularly suitable for installation in drag chains.

Note

During installation and operation, all mechanical requirements for the cable such as bending radii, tensile strain etc. must be kept to.

Segment lengths

Due to the increased loop resistance, somewhat shorter segment lengths are permitted at low transmission speeds, see Section Network configuration (Page 41). At transmission speeds 500 kbps, the trailing cable has the same values as the standard bus cable.

Note

If you connect to screw terminals, the stranded cores must be fitted with wireend ferrules (0.25 mm^2 complying with DIN 46228). Use only wireend ferrules made of materials with permanently stable contact properties, for example copper with a tinplated surface (not aluminum).

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

5.10 PROFIBUS festoon cable

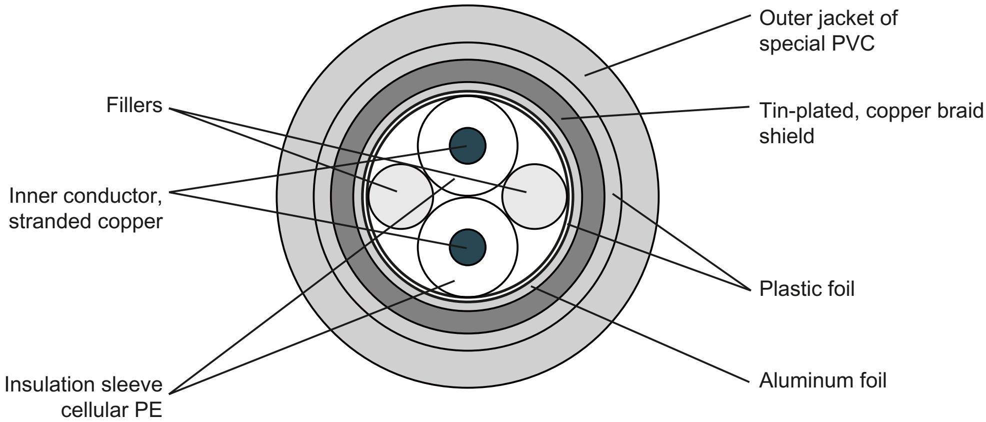


Figure 5-10 Structure of the festoon cable

Festoon cable 6XV1 8303GH10

The festoon cable 6XV1 830-3GH10 corresponds to the specification IEC 61158-2 / EN 61158-2, cable type A, with stranded copper cores (approximately AWG 24 19/36) with the exception of the higher d.c. loop resistance.

This difference means a reduced segment length; refer to the table in Section "Network configuration (Page 41)".

With its flexible structure, the festoon cable 6XV18303GH10 can be used in festoons with large and small cable loops. The cable carries its own weight but is not suitable for tensile loading > 80 N.

The outer jacket is labeled "SIMATIC NET PROFIBUS RS485 Festoon Cable 6XV1830-3GH10 * (UL) CMX 75 °C (SHIELDED) AWG 24" and has meter markings.

If screw terminals are used, the stranded cores must be fitted with wireend ferrules (0.25 mm^2 complying with DIN 46228).

The cable is not suitable for use of the FastConnect (FC) stripping tool.

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

Use

The bus cable for festoons is designed for at least 5 million bending cycles at the specified bending radius and at a maximum acceleration of 4 m/s^2.

Note

During installation and operation, all mechanical requirements for the cable such as bending radii, tensile strain etc. must be kept to.

Example of installation

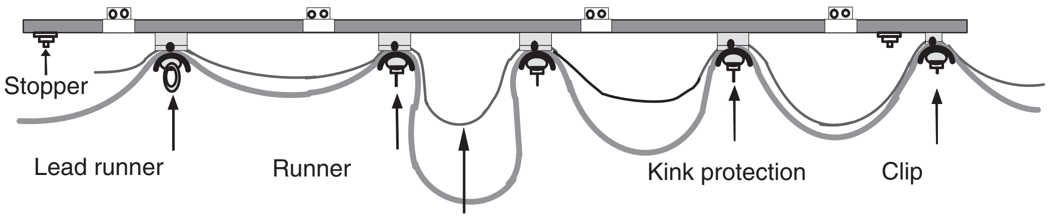


Figure 5-11 Installation of the PROFIBUS festoon cable (schematic)

Segment lengths

Due to the increased loop resistance, somewhat shorter segment lengths are permitted at low transmission speeds, see Section "Network configuration (Page 41)". For transmission speeds ≤ 500 kbps, the trailing cable has the same values as the standard bus cable.

Note

If you connect to screw terminals, the stranded cores must be fitted with wireend ferrules (0.25 mm^2 complying with DIN 46228). Use only wireend ferrules made of materials with permanently stable contact properties, for example copper with a tinplated surface (not aluminum).

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

Installation guidelines

The cable must be unwound at a tangent from the drum and installed in the cable carriage free of torsion.

The cable must be mounted on a flat cable carriage on a round half-shell support (angle between cable and half-shell 90 degrees) and the radius of the half-shell must be greater than > 70 mm.

The strain relief mechanisms on the cable carriage must have rubber clamps to avoid crimping the cable.

Other cables installed in the festoon must not cause bends tighter than the minimum bending radius of the trailing cable.

Figure 5-12 Example of the use of the PROFIBUS festoon cable

5.11 PROFIBUS torsion cable

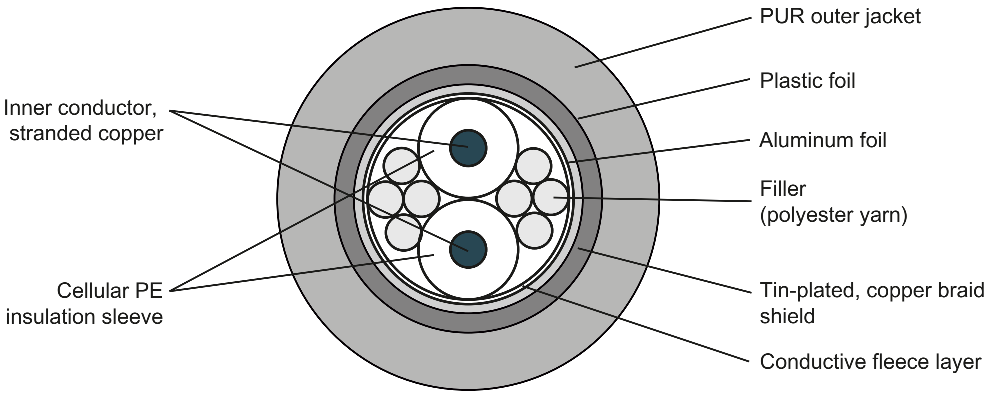


Figure 5-13 Structure of the torsion cable (robot cable)

Torsion cable 6XV1 8300FH10

The torsion cable 6XV1 830-0PH10 corresponds to the specification IEC 61158-2 / EN 61158-2, cable type A, with stranded copper cores (approximately AWG 24 19/36) with the exception of the higher d.c.loop resistance.

This difference means a reduced segment length; refer to the table in Section "Network configuration (Page 41)".

In contrast to the standard bus cable, the cores of the torsion cable are of stranded copper. In conjunction with the special combination of braid shield, foil shield, fleece layer and the jacket material of polyurethane, the cable has a torsional strength of ±180° while retaining highly constant electrical characteristics. The cable has been tested to a minimum of 5 million torsional movements on 1 m cable length (±180°).

If screw terminals are used, the stranded cores must be fitted with wireend ferrules (0.25 mm^2 complying with DIN 46228).

The cable is not suitable for use of the FastConnect (FC) stripping tool.

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

Properties

The characteristics of the flexible cable differ from those of the standard bus cable as follows:

- The jacket material is free of halogens (polyurethane, PUR)
- Extremely good resistance to abrasion
- Resistance to mineral oils and fats
- Extremely good resistance to UV radiation
- Small bending radii for installation and operation
- Due to the smaller copper crosssection, the d.c. loop resistance and the HF attenuation are higher which means reduced segment lengths.
- The jacket material is flame resistant

Use

The flexible cable is designed for torsion of ±180° and is therefore particularly suitable for networking moving plant parts, for example robots.

Note

If you connect to screw terminals, the stranded cores must be fitted with wireend ferrules (0.25 mm2 complying with DIN 46228). Use only wireend ferrules made of materials with permanently stable contact properties, for example copper with a tinplated surface (not aluminum).

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

5.12 PROFIBUS FC flexible cable

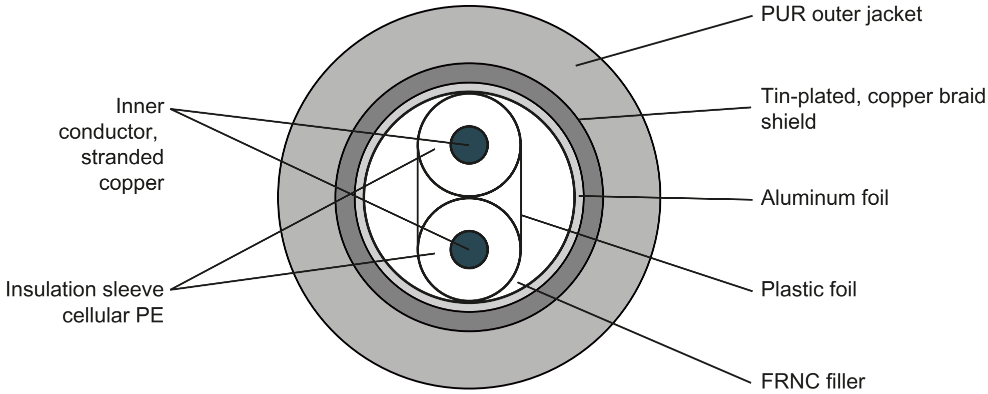


Figure 5-14 Structure of the FC flexible cable

Bus cable for occasional movement 6XV1 831-2K

The double shield makes it especially suitable for laying in industrial areas with strong electro-magnetic fields. A consistent grounding concept can be implemented via the outer shield of the bus cable and the ground terminals of the bus terminal.

Properties

- High noise immunity due to double shielding
- Flame-retardant bus cable (halogen-free)
- Bus cable for occasional movement (for example a cabinet door)
- Silicone-free, therefore particularly suitable for use in the automotive industry (for example on paint shop conveyors)

Use

For machine parts that move occasionally or cabinet doors.

Not suitable for drag chains.

Segment lengths

Due to the increased loop resistance, somewhat shorter segment lengths are permitted at low transmission speeds, see Section "Network configuration (Page 41)". For transmission speeds ≤ 500 kbps, the trailing cable has the same values as the standard bus cable.

Note

If you connect to screw terminals, the stranded cores must be fitted with wireend ferrules (0.25 mm² complying with DIN 46228). Use only wireend ferrules made of materials with permanently stable contact properties, for example copper with a tinplated surface (not aluminum).

6ES7 972-0BA30-0XA0 bus connectors **cannot** be connected.

5.13 PROFIBUS hybrid standard cable GP

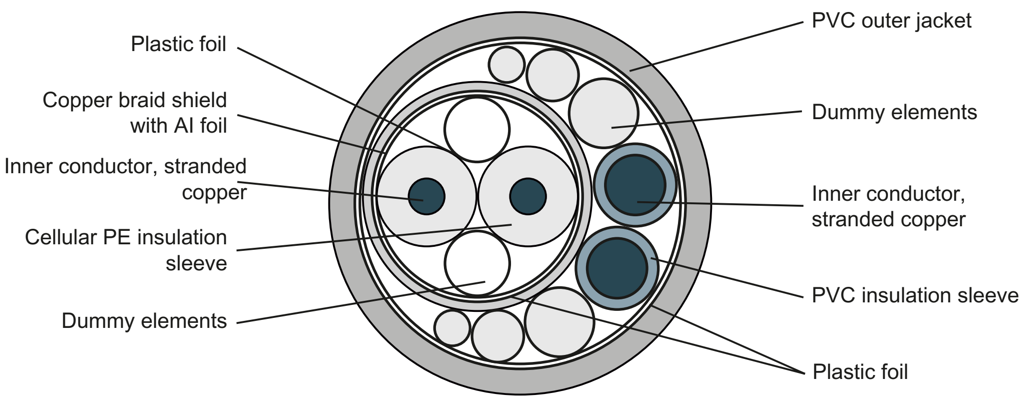


Figure 5-15 Structure of the FC hybrid standard cable GP

Standard bus cable 6XV1 860-2R

Standard hybrid cable with two copper conductors for data transmission and two copper conductors for the power supply of ET 200pro

Properties

The characteristics of the hybrid cable differ from those of the standard bus cable as follows:

- Resistance to mineral oils and fats
- Small bending radii for installation and operation
- The jacket material is flame resistant
- Extremely resistant to tensile load
- The jacket material is not halogen-free
- Extremely high operating voltage

Use

Standard PROFIBUS hybrid cable with 2 power conductors (1.5 mm^2) for supply of data and power to ET 200pro.

5.14 PROFIBUS Hybrid Robust Cable

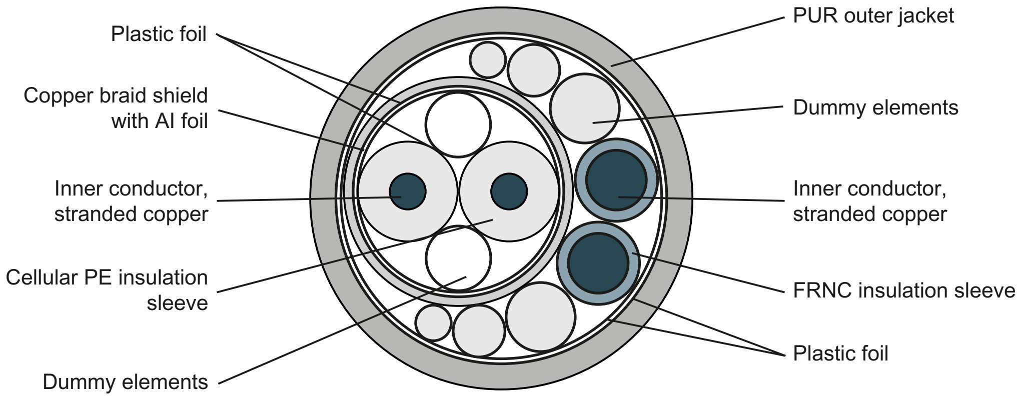


Figure 5-16 Structure of the FC hybrid robust cable

Robust bus cable 6XV1 860-2S capable of trailing

Rugged hybrid cable suitable for trailing with two copper conductors for data transmission and two copper conductors for the power supply of ET 200pro.

Properties

The characteristics of the hybrid cable differ from those of the standard bus cable as follows:

- Very good resistance to mineral oil and greases
- Small bending radii for installation and operation
- Very high number of bending cycles of 3,000,000 bends
- The jacket material is flame resistant and resistant to weld beads
- Extremely resistant to tensile load
- The jacket material is halogen-free
- Extremely high operating voltage

Use

Robust PROFIBUS hybrid cable with 2 power conductors (1.5 mm^2) for supply of data and power to ET 200pro.

5.15 SIENOPYR FR marine cable

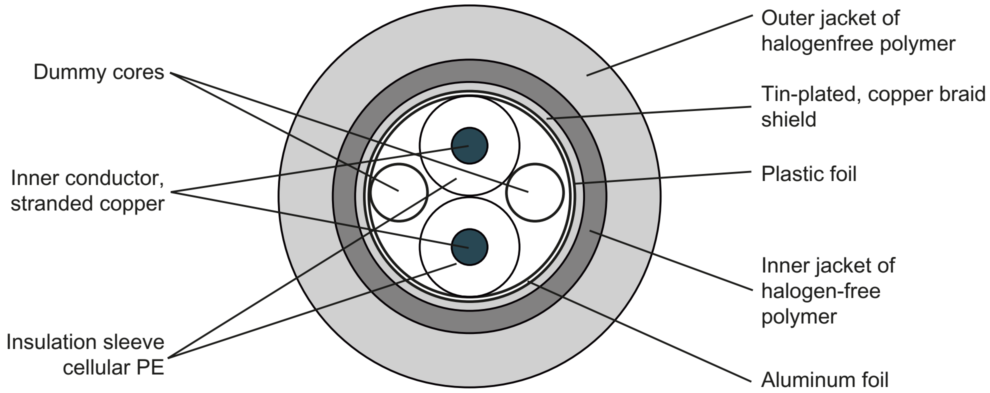


Figure 5-17 Structure of the SIENOPYRFR marine cable

SIENOPYRFR marine cable 6XV18300MH10

The SIENOPYRFR marine cable meets the requirements of IEC 61158-2 / EN 61158-2, cable type A. The inner conductor consists of 7-strand copper wires (approximately AWG 22). The outer jacket of crosslinked, halogenfree polymer is extremely resistant to lubricants and fuels, hydraulic fluid, cold cleansing agents and deionized water.

The outer jacket of the SIENOPYRFR marine cable can be removed separately so that the inner jacket can be fitted into all PROFIBUS connectors with an 8 mm cable inlet.

The cable is not suitable for use of the FastConnect (FC) stripping tool.

Properties

The SIENOPYRFR marine cable has the following properties:

- Halogen-free
- Resistant to diesel fuel, ASTM oil, hydraulic fluid, cold cleansing agents, deionized water complying with VG 95 218 Part 2
- Resistance to ozone complying with DIN VDE 0472 Part 805, test type B
- Burning behavior complying with DIN VDE 0472 Part 804, test type C
- Corrosivity of combustion gases complying with DIN VDE 0472 Part 813 (corresponds to IEC 607542)
- Shipbuilding approvals (Germanischer Lloyd, Lloyd's Register, Registro Italiano Navale)

Use

The SIENOPYRFR marine cable is intended for fixed installation on ships and offshore facilities in all rooms and on open decks.

Bus connectors and preassembled cables 6

6.1 The FastConnect system

Area of application

PROFIBUS FastConnect is a system for fast and easy assembly of PROFIBUS copper cables.

Design

The system comprises three compatible components:

- FastConnect bus cables for fast assembly
- FastConnect stripping tool
- FastConnect bus connectors for PROFIBUS (with insulation piercing technique)

Note

All PROFIBUS FastConnect bus cables can also be fitted into the normal bus connectors with screw terminals.

Functions

The FastConnect stripping system allows PROFIBUS connectors to be fitted to PROFIBUS bus cables extremely quickly.

The special design of the FastConnect bus cables permits the use of the FastConnect stripping tool, with which the outer jacket and the braided shield can be removed to measure in one operation. Cables prepared in this way are attached to the FastConnect bus connectors using the insulation displacement method.

Designed for Industry

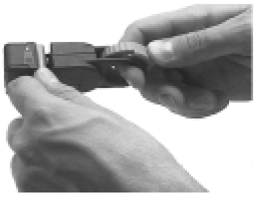
- Reduction of the connection times of end devices by removing the outer jacket and braid shield in one operation.
- Simple connector fitting with the preset FC stripping tool.
- Correct contact in the PROFIBUS FC connector can be checked without opening the connector thanks to the transparent cover of the insulation displacement terminals and color coding for the core assignment.

6.2 Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT

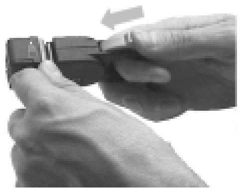
Fitting connectors

1. How to hold the stripping tool in your right hand

2. Measuring the cable length by placing the cable on the template. End stop with the index finger of your left hand.



3. Insert the measured end of the cable into the tool. The index finger of your left hand is used as a limit stop.

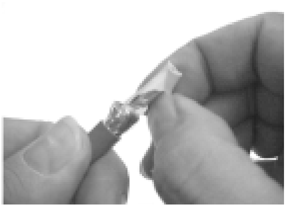


4. Clamp the cable in the stripping tool as far as the limit stop.

5. Turn the stripping tool approx. 4 times for PVC insulation, approx. 8 times for PUR or PE insulation in the direction of the arrow.

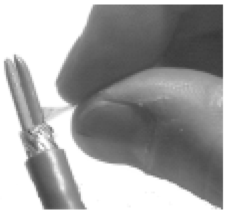
6. Keeping the tool closed, remove it from the end of the cable. If the cut is poor, change the blade cassette.

7. Remnants remain in the tool. After opening
the tool, the remnants of the cable can be removed.

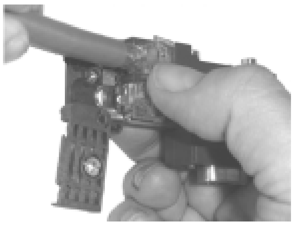


8. If the white filler compound was not removed during stripping,
remove it by hand.

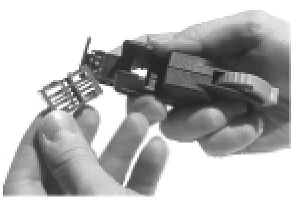
9. The protective foil is easier to remove if you score it between
the wires with a screwdriver.



10. Remove the protective foil from the cores.



11. After stripping the wires, the cable can be inserted in
the FastConnect PB plug.



12. Replace the knife cassette after approx.
- 1500 operations on cables with PVC
outer jackets
- 150 operations on cables with
PUR outer jackets

6.3 FastConnect D-sub bus connector

6.3.1 Area of application and technical specifications of the FastConnect connector

Use of the FastConnect bus connector

Using the D-sub and M12 bus connectors for SIMATIC NET PROFIBUS:

- Nodes with an electrical interface complying with IEC 61158-2 / EN 61158-2 can be connected directly to the SIMATIC NET PROFIBUS cables
- Electrical segments or individual nodes can be connected to the optical link module (OLM, OBT).
- Nodes or programming devices can be connected to a repeater.

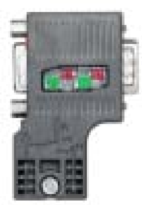
Note

The integrated bus terminating resistors and the mechanical specifications of the SIMATIC NET bus connectors are tailored to the SIMATIC NET PROFIBUS cables (cable type A of the PROFIBUS standard IEC 61158-2 / EN 61158-2). Fitting bus connectors to cables with different electrical or mechanical properties can cause problems during operation!

Area of application

You require bus connectors to attach the PROFIBUS cables to 9pin D-sub interfaces. Within the FastConnect system, there are various bus connectors with degree of protection IP 20. The different applications for these connectors are shown in the table below.

Table 6- 1 Design and applications of the IP20 FastConnect bus connectors

Order numbers:	6ES7 972-0BA30-0XA0	6ES7 972-0BA52-0XA0 6ES7 972-0BB52-0XA0	6ES7 972 0BA60-0XA0 6ES7 972 0BB60-0XA0	6GK1 500-0FC10
Design				
Recommended for: IM 308-B IM 308-C IM 467	X	X X		

Order numbers:	6ES7 972-0BA30-0XA0	6ES7 972-0BA52-0XA0 6ES7 972-0BB52-0XA0	6ES7 972 0BA60-0XA0 6ES7 972 0BB60-0XA0	6GK1 500-0FC10
S7-200		X	X	
S7-300	X	X	X	
S7-400	X	X	X	
C7-633 DP		X	X	
C7-634 DP	X	X	X	
C7 -635	X	X	X	
C7 -636	X	X	X	
S5-115U to 155U	X	X	X	
CP 5613 /	X	X	X	X
CP 5614				X
CP 5512	X	X	X	X
CP 5511	X	X	X	X
CP 5611	X	X	X	X
CP 5621	X	X	X	X
CP 5431 FMS/DP	X	X	X	
CP 342-5		X	X	
CP 343-5		X	X	
CP 443-5		X	X	
ET 200B	X	X	X	
ET 200L	X	X	X	
ET 200M	X	X	X	
ET 200S	X	X	X	
PG 720/720C	X			X
PG 740	X			X
PG 760	X			X
RS-485 repeater	X	X	X	
OP			X	X
OLM/OBT	X	X	X	X

Technical specifications

The following table shows the technical data of the various bus connectors:

Table 6- 2 Technical specifications of the IP20 bus connectors

Order numbers:	6ES7 972-0BA30-0XA0	6ES7 972-0BA52-0XA0 6ES7 972-0BB52-0XA0	6ES7 972-0BA60-0XA0 6ES7 972-0BB60-0XA0	6GK1 500-0FC10
PG socket	No	0BA52: No 0BB52: Yes	0BA60: No; 0BB60: Yes	No
Max. transmission speed	1.5 Mbps	9.6 kbps to 12 Mbps	9.6 kbps to 12 Mbps	9.6 Kbps to 12 Mbps

Order numbers:	6ES7 972-0BA30-0XA0	6ES7 972-0BA52-0XA0 6ES7 972-0BB52-0XA0	6ES7 972-0BA60-0XA0 6ES7 972-0BB60-0XA0	6GK1 500-0FC10
Cable outlet	30°	90 °	35 °	180 °
Terminating resistor and disconnect function	No	Integrated	Integrated	Integrated
Interfaces • to PROFIBUS node • to PROFIBUS bus cable	 • 9-pin D-sub male • 4 insulation piercing terminals for all PROFIBUS cables (except for FC process cable, not for stranded cores)	 • 9-pin D-sub male • 4 insulation piercing terminals for all PROFIBUS cables (except FC process cable)	 • 9-pin D-sub male • 4 insulation piercing terminals for all PROFIBUS cables (except FC process cable)	 • 9-pin D-sub male • 4 insulation piercing terminals for all PROFIBUS cables (except FC process cable)
Power supply (must come from end device)	-	4.75 to 5.25 V DC	4.75 to 5.25 V DC	4.75 to 5.25 V DC
Current input	-	Max. 5 mA	Max. 5 mA	Max. 5 mA
Permissible ambient conditions • Operating temperature • Transportation/storage temperature • Relative humidity	 • 0 °C to +60 °C • -25 °C to +80 °C • max. 75 % at +25 °C	 • 0 °C to +60 °C • -25 °C to +80 °C • max. 75% at +25 °C	 • 0 °C to +60 °C • -25 °C to +80 °C • max. 75% at +25 °C	 • 0 °C to +60 °C • -25 °C to +80 °C • max. 75% at +25 °C
Construction • Dimensions (WxHxD) • Weight	 • 15 x 58 x 34 • Approx. 30 g	 • 72.7x16x34 • Approx. 50 g	 • 72.7x16x34 • Approx. 50 g	 • 61.7x16x35 • Approx. 50 g
Type of protection	IP20	IP20	IP20	IP20
Connectable PROFIBUS cable diameter	8 ± 0.5 mm	8 ± 0.5 mm	8 ± 0.5 mm	8 ± 0.5 mm

Disconnect function

The disconnect function means that the outgoing bus cable is disconnected from the bus when the terminating resistor is activated. If the terminating resistor is accidentally activated in the middle of the bus cable, the error can be recognized and localized immediately due to the nodes that are no longer accessible.

Disconnecting a station

The bus connector allows you to disconnect a node from the bus without interrupting the data traffic on the bus.

Removing the bus connector when the terminating resistor is activated at the ends of the cable causes disruptions on the bus and is not permitted.

Bus connector with a programming device socket

We recommend that you include at least one bus connector with a PG socket in each bus segment. This makes it easier to commission using a programming device or PC.

In the bus connectors with a PG socket, all the contacts are connected 1:1 with the connector pins; in other words, the pinout is the same as the pinout of the attached device.

Pinout of the D-sub male connector

The following table shows the pinout of the 9pin D-sub male connector.

Table 6- 3 Pinout of the 9-pin D-sub male connector

Pin no.	Signal name	Description
1	-	-
2	-	-
3	RxD/TxD-P	Data line B
4	-	-
5	M5V2	Data reference potential (from node)
6	P5V2	Power supply plus (from node)
7	-	-
8	RxD/TxD-N	Data line A
9	-	-

6.3.2 Connecting the bus cable to bus connector (6ES7 9720BA300XA0)

Visual appearance (6ES7 972-0BA30-0XA0)

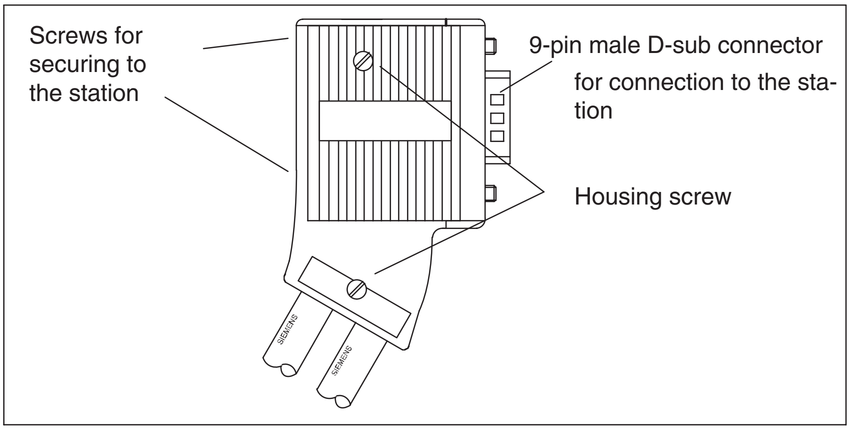


Figure 6-1 Bus connector (order number 6ES7 972-0BA30-0XA0)

Connecting up the bus cable

Connect up the bus cable to the bus connector with order number 6ES7 972-0BA30-0XA0 as follows:

- Strip the insulation as shown in the following figure.

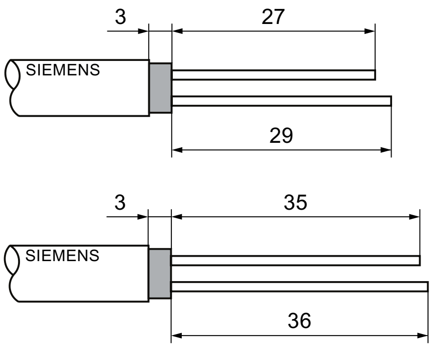


Figure 6-2 Length of cable stripped for connection to bus connector (6ES7 972-0BA30-0XA0)

- Open the casing of the bus connector by undoing the screws and removing the cover.
- Press the bus cable into the strain relief clips. The cable shield must lie directly on the metal guide.
- Place the green and red wires in the cable guides above the insulation piercing contacts as shown in the following figure.
  Always connect the same wires to the same terminal A or B (for example green wire to terminal A, red wire to terminal B).

- Press the red and green wires into the insulation piercing contacts lightly using your thumb.
- Secure the cover with the screws.

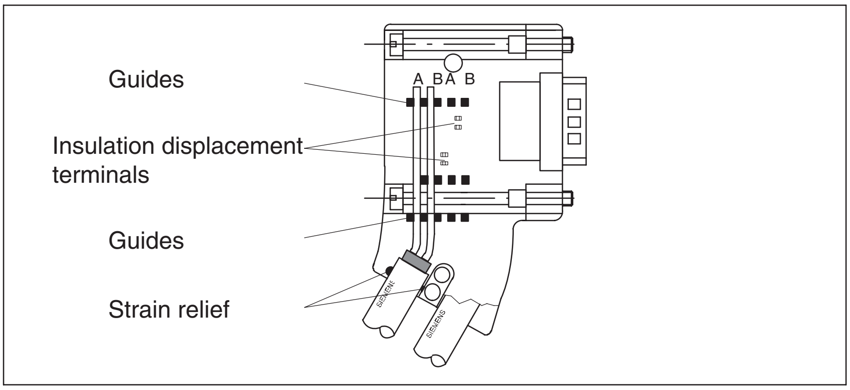


Figure 6-3 Connecting the bus cable to bus connector (6ES7 972-0BA30-0XA0)

Note

The bus connector 6ES7 972-0BA30-0XA0 cannot be fitted to bus cables with stranded cores.

6.3.3 Connecting the bus cable to bus connector (6ES7 972-0Bx52 ...)

Visual appearance (6ES7 972 0Bx52 ...)

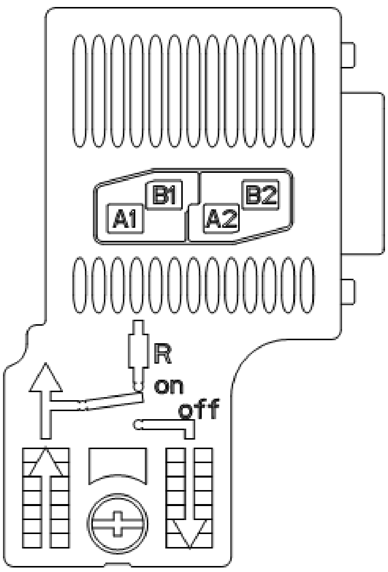


Figure 6-4 Connecting bus connector 6ES7 972-0Bx52-0XA0

Connecting up the bus cable

Connect up the bus cable to the bus connector with order number 6ES7 972 0Bx52 ... as follows:

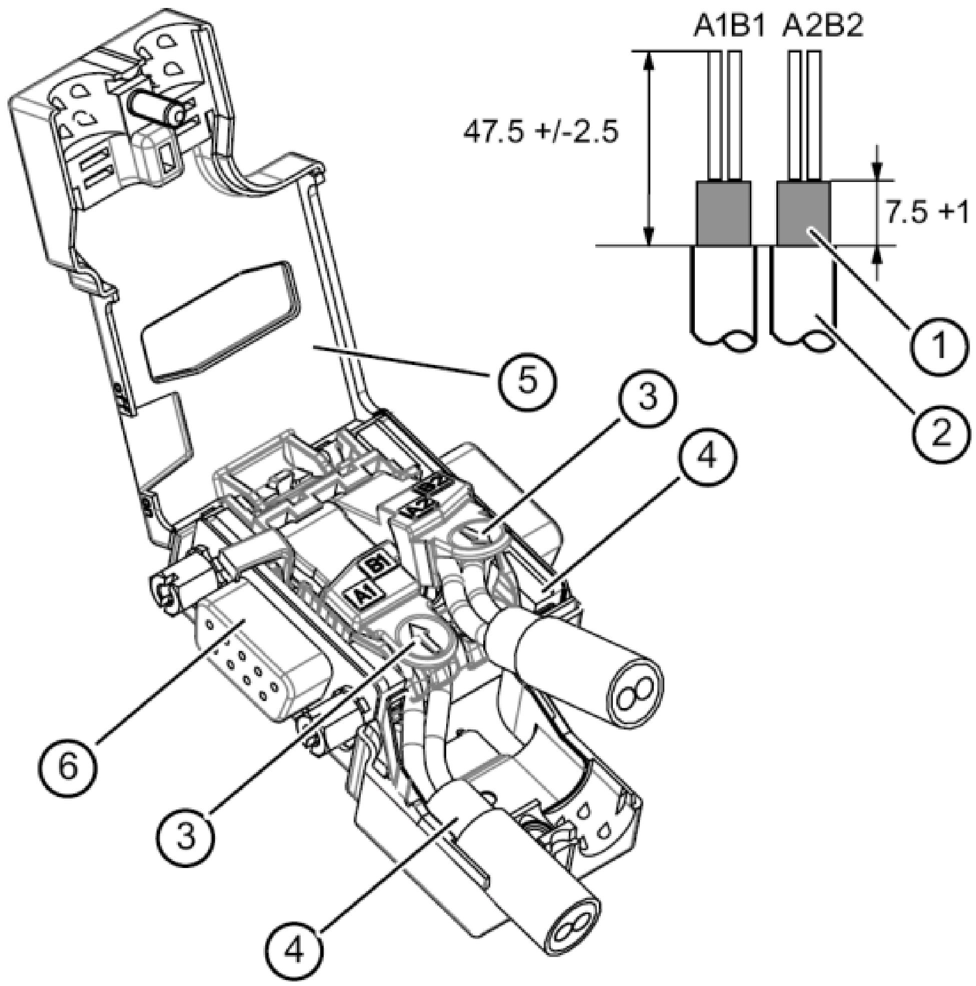


Figure 6-5 Bus connector 6ES7 972-0Bx52-0XA0

① Cable shield

② Bus cable (for example 6XV1 830-0EH10)
strip, for example with stripping tool 6GK1 905-6AA00

③ Cover for insulation piercing contacts
Insert the green and red wires as far as the limit stop in the open contact cover
Close the contact cover completely (push down as far as the limit stop)

④ Press the cable into the recess (the cable shield must lie on the contact element)

⑤ Close the housing cover and screw down

⑥ PG connector (only with 6ES7972-0BB51-0XA0)

Note

The bus cables are connected using the insulation piercing technique (Fast Connect).

The insulation piercing terminals are designed for 10 connection cycles. If you want to reuse a cable that has already been connected, you will first need to cut off the end.

6.3.4 Connecting the bus cable to bus connector (6ES7 972-0Bx60 ...)

Visual appearance (6ES7 972-0Bx60 ...)

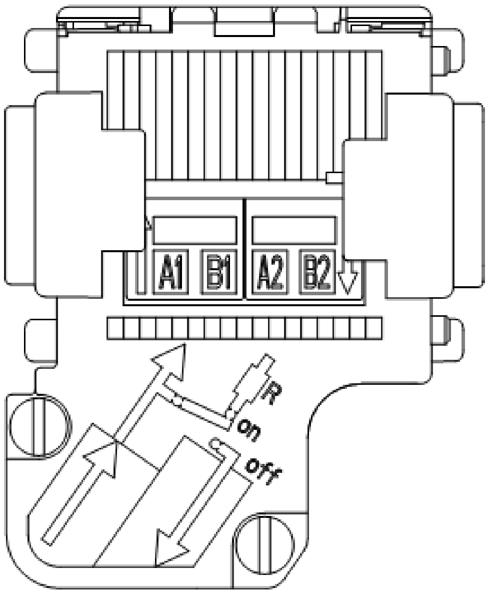


Figure 6-6 Bus connector 6ES7 972-0Bx60-XA00

Connecting up the bus cable

Connect the bus cable to the bus connector with order number 6ES7 972-0Bx60 as follows:

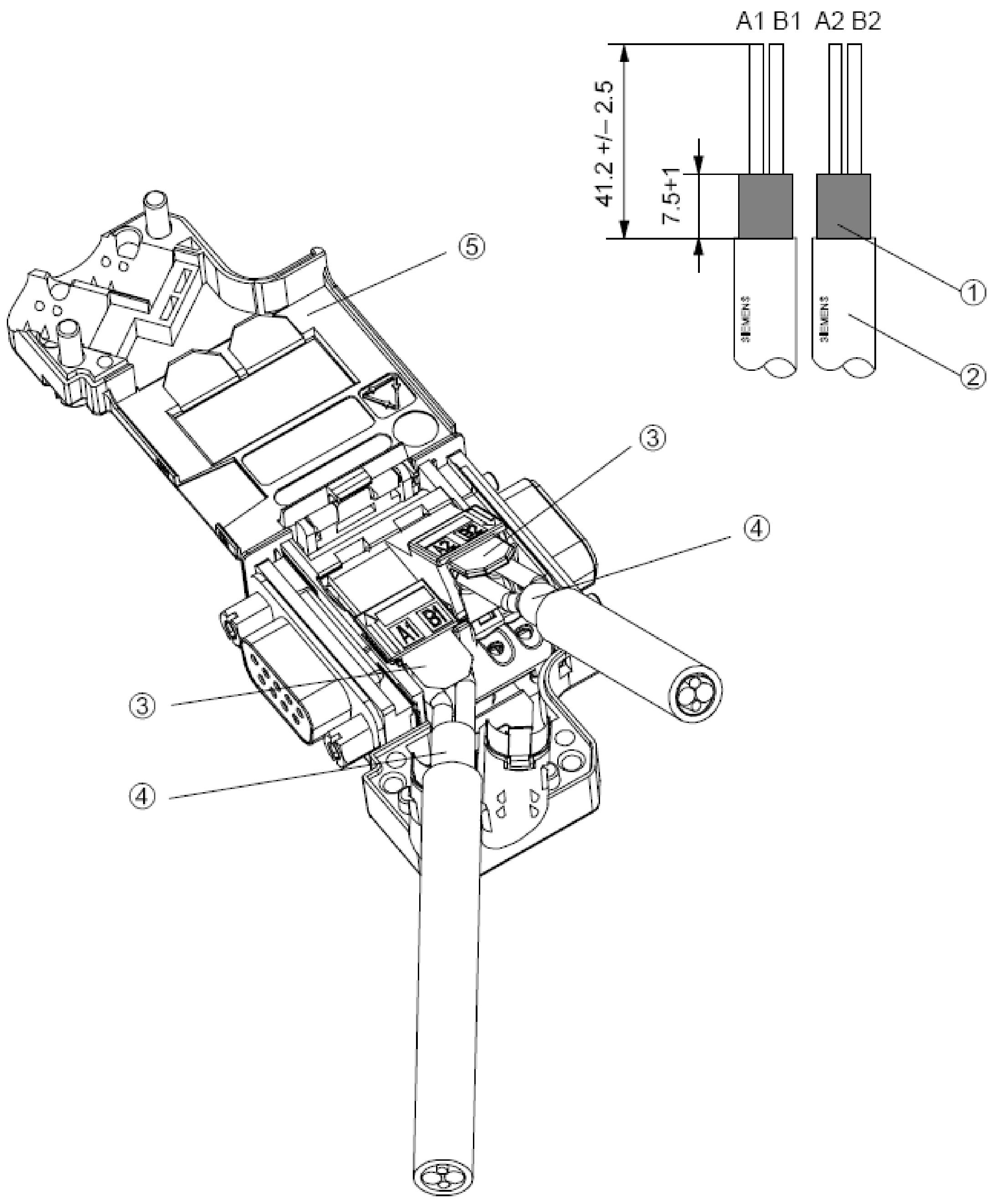


Figure 6-7 Bus connector (order number 6ES7 972-0Bx60-0XA0)

① Cable shield

② Bus cable (for example 6XV1 830-0EH10)
strip, for example with stripping tool 6GK1 905-6AA00

③ Cover for insulation piercing contacts
Insert the green and red wires as far as the limit stop in the open contact cover
Close the contact cover completely (push down as far as the limit stop)

④ Press the cable into the recess (the cable shield must lie on the contact element)

⑤ Close the housing cover and screw down

⑥ PG connector (only with 6ES7972-0BB60-0XA0)

Bus connection

- Bus connection for **first and last** node on PROFIBUS.
  The cable must always be connected on the left (see A1, B1).
  Switch setting for the first and last node on PROFIBUS: "ON" (terminating resistor activated).
- Bus connection for **all other** nodes on PROFIBUS.
  The incoming cable must always be connected on the left (A1, B1). The outgoing cable must always be connected on the right (A2, B2).
  Switch setting for all other nodes on PROFIBUS: "OFF" (terminating resistor deactivated). If the switch is set to "ON", the PROFIBUS to the remaining nodes is disconnected at this point (for example during servicing).

Note

The bus cables are connected using the insulation piercing technique (Fast Connect).

The insulation piercing terminals are designed for 10 connection cycles. If you want to reuse a cable that has already been connected, you will first need to cut off the end.

6.3.5 Connecting the bus cable to bus connector (6GK1 500-0FC10)

Visual appearance (6GK1 500-0FC10)

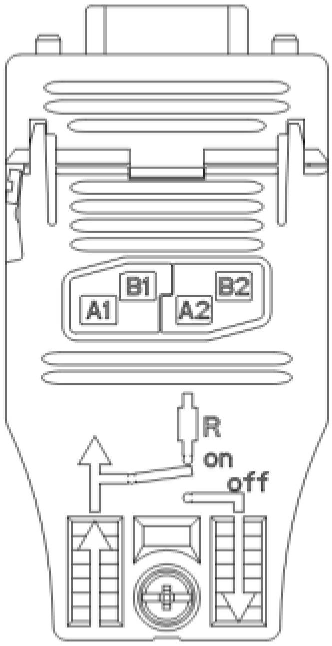


Figure 6-8 Bus connector 6GK1 500-0FC10

Connecting up the bus cable

Connect the bus cable to the bus connector with order number 6GK1 500-0FC00 as follows:

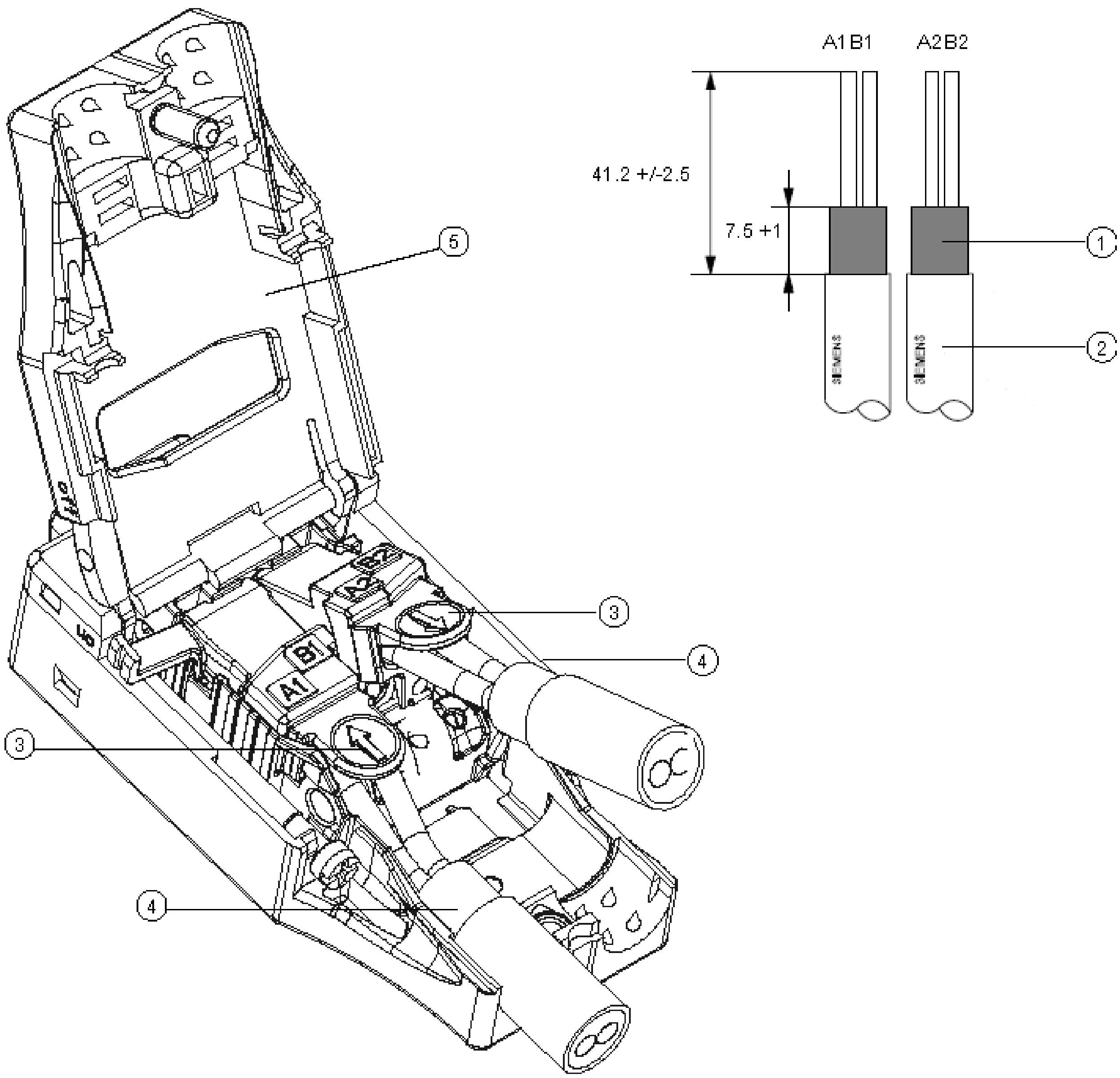


Figure 6-9 Connecting up bus connector 6GK1500-0FC10

① Cable shield

② Strip bus cable (for example 6XV1 830-0EH10) for example with stripping tool 6GK1 905-6AA00

③ Cover for insulation piercing contacts
Insert the green and red wires as far as the limit stop in the open contact cover
Close the contact cover completely (push down as far as the limit stop)

④ Press the cable into the recess (the cable shield must lie on the contact element)

⑤ Close the housing cover and screw down

Note

The bus cables are connected using the insulation piercing technique (Fast Connect).

The insulation piercing terminals are designed for 10 connection cycles. If you want to reuse a cable that has already been connected, you will first need to cut off the end.

6.3.6 Inserting the bus connector (D-sub) in the module

Connecting the bus connector

Follow the steps below to connect the bus connector:

- Plug the bus connector into the module.
- Screw the bus connector tightly onto the module.
- If the bus connector is located at the start or the end of a segment, you must connect the terminating resistor ("ON" switch setting) (refer to the following figure).

  It is not possible to activate the terminating resistor on the bus connector 6ES7 972-0BA30-0XA0.

Note

Please note that:

- By activating the terminating resistor, the outgoing bus cable is disconnected from the incoming bus cable.
- Stations equipped with a terminating resistor must always be supplied with power when the network starts up and during operation.

Figure 6-10 Bus connector (6ES7 972-0Bx12-...): Terminating resistor on and off

Removing the bus connector

You can unplug a bus connector with a looped-through bus cable at any time from the PROFIBUS DP interface without interrupting data exchange on the bus.

NOTICE
A bus segment must always be terminated with the terminating resistor at both ends. This is not the case, for example, if the last bus connector node is de-energized. Because the bus connector takes its voltage from the station, this terminating resistor is ineffective. Make sure that the stations on which the terminating resistor is activated are always supplied with power. As an alternative, the PROFIBUS terminator can also be used for active bus termination, see Section PROFIBUS terminator (active RS485 terminator) (Page 81).

6.4 D-sub bus connector with screw terminals

6.4.1 Use of the D-sub bus connector

Use

Using the bus connector for SIMATIC NET PROFIBUS:

- Nodes with an electrical 9pin D-sub interface complying with IEC 61158-2 / EN 61158-2 can be connected directly to the SIMATIC NET PROFIBUS cables
- Electrical segments or individual nodes can be connected to the optical link module (OLM, OBT).
- Nodes or programming devices can be connected to a repeater.

Note

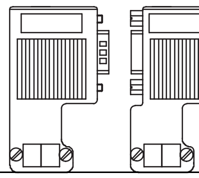
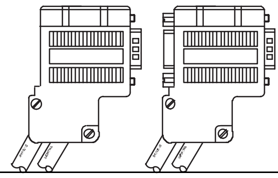
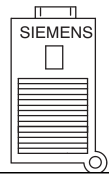
The integrated bus terminators and the mechanical specifications of the SIMATIC NET bus connectors are tailored to the SIMATIC NET PROFIBUS cables (cable type A of the PROFIBUS standard IEC 61158-2 / EN 61158-2). Fitting bus connectors to cables with different electrical or mechanical properties can cause problems during operation!

6.4.2 Area of application and technical specifications of the bus connectors

Area of application

You require bus connectors to attach the PROFIBUS bus cable to 9pin D-sub interfaces. The various bus connectors with degree of protection IP20 and the situations in which they are used are listed in the following table.

Table 6- 4 Design and applications of the IP20 bus connectors

Order numbers:	6ES7 972-0BA12-0XA0 6ES7 972-0BB12-0XA0	6ES7 972-0BA41-0XA0 6ES7 972-0BB41-0XA0	6GK1 500-0EA02
			
Recommended for:			
IM 308-B			
IM 308-C	X		
IM 467	X		
Use in PLC with integrated interface:			
S7-200	X		
S7-300	X	X	
S7-400	X	X	
M7-300			
C7-633 DP	X	X	
C7-634 DP	X	X	
C7 -635	X	X	
C7 -636	X	X	
S5-115U - S5-155U	X	X	
Use in PLC with			
IM 308 C	X	X	
CP 5431 FMS/DP	X	X	
CP 342-5	X		
CP 343-5	X	X	
CP 443-5	X	X	
Use in PG with			
MPI interface			X

Order numbers:	6ES7 972-0BA12-0XA0 6ES7 972-0BB12-0XA0	6ES7 972-0BA41-0XA0 6ES7 972-0BB41-0XA0	6GK1 500-0EA02
Use in PG with			
IM 467	X	X	
CP 5512	X	X	X
CP 5411			X
CP 5511	X	X	X
CP 5611	X	X	X
CP 5613/14	X	X	X
ET 200B	X	X	
ET 200L	X	X	
ET 200M	X	X	
ET 200S	X	X	
PG 720/720C		X	X
PG 740		X	X
PG 760		X	X
Repeater	X	X	X
OP			
OLM	X	X	X
Use in SINUMERIK 840 C and 805 SM			
IM 328N		X	
IM 329N	X		
Use in NC 840 D and FM NC SIMODRIVE 611 MCU			
CP 342-5	X		
Use in TI 505			
TI 505 FIM			X
TI 505 PROFIBUS DP			
RBC	X		

Technical specifications

The following table shows the technical data of the various bus connectors:

Table 6- 5 Technical specifications of the IP20 bus connectors

Order numbers	6ES7 972- ... 0BA12-0XA0 ... 0BB12-0XA0	6ES7 972- ... 0BA41-0XA0 ... 0BB41-0XA0	6GK1 500- 0EA02
PG socket	0BA12: No 0BB12: Yes	0BA41: No 0BB41: Yes	No
Max. transmission speed	12 Mbps	12 Mbps	12 Mbps
Terminating resistor and disconnect function	Integrated	Integrated	Integrated
Cable outlet	90 °	35°	180 °

Order numbers	6ES7 972- ... 0BA12-0XA0 ... 0BB12-0XA0	6ES7 972- ... 0BA41-0XA0 ... 0BB41-0XA0	6GK1 500- 0EA02
Interfaces to PROFIBUS node to PROFIBUS bus cable	 9-pin D-sub male 4 terminal blocks for wires up to 1.5 mm²	 9-pin D-sub male 4 terminal blocks for wires up to 1.5 mm²	 9-pin D-sub male 4 terminal blocks for wires up to 1.5 mm²
Connectable PROFIBUS cable diameter	8 ± 0.5 mm	8 ± 0.5 mm	8 ± 0.5 mm
Power supply (must be provided by end device)	4.75 to 5.25 V DC	4.75 to 5.25 V DC	4.75 to 5.25 V DC
Current input	Max. 5 mA	Max. 5 mA	Max. 5 mA
Permitted ambient conditions Operating temperature Transportation/storage temperature Relative humidity	 0 °C to +60 °C -25 °C to +80 °C max. 75 % at +25 °C	 0 °C to +60 °C -25 °C to +80 °C max. 75 % at +25 °C	 0 °C to +55 °C -25 °C to +70 °C max. 95 % at +25 °C
Dimensions (in mm)	15.8 x 54 x 34	16 x 54 x 38	15 x 39 x 57
Weight	Approx. 40 g	Approx. 40 g	Approx. 100 g

Disconnect function

The disconnect function means that the outgoing bus cable is disconnected from the bus when the terminating resistor is activated. If the terminating resistor is accidentally activated in the middle of the bus cable, the error can be recognized and localized immediately due to the nodes that are no longer accessible.

Disconnecting a station

The bus connector allows you to disconnect a node from the bus without interrupting the data traffic on the bus.

Removing the bus connector when the terminating resistor is activated at the ends of the cable causes disruptions on the bus and is not permitted.

Bus connector with a programming device socket

We recommend that you include at least one bus connector with a PG socket in each bus segment. This makes it easier to commission using a programming device or PC.

In the bus connectors with a PG socket, all the contacts are connected 1:1 with the connector pins; in other words, the pinout is the same as the pinout of the attached device.

Pinout of the D-sub male connector

The following table shows the pinout of the 9pin D-sub male connector.

Table 6- 6 Pinout of the 9-pin D-sub male connector

Pin no.	Signal name	Description
1	-	-
2	-	-
3	RxD/TxD-P	Data line B
4	-	-
5	M5V2	Data reference potential (station)
6	P5V2	Supply plus (station)
7	-	-
8	RxD/TxD-N	Data line A
9	-	-

6.4.3 Connecting the bus cable to bus connector (6ES7 972-0Bx12 ...)

Appearance (6ES7 972-0B.12 ...)

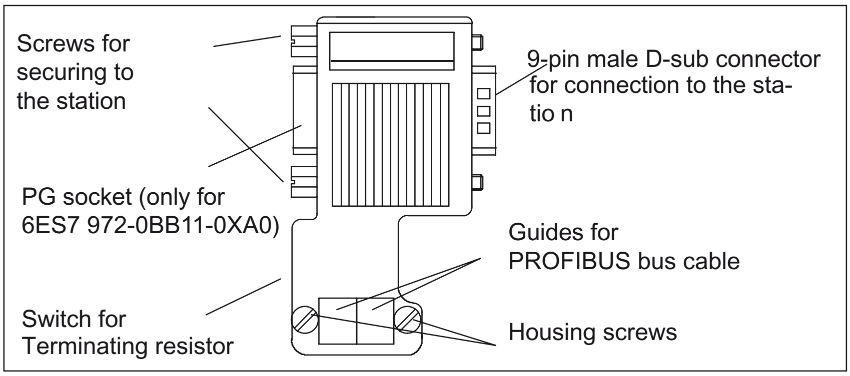


Figure 6-11 Bus connector (order number 6ES7 972-0Bx12 ...)

Connecting up the bus cable

Connect up the bus cable to the bus connector with order number 6ES7 972-0Bx12 ... as follows:

- Strip the bus cable as shown in the figure below using the FastConnect stripping tool (sizes and lengths are shown in the table on the rear of the tool).

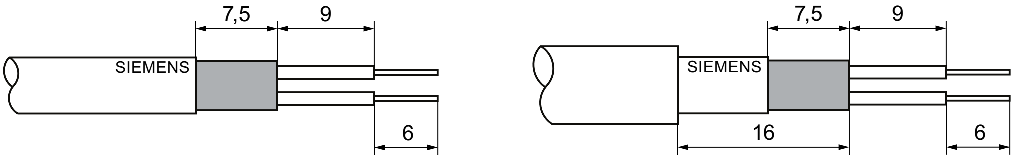


Figure 6-12 Length of cable stripped for connection to bus connector (6ES7 972-0B.12 ...)

- Open the casing of the bus connector by undoing the screws and removing the cover.
- Insert the green and the red wire into the screw-terminal block as shown in the figure below.
- Always connect the same wires to the same terminal A or B (for example green wire to terminal A, red wire to terminal B).
- Press the cable jacket between the two clip bars. This secures the cable.
- Screw the green and red cores tight in the screw terminal.

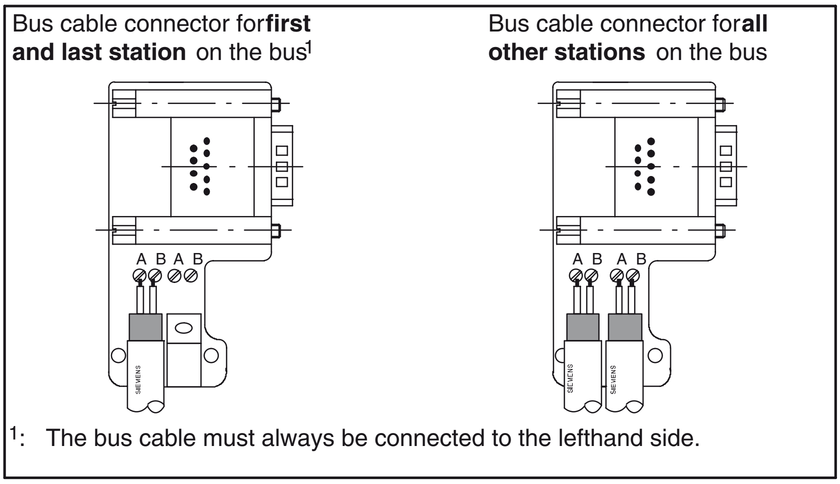


Figure 6-13 Bus cable attached to bus connector (6ES7 972-0xB12 ...)

- Screw the casing together.
  Make sure that the cable shield is located directly below the shield clamp.

Note

Stranded cores must only be used in screw terminals with wireend ferrules fitted (0.25 mm^2 complying with DIN 46228). Use only wireend ferrules made of materials with permanently stable contact properties, for example copper with a tinplated surface (not aluminum).

6.4.4 Connecting the bus cable to bus connector (6ES7 972-0Bx41)

Visual appearance (6ES7 972-0Bx41 ...)

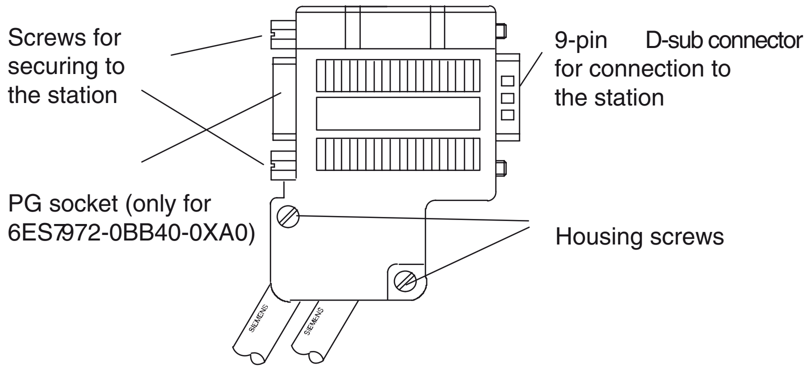


Figure 6-14 Bus connector (order number 6ES7 972-0Bx41...)

Connecting up the bus cable

Connect up the bus cable to the bus connector with order number 6ES7 972-0Bx41... as follows:

- Strip the bus cable as shown in the figure below using the FastConnect stripping tool (sizes and lengths are shown in the table on the rear of the tool).

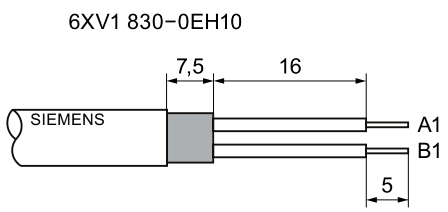


Figure 6-15 Length of cable stripped for connection to bus connector (6ES7 972-0Bx41...)

- Open the casing of the bus connector by undoing the screws and removing the cover.
- Insert the green and the red wire into the screw-terminal block as shown in the figure below.
  Always connect the same wires to the same terminal A or B (for example green wire to terminal A, red wire to terminal B).

- Press the cable jacket between the two clip bars. This secures the cable.
- Screw the green and red cores tight in the screw terminal.

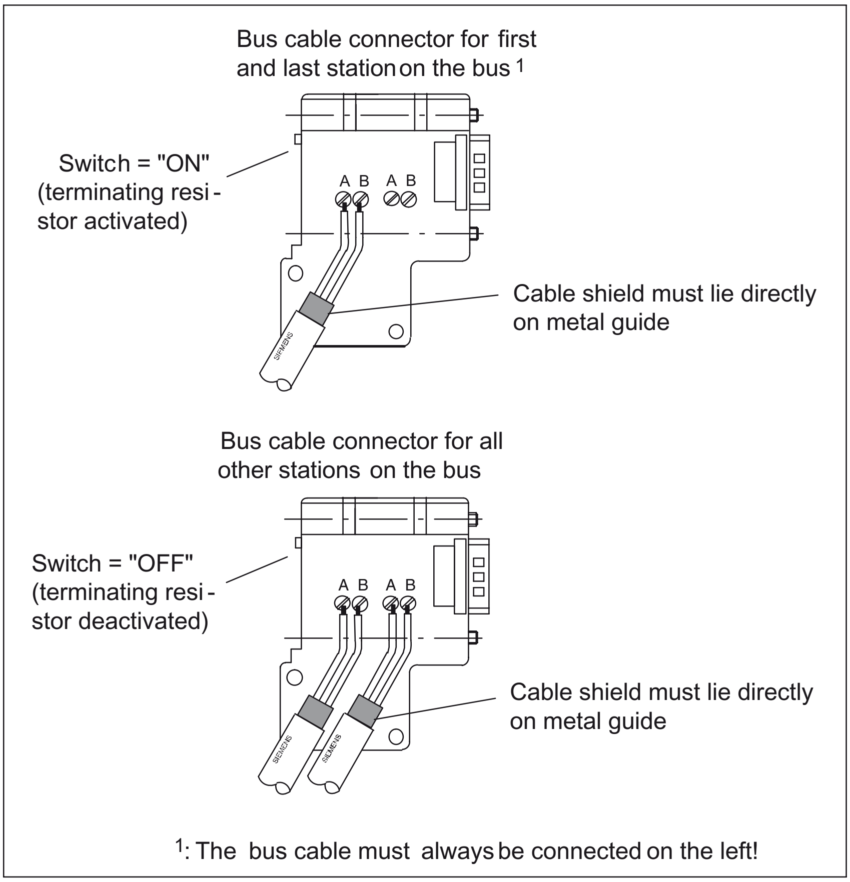


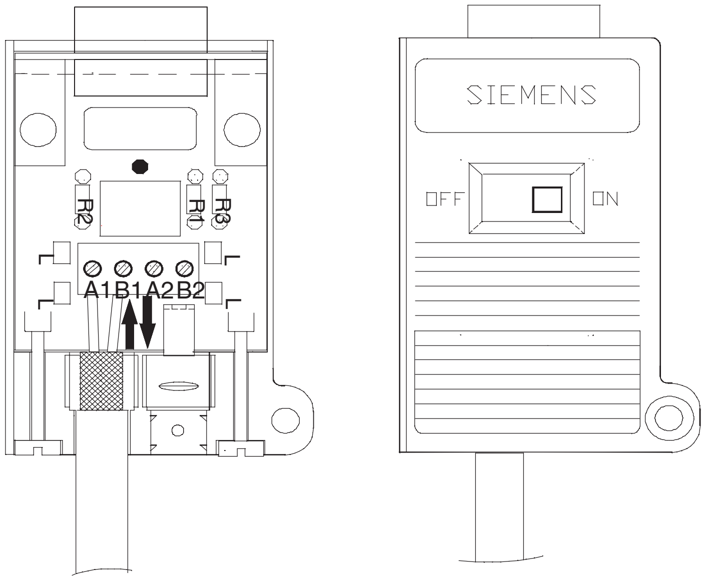
Figure 6-16 Connecting the bus cable to bus connector (6ES7 972-0Bx41...)

Note

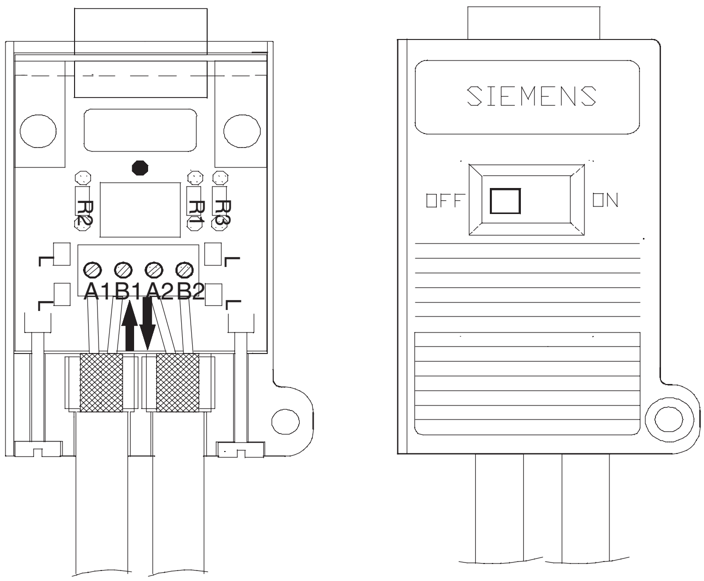
Stranded cores must only be used in screw terminals with wireend ferrules fitted (0.25 mm² complying with DIN 46228). Use only wireend ferrules made of materials with permanently stable contact properties, for example copper with a tinplated surface (not aluminum).

6.4.5 Connecting up the bus connector with axial cable outlet

Visual appearance (6GK1500-0EA02)



Bus cable connector and switch setting for first and last station on the bus



Bus cable connector and switch setting for all other stations on the bus

Figure 6-17 Connecting up the bus connector with axial cable outlet

Fitting the bus connector

Points to note about installing the bus connector with axial cable outlet (order number 6GK1 500-0EA02):

- Strip both cable ends as shown in the figure below with the FastConnect stripping tool (sizes and lengths are shown in the table on the rear of the tool).

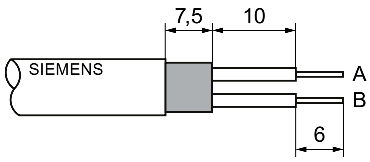


Figure 6-18 Preparing the ends of the cable for the bus connector with axial cable outlet

- Undo the screws in the casing and remove the cover.
- Feed the wires into the terminals of the screw terminal blocks.
- Press the cable jacket between the two clip bars.
- Make sure that the cable shields are lying on the metal guide.
- When you connect to the screw terminals, the stranded cores must be fitted with wireend ferrules (0.25 mm^2 complying with DIN 46228).
- Make sure that the braid shield lies on the contact surfaces of the connector.
- Replace the cover and screw it tight.
- Activate the terminating resistor if the bus connector is at the end of a segment.

Note

Stranded cores must only be used in screw terminals with wireend ferrules fitted (0.25 mm^2 complying with DIN 46228). Use only wireend ferrules made of materials with permanently stable contact properties, for example copper with a tinplated surface (not aluminum).

6.4.6 Inserting the bus connector (D-sub) in the module

Connecting the bus connector

Follow the steps below to connect the bus connector:

- Plug the bus connector into the module.
- Screw the bus connector tightly onto the module.
- If the bus connector is located at the start or the end of a segment, you must connect the terminating resistor ("ON" switch setting) (refer to the following figure).

  It is not possible to activate the terminating resistor on the bus connector 6ES7 972-0BA30-0XA0.

Note

Please note that:

- By activating the terminating resistor, the outgoing bus cable is disconnected from the incoming bus cable.
- Stations equipped with a terminating resistor must always be supplied with power when the network starts up and during operation.

Figure 6-19 Bus connector (6ES7 972-0Bx12-...): Terminating resistor on and off

Removing the bus connector

You can unplug a bus connector with a looped-through bus cable at any time from the PROFIBUS DP interface without interrupting data exchange on the bus.

NOTICE
A bus segment must always be terminated with the terminating resistor at both ends. This is not the case, for example, if the last bus connector node is de-energized. Because the bus connector takes its voltage from the station, this terminating resistor is ineffective. Make sure that the stations on which the terminating resistor is activated are always supplied with power. As an alternative, the PROFIBUS terminator can also be used for active bus termination.

6.5 M12 bus connector

6.5.1 Area of application and technical specifications of the M12 bus connectors

Use

Using the M12 bus connector for SIMATIC NET PROFIBUS:

- Nodes with an electrical M12 interface can be connected directly to the SIMATIC NET PROFIBUS cables.

Note

The mechanical specifications of the SIMATIC NET bus connectors are tailored to the SIMATIC NET PROFIBUS cables (cable type A of the PROFIBUS standard IEC 61158-2 / EN 61158-2). Fitting bus connectors to cables with different electrical or mechanical properties can cause problems during operation!

Table 6- 7 Design and applications of the M12 bus connectors to IP65

	M12 bus connector with screw terminals	M12 bus connector with insulation piercing terminals
Order numbers:	6GK1 905-0EA00 6GK1 905-0EB00	6GK1 905-0EA10 6GK1 905-0EB10
Design		
ET 200B ET 200L ET 200M ET 200S ET 200pro ET 200eco	 X X	 X X
PG 720/720C PG 740 PG 760 RS-485 repeater OP OLM/OBT		

Table 6- 8 Technical specifications of the M12 bus connector to IP65

	M12 bus connector with screw terminals	M12 bus connector with insulation piercing terminals
Order numbers:	6GK1 905-0EA00 6GK1 905-0EB00	6GK1 905-0EA10 6GK1 905-0EB10
Max. transmission speed	9.6 kbps to 12 Mbps	9.6 kbps to 12 Mbps
Cable outlet	180 °	180 °
Terminating resistor	No	No
Interfaces • to PROFIBUS node • to PROFIBUS bus cable	 M12, B-coded screw terminals	 M12, B-coded insulation piercing terminals
Permissible ambient conditions • Operating temperature • Transportation/storage temperature • Relative humidity – Transportation and storage – Installed	 • -40 °C .. +85 °C • -40 °C .. +85 °C 5 .. 95 % without condensation 5 .. 100 % with condensation	 • -40 °C .. +85 °C • -40 °C .. +85 °C 5 .. 95 % without condensation 5 .. 100 % with condensation
Construction • Dimensions (WxHxD) • Weight	 19 x 19 x 70 mm 40 g	 19 x 19 x 73 mm 40 g
Type of protection	IP65/67	IP65/67
Connectable PROFIBUS cable diameter	8 ± 0.5 mm	8 ± 0.5 mm

6.5.2 Connecting the bus cable to the FC M12 bus connector (6GK1 905-0Ex10)

Visual appearance (6GK1 905-0Ex10)

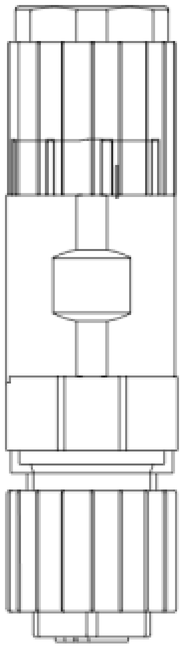


Figure 6-20 Visual appearance (6GK1 905-0Ex10)

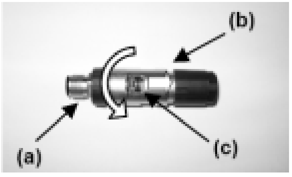
Connecting up the bus cable

The instructions apply to the following cable types

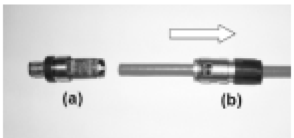
PROFIBUS FC standard cable	6XV1 830-0EH10
PROFIBUS FC robust cable	6XV1 830-0JH10
PROFIBUS FC food cable	6XV1 830-0GH10
PROFIBUS FC ground cable	6XV1 830-3FH10
PROFIBUS FC FRNC cable	6XV1 830-0LH10
PROFIBUS FC trailing cable	6XV1 830-3EH10
PROFIBUS FC flexible cable	6XV1 830-2K
PROFIBUS festoon cable	6XV1 830-3GH10
PROFIBUS torsion cable	6XV1 830-0PH10

Fitting connectors

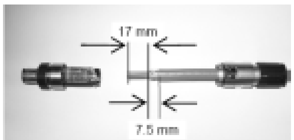
Table 6- 9 Fitting the connector



1. Press the catch (c) in the direction of the arrow.
2. Unscrew the connector housing (b) from the front part of the connector (a).

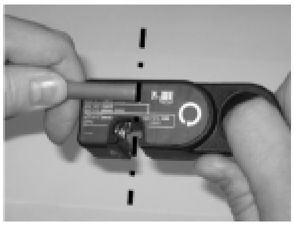


3. Fit the connector housing (b) over the cable.

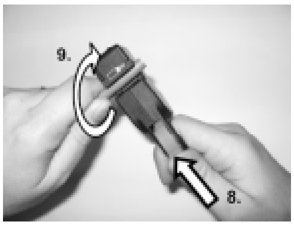


4. Strip the cable as shown in the drawing using a suitable stripping tool with the required cutting depth or using the PROFIBUS stripping tool*.

* The stripping tool is not suitable for cables other than FC cables.

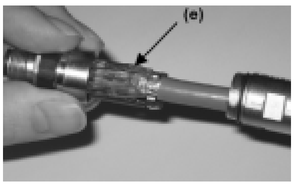


5. In the stripping tool 6GK1 905-6AA00, use the brown knife cassette 6GK1 905-6AB00.
6. Measure the cable length to be stripped by placing the cable on the template. The correct length is indicated by the marker with the number 6GK1 905-0EA10 or -0EB10.



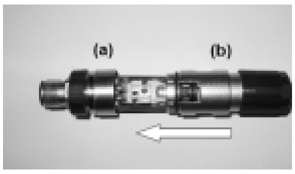
7. Insert the cable. Your index finger acts as the limit stop.
8. Clamp the stripping tool as far as it will go.
9. Turn the stripping tool as follows:
   - 4 times for PVC cables,
   - 8 times for PUR cables

in the direction of the arrow and remove the remains of the jacket.

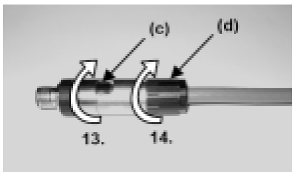


10. Open the flap (e) and push the PROFIBUS wires according to the colored marking as far into the holder as they will go.

11. Press down the holder flap (e) until it is fully closed. Make sure that the jacket shield fully covers the shield contact surface.



12. Push the connector housing (b) up to the front part of the connector (a).



13. Screw the connector housing and the front of the connector together until the catch (c) locks in position.

14. Screw the pressure nut (d) and the connector housing together.

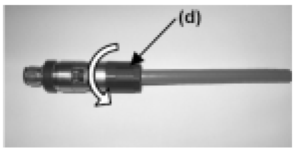
Note

Replace the knife cassette if the cut edges become ragged or after approx.

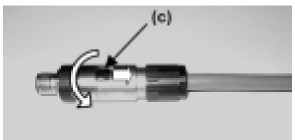
- 1500 operations on cables with PVC outer jackets
- 150 operations on cables with PUR outer jackets

The piercing contacts of the PROFIBUS FC M12 Plug PRO can be released and reused up to 10 times. Cable ends that have already been pierced must not be used again but must be cut off.

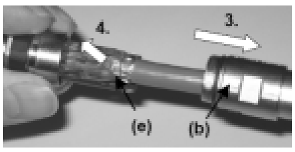
Table 6- 10 Dismantling the plug



1. Release the pressure nut (d).



2. Press the catch (c) in the direction of the arrow and at the same time unscrew the connector housing from the front part of the connector.



3. Push the connector housing (b) to the back.

4. Open the holder flap (e) of the front part of the connector by pushing up the inserted cable.

5. Remove the cable from the holder (e) and pull the connector housing off the cable.

Further information

You will find further information on the cables, connectors and tools described here in the IK PI catalog.

6.5.3 Connecting the bus cable to the M12 bus connector (6GK1 905-0Ex00)

Visual appearance (6GK1 905-0Ex00)

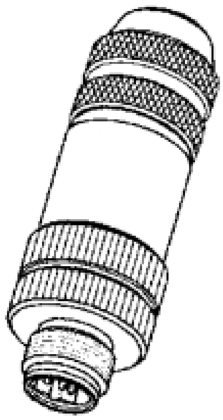


Figure 6-21 6GK1905-0Ex00

Connecting up the bus cable

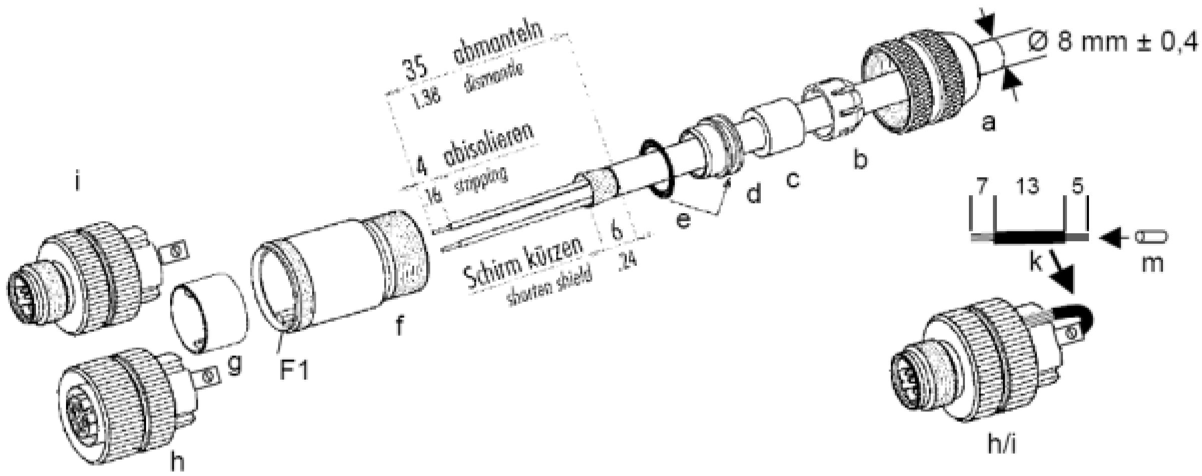


Figure 6-22 Inserting the bus cables in the M12 connector 6GK1 905-0Ex00

Suitable cables

SIMATIC NET PB M12 bus connectors are suitable for fitting to all SIMATIC NET PROFIBUS cables.

Fitting connectors to cables

Note

With some connectors, the insulation sleeve (g) is supplied separately. If this is the case, prior to all other steps, fit the O-ring on to the shield (d) and insert the insulation sleeve (g) into the coupling sleeve (f) as shown in the diagram above.

1. Push the clamping screw (a), pinch ring (b), sealing ring (c) and shield ring (d) with the O-ring (e) fitted over the cable.
2. Strip the cable jacket and wire insulation as shown in the diagram.
3. Fold the cable shield over the shield ring (d).
4. Push the coupling sleeve (f) over the PROFIBUS wires and tighten the clamping screw (a).
5. Fit the 0.5 mm² wire end ferrules to the PB stranded wires. Fit the green and red PB wires into the screw terminals of the socket or plug insert (h/i) and screw tight.
6. Push the coupling sleeve (f) onto the socket or plug insert (h/i).
7. Screw the coupling sleeve (f) to the socket or plug insert (h/i).

Optional – Contacting pin 5 with the shield

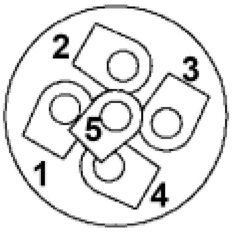
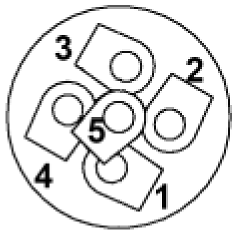
Note

Contacting the shield with pin 5 is not recommended, see: PROFIBUS Interconnection Technology Guideline V1.4.

If shield contact using pin 5 is specified by the manufacturer of your device, follow the steps below:

1. Perform steps 1 to 4 as described above.
2. Strip the insulation from the ends of a 2.5 cm long piece of stranded wire 0.75 mm² (k) as shown in the diagram.
3. Fit a wire end ferrule 0.75 mm² (m) to the prepared 5 mm long end of the wire and fit this in pin 5 (shield contact) of the socket or plug insert (h/i) and screw tight.
4. Fit the 0.5 mm² wire end ferrules to the PROFIBUS stranded wires. Fit the green and red PROFIBUS wires into the screw terminals of the socket or plug insert (h/i) and screw tight.
5. Fit the other end of the stranded wire for the shield contact into one of the four grooves on the side of the insulator body.
6. Push the coupling sleeve (f) onto the socket or plug insert (h/i) so that the metal bar F1 on the inner side presses the shield contact wire into the groove to contact the shield.
7. Screw the coupling sleeve (f) to the socket or plug insert (h/i).

Pin assignment

<table>
<tr><th>View of the contact face</th><th>Pin
(6GK1 905-0EA00)</th><th>Lead</th><th>Socket
(6GK1 905-0EB00)</th><th>View of the contact face</th></tr>
<tr><td rowspan="6">
</td><td>Pin 1</td><td>not used</td><td>Pin 1</td><td rowspan="6">
</td></tr>
<tr><td>Pin 2</td><td>PROFIBUS A, green</td><td>Pin 2</td></tr>
<tr><td>Pin 3</td><td>not used</td><td>Pin 3</td></tr>
<tr><td>Pin 4</td><td>PROFIBUS B, red</td><td>Pin 4</td></tr>
<tr><td>Pin 5</td><td>Optional: Shield</td><td>Pin 5</td></tr>
<tr><td>Threaded joint</td><td>Shield</td><td>Threaded joint</td></tr>
</table>

6.5.4 Inserting an M12 bus connector in a module

Properties

The M12-PROFIBUS connector of a device consists of an M12 socket for the incoming bus signal and an M12 male connector for looping through the signal. This means that the M12 connector must be equipped with socket contacts for the incoming cable and pin contacts for the outgoing cable.

Connecting the bus connector

To connect the bus connector to the device, follow the steps below:

1. Turn the connector so that the slot and key of the mating mechanism fit together.
2. Plug the bus connector loosely into the module.
3. By carefully turning the male connector, make sure the connector and socket are properly interlocked (slot and key).
4. Secure the bus connector to the module with the locking nut (tightening torque 0.6 ± 0.1 Nm).

Terminating resistor and the start or end of a segment

If the device is located at the start or end of a segment, you will need to screw a bus terminating resistor with pin contacts (6GK1 905-0EC00) or with socket contacts (6GK1 905-0ED00) to the second bus connector of the device.

Closing unused M12 connection points

Close all unused M12 connection points with sealing caps (3RX9 802-0AA00) to achieve degree of protection IP65 or IP67 (tightening torque 0.6 ± 0.1 Nm).

6.6 M12 bus terminating resistor

Terminating resistor and the start and end of a segment

A PROFIBUS segment must always be terminated at both ends with a bus terminating resistor.

For each M12 bus line, you require both a bus terminating resistor with pin contacts (6GK1 905-0EC00) and with socket contacts (6GK1 905-0ED00).

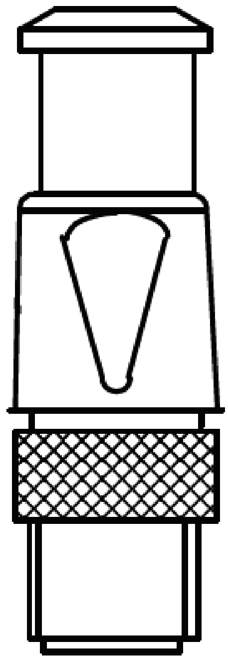


Figure 6-23 M12 bus terminating resistor

6.6.1 Inserting an M12 bus terminating resistor in a module

Properties

The M12-PROFIBUS connector of a device consists of an M12 socket for the incoming bus signal and an M12 male connector for looping through the signal.

At the start and end of a bus, instead of looping the bus through, a bus terminating resistor must be fitted.

Fitting the bus terminating resistor

To connect the bus terminating resistor to the device, follow the steps below:

1. Turn the bus terminating resistor so that the slot and key of the mating mechanism fit together.
2. Plug the bus terminating resistor loosely into the module.
3. By carefully turning the bus terminating resistor, make sure the connector and sockets are properly interlocked (slot and key).
4. Secure the bus terminating resistor to the module with the locking nut (tightening torque 0.6 ± 0.1 Nm).

6.7 Bus terminals for RS485 networks

6.7.1 Versions available

Overview

A bus terminal is used to attach a single PROFIBUS node with an RS485 interface to the PROFIBUS cable.

Bus terminals are available in the following versions:

Table 6- 11 Variants of the bus terminal

	RS-485 bus terminal	Bus terminal 12 M
With 1.5 m spur line		Order no.: 6GK1 500-0AA10
With 1.5 m spur line and additional PG interface	Order no.: 6GK1 500-0DA00	
With 3 m spur line	Order no.: 6GK1 500-0AB00	
Transmission speed	9.5 kbps to 1.5 Mbps	9.5 kbps to 12 Mbps
Power supply	5V/10 mA from the node interface	5V/90 mA from the node interface
Terminating resistor combination	integrated, can be added	Integrated, can be activated with disconnect function
Casing degree of protection	IP20	IP20

6.7.2 Design and functions of the RS485 bus terminal

RS-485 bus terminal

The RS485 bus terminal is used to connect end devices with an RS485 interface to the bus cable. This contains:

- 6 modular terminals for wires with a crosssectional area ≤1.5 mm^2 to connect the incoming and outgoing bus cable and, if necessary, the protective earth (PE)
- Screw down clamps for field contact
- a switch ("bus terminated") to allow termination at the end of an RS485 segment with the characteristic impedance
- a spur line (preassembled either 1.5 m or 3 m long) with a 9pin D-sub male connector for direct connection to an end device.

Terminator

The D-sub male connector is plugged into the D-sub female connector of the end device and secured by screws. If the terminator is activated (switch setting "bus terminated"), the RS485 bus terminal requires current of max. 5 mA with a supply voltage of 5 V supplied by the end device between pins 5 and 6 of the connector.

Table 6- 12 Pinout of the D-sub connector

Pin	Signal	Meaning
1	PE	Protective earth
2	NC	not used
3	B (RXD/TXD-P)	Data line B (receive/transmit data P)
4	NC	not used
5	M5V2 (DGND)	Data ground
6	P5V2 (VP)	+ 5 V (voltage plus)
7	NC	not used
8	A (RXD/TXD-N)	Data line A (receive/transmit data N)
9	NC	not used

Additional PG interface

The RS-485 bus terminal with additional PG interface has an additional 9-pin D-sub socket on the front panel for connecting a device such as a programming device using a PG connecting cable. The pinout is identical to that shown in the table above.

Note

The SIMATIC NET PROFIBUS RS-485 bus terminals are suitable for transmission speeds ≤ 1.5 Mbps.
At higher speeds, you should use the 12M bus terminal.

6.7.3 Design and functions of the 12M bus terminal

Figure 6-24 12M bus terminal (BT12M)

12M bus terminal

The 12M bus terminal is used to connect end devices with an RS485 interface to the bus cable.

This contains:

- 1 terminal block with 6 terminals for wires with a crosssectional area <=1.5 mm^2 to connect the incoming and outgoing bus cable and, if necessary, the protective earth (PE)
- Screw down clamps for shield contact

  two switches:
  Right switch (\`Termination\`), to terminate the end of an incoming, electrical segment (A1, B1) with the characteristic impedance (switch on). At the same time, the outgoing, electrical segment (A2, B2) is interrupted.
  Left switch, used to set the range of the transmission speed 9.6 kbps to 1.5 Mbps and 3 Mbps to 12 Mbps.
- A 1.5 m long spur line with a 9pin D-sub male connector for direct attachment to an end device.

The D-sub male connector is plugged into the D-sub female connector of the end device and secured by screws. The 12M bus terminal requires a current of 90 mA with a voltage of 5 V supplied by the end device between pins 5 (M5) and 6 (P5) of the D-sub male connector.

A maximum of 32 BT12M terminals can be connected to one bus segment. If other components, such as repeaters are connected to a bus segment, this reduces the maximum number of 12M bus terminals that can be connected.

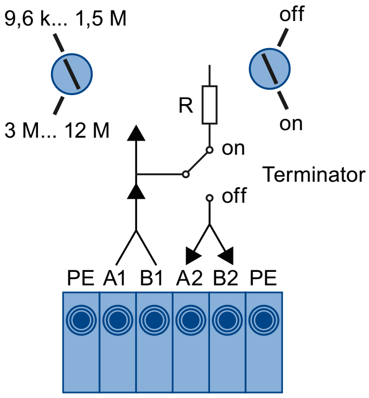


Figure 6-25 Control elements

Termination

The termination must be activated on the first and last node on the bus segment. If termination is activated (termination on), the connection between the incoming (A1, B1) and outgoing (A2, B2) segment is interrupted. The advantage of this is that if a bus terminating resistor is activated incorrectly, the stations after the bus terminal can no longer be accessed. When a segment is started up, you can then make sure that no bus terminating resistors are activated that are not located at the beginning or end of the network.

Note

Restriction when using the 12M bus terminal at 500 kbps

This restriction only affects segments longer than 80 m.

If the 12M bus terminal is operated at a transmission rate of 500 kbps along with the RS485 bus terminal with a 3.0 m spur line (6GK1 5000AB00), a minimum clearance of 5 m (= 5 m PROFIBUS cable) must be maintained between the RS485 bus terminal with the 3.0 m spur line. The 12M bus terminals can be located anywhere in the segment, in other words, there is no minimum clearance that needs to be maintained. The 12M bus terminal can also be included between two RS485 bus terminals with a 3.0 m spur line. The only important point in this respect is that the PROFIBUS cable between the two RS485 bus terminals with 3.0 m spur lines must be a total of at least 5 m long.

6.7.4 Mounting and attaching the bus cable(s)

Mounting methods

The bus terminal can be mounted in three different ways:

- By snapping it on to a 15 x 35 mm standard DIN rail to EN5002235x15
- By screwing it to a mounting plate using two fillister head screws. The following figure shows the drilling template for mounting on a plate.

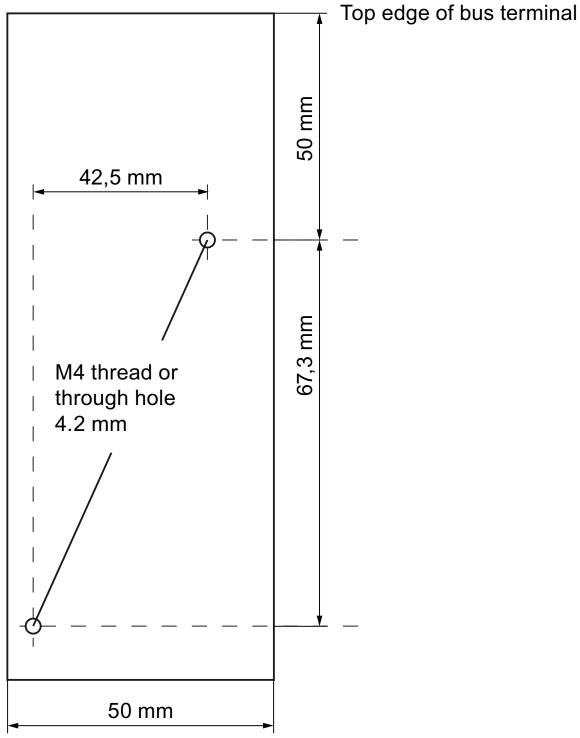


Figure 6-26 Drilling template for the bus terminal

- Wall mounting (brick, concrete). You require 2 type 5 plugs, 2 half-round wood screws DIN 96, size 3.5 , L70 and two washers DIN 125-4.3. The required holes are shown in the figure in above

---

Note

Please make sure that the bus terminal is accessible for maintenance and installation work even during operation.

To connect the bus cable, follow the steps below (see figure below):

- Open the bus cable at the point at which the bus terminal will be inserted.
- Strip approximately 33 mm of the outer jacket. Make that the braid shield is not damaged when you strip the jacket.

- Remove a length of approximately 12 mm of the braid shield and foil shield (the foil shield can be left somewhat longer).

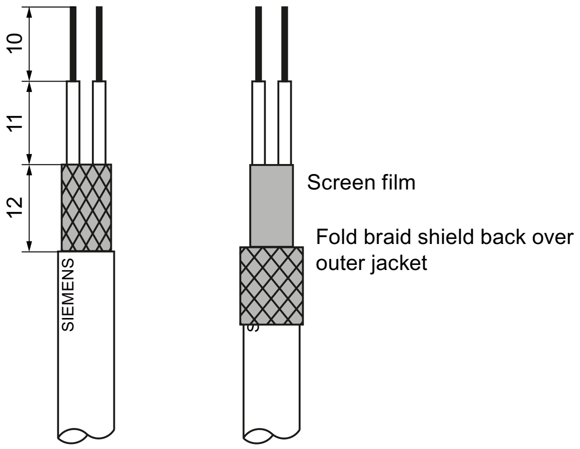


Figure 6-27 Preparing the bus cable for connection to the bus terminal

- Fold back the braid shield over the cable jacket.
- Strip approximately 10 mm from the end of the wires.
- Fit the bus cable to the terminal so that the braid shield is lying directly under the cable clamp.

- Screw the ends of the wires to the appropriate terminals (if the cores are stranded, for example, the trailing cable, 0.25 mm^2 wireend ferrules complying with DIN 46228 must be used).
- If the bus terminal is at the start or end of a segment, the integrated terminator must be activated (switch set to Terminator on).

Note

The shield clamps are used solely to contact the shields and are not suitable as strain-relief clamps. This means that the bus cables must be secured as close as possible to the bus terminals to provide mechanical strain relief.

Note

Bus terminals installed at the end of segments require the 5 V power supply from the end device interface to supply the activated, integrated terminator.

The D-sub male connector must therefore always be plugged in and secured by screws. The attached end device must not be turned off.

Note

The same wires (green or red) must always be connected to the same terminal A or B in all bus terminals (and with all bus connections) and be uniform throughout the segment.

The following scheme is recommended for a PROFIBUS network:

- Connector A: green wire
- Connector B: red wire

Note

Notes on the 12M bus terminal

The 12M bus terminal may only be plugged into an interface when the power is off.

At the ends of a segment, the PROFIBUS cable must only be connected to terminal pair A1, B1. Terminals A2, B2 are disconnected from the bus when the terminator is activated.

6.7.5 Grounding measures

Grounding

If the bus terminal is mounted on a DIN rail (see figure below), the shield clamp makes large-area contact with the rail via an internal spring. To connect the cable shield with local ground, a connection between the DIN rail over as short a distance as possible to local earth is adequate.

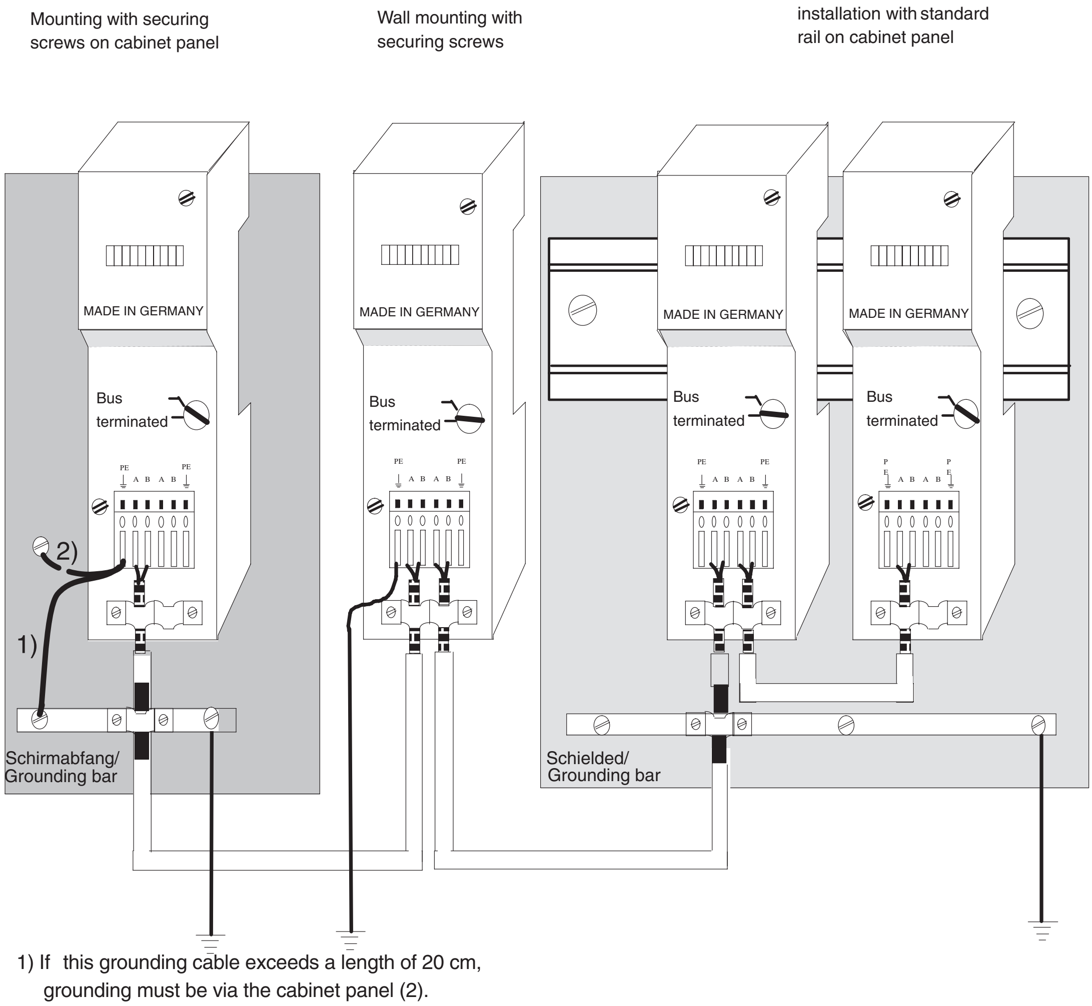


Figure 6-28 Ways of installing and grounding the bus terminal

---

Note

The grounding bar and local ground must be connected together over as short a distance as possible with a copper conductor with ≥ 6 mm^2 cross section.

Note

The DIN rail must have a good conducting surface (for example tin plated).

Wall mounting

Note

If the bus terminal is mounted on a wall, at least one PE terminal must be connected to local ground. This connection should be over the shortest possible distance.

6.7.6 Technical data of the RS485 bus terminal

Table 6- 13 Technical data of the RS485 bus terminal

Connector to end device	9pin D-sub male connector
Transmission speed	9.6 to 1,500 kbps
PG interface (optional)	9-pin D-sub socket
Power supply range	4.75 to 5.25 V DC
Current consumption:	5 mA
Environmental conditions:	
Operating temperature	0 to 55 °C
Storage/transport temperature	-25 to 70 °C
Relative humidity	F to DIN 40040 15% to 95% at +25 °C, no condensation
Construction Dimensions (W x H x D) in mm	 RS-485 50 x 135 x 47 RS-485/PG 50 x 135 x 52
Weight (incl. 1.5 m spur line)	RS485, RS485/PG approx. 310 g

6.7.7 Technical data of the 12M bus terminal

Table 6- 14 Technical data of the 12M bus terminal

Connector to end device	9pin D-sub male connector
Transmission speed	9.6 kbps - 12 Mbps
Power supply	DC 5 V + 5% safety extralow voltage (SELV) complying with 60950
Current input	90 mA at 5 V

Total power loss	0.45 W
Weighting value	0.1 In operation at 1.5 Mbps along with RS485 bus terminal. (see Section: "Network configuration")
Electromagnetic compatibility	
Emission Limit class	 B complying with EN 55022=CISPR 22
Noise immunity on signal lines	± 2kV (to IEC 801-5 / IEC 1000-4-5, surge) ± 2kV (to IEC 801-4 / IEC 1000-4-4, burst)
Immunity to discharges of static electricity	± 6kV, contact discharge (to IEC 801-2; ESD / IEC 1000-4-2)
Immunity to RF interference	10 V/m at 80 % amplitude modulation with 1 kHz, 80 MHz - 1 GHz (to IEC 801-3 / ENV 50140) 10 V/m 50 % load factor at 900 MHz (to ENV 50204) 10 V with 80 % amplitude modulation at 1 kHz 10 kHz - 80 MHz (to IEC 801-6 / ENV 50141)
Climatic conditions:	
Operating temperature	0 to 60 °C
Storage/transport temperature	-40 to 70 °C
Relative humidity	max. 95% at +25 °C no condensation
Mechanical conditions:	
Vibration Operation	tested to DIN IEC 68-2-6 10 to 58 Hz; amplitude 0.075 mm 58 to 500 Hz; acceleration 9.8 m/s^2
Shock Operation	tested to DIN IEC 68-2-27 Half-sine: 100 m/s^2, 16 ms
Construction	
Dimensions (W x H x D) in mm	50 x 135 x 47
Spur line length	1.5 m
Weight (incl. 1.5 m spur line)	Approx. 350 g
Type of protection	IP20
Error Detection Character	CE, UL, CSA

6.8 Cable connections

6.8.1 Mixing cable types

Using different cable types

Note

If different cable types are used in a PROFIBUS segment, remember that the segment length is reduced accordingly.

6.8.2 Connecting cables together using network components

Sometimes, a connection between two different bus cable sections is necessary, for example, to change from the standard bus cable to a section with festoon cable.

The easiest way to implement this cable change is to use the two bus cable terminals of a bus connector, bus terminal or repeater. The connection of the cables is described in detail in Section "Cables for PROFIBUS RS485 networks (Page 113)". For information about laying cables and mechanical protection of the cables refer to Appendix "Installing bus cables (Page 259)".

To change from an underground cable to the standard bus cable, it is advisable to protect against overvoltage (see Appendix B "Lightning and overvoltage protection of bus cables between buildings (Page 253)".

6.8.3 Connecting cables together using FC M12 bus connectors

Sometimes, a connection is necessary between bus cable sections at locations where no nodes or network component connections are intended, for example, when repairing a broken bus. In this case, connect the two cable sections with a
PROFIBUS FC M12 Plug PRO (6GK1 905-0EA10) and a
PROFIBUS FC M12 cable connector PRO (6GK1 905-0EB10).
This connection ensures EMC stability due to the all-round shield connection and provides protection from the ingress of dust and water to IP65/IP67.

Figure 6-29 Connecting cables together using FC M12 bus connectors

Avoid accidental shield contact with the environment.

The male connector shield should not make any undefined, accidental contact to conductive parts, since this can lead to undefined shield currents. Connect the connector casing either permanently to ground potential or wrap the connector in insulation that reliably prevents contact.

Keep to the permitted ambient conditions

Remember that a standard connecting cable cannot stand up to the same environmental conditions as an uninterrupted bus cable. If necessary, provide extra protection for the connection to avoid permanent dampness or aggressive gases causing problems by covering the connection in a cable sleeve.

6.9 Preassembled connecting cables

6.9.1 Connecting cable 830-1T

Area of application

The 8301T connecting cable is a preassembled cable for fast and costeffective attachment of end devices to OLMs and OBTs for transmission speeds up to 12 Mbps.

Design

The 8301T connecting cable consists of a twisted pair (stranded copper cores) with a braid shield. It is fitted with a 9pin D-sub male connector at both ends. Both ends of the cable have terminating resistors (cannot be deactivated). The cable is available in lengths of 1.5 and 3 m.

Figure 6-30 Connecting cable 830-1T

Function

The 8301T connecting cable connects the following:

- The electrical interface of the Optical Link Module (OLM, OBT) with the PROFIBUS interface of an end device.

> **Note**
>
> Due to the integrated terminating resistors, the 8301T connecting cable must not be used as a spur line (for example for attaching a PG) to a PROFIBUS segment.

Table 6- 15 Ordering data for the SIMATIC NET 8301T connecting cable

Ordering data:	
SIMATIC NET 8301T connecting cable for PROFIBUS for connecting end devices to OLMs and OBTs, preassembled with 2 D-sub male connectors, 9-pin cable terminated at both ends.	
1.5 m	6XV1 830-1CH15
3 m	6XV1 830-1CH30

6.9.2 Connecting cable 830-2

Area of application

The 8302 connecting cable is a preassembled cable for fast and costeffective attachment of PROFIBUS nodes (for example HMI) to programmable controllers for transmission rates up to 12 Mbps.

Design

The 8302 connecting cable consists of the PROFIBUS standard cable. At one end, it has a 9-pin D-sub male connector with a straight cable outlet and at the other end, it has a 9-pin D-sub male connector with a 90° cable outlet. The connector with the 90° cable outlet is equipped with a PG interface. The terminating resistors can be activated in both connectors. The cable is available in lengths of 3 m, 5 m and 10m.

Figure 6-31 Connecting cable 830-2

Function

The 8302 connecting cable connects the following:

- The electrical interface of the Optical Link Module (OLM, OBT) and the PROFIBUS interface of a PROFIBUS node
- The electrical interface of two PROFIBUS nodes (OP, programmable controller)

Table 6- 16 Ordering data for the SIMATIC NET 8302 connecting cable

Ordering data:	
SIMATIC NET 8302 connecting cable for PROFIBUS for connecting end devices to OLMs and OBTs, preassembled with 2 D-sub male connectors, 9-pin, terminators can be activated.	
3 m 5 m 10 m	6XV1 830-2AH30 6XV1 830-2AH50 6XV1 830-2AN10

6.9.3 M12 connecting cable

Area of application

The M12 connecting cable is a preassembled connecting cable (PROFIBUS FC trailing cable) for connecting PROFIBUS nodes (for example SIMATIC ET 200) with degree of protection IP65; for transmission speeds up to 12 Mbps.

Design

The M12 connecting cable consists of the PROFIBUS trailing cable. At one end, it has a 5-pin M12 male connector with a straight cable outlet and at the other end, it has a 5-pin M12 socket with a straight cable outlet, in each case B coded. The cable is available in lengths of 0.3 m to 15 m.

Figure 6-32 M12 connecting cable

Function

The M12 connecting cable connects PROFIBUS nodes.

Table 6- 17 Ordering data for the SIMATIC NET M12 connecting cable

Ordering data:	
SIMATIC NET M12 connecting cable Pre-assembled for PROFIBUS with two 5-pin M12 male/female connectors up to max 100 m; length: * Additional special lengths with 90° or 180° cable outlet	Special lengths (http://support.automation.siemens.com/WW/view/en/26999294)
0.3 m 0.5 m 1.0 m 1.5 m 2.0 m 3.0 m 5.0 m 10 m 15 m	6XV1 830-3DE30 6XV1 830-3DE50 6XV1 830-3DH10 6XV1 830-3DH15 6XV1 830-3DH20 6Xv1 830-3DH30 6XV1 830-3DH50 6XV1 830-3DN10 6XV1 830-3DN15

7 Passive components for optical networks

7.1 Fiber-optic cables

Fiber-optic cable

On fiber-optic cables (FOC) data is transmitted by modulating electromagnetic waves in the range of visible and invisible light. The materials used are highquality plastic and glass fibers.

This sections below describe only the fiberoptic cables from the SIMATIC NET range intended for PROFIBUS. The various types of fiberoptic cable allow components to be connected together in a way suitable for the operating and environmental conditions.

Compared with electrical cables, fiberoptic cables have the following advantages:

Benefits

- Galvanic isolation of stations and segments
- No equipotential bonding currents
- Transmission path immune to external noise
- No lightning protection required
- No noise radiation along the transmission path
- Low weight
- Depending on the fiber type, cables several kilometers long can be used even at higher transmission rates.
- The transmission rate does not affect the maximum permitted cable length
- The meter markers printed on the cable make it easier to identify the length. (Serve as orientation; accuracy ±5 %.)

Point-to-Point Connection

For technological reasons, only pointtopoint connections are possible with fiberoptic cables; in other words, one transmitter is connected to one receiver. For duplex transmission between two nodes, two fibers are therefore necessary (one for each transmission direction).

With the optical components for PROFIBUS, bus, star and ring structures can be implemented.

Optical bus cables

Table 7- 1 Overview - Optical bus cables

Designation	Area of application
Glass fiber, sold by the meter or pre-assembled with 4 BFOC connectors Laying in indoor and outdoor areas	
FO Standard Cable GP	• Rugged standard cable for universal applications
FO ground cable	• Longitudinally and laterally watertight cable for use outdoors; • With non-metallic rodent protection; • Can be laid underground
FO trailing cable GP FO trailing cable	• Cable for use in drag chains
Plastic/PCF fiber-optic cable; sold by the meter or pre-assembled. Installation indoors	
POF duplex core	• up to 80 m • Low mechanical strain, for example in laboratories
POF standard cable	• up to 50 m, • with Kevlar strain relief elements
PCF fiber optic, standard cable PCF standard cable GP PCF trailing cable PCF trailing cable GP	• up to 400 m, • with Kevlar strain relief elements

7.2 Plastic and PCF fiber-optic cable

Plastic and PCF fiber-optic cable

Plastic and PCF FO cables are used to connect optical link modules with connectors for plastic FO cables (OLM/P), optical bus terminals (OBT) and devices with an integrated optical interface. Under certain circumstances, this is a costeffective alternative to conventional glass fiberoptic cables.

Properties of fiberoptic cables

Use Siemens plastic and PCF fiber-optic cables with the following features:

Table 7- 2 Properties of fiberoptic cables

Description	Plastic fiber-optic duplex core	Plastic fiber-optic standard cable	PCF fiber-optic standard cable
Order no.	6XV1 821-2AN50	6XV1 821-0AH10	6XV1 821-1BN75
Standard code	I-VY2P 980/1000 150A	I-VY4Y2P 980/1000 160A	I-VY2K 200/230 10A17+8B20
Area of application	Used indoors in areas where little mechanical load is expected, such as in laboratory setups or in cubicles	For indoor use with cable lengths up to 80 m	For indoor use with cable lengths up to 300 m Only available preassembled with BFOC or simplex connectors
Cable length between • OLM - OLM • Integrated optical interfaces, OBT	 • 50 m • 50 m	 • 80 m • 50 m	 • 400 m • 300 m
Fiber Type	Step-index cable		
Core diameter	980 µm		200 µm
Core material	Polymethyl methacrylate (PMMA)		Fused silica
Cladding outer diameter	1000 µm		230 µm
Cladding material	Fluoridated special polymer		
Inner jacket • Material • Color • Diameter	 • PVC • gray • 2.2 ± 0.01 mm	 • PA • black and orange • 2.2 ± 0.01 mm	 • - • (without inner jacket) • -
Outer jacket • Material • Color	 • - • -	 • PVC • Purple	 • PVC • Purple
Number of fibers	2		
Attenuation at wavelength	≤ 230 dB/km 660 nm		≤ 10 dB/km 660 nm
Strain relief	-	Kevlar fibers	Kevlar fibers
Maximum permitted tensile strain • brief • Continuous	 • ≤ 50 N • not suitable for continuous tensile load	 • ≤ 100 N • not suitable for continuous tensile load	 • ≤ 500 N • ≤ 100 N (only on strain relief, ≤ 50 N on plug or single core)
Permitted ambient conditions • Transportation/storage temperature • Installation temperature • Operating temperature	 • -35 °C to +85 °C • 0 °C to +50 °C • -30 °C to +70 °C	 • -30 °C to +70 °C • 0 °C to +50 °C -30 °C to +70 °C	 • -20 °C to +70 °C • -5 °C to +50 °C -20 °C to +70 °C

Description	Plastic fiber-optic duplex core	Plastic fiber-optic standard cable	PCF fiber-optic standard cable
Resistant to • mineral oil ASTM no. 2, • grease or water • UV radiation	 • conditional[1] • conditional[1] • Not UV resistant	 • conditional[1] • conditional[1] • conditional[1]	 • conditional[1] • conditional[1] • conditional[1]
Silicone-free	contains small quantities of a non-migrating silicone elastomer	Yes	Yes
ROHS-compliant	Yes	Yes	Yes
Resistance to fire	Flameresistant acc. to flame test VW-1 to UL 1581		
Outer dimensions	2.2 x 4.4 mm ±0.01 mm	Diameter: 7.8 ± 0.3 mm	Diameter: 4.7 ± 0.3 mm
Weight	7.8 kg/km	65 kg/km	22 kg/km
[1] Please ask your Siemens contact about specific applications.			

Table 7- 3 Properties of fiberoptic cables

Description	PCF standard cable GP	PCF trailing cable	PCF trailing cable GP
Order no.	6XV1 861-2A	6XV1 861-2C	6XV1 861-2D
Standard code	ATI-V(ZN)YY 2K200/230	AT-V(ZN)Y(ZN)11Y 2K200/230	AT-V(ZN)Y(ZN)Y 2K200/230
Area of application	For permanent indoor and outdoor installation	For moving applications	For moving applications
Cable length between • OLM - OLM • Integrated optical interfaces, OBT	 400 m 300 m	 400 m 300 m	 400 m 300 m
Fiber Type	Step Index 200/230		
Core diameter	200 µm		
Core material	Fused silica		
Cladding outer diameter	230 µm		
Cladding material	Special polymer		
Inner jacket • Material • Color • Diameter	 • PVC • orange/black • 2.2 mm Ø	 • PVC • orange/black • 2.2 mm Ø	 • PVC • orange/black • 2.2 mm Ø
Outer jacket • Material • Color	 • PVC • Green	 • PUR • Green	 • PVC • Green
Number of fibers	2		
Attenuation at wavelength	≤ 10 dB/km at 650 nm		
Strain relief	Aramid yarn		

Description	PCF standard cable GP	PCF trailing cable	PCF trailing cable GP
Maximum permitted tensile strain Brief/permanent	100 N	800 N	
Permitted ambient conditions • Transportation/storage temperature • Installation temperature • Operating temperature	• -25°C to 75°C • -5°C to 50°C • -25°C to 75°C	• -25°C to 75°C • -5°C to 50°C • -30°C to 75°C	
Resistant to • mineral oil ASTM no. 2, • grease or water • UV radiation	• conditional[1] • conditional[1] • Yes		
Silicone-free	Yes	Yes	Yes
ROHS-compliant	Yes	Yes	Yes
Resistance to fire	Flame retardant to IEC 60332-1		
Outer dimensions	7.2 mm	8.8 mm	
Weight	45 kg/km	85 kg/km	
UL/CSA approval	OFN (NEC Article 770, UL1651)/ OFN, 90°C, FT1, FT4 (CSA-Standard C22.2 No232-M1988)	-	OFN (NEC Article 770, UL1651)/ OFN, 90°C, FT1, FT4 (CSA-Standard C22.2 No232-M1988)
[1] Please ask your Siemens contact about specific applications.			

7.2.1 Plastic fiber-optic duplex cable

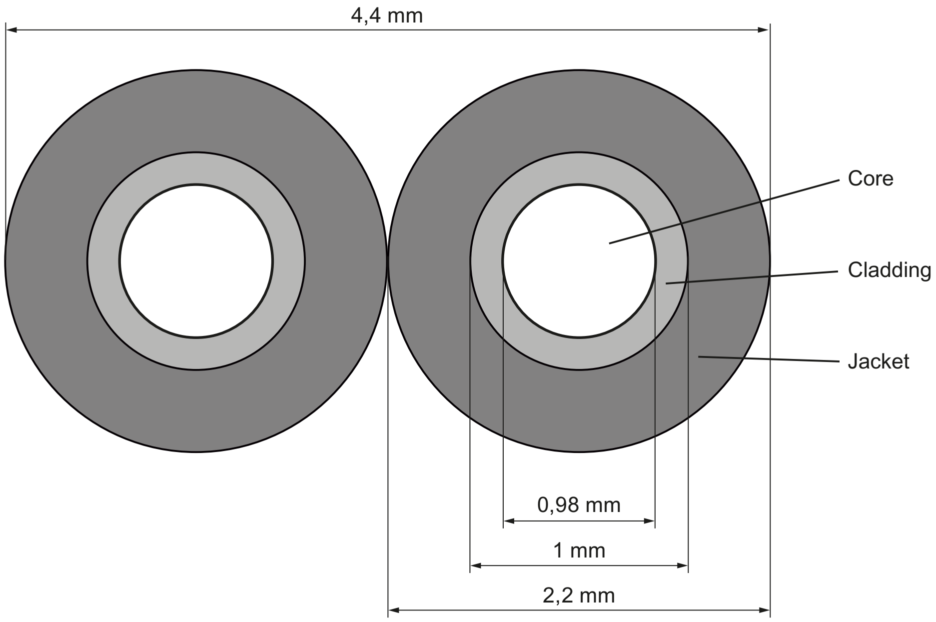


Figure 7-1 Structure of the plastic FO cable, duplex core 6XV1 821-2AN50

Plastic FO cable, duplex core 6XV1 821-2AN50

The plastic FO cable, duplex core 6XV1 821-2AN50 is a flat double core with PVC inner jacket without an outer jacket. The jacket color is gray, there is no information printed on it. The standard code is I-VY2P 980/1000 150.

The cable is easy to assembly onsite. The cable is fitted with 2 x 2 simplex connectors for devices with integrated optical interfaces. The cable must be fitted with 2 x 2 BFOC connectors when connecting OLM/P11 and OLM/P12.

Properties

The plastic FO cable, duplex core 6XV1 821-2AN50 is

- not suitable for continuous tensile load
- conditionally resistant to mineral oil ASTM no. 2
- conditionally resistant to greases
- conditionally resistant to water
- Not UV resistant
- flameresistant acc. to flame test VW-1 to UL 1581

Use

The plastic FO cable, duplex core 6XV1 821-2AN50 is intended for applications indoors in areas where it is subjected to little mechanical load, such as in laboratories or within cubicles. The cable is supplied in 50 m rings. Both with OLM connections and with integrated optical interfaces, connections up to 50 m in length can be spanned between two nodes with this cable.

Table 7- 4 order numbers of the plastic FO cable, duplex core 6XV1 821-2AN50

Ordering data	
SIMATIC NET PROFIBUS plastic fiber-optic, duplex cable I-VY2P 980/1000 150A Plastic fiber-optic cable with 2 cores, PVC jacket, without connectors, for use in areas with low mechanical strain (for example inside a cabinet or in test setups in a laboratory)	
50 m ring	6XV1 821-2AN50

7.2.2 Plastic fiberoptic, standard cables

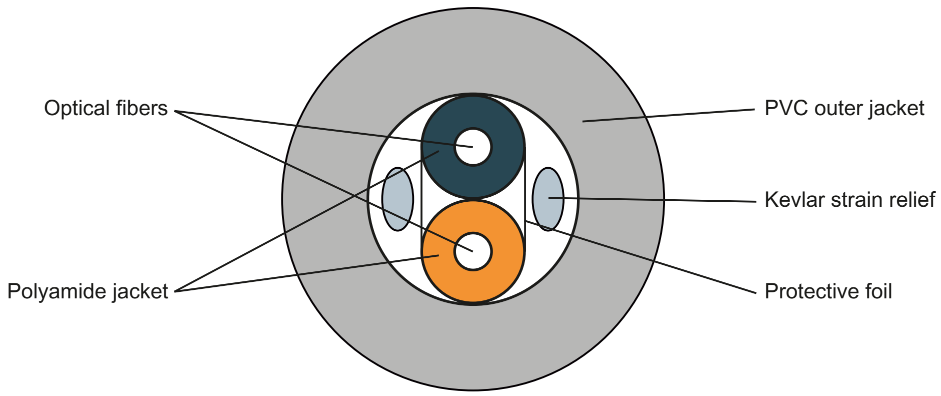


Figure 7-2 Structure of the plastic fiberoptic standard cable

Plastic FO cable, standard cable 6XV1 821-0A***

The plastic FO cable, standard cable 6XV1 821-0A*** consists of two plastic fibers with a robust polyamide inner jacket surrounded by Kevlar strain relief elements and a lilac PVC outer jacket. The standard code is I-VY4Y2P 980/1000 160A. The outer jacket is labeled "SIEMENS SIMATIC NET PLASTIC FIBER OPTIC 6XV1 821-0AH10 (UL)" and has meter markers.

The cable is easy to assembly onsite. The cable is fitted with 2 x 2 simplex connectors for devices with an integrated optical interface. The cable must be fitted with 2 x 2 BFOC connectors when connecting OLM/P11 and OLM/P12. It can also be ordered preassembled.

Properties

The plastic FO cable, standard cable 6XV1 821-0A*** is

- not suitable for continuous tensile load
- conditionally resistant to mineral oil ASTM no. 2
- conditionally resistant to greases
- conditionally resistant to water
- conditionally UV resistant
- flameresistant acc. to flame test VW-1 to UL 1581

Use

The plastic FO cable, standard cable 6XV1 821-0A*** is a robust round cable for indoor applications. The maximum distance that can be spanned is 80 m for OLM/P connections and 50 m for integrated optical interfaces and OBTs.

Table 7- 5 Ordering data for plastic fiberoptic, standard cable, can be ordered in meters for OLMs, OBTs and integrated optical interfaces

Ordering data	
SIMATIC NET PROFIBUS plastic fiber optic, standard cable I-VY4Y2P 980/1000 160A Rugged round cable with 2 plastic fiber-optic cores, PVC outer sheath and PA inner jacket, without connectors, for indoor use,	
Sold by the meter 50 m ring 100 m ring	6XV1 821-0AH10 6VX1 821-0AN50 6XV1 821-0AT10

Table 7- 6 Ordering data for preassembled plastic fiberoptic cable, standard cable, for OLM/P

Ordering data	
SIMATIC NET PROFIBUS plastic fiber optic, standard cable I-VY4Y2P 980/1000 160A Rugged round cable with 2 plastic fiber-optic cores, PVC outer sheath and PA inner jacket, for indoor use, preassembled with 2x2 BFOC connectors, outer jacket stripped over 20 cm, for connection of OLM/P.. * other lengths on request Preferred lengths*	
1 m	6XV1 821-0BH10
2 m	6XV1 821-0BH20
5 m	6XV1 821-0BH50
10 m	6XV1 821-0BN10
15 m	6XV1 821-0BN15
20 m	6XV1 821-0BN20
25 m	6XV1 821-0BN25
30 m	6XV1 821-0BN30
50 m	6XV1 821-0BN50
65 m	6XV1 821-0BN65
80 m	6XV1 821-0BN80

7.2.3 PCF standard cable

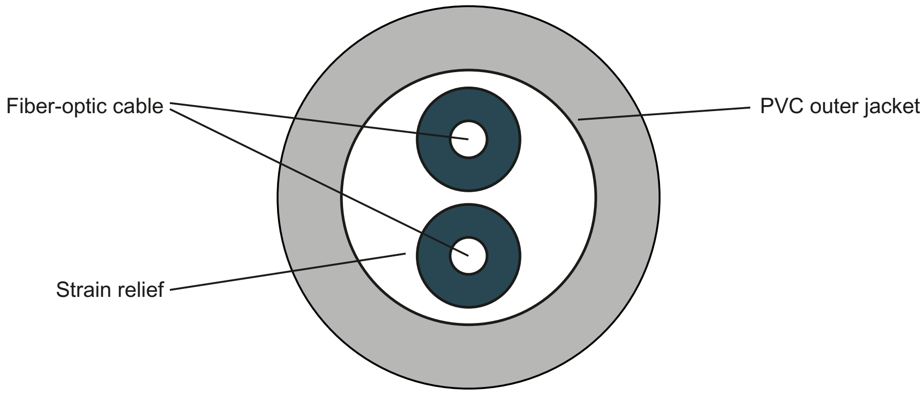


Figure 7-3 Structure of the PCF standard cable

PCF standard cable 6XV1 821-1B***

The PCF standard cable 6XV1 821-1B*** consists of two PCF fibers surrounded by Kevlar strain relief elements and a violet PVC outer jacket. The standard code is I-VY2K 200/230 10A17+8B20. The outer jacket has the identifier "SIEMENS SIMATIC NET PROFIBUS PCF FIBER OPTIC 6XV1 821-1AH10 (UL)" printed on it as well as meter markers.

The cable is only available as a preassembled cable. Cables for devices with an integrated optical interface are fitted with 2 x 2 simplex connectors, cables for connection of OLM/P11 and OLM/P12 have 2 x 2 BFOC connectors. The cables are supplied with a pulling loop at one end that allows the cables to be pulled, for example, into cable channels.

Properties

The PCF standard cable is

- Designed for 100 N permanent tensile strain
- Conditionally resistant to mineral oil ASTM no. 2
- Conditionally resistant to greases
- Conditionally resistant to water
- Conditionally UV resistant
- Flameretardant acc. to flame test VW-1 to UL 1581

Use

The PCF standard cable 6XV1 821-1B*** is a robust round cable for use indoors with cable lengths up to 400 m (OLM) or 300 m (integrated optical interfaces, OBT) in each case between two nodes.

Table 7- 7 Ordering data: Preassembled PCF fiberoptic cables for OLM/P

Ordering data	
SIMATIC NET PROFIBUS PCF fiber üptic I-VY2K 200/230 10A17 + 8B20 PCF fiber-optic cable with 2 cores, PVC outer jacket, for bridging large distances up to 400 m, preassembled with 2x2 BFOC male connectors, Outer jacket stripped over 20 cm at both ends and pulling loop at one end, for connection of OLM/P. * other lengths on request Preferred lengths*	
75 m	6XV1 821-1BN75
100 m	6XV1 821-1BT10
150 m	6XV1 821-1BT15
200 m	6XV1 821-1BT20
250 m	6XV1 821-1BT25
300 m	6XV1 821-1BT30
400 m	6XV1 821 1BT40

Table 7- 8 Ordering data: Preassembled PCF fiberoptic cables for integrated optical interfaces

Ordering data	
SIMATIC NET PROFIBUS PCF fiber üptic I-VY2K 200/230 10A17 + 8B20 PCF fiber-optic cable with 2 cores, PVC outer jacket, for bridging large distances up to 300 m, preassembled with 2x2 simplex male connectors, Outer jacket stripped over 30 cm at both ends and pulling loop at one end, for connecting devices with integrated optical interfaces, OBT * other lengths on request Preferred lengths*	
50 m	6XV1 821-1CN50
75 m	6XV1 821-1CN75
100 m	6XV1 821-1CT10
150 m	6XV1 821-1CT15
200 m	6XV1 821-1CT20
250 m	6XV1 821-1CT25
300 m	6XV1 821-1CT30

7.2.4 PCF standard cable GP

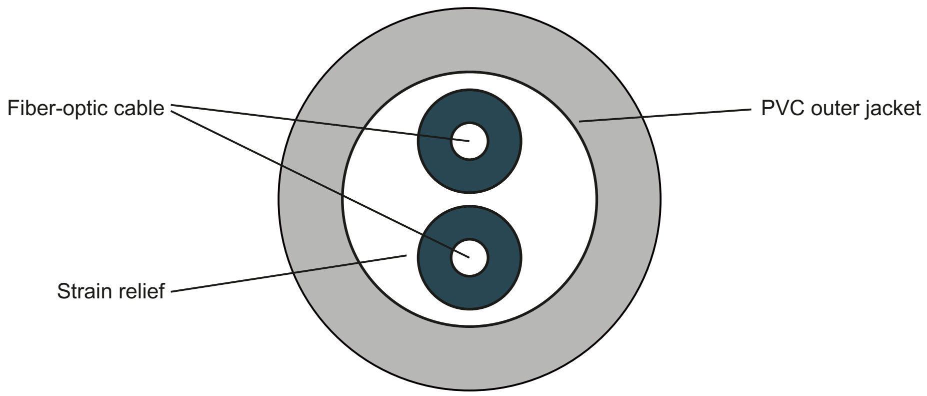


Figure 7-4 Structure of the PCF standard cable GP

PCF standard cable GP 6XV1 861-2A/3A/7A***

The PCF standard cable GP 6XV1 861-2A/3A/7A *** consists of two PCF fibers surrounded by Aramid strain relief elements and a green PVC outer jacket. The standard code is I V(ZN)YY 2K200/230. The outer jacket has "SIEMENS SIMATIC NET PCF Standard Cable GP (PROFINET Type B) 2K200/230 6XV1 861-2A (UL)E157125 OFN LL 64163 OFN FT4 90C CSA (drum number)/(year of manufacture)" printed on it as well as meter markers.

The cable can be ordered both in meters and as a preassembled cable. Cables for devices with an integrated optical interface are fitted with 2 x 2 simplex connectors, cables for connection of OLM/P11 and OLM/P12 have 2 x 2 BFOC connectors. The cables are supplied with a pulling loop at one end that allows the cables to be pulled, for example, into cable channels.

Properties

The PCF standard cable GP is

- Designed for 100 N permanent tensile strain
- Conditionally resistant to mineral oil ASTM no. 2
- Conditionally resistant to greases
- UV resistant
- Flame retardant to IEC 60332-1
- Equally suitable for PROFIBUS and PROFINET (outer jacket green)

Use

The PCF standard cable GP 6XV1 861-2A/3A/7A *** is a robust round cable for use indoors and outdoors with cable lengths up to 400 m (OLM) or 300 m (integrated optical interfaces, OBT) in each case between two nodes.

Table 7- 9 Ordering data: In meters and preassembled PCF fiberoptic cables for OLM/P

Ordering data	
PROFIBUS PCF Standard Cable GP 200/230 I V(ZN)YY 2K200/230 Sold by the meter; max. length 2,000 m; minimum order 20 m	6XV1 861-2A
PCF fiber-optic cable with 2 cores, PVC outer jacket, for bridging large distances up to 400 m, preassembled with 2x2 BFOC male connectors, Outer jacket stripped over 20 cm at both ends and pulling loop at one end, for connection of OLM/P. * other lengths on request Preferred lengths*	
75 m 100 m 150 m 200 m 250 m 300 m 400 m	6XV1 861-3AN75 6XV1 861-3AT10 6XV1 861-3AT15 6XV1v861-3AT20 6XV1 861-3AT25 6XV1 861-3AT30 6XV1 861-3AT40

Table 7- 10 Ordering data: In meters and preassembled PCF fiber-optic cables with simplex male connectors for devices with an integrated optical interface

Ordering data	
PCF fiber-optic cable with 2 cores, PVC outer jacket, for bridging large distances up to 300 m, preassembled with 2x2 simplex male connectors, Outer jacket stripped over 20 cm at both ends and pulling loop at one end, for connecting devices with an integrated optical interface. * other lengths on request Preferred lengths*	
50 m	6XV1 861-7AN50
75 m	6XV1 861-7AN75
100 m	6XV1 861-7AT10
150 m	6XV1 861-7AT15
200 m	6XV1v861-7AT20
250 m	6XV1 861-7AT25
300 m	6XV1 861-7AT30

7.2.5 PCF trailing cable

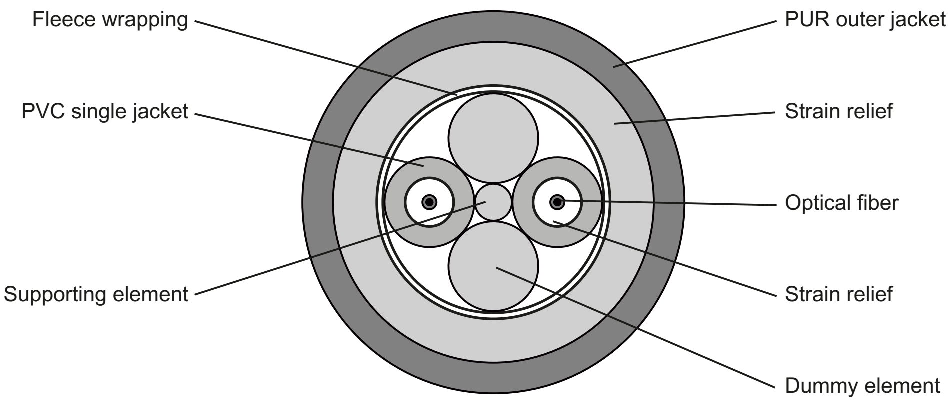


Figure 7-5 Structure of the PCF trailing cable

PCF FO trailing cable 6XV1 861-2C/3C/7C***

The PCF trailing cable 6XV1 861-2C/3C/7C*** consists of two PCF fibers surrounded by Aramid strain relief elements and a green PUR outer jacket. The standard code is AT-V(ZN)Y(ZN)11Y 2K200/230. The outer jacket is labeled "SIEMENS SIMATIC NET PCF Trailing Cable (PROFINET Type B) 2K200/230 6XV1 861-2C" and has meter markers.

The cable can be ordered both in meters and as a preassembled cable. Cables for devices with an integrated optical interface are fitted with 2 x 2 simplex connectors, cables for connection of OLM/P11 and OLM/P12 have 2 x 2 BFOC connectors. The cables are supplied with a pulling loop at one end that allows the cables to be pulled, for example, into cable channels.

Properties

The PCF trailing cable is

- Designed for 800 N permanent tensile strain
- Conditionally resistant to mineral oil ASTM no. 2
- Conditionally resistant to greases
- UV resistant
- Flame retardant to IEC 60332-1
- Equally suitable for PROFIBUS and PROFINET (outer jacket green)
- 5,000,000 bending cycles at 175 mm bending radius

Use

The PCF trailing cable 6XV1 821-2C/3C/7C*** is a robust round cable for moving applications indoors and outdoors with cable lengths up to 400 m (OLM) or 300 m (integrated optical interfaces, OBT) in each case between two nodes.

Table 7- 11 Ordering data: In meters and preassembled PCF fiberoptic cables with BFOC male connectors for OLM/P

Ordering data	
PROFIBUS PCF trailing cable 200/230 AT-V(ZN)Y(ZN)11Y 2K200/230 Sold by the meter; max. length 2,000 m; minimum order 20 m	6XV1 861-2C
PCF fiber-optic cable with 2 cores, PUR outer jacket, for bridging large distances up to 400 m, preassembled with 2x2 BFOC male connectors, Outer jacket stripped over 20 cm at both ends and pulling loop at one end, for connection of OLM/P. * other lengths on request Preferred lengths*	
75 m 100 m 150 m 200 m 250 m 300 m 400 m	6XV1 861-3CN75 6XV1 861-3CT10 6XV1 861-3CT15 6XV1 861-3CT20 6XV1 861-3CT25 6XV1 861-3CT30 6XV1 861-3CT40

Table 7- 12 Ordering data: Preassembled PCF fiber-optic cables with simplex male connectors for devices with an integrated optical interface

Ordering data	
PCF fiber-optic cable with 2 cores, PUR outer jacket, for bridging large distances up to 300 m, preassembled with 2x2 simplex male connectors, Outer jacket stripped over 20 cm at both ends and pulling loop at one end, for connecting devices with an integrated optical interface. * other lengths on request Preferred lengths*	
50 m	6XV1 861-7CN50
75 m	6XV1 861-7CN75
100 m	6XV1 861-7CT10
150 m	6XV1 861-7CT15
200 m	6XV1 861-7CT20
250 m	6XV1 861-7CT25
300 m	6XV1 861-7CT30

7.2.6 PCF trailing cable GP

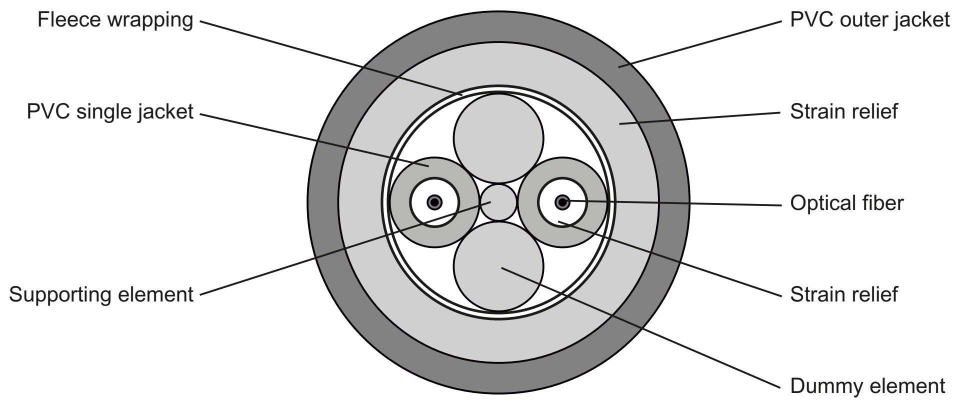


Figure 7-6 Structure of the PCF trailing cable GP

PCF FO trailing cable GP 6XV1 861-2D/3D/7D***

The PCF trailing cable GP 6XV1 861-2D/3D/7D*** consists of two PCF fibers surrounded by Aramid strain relief elements and a green PVC outer jacket. The standard code is AT-V(ZN)Y(ZN)Y 2K200/230. The outer jacket is labeled "SIEMENS SIMATIC NET PCF Trailing Cable GP (PROFINET Type B) 2K200/230 6XV1 861-2D (UL)E157125 OFN LL 64163 OFN FT4 90C CSA" and has meter markers.

The cable can be ordered both in meters and as a preassembled cable. Cables for devices with an integrated optical interface are fitted with 2 x 2 simplex connectors, cables for connection of OLM/P11 and OLM/P12 have 2 x 2 BFOC connectors. The cables are supplied with a pulling loop at one end that allows the cables to be pulled, for example, into cable channels.

Properties

The PCF trailing cable is

- Designed for 800 N permanent tensile strain
- Conditionally resistant to mineral oil ASTM no. 2
- Conditionally resistant to greases
- UV resistant
- Flame retardant to IEC 60332-1
- Equally suitable for PROFIBUS and PROFINET (outer jacket green)
- 3,500,000 bending cycles at 175 mm bending radius

Use

The PCF trailing cable GP 6XV1 861-2D/3D/7D*** is a robust round cable for moving applications indoors and outdoors with cable lengths up to 400 m (OLM) or 300 m (integrated optical interfaces, OBT) in each case between two nodes.

Table 7- 13 Ordering data: In meters and preassembled PCF fiberoptic cables with BFOC male connectors for OLM/P

Ordering data	
PROFIBUS PCF Trailing Cable GP 200/230 AT-V(ZN)Y(ZN)Y 2K200/230 Sold by the meter; max. length 2,000 m; minimum order 20 m	6XV1 861- 2D
PCF fiber-optic cable with 2 cores, PVC outer jacket, for bridging large distances up to 400 m, preassembled with 2x2 BFOC male connectors, Outer jacket stripped over 20 cm at both ends and pulling loop at one end, for connection of OLM/P. * other lengths on request Preferred lengths*	
75 m	6XV1 861-3DN75
100 m	6XV1 861- 3DT10
150 m	6XV1 861- 3DT15
200 m	6XV1 861- 3DT20
250 m	6XV1 861- 3DT25
300 m	6XV1 861- 3DT30
400 m	6XV1 861- 3DT40

Table 7- 14 Ordering data: Preassembled PCF fiber-optic cables with simplex male connectors for devices with an integrated optical interface

Ordering data	
PCF fiber-optic cable with 2 cores, PVC outer jacket, for bridging large distances up to 300 m, preassembled with 2x2 BFOC male connectors, Outer jacket stripped over 20 cm at both ends and pulling loop at one end, for connecting devices with an integrated optical interface. * other lengths on request Preferred lengths*	
50 m	6XV1 861-7DN50
75 m	6XV1 861-7DN75
100 m	6XV1 861-7DT10
150 m	6XV1 861-7DT15
200 m	6XV1 861-7DT20
250 m	6XV1 861-7DT25
300 m	6XV1 861-7DT30

7.3 Glass FO cables

7.3.1 Overview

Designed for Industry

SIMATIC NET glass fiberoptic cables (FO) are available in various designs allowing optimum adaptation to a wide range of applications.

Area of application

- Fiber-optic standard cable m
  Universal cable for use indoors and outdoors
- INDOOR fiber-optic cable
  Halogen-free, tread-resistant, and flame retardant fiber-optic cable for use in buildings
- Flexible fiber-optic trailing cable
  For special applications with forced movement

SIMATIC NET multimode fibers

SIMATIC NET offers glass multimode fiber-optic cables with fiber types 50/125 µm and 62.5/125 µm core diameter. SIMATIC NET bus components are ideally matched to these standard fibers allowing large distances to be covered while keeping the configuration rules simple.

Simple configuration

All the descriptions and operating instructions for SIMATIC NET bus components contain information about the distances that can be covered with the multimode fibers described above. You can configure your optical network without complicated calculations using simple limit values (refer to Section "Network configuration (Page 41)").

Guidelines for laying cables

You will find information about laying SIMATIC NET glass multimode fiberoptic cables in Appendix "Installing bus cables (Page 259)" in this manual.

Technical specifications

The following tables show an overview of the technical specifications of all SIMATIC NET glass multimode fiber-optic cables.

Table 7- 15 Technical specifications for the INDOOR fiber optic cable and fiber optic standard cable

Cable type	fiber-optic Standard cable (62.5/125 µm)	INDOOR fiber optic Indoor cable (62.5/125 µm)
Order no.	6XV1 820-5AH10	6XV1 820-7AH10
Area of application	Universal cable for use indoors and outdoors	Non-crush, halogen-free and flame-retardant cable for use indoors
How supplied	Preassembled cable with 4 BFOC connectors in fixed lengths, also available in meters	Preassembled with 4 BFOC connectors in fixed lengths
Cable type (Standard code)	AT-VYY 2G62.5/125 3.1B200+0.8F600 F	I-VHH 2G62.5/125 3.2B200+0.9F600 F TB3 FRNC OR
Fiber type	Multimode graded-index fiber 62.5/125 µm	Multimode graded-index fiber 62.5/125 µm
Power loss at 850 nm Power loss at 1300 nm	≤ 3.1 dB/km ≤ 0.8 dB/km	≤ 3.2 dB/km ≤ 0.9 dB/km
Modal bandwidth at 850 nm at 1300 nm	 200 MHz * km 600 MHz * km	 200 MHz * km 600 MHz * km
Number of fibers	2	2
Cable design	Splittable outdoor cable	Splittable indoor cable
Core type	Compact core	Fixed core
Materials basic element	PVC, gray	Copolymer, orange (FRNC)
Strain relief	Kevlar yarn and impregnated glass fiber yarn	Aramid yarn
Outer jacket/ Wire color	PVC / black	Copolymer/ bright orange (FRNC)
Dimensions Basic element	(3.5 ± 0.2) mm ∅	2.9 mm ∅
Outer dimensions	(6.3 x 9.8) ± 0.4 mm	approx. 3.9 x 6.8 mm

Cable type	fiber-optic Standard cable (62.5/125 µm)	INDOOR fiber optic Indoor cable (62.5/125 µm)
Order no.	**6XV1 820-5AH10**	**6XV1 820-7AH10**
Cable weight	Approx. 74 kg/km	Approx. 30 kg/km
Permitted tensile force	≤ 370 N (in operation) ≤ 500 N (brief)	≤ 200 N (in operation) ≤ 800 N (brief)
Bending radiuses	100 mm only over the flat side	100 mm (during laying) 60 mm (in operation) only over the flat side
Transverse compressive strength	-	10,000 N/10 cm (brief) 2,000 N/10 cm (permanent)
Resistance to impact	-	20 blows (initial energy: 1.5 Nm Hammer radius Ø: 12.5 mm)
Installation temperature	-5°C to +50°C	-5°C to +50°C
Operating temperature	-25°C to +60°C	-20°C to +60°C
Storage temperature	-25°C to +70°C	-25°C to +70°C
Resistance to fire	to IEC 60332-3 and VDE 0482-266-2-4	flame resistant to IEC 60332-1 and VDE 0482-265-2-1
Free of halogens	No	Yes
Silicone-free	Yes	Yes
ROHS-compliant	Yes	Yes
UL approval	No	No
Shipbuilding approval	No	No

Table 7- 16 Technical specifications of the flexible fiber optic trailing cable

Cable type	Flexible fiberoptic Trailing cable (62.5/125 µm)
Order no.	**6XV1 820-6AH10**
Area of application	Flexible cable for installation in drag chains indoors and outdoors
How supplied	Preassembled cable with 4 BFOC connectors in fixed lengths, also available in meters
Cable type (Standard code)	AT-W11Y (ZN) 11Y 2G62.5/125 3.1B200 + 0.8F600 F
Fiber type	Multimode graded-index fiber 62.5/125 µm
Attenuation • at 850 nm • at 1300 nm	 • ≤ 3.1 dB/km • ≤ 0.8 dB/km
Modal bandwidth • at 850 nm • at 1300 nm	 • 200 MHz * km • 600 MHz * km
Number of fibers	2

Cable type	Flexible fiberoptic Trailing cable (62.5/125 µm)
Order no.	6XV1 820-6AH10
Cable design	Splittable outdoor cable
Core type	Hollow core, filled
Materials basic element	PUR, black
Strain relief	GFK central element, Aramid yarn
Outer jacket/ Wire color	PUR, black
Dimensions of basic element	(3.5 ± 0.2) mm
Outer dimensions	13.4 ± 0.4 mm
Cable weight	Approx. 135 kg/km
Permitted tensile force	≤ 2000 N (in operation) ≤ 1000 N (brief)
Bending radiuses	150 mm max. 100,000 bending cycles
Installation temperature	-5°C to +50°C
Operating temperature	-30°C to +60°C
Storage temperature	-30°C to +70°C
Resistance to fire	-
Free of halogens	No
Silicone-free	Yes
ROHS-compliant	Yes
UL approval	No
Shipbuilding approval	No

[1)] With copper cores and no load

[2)] With copper cores and maximum load (6 A)

Table 7- 17 Technical specifications of the fiber-optic standard cable GP and fiber-optic ground cable

Cable type	Fiber-optic standard cable GP (50/125 µm)	Fiber-optic ground cable (50/125 µm)
Order no.	6XV1 873-2A	6XV1 873-2G
Area of application	Universal cable for use indoors and outdoors	Longitudinally and laterally watertight cable for use outdoors with non-metallic rodent protection for direct underground installation
How supplied	Sold by the meter; pre-assembled with 4 BFOC connectors	Sold by the meter; pre-assembled with 4 BFOC connectors
Cable type (Standard code)	AT-W(ZN)YY 2x1G50/125	AT-WQ(ZN)Y(ZN)B2Y 2G50/125
Fiber type	Multimode graded-index fiber 50/125 µm	Multimode graded-index fiber 50/125 µm

Cable type	Fiber-optic standard cable GP (50/125 µm)	Fiber-optic ground cable (50/125 µm)
Order no.	6XV1 873-2A	6XV1 873-2G
Power loss at 850 nm Power loss at 1300 nm	≤ 2.7 dB/km ≤ 0.7 dB/km	≤ 2.7 dB/km ≤ 0.7 dB/km
Modal bandwidth • at 850 nm • at 1300 nm	 • ≥ 600 MHz *km • ≥ 1200 MHz *km	 • ≥ 600 MHz *km • ≥ 1200 MHz *km
Number of fibers	2	2
Cable design	Splittable	Splittable
Core type	Hollow core, filled	Hollow core, filled
Materials basic element	PVC, orange/black	PVC, orange/black
Strain relief	Aramid yarn	Aramid yarn
Outer jacket/ Wire color	PVC Green	PE black
Dimensions Basic element	 2.9 mm Ø	 2.9 mm Ø
Outer dimensions	4.5 x 7.4 mm	10.5 mm
Cable weight	Approx. 40 kg/km	Approx. 90 kg/km
Permitted tensile force	≤ 500 N	≤ 800 N
Bending radiuses	65 mm	155 mm
Transverse compressive strength	300 N/cm	300 N/cm
Resistance to impact	-	-
Installation temperature	–5 ºC to +50 ºC	–5 ºC to +50 ºC
Operating temperature	-25 ºC to +80 ºC	-25 ºC to +70 ºC
Storage temperature	-25 ºC to +80 ºC	-25 ºC to +70 ºC
Resistance to fire	-	-
Free of halogens	-	-
Silicone-free	Yes	Yes
ROHS-compliant	Yes	Yes
UL approval	OFN (NEC Article 770, UL1651)/ OFN, 90°C, FT1, FT4 (CSA Standard C22.2 No232-M1988)	-

Table 7- 18 Technical specifications of the fiber-optic trailing cable and fiber-optic trailing cable GP

Cable type	Fiber-optic trailing cable (50/125 µm)	Fiber-optic trailing cable GP (50/125 µm)
Order no.	6XV1 873-2C	6XV1 873-2D
Area of application	Cable for use in drag chains and for high mechanical strain, PUR outer jacket, no UL approval	Cable for use in drag chains and for lower mechanical strain, PVC outer jacket, UL approval
How supplied	Sold by the meter; pre-assembled with 4 BFOC connectors	Sold by the meter; pre-assembled with 4 BFOC connectors

Cable type	Fiber-optic trailing cable (50/125 µm)	Fiber-optic trailing cable GP (50/125 µm)
Order no.	6XV1 873-2C	6XV1 873-2D
Cable type (Standard code)	AT-W(ZN)Y(ZN)11Y 2G50/125	AT-W(ZN)Y(ZN)Y 2G50/125
Fiber type	Multimode graded-index fiber 50/125 µm	Multimode graded-index fiber 50/125 µm
Power loss at 850 nm Power loss at 1300 nm	2.7 dB/km 0.7 dB/km	2.7 dB/km 0.7 dB/km
Modal bandwidth • at 850 nm • at 1300 nm	 • 600 MHz * km • 1200 MHz * km	 • 600 MHz * km • 1200 MHz * km
Number of fibers	2	2
Cable design	Splittable	Splittable
Core type	Hollow core, filled	Hollow core, filled
Materials basic element	PVC, orange/black	PVC, orange/black
Strain relief	Aramid yarn	Aramid yarn
Outer jacket/ Wire color	PUR Green	PVC Green
Dimensions Basic element	 2.9 mm Ø	 2.9 mm Ø
Outer dimensions	10.5 mm	10.5 mm
Cable weight	Approx. 90 kg/km	Approx. 90 kg/km
Permitted tensile force	800 N	800 N
Bending radiuses	200 mm	200 mm
Transverse compressive strength	300 N/cm	300 N/cm
Resistance to impact	-	-
Installation temperature	-5 ºC to +50 ºC	-5 ºC to +50 ºC
Operating temperature	-25 ºC to +80 ºC	-25 ºC to +80 ºC
Storage temperature	-25 ºC to +80 ºC	-25 ºC to +80 ºC
Resistance to fire	-	-
Free of halogens	-	-
Silicone-free	Yes	Yes
ROHS-compliant	Yes	Yes
UL approval	-	OFN (NEC Article 770, UL1651)/ OFN, 90°C, FT1, FT4 (CSA Standard C22.2 No232-M1988)

Table 7- 19 Technical specifications of the fiber-optic FRNC cable

Cable type	Fiber-optic FRNC cable (50/125 µm)
Order no.	**6XV1 873-2B**
Area of application	Halogen-free cable for fixed installation indoors and outdoors
How supplied	Sold by the meter
Cable type (Standard code)	AT-W(ZN)HH 2G50/125 UV
Fiber type	Multimode graded-index fiber 50/125 µm
Power loss at 850 nm Power loss at 1300 nm	2.7 dB/km 0.7 dB/km
Modal bandwidth • at 850 nm • at 1300 nm	 • 600 MHz * km • 1200 MHz * km
Number of fibers	2
Cable design	Splittable
Core type	Hollow core, filled
Materials basic element	FRNC, orange/black
Strain relief	Aramid yarn
Outer jacket/ Wire color	FRNC Green
Dimensions Basic element	 2.9 mm Ø
Outer dimensions	9.2 mm
Cable weight	Approx. 85 kg/km
Permitted tensile force	1200 N
Bending radiuses	90 mm
Transverse compressive strength	500 N/cm
Resistance to impact	-
Installation temperature	-5 ºC to +50 ºC
Operating temperature	-40 ºC to +70 ºC
Storage temperature	-40 ºC to +70 ºC
Resistance to fire	Flame retardant to IEC 60332-1 and IEC 60332-3 Category A/F
Free of halogens	Yes
Silicone-free	Yes
ROHS-compliant	Yes
UL approval	Yes/OFN (NEC Article 770, UL 1651)

7.3.2 Fiber-optic standard cable (62.5/125 µm)

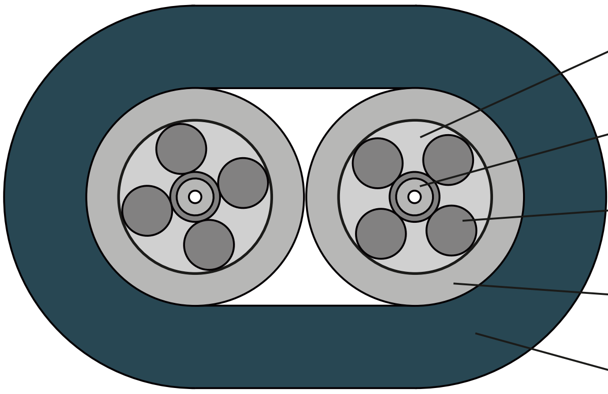


Figure 7-7 Structure of the fiberoptic standard cable

Fiberoptic standard cable 6XV1 820-5****

The fiberoptic standard cable contains two multimode graded fibers of type 62.5/125 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET FIBER OPTIC 6XV1 820-5AH10" approximately every 50 cm. Meter markers consisting of a vertical line and a 4figure number make it easier to estimate the length of an installed cable.

Properties

The fiberoptic standard cable has the following properties:

- Can be walked on
- Flame retardant to IEC 60332-3 Cat. CF
- Not halogen free
- Available in meters up to 4000 m
- Available preassembled with 4 BFOC connectors in lengths up to 1000 m

Use

The fiberoptic standard cable is the universal cable for use indoors and outdoors. It is suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

7.3.3 INOOR fiber-optic cable (62.5/125 µm)

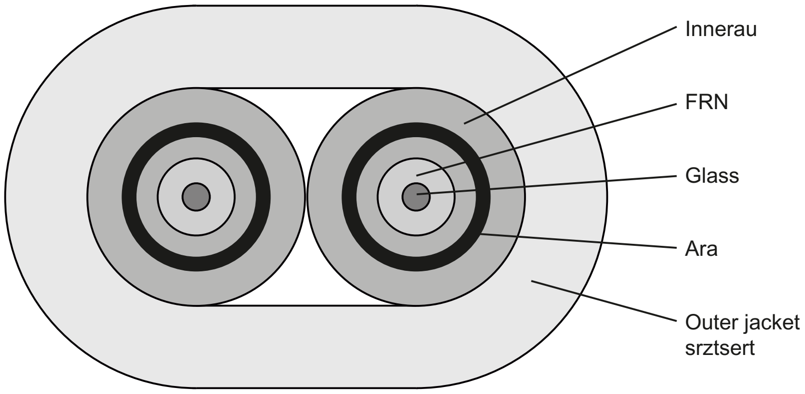


Figure 7-8 Structure of the INDOOR fiberoptic cable

INDOOR fiberoptic cable 6XV1 820-7****

The INDOOR fiberoptic cable contains two multimode graded fibers 62.5/125 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET INDOOR FIBER OPTIC 6XV1 820-7AH10 FRNC" at intervals of approximately 50 cm. Meter markers consisting of a vertical line and a 4figure number make it easier to estimate the length of an installed cable.

Properties

The INDOOR fiberoptic cable has the following properties:

- Can be walked on
- Flameretardant complying with IEC 603323 and DIN VDE 0472 Part 804, test type B
- Halogen-free
- Preassembled with 4 BFOC connectors in lengths from 0.5 m to 100 m.

Use

The INDOOR fiberoptic cable is intended for use indoors in areas protected from the weather. It is suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

7.3.4 Flexible fiber optic trailing cable (62.5/125 µm)

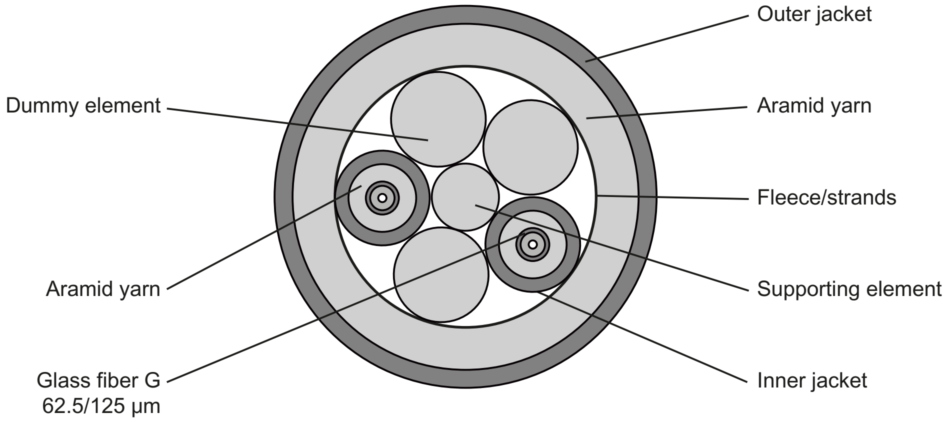


Figure 7-9 Structure of the flexible fiberoptic trailing cable

Flexible fiberoptic trailing cable 6XV1 820-6****

The flexible fiberoptic trailing cable contains two multimode graded index fibers 62.5/125 µm. Integrated dummy elements produce a round cable crosssection.

The outer jacket is labeled “SIEMENS SIMATIC NET FLEXIBLE FIBER OPTIC 6XV1 820-6AH10" at intervals of approximately 50 cm. Meter markers consisting of a vertical line and a 4figure number make it easier to estimate the length of an installed cable.

Properties

The flexible fiberoptic trailing cable has the following properties:

- Flexible (100,000 bending cycles at a minimum bending radius of 150 mm)
- Not halogen free
- Available in meter lengths for up to 2000 m
- Available preassembled with 4 BFOC connectors in fixed lengths up to 650 m

Use

The flexible fiberoptic trailing cable was developed for applications in which the cable must be flexible enough to move, for example when attached to moving machine parts (drag chains). The cable is designed for 100,000 bending cycles through ±90° (at the specified minimum bending radius). The trailing cable can be used both indoors and outdoors. It is suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

⚠ WARNING

During installation and operation, all mechanical requirements for the cable such as bending radii, tensile strain etc. must be kept to. If these limits are exceeded, permanent deterioration of the transmission characteristics may result that can cause temporary or permanent failure of data transmission.

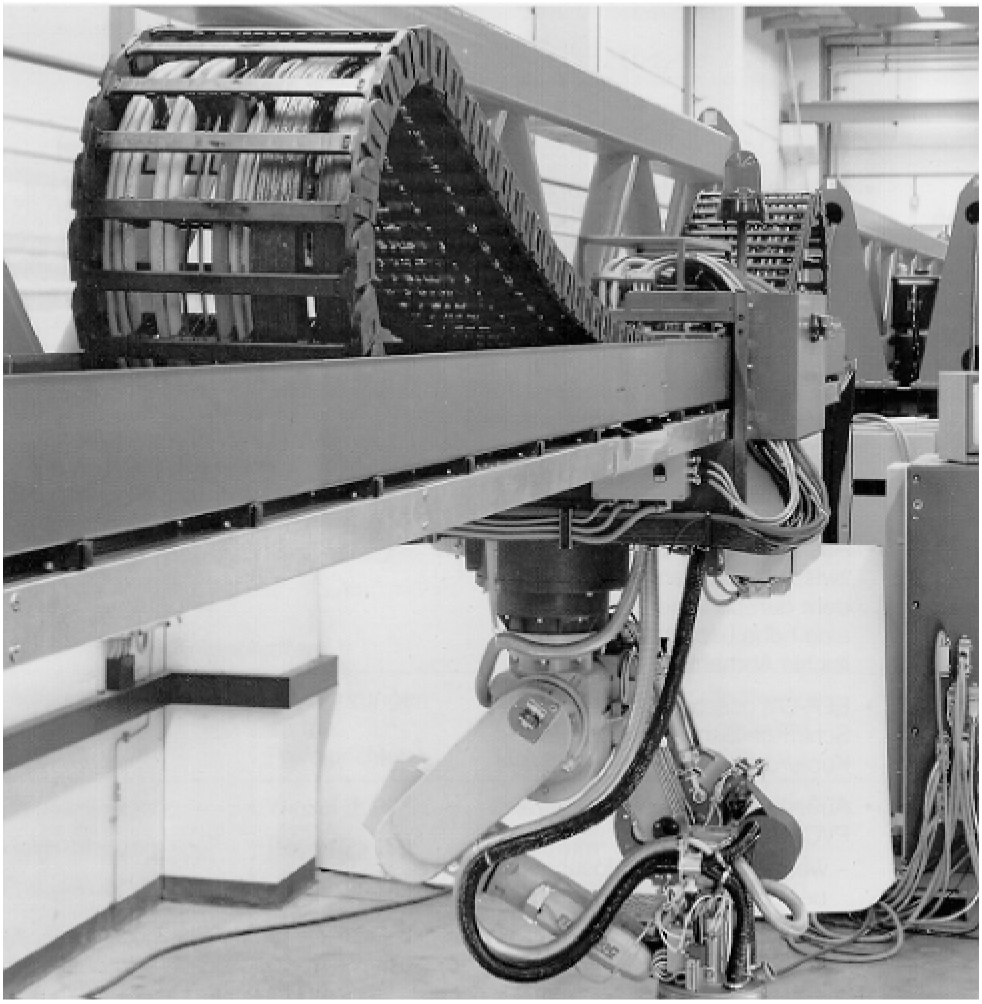


Figure 7-10 Example of using the glass fiberoptic trailing cable in a drag chain

7.3.5 Fiber-optic standard cable GP (50/125 µm)

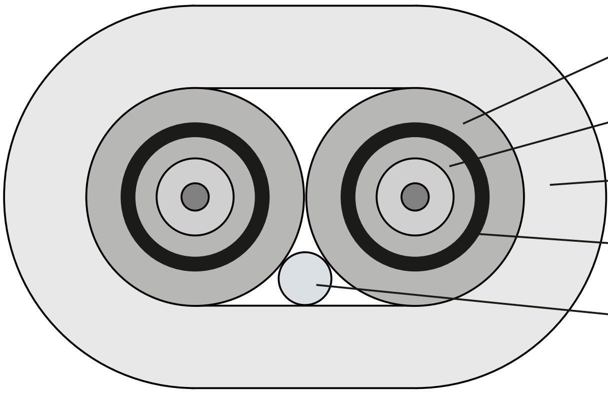


Figure 7-11 Structure of the standard cable GP

Fiber-optic standard cable GP 6XV1 873-2A/3A***/6A***

The fiber-optic standard cable GP duplex cable contains 2 multimode graded index fibers 50/125 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET FO Standard Cable GP (PROFINET Type C) 2G50/125 6XV1 873-2A (UL) E157125 OFN LL 64163 OFN FT4 90C CSA" as well as having meter markers.

Properties

The fiber-optic standard cable GP duplex cable has the following properties:

- Flame-retardant to IEC 60332 1-2 and IEC 60332 3-22 Cat A
- Designed for 500 N permanent tensile strain
- No silicone
- Available in meter lengths for up to 1000 m
- Available preassembled with 4 BFOC or SC connectors in fixed lengths up to 300 m
- Equally suitable for PROFIBUS and PROFINET (outer jacket green)

Use

The fiber-optic standard cable GP is a standard cable for permanent installation indoors or outdoors.

7.3.6 Fiber-optic ground cable (50/125 µm)

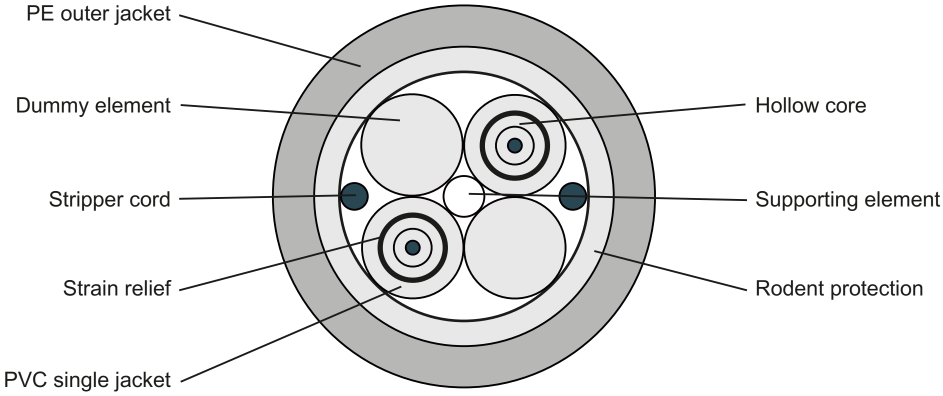


Figure 7-12 Design of the fiber-optic ground cable

Fiber-optic ground cable 6XV1 873-2G/3GT**/6GT**

The fiber-optic ground cable duplex cable contains 2 multimode graded index fibers 50/125 µm.

The round cross section of the cable makes it easier to seal cable feedthroughs.

The outer jacket is labeled "SIEMENS SIMATIC NET FO Ground Cable (PROFINET Type C) 2G50/125 6XV1 873-2G" as well as having meter markers.

Properties

The fiber-optic ground cable duplex cable has the following properties:

- Designed for 800 N permanent tensile strain
- No silicone
- Available in meter lengths for up to 2000 m
- Available preassembled with 4 BFOC or SC connectors in fixed lengths up to 300 m
- Resistant to mineral oil
- Resistant to grease
- Equally suitable for PROFIBUS and PROFINET (outer jacket green)

Use

The fiber-optic ground cable is a standard cable for laying directly in the ground, in pipes, cable channels or on cable racks, also suitable for cable ladders.

7.3.7 Fiber-optic trailing cable (50/125 µm)

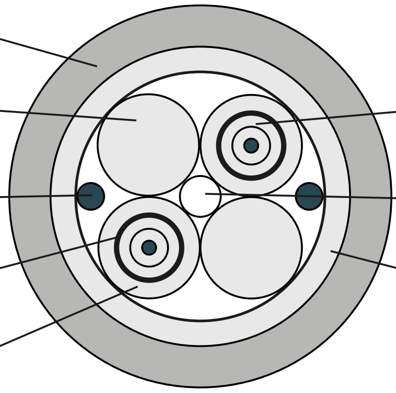


Figure 7-13 Design of the fiber-optic trailing cable

Fiber-optic trailing cable 6XV1 873--2C/3C***/6C***

The fiber-optic duplex trailing cable contains 2 multimode graded index fibers 50/125 µm.

The round cross section of the cable makes it easier to seal cable feedthroughs.

The outer jacket is labeled "SIEMENS SIMATIC NET FO Trailing Cable (PROFINET Type C) 2G50/125 6XV1 873-2C" and has meter markers.

Properties

The fiber-optic duplex trailing cable has the following properties:

- Designed for 800 N permanent tensile strain
- No silicone
- Available in meter lengths for up to 1000 m
- Available preassembled with 4 BFOC or SC connectors in fixed lengths up to 100 m
- Resistant to mineral oil
- Resistant to grease

Use

The fiber-optic trailing cable is a standard cable for flexible applications in drag chains both indoors and outdoors.

7.3.8 Fiber-optic trailing cable GP (50/125 µm)

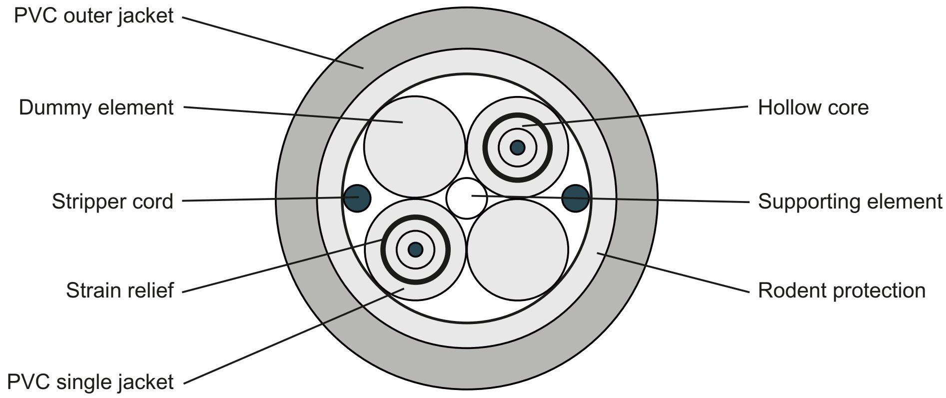


Figure 7-14 Design of the fiber-optic trailing cable GP

Fiber-optic trailing cable GP 6XV1 873-2D/3D***/6D***

The fiber-optic duplex trailing cable GP contains 2 multimode graded index fibers 50/125 µm.

The round cross section of the cable makes it easier to seal cable feedthroughs.

The outer jacket is labeled "SIEMENS SIMATIC NET FO Trailing Cable GP (PROFINET Type C) 2G50/125 6XV1 873-2D (UL)E157125 OFN LL 64163 OFN FT4 90C CSA" and has meter markers.

Properties

The fiber-optic duplex trailing cable GP has the following properties:

- Designed for 800 N permanent tensile strain
- No silicone
- Available in meter lengths for up to 1000 m
- Available preassembled with 4 BFOC or SC connectors in fixed lengths up to 100 m
- Conditionally resistant to mineral oil
- Conditionally resistant to greases

Use

The fiber-optic trailing cable GP is a standard cable for flexible applications in drag chains both indoors and outdoors.

7.3.9 Special cables

Special cables

In addition to the preferred SIMATIC NET FO cable types described in the IK PI catalog, there are numerous special cables and installation accessories available. Listing all would exceed the scope of both the catalog and this manual.

The technical specifications of the SIMATIC NET bus components contains the SIMATIC NET FO cables used as standard cables for connections and also lists additional fiber types that can be used.

Note

Remember that the distances that can be covered change if you use fibers with a different core diameter or attenuation properties from those listed as standard in the operating instructions.

Fiber types

In addition to the preferred SIMATIC NET FO cable types, the following fiber types are often used:

- 10 µm fiber
  This singlemode fiber is used for transmission over extremely long distances. The use of this singlemode fiber requires special, highquality transmitter and receiver elements and connectors. In conjunction with OLM/G111300 or OLM/G121300, distances up to 15 km can be spanned.

Cable design

For special applications, numerous variations in the cable structure are available, for example:

- Bundled cords (cables with hollow cords capable of accommodating several fibers)
- Hybrid cable with fibers and copper conductors in one jacket
- Certified cables, for example for use on ships

Ordering special cables, accessories, and tools

Special cables and special lengths of all SIMATIC NET bus cables as well as accessories, tools and measuring equipment can be obtained from:

I IA SE IP S BD 1
Jürgen Hertlein
Tel.: +49 (911) 750-4465
Fax: +49 (911) 750-9991
juergen.hertlein@siemens.com (mailto:juergen.hertlein@siemens.com)

7.4 Fiberoptic connectors

Note

Fiber-optic cable connectors are susceptible to contamination and mechanical damage to the face.

Protect open connectors with the supplied dust caps.

7.4.1 Connectors for plastic fiberoptic cables

Versions

Fitting connectors to plastic fiberoptic cables is simple. The following connectors are available:

- Simplex connector for connecting OBTs and integrated optical interfaces
- Adapter for simplex connector for integrated optical interfaces
- BFOC connector for OLM/P

7.4.2 Simplex connector and connector adapter for devices with integrated optical interfaces

Definition

Simplex connectors allow you to connect the fiber-optic cable to the integrated fiber-optic cable interface on the PROFIBUS device. With certain Siemens modules (for example IM 1532 FO, IM 467 FO) two simplex connectors (one for the transmitter and one for the receiver) are plugged on to the module using a special adapter.

Requirement

The PROFIBUS device must be equipped with a fiber-optic cable interface, such as the ET 200S (IM 151 FO) or the IM 467 FO for S7-400.

Design

Two simplex connectors (a sender and a receiver) and, where necessary, a connector adapter with the following attributes are required for a fiber-optic cable connection:

- Degree of protection IP20
- Data transmission rates from 9.6 Kbps to 12 Mbps

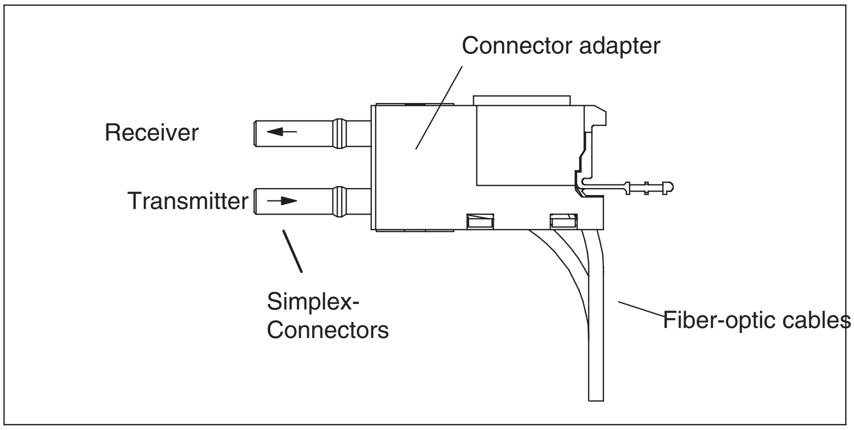


Figure 7-15 Simplex connector and special adapter fitted together

Order numbers

The simplex connector and adapter can be ordered as follows:

Table 7- 20 Order numbers - simplex connectors and connector adapters

Accessories	Order no.
SIMATIC NET PROFIBUS plastic fiber-optic simplex connector/polishing set 100 simplex connectors and 5 polishing kits for assembling SIMATIC NET PROFIBUS plastic fiberoptic cables	6GK1 901-0FB00-0AA0
Connector adapter Pack of fifty for assembling the simplex connectors in conjunction with the IM 467 FO, CP 342-5 FO and the IM 153-2 FO	6ES7 195-1BE00-0XA0

Installation instructions

In Appendix "Installation instructions and notes on usage (Page 277)" of this manual, you will find installation instructions for the following:

- Fitting connectors to SIMATIC NET PCF fiber-optic cables with the simplex 6GK1 900-0KL00-0AA0 termination kit (Page 278)
- Fitting connectors to SIMATIC NET PCF fiber-optic cables with the BFOC 6GK1 900-0HL00-0AA0 termination kit (Page 285)

- Assembly instructions for SIMATIC NET PROFIBUS plastic fiber-optics with simplex connectors (Page 291)
- Assembly instructions for SIMATIC NET PROFIBUS plastic fiber optics with BFOC connectors (Page 302)

7.4.3 BFOC connector for plastic FO cable

Properties

The BFOC connectors allow precision fiberoptic cable connections. The construction of the BFOC connector allows the strain relief of cables to be used. These are essential for setting up longer FO connections, for example, between different OLM/Ps. The BFOC connectors must be ordered separately.

For ordering data and instructions on fitting connectors, refer to the IK PI catalog and Section Installation instructions and notes on usage (Page 277).

Figure 7-16 BFOC connectors with accessories (crimping sleeve and antikink sleeve), for plastic FO cables

7.4.4 Connectors for glass fiber-optic cables

BFOC connectors for glass fiberoptic cables

In PROFIBUS, only BFOC connectors are used for glass fiberoptic cables.

Figure 7-17 BFOC connector with dust cap

Fitting connectors on site

When connectors need to be fitted on site,

- SIEMENS provides this service,
- BFOC connectors (6GK1 901-0DA20-0AA0) and a suitable special tool can be ordered.

Note

Connectors should only be fitted to glass fiber-optic cables by trained personnel. When fitted correctly, they allow extremely low insertion loss and the value is highly reproducible after multiple plugging cycles.

Prefabricated cables

To be able to use glass fiber-optic cables with untrained personnel, glass fiber-optic cables are also available with four BFOC connectors already fitted.

For ordering data, please refer to the current SIMATIC NET Catalog IK PI.

Note

Fiber-optic cable connectors are susceptible to contamination and mechanical damage to the face. Protect open connectors with the supplied dust caps.

Clean the faces of the connectors before inserting them in devices or FO couplers.

Passive Components for PROFIBUSPA 8

8.1 SIMATIC NET cables for PROFIBUS PA

PROFIBUS PA cables

The following applies for PROFIBUS PA cables:

- Due to the double shielding, they are particularly suitable for laying in industrial environments subject to electromagnetic interference.
- A consistent grounding concept can be implemented via the outer jacket and the ground terminals of the SplitConnect Tap.
- The meter markers printed on the cable make it easier to identify the length. (Serve as orientation; accuracy ±5 %.)

Notes on laying PROFIBUS PA cables

Bus cables are impaired by mechanical damage. How to install bus cables correctly is described in detail in Appendix "Installing bus cables (Page 259)".

To make it easier to measure the length of cables, they have a marker every meter.

Overview

The table below is an overview of the bus cables for PROFIBUS PA showing their mechanical and electrical characteristics.

If you require a cable with characteristics that are not covered by the range of products described here, please contact your local SIEMENS office.

Ordering special cables, accessories, and tools

Special cables and special lengths of all SIMATIC NET bus cables as well as accessories, tools and measuring equipment can be obtained from:

I IA SE IP S BD 1
Jürgen Hertlein
Tel.: +49 (911) 750-4465
Fax: +49 (911) 750-9991
juergen.hertlein@siemens.com (mailto:juergen.hertlein@siemens.com)

Table 8- 1 Bus cables for PROFIBUS PA

Technical specifications 1) Cable type	FC process cable for PROFIBUS PA3) 2)
Order no.	6XV1 830-5EH10 6XV1 830-5FH10
Attenuation • at 16 MHz • at 4 MHz • at 38.4 kHz • at 9.6 kHz	 • - • - • ≤ 3 dB/km • -
Surge impedance • at 9.6 kHz • at 31.25 kHz • at 38.4 kHz • at 3 to 20 MHz • Rated value	 • - • 100 ± 20 Ω • 100 ± 20 Ω • - • 100 Ω
Loop resistance	22 Ω/km
Shield resistance	6.5 Ω
Effective capacitance at 1 kHz • Wire-wire • Wire-shield	 • 50 nF/km • 90 nF/km
Operating voltage (rms value)	100 V
Continuous current of the power wires at 25 °C	-
Cable type standard code	02Y SY (ST)CY 1x2x1.0/2.55-100 BL/SW OE FR
Jacket • Material • Color • Diameter	 • PVC • blue / black • 8.0 ± 0.4 mm
Wires • Conductor cross section • Color of the wire insulation	 • 0.83 mm² (AWG18) • Red/green
Perm. ambient conditions • -Operating temperature • -Transportation/storage temperature • -Installation temperature	 • -40°C + 80°C • -40°C + 80°C • -20°C + 80°C
Bending radiuses • Single bend • Multiple bends	 • 40 mm • 80 mm
Max. tensile load	150 N
Approx. weight	103 kg/km
Resistance to fire	Flame retardant to IEC 60332-3-24
Resistance to oil	Resistant to mineral oils and grease
UV resistance	Yes

Technical specifications 1) Cable type	FC process cable for PROFIBUS PA3) 2)
Product property • Halogen-free • Silicone-free • ROHS-compliant	 • No • Yes • Yes
UL listing at 300 V rating UL style at 600 V rating	Yes Yes
1) Electrical characteristics at 20 °C, tests according to DIN 47250 Part 4 or DIN VDE 0472 2) Not suitable for connection to PROFIBUS RS-485 bus connectors with insulation piercing contacts 3) Transmission rate 31.25 kbps	

8.1.1 FC process cable GP (PROFIBUS PA cable)

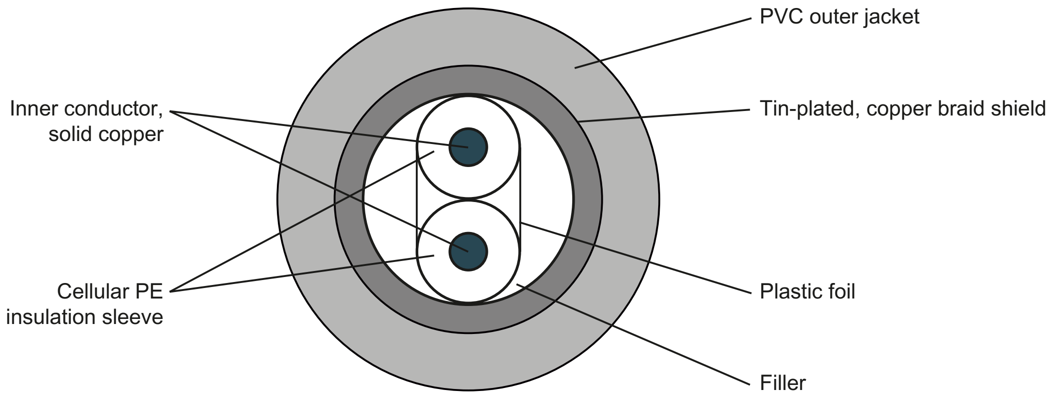


Figure 8-1 Design of the FC bus cable for PROFIBUS PA

FC bus cables for PROFIBUSPA 6XV1 830-5EH10 and 6XV1 830-5FH10

The bus cables 6XV1 830-5EH10 (blue jacket) and 6XV1 830-5FH10 (black jacket) are standard cables for PROFIBUS PA networks. They can be used generally for all systems using the transmission technique complying with IEC 611582 (Manchester coded and bus powered), for example, Foundation Fieldbus and PROFIBUS PA. They meet the requirements of cable type A to MBP The combination of twisted pairs and braid shield make the cables particularly suitable for industrial environments subject to electromagnetic interference. The design of the cable also guarantees stable electrical and mechanical properties after the cable has been installed.

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the outer jacket, see Section "Installation instructions for SIMATIC NET PROFIBUS FAST CONNECT (Page 138)".

Properties

- Flameretardant
- Selfextinguishing in case of fire

- Resistant to UV radiation
- Conditionally resistant to mineral oil and greases
- The FC Process Cable corresponds to the FISCO model
- Cable with black outer jacket for non-hazardous area (6XV1 830-5FH10)
- Cable with blue outer jacket for hazardous area (6XV1 830-5EH10)
- Cable for the hazardous area with PROFIBUS PA
- High noise immunity due to double shielding

Use

The bus cable for PROFIBUS PA bus connections is designed for MBP transmission technology. It is intended for fixed installation indoors and outdoors.

For the construction of fieldbus networks according to IEC 61158-2 (for example PROFIBUS PA), different color-coded cable types are available for the different types of applications (hazardous, non-hazardous areas).

8.2 SpliTConnect Tap

Area of application

The SpliTConnect Tap allows the setup of a PROFIBUS PA bus segment with end device attachment points. The SpliTConnect Coupler can be used to construct a PROFIBUS PA hub by connecting SpliTConnect Taps in series. By replacing the contacting screw with the SpliTConnect terminator, the SpliTConnect tap can be used as a bus terminating element.

	
PROFIBUS SpliTConnect tap	SpliTConnect Coupler
	
SpliTConnect terminator	SpliTConnect M12 Outlet
	
SpliTConnect M12 Jack	

Design

The SpliTConnect tap has a rugged plastic casing of PBT (polybuthylene-terephthalate) complying with IP67 and is suitable for mounting on a rail or wall. The integrated metal casing ensures complete shielding. In conjunction with the PROFIBUS FC process cable GP, the SpliTConnect tap provides a simple cable attachment that can be installed quickly. The contacting and connection of the PROFIBUS FC process cable GP uses the insulation piercing technique with a contact screw. It is also possible to ground the SpliTConnect tap using the contact screw.

How it works

The SpliTConnect tap is used to install a PROFIBUS PA bus segment complying with IEC 611582 (Page 337) attachment points for end devices. The FastConnect system (FastConnect stripping tool, PROFIBUS FC process cable GP) allows simple fitting of connectors. The end devices can be connected directly via the PROFIBUS FC process cable GP or via the SpliTConnect M12 outlet.

Description	Order no.
SpliTConnect Tap for implementing PROFIBUS PA segments and attaching PA field devices, insulation piercing contacts, IP67 How supplied: Available in packs of 10	6GK1 905-0AA00
SpliTConnect M12 Outlet element for direct attachment of PROFIBUSPA field devices to the SpliTConnect tap via the M12 connector How supplied: Available in packs of 5	6GK1 905-0AB00
SpliTConnect Coupler connection element for cascading SpliTConnect taps to create star hubs How supplied: Available in packs of 10	6GK1 905-0AC00
SpliTConnect terminator (Ex) for terminating PROFIBUSPA segments, can be used in hazardous areas How supplied: Available in packs of 5	6GK1 905-0AD00
SpliTConnect terminator (not Ex) for connecting PROFIBUSPA segments, cannot be used in hazardous areas How supplied: Available in packs of 5	6GK1 905-0AE00
SpliTConnect M12 Jack for direct attachment of PROFIBUS PA field devices to the PROFIBUS PA segment via an M12 connector How supplied: Available in packs of 5	6GK1 905-0AF00

9 Passive components for power supply

9.1 Overview of 7/8" cabling system

9.1.1 Overview of 7/8" cabling system

7/8" cabling system for supplying power

To supply power to IP65 PROFIBUS nodes (for example the SIMATIC ET 200), there is a 7/8" cabling system available.

The power supply concept of the ET 200 involves power being supplied by a central power supply unit and being looped through from device to device. The load and device supply are over separate circuits. The devices have a 7/8" male connector on the input side and a socket on the output side.

7/8" connecting cables consist of a flexible 5-wire cable to supply two independent circuits and have both a 7/8" male and female connector.

The cable is available both in meters to allow connectors to be fitted on-site and preassembled in various lengths.

Note

How to lay power cables

- When laying power cables, the same physical constraints apply as described in Section "Installing bus cables (Page 259)" for bus cables.
- The limits for temperature, tensile loading, pressure, torsion, bending radii etc. specified in the data sheet must not be exceeded.

Ordering special cables, accessories, and tools

Special cables and special lengths of all SIMATIC NET cables as well as accessories, tools and measuring equipment can be obtained from:

I IA SE IP S BD 1
Jürgen Hertlein
Tel.: +49 (911) 750-4465
Fax: +49 (911) 750-9991
juergen.hertlein@siemens.com (mailto:mailto:juergen.hertlein@siemens.com)

Table 9- 1 Cable for power supply

Technical specifications 1) Cable type	Energy cable
Order no.	6XV1 830-8AH10
Use	Power supply of ET 200 modules with 7/8" power interface
Operating voltage (rms value)	600 V
Cross section of the power cores	1.5 mm^2
Continuous current of the power cores	16 A
Cable type standard code	L-Y11Y-JZ 5x1x1.5 GR
Jacket • Material • Color • Diameter	 • PUR • gray • 10.5 ± 0.3 mm
Power cores • Conductor cross section • Color of the wire insulation	 • 1.5 mm^2 • 4 x black, green/yellow
Perm. ambient conditions • -Operating temperature • -Transportation/storage temperature • -Installation temperature	 • -40°C + 80°C • -40°C + 80°C • -40°C + 80°C
Bending radiuses • Single bend • Multiple bends • Number of bending cycles	 • 26 mm • 63 mm • 5.000.000
Max. tensile load	500 N
Approx. weight	149 kg/km
Resistance to fire	Flame retardant to IEC 60332-1
Resistance to oil	Resistant to mineral oils and grease
UV resistance	Resistant
FastConnect electrical connection version	No
Product property • Halogen-free • Silicone-free • ROHS-compliant	 • No • Yes • Yes
UL listing at 300 V rating UL style at 600 V rating	No Yes
1) Electrical characteristics at 20 °C, tests according to DIN 47250 Part 4 or DIN VDE 0472	

9.1.2 Energy cable 5 x 1.5

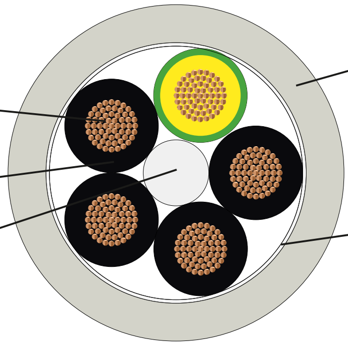


Figure 9-1 Energy cable 5 x 1.5

Energy cable 6XV1 830-8AH10

Rugged cable suitable for trailing with 5 copper wires for supplying power to the ET 200pro.

The 6XV1 830-0AH10 energy cable corresponds to UL style AWM 20669; 90 °C; 600 V.

Properties

The 6XV1 830-8AH energy cable has the following properties:

- Resistant to mineral oils and greases to EN 60811-2-1
- Small bending radii for installation and operation
- Very high number of bending cycles of 5,000,000 bends
- The jacket material is flame resistant to IEC 60332-1
- The jacket material is halogen-free

Use

Rugged cable suitable for trailing with 5 copper wires (1.5 mm²) for connection to a 7/8" connector.

9.2 7/8" energy connector and connecting cables

Use

Using the 7/8" energy connector and connecting cables, SIMATIC NET PROFIBUS nodes can be supplied with electrical power.

Area of application

You require the 7/8" energy connector to supply SIMATIC NET PROFIBUS nodes with power.

Table 9- 2 Design and area of application of the energy connector and the Power T-Tap PRO in IP65

	7/8" connector	Power T-Tap PRO	7/8" connecting cable
Order numbers:	6GK1 905-0FA00 6GK1 905-0FB00	6GK1 905-0FC00	6XV1 822-5B***
Design			
ET 200B ET 200L ET 200M ET 200S ET 200pro ET 200eco	 X X	 X X	 X X
PG 720/720C PG 740 PG 760 RS-485 repeater OP OLM/OBT			

Technical specifications

Table 9- 3 Technical specifications of the energy connector and the Power T-Tap PRO in IP65

	7/8" connector		Power T-Tap PRO	7/8" connecting cable
Order numbers:	6GK1 905-0FA00	6GK1 905-0FB00	6GK1 905-0FC00	6XV1 822-5B***
Cable outlet	180 °		180/90 °	180 °*
Interfaces • to the device • to the energy cable	 • 7/8" male • Screw terminal	 • 7/8" female • Screw terminal	 • 7/8" female • 7/8" male/female	 • 7/8" female • 7/8" male
Rated current (40 °C)	9 A		5.3 A	9 A

	7/8" connector		Power T-Tap PRO	7/8" connecting cable
Order numbers:	6GK1 905-0FA00	6GK1 905-0FB00	6GK1 905-0FC00	6XV1 822-5B***
Permissible ambient conditions • Operating temperature • Transportation/storage temperature	• -40 °C .. +85 °C • -40 °C .. +85 °		• -40 °C .. +80 °C • -40 °C .. +80 °C	• -40 °C .. +85 °C • -40 °C .. +80 °C
• Relative humidity – Installed – Transportation and storage	5 to 100 % with condensation 5 to 95 % without condensation			
Construction • Dimensions (WxHxD) • Weight	• 27x27x83 mm • 55 g		• 26x55x73 mm • 110 g	• ∅ 27 mm
Type of protection	IP67		IP67	IP67
Connectable cable diameters	10.5 ± 0.3 mm			
ROHS-compliant	Yes		Yes	Yes

* 90 ° cable outlet available as special cable (special lengths (http://support.automation.siemens.com/WW/view/en/26999294))

9.3 Connecting the energy cable to the 7/8" energy connector

Design

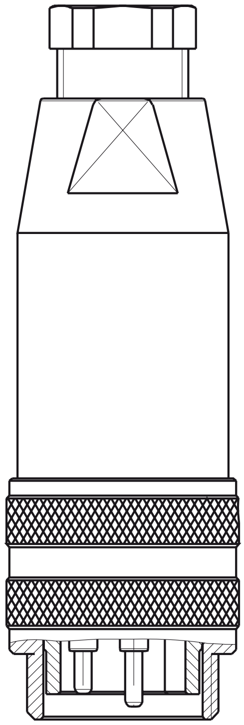


Figure 9-2 7/8" energy connector

Suitable cables

7/8" energy connectors are intended for making connections to the SIMATIC NET energy cable (5 x 1.5 mm^2). The stranded wires of the energy cable must be fitted with 0.75 mm^2 wire-end ferrules.

Note

The mechanical data of the 7/8" energy connector are tailored to the SIMATIC NET energy cables (6XV1 830-8AH10). Fitting 7/8" energy connectors to cables with different electrical or mechanical properties can cause problems during operation!

Connecting up the bus cable

Fit the energy connector to the energy cable (6XV1 830-0AH10) as follows:

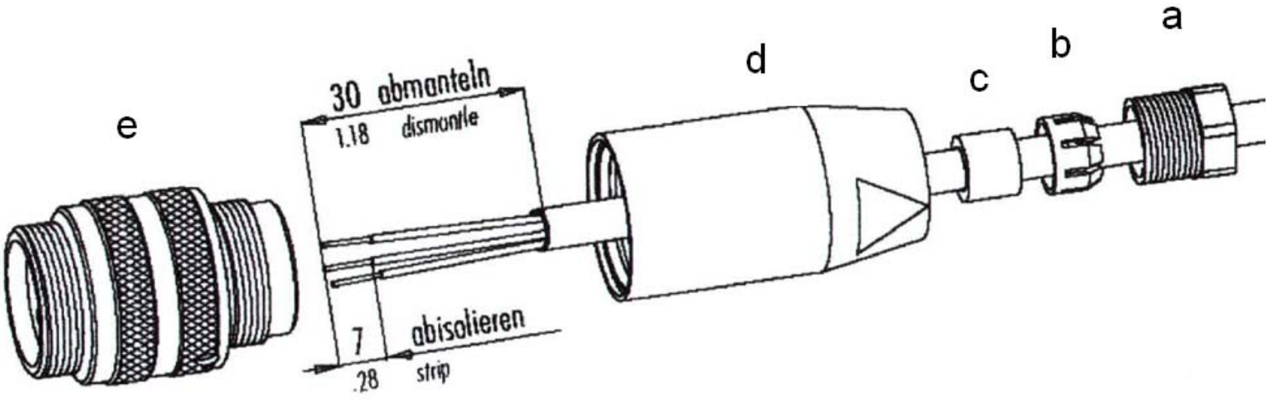
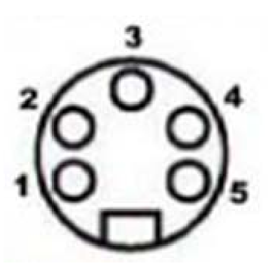


Figure 9-3 Energy connector - fitting

Fitting connectors to cables

1. Push the clamping screw (a), pinch ring (b) and sealing ring (c) over the cable.
2. Strip the jacket and wires as shown in the drawing.
3. Fit the 0.75 mm² wire-end ferrules to the stranded wires.
4. Push the connector sleeve (d) over the wires.
5. Screw the wires into the screw terminals of the female or male connector insert as shown in the chart.
6. Push the connector sleeve (d) onto the female or male insert (e) and screw the two parts together.
7. Push the pinch ring (b) over the sealing ring (c) and press the two parts together with the pressure nut (a) into the connector sleeve.
8. Screw the pressure nut tight.

Pin assignment

View of the connector face	Pin (6GK1905-0EA00)	Lead	Socket (6GK1905-0EB00)	View of the connector face
	Pin 1	Wire 1	Pin 1	
	Pin 2	Wire 2	Pin 2	
	Pin 3	PE	Pin 3	
	Pin 4	Wire 3	Pin 4	
	Pin 5	Wire 4	Pin 5	

9.4 7/8" connecting cable for power supply

Area of application

The 7/8" connecting cable is a preassembled cable used for supplying power to PROFIBUS nodes (for example the SIMATIC ET 200) with IP65 protection

Design

The 7/8" connecting cable id based on the energy cable 5 x 1.5 mm^2 (6XV1 830-8AH10). At one end, it has a 5-pin 7/8" male connector with a straight cable outlet and at the other end, it has a 5-pin 7/8" socket with a straight cable outlet. The cable is available in lengths of 0.3 m to 15 m.

Figure 9-4 7/8" connecting cable

Function

The 7/8" connecting cable is used to supply power to PROFIBUS nodes.

Table 9- 4 Ordering data for the SIMATIC NET 7/8" connecting cable

Ordering data:	
SIMATIC NET 7/8" connecting cable For power supply; pre-assembled with two 5-pin 7/8" male/female connectors up to 50 m max.; length * Additional special lengths with 90° or 180° cable outlet	Special lengths (http://support.automation.siemens.com/WW/view/en/26999294)
0.3 m	6XV1 822-5BE30
0.5 m	6XV1 822-5B E50
1.0 m	6XV1 822-5B H10
1.5 m	6XV1 822-5B H15
2.0 m	6XV1 822-5B H20
3.0 m	6Xv1 822-5B H30
5.0 m	6XV1 822-5B H50
10 m	6XV1 822-5B N10
15 m	6XV1 822-5B DN15

9.5 Connecting the 7/8" energy connector to a module

Properties

The 7/8" energy connector of a device consists of a 7/8" male incoming connector and a 7/8" female outgoing connector. This means that the 7/8" connector must be equipped with socket contacts for the incoming energy cable and pin contacts for the outgoing energy cable.

NOTICE
Insert or remove the 7/8" energy connector only when the power supply is turned off.

connecting the 7/8" energy connector

To connect the 7/8" energy connector to the device, follow the steps below:

1. Turn off the power supply.
2. Turn the connector so that the slot and key of the mating mechanism fit together.
3. Plug the 7/8" energy connector loosely into the module.

4. By carefully turning the male connector, make sure the connector and socket are properly interlocked (slot and key).
5. Tighten the locking nut to secure the 7/8" energy connector to the module.

Closing unused 7/8" connection points

Close all unused 7/8" connection points with sealing caps (6ES7 194-3JA00-0AA0) to achieve degree of protection IP65 or IP67.

Testing PROFIBUS A

A.1 Hardware test device BT200 for PROFIBUS DP

A.1.1 Possible applications

Possible applications

The BT200 hardware test device for PROFIBUS DP can be used as an installation, commissioning, and service tool. Due to its versatility, it is useful for both the installer of PROFIBUS networks as well as the experienced commissioning engineer and service engineer. An acceptance report can also be created following installation of the system.

A.1.2 Area of application

Area of application

During installation, the BT200 test device can be used to test the PROFIBUS cable. Installation errors are found quickly and simply and the installation engineer requires no special knowledge of PROFIBUS. Even before the system is put into operation, the BT 200 device can be used to test the RS485 drivers of the PROFIBUS nodes. Outputting a list of accessible slaves on the pre-wired bus is also possible, and this without a master on PROFIBUS DP. This means that individual bus segments can be checked in advance, reducing the commissioning times. If an error occurs, these test functions can be useful in localizing the problem and minimizing the downtimes of the system.

Note

Check the physical bus properties before commissioning with the BT 200. This reduces the time required for commissioning and prevents system downtimes and sporadic bus errors.

A.1.3 Logging function

Logging function

All the test results can be stored on the BT 200. Using a pointtopoint cable, the data can be transferred to a PC. The test results can be edited on the PC and printed out as a log.

A.1.4 Design and properties

Figure A-1 Hardware test device BT200 for PROFIBUS DP

Properties

- Compact plastic casing, degree of protection IP 30
- Dimensions (W x H x D) in mm: Approx. 210 x 100 x 50
- LCD display with 2 x 16 characters
- 8-key membrane keyboard
- Attachment to the PROFIBUS network via 9pin D-sub female connector
- Power supply from integrated NC battery
- Attachment to charger (accessories)

A.1.5 Functions

Checking the PROFIBUS cable

In this test, only the PROFIBUS cable is tested. The following errors can be detected:

- Shortcircuit between data lines or between data line and shield
- Line interruption
- Shield break
- Reversed polarity (A and B)
- Reflections that could cause errors
- The number of activated terminating resistors is checked

The length of the PROFIBUS cable can also be measured.

Checking the RS485 interface of a slave

The test device is connected to one slave. This is supplied with power. The test device then makes the following measurements:

- RS485 driver OK/defective
- Power supply to the terminating resistor OK/not OK
- RTS signal present/not present

Checking the accessibility of nodes

- List of accessible slaves (live list)
- Specific addressing of individual slaves

A.1.6 How it works

Testing cables

The previously described tests and measurements are based essentially on various voltage, reflection and resistance measurements. To check the cable, the test device is connected to one end of the cable and a test connector at the other. When installing the cable, the user works gradually from connector to connector. At the press of a button the measurements are made automatically and the test results displayed.

Tests on nodes

When testing on the node itself, a pointtopoint link is established between the test device and the node. To complete the tests, the accessibility of the attached slaves is checked on the wiredup bus. The user can have a list of accessible slaves created automatically or can check the accessibility of a single slave by specifying its address manually.

Displaying test results

Apart from the actual test result, the display also shows concrete measures that can be taken to remedy problems. During the measurement of the reflections, the location of the problem is also displayed. This means that the user does not require specialized PROFIBUS knowledge to work with the test unit and to find typical problems in the wiring and setup and to eliminate them. No additional devices are necessary for the measurements. This means a drastic reduction in commissioning times and plant downtimes.

Documenting the system status

The BT 200 simplifies the creation of an acceptance report to document the system status at the time of acceptance. As standard, the unit is designed for operation on PROFIBUS cables complying with type A (EN 50170). The unit parameters can, however, be modified by entering the electrical parameters for the cable to be tested. This means (whatever cable type is used) that the location of a problem can be displayed in meters as well as the total length of the installed cable.

Battery operation

The device has an accumulator battery. This ensures that the user can test the entire system without requiring a power supply. The device is turned off automatically to save power after 3 minutes if no input is made ensuring that the battery has a long working life.

Ordering data

Table A- 1 BT 2000 hardware test device ordering data

Ordering data	Order no.
BT 200 hardware test device (charging unit not included) - with point-to-point cable for connecting to a node - with test connector - with operating instruction German/English	6ES7 181-0AA01-0AA0
Charging unit (230V AC / 2.4 - 10 V DC)	6ES7 193-8LA00-0AA0
Charging unit (110V AC / 2.4 - 10 V DC)	6ES7 193-8LA00-0AB0
Test connector (spare)	6EP8 106-0AC20
NC battery pack (spare)	6EP8106-0HA01
Pointtopoint cable (spare)	6EP8106-0HC01
The operating instructions can also be found on the Internet (http://support.automation.siemens.com/WW/view/de/857969).	

A.2 Testing fiber-optic cable

A.2.1 Necessity of a final test

The total loss on an FO transmission path, particularly the influence of splices, can only be estimated roughly during planning. As a result of inaccuracies when creating the splices and subjecting cables to excessive stress during installation, the actual loss may well be higher than the calculated values. The only way to be sure that a fiberoptic link functions reliably and has an adequate link power margin is to measure the loss following installation. It is advisable to test every fiberoptic link in which the connectors were fitted onsite and to document the results in an acceptance report.

Attenuation

Attenuation defined as the optical power loss in decibels (dB) is the decisive criterion in optical networks. All the system components such as the cable, connectors, splices, couplers etc. contribute to the total loss. To measure this loss, fiberoptic test units must be used following installation. During the measurements, light with the same wavelength must be used as in the optical transmission system.

Measuring methods

In the main, two test methods are used:

1. The optical power source and meter
2. Optical time domain reflectometer (OTDR)

As of version 3, the PROFIBUS OLM has an integrated diagnostic option with which the quality of the received optical signal can be checked.

A.2.2 Optical power source and meter

All the components of a fiber-optic link such as the fiber, connectors, couplers and splices contribute to losses. The total loss must be below the available optical power budget between the optical transmitter and receiver.

The optical power source and meter method allows the link loss to be measured. Light from a defined light source is sent through the link and the resulting losses are measured with an optical power meter.

This method can be used for plastic, PCF, multimode and singlemode fiberoptic cables.

Since attenuation depends on wavelength, the measurement must be performed at the same wavelength that will later be used during operation (650 nm, 850 nm or 1300 nm)

Arrangement for measuring loss

The arrangement for measuring loss consists of a light source and an optical power meter. The light source is first connected to the receiver via a reference fiber. The optical power measured at the receiver is the reference value for a link without attenuation. Following this, the reference fiber is opened and the link to be measured is inserted. The meter compares the optical power received now with the previously measured reference value and calculates the attenuation of the inserted link on this basis.

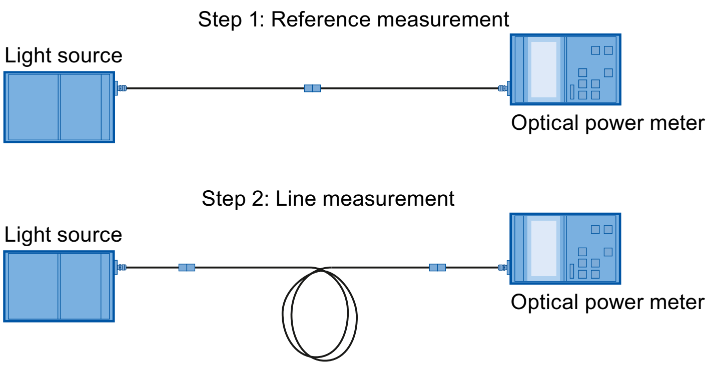


Figure A-2 Measuring the total loss of a fiber-optic link

Evaluating the results of the loss measurements

An optical power budget is available between an optical transmitter and optical receiver. This identifies the difference between the minimum power launched by the transmitter and the minimum optical power required at the receiver. The optical power budget is normally specified in dB. The measured total loss on the fiberoptic link must be less than this optical power budget.

The greater the difference between the total loss and the optical power budget, the greater the operating reliability and longterm stability of the optical link. The difference between the optical power budget and the total attenuation is known as the link power margin of an optical link. For multimode glassfiber links, this link power margin should not be below 3 dB and for singlemode glassfiber links should not be below 2 dB.

A.2.3 Optical time domain reflectometer (OTDR)

If the attenuation measurement described above indicates that the total attenuation of the fiberoptic link is too high, the causes and the location of the problem must be established. Here, OTDRs are used.

Figure A-3 Optical time domain reflectometer (OTDR)

OTDRs exist for the wavelengths 850 nm and 1300 nm. This means that this method can be used for both multimode and singlemode fiberoptic cables.

How an OTDR Functions

An OTDR can be compared to a radar unit The OTDR sends laser light pulses on the FO cable to be tested (the end of the cable is open). These light pulses are reflected more or less strongly by all problem points along the cable. A meter evaluates the intensity and propagation time of the reflected pulses.

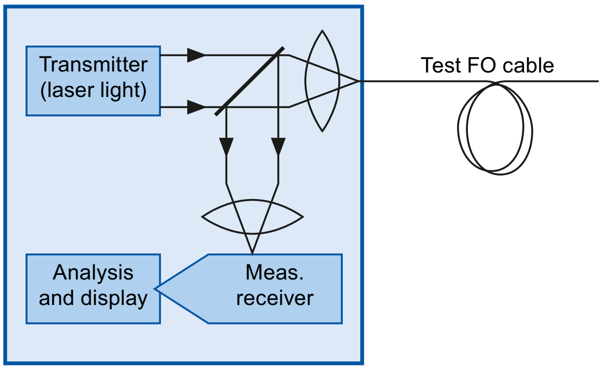


Figure A-4 How an OTDR Functions

OTDR evaluation

The OTDR provides the measurement results graphically

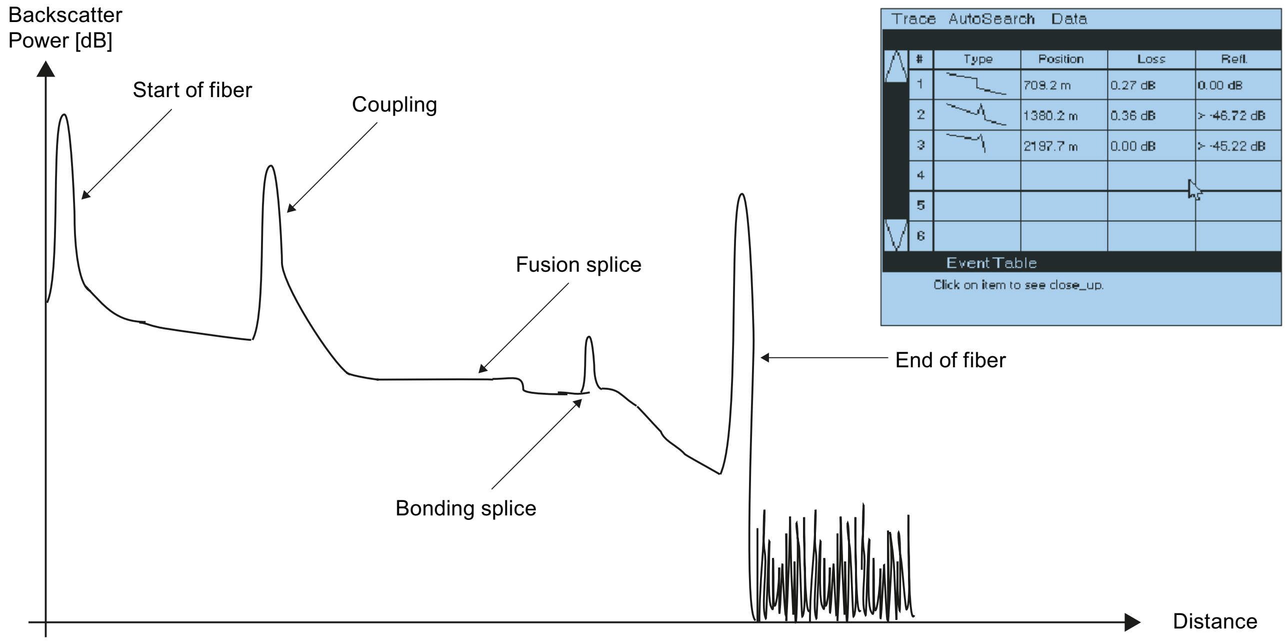


Figure A-5 Representation of the OTDR measurement results

The figure above clearly illustrates that the power of the launched light reduces constantly along the fiberoptic link. There are significant jumps at the coupling points of the fiber.

The following conclusions can be drawn from these results:

- Whether the coupling points should be replaced due to excessive attenuation
- Whether the fiber has been damaged when installing the cable
- The distance between the impairments and the start of the fiber

Based on this information,

- defects resulting from installation can be eliminated,
- fiberoptic links can be documented in detail and, if problems occur, can be compared with the link at the time it was installed.

A.2.4 Checking the optical signal quality with PROFIBUS OLM V4

Checking

The receive level of the two optical channels can be detected using a normal commercially available voltmeter attached to measurement terminals on the PROFIBUS OLM V4. The voltmeter can be inserted and removed during operation using 2 mm laboratory test plugs.

This allows the following:

- The incoming optical power can be documented, for example for later measurements (aging, damage)

  Comment: On the OLM V4, the incoming light power is displayed on the optical channels by LEDs (CH2/3 Level).
- A good/bad check can be made (limit value).

The correlation between the measured output voltage and the signal quality is in the form of a curve (see figure).

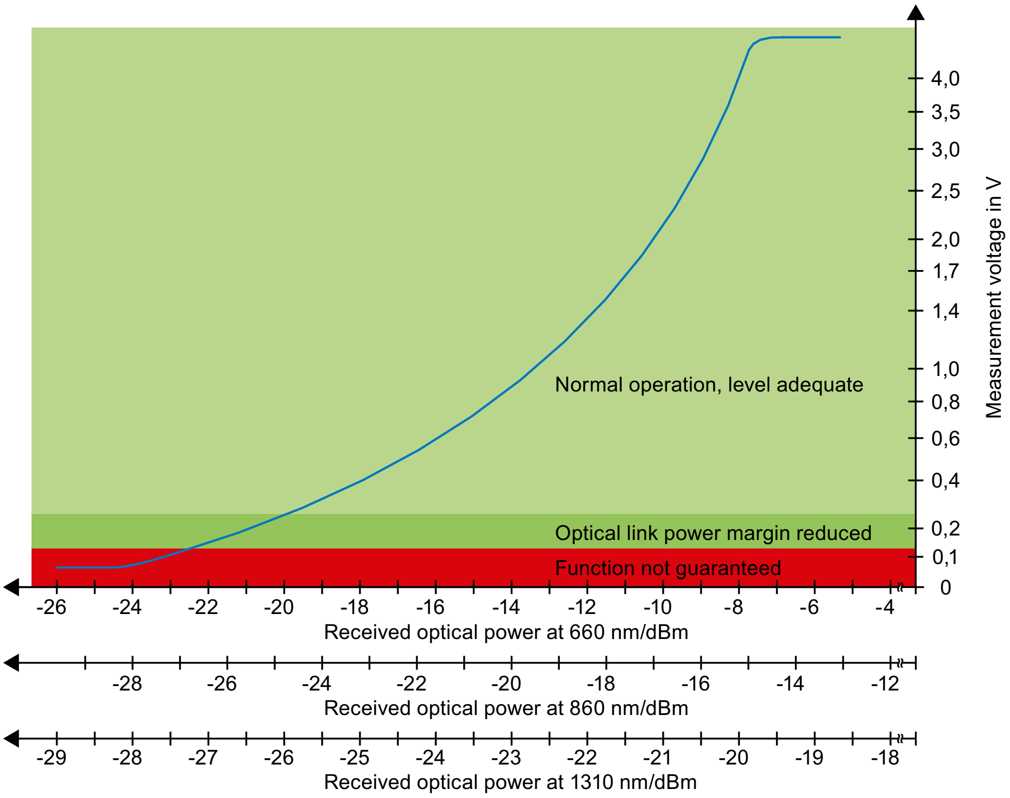


Figure A-6 Example Correlation between the measured voltage and signal quality with an OLM/G12

Further information

You will find more detailed information on the OLM in the IK PI catalog and on the Internet (http://support.automation.siemens.com/WW/view/en/24164176).

Lightning and overvoltage protection of bus cables between buildings

B

B.1 Why protect your automation system from overvoltage?

Introduction

One of the most common causes of hardware failures is overvoltage, caused by the following:

- Switching in power networks
- Atmospheric discharge or
- Electrostatic discharge

We will show you how to protect devices attached to a PROFIBUS bus cable from overvoltages.

Note

This section contains information about protecting hardware components on a PROFIBUS bus cable from overvoltages.

Comprehensive protection from overvoltage is, however, only assured when the entire automation system and the entire surrounding building is designed for protection from overvoltages. In particular, this involves structural measures in the building design phase.

Therefore, for detailed information regarding overvoltage protection, we recommend that you contact your Siemens representative or a company specializing in lightning protection.

Further references

You will find detailed information on protection of systems automated with SIMATIC S7 from overvoltage in the relevant system manuals

S7-300 (Page 337) , S7-400 (Page 337) , ET 200 (Page 337).

The solution shown there is based on the lightning protection zone concept described in IEC 61312-1/DIN VDE 0185 T103.

B.2 Protecting bus cables from lightning

Bus cables within buildings

If you keep to the instructions for installing bus cables located entirely within a building, no special lightning protection is necessary.

Bus cables between buildings

Since bus cables between buildings are subject to higher overvoltage risks (the effects of lightning), the nodes included in the attached bus segment must be protected from the effects of overvoltage.

Lightning protection facilities for bus cables are implemented in two different components, coarse protection and fine protection.

Basic protection

While coarse protection prevents the progress of highenergy lightning currents at the point of entry to the building, the fine protection installed in the vicinity of the DTE provides finer limitation of overvoltage for the bus node.

- The lightning protection devices described below represent a protection concept developed in conjunction with the company of Dehn & Söhne for SIMATIC NET PROFIBUS and that can be used for all transmission rates (9.6 kbps to 12 Mbps). The devices can be ordered directly from the firm of Dehn & Söhne; ordering data are listed below.
- When configuring a network, remember that the coarse and fine protection together must be considered as a node (reduction of the number of nodes in segments with lightning protection modules).
- If a PROFIBUS segment runs through several buildings (several lightning components used in series), a repeater should be installed in each building to refresh the signal.

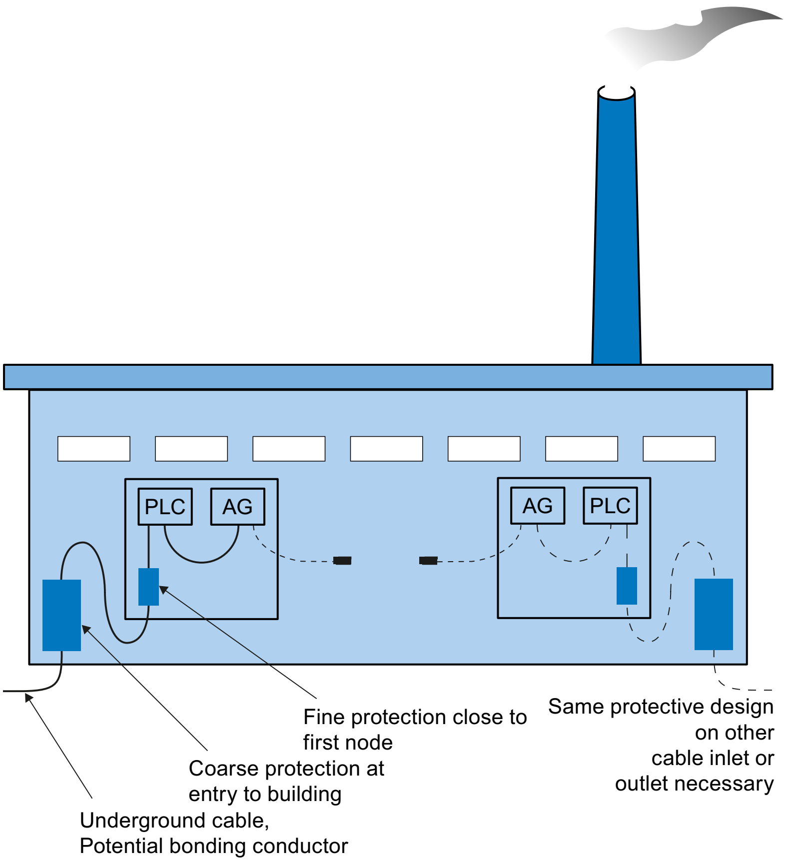


Figure B-1 Lightning protection concept for bus cables between buildings

B.3 Instructions for installing coarse protection

Basic protection

The coarse protection must be installed at the point where the bus cable enters the building and connected to the building equipotential bonding system with low impedance.

The following are required to create the coarse protection:

- The base section type no. 919506,
- The protection module type B, type no. 919510 and
- The shield contact terminals type no. 919508 are required.

To keep EMC* and environmental influences away from the coarse protection, this should be installed in a protective enclosure type no. 906055. At the same time, the transition from the underground cable to the standard indoor cabling can be made here.

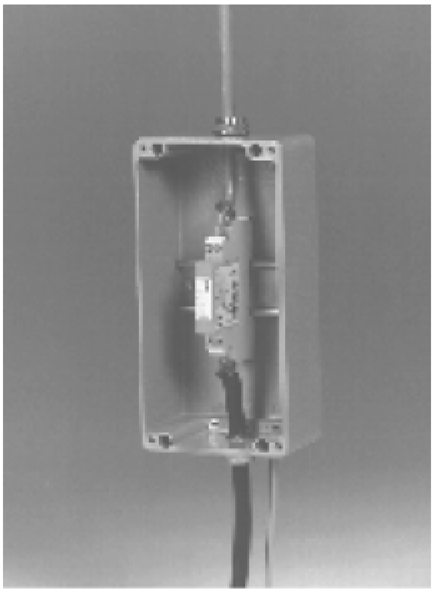


Figure B-2 Coarse protection installed at the entry or exit of the building

B.4 Instructions for installing fine protection

Low-voltage protection

The fine protection should be installed as close as possible to the 1st node following the coarse protection.

The following are required to install the fine protection:

- The base section type no. 919506,
- The protection module MD/HF type no. 919570,

and

- The shield contact terminals type no. 919508

are required.

The fine protection should be connected with low impedance to the reference ground of the 1st node on the bus (for example, grounded DIN rail when installed in a cabinet). When installing the fine protection outside cubicles (IP 65 area or higher) this must be installed in

- protective casing, type no. 906055

as described in the installation instructions for the coarse protection.

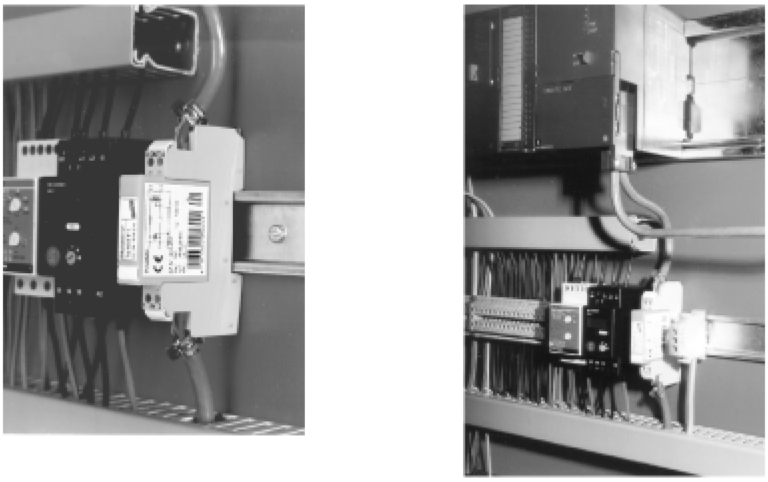


Figure B-3 Fine protection in the cubicle close to the first bus node

B.5 General information on the lightning protection equipment from the firm of Dehn & Söhne

- When installing the modules read the instructions regarding the products from Dehn & Söhne.
- If there is a fault in a lightning protection module, communication on the bus is interrupted (cable shortcircuit). To reestablish communication temporarily (without lightning protection) the protective modules can be removed from the base modules since these function as throughconnected terminals without the protective module.
- The rest of the plant protection concept must be implemented complying with VDE 0185 Part 103.

Installing bus cables C

C.1 Bus cables in automation systems

Bus cables as important plant connections

In automation systems, the bus cables are the most important connections between individual plant components. Mechanical damage (cable break) or repeated electrical interference affecting these bus connections reduces the transmission capacity of the system. In extreme cases, such problems can lead to failure of the entire automation system. The following sections explain how to protect cables from mechanical and electrical impairment.

Keep the overall system concept in mind

Bus cables connect automation systems that in turn are connected to transducers, power supply units, peripheral devices etc. via cables. All the components together form an electrically networked automation system.

When connecting system components via electrical cables (in this case bus cables), remember to take into account the specific requirements of the overall system structure.

Connecting cables, in particular, affect the concepts

- for safe isolation of dangerous power supply voltages
- for protecting the system from overvoltage (for example lightning protection)
- for EMC (noise emission and noise immunity)
- for electrical isolation.

Networking SIMATIC with SIMATIC NET

SIMATIC NET network components and SIMATIC automation components are designed to operate together taking into account the aspects listed above. By keeping to the installation instructions described in the system manuals, you will create an automation system that meets the legal and normal industrial requirements for safety and noise immunity.

C.2 Electrical safety

The signal levels on electric PROFIBUS cables are low voltage. Correctly installed and operated PROFIBUS bus cables do not have dangerous electrical voltages.

Remember, however, the following rules when installing the power supply for all components (nodes, bus components, etc.) that you want to connect to a PROFIBUS cable.

Line voltage

Between components operated on mains power supply and the PROFIBUS interface, the requirements of safe electrical isolation from the power supply complying with DIN VDE 0160 and DIN IEC 60950 (Page 337) / VDE 0805/EN 60950/ UL 1950/ CSA 22.2 No. 950 must be met.

24 V DC supply

24 V DC power supplies for components must meet the requirements of low voltage with safe electrical isolation from the network complying with DIN VDE 0160 and DIN IEC 60950 (Page 337) / VDE 0805/EN 60950/ UL 1950/ CSA 22.2 No. 950.

Protection against external electrical interference

Cable or wire breaks must not lead to undefined statuses in the plant or system.

C.3 Mechanical protection of bus cables

Protection of electrical and optical bus cables

Mechanical protection is required to protect bus cables from breaks or mechanical damage.

Note

The measures described here for mechanical protection apply both to electrical and optical cables.

Measures for mechanical protection

The following measures are recommended to protect bus cables from physical damage:

- When cable cannot be installed on a cable rack or similar construction, it should be installed in a conduit (for example PG 11-16)
- In areas where the cable is subject to mechanical stress, install the cable in a heavy-gauge aluminum conduit or in a heavygauge plastic conduit.
- When 90° bends are necessary and at the junctions between buildings (for example expansion joints), a break in the conduit is acceptable only when there is no likelihood of damage to the cable, for example due to falling objects.
- In areas where the cable is likely to be walked on or driven over, the cable must be protected from damage by a closed heavygauge aluminum or steel conduit. As an alternative, the cable can be laid in a metal cable gutter.

Remember the instructions for laying cables outside buildings.

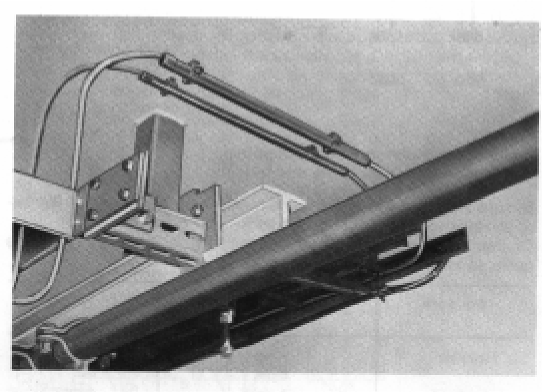


Figure C-1 Mechanical protection of the bus cable

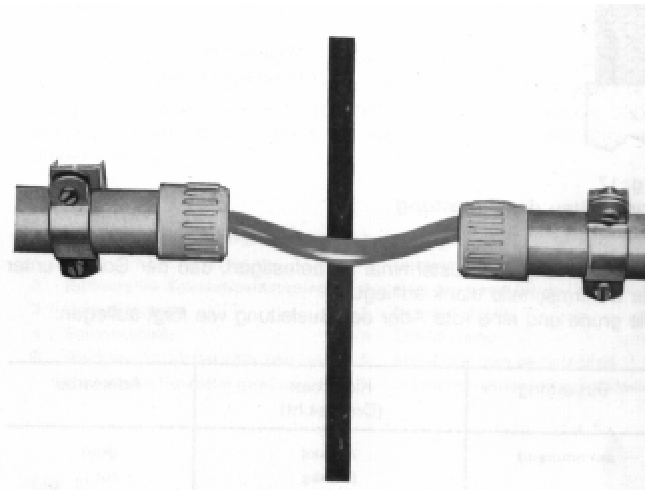


Figure C-2 Interrupting the conduit at an expansion joint

Bus Terminal RS485

The installation of electrical bus cables in a protected area is supported by the use of the RS485 bus terminal. This allows the attachment of end devices and service and commissioning work on the end devices without needing to move the actual bus cable.

Redundant bus cables

The installation of redundant bus cables involves special requirements. Redundant cables should always be installed on separate cable racks to avoid simultaneous damage by the same event.

Do not operate trailing or festoon cables if they are twisted

To ensure that the working life of trailing and festoon cables, make sure they are not twisted during installation. A line is printed on the outer sheath along the length of the cables to allow the cable to be checked for twists.

Install bus cables separately

To prevent accidental damage to bus cables, they should be clearly visible and should be separate from all other wiring and cables. To improve EMC, it is often advisable to install the bus cables in a separate cable channel or in conductive metal tubes. Such measures also make it easier to localize a faulty cable.

C.4 Electromagnetic compatibility of fiberoptic cables

Fiber-optic cables

For bus connections between buildings and/or external facilities, the use of fiberoptic cables is generally recommended. Due to the optical transmission principle, fiberoptic cables are not affected by electromagnetic interference. Measures for equipotential bonding and for overvoltage protection are unnecessary with fiberoptic cables.

Note

Fiberoptic cables are ideally suited for bus connections in areas with high noise levels.

Remember, however, that the LAN components operating on an electrical basis such as OLMs, OBTs or PLCs with integrated optical interfaces may require additional noise protection measures in such areas before they can be included in the fiber-optic link. These must be protected using the measures already mentioned such as shielding, grounding, greater clearance to sources of interference etc.

C.5 Additional instructions on installing fiberoptic cables

Protecting connectors from contamination

Fiberoptic cable connectors are sensitive to contamination. Unconnected male and female connectors must be protected with the supplied dust caps.

The faces of the connectors should be cleaned before they are inserted in a device.

Attenuation variations under load

During installation, fiberoptic cables must not be twisted, stretched or squashed. The specified limit values for tensile strain, bending radii and temperature ranges must be adhered to. During installation, the attenuation values can vary slightly, these variations are, however, reversible providing the strain limits are not exceeded.

Using the pulling loop, protecting connectors

Preassembled SIMATIC NET PCF fiber-optic cables are supplied with a pulling loop and Kevlar sleeve to allow them to be pulled. Make sure that you only connect your traction device to this loop. You will find detailed instructions about using the loop in Appendix "Installation instructions and notes on usage (Page 277)".

Fitting strain relief

Although the BFOC connectors have their own strain relief and kink protection, it is advisable to arrange for additional strain relief as close as possible to the connected device to protect against mechanical strain.

Plan adequate attenuation reserves

When installing the cables over long distances, it is advisable to include one or more future repair splices in the power loss budget.

Electromagnetic immunity

Fiberoptic cables are immune to electromagnetic interference. Installing cables in cable channels along with other cables (for example 230 V/380 V power supply cables) causes no problems. When installing in cable channels, however, make sure that the permitted strain on the fiberoptic cables is not exceeded when pulling in other cables later.

Attaching PROFIBUS fiber-optic cables

The attachment of the various PROFIBUS fiber-optic cables to optical bus components (OLM, OBT,...) and devices with an integrated optical interface is described in the chapter "Passive components for optical networks" and in Appendix "Installation instructions and notes on usage (Page 277)".

C.6 Electromagnetic compatibility of bus cables

Electromagnetic compatibility (EMC)

Electromagnetic compatibility (EMC) includes all questions of electrical, magnetic and electromagnetic immunity and emission.

To avoid interference affecting electrical systems, these effects must be reduced to a certain level. The measures involved in achieving this limitation include the design, construction, and correct connection of bus cables. The components and bus cables for SIMATIC NET PROFIBUS meet the requirements of the European standards for devices used in an industrial environment. This is documented by the CE marking.

Note

The limit values specified can only be guaranteed if the matched components for SIMATIC NET PROFIBUS are used consistently! The installation instructions in this manual and in the manuals of the networked programmable logic controllers must also be adhered to exactly!

C.6.1 Measures to counter interference voltages

Overview

Measures to suppress interference voltages are often only implemented when the control system is already in operation and proper reception of a useful signal is impaired. Expenditure and effort involved in such measures (for example special relays) can be reduced considerably when installing the control system by taking into account the following points.

Included here:

- Grounding of all inactive metal elements
- Shielding devices and cables
- Suitable positioning of devices and cable routing
- Special noise suppression measures

C.6.2 Installation and grounding of inactive metal parts

Grounding

Connect all inactive metal parts in the immediate vicinity of your automation components and bus cables to ground (PE system). This includes all metal parts of cabinets, machine parts etc. that have no electrical function in the automation system. Connecting these parts to a uniform system chassis produces a uniform reference potential for your system and reduces the effects of coupledin interference. For detailed information about grounding techniques, refer to the system manuals of the SIMATIC S7-300 (Page 337) and S7-400 (Page 337) automation systems.

C.6.3 Using the shields of electrical bus cables

Definition

Shielding is a technique used to counteract the effects of magnetic, electrical or electromagnetic interference fields.

Interference currents on cable shields must be discharged to ground by short, conductive, largearea connections. To prevent these interference currents reaching a device or wiring closet, this discharge must take place immediately before or at the point at which the cable enters the device casing/wiring closet.

Cable Shields

Note the following points about cable shields:

- Use SIMATIC NET PROFIBUS cables throughout your system. The shields of these cables have an adequate shield density to meet the legal requirements regarding noise emission and immunity.
- Always contact the shields of bus cables at both ends. The legal requirements for noise emission and noise immunity in your system (CE marking) can only be achieved when the shields make contact at both ends.
- Secure the shield of the bus cable to the connector casing.
- If cables are installed permanently, it is advisable to remove the insulation of the shielded cable and to establish contact on the shield/PE conductor bar.

Note

If there is a potential difference between the grounding points, an illegally high compensating current can flow through the shield grounded at both ends. To rectify the problem, do not, under any circumstances, open the shield of the bus cable.

Install an additional bonding conductor parallel to the bus cable that takes over the shield current (for notes on equipotential bonding refer to Section "Equipotential bonding (Page 267)") or use fiberoptic cable instead of electrical cable (safest solution).

Handling the shield

Note the following points when handling the shield:

- Secure the braided shield with metal cable clamps.
- The clamps must make good and largearea contact with the shield (see following figure).
- Contact SIMATIC NET PROFIBUS cables only using the braided copper shield and not the aluminum foil shield. The foil shield is applied on one side to a plastic foil to increase tearing strength and is therefore non-conductive.

- Contact the shield with the shielding bar directly at the point at which the cable enters the cabinet.

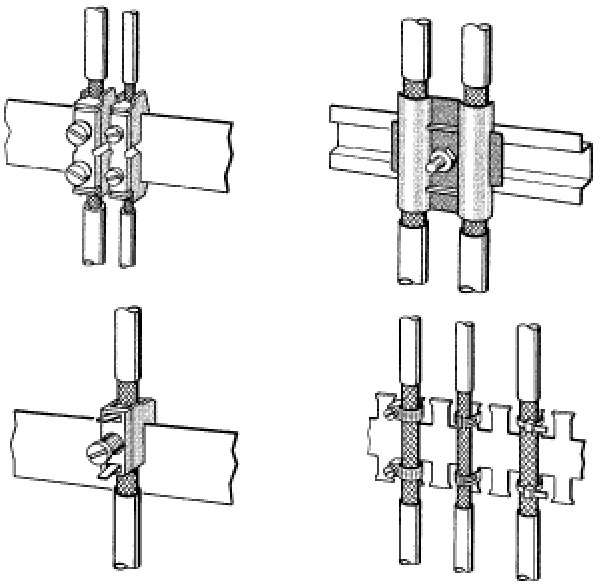


Figure C-3 Securing shielded cables with cable clamps and ties (schematic representation)

- When removing the sheath of the cable, make sure that the braid shield of the cables is not damaged.
- When selecting contact elements, remember that the cables for SIMATIC NET PROFIBUS have a braid shield outer diameter of approximately 6 mm.
- To allow good contact between grounding elements, tin-plated or galvanically stabilized surfaces are ideal. With galvanized surfaces, the necessary contact should be achieved using suitable screws. Painted surfaces should be avoided at the contact points.
- Do not use shield clamps/contacts for strain relief. The contact with the shielding bar could be impaired or be broken altogether.

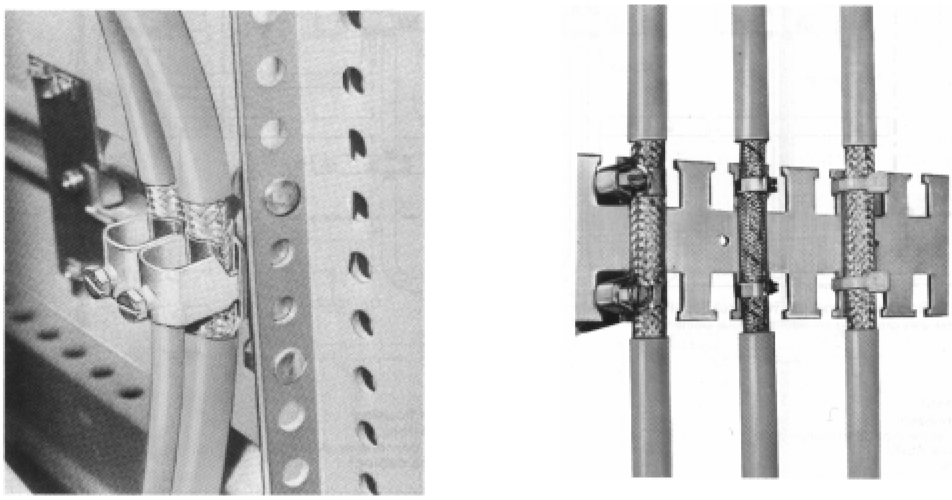


Figure C-4 Contacting the shield at the point of entry to a cabinet

C.6.4 Equipotential bonding

When do potential differences occur?

Potential differences can, for example, be caused by different power supplies. Potential differences between separate parts of the plant can be damaging to the system in the following situations:

- Programmable controllers and peripheral devices are linked on grounded connections
- Cable shields are contacted at both ends and grounded to different parts of the plant.

How do you avoid potential differences?

Potential differences must be reduced by installing bonding conductors so that the functions of the electronic components used are guaranteed.

When and why is equipotential bonding necessary?

Several good reasons for equipotential bonding are listed below:

- Devices with a grounded interface can be damaged by potential differences.
- The shield of the PROFIBUS cable must not be used for equipotential bonding. This is, however, the case if parts of the system connected by the cable shield are connected to different grounding points.
- Equipotential bonding is a requirement for lightning protection.

Rule for equipotential bonding

Remember the following points about equipotential bonding systems:

- The lower the impedance of the equipotential bonding cable, the greater the effectiveness of the equipotential bonding.
- The impedance of the additional bonding conductor must not exceed 10% of the shield impedance of the bus cable.
- Make largearea contact between the bonding conductor and the PE conductor.
- Protect the bonding conductor from corrosion.
- Install the bonding conductor so that the area enclosed by the bonding conductor and signal cables is as small as possible.
- Use copper or galvanized steel for the bonding conductor.
- Include metal, conductive cable channels/racks in the equipotential bonding of the building and between the individual parts of the system. The individual segments of the channels/racks must be connected together with low inductance and low resistance and connected to the building ground system as often as possible. Expansion joints and angled connections should be bridged by additional flexible grounding bands.
- The connections between the individual segments of channels must be protected from corrosion (longterm stability)
- If there are connections between sections of buildings (for example separated by expansion joints) with their own reference point for the building ground network, a

bonding conductor (equivalent copper crosssectional area ≥10 mm²) must be installed parallel to the cables. This bonding conductor is not necessary if metal, conducting cable channels/racks are used.

Note

Bonding conductors are unnecessary if the sections of a system are connected exclusively using fiberoptic cable (FO).

C.7 Routing electrical bus cables

Voltages and currents

Wiring and cables in a system conduct voltages and currents. Depending on the application, the amplitudes can be of an order much higher than the signal voltage on the cable. Switching supply voltages can, for example, produce sharply rising surge voltage peaks in the kV range. If other cables are laid parallel to the bus cable, data exchange on the bus cables can be disturbed by crosstalk. To achieve problemfree operation of the bus system, certain rules must be adhered to when installing cables. One extremely effective method of suppressing interference is to keep as large a distance as possible between the cable causing the interference (the culprit) and the cable affected by the interference (the victim).

Fiber-optic cables

Fiberoptic cables are not affected by electrical interference and, while mechanical protection is necessary, the EMC rules do not apply.

Telecom cables

Cables for Telecom have special rules generally specified for a particular country (in Germany, Telecom cables must not be laid along with other cables).

C.7.1 Cable categories and clearances

Grouping in categories

It is useful to group wires and cables into various categories according to the signals they carry, possible interference signals, and their sensitivity to interference. Minimum clearances can be specified for these categories so that interferencefree operation can be expected under normal operating conditions if the clearance is adhered to.

Constraints

Grouping cables according to voltage classes assumes that the interference voltages relate directly to the power supply voltage conducted (the lower the supply voltage, the lower the interference voltage). Remember, however, that DC or 50 Hz power supply voltages do not represent any danger to PROFIBUS cables. The critical interference voltages in the kHz to MHz frequency range are created by the consumers connected to the cable. A 24 V DC cable with which a relay is switched regularly has a far more critical interference range than a 230 V cable supplying a lightbulb.

In the information shown below, it is assumed that all the components within an automation system and all the plant components controlled by the system (for example machines, robots etc.) at least meet the requirements of the European standards for electromagnetic compatibility in an industrial environment. If devices are defective or incorrectly installed, higher interference voltages must be expected!

The following is assumed:

- The cables for analog signals, data signals and process signals are always shielded.
- The distance from the cables to the chassis surface of the system (cabinet wall, grounded cable channel, ...) is not more than 10 cm.

Note

In general, the greater the distance between cables and the shorter the distances over which the cables run parallel to each other, the less the danger of interference.

Clearance table

The following table contains information on the general rules governing clearances to enable you to choose the right cables. The rules should be understood as minimum requirements for positioning bus cables within buildings (inside and outside cabinets).

How to read the table

To check how cables of different types must be laid, follow the steps outlined below:

1. Find the cable type of the first cable in column 1 (Cables for ...).
2. Find the cable type of the second cable in the relevant section in column 2 (and cables for ...).
3. Read the guidelines for laying the cables in column 3 (lay ...).

Table C- 1 Cabling within buildings

Cables for ...	and cables for ..	lay ...
Bus signals, shielded (PROFIBUS, Industrial Ethernet) Bus signals, unshielded (AS-Interface)	Bus signals, shielded (PROFIBUS/Industrial Ethernet) Bus signals, unshielded (ASInterface) Data signals, shielded (programming devices, operator panels, printers, counter inputs, etc.) Analog signals, shielded DC voltage (≤ 60 V), unshielded Process signals (≤ 25 V), shielded AC voltage (≤ 25 V), unshielded Monitors (coaxial cable)	In common bundles or cable channels
	DC voltage (> 60 V and ≤ 400 V), unshielded AC voltage (> 25 V and ≤ 400 V), unshielded	In separate bundles or cable channels (no minimum clearance required)
	DC and AC voltage (> 400 V), unshielded	Within closets: In separate bundles or cable channels (no minimum clearance required) Outside cabinets: On separate cable paths with at least 10 cm clearance

C.7.2 Cabling within cabinets

What must be taken into account?

When running cables within cabinets, remember the following rules:

- The minimum clearance between cables of different categories can be found in Section "Cable categories and clearances (Page 268)". In general, the risk of interference due to crosstalk is less the greater the clearance between the cables.
- Where cables of different categories cross, they must always cross at right angles (wherever possible avoid sections where the cables run parallel).
- If there is not enough space to maintain a clearance ≥ 10 cm between the individual categories, install the cables sorted according to category in separate metallic and conductive channels. You can then arrange these channels next to each other. Screw the metallic, conductive channels to the struts of the rack or cabinet walls approximately every 50 cm making lowresistance and lowinductance contact.
- The shields of all cables entering the cabinet must be secured as close as possible to the point of entry and should make largearea contact with cabinet ground.
- Make sure that you avoid parallel installation of cables entering from outside between the point of entry to the cabinet and the shield clamp and purely internal cabinet cables, even if the cables are of the same category.

C.7.3 Cabling within buildings

What do I need to remember?

When laying cables outside cabinets but within buildings, note the following points:

- The clearances listed in Section "Cable categories and clearances (Page 268)" must be maintained between the various cable categories and when laying cables on common cable racks
- If the cables are laid in metal cable channels, the channels can be arranged directly beside each other.
- If there is only one common metal channel available for all categories, either the clearances shown in Section "Cable categories and clearances (Page 268)" must be maintained or if this is not possible for lack of space, the individual categories should be separated from each other by metallic partitions. The partitions must be connected to the channel making lowresistance and lowinductance contact.
- Cable racks should cross each other at right angles.
- Include metal, conductive cable channels/racks in the equipotential bonding of the building and between the individual parts of the system.
- Note the information on equipotential bonding in Section "Equipotential bonding (Page 267)" in this manual.

C.7.4 Cabling outside buildings

Fiberoptic cables should be given preference

For communications between buildings and between buildings and external facilities, the use of fiberoptic cables is generally recommended. Due to the optical transmission principle, fiberoptic cables are not affected by electromagnetic interference. Measures for equipotential bonding for overvoltage protection are unnecessary with fiberoptic cables.

EMC rules for electrical bus cables

When installing electrical bus cables outside buildings, the same EMC rules apply as for cables inside buildings. In addition, the following applies:

- Install cables on metal cable racks
- Electrically connect the cable racks where they join
- Ground the cable racks
- There must be adequate potential equalization between buildings and external facilities regardless of the bus cables. (see Section "Equipotential bonding (Page 267)")
- The cables should be installed as close as possible and parallel to the equipotential bonding.
- Connect the shields of the cables to the grounding network as close as possible to the point of entry into the building or facility.

- Electrical bus cables installed outside buildings must be included in the lightening protection and grounding concept of the entire system. Please note the information in Appendix "Lightning and overvoltage protection of bus cables between buildings (Page 253)" of this manual.
- All SIMATIC NET PROFIBUS cables can be used if they are installed in cable channels protected against dampness. In this case, the clearances specified in Section "Cable categories and clearances (Page 268)" of this manual must be adhered to.

Underground cabling

Note

Only the SIMATIC NET PROFIBUS underground cable is suitable for direct installation underground.

If the bus cables are installed directly in the earth, we recommend the following:

- Install the bus cable in a trench.
- Install the bus cable approximately 60 cm below the surface of the ground.
- Mechanical protection must be provided for the bus cables and a cable warning band should also be included.
- The equipotential bonding between the buildings being connected must be installed approximately 20 cm above the bus cables (for example a tin-plated strip conductor). The strip conductor also provides protection against direct lightening strikes.
- When installing bus cables along with other cables, the clearances specified in Section "Cable categories and clearances (Page 268)" must be adhered to (for example using bricks to maintain clearance).
- The clearance to power cables should be ≥ 100 cm if other regulations do not demand a greater clearance.

C.7.5 Special noise suppression measures

Connecting switched inductances to suppressors

Some inductive switching devices (for example relays) create interference voltages that are a multiple of the connected operating voltage. The distributed ET 200 (Page 337) system manuals contain suggestions about how to limit the interference voltages caused by inductance by connecting them to suppressors.

Power supply for programming devices

It is advisable to include a power socket for programming devices in each cabinet. The socket must be supplied by the same system to which the PE conductor for the cabinet is connected.

Cabinet lighting

Use bulbs for the cabinet lighting, for example LINESTRAR® lamps. Avoid the use of fluorescent lamps since they cause interference. If you need to use fluorescent lamps, take the measures shown in the figure below.

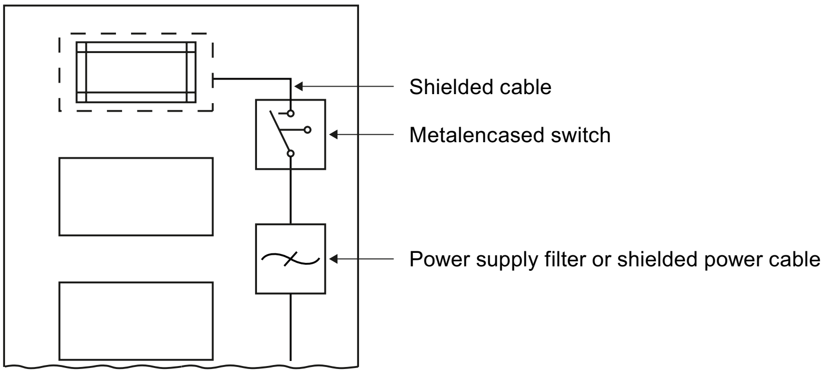


Figure C-5 Measures for interference suppression of fluorescent lamps in a cabinet

C.8 Laying bus cables

General information

During installation, remember that bus cables can only be subjected to a certain amount of mechanical strain. Cables can be damaged or even destroyed by too much tensile stress or pressure, by torsion or by bending them too sharply. The following instructions will help you to avoid damage when installing bus cables.

If cables are subjected to strain or stress as listed above, they should always be replaced.

Storage and transport

During storage, transportation and cabling, the open ends of the bus cable (without connectors) must be kept closed with a shrinkon cover to prevent oxidation of the cores and to keep dampness out of the cable.

Temperatures

During transportation, cabling and operation, the cable must not be exposed to temperatures below the specified minimum temperature or above the specified maximum temperature otherwise the electrical and mechanical characteristics of the cables can deteriorate. The permitted temperature ranges of your bus cable can be found in the technical data sheets of the bus cables (see Cables for PROFIBUS RS485 networks (Page 113)).

Tensile strength

The tensile force exerted on the cables during or after installation must not exceed the limits of tensile strength of the cables. The permitted tensile loading on your bus cable can be found in the technical data sheets of the bus cables (see Cables for PROFIBUS RS485 networks (Page 113)).

Pull cables using cable grips and protect connectors

To pull cables, make sure that you use cable grips. Before fitting the cable grip, make sure that the connectors of preassembled cables are protected from the pressure exerted by the cable grip, for example using a piece of protective tube.

Fitting strain relief

Make sure that you provide strain relief approximately 1 m from the connection point on all cables subject to tensile loading. Shield clamps are not adequate for strain relief.

Pressure

Too much pressure on the cables must also be avoided, for example crimping the cable when securing it in position.

Torsion

Torsion can lead to the elements of a cable being displaced and degrading the electrical characteristics of cables. Bus cables must therefore not be twisted.

Do not twist trailing cables and festoon cables

Make sure that you install the SIMATIC NET trailing cable and the SIMATIC NET festoon cable without any twisting. The line printed on the outer jacket along the length of the cable helps to make sure that the cable in not twisted. If such moving cables are twisted during installation, the cables will probably be damaged soon after they are put into operation!

Flexible cable for torsional load

If the cable is liable to be subjected to torsional load (for example robot cables), use the "SIMATIC NET torsion cable". This cable is described in Section Cables for PROFIBUS RS-485 networks (Page 113).

Bending radiuses

To avoid damage within the bus cables, they must at no time be bent more sharply than the minimum bending radius.

Please note:

- When pulling in cables under tensile load, much larger bending radii must be adhered to than when the cable is in its final installed position.
- Bending radii for non-circular cables apply only to bending the flat, broader surface. Bends in the narrower surface require much greater radii.

The permitted bending radii of your bus cable can be found in the technical data sheets of the bus cables in Chapter Cables for PROFIBUS RS485 networks (Page 113)

Avoid loops

When laying bus cables, unwind them at a tangent from the cable drum or use appropriate rotary tables. This prevents loops forming and resulting in kinks and torsion.

Installing other cables

Remember that existing bus cables must not be subjected to excessive strain and stress when installing other cables later. This can, for example, happen when cables have been installed along with other cables on a common rack or in a common duct (providing this is electrically permitted) and then new cables are pulled along the same path later (during repairs or when extending a system). If bus cables are installed along with other cables in the same cable channel, it is advisable to pull in the sensitive bus cables last.

Connecting the PROFIBUS cables

The attachment of bus connectors and network components (bus terminals, repeaters, OLMs, ...) to the electrical PROFIBUS cables is described in the operating instructions or descriptions of the relevant component.

D Installation instructions and notes on usage

D.1 Fitting connectors to SIMATIC NET PCF fiber-optic cables with the simplex 6GK1 900-0KL00-0AA0 termination kit

Handling instructions

NOTICE

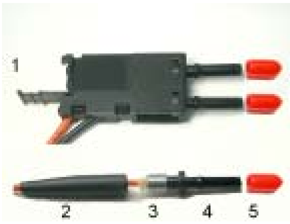
Please keep to the following handling instructions to avoid damage:

- Make sure that the selected cable is suitable for your particular application.
  You should, for example, check the following:
  - Required temperature range
  - Resistance of the jacket materials to chemicals, water, oils, rodents etc. to which your cable will be exposed when in use
  - Required mechanical properties (bending radii, tensile strain, transverse compression)
  - Requirements regarding the behavior of the cable in fire
  - Suitability of the cable and connectors for the devices being connected
- If in doubt, use a special cable to meet your requirements. You SIMATIC NET contact in your Siemens branch will be happy to advise you.
- Never exceed the maximum permitted forces (tensile strain, transverse compression etc.) specified in the data sheet of the cable you are using. Excessive transverse compression can, for example, arise when using screw-down clamps to secure the cable.
- Only use PCF fiber-optic cables in conjunction with devices approved for these cables. Remember the maximum permitted cable lengths.
- When cutting cable sections to length, make sure that no loops result and that the cable is not twisted. Loops and torsion can cause kinks or tears under tensile loading and cause damage to the cable.
- Follow the steps described in these installation instructions and use only the tools specified here.
- Make sure that the outer jacket, the jackets of the cores, and the PCF optical fibers are not damaged.
- When stripping the core jacket, use only the opening labeled 1.0 mm on the stripping pliers.
- Dents or scratches can allow light to escape and increase the attenuation values and cause link failure. Over time, these can also lead to breaks in fibers causing network failure.
- Never insert dirty connectors or connectors with protruding fibers into the device sockets. This can destroy the optical transmit and receive elements.
- When assembling adapters for connectors and when connecting the cable to them, make sure that send and receive data are crossed in the cable.
- Close unused connectors with dust protection caps. Remove the dust protection caps only immediately before connecting cables together or plugging cables into devices.

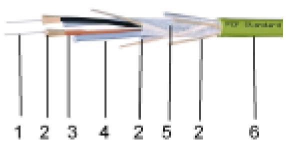
⚠ CAUTION
Note the following safety information • Wear protective glasses during cleaving. • Dispose of the fiber remnants in a suitable container.

Preparations

1. Cable stripper
2. Kevlar scissors
3. Crimping tool
4. Cleave tool
5. Microscope

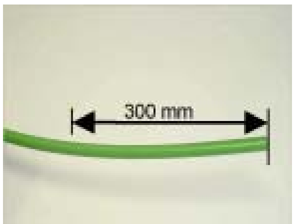


1. Connector adapter
2. Anti-kink sleeve
3. Crimp ring
4. Ferrule
5. Dust protection



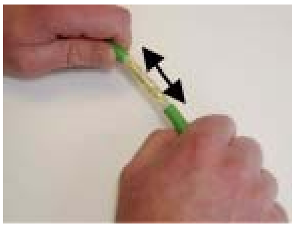
1. Fiber
2. Kevlar fibers
3. Cores (black and orange)
4. Blind elements (gray)/support element (white)
5. Fleece wrapping
6. Outer jacket

Fitting connectors

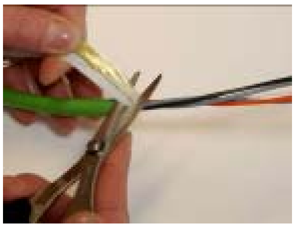


1. Remove the outer jacket using a stripping tool.

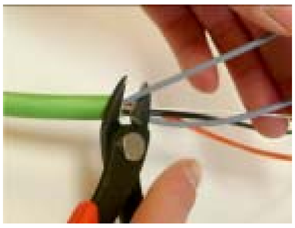
2. Set the cutting depth of the stripping tool so that the inner cores cannot be damaged.



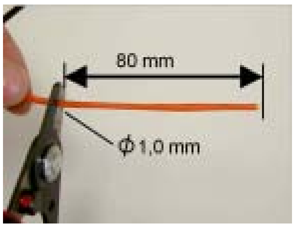
3. Pull off the outer jacket.



4. Cut off the Kevlar yarn and fleece wrapping with the Kevlar scissors.

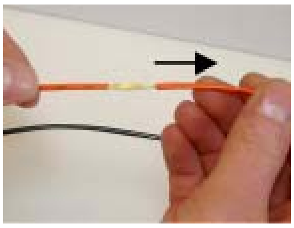


5. Cut off the blind elements (gray) and the support element (white) with the side cutter.

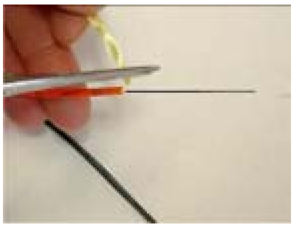


6. Position the ø 1 mm opening of the stripping pliers approximately 80 mm from the end of the core.

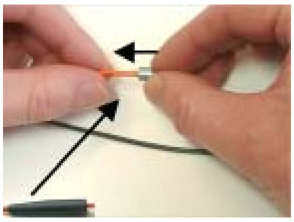
7. Cut into the core jacket and pull the jacket partly off without skewing.



8. Remove the loose core sleeve with your hand.



9. Cut back the Kevlar with the Kevlar scissors leaving 5 mm and fold it back uniformly over the core jacket.

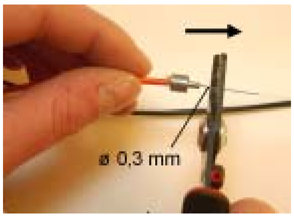


10. Push the anti-kink sleeve over the fiber and the core jacket.

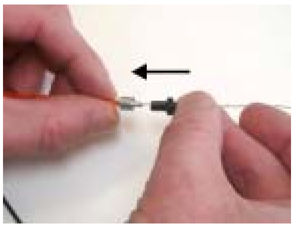
If you want to use the connector adapter (see description below), you do not need to use the anti-kink sleeve.

11. Push the crimp ring over the fiber and screw it onto the jacket.

12. Insert the crimp ring in the front recess of the crimping pliers and close the pliers.

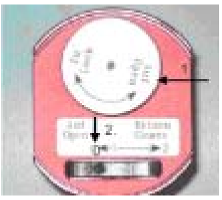


13. Cut into the buffer with pliers opening ø 0.3 mm and pull off the buffer without skewing. Approximately 5 mm of the buffer remain.



14. Push the ferrule over the fiber and insert this into the crimp ring.

15. Insert the crimp ring in the large crimp recess and close the pliers tightly.



16. Turn the "Clamp" wheel to "Open" and the "Cleave" wheel to the "0“ setting.

17. Insert the fiber in the cleave tool. The fiber projects through the clamp wheel.

18. Turn the "Clamp" wheel gently towards the "Lock" direction to clamp the fiber.

19. Turn the "Cleave" wheel slowly from setting "0" to setting "2".

20. Turn the "Clamp" wheel in the direction of "Open" and remove the fiber remnant.
21. Remove the cable connector from the cleave tool.

22. Check the assembled connector with the microscope.

The connector surface is OK. Slight irregularities at the edge are of no significance.

23. Clean a contaminated connector with lint-free cloths.

Greater irregularities in the broken edges and irregular light distribution indicate a damaged connector surface.

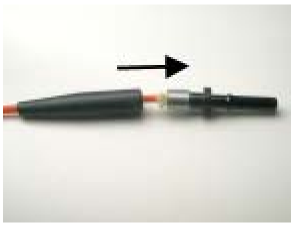
24. Repeat the connector assembly.

Note

If you find that the edge breaks are on the increase, the cleave tool should be sent in for inspection. When used correctly, up to 2000 assemblies are possible.

If you need to return the tool, talk to your Siemens contact.

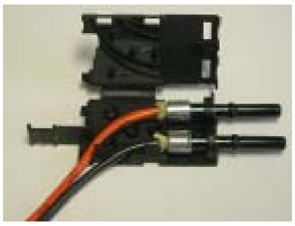
If you use anti-kink protection...



1. Push the anti-kink sleeve onto the connector as far as it will go.

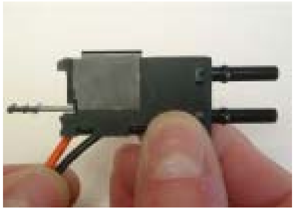
2. Close the connector with the dust protection cap until you require it.

If you use a connector adapter...

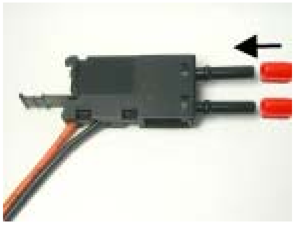


1. Insert the PCF fibers and the connector into the channels of the connector adapter.

Note:
The direction of the arrows in the connector adapter and on the orange core must match.



2. Close the connector adapter so that the two halves lock.



3. Close the connector with the supplied dust protection caps until you require it.

Further information

You will find further information on the cables, connectors and tools described here in the IK PI catalog.

D.2 Fitting connectors to SIMATIC NET PCF fiber-optic cables with the BFOC 6GK1 900-0HL00-0AA0 termination kit

Handling instructions

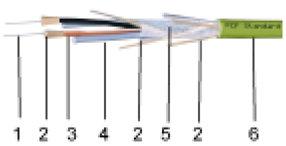
NOTICE
Please keep to the following handling instructions to avoid damage: • Make sure that the selected cable is suitable for your particular application. You should, for example, check the following: – Required temperature range – Resistance of the jacket materials to chemicals, water, oils, rodents etc. to which your cable will be exposed when in use – Required mechanical properties (bending radii, tensile strain, transverse compression) – Requirements regarding the behavior of the cable in fire – Suitability of the cable and connectors for the devices being connected • If in doubt, use a special cable to meet your requirements. You SIMATIC NET contact in your Siemens branch will be happy to advise you. • Never exceed the maximum permitted forces (tensile strain, transverse compression etc.) specified in the data sheet of the cable you are using. Excessive transverse compression can, for example, arise when using screw-down clamps to secure the cable. • Only use PCF fiber-optic cables in conjunction with devices approved for these cables. Remember the maximum permitted cable lengths. • When cutting cable sections to length, make sure that no loops result and that the cable is not twisted. Loops and torsion can cause kinks or tears under tensile loading and cause damage to the cable. • Follow the steps described in these installation instructions and use only the tools specified here. • Make sure that the outer jacket, the jackets of the cores, and the PCF optical fibers are not damaged. • When stripping the core jacket, use only the opening labeled 1.0 mm on the stripping pliers. • Dents or scratches can allow light to escape and increase the attenuation values and cause link failure. Over time, these can also lead to breaks in fibers causing network failure. • Never insert dirty connectors or connectors with protruding fibers into the device sockets. This can destroy the optical transmit and receive elements. • When assembling adapters for connectors and when connecting the cable to them, make sure that send and receive data are crossed in the cable. • Close unused connectors with dust protection caps. Remove the dust protection caps only immediately before connecting cables together or plugging cables into devices.

⚠ CAUTION
Note the following safety information • Wear protective glasses during cleaving. • Dispose of the fiber remnants in a suitable container.

Preparations

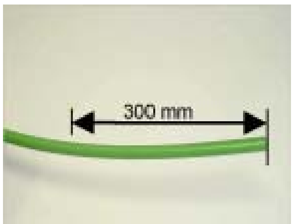
1. Cable stripper
2. Kevlar scissors
3. Cleave tool
4. Microscope

1. Anti-kink sleeve
2. Union nut
3. Buffer and Kevlar clamp
4. Body of connector
5. Ferrule
6. Dust protection

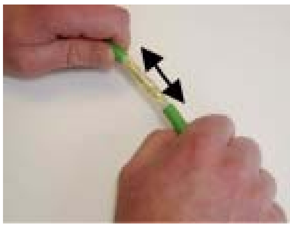


1. Fiber
2. Kevlar fibers
3. Cores (black and orange)
4. Blind elements (gray)/support element (white)
5. Fleece wrapping
6. Outer jacket

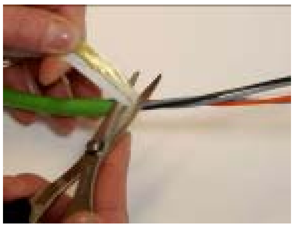
Fitting connectors



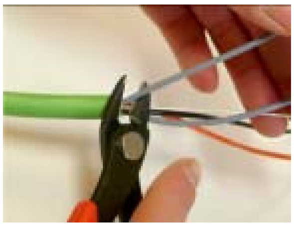
1. Remove the outer jacket using a stripping tool.
2. Set the cutting depth of the stripping tool so that the inner cores cannot be damaged.



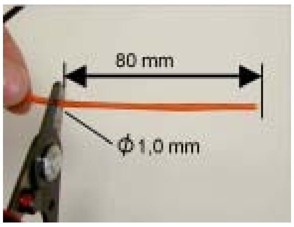
3. Pull off the outer jacket.



4. Cut off the Kevlar yarn and fleece wrapping with the Kevlar scissors.

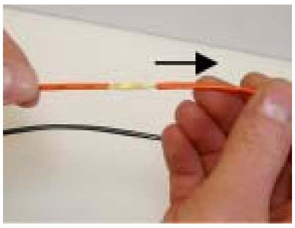


5. Cut off the blind elements (gray) and the support element (white) with the side cutter.

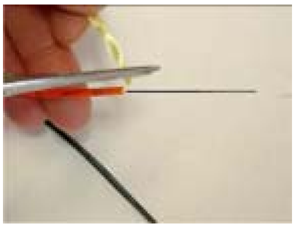


6. Position the ø 1 mm opening of the stripping pliers approximately 80 mm from the end of the core.

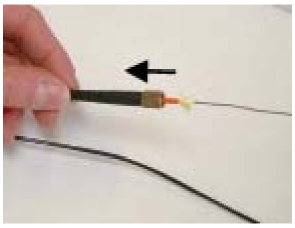
7. Cut into the core jacket and pull the jacket partly off without skewing.



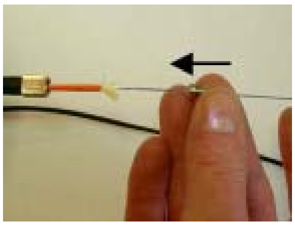
8. Remove the loose core sleeve with your hand.



9. Cut back the Kevlar with the Kevlar scissors leaving 5 mm.

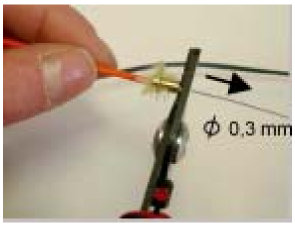


10. Push the anti-kink sleeve over the fiber and the core jacket.

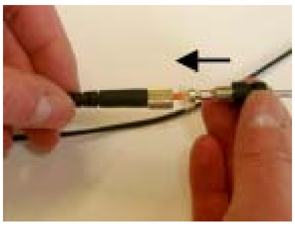


11. Push the buffer and Kevlar clamp over the fiber as far as the core sleeve.

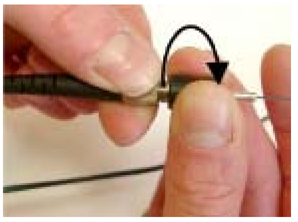
12. Fold back the Kevlar yarn.



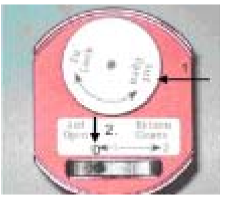
13. Cut into the buffer with pliers opening ø 0.3 mm and pull off the buffer without skewing. Approximately 5 mm of the buffer remain.



14. Push the connector body with the ferrule onto the fiber.



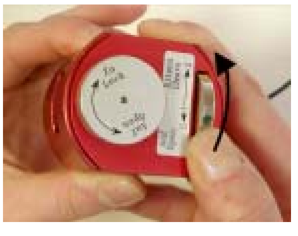
15. Screw the connector body and union nut together.



16. Turn the "Clamp" wheel to "Open" and the "Cleave" wheel to the "0“ setting.

17. Feed the fiber into the cleave tool and lock the connector. The fiber projects through the clamp wheel.

18. Turn the "Clamp" wheel gently towards the "Lock" direction to clamp the fiber.



19. Turn the "Cleave" wheel slowly from setting "0" to setting "2".

20. Turn the "Clamp" wheel in the direction of "Open" and remove the fiber remnant.
21. Unlock the connector and remove it.

22. Check the assembled connector with the microscope.
23. Then place the dust protection cap on the ferrule.

The connector surface is OK. Slight irregularities at the edge are of no significance.

24. Clean a contaminated connector with lint-free cloths.

Greater irregularities in the broken edges and irregular light distribution indicate a damaged connector surface.

25. Repeat the connector assembly.

Note

If you find that the edge breaks are on the increase, the cleave tool should be sent in for inspection. When used correctly, up to 2000 assemblies are possible.

If you need to return the tool, talk to your Siemens contact.

Further information

You will find further information on the cables, connectors and tools described here in the IK PI catalog.

D.3 Assembly instructions for SIMATIC NET PROFIBUS plastic fiber-optics with simplex connectors

Handling instructions

NOTICE

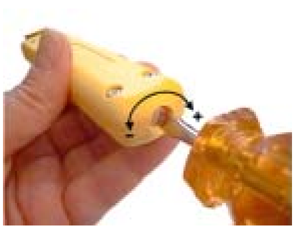
Please keep to the following handling instructions to avoid damage:

- Make sure that the selected cable is suitable for your particular application.
  You should, for example, check the following:
  - Required temperature range
  - Resistance of the jacket materials to chemicals, water, oils, rodents etc. to which your cable will be exposed when in use
  - Required mechanical properties (bending radii, tensile strain, transverse compression)
  - Requirements regarding the behavior of the cable in fire
  - Suitability of the cable and connectors for the devices being connected
- If in doubt, use a special cable to meet your requirements. You SIMATIC NET contact in your Siemens branch will be happy to advise you.
- Never exceed the maximum permitted forces (tensile strain, transverse compression etc.) specified in the data sheet of the cable you are using. Excessive transverse compression can, for example, arise when using screw-down clamps to secure the cable.
- Only use PCF fiber-optic cables in conjunction with devices approved for these cables. Remember the maximum permitted cable lengths.
- When cutting cable sections to length, make sure that no loops result and that the cable is not twisted. Loops and torsion can cause kinks or tears under tensile loading and cause damage to the cable.
- Follow the steps described in these installation instructions and use only the tools specified here.
- Set the cutting depth of the cable knife (part of the stripping tool set, order no. 6GK1 905-6PA10) to a depth of 1.5 mm before used.
  The cutting depth is adjusted with setting screw at the end of the handle:
  - Turning the setting screw clockwise increases the cutting depth
  - Turning the setting screw counterclockwise reduces the cutting depth
- Make sure that the outer jacket, the jackets of the cores, and the PCF optical fibers are not damaged.

NOTICE
Please keep to the following handling instructions to avoid damage: • When stripping the core jacket, use only the opening labeled AWG 16 on the stripping pliers. • Dents or scratches can allow light to escape and increase the attenuation values and cause link failure. Over time, these can also lead to breaks in fibers causing network failure. • Grind and polish by pressing the connector only lightly against the polishing foil to prevent the connector fusing with the fiber. • Make sure that you keep within the specified bending radii when grinding and polishing, particularly when cables are supported to provide mechanical strain relief. In this case, make sure that an adequate length of jacket is stripped. • On the bottom of the grinding holder there are four depressions. Replace the grinding holder as soon as any of the depressions is no longer visisble. • Never insert dirty connectors or connectors with protruding fibers into the device sockets. This can destroy the optical transmit and receive elements. • When assembling adapters for connectors and when connecting the cable to them, make sure that send and receive data are crossed in the cable. • Connector adapters are designed for cores with their connectors to be inserted once. If a core needs to be taken out again, the bent core region must not be used again. Cut off the bent core region and refit the simplex connector.

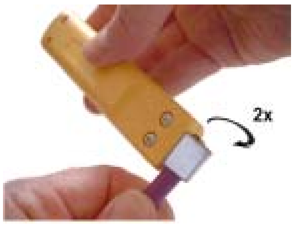
Fitting connectors

Table D- 1 Set the cutting depth of the cable knife

	1. Set the cutting depth of the cable knife for removing the outer jacket of the SIMATIC NET PLASTIC FIBER OPTIC standard cable to a depth of 1.5 mm. Follow the steps described below.
	2. The cutting depth is adjusted with setting screw at the end of the handle: • Turning the setting screw clockwise increases the cutting depth • Turning the setting screw counterclockwise reduces the cutting depth

3. Make a trial cut

Press the grip of the cable knife in the direction of the arrow.
Insert the cable.



4. Cut round twice.

5. Cut along the outer jacket to the end of the cable.

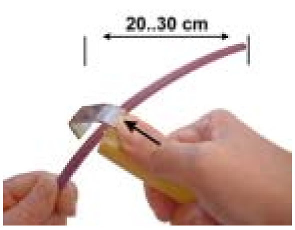
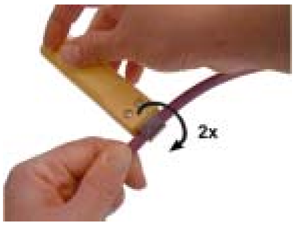
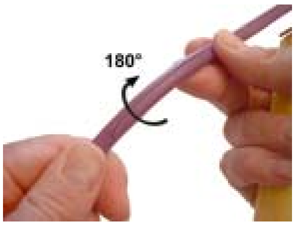
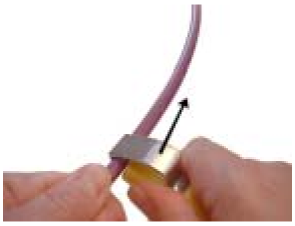
6. Remove the jacket

If you find it difficult to remove, the cutting depth is too shallow. In this case, increase the cutting depth by turning the setting screw at the bottom of the cable knife clockwise.
Try out the cutting depth again with a trial cut.

7. If the foil and the inner core jacket is damaged, the cutting depth is too deep. In this case, decrease the cutting depth by turning the setting screw at the bottom of the cable knife counterclockwise.
Try out the cutting depth again with a trial cut.

8. The cut surface of the jacket with the cable knife set to the correct depth.

Table D- 2 Removing the outer jacket of the SIMATIC NET PLASTIC FIBER OPTIC standard cable

	1. Press the grip of the cable knife in the direction of the arrow. Insert the cable 20 cm deep (if using a connector adapter 30 cm deep). Note: The cable knife must be set to a cutting depth of 1.5 mm.
	2. Cut round twice.
	3. Cut along the outer jacket to the end of the cable.
	4. Make a second cut along the opposite side of the jacket. To do this, first turn the cable through 180°.
	5. Then make a second cut along the jacket to the end of the cable starting at the round cut.
	6. Strip the outer jacket, Kevlar yarn and foil back from the black and orange FO cores starting at the end of the cable and working towards the round cut.

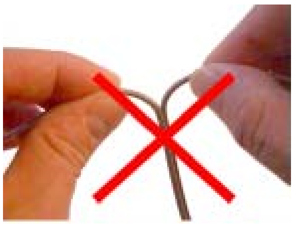
7. Cut off the remains of the jacket, Kevlar yarn and foil with scissors.

8. Standard cable with outer jacket removed.

Table D- 3 Splitting the SIMATIC NET PLASTIC FIBER OPTIC duplex core

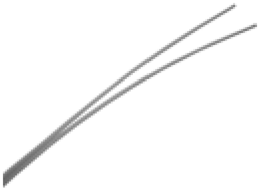
1. Insert a sharp knife in the depression between the two cores 20 cm (if using a connector adapter 30 cm) from the end and split the duplex core to the end of the cable.

Notice: The jacket of the individual cores must not be damaged.



2. Notice:

Do not split the cores with your hand otherwise you can soon bend the cores beyond their minimum bending radius.



3. Separated duplex core

Table D- 4 Stripping the core jacket

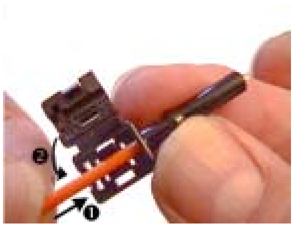
	1. To strip the plastic FO cores, use the SIMATIC NET round cutting pliers (included in the stripping tool set).
	2. Important note: The opening labeled AWG 16 must be used (1.5 mm Ø). Smaller openings will damage the fiber and must not be used.
	3. insert the core in the opening labeled AWG 16. The core must extend approx. 5 mm beyond the blade.
	4. Press the two handles of the pliers tightly together and hold them together.
	5. The core is automatically held tight by the grip of the pliers...
	6. ... and the core jacket is removed.

7. Open the handles of the pliers slowly until the grip releases the core. Take the core out of the pliers. Only then should you open the handles fully again.

Notice: If the handles are opened fully before the core is removed, the fiber may be damaged as the blade retracts.

8. Repeat the same steps with the second core.

Table D- 5 Installing simplex connectors



1. Insert the core into the simplex connector as far as the limit stop ① fold down the top half of the grip ②.

Notice: The fiber must extend at least 1.5 mm beyond the face of the connector.

2. Press the two halves of the grip together until you hear them lock together.

3. Repeat the same steps with the second core.

Notice: Do not insert the connector into the device socket yet, the excess fiber could damage the send and receive elements.

Table D- 6 Grinding and polishing the simplex connector

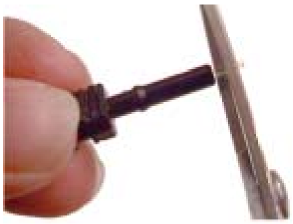
	1. Shorten the fiber extending out of the connector face to a length of 1.5 mm with scissors.
	2. Insert the simplex connector into the grinding holder as far as the limit stop.
	3. Grind down the excess fiber by making figure of eight movements on the abrasive paper (600 grit) supported by a flat surface.
	4. Grinding is complete when the fiber is flush with the connector face. Remove the debris from the bottom of the grinding holder and from the connector face with clean cloth.
	5. The polish the connector face again with figure of eight movements on the pink polishing foil (rough side). About 25 figures of eight are normally required. Polishing reduces loss by approximately 2 dB (corresponding to approximately 10 m of cable). it is not necessary with shorter cable lengths.
	6. Repeat the same steps with the second connector and clean the connector face with a clean cloth.

Table D- 7 Assemble the connector adapter
(only for integrated optical interfaces such as the IM 153-2 FO and IM 467 FO)

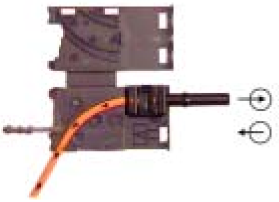
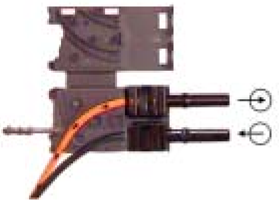
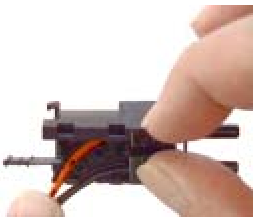
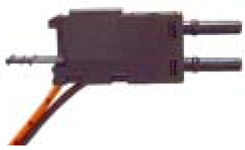
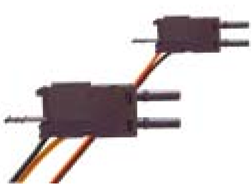
	1. Insert the connector on the orange core marked with an arrow in the holder whose triangle symbol is pointing in the same direction. Notice: The hinge of the simplex connector must be inside the connector adapter.
	2. insert the connector with the black core in the free holder. Notice: Once again, the hinge of the simplex connector must be inside the connector adapter. The two hinges must not jut out of the connector adapter.
	3. Fold down the upper half of the connector adapter.
	4. Press the two halves together until you hear them lock together.
	5. Fully assembled connector adapter.
	6. Cable fitted with connector adapters at both ends with crossed over core pairs.

Table D- 8 Connection aids of the SIMATIC NET PROFIBUS plastic fiber-optic standard cable for assembly without a connector adapter

1. The standard cable has a connection aid in the form of arrow markings on the orange core.

The connection aid makes it easier to assign the sender at one end of the cable to the receiver at the other end (core pairs crossed over).

2. First connect the orange core:

- If the arrow on the orange core is pointing out of the cable (figure), connect this core to the receiver. The receiver is indicated by an arrow pointing into a circle.
- If the arrow on the orange core is pointing into the cable, connect this core to the sender. The sender is indicated by an arrow pointing out of a circle.

3. The black core is connected to the free socket of the same FO interface.

Table D- 9 Cables, tools and accessories

SIMATIC NET PROFIBUS plastic fiber optic, standard cable I-VY4Y2P 980/1000 160A

Rugged round cable with 2 plastic fiber-optic cores, lilac PVC outer sheath and PA inner sheath, without connectors, for indoor use.

6XV1 821-0AH10 sold in meters

50 m ring 6XV1 821-0AN50

100 m ring 6XV1 821-0AT10

SIMATIC NET PROFIBUS plastic fiber-optic, duplex cable

I-VY2P 980/1000 150A

Plastic fiber-optic cable with 2 cores, PVC jacket, without connectors, for use in areas with low mechanical strain (for example inside a cabinet or in test setups in a laboratory)

50 m ring 6XV1 821-2AN50

SIMATIC NET PROFIBUS plastic fiber optic,

stripping tool set

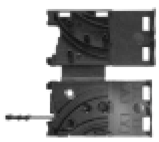
Cable knife for removing the outer jacket and stripper (round cutting pliers) for removing the core jacket of SIMATIC NET plastic fiber-optic cables

6GK1 905-6PA10

SIMATIC NET PROFIBUS plastic fiber-optic,
plastic simplex connector/polishing set

100 plastic simplex connectors and 5 polishing sets for assembling SIMATIC NET PROFIBUS plastic fiberoptic cables.

6GK1 901-0FB00-0AA0



Connector adapter

Pack of 50 for fitting plastic simplex connectors,for example with the IM 467 FO and the IM 153-2 FO

6ES7 195-1BE00-0XA0

Other commercially available accessories:

- Sharp scissors for shortening the Kevlar and the fibers
- Sharp knife for dividing the duplex cores
- Clean, soft cloth for cleaning the grinding holder and face of the connector

Further information

You will find further information on the cables, connectors and tools described here in the IK PI catalog.

D.4 Assembly instructions for SIMATIC NET PROFIBUS plastic fiber optics with BFOC connectors

Handling instructions

NOTICE

Please keep to the following handling instructions to avoid damage:

- Make sure that the selected cable is suitable for your particular application.
  You should, for example, check the following:
  - Required temperature range
  - Resistance of the jacket materials to chemicals, water, oils, rodents etc. to which your cable will be exposed when in use
  - Required mechanical properties (bending radii, tensile strain, transverse compression)
  - Requirements regarding the behavior of the cable in fire
  - Suitability of the cable and connectors for the devices being connected
- If in doubt, use a special cable to meet your requirements. You SIMATIC NET contact in your Siemens branch will be happy to advise you.
- Never exceed the maximum permitted forces (tensile strain, transverse compression etc.) specified in the data sheet of the cable you are using. Excessive transverse compression can, for example, arise when using screw-down clamps to secure the cable.
- Only use PCF fiber-optic cables in conjunction with devices approved for these cables. Remember the maximum permitted cable lengths.
- When cutting cable sections to length, make sure that no loops result and that the cable is not twisted. Loops and torsion can cause kinks or tears under tensile loading and cause damage to the cable.
- Follow the steps described in these installation instructions and use only the tools specified here.
- Set the cutting depth of the cable knife (part of the stripping tool set, order no. 6GK1 905-6PA10) to a depth of 1.5 mm before used.
  The cutting depth is adjusted with setting screw at the end of the handle:
  - Turning the setting screw clockwise increases the cutting depth
  - Turning the setting screw counterclockwise reduces the cutting depth
- Make sure that the outer jacket, the jackets of the cores, and the PCF optical fibers are not damaged.

NOTICE
Please keep to the following handling instructions to avoid damage: • When stripping the core jacket, use only the opening labeled AWG 16 on the stripping pliers. • Dents or scratches can allow light to escape and increase the attenuation values and cause link failure. Over time, these can also lead to breaks in fibers causing network failure. • Grind and polish by pressing the connector only lightly against the abrasive paper foil to prevent the metal particles fusing with the fiber. • Never insert dirty connectors or connectors with protruding fibers into the device sockets. This can destroy the optical transmit and receive elements. • When connecting the cable, make sure that the send and received data are crossed over in the cable.

Fitting connectors

Table D- 10 Set the cutting depth of the cable knife

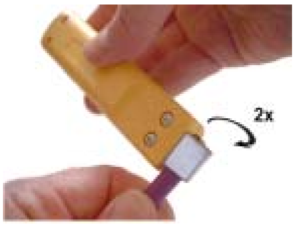
1. Set the cutting depth of the cable knife for removing the outer jacket of the SIMATIC NET PLASTIC FIBER OPTIC standard cable to a depth of 1.5 mm. Follow the steps described below.

2. The cutting depth is adjusted with setting screw at the end of the handle:

- Turning the setting screw clockwise increases the cutting depth
- Turning the setting screw counterclockwise reduces the cutting depth

3. Make a trial cut

Press the grip of the cable knife in the direction of the arrow.
Insert the cable.



4. Cut round twice.

5. Cut along the outer jacket to the end of the cable.

6. Remove the jacket

If you find it difficult to remove, the cutting depth is too shallow. In this case, increase the cutting depth by turning the setting screw at the bottom of the cable knife clockwise.

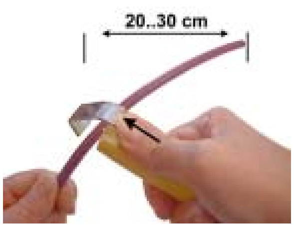
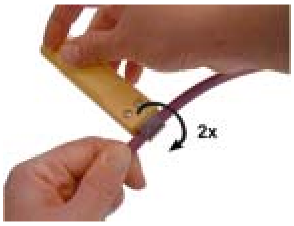
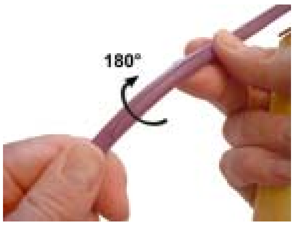
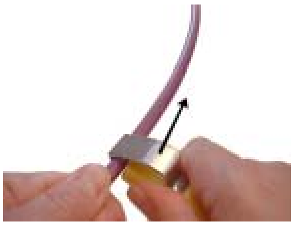
Try out the cutting depth again with a trial cut.

7. If the foil and the inner core jacket is damaged, the cutting depth is too deep. In this case, decrease the cutting depth by turning the setting screw at the bottom of the cable knife counterclockwise.

Try out the cutting depth again with a trial cut.

8. The cut surface of the jacket with the cable knife set to the correct depth.

Table D- 11 Removing the outer jacket of the SIMATIC NET PLASTIC FIBER OPTIC standard cable

	1. Press the grip of the cable knife in the direction of the arrow. Insert the cable 20 cm deep (if using a connector adapter 30 cm deep). Note: The cable knife must be set to a cutting depth of 1.5 mm.
	2. Cut round twice.
	3. Cut along the outer jacket to the end of the cable.
	4. Make a second cut along the opposite side of the jacket. To do this, first turn the cable through 180°.
	5. Then make a second cut along the jacket to the end of the cable starting at the round cut.
	6. Strip the outer jacket, Kevlar yarn and foil back from the black and orange FO cores starting at the end of the cable and working towards the round cut.

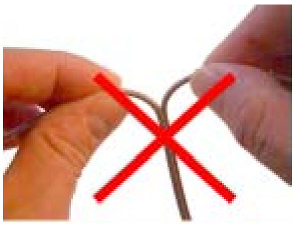
7. Cut off the remains of the jacket, Kevlar yarn and foil with scissors.

8. Standard cable with outer jacket removed.

Table D- 12 Splitting the SIMATIC NET PLASTIC FIBER OPTIC duplex core

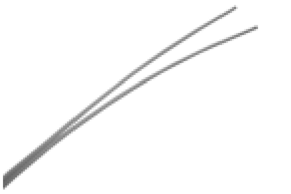
1. Insert a sharp knife in the depression between the two cores 20 cm (if using a connector adapter 30 cm) from the end and split the duplex core to the end of the cable.

Notice: The jacket of the individual cores must not be damaged.



2. Notice:

Do not split the cores with your hand otherwise you can soon bend the cores beyond their minimum bending radius.



3. Separated duplex core

Table D- 13 Stripping the core jacket

1. To strip the plastic FO cores, use the SIMATIC NET round cutting pliers (included in the stripping tool set).

2. Important note:

The opening labeled AWG 16 must be used (1.5 mm Ø). Smaller openings will damage the fiber and must not be used.

3. insert the core in the opening labeled AWG 16. The core must extend approx. 10 mm beyond the blade.

4. Press the two handles of the pliers tightly together and hold them together.

5. The core is automatically held tight by the grip of the pliers.

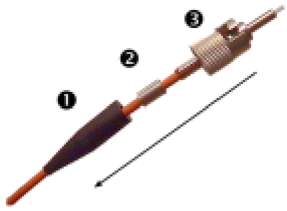
6. ... and the core jacket is removed.

7. Open the handles of the pliers slowly until the grip releases the core. Take the core out of the pliers. Only then should you open the handles fully again.

Notice: If the handles are opened fully before the core is removed, the fiber may be damaged as the blade retracts.

8. Repeat the same steps with the second core.

Table D- 14 Crimping BFOC connectors



1. Push the black anti-kink sleeve ①, short crimping sleeve ② and connector body ③ onto the stripped cores.

Notice: The fiber must extend at least 1 mm out of the face of the connector.

2. Push the crimping sleeve onto the connector body as far as the limit stop.

3. Press the handles of the crimping pliers firmly together to open the tool.

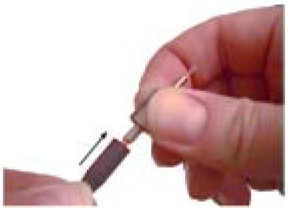
4. Insert the crimp sleeve in the front opening (hexagonal 3.25 mm).

Make sure that the crimping sleeve is located fully in the pliers.

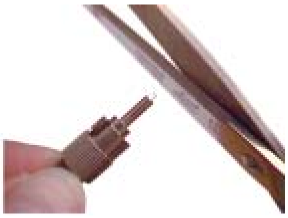
5. Press the handles of the crimping pliers firmly together. The connector body is joined to the core and the crimping sleeve.

Note: The pliers can only be opened again when the required pressure has been reached.

6. Open the crimping pliers and remove the core.



7. Push the anti-kink sleeve onto the connector body as far as the limit stop.

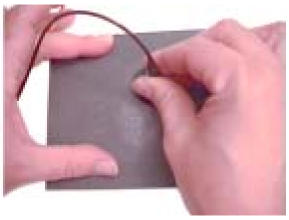
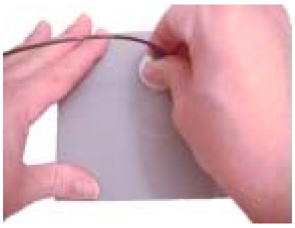


8. Shorten the end of the fiber extending out of the connector face to a length of 0.5 mm with scissors.

9. Repeat the same steps with the second core.

Notice: Do not insert the connector into the device socket yet, the excess fiber extending out of the connector face could damage the send and receive elements.

Table D- 15 Grinding and polishing the BFOC connector

	1. For initial grinding, insert the BFOC plug into the black polishing disk.
	2. Grind down the excess fiber by making figure of eight movements on the abrasive paper (400 grit) supported by a flat surface. Press the connector gently against the abrasive paper.
	3. Remove the plug from the polishing disk and remove debris with a soft, lint-free cloth.
	4. To polish the connector, insert it in the white polishing disk.
	5. Finally, polish the surface of the plug by describing figures of eight on a flat and firm surface with the light-gray polishing paper (1500 grit). Press the connector gently against the polishing paper. About 25 figures of eight are normally required.

6. Remove the plug from the polishing disk and remove debris with a soft, lint-free cloth.

7. Repeat the same steps with the second connector.

Table D- 16 Connection aid of the SIMATIC NET PROFIBUS plastic fiber optic, standard cable

1. The standard cable has a connection aid in the form of arrow markings on the orange core.

The connection aid makes it easier to assign the sender at one end of the cable to the receiver at the other end (core pairs crossed over).

2. First connect the orange core:

- If the arrow on the orange core is pointing out of the cable, connect this core to the receiver. The receiver is indicated by an arrow pointing into a circle.
- If the arrow on the orange core is pointing into the cable, connect this core to the sender. The sender is indicated by an arrow pointing out of a circle.

3. The black core is connected to the free socket of the same FO interface.

Table D- 17 Cables, tools and accessories

	SIMATIC NET PROFIBUS plastic fiber optic, standard cable I-VY4Y2P 980/1000 160A Rugged round cable with 2 plastic fiber-optic cores, lilac PVC outer sheath and PA inner sheath, without connectors, for indoor use. 6XV1 821-0AH10 sold in meters 50 m ring 6XV1 821-0AN50 100 m ring 6XV1 821-0AT10
	SIMATIC NET PROFIBUS plastic fiber-optic, duplex cable I-VY2P 980/1000 150A Plastic fiber-optic cable with 2 cores, PVC jacket, without connectors, for use in areas with low mechanical strain (for example inside a cabinet or in test setups in a laboratory) 50 m ring 6XV1 821-2AN50
	SIMATIC NET PROFIBUS plastic fiber optic, stripping tool set Cable knife for removing the outer jacket and stripper (round cutting pliers) for removing the core jacket of SIMATIC NET plastic fiber-optic cables 6GK1 905-6PA10
	SIMATIC NET PROFIBUS plastic fiber optic, BFOC crimping pliers For assembly of BFOC plug on PROFIBUS plastic fiber-optic cables. 6GK1 905-6PB00
	SIMATIC NET PROFIBUS plastic fiber optic, BFOC connector set 20 BFOC plugs for assembly of PROFIBUS plastic fiber-optic cables for OLM/P. 6GK1 905-1PA00

SIMATIC NET PROFIBUS plastic fiber-optic,
plastic simplex connector/polishing set

100 plastic simplex connectors and 5 polishing sets for assembling SIMATIC NET PROFIBUS plastic fiberoptic cables.

6GK1 901-0FB00-0AA0

Other commercially available accessories:

- Sharp scissors for shortening the Kevlar and the fibers
- Sharp knife for dividing the duplex cores
- Clean, soft cloth for cleaning the grinding holder and face of the connector

Further information

You will find further information on the cables, connectors and tools described here in the IK PI catalog.

D.5 Notes on using the pulling loop of the SIMATIC NET PROFIBUS PCF fiber-optic standard cable

Handling instructions

NOTICE
Please keep to the following handling instructions to avoid damage: • Make sure that the selected cable is suitable for your particular application. You should, for example, check the following: – Required temperature range – Resistance of the jacket materials to chemicals, water, oils, rodents etc. to which your cable will be exposed when in use. – Required mechanical properties (bending radii, tensile strain, transverse compression) – Requirements regarding the behavior of the cable in fire – Suitability of the cable and connectors for the devices being connected • If in doubt, use a special cable to meet your requirements. You SIMATIC NET contact in your Siemens branch will be happy to advise you. • Never exceed the maximum permitted forces (tensile strain, transverse compression etc.) specified in the data sheet of the cable you are using. Excessive transverse compression can, for example, arise when using screw-down clamps to secure the cable. • Always use the pulling loop to pull in the PCF standard cable. Never pull the cable by the connector or exposed cores. • Only use PCF fiber-optic cables in conjunction with devices approved for these cables. Remember the maximum permitted cable lengths. • When cutting cable sections to length, make sure that no loops result and that the cable is not twisted. Loops and torsion can cause kinks or tears under tensile loading and cause damage to the cable. • Follow the steps described in these installation instructions and use only the tools specified here. • Ensure that the outer jacket and the core jackets of the cable are not damaged. • Never insert dirty connectors or connectors with protruding fibers into the device sockets. This can destroy the optical transmit and receive elements. • When connecting the cable, make sure that the send and received data are crossed over in the cable.

Fitting connectors

Table D- 18 Using the pulling loop

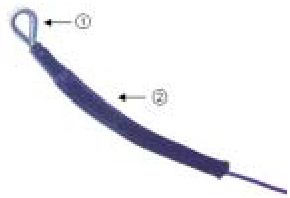
	1. The SIMATIC NET PCF fiber-optic standard cable has a pulling loop at one end. It consists of a cable eye ① and protective sleeve ②.
	2. The eye takes the tensile strain and transfers it to the Kevlar yarn (tensile strain elements) of the PCF standard cable. The protective sleeve surrounds the connectors of assembled cables and prevents kinking. Notice: Only pull the cable using the cable eye. Never pull on the protective sleeve or outer jacket of the cable.
	3. After the cable has been laid, the pulling loop must be removed. To do this, open the protective sleeve approximately 10 cm deep from the back end with scissors. Notice: Make sure that you do not damage the cores below the protective sleeve.
	4. Free the cores from the protective sleeve and cut off the Kevlar yarn with scissors. Notice: Never cut the black or orange cores.
	5. Care pull the loop by off the end of the cable using the cable eye.
	6. Done.

Table D- 19 Connection aid of the SIMATIC NET PROFIBUS plastic fiber optic, standard cable

1. The standard cable has a connection aid in the form of arrow markings on the orange core.

The connection aid makes it easier to assign the sender at one end of the cable to the receiver at the other end (core pairs crossed over).

Immediately before inserting the connector, remove the dust cap from the socket.

2. First connect the orange core:

- If the arrow on the orange core is pointing out of the cable, connect this core to the receiver. The receiver is indicated by an arrow pointing into a circle.
- If the arrow on the orange core is pointing into the cable, connect this core to the sender. The sender is indicated by an arrow pointing out of a circle.

3. The black core is connected to the free socket of the same FO interface.

Table D- 20 Ordering data

SIMATIC NET PROFIBUS PCF fiber-optic, standard cable

I-VY2K 200/230 10A17 + 8B20

PCF FO cable with 2 cores, PVC outer jacket, for covering longer distances up to 400 m, preassembled with **2x2 BFOC connectors**, stripped core length 20 cm, with pulling loop at one end, for connecting to OLM/P.

Preferred lengths*

75 m 6XV1 821-1BN75

100 m 6XV1 821-1BT10

150 m 6XV1 821-1BT15

200 m 6XV1 821-1BT20

250 m 6XV1 821-1BT25

300 m 6XV1 821-1BT30

400 m 6XV1 821-1BT40

* other lengths on request

SIMATIC NET PROFIBUS PCF fiber-optic, standard cable

I-VY2K 200/230 10A17 + 8B20

PCF FO cable with 2 cores, PVC outer jacket, for covering longer distances up to 300 m, preassembled with **2x2 simplex connectors**, stripped core length 30 cm, with pulling loop at one end, for connecting to devices with integrated optical interfaces and OBT.

Preferred lengths*

50 m 6XV1 821-1CN50

75 m 6XV1 821-1CN75

100 m 6XV1 821-1CT10

150 m 6XV1 821-1CT15

200 m 6XV1 821-1CT20

250 m 6XV1 821-1CT25

300 m 6XV1 821-1CT30

* other lengths on request

* Note:

You can order other lengths and additional components from the SIMATIC NET cabling range from your local contact.

Technical advice on this subject is available from:

I IA SE IP S BD 1
Jürgen Hertlein
Tel.: +49 (911) 750-4465
Fax: +49 (911) 750-9991
juergen.hertlein@siemens.com (mailto:juergen.hertlein@siemens.com)

Further information

You will find further information on the cables, connectors and tools described here in the IK PI catalog.

Installing network components in cabinets

E

E.1 IP degrees of protection

IP degrees of protection

Electrical equipment is normally surrounded by a protective casing. The purpose of this casing includes

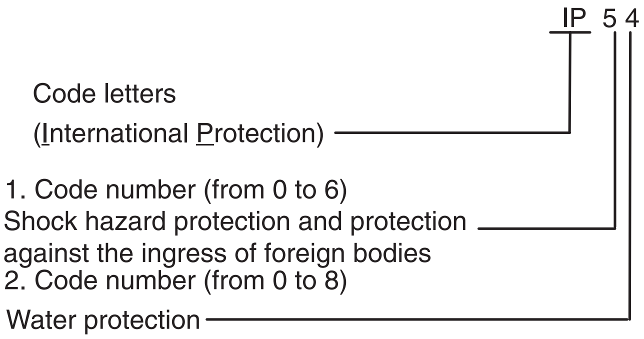
- Protection of persons from touching live components or moving parts (accidental contact protection)
- Protection of equipment from intrusion of solid foreign bodies (solid body protection)
- Protection of equipment from ingress of water (water protection).

IEC 60529, EN 60529

The degree of protection specifies the degree to which the casing meets these three protective functions.

The degrees of protection are specified uniformly in the "International Standard IEC 60529" or in the identical European standard EN 60529.

The degree of protection of a casing is indicated by a code. The code consists of the letters IP (International Protection) followed by a code number for contact, solid body and water protection as shown below:



In some situations, the degree of protection is specified in even greater detail by adding letters to the code numbers.

Scope of protection

The various degrees of protection are shown and explained briefly in the following table. For more detailed information on the individual ratings and the test conditions that must be fulfilled, please refer to the standards listed above.

Table E- 1 Protection provided by the various IP levels (brief outline)

digit	Shock hazard protection and protection against the ingress of foreign bodies	Protection against water
1	No protection	No protection
2	against foreign bodies ≥ 50 mm diameter	dropping vertically
3	against foreign bodies ≥ 12 mm diameter	with drops falling at 15°
4	against foreign bodies ≥ 2.5 mm diameter	spay water, at an angles up to 60°
5	against foreign bodies ≥ 1 mm diameter	spray water from any direction
6	Dust deposits	spray water - water jet from nozzle
7	ingress of dust (dustproof)	strong jet water
8	-	intermittent immersion at specified pressure for specified time
9	-	permanent immersion at specified pressure for specified time

E.2 Installed in cabinet:

Ventilation openings

The casings of most SIMATIC NET network components have ventilation openings. To allow more effective cooling of the electronics components, ambient air can flow through the casing. The maximum operating temperatures quoted in the technical specifications apply only when there is unrestricted flow of air through the ventilation openings.

Depending on the size of the ventilation openings, such modules comply with degree of protection IP 20, IP 30 to IP 40. You will find the precise degree of protection of a SIMATIC NET component in its operating instructions.

Components with the degrees of protection mentioned above do not provide protection against dust and water! If the installation site requires such protection, the components must be installed in an additional enclosure such as a switching cubicle that provides the higher degree of protection (for example IP65/ IP67).

If you install these components in an additional enclosure, make sure that the conditions required for operation are maintained!

Heat dissipation

Make sure that the temperature inside the additional enclosure does not exceed the permitted ambient temperature for the installed components. Select an enclosure with adequate dimensions or use heat exchangers.

Outdoor installation

If you install the equipment outdoors, make sure that the additional enclosure is not subjected to direct sunlight. This can lead to a considerable rise in temperature within the enclosure.

Clearances

Make sure that there is adequate clearance around the component so that

- the convection cooling of the component is not restricted
- components do not cause neighboring components to heat up more than permitted
- there is enough space for installing cabling
- there is enough space to remove components for maintenance or repair.

Note

Regardless of the degree of protection of the casing, the electrical and optical ports are always sensitive to

- mechanical damage
- damage caused by electrostatic contact discharge when touched
- contamination by dust and fluids

Close unused ports with the supplied dust protection caps. Remove these caps only immediately before connecting up the cables to the ports.

Standards

EN 60529:1991 degrees of protection due to enclosure (IP code) (IEC 60529)

EN 60529:1989 Degrees of protection provided by enclosures (IP code)

Further references

Klingberg, G.; Mähling, W.:

Schaltschrank- und Gehäuse-Klimatisierung in der Praxis mit EMV;

Heidelberg 1998

Dimension drawings

F

F.1 Dimension drawings of the bus connectors

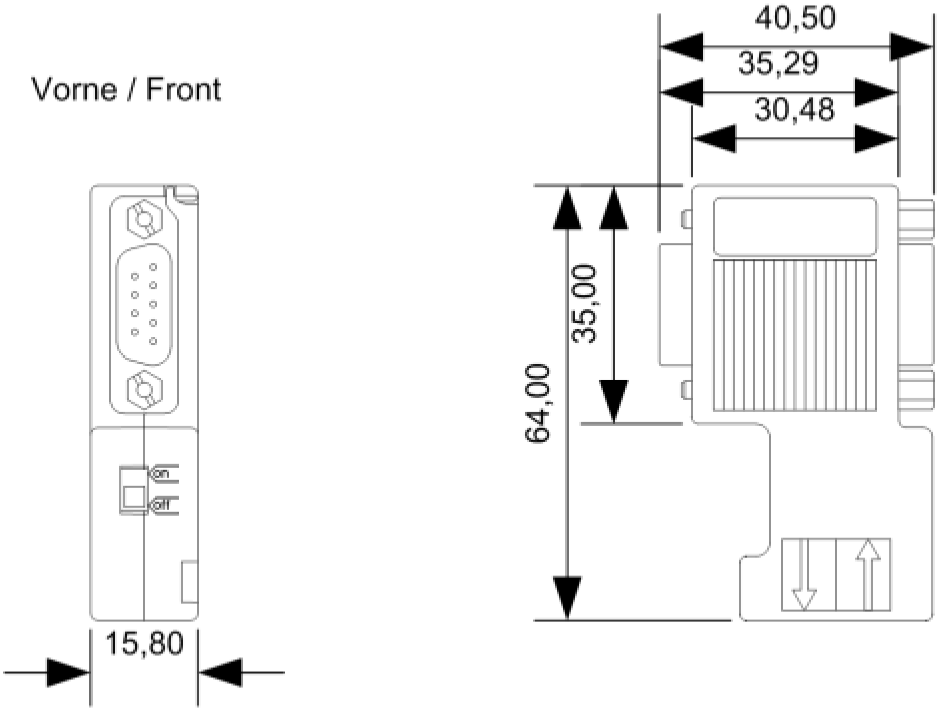


Figure F-1 Bus connector to IP20 (6ES7 972-0Bx12-0XA0)

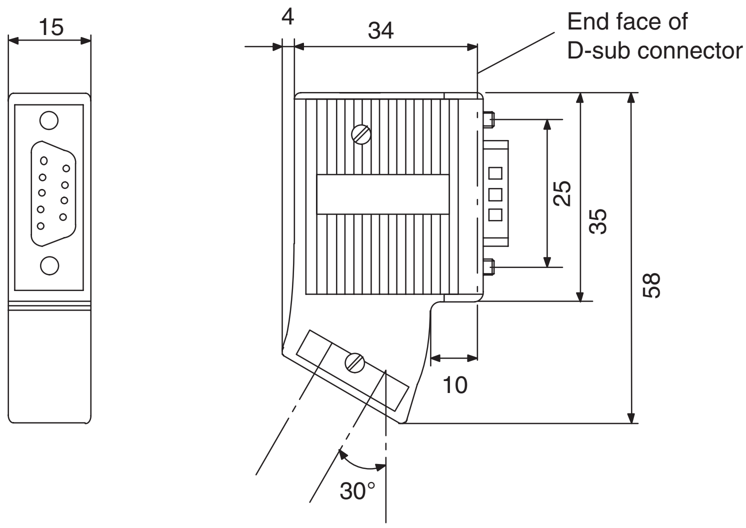


Figure F-2 Bus connector to IP20 (6ES7 972-0BA30-0XA0)

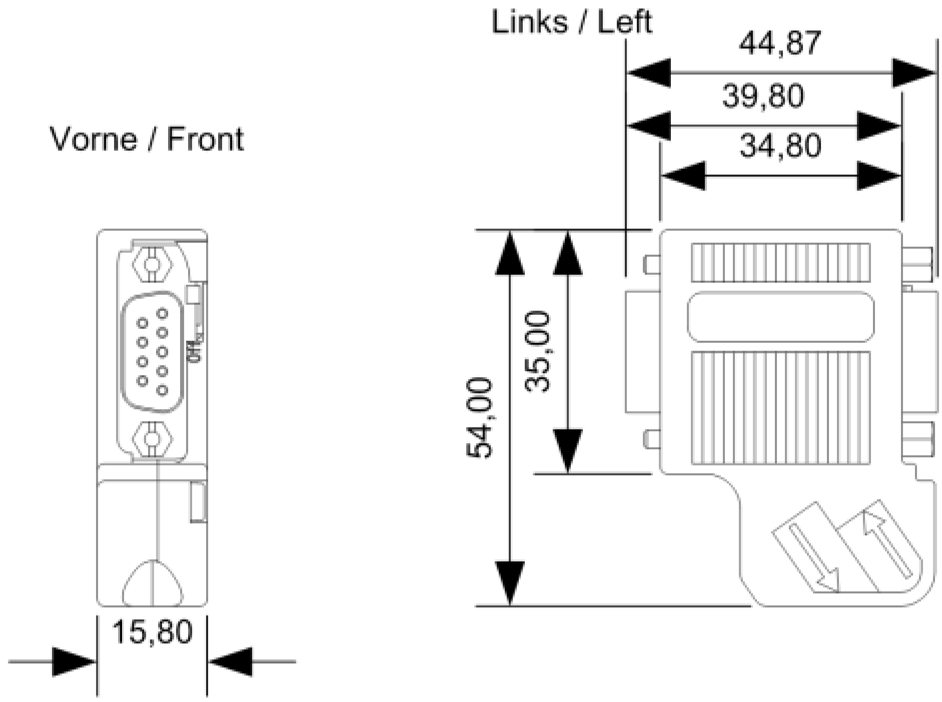


Figure F-3 Bus connector to IP20 (6ES7 972-0Bx41-0XA0)

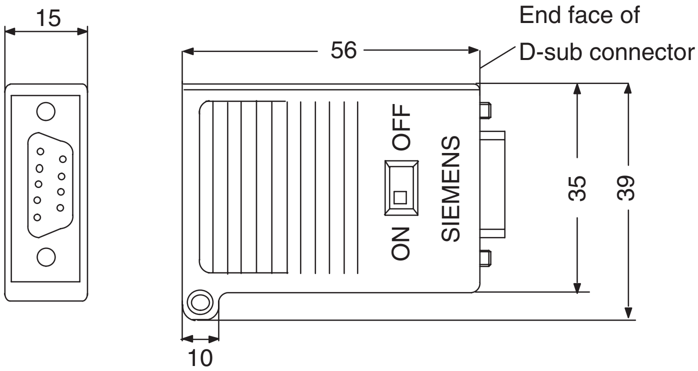


Figure F-4 Bus connector to IP20 (6GK1 500-0EA02)

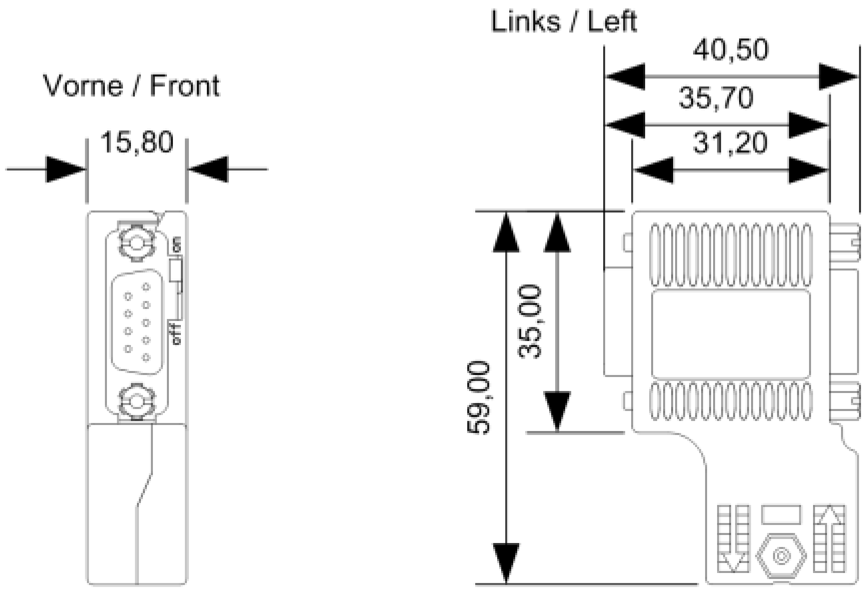


Figure F-5 FastConnect bus connector (6ES7 972-0Bx52-0XA0)

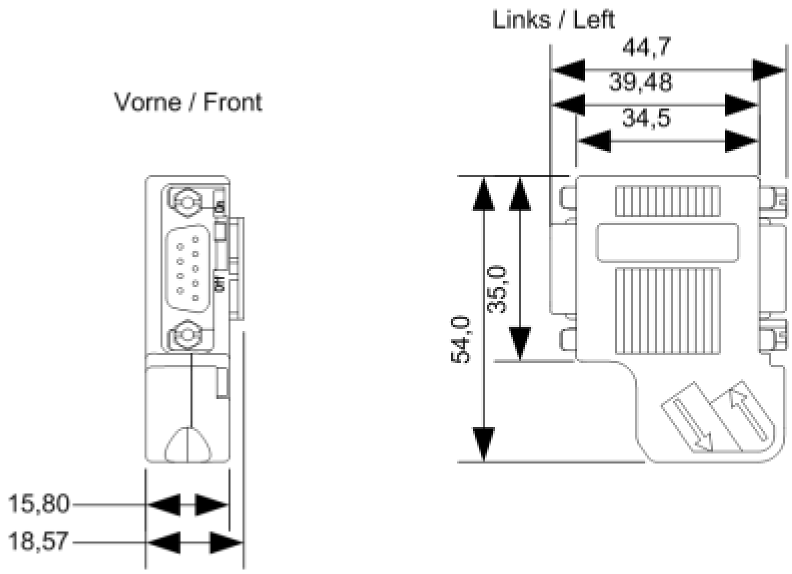


Figure F-6 FastConnect bus connector (6ES7 972-0Bx60-0XA0)

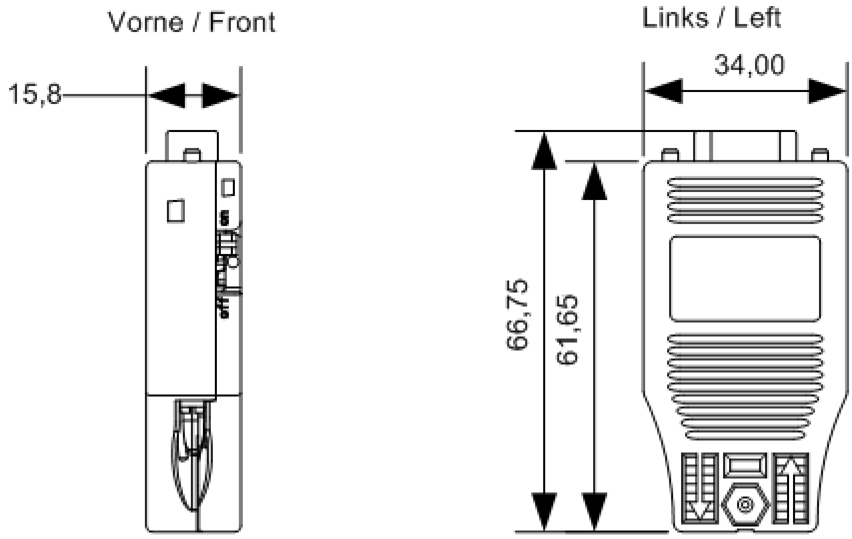


Figure F-7 Fast Connect bus connector (6GK1 500-0FC10)

F.2 Dimension drawings of the RS485 repeater

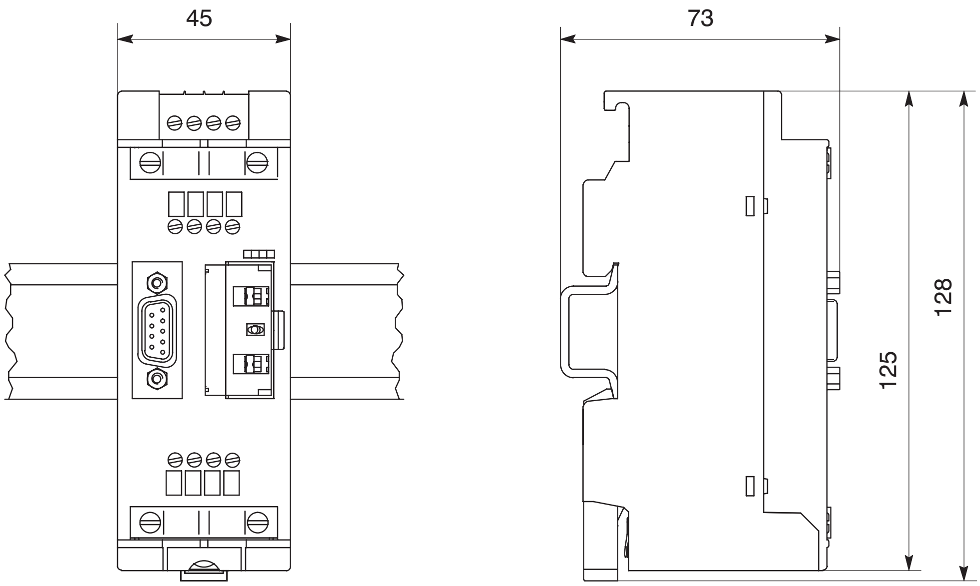


Figure F-8 RS 485 Repeater on standard rail

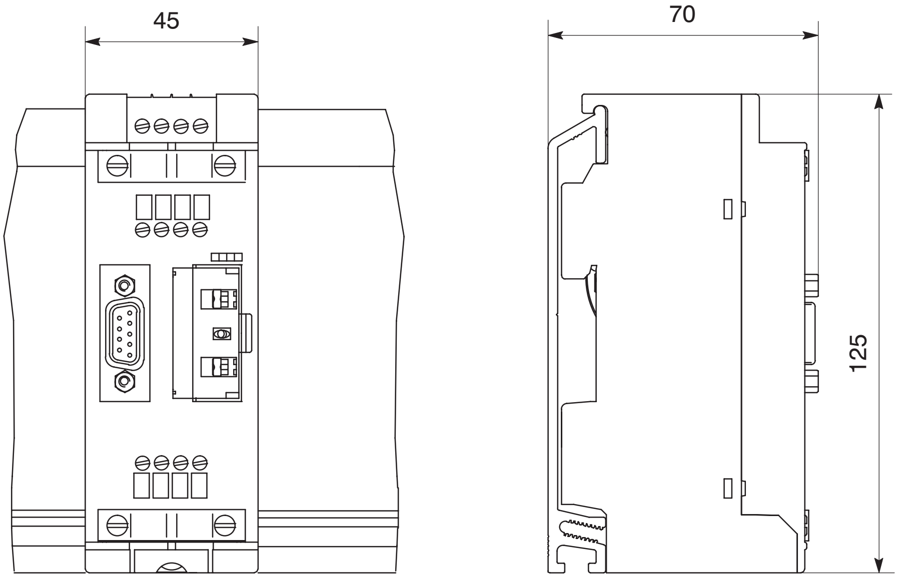


Figure F-9 RS485 repeater on S7300 rail

F.3 Dimension drawing of the PROFIBUS terminator

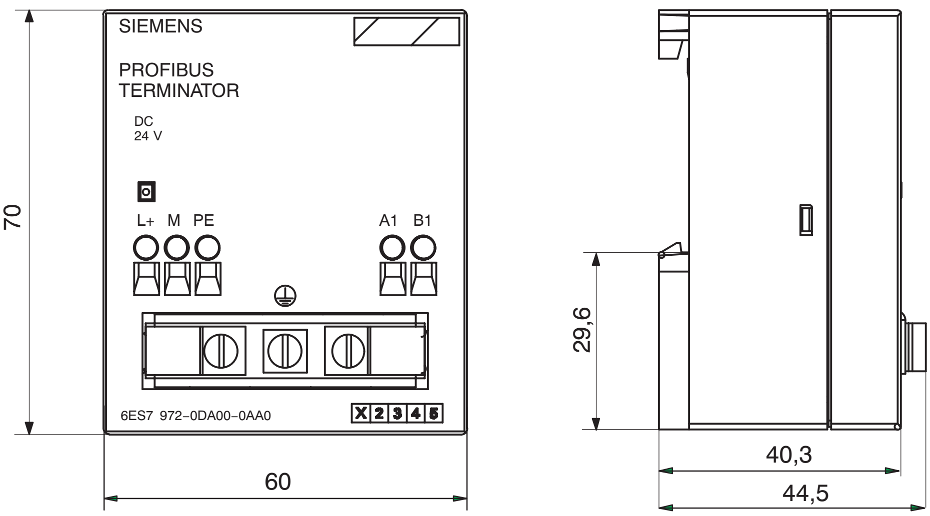


Figure F-10 PROFIBUS terminator

F.4 Dimension drawings of the RS485 bus terminal

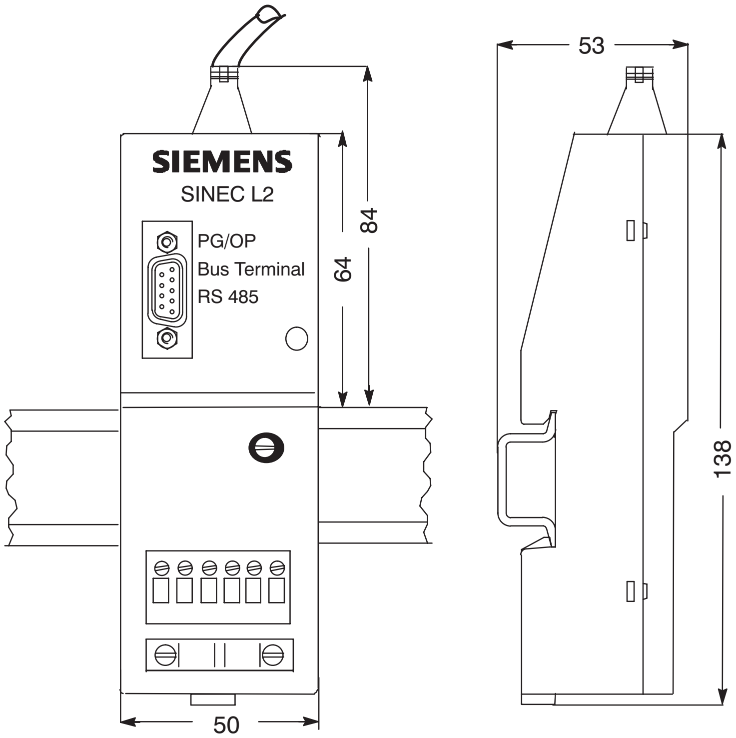


Figure F-11 RS485 bus terminal on 15 mm high standard rail

F.5 Dimension drawings of the BT12M bus terminal

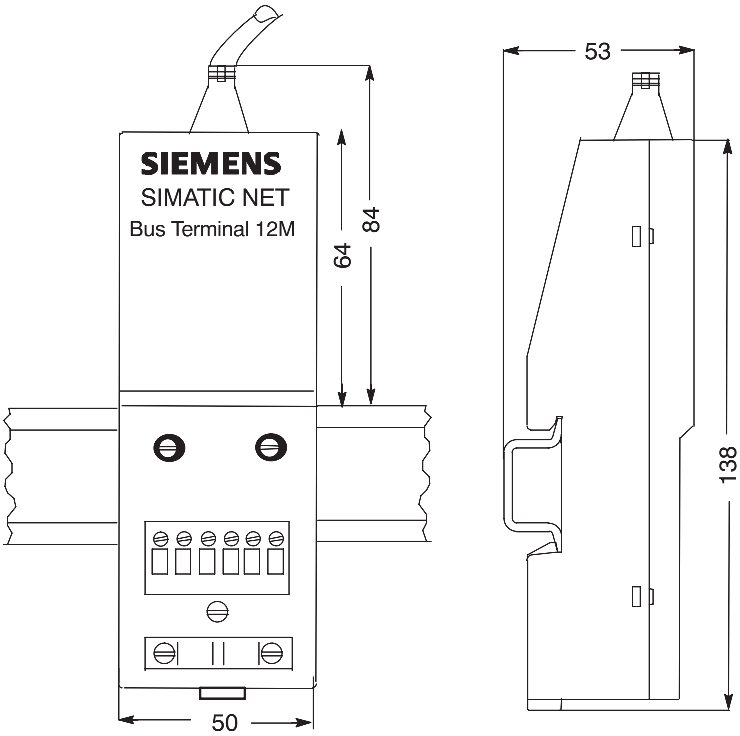


Figure F-12 BT12M bus terminal on 15 mm high standard rail

F.6 Dimension drawings of the optical bus terminal OBT

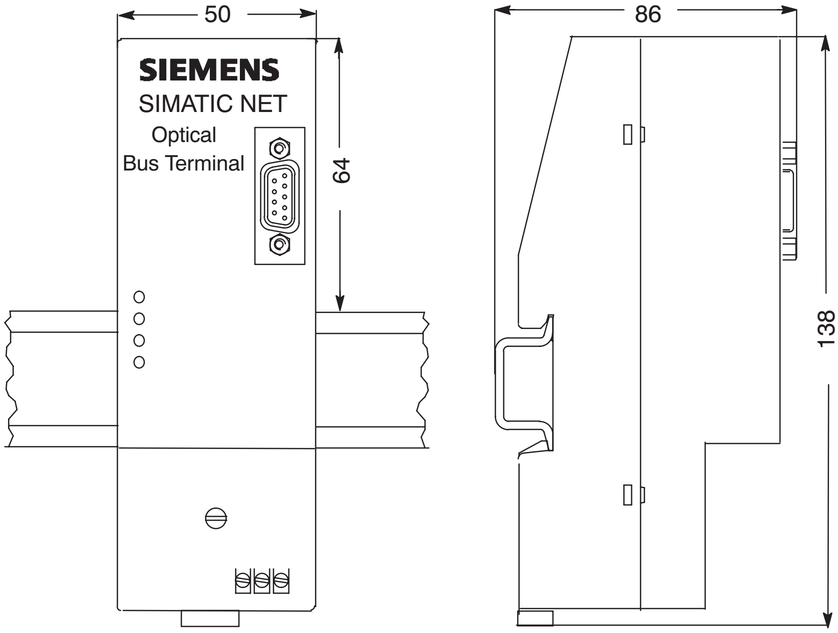


Figure F-13 Optical bus terminal OBT on 15 mm high standard rail

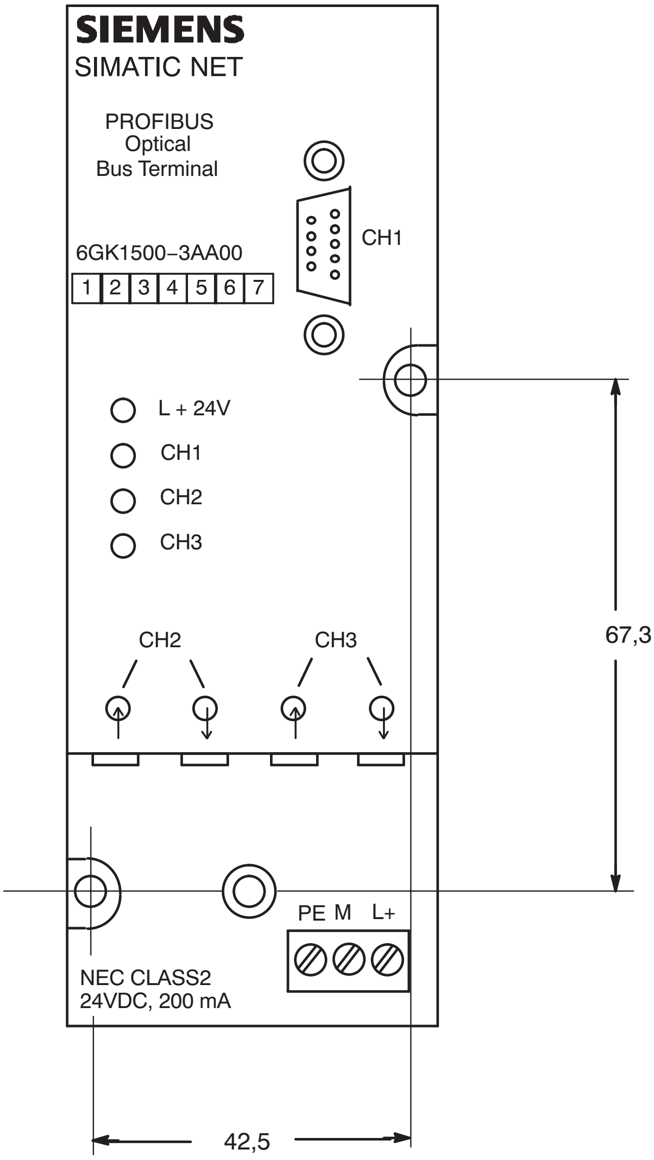


Figure F-14 Drilling template for the optical bus terminal OBT

F.7 Dimension drawings of the optical link module OLM

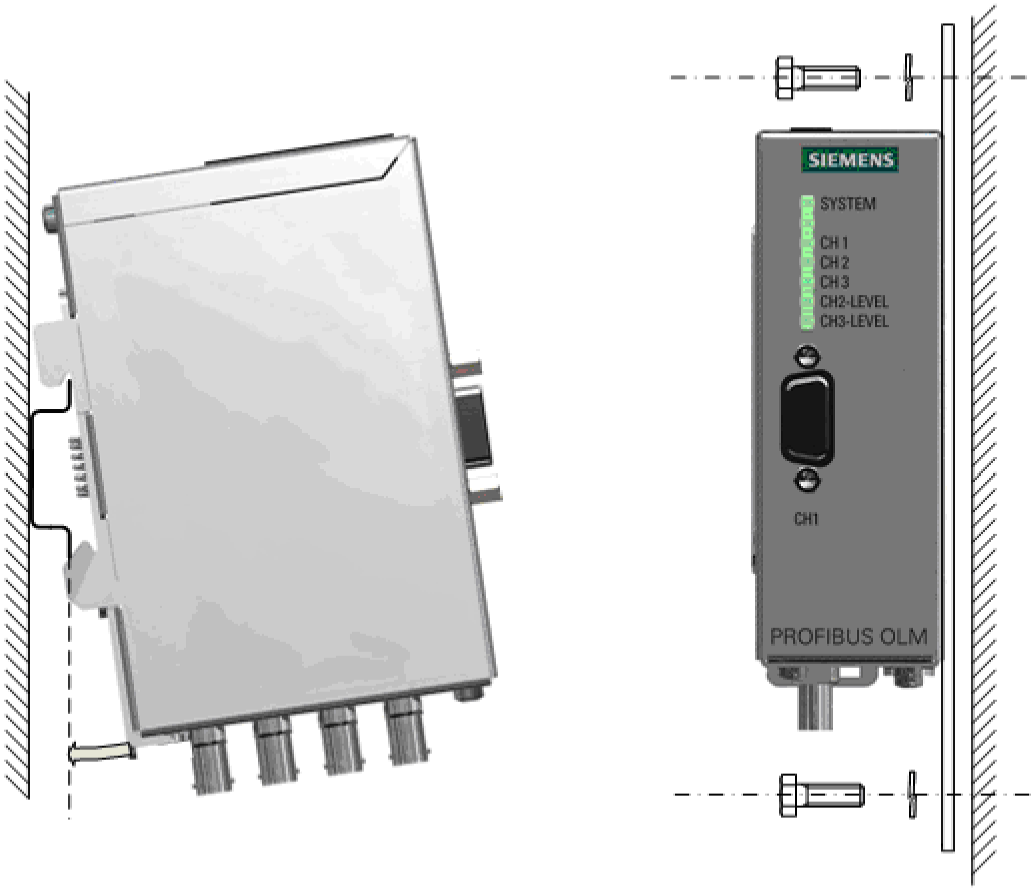


Figure F-15 Mounting the optical link module OLM

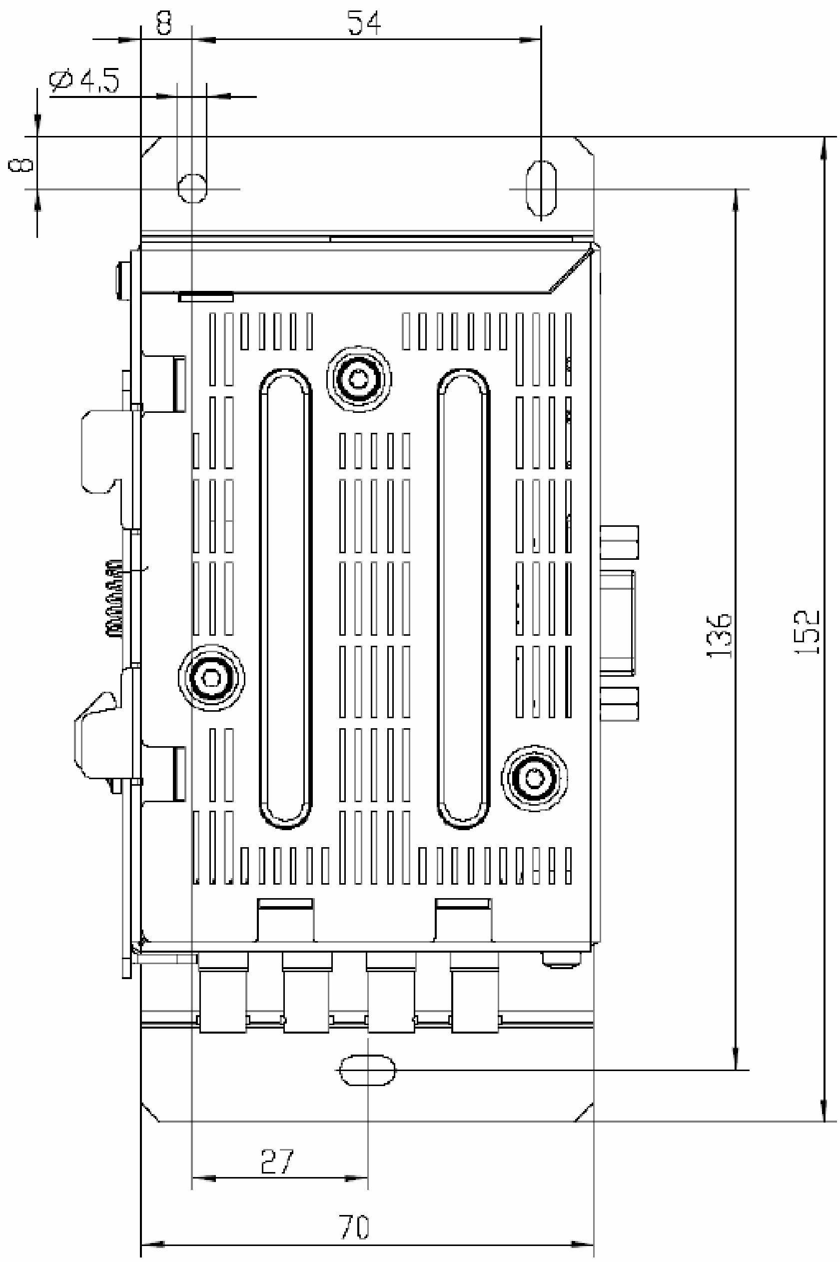


Figure F-16 Mounting plate of the optical link module OLM

List of abbreviations

G

Al	Aluminum
AS-Interface	Actuator-sensor interface
AS-i	Short form of AS-Interface
AWG	American Wire Gauge
BER	Bit Error Rate
BFOC	Bayonet Fiber Optic Connector
CP	Communication Processor
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
Cu	Copper
DIN	Deutsche Industrie Norm (German Industry Standard)
DP	Distributed I/O
EIA	Electronic Industries Association
EN	Europäische Norm (European standard)
EMC	Electromagnetic compatibility
FC	Fast Connect
FMS	Fieldbus Message Specification
FO	Fiber Optics
FRNC	Flame Retardant Non Corrosive
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
ISO/OSI	International Standards Organization / Open System Interconnection
ITP	Industrial Twisted Pair
IR	Infrared
LAN	Local Area Network
LEDs	Light Emitting Diode
FOC	Fiber-optic cables
MPI	Multipoint Interface
NRZ	Non Return to Zero
OBT	Optical bus terminal
OLM	Optical link module
OP	Operator Panel
PCF	Plastic Cladding Silica Fiber
PE	Polyethylene
PG	Programming device
PMMA	Polymethylmethacrylate

PNO	PROFIBUS User Organization
POF	Polymer Optical Fiber
PROFIBUS DP	PROFIBUS Distributed I/O
PROFIBUS PA	PROFIBUS Process Automation
PTB	Physikalisch Technische Bundesanstalt (German Technical Inspectorate)
PUR	Polyurethane
PVC	Polyvinylchloride
SELV	Safety Extra-Low Voltage (to EN 60950)
UL	Underwriters Laboratories
SUB	ultraviolet
VDE	Verein Deutscher Elektroingenieure (association of German electronics engineers)
W	Weighting value

Bibliography

H

IEC 61158-2 to 6

Digital data communications for measurement and control - fieldbus for use in industrial control systems

IEC 61158-4-2

Industrial Communications Networks - Fieldbuses- Part 4-2: Protocol specification of the data link layer - type 2 elements

DIN VDE 0100

- Part 410
  Erection of power installations with rated voltages below 1000 V; Protective measures and protection against electric shock
- Part 540
  Erection of power installations with rated voltages below 1000 V; Selection and erection of electrical equipment, earthing arrangements, protective conductors, equipotential bonding conductors

DIN EN 60950

Safety of information technology equipment, including electrical office machines

EIA RS-485

Standard for electrical characteristics of generators and receivers for use in balanced digital multipoint systems

VG 95375

- Part 3
  Electromagnetic Compatibility, Fundamentals and Measures for the Development of systems
- Part 2
  Cabling, December 1994
  DIN Deutsches Institut für Normung e.V. Berlin (German standards organization)

SIMATIC S5 ET 200 distributed I/O system

SIEMENS AG

Order no. EWA 4NEB 780 6000-01c

SIMATIC S7-300 automation system

Hardware, CPU Data Manual

SIEMENS AG

included in "Manual Package S7-300, M7-300,

Order no. 6ES7 398-8AA02-8BA0"

SIMATIC S7-400 automation system

Configuration and Use

Brochure

SIEMENS AG

Order no.6ES7498-8AA00-8BB0

SIMATIC S7-400, M7-400 automation system

Hardware and Installation

SIEMENS AG

included in "Manual Package S7-400, M7-400,

Order no. 6ES7 398-8AA02-8BA0"

SIMATIC DP/PA bus coupler

Manual

SIEMENS AG

Order no. 6ES7157-0AA00-0BA0

Further information

You will find further information on the topic of intrinsic safety and explosion protection in:

- Manual Automation Systems S7-300, M7-300, ET 200M Ex I/O Modules
(order number 6ES7 398-8RA00-8BA0)
- Untersuchungen zur Eigensicherheit bei Feldbus-Systemen; PTB-Bericht W-53, Braunschweig, März 1993
- PROFIBUS PA Installation Guideline, Technical Guidance for Use of IEC 11582 with PROFIBUS, No. 2.091
PROFIBUS User Organization e. V., HaidundNeuStraße 7, D-76131 Karlsruhe, Germany

Order numbers

The order numbers of the SIEMENS documentation listed above can be found in the catalogs SIMATIC NET Industrial Communication, Catalog IK PI" and "SIMATIC Automation Systems SIMATIC S7 / M7 / C7".

You can order these catalogs and obtain further information and details of available training courses from your local SIEMENS office or national head office.

Glossary

Active RS 485 terminator

Separate -> terminating resistor in bus segments at transmission rates of 9.6 kbps to 12 Mbps. The power supply is separate from the bus nodes.

Baud rate

-> Transmission speed

Bus

Data transfer bus to which all nodes are connected. It has two defined ends.

In the case of PROFIBUS, the bus is a twisted-pair cable or optical fiber cable.

Bus connector

Physical connection between the node and bus cable.

The following bus connectors are available in SIMATIC NET

- D-sub (9-pin) with and without a connector for the PG, with degree of protection IP20
- M12 with socket or pin contacts with degree of protection IP65/67.

Bus segment

-> Segment

Bus system

All nodes physically connected to a bus cable form a bus system.

Configuring

Configuring means entering a PROFIBUS configuration with all the specific parameters using, for example, STEP 7 or COM PROFIBUS.

Electromagnetic compatibility (EMC)

Electromagnetic compatibility (EMC) deals with all questions of electrical, magnetic and electromagnetic emission and immunity and the functional disturbances in electrical devices resulting from these effects.

Equipotential bonding for lightning protection

The lightning protection equipotential bonding includes the parts of the indoor lightning protection system required to reduce the potential differences caused by lightning currents, for example, the equipotential bonding bars, the equipotential bonding conductors, terminals, connectors, isolating spark gaps, lightning arresters, surge voltage arresters

Fiber-optic cable

A fiber-optic cable is a transmission medium made of optically transparent material (glass fiber, plastic fiber) for forwarding light signals in the optical network.

FISCO

A model (FISCO - Fieldbus Intrinsically Safe COncept) created by the PTB in cooperation with well-known manufacturers describing one method of implementing an "i" fieldbus for use in hazardous areas. This model is characterized by there being only one "active" device, the bus power supply, connected to the fieldbus. The other devices are all "passive" in terms of their ability to supply power to the cable. The characteristics of the cables do not influence the intrinsic safety (within certain limits).

GAP factor

GAP update factor. The gap between the local PROFIBUS address of the master to the next PROFIBUS address of a master is known as the GAP. The GAP update factor specifies how many token rotations the master waits before checking whether there is another master in the GAP.

If the GAP update factor is 3, this means that each master checks whether a new master is located between its own PROFIBUS address and the PROFIBUS address of the next master after approximately 3 token rotations.

GroundGround

Ground is the conductive ground area whose potential at any point can be taken as zero.

Chassis ground includes all the interconnected inactive parts of equipment that must not carry a hazardous voltage even in the event of a fault.

GroundGround

Ground is the conductive ground area whose potential at any point can be taken as zero.

Chassis ground includes all the interconnected inactive parts of equipment that must not carry a hazardous voltage even in the event of a fault.

Grounding

Grounding involves connecting an electrically conductive part with the ground electrode through a grounding system.

GSD

Generic Station Description: A GSD contains an XML-based description of the properties of IO devices such as communications parameters as well as number, type, configuration data, parameter and diagnostics information of modules. The use of GSD files makes it easier to configure the master and DP slave.

IP20

Degree of protection to IEC 60529: Protection to prevent finger contact and ingress of particles larger than 12 mm Ø.

IP65

Degree of protection to IEC 60529: Complete protection against touch, protection against the ingress of dust and protection against jet water from all directions.

IP66

Degree of protection to IEC 60529: Complete protection against touch, protection against ingress of dust and protection against damaging penetration of heavy seas or strong jet water.

IP67

Degree of protection to IEC 60529: Complete protection against touch, protection against ingress of dust and protection against damaging penetration of water at a certain pressure during immersion.

ITP

Industrial Twisted Pair; bus system suitable for industrial used based on the twisted pair standards IEEE 802.3i: 10BASE-T and IEEE 802.3j: 100BASE-T.

Lightning arrester

These are capable of diverting multiple lightning currents or parts of them without any damage occurring.

Loop resistance

Total resistance of the outward and return line of a cable.

Master

A master station that is in possession of the token can send data to other nodes and request data from these (= active node.)

Master-slave process

Bus access method where only one node is → master, and all other nodes are → slaves.

Max. retry limit

Max. retry limit is a bus parameter and specifies maximum number of call repetitions to a DP slave.

max_T_{SDR}

max_T_{SDR} is a bus parameter and specifies the maximum protocol processing time of the responding node (station delay responder).

MBP

MBP (Manchester coded and Bus Powered) identifies a synchronous transmission technique with simultaneous power supply to the nodes via the bus cable. MBP is defined as a transmission technique for -> PROFIBUS PA in IEC 61784-1.

MBP-IS

MBP-IS (Intrinsically Safe) in addition to the technology of MBP-LP, this also meets the requirements of intrinsic safety to IEC 60079-27. MBP-IS is defined in as a transmission technique for -> PROFIBUS PA in IEC 61784-1.

MBP-LP

MBP-LP (Low Power) is an MBP version with limited power consumption by the bus nodes. MBP-LP is defined as a transmission technique for -> PROFIBUS PA in IEC 61784 1.

min_T_{SDR}

min_T_{SDR} is a bus parameter and specifies the minimum protocol processing time of the responding node (station delay responder).

Nodes

A device that can send and receive data on PROFIBUS as a master or slave.

Optical power budget (FO)

This is available between a sender and receiver on a fiberoptic link. It indicates the difference between the optical power coupled into a particular fiber by the optical transmitter and the input power required by an optical receiver for reliable signal detection.

Optical power loss (FO)

The optical power loss is the cumulative value of all the losses occurring in the fiber-optic transmission path. These are due mainly to the attenuation of the fiber itself and the splices and couplings. The optical power loss must be less than the optical power budget available between the transmitter and receiver.

PELV

Protective Extra Low Voltage (PELV) Provides protection against electric shock (EN 50178).

PROFIBUS

PROcess Field BUS, bit-serial fieldbus system standardized in IEC 61158-2 as "Type 3". The standard specifies functional, electrical and mechanical properties.

PROFIBUS is a bus system that connects PROFIBUS compatible automation systems and field devices on a cell and field level. PROFIBUS exists with the DP protocol (= Distributed Peripheral I/Os), FMS protocol (= Fieldbus Message Specification) or PA protocol (= Process Automation).

PROFIBUS address

To identify it uniquely, every station must be assigned a PROFIBUS address.

PC / PG or the ET 200 Handheld have the PROFIBUS address "0".

Master and slaves use a PROFIBUS address between 1 and 125.

PROFIBUS DP

PROFIBUS bus system with the DP protocol. DP stands for the German equivalent of distributed I/O. The main task of PROFIBUSDP is the fast, cyclic data exchange between the central DP master and the peripheral devices.

PROFIBUS PA

PROFIBUS bus system with the transmission technology MBP, MBP-IS and MBP-LP to IEC 61784-1. PA stands for "Process Automation". PROFIBUS PA is the PROFIBUS for applications in process automation and in the intrinsically safe area.

PROFIBUS FMS

PROFIBUS bus system with the FMS protocol. FMS stands for Fieldbus Message Specification.

Redundancy

This means that standby equipment exists that is not required for the basic functioning of a system. If equipment fails, the standby can take over its function.

Example:
media redundancy

An additional link closes the bus to form a ring. If there is a failure on part of the bus, the redundant link is activated to maintain the functionality of the network.

Reference potential

Reference potential for the evaluation / measuring of the voltages of participating circuits.

Response time

The response time is the average time interval between an input modification and the relevant output modification.

RS 485

Asynchronous data transmission technology for PROFIBUS DP to ANSI TIA/EIA-RS485-A.

RS-485 repeater

Device for amplifying bus signals and for linking → segments over long distances.

RS-485-IS

Intrinsically safe version of RS-485.

Segment

The bus line between two terminating resistors forms a segment. A segment can contain a maximum of 32 bus attachments (-> nodes, -> RS485 repeaters -> OLMs, ...). Segments can be interconnected by -> RS485 repeaters.

Shield impedance

Resistance to alternating current of the cable shield. Shield impedance is a characteristic of the cable used and is normally specified by the manufacturer.

Signal Propagation Delay

The time required by a data packet to on its way through the network.

SIMATIC NET PC modules

SIMATIC NET PC modules are modules for connecting the PC to bus systems, such as PROFIBUS or Industrial Ethernet.

Slave

A slave can only exchange data after being requested to by a -> master. Slaves include, for example, all DP slaves such as ET 200S, ET 200X, etc.

SOFTNET for PROFIBUS

SOFTNET for PROFIBUS is the protocol software for the SIMATIC NET PC modules CP 5511 and CP 5611.

Standard mounting rail

Metal rail standardized in compliance with EN 50 022.

The standard rail is used for the snapon installation of network components such as OLMs, repeaters etc.

Suppressor

Component for reducing induced voltages. Induced voltages occur when circuits with inductances are turned off.

Surge arrester

are used to limit overvoltages from remote strikes or from induction effects (for example switching in power circuits). Surge arresters (in contrast to lightning arresters) divert currents with a significantly lower peak value, discharges and specific energies.

Terminating resistor

Is a resistor that terminates a bus cable with its characteristic impedance; terminating resistors are always required at both ends of a PROFIBUS segment.

In SIMATIC NET PROFIBUS DP, the terminating resistors are

- activated and deactivated in the D-sub bus connectors or bus terminals.
- Screwed onto the device as an M12 bus terminator
- Installed as an active RS-485 terminator

In SIMATIC NET PROFIBUS PA, the terminating resistors are

- Screwed onto the SpliTConnect Tap as SpliTConnect terminators.

Terminator

-> terminating resistor in bus segments at transmission rates of 9.6 kbps to 12 Mbps; the power supply is separate from the bus nodes.

Token

is a frame that represents the right to transmit in a network. It signals the two states "occupied" or "free". The token is passed from master to master.

Token Ring

All masters physically connected to a bus receive the token and pass it on to the next master: The masters are in a token ring.

Token rotation time

is the time that elapses between receiving the -> token and receiving the next token.

Transmission speed

The transmission speed specifies the number of bits transmitted per second. On PROFIBUS, transmission speeds of 9.6 kbps to 12 Mbps are possible.

T_{RDY}

Indicates readiness to acknowledge or respond (ready time)

T_{SET}

Setup time. The setup time is the time that can elapse between receiving a data frame and reacting to it.

T_{SL}

The wait to receive time (slot time) is the maximum time that can elapse while the sender waits for a response from the addressed station.

T_{TR}

Target rotation time Each master compares the target rotation time with the actual token rotation time. The difference between the two decides how much time the DP master has available to send its own data frames to the slaves.

Index

O

P

R

S

T

W