SIEMENS

SIMATIC NET PROFIBUS Networks

Manual

05/2000

6GK1970–5CA20–0AA1

Release 2

Safety Guidelines

Danger

indicates that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage **can** result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified Personnel

Only **qualified personnel** should be allowed to install and work on this equipment Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct Usage

Note the following:

Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

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Disclaimer of Liability

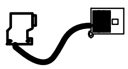
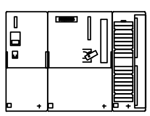
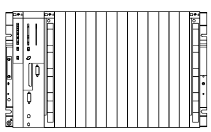
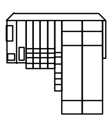
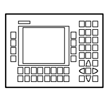
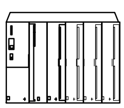
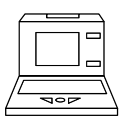
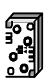
We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

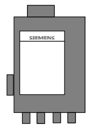
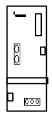
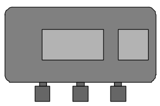
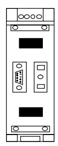
Siemens AG
Bereich Automatisierungs– und Antriebstechnik
Geschäftsgebiet Industrielle Kommunikation
Postfach 4848, D-90327 Nürnberg

Siemens Aktiengesellschaft

Order no. 6GK 1970–5AC20–0AA1

Symbols

	PROFIBUS 830–1 T connecting cable
	PROFIBUS 830-2 connecting cable
	LAN cable (twisted-pair)
	Duplex FO cable
	Wireless transmission (infrared)
	Bus connector
	S7–300
	S7–400
	ET200S
	OP25
	ET 200M (with IM 153–2 FO)
	PG/PC/OP
	AS-i branch

	Optical link module (OLM)
	Optical bus terminal (OBT)
	Infrared link module (ILM)
	Repeater

Contents

1

PROFIBUS NETWORKS

1.1 Local Area Networks in Manufacturing and Process Automation

1.1.1 General Introduction

Communication 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 high-performance 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. As a result, efficient communication between the distributed systems is an absolute necessity. 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
- System-wide 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 comprehensive, high-performance communication system is a must for a distributed system structure.

SIMATIC NET

With SIMATIC NET, Siemens provides an open, heterogeneous communication system for various levels of 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 are local area networks (LANs) which can be implemented in one of the following ways:

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

1.1.2 Overview of the SIMATIC NET System

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 transmission media, network attachment and transmission components and the corresponding transmission techniques
- Protocols and services used to transfer data between the devices listed above
- The modules of the programmable controller 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:

Industrial Ethernet/Fast Ethernet

A communication network for the LAN and cell area using baseband technology complying with IEEE 802.3 and using the CSMA/CD medium access technique (Carrier Sense Multiple Access/Collision Detection). The network is operated on

- 50 Ω triaxial cable
- 100 Ω Twisted pair cables
- Glass fiber-optic cable

AS-Interface

The actuator sensor interface (AS-i) is a communication network for automation at the lowest level for connecting binary actuators and sensors to programmable logic controllers via the AS-i bus cable.

PROFIBUS

A communication network for the cell and field area complying with EN 50170-1-2 with the hybrid medium access technique token bus and master slave. Networking is on twisted pair, fiber-optic cable or wireless.

PROFIBUS-PA

PROFIBUS-PA is the PROFIBUS for process automation (PA). It connects the PROFIBUS-DP communication protocol with the IEC 61158-2 transmission technique.

1.2 Basics of the PROFIBUS Network

EN 50170

SIMATIC NET PROFIBUS products and the networks they make up comply with the PROFIBUS standard EN 50170 (1996). The SIMATIC NET PROFIBUS components can also be used with SIMATIC S7 to create a SIMATIC MPI subnet (MPI = Multipoint Interface).

Attachable Systems

The following systems can be connected:

- SIMATIC S5/S7/M7/C7 programmable controllers
- ET 200 distributed I/O system
- SIMATIC programming devices/PCs
- SIMATIC operator control and monitoring devices or systems
- SICOMP IPCs
- SINUMERIK CNC numerical controls
- SIMODRIVE sensors
- SIMOVERT master drives
- SIMADYN D digital control system
- SIMOREG
- Micro-/Midimasters
- SIPOS reversing power controllers/actuators
- SIPART industry/process controllers
- MOBY identification systems
- SIMOCODE low-voltage switchgear
- Circuit breakers
- SICLIMAT COMPAS compact automation stations
- TELEPERM M process control system
- Devices from other manufacturers with a PROFIBUS-compliant interface

Transmission Media

PROFIBUS networks can be implemented with the following:

- Shielded, twisted pair cables (characteristic impedance 150 Ω)
- Shielded, twisted pair cables, intrinsically safe (with PROFIBUS-PA)
- Fiber-optic cables
- Wireless (infrared technology)

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

1.2.1 Standards

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

IEC 61158–2 to 6: 1993/2000
Digital data communications for measurement and control – Fieldbus for use in industrial control systems

EN 50170-1-2: 1996
General purpose field communication system
Volume 2 : Physical Layer Specification and Service Definition

PROFIBUS User Organization Guidelines:
PROFIBUS Implementation Guide to DIN 19245
Part 3 (Draft)
Version 1.0 dated 14.12.1995

Fiber Optic Data Transfer for PROFIBUS
Version 2.1 dated 12.98

EIA RS-485: 1983
Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

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

EN 50170-1-2: 1996
General Purpose Field Communication System
Volume 2 : Physical Layer Specification and Service Definition

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-Bericht W-53: 1993
Untersuchungen zur Eigensicherheit bei Feldbussystemen
Braunschweig, March 1993

PNO-Richtlinie: 1996
PROFIBUS-PA Inbetriebnahmeleitfaden (Hinweise zur Nutzung der IEC 61158-2-Technik für PROFIBUS, Art.-Nr. 2.091)

1.2.2 Access Techniques

TOKEN BUS/Master-Slave Method

Network access on PROFIBUS corresponds to the method specified in EN 50170, Volume 2 “Token Bus” for active and “Master-Slave” for passive stations.

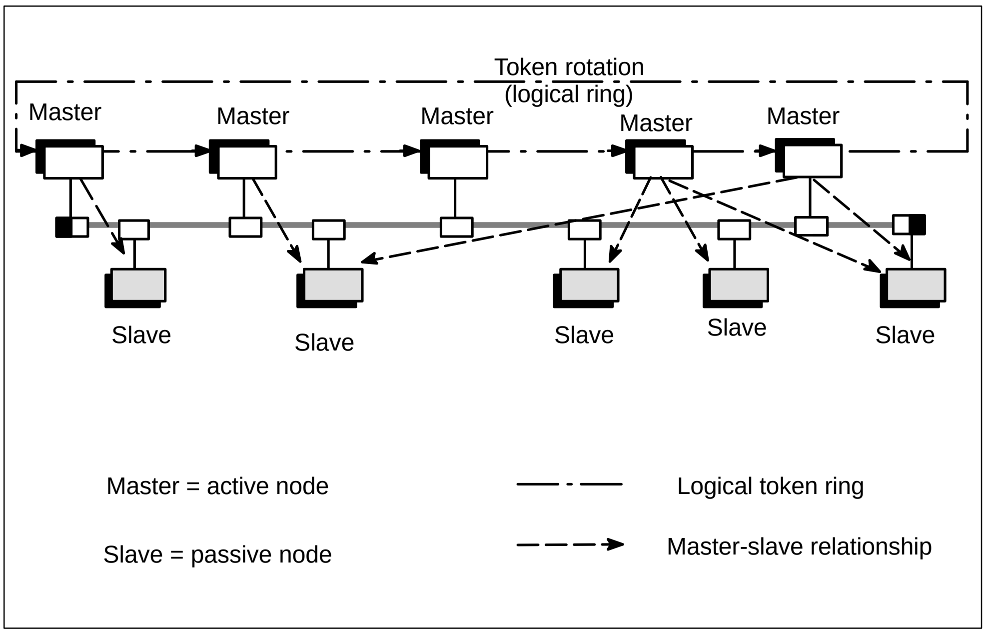


Figure 1-1 Principle of the PROFIBUS Medium Access Technique

Active and Passive Nodes

The access technique is not dependent on 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 (master-slave 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.

1.2.3 Transmission Techniques

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

- RS-485 for electrical networks on shielded, twisted pair cables
- Optical techniques according to the PROFIBUS User Organization guideline /3/ on fiber-optic cables
- Wireless techniques based on infrared radiation
- IEC 61158-2 technique for intrinsically safe and non-intrinsically safe electrical networks in process control (PROFIBUS-PA) based on shielded, twisted pair cables.

1.2.4 Transmission Techniques According to EIA Standard RS-485

EIA Standard RS-485

The RS-485 transmission technique corresponds to balanced data transmission as specified in the EIA Standard RS-485 /4/. This transmission technique is mandatory in the PROFIBUS standard EN 50170 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 terminated bus cable is known as a segment.

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

The maximum length of a segment depends on the following:

- The transmission rate
- The type of cable being used

Advantages:

- Flexible bus or tree structure with repeaters, bus terminals, and bus connectors for attaching PROFIBUS nodes
- Purely passive passing on 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 RS-485 Transmission Technique

The RS-485 transmission technique in PROFIBUS has the following physical characteristics:

Table 1-1 Physical Characteristics of the RS-485 Transmission Technique

Network topology:	Bus, tree structure with the use of repeaters
Medium:	Shielded, twisted pair cable
Possible segment lengths: (depending on the cable type, see Table 3.1)	1,000 m For transmission rates up to 187.5 Kbps 400 m For a transmission rate of 500 Kbps 200 m For a transmission rate of 1.5 Mbps Mbps 100 m For transmission rates of 3.6 and 12 Mbps
Number of repeaters connected in series:	Maximum 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

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Note

The properties listed in 1-1 assume a bus cable of type A and a bus terminator according to the PROFIBUS standard EN 50170–1–2. 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 d.c. loop resistance, this is pointed out in the sections on “Configuration” and “SIMATIC NET PROFIBUS Cables”.

1.2.5 Transmission Techniques for Optical Components

PROFIBUS User Organization Guideline

The optical transmission technique complies with the PROFIBUS User Organization guideline:
“Fiber Optic Data Transfer for PROFIBUS” /3/.

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 fiber-optic cables are used as the medium made of glass, PCF or plastic fibers. Duplex fiber-optic cables consist of two 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.

Advantages:

- Regardless of the transmission rate, large distances can be covered between two DTEs
  (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 fiber-optic cables
- High availability of the LAN due to the use of a ring topology
- Extremely simple attachment technique using plastic fiber-optic cables over shorter distances.

Restrictions:

- Frame throughput times are increased compared with an electrical network
- The assembly of glass fiber-optic 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:	Fiber-optic cables with glass, PCF or plastic fibers
Link lengths (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 rate:	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.

1.2.6 Transmission Technique for Wireless Infrared Technology

The wireless PROFIBUS network uses infrared light for signal transmission. The only transmission medium is a free line-of-sight connection between two nodes. The maximum distance covered is approximately 15 m. Wireless networks are implemented using infrared link modules (ILM). The nodes to be networked are attached to the electrical port of the ILM.

Advantages:

- High mobility of attached plant components (for example trolleys)
- Coupling and decoupling from the fixed network with no wear and tear (for example substitute for a slip ring)
- Coupling without cable installation (temporary setup, inaccessible areas)
- Not protocol dependent
- Electrical isolation between nodes and hardwired network

Restrictions

- Transmission rate <= 1.5 Mbps
- Free line-of-sight path required between nodes
- Maximum distance covered <= 15 m
- Only for single master networks

Characteristics of the Wireless Infrared Transmission Technique

The wireless infrared transmission technique has the following characteristics:

Network topology:	Point-to-point Point-to-multipoint
Medium:	Free space with line-of-sight path
Maximum link length:	15 m
Transmission rate ILM:	9.6 Kbps, 19.2 Kbps, 45.45 Kbps, 93.75 Kbps, 187.5 Kbps, 500 Kbps, 1.5 Mbps
Number of nodes:	Maximum 127 per network

1.2.7 Transmission Technique for PROFIBUS-PA

IEC 61158-2 Standard

The transmission technique corresponds to the IEC 61158-2 standard (identical with EN 61158-2).

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

Advantages:

- 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 32 nodes per cable segment

Restrictions:

- Transmission rate restricted to 31.25 Kbps

Characteristics of the IEC 61158-2 Transmission Technique

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

Network topology:	Bus, star and tree topology
Medium:	Shielded, twisted pair cable
Achievable segment lengths:	1900 m
Transmission rate:	31.25 Kbps
Number of nodes:	Maximum 127 per network

Topologies of SIMATIC NET PROFIBUS Networks

2

2.1 Topologies of RS-485 Networks

Transmission Rate

When operating SIMATIC NET PROFIBUS in the RS-485 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

LAN 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 LAN cables via bus connectors, bus terminals or RS-485 repeaters.

Cable Termination

Each bus segment must be terminated at both ends with its characteristic impedance. This cable terminator is integrated in the RS-485 repeaters, the bus terminals, the ILM and the bus connectors and can be activated if required.

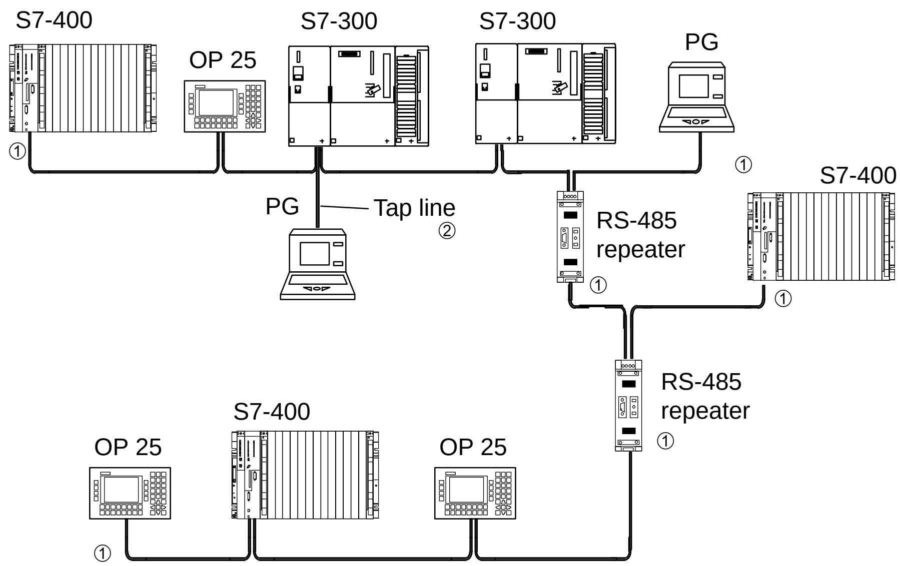
Before the cable terminator can be activated, the component must be supplied with power. With the bus terminals and the bus connectors, this power is supplied by the connected DTE, whereas the RS-485 repeater, the ILM, and the terminator have their own power supply.

The RS-485 transmission technique allows the attachment of a maximum of 32 devices (DTEs and repeaters) per bus segment. The maximum permitted cable length of a segment depends on the transmission rate and the LAN cable used.

Connecting Segments Using RS-485 Repeaters

By using RS-485 repeaters, segments can be interconnected. The RS-485 repeater amplifies the data signals on the LAN cables. You require an RS-485 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.

Figure 2-1 shows a typical topology using the RS-485 technique with 3 segments and 2 repeaters.



① Terminating resistor activated

② PG attached via tap line (6ES7 901-4BD00-0XA0) for maintenance purposes

Figure 2-1 Topology Using the RS-485 Technique

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 (see Chapter 3).

2.1.1 Components for Transmission Rates up to 1.5 Mbps

All SIMATIC NET bus attachment components can be used for transmission rates ≤ 1.5 Mbps.

2.1.2 Components for Transmission Rates up to 12 Mbps

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

Table 2-1 Bus Attachment Components for Transmission Rates up to 12 Mbps

	Order number
PROFIBUS bus connector with axial cable outlet	6GK1 500-0EA02
PROFIBUS FastConnect bus connector RS-485 Plug 180 with 180° cable outlet	 6GK1500-0FC00
RS-485 bus connector with vertical cable outlet Without PG interface With PG interface	 6ES7 972-0BA11-0XA0 6ES7 972-0BB11-0XA0
PROFIBUS FastConnect RS-485 bus connector with 90° cable outlet with insulation displacement terminal system max. transmission rate 12 Mbps Without PG interface With PG interface	 6ES7 972-0BA50-0XA0 6ES7 972-0BB50-0XA0
RS-485 bus connector with 35° cable outlet Without PG interface With PG interface	 6ES7 972-0BA40-0XA0 6ES7 972-0BB40-0XA0
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	 6XV1830-1CH15 6XV1830-1CH30
SIMATIC NET 830-2 connecting cable for PROFIBUS, preassembled cable with two sub-D, 9-pin male connectors, terminating resistors can be activated. 3 m 5 m 10 m	 6XV1830-2AH30 6XV1830-2AH50 6XV1830-2AN10
SIMATIC S5/S7 PROFIBUS connecting cable for connecting programming devices up to 12 Mbps preassembled with 2 sub-D connectors, length 3 m	 6ES7 901-4BD00-0XA0
PROFIBUS RS-485 repeater 24 V DC, casing with IP 20 degree of protection	6ES7 972-0AA01-0XA0
Bus terminal BT12M	6GK1 500-0AA10
Optical Link Module OLM V3	6GK1 502-_C_00

Table 2-1 Bus Attachment Components for Transmission Rates up to 12 Mbps, continued

Optical Bus Terminal OBT	6GK1 500-3AA0
PROFIBUS Terminator	6ES7 972-0DA00-0AA0

2.2 Topologies of Optical Networks

Interfacing Electrical and Optical Networks/Components

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 fiber-optic cables instead of copper cable.

To interface electrical cables with fiber-optic cables, you have the following possibilities:

- The PROFIBUS nodes with a PROFIBUS DP interface (RS-485) are attached to the optical network using an optical bus terminal (OBT) or using an optical link module (OLM).
- PROFIBUS nodes with an integrated FO port (for example ET 200M (IM 153-2 FO), S7-400 (IM 467 FO)) can be connected directly to 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 ET200 system manual.

2.2.1 Topology with Integrated Optical Interfaces

The optical PROFIBUS network with nodes having an integrated FO interface is structured as a **bus topology**. The PROFIBUS nodes are interconnected in pairs by 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 bus topology means that all DP slaves on the side away from the DP master are no longer obtainable for the DP master.

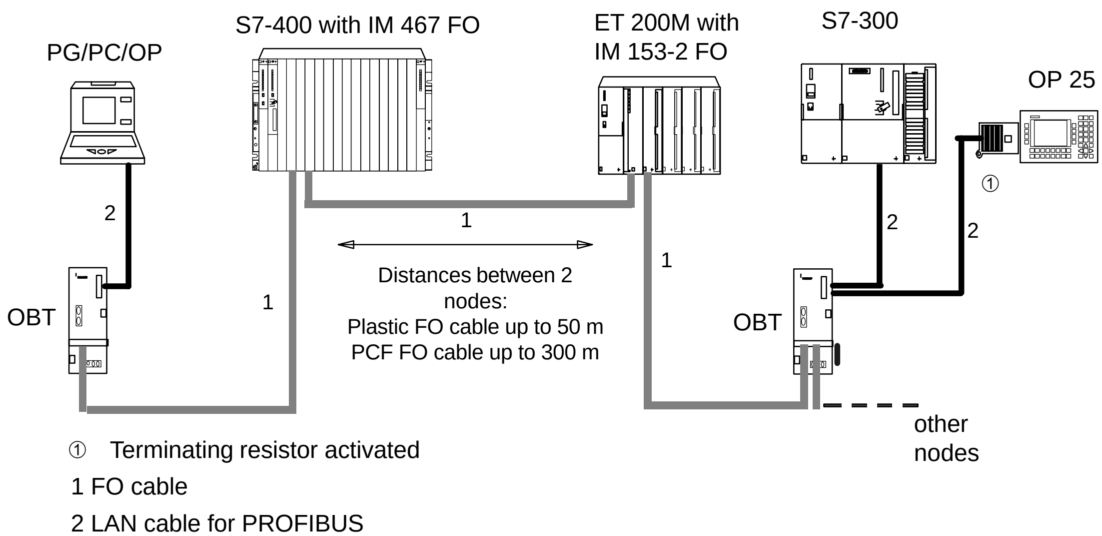


Figure 2-2 PROFIBUS DP Network with Nodes Having Integrated FO Interfaces

For short distances, the preassembled 830-1T or 830-2 connecting cables can be used as an alternative to the PROFIBUS cable.

Transmission Rate

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

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 RS-485 segment can be attached to the optical PROFIBUS network (see Figure 2-2).

The attachment is made to the RS-485 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.

2.2.2 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.

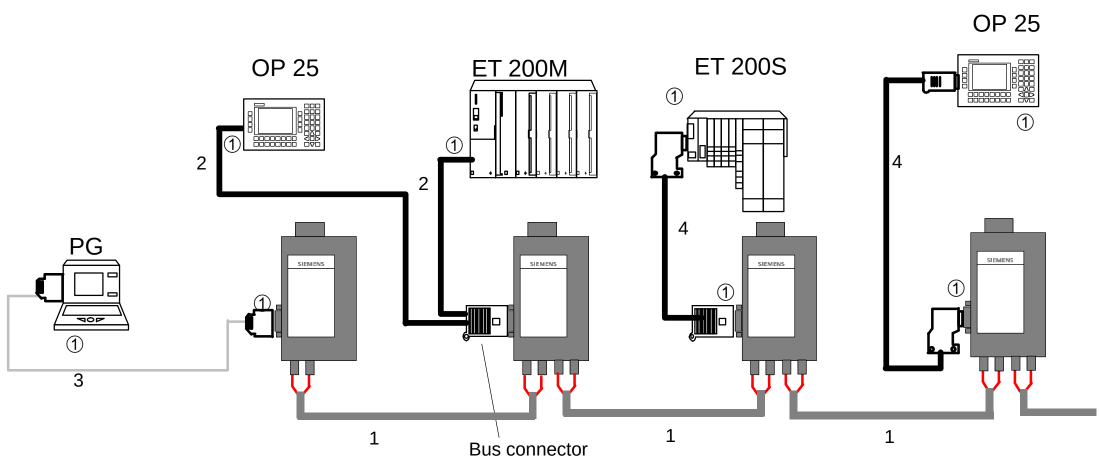
Bus Topologies

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 fiber-optic 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 DTEs are attached to the electrical interfaces of the OLMs. Either individual DTEs or complete PROFIBUS segments with a maximum of 31 nodes can be connected to the RS-485 interface.



① Terminating resistor activated
1 FO cable
2 LAN cable for PROFIBUS
3 PROFIBUS 830-1T connecting cable
4 PROFIBUS 830-2 connecting cable

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 RS-485 interfaces. This RS-485 connection allows the attachment of further DTEs until the maximum permitted number of 32 bus attachments per segment is reached.

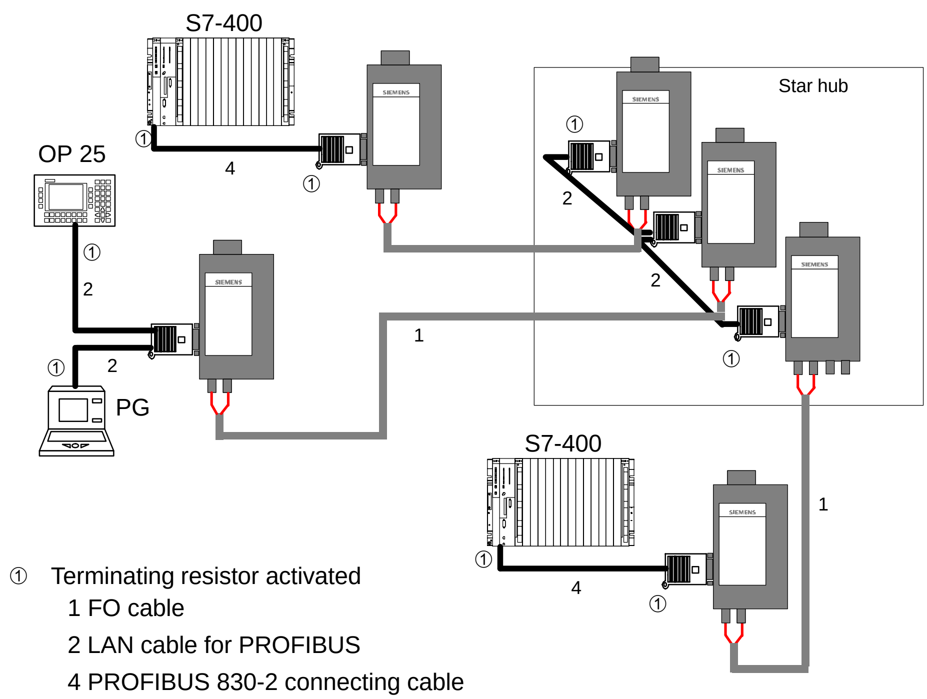


Figure 2-4 Example of a Star Topology with OLMs

Optical Channels

The OLMs are connected to the star coupler by duplex fiber-optic cables.

Both DTEs and electrical bus segments can be connected to the OLMs attached by the duplex fiber-optic 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 fiber-optic sections. A break on a link is indicated by a display LED and by the signaling contact responding.

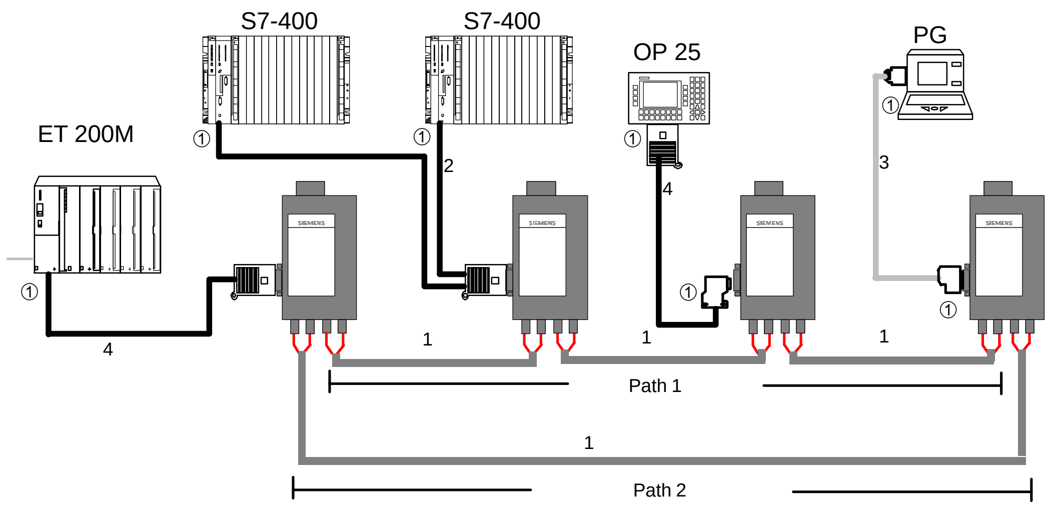
Even if only one transmission direction is lost, the segmentation triggered by the monitoring function leads to safe disconnection of the OLM from the star coupler. The remaining network can continue to work without problems.

Mixed Structure

The star coupler can be made up with combinations of OLM/P, OLM/G and OLM/G-1300 modules and at the RS-485 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 FO cable
2 LAN cable for PROFIBUS
3 PROFIBUS 830-1T connecting cable
4 PROFIBUS 830-2 connecting cable

Figure 2-5 Network Structure in a Redundant, Optical, Two-Fiber Ring Topology

A break on a fiber-optic 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 DTEs 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.

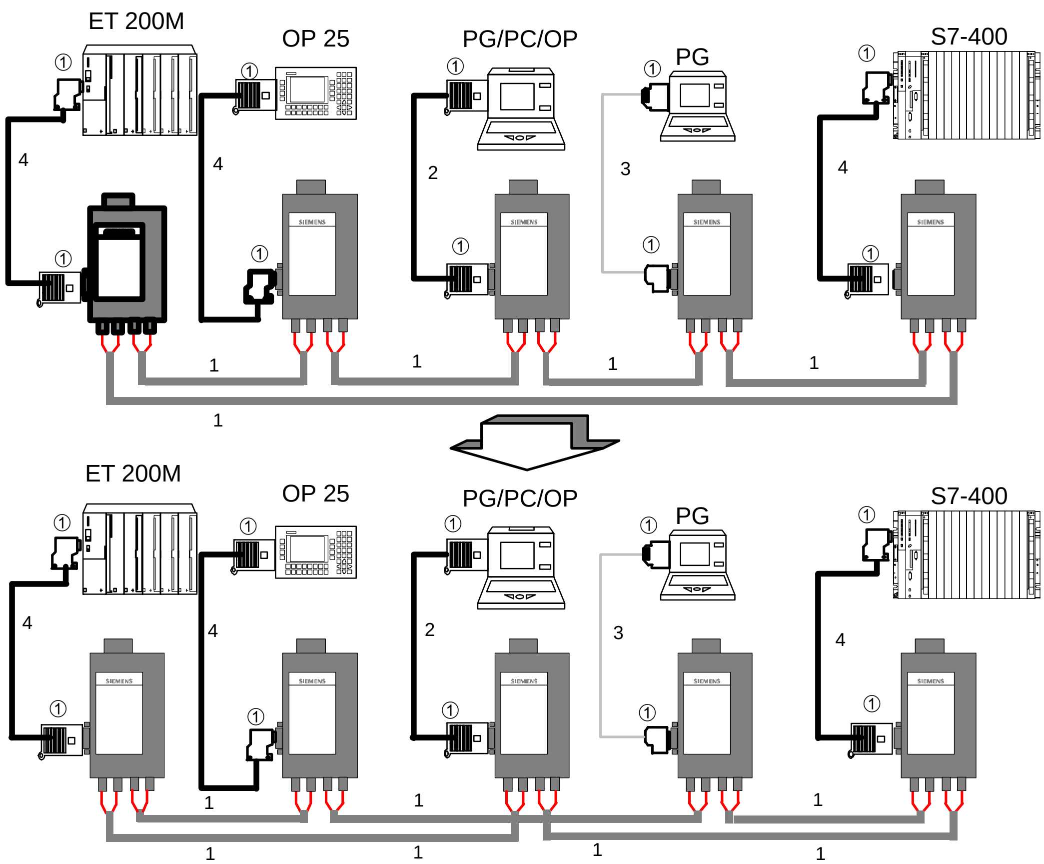
After the problem is eliminated, the modules involved cancel the segmentation automatically and the bus is once again closed to form a ring.

Note

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

Alternative Cabling Strategy

If the distance between two OLMs turns out to be too long, a structure as shown in Figure 2-6 can be implemented.



① Terminating resistor activated

1 FO cable

2 LAN cable for PROFIBUS

3 PROFIBUS 830-1T connecting cable

4 PROFIBUS 830-2 connecting cable

Figure 2-6 Alternative Cabling of a Network Structure in an Optical Two-Fiber Ring Topology

2.2.3 Combination of Integrated Optical Interfaces and OLMs

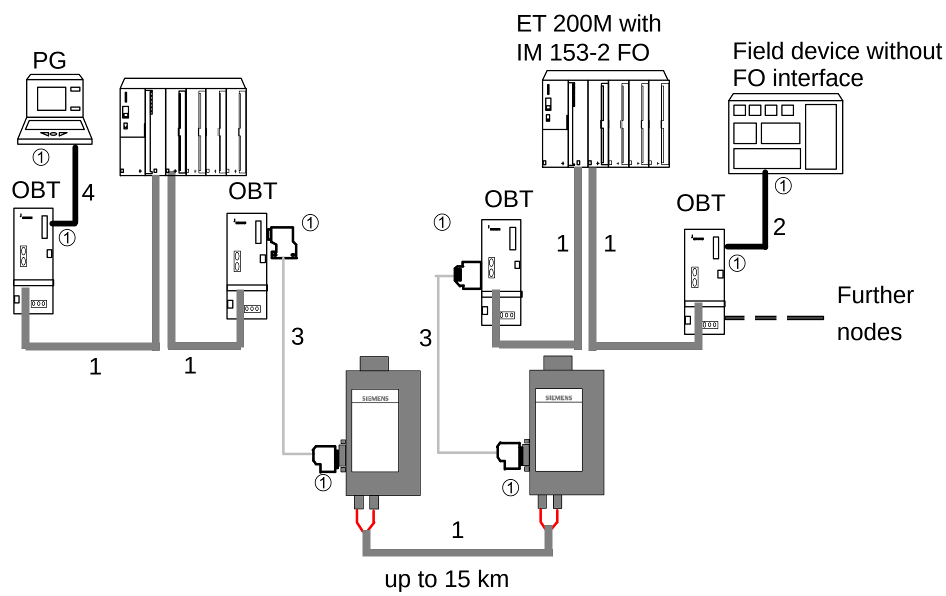
Note

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.

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 RS-485 interface of an OBT. The following schematic shows an example of an application:



① Terminating resistor activated

1 FO cable

2 LAN cable for PROFIBUS

3 PROFIBUS 830-1T connecting cable

4 PROFIBUS 830-2 connecting cable

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

Infrared Link Module (ILM)

In SIMATIC NET, wireless PROFIBUS networks are implemented with the “Infrared Link Module (ILM)”.

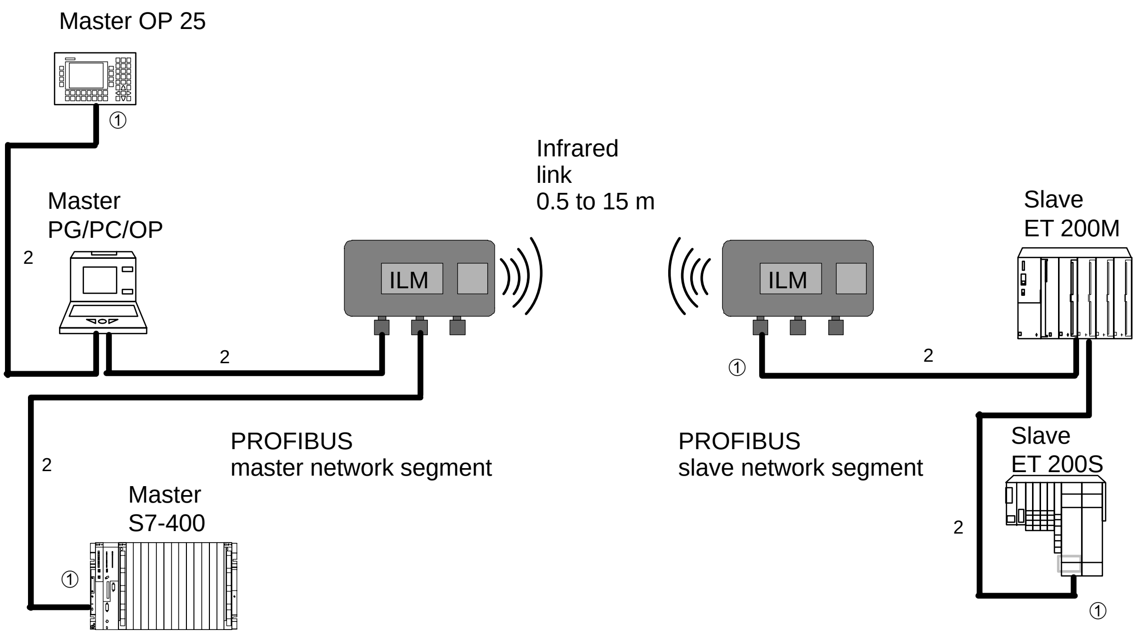
Figure 2-8 PROFIBUS ILM

Maximum Length of a Link

Regardless of the transmission rate, the maximum length of a link is 15 m. The infrared light used for data transmission is radiated at an angle of +/- 10^{o} around the mid axis. This means that at a distance of 11 m, an ILM illuminates a circular area with a diameter of 4 m. The communication partner must be within this illuminated area. There must be an uninterrupted line-of-sight path between both ILMs. The ILMs are suitable for transmission rates of 9.6 Kbps to 1.5 Mbps.

Point-to-Point Link

To implement a point-to-point link, two ILMs are positioned opposite each other so that each is located within the infrared light cone of the other. The maximum distance between two modules is 15 m.



① Terminating resistor activated

2 LAN cable for PROFIBUS

Figure 2-9 Point-to-Point Link with Two PROFIBUS ILMs

Figure 2-9 illustrates the typical structure of a PROFIBUS network with master and slave nodes and an infrared link with two PROFIBUS ILMs. The infrared link is implemented as a point-to-point link between the two PROFIBUS ILMs. The two PROFIBUS ILMs replace a cable connection between the two network segments. Remember that only slave nodes are permitted in the slave network segment.

Point-to-Multipoint Link

Several ILMs are positioned opposite to a single ILM so that several ILMs are in the infrared light cone of another ILM. Only the ILMs positioned opposite each other can exchange data. A data exchange between adjacent ILMs is only possible by using a surface that reflects infrared light. If you consider this option, remember that the length of the link is the path from the ILM to the reflector and from the reflector to the partner ILM. Signal attenuation will also occur since the reflector can only reflect part of the infrared light to the partner ILM. Such losses mean a reduction in the maximum length of a link.

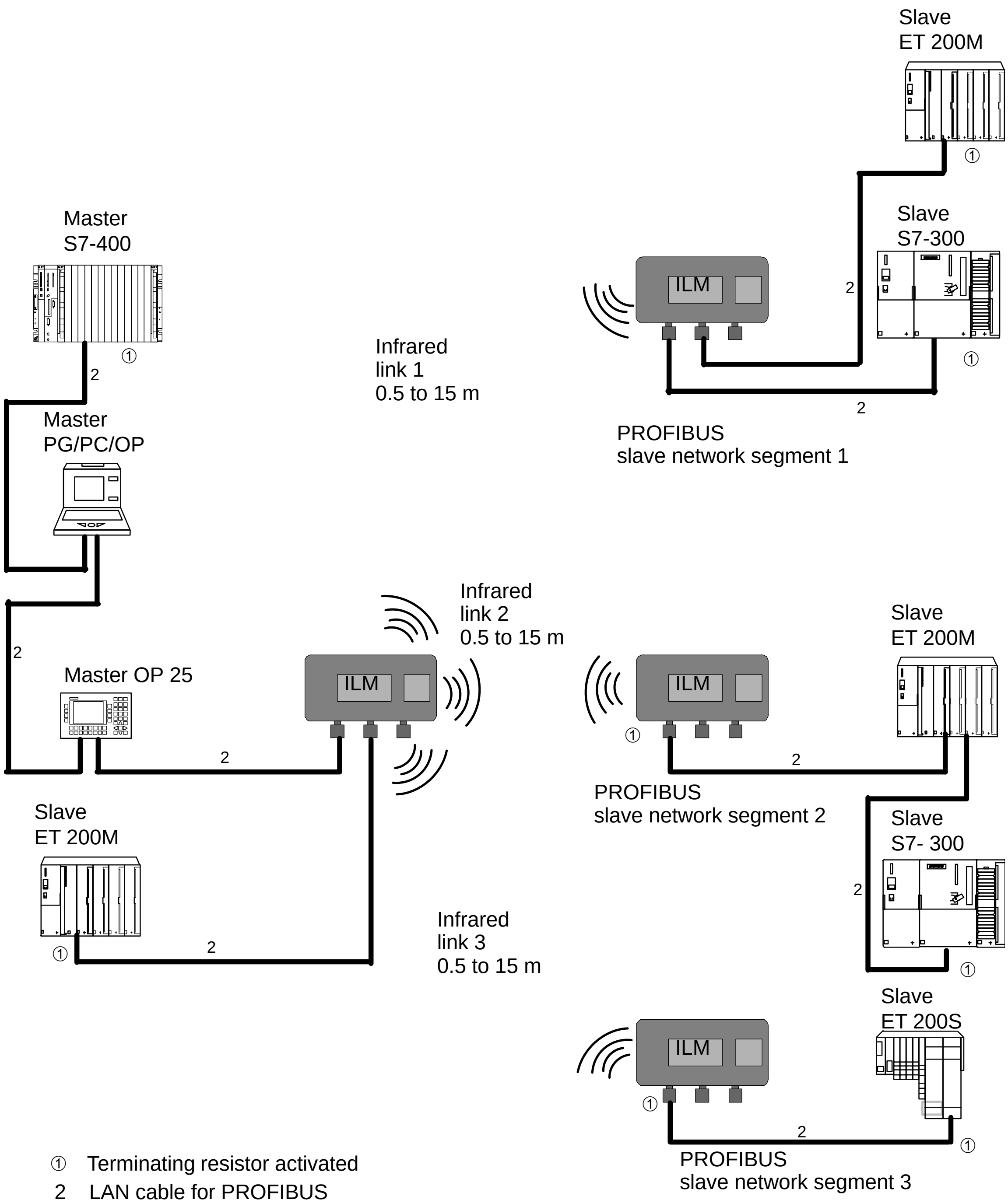


Figure 2-10 Point-to-Multipoint Link Using PROFIBUS ILMs (One Master Subnet, Three Subnets with Slaves)

2.4 Topologies with PROFIBUS-PA

Bus and Star Topology

With PROFIBUS-PA, the topology can be either a bus or star.

SpliTConnect System

The SpliTConnect tap (T tap) allows the structuring of a bus segment with DTE attachment points. The SpliTConnect tap can also be cascaded with the SpliTConnect coupler to form attachment distributors. Using the SpliTConnect terminator, the tap can be extended to become the segment terminator.

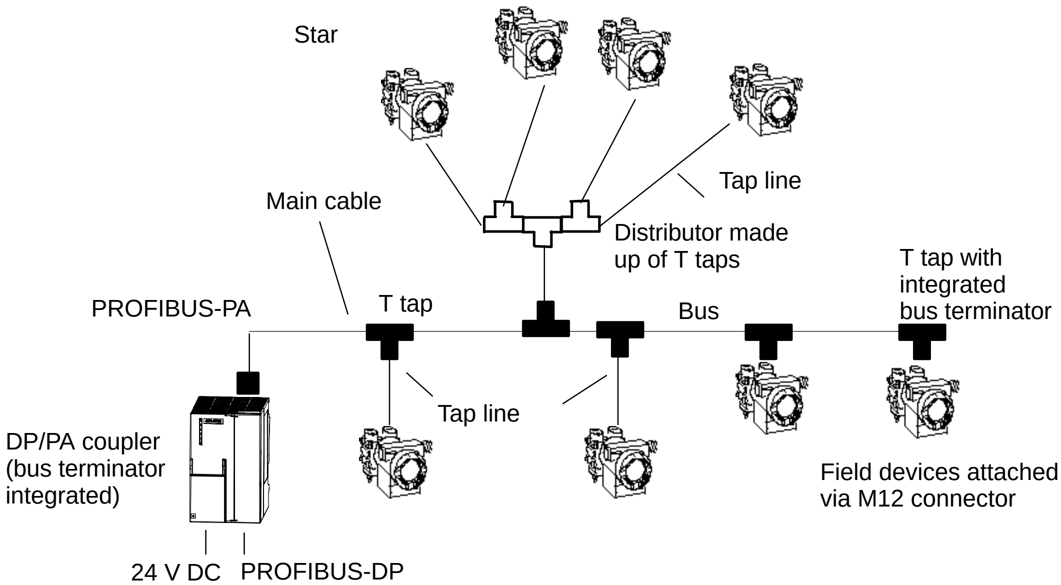


Figure 2-11 Bus and Star Topology

Field Device Power 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 field devices must not exceed the maximum output current of the DP/PA coupler. The maximum output current therefore limits the number of field devices that can be attached to PROFIBUS-PA.

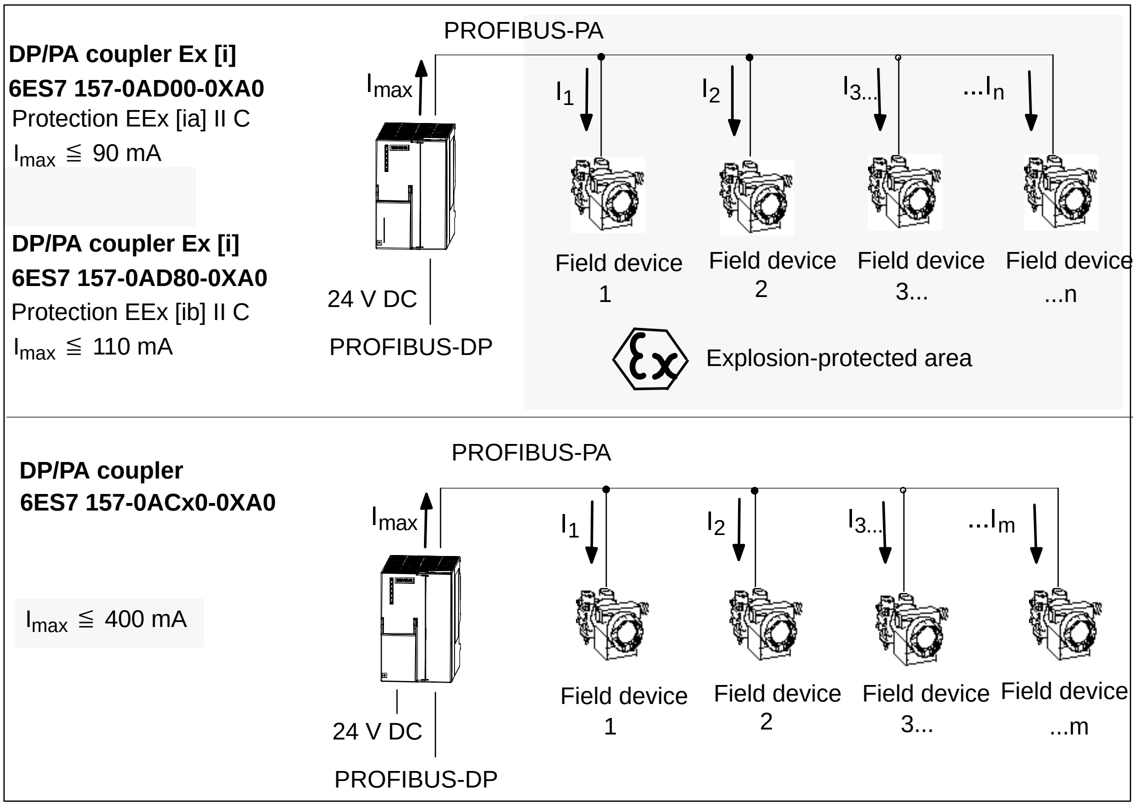


Figure 2-12 Field Device Power Supply in the Hazardous and Non-Hazardous Area

Expansion

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

Total Cable

The total cable is the total of the main cable and all the tap lines.

When using a standard PROFIBUS-PA cable with a cross-sectional area of 0.8 mm^2, the maximum length of the total cable (with a maximum number of field devices and worst-case positioning at the end of the cable) is as follows:

- 560 m for DP/PA coupler (6ES7 157-0AC00-0XA0)
- 680 m for DP/PA coupler (6ES7 157-0AD80-0XA0)
- 790 m for DP/PA coupler Ex [i] (6ES7 157-0AD00-0XA0)

Tap Line

The maximum permitted tap line lengths are listed in Table 2-2. You should also remember the maximum length of the total cable (see above).

Table 2-2 Tap Line Lengths for DP/PA Couplers

Number of tap lines	Maximum length of the tap line	
	DP/PA coupler	DP/PA coupler Ex [i]
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

2.5 Connectivity Devices

2.5.1 DP/DP Coupler

Uses

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

This principle corresponds to the hardware wiring of inputs and outputs. The coupler has two independent DP interfaces with which it attaches to the two DP networks.

The DP/DP coupler is a slave attached to the DP networks. The data exchange between the two DP networks involves internal copying within the coupler.

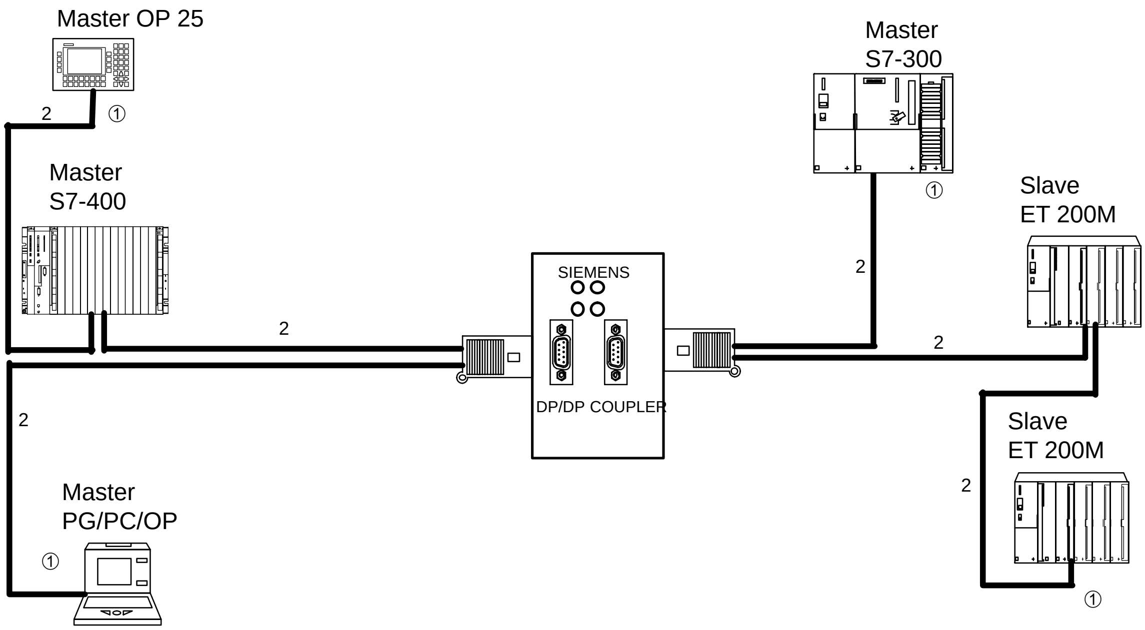
Figure 2-13 DP/DP Coupler

Design

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

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

The coupler is attached to each PROFIBUS-DP network via an integrated 9-pin sub-D connector.



① Terminating resistor activated
2 LAN cable for PROFIBUS

Figure 2-14 Configuration Example of the DP/DP Coupler

How the DP/DP Coupler Works

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

Parameter Assignment

The PROFIBUS-DP addresses are set using two DIP 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.

2.5.2 Connecting to PROFIBUS-PA

DP/PA Bus Coupling

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 the process automation (PA).

The DP/PA bus coupler is made up of the following modules:

- DP/PA Coupler Ex [i] (6ES7 157-0ADx0-0XA0)
- DP/PA Coupler (6ES7 157-0ACx0-0XA0)
- DP/PA Link IM 157 (6ES7 157-0AA80-0XA0)

To implement a DP/PA link in redundant operation, you also require the following:

- Bus module BM IM 157 for 2 x IM 157 (6ES7 195-7HE80-0XA0)
- Bus module BM DP/PA Coupler for 1 DP/PA Coupler (6ES7 195-7HF80-0XA0)

2.5.3 DP/PA Coupler

Figure 2-15 below illustrates how the DP/PA coupler is included in the system.

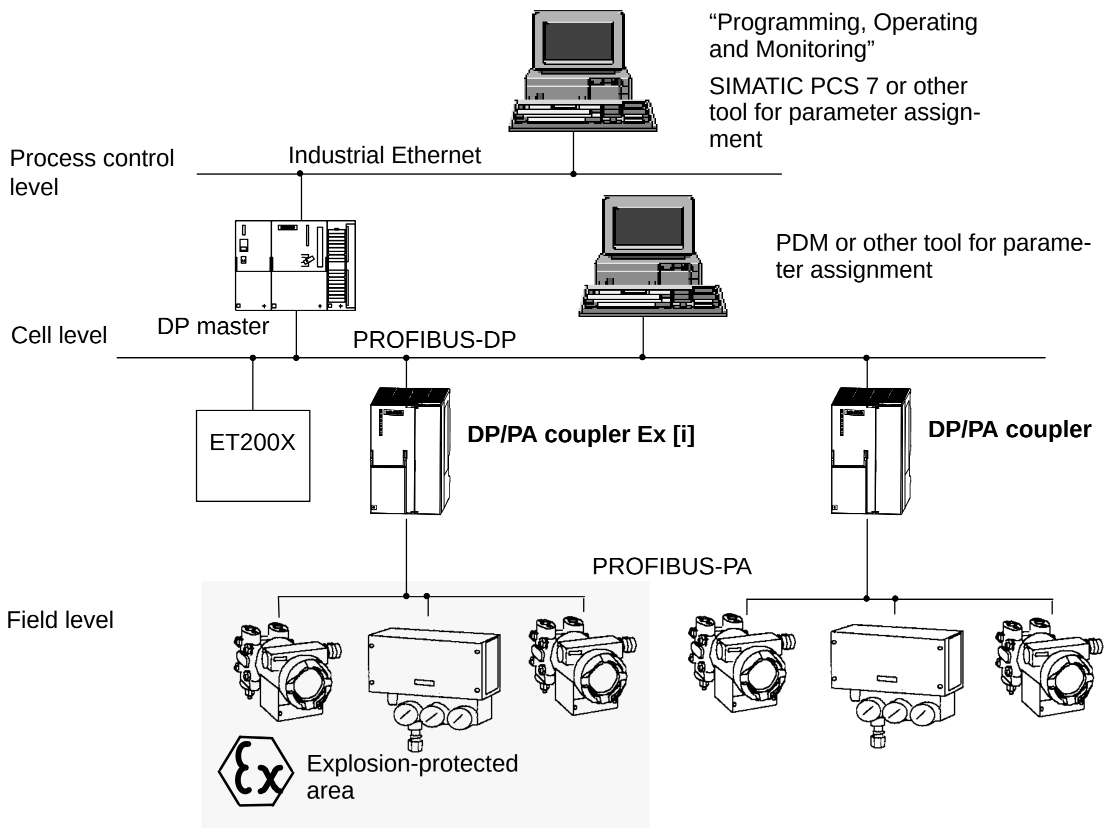


Figure 2-15 Linking the DP/PA Coupler into the System

Uses of the DP/PA Coupler

The DP/PA coupler is available in two versions:

- DP/PA coupler Ex [i]: You can attach all field devices certified for PROFIBUS-PA and that are located within the hazardous area.
- DP/PA coupler: You can attach all field devices that are certified for PROFIBUS-PA and that are outside the hazardous area.

The DP/PA coupler is an accompanying component according to EN 50014 or EN 50020 and must be installed outside the hazardous area.

Properties of the DP/PA Coupler (General)

The DP/PA coupler has the following characteristics:

- Electrical isolation between PROFIBUS-DP and PROFIBUS-PA
- Conversion of the physical transmission mechanism between RS-485 and IEC 61158-2
- Diagnostics using LEDs
- Transmission rate on PROFIBUS-DP 45.45 Kbps
- Transmission rate on PROFIBUS-PA 31.25 Kbps
- Integrated power supply unit

Properties of the DP/PA Coupler Ex [i]

The DP/PA coupler Ex [i] (6ES7 157-0AD00-0XA0) has the following additional characteristics:

- Type of Protection EEx [ia] II C
- Intrinsic safety
- Integrated, intrinsically safe power supply unit and integrated barrier

The DP/PA coupler Ex [i] (6ES7 157-0AD80-0XA0) has the following characteristics that differ from the DP/PA coupler EX [i] (6ES7 157-0AD00-0XA0):

- Type of protection EEx [ib] II C
- Extended environmental conditions (SIMATIC outdoor)

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.
- The DP/PA coupler does not need to be configured. You must only set the transmission rate 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 vendor-specific software configuration tool.

2.5.4 DP/PA Link

Definition

The DP/PA link consists of the IM 157 and up to a maximum of five DP/PA couplers. The DP/PA link is a DP slave at the PROFIBUS-DP side and a PA master at the PROFIBUS-PA side.

Uses

With the DP/PA link, you have an isolated interconnection between PROFIBUS-PA and PROFIBUS-DP with transmission rates of 9.6 Kbps to 12 Mbps.

The DP/PA link can only be used in SIMATIC S7.

Figure 2-16 below shows where the DP/PA link fits in.

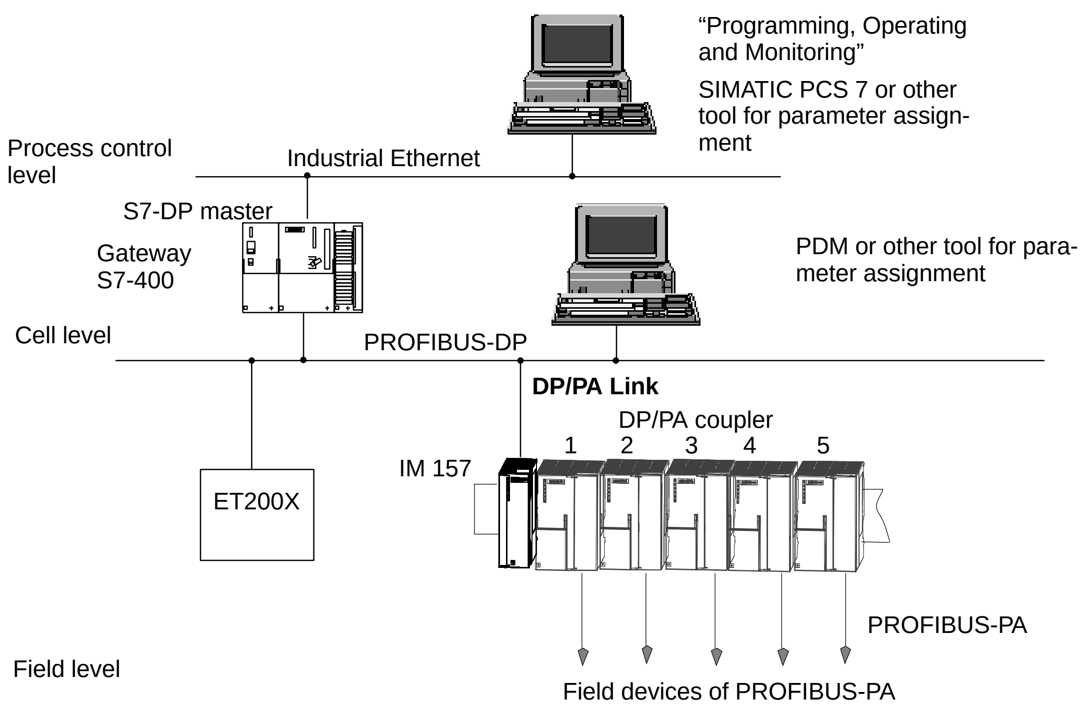


Figure 2-16 Location of the DP/PA Link

The DP/PA link must be installed outside the hazardous area.

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 rates (9.6 Kbps to 12 Mbps)
- Only DP/PA couplers can be operated with an IM 157

How the DP/PA Link Works

Figure 2-17 shows how the DP/PA link with the IM 157 and the DP/PA couplers functions.

- The DP/PA link maps the underlying PROFIBUS-PA system on a DP slave.
- With the DP/PA link, PROFIBUS-DP is completely isolated from PROFIBUS-PA.
- The PA master and PA slaves form a separate, underlying bus system.
- The number of DP/PA couplers simply reflects the amount of current required. All DP/PA couplers along with the attached PA field devices form **one** common PROFIBUS-PA bus system.

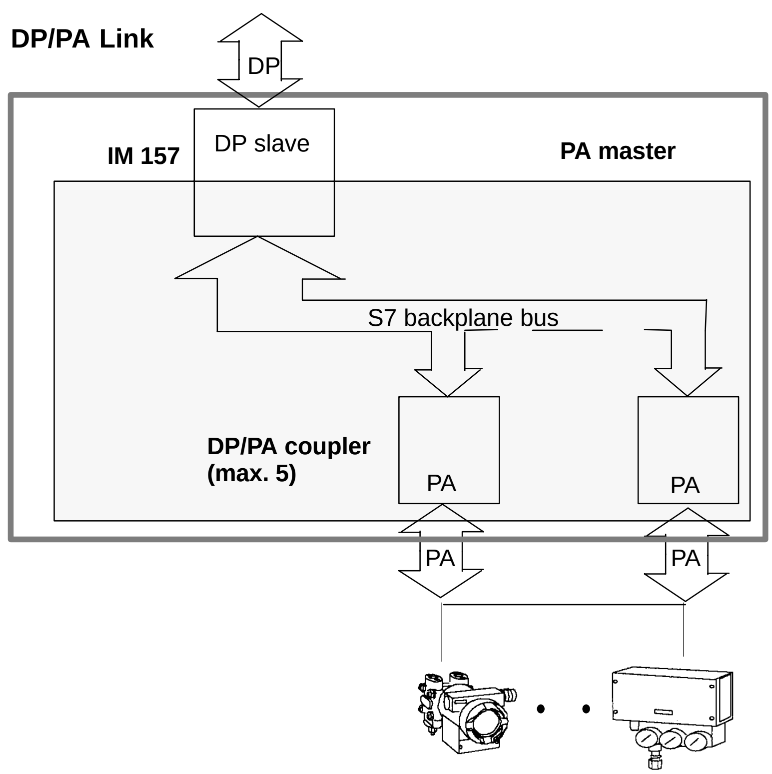


Figure 2-17 The DP/PA Link with DP/PA Couplers

Rules

The following rules must be taken into account when extending 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) can 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.

2.5.5 Connecting PROFIBUS-DP to RS-232C

Design

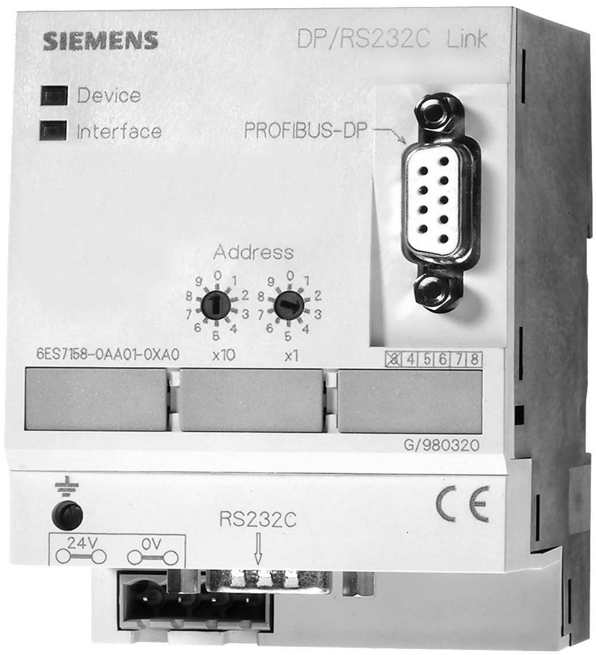


Figure 2-18 DP/RS-232C Link for PROFIBUS-DP

The DP/RS-232C link consists of a compact 70 mm housing for standard rail mounting. Ideally the module should be installed vertically. The modules can be inserted one beside the other without gaps being necessary. The module is attached to PROFIBUS-DP via a 9-pin sub-D female connector. The RS-232C interface is implemented as a 9-pin sub-D connector.

Uses

The PROFIBUS-DP/RS-232C link is a converter between an RS-232C (V.24) interface and PROFIBUS-DP. Devices with an RS-232C interface can be linked to PROFIBUS-DP with the DP/RS-232C link. The DP/RS-232C link supports the procedures 3964 R and free ASCII protocol.

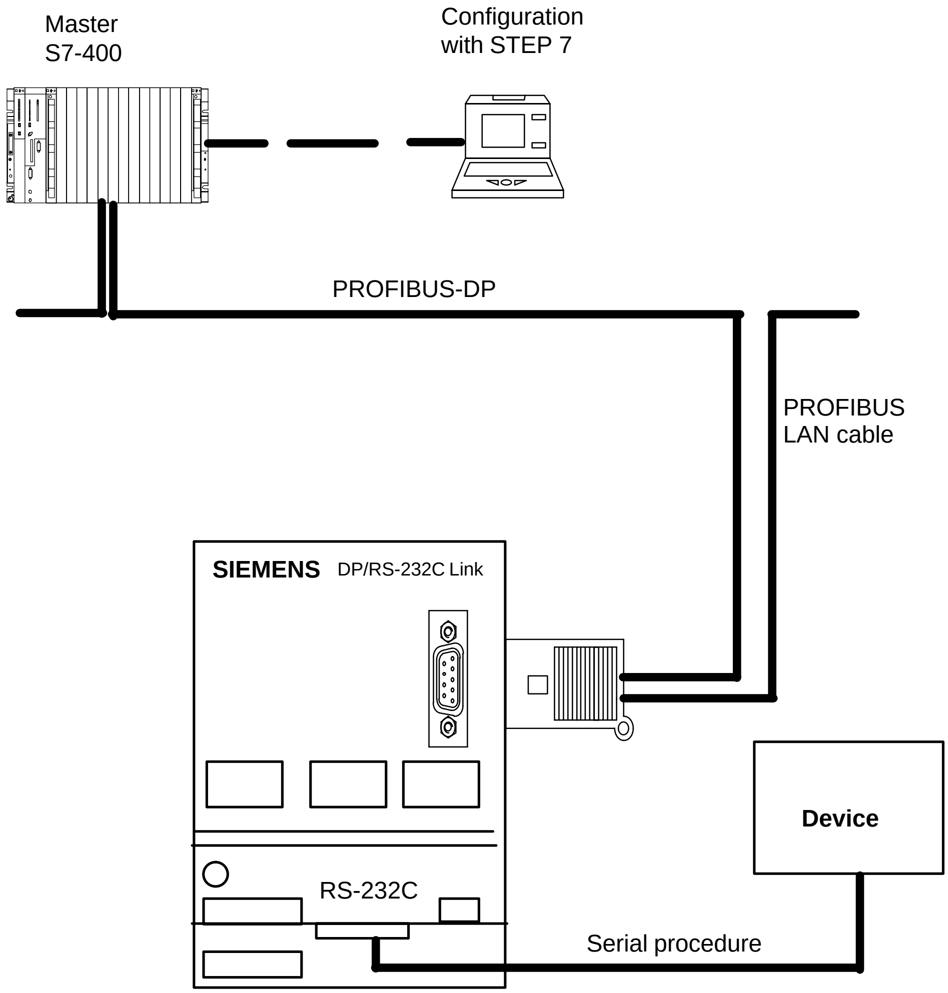


Figure 2-19 Example of a Configuration with DP/RS-232C Link

How the DP/RS-232C Link Works

The PROFIBUS-DP/RS-232C link is connected with the device over a point-to-point connection. The PROFIBUS-DP/RS-232C link converts to the PROFIBUS-DP protocol. Consistent data are transferred in both directions. A maximum of 224 bytes of user data can be transferred per frame.

Parameter Assignment

The PROFIBUS-DP address can be set using two switches on the front panel. To configure the unit, you use the GSD file and the configuration tool of the connected device, for example STEP 7.

2.5.6 Connecting with the DP/AS-Interface Link 65

Design

Figure 2-20 DP/AS-Interface Link 65

The DP/AS-interface link has a robust aluminum die-cast casing with the degree of protection IP 65. In terms of water tightness, it complies with the standard “Enclosures for Electrical Equipment UL 50, Type 4”, and is suitable for temperatures from -25 °C to +60 °C. On the casing, there are diagnostic LEDs for PROFIBUS-DP and the AS interface. The node address for PROFIBUS-DP can be set using DIL switches or using an EEPROM. To set the address using the EEPROM, you can use the ET 200 handheld. The DP/AS-interface link can be installed anywhere and in any position. The attachment to PROFIBUS-DP is via a 12-pin round connector, the attachment to AS-interface is via a 4-pin modular connector (M12 AS-interface attachment).

Uses

The DP/AS-interface link connects the PROFIBUS-DP fieldbus with the AS-interface. The DP/AS-interface link 65 can be connected to any PROFIBUS-DP master capable of handling parameter assignment and diagnostic frames with a length of 32 bytes. The DP/AS-interface link 65 allows the actuator-sensor interface to be used as a subnet for PROFIBUS-DP. You can therefore combine the advantages of PROFIBUS-DP and AS-interface in a common bus system.

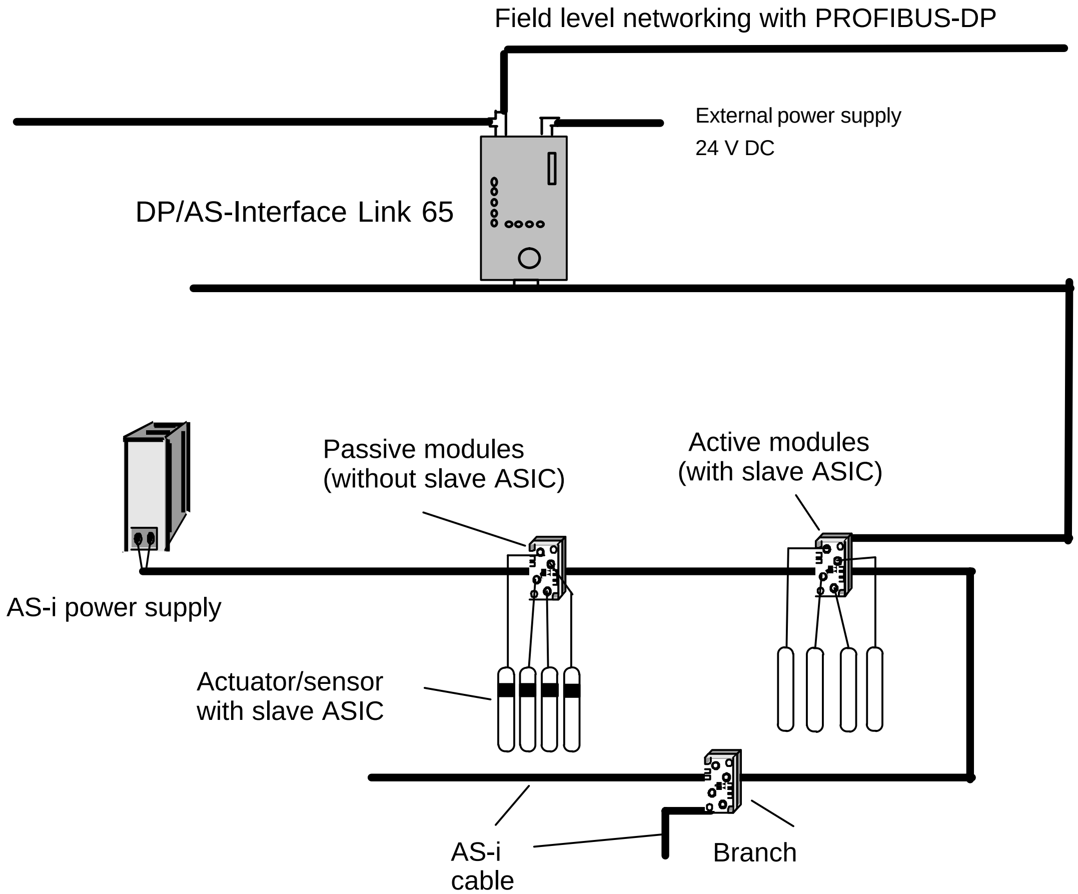


Figure 2-21   Example of a Configuration with DP/AS-Interface Link 65

How the DP/AS-Interface Link 65 Works

The DP/AS-interface link 65 links PROFIBUS-DP with the AS-interface with degree of protection IP 65. The DP/AS-interface link 65 can be connected to any PROFIBUS-DP master that can send parameter assignment frames with a length of 32 bytes. To act as a connectivity device between the two bus systems, the DP/AS-interface link has the functionality of an AS-interface master towards the AS-interface and the functionality of a PROFIBUS-DP slave towards PROFIBUS-DP. Up to 31 DP/AS-interface slaves can be attached to the DP/AS-interface link. The DP/AS-interface link is therefore a modular slave with up to 31 modules from the point of view of PROFIBUS-DP.

Parameter Assignment

Like all other components of the distributed I/O system ET 200, the DP/AS-interface link is an integral part of STEP 7 and COM PROFIBUS. You can display information about working with the parameter assignment software and configuring at any time using the context-sensitive help.

2.5.7 Connecting with the DP/AS-Interface Link 20

Design

Figure 2-22 DP/AS-Interface Link 20

The DP/AS-interface link 20 consists of a small, compact casing with degree of protection IP20. The LEDs on the front panel indicate the following:

- AS-Interface statuses
- Attached and active slaves and their operability
- PROFIBUS slave address
- PROFIBUS bus errors and diagnostics

The DP/AS-interface link 20 also has a button with which the operating mode can be changed, with which the existing configuration can be adopted and for setting the PROFIBUS slave address.

Uses

The DP/AS-interface link 20 implements a small, cost-effective link between PROFIBUS and AS-interface. The DP/AS-interface link 20 requires no additional power supply, the power is supplied on the AS-interface cable. The AS-interface segment can be started up without PROFIBUS-DP being in operation.

The DP/AS-interface link 20 is a PROFIBUS-DP slave (complying with EN 50170) and AS-interface master in one unit and provides a simple link between PROFIBUS-DP and the AS-interface. The DP/AS-interface link 20 allows system attachment of the following:

- PROFIBUS-DP master, for example CP 342-5 for S7-300, CP 443-5 extended for S7-400, CP 5431 FMS/DP or IM 308C for SIMATIC S5, CP 5412 (A2) for PC or CP 5611/CP 5511 for PCs with DP-SOFTNET software.
- Other systems with DP master functionality

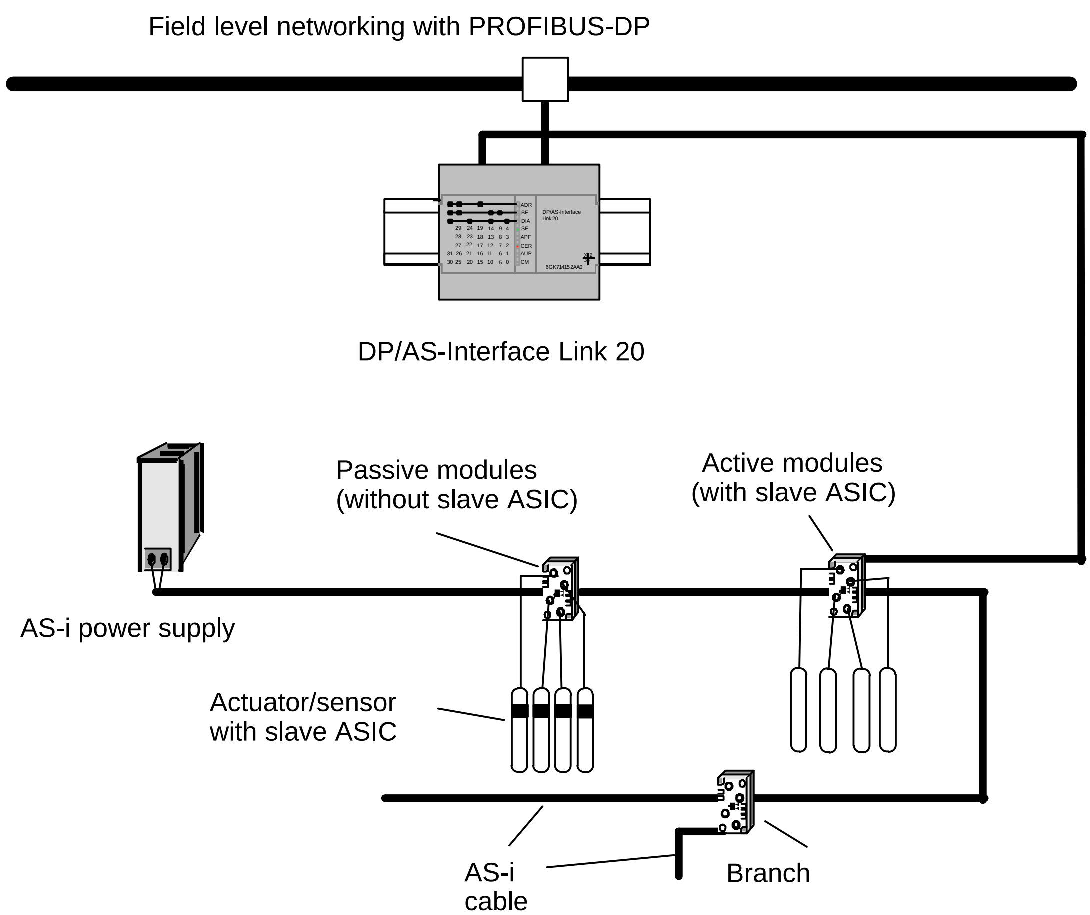


Figure 2-23 Example of a Configuration with DP/AS-Interface Link 20

How the DP/AS Interface Link 20 Works

With the DP/AS-interface link 20, up to 248 binary elements are accessible to a DP master on the AS-interface (124 inputs and 124 outputs). You can therefore combine the advantages of PROFIBUS-DP and AS-interface in a plant. The DP/AS-interface link 20 can be used in the AS-interface standard mode (M2). In this mode, the data bits of the slaves are accessible. The following master calls are supported.

- Change address
- Write parameters
- Read configuration data
- Set configuration mode
- Configure actual configuration

Parameter Assignment

The DP/AS-interface link 20 is supported by STEP 7 (V4.1 and higher) and COM PROFIBUS (V 3.2 and higher). The type and GSD files are shipped along with the manual. On the AS-interface side, no special configuration is necessary; the AS-Interface segment can be put into operation without PROFIBUS.

2.5.8 Connecting PROFIBUS-DP to *instabus EIB*

Design

Figure 2-24 DP/*EIB* Link

The DP/EIB link allows a connection between the two open standard systems for industrial automation PROFIBUS-DP and building automation *instabus EIB*. This provides an ideal connection between the high performance of the PROFIBUS components and the extreme flexibility of the *instabus EIB* system.

The DP/EIB link is a DP slave (complying with EN 50170) and at the same time a node on the *instabus EIB*.

The displays and operating controls are as follows:

- LED for *EIB* bus errors
- LED for PROFIBUS bus errors
- LED for power supply OK
- Coding switch for the PROFIBUS address
- Programming button for *EIB*.

Uses

The DP/EIB link can be used wherever PROFIBUS or *instabus EIB* is used; in other words, a distinction can be made between two areas of application:

Building Automation

In other words, we are assuming that *instabus EIB* exists and that you want to use, for example, an S7 PLC for administrative control tasks or, for example, an HMI system for central operator control and monitoring. The main emphasis here is in offices or apartment blocks etc.

The simplest option for connecting these systems to *instabus EIB* is provided by the DP/EIB link since these systems generally access the peripheral devices via PROFIBUS.

The main areas of application are as follows:

- (Primary) open-loop control, closed-loop control and monitoring of heating systems
- Ventilation, air-conditioning, and
- Energy management and optimization

Industrial Automation

In this case, we assume that PROFIBUS exists and that you would like to include the electrical components of an assembly line, plant or production building in the automation. The main emphasis here is the equipment of industrial buildings themselves.

Applications include, for example, the following:

- lighting control
- shutter control,
- measurement of temperature, wind strength, or the position of the sun,
- door control and
- building access controls.

The *instabus EIB* is specifically designed for such tasks and provides a wide selection of components and a large network span (maximum 1000 m per bus). Up to 11,520 *instabus EIB* devices are possible in one network (a maximum of 15 areas each with a maximum of 12 buses each with up to 64 nodes).

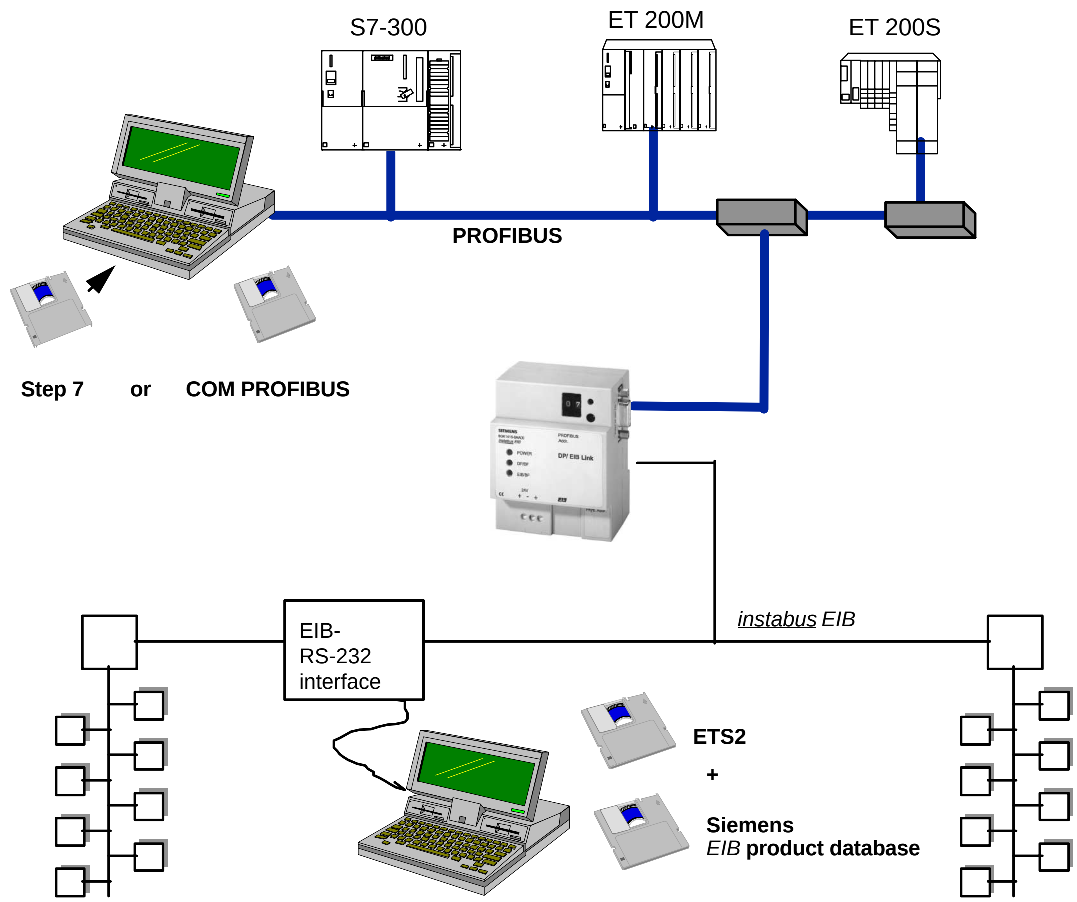


Figure 2-25 Example of a System Structure using DP/*EIB* Link

How the DP/*EIB* Link Works

The data objects of the *instabus EIB* are mapped in the PROFIBUS I/O area.

The structuring of the PROFIBUS slave I/O area and the number of *EIB* data objects with which the DP master communicates is decided by a selectable profile. In total, five different profiles are available that allow the user to adapt the DP/*EIB* link to the relevant application and to make optimum use of the memory resources of the DP master.

You configure the system (in other words set a profile) via PROFIBUS using, for example STEP 7 or COM PROFIBUS. The number of data objects specified by the selected profile can be assigned to the required *instabus EIB* components with the *instabus EIB* configuration software ETS 2.

Due to the database entry of the DP/*EIB* link, the *instabus EIB* configuration software ETS 2 is capable of displaying the number and data type of the valid *instabus EIB* data objects to the user. This allows a simple error-free assignment to be made. Following configuration, the PROFIBUS-DP master can both write and read the *instabus EIB* data objects.

Configuring

The link module can be configured as a DP slave, for example with the standard tools STEP 7 or COM PROFIBUS and on the *instabus EIB* using the configuration software ETS 2.

- DP
  A GSD file is supplied with the manual. The DP slave address is set with a coding switch on the DP/EIB link.
- *instabus EIB*
  The database entry of the DP/EIB link for *instabus EIB* configuration software ETS 2 is supplied with the DP/EIB manual.

For further details, refer to the DP/EIB link manual.

Configuring Networks 3

3.1 Configuring Electrical Networks

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.

Parameters

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

- The transmission rate required for the task
  (within a network, only one uniform transmission rate can be used)
- The required number of nodes
- The type of network components required (bus terminals, bus connectors, connecting cables)
- The LAN cables to be used
- The required segment lengths
- The electromagnetic and mechanical environment of the cabling (for example surge voltage protection, cable route)
- The number of RS-485 repeaters between any two DTEs is limited to a maximum of 9
- 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 (see Section 3.3).

Cable Termination

Regardless of the transmission rate, the ends of all segments must be terminated by activating the terminating resistor in the connector. After the terminating resistor has been activated, no further cable sections are permitted.

The terminating resistor is only effective when it is supplied with voltage. This means that the corresponding DTE or the RS-485 repeater must be supplied with power. As an alternative, the PROFIBUS terminator can be used as a permanent terminating resistor.

Note

The power supply to terminating resistors must not be interrupted by turning off the DTE or repeater or by unplugging the bus connector or tap line. If the power supply to the terminating resistors cannot be guaranteed, the PROFIBUS terminator must be used.

3.1.1 Segments for Transmission Rates up to a Maximum of 500 Kbps

Transmission Rates up to a Maximum of 500 Kbps

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

Table 3-1 Possible Segment Lengths

Transmission Rate in Kbps	Segment Length for Cable Type	
	– FC Standard Cable – 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
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 (DTEs, repeaters, OLMs, BT12 M,...) to one segment is 32.

Length of the Tap Lines

If you do not attach the LAN cable directly to the bus connector (for example,when using a PROFIBUS bus terminal), you must take into account the maximum possible tap line length!

The following table shows the maximum permitted lengths of tap lines per bus segment:

Table 3-2 Lengths of the Tap Lines per Segment

Transmission rate	Max. length of the tap lines per segment	Number of nodes with tap line length of ...	
		1.5 m or 1.6 m	3 m
9.6 – 93.75 Kbps	96 m	32	32
187.5 Kbps	75 m	32	25
500 Kbps	30 m	20	10

3.1.2 Segments for a Transmission Rate of 1.5 Mbps

Transmission Rate 1.5 Mbps

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

Table 3-3 Possible Segment Lengths

	Segment Length for Cable Type	
Transmission Rate in Kbps	– FC Standard Cable – 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
1.500	200 m	200 m

Node Attachments at 1.5 Mbps

Each attachment of a node to the LAN cable represents a capacitive mismatch that has no effect at lower transmission rates. At a transmission rate 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.

Value 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 value factors to the components (see Table 3-4).

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

Table 3-4 Values for Segments at 1.5 Mbps

Product Name	Value (V)
Bus terminal with 1.5 m long tap line (Order no. 6GK1 500-0AA00, Version 2)	1.5
Bus terminal with 1.5 m long tap line, with PG interface (Order no. 6GK1 500-0DA00, Version 2)	1.5
Bus terminal with 3.0 m long tap line (Order no. 6GK1 500-0BA00, Version 2)	2.5
Bus connector with 30° cable outlet (Order no. 6ES7 972-0BA30-0XA0)	0.7
Bus connector with axial cable outlet (Order no.: 6GK1 500-0EA02) Bus connector with axial cable outlet for FastConnect system (Order no.: 6GK1 500-0FC00) Bus connector with 90° cable outlet (Order no.: 6ES7 972-0BA11-0XA0) Bus connector with 90° cable outlet with PG interface (Order no.: 6ES7 972-0BB11-0XA0) Bus connector with 90° cable outlet for FastConnect system (Order no.: 6ES7 972-0BA50-0XA0) Bus connector with 90° cable outlet with PG interface (Order no.: 6ES7 972-0BB50-0XA0) Bus connector with 35° cable outlet (Order no.: 6ES7 972-0BA40-0XA0) Bus connector with 35° cable outlet with PG interface (Order no.: 6ES7 972-0BB40-0XA0)	0.1
Bus terminal BT12M (Order no. 6GK1500-0AA10)	0.1
RS-485 repeater (attachment of bus segments) (Order no. 6ES7 972-0AA01-0XA0)	0.1
PROFIBUS terminator (active RS-485 attachment element) (Order no. 6ES7 972-0DA01-0AA0)	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 rate of 1.5 Mbps, the following rules apply to the permitted number of nodes and their distribution/layout on a SIMATIC NET PROFIBUS segment:

1. The maximum permitted number of nodes on any segment is 32.
2. The sum of the values of all the connection elements in a segment must be $\leq$ 25.
3. The rules for the distance between adjacent connection elements are as follows (distance in this case is the length of the LAN cable):

   3.1 If the distance between adjacent connection elements is greater than 10 m, the values of the connection elements can be ignored.

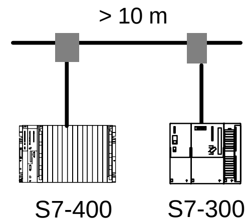
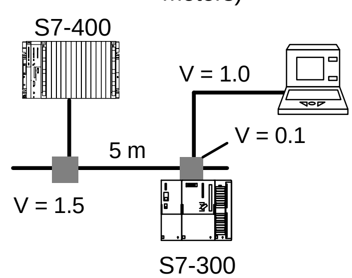
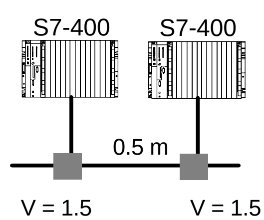
   3.2 If the distance between adjacent connections elements is greater than the sum of the two values of the elements in meters, the layout is not critical and no additional conditions need to be taken into account. The value of the PG connecting cable, SIMATIC S5/S7 connecting cable 12 Mbps must be added to the value of the corresponding connection element.

   3.3 If the minimum clearance described in 3.2 is not kept to, this results in a group being formed and the following additional conditions must be met:

   – Attachment elements can be arranged as close to each other as required providing the sum of their 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 values of the two groups.

Table 3-5 Examples Illustrating the Configuration Rules

No special conditions if the length of the LAN cable between two DTEs > 10 m	LAN cable > 10 m 
No special conditions if the length of the LAN cables between two DTEs is greater than the sum of values of both DTEs. If a bus terminal or a bus connector has a PG interface, a connected PG connecting cable must be taken into account when calculating the values.	Bus cable, e.g. 5 m V = 1.5 + 1.0 + 0.1 = 2.6 5 m > 2.6 m (sum of the values in meters) 
Take the values of a group into account if the sum of the values is greater than the LAN cable between the DTEs. Elements can be close to each other providing the total value of a group does not exceed 5.	LAN cable e.g. 0.5 m group V = 1.5 + 1.5 0.5 m < 3 m $\Rightarrow$ group formed $\Rightarrow$ sum of the values ≤ 5 

3.1.3 Segments for Transmission Rates up to a Maximum of 12 Mbps

Transmission Rate up to a Maximum of 12 Mbps

Table 3-6 Possible Segment Lengths

Transmission Rate in Mbps	Segment Length for Cable Type – FC Standard Cable – 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
3	100 m	100 m
6	100 m	100 m
12	100 m	100 m

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

- To attach DTEs to bus segments, only the bus connectors permitted for 12 Mbps or the BT12M bus terminal can be used.
- The maximum length of a segment must not exceed 100 m.
- The maximum number of bus attachments (nodes, OLMs, RS-485 repeaters,...) in one segment is restricted to 32.
- To attach a programming device or PC via a tap line, only the “SIMATIC S5/S7 connecting cable, 12 Mbps, order no. 6ES7901-4BD00-0XA0” can be used.

Note

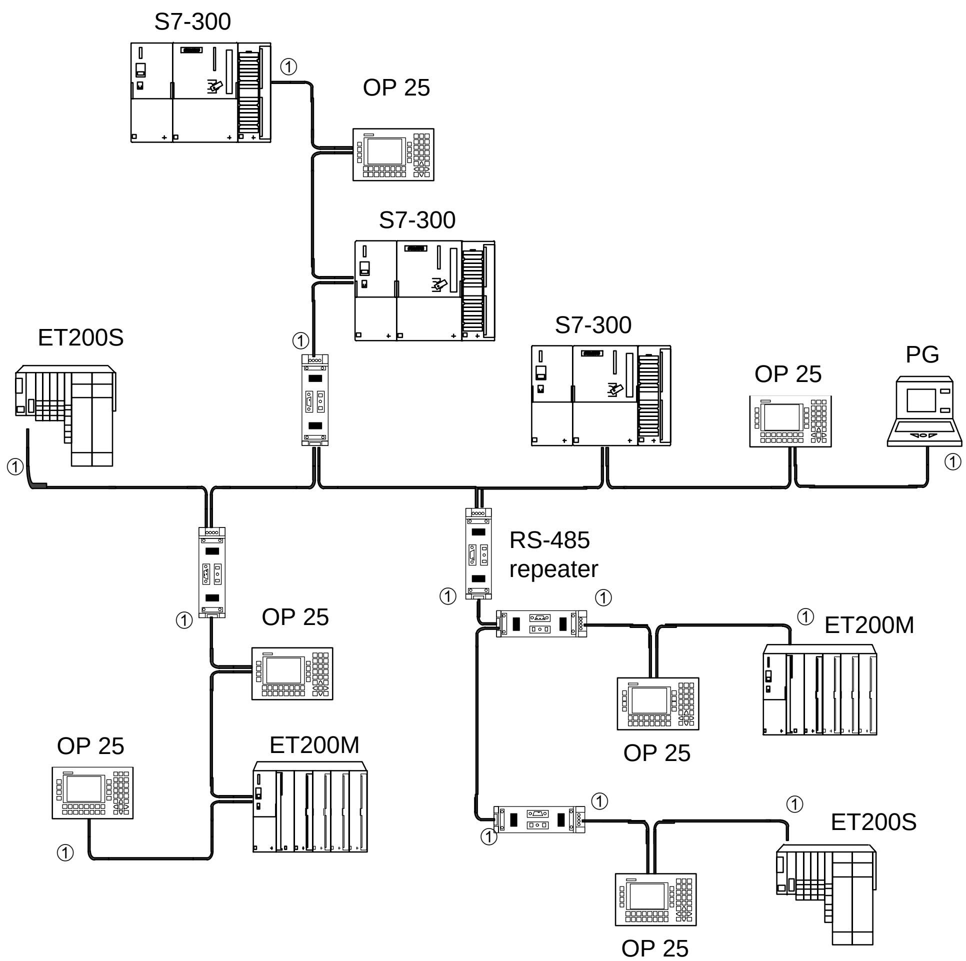
If several bus connectors are used at electrically short distances (in other words, the cable length between adjacent connectors is less than 1 m) (for example, several slaves in one cubicle), avoid disconnecting several bus connectors at the same time for longer periods. Disconnecting more than one bus connector does not necessarily mean errors but may well reduce the reliability (immunity to noise) of a segment.

3.1.4 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 RS-485 repeaters to form a network. Figure 3-1 illustrates how several segments can be connected together with repeaters to create a network.

The RS-485 repeaters support all transmission rates from 9.6 Kbps to 12 Mbps.



① Terminating resistor activated

Figure 3-1 Layout of an Electrical PROFIBUS Network Using RS-485 Repeaters

Configuring

When configuring an electrical network with RS-485 repeaters, the following conditions must be taken into account:

- The maximum segment length for the transmission rate must be adhered to (see Table 3-1, Table 3-3, Table 3-6,)
- The maximum number of bus attachments (nodes, OLMs, RS-485 repeaters,...) in one segment is restricted to 32. There may be further restrictions at a transmission rate of 1.5 Mbps (see Section 3.1.2).
- The maximum number of nodes in one network is limited to 127.
- A maximum of 9 RS-485 repeaters can be installed between two nodes.

3.2 Configuring Optical Networks

Configuration Parameters for Optical Networks

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

- Using fiber-optic cables, only point-to-point 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 rates of the components (only one uniform transmission rate can be used in a network).
- The cascading rules for the components used.
- The maximum permitted number of nodes in the network.
- In large-span networks, the transmission delay time.

3.2.1 How a Fiber-Optic 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 Path

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

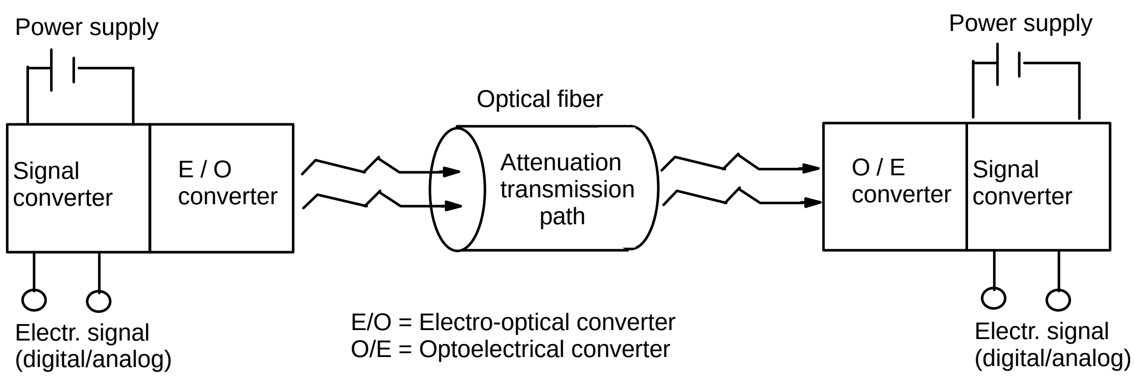


Figure 3-2 Structure of a Link

Transmitter

The **transmitter** in an optical digital transmission system consists of a signal converter that converts the digital signals from the electronics in to a pulse type suitable for the electro-optical converter, and an electro-optical 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. The LEDs are specially adapted to the various transmission media.

Transmission Media

The **transmission media** used in SIMATIC NET PROFIBUS are as follows:

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

For more detailed information about the various fiber-optic cables for SIMATIC NET PROFIBUS, refer to Chapter 7.

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).

3.2.2 Optical Power Budget of a Fiber-Optic Transmission System

Optical Power Budget

The transmitted optical power P_{out} and the received optical power P_{rec} 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 P_0=1mW. The following formula applies:

$$P_x \text{ [in dBm]} = 10*\log(P_x \text{ [in mW]} / P_0)$$

Examples:

Transmitter Power P_x	Transmitter Power as Logarithmic Power Ratio P_x to P_o
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 signal-to-noise 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 transmitter 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 transmitter power:

- The attenuation of the fiber a_{FOC} [in dB/km or dB/m] (see manufacturers 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 transmitter power and receiver sensitivity.

Plastic and PCF FO Cables

Plastic and PCF FO cables can only be used on short distances due to their relatively high fiber attenuation. They are installed in one piece. Fiber-optic connections with couplers or splices should not be considered since they further reduce the distance that can be covered.
The maximum permitted cable lengths are listed in Tables 3-7 and 3-8.

Glass FO Cables

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 fiber-optic path must then be put together in cable sections.
The couplers or splices where the sections are joined always involve certain attenuation losses.
With transmission paths using glass fibers, the following aspects must also be taken into account:

- The attenuation of splices
- The attenuation of 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).

Link Power Margin

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 link power margin calculated is lower, the transmission path will not be reliable 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 path, when installing glass fibers, the installed sections must be tested during installation and the measured values logged (see Section A-2 “Testing FO Transmission Paths”).

Work Sheet

Section 3.2.4 of this manual contains a work sheet for calculating the power budget of glass fiber-optical links.

3.2.3 Cable Lengths for Plastic and PCF FO Paths

The length of the transmission path on fiber-optic cables is **not dependent** on the transmission rate.

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 fiber-optic cable used and the optical network components.

Table 3-7 Permitted Cable Lengths with Integrated Optical Interfaces or OBT

Fiber-optic cable SIMATIC NET PROFIBUS	Maximum cable lengths between two nodes (in m)	For 1 Network (= 32 nodes) (in m)
Plastic fiber-optic, duplex cord	50	1550
Plastic fiber-optic, standard cable	50	1550
PCF fiber-optic, standard cable	300	9300

Table 3-8 Permitted Cable Lengths in an OLM Network

Fiber-optic cable SIMATIC NET PROFIBUS	Maximum cable lengths between two nodes (in m)	For 1 Network (= 32 nodes) (in m)
Plastic fiber-optic, duplex cord	50	1550
Plastic fiber-optic, standard cable	80	2480
PCF fiber-optic, standard cable	400	12400

Note

- Optical buses can contain max. 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 3.3). This number must not exceed 122.

Mixing Plastic Fiber-Optic and PCF Fiber-Optic

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

For example, connection between distributed local DP slaves using plastic fiber-optic (distances $<$ 50 m) and connection between DP master to the first DP slave of the bus topology with PCF fiber-optic (distance $>$ 50 m).

3.2.4 Calculating the Power Budget of Glass Fiber Optical 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/G11-1300 and OLM/G12-1300 at a wavelength of 1300 nm.

Note

Please note that the information on fiber attenuation in the data sheets and type specifications of fiber-optic cables are based on measurements with narrow-band laser light sources exactly 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 fiber-optic 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 two 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 point-to-point 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}	Number
0.4 dB	1

+

Number * a_{Conn} **0.4 dB**

+

Attenuation caused by splices

a_{Spl}	Number
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

$P_{out, min}$
–13 dBm

Receiver sensitivity

$P_{rec, min}$
–28 dBm

Maximum permitted attenuation **$a_{max} = P_{out, min} - P_{rec, min}$ =** **15.0 dB**

Link power margin **$a_{max} - a_{Path}$ =** **4.0 dB**

The transmission path can be implemented as planned.

Power Budget for OLM G11-1300, G12-1300 for One Point-to-Point Link at Wavelength λ = 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}	Number
1 dB	0

+

Number * a_{Conn} **0 dB**

+

Attenuation caused by splices

a_{Spl}	Number
0.2 dB	5

Number * a_{Spl} **1.0 dB**

Attenuation of the transmission path **a_{Path} =** **10.0 dB**

Data of the OLM/G11-1300, G12-1300 power that can be coupled into 62.5/125 µm fibers

$P_{out, min}$
–17 dBm

Receiver sensitivity

$Prec_{, min}$
–29 dBm

Maximum permitted attenuation **$a_{max} = P_{out, min} - P_{rec, min}$ =** **12 dB**

Link power margin **$a_{max} - a_{Path}$ =** **2 dB**

The transmission path can be implemented as planned.

Note

The maximum length of fiber-optic 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.

Blank form for a power budget using OLMs

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

Attenuation on the cable

Fiber type (µm)	Attenuation a_{FOC} in dB/km	Cable length L in km

L* a_{FOC} = dB

Attenuation of connectors

a_{Conn} (dB)	Number

\+

Number * a_{Conn} dB

Attenuation caused by splices

a_{Spl} (dB)	Number

Number * a_{Spl} dB

Attenuation of the transmission path **a_{Path} =** dB

Power that can be coupled into µm fiber

$P_{out, min}$ (dBm)

Receiver sensitivity

$P_{rec, min}$ (dBm)

Maximum permitted attenuation **$a_{max} = P_{out, min} - P_{rec, min}$ =** dB

Link power margin **$a_{max} - a_{Path}$ =** dB

3.3 Transmission Delay Time

The system reaction time of a PROFIBUS network depends largely 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 bus parameters are adapted (configured) 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 rate.

3.3.1 Configuring Optical Buses and Star Topologies with OLMs

Creating a System Overview

You configure the PROFIBUS network, for example with SIMATIC STEP 7. The bus-specific configuration begins with the creation of the system overview in the hardware configuration dialog “HW Config” of STEP 7 (V5.0).

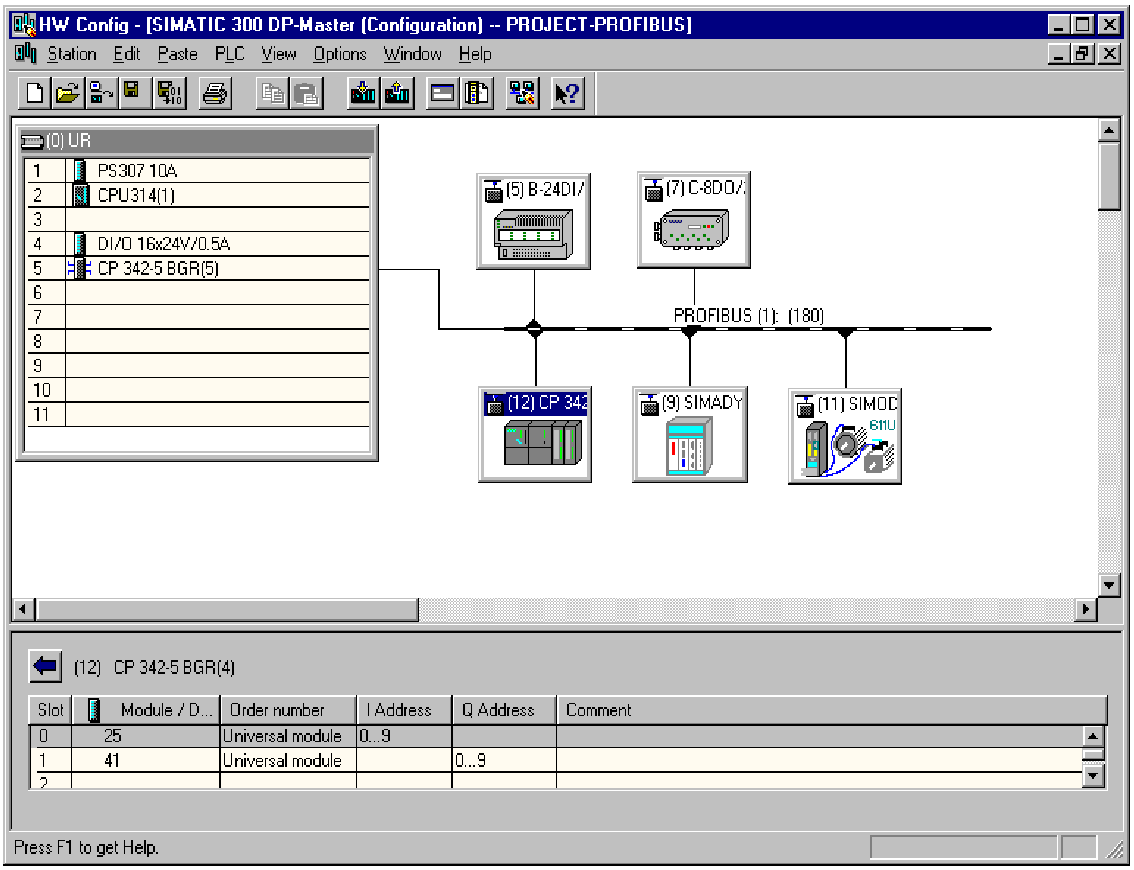


Figure 3-3 “HW Config” Dialog in STEP 7 (V5.0)

Setting the PROFIBUS Properties

In the “Properties – PROFIBUS” dialog, you can set the highest station address (HSA), the transmission rate and the bus profile.

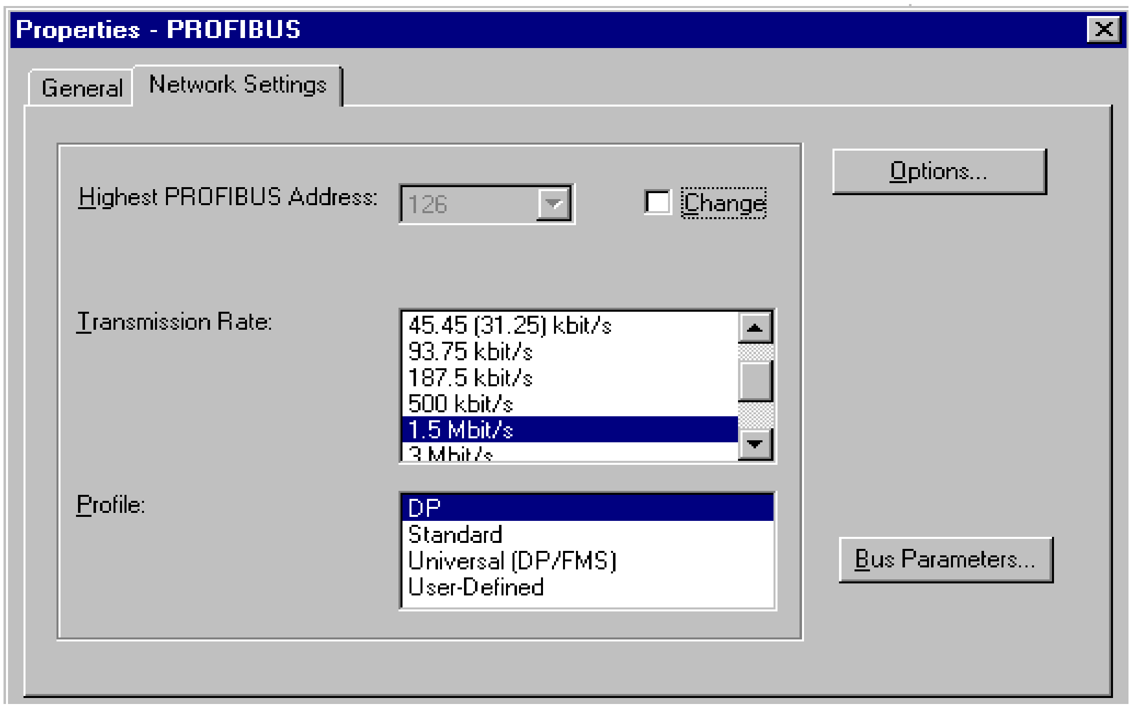


Figure 3-4 ”Properties – PROFIBUS” Dialog

Entering the Cabling Configuration

You can make the settings for the cabling configuration (number of OLMs, cable length) in the “Cables” tab under “Options”.

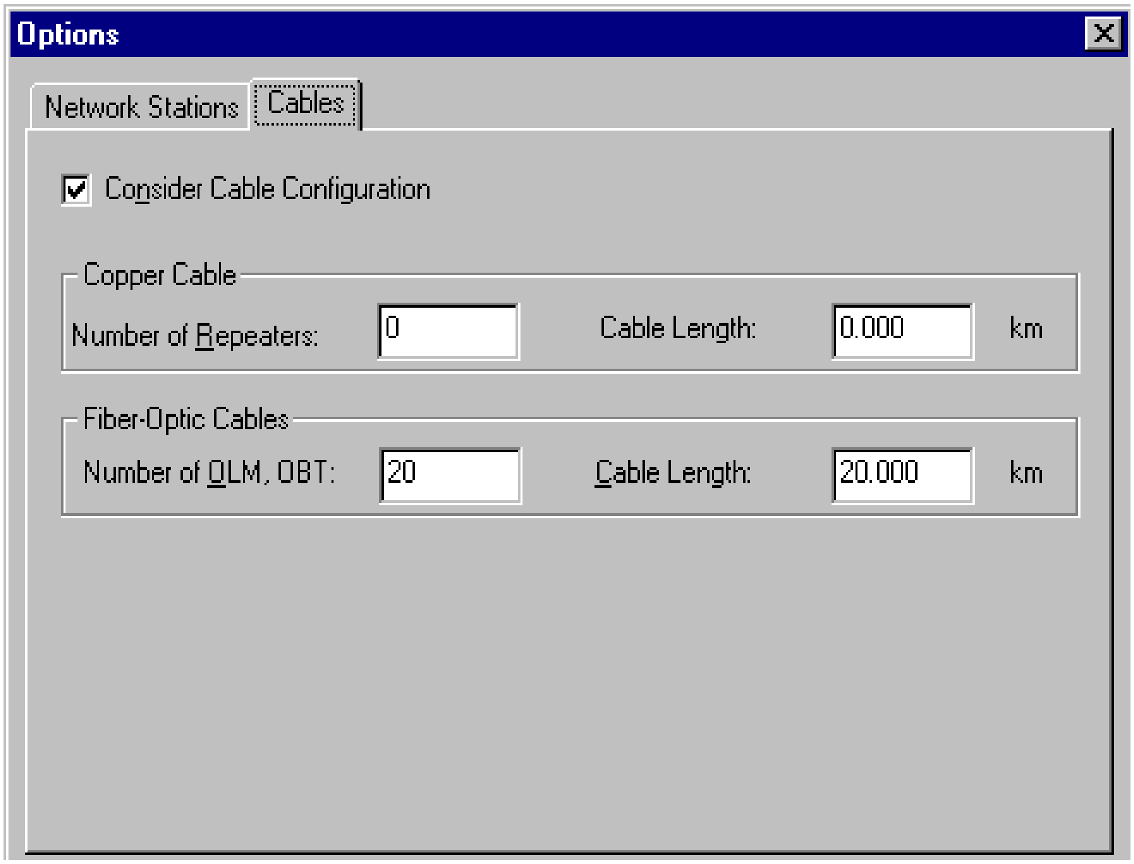


Figure 3-5 “Options” –> “Cables” Tab

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 system would exceed the value, due to the additional delays of OLM and FO cables, the parameters are adapted. The newly calculated bus parameters are displayed in the “Bus Parameters” dialog.

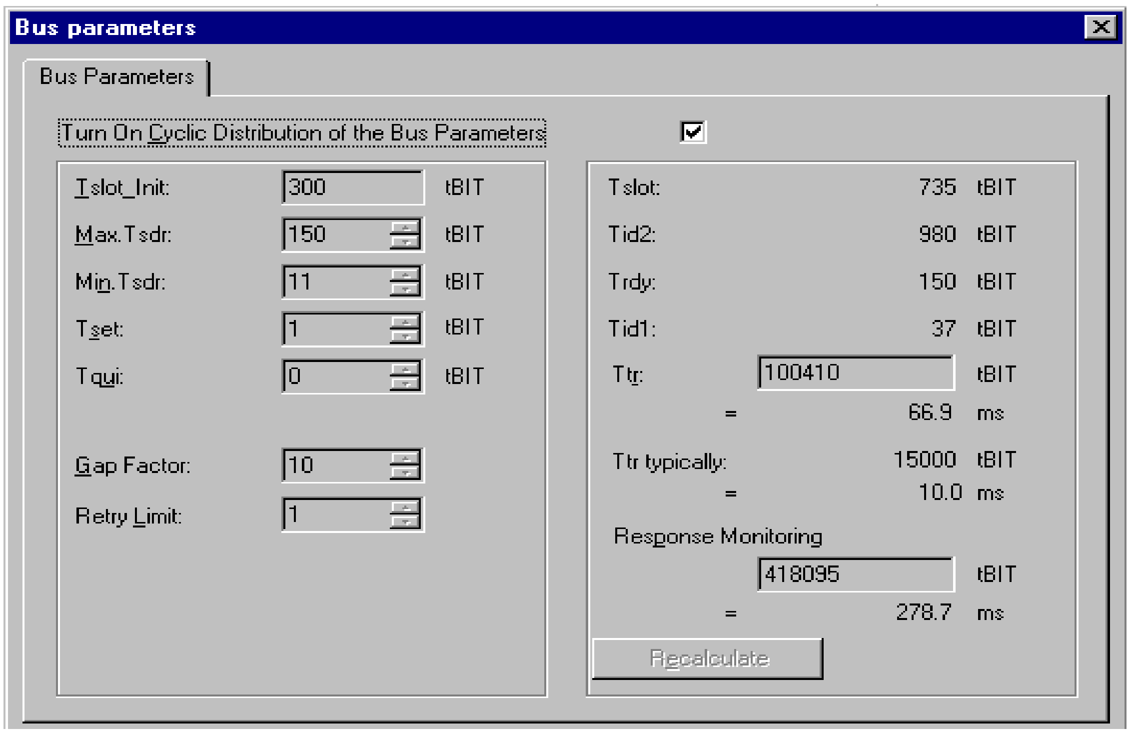


Figure 3-6 Bus Parameters Adapted to the System

3.3.2 Configuring Redundant Optical Rings with OLMs

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

1. Configuration of a Non-Existent Node
2. Raising the retry value to at least the value 3
3. Checking and adaptation of the slot time

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

Configuration of a Non-existent Node

The value of the HSA (Highest Station Address) parameter must be set on all DTEs 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 obtain this address gap simply by increasing the value of the HSA parameter by 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 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.

Raising the Retry Value to at Least the Value 3

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

Checking and Adapting the 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 switch-back 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 query sequence to form the optical ring again.

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

Calculate the slot time according to the following formula:

Slot time = a + (b x length $_{FOC}$) + (c x number$_{OLM}$)

Slot time	is the monitoring time in bit times
Length $_{FOC}$	is the sum of all FO cables (segment lengths) in the network. The lengths must be specified in km.
Number $_{OLM}$	is the number of PROFIBUS OLMs in the network

The factors a, b and c depend on the transmission rate and can be found in Tables 3–9 and 3–10.

Table 3-9 Constants for Calculating the Slot Time with DP Standard (redundant optical ring)

Transmission rate	a	b	c
12 Mbps	1651	240	28
6 Mbps	951	120	24
3 Mbps	551	60	24
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 3-10 Constants for Calculating the Slot Time with DP/FMS ("Universal") and DP with S5–95U (redundant optical ring)

Transmission rate	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 RS-485 bus segment. Longer RS-485 bus segments must be included by adding them to the length $_{FOC}$.

With the OLM/G11-1300 and OLM/G12-1300, the minimum slot times shown in the following table must be maintained at transmission rates of 12 Mbps, 6 Mbps, 3 Mbps and 1.5 Mbps.

Table 3-11 Minimum Slot Time for OLM/G11-1300 and OLM/G12-1300

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

When configuring the slot time, use the minimum slot time as shown in Table 3-11 if the calculated slot time is less than the minimum slot time.

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.

3.3.3 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 Rate 1.5 Mbps
- Nodes attached directly to OLMs
- “PROFIBUS-DP” bus protocol

Calculation of the Slot Time

For the transmission rates of 1.5 Mbps selected in the example, Table 3-9 lists the following values

a = 351
b = 30
c = 24

On this basis, 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 three bus parameters must be entered for the example:

Slot time (T_slot_Init)	=	1431	
Retries (Retry_Limit)	=	3	
Highest station address (HSA)	=	126	(default)

These values are entered in STEP 7 in the “Bus Parameters” dialog for the “User-Defined” 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 fiber-optic and RS-485 cables, the “Consider Cable Configuration” check box must not be activated in the “Cables” tab on the “Options” dialog.

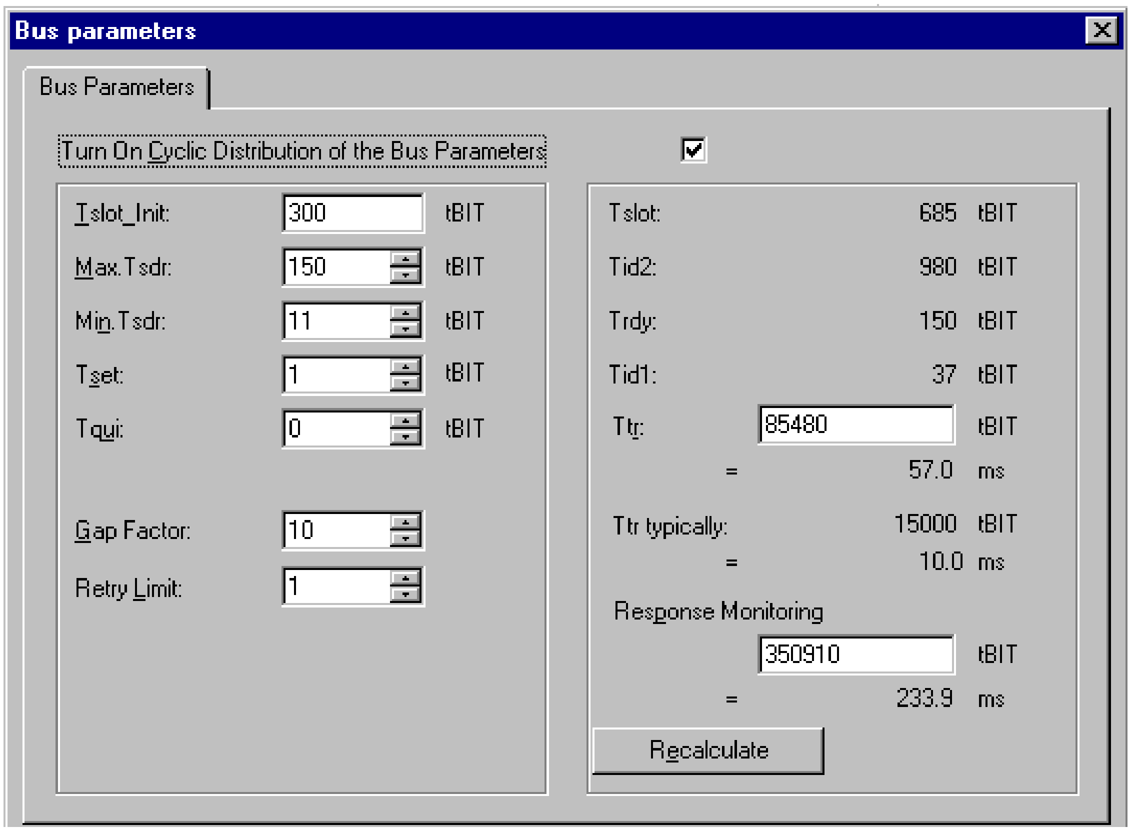


Figure 3-7 “Bus Parameters/User-Defined” Dialog in STEP 7 (V5.0)

Passive Components for RS-485 Networks 4

4.1 SIMATIC NET PROFIBUS Cables

PROFIBUS Cables

A variety of SIMATIC NET PROFIBUS cables are available allowing optimum adaptation to a variety of environments.

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

Notes on Installing RS-485 LAN Cables

LAN cables are impaired by mechanical damage. How to install LAN cables correctly is described in detail in Appendix C.

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

Overview

Table 4-1 is an overview of the LAN 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 or representative (see Appendix I.2).

Table 4-1 LAN Cables for PROFIBUS (1)

Technical Specifications [1)] Cable Type	**FC Standard Cable**	**FC FRNC Cable**	**FC Food Cable**	**FC Robust Cable**	**FC Under-ground Cable**
Order Number	6XV1 830 -0EH10	6XV1 830 -0LH10	6XV1 830 -0GH10	6XV1 830 -0JH10	6XV1 830 -3FH10
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
Characteristic impedance at 9.6 kHz at 31.25 kHz at 38.4 kHz at 3 to 20 MHz Rated value	 270 ± 27 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω	 270 ± 27 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω	 270 ± 27 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω	 270 ± 27 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω	 270 ± 27 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω
d.c. 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	approx. 28.5 nF/km	approx. 28.5 nF/km	approx. 28.5 nF/km	approx. 28.5 nF/km	approx. 28.5 nF/km
Operating voltage (effective)	≤ 100 V	≤ 100 V	≤ 100 V	≤ 100 V	≤ 100 V
Cable type standard code	02YY(ST)CY 1x2x0.64/2.55-150 KF 40 FRNC VI	02YSH(ST)CH 1x2x0.64/2.55-150 VI KF25 FRNC	02YSY(ST)C2Y 1x2x0.64/2.55-150 KF40	02YSY(ST)C11Y 1x2x0.64/2.5-150 KF40 FRNC VI	02YSY(ST) CY2Y 1x2x0.64/2.5-150 KF 40 SW
Sheath Material Color Diameter	 PVC violet 8.0 ± 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	 PE/PVC black 10.8 ± 0.5 mm [3)]
Permitted ambient conditions – Operating temperature – Transport/storage temperature – Installation temperature	 -40°C + 60°C -40°C + 60°C -40°C + 60°C	 -25°C + 60°C -25°C + 60°C -25°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 + 60°C
Bending radii One-time bending Repeated bending	 ≥ 75 mm ≥ 150 mm	 ≥ 75 mm ≥ 150 mm	 ≥ 75 mm ≥ 150 mm	 ≥ 75 mm ≥ 150 mm	 ≥ 80 mm ≥ 150 mm
Max. tensile load	100 N	100 N	100 N	100 N	100 N
Weight approx.	76 kg/km	67 kg/km	67 kg/km	73 kg/km	117 kg/km
Halogen free	no	yes	no	no	no
Behavior in fire	flame-retardant according to VDE 0472 T804 test type C	flame-retardant according to VDE 0472 T804 test type C	flammable	flame-retardant according to VDE 0472 T804 test type B	flammable
Oil resistance	Conditionally resistant to mineral oil and greases	Conditionally resistant to mineral oil and greases	Conditionally resistant to mineral oil and greases	good resistance to mineral oil and greases	Conditionally resistant to mineral oil and greases

UV resistance	no	no	yes	yes	yes
UL listed	yes	no	no	yes	no

[1] Electrical characteristics at 20 °C, tested in compliance with DIN 47250 Part 4 or DIN VDE 0472
[2] Cables capable of trailing for the following requirements:
- min. 4 million bending cycles at the specified bending radius and max. acceleration of 4 m/s^2
[3] Outer diameter > 8 mm; bus connectors can only be attached after removing the outer sheath
[4] Not suitable for fitting in a bus connector with insulation displacement system (6ES7 972-0BA30-0XA0)
[5] At 800 Hz
[6] Unrestricted 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 4-2 LAN Cables for PROFIBUS (2)

Technical Specifications [1] Cable Type	**FC Trailing Cable** [6) 4)]	**Festoon Cable** [6) 4)]	**Flexible Cable** [6) 4)]	**FC Process Cable for IEC 61158-2** [7)]	**SIENOPYR FR Marine Cable**
Order Number	6XV1 830 -3EH10	6XV1 830 -3GH10	6XV1 830 -0FH10	6XV1 830 -5EH10, -5FH10	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	 <= 3 dB/km	 < 45 dB/km < 22 dB/km < 5 dB/km < 3 dB/km
Characteristic impedance at 9.6 kHz at 31.25 kHz at 38.4 kHz at 3 to 20 MHz Rated value	 270 ± 27 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω	 270 ± 27 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω	 270 ± 27 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω	 100 ± 20 Ω 100 Ω	 250 ± 25 Ω - 185 ± 18.5 Ω 150 ± 15 Ω 150 Ω
d.c. loop resistance	≤ 133 Ω /km	≤ 133 Ω /km	≤ 133 Ω /km	≤ 44 Ω /km	≤ 110 Ω /km
Shield resistance	≤ 14 Ω /km	≤ 19 Ω /km	≤ 14 Ω /km	-	-
Effective capacitance at 1 kHz	approx. 28.5 nF/km	approx. 28.5 nF/km	approx. 28 nF/ km	-	approx. 30 nF/ km [5)]
Operating voltage (effective)	≤ 100 V	≤ 100 V	≤ 100 V	≤ 100 V	≤ 100 V
Cable type standard code	02YY(ST)C11Y 1x2x0.64/2.55-150 KF LI 40 FR petrol	02Y(ST)CY 1x2x0.65/2.56-150 LI petrolFR	02Y(ST)C11Y 1x2x0.65/2.56-150 LI VI FRNC	02Y SY (ST) CY 1x2x1.0/2.55-100 BL OE FR	M-02Y(ST)CH X 1x2x0.35 100V
Sheath Material Color Diameter	 PUR petrol 8.0 ± 0.4 mm	 Special PVC petrol 8.0 ± 0.3 mm	 PUR violet 8.0 ± 0.4 mm	 PVC blue / black 8.0 ± 0.4 mm	 Polymer [3)] black 10.3 ± 0.5 mm
Permitted ambient conditions – Operating temperature – Transport/storage temperature – 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	 -20°C + 60 °C -20°C + 60 °C -20°C + 60°C	 -40°C + 80 °C -40°C + 80 °C -10°C + 50°C
Bending radii One-time bending Repeated bending	 ≥ 40 mm ≥ 60 mm [2)]	 ≥ 30 mm ≥ 70 mm [2)]	 ≥ 60 mm ≥ 120 mm [8)]	 ≥ 60 mm ≥ 160 mm	 ≥ 108 mm ≥ 216 mm
Max. tensile load	100 N	80 N	100 N	150 N	100 N
Weight approx.	74 kg/km	56 kg/km	67 kg/km	103 kg/km	109 kg/km
Halogen free	no	no	yes	no	yes
Behavior in fire	flame-retardant according to VDE 0472 T804 test type B	flame-retardant according to VDE 0472 T804 test type B	flame-retardant according to VDE 0472 T804 test type B	flame-retardant according to VDE 0472 T804 test type B	flame-retardant according to VDE 0472 T804 test type C
Oil resistance	good resistance to mineral oil and greases	conditionally resistant to mineral oil and greases	good resistance to mineral oil and greases	good resistance to mineral oil and greases	very good resistance to mineral oil and greases
UV resistance	yes	yes	yes	yes	yes

UL listed	yes	yes	yes	yes	no

1) Electrical characteristics at 20 °C, tested in compliance with DIN 47250 Part 4 or DIN VDE 0472
2) Cables capable of trailing for the following requirements:
- min. 4 million bending cycles at the specified bending radius and max. acceleration of 4 m/s^2
3) Outer diameter > 8 mm; bus connectors can only be attached after removing the outer sheath
4) Not suitable for fitting in a bus connector (6ES7 972-0BA30-0XA0)
5) At 800 Hz
6) Unrestricted segment lengths
7) Transmission rate 31.25 Kbps, cable corresponds to FISCO model
8) Cable suitable for applications involving torsion: min. 5 million torsion movements on 1 m cable length (+/-180º)

4.1.1 FC Standard Cable

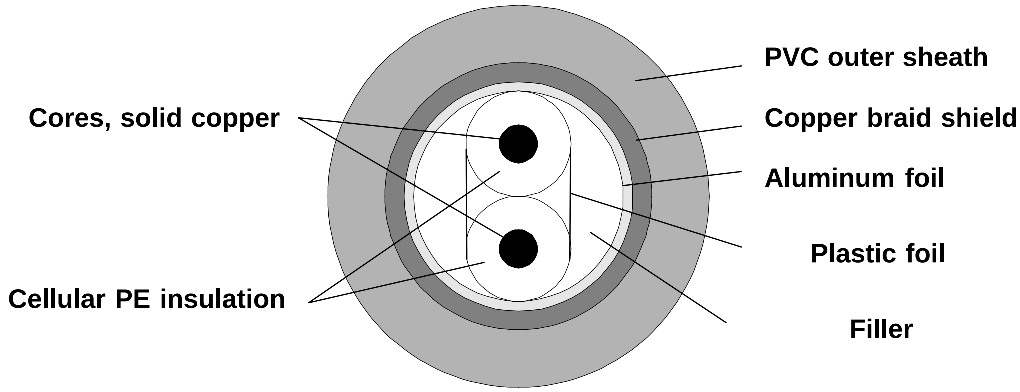


Figure 4-1 Structure of the FC Standard Cable

FC Standard Cable 6XV1 830-0EH10

The LAN cable with the order number 6XV1 830-0EH10 is the FastConnect standard LAN cable for SIMATIC NET PROFIBUS networks. It meets the requirements of EN 50170, cable type A, with solid copper cores (22 gauge).

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 LAN 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 4.2.3).

Properties

Due to the composition of the sheath material, the LAN cable has the following characteristics:

- Flame-retardant
- Self-extinguishing in case of fire
- Conditionally resistant to mineral oil and greases
- Sheath material not free of halogens

Uses

The LAN cable is intended for fixed installation in buildings (in-house cabling).

4.1.2 FC-FRNC Cable (LAN cable with halogen-free outer sheath)

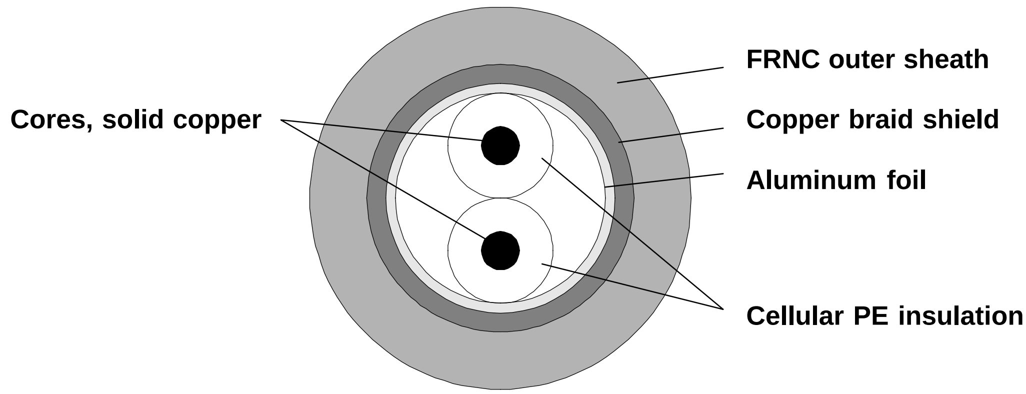


Figure 4-2 Structure of the FRNC LAN Cable (Halogen-Free Outer Sheath)

LAN Cable with Halogen-free Outer Sheath 6XV1 830-0LH10

The LAN cable with a halogen-free outer sheath 6XV1 830-0LH10 complies with the specification EN 50170, cable type A, with solid copper cores (22 gauge).

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the PROFIBUS cable (see Section 4.2.3).

Properties

The characteristics of the sheath material differ from those of the standard LAN cable as follows:

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

Uses

The FRNC cable is particularly suitable for use inside buildings.

4.1.3 FC Food Cable

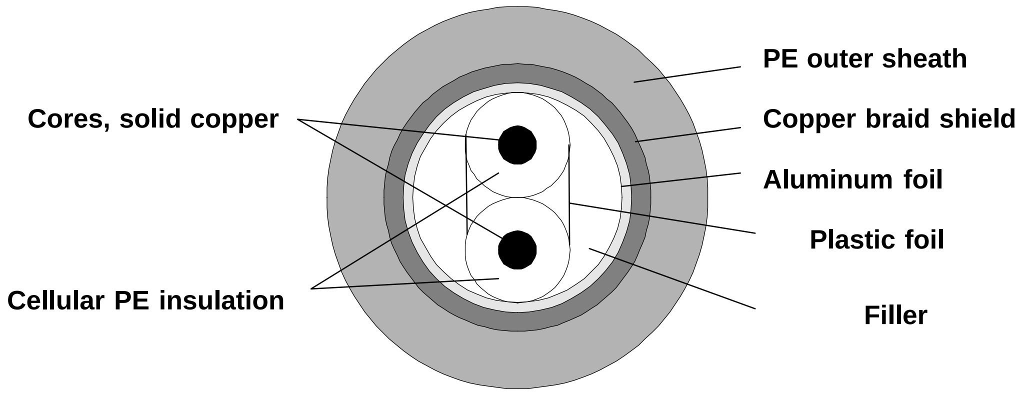


Figure 4-3 Structure of the FC Food Cable

FC Food Cable 6XV1 830-0GH10

The FC food cable 6XV1 830-0GH10 complies with the specification EN 50170, cable type A, with solid copper cores (22 gauge). 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 4.2.3).

Properties

The characteristics of the polyethylene (PE) sheath differ from those of the standard LAN cable as follows:

- Improved resistance to abrasion
- Improved resistance to oil and lubricants
- Resistant to UV radiation
- Resistant to water and steam
- The sheath material is flammable

Uses

The food cable with its PE sheath is particularly suited for use in the food, beverages and tobacco industry. It is designed for fixed installation within buildings (in-house cabling).

4.1.4 FC Robust Cable

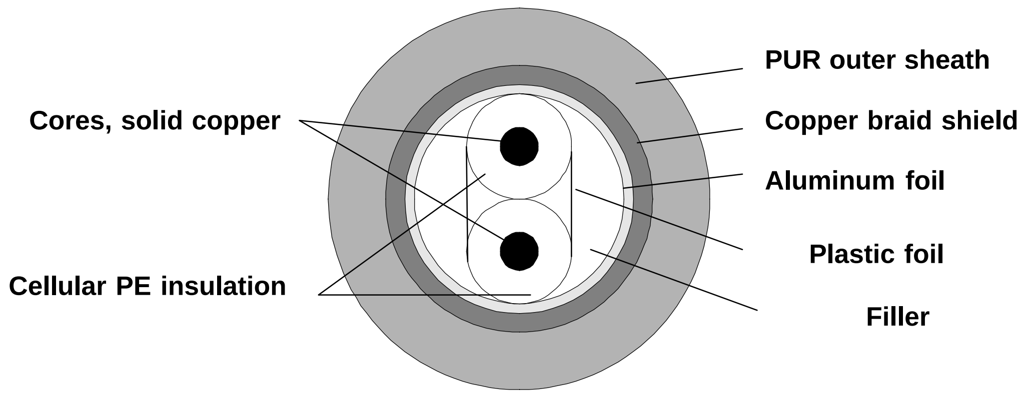


Figure 4-4 Structure of the FC Robust Cable

FC Robust Cable 6XV1 830-0JH10

The FC robust cable 6XV1 830-0JH10 with its PUR sheath complies with the specification EN 50170, cable type A, with solid copper cores (22 gauge). 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 4.2.3).

Properties

The characteristics of the PUR sheath material differ from those of the standard LAN cable as follows:

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

Uses

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

4.1.5 PROFIBUS Flexible Cable

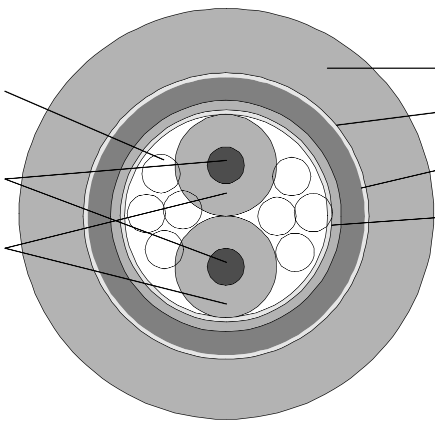


Figure 4-5 Structure of the Flexible Cable (Robot Cable)

PROFIBUS flexible cable 6XV1 830-0FH10

The flexible cable 6XV1 830-0FH10 complies with the specification EN 50170, Cable Type A, with stranded copper cores (approximately 24 gauge - 19/36) apart from the higher loop resistance.

This difference means a reduced segment length; refer to the table in Chapter 3 “Notes on Configuration”.

In contrast to the standard LAN cable, the cores of the flexible cable are of stranded copper. In conjunction with the special combination of braid shield, foil shield, fleece layer and the sheath material of polyurethane, the cable has a torsional strength of $\pm 180^o$ while retaining highly constant electrical characteristics. The cable has been tested to a minimum of 5 million torsional movements on one meter cable length ($\pm 180^o$).

If screw terminals are used, the stranded cores must be fitted with wire-end ferrules (0.25 mm^2 complying with DIN 46228).
The bus connector 6ES7 972-0BA30-0XA0 cannot be connected.

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

Properties

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

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

Uses

The flexible cable is designed for torsion of $\pm 180^{o}$ 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 wire-end ferrules (0.25 mm^2 complying with DIN 46228). Use only wire-end ferrules made of materials with permanently stable contact properties, for example copper with a tin-plated surface (not aluminum).
The bus connector 6ES7 972-0BA30-0XA0 cannot be connected to the stranded cores.

4.1.6 FC Underground Cable

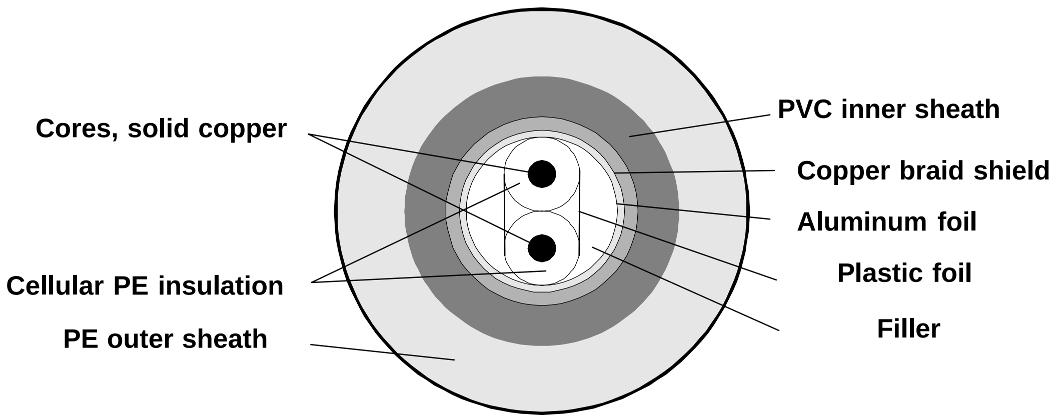


Figure 4-6 Structure of the Underground Cable

FC Underground Cable 6GK1 830-3FH10

The FC underground cable 6GK1 830-3FH10 meets the requirements of EN 50170, cable type A, with solid copper cores (22 gauge). The internal structure of the cable corresponds to that of the standard LAN cable, the electrical characteristics are identical. The cable has an additional PE outer sheath. The outer and inner sheath are bonded together so that the FC underground cable can be fitted with all SIMATIC NET PROFIBUS connectors after removing the outer sheath.
After removing the outer sheath, the structure of the cable also allows use of the FastConnect (FC) stripping tool for fast stripping of the inner cable (see Section 4.2.3).

Properties

The characteristics of the underground cable differ from those of the standard LAN 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 sheath material is flammable
- Resistant to water and steam

Uses

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

4.1.7 FC Trailing Cable

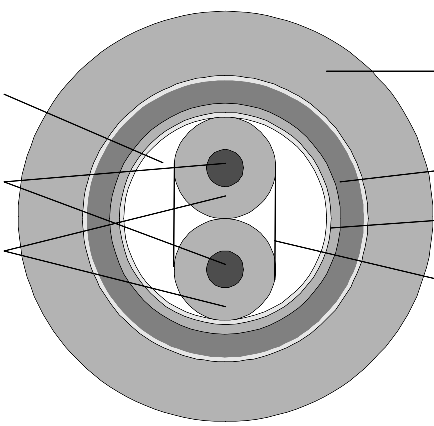


Figure 4-7 Structure of the Trailing Cable

Trailing Cable 6XV1 830-3EH10

The trailing cable 6XV1 830-3EH10 corresponds to the specification EN 50170 Cable Type A, with stranded copper cores (approximately 24 gauge - 19/36) with the exception of the higher loop resistance.

This difference means a reduced segment length; refer to the tables in Chapter 3 “Notes on Configuration”.

In contrast to the standard LAN cable, the cores of the trailing cable are of stranded copper. In conjunction with the special combination of braid shield, foil shield, and the sheath 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 wire-end ferrules (0.25 mm^2 complying with DIN 46228).
The bus connector 6ES7 972-0BA30-0XA0 cannot be connected.

To help to avoid twisting the cable during installation, the outer sheath has a line printed along its full length.

The structure of the cable allows the use of the FastConnect (FC) stripping tool for fast stripping of the outer sheath (see Section 4.2.3).

Properties

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

- Extremely good resistance to abrasion
- Resistant to mineral oils and grease
- Extremely good resistance to UV radiation
- Small bending radii for installation and operation
- Due to the smaller Cu cross-section, the d.c. loop resistance and the HF attenuation are higher which means reduced segment lengths.
- The sheath material is flame resistant

Uses

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 the mechanical restrictions involving the cable such as bending radii, tensile load etc. must be adhered to.

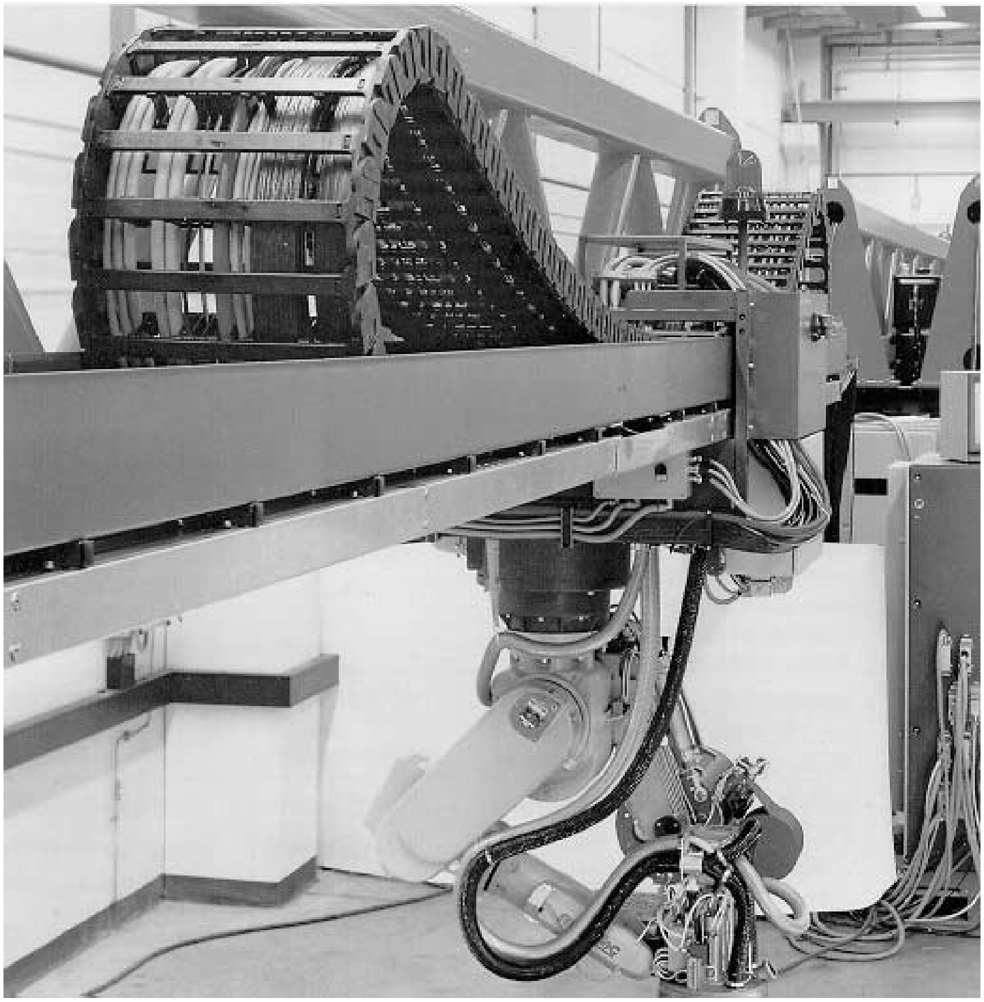


Figure 4-8 Example of Using the PROFIBUS Trailing Cable in a Drag Chain

Segment Lengths

Due to the increased loop resistance, somewhat shorter segment lengths are permitted at low transmission rates (see Table 3.1). At transmission rates ≥ 500 Kbps, the trailing cable has the same values as the standard LAN cable.

Note

If you connect to screw terminals, the stranded cores must be fitted with wire-end ferrules (0.25 mm^2 complying with DIN 46228). Use only wire-end ferrules made of materials with permanently stable contact properties, for example copper with a tin-plated surface (not aluminum).
The bus connector 6ES7 972-0BA30-0XA0 cannot be connected to the stranded cores.

4.1.8 PROFIBUS Festoon Cable

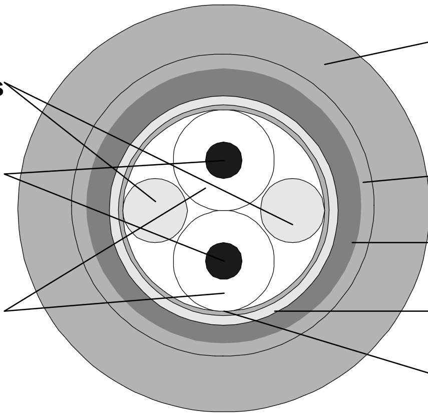


Figure 4-9 Structure of the Festoon Cable

Festoon Cable 6XV1 830-3GH10

The festoon cable 6XV1 830-3GH10 complies with the specification EN 50170, cable type A, with stranded copper cores (approximately 24 gauge - 19/36) apart from the higher loop resistance.

This difference means a reduced segment length; refer to the table in Chapter 3 “Notes on Configuration”.

With its flexible structure, the festoon cable 6XV1830-3GH10 can be used in festoons with large and small cable loops. The cable carries its own weight but is not suitable for tensile stress > 80 N.

The outer sheath has the identification “SIMATIC NET PROFIBUS RS-485 Festoon Cable 6XV1830-3GH10 * (UL) CMX 75 °C (SHIELDED) AWG 24” printed on it along with meter markings.

To help to avoid twisting the cable during installation, the outer sheath has a line printed along its full length.

If screw terminals are used, the stranded cores must be fitted with wire-end ferrules (0.25 mm^2 complying with DIN 46228).
The bus connector 6ES7 972-0BA30-0XA0 cannot be connected.

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

Properties

The festoon cable has the following properties:

- The outer sheath contains halogens (PVC)
- Conditionally resistant to mineral oil and greases
- Resistant to UV radiation
- Small bending radii both during installation and operation
- Due to the smaller Cu cross-section of the inner conductors, the d.c. loop resistance and the HF attenuation are somewhat higher which means reduced segment lengths.
- The sheath material is flame-retardant complying with VDE 0472 T804 test type B.

Uses

The LAN 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 the mechanical restrictions involving the cable such as bending radii, tensile load etc. must be adhered to.

Example of installation:

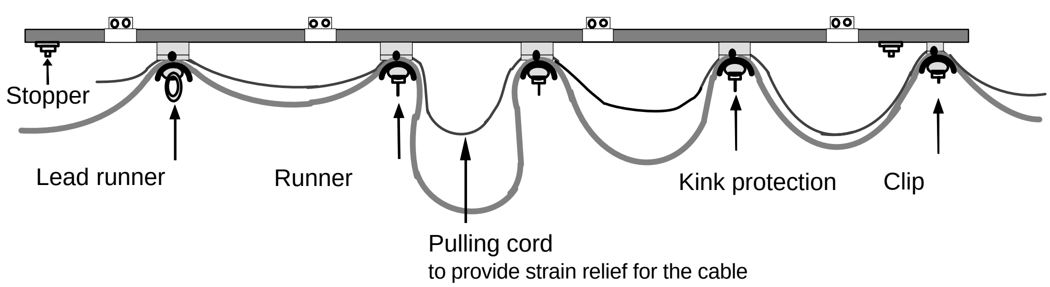


Figure 4-10 Installation of the PROFIBUS Festoon Cable (Schematic)

Segment Lengths

Due to the increased loop resistance, somewhat shorter segment lengths are permitted at low transmission rates (see Table 3.1). At transmission rates ≥ 500 Kbps, the trailing cable has the same values as the standard LAN cable.

Note

If you connect to screw terminals, the stranded cores must be fitted with wire-end ferrules (0.25 mm^2 complying with DIN 46228). Use only wire-end ferrules made of materials with permanently stable contact properties, for example copper with a tin-plated surface (not aluminum).
The bus connector 6ES7 972-0BA30-0XA0 cannot be connected to the stranded cores.

Installation Guidelines

When it is installed, the cable must be unwound at a tangent from the drum and with no torsion (keep watching the line down the length of the cable) and installed in the cable carriage.

The cable must be installed in a flat cable carriage on a round support to avoid kinking. The radius of the round support 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.

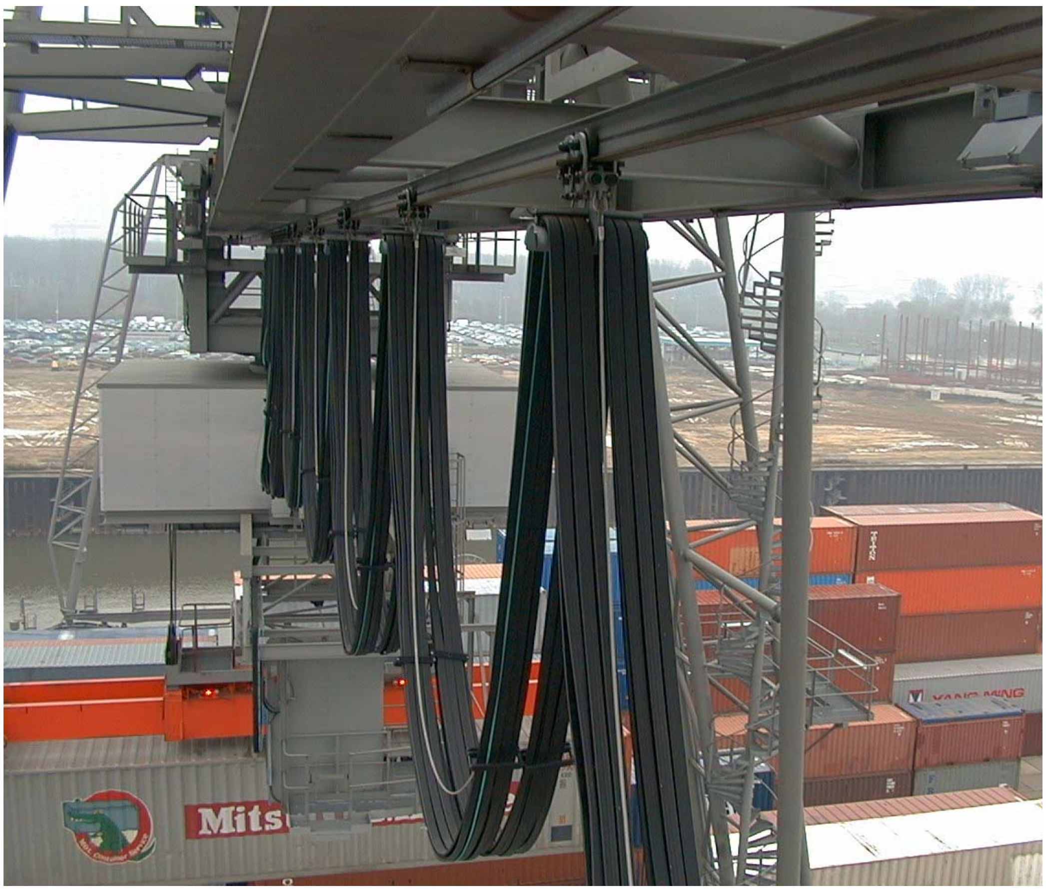


Figure 4-11 Use of the PROFIBUS Cable for Festoons

4.1.9 SIENOPYR-FR Marine Cable

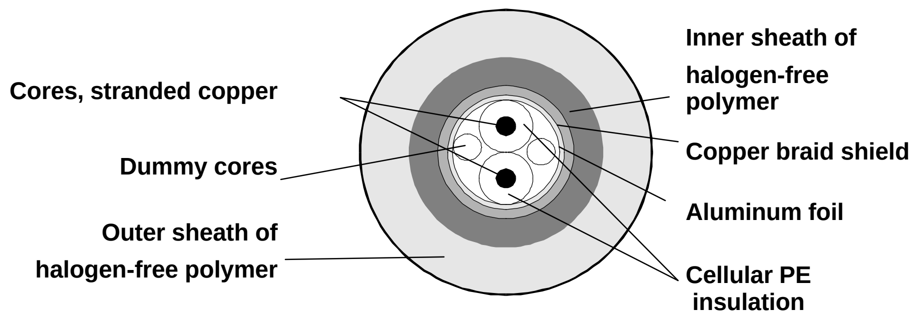


Figure 4-12 Structure of the SIENOPYR-FR Marine Cable

SIENOPYR-FR Marine Cable 6XV1830-0MH10

The SIENOPYR-FR marine cable meets the requirements of EN 50170, cable type A. The inner conductor consists of 7-strand copper (approximately 22 gauge). The outer sheath of cross-linked, halogen-free polymer is extremely resistant to lubricants and fuels, hydraulic fluid, cold cleansing agents and deionized water.

The outer sheath of the SIENOPYR-FR marine cable can be removed separately so that the inner sheath 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 SIENOPYR-FR 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 60754-2)
- Ship-building approvals (Germanischer Lloyd, Lloyd’s Register, Registro Italiano Navale)

Uses

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

4.2 FastConnect Bus Connector

Uses

Using the bus connector for SIMATIC NET PROFIBUS:

- Nodes with an electrical 9-pin sub-D interface complying with EN 50170 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 EN 50170-1-2). Fitting bus connectors to cables with different electrical or mechanical properties can cause problems during operation!

4.2.1 The FastConnect System

Uses

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

Design

The system consists of three components:

- FastConnect LAN cables for fast installation
- FastConnect stripping tool
- FastConnect bus connectors for PROFIBUS (with insulation displacement system)

Note

All PROFIBUS FastConnect LAN 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 LAN cables extremely quickly.

The design of the FastConnect LAN cables allows the use of the FastConnect stripping tool with which the outer sheath and braid shield can be removed precisely in one step. Once the cable has been prepared in this way, the FastConnect bus connectors can be fitted using the insulation displacement system.

Designed for Industry

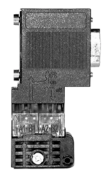
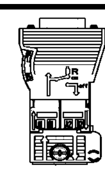
- Reduction of the assembly times for attaching DTEs by removing the outer sheath and braid shield in one step.
- Simple connector fitting with the preset FC stripping tool.
- Correct contact in the PROFIBUS FC connector can be checked without opening the connector thanks to the transparent cover of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

4.2.2 Area of Application and Technical Specifications of the FastConnect Bus Connector

Uses

You require bus connectors to attach PROFIBUS cables to 9-pin sub-D 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 Table 4-3.

Table 4-3 Structure and Uses of the IP 20-compliant FastConnect Bus Connectors

Order numbers:	**6ES7 972-0BA50-0XA0** **6ES7 972-0BB50-0XA0**	**6GK1 500-0FC00**
Appearance:		
Recommended for:		
• IM 308-B	● (version 6 or higher)	
• IM 308-C	●	
• S5-95U		
• S7-200	●	
• S7-300	●	
• S7-400	●	
• M7-300	●	
• M7-400		
• C7-626 DP	●	
• S5-115U to 155U	●	
• CP 5412 / CP 5613 / CP 5614		●
• CP 5411		●
• CP 5511		●
• CP 5611		●
• CP 5431 FMS/DP	●	
• CP 342-5	●	
• CP 342-5	●	
• CP 443-5	●	
• ET 200B	●	
• ET 200L	●	
• ET 200M	●	
• ET 200S	●	
• ET 200U	●	
• PG 720/720C		●
• PG 730		●
• PG 740		●
• PG 750		●
• PG 760		●
• Repeater RS-485	●	●
• OP		●
• OLM	●	●

Technical Specifications

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

Table 4-4 Technical Specifications of the IP 20-compliant Bus Connectors

Order numbers:	6ES7 972- ... 0BA50-0XA0 ... 0BB50-0XA0	6GK1 500- 0FC00
PG socket	0BA50: no 0BB50: yes	no
Max. transmission rate	9.6 Kbps to 12 Mbps	9.6 Kbps to 12 Mbps
Cable outlet	90 °	180 °
Terminating resistor	Integrated terminating resistor can be activated with sliding switch. Disconnect function: When the resistor is activated, the outgoing bus is disconnected. Attachment with insulation displacement system for FastConnect system	Integrated terminating resistor can be activated with sliding switch. Disconnect function: When the resistor is activated, the outgoing bus is disconnected. Attachment with insulation displacement system for FastConnect system
Interfaces – to PROFIBUS node – to PROFIBUS LAN cable	 9-pin sub-D connector 4 insulation displacement terminals for all FastConnect PROFIBUS cables (except for FC process cable)	 9-pin sub-D connector 4 insulation displacement terminals for all FastConnect PROFIBUS cables (except for FC process cable)
Power supply (must be supplied by the DTE)	4.75 to 5.25 V DC	4.75 to 5.25 V DC
Current consumption	max. 5 mA	max. 5 mA
Permitted ambient conditions – Operating temperature – Transport/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
Construction – Dimensions (W x H x D) – Weight	 72.7x16x34 approx. 50 g	 61.7x16x35 approx. 50 g
Degree of protection	IP20	IP20
Connectable PROFIBUS cable diameter	8 ± 0.5 mm	8 ± 0.5 mm

Disconnect Function

The disconnect function means that the remaining LAN cable is disconnected from the bus when the terminating resistor is activated. If the terminating resistor is accidentally activated in the middle of the LAN 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 end of the cable causes disruptions on the bus and is not permitted.

Bus Connector with PG 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 Sub-D Male Connector

Table 4-5 shows the pinout of the 9-pin sub-D male connector.

Table 4-5 Pinout of the 9-pin Sub-D Male Connector

Pin no.	Signal name	Meaning
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	-	-

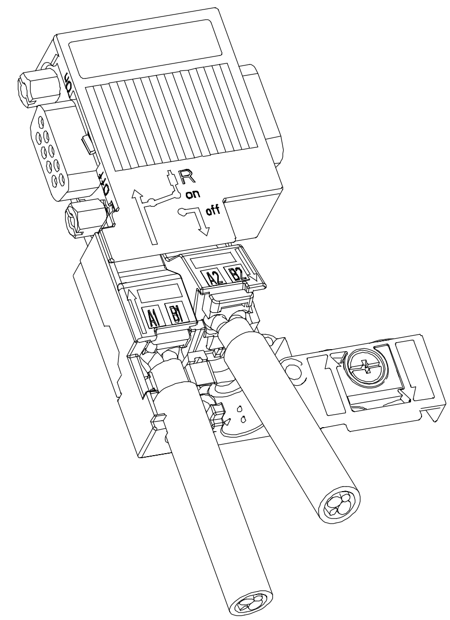


Figure 4-13 Fitting the LAN Cables in the FastConnect Bus Connector 6ES7972-0B.50-0XA0

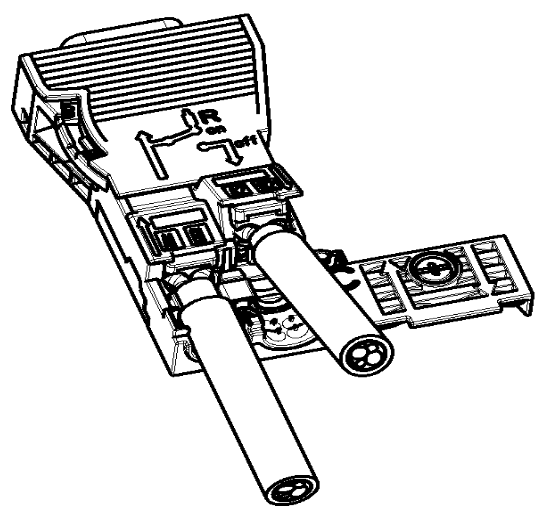


Figure 4-14 Fitting the LAN Cables in the FastConnect Bus Connector 6G1500-0FC00

4.2.3 Using the FastConnect Stripping Tool for Preparing FC Cables

The steps required to strip a cable are illustrated using the using the FastConnect bus connector with a 90° cable outlet 6ES7972-0BB50-0XA0.

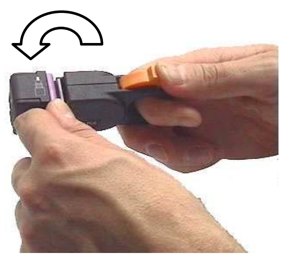
They apply analogously to the FastConnect bus connector with a 180° cable outlet 6GK1500-0FC00.

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

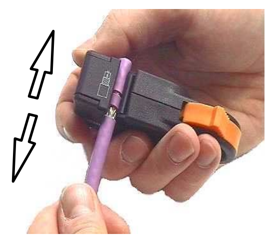
2. Measure the length to be stripped by holding the cable against the template. Mark the position using the index finger of your left hand.

3. Insert the measured end of the cable into the tool as far as allowed by the index finger of the left hand.

4. Clamp the end of the cable in the stripping tool.

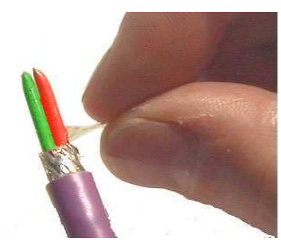


5. Turn the tool four times in the direction of the arrow for PVC insulation (eight times for PUR or PE insulation).



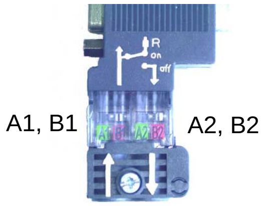
6. Keeping the tool closed, remove it from the end of the cable. If the cut is poor, change the blade cassette.

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



8. Remove the protective layer from the cores.

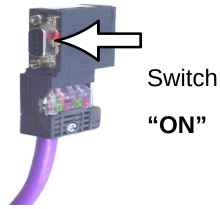
9. Fit the FastConnect cable into the connector.



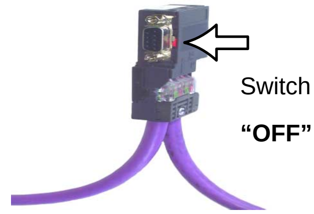
Incoming cable A1, B1

Outgoing cable A2, B2

Terminating resistor with disconnect function

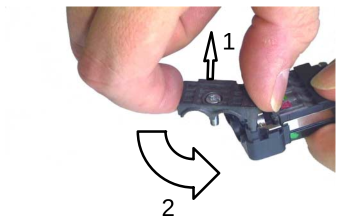


When you use the connector at the end of a segment, set the switch to “ON” (disconnect function)

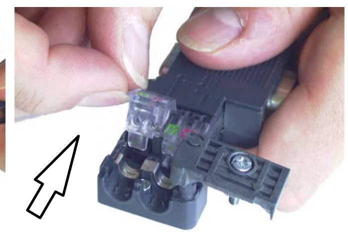


When you use the connector within a segment, set the switch to “OFF”.

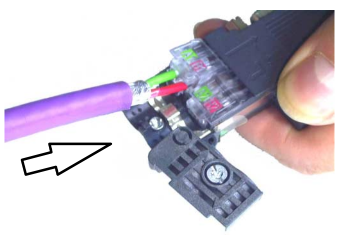
1. Undo the screw of the strain relief.



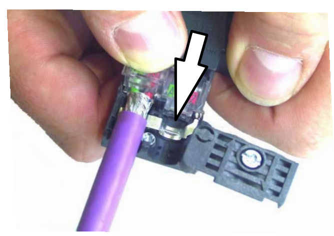
2. Turn back the strain relief clamp.



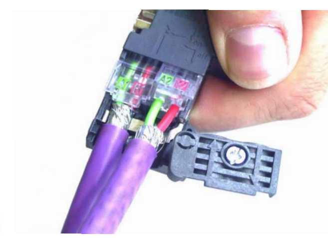
3. Lift the contact cover.



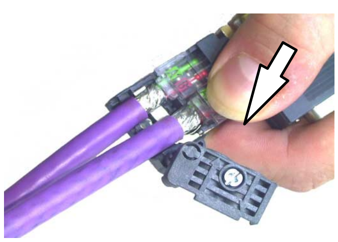
4. Fit the incoming cable into the contact cover labeled A1, B1 (remember to keep the color coding consistent).



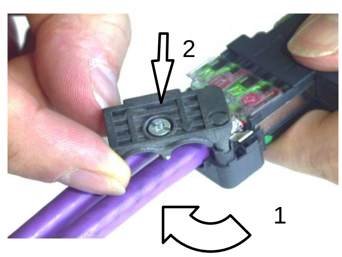
5. Press down the contact cover firmly.



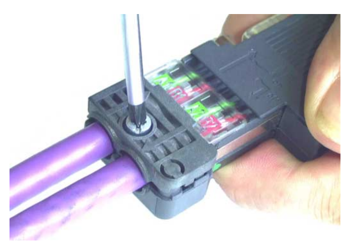
6. If you use the connector within a segment, fit the outgoing cable into the contact cover labeled A2, B2.



7. Press down the contact cover firmly.



8. Turn back the strain relief clamp.



9. Tighten the screw of the strain relief clamp.

4.3 Bus Connectors

Uses

Using the bus connector for SIMATIC NET PROFIBUS:

- Nodes with an electrical 9-pin sub-D interface complying with EN 50170 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 EN 50170-1-2). Fitting bus connectors to cables with different electrical or mechanical properties can cause problems during operation!

4.3.1 Area of Application and Technical Specifications of the Bus Connector

Uses

You require bus connectors to attach the PROFIBUS LAN cable to 9-pin sub-D interfaces. There are various bus connectors with the degree of protection IP 20 and the situations in which they are used are listed in Table 4-6.

Table 4-6 Design and Applications of the IP 20-compliant Bus Connectors

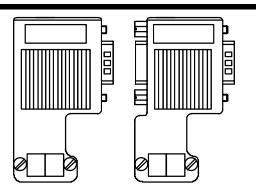
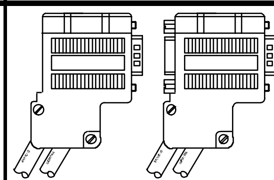
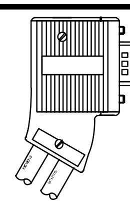
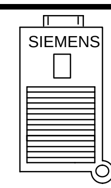
Order numbers:	**6ES7 972-0BA11-0XA0 6ES7 972-0BB11-0XA0**	**6ES7 972-0BA40-0XA0 6ES7 972-0BB40-0XA0**	**6ES7 0BA30-0XA0**	**6GK1 500-0EA02**
Appearance:		 35° cable outlet	 30° cable outlet	
Recommended for:				
• IM 308-B	● (version 6 or higher)	●	●	
• IM 308-C	●	●	●	
• S5-95U		●	●	
Use in PLC with integrated interface:				
• S7-300	●	●	●	
• S7-400	●	●	●	
• M7-300	●	●	●	
• M7-400		●	●	
Use in PLC with				
• IM 308 C	●	●	●	
• CP 5431 FMS/DP	●	●	●	
• CP 342-5	●	●	●	
• CP 343-5	●	●	●	
• CP 443-5	●	●	●	
Use in PG with MPI interface				●
Use in PG with				
• CP5412(A2)				●
• CP 5411				●
• CP 5511				●
• CP 5611				●
• CP 5613/14				●

Table 4-6 Design and Applications of the IP 20-compliant Bus Connectors, continued

Order numbers:	**6ES7 972-0BA11-0XA0 6ES7 972-0BB11-0XA0**	**6ES7 972-0BA40-0XA0 6ES7 972-0BB40-0XA0**	**6ES7 0BA30-0XA0**	**6GK1 500-0EA02**
• ET 200B	●	●	●	
• ET 200L	●	●	●	
• ET 200M	●	●	●	
• ET 200S	●	●	●	
• ET 200U	●	●	●	
• PG 720/720C		●	●	●
• PG 730		●	●	●
• PG 740		●	●	●
• PG 750		●	●	●
• PG 760	●	●	●	●
• Repeater	●	●	●	●
• OP				●
• OLM	●	●	●	●
Use in SINUMERIK 840 C and 805 SM				
• IM 328N		●	●	
• IM 329N	●		●	
Use in NC 840 D and FM NC SIMODRIVE 611 MCU				
• CP 342-5	●		●	
Use in TI 505				
• TI 505 FIM				●
• TI 505 PROFIBUS DP	●		●	
• RBC				

Technical Specifications

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

Table 4-7 Technical Specifications of the IP 20-compliant Bus Connectors

Order numbers:	**6ES7 972- ... 0BA11-0XA0 ... 0BB11-0XA0**	**6ES7 972- ... 0BA40-0XA0 ... 0BB40-0XA0**	**6ES7 972- 0BA30-0XA0**	**6GK1 500- 0EA02**
PG socket	0BA11: no 0BB11: yes	0BA40: no 0BB40: yes	no	no
Max. transmission rate	12 Mbps	12 Mbps	1.5 Mbps	12 Mbps
Terminating resistor and disconnect function	integrated	integrated	no	integrated
Cable outlet	vertical	oblique 35°	oblique 30°	axial
Interfaces • to PROFIBUS node • to PROFIBUS LAN cable	9-pin sub-D male connector 4 modular terminals for wires up to 1.5 mm^2	9-pin sub-D male connector 4 modular terminals for wires up to 1.5 mm^2	9-pin sub-D male connector 4 insulation displacement terminals for wires 0.644 ± 0.04 mm	9-pin sub-D male connector 4 modular terminals for wires up to 1.5 mm^2
Connectable PROFIBUS cable diameter	8 ± 0.5 mm	8 ± 0.5 mm	8 ± 0.5 mm	8 ± 0.5 mm
Power supply (must be supplied by DTE)	4.75 to 5.25 V DC	4.75 to 5.25 V DC	---	4.75 to 5.25 V DC
Current consumption	max. 5 mA	max. 5 mA	---	max. 5 mA
Permitted ambient conditions • Operating temperature • Transport/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 +55 °C -25 °C to +70 °C max. 95 % at +25 °C
Dimensions (in mm)	15.8 × 54 × 34	16 × 54 × 38	15 × 58 × 34	15 × 39 × 57
Weight	approx. 40 g	approx. 40 g	approx. 30 g	approx. 100 g

Disconnect Function

The disconnect function means that the remaining LAN cable is disconnected from the bus when the terminating resistor is activated. If the terminating resistor is accidentally activated in the middle of the LAN 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 end of the cable causes disruptions on the bus and is not permitted.

Bus Connector with PG 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 Sub-D male Connector

Table 4-8 shows the pinout of the 9-pin sub-D male connector.

Table 4-8 Pinout of the 9-pin Sub-D Male Connector

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

4.4 Attaching the LAN Cable to the Bus Connector

4.4.1 Attaching the LAN Cable to Bus Connector (6ES7 972-0B.11..)

Appearance (6ES7 972-0B.11 ...)

Figure 4-15 shows the bus connector with order number 6ES7 972-0B.11 ...

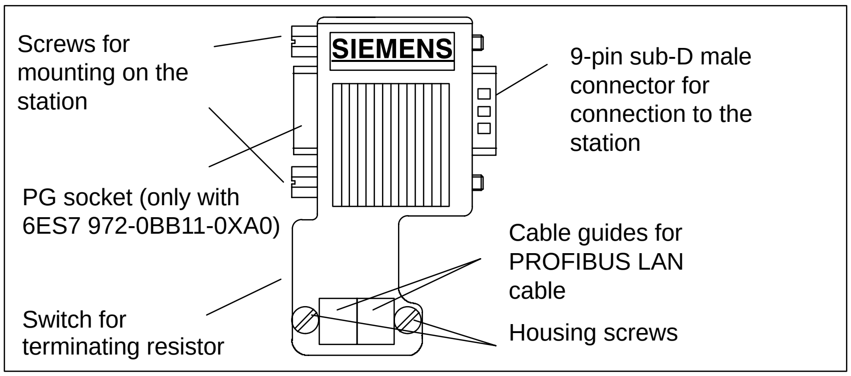


Figure 4-15 Bus Connector (order number 6ES7 972-0B.11 ...)

Connecting Up the LAN Cable

Connect up the LAN cable to the bus connector with order number 6ES7 972-0B.11 ... as follows:

1. Strip the LAN cable as shown in Figure 4-16 using the FastConnect stripping tool (sizes and lengths are shown in the table on the rear of the tool).

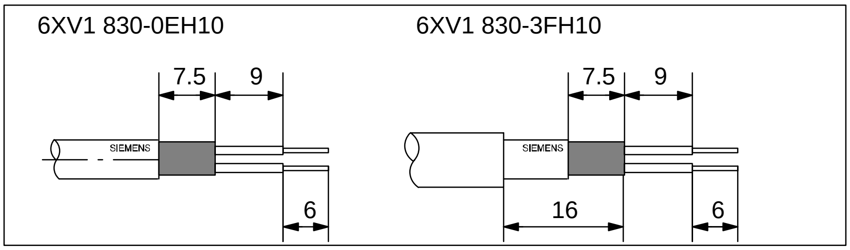


Figure 4-16 Cable Stripped for Connection to Bus Connector (6ES7 972-0B.11 ...)

2. Open the casing of the bus connector by undoing the screws and removing the cover.
3. Insert the green and red cores in the screw terminal as shown in Figure 4-17.

   Make sure that you always connect the same cores to the same terminal A or B (for example terminal A is always connected to green and terminal B always to red).
4. Press the cable sheath between the two clips. This secures the cable.
5. Screw the green and red cores tight in the screw terminal.

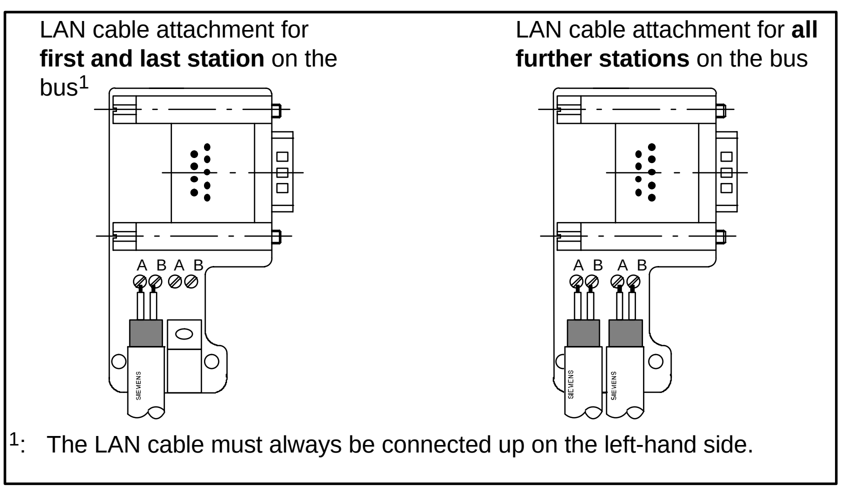


Figure 4-17 Connecting the LAN Cable to the Bus Connector (6ES7 972-0B.11 ...)

6. Fasten the cover again with the screws.

   Make sure that the cable shield makes good contact with the shield clamp.

Note

Stranded cores must only be used in screw terminals with wire-end ferrules fitted (0.25 mm^2 complying with DIN 46228). Use only wire-end ferrules made of materials with permanently stable contact properties, for example copper with a tin-plated surface (not aluminum).

4.4.2 Connecting the LAN Cable to Bus Connector (6ES7 972-0BA30-0XA0)

Appearance (6ES7 972-0BA30-0XA0)

Figure 4-18 shows the bus connector with order number 6ES7 972-0BA30-0XA0:

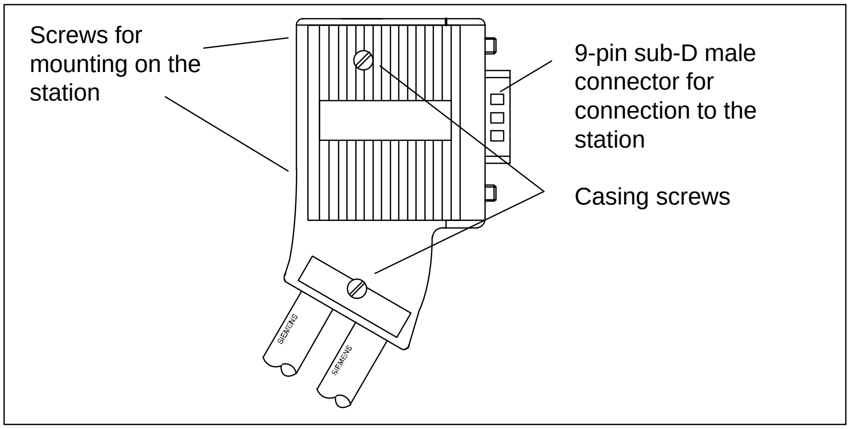


Figure 4-18 Bus Connector (order number 6ES7 972-0BA30-0XA0)

Connecting Up the LAN Cable

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

1. Strip the insulation as shown in Figure 4-19.

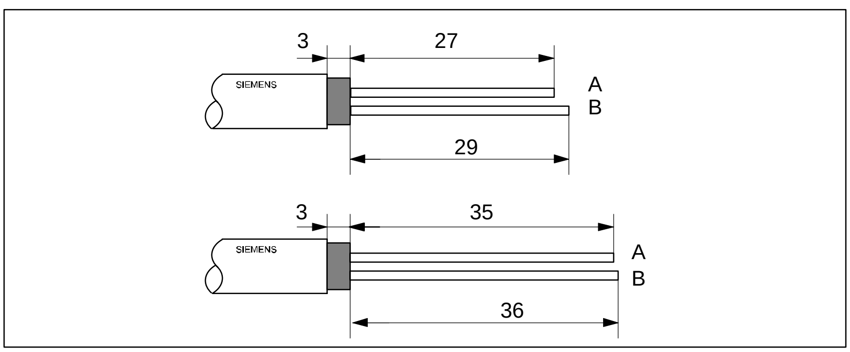


Figure 4-19 Cable Stripped for Connection to Bus Connector (6ES7 972-0BA30-0XA0)

2. Open the casing of the bus connector by undoing the screws and removing the cover.
3. Press the LAN cable into the strain relief clips. The cable shield must make good contact with the metal part.

4. Place the green and red cores in the cable guides above the insulation displacement terminals as shown in Figure 4-20.

   Make sure that you always connect the same cores to the same terminal A or B (for example terminal A is always connected to green and terminal B always to red).

5. Press the red and green cores into the insulation displacement terminals lightly using your thumbs.
6. Secure the cover with the screws.

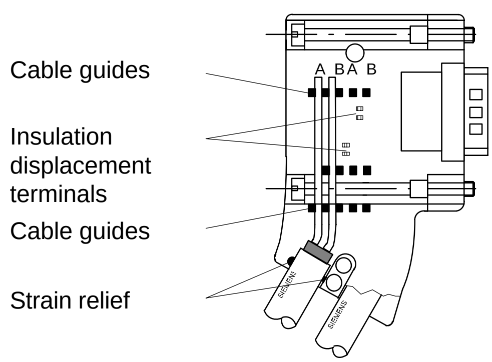


Figure 4-20 Connecting the LAN cable to bus connector (6ES7 972-0BA30-0XA0)

Note

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

4.4.3 Connecting the LAN Cable to Bus Connector (6ES7 972-0B.40)

Appearance (6ES7 972-0B.40 ...)

Figure 4-21 shows the bus connector with order number 6ES7 972-0B.40 ...

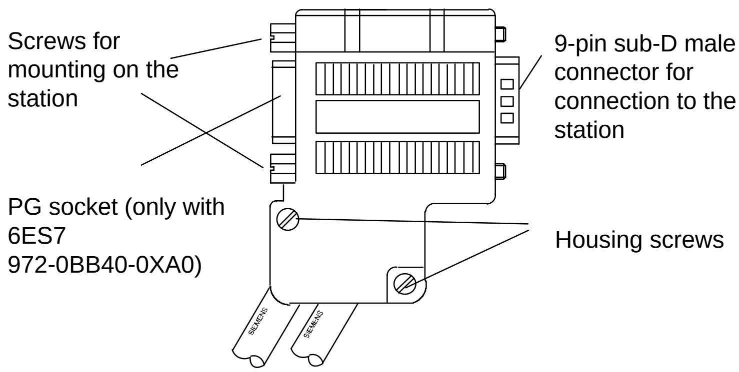


Figure 4-21 Bus Connector (order number 6ES7 972-0B.40 ...)

Connecting Up the LAN Cable

Connect up the LAN cable to the bus connector with order number 6ES7 972-0B.40 ... as follows:

1. Strip the LAN cable as shown in Figure 4-22 using the FastConnect stripping tool (sizes and lengths are shown in the table on the rear of the tool).

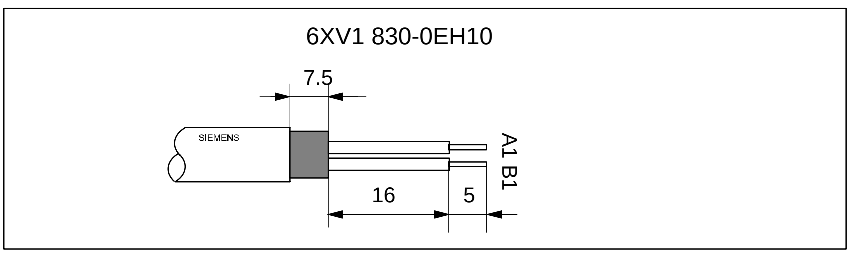
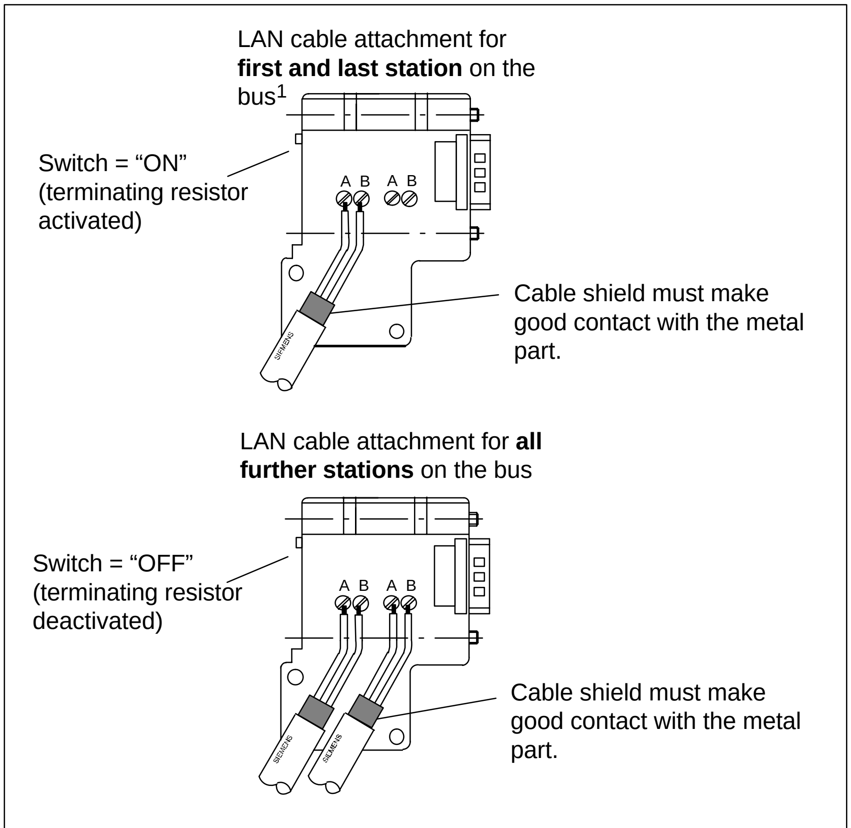


Figure 4-22 Cable Stripped for Connection to Bus Connector (6ES7 972-0B.40 ...)

2. Open the casing of the bus connector by undoing the screws and removing the cover.
3. Insert the green and red cores in the screw terminal as shown in Figure 4-22.

   Make sure that you always connect the same cores to the same terminal A or B (for example terminal A is always connected to green and terminal B always to red).
4. Press the cable sheath between the two clips. This secures the cable.

5. Screw the green and red cores tight in the screw terminal.



[1]: The LAN cable must always be connected up on the left-hand side.

Figure 4-23 Connecting the LAN Cable to Bus Connector (6ES7 972-0B.40 ...)

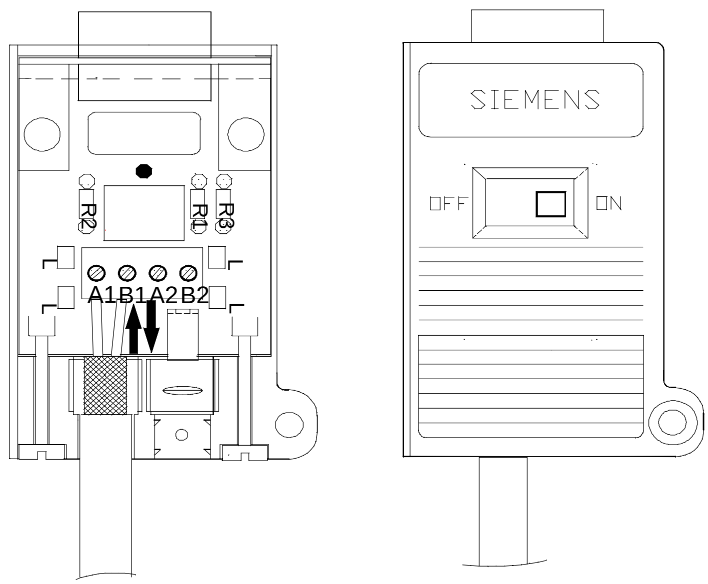
6. Fasten the cover again with the screws.

Note

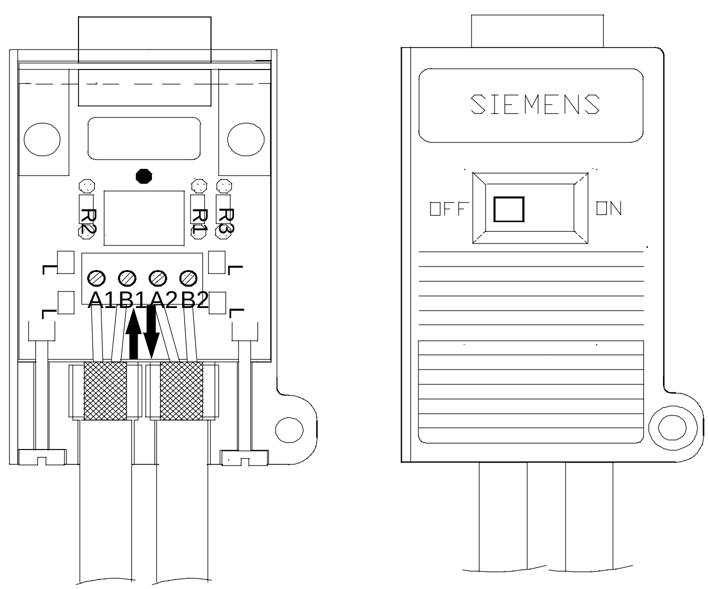
Stranded cores must only be used in screw terminals with wire-end ferrules fitted (0.25 mm^2 complying with DIN 46228). Use only wire-end ferrules made of materials with permanently stable contact properties, for example copper with a tin-plated surface (not aluminum).

4.5 Installing the Bus Connector with Axial Cable Outlet

Appearance (6GK1500-0EA02)



LAN Cable Connection and Switch Setting for First and Last Station on the Bus



LAN Cable Connection and Switch Setting for all Other Stations on the Bus

Figure 4-24 Installing 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 Figure 4-25 with the FastConnect stripping tool (sizes and lengths are shown in the table on the rear of the tool).

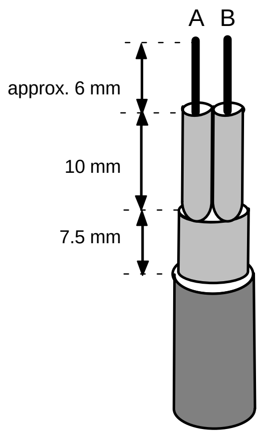


Figure 4-25 Preparing the Ends of the Cable for the Bus Connector with Axial Cable Outlet

- Undo the screws in the casing and remove the cover.
- Feed the wires into the required terminals of the screw terminal blocks.
- Press the cable sheath between the two clips.
- Make sure that the cable sheaths are lying on the metal conductor.
- When you connect to the screw terminals, the stranded cores must be fitted with wire-end 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 wire-end ferrules fitted (0.25 mm^2 complying with DIN 46228). Use only wire-end ferrules made of materials with permanently stable contact properties, for example copper with a tin-plated surface (not aluminum).

4.6 Plugging the Bus Connector into the Module

Fitting the Bus Connector

To fit the bus connector, follow the steps outlined below:

1. Plug the bus connector into the module.
2. Screw the bus connector to the module.
3. If the bus connector is located at the start or end of a segment, you must activate the terminating resistor (switch setting ON”) (see Figure 4-26).

   It is not possible to activate the terminating resistor on the bus connector 6ES7 972-0BA30-0XA0.

Note

Remember the following:

- By activating the terminating resistor, the outgoing LAN cable is disconnected from the incoming LAN cable.
- Stations equipped with a terminating resistor must always be supplied with voltage when the network starts up and during operation.

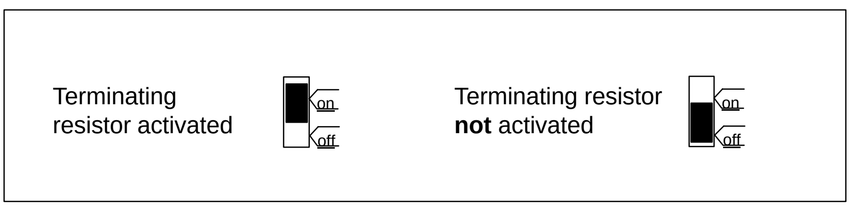


Figure 4-26 Bus Connector (6ES7 972-0B.11-...): Terminating Resistor Activated and deactivated

Removing the Bus Connector

If the **LAN cable is connected through**, you can remove the bus connector from the PROFIBUS-DP interface at any time without interrupting data traffic on the bus.

Warning

Possible disturbance of data traffic on the bus

A bus segment must always be terminated at both ends with the terminating resistor. This is, for example, not the case when the power supply to the last node with a bus connector is turned off. Since the bus connector is supplied with power from the station, the terminating resistor has no effect.

Make sure that the power supply for the stations on which a terminating resistor is activated is always turned on.

As an alternative, you can also use the PROFIBUS terminator as an active terminating resistor (see Section 5.7).

4.7 Bus Terminals for RS-485 Networks

4.7.1 Versions

Overview

A bus terminal is used to attach a single PROFIBUS node with an RS-485 interface to the PROFIBUS LAN cable.

Bus terminals are available in the following versions:

Table 4-9 Versions of the Bus Terminal

	Bus terminal RS-485	Bus terminal 12 M
Order no.:		
With 1.5 m tap line		6GK1 500-0AA10
With 1.5 m tap line and additional PG interface	6GK1 500-0DA00	
With 3 m tap line	6GK1 500-0AB00	
Transmission rate	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, on/off	Integrated, can be activated with disconnect function
Casing degree of protection	IP20	IP20

4.7.2 Design and Functions of the RS-485 Bus Terminal

Figure 4-27 RS-485 Bus Terminal

Bus Terminal RS-485

The RS-485 bus terminal is used to connect data terminal equipment (DTEs) with an RS-485 interface to the LAN cable. It includes the following:

- 6 modular terminals for conductors with a cross-sectional area ≤ 1.5 mm^2 for connection of the incoming and outgoing LAN cable and, if necessary, the protective earth (PE)
- Screw down clamps for shield contact
- A switch (“Bus terminated”) to allow termination at the end of an RS-485 segment with the characteristic impedance
- A connecting cable preassembled (either 1.5 m or 3 m long) with a 9-pin sub-D male connector for direct connection to a DTE.

Cable Termination

The sub-D connector is plugged into the sub-D female connector of the DTE and secured by screws. If the terminating resistor is activated, the RS-485 bus terminal requires current of maximum 5 mA at a power supply of 5 V between pins 5 and 6 of the connector from the DTE.

Table 4-10 Pinout of the Sub D 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)	+ 5V 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 (see Figure 4-28) has an additional 9-pin sub-D female connector on the front panel for connecting, for example a programming device using a PG connecting cable. The pinout is identical to that shown in Table 4-10.

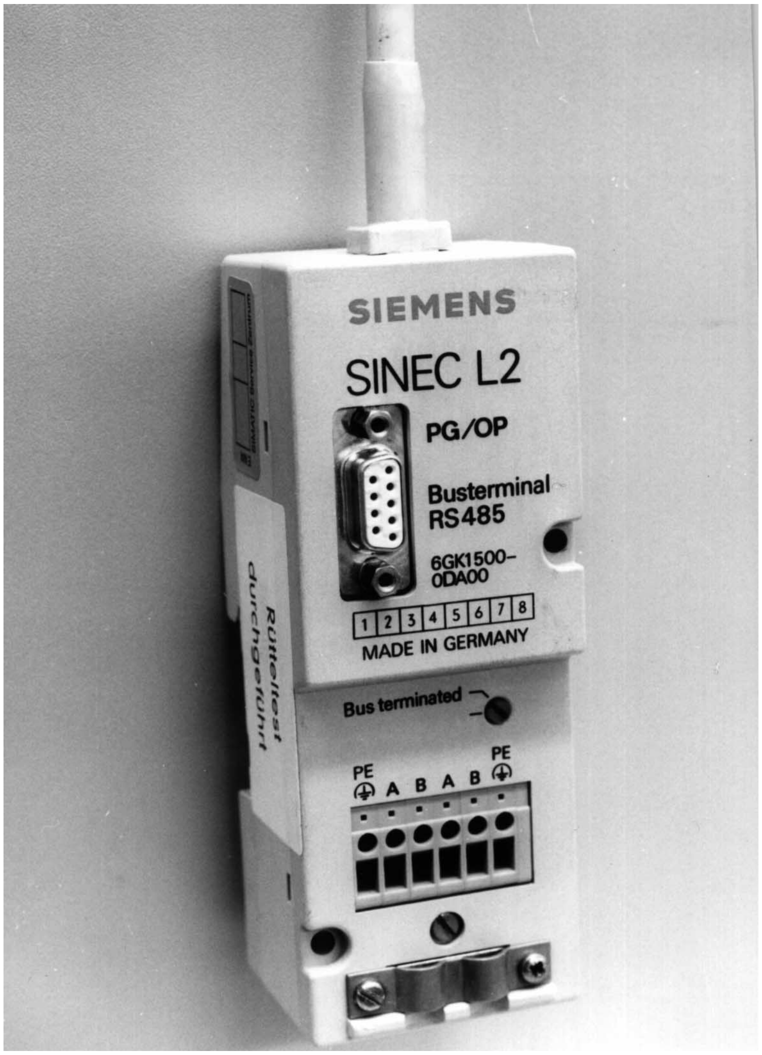


Figure 4-28   RS-485 Bus Terminal with Additional PG Interface

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Note

The SIMATIC NET PROFIBUS RS-485 bus terminals are only suitable for transmission rates ≤ 1.5 Mbps. For higher transmission rates, use the 12M bus terminal.

4.7.3 Design and Functions of the 12M Bus Terminal

Figure 4-29 12M Bus Terminal (BT12M)

Bus terminal 12 M

The 12M bus terminal is used to connect data terminal equipment (DTEs) with an RS-485 interface to the LAN cable.

It includes the following:

- 1 modular terminal block with 6 terminals for conductors with a cross-sectional area <= 1.5 mm^2 for connection of the incoming and outgoing LAN cable and, if necessary, the protective earth (PE)
- Screw down clamps for field 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 rate 9.6 Kbps to 1.5 Mbps and 3 Mbps to 12 Mbps.
- A 1.5 m long tap line with a 9-pin sub-D male connector for direct attachment to a DTE.

The sub-D connector is plugged into the sub-D female connector of the DTE and secured by screws. **The 12M bus terminal requires a current of 90 mA at a power supply of 5 V from the DTE** between pins 5 (M5) and 6 (P5) of the sub-D male connector.

A **maximum of 32 BT12M modules 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.

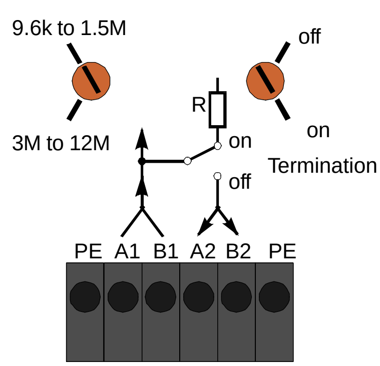

Figure 4-30 Operator Controls

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, B20 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 RS-485 bus terminal with a 3.0 m tap line (6GK1 500-0AB00), a minimum clearance of 5 m (= 5 m PROFIBUS cable) must be maintained between the RS-485 bus terminal with the 3.0 m tap line. The 12M bus terminals can be arranged at any point in the segment; in other words, no minimum clearance needs to be maintained. The 12M bus terminal can also be included between two RS-485 bus terminals with a 3.0 m tap line. The only important point in this respect is that the PROFIBUS cable between the two RS-485 bus terminals with 3.0 m tap lines must be a total of 5 m long.

4.7.4 Mounting/Attaching the LAN Cables

The bus terminal can be mounted in three different ways:

- By snapping it on to a 15 x 35 mm standard DIN rail (DIN EN50022-35x15)
- By screwing the unit to a mounting plate using two fillister head screws. Figure 4-31 shows the drilling diagram for mounting the unit.

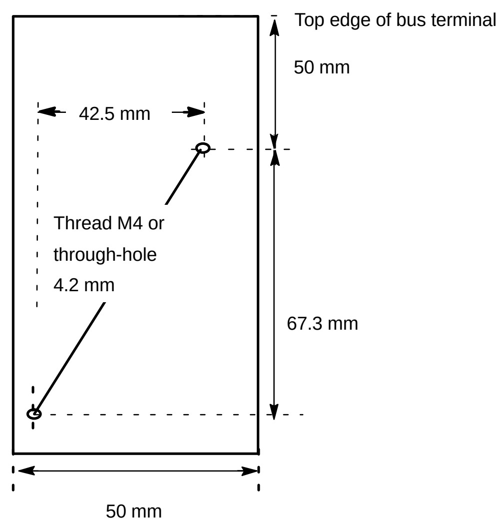

Figure 4-31 Drilling Diagram for the Bus Terminal

- Wall mounting (brick, concrete). Fittings required: 2 x 5 mm plugs, 2 round head wood screws size 3.5 mm and 2 washers 4.3 mm inner diameter. The holes must be drilled as shown in Figure 4-31.

Note

Please make sure that the bus terminal is accessible for maintenance and installation work even during operation.

To connect the LAN cable, follow the steps below (see Figure 4-32):

1. Open the LAN cable at the point at which the bus terminal will be inserted.
2. Strip approximately 33 mm of the outer sheath. Make sure when removing the sheath that the braid shield is not damaged.
3. Remove a length of approximately 12 mm of the braid shield and foil shield (the foil shield can be left somewhat longer).

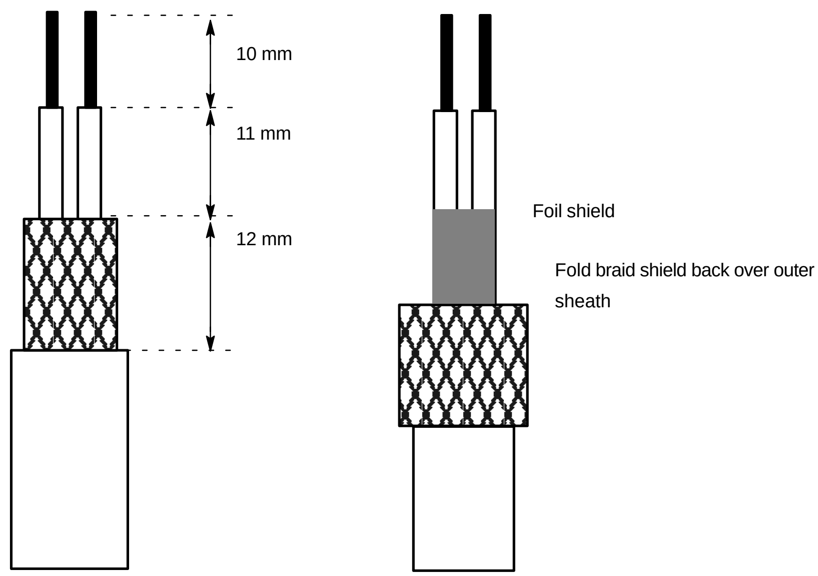

Figure 4-32 Preparing the LAN Cable for Connection to the Bus Terminal

4. Fold back the braid shield over the cable sheath.
5. Remove approximately the last 10 mm of insulation from the cores.
6. Fit the LAN cable to the terminal so that the braid shield is lying bare under the cable clamp.
7. Screw the ends of the cores to the corresponding terminals (if the cores are stranded, for example, the trailing cable, wire-end ferrules with 0.25 mm^2 complying with DIN 46228 must be used).
8. If the bus terminal is at the start or end of a segment, the integrated terminating resistor must be turned on (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 LAN 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 DTE interface to supply the activated, integrated terminating resistor.

The sub-D male connector must therefore always be plugged in and secured by screws. The attached DTE 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:

Terminal A: green wire
Terminal B: red wire

Note

Notes on the 12M bus terminal

The 12M bus terminal must only be plugged in to an interface with the power turned 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 terminating resistor is activated.

4.7.5 Grounding

If the bus terminal is mounted on a DIN rail (see Figure 4-33), 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.

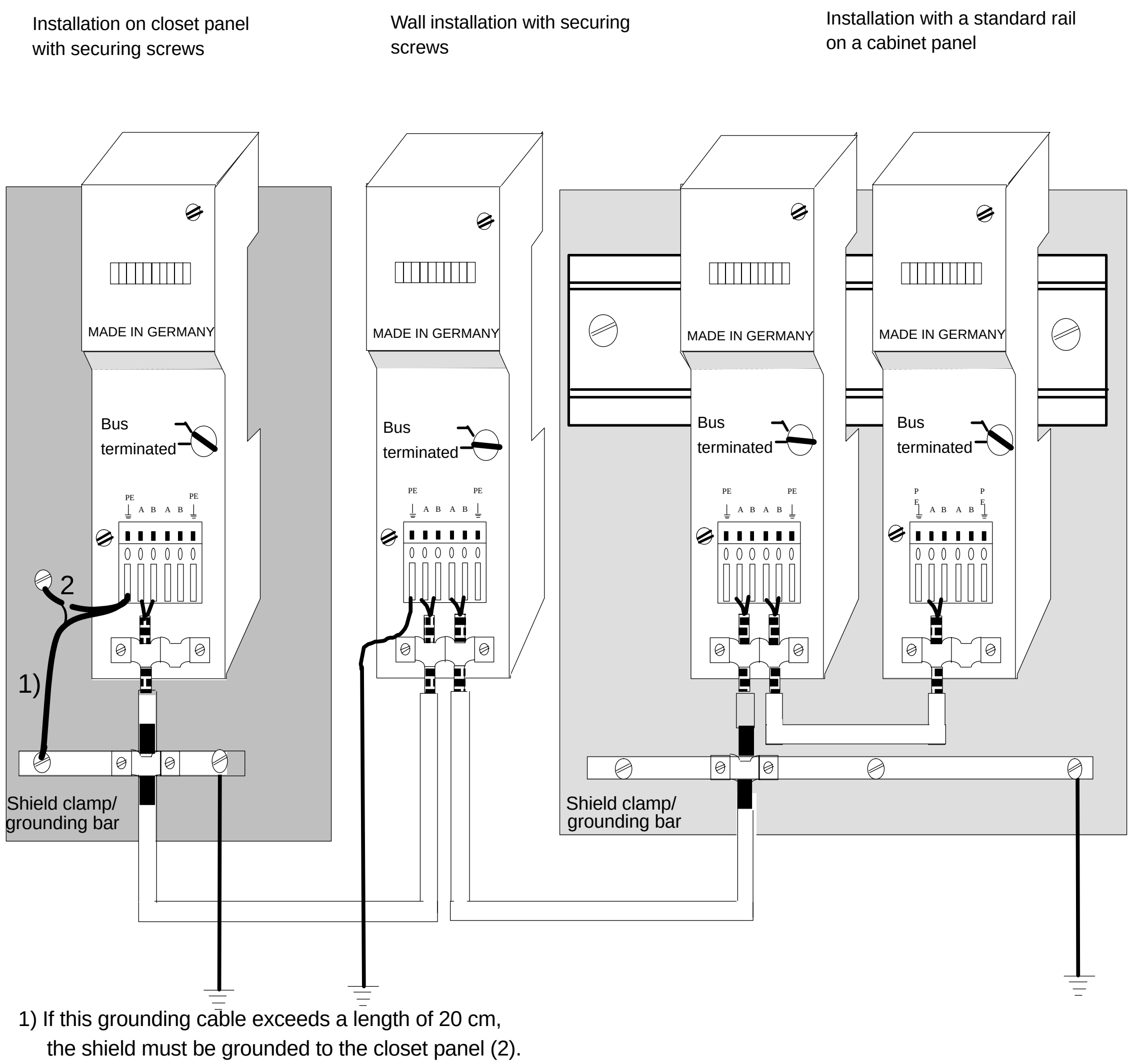

Figure 4-33 Ways of Installing and Grounding the Bus Terminal

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Note

The grounding bar and local ground must be connected by a Cu conductor with ≥ 6 mm^2 cross-section over as short a distance as possible.

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.

4.7.6 Technical Data of the RS-485 Bus Terminal

Technical Data of the RS-485 Bus Terminal		
Connector to DTE	9-pin sub-D male connector	
Transmission rate	9.6 to 1.500 Kbps	
PG interface (optional)	9-pin sub-D female connector	
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 complying with DIN 40040 15% to 95% at 25 °C no condensation	
Construction Dimensions (W x H x D) in mm	RS-485 RS-485/PG	50 x 135 x 47 50 x 135 x 52
Weight (incl. 1.5 m connecting cable)	RS-485, RS-485/PG approx. 310 g	

4.7.7 Technical Data of the 12M Bus Terminal

Technical Data of the 12M Bus Terminal	
Connector to DTE	9-pin sub-D male connector
Transmission rate	9.6 Kbps to 12 Mbps
Power supply	DC 5 V ± 5% safety extra-low voltage (SELV) complying with EN 60950
Current consumption	90 mA at 5 V
Total power dissipation	0.45 W
Value factor	0.1 In operation at 1.5 Mbps along with RS-485 bus terminal. (See Section: “Network Configuration”)
Electromagnetic Compatibility	
Noise emission limit class	B complying with EN 55022=CISPR 22
Noise immunity on signal lines	+/– 2 kV (to IEC 801-5 / IEC 1000-4-5, surge) +/– 2 kV (to IEC 801-4 / IEC 1000-4-4, burst)
Noise immunity to static electricity discharge	+/– 6 kV, contact discharge (to IEC 801-2; ESD / IEC 1000-4-2)
Noise immunity to high-frequency interference	10 V/m with 80% amplitude modulation at 1 kHz, 80 MHz – 1 GHz (to IEC 801-3 / ENV 50140) 10 V/m 50 % on time 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	
Oscillation 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
Tap line length	1.5 m
Weight (incl. 1.5 m connecting cable)	approx. 350 g
Degree of protection	IP20
Test Marks	CE, UL, CSA

4.8 Cable Connections

4.8.1 Cable Connections to Network Components

Sometimes, a connection between two different LAN cable sections is necessary, for example, a transition from the standard LAN cable to a section with trailing cable.

The easiest way to implement this transition is to use the two LAN cable attachments of a bus connector, bus terminal or repeater. The attachment of the cables is described in detail in this chapter. For information about laying cables and mechanical protection of the cables refer to Appendix C “Installing LAN Cables”.

For the transition from the underground cable to the standard LAN cable, it is advisable to protect against overvoltage (see Appendix B “Lightning and Overvoltage Protection”.

4.8.2 Cable Connection without Bus Connection Elements

Sometimes, a connection is necessary between LAN cable sections at locations where no nodes or network component connections are intended, for example, when repairing a broken LAN cable. Note the following information:

The all-round shielding of the LAN cable must be retained

To make the cable connection, use, for example, a commercially available sub-D male connector and socket with metal casing. Only sub-D components with a spring shield collar ensure a reliable shield connection.

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 LAN cable. If necessary, provide extra protection for the connection to avoid dampness, dust or aggressive gases causing problems by covering the connection in a cable sleeve. You can find information about ordering this in Appendix I-2 “SIMATIC NET Support and Training”.

4.9 Preassembled Connecting Cables

4.9.1 830-1T Connecting Cable

Uses

The 830-IT connecting cable is a preassembled cable for fast and cost-effective attachment of DTEs to OLMs and OBTs.

Design

The 830-1T connecting cable consists of a twisted pair (stranded copper cores) with a braid shield. It is fitted with a 9-pin sub-D 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.

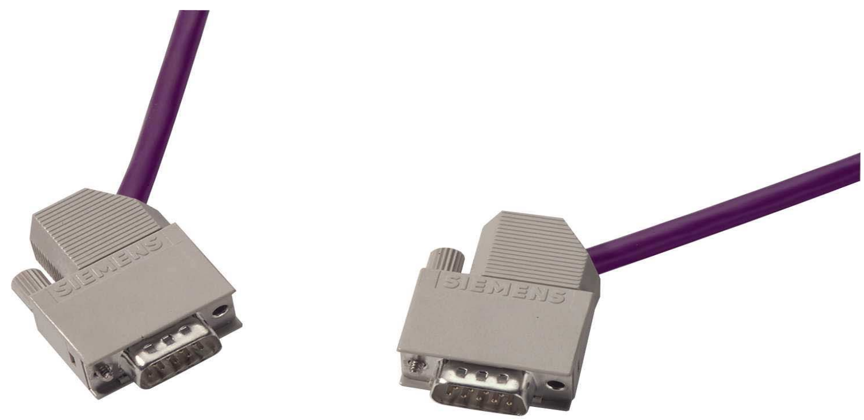


Figure 4-34 830-1T Connecting Cable

Function

The 830-1T connecting cable connects the following:

- The electrical interface of the Optical Link Module (OLM, OBT) with the PROFIBUS interface of a DTE.

Note

Due to the integrated terminating resistors, the 830-1T connecting cable must not be used as a tap line (for example for attaching a PG) to a PROFIBUS segment.

Table 4-11 Ordering Data for SIMATIC NET 830-1T Connecting Cable

Ordering Data:	
SIMATIC NET 830-1T connecting cable for PROFIBUS for connecting DTEs to OLMs and OBTs, preassembled with two sub-D male connectors, 9-pin cable, terminated at both ends	
1.5 m	6XV1830-1CH15
3 m	6XV1830-1CH30

4.9.2 830-2 Connecting Cable

Uses

The 830-2 connecting cable is a preassembled cable for fast and cost-effective attachment of PROFIBUS nodes (for example HMI) to programmable controllers for transmission rates up to 12 Mbps.

Design

The 830-2 connecting cable consists of the PROFIBUS standard cable. It has a 9-pin sub-D male connector with a straight cable outlet at one end and a 9-pin sub-D male connector with a 90° cable outlet at the other. 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 4-35 830-2 Connecting Cable

Function

The 830-2 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 4-12 Ordering Data for SIMATIC NET 830-2 Connecting Cable

Ordering Data:	
SIMATIC NET 830-2 connecting cable for PROFIBUS for connecting DTEs to OLMs and OBTs, preassembled with two sub-D male connectors, 9-pin, terminating resistors can be activated.	
3 m	6XV1830-2AH30
5 m	6XV1830-2AH50
10 m	6XV1830-2AN10

Active Components for RS-485 Networks 5

5.1 RS-485 Repeater

What is an RS-485 Repeater?

An RS-485 repeater amplifies data signals on bus cables and links bus segments.

Using the RS-485 Repeater (6ES7 972-0AA01-0XA0)

You require an RS-485 repeater in the following situations:

- When there are more than 32 stations (including repeaters) connected to the bus
- When electrically isolated bus segments are required or
- When the maximum cable length of a segment is exceeded (see Chapter 3 “Network Configuration”).

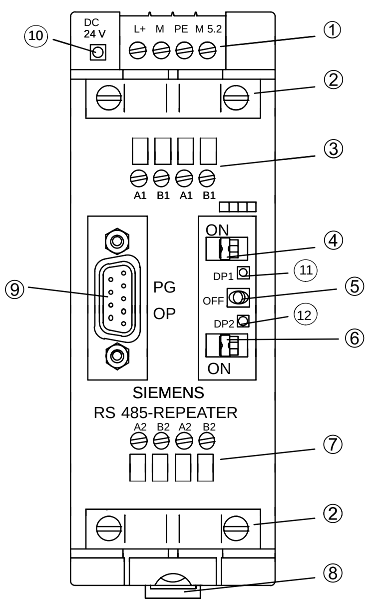
Rules

If you want to install a PROFIBUS network with RS-485 repeaters, you can connect a maximum of nine RS-485 repeaters in series.

Design of the RS-485 Repeater

Table 5-1 shows the elements of the RS-485 repeater.

Table 5-1 Description and Functions of the RS-485 Repeater

Layout of the Repeater	No.	Function
	①	Terminal for connecting the power supply of the RS 485 repeater (pin “M5.2” is the reference ground if you want to measure the voltage between terminals “A2” and “B2”).
	②	Shield clamp for strain relief and grounding the LAN cable of bus segment 1 or bus segment 2
	③	Terminal for the LAN 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	Terminal for the LAN cable of bus segment 2
	⑧	Catch for mounting and removing the RS-485 repeater on a standard rail
	⑨	Interface for PG/OP on bus segment 1
	⑩	LED 24 V 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 attachment is disconnected (see Figure 5-3) !

Note

Terminal M5.2 of the power supply (see Table 5-1, no. ①) is used as the reference ground for signal measurements if problems occur and must not be wired up.

Technical Specifications

Table 5-2 lists the technical data of the RS-485 repeater:

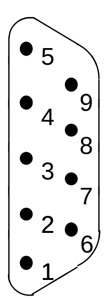
Table 5-2 Technical Data of the RS-485 Repeater

Technical Specifications	
Power supply • Rated voltage • Ripple (static limit)	 24 V DC 20.4 V DC to 28.8 V DC
Power consumption at rated voltage • Without load on the PG/OP connector • Load on the PG/OP connector (5 V/90 mA) • Load on the PG/OP connector (24 V/100 mA)	 200 mA 230 mA 300 mA
Electrical isolation	yes, 500 V AC
Transmission rate (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
Degree of protection	IP20
Dimensions W × H × D (in mm)	45 × 128 × 67
Weight (including packing)	350 g

Pinout of the Sub D Connector (PG/OP Connector)

The 9-pin sub D connector has the following pinout:

Table 5-3 Pin Assignment of the 9-Pin Sub D Connector PG/OP Connector

Layout	Pin no.	Signal name	Meaning
	1	–	–
	2	M24V	Chassis 24 V
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference potential (from station)
	6	P5V2	Power supply plus (from station)
	7	P24V	24 V
	8	RxD/TxD-N	Data line A
	9	–	–

Block Diagram

Figure 5-1 shows the block diagram of the RS-485 repeater:

- Bus segment 1 and bus segment 2 are electrically isolated.
- Bus segment 2 and the PG/OP connector are electrically isolated.
- Signals are amplified:
  - between bus segment 1 and bus segment 2
  - between the PG/OP connector and bus segment 2

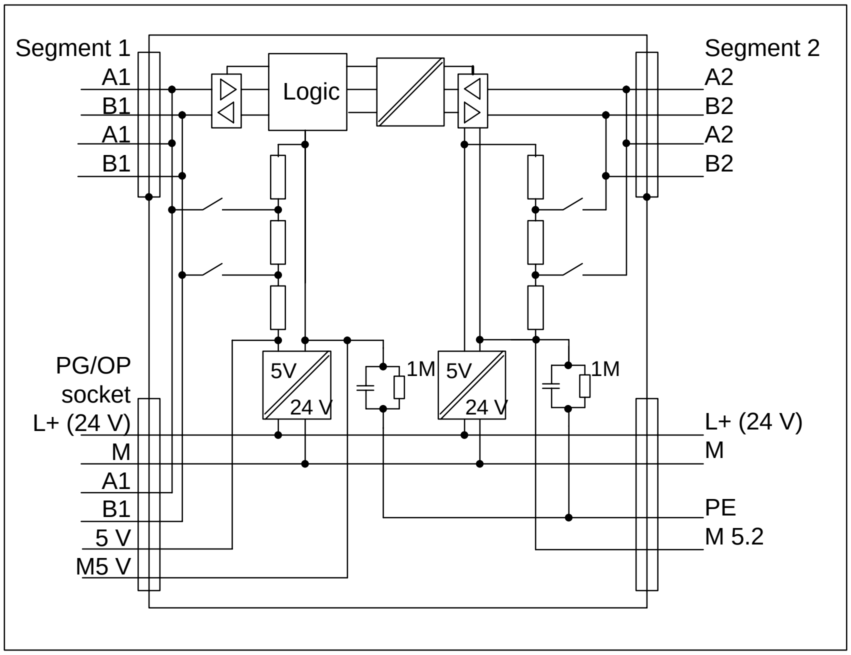


Figure 5-1 Block Diagram of the RS-485 Repeater

5.2 Possible Configurations with the RS-485 Repeater

Overview

The following section explains the configurations in which you can use the RS-485 repeater:

- Segment 1 and Segment 2 terminated on the RS-485 repeater (see Figure 5-3)
- Segment 1 terminated on the RS-485 repeater and segment 2 connected through on the RS-485 repeater (see Figure 5-4)

  and
- Segment 1 and Segment 2 connected through on the RS-485 repeater (see Figure 5-5)

Terminating Resistor On/Off

Figure 5-2 shows the setting for the terminating resistor:

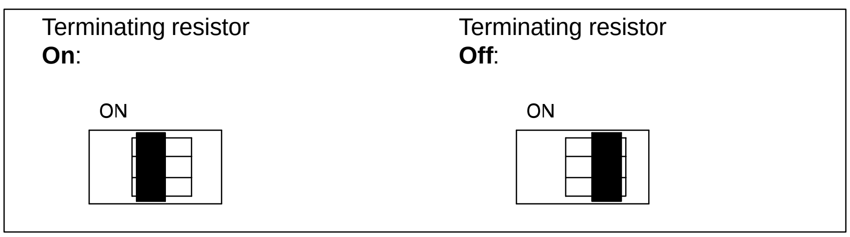


Figure 5-2 Setting of the Terminating Resistor

Segments 1 and 2 Terminated

Figure 5-3 shows how to connect the RS-485 repeater to the ends between two segments:

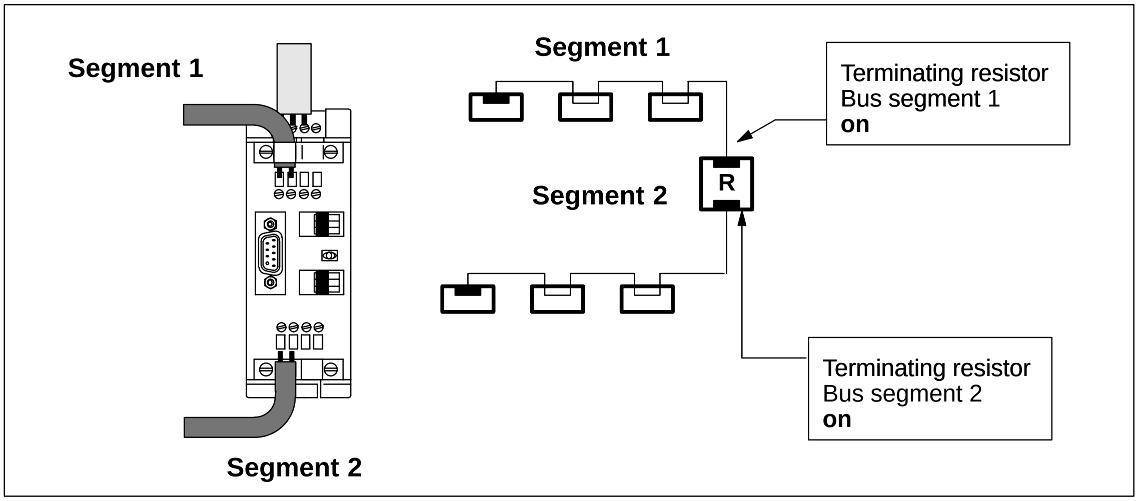


Figure 5-3 Connecting Two Bus Segments to the RS-485 Repeater

Segment 1 Terminated, Segment 2 Connected Through

Figure 5-4 shows the connection between two segments via an RS-485 repeater with one segment connected through:

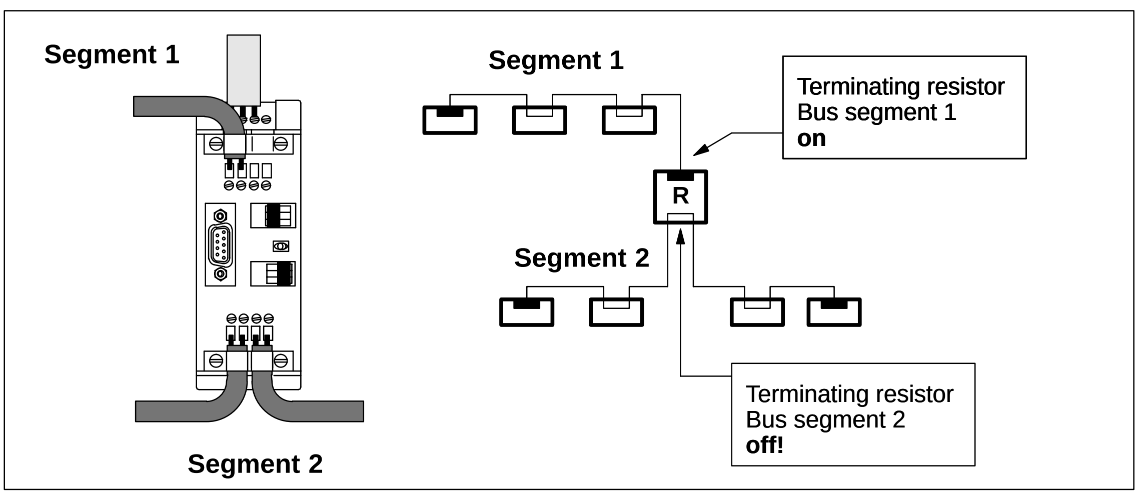


Figure 5-4 Connecting Two Bus Segments to the RS-485 Repeater

Segments 1 and 2 Connected Through

Figure 5-5 shows the connection between two segments via an RS-485 repeater with each LAN cable connected through:

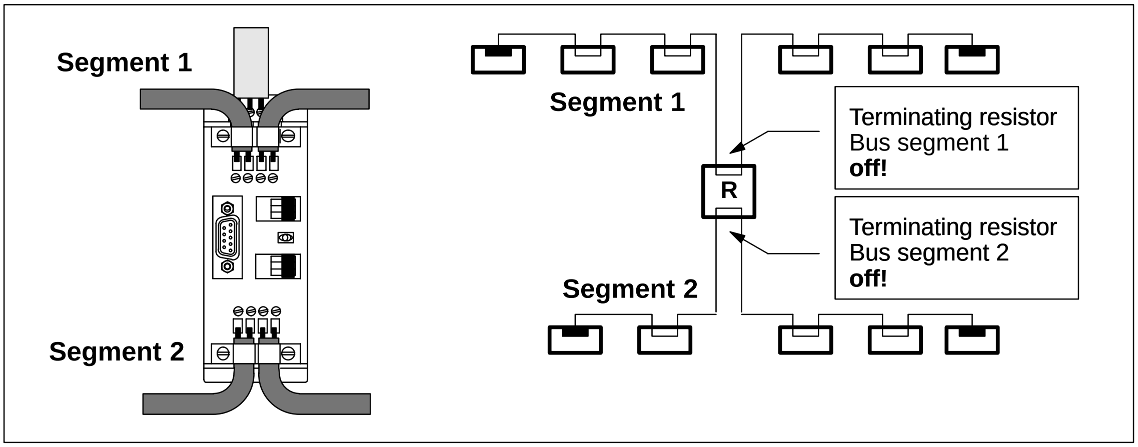


Figure 5-5 Connecting Two Bus Segments to the RS-485 Repeater

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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 RS-485 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 is then the terminating resistor 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 one terminator if the bus segment to be turned off ends at the repeater, otherwise you require two terminators.

5.3 Installing and Uninstalling the RS-485 Repeater

Overview

You can install the RS-485 repeater as follows:

- On an S7-300 rail

  or

- On a standard rail (order number 6ES5 710-8MA..)

Installation on an S7-300 Rail

To install the RS-485 repeater on an S7-300 rail, the catch on the rear of the RS-485 repeater must first be removed (see Figure 5-6):

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

   Result: The catch is released from the RS- 485 repeater.
3. 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.
4. Fit the RS-485 repeater onto the rail for an S7-300 (4).
5. Push it towards the back as far as it will go (5).
6. Tighten the securing screw with a torque of 80 to 110 Ncm (6).

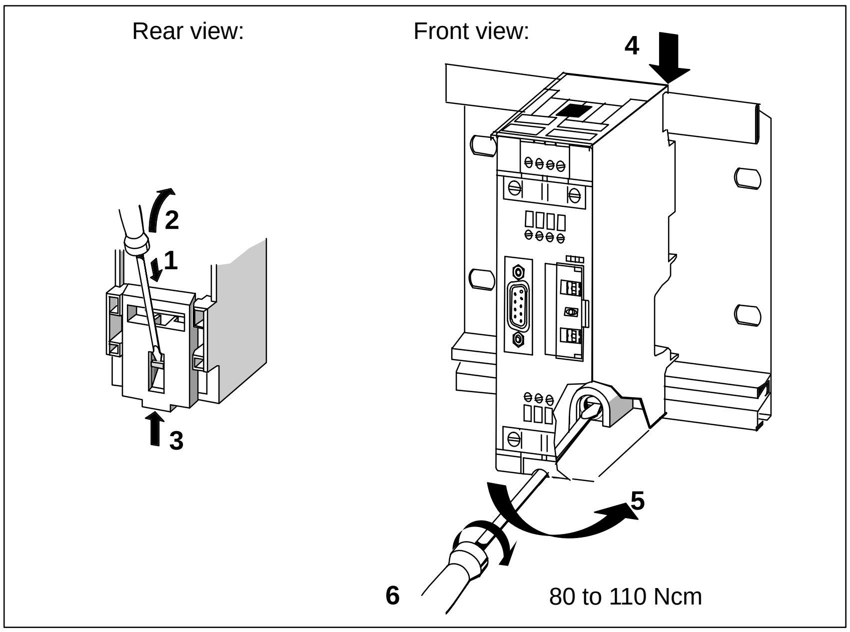


Figure 5-6 Installing the RS-485 Repeater on an S7-300 Rail

Removing the Repeater from an S7-300 Rail

To remove the RS-485 repeater from the S7-300 rail:

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

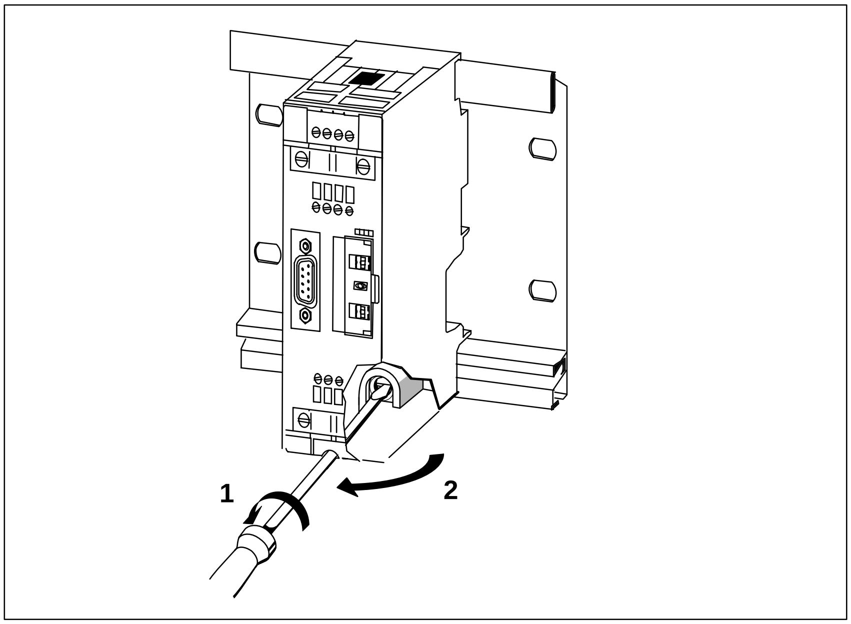


Figure 5-7 Removing the RS-485 Repeater from the S7-300 Rail

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 RS-485 repeater:

1. Fit the RS-485 repeater on to the standard rail from above and
2. Push it towards the back until the catch locks it in place.

Removing the RS-485 from the Standard Rail

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

1. Press down the catch on the bottom of the RS-485 repeater using a screwdriver and
2. Pull the RS-485 repeater out and upwards to remove it from the standard rail.

5.4 Ungrounded Operation of the RS-485 Repeater

Ungrounded Operation

Ungrounded operation means that chassis and PE are not connected.

The ungrounded operation of the RS-485 repeater allows you to operate electrically isolated bus segments.

Figure 5-8 shows the change in the potentials resulting from using the RS 485 repeater.

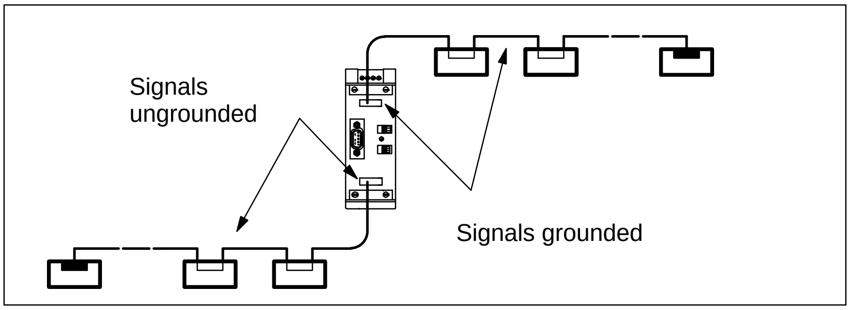


Figure 5-8 Ungrounded Operation of Bus Segments

5.5 Connecting the Power Supply

Cable Type

To connect the 24 V 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:

1. Strip the insulation from the wire for the 24 V DC power supply.
2. Connect the cable to terminals “L+”, ”M” and “PE”.

5.6 Connecting the LAN Cable

All the LAN cables described in Chapter 4 are suitable for attachment to the RS-485 repeater.

Connecting the PROFIBUS Cable

Connect the PROFIBUS LAN cable to the RS-485 repeater, as follows:

1. Cut the PROFIBUS cable to the required length.
2. Strip the insulation from the PROFIBUS cable as shown in Figure 5-9.

   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.

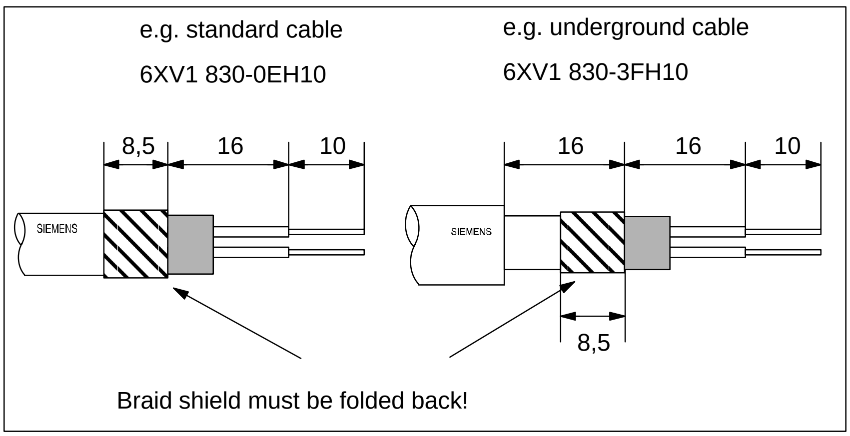


Figure 5-9 Stripping the Cable to Connect it to the RS-485 Repeater

3. Connect the PROFIBUS cable to the RS-485 repeater:

   Connect the same wires (green/red for the PROFIBUS LAN 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).
4. Tighten the shield clamps so that the shield makes good contact with the clamp.

5.7 PROFIBUS Terminator

What is a PROFIBUS Terminator?

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

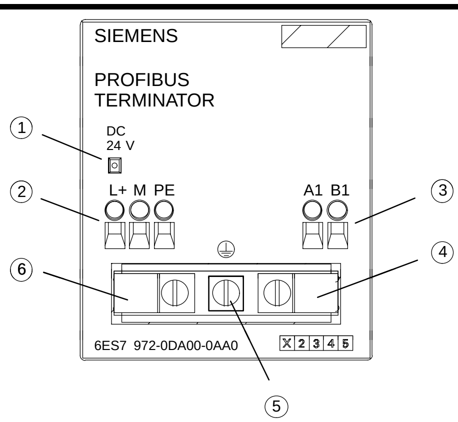
Order number

6ES7 972-0DA00-0AA0

Design of the PROFIBUS Terminator

Table 5-4 shows the design of the PROFIBUS terminator:

Table 5-4 Design of the PROFIBUS Terminator

Design of the PROFIBUS Terminator	No.	Function
	①	LED 24 V power supply
	②	Connection for power supply 24 V DC
	③	PROFIBUS attachment
	④	Shield clamp grounding the braid shield and for strain relief of the LAN cable
	⑤	Ground screw
	⑥	Cable clamp for strain relief of the power supply cable

Technical Specifications

Table 5-5 lists the technical data of the PROFIBUS terminator:

Table 5-5 Technical Specifications of the PROFIBUS Terminator

Technical Specifications	
Power supply • Rated voltage • Ripple (static limit)	 24 V DC 20.4 V DC to 28.8 V DC
Power consumption at rated voltage	max. 25 mA
Electrical isolation	yes, 600 V DC
Transmission rate	9.6 Kbps to 12 Mbps
Degree of protection	IP20
Permitted ambient temperatures	0° C to 60° C
Storage temperature	– 40° C to +70° C
Connectable cables; power supply • Flexible cables – With wire-end ferrule – Without wire-end ferrule • Solid cables	Screw mechanism; 0.25 mm^2 to 1.5 mm^2 0.14 mm^2 to 2.5 mm^2 0.14 mm^2 to 2.5 mm^2
Connectable cables; PROFIBUS	Screw mechanism; all SIMATIC NET PROFIBUS cables
Dimensions W × H × D (in mm)	60 × 70 × 43
Weight (including packing)	95 g

Connecting the PROFIBUS Cable

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

1. Cut the PROFIBUS cable to the required length.
2. 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.

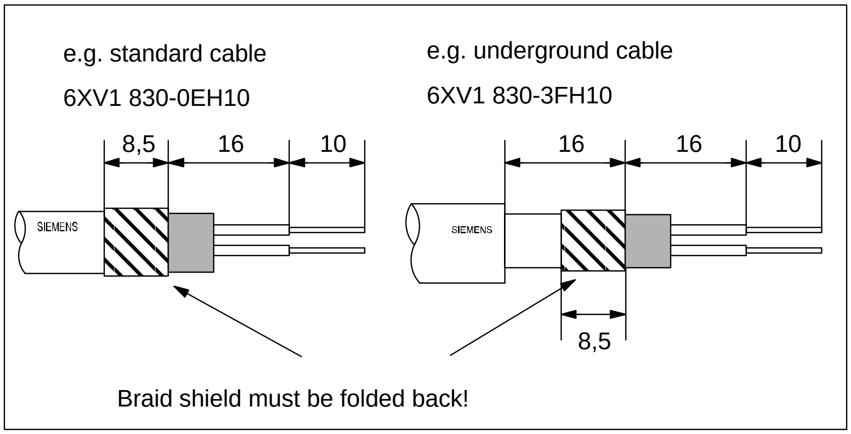


Figure 5-10 Stripping the Insulation to Connect to the PROFIBUS Terminator

3. Connect the PROFIBUS LAN cable to the PROFIBUS terminator:

   Connect the same wires (green/red for the PROFIBUS LAN 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).
4. 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.

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6 Passive Components for PROFIBUS-PA

6.1 FC Process Cable

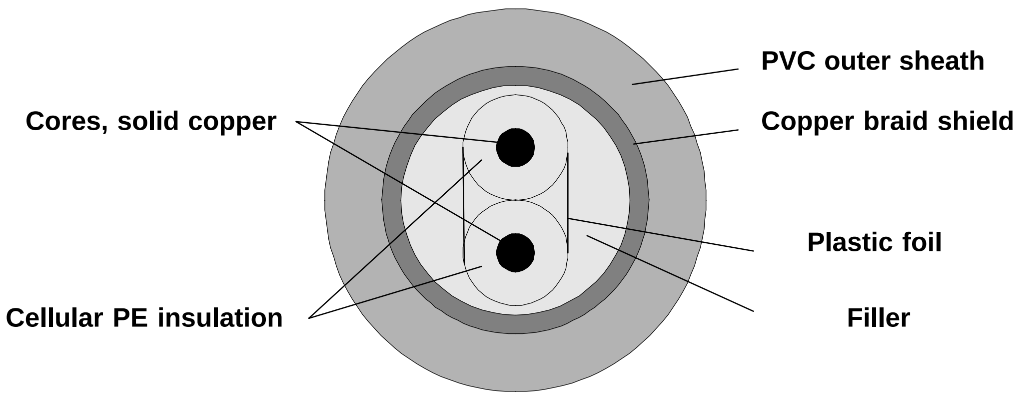


Figure 6-1 Cross-Section of the FC LAN Cable for PROFIBUS-PA

FC LAN Cables for PROFIBUS-PA 6XV1 830–5EH10 and 6XV1 830–5FH10

The LAN cables 6XV1 830–5EH10 (blue sheath) and 6XV1 830–5FH10 (black sheath) are standard cables for PROFIBUS-PA networks. They can be used generally for all systems using the transmission technique complying with IEC 61158-2, for example, Foundation Fieldbus and PROFIBUS-PA. They meet the requirements of cable type A complying with IEC 61158-2 (see also Chapter 4). 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 sheath. (See Section 4.2.3)

Properties

- Flame-retardant
- Self-extinguishing in case of fire
- Resistant to UV radiation
- Conditionally resistant to mineral oil and greases
- The FC Process Cable corresponds to the FISCO model

Uses

The LAN cable is intended for bus connections using the IEC 61158-2 /5/ transmission technique. It is intended for fixed installation indoors and outdoors.

6.2 SpliTConnect Tap

Uses

The SpliTConnect tap allows a PROFIBUS-PA bus segment complying with IEC 61158-2 to be implemented with DTE attachment points. Using the SpliTConnect coupler, it is possible to cascade SpliTConnect Taps to create a PROFIBUS-PA distributor. By replacing the contact screw with the SpliTConnect terminator, the SpliTConnect tap can be used as a bus terminating resistor.

Figure 6-2 PROFIBUS SpliTConnect Tap

Figure 6-3 SpliTConnect Coupler

Figure 6-4 SpliTConnect Terminator

Figure 6-5 SpliTConnect M12 Outlet

Design

The SpliTConnect tap has a sturdy 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 FastConnect LAN cable for IEC 61158-2, the SpliTConnect tap represents a simple cable attachment that can be installed quickly. FastConnect LAN cables for IEC 61158-2 are contacted and connected using insulation displacement terminals with contact screws. It is also possible to ground the SpliTConnect tap using the contact screw.

How the SpliTConnect Tap Works

The SpliTConnect Tap is used to install a PROFIBUS-PA bus segment complying with IEC 61158-2 /5/ with DTE attachment points. The FastConnect attachment system (FastConnect stripping tool, FastConnect LAN cable for IEC 61158-2) allows straightforward assembly of cables. DTEs can be attached directly via the FastConnect LAN cable for IEC 61158-2 or via the SpliTConnect M12 outlet.

Table 6-1 Ordering Data:

Ordering Data:	Order no.
SpliTConnect Tap for implementing PROFIBUS-PA segments and attaching PA field devices, insulation displacement terminals, IP 67 Consignment: pack of 10	**6GK1 905-0AA00**
SpliTConnect M12 Outlet element for direct attachment of PROFIBUS-PA field devices to the SpliTConnect tap via the M12 connector Consignment: pack of 5	**6GK1 905-0AB00**
SpliTConnect Coupler connection element for cascading SpliTConnect taps to create star hubs Consignment: pack of 10	**6GK1 905-0AC00**
SpliTConnect Terminator (Ex) for terminating PROFIBUS-PA segments, can be used in hazardous areas Consignment: pack of 5	**6GK1 905-0AD00**
SpliTConnect Terminator (not Ex) for connecting PROFIBUS-PA segments, cannot be used in hazardous areas Consignment: pack of 5	**6GK1 905-0AE00**

SIEMENS

SIMATIC NET

Produktinformation
Product Information

Stand / *Dated* / 10.99

Montageanleitung für SIMATIC NET PROFIBUS SpliTConnect System
Mounting Instructions for SIMATIC NET PROFIBUS SpliTConnect System

039 242-001-03-1099
Printed in Federal Republic of Germany

Wir haben den Inhalt der Druckschrift auf Übereinstimmung mit dem beschriebenen SpliTConnect System geprüft. Dennoch können Abweichungen nicht ausgeschlossen werden, so daß wir für die vollständige Übereinstimmung keine Gewähr übernehmen. Die Angaben in der Druckschrift werden jedoch regelmäßig überprüft. Notwendige Korrekturen sind in den nachfolgenden Auflagen enthalten. Für Verbesserungsvorschläge sind wir dankbar.

Technische Änderungen vorbehalten.

Wichtiger Hinweis

Wir weisen darauf hin, daß der Inhalt dieser Betriebsanleitung nicht Teil einer früheren oder bestehenden Vereinbarung, Zusage oder eines Rechtsverhältnisses ist oder diese abändern soll. Sämtliche Verpflichtungen von Siemens ergeben sich aus dem jeweiligen Kaufvertrag, der auch die vollständige und allein gültige Gewährleistungsregel enthält. Diese vertraglichen Gewährleistungsbestimmungen werden durch die Ausführungen dieser Betriebsanleitung weder erweitert noch beschränkt.

Wir weisen außerdem darauf hin, daß aus Gründen der Übersichtlichkeit in dieser Betriebsanleitung nicht jede nur erdenkliche Problemstellung im Zusammenhang mit dem Einsatz dieses Systems beschrieben werden kann. Sollten Sie weitere Informationen benötigen oder sollten besondere Probleme auftreten, die in der Betriebsanleitung nicht ausführlich genug behandelt werden, können Sie die erforderliche Auskunft über die örtliche Siemens-Niederlassung anfordern.

WARNUNG!

– Das in der Anleitung beschriebene SpliTConnect Tap System ist nur für die Verwendung mit PROFIBUS FC Process Cable bestimmt. Bei anderweitiger Verwendung kann es zu Unfällen oder zur Zerstörung des SpliTConnect Systems und der Leitung kommen.
– Die Montage von Komponenten des SpliTConnect Tap Systems darf nur an Bussegmenten erfolgen, die nicht in Betrieb sind.

Anforderung an die Qualifikation des Personals

Qualifiziertes Personal im Sinne dieser Betriebsanleitung bzw. der Warnhinweise sind Personen, die mit Aufstellung, Montage, Inbetriebsetzung und Betrieb dieses Produktes vertraut sind und über die ihrer Tätigkeit entsprechenden Qualifikation verfügen und in erster Hilfe geschult sind.

We have checked the contents of this manual for agreement with this SpliTConnect System described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcome.

Technical data subject to change.

Note

We would point out that the contents of this product documentation shall not become a part of or modify any prior or existing agreement, commitment or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Siemens. Any statements contained in this documentation do not create new warranties or restrict the existing warranty.

We would further point out that, for reasons of clarity, these operating instructions cannot deal with every possible problem arising from the use of this system. Should you require further information or if any special problems arise which are not sufficiently dealt with in the operating instructions, please contact your local Siemens representative.

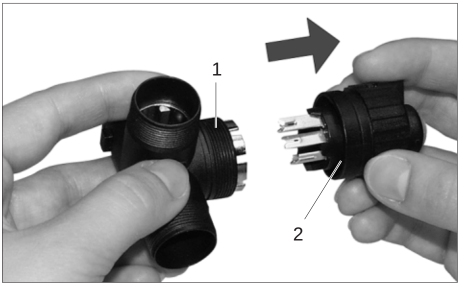
WARNING!

– The SpliTConnect Tap System described in this Mounting Instructions is intended only for use with PROFIBUS FC Process Cable. Using the system for any other purpose can lead to injury or to damage of the SpliTConnect System or the cable.
– Mounting of SpliTConnect System components only may be done with bus segments which are not in operation.

Personnel qualification requirements

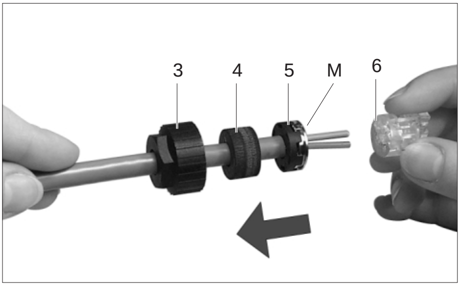
Qualified personnel as referred to in the operating instructions or in the warning notes are defined as persons who are familiar with the installation, assembly, startup and operation of this product and who possess the relevant qualifications for their work and have a First Aid qualification.

Montage / Mounting **SpliTConnect Tap** **Bestell-Nummer / Ord. code 6GK1905-0AA00**

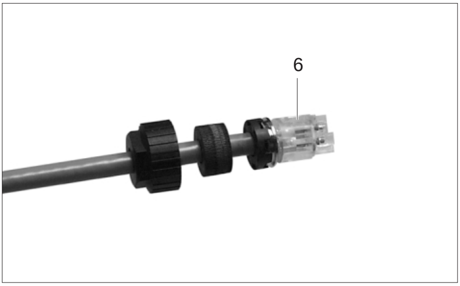


1. Kontaktierelement (2) losschrauben und von SpliTConnect Tap (1) abziehen.
   Screw off contacting element (2) and remove it from the SpliTConnect Tap (1).

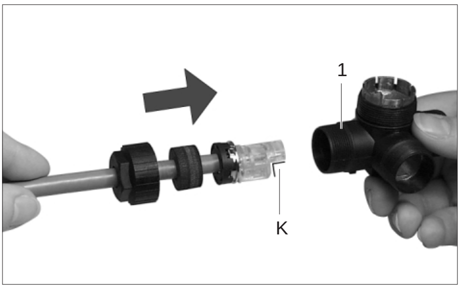
2. Leitung mit FastConnect Stripping Tool 1) abisolieren.
   Strip off cable by using the FastConnect Stripping Tool 1).



3. Mutter (3), Dichtung (4) und Schirmkontaktierelement (5) auf die Leitung schieben.
   Achtung! Metallseite (M) des Schirmkontaktierelementes (5) muß in Richtung Litzenhalter (6) zeigen.
   Assemble cable with nut (3), seal (4) and shield contacting element (5).
   Attention! *Metal side (M) of the shield contacting element (5) must point to the strand holder (6).*



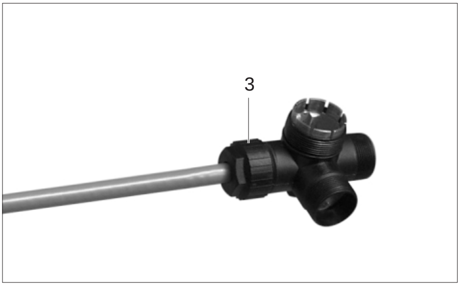
4. Litzenhalter (6) auf die **nicht abisolierten** Litzen aufstecken.
   Achtung! Farbcodierung beachten.
   Insert the strand holder (6) onto the ***not stripped off*** *strands.*
   Attention! *Follow the colour coding.*



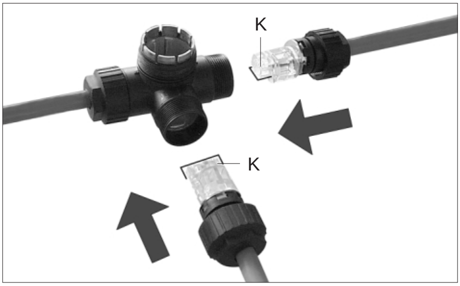
5. Bestückte Leitung in den SpliTConnect Tap (1) einführen, dabei Kodierung (K) beachten.
   Insert the assembled cable into the SpliTConnect Tap (1) and pay attention to the coding (K) in doing so.

1) siehe Montageanleitung des FastConnect Stripping Tool
See Mounting Instructions of the FastConnect Stripping Tool

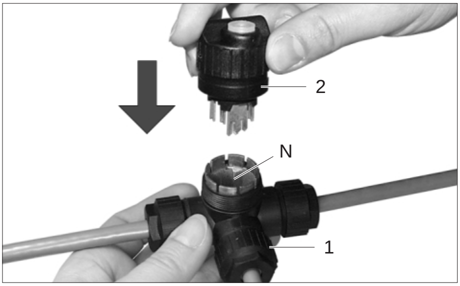
Montage / Mounting **SpliTConnect Tap**



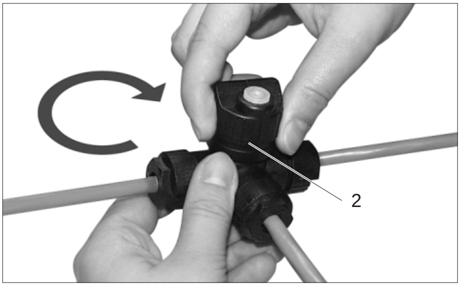
6. Mutter (3) bis zum Anschlag anziehen.
   Tighten nut (3) as much as possible.



7. Montageschritte 2 bis 6 für die zwei anderen Leitungsabgänge durchführen, dabei jeweils Kodierung (K) beachten.
   Repeat assembling steps 2 to 6 for the remaining cable ports and pay attention to the codings (K) by doing so.



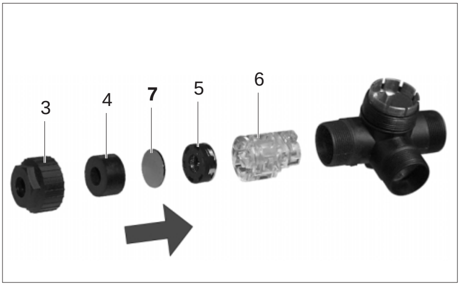
8. Kontaktierelement (2) in SpliTConnect Tap (1) einführen; Ausrichtung ist durch Nut (N) und Führung im Kontaktierelement (2) vorgegeben.
   Achtung! Alle 3 Abgänge müssen korrekt bestückt sein.
   Insert contacting element (2) into SpliTConnect Tap (1). Alignment is given by groove (N) and slot in the contacting element (2).
   Attention! *All 3 ports have to be mountet correctly.*



9. Kontaktierelement (2) bis auf Anschlag anziehen. Zur Unterstützung kann ein Schraubendreher durch die dafür vorgesehene Öffnung im Kontaktierelement (2) gesteckt werden.
   Tighten contacting element (2) as much as possible. For supporting this, a screw driver can be used by inserting in the provided hole of the contacting element (2).

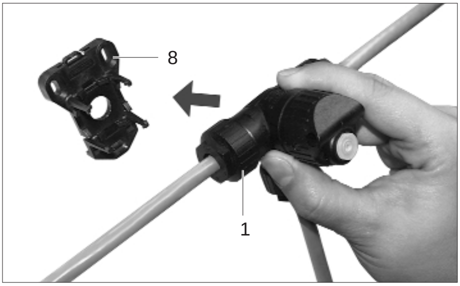
Erdung
Bei Bedarf kann das SpliTConnect Tap geerdet werden. Hierzu steht am Kontakierelement (2) ein M4 Gewinde zur Verfügung. Es wird empfohlen einen Kabelschuh zu verwenden.
Grounding
If neccessary the SpliTConnect Tap can be grounded. For this purpose a M4 thread at the contacting element (2) is available. It is recommended to use a thimble.

Montage nicht benutzter Ausgänge / *Mounting of not used ports*



Ein **nicht benutzter Ausgang** wird mit Mutter (3), Dichtung (4), **Dichtscheibe (7)**, Schirmkontaktier-element (5) und Litzenhalter (6) abgeschlossen (Reihenfolge beachten).
*A **not used port** can be closed with nut (3), seal (4), **sealing disk (7)**, shield contacting element (5) and strand holder (6). Pay attention to the order!*

Montage auf Fläche oder Hutschiene / *Mounting on a flat surface or on a hat rail*



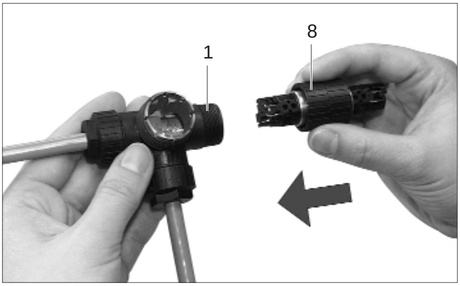
Zur **Montage auf einer ebenen Fläche oder auf einer Hutschiene** den fertig montierten SpliTConnect Tap (1) auf den SpliTConnect Clip (8) aufstecken.
*For **mounting on a flat surface or on a hat rail** insert the completely assembled SpliTConnect Tap (1) into the SpliTConnect Clip (8).*

Hinweis
Der SpliTConnect Tap dient nicht als Zugentlastung für die PROFIBUS-Leitung.
Die Leitung muß daher zugentlastet angebracht werden!
Note
The SpliTConnect Tap is not a strain relieve for the PROFIBUS cable.
Therefore the cable has to be mounted strain relieved.

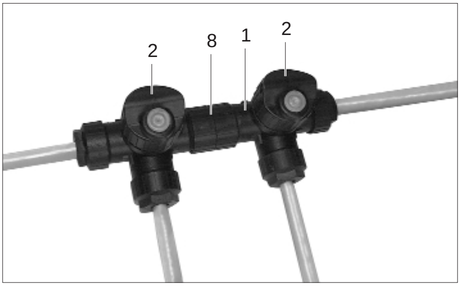
Zubehör (nicht im Lieferumfang enthalten) / *Accessoires (not included in scope of delivery)*

Typ / *Type*	Beschreibung / *Description*	Bestell-Nummer / *Ord. code*
SpliTConnect Coupler	Zur Kopplung zweier oder mehrerer SpliTConnect Tap *For coupling of two or more SpliTConnect Tap*	6GK1905-0AC00

Montage / *Mounting*



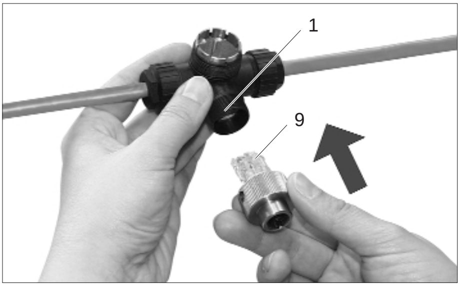
1. SpliTConnect Coupler (8) auf einen freien Leitungsabgang eines SpliTConnect Tap (1) aufschrauben.
   Srew the SpliTConnect Coupler (8) onto a free port of the SpliTConnect Tap (1).



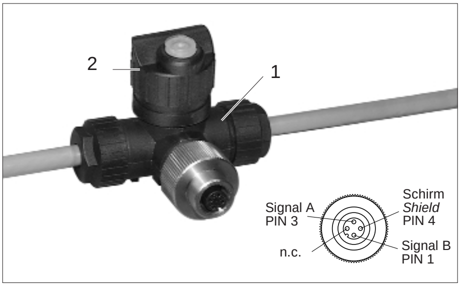
2. SpliTConnect Coupler (8) auf einen freien Leitungsabgang eines zweiten SpliTConnect Tap (1) aufschrauben. Kontaktierelemente (2) auf die **komplett bestückten** SpliTConnect Tap aufschrauben.
   *Srew the SpliTConnect Coupler (8) onto a free port of a second SpliTConnect Tap (1). Screw contacting element (2) onto the **completely assembled** SpliTConnect Tap.*

Typ / *Type*	Beschreibung / *Description*	Bestell-Nummer / *Ord. code*
SpliTConnect M12 Outlet	Abgang mit M12 Buchse. Verwendung anstelle des Abgangs für Leitungsanschluss. *Port with M12 socket.* *To be used instead of the port for cable connection.*	6GK1905-0AB00

Montage / *Mounting*



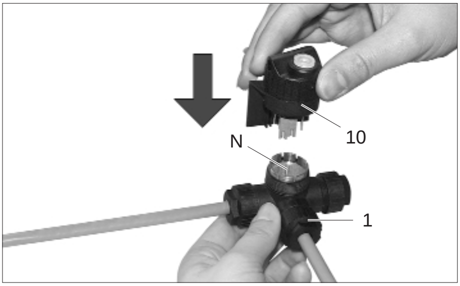
1. SpliTConnect M12 Outlet (9) auf einen freien Leitungsabgang eines SpliTConnect Tap (1) aufschrauben.
   Screw the SpliTConnect M12 Outlet (9) onto a free port of the SpliTConnect (1).



2. Kontaktierelement (2) auf den **komplett bestückten** SpliTConnect Tap (1) aufschrauben.
   *Screw contacting element (2) onto the **completely assembled** SpliTConnect Tap (1).*

Typ / *Type*	Beschreibung / *Description*	Bestell-Nummer / *Ord. code*
SpliTConnect Terminator **SpliTConnect Terminator Ex**	Zum elektrischen Abschluß eines Bussegments. *For electrical termination of a bus segment.*	6GK1905-0AE00 6GK1905-0AD00

Montage / *Mounting*



SpliTConnect Terminator (Ex) (10) in SpliTConnect Tap (1) einführen. Ausrichtung ist durch Nut (N) und Führung im SpliTConnect Terminator (Ex) (10) vorgegeben. **Achtung!** Alle 3 Abgänge müssen korrekt bestückt sein.
SpliTConnect Terminator (Ex) (10) bis auf Anschlag anziehen. Zur Unterstützung kann ein Schraubendreher durch die dafür vorgesehene Öffnung im SpliTConnect Terminator (Ex) (10) gesteckt werden.
Insert SpliTConnect Terminator (Ex) (10) into SpliTConnect Tap (1). Alignment is given by groove (N) and slot in the SpliTConnect Terminator (Ex) (10).
Attention! *All 3 ports have to be mountet correctly. Tighten SpliTConnect Terminator (Ex) (10) as much as possible. For supporting this, a screw driver can be used by inserting in the provided hole of the contacting element (2).*

SpliTConnect Terminator Ex

– Zum Einsatz in *For use in*
II 1G EEx ia IIC T6

– Zert. Nr. *Cert.No.*: DMT 99 ATEX E 054

– T_{Umax} – 20 °C … +50 °C
U_{max} 15 V
I_{max} 128 mA

– Parameter gemäß EN 50020, FISCO-Modell
Parameter according EN 50020, FISCO model

Typ / *Type*	Beschreibung / *Description*	Bestell-Nummer / *Ord. code*
FastConnect Stripping Tool	Werkzeug zum einfachen und schnellen Abisolieren des PROFIBUS FC Process Cable [1)]. *Tool for simple and fast insulation of the PROFIBUS FC Process Cable [1)].*	6GK1905-6AA00

1) siehe Montageschritt 2
see mounting step 2

Technische Daten /*Technical Data*

Elektrische Daten / *Electrical data*	gemäß PROFIBUS-Spezifikation;IEC 61158-2/ *according PROFIBUS specification, IEC 61158-2*
Schutzart / *Protection class*	IP 67 [1)]
Kontaktierhäufigkeit / *Contacting amount*	4 mal [2)]/ *4 times* [2)]

1) nur wenn alle Abgänge ordnungsgemäß bestückt sind
only if all user ports are mounted correctly

2) wenn erneut kontakiert wird, muß die Leitung unbedingt neu abgesetzt werden
if cable is connected again, it has to be stripped off new

Lieferumfang SpliTConnect Tap / *Scope of delivery SpliTConnect Tap*

1 x SpliTConnect Tap
1 x Kontaktierelement / *Contacting element*
3 x Mutter M22 / *Nut M22*
3 x Dichtung / *Seal*
3 x Schirmkontaktierungselement / *Shield contacting element*
3 x Litzenhalter / *Strand holder*
3 x Dichtscheibe / *Sealing disk*
1 x SpliTConnect Clip

Passive Components for Electrical Networks

7

7.1 Fiber-Optic Cables

Fiber-Optic Cable (FO)

On fiber-optic cables (FO) data is transmitted by modulating electromagnetic waves in the range of visible and invisible light. The materials used are high-quality plastic and glass fibers.

This chapter describes only the fiber-optic cables from the SIMATIC NET range intended for PROFIBUS. The various types of fiber-optic cable allow components to be connected together in a way suitable for the operating and environmental conditions.

Compared with electrical cables, fiber-optic cables have the following advantages:

Advantages

- Electrical isolation of nodes and segments
- No potential equalization currents
- Transmission path immune to external noise
- No lightning protection required
- No noise emission along the transmission path
- Light 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

Point-to-Point Link

For technological reasons, only point-to-point connections are possible with fiber-optic 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.

7.2 Plastic Fiber-Optic Cables

Plastic Fiber-Optic Cables

Plastic FO cables are used to connect optical link modules with attachments for plastic FO cables (OLM/P), optical bus terminals (OBT) and devices with an integrated optical interface. Under certain circumstances, this is a cost-effective alternative to traditional glass fiber-optic cables.

Properties of Fiber-Optic Cables

Use the Siemens plastic and PCF FO cables with the following properties:

Table 7-1 Properties of Fiber-Optic Cables

Meaning	SIMATIC NET PROFIBUS		
	Plastic Fiber Optic Duplex Cord	**Plastic Fiber Optic, Standard Cable**	**PCF Fiber Optic, Standard Cable**
Standard designation	I–VY2P 980/1000 150A	I–VY4Y2P 980/1000 160A	I–VY2K 200/230 10A17+8B20
Uses	Used indoors in areas where little mechanical load is expected, such as in laboratory setups or in cubicles	Used indoors	Used indoors
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		
Core diameter	980 µm		200 µm
Core material	Polymethylmethacrylate (PMMA)		Quartz glass
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 lilac	 PVC lilac
Number of fibers	2		

Table 7-1 Properties of Fiber-Optic Cables, continued

Meaning	SIMATIC NET PROFIBUS		
	Plastic Fiber Optic Duplex Cord	**Plastic Fiber Optic, Standard Cable**	**PCF Fiber Optic, Standard Cable**
Attenuation at Wavelength	≤ 230 dB/km 660 nm		≤ 10 dB/km 660 nm
Strain relief	–	Kevlar fibers	Kevlar fibers
Max. tensile strain • brief • permanent	 ≤ 50 N not suitable for permanent tensile strain	 ≤ 100 N not suitable for permanent tensile strain	 ≤ 500 N ≤ 100 N (only on strain relief, ≤50 N on connector or cord)
Transverse compressive strength per 10 cm length (brief)	≤ 35 N/ 10 cm	≤ 100 N/ 10 cm	≤ 750 N/ 10 cm
Bending Radius • single bend (without tensile strain) • multiple bending (with tensile strain)	 ≥ 30 mm ≥ 50 mm (only the flat surface)	 ≥ 100 mm ≥ 150 mm	 ≥ 75 mm ≥ 75 mm
Permitted ambient conditions • Transport/ storage temperature • Temperature for installation • Operating temperature	 –30 °C to +70 °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	 –30 °C to +70 °C –5 °C to +50 °C –20 °C to +70 °C
Resistant to • Mineral oil ASTM no. 2, greases or water • UV radiation	 conditionally[1] not UV resistant	 conditionally[1] conditionally[1]	 conditionally[1] conditionally[1]
Behavior in fire	Flame-resistant acc. to flame test VW–1 to UL 1581		
Outer dimensions	2.2 × 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 For special applications, contact your Siemens representative.

7.2.1 Plastic Fiber Optic, Duplex Cord

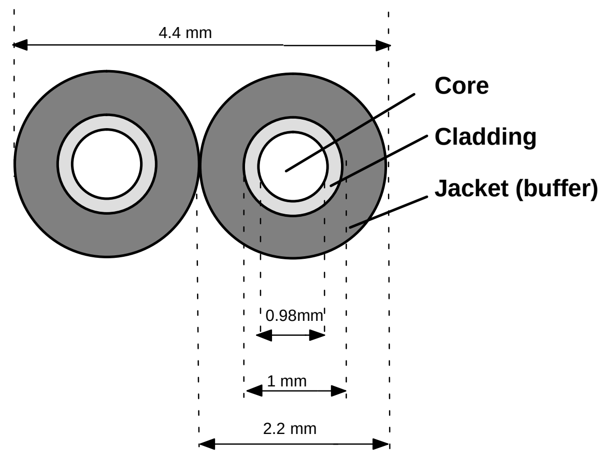


Figure 7-1 Structure of the Plastic FO Cable, Duplex Cord 6XV1821–2AN50

Plastic FO Cable, Duplex Cord 6XV1821–2AN50

The plastic FO cable, duplex cord 6XV1821–2AN50 is a flat, double-fiber cable with PVC inner jacket without an outer jacket. The jacket color is gray and no labeling is printed on it. The standard code is I-VY2P 980/1000 150.

The cable is easy to assembly on-site. 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, duplex cord 6XV1821-2AN50 is

- not suitable for permanent tensile strain
- conditionally resistant to mineral oil ASTM no. 2
- conditionally resistant to greases
- conditionally resistant to water
- not UV resistant
- flame-resistant acc. to flame test VW-1 to UL 1581

Uses

The plastic FO cable, duplex cord 6XV1821-2AN50 is intended for applications indoors in areas with 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 7-2 Order Numbers of the Plastic FO Cable, Duplex Cord 6XV1821-2AN50

Fiber-Optic Cables	Version	Order Number
SIMATIC NET PROFIBUS Plastic Fiber Optic, Duplex Cord I–VY2P 980/1000 150A Plastic FO cable with two fibers, PCV jacket, without connector, for use in areas where it is not subjected to mechanical load (for example within a cubicle or in laboratories)	50 m ring	6XV1821-2AN50

7.2.2 Plastic Fiber-Optic, Standard Cables

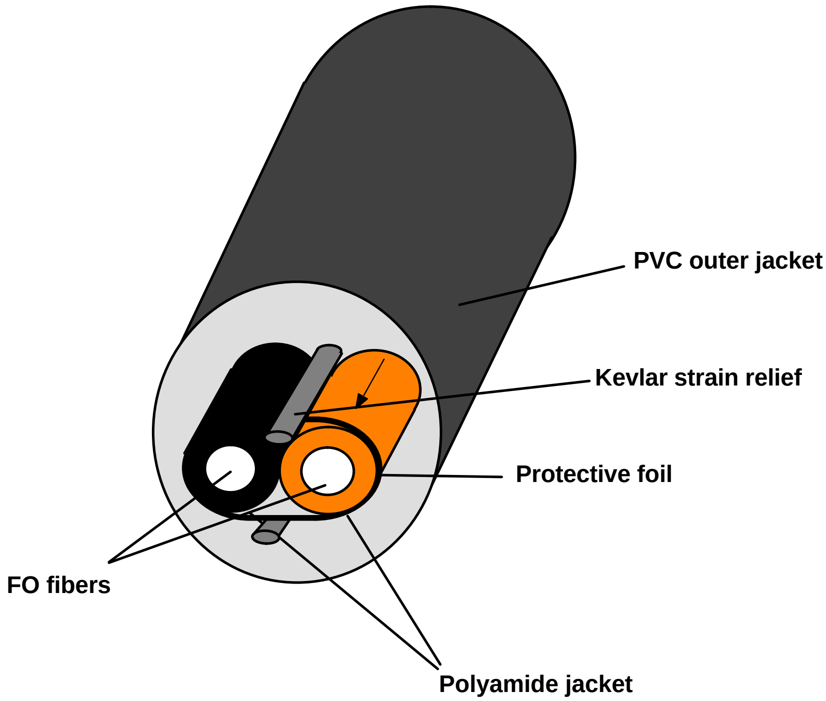


Figure 7-2 Structure of the Plastic Fiber-Optic Standard Cable

Plastic FO Cable, Standard Cable 6XV1821-0A***

The plastic FO cable, standard cable 6XV1821-0A*** 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 has the identifier “SIEMENS SIMATIC NET PLASTIC FIBER OPTIC 6XV1821-0AH10 (UL)” printed on it as well as meter markers.

The cable is easy to assembly on-site. 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 6XV1821-0A*** is

- not suitable for permanent tensile strain
- conditionally resistant to mineral oil ASTM no. 2
- conditionally resistant to greases
- conditionally resistant to water
- conditionally UV resistant
- flame-resistant acc. to flame test VW-1 to UL 1581

Uses

The plastic FO cable, standard cable 6XV1821-0A*** 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 7-3 Order Numbers of the Plastic Fiber-Optic Standard Cable

Ordering data: Plastic fiber-optic, standard cable, can be ordered in meters for OLMs, OBTs and integrated optical interfaces.	
SIMATIC NET PROFIBUS plastic fiber-optic, standard cable I-VY4Y2P 980/1000 160A Robust round cable with two plastic FO fibers, PVC outer jacket and PA inner jacket, without connectors, for use indoors, can be ordered in meters 50 m ring 100 m ring	 6XV1821-0AH10 6VX1821-0AN50 6XV1821-0AT10

Ordering data: Preassembled plastic fiber-optic cable, standard cable, for OLM/P	
SIMATIC NET PROFIBUS plastic fiber-optic, standard cable I-VY4Y2P 980/1000 160A Robust round cable with two plastic FO cords, PVC outer jacket and PA inner jacket**,** for use indoors, preassembled with 2 x 2 BFOC connectors, outer jacket stripped over 20 cm, for connection to OLM/P.	
Standard lengths*	
1 m	
2 m	6XV1821-0BH10
5 m	6XV1821-0BH20
10 m	6XV1821-0BH50
15 m	6XV1821-0BN10
20 m	6XV1821-0BN15
25 m	6XV1821-0BN20
30 m	6XV1821-0BN25
50 m	6XV1821-0BN30
65 m	6XV1821-0BN50
80 m	6XV1821-0BN65
*other length available on request	6XV1821-0BN80

7.2.3 PCF Fiber-Optic Cables

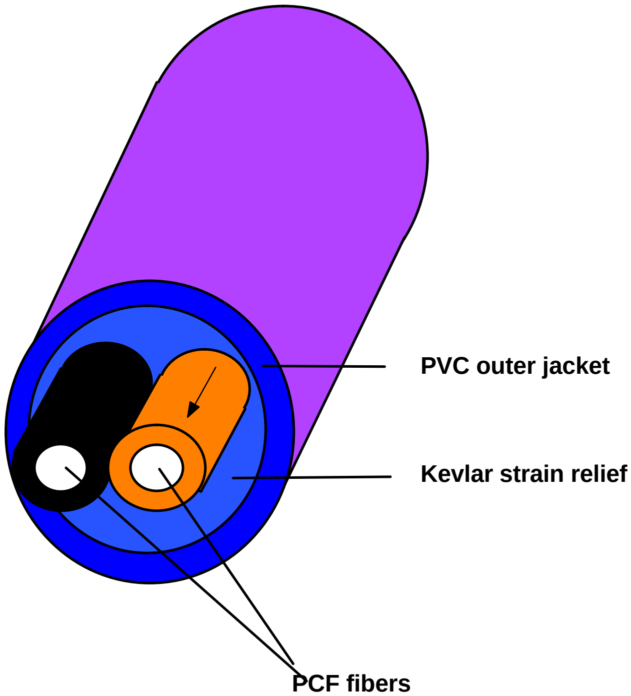


Figure 7-3 Structure of the PCF FO Standard Cable

PCF FO Cable, Standard Cable 6XV1821-1B***

The PCF FO cable, standard cable 6XV1821-1B*** 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 6XV1821-1AH10 (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 FO 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
- flame-resistant acc. to flame test VW-1 to UL 1581

Uses

The PCF FO standard cable 6XV1821-1B*** 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.

Ordering data: Preassembled PCF fiber-optic cables for OLM/P	
SIMATIC NET PROFIBUS PCF fiber-optic cable I-VY2K 200/230 10A17 + 8B20 PCF FO cable with 2 cords, PVC outer jacket, for spanning distances up to 400 m, preassembled with 2 x 2 BFOC connectors, outer jacket stripped over 20 cm, with a pulling loop fitted at one end, for connecting OLM/P.	
Standard lengths*	6XV1821-1BN75
75 m	6XV1821-1BT10
100 m	6XV1821-1BT15
150 m	6XV1821-1BT20
200 m	6XV1821-1BT25
250 m	6XV1821-1BT30
300 m	6XV1821-1BT40
400 m	
*other lengths available on request	

Ordering data: Preassembled PCF fiber-optic cables for integrated optical interfaces	
SIMATIC NET PROFIBUS PCF fiber-optic cable I-VY2K 200/230 10A17 + 8B20 PCF FO cable with 2 cords, PVC outer jacket, for spanning distances up to 300 m, preassembled with 2 x 2 simplex connectors, outer jacket stripped over 30 cm, with pulling loop fitted at one end, for connecting devices with integrated optical interfaces, OBT	
Standard lengths*	
50 m	6XV1821-1CN50
75 m	6XV1821-1CN75
100 m	6XV1821-1CT10
150 m	6XV1821-1CT15
200 m	6XV1821-1CT20
250 m	6XV1821-1CT25
300 m	6XV1821-1CT30
*other lengths available on request	

7.3 Glass Fiber-Optic Cables

Designed for Industry

SIMATIC NET glass fiber-optic cables (FO) are available in various designs allowing optimum adaptation to a wide range of applications.

Uses

Fiber-optic standard cable

- Universal cable for use indoors and outdoors

INDOOR fiber-optic cable

- Free of halogens, can be walked on, and extremely flame-retardant FO cable for use in buildings

Flexible fiber-optic trailing cable

- Specially designed for non-stationary use, for example with moving machinery

SIENOPYR duplex marine fiber-optic cable

- Hybrid cable consisting of two fibers and two additional copper wires for fixed installation on ships and offshore facilities

SIMATIC NET Standard Fibers

In glass fiber-optic cables, SIMATIC NET uses a fiber with 62.5 µm diameter as its standard fiber. 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 standard fibers described above. You can configure your optical network without complicated calculations using simple limit values (refer to Chapter 3 “Network Configuration”.

Guidelines for Laying Cables

You will find information about laying SIMATIC NET glass fiber-optic cables in Appendix C in this manual.

Technical Specifications

Tables 7-4 and 7-5 provide an overview of the technical specifications of all SIMATIC NET glass fiber-optic cables.

Table 7-4 Technical Specifications of the INDOOR Fiber-Optic Cable and Fiber-Optic Standard Cable

Cable Type	Fiber-Optic Standard Cable	INDOOR Fiber-Optic Cable
Areas of application	Universal cable for use indoors and outdoors	Halogen-free and extremely flame-retardant cable for indoor use that can be walked on
Available as	Preassembled cable with 4 BFOC connectors in fixed lengths, also available in meters	Preassembled cable with 4 BFOC connectors in fixed lengths
Cable type (standard designation)	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 fiber 62.5/125 µm	Multimode graded 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
Basic element materials	PVC, gray	Copolymer, orange (FRNC)
Strain relief	Aramid yarn and impregnated glass fiber yarn	Aramid yarn
Outer jacket/ color of cable	PVC/black	Copolymer/ bright orange (FRNC)
Dimensions of 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 weight	approx. 74 kg/km	approx. 30 kg/km
Permitted tensile load	<= 370 N (in operation) <= 500 N (brief)	<=200 N (in operation) <= 800 N (brief)
Bending radii	100 mm Only the flat surface	100 mm (during installation) 60 mm (in operation) Only the flat surface
Transverse compressive strength	5,000 N/10 cm	3,000 N/10 cm (brief) 1,000 N/10 cm (permanent)

Table 7-4 Technical Specifications of the INDOOR Fiber-Optic Cable and Fiber-Optic Standard Cable

Cable Type	Fiber-Optic Standard Cable	INDOOR Fiber-Optic Cable
Impact strength	3 blows (initial energy: 5 Nm hammer radius: 300 mm)	3 blows (initial energy: 1.5 Nm hammer radius: 300 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
Behavior in fire	Flame retardant complying with IEC 60332-3 cat. CF	Flame retardant complying with IEC 60332-3 and DIN VDE 0472 Part 804, test type B
Free of halogens	no	yes
UL approval	no	no
Ship building approval	no	no

Table 7-5 Technical Specifications of the Flexible Fiber-Optic Trailing Cable and the SIENOPYR Duplex Fiber-Optic Marine Cable

Cable Type	Flexible Fiber-Optic Trailing Cable	SIENOPYR Duplex Fiber-Optic Marine Cable
Areas of application	Flexible cable for installation in a drag chain indoors and outdoors	Fixed installation on ships and offshore facilities in all enclosed spaces and on free decks
Available as	Preassembled cable with 4 BFOC connectors in fixed lengths, also available in meters	Sold in meters
Cable type (standard designation)	AT-W11Y (ZN) 11Y2G62.5/125 3,1B200+0.8F600 LG	MI-VHH 2G 62.5/125 3.1B200 + 0.8F600 + 2x1CU 300 V
Fiber type	Multimode graded fiber 62.5/125 µm	Multimode graded fiber 62.5/125 µm
Power loss at 850 nm Power loss at 1300 nm	<= 3.1 dB/km <= 0.8 dB/km	<= 3.1 dB/km <= 0.8 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 outdoor cable
Core type	Hollow core, filled	Solid core
Basic element materials	PUR, black	Polyolefin

Table 7-5 Technical Specifications of the Flexible Fiber-Optic Trailing Cable and the SIENOPYR Duplex Fiber-Optic Marine Cable

Cable Type	**Flexible Fiber-Optic Trailing Cable**	**SIENOPYR Duplex Fiber-Optic Marine Cable**
Strain relief	GFK central element, Aramid yarn	Aramid yarn
Outer jacket/color of cable	PUR, black	SHF1 mixture/black
Dimensions Basic element	(3.5 ± 0.2) mm ∅	(2.9 ± 0.2) mm ∅
Outer dimensions	approx. 12.9 mm	(13.3 ± 0.5) mm
Cable weight	approx. 136 kg/km	approx. 220 kg/km
Permitted tensile load	<= 2000 N (brief) <=1000 N (permanent)	<= 500 N (brief) <= 250 N (permanent)
Bending radii	150 mm Max. 100,000 bending cycles	133 mm (single) 266 mm (multiple)
Installation temperature	-5°C to +50°C	-10°C to +50°C
Operating temperature	-25°C to +60°C	-40°C to +80°C 1) -40°C to +70°C 2)
Storage temperature	-25°C to +70°C	-40°C to +80°C
Resistance to fire	Complying with IEC 60332-1	Complying with IEC 60332-3 cat. A
Free of halogens	no	yes
UL approval	no	no
Ship building approval	no	yes

1) With no load on copper cores
2) With maximum load on copper cores (6 A)

7.3.1 Fiber-Optic Standard Cable

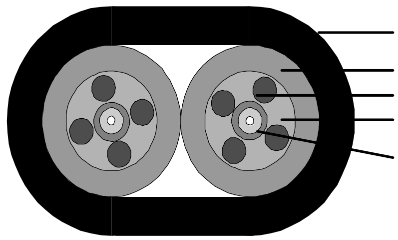


Figure 7-4 Structure of the Fiber-Optic Standard Cable

Fiber-Optic Standard Cable 6XV1820-5****

The fiber-optic 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 4-figure number make it easier to estimate the length of an installed cable.

Properties

The fiber-optic standard cable has the following properties:

- Can be walked on
- Flame-retardant complying with IEC 60332-3 cat. CF
- Not halogen free
- Available in meter lengths up to 4000 m
- Available preassembled with 4 BFOC connectors in lengths up to 1000 m

Uses

The fiber-optic standard cable is the universal cable for use indoors and outdoors. It is suitable for connecting optical ports operating at the wavelengths of 850 nm and 1300 nm.

7.3.2 INDOOR Fiber-Optic Cable

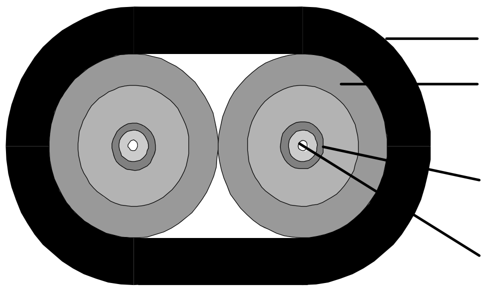


Figure 7-5 Structure of the INDOOR Fiber-Optic Cable

INDOOR Fiber-Optic Cable 6XV1820-7****

The INDOOR fiber-optic 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 4-figure number make it easier to estimate the length of an installed cable.

Properties

The INDOOR fiber-optic cable has the following properties:

- Can be walked on
- Flame-retardant complying with IEC 60332-3 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.

Uses

The INDOOR fiber-optic cable is intended for use indoors in areas protected from the weather. It is suitable for connecting optical ports operating at the wavelengths of 850 nm and 1300 nm.

7.3.3 Flexible Fiber-Optic Trailing Cable

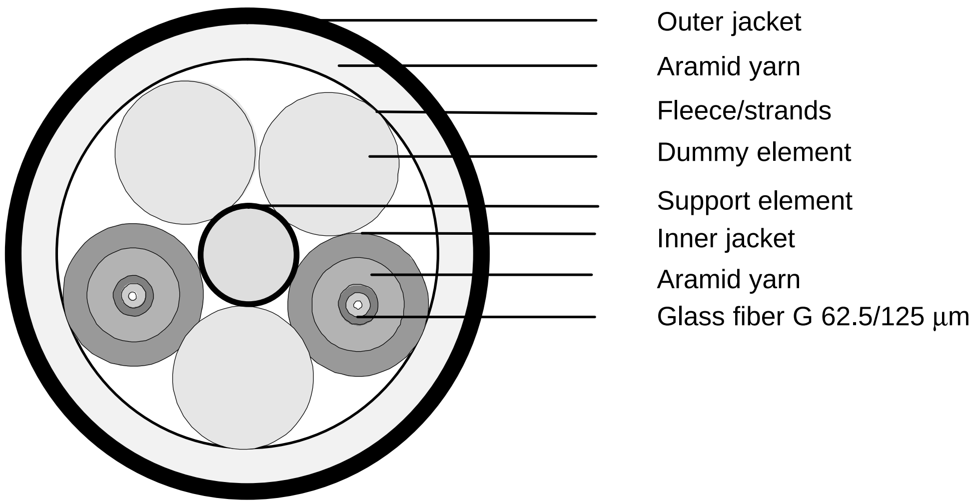


Figure 7-6 Structure of the Flexible Fiber-Optic Trailing Cable

Flexible Fiber-Optic Trailing Cable 6XV1820-6****

The flexible fiber-optic trailing cable contains two multimode graded fibers 62.5/125 µm. Integrated dummy elements produce a round cross-section.

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 4-figure number make it easier to estimate the length of an installed cable.

Properties

The flexible fiber-optic trailing cable has the following properties:

- Highly 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

Uses

The flexible fiber-optic 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 $\pm$ 90° (at the specified minimum bending radius). The trailing cable can be used both indoors and outdoors. It is suitable for connecting optical ports operating at the wavelengths of 850 nm and 1300 nm.

Warning

During installation and operation, all the mechanical restrictions involving the cable such as bending radii, tensile load etc. must be adhered to. If these limits are exceeded, permanent deterioration of the transmission characteristics may result that can cause temporary or permanent failure of data transmission.

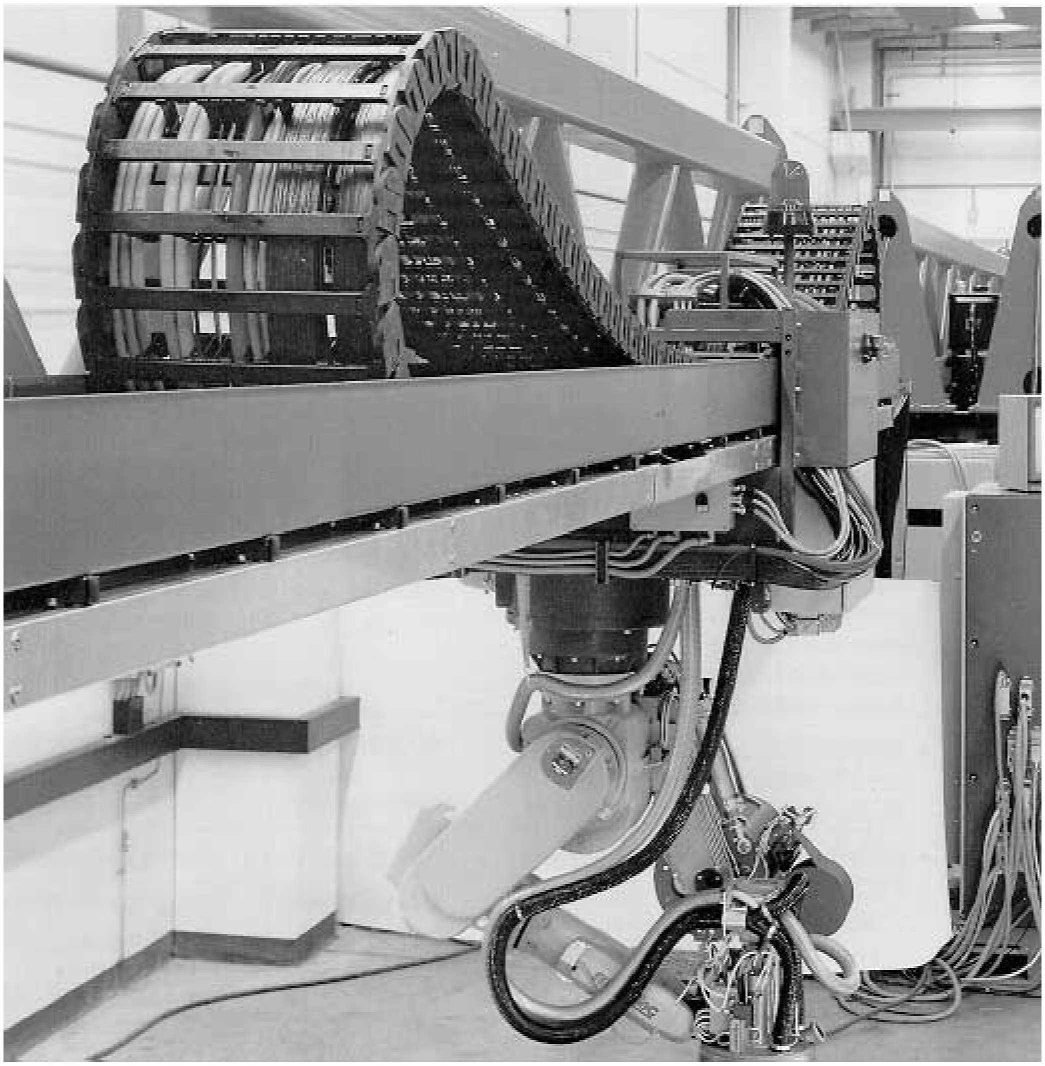


Figure 7-7 Example of Using the Glass Fiber-Optic Trailing Cable in a Drag Chain

7.3.4 SIENOPYR Duplex Fiber-Optic Marine Cable

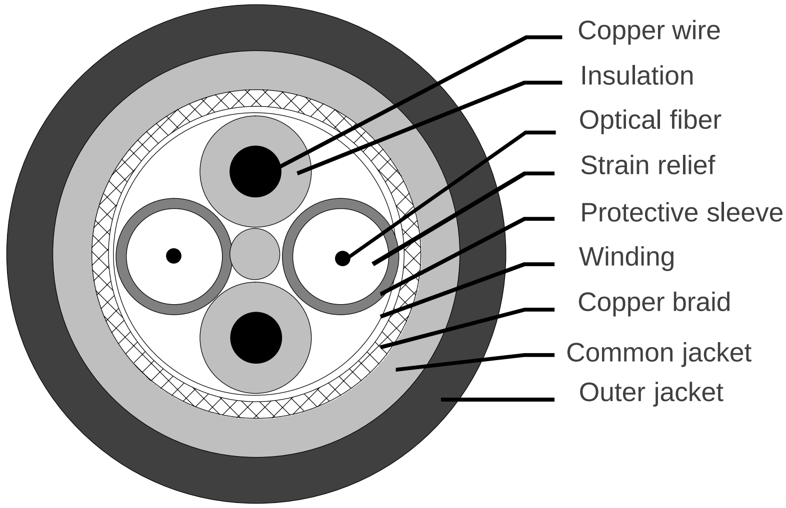


Figure 7-8 Structure of the SIENOPYR Duplex Fiber-Optic Marine Cable

SIENOPYR Duplex Fiber-Optic Marine Cable 6XV1 830–0NH10

The SIENOPYR duplex fiber-optic marine cable contains two multimode graded fibers 62.5/125 µm. The cable also contains two stranded, rubber-insulated copper wires with a 1 mm^2 cross-sectional area. These can be used, for example, to supply power to the attached devices.

The round cross-section of the cable makes it easier to seal cable glands.

The outer jacket is labeled with the year of manufacture and the label “SIENOPYR-FR MI-VHH 2G 62.5/125   3,1B200+0,8F600+2x1CU   300V” at intervals of approximately 50 cm.

Properties

The SIENOPYR duplex fiber-optic marine cable has the following properties:

- Ozone proof complying with DIN VDE 0472 Part 805 test type B
- Behavior in fire complying with IEC 60332-3 cat. A
- Corrosivity of combustion gases complying with IEC 60754-2
- Smoke density complying with IEC 61034
- Free of halogens
- Approved for ship building (Germanischer Lloyd, Lloyd’s Register, Registro Italiano Navale).

Uses

The SIENOPYR duplex marine fiber-optic able is intended for fixed installation on ships and offshore facilities in all enclosed spaces and on open decks. It is suitable for connecting optical ports operating at the wavelengths of 850 nm and 1300 nm.

Ordering

Appendix I-2 lists an address from which this cable can be ordered.

7.3.5 Special Cables

Special Cables

In addition to the SIMATIC NET standard fiber-optic cables described in the Catalog IK 10, numerous special cables and accessories are also available. Listing all the versions available is beyond the scope of the catalog and of this manual.

The technical specifications of the SIMATIC NET bus components indicate which SIMATIC NET fiber-optic cable is the normal connecting cable and which other fiber types are suitable.

Note

Remember that the distances that can be covered differ if you use fibers with other core diameters or attenuation characteristics than those listed in the operating instructions.

Fiber Types

In addition to the standard SIMATIC NET fiber types, the following fiber types are often used:

- 50 µm Fiber
  This fiber is used particularly in Europe in Telecom applications instead of the 62.5 µm fiber. The smaller core diameter means that less power can be coupled into the fiber and reduces the distance that can be covered.
- 10 µm Fiber
  This single-mode fiber is used for transmission over extremely long distances. The use of this single-mode fiber requires special, high-quality transmitter and receiver elements and connectors. In conjunction with OLM/G11-1300 or OLM/G12-1300, distances up to 15 km can be spanned.

Cable Structures

For special applications, numerous variations in the cable structure are available, for example:

- Bundled cords (cables with hollow cords capable of accommodating several fibers)
- Cables with rodent protection for underground installation
- Halogen-free cables, for example for use in underground train systems
- Hybrid cable with fibers and copper conductors in one jacket
- Certified cables, for example for use on ships

Ordering

If you require fiber-optic cables for particular applications, please contact your Siemens representative (see Appendix I-2).

7.4 Fiber-Optic Connectors

Note

Fiber-optic connectors are impaired by dirt and mechanical damage to the end faces.

Protect open connections with the supplied dust caps.

7.4.1 Connectors for Plastic Fiber-Optic Cables

Fitting connectors to plastic fiber-optic cables is relatively 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 Adapter for Devices with Integrated Optical Interfaces

Definition

Simplex connectors are used to attach the fiber-optic cable to the integrated fiber-optic interface of the PROFIBUS device. With certain Siemens modules (for example IM 153-2 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.

Requirements

The PROFIBUS device must be equipped with a fiber-optic interface, such as the ET 200S (IM151 FO) or the IM 467 FO for the S7-400.

Design

For a fiber-optic attachment, two simplex connectors (transmitter and receiver) and, if necessary, also an adapter with the following characteristics are required:

- Degree of protection IP 20
- Transmission rates from 9.6 Kbps to 12 Mbps

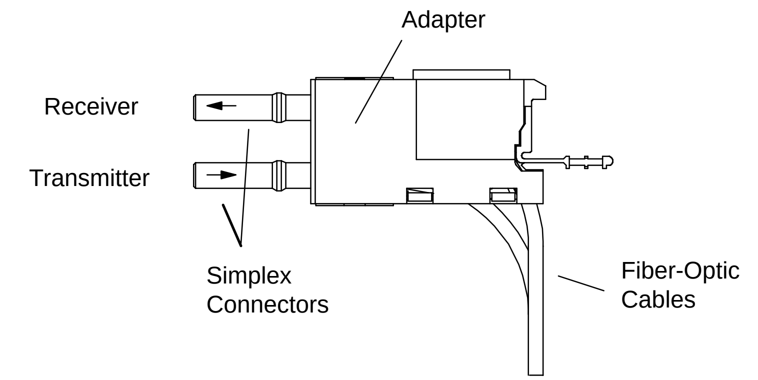


Figure 7-9 Simplex Connector and Special Adapter Fitted Together

Order Numbers

The simplex connector and adapter can be ordered as follows:

Table 7-6 Order Numbers - Simplex Connector and Adapter

Accessories	Order number
SIMATIC NET PROFIBUS plastic fiber-optic cable, simplex connector/polishing kit 100 simplex connectors and 5 polishing kits for assembling SIMATIC NET PROFIBUS plastic fiber-optic cables	6GK1901-0FB00-0AA0
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	6ES7195-1BE00-0XA0

Cable Lengths

The length of the transmission path on fiber-optic cables is **not dependent** on the transmission rate.

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 in a bus topology.

The maximum cable length between two PROFIBUS nodes depends on the type of fiber-optic cable used.

Table 7-7 Permitted Cable Lengths in Networks with Integrated Optical Interfaces (Bus Topology)

Fiber-optic cable SIMATIC NET PROFIBUS	Maximum cable lengths between two nodes (in m)	For 1 Network (= 32 nodes) (in m)
Plastic fiber-optic, duplex cord	50	1550
Plastic fiber-optic, standard cable	50	1550
PCF fiber-optic, standard cable	300	9300

Table 7-8 Permitted Cable Lengths in an OLM Network

Fiber-optic cable SIMATIC NET PROFIBUS	Maximum cable lengths between two nodes (in m)	For 1 Network (= 32 nodes) (in m)
Plastic fiber-optic, duplex cord	50	1550
Plastic fiber-optic, standard cable	80	2480
PCF fiber-optic, standard cable	400	12400

Mixing Plastic Fiber-Optic and PCF Fiber-Optic

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

For example, connection between distributed local DP slaves using plastic fiber-optic (distances $<$ 50 m) and connection between DP master to the first DP slave of the bus topology with PCF fiber-optic (distance $>$ 50 m).

Installing Plastic Fiber-Optic Cables

You can assemble and install plastic fiber-optic cables simply yourself. The paragraph below contains information about the installation instructions and the rules for laying cables are explained in Appendix C.

Instructions for Assembling Plastic Fiber-Optic Cables

A detailed instruction manual explaining how to assemble plastic fiber-optic cables with simplex connectors and illustrated by photographs is available from the following sources:

- Appendix D of this manual
- On the Internet
  - German: http://www.ad.siemens.de/csi/net
  - English: http://www.ad.siemens.de/csi_e/net

  Select SEARCH on this Internet page, enter the number “574203” as the “Entry ID” and start the search.
- As a leaflet supplied with the simplex connector/polishing kit (see Table 7-6)

Title: *Installation Instructions for SIMATIC NET PROFIBUS Plastic Fiber-Optic Cables with Simplex Connectors*

7.4.3 BFOC Connectors for OLMs

The BFOC connectors allow precision fiber-optic cable connections. The construction of the BFOC connector allows the strain relief of cables to be used. This is necessary for installing longer fiber-optic cable connections, for example between OLM/P modules. BFOC connectors must be ordered separately.

Ordering information and instructions on fitting the connectors can be found in Appendix D.

Figure 7-10 BFOC Connectors with Accessories (Crimping Sleeve and Anti-Kink Sleeve), for Plastic FO Cables

7.4.4 Connectors for Glass Fiber Cables

BFOC Connectors for Glass Fiber-Optic Cables

In PROFIBUS, only BFOC connectors are used for glass fiber-optic cables.

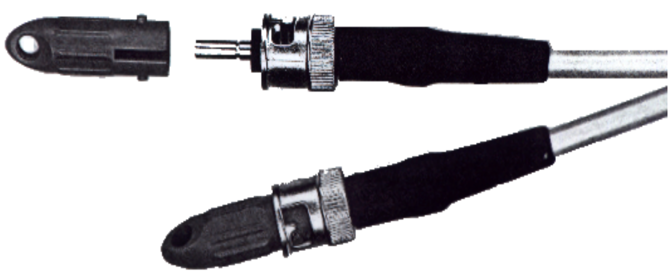


Figure 7-11 BFOC Connectors with Dust Caps

Fitting Connectors On-Site

If it is necessary to fit connectors on-site,
– SIEMENS provides this service (see Appendix I-2)
– BFOC connectors and special tools can be ordered (see I-2).

Note

Connectors for glass fiber-optic cables should only be fitted by trained staff. When fitted correctly, they allow extremely low coupling attenuation and the value can be repeated after inserting the connector several times.

Preassembled 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 10.

Note

Fiber-optic connectors are impaired by dirt and mechanical damage to the end faces. Protect open connections with the supplied dust caps.

Active Components for Optical Networks 8

8.1 Optical Bus Terminal OBT

Figure 8-1 Optical Bus Terminal

Uses

The OBT (Optical Bus Terminal) is used to attach a single PROFIBUS node without an integrated optical interface or a PROFIBUS RS-485 segment with up to 31 nodes to the optical PROFIBUS. The OBT therefore provides the advantages of optical data transmission for existing DP devices.

A single PROFIBUS–DP node is attached using its RS–485 port via a connecting cable terminated at both ends, for exampledrop cable 830–1T, to the RS-485 port of the OBT. The OBT is included in the optical bus two FO interfaces.

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

- Plastic fiber-optic cables can be used up to a distance of 50 m. These can be assembled extremely simply with 2 x 2 simplex connectors on site.
- PCF fiber-optic cables can be used for distances up to 300 m. These cables must be ordered preassembled.

Design

The OBT has a compact, plastic casing. It is suitable both for mounting on a rail and for wall mounting (two holes available for screws).

The OBT has the following connections:

- 9-pin sub-D female connector for connection of a PROFIBUS RS-485 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 fiber-optic cables with simplex connectors (connection to CP 342-5 FO, IM 467 FO or ET 200 with an integrated optical interface)[2]
- 24 V DC power supply

2) For further information, refer to the catalog “PROFIBUS & AS-Interface”.

Functions

- Attachment of a PROFIBUS RS-485 segment
- Provides an electrical attachment to the optical PROFIBUS (for example a PG attachment for commissioning and diagnostics)
- Supports all PROFIBUS transmission rates from 9.6 kbps to 1.5 Mbps and 12 Mbps
- The OBT regenerates the signals in amplitude and time.
- Cascading depth when using user-defined bus parameters up to 126 nodes
- Isolation of the DP node via fiber-optic cable
- Simple diagnostics with LEDs for operating voltage and for data reception CH1, CH2 and CH3.

Ordering Data:	Order no.
PROFIBUS OBT Optical bus terminal for attachment of a PROFIBUS RS-485 segment to an optical bus without simplex connector	**6GK1 500-3AA00**

Operating Instructions

The full Operating Instructions for Optical Bust Terminal OBT are included in the Appendix of this manual.

8.2 Optical Link Module OLM

Figure 8-2 Optical Link Module (OLM)

Uses

With the PROFIBUS OLM (Optical Link Module), Version 3, PROFIBUS networks can be implemented as bus, star and redundant ring structures.

The transmission rate of a fiber-optic 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, inter-building networks with glass fiber-optic cables, mixed networks with electrical and optical segments, large-span 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 fiber-optic interfaces for different types of fiber-optic cable:

- Plastic fiber-optic cable (980/1000 µm) can be used for distances 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 distances up to 400 m. They are available preassembled with 4 BFOC connectors and a pulling loop.
- Glass-fiber multimode fiber-optic cable (62.5/125 µm) such as the SIMATIC NET fiber-optic cables can be used to span distances up to 3000 m. They must be ordered preassembled with 4 BFOC connectors and are tested before they are supplied.
- Monomode fiber-optic 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 RS-485 interface and individual nodes or entire electrical segments can be included in the PROFIBUS network.

The version 3 OLMs support all PROFIBUS transmission rates 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 side-by-side needing gaps between them.

Functions

- Automatic detection of all PROFIBUS data rates: 9.6 Kbps to 12 Mbps including 45.45 Kbps (PROFIBUS-PA)
- Implementation of the following network topologies:

  Bus, star, redundant ring
- High availability with redundant media. Distance between two OLMs in the redundant ring limited only by the maximum optical distance.
- Attachment to different types of fiber-optic transmission media (one or two optical interfaces, BFOC connectors)
- Isolated RS-485 interface with segment capability (sub-D female connector)
- Unrestricted multimaster operation:

  Extended segmentation function for limiting errors to FO and RS-485 segments
- Fast localization of faults:
  - Display of the module status via floating signaling contact
  - Testing of the FO path quality: Measuring output for optical receiver for logging and detecting the fiber-optic signal quality with a voltmeter.
- High cascading depth:

  Bus and redundant ring up to 122 OLMs (limited only by monitoring times)
- 24 V DC power supply with redundant power supply option.

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.

Ordering Data:	Order no.
PROFIBUS OLM/P11 Optical Link Module with 1 x RS-485 and 1 x plastic FO interface, with signaling contact and measurement output	6GK1 502-2CA00
PROFIBUS OLM/P12 Optical Link Module with 1 x RS-485 and 2 x plastic FO interfaces, with signaling contact and measurement output	6GK1 502-3CA00
PROFIBUS OLM/G11 Optical Link Module with 1 x RS-485 and 1 x glass FO interface, for standard distances, with signaling contact and measurement output	6GK1 502-2CB00
PROFIBUS OLM/G12 Optical Link Module with 1 x RS-485 and 2 x glass FO interface, for standard distances, with signaling contact and measurement output	6GK1 502-3CB00
PROFIBUS OLM/G11-1300 Optical Link Module with 1 x RS-485 and 1 x glass FO interface, for long distances, with signaling contact and measurement output	6GK1 502-2CC00
PROFIBUS OLM/G12-1300 Optical Link Module with 1 x RS-485 and 2 x glass FO interface, for long distances, with signaling contact and measurement output	6GK1 502-3CC00

Operating Instructions

The full Operating Instructions for Optical Link Module OLM are included in the Appendix of this manual.

Active Components for Wireless Networks 9

9.1 Infrared Link Module ILM

Uses

The Infrared Link Module ILM is used for wireless PROFIBUS transmission over short distances (≤ 15m). With the ILM, individual nodes can be attached to a segment or two segments can be interconnected. The ILM allows communication between moving nodes, for example automatic trolleys or with changing nodes, for example stations along conveyor belts or production lines.

The ILM can be used in the installation of communication systems and in temporary configurations, for example for test purposes.

The ILM can be used to replace systems subject to wear and tear, for example slip rings etc.

At a distance of 11 m, an ILM illuminates a circular area with a diameter of 4 m.

Design

- Robust aluminum die-cast casing with degree of protection IP 65
- 2 x 2-pin terminal block in the casing (with cable connection through heavy-duty threaded conduit) for attachment to PROFIBUS segment
- 4-pin terminal block in the casing (with cable connection through heavy-duty threaded conduit) for connection of the power supply (24 V DC) and signaling contact
- Permanent wiring; in other words, fast and simple replacement of the electronics if a fault occurs
- Status displays of the operating states via LEDs
- Transmission rate set with switch inside casing
- Protected from interfering ambient light by integrated daylight filter
- Easy alignment due to area of radiated cone (± 10 ° solid angle).

Functions

The ILM allows a wireless link with PROFIBUS slaves at a maximum range of 15 m. Communication with several slaves is possible. Interruptions in transmission are detected and indicated by LEDs and the signaling contact. If there is a deterioration in the transmission quality, this is indicated by LEDs and the signaling contact before data transmission is stopped.

The module can be operated in daylight thanks to an integrated filter. When installing the Infrared Link Module, make sure that there is a free line-of-sight link between the modules.

When using several ILM transmission paths, avoid one path interfering with another by including partitions or maintaining minimum clearances.

Ordering Data:

PROFIBUS ILM Infrared Link Module for wireless links between PROFIBUS nodes and segments	Order number 6GK1 503-0AA00

Operating Instructions

The full Operating Instructions are included in the Appendix of this manual.

Testing PROFIBUS A

A.1 Hardware Test Device BT200 for PROFIBUS-DP

A.1.1 Possible Uses

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

During installation, the BT200 test device can be used to test the PROFIBUS cable. Errors made during installation are located quickly and simply, the installer does not need specific PROFIBUS experience. Even before the system is put into operation, the BT200 device can be used to test the RS-485 drivers of the PROFIBUS nodes. It is also possible to obtain a list of the accessible slaves on the bus on completion of the wiring, without having a PROFIBUS-DP master available. 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 BT200. This reduces the time required for commissioning and prevents system downtimes and sporadic bus errors.

A.1.3 Logging Functions

All the test results can be stored on the BT200. Using a point-to-point 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

Figure A-1 Hardware Test Device BT200 for PROFIBUS DP

- 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
- Sealed keypad with eight buttons
- Attachment to the PROFIBUS network via 9-pin sub-D female connector
- Power supply from integrated NC battery
- Attachment to charger (accessories)

A.1.5 Functions

Checking the PROFIBUS Cable

In this test, the PROFIBUS cable alone is tested. The following errors can be detected:

- Short-circuit between data lines or between data line and shield
- Line break
- Shield break
- Reversed polarity (A and B)
- Reflections that could cause errors
- Check of the number of activated terminating resistors

The length of the PROFIBUS cable can also be measured.

Checking the RS-485 Interface of a Slave

The test device is connected to one slave. This is supplied with power. The device then makes the following measurements:

- RS-485 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)
- Addressing of specific slaves

A.1.6 How the Unit Functions

Testing Cables

The previously described tests and measurements are based essentially on various voltage, reflection and resistance measurements. To check the cable, the test unit 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 point-to-point link is established between the test unit and the node. To complete the tests, the accessibility of the attached slaves is checked on the wired-up 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 the Test Results

Apart from the actual test result, the display also indicates 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 BT200 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 regardless of the network. The unit is turned off automatically after 3 minutes if no input is made ensuring that the battery has a long working life and saving power.

Ordering Data

BT200 hardware test unit	6ES7 181-0AA00-0AA0

- With point-to-point cable for node attachment
- with test connector
- with operating instruction German/English

(without charging unit)

Charging unit (230V AC / 2.4 – 10 V DC)	6GT2 003-1AA00
Charging unit (110V AC / 2.4 – 10 V DC)	6EP8106-0HB01
Test connector (spare)	6EP8 106-0AC20
NC battery pack (spare)	6EP8106-0HA01
Point-to-point cable (spare)	6EP8106-0HC01

You can download the operating instructions free of charge from the Internet under the entry ID 857969:

www.ad.siemens.de/simatic-cs

A.2 Testing FO Transmission Paths

A.2.1 Necessity of a Final Test

The total attenuation of 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 attenuation may well be higher than the calculated values. The only way to be sure that a fiber-optic link functions reliably and has an adequate link power margin is to measure the attenuation following installation. It is advisable to test every fiber-optic link in which the connectors were fitted on-site 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 system components such as the cable, connectors, splices, couplers etc. add to the total attenuation of a link and with it to the attenuation within the entire network. To measure this attenuation, fiber-optic test units must be used following installation. During the measurements, light with the same wavelength must be used as in the optical transmission system.

Test Methods

In the main, two test methods are used:

1. The Optical Power Source and Meter
2. Optical Time Domain Reflectometer (OTDR)

A valuable tool for every user is also the fiber-optic troubleshooter. This light source sends visible light so that fiber breaks, bad splices etc. can be localized visually.

Some new network components, such as the PROFIBUS OLM version 3 have integrated diagnostic functions with which they can check the quality of the received optical signal.

A.2.2 Optical Power Source and Meter

The attenuation on the fiber-optic link is first measured. All the link components such as the fiber, connectors, couplers and splices contribute to the total attenuation. The total attenuation must be below the available optical power budget between the optical transmitter and receiver. Light sources are available for all normal wavelengths (650 nm, 850 nm and 1300 nm). This means that this method can be used for plastic, PCF, multimode and single-mode fiber-optic cables.

Arrangement for Measuring Attenuation

The arrangement for measuring attenuation consists of a light source and an optical 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.

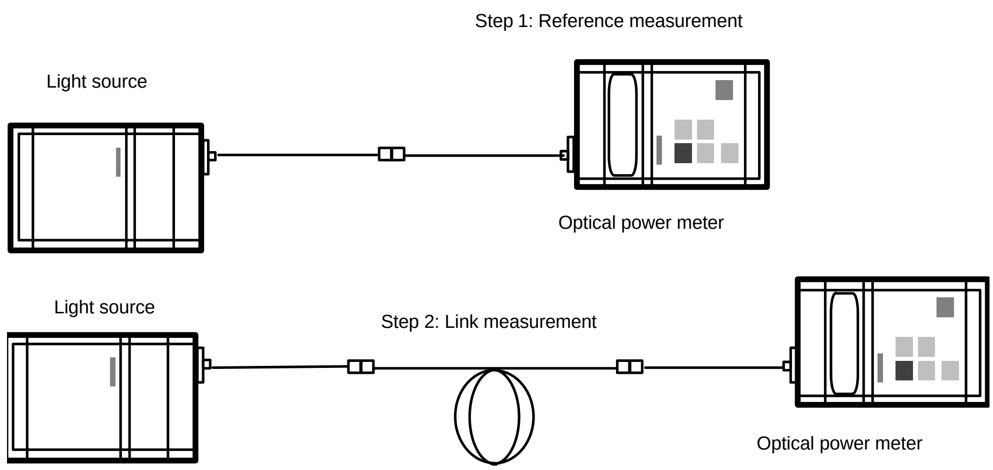


Figure A-2 Measuring the Total Attenuation of a FO Link

Evaluating the Results of the Attenuation 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 attenuation of the fiber-optic link must be below this optical power budget.

The greater the difference between the total attenuation and the optical power budget, the greater the operating reliability and long-term 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 glass-fiber links, this link power margin should not be below 3 dB and for single-mode glass-fiber 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 fiber-optic link is too high, the causes and the location of the problem must be established. In this case OTDR units are used (OTDR = Optical Time Domain Reflectometer).

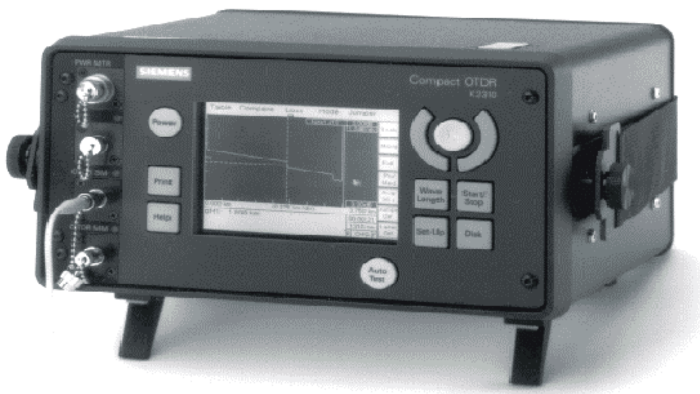


Figure A-3 Optical Time Domain Reflectometer (OTDR)

OTDRs exist for the wavelengths 850 nm and 1300 nm. This means that this method can be used for both multimode and single-mode fiber-optic 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.

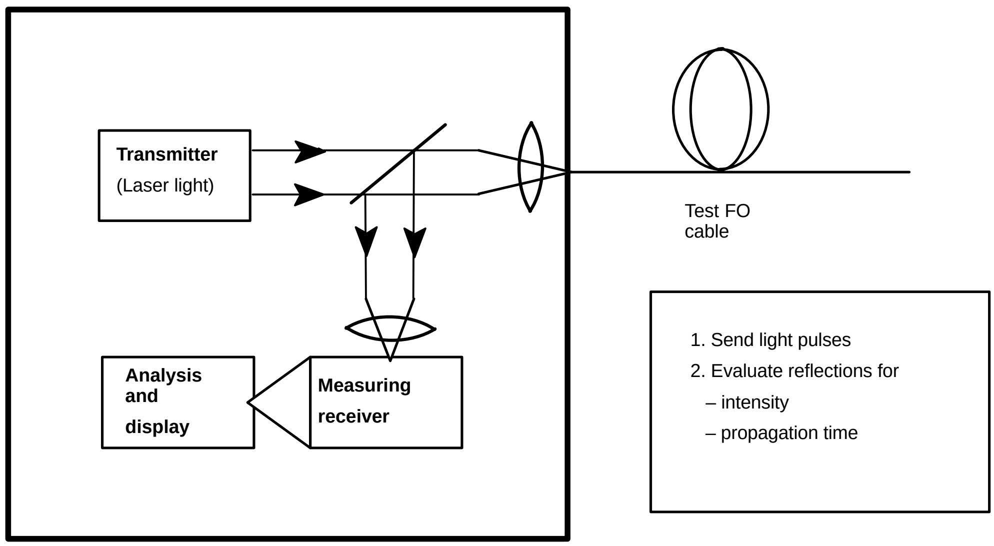


Figure A-4 How an OTDR Functions

OTDR Evaluation

The OTDR provides the measurement results graphically

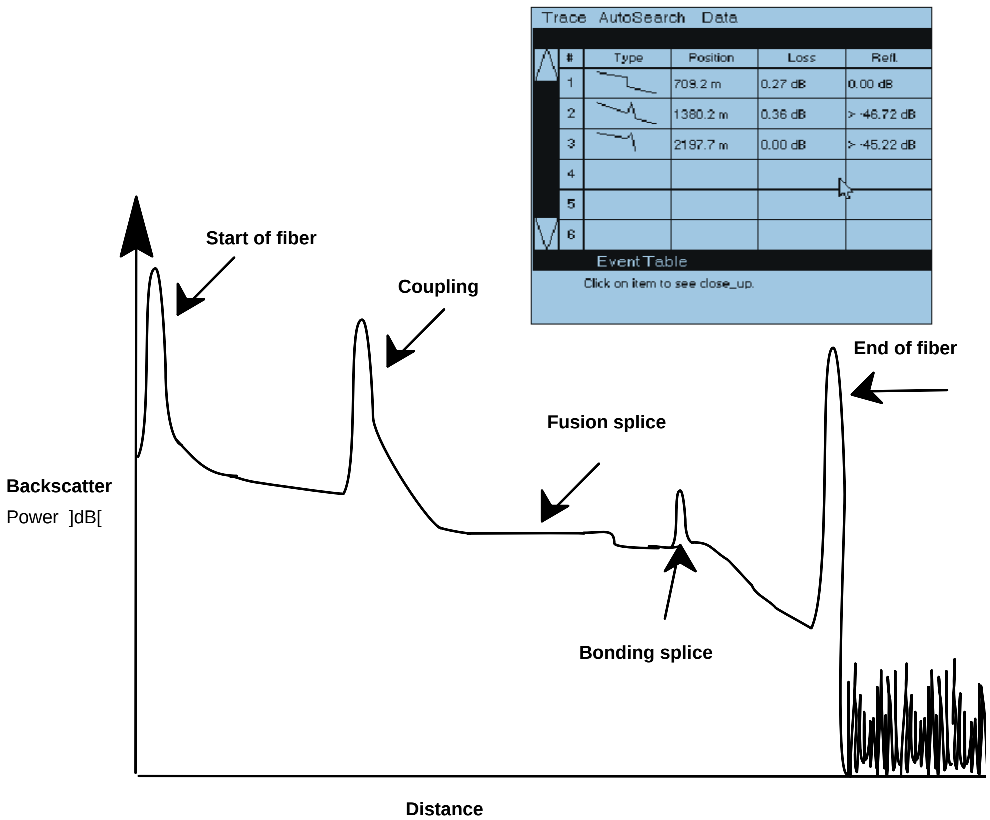


Figure A-5 Representation of the OTDR Measurement Results

Figure A-5 clearly illustrates that the power of the launched light reduces constantly along the fiber-optic 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,
- fiber-optic links can be documented in detail and, if problems are occurring, can be compared with the link at the time it was installed (warranty or not).

A.2.4 Checking the Optical Signal Quality with PROFIBUS OLM V3

The receive level of the two optical channels can be detected using a normal commercially available voltmeter attached to measurement sockets on the PROFIBUS OLM V3. The voltmeter can be inserted and removed during operation using 2 mm laboratory test plugs (see Figure A-6).

Figure A-6 Testing the Signal Quality on an OLM V3 with a Voltmeter

This allows the following:

- The incoming optical power can be documented, for example for later measurements (aging, damage)
- 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 A-7).

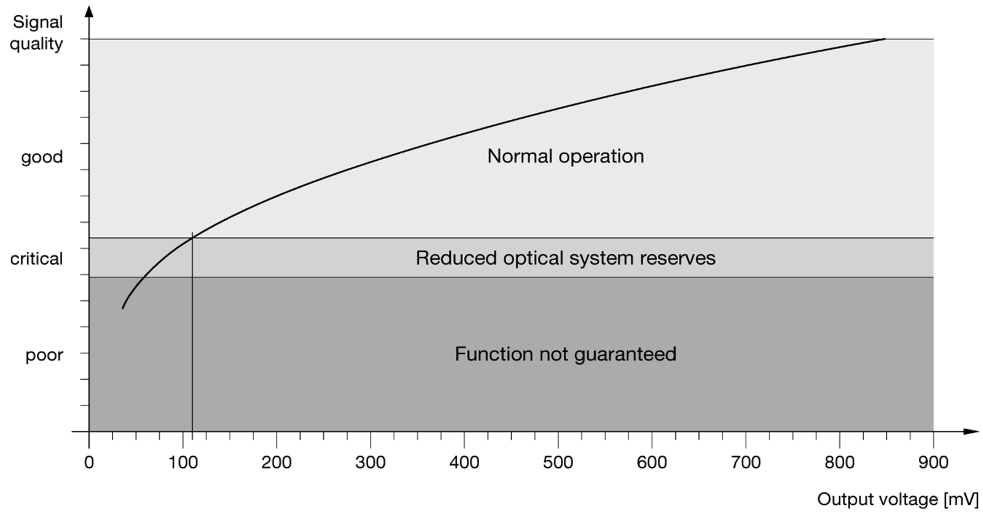


Figure A-7 Correlation Between the Measured Voltage and Signal Quality with an OLM/G12

Lightning and Surge Voltage Protection for LAN 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 LAN cable from overvoltages.

Note

This chapter contains information about protecting **hardware components on a PROFIBUS LAN 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. This relates particularly to building structures included in the planning of the building.

We therefore recommend that you contact your Siemens representative or a company specialized in lightning protection if you require more detailed information about overvoltage.

Further Literature

You will find detailed information about protecting automation systems from overvoltages with SIMATIC S7 in the relevant system manuals
S7-300 /11/, S7-400 /12/, ET 200 /9/.

The solutions explained in these manuals are based on the lightning protection zone concept described in the standard IEC 1024-2 *Protection against LEMP*.

B.2 Protecting LAN Cables from Lightning

Bus Cables within Buildings

If you keep to the instructions for installing LAN cables located entirely within a building, no special lightning protection is necessary.

LAN Cables between Buildings

Since LAN 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 LAN cables are implemented in two different components, coarse protection and fine protection.

Coarse Protection

While coarse protection prevents the progress of high-energy 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 make sure 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.

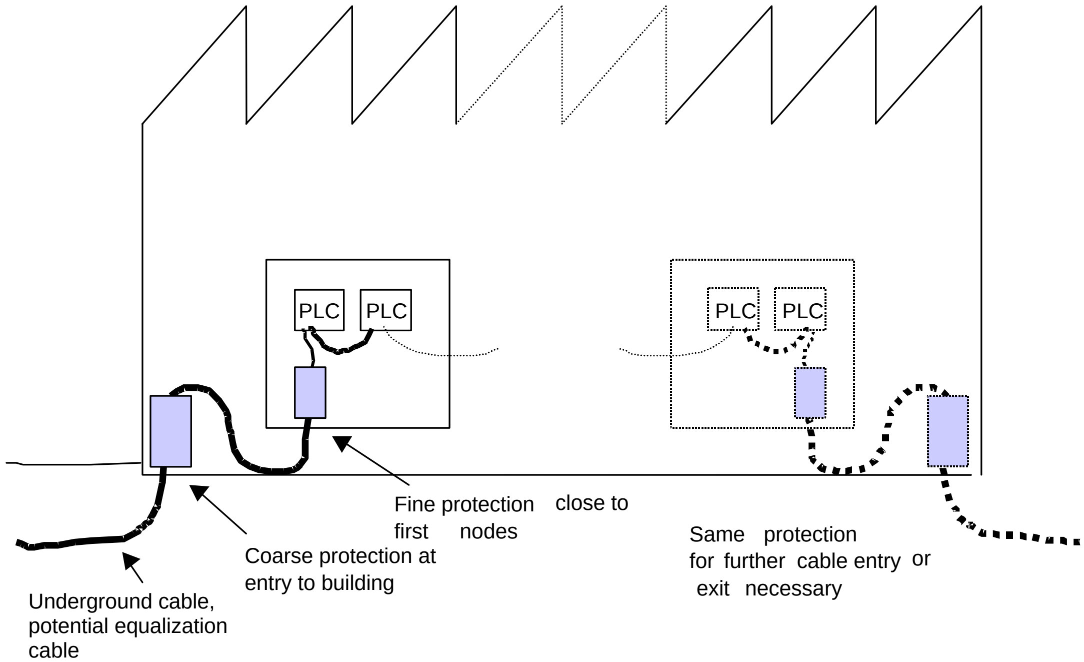


Figure B-1 Lightning Protection Concept for LAN Cables Between Buildings

B.2.1 Instructions for Installing Coarse Protection

The coarse protection must be installed at the point where the LAN 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

To avoid EMC and environmental conditions affecting the coarse protection, it should be installed in a

- protective casing, type no. 906055

At the same time, the transition from the underground cable to the standard indoor cabling can be made here.

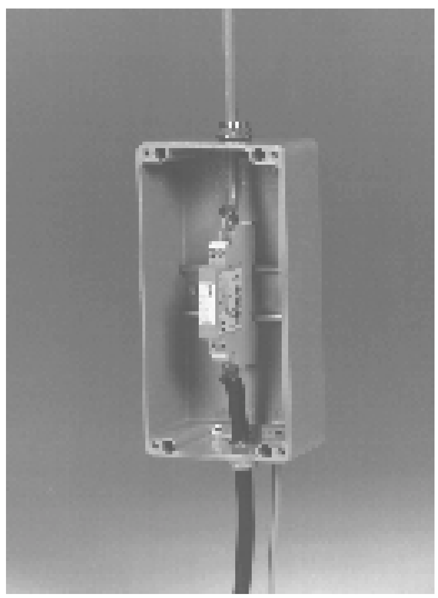


Figure B-2 Coarse Protection Installed at the Entry or Exit of the Building

B.2.2 Instructions for Installing Fine Protection

The fine protection should be installed as close as possible to the first bus 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

The fine protection should be connected to the reference ground of the first bus node (for example grounded DIN rail when installing in a cubicle). 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.

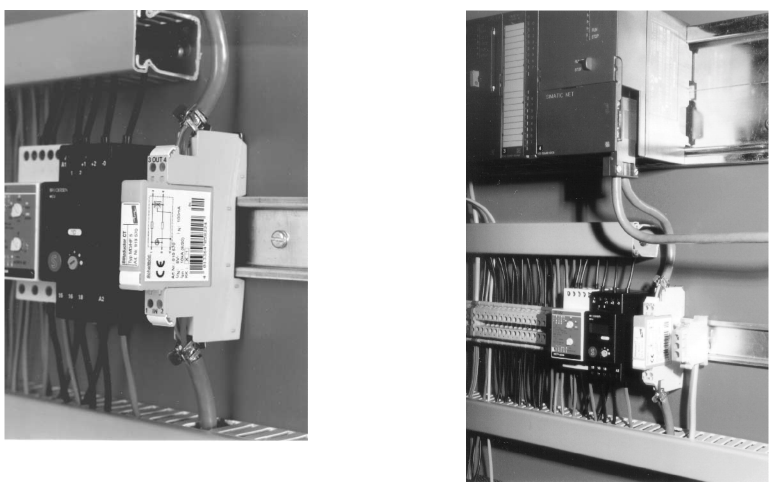


Figure B-3 Fine Protection in the cubicle Close to the First Bus Node

B.2.3 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 short-circuit). To re-establish communication temporarily (without lightning protection) the protective modules can be removed from the base modules since these function as through-connected terminals without the protective module.
- The rest of the plant protection concept must be implemented complying with VDE 0185 Part 103.

Installing LAN Cables

C

C.1 LAN Cables in Automation Systems

LAN Cables as Important Plant Connections

In automation systems, the LAN 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. This section explains how to protect cables from mechanical and electrical impairment.

Keep the Overall System Concept in Mind

LAN 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 LAN cables), remember to take into account their specific requirements in terms of 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 LAN 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.

Power Supply 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 950/VDE 0805/EN 60950/ UL 1950/ CSA 22.2 No. 950 must be met. /7/

24 V DC Power 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 950/ VDE 0805/EN 60950/ UL 1950/ CSA 22.2 No. 950 must be met. /7/

Protection from External Electrical Influences

Cable or wire breaks must not lead to undefined statuses in the plant or system.

C.3 Mechanical Protection of LAN Cables

Protection of Electrical and Optical LAN Cables

Mechanical protection is required to protect LAN cables from breaks or mechanical damage.

Note

The guidelines for mechanical protection apply both to electrical and optical cables.

Mechanical Protection

The following measures are recommended to protect LAN cables from physical damage:

- When a 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 heavy-gauge plastic conduit (see Figure C-1)
- 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 (see Figure C-2).
- In areas where the cable is likely to be walked on or driven over, the cable must be protected from damage by a closed heavy-gauge 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.

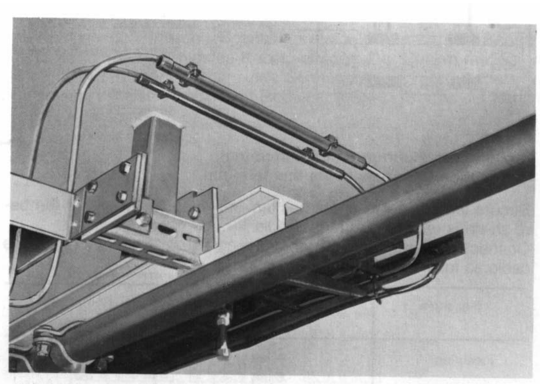


Figure C-1 Mechanical Protection of the LAN Cable

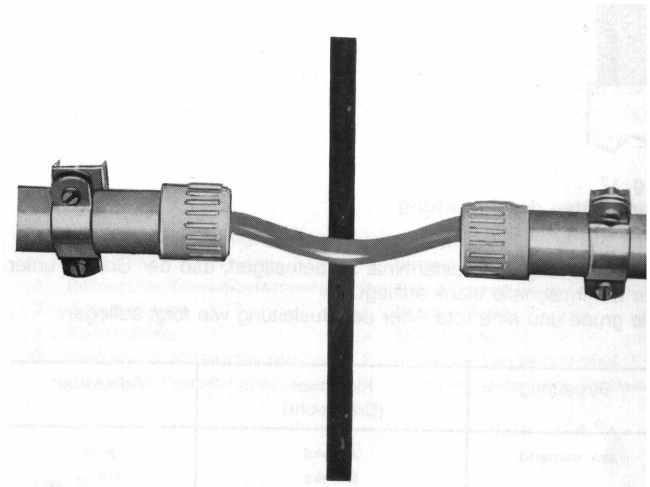


Figure C-2 Interrupting the Conduit at an Expansion Joint

Bus Terminal RS-485

The installation of electrical LAN cables in a protected area is supported by the use of the RS-485 bus terminal. This allows the attachment of DTEs and service and commissioning work on the DTEs without needing to move the actual LAN cable.

Redundant LAN Cables

The installation of redundant LAN cables involves special requirements. Redundant cables should always be installed on separate cable racks to avoid simultaneous damage by the same event.

Do not kink or crimp the trailing and festoon cables

When installing trailing and festoon cables in moving equipment, make sure that the cables are not kinked or crimped by other cables and equipment when the cables are moved.

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 LAN cables separately

To prevent accidental damage to LAN 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 LAN 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 LAN Cables

Electromagnetic Compatibility (EMC)

Electromagnetic compatibility (EMC) includes all questions of electrical, magnetic and electromagnetic immunity and emission.

To avoid external interference affecting electrical systems, these effects must be reduced to a certain level. The measures involved include the design, structure and correct connection of the LAN cable. The components and LAN 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.4.1 Measures to Counter Interference Voltages

Overview

Measures are often taken to suppress interference voltages when the control system is already in operation and problems occur receiving signals. You can often reduce the investment necessary for such measures (for example special contactors) by remembering the following points when installing your automation system.

These include the following:

- Connecting all inactive metal parts to chassis ground
- Shielding devices and cables
- Suitable positioning of devices and cable routing
- Special noise suppression measures

C.4.2 Installation and Grounding of Inactive Metal Parts

Grounding

Connect all inactive metal parts in the immediate vicinity of your automation components and LAN 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 coupled-in interference. For detailed information about grounding techniques, refer to the system manuals of the SIMATIC S7–300 /11/ and S7–400 /12/ programmable controllers.

C.4.3 Using the Shields of Electrical LAN 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, large-area 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 LAN 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 LAN 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 LAN cable.

- Install an additional bonding conductor parallel to the LAN cable that takes over the shield current (for notes on equipotential bonding refer to Section C.4.4)
- Use fiber-optic 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 large-area contact with the shield (see Figure C.3).
- Contact SIMATIC NET PROFIBUS cables only using the braided copper shield and not the aluminum foil shield. The foil shield is connected 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.

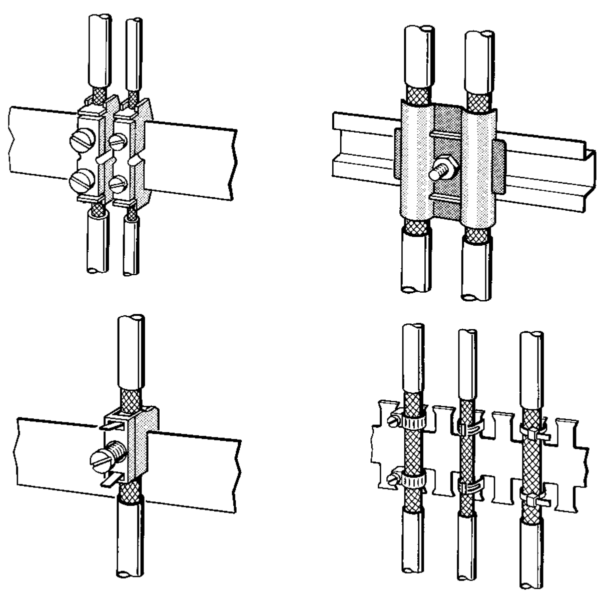


Figure C-3 Securing Shielded Cables with Cable Clamps and Ties (schematic representation).

- 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.

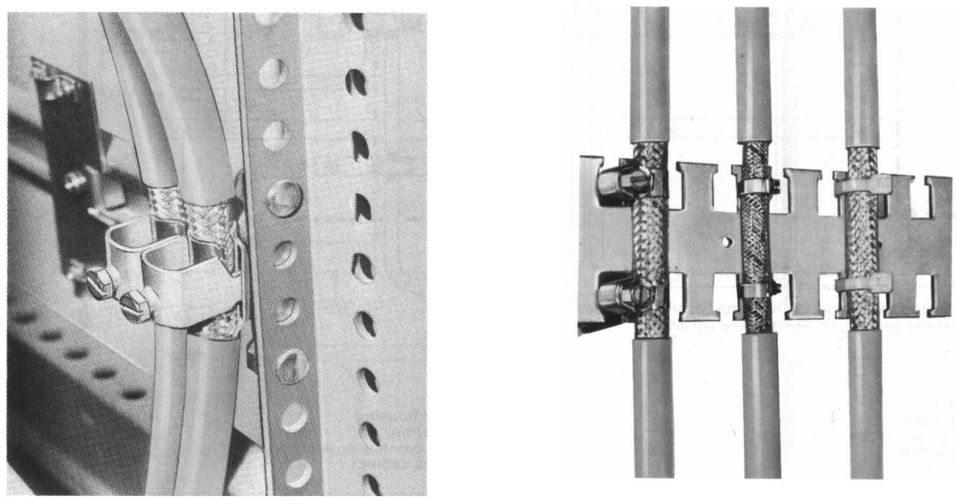


Figure C-4   Contacting the Shield at the Point of Entry to a Closet

C.4.4 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 for 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?

The following reasons speak in favor of equipotential bonding:

- 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.

Rules for Equipotential Bonding

Remember the following points about equipotential bonding systems:

- The effectiveness of equipotential bonding is greater when the impedance of the bonding conductor is low.
- The impedance of the additional bonding conductor must not exceed 10% of the shield impedance of the LAN cables.
- Make large-area 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, conducting 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 (long-term 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 cross-sectional area $\geq 10mm^2$) 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 fiber-optic cable (FO).

C.5 Routing Electrical LAN 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 LAN cable, data exchange on the LAN cables can be disturbed by crosstalk. To achieve problem-free 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

Fiber-optic 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.5.1 Cable Categories and Clearances

Cable Groups

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 interference-free operation can be expected under normal operating conditions if the clearance is adhered to.

Conditions

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 “consumer” 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 light bulb.

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

Table C-1 contains the general rules for clearances between a variety of cables. The rules should be understood as minimum rules for positioning LAN cables within buildings (inside and outside cubicles).

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 (AS-Interface) Data signal, shielded (PG, OP, printer, counter inputs etc.) Analog signals, shielded DC voltage ($\leq$ 60 V), unshielded Process signals ($\leq$ 25 V), shielded AC voltage ($\leq$ 25 V), unshielded Monitors (coaxial cable)	In common bundles or cable channels
	DC voltage ($>$ 60 V and $\leq$ 400 V), unshielded AC voltage ($>$ 25 V and $\leq$ 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 closets:** On separate cable paths with at least 10 cm clearance

C.5.2 Cabling within Closets

When cabling within wiring closets, note the following points:

- The minimum clearance between cables of different categories can be found in Table C-1. 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 should cross at right angles (keep sections where the cables run parallel as short as possible).
- If there is not enough space to maintain a clearance≥ 10 cm, the cables should be arranged according to their categories in separate metal, conductive channels. These channels can then be arranged next to each other. The metal, conductive channels should be screwed to the struts of the rack or the closet walls making low-resistance and low-inductance contact.
- The shields of all cables entering the wiring closet must be secured as close as possible to the point of entry and should make large-area contact with closet ground.
- Parallel routing of incoming cables and internal closet wiring between the point of entry into the closet and the shield clamp should be avoided at all costs even with cables of the same category.

C.5.3 Cabling within Buildings

When laying cables outside cabinets but within buildings, note the following points:

- The clearances listed in Table C-1 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 Table C-1 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 low-resistance and low-inductance contact.
- Cable racks should cross each other at right angles.
- Include metal, conducting 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 C.4.4 in this manual.

C.5.4 Cabling outside Buildings

Fiber-optic cables should be given preference

For communications between buildings and between buildings and external facilities, the use of fiber-optic cables is generally recommended. Due to the optical transmission principle, fiber-optic cables are not affected by electromagnetic interference. Measures for equipotential bonding for overvoltage protection are unnecessary with fiber-optic cables.

EMC Rules for Electrical LAN Cables

When installing electrical LAN cables outside buildings, the same EMC rules apply as to cables inside buildings. The following additional rules apply:

- 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 LAN cables**. (see section C.4.4 in this manual)
- 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 LAN cables installed outside buildings must be included in the lightening protection and grounding concept of the entire system. Please note the information in Appendix B 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 C.5.1 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 LAN cables are installed directly in the earth, we recommend the following:

- install the LAN cable in a trench.
- Install the LAN cable approximately 60 cm below the surface of the ground.
- Mechanical protection should be provided for the LAN cables and a cable warning band should also be included.
- The equipotential bonding between the buildings being connected should be installed approximately 20 cm above the LAN cables (for example a tin–plated strip conductor), The strip conductor also provides protection against direct lightening strikes.
- When installing LAN cables along with other cable, the clearances specified in section C.5.1 must be adhered to (for example using bricks to maintain clearance).
- The clearance to power cables should be ≥ 100 cm unless other regulations require a greater clearance.

C.5.5 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 switched operating voltage. The distributed ET200 system manuals /9/ 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 LINESTRA® lamps. Avoid the use of fluorescent lamps since they cause interference. If you need to use fluorescent lamps, take the measures shown in Figure C-5.

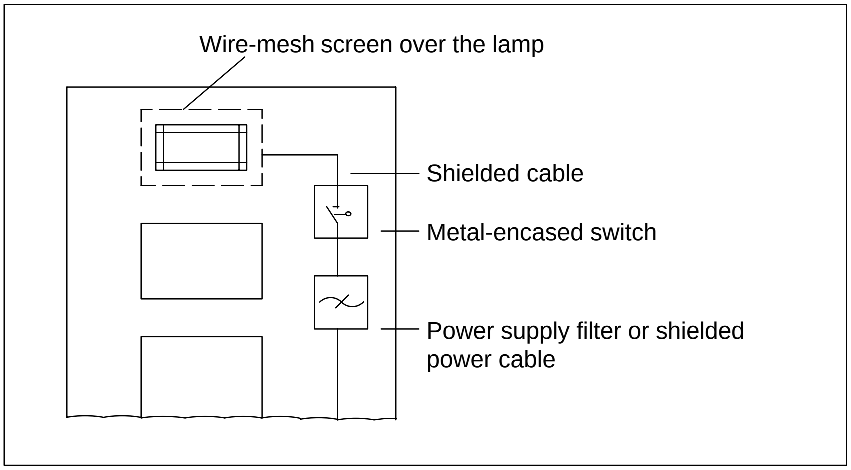


Figure C-5 Measures for Interference Suppression of Fluorescent Lamps in a Cabinet

C.6 Electromagnetic Compatibility of Fiber-Optic Cables

Fiber-Optic Cables

For LAN cables between buildings and/or external facilities, the use of fiber-optic cables is generally recommended. Due to the optical transmission principle, fiber-optic cables are not affected by electromagnetic interference. Measures for equipotential bonding and for overvoltage protection are unnecessary with fiber-optic cables.

Note

Fiber-optic cables are ideally suited for LAN 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 path. These must be protected using the measures already mentioned such as shielding, grounding, greater clearance to sources of interference etc.

C.7 Installing LAN Cables

C.7.1 Instructions for Installing Electrical and Optical LAN cables

General

During installation, remember that LAN 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 LAN cables.

If cables are subjected to strain or stress as listed above, they should always be replaced.

Storage and Transportation

During storage, transportation and cabling, the open ends of the LAN cable (without connectors) must be kept closed with a shrink-on 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 LAN cable can be found in the technical data sheets of the LAN cables in Chapter 4.

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 strain on your LAN cable can be found in the technical data sheets of the LAN cables in Chapter 4.

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 force. 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. LAN cables must not be twisted.

Do not twist trailing cables and festooned 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 sheaf 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” flexible cable. This cable is described in Chapter 4 “SIMATIC NET PROFIBUS Cables”.

Bending Radius

To avoid damage within the LAN cables, they must at no time be bent more sharply than the minimum bending radius.

Note the following:

- When pulling in cables under tensile load, much larger bending radii must be adhered to and 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 LAN cable can be found in the technical data sheets of the LAN cables in Chapter 4.

Avoid Loops

When laying LAN cables, roll them tangentially from the cable drum or use appropriate rotary tables. This prevents loops forming and resulting in kinks and torsion.

Installing other Cables

Remember that LAN cables must not be subjected to excessive strain and stress when installed. This can, for example, happen when cables are installed along with other cables on a common rack or in a common duct (providing this is electrically permitted) and when new cables are pulled along the same path later (during repairs or when extending a system). If LAN cables are installed along with other cables in the same cable channel, it is advisable to pull in the sensitive LAN cables last.

Attachments to 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 .

C.8 Additional Instructions on Installing Fiber-Optic Cables

Protecting Connectors from Contamination

Fiber-optic cable connectors are sensitive to contamination. Unconnected male and female connectors must be protected with the supplied dust caps.

Attenuation Variations under Load

During installation, the fiber-optic cables must not be twisted, stretched or crimped. 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 D.

Fitting Strain Relief

Although the BFOC connectors have integrated strain relief and provide protection against kinking, it is advisable to secure the cable additionally as close as possible to the connector to protect it from mechanical stress.

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

Fiber-optic cables are immune to electromagnetic interference. This means that the cables can be laid in conduits along with other cables (for example 230 V/380 V power supply cables) without any problems occurring. When the cables are installed in cable conduits, make sure that when other cables are pulled through, the maximum strain on the fiber-optic cables is not exceeded.

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 D.

Installation Instructions for SIMATIC NET PROFIBUS Plastic Fiber-Optic with Simplex Connectors or BFOC Connectors and Pulling Loop for the FO Standard Cable

D

SIEMENS

SIMATIC NET

Product Information Dated 08.99

Installation Instructions for SIMATIC NET PROFIBUS Plastic Fiber Optic with Simplex Connectors

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This document contains information in English.

Note

We would point out that the contents of this product documentation shall not become a part of or modify any prior or existing agreement, commitment or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Siemens. Any statements contained in this documentation do not create new warranties or restrict the existing warranty.

We would further point out that, for reasons of clarity, these operating instructions cannot deal with every possible problem arising from the use of this device. Should you require further information or if any special problems arise which are not sufficiently dealt with in the operating instructions, please contact your local Siemens representative.

WARNING !

!

The tools described in these instructions are intended only for stripping the jackets from SIMATIC NET PROFIBUS Plastic Fiber Optic cables. Using the tools for any other purpose can lead to injury or to damage of the tools or cable.

Under no circumstances must the tools be used on live cables.

Personnel qualification requirements

Qualified personnel as referred to in the operating instructions or in the warning notes are defined as persons who are familiar with the installation, assembly, startup and operation of this product and who possess the relevant qualifications for their work and have a First Aid qualification.

General Instructions for Working with SIMATIC NET PROFIBUS Plastic Fiber Optic Cables

Please note the following instructions to avoid damage to cables:

☞ Make sure that the selected cable is suitable for the area of application.
You should, for example, check the following:
– Required temperature range
– Resistance of the jacket materials to chemicals, water, oils, rodents etc. to which the cable may be exposed in your application
– Required mechanical properties (bending radii, tensile strength, transverse compressive strength)
– Required behavior of the cable in fire
– Suitability of the cable including the connectors for the devices to be interconnected

If necessary, use a special cable that meets your requirements. Your SIMATIC NET contact in your local Siemens branch will be happy to advise you.

☞ Never exceed the maximum permitted loads (tensile load, transverse compressive load etc.) specified in the data sheet of the cable you are using. Excessive transverse compressive load can, for example, result from using screw clamps to secure the cable.

☞ Only use plastic fiber-optic cables with devices approved for this plastic FO cable. Keep to the maximum permitted cable lengths.

☞ When cutting cables to length, make sure that no loops are formed and that the cable is not twisted. Loops and torsion under tensile load can cause kinks or cracks that may mean irreparable damage to the cable.

☞ Follow the instructions in this manual and use the tools described 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 prior to use.
The cutting depth is set with the adjusting screw at the end of the handle:
- Turning the adjusting screw clockwise increases the cutting depth
- Turning the adjusting screw counter clockwise reduces the cutting depth

☞ Make sure that the outer jacket and buffers of the cable and the plastic fibers are not damaged. When stripping the buffer from the fiber, use only the opening in the stripper marked AWG 16. Nicks or scratches can allow light to escape and can therefore lead to increased attenuation values and failure of the transmission path. With time, such defects can also lead to breaks in the fiber and to failure of the network.

☞ When grinding and polishing make sure that there is only slight pressure from the connector on to the foil to avoid fusion of the connector and fiber plastic.

☞ Make sure that you keep to the bending radii when grinding and polishing particularly when the cables are supported to provide mechanical strain relief. In this case, make sure that you strip an adequate length of the outer jacket.

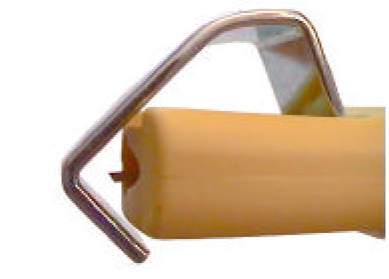
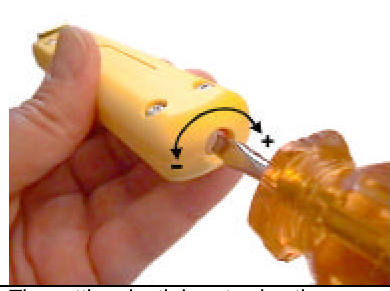
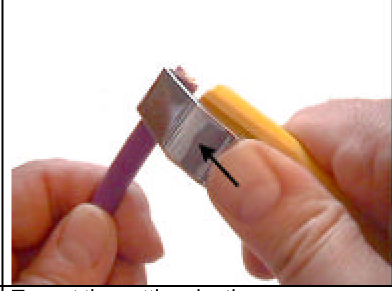
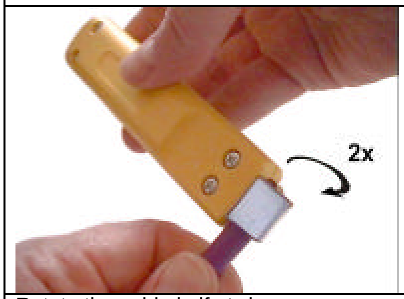
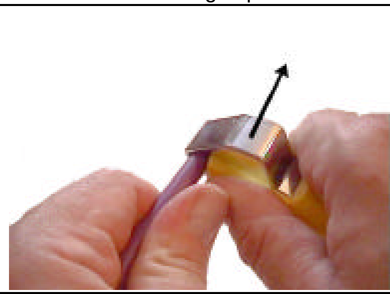
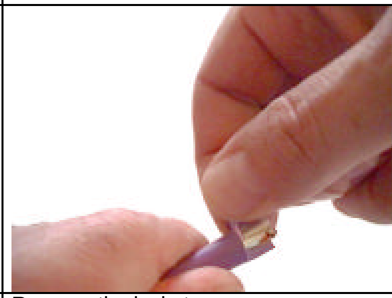
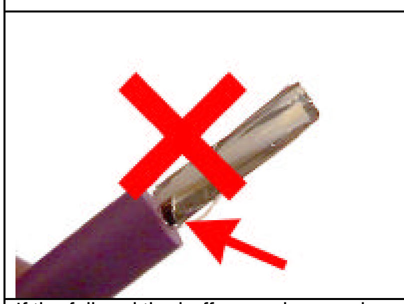
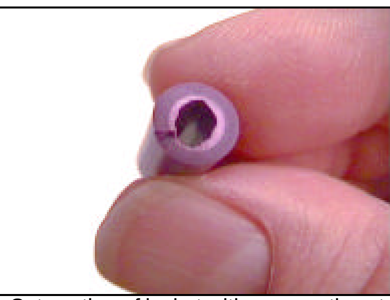
☞ The polishing holder has four recesses on the bottom surface. Replace the polishing holder as soon as any of these recesses is no longer visible.

☞ Never insert contaminated connectors or connectors with fibers extending beyond the end face into the device sockets. The optical transmitter and receiver elements could otherwise be destroyed.

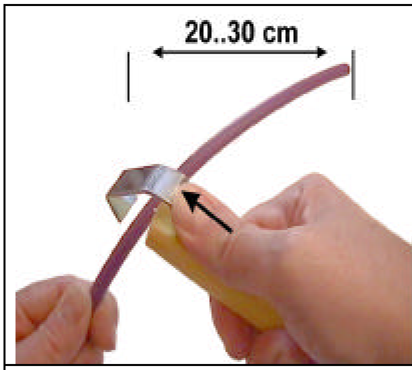
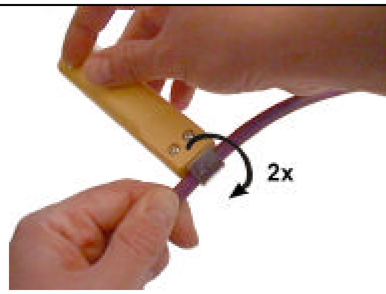
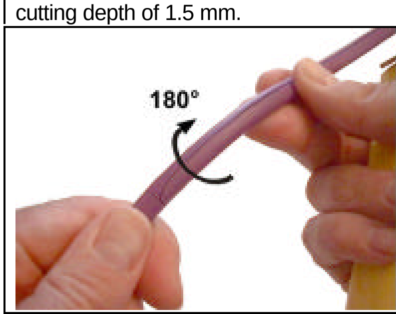
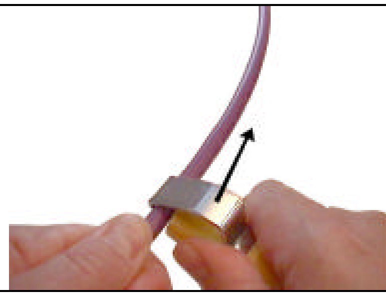
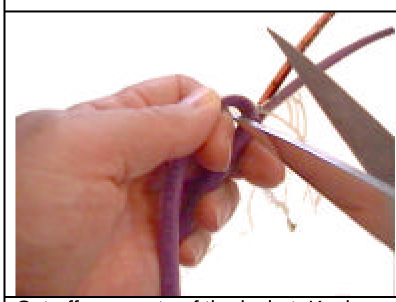
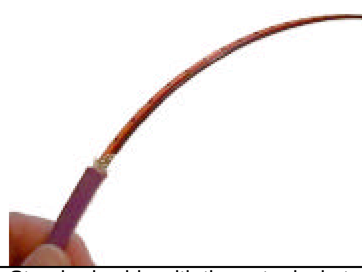
☞ When assembling plug adapters and when fitting the cable to them make sure that the transmit and receive lines are crossed over.

☞ Plug adapters are designed for fitting preassembled cords once. If a cord has been inserted and must be removed again, the bent cord section must not be used again. Cut off the bent cord section and refit the simplex connector.

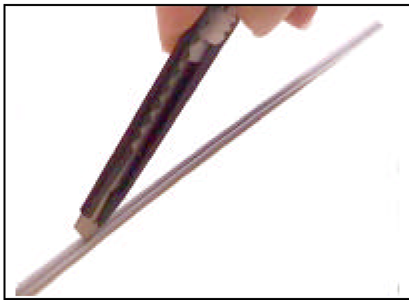
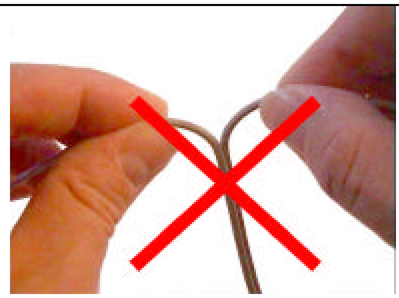
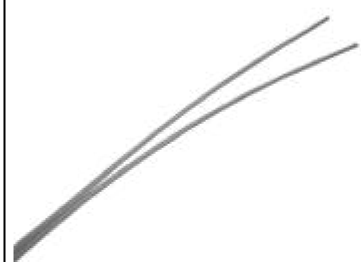
Setting the Cutting Depth of the Cable Knife

		
Set the cutting depth of the cable knife for stripping the outer jacket of the SIMATIC NET PLASTIC FIBER OPTIC standard cable to a depth of 1.5 mm. Then follow the steps as described below:	The cutting depth is set using the adjusting screw at the end of the handle. • Turning the screw clockwise increases the cutting depth • Turning the screw counter clockwise reduces the cutting depth	Try out the cutting depth: Press the clamp of the cable knife in the direction of the arrow. Insert the cable.
		
Rotate the cable knife twice.	Slit the outer jacket up to the end of the cable.	Remove the jacket. If the jacket is difficult to remove, the cutting depth is not adequate. In this case increase the cutting depth by turning the adjusting screw of the cable knife clockwise. Try out the setting by stripping a piece of cable again.
		
If the foil and the buffer are damaged, the cable knife is set too deep. In this case, reduce the cutting depth by turning the adjusting screw in the handle counter clockwise. Try out the setting by stripping a piece of cable again.	Cut section of jacket with a correctly set cable knife.	

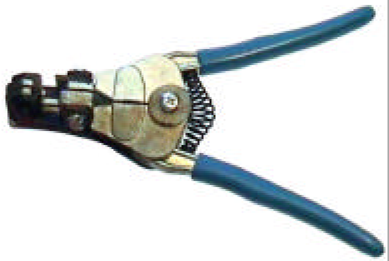
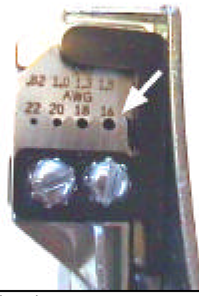
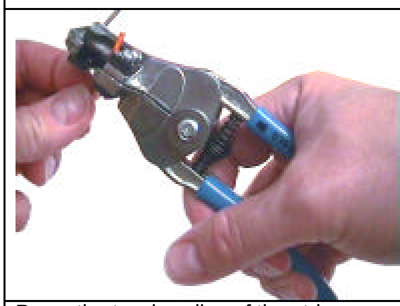
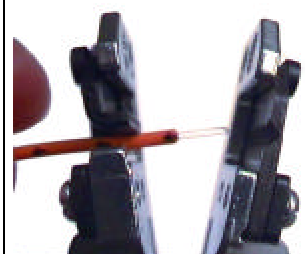
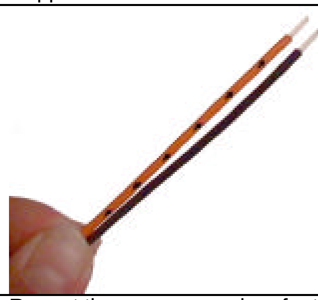
Stripping the Outer Jacket of the SIMATIC NET PLASTIC FIBER OPTIC Standard Cable

		
Press the clamp of the cable knife in the direction of the arrow. Insert the cable up to a length of 20 cm (if you are fitting a plug adapter, 30 cm). Note: The cable knife must be set to a cutting depth of 1.5 mm.	Rotate the cable knife twice.	Slit the outer jacket up to the end of the cable.
		
Make a second slit up to the end of the cable on the opposite side of the jacket. First turn the cable through 180°.	Then make a second slit up to the end of the cable starting from the round cut.	Remove the outer jacket, Kevlar fibers and foil working from the end of the cable towards the round cut leaving the black and orange FO cords.
		
Cut off remnants of the jacket, Kevlar fibers and foil with scissors.	Standard cable with the outer jacket stripped	

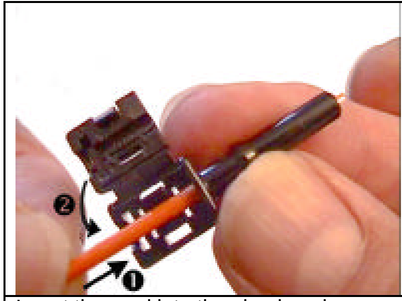
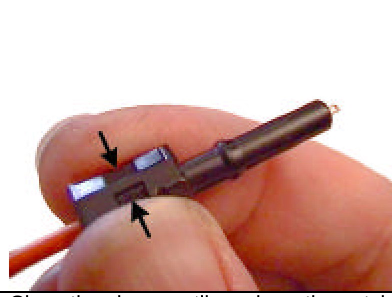
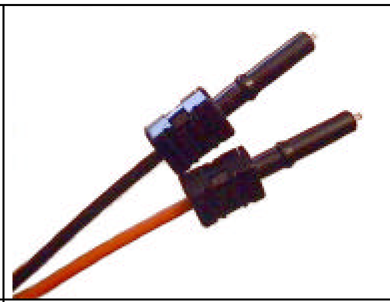
Separating the SIMATIC NET PLASTIC FIBER OPTIC Duplex Cord

		
Insert a sharp knife 20 cm (if fitting a plug adapter 30 cm) from the end of the cable in the groove between the two cords and split the cords up to the end of the cable. Caution: The buffer of the cords must not be damaged.	Caution: Do not split the cords simply by hand, since the fibers can easily be bent beyond the minimum bending radius.	Separated duplex cords

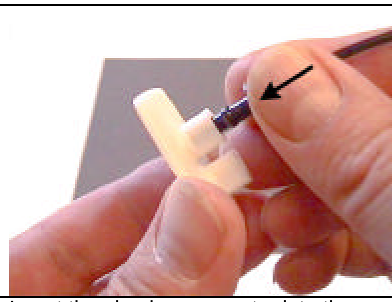
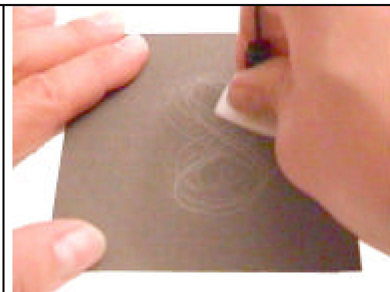
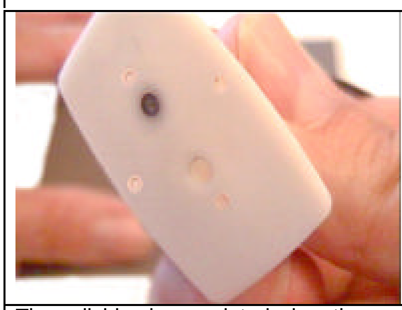
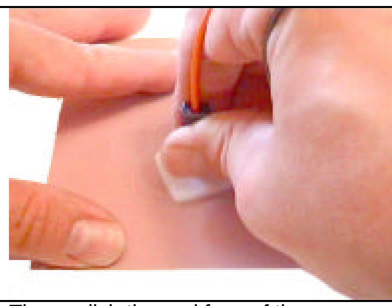
Removing the Buffer

		
To strip the buffer from the plastic fibers, use the SIMATIC NET buffer stripper (included in the stripping tool set).	Important note: Use the opening labeled AWG 16 (1.5 mm Ø). Smaller openings damage the fiber and must not be used.	Insert the cord into the opening labeled AWG 16. The cord must extend approximately 5 mm beyond the blade.
		
Press the two handles of the stripper together and hold them together.	The cord is automatically clamped in the stripper...	...and the buffer is removed.
		
Open the handles of the stripper slowly until the clamp releases the cord. Remove the cord from the stripper. Only open the handles of the stripper completely after you have removed the cord. Caution: If the handles are opened completely before the cord has been removed, the fiber can be damaged by the blade as it is retracted.	Repeat the same procedure for the second cord.	

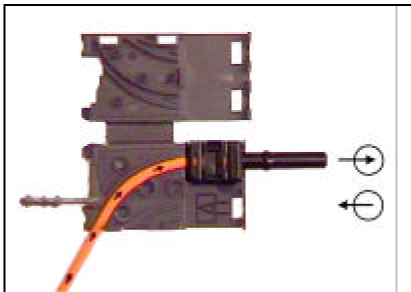
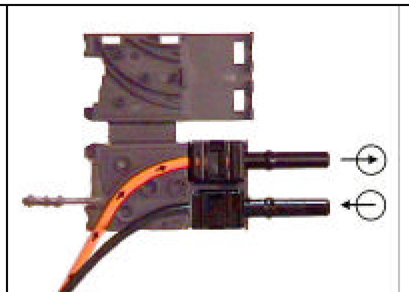
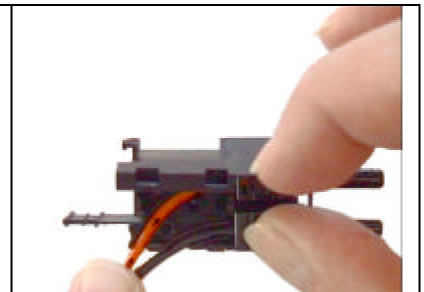
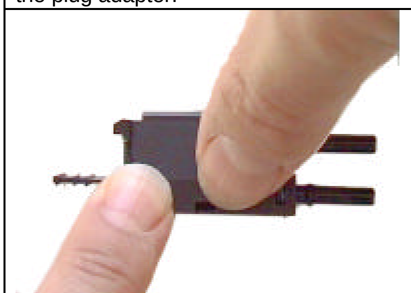
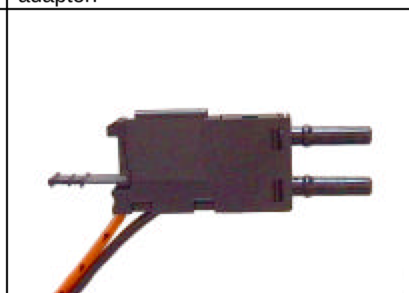
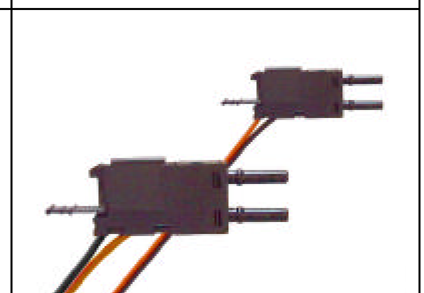
Fitting Simplex Connectors

		
Insert the cord into the simplex plug as far as it will go ❶ and close the clamp ❷. Caution: The fiber must extend at least 1.5 mm beyond the end face of the connector.	Close the clamp until you hear the catch lock in place.	Repeat the same procedure for the second cord. Caution: Do not insert the connector into a device socket, otherwise the excess fiber length is liable to damage the transmitter and receiver elements.

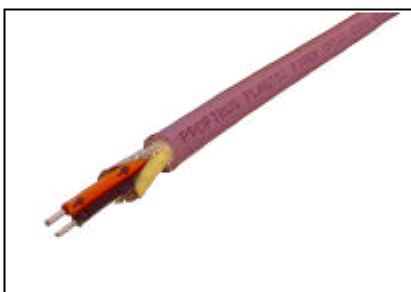
Grinding and Polishing Simplex Connectors

		
Cut off excessive fiber with scissors leaving approximately 1.5 mm in length.	Insert the simplex connector into the polishing holder as far as it will go.	Grind down the excess fiber by describing a figure-of-eight on polishing paper (600 grit) on a flat solid surface.
		
The polishing is completed when the fiber is flush with the end face of the connector. Remove the debris from the polishing holder and from the end face of the connector using a clean cloth.	Then polish the end face of the connector by describing figures-of-eight on the pink polishing foil (rough side). Repeat the figure-of-eight movement approximately 25 times. Polishing reduces the attenuation by approximately 2 dB (corresponds to approximately 10 m cable length). With short lengths of cable polishing is unnecessary.	Repeat the procedure with the second connector and clean the surfaces of the plug with a clean cloth.

Assembling the Plug Adapter (only with integrated optical interfaces such as the IM 153-2 FO and IM 467 FO)

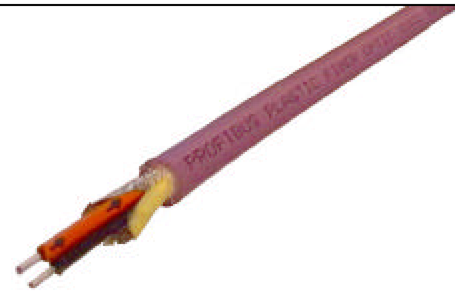
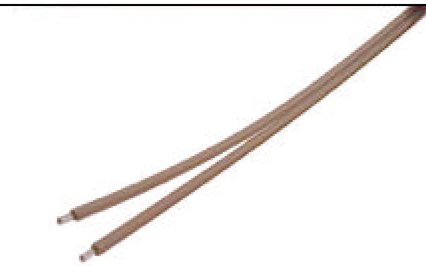
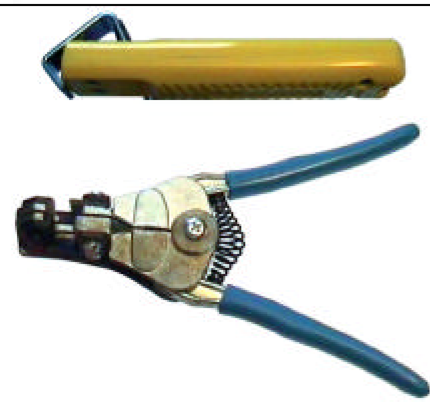
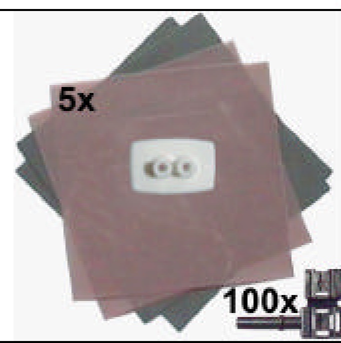
		
Insert the connector of the orange cord [1] with the direction arrows into the holder whose triangle (arrow head) symbol points in the same direction. Caution: The hinge of the simplex connector must be towards the center of the plug adapter.	Insert the connector with the black cord into the free holder. Caution: Once again the hinge of the simplex connector must be towards the center of the plug adapter. The two hinges must not jut out of the plug adapter.	Close the upper half of the plug adapter.
		
Press the two halves together until you hear them click closed.	Assembled plug adapter.	Cable with plug adapters assembled at both ends with crossed over cords.

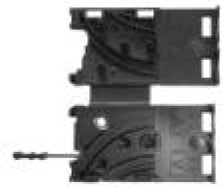
Marking of the SIMATIC NET PROFIBUS plastic fiber-optic standard cable for installation without plug adapters

		
To help you connect up the cable correctly, the standard cable has arrow markings on the orange cord. This helps to make sure that you attach one end of a cord to the transmitter and the other to a receiver (crossed over cords).	First connect the orange cord: • If the arrow on the orange cord is pointing out of the cable (as shown in the figure), connect this cord to the receiver. The receiver is identified by an arrow pointing into a circle. • If the arrow on the orange cord points into the cable, connect this cord to the transmitter. The transmitter is identified by an arrow pointing out of a circle.	The black cord is then connected to the free socket of the same FO interface.

[1] Only the standard cable has this marking (orange core with arrows), the duplex cord does not have this marking.

Cables, Tools and Accessories

SIMATIC NET PROFIBUS Plastic Fiber Optic, standard cable I-VY4Y2P 980/1000 160A Robust round cable with two plastic FO cords, violet PVC outer jacket and PA inner jacket, without connectors, for use indoors in meters 6XV1 821-0AH10 50 m ring 6XV1 821-0AN50 100 m ring 6XV1 821-0AT10	
SIMATIC NET PROFIBUS Plastic Fiber Optic, duplex cord I-VY2P 980/1000 150A Plastic FO cable with two cords, PVC jacket, without connectors, for use in environments where it is subjected to little mechanical stress (for example within a cubicle or 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 buffer stripper (round cutting pliers) for removing the buffer of SIMATIC NET plastic fiber-optic cables. 6GK1 905-6PA10	
SIMATIC NET PROFIBUS Plastic Fiber Optic, Plastic Simplex Connector/Polishing Kit 100 plastic simplex connectors and 5 polishing kits for assembling SIMATIC NET PROFIBUS plastic fiber-optic cables 6GK1 901-0FB00-0AA0	

Plug adapter Pack of 50 for installing plastic simplex connectors in conjunction with, for example, IM 467 FO and IM 153-2 FO 6ES7 195-1BE00-0XA0	

Other commercially available accessories

- Sharp scissors for shortening the Kevlar and the fibers
- Sharp knife for separating the duplex cords
- Clean, soft cloth for cleaning the polishing holder and the connector end face.

SIEMENS

SIMATIC NET

Product Information

Dated 08.99

Installation Instructions for SIMATIC NET PROFIBUS Plastic Fiber Optic with BFOC Connectors

This document contains information in English.

Note

We would point out that the contents of this product documentation shall not become a part of or modify any prior or existing agreement, commitment or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Siemens. Any statements contained in this documentation do not create new warranties or restrict the existing warranty.

We would further point out that, for reasons of clarity, these operating instructions cannot deal with every possible problem arising from the use of this device. Should you require further information or if any special problems arise which are not sufficiently dealt with in the operating instructions, please contact your local Siemens representative.

WARNING !

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The tools described in these instructions are intended only for stripping the jackets from SIMATIC NET PROFIBUS Plastic Fiber Optic cables. Using the tools for any other purpose can lead to injury or to damage of the tools or cable.

Under no circumstances must the tools be used on live cables.

Personnel qualification requirements

Qualified personnel as referred to in the operating instructions or in the warning notes are defined as persons who are familiar with the installation, assembly, startup and operation of this product and who possess the relevant qualifications for their work and have a First Aid qualification.

General Instructions for Working with SIMATIC NET PROFIBUS Plastic Fiber Optic Cables

Please note the following instructions to avoid damage to cables:

- ☞ Make sure that the selected cable is suitable for the area of application.
  You should, for example, check the following:
  – Required temperature range
  – Resistance of the jacket materials to chemicals, water, oils, rodents etc. to which the cable may be exposed in your application
  – Required mechanical properties (bending radii, tensile strength, transverse compressive strength)– Required behavior of the cable in fire
  – Suitability of the cable including the connectors for the devices to be interconnected

  If necessary, use a special cable that meets your requirements. Your SIMATIC NET contact in your local Siemens branch will be happy to advise you.

- ☞ Never exceed the maximum permitted loads (tensile load, transverse compressive load etc.) specified in the data sheet of the cable you are using. Excessive transverse compressive load can, for example, result from using screw clamps to secure the cable.

- ☞ Only use plastic fiber-optic cables with devices approved for this plastic FO cable. Keep to the maximum permitted cable lengths.

- ☞ When cutting cables to length, make sure that no loops are formed and that the cable is not twisted. Loops and torsion under tensile load can cause kinks or cracks that may mean irreparable damage to the cable.

- ☞ Follow the instructions in this manual and use the tools described 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 prior to use.
  The cutting depth is set with the adjusting screw at the end of the handle:
  - Turning the adjusting screw clockwise increases the cutting depth
  - Turning the adjusting screw counter clockwise reduces the cutting depth

- ☞ Make sure that the outer jacket and buffers of the cable and the plastic fibers are not damaged. When stripping the buffer from the fiber, use only the opening in the stripper marked AWG 16. Nicks or scratches can allow light to escape and can therefore lead to increased attenuation values and failure of the transmission path. With time, such defects can also lead to breaks in the fiber and to failure of the network.

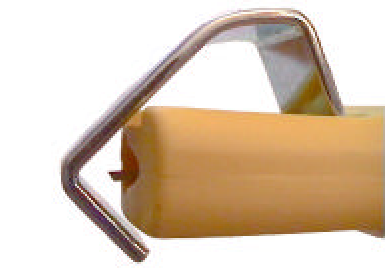
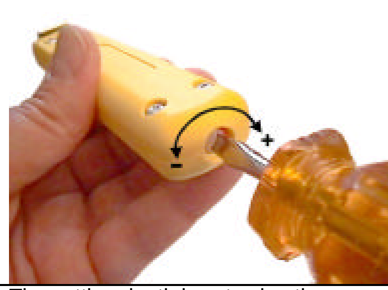
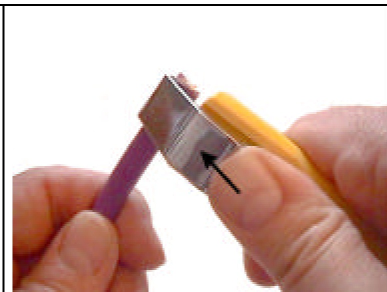
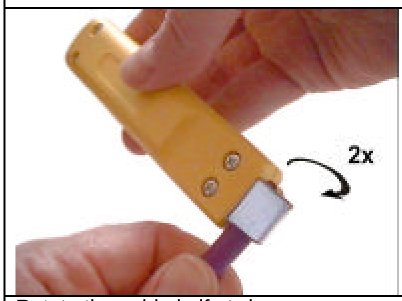
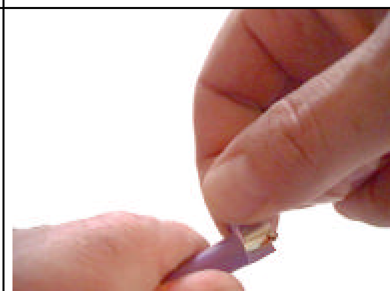
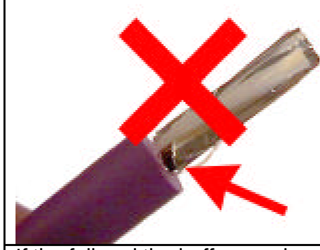
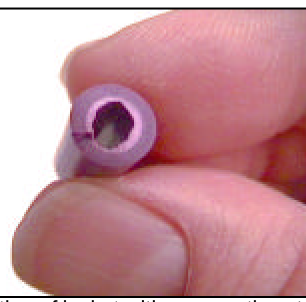
- ☞ When grinding and polishing make sure that there is only slight pressure from the connector onto the paper to avoid fusion of the metal parts and fiber plastic.

- ☞ Make sure that you keep to the bending radii when grinding and polishing particularly when the cables are supported to provide mechanical strain relief. In this case, make sure that you strip an adequate length of the outer jacket.

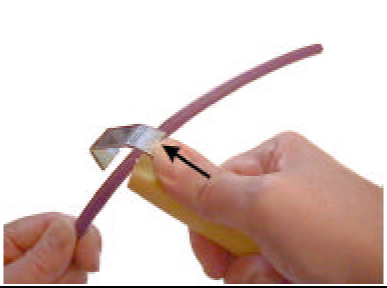
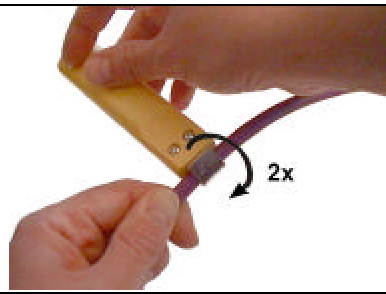
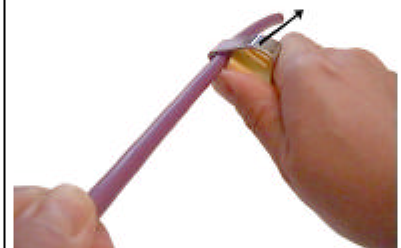
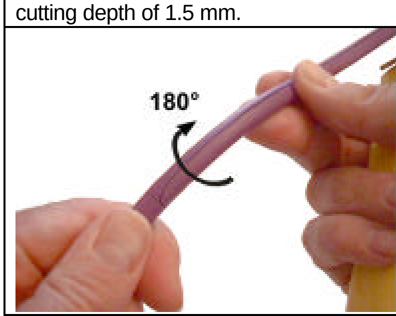
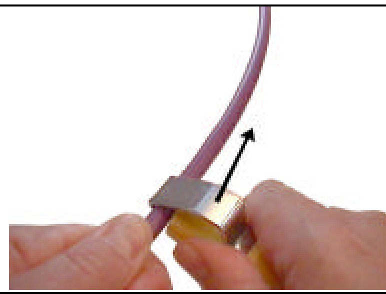
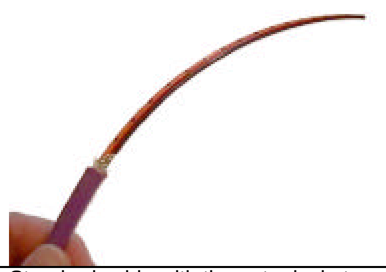
- ☞ Never insert contaminated connectors or connectors with fibers extending beyond the end face into the device sockets. The optical transmitter and receiver elements could otherwise be destroyed.

- ☞ When fitting the cable to connectors make sure that the transmit and receive lines are crossed over.

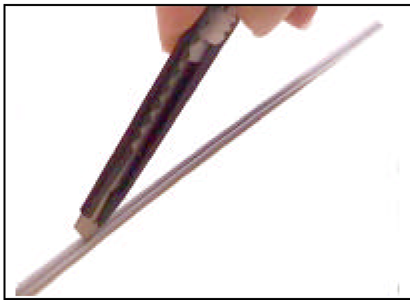
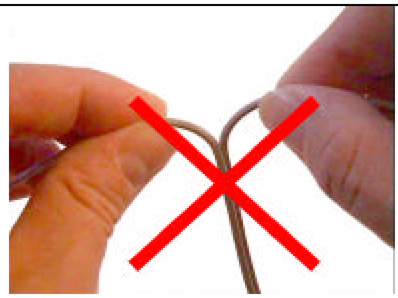
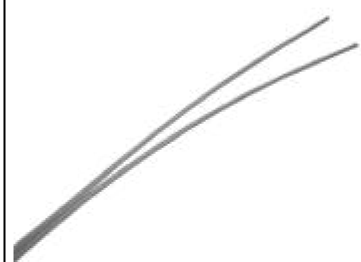
Setting the Cutting Depth of the Cable Knife

		
Set the cutting depth of the cable knife for stripping the outer jacket of the SIMATIC NET PLASTIC FIBER OPTIC standard cable to a depth of 1.5 mm. Then follow the steps as described below:	The cutting depth is set using the adjusting screw at the end of the handle. • Turning the screw clockwise increases the cutting depth • Turning the screw counter clockwise reduces the cutting depth	Try out the cutting depth: Press the clamp of the cable knife in the direction of the arrow. Insert the cable.
		
Rotate the cable knife twice.	Slit the outer jacket up to the end of the cable.	Remove the jacket. If the jacket is difficult to remove, the cutting depth is not adequate. In this case increase the cutting depth by turning the adjusting screw of the cable knife clockwise. Try out the setting by stripping a piece of cable again.
		
If the foil and the buffer are damaged, the cable knife is set too deep. In this case, reduce the cutting depth by turning the adjusting screw in the handle counter clockwise. Try out the setting by stripping a piece of cable again.	Cut section of jacket with a correctly set cable knife.	

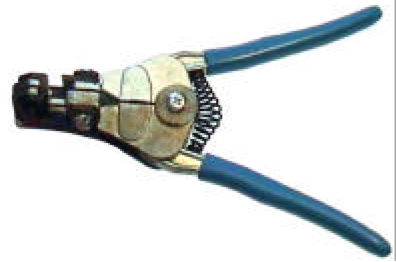
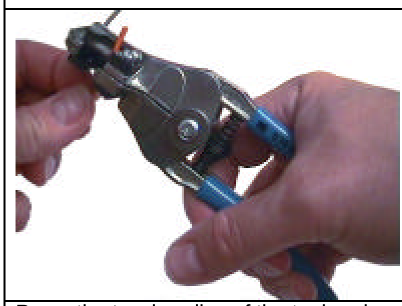
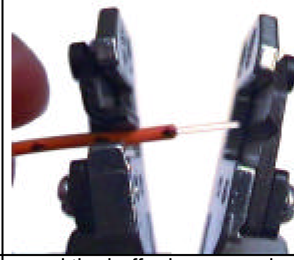
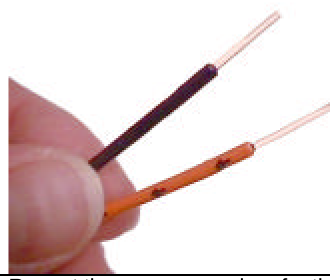
Stripping the Outer Jacket of the SIMATIC NET PLASTIC FIBER OPTIC Standard Cable

		
Press the clamp of the cable knife in the direction of the arrow. Insert a length of 20 cm of cable. Note: The cable knife must be set to a cutting depth of 1.5 mm.	Rotate the cable knife twice.	Slit the outer jacket up to the end of the cable.
		
Make a second slit up to the end of the cable on the opposite side of the jacket. First turn the cable through 180°.	Then make a second slit up to the end of the cable starting from the round cut.	Remove the outer jacket, Kevlar fibers and foil working from the end of the cable towards the round cut leaving the black and orange FO cords.
		
Cut off remnants of the jacket, Kevlar fibers and foil with scissors.	Standard cable with the outer jacket stripped	

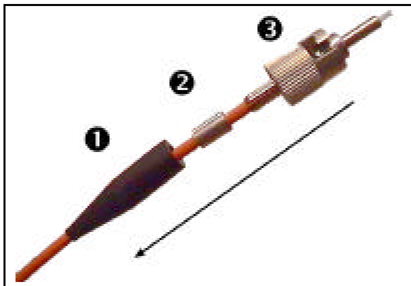
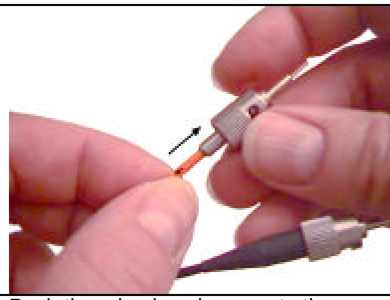
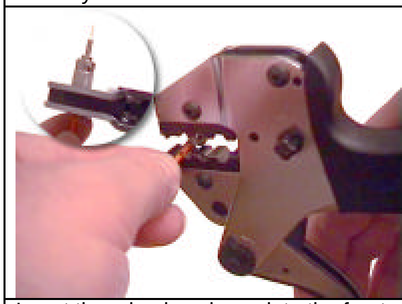
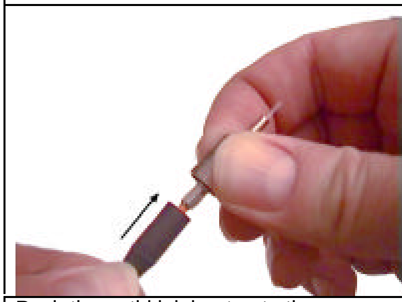
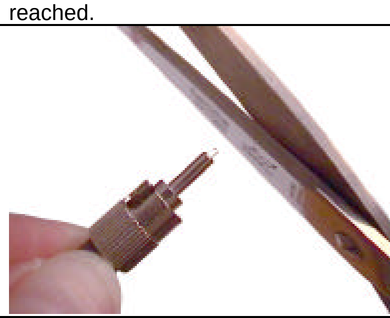
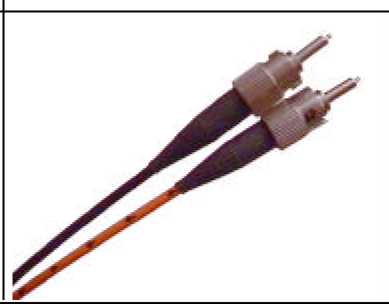
Separating the SIMATIC NET PLASTIC FIBER OPTIC Duplex Cord

		
Insert a sharp knife 20 cm from the end of the cable in the groove between the two cords and split the cords up to the end of the cable. Caution: The buffer of the cords must not be damaged.	Caution: Do not split the cords simply by hand, since the fibers can easily be bent beyond the minimum bending radius.	Separated duplex cords

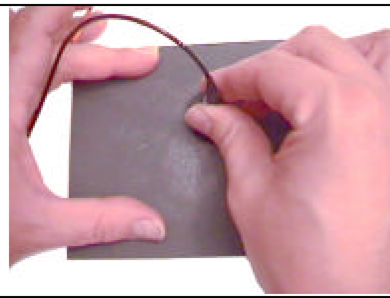
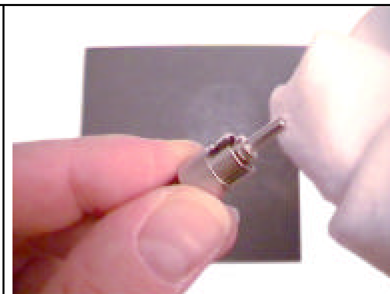
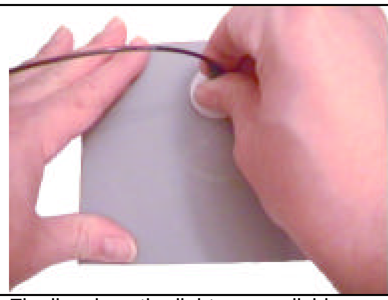
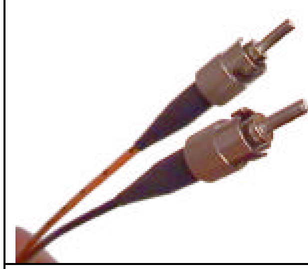
Removing the Buffer

		
To strip the buffer from the plastic fibers, use the SIMATIC NET buffer stripper (included in the stripping tool set).	Important note: Use the opening labeled AWG 16 (1.5 mm Ø). Smaller openings damage the fiber and must not be used.	Insert the cord into the opening labeled AWG 16. The cord must extend at least 10 mm beyond the blade.
		
Press the two handles of the tool and hold them together.	The cord is automatically clamped in the tool...	...and the buffer is removed.
		
Open the handles of the tool until the clamp releases the cord. Remove the cord from the tool. Only open the handles of the tool completely after you have removed the cord. Caution: If the handles are opened completely before the cord has been removed, the fiber can be damaged by the blade as it is retracted.	Repeat the same procedure for the second cord.	

Crimping the BFOC Connector

		
Push the black anti-kink boot ❶, short crimping sleeve ❷ body of the connector ❸ onto the stripped cords. Caution: The fiber must extend at least 1 mm beyond the face of the connector.	Push the crimping sleeve onto the connector body as far as the end stop.	Press together the handles of the crimping tool to open it.
		
Insert the crimping sleeve into the front opening (hexagonal 3.25 mm). Make sure that the crimping sleeve is fully in the tool.	Press the handles of the crimping tool together firmly. The connector body is fixed to the cord and the crimping sleeve. Note: The tool can only be opened again after the required pressure has been reached.	Open the crimping tool and remove the cord.
		
Push the anti-kink boot onto the connector body as far as the end stop.	Cut off excessive fiber with scissors leaving approximately 0,5 mm in length.	Repeat the same procedure for the second cord. Caution: Do not insert the connector into a device socket, otherwise the excess fiber length extending out of the end face of the connector is liable to damage the transmitter and receiver elements.

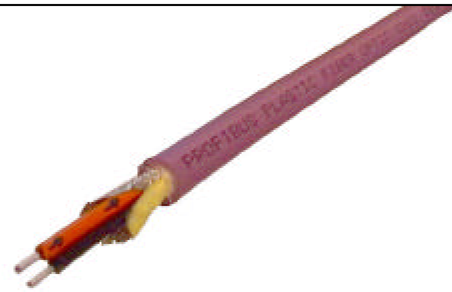
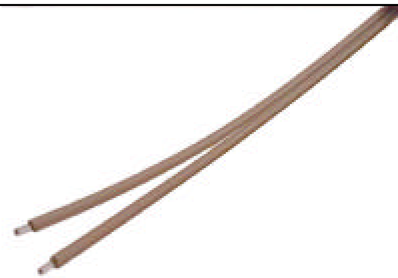
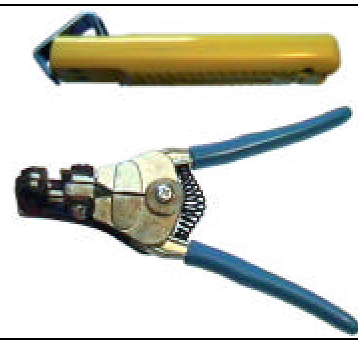
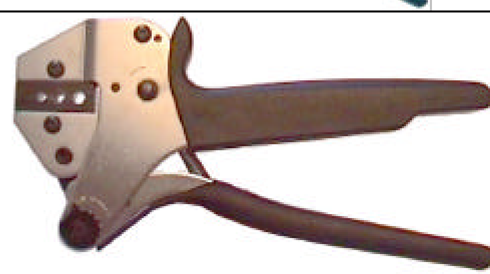
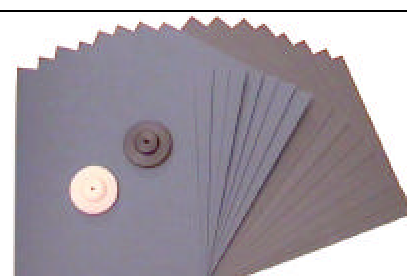
Grinding and Polishing BFOC Connectors

		
To grind the BFOC connector, insert it in the black polishing disc.	Grind down the excess fiber by describing a figure-of-eight on polishing paper (400 grit) on a flat solid surface by applying gentle pressure to the connector.	Remove the connector from the polishing disc and remove the debris with a soft lint-free cloth.
		
Fit the connector into the white polishing disc	Finally, place the light gray polishing paper (1500 grit) on a firm flat surface and polish the connector end face by describing a figure of eight while applying gentle pressure to the connector. Repeat the figure-of-eight movement approximately 25 times.	Remove the connector from the polishing disc and remove the debris with a soft lint-free cloth.
		
Repeat this procedure with the second connector.		

Marking of the SIMATIC NET PROFIBUS plastic fiber-optic standard cable

		
To help you connect up the cable correctly, the standard cable has arrow markings on the orange cord. This helps to make sure that you attach one end of a cord to the transmitter and the other to a receiver (crossed over cords).	First connect the orange cord: • If the arrow on the orange cord is pointing out of the cable, connect this cord to the receiver. The receiver is identified by an arrow pointing into a circle. • If the arrow on the orange cord points into the cable (picture), connect this cord to the transmitter. The transmitter is identified by an arrow pointing out of a circle.	The black cord is then connected to the free socket of the same FO interface.

Cables, Tools and Accessories

SIMATIC NET PROFIBUS Plastic Fiber Optic, standard cable I-VY4Y2P 980/1000 160A Robust round cable with 2 plastic FO cords, violet outer jacket and PA inner jacket without connector for use indoors In meters 6XV1 821-0AH10 50 m Ring 6XV1 821-0AN50 100 m Ring 6XV1 821-0AT10	
SIMATIC NET PROFIBUS Plastic Fiber Optic, duplex cord I-VY2P 980/1000 150A Plastic FO cable with two cords, PVC jacket, without connectors, for use in environments where it is subjected to little mechanical stress (for example within a cubicle or 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 buffer stripper (round cutting pliers) for removing the buffer of SIMATIC NET PROFIBUS plastic fiber-optic cables. 6GK1 905-6PA10	
SIMATIC NET PROFIBUS Plastic Fiber Optic, BFOC crimping tool For fitting BFOC connectors to PROFIBUS Plastic Fiber Optic cables 6GK1 905-6PB00	
SIMATIC NET PROFIBUS Plastic Fiber Optic, BFOC connector set pack of 20 BFOC connectors for assembly of PROFIBUS Plastic Fiber Optic cables for OLM/P. 6GK1 905-1PA00	**20x** 
SIMATIC NET PROFIBUS Plastic Fiber Optic, BFOC polishing set Polshing set for grinding and polishing the end face of the BFOC connector for PROFIBUS Plastic Fiber Optic cables OLM/P. 6GK1 905-6PS00	

Other commercially available accessories
- Sharp scissors for shortening the Kevlar and the fibers
- Sharp knife for separating the duplex cords
- Clean, soft cloth for cleaning the polishing discs and the connector end face.

SIEMENS

SIMATIC NET

Product Information Dated 08.99

How to Use the Pulling Loop for the SIMATIC NET PROFIBUS PCF Fiber Optic Standard Cable

This document contains information in English.

We have checked the contents of this manual for agreement with the tools described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcome.

Technical data subject to change.

Note

We would point out that the contents of this product documentation shall not become a part of or modify any prior or existing agreement, commitment or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Siemens. Any statements contained in this documentation do not create new warranties or restrict the existing warranty.

We would further point out that, for reasons of clarity, these operating instructions cannot deal with every possible problem arising from the use of this device. Should you require further information or if any special problems arise which are not sufficiently dealt with in the operating instructions, please contact your local Siemens representative.

Personnel qualification requirements

Qualified personnel as referred to in the operating instructions or in the warning notes are defined as persons who are familiar with the installation, assembly, startup and operation of this product and who possess the relevant qualifications for their work and have a First Aid qualification.

General Instructions for Working with SIMATIC NET PROFIBUS PCF Fiber Optic Cables

Please note the following instructions to avoid damage to cables:

☞ Make sure that the selected cable is suitable for the area of application.
You should, for example, check the following:
– Required temperature range
– Resistance of the jacket materials to chemicals, water, oils, rodents etc. to which the cable may be exposed in your application
– Required mechanical properties (bending radii, tensile strength, transverse compressive strength)
– Required behavior of the cable in fire
– Suitability of the cable including the connectors for the devices to be interconnected

If necessary, use a special cable that meets your requirements. Your SIMATIC NET contact in your local Siemens branch will be happy to advise you.

☞ Never exceed the maximum permitted loads (tensile load, transverse compressive load etc.) specified in the data sheet of the cable you are using. Excessive transverse compressive load can, for example, result by using screw clamps to secure the cable.

☞ Always use the pulling loop to pull in the PCF standard cable. Never pull in the cable by the connectors or stripped cords.

☞ Only use PCF fiber-optic cables with devices approved for this FO cable type. Keep to the maximum permitted cable lengths.

☞ When cutting cables to length, make sure that no loops are formed and that the cable is not twisted. Loops and torsion under tensile load can cause kinks or cracks that may mean irreparable damage to the cable.

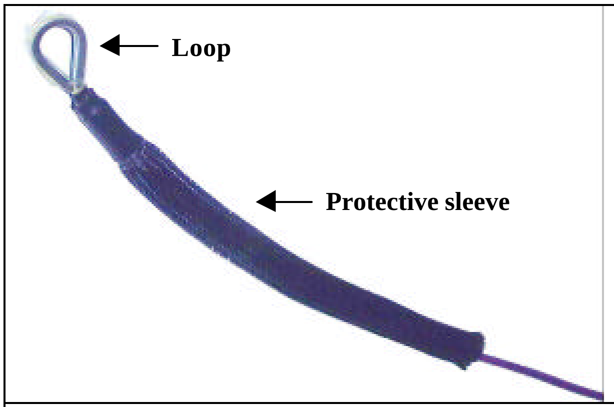
☞ Follow the steps outlined in these instructions.

☞ Make sure that the outer jacket and buffers of the cable are not damaged.

☞ Never insert contaminated connectors in the device sockets. The optical transmitter and receiver elements could otherwise be destroyed.

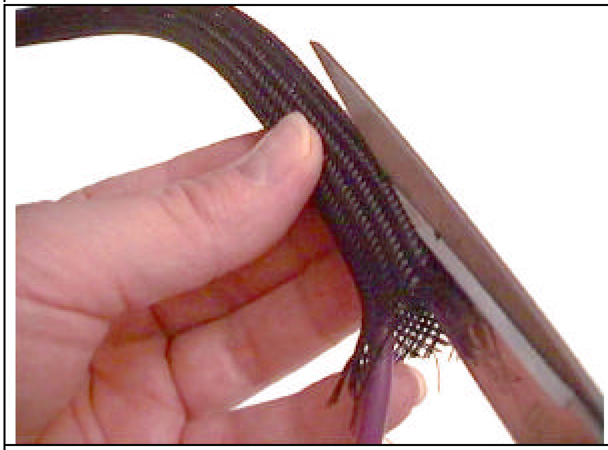
☞ When fitting the cable to connectors make sure that the transmitted and received data are crossed in the cable.

Using the Pulling Loop

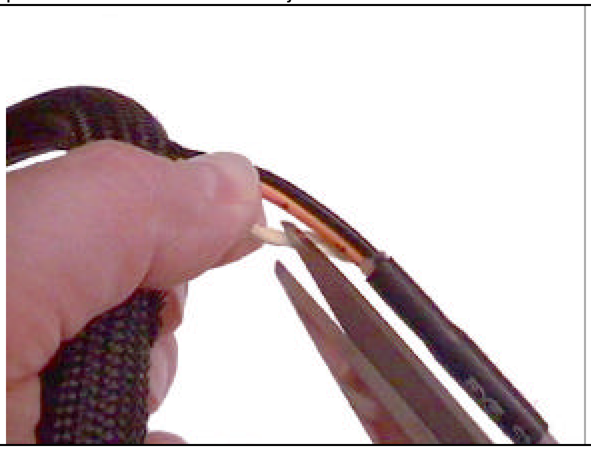


Die SIMATIC NET PCF Fiber Optic Standard cable is fitted with a pulling loop at one end. It consists of the loop and a protective sleeve.

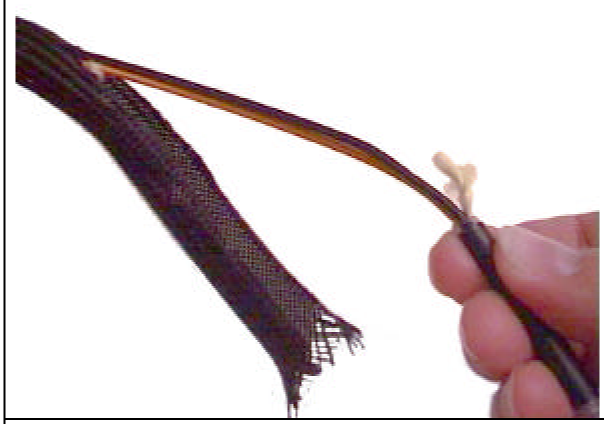
The tensile load is applied to the loop and is distributed over the Kevlar fibers (strain-relief elements) of the PCF standard cable. The protective sleeve surrounds the cores with their preassembled connectors and prevents them from kinking.
Caution: Pull in the cable using only the loop. Never pull on the protective sleeve or the outer jacket of the cable.



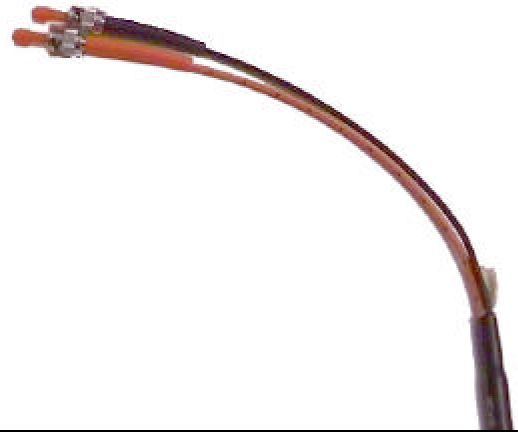
After the cable has been installed, the pulling loop must be removed. Cut open the back end of the protective sleeve with scissors for a length of approximately 10 cm.
Caution: Make sure that you do not damage the cords beneath the protective sleeve.



Free the cords from the protective sleeve and cut away the Kevlar fibers with scissors.
Caution: Never cut the black or orange cords.

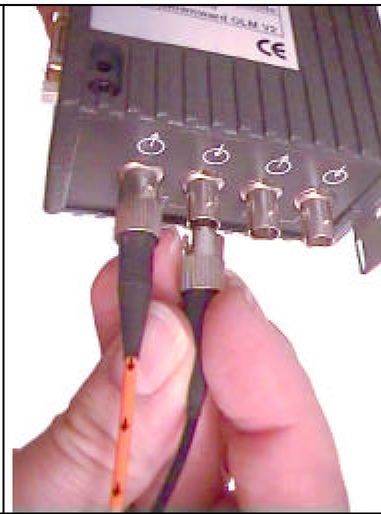


Carefully remove the pulling loop from the end of the cable by pulling on the loop.



The job is done!

Marking of the SIMATIC NET PROFIBUS PCF Fiber Optic Standard Cable

		
To help you connect up the cable correctly, the PCF standard cable has arrow markings on the orange cord. This helps to make sure that you attach one end of a cord to the transmitter and the other to a receiver (crossed over cords). Remove the dust cap shortly before you insert the connector into the socket.	First connect the orange cord: • If the arrow on the orange cord is pointing out of the cable, connect this cord to the receiver. The receiver is identified by an arrow pointing into a circle. • If the arrow on the orange cord points into the cable (picture), connect this cord to the transmitter. The transmitter is identified by an arrow pointing out of a circle.	The black cord is then connected to the free socket of the same FO interface.

Ordering Data

SIMATIC NET PROFIBUS PCF Fiber Optic, standard cable I-VY2K 200/230 10A17 + 8B20 PCF FO cable with 2 cords, PVC outer jacket, for spanning distances up to 400 m, **assembled with 2 x 2 BFOC connectors**, outer jacket stripped over 20 cm at both ends, with pulling loop fitted at one end, **for connecting OLM/P.** Standard lengths* 75 m 6XV1821-1BN75 100 m 6XV1821-1BT10 150 m 6XV1821-1BT15 200 m 6XV1821-1BT20 250 m 6XV1821-1BT25 300 m 6XV1821-1BT30 400 m 6XV1821-1BT40 *other lengths available on request	
SIMATIC NET PROFIBUS PCF Fiber Optic cable I-VY2K 200/230 10A17 + 8B20 PCF FO cable with 2 cords, PVC outer jacket, for spanning distances up to 300 m, **preassembled with 2 x 2 simplex connectors,** outer jacket stripped over 30 cm, with pulling loop fitted at one end, **for connecting devices with integrated optical interfaces and OBT** **Standard lengths*** 50 m 6XV1821-1CN50 75 m 6XV1821-1CN75 100 m 6XV1821-1CT10 150 m 6XV1821-1CT15 200 m 6XV1821-1CT20 250 m 6XV1821-1CT25 300 m 6XV1821-1CT30 *other lengths available on request	

*Note:
You can order other lengths and additional components for the SIMATIC NET cabling range from your local representative.
For technical advice, contact:

J. Hertlein
Siemens AG, A&D SE V22
Tel. 0911/750-4465
Fax 0911/750-9991
E-mail: juergen.hertlein@fthw.siemens.de

Installing Network Components in Cubicles

E

E.1 IP Degrees of Protection

Electrical equipment is normally surrounded by a protective casing. The purpose of this casing includes

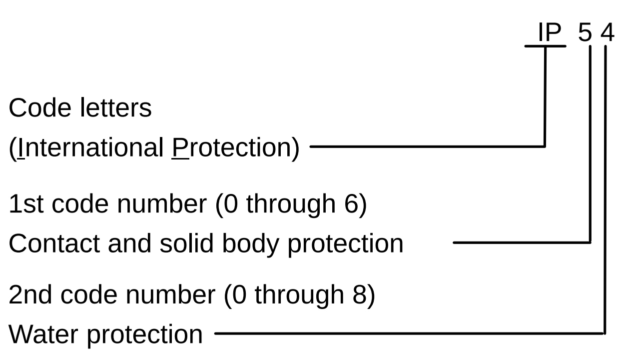
- Protection of persons from touching live components or moving parts (accidental contact protection)
- Protection of equipment from intrusion of solid foreign bodies (solid body protection)
- Protection of equipment from ingress of water (water protection).

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.

Degree of Protection

The various degrees of protection are shown and explained briefly in Table E–1. 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 Degree of Protection Afforded (Brief Outline)

Code Number	Contact and Solid Body Protection	Water Protection
0	No protection	No protection
1	against solid bodies ≥ 50 mm diameter	dropping vertically
2	against solid bodies ≥ 12 mm diameter	dropping inclined at 15°
3	against solid bodies ≥ 2.5 mm diameter	spray water, inclined up to 60°
5	against solid bodies ≥ 1 mm diameter	spray water from any direction
6	dust deposits	spray water – water jet from nozzle
7	ingress of dust (dustproof)	Heavy spray water
8	–	intermittent immersion at specified pressure for specified time
9	–	permanent immersion at specified pressure for specified time

E.2 SIMATIC NET Components

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 the degrees of protection IP 20, IP 30 to IP 40. You will find the actual degree of protection of a SIMATIC NET component in its documentation.

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 IP 65/ IP 67).

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

– 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 provided by casing (IP code) (IEC 60529:1989)
EN 60529:1989 Degrees of protection provided by enclosures (IP Code)

Further Literature

Klingberg, G.; Mähling, W.: Schaltschrank– und Gehäuse–Klimatisierung in der Praxis mit EMV; Heidelberg 1998

F Dimension Drawings

F.1 Dimension Drawings of the Bus Connectors

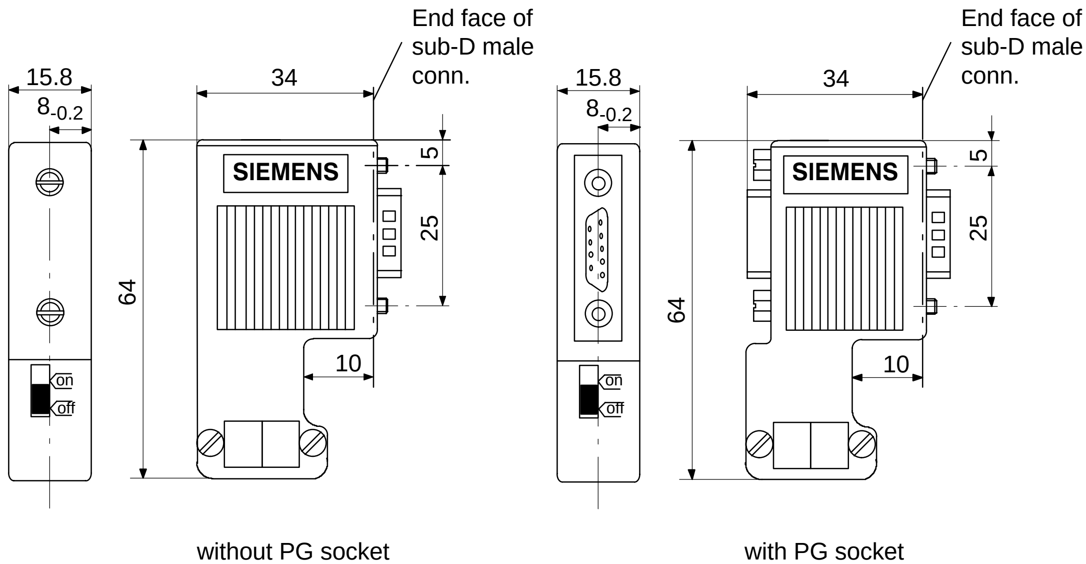


Figure F-1 Bus Connector to IP 20 (6ES7 972-0B.11-0XA0)

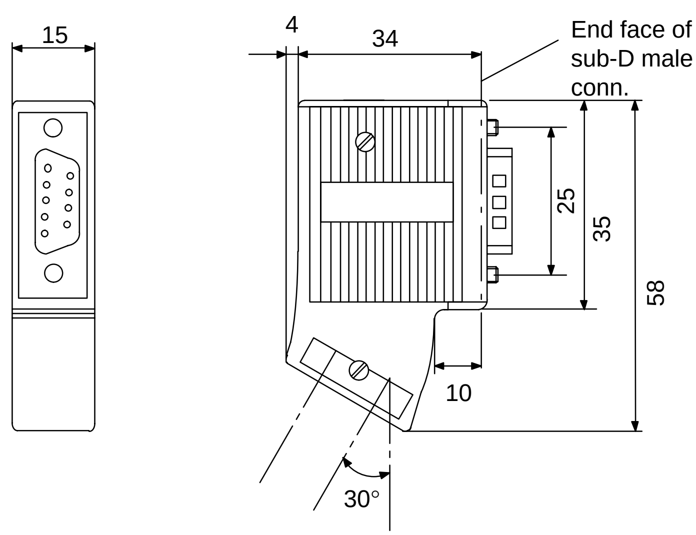


Figure F-2 Bus Connector to IP 20 (6ES7 972-0BA30-0XA0)

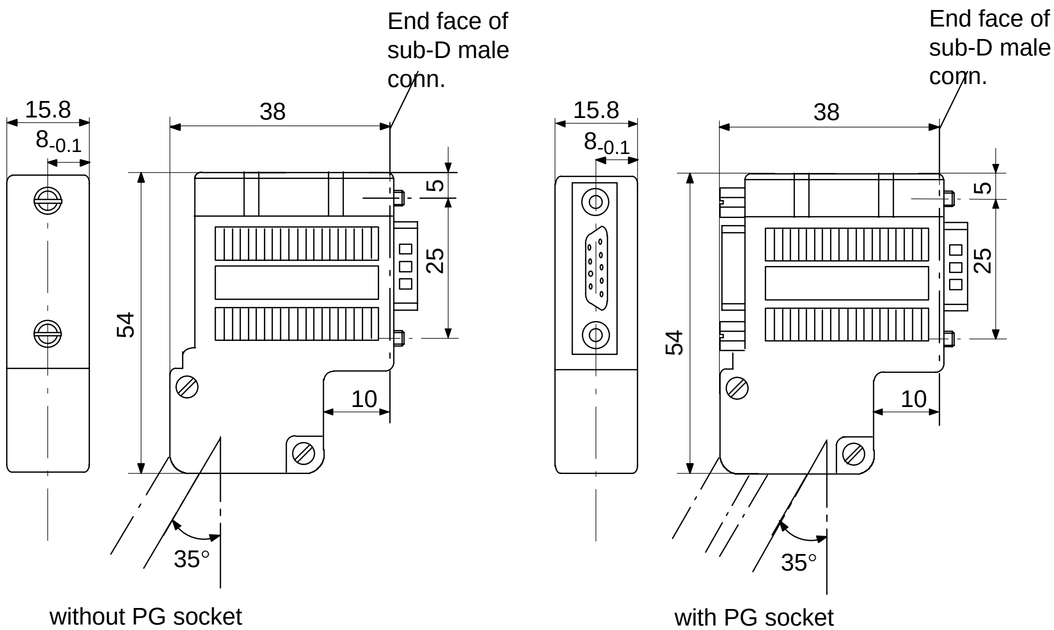


Figure F-3 Bus Connector to IP 20 (6ES7 972-0B.40-0XA0)

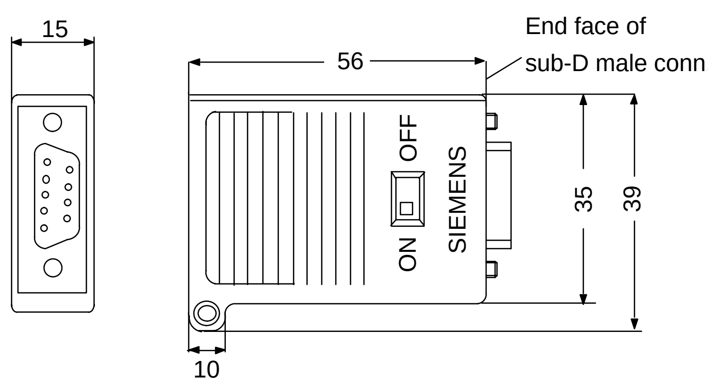


Figure F-4 Bus Connector to IP 20 (6GK1 500-0EA02)

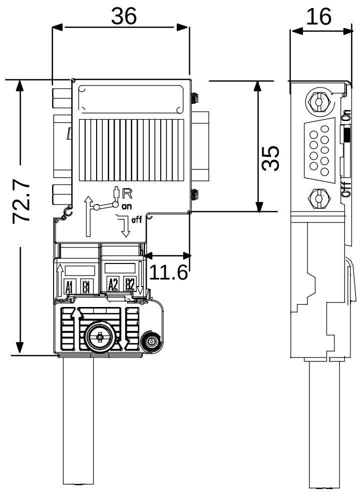


Figure F-5 FastConnect Bus Connector (6ES7 972–0B.50–0XA0)

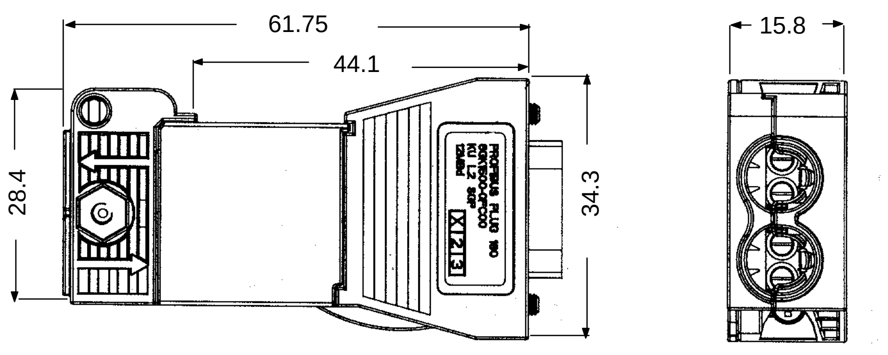


Figure F-6 FastConnect Bus Connector (6GK1 500–0FC00)

F.2 Dimension Drawings of the RS-485 Repeater

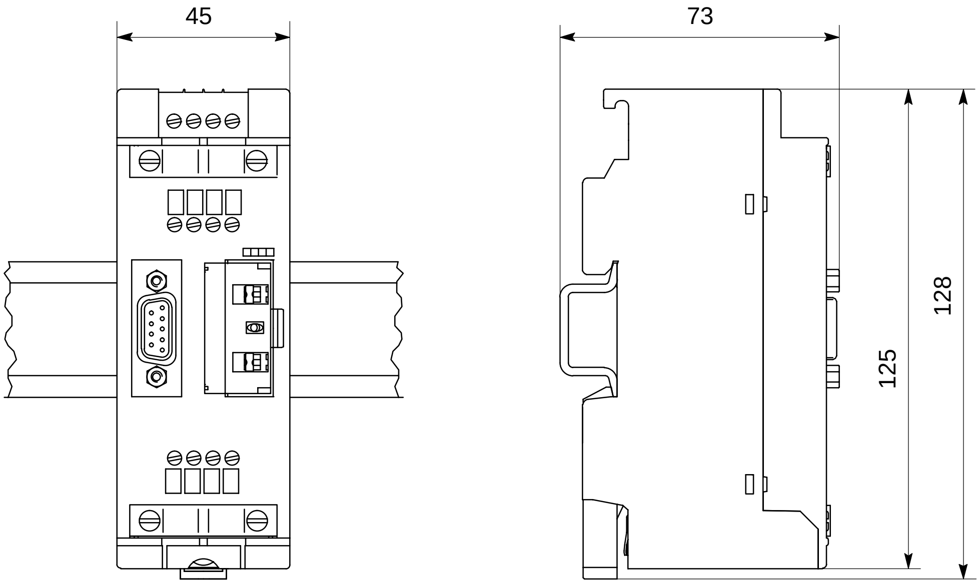


Figure F-7 RS–485 Repeater on Standard Rail

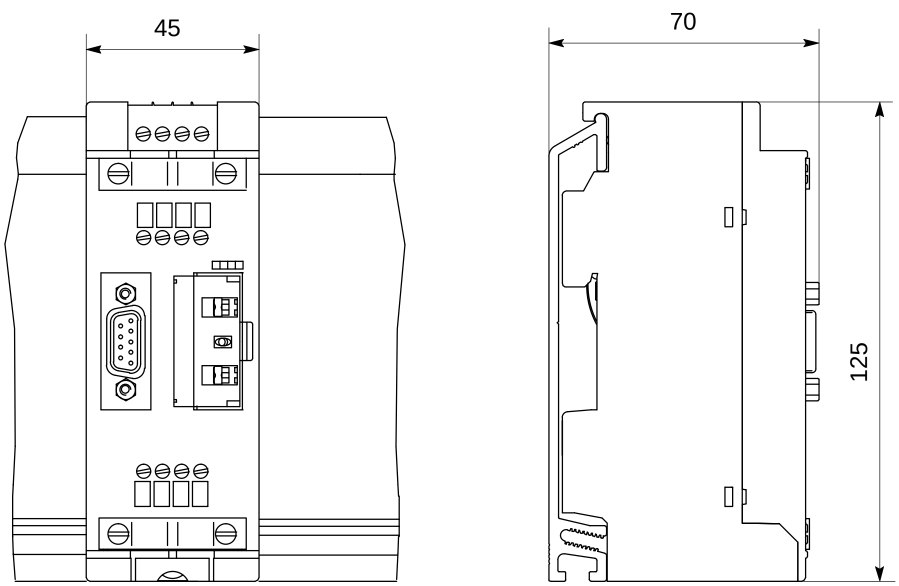


Figure F-8 RS-485 Repeater on S7-300 Rail

F.3 Dimension Drawing of the PROFIBUS Terminator

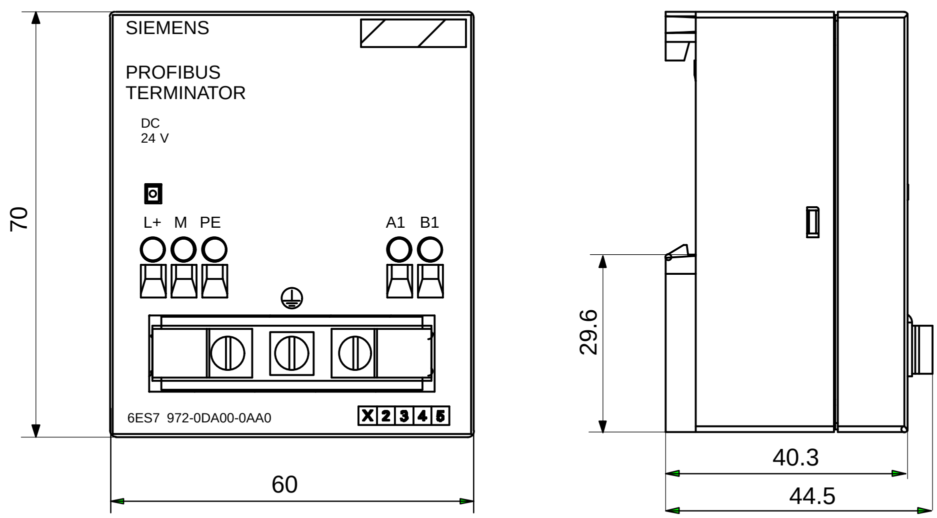


Figure F-9 PROFIBUS Terminator

F.4 Dimension Drawings of the RS-485 Bus Terminal

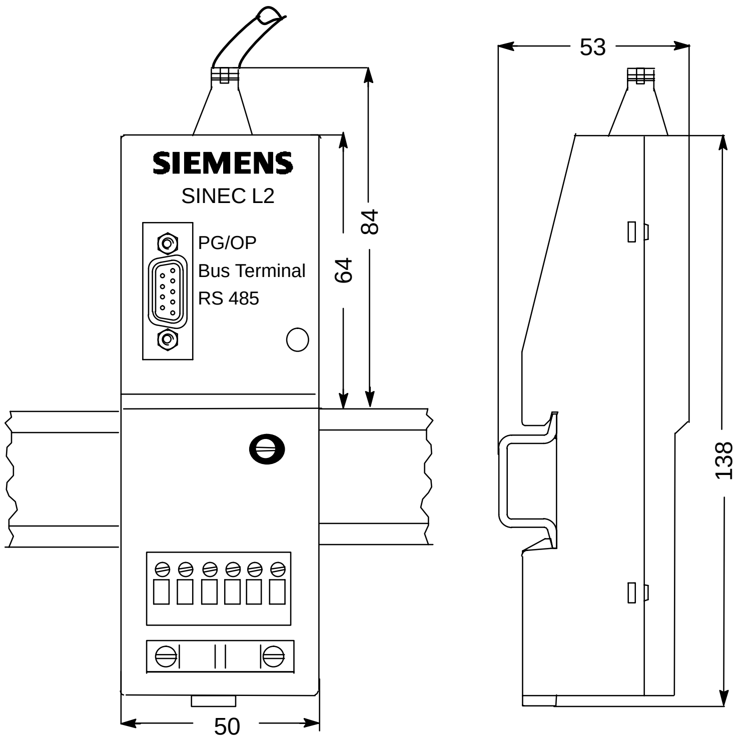


Figure F-10 RS-485 Bus Terminal on 15 mm high Standard Rail

F.5 Dimension Drawings of the BT12M Bus Terminal

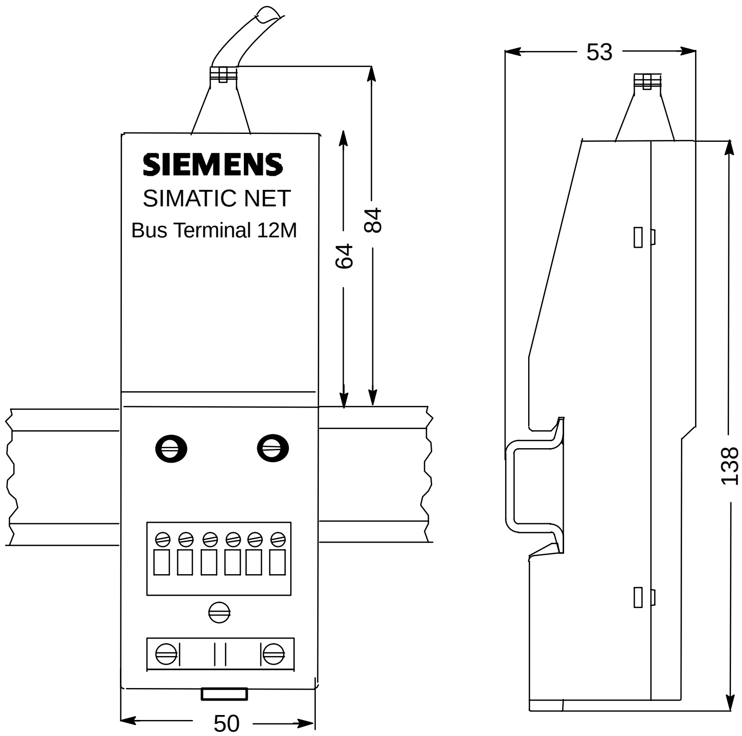


Figure F-11 BT12M Bus Terminal on 15 mm high Standard Rail

F.6 Dimension Drawings of the Optical Bus Terminal OBT

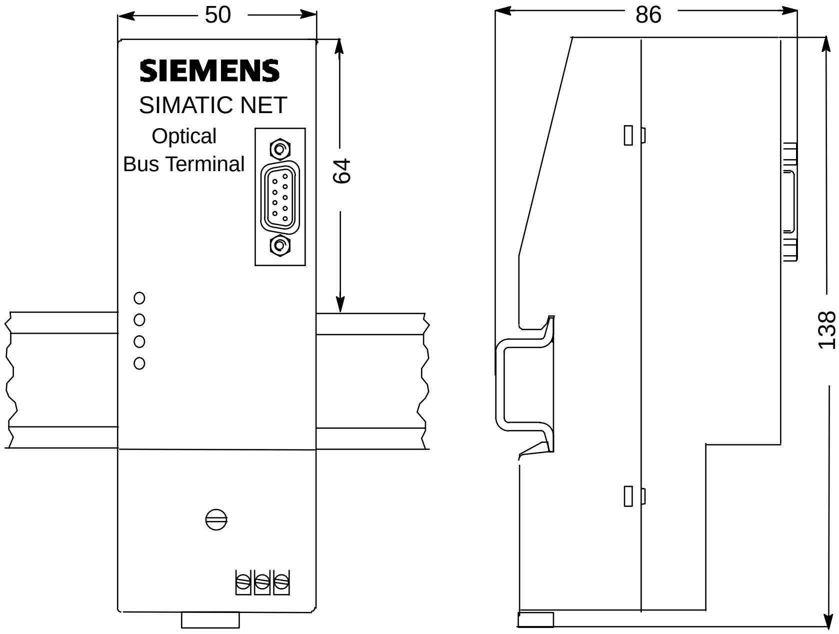


Figure F-12 Optical Bus Terminal OBT on 15 mm high Standard Rail

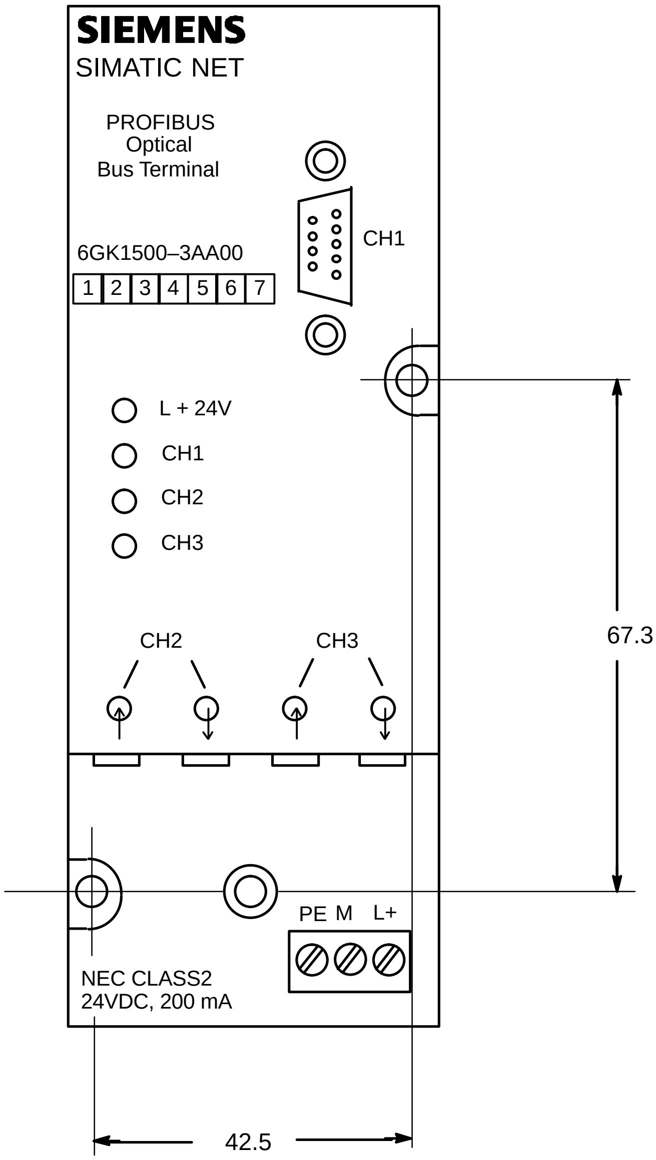


Figure F-13 Drilling Template for the Optical Bus Terminal OBT

F.7 Dimension Drawings Infrared Link Module ILM

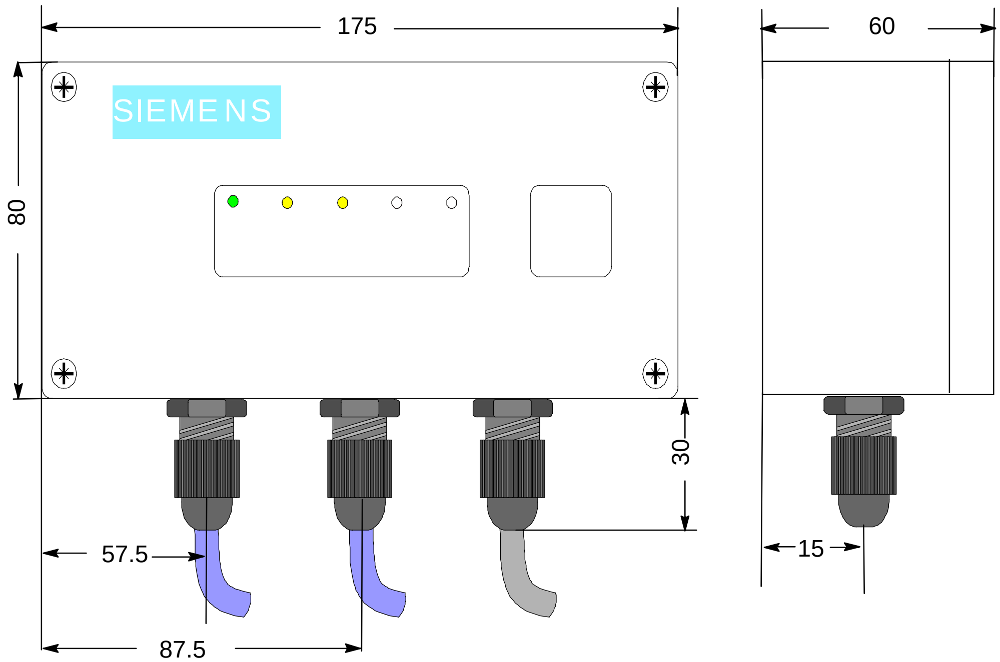


Figure F-14 PROFIBUS ILM

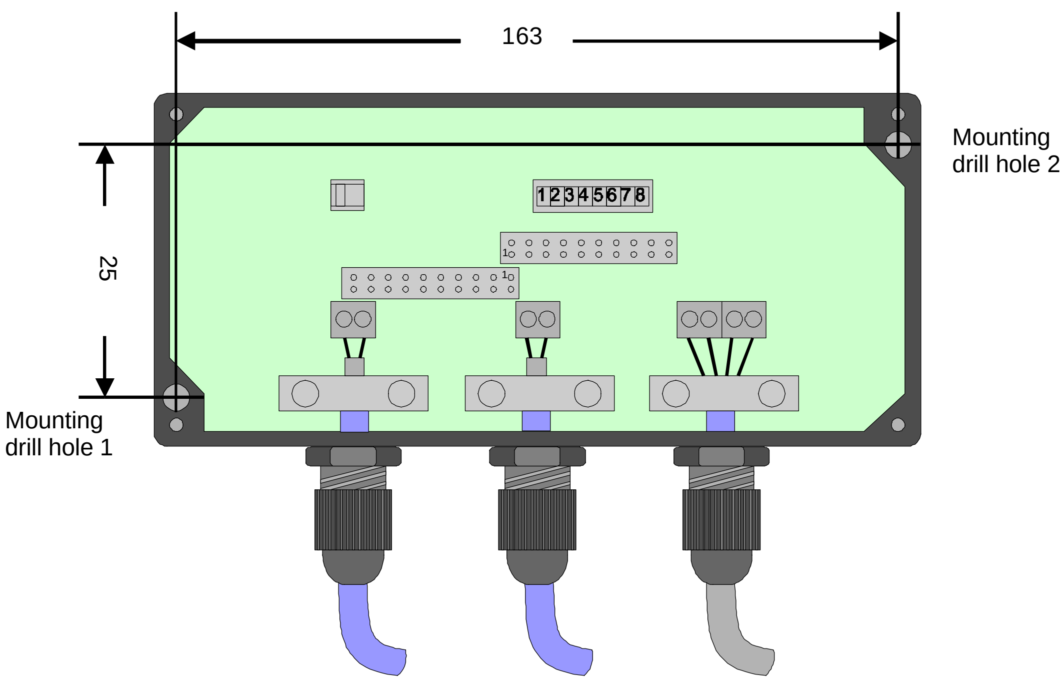


Figure F-15 Drilling Dimensions for Securing the PROFIBUS ILM to a Mounting Plate

F.8 Dimension Drawings Optical Link Module OLM

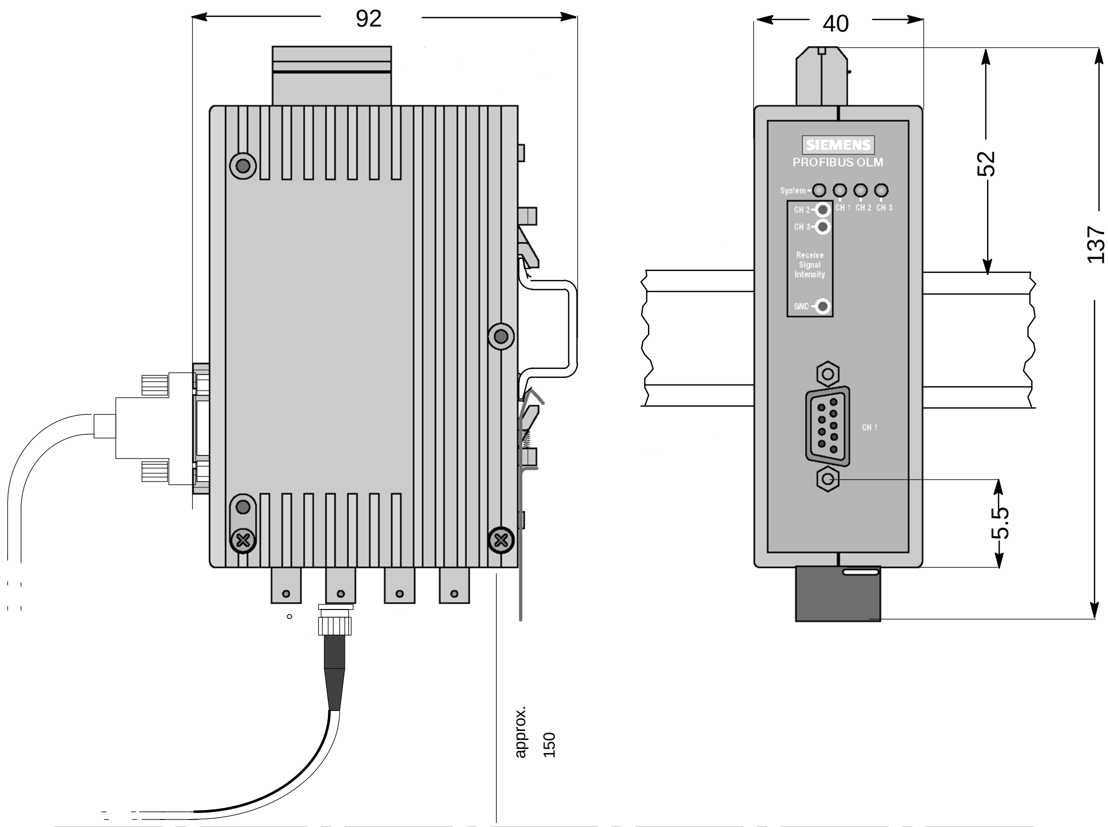


Figure F-16 Optical Link Module OLM on 15 mm high Standard Rail

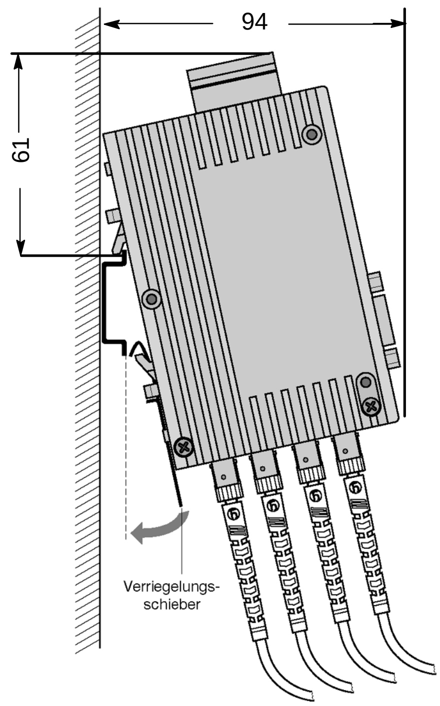


Figure F-17 Mounting the Optical Link Module OLM on a 7.5 mm high Standard Rail

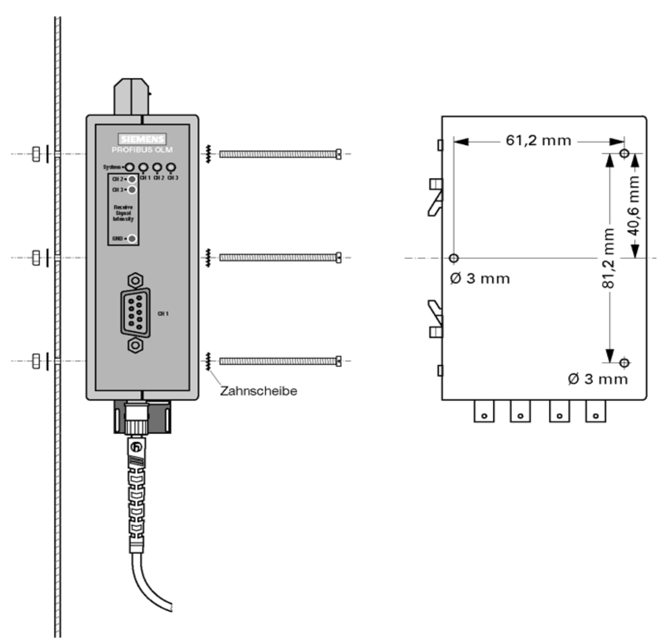


Figure F-18 Mounting the Optical Link Module OLM on a Mounting Plate

Operating Instructions ILM / OLM / OBT

G

SIEMENS

SIMATIC NET

Description and Operating Instructions **Stand/ Dated / 1/00**

Order Number **6ZB5530-3AC30-0BA1**

PROFIBUS ILM (Infrared Link Module)

Im Nachfolgenden finden Sie Informationen in deutscher Sprache.
The following description contains information in English.

Hinweis / Note / Avertissement / Avvertenza / Indicatiòn

Achtung

Vor der Inbetriebnahme Hinweise in der entsprechenden aktuellen Dokumentation beachten. Die Bestelldaten hierfür entnehmen Sie bitte den Katalogen oder wenden Sie sich an Ihre örtliche SIEMENS-Niederlassung.

Die Inbetriebnahme ist solange untersagt, bis festgestellt wurde, daß die Maschine, in die diese Komponente eingebaut werden soll, den Bestimmungen der Richtlinie 89/392/EWG entspricht.

Attention

Prior to startup you must observe the notes in the relevant documentation. For ordering data of the documentation please refer to catologs or contact your local SIEMENS representative.

Startup must not take place until it is established that the machine, which is to accommodate this component, is in conformity the guideline 89/392/EEC.

Attention

Avant la mise en service, respecter les instructions de la documentation actuelle correspondante. Pour les références de commande de la documentation, veuillez-vous reporter aux catalogues ou consulter votre agence locale SIEMENS.

La mise en service est interdite tant que la machine dans laquelle est incorporé ce composant n'est pas conforme aux prescriptions de la directive 89/392/CEE.

Attenzione

Prima della messa in funzione, osservare attentamente le avvertenze riportate nella documentazione corrente. Per i dati di ordinazione consultare i cataloghi oppure rivolgersi alla locale fidale SIEMENS.

La messa in funzione è vietata fino a quando non è stato acctertato che macchina, in cui il componente deve essere installato, non rispetta le disposizioni della direttiva 89/392/CCE.

Atenciòn

Antes de la puesta en marcha observar las indicaciones contenidas en la documentatción actual correspondiente. La referencia de la misma puede consultarse en los catáloges o solicitarse a su agencia SIEMENS local.

Está prohibida la puesta en marcha hast comprobar que la máquina en donde ca a incorporarse este componente cumpie lo especificado en la directiva 89/392/CCE.

Order Number

SIMATIC NET PROFIBUS ILM	6GK1 503-0AA00
Description and Operating Instructions	6ZB5530-3AC30-0BA1

Siemens AG
Infoservice
Abteilung A&D Z 533
Postfach 23 48
90713 Fürth

Germany

Note

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We would further point out that, for reasons of clarity, these operating instructions cannot deal with every possible problem arising from the use of this device. Should you require further information or if any special problems arise which are not sufficiently dealt with in the operating instructions, please contact your local Siemens representative.

General

This device is electrically operated. Adhere strictly to the safety requirements relating to voltages applied to the device as described in the operating instructions!

WARNING!

Failure to heed warnings may result in serious physical injury and/or material damage. Only appropriately qualified personnel may operate this equipment or work in its vicinity. Personnel must be thoroughly familiar with all warnings and maintenance measures in accordance with these operating instructions. Correct and safe operation of this equipment requires proper transport, storage and assembly as well as careful operator control and maintenance.

Personnel qualification requirements

Qualified personnel as referred to in the operating instructions or warning notes are defined as persons who are familiar with the installation, startup and operation of this product and who possess the relevant qualifications for their work, e.g. B.:

- ➢ Training in or authorization for connecting up, grounding or labeling circuits and devices or systems in accordance with current standards in safety technology;
- ➢ Training in or authorization for the maintenance and use of suitable safety equipment in accordance with current standards in safety technology;
- ➢ First Aid qualification.

1 The Product

1 x PROFIBUS ILM

1 x sealing plugs for unused threaded cable inlet
1 x order form

Not included with the product are:

- Mounting brackets
- Cables for attaching to PROFIBUS or power supply cables
- Description and Operating Instructions

2 Symbols

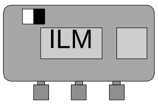
LAN cable (twisted pair)

Bus connector
terminating resistor deactivated

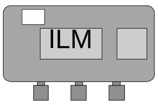
Bus connector
terminating resistor activated

Active or (or passive) bus node

Passive bus node



Infrared link module (ILM)
terminating resistor activated



Infrared link module (ILM)
terminating resistor deactivated

☞ Important information and notes

✓ “Sequence of actions” to be performed by the user.

3 Introduction

The SIMATIC NET PROFIBUS ILM (Infrared Link Module) is intended for use in PROFIBUS networks. It allows the conversion of electrical PROFIBUS interfaces (RS 485 level) into transmittable light signals in the infrared, invisible wavelength range and vice-versa.

With the PROFIBUS ILM, it is possible to link an existing PROFIBUS network with a second PROFIBUS network without a physical cable connection between the two subnets (electrical cables or fiber-optic cable).

The PROFIBUS ILM is therefore particularly suitable for cableless links with the following:

- Turntables
- Automatic transport systems
- Modifiable test equipment

The transmission is optical and therefore depends on line-of-sight contact between two PROFIBUS ILMs. Apart from point-to-point links, point-to-multipoint links are also possible.

At least two PROFIBUS ILMs are necessary for a transmission link.

4 Description of the Device

Each PROFIBUS ILM has an optical and an electrical channel each with a transmitter and receiver section.

The sending PROFIBUS node generates an electrical signal with RS 485 level that is transferred via the PROFIBUS cable to the PROFIBUS ILM of the sending PROFIBUS node. The PROFIBUS ILM converts this electrical signal to a coded light signal. This coded light signal is detected by the optical receiver of the PROFIBUS ILM of the receiving PROFIBUS node. After filtering and decoding, an electrical signal is available on the receiving PROFIBUS ILM that is then transferred via the PROFIBUS cable to the receiving PROFIBUS node.

The data transmission is half duplex as normal in PROFIBUS, in other words at any point in time only one node can send while all others receive. Each node can, however, send and receive.

A wireless link between PROFIBUS ILM and data light barriers of other manufacturers is not possible due to the differences in the optical transmission techniques.

The electrical channel of the PROFIBUS ILM uses the RS 485 transmission technique which is typical for PROFIBUS and processes the standard data rates of 9600 bps to 1.5 Mbps. The data rate must be set by the user.

The electrical channel is connected via SIMATIC NET PROFIBUS cables (for ordering data, see Catalog IK10). The cables enter the casing via heavy-duty threaded cable inlets. The shield makes contact here and the wires are connected using screw-type terminals.

The PROFIBUS ILM can be used at any position in an electrical PROFIBUS network. When it is connected at the end of a segment, the user must activate a terminating resistor.

The operating voltage is an intrinsically safe 24 V direct voltage and is connected just as the PROFIBUS cables by feeding the cable through a heavy-duty threaded cable inlet to a terminal block.

LEDs signal the correct operating status and any problems in operation.

Problems occurring during operation can also trigger a signaling contact allowing centralized monitoring of a system.

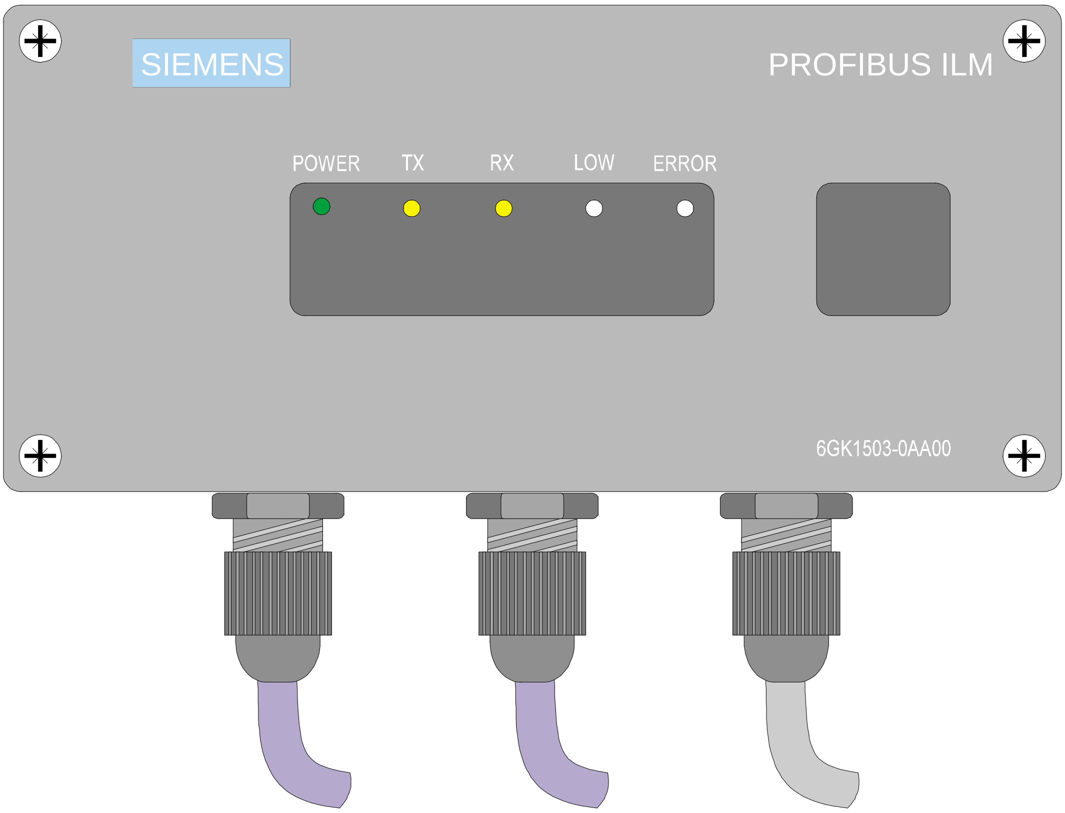


Figure 1: PROFIBUS ILM

The mechanical construction is a compact, stable metal housing (splash-water protected) with degree of protection IP65. The casing must be mounted by the user on a grounded surface with two screws. **When shipped, the data rate is set to 1.5 Mbps, the signaling contact is not activated if errors occur and the terminating resistor is not activated.**

5 Description of the Functions

5.1 Transmission Rate

The SIMATIC NET PROFIBUS ILM supports the following transmission rates:

9.6 Kbps
19.2 Kbps
45.45 Kbps
93.75 Kbps
187.5 Kbps
500 Kbps
1.5 Mbps (default)

The transmission rates of the connected network nodes can have the tolerance of +/–0.3% as specified in the PROFIBUS standard.

5.2 Topologies

The PROFIBUS ILM can be used in two topologies:

➢ The point-to-point link between two PROFIBUS ILMs where **one or more master or slave nodes can be attached to one subnet** and **one or more slave nodes can be attached to the other.**

➢ The point-to-multipoint link between a PROFIBUS ILM to which **a subnet with one or more masters or slaves** is connected and n PROFIBUS ILMs **with n subnets or DTEs without master functionality**. In a point-to-multipoint link, the optical contact between the master network and the subnets is necessary. For a PROFIBUS ILM with purely slave subnets, an unobstructed view between them is not necessary.

Possible topologies are illustrated below based on sample configurations.

5.2.1 Point–to–Point–Link

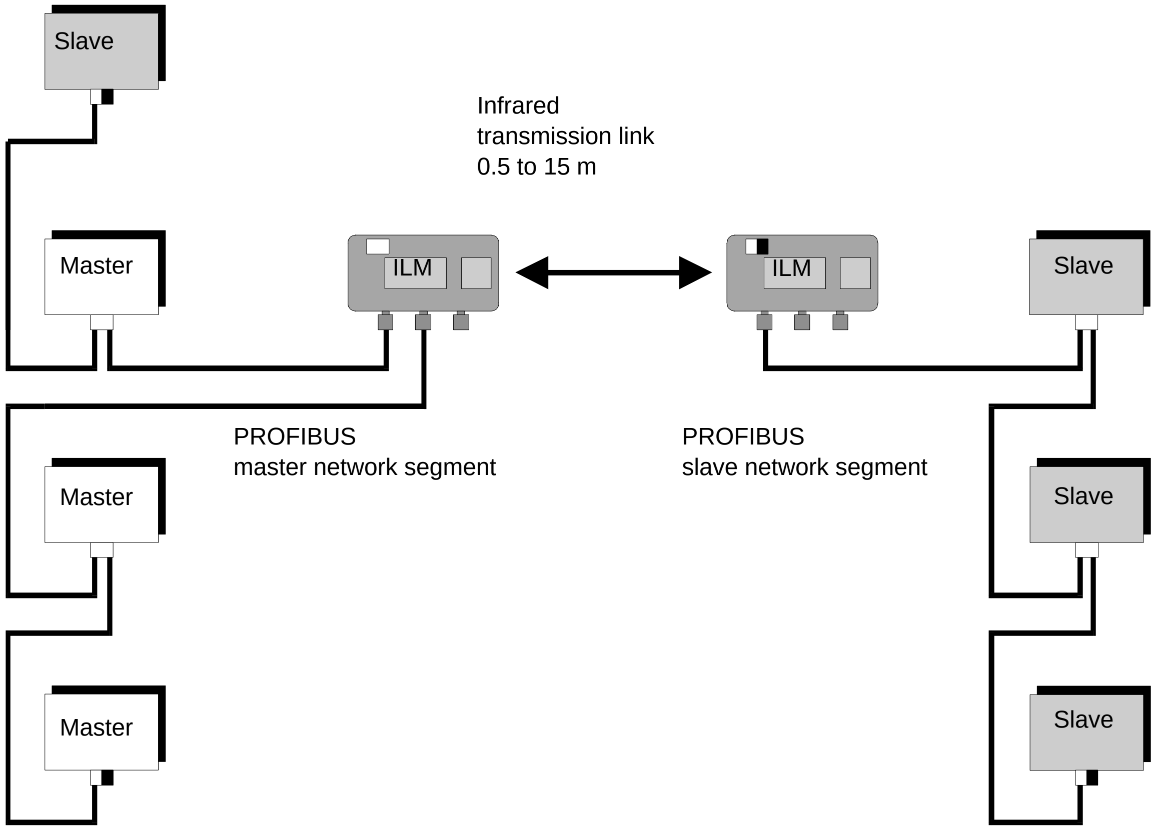


Figure 2: Point-to-Point Link with Two PROFIBUS ILMs

Figure 2 describes the typical layout of a PROFIBUS network with master and slave nodes and an infrared transmission link with two PROFIBUS ILMs. The infrared transmission link is implemented as a point-to-point link by the two PROFIBUS ILMs. In this situation, the two PROFIBUS ILMs replace a cable connection between the two network segments. Remember that only slave nodes are permitted in the slave network segments.

☞ **Make sure that the terminating resistors are activated at the segment ends (either in the bus connector or in a PROFIBUS ILM).**

Cascading is a further application for a point-to-point link.

Note

This “cascading with PROFIBUS ILM” mode is possible, but does involve a risk when operating PROFIBUS. The transmission using an infrared link is generally more susceptible to problems than transmission via cable (optical or electric).

☞ **Make sure that the infrared link cannot be disturbed, for example by “interrupting” the link with obstacles, extraneous light etc.**

When cascading with PROFIBUS ILM, only one segment with master nodes is permitted, the cascaded segments must only contain slave nodes.

☞ **Make sure that the two infrared transmission links do not interfere with each other, in other words either the spatial arrangement of the modules (clearance) or a physical barrier (wall) must ensure that each PROFIBUS ILM can only detect the transmission of its partner module and cannot detect emissions from either of the modules of the other infrared link.**

Note

When cascading, the delay times of the PROFIBUS ILMs must be taken into account. The delay times are shown in Table 3 and must be included in the calculations during configuration.

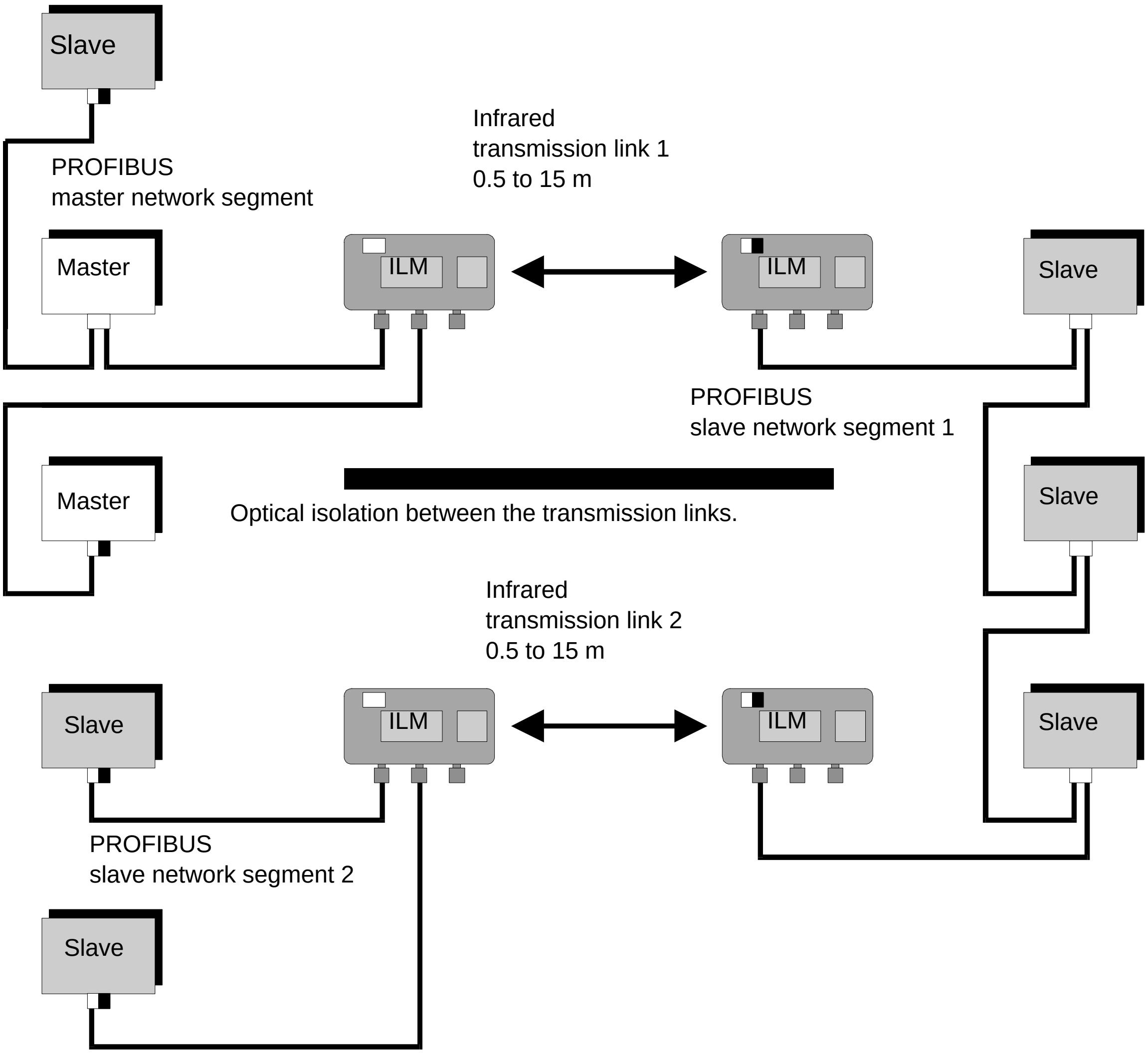


Figure 3: Cascading Two PROFIBUS ILM Transmission Links

A further application of a point-to-point link is described below. Figure 4 shows how several slave network segments can be connected to one master network segment using their own infrared transmission links.

☞ **Once again, make sure that the infrared transmission links do not interfere with each other, in other words either the spatial arrangement of the modules (clearance) or a physical barrier (wall) must ensure that each PROFIBUS ILM can only detect the emission of its partner module and cannot detect emissions from the modules of the other infrared links.**

If this is not guaranteed, this can lead to problems in the master network segment. The response of a slave node is detected at slightly different times in the master segment due to the unsynchronized operation of the PROFIBUS ILM causing pulses to be lost on the master network segment.

The advantage of this arrangement is that if there is a problem on an infrared link between two PROFIBUS ILMs, only the connected slave segment is disconnected. The master network segment and the other slave network segments retain their functionality. This topology is also suitable when the PROFIBUS ILMs of the slave network segments cannot be arranged so that they are all located in the light cone of the PROFIBUS ILM on the master network segment.

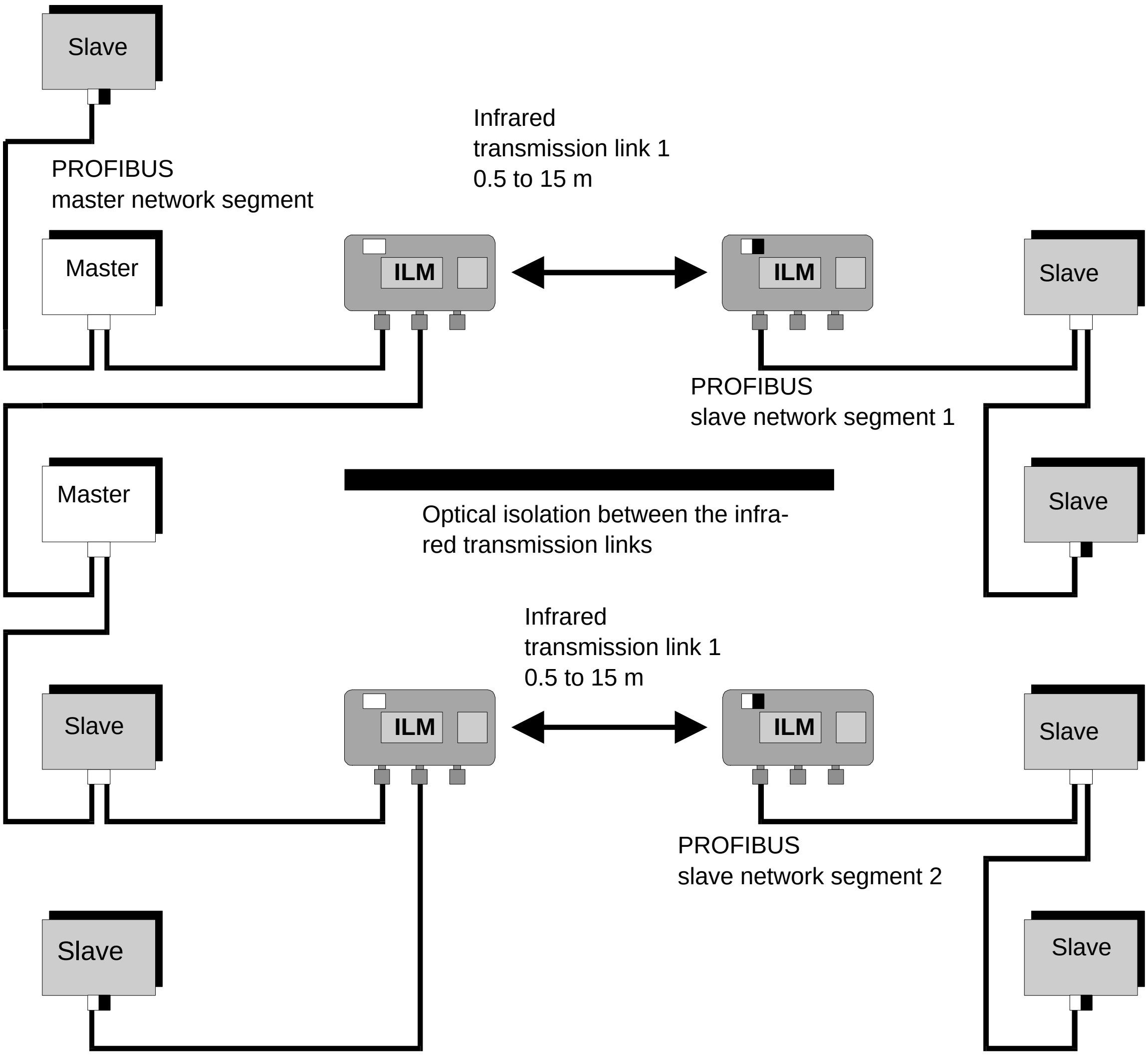


Figure 4: Link Between Several Slave Network Segments and One Master Network Segment

5.2.2 Point–to–Multipoint Link

Instead of the multiple use of point-to-point links, the point-to-multipoint link can also be used. Optical isolation between the infrared transmission links is not necessary. If the configuration is correct, only one slave node responds to the request of a master node and because there is only one PROFIBUS ILM on the master network segment, there are no synchronization problems with the response.

The advantage of this arrangement is that with n slave segments only n + 1 PROFIBUS ILMs are required.

The disadvantages of this arrangement are not only the restrictions in the arrangement of the slave PROFIBUS ILMs to a solid angle of +/–10 degrees but also from the point of view of the master PROFIBUS ILM the poorer monitoring of the link because the acknowledgment pulse mechanism cannot be used (see Section 5.6.2).

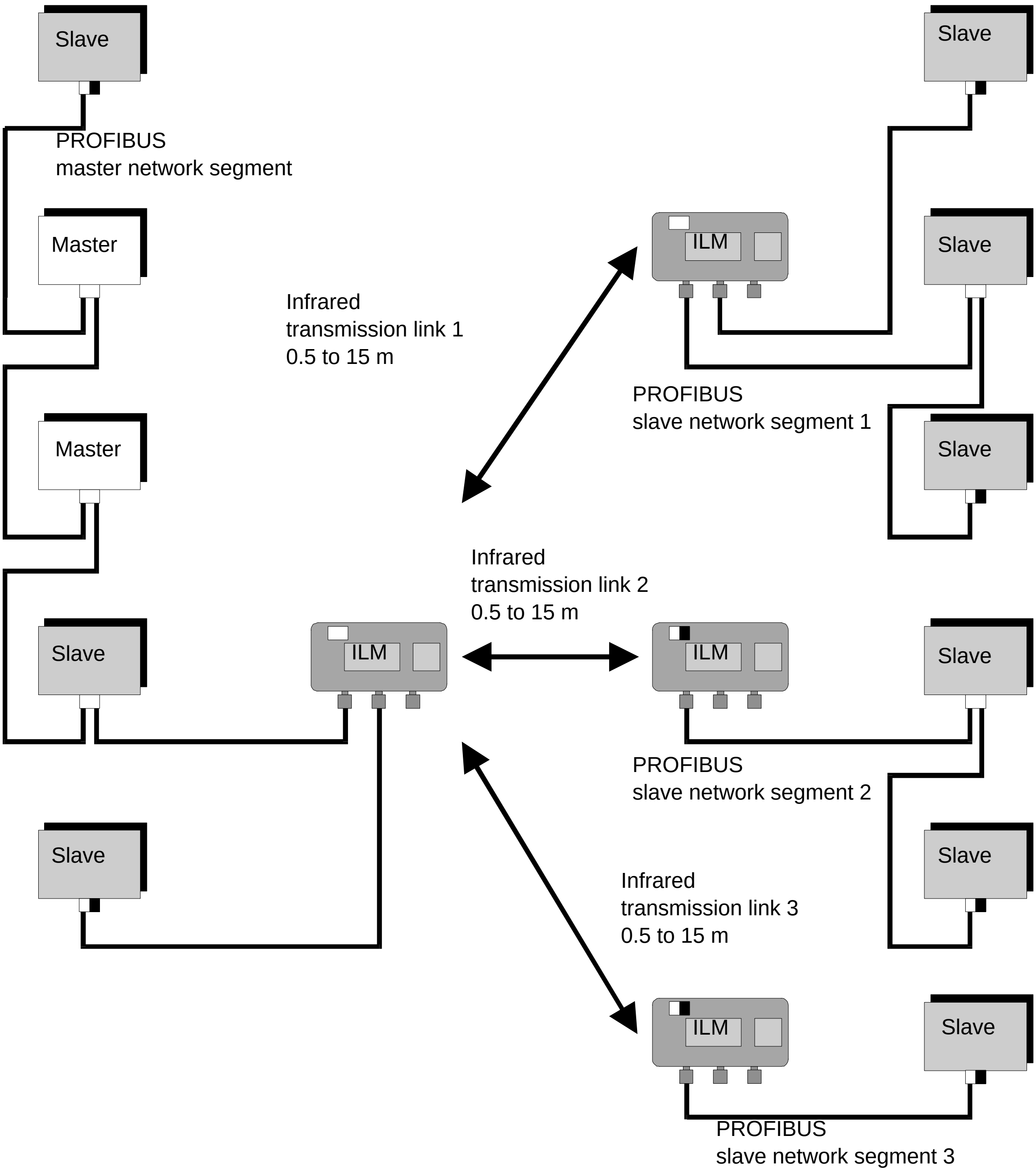


Figure 5: Point-to-Mulitpoint Link with n + 1 PROFIBUS ILMs (One Master Subnet, 3 Subnets with Slaves)

5.3 Signal Regeneration

The PROFIBUS ILM regenerates the signal shape and amplitude of the received signals. This makes it possible to cascade unconnected network segments using infrared transmission links. Since the PROFIBUS ILM, however, has a delay time for processing and passing on the signal the delay on the PROFIBUS ILM must be taken into account. If fast response times are required in a DP system, cascading must be restricted depending on the remaining network length and other active components in the network (repeaters, OLMs).

5.4 Monitoring the Received Optical Level

The PROFIBUS ILM monitors the received level when receiving data via the infrared link. The receive level is compared with a fixed reference value. If the level falls below this reference value during reception, the red **”LOW”** LED is always lit. With suitable configuration, the user can also trigger the signaling contact in this situation.

The reference value corresponds to 1.4 x the minimum receive level. This situation (1.4 x the minimum receive level) applies when the distance between the sending and receiving PROFIBUS ILM is 80 to 85% of the maximum distance in this direction.

In the optical axis (receiver and sender are directly opposite and turned through exactly 180 degrees to each other) the maximum distance is 15 m, in other words at approximately 12 m to 13 m between the sending and receiving PROFIBUS ILMs, the received optical level is still 1.4 times the minimum receive level. A reserve of 2 to 3 m remains along the optical axis. This reserve is however drastically reduced if the position of one of the PROFIBUS ILMs is changed in such a way that it is moved out of the optical axis (if the PROFIBUS ILM is moved sideways or turned). When close together, a displacement of only a few centimeters vertically away from the optical axis can lead not only to the level monitoring responding but also to errors on the bus.

5.5 Constant Light Monitoring

To transmit data, the PROFIBUS ILM uses infrared light as emitted by other energy sources. If the received light exceeds a certain intensity, the working range of the receiving diode is exceeded and errors in the data can occur. The infrared wavelength used cannot be seen by the human eye.

The PROFIBUS ILM therefore indicates when other light sources subject it to an illegally high infrared radiation by lighting up the red **”ERROR”** LED. The user can also configure a switch to activate the signaling contact in this situation.

5.6 Monitoring the Optical Link

The PROFIBUS ILM has two mechanisms with which it monitors problems on the optical link.

– monitoring of the optical receive activity

– monitoring of the optical link with an acknowledgment pulse

5.6.1 Monitoring the Optical Receive Activity

With the yellow “RX” LED, the PROFIBUS ILM indicates the reception of data via the optical channel of the PROFIBUS ILM. The pulse for the LED is extended to approximately 300 ms so that it is possible to recognize data reception even when small amounts of data are received.

Apart from the optical display using the “RX” LED, the PROFIBUS ILM also has integrated monitoring logic that triggers the signaling contact when problems occur receiving data on the optical channel provided the user configures this function with a switch. Problems in reception on the optical channel occur when there has been no change in the status of the optical receive channel for a period of approximately 300 ms, in other words when no message was received within 300 ms or a received message takes longer than 300 ms.

Note

The “activate signaling contact if problems occur in reception” configuration should not be set on the PROFIBUS ILM in the master subnet if its partner ILM only has one slave node that is not addressed during this time.

5.6.2 Monitoring the Optical Link with an Acknowledgment Pulse

During configuration, the user can activate a mechanism so that an acknowledgment pulse is expected from the receiving station after data have been sent. This acknowledgment must be received within the time set as the interval between sending and transmitting on PROFIBUS (11 bit times). This acknowledgment pulse is not passed on to the electrical channels of the sending or receiving PROFIBUS ILM but is restricted exclusively to the optical transmission link.

Note

The “monitor link with acknowledgment pulse” configuration must be activated on both PROFIBUS ILMs of a point-to-point link.

This monitoring logic must not be used on a point-to-multipoint link. Otherwise problems can occur in the PROFIBUS network.

The display of the acknowledgment pulse function is one of the functions of the “TX” LED. With the yellow “TX” LED, the PROFIBUS ILM indicates that data are being sent on the optical channel of the PROFIBUS ILM. The pulse for the LED is extended to approximately 300 ms so that send activity can also be recognized with short data fields.

➢ If an acknowledgment is received for a sent frame and the “monitor link with acknowledgment pulse” configuration is set, the “TX” LED is lit yellow.

➢ If no acknowledgment is received and the “monitor link with acknowledgment pulse” configuration is set, the “TX” LED changes color from yellow to orange. The pulse for this display is also extended to 300 ms so that a lost acknowledgment can also be recognized by the user.

The user can also configure a switch to activate a signaling contact. The signaling contact remains inactive unless the “monitor link with acknowledgment pulse” configuration was set.

6 Modes and Settings

To operate the PROFIBUS ILM, **the terminating resistor**, **the data rate and the monitoring options must be set manually**.

Note:

When shipped, the configuration is as follows:

- ➢ The terminating resistor is inactive
- ➢ The data rate is set to 1.5 Mbps
- ➢ The “monitor link with acknowledgment pulse” monitoring mechanism is inactive.
- ➢ The activation of the signaling contact is disabled.

The settings can be made after removing the cover from the basic module using switches S201 (transmission rate and monitoring mechanisms) and S202 (terminating resistor).

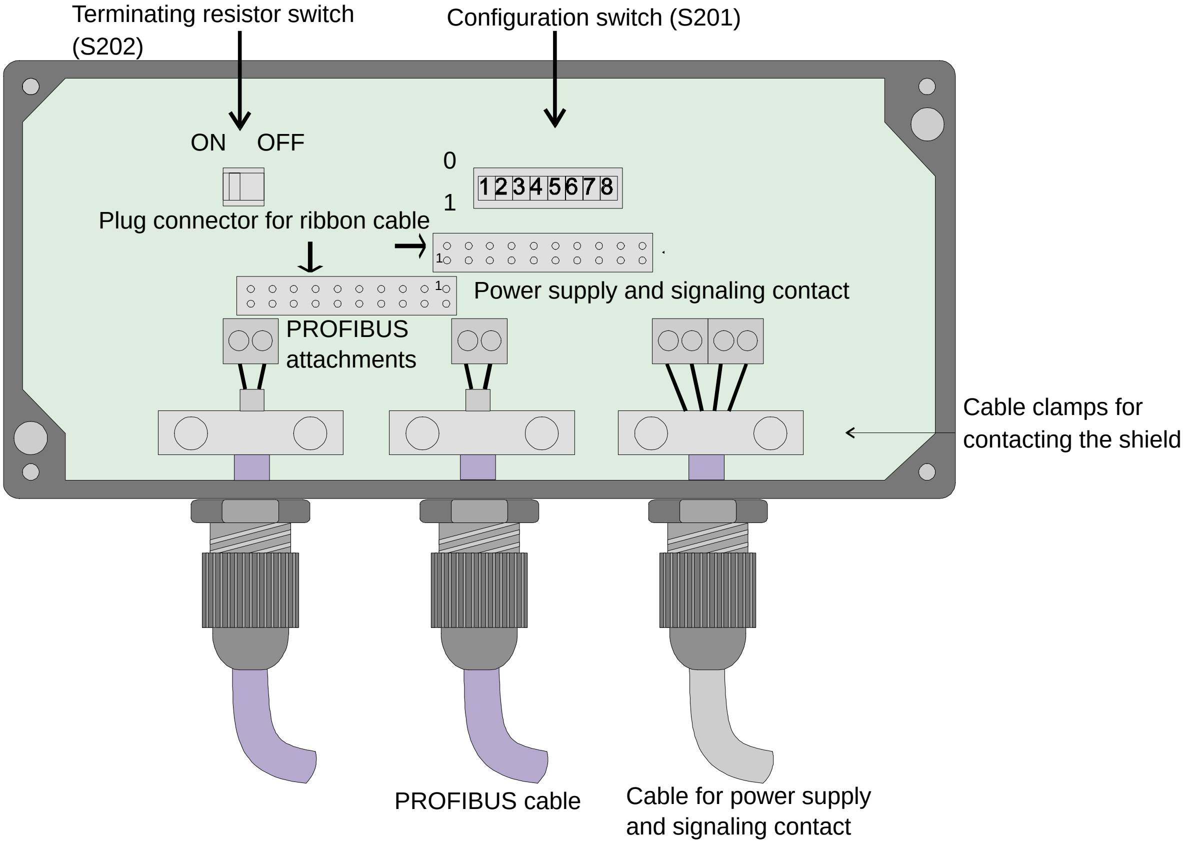


Figure 6: Elements for Setting the Configuration of the PROFIBUS ILM

6.1 Setting the Terminating Resistor

Electrical cables in a PROFIBUS network must be terminated with the characteristic impedance of the cable at the start and end of the bus. Switch S202 is used for this purpose on the basic module of the PROFIBUS ILM.

Note

Note that the switch must be set to “terminating resistor activated” if a PROFIBUS ILM is located at the start or end of an electrical PROFIBUS network (only one PROFIBUS cable connected).

The switch must be set to “terminating resistor deactivated” if a PROFIBUS ILM is looped into a PROFIBUS network (two PROFIBUS cables connected).

If the terminating resistor is not set correctly, sporadic errors will occur on PROFIBUS that cannot be detected by the PROFIBUS ILM.

Terminating resistor off

Terminating resistor on

Figure 7: Setting the Terminating Resistor

6.2 Setting the Transmission Rate

To operate the PROFIBUS ILM, the **transmission rate must be set manually**. The transmission rates normal in PROFIBUS (9,6 Kbps to 1.5 Mbps) are possible and in addition also the transmission rate of 45.45 Kbps. The transmission rate of the attached bus nodes must be within the tolerance of +/– 0.3%. The user must set the same transmission rate on all PROFIBUS ILMs in a PROFIBUS network.

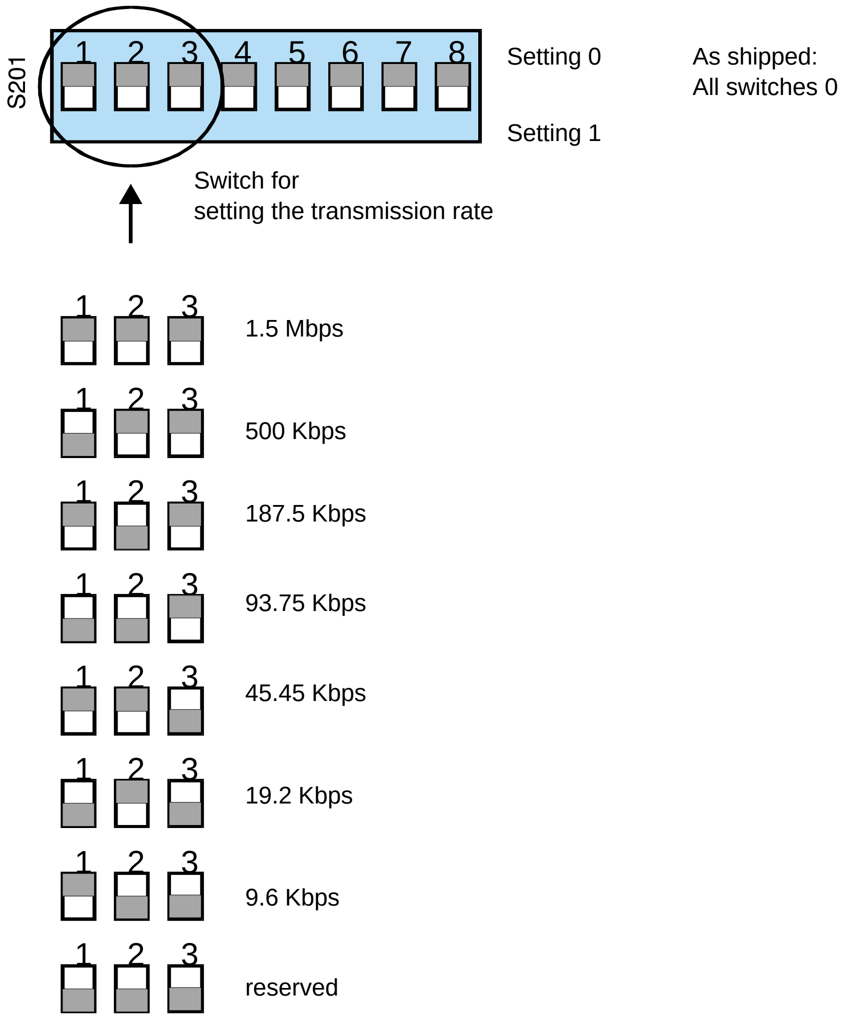


Figure 8: Setting the Transmission Rate

6.3 Operation With Acknowledgment Pulse

For operation of the PROFIBUS ILM with acknowledgment pulses, a manual setting must made during configuration. Operation with acknowledgment pulse is only intended for the use of point-to-point links between two PROFIBUS ILMs.

Note

If a point-to-multipoint topology is being used, this mechanism must be deactivated otherwise problems can occur on the bus.

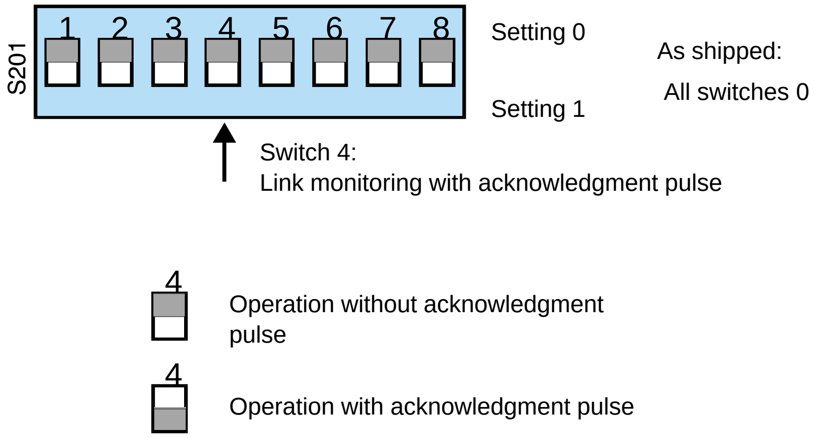


Figure 9: Operation with Acknowledgment Pulse and the Corresponding Switch Setting

6.4 Operation with Signaling Contact

The signaling contact is used to monitor the PROFIBUS ILM via a digital input on a PLC or as part of a current loop. **If problems occur the contact opens**, in other words a connected current loop is then interrupted. By setting four switches, the user decides which events trigger the signaling contact. If more than one problem is configured to trigger the signaling contact, the problem cannot be localized using the signaling contact alone. In this case, the LED displays can also provide information and step-by-step disabling of the switches that activate the signaling contact can narrow down the problem.

Note

Remember that if you want to activate the signaling contact when the acknowledgment pulse is absent, the “monitor link with acknowledgment pulse” configuration must be activated.

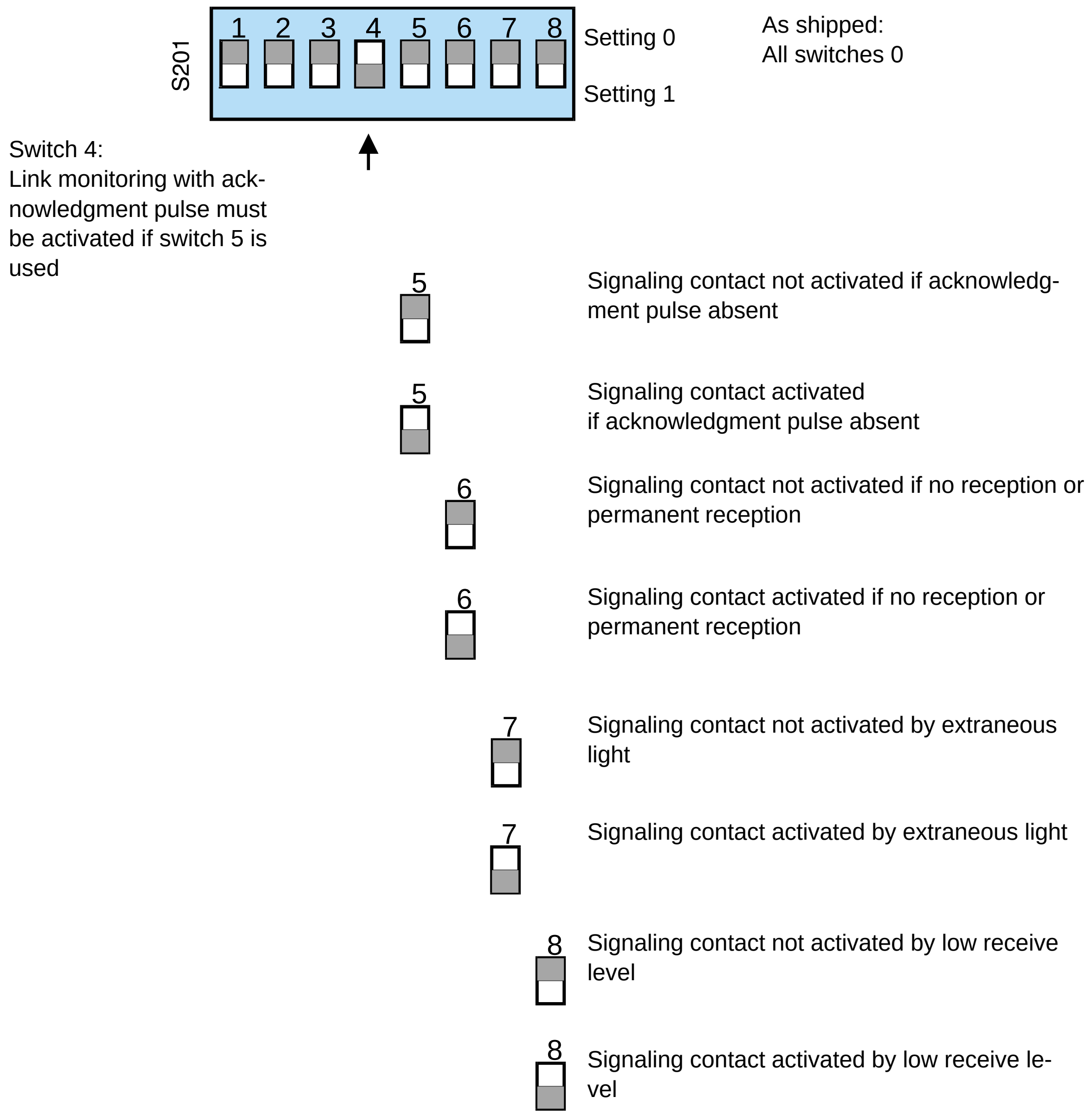


Figure 10: Configuration for Triggering the Signaling Contact

7 Installation and Startup

7.1 Notes on Safety

- Use the PROFIBUS ILM only as described in this “description and operating instructions”.
- Never connect the PROFIBUS ILM to the mains power supply 110 V – 240 V.
- In particular, take note of all the warnings and notes relating to safety.
- The operating voltage must be a safety extra-low voltage complying with IEC 950/EN 60 950/VDE 0805 of maximum +30V (typically +24 V). According the CUL approval you should connect the PROFIBUS ILM only at the load side of a Class 2 or Class 3 Power source as defined by the National Electric Code (NEC), Article 725–2 and the Canadian Electrical Code (CEC).
- The voltage connected to the signalling contact must be a safe extra-low voltage complying with IEC 950/EN 60 950/ VDE 0805 According the CUL approval you should connect the signalling contact only at the load side of a Class 2 or Class 3 power source as defined by the National Electric Code (NEC), Article 725–2 and the Canadian Electrical Code (CEC).
- Wiring the PROFIBUS ILM, pay attention to the wiring methods described in NEC article 725–52, 725–54, 725–61 and 725–71.
- Select a site to install the module so that the climatic limit values listed in the technical specifications are not exceeded.
- The device emits infrared light in the non-visible range. According to the currently valid regulations, the PROFIBUS ILM is included in the class of devices subject to the regulations covering laser protection IEC 60 825–1 although the device does not include laser equipment. The emitted infrared power is below the limit values of laser protection class 1.

7.2 General Notes on Installation and Startup

First, select the network topology suitable for your system.

You can then install and start up the PROFIBUS ILM step-by-step as shown below:

✓ Check the area for suitable sites where you can install the modules.

✓ Make mounting brackets suitable for the sites you have chosen. Chapter 8 describes an example of a general-purpose support consisting of two identical mounting brackets that are easy to make.

✓ Remove the four cover screws and disconnect the 20-pin ribbon cable from the basic module and then remove the top panel of the PROFIBUS ILM.

☞ **Caution:**
Disconnect the cable by pulling out the connector, do not pull the cable itself !
Do not touch the electronics module in the top panel !
Do not loosen the screws securing the electronics module !

✓ Mount the PROFIBUS ILM on the support or device using two screws.

✓ Ground the PROFIBUS ILM with low resistance.

✓ Connect the PROFIBUS cable(s) and the power supply and signaling contact cable. In awkward locations, it is sometimes better to connect the cables before actually mounting the modules.

✓ Depending on your bus topology, activate or deactivate the terminating resistor (active when the ILM is at the end of the cable, deactivated if the ILM is looped into the cable),

✓ Set the transmission rate configured in the PROFIBUS network to the same setting on all PROFIBUS ILMs of a PROFIBUS network using the switches.

✓ Set the “monitor link with acknowledgment pulse” mode for a point-to-point link, if required.

✓ Set the errors to trigger the signaling contact using the switch if you want to use the signaling contact for monitoring.

✓ Plug in the ribbon cable of the electronics section into one of the coded plug connectors on the basic module. The plug connectors are coded to prevent reverse polarity.

✓ Replace the top cover of the PROFIBUS ILM using the four cover screws.

✓ Align the PROFIBUS ILM to the partner station so that the emission of the PROFIBUS ILM is along the optical axis to the partner ILM.

✓ Test the arrangement with power applied but without data exchange.

Only the green POWER LED must be lit.

✓ Test the transmission link with data exchange.

The yellow TX and RX LEDs should be lit as well as the green power LED.

The red “ERROR” LED must not be lit since this indicates too much extraneous light which always causes transmission errors.

The red “LOW” LED should only be lit when the level on the infrared link is close to the minimum receive level (operation at the edge of the illumination cone).

✓ Check the data exchange for incorrect data using SCOPE for PROFIBUS (TMG i-tec), a tool for diagnostics on PROFIBUS networks.

8 Installing the PROFIBUS ILM

The PROFIBUS ILM can be mounted with two screws on a flat surface (approximately 180 x 80 mm). This can be a wall, a mounting plate or the surface of a device or vehicle.

The holes in the PROFIBUS ILM are intended for screws with a thread diameter of maximum 4.5 mm and a screw head diameter of maximum 8.5 mm.

Figure 11 shows the location of the holes drilled in the ILM.

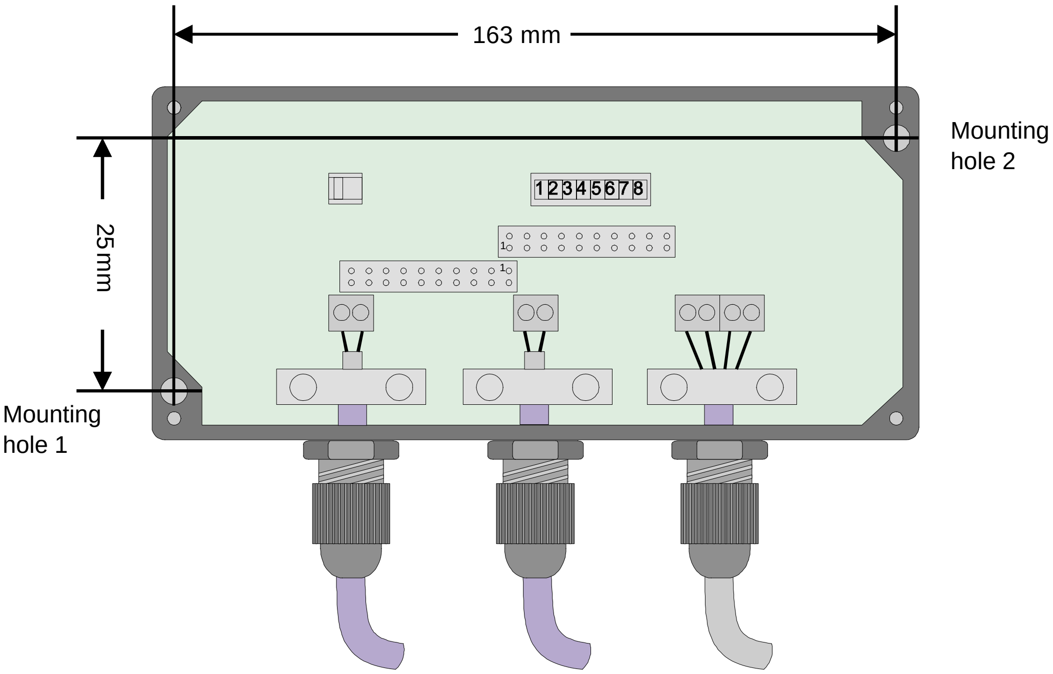


Figure 11: Dimensions for Securing the PROFIBUS ILM to a Mounting Plate

Select the site for installing the module so that the climatic limit values and mechanical stress values as described in the technical specifications are adhered to. When installing the module, make sure, in particular, that no direct sunlight falls on the device otherwise both the temperature range of the device (maximum 60°C) and the light intensity in the infrared range will be exceeded and cause functional problems. It is advisable to protect the device with a “sunshade” making sure that it cannot subjected to direct sunlight even when the sun is extremely low.

Note

Make sure that there is sufficient space to connect the bus and power supply cables. The cables must not extend into the area of the send and receive window.

Make sure that there are no infrared sources in the illumination cone in front of a PROFIBUS ILM. There should also be no reflecting surfaces in any part of the illumination cone to avoid reflecting back the modules own emission.

Before mounting the PROFIBUS ILM, connect the power supply and PROFIBUS cables if the site where the module is being installed is awkward to reach.

Mount the PROFIBUS ILM on a low-resistance and low-inductance earthed metal wall, support or mounting plate. Make sure that there is a reliable electrical connection between the ILM casing and the mounting plate. Use toothed washers under the screw heads to break through any paint. Secure the modules with machine screws (for example M 4 x 30).

The most suitable way of mounting the PROFIBUS ILM is to use a support that allows the module to be aligned with the partner station.

A suitable support would be as follows:

- Mechanically stable
- Low-resistance and low-inductance connection to ground or the vehicle chassis
- Adjustable so that optimum alignment along the optical axis to the partner station is possible.
- Simple and cheap to make
- Corrosion-proof depending on the characteristics of the installation site.

One possible design of a support is the mounting angle shown in Figure 12. This can be made easily in any workshop (cutting sheet metal, bending, drilling). Each support requires two identical angles to allow adjustment in two axes.

The angles are bolted together with standard components such as M4 or M6 bolts, washers or toothed washers and M4 and M6 nuts.

3 mm thick sheet aluminum is, for example, suitable or galvanized 2 mm sheet steel. If suitable profile material is available, this makes construction even simpler since it is not necessary to bend the arm.

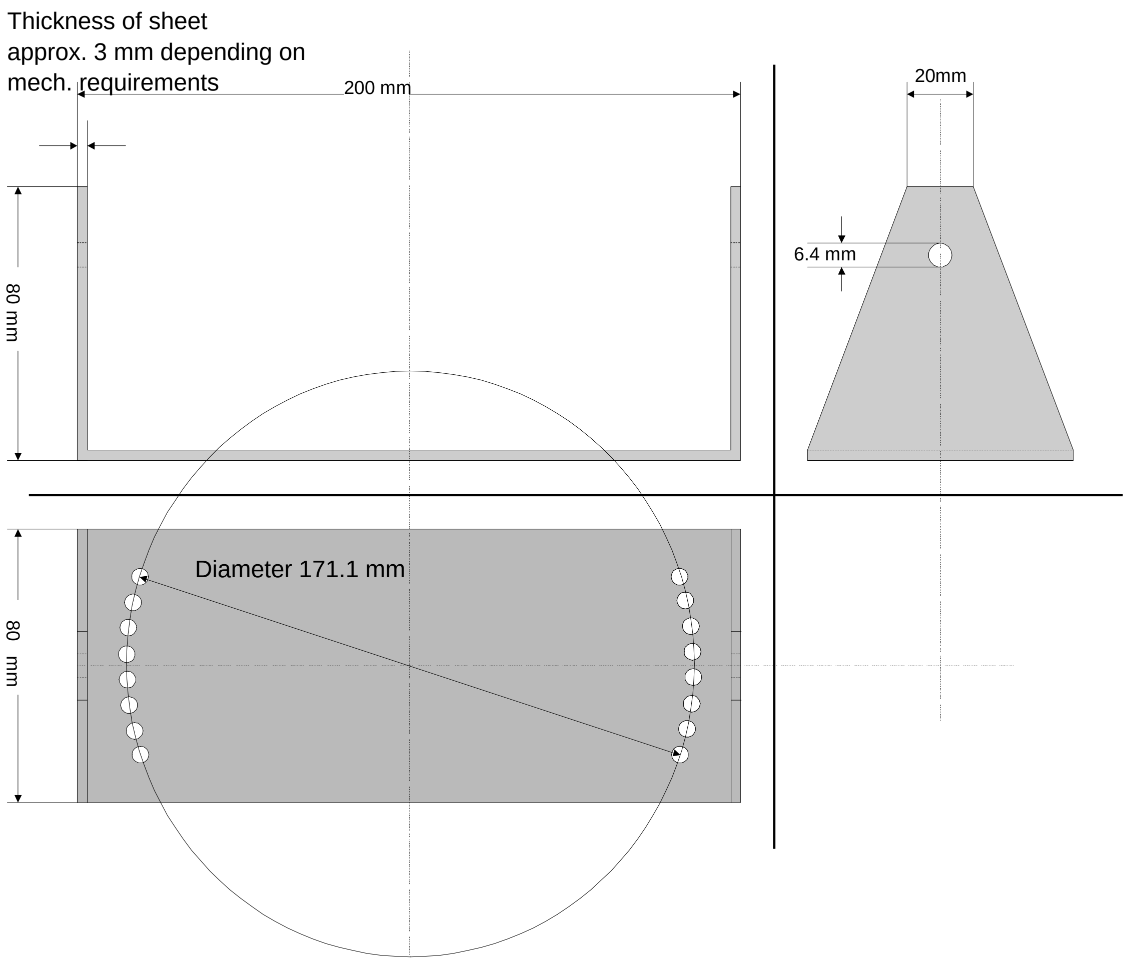
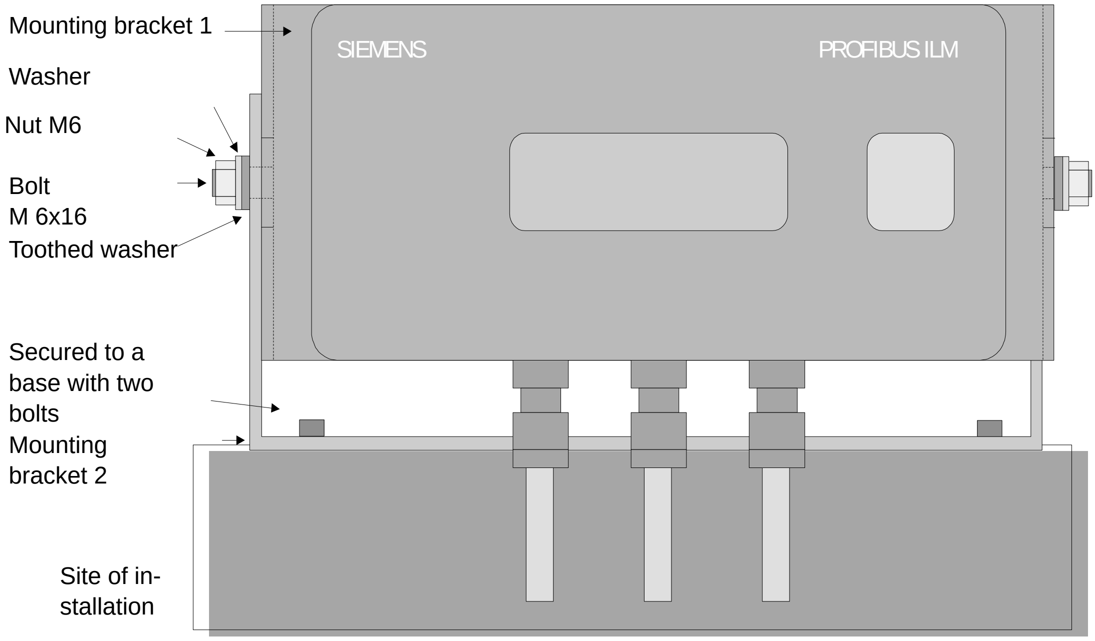


Figure 12: Example of a Simple Mounting Bracket

Instead of drilling individual holes in a circular arc with a diameter of 171.1 mm with 4.5 mm diameter pairs of holes opposite each other, you can also cut two arc-shaped slits in the plate.This requires a cutting device but has the advantage that the ILM can be aligned continuously and therefore more accurately on the vertical axis during operation.

The finished construction of the support with two mounting angles and the securing of the PROFIBUS ILM is described in Figures 13 to 15.



Installation of the ILM with a mounting bracket front view

Figure 13: Front View of the PROFIBUS ILM Installed with Mounting Brackets

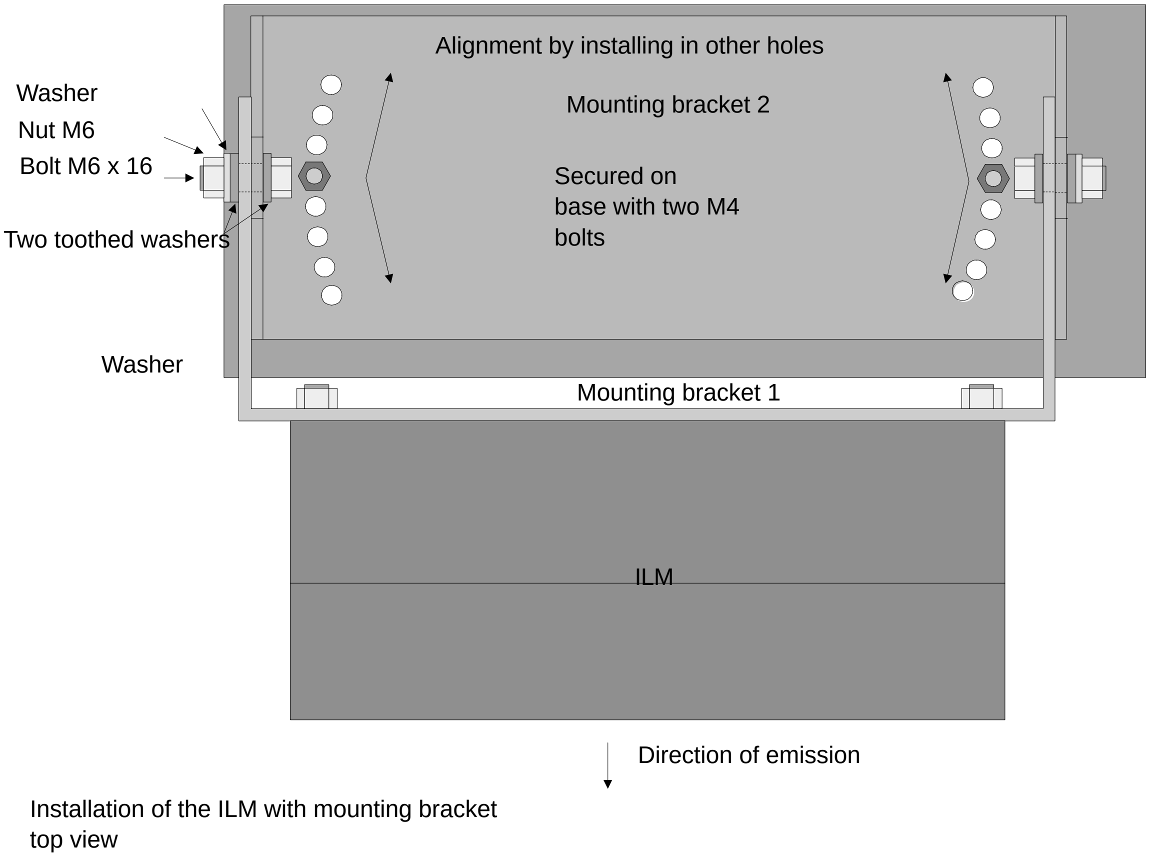


Figure 14: Top View of the PROFIBUS ILM Installed With Mounting Brackets

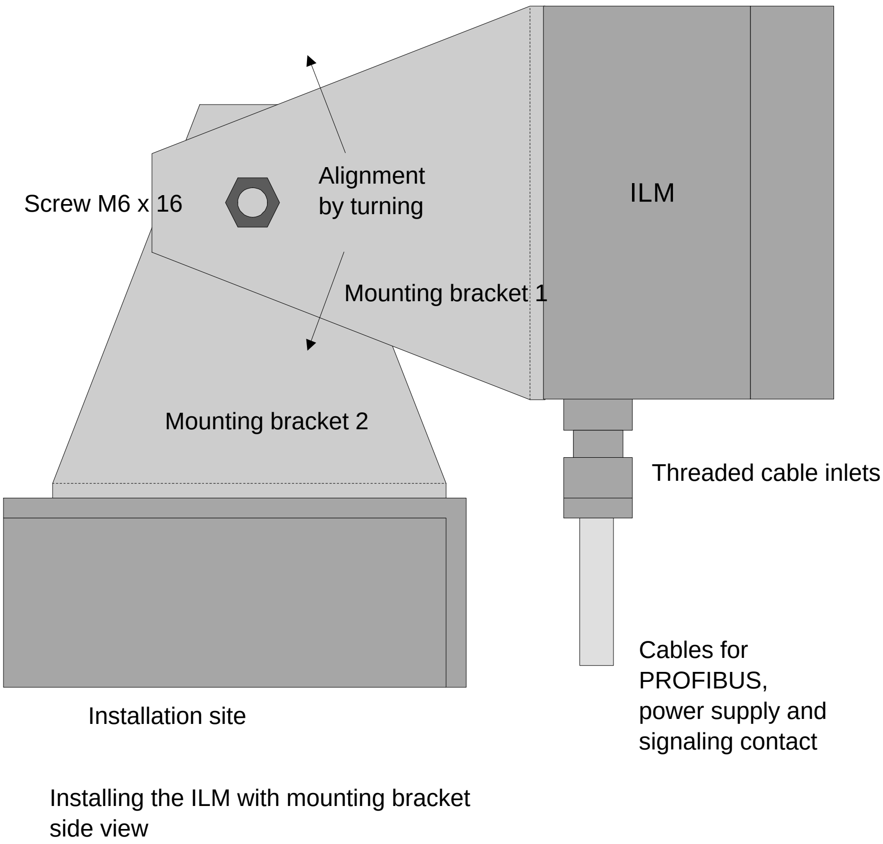


Figure 15: Side View of a PROFIBUS ILM Installed With Mounting Brackets

By installing angle 1 in different holes on the mounting surface, it is possible to turn the PROFIBUS ILM through the vertical axis, however the adjustment is not continuous.

By loosening the M6 securing bolts, the PROFIBUS ILM can be adjusted continuously to align it to the partner station in the horizontal axis. To add greater stability, it is advisable to use toothed washers with the bolts.

It is also advisable to install the module at the edge of the mounting surface so that the cables lead to and from the module unhindered and to make sure that there is no reflection of the sender to its own receiver caused by the installation site itself.

8.1 Connecting the Electrical RS 485 Bus Cables

For the RS 485 bus cable, use only shielded twisted pair cables with an outer diameter of 7.5 to 10 mm. Appendix B lists the electrical parameters of cable types recommended in compliance with the standard.

Make sure that you connect the same cores (green or red) uniformly to all bus terminals of a cable section, either terminal A or terminal B.

The following are recommended for field bus networks:

Terminal A: Green core

Terminal B: Red core

Do not connect any RS 485 LAN cables that are laid completely or partly outside buildings without first protecting the network using a suitable surge voltage protector. Otherwise, lightning strikes in the area can destroy the PROFIBUS ILM or other network components.

Connect the RS 485 LAN cable to the terminal block as shown in Figure 16.

The terminals marked A or B are electrically identical.

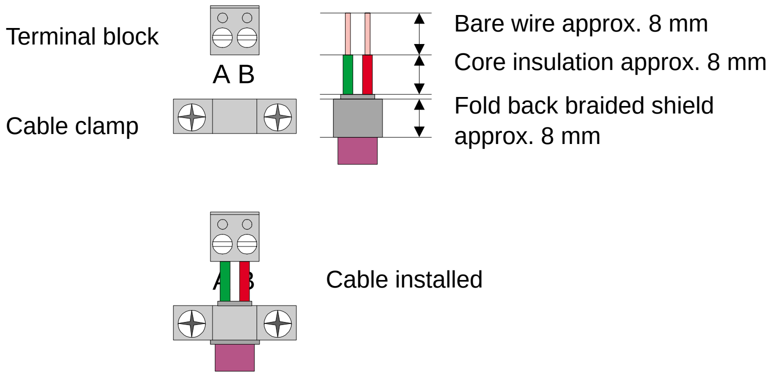


Figure 16: Connecting the PROFIBUS Cables

Fold back the braided shield over the outer jacket of the LAN cable. This provides you with a sufficiently large cable diameter to clamp the cable.

Screw the threaded cable inlet so that if IP65 is required, the cable connection is watertight. If this is required, PROFIBUS cables with a round cross-section and an outer diameter of 7.5 to 10 mm must be connected.

Tighten the threaded cable inlet with a torque of approx. 2.5 to 3 Nm so that the collar of the cable inlet is sealed against the casing of the PROFIBUS ILM. When the cable is connected, the union nut of the cable inlet must be tightened so that the cable can no longer be pulled out. When tightening the nut, make sure that the cable does not turn with it.

If a union nut must be released again, the threaded cable inlet should be tightened again afterwards to make sure that this is still flush against the casing.

If the device is at the start or end of an electrical PROFIBUS segment, you must seal one threaded cable inlet using the accompanying sealing plug.

If the mechanical stress on the PROFIBUS cable is liable to change, make sure that you install additional strain relief. The cable clamp in the device itself is only intended for low-resistance discharge of spurious voltages on the shield. The threaded cable inlet is used only for sealing the cable entry and to prevent the cable being pulled out accidentally. Neither of these, however, is intended as strain relief against continuous tensile stress on the cables.

8.2 Connecting the Power Supply and the Signaling Contact

Use a two-wire round cable if you do not want to use the signaling contact or a four-wire round cable if the signaling contact is required. This is necessary so that the threaded cable inlet seals the cable entry and prevents the cable from being pulled out. Ideally, you should use twisted pair cables since they are less susceptible to noise. The outer diameter of the cables must be between 7.5 and 10 mm.

Do not connect power supply or signaling contact cables that are laid partly or completely outside buildings without first providing a suitable surge voltage protector to protect the PROFIBUS ILM and your low-voltage network. Otherwise, lightning strikes in the area can destroy the PROFIBUS ILM or other network components. If the cable is laid outside buildings and in cable cable conduits along with cables supplying power, you should also use a shielded cable for the power supply and signaling contact to prevent interference from the power cables.

Connect the power supply and signaling contact cable to the terminal block as illustrated in Figure 17.

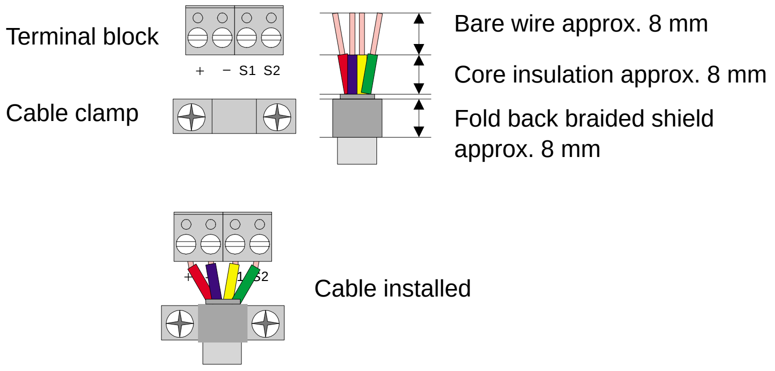


Figure 17: Connecting the Power Supply and Signaling Contact Cable

If you have chosen a shielded cable, make sure that there is a good electrical connection between the braided shield and shield clamp. This is guaranteed if you fold back the braided shield over the outer jacket of the cable. This provides you with a sufficiently large cable diameter to clamp the cable.

Screw the threaded cable inlet so that if IP65 is required, the cable connection is watertight.

If this is required, PROFIBUS cables with a round cross-section and an outer diameter of 7.5 to 10 mm must be connected.

Tighten the threaded cable inlet with a torque of approx. 2.5 to 3 Nm so that the collar of the threaded cable inlet is sealed against the casing of the PROFIBUS ILM. When the cable is connected, the union nut of the cable inlet must be tightened so that the cable can no longer be pulled out. When tightening the nut, make sure that the cable does not turn with it.

If the power supply and signaling contact cable is subject to changing tensile stress, make sure that you provide additional strain relief. The cable clamp in the device itself is only intended for low-resistance discharge of spurious voltages on the shield. The threaded cable inlet is used only for sealing the cable entry and to prevent the cable being pulled out accidentally. Neither of these, however, is intended as strain relief against continuous tensile stress on the cables.

Figure 18 shows the functional wiring of the power supply and signaling contact cable. The pair of cores connected to "+" and "–" supplies the power for the PROFIBUS ILM. This pair must always be wired up.

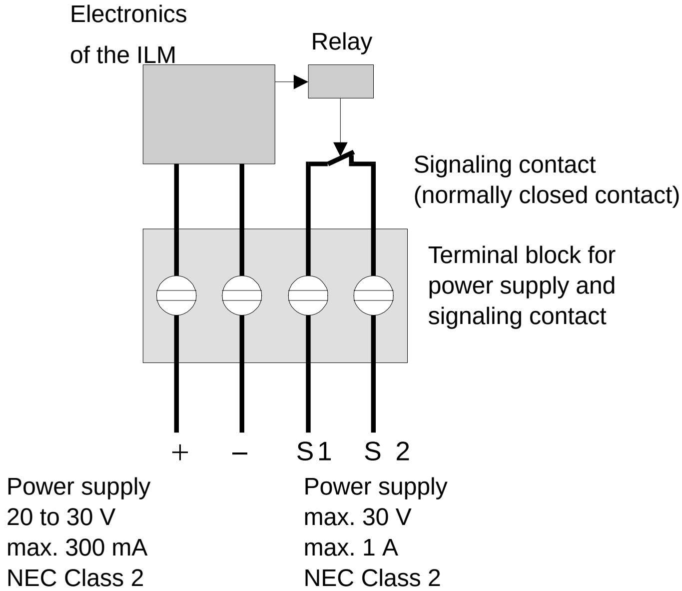


Figure 18: Wiring of the Power Supply and Signaling Contact

The pair of cores connected to "S1" and "S2" is used to wire the signaling contact and is only necessary if you intend to use the signaling contact.

The signaling contact is closed in normal operation and opens if the following problems occur:

- The device has no power supply
- Acknowledgment pulse was not detected (acknowledgment pulse mechanism activated and configured to trigger the signaling contact),
- No changing reception activity on the optical receiver if this was configured to trigger the signaling contact.
- Too much extraneous light at the optical receiver if this was configured to trigger the signaling contact.
- Receive level low at optical receiver if this was configured to trigger the signaling contact.

The signaling contact has no electrical connection to any other components of the PROFIBUS ILM.

Limit values of the relay

- Maximum switching power: 30 W
- Maximum switching voltage: 30V DC;
- Maximum switching current: 1.0 A

The voltage connected to the signaling contact must be a safety extra-low voltage complying with IEC 950/EN 60 950/ VDE 0805. According to the CUL approval you should connect the signalling contact only at the load side of a Class 2 or Class 3 power source as defined by the National Electric Code (NEC), Article 725–2 and the Canadian Electrical Code (CEC).

9 Displays

POWER		
green LED	not lit	No power supply or internal power supply defective or ribbon cable not plugged in.
	lit green	Power supply OK
TX		
yellow/orange LED	not lit	Data not sent optically
	lit yellow	Data are sent, acknowledgment bit correctly received or acknowledgment bit mechanism not activated.
	lit orange	Data being sent, acknowledgment bit activated but not correctly received.
RX		
yellow LED	not lit	Data not optically received
	lit yellow	Data optically received
LOW		
red LED	not lit	Receive level OK (RX LED lit) no receive level (RX LED also not lit)
	lit red	Data optically received, the level is however low (RX LED also lit) risk of data errors
ERROR		
red LED	not lit	Infrared level at receiver is not critical
	lit red	Infrared level at receiver is critical, risk of data errors

10 Help With Problems During Operation

10.1 Status Displays for Incorrect Operation

LED Display		Possible Causes	Signaling Contact
POWER LED	not lit	- Power supply failed or turned off - Module defective - Ribbon band cable not plugged in when assembling the module	Always signals
POWER LED TX LED RX LED	lit green not lit not lit	- Interruption on one or more cores of the RS 485 LAN cable - Reversed connection of core A and B of the RS 485 LAN cable - Connected PROFIBUS master defective (not sending) - PROFIBUS node is not attached or attached PROFIBUS node is not turned on - No partner station detected with attached PROFIBUS master	
POWER LED TX LED RX LED	lit green not lit lit yellow	- Interruption on one or more cores of the RS 485 LAN cable - Reversed connection of core A and B of the RS 485 LAN cable - Attached PROFIBUS slave defective (not sending) - PROFIBUS slave is not attached or attached PROFIBUS slave is not turned on - PROFIBUS slave node not correctly addressed and therefore not responding	
POWER LED TX LED RX LED	lit green lit orange, not lit	- No acknowledgment pulse received, partner station not responding	Signals when configured (acknowledgment pulse)

LED Display		Possible Causes	Signaling Contact
POWER LED TX LED RX LED	lit green lit orange, lit yellow	- No acknowledgment pulse received since partner station not configured with acknowledgment pulse - On point-to-multipoint links on the PROFIBUS ILM of the master subnet if acknowledgment bit configured (see Section 6.4)	Signals when configured (acknowledg-ment pulse)
POWER LED TX LED RX LED LOW LED	lit green lit orange, lit yellow, lit red	- No acknowledgment pulse received since partner station is not configured with acknowledgment pulse or receive level for acknowledgment pulse and response frame too low. - On a point-to-multipoint link on the PROFIBUS ILM on a slave subnet if configured with acknow-ledgment bit (see Section 6.4)	Signals if configured (acknowledg-ment pulse, level monito-ring)
POWER LED TX LED RX LED	lit green lit yellow not lit	- Partner station not responding because not atta-ched, infrared link interrupted, incorrectly configu-red (PROFIBUS address of the slave incorrect, data rate of the partner PROFIBUS ILM set incor-rectly etc.)	Signals when configured (bus activity)
POWER LED TX LED RX LED LOW LED	lit green lit yellow, lit yellow, lit red	- Risk of problems on bus, since infrared link has too much attenuation (obstacles in area of trans-mission link, distance between PROFIBUS ILMs too great, PROFIBUS ILM turned out of line with partner station)	Signals when configured (level monito-ring)
POWER LED TX and RX LEDs ERROR LED	lit green not lit lit red	- Risk of problems on bus due to incidence of ex-traneous light (for example sunlight, lamps with infrared component, halogen lamps with high energy)	Signals when configured (constant light)
POWER LED RX LED ERROR LED	lit green lit yellow lit red	- Bus problems must be expected due to incidence of extraneous light with high-frequency modula-tion (for example energy-saving lamps with HF switching device)	Signals when configured (constant light)

Table 1: Possible problems operating the PROFIBUS ILM

If no display indicates an error and communications problems nevertheless occur, check the parameters set on both PROFIBUS nodes. You should also check the electrical RS 485 wiring. The most common cause of problems is activating or deactivating the terminating resistor incorrectly. You should also check that the cable shields at the ends of all PROFIBUS cables and all shielded power supply cables are making satisfactory contact.

Note

Remember that sporadic data errors on the cable network are not detected by the PROFIBUS ILM. The PROFIBUS ILM cannot check the contents of frames but can only monitor the basic functions and optical transmission quality.

10.2 Errors Due to Incorrect Network Configuration

In large PROFIBUS networks with numerous modules and long cable lengths, the delay caused by network components and cables (transmission delay) must be taken into account when setting the monitoring times. If you do not take these delay times into account, problems will occur during operation. In such situations, the active partner does not receive a response to a request within the slot time of PROFIBUS because this has been configured too short.

In large networks, or networks with looped-in active components, the transmission delay time(TTD) must be calculated to allow correct configuration.

The transmission delay time is the maximum time that can elapse during the transmission of a frame between the sender and receiver on the transmission medium.

Note

If the configuration software you have used to configure your PROFIBUS network does not support the PROFIBUS parameter TTD, increase the two times min. TSDR and max. TSDR in each case by 2 x TTD (the reaction time of the responder is increased by the transmission delay time for the outward and return path).

10.2.1 Calculating the Propagation Time on Electric Cables and Fiber-Optic Cables

The propagation times on electrical cables or fiber-optic cables are physically related to the speed of light and certain material characteristics and are therefore almost constant (approximately 5 µs/km).

First calculate the transmission link with the longest propagation time between the sender and receiver of a frame. PROFIBUS nodes that communicate with each other (for example DP slave with DP slave) do not need to be taken into account.

Indicators for long propagation times are as follows:

- ➢ Long fiber-optic or copper cables
- ➢ High cascading depth of active components (PROFIBUS OLMs, PROFIBUS ILMs, PROFIBUS repeaters)

The delay time is approximately 5 µs per km cable length.

Converted to bit times this results in the following:

Transmission Rate in Kbps	Delay Time in bit times per km
9.6	0.05
19.2	0.10
45.45	0.23
93.75	0.47
187.5	0.94
500.0	2.50
1500.0	7.50

Table 2: Delay Times of Fiber-Optic and RS 485 LAN Cables

To calculate the cable delay time, the maximum cable length in km is multiplied by the delay time corresponding to the transmission rate from the table.

10.2.2 Delay Time of the PROFIBUS ILM

In contrast to the propagation time of electrical cables and fiber-optic cables, the delay time through the logic of the PROFIBUS ILM clocked at the transmission frequency is not a physical time constant but depends on the transmission rate. The number of logic levels in series is relevant with each causing a bit time delay.

The delay time per PROFIBUS ILM is 6 bit times from RS 485 input to infrared output when sending and 3 bit times from infrared input to RS 485 output when receiving. The total delay time of the RS 485 input of the sending PROFIBUS ILM to the RS 485 output of the receiving PROFIBUS ILM is therefore 9 bit times.

If several PROFIBUS ILM links are cascaded, the total delay time is the product of 9 bit times of the individual links and the cascading depth.

10.2.3 Delay Time of Further Active PROFIBUS Network Components

Please refer to the delay time listed in the documentation of the specific product.

10.2.4 Transmission Delay Time TTD

The total delay time of the PROFIBUS network is the sum of all the values calculated in Sections 10.2.1 to 10.2.3.

11 Technical Specifications

Operating voltage Safety extra-low voltage (SELV)	24 V DC (20 V to 30 V)
Current consumption	max. 300 mA
Transmission rate	9.600 Kbps; 19.200 Kbps; 45.45 Kbps, 93.75 Kbps; 187.5 Kbps; 500 Kbps; 1.5 Mbps;
Setting the transmission rate	Using 3 DIP switches
Setting the mode	Using 5 DIP switches
Bit error rate	$<10^{-6}$
Signal delay time RS 485 input → infrared output	<= 6 bit times
Signal delay time infrared input → RS 485 output	<= 3 bit times
Electrical channel	
Input/output signal	RS 485 level
Input voltage dielectric strength	–10 V to +15 V
Interface signals	Ungrounded within the SELV limits
Terminating resistors	Activated with DIP switch
Optical channel	
Optical source	21 LEDs
Optical power	280 mW effective with alternating 0–1 sequence
Receiver sensitivity	0.5 A/W – 28 dBmW
Wavelength	860 nm to 880 nm
Distance between two ILMs	maximum 15 m in the optical axis 12 m at +/–2 m distance from the optical axis
Signaling contacts	Limit values of the relay maximum switching power 30 W Maximum switching voltage 30 V DC Maximum switching current 1.0 A

Table 3: Technical Specifications of the PROFIBUS ILM

Electromagnetic Compatibility (EMC)	
Noise emission	Limit Class B (EN 55022)
Immunity to static discharge	On shield connection and casing ±8 kV contact discharge (IEC 1000–4–2)
Immunity to high frequency noise	10 V/m at 80% amplitude modulation with 1 kHz, 80 MHz – 1 GHz (ENV 50140; IEC 1000–4–3) 10V/m at 50% duty cycle at 900 MHz (ENV 50 204) 10 V/m at 80% amplitude modulation at 1 kHz, 10 kHz – 80 MHz (ENV 50141)
Immunity to disturbances on the cable (burst)	On power supply cables and shielded RS 485 LAN cables: ±2 kV (IEC 1000–4–4)
Immunity to disturbances on the cable (surge)	On power supply cables: ±1 kV balanced On shielded RS 485 cables: ±2 kV unbalanced (IEC 1000–4–5)

Safety	
VDE specifications	VDE 0806=EN60950 and IEC950
UL/CSA approval	Requirements are met
Climatic environmental conditions	
Ambient temperature	0 °C to +60 °C (IEC 68–2–1, IEC 68–2–2)
Storage temperature	–40 °C to +70 °C (IEC 68–2–14)
Relative humidity	< 95% (none condensing) (IEC 68–2–30) If condensation forms on the window, there is a temporary reduction in the distance that can be covered. There is no permanent functional disturbance and no damage to the electronics if the threaded cable inlet fulfills the requirements of IP65.
Mechanical environmental conditions	
Oscillation during operation	10 to 58 Hz, 0.075 mm deflection 58 to 150 Hz, 10 m/s^2 (1g) acceleration (IEC 68–2–6)
Oscillation during transportation	5 to 9 Hz, 3.5 mm deflection 9 to 500 Hz, 10m/s^2 (1g) acceleration
Degree of protection	IP 65
Weight	800 g
Dimensions	175 × 80 × 58 mm
Casing material	Die-cast aluminum

Table 4: Environmental Conditions for the Use of the PROFIBUS ILM

11.1 Illumination Range

To determine the arrangement of two PROFIBUS ILMs on an infrared transmission link, the illumination range of the sending PROFIBUS ILM must be known. The receive cone is broader so that with the half-duplex transmission used with PROFIBUS the restriction results from the narrower cone.

Note

Each PROFIBUS ILM on an infrared link must be arranged and aligned so that it reaches its partner with its transmit cone.

The illumination range of the sender is shown in Figure 19. In the range from 0.5 to 12 m, there is adequate illumination density in a solid angle of +/– 10 degrees with free emission without shadows caused by obstacles. At 12 m distance from the sending PROFIBUS ILM, there is an illuminated circular area with a diameter of approximately 4 m. Although the send window of the PROFIBUS ILM is neither round nor square, from a distance of 2 m the illuminated area is practically round since from this distance the light source can be assumed to be a point.

At a distance greater than 12 m, in the same way as the illumination provided by a spotlight, the illuminated area starts to reduce. At 15 m distance, an illuminated area of 2 m diameter is guaranteed.

Note

These data are only guaranteed when the windows of the PROFIBUS ILM are clean. From time to time, the window should be cleaned using a clean soft cloth as usual with other optical devices or glasses. Under no circumstances should aggressive or abrasive cleaning agents be used.

Condensation on the window or wetting with water or other liquids reduces the illumination range. With condensation, a reduction of approximately half of the maximum range has been measured. If the liquid produces bubbles, the reduction is sometimes even higher since not only the optical attenuation but also the optical refraction of the liquid takes effect.

The “LOW” LED displays critical receive levels.

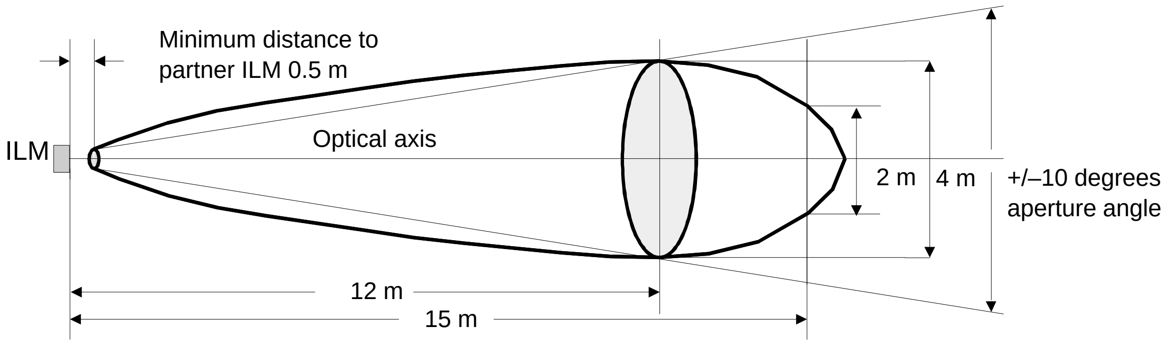


Figure 19: Transmitter Illumination of the PROFIBUS ILM

12 Appendix

Electrical parameters of the RS 485 LAN cables

You can use the following cables to attach an RS 485 bus segment and individual DTEs to the PROFIBUS ILM:

- ➢ Cable Type A complying with PROFIBUS DP; (DIN 19 245 Part 2)
- ➢ Cable Type B complying with DIN 19 245 Part 1; 04.91; Section 3.1.2.3

Remember the restricted distance and transmission rate possible with the Type B cable (according to Table 2).

Cable Parameters	Type A	Type B
Characteristic resistance	135 to 165 ohms (3 to 20 MHz)	100 to 130 ohms (f →100 kHz)
Capacitance per unit length	<30 pF/m	<60 pF/m
Loop resistance	<110 Ohms/km	–
Core diameter	→0.64 mm	→0.53 mm
Core cross-section	→0.34 mm^2	→0.22 mm^2

Table 5: Electrical Parameters of the Shielded Twisted Pair LAN Cables

13 References

- PROFIBUS networks
  SIEMENS AG
- DIN 19245 Part 1 (04.91):
  "Messen, Steuern, Regeln; PROFIBUS Teil 1;
  Process Field Bus; Übertragungstechnik, "
- DIN 19245 Teil 2 (10.91):
  "Messen, Steuern, Regeln; PROFIBUS Teil 3;
  Process Field Bus; Dezentrale Peripherie (DP)"
- EIA Standard RS 485 (April 1983):
  "Standard for electrical characteristics of generators
  and receivers for use in balanced digital multipoint systems"

Product name:

Infrared Link Module (ILM) Order no. 6GK1 503–0AA00

The SIMATIC NET product named above meets the reuirements of the following EU directives:

EMC 89/336/EEC

Directive 89/336/EEC “Electromagnetic Compatibility”.

Area of application

The product is designed for operation in an industrial and domestic environment.

Area of application	Requirements	
	Noise emission	Noise immunity
Industrial	EN 50081–2 : 1993	EN 50082–2 : 1995
Domestic, business and workshop	EN 50081–1 : 1992	EN 50082–1 : 1997

Conformity Certificates

The EU conformity certificates are available for the relevant authorities according to the EU directive and are kept at the following address:

Siemens Aktiengesellschaft
A&D PT2
Industrielle Kommunikation
Postfach 4848
D–90327 Nürnberg

Directive on Machines

The product remains a component in compliance with Article 4(2) of the EU directive on machines 89/392/EEC.
According to the directive on machines, we are obliged to point out that this product is intended solely for installation in a machine. Before the final product is started up, it must be established that it conforms to the directive 89/392EEC.

Installation Guidelines

The product meets the requirements providing you adhere to the guidelines for installation and operation in the documentation SIMATIC NET PROFIBUS Networks.

SIEMENS

Description and Operating Instructions
SIMATIC NET PROFIBUS
Optical Link Modules

OLM/P11
OLM/P12

OLM/G11
OLM/G12
OLM/G12-EEC

OLM/G11-1300
OLM/G12-1300

Safety Instructions

This manual contains instructions which must be observed to ensure your own personal safety and to avoid damage to devices and machinery. The instructions are highlighted with a warning triangle and are shown as follows according to the degree of endangerment:

Danger
means that death, serious injury or considerable damage to property **will** result if the appropriate safety measures are not taken.

Warning
means that death, serious injury or considerable damage to property **can** result if the appropriate safety measures are not taken.

Caution
means that light injury or damage to property can result if the appropriate safety measures are not taken.

Note
is an important piece of information about the product, how to use the product, or the relevant section of the documentation to which particular attention is to be drawn.

Qualified personnel

A device may only be put into operation and operated by qualified personnel.
Qualified personnel in the sense of the safety instructions detailed in this manual are persons who are authorized to operate, ground and label devices, systems and electrical circuits in accordance with the standards of the safety systems employed in the plant.

Certified usage

Please observe the following:

Warning
The device may only be employed for the purposes described in the catalog and technical description, and only in conjunction with external devices and components recommended or approved by Siemens.
The product can only be operated correctly and safely if it is transported, stored, installed and assembled properly and correctly. Furthermore, it must be operated and serviced carefully.

Trademarks

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Other designations in this manual may be registered trademarks, the use of which by third parties for their own purposes may violate the rights of the owner.

Siemens AG
A&D
Industrial Automation Systems SIMATIC NET
Postfach 4848, D-90327 Nürnberg

Disclaimer of liability

We have checked this manual to ensure that the contents comply with the described hardware and software. However, deviations cannot be excluded. We can therefore assume no responsibility for the total compliance of these contents.
The details and information in this manual are regularly controlled, and any corrections and amendments which may prove to be necessary are included in subsequent editions. We welcome any suggestions for improvement.

Siemens Aktiengesellschaft

Printed in the Federal Republic of Germany

Contents

Order Numbers

SIMATIC NET OLM/P11	6GK1 502-2CA00
SIMATIC NET OLM/P12	6GK1 502-3CA00
SIMATIC NET OLM/G11	6GK1 502-2CB00
SIMATIC NET OLM/G12	6GK1 502-3CB00
SIMATIC NET OLM/G12-EEC	6GK1 502-3CD00
SIMATIC NET OLM/G11-1300	6GK1 502-2CC00
SIMATIC NET OLM/G12-1300	6GK1 502-3CC00

1 Introduction

The PROFIBUS OLM (Optical Link Module) product family consists of

- **OLM/P11,**
- **OLM/P12,**

- **OLM/G11,**
- **OLM/G12,**
- **OLM/G12-EEC,**

- **OLM/G11-1300** and
- **OLM/G12-1300.**

PROFIBUS OLMs are designed to be used in optical PROFIBUS field bus networks. They enable electrical PROFIBUS interfaces (RS 485 level) to be converted into optical PROFIBUS interfaces and vice-versa.

By profiting from the familiar advantages of optical transmission technology, the modules can be integrated into existing PROFIBUS field bus networks. A complete PROFIBUS field bus network with modules in line, star or ring topology, and an arbitrary combination of these, can also be built up.

The redundant ring is also supported, thereby increasing the fail-safety of the field bus network.

Each module has two or three mutually independent ports, which in turn consist of a transmitting and a receiving component.

The device is powered by 24V DC voltage. A redundant feed increases operational safety.

The electric port is a 9-pole Sub-D socket (female). An RS 485 bus segment in line with the PROFIBUS standard EN 50170 can be connected to this port.

The optical fibers are connected using BFOC[1] /2.5 connectors.

Four multicolored light-emitting diodes indicate the current operating status and possible operating malfunctions.

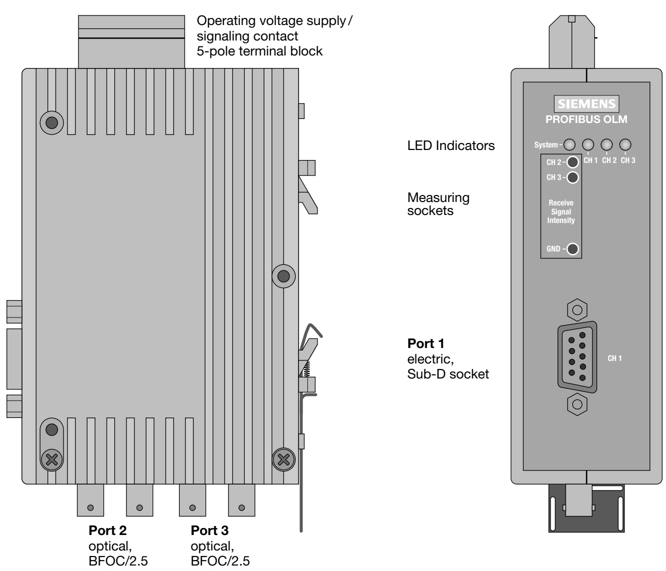


Fig.1: PROFIBUS OLM module showing the location of the LED indicators, measuring sockets and the individual ports.

1) BFOC stands for Bayonett Fiber Optic Connector.
This connector type is functionally compatible with ST ® connectors.
ST is a registered trademark of AT&T.

Table 1 shows the different methods for connecting the modules, and the maximum optical ranges of each port.

OLM/	P11	P 12	G11	G12 G12-EEC	G11-1300	G12–1300
Number of ports						
– electrical	1	1	1	1	1	1
– optical	1	2	1	2	1	2
Fiber types						
– Plastic optical fibers						
980/1000 µm	80 m	80 m	–	–	–	–
– PCF optical fibers						
200/230 µm	400 m	400 m	–	–	–	–
Quartz glass optical fibers						
10/125 µm	–	–	–	–	15 km	15 km
50/125 µm	–	–	3000 m	3000 m	10 km	10 km
62.5/125 µm	–	–	3000 m	3000 m	10 km	10 km

Table 1: Number of electrical and optical ports per module, fiber types which can be used, as well as the maximum possible optical fiber distances between two modules. See Technical Data, p. 31 for more details about ambient conditions. PCF stands for Polymer Cladded Fiber, and is the same as HCS ®. HCS is a registered trademark of Ensign-Bickford Optics Company.

One measuring output is available for each optical port where the optical input level can be measured using a conventional voltmeter.

Different OLM malfunction reports are provided as an accumulative signal via a signaling contact (relay with unconnected contacts) for further processing.

The mechanical design consists of a compact, stable metal housing which can be mounted on a hat rail or mounting plate as required.

The module is configured using easily accessible switches.

The PROFIBUS OLM complies with the standard EN 50170 and the technical guidelines issued by the PROFIBUS user organization, PNO, ”PROFIBUS optical transmission technology“.

OLM/G12 und OLM/G12-EEC have the same function. They only differ in the specification of the climatic ambient conditions: while the OLM/G12 is suitable for employment in the standard temperature range from 0°C to 60°C, the OLM/G12-EEC (extended environmental conditions) can be used in the extended temperature range from –20°C to +60°C and at up to 100% humidity.

2 General Functions

2.1 Non operating mode related functions

Transmission rate

The PROFIBUS OLMs support all the transmission speeds (transmission rates) defined in the EN 50170 standard:

9.6 kBit/s, 19.2 kBit/s, 45.45 kBit/s, 93.75 kBit/s, 187.5 kBit/s and 500 kBit/s,
and additionally
1.5 MBit/s, 3 MBit/s, 6 MBit/s and 12 MBit/s.

The transmission rate is set automatically as soon as the PROFIBUS OLM receives a frame. The setting or adjustment is dependent on the transmission rate and the set operating mode. Depending on the OLM, this can last a maximum of between 0.5 s (at 12 MBit/s) and 5 s (at 9.6 KBit/s).

If the transmission speed has not been recognized, the outputs of all ports are blocked. If the transmission rate changes during operation, this is detected by the modules, which then automatically adjust their settings accordingly. Transfer malfunctions may temporarily occur while the rate is being altered.

Signal regeneration

The modules regenerate the signal form and amplitude of the data received. This allows up to 122 PROFIBUS OLMs to be cascaded (limited by the address space in PROFIBUS networks).

Help when setting up

At least one bus subscriber must be switched on and active in order to check the optical fiber connections during the installation. This bus subscriber serves as the frame source. The PROFIBUS OLMs act passively when it is switched on. They recognize the transfer speed from the frames sent by the bus subscriber. An optical help when putting the device into operation is provided by the port LED which then lights up.

2.2 Operating mode related functions

The operating mode is set using switches located on the top of the module. A sticker attached to the side of the module provides assistance with the settings.

Segment monitoring at the RS 485 port

If the operating mode ”Electric port with segment monitoring“ is set, each receiver monitors the RS 485 bus segment connected to it for faulty frames or continuously busy networks. If faulty frames are received by the receiver, or if the network is busy for longer than the maximum permitted send time, forwarding of the received signals is blocked until frames can be received again correctly, or if no signal is received for one second.

The RS 485 bus segment is not monitored in the operating mode ”Electric port without segment monitoring“. Interference from the electrical segment affects the entire network.

Please observe the installation notes in 4.4.3. ”Connecting the electrical RS 485 bus lines“, p. 22 .

The following functions are only available for the optical ports. Whether the functions can be activated depends on the operating mode which has been set. Please refer to the following chapters for details.

Line monitoring with echoes

The modules enable the connected optical paths to be actively monitored for interruptions in the fiber line by means of the functions ”Send echo“, ”Monitor echo“ and ”Suppress echo“.

Send echo

A frame which is received by a module via any port is transmitted to all other ports. If the receiving port is an optical port, the module sends the frame back to the corresponding optical sender.

Monitor echo

If a module sends a frame - no echo! – to an optical port, the module expects to receive an echo. If the echo is not received after a predefined time, an echo monitoring error is indicated by a red LED belonging to the port.

Suppress echo

The relevant receiver is separated from the other ports from the moment a frame is sent until the echo has been received correctly.

Segmentation

If an echo monitoring error or a frame falsification arises at an optical port, the module assumes that the line is faulty and blocks this port for user data. The connected field bus partial network is then segmented (cut off). This segmentation causes the module at the other end of the optical fiber to be segmented as well.
Both modules connected to the segmented field bus partial network send test frames to the segmented ports. These test frames – which are to be received regularly – can be used by both modules to check the status of the field bus partial network.
The segmentation is automatically lifted as soon as the test frames indicate to both modules that the segmented field bus partial network is no longer disturbed.

If all active bus subscribers are deactivated in a previously active network, the modules are segmented cyclically in order to check the fiber links to the neighboring modules. If there is no frame traffic, but the fiber links are intact, the port LEDs of the optical ports flash yellow cyclically.

3 Network Topologies

The following network topologies can be realized with the PROFIBUS OLM:

- Point-to-point connections
- Line topologies
- Star topologies
- Redundant optical rings

Combinations of these basic types are also possible. Lines with two optical fibers are used to create the fiber links for these network topologies.

If a malfunction – e.g. a break in a fiber line – makes a high degree of field bus network fail-safety necessary, the availability of the network can be increased using a redundant network configuration.

Please note:

- Single terminals or entire PROFIBUS segments with max. 31 subscribers can be connected to the electrical interface of the PROFIBUS OLM.
- In areas with a high EMC incidence, only lay optical fiber lines in order to exclude the possibility of EMC affecting the whole network.
- Optically only **OLMs of the same type** can be connected together:
  – OLM/P11 with OLM/P12
  – OLM/G11 with OLM/G12 and OLM/G12 EEC
  – OLM/G11-1300 with OLM/G12-1300
- Optical ports which are connected by optical fiber must be set to the same operating mode.
- Junctions between different OLM types are only possible via the RS485 interface.
- OLM/G12-EEC can be used everywhere in those network topologies described below in which a OLM/G12 can also be used.

3.1 Line topology

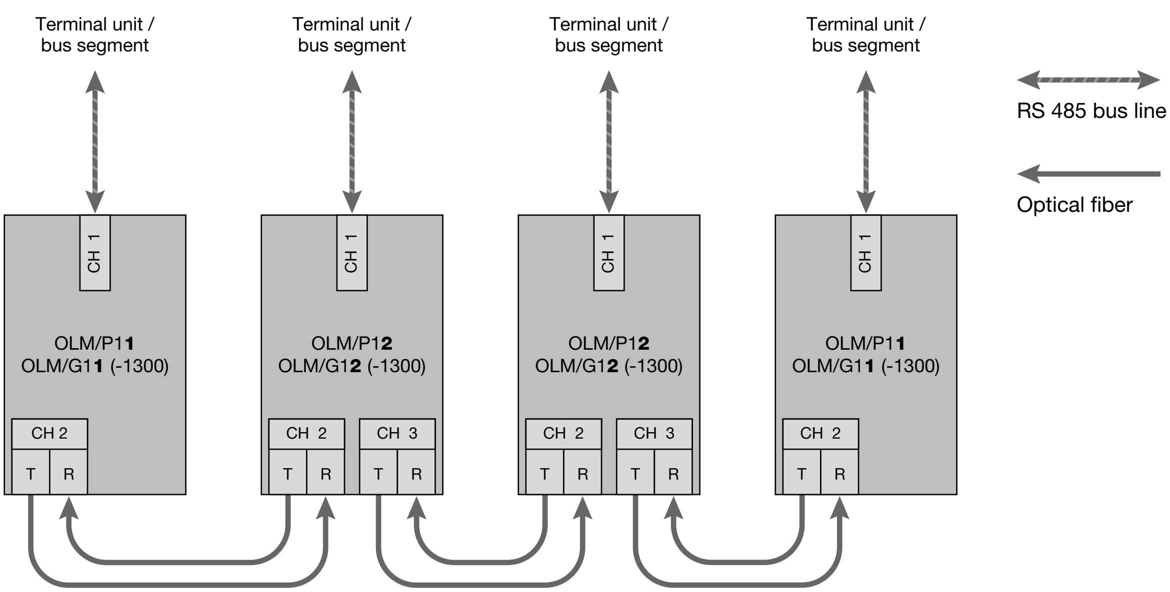


Fig. 2: Network structure in an optical line topology

In a line structure, the individual PROFIBUS OLMs are connected together by dual-fiber optical fibers. Modules with one optical port are sufficient at the beginning and end of a line, between which modules with two optical ports are necessary.

If single point-to-point connections are to be built up, this can be achieved using two modules each with one optical port.

The line topology can be realized with and without fiber link monitoring. If both operating modes are used within an optical fiber line, the operating mode ”Line topology without fiber link monitoring“ determines the availability of this fiber line. It is recommended that fiber link monitoring be used in homogeneous OLM networks (default factory setting).

Please note that the following ambient conditions must be fulfilled to ensure that network configuration functions correctly:

- The parameters MIN T_{SDR} described in the PROFIBUS standard EN 50170 must be set to a value ≥ 11 on all terminals. This is usually the case, but the setting should be checked if communication malfunctions continuously arise.
- When configuring your network, select low bus subscriber addresses wherever possible. This ensures that master timeout times which may arise are kept as short as possible in the event of a malfunction.

Refer to the manufacturer’s manual of the terminal concerned for details about how to alter the settings.

3.1.1 Line topology with optical fiber link monitoring and segmentation

This operating mode should preferably be used if an interrupted fiber segment is to be separated from the rest of the network.
Only use this operating mode if you have just connected PROFIBUS OLMs together of the same version.

- **Monitoring mechanisms:**

Send echo:	yes
Monitor echo:	yes
Suppress echo:	yes
Monitor:	yes
Segmentation:	yes

In this operating mode the individual fiber links are monitored by the two connected modules.

If a module fails, an optical fiber breaks or faults are determined on the optical transfer link, the fiber link between the two OLMs is interrupted (segmented). The PROFIBUS network is divided into two partial networks, which remain functional independently of one other.
The malfunction is indicated at the two OLMs connected to the malfunctioning fiber link by the port LEDs switching to red and by activation of the signaling contacts. The segmentation is lifted automatically as soon as both modules recognize that the field bus network is functioning correctly with the help of test frames.

Please note that in the case of networks with several active bus subscribers, two logical token rings are formed in the event of an error. Every time the partial networks are switched together, network malfunctions may arise due to the double tokens or frame collisions.

Note:
If a module with two optical ports is used at the beginning or end of a line, the optical port which is not assigned must be switched to the operating mode ”Line without fiber link monitoring“, so that it does not signal a break in the fiber line.
Please note that optical ports which are not connected must always be fitted with protective caps to guard against extraneous light and dirt.

3.1.2 Line topology without optical fiber link monitoring

Use this operating mode if you connect a PROFIBUS OLM with another optical fiber network component, which does not send a frame echo and does not expect or is not compatible with a frame echo in accordance with PROFIBUS guidelines (optical/electrical converter).

- **Monitoring mechanisms:**
  Send echo: no
  Monitor echo: no
  Suppress echo: no
  Monitor: no
  Segmentation: no

Individual fiber links are not monitored in this operating mode.

3.2 Star topology

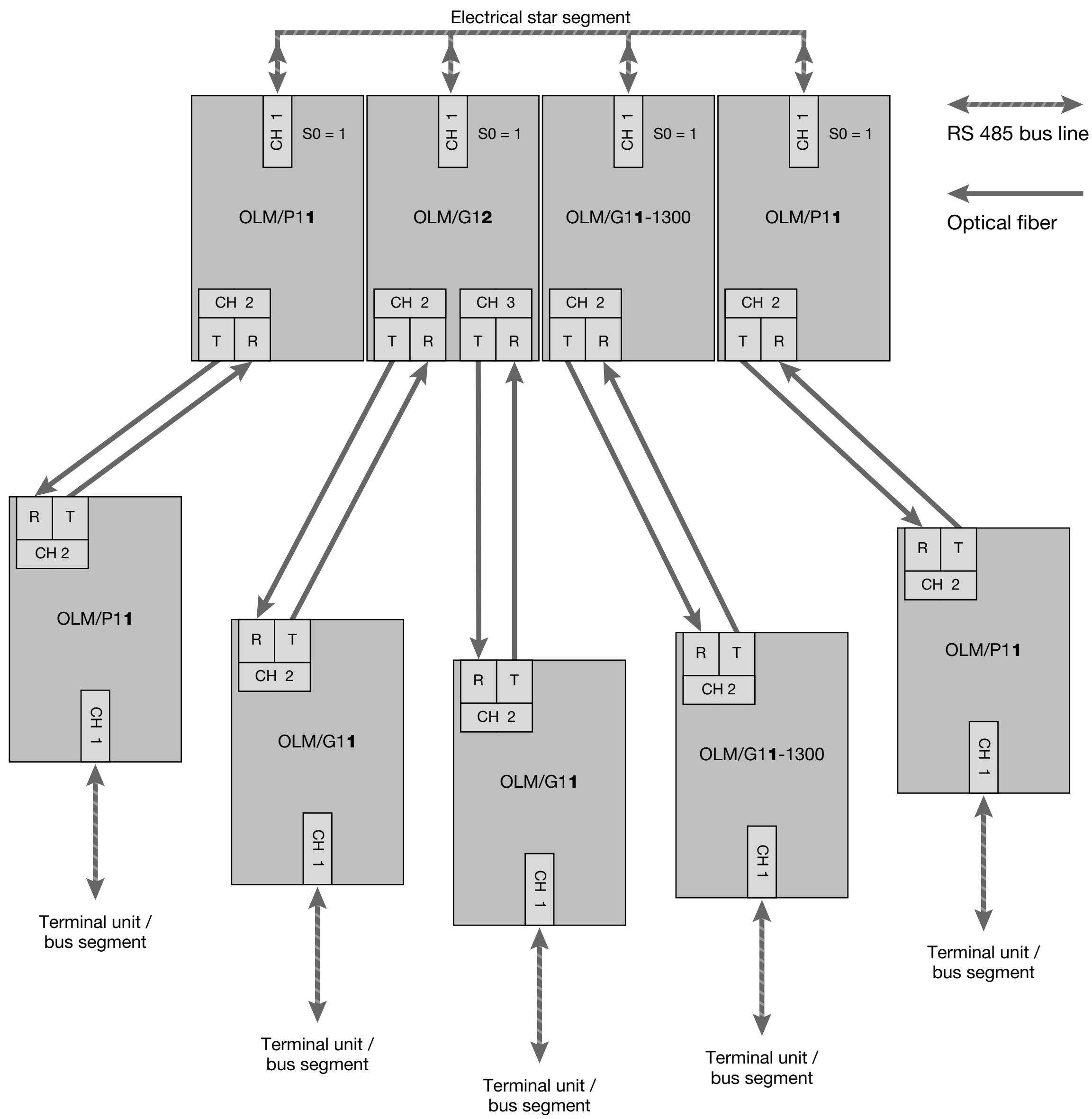


Fig. 3: Network structure in an optic star topology

Several modules are combined to form an active PROFIBUS star coupler. Other modules are connected to this by dual-fiber optical fiber lines. The modules of the star coupler are connected to one another via the electrical port (electrical star segment).
All OLM types for different fiber types (plastic, PCF, glass) can be combined using the electrical star segment.

Please note:

- CH1 in mode ”Monitor off“ (S0 = 1) must be activated on all OLMs which are connected to the electrical star segment. This deactivates the segmenting function of the RS 485 port on these OLMs, providing a high degree of availability of the electrical star segment.
- Ensure that the electrical star segment is wired carefully. Keep it as small as possible to avoid interference injection into the electrical star segment, and from here into the entire network. This can be achieved by laying out the OLMs in the electrical star segment directly next to each other on a hat rail.

- Switch on the terminating resistors in the bus port connectors (see 4.4.3, ”Connecting the electric RS 485 bus lines“, p. 22) at both ends of the electrical star segment.
- Do not connect a bus subscriber to the electrical star segment wherever possible.

Modules with one or two optical ports can be used to create an active PROFIBUS star coupler. Modules with one optical port are sufficient for connecting a terminal or an RS 485 bus segment to the active star coupler.

If the link monitoring on the optical ports is activated, the fiber optic links are monitored by the respectively connected OLM.

Note:
Optical ports which are not assigned (for instance, because they are reserved for a future system extension) indicate a fiber break if the link monitoring is activated.
You can prevent this error report from being issued by activating the operating mode ”Line without fiber link monitoring “ at the non-assigned ports.
Please note that optical ports which are not connected must always be fitted with protective caps to guard against extraneous light and dirt.

3.3 Redundant optical ring

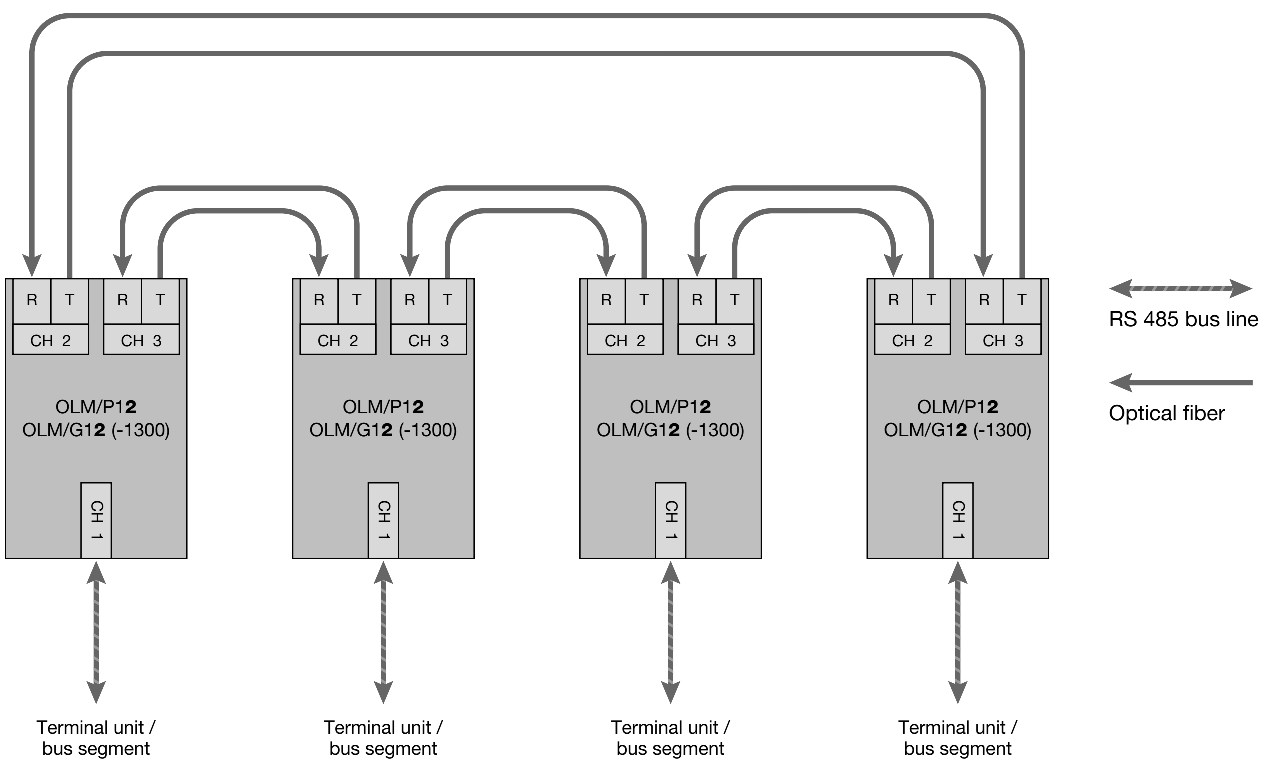


Fig. 4: Network structure in a redundant optical ring topology

This network topology represents a special form of line topology. A high degree of network operating safety is achieved by ”closing“ the optical line. A redundant optical ring can only be realized with modules with two optical ports of the same type.

- **Monitoring mechanisms:**
  Send echo: yes
  Monitor echo: yes
  Suppress echo: yes
  Segmentation: yes

An interruption of one or both optical fibers between two modules is detected by the OLM and the ring is transformed into an optical line.

If one module fails only those terminals connected to this module or the RS 485 segment are uncoupled from the ring. The remainder of the network itself continues to function as a line. The error is indicated by the LEDs on the two OLMs connected to the malfunctioning optical fiber and their signaling contacts. The segmentation is lifted automatically as soon as both modules recognize that the segmented field bus network is functioning correctly with the help of test frames. The line forms itself into a ring.

Please note:
The following ambient conditions must be fulfilled to ensure that the network configuration functions correctly:

- Only use this operating mode if you optically connect PROFIBUS OLMs of the same version.
- The operating mode ”Redundant optical ring“ must be set at both optical ports of all the PROFIBUS OLM.
- All modules in a ring must be connected to one another by fiber lines. The ring may not include an RS 485 bus line.
- The parameter MIN T_{SDR} described in the PROFIBUS standard EN 50170 must be set to a value ≥ 11 on all terminals. This is usually the case, but the setting should be checked if communication malfunctions continuously arise.
- When configuring your network, select low bus subscriber addresses wherever possible. This ensures that master timeout times which may arise are kept as short as possible in the event of a malfunction.
- If a redundancy case occurs (e.g. a line break), there is a switching time during which data cannot be correctly transmitted. In order to ensure a smooth transition, it is recommended that the frame repeat setting (Retry) on the PROFIBUS master be set to at least 3.
  After the error has been corrected, no frames should be present in the network when the optical line is transformed back into an optical ring to ensure that the process is completed smoothly. This condition can arise when a master selects a device whose address has been configured, but which does not physically exist. The master tries to address this device cyclically and waits for a reply only until the configured slot time has been exceeded (”GAP request“). The OLM recognizes this condition and closes the optical line to an optical ring in the middle of this request sequence.
  This results in two configuration requirements for the redundant optical ring:
  – The value of the parameter HSA (Highest Station Address) must be set at all terminals so that between the bus address 0 and the value HSA at least one address in the network has **not** been assigned to a bus subscriber, i.e. so that there is at least one address gap. This address gap can also be created by simply setting the value of the parameter HSA so that it is at least one greater than the highest number of subscriber bus addresses present in the network.
  Attention: If this requirement is not or no longer fulfilled, the optical line will no longer be closed into a redundant optical ring after segmentation. The error report (LED and signaling contact) of the two affected OLMs is not cancelled even after the error has been corrected.
  – The slot time must be set to approximately twice the value required in a non-redundant network. Further information can be found in Chapter 6 ”Configuration“, p. 29.
  Refer to the manufacturer’s documentation provided with the terminal or configuration software for details about how to adjust the settings.

4 Setting Up

4.1 Safety notice

⚠ Only use the PROFIBUS OLM as described in this "Description and Operating Instructions".
Pay particular attention to all the warnings and safety instructions.

⚠ Only operate the modules with a safety extra-low voltage in accordance with IEC 950/EN 60 950/VDE 0805 with a maximum rating of +32 V (typically +24 V).
The power source must comply with NEC, Class 2, regulations as stipulated by UL/CSA.

⚠ Pay attention to the electrical limit values when connecting the power supply to the signaling contacts:
max. voltage 60 V DC, 42 V AC.
The connected power supply must also be safety extra-low voltage in accordance with IEC 950/ EN 60 950/ VDE 0805 and comply with NEC, Class 2, regulations as stipulated by UL/CSA.

⚠ **DANGER:** Never connect the PROFIBUS OLM to the main power supply.

⚠ Only install the device in a location where the climatic and mechanical limit values given in the Technical Data can be complied with.

⚠ **WARNING:** Do not look directly into the aperture of the optical transmitting diode or the optical fiber.
The light beam which is emitted could endanger your eyesight.

OLM/P11 **OLM/P12** **OLM/G11-1300** **OLM/G12-1300**	The optical radiated power of the components used in this device does not represent a potential health hazard of any description under normal, foreseeable conditions, and it complies with Class 1 in accordance with IEC 60825-1:1994+A1:1997 resp. the Degree of Endangerment 1 in accordance with IEC 60825-2:1993.
OLM/G11 **OLM/G12** **OLM/G12-EEC**	Non-visible LED radiation. Do not look into the beam, not even with optical instruments. LED class 1M. Classification according IEC 60825-1:1993+A1:1997+A2:2000.

4.2 General information about setting up

Select the network topology which is most suitable for your requirements. The modules can then be put into operation in the following steps:

- Check and adjust (if necessary) the DIL switch
  Note: The DIL switches may only be operated in an ambient temperature of between 0°C and +60°C. This also applies to the OLM/G12-EEC.
- Mount the modules
- Connect the power supply and the signaling contacts
- Connect the electric RS 485 bus line with pre-mounted bus connector
- Connect the optical bus lines

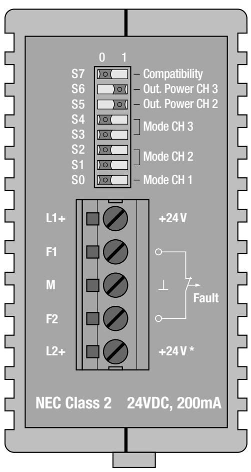


*Fig. 5: Top view of the Module OLM – location of the DIL switches and terminal block for the operating power supply/signaling contacts.
The illustration shows the factory settings of the DIL switches (switches S0, S1, S2, S3, S4 and S7 in Position "0", switches S5 and S6 in Position "1").*

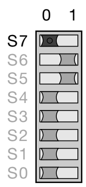
4.3 Setting compatibility, operating mode and transmitting power

Please note:

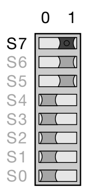
The OLM must be switched off when changing the operating mode.
You can switch off the OLM by, e.g., unplugging the 5-pin terminal block.

4.3.1 Setting the compatibility

The DIL switch S7 is used to switch the functional compatibility to devices of the preceding generation (SINEC L2FO OLM/P3, -P4, -S3, -S4, S3-1300 and -S4-1300) either off or on. Default setting at S7 is Position 0 (compatibility is switched off).



DIL switch S7 (compatibility) in Position 0:
compatibility to SINEC L2FO OLM/P3, -P4, -S3, -S4, -S3-1300, -S4-1300 **switched off**



DIL switch S7 (compatibility) in Position 1:
compatibility to SINEC L2FO OLM/P3, -P4, -S3, -S4, -S3-1300, -S4-1300 **switched on**

The **functional compatibility** to SINEC L2 Optical Link Modules of the preceding generation SINEC L2FO OLM/P3, OLM/P4, OLM/S3, OLM/S4, OLM/S3-1300 and OLM/S4-1300 is **switched on** with the **DIL switch S7=1**.
This operating mode is required when operating this module together with new devices.
Only turn switch S7 to Position 1 if the PROFIBUS OLM is being used as a spare or expansion device in existing networks in conjunction with OLMs of the preceding generation, and a direct optical connection is to be made.

The following illustrations show the switch assignment of the OLM at S7=1 for

OLM/P3 und OLM/P4:

SIEMENS
SINEC L2FO
OLM/P3; OLM/P4

S7 = 1	Compatibility Mode ON	
S0	Reserved	
S1	Mode	Monitor
0	Line/Ring	On
1	Line	Off
S2	Redundancy	
0	Off	
1	On	
S3,S4	Reserved	
S5	Output Power CH3	
0	Standard	
1	High	
S6	Output Power CH4	
0	Standard	
1	High	

OLM/P3: S6 reserved

OLM/S3, OLM/S4, OLM/S3-1300 und OLM/S4-1300:

SIEMENS
SINEC L2FO
OLM/S3; OLM/S4;
OLM/S3-1300; OLM/S4-1300

S7 = 1	Compatibility Mode ON	
S0	Reserved	
S1	Mode	Monitor
0	Line/Ring	On
1	Line	Off
S2	Redundancy	
0	Off	
1	On	
S3	Distance	
0	Extended	
1	Standard	
S4,S5,S6	Reserved	

OLM/S3, OLM/S3-1300: S2 reserved

Further information about adjusting the S7 in Position 1 can be found in the ”Description and Operating Instructions SINEC L2 Optical Link Module OLM/P …, OLM/S …“ for this SINEC L2 OLM.

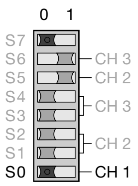
4.3.2 Setting the operating mode

Attention! The following details only apply for the S7 default position (S7 = 0)!

The DIL switch **S0** is used to set the operating mode of the electrical port **CH1**.
The DIL switches **S1 and S2** are used to set the operating mode of the optical port **CH2**.
The DIL switches **S3 and S4** are used to set the operating mode of the optical port **CH3**.
S3 and S4 do not have a function on OLMs with only one optical interface.

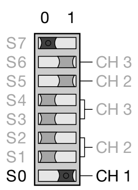
4.3.2.1 Setting the operating mode of the electrical port (CH1)

Operating mode ”Electrical Port with segment monitoring“



CH1 is activated in this operating mode if S0 is in Position 0.

Operating mode ”Electrical Port without segment monitoring“



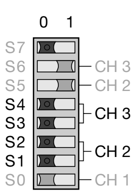
CH1 is activated in this operating mode if S0 is in Position 1.

Please note that this operating mode should only be set in the star segment of the star topology.

4.3.2.2 Setting the operating mode of the optical ports (CH2, CH3)

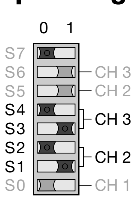
The operating mode can be set individually for each optical port. Combinations of the operating modes "Line with optical fiber link monitoring" and "Line without optical fiber link monitoring" are also possible.
Note that the operating mode of the two optical ports which are connected by the fiber line must always have the same settings! The operating mode "Redundant optical ring" must always be set at both of the optical ports.

Operating mode ”Line with optical fiber link monitoring and segmentation“



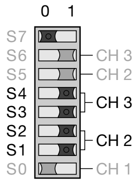
CH3 is activated in this operating mode if S3 and S4 are in Position 0.
CH2 is activated in this operating mode if S1 and S2 are in Position 0.

Operating mode ”Line without optical fiber link monitoring“



CH3 is activated in this operating mode if S3 is in Position 1 and S4 is in Position 0.
CH2 is activated in this operating mode if S1 is in Position 1 and S2 is in Position 0.

Operating mode ”Redundant optical ring“



CH3 is activated in this operating mode if S3 and S4 are in Position 1.
CH2 is activated in this operating mode if S1 and S2 are in Position 1.

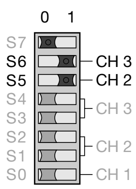
Note: This operating mode must always be set at both of the optical ports of a module.

4.3.3 Reducing the optical transmitting power on the OLM/P11 and OLM/P12

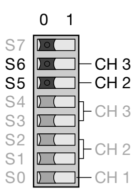
Attention! The following details only apply for the S7 default position (S7 = 0)!

The OLM/P11 and OLM/P12 have a high level of optical transmitting power. Optical overloading may result if these modules are connected with non-OLM devices using plastic optical fiber cables, particularly if short cable lengths are used.
In this case the optical transmitting power can be reduced.

The DIL switch **S5** is used to set the transmitting power of **CH2**.
The DIL switch **S6** is used to set the transmitting power of **CH3**.
S6 does not have a function on the OLM/P11.



Leave S6 in Position 1 (default) if the optical fiber link to CH3 functions correctly in this position.
Leave S5 in Position 1 (default) if the optical fiber link to CH2 functions correctly in this position.



Switch S6 to Position 0 (reduced) if overloading is detected at a non-OLM device when using plastic optical fiber cables to CH3.
Switch S5 to Position 0 (reduced) if overloading is detected at a non-OLM device when using plastic optical fiber cables to CH2.

Note:
The DIL switches S5 and S6 on the OLM for glass optical fiber cables do not have a function (the optical transmitting power cannot be reduced).

The transmitting power default setting (S5 or S6 in Position 1) must be set when using PCF fibers.

4.4 Installation

4.4.1 Connecting the optical lines

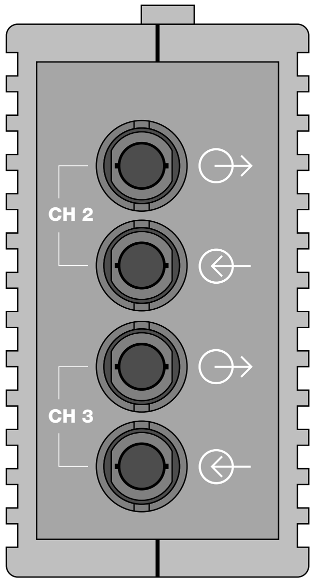


Fig. 6. View of the bottom of the module with the optical ports 2 and 3 (device with two optical ports).

- Connect the individual modules using a dual-fiber optical fiber line with BFOC/2.5 connectors.
- Ensure
  – that the end faces of the optical plugs are free of contamination.
  – that respectively one optical input and one optical output are connected to one another (crossover connection). The BFOC port sockets which belong to one other are marked on the bottom of the front plate.
  – that the optical plugs on the BFOC socket are securely attached (bayonet fastener must be slotted in).
- Ensure that there is sufficient strain relief on the optical fiber line, and pay attention to the minimum bend radius.
- Seal BFOC sockets which have not been assigned using the supplied protective caps (note: an optical port which has not been assigned should be switched to the operating mode ”Line without optical fiber link monitoring“ to avoid a break in the fiber line from being signaled).
  Extraneous ambient light can cause interference in the network, especially under very bright conditions. Optical components can be rendered useless if dust infiltrates them.
- Please note the maximum length of the optical fiber line and the possible fiber types which are shown in Table 1, p. 6 and in the Technical Data, p. 31.

4.4.2 Mounting the modules

The OLM modules can either be mounted on a 35 mm hat rail in accordance with DIN EN 50022 or directly on to a flat surface.

- Install the device in a location where the climatic and mechanical limit values defined in the Technical Data can be complied with.
- Ensure that there is sufficient room to connect the bus and power supply cabling.
- Connect the optical fiber line before mounting the module. This is easier than connecting it after the module has been installed.
- Only mount the module on a low-impedance and low-induction grounded hat rail or base plate. No other grounding measures are required.

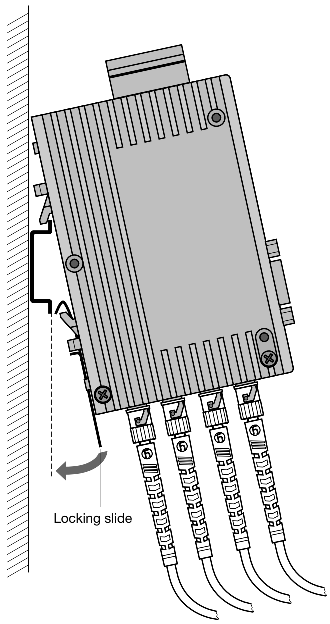


Fig. 7: Mounting a module on a standard hat rail

Mounting on a hat rail

- Hang the top snap-in hooks of the module into the hat rail and press the underside onto the rail (as shown in Fig. 7) until it audibly clicks in.
- To remove the module, pull down on the locking slide.

Mounting on a mounting plate

The modules have three through-holes. This allow it to be mounted on any flat surface, e.g. on the mounting plate of a switch cabinet.

- Drill three holes in the mounting plate corresponding to the drilling template in Fig. 8.
- Secure the modules with machine bolts (e.g. M 3 x 40).
- Ensure that there is a reliable electrical connection between the module housing and the mounting plate. Place toothed washers under the bolt heads to pierce the varnish.

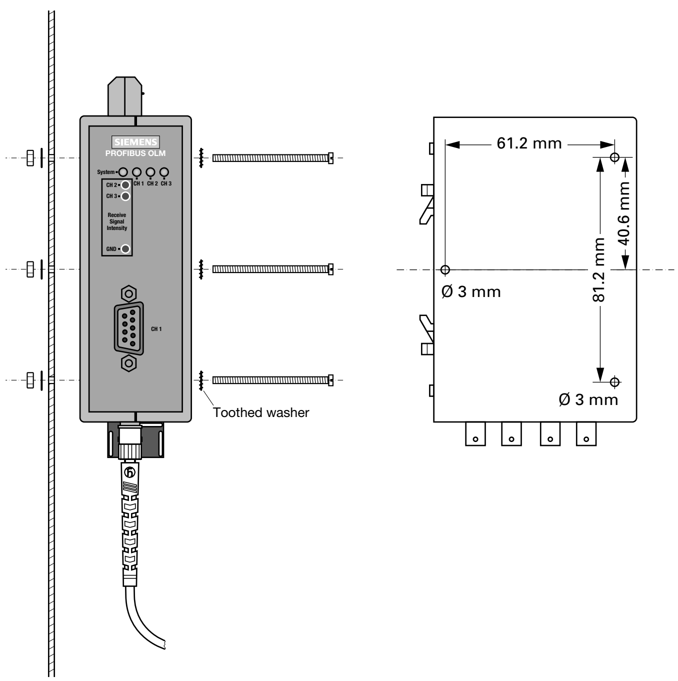


Fig. 8: Mounting a module on a mounting plate

4.4.3 Connecting the electric RS 485 bus lines

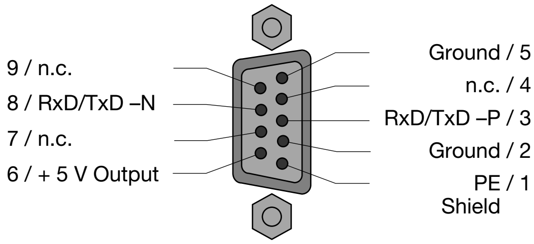


Fig. 9: Electrical port – assignment of Sub-D sockets

The modules are fitted with an RS 485 electrical port. This is a 9-pin Sub-D socket with a screw lock (inside thread UNC 4-40).

The pin assignment complies with the PROFIBUS standard. At Pin 6 there is a short circuit-proof 5V output for supplying external pull-up/pull-down resistors.

As opposed to the 24V power supply and the casing (ground potential), the RS 485 bus lines RxD/TxD–N and RxD/TxD–P are indirect-coupled (functional separation) within SELV restrictions.

- Only use shielded and twisted-pair wiring as a RS 485 bus line as described in the manual ”SIMATIC NET PROFIBUS networks“. Do not exceed the segment lengths given there.
- Use a PROFIBUS bus connector plug to connect the RS 485 bus segment. If the module is at the beginning or end of a bus segment, this connector must have an activated bus terminal resistor combination.
- All PROFIBUS bus connector plugs in a network must be securely screwed onto the RS 485 interfaces.
- Attaching or removing the bus connector plugs, inadequately attached bus connector plugs or loose bus wires within the plug can lead to malfunctions in the optical and electrical networks.
- Attach or remove the RS 485 bus connector plug quickly and without twisting them.
- Remove the RS 485 bus line from the OLM if a device is not connected to the other end, or there is an OLM which has been disconnected from the power supply. The open line otherwise acts as an antenna and can cause interference.
- When connecting a RS 485 bus line to the PROFIBUS OLM in an active network, keep to the following sequence in order to avoid interference:
  1. Place the RS 485 bus connector plug onto the device which is to be connected (e.g. to a programming device) and screw it on tightly.
  2. Attach the RS 485 bus connector plug to the PROFIBUS OLM quickly and without twisting the connector, and screw it on tightly.

  Proceed in the reverse order when removing a device from the network
- Ensure that the bus segment connected to the RS 485 interface is terminated at both ends. Only use a connecting cable which is terminated at both ends to connect a single device.

Observe the following safety notice:

Do not connect any bus lines which have been partially or totally laid outside of buildings. Otherwise lightning strikes in the vicinity of the cable could destroy the module. Use optical fiber lines for bus connections which lead out of a building!

4.4.4 Connecting the power supply

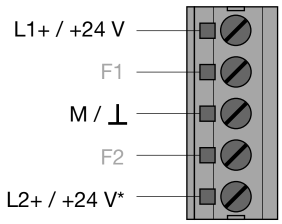


Fig. 10: Operating voltage supply – assignment of 5-pin terminal block

The terminal block can be removed from the device to connect the lines.

- The module should only be supplied with a regulated **safety extra-low voltage** in accordance with IEC 950/EN 60 950/VDE 0805 with a maximum of +32 V (typical +24 V). The power source must comply with the regulations of the NEC, Class 2 in accordance with UL/CSA approval.
  It can be fed in using the 5-pin terminal block on the top of the module.
- To increase operational safety, the module can be redundantly supplied via the terminals L2+/+24 V* and M/⊥.
  In the event of a failure of the regular power supply, the module switches automatically to the redundant power supply. Load distribution between the individual alternative supply sources does not take place.
  The signaling contact does not signal the failure of a single 24 V infeed. Both of the infeeds and the signaling contact must be connected to an input module for monitoring to take place.

Clips on the terminal block ensure that it is securely attached to the device, and simultaneously provide polarity reversal protection.

4.4.5 Connecting the signaling contact lines

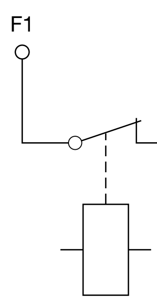


Fig. 11: Signaling contact - relay with unconnected contacts; the contact is open if a fault occurs

The terminal block can be removed from the device to connect the lines.

A relay with unconnected contacts as signaling contacts is fitted to the 5-pin terminal block on the top of the module. This signals faults and interference in the network and modules. The contact is open if a fault occurs. This also signals a total loss of power at the module.

Refer to Chapter 5.1 ”LED indicators“ p. 25 for more details about malfunctions which are signaled by the signaling contact.
Signaling contact limit values:
– maximum switching voltage 60 V DC; 42 V AC
– maximum switching current 1.0 A

The voltage connected to the relay must be **regulated safety extra-low voltage** in accordance with IEC 950/EN 60 950/ VDE 0805 and must comply with the regulations of the NEC, Class 2 in accordance with UL/CSA approval.

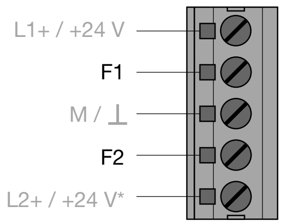


Fig. 12: Signaling contact – pin assignment 5-pin terminal block

- Pin assignment, 5-pin terminal block: terminals F1 and F2.
- Always ensure that the pins are correctly assigned at the 5-pin terminal block. Make sure that the connecting leads of the signaling contacts are adequately insulated, particularly if you are working with voltages greater than 32 V. Incorrect assignment can lead to destruction of the module.

4.4.6 Defining the receiving level of the optical ports

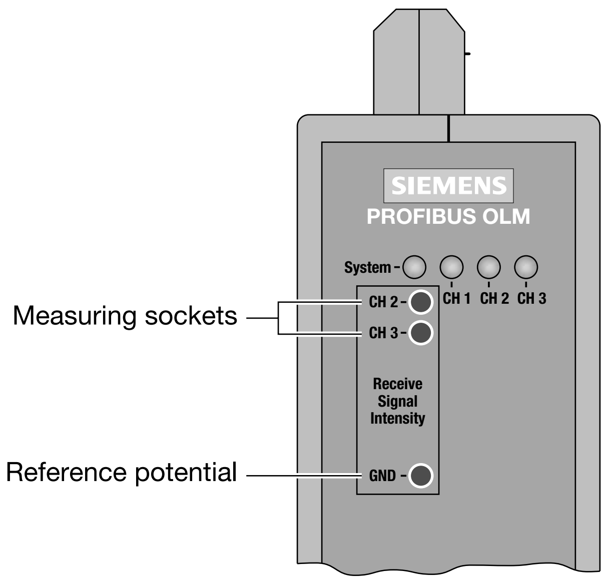


Fig. 13: Location of the measuring sockets

The receiving level of the two optical Ports CH2 and CH 3 can be measured using a conventional voltmeter connected to the measuring sockets. The voltmeter can be connected and disconnected while the module is in operation without any interference using 2 mm laboratory test plugs.
The OLM is protected against short circuits at the measuring sockets, although data transmission may be briefly disrupted*.

With this
– the incoming optical performance can be documented, e.g. for later measurements (ageing, damage)
– a good/poor check can be carried out (limit value).

Further information can be found in Appendix 8.4 ”Measuring sockets“ p.35.

* Only an ungrounded, high-resistance voltmeter may be used to take measurements.
The reference potential socket may not be connected to the OLM housing.

5 LED Indicators and Troubleshooting

5.1 LED Indicators

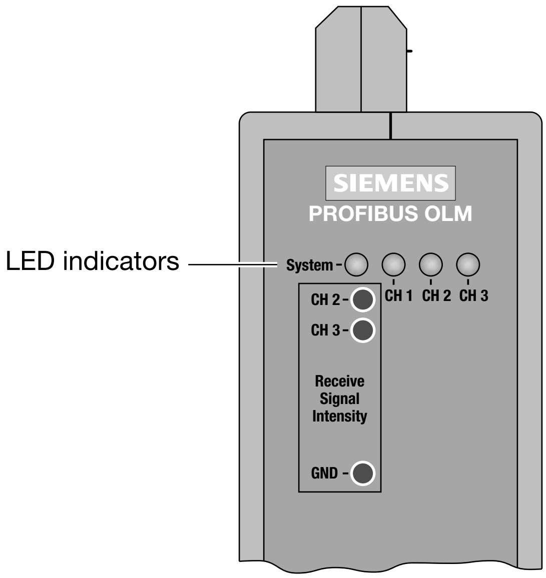


Fig. 14: LED indicators on the front plate

LED Indicator		Possible causes	Signaling contact
System	lights green	– The transmission rate has been recognized and the power supply is in order	no signal
	not lit	– Power supply has failed (total failure*) – Power supply connected incorrectly – Module defective	signal
	flashes red	Transmission rate has not yet been recognized – No transmitting bus subscriber present – No connection to a partner module sending frames – Send and receive optical fibers have been transposed – Transmission rate does not correspond to the PROFIBUS standard – Only one active bus subscriber is connected, which is only sending tokens to itself. The indicator must switch over after a second bus subscriber has been activated (token frames on their own are not enough to set the transfer rate). – The connected RS 485 segment is only terminated at one end.	no signal
	flashes red/green	Transmission rate recognized but – the network slot time could not be determined (network parameter HSA is set too low, no transmitting bus subscriber present) – one optical port is set to ”Redundant optical ring“ mode, but not the second (this operating mode must always be set at both optical ports) – the slot time of the network configuration is too short	no signal

* failure of both power supply sources with redundant infeed

LED Indicator		Possible causes	Signaling contact
CH1 electric	lights yellow	Signals are being received on the RS 485 bus line	no signal
	not lit	– Bus subscriber is not connected – Connected bus subscriber is not switched on – One or both conductors in the RS 485 bus line is broken	no signal
	flashes/lights red	Sporadic interference signals because – the RS 485 bus line being insufficiently shielded – an open RS 485 bus line, i.e. it is only connected to the module at one end – the RS 485 segment is not terminated or only terminated at one end – an RS 485 bus terminal or terminal connector has been plugged in/ pulled out Permanent interference because – conductors A and B in the RS 485 bus line have been transposed – of an RS 485 bus line short circuit – the send time has been exceeded caused by a bus subscriber in a bus segment connected to Port 1	signal
		– module and another bus subscriber connected via Port 1 are both sending at the same time (e.g. because an address has been assigned twice, the setting of the slot time is too low, or during lifting of the segmentation in the optical line, see Chap. 3.1.1) – RS 485 driver of the module is defective (e.g. after lightning strike)	no signal
CH2, CH3 optical	lights yellow	PROFIBUS frames are being received at the optical port	no signal
		Operating mode "Line with optical fiber link monitoring" and "Redundant optical ring"	
	not lit	Transmission rate has not yet been recognized – LED "System" flashes red – No transmitting bus subscriber present – Send and receive optical fibers have been transposed – No partner module connected or partner module is not switched on – Connected partner module is defective Transmission rate has been recognized - LED "System" flashes green – If the operating mode "Redundant optical ring" has been set, the optical port works as a stand-by port. There is no malfunction in the OLM or the optical fiber. – If one of the operating modes "Line with optical fiber link monitoring …" has been set, no PROFIBUS frames are received at the optical port. There is no malfunction in the OLM or the optical fiber.	no signal
		Transmission rate has been recognized – LED "System" lights green or flashes red/green	
	flashes yellow	– No transmitting bus subscriber present (optical fiber connection is OK)	no signal
	lights red	– Send and receive optical fibers have been transposed – No partner module connected or partner module is not switched on – Connected partner module is defective – Send time of connected partner module has been exceeded – An optical fiber line is broken – Optical fiber link to partner module is too long – Loose connection in an optical fiber connector – Optical fiber in the optical fiber connector is loose – When using a redundant optical ring: if a fault in the optical fiber has been corrected but the port LEDs on both of the OLMs concerned still light red, check whether parameter HSA has been set as described the in Chap. 3.3.	signal
	flashes red/yellow	– Fault occurs periodically (see above) – Loose connection in an optical fiber connector – Optical fiber in the optical fiber connector is loose – Only one active bus subscriber is connected, which only sends tokens to itself. A fault should not be signaled as soon as a second subscriber is activated.	signal
		Operating mode "Line without optical fiber link monitoring"	
	lights yellow	Signals are received at the optical port.	no signal
	not lit	– No transmitting bus subscriber present – Send and receive optical fibers have been transposed – No partner module connected or partner module is not switched on – Connected partner module is defective	no signal

Table 2: What the LED indicators and signaling contacts mean

5.2 Troubleshooting

This chapter helps you to localize faults after they have been indicated (by LEDs or signal contacts). Please also refer to the description of the LED indicators in 5.1, p. 25.

Fault indicated on the system LED

See description of the LED indicators in 5.1, p. 25.

Fault indicated on CH1

Check the following:

- the DIL switch S0 is in Position 1 if the OLM is connected to the electrical star segment of a star topology (see Chap. 3.2 ”Star topology“, p. 12).
- the fault is still displayed after removal of the RS485 connector.
  Still displayed: Device is defective*.
  Replace the OLM.
  No longer displayed: The fault lies in the RS485 bus segment.
  Check
  – all RS485 connectors as described in 4.4.3 ”Connecting the electrical RS 485 bus lines“, p. 22
  – the structure and shielding of the RS485 bus segment
  – the RS485 bus segment using a PROFIBUS bus monitor
  – the configuration of all bus subscribers.

  * This is not the case if the monomaster of a PROFIBUS network is connected to the RS485 bus segment which is to be examined. Replace the OLM concerned with another OLM from the network, and then carry out the test described above.
  If the OLM still malfunctions when connected elsewhere, the device is defective.
  Replace the OLM.
  If the OLM does not malfunction elsewhere, the fault lies in the RS485 bus segment.
  Carry out the measures described above.

Fault indicated on CH2 / CH3

1. Check the following:

- optically only modules of the same type are connected together (see 3, ”Network topologies“, p. 9)
- the optical fiber has been approved for the module type being used, and that it does not exceed the permitted length (see Table 1, p. 6)
- the optical ports, which are connected via optical fibers, have been set to the same operating mode (see 4.3, ”Setting compatibility, operating mode and transmitting power“, p. 17)
- the settings given in 4.4.1, ”Connecting the optical lines“ (p. 20) have been observed when connecting and laying the optical bus lines.

2. Define the optical receiving level (see 4.4.6 ”Defining the receiving level of the optical ports“, p. 24 and 8.4 ”Measuring sockets“, p. 35):

   – Level is in the range ”Function is not guaranteed“.
     ▶ Check the optical fiber absorption using an optical level measuring device.
     too high: replace the optical fiber
     in valid range: one of the two OLMs of the disturbed optical fiber segments is defective. First replace the other OLM of the disturbed optical fiber segments (i.e. the OLM, which supplies the send signal for the measurement described above). If the fault still persists, replace the other OLM instead.

   – Level is in the range ”Optical system reserves reduced“ or ”Normal mode“.
     ▶ As described above, check the optical receiving level of the other OLM in the disturbed optical fiber segment at the appropriate port.

   – The levels at **both** OLMs of the disturbed optical fiber segments are in the range ”Optical system reserves reduced“ or ”Normal mode": one of the two OLMs in the disturbed optical fiber segments is defective.
     ▶ First replace one of the OLMs in the disturbed optical fiber segment. If the fault still persists, replace the other OLM instead.

6 Configuration

During configuration, the PROFIBUS network parameter "Slot time" must be adapted to the network coverage, network topology and the data rate due to frame delays caused by lines and network components, as well as by monitoring mechanisms in the network components.

6.1 Configuration of optical line and star topologies

The PROFIBUS network is configured, e.g. with SIMATIC STEP 7 (V5) or COM PROFIBUS (V5). The number of OLMs ($Number_{OLM}$) and overall line lengths can be entered in an input mask. The configuration tools control whether the slot time in the selected communications profile can be retained. If this time is exceeded as a result of additional OLM and optical fiber line runtimes, an error message is issued and the parameters are adapted accordingly.

6.2 Configuration of redundant optical rings

The following configuration conditions must be fulfilled in the redundant optical ring (for details see Chap. 3.3 ”Redundant optical ring“, p.13):

- (1) Configuration of a non-existent bus subscriber
- (2) Increasing the retry value to at least 3
- (3) Checking and adjusting the slot time

Use the user-specific profile of the configuration tool to set the parameters under (2) and (3).
Calculate the slot time with the following equation:

$$\text{Slot time} = a + (b \cdot \text{Length}_{OF}) + (c \cdot \text{Number}_{OLM})$$

- ”Slot time“ is the monitoring period in bit times
- ”Length_{OF}“ is the sum of all the optical fiber lines (segment lengths) in the network. The length must be given in km!
- ”Number_{OLM}“ is the number of PROFIBUS OLMs in the network.

The factors a, b and c are dependent on the transmission rate and are listed in the tables below.

Data rate	a	b	c
12 MBit/s [1]	1651	240	28
6 MBit/s [1]	951	120	24
3 MBit/s [1]	551	60	24
1.5 MBit/s	351	30	24
500 kBit/s	251	10	24
187.5 kBit/s	171	3.75	24
93.75 kBit/s	171	1.875	24
45.45 kBit/s	851	0.909	24
19.2 kBit/s	171	0.384	24
9.6 kBit/s	171	0.192	24

Table 3a: Constants for calculating the slot time at DP standard (redundant optical ring)

Data rate	a	b	c
12 MBit/s [1]	1651	240	28
6 MBit/s [1]	951	120	24
3 MBit/s [1]	551	60	24
1.5 MBit/s	2011	30	24
500 kBit/s	771	10	24
187.5 kBit/s	771	3.75	24
93.75 kBit/s	451	1.875	24
45.45 kBit/s	851	0.909	24
19.2 kBit/s	181	0.384	24
9.6 kBit/s	171	0.192	24

Table 3b: Constants for calculating the slot time at DP/FMS (”universal“) and DP with S5 95U (redundant optical ring)

The calculation of the slot time only takes into consideration the optical network and the connection of bus subscribers to the OLM via an RS 485 bus segment with a respctive length of max. 20 m. Longer RS 485 bus segments must be allowed for by adding them to the Length_{OF} .

Note:
When the slot time is configured with a too small value the OLM will, through it’s fault function and fault indications, indicate such. The System-LED will blink red/green.

[1] Using the OLM/G11-1300 and OLM/G12-1300 at data rates of 12 MBit/s, 6 MBit/s, 3 MBit/s and 1.5 MBit/s the minimum slot times according to the following table must be met.

Data rate	Minimum slot time
12 MBit/s	3800 t_{Bit}
6 MBit/s	2000 t_{Bit}
3 MBit/s	1000 t_{Bit}
1.5 MBit/s	530 t_{Bit}

Table 4: Minimum slot time on OLM/G11-1300 and OLM/G12-1300

Use the values from Table 4 if the calculated slot time is smaller than the minimum slot time indicated in the table.

7 Technical Data

OLM Module	P11 P12	G11 G12 G12-EEC	G11-1300 G12-1300
Voltage/power supply			
Operating voltage	18 V to 32 V DC, typ. 24 V, (redundant inputs uncoupled), safety extra-low voltage, indirect-coupled		
Current consumption	max. 200 mA		
Output voltage/current for terminal resistors (Pin 6 Sub-D socket)	5 V +5%, −10% / 90 mA; short circuit-proof		
Signaling contact Maximum switch voltage Maximum switch current	 60 V DC; 42 V AC (safety extra-low voltage) 1.0 A		
Signal transmission			
Transmission rate	9.6; 19.2; 45.45; 93.75; 187.5; 500 kBit/s 1.5; 3; 6; 12 Mbit/s		
Setting transmission rate	automatic		
Bit error rate	$< 10^{-9}$		
Signal processing time (any input/output)	$\leq 6.5\ t_{Bit}$		
Retimer			
Input Port 1 to 3 Signal distortion Bit length	 ±30 % ±0.12 %		
Output Port 1 to 3 Mean bit length	 ±0.01 %		
Safety			
VDE regulation	VDE 0806 = EN 60950 and IEC 950		
UL/CSA approval	UL 1950/CSA 950		
FM approval	in preparation (Class 2)		
Electrical port			
Input/output signal	RS 485 level		
Input dielectric strength	−10 V to +15 V		
PIN assignment, port 1	in accordance with EN 50170 Part 1		
Indirect-coupled	yes, within SELV limits		
Optical ports			
Wavelength	660 nm	860 nm	1310 nm
Launchable optical power			
– in glass fiber **E 10/125**	–	–	−19 dBm
– in glass fiber **G 50/125**	–	−15 dBm	−17 dBm
– in glass fiber **G 62.5/125**	–	−13 dBm	−17 dBm
– in PCF fiber **S 200/230**			
transmitting power ”Reduced“	–	–	–
transmitting power ”Default“	−17 dBm	–	–
– in plastic fiber **S 980/1000**			
transmitting power ”Reduced“	−9.5 dBm	–	–
transmitting power ”Default“	−5 dBm	–	–
Receiver sensitivity	−25 dBm	−28 dBm	−29 dBm
Receiver overload	−3 dBm	−3 dBm	−3 dBm

OLM Module	P11 P12	G11 G12 G12-EEC	G11-1300 G12-1300
Transmission distance			
– with glass fiber **E 10/125** (0.5 dB/km)	–	–	0 - 15000 m [2]
– with glass fiber **G 50/125** (860 nm: 3.0 dB/km; 1310 nm: 1.0 dB/km)	–	0 - 3000 m [2]	0 - 10000 m
– with glass fiber **G 62,5/125** (860 nm: 3.5 dB/km; 1310 nm: 1.0 dB/km)	–	0 - 3000 m [2]	0 - 10000 m
– with PCF fiber **S 200/230**			
Transmitting power ”Reduced“	–	–	–
Transmitting power ”Default“ (660 nm: 10.0 dB/km; 860 nm: 8.0 dB/km)	0 - 400 m [2]	–	–
– with plastic fiber **S 980/1000**			
Transmitting power ”Reduced“	0 - 50 m	–	–
Transmitting power ”Default“ (0.25 dB/m)	0 - 80 m	–	–
Connector	BFOC/2.5		
Electromagnetic compatibility (EMC)			
Interference emissions	Limit class B (EN 55022)		
Interference immunity against static charges	At shielded socket and housing parts: ±8 kV contact discharge (EN 61000-4-2)		
Immunity against high-frequency interference	– 10 V/m at 80% amplitude modulation with 1 kHz, 80 MHz - 1 GHz (EN 61000-4-3) – 10 V/m at 50% on-period at 900 MHz (ENV 50204) – 10 V/m at 80% amplitude modulation with 1 kHz, 10 kHz - 80 MHz		
Immunity against line-conducted disturbance (Burst)	On power supply lines and shielded RS 485 bus lines: ±2 kV (EN 61000-4-4)		
Immunity against line-conducted disturbance (Surge)	– On power supply lines: ±1 kV symmetrical – On shielded RS 485 bus lines: ±2 kV asymmetrical (EN 61000-4-5)		
Climatic ambient conditions			
Ambient temperature	0 °C to +60 °C (IEC 68-2-1, IEC 68-2-2) –20 °C to +60 °C at OLM/G12-EEC [1] (IEC 68-2-1, IEC 68-2-2)		
Storage temperature	–40 °C to +70 °C (IEC 68-2-14)		
Relative humidity	<95 %, non-condensing (IEC 68-2-30) 100 %, condensing at OLM/G12-EEC [1] (IEC 68-2-30)		
Mechanical ambient conditions			
Vibration (during operation)	10 to 58 Hz, 0.075 mm displacement; 58 to 150 Hz, 10 m/s^2 (1 g) acceleration (IEC 68–2–6)		
Vibration (during transport)	5 to 9 Hz, 3.5 mm displacement; 9 to 500 Hz, 10 m/s^2 (1 g) acceleration		
Protection class	IP 40		
Dimensions (W x H x D)	39.5 x 110 x 73.2 mm		
Housing material	Die-cast zinc		
Weight	approx. 500 g		

1) The OLM/G12 can also be supplied in a special design for more severe environmental conditions. This variant is designated the OLM/G12-EEC. The DIL switches on the OLM/G12-EEC may also only be operated at ambient temperatures between 0°C and + 60°C.
2) The specified distance allowed between two OLMs must not be exceeded regardeless of the optical power budget.

The module does not contain any silicon.

8 Appendix

8.1 CE Designation

Product Designation

SIMATIC NET

OLM/P11	6GK1502-2CA00
OLM/P12	6GK1502-3CA00
OLM/G11	6GK1502-2CB00
OLM/G12	6GK1502-3CB00
OLM/G11-1300	6GK1502-2CC00
OLM/G12-1300	6GK1502-3CC00
OLM/G12-EEC	6GK1502-3CD00

EMC Directive

The SIMATIC NET products named above fulfill the requirements of the following EC directives:

CE Directive 89/336/EEC
"Electromagnetic Compatibility"

Application

The product is designed for use in the following areas:

Area of application	Requirement for Interference emissions	Interference immunity
Domestic, business and commercial use, as well as in small factories	EN 50081-1: 1992	EN 50082-1: 1997
Industrial plants	EN 50081-2: 1993	EN 50082-2: 1995

Observe assembly guidelines

The product complies with the specifications if the assembly guidelines and safety instructions are observed during installation and operation as described in this ”Description and Operating Instructions SIMATIC NET Optical Link Modules“ and the following documentation:

SIMATIC NET PROFIBUS Networks Manual

Declaration of Conformity

In accordance with the above-named EC directive, the EC Declaration of Conformity can be viewed by the authorities responsible at:

Siemens AG
Bereich Automatisierungs- und Antriebstechnik
Geschäftszweig Industrielle Kommunikation SIMATIC NET
Postfach 4848
D-90327 Nürnberg

Machine Directive

Furthermore, the product is a component in accordance with Article 4(2) of the EC Machine Directive 89/392/EWG.

In accordance with the Machine Directive, we are obliged to draw attention to the fact that the designated product is solely designed for installation in a machine. Before the end product is put into operation, it must be ensured that it conforms with the directive 89/392/EEC.

8.2 Literature notes

– Manual SIMATC NET PROFIBUS Networks SIEMENS AG 6GK1970-5CA20-0AA0 (German)
-0AA1 (English)
-0AA2 (French)
-0AA4 (Italian)

– EN 50170-1-2 1996:
„General Purpose Field Communication System“, Volume 2 „Physical Layer Spezification and Service Definition“

– DIN 19245:
„Messen, Steuern, Regeln; PROFIBUS Teil 3; Process Field Bus; Dezentrale Peripherie (DP)“
(”Measuring, controlling, governing; PROFIBUS Part 3; Process Field Bus; Decentral Periphery Devices (DP)“)

– EIA Standard RS–485 (April 1983): „Standard for electrical characteristics of generators“

8.3 List of abbreviations

BFOC	Bayonet Fiber Optic Connector
DIN	Deutsche Industrie Norm (German Industrial Standard)
EEC	Extended Environmental Conditions
EIA	Electronic Industries Association
EN	Europäische Norm (European Standard)
EMC	Electromagnetic Compatibility
HCS™	Hard Polymer Cladded Silica Fiber (registered trademark of Ensign-Bickford)
IEC	International Electrotechnical Commission
LED	Light Emitting Diode
OBT	Optical Bus Terminal
OLM	Optical Link Module
PCF	Polymer Cladded Fiber (equal to HCS™)
PNO	PROFIBUS Nutzer Organisation (PROFIBUS User Organization)
SELV	Secure Electrical Low Voltage
UL	Underwriter Laboratories
VDE	Verein Deutscher Elektroingenieure (Association of German Electrical Engineers)

8.4 Measuring sockets

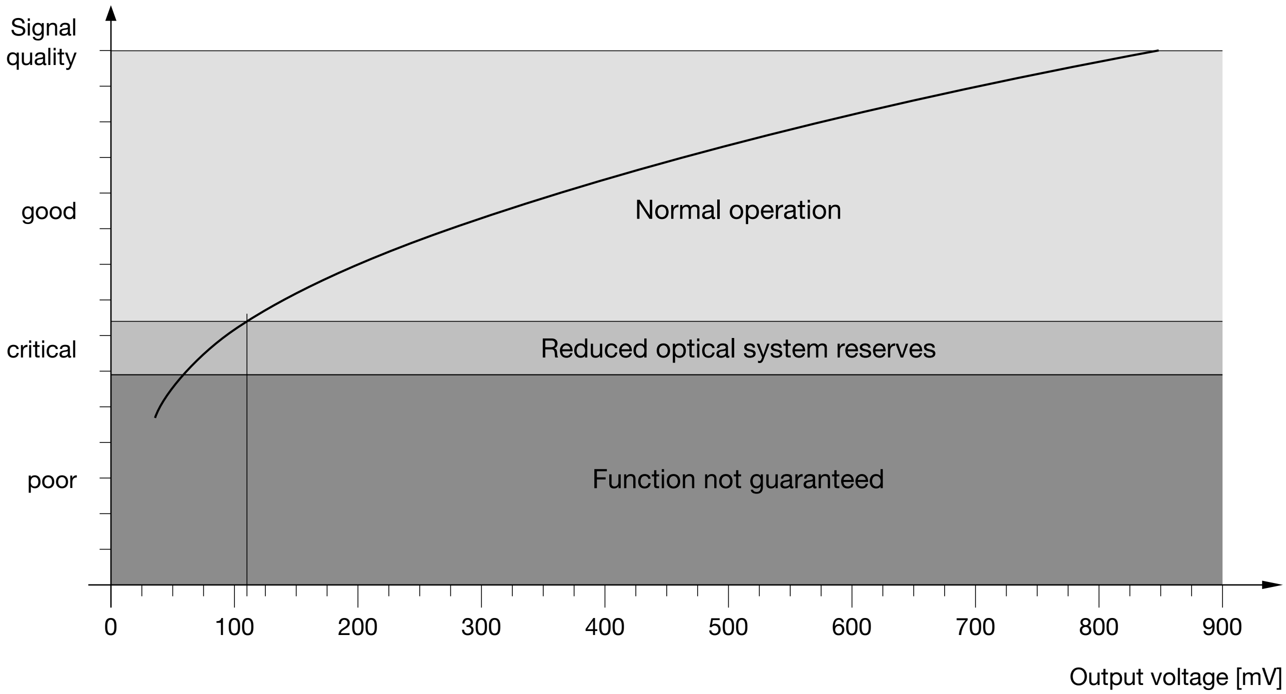


Diagram 1: Assignment of measured output voltage to signal quality.

Notes:
In order to attain a valid reading, it is necessary for the partner OLM at the other end of the optical fiber to send regular PROFIBUS frames. This can be seen on the LED display of the partner OLM (see 5, ”LED Indicators and Troubleshooting“, p. 25).

The output voltage at the measuring sockets is subject to many influencing factors, such as:

- the strength of the transmitting power of the partner OLM
- the ambient temperature of the optical sender and receiver
- attenuation of the transmitting link
- the transfer rates being used

The measuring sockets are therefore not intended as a substitute for a calibrated level measuring device with a calibrated light source.
The readings taken should only serve to classify the optical signal being received in the 3 classes

- good (normal operation)
- critical (reduced optical system reserves)
- poor (function not guaranteed)

Measurements must be taken with a conventional ungrounded and high-resistance voltmeter. A connection to the OLM housing is not permitted either from the measuring sockets or the reference potential.

8.5 SIMATIC NET - Support and Training

SIMATIC Training Centers

We offer courses designed to enable you to familiarize yourself with the SIMATIC S7 automation system. Please contact your regional Training Center or the Central Training Center in 90327 Nuremberg, Germany.

Internet: http://www.ad.siemens.de/training

E-Mail: AD-Training@nbgm.siemens.de

SIMATIC Customer Support Hotline

Available worldwide 24 hours a day:

Nuremberg (Nürnberg)
SIMATIC BASIC Hotline
Local time: Mo - Fr 8:00 to 18:00
Telephone: +49 (911) 895-7000
Fax: +49 (911) 895-7002
E-Mail: simatic.support@nbgm.siemens.de

Johnson City
SIMATIC BASIC Hotline
Local time: Mo - Fr 8:00 to 17:00
Telephone: +1 423 461-2522
Fax: +1 423 461-2231
E-Mail: simatic.hotline@sea.siemens.com

Singapore (Singapur)
SIMATIC BASIC Hotline
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Telephone: +65 740-7000
Fax: +65 740-7001
E-Mail: simatic.hotline@sae.siemens.com.sg

SIMATIC Premium Hotline
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Time: Mo - Fr 0:00 to 24:00
Telephone: +49 (911) 895-7777
Fax: +49 (911) 895-7001

SIMATIC Customer Support On-line Services

The SIMATIC Customer Support offers you comprehensive additional information about SIMATIC products with its on-line services:

- General current information is available on the Internet at
  http://www.ad.siemens.de/net
- Current product information and downloads, which could be useful when using our products, are available on the Internet at
  http://www.ad.siemens.de/csi/net

Source for special cables

Special cables and cable lengths for all SIMATIC NET cables are available on request from

A&D SE V22
WKF Fürth, Germany
Mr. Hertlein
Telephone: +49 (911) 750-4465
Fax: +49 (911) 750-9991
E-Mail: juergen.hertlein@fthw.siemens.de

Further support

If you have any more questions about SIMATIC NET products, please contact your Siemens contact partner at your local or regional branch office.

The addresses can be found
– in our catalogue IK 10
– on the Internet at http://www.ad.siemens.de

Siemens AG
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Printed in Germany

SIEMENS

SIMATIC NET

PROFIBUS Optical Bus Terminal (OBT)

Manual

Contents

C79000-G8976-C122-02

Release 2

Safety Guidelines

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:

Danger

indicates that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage **can** result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified Personnel

Only **qualified personnel** should be allowed to install and work on this equipment Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct Usage

Note the following:

Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

Trademarks

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Third parties using for their own purposes any other names in this document which refer to trademarks might infringe upon the rights of the trademark owners.

Disclaimer of Liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Siemens AG
Bereich Automatisierungstechnik
Geschäftsgebiet Industrie-Automatisierung
Postfach 4848, D-90327 Nürnberg

Siemens Aktiengesellschaft

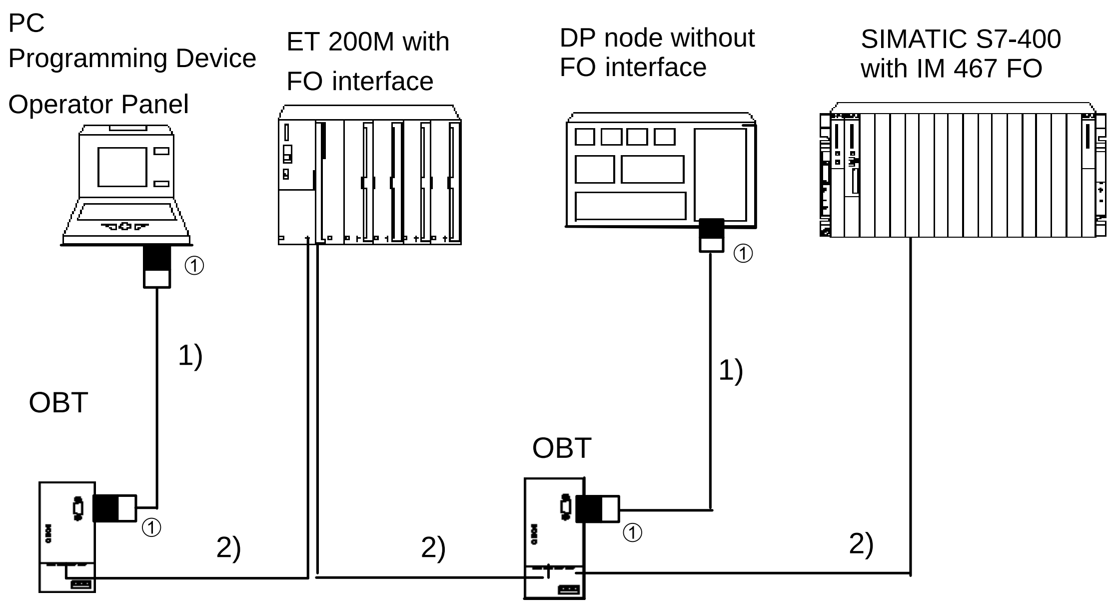
Order no. C79000–G8976–C122

Contents

Introduction

1

The PROFIBUS OBT (Optical Bus Terminal) is a network component for use in optical PROFIBUS DP fieldbus networks. It allows the attachment of a single device without an integrated optical interface to the optical PROFIBUS DP. The following figure illustrates a typical configuration.



① Terminating resistor activted
1) PROFIBUS cable (terminated at both ends)
2) Plastic FO cable or PCF FO cable with two fibers

Figure 1-1 Example of an Optical PROFIBUS DP Configuration

Connections

The connection between the individual nodes takes the form of an optical bus with two-fiber plastic FO cables (plastic fiber-optic cables are also known as POF, Polymer Optical Fiber) or PCF FO cables (PCF = Polymer Cladded Fiber, corresponds to HCS™ [1] fiber-optic cable). Since fiber-optic cables are completely insensitive to electromagnetic disturbance, no grounding concept whatsoever is necessary. For the same reason, equipotential bonding is also not necessary. The optoelectronic conversion provides automatic isolation so that differences in potential as can occur in extensive systems have no effect.

1) HCS™ is a registered trademark of Ensign-Bickford Optics Company and stands for “Hard Polymer Cladded Silica Fiber”.

Sensitivity

Just as fiber-optic cable is insensitive to electromagnetic noise, a fiber-optic cable emits no electromagnetic noise into the environment. Sensitive electronic devices close to the fiber-optic cable therefore need no additional protection or noise suppression.

Power Supply

The OBT requires an operating power supply of 24 V direct voltage that is connected via two terminal screws.

Operating Mode

LEDs signal the current mode and any problems in operation.

Mechanical Design

The optical bus terminal consists of a compact plastic casing which can be installed either on a standard rail or on any flat surface.

The SIMATIC NET PROFIBUS OBT Product 2

Supplied

1 x PROFIBUS OBT

1 x order form for the PROFIBUS OBT operating instructions

Not supplied

- Plastic fiber–optic cable, can be purchased by the meter
- Tools for connectoring fiber-optic cables
- PROFIBUS OBT operating instructions
- Fiber-optic cable connectors

3 Functional Description

The OBT is a repeater with 3 channels.

3.1 Interfaces

The OBT has the following interfaces for attachment to PROFIBUS DP segments:

- Channel 1 (CH1) is an electrical RS-485 interface. This is implemented as a 9-pin D SUB female connector. A single PROFIBUS DP node can be connected via this channel or a PC, PG or OP can be connected to the OBT. The maximum permitted segment length is 100 m. The copper segment should, however, be kept as short as possible since disturbances can be coupled into the optical PROFIBUS DP from this segment.
- Channel 2 (CH2) and channel 3 (CH3) are optical interfaces. They are designed as duplex sockets. The end of a two-fiber plastic or PCF fiber-optic cable with two simplex connectors is connected to each of these duplex sockets.

The OBT also has a block with three terminals for connecting the 24 V power supply and, if necessary, a grounding conductor.

3.2 Optoelectric Signal Conversion and Signal Regeneration

The OBT converts the RS-485 level signal received at channel 1 into an optical signal level that is then output via channel 2 and channel 3.

Signals received in channel 2 or 3 are converted to electrical signals and

- output on channel 1 as an electrical signal
- changed back to an optical signal and then output again on the other optical channel.

The receive channels have no echo, in other words received signals are not sent back on the same channel.

The OBT regenerates the signals in amplitude and time. This allows up to 126 modules to be cascaded in an optical bus. The cascading depth is limited solely by the monitoring times of the attached devices.

The propagation delay per OBT is 6 bit times.

3.3 Automatic Transmission Rate Detection

The OBT supports all PROFIBUS transmission rates (12 Mbps , 6 Mbps, 3 Mbps, 1.5 Mbps, 500 Kbps and 187.5 Kbps, 93.75 Kbps, 45.45 Kbps, 19.2 Kbps, 9.6 Kbps).

The transmission rate is detected automatically. No settings are necessary.

3.4 Supported FO Fiber Types

The OBT supports the fiber types listed in the table below:

Table 3-1 Distance Covered by Fiber-optic Cable between Two Devices on the Optical PROFIBUS DP

Fiber Type	Distance Between Two Devices
Plastic FO 980/1000 µm with 2 fibers and max. 200 dB/km cable attenuation	0.1 m to 50 m
PCF FO 200/230 µm with 2 fibers and max. 10 dB/km cable attenuation	0 m to 300 m

The specified distances between the devices assume that the partner devices use the same optical components as the OBT. This is, for example, the case with the IM 153-2 FO, IM 467 FO and OLM 12M.

The transmission rate is independent of the type of fiber used and the cable length. It can be up to 12 Mbps.

The following accessories are available:

- Plastic FO cable (sold in meters), connectors, polishing set and tools for connectoring plastic FO cables
  The plastic fiber-optic cables are supplied with connectors. The plastic simplex connectors can be fitted with the available tools on site.
- PCF FO cable (with connectors)
  PCF cables in fixed lengths are available with 4 simplex connectors already fitted.

3.5 Displays

The OBT has 4 LEDs for displaying the various states.

L+ 24V (green)

Unlit:	No power supply or internal power supply is defective or short-circuited
Flashes:	Power supply present; Transmission rate not yet set
Lit green:	Transmission rate set, power supply O.K.

CH1, CH2 , CH3 (channel 1 to 3, yellow)

Unlit:	No data being received
Lit yellow:	Data being received

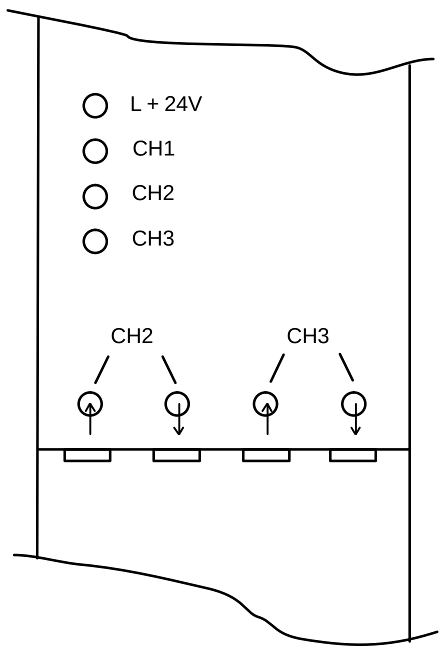


Figure 3-1 LED Displays on the Front Panel

3.6 Operator Controls

The OBT itself does not have operator controls. Care must simply be taken that the PROFIBUS connecting cable (not supplied) attached to Channel 1 is terminated at both ends.

4 Network Topology

4.1 Optical Bus

The OBT is operated in conjunction with other SIMATIC devices, for example the IM 153-2 FO or IM 467 FO on the optical PROFIBUS DP in the form of an optical bus.

Individual PROFIBUS DP nodes with an RS-485 interface are connected to channel 1 of the OBT via a maximum 100 m long PROFIBUS cable with bus connectors fitted at both ends. The terminating resistors on the bus connectors must be activated. An active or passive PROFIBUS DP node can be connected.

The OBT can be included at any point in the optical bus. If it is included at the start or end, the unused optical channel must be closed with the rubber plug supplied. This prevents contamination of the optical elements and disturbances caused by light entering the module.

The connection forming the optical bus is a two-fiber plastic FO cable (maximum length 50 m) or PCF FO cable (maximum length 300 m). The fiber-optic cables have two simplex connectors at each end.

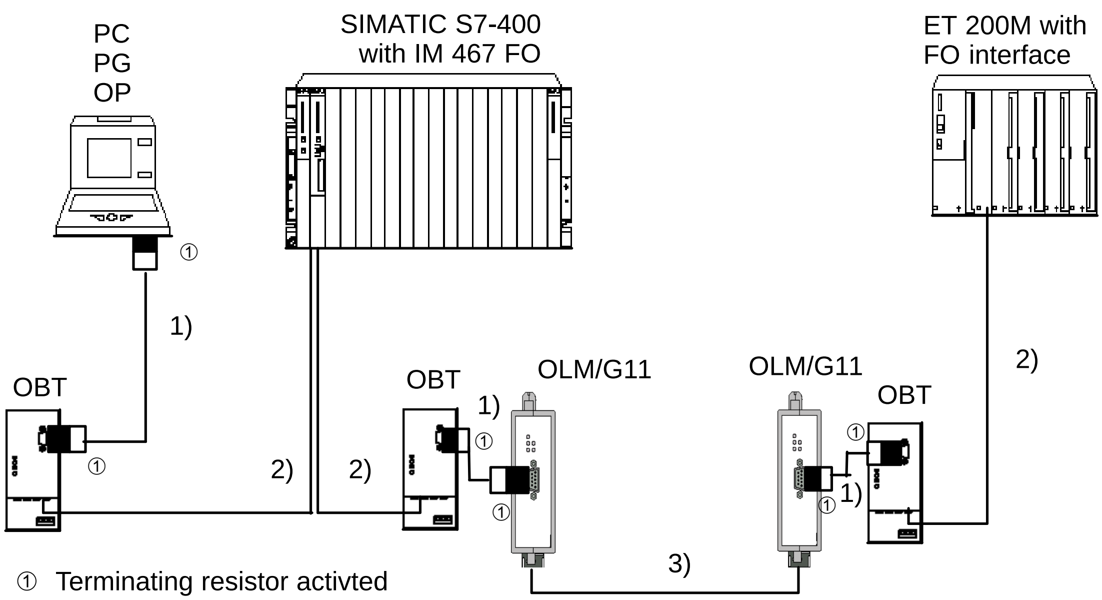
The fiber-optic connection between two devices is established by connecting the optical sender of one device with one fiber to the optical receiver of the other device and the optical receiver of the one device to the optical sender of the other device (cross-over connection).

If an OBT or a fiber-optic cable fails, the entire network becomes two subnets. Depending on the location of the problem, individual devices may no longer be accessible.

The OBT does not support the creation of single-fiber rings, of monitored optical busses or redundant ring structures.

4.2 Using Long Fiber Optic Sections

The maximum permitted length of PCF FO cables with the OBT is 300 m. If longer distances are required with fiber-optic cables, then other fiber-optic types such as graded glass fibers or monomode fibers are necessary and these can be used in a combination of OBT with OLM (Optical Link Module). The OBT is then connected electrically to the OLM (for example OBT/CH 1 to OLM/CH 1) and the OLM is attached to the long fiber-optic section. At the other end of the fiber-optic section, the arrangement is reversed by another OLM/OBT pair.



① Terminating resistor activted

1) PROFIBUS cable (terminated at both ends)
2) Plastic FO cable or PCF FO cable with two fibers
3) FO cable for long distances

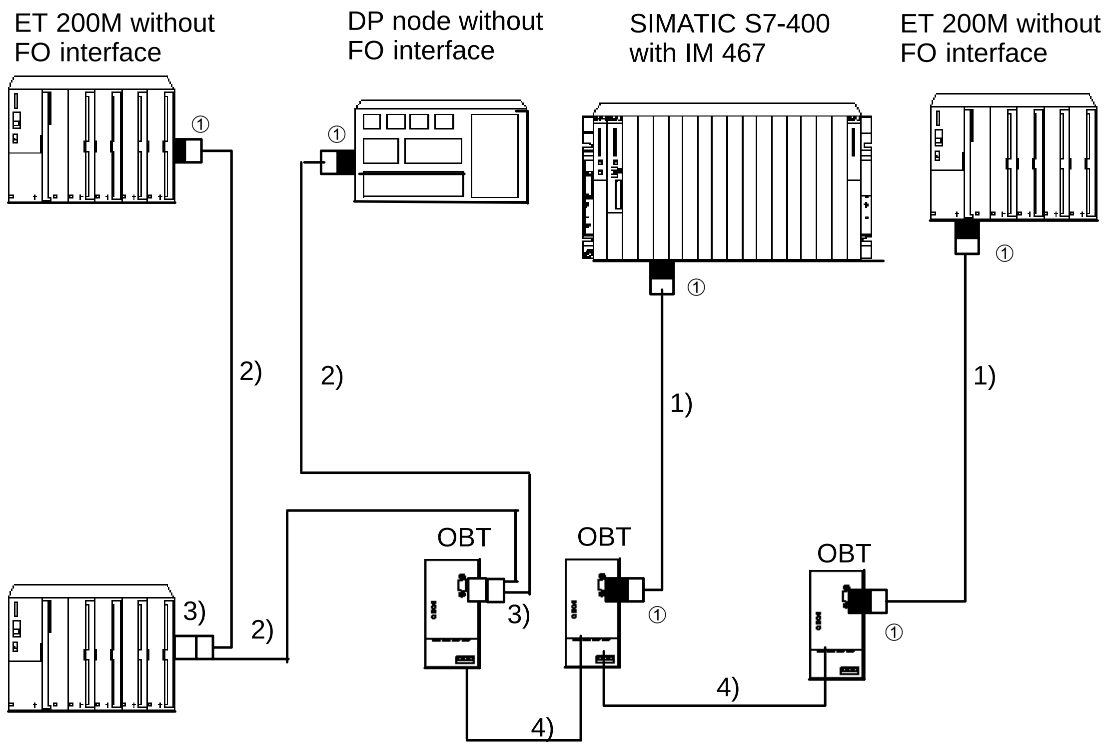
Figure 4-1 Example of Including Long Fiber-optic Segments with OBT and OLM

The maximum permitted transmission rate and the type and maximum length of the fiber-optic segment are determined by the OLM type.

4.3 Attaching RS-485 Segments

The OBT allows the attachment of a single PROFIBUS DP node. To attach RS-485 segments with more than one node, a further network component is available, the OLM 12M. The requirement for using the OLM 12M is that the PROFIBUS DP network is operated at a transmission rate of 187.5 Kbps, 500 Kbps, 1.5 Mbps or 12 Mbps.

The optical channels of the OLM 12M can be connected as follows with the OBT or with other SIMATIC devices on the optical PROFIBUS DP:
The connection is established with a two-fiber plastic FO cable (maximum length 50 m) or PCF FO cable (maximum length 300 m). The fiber-optic cable has two simplex connectors at each end. The optical channel of the OLM 12M connected to the OBT must be operated in the “Line“ mode with the monitoring deactivated.



① Terminating resistor activted

1) PROFIBUS cable
(terminated at both ends)
2) PROFIBUS cable
3) PROFIBUS connector (not terminated)
4) Plastic FO or PCF FO with two fibers

Figure 4-2 Example of Attaching RS-485 Segments

Installation and Startup 5

Note

Use the PROFIBUS OBT only as described in this manual.

Note

Pay particular attention to all warnings and safety–related instructions.

Note

The PROFIBUS OBT must only be operated with a safety extra-low voltage (SELV) complying with IEC 950/ EN 60 950/ VDE 0805 with a maximum of +32 V (typically +24 V). The power source must comply with the regulations of NEC class 2 according to the UL/CSA approval.

Note

Do not look directly into the opening of the optical transmitter diode. The emitted light could injure your eyes.

Danger

Never connect the PROFIBUS OBT to a power supply of 110 V – 240 V.

Note

Select the installation location so that the climatic limit values listed in the technical specifications can be adhered to.

Note

The RS-485 channel CH1 of the PROFIBUS OBT is electrically isolated from the 24V input. This isolation is required for correct functioning and is not a safety measure.

Note

Make sure that the PROFIBUS OBT is adequately grounded by connecting the rail or mounting plate to local ground with low resistance and low inductance.

Note

As the RS-485 cable, use only LAN cables approved for PROFIBUS.

Note

Do not open the OBT casing.

5.1 Precedure for Installation

Installation of the PROFIBUS OBT involves the following steps:

- Installing the PROFIBUS OBT
- Connecting the power supply
- Connecting the optical cables
- Attaching the electrical RS-485 LAN cable.

5.2 Installation

Installing the PROFIBUS OBT

PROFIBUS OBT can be installed either on a 35 mm standard rail with a height of 15 mm in compliance with DIN EN 50 022 – 35 x 15 or directly on a level surface.

- Select the installation location so that the climatic limit values listed in the technical specifications can be adhered to.
- Make sure there is enough space for connecting the bus and power supply cables.
- Install the modules only on a low-resistance and low-inductance grounded standard rail or mounting plate. If you secure the modules on a mounting plate, make sure that as short a cable as possible leads from the ground terminal of the OBT to the nearest possible ground point.

Installation on a Standard rail

- Fit the upper catch of the module onto the standard rail and push in the lower part of the module as shown in Figure 5-1 until it audibly clicks into position.
- The module is removed by pulling down the locking bar.

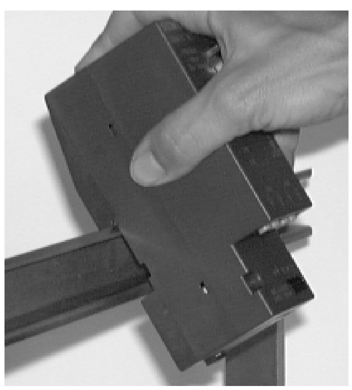


Figure 5-1 Installation of a Module on a Standard Rail

Installation on a Mounting Plate

PROFIBUS OBTs have two holes drilled in them. This allows them to be installed on any flat surface, for example on the mounting plate of a cubicle.

- Drill two holes in the mounting plate as shown in the drill template in Figure 5-2.
- Secure the modules with machine screws (for example M3 x 75 and M3 x 55).
- Use a grounding conductor with at least 2.5 mm^2 to establish a reliable electrical connection between the PE terminal of the module casing and the grounded mounting plate.

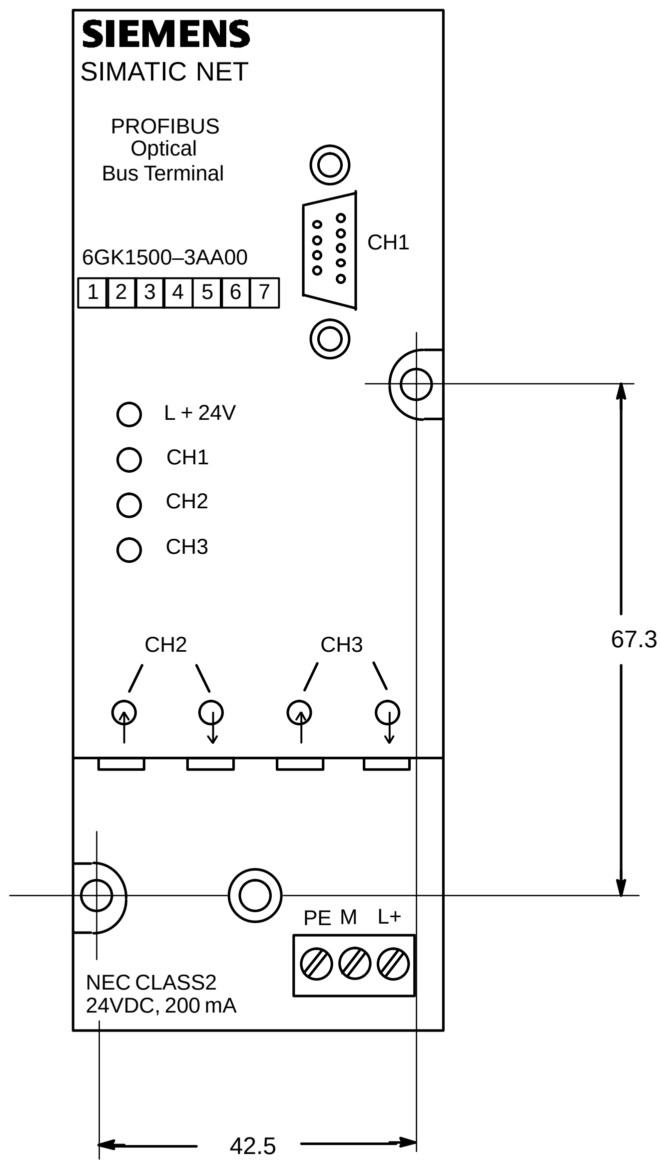


Figure 5-2 Installing a Module on a Mounting Plate

Instructions for Connectoring Plastic Fiber–Optic Cables (with photos)

You can download a detailed instruction brochure with photos illustrating how to connector plastic fiber–optic cables from the Internet:

- German: http://www.ad.siemens.de/csi/net
- English: http://www.ad.siemens.de/csi_e/net

Select SEARCH on this page and enter the number 574203 in the Entry ID box and start the search.

Connecting the Power Supply

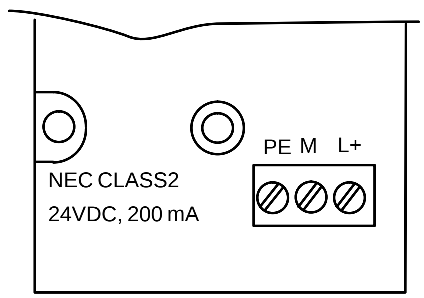


Figure 5-3 Layout of the Terminal Block – Ground Terminal PE and Power Supply Terminals M, L+

- The power supply for the PROFIBUS OBT must be a stabilized safety extra-low voltage complying with IEC 950 / VDE 0805, minimum +18 V and maximum +32 V (typically +24 V). The power source must meet the specifications of NEC class 2 to comply with the UL/CSA approval. The unit is intended to be installed on the load side of the class 2 or class 3 power source as defined by the National Electric Code (NEC), Article 725–2

  The module must be wired correctly according to the National Electrical code (NEC) complying with NEC Article 725–52, 725–54, 725–61 and 725–71.

- If the PROFIBUS OBT is not installed on a grounded rail, a grounding conductor with a cross-section of 2.5 mm^2 should be connected from the PE terminal to the nearest possible ground point.

Connecting the Optical Cables

Figure 5-4 View of the Module from Below with the Optical Channels CH2 and CH3

A = CH2, optical receiver

B = CH2, optical sender

C = CH3, optical receiver

D = CH3, optical sender

- Connect the individual PROFIBUS OBTs using a duplex FO cable, fitted with two pairs of simplex connectors.
- Make sure that in each case an optical input is connected to an optical output (crossover).
- Make sure that there is reliable strain relief for the FO cable and do not bend the cable beyond the minimum bending radius.
- Close unused FO sockets with the plastic plugs provided. Extraneous light, particularly when it is extremely bright can cause disturbances on the PROFIBUS network.
- Remember the minimum and maximum length of the FO cable and the permitted fiber types specified in Table 1 and in the technical specifications.
- You should also make sure that no dust can enter the optical components. Dust in optical components can make them unusable.
- The fibers of the cable must be flush with the front surface of the connector.

Note

If the fiber protrudes beyond the surface of the connector, the connector must not be inserted into the socket otherwise the optical components can be permanently damaged.

Connecting the Electrical RS–485 Cable

Channel CH1 is used to connect a single PROFIBUS DP DTE. CH1 is designed as an electrical RS 485 interface with a 9-pin sub D female connector. The maximum cable length between the OBT and DTE is 100 m. Since this involves a point-to-point connection, the terminating resistors in the PROFIBUS connectors must be activated at both ends of the cable.

Use only SIMATIC NET shielded Twisted Pair cables as the RS 485 cable for PROFIBUS.

Do not connect RS 485 cables when all or part of the cable is outside a building. Lightning in the area can otherwise destroy the PROFIBUS OBTs. If connections exit the building, use FO cables whenever possible!

Remove the RS 485 cable from the OBT if there is no node connected to the other end of the cable. Noise can lead to problems on the PROFIBUS network.

6 Troubleshooting

Table 6-1

LED Display	Possible Cause of Problem
L+ 24V LED not lit	- Power outage - OBT defective
L+ 24V LED flashing	- The transmission rate could not be set
CH1 LED not lit	- Break on one or more wires of the RS-485 LAN cable - Wires A and B of the RS-485 LAN able connected to wrong terminals - Attached PROFIBUS node is defective or not sending - PROFIBUS node not attached or attached node is not turned on
CH1 LED lit But PROFIBUS nodes signaling bus problems	- Wires A and B of the RS-485 LAN able connected to wrong terminals - Short-circuit on the RS-485 LAN cable - Break on one of the wires of the RS-485 LAN cable and wires A and B connected to wrong terminals - No or wrong termination
CH2, CH3 LED not lit	- Send and receive FO cords swapped over - Break on FO cord receiving receiving from partner module - No partner module connected or partner module is not turned on - Attached partner module is defective (not sending)
CH2, CH3 LED lit But PROFIBUS nodes signaling bus problems	- FO connector is loose - FO cable distance to next module too long - Receive FO cord interrupted and disturbance caused by extraneous light

If none of the LEDs indicates a problem and you still encounter communication problems (for example no confirmation, unexpected frames), check the monitoring times set on the PROFIBUS nodes (such as the Slot Time).

For more detailed information on these parameter settings, refer to the description of your PROFIBUS DTEs and the configuration software.

7 Technical Specifications

Table 7-1 Technical Specifications

Technical Specifications	
Power supply (safety extra–low voltage with reliable isolation, SELV or complying with NEC Class 2)	24 VDC (18 V to 32 V)
Power consumption at 24 V input	max. 200 mA
Transmission rate	12 Mbps, 6 Mbps, 3 Mbps, 1.5 Mbps, 500 Kbps, 187.5 Kbps , 93.75 Kbps, 45.45 Kbps, 19.2 Kbps, 9.6 Kbps
Transmission rate setting	made automatically
Mode	optical bus
Bit error rate	$<10^{-9}$
Input channel 1 to channel 3 Bit length Jitter	 0.7 to 1.3 tBit -0.03 to +0.03 tBit
Output channel 1 to 3 Bit length Jitter	 0.99 to 1.01 tBit -0.003 to +0.003 tBit
Signal delay time (any input/output)	≤ 6 tBit
Cascading depth of optical bus	limited only by signal run time
Electrical channel	
Input/output signal	RS–485 level
Input dielectric strength	-7 V to +12 V
Minimum current at 5V (for terminating resistors)	10 mA
Electrical isolation from 24V input	Isolation due to function; **not safety–related!**
Optical channels	
Optical source	LED
Coupled optical power – in plastic fiber 980/1000 – in PCF fiber 200/230	$P_{T(min)}$ $P_{T(max)}$ – 5.9 dBm +0.5 dBm – 16 dBm –1.5 dBm
Receiver sensitivity – with plastic fiber 980/1000 – with PCF fiber 200/230	$P_{R(min)}$ $P_{R(max)}$ –20 dBm 0 dBm –22 dBm –2 dBm

Wavelength	640 nm to 660 nm
Permitted FO cable attenuation (with link power margin) – for plastic fiber 980/1000 – for PCF fiber 200/230	 13 dB 3 dB
Transmission distance with 3dB link power margin – with plastic fiber 980/1000 with max. 200 dB/km cable attenuation – for PCF fiber 200/230 with max. 10 dB/km cable attenuation	 0.1m to 50m 0 m to 300m
FO connector	Simplex / duplex

Electromagnetic compatibility (EMC)	
Noise emission	Limit class A (EN 55022)
Immunity to static discharge	On shield connection and casing: ±6 kV contact discharge (IEC 1000–4–2)
Immunity to high frequency interference	10 V/m at 80% amplitude modulation at 1kHz, 80MHz – 1GHz (ENV 50140; IEC 61000–4–3) 10V/m at 50% on time at 900MHz (ENV 50 204) 10 V/m at 80% amplitude modulation at 1kHz, 10kHz – 80MHz (ENV 50141)
Immunity to conducted interference (burst)	On power supply cables and shielded RS 485 LAN cables: ±2 kV (IEC 61000–4–4)
Immunity to conducted interference (surge)	On power supply cables: ±1 kV balanced On shielded RS 485 LAN cables: ±2 kV unbalanced (IEC 61000–4–5)
Safety	
VDE requirements	VDE 0806=EN60950 and IEC950
UL/CSA approval	complying with UL1950/CSA950
Climatic conditions	
Ambient temperature	0 °C to +60 °C (IEC 68–2–1, IEC 68–2–2)
Storage temperature	-40 °C to +70 °C (IEC 68–2–14)

Relative humidity	< 95% (no condensation) (IEC 68–2–30)
Mechanical conditions	
Vibration during operation	10 to 58 Hz, 0.075 mm deflection 58 to 150 Hz, $10 m/s^2$ (1g) acceleration (IEC 68–2–6)
Vibration during transportation	5 to 9 Hz, 3.5 mm deflection 9 to 500 Hz, $10 m/s^2$ (1g) acceleration
Type of protection (with external fusing ≤ 8A)	IP 30
Weight	400 g
Dimensions	50.5 x 138 x 78 mm
Casing material	Noryle anthracite

Notes on the CE Label 8

Product Name:

Optical Bus Terminal PROFIBUS OBT, Order no.: 6GK1500–3AA00

EU Directive EMC 89/336/EEC

The product listed above meets the requirements of the EU directive 89/336/EEC “Electromagnetic Compatibility” in an industrial environment.

Area of application	Requirements	
	Noise emission	Noise immunity
Industrial	EN 50081–2 : 1993	EN 50082–2 : 1995

Conformity Certificates

The EU conformity certificates are available for the relevant authorities according to the EU directive and are kept at the following address:

Siemens Aktiengesellschaft
Bereich Automatisierungstechnik
Industrielle Kommunikation (A&D PT2)
Postfach 4848
D–90327 Nürnberg
Germany

Installation Instructions

The product meets the requirements above when it is installed and operated according to the instructions in the Optical Bus Terminal PROFIBUS OBT documentation.

The accessible radiated power of the transmitting LEDs used complies with class 1 EN 60825–1:1994 + A11:1996 or IEC 60825–1:1993 incl. amendment 1:1997 LED class 1

The accessible radiated power if the fiber cable is opened accidentally or deliberately corresponds to degree of danger 1 in compliance with EN 60825–2:1994 or 60825–2:1993

Information for Manufacturers of Machines

The product remains a component according to article 4(2) of the EU directive on machines 89/392/EEC.

According to the directive on machines, we are obliged to point out that this product is intended solely for installation in a machine. Before the final product can be put into operation, it must be tested for compliance with the directive 89/392/EEC.

Notes for Australia

SIMATIC NET OBT meets the requirements of AS/NZS 2064 (Class A) standard.

References

9

/1/ Wrobel, Christoph (Herausgeber):
“Optische Übertragungstechnik in industrieller Praxis”, Hüthig Buch Verlag GmbH, Heidelberg 1994

/2/ G. Mahlke, P Gössig:
“Lichtwellenleiterkabel: Grundlagen, Kabeltechnik”
3. Auflage, Berlin 1992

SIMATIC NET PROFIBUS is based on the following standards and directives

/3/ EN 50170–1–2: 1996
General Purpose Field Communication System
Volume 2 : Physical Layer Specification and Service Definition

PROFIBUS Users Organization:

/4/ PROFIBUS Implementation Instructions for DIN 19245 Draft Part 3
Version 1.0 dated 14.12.1995

/5/ EIA Standard RS–485 (April 1983):
“Standard for electrical characteristics of generators and receivers for use in balanced digital multipoint systems”

/6/ SIMATIC NET Manual for PROFIBUS Networks
SIEMENS AG order number: 6GK19705AC10–0BA0

/7/ SIMATIC NET Industrial Communication Catalog IK10
SIEMENS AG
Bereich Automatisierungstechnik
Geschäftszweig Industrielle Kommunikation SIMATIC NET
Postfach 4848
D–90327 Nürnberg
Germany

8/ SIMATIC NET Product Information Installation Instructions for SIMATIC NET PROFIBUS
Plastic Fiber Optic with Simplex Connectors
These instructions can be downloaded from the Internet
– German: http://www.ad.siemens.de/csi/net
– English: http://www.ad.siemens.de/csi_e/net
Select SEARCH on this page and enter the number ”574203” in the “Entry ID” box and start the search.

/9/ SIMATIC NET Description and Operating Instructions OLM 12M
SIEMENS AG order number: 6ZB5530–3AB00–0BA0

Abbreviations 10

DIN	Deutsche Industrie Norm (German industrial standard)
ESD	Electrostatic discharge
EN	European standard
EMC	Electromagnetic compatibility
FO	Fiber–optic
IEEE	Institute of Electrical and Electronic Engineers
ISO/OSI	International Standards Organization / Open System Interconnection
HCS™	HCS™ is a registered trademark of Ensign–Bickford Optics Company and stands for “Hard Polymer Cladded Silica Fiber”. In these instructions, only the general term PCF is used.
LAN	Local Area Network
LED	Light Emitting Diode
OBT	Optical Bus Terminal
OLM	Optical Link Module
PCF	Polymer Cladded Fiber, synonymous with HCS™ fiber
POF	Polymer Optical Fiber; synonymous with plastic FO cable
PROFIBUS DP	PROFIBUS Distributed I/Os
SELV	Safety extra–low voltage
UL	Underwriter Laboratories
VDE	Verein Deutscher Elektroingenieure (association of German electrical and electronics engineers)

An
Siemens AG
SIMATIC NET A&D PT2
Postfach 4848
D–90327 Nürnberg

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City, Zip Code _

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General Information

H

H.1 Abbreviations/Acronyms

Al	Aluminum
AS–Interface	Actuator–Sensor Interface
AWG	American Wire Gauge
BER	Bit Error Rate
BFOC	Bayonet Fiber Optic Connector
CP	Communications Processor
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
Cu	Copper
DIN	Deutsche Industrie Norm (German industrial standard)
DP	Distributed (peripheral) I/Os
ESD	Electrostatic discharge
EIA	Electronic Industries Association
EN	European standard
EMC	Electromagnetic compatibility
FC	Fast Connect
FMS	Fieldbus Message Specification
FO	Fiber Optics
FRNC	Flame Retardant Non Corrosive
HCS	Hard Cladded Silica
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
ILM	Infrared Link Module
ISO/OSI	International Standards Organization / Open System Interconnection
ITP	Industrial Twisted Pair

IR	Infrared
LAN	Local Area Network
LED	Light Emitting Diode
MPI	Multipoint Interface
NRZ	Non Return to Zero
OBT	Optical Bus Terminal
OLM	Optical Link Module
OP	Operator Panel
PCF	Polymer Cladded Fiber
PE	Polyethylene
PG	Programming device
PMMA	Polymethylmethacrylate
PNO	PROFIBUS User Organization
POF	Polymer Optical Fiber
PROFIBUS–DP	PROFIBUS distributed I/Os
PROFIBUS–PA	PROFIBUS Process Automation
PTB	Physikalisch–Technische Bundesanstalt (German official body)
PUR	Polyurethane
PVC	Polyvinylchloride
SELV	Safety Extra–Low Voltage (to EN 60950)
UL	Underwriter Laboratories
UV	ultraviolet
V	Value factor
VDE	Verein Deutscher Elektroingenieure (association of German electronics engineers)

References

I

Standards, Manuals and Further Information

/1/ EN 50170–1–2: 1996
General Purpose Field Communication System
Volume 2 : Physical Layer Specification and Service Definition

/2/ PNO Guideline:
PROFIBUS Implementation Guide to DIN 19245 Part 3 (Draft)
Version 1.0, dated 14.12.1995

/3/ PNO Guideline:
Fiber Optical Data Transfer for PROFIBUS
Version 2.1 dated 12.98

/4/ EIA RS–485: 1983
Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

/5/ IEC 61158–2 to 6: 1993/2000
Digital data communications for measurement and control – Fieldbus for use in industrial control systems

/6/ DIN VDE 0100 Teil 410
Errichten von Starkstromanlagen mit Nennspannungen bis 1000 V; Schutzmaßnahmen; Schutz gegen gefährliche Körperströme

and

DIN VDE 0100 Teil 540
Errichten von Starkstromanlagen mit Nennspannungen bis 1000 V; Auswahl und Errichtung elektrischer Betriebsmittel; Erdung, Schutzleiter, Potentialausgleichsleiter

/7/ DIN EN 60950,
Safety of information technology equipment including electrical office equipment
(IEC950; 1991, modified and IEC 950A1; 1992
German Version EN 60950; 1992 + A1: 1993
DIN Deutsches Institut für Normung e.V. Berlin

/8/ VG 95375, Teil 3
Elektromagnetische Verträglichkeit, Grundlagen und Maßnahmen für die Entwicklung von Systemen,
Teil 2: Verkabelung, Dezember 1994
DIN Deutsches Institut für Normung e.V. Berlin

/9/ SIMATIC S5 Distributed I/O System ET 200
SIEMENS AG
Order no. EWA 4NEB 780 6000–01c,
Version 4

/10/ SIMATIC S7–400 Programmable Controller
Installation and Application
Brochure
SIEMENS AG
Order no. 6ES7498–8AA00–8BB0,
Version 1

/11/ SIMATIC S7–300 Programmable Controller,
Hardware and Installation Manual
SIEMENS AG
Part of the “S7–300, M7–300 Documentation Package,
Order no. 6ES7 398–8AA02–8BA0”

/12/ SIMATIC S7-400, M7-400 Programmable Controller
Hardware and Installation Manual
SIEMENS AG
Part of the “S7–400, M7–400 Documentation Package,
Order no. 6ES7 398–8AA02–8BA0”

/13/ SIMATIC DP/PA Bus Coupling
Manual
SIEMENS AG
Order no. 6ES7157–0AA00–0BA0,
Version 2

/14/ S7–300, M7–300, ET 200M Modules with
Intrinsically Safe Signals
Reference Manual
SIEMENS AG
contained in the “Manual for S7–300 in the EXCi) Area, Installation Instructions and Module Data Sheets”
Order no. 6ES7 398–8RA00–8BA0

/15/ S7–300, M7–300, ET 200M Principles of Intrinsically–Safe Design
Manual
SIEMENS AG
contained in the “Manual for S7–300 in the EXCi) Area, Installation Instructions and Module Data Sheets”
Order no. 6ES7 398–8RA00–8BA0

Further Information

You will find further information on the topic of intrinsic safety and explosion protection in:

- Manual *S7-300, M7-300, ET 200M Modules with Intrinsically Safe Signals* (Order no. 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 1158-2 with PROFIBUS–PA, No. 2.091
  PROFIBUS User Organization e. V., Haid-und-Neu-Str. 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 10” and ”SIMATIC Programmable Controllers 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.

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SIMATIC NET – Support and Training

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SIMATIC Training Center

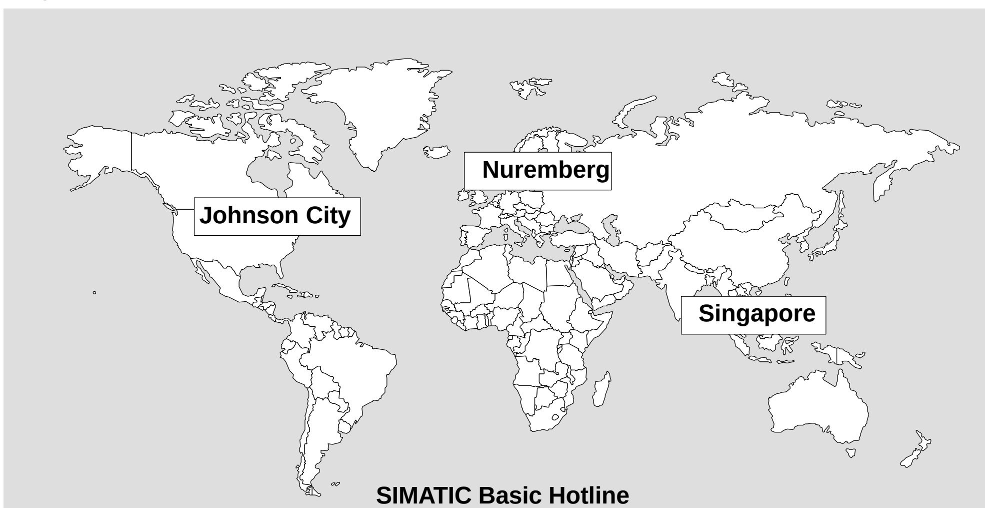
To help you to become familiar with the SIMATIC S7 automation system, we offer a range of courses. Please contact your regional training center or the central training center in D 90327 Nürnberg, Germany. Infoline: Tel. +49 180 523 5611 Fax. +49 180 523 5612

Internet: `http://www.ad.siemens.de/training`

E-mail: AD–Training@nbgm.siemens.de

SIMATIC Customer Support Hotline

Open round the clock, worldwide:



Nuremberg	Johnson City	Singapore
SIMATIC BASIC Hotline	**SIMATIC BASIC Hotline**	**SIMATIC BASIC Hotline**
Local time: Mo.-Fr. 8:00 to 18:00	Local time: Mo.-Fr. 8:00 to 17:00	Local time: Mo.-Fr. 8:30 to 17:30
Phone: +49 (911) 895-7000	Phone: +1 423 461-2522	Phone: +65 740-7000
Fax: +49 (911) 895-7002	Fax: +1 423 461-2231	Fax: +65 740-7001
E-Mail: simatic.support@ nbgm.siemens.de	E-Mail: simatic.hotline@ sea.siemens.com	E-Mail: simatic.hotline@ sae.siemens.com.sg

SIMATIC Premium Hotline

(Calls charged, only with SIMATIC Card)

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SIMATIC Customer Support Online Services

The SIMATIC Customer Support team provides you with comprehensive additional information on SIMATIC products in its online services:

- You can obtain general current information:
  - On the Internet at `http://www.ad.siemens.de/net`
  - Using fax polling no. 08765 - 93 02 77 95 00
- Current Product Information leaflets and downloads which you may find useful for your product are available:
  - On the Internet at `http://www.ad.siemens.de/csi/net`
  - Via the Bulletin Board System (BBS) in Nuremberg (*SIMATIC Customer Support Mailbox)* under the number +49 (911) 895-7100.

    To access the mailbox, use a modem with V.34 (28.8 Kbps) capability whose parameters you should set as follows: 8, N, 1, ANSI, or dial in using ISDN (x.75, 64 Kbps).

Ordering Special Cables, Accessories, and Tools

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

A&D SE V22
WKF Fürth
Hr. Hertlein
Tel.: +49 911 /750–4465
Fax: +49 911/750–9991
email: juergen.hertlein@fthw.siemens.de

Further Support

if you have further questions on SIMATIC NET products, please contact your Siemens representative in your local Siemens office.

You will find the addresses listed

- in our catalog IK 10
- on the Internet (http://www.ad.siemens.de)

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Glossary

Baud rate

–> Transmission rate

Bus

Common transmission path on which all nodes are connected; it has two defined ends.
In PROFIBUS, the bus is a twisted-pair cable or a fibre-optic cable.

Bus connector

Physical connection between the node and LAN cable.
In SIMATIC NET, there are bus connectors with and without sockets for the PG with the degree of protection IP 20.

Bus segment

→ Segment

Bus system

All stations that are physically connected via a LAN cable form a bus system.

Chassis ground

Chassis ground includes all the interconnected inactive parts of equipment that must not carry a hazardous voltage even in the event of a fault.

Configuring

Configuring means entering a PROFIBUS configuration with all the specific parameters using, for example, STEP 7 or COM PROFIBUS.

d.c. loop resistance

Total resistance of the outward and return line of a cable.

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.

Fiber-optic cable (FO)

A fiber-optic cable is a transmission medium in an 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 chekking whether there is another master in the GAP.
For example, 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.

Ground

Ground is the conductive ground area whose potential at any point can be taken as zero.

Grounding

Grounding means connecting a conductive part to ground via a grounding system.

GSD

Device data bases (GSD files) contain DP slave descriptions in a uniform format. The use of GSD files makes it easier to configure the master DP slave.

IP 20

Degree of protection complying with DIN 40050: Protection against touch with fingers and against the penetration of solid foreign bodies with more than 12 mm ∅.

IP 65

Degree of protection complying with DIN 40050: complete protection against touch, protection against the penetration of dust and protection against jet water from all directions.

IP 66

Degree of protection complying with DIN 40050: complete protection against touch, protection against penetration of dust and protection against damaging penetration of heavy seas or strong jet water.

IP 67

Degree of protection complying with DIN 40050: complete protection against touch, protection against penetration of dust and protection against damaging penetration of water at a certain pressure during immersion.

ITP

Industrial Twisted Pair; bus system based on the Twisted Pair standards IEEE 802.3i: 10BASE-T and IEEE 802.3j: 100BASE-T for industrial application.

Lightning arresters

are capable of diverting multiple lightning currents or parts of them without any damage occurring.

Lightning protection equipotential bonding

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

Master

When a master is in possession of the token, it can send data to other nodes and request data from other nodes (= active node).

Master-slave technique

Bus access technique in which only one node is the → 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).

Min_T_{SDR}

Min_T_{SDR} is a bus parameter and specifies the minimum protocol processing time of the responding node (station delay responder).

Node

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 fiber-optic 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.

PROFIBUS

PROcess FIeld BUS, European process and fieldbus standard specified in the PROFIBUS standard (EN 50 170, Volume 2, PROFIBUS).
This specifies the functional, electrical and mechanical characteristics of a bit-serial fieldbus system.
PROFIBUS is a bus system that networks PROFIBUS-compatible automation systems and field devices at the 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.
A PC/PG or the ET 200 Handheld have the PROFIBUS address ”0”.
Master and slaves have a PROFIBUS address in the range 1 to 125.

PROFIBUS-DP

PROFIBUS bus system with the DP protocol. DP stands for distributed peripheral I/Os.
The main task of PROFIBUS-DP is the fast, cyclic data exchange between the central DP master and the peripheral devices.

PROFIBUS-FMS

PROFIBUS bus system with the FMS protocol. FMS stands for Fieldbus Message Specification.

Reaction time

The reaction time is the average time that elapses between the change at an input and the corresponding change at an output.

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:
Medium 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

The voltages of circuits are considered and/or measured relative to this potential.

RS-485 repeater

Device for amplifying bus signals and coupling → segments over large distances.

Segment

The LAN cable between two terminating resistors forms a segment. A segment can contain a maximum of 32 bus attachments (–>nodes, –>RS-485 repeaters –>OLMs, ...). Segments can be interconnected by → RS-485 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 time

The time required by a data packet on its way through the network.

SIMATIC NET PC modules

SIMATIC NET PC modules are modules for coupling the PC to bus systems, such as PROFIBUS or Industrial Ethernet.

Slave

A slave can only exchange data with a → master after it has been request to send data by the 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 rail

Metal rail standardized in compliance with EN 50 022.
The standard rail is used for the snap-on 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 arresters

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

A resistor to terminate the LAN cable; terminating resistors are always necessary at the ends of the cable or segment.
In SIMATIC NET PROFIBUS, terminating resistors are activated or deactivated in the → bus connector or bus terminal or are installed as → terminators.

Terminator

A → 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 the masters physically connected to a bus receive the token and pass it on to the next master: the masters are located in a token ring.

Token rotation time

is the time that elapses between receiving the → token and receiving the next token.

Transmission rate

The transmission rate specifies the number of bits transferred per second. On PROFIBUS, transmission rates 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