SIEMENS

Industrial Communication

SIMATIC NET Industrial Ethernet Networking Manual

System Manual

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Safety Guidelines

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

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

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

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

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

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

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

Qualified Personnel

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

Prescribed Usage

Note the following:

⚠WARNING
This device 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. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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

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Postfach 48 48
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Preface

Target group and motivation

The networking manual accompanies you through all phases of preparation and implementation of network projects. It provides you with an overview of the structure and configuration of Industrial Ethernet networks with the aid of SIMATIC NET.

On the one hand, the target groups are decision makers and planners; with this documentation, they can gain an overview of the technical principles, the SIMATIC NET product range and the most important practical applications. On the other hand, it provides configuration engineers and commissioning personnel with extensive information and reference data to which they can refer when setting up their network systems.

Structure of the document

The networking manual consists of three parts, structured as follows:

Table 1 Structure of the Networking Manual

Part	Content and target group
Part A: Basics Chapters 1 and 2	This part is intended for decision makers and planners. The basics of network communication technology, the special features of Industrial Ethernet and the essential characteristics of SIMATIC NET products are presented in a readily understandable form. Particular emphasis is placed on the SCALANCE generation of devices. This part closes with a chapter introducing the most common network topologies and practical applications along with the components required for them. The chapter is not only instructive; you can also use it as a practical starting point for planning your own systems.
Part B: Product overview Chapters 3 to 5	The second part is also intended for decision makers and planners. This part introduces the entire product ranges of SIMATIC NET. Here, you will find the main characteristics of the SCALANCE generation of switches, security and wireless components - the emphasis being on their technical properties. OSM and ESM devices, passive components (such as cables and connectors) and accessories are also described.
Part C: Technical specifications and reference Chapters 6 to 12	The last part is intended for configuration engineers and commissioning personnel. You will find extensive reference data as required in the planning and commissioning of a system. The document contains dimension drawings, specifications, certifications and much more helpful information on SIMATIC NET components that will support you when setting up an actual plant or network.

Topics such as product properties or supported network topologies are therefore described more than once at various points in this book. The various aspects that are in the foreground for the reader at a particular point are then highlighted.

Operating Instructions and other documents

Despite every effort being made to provide a complete and thorough picture, the Industrial Ethernet Networking Manual cannot replace the Operating Instructions and reference documents of the individual devices and components. You will find the detailed documentation of the individual components on the Manual Collection DVD.

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Part A:

Target group and content

This part is intended for decision makers and planners.

The basics of network communication technology, the special features of Industrial Ethernet and the essential characteristics of SIMATIC NET products are presented in a readily understandable form. Particular emphasis is placed on the SCALANCE generation of devices.

This part closes with a chapter introducing the most common network topologies and practical applications along with the components required for them. The chapter is not only instructive; you can also use it as a practical starting point for planning your own systems.

Part A: Basics of communication with Industrial Ethernet

1

1.1 Terminology

"Industrial Ethernet"

The term "Industrial Ethernet" covers a series of expansions to the Ethernet standard (IEEE 802) with which communication suitable for an industrial environment is implemented. The main aims are as follows:

- Deterministic data transmission (guaranteed response times and data rates)
- Safeguarding against component failure
- Network topologies adapted to a particular plant with the emphasis on linear (bus), redundant network structures.

The components must meet the following requirements:

- Equipment designed for industry (signaling contacts, protected cables and cable connectors),
- Resistant to extreme conditions (temperature, vibration, pollution, electromagnetic interference etc.)

Figure 1-1 Industrial Ethernet Logo

"PROFINET"

PROFINET is the name of the standard for Industrial Ethernet developed and maintained by the PROFIBUS user organization. PROFINET unites **protocols** and **specifications** with which Industrial Ethernet meets the requirements of industrial automation technology.

These include, for example:

- Real-time conditions,
- Environment strongly affected by EMI,

- Demanding requirements for safety, reliability and availability.

This world is in stark contrast to an office environment where high data throughput and large-area networking are the main objectives. Further differences between the two network types can be found in the numbers and heterogeneity of the nodes and their intermeshing.

Figure 1-2 PROFINET Logo

SIMATIC NET

SIMATIC NET stands for a wide range of **network components** grouped under the motto "Totally Integrated Automation" to reflect the modern fully integrated implementation of automation solutions. PROFINET is the protocol used by SIMATIC NET components within the framework of Industrial Ethernet.

1.2 Industrial Ethernet

1.2.1 Basics of Industrial Ethernet

The special features of Industrial Ethernet

Ethernet was developed for the office environment and is subject to certain restrictions due to its origins. Industrial Ethernet therefore offers significant expansions of the Ethernet technology for the industrial environment:

- Protected investment due to continuous and compatible further development
- Network components for use in a tough industrial environment
- Fast assembly and commissioning on site with cabling technology suitable for industry
- High transmission performance even with large numbers of nodes thanks to the end-to-end availability of components with 100 Mbps transmission rates complying with Fast Ethernet and 1000 Mbps with Gigabit Ethernet (see below) on all network components
- Fulfillment of the most stringent real-time requirements due to software and hardware adaptation
- Integrated security concepts to protect against unauthorized access
- High availability of the networks due to redundancy functionality (for example ring redundancy) and redundant power supply
- Permanent monitoring of the network components with simple and effective signaling concept
- Almost unlimited communication performance with scalable performance available when necessary with switching technology.
- Networking of different areas of application such as office and production
- Data reservation in Industrial Wireless LAN (IWLAN)
- "Rapid Roaming" in Industrial Wireless LAN (IWLAN) for extremely fast handover of mobile nodes between different access points and therefore fast cyclic data communication (iPCF)
- Communication throughout the enterprise with the options of linking over WAN (Wide Area Network) such as ISDN or Internet
- Precise time stamping of events in the entire system with plant-wide timekeeping

By using switching technology, the network span is almost unlimited. Industrial Ethernet also provides the option of wireless communication that can be integrated seamlessly in the network structure. This means that information is available everywhere and at any time and mobile access via Industrial Wireless LAN to the intranet/Internet is possible. Security modules protect the network reliably from sabotage and espionage.

Industrial Ethernet uses data communication to exchange data between automation systems or between automation system and intelligent partners (for example PCs).

High-speed communications networks can be set up with Industrial Ethernet in linear bus, ring or start structures with large spans.

Fast Ethernet

Fast Ethernet is the further development of the Ethernet technology with data rates of 100 Mbps. The Fast Ethernet standard IEEE 802.3 u is based essentially on the classic Ethernet standard.

Ethernet and Fast Ethernet have the following common features:

- Data format
- Access Methods (Page 29)

They differ from each other in the following respects:

- Network span
- Rules for network design
- Autosensing, the automatic detection of the transmission rate
- Higher data rate (see below)

Gigabit Ethernet

Gigabit Ethernet is an expansion of the Ethernet specifications to increase the data transmission rate to 1000 Mbps or 1 Gbps. The relevant standards are IEEE 802.3z for transmission over glass fiber and IEEE 802.3ab for electrical cable. An even faster standard with 10 Gbps (IEEE 802.3an for electrical cable, IEEE 802.3 ae for fiber-optic cable) is currently being introduced.

Apart from making adaptations to the protocol, the increase in transmission speed is also achieved by the network nodes having suitably powerful ports and by the use of highly immune category "5e" twisted-pair cables on the electrical connections.

Restrictions of Industrial Ethernet

Despite these adaptations, Industrial Ethernet in this form would still be lacking certain properties that are of major significance for industrial applications. These include:

- Transmission mode and real-time response; in other words, it is guaranteed that frames are transferred within a specified time,
- Determinism; put simply: The same preconditions always lead to the same results and there are no undefined statuses,
- Fault-tolerance and redundancy with redundancy mechanisms that can compensate the failure of components.

These restrictions are overcome with PROFINET.

See also

Transmission procedures and real-time response (Page 26)

Fault tolerance and redundancy (Page 28)

1.2.2 PROFINET

1.2.2.1 Basics of PROFINET

The special features of Industrial PROFINET

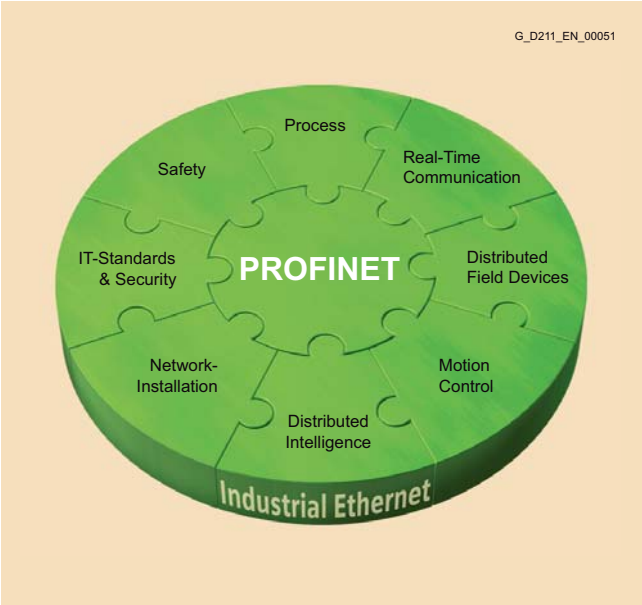

Figure 1-3 PROFINET overview

PROFINET is the innovative and open Industrial Ethernet standard (IEC 61918, for PROFINET also IEC 61784-5-3) for industrial automation.

PROFINET uses the existing IT standards and allows end-to-end communication from the field level to the management level as well as plant-wide engineering.

Real-time communication

PROFINET is based on Industrial Ethernet and uses the TCP/IP standard (Transport Control Protocol/Internet Protocol) for parameter assignment, configuration and diagnostics. Real-time communication for the transfer of user/process data uses the same cable. PROFINET can support the following real-time properties:

- With the option of prioritizing the bus nodes, *Real Time* (RT) uses the optimization or the communications stack in the switch. This allows high-speed data transfer with standard network components in automation.
- *Isochronous Real Time* (IRT): Hardware-supported real-time communication allows, among other things, isochronous data transfer with very short update times for highly dynamic motion control applications.

Distributed field devices

PROFINET allows the integration of distributed field devices (IO devices, for example signal modules) directly in Industrial Ethernet.

During the familiar configuration with STEP 7, these field devices are assigned to a central control unit (known as the IO controller). Existing modules or devices can continue to be used with PROFINET-compliant interface modules or links, guaranteeing the investments of PROFIBUS users: Fieldbus integration is simplified.

Fieldbus integration

PROFINET allows the simple integration of existing fieldbus systems. To allow this, a proxy is used; on the one hand this is the master of the PROFIBUS or AS-Interface system, on the other hand it is a node on Industrial Ethernet and supports PROFINET communication. This protects the investment of plant operators, machine and plant assemblers and device manufacturers.

Motion control

Based on PROFINET, isochronous real time (IRT) can be used to implement extremely fast isochronous mode drive controls for high-speed motion control applications without great effort.

The standardized drive profile PROFIdrive allows vendor-independent communication between motion controllers and drives, regardless of the bus system - Industrial Ethernet or PROFIBUS.

Standard IT functions can be used at the same time on the same cable without impairing real-time communication.

Distributed intelligence and machine-machine communication

PROFINET offers distributed automation on the basis of Component Based Automation – the modular solution for machine and plant assembly and installation. Machines and plants can be broken down into reusable, intelligent modules. Such modules include the mechanical parts, the electrical/electronic parts and the user program of a plant unit.

Network installation

With PROFINET, the network can be installed without any specialist knowledge. At the same time, the open standard based on Ethernet meets all the requirements relevant to an industrial environment. PROFINET allows the simple setup of the usual network topologies such as star, tree, linear bus and ring for increased availability using cabling designed for industry.

Wireless networks

PROFINET provides new functions and applications for wireless communication with Industrial Wireless LAN. This makes is possible to replace technologies subject to wear and tear such as slip rings and allows the use of automated guided vehicle systems or personalized operator control and maintenance devices. Industrial WLAN is based on standards but also offers additional features to allow high-speed linking of field devices to controllers:

- "Data reservation" is used to reserve bandwidth between an access point and defined clients. This guarantees high and reliable performance for this client regardless of the number of clients operating with the access point.
- "Rapid Roaming" for extremely fast handover of mobile nodes between different access points and therefore fast cyclic data communication (iPCF).

IT standards

Within the framework of Web integration, the data of PROFINET components are represented in HTML or XML format.

Regardless of the tool used, information at the automation level can be accessed with one of the commonly used Internet browsers from any location greatly simplifying commissioning and diagnostics. ("Web Based Management")

Security

PROFINET defines a graduated security concept that can be used without specialist knowledge and that largely excludes operator error, unauthorized access and manipulation without any detrimental effect on production. This functionality is provided by the SCALANCE S product family with software and hardware modules.

Safety

The safety profile PROFIsafe (complying with safety standard IEC 61508) that was tried and tested with PROFIBUS and that allows the transmission of standard and safety-oriented data on one bus cable can be used regardless of the bus medium. PROFIsafe is the first profile certified by the German TÜV for failsafe communication for Ethernet. This also allows wireless communication for failsafe applications with Industrial Wireless LAN.

PROFINET therefore allows the implementation of failsafe applications with end-to-end configuration in the entire network – whether planning new systems or upgrading existing systems.

Process

PROFINET is the standard for all applications in automation. With its integration in PROFIBUS, it also covers the process industry - even including hazardous areas.

See also

PROFINET communication services (Page 23)

1.2.2.2 PROFINET communication services

PROFINET IO and PROFINET CBA

PROFINET supports the PROFINET IO and PROFINET CBA communications services as well as various profiles such as PROFIsafe and PROFIdrive.

The PROFINET IO and PROFINET CBA communications services provide the functionality required by automation systems.

PROFINET IO

- PROFINET IO allows the direct connection of distributed field devices (IO devices, for example signal modules) to Industrial Ethernet. To further support failsafe applications, the devices communicate over PROFINET IO with the PROFIsafe profile.
- With PROFINET IO, you use the familiar SIMATIC software tools, for example STEP 7 for engineering and diagnostics at the field level and SIMOTION Scout for configuring motion control applications.
- With IRT communication (IRT: Isochronous Real Time), part of the transfer time is reserved for cyclic (deterministic) data transfer. This divides the communication cycle into a deterministic part and an open part.
- You can run both IRT and TPC/IP communication over the same network at the same time without one impairing the other.
- By supporting isochronous real-time communication, PROFINET provides the short and deterministic update times decisive for motion control applications.

PROFINET CBA

- With PROFINET CBA (Component Based Automation), you can implement a modular solution for your distributed automation system. With the component-based functionality of PROFINET CBA, you divide the automation system into independent modules. You implement the connections between the modules with the graphic engineering tool SIMATIC iMap. This tool supports you when interconnecting modules right through to complete plants and entire systems.
- PROFINET CBA supports cyclic and acyclic communication and with update times up to 10 ms is particularly suitable for data transmission between controllers.
- PROFIdrive is the functional interface between controllers and drives in PROFINET and PROFIBUS. PROFIdrive is defined by the PROFIdrive profile of the PROFIBUS user organization (PNO). The PROFIdrive profile specifies the device behavior and the mechanism for accessing drive data for electrical drives, from a simple frequency converter to high-performance servo controllers.
- PROFIsafe is the profile of PROFINET and PROFIBUS for safety-oriented communication. PROFIsafe uses the conventional standard automation of PROFINET and PROFIBUS and is certified for safety levels up to SIL 3 (Safety Integrated Level) of the IEC 61508 and category 4 of EN954-1.
- PROFINET defines requirements regarding information integrity for automation systems and supports the user with possible safety solutions specifically for an industrial environment.

1.2.3 SIMATIC NET

SIMATIC NET in the automation world

SIMATIC NET is the name of an entire family of networks. The various networks meet the widest possible range of performance and application requirements:

They can exchange data at various levels, between various parts of a plant or between various automation stations. SIMATIC NET components also have uniform system interfaces and are extremely well coordinated with each other. In addition to the previous wired solutions, wireless communication is gaining ground in industry. SIMATIC NET provides products for enterprise-wide transmission of data over local area networks, intranet, Internet or wireless networks.

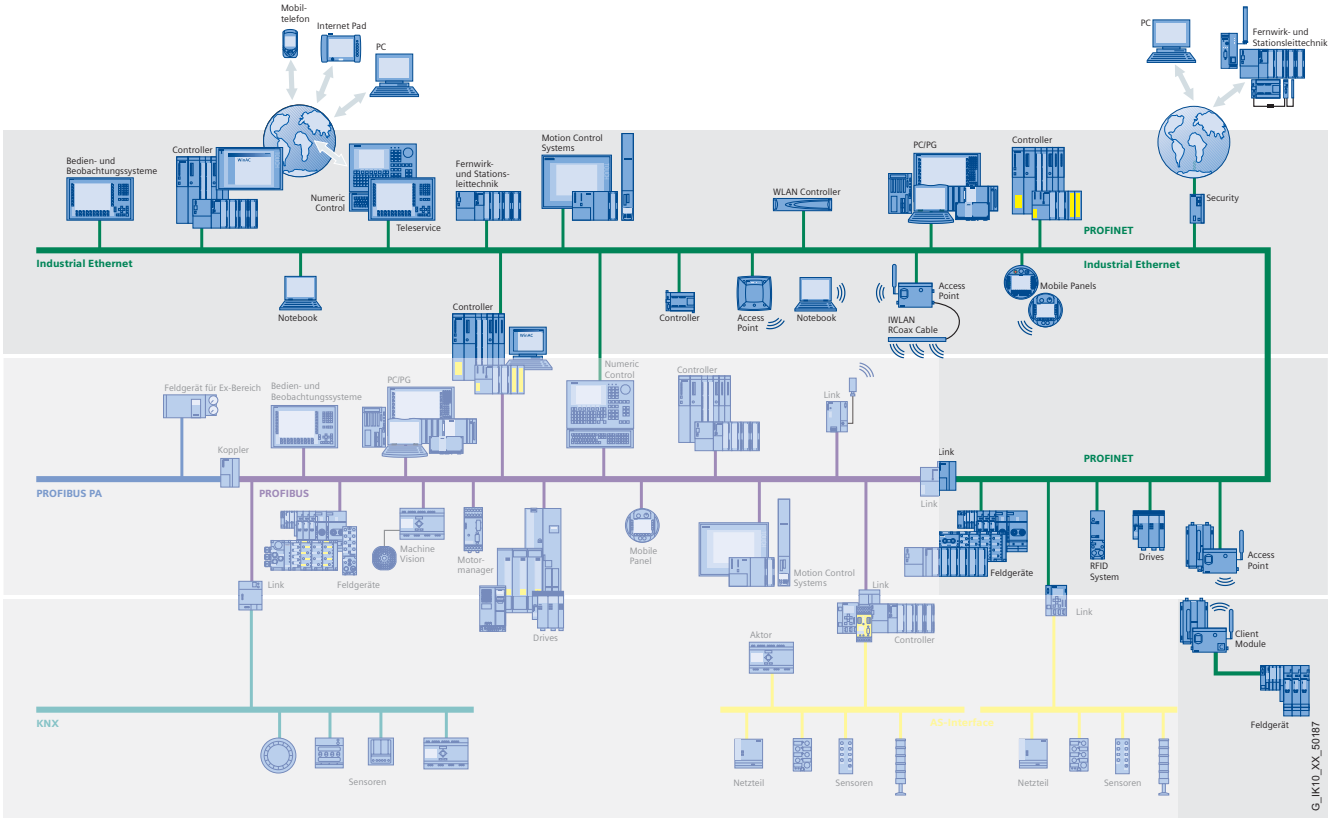

Figure 1-4 Industrial Ethernet and PROFINET in the SIMATIC NET environment

SIMATIC NET is characterized by the following features:

- Complete integration from the field level to the enterprise level,
- Coverage of the field area with Industrial Ethernet,
- Promotion of mobile communication,
- Integration of the IT technologies.

These communication network options allow SIMATIC products and intelligent devices to be combined locally according to your requirements. Flexibility and openness of the standards

of SIMATIC communications networks make it possible to link different systems and to implement extensions.

Thanks to its scalable performance, SIMATIC NET allows the implementation of enterprise-wide communication – from the simplest device to the complex system. The SIMATIC NET components used with Industrial Ethernet are particularly powerful. The devices of the SCALANCE product family represent the latest and most advanced generation of active SIMATIC NET network components.

Technical requirements

Communications networks are a central component of modern automation solutions. Industrial networks have to fulfill special requirements, for example:

- Linking of automation systems, PCs as well as simple sensors, actuators and computers,
- Correct transfer of information and at the right time,
- Robust against electromagnetic interference, mechanical stress and pollution
- Flexible adaptation to the production requirements.

Industrial networks belong to the LANs (Local Area Networks) and allow communication within a limited area.

Industrial networks fulfill the following communications functions:

- Process and field communication of the automation systems including sensors and actuators,
- Data communication between automation systems,
- IT communication to integrate modern information technology.

SIMATIC NET and TIA

The network solutions of SIMATIC NET are an integral component of Totally Integrated Automation (TIA). With Totally Integrated Automation (TIA), Siemens is the only manufacturer to provide a totally integrated basis for implementing customer-specific automation solutions.

1.2.4 Transmission procedures and real-time response

Overview

Industrial Ethernet uses the protocol family TCP/IP or UDP/IP for data transfer. These are essentially defined in the following RFCs (RFC: Request For Comment):

- RFC 768: UDP (User Datagram Protocol)
- RFC 791: IP (Internet Protocol)
- RFC 792: ICMP (Internet Control Message Protocol)
- RFC 793: TCP (Transmission Control Protocol)

However, Industrial Ethernet is unsuitable for cyclic data exchange due to its telegram overhead. An optimized Layer-2 protocol conforming to IEEE 802.3 that makes real-time communication on the basis of Industrial Ethernet possible is therefore used.

Real-time communication (RT) and determinism

"Real time" means that a system guarantees the processing of external events within a certain time. A high data rate alone is no guarantee for real-time response, since delays are possible at "bottlenecks" in the network. Instead, the network protocol must ensure that time critical frames are given preferential treatment.

This is achieved by defining real-time classes:

- RTC 1: Suitable for transfer of cyclic data. There are no special requirements for the switches used.
- RTC 2: Suitable for transfer of alarms and cyclic data. Special switches must be used here. There is, however, not yet any need for particular communication planning in the form of a special configuration.
- RTC 3: ("Isochronous real time", see below) suitable for transfer of cyclic data for motion control applications. RTC 3 also means not only that special switches are necessary but also that explicit communication planning is required.

"Determinism" means that a system's reaction is predictable, in particular that the same input data always result in the same reactions. One requirement, for example, would be that frames must not be able to overtake each other; in other words, input values read later must be arrive at the controller before others that were read earlier.

Both requirements are important for industrial networks. PROFINET fulfills these requirements with the following transfer characteristics:

- Transfer of time-critical data takes place at guaranteed time intervals.

  To achieve this, PROFINET provides an optimized communication channel for real-time communication.
- The time of transfer can be accurately determined.(forecast).
- Problem-free communication using other standard protocols is guaranteed within the same network.

Isochronous Real-Time Communication, IRT

In PROFINET with IRT, communication over Ethernet is divided into individual cycles. Each cycle consists of two phases, an IRT channel reserved for extremely time-critical data, and an "open channel", within which RT and non-time critical frames can be sent.

This allows time-critical and uncritical data to be sent on the same connection. At the same time, however, a certain data rate (and therefore a transmission time) is reserved for the critical data and real-time capability can therefore be guaranteed.

When this transmission method is implemented in ERTEC-ASICs (Enhanced Real-Time Ethernet Controller), cycle times of 0.25 ms and jitter accuracy below 1 µs are achieved.

Applications for IRT

IRT is used in areas with particularly stringent requirements for response times that cannot be exceeded. This is the case, for example, for motion control applications, which require response and update times in the range of a few milliseconds.

IRT Communication / Real-Time and TCP/IP Communication

Alongside IRT communication for which a bandwidth is reserved within the update time, RT and TCP/IP communication is also permitted within a transfer cycle.

In RT communication the cyclic data are transferred between the IO controller and IO device, however, without the "best possible synchronicity".

Unsynchronized IO devices automatically exchange data using RT communication.

Other procedures

Other procedures used in the S5/S7 environment to meet real-time requirements are known under the names "ISO (H1)" or "ISO on TCP/RFC 1006".

1.2.5 Fault tolerance and redundancy

Overview

Fault-tolerant systems are designed to reduce production downtime. Availability can be enhanced, for example, by means of component redundancy. Communication systems are thus extended to automation systems.

Redundant systems in industrial Ethernet are characterized by the multiple (redundant) presence of important automation components. When a redundant component fails, processing of the program is not interrupted.

Redundancy is achieved by duplicating the part components such as CPU, network, CP, etc.

Monitoring and synchronization mechanisms ensure that if the active redundant connection path fails, the previously passive (redundant) connection path takes over the communication automatically. The connection itself remains established.

Redundant connection of several rings

The following graphic illustrates the principle of fault tolerance based on a network consisting of several optical (yellow) and electrical (yellow) rings. The interconnection of the rings is redundant.

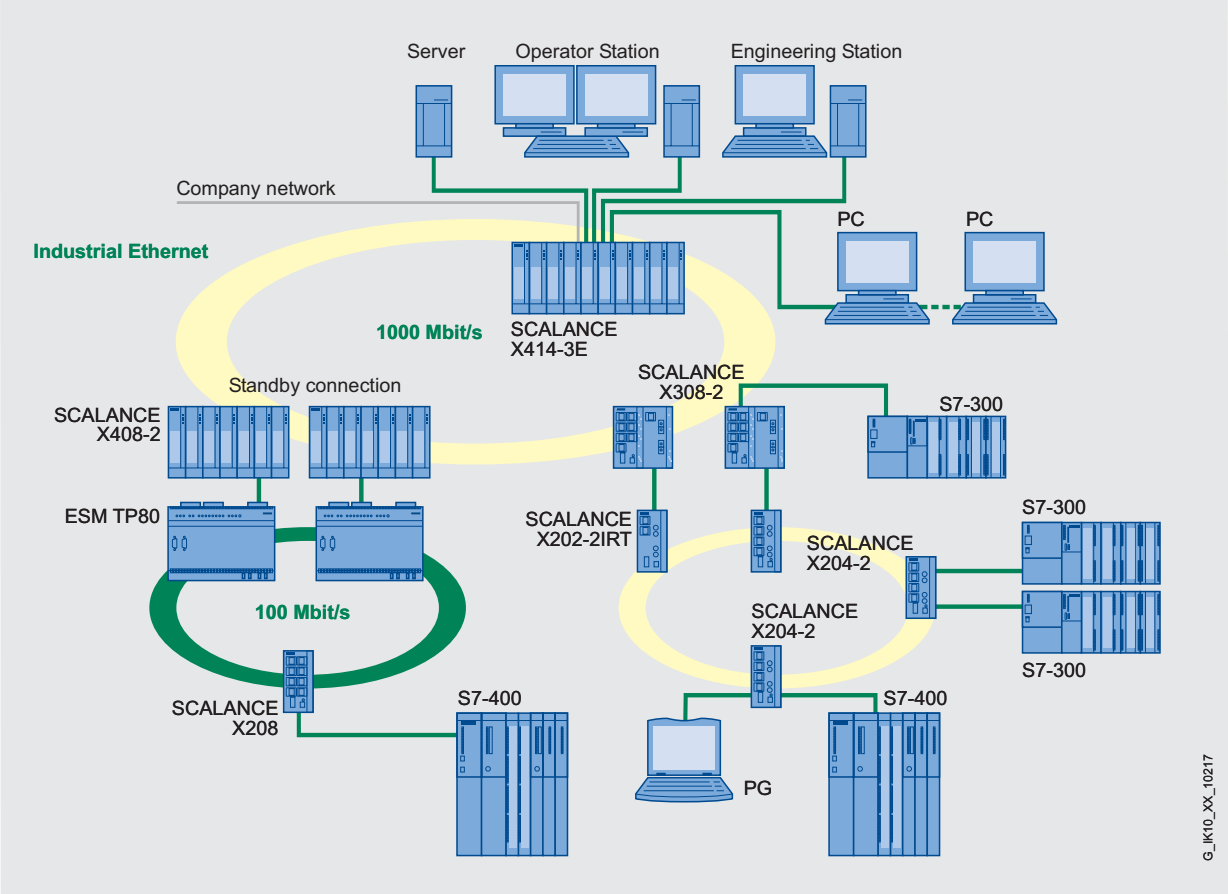

Figure 1-5 Optical and electric ring linked redundantly by SCALANCE X

The secondary rings (at the bottom) are connected redundantly with the main ring (at the top): Of the two connections, one is inactive and is only activated when the other fails.

See also

SCALANCE X-400 (Page 293)

1.2.6 Access Methods

Switching mechanisms

Industrial Ethernet and therefore also PROFINET use switched Ethernet for data transfer. The data traffic on the network is channeled and prioritized by dedicated devices known as switches. A switch enables communication to take place simultaneously in both directions (sending and receiving). This provides a network capacity of 200 Mbps, or twice the bandwidth of Fast Ethernet (100 Mbps).

Switches of the SCALANCE X device family support real-time capability in the network with two mechanisms: "Store and Forward" in general, and "Cut through" for "hard" real-time requirements (IRT).

The advantage of the switching mechanism is that nodes or network areas that do not need a particular frame are not subjected to any load by irrelevant data. The resulting free network capacities can be used by further devices. In contrast to hub-based shared medium solutions, with switching technology it is possible to communicate in different network sections at the same time and so increase the effective bandwidth.

Store and forward

With the store and forward mechanism, the switch stores the frames and then queues them. The frames are then forwarded selectively to the specific port that can access the addressed node (store and forward).

Advantages of store and forward

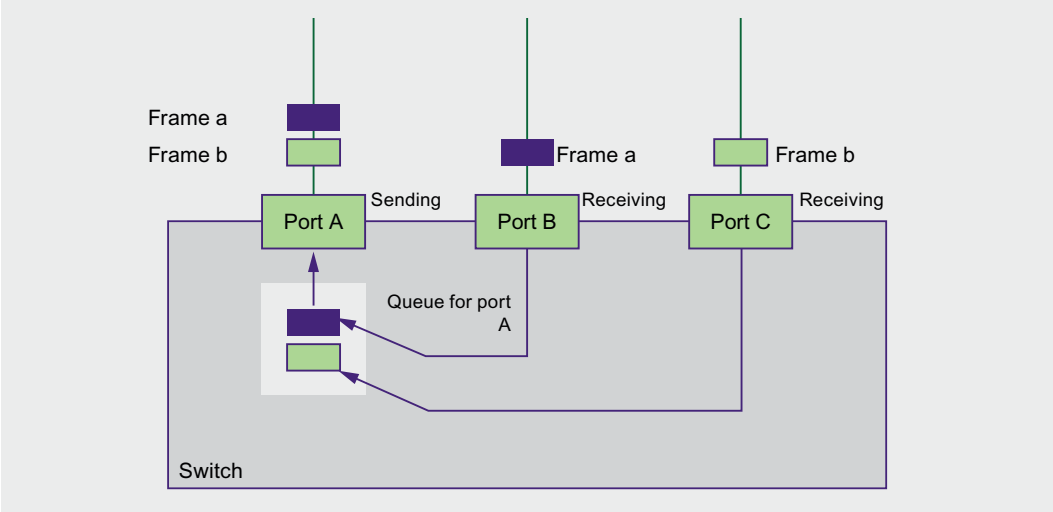

Figure 1-6 Store and Forward at Industrial Ethernet

Store and forward optimizes data traffic. With this function, the switch can check the formal correctness of frames and prevent bad or corrupted frames being distributed any further over the network.

Cut through

In the Cut Through process not the entire data package is stored temporarily in a buffer, but is passed directly onto the target port as soon as the first 6 bytes (target address) have been read. The times required by the data package to pass through the switch are then minimal. The data is only stored temporarily using the store and forward mechanism when the section between the target part and the port of the next switch is in use.

In PROFINET switches, cut through is implemented by using ERTEC-ASICs.

See also

Switches and switched LANs (Page 38)

1.3 Technologies of Industrial Ethernet

1.3.1 Communications media

Selection of media

Industrial Ethernet provides you with three different technologies to solve your automation task:

- Electrical cabling: "Twisted pair"
- Fiber-optic cable: "Fiber optic"
- Wireless/radio

Configuration limits

For a basic application, the various media typically have the following configuration limits:

Table 1-1 Typical configuration limits for media with Industrial Ethernet

Medium	Typical numbers of nodes per segment	Network span
Electrical cabling (twisted pair, copper)	approx. 100	up to 5 km
Fiber optic	more than 1000	up to 150 km
Wireless/radio	approx. 10, more when using RCoax cables	up to 1000 m per segment

Note that by using switches or access points, the actual network installations can be much larger.

With PROFINET and suitable gateway modules, you can also integrate existing subnets (for example PROFIBUS, ASi) in the Industrial Ethernet architecture.

Guide to selection

The following table shows with of the three communications media is best suited to which requirements:

	Twisted-pair network	Fiber optic network	Wireless link
Flexibility of the network topology	■■□□	■■■■	■■■■
Suitability for high data rates	■■■□ 1)	■■■■ 1)	■■□□
Networking between buildings	□□□□	■■■■	■■■□
EMC	■■■□	■■■■	■■■■
Simple cable laying	■■■□	■■■□	
Range of cables for special applications	Cables for indoor area; trailing cable; marine cable; FastConnect cables	Cables for indoor and outdoor area; trailing cable; halogen-free cables	
Effect of power failure	Failure of a subnet 2)	Failure of a subnet 2)	Failure of a subnet 2)
Effect of connection failure	Network breaks down into two subnets that function in isolation 3)	Network breaks down into two subnets that function in isolation 3)	
Max. length of the network	5000 m 4)	up to 150 km: over 150 km observe signal runtime	1000 m per segment 5)
Max. distance between two network nodes/Access Points	100 m	3000 m 50 m POF 100 m PCF multimode 26000 m singlemode	30 m indoor per segment 100 m outdoor per segment
Max. length of connection cable	100 m	3000 m multimode 50 m POF 100 m PCF 26000 m singlemode	100 m feeder cable to access point
Pre-assembled cables	yes	yes	
On-site assembling	without special tool; FastConnect system	with special tool	with trained staff
Integrated diagnostics support	LEDs; signal contact; SNMP network management; Web-based management, PROFINET diagnosis	LEDs; signal contact; SNMP network management; Web-based management, PROFINET diagnosis	LEDs; SNMP network management; Web-based management
Redundant network structures	Electrical ring or doubling of the infrastructure (linear bus, star, tree)	Optical ring or doubling of the infrastructure (linear bus, star, tree)	multiple coverage

■■■■ Well-suited
■■■□ suitable
□□□□ not suitable

1) Suitable for 10 Mbit/s and 100 Mbit/s and 1000 Mbit/s
2) Protection against subnet failure using redundant voltage supply
3) no effect in ring structure
4) depending on the network components used
5) depending on the antenna used

G_IK10_XX_10013

Figure 1-7 Overview: Criteria for selecting the network configuration

1.3.2 Active and passive network components

Active and passive network components

Industrial Ethernet networks are created using *active* and *passive* network components:

- Active network components are for example switches, access points, client modules, media converters and link modules.
- Passive network components are, for example, power cables and plug connectors.

The following tables contain a selection of network components for PROFINET/Industrial Ethernet.

Table 1-2 Active network components for PROFINET

Medium	Components	Remark
Copper (electrical)	SCALANCE X switches	To interconnect nodes on Industrial Ethernet and to set up networks with more complex topologies
	ESM	"Electrical Switch Module"
	ELS	"Electrical Lean Switch"
	PN/IO Link	Used to couple PROFINET to PROFIBUS
	SCALANCE S	"Security Module" to secure networks against unauthorized access
	Media and extender modules	To expand the functionality of SCALANCE X switches
Fiber-optic cable (optical)	SCALANCE X switches	see above
	OSM	Optical Switch Module
Radio (wireless)	SCALANCE W access point and client modules	For close-range wireless transfer
	IWLAN/PB Link PN IO	For wireless coupling of Industrial Ethernet to PROFIBUS DP

Table 1-3 Passive network components for PROFINET

Medium	Connector technology	Cable type / transmission medium Standard
Copper (electrical)	RJ-45 cable connector ISO/IEC 61754-24 IE FC RJ-45 Plug 90/145/180 M12 cable connector D-coded	100Base-TX Two-pair, symmetrical and shielded copper cable IEC 61158 IE FC TP standard cable GP 2x2 IE FC TP flexible cable GP 2x2 IE FC TP trailing cable GP 2x2 IE TP torsion cable GP 2x2 IE FC TP trailing cable 2x2 IE FC TP marine cable 2x2 IE FC TP FRNC cable GP 2x2

Medium	Connector technology	Cable type / transmission medium Standard
Fiber-optic cable (optical)	SC RJ Plug ISO/IEC 61754-24	POF-LWL (Plastic Optical Fiber) ISO/IEC 60793-2-40
		PCF-LWL (Plastic Cladded Fiber) ISO/IEC 60793-2-30 PCF standard cable GP PCF trailing cable PCF trailing cable GP (for SC RJ Plug)
	BFOC (Bayonet Fiber Optic Connector) ISO/IEC 60874-10 SC Plug ISO/IEC 60874-14	Glass fiber cable - multimode fiber (62.5/125 µm) ISO/IEC 60793-2-10 Fiber-optic standard cable INDOOR fiber-optic indoor cable Flexible fiber-optic trailing cable SIENOPYR shipping duplex FO cable (for BFOC connectors)
		Glass fiber cable - multimode fiber (50/125 µm) ISO/IEC 60793-2-10 FO standard cable GP FO Trailing Cable FO Trailing Cable GP FO Ground Cable (for BFOC and SC connectors)
Radio (wireless)	IWLAN RCoax N connector	IEEE 802.11 IWLAN RCoax cable 2.4 GHz, 5 GHz

Note

Cable assembly

FastConnect cables can be assembled particularly fast and simply on site. This means that RJ-45 cabling technology, an existing standard, is also available in a version suitable for industry.

Product overview

For a detailed overview of the available modules and accessories, refer to Part "B" of this document, "Product overview". (Sections 3 -- 5)

Reference data

You will find reference data, installation instructions etc. for the individual modules in the reference section "C" of this document. (Sections 6 -- 12)

See also

Part B: Active components and supported topologies (Page 103)

Part B: Passive components and accessories (Page 183)
SCALANCE X switches and media converters (Page 105)
SCALANCE W wireless network components (Page 139)
SCALANCE S Security Module (Page 158)
OSM/ESM and ELS (Page 170)
Components for electrical networks (Page 186)
Components for optical networks (Page 201)
Components for wireless networks (Page 209)
Accessories (Page 222)

1.4 Network security

1.4.1 Basics

Security in automation technology

In principle, the security of every network with a connection to the outside world is at risk of being compromised. Attacks from the outside can take the form of widespread viruses or other malware, but may also involve sabotage or data espionage with an attacker deliberately attempting to take control of a network or to access relevant information.

The potential damage caused by such an attack (if it succeeds) is high and can involve not only serious production and machine downtimes but also a loss of customer confidence. Security of the networks should therefore always be given high priority, even more so today because island solutions are no longer practicable and automation networks normally also require access to the Internet.

1.4.2 Firewalls

"Gatekeeper" function

Put simply, a firewall is a device or a software application inserted between the network and the outside world as a "gatekeeper" to protect the network. The firewall represents the only access to the local area network from outside and the entire data traffic crossing the boundaries of the network is directed via the firewall. This means that the firewall can block unwanted and potentially dangerous access from the outside. Various techniques are available.

Packet filter

A packet filter inspects data packets entering or leaving the network, their sender and receiver addresses and the "port", or service, to which the data packet will be transferred. Such services might be E-mail, file transfer with FTP, database access, SSH for encrypted transfer etc.

Filter rules stored in the firewall now block the access to certain addresses or certain services. Firewalls can implement complex filter rules in which, for example, service "A" is available only for IP addresses "B" and "C" but is not allowed for other communications partners.

"Stateful Inspection"

"Stateful Inspection" goes a step further than the packet filter and takes into consideration the "context" within the communication in addition to the addresses and ports.

In concrete terms, this means, for example, that Web pages sent be an external server to an internal computer can only pass through the firewall if the internal computer has actually requested this page.

Such techniques are, for example, relevant for preventing "Denial of Service" attacks (DoS) in which an external intruder sends queries to the computer under attack from numerous computers at the same time in the hope of overloading and paralyzing the network. Since, however, the stateful inspection detects these illegitimate queries at the boundary of the local area network, local traffic continues unaffected by the DoS attacks.

"Network Address Translation" (NAT)

"Network Address Translation" ("NAT") is a function with which a router (or, in our case, the firewall) replaces the addresses of the local nodes involved in data traffic with its own IP address whenever the traffic goes beyond the network boundaries. Incoming replies are only assigned to the actual addressees with their IP addresses after passing the firewall.

This mechanism can be used for ergonomic reasons since to the outside only one single IP address is required for any number of local nodes.

It does, however, also provide a certain protection from attacks since only one single address is visible to the outside namely that of the firewall. A "naive" attack would always be aimed at the firewall directly and not at the local computers being protected behind it.

"Personal firewalls"

For professional applications, the firewalls normally used are separate devices. The alternative to these devices are "personal firewalls" in the form of software running on the target computers themselves.

Personal firewalls cannot, however, provide the same security as dedicated devices. Errors in the operating system or badly programmed or configured personal firewalls allow an attacker to avoid the "gatekeeper" filter function and to attack the target computer or target network despite the firewall.

1.4.3 "Virtual Private Networks" (VPNs)

The function of Virtual Private Networks

A VPN means that a public network is used to transfer private data by "embedding" the private communication in the traffic of the public network.

The nodes of the VPN have the impression that they are connected directly to each other. They are not aware of the intermediate steps inserted in the transmission via the public network. For this reason, the mechanisms are known as "tunneling" through the public network. Using VPNs, for example, two subnets at a considerable physical distance from each other can be connected so that the users can address them as one unit.

Security of VPNs

The term "private" relates primarily to the use of VPNs and not to the confidentiality of the data: VPNs are not automatically secure since it is not essential for the data traffic to be encrypted. If, however, suitable encryption techniques are used, communication via the VPN is practically safe from eavesdropping.

See also

Encryption and data security (Page 42)

1.5 Switches and switched LANs

Switches and hubs

If a network needs to be divided into several (logical and physical) subunits, switches are used at the connection points of the network sections.

Switches are active components that can receive and send at several ports independently. There are equipped with intelligence that allows them to forward received messages only via the port connected to the segment in which the actual addressee is located. This can be connected directly to the port or via a further switch.

Since all direct connections are point-to-point and since the medium used allows full duplex communication, it is no longer possible for collisions to occur.

- Hubs also connect network sections but only establish physical contact without controlling the traffic. In contrast to switches, all the subnets connected via hubs form a single collision domain.

Switched connection paths: "Shared LANs" and "Switched LANs"

"Shared LANs" are networks on which a message being transmitted blocks the network for all other nodes; in other words, there can only be one sender at any one time. A wireless network is a simple example of such a shared LAN.

"Switched LANs" are set up using switches and are characterized by the connection paths for each data packet being switched based on the target address. Different data packets can be in transit in the network at the same time on different connection paths. The data packets only run through segments that lead to the recipient. All the SCALANCE X products and the OSMs and ESMs belong to the products that use switching mechanisms and are therefore used to set up switched LANs.

Functions of switches

Essentially, switches have the following functions:

- Connecting sublets
  In contrast to hubs, switches connect several collision domains. This means that switches can be used to set up networks with a far greater span and much higher number of nodes than is possible with hubs. The distances achieved depend on the fiber-optic interfaces used in the devices and the FOR fibers used. (For achievable spans, check the reference section of this manual.)
- Containing load
  By filtering the data traffic based on the Ethernet (MAC) addresses, local data traffic remains local. In contrast to repeaters or hubs, which distribute data unfiltered to all ports / network nodes, switches operate selectively. Only data intended for nodes in other sublets is switched from the input port to the appropriate output port of the switch. To make this possible, a table assigning Ethernet (MAC) addresses to output ports is created by the switch in a "teach-in" mode.

- Limitation of errors to the network segment affected
  By checking the validity of a data packet on the basis of the checksum which each data packet contains, the switch ensures that bad data packets are not transported further. Collisions in one network segment are not passed on to other segments.
- Increase in the number of connectable end devices compared with classic Ethernet

Advantages of switched LANs

The advantages of such switched LANs are:

- Improved performance (since the messages only block the sections of cable actually between the sender and receiver),
- Avoidance of data collisions (because the sender does not block the entire network),
- Increased availability particularly in topologies that include redundancy,
  - If a connection path is blocked in a redundant topology (due to a cable break or component failure), switches can still redirect the messages over an alternative path and maintain communication. A network with a ring topology (see below) is a classic example of using switches in this way.
- Option of forming subnets and network segments,
- Simple rules for network configuration,
- Network topologies with 50 switches in the ring and a total span of up to 150 km can implemented without any problems and without needing taking the signal delay into account,
- Unlimited expansion of the network span by connecting individual subnets (upwards of 150 km, signal delay must be taken into account),
- Simple, expansion is possible without affecting the existing network.

Application example: Redundant ring

Using an IE switch as the redundancy manager in a ring with redundancy manager provides greater availability. If there is an interruption on the connection between these switches, the IE switch used as redundancy manager acts like a switch and in a very short time creates a line from the ring with redundancy manager. As a result, a functional, end-to-end structure is restored.

See also

Redundant ring structure (Page 59)

1.6 Wireless LAN

1.6.1 What are WLANs?

WLAN

A WLAN is a "Wireless Local Area Network".

IWLAN

An IWLAN is an "Industrial WLAN", in other words, a wireless network "hardened" to cope with the wireless complications of an industrial environment.

"Hardening" measures

Conventional wireless connections are not well suited to an industrial environment, on the one hand because the production and automation level include numerous sources of EMI, and on the other hand, automation has strict demands in terms of real-time requirements and deterministic data transmission. The very nature of wireless networks also increases the risk of eavesdropping or manipulation by unauthorized third parties. For this reason, wireless networks need to be "hardened".

The "hardening" measures include, on the one hand robust and immune modules, and on the other, the use of special protocols and security measures to ensure a deterministic response and data protection.

1.6.2 Differences between wireless LAN and wired networks

Cable as opposed to radio waves

The use of cables and wires for communication has certain advantages because this makes an exclusive medium available: The transmission characteristics of this medium are well-defined and constant (as long as cables, routers or similar are not replaced) and it is clear at all times which nodes are connected to a local area network and which are not.

On the other hand, the effort and cost of cabling increases with the number of nodes (and at the same time the potential for broken cables and other hardware faults). Finally, communication with freely moving nodes using wired methods is practicable only in exceptional situations. Wireless links also allow areas to be covered that would present problems using cables (across streets, over water).

In such situations, the advantages of wireless-supported networks come to the fore (essentially the breaking of ties with any fixed location). In such cases, the possibly higher required investment can be compensated by the customer benefits.
In networks with large numbers of nodes, however, it must not be forgotten that the space in which wireless propagates is effectively a "shared medium" so that the effective data rate decreases as the number or nodes increases.

Complexity of the RF field

Radio waves propagate through space, are diffracted by obstacles or attenuated passing through objects. This means that they form a complex RF field that changes yet again if the obstacles move. Obviously, the area illuminated by one or more transmitters is not sharply defined. There is also no clear delineation of the RF field and the transmission characteristics of the individual nodes in the wireless network fluctuate depending on their position. Lastly, it is also practically impossible to detect a "silent listener" in a wireless network.

These characteristics are fundamental when it comes to connection reliability, security and immunity of a network. With responsible administration, careful planning and the use of trained employees aware of the particular requirements of a wireless network, they can nevertheless be as reliable, secure and robust as wired networks.

1.6.3 Preferred areas of application for WLANs

Preferred areas of application

In many environments, their special qualities make wireless networks the preferred, and in some cases only practical medium.

These areas of application predestined for wireless networks include:

- Connection of mobile nodes both among themselves and with stationary nodes,
- Connection of mobile nodes with wired networks (Ethernet etc.),
- Contact with rotating nodes (cranes, carousels, ...),
- Connection of nodes with restricted mobility (monorail suspension tracks, high-bay storage racks, ...), as a replacement for slip contacts or trailing cables,
- Establishing wireless bridges between physically separate wired subnets (different buildings, across streets, over water, ...),
- Communication with nodes in inaccessible areas.

See also

Configuring an IWLAN (Page 66)

1.6.4 The standards of the "IEEE 802.11" series

Standardization of WLANs

IEEE

The acronym "IEEE" stands for the Institute of Electrical and Electronics Engineers, an organization that has taken on the task of developing, publishing and promoting electronic and electrotechnical standards and that can be compared in some ways with DIN.

The IEEE 802.11 group

Under the project number "802", a number of working groups were given the task of developing standards for setting up and operating networks. Group "802.3" is responsible, for example, for the standards relating to Ethernet connections.

The "802.11" working group developed the specification for wireless LANs, and the most important variants of this specification "802.11 a/h" and "802.11 b/g" currently represent the *de facto* standard for wireless networks.

Versions of the "802.11" standard

The following table provides an overview of the features of the individual versions.

	802.11 "a"/"h"	802.11 "b"	802.11 "g"
Frequency band	5 GHz	2.4 GHz	2.4 GHz
Gross data rate	54 Mbps	11 Mbps	54 Mbps
Modulation	OFDM	DSSS	OFDM

Expansions of the 802.11 standard include the following:

- 802.11 "e": Introduces QoS to provide better support for real-time applications (VoIP, streaming),
- 802.11 "i": Replaces the no longer tenable WEP encryption mechanism with WPA or WPA2.

1.6.5 Encryption and data security

WEP ("Wired Equivalent Privacy")

WEP is the oldest and at the same time the least secure encryption method with which WLAN transmission is protected against unauthorized intruders according to the 802.11 standard.

With this method, a user password is used as a key from which a series of pseudo random numbers is generated. Each character of the frame to be transmitted is then encoded with next number of this series and decoded at the receiver.

WEP is generally considered to be inadequately secure today.

WPA ("Wi-Fi Protected Access")

WPA is the further development of WEP and still counts as the standard today despite several weaknesses. Apart from technical modifications in the actual encryption algorithm, the protocol was also adapted:

- Passwords for network access (authentication) are stored on a central server ("RADIUS"),
- The key for frame transmission changes dynamically making statistical attacks more difficult,

- The MAC address is worked into the key (in other words, unique hardware identification) of the sender making it more difficult to falsify the sender of the message.

WPA2 and AES ("Advanced Encryption Standard")

The major difference between WPA2 and WPA is the encryption method: The weaknesses identified in WPA no longer exist in the AES method used in WPA2.

If a "sensible" passwords are selected that it are adequately long and cannot be guessed, messages encrypted with AES are considered proof against eavesdropping with the current state of the art (Spring 2007).

EAP ("Extensible Authentication Protocol")

The acronym EAP covers a wide framework of different authentication mechanisms for network access. In other words, EAP is not an authentication method itself but describes the mechanism according to which the client and server can agree on a method.

MAC filter

MAC addresses ("Media Access Control A.") are codes with which hardware elements (for example network cards, modules, motherboards) can be uniquely identified worldwide.

The addresses are normally encoded in 6 bytes (48 bits) and hardwired in the relevant components; on request, the components identify themselves by returning their MAC address.

Filter tables with MAC addresses can be created in network management that permit or forbid access for certain addresses. This allows simple although comparatively unsecured access protection for the network to be implemented.

Manipulation of MAC addresses (spoofing) cannot be excluded which means that MAC filters only provide adequate security for a network in conjunction with other measures.

1.6.6 Avoiding collisions in wireless networks

CSMA/CA with RTS/CTS

Ethernet uses the bus access method CSMA/CD. This acronym stands for Carrier Sense Multiple Access with Collision Detection. In this method a node that wants to send listens to the common bus line (Carrier Sense) and sends if it is not occupied. If the bus line is occupied by another node, the node that wants to send postpones its wish to send and tries to transfer again later on (Multiple Access). This functions, however, only on media on which the node can send and receive at the same time (for example Ethernet); in other words, not in WLANs.

For this reason, a different mechanism is used in wireless networks. CSMA/CA ("Collision Avoidance") attempts to avoid the occurrence of collisions in advance. This is achieved, for example, using the RTS/CTS method in which the sender sends a short test signal ("Ready To Send" -- RTS). The actual transmission only begins after the recipient has replied to this with "Clear To Send" (CTS). If a collision occurs, the retransmission follows after a pause not

selected at random but according to priority. With this strategy, communication remains deterministic.

1.7 The SCALANCE generation of devices

The SCALANCE generation of devices

The name SCALANCE stands for the current generation of SIMATIC NET network components for simple setup, management and operation of Industrial Ethernet LANs. The three product families are as follows:

- SCALANCE X is the new product family of Industrial Ethernet switches. Switches are active network components that distribute data to specific addressees, control network traffic and ensure that the load on network connections is optimally distributed. SCALANCE X switches are available in a wide range of variants with electrical and/or optical ports, and in some cases with special functionalities to meet strict real-time requirements.
- SCALANCE W is the family of components and accessories for wireless local area networks ("WLANs"). The use of access points,clients and accessories allows the connection of mobile nodes and the establishment of networks in exacting environments. SCALANCE W components are distinguished by their robustness, security and reliability. Wireless transmission can be implemented using conventional antennas, directional antennas or over short distances with leaky feeder cables (RCoax cable).
- SCALANCE S security modules protect automation networks from unauthorized access and unnecessary communication load. Both eavesdropping and attacks by outsiders are prevented reliably. Even if there are disturbances in the external network, data traffic in the automation cell remains unaffected. Communication is protected regardless of the application protocol used.

You will find a detailed introduction to the members of the SCALANCE generation of devices in Part "B" of this document.

See also

Part B: The SCALANCE generation of devices (Page 89)

Part A: Network structures and network configuration 2

2.1 Note

Note

Please note the following:

You will find further use cases and information on configuration of various network topologies in Part "B" in the descriptions of the individual components.

2.2 Electrical networks

Products

The following components and cables are used in a 100 Mbps switched LAN:

- Components
  - SCALANCE X switches
  - OSM/ESM
- Cables
  - Twisted-pair cable
  - TP Cord

See also

SCALANCE X switches and media converters (Page 105)
Optical and electrical switch module (OSM/ESM) (Page 171)
Components for electrical networks (Page 186)

2.2.1 Twisted-pair cable runs

100BASE-TX

The twisted pair interfaces of the SCALANCE X products comply with the IEEE 802.3u: 100BASE-TX standard. Depending on the particular variant, the switches have one or more RJ-45 or M12 jacks.

Requirements of twisted-pair cables

The twisted-pair cables inserted between two adjacent SCALANCE X modules must not exceed the following maximum lengths:

Table 2-1 Maximum runs with twisted-pair cables

Cabling structure	Cable type	Max. length	Max. total of the patch cables (TP cord)
In one piece (with D-sub connectors)	ITP standard 2x2	100 m	-
In one piece (without using patch cable)	IE FC standard cable GP	100 m	-
	IE FC flexible cable GP	85 m	-
	IE FC torsion cable GP	55 m	-
	IE FC trailing cable GP	85 m	-
	IE FC trailing cable	85 m	-
	IE FC marine cable	85 m	-
	IE FC TP FRNC cable GP	85 m	-
Structured (with patch cable and IE FC Outlet RJ-45 or IE FC RJ-45 Modular Outlet)	IE FC standard cable GP	90 m	10 m
	IE FC flexible cable GP	75 m	10 m
	IE FC torsion cable GP	45 m	10 m
	IE FC trailing cable GP	75 m	10 m
	IE FC trailing cable	75 m	10 m
	IE FC marine cable	75 m	10 m
	IE FC TP FRNC cable GP	75 m	10 m

2.3 Optical networks

Products

The following components and cables are used in an optical 100 Mbps switched LAN:

- Components
  - SCALANCE X products with FO interfaces
  - OSM (I)TPnn (switches with multimode glass fibre-optic cables) or OSM (I)TPnn-LD (switches with single mode glass fibre optic cables)
- Cables
  - Multimode glass fiber-optic cable type 50/125 µm
  - Single mode glass fiber-optic cable type 10/125 µm
  - Twisted-pair cable, TP Cord

See also

SCALANCE X switches and media converters (Page 105)

Optical and electrical switch module (OSM/ESM) (Page 171)

Components for optical networks (Page 201)

2.3.1 FOC links

Standard Fast Ethernet

The switches equipped with interfaces for 100BASE-FX comply with the standard IEEE 802.3u. They operate at a wavelength of 1300 nm.

Multimode glass fibers of the type 50/125 µm are suitable for the connection.

Switches or media modules equipped with an optical interface for single mode glass fibers of the type 10/125 µm have the supplement LD in their names (Long Distance).

The length of an insertable FOC link is decided by:

- The fiber type multimode/ single mode
- The FO cable attenuation at the wavelength used
- The bandwidth distance product of the fiber-optic cable

Requirements of multimode glass fiber-optic cables

Table 2-2 Max. length of a link with multimode FO cables between two switches:

Fiber-optic cable type	FO power loss at 1300 nm	Bandwidth distance product	Max. length
50/125 µm	<= 0.7 dB/km	>= 1200 MHz * km	3,000 m

Requirements of single mode glass fiber-optic cables

Single mode glass fiber-optic cables between two switches with suitable interfaces must meet the following requirements in terms of power loss and the bandwidth distance product:

Table 2-3 Max. length of a link with single mode FO cables between two suitable equipped switches:

Fiber-optic cable type	FO power loss at 1300 nm	Bandwidth distance product	Max. length
10/125 µm	<=0.5 dB/km	No info	26,000 m

SIMATIC NET multimode glass fiber-optic cables

The SIMATIC NET product range for Industrial Ethernet includes various types of multimode glass fiberoptic cables with 50/125 µm fibers (see "Passive components for optical networks").

- FO Standard Cable
- FO Ground Cable
- FO Trailing Cable
- FO Trailing Cable GP
- SIENOPYR duplex marine fiberoptic cable

When connecting SIMATIC NET Industrial Ethernet switches using SIMATIC NET multimode glass fiberoptic cables, distances of 0 to 3000 m are permitted between two adjacent components.

Note

Single mode glass fiberoptic cables with fiber type 10/125 are available in customized lengths. You will find contacts in the "Support and training" section of this manual.

Standard 1 Gbps Ethernet

In Gbps Ethernet, a distinction is made in much the same way as in Fast Ethernet between two versions both of which are described in the IEEE 802.3z standard.

1000BASE-SX is the name of the version for multimode glass fiber. A wavelength of 850 nm is used. Due to their properties, the same 50/125 µm fiber from the SIMATIC NET product

range can be used as for 100BASE-FX. The range between two points is 750 m. As long as this range is not exceeded, it is possible to upgrade from 100 Mbps Ethernet to 1 Gbps Ethernet over existing installed cable of this type without needing to install new cables.

The version for single mode glass fibers is 1000BASE-LX. A wavelength of 1300 nm is used here. A single mode glass fiber-optic cable 10/125 µm may be up to 10,000 m long.

In terms of the FO link length that can be included, the dependencies are basically the same as for 100 Mbps Ethernet.

Table 2-4 Maximum link length with multimode glass fiber-optic cables with 1 Gbps Ethernet:

Fiber-optic cable type	FO power loss	Bandwidth distance product	Max. length
50/125 µm Multimode	≤ 2.7 dB/km at 850 nm	≥ 600 MHz * km	750 m
9/125 µm Single mode	≤ 0.5 dB/km at 1310 nm		10,000 m
	≤ 0.28 dB/km at 1550 nm		

See also

Components for optical networks (Page 201)

2.4 Web Based Management for configuring networks

Configuration over a Web interface

All SCALANCE devices that have management functions can be configured using "Web Based Management" (WBM).

The devices have an integrated Web server that can be accessed by the configuration engineer with a browser over every Ethernet connection. The server provides a series of pages like those familiar from the Internet. On these pages, the configuration engineer can make all important settings and can also run diagnostics and report functions.

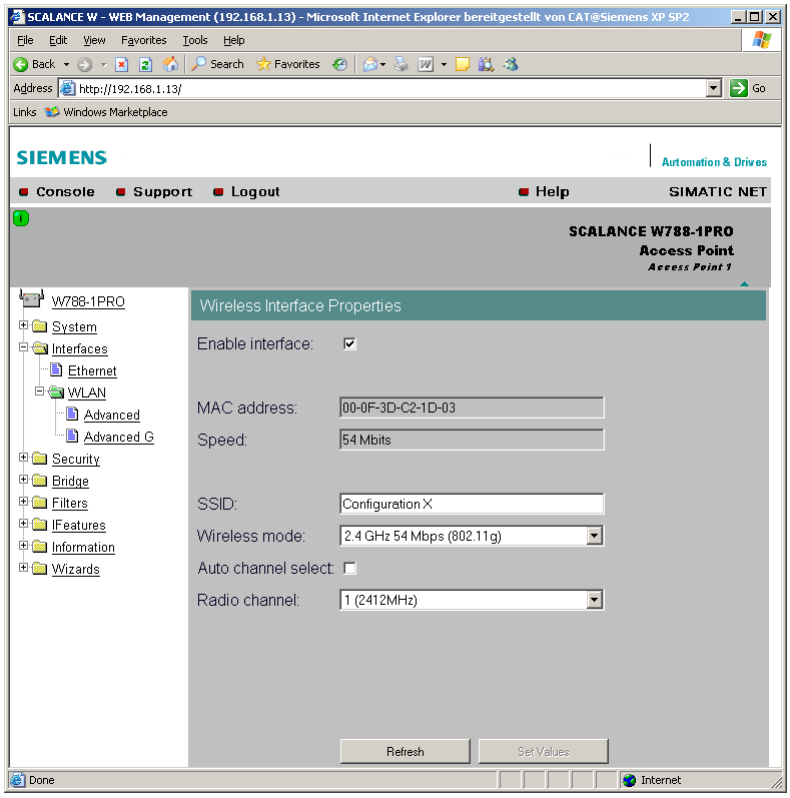

Figure 2-1 Web Based Management based on the example of configuring a W-788 access point

Advantages

- Access is possible from any PC with a Web browser installed on it and with an Ethernet connection to the target device. (With SCALANCE W devices, this connection can also be over a wireless network.)
- The installation of special software is not necessary and no specialist knowledge is required to navigate through and work with WBM.
- Access is, of course, password protected.

For more detailed information on the functions of the WBM, refer to the operating instructions of the individual devices.

2.5 Basic structures

2.5.1 Network topologies

Topologies

"Topology" means the spatial arrangement and interconnection of the nodes of a wired network.

Which topology is preferable depends on the position of the nodes relative to each other and what is required of the network. If it is required that the network remains working in the event of a failure, a ring structure is an advantage in which each node can reach the others over both branches of the ring. A linear bus topology in which the nodes follow on from each other like a chain is, on the other hand, more adversely affected by the failure of a component or a cable break which causes the network to break up into separate sections.

In many cases, networks do not have a "pure" topology but rather a hybrid configuration; or the full network consists of several subnets with different topologies.

The elementary topologies: Linear bus, star, tree and ring

In principle, wired networks with more than two nodes can be configured in three basic structures: As a linear bus, a star and as a tree or ring.

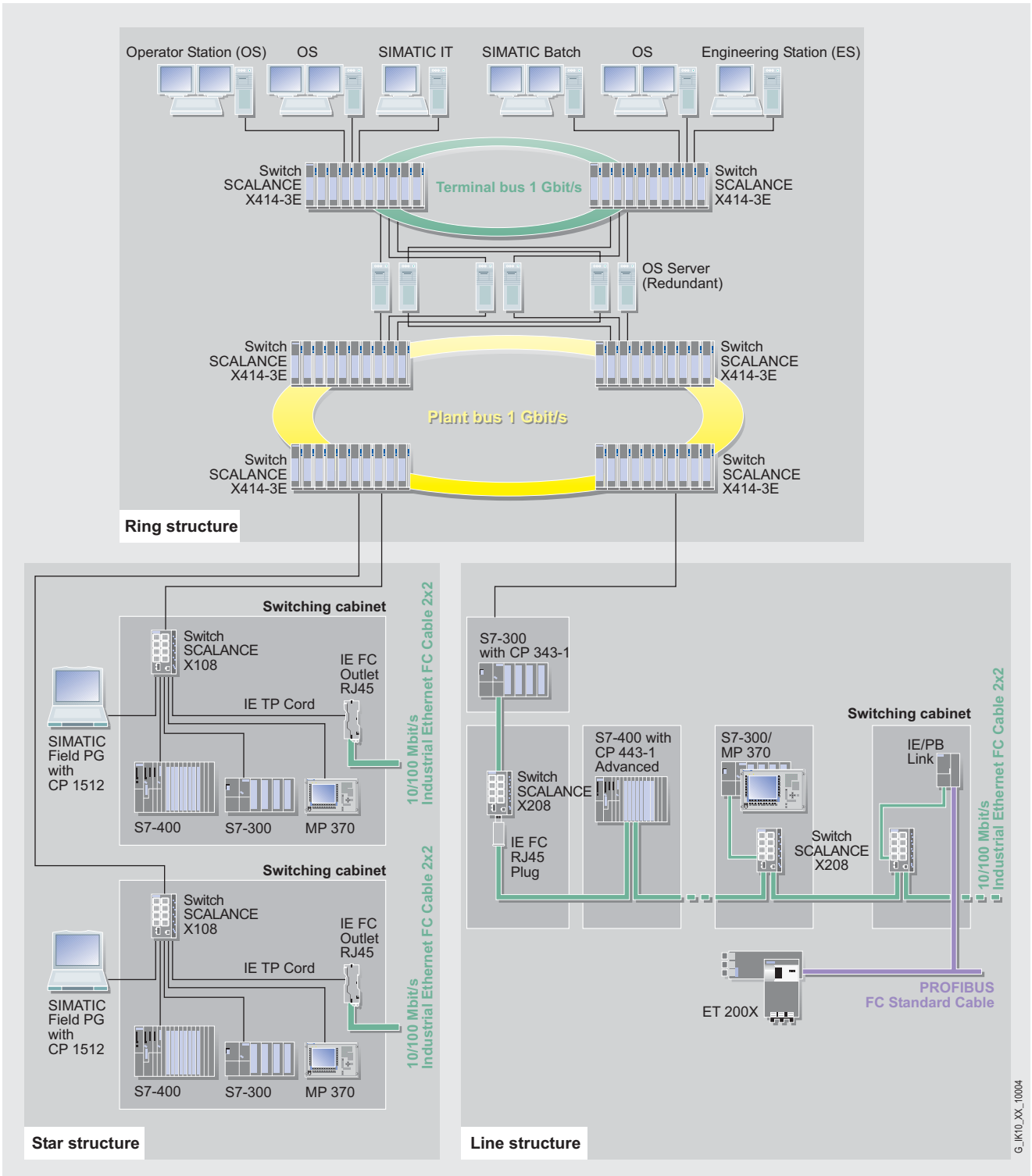

Figure 2-2 Selection of various network topologies (schematic): Ring (top center), star (bottom left) and linear bus (bottom right)

See also

Linear structure (Page 54)
Star structure (Page 55)
Redundant ring structure (Page 59)
Configuring an IWLAN (Page 66)

2.5.2 Linear structure

Linear bus

The linear bus is the simplest network structure. It is characterized by a network backbone to which the individual nodes are connected directly or over a branch (only one node is permitted per branch).

- The advantage of the linear bus topology is its simple setup and low hardware investment. It is suitable, for example, for networking of rigidly linked machines over a wide area as found in assembly lines.
- The disadvantage of the linear bus topology is the inefficient use of resources and the lack of redundancy: A break on the cable at any point cannot be bridged. Connecting the ends of the linear bus, on the other hand, creates a ring with which these disadvantages can be avoided.

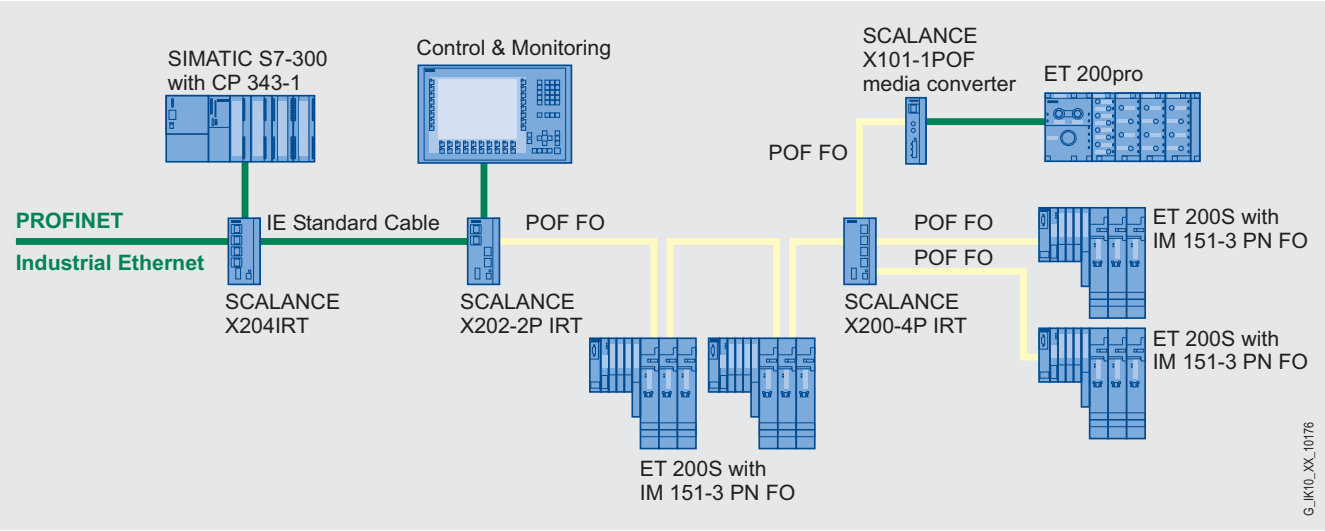

Figure 2-3 Linear bus network topology based on the example of Industrial Ethernet

A further restriction for networks with a linear bus structure is the physical arrangement of the network nodes. Depending on their position, the backbone may need take long detours which may, in turn, lead to problems with frame delay times.

In a linear network topology, the network components such as switches typically have only one or few connection points for network nodes. Linear bus structures can also be created with devices with two integrated network interfaces.

Example: 100 Mbps switched LAN with a bus structure

SCALANCE X devices/Industrial Ethernet ESMs allow the setup of 100 Mbps switched LANs with a bus structure. There may be a maximum distance of 100 m between two of these devices. Any TP ports can be use to cascade and form a linear bus. The number of SCALANCE X devices/Industrial Ethernet ESMs that can be cascaded depends on the response times of the applications operating over this linear bus.

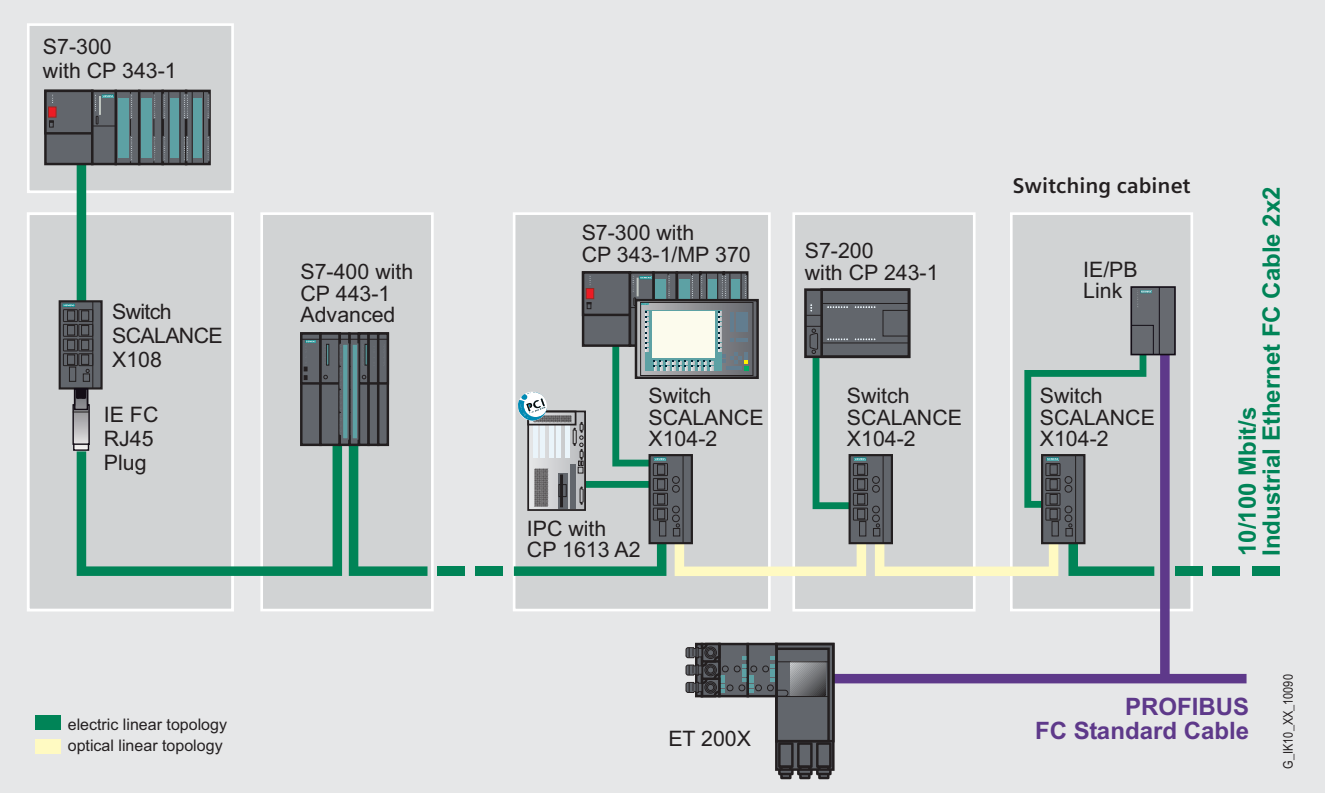

Figure 2-4 Linear structure (electrical)

See also

SCALANCE X-100 unmanaged (Page 114)

Optical linear structure (Page 61)

SCALANCE X-200/X-200 IRT (Page 260)

2.5.3 Star structure

"Star"

The difference between the star topology and linear bus topology is that one switch functions as the central node from which the spokes branch off to the individual nodes. The individual nodes of the network therefore have separate point-to-point links with the active network component (i.e. with the switch).

The immediate effect is that the messages only run via the spokes between sender and recipient, in other words network performance improves significantly because several nodes can communicate at the same time.

In practice, these may be a mixture of fiber-optic and twisted-pair cables depending on what is required of the individual links. Typical applications are Ethernet office networking or the networking of production cells in manufacturing with Industrial Ethernet.

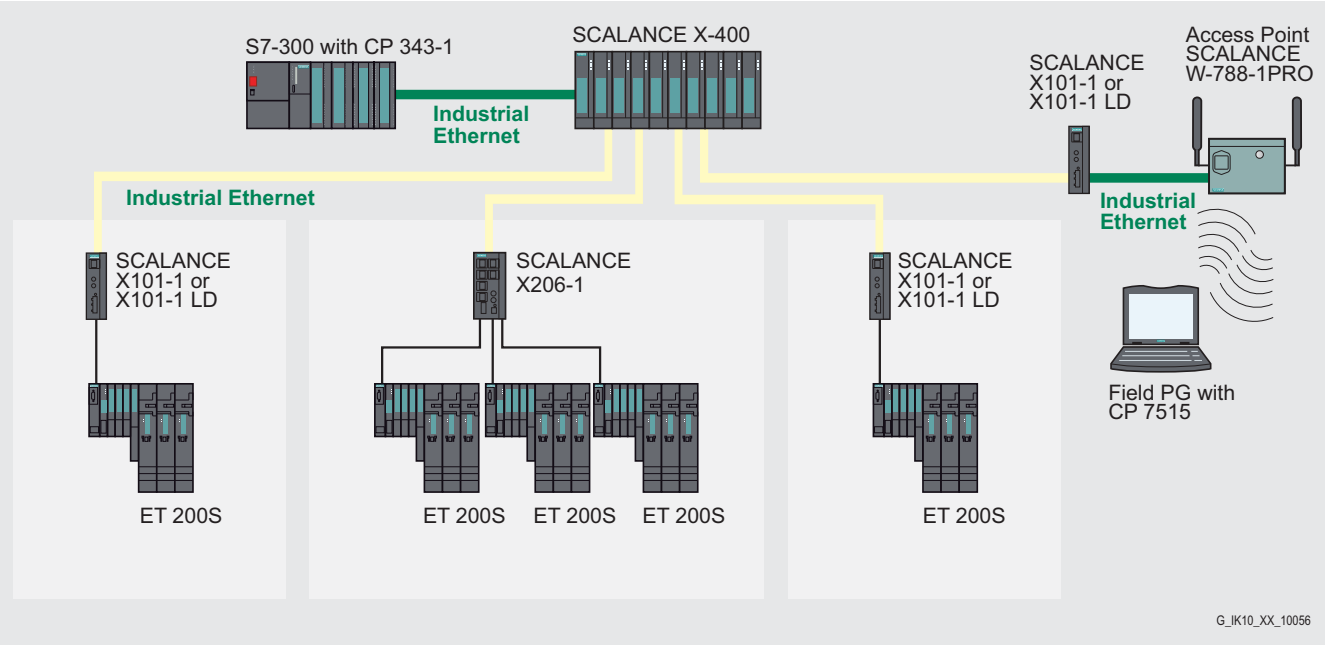

Figure 2-5 Star topology based on the example of Industrial Ethernet with a gateway to Industrial Wireless LAN

- The use of a switch optimizes data throughput in the network. Messages are transferred only on the star segments between sender and recipient and the segments of the other nodes remain unaffected by them. If a node fails, the communication between the other network nodes remains intact.
- Compared with ring or linear bus structures, however, the investment in cabling increases considerably due to the long distances back to the star center.

Typical use cases for star networks are switching cubicles, individual machines or manufacturing cells.

Examples of simple star structures

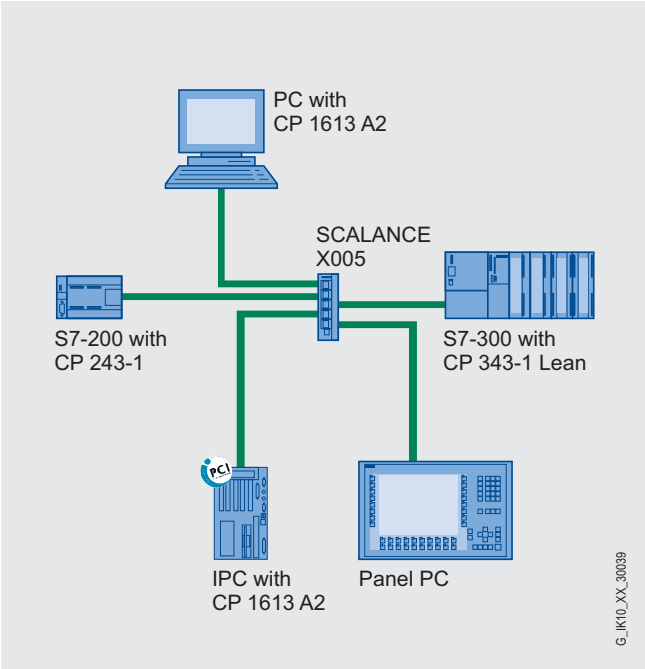

Figure 2-6 Star structure with SCALANCE X005

The number and technology of the connections to the end nodes (electrical/optical) depends on the number of relevant ports on the switch: In the example above, the SCALANCE X005 can support five 10/100 Mbps cables with RJ-45 connectors and no fiber-optic connections.

The cable lengths listed in the linear bus topology example apply; with an FC TP Standard Cable, the end nodes can be installed up to 100 m from the switch.

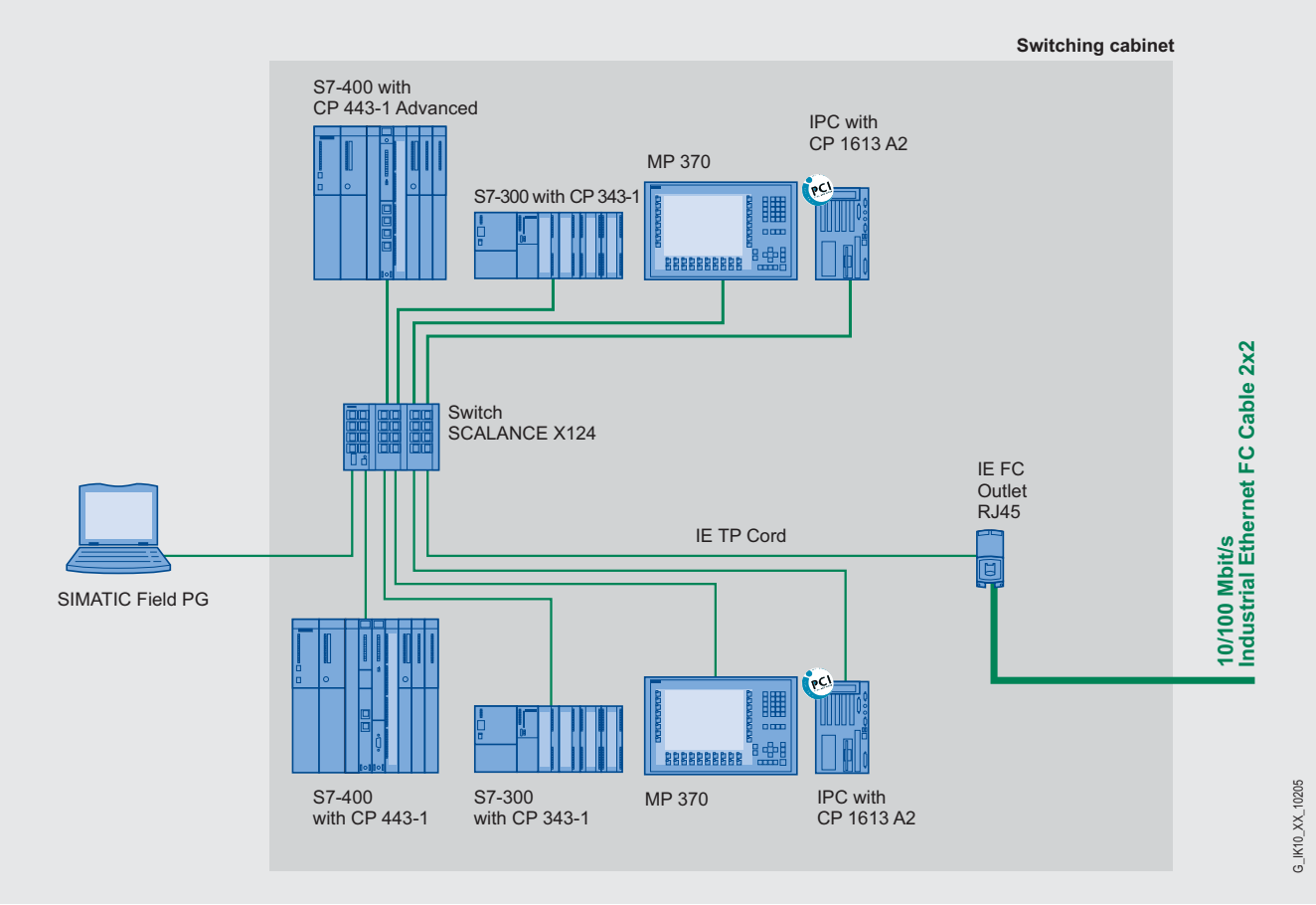

Figure 2-7 Star network structure with SCALANCE X124

More complex network structures can be set up by using switches with a higher number of ports. (In the example above, a SCALANCE X124 with 24 electrical ports.) In terms of the numbers of nodes and the physical span of the network, this is practicable only up to a certain limit.

If more extensive networks need to be configured, it is advisable to use more switches and the extra subnets that result.

Tree structure

If several start networks, for example manufacturing cells, need to be interconnected in a network, a tree-shaped network results.

See also

Entry level SCALANCE X005 (Page 109)

SCALANCE X-100 unmanaged (Page 114)

2.5.4 Redundant ring structure

"Redundant rings"

The simple ring topology (Page 52) results from connecting the two ends of an active linear bus topology to form a physical ring. A special redundancy mechanism ensures that the redundant ring structure (Page 62) remains a logical bus in normal situations and prevents frames from circulating. If a section of the ring fails, the mechanism quickly makes a substitute path available in ring: The message now travels the long way round via the intact network section instead of over the direct interrupted path and reaches its recipient via this detour. The network does not break down into two segments.

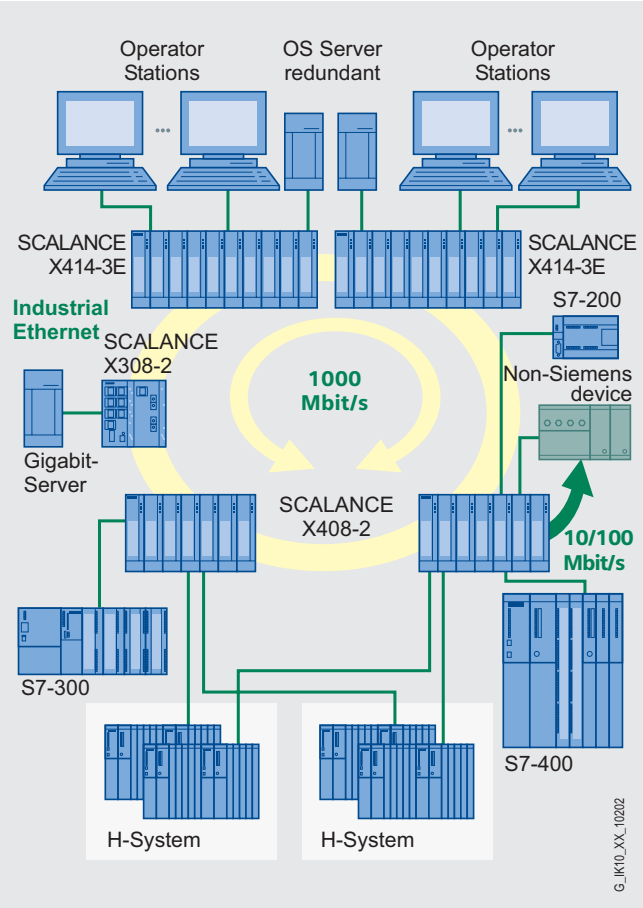

Figure 2-8 Ring topology based on the example of Industrial Ethernet with glass fiber-optic cables

- The effects of a network component being disrupted are restricted to the failed component and to the end devices connected to it. If a ring section is interrupted, for example by a cable break, communication continues without any disruption.

The reconfiguration time is faster here than in the office world and meets the requirements of the automation world.

Creating a ring from a linear bus

A simple ring structure is created from a linear bus by connecting the ends together.

This arrangement does, however, require a switch operating in redundancy manager mode at the end of the line.

Example: Structure of a redundant network with SCALANCE X-200IRT switches

To increase availability, optical or electrical linear bus topologies made up of SCALANCE X-200/X-200 IRT (Page 260) switches and a SCALANCE X-200/X-200 IRT (Page 260) , SCALANCE X-300 (Page 278) , SCALANCE X-400 (Page 293) , OSM version 2 (Page 389) or ESM version 2 (Page 389) configured as redundancy manager, can be closed to form a ring. The SCALANCE X-200 switches are first connected over their ring ports to form a linear bus. The two ends of the line are closed to form a ring by a switch operating in redundancy manager mode. Devices of the SCALANCE X-200, X-300, X-400 product families, or OSMs / ESMs can be used as redundancy managers. When a switch is used as the redundancy manager, the ring ports are isolated from each other if the network is operating problem-free.

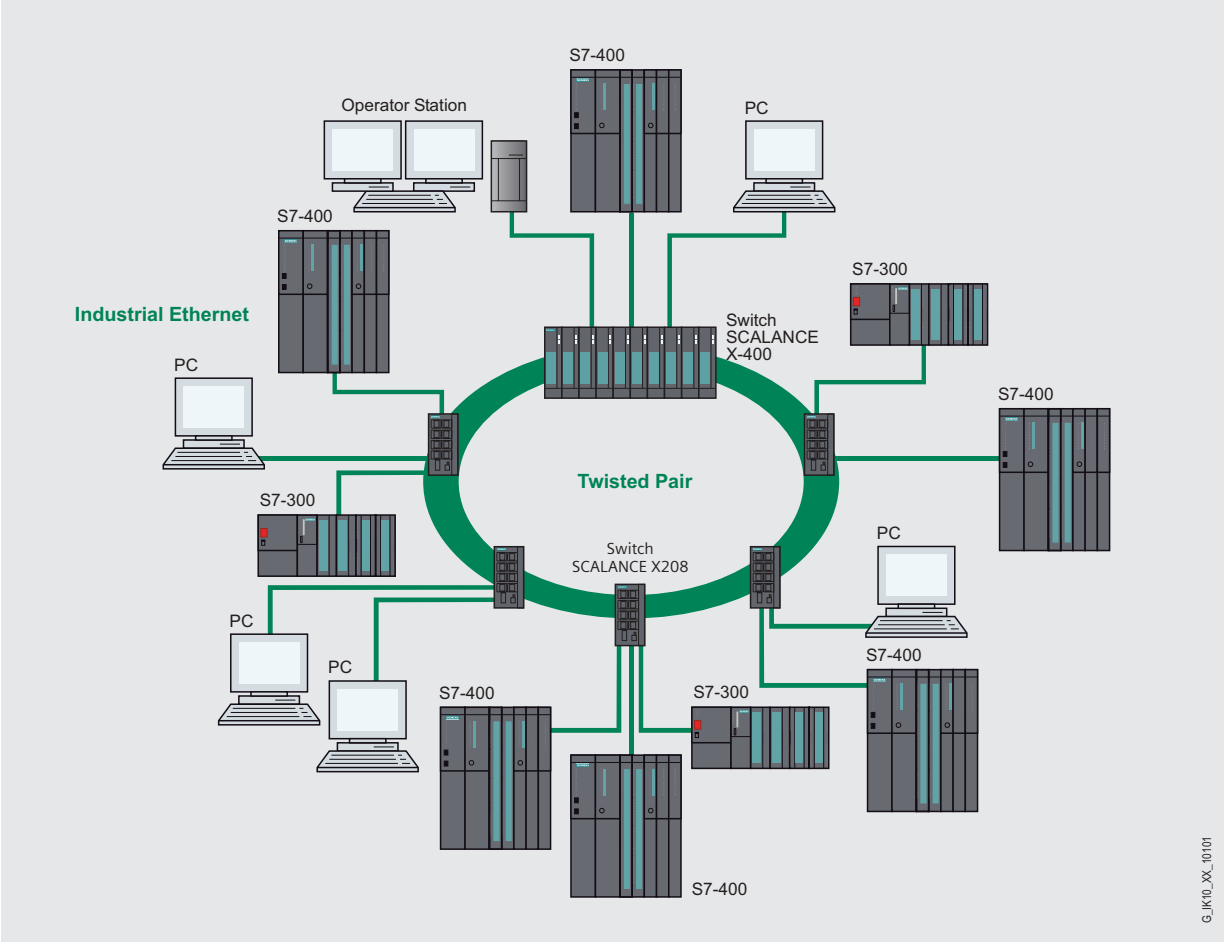

Figure 2-9 SCALANCE X: Configuration with high-speed redundancy in the electrical ring

The SCALANCE switch or OSM / ESM operating in the redundancy manager mode monitors the connected linear bus over its ring ports and switches the ring ports through if there is an interruption on the connected bus; in other words, it restores a functioning line over this

substitute path. Reconfiguration takes place within 0.3 seconds. As soon as the problem has been eliminated, the original topology is restored; in other words, the ring ports in the redundancy manager are once again disconnected from each other.

See also

Part C: SCALANCE X switches and media converters (Page 229)

2.5.5 Optical linear structure

Structure of a fiber-optic linear bus structure

The Industrial Ethernet SCALANCE X devices/OSMs allow the setup of 100 Mbps, 1 Gbps or mixed switched LANs with a linear bus structure. At 100 Mbps, the maximum distance of a link between two devices is 3000 m or 26 km with LD variants. At 1 Gbps, the maximum distance of a link between two devices is 750 m or 10 km with LD variants. Devices are cascaded over the FO ports. Up to 50 devices can be cascaded.

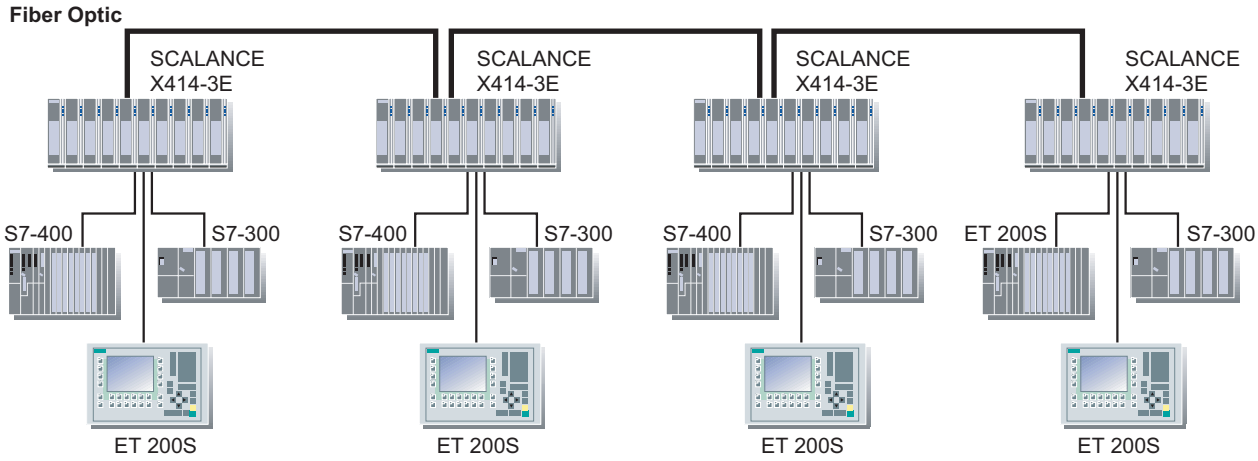

Figure 2-10 Linear structure (optical)

See also

SCALANCE X-400 modular (Page 132)

2.5.6 Optical redundant ring structure

Redundant optical ring

With the aid of a redundancy manager (RM), the ends of an optical linear bus can be connected together to form a redundant optical ring. All media converters, SCALANCE X-100/-200/300 and -400 devices as well as OSMs can be used. The SCALANCE X-200 devices, all SCALANCE X-300/-400 devices and OSMs can take on the role of RM.

The RM monitors the line connected to it. If it detects a break on the line, it interconnects the ends of the line to reestablish a functioning linear bus configuration.

A maximum of 50 of the listed SCALANCE X/OSMs are permitted in an optical ring. This strategy achieves a reconfiguration time of less than 0.3 seconds. The RM mode is activated on the OSM using a DIP switch. SCALANCE X devices that can operate as the RM, no longer have a DIP switch for setting this function, but are configured by the software.

The maximum length of the fiberoptic cable between two devices is 3,000 m. This means that an optical ring including 50 switches can have a maximum span of 150 km.

Note

The reconfiguration time of less than 0.3 s can only be achieved when no components (for example switches from other vendors) other than ring-compliant SCALANCE X switches / OSMs are used in the redundant ring.

In a ring, one device and one device only must operate in the redundancy manager mode.

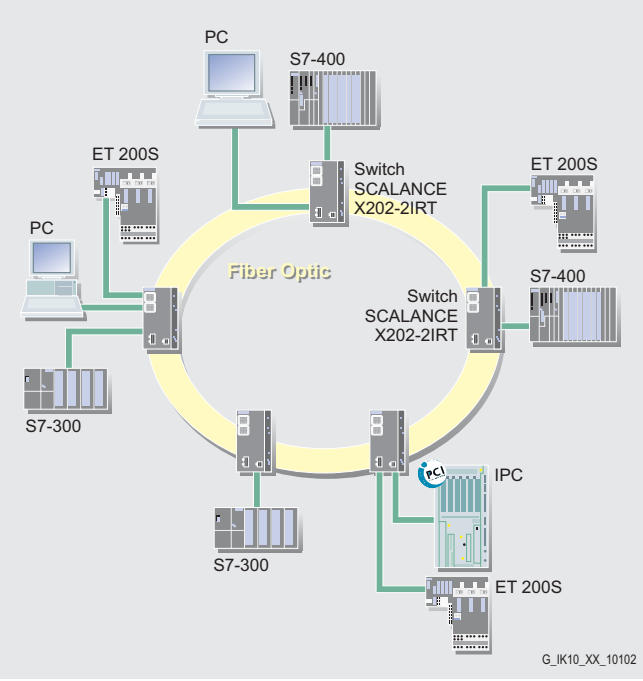

Figure 2-11 Redundant ring structure with optical ring, example with SCALANCE X-202IRT

The interconnected switches in this ring do not need to be connected only with FO cables or only with electrical cables. A mixed electrical and optical ring is also permitted.

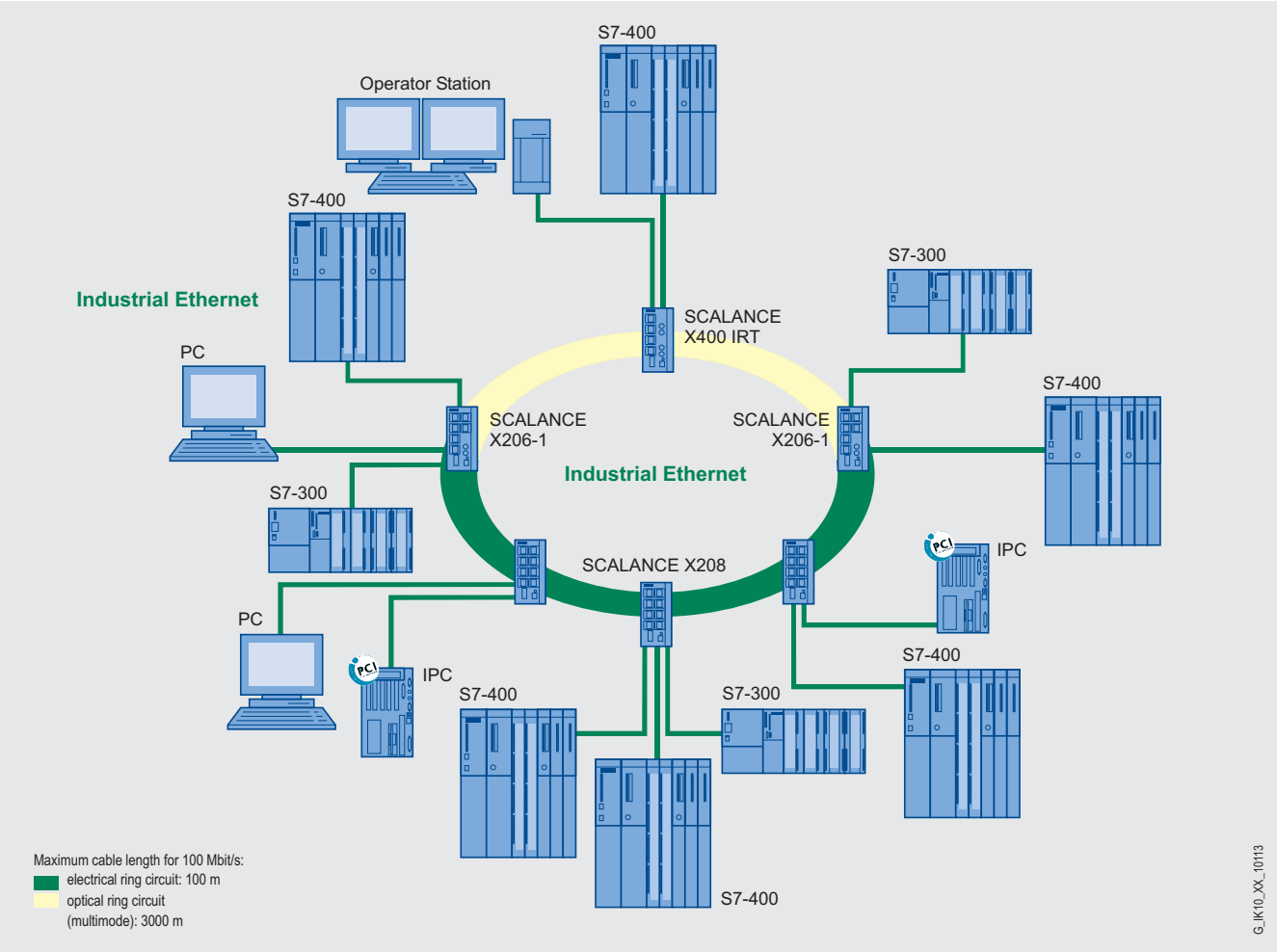

Figure 2-12 High-speed redundancy in a mixed ring

See also

SCALANCE X-100 media converters (Page 116)

SCALANCE X-200/X-200 IRT (Page 121)

SCALANCE X-300 (Page 128)

SCALANCE X-400 modular (Page 132)

OSM/ESM and ELS (Page 170)

2.5.7 Redundant linking of network segments with electrical and FO components

General

SCALANCE X switches support not only ring redundancy within a ring but also redundant linking of several rings or open network segments (linear bus). In the redundant link, two

rings are connected together over two Ethernet connections. This is achieved by configuring a master/slave device pair in one ring so that the devices monitor each other and, in the event of a fault, redirect the data traffic from the normally used master Ethernet connection to the substitute (slave) Ethernet connection.

Standby redundancy

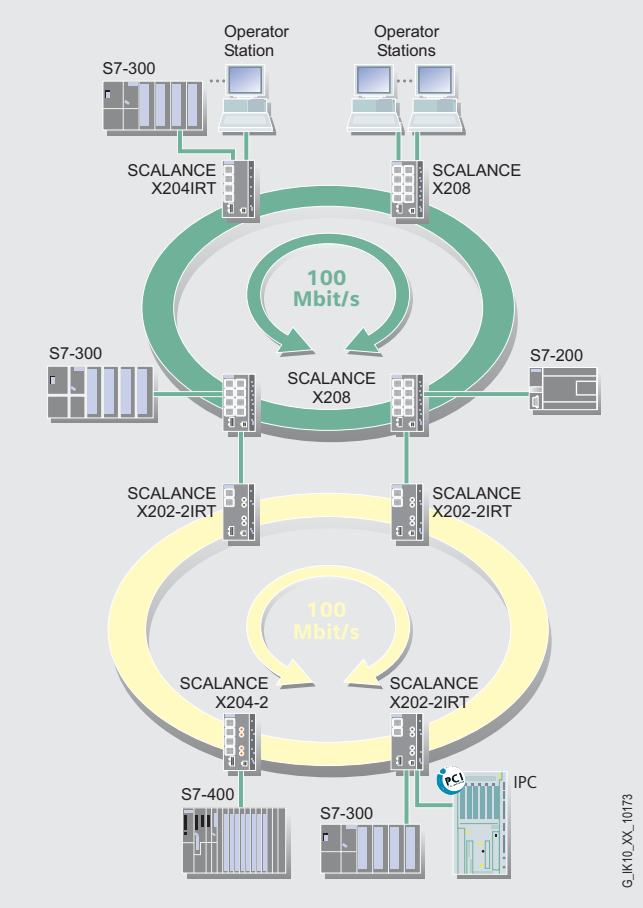

Figure 2-13 Example of redundant linking of two SCALANCE X-200 IRT rings

For a redundant link as shown in the figure, two devices must be configured as standby redundancy switches within a network segment. Here, network segments are rings with a redundancy manager (RM, in the example, the SCALANCE X202-2IRT switches). Instead of rings, network segments might also be linear.

The two X202 devices connected in the configuration exchange data frames with each other to synchronize their operating statuses (one device is master and the other slave). If there are no problems, only the link from the master to the other network segment is active. If this link fails (for example due to a link-down or a device failure), the slave activates its link as long as the problem persists.

See also

SCALANCE X-200/X-200 IRT (Page 121)

SCALANCE X-300 (Page 128)
SCALANCE X-400 modular (Page 132)
OSM/ESM and ELS (Page 170)
Redundant linking of subnets using the OSM/ESM (Page 176)

2.6 Advanced network configurations

2.6.1 Configuring an IWLAN

2.6.1.1 Structure of an IWLAN

Basic structure of a WLAN

WLANs do not have a physical topology like traditional wired networks. There are no "linear bus", "ring" or "star" structures, instead wireless networks are unstructured (ad hoc) or divided into individual cells.

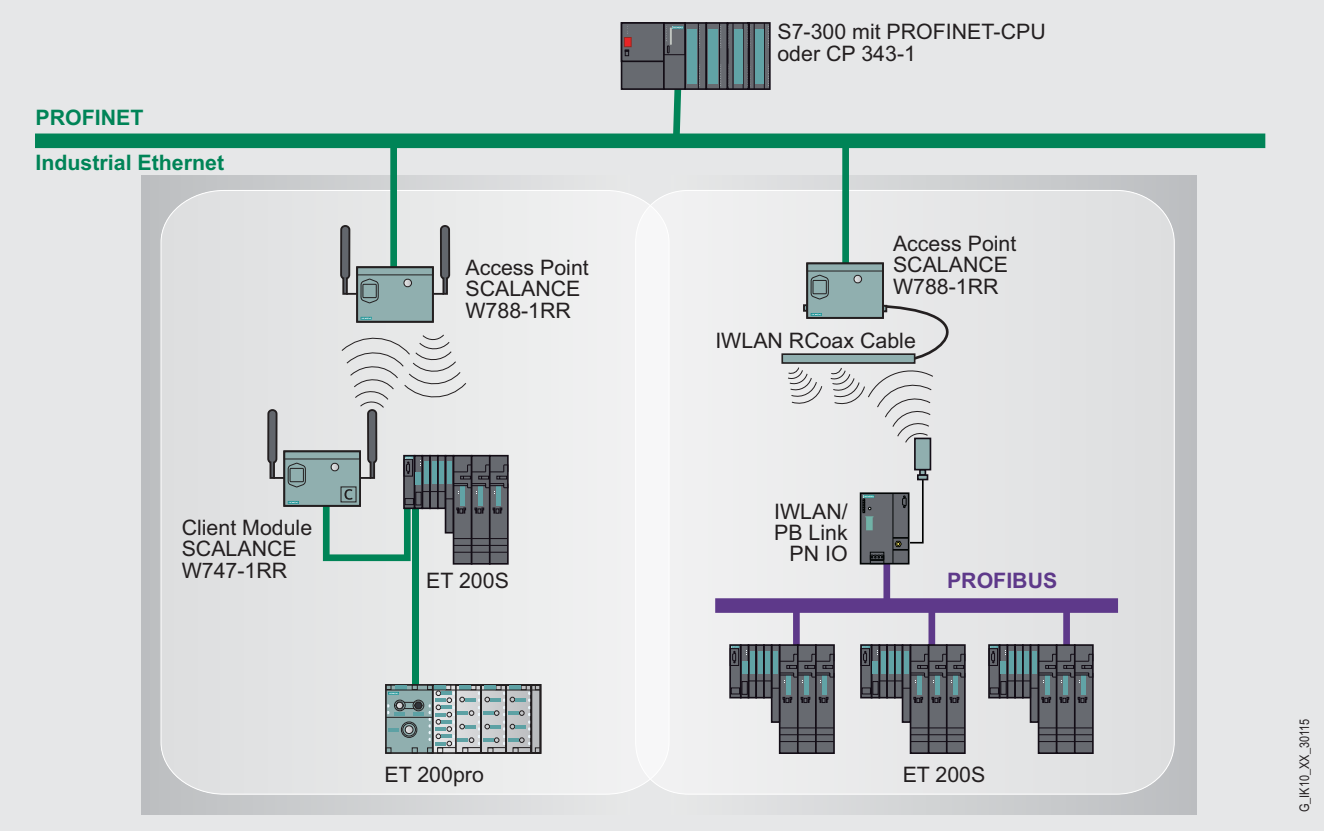

Figure 2-14 Simple WLAN structure with two access points/wireless cells, RCoax cable and IWLAN/PB Link PN IO gateway

Here, access points take over the role of switches. End nodes are connected to the network by activating clients. Larger networks can be achieved by setting up several wireless cells each under the control of an access point. The connection between individual cells is also via access points.

The cells have the function of subnets between which the mobile nodes can move. ("Roaming")

Shared medium instead of switched medium

It must be remembered that wireless networks always operate according to the shared medium principle; in other words, only one node can send at any one time. As the number of nodes increases, the achievable data rate inevitably falls for the individual nodes.

See also

Structuring wireless networks (Page 67)

Access points W-780 (Page 143)

Various WLAN accessories (Page 214)

IWLAN RCoax Cable (leaky feeder cable) (Page 213)

IWLAN/PB Link PN IO (Page 156)

Connecting a PROFIBUS network to a PROFINET installation (Page 77)

IWLAN application example: Power screwdriver control (Page 75)

2.6.1.2 Structuring wireless networks

Ad hoc networks

If wireless networks are set up without any further structuring, they are known as *ad hoc* networks.

In such networks, each node can contact any other node at any time. The achievable data rate sinks quickly because every active sender blocks all others. At the same time, there are serious security and reliability problems because no control entity is controlling the data traffic.

Ad hoc networks can only operated according to the 802.11 "b" standard.

For reasons of data security, transmission reliability and optimum performance, it is not advisable to operate an industrial wireless network as an ad hoc network. With ad hoc networks, protection against unauthorized intrusion and eavesdropping is difficult while the uncoordinated data traffic is not ideal for optimum performance. Response time and data rates cannot be guaranteed.

As an alternative, wireless networks can be configured in "infrastructure mode".

Use of access points and clients in infrastructure mode

A wireless network can be structured by using one node as an access point that manages communication with other nodes, the clients. When a network is structured in this way, this is known as *infrastructure mode*. The access point can manage access authorization for the nodes and assign them time slots for communication to ensure real-time response and deterministic communication.

Coordination by an access point: Standalone networks

The simplest form of an infrastructure network is a single wireless cell that is coordinated by an access point.

In this case, a central access point functions like a switch receiving the frames from the individual nodes (clients) and forwarding them.

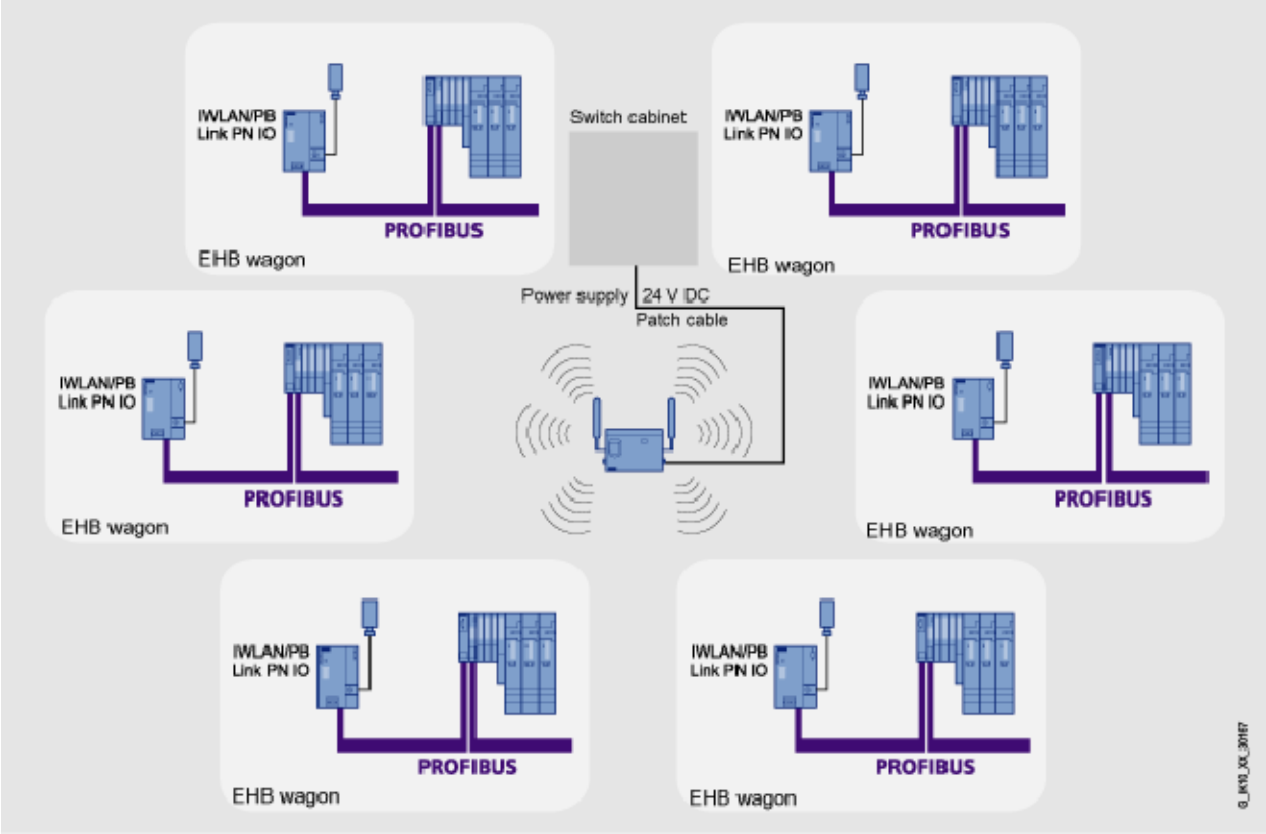

Figure 2-15 Wireless network in standalone mode Normally, SCALANCE W clients take the place of PROFIBUS links.

This mechanism has several advantages:

- It is not necessary for all nodes to be within the range of the others; it is adequate if all nodes have a connection to the access point.
- The access point can control and coordinate data traffic. Assigning time slots during which the individual clients are permitted to send, means, for example, that cycle times and data rates can be guaranteed.

Structuring of wireless networks with wireless cells

It is also more economical to divide a WLAN into several cells since only one node can transmit on one channel at any one time. If several cells are available, there can be an active sender in *every* cell and the actual data throughput is increased.

Connecting individual wireless cells

If the network has a larger span, the wireless network is divided into cells. All clients within the cell are within the range of a central access point (AP). The other nodes, the clients, only ever communicate with their access point and not directly with other clients.

The actual users of the network, CPUs, HMI devices etc. are also connected over wired Ethernet with the second interface of the client.

The setting up of a network with more than one cell may be necessary due to the span involved: It is practically impossible to predict the range that can be covered by an access point. (This is influenced by shadowing and reflections caused by stationary or mobile objects and interference from other transmitters.) In closed rooms, omnidirectional antennas typically cover distances between 30 m and 100 m.

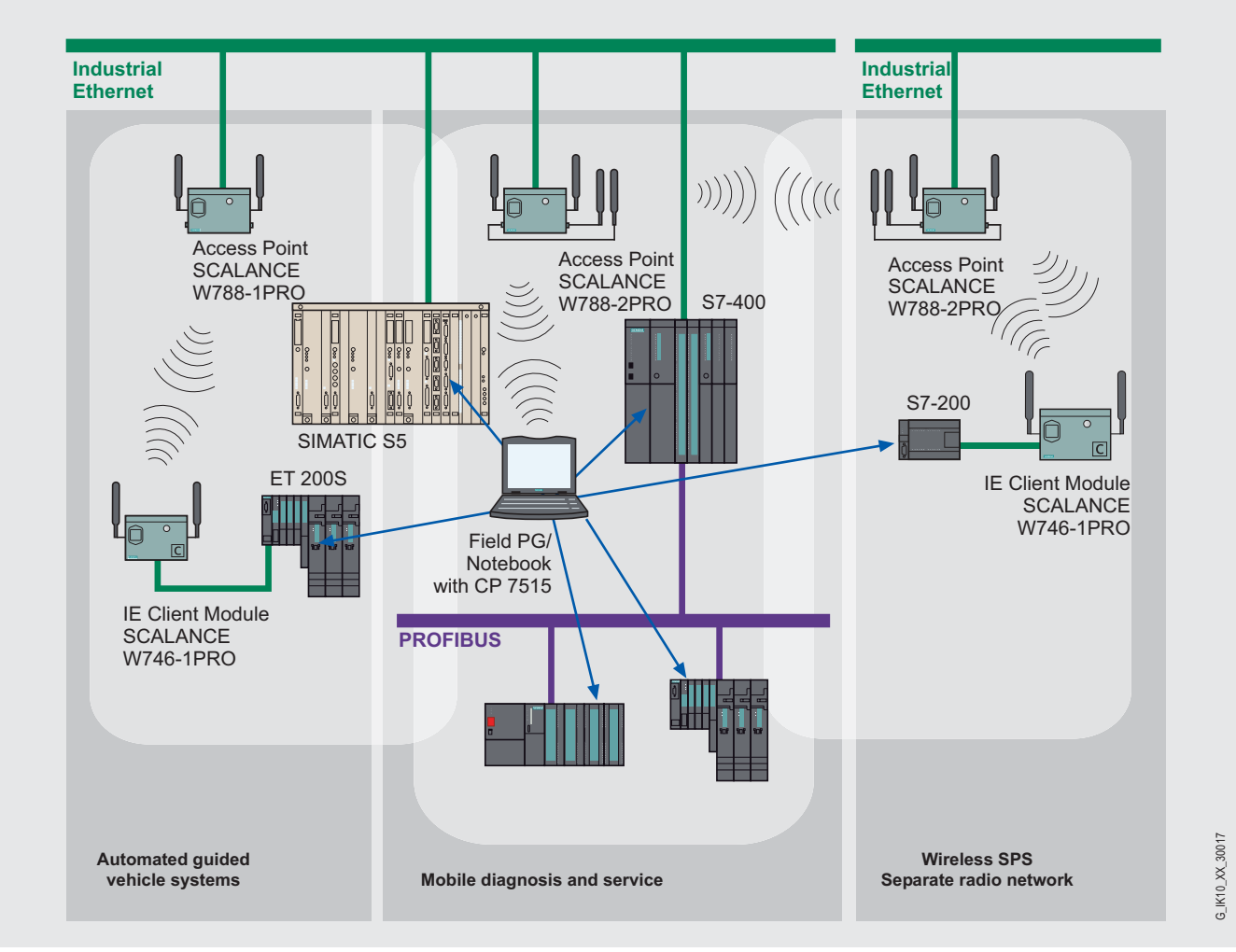

Figure 2-16 Structure of a WLAN with several wireless cells

In the illustration above, the access points are interconnected by wired Industrial Ethernet. Each access point spreads a wireless cell (light shaded area) within which it communicates with its (stationary) clients. Communication between cells is handled over Industrial Ethernet.

If a network with several cells is necessary, the APs have to communicate with each other over a separate channel. To allow this, all W-780 access points have a wired Ethernet interface; the W788-1PRO and W788-2PRO access points also have a second *wireless* interface that serves the same purpose. This means that the connection between the cells can be established over cable or over wireless.

Communication between a client located in cell "A" and a client in cell "B" is always handled via the APs in cells "A" and "B" even if the two clients are theoretically within each other's range.

Clients moving between wireless cells: "Roaming"

The situation becomes more complicated if clients are allows to move: What happens when the leave the area of one wireless cell and enter another? This is known as roaming and the control of the mobile client must then be passed from one access point to another.

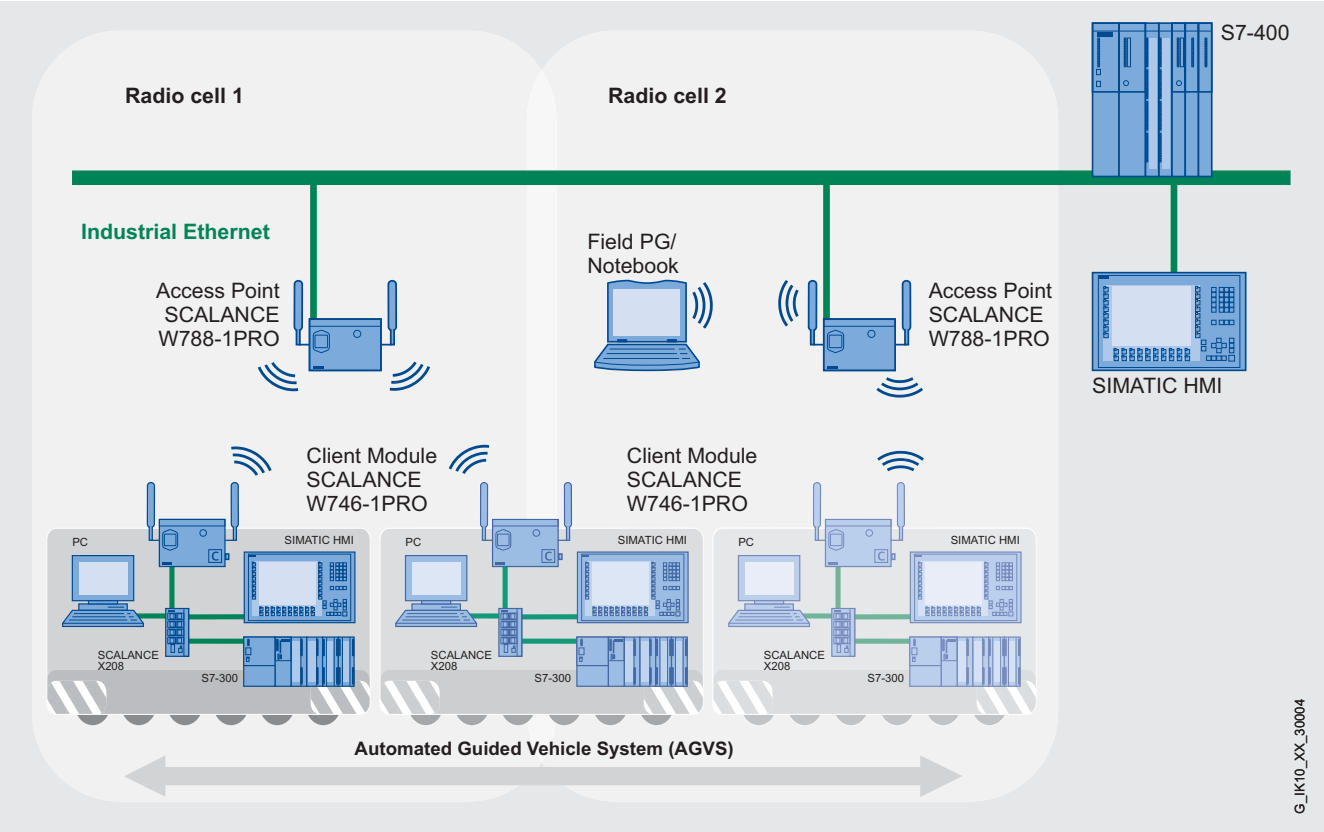

Figure 2-17 Roaming between wireless cells

The figure above shows how a moving node (in this case an automated guided vehicle system) is handed over between two wireless cells: The access point of the first cell in which the AGVS is originally located hands over the router function of the AGVS when this reaches the boundary between its own cell and the cell of the next access point. As of this point, the second access point is responsible for managing the client AGVS.

Roaming causes problems

One problem associated with roaming is the time required

- to detect that the old wireless cell is being exited and
- to establish the connection to a new wireless cell.

This handover typically takes several hundred milliseconds; and this time is too long for many industrial applications. To speed up the handover, "rapid roaming" with the iPCF method ("industrial Point Coordination Function") is used to reduce the interruption to a length of time acceptable for industrial requirements. SCALANCE W access points and clients with the supplement "RR" in the device name have the rapid roaming function that reduces the interruption to only a few milliseconds.

Complex structures

Depending on the requirements of the automation task and the performance of the devices, even more complex structures are possible:

- *Multichannel configuration*: Adjacent wireless cells communicate on different frequencies. This ensures that nodes in cell "A" cannot disrupt cell "B" and that communication can continue reliably.
- *Wireless Distribution System* ("WDS"): An infrastructure network in which the connection between the cells (the backbone) is not over cable but over a second wireless interface of the access point.
- *Redundant Wireless LAN* ("RWLAN"): In this case, there are two frequencies available for the backbone. If one of these frequencies is disrupted, the APs can change to the other frequency. This means that the availability and reliability of the network is retained even in a disrupted environment.

Leaky feeder cable

In environments that make the use of wireless difficult (for example in tunnels), or when the node only moves along predefined rails (for example automated guided vehicle systems), it is sometimes preferable to replace the omnidirectional antennas with an RCoax leaky feeder cable.

The leaky feeder cable is a special antenna in the form of a thick, flexible cable that produces an RF field with high intensity but only over a very limited range. As long as it can be guaranteed that the communication partner moves in an area close to the RCoax cable, the leaky feeder cable provides a reliable RF field and an excellent connection to the nodes.

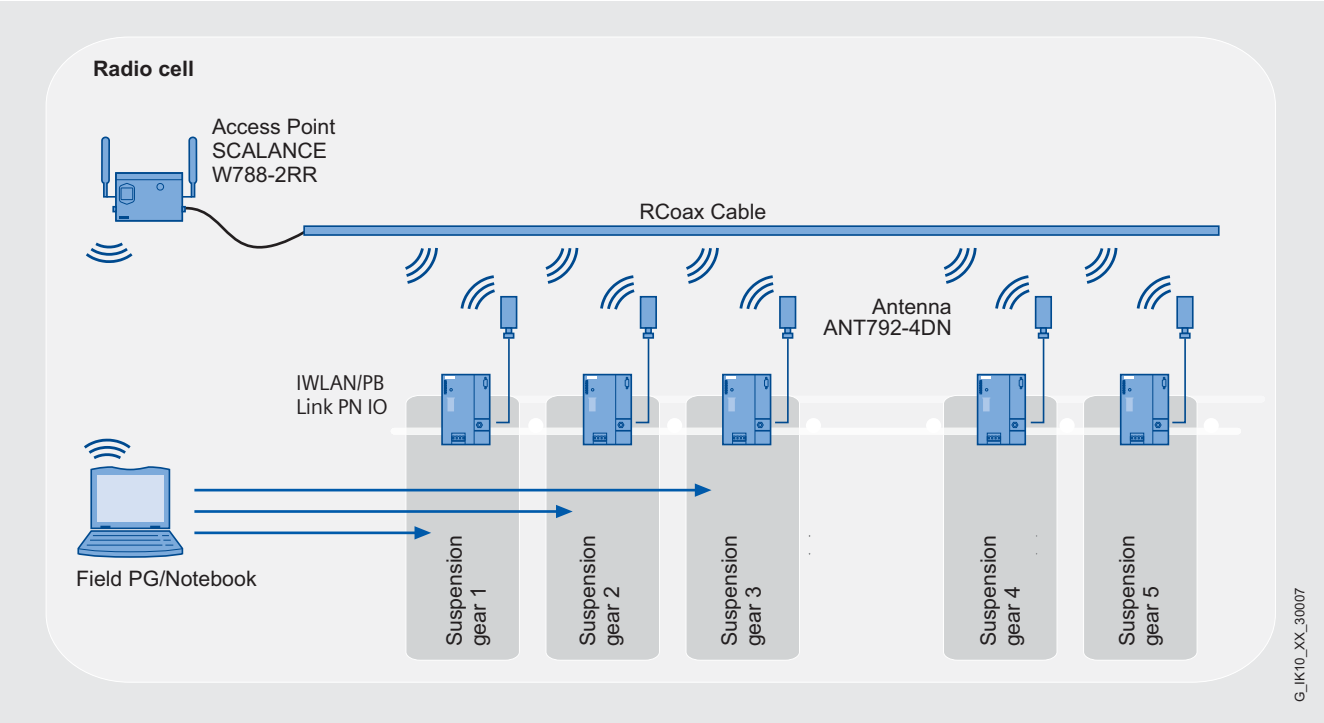

Figure 2-18 Function of the RCoax leaky feeder cable

The distance between the end node and the leaky feeder cable can be up to approx. 1 m. Several leaky feeder cable elements can be combined up to a total length of approx. 100 m. They create individual antenna wireless cells and the node roams between them. Refer to IWLAN application example for a use case. Power screwdriver control.

Connecting PROFIBUS segments: IWLAN/PB Link PN IO

To connect PROFIBUS nodes to an Industrial WLAN, the IWLAN/PB Link PNIO can be used. This provides the gateway between IWLAN and a PROFIBUS network and can be equipped with omnidirectional antennas or with a special antenna for communication with a leaky feeder cable.

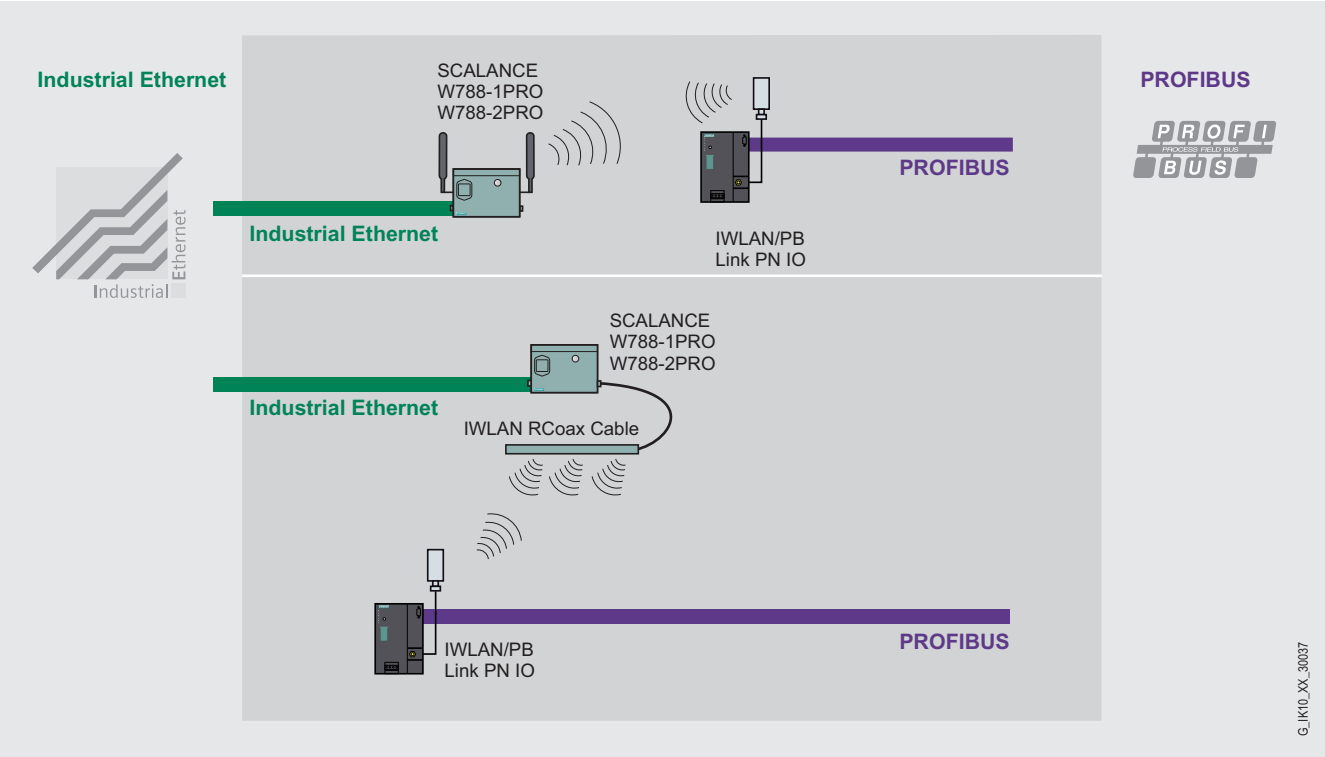

Figure 2-19 IWLAN/PROFIBUS gateway

Refer to Connecting a PROFIBUS network to a PROFINET installation (Page 77) for a use case.

See also

IWLAN application example: Power screwdriver control (Page 75)

SCALANCE W wireless network components (Page 139)

Components for wireless networks (Page 209)

IWLAN/PB Link PN IO (Page 156)

Access points W-780 (Page 143)

RCoax leaky feeder cable (Page 519)

2.6.1.3 IWLAN application example: Bottling plant

Task

An optimum solution is required for a filling machine with moving bottles. The valves on the moving part of the filling machine need to open and close in real-time.

The wired solution used up to now had too many downtimes because the slip ring contacts were subject to wear and tear and the communication system suffered from a lot of disruptions.

Solution

Alternative wireless solutions such as the use of infrared over the AS-Interface and PROFIBUS did not match up to the required performance and reliability. The final decision is a PROFINET solution with IO communication.

A SIMATIC ET 200S is installed as the control unit on the moving parts of the filling machine along with a SCALANCE W788-1RR access point and a SCALANCE W747-1RR as client module to control the fast opening and closing of the valves.

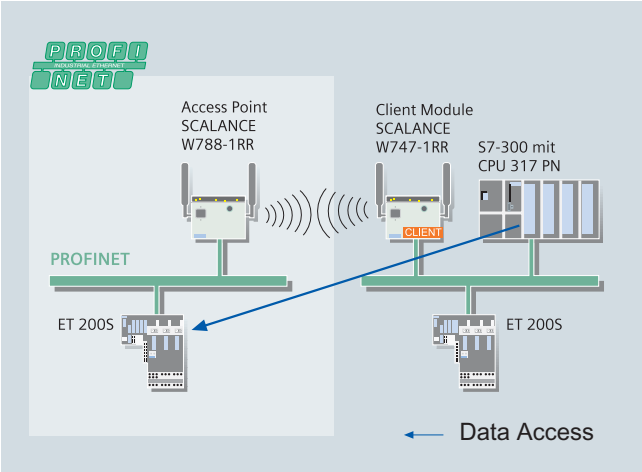

Figure 2-20 IWLAN: System solution for bottling plants

The wireless PROFINET communication allows the common use of real-time and TCP/IP-based communication on one cable and permits the integration of controller, distributed I/O and other Ethernet-based devices in one communications structure. The cyclic transfer of I/O data along with the process image of the corresponding controller makes for precise and very fast opening and closing of the valves.

With the wireless access to the moving parts of the machine, there is no longer any wear and tear costing long downtimes and high costs.
This interface can, in future, also be used for service making programming much simpler.

Benefits

- Costs saved by reduction of the downtimes with reliable communication in real time and savings on slip rings
- Significant improvement in performance
- Protection of investment by integrating PROFIBUS field devices in an IWLAN wireless network
- Cost-effective solution even compared with AS-Interface or PROFIBUS
- Option of wireless programming for service purposes
- Future-proof solution due to the use of the PROFINET standard and due to the option of integrating further applications such as a weighing system with SIWAREX

See also

Access points W-780 (Page 143)

SCALANCE W-740 Client Modules (Page 150)

IWLAN/PB Link PN IO (Page 156)

2.6.1.4 IWLAN application example: Power screwdriver control

Task

The aim is to reduce the number of power screwdrivers in motor vehicle assembly. The previous solution has a power screwdriver for each cycle and every bar code acquisition. Since the wired solution with slip rings required maintenance, a reliable wireless communications solution is intended to increase efficiency and reduce tooling times.

The products should be suitable for industry and be available worldwide. Investment should be protected by components that will be available in the long term.

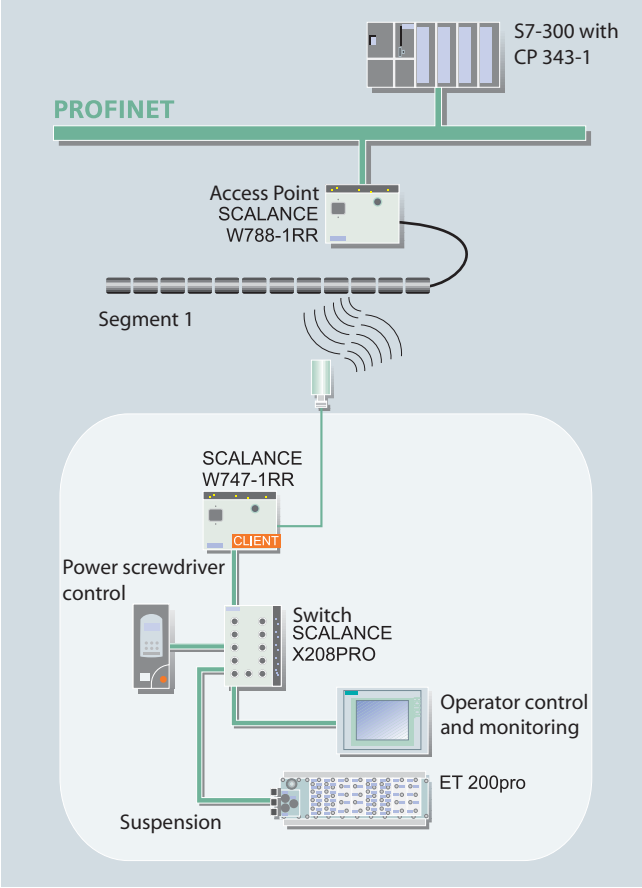

Figure 2-21 IWLAN: System solution for screwdriver controller with RCoax cable and SCALANCE W747-1RR

Solution

To set up the wireless data transmission, the silicon-free leaky feeder cable IWLAN RCoax cable will be used along the coding bar. This generates a defined, cone-shaped and reliable RF field and can be moved easily. The RCoax cable is therefore ideal for use in environments in which wireless is otherwise difficult and whenever rail-guided vehicles are involved.

For the feed-in stations for the RCoax Cable, IWLAN access points SCALANCE W788-1RR to IEEE 802.11 b/g (2.4 GHz) with data rates up to 54 Mbps will be used. The client module SCALANCE W747-1RR will be installed as the mobile node. This allows the same mobile unit to be used for all applications so that a mobile power screwdriver can be used for several cycles.

With this implementation with SCALANCE W747-1RR, there is also the option of using up to eight end devices

Benefits

- Lower investment costs due to the savings on power screwdrivers
- Reduction of maintenance costs and downtimes with a reliable wireless and therefore non-wearing data transmission to mobile communications partners
- Reduction of downtimes in the event of faults by using the C-PLUG (configuration plug); devices can be replaced without a programming device and without needing specialist personnel
- Reduction of operator activity, for example scanning, cycle transfer, travel time
- Changing models is straightforward and depends only on materials logistics
- Integration of further applications for quality control is possible
- Full screwdriver data can be loaded over the IWLAN link

See also

Access points W-780 (Page 143)

SCALANCE W-740 Client Modules (Page 150)

C-PLUG configuration memory (Page 223)

2.6.1.5 Wireless networks under extreme climatic conditions

The W-786 access points

SCALANCE W-786 products are particularly suitable in areas with extreme climatic conditions. Even at temperatures down to -40 °C or up to +70 °C, SCALANCE W-786 devices can be installed and operated with no problems.

With their resistance to UV and salt spray, they are suitable for installation in areas with hard requirements such as harbors. When antennas are necessary in exacting environmental conditions, the variants of the SCALANCE W-786 product line with internal antennas are available.

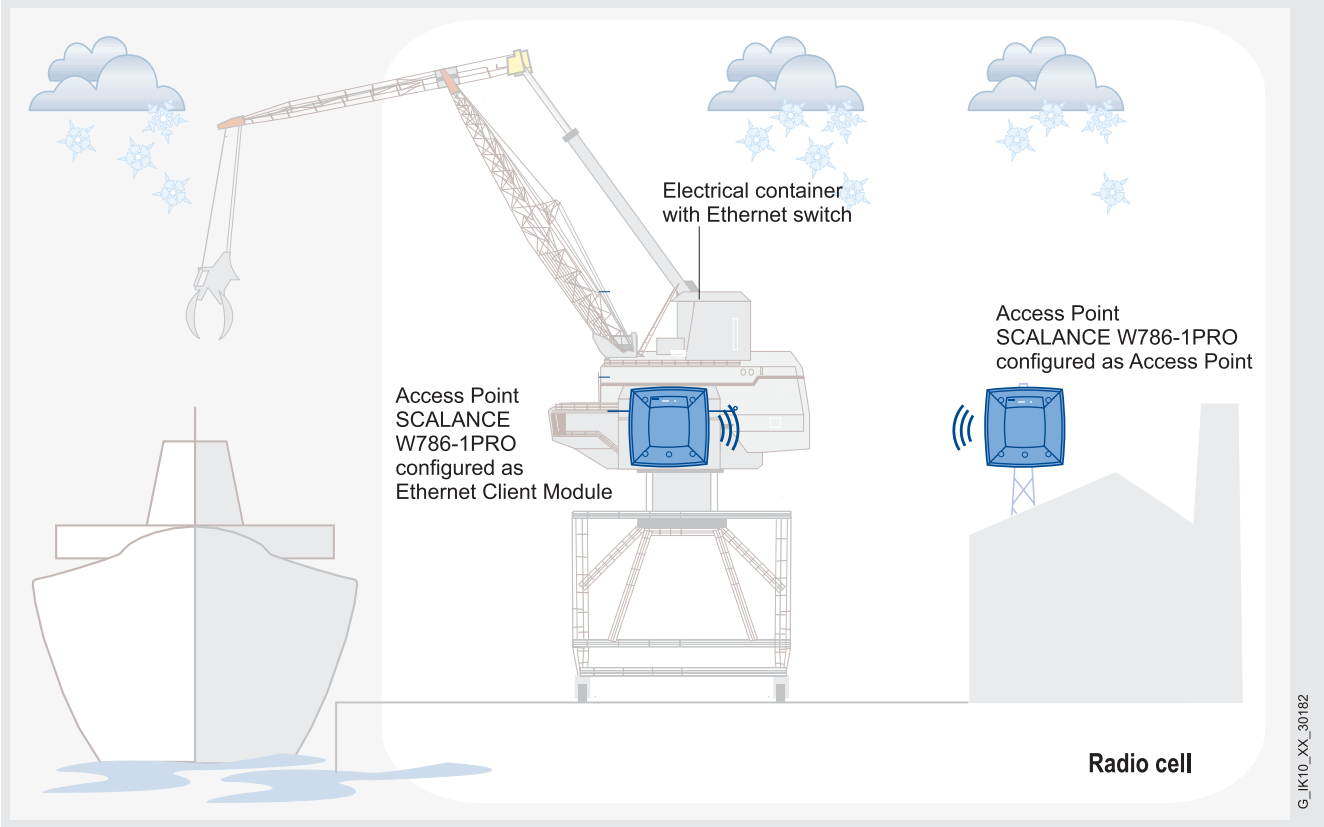

Figure 2-22 Harbor installation as an example of wireless networks in hostile climatic conditions

The SCALANCE W-786 is only an access point but it can nevertheless be configured as a client module using Web-based management.

If SCALANCE W-786 devices are configured as client modules, then depending on the selected variant, a maximum of one wireless module is available as client.

See also

SCALANCE W-786 (Page 145)

2.6.1.6 Connecting a PROFIBUS network to a PROFINET installation

Task

In a brick works, during production the green bricks are transported to the drying chamber by a trolley or shuttle conveyor. The shuttle conveyor not only runs back and forth between the two stations, but also fulfills other tasks. When the shuttle conveyor arrives, the doors or the drying chamber open or close automatically.

The original solution used a trailing cable for communication between the conveyor and the plant control, however this turned out to require too much maintenance. The plant then converted to wireless PROFIBUS modems:

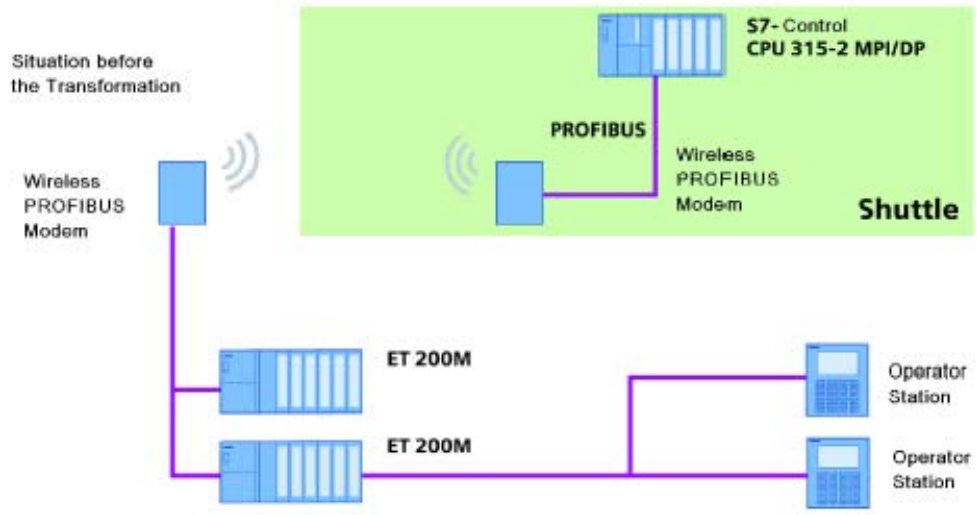

Figure 2-23 PROFIBUS/PROFINET gateway, 1st stage

The results were, however, not satisfactory. The maintenance was no longer required but communication was liable to disruption and was interrupted time and again for short periods. The reason turned out to be that the cycle time and transmission rate via wireless PROFIBUS were inadequate to meet the requirements of the plant.

Solution

The system was replaced by a PROFINET IWLAN. Instead of the wireless PROFIBUS modem, an IWLAN/PB Link PN/IO took over communication between the ET 200M head modules, the HMI operator station and the S7 plant controller that in turn communicate over SCALANCE W access points or clients.

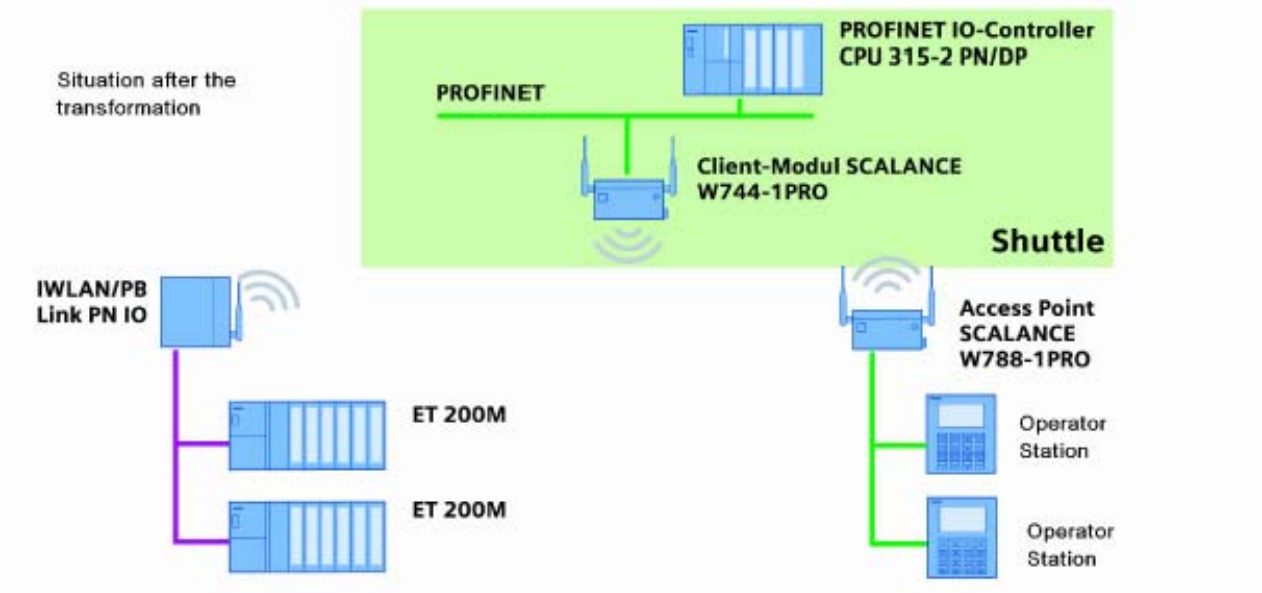

Figure 2-24 PROFIBUS/PROFINET gateway, 2nd stage

This solution combines PROFINET IO and wireless industrial technology. The plant therefore has real-time PROFINET communication based on Ethernet with a high data rate and is transparent to the PROFIBUS network.

Benefits

- Maintenance-free communications medium (no more moving parts),
- Transparent network with wireless PROFINET/PROFIBUS gateway,
- More user friendliness with wireless PCs for diagnostics, process visualization etc.,
- High data rate, reliable communication,
- Elimination of downtimes due to disruptions,
- Operating costs, particularly for maintenance, significantly lower,
- Increased productivity,
- Installation of a flexible, expandable system with system reserves.

See also

Access points W-780 (Page 143)
SCALANCE W-740 Client Modules (Page 150)
IWLAN/PB Link PN IO (Page 156)

2.6.2 Secured networks

2.6.2.1 Protection of the production network when networking with the office network

Task

- The production network needs to be protected from unauthorized attacks from the office network and the automation cells from mutual influence.
- Total integration from the management level to field level should be possible to allow comprehensive diagnostics for field devices and network components.
- Cells with predominantly the same structure (same private IP addresses) should be protected from illegal access.
  - A Syslog server should log all attacks, for example by hackers, or overload.
  - Process data such as numbers produced, fabrication numbers, type designations should be logged.
- The configuration should be simple since personnel without special training in security will be used for commissioning and service.

Solution

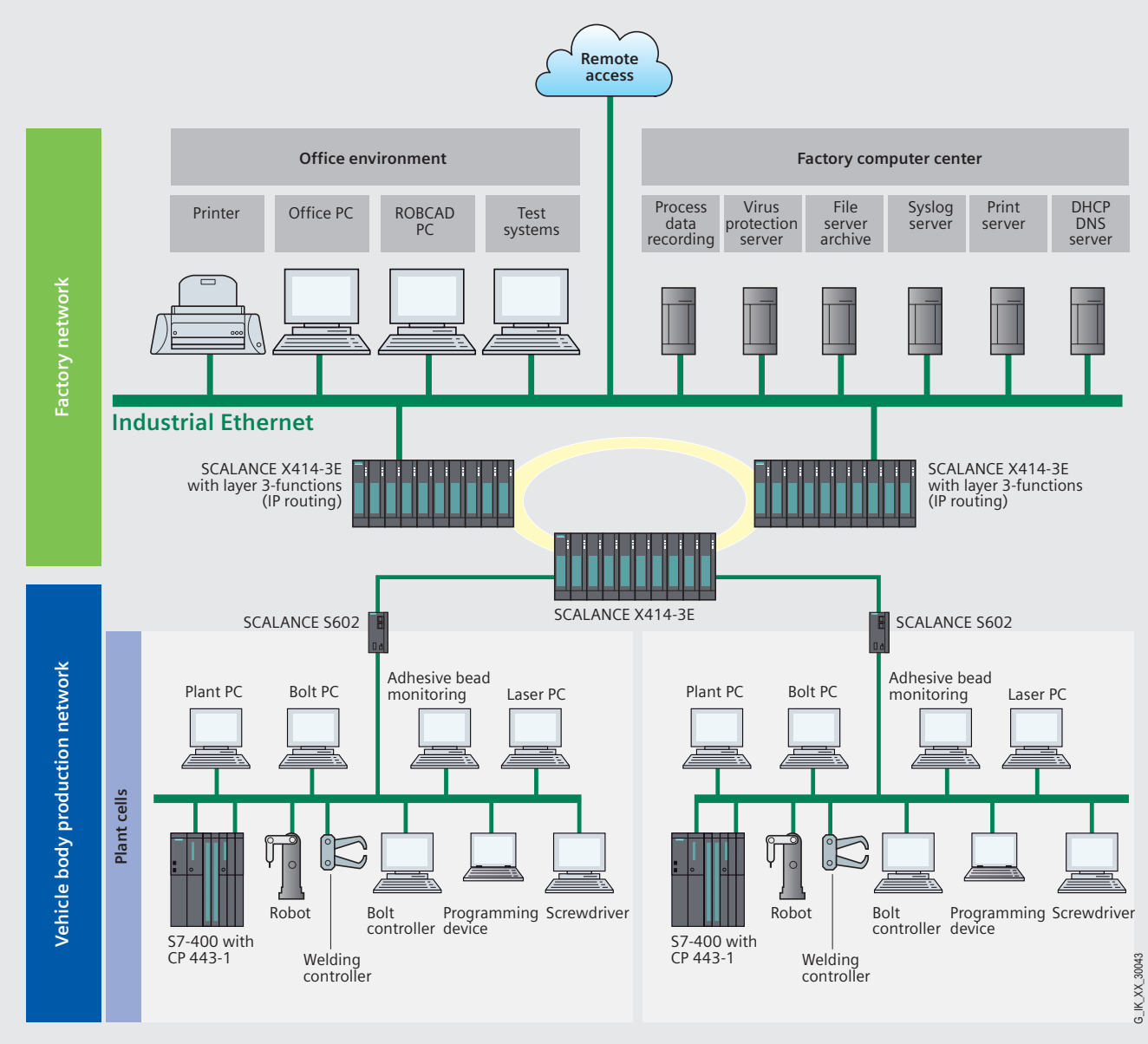

Figure 2-25 Plant network protected with SCALANCE S

The use of SCALANCE S602 as a firewall serves to filter data packets and to allow communication connections according to the firewall rules. Incoming and outgoing communication can be filtered as well as IP and MAC addresses or communications protocols (ports). It is also possible to set an overload limit.

The firewall integrated in the security modules can be configured so that only a certain number of stations are permitted access.

The logging functionality allows access monitoring and logs attacks and attempted access to allow preventive measures to be taken.

An IP address conversion is necessary for effective protection of the established cells. The SCALANCE S602 security modules with NAT/NAPT functionality are used to achieve this.

Syslog information such as process data is automatically sent to the Syslog server.

This means that the production network is protected effectively and reliably from unauthorized access from the office network, but that the office network is also protected from influence from the production network.

Benefits

- Protecting the plant from unauthorized attacks and communication overload by using SCALANCE S
- Effective protection from mutual influence between production and office network
- Continuous monitoring of access to the production network
- Cost saving by saving on public IP addresses
- Simple maintenance and diagnostics, since all protected cells can be set up identically.

Note

The SCALANCE S602 security modules do not work in conjunction with the SOFTNET security client.

See also

SCALANCE S Security Module (Page 158)

2.6.2.2 Automation network with protection from office network influences

Task

- Automation systems should be protected within the automation cell even without their own security functionality.
- Existing network settings such as topology, addresses or protocols used should remain unchanged by implementing security.
- Mechanisms for authentication and data encryption should be used to prevent falsification of IP addresses or manipulation and espionage

Solution

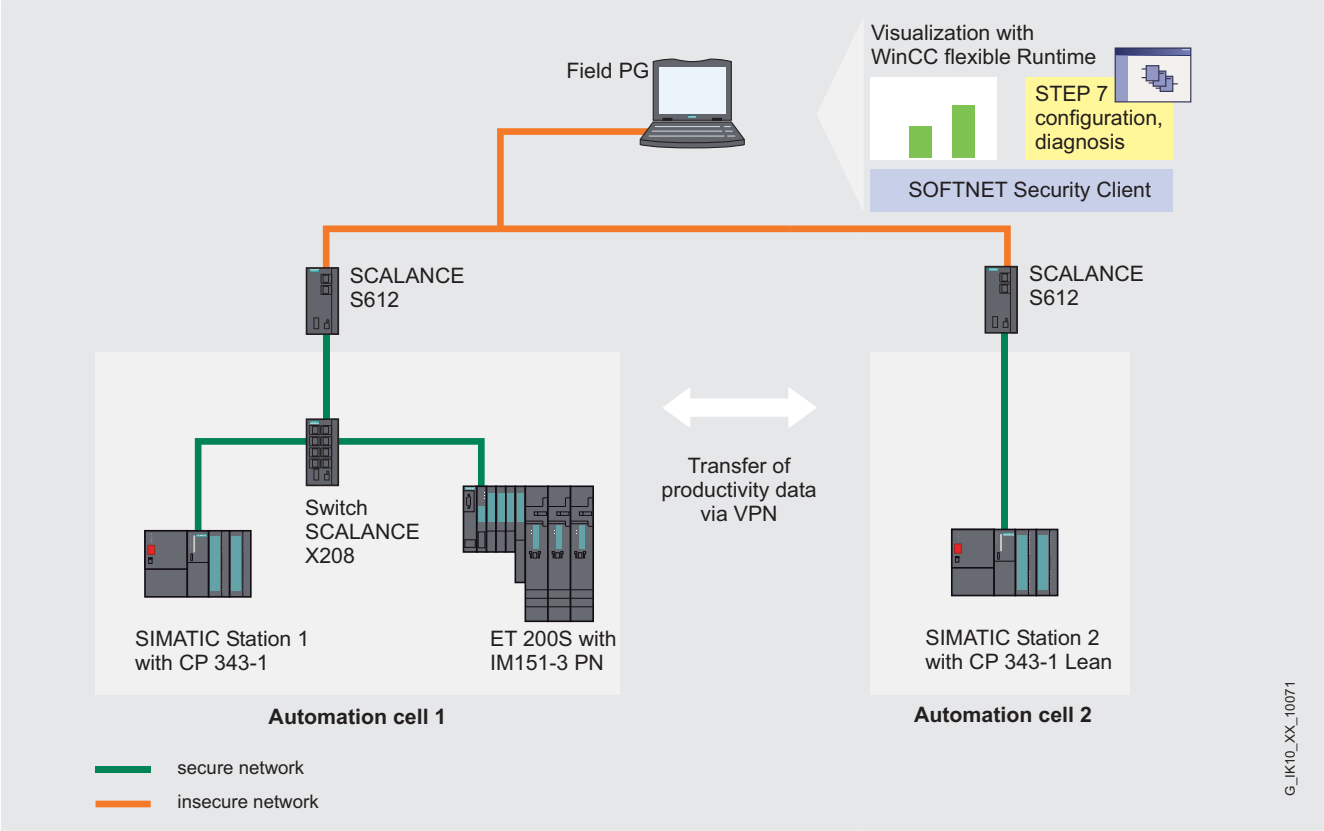

Figure 2-26 Protection of automation cells via a VPN tunnel

VPNs (Virtual Private Networks) allow the secure authentication of communication nodes and the encryption of data transmission.

The SCALANCE S security modules are used to protect automation networks and for the secure exchange of data between automation systems.

They only allow communication between authenticated and authorized devices. This protects from operator errors, prevents unauthorized access and avoids disruptions and communication overload.

The data transmission is also encrypted providing protection from espionage and manipulation.

The SOFTNET security client software is used to set up secure VPN connections from PGs/PCs with network segments. This allows secure VPN client access by PCs/notebooks to automation systems or cells protected by SCALANCE S.

Benefits

- Enhanced protection of the plant from unauthorized access, manipulation, espionage and communication overload by the SOFTNET security client using VPN technology with SCALANCE S
- Simple configuration of security mechanisms is possible without specialist knowledge

- No modification or adaptation of the existing network structure, applications or nodes necessary and therefore simple integration in existing systems

See also

SCALANCE S Security Module (Page 158)

2.6.2.3 Data protection for mobile communication

Task

- Mobile access for commissioning, maintenance and service of field devices, control technology and mobile operator control and monitoring should only be possible for authorized personnel.
- Personnel should be able to move around freely and have access within the RF field to data from the machine room and control components.
- This should minimize downtimes and personnel requirements.
- It should be possible to use the components both in the indoor and outdoor areas.
- The configuration of restricted access should be as simple as possible to set since the plant will only be operated by automation technicians.

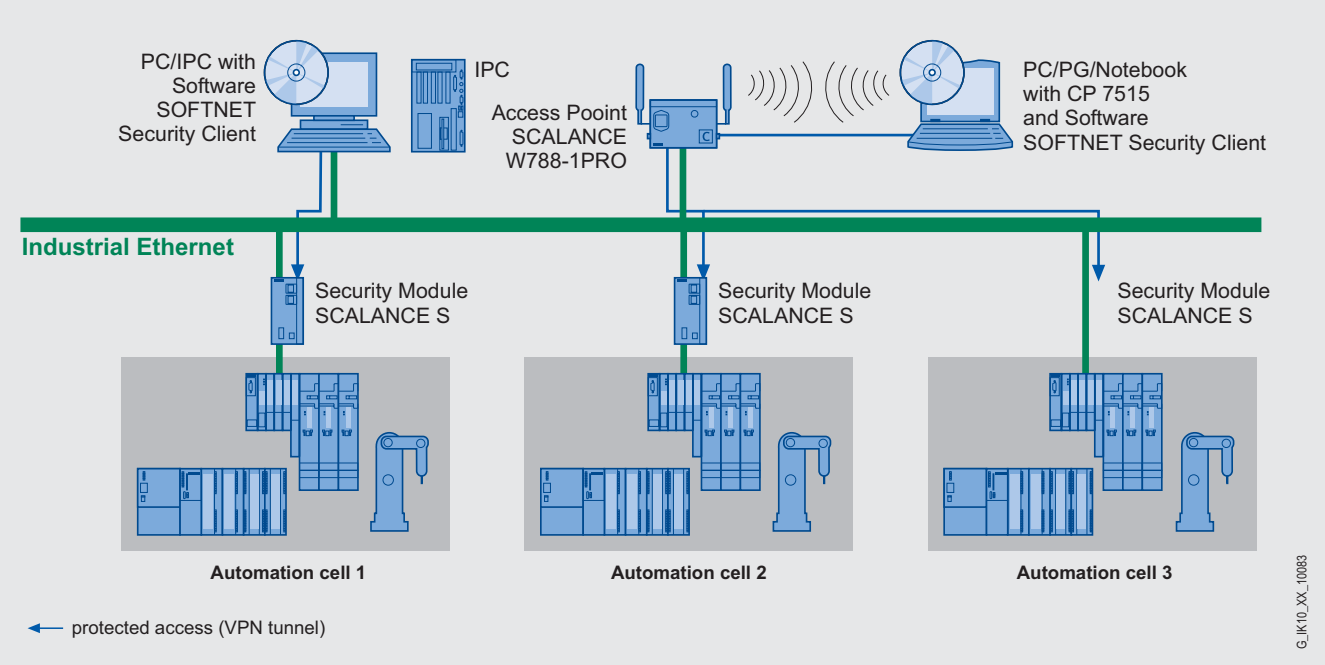

Figure 2-27 Secure access to automation cells protected by SCALANCE S with SOFTNET security client

Solution

To achieve the optimum coverage with the RF field, a preliminary illumination is performed and the RF field planned.

A W788-1PRO access point is used to illuminate the space involved. With its robust IP65 metal housing, it can be used both indoors and outdoors. Thanks to the roaming function of Industrial Wireless LAN (IWLAN), the nodes can move freely in the wireless network.

A field PG is used as the mobile end device.

Use the SCALANCE S security modules and the SOFTNET Security Client software achieves secure authentication of the communications nodes and encryption of the data transmission through the VPN tunnel, operator errors and unauthorized access are prevented as well as espionage and manipulation.

Benefits

- Mobile communication is protected from unauthorized access, manipulation, espionage and communications overload
- Simple integration of other mobile nodes even in existing automation systems
- Savings in resources for service and maintenance
- Simple configuration of the security mechanisms without specialist knowledge

See also

SCALANCE S Security Module (Page 158)

2.6.3 Mesh networks

Mesh networks

In a mesh network, every network node is connected to one or more of the other nodes. Information is passed from node to node until it reaches its destination. If every node is connected to every other node, this is known as a fully connected network.

- Mesh networks are normally self-healing: If a node or a connection is blocked, the network can reconfigure itself around the problem. The data is redirected and the network is then operational again.
- The reconfiguration time can, however, be a problem for industrial applications.

The concept of mesh networks can be used both for wired and wireless networks. Powerful switches such as the SCALANCE X-300 and X-400 devices are capable of setting up and controlling mesh networks. These topologies are used in particular when setting up networks over large areas and at the transition to enterprise networks.

Example: Connecting a redundant ring to a mesh network

From any SCALANCE X-200 / X-300 / X-400 in the ring, a connection can be established to a component in a mesh network. This connection is not redundant. However, by using the spanning tree protocol, an alternative route can switched to the component in the ring. From the perspective of the mesh network, the redundant ring is treated as a hub or switch. Each connection to a switch in the ring is like a connection to the port of a switch without STP capability that forwards STP frames transparently. This means that a redundant ring in a manufacturing process can be connected to a network in the office world.

With a SCALANCE X-400, the simultaneous use of STP and ring redundancy is not possible. A SCALANCE X-400 cannot use more than one method at one time. If (R)STP is disabled, a SCALANCE X-400 works in the (R)STP listening mode. In this mode, the switch forwards (R)STP configuration frames transparently even when (R)STP is disabled for it. If it recognizes a topology change frame, it reduces the aging time for a limited period or deletes the address table so that the node list is updated more quickly.

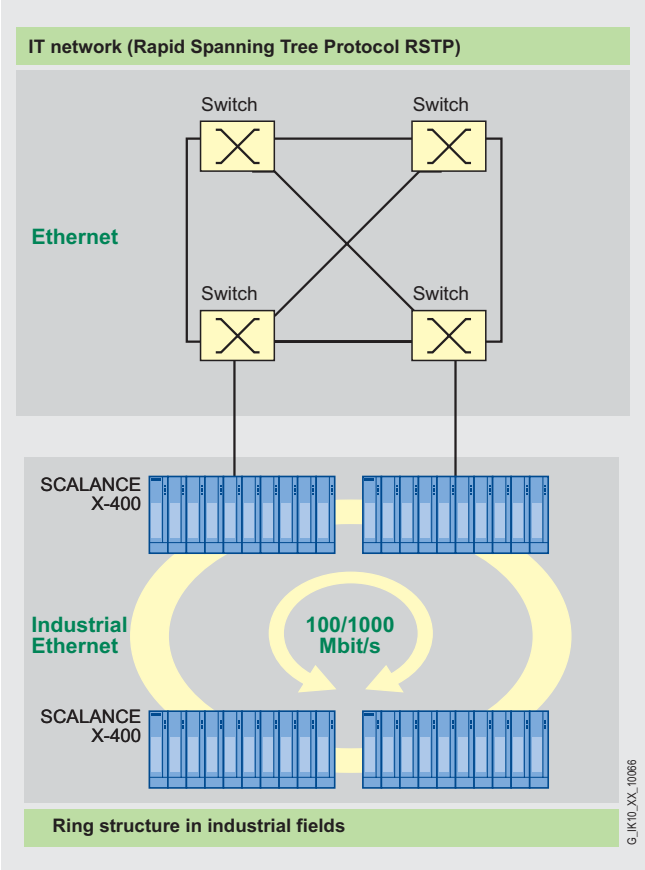

Figure 2-28 Integration of an optical ring in a mesh network

See also

SCALANCE X-200/X-200 IRT (Page 121)

SCALANCE X-400 modular (Page 132)

Part B:

Target group and content

This part is intended for decision makers and planners.

This part introduces the entire SIMATIC NET product lines. Here, you will find the main characteristics of the SCALANCE generation of switches, security and wireless components - the emphasis being on their technical properties. OSM and ESM devices, passive components (such as cables and connectors) and accessories are also described.

Part B: The SCALANCE generation of devices

3

3.1 The SCALANCE X family of switches

3.1.1 Switches in the Industrial Ethernet environment

Overview of the SCALANCE X Industrial Ethernet switches

Figure 3-1 SCALANCE X device overview

SCALANCE X is the current family of Industrial Ethernet switches from SIMATIC NET. It is made up of various product lines each complementing the other that are also available for PROFINET applications and are tailored to specific automation tasks.

Switched network

The transmission media used between the switches are fiber-optic cables (optical) or twisted-pair cables (electrical). End devices or network segments are connected over twisted-pair cable.

Highlights of the Industrial Ethernet switches SCALANCE X

- Graduated portfolio of complementary products from the entry level to modular high-end device,
- Use as redundancy manager for setting up redundant network structures,
- Seamless integration of automation and existing office networks,
- Routing functions at layer 3 level for communication between IP subnets,
- Robust, innovative and space-saving housing concept; extremely good integration in SIMATIC automation solutions; free choice between 35 mm DIN rail, S7-300 standard rail or direct wall mounting,
- Securing collar concept; with the PROFINET-compliant connector Industrial Ethernet FastConnect RJ-45 Plug 180 from SIMATIC NET provides additional tensile and bending strain relief for the RJ-45 port,
- High-speed redundancy allows very fast reconfiguration (< 0.3 seconds) with up to 50 SCALANCE X-200, SCALANCE X-300 or SCALANCE X-400 switches in the ring.

3.1.2 Device series of the SCALANCE X switches

SCALANCE X005 entry level

Unmanaged switch with five RJ-45 ports for use in machine and plant islands.

SCALANCE X-100 unmanaged

Switches with up to twenty-four electrical and up to two optical ports and on-site diagnostics for use in applications in the immediate vicinity of machinery.

SCALANCE X-100 unmanaged media converters

Media converters are used to convert electrical to optical signals and to connect existing networks, for example AUI networks.

The unmanaged Industrial Ethernet media converters are ideally suited for converting various transmission media in 10/100 Mbps Industrial Ethernet networks in linear bus, star and ring structures. They are all designed for industry and equipped with a compact housing.

SCALANCE X-200 managed

Configuration and remote diagnostics are integrated in the SIMATIC STEP 7 engineering tool. This increases plant availability. Devices with a high degree of protection allow installation without a cabinet.

Universally use from machine-oriented applications to networked units.

SCALANCE X-200IRT managed

For use in unit networks with hard real-time requirements (isochronous real time) and maximum availability. Data traffic without real-time requirements can be handled on the same network. Dual network structures are therefore not necessary.

SCALANCE X-300 managed plus

The main area of application of the SCALANCE X-300 switches is in high-speed plant networks with an interface to the Enterprise network. The SCALANCE X-300 managed plus product line combines the firmware functionality of the SCALANCE X-400 product line (without routing functions at the layer 3 level) with the compact design of the SCALANCE X-200 product line. The "managed plus" attribute means both enhanced management functions compared with the SCALANCE X-200 and enhanced firmware functionality.

SCALANCE X-400 modular

For use in high-speed plant networks that will also be capable of meeting future requirements (for example high-speed redundancy). The partially modular design concept provides optimum flexibility to allow this switch to be adapted to the task in hand. Support of numerous standardized IT functions makes the smooth integration of automation networks in existing office networks possible.

3.2 The SCALANCE W family of components for wireless networks

3.2.1 Wireless components for Industrial Ethernet

Industrial mobile communication with SCALANCE W

Figure 3-2 Industrial mobile communication

The key to market success tomorrow is the availability of information at any location and at any time. Processes can be much more efficiently designed using mobile devices networked over standardized and available wireless networks. The advantage of wireless solutions is primarily the simple and flexible accessibility of mobile nodes.

SCALANCE W – wireless communication

Figure 3-3 SCALANCE W wireless group

The SCALANCE W products offer a unique combination of reliability, robustness and security in one product. With the basic technology of Industrial Wireless LAN (IWLAN), they offer an enhancement of the IEEE 802.11 standard that is particularly attractive to industrial customers requiring determinism and redundancy. For the first time, a single wireless network is available both for process-critical data, for example alarm messages (IWLAN), as well as for non-critical communication (WLAN), for example for service and diagnostics. The outstanding features of SCALANCE W products are the reliability of the wireless channel and the dust- and waterproof design (IP65) of the metal housing along with the high degree of mechanical stability familiar in SIMATIC products. To protect them from unauthorized access, the products provide modern standard mechanisms for user authentication and encryption of data, which does not prevent them from being easily integrated into existing security concepts.

Wireless infrastructure

In contrast to copper and fiber-optic cables, wireless transmission makes use of radio waves. The propagation characteristics of the electromagnetic waves can differ considerably and depend on the spatial environment and the installed wireless infrastructure.

To achieve better reception, SIMATIC NET modules use techniques such as antenna diversity, top-quality receivers and fault-tolerant modulation techniques to improve signal quality and to prevent the wireless traffic being interrupted. To ensure reliable wireless links, it is even possible to activate data reservation on the access points to achieve a reliability similar to that of wired links.

Industrial mobile communication uses the various wireless networks, for example WLAN, GSM or GPRS together in harmony. First and foremost, this relates to the various frequency ranges for different applications, the restrictions regarding the maximum transmit power and the selection of specific transmission techniques.

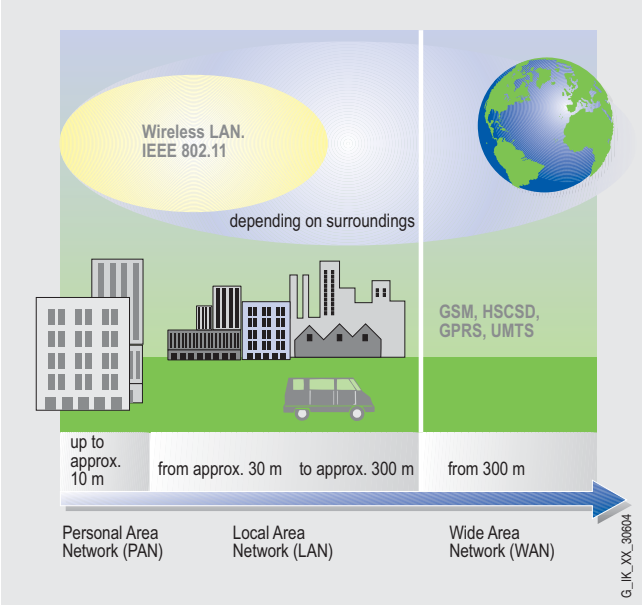

Figure 3-4 Using different wireless networks

Network solution with Industrial Mobile Communication (IMC)

Mobile end devices allow an uninterrupted flow of information from the enterprise level right through to the production level.

To simplify planning and configuration of an IWLAN network, the SINEMA E software is available providing a series of simulation functions. It can visualize wireless and device properties clearly and in detail and therefore reduce configuration and commissioning effort and help to avoid configuration errors. It can also be used to detect and precisely evaluate existing wireless networks to avoid unnecessary coverage ranges or possible wireless dead spots.

For wireless communication in a PROFIBUS environment, a wireless-based solution is available with the IWLAN/PB Link PN IO.

This allows fast, mobile, secure and simple availability of information at the right place and at the right time.

Reliability

Using redundancy mechanisms and packet repetitions, the SCALANCE W access points create a reliable wireless link that can also resist the interference found in the industrial sector.

The reservation of the data rate makes wireless traffic plannable and prevents delays or even production downtimes when accessing data.

The C-PLUG exchangeable medium stores project engineering and configuration data making it possible to replace devices quickly and without specially trained personnel. This minimizes downtimes and saves training costs.

With "rapid roaming", mobile nodes can be handed over quickly from one RF field to the next avoiding any interruption in PROFINET IO communication. Several PROFINET IO devices can also be operated simultaneously over wireless links in real time.

Robustness and suitable for industry

Depending on their degree of protection, SCALANCE W products can be subjected to temperature fluctuations from -20 °C to +60 °C or come into constant contact with dust and water. With a metal housing and constructed to withstand shock and vibration, they can be used in a tough industrial environment.

Accessories such as the antennas, power supply unit and the cabling are included in this concept and manufactured for industrial use.

Power and data are transferred over one cable with Power-over-Ethernet saving investment and maintenance costs.

Security of the data

Defined transmission times and a net bit rate for the data packets are implemented with the "reservation of the data rate" function and make cyclic wireless traffic available. Even real time can be used in a wireless network.

Redundant network concepts can also be implemented over wireless: Wireless channels are designed redundantly with a switchover in milliseconds so that the application is not affected by packet repetitions or disruptions on the wireless channel.

The latest encryption mechanisms make the data safe from unwanted access.

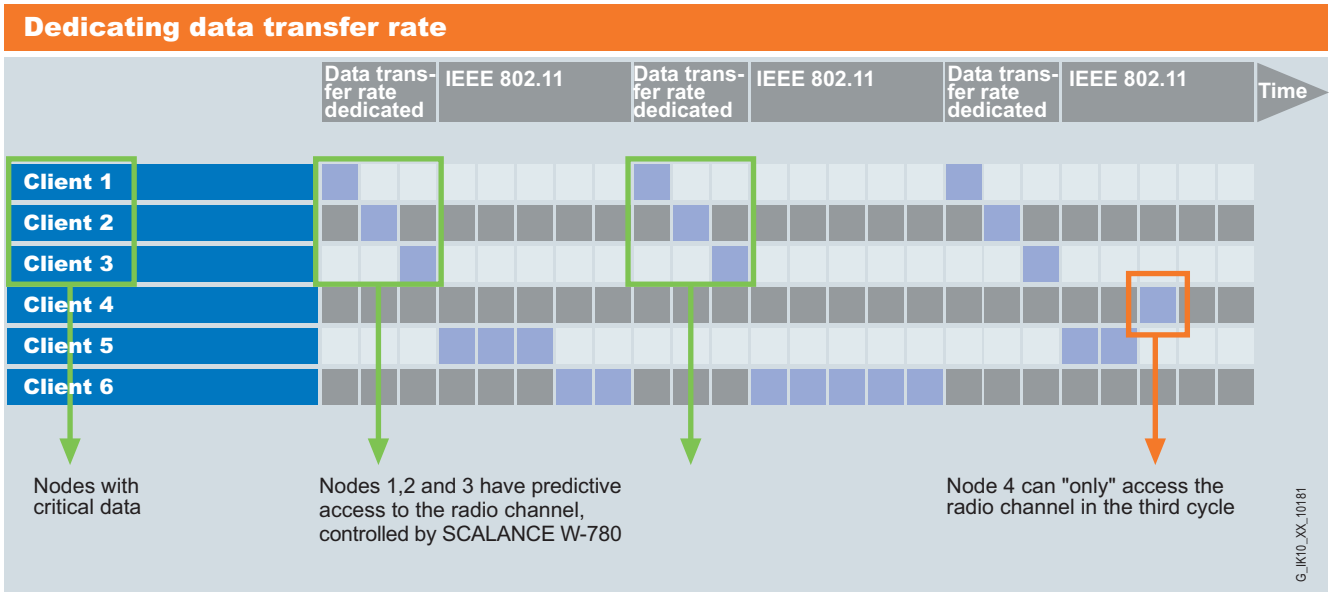

Figure 3-5 Reserving the data rate

3.2.2 Device series of the SCALANCE W components

Access points and clients

The SCALANCE W product family includes access points that can handle coordination and routing functions in the wireless network and pure clients that only establish the connection between wired end devices and the wireless network.

The functionality of all access points can be reduced so that they can also be used purely as clients; a client cannot, however, be upgraded to become an access point.

SCALANCE W-788: Standard access points

The W-788 access points are the "workhorses" of the SCALANCE W product range. Robust, compact and powerful, they all have two antenna interfaces with which even wireless problem areas can be illuminated.

Web-Based Management and wide range of administrative and date protection functions is common to all models. Some devices also have rapid roaming capability or have two wireless interfaces for redundant connections.

SCALANCE W-744: Clients

In terms of their hardware and most technical specifications, the clients of the W-744 series correspond to the W-788 access points but have a reduced range of software that does not allow them to be used as access points.

SCALANCE W-786: Access points for difficult external conditions

With degree of protection IP65 and a particularly robust vandal-proof housing no parts accessible from the outside, the W-786 access points are particularly suited for use in tough climatic conditions (harbor installations with salt spray etc.) or public places and facilities.

SCALANCE W-784: Access points reduced to the basics

The W-784 access points are a less expensive variant compared with the other access points. In these devices, the extras have been reduced to a minimum so that their extremely compact design makes them suitable for installation in switching cubicles or other environments in which cost containment is more important than resistance to external influences.

See also

SCALANCE W wireless network components (Page 139)

3.3 The SCALANCE S family of security modules

Industrial security with SCALANCE S

Figure 3-6 SCALANCE S picture of the product

Modern automation engineering is based on communication and the increasing networking of individual manufacturing cells. The integration of all manufacturing components with continuous networking through to the office network or the company intranet is gaining in importance all the time. This also applies to remote access options for service, the increasing use of IT mechanisms such as Web servers and E-mail in programmable controllers and the use of wireless LANs. This brings industrial communication and the IT world closer together and subjects it to the known risks from the office and IT environment, such as hackers, viruses, worms or trojans.

The existing security concepts were developed for the office world and require constant upkeep and specialist knowledge. Moreover, they are not normally capable of dealing with the special protocols of industrial communication or the special environmental conditions.

With its Industrial Security concept, Siemens offers a security solution specifically for industrial automation engineering to meet the requirements of this application environment.

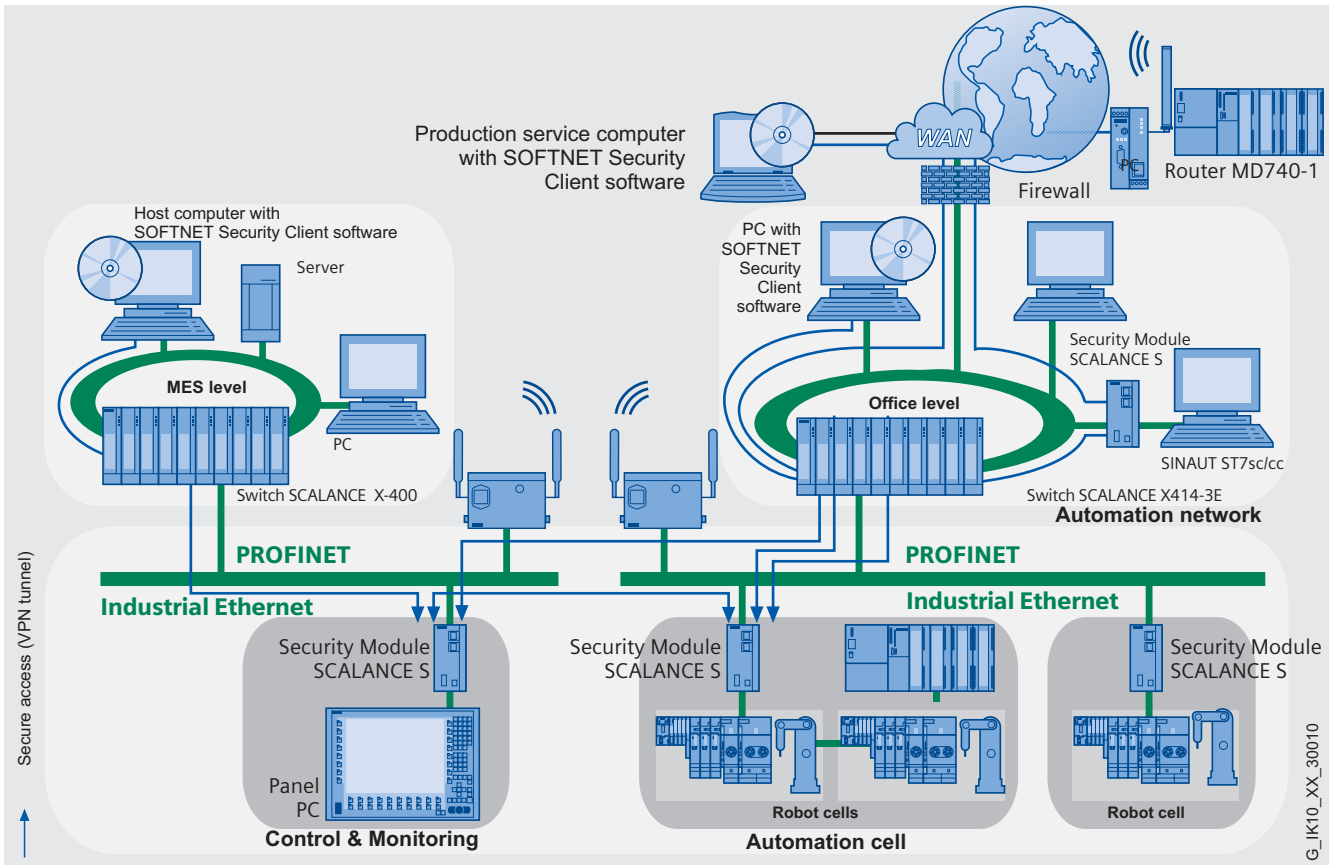

Figure 3-7 SCALANCE S application scheme

Advantages of the Industrial Security concept:

- Protection from data espionage and data manipulation
- Protection against overload of the communications system
- Protection against mutual influence
- Protection against incorrect addressing
- Reliable remote access even via the Internet
- User-friendly and simple configuration and administration without specialist IT security knowledge
- No changes or adaptation of the existing network structures necessary
- No changes or adaptation of the existing applications or nodes necessary
- Robust design, suitable for industry

SCALANCE S security modules provide scalable security functions:

- Stateful inspection and firewall to protect automation devices from unauthorized access regardless of the size of the network to be protected.

- Alternatively or additionally with VPN (Virtual Private Network) for secure authentication of the communications nodes and encryption of the data transmission
- SOFTNET Security Client for secure access from PCs/notebooks to automation systems protected by SCALANCE S (in bridge mode).

SOFTNET security modules

The SOFTNET Security Client software serves as a VPN client for programming devices, PCs and notebooks in an industrial environment. It allows secure VPN client access to automation systems protected by SCALANCE S.

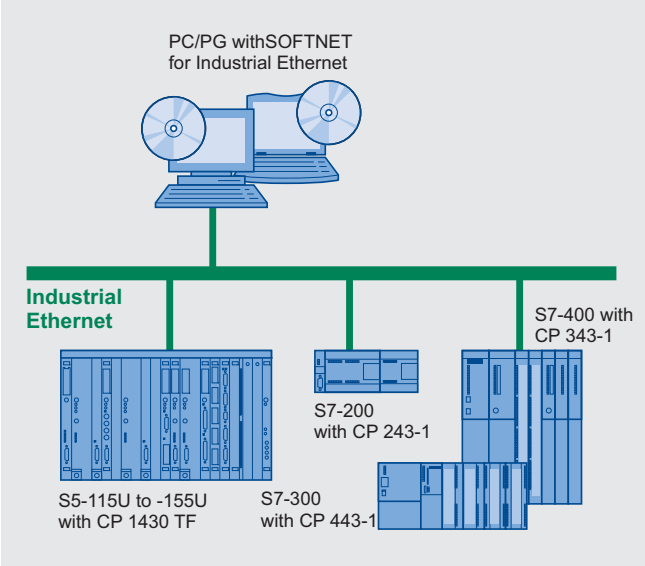

Figure 3-8 System configuration SOFTNET for Industrial Ethernet

SCALANCE S models

- SCALANCE S602
  - Protects with the stateful inspection firewall, address translation (NAT/NAPT), DHCP server and Syslog.
- SCALANCE S612
  - Protects with stateful inspection firewall
  - Up to 64 VPN tunnels simultaneously with up to 32 devices
- SCALANCE S613
  - Protects with stateful inspection firewall
  - Up to 128 VPN tunnels simultaneously with up to 64 devices
  - Expanded temperature range from -- 20 °C to + 70 °C

Advantages of SCALANCE S

Security modules of the SCALANCE S family are intended specifically for use in automation engineering but nevertheless fit in seamlessly with the security structures of the office and IT world. They provide security and meet the special requirements of automation engineering, such as simple upgrading of existing plants, simple installation and minimized downtimes in the event of faults.

Various security measures can be combined depending on the security requirements.

See also

Part C: SCALANCE S security components (Page 383)

3.4 FastConnect (FC): The fast assembly system for SCALANCE components

The FastConnect connector technology

Figure 3-9 IE FastConnect product group

When installing cables, problems are often encountered stripping the cables, there are too many connector bits to get lost, wires are incorrectly connected or mistakes are made during assembly. To avoid this, SCALANCE devices are designed for the use of the fast assembly system FastConnect (FC).

Components

The FastConnect system covers FC cables, preset stripping tools and specially developed connectors and includes the following:

- Industrial Ethernet FastConnect cables (IE FC Cable 2x2) specially designed for fast assembly (PROFINET-compliant, silicone free, halogen free, UL and CAT5e certified) for a variety of applications as FC TP Standard Cable, FC TP Flexible Cable, FC TP Trailing Cable and FC TP Marine Cable, and with FRNC jacket.
- Convenient stripping with the FastConnect Stripping Tool for Industrial Ethernet cables, with which the outer jacket and braid shield can be removed to the perfect length in one step.
- Cables prepared in this way are connected to the FastConnect using the insulation piercing technique.
- Industrial Ethernet FC RJ-45 Plugs with 90°, 145° and 180° cable outlet (PROFINET-compliant) or IE FC Modular Outlet for gigabit cabling

See also

Components for electrical networks (Page 186)

Part B: Active components and supported topologies 4

4.1 Common properties of all SCALANCE devices

Properties shared by all SCALANCE devices

All SCALANCE devices have the following properties. If there are exceptions, this will be pointed out in the description of the relevant device.

Autocrossover function

All SCALANCE devices have an integrated MDI/MDIX autocrossover function on their electrical ports making it possible to use straight-through cables. This prevents malfunctions resulting from mismatching send and receive wires. This makes installation much easier for the user.

Autonegotiation

All SCALANCE devices also have the autonegotiation function. Autonegotiation means the automatic detection of the functionality of the port at the opposite end. Using autonegotiation, repeaters or end devices can detect the functionality available at the port of a partner device allowing automatic configuration of different types of device. With autonegotiation, two components connected to a link segment can exchange parameters and set themselves to match the supported communication functionality.

The SCALANCE devices are therefore plug-and-play devices that require no settings when they are put into operation.

Please note that devices not supporting autonegotiation must be set to 100 Mbps/ half duplex or 10 Mbps half duplex.

Fault mask

On all SCALANCE devices with a button on the front panel, it is possible to set a specific configuration as the desired status (good status). Deviations from this setting occurring during operation are treated as errors.

Monitored error statuses include, for example, the status of the power supply or link down to a communications partner, to which the SCALANCE device reacts with a fault LED and by opening the signaling contact.

Formation of loops

The typical configuration of a network with the SCALANCE products is a tree structure. The direct connection of two ports on the switch or accidental connection over several switches causes an illegal loop. Such a loop can lead to network overload and network failures.

When configuring the network with SCALANCE X400, meshing is possible since, in this case, the spanning tree algorithm can eliminate the loop. Other SCALANCE products can also be used in this loop if they cannot form a loop with each other.

Cable length at the electrical ports

A maximum of two IE-TP cords or IE-TP-XP cords with a total length of max. 10 m can be used between two adjacent SCALANCE devices.

With the IE FC cables and IE FC RJ-45 plug, an overall cable length of a maximum of 100 m is permitted between two devices depending on the cable type.

Table 4-1 Maximum runs with twisted-pair cables

Cabling structure	Cable type	Max. length	Max. total of the patch cables (TP cord)
In one piece (without IE TP cords)	IE FC standard cable GP	100 m	-
	IE FC flexible cable GP	85 m	
	IE FC torsion cable GP	55 m	
	IE FC trailing cable GP	85 m	
	IE FC trailing cable	85 m	
	IE FC marine cable	85 m	
Structured (with IE-TP cords and IE FC Outlet RJ-45 or IE FC RJ-45 Modular Outlet)	IE FC standard cable GP	90 m	10 m
	IE FC flexible cable GP	75 m	
	IE FC torsion cable GP	45 m	
	IE FC trailing cable GP	75 m	
	IE FC trailing cable	75 m	
	IE FC marine cable	75 m	

4.2 SCALANCE X switches and media converters

4.2.1 Product features of the SCALANCE X devices

Overview of the performance classes of the SCALANCE X devices

Figure 4-1 Overview of Industrial Ethernet switches

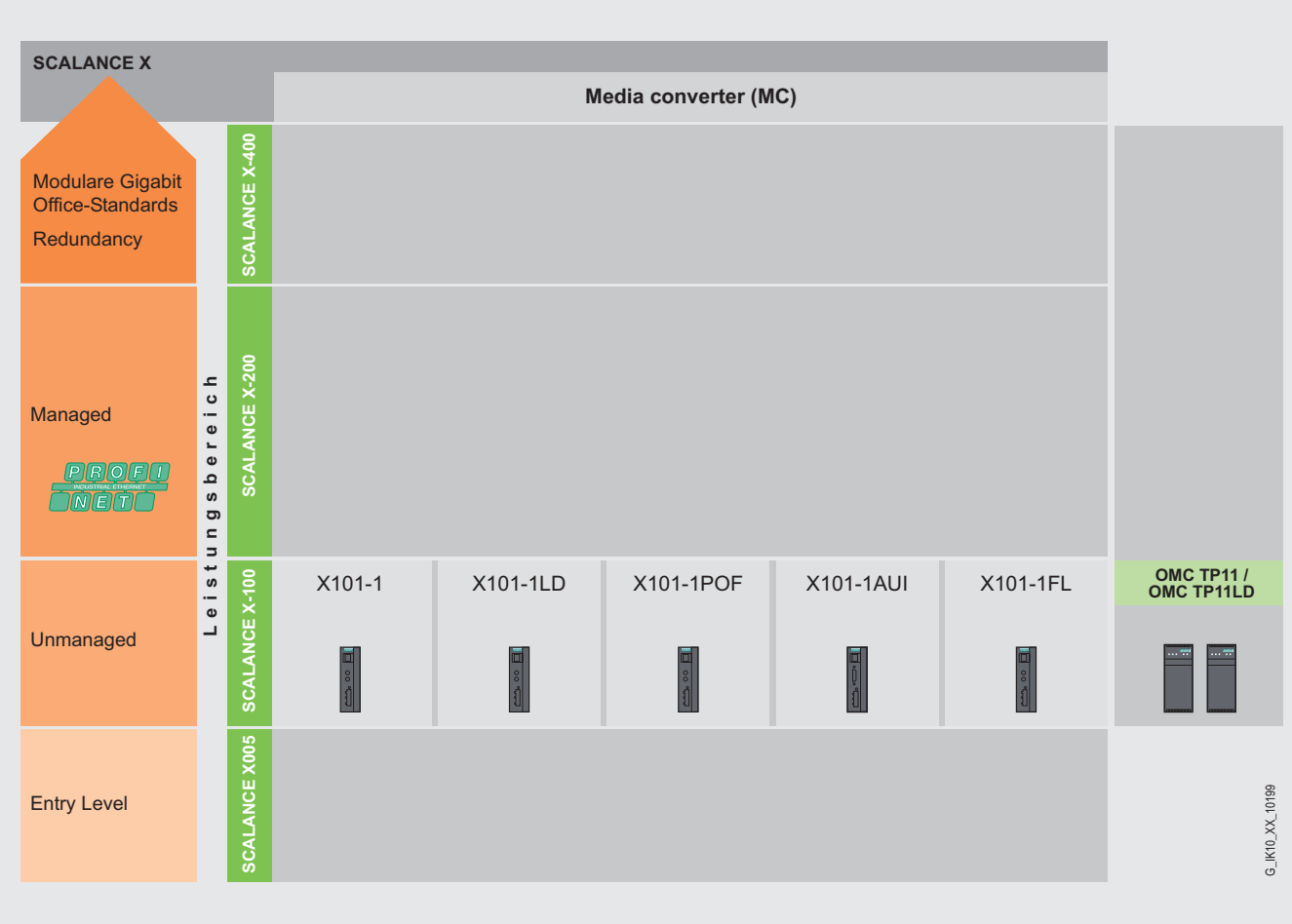

Figure 4-2 Performance range of the SCALANCE X-100 media converters

Overview table

You will find a table with an overview of the product features of the various SCALANCE X devices at the end of this section.

Electrical and optical interfaces

SCALANCE devices can be used as switches in both optical and electrical Industrial Ethernet networks. Each performance class therefore includes a mixture of devices with varying numbers of electrical and optical interfaces. The optical interfaces also include versions specially designed to cover long distances. These are available in devices that have LD in the device designation.

Management functions

A further distinction between the devices is that the SCALANCE X200, SCALANCE X300 and SCALANCE X400 devices have management functions whereas the SCALANCE X100 and SCALANCE X005 do not. While unmanaged devices are less expensive, managed

devices provide numerous configuration and diagnostics functions that make the operation of an Industrial Ethernet network much more convenient.

Fault-tolerance due to redundancy

The SCALANCE X-200, X-300 and X-400 switches have functions that allow the setup and management of redundant networks in a ring structure. These networks can handle the failure of individual nodes or cable sections and "divert" the data traffic so that the network remains available.

IRT for strict real-time requirements

Devices with the IRT supplement (Isochronous Real Time) are particularly suitable for applications in which a data transmission must be guaranteed at fixed intervals. To allow this, all devices in an Industrial Ethernet have the same timebase. The messages of the preferred nodes are transmitted together at previously configured times. Frames of other nodes are held back by the IRT switches and sent later.

SCALANCE X-100 media converters

The media converters of the SCALANCE X-100 line are particularly suitable for applications in which two Industrial Ethernet networks implemented with different media need to be linked. These have only two interfaces and therefore fit into an extremely narrow casing. They can also be used in a redundant ring.

The media converters have electrical and optical interfaces to link optical media with electrical networks and to link existing network segments or individual end devices via 10BaseFL, AUI drop cable, etc.

SCALANCE X-400 modular switches

To achieve the greatest possible flexibility in terms of interfaces, the use of the modular devices SCALANCE X414-3E and SCALANCE X408-2 is recommended. By making use of media modules, these provide the maximum possible variability. Apart from numerous management functions, these devices can also be used to link redundant electrical and optical rings.

Table showing an overview of the functions

Type of module	Type and number of ports: Gigabit Ethernet 10 / 100 / 1000 Mbit/s TP	Gigabit Ethernet 10 / 100 / 1000 Mbit/s FO	Fast Ethernet 10/100 Mbit/s TP RJ45	Fast Ethernet 10/100 Mbit/s TP M12	Fast Ethernet 100 Mbit/s Fiber Optic POF/PCF	Fast Ethernet 100 Mbit/s Fiber Optic Multi-mode BFOC	Fast Ethernet 100 Mbit/s Fiber Optic Single-mode BFOC	Features: Compact housing	LED diagnostics	SIMATIC environment	2 x 24 V DC	Signal contact	Local display (set button)	Diagnostics: Web, SNMP	PROFINET diagnostics	C-PLUG slot	Ring redundancy with RM	Standby redundancy	IRT capability	Gigabit technology	Modular design	Digital inputs	IT features: VLAN	IT features: RSTP	IT features: IGMP	Layer 3 switching	
X414-3E	2	2 [4]	20 [3]			12 [3]	12 [3]		■	■	■	■	■	■	■	■	■	■	■		■	■	8	■	■	■	■	X-400
X408-2	4	4 [4]	4			4 [1]	4 [2]		■	■	■	■	■	■	■	■	■	■	■		■	■		■	■	■		
X310	3		7					■	■	■	■	■	■	■	■	■	■	■	■		■			■	■	■		X-300
X308-2	1	2 [5]	7					■	■	■	■	■	■	■	■	■	■	■	■		■			■	■	■		
X308-2LD	1	2 [5]	7					■	■	■	■	■	■	■	■	■	■	■	■		■			■	■	■		
X204IRT			4					■	■	■	■	■	■	■	■	■	■	■	■	■								X-200
X202-2IRT			2			2		■	■	■	■	■	■	■	■	■	■	■	■	■								
X202-2P IRT			2		2			■	■	■	■	■	■	■	■	■	■	■	■	■								
X201-3P IRT			1		3			■	■	■	■	■	■	■	■	■	■	■	■	■								
X200-4P IRT					4			■	■	■	■	■	■	■	■	■	■	■	■	■								
X224			24					■	■	■	■	■	■	■	■	■	■	■										
X216			16					■	■	■	■	■	■	■	■	■	■	■										
X212-2			12			2		■	■	■	■	■	■	■	■	■	■	■										
X212-2LD			12				2	■	■	■	■	■	■	■	■	■	■	■										
X208			8					■	■	■	■	■	■	■	■	■	■	■										
X208PRO				8				■	■	■	■	■	■	■	■	■												
X206-1			6			1		■	■	■	■	■	■	■	■	■	■	■										
X206-1LD			6				1	■	■	■	■	■	■	■	■	■	■	■										
X204-2			4			2		■	■	■	■	■	■	■	■	■	■	■										
X204-2LD			4				2	■	■	■	■	■	■	■	■	■	■	■										
X124			24					■	■	■	■	■	■															X-100
X116			16					■	■	■	■	■	■															
X112-2			12			2		■	■	■	■	■	■															
X108			8					■	■	■	■	■	■															
X106-1			6			1		■	■	■	■	■	■															
X104-2			4			2		■	■	■	■	■	■															
X005			5					■	■	■																		X005

■ well suitable

[1] can be additionally plugged in via multimode media modules
[2] can be additionally plugged in via singlemode media modules
[1] and [2] a total of max. 2 media modules 100 MBit/sec can be plugged in

[3] with extender module
[4] can additionally be plugged with singlemode or multimode media modules with SC interface
[5] singlemode or multimode with SC interface

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Figure 4-3 SCALANCE X product table

Diagnostics options

The individual SCALANCE X devices provide the following diagnostics options:

Module type	Possibilities of diagnostics with switches										
	LED	Error signal contact	Signal screen form	PROFINET diagnostics	Web-based manage-ment	Diagnostics via SNMP	VLAN	IGMP-Snooping/ -Querier	RSTP	Multicast-/ broadcast-limitation	Layer 3 (IP-Routing)
SCALANCE X414-3E/X408-2	■	■	■	■	■	■	■	■	■	■	■ 1)
SCALANCE X-300	■	■	■	■	■	■	■	■	■	■	
SCALANCE X-200/X-200IRT/ X-200P IRT	■	■	■	■	■	■					
SCALANCE X-100	■	■	■								
SCALANCE X005	■										
OSM	■	■	■		■	■					
ESM	■	■	■		■	■					

1) with SCALANCE X414-3E

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Figure 4-4 Diagnostics options of the SCALANCE X switches

See also

Part C: SCALANCE X switches and media converters (Page 229)

4.2.2 Entry level SCALANCE X005

4.2.2.1 X005 area of application

Overview

Figure 4-5 SCALANCE X005

The SCALANCE X005 switch allows the cost-effective installation of small Industrial Ethernet linear bus or star structures with switching functionality. The devices are designed for installation in a switching cubicle.

The SCALANCE X005 has five RJ-45 jacks for connection of end devices or other network segments.

See also

SCALANCE X005 (Page 233)

Product features of the SCALANCE X devices (Page 105)

4.2.2.2 Design of the SCALANCE X005

Design of the SCALANCE X005

The SCALANCE X005 Industrial Ethernet switch with its robust metal casing is ideal for installation on a DIN rail and an S7 standard rail. It is also possible to install the device directly on a wall in various positions. Thanks to its S7-300 housing dimensions, the device is ideal for integration in an automation solution with S7-300 components.

The SCALANCE X005 has five RJ-45 jacks with MDI-X pin assignment, automatic detection of the data rate (10 or 100 Mbps), autosensing and autocrossing function for connecting Industrial Ethernet FC cables.

No power supply redundancy, no signaling contact

To accommodate as many TP interfaces as possible in the smallest possible space, it was decided not to include a redundant power supply or a signaling contact.

See also

Common connector pin assignments of SCALANCE X devices (Page 230)

4.2.2.3 Functions of the X005

Functions

The SCALANCE X005 supports the MDI / MDIX autocrossover function. This makes it possible to use straight-through cables.

The SCALANCE X005 also has the autonegotiation and auto polarity exchange functions. This makes the SCALANCE X005 a plug-and-play device that does not require settings to be made for commissioning.

Please note that ports of partner stations requiring a fixed configuration must be set to 100 Mbps/ half duplex or 10 Mbps half duplex.

4.2.2.4 Topologies with the SCALANCE X005

Network topologies

Switching technology allows extensive networks to be set up with numerous nodes and simplifies network expansion.

With the SCALANCE X005 device, linear bus and star topologies can be implemented.

It is not possible to use a SCALANCE X005 switch in a redundant ring because it does not support redundancy.

See also

Linear structure (Page 54)

Star structure (Page 55)

4.2.3 SCALANCE X-100 and X-200 devices

4.2.3.1 Overview of the SCALANCE X-100 and X-200 devices

Comparison of the features of the SCALANCE X100 and 200 devices

This section compares the major features of the SCALANCE X100 and 200 devices to help you to find the most suitable device for a given application.

The devices of the SCALANCE X100 product line are unmanaged Industrial Ethernet switches with up to 24 ports and on-site diagnostics for applications in the vicinity of the machinery.

The devices of the SCALANCE X-200 product line are managed Industrial Ethernet switches also with a maximum of 24 ports that can be used universally for applications ranging from those in the vicinity of the machinery to networked plant subunits. Configuration engineering and remote diagnostics are integrated in the SIMATIC STEP 7 engineering tool increasing the plant availability. Devices with a high degree of protection allow installation without a cabinet.

With the SCALANCE X200-4P IRT, X201-3P IRT, X202-2P IRT, X202-2IRT and X204IRT (isochronous real time), SIMATIC NET offers the first Industrial Ethernet real-time switches from the new SCALANCE series with innovative housing concept and integrated ERTEC (Enhanced Real-Time Controller). By using the "cut through" switching mechanism, the switches are ideal to meet the real-time requirements of PROFINET. This reduces the delay in an IRT switch from approximately 10 us to approximately 3.5 us (best case).

The following SCALANCE X-100/200 devices are available with optical interfaces. The transmission mode of these 100Base-FX connectors conforms to the IEEE 802.3 standard.

- SCALANCE X204-2LD, SCALANCE X206-1LD, SCALANCE X212-2LD

  These devices have FO interfaces that are particularly suited to the use of single mode FO cables with a core diameter of 10 µm. The light source is an LED that emits light with a wavelength of 1310 nm.

The maximum transmission range (segment length) is 26 km.

The cables are connected over BFOC sockets.

- SCALANCE X104-2, SCALANCE X106-1, SCALANCE X112-2, SCALANCE X204-2, SCALANCE X206-1, SCALANCE X212-2, SCALANCE X202-2IRT

  Data transmission is over multimode fiber-optic cable (FOC). The wavelength is 1310 nm. Multimode FO cable is used with a core diameter of 50 or 62.5 µm. The light source is an LED. The outer diameter of the FO cable is 125 µm.

  The maximum transmission range (segment length) is 3 km.

  The cables are connected over BFOC sockets.

- SCALANCE X202-2P IRT, SCALANCE X201-3P IRT, SCALANCE X200-4P IRT

  Data is transferred using plastic optical fiber (POF) or polymer cladded fiber (PCF). The wavelength is 650 nm. POF cables with a core diameter of 980 µm as well as PCF cables with core diameter of 200 µm are used. The light source is an LED.

  The minimum cable length is 1 m. The maximum transmission range (segment length) is 50 m for POF and 100 m for PCF cables.

  The cables are connected over SC-RJ sockets.

Features common to all X-100/X-200 switches

All SCALANCE switches of the X-100/X-200 series have the following features:

- They are robust and suitable for use in an industrial environment,
- Diagnostics LEDs,
- Redundant 24 V DC power supply,
- Compact housing (securing collars, etc.)
- Signaling contact and local operation.

Features of the specific products

The following table provides an overview of the features of the individual switches.

Table 4-2 Overview of the product characteristics

Device type SCALANCE X						
	104-2 106-1 108 112-2 116, 124	**204-2 206-1 208 208PRO**	**212-2 216 224**	**204-2LD 206-1LD**	**212-2LD**	**200-4PIRT 201-3PIRT 202-2IRT 202-2PIRT 204IRT**
Fast learning	-	+	+	+	+	+
Passive listening	-	+ 1)	+	+	+	+
Log table	-	+ 1)	+	+ 2)	+	+
SNTP + SICLOCK	-	+ 1) 2)	+	+ 2)	+	+
Cut through	-	-	-	-	-	+

Fast learning: Quick recognition of MAC addresses on the device that change during operation (for example, when an end node is reconnected).

1) Except 208PRO

2) As of hardware/firmware version V2

Cut through is not possible

- between a port set to 10 Mbps and a port set to 100 Mbps
- when two packets are to be sent at the same time on one port.

4.2.3.2 SCALANCE X-100 unmanaged

Area of application of the X-100

Overview

Figure 4-6 Product pictures of the SCALANCE X-100 series

The unmanaged Industrial Ethernet switches of the SCALANCE X-100 series allow cost-effective setup of Industrial Ethernet with 10/100 Mbps linear bus or star structures with switching functionality. They are particularly suitable for applications in the immediate vicinity of machines and have a robust metal housing for space-saving installation in a cubicle on a DIN rail, S7-300 standard rail or for wall mounting.

The node or network connectors are robust, designed for industry and have electrical or optical interfaces depending on the model. The cable connectors conform to PROFINET and lock into the housing providing additional strain and bending relief.

Simple diagnostics is possible on the device with the LEDs (power LED, fault LED, LED for link status or data traffic) and signaling contact.

The use of a redundant power supply is also possible.

See also

SCALANCE X-100 (Page 237)

Product features of the SCALANCE X devices (Page 105)

X-100 design

Design

The SCALANCE Industrial Ethernet switches with their robust metal IP30 housing are ideal for installation on a DIN rail and an S7-300 standard rail. It is also possible to install the device directly on a wall in various positions. Thanks to its the housing dimensions that match those of the S7-300, the devices are ideal for integration in an automation solution with S7-300 components.

All SCALANCE X-100 switches have the following connectors:

- A 4-pin terminal block for connecting the redundant power supply (2 x 24 V DC)
- A 2-pin terminal block for connecting the floating signaling contact

The following are available depending on the device:

- 10/100BaseTX, RJ-45 connector:
  RJ-45 jack, automatic detection of the data rate (10 or 100 Mbps), autosensing and autocrossing function for connecting Industrial Ethernet FC cables via Industrial Ethernet FC RJ-45 Plug 180 up to 100 m
- 100BaseFX, ST connectors, for multimode fiber-optic cables
  ST sockets for direct connection to the Industrial Ethernet FO cables up to 3000 m to set up linear bus and star structures. Wavelength: 1310 nm

With the Industrial Ethernet FastConnect RJ-45 Plug and Industrial Ethernet FastConnect standard cable, installation is possible without a patch panel.

Functions of the X-100

Functions

The integrated switch functionality results in a distribution of network load.

Diagnostics

LEDs display the following information locally:

- Power
- Port status
- Data traffic
- Signaling contact

Signaling contact

X-100 switches can indicate the following errors/faults via the floating signaling contact:

- The failure of a link at a monitored port,
- The failure of one of the two redundant power supplies,

The connection or disconnection of a communication node on an unmonitored port does not lead to an error message.

The signaling contact remains activated until the error/fault is eliminated or until the current status is applied as the new desired status by Web Based Management or using the button.

When the device is turned off, the signaling contact is always activated (open).

Topologies with X-100

Network topology and network configuration

SCALANCE X-100 switches are particularly suitable for setting up electrical and optical Industrial Ethernet linear bus or star structures. These are normally installed in a switching cubicle along with the nodes to be connected.

When the switches of the SCALANCE X-100 family are cascaded, there is no restriction to the network span. This makes network configuration simple and the delay time does not need to be calculated. The network can be expanded at any time without problems.

During network configuration, however, the following constraints must be remembered:

- Length of the TP cable between two SCALANCE X switches:
  - Max. 100 m via Industrial Ethernet FC cable with Industrial Ethernet FC RJ-45 Plug
  - Max. 10 m via patch cables with TP Cord
  - Max. 100 m via Industrial Ethernet FC Outlet RJ-45 or Industrial Ethernet FC modular Outlet RJ-45, IE FC standard cable and TP Cord (total portion via TP Cord max. 10 m)
- Length of the optical cables:
  - Max. 3000 m with Industrial Ethernet FO cables

See also

Linear structure (Page 54)

Star structure (Page 55)

4.2.3.3 SCALANCE X-100 media converters

Overview of the media converters

Comparison of the features of the media converters

Media converters are used to link two Industrial Ethernet networks. The major advantage of the converters is their compact construction and cost-effective design.

This section provides an overview of the features of these unmanaged Industrial Ethernet media converters.

Product features

The media converters of the SCALANCE X-100 series allow the cost-effective installation of Industrial Ethernet linear (bus) and star structures with transitions from one media to another.

Type of module	Type and number of ports						Features						
	Twisted Pair	Fiber Optic											
		Fast Ethernet											
	10 / 100 Mbit/s	100 Mbit/s			10 Mbit/s								
	RJ45	POF / PCF	Multimode BFOC	Singlemode BFOC	AUI	Multimode BFOC	Compact housing	LED diagnostics	SIMATIC evironment	2 x 24 V DC	Signal contact	Local display (SET button)	Ring redundancy without RM
SCALANCE X101-1	1		1				■	■	■	■	■	■	■
SCALANCE X101-1LD	1			1			■	■	■	■	■	■	■
SCALANCE X101-1POF	1	1					■	■	■	■	■	■	■
SCALANCE X101-1AUI	1				1		■	■	■	■	■	■	■
SCALANCE X101-1FL	1					1	■	■	■	■	■	■	■
OMC TP11	1		1				■	■	■	■	■		■
OMC TP11LD	1			1			■	■	■	■	■		■

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Figure 4-7 Overview of the SCALANCE X-100 media converters

See also

SCALANCE X-100 media converters (Page 251)

X-100 media converter design

Design

The SCALANCE X-100 media converters with their robust metal housing are ideal for installation on a DIN rail and an S7 standard rail. It is also possible to install the device directly on a wall in various positions. Thanks to their S7-300 housing dimensions, the devices are ideal for integration in an automation solution with S7-300 components.

The SCALANCE X-100 media converters have

- A 2-pin terminal block for connecting the floating signaling contact

and directly below this

- A 4-pin terminal block for connecting the redundant power supply (2 x 24 V DC)

All media converters have two interfaces for connecting to an Industrial Ethernet network as shown in the table in the previous section.

See also

Overview of the media converters (Page 116)

Functions of the X-100 media converters

Network connection and media transition

The unmanaged media converters of the SCALANCE X-100 product line allow the cost-effective connection of network segments or nodes with different transmission media (optical/electrical) within Industrial Ethernet linear bus, star and ring structures. They are designed for installation in a switching cubicle.

Individual end devices or network segments located at a distance from the main network can be connected via the optical link of the SCALANCE X-100 media converters. It is also possible to integrate an optical link into a redundant ring and to install the SCALANCE X-100 media converters in a standby link.

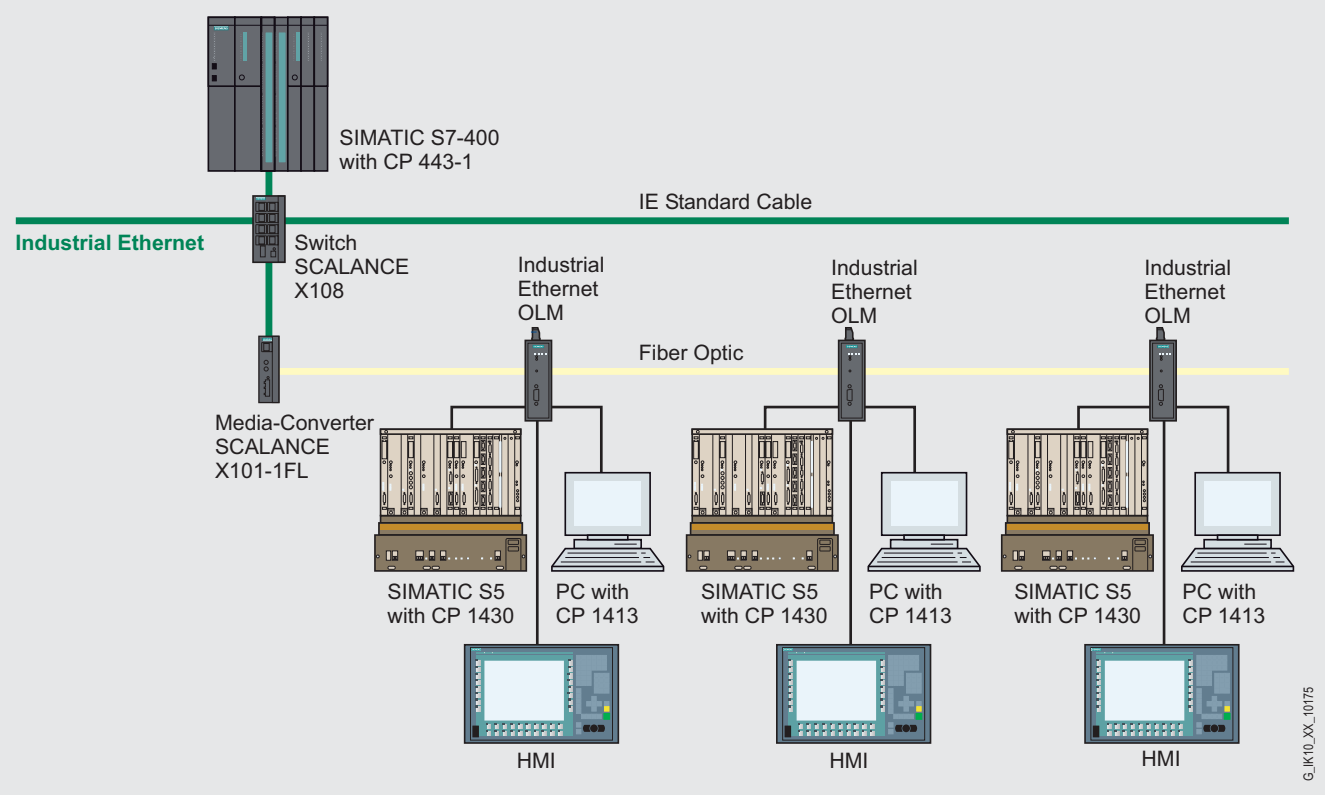


Figure 4-8 Example of using the X101-1FL media converter: Connection of an optical network segment to copper Industrial Ethernet

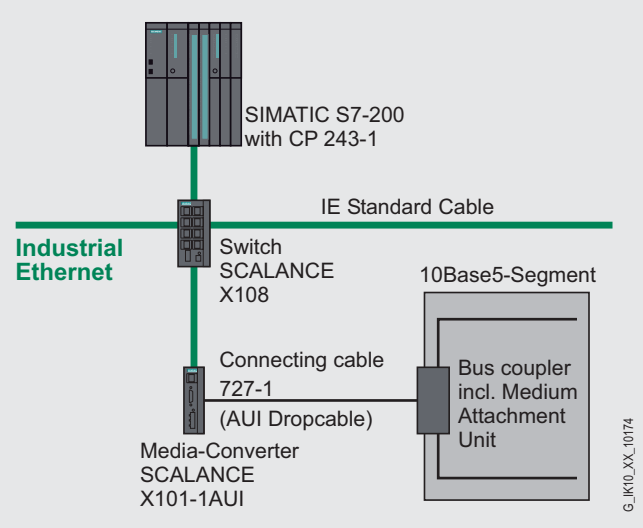


Figure 4-9 Example of using the X101-1AUI media converter: Connection of existing network segments to IE networks

Cascading (series connection) two media converters

In this mode, two media converters are connected in series via their FO ports. This mode is, for example, useful when two electrical Industrial Ethernet networks located at some distance from each other need to be linked together.

Topologies with the X-100 media converters

Network topologies

Linear bus and star topologies can be implemented with an Industrial Ethernet media converter of the SCALANCE X-100 series. It is also possible to link rings and to use two identical media converters in a ring structure.

Depending on the local conditions, the transition from electrical to optical media using media converters may be a cost-effective way of bridging longer distances.

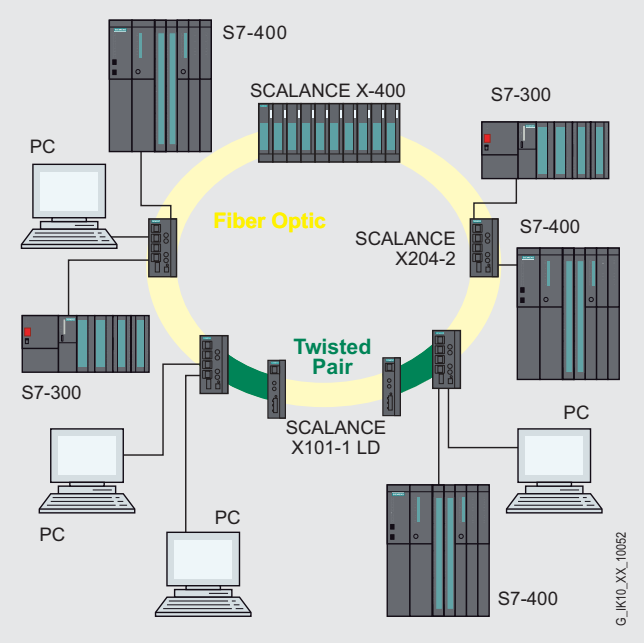


Figure 4-10 Optical ring with SCALANCE X-100 media converters

The passive use of two identical media converters of the SCALANCE X-100 series within a redundant ring is possible. In this case, the media converters behave "like a section of cable".

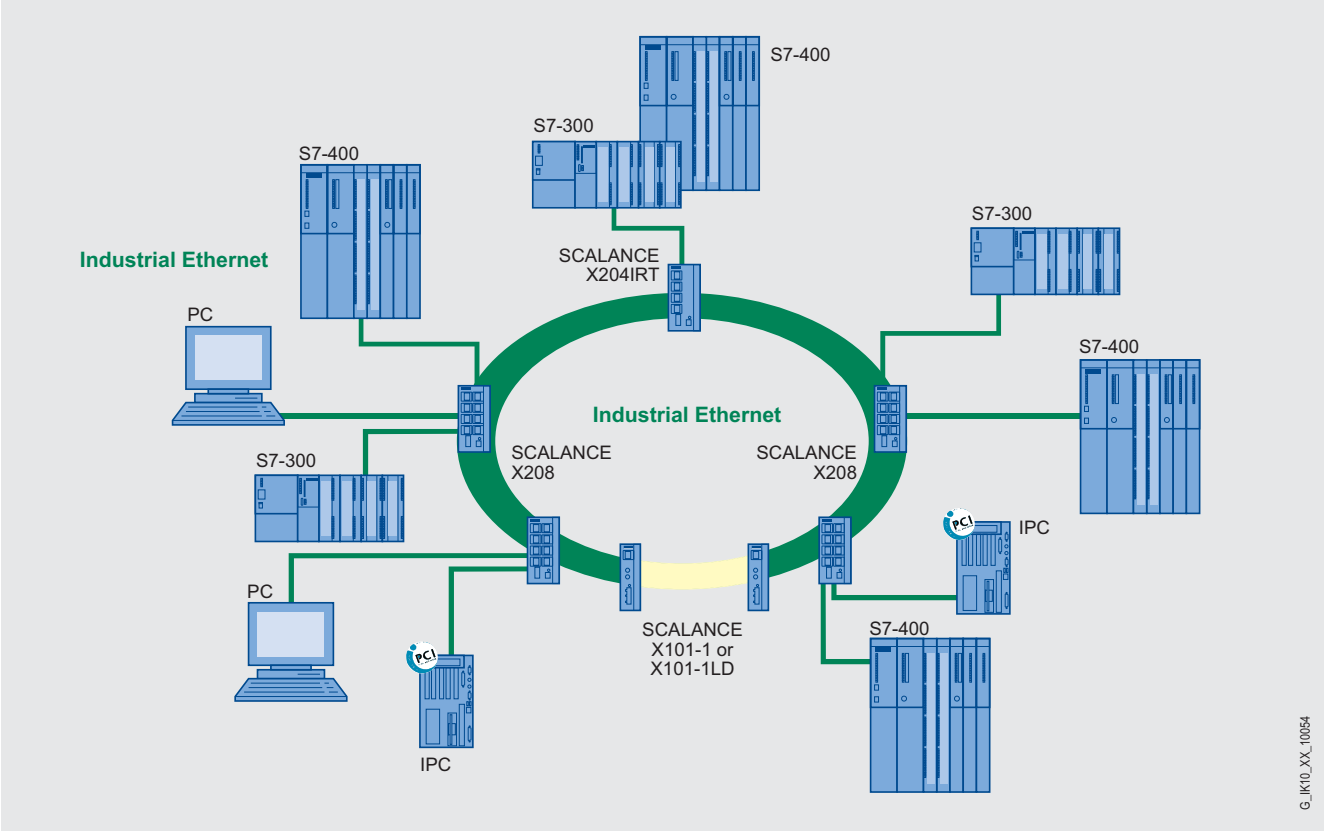


Figure 4-11 Electrical ring with SCALANCE X100 media converters

See also

Linear structure (Page 54)

Star structure (Page 55)

4.2.3.4 SCALANCE X-200/X-200 IRT

Area of application of the X-200

Overview

SCALANCE X-200 Industrial Ethernet switches allow the cost-effective installation of 10/100 Mbps Industrial Ethernet linear (bus), star and ring structures with switching functionality, where availability of the network or remote diagnostics options are required. The devices have degree of protection IP30 and are designed for installation in a switching cubicle. With IP65, the SCALANCE X208PRO is intended for installation outside a cubicle.

SCALANCE X-200 switches vary in terms of the functions they provide and the number and type of electrical and optical IE interfaces.

The SCALANCE X-200IRT switches form a special class by using the "cut through" switching mechanism, the optimum solution to meet the real-time requirements of

PROFINET. SCALANCE X-200IRT switches allow the installation of isochronous mode real-time Industrial Ethernet linear bus, ring and star structures with switching functionality. The special requirements for automation solutions in terms of linear topology, hard real time and unrestricted IT openness are incorporated in one technology.

Figure 4-12 SCALANCE X-200 managed switches

See also

SCALANCE X-200/X-200 IRT (Page 260)

X-200 design

Design

The SCALANCE X-200 and SCALANCE X-200IRT Industrial Ethernet switches with their robust metal housing are ideal for installation on a DIN rail and an S7-300 standard rail. It is also possible to install the device directly on a wall in various positions. Thanks to their S7-300 housing dimensions, the devices are ideal for integration in an automation solution with S7-300 components.

The modules have a 4-pin terminal block, the SCALANCE X208PRO has two 4-pin M12 interfaces for connecting to the redundant power supply (2 x 24 V DC). They also have a 2-pin terminal block to allow the use of the signaling contact. On the SCALANCE X208PRO, the signaling contact is connected to a 5-pin M12 socket.

Status information is indicated by a row of LEDs (power, link status, data traffic, power supply, signaling contact).

The SCALANCE X-200 modules and SCALANCE X-200IRT are available with the following port types for communication:

- RJ-45 connector; 10/100BaseTX:
  Automatic detection of the data rate (10 or 100 Mbps), autosensing and autocrossing function for connecting Industrial Ethernet FC cables via Industrial Ethernet FC RJ-45 Plug 180 or Industrial Ethernet RJ-45 Plug up to 100 m.

- 4-pin M12 connector, d-coded; 10/100BaseTX:
  Automatic detection of the data rate (10 or 100 Mbps), autosensing and autocrossing function for connecting Industrial Ethernet FC cables with 4-pin M12 connectors up to 100 m.
- BFOC (Bayonet Fiber Optic Connector) plug for multimode glass fibers; 100BaseFX:
  For direct connection of preassembled Industrial Ethernet FO standard cables with a core diameter of 50 or 62.5 µm and a maximum segment length up to 3000 m for setting up linear bus and star structures; wavelength approx. 1310 nm.
- BFOC Plug for single mode glass fibers; 100BaseFX:
  For direct connection of preassembled single mode glass fibers with a core diameter of 10 µm and a maximum segment length up to 26 km for setting up linear bus and star structures; wavelength approx. 1310 nm.

  SCALANCE X-200 devices with one or more of these interfaces have the letters LD appended to the designation. Example: SCALANCE X204-2 LD
- SC-RJ sockets for connecting Plastic Optical Fiber cable (POF) or Polymer Cladded Fiber cable (PCF); 100BaseFX:

  For direct connection of a preassembled POF standard cable with a core diameter of 980 µm or PCF standard cable with a core diameter of 200 µm. The minimum cable length for POF and PCF cables is 1 m. The maximum segment length for POF is 50 m and 100 m for PCF. Wavelength approx. 850 nm.

  SCALANCE X-200 devices with one or more of these interfaces have the letter P appended to the designation. Example: SCALANCE X201-3P IRT

The connector technology is the same for multimode and single mode fibers. The devices themselves, however, have transmitter/receiver modules specially adapted to the type of fiber.

Table 4-3 TP and FO interfaces of the SCALANCE X200 devices

	RJ-45 connectors	M12 Connectors	IE FO multimode connectors (BFOC)	IE FO single mode connectors (BFOC)	IE FO POF/PCF Connectors (SC-RJ)
SCALANCE X224	24	-	-	-	-
SCALANCE X216	16	-	-	-	-
SCALANCE X208	8	-	-	-	-
SCALANCE X208 PRO	-	8	-	-	-
SCALANCE X212-2	12	-	2	-	-
SCALANCE X206-1	6	-	1	-	-
SCALANCE X204-2	4	-	2	-	-
SCALANCE X212-2 LD	12	-	-	2	-
SCALANCE X206-1 LD	6	-	-	1	-
SCALANCE X204-2 LD	4	-	-	2	-
SCALANCE X204 IRT	4	-	-	-	-
SCALANCE X202-2 IRT	2	-	1	-	-
SCALANCE X202-2 PIRT	2	-	-	-	2
SCALANCE X201-3 PIRT	1	-	-	-	3
SCALANCE X200-4 PIRT	-	-	-	-	4

Connectors

The pin assignment of the 10/100BaseTX RJ-45 connectors, the power supply terminals and the signaling contact terminals are the same on all SCALANCE X200 devices except for the SCALANCE X208 PRO. They are described in the section Common connector pin assignments.

Functions of the X-200

Signaling contact

The following errors/faults can be signaled by the signaling contact:

- The failure of a link at a monitored port,
- The failure of one of the two redundant power supplies,
- The C-PLUG (see below) is also monitored. If a C-PLUG is in the device when you press the button, this is also stored and monitored,
- Redundancy manager connected through,
- Monitoring the POF connectors on the SCALANCE X200-P IRT devices (maintenance request or maintenance required)

  POF cables age significantly faster than glass fibers. SCALANCE X200-PIRT devices monitor the quality of the signals received via POF cables. If the signals become too weak, this is indicated by the signaling contact. This means that maintenance can be performed in good time before there is a breakdown in communication.

The SCALANCE X-200IRT variants have the following additional monitoring functions:

- Switchover of standby connection

The connection or disconnection of a communication node on an unmonitored port does not lead to an error message.

The signaling contact remains activated until the error/fault is eliminated or until the current status is applied as the new desired status by Web Based Management or using the button.

When the device is turned off, the signaling contact is always activated (open).

C-PLUG

The C-PLUG is an exchangeable medium for storage of the configuration and project engineering data of the base device. When replacing the base device, it can be used to transfer the data it contains to the new device without requiring a programming device.

During operation, the C-PLUG is supplied with energy by the base device. It retains all data permanently when the power is turned off.

If an empty C-PLUG (factory settings) is inserted, all configuration data of the SCALANCE X-200 is saved to it when the device starts up. Changes to the configuration during operation are also saved on the C-PLUG without any operator intervention being necessary.

A basic device with an inserted C-PLUG automatically uses the configuration data of the C-PLUG when it starts up. This is, however, only possible when the data was written by a compatible device type.

Inserting a C-PLUG that does not contain the configuration of a compatible device type, inadvertently removing the C-PLUG, or general malfunctions of the C-PLUG are indicated by the diagnostic mechanisms of the SCALANCE X-200 (LEDs, PROFINET, SNMP, WBM, etc.).

This allows fast and simple replacement of the basic device. If a device is replaced, the C-PLUG is taken from the failed component and inserted in the replacement. The first time it is started up, the replacement device has the same configuration as the failed device except for the MAC address set by the vendor.

Configuration and diagnostics over the Industrial Ethernet network

SCALANCE X-200 devices provide various functions that can be started or executed via the Industrial Ethernet network. Before the SCALANCE X-200 can be addressed via the network, it must first be given an IP address. There are three ways of doing this:

- Configuration with the Primary Setup Tool (PST) V3 or higher;
- To be able to use the setup tool to assign the IP address, the SCALANCE X-200 must be accessible over Ethernet.
- Configuration with DHCP
- Configuration with STEP 7 V 5.3 plus SP 1

After an IP address has been assigned, data such as diagnostics and configuration data can be called up from components that have Web Based Management (WBM -- see below). This, for example, allows port information to be queried such as the transmission speed being used, transmission mode (full, half duplex), autonegotiation, link status and whether or not a port is active.

The data stored on the C-PLUG can also be read.

Using WBM, various settings can be made on the SCALANCE X-200. It is possible, for example, to specify whether or not messages are sent by E-mail or using an SNMP trap.

Port mirroring can also be enabled or disabled. Port mirroring means that all the frames sent and received via a port are also sent via a different port to a connected monitoring device. It is also possible to set the port to be monitored and the port via which the frames are mirrored (the monitor port).

Any statistical data recorded by the SCALANCE X-200 can also be read out. This means, for example, that the number of frames sent or received per port and the number of bad frames can be queried.

The Primary Setup Tool (PST)

The Primary Setup Tool is used mainly to assign an IP address to a SCALANCE X-200. This is available on the CD that ships with the SCALANCE X-200.

Dynamic Host Configuration Protocol (DHCP)

The Dynamic Host Configuration Protocol (DHCP) is a protocol that allows the dynamic configuration of IP addresses and provides additional information.

This allows the use of a limited number of existing IP addresses by managing the address assignment centrally. When a PC is first turned on in a LAN, the PC logs on at a server with

this service. The server assigns a free IP address so that at the next startup, a connection is not absolutely necessary.

The use of DHCP is not restricted to the startup phase. DHCP can also be used during operation.

The IP address remains valid for a selectable period known as the "lease time". When this expires, it must be renewed or extended.

Generally, there is no fixed address assignment; in other words, when a client requests an IP address again, it is normally assigned a different address. It is, however, possible to configure the DHCP server so that it makes a fixed address assignment.

Web Based Management (WBM)

With Web Based Management, the Industrial Ethernet switches of the SCALANCE X-200 product line provide various diagnostic functions that can be controlled using an Internet browser (for example the Microsoft Internet Explorer or Netscape). The functions are controlled using a Java script stored on the Industrial Ethernet switches of the SCALANCE X-200 product line that can be loaded by the browser. To access Industrial Ethernet switches of the SCALANCE X-200 product line, the IP address of the device must be entered in the address box of the browser.

Topologies with X-200

Linear and star structure

All SCALANCE X-200 products can be used in electrical, optical and mixed linear and star structures. Networks are also possible in which these structures are interlinked. These are known as tree structures.

Ring structures

SCALANCE X-200 products can be used in electrical, optical and mixed ring structures. There can be up to 50 switches in a ring.

In a ring structure, the SCALANCE X-200 switches are initially connected via their ring ports to form a linear bus. The two ends of the line are closed to form a ring by a switch operating in redundancy manager mode. When the network is functioning correctly, the ring ports of the redundancy manager are disconnected.

The switch operating in redundancy manager mode monitors the connected line over its ring ports and switches the ring ports through if there is an interruption on the connected line; in other words, it restores a functioning line over this substitute path. Reconfiguration takes place within 0.3 s.

As soon as the problem has been eliminated, the original topology is restored; in other words, the ring ports in the redundancy manager are once again disconnected from each other.

Only one switch can be configured as redundancy manager (RM) in a ring.

The redundancy function of the SCALANCE X-200 is enabled and disabled by pressing a button on the front of the device or with Web Based Management (WBM) (cannot be set via PNIO). After the RM function has been enabled or after the RM has been switched through, this is indicated by the RM LED on the housing.

Redundant coupling of network segments

The redundant coupling of two rings is handled by the standby manager mechanism. This function can only be configured with Web Based Management (WBM).

The redundant coupling of two network segments shown here as an example is only possible between SCALANCE X-200IRT devices, since this requires the standby function of the SCALANCE X-200IRT.

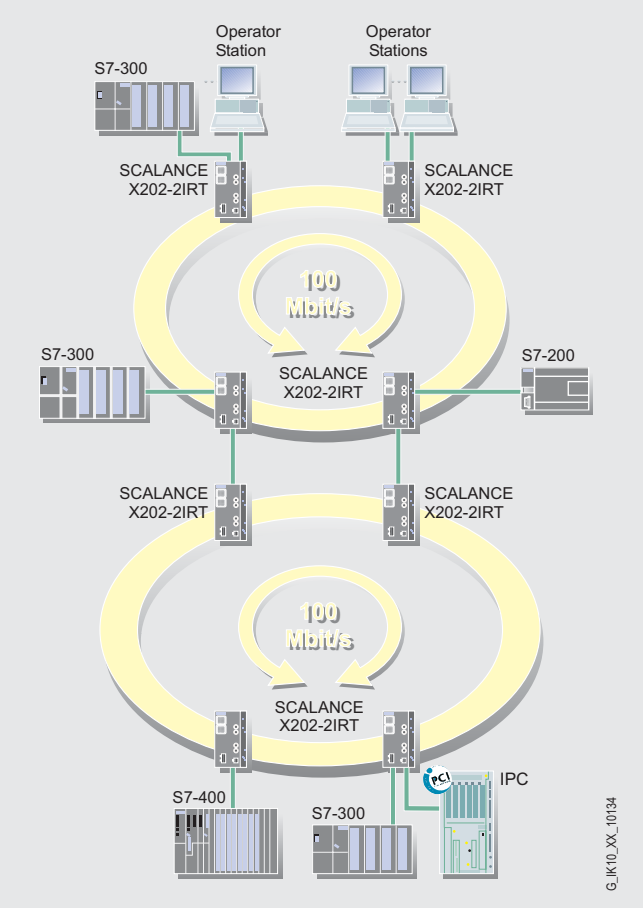


Figure 4-13 Redundant coupling of two optical rings with SCALANCE X202-2IRT

The SCALANCE X-200IRT can be operated either as RM or in standby mode. It cannot, however, handle both functions at the same time. When standby or redundancy manager function is activated, this is signaled by the RM-LED. The standby manager is configured using WBM.

See also

Linear structure (Page 54)

Star structure (Page 55)

Redundant ring structure (Page 59)

Optical redundant ring structure (Page 62)

Optical linear structure (Page 61)

4.2.4 SCALANCE X-300

4.2.4.1 Area of application of the X-300

Area of application of the SCALANCE X-300 switches

Figure 4-14 SCALANCE X-300 product group

The IE Switches SCALANCE X-300 from SIMATIC NET are designed for use in high-speed plant networks that will also meet future requirements. With the HSR redundancy function and standby coupling of rings, high network availability can be achieved. Support of IT standards such as VLAN, RSTP, IGMP, and GARP makes seamless integration of automation networks in existing office networks possible.

The IE Switches SCALANCE X-300 are designed for use in switching cubicles and cabinets.

Technical options (network topologies)

The IE Switches SCALANCE X-300 simplify the expansion of a network regardless of the network topology.

You can use an IE Switch SCALANCE X-300 in the following network topologies:

- Linear structure
- Star/tree structure
- Ring with redundancy manager (standby function)

The maximum cable length is 10 km for single mode gigabit transmission. A mixed topology between IE Switch SCALANCE X-300 devices and OSMs/ESMs is possible only via the electrical ports. Mixed operation in the topology between SCALANCE X308-2 and an OSM over the optical ports is not possible because the SCALANCE X308-2 only supports gigabit.

Using an IE Switch SCALANCE X-300 as the redundancy manager in a ring with redundancy manager provides greater availability. If there is an interruption on the connection between these switches, the IE Switch SCALANCE X-300 used as the redundancy manager acts like a switch and in a very short time creates a line from the ring with redundancy manager. As a result, a functional, end-to-end structure is restored. For information on this topic, refer to the Configuration Manual "SIMATIC NET; Industrial Ethernet Switches SCALANCE X-300 SCALANCE X-400".

Relationship with X-400 switches

The essential technical features of X-300 switches are the same as those of SCALANCE X-402-2 devices.

Refer to the compatibility overview in the section below (Page 129)!

See also

SCALANCE X-300 (Page 278)

4.2.4.2 X-300 design

Design

SCALANCE X-300 devices have the same functionality as the devices of the SCALANCE X-400 series, however, they have the compact design of the SCALANCE X-200 devices.

See also

X-200 design (Page 122)

4.2.4.3 Functions of the X-300

Functionality of the X-408-2

Functionally, SCALANCE X-300 switches are identical to the X-408-2 devices. (No layer 3 functionality on the X-300)

See also

Functions of the X-400 (Page 133)

4.2.4.4 Compatibility with other devices

Compatibility list

The following products and devices are compatible with IE Switches X-300:

- End devices
  All SIMATIC NET products with a TP port can be connected to the ports of IE Switches X-300.
- Network components in linear or star structure
  ESM/OSM
  OMC (TP cable max. 6 m long)
  SCALANCE X005
  SCALANCE X-100
  SCALANCE X-100 medium converter
  SCALANCE X-200
  SCALANCE X-200IRT
  SCALANCE X-300
  SCALANCE X-400
  SCALANCE S-600
  SCALANCE W-700
- Network components in a ring structure with IE Switches X-300 as RM
  - Ring structure electrical
    (All IE Switches X-300 possible, it may be necessary to reconfigure ring ports):
    ESM/OSM
    SCALANCE X-200
    SCALANCE X-200IRT
    SCALANCE X-300
    SCALANCE X-400
  - Optical ring structure
    (possible only with SCALANCE X308-2 and X308-2LD):
    SCALANCE X-400
    SCALANCE X-300
- Redundant coupling of networks.
  - In the network segment with the master-slave pair of devices to be configured:
    SCALANCE X-400
    SCALANCE X-300
    on the standby link also to SCALANCE X-200
  - In the network segment to be coupled:
    ESM/OSM
    SCALANCE X-200
    SCALANCE X-200IRT
    SCALANCE X-300
    SCALANCE X-400

Note

All compatibility information assumes the correct use of the TP and FOC cables.

4.2.4.5 Overview of the product characteristics

Table 4-4 Overview of the product characteristics

Device type SCALANCE			
	X310	**X308-2**	**X308-2 LD**
SIMATIC environment	+	+	+
Diagnostics LED	+	+	+
24 V DC	+	+	+
Compact housing (securing collar, etc.)	+	+	+
2x 24 V DC	+	+	+
Signaling contact + on-site operation	+	+	+
Diagnostics: Web, SNMP, PROFINET	+	+	+
C-PLUG	+	+	+
IRT capability	-	-	-
Fast learning[1]	+	+	+
Passive listening	+	+	+
Log table	+	+	+
SNTP + SICLOCK	+	+	+
Cut through	-	-	-
Use in ring possible (not as RM)	+	+	+
Redundancy manager	+	+	+
Standby manager	+	+	+

[1]Fast learning:
Fast recognition of MAC addresses on the device that change during operation (for example, when an end node is reconnected).

Table 4-5 Overview of the connection options

Fast Ethernet **10/100 Mbps**	**Device type SCALANCE**		
	X310	**X308-2**	**X308-2 LD**
TP (RJ-45)	10	8	8
Fiber multimode (SC)	-	2	-
Fiber single mode (SC)	-	-	2

4.2.5 SCALANCE X-400 modular

4.2.5.1 SCALANCE X-400

Area of application of the X-400

Overview

Figure 4-15 SCALANCE X414-3E

The SCALANCE X-400 product line consists of modular Industrial Ethernet switches, media modules, and extenders. 100 Mbps and 1000 Mbps technology is supported for different transmission media (twisted pair, fiber-optic) and increased port requirements. The main areas of application are high-performance plant networks (control level). Due to its modular structure, the X-400 product line is designed to meet future demands and can be adapted to meet the requirements of a particular task.

The integrated redundancy manager allows fast medium redundancy even for large networks both for Gigabit Ethernet (SCALANCE X-300 and X-400 switches in the ring) and for Fast Ethernet (SCALANCE X-400 switches in the ring combined with SCALANCE X-200 switches or OSMs/ESMs).

To set up optical Gigabit Ethernet rings, the integrated Gigabit Ethernet ports can be converted to fiber-optic cable via a 2-port Gigabit Ethernet media module. Module variants for multimode (up to 750 m FO cable) and single mode (up to 10 km) are available.

Using a plug-in 2-port Fast Ethernet media module for multimode or single mode FO cable, SCALANCE X-400 switches can also be integrated in 100 Mbps rings with SCALANCE X204-2 or OSMs. A second plug-in 2-port Fast Ethernet FO cable media module allows distant nodes to be connected optically.

Remote diagnostics is possible using PROFINET diagnostics, a Web browser or SNMP.

Switches of the SCALANCE X-400 product line support office standards and therefore allow seamless integration of automation networks into existing office networks. Virtual networks (VLANs) can be set up. The support of standardized redundancy methods (Rapid Reconfiguration Spanning Tree Protocol) allows redundant interfacing to higher-level Enterprise networks.

Interfaces

The SCALANCE X408-2 switch has four integrated gigabit Ethernet twisted-pair interfaces (10, 100 or 1000 Mbps) to interconnect multiple switches and to connect end devices. The nodes are connected over 4 Fast Ethernet ports integrated in the switch (10 or 100 Mbps).

The X414-3E switch has two integrated gigabit Ethernet twisted pair ports (100 or 1000 Mbps) to interconnect multiple switches. The nodes are connected over 12 Fast Ethernet twisted-pair ports integrated in the switch (100 Mbps or even 10 Mbps).

A further eight nodes can be connected over an 8-port Fast Ethernet twisted-pair extender docked to the right of the switch.

See also

Accessories for SCALANCE X-400 switches (Page 222)

SCALANCE X-400 (Page 293)

X-400 design

SCALANCE X-400 design

The base device consists of a basic module, the power supply and a switch CPU. The SCALANCE X414-3E also has 8 digital inputs. On the SCALANCE X408-2, the CPU is integrated in the basic module. Unused slots or slots in which nothing can be inserted, are protected by covers.

SCALANCE X-400 provides a modular structure for the required ports. This modularity simplifies setup and subsequent expansion of complex network topologies to meet current needs.

SCALANCE X-400 provides electrical ports that can be used as gigabit and ring ports. Expanding with media modules provides additional optical ports.

On the SCALANCE X414-3E, attaching the extender module EM495-8 can increase the number of ports by a maximum of eight. Attaching the EM496-4 extender module makes two further slots available for media modules.

The SCALANCE X-400 devices have numerous LEDs and a selection button with which a range of mode and status information can be displayed.

The SCALANCE X-400 is powered by a 24 V DC supply. To protect the device from failure of the external power supply, two power supplies can be connected. To use 110/220 V AC line power, S7-300 power supplies are suitable that convert to 24 V DC. These must guarantee a current of at least 2 A to supply the 24 V side of a SCALANCE X414-3E. They must also meet the requirements of SELV to NEC Class 2.

Functions of the X-400

Functions

- Increased network performance
  By filtering the data traffic based on the Ethernet (MAC) address of the end devices, local data traffic remains local, only data intended for nodes in another network segment is

forwarded by the switch. With DHCP support, the IP address can be assigned by a central DHCP server.

- Simple network configuration and network expansion:
  The switch stores the data received at the ports and then forwards it to the destination address. The restriction of the network span resulting from collision detection (CSMA/CD) ends at the port.
- Restricting errors to the network segment affected:
  SCALANCE X-400 switches only forward data with a valid checksum (CRC).
- Integration of existing network segments operating at 10 Mbps in Fast Ethernet networks operating at 100 Mbps:
  At its twisted-pair ports, the X-400 switch automatically detects the send and receive pairs (autocrossover), the data rate 10 or 100 Mbps and full and half duplex operation (autonegotiation).
- High-speed connection of SCALANCE X-400 switches operating at 1 Gbps:
  X-400 switches have several gigabit Ethernet ports for interconnecting switches.
- Fast redundancy in the ring (reconfiguration time of the ring max. 0.3 seconds):
  By interconnecting the ends of an optical line using X-400 switches to form a ring, reliable communication can be achieved. The X-400 switch has an integrated redundancy manager (RM) that permanently monitors the functioning of the network. It recognizes the failure of a section in the ring or of a SCALANCE X-400 switch and activates the substitute path within a maximum of 0.3 seconds. Rings consisting of SCALANCE X400 switches can be operated at 1000 Mbps. In rings with SCALANCE X-200 or OSMs/ESMs, it is possible to integrate X400 switches at 100 Mbps.
- Layer 3 routing with the SCALANCE X414-3E allows communication between different IP subnets:
  - Static routing
  - Dynamic routing OSPF (Open Shortest Path First) and RIPv1/2 (Routing Information Protocol)
  - Redundant routing VRRP (Virtual Router Redundancy Protocol)
- Redundant connection to company networks:
  X-400 switches support the standardized redundancy mechanism Rapid Spanning Tree Protocol (RSTP). This allows a subnet to connected redundantly to a higher-level company network with reduced requirements for the reconfiguration time (in the seconds range).
- Support of virtual networks (VLAN):
  To structure Industrial Ethernet networks with a with a growing number of nodes, an existing physical network can be divided into several virtual subnets.
- Load limitation when using multicast protocols (for example Voice over IP, video):
  By learning the multicast sources and destinations (IGMP snooping), X-400 switches can also filter multicast data traffic and therefore limit load in the network.
- Time synchronization:
  Diagnostics messages (log table entries, E-mails) are given a time stamp. The local time is uniform throughout the network due to synchronization with a SICLOCK time transmitter making it easier to assign diagnostics messages to several devices.
- Simple device replacement:
  All settings are automatically stored on the C-PLUG exchangeable storage medium. If a switch of the X-400 series needs to be replaced, these settings are simply transferred by inserting the C-PLUG.

Topologies with X-400

Network topology and network configuration

With X-400 switches, the network topology can be adapted easily to the structure of the plant. The following network structures and combinations of them can be implemented:

- Fast Ethernet and gigabit rings with fast medium redundancy:
  An **electrical ring** with redundancy manager can be set up without media modules.
  An **optical ring** with redundancy manager requires the use of media modules. Which slots or ports should be used, depends on the selected transmission rate.
- Star structure with X-400 switches:

Each X-400 represents a point of the star. The cascading depth and total span of a network are limited only by the signal propagation times of the communication connections.

- Linear bus structure with X-400 switches:

Linear structures can also be implemented with the SCALANCE X-400. The cascading depth and total span of a network are limited only by the signal propagation times of the communication connections.

- Redundant coupling of network segments

In this case, network segments are rings with a redundancy manager (RM). The rings can also be interrupted at one point (linear topology).

During network configuration, however, the following constraints must be remembered:

General configuration rules

Maximum cable length with multimode FO cable between two modules:

- 3000 m at 100 Mbps
- 750 m at 1 Gbps

Maximum cable length with single mode FO cable between two modules:

- 26 km at 100 Mbps
- 10 km at 1 Gbps

Maximum cable length for twisted pair:

- 100 m

Network configuration rules such as "delay equivalents" and "variability value" end at the port of the switch and are meaningless for the cascading of switches such as those of the SCALANCE X-400 series.

Application examples

Detailed application examples can be found in the section on network topologies.

See also

Basic structures (Page 52)

Advanced network configurations (Page 66)

4.2.5.2 Overview of the media modules

Overview of the media modules

The Industrial Ethernet SCALANCE X400 devices can be equipped with media modules to allow FO cables to be used. Media modules are available both for multimode FO cables and for single mode FO cables. They can be added or changed during operation. SCALANCE X414-3E supports two optical gigabit Ethernet ports and up to four extra optical Fast Ethernet ports.

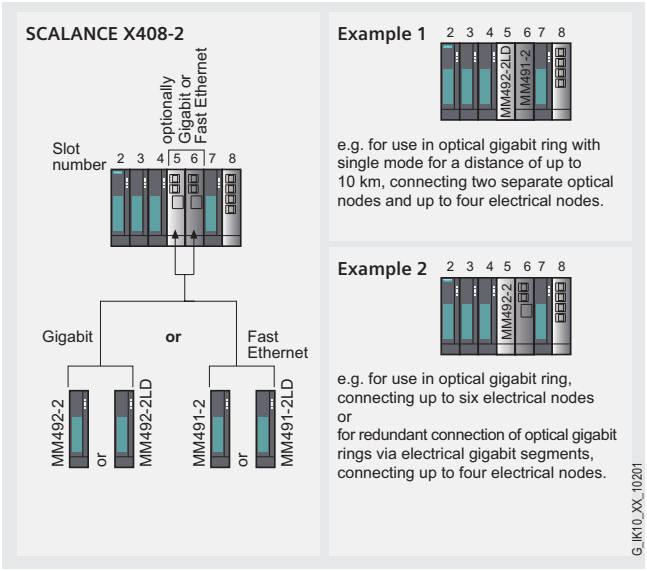


Figure 4-16 Examples of using the MM491-2x media modules

The following media modules are available:

Table 4-6 Overview of the properties of the media modules

Module type	Procedure	Cabling	Connectors	Segment length	Wavelength
MM491-2	100Base-FX	Multimode	2x2 BFOC	3 km	1310 nm
MM491-2LD	100Base-FX	Single mode	2x2 BFOC	26 km	1310 nm
MM492-2	1000Base-SX	Multimode	2 SC duplex	750 m	850 nm
MM492-2LD	1000Base-LX	Single mode	2 SC duplex	10 km	1310 nm

An inserted media module for gigabit Ethernet converts the two gigabit Ethernet twisted-pair ports to optical, the onboard ports are disabled. Media modules can be added or replaced during operation.

Media modules can be inserted in the following slots:

Table 4-7 Options for inserting media modules

Media module	In device	Slot
MM491-2	SCALANCE X414-3E	6, 7
	SCALANCE X408	5, 6
	EM496-4	12 - 15
MM491-2LD	SCALANCE X414-3E	6, 7
	SCALANCE X408	5, 6
	EM496-4	12 - 15
MM492-2	SCALANCE X414-3E	5
	SCALANCE X408	5, 6
MM492-2LD	SCALANCE X414-3E	5
	SCALANCE X408	5, 6

See also

Media modules (Page 324)

4.2.5.3 Overview of extender modules

Overview of the extender modules

The SCALANCE X414-3E has an expansion interface on the right-hand side of the device. An optional extender module can be attached to this interface.

The SCALANCE X408-2 cannot be extended with an extender module.

The following extender module variants are available:

- EM495-8:
  This has 8 twisted-pair 10/100 Mbps ports (RJ-45 jacks). This allows the twelve onboard Fast Ethernet twisted-pair ports of the SCALANCE X414-3E to be extended to a total of 20 ports.

Figure 4-17 Twisted pair extender EM495-8

The twisted pair extenders can also be installed during operation. No media module is required for data transfer with this extender module.

For slots 12 and 13 of the twisted pair extender EM495-8, you can use the cover that can also be used on slots 9 to 11 on the basic device. Two CV490 4x100 covers are supplied with the twisted pair extender.

- EM496-4:
  This has 4 media module slots for the Fast Ethernet media modules MM491-2 and MM491-2LD so that the SCALANCE X414-3E can be extended by up to 8 optical Fast Ethernet ports (100 Mbps).

Figure 4-18 Empty media module extender EM496-4 without protective caps for the media module terminal strips and without cover

Installation of the media module extender and removal or insertion of the media modules is possible during operation. You require at least one media module for data transfer over this extender module.

Mixed operation in slots 12 through 15 with MM491-2 and MM491-2LD modules is possible. The media module plug connectors are protected by protective caps.

Four CV490 2x100 covers are supplied with the twisted media module extender EM496-4. The media module plug connectors are also protected from damage by protective caps.

See also

Extender modules (Page 328)

4.3 SCALANCE W wireless network components

4.3.1 Versions of the SCALANCE W devices

Overview of the features of the individual SCALANCE W devices

Table 4-8 Overview of the SCALANCE W700 product range

Functionality	Device name	Special features
Access points	W788-1PRO W788-2PRO	"Standard" access points
	W788-1RR W788-2RR	Access points with "Rapid Roaming" functionality
	W786-1PRO W786-2PRO W786-3PRO	Particularly robust devices for use in tough mechanical and climatic environments
	W784-1 W784-1RR	Cost-effective access points with small dimensions and reduced hardware features, "RR" with "Rapid Roaming"
Clients	W744-1PRO	Client for connecting an end node
	W746-1PRO	Client for up to eight end nodes *)
	W747-1RR	Client for up to eight end nodes *) with "Rapid Roaming" functionality
	W744-1 W746-1 W747-1	As the "PRO"/"RR" models however with the hardware of the W784-1 access points

The access points can also be configured as clients

*) including one PROFINET I/O client

	with HiPath Wireless Controller	Number of radio interfaces	Antennae diversity	WDS (Wireless Distribution System)	PoE (Power-over-Ethernet) 802.3af	redundant power supply	Wall mounting	IP protection class	Resistant to condensation	-20°C to +60°C	0°C to+60°C	Resistant to saltwater	Resistant to UV	-40°C to +70°C	Rugged design	Rapid Roaming	Number of addresses	Conducted interface	IEEE 802.11a/b/g/h	IEEE 802.11e (QoS/WMM)	Antennae connections	WEP / WPA / WPA2 IEEE 802.11i, Hidden SSID	IEEE 802.1x (RADIUS) EAP-TLS, EAP-TTLS, PEAP	SSH / HTTPS / Admin password	Use in Ex zones	Interference redundancy	C-PLUG	PRESET-PLUG	Client-Mode	VLANs (Multi-SSID)	NAT/PAT (Client-Mode)	STP/RSTP (IEEE 802.1d/w)	Forced Roaming	Syslog	SNMP
SCALANCE W788-1PRO		1	■	■	■	■	■	65	■	■	■				■		2048	RJ45	■	■	external	■	■	■	■		■	■	■	■	■	■	■	■	■
SCALANCE W788-2PRO		2	■	■	■	■	■	65	■	■	■				■		2048	RJ45	■	■	external	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SCALANCE W788-1RR		1	■	■	■	■	■	65	■	■	■				■	■	2048	RJ45	■	■	external	■	■	■	■		■	■	■	■	■	■	■	■	■
SCALANCE W788-2RR	■	2	■	■	■	■	■	65	■	■	■				■	■	2048	RJ45	■	■	external	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SCALANCE W786-1PRO		1	■	■	■	■	■	65	■	■	■	■	■	■	■		2048	RJ45/ BFOC	■	■	internal/ external	■	■	■	■		■	■	■	■	■	■	■	■	■
SCALANCE W786-2PRO		2	■	■	■	■	■	65	■	■	■	■	■	■	■		2048	RJ45/ BFOC	■	■	internal/ external	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SCALANCE W786-2HPW[1]	■	2	■		■	■	■	65	■	■	■	■	■	■	■		2048	RJ45/ BFOC			internal/ external				■										
SCALANCE W786-3PRO		3	■	■	■	■	■	65	■	■	■	■	■	■	■		2048	RJ45/ BFOC	■	■	external	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SCALANCE W784-1		1	■	■	■	■	■	30		■	■						2048	RJ45	■	■	external	■	■	■	■			■	■	■	■	■	■	■	■
SCALANCE W784-1RR		1	■	■	■	■	■	30		■	■					■	2048	RJ45	■	■	external	■	■	■				■	■	■	■	■	■	■	■

■ suitable 1) Firmware from Hipath Wireless Controller G_IK10_XX_30183

Figure 4-19 Functional overview of SCALANCE W access points

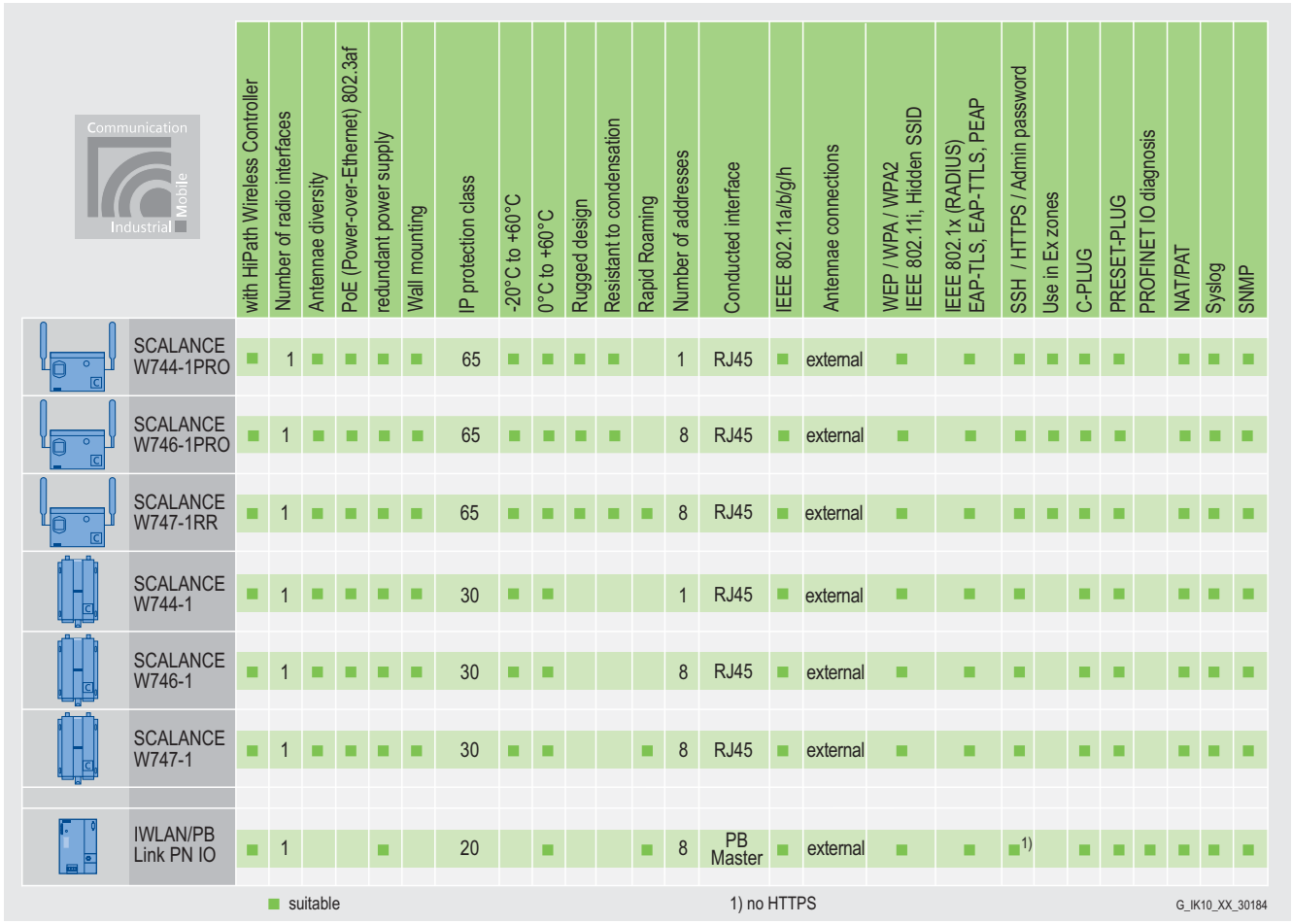


Figure 4-20 Functional overview of SCALANCE W clients

Overview of the communications options (schematic)

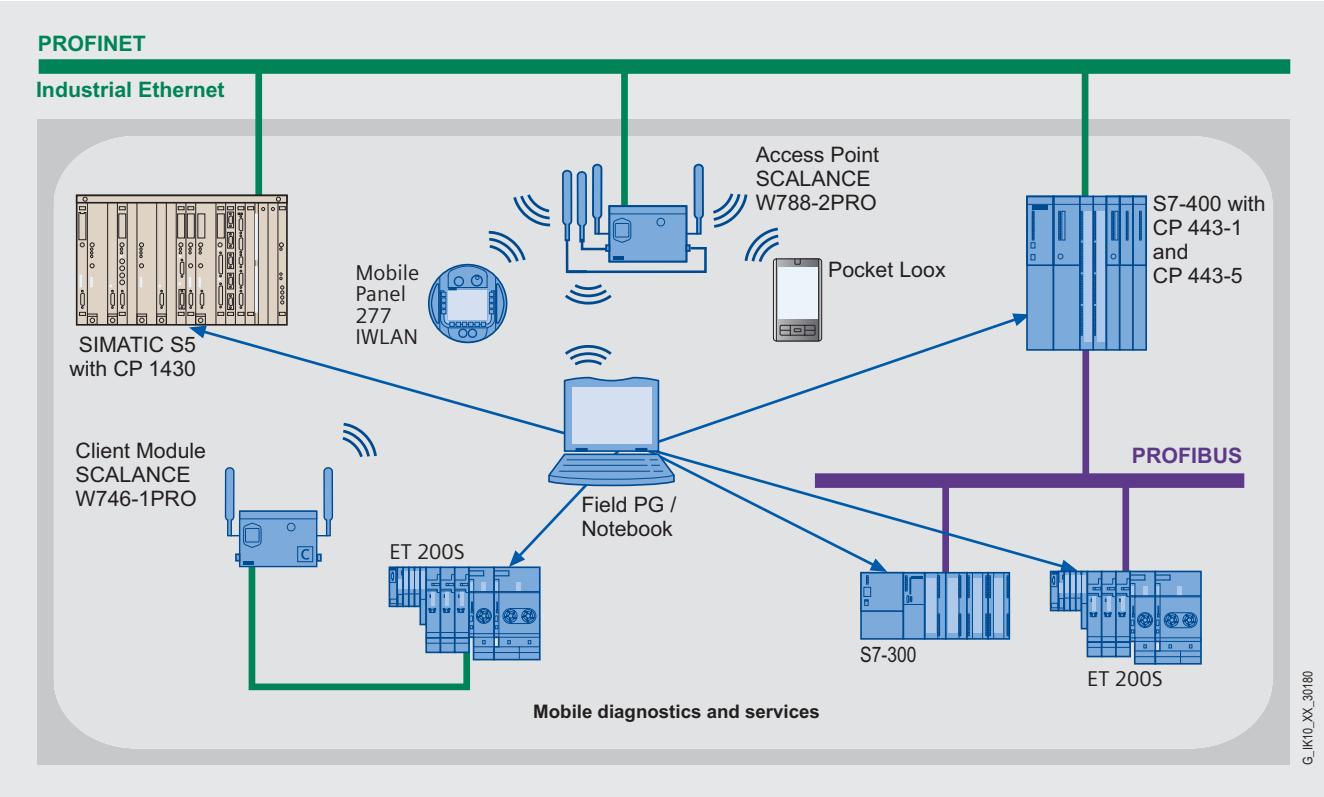


Figure 4-21 IWLAN product schematic

See also

Part C: SCALANCE W wireless network components (Page 339)

4.3.2 Access points W-780

4.3.2.1 SCALANCE W-788

The W-788 product line

Figure 4-22 SCALANCE W788-1PRO access point

The access points are used to set up wireless networks complying with IEEE 802.11 a/b/g/h up to 54 Mbps both at 2.4 GHz and at 5 GHz in a rough industrial environment. Existing LANs and WLANs can be expanded simply with Industrial Wireless LAN using the SCALANCE W-780 access points.

All SCALANCE W78x devices are equipped with an Ethernet interface and a wireless LAN interface (SCALANCE W788-2PRO and SCALANCE W788-2RR: two WLAN interfaces). This makes them suitable for the following applications:

- The SCALANCE W78x forwards data within its transmission range from one node to another without a connection to wired Ethernet being necessary.
- The SCALANCE W78x can be used as a gateway from a wired to a wireless network.
- The SCALANCE W78x can be used as a wireless bridge between two networks at different locations.
- The SCALANCE W78x can be used as a wireless bridge between nodes operating on two different channels.

Other properties

- High availability and reliable wireless communication for productive operation in the plant by reserving bandwidth and cyclic monitoring of the connection to the clients,

- Protection of investments by using the industrial standard IEEE 802.11 that is recognized worldwide,
- Four devices in one: Access point or point-to-point connection at 2.4 GHz or 5 GHz,
- Designed for tough everyday industry thanks to robust construction, protection from vibration and shock and operation at -20 °C to 60 °C,
- Simple installation and flexible power supply with one cable for data and power with Power-over-Ethernet (PoE) complying with IEEE 802.3af,
- High data security to protect from hackers and operator errors with the latest security mechanisms such as WPA or 128-bit encryption (AES),
- Silicone and halogen-free along with ATEX approval for hazardous areas,
- Simple device replacement in the event of a fault with C-PLUG (configuration plug),
- Simple and fast configuration with installation wizard,
- High degree of system reliability with Totally Integrated Automation (TIA),
- Automatic roaming when the connection to Industrial Ethernet is lost.

Additional functions of the SCALANCE W788-1PRO and SCALANCE W788-2PRO

- Second IEEE 802.11a/b/g/h wireless card with up to 54 Mbps at 2.4 GHz and 5 GHz
- Redundancy mode (WDS) for extremely reliable point-to-point operation using both wireless cards

Additional functions of the SCALANCE W788-1RR and SCALANCE W788-2RR

- "Rapid roaming" for extremely fast handover of mobile nodes between different access points

Table 4-9 Differences between the SCALANCE W-788 access points

Type	Quantity WLAN interfaces		Number supported IP nodes		iPCF mode (1)
	1	2	1	several	
W788-1PRO	X			x	
W788-2PRO		x		x	
W788-1RR	X			x	X
W788-2RR		x		x	x

(1) The iPCF mode provides an optimized data throughput and minimum handover times.

See also

SCALANCE W access points and client modules (Page 339)

4.3.2.2 SCALANCE W-786

Basics: Extremely robust

The three devices SCALANCE W786-1PRO/-2PRO/-3PRO are access points with the same construction having one, two or three wireless interfaces and standardized electrical RJ-45 or fiber optic cable ports. With the fiber-optic connectors, sections of up to 3000 m can be covered through areas of high EMI.

The access points are designed for maximum robustness. The important features include:

- All destructible parts are kept inside the product,
- High resistance to dropping and tension compression with impact-resistant and shockproof housing,
- Salt spray and UV resistant,
- Temperature range in operation: - 40 °C through + 70 °C
- Resistant to dew and condensation,
- Degree of protection: IP65

With these features, the access points are ideal for use outdoors and under difficult conditions (harbor installation, public places/public transport).

SCALANCE W786-3PRO

Figure 4-23 SCALANCE W-786 access point

The SCALANCE W786-3PRO access point equipped with three wireless modules uses two modules to provide communication between the access points themselves while the third wireless module is used to establish the RF field for the nodes, for example an automated guided vehicle system. This also allows mesh networks to be implemented.

Possible applications of the SCALANCE W-786

A SCALANCE W-786 is equipped with an Ethernet port and up to three wireless LAN ports. This makes the device suitable for the following applications:

- The SCALANCE W-786 forwards data within its transmission range from one node to another without a connection to wired Ethernet being necessary.

- The SCALANCE W-786 can be used as a gateway from a wired to a wireless network.
- The SCALANCE W-786 can be used as a wireless bridge between two networks.
- The SCALANCE W-786 can be used as a bridge between two cells operating at different frequencies.

With a SCALANCE W-786 with more than one WLAN interface, you can also implement a redundant wireless connection to a SCALANCE W78x with at least two WLAN interfaces.

The SCALANCE W-786 is only an access point but it can nevertheless be configured as a client module using Web-based management. In this case, depending on the selected model, only one wireless module is available as client.

Properties of the SCALANCE W-786

- The Ethernet interface supports 10 Mbps and 100 Mbps, both in full and half duplex as well as autocrossing and autopolarity.
- Operating the wireless interface in the frequency bands 2.4 GHz and 5 GHz.
- The wireless interface is compatible with the standards IEEE 802.11a, IEEE 802.11h, IEEE 802.11b and IEEE 802.11g. In the 802.11a, 802.11h and 802.11g mode, the gross transmission rate is up to 54 Mbps. In turbo mode, the transmission rate is up to 108 Mbps (not permitted in all countries and modes).
- As an expansion of the 802.11a mode, it is also possible to operate according to the IEEE 802.11h standard. In 802.11h mode, the procedures Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS) are used in the range 5.25 - 5.35 and 5.47 - 5.75 GHz. In some countries, this allows the frequency subband of 5.47 - 5.725 GHz to be used outdoors even with a higher transmit power.
  TPC is a technique of controlling the transmit power by reducing it to the strength actually required. With dynamic frequency selection (DFS), the access point searches for primary users (for example radar) on a randomly selected channel before starting communication. If signals are found on the channel, this channel is disabled for 30 minutes and the availability check is repeated on another channel.
- Support of the authentication standards WPA, WPA-PSK, WPA2, WPA2-PSK and IEEE 802.1x and the encryption methods WEP, AES and TKIP.
- Suitable for inclusion of a RADIUS server for authentication.
- Device-related and application-related monitoring of the wireless connection.
- The interoperability of SCALANCE W786 devices with Wi-Fi devices of other vendors was tested thoroughly.

Overview table

The following table illustrates the differences between the various variants of the SCALANCE W786:

Type	Number of WLAN ports	Number and type of Ethernet ports	Number of internal antennas	Number of R-SMA sockets for external antennas	Order no.
W786-1PRO	1	1 RJ-45	1 (diversity(2))	—	6GK5786-1BA60-2AA0 6GK5786-1BA60-2AB0 (1)
W786-1PRO	1	1 RJ-45	—	2	6GK5786-1AA60-2AA0 6GK5786-1AA60-2AB0 (1)
W786-1PRO	1	1 ST duplex multimode FO cable	1 (diversity(2))	—	6GK5786-1BB60-2AA0 6GK5786-1BB60-2AB0 (1)
W786-1PRO	1	1 ST duplex multimode FO cable	—	2	6GK5786-1AB60-2AA0 6GK5786-1AB60-2AB0 (1)
W786-2PRO	2	1 RJ-45	2 (diversity(2))	—	6GK5786-2BA60-2AA0 6GK5786-2BA60-2AB0 (1)
W786-2PRO	2	1 RJ-45	—	4	6GK5786-2AA60-2AA0 6GK5786-2AA60-2AB0 (1)
W786-2PRO	2	1 ST duplex multimode FO cable	2 (diversity(2))	—	6GK5786-2BB60-2AA0 6GK5786-2BB60-2AB0 (1)
W786-2PRO	2	1 ST duplex multimode FO cable	—	4	6GK5786-2AB60-2AA0 6GK5786-2AB60-2AB0 (1)
W786-3PRO	3	1 RJ-45	—	6	6GK5786-3AA60-2AA0 6GK5786-3AA60-2AB0 (1)
W786-3PRO	3	1 ST duplex multimode FO cable	—	6	6GK5786-3AB60-2AA0 6GK5786-3AB60-2AB0 (1)

(1) US variant

(2) There are two internal antennas per WLAN port. The antenna used is always the one that provides the best possible data transmission (diversity).

You will find more information on the configuration parameters of the particular device in the SCALANCE W786 online help of Web Based Management.

See also

SCALANCE W-786 Access Points (Page 354)

4.3.2.3 SCALANCE W-784

Basics

Figure 4-24 SCALANCE W784 Access Point

SCALANCE W-784 Access Points are produced in two variants:

- SCALANCE W784-1 with an integrated wireless card,
- SCALANCE W784-1RR with an integrated wireless card and additional functions.

The access points can also be operated as clients.

The following table illustrates the differences between the various variants of the SCALANCE W784:

Type	Number of WLAN ports	Number of supported IP nodes (3)	Number of supported MAC nodes (3)	iPCF mode (1)	Order no.
W784-1	1	several	several	No	6GK5784-1AA30-2AA0 6GK5784-1AA30-2AB0 (2)
W784-1RR	1	several	several	Yes	6GK5784-1AA30-6AA0 6GK5784-1AA30-6AB0 (2)

(1) The iPCF mode provides an optimized data throughput and minimum handover times.

(2) US variant

Cost-optimized installation variant

Due to its compact and space-saving design, the SCALANCE W-784 device line is particularly suitable for applications in which IWLAN is used in the switching cubicle or needs to be integrated in device or machine.

SCALANCE W-784 access points have an IP30 aluminum housing to provide mechanical and electromagnetic protection.

They are suitable for industry-related applications in which the environment does not create any increased demands. An optimum price-performance ratio is achieved because no unnecessary hardware is used for indoor applications.

Rapid roaming with SCALANCE W784-1RR

The SCALANCE W784-1RR Access Point with rapid roaming , just like the SCALANCE W-788 product line, provides an expanded range of functions such as iPCF mode. This allows applications with real-time requirements and deterministic response times to be implemented for wireless networks as well -- even during roaming.

This means that wireless PROFINET IO is supported.

See also

Structuring wireless networks (Page 67)

SCALANCE W-788 (Page 143)

PROFINET communication services (Page 23)

SCALANCE W-784 Access Points (Page 369)

4.3.3 SCALANCE W-740 Client Modules

SCALANCE W744-1PRO, SCALANCE W746-1PRO and SCALANCE W747-1RR

Figure 4-25 SCALANCE W744-1PRO Client Module

The client modules serve as the wireless interface between a client with an Industrial Ethernet interface, for example, an S7-300 with CP 343-1 or ET 200pro, and the wireless network complying with IEEE 802.11 a/b/g/h at up to 54 Mbps both at 2.4 GHz and at 5 GHz in a tough industrial environment.

SCALANCE W-740 clients are equipped with an Ethernet port and a wireless LAN port. This makes these devices suitable for the following applications:

- The SCALANCE W-740 is used to connect a device with an Ethernet port (for example, a SIMATIC PLC with Industrial Ethernet communications processor) to a WLAN.
- The SCALANCE W-740 can be used as a gateway from a wired to a wireless network. Depending on the device, one or eight nodes are supported on the wired network segment.

Other properties

- High availability and reliable wireless communication for productive operation in the plant by reserving bandwidth and cyclic monitoring of the connection to the clients.
- Protection of investments by using the industrial standard IEEE 802.11 that is recognized worldwide
- Two devices in one: Operation at 2.4 GHz or 5 GHz
- Designed for tough everyday industry thanks to robust construction, protection from vibration and shock and operation at -20 °C to 60 °C
- Simple installation and flexible power supply with one cable for data and power with Power-over-Ethernet (PoE) complying with IEEE 802.3af, even with 24 V DC
- High data security to protect from hackers and operator errors with the latest security mechanisms such as WPA or 128-bit encryption (AES)
- Silicone and halogen-free along with ATEX approval for hazardous areas
- Simple device replacement in the event of a fault with C-PLUG (configuration plug)

- Simple and fast configuration with installation wizard
- High degree of system reliability with Totally Integrated Automation

Extra for SCALANCE W746-1PRO and W747-1RR

- Establishment of connections to up to 8 IP devices

Extra for SCALANCE W747-1RR

- "Rapid roaming" for the fast handover of mobile nodes from one RF field to the next in iPCF mode

Table 4-10 Differences between the SCALANCE W740 devices

Type	Quantity WLAN interfaces		Number supported IP nodes		iPCF mode (1)
	1	2	1	several	
W744-1PRO	X		x		
W746-1PRO	X			x	
W747-1RR	X			x	x

(1) The iPCF mode provides an optimized data throughput and minimum handover times.

See also

SCALANCE W access points and client modules (Page 339)

4.3.4 Special functions of SCALANCE W devices

4.3.4.1 Access control: Encryption and authentication

Control of WLAN access

With wireless LANs, the a danger of unwanted eavesdropping or unauthorized intervention in communication is much greater than with wired communication. Measures to protect the networks from misuse should therefore be implemented.

the relevant settings can be made with Web Based Management (WBM) or using the Command Line Interface (CLI).

Authentication

Authentication protects the network from unwanted access. This is normally achieved by an exchange of keys or certificates between client and server. There are various methods

available and these are described in the operating instructions of the SCALANCE W78x or SCALANCE W74x.

If no authentication is required, this is possible by configuring the network as an "Open System".

Encryption

Encryption protects the transferred data from eavesdropping and corruption. Encryption can only be disabled if open system was selected as the authentication setting. All other security methods include both authentication and encryption.

Various encryption methods are possible.

If you have selected Open System including encryption or Shared Key as the authentication, you will need to define a key in the Keys menu.

- WEP (Wired Equivalent Privacy)

  A weak, symmetrical stream encryption method with only 40- or 104-bit long keys based on the RC4 algorithm (Ron's Code 4).

If the WPA-PSK or WPA (RADIUS) authentication method is selected, the following alternatives are available:

- TKIP (Temporal Key Integrity Protocol)

  A symmetrical encryption method with the RC4 algorithm (Ron's Code 4). In contrast to the weak WEP encryption, TKIP uses changing keys derived from a main key. TKIP can also recognize corrupted packets.

- AES (Advanced Encryption Standard)

  Strong symmetrical block encryption method based on the Rijndael algorithm that further improves the functions of TKIP.

4.3.4.2 Logging

Information on system events

With WBM, it is possible to read out information on system events and the behavior of the protocols (IP, TCP, UDP, ICMP, SNMP). A log table records the type of event and the time at which it occurred. The events to be logged can be configured.

Several events that can be recorded are listed below:

- Authentication attempts

  With all SCALANCE W devices, a table can be read out with information on successful or failed authentication attempts.

- Ethernet and WLAN interface

  Information on the current settings of the Ethernet interface and the WLAN interface and their current operating data is displayed.

  The statistics of the transferred data of the WLAN interface in particular provide information on the quality of the wireless connection. A large number of transmission errors indicates a bad connection.

- Overlap AP

To evaluate the transmission quality of the SCALANCE W78x operating as the access point, the Overlap AP function can provide interesting information. This shows all access points that are visible on the set or adjacent channels (at 2.4 GHz). If entries exist here, the maximum data throughput of the access point will be restricted.

For optimum data throughput, the set wireless channel must not be used by other access points. In the 2.4 GHz band (802.11b or 802.11g), there is overlapping of the wireless channels so that an access point occupies not only the set channel but also the two or three adjacent channels. Care should therefore be taken the ensure that there is adequate channel spacing to neighboring access points.

- Signal recorder

  All SCALANCE W devices can record or display the signal strength of the connected access point with the Signal Recorder function. Using this data, areas with an inadequate signal strength can be located. The Signal Recorder can be particularly advantageous when the client moves along a fixed path (for example suspension track).

  The Signal Recorder can, however, only be controlled using the Command Line Interface.

- List of access points

  The list of access points displays all available access points to which a SCALANCE W74x can establish a wireless connection. To achieve this, the client runs a background scan (possible only when iPCF mode is enabled). If, for example, the security settings do not match up, the access point would not be included in the list.

  Each wireless LAN has a configurable SSID (Service Set Identifier) to be able to identify the wireless network uniquely. This is the network name and is configured on the access point. All clients with access to this access point adopt this SSID. The SSID is displayed in the list of access points.

- Client list

  All the clients logged on at the SCALANCE W78x along with certain additional information (wireless channel, status etc.) are displayed in the client list. This list is available only in access point mode of the SCALANCE W78x. The list contains the following information:

  – MAC address of the client
  – The wireless interface via which the client is connected
  – The signal strength specified in RSSI (Received Signal Strength Indicator from 0% to 100%); the higher the value, the better the signal
  – which encryption is activated
  – the current channel over which the client communicates with the SCALANCE W78x
  – the current state of the clients

4.3.4.3 SCALANCE W devices as bridges

SCALANCE W as bridge

A bridge is a network component that connects two networks. A bridge is not dependent on the protocol; management of the data packages is based on the physical address of the network nodes (MAC address). The SCALANCE W provides bridge functionality because it handles data exchange between wired and wireless Ethernet.

Learning Table

The SCALANCE W saves the information about which MAC address can be reached over which port in a learning table. Entries in this list are deleted automatically when there is no further data transfer for the corresponding MAC addresses. The time after which addresses are deleted if there is no data traffic is set in the Aging Time parameter.

The learning table contains the information about whether a MAC address can be reached over the wired Ethernet interface or over the wireless interfaces. The SCALANCE W obtains this information from the active data exchange.

ARP protocol (Address Resolution Protocol)

If the IP address of a node is known, the ARP protocol can be used to find out the corresponding MAC address.

NAPT (Network Address Port Translation)

In Network Address Port Translation (NAPT) or Port Address Translation (PAT), several internal source IP addresses are translated into the same external source IP address. To identify the individual source nodes, the port of the source device is also stored in the translation list of the NAT gateway and translated for the external address.

If several local clients send a query to the same external destination IP address over the NAT gateway, the gateway enters its own external source IP address in the header of these forwarded frames. Since the forwarded frames have the same global source IP address, the NAT gateway assigns the frames to the clients using different port number.

The NAT/NAPT functions are only available in the SCALANCE W746-1PRO, SCALANCE W747-1RR and SCALANCE W78x (only in client mode).

NAT/NAPT is possible only on layer 3 of the ISO/OSI reference model. To use the NAT function, the networks must use the IP protocol. When using the ISO protocol that operates at layer 2, it is not possible to use NAT.

IP mapping table

It is possible to allow WLAN access to several devices in a wired network via a SCALANCE W746-1PRO, SCALANCE W747-1RR and SCALANCE W78x operating as client. This makes it unnecessary to equip every device with its own wireless client. This so-called IP mapping is possible only if the connected devices are addressed only by IP frames. Communication with a component at the MAC address level (ISO/OSI layer 2) is possible only if its MAC address is configured on the client.

The client maintains a table (the IP mapping table) with the assignment of MAC address and IP address to be able to send incoming IP frames to the correct MAC address. In principle, any number of device is can be reached downstream from a client using IP. The client can manage up to eight devices. When a new device is added, the oldest entry is deleted from the table to make space is for the new entry. Since the data throughput of a wireless connection cannot be increased indefinitely, a maximum of eight devices should be managed by one client.

4.3.4.4 Functions for improving performance

iPCF (industrial Point Coordination Function)

iPCF ensures that the entire data traffic of a cell is ordered, controlled by the access point. By avoiding collisions, the throughput can be optimized even with large numbers of nodes. iPCF also allows fast cell changes.

The basic principle of iPCF is that the access point scans all nodes in the cell cyclically. The same time, the scan includes the downlink traffic for this node. In the reply, the node sends the uplink data. The access point scans a new node at least every 5 ms.

The scan of a node can be seen by all other nodes in the cell. This allows a client to detect the quality of the link to the access point even when it is not communicating with the access point itself. If it does not receive a frame from the access point for a certain time, it starts to search for a new access point.

In iPCF mode, both the search for a new access point and the registration with this new access point have been optimized in terms of time. This handover time is significantly below 50 ms.

iPCF can be recommended, in particular, when a high data throughput is required despite a large number of nodes or when extremely short handover times from cell to cell are required. ("Rapid roaming")

WDS (Wireless Distributed System)

In normal operation, the SCALANCE W78x is used as an interface to a wireless network and communicates with clients. There are, however, situations in which several SCALANCE W78x devices need to communicate with each other, for example to extend wireless coverage or to set up a wireless backbone. This mode is possible with WDS.

WDS is available only when the SCALANCE W78x is used in access point mode and iPCF is not activated.

4.3.4.5 Filter functions

Filter

If a SCALANCE W78x is used as an access point, various filter functions can be set using the WBM.

MAC filter

If the MAC filter is activated, communication with clients on the Ethernet side is possible only when their source MAC addresses are entered in the table. As an alternative, there is a possible setting with which access is denied for all specified MAC addresses. A maximum of 50 MAC addresses can be entered in the table.

With IP mapping of a SCALANCE W78x in client mode, only the MAC address assigned to this device is relevant, the MAC addresses of the devices downstream from it on the Ethernet side are irrelevant for filtering.

MAC Dir filter; restriction of the data traffic between MAC addresses

It is possible to filter the data traffic intended for wireless clients linked to the SCALANCE W78x access point. This filter is used to permit a specified MAC address access only to other specified MAC addresses. You can specify several source addresses or entries for one destination address. The communication of the destination address is then restricted to these entries. If a destination address is not entered in the filter, it is not subjected to any restrictions.

Protocol filter

Without protocol filtering, the SCALANCE W78x processes all data packets regardless of the protocol being used. To increase data security and to reduce load, it can nevertheless be useful to prevent communication using certain protocols.

4.3.5 Other active WLAN components

4.3.5.1 IWLAN/PB Link PN IO

IWLAN/PB Link PN IO

Figure 4-26 IWLAN/PB Link PN IO gateway module

The IWLAN/PB Link PN IO is a compact gateway between Industrial Wireless LAN and PROFIBUS.

- PROFIBUS master interface for flexible integration of systems from the field level in an IWLAN wireless infrastructure complying with IEEE 802.11 a/b/g/h at up to 54 Mbps at 2.4 GHz or 5 GHz, for example with SCALANCE W access points

- PROFINET IO proxy;
  Connection of PROFIBUS DP slaves to a PROFINET IO controller according to PROFINET standard:
  From the perspective of the IO controller, all DP slaves are treated like IO devices with an Ethernet interface, in other words, the IWLAN/PB Link PN IO is their proxy.
- Can be used flexibly by connecting an IWLAN antenna or alternatively an antenna for operation with RCoax cable (leaky feeder cable)
- Communication with automation systems in mobile applications, such as automated guided vehicle systems (AGVS), storage bay conveyor systems or monorail suspension tracks
- Increased plant availability with wireless and therefore wear-free data transmission to mobile communications partners, for example the controller of an automated guided vehicle systems (AGVS)
- Non-touch technology with RCoax as a substitute for slip rings, for example monorail suspension tracks
- Integration of PROFIBUS field devices in an IWLAN wireless network (protection of investment)
- Design to match power rail booster ideal for mounting on monorail suspension tracks along with ET 200S
- Device replacement without PG by using the C-PLUG exhangeable medium to store configuration, engineering and application data.

4.4 SCALANCE S Security Module

4.4.1 Area of application of SCALANCE S

Area of application of SCALANCE S devices

The SCALANCE S devices protect nodes connected to the protected network with a combination of different security measures. SCALANCE S602 and SCALANCE S612/S613 have different protective functions. Individual devices or even entire automation cells can be protected by all SCALANCE S devices.

Figure 4-27 SCALANCE S product family

The range of devices is expanded by the SOFTNET Security Client; a sofware application that allows secure access to automation systems protected by SCALANCE S devices.

SCALANCE S602

Figure 4-28 SCALANCE S602

The SCALANCE S602 device provides flexible protection without complicated handling with a combination of different security measures:

- Data espionage;
- Unauthorized access;

SCALANCE S602 is configured with the Security Configuration Tool.

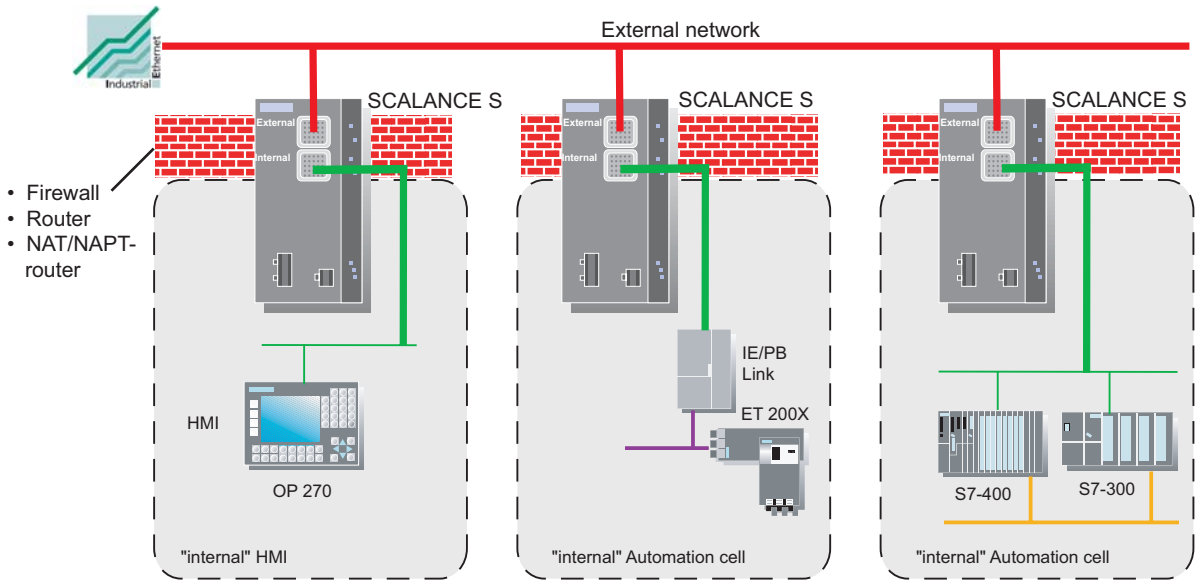


Figure 4-29 Setting up a system with SCALANCE S602

The SCALANCE S602 provides the following security functions:

- Firewall
  - IP firewall with stateful packet inspection
  - Firewall also for Ethernet "non-IP" frames according to IEEE 802.3 (layer 2 frames; does not apply to S602 if router mode is used)

  All network nodes located in the internal network segment of a SCALANCE S are protected by its firewall.
- Router mode

  By operating the SCALANCE S as a router, you separate the internal network from the external network based on the analysis of the IP addresses. The internal network detached by SCALANCE S therefore becomes a separate subnet; SCALANCE S must be addressed explicitly as a router using its IP address.
- Protection for devices and network segments

  The firewall protective function can be applied to the operation of single devices, several devices, or entire network segments.
- No repercussions when included in existing networks

  If a SCALANCE S602 is included in bridge mode in an existing network infrastructure, this does not mean that new settings need to be made for the end devices; in other words, division into IP subnets is not necessary.

SCALANCE S612/S613

Figure 4-30 SCALANCE S612

The security functions of the SCALANCE S612/S613 provide flexible protection against the following, without system repercussions, protocol-independent (as of Layer 2 according to IEEE 802.3) and without complicated handling:

- Data espionage
- Data manipulation
- Unauthorized access

The SCALANCE S612 / S613 and SOFTNET Security Client are also configured with the Security Configuration Tool.

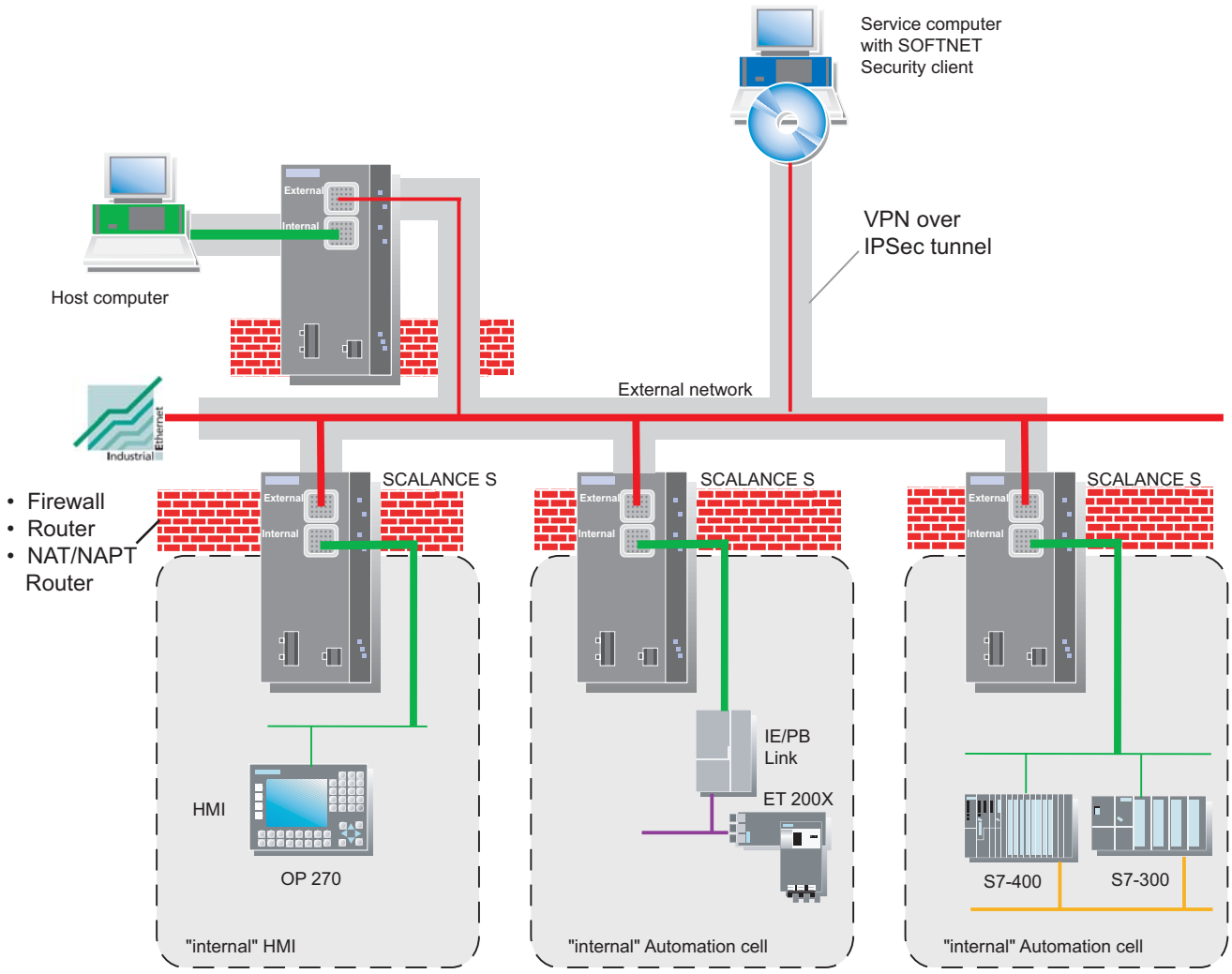


Figure 4-31 Setting up a system with SCALANCE S612/S613

The SCALANCE S612/S613 provide the following security functions:

- Firewall
  - IP firewall with stateful packet inspection
  - Firewall also for Ethernet "non-IP" frames according to IEEE 802.3 (Layer 2 frames)

  All network nodes located in the internal network segment of a SCALANCE S are protected by its firewall.
- Communication made secure by IPSec tunnels

  SCALANCE S612 / S613 devices can be configured to form groups. IPSec tunnels are created between all SCALANCE S612 / S613 devices of a group (VPN, Virtual Private Network). All internal nodes of this SCALANCE S can communicate securely with each other through these tunnels.
- Protocol-independent

Tunneling includes all Ethernet frames according to IEEE 802.3 (Layer 2 frames). Both IP and non-IP frames are transmitted through the IPSec tunnel.

- Protection for devices and network segments

  The firewall and VPN protective function can be applied to the operation of single devices, several devices, or entire network segments.

- No repercussions when included in existing networks

  Internal network nodes can be found without configuration. If a SCALANCE S612 / S613 is included in an existing network infrastructure, this does not mean that new settings need to be made for the end devices; in other words, division into IP subnets is not necessary.

Internal and external network nodes

SCALANCE S602/S612/S613 divides networks into two areas:

- Internal network: Protected areas with the "internal nodes"

  Internal nodes are all the nodes secured by a SCALANCE S

  .

- External network: Unprotected areas with the "external nodes"

  External nodes are all the nodes located outside the protected areas.

The internal network is considered to be secure (trustworthy). Connect an internal network segment to the external network segments only over SCALANCE S.

There must be no other paths connecting the internal and external network!

Configuration and administration

A CD ships with the SCALANCE S containing not only the manual but also the Security Configuration Tool.

The Security Configuration Tool is used for the following tasks:

- Configuration of SCALANCE S;
- Configuration of SOFTNET Security Client; (S612/S613)
- Test and diagnostics functions, status displays.

To operate the SCALANCE S, you must download a configuration created with the Security Configuration Tool. A SCALANCE S configuration includes the IP parameters and the setting for firewall rules and, if applicable, the setting for IPSec tunnels (S612 / S613) or router mode (S602).

The Security Configuration Tool has two modes:

- Offline - configuration view

  In offline mode, you create the configuration data for the SCALANCE S modules and SOFTNET Security Clients. Prior to downloading, there must already be a connection to a SCALANCE S.

- Online

  The online mode is used for testing and diagnostics of a SCALANCE S.

Before putting the device into operation, you can first create the entire configuration offline and then download it. For the first configuration (device with factory settings), use the MAC address printed on the device.

The Security Configuration Tool provides two operating views in offline mode:

- Standard mode

  Standard mode is the default mode in the Security Configuration Tool. It allows fast, uncomplicated configuration of SCALANCE S operation.

- Advanced mode

  Advanced mode provides extended options allowing individual settings for the firewall rules and security functionality.

  In advanced mode, a further distinction must be made between local firewall rules and global firewall rules for modules:

  – Local firewall rules are always assigned to a module. They are configured in the properties dialog of the modules.

  – Global firewall rules can be assigned to several modules at the same time. This option simplifies configuration in many situations.

Consistency checks are running even while you make the entries in the dialogs. You can also start a project-wide consistency check for all dialogs at any time. Only consistent project data can be downloaded.

The saved project and configuration data are protected by encryption both in the project file and on the SCALANCE S.

On the SCALANCE S, they are in a plug-in exchangeable medium, the C-PLUG. The C-PLUG an exchangeable medium that allows the device to be replaced in the event of a fault without requiring a programming device.

Each project can be protected from unauthorized access by assigning passwords.

To ensure security of administrative communication, the settings are made on the SCALANCE S via an SSL encrypted channel.

The SSL protocol is located between the TCP (OSI layer 4) and the transmission services (such as HTTP, FTP, IMAP etc.) and is used for a secure transaction. With SSL, the user is sure that it is connected to the required server (authentication) and that the sensitive data is transferred over a secure (encrypted) connection.

See also

C-PLUG configuration memory (Page 223)

Part C: SCALANCE S security components (Page 383)

4.4.2 SCALANCE S design

SCALANCE S design

The SCALANCE S has a robust metal housing ideal for installation on a DIN rail and an S7 standard rail. It is also possible to install the device directly on a wall in various positions.

Thanks to their S7-300 housing dimensions, the devices are ideal for integration in an automation solution with S7-300 components.

Configuration and engineering data is stored in internal non-volatile memory on the SCALANCE S. A C-PLUG can also be inserted to store this data. The compartment for the C-PLUG is below a screw cover on the back of the device. If a SCALANCE S needs to be replaced, the stored data can be transferred simply to the new device.

SCALANCE S devices have the following connectors:

- A 4-pin terminal block for connecting the redundant power supply (2 x 24 V DC)
- A 2-pin terminal block for connecting the floating signaling contact
- Two Industrial Ethernet connectors in the form of RJ-45 jacks with standard pinning for connecting two separate Industrial Ethernet networks

The two Industrial Ethernet connectors, port 1 and port 2, are handled differently by the SCALANCE S and must not be swapped over when connecting to the communication network.

- Port 1 - external network

  Upper RJ-45 jack, marked red = unprotected network area;

- Port 2 - internal network

  lower RJ-45 jack, marked green = network protected by SCALANCE S;If the ports are reversed, the device loses its protective function.

Both connectors support autonegotiation and the MDI / MDIX autocrossing function.

The advantage of the MDI /MDIX autocrossing function is that straight-through cables can be used throughout and crossover Ethernet cables are unnecessary. This prevents malfunctions resulting from mismatching send and receive wires. This greatly simplifies installation.

IE TP cords or IE TP-XP cords with a maximum length of 10 m can be connected to the two IE TP ports. In conjunction with the Industrial Ethernet FastConnect IE FC Standard Cable and IE FC RJ-45 Plug 180, a total cable length of maximum 100 m is possible between two devices.

4.4.3 SCALANCE S functions

SCALANCE S functions

The SCALANCE S602, SCALANCE S612 and SCALANCE S613 differ from each other mainly in their firmware. The differences are shown in the following table.

Table 4-11 Overview of the functions

Function	S602	S612	S612 V2	S613	S613 V2
Firewall	x	x	x	x	x
NAT/NAPT router	x	-	x	-	x
DHCP server	x	-	x	-	x
Network Syslog	x	-	x	-	x
IPSec tunnel (VPN, Virtual Private Network)	-	x	x	x	x
Softnet Security Client	-	x	x	x	x

Legend:

x function supported

- function not supported

Firewall

The firewall functionality of SCALANCE S has the task of protecting the internal network from influences or disturbances from the external network. This means that; depending on the configuration, only certain previously specified communication relations between network nodes from the internal network and network nodes from the external network are allowed.

All network nodes located in the internal network segment of a SCALANCE S are protected by its firewall.

The firewall functionality can be configured for the following protocol levels:

- IP firewall with stateful packet inspection;
- Firewall also for Ethernet "non-IP" frames according to IEEE 802.3; (Layer 2 frames)

Stateful Inspection (also known as Stateful Packet Filter or Dynamic Packet Filter) is a firewall technology that operates both on the network and at the application layer. The IP packets are accepted on the network layer, inspected according to their state by an analysis module and compared with a status table.

For the communication partner, a firewall with stateful inspection appears as a direct cable that only allows communication according to the rules.

Firewall rules for data traffic in the following directions:

- from the internal to the external network and vice versa;
- from the internal network into an IPSec tunnel and vice versa (S612/S613 only).

SCALANCE S in routing mode (S602)

By operating the SCALANCE S602 in routing mode, you separate the internal network from the external network based on the analysis of the IP addresses. The internal network separated by SCALANCE S602 therefore becomes a separate subnet.

You have the following options:

- Routing - can be set in both standard and advanced mode

  Packets intended for an existing IP address in the subnet (internal or external) are forwarded. The firewall rules for the direction of transmission also apply.

  For this mode, you must also configure an IP address for the internal subnet.

  Note: In contrast to the bridge mode of the SCALANCE S, VLAN tags are lost in routing mode.

- NAT/NAPT routing - can be set in advanced mode

  In this mode, the IP addresses are also converted. The IP addresses of the devices in the internal subnet are mapped to external IP addresses and are therefore not "visible" in the external network.

  For this mode, you configure the address conversion in a list. You assign an external IP address to an internal address.

  Depending on the method you want to use, the following applies to the assignment:

  – NAT (Network Address Translation)

    The following applies here: Address = IP address

  – NAPT (Network Address Port Translation)

    The following applies here: Address = IP address + port number

NAT (Network Address Translation) is a routine with which an IP address in a frame is replaced on the router by another.

With NAPT (Network Address Port Translation), not only an IP address is replaced in the frame on the router by another address but also the port number by another port number.

By configuring address translation in the "Router Mode" dialog, you operate the SCALANCE S as NAT/NAPT router. With this technique, the addresses of the nodes in the internal subnet are not known in the external network; the internal nodes are visible in the external network only under the external IP addresses defined in the address conversion list (NAT table and NAPT table) and are therefore protected from direct access.

SCALANCE S as DHCP server (S602)

A DHCP server assigns an IP address to each client throughout the network. DHCP (Dynamic Host Configuration Protocol) in conjunction with a suitable server, allows the dynamic assignment of an IP address and other configuration parameters to computers in the network.

SCALANCE S602 can be operated in the internal network as a DHCP server. This allows IP addresses to be assigned automatically to the devices connected to the internal network.

The IP addresses are assigned either dynamically from an address band you have specified or you can select a specific IP address for a particular device.

Test, diagnostics, logging, network Syslog (S602)

For test and monitoring purposes, all SCALANCE S devices have various diagnostics and logging functions. Only the SCALANCE S602, however, supports network Syslog.

- Diagnostic functions

  These include various system and status functions that you can use in online mode.

- Logging functions

  This involves the recording of system and security events. The events are logged in the buffer area of the SCALANCE S or a server. These functions can only be assigned parameters and evaluated when there is a network connection to the selected SCALANCE S module.

The events to be logged are selected in the log settings for the relevant SCALANCE S module. The following variants can be configured for logging:

- Local log

  In this variant, events are recorded in the local buffers of the SCALANCE S module. These logs can then be accessed, displayed and archived on the service station in the online dialog of the Security Configuration Tool.

- Network Syslog (S602)

  Network Syslog uses the Syslog server in a network. This records the events in log files according to the configuration in the log setting for the relevant SCALANCE S module.

  SCALANCE S602 can be configured so that it sends Syslog information as a client to a Syslog server. The Syslog server can be in the internal or external subnet. The implementation corresponds to RFC 3164.

In both logging procedures, SCALANCE S recognizes the three following types of events:

- Packet filter events (firewall) / packet filter log

  The packet filter log records certain packets from the data traffic. Data packets are only logged if they match a configured packet filter rule (firewall) or to which the basic protection reacts (corrupt or invalid packets). This is only possible when logging is enabled for the packet filter rule.

- Audit events / audit log

  The audit log automatically logs successive security-relevant events. This would include, for example, enabling or disabling packet logging or actions when users did not authenticate themselves correctly with a password.

- System events / system log

  The system log automatically logs successive system events, for example the start of a process. The logging can be scaled based on event classes.

  Line diagnostics can also be configured (S602). Line diagnostics returns messages as soon as the number of bad packets exceeds a selectable limit.

IPsec tunnel (S612/S613)

IPsec (IP Security Protocol) is a layer 3 tunneling protocol and is an expansion/addition to IP. IPSec (currently), however, only allows encryption of IP packets, does not transfer multicasts and only supports static routing.

This protocol is used only by SCALANCE S612/S613.

In the internal networks protected by the SCALANCE S612/S613, the IPsec tunnel provides the nodes with a secure data connection through the unsecured external network to other internal networks protected by the SCALANCE S612/S613. Data exchange between devices through the IPSec tunnel in the VPN (Virtual Private Network) has the following properties:

- Confidentiality

  The data exchanged is safe from eavesdropping.

- Integrity

  The data exchanged is safe from corruption/counterfeiting.

- Authenticity

  Only those with the appropriate rights can set up a tunnel.

With the Security Configuration Tool, the SCALANCE S612/S613 and SOFTNET Security Client modules that are intended to belong to an internal network can be configured to form groups or VPNs (Virtual Private Network).

IPSec tunnels are established automatically between all SCALANCE S612/S613 modules and SOFTNET Security Client modules that belong to the same group. All internal nodes of this SCALANCE S612/S613 can communicate securely with each other through these tunnels.

Tunneling includes all Ethernet frames according to IEEE 802.3 (Layer 2 frames). Both IP and non-IP frames are transmitted through the IPSec tunnel.

4.4.4 SOFTNET Security Client

Function

The SOFTNET Security Client is a software application and an integral part of the industrial security concept that is used to protect automation systems and secure data exchange between automation systems:

- Fully integrated intuitive configuration without specialist security knowledge
- A common configuration tool with a common database for SCALANCE S and SOFTNET Security Client
  - Automatic generation of certificates by the Security Configuration Tool
  - Automatic learning of the nodes of the internal network and detection of the SCALANCE S modules in the external network
- Use of the tried-and-tested IPsec mechanisms for setting up and operating VPNs
- Allows secure access by programming devices, PCs and notebooks to automation systems or automation cells protected by SCALANCE S.

Principle of application

The SOFTNET Security Client PC software provides VPN services on the PG or notebook. This allows secure IP-based access from a PC/PG to automation systems in subnets protected by SCALANCE S612/S613.

Area of application - access over VPN

With the SOFTNET Security Client, a PC/PG is configured automatically so that it can establish IPsec tunnels to one or more SCALANCE S modules.

Thanks to this IPsec tunnel communication, it is possible to access devices or networks located in an internal network protected by SCALANCE S securely using PG/PC applications such as NCM Diagnostics or STEP 7.

Remember that you can only use the SOFTNET Security Client in groups with modules in bridge mode.

Automatic communication over VPN

For your application, it is important that the SOFTNET Security Client automatically detects access to the IP address of a VPN node. You address the node simply using the IP address as if it was located in the local subnet to which the PC/PG with the application is attached.

How it works

The SOFTNET Security Client reads in the configuration created with the Security Configuration Tool and gets the required information on the certificates to be imported from the file. The root certificate and the private keys are imported and stored on the local PG/PC. Following this, security settings are made based on the data from the configuration so that applications can access IP addresses downstream from the SCALANCE S modules.

If a learning mode for the internal nodes or programmable controllers is enabled, the configuration module first sets a security policy for the secure access to SCALANCE S modules. The SOFTNET Security Client then addresses the SCALANCE S modules to obtain the IP addresses of the relevant internal nodes. SOFTNET Security Client enters these IP addresses in special filter lists belonging to this security policy. Following this, applications such as STEP 7 can communicate with the programmable controllers over VPN.

4.5 OSM/ESM and ELS

4.5.1 Introduction

Basics

The OSMs/ESMs ("Optical Switch Module", "Electrical Switch Module") and ELS ("Electrical Lean Switch") are an older generation of Industrial Ethernet Switches from SIMATIC NET.

4.5.2 Overview of the functions

Overview of the functions of the individual modules

	Type and number of ports								Features																					
	Gigabit Ethernet			Fast Ethernet																										
	10 / 100 / 1000 Mbit/s	10 / 100 Mbit/s				100 Mbit/s																								
	TP / FO	TPTP				Fiber Optic																								
Module type		RJ45	M12	Fast Connect	ITP	POF/ PCF	Multi-mode BFOC	Single-mode BFOC	Compact housing	LED diagnosis	SIMATIC environment	2 x 24 V DC	Signal contact	Local display (set button)	Diagnosis: Web, SNMP	PROFINET diagnosis	Ring redundancy without RM	C-PLUG	Ring redundancy with RM	Standby redundancy	IRT capability	Gigabit technology	Modular design	Digital inputs	Office features (VLAN, RSTP, IGMP, ...)	Layer 3 switching				
OSM TP22		2					2		■	■	■	■	■	■	■		■		■					4			OSM			
OSM TP62		6					2		■	■	■	■	■	■	■		■		■	■				8						
OSM ITP62					6		2		■	■	■	■	■	■	■		■		■	■				8						
OSM ITP53					5		3		■	■	■	■	■	■	■		■		■	■				8						
OSM ITP62-LD					6			2	■	■	■	■	■	■	■		■		■	■				8						
OSM BC08							8		■	■	■	■	■	■	■		■		■	■				8						
ESM TP40		4							■	■	■	■	■	■	■		■		■					4			ESM			
ESM TP80		8							■	■	■	■	■	■	■		■		■	■				8						
ESM ITP80					8				■	■	■	■	■	■	■		■		■	■				8						
ELS TP40		2		2					■	■	■																ELS			
ELS TP40M		2		2					■	■	■				■															
ELS TP80		8							■	■	■																			

■ suitable

G_IK10_XX_10208

Figure 4-32 OSM/ESM and ELS - overview of the functions

4.5.3 Optical and electrical switch module (OSM/ESM)

4.5.3.1 Area of application of OSMs/ESMs

Properties

Figure 4-33 ESM and OSM

The version 2 OSMs/ESMs (Optical/Electrical Switch Modules) allow cost-effective setup of 100 Mbps switched networks.

By creating segments (dividing a network into subnets/segments) and attaching these segments to an OSM/ESM it is possible to contain the load in existing networks and to achieve an improvement in network performance.

The OSM/ESM allows the creation of redundant Industrial Ethernet ring structures using switching technology with fast medium redundancy (reconfiguration time maximum 0.3 seconds).

To create an optical ring, OSMs with two FO ports are required.

To create an electrical ring, ports 7 and 8 of the ESM are interconnected using Industrial Twisted Pair cables.

The data rate in the ring is 100 Mbps; a maximum of 50 OSMs/ESMs can be used.

In addition to the two ring ports, OSMs/ESMs have a further six ports (optionally D-sub or RJ45 ports), to which both end devices and network segments can be attached.

Several rings can be interconnected redundantly using the integrated standby function.

There are three ways of signaling errors:

- via the signal contact
- via SNMP (traps)
- by Email

See also

Optical Switch Module (OSM) and Electrical Switch Module (ESM) (Page 389)

4.5.3.2 OSM/ESM functions

Functions
Improving network performance

By filtering the data traffic based on the Ethernet (MAC) address of the end devices, local data traffic remains local, only data intended for nodes in another subnet is forwarded by the OSM or ESM.

Simple network configuration and network expansion

A total network span of up to 150 km (OSM) or 5 km (ESM) presents no problem.
The OSM/ESM stores the data received at the ports and then forwards it to the destination address. The restriction of the network span resulting from collision detection (CSMA/CD) ends at the OSM/ESM port.

Error containment

The OSM/ESM limits the propagation of errors in a network to the subnet involved because it forwards only valid data.

Integration of Ethernet networks operating at 10 Mbps and 100 Mbps

The OSM/ESM is suitable for the integration of existing subnets operating at 10 Mbps in Fast Ethernet networks operating at 100 Mbps.

The OSM/ESM automatically detects the data rate (10 or 100 Mbps) at the twistedpair ports as well full or half duplex mode.

Fast redundancy in the ring

By interconnecting the ends of an optical bus using OSMs/ESMs to form a ring, reliable communication can be achieved. With an OSM/ESM in the ring, the integrated redundancy manager is activated using a DIL switch. The redundancy manager constantly monitors the operation of the network.

It recognizes the failure of a section in the ring or of an OSM/ESM and activates the substitute path within a maximum of 0.3 seconds.

Redundant linking of networks.

The standby function integrated in the OSM/ESM allows the redundant linking of two networks (ring or bus structure). To achieve this, two OSMs/ESMs are set as the standby master/slave using a DIL switch in one network and their standby ports connected to

partners in the other network. These partners can be OSMs/ESMs or SCALANCE X switches.

Priority for forwarding timeofday frames

OSMs/ESMs recognize a SIMATIC NET timeofday frame by its multicast address 09:00:06:01:FF:EF $_H$ and forward it with priority over other frames. Giving priority to forwarding of timeofday frames minimizes their delay time in the network and keeps this as low as possible regardless of the network load.

Interfaces

All modules have the following connectors and operator controls:

- A 6pin terminal block for connecting the power supply (redundant 24 V DC power supply) and the floating signal contact.
- A row of LEDs and a selection button to display the mode and status information.
- The StandbySync port is used to synchronize two modules when linking redundant networks.
- The OSMs/ESMs can be upgraded to new firmware revisions and can be assigned parameters via the serial port.

The OSM/ESM has a total of eight LAN ports. Depending on the particular variant, they have the following ports:

- Twistedpair port (D-sub): 10/100Base-TX
  9pin D-sub socket (ITP port), automatic data rate detection (10 or 100 Mbps) for connection of TP cables (max. length 100 m)
- Twistedpair port (RJ-45): 10/100Base-TX
  RJ45 jack, automatic data rate detection (10 or 100 Mbps) for connection of TP Cords (max. length 10 m, in conjunction with FC Outlets RJ45 and Industrial Ethernet FastConnect cable (patch cabling) up to 100 m)
- Glass FOC: Multimode (MM); 100Base-FX BFOC
  2 BFOC sockets per port, data rate 100 Mbps, for connection of multimode FOC in environments with high EMI levels and for distances up to 3000 m between two OSMs
- Glass FOC: Single mode (SM); 100Base-FX BFOC
  2 BFOC sockets per port, data rate 100 Mbps, for connection of single mode FOC in environments with high EMI levels and for distances up to 26 km between two OSM ITP62LD modules.

For an overview of the number of interfaces available on the various models, refer to the Overview of the functions.

See also

Overview of the functions (Page 170)

4.5.3.3 Bus (linear) topologies with OSMs/ESMs

Bus (linear) topologies with the OSM/ESM

Linear bus topologies can be implemented with OSMs/ESMs. The maximum cascading depth is 50 OSMs/ESMs in series.

The entire segment lengths permitted for a port type (TP, FO) can be used.

See also

Linear structure (Page 54)

4.5.3.4 Redundant ring structure with OSMs/ESMs

Redundant ring structure with OSMs

With the aid of an OSM functioning as the redundancy manager (RM), the ends of an optical bus made up of OSMs can be connected together to form a redundant optical ring. The OSMs are connected together using ports 7 and 8.

The RM monitors the line of OSMs connected to it at ports 7 and 8 in both directions. If it detects a break on the line, it interconnects the ends of the line to reestablish a functioning linear bus configuration. A maximum of 50 OSMs are permitted in an optical ring. This strategy achieves a reconfiguration time of less than 0.3 seconds.

The RM mode is activated on the OSM using a DIP switch.

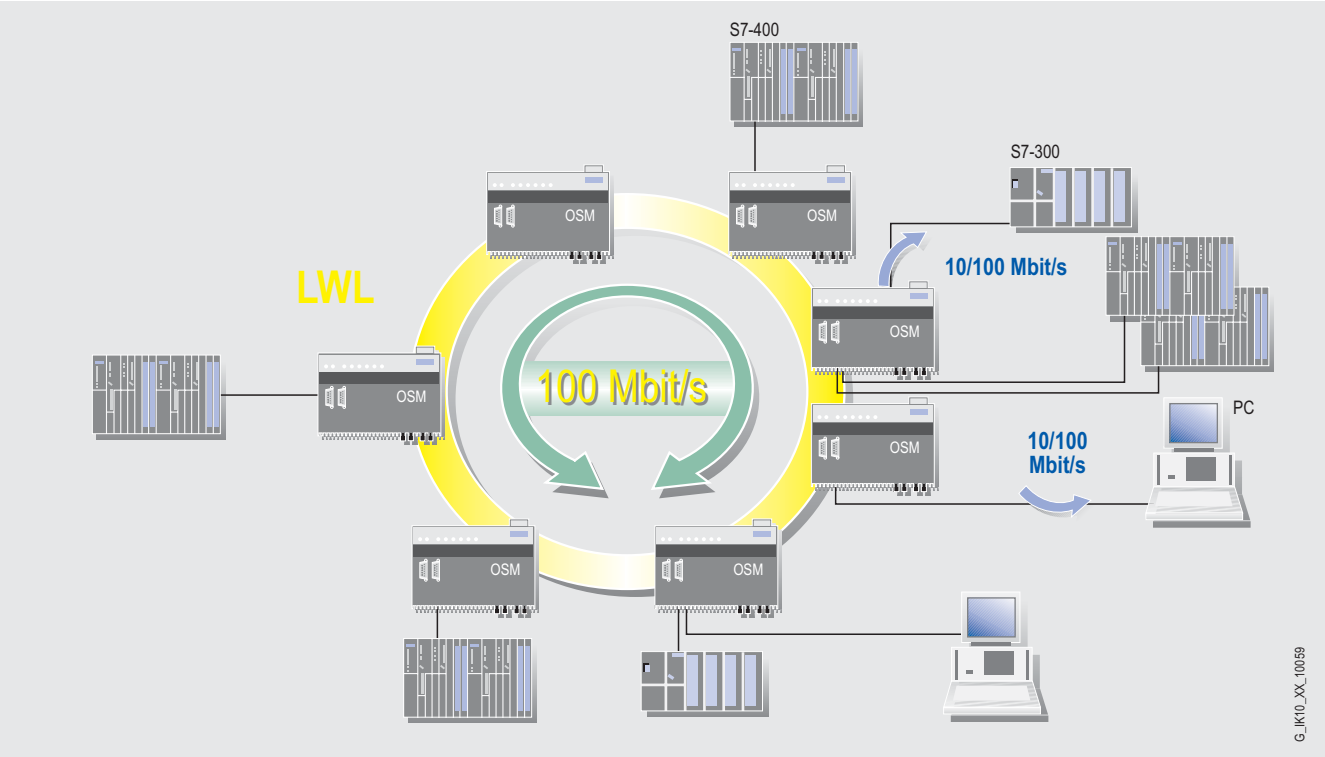


Figure 4-34 Redundant ring structure with OSMs (switched network)

Redundant ring structure with ESMs

A redundant electrical ring can also be set up with ESMs. To achieve this, the ESMs are connected together using ports 7 and 8. One device must be switched to the redundancy manager mode. With ESMs and a maximum of 50 devices in the ring, a reconfiguration time of less than 0.3 s can also be achieved.

Note

The reconfiguration time of less than 0.3 s can only be achieved when no components (for example switches from other vendors) other than SCALANCE X switches OSMs or ESMs are used in the redundant ring.

In a ring, one device and one device only must operate in the redundancy manager mode.

End devices or complete network segments can be attached to ports 1 - 6 of an OSM/ESM operating in the RM mode.

See also

Optical redundant ring structure (Page 62)

Redundant ring structure (Page 59)

4.5.3.5 Redundant linking of subnets using the OSM/ESM

Redundant linking of subnets using the OSM/ESM

Using an OSM/ESM, fast, redundant links between two Ethernet subnets or networks can be implemented. These networks can, for example, consist of redundant OSM/ESM rings.
The redundant link as shown in the figure below is established on separate paths via the two TP ports (default port 1) of an OSM/ESM pair. The standbysync ports of both OSMs/ESMs must be connected using an ITP XP standard cable 9/9 with a maximum length of 40 m.

How standby redundancy works

One of the two OSMs/ESMs must be set to the standby mode by setting the DIP switch. This OSM/ESM forms the redundant link that only transfers data when the other path (main link) fails. The OSM/ESM in the standby mode receives information about the state of the main link via the synchronization connection between the standbysync ports. If the main link fails, the redundant OSM/ESM activates the standby link within 0.3 seconds.
If the problem is eliminated on the main link, this also causes a signal on the synchronization connection. The main link is enabled again and the standby link disabled.

Faults managed by the redundancy function

The following problems on the main link activate the standby link:

- Main OSM/ESM without power
- Cable break at a cascaded port of the main OSM/ESM
- Defective or deactivated partner on a cascaded port of the main OSM/SM.

Port assignment in OSM/ESM standby mode

On the standby master and standby slave, only port 1 (standby port) can be used for the link to the neighboring ring. Ports 2 to 6 can be used just as normal OSM ports.

The port assignment is the default setting of an OSM when shipped.

With network management, it is also possible to configure ports other than port 1 or several ports as standby ports (see also OSM/ESM Network Management Manual).

Simultaneous standby and redundancy manager operation

A standby master or standby slave can act as a redundancy manager in a redundant ring at the same time.

4.5.3.6 OSM/ESM network management

Functions

Network management provides the following functions:

- Password protected login for administrators (write and read rights) and users (read rights only),
- Reading out version and status information
- Setting the message and standby mask and address information,
- Fixed parameter settings for ports and filter tables,
- Output of statistical information,
- Diagnostics of data traffic,
- Selectable mirror port,
- Downloading new firmware versions via the network.

If problems occur in the network, the OSM/ESM can send error messages (traps) automatically to a network management system or Emails to a network administrator.

Remote monitoring

Remote monitoring (RMON) provides the following functions:

The OSM/ESM is capable of visualizing statistical information according to the RMON Standards 1 to 3. These include, for example, error statistics maintained for each port separately.

WebBased management functions

The management level of the OSM is accessible using a web browser. Masks, filters, and ports can be configured. Diagnostics of the device and the ports is possible via the Web.

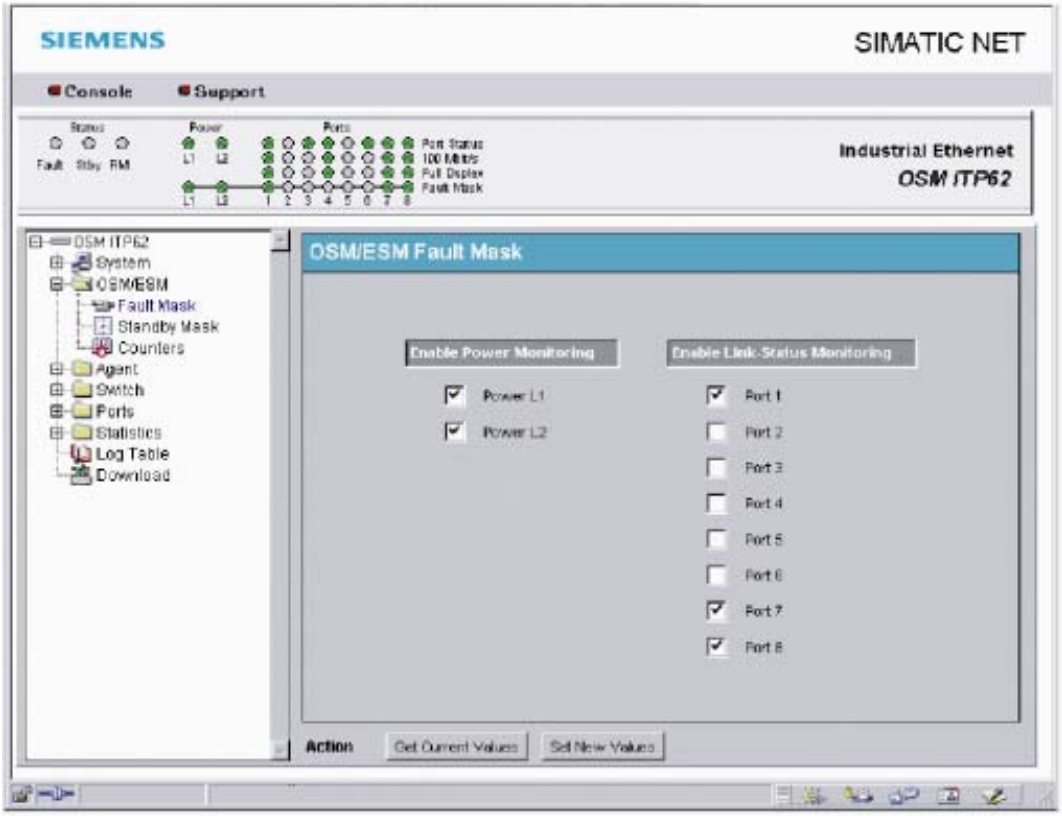


Figure 4-35 Network management with Web browser

4.5.4 Electrical Lean Switch (ELS)

4.5.4.1 Area of application of the ELS

Overview

Figure 4-36 ELS TP40M

The Electrical Lean Switch ELS product generation allows powerful Fast Ethernet networks with a small number of interfaces to be set up in industry. Nodes are connected solely over twisted-pair interfaces, in other words, electrical interfaces.

Figure 4-37 ELS TP80

The Electrical Lean Switches (ELS) allow the cost-effective installation of Industrial Ethernet bus or star structures with switching functionality. The ELS are designed for installation in a switching cubicle.

The following ELS variants are available:

- ELS TP40
- ELS TP40M
- ELS TP80

Compared with the other devices, the ELS TP40M has the following extra features:

- Additional integrated Web server
- SNMP access
- E-mail function for remote diagnostics and signaling over the network

See also

Electrical Lean Switch (ELS) (Page 412)

4.5.4.2 ELS functions

General

The ELS TP devices are plug-and-play devices that require no settings when they are put into operation.

All ELS TP devices provide the following functions:

- Autonegotiation,
- MDI/MDIX autocrossover function

Additional functions of the ELS TP40M

The ELS TP40M alone has the following functions.

Diagnostics functions:

- Display of the current state of the port (link up/down, transmission rate and duplicity)
- Display of the MAC address, the IP address, the subnet mask, the gateway, and the type of configuration (manual or using DHCP).
- Trap and E-mail monitoring unit: Cold start events and status changes at the port can be sent to E-mail and/or trap recipients,
- Display of statistical values of errors that have occurred on the network and that were detected by the ELS (CRC, defective frames, collisions etc.).
- Display of the system up time and the hardware and firmware version.

Configuration functions:

- Configuration of the IP address, the subnet mask and the gateway using the Primary Setup Tool (PST),
- Reset of all values to the factory settings using the PST.
- Configuration of E-mail and trap recipients.

- Configuration of individual events that will trigger the sending of E-mails and/or traps.

The ELS TP40M includes integrated Web-Based Management; in other words, it can be operated using an Internet browser (such as Microsoft Internet Explorer or Netscape). The modules are operated using a Java applet stored on the ELS that is loaded by the browser. For the browser to be able to load the applet, a Java virtual machine (JVM) is required. As of Version 6.x, Netscape provides a JVM integrated in the browser that can be used for Web Based Management. For the Microsoft Internet Explorer, the JVM Plugin must be installed separately. On the CD supplied with the ELS TP40M, you will find a suitable JVM from Sun Microsystems. The latest JVM versions can also be downloaded free from the Web pages of Sun Microsystems.

4.5.4.3 Topologies with the ELS

Topologies with the ELS

The ELS TP40 and ELS TP40M are optimized for installation in 10/100 Mbps Industrial Ethernet networks with a linear structure but they can also be used as a single start point. The ELS TP40 themselves are interconnected using IE FC 2x2 cables. These are connected to the devices using insulation piercing contacts. One or two nodes or one node and a programming device can be connected via two RJ-45 jacks.

The ELS TP80 also allows a star network to be set up with up to 8 nodes via RJ-45 jacks or the expansion of the number of ports for OSM/ESM applications.

Part B: Passive components and accessories

5

5.1 Product overview of "passive IE components"

Table of available passive IE components

See following page.

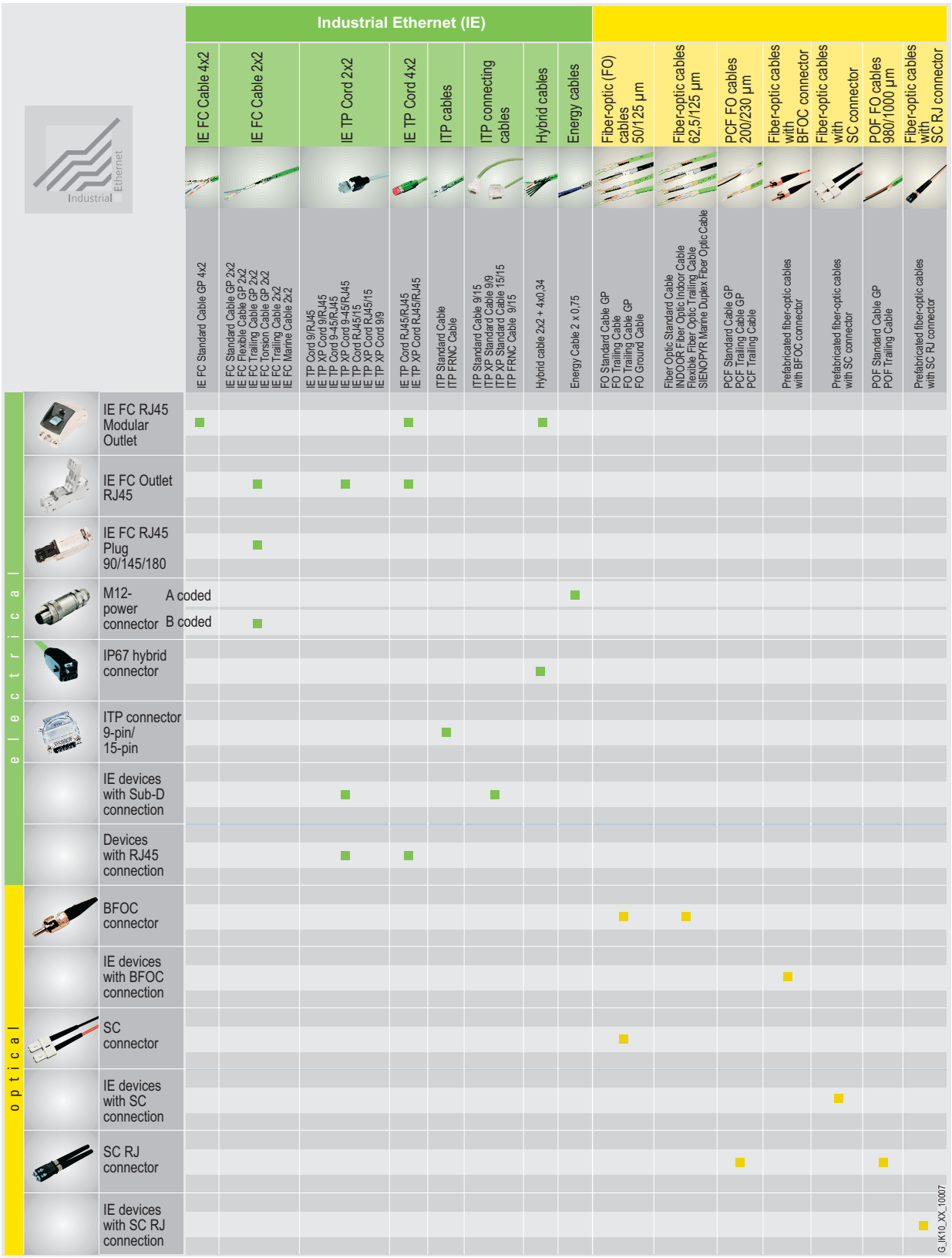


Figure 5-1 Product overview of "passive IE components"

5.2 Contacts for special cables and special lengths

Contacts for special cables and special lengths

If you require special cables and special lengths of the cable types, please contact:

Jürgen Hertlein
SIEMENS A&D SE PS 1
E-mail: juergen.hertlein@siemens.com
Tel.: + + 49 (911) 750-4465
Telefax: + 49 (911) 750-9991

5.3 Components for electrical networks

5.3.1 Overview of twisted-pair cables

Properties

This section describes the technical properties of the Industrial Twisted Pair and twisted-pair cables. The unassembled cables are described first. Following this, the available assembled cables will be introduced.

Fast Connect (FC) Twisted Pair

For structured cabling within a factory, the FC twistedpair cabling system is ideal. Using the FastConnect (FC) system for Industrial Ethernet, structured cabling from the office environment has been further developed for use in the factory.

FastConnect cables can be assembled fast and simply on site. This means that RJ-45 cabling technology, an existing standard, is also available in a version suitable for industry and making such cabling possible in an industrial environment.

With the IE RJ-45 Plug and FastConnect cables, runs of up to 100 m cable length are possible without patching.

Twisted Pair Cord

The TP Cord is used to connect end devices to the Industrial Ethernet FC cabling system. It is intended for use in switching cubicles. It is used mainly as a patch cable.

The maximum total length of the two TP Cords in a point-to-point connection is 10 m.

ITP ("Industrial Twisted Pair" with D-sub connectors)

To establish a direct link between nodes and network components, the ITP Standard Cable preassembled with robust D-sub male connectors is available.

This allows a cable length of up to 100 m without patch cables.

Standards

The EN 50173 standard describes the structured cabling of office buildings. IEC 24702 describes the structured building networking of an industrial building. The description of the automation system within an industrial building can be found in IEC 61918 and the communications-specific part of PROFINET is in IEC 61784-5-3.

See also Appendix (Page 583)

Structured cabling

Structured cabling describes the cabling of building complexes for information technology purposes regardless of the applications used. A building is divided into the following areas:

- Primary area
  (interconnection of buildings of a campus)
- Secondary area
  (interconnection between floors of a building)
- Tertiary area (information technology connectors for the end devices of a floor)

TP Cords can be used as patch cables between devices and on patch panels.

The structured cabling that can be implemented with the Industrial Ethernet FastConnect system complies with the tertiary cabling described in EN 50173.

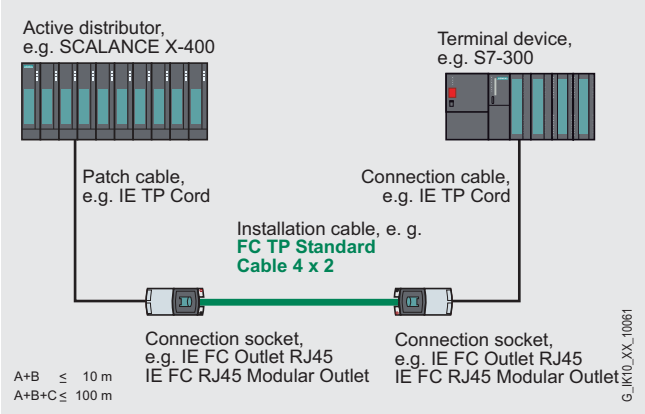


Figure 5-2 Structured cabling to EN 50173

Table 5-1 Cables for structured cabling to EN 50173

Uses	SIMATIC NET cable	Maximum length
Patch cable	IE TP Cord	A+C max. 10 m
Tertiary cable	IE FC standard cable GP	B max. 90 m
	IE FC flexible cable GP	B max. 75 m
	IE FC torsion cable GP	B max. 45 m
	IE FC trailing cable GP	B max. 75 m
	IE FC trailing cable	B max. 75 m
	IE FC marine cable	B max. 75 m
	IE FC TP FRNC cable GP	B max. 75 m

Note

Industrial Twisted Pair cables (IE FC Standard Cable) are intended for indoor use.

Twisted Pair cables (TP Cord) are intended for use in switching cubicles.

See also

Components for electrical networks (Page 423)

Appendix (Page 583)

5.3.2 Individual cable types

5.3.2.1 FastConnect (FC) twisted-pair cables 4-wire for 100 Mbps Ethernet

General

When installing Industrial Ethernet (IE) networks, there are various cable types available for different applications.

The Industrial Ethernet FC cables listed should be used.

The symmetrical radial structure of the FastConnect (FC) twistedpair cables allows the use of the IE FC stripping tool. This allows fast and straightforward assembly of the IE FC RJ-45 Outlet or IE FC RJ-45 Plug.

See also

FastConnect (FC) twisted-pair cables 4-wire for 100 Mbps Ethernet (Page 428)

5.3.2.2 FastConnect (FC) twisted-pair cables 8-wire for Gigabit Ethernet

General

To operate 1 gigabit Ethernet networks, 8-wire cables are required. The available FastConnect (FC) Industrial Ethernet cable is category 6 (CAT6) according to the international cabling standards ISO/IEC 11801 and EN 50173. This cable is also suitable for lower data rates such as 100 Mbps.

The symmetrical radial structure of the FastConnect (FC) twistedpair (TP) cable allows the use of the IE FC stripping tool. This allows fast and straightforward assembly of the IE FC RJ-45 Modular Outlet.

Note: The user may need to readjust the IE FC stripping tool 6GK1 901-1GA00 for the 4x2 cable variant. The two setting screws of the knife cassette on the stripping tool must be opened by approximately half a turn.

Cabling with 8-wire cables is always advisable if there is any plan to change over to 1 gigabit in the foreseeable future.

See also

FastConnect (FC) twisted-pair cables 8-wire for Gigabit Ethernet (Page 438)

5.3.2.3 Twisted Pair Cord (4-wire for Fast Ethernet)

General

The IE TP 2 x 2 Cord is used to connect end devices to the Industrial Ethernet FC cabling system. It is intended for use in switching cubicles. The cable is now only used as an adapter cable to connect devices with a D-sub port to devices with an RJ45 port.

The cable is suitable for a transmission rate of 10/100 Mbps.

A maximum of 10 m of twistedpair cord can be used between two devices. With structured cabling using two IE TP Cords, this length is the maximum for both patch cables together.

The TP interface converter is used to connect an end device with an RJ45 port to the Industrial Twisted Pair cabling system with a D-sub port.

See also

Twisted Pair Cord (4-wire for Fast Ethernet) (Page 423)

5.3.2.4 Twisted Pair Cord (8-wire for Gigabit Ethernet)

General

The IE TP 4x2 Cord is used to connect end devices to the Industrial Ethernet FC cabling system. It is intended for use in switching cubicles. This cable is only available preassembled.

The cable is suitable for a transmission rate of 10/100/1000 Mbps.

A maximum of 10 m of twistedpair cord can be used between two devices. With structured cabling using two IE TP Cords, this length is the maximum for both patch cables together.

See also

Twisted Pair Cord (8-wire for Gigabit Ethernet) (Page 426)

5.3.2.5 IE Hybrid Cable

General

The IE Hybrid Cable 2x2 + 4x0.34 in conjunction with the IE FC RJ-45 Modular Outlet is the ideal solution when a device such as the SCALANCE W needs to be supplied with power at the same time. The cable includes

- 2 x 2 wires for data transmission according to CAT 5e
- 2 x 2 wires each with a core diameter of 0.76 mm to supply power

Power supply according to the Power over Ethernet standard (PoE) can also be carried on the power wires; in other words up to 57 V.

Application

With the IE Hybrid Cable 2x2 + 4x0.34 and the IE FC RJ-45 Modular Outlet with power insert, distant nodes such as the SCALANCE W can be supplied with data (10/100 Mbps) and power at the same time. Having both data and power on one cable leads to a significant reduction of installation costs.

The IE Hybrid Cable 2x2 + 4x0.34 is halogen-free for universal use in industry and office. It is UV resistant to UL 1581 Sec. 1200.

The maximum cable length between the IE FC RJ-45 Modular Outlet and the SCALANCE W access point is 80 m with an additional 6 m patch cable to the Modular Outlet. An IP67 hybrid cable connector is recommended for connection to the SCALANCE W.

See also

IE Hybrid Cable (Page 445)

5.3.2.6 Industrial Twisted Pair cables (ITP)

General

Two cable types are used for the Industrial Twisted Pair cable (ITP cable):

- ITP Standard Cable for Industrial Ethernet
- ITP FRNC Cable for Industrial Ethernet

Compared with the standard cable, the FRNC cable has a jacket of thermoplastic copolymer that is extremely flame retardant and halogen-free. The electrical properties are largely the same.

Both ITP cables can be ordered either in meters or preassembled with connectors. They allow connection of a single end device or the connection of two active network components (SCALANCE X / OSM / ESM).

See also

Industrial Twisted Pair cables (ITP) (Page 448)

5.3.3 Preassembled cable types

5.3.3.1 Preassembled twisted-pair cords

General

The preassembled Twisted Pair Cords (patch cables) can be used inside switching cubicles and for transmission links up to 10 m. Compared with the Industrial Twisted Pair cables, the Twisted Pair Cords are much thinner and more flexible. The connectors are standardized RJ-45 plugs and D-sub male connectors for connection to Industrial Twisted Pair components.

The IE TP Cord RJ-45/RJ-45 and IE TP XP Cord RJ-45/RJ-45 have 4 x 2 wires. They therefore comply with category 6 of the international cabling standards ISO/IEC 11801 and EN 50173 and are therefore suitable for 10/100/1000 Mbps Ethernet.

The other cables have 2 x 2 wires. They comply with Cat 5e and are suitable for 10/100 Mbps Ethernet.

Application

The following schematics show the available cables and their applications.

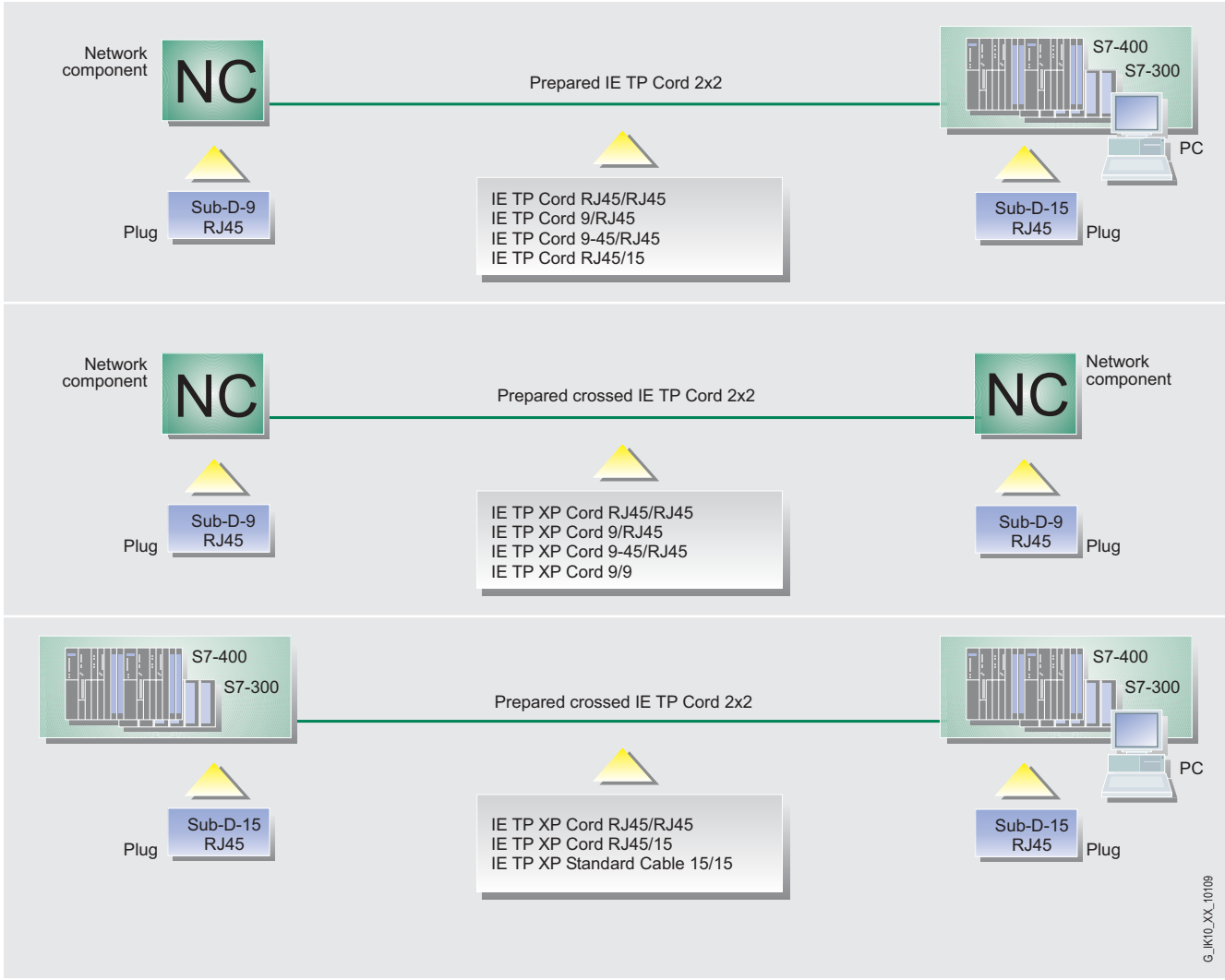


Figure 5-3 Use of TP Cord for direct connection of individual components (10/100 Mbps)

From top to bottom:

- Direct connection between an end device and a network component
- Direct connection between two network components
- Direct connection between two end devices

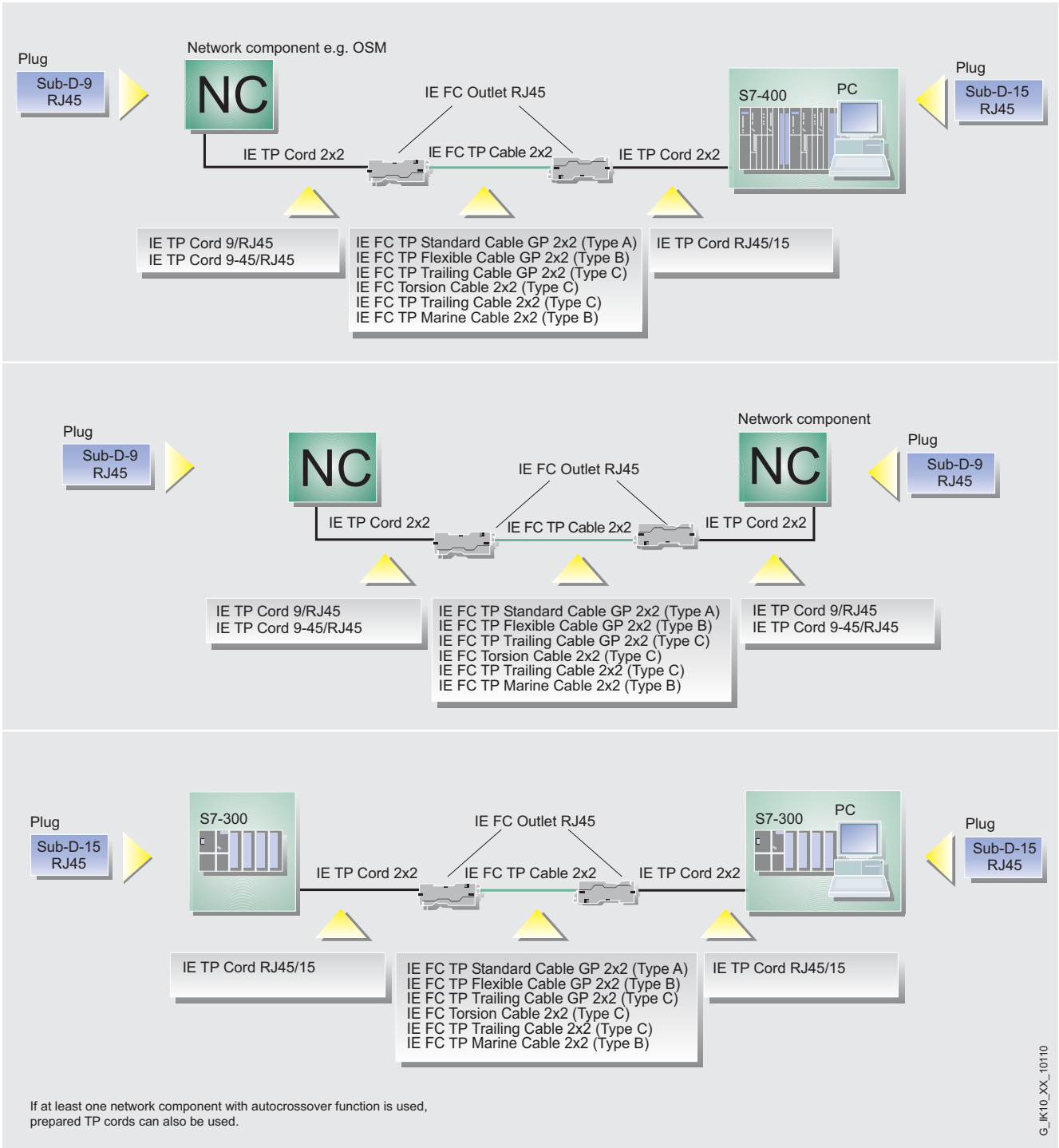


Figure 5-4 Use of TP Cord as a patch cable with IE FC Outlets RJ-45 (10/100 Mbps)

From top to bottom:

- Structured cabling between an end device and a network component
- Structured cabling between two network components
- Structured cabling between two end devices

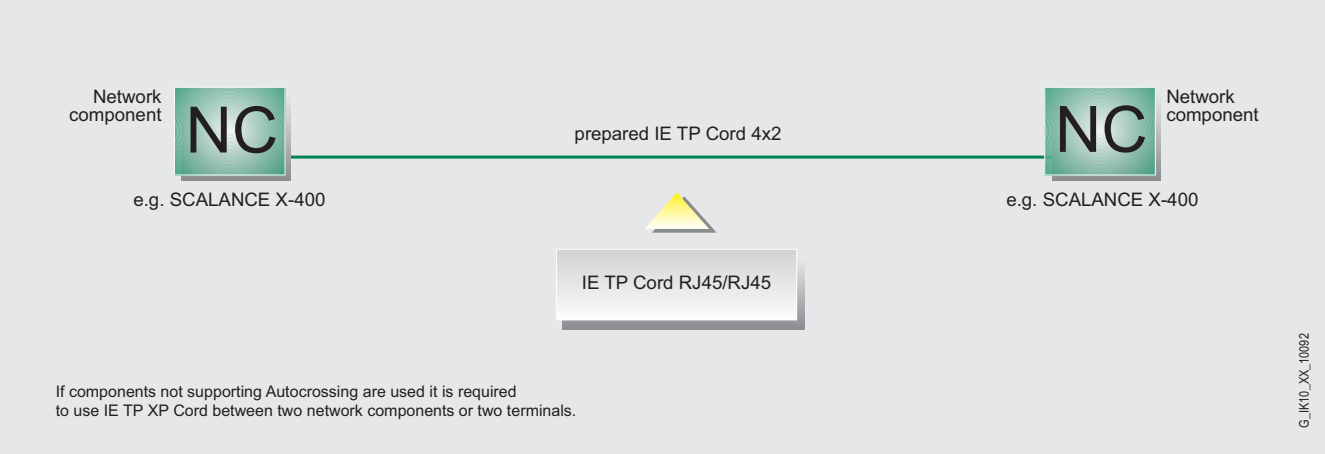


Figure 5-5 Use of TP Cord for direct connection of individual components (10/100/1000 Mbps)

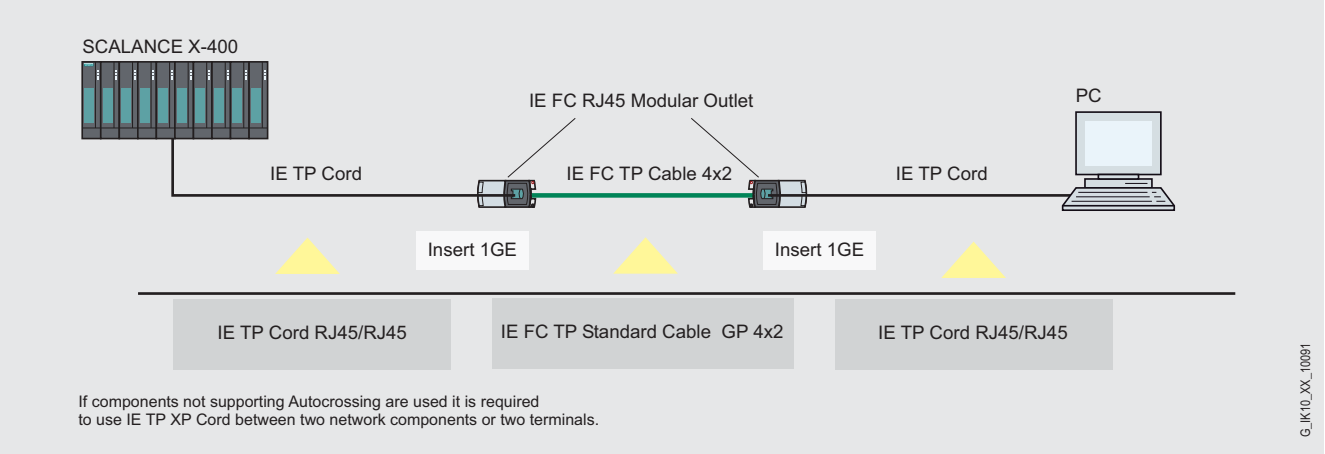


Figure 5-6 Use of TP Cord as a patch cable with IE FC RJ-45 Modular Outlets (10/100/1000 Mbps)

See also

Preassembled twisted-pair cords (Page 451)

5.3.3.2 IE M12 connecting cable

General

The preassembled IE M12 Connecting Cables are ideally suited for connecting Industrial Ethernet nodes (for example SCALANCE X208PRO) with degree of protection IP65. They are suitable for transmission rates of 10/100 Mbps. These is IE FC TP Trailing Cable GP with D-coded M12 male connectors at both ends.

Figure 5-7 IE M12 connecting cable

See also

IE M12 Plug PRO (Page 197)

IE M12 connecting cable (Page 458)

5.3.3.3 Preassembled Industrial Twisted Pair cables

General

The preassembled Industrial Twisted Pair cables use the robust 9 or 15-pin D-sub male connectors on an ITP standard cable. These cables have the supplement "ITP". These cables require end devices and network components with Industrial Twisted Pair ports.

The connection between an active network component and the end device is established with an Industrial Twisted Pair cable with a 9pin (network component end) and a 15pin D-sub connector at the end device end.

To connect two active network components, an Industrial Twisted Pair cable with two 9pin D-sub connectors is used. The two wire pairs are crossed over. Crossover cables have the additional "XP" marking (crossed pairs).

To connect two end devices to each other, an Industrial Twisted Pair cable with two 15pin D-sub connectors is used. The wire pairs are again crossed over and this cable also has the additional "XP" marking.

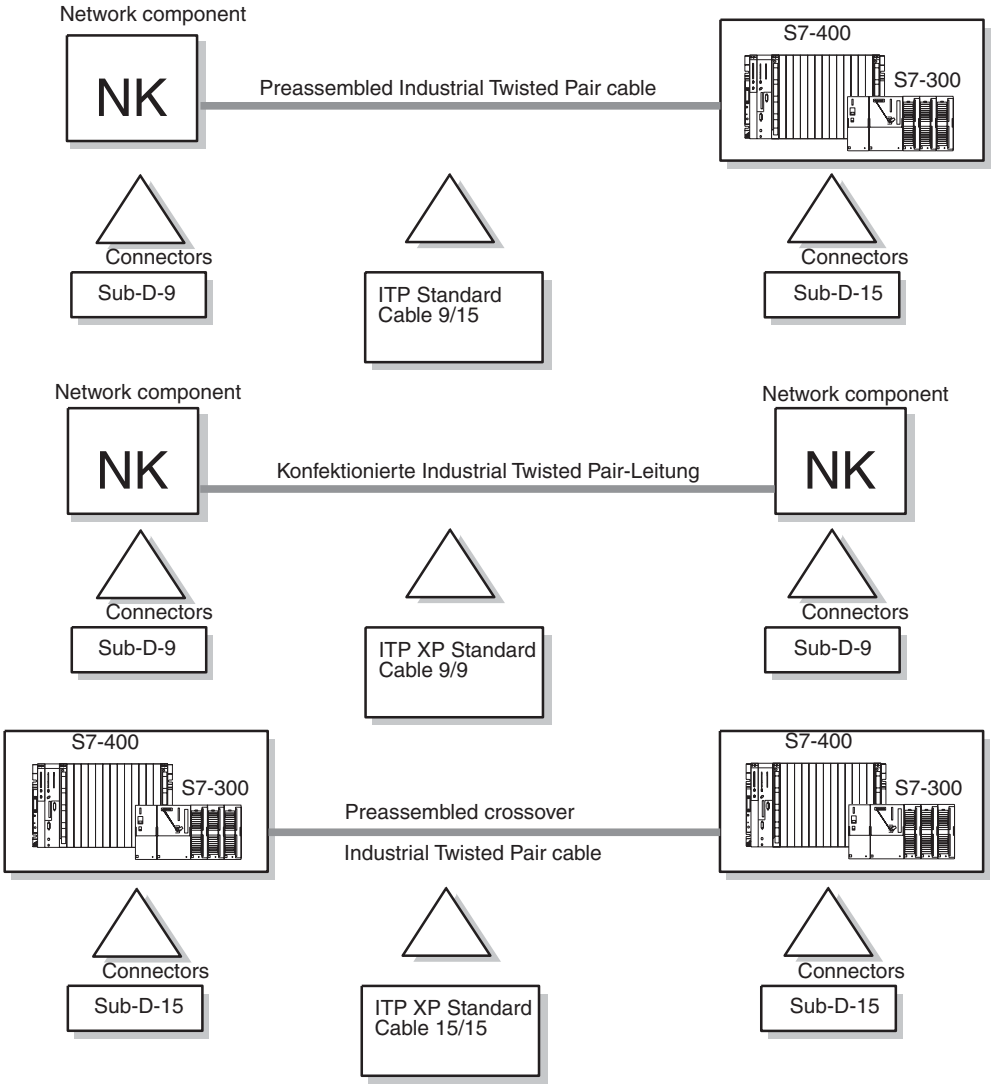


Figure 5-8 Use of preassembled Industrial Twisted Pair cables for direct connection of individual components

See also

Preassembled Industrial Twisted Pair cables (Page 459)

5.3.4 Twisted pair interface converters

General

Interface converters are used to connect an end device with an RJ-45 port to the Industrial Twisted Pair cabling system.

At one end, the interface converter has an RJ-45 plug to connect the end device, at the other end it has a 15-pin D-sub female connector with slide locking mechanism. Plug and female connector are connected by a short TP Cord. This converts the RJ-45 jack of the end device into an Industrial Twisted Pair end device interface. Double-shielded ITP standard cables up to 90 min length can be connected to the 15-pin D-sub female connector. These cables can also be installed in areas with strong EMI.

See also

Twisted pair interface converters (Page 457)

5.3.5 Cable connectors

5.3.5.1 IE FC RJ-45 Plug

General

Figure 5-9 IE FC RJ-45 Plug with IE FC TP Standard Cable

IE FC RJ-45 Plugs are compact and robust cable connectors that can be used both in an industrial environment as well as in the office world. The connectors have a robust metal casing suitable for industry that provides ideal protection from interference for the data communication.

The cable connectors allow point-to-point connections (10/100 Mbps) to be implemented for Industrial Ethernet between two end devices/network components up to 100 m without patch cables.

The Industrial Ethernet FastConnect RJ-45 Plugs allow simple and fast assembly of the Industrial Ethernet FastConnect installation cables 2 x 2 (4-wire twisted-pair cables) on site.

The Industrial Ethernet FastConnect Stripping Tool for preparing the end of a cable (stripping the jacket and shield in one step) allows simple stripping and fast fitting of the cable connector to the cable. Since the cable connector does not have any loose parts, it can be fitted in difficult conditions.

See also

IE FC RJ-45 Plug (Page 463)

5.3.5.2 IE Hybrid RJ-45 Plug

General

The IP 67 hybrid cable connector is used to connect a SCALANCE W-700 to Industrial Ethernet. In conjunction with the IE Hybrid Cable 2x2 + 4x0.34 and the IE FC RJ-45 Modular Outlet with power insert, power can also be supplied to the target device alongside the data transmission. The connection of a power supply for Power over Ethernet (PoE) is possible.

The IP 67 hybrid cable connector cannot be ordered separately. It ships with the SCALANCE W-700.

See also

IE Hybrid RJ-45 Plug (Page 466)

5.3.5.3 IE M12 Plug PRO

General

The IE M12 Plug PRO is a 4-pin, D-coded M12 male connector with degree of protection IP67. It is particularly suitable for use with devices with the relevant degree of protection such as the SCALANCE X208PRO. It can fitted to cables with an outer diameter of 6 mm to 8 mm. It is suitable for assembling IE FC cables with a transmission rate of up to 100 Mbps. This allows the IE FastConnect Stripping Tool to be used. By using the insulation piercing technique, assembly is simple and fast and requires no additional special tools.

With IE FC cable 2 x 2 and IE M12 Plug PRO, an overall cable length of up to 100 m is permitted between two devices depending on the cable type.

Figure 5-10 IE M12 Plug PRO

See also

IE M12 Plug PRO (Page 468)

5.3.5.4 IP65 plug

Overview

The previous section IE M12 Plug PRO introduced the IE M12 Plug PRO and the IE Hybrid RJ-45 Plug. These plugs are used to connect IE FC cables to IP65 devices. Power can also be supplied via the IE Hybrid RJ-45 Plug.

For devices such as the SCALANCE X208PRO, other cable connectors are required:

- The Power M12 Cable Connector PRO (female), a 4-pin M12 cable connector, A-coded, to supply the 24 V operating voltage; the power cable 2 x 0.75 is recommended as the cable.
- The Signaling Contact M12 Cable Connector PRO (female), a 5-pin M12 cable connector, B-coded, for the signaling contact.

See also

IP65 plug (Page 467)

5.3.6 Outlets

5.3.6.1 Industrial Ethernet FC Outlet RJ-45

General

The Industrial Ethernet FC Outlet RJ45 is used to implement the transition from the robust Industrial Ethernet FC TP cables used in the industrial environment to preassembled TP Cord cables using an RJ45 jack. When used with FC TP cables and preassembled TP Cords, the Industrial Ethernet FC Outlet RJ45 saves considerable time during installation.

Figure 5-11 TP Cord with FC Outlet RJ-45 (top)

Color coding prevents errors when connecting the wires. The Industrial Ethernet FC Outlet RJ45 corresponds to category 5e of the international cabling standards ISO/IEC 11801 and EN 50173.

Design

The Industrial Ethernet FC Outlet RJ45 consists of a robust metal casing. The screw-on cover ensures reliable shield contact and strain relief for the Industrial Ethernet FC cable.

The Outlet RJ45 has the following terminals:

- 4 insulationpiercing contacts for connecting the Industrial Ethernet FC cable (contacts colorcoded)
- RJ45 jack with dust protection cap for connecting various TP Cord cables.

See also

Industrial Ethernet FC Outlet RJ-45 (Page 474)

5.3.6.2 IE FC Modular Outlet

General

The IE FC RJ-45 Modular Outlet is designed for use in industry and is suitable for transmission links with data rates of 10/100/1000 Mbps according to ISO/IEC 11801 and EN 50173.

The IE FC RJ-45 Modular Outlet basic module can be equipped with various optional inserts without changing the wiring (permanent wiring):

- Insert 2 FE: Two Fast Ethernet connections for attachment of two 10/100 Mbps end devices/network components

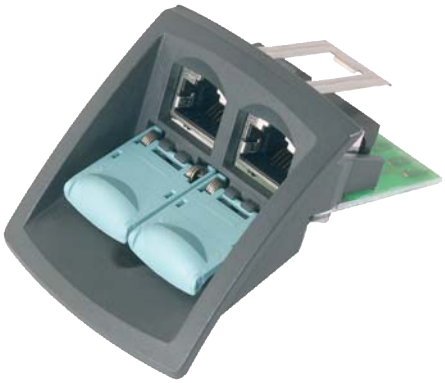


Figure 5-12 Modular Outlet 2xLAN

- Insert 1 GE: One gigabit Ethernet connection for attaching a 10/100/1000 Mbps end device/network component

Figure 5-13 Insert 1GE

- Power insert: For power supply

Figure 5-14 Modular outlet with power insert

See also

IE FC Modular Outlet (Page 470)

5.4 Components for optical networks

5.4.1 Optical transmission technology

Fiber-optic cables (FO cables)

On fiber-optic cables (FO) data is transmitted by modulating electromagnetic waves in the range of visible and invisible light. The materials used include the following:

- For high-quality FO cables: Glass fibers
- For robust FO cables: Plastic; known as POF cables
- PCF fibers with a glass core and plastic fiber cladding

A distinction is made between

- Step-index fibers and
- Graded-index fibers

Basically, the step-index fiber consists of a glass fiber surrounded by a glass tube with different refractive indices. The light used to transmit the message propagates only through the glass fiber. Simple step-index fibers have a relatively large diameter. The light launched into the glass fiber is refracted (and is no longer available for message transmission) or reflected so that it remains inside the glass fiber. Beams that are reflected often on their way to the receiver travel a greater distance than those that are reflected less often or not at all. This results in different delays. At the receiver, the edges of the coded signal become blurred. As a result, the maximum transmittable frequency and the maximum length of the fiber-optic cable are restricted.

Monomode FO cables have a very thin glass fiber with a diameter of around 10 µm and a cladding diameter 125 µm. Since the core diameter is only is only approximately 6 times the wavelength, the light propagates without blurring the edges of the coded light.

Graded-index fibers consist of many layers with the refractive index reducing from the center of the core towards the outside. The speed of propagation increases as the refractive index reduces. This means that the differences in the delay times on the possible paths through the FO cable caused by reflection are much less than in step-index fibers. The blurring of the edges of the coded light is therefore also significantly reduced so that cable lengths of several kilometers are possible at 100 Mbps depending on the wavelength of the light.

One point to note is that as the fiber diameter reduces, the more important it is to assemble connectors precisely. The actual maximum length possible with a FO cable also depends on the power loss budget resulting from the transmit and receive elements used and the attenuation of the FO cable itself including the coupling loss between the sending and receiving elements.

Only the fiber-optic cables intended for SIMATIC NET for Industrial Ethernet are described below. These are all graded-index fibers. The various FO cable types allow solutions for connecting the components with each other adapted to the operating and environmental conditions.

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

Advantages

- Electrical isolation of nodes and segments
- No grounding problems,
- No shield currents,
- Transmission path immune to external electromagnetic 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.

Point-to-point link

Fiber-optic technology only allows the implementation of point-to-point links; in other words, one transmitter is connected to only one receiver. The transmission path between two nodes therefore requires two fibers (one for each transmission direction). All SIMATIC NET standard fiber-optic cables are therefore designed as duplex cables.

Fiber diameter: 50 µm and 62.5 µm fibers

Previously not only 50 µm fibers Properties of glass FO cable 50/125 µm (Page 202) but also 62.5 µm fibers Overview of the glass fiber-optic cables 62.5/125 µm (Page 204) were widespread. In the meantime, 50 µm fibers have improved considerably and their values are in some cases better than the previous 62.5 µm fibers. For this reason, 50 µm fibers are now used in the SIMATIC NET standard FO cables. Only the SIENOPYR marine duplex FO cable still uses 62.5 µm fibers.

See also

Overview of plastic FO cable and PCF FO cable (Page 205)

5.4.2 Glass FO cables

5.4.2.1 Properties of glass FO cable 50/125 µm

Designed for Industry

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

Application

FO Standard Cable

- Universal cable for use indoors and outdoors

FO Ground Cable

- Longitudinally and laterally watertight cable for use outdoors with non-metallic rodent protection for direct underground installation

FO Trailing Cable

- Cable for use in drag chains and for high mechanical strain, PUR outer jacket, no UL approval

FO Trailing Cable GP

- Cable for use in drag chains and for lower mechanical strain, PVC outer jacket, UL approval

SIENOPYR Duplex Fiber-Optic Marine 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 50 µm core 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 structures and network configuration").

See also

Glass FO cables 50/125 (Page 481)

5.4.2.2 FO Ground Cable 50/125 µm

Application

The FO Ground Cable is a longitudinally watertight and laterally water protected cable with non-metallic rodent protection that is suitable for direct installation underground. It is suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

Properties

The FO Ground Cable has the following properties:

- UV resistant
- Silicone-free

- Suitable for direct connector assembly

It is available with and without connectors as follows:

- In meters up to 3000 m,
- With 4 BFOC connectors in lengths up to 300 m,
- With 4 SC connectors in lengths up to 300 m,
- With 2 SC duplex connectors.

5.4.2.3 Overview of the glass fiber-optic cables 62.5/125 µm

Designed for Industry

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

Application

Fiber-optic standard cable

- Universal cable for use indoors and outdoors

INDOOR fiber-optic indoor cable

- halogen-free, can be walked on, flame retardant FO cable for use in buildings

Flexible fiber-optic trailing cable

- for situations in which the cable must be capable of moving

SIENOPYR Duplex Fiber-Optic Marine 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 core 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 structures and network configuration").

See also

Glass FO cables 62.5/125 (Page 492)

5.4.2.4 Note on using preassembled glass FO cables

General

Special tools are necessary to fit connectors to glass FO cables. This should also only be performed by trained personnel. If users keep to certain rules when handling and laying preassembled glass FO cables, they can be very useful if the users do not have the personnel required for such tasks.

You will find information on handling fiber-optic cables in the sections Connecting fiber-optic cables and Laying bus cables.

When connecting cables with BFOC connectors to the devices, remember that these must be crossed over so that there is a connection between transmitter and receiver and receiver and transmitter. If the cables have SC connectors, this is guaranteed by the connector coding.

See also

Connecting fiber-optic cables (Page 559)

Laying bus cables (Page 574)

Preassembled FO cables (Page 508)

5.4.3 Overview of plastic FO cable and PCF FO cable

Properties of plastic FO cables

Plastic fibers have several properties that differ from those of glass fibers. For example, the maximum possible cable length is shorter with glass fibers due to the higher attenuation and the bandwidth is smaller.

Plastic fibers are, however, easier to work with than glass fibers and on-site connector assembly is more straightforward.

In particular when networking production cell solutions, such as when using the ET200, the maximum length of plastic cables is often not required. In such situations, plastic fibers may the ideal solution.

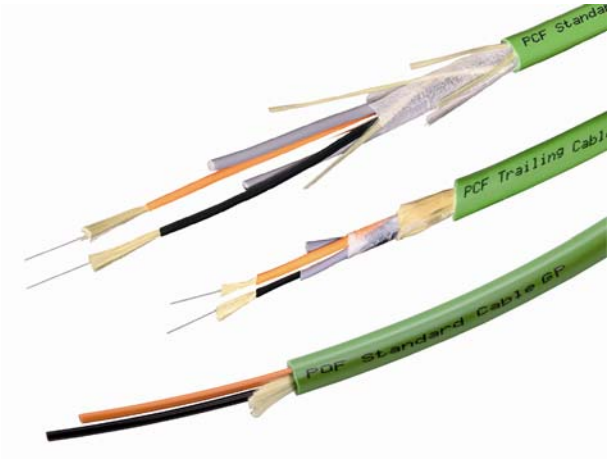


Figure 5-15 Plastic optical fiber (POF) and plastic cladded fiber (PCF) cables

Plastic FO cable also known as POF cable (Plastic Optical Fiber) can be installed with a cable length of up to 50 m. In SIMATIC NET, POF cables with a fiber diameter of 980 µm are used. PCF and POF cables work at a light wavelength of 650 nm.

If the cable length is not adequate, PCF (Plastic Cladded Fiber) can be used instead. The maximum length of a PCF cable is 100 m.

Examples of application

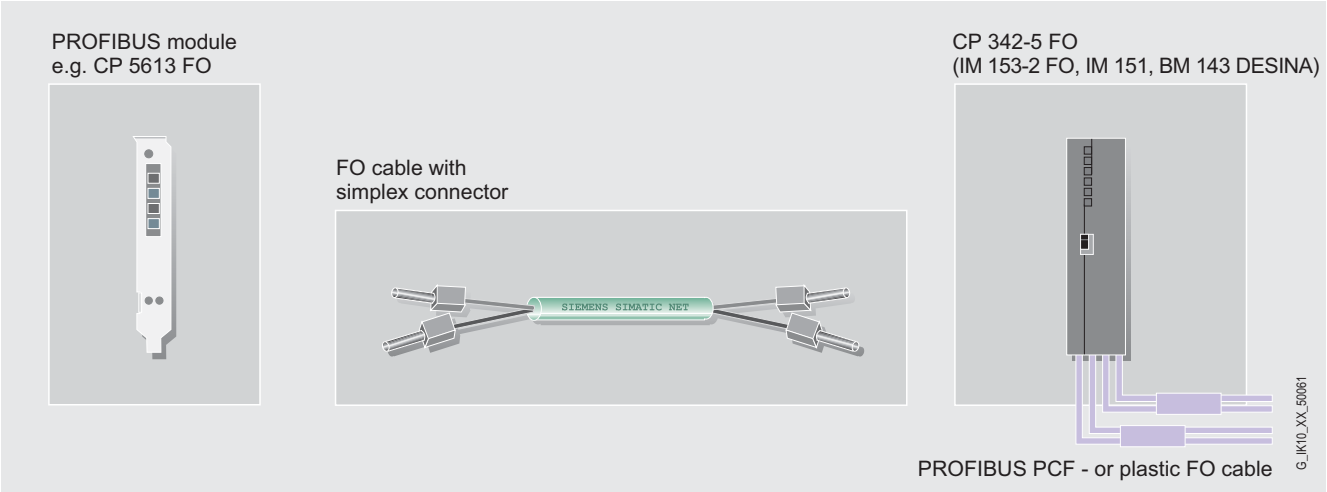


Figure 5-16 Connection example: Optical networking of two components with plastic FO cable (here in a PROFIBUS installation)

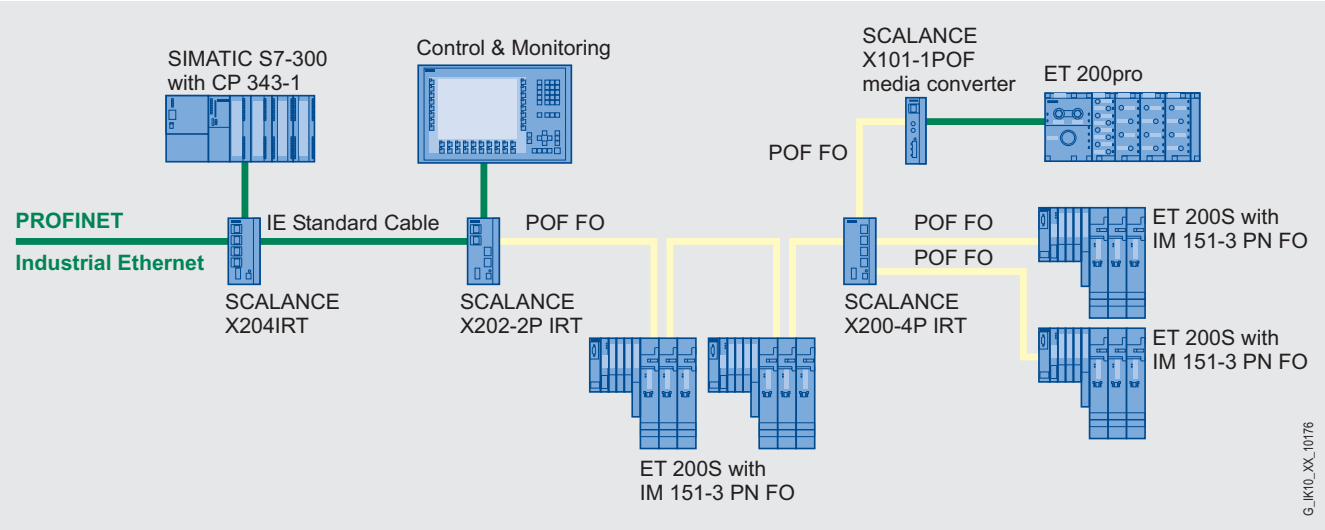


Figure 5-17 Application example: Setup of a network using POF cables in Industrial Ethernet

Available plastic FO cables

The following variants of plastic FO cables are currently available:

Cable	Installation	Use	Jacket
POF standard cable GP	Stationary	Indoor	PVC
POF trailing cable	As trailing cable	Indoor	PUR
PCF standard cable GP	Stationary	Indoors and outdoors	PVC
PCF trailing cable	As trailing cable	Indoors and outdoors	PUR
PCF trailing cable GP	As trailing cable	Indoors and outdoors	PVC

See also

Plastic FO cable POF and PCF (Page 497)

5.4.4 Special cables

Special cables

In addition to SIMATIC NET standard FO cables described in the IK PI catalog, there are numerous special cables and installation accessories available. Listing all would exceed the scope of both the catalog and this manual.

The technical specifications of the SIMATIC NET bus components contains the SIMATIC NET FO cables used as standard cables for connections and also lists additional fiber types that can be used.

Note

Remember that the distances that can be covered change if you use fibers with a different core diameter or attenuation properties from those listed as standard in the operating instructions.

See also

Contacts for special cables and special lengths (Page 185)

5.5 Components for wireless networks

5.5.1 Antennas

Antennas

Figure 5-18 Antennas for SCALANCE W

Antennas for use with SCALANCE W devices are distinguished by the following characteristics:

- *Omnidirectional antennas* emit and receive in all directions; *Directional antennas* cover greater distances and increase the link quality in environments with multiple sources of EMI interference but provide no significant area coverage.
- *Detached antennas* increase the reliability of wireless connections by optimizing the transmission and reception conditions; connection to access point/client over cable; *antennas directly on the device* allow a compact, low-maintenance design.
- Frequency band: The antennas can communicate in the 2.4 GHz band, in the 5 GHz band or in both bands.
- *RCoax leaky feeder cables* can be used in special environments as an alternative to conventional antennas.
- Antenna diversity stabilizes wireless links

The individual antenna types are as follows:

ANT795-4MR, ANT795-4MS

Figure 5-19 ANT795-4MR

Figure 5-20 ANT795-4MS

With these omnidirectional antennas, the RF field is concentrated at 2.4 GHz and 5 GHz in the vertical plane of the antenna. Both antennas have a beamwidth of 30° and an antenna again of 4 dB. They are mounted directly on the R-SMA connector on the SCALANCE W housing.

The ANT795-4MR antenna can only be turned around one axis and is normally used due to its IP65 degree of protection primarily with the SCALANCE W-788 access points and the SCALANCE W744-1PRO, W746-1PRO and W747-1PRO client modules. Two of these antennas ship with these access points or client modules.

The ANT795-4MS has an additional joint and is therefore suitable for the SCALANCE W784-1 and W784-1RR access points and the SCALANCE W744-1, W746-1 and W747-1 client modules.

ANT792-6MN, ANT793-6MN

Figure 5-21 ANT792-6MN

Figure 5-22 ANT793-6MN

With these omnidirectional antennas, the RF field is concentrated at 2.4 GHz (ANT792-6MN) and 5 GHz (ANT793-6MN) in the vertical plane of the antenna. The antennas have an antenna gain of 6 dB or 5 dB respectively.

The N-Connect connector is used that can be connected to a SCALANCE W over a variety of IWLAN extension cables. Both antennas ship with a mounting bracket that allows wall or mast mounting. This makes the antennas particularly suitable, for example, for illuminating a space with a mounting mast in the middle.

The TI795-1R terminator also ships with both antennas. This is required to terminate the radio waves of the second antenna connector on a SCALANCE W when only one antenna is being used.

ANT795-6MN, Antenna Mounting Tool (ANT795-6MN)

Figure 5-23 ANT795-6MN

With this omnidirectional antenna, the RF field is concentrated at 2.4 GHz and 5 GHz in the vertical plane of the antenna. The antenna has an antenna gain of 6 dB or 8 dB.

The N-Connect connector is used that can be connected to a SCALANCE W over a variety of IWLAN extension cables. The antenna characteristics are such that transmission properties are good even directly below or above the antenna. It is designed for roof installation but can be installed on or under a roof and is therefore suitable for mobile application, for example in an automated guided vehicle system. If it needs to be installed on ceiling below a roof, the optional antenna mounting tool (ANT795-6MN) is used.

ANT795-6DN

Figure 5-24 ANT795-6DN

This wide-angled antenna aligns the RF field at 2.4 GHz and 5 GHz.

The antenna is suitable, for example, for illuminating the space located in front of a wall.

ANT792-8DN, ANT793-8DN

Figure 5-25 ANT792-8DN

Figure 5-26 ANT793-8DN

These antennas genuinely radiate the RF field in a specific direction at 2.4 GHz (ANT792-8DN) or 5 GHZ (ANT793-8DN). Due to the restricted beamwidth, the RF field is concentrated into a narrow cone. This achieves high passive gain and long distances.

With their high passive gain, the antennas are suitable for covering long distances with IWLAN.

See also

Antennas (Page 511)

5.5.2 IWLAN RCoax Cable (leaky feeder cable)

IWLAN RCoax Cable

Figure 5-27 RCoax cable

IWLAN RCoax leaky feeder cables when operated as the antennas of SCALANCE W access points, provide a reliable wireless connection in areas in which it would be difficult to install traditional antenna technology.
The defined cone-shaped RF field that develops along the leaky feeder cable allows reliable transmission of data in all systems in which the mobile nodes move on defined paths. The IWLAN RCoax cable is therefore not subjected to wear and tear and requires little maintenance.

- Reliable illumination in areas otherwise difficult for wireless, for example in cranes, high-bay storage stackers/retrievers, transfer lines, tunnels or monorail suspension tracks
- Generation of a wedge-shaped RF field
- Low interference or mutual disturbance with low transmit power
- Cost saving by direct replacement slip rings and trailing cable
- Highly flexible application

See also

RCoax leaky feeder cable (Page 519)

5.5.3 Various WLAN accessories

Antenna cables

Figure 5-28 Antenna ANT 793-8 DR with extension cable

- Antennas are fitted with antenna cables and R-SMA connectors; as an option, an extension cable is available,
- All cables provide flame protections, are chemically resilient and silicone free. ("FRNC" cable)

Termination Impedance TI795-1R

- The cable terminator TI795-1R must be used with SCALANCE W-700 products if only one antenna is installed.

Lightning Protector LP798-1PRO

- The lightning protector LP798-1PRO expands the possible uses of separate antennas used outdoors,
- Flexible industrial use due to protection against water and dust with class of protection IP65,
- Operation outdoors with expanded temperature range,
- This accessory is suitable for use with SCALANCE W-700 including national approvals.

Power Supply PS791-1PRO

See alsoIP65 power supply (Page 224)

See also

Antennas (Page 511)

Various WLAN accessories (Page 521)

5.5.4 SINEMA E

5.5.4.1 SINEMA E

SINEMA E as planning and configuration tool

SINEMA E (SIMATIC Network Manager Engineering) is software for planning, simulating, configuring and measuring (site survey) for Industrial Wireless LAN (IWLAN) applications complying with the 802.11 a/b/g standard.

It is used for the following purposes:

- Visualization of IWLAN networks, for example according to coverage, data transfer rate, signal/noise ratio and overlapping taking into account environmental and device characteristics
- Prognosis/simulation of proposed RF fields and recording of existing RF fields (site survey)
- Configuration of individual and multiple devices as well as upload/download of IWLAN device parameters
- Integrated and expandable catalog entries for WLAN devices, antennas and wireless obstacles as well as standard graphics formats for importing floor plans
- Report function for documenting the configured IWLAN environment and device properties

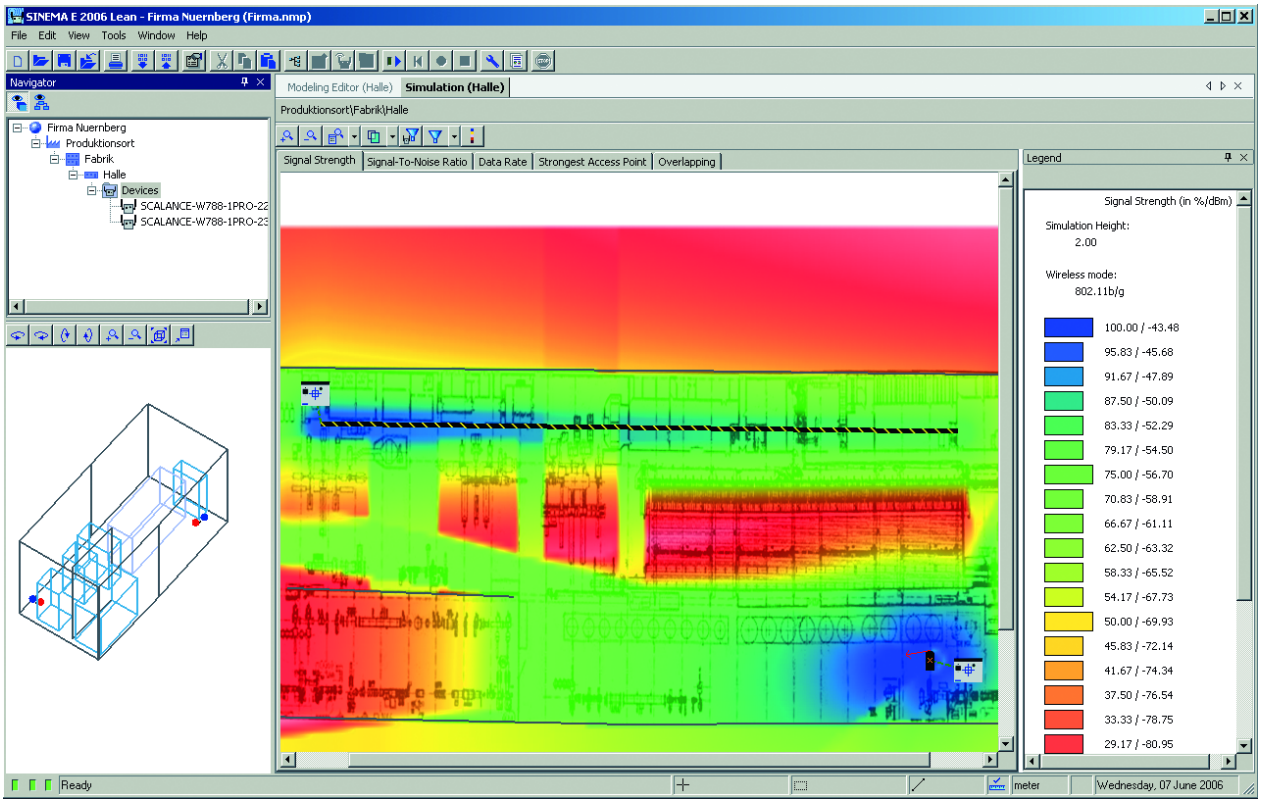


Figure 5-29 Sinema Lean 2006 screenshot

A whole range of customer benefits

SINEMA E brings many benefits to the customer in all phases of network planning and commissioning:

- Simplified planning and configuration of IWLAN applications with the aid of simulation functions
  - to detect the number, location and parameters of the IWLAN devices
  - for industrial and office environment including outdoor areas
  - for specialists and first time users, for example creating offers with the Sales Wizard
- Clear and detailed visualization of wireless and device properties
- Minimization of the configuration and commissioning effort with grouped configuration and online functions and support during initial commissioning
- Reduction of configuration errors with integrated validation function
- Reports for creating offers, device installation instructions and plant documentation
- Flexible and open architecture for the integration of further WLAN devices (according to 802.11 a/b/g/h standard) for modeling and simulation of obstacles that could influence the RF illumination

Versions "Lean" and "Standard", along with "PowerPack" license

SINEMA E is marketed in a "Lean" and a "Standard" version. Compared with the "Lean" version, the "Standard" version provides an expanded range of functions.

Along with the two versions, a "PowerPack" license is also available with which a "Light" version can be upgraded to the "Standard" version.

See also

Expanded functions of SINEMA E Standard (Page 221)

SINEMA E (Page 522)

5.5.4.2 SINEMA E application

Use of SINEMA E in the planning and configuration phase

SINEMA E is the generic term for the engineering of network products such as SCALANCE W.

The SINEMA E software application includes the following functions for engineering IWLAN networks:

- Offer phase
  - Simple Sales Wizard
  - Report on creation of offer
- Planning, simulation and configuration
  - Planning and simulation of a WLAN Infrastructure

  - Simultaneous configuration of device groups
  - Acquisition of an existing RF field (site survey)
  - Creation of a report with installation rules
- Central detection, upload/download and modification of device parameters
- Report for completion documentation
- Measures if faults occur or service is necessary

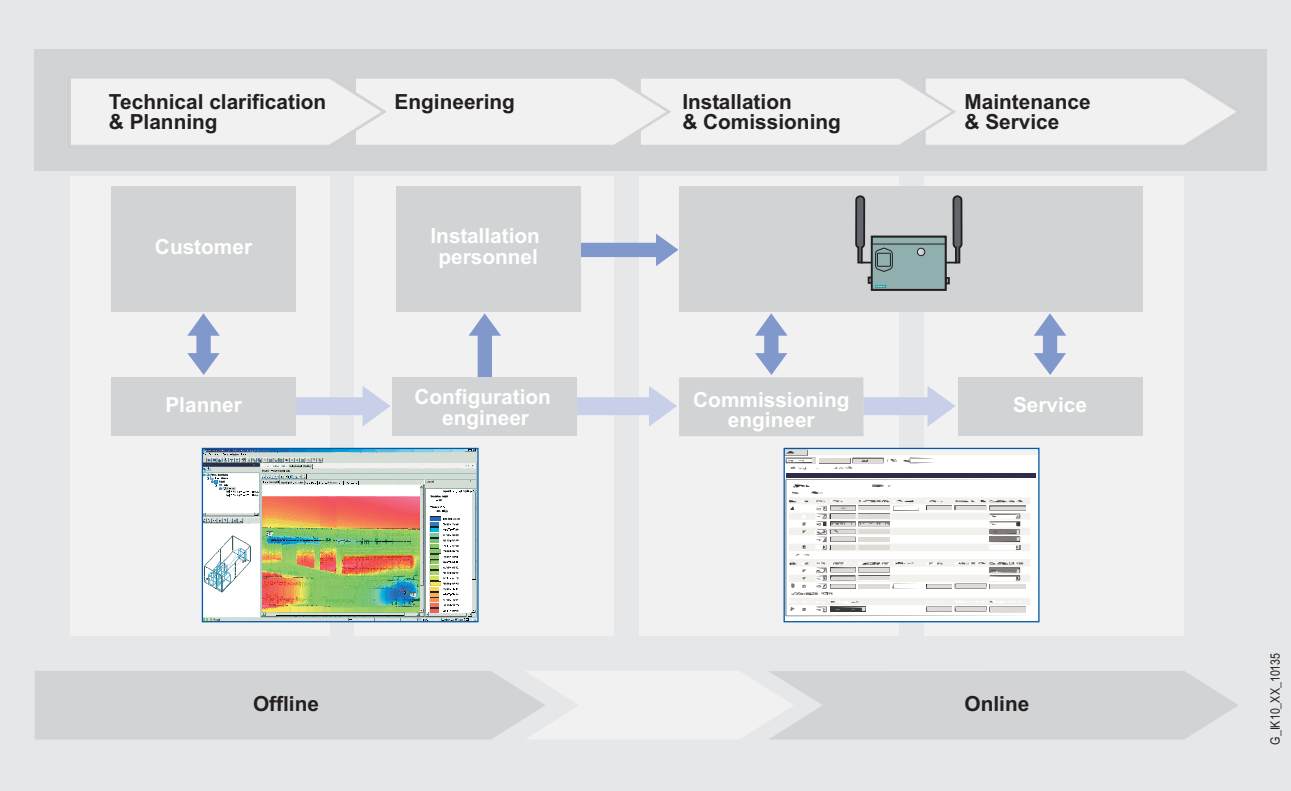


Figure 5-30 Schematic representation of the use of SINEMA E

5.5.4.3 Range of functions of SINEMA E

Modeling the environment and the RF field

To achieve the simulation, the user models the environment within which the WLAN will be set up. This includes walls, windows, doors, ceilings and flooring of the building for which the thickness, composition etc. can be taken into account as well as larger obstacles such as machines.

In a later step, the active components are placed in position; in other words, the access points and clients within the modeled office or industrial environment.

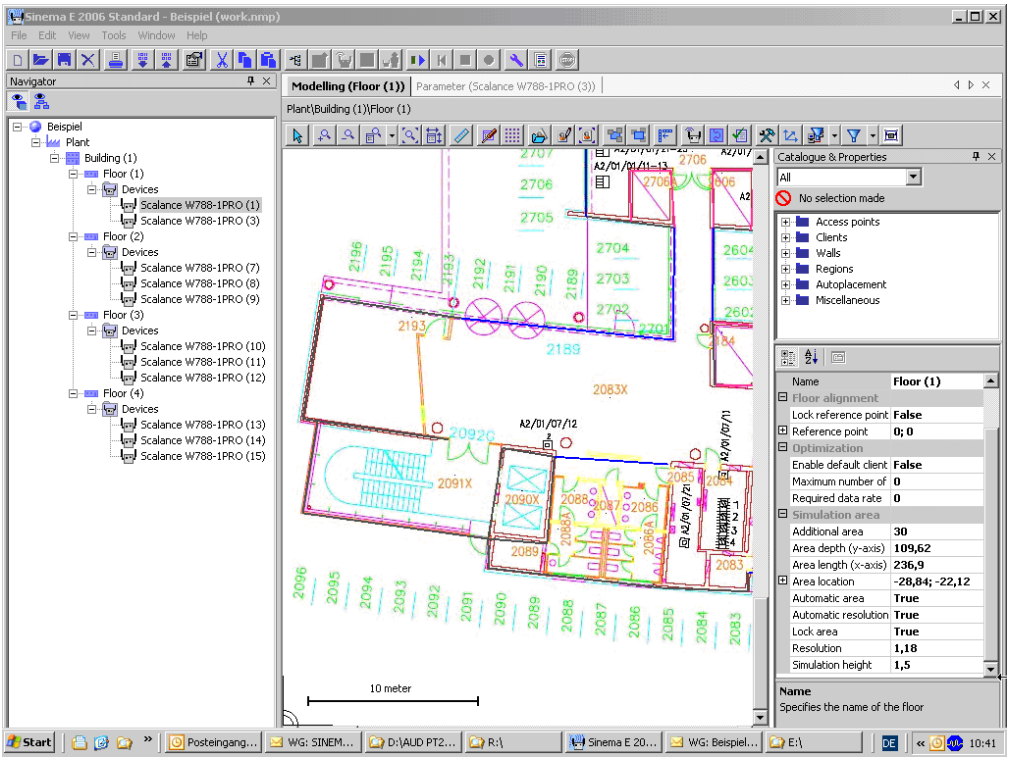


Figure 5-31 SINEMA E in the modeling phase

Above, you can see a screenshot of the SINEMA E application showing the modeling of a building. The simulation acquires a three-dimensional arrangement of the building parts and equipment as well as the active and passive components of the wireless network.

Devices, antennas and wireless obstacles can be selected from a component catalog and adapted to the actual situation. The simulation that follows soon provides the configuration engineer with a picture of the signal qualities that can be expected in individual configured areas. An integrated consistency check ensures the validity of the configuration and reduces possible errors before the network is installed.

With the graphic user interface, even complex environments can be simulated with little effort.

Simulation of the resulting RF field

Based on the access points and clients distributed in the modeled building by the user, SINEMA E simulates the resulting RF field and displays it graphically so that the user can see at a glance whether the illumination and data rate of the wireless cell are adequate. The frequency of the transmitters used and the characteristics of the antennas or RCoax cables are also taken into account.

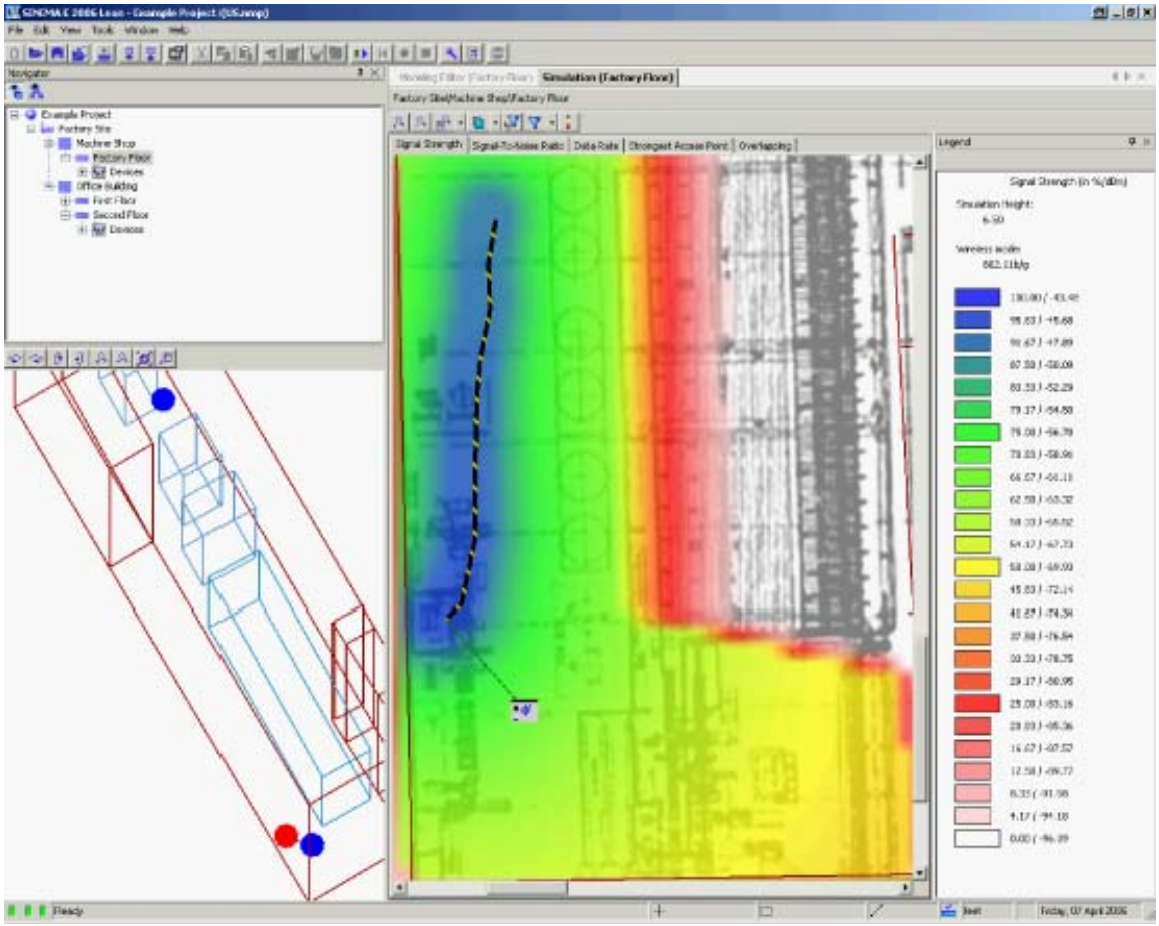


Figure 5-32 SINEMA E simulation

In the area configured in the previous step, the expected signal strengths are calculated for each point and represented in a pseudo color image.

Three-dimensional evaluation of indoor and outdoor areas

The simulation is three-dimensional and therefore allows evaluation of the effects of ceilings and floorings and the transmission characteristics over several floors. SINEMA E is not restricted to the interior of office or industrial premises but can also be used in outdoor areas. This is relevant, for example, to evaluate possible wireless leaks outside the buildings or the connection between two buildings.

Product catalogs

This simulation is made particularly user-friendly by the comprehensive product catalogs supplied with the tool. These allow simulated hardware based on SIEMENS own products and third-party products to be included in the simulation. Modules shown with a precise list of their technical characteristics are simply taken from the catalog and placed in the simulated building.

The catalog can also be expanded by the customer to include new models and functionalities.

In the simulation mode shown above, a building floorplan can be seen with RF fields generated by several access points. The signal strengths achieved at various points in the room are shown by different color intensities.

Note how the geometry of the room (for example the corridor bottom center) is also taken into account and included in the realistic prognosis.

Report module

A report module is integrated in both the simulation and diagnostics functions of both SINEMA E versions, Lean and Standard.

Based on the configuration that develops through the stages of simulation, this generates a parts list including the ordering data of all the devices used from the module catalog. This simplifies the creation of an offer, planning and cost predictions for a project.

When setting up the wireless network, the coordinates at which the individual devices should be installed can also be taken from the report. This simplifies fast, problem-free and reliable installation of the individual components.

The report also contains the simulations performed in the form of informative graphics containing the signal strength and data rate along with interference. This report is therefore also the acceptance document for commissioning and can be used in questions involving warranties and service situations.

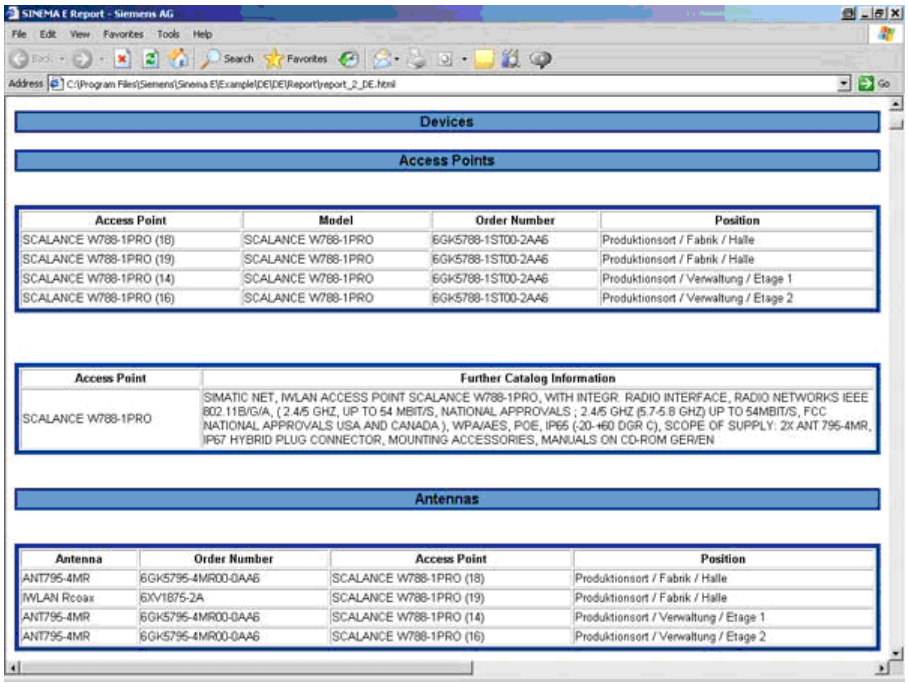


Figure 5-33 SINEMA E screenshot of the generated report

Other properties

Using the materials/regions builder, a further component of the SINEMA E module, complex obstacles and other building parts (such as large transformers or turbines) can be measured as they stand, stored and then used in the current or future simulations.

This avoids unnecessary repetitions of time-consuming measurements and allows user-specific libraries of wireless obstacles and their precise geometries and characteristics to be created.

5.5.4.4 Expanded functions of SINEMA E Standard

"Lean" and "Standard"

The functions described above are available in both SINEMA E versions. The standard version also has two useful additional functions: "Autoplacement" and the "Site Survey".

"Autoplacement": Automatic optimization

After configuring the environment, a further step is available in which SINEMA E itself attempts to find the optimum location for the access points: Once configuration of the building geometry is completed and the areas of the building that must at all events be covered by the WLAN have been defined, SINEMA E then calculates the optimum (and resource-saving) positioning of the individual access points.

"Site Survey" mode: Analysis and diagnostics of existing networks

SINEMA E is also a complete tool for measuring (site survey) existing WLAN networks according to the 802.11 a/b/g/h standard. This means that WLAN signals can be measured at the start of planning or for verification during commissioning and then later for troubleshooting during maintenance or service work.

The software stores and links received measured values of the WLAN adapter in use along with the coordinates in the floorplan. Depending on the application, various methods are available for measurement and evaluation. With the standard measurement method, the WLAN adapter used for the measurement is always connected to a previously defined WLAN (SSID). Properties such as speed, signal strength and roaming behavior of this existing client-access point connection are recorded. With continuous measurements along a path, it is adequate to simply set a start and end point; all other measurement coordinates are then determined automatically by the software. This allows the WLAN connection properties of a client to be measured quickly even when large areas are involved.

Using the Advanced measurement method, on the other hand, all WLAN signals in the environment are scanned to acquire signals from known and unknown devices. To analyze and display the measurement results, there is a wide range of filter functions available, such as minimum, maximum, average value etc.

5.6 Accessories

5.6.1 Accessories for SCALANCE X-400 switches

Covers, and dummy cover, terminal set

The protective caps for the media module terminal strips and the covers must be fitted in all slots that do not contain media modules.

For slots for twisted pair (9 through 11), the covers are recommended to protect the RJ-45 jacks.

Due to the varying availability of of RJ-45 connectors and the resulting numbers of LEDs and their significance, there are covers available with different labeling to suit the situation.

Table 5-2 Overview of the use of covers and dummy cover

	Slot	Labeling for / Cover suitable for
CV490 2x1000	SCALANCE X414-3E: 5	Gigabit ports
CV490 2x100	SCALANCE X414-3E: 6, 7 Extender EM496-4: 12 - 15	Media module slots
CV490 4x100	SCALANCE X414-3E: 9 - 11 Extender EM495-8: 12, 13	Fast Ethernet port
CV490 COVER	SCALANCE X414-3E: 8	Slot without function

The various covers cannot be ordered individually. They are available as a complete set for a SCALANCE X414-3E. There is also a terminal set consisting of ten 4-wire and ten five-wire terminals.

Table 5-3 Order numbers for accessories

	Order number
SCALANCE X400 cover set	6GK5490-0AA00-0AA2
Terminal set	6GK5498-0AA00-0AA0

5.6.2 C-PLUG configuration memory

Application

Figure 5-34 C-PLUG

The C-PLUG is an exchangeable medium for storage of the configuration and project engineering data of the basic device. This means that the configuration data remains available if the basic device is replaced. It is therefore used when the replacement of network components or communications modules needs to be quick if a fault occurs without needing to configure a replacement and without needing specialist personnel. Downtimes of network segments and connected Industrial Ethernet nodes can therefore be minimized if a fault occurs.

It can be used in all SIMATIC NET products with a C-PLUG slot.

Design

The C-PLUG has degree of protection IP20. With IP65 components, the degree of protection is retained because the C-PLUG is installed inside the protected housing.

Power is supplied by the host device. The C-PLUG retains all data when the power is turned off.

Function

If an empty CPLUG (as supplied) is inserted in a SIMATIC NET component, the device automatically backs up the configuration data during startup. Changes to the configuration during operation are also saved on the C-PLUG without any additional operator intervention being necessary.

When an unconfigured device starts up, it automatically adopts the configuration data of an inserted C-PLUG assuming the data was written by a compatible device type.

The C-PLUG can also be used to store application data such as documentation or Web pages.

Diagnostics

Incorrect use of the C-PLUG, such as inserting a C-PLUG containing the configuration of a different device group or general malfunctions of the C-PLUG are indicated by diagnostics mechanisms of the host device (LEDs, PROFINET, SNMP, Web based Management, etc.).

See also

C-PLUG configuration memory (Page 525)

5.6.3 IP65 power supply

Power supply PS791-1PRO

- AC/DC power supply unit for input voltages from 90 to 265 V AC,
- Water and dust protection with robust metal housing to IP65,
- Can be used with all SCALANCE products,
- Redundant power supply possible.

To connect the M12 socket X2 with the SCALANCE products X788 and X744 and the SCALANCE X208PRO, the M12 power cord supplied with the products can be used. As an alternative, a user-assembled cable can also be used.

Figure 5-35 PS791-1PRO

See also

IP65 power supply (Page 526)

IE M12 Plug PRO (Page 468)

Part C:

Target group and content

This part is intended for configuration and commissioning engineers.

Here, you will find a wide range of reference data that you will require during the planning and commissioning of a system. The document contains dimension drawings, specifications, certifications and much more helpful information on SIMATIC NET components that will support you when setting up an actual plant or network.

Validity of the information

Note

Please note that the data provided here is only intended to give you general information.

Our products are in constant development and the specifications and reference data may change in the course of this development. Despite all our efforts, it is possible that individual items of information in this networking manual are out of date.

You will find the continuously updated data in the product manuals of the individual devices.

Part C: SCALANCE X switches and media converters

6

6.1 Basic information on the use of SCALANCE X devices

6.1.1 General information on the use of SCALANCE X devices

Note the following information and warnings relating to the SCALANCE X switches and media converters:

Note

The requirements of EN61000-4-5, surge test on power supply lines are met only when a Blitzductor VT AD 24V type no. 918 402 is used

Manufacturer:
DEHN+SÖHNE GmbH+Co.KG Hans Dehn Str.1 Postfach 1640 D-92306 Neumarkt, Germany

⚠ WARNING

When used under hazardous conditions (zone 2), the devices of the SCALANCE X-100/X-200/X-300 and X-400 product lines must be installed in an enclosure.

To comply with ATEX100a (EN 60079-15), this enclosure must meet the requirements of at least IP54 in compliance with EN 60529.

WARNING – EXPLOSION HAZARD: DO NOT DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.

6.1.2 General information on approvals and certifications

Please note the following:

Note

The approvals specified for the individual products apply only when the corresponding mark is shown on the product. You can check which of the various approvals have been granted for your product by the markings on the type plate.

CE mark

SIMATIC NET SCALANCE X Industrial Ethernet switches meet the requirements and aims of the following EU directives and comply with the harmonized European standards (EN) for programmable logic controllers published in the Official Journal of the European Communities:

- Directive 89/336/EEC "Electromagnetic Compatibility" (EMC Directive)
- Directive 73/23/EEC "Electrical Equipment Designed for Use within Certain Voltage Limits" (Low Voltage Equipment Directive)
- Directive 94/9/EEC Equipment and Protective Systems intended for Use in Potentially Explosive Atmospheres (Explosion Protection Directive).

The EC Declarations of Conformity are available for the responsible authorities according to the above-mentioned EC Directive at the following address:

Siemens Aktiengesellschaft
Bereich Automatisierungs- und Antriebstechnik
Industrielle Kommunikation SIMATIC NET
Postfach 4848

D-90327 Nürnberg, Germany

6.1.3 Common connector pin assignments of SCALANCE X devices

Common connector pin assignments of SCALANCE X devices:

Some of the connector pin assignments are the same on all SCALANCE X devices with the following exceptions:

- The SCALANCE X005 does not have a signaling contact and has a single non-redundant power supply connector.
- On the SCALANCE X-100 media converters, the terminal blocks for the signaling contact and power supply connectors are arranged directly one above the other. The pin assignment is, however, as described below.
- Due to its higher degree of protection, the SCALANCE X208PRO is equipped with M12 sockets.

- On the SCALANCE X-400, the signaling contact is connected by contacts MK1 and MK2 on the 4-pin connector on the rear terminal block on the power module.

You should also refer to the operating instructions of the individual devices in question.

Pin assignment of the RJ-45 connectors:

On the SCALANCE devices, the IE TP ports are implemented as RJ-45 jacks with MDI-X assignment (Medium Dependent Interface–Autocrossover) of a network component.

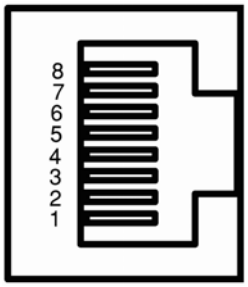


Figure 6-1 RJ-45 jack

Table 6-1 Pin assignment of the RJ-45 jack

Pin number	Pin assignment of 10/100BaseTX	Pin assignment of the gigabit Ethernet ports
Pin 8	n. c.	3-
Pin 7	n. c.	3+
Pin 6	TD-	1-
Pin 5	n. c.	2-
Pin 4	n. c.	2+
Pin 3	TD+	1+
Pin 2	RD-	0-
Pin 1	RD+	0+

Pin assignment of the power supply connectors:

The power supply is connected using a 4-pin plug-in terminal block. The power supply can be connected redundantly. Both inputs are isolated. If there is a voltage difference greater than 1 V, there is no load distribution between the two external power supplies. When a redundant power supply is used, the power supply unit with the higher output voltage supplies the SCALANCE alone. The power supply is connected over a high resistance with the enclosure to allow an ungrounded set up. The two power supplies are non-floating.

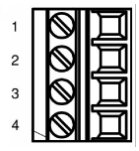


Figure 6-2 IP30 power supply

Table 6-2 Pin assignment of the power supply terminals

Pin number	Assignment
Pin 1	L1+ 24 V DC
Pin 2	M1
Pin 3	M2
Pin 4	L2+ 24 V DC

Pin assignment of the signaling contact:

When present, the signaling contact is connected to a 2-pin plug-in terminal block. The signaling contact (relay contact) is a floating switch with which error/fault states can be signaled by breaking the contact.

Figure 6-3 IP30 signaling contact

Table 6-3 Pin assignment of the signaling contact terminal

Pin number	Assignment
Pin 1	F1
Pin 2	F2

- The connection is different for SCALANCE X-400 devices: The connection is made here by contacts MK1 and MK2 on the 4-pin connector to the rear terminal block on the power module.

Among other things, the following errors/faults can be signaled by the signaling contact:

- The failure of a link at a monitored port,
- The failure of one of the two redundant power supplies (if present),
- C-PLUG faults and linkdown.

The connection or disconnection of a communication node on an unmonitored port does not lead to an error message. The signaling contact remains activated until the error/fault is eliminated or until the current status is applied as the new desired status using the button.

When the device is turned off, the signaling contact is always activated (open).

Other error/fault messages are listed in the sections on functions in the descriptions of the SCALANCE devices.

See also

IE M12 Plug PRO (Page 468)

6.2 SCALANCE X005

6.2.1 Certifications and approvals, degree of protection X005

Certifications:

Table 6-4 Approvals

	SCALANCE X005
c-UL-us	UL 60950-1; CSA C22.2 No. 60950-1
C-Tick	AS/NZS 2064 (Class A)
CE	EN 61000-6-2; EN 61000-6-4

Degree of protection

Tested to IP30.

See also

General information on approvals and certifications (Page 230)

6.2.2 Installation instructions and guidelines X005

Installation as for SCALANCE X-100

The switches are installed in the same way as the SCALANCE X-100 devices.

Note the following however

- The shape factors of the devices differ,
- The signaling contact connector is not present on the SCALANCE X005 switches,
- Power is supplied via a non-redundant two-pin terminal block.

See also

X-100 installation instructions and guidelines (Page 237)

6.2.3 Operator control and display elements of the X005

Display elements

The status of the power supply is indicated by a green LED. It is lit green when an operating voltage between 18 V and 32 V is connected.

The status of the communication ports is indicated by five LEDs, one per port:

Table 6-5 Port status display

Status	Meaning
Ports 1 to 5: LED lit green	TP link exists, no data reception
Ports 1 to 5: LED lit yellow	TP link exists, data received at TP port
Ports 1 to 5: LED flashes yellow	Test phase during power on

Operator controls

The SCALANCE X005 does not have any operator controls.

6.2.4 Connector pin assignments X005

Connector pin assignments

The connector pin assignment of the SCALANCE X005 is the same as on the other SCALANCE-X devices with two exceptions:

- The SCALANCE X005 does not have a signaling contact,
- The power supply is not redundant but in the form of a two-pin plug-in terminal block. (See below)

Connecting the power supply

Figure 6-4 Pin assignment of the two-pin plug-in terminal block for the power supply

Pin	Assignment
1	M (chassis ground)
2	L+ (+18 -- +32 V DC)

See also

Common connector pin assignments of SCALANCE X devices (Page 230)

6.2.5 Dimension drawing X005

Dimension drawing SCALANCE X005

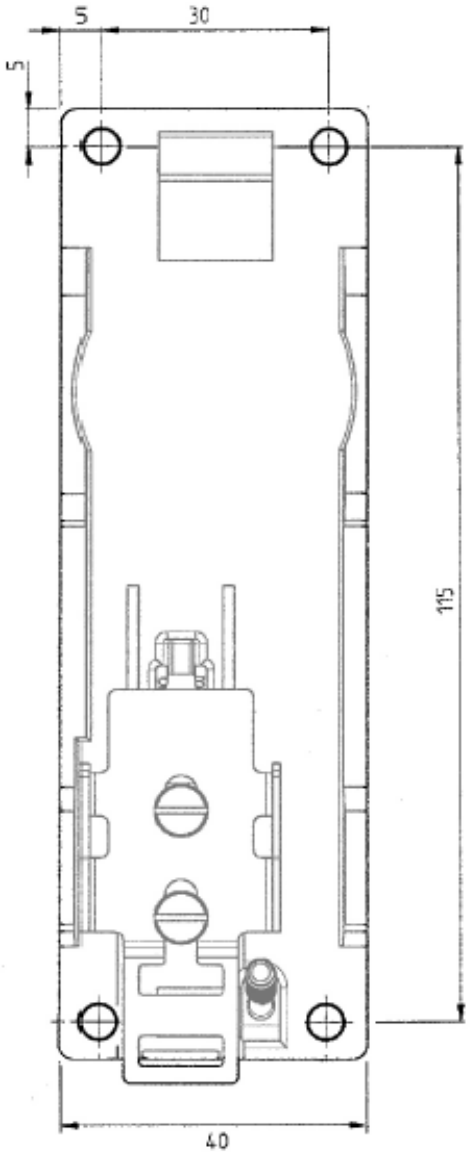


Figure 6-5 Drilling template SCALANCE X005

6.2.6 X005 technical specifications

Technical specifications of the SCALANCE X005

Table 6-6 Electrical data

	SCALANCE X005
Power supply	24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)
Power loss at 24 V DC	2 W
Current consumption at 24 V DC	80 mA
Overvoltage protection at input	PTC resettable fuse (0.5 A / 60 V)
Transmission rate	10/100 Mbps
Aging time	375 seconds
Emission	EN 61000-6-4 EN 61000-6-3 with snap ferrite on the cables Manufacturer: Würth Elektronik - type: 742 711 31
Immunity	EN 61000-6-2
MTBF	167.1 years

Table 6-7 Environmental conditions

	SCALANCE X005
Operating temperature	0 °C - +65 °C
Storage/transport temperature	-40 °C - +80 °C
Relative humidity in operation	< 95% (no condensation)
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature

Table 6-8 Mechanical data

	SCALANCE X005
Dimensions (W x H x D) mm	40 x 125 x 124
Weight	550 g
Installation options	• DIN rail • S7-300 standard rail • Wall mounting

Table 6-9 Order number

SCALANCE X005	6GK5005-0BA00-1AA3

6.3 SCALANCE X-100

6.3.1 Certifications and approvals, degree of protection X-100

Certifications

	SCALANCE X104-2, SCALANCE X106-1 and SCALANCE X108
c-UL-us	UL 60950-1; CSA C22.2 No. 60950-1
c-UL-us for hazardous locations	UL 1604, UL 2279Pt.15
FM	FM 3611
C-Tick	AS/NZS 2064 (Class A)
CE	EN 61000-6-2, EN 61000-6-4
ATEX Zone 2	EN 50021 [1])

[1]) For temperature information "T.." or the maximum ambient temperature "Ta:...", refer to the type plate.

Degree of protection

Tested to IP30.

See also

General information on approvals and certifications (Page 230)

6.3.2 X-100 installation instructions and guidelines

6.3.2.1 Installation on a DIN rail

Assembly

Install the Industrial Ethernet switches of the SCALANCE X-100 product line on a 35 mm rail according to DIN EN 50022.

1. Place the upper catch of the device over the top of the DIN rail and then push in the lower part of the device against the rail until it clips into place.
2. Fit the connectors for the power supply.
3. Fit the connectors for the signaling contact.
4. Insert the terminal blocks into the sockets on the device.

Figure 6-6 SCALANCE X-100 installation on a DIN rail (35 mm)

Uninstalling

To remove the Industrial Ethernet switches of the SCALANCE X-100 product line from the DIN rail:

1. First disconnect all connected cables.
2. Use a screwdriver to release the lower DIN rail catch of the device and pull the lower part of the device away from the rail.

Figure 6-7 SCALANCE X-100 removing from a DIN rail (35 mm)

6.3.2.2 Installation on a standard rail

Installation on a SIMATIC S7-300 standard rail

1. Place the upper guide at the top of the SCALANCE housing in the S7 standard rail.
2. Screw the Industrial Ethernet switches of the SCALANCE X-100 product line to the underside of the S7 standard rail.
3. Fit the connectors for the power supply.
4. Fit the connectors for the signaling contact.
5. Insert the terminal blocks into the sockets on the device.

Figure 6-8 SCALANCE X-100 installation on a SIMATIC S7-300 standard rail

Uninstalling

To remove Industrial Ethernet switches of the SCALANCE X-100 product line from the SIMATIC S7-300 standard rail:

1. First disconnect all connected cables.
2. Loosen the device screws on the underside of the S7 standard rail and lift the device away from the rail.

6.3.2.3 Wall mounting

Wall mounting

1. For wall mounting, use suitable mounting fittings for the wall (for example, for a concrete wall, four plugs 6 mm diameter and 30 mm long, 4 screws 3.5 mm diameter and 40 mm long).
2. Connect the electrical cable connecting cables.
3. Fit the connectors for the signaling contact.
4. Insert the terminal blocks into the sockets on the device.

For more exact dimensions, please refer to the section "Dimension drawings".

Note

The wall mounting must be capable of supporting at least four times the weight of the device.

6.3.2.4 Grounding

Installation on a DIN rail

The device is grounded over the DIN rail.

S7 standard rail

The device is grounded over its rear panel and the neck of the screw.

Wall mounting

The device is grounded by the securing screw in the unpainted hole.

Please note that the SCALANCE X-100 must be grounded over one securing screw with minimum resistance.

If a device of the SCALANCE X100 product line is mounted on a non-conducting base, a grounding cable must be installed. The grounding cable is not supplied with the device. Connect the paint-free surface of the device to the nearest grounding point using the grounding cable.

6.3.3 X-100 operator controls and displays

6.3.3.1 SCALANCE X-100 button

What does the button do?

Using the button, you can display and modify the set fault mask. The fault mask setting is retained after device power off/on.

After pressing and holding down the button, the currently valid fault mask is displayed for approximately 3 seconds. The LEDs of the monitored ports flash at a frequency of 5 Hz.

To change the fault mask, keep the button pressed. Within the next 3 seconds, the current link status of the ports is displayed flashing at a frequency of 2.5 Hz. Keep the button pressed. This new status is adopted as the new fault mask. The monitored ports now are indicated by permanently lit LEDs until the button is released. As long as the LEDs are still flashing, however, the saving of the mask can be stopped by releasing the button.

If an empty fault mask is set (no port is monitored), the two neighboring port LEDs flash on and off alternately. To create an empty fault mask when you save as described above, the port cables must not be connected.

At the same time, the monitoring of the connected power supplies is set with the fault mask. The existence of the two power sources is monitored only if they are connected when the fault mask is saved.

The failure of the link of one of the monitored ports or one of the monitored power supplies is indicated by the red fault LED lighting up. At the same time, the signaling contact opens.

Note

Port monitoring and power supply monitoring are not activated when the device is delivered (factory default).

6.3.3.2 Fault indicator (red LED)

Fault indicator (red LED)

If the red LED is lit, the SCALANCE X-100 has detected a problem.
The signaling contact opens at the same time.

The LED signals that the device can adopt the following statuses:

Device type SCALANCE	LED lit red	LED not lit
X104-2	1, 2	4
X106-1	1, 2	4
X108	1, 2	4
X112-2	1, 2, 3	4
X116	1, 2, 3	4
X124	1, 2, 3	4

1. Link down event on a monitored port.
2. Loss of one of the monitored power supplies or voltage dropped below approximately 14 V. Refer also to Section ..
3. Both supply voltages are below approximately 14 V (reduced voltage)
4. No fault detected by the SCALANCE X-100.

6.3.3.3 Power display

Power display

The LEDs signal that the device can adopt the following statuses:

The status of the power supply is indicated by two green LEDs or one green/yellow LED:

Device type SCALANCE	Green LED lit	LED not lit
X104-2	1	2
X106-1	1	2
X108	1	2
X112-2	1	2
X116	1	2
X124	1	2

1. Power supply L1 or L2 is connected.
2. Power supply L1 and/or L2 not connected or <14 V.

6.3.3.4 Port status indicator (green/yellow LEDs)

Port status indicator (green/yellow LEDs)

The LEDs signal that the device can adopt the following statuses.
The status of the interfaces is indicated by two-color LEDs:

Device type SCALANCE		LED lit green	LED lit yellow	LED flashes yellow
	Number of port LEDs			
X104-2	6 port LEDs	1	2	3
X106-1	7 port LEDs	1	2	3
X108	8 port LEDs	1	2	3
X112-2	14 port LEDs	1	2	3
X116	16 port LEDs	1	2	3
X124	24 port LEDs	1	2	3

1. TP link exists, no data reception.
2. TP link, data received at TP port.
3. Setting or display of the fault mask.

6.3.4 Connector pin assignments

6.3.4.1 Power supply

Power supply

The power supply is connected using a 4-pin plug-in terminal block.

The power supply can be connected redundantly. Both inputs are isolated. There is no distribution of load. When a redundant power supply is used, the power supply unit with the higher output voltage supplies the device alone. The power supply is connected over a high resistance with the enclosure to allow an ungrounded set up. The two power supplies are non-floating.

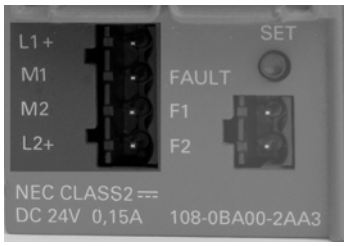


Figure 6-9 Power supply SCALANCE X-100

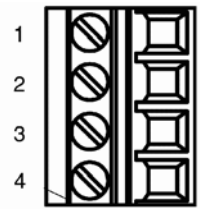


Figure 6-10 Terminal block, four-pin

Table 6-10 Pin assignment for the power supply

Pin number	Assignment
Pin 1	L1+ 24 V DC
Pin 2	M1
Pin 3	M2
Pin 4	L2+ 24 V DC

⚠WARNING

The device is designed for operation with safety extra-low voltage. This means that only safety extra-low voltages (SELV) complying with IEC950/EN60950/ VDE0805 can be connected to the power supply terminals.

The power supply unit for the device power supply must meet NEC Class 2, as described by the National Electrical Code(r) (ANSI/NFPA 70).

The power of all connected power supply units must total the equivalent of a power source with limited power (LPS limited power source).

If the device is connected to a redundant power supply (two separate power supplies), both must meet these requirements.

The signaling contact can be subjected to a maximum load of 100 mA (safety extra-low voltage (SELV), 24 V DC).

Never connect the device to AC voltage.
Never operate the device with DC voltage higher than 32 V DC.

6.3.4.2 Signaling contact

Signaling contact

The signaling contact (relay contact) is a floating switch with which error/fault states can be signaled by breaking the contact.

The signaling contact is connected to a 2-pin plug-in terminal block.

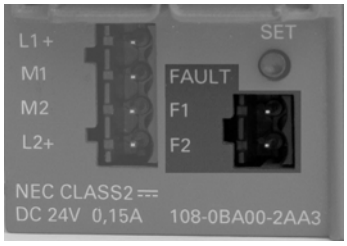


Figure 6-11 Signaling contact SCALANCE X-100

Figure 6-12 Terminal block, two-pin

Table 6-11 Pin assignment of the signaling contact

SCALANCE X-100	
Pin number	**Assignment**
Pin 1	F1
Pin 2	F2

The following errors/faults can be signaled by the signaling contact:

- The failure of a link at a monitored port.
- The failure of one of the two monitored power supplies.

The connection or disconnection of a communication node on an unmonitored port does not lead to an error message.

The signaling contact remains activated until the error/fault is eliminated or until the current status is applied as the new desired status using the button.

When the device is turned off, the signaling contact is always activated (open).

6.3.5 SCALANCE X-100, SCALANCE X-200 and SCALANCE S dimension drawings

Dimension drawings for SCALANCE X-200

The following dimension drawings are intended as examples and apply to the SCALANCE X-100, SCALANCE X-200 and SCALANCE S with an installation width of 60 mm:

- SCALANCE X104-2
- SCALANCE X106-1
- SCALANCE X108
- SCALANCE X202-2IRT
- SCALANCE X204IRT

- SCALANCE X200-4PIRT
- SCALANCE X201-3PIRT
- SCALANCE X202-2PIRT
- SCALANCE X204-2
- SCALANCE X206-1
- SCALANCE X208
- SCALANCE X204-2LD
- SCALANCE X206-1LD
- SCALANCE S602
- SCALANCE S612
- SCALANCE S613

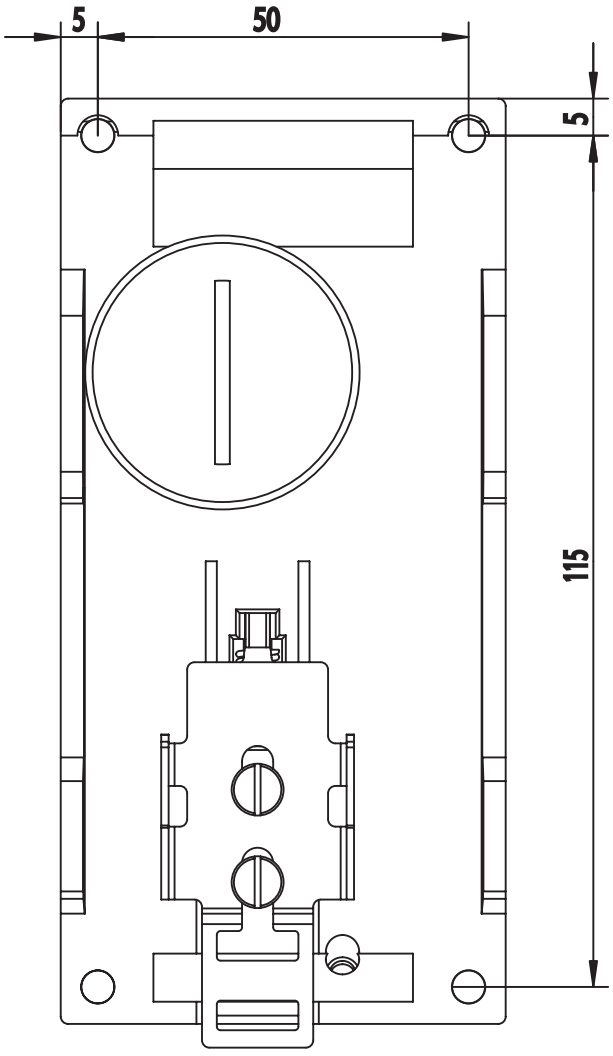


Figure 6-13 SCALANCE X100, SCALANCE X200, SCALANCE S dimension drawing

The schematic below shows the minimum bending radii for an optical cable including connector (external cable with 150 mm radius) and an IE FC cable with IE FC RJ-45 Plug 180 (inner cable with 76 mm radius).

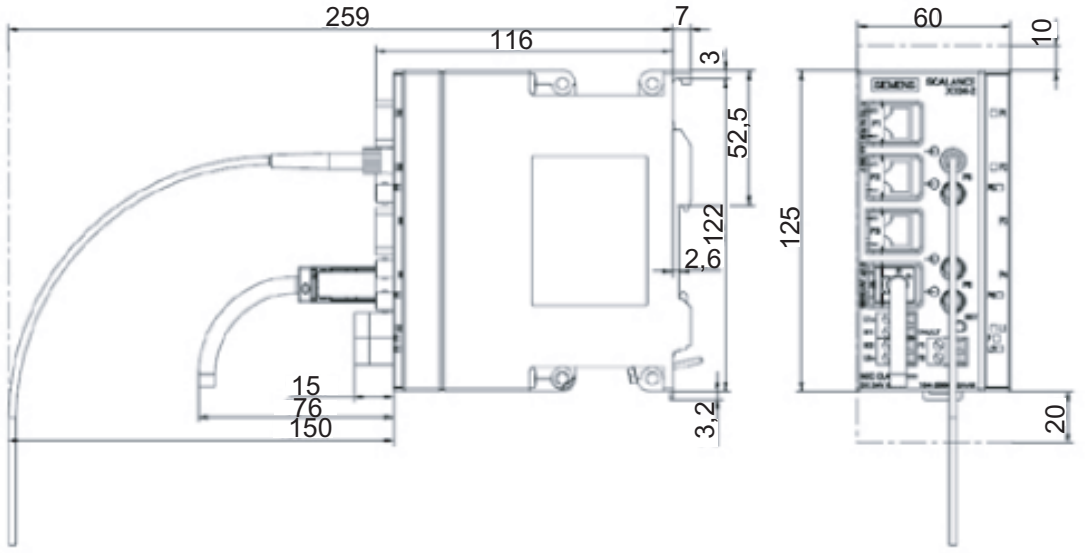


Figure 6-14 Side view

See also

Dimension drawing X-200 (Page 270)

6.3.6 X-100 technical specifications

Table 6-12 Connectors

Device type SCALANCE	Attachment of end devices or network components over twisted pair	Connecting end devices or network components over fiber-optic	Connector for power supply	Connector for signaling contact
X104-2	4 x RJ-45 jacks with MDI-X pinning 10/100 Mbps (half/ full duplex)	2 x 2 BFOC sockets (100 Mbps, full duplex to 100BaseFX)	1 x 4-pin plug-in terminal block	1 x 2-pin plug-in terminal block
X106-1	6 x RJ-45 jacks with MDI-X pinning 10/100 Mbps (half/full duplex)	1 x 2 BFOC sockets (100 Mbps, full duplex to 100BaseFX)	1 x 4-pin plug-in terminal block	1 x 2-pin plug-in terminal block
X108	8 x RJ-45 jacks with MDI-X pinning 10/100 Mbps (half/ full duplex)	-	1 x 4-pin plug-in terminal block	1 x 2-pin plug-in terminal block
X112-2	12 x RJ-45 jacks with MDI-X pinning 10/100 Mbps (half/full duplex)	2 x 2 BFOC sockets (100 Mbps, full duplex to 100BaseFX)	1 x 4-pin plug-in terminal block	1 x 2-pin plug-in terminal block
X116	16 x RJ-45 jacks with MDI-X pinning 10/100 Mbps (half/full duplex)	-	1 x 4-pin plug-in terminal block	1 x 2-pin plug-in terminal block
X124	24 x RJ-45 jacks with MDI-X pinning 10/100 Mbps (half/ full duplex)	-	1 x 4-pin plug-in terminal block	1 x 2-pin plug-in terminal block

Table 6-13 Electrical data

Device type SCALANCE	Power supply 2 x 24 V DC (18-32 V DC) Safety extra-low voltage (SELV)	Power loss at 24 V DC	Current consumption at rated voltage	Overcurrent protection at input PTC resettable fuse (0.6 A / 60 V)
X104-2	+	4.2 W	175 mA	+
X106-1	+	3.6 W	150 mA	+
X108	+	3.36 W	140 mA	+
X112-2	+	10.8 W	450 mA	-
X116	+	7.2 W	300 mA	-
X124	+	10.8 W	450 mA	-

Table 6-14 Signaling contact

Device type SCALANCE	Voltage at signaling contact	Current through signaling contact
X104-2	24 V DC	max. 100 mA
X106-1	24 V DC	max. 100 mA
X108	24 V DC	max. 100 mA
X112-2	24 V DC	max. 100 mA
X116	24 V DC	max. 100 mA
X124	24 V DC	max. 100 mA

Table 6-15 Permitted cable lengths (copper)

Device type SCALANCE	0 - 55 m IE TP torsion cable with IE FC RJ-45 Plug 180 or 0 - 45 m IE TP torsion cable with IE outlet RJ-45 + 10 m TP cord	0 - 85 m IE FC TP marine/trailing/ flexible cable with IE FC RJ-45 Plug 180 or 0 - 75 m IE FC TP marine/ trailing/flexible cable + 10 m TP cord over IE FC outlet RJ-45	0 - 100 m IE FC TP standard cable with IE FC RJ-45 plug 180 or over IE FC outlet RJ-45 with 0 - 90 m IE FC TP standard cable + 10 m TP cord
X104-2	+	+	+
X106-1	+	+	+
X108	+	+	+
X112-2	+	+	+
X116	+	+	+
X124	+	+	+

Table 6-16 Permitted cable lengths (fiber-optic)

Device type SCALANCE	1 - 50 m 980/1000 plastic optical fiber (POF)	1 - 100 m 200/230 polymer cladded fiber (PCF) 6 dB max. permitted FO cable attenuation with 3 dB link power margin	0 - 3,000 m glass FOC 62.5/125 µm or 50/125 µm glass fiber; ≤ 1 dB/km at 1300 nm; ≥ 600 MHz x km; 6 dB max. permitted FO cable attenuation with 3 dB link power margin	0 - 26000 m glass FOC 10/125 µm single mode fiber; 0.5 dB/km at 1300 nm; 13 dB max. permitted FO cable attenuation with 2 dB link power margin
X104-2	-	-	+	-
X106-1	-	-	+	-
X108	-	-	-	-
X112-2	-	-	+	-
X116	-	-	-	-
X124	-	-	-	-

Table 6-17 Aging time/ MTBF

Device type SCALANCE	Aging time	MTBF
X104-2	30 seconds	134.87 years
X106-1	30 seconds	136.65 years
X108	30 seconds	139.83 years
X112-2	30 seconds	61.3 years
X116	30 seconds	61.3 years
X124	30 seconds	49.3 years

Table 6-18 Permitted environmental conditions / EMC

Device type SCALANCE	Operating temperature	Storage/transport temperature	Relative humidity in operation	Operating altitude at max. xx°C ambient temperature
X104-2	-10 °C through +60 °C	-40 °C through +80 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C
X106-1	-10 °C through +60 °C	-40 °C through +80 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C
X108	-20 °C through +70 °C	-40 °C through +80 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C
X112-2	-10 °C through +70 °C	-40 °C through +80 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C
X116	-20 °C through +70 °C	-40 °C through +80 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C
X124	-20 °C through +70 °C	-40 °C through +80 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C

Table 6-19 Order numbers for accessories

	Order number
IE FC Stripping Tool	6GK1901-1GA00
IE FC blade cassettes	6GK1901-1GB00
IE FC TP standard cable GP	6XV1840-2AH10
IE FC TP trailing cable	6XV1840-3AH10
IE FC TP marine cable	6XV1840-4AH10
IE FC TP trailing cable GP	6XV1870-2D
IE FC TP flexible cable GP	6XV1870-2B
IE TP torsion cable	6XV1870-2F
FO FRNC Cable 50/125	6XV1 873-2B
IE FC RJ-45 Plug 180 pack of 1	6GK1901-1BB10-2AA0
IE FC RJ-45 Plug 180 pack of 10	6GK1901-1BB10-2AB0
IE FC RJ-45 Plug 180 pack of 50	6GK1901-1BB10-2AE0

Note

The number of SCALANCE X Industrial Ethernet Switches connected in a line influences the frame propagation time.

When a frame passes through devices of the SCALANCE X-100 product line, it is delayed by the store and forward function of the switch

- with a 64 byte frame length by approx. 10 microseconds (at 100 Mbps)
- with a 1500 byte frame length by approx. 130 microseconds (at 100 Mbps)

This means that the more devices of the SCALANCE X-100 product line, the frame passes through, the longer the frame delay.

6.4 SCALANCE X-100 media converters

6.4.1 Certifications and approvals, degree of protection X-100 media converters

Certifications

Table 6-20 Approvals for SCALANCE media converters X101-1, X101-1LD, X101-1POF, X101-1FL and X101-1AUI

c-UL-us	UL 60950-1; CSA C22.2 No. 60950-1
c-UL-us for hazardous locations	UL 1604, UL 2279Pt.15
FM	FM 3611
C-TICK	AS/NZS 2064 (Class A)
CE	EN 61000-6-2, EN 61000-6-4
ATEX Zone 2	EN 50021

Degree of protection

Tested to IP30.

6.4.2 X-100 media converter installation instructions and guidelines

Installation as for SCALANCE X-100

The switches are installed in the same way as the SCALANCE X-100 devices.

Note the following however:

- The connectors of the signaling contact on the SCALANCE X-100 media converters are located directly above the power supply connectors.

See also

X-100 installation instructions and guidelines (Page 237)

6.4.3 X-100 media converter operator controls and displays

Display elements

The following LEDs exist on all SCALANCE X-100 media converters and in the same numbers:

- Fault indicator (red LED); Labeled: F): This is lit if one of the two redundant power supplies fails and/or if there is a link down on a monitored port. The signaling contact opens at the same time.
- Power indicator (green LED); Labeled: L): This is lit when an adequate power supply is connected to at least one of the power supply terminals. The LED goes off if the supplied power drops below 14 V at both inputs.
- Transparent Link indicator (green LED); Labeled: TL): This is lit when transparent link is set. It is not lit in standalone mode; in other words when end devices are attached to both ports of the media converter (no cascading).

The status of the ports is indicated by two LEDs:

Table 6-21 Status of the port

Port status display	Meaning
Port 1: LED lit green	TP link exists, no data reception
Port 2: LED lit green	FO link exists, no data reception
Port 1: LED lit yellow	TP link exists, data received at TP port
Port 2: LED lit yellow	FO link exists, data received at FO port
Ports 1 and 2: LEDs flash yellow	Setting or display of the fault mask

Operator controls

The media converters have a button with which the set fault mask can be displayed and modified and with which the transparent link mode can be set.

After pressing the button, the currently valid fault mask is displayed for approximately 3 seconds. The LEDs of the monitored ports flash at a frequency of 5 Hz.

If the button remains pressed, the new fault mask is displayed after the 3 seconds have elapsed. The flashing frequency is reduced to 2.5 Hz. After a further 3 seconds, the new fault mask is adopted and saved. The monitored ports are indicated by permanently lit LEDs until the button is released.

As long as the LEDs are still flashing, the saving of the mask can be interrupted by releasing the button.

If an empty fault mask is set (no port is monitored) or you want to set an empty mask, the 2 port LEDs flash on and off alternately.

At the same time, you can also set the monitoring of the redundant power supply with the fault mask. Monitoring of the power supply is activated only when both power supplies are connected when the fault mask is stored.

The factory default is no port monitoring.

The setting is retained after a power cycle.

6.4.4 Connector pin assignments X-100 media converters

Connector pin assignments

The connector pin assignment of the SCALANCE X-100 media converters is the same as on the other SCALANCE-X devices.

Note the following however:

- The connectors of the signaling contact are located directly above the connectors for the power supply.

See also

Common connector pin assignments of SCALANCE X devices (Page 230)

6.4.5 Dimension drawing SCALANCE X-100 media converters

Dimension drawing SCALANCE X-100 media converters

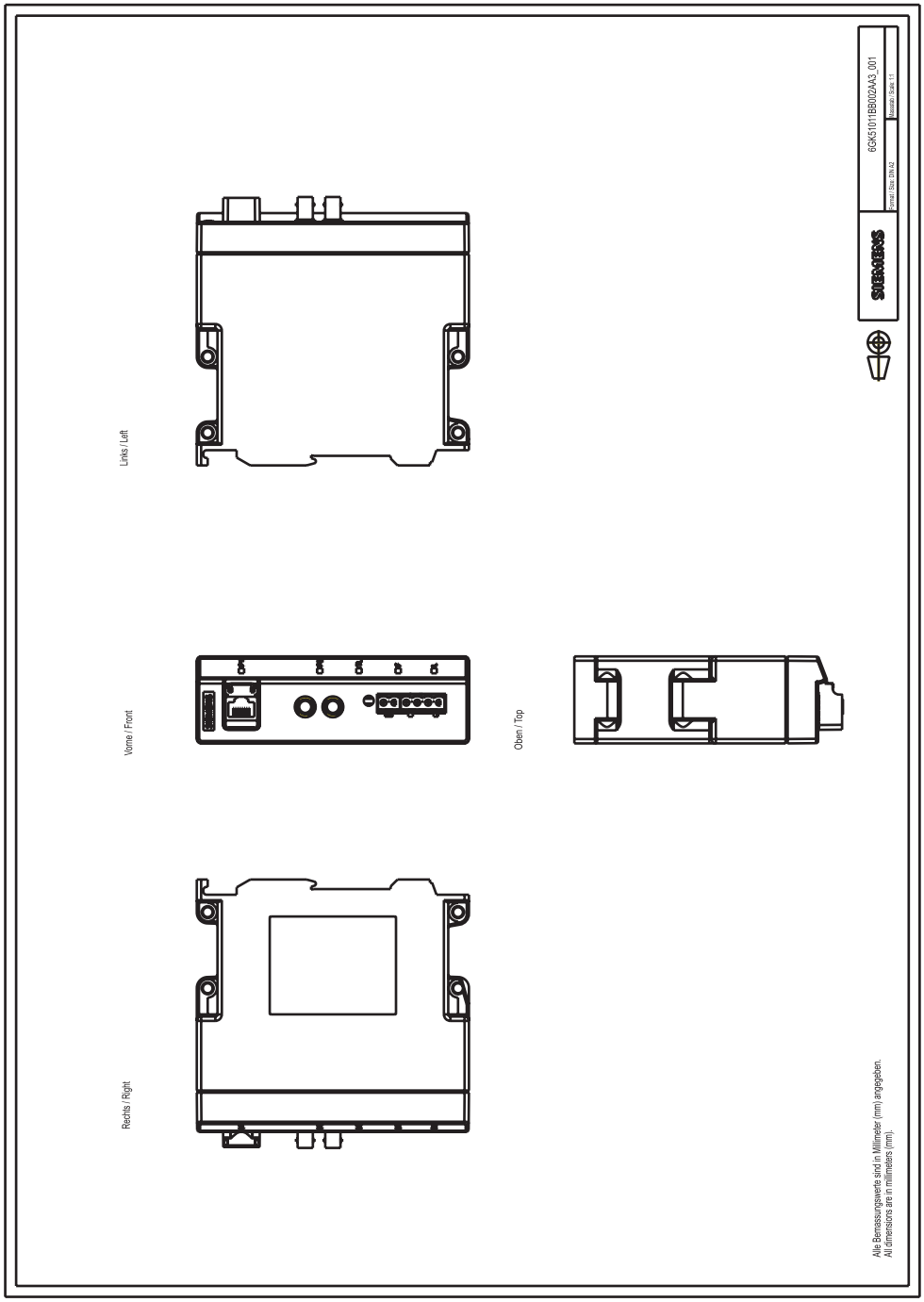


Figure 6-15 Dimension drawing X101-1

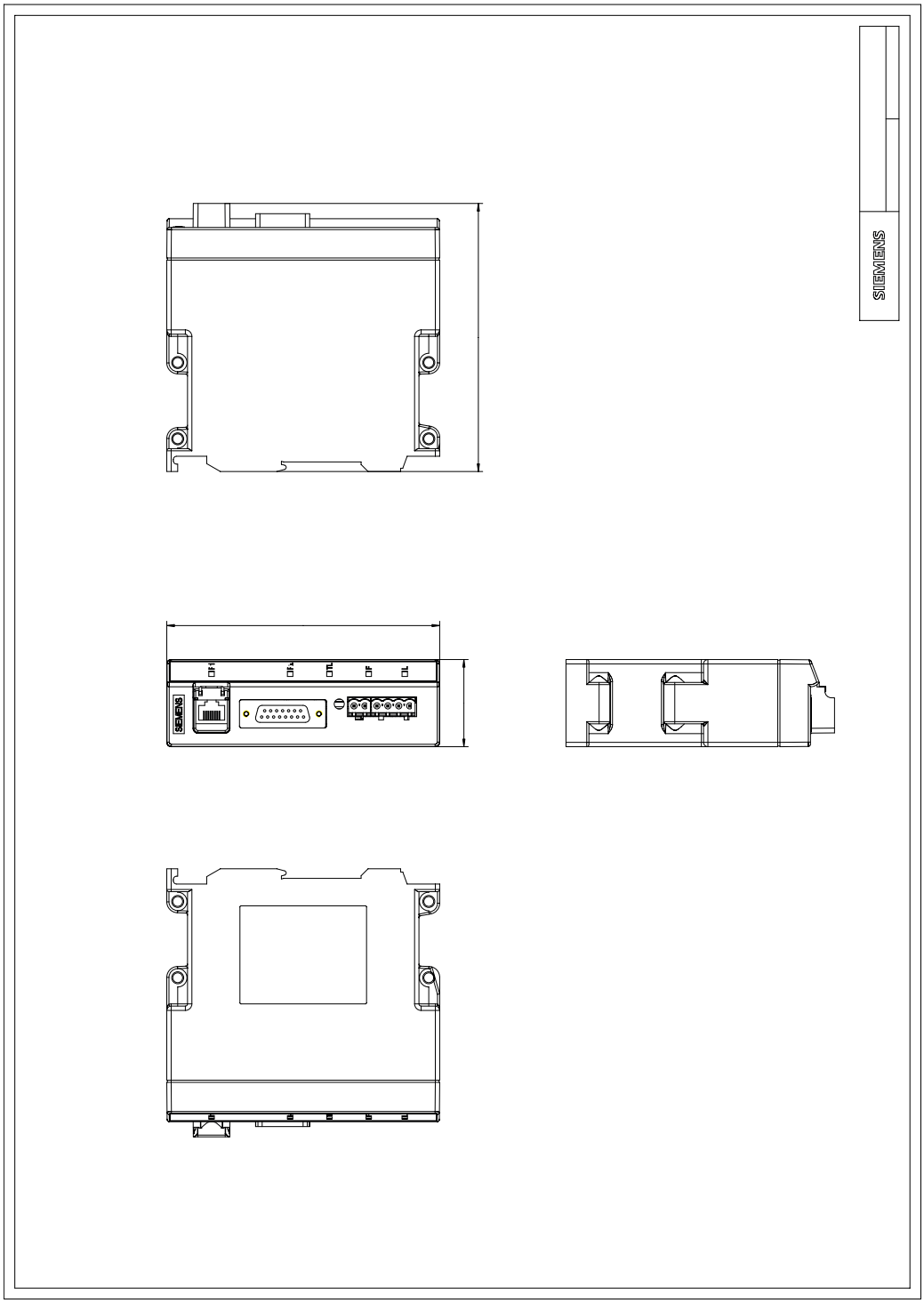


Figure 6-16 Dimension drawing X101-1AUI

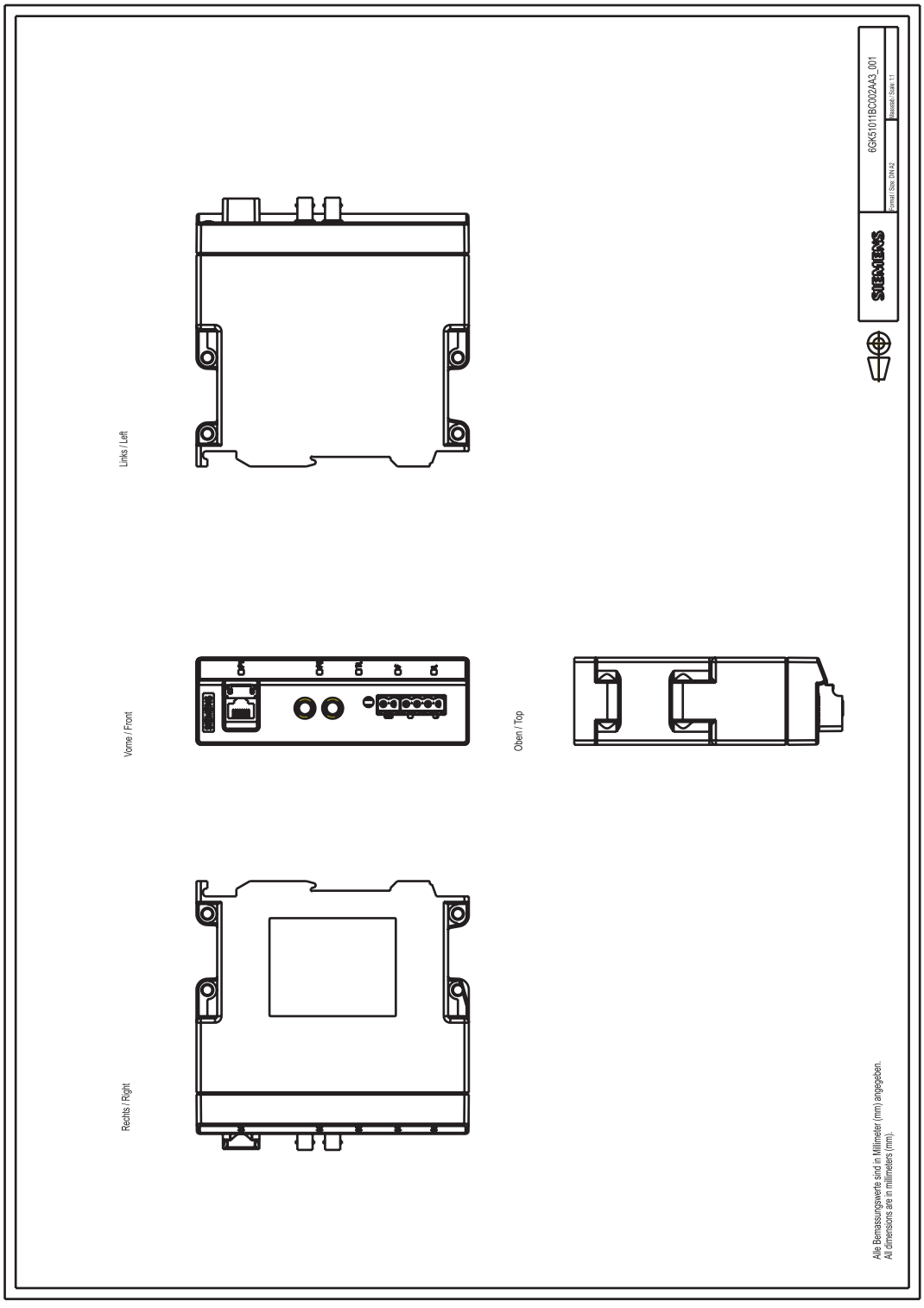


Figure 6-17 Dimension drawing X101-1LD

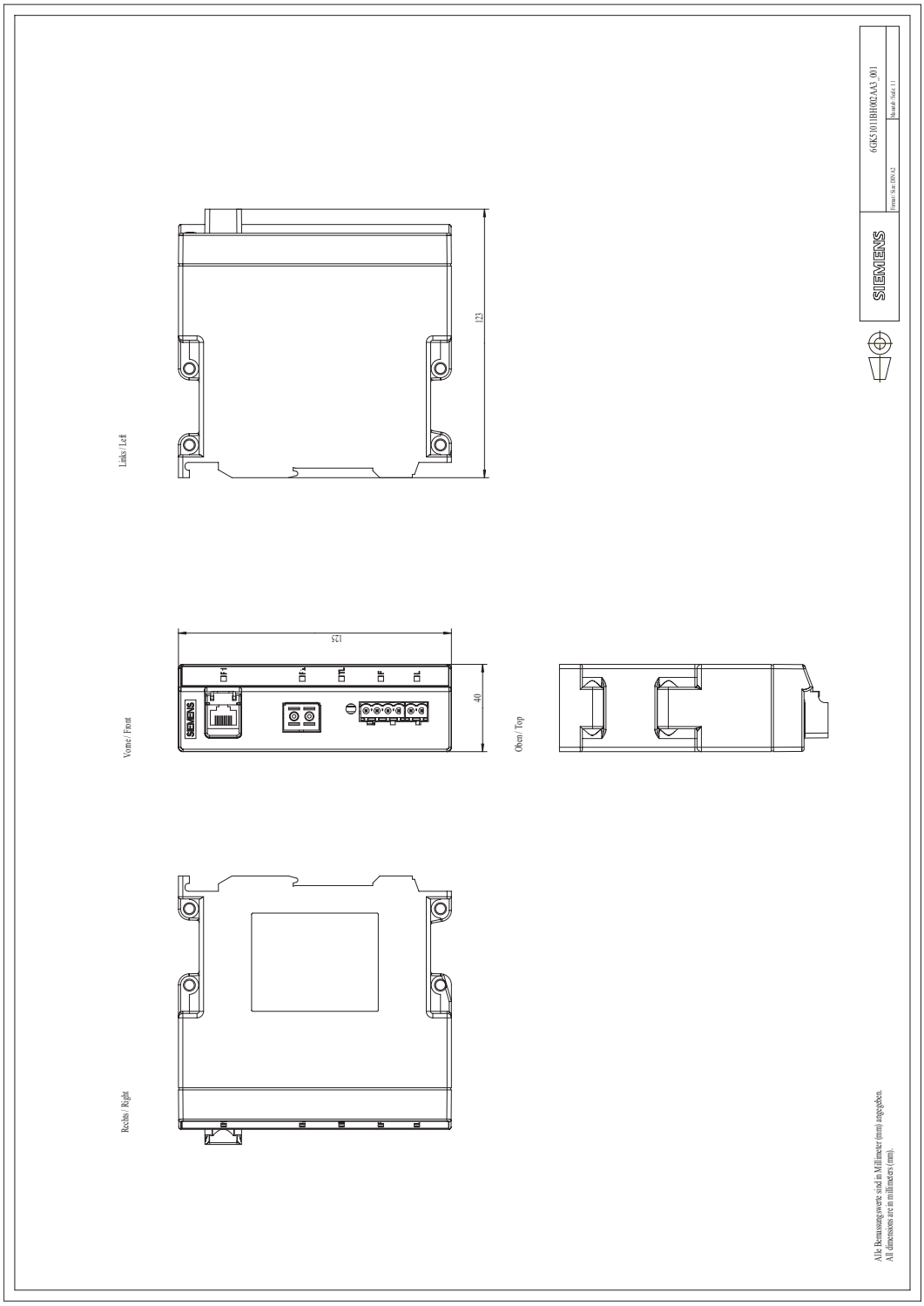


Figure 6-18 Dimension drawing X101-1POF

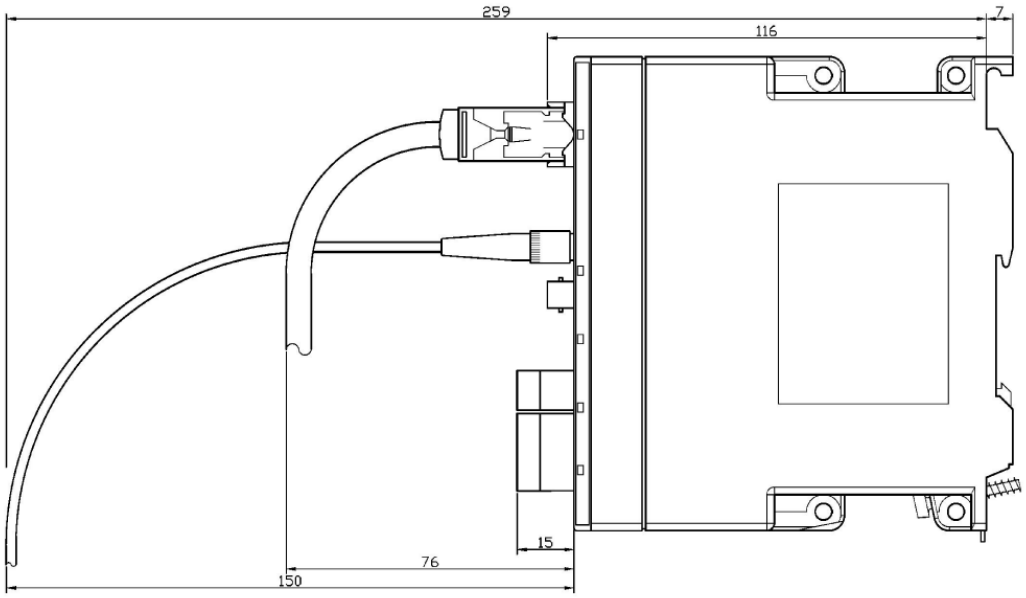


Figure 6-19 Bending radii SCALANCE X-100 media converters

6.4.6 X-100 media converter technical specifications

SCALANCE X-100 media converter technical specifications

Table 6-22 Electrical data

	Device type SCALANCE X				
	X101-1	X101-1LD	X101-1POF	X101-1FL	X101-1AUI
Power supply	2 x 24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)				
Power loss at 24 V DC (typical)	3 W	3 W	3 W	3 W	3 W
Power consumption at 24 V DC (typical)	120 mA	120 mA	120 mA	120 mA	160 mA
Minimum rated current of the supplying power unit	170 mA	200 mA	200 mA	200 mA	200 mA
Overvoltage protection at input	PTC resettable fuse (0.5 A / 60 V)				
Voltage at signaling contact	24 V DC				24 V DC
Current through signaling contact	max. 100 mA				No info
Transmission rate	10/100 Mbps			10 Mbps	
Interference emission	EN 61000-6-3	EN 61000-6-4	EN 61000-6-3	EN 61000-6-3	EN 61000-6-4
Immunity	EN 61000-6-2				
MTBF	> 130 years				

Table 6-23 Environmental conditions

	Device type SCALANCE X				
	X101-1	**X101-1LD**	**X101-1POF**	**X101-1FL**	**X101-1AUI**
Operating temperature	-10 °C - +60 °C				
Storage/transport temperature	-40 °C - +80 °C				
Relative humidity in operation	< 95% (no condensation)				
Operating altitude	2000 m at max. 56 °C ambient temperature 3000 m at max. 50 °C ambient temperature				
Degree of protection	Tested to IP30				

Table 6-24 Mechanical data

	Device type SCALANCE X				
	X101-1	**X101-1LD**	**X101-1POF**	**X101-1FL**	**X101-1AUI**
Dimensions (W x H x D) mm	40 x 125 x 124				
Weight	550 g				
Installation options	• DIN rail • S7-300 standard rail • Wall mounting				

Table 6-25 Order numbers

SCALANCE X101-1	6GK5101-1BB00-2AA3
SCALANCE X101-1LD	6GK5101-1BC00-2AA3
SCALANCE X101-1POF	6GK5101-1BH00-2AA3
SCALANCE X101-1FL	6GK5101-1BY00-2AA3
SCALANCE X101-1AUI	6GK5101-1BX00-2AA3

6.5 SCALANCE X-200/X-200 IRT

6.5.1 Certifications and approvals, degree of protection X-200

Overview

The following tables apply to the SCALANCE X models

- X200-4PIRT
- X201-3PIRT
- X202-2IRT, X202-2PIRT
- X204IRT, X204-2, X204-2LD
- X206-1, X206-1LD
- X208, X208PRO
- X212-2, X212-2LD
- X216
- X224

Table 6-26 Approvals

c-UL-us	UL 60950; CSA C22.2 No. 60950 UL 60950-1; CSA C22.2 No. 60950-1 for IRT devices
c-UL-us for hazardous locations	UL 1604, UL 2279Pt.15
FM	FM 3611
C-TICK	AS/NZS 2064 (Class A)
CE	EN 61000-6-2, EN 61000-6-4
ATEX Zone 2[1]	EN60079-15II 3 G EEx nA II T..KEMA 03 ATEX 1226 X

[1]For temperature information "T.." or the maximum ambient temperature "Ta:..", refer to the type plate.

Degree of protection

Tested to IP30.

Except for X208PRO: Tested to IP65.

See also

General information on approvals and certifications (Page 230)

6.5.2 X-200 installation instructions and guidelines

Installation of SCALANCE X-200 switches

The switches are installed in the same way as the SCALANCE X-100 line apart from the exception below.

Ring port settings

By default, the following ring ports are set:

X208	X208PRO	X216	X224	X204-2	X206-1	X212-2	X204-2 LD	X206-1 LD	X212-2 LD
P1, P2	P1, P2	P1, P2	P1, P2	P5, P6	P1, P2	P1, P2	P5, P6	P1, P2	P1, P2

X202-2IRT	X204IRT	X204IRT PRO	X202-2P IRT PRO	X202-2P IRT	X201-3P IRT	X200-4P IRT
P3, P4	P1, P2	P1, P2	P3, P4	P3, P4	P3, P4	P3, P4

On a SCALANCE X-200, these ports are enabled as ring ports when the module is supplied. Without deactivating them, they can also be used as normal ports, for example, in a tree structure.

The ports of a SCALANCE X-200 that will be used as ring ports must be configured using the WBM if they are not default ring ports.

6.5.3 X-200 operator controls and displays

6.5.3.1 SCALANCE X-200 button

Button function

Using the button, you can display and modify the set fault mask. The fault mask setting is retained after device power off/on.

After pressing and holding down the button, the currently valid fault mask is displayed for approximately 3 seconds. The LEDs of the monitored ports flash at a frequency of 5 Hz.

To change the fault mask, keep the button pressed. After a further 3 seconds, the current link status of the ports is displayed and the the power supply LEDs flash at a frequency of 2.5 Hz. Keep the button pressed. After a further 3 seconds, this status is adopted and saved as the new fault mask. The monitored ports now are indicated by permanently lit LEDs until the button is released. As long as the LEDs are still flashing, however, the saving of the mask can be stopped by releasing the button.

If an empty fault mask is set (no port is monitored) or you want to set an empty mask, the 2 port LEDs flash on and off alternately.

At the same time, the monitoring of the connected power supply is set with the fault mask. The existence of the two power sources is monitored only if they are connected when the fault mask is saved.

The failure of the link of one of the monitored ports or one of the monitored power supplies is indicated by the red fault LED lighting up. At the same time, the signaling contact opens.

Port monitoring and power supply monitoring are not activated when the device is delivered (factory default), the redundancy manager is disabled.

The following applies to IE Switches X-200 (except SCALANCE X208 PRO): If the button is pressed for 2-3 seconds longer, the RM LED starts to flash for approx. 2 seconds. If the button is released during this time, the RM is disabled. If you hold down the button, the RM LED lights up permanently and the RM is enabled. If the button is pressed longer (15 seconds), the device is reset to "factory defaults". This is indicated by all the Port LEDs (green) flashing. During this activity, the device must not be turned off.

Note

On the SCALANCE X204 IRT PRO, SCALANCE X202-2P IRT PRO and SCALANCE X208 PRO, the button is beneath the C-PLUG cover on the rear of the device.

6.5.3.2 Fault indicator (red LED)

Fault indicator (red LED)

If the red LED is lit, the IE Switch X-200 has detected a problem.
The signaling contact opens at the same time.

The LED signals that the IE Switch X-200 can adopt the following statuses:

Device type SCALANCE	LED lit red	LED flashing red	LED not lit
X208	1, 2, 3, 4	9	10
X208PRO	1, 2, 3, 4	9	10
X216	1, 2, 3, 4	9	10
X224	1, 2, 3, 4	9	10
X204-2	1, 2, 3, 4	9	10
X206-1	1, 2, 3, 4	9	10
X212-2	1, 2, 3, 4	9	10
X204-2 LD	1, 2, 3, 4	9	10
X206-1 LD	1, 2, 3, 4	9	10
X212-2LD	1, 2, 3, 4	9	10
X202-2IRT	1, 2, 3, 4, 5, 6, 7	9	10
X204IRT	1, 2, 3, 4, 5, 6, 7	9	10
X204 IRT PRO	1, 3, 4, 5, 6, 7	9	10
X202-2P IRT PRO	1, 3, 4, 5, 6, 7, 8	9	10
X202-2P IRT	1, 2, 3, 4, 5, 6, 7, 8	9	10
X201-3P IRT	1, 2, 3, 4, 5, 6, 7, 8	9	10
X200-4P IRT	1, 2, 3, 4, 5, 6, 7, 8	9	10

1. Link down event on a monitored port.
2. Failure of one of the two redundant power supplies.

   Note

   SCALANCE X204 IRT PRO and SCALANCE X202-2P IRT PRO have no redundant power supply.

3. C-PLUG
4. Device startup, the LED is lit for approx. 20 seconds.
5. Device is in PROFINET mode:
   - a) There is no connection to the controller
   - b) There is a connection to the controller, there is also a configured diagnostic interrupt, for example power fail interrupt, C-PLUG interrupt etc.
6. Redundancy manager connected through.
7. Switchover of standby connection.
8. Maintenance request or maintenance requirement.
9. An internal fault was detected. Inform the maintenance personnel and, if necessary, send the device in for repair.
10. No fault detected by the IE Switch X-200.

6.5.3.3 Power display

Power display

The LEDs signal that the IE Switch X-200 can adopt the following statuses:

The status of the power supply is indicated by two green LEDs or one green/yellow LED:

Device type SCALANCE	Green LED lit	Yellow-green LED		LED not lit
		LED lit green	LED lit yellow	
X208	-	2	3	4
X208PRO	1	-	-	4
X216	-	2	3	4
X224	-	2	3	4
X204-2	-	2	3	4
X206-1	-	2	3	4
X212-2	-	2	3	4
X204-2 LD	-	2	3	4
X206-1 LD	-	2	3	4
X212-2LD	-	2	3	4
X202-2IRT	-	2	3	4
X204IRT	-	2	3	4
X204 IRT PRO	-	2	3	4
X202-2P IRT PRO	-	2	3	4
X202-2P IRT	-	2	3	4
X201-3P IRT	-	2	3	4
X200-4P IRT	-	2	3	4

1. Power supply L1 or L2 is connected.
2. Both L power supplies are connected (redundant supply).
3. One L power supply is connected (non-redundant supply).
4. Power supply L1 and/or L2 not connected or <14 V.

Note

SCALANCE X204 IRT PRO and SCALANCE X202-2P IRT PRO have no redundant power supply.

6.5.3.4 Port status indicator (green/yellow LEDs)

Port status indicator (green/yellow LEDs)

The LEDs signal that the IE Switch X-200 can adopt the following statuses.
The status of the interfaces is indicated by two-color LEDs:

Device type SCALANCE		LED lit green	LED lit yellow	LED flashes yellow	LED flashes green
	Number of port LEDs				
X208	8 port LEDs	1	2, 3	4	5, 6
X208PRO	8 port LEDs	1	2, 3	4	5
X204-2	6 port LEDs	1	2, 3	4	5, 6
X206-1	7 port LEDs	1	2, 3	4	5, 6
X204-2 LD	6 port LEDs	1	2, 3	4	5, 6
X206-1 LD	7 port LEDs	1	2, 3	4	5, 6
X202-2IRT	4 port LEDs	1	2, 3	4	5, 6
X204IRT	4 port LEDs	1	2, 3	4	5, 6
X204 IRT PRO	4 port LEDs	1	2, 3	4	5, 6
X202-2P IRT PRO	4 port LEDs	1	2, 3	4	5, 6
X202-2P IRT	4 port LEDs	1	2, 3	4	5, 6
X201-3P IRT	4 port LEDs	1	2, 3	4	5, 6
X200-4P IRT	4 port LEDs	1	2, 3	4	5, 6
X216	16 port LEDs	1	2, 3	4	5, 6
X212-2	14 port LEDs	1	2, 3	4	5, 6
X212-2LD	14 port LEDs	1	2, 3	4	5, 6
X224	24 port LEDs	1	2, 3	4	5, 6

1. TP link exists, no data reception.
2. TP link, data received at TP port.
3. Device startup, the LED is lit for approx. 6 seconds.
4. Setting or display of the fault mask.
5. The "Show Location" function was enabled over Ethernet (for example, PST tool).
   The button was pressed for longer than 15 seconds to reset the configuration.
6. PROFINET IO operation was started with the PN IO controller, the attempt to change the fault mask with the button was rejected by all the port LEDs flashing once.

6.5.3.5 Redundancy manager indicator (green LED)

Redundancy manager indicator (green LED)

The LED signals that the IE Switch X-200 can adopt the following statuses:

Device type SCALANCE	LED lit green	LED flashes green	LED not lit
X208	1	2	3
X208PRO	-	-	-
X216	1	2	3
X224	1	2	3
X204-2	1	2	3
X206-1	1	2	3
X212-2	1	2	3
X204-2LD	1	2	3
X206-1LD	1	2	3
X212-2LD	1	2	3
X202-2IRT	1	2	3
X204IRT	1	2	3
X204 IRT PRO	1	2	3
X202-2P IRT PRO	1	2	3
X202-2P IRT	1	2	3
X201-3P IRT	1	2	3
X200-4P IRT	1	2	3

1. Redundancy manager RM is enabled.
2. Redundancy manager is switched over.
3. Redundancy manager is disabled.

Note

The redundancy manager indicator and the standby indicator are implemented as a dual LED, the indicator color changes depending on the function (Redundancy function -> green, standby function -> yellow).

6.5.3.6 Standby functions (yellow LED)

Standby functions (yellow LED)

The LED signals that the IE Switch X-200 can adopt the following statuses:

Device type SCALANCE	LED lit yellow	LED flashes yellow (slowly)	LED flashes yellow (fast)	LED not lit
X208	-	-	-	-
X208PRO	-	-	-	-
X216	-	-	-	-
X224	-	-	-	-
X204-2	-	-	-	-
X206-1	-	-	-	-
X212-2	-	-	-	-
X204-2 LD	-	-	-	-
X206-1 LD	-	-	-	-
X212-2LD	-	-	-	-
X202-2IRT	1	2	3	4
X204IRT	1	2	3	4
X204 IRT PRO	1	2	3	4
X202-2P IRT PRO	1	2	3	4
X202-2P IRT	1	2	3	4
X201-3P IRT	1	2	3	4
X200-4P IRT	1	2	3	4

1. Standby function is enabled (IE Switch X-200 is in standby active mode).
2. Standby function is enabled (IE Switch X-200 is in standby passive mode).
3. Standby partner lost.
4. Standby function is disabled.

Note

When the device switches from active to passive mode because of a fault, the red fault LED is also activated. This is possible only when standby monitoring is enabled in the fault mask.

6.5.3.7 FOC diagnostic display (yellow LED)

Note

Only the SCALANCE X202-2P IRT, X202-2P IRT PRO, X201-3P IRT and X200-4P IRT devices have the FO cable diagnostic display.

FOC diagnostic display (yellow LED)

The diagnostic status of the SC RJ interfaces is signaled by an additional LED per port. The LED signals that the device can adopt the following statuses:

Device type SCALANCE	LED lit yellow	LED not lit
X202-2P IRT PRO	1	2
X202-2P IRT	1	2
X201-3P IRT	1	2
X200-4P IRT	1	2

1. Signaling maintenance is necessary. Maintenance should be performed to ensure problem-free operation.
2. Relevant only when the link exists:
   The available link power margin is adequate for problem-free operation.

6.5.3.8 LED display during startup

LED display during startup

Device type SCALANCE	When the device starts up, the following LEDs light up in the following order: 1. Power LEDs (green) light up immediately after turning on the power. 2. Port LEDs (yellow) light up for approx. 6 seconds, the red LED is off. 3. Port LEDs go off, the red error LED is lit for approx. 20 seconds. 4. After the port LEDs go off, the correct link status is displayed after approx. 2 seconds. 5. The IE Switch X-200 is now ready for operation.
X208	+
X208PRO	+
X216	+
X224	+
X204-2	+
X206-1	+
X212-2	+
X204-2 LD	+
X206-1 LD	+
X212-2LD	+
X202-2IRT	+
X204IRT	+
X204 IRT PRO	+
X202-2P IRT PRO	+
X202-2P IRT	+
X201-3P IRT	+
X200-4P IRT	+

6.5.4 Connector pin assignments X-200

General

The pin assignment of the SCALANCE X-200 devices is the same as with other SCALANCE X devices.

Pin assignments of the SCALANCE X208 PRO

Due to the use of M12 connectors, the SCALANCE X208 PRO is waterproof according to IP65. At the same time, the requirements for CAT5 are met.

See also

Common connector pin assignments of SCALANCE X devices (Page 230)

6.5.5 Dimension drawing X-200

General dimension drawings

You will also find dimension drawings for most SCALANCE X-200 devices in the section with the reference data of the SCALANCE X-100 line. (See below)

Dimension drawings SCALANCE X208PRO

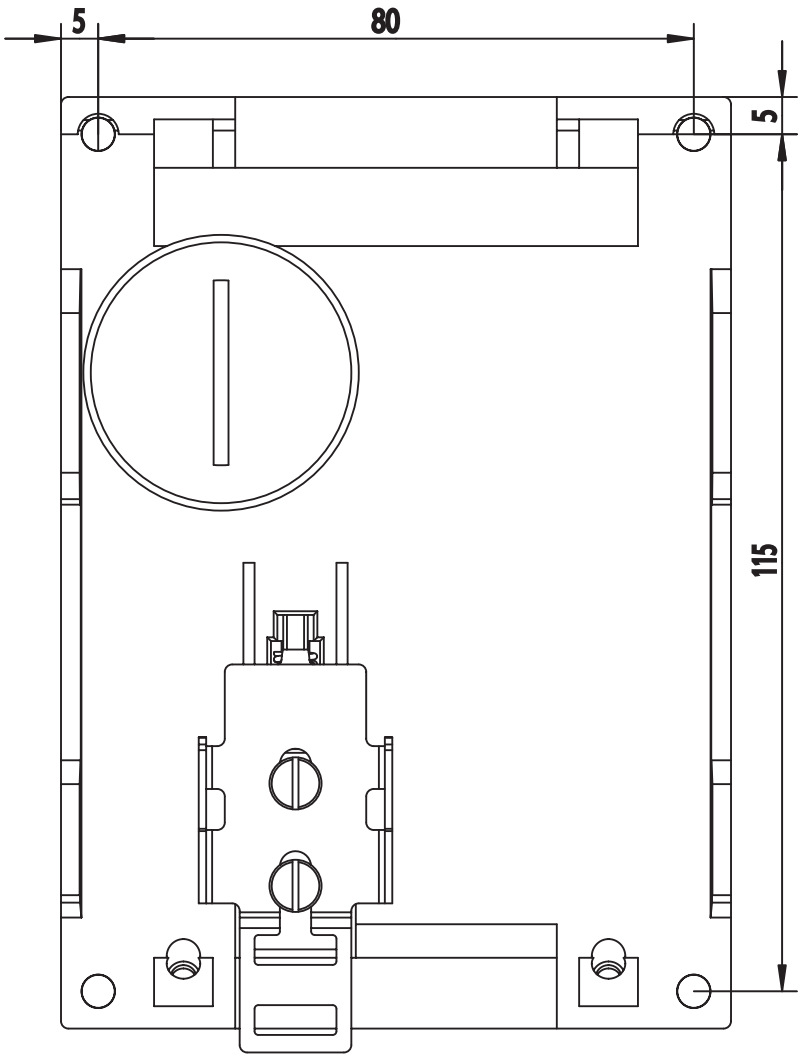


Figure 6-20 Dimension drawing SCALANCE X208PRO

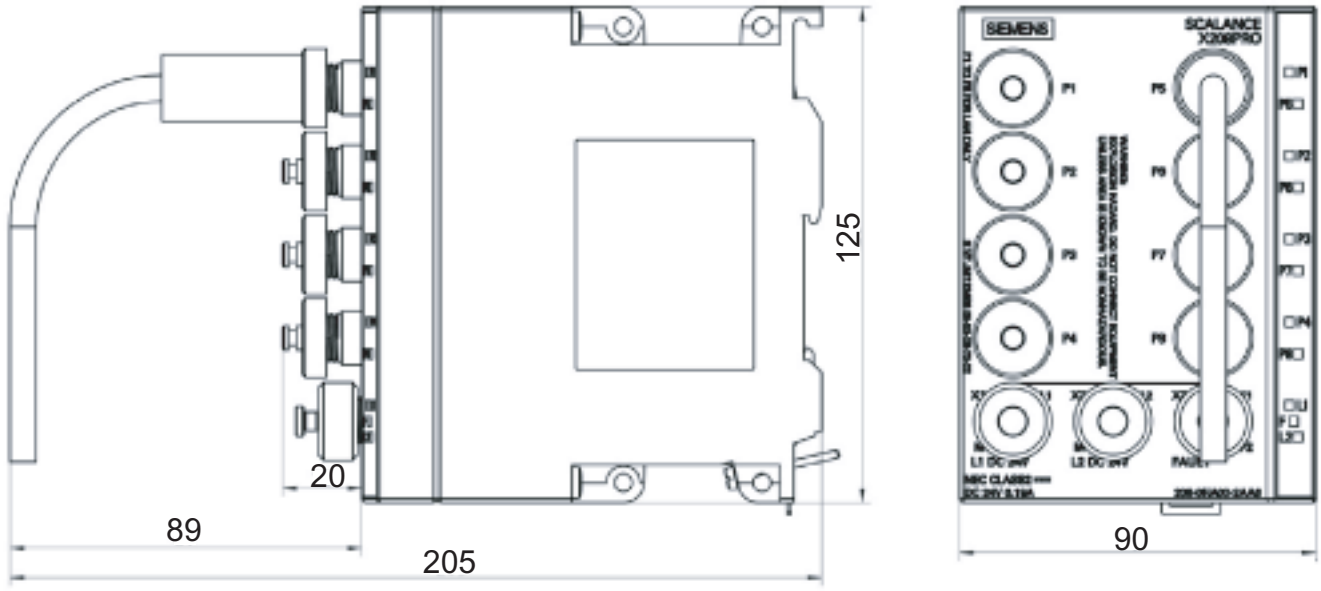


Figure 6-21 SCALANCE X208PRO_M12 bending radius

See also

SCALANCE X-100, SCALANCE X-200 and SCALANCE S dimension drawings (Page 244)

6.5.6 X-200 technical specifications

Technical specifications of the SCALANCE X-200 devices without optical interface and with interface for multimode FO cable

Table 6-27 Electrical data

	SCALANCE X 204-2	SCALANCE X206-1	SCALANCE X208	SCALANCE X20 8PRO
Power supply	2 x 24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)			
Power loss at 24 V DC	6.36 W	5.28 W	3.84 W	4.4 W
Current consumption at 24 V DC	265 mA	220 mA	160 mA	185 mA
Overvoltage protection at input	PTC resettable fuse (0.6 A / 60 V)			
Voltage at signaling contact	24 V DC			
Current through signaling contact	max. 100 mA			
Transmission rate	10/100 Mbps			
Aging time	30 seconds			
Interference emission	EN 61000-6-4 Class A			
Immunity	EN 61000-6-2			
MTBF	74.64 years	78.71 years	83.71 years	115.48 years

Table 6-28 Environmental conditions

	SCALANCE X 204-2	SCALANCE X206-1	SCALANCE X208	SCALANCE X20 8PRO
Operating temperature	-10 °C - +60 °C		-20 °C - +60 °C	-20 °C - +70 °C
Storage/transport temperature	-40 °C - +70 °C			
Relative humidity in operation	< 95% (no condensation)			
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature			

Table 6-29 Mechanical data

	SCALANCE X 204-2	SCALANCE X206-1	SCALANCE X208	SCALANCE X20 8PRO
Dimensions (W x H x D) mm	60 x 125 x 124			90 x 125 x 124
Weight	780 g			1000 g
Installation options	• DIN rail • S7-300 standard rail • Wall mounting			

Technical specifications of the SCALANCE X216, X212-2 and X224 devices

Table 6-30 Electrical data

	SCALANCE X216	SCALANCE X212-2	SCALANCE X224
Power supply	2 x 24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)		
Power loss at 24 V DC	5.76 W	7.92 W	8.40 W
Current consumption at 24 V DC	240 mA	330 mA	350 mA
Overvoltage protection at input	PTC resettable fuse (1.1 A / 33 V)		
Voltage at signaling contact	24 V DC		
Current through signaling contact	max. 100 mA		
Transmission rate	10/100 Mbps		
Aging time	30 seconds		
Interference emission	EN 61000-6-4 Class A		
Immunity	EN 61000-6-2		
MTBF	52.07 years	51.18 years	45.87 years

Table 6-31 Environmental conditions

	SCALANCE X216	SCALANCE X212-2	SCALANCE X224
Operating temperature	0 °C - +60 °C		
Storage/transport temperature	-40 °C - +70 °C		
Relative humidity in operation	< 95% (no condensation)		
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature		

Table 6-32 Mechanical data

	SCALANCE X216	SCALANCE X212-2	SCALANCE X224
Dimensions (W x H x D) mm	120 x 125 x 124		180 x 125 x 124
Weight	1200 g		1600 g
Installation options	• DIN rail • S7-300 standard rail • Wall mounting		

Technical specifications of the SCALANCE X200 LD devices

Table 6-33 Electrical data

	SCALANCE X204-2LD	SCALANCE X206-1LD	SCALANCE X212-2LD
Power supply	2 x 24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)		
Power loss at 24 V DC	6.36 W	5.28 W	7.92 W
Current consumption at 24 V DC	265 mA	220 mA	330 mA
Overvoltage protection at input	PTC resettable fuse (1.1 A / 33 V)		
Voltage at signaling contact	24 V DC		max. 28.8 V DC
Current through signaling contact	max. 100 mA		
Transmission rate	10/100 Mbps		
Aging time	30 seconds		
Interference emission	EN 61000-6-4 Class A		
Immunity	EN 61000-6-2		
MTBF	74.64 years	78.71 years	51.18 years

Table 6-34 Mechanical data

	SCALANCE X204-2LD	SCALANCE X206-1LD	SCALANCE X212-2LD
Dimensions (W x H x D) mm	60 x 125 x 124		120 x 125 x 124
Weight	780 g		1200 g
Installation options	• DIN rail • S7-300 standard rail • Wall mounting		

Table 6-35 Environmental conditions

	SCALANCE X204-2LD	SCALANCE X206-1LD	SCALANCE X212-2LD
Operating temperature	0 °C - +60 °C		
Storage/transport temperature	-40 °C - +70 °C		
Relative humidity in operation	< 95% (no condensation)		
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature		

Technical specifications of the SCALANCE X200IRT devices

Table 6-36 Electrical data

	SCALANCE X204IRT	SCALANCE X202-2IRT
Power supply	2 x 24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)	
Power loss at 24 V DC	4.8 W	6 W
Current consumption at 24 V DC	200 mA	300 mA
Overvoltage protection at input	PTC resettable fuse (0.6 A / 60 V)	
Voltage at signaling contact	24 V DC	
Current through signaling contact	max. 100 mA	
Transmission rate	10/100 Mbps	
Aging time	30 seconds	
Interference emission	EN 61000-6-4 Class A	
Immunity	EN 61000-6-2	
MTBF	80.58 years	70.90 years

Table 6-37 Environmental conditions

	SCALANCE X204IRT	SCALANCE X202-2IRT
Operating temperature	-20 °C - +70 °C	-10 °C - +60 °C
Storage/transport temperature	-40 °C - +70 °C	
Relative humidity in operation	< 95% (no condensation)	
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature	

Table 6-38 Mechanical data

	SCALANCE X204IRT	SCALANCE X202-2IRT
Dimensions (W x H x D) mm	60 x 125 x 124	
Weight	780 g	
Installation options	• DIN rail • S7-300 standard rail • Wall mounting	

Table 6-39 Electrical data

	SCALANCE X202-2PIRT	SCALANCE X201-3PIRT	SCALANCE X200-4PIRT
Power supply	2 x 24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)		
Power loss at 24 V DC	7.2 W	8.4 W	9.6 W
Current consumption at 24 V DC	300 mA	350 mA	400 mA
Overvoltage protection at input	PTC resettable fuse (1.1 A / 33 V)		
Voltage at signaling contact	24 V DC		
Current through signaling contact	max. 100 mA		
Transmission rate	10/100 Mbps		
Aging time	30 seconds		
Interference emission	EN 61000-6-4 Class A		
Immunity	EN 61000-6-2		
MTBF	83.72 years	78.03 years	73.06 years

Table 6-40 Environmental conditions

	SCALANCE X202-2PIRT	SCALANCE X201-3PIRT	SCALANCE X200-4PIRT
Operating temperature	0 °C - +60 °C	0 °C - +50 °C	0 °C - +40 °C
Storage/transport temperature	-40 °C - +70 °C		
Relative humidity in operation	< 95% (no condensation)		
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature		

Table 6-41 Mechanical data

	SCALANCE X202-2PIRT	SCALANCE X201-3PIRT	SCALANCE X200-4PIRT
Dimensions (W x H x D) mm	60 x 125 x 124		
Weight	780 g		
Installation options	• DIN rail • S7-300 standard rail • Wall mounting		

Order numbers

SCALANCE X204-2	6GK5204-2BB10-2AA3
SCALANCE X206-1	6GK5206-1BB10-2AA3
SCALANCE X208	6GK5208-0BA10-2AA3
SCALANCE X208PRO	6GK5208-0HA00-2AA6
SCALANCE X216	6GK5216-0BA00-2AA3
SCALANCE X212-2	6GK5212-2BB00-2AA3
SCALANCE X224	6GK5224-0BA00-2AA3

Table 6-42 "LD" devices

SCALANCE X204-2LD	6GK5204-2BC10-2AA3
SCALANCE X206-1LD	6GK5206-1BC10-2AA3
SCALANCE X212-2LD	6GK5212-2BC00-2AA3

Table 6-43 "IRT" devices

SCALANCE X204IRT	6GK5204-0BA00-2BA3
SCALANCE X202-2IRT	6GK5202-2BB00-2BA3
SCALANCE X202-2P IRT	6GK5202-2BH00-2BA3
SCALANCE X201-3P IRT	6GK5201-3BH00-2BA3
SCALANCE X200-4P IRT	6GK5200-4AH00-2BA3

Web Based Management

Note

You will find information on configuring the SCALANCE X switches using Web Based Management in the relevant operating instructions.

6.6 SCALANCE X-300

6.6.1 Certifications and approvals, degree of protection X-300

Validity

The following information applies to the SCALANCE X devices

- X310
- X308-2
- X308-2LD

Approvals

Device type SCALANCE	c-UL-us	c-UL-us for hazardous locations[1]	FM[1]	C-TICK	CE	ATEX Zone 2[1]	E1
X310	UL 60950-1 CSA C22.2 No. 60950-1	UL 1604, UL 2279Pt.15 CL.1, Div.2 GP. A.B.C.D T.. CL.1, Zone 2, GP, IIC, T.. CL.1, Zone2, AEx nC IIC T..	FM 3611 CL.1, Div.2 GP. A.B.C.D T.. CL.1, Zone 2, GP. IIC, T.. Ta:..	AS/NZS 2064 (Class A).	EN 61000-6-4 Class A, EN 61000-6-2	EN60079-15 II 3 G EEx nA II T.. KEMA 03 ATEX 1226 X	ECE-G 95/54/EEC test number 024734
X308-2	UL 60950-1 CSA C22.2 No. 60950-1	UL 1604, UL 2279Pt.15 CL.1, Div.2 GP. A.B.C.D T.. CL.1, Zone 2, GP, IIC, T.. CL.1, Zone2, AEx nC IIC T..	FM 3611 CL.1, Div.2 GP. A.B.C.D T.. CL.1, Zone 2, GP. IIC, T.. Ta:..	AS/NZS 2064 (Class A).	EN 61000-6-4 Class A, EN 61000-6-2	EN60079-15 II 3 G EEx nA II T.. KEMA 03 ATEX 1226 X	-
X308-2 LD	UL 60950-1 CSA C22.2 No. 60950-1	UL 1604, UL 2279Pt.15 CL.1, Div.2 GP. A.B.C.D T.. CL.1, Zone 2, GP, IIC, T.. CL.1, Zone2, AEx nC IIC T..	FM 3611 CL.1, Div.2 GP. A.B.C.D T.. CL.1, Zone 2, GP. IIC, T.. Ta:..	AS/NZS 2064 (Class A).	EN 61000-6-4 Class A, EN 61000-6-2	EN60079-15 II 3 G EEx nA II T.. KEMA 03 ATEX 1226 X	-

[1]For temperature information "T.." or the maximum ambient temperature "Ta:..", refer to the type plate.

Degree of protection

Tested to IP30.

Order numbers

SCALANCE X310	6GK5 310-0FA00-2AA3
SCALANCE X308-2	6GK5 308-2FL00-2AA3
SCALANCE X308-2 LD	6GK5 308-2FM00-2AA3

See also

General information on approvals and certifications (Page 230)

6.6.2 X-300 installation instructions and guidelines

Installation of SCALANCE X-300 switches

The switches are installed in the same way as the SCALANCE X-100 line.

See also

X-100 installation instructions and guidelines (Page 237)

6.6.3 X-300 operator controls and displays

6.6.3.1 LED display

Overview

The following table shows the states indicated by the LEDs in the various display modes.

	LED	Display mode A	Display mode B	Display mode C	Display mode D
IE Switch X-300	F	Problem, signaling contact opens			
	L1	Power supply L1 is applied.			Power supply L1 is monitored
	L2	Power supply L2 is applied.			Power supply L2 is monitored
	RM	Device is operating as RM			
	SB	Device operates in standby mode.			
	DM	off	Lit green	Lit orange	Flashes orange/yellow
	P1 P2 P3 P4 P5 P6 P7 P8 P9 P10	Port status	Transmission rate	Half / full duplex	Fault mask

6.6.3.2 LED display - Fault and Power

Display modes A through C

In display modes A to C, the status of the signaling contact and the presence of the supply voltages are displayed by the LEDs of the IE Switch X-300.

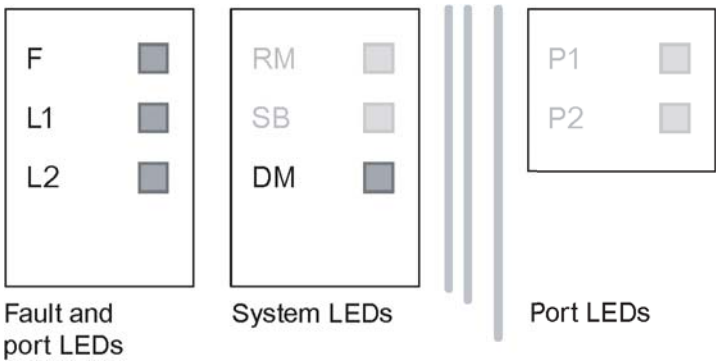


Figure 6-22 Example of the LED display of the device in DMode A

The following table lists the significance of the three LEDs on the IE Switch X-300 for display modes A through C:

Label	Color	Status	Meaning
F		off	The IE Switch X-300 has not detected any faults, the signaling contact is closed.
	Red	on	The IE Switch X-300 has detected a fault, the signaling contact opens.
L1		off	Power supply L1 lower than 17 V.
	Green	on	Power supply L1 higher than 17 V.
L2		off	Power supply L2 lower than 17 V.
	Green	on	Power supply L2 higher than 17 V.

For information on the "DM" LED, refer to the operating instructions of the switch.

Display in display mode D

In display mode D, the DM LED of the IE Switch X-300 flashes yellow/orange. This mode indicates whether the power supply is being monitored with the signaling contact.

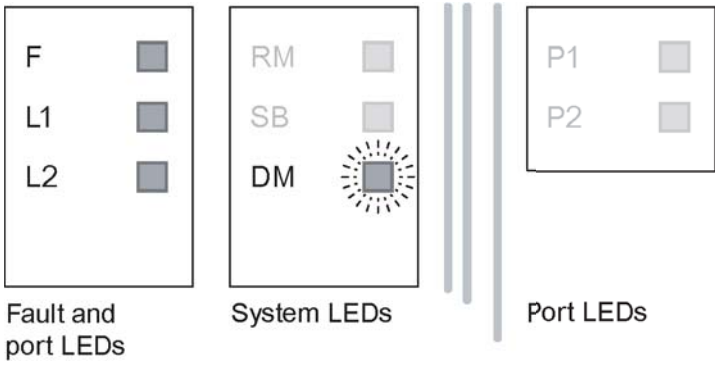


Figure 6-23 LED Fault / Power and System display in display mode D

The following table shows the meaning of the three LEDs on the IE Switch X-300 in display mode D:

Label	Color	Status	Meaning
F		off	No problem has been detected by the IE Switch X-300.
	Red	on	The IE Switch X-300 detects a fault. The signaling contact opens.
L1		off	Power supply L1 is not monitored. If L1 falls below 17 V, the signaling contact does not respond.
	Green	on	Power supply L1 is monitored. If L1 falls below 17 V, the signaling contact responds.
L2		off	Power supply L2 is not monitored. If L2 falls below 17 V, the signaling contact does not respond.
	Green	on	Power supply L2 is monitored. If L2 falls below 17 V, the signaling contact responds.

6.6.3.3 LED display - System

System

On the IE Switch X-300, the LEDs of the system are on the right-hand LED strip.

Display modes A through D

The set display modes are indicated as follows:

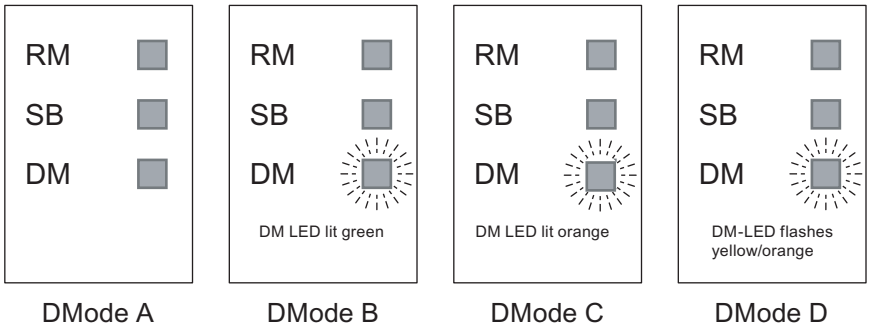


Figure 6-24 Display of the possible display modes (DMode A through DMode D)

The individual functions (RM, SB and DM) are independent of each other. The LED displays are described below:

Label	Color	Status	Meaning
RM		off	The IE Switch X-300 is not operating in redundancy manager mode.
	Green	on	The IE Switch X-300 is operating in redundancy manager mode. The ring is working without problems, monitoring is activated.
		flashes	The IE Switch X-300 is operating in redundancy manager mode. An interruption has been detected on the ring; the IE Switch X-300 has switched through.
SB		off	The standby function is disabled.
	Green	on	The standby function is enabled. The standby link is passive.
		flashes	The standby function is enabled. The standby link is active.
DM		off	Mode A
	Green	on	Mode B
	Orange	on	Mode C
	Yellow/orange	flashes	Mode D

6.6.3.4 LED display of the ports (DMode A through DMode D)

LEDs of the ports

The LED displays of the 10 ports indicate different port states depending on the set display mode. The displays have the same meaning for all ports.

Port statuses in DMode A

In display mode A, the current port status is displayed.

Port	Color	Status	Meaning
P1 P2 P3 P4 P5 P6 P7 P8 P9 P10		off	No valid link to the port (for example station turned off or cable not connected)
	Green	on	Link exists and port in normal status. In this status, the port can receive and send data.
		flashes once per period	Link exists and port in "blocking" status. In this status, the port only receives management data (no user data).
		flashes three times per period	Link exists and port turned off by management. In this status, no data is sent or received over the port.
		flashes four times per period	Port exists and is in the "monitor port" status. In this status, the data traffic of another port is copied to this port.
	Yellow	Flashes / lit	Link exists, port is in normal status and data is being received at the port. The optical gigabit ports of the IE Switch X-300 signal data reception and data transmission.

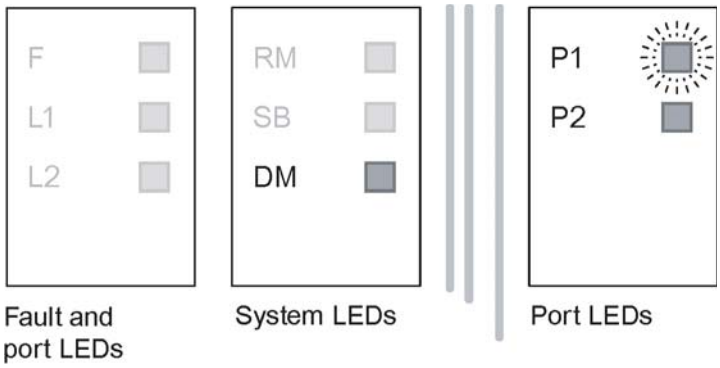


Figure 6-25 Display of the port status of port 1

Port statuses in DMode B

In display mode B, the current transmission rate is displayed.

Port	Color	Status	Meaning
P1 P2 P3 P4 P5 P6 P7 P8 P9 P10		off	Port operating at 10 Mbps
	Green	on	Port operating at 100 Mbps
	Orange	on	Port operating at 1000 Mbps

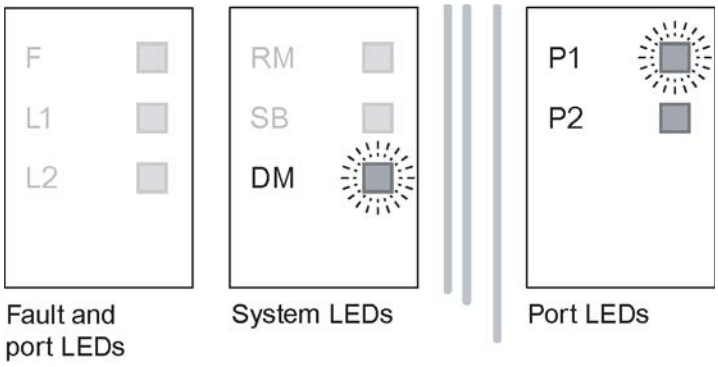


Figure 6-26 Display of the transmission speed of port 1

Note

If there is a link fault and the type of transmission is fixed (autonegotiation off), in DMode B, the desired status, in other words the set transmission rate (1000 Mbps, 100 Mbps, 10 Mbps) continues to be displayed. If there is a link fault and autonegotiation is active, the port LED goes off.

Port statuses in DMode C

In display mode C, the current mode (half duplex, full duplex) is indicated.

Port	Color	Status	Meaning
P1		off	Port operating in half duplex
P2 P3 P4 P5 P6 P7 P8 P9 P10	Green	on	Port operating in full duplex

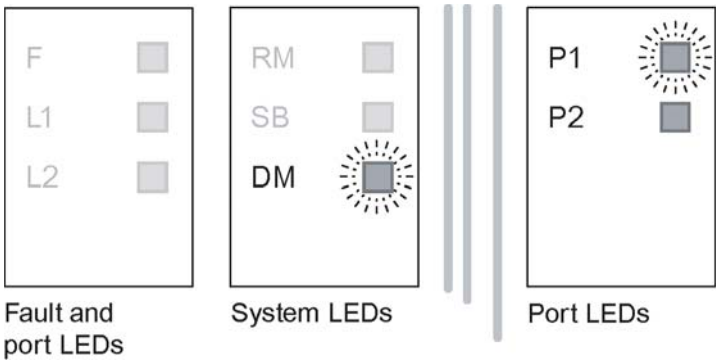


Figure 6-27 Mode display (full / half duplex) of port 1

Note

If there is a link fault and the type of transmission is fixed (autonegotiation off), in DMode C, the desired status, in other words the set type of transmission (full or half duplex) continues to be displayed. If there is a link fault and autonegotiation is active, the port LED goes off.

Port statuses in DMode D

In display mode D, you can see whether or not the port is monitored.

Port	Color	Status	Meaning
P1 P2		off	The port is not monitored; in other words, if a link is not established at the port, this does not trigger the signaling contact.
P3 P4 P5 P6 P7 P8 P9 P10	Green	on	Port is monitored; in other words, if there is no link established at the port (for example cable not plugged in or connected IE Switch X-300 turned off), this triggers the signaling contact and to a fault state.

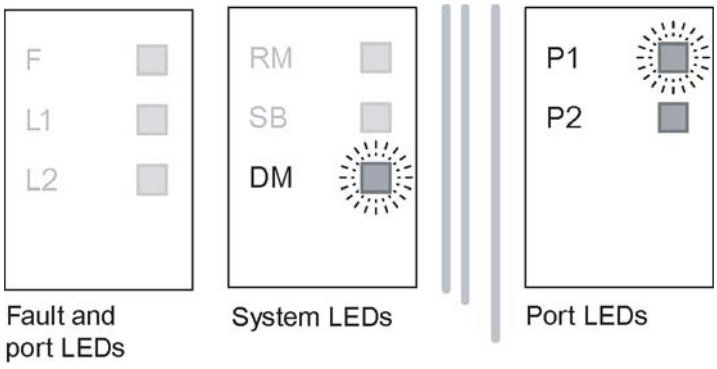


Figure 6-28 Example: Monitoring of port 1 is "on“

6.6.4 Connector pin assignments X-300

Connector pin assignments

The connector pin assignments are identical to those of the other SCALANCE X devices.

See also

Common connector pin assignments of SCALANCE X devices (Page 230)

6.6.5 Dimension drawing

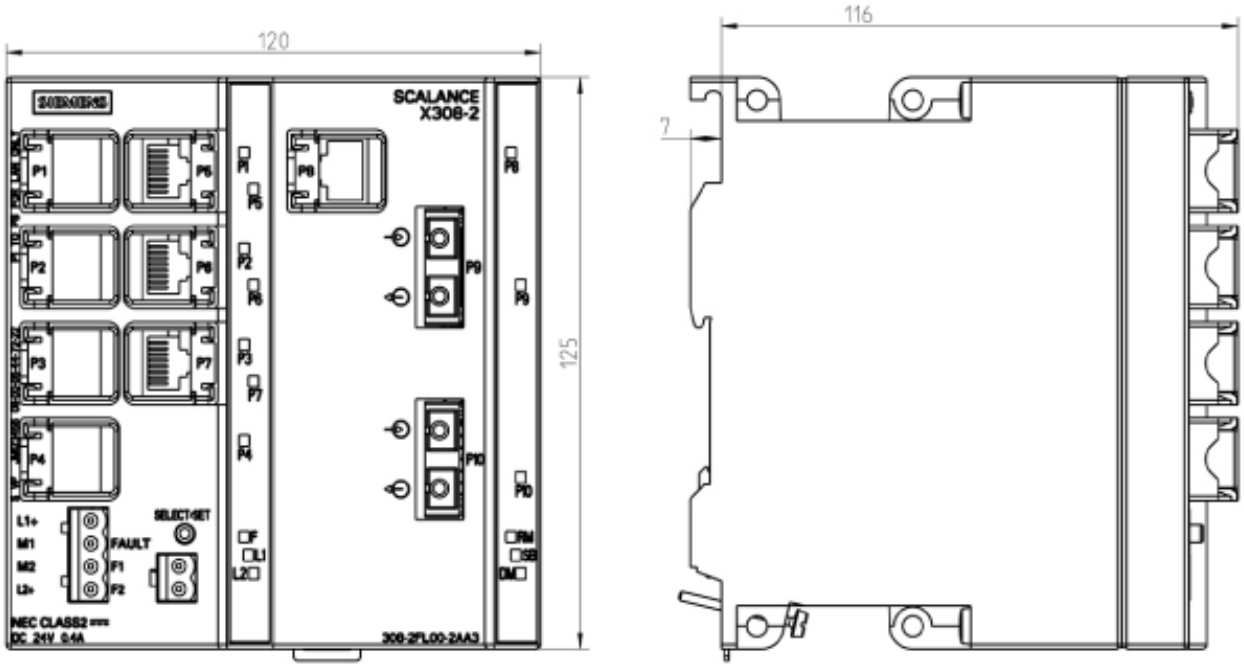


Figure 6-29 Dimension drawing SCALANCE X-300 (here based on the example of the SCALANCE X308-2)

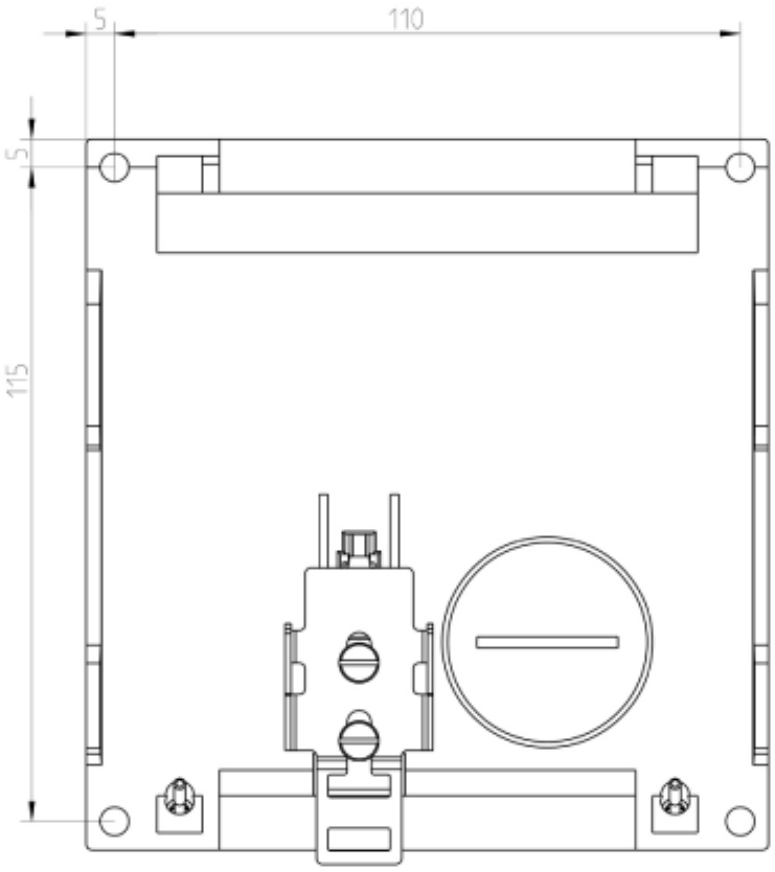


Figure 6-30 Drilling template for the IE Switch X-300

6.6.6 X-300 technical specifications

Device type SCALANCE	Dimensions (W x H x D) in mm	Weight in g	Installation options - DIN rail - S7-300 standard rail - Wall mounting
X310	120 x 125 x 123	1400	+
X308-2	120 x 125 x 123	1400	+
X308-2 LD	120 x 125 x 123	1400	+

Table 6-44 Connectors

Device type SCALANCE	Attachment of end devices or network components over twisted pair	Connecting end devices or network components over fiber-optic	Connector for power supply	Connector for signaling contact
X310	7 x RJ-45 sockets with MDI-X pinning 10/100 Mbps (half/ full duplex) 3 x RJ-45 sockets with MDI-X pinning 10/100/1000 Mbps (half/ full duplex)	-	1x4-pin plug-in terminal block	1 x 2-pin plug-in terminal block
X308-2	7 x RJ-45 sockets with MDI-X pinning 10/100 Mbps (half/ full duplex) 1 x RJ-45 socket with MDI-X pinning 10/100/1000 Mbps (half/ full duplex)	2 SC duplex sockets (1000 Mbps, full duplex to 1000BaseSX)	1 x 4-pin plug-in terminal block	1 x 2-pin plug-in terminal block
X308-2 LD	7 x RJ-45 sockets with MDI-X pinning 10/100 Mbps (half/ full duplex) 1 x RJ-45 socket with MDI-X pinning 10/100/1000 Mbps (half/ full duplex)	2 SC duplex sockets (1000 Mbps, full duplex to 1000BaseLX)	1 x 4-pin plug-in terminal block	1 x 2-pin plug-in terminal block

Table 6-45 Electrical data

Device type SCALANCE	Power supply 2 x 24 V DC (18-32 V DC) Safety extra-low voltage (SELV)	Power loss at 24 V DC	Current consumption at rated voltage	Overcurrent protection at input Non-replaceable fuse (F 3 A / 32 V)
X310	+	9.6 W	400 mA	+
X308-2	+	9.6 W	400 mA	+
X308-2 LD	+	9.6 W	400 mA	+

Table 6-46 Signaling contact

Device type SCALANCE	Voltage at signaling contact	Current through signaling contact
X310	24 V DC	max. 100 mA
X308-2	24 V DC	max. 100 mA
X308-2 LD	24 V DC	max. 100 mA

Table 6-47 Permitted cable lengths (copper)

Device type SCALANCE	0 - 55 m IE TP torsion cable with IE FC RJ-45 Plug 180 or 0 - 45 m IE TP torsion cable with IE outlet RJ-45 + 10 m TP cord	0 - 85 m IE FC TP marine/trailing/ flexible cable with IE FC RJ-45 Plug 180 or 0 - 75 m IE FC TP marine/ trailing/flexible cable + 10 m TP cord over IE FC outlet RJ-45	0 - 100 m IE FC TP standard cable with IE FC RJ-45 plug 180 or over IE FC outlet RJ-45 with 0 - 90 m IE FC TP standard cable + 10 m TP cord
X310	+	+	+
X308-2	+	+	+
X308-2 LD	+	+	+

Table 6-48 Permitted cable lengths (fiber-optic)

Device type SCALANCE	0 - 750 m glass FOC 50/125 µm multimode fiber; 2.5 dB/km at 850 nm 4.5 dB max. permitted FO cable attenuation with 3 dB link power margin	0 - 10000 m glass FOC 9/125 µm single mode fiber; 0.5 dB/km at 1310 nm; 6 dB max. permitted FO cable attenuation with 3 dB link power margin
X310	-	-
X308-2	+	-
X308-2 LD	-	+

Note

Maximum insertion loss of 0.5 dB per SC connector.

Table 6-49 Aging time

Device type SCALANCE	Aging time
X310	30 seconds
X308-2	30 seconds
X308-2 LD	30 seconds

Table 6-50 MTBF

Device type SCALANCE	MTBF
X310	46 years
X308-2	48 years
X308-2 LD	48 years

Table 6-51 Permitted ambient conditions

Device type SCALANCE	Operating temperature	Storage/transport temperature	Relative humidity in operation	Operating altitude at max. xx°C ambient temperature
X310	0 °C through +60 °C	-40 °C through +70 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C
X308-2	0 °C through +60 °C	-40 °C through +70 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C
X308-2 LD	0 °C through +60 °C	-40 °C through +70 °C	‹ 95 % (no condensation)	2000 m at max. 56 °C 3000 m at max. 50 °C

Note

The following applies to IE Switches X-300:

The number of IE Switches X-300 connected in a line influences the frame propagation time.

When a frame passes through an IE Switch X-300, it is delayed by the Store&Forward function of the IE Switch X-300

- with a 64 byte frame length by approx. 10 microseconds (at 100 Mbps)
- with a 1500 byte frame length by approx. 130 microseconds (at 100 Mbps)

This means that the more IE Switch X-300 devices the frame passes through, the longer the frame delay.

6.7 SCALANCE X-400

6.7.1 Certifications and approvals, degree of protection X-400

Certifications

	SCALANCE X408-2, X414-3E
c-UL-us (Information Technology Equipment)	UL 60950-1; CSA C22.2 No. 60950-1-03
c-UL-us (Industrial Control Equipment)	UL 508; CSA C22.2 No. 14-M91
c-UL-us for hazardous locations	UL 1604, UL 2279Pt.15
FM	FM 3611
C-Tick	AS/NZS 2064 (Class A)
CE	EN 61000-6-2, EN 61000-6-4
ATEX Zone 2	EN 50021

Degree of protection

Tested to IP20.

Order numbers

SCALANCE X414-3E	6GK5414-3FC00-2AA2
SCALANCE X408-2	6GK5408-2FD00-2AA2

See also

General information on approvals and certifications (Page 230)

6.7.2 Overview of X408-2

Design of the SCALANCE X408-2

Figure 6-31 SCALANCE X408-2

SCALANCE X-400 products are designed for installation in switching cubicles and have degree of protection IP20. The installation width of the X408-2 basic device is 9 inches.

The SCALANCE X408-2 basic device consists of a basic module with the following permanently installed modules:

- Slot 2: A power supply module for supplying the SCALANCE X408-2 with 24 V DC; redundant 24 V supply is possible. The module also provides a floating signal output for simple display of disruptions.
- Slot 3: A dummy module for the following LED displays: RM, STBY, DM1, DM2.

Slots 4 and 7 are covered by dummy modules and have no function.

The following ports are located on the basic module:

- Slots 5 and 6: Each slots for an optical Fast Ethernet media module each with 2 ports.
- In slots 5 and 6: Each with two RJ-45 jacks allowing connection of electrical (twisted pair) connections at 10/100/1000 Mbps.
  As an option, slots 5 and 6 can be used for an optical gigabit module with two ports.
- In slot 8: Four RJ-45 jacks for electrical (twisted pair) connections (10, 100 Mbps). These cannot be used by media modules. Here, there is also a D-sub socket (RS-232) as configuration and diagnostics port.

6.7.3 Overview of the X414-3E

Design of the SCALANCE X414-3E

SCALANCE X-400 products are designed for installation in switching cubicles and have degree of protection IP20. The installation width of the SCALANCE X414-3E with extender is 19 inches.

Figure 6-32 Basic device without media modules, protective caps and covers

The SCALANCE X414-3E consists of a frame with basic module. This has the following slot numbering:

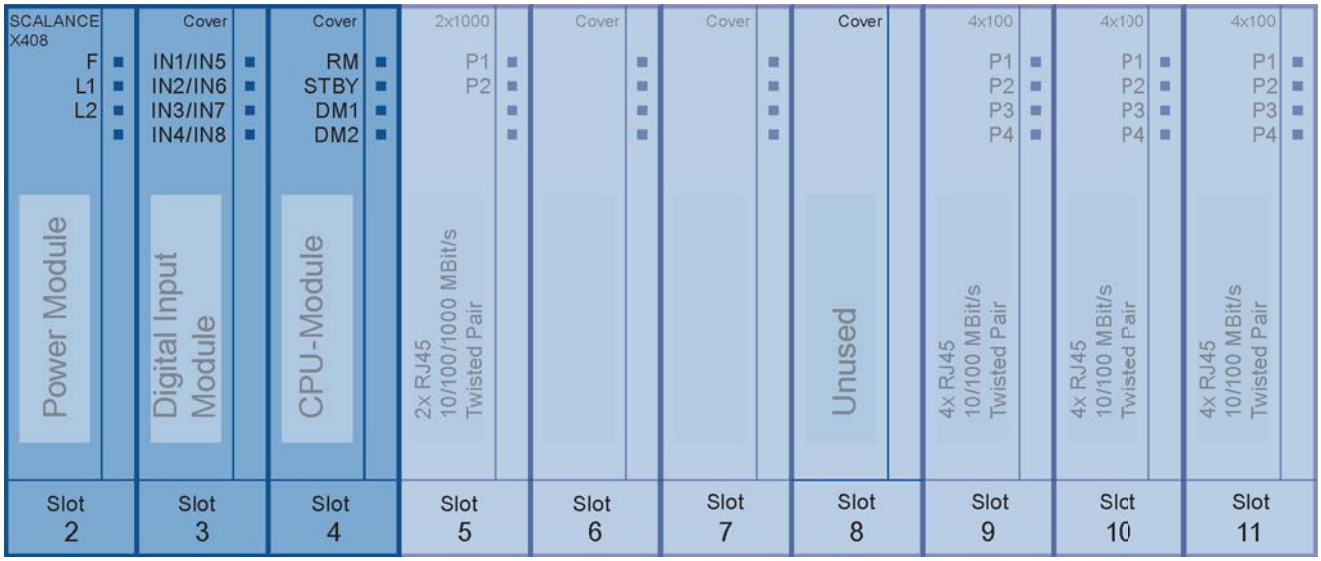


Figure 6-33 Basic device X414-3E without media modules with existing ports

As default, the following modules are inserted:

- Slot 2: A power supply module for supplying the SCALANCE X414-3E with 24 V DC; redundant 24 V supply is possible. The module also provides a floating signal output for simple display of disruptions.
- Slot 3: A module with 8 floating inputs for acquiring digital status information, such as signaling contacts from PROFIBUS OLMs or door contacts and forwarding via SCALANCE X-400 diagnostics methods (LED display, log table, trap or E-mail)
- Slot 4: A CPU module responsible for the management of the SCALANCE X414-3E

The following ports are located on the basic module:

- In slot 5: Two integrated Gigabit Ethernet twisted-pair ports (10, 100 or 1000 Mbps, RJ-45 jacks) for interconnecting the SCALANCE X-400 switches. Slot for an optical gigabit Ethernet media module with 2 ports; when this module is inserted, the two RJ-45 gigabit Ethernet twisted-pair ports on the same slots cannot be used.
- Slots 6 and 7: Each slots for an optical Fast Ethernet media module each with 2 ports.
- In slots 9 to 11: 12 integrated Fast Ethernet twisted-pair ports (10 or 100 Mbps, RJ-45 jacks),
- An extender expansion port

Using this extender expansion port, the X414-3E can be expanded with the twisted-pair extender EM495-8 by a further 8 Fast Ethernet ports:

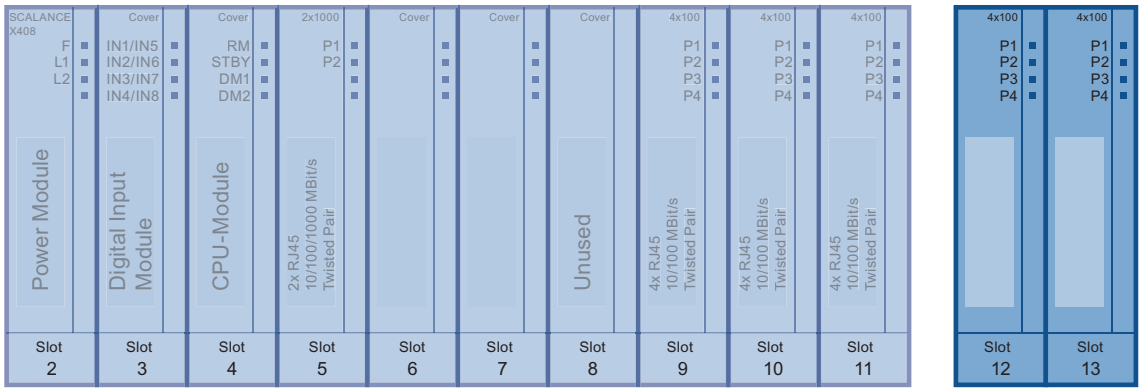


Figure 6-34 Basic device with twisted pair extender module

Using the media module extender EM496-4, an expansion of 4 ports for media modules is possible, so that up to 8 optical Fast Ethernet ports (100 Mbps) are available:

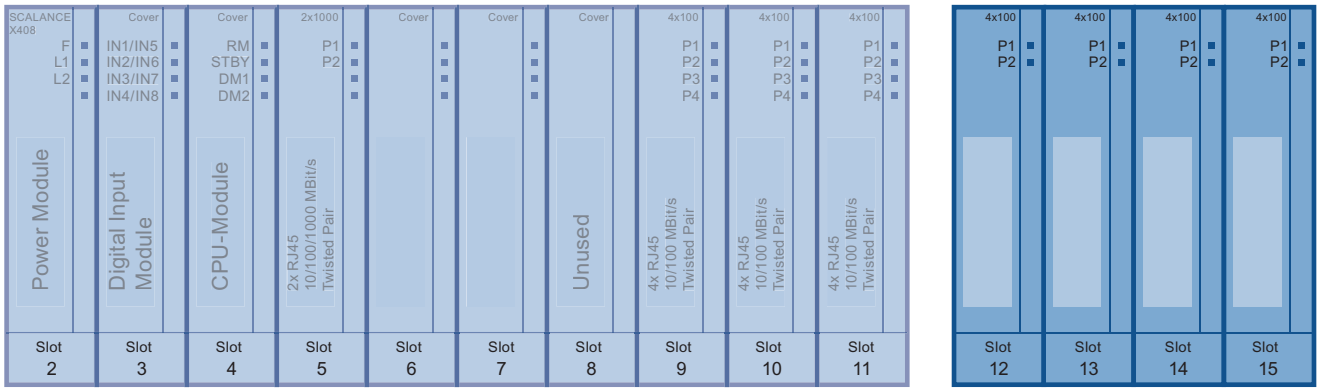


Figure 6-35 Basic device with media module extender

The media module plug connectors are protected by protective caps.

Both the installation of the media module extender and removal or insertion of the media modules is possible during operation. For data transfer via the extender module EM496-4, at least one media module is required.

The SCALANCE X414-3E also has the following ports:

- Serial port
- Console port (Ethernet twisted-pair port) for on-site parameter assignment/diagnostics, for firmware update and for standby synchronization
- Slot for optional C-PLUG exchangeable medium for simple device replacement (ships with the product; it is located on the CPU module below the labeling strip)

Serial port

The CPU module of the SCALANCE X414-3E has an RS-232 port. This is used for the following purposes:

- Firmware updates
- Management with the aid of the command interpreter (Command Line Interpreter, CLI) including setting of the IP address information.

Input to the command interpreter is over command lines.

For more detailed information, refer to the Configuration Manual - SCALANCE X-400 Industrial Ethernet Switches.

Console port (Ethernet twisted-pair port)

On the bottom panel of the CPU module of the SCALANCE X414-3E, there is an 8-pin RJ-45 jack. This Ethernet interface can be used for productive communication with other switches or end devices. This is used for the following purposes:

- Configuration
- Commissioning

The SCALANCE X414-3E can be configured either locally or over a network. For more detailed information, refer to the Configuration Manual - SCALANCE X-400 Industrial Ethernet Switches.

6.7.4 X-400 installation instructions and guidelines

6.7.4.1 Installing / uninstalling the SCALANCE X-400

Notes on installation

IE Switches X-400 are designed for installation on an S7-300 standard rail and installation on a 35 mm DIN rail.

You will find general information on this in the section on installing SCALANCE X-100 devices.

Clearances

Certain minimum clearances between an IE Switch X-400 and neighboring equipment must be taken into account. These minimum clearances are necessary during installation and operation to allow the following:

- Install and remove modules,
- To allow the flow of air required for heat dissipation during operation of the IE Switches X-400.

The following figure shows the space you need to allow for an IE Switch X-400.

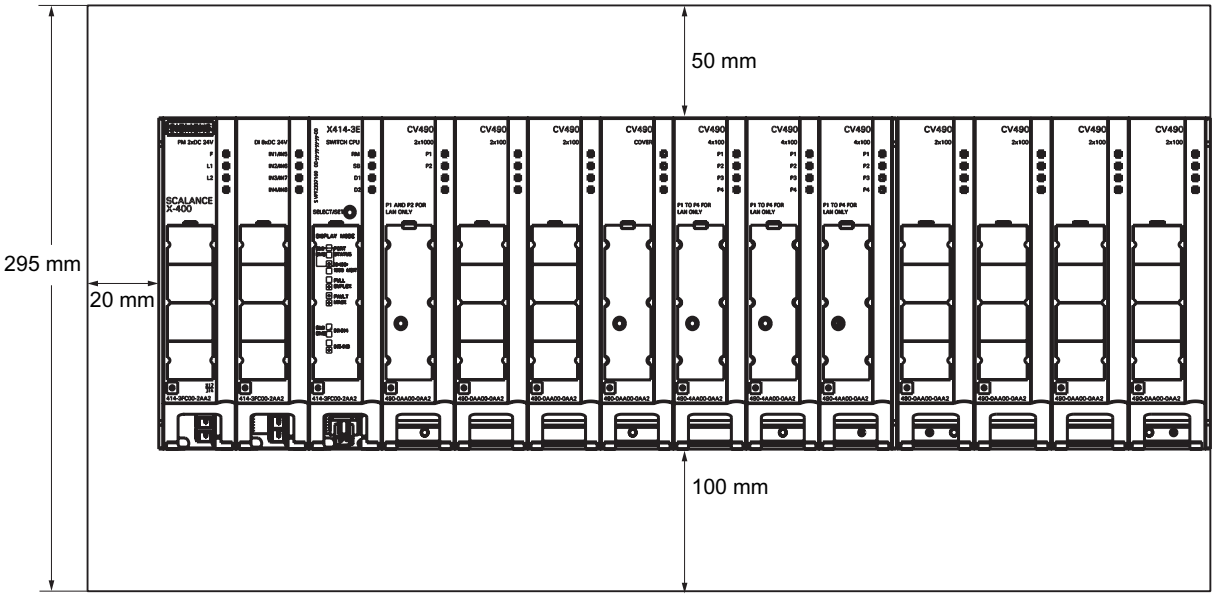


Figure 6-36 Installation clearances for the IE Switches X-400 based on the example of a SCALANCE X414-3E with extender module

See also

X-100 installation instructions and guidelines (Page 237)

6.7.4.2 Installing / uninstalling with a 35 mm DIN rail

Installation on a 35 mm DIN rail

⚠ CAUTION
If the IE Switch X-400 is liable to be subjected to severe vibration (> 10 g), use the S7-300 standard rail for installation. The DIN rail does not provide adequate support for the IE Switch X-400 with vibration greater than 10 g.

Since the two captive screws are not used to secure the device when installing on a 35 mm DIN rail, it is not absolutely necessary to remove the covers and the blind cover, although this does make it easier to handle the basic device.

NOTICE
When installing the IE Switch X-400, hold it by the backplane and not by the modules, otherwise the device may be damaged.

To install the device, follow the steps below:

1. Place the central groove containing two spring clips on the back of the basic device on the upper edge of the DIN rail with the device tilted slightly towards the back. Note that both spring clips must be located behind the edge of the DIN rail.
2. Press the basic device down and push in the lower part until you hear it click into place in the DIN rail.
3. Adjust the basic device to the right or left until it is in the required position.

Note

Only horizontal installation permitted (ventilation slit top/bottom).

Figure 6-37 Installing the SCALANCE X414-3E on a 35 mm DIN rail

Removing the SCALANCE X414-3E from a 35 mm DIN rail

Since the two captive screws are not used to secure the device when removing from a 35 mm DIN rail, it is not absolutely necessary to remove the covers and the blind cover, although this does make it easier to handle the basic device.

NOTICE
When uninstalling the SCALANCE X414-3E, hold it by the backplane and not by the modules, otherwise the device may be damaged.

To remove the device, follow the steps below:

1. Push the basic device down until the lower part can be pulled away from the rail to the front.
2. Lift the IE Switch X-400 up and off the DIN rail.

Removing the SCALANCE X408-2 from a 35 mm DIN rail

Since the two captive screws are not used to secure the device when removing from a 35 mm DIN rail, it is not absolutely necessary to remove the covers and the blind cover, although this does make it easier to handle the basic device.

NOTICE
When uninstalling the SCALANCE X408-2, hold it by the backplane and not by the modules, otherwise the device may be damaged.

To remove the device, follow the steps below:

1. Using a slotted screwdriver with a 5.5 mm wide blade, pull down the clip on the basic device slightly and pull out the lower part of the basic device to the front so that the spring clips can no longer engage.
2. Lift the IE Switch X-400 up and off the DIN rail.

Figure 6-38 Removing the SCALANCE X408-2 from a 35 mm DIN rail

6.7.4.3 Fitting / removing a cover/dummy cover

Variants of the covers/dummy cover

There are three variants of the covers

- CV490 2x1000
  1 Gbps, electrical transmission, 2 port displays
  possible slots:

SCALANCE X414-3E: 5
SCALANCE X408-2: 5 and 6

- CV490 2x100
  possible slots
  SCALANCE X414-3E: 6, 7 and extender module EM496-4 slots 12 through 15
- CV490 4x100
  10/100 Mbps, electrical transmission, 4 port displays
  possible slots
  SCALANCE X414-3E: 9 through 11 and extender module EM495-8 slots 12, 13
  SCALANCE X408-2: 8

There is a dummy cover

- CV490 COVER
  (no displays connected to front)
  possible slots
  SCALANCE X414-3E: 8
  SCALANCE X408-2: 4 and 7

Fitting a cover/dummy cover

There is only a dummy cover (no port displays to the front) on slot 8 (SCALANCE X414-3E) or slot 7 (SCALANCE X408-2).

To fit a cover, you do not require any tools.

1. Place the two lower guides of the cover/dummy cover into the recesses at the lower edge of the basic device. It should no longer be possible to move the cover/dummy cover to the side.
2. Tilt the cover/dummy cover at an angle towards the back until the two plastic pins at the back top edge of the cover/dummy cover jut into the recesses in the basic device.
3. Press the upper part of the cover/dummy cover onto the basic device until the fluted middle section of the cover/dummy cover is heard to click into place.
4. Secure the labeling strip on the front of the cover/dummy cover.

Removing a cover/dummy cover

To remove a cover, you do not require any tools.

1. Press on the fluted middle section of the top of the cover/dummy cover next to the backplane.
2. At the same time, tilt the cover/dummy cover down at an angle, the two guides initially remain in the recesses at the lower edge of the basic device.
3. Remove the cover/dummy cover by pulling it upwards.

6.7.5 X-400 operator controls and displays

6.7.5.1 X-400 display elements

Display elements:

Depending on the display mode, the LEDs have the following meaning. To set the display mode, press the SELECT / SET button on the CPU module until the DM1 and DM2 LEDs light up on the CPU in the required combination. The selected display mode is then activated. There is an automatic switchover to Dmode A if the button is not pressed for longer than one minute.

The following table shows the states indicated by the LEDs in the various display modes. You will find detailed information in the Operating Instructions SCALANCE X-400 Industrial Ethernet Switches.

	LED	Display mode A	Display mode B	Display mode C	Display mode D
Power module for X414-3E and X408-2	F	Problem, signaling contact opens			
	L1	Power supply L1 is applied. No monitoring with the signaling contact.			Power supply L1 is monitored
	L2	Power supply L2 is applied. No monitoring with the signaling contact.			Power supply L2 is monitored
DI module only for X414-3E	IN1/IN5	Signal at input IN1	Signal at input IN5	Signal at input IN1	Signal at input IN5
	IN2/IN6	Signal at input IN2	Signal at input IN6	Signal at input IN2	Signal at input IN6
	IN3/IN7	Signal at input IN3	Signal at input IN7	Signal at input IN3	Signal at input IN7
	IN4/IN8	Signal at input IN4	Signal at input IN8	Signal at input IN4	Signal at input IN8
Switch CPU for X414-3E and X408-2	RM	Device is operating as RM			
	STBY	Device is in standby mode			
	DM1	off	on	off	on
	DM2	off	off	on	on
Ports for X414-3E and X408-2	P1	Port status	Transmission rate	Half / full duplex	Fault mask
	P2				
	P3				
	P4				

While the device is starting up, the red LED on the power module indicates the current status of the device. For more detailed information, refer to the following table:

	LED on	LED off	LED flashing
During device startup	Device starts or a fault/error was detected	Device startup successful	Error in keyboard input over serial interface or bad firmware image
During operation	Fault/error detected	Operation not OK	

6.7.5.2 SELECT / SET button

Function

The SELECT / SET button is used to switch over the display modes (DMode) and to make other settings. After turning on the IE Switch X-400, it is in DMode A.

The button has the following functions:

- Changing the display modes
  By pressing the button briefly, you change from one display mode to the next. The selected mode or current status is displayed by the LEDs (D1, D2).
- Resetting to the factory defaults
  It is possible to restore some of the factory defaults in DMode A. You do this by pressing the button for 12 seconds. You can cancel the reset procedure by releasing the button before the 12 seconds have elapsed. All previously made settings are overwritten by the factory defaults.
- Defining the fault mask and the LED displays
  It is possible to set the fault mask in DMode A and DMode D. This allows you to specify the mask for signaling faults by defining an individual "good status" for the connected ports and the power supplies. In this case, you press the button for 5 seconds in DMode A or DMode D. After 3 seconds, the two LEDs (D1 and D2) start to flash. You can cancel the procedure by releasing the button before the 5 seconds have elapsed. If, however, you press the button for a further 2 seconds, the current states of all ports and the states of the power supplies L1 and L2 are included in the fault mask. The previous fault mask is then overwritten.
- Activating/deactivating the redundancy manager
  It is only possible to activate/deactivate the RM in DMode B. You do this by pressing the button for 5 seconds. After 3 seconds, the two LEDs (D1 and D2) start to flash. If you release the button before the 5 seconds have elapsed, the action is aborted. After 5 seconds the redundancy manager is activated/deactivated. If the redundancy manager as well as ring redundancy were deactivated, ring redundancy is also activated at the same time. If you deactivate, only the redundancy manager is deactivated.

6.7.5.3 DIL switches of the SCALANCE X-414-3E

Meaning of the DIL switches

The RM switch allows you to configure the SCALANCE X414-3E as a redundancy manager in a ring with redundancy manager.

Note

Only the SCALANCE X414-3E basic device has DIL switches.

Ring redundancy can be configured with these DIL switches. These settings are made in the software for the SCALANCE X408-2 basic device. On the SCALANCE X408-2, the RM can also be enabled / disabled with the SET/SELECT button. For more detailed information, refer to the configuration manual "SCALANCE X-300 SCALANCE X-400 Industrial Ethernet Switches".

Changing the switch settings during operation causes fault displays and activates the signaling contact. The settings are adopted only after the device is restarted.

Configuration options

Below the labeling strip on the CPU module on slot 4, there are four DIL switches. These DIL switches can have one of two states (*ON* / *OFF*).

Figure 6-39 Power module, digital inputs and CPU module with operator controls on the SCALANCE X414-3E

- The RM switch allows you to configure the SCALANCE X414-3E as a redundancy manager in a ring with redundancy manager. When using a SCALANCE X408-2, this setting is made in the software or using the SELECT/SET button.
- The STBY switch is reserved for future functionality and does not currently have any function.
- With switches R1 and R2, you can specify either the two ports in slot 5, the two ports in slot 6 or the first ports of slots 6 and 7 as ring ports. When both switches are set to ON, ring redundancy is configured by the software as with the SCALANCE X408-2.

Switch	Status	Meaning
RM	OFF	SCALANCE X414-3E is not a redundancy manager.
	ON	SCALANCE X414-3E is a redundancy manager.
- -		No function.
R1	OFF	Ports in slot 5 (gigabit ports) are ring ports.
R2	OFF	
R1	ON	Ports 1 and 2 of slot 6 are ring ports.
R2	OFF	.
R1	OFF	Port 1 of slot 6 is first ring port.
R2	ON	Port 1 of slot 7 is second ring port.
R1	ON	Setting ring redundancy with software
R2	ON	

When shipped from the factory, all DIL switches are set to OFF.

Using the C-PLUG

C-PLUG settings overwrite the DIL switches during startup

Ring ports on slots 5 to 7

NOTICE

When supplied, the DIL switches R1 and R2 on the **SCALANCE X414-3E** are set to OFF. As a result, the gigabit ports on slot 5 are defined as ring ports and ring redundancy is therefore enabled. In this case, you cannot enable rapid spanning tree / spanning tree. For more detailed information, refer to the configuration manual "SCALANCE X-300 SCALANCE X-400 Industrial Ethernet Switches".

If R1 and R2 are set to OFF, the two gigabit ports of slot 5 are selected as ring ports.

Note

If the SCALANCE X414-3E is operated without media modules, R1 and R2 must be set to OFF, otherwise ports in slots 6 and 7 will be defined as ring ports that are only available when media modules are plugged in.

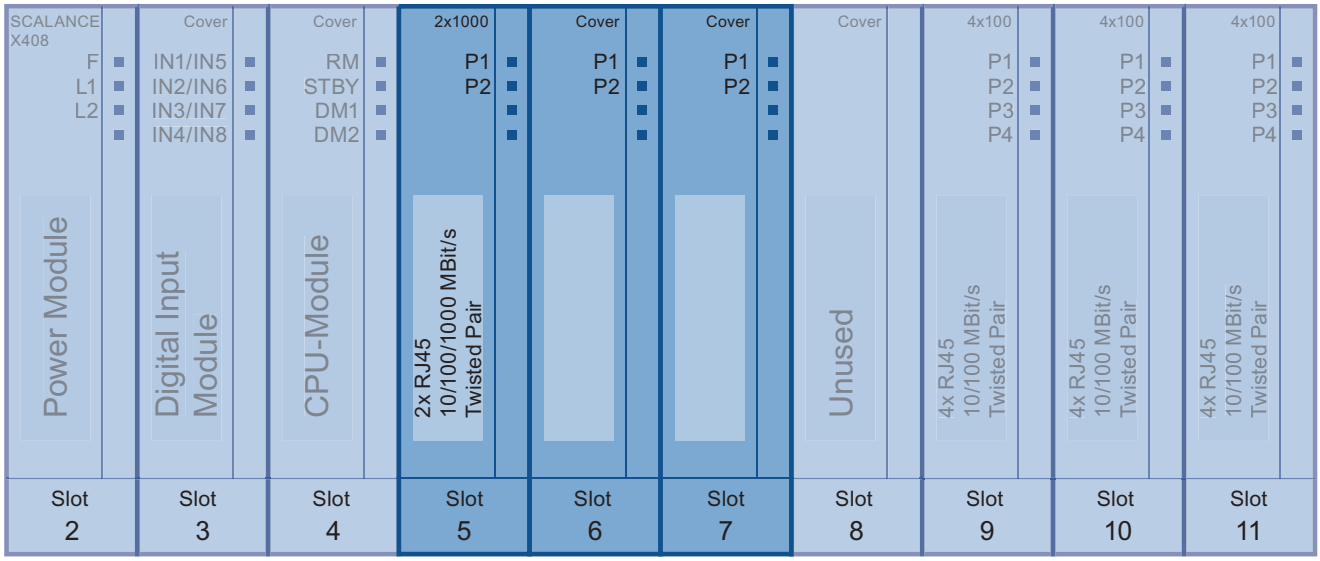


Figure 6-40 Ring ports that can be defined with switches R1 and R2

Possible settings of the ring ports

Note

Only two ports of a switch can ever be defined as ring ports. All other ports in slots 6 and 7 that are not defined as ring ports can be used for the optical connection of nodes or subnets.

- Switch 1:
  In the schematic below, switches R1 and R2 are set to OFF.
- Switch 2:
  In the schematic below, switch R1 is set to ON and R2 to OFF.
- Switch 3:
  In the schematic below, switch R1 is set to OFF and R2 to ON.

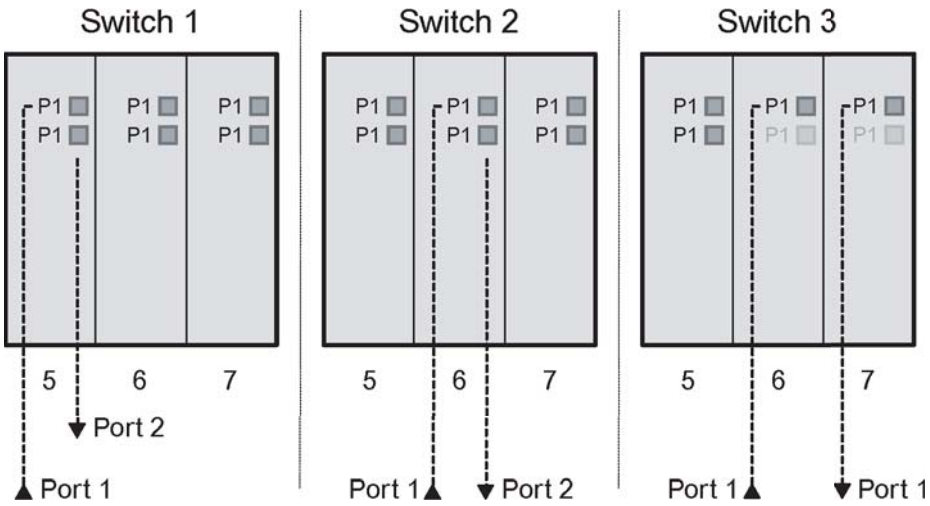


Figure 6-41 The three possible settings for ring ports with R1 and R2

6.7.6 Connector pin assignments X-400

6.7.6.1 Connectors for the twisted pair cables

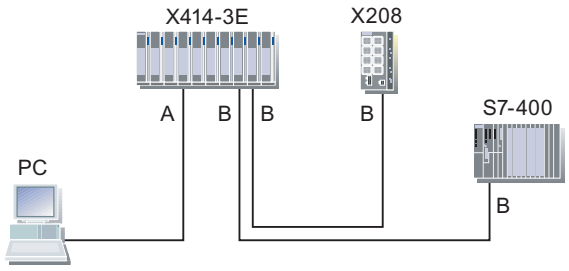
The FastConnect cabling system

With the IE FC RJ-45 Plug and the FastConnect cables (FC), you can achieve a segment length up to 100 m without patching. In this case, the IE FC standard cable 2x2 is connected directly to the SCALANCE X414-3E and other components on the network.

Two FastConnect cable types are available, the eight-wire IE FC standard cable 4x2 and the four-wire IE FC standard cable 2x2.

The diameter of the IE FC standard cable 4x2 does not allow connection to an RJ-45 plug so that only the IE FC standard cable 2x2 as a four-wire cable is suitable for RJ-45 plugs. This means that the maximum transmission rate is 100 Mbps.

The flexible eight-wire patch cable (TP cord) for gigabit transmission allows a maximum cable length of 10 m.



A = 10 m
B = 100 m

Figure 6-42 FastConnect cabling
A TP cord (1 Gbps)
B IE FC standard cable 2x2 (100 Mbps)

Connecting TP cord to FC cable

To connect TP Cord to FC cables, two IE FC RJ-45 modular outlet insert types are available:

- IE FC RJ-45 modular outlet insert 1GE
  1 RJ-45 jack with 4x2 wire cable for 1 Gbps
- IE FC RJ-45 modular outlet insert 2FE
  2 RJ-45 jacks each with 2x2 wire cable for 100 Mbps

With the IE FC RJ-45 modular outlet insert 1GE, the eight-wire FastConnect cable allows a transmission rate of 1 Gbps.

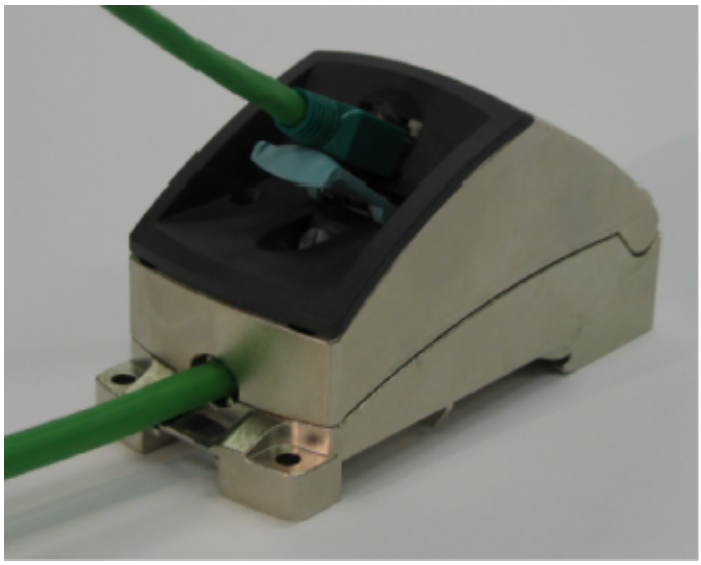


Figure 6-43 IE FC RJ-45 modular outlet insert 1GE

With the IE FC RJ-45 modular outlet insert 2FE, the eight-wire FastConnect cable is split over two RJ-45 jacks and allows a transmission rate of 2 x 100 Mbps.

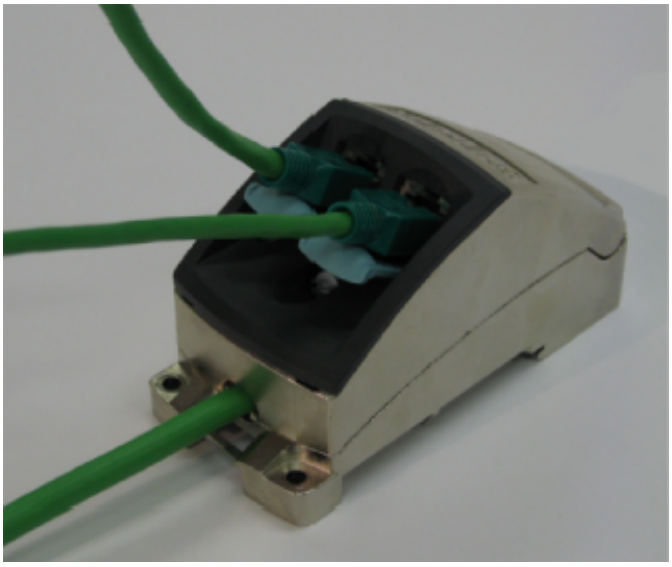


Figure 6-44 IE FC RJ-45 modular outlet insert 2FE

The maximum segment length of 100 m also applies when using the FastConnect cabling with TP cord. Normally, FastConnect cable with a length of 90 m is used. The remaining 10 m is then available for TP cord at both ends (total of 10 m).

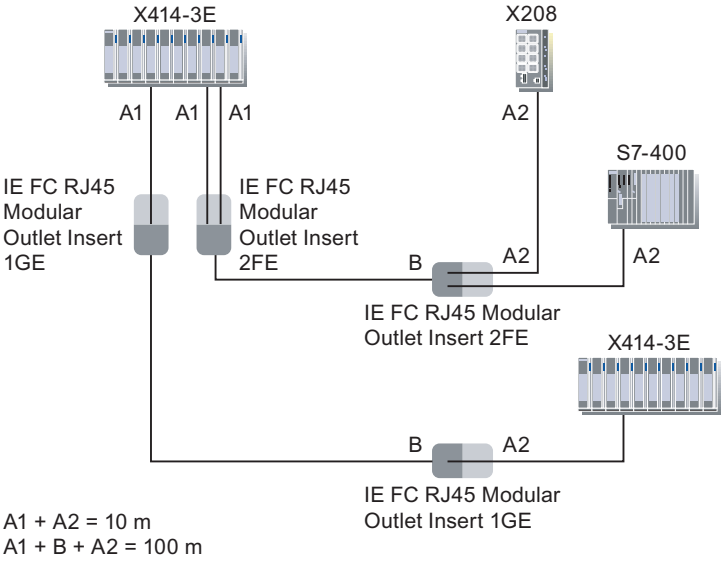


Figure 6-45 FastConnect cabling
A1 TP cord 4x2
A2 TP cord 4x2
B IE FC standard cable 4x2

Removing the FC cable from IE Switches X-400

Under some circumstances, a screwdriver is necessary to remove the twisted pair cables with RJ-45 plugs because it may not be possible to reach the connector with your hand due to neighboring media modules, covers, or the dummy cover.

If this is the situation, do the following:

1. Press the catch on the RJ-45 plug to the left with a small screwdriver.
2. Remove the cable.

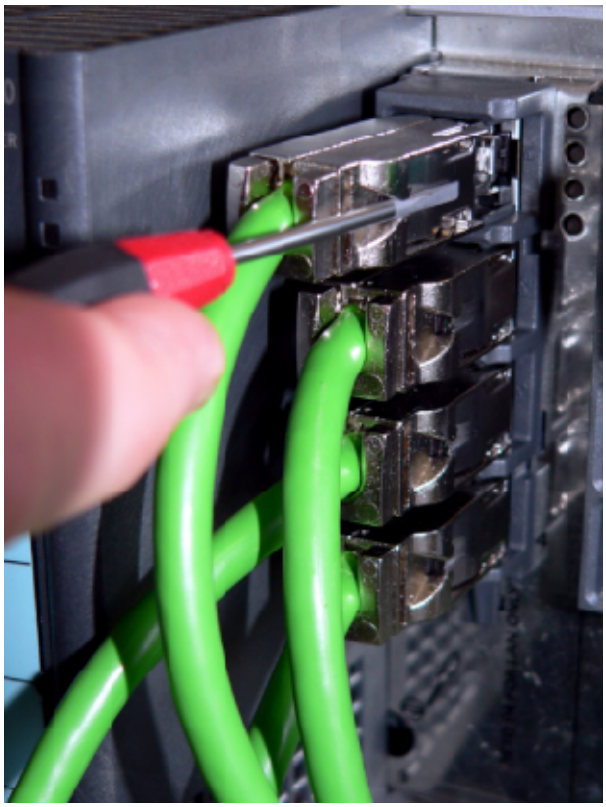


Figure 6-46 Unlocking the FastConnect RJ-45 plug

6.7.6.2 Connectors for fiber-optic cables

Gigabit transmission with FOC

Data transmission at 1 Gbps is over multimode FOC or single mode FOC. In both cases, the fiber-optic cable is plugged into the SC duplex socket with the SC duplex plug. The connectors have polarity reversal protection mechanisms.

When a media module is inserted, port 1 is to the front and port 2 to the rear.

NOTICE
Fiber-optic cable connectors are susceptible to contamination and mechanical damage to the face. Protect open connections with the supplied dust caps.

Figure 6-47 SC duplex plug with gigabit media module MM492-2LD

Fast Ethernet transfer with FOC

Data transmission at 100 Mbps is over multimode FOC or single mode FOC. In both cases, the BFOC plug on the fiber-optic cable is plugged into the BFOC socket. When using the LH module, SC duplex sockets are used as the connectors.

When a media module is inserted, the front two sockets belong to port 1 and the two back sockets to port 2. The front socket is the input and the rear socket the output socket of the respective port. Behind the labeling strip on the front of the media module, you will see the relevant symbols.

NOTICE
Fiber-optic cable connectors are susceptible to contamination and mechanical damage to the face. Protect open connections with the supplied dust caps.

Figure 6-48 BFOC plug with Fast Ethernet media module MM491-2

6.7.6.3 Connectors of the power supply (X1) of the SCALANCE X-400

Polarity reversal protection X1, X2

The two 4-pin male connectors (X1, X2) for the power supply and the signaling contact have no polarity reversal protection. If the connectors are accidentally swapped over, this does not cause damage or destroy circuits. Normal functionality is, however, not available while the connectors are swapped over.

Connectors of the power supply (X1)

The redundant power supply is connected over a 4-pin connector at the front terminal block on the power module.

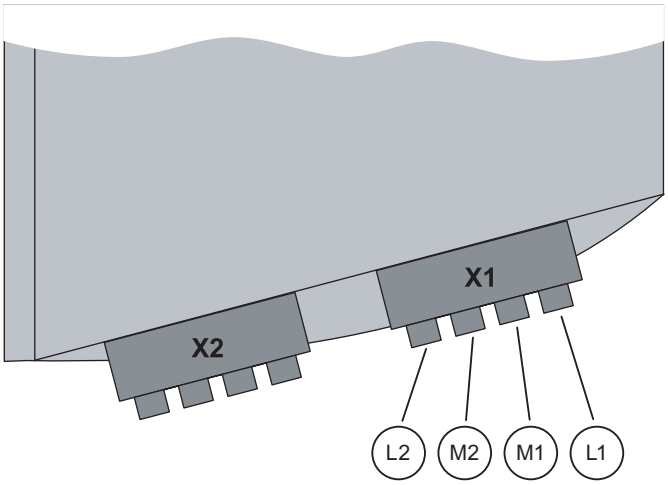


Figure 6-49 Pins of connector X1

Conn. 1	L1+	+ 24 V power supply 1
	M1	Ground
	M2	Ground
	L2+	+ 24 V power supply 2

CAUTION
If IE Switches X-400 are supplied over long 24 V power supply lines or networks, measures are necessary to prevent interference by strong electromagnetic pulses on the supply lines. These can result, for example, due to lightning or switching of large inductive loads. One of the tests used to attest the immunity of devices of the IE Switches X-400 to electromagnetic interference is the "surge immunity test" according to EN61000-4-5. This test requires overvoltage protection for the power supply lines. A suitable device is, for example, the Dehn Blitzductor VT AD 24 V type no. 918 402 or comparable protective element. Manufacturer: DEHN+SÖHNE GmbH+Co.KG, Hans-Dehn-Str.1, Postfach 1640, D-92306 Neumarkt, Germany.

6.7.6.4 Connectors of the signaling contact and grounding strap (X2) of the SCALANCE X-400

Polarity reversal protection X1, X2

The two 4-pin male connectors (X1, X2) for the power supply and the signaling contact have no polarity reversal protection. If the connectors are accidentally swapped over, this does not cause damage or destroy circuits. Normal functionality is, however, not available while the connectors are swapped over.

Connectors of the signaling contact and grounding strap (X2)

The signaling contact is connected by contacts MK1 and MK2 on the 4-pin connector to the rear terminal block on the power module.

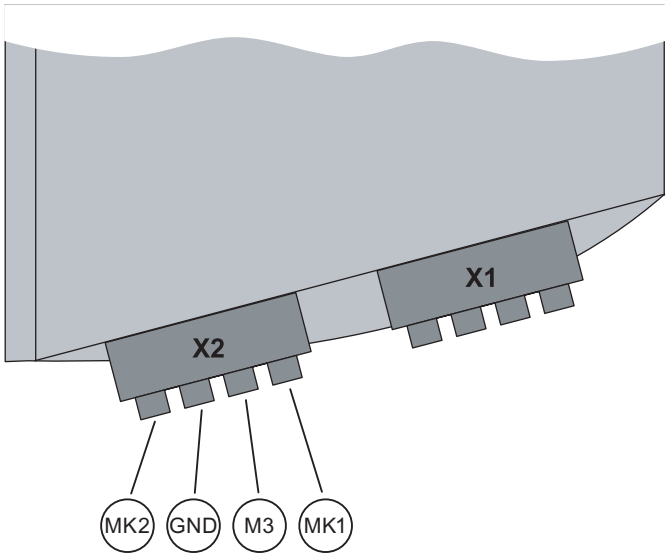


Figure 6-50 Pins of connector X2

By inserting a strap between protective earth GND and M3, IE Switches X-400 can be operated with grounded reference potential.

When the device ships, no strap is fitted (non-grounded reference potential).

Conn. 2	MK1	Floating signaling contact relay connector 1
	M3	Ground
	GND	Protective earth
	MK2	Floating signaling contact relay connector 2

6.7.6.5 Connectors of the digital inputs (X2) of the SCALANCE X414-3E

Ports

Digital inputs 5 through 8 are connected using a 5-pin connector at the rear terminal block on the DI module.

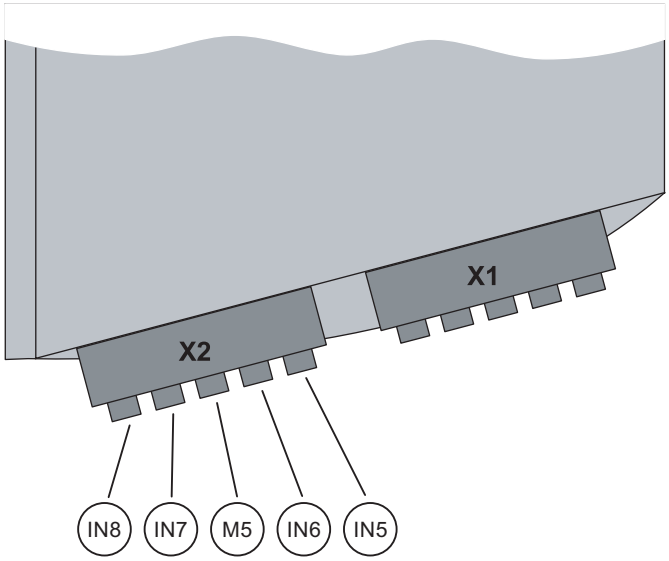


Figure 6-51 Pins of connector X2 (inputs 5-8)

Conn. 2	IN5	Digital input 5
	IN6	Digital input 6
	M5	Ground
	IN7	Digital input 7
	IN8	Digital input 8

6.7.6.6 Note

Note the following:

You should also compare the general connector pin assignments for SCALANCE X devices.

See also

Common connector pin assignments of SCALANCE X devices (Page 230)

6.7.7 Dimension drawings X-400

6.7.7.1 SCALANCE X408-2

Dimension drawings for the SCALANCE X408-2

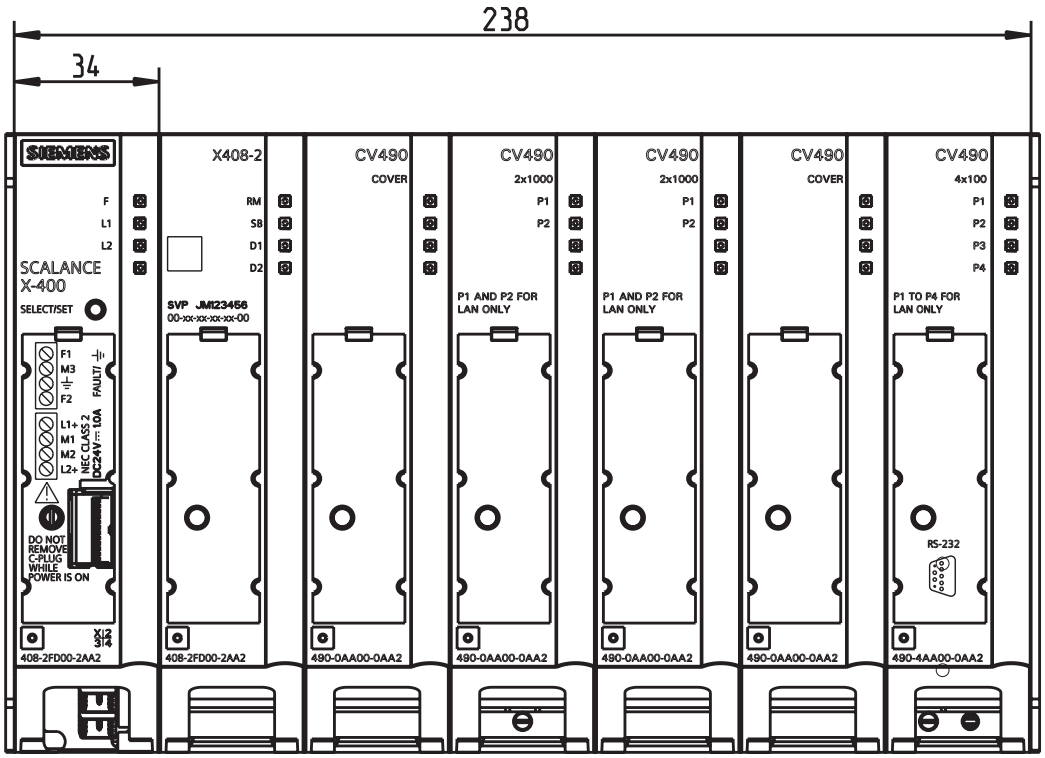


Figure 6-52 SCALANCE X408-2 front

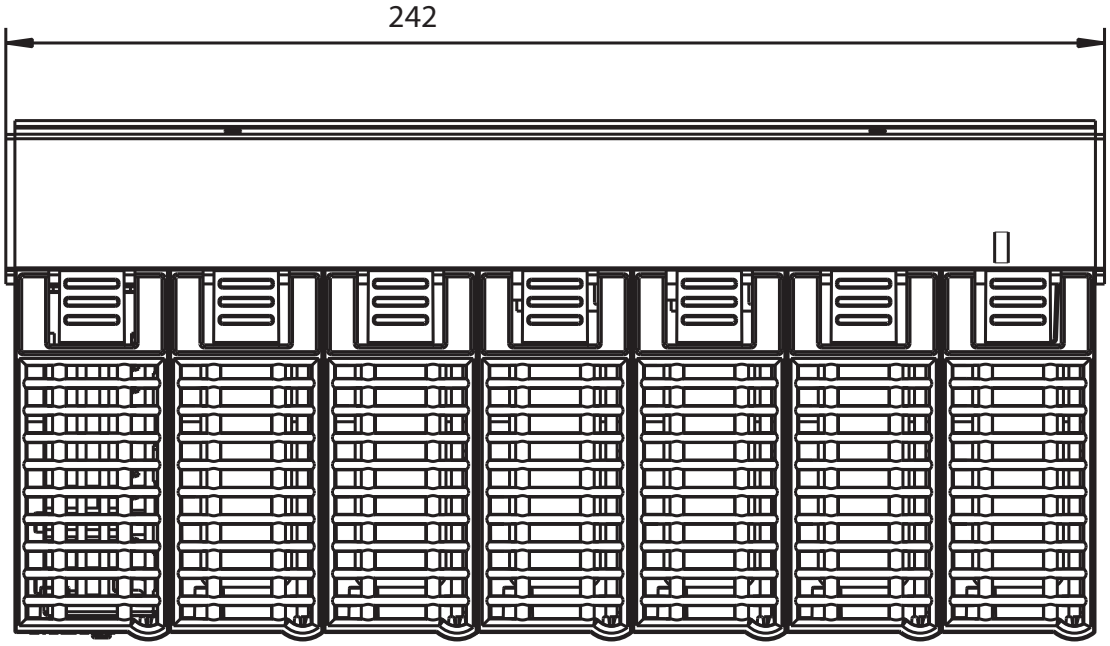


Figure 6-53 SCALANCE X408-2 top

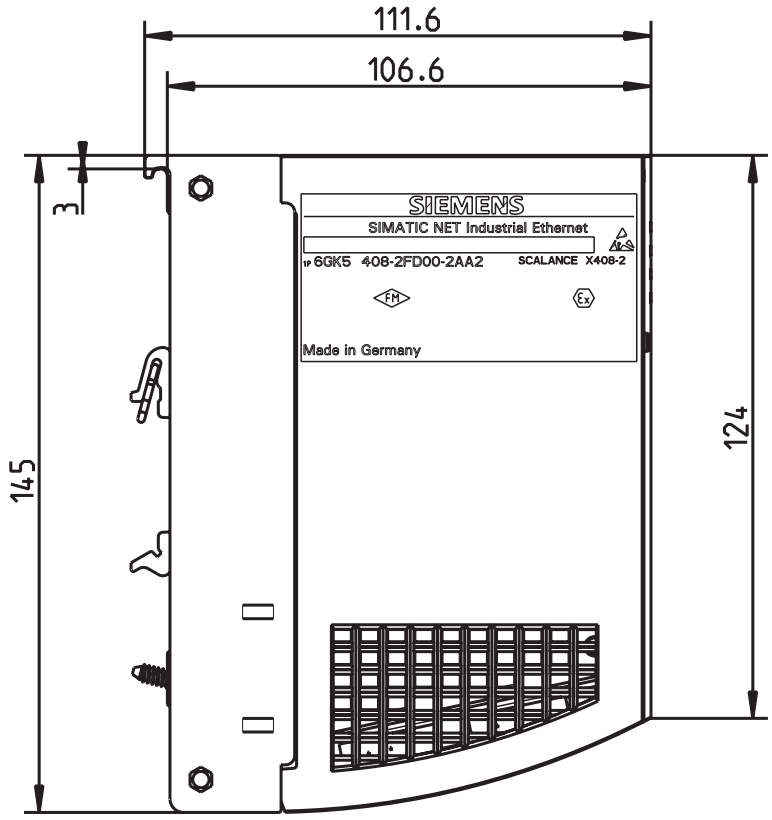


Figure 6-54 SCALANCE X408-2 left

6.7.7.2 SCALANCE X-414-3E

Dimension drawings for the SCALANCE X414-3E

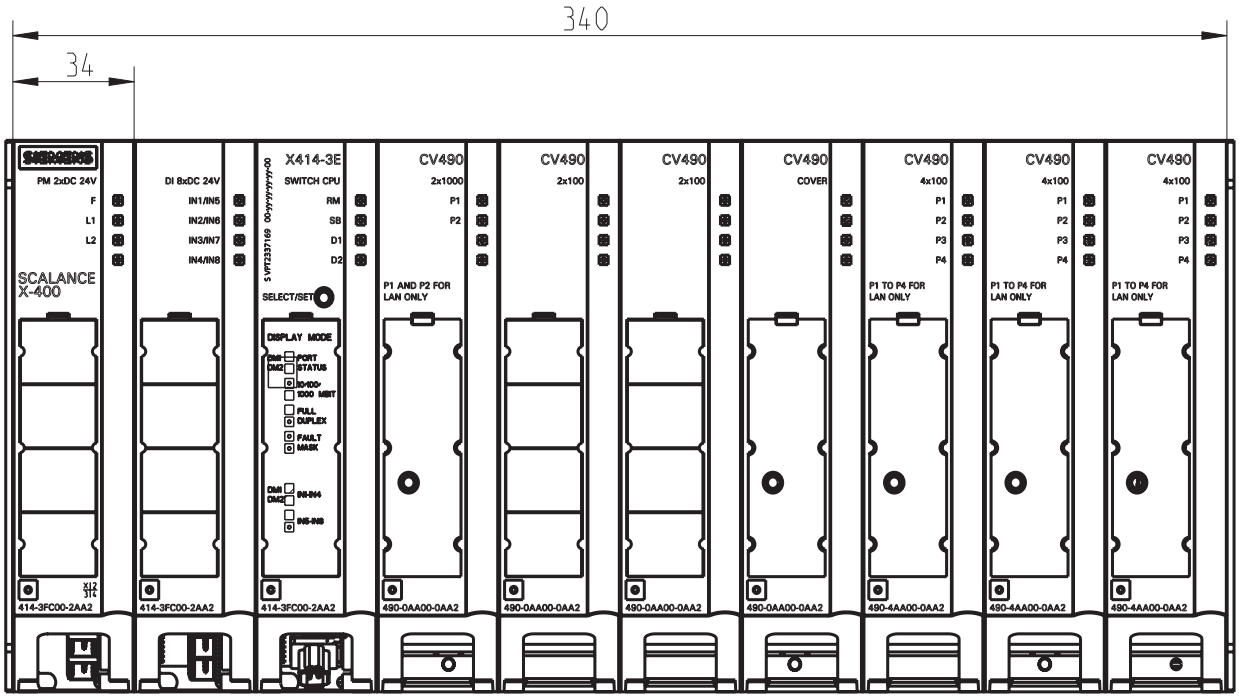


Figure 6-55 SCALANCE X414-3E front

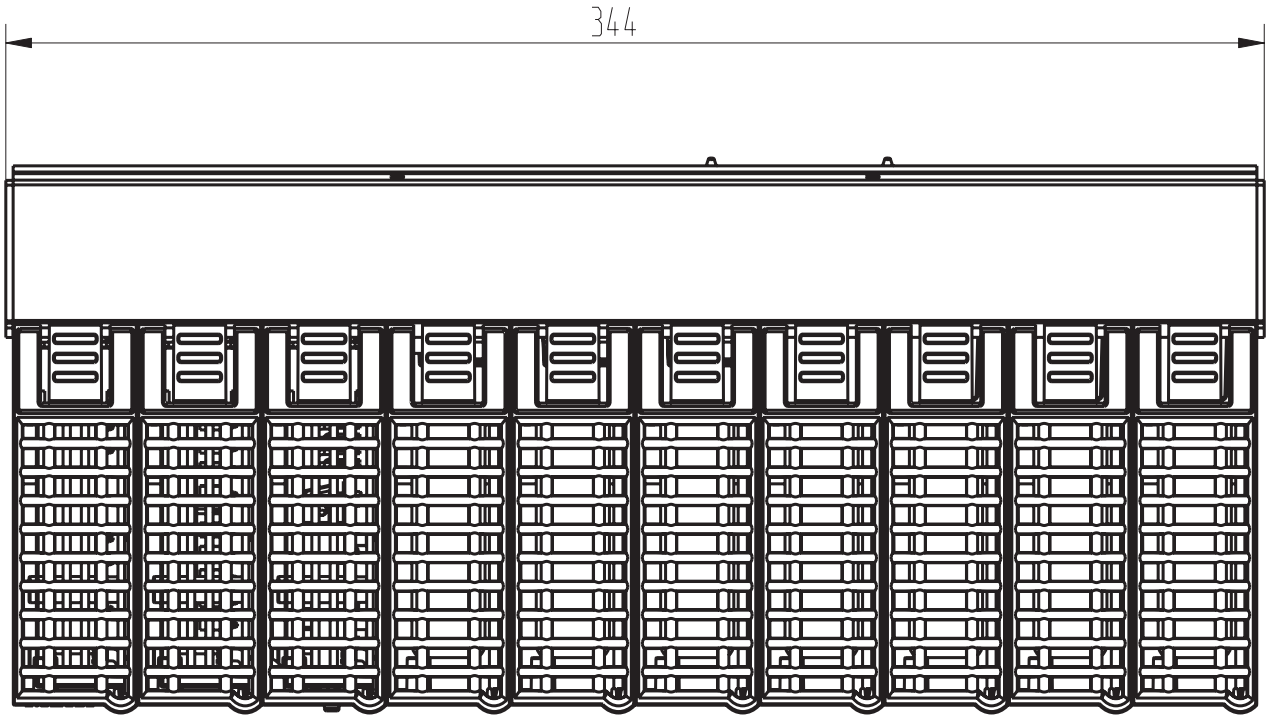


Figure 6-56 SCALANCE X414-3E top

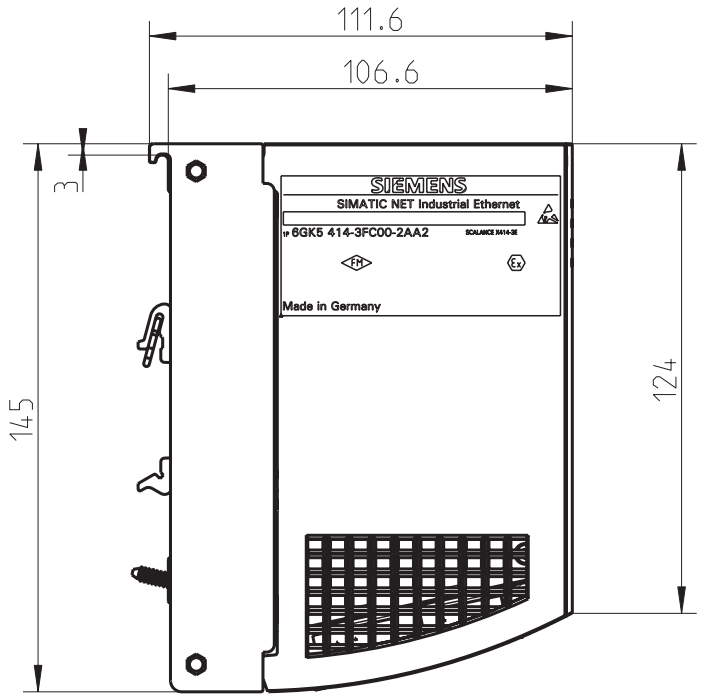


Figure 6-57 SCALANCE X414-3E left

6.7.8 X-400 technical specifications

6.7.8.1 SCALANCE X414-3E and X408-2 - technical specifications

Interfaces

	SCALANCE X414-3E	SCALANCE X408-2
Connecting end devices or network segments over twisted pair	2 x RJ-45 jack (10/100/1000 Mbps) 12 x RJ-45 jack (10/100 Mbps) All electrical ports support autonegotiation and autocrossover.	4 x RJ-45 jack (10/100/1000 Mbps) 4 x RJ-45 jack (10/100 Mbps)
Installation of media modules	2 x slot (6 and 7) for media module types MM491-2 and MM491-2LD. 1 x slot (5) for media module types MM492-2, MM492-2LD, MM492-2LH and MM492-2LH+	2 x universal slot for media module types MM491-2 or MM491-2LD or MM492-2 or MM492-2LD or MM492-2LH or MM492-2LH+
Installation of extender modules	1 x slot for extender module EM495-8 or EM496-4	Not present.
Connector for power supply and signaling contact	2 x 4-pin plug-in terminal blocks	2 x 4-pin plug-in terminal blocks
Connection of digital inputs	2 x 5-pin plug-in terminal blocks	Not present.
Power supply (redundant inputs isolated)	2 power supplies 24 V DC (20.4 to 28.8 V) safety extra-low voltage (SELV) Power supply voltage connected over high resistance with housing (not electrically isolated). Tested to IEC 6100-4-5, 1995 "Surge Immunity Test", performed with lightning protection device DEHN Blitzductor VT AD 24 V, article no. 918 402	2 power supplies 24 V DC (20.4 to 28.8 V) safety extra-low voltage (SELV) Power supply voltage connected over high resistance with housing (not electrically isolated). Tested to IEC 6100-4-5, 1995 "Surge Immunity Test", performed with lightning protection device DEHN Blitzductor VT AD 24 V, article no. 918 402
Power consumption (without modules) at 24 V DC	15 W	8 W
Current consumption at 24 V DC	< 2000 mA	< 700 mA
Load on the signaling contact	24 V DC / max. 100 mA safety extra-low voltage (SELV)	24 V DC / max. 100 mA safety extra-low voltage (SELV)
Overvoltage protection at input	Non-replaceable fuse (F 3.15 A / 250 V)	Non-replaceable fuse (F 3 A / 32 V)

	SCALANCE X414-3E	SCALANCE X408-2
Digital Inputs	Input voltage: • Rated value 24 V DC safety extra-low voltage (SELV) • For state "1": + 13 V ...+ 30 V • For state "0": – 30 V... + 3 V Max. input current: 8 mA Max. cable length: 30 m Inputs isolated from electronics.	Inputs not present.

C-PLUG

	SCALANCE X414-3E	SCALANCE X408-2
Dimensions (width x height x depth)	24.3 x 17.0 x 8.1 mm	24.3 x 17.0 x 8.1 mm
Weight	approx. 5 g	approx. 5 g
Power consumption	0.015 W	0.015 W
Memory capacity	32 Mbytes	32 Mbytes

Permitted cable lengths

	SCALANCE X414-3E	SCALANCE X408-2
TP cable length	With TP cord up to 10 m, with FastConnect cabling system up to 100 m.	With TP cord up to 10 m, with FastConnect cabling system up to 100 m.

Cascading depth

	SCALANCE X414-3E	SCALANCE X408-2
Linear/star structure	Any (only depending on signal propagation time)	Any (only depending on signal propagation time)
Ring with redundancy manager	50 (for reconfiguration time < 0.3 seconds)	50 (for reconfiguration time < 0.3 seconds)

Switching properties

	SCALANCE X414-3E	SCALANCE X408-2
Max. number of learnable addresses	8000	8000
Aging time (default)	40 s	40 s
Switching technique	Store and forward	Store and forward
Latency (store and forward time)	5 µs	5 µs (10 µs when changing from gigabit to Fast Ethernet or vice versa)

Permitted environmental conditions / EMC

	SCALANCE X414-3E	SCALANCE X408-2
Operating temperature	Product version < 07 0°C to + 60°C Product version ≥ 07 -40°C to + 70°C	0°C through + 60°C
Storage/transport temperature	- 40 °C through + 80 °C	- 40 °C through + 80 °C
Relative humidity in operation	< 95% (no condensation)	< 95% (no condensation)
Operating altitude	Max. 2000 m	Max. 2000 m
RF interference level	EN 55081 Class A	EN 55081 Class A
Immunity	EN 61000-6-2: 2001	EN 61000-6-2: 2001

Construction

	SCALANCE X414-3E	SCALANCE X408-2
Dimensions (W x H x D)	344 x 145 x 117 mm	242 x 145 x 117 mm
Weight	3,070 g	1,900 g
Installation options	35 mm DIN rail S7-300 standard rail	35 mm DIN rail S7-300 standard rail
Degree of protection	IP20	IP20

MTBF information (mean time between failure)

Device type	MTBF
SCALANCE X414-3E basic device 6GK5 414-3FC00-2AA2	24 years
SCALANCE X408-2 basic device 6GK5 408-2FD00-2AA2	18 years
Twisted pair extender EM495-8 6GK5 495-8BA00-8AA2	1,474 years
Media module extender EM496-4 6GK5 496-4MA00-8AA2	2,038 years
Fast Ethernet media module MM491-2 6GK5 491-2AB00-8AA2	138 years
Fast Ethernet media module MM491-2LD 6GK5 491-2AC00-8AA2	141 years
Gigabit media module MM492-2 6GK5 492-2AL00-8AA2	400 years
Gigabit media module MM492-2LD 6GK5 492-2AM00-8AA2	400 years
Gigabit media module MM492-2LH 6GK5 492-2AN00-8AA2	400 years
Gigabit media module MM492-2LH+ 6GK5 492-2AP00-8AA2	400 years

6.7.9 Media modules

6.7.9.1 Installing / removing a media module

Installing a media module

For installation, you require a slotted screwdriver with a 2.8 mm wide blade.

Note

Installing a Fast Ethernet media module is the same in the IE Switch X-400 and in the media module extender.

1. Remove the cover from the slot of the media module and remove the protective cap of the module terminal strip underneath from the backplane of the basic device.

   Note

   Keep these parts in a safe place in case you want to remove the media module later.

2. Remove the inserted labeling strip from the front of the media module.
3. Place the two lower guides of the media module into the recesses at the lower edge of the basic device. It should no longer be possible to move the media module to the side.
4. Tilt the media module at an angle towards the back until the two plastic pins at the back top edge of the media module jut into the recesses in the basic device. The terminal strip of the media module must fit into the guide in the backplane.
5. Press the upper part of the media module onto the basic device until the fluted middle section of the media module is heard to click into place.
6. Tighten the captive screw on the front of the media module with a slotted screwdriver with a 2.8 mm wide blade.
7. Secure the labeling strip on the front of the media module.

Figure 6-58 Inserting a media module

Removing a media module

To remove the device, you require a slotted screwdriver with a 2.8 mm wide blade.

Note

Removing a Fast Ethernet media module is the same in the IE Switch X-400 and in the media module extender.

1. Remove the inserted labeling strip from the front of the media module.
2. Release the captive screw on the front of the media module as far as it will go with a slotted screwdriver with a 2.8 mm wide blade.
3. Press on the fluted middle section of the top of the media module next to the backplane.
4. At the same time, tilt the media module down at an angle, the two guides initially remain in the recesses at the lower edge of the basic device.
5. Remove the media module by pulling it upwards.

6. Fit the protective cap on the module terminal strip on the backplane of the basic device. Fit a suitable cover on the slot of the media module.

6.7.9.2 Display elements of the media modules

LED display of the modules

All media modules have 2 LEDs. In principle, their significance is the same for each module. They match the LED displays of the basic device. With optical transmission, only a fixed transmission rate and full duplex mode are possible. The display in display modes B and C is analogous.

- In display mode A, the current connection status is displayed.
- In display mode B, the fixed transmission rate is displayed.
- In display mode C, the full duplex mode is always displayed.
- In display mode D, you can see whether or not the port is monitored.

6.7.9.3 Technical specifications of the media modules

Technical specifications of the media modules

Table 6-52 Electrical data

	MM491-2	MM491-2LD	MM492-2	MM492-2LD
Power consumption	2 W	2 W	4 W	4 W
Transmission rate	100 Mbps	100 Mbps	1000 Mbps	1000 Mbps
Interference emission	EN 61000-6-4 Class A			
Immunity	EN 61000-6-2			
MTBF	> 130 years	> 130 years	> 400 years	> 400 years

Table 6-53 Environmental conditions

	MM491-2	MM491-2LD	MM492-2	MM492-2LD
Operating temperature	0 °C - +60 °C			
Storage/transport temperature	-40 °C - +80 °C			
Relative humidity in operation	< 95% (no condensation)			
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature			
Degree of protection, tested to	IP20			

Table 6-54 Mechanical data

	MM491-2	MM491-2LD	MM492-2	MM492-2LD
Dimensions (W x H x D) mm	35 x 145 x 90 mm			
Weight	260 g		250 g	

Table 6-55 Permitted cable lengths

Cable length	SCALANCE X408-2	SCALANCE X414-3E
0 - 3000 m	Cable length multimode FOC at 100 Mbps; MM491-2 with glass FOC 62.5/125 µm or 50/125 µm; ≤ 1 dB/km at 1300 nm; ≥ 600 MHz x km	Cable length multimode FOC at 100 Mbps; MM491-2 with glass FOC 62.5/125 µm or 50/125 µm; ≤ 1 dB/km at 1300 nm; ≥ 600 MHz x km
0 - 750 m	Cable length multimode FOC at 1000 Mbps; MM492-2 with glass FOC 50/125 µm; ≤ 2.7 dB/km at 850 nm; ≥ 600 MHz x km	Cable length multimode FOC at 1000 Mbps; MM492-2 with glass FOC 50/125 µm; ≤ 2.7 dB/km at 850 nm; ≥ 600 MHz x km
0 - 26 km	Cable length single mode FOC at 100 Mbps; MM491-2 LD with glass FOC 10/125 µm or 9/125 µm; ≤ 0.5 dB/km at 1300 nm	Cable length single mode FOC at 100 Mbps; MM491-2 LD with glass FOC 10/125 µm or 9/125 µm; ≤ 0.5 dB/km at 1300 nm
0 - 10 km	Cable length single mode FOC at 1000 Mbps; MM492-2 LD with glass FOC 10/125 µm or 9/125 µm; ≤ 0.5 dB/km at 1300 nm	Cable length single mode FOC at 1000 Mbps; MM492-2 LD with glass FOC 10/125 µm or 9/125 µm; ≤ 0.5 dB/km at 1300 nm

Table 6-56 Order numbers of the media modules

Media module	Order number
MM491-2 (100 Mbps)	6GK5 491-2AB00-8AA2
MM491-2LD (100 Mbps)	6GK5 491-2AC00-8AA2
MM492-2 (1000 Mbps)	6GK5 492-2AL00-8AA2
MM492-2LD (1000 Mbps)	6GK5 492-2AM00-8AA2

6.7.10 Extender modules

6.7.10.1 Installation instructions and guidelines

Twisted-pair and media module extenders

These instructions apply to installation of the modules

- Twisted pair extender EM495-8
- Media module extender EM496-4

Installing the extender modules on an S7-300 standard rail

You require the following tools:

- slotted screwdriver with a 2.8 mm wide blade
- slotted screwdriver with a 5.5 mm wide blade

Note

Make sure that in addition to the extender width of 87 mm (EM495-8) or 155 mm (EM496-4), there is a clearance of 20 mm to the right of the basic device on the standard rail to be able to align the guide bolts of the extender with the holes in the basic device during installation.

Note

Protective caps and CV490 2x100 covers must be fitted to all slots without media modules.

When installing an extender module on an S7-300 standard rail, the basic device remains in position. Follow the steps below:

1. Remove the cover from slot 11 of the basic device.
2. Remove the right-hand side panel of the basic device. To do this, use a slotted screwdriver with a 2.8 mm wide blade to loosen the two captive slug screws on slot 11 in the upper and lower recesses as far as they will go.
3. Remove the side panel of the basic device from the basic device to the right.

Note

Keep the panel in a safe place in case the extender needs to be removed again later.

4. Remove the two covers from the extender.
5. Place the extender module on the edge of the S7-300 standard rail with the upper groove angled slightly towards the back and tilt the extender towards the back. Make sure that there is adequate clearance between the guide bolts of the extender module and the basic device. In this position, the extender module should not be able to slip off, however it can be moved horizontally in both directions.
6. Push the extender module slowly to the left while keeping it straight and without skewing and check that the two guide bolts on the extender fit into the holes in the basic device.

Then push the extender module to the left as far as it will go so that it is flush with the right side of the basic device.

7. Using a slotted screwdriver with a 5.5 mm wide blade, tighten the captive screw between slots 12 and 13 (EM495-8) or 13 and 14 (EM496-4) in the lower part of the extender module.
8. Using a slotted screwdriver with a 2.8 mm wide blade, tighten the two captive slug screws on slot 11. The screws lock the two guide bolts, so do not use excessive force when tightening them.
9. Fit the CV490 4x100 cover on slot 11 of the basic device. Make sure that the unused slots have protective caps and covers CV490 2x100 fitted to them.

Figure 6-59 Installing the twisted pair extender on the S7-300 standard rail

Removing the extender modules from an S7-300 standard rail

You require the following tools:

- slotted screwdriver with a 2.8 mm wide blade
- slotted screwdriver with a 5.5 mm wide blade

When removing an extender module from an S7-300 standard rail, the basic device remains in position. Follow the steps below:

1. To remove an extender module, remove the two covers on the extender.
2. Using a slotted screwdriver with a 5.5 mm wide blade, open the captive screw between slots 12 and 13 (EM495-8) or 13 and 14 (EM496-4) in the lower part of the extender module.
3. Remove the cover from slot 11 of the basic device.

4. Use a slotted screwdriver with a 2.8 mm wide blade to loosen the two captive slug screws on slot 11 of the basic device in the upper and lower recesses as far as they will go.
5. Push the extender module slowly to the right while keeping it straight until the two guide bolts of the extender module are completely outside the holes in the basic device.
6. Pull out the lower part of the extender module slightly towards the front and lift it from the S7-300 standard rail.
7. Replace the right side panel of the basic device so that the guide bolts fit into the two holes in the basic device.
8. Using a slotted screwdriver with a 2.8 mm wide blade, tighten the two captive slug screws on slot 11. The screws lock the two guide bolts, so do not use excessive force when tightening them.
9. Fit a suitable cover on slot 11 of the basic device.

Note

The basic device must not be used permanently without the right side panel.

Installing extender modules on a 35 mm DIN rail

⚠ CAUTION

If the IE Switch X-400 with extender is liable to severe vibration (> 10 g), use the S7-300 standard rail for installation. The DIN rail does not provide adequate support for the extender modules with vibration greater than 10 g.

For installation, you require a slotted screwdriver with a 2.8 mm wide blade.

Although the captive screw in the lower part between slots 12 and 13 (EM495-8) or 13 and 14 (EM496-4) of the extender module is not used when installing on a 35 mm DIN rail, it is nevertheless advisable to remove the media modules.

Note

Make sure that in addition to the extender width of 87 mm (EM495-8) or 155 mm (EM496-4), there is a clearance of 20 mm to the right of the basic device on the DIN rail to be able to align the guide bolts of the extender with the holes in the basic device during installation.

Note

Protective caps and CV490 2x100 covers must be fitted to all slots without media modules.

When installing an extender module on a 35 mm DIN rail, the basic device remains in position. Follow the steps below:

1. Remove the cover from slot 11 of the basic device.
2. Remove the right-hand side panel of the basic device. To do this, use a slotted screwdriver with a 2.8 mm wide blade to loosen the two captive slug screws on slot 11 in the upper and lower recesses as far as they will go.
3. Remove the side panel of the basic device from the basic device to the right.

Note

Keep the panel in a safe place in case the extender needs to be removed again later.

4. Place the central groove containing a spring clip on the back of the extender module on the upper edge of the DIN rail with the module tilted slightly towards the back. Make sure that there is adequate clearance between the guide bolts of the extender module and the basic device.
5. The spring clip must be located behind the edge of the DIN rail so that it is visible from the rear of the frame.
6. Press the extender module down and push in the lower part until you hear it click into place in the DIN rail.
7. Push the extender module slowly to the left while keeping it straight and without skewing and check that the two guide bolts on the extender fit into the holes in the basic device. Then push the extender module to the left as far as it will go so that it is flush with the right side of the basic device.
8. Using a slotted screwdriver with a 2.8 mm wide blade, tighten the two captive slug screws on slot 11. The screws lock the two guide bolts, so do not use excessive force when tightening them.
9. Fit the CV490 4x100 cover on slot 11 of the basic device.

Figure 6-60 Installing the twisted pair extender on the 35 mm DIN rail

Removing extender modules from a 35 mm DIN rail

To remove the device, you require a slotted screwdriver with a 2.8 mm wide blade. The captive screw in the lower part of the extender module between slot 12 and 13 (EM495-8) or 13 and 14 (EM496-4) is not used for mounting on a 35 mm DIN rail. When removing an

extender module from a 35 mm DIN rail, the basic device remains in position. Follow the steps below:

1. Remove the cover from slot 11 of the basic device.
2. Use a slotted screwdriver with a 2.8 mm wide blade to loosen the two captive slug screws on slot 11 of the basic device in the upper and lower recesses as far as they will go.
3. Push the extender module slowly to the right while keeping it straight until the two guide bolts of the extender module are completely outside the holes in the basic device.
4. Push the extender module down until the lower part can be pulled away from the rail to the front.
5. Lift the extender module up and off the DIN rail.
6. Replace the right side panel of the basic device so that the guide bolts fit into the two holes in the basic device.
7. Using a slotted screwdriver with a 2.8 mm wide blade, tighten the two captive slug screws on slot 11. The screws lock the two guide bolts, so do not use excessive force when tightening them.
8. Fit a suitable cover on slot 11 of the basic device.

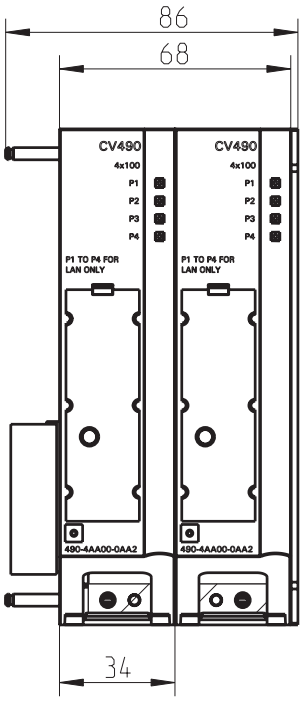
Note

The basic device must not be used permanently without the right side panel.

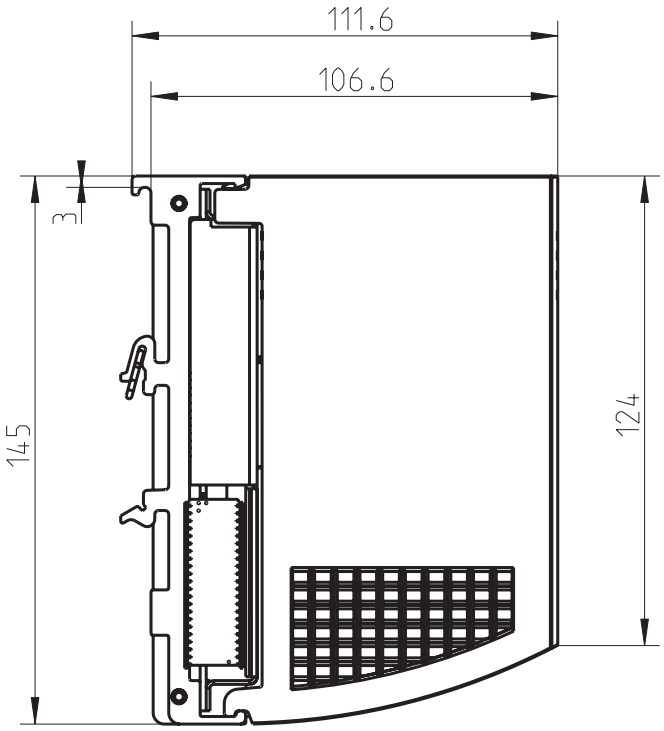
6.7.10.2 Dimension drawings

Dimension drawing - EM495-8 extender module

Front

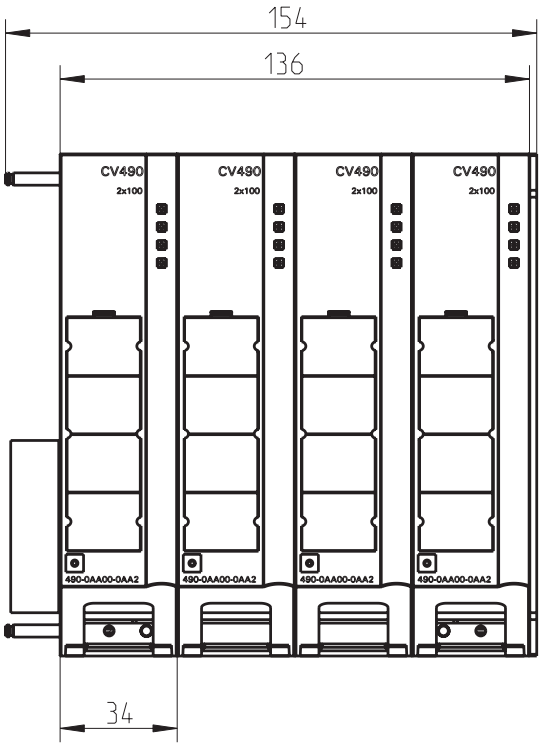


Side

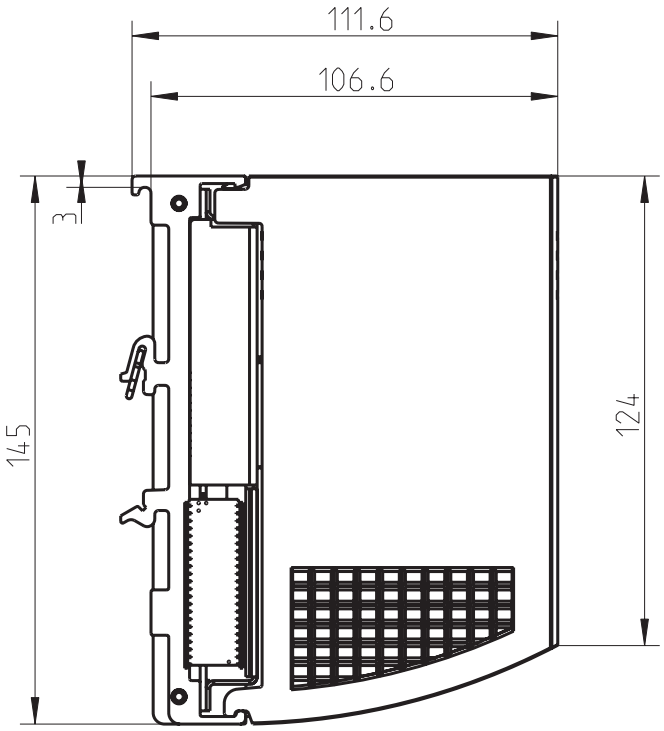


Dimension drawing - EM496-4 extender module

Front



Side



6.7.10.3 Technical specifications of the extender modules

Technical specifications of the extender modules

Table 6-57 Electrical data

	EM495-8		EM496-4	
Power consumption	< 0.5 W		< 0.1 W	
Transmission rate	10/100 Mbps		100 Mbps	
Interference emission	EN 61000-6-4 Class A			
Immunity	EN 61000-6-2			
MTBF	> 130 years	> 140 years	> 400 years	> 400 years

Table 6-58 Environmental conditions

	EM495-8	EM496-4
Operating temperature	0 °C - +60 °C	
Storage/transport temperature	-40 °C - +80 °C	
Relative humidity in operation	< 95% (no condensation)	

	EM495-8	EM496-4
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature	
Degree of protection, tested to	IP20	

Table 6-59 Mechanical data

	EM495-8	EM496-4
Dimensions (W x H x D) mm	86 x 145 x 112.5 mm	154 x 145 x 112.4 mm
Weight	560 g	980 g

Part C: SCALANCE W wireless network components 7

7.1 SCALANCE W access points and client modules

7.1.1 Designation of the SCALANCE W product lines

Overview of the product lines

For technical reasons, the SCALANCE W devices are grouped in the following product lines:

Table 7-1 SCALANCE W product lines and members

Name of the line	Models		
W -788	W788-1PRO W788-2PRO	W-788-1RR W-788-2RR	
	W744-1PRO W746-1PRO		
		W747-1RR	
W -786	W786-1PRO W786-2PRO W786-3PRO		
W -784	W784-1PRO	W-784-1RR	
			W744-1 W746-1 W747-1

7.1.2 Certifications and approvals of the SCALANCE W-788 and W-740PRO/RR

Certifications

	SCALANCE W-788/W740-PRO/RR
c-UL-us (Information Technology Equipment)	UL 60950-1; CSA C22.2 No. 60950-1-03
c-UL-us for hazardous locations	UL 1604, UL 2279Pt.15 Non Incendive / Class I / Division 2 / Groups A,B,C,D / T* and Non Incendive / Class I / Zone 2 / Group IIC / T* (T* = For concrete information on the temperature class, refer to the type plate)
FM	FM 3611 FM Hazardous (Classified) Location Electrical Equipment: Non Incendive / Class I / Division 2 / Groups A,B,C,D / T* and Non Incendive / Class I / Zone 2 / Group IIC / T* (T* = For concrete information on the temperature class, refer to the type plate)

	SCALANCE W-788/W740-PRO/RR
CE	The products SIMATIC NET SCALANCE W744-1PRO SIMATIC NET SCALANCE W746-1PRO SIMATIC NET SCALANCE W747-1RR SIMATIC NET SCALANCE W788-1PRO SIMATIC NET SCALANCE W788-2PRO SIMATIC NET SCALANCE W788-1RR SIMATIC NET SCALANCE W788-2RR in the version put into circulation by Siemens A&D conform to the regulations of the following European directive: 99/5/EC Directive of the European Parliament and of the Council relating to Radio Equipment and Telecommunications Terminal Equipment and the Mutual Recognition of their Conformity. Conformity with the essential requirements of the directive is attested by adherence to the following standards: EN 60950 Safety of Information Technology Equipment EN 301489-1 Electromagnetic Compatibility for Radio Equipment and Services EN 301489-17 Specific requirements for broadband data transmission systems and for equipment in local high-performance radio networks (HIPERLAN) EN 300328 Electromagnetic Compatibility and Radio Spectrum Issues EN 301893 Broadband Radio Access Networks (BRAN) – 5 GHz high-performance RLAN EN 50371 Compliance of low power electronic and electrical apparatus with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz) 1999/519/EC Council recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) Devices connected to the system must meet the relevant safety regulations.
ATEX Zone 2 *	EN 50021

⚠WARNING

*** ATEX Zone 2**

When used under hazardous conditions (Zone 2), the SCALANCE W78x product must be installed in an enclosure. To comply with EN 50021, this enclosure must meet the requirements of at least IP54 in compliance with EN 60529.

DO NOT DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.

The purpose of installation in an enclosure with at least IP54 is to prevent accidental insertion and removal of cables on the SCALANCE W. This is possible by installing in a lockable switching cubicle.

Wireless approvals

For the current wireless approvals for these products, please visit http://www.siemens.com/simatic-net/ik-info.

Order numbers

Table 7-2 Order numbers

	National approvals for operation	Order no.
SCALANCE W744-1PRO	Outside the USA	6GK5744-1ST00-2AA6
	In the USA	6GK5744-1ST00-2AB6
SCALANCE W746-1PRO	Outside the USA	6GK5746-1ST00-2AA6
	In the USA	6GK5746-1ST00-2AB6
SCALANCE W747-1RR	Outside the USA	6GK5747-1SR00-2AA6
	In the USA	6GK5747-1SR00-2AB6
SCALANCE W788-1PRO	Outside the USA	6GK5788-1ST00-2AA6
	In the USA	6GK5788-1ST00-2AB6
SCALANCE W788-2PRO	Outside the USA	6GK5788-2ST00-2AA6
	In the USA	6GK5788-2ST00-2AB6
SCALANCE W788-1RR	Outside the USA	6GK5788-1SR00-2AA6
	In the USA	6GK5788-1SR00-2AB6
SCALANCE W788-2RR	Outside the USA	6GK5788-2SR00-2AA6
	In the USA	6GK5788-2SR00-2AB6
Antenna ANT795-4MR	6GK5795-1MR00-0AA6	
Lightning Protector LP798-1PRO	6GK5798-1LP00-0AA6	

Degree of protection

Tested to IP65.

7.1.3 Installation instructions and guidelines

7.1.3.1 Securing the housing

Wall mounting or standard rail

There are two ways of securing the housing:

- Wall mounting
  Use the holes in the housing to screw the device to the wall or on a horizontal surface.
- Standard rail mounting
  Mount the SCALANCE W788-xPRO/RR or W74x-1PRO/RR on a 90 mm long, vertically mounted section of standard rail (S7-300). In this case, the standard rail serves as an adapter between the wall and SCALANCE W788-xPRO/RR or W74x-1PRO/RR. If you want to mount the SCALANCE W788-xPRO/RR or W74x-1PRO/RR along with a PS791-1PRO, you will require a 150 mm long standard rail.

Make sure that there is suitable strain relief for the connecting cable.

CAUTION
Premature aging of the device and cables due to UV radiation Provide suitable shade to protect the device against direct sunlight. This avoids unwanted heating of the device and prevents premature aging of the device and cabling. When operating the SCALANCE W outdoors, it must be mounted so that it is protected from UV. UV radiation can discolor the front panel of the SCALANCE W788-xPRO/RR or W74x-1PRO/RR. Discoloring of the front panel does not impair the mechanical stability of the device. The device must also not be subjected to long periods of rain (provide cover to protect from rain). The cover should be made of a synthetic material since metal impairs the radiation of radio waves.

Note

The minimum distance to fluorescent lamps should be 0.5 m. When installed in a cabinet, we recommend that you do not install relays on the same or on directly neighboring mounting rails.

7.1.3.2 Installation instructions for the SCALANCE W-788 and W-740PRO/RR

Installation

The SCALANCE W has a robust IP65 metal housing optimally designed for installation on an S7-300 standard rail. With drill holes in the housing, wall mounting is also possible. Installation on a DIN rail is possible only with additional fittings.

On the back of the device, there is a locking screw below which the receptacle for a C-PLUG is located. This is used to store the device configuration. If the device develops a fault, the

configuration can be transferred to the replacement device from the C-PLUG without needing a programming device.

To achieve degree of protection IP65, however, suitable cables and connectors must be used.

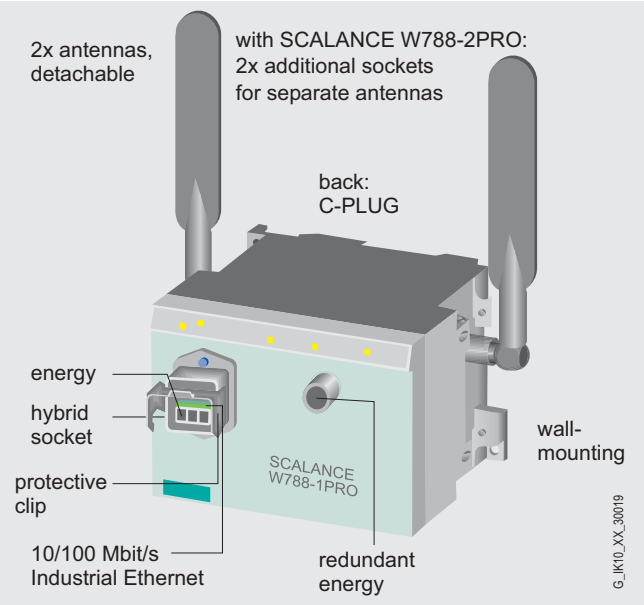


Figure 7-1 Connectors of the SCALANCE W access points and clients (here: W788-1PRO AP)

Suitable cables

The following cable variants are available to connect a SCALANCE W to the power supply and to Ethernet:

- IE hybrid cable 2 x 2 + 4 x 0.34 (order no. 6XV1870-2J)

  The two data wire pairs are separately shielded. This cable is particularly suitable for assembly with the IE IP67 hybrid connector shipped with SCALANCE W. The 4 x 0.34 cables are used to supply power.

- IE FC TP standard cable 4 x 2 GP (order no. 6XV1870-2E)

  IE FC TP Flexible Cable 4 x 2 GP (order no. 6XV1870-2H -- as spare part only)

  In these cable types, two wires are twisted. All four pairs of wires are inside a common shield. Two of the cable pairs are used to supply power. This cable is also suitable for assembly with the IE IP67 hybrid connector shipped with SCALANCE W.

- 2 x 2 IE cable, the optional power supply (18 - 32 V DC) is over M12 connectors.

How to fit the connectors and cables is described in the general installation instructions or the connector pin assignments of the SCALANCE W components.

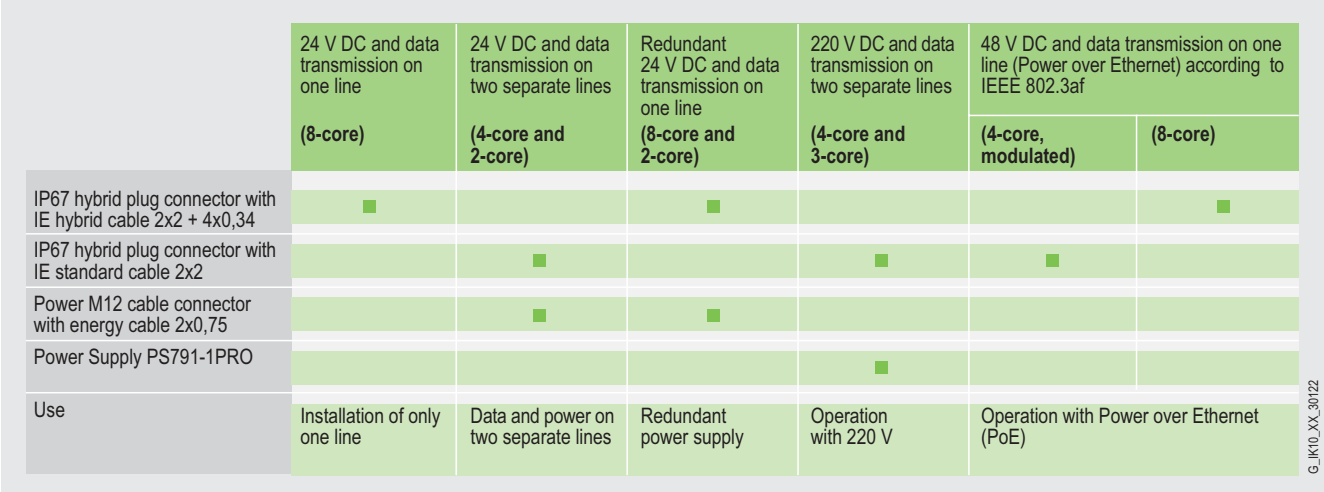


Figure 7-2 Options for power supply to the SCALANCE W access points and clients

Supplying power

For a 24 V power supply to IP65, the AC/DC power unit PS791-1PRO is particularly suitable. This is supplied with 115 V AC / 230 V AC (permitted voltage range 90 V AC to 265 V AC). The generated 24 V DC is available via the supplied cable to the M12 socket of the SCALANCE W.

If the power is supplied via the IE hybrid cable 2x2 + 4x0.34, the IE FC RJ-45 Modular Outlet Power Insert (6GK1901-1BE00-0AA3) can be strongly recommended (see also section IE FC Modular Outlet).

Grounding

There must be no potential difference between the following parts otherwise there is a risk that the device will be destroyed:

- Ground potential of the power supply and ground potential of the antenna ground.
- Ground potential of the power supply and a grounded housing.
- Ground potential of the power supply and the ground potential of the device connected to Industrial Ethernet (for example PC, AS-300, AS-400 etc.)

Connect both grounds to the same foundation earth or use an equipotential bonding cable.

Antenna connectors

All SCALANCE W devices have at least two R-SMA antenna connectors and ship with two ANT795-4MR antennas.

The SCALANCE W788-2PRO and SCALANCE W788-2RR each have two integrated wireless adapters. They therefore have two additional antenna connectors to which the additional antennas can be connected to the sides of the housing via antenna connecting cables.

If the SCALANCE W is installed in a switching cubicle, the antennas must be removed due to the restricted communication. In this case, the connection is over detached antennas that must be installed outside the cabinet. On the front panel, there is an identifier for the antenna

connectors. The A connectors are on the right-hand side and B connectors B on the left-hand side.

SIMATIC NET offers the IWLAN FRNC antenna extension cable for the connection between the SCALANCE W and a detached antenna. To avoid violating the approvals, only antennas released for this product can be used.

The distance between a pair of antennas for the first and second WLAN interface must be at least 0.5 m.

Lightning protection

⚠ WARNING

Installing antennas outdoors

Antennas installed outdoors must be within the area covered by a lightning protection system. Make sure that all conducting systems entering from outdoors can be protected by a lightning protection potential equalization system.

When implementing your lightning protection concept, make sure you adhere to the VDE 0182 or IEC 62305 standard.

Suitable lightning protectors are available in the range of accessories of SIMATIC NET Industrial WLAN:

- Lightning Protector LP798-1PRO (with R-SMA connector, order no. 6GK5798-1LP00-0AA6)
- Lightning protector LP798-1N (with N/N female/female connector, order no. 6GK5798-2LP00-2AA6)

Installing one of these lightning protectors between an antenna and a SCALANCE W is not adequate protection against a lightning strike. The LP798-1PRO/N lightening protector only works within the framework of a comprehensive lightning protection concept. If you have questions, ask a qualified specialist company.

See also

Part C: Instructions for fitting connectors, attachments and devices (Page 527)

IE FC Modular Outlet (Page 199)

IE Hybrid Cable (Page 189)

Twisted Pair Cord (4-wire for Fast Ethernet) (Page 188)

Connector pin assignments for the SCALANCE W-788 and W-740PRO/RR clients (Page 349)

7.1.4 Display elements of SCALANCE W

7.1.4.1 LEDs on the W-788

Information on operating status and data transfer

On the front of the housing, several LEDs provide information on the operating status of the SCALANCE W788:

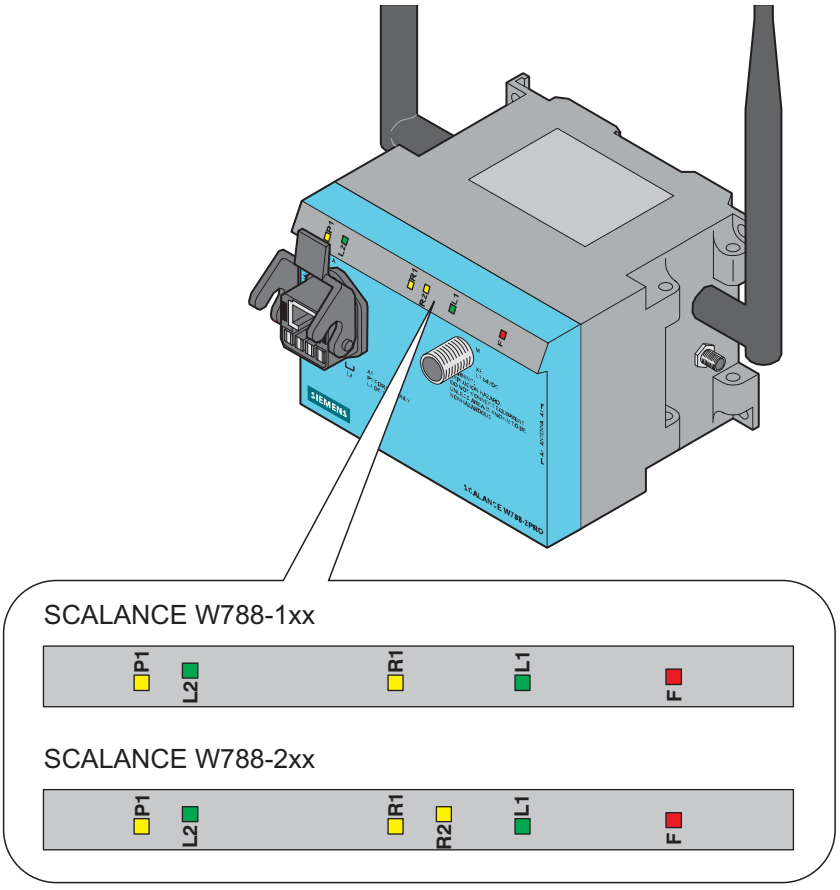


Figure 7-3 The LED display of the SCALANCE W788

LED	Color	Meaning
P1	Yellow	Data transfer over the Ethernet interface (traffic).
	Green	There is a connection over the Ethernet port. (Link)
	Flashing yellow	PRESET-PLUG detected.
	Yellow/green	PRESET function completed successfully.
	Flashing green	"Flashing" enabled over PST.
L2	Green	Power supply over the hybrid connector X1 (PoE or energy contacts).

LED	Color	Meaning
R1	Yellow	Data transfer over the first WLAN interface.
	Green	*Access Point Mode:* The WLAN interface is initialized and ready for operation. *Client Mode:* There is a connection over the first WLAN port.
	Flashing green	*Access Point Mode:* The channels are being scanned. *Client Mode:* The client is searching for a connection to an access point or ad hoc network.
	Green flashing quickly	*Access Point Mode:* With 802.11h, the channel is scanned for one minute for primary users before the channel can be used for data traffic. *Client Mode:* The client waits for the adopt MAC address due to the setting <Auto Find Adopt MAC> and is connected to no access point.
	Flashing yellow	PRESET-PLUG detected.
	Green 3 x fast ,1 x long flashing	*Client mode:* The client waits for the adopt MAC address due to the setting <Auto Find Adopt MAC> and is connected to an access point.
	Yellow/green	PRESET function completed successfully.
R2	Yellow	*Access Point Mode:* Data transfer over the second WLAN port. *Client Mode:* The LED is always off because the 2nd port is not available in client mode.
	Green	*Access Point Mode:* The WLAN interface is initialized and ready for operation. *Client Mode:* The LED is always off because the 2nd port is not available in client mode.
	Flashing green	*Access Point Mode:* The channels are being scanned. *Client Mode:* The LED is always off because the 2nd port is not available in client mode.
	Green flashing quickly	*Access Point Mode:* With 802.11h, the channel is scanned for one minute for primary users before the channel can be used for data traffic. *Client Mode:* The LED is always off because the 2nd port is not available in client mode.
	Flashing yellow	PRESET-PLUG detected.
	Yellow/green	PRESET function completed successfully.
L1	Green	Power supply over the M12 connector (X2).
F	Red	An error occurred during operation with the SCALANCE W78x.

Note

If the LED for the WLAN port is not green when the device starts up, although it is activated, the port is not ready for operation (interface not initialized).

The main reason for this is usually that during commissioning of the SCALANCE W78x products, a waiting time of up to 15 minutes can occur when the ambient temperature is below zero. The device is ready for operation at the specified ambient temperature as soon as the LED for the WLAN interface is lit green.

7.1.4.2 LEDs of the W-740PRO/RR clients

Note

The arrangement and functions of the LEDs on the W-740 clients correspond to those on the W788-1xx access point.

See also

LEDs on the W-788 (Page 347)

7.1.5 Connector pin assignments for the SCALANCE W-788 and W-740PRO/RR clients

Attachment for Ethernet

The SCALANCE W is attached to an Ethernet network using a hybrid socket on the front of the housing. This port also has contacts for the operating voltage.

There is an RJ-45 jack integrated in the hybrid jack. A standard Ethernet cable with an RJ-45 plug can be inserted into this, however, this does not achieve IP65.

Connectors for the power supply

Depending on the selected connector type (hybrid connector or M12), the power supply pinning is as follows:

Table 7-3 Pinning of the hybrid connector for the power supply

Wire coding IE hybrid cable 2 x 2 + 4 x 0.34	Brown	Brown	Black	Black
Wire coding IE FC TP standard cable 4 x 2 GP or IE FC TP flexible cable 4 x 2 GP	White/blue	Blue	White/brown	Brown
	24 V	24 V	Ground	Ground
Power supply insert module	1	2	3	4

Table 7-4 Pinning of the M12 connector

	X2 Socket
Pin 1	24 V DC
Pin 2	-
Pin 3	Ground
Pin 4	-

If you do not use the hybrid socket, this must be covered with a protective cap, otherwise IP 65 protection is lost. A suitable protective cap is available as an accessory (order no. 6ES7194-1JB10-0XA0). If you do not use the M12 connector, the supplied protective cap must also be fitted to retain the IP65 degree of protection.

See also

Installation instructions for the SCALANCE W-788 and W-740PRO/RR (Page 343)

7.1.6 Dimension drawing W-788/W-740PRO/RR

Dimension drawing for SCALANCE W-780 and SCALANCE W-740PRO/RR

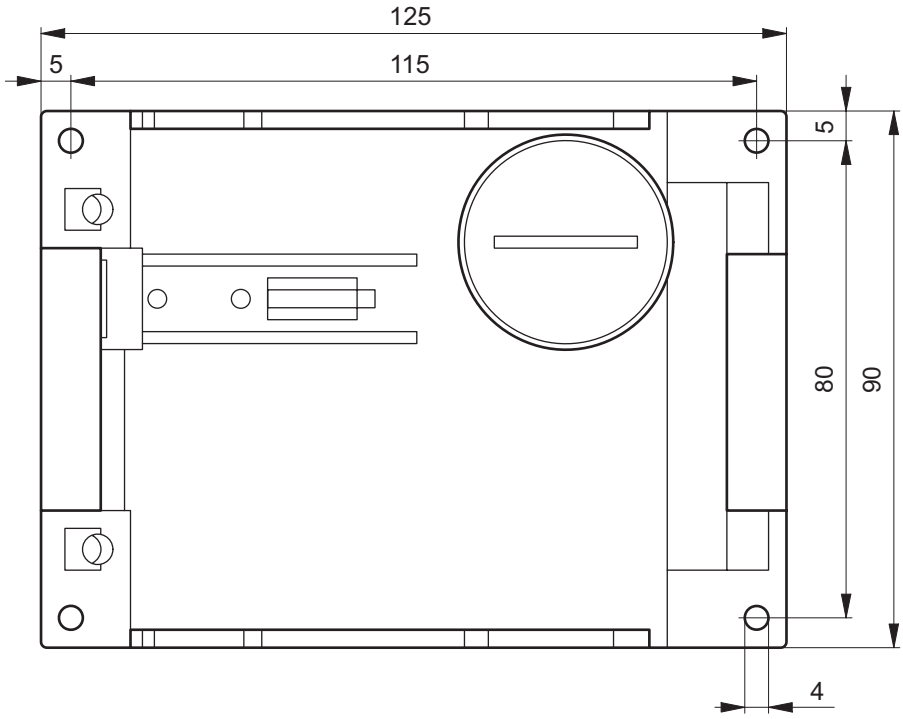


Figure 7-4 Dimension drawing for SCALANCE W-780 and SCALANCE W-740PRO/RR

The cubicle installation depth with the hybrid cable connected is approx. 230 mm.

7.1.7 Technical specifications for the SCALANCE W788-xPRO/RR and W74x-1PRO/RR

Device variants

The technical specifications of the

- SIMATIC NET SCALANCE W744-1PRO
- SIMATIC NET SCALANCE W746-1PRO
- SIMATIC NET SCALANCE W747-1RR

- SIMATIC NET SCALANCE W788-1PRO
- SIMATIC NET SCALANCE W788-2PRO
- SIMATIC NET SCALANCE W788-1RR
- SIMATIC NET SCALANCE W788-2RR

are largely identical. Unless indicated otherwise in the table, the following tables apply to all the devices listed above:

Data transfer

Ethernet transfer rate	10/100 Mbps
Wireless transmission rate	1 ... 54 Mbps (108 Mbps)
Wireless standards supported	802.11a 802.11b 802.11g 802.11h
Power supply standards supported	802.3af (Power over Ethernet)

Interfaces

Note

Bridging a power outage is is possible only with an input voltage of 24 V DC (-15% . . . +20%).

Power	• M12 connector (24 V DC, 48 V DC) • Energy contacts in the hybrid connector (24 V DC, 48 V DC) • RJ-45 jack Power over Ethernet (48 V DC) 2 supplies 24 V DC (24 V DC, 48 V DC) safety extra-low voltage (SELV). Power supply isolated according to IEEE 802.3af, isolation resistance > 2 Mohms.
Back up	IE IP 67 hybrid connector R-SMA antenna sockets (2 x or 4 x with the 788-2PRO)

Electrical data

Power consumption	< 10 W

Construction

Dimensions without antennas (W x H x L)	125 mm x 88 mm x 108 mm
Weight	approx. 1050 g

Permitted ambient conditions

Operating temperature	-20°C to 60°C
Transport/storage temperature	-40°C to 70°C
Degree of protection	Tested to IP65

MTBF information (mean time between failure)

MTBF	67 years

7.2 SCALANCE W-786 Access Points

7.2.1 Certifications and approvals, degree of protection

7.2.1.1 Certifications and approvals for the SCALANCE W786

CE conformity

The products

SIMATIC NET SCALANCE W786-1PRO
SIMATIC NET SCALANCE W786-2PRO
SIMATIC NET SCALANCE W786-3PRO
in the version put into circulation by Siemens A&D meets the regulations of the following European directives:

- 99/5/EC
  Directive of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity. Conformity with the basic requirement of the directive is attested by adherence to the following standards:
- EN 60950-1
  Safety of information technology equipment
- EN 301489-1 V1.6.1
  Electromagnetic compatibility for radio equipment and services
- EN 301489-17 V1.2.1
  Specific requirements for broadband data transmission systems and for equipment in local high-performance wireless networks (HIPERLAN)
- EN 300328 V1.6.1
  Electromagnetic compatibility and radio spectrum issues
- EN 301893 V1.3.1
  Broadband radio access networks (BRAN) – 5 GHz high-performance RLAN
- EN 50385:2002
  Generic standard to demonstrate the compliance of low power electronic and electrical apparatus with the basic restrictions related to human exposure to electromagnetic fields (110 MHz to 40 GHz)
- 1999/519/EC
  Council recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

Devices connected to the system must meet the relevant safety regulations.

The EC Declaration of Conformity is available for the responsible authorities according to the above-mentioned EC Directive at the following address:

Siemens Aktiengesellschaft
Automation and Drives
Industrielle Kommunikation
Postfach 4848
D-90327 Nürnberg

This declaration certifies compliance with the directives named above, but does not guarantee any specific properties.

Note

The specified approvals apply only when the corresponding mark is printed on the product.

Wireless approvals

For the current wireless approvals for these products, please visit http://www.siemens.com/simatic-net/ik-info.

7.2.1.2 Degree of protection

Degree of protection

The SCALANCE W-786 access point is certified according to IP65.

Shock resistant plastic housing, UV and salt spray resistant.

7.2.2 Installation instructions and guidelines

7.2.2.1 Removing / fitting the housing cover

When does the housing cover need to be removed?

You can only perform the following activities when the cover is removed:

- You want to screw the SCALANCE W786 to a wall or onto the optional mounting plate.
- You want to connect cables to the SCALANCE W786 for the power supply, for Ethernet or for external antennas.
- You want to insert a C-PLUG in the device or replace an existing C-PLUG.
- You want to use the reset button.

Removing the housing cover

⚠WARNING

Danger from line voltage

Once you have removed the housing cover, there is the danger from line voltage in the area of the connecting terminals on the power supply adapter.

Only authorized personnel is permitted to open the device and carry out any work on the open device (e.g. connection and disconnection of lines, operating the reset button, replacing the C-PLUG)!

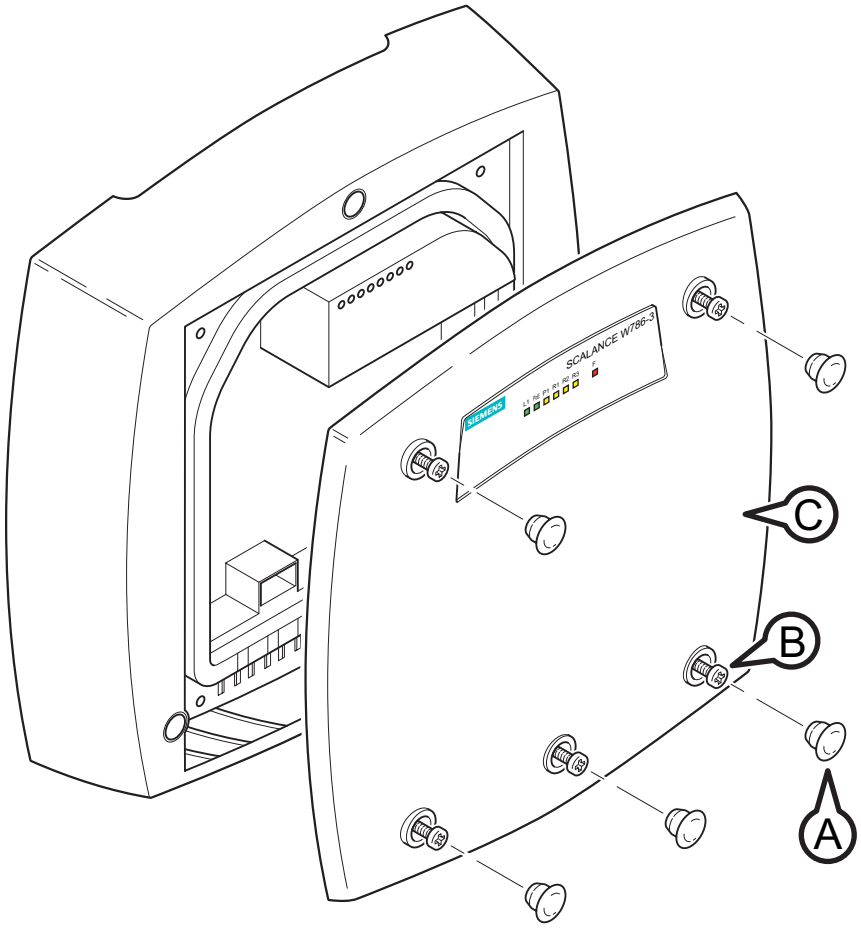


Figure 7-5 Removing the cover
A Sealing cap
B Cover screw
C Housing cover

Follow the steps below to remove the housing cover:

1. Remove the sealing caps from the housing cover (position **A** in the figure above)
2. Loosen the screws in the cover (position **B** in the figure above).

Note

These screws remain in the cover after they have been loosened (prevents them being lost). Never attempt to remove these screws from the housing cover using force, otherwise the housing cover will be damaged!

3. Remove the housing cover with the captive screws (position **C** in the figure above).

Fitting the housing cover

Fitting the housing cover is carried out in the reverse order. Tightening torque for the cover screws 1.8 Nm.

7.2.2.2 Connecting up cables

Connecting up cables prior to mounting

Before you screw a SCALANCE W786 to a wall or to the optional mounting plate, the cables for the power supply, for Ethernet, and, when necessary, for the external antennas must be connected up first. The available options are as follows:

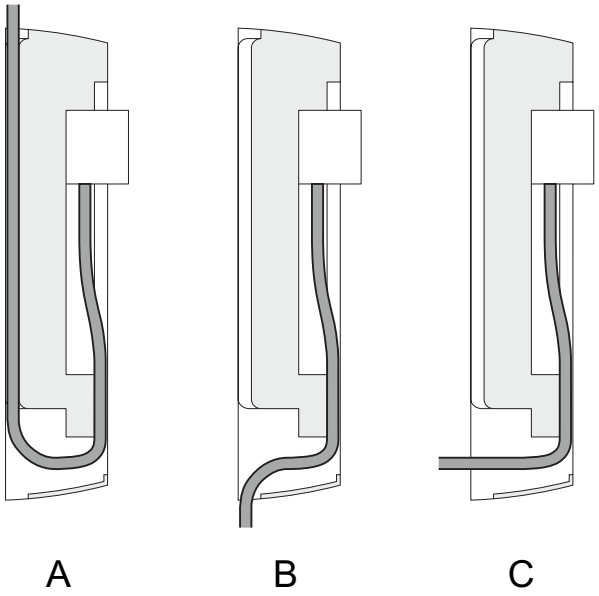


Figure 7-6 Side view of a SCALANCE W786 with cables entering from different directions

- The cables are inserted from above (position **A** in the previous schematic). The housing of the SCALANCE W786 has an opening at the top for this purpose.
- The cables are inserted from below (position **B** in the previous schematic). There is also an opening at the bottom for this purpose.
- Cables inserted through a wall behind the SCALANCE W786 (position **C** in the previous schematic). In this case, you will need to mount the SCALANCE W786 so that the opening in the wall is located above the lower edge of the device.

Connecting up FO cables

Fiber-optic cables have a minimum bending radius. The cable must not be bent tighter than this bending radius during installation or operation, otherwise the FO cable will be irreperably damaged.

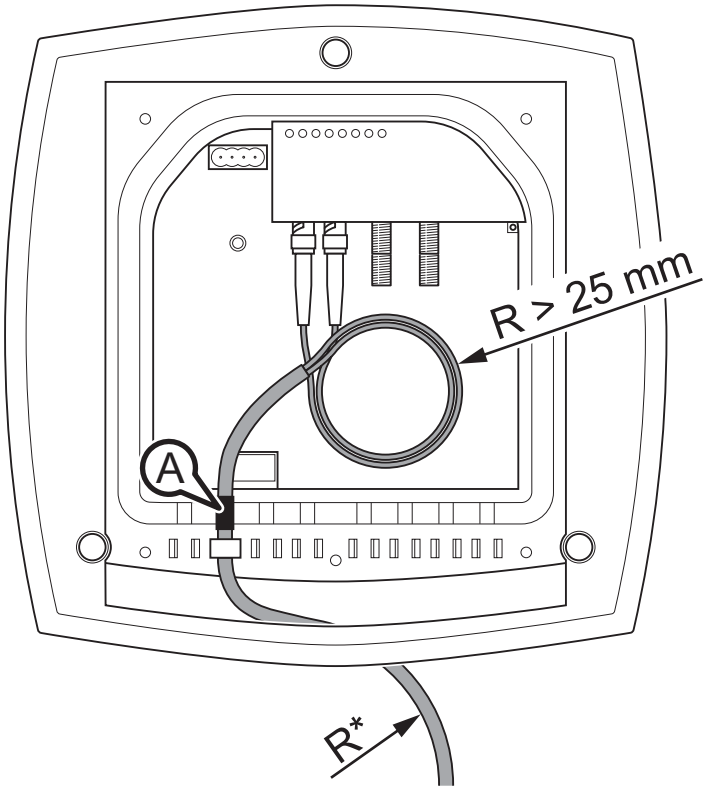


Figure 7-7 Connecting up an FO cable

For the FO cable, use the second opening from the left in the seal. Cable routing is illustrated in the figure above. For individual cores immediately following the connector, the minimum bending radius is 25 mm. Refer to the specification of the cable you are using for the minimum permitted bending radius of the cable within the jacket. Make sure that the FO cable is not sharply kinked after passing through the housing.

An adhesive sealing foil must be used in the housing sealing with FO cables (position **A** in the figure above). For more detailed information, refer to the section "Connecting the cables".

Grounding terminal

⚠ WARNING
To operate the SCALANCE W786 safely, the chassis ground connector must have a suitable cable connected. Do not use the SCALANCE W786 without a ground cable connected.

The chassis ground connector is located on the rear of the device (M4 thread). Connect the ground cable before you mount the SCALANCE W786 on a wall or on the optional mounting plate. Once the SCALANCE W786 is mounted, the connector is no longer accessible.

Place the supplied toothed washer directly on the rear of the device before screwing on the ground cable. Only then can you be sure that there is ideal contact with the screwed-on cable.

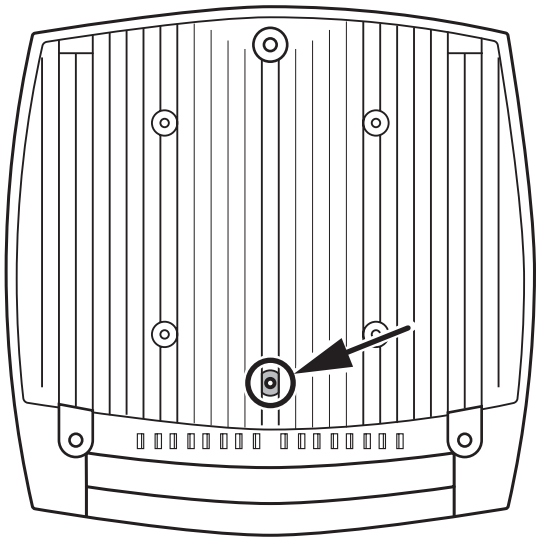


Figure 7-8 Chassis ground connector on the rear of the SCALANCE W786

7.2.2.3 Mounting without an adapter (wall mounting only)

Drilling template

The location of the holes for mounting the SCALANCE W786 on a wall is shown in the following figure:

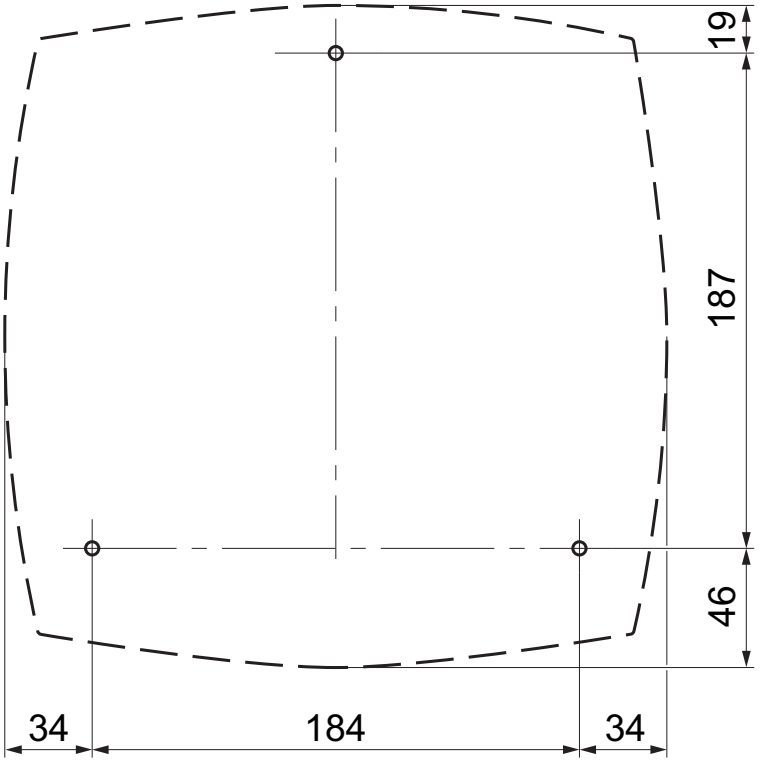


Figure 7-9 Drilling template for wall mounting of the SCALANCE W786

Procedure

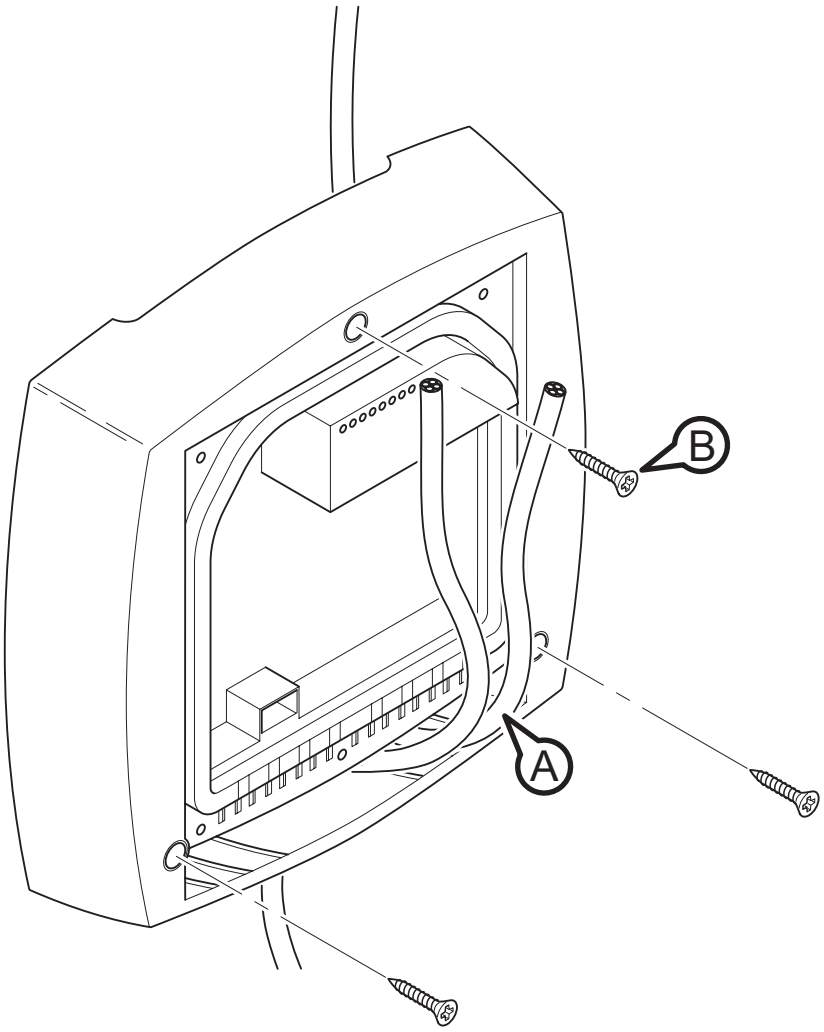


Figure 7-10 SCALANCE W786 wall mounting

Follow the steps below to screw a SCALANCE W786 to a wall:

1. Lead the cables into the housing of the SCALANCE W786 (position **A** in the figure above). Note the information in the section "Connecting up cables".
2. Secure the SCALANCE W786 to the wall with three screws (position **B** in the figure above). The screws are not supplied with the device. The type and length of the screws depend on the type of wall.
   Type of screw:
   - for wooden walls: wood screw 4 x 30 mm
   - for concrete walls: 4 x 50 mm with 5 mm concrete plug
   - for metal walls: M4 x 25 mm with machine thread in the wall

Option: Threaded holes on rear of housing

When a wall is extremely thin, it is often not possible to use wall plugs for the screws. To allow wall mounting even in this situation, there are four M4 threaded holes on the rear of the SCALANCE W786. The drilling template is a square with sides 100 mm long. The device can therefore be mounted on a wall with bolts through the wall.

Calculate the length of the required M4 screws as follows:

Screw length = wall thickness + 7 mm

7.2.3 LED display

Information on operating status and data transfer

On the front of the housing, several LEDs provide information on the operating status of the SCALANCE W786:

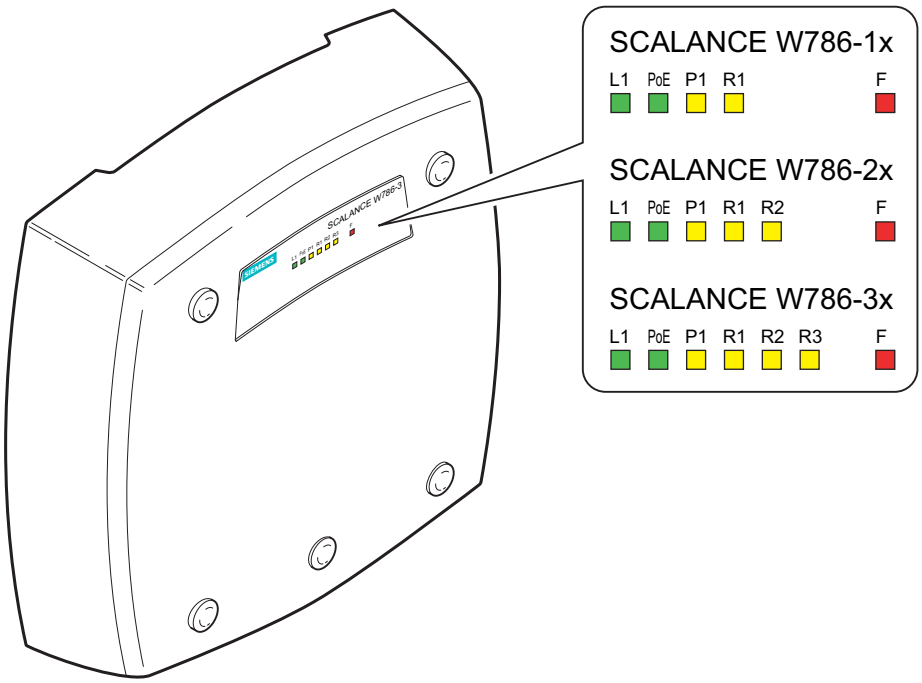


Figure 7-11 The LED display of the SCALANCE W786

Note

The "PoE" LED does not exist on devices with a port for FO cable.

LED	Color	Description
L1	Green	Power supply over a power supply adapter or the 48 V DC energy contacts of devices with a port for FO cable.
PoE	Green	Power over Ethernet or power over the 48 V DC energy contacts of devices with an RJ-45 port.
P1	Yellow	Data transfer over the Ethernet interface (traffic).
	Green	There is a connection over the Ethernet port. (Link).
	Flashing yellow	PRESET-PLUG detected.
	Yellow/green	PRESET function completed successfully.
	Flashing green	"Flashing" enabled over PST.
R1	Yellow	Data transfer over the first WLAN interface.
	Green	*Access Point Mode:* The WLAN interface is initialized and ready for operation. *Client Mode:* There is a connection over the first WLAN port.
	Flashing green	*Access Point Mode:* The channels are being scanned. *Client Mode:* The client is searching for a connection to an access point or ad hoc network.
	Green flashing quickly	*Access Point Mode:* With 802.11h, the channel is scanned for one minute for primary users before the channel can be used for data traffic. *Client Mode:* The client waits for the adopt MAC address due to the setting <Auto Find Adopt MAC> and is connected to no access point.
	Green 3x fast, 1x long flashing	*Client Mode:* The client waits for the adopt MAC address due to the setting <Auto Find Adopt MAC> and is connected to an access point.
	Flashing yellow	PRESET-PLUG detected.
	Yellow/green	PRESET function completed successfully.
R2	Yellow	*Access Point Mode:* Data transfer over the second WLAN port. *Client Mode:* The LED is always off because the 2nd port is not available in client mode.
	Green	*Access Point Mode:* The WLAN interface is initialized and ready for operation. *Client Mode:* The LED is always off because the 2nd port is not available in client mode.
	Flashing green	*Access Point Mode:* The channels are being scanned. *Client Mode:* The LED is always off because the 2nd port is not available in client mode.

LED	Color	Description
	Green flashing quickly	*Access Point Mode:* With 802.11h, the channel is scanned for one minute for primary users before the channel can be used for data traffic. *Client Mode:* The LED is always off because the 2nd port is not available in client mode.
	Flashing yellow	PRESET-PLUG detected.
	Yellow/green	PRESET function completed successfully.
R3	Yellow	*Access Point Mode:* Data transfer over the third WLAN port. *Client Mode:* The LED is always off because the 3rd port is not available in client mode.
	Green	*Access Point Mode:* The WLAN interface is initialized and ready for operation. *Client Mode:* The LED is always off because the 3rd port is not available in client mode.
	Flashing green	*Access Point Mode:* The channels are being scanned. *Client Mode:* The LED is always off because the 3rd port is not available in client mode.
	Green flashing quickly	*Access Point Mode:* With 802.11h, the channel is scanned for one minute for primary users before the channel can be used for data traffic. *Client Mode:* The LED is always off because the 3rd port is not available in client mode.
	Flashing yellow	PRESET-PLUG detected.
	Yellow/green	PRESET function completed successfully.
F	Red	An error occurred during operation with the SCALANCE W786.
	Flashing red	Ready to load firmware. The device was either stopped with the reset button or there is incorrect firmware on the device.

Note

If the LED for the WLAN port is not green when the device starts up, although it is activated, the port is not ready for operation (interface not initialized).

The main reason for this is usually that during commissioning of the SCALANCE W78x products, a waiting time of up to 15 minutes can occur when the ambient temperature is below zero. The device is ready for operation at the specified ambient temperature as soon as the LED for the WLAN interface is lit green.

7.2.4 Connector pin assignment W-786

Connector variants

With a SCALANCE W786, you have the choice of two Ethernet ports:

- RJ-45 jack
- ST duplex socket for multimode FO cables 1310 nm and a maximum cable length of 3000 m

Location of the connectors and pin assignment of the Ethernet cable

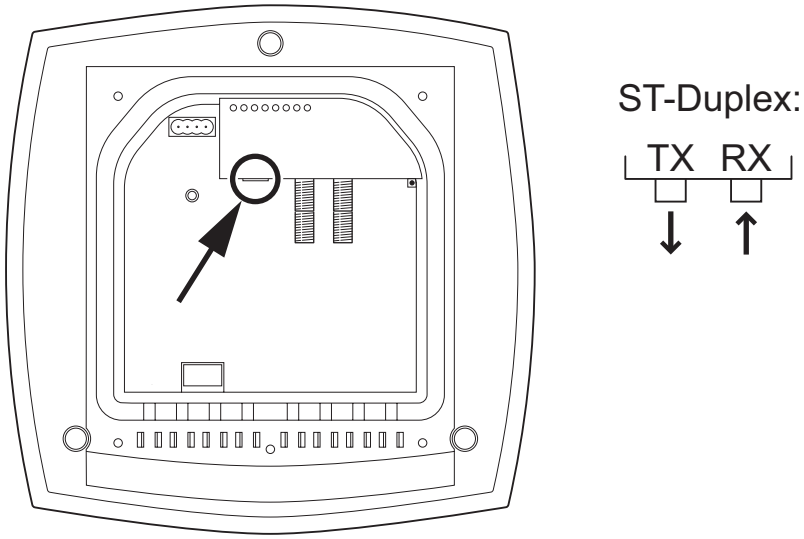


Figure 7-12 Position of the Ethernet port with the housing cover removed

7.2.5 SCALANCE W786 technical specifications

Product versions

- SCALANCE W786-1PRO with one wireless interface and in the variants with two internal antennas or two external antenna connectors and with RJ-45 or FO connector
- SCALANCE W786-2PRO with two wireless interfaces and in the variants with four internal antennas or four external antenna connectors and with RJ-45 or FO connector
- SCALANCE W786-3PRO with three wireless interfaces and in the variants with six external antenna connectors and with RJ-45 or with FO connector

Data transfer

Ethernet transfer rate	10/100 Mbps

Wireless transmission rate	1 ... 54 Mbps (108 Mbps)
Wireless standards supported	802.11a 802.11b 802.11g 802.11h
Power supply standards supported	802.3af (Power over Ethernet)

Interfaces

Power	• 48 V DC supply via supplied connector • RJ-45 jack Power over Ethernet (48 V DC) • 2 x 12 - 24 V DC supplies with optional power supply adapter (available as accessory) • 100 - 240 V AC with optional power supply adapter (available as accessory) Power supply isolated according to IEEE 802.3af, isolation resistance > 2 Mohms.
Data	• RJ-45 jack for Ethernet or on devices for FO cable: 1 x 2 BFOC sockets • depending on version, up to six R-SMA antenna sockets

Electrical data

Power consumption depending on power supply	PoE	12.9 W
	48 V DC	12.9 W
	12 - 24 V DC (adapter)	15 W
	100 - 240 V AC (adapter)	15 W

Construction

Dimensions (W x H x D)	251 mm x 251 mm x 72 mm	
Weight (version with three IWLAN ports)	Without power supply adapter	2241 g
	With power supply adapter 12 - 24 V DC	2428 g
	With power supply adapter 100 - 240 V AC	2433 g

Permitted ambient conditions

Operating temperature	-40°C to 70°C
Transport/storage temperature	-40°C to 85°C
Degree of protection	Tested to IP65

MTBF information (mean time between failure)

MTBF	61 years

Specifications and order numbers

Type	Number of WLAN ports	Number and type of Ethernet ports	Number of internal antennas	Number of R-SMA sockets for external antennas	Order no.
W786-1PRO	1	1 RJ-45	1 (diversity(2))	—	6GK5786-1BA60-2AA0 6GK5786-1BA60-2AB0 (1)
W786-1PRO	1	1 RJ-45	—	2	6GK5786-1AA60-2AA0 6GK5786-1AA60-2AB0 (1)
W786-1PRO	1	1 ST duplex multimode FO cable	1 (diversity(2))	—	6GK5786-1BB60-2AA0 6GK5786-1BB60-2AB0 (1)
W786-1PRO	1	1 ST duplex multimode FO cable	—	2	6GK5786-1AB60-2AA0 6GK5786-1AB60-2AB0 (1)
W786-2PRO	2	1 RJ-45	2 (diversity(2))	—	6GK5786-2BA60-2AA0 6GK5786-2BA60-2AB0 (1)
W786-2PRO	2	1 RJ-45	—	4	6GK5786-2AA60-2AA0 6GK5786-2AA60-2AB0 (1)

Type	Number of WLAN ports	Number and type of Ethernet ports	Number of internal antennas	Number of R-SMA sockets for external antennas	Order no.
W786-2PRO	2	1 ST duplex multimode FO cable	2 (diversity(2))	—	6GK5786-2BB60-2AA0 6GK5786-2BB60-2AB0 (1)
W786-2PRO	2	1 ST duplex multimode FO cable	—	4	6GK5786-2AB60-2AA0 6GK5786-2AB60-2AB0 (1)
W786-3PRO	3	1 RJ-45	—	6	6GK5786-3AA60-2AA0 6GK5786-3AA60-2AB0 (1)
W786-3PRO	3	1 ST duplex multimode FO cable	—	6	6GK5786-3AB60-2AA0 6GK5786-3AB60-2AB0 (1)

(1) US variant

(2) There are two internal antennas per WLAN port. The antenna used is always the one that provides the best possible data transmission (diversity).

7.3 SCALANCE W-784 Access Points

7.3.1 Certifications for SCALANCE W784-1xx / W74x-1

CE conformity

The products

SIMATIC NET SCALANCE W784-1
SIMATIC NET SCALANCE W784-1RR

SIMATIC NET SCALANCE W744-1
SIMATIC NET SCALANCE W746-1
SIMATIC NET SCALANCE W747-1

in the version put into circulation by Siemens A&D conform to the regulations of the following European directive:

- 99/5/EC
  Directive of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity. Conformity with the basic requirement of the directive is attested by adherence to the following standards:
- EN 60950
  Safety of information technology equipment
- EN 301489-1
  Electromagnetic compatibility for radio equipment and services
- EN 301489-17
  Specific requirements for broadband data transmission systems and for equipment in local high-performance wireless networks (HIPERLAN)
- EN 300328
  Electromagnetic compatibility and radio spectrum issues
- EN 301893
  Broadband radio access networks (BRAN) – 5 GHz high-performance RLAN
- EN 50371
  Compliance of low power electronic and electrical apparatus with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)
- 1999/519/EC
  Council recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

Devices connected to the system must meet the relevant safety regulations.

The EC Declaration of Conformity is available for the responsible authorities according to the above-mentioned EC Directive at the following address:

Siemens Aktiengesellschaft
Automation and Drives
Industrielle Kommunikation
Postfach 4848
D-90327 Nürnberg

This declaration certifies compliance with the directives named above, but does not guarantee any specific properties.

Note

The specified approvals apply only when the corresponding mark is printed on the product.

ATEX, cULus and FM approvals

The products

SIMATIC NET SCALANCE W784-1
SIMATIC NET SCALANCE W784-1RR

SIMATIC NET SCALANCE W744-1
SIMATIC NET SCALANCE W746-1
SIMATIC NET SCALANCE W747-1

have the following approvals

- EN 60079-15
  II 3 G Ex nA II T..
  KEMA 07 ATEX 0145X
- c-UL-us:
  UL 60950-1 CSA C22.2 No.
- c-UL-us for hazardous location*:
  ISA 12.12.01-2000, CSA C22.2 No. 213-M1987
  CL. 1, Div. 2 GP. A.B.C.D T..
  CL. 1, Zone 2, GP, IIC, T..
  CL. 1, Zone 2, AEx nC IIC T..
- FM 3611 Hazardous (Classified) Location Electrical Equipment:
  Non Incendive / Class I / Division 2 / Groups A,B,C,D / T* and
  Non Incendive / Class I / Zone 2 / Group IIC / T*

(T.. / T* = For concrete information on the temperature class, refer to the type plate)

⚠ WARNING

When used under hazardous conditions (Zone 2), the SCALANCE W784-1xx or W74x-1 product must be installed in an enclosure. To comply with EN 50021, this enclosure must meet the requirements of at least IP 54 in compliance with EN 60529.

DO NOT DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.

Note

The specified approvals apply only when the corresponding mark is printed on the product.

Wireless approvals

For the current wireless approvals for these products, please visit http://www.siemens.com/simatic-net/ik-info.

7.3.2 Technical specifications of the SCALANCE W784-1xx / W74x-1

Device variants

The technical specifications apply to the following products:

- SIMATIC NET SCALANCE W784-1
- SIMATIC NET SCALANCE W784-1RR
- SIMATIC NET SCALANCE W744-1
- SIMATIC NET SCALANCE W746-1
- SIMATIC NET SCALANCE W747-1

Data transfer

Ethernet transfer rate	10/100 Mbps
Wireless transmission rate	1 ... 54 Mbps (108 Mbps)
Wireless standards supported	802.11a, 802.11b, 802.11g, 802.11h, 802.11i
Power supply standards supported	802.3af (Power over Ethernet)

Interfaces

Power	• Rated voltages 24 V DC or 48 V DC safety extra-low voltage (SELV) (minimum permitted voltage 18 V, maximum permitted voltage 57 V) • RJ-45 jack Power over Ethernet (48 V DC) Power supply isolated according to IEEE 802.3af, isolation resistance > 2 Mohms.
Data	• RJ-45 jack for Ethernet • 2 R-SMA antenna sockets

Electrical data

Power consumption	5 W

Construction

Dimensions without antennas and adapter plate (W x H x D)	100 mm x 205 mm x 20 mm
Weight	approx. 291 g

Permitted ambient conditions

Operating temperature	-20°C to 60°C
Transport/storage temperature	-40°C to 70°C
Degree of protection	Tested to IP30

MTBF information (mean time between failure)

MTBF	67 years

7.3.3 Installation instructions and guidelines

7.3.3.1 Mounting without an adapter (wall mounting only)

Drilling template and procedure

The location of the holes for mounting the SCALANCE W784-1xx / W74x-1 on a wall is shown in the following figure:

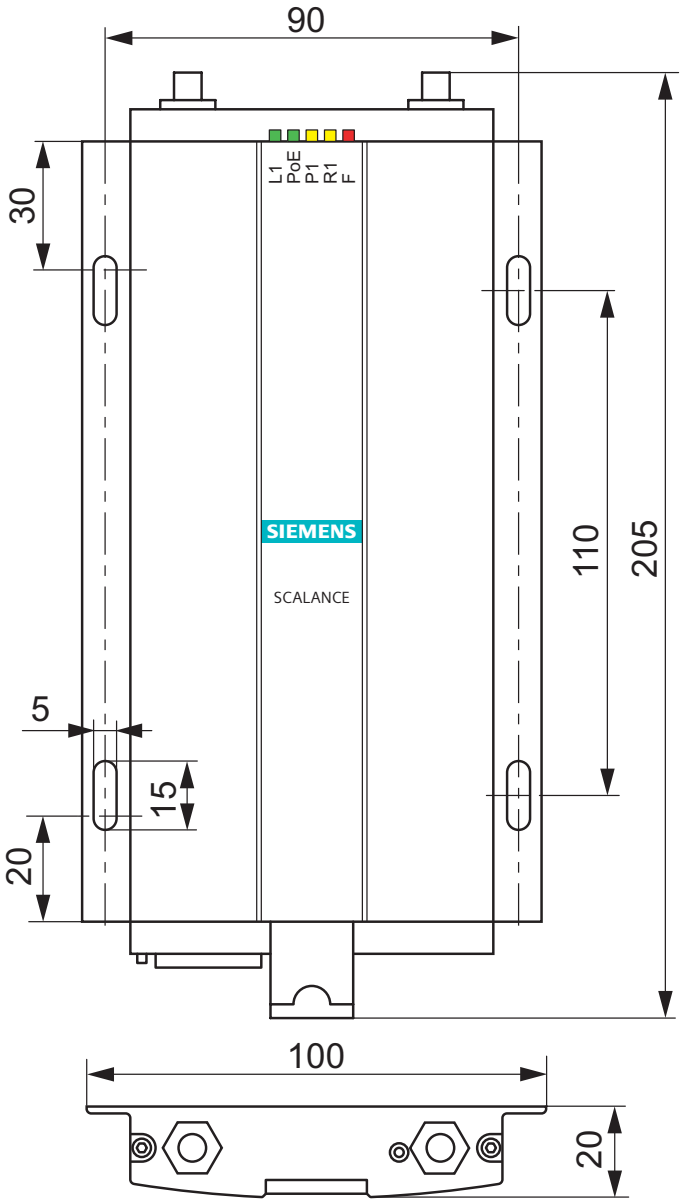


Figure 7-13 Drilling template for wall mounting of a SCALANCE W784-1xx / W74x-1

Secure the SCALANCE W784-1xx / W74x-1 to the wall using four screws. The screws are not supplied with the device. The type and length of the screws depend on the type of wall.

Note

The minimum clearance between the SCALANCE W784-1xx / W74x-1 and fluorescent lamps should be 0.5 m.

7.3.3.2 Lightning protection, power supply, and grounding

Notes on lightning protection

⚠WARNING

Danger due to lightning strikes

Antennas installed outdoors must be within the area covered by a lightning protection system. Make sure that all conducting systems entering from outdoors can be protected by a lightning protection potential equalization system.

When implementing your lightning protection concept, make sure you adhere to the VDE 0182 or IEC 62305 standard.

A suitable lightning conductor is available in the range of accessories of SIMATIC NET Industrial WLAN:

Lightning protector LP798-1N (order no. 6GK5798-2LP00-2AA6)

⚠WARNING

Danger due to lightning strikes

Installing this lightning protector between an antenna and a SCALANCE W-700 is not adequate protection against a lightning strike. The LP798-1N lightening protector only works within the framework of a comprehensive lightning protection concept. If you have questions, ask a qualified specialist company.

Note

The requirements of EN61000-4-5, surge immunity tests on power supply lines, are met only when a Blitzductor is used with 12 - 24 V DC and 48 V DC:

12 - 24 V DC: VT AD 24V type no. 918 402

48 V DC: Type no. 919 545 and 919 506 (holder)

Manufacturer: DEHN+SÖHNE GmbH+Co.KG, Hans Dehn Str. 1, Postfach 1640, D-92306 Neumarkt, Germany

Safety extra low voltage

⚠WARNING

Danger to life from overvoltage, fire hazard

SCALANCE W-700 devices are designed for operation with a directly connectable safety extra-low voltage or with the power supply adapters available as accessories (available only for the SCALANCE W786-xPRO device). Therefore only safety extra-low voltage (SELV) with limited power source (LPS) complying with IEC950/EN60950/VDE0805 may be connected to the power supply terminals (exception: Power supply adapter for 100 - 240 V AC for the SCALANCE W786-xPRO).

Take measures to prevent transient voltage surges of more than 40% of the rated voltage. This is the case if you only operate devices with SELV (safety extra-low voltage).

The power supply unit to supply the SCALANCE W-700 must comply with NEC Class 2 (requirements of class 2 for power supply units of the "National Electrical Code, table 11 (b)") or SELV with LPS (Limited Power Source) EN 60950-1. If the power supply is designed redundantly (two separate power supplies), both power supplies must meet these requirements.

Exceptions:

- Power supply with PELV (according to VDE 0100-410 or IEC 60364-4-41) is also possible if the generated rated voltage does not exceed the voltage limits 25 V AC or 60 V DC.

Grounding

CAUTION

Damage to the device due to potential differences

To avoid the influence of electromagnetic interference, the device should be grounded. There must be no potential difference between the following parts, otherwise the device or other connected device could be severely damaged:

- Housing of the SCALANCE W-700 and the ground potential of the antenna.
- Housing of the SCALANCE W-700 and the ground potential of a device connected over Ethernet.
- Housing of the SCALANCE W-700 and the shield contact of the connected Ethernet cable.

Connect both grounds to the same foundation earth or use an equipotential bonding cable.

Interruption of the power supply

CAUTION
Damage to the Ethernet interface Repeated fast removal and insertion of the Ethernet cable when using Power-over-Ethernet and when there is a redundant power supply can cause damage to the Ethernet interface. Avoid repeatedly removing and inserting the Ethernet cable when using Power-over-Ethernet and a redundant power supply.

FM warning notice

When operated in potential hazardous areas:

WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR DIVISION 2

WARNING - DO NOT OPEN WHEN ENERGIZED

WARNING - DO NOT DISCONNECT EQUIPMENT WHEN A FLAMMABE OR COMBUSTIBLE ATMOSPHERE IS PRESENT

7.3.3.3 Connectors for the power supply of the SCALANCE W784-1xx / W74x-1

Possible power supplies

The following power supplies are suitable for the SCALANCE W784-xx / W74x-1:

- 24 V DC or 48 V DC direct voltage
- Power over Ethernet (PoE)
  If an eight-wire Ethernet cable is used, it is possible to supply power over the four wires that are not used as data lines. As an alternative, the voltage can be modulated onto the data lines ("phantom power")
  If a Fast Connect Ethernet connector is used to allow cable assembly in the field and due to its greater mechanical strength, you can only use four-wire cables. In this case, only phantom power is possible.

Procedure for connecting the supplied connector

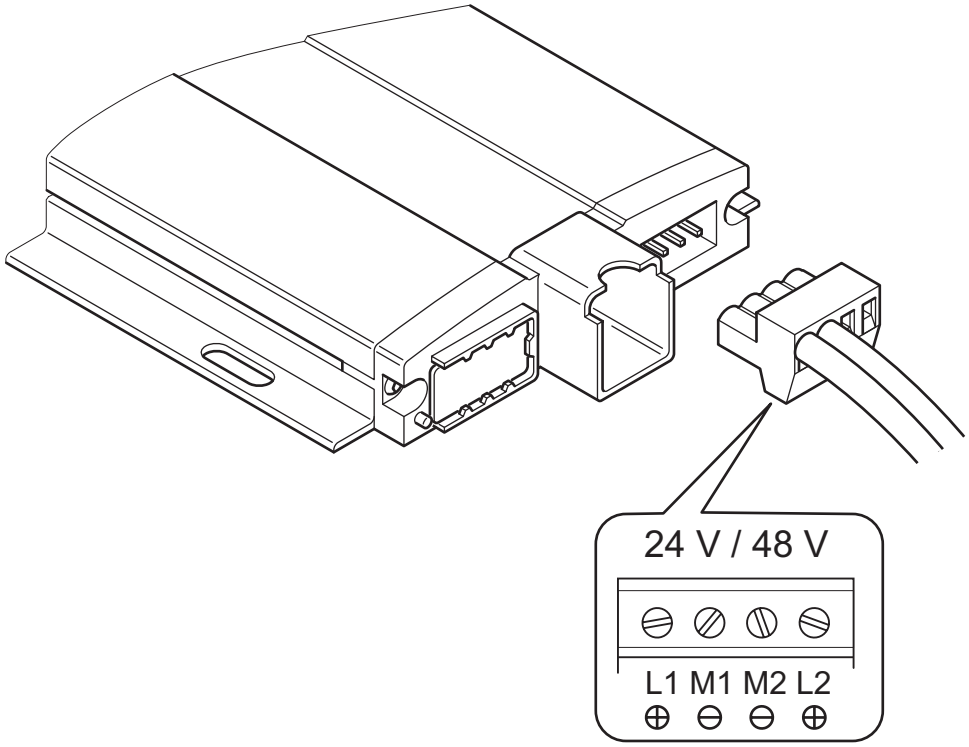


Figure 7-14 Connector for the power supply of the SCALANCE W784-1xx / W74x-1. The screw terminal is located as shown on the rear of the connector.

Perform the following steps to connect a power supply cable to a SCALANCE W784-1xx / W74x-1:

1. Connect the supplied connector to the power supply cable. The figure above shows the location of the socket in the housing and the contact assignment. The connector is protected against polarity reversal. When connecting the wires, make sure that the connector is oriented correctly.
2. Press the connector into the socket in the housing until it engages.
3. Make sure that there is suitable strain relief for the power cable.

7.3.3.4 Connection for Industrial Ethernet

Ethernet connector on the base of the housing

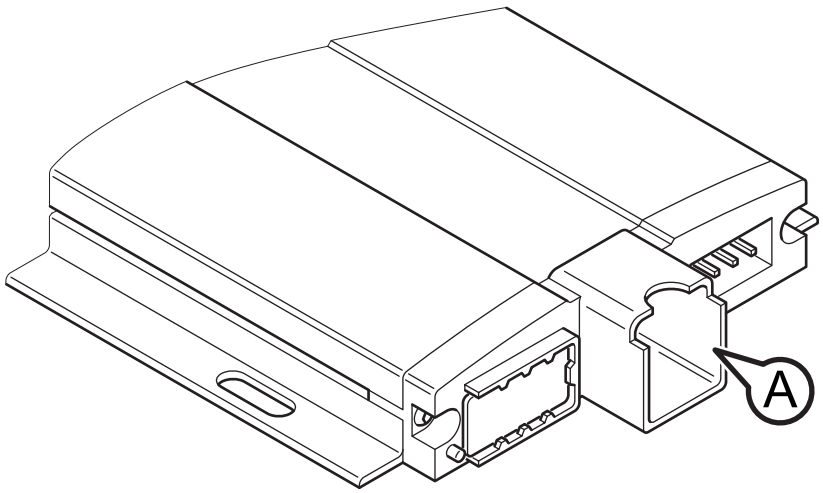


Figure 7-15 Connector for Industrial Ethernet on a SCALANCE W784-1xx / W74x-1

The Ethernet connector is located on the underside of the SCALANCE W784-1xx / W74x-1 (position A in the figure above)

Insert the Ethernet connector into this jack until it locks in place. Make sure that there is suitable strain relief for the Ethernet cable.

7.3.3.5 Connectors for external antennas

How to connect antennas

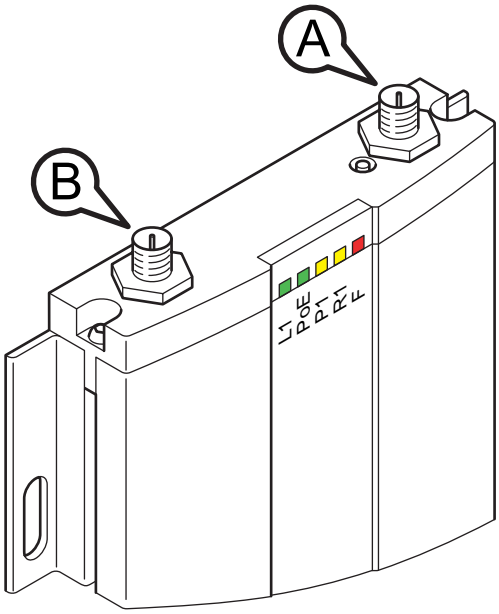


Figure 7-16 Connectors for external antennas on the top of a SCALANCE W784-1xx / W74x-1

The figure above shows the location of the antenna sockets "A" and "B". Perform the following steps to connect a cable for an external antenna to a SCALANCE W784-1xx / W74x-1:

1. Insert the connector on the antenna cable into the R-SMA socket and tighten the sleeve nut on the socket (key size SW8). The maximum tightening torque is 0.6 Nm.
2. Screw a terminating resistor to the unused socket if you are only using one antenna.

7.3.3.6 Mounting with adapter plate

Fitting the adapter plate to an S7-300 standard rail

Procedure

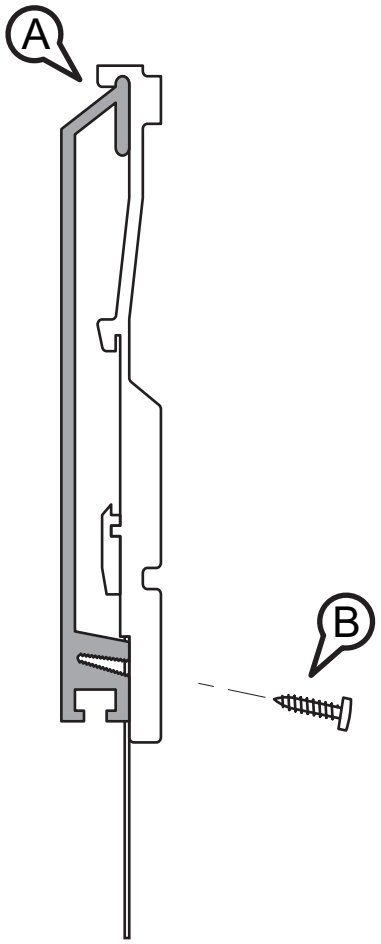


Figure 7-17 Side view of an S7-300 standard rail (shown in gray) with an adapter plate fitted

Note

For cabinet installation, we recommend that you do not install relays on the same or on directly neighboring mounting rails

Follow the steps below to fit the adapter plate to an S7-300 standard rail:

1. Place the adapter plate on the upper edge of the S7-300 standard rail (position **A** in the figure above).

2. At the bottom of the adapter plate, there are two holes with recesses. Use these holes to screw the adapter plate to the S7-300 standard rail. The required screws (position **B** in the figure above) are supplied with the adapter plate.

   The threaded holes at the bottom of the adapter plate are not suitable for screwing the plate to the S7-300 standard rail.

Mounting the adapter plate on a 35 mm DIN rail

Procedure

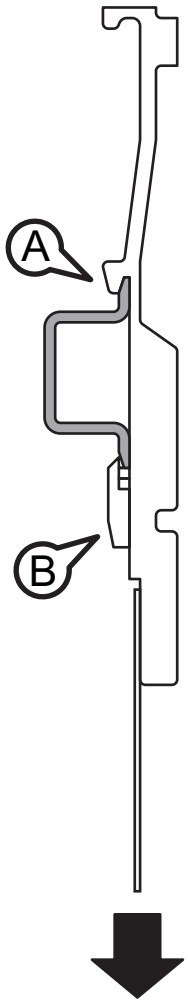


Figure 7-18 Side view of a DIN rail (shown in gray) with an adapter plate fitted

Note

For cabinet installation, we recommend that you do not install relays on the same or on directly neighboring mounting rails

Follow the steps below to fit the adapter plate to a DIN rail:

1. Place the adapter plate on the upper edge of the DIN rail (position A in the figure above).
2. Pull down the DIN rail sliding catch (position B in the figure above) and press the adapter plate against the DIN rail until the sliding catch engages.

Mounting the SCALANCE W784-1xx / W74x-1 on an adapter plate

Procedure

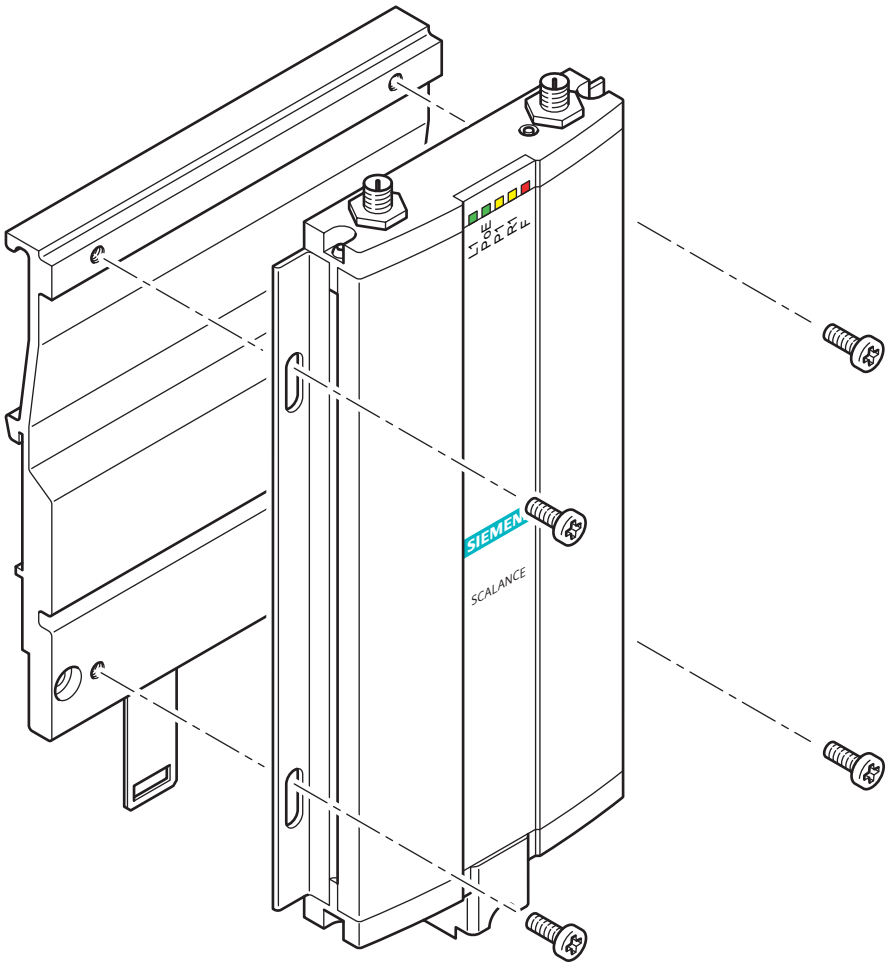


Figure 7-19 Screwing the SCALANCE W784-1xx / W74x-1 to an adapter plate

Screw the SCALANCE W784-1xx / W74x-1 to the plate using the four M4 screws supplied with the adapter plate. The maximum tightening torque for these screws is 0.7 Nm.

Part C: SCALANCE S security components

8

8.1 SCALANCE S certifications and approvals, degree of protection

Certifications

Table 8-1 Approvals

	SCALANCE S602, SCALANCE S612, SCALANCE S613
c-UL-us (Information Technology Equipment)	UL 60950; CSA C22.2 No. 60950
c-UL-us for hazardous locations	UL 1604, UL 2279Pt.15
FM	FM 3611
C-TICK	AS/NZS 2064 (Class A)
CE	EN 61000-6-2, EN 61000-6-4
ATEX Zone 2	EN 50021

Degree of protection

Tested to IP30.

8.2 SCALANCE S installation and setup instructions

Installation

Installation is analogous to the SCALANCE X-100 modules.

Parameter settings

To operate the SCALANCE S, you must download a configuration created with the Security Configuration Tool. To set the parameters, use the software application "Security Configuration Tool" that ships with the product.

A SCALANCE S configuration includes the IP parameters and the setting for firewall rules and, if applicable, the setting for IPsec tunnels (S612 / S613) or router mode.

Before putting the device into operation, you can first create the entire configuration offline and then download it. For the first configuration (device with factory settings), use the MAC address printed on the device.

Depending on the application, you will download the configuration to one or more modules during the commissioning phase.

Factory defaults

With the factory defaults (settings as supplied or after resetting to factory defaults), the SCALANCE S behaves as follows after turning on the power supply:

- IP communication is not possible since the IP settings are missing; in particular, the SCALANCE S does not yet have an IP address.
  As soon as the SCALANCE S module is assigned a valid IP address during configuration, the module can also be reached via a router (IP communication is then possible).
- The device has a fixed, default MAC address; the MAC address is printed on the device and must be used during configuration.
- The firewall is preconfigured with the following basic firewall rules:
  - Unsecured data traffic from internal port to external port and vice versa (external ↔ internal) is not possible;

The unconfigured status can be recognized when the F LED is lit yellow.

See also

X-100 installation instructions and guidelines (Page 237)

8.3 Display elements SCALANCE S

Displays

The following LEDs exist on all SCALANCE S devices and in the same numbers:

- Fault indicator (red LED); Labeled: F):

Table 8-2 Display of the operating state

Status	Meaning
Lit red	Module detects a fault. (Signaling contact is open). The following faults are detected: • Internal error/fault (for example: startup failed) • Invalid C-PLUG (invalid formatting)
Lit green	Module is in productive mode (signaling contact is closed).
Not lit	Module has failed; no power supply (signaling contact is open).
Lit yellow	Module in startup. (Signaling contact open). If no IP address exists, the module remains in this status.
Flashes yellow and red alternately	Module resets itself to factory settings. (Signaling contact open).

- Power indicator (red-green double LED; labeling: L1, L2):

The status of each power supply is indicated by a double LED:

Table 8-3 Status of the power supply

Status	Meaning
Lit green	Power supply L1 or L2 is connected.
Not lit	Power supply L1 or L2 not connected or < 14 V (L+)
Lit red	Power supply L1 or L2 failed during operation or < 14 V (L+)

- Port status displays (one green-yellow double LED per RJ-45 jack, labeling: P1 or P2 and a yellow LED, labeling: TX

Table 8-4 Port status display P1 or P2

Status	Meaning
Lit green	TP link exists
Flashes / lit yellow	Receiving data at RX
Not lit	No TP link or no data being received

Table 8-5 Port status display TX

Status	Meaning
Flashes / lit yellow	Data being sent
Not lit	No data being sent

Operator controls

SCALANCE S devices have a reset button. The reset button is located on the rear of the housing below a cover secured with screws immediately beside the C-PLUG. The reset button is therefore mechanically protected against being activated accidentally.

Two functions can be triggered with the reset button:

- Restart

  If the reset button is pressed for shorter than 5 seconds, the module is restarted. The loaded configuration is retained.

- Reset to factory settings

  If the reset button is pressed for longer than 5 seconds, the error LED starts to flash yellow-red. The module is restarted and reset to the status set in the factory. A loaded configuration is deleted. Resetting takes up to 2 minutes. During the reset, the fault LED continues to flash yellow-red. The power supply must not be interrupted during this procedure.

  On completion of the reset, the device starts up again automatically. The fault LED is then lit yellow.

  If a C-PLUG is plugged in when you reset to factory settings, the C-PLUG is erased!

After pressing the button, the C-PLUG compartment must be closed again with the screw cover.

8.4 Connector pin assignments SCALANCE S

Connector pin assignments

They correspond to those of the SCALANCE X products and are described in the section Common connector pin assignments.

See also

Common connector pin assignments of SCALANCE X devices (Page 230)

8.5 Dimension drawings for SCALANCE S

Dimensions of the SCALANCE S602, S612 and S613 modules

The dimension drawings of the SCALANCE S devices can be found in the SCALANCE X reference section.

See also

SCALANCE X-100, SCALANCE X-200 and SCALANCE S dimension drawings (Page 244)

8.6 SCALANCE S technical specifications

Technical specifications

Table 8-6 Electrical data

	SCALANCE S602, SCALANCE S612, SCALANCE S613
Power supply	2 x 24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)
Power loss at 24 V DC	3.84 W
Current consumption at 24 V DC	130 A at 24 V
Overvoltage protection at input	Non-replaceable fuse (T 1.6 A / 250 V)
Voltage at signaling contact	24 V DC
Current through signaling contact	max. 100 mA
Interference emission	EN 61000-6-4 Class A
Immunity	EN 61000-6-2
MTBF	> 80 years

Table 8-7 Mechanical data

	SCALANCE S602, SCALANCE S612, SCALANCE S613
Dimensions (W x H x D) mm	60 x 125 x 124
Weight	0.7 kg
Installation options	• DIN rail • S7-300 standard rail • Wall mounting

Table 8-8 Environmental conditions

	SCALANCE S602, SCALANCE S612	SCALANCE S613
Operating temperature	0 °C - +60 °C	-20 °C to +70 °C
Storage/transport temperature	-40 °C - +85 °C	
Relative humidity in operation	< 95% (at 30 °C, no condensation)	
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature	
Degree of protection, tested to	IP30	

Table 8-9 Order numbers

SCALANCE S612	6GK5612-0BA00-2AA3
SCALANCE S613	6GK5613-0BA00-2AA3
SCALANCE S602	6GK5602-0BA00-2AA3

Part C: OSM, ESM and ELS

9

9.1 Optical Switch Module (OSM) and Electrical Switch Module (ESM)

9.1.1 Certifications and approvals, degree of protection OSM/ESM

Product name

The OSM/ESM products below meet the regulations listed if the corresponding symbols are shown on the type plate:

Industrial Ethernet OSM ITP62 with digital inputs	6GK1105-2AA10
Industrial Ethernet OSM ITP62 without digital inputs	6GK1105-2AA00
Industrial Ethernet OSM ITP62-LD with digital inputs	6GK1105-2AC10
Industrial Ethernet OSM ITP62-LD without digital inputs	6GK1105-2AC00
Industrial Ethernet OSM ITP53 with digital inputs	6GK1105-2AD10
Industrial Ethernet OSM ITP53 without digital inputs	6GK1105-2AD00
Industrial Ethernet ESM ITP80 with digital inputs	6GK1105-3AA10
Industrial Ethernet ESM ITP80 without digital inputs	6GK1105-3AA00
Industrial Ethernet OSM TP 62 with digital inputs	6GK1105-2AB10
Industrial Ethernet OSM TP62 without digital inputs	6GK1105-2AB00
Industrial Ethernet OSM TP80 with digital inputs	6GK1105-3AB10
Industrial Ethernet ESM TP 80 without digital inputs	6GK1105-3AB00
Industrial Ethernet OSM TP22 with digital inputs	6GK1105-2AE00
Industrial Ethernet ESM TP40 with digital inputs	6GK1105-3AC00
Industrial Ethernet OSM BC08 with digital inputs	6GK1105-4AA00

CE mark

SIMATIC NET OSMs/ESMs meet the requirements of the following EC directives:

- Directive 89/336/EEC "Electromagnetic Compatibility" (EMC Directive)
- Directive 73/23/EEC "Electrical Equipment Designed for Use within Certain Voltage Limits" (Low Voltage Equipment Directive)

The EC Declaration of Conformity is available for the responsible authorities according to the above-mentioned EC Directive at the following address:

Siemens Aktiengesellschaft
Bereich Automatisierungs- und Antriebstechnik
Industrielle Kommunikation (A&D SC IC)
Postfach 4848

D-90327 Nürnberg, Germany

Area of application

The products are designed for use in an industrial environment:

Area of application:	Requirements Emission	Requirements Immunity
Industrial area	EN 50081-2 : 1993	EN 50082-2 : 1995

Note for the manufacturers of machines

This product is not a machine in the sense of the EC Machinery Directive. There is therefore no declaration of conformity relating to the EC Machinery Directive 89/392/EEC for this product.

If the product is part of the equipment of a machine, it must be included in the procedure for obtaining the declaration of conformity by the manufacturer of the machine.

Marking for Australia

C-Tick Mark, AS/NZS 2064 (Class A)

UL approval

UL Recognition Mark

Underwriters Laboratories UL 1950 / UL 60950 (Information Technology Equipment)

CSA approval

CSA Certification Mark

Canadian Standard Association CSA C22.2 No. 60950-00

FM Approval

FM Hazardous (Classified) Location Electrical Equipment:
Non Incendive / Class I / Division 2 / Groups A,B,C,D / T* and
Non Incendive / Class I / Zone 2 / Group IIC / T4

*) Temperature Class T4 or T4A, depending on model

⚠ WARNING
In hazardous areas, personal injury or damage to property may occur if you make or break an electrical circuit while an OSM/ESM is in operation. Do not connect or disconnect equipment when a flammable or combustible atmosphere is present.

Degree of protection

Tested to IP20.

9.1.2 Installation instructions and guidelines for OSM/ESM

Housing, installation

The Industrial Ethernet OSMs and ESMs have a sheet steel casing with degree of protection IP20. They are suitable for the following types of installation:

- Installation on a 35 mm DIN rail
- Installation on a SIMATIC S7-300 standard rail
- Installation in pairs in a 19" cubicle
- Wall mounting

The modules can be installed vertically, one beside the other with no spacing between. Unobstructed convection of surrounding air is essential, in particular air must be able to circulate freely through the ventilation openings of the OSM/ESM.

Preparations

1. Prior to installation, check whether the settings of the DIP switch are correct for your application.
2. Remove the terminal block for the power supply and signaling contact from the OSM and wire up the power supply and signal cables.
3. Only for OSMs/ESMs with digital inputs:
   Where necessary, remove the terminal blocks for the digital inputs from the OSM/ESM and wire up the input signals.

Installation on a DIN rail

1. Install the OSM/ESM on a 35 mm DIN rail complying with DIN EN 50022.
2. Place the upper catch of the OSM/ESM over the top of the DIN rail and then push in the lower part of the device against the rail until it clips into place.
3. Connect the electrical and optical connecting cables, the terminal block for the power supply and, where necessary, the standard cable 9/9 to the standby sync port.

Removing from the DIN rail

To remove the OSM/ESM from the DIN rail, pull the device down pull out the bottom part away from the DIN rail.

Installation on a SIMATIC S7-300 standard rail

1. First secure the two supplied brackets on both sides of the OSM/ESM.
2. Place the upper guide at the top of the OSM housing in the S7 standard rail.
3. Secure the OSM/ESM with the supplied screws to the lower part of the rail.

Installation in pairs in a 19" cubicle

To install in pairs in the 19" cubicle, you require the two securing brackets supplied.

1. First screw the two OSMs/ESMs together using the supplied holding plate on the rear.
2. Fit two of the supplied brackets to the sides
3. Secure the two devices using the brackets in the 19" cubicle. Please note that the OSM/ESM must be grounded with a low resistance via the two holding brackets.

Wall mounting

To install an OSM/ESM on a wall, follow the steps below:

1. Fit the supplied mounting brackets on the sides.
2. Secure the device to the wall using the brackets.
3. Connect the device to protective earth with a low-resistance connection via one of the brackets.

The following table shows how to mount the device on different types of walls:

Wall	Mounting
Concrete wall	Use the four wall plugs (6 mm diameter and 30 mm long). (drill hole 6 mm in diameter, 45 mm deep). To secure the device, use 4.5 mm diameter and 40 mm long screws.
Metal wall (min. 2 mm thick)	To secure the device, use 4 mm diameter screws at least 15 mm long.
Sandwich type plaster walll (min. 15 mm thick)	Use an anchoring plug with at least 4 mm diameter.

Note

The wall mounting must be capable of supporting at least four times the weight of the device.

9.1.3 Operator control and display elements of the OSM/ESM

9.1.3.1 "Status" LED display

Fault (red LED)

Status	Effect
Lit	The OSM/ESM has detected an error. At the same time, the signaling contact opens.
Not lit	No problems detected by the OSM/ESM.

Stby – Standby (green LED)

This LED does not exist on the OSM TP22 and ESM TP40.

Status	Effect
Lit	The standby function is activated, the OSM/ESM is in standby passive mode.
Not lit	The standby function is disabled.
flashes	The standby function is activated, OSM/ESM is in the standby active mode; in other words, the master OSM/ESM has failed and the standby OSM/ESM takes over data traffic.

RM – Redundancy Manager (green LED)

Status	Effect
Lit	The OSM/ESM is operating in the redundancy manager mode. The ring is operating free of errors in other words the redundancy manager does not allow traffic through but monitors the ring. Note: One OSM must operate in the redundancy manager mode (and one only) in each OSM/ESM ring.
Not lit	The OSM/ESM is not operating in redundancy manager mode.
flashes	The OSM/ESM is in redundancy manager mode and has detected a break on the ring. The OSM/ESM makes the connection between its two ring ports so that a functional linear configuration is reestablished.

9.1.3.2 "Power" LED display

Overview

The display mode of the "Power" LED can be switched over by briefly pressing the "Select/Set" button on the front panel of the OSM/ESM. The valid display mode is indicated by the display mode LEDs on the OSM/ESM.

Depending on the status of the display mode LEDs, the "Power" LED has the two following display modes:

Display mode	Display mode LED	Power LED
Status of the power supplies	In the following states of the display mode LEDs, the Power LEDs indicate the current status of the two power supplies of the OSM/ESM: ③ ② ① □ □ □ or □ □ ♦ or □ ♦ □ or ♦ □ □	Power LED L1 or L2 Lit green; in other words, power supply 1 or 2 (line 1 or line 2) is applied. Not lit; in other words power supply 1 or 2 (line 1 or line 2) is lower than 14 V.
Fault mask	In this display mode LED status, the Power LED indicates the fault mask status: ③ ② ① □ ♦ ♦	With the line 1 or 2 LEDs, the fault mask indicates whether the power supplies are monitored with the signaling contact. L1 or L2 LED Lit green; in other words the corresponding power supply (line 1 or line 2) is monitored. If the power supply falls below 14 V, the signaling contact responds. Not lit, in other words the corresponding power supply (line 1 or line 2) is not monitored. If the power supply falls below 14 V this does not trigger the signaling contact. The fault mask can be set again with the button on the front panel of the OSM/ESM.

("□" -- LED off, "♦" -- LED on, Note: LED 3 exists only on devices with digital inputs.)

The "Select/Set" button on the front panel of the OSM/ESM changes the display mode of the display mode LEDs. Using this button, a new status can be programmed for the fault mask

9.1.3.3 Port LEDs

Overview

The port LEDs indicate the operating states of the individual ports of the OSM/ESM. On the OSM/ESM variants with digital inputs, the state of the inputs is also indicated by the port LEDs. To allow this, the OSMs/ESMs have an additional display mode. The display mode of the port LEDs can be changed using the Select/Set button on the front panel of the OSM/ESM allowing all operating states to be displayed. The current display mode is signaled by the display mode LEDs.

Display mode	Mode LED status	Meaning of the Port LED
Port status	③ ② ① □ □ □	Not lit: No valid link to the port (for example station turned off or cable not connected) Lit green: Valid link Flashes green (once per period): Port switched to standby Flashes green (twice per period): Port is segmented Flashes green (three times per period): Port is turned off Flashes green (four times per period): Port is mirrored port Flashes / lit yellow: Data reception on this port
100 Mbps	③ ② ① □ □ ◆	Lit green: Port operating at 100 Mbps Not lit: Port operating at 10 Mbps
Full duplex	③ ② ① □ ◆ □	Lit green: Port operating in full duplex mode Not lit: Port operating in half duplex mode

Display mode	Mode LED status	Meaning of the Port LED
Fault mask	③ ② ① □ ◆ ◆	*The fault mask indicates whether the ports and the power supplies are monitored with the signaling contact.* Lit green: Port is monitored; in other words, if the port does not have a valid connection (for example cable not plugged in or attached device turned off), the signaling contact is triggered. Not lit: The port is not monitored; in other words, an invalid or valid connection at the port does not trigger the signaling contact. *The fault mask can be set again with the button on the front panel of the OSM.*
Digital Inputs	③ ② ① ◆ □ □	Lit green: The logical state "1" is applied to the corresponding digital input. This requires an input voltage of + 13 V DC to + 30 V DC. Not lit: The logical state "0" is applied to the corresponding digital input. This requires an input voltage of –30 V DC to + 3 V DC.

("□" -- LED off, "◆" -- LED on, Note: LED 3 exists only on devices with digital inputs.)

9.1.3.4 Operator controls

Two-pin DIP switch

The two-pin DIP switches on the upper casing of the OSM/ESM have the following functions:

- The standby function can be enabled or disabled with the Stby switch.
  This switch has no function on the OSM TP22 and ESM TP40.
- With the RM switch, you can activate the redundancy manager function.

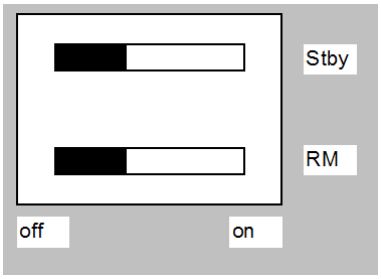


Figure 9-1 Functions of the "Stby" and "RM" DIP switches

Note

Please restart the device after changing DIP switch settings. The switch setting is adopted only when the device starts up.

"Select/Set" button

The "Select/Set" button on the front panel of the OSM/ESM has the following functions

- Pressing the button briefly moves on the display of the port LEDs (display mode). The current display mode is indicated by the display mode LEDs.
- If the display is in the port status (all display mode LEDs off) and if the button is pressed for three seconds, the display mode LEDs begin to flash. If you then continue to press the button for a further two seconds, the OSM/ESM is reset.

  When it is reset, all the settings of the OSM/ESM are set to their defaults (as set in the factory). This allows you to cancel settings made, for example, with Web-Based Management (WBM) (see also OSM/ESM Network Management, User Manual).
- If the display is in the fault mask status and you press the button for two seconds, the display LEDs start to flash. If you then press the button for a further two seconds, the current status of the ports and the supply voltages are entered in the fault mask. This means, if, for example, the ports 1, 5, 6 had a valid connection (in other words the port status displays of these ports are lit green or yellow) and if power supply 1 was active at the point when the values were entered in the fault mask, ports 1, 5, 6 and power supply 1 will then be monitored.

Note

If the "Select/Set" button is pressed while the device is starting up (takes approximately 20 seconds) after turning on the OSM/ESM, the OSM/ESM changes to the load firmware status (all display mode LEDs flash simultaneously). This status is exited by pressing the button again.

9.1.4 Connector and outlet pin assignment

9.1.4.1 Interface pin assignments

ITP ports

In the ITP variant of the OSM/ESM, the end devices are attached via D-sub female connectors. The casings of the connectors are electrically connected to the housing of the OSM. A screw locking mechanism holds the connectors firmly in place.

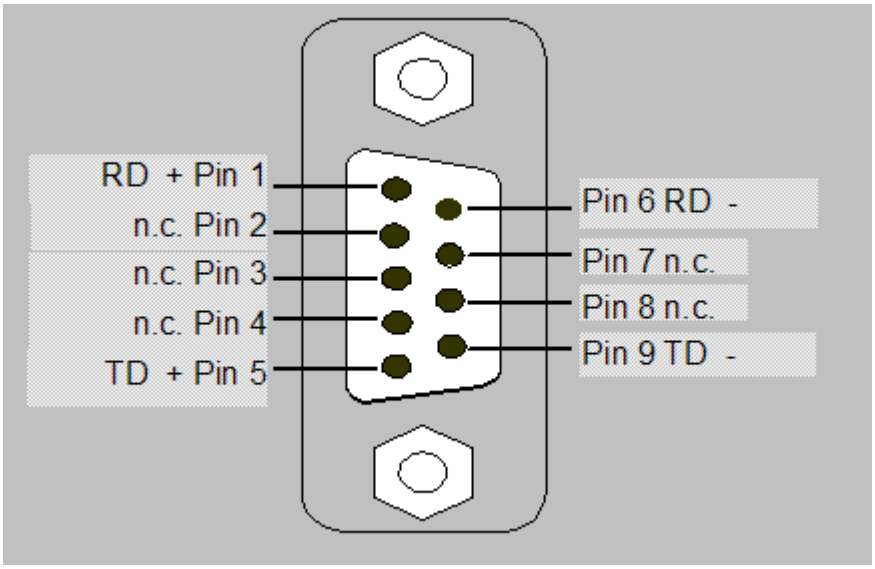


Figure 9-2 ITP port

TP ports

With OSM TP62, OSM TP22, ESM TP40, and ESM TP80 modules, the end devices are connected via RJ-45 jacks with MDI-X assignment (Medium Dependent Interface Crossover).

Fiber-optic ports

The FO ports have BFOC/2.5(ST) female connectors. They monitor the connected cable for wire breaks complying with the IEEE 802.3 100 Base-FX standard. A break on the FO cable is always signaled by the port status display of both connected OSMs (status LED of the port goes off).

Note

The FO ports operate at the fixed transmission rate of 100 Mbps. An optical link, for example, to OLM (10 Mbps) is not possible.

Standby-sync port

A 9-pin female connector is used to connect the ITP XP standard cable 9/9 for the redundant standby coupling. The casing of the connector is electrically connected to the housing of the OSM/ESM.
The OSM TP22 and ESM TP40 do not have a standby-sync port.

A screw locking mechanism holds the connectors firmly in place.

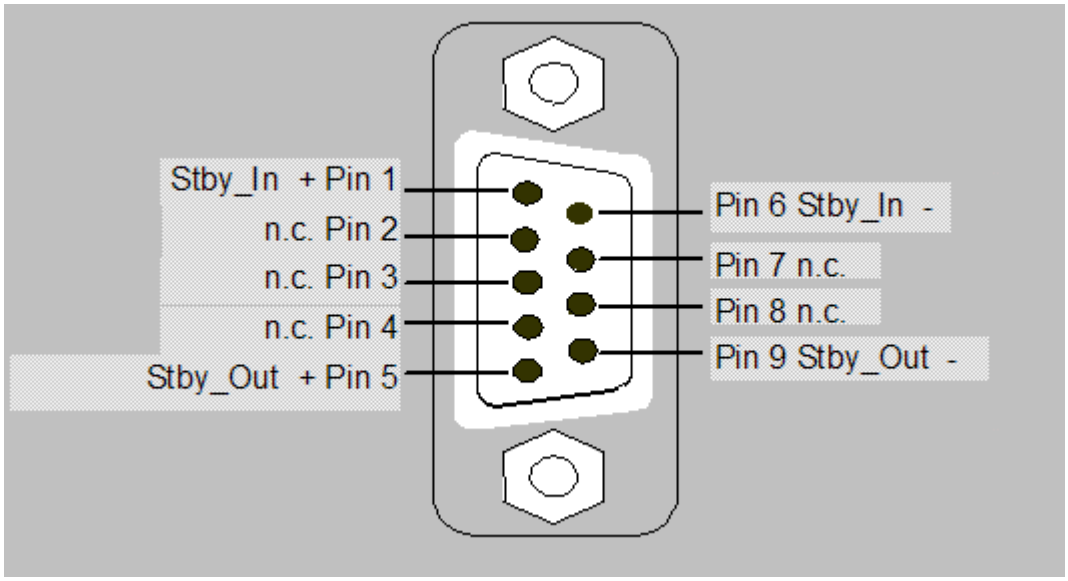


Figure 9-3 Standby-sync port

Serial port

OSM/ESM modules have an RS-232 interface. This is used for the following purposes:

- Firmware updates
- Management with the aid of the command interpreter (Command Line Interpreter, CLI) including setting of the IP address information

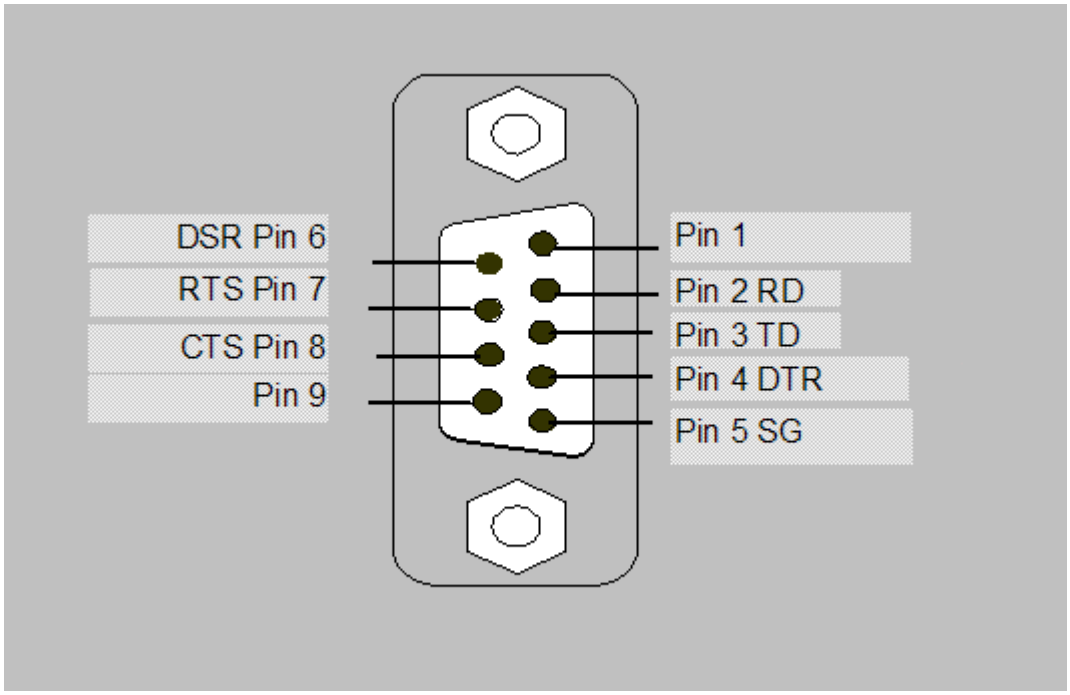


Figure 9-4 Serial port

Signaling contact/terminal block fir connecting the power supply

The connection of the power supply and the signaling contact is made using a 6-pin plug-in terminal block with a screw locking mechanism.

⚠WARNING

Industrial Ethernet OSMs/ESMs are designed for operation with safety extra-low voltage. This means that only safety extra-low voltages (SELV) complying with IEC950/EN60950/ VDE0805 can be connected to the power supply terminals and the signaling contact.

The power supply unit to supply the OSM/ESM must comply with NEC Class 2 (voltage range 18 - 32 V, current requirement 1 A)

The signaling contact can be subjected to a maximum load of 100 mA (safety extra-low voltage (SELV), 24 V DC).

Exceptions:

* Power supply with PELV (according to VDE 0100-410) is also possible if the generated rated voltage does not exceed the voltage limits 25 V AC or 60 V DC.

* Power supply by a SELV power source (according to IEC 60950) or PELV power source (according to VDE 0100-410) without limited power is also permitted if suitable fire protection measures are taken by:

- Installation in a cubicle

- Installation in a suitable enclosure

- Installation in a suitably equipped, closed room.

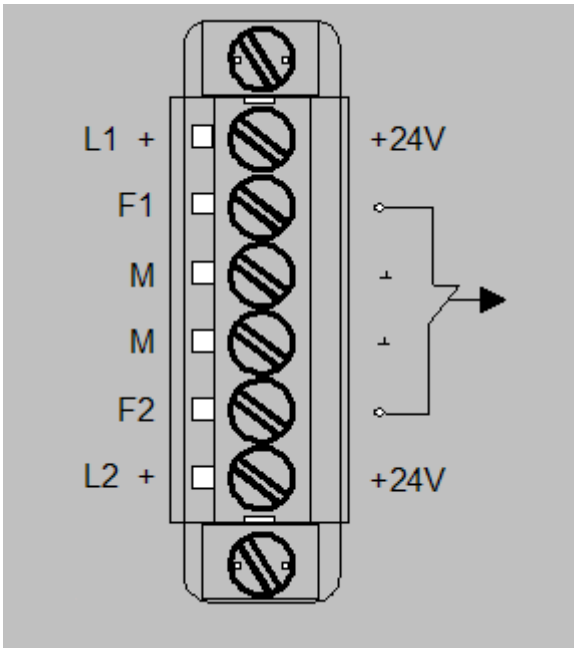


Figure 9-5 Signaling contact/terminal block for power supply

Power supply

The power supply can be connected redundantly. Both inputs are isolated. There is no distribution of load. When a redundant power supply is used, the power supply unit with the higher output voltage supplies the OSM/ESM alone.

Digital Inputs

In the case of the OSMs/ESMs with digital inputs, the states of these inputs are available in a management information base (MIB) and can be read with an SNMP get request. Depending on the configuration of the device, changes at these inputs can also trigger the sending of E-mails, SNMP traps and/or entries in the log of the OSM/ESM. The use of these functions is described in the OSM/ESM Network Management User Manual /1/.

The digital inputs are attached using six-pin plug-in terminal blocks with screw locking mechanisms.

⚠ WARNING
The input voltage must not exceed +30 V DC or fall below -30 V DC.

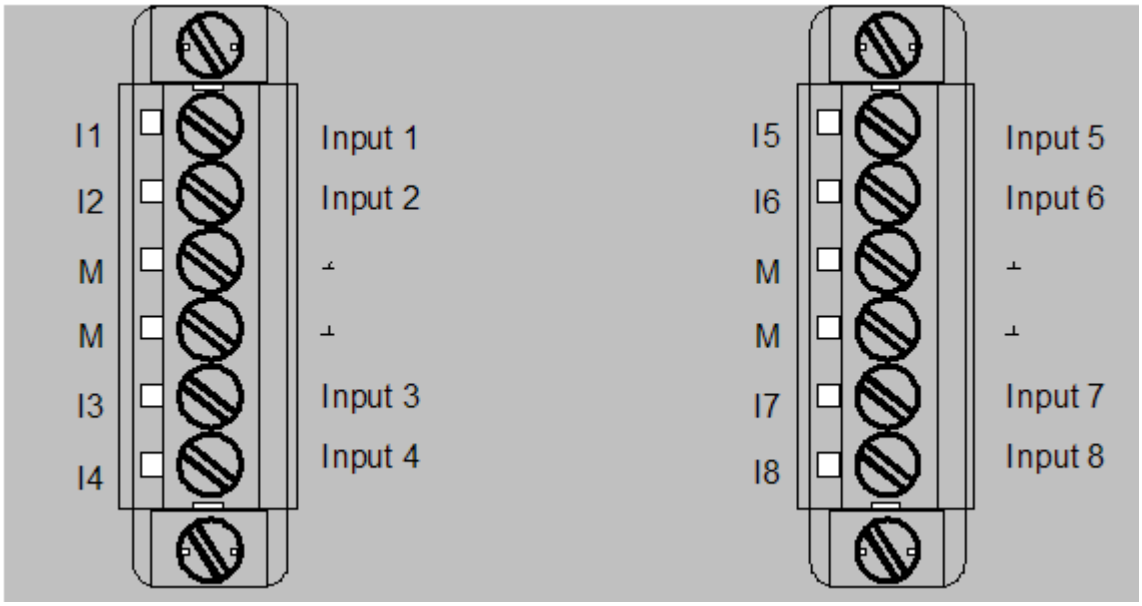


Figure 9-6 Digital Inputs

9.1.5 Dimension drawing

9.1.5.1 Optical Switch Module (OSM)

Outer dimensions and installation clearances for the OSM ITP62, OSM ITP62-LD, ITP53

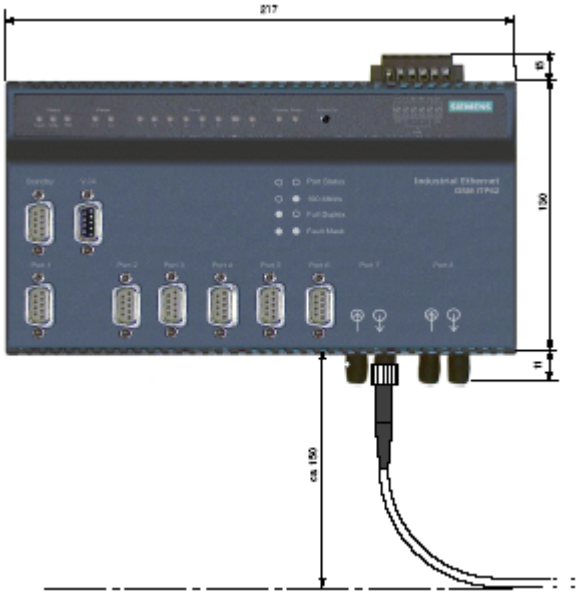


Figure 9-7 Industrial Ethernet OSM ITPxx (dimensions in mm)

Outer dimensions and installation clearances for the OSM TP62

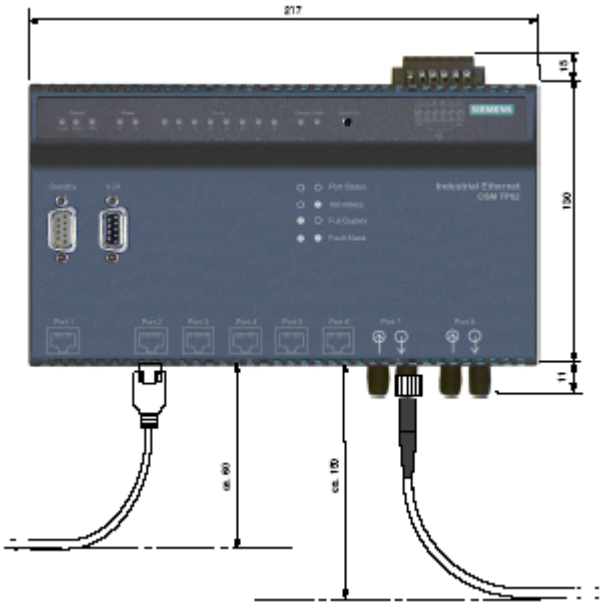


Figure 9-8 Industrial Ethernet OSM TPxx (dimensions in mm)

Side view of the OSM

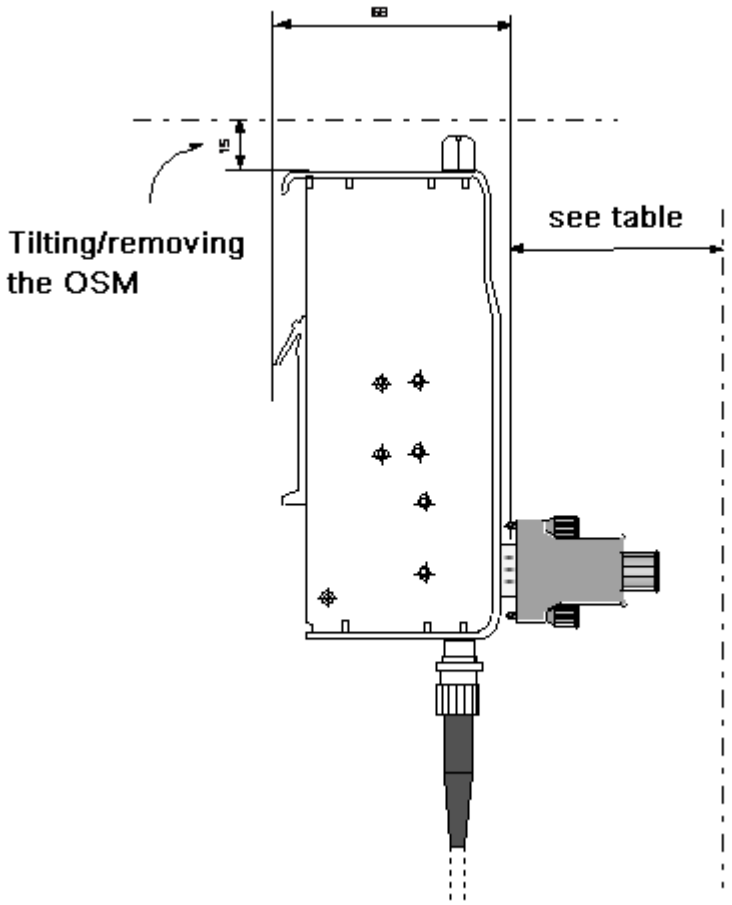


Figure 9-9 Industrial Ethernet OSM (side view; dimensions in mm)

Cable type	Required clearance*
9pin D-sub connector for user assembly on ITP standard cable	approx. 160 mm
Preassembled cables	
ITP Standard Cable 9/x	approx. 95 mm
ITP XP Standard Cable 9/x	approx. 95 mm
Preassembled cables	
TP Cord 9/x (horizontal cable outlet)	approx. 95 mm
ITP Cord 9/x (horizontal cable outlet)	approx. 95 mm
TP Cord 945/x (45° cable outlet)	approx. 95 mm
TP XP Cord 945/x (45° cable outlet)	approx. 95 mm

9.1.5.2 Electrical Switch Module (ESM)

Outer dimensions of the ESM ITP80

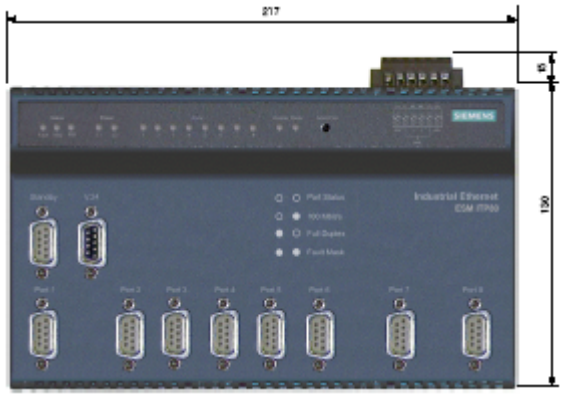


Figure 9-10 Industrial Ethernet ESM ITP80 (dimensions in mm)

Outer dimensions of the ESM TP80

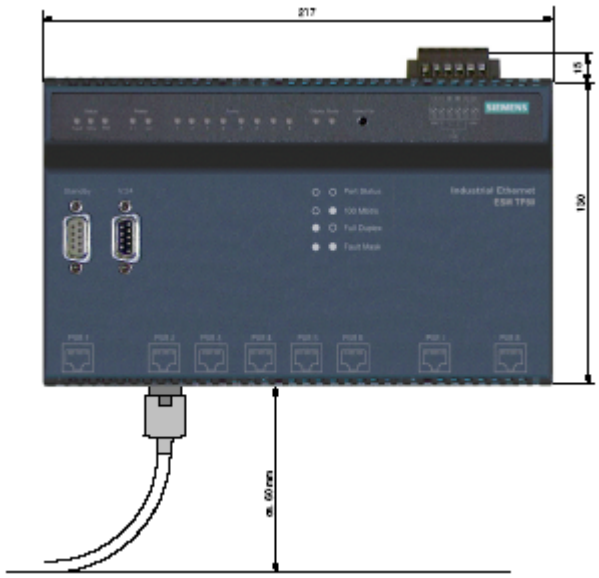


Figure 9-11 Industrial Ethernet ESM TP80 (dimensions in mm)

Outer dimensions and installation clearances for the ESM ITP80/TP80 (side view)

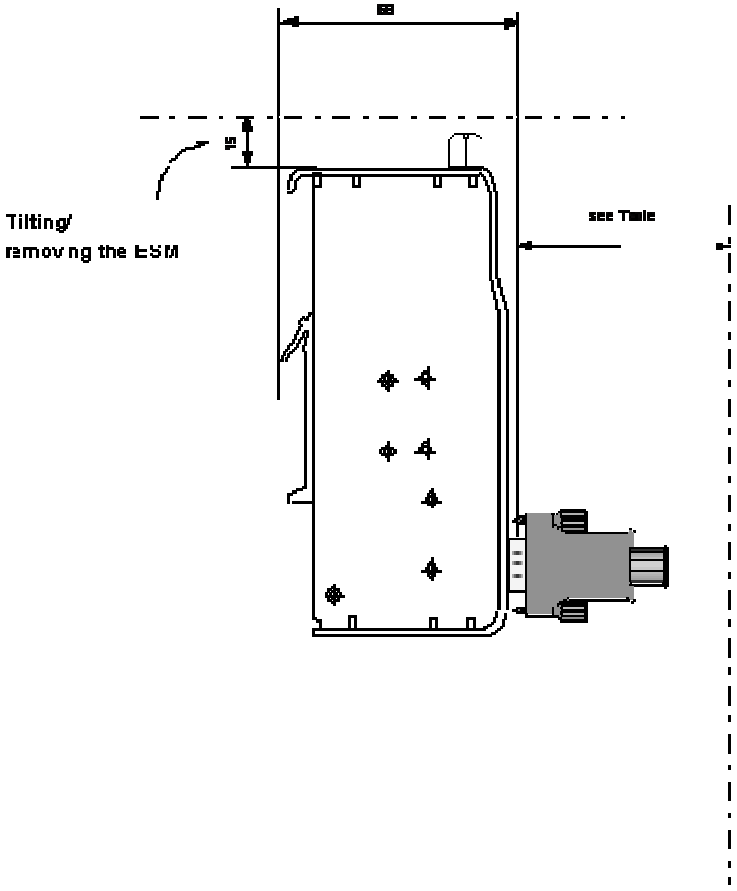


Figure 9-12 Industrial Ethernet ESM (side view; dimensions in mm)

Cable type	Required clearance*
9pin D-sub connector for user assembly on ITP standard cable	approx. 160 mm
Preassembled cables	
ITP Standard Cable 9/x	approx. 95 mm
ITP XP Standard Cable 9/x	approx. 95 mm
Preassembled cables	
TP Cord 9/x (horizontal cable outlet)	approx. 95 mm
ITP Cord 9/x (horizontal cable outlet)	approx. 95 mm
TP Cord 945/x (45° cable outlet)	approx. 65 mm
TP XP Cord 945/x (45° cable outlet)	approx. 65 mm

9.1.6 Components supplied with the OSM/ESM

Components supplied with the OSM/ESM

SIMATIC NET Industrial Ethernet OSM/ESM incl.

- Terminal block for the power supply
- Fittings for wall mounting
- Product information
- CD with Operating Instructions and "Network Management" manual

	Order number
SIMATIC NET Industrial Ethernet OSM	See catalog IK PI
SIMATIC NET Industrial Ethernet ESM	See catalog IK PI

Accessories

SIMATIC NET ITP Standard Cable
SIMATIC NET ITP XP Standard Cable
SIMATIC NET FIBER OPTIC glass FOC
SIMATIC NET TP Cord
SIMATIC NET FC Outlet RJ-45
SIMATIC NET FC TP cables

You will find ordering data in the catalog IK PI.

⚠ WARNING

The Industrial Ethernet OSM/ESM is designed for operation with safety extra-low voltage. This means that only safety extralow voltages (SELV) complying with IEC 950/EN 60950/VDE 0805 may be connected to the power supply terminals or the signaling contact.

For more detailed information on the OSM/ESM, refer to the "Industrial Ethernet OSM/ESM" operating instructions.

9.1.7 Technical specifications

Interfaces

Connecting end devices or network segments over twisted pair / Industrial Twisted Pair	6 x 9-pin D-sub sockets on OSM ITP62 and OSM ITP62-LD 5 x 9-pin D-sub sockets on OSM ITP53 8 x 9-pin D-sub sockets on ESM ITP80 2 x RJ-45 jacks on OSM TP22 4 x RJ-45 jacks on ESM TP40 6 x RJ-45 jacks on OSM TP62 8 x RJ-45 jacks on ESM TP80 All electrical ports support 10/100 Mbps autonegotiation. OSMs/ESMs with digital inputs: The electrical ports support autocrossover.
Standby-sync port for redundant coupling of rings	1 x 9-pin D-sub female connector (not OSM TP22, ESM TP40)
Attachment of further OSMs and end devices via FO	2 x 2 BFOC sockets on OSM ITP 62, OSM ITP62-LD, OSM TP62 and OSM TP22 3 x 2 BFOC sockets on OSM ITP 53 8 x 2 BFOC sockets on OSM BC08 (100 Mbps, 100BaseFX, full duplex)
Connector for power supply and signaling contact	1 x 6-pin plug-in terminal block
Power supply (redundant inputs isolated)	2 x 24 V DC power supplies (18 to 32 V DC) safety extra-low voltage (SELV) Power supply voltage connected over high resistance with housing (not electrically isolated). Tested to IEC 6100-4-5, 1995 "Surge Immunity Test", performed with lightning protection device DEHN Blitzductor VT AD 24V, article no. 918 402
Power loss at 24 V DC	20 W
Load on the signaling contact	24 V DC / max. 100 mA safety extra-low voltage (SELV)
Current consumption at rated voltage	1000 mA
Overvoltage protection at input	Non-replaceable fuse (1.6 A / 250 V / time lag)
Digital Inputs	Input voltage: Rated value 24 V DC safety extra-low voltage (SELV) For state "1": +13 ...+30 V For "0" state: –30 ... +3 V Max. input current: 8 mA Max. cable length: 30 m Inputs isolated from electronics.

Permitted cable lengths

FO cable length between two OSMs	For OSM ITP62, OSM ITP53, OSM TP62, OSM TP22: 0-3000 m (62.5/125 µm glass fiber; 1 dB/km at 1300 nm; 600 MHz*km; 6 dB max. permitted FO cable attenuation at 3 dB link power margin) 0-3000 m (50/125 µm glass fiber; 1 dB/km at 1300 nm; 600 MHz*km; 6 dB max. permitted FO cable attenuation at 3 dB link power margin) For OSM ITP62-LD: 0-26000 m (10/125 µm single mode fiber; 0.5 dB/km at 1300 nm; 13 dB max. permitted FO cable attenuation at 2 dB link power margin)
ITP cable length	0 - 100 m
TP cable length	0-10 m with TP cord up to 100 m total length when using the FastConnect cabling system
Length of the ITP XP Standard Cable 9/9 at standby-sync port	0 - 40 m

Cascading depth

Linear/star structure	Any (only depending on signal propagation time)
Redundant ring	50 (for reconfiguration time < 0.3 s)

Switching properties of OSM/ESM

Number of learnable addresses	Up to 7000
Aging time	40 s (default)
Latency	4 µs (measured at 75% load between two ports operating at 100 Mbps)
Switching procedure	Store and forward

Permitted ambient conditions

Operating temperature	0 °C to +60 °C (OSM ITP62-LD: 0 °C to +55 °C)
Storage/transport temperature	-20 °C to +80 °C
Relative humidity in operation	‹ 95% (at 25 °C, no condensation)
Operating altitude	Max. 2000 m
Interference emission	EN 55081 Class A
Immunity	EN 50082-2
Laser protection	Class 1 complying with IEC 60825 -1

Construction

Dimensions (W x H x D) in mm	217 x 156.5 x 69
Weight in g	1400
Installation options	DIN rail S7-300 standard rail Wall mounted Installation in 19" cubicle Only horizontal installation permitted (ventilation slit top/bottom)

Scope of supply

SIMATIC NET Industrial Ethernet OSM/ESM

Fittings for 19" cubicle installation/wall mounting

6-pin plug-in terminal block for power supply and signaling contact

One to two 6-pin plug-in terminal blocks for OSMs/ESMs with digital inputs

Documentation on the CD

Order numbers

Industrial Ethernet OSM ITP62 with digital inputs	6GK1105-2AA10
Industrial Ethernet OSM ITP62 without digital inputs	6GK1105-2AA00
Industrial Ethernet OSM ITP62-LD with digital inputs	6GK1105-2AC10
Industrial Ethernet OSM ITP62-LD without digital inputs	6GK1105-2AC00
Industrial Ethernet OSM ITP53 with digital inputs	6GK1105-2AD10
Industrial Ethernet OSM ITP53 without digital inputs	6GK1105-2AD00
Industrial Ethernet ESM ITP80 with digital inputs	6GK1105-3AA10
Industrial Ethernet ESM ITP80 without digital inputs	6GK1105-3AA00
Industrial Ethernet OSM TP 62 with digital inputs	6GK1105-2AB10
Industrial Ethernet OSM TP62 without digital inputs	6GK1105-2AB00
Industrial Ethernet OSM TP80 with digital inputs	6GK1105-3AB10
Industrial Ethernet ESM TP 80 without digital inputs	6GK1105-3AB00
Industrial Ethernet OSM TP22 with digital inputs	6GK1105-2AE00

Industrial Ethernet ESM TP40 with digital inputs	6GK1105-3AC00
Industrial Ethernet OSM BC08 with digital inputs	6GK1105-4AA00

Accessories

Triaxial networks for Industrial Ethernet manual	6GK1970-1AA20-0BA0

9.2 Electrical Lean Switch (ELS)

9.2.1 Certifications and approvals, degree of protection ELS

Approvals

Table 9-1 ELS TP40, ELS TP40M and ELS TP80

UL	UL 1950
CSA	CSA C22.2 No. 950
FM	FM 3611
C-TICK	AS/NZS 2064 (Class A).
CE	yes
Shipbuilding approval	-

Degree of protection

Tested to IP20.

9.2.2 Installation instructions and guidelines ELS

Housing, installation

The ELS has a robust sheet steel casing with degree of protection IP20. They are suitable for the following types of installation:

- Installation on a 35 mm DIN rail
- Installation on a SIMATIC S7-300 standard rail
- Installation in a 19" cubicle (along with other ELS modules in the 19" mounting system)
- Wall mounting

Note

Remember that the ELS must only be installed horizontally (ventilation slits top/bottom see Figure 4). To ensure adequate convection, there must be a clearance of at least 5 cm above and below the ventilation slits. You should also make sure that the permitted ambient temperature range is not exceeded.

Preparations

Remove the terminal block from the ELS and wire up the power supply lines

Installation on a DIN rail

1. Install the ELS on a 35 mm DIN rail complying with DIN EN 50022.
2. Place the upper catch of the ELS over the top of the DIN rail and then push in the lower part of the device against the rail until it clips into place.
3. Install the electrical connecting cables and the terminal block for the power supply.

Removing from the DIN rail

1. To remove the ELS from the DIN rail, first disconnect the TP cables and pull off the terminal block.
2. Then pull down the device and release it from the rail.

Installation on a SIMATIC S7-300 standard rail

1. First secure the supplied brackets to the left and right of the ELS.
2. Place the upper guide at the top of the ELS housing in the S7 standard rail.
3. Screw the ELS to the bottom of the standard rail.

Installation in a 19" cubicle

To install in the 19" cubicle, you require the securing brackets supplied. You can achieve the 19" width

• with 3 ELS devices

Follow the steps outlined below:

1. First screw the ELS switches to the supplied mounting plates at the rear.
2. Fit two of the supplied brackets to the sides
3. Secure the devices using the brackets in the 19" cubicle.

Wall mounting

To install an ELS on a wall, follow the steps below:

1. Fit the supplied mounting brackets on the sides of the ELS.
2. Secure the device to the wall using the brackets and fittings suitable for the wall in question.
3. Using one of the brackets or the PE screw terminal, connect the device with protective earth with as low a resistance as possible.

Note

The wall mounting must be capable of supporting at least four times the weight of the device.

Grounding

- 19" cubicle: Please note that the ELS must be grounded with a low resistance via the two holding brackets. It is also possible to ground the device using the PE screw terminal on the terminal block.
- Installation on a DIN rail: The device is grounded either via the DIN rail or the PE screw terminal on the terminal block.
- Wall mounting: Please note that the ELS must be grounded with a low resistance via the two holding brackets. It is also possible to ground the device using the PE screw terminal on the terminal block.
- S7 standard rail: The device is grounded either via the two mounting brackets or the PE screw terminal on the terminal block.

Connecting the IE FC TP Cable to the ELS TP40 or ELS TP40M

When connecting the IE FC cables, follow the steps outlined below:

1. Strip the insulation from the FC TP cable with the IE FastConnect stripping tool. (Refer to the instructions for the IE FC stripping tool, Order no. 6GK1901-1GA00)
2. Remove the protective foil from the cores and remove the support element between the cores.
3. Open the cover of the TP ports with insulation piercing contacts.
4. Open the two contact covers.
5. Arrange the wires according to the color code of the contact cover of the TP ports with insulation piercing contacts.
6. Insert the wires of the IE FC TP cable into the contact cover according to the color code.
7. Press down both contact covers to establish contact with the cores.
8. Close and screw down the cover of the TP ports with insulation piercing contacts.

9.2.3 Operator control and display elements of the ELS

LEDs

ELS modules have the following LED displays:

- Power display: The status of the ELS TP40M is indicated by a green and a red LED, on the ELS TP40 and ELS TP80, a green LED is used.
- The status of each TP interface is indicated by a green/yellow LED:

9.2.4 Connector pin assignments

Power supply

The connection of the power supply on all ELS is made using a 3-pin plug-in terminal block with a screw locking mechanism. A suitable terminal block is supplied with all ELS devices.

The power supply is connected over a high resistance with the enclosure to allow an ungrounded set up. The ELS TP80 can also be grounded via the PE screw terminal on the terminal block.

No signaling contact

The ELS devices do *not* have a signaling contact.

9.2.5 Dimension drawings of the ELS

Dimension drawings

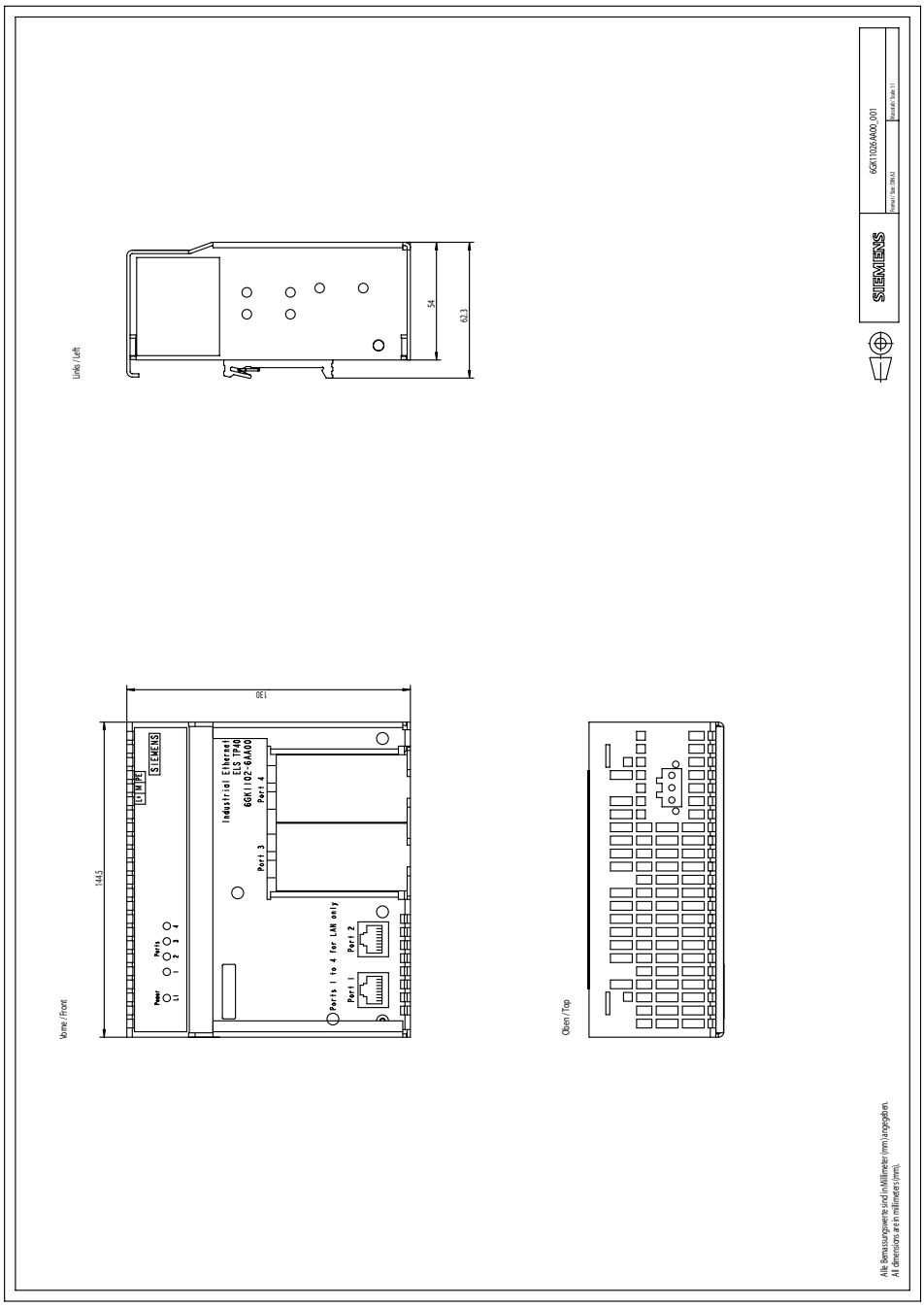


Figure 9-13 Dimension drawing ELS 40

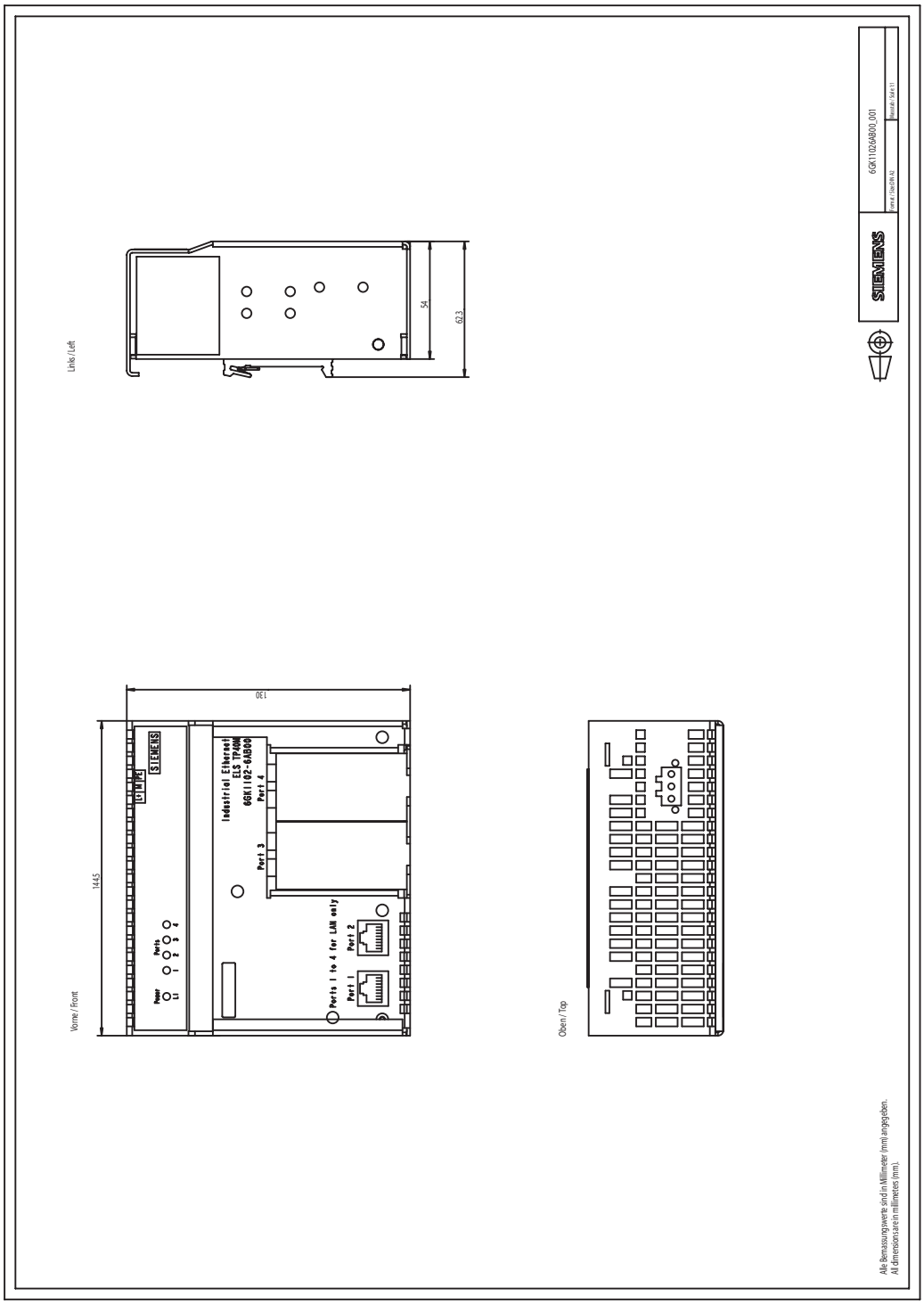


Figure 9-14 Dimension drawing ELS TP40M

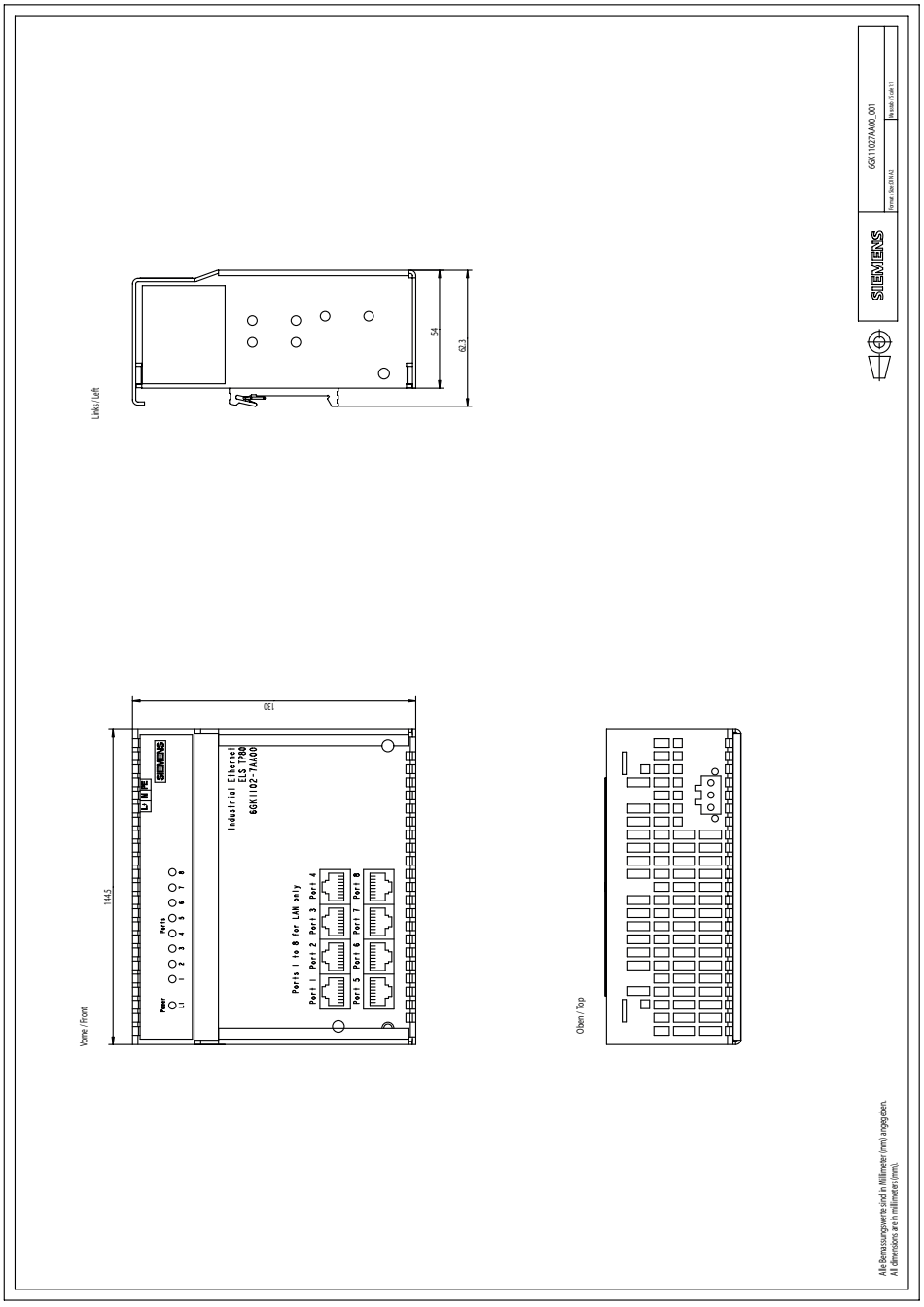


Figure 9-15 Dimension drawing ELS TP80

9.2.6 Technical specifications of the ELS

Technical specifications of the Industrial Ethernet ELS

Table 9-2 Electrical data

	ELS TP40	ELS TP40M	ELS TP80
Transmission rate	10/100 Mbps		
Power supply	24 V DC (18 - 32 V DC) safety extra-low voltage (SELV)		
Power consumption	150 mA	200 mA	150 mA
Power loss at 24 V DC	3.6 W	4.8 W	3.6 W
Overvoltage protection at input	PTC resettable fuse (0.6 A / 60 V)		
Aging time	5 minutes		
Interference emission	EN 61000-6-4		
Immunity	EN 61000-6-2		
MTBF	108.85 years	51 years	81.52 years

Interfaces

Depending on the variant, the following TP interfaces are available:

- Twistedpair port (RJ-45): TP cords or TP-XP cords with a maximum length of 10 m can be connected to the RJ-45 TP port. In conjunction with IE FC outlet RJ-45, a total cable length of up to 100 m is permitted.
- Twisted pair interface as insulation piercing contacts: IE FC TP cables with a maximum length of up to 100 m can be connected to the TP interfaces with insulation piercing contacts.

Table 9-3 Interfaces

	ELS TP40	ELS TP40M	ELS TP80
RJ-45 jacks	2 x (10/100 Mbps; TP)		8 x (10/100 Mbps; TP)
Insulation piercing contacts	2 x (10/100 Mbps)		-
Connector for power supply	1 x 3-pin terminal block (L1+ (24 V), M, PE)		

Further data

Table 9-4 Environmental conditions

	ELS TP40	ELS TP40M	ELS TP80
Operating temperature	0 °C - +60 °C		
Storage/transport temperature	-40 °C - +80 °C		
Relative humidity in operation	< 95% (no condensation)		
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature		
Degree of protection	IP20		

Table 9-5 Mechanical data

	ELS TP40	ELS TP40M	ELS TP80
Dimensions (W x H x D) mm	145 x 126.5 x 62.5		
Weight	950 g		
Installation	• DIN rail • S7-300 standard rail • Wall mounting Installation in a 19" cubicle. Only horizontal installation permitted**(ventilation slit top/bottom)**		

Order numbers

Industrial Ethernet ELS TP40	6GK1 102-6AA00
Industrial Ethernet ELS TP40M	6GK1 102-6AB00
Industrial Ethernet ELS TP80	6GK1 102-7AA00

Part C: Passive components and accessories

10

10.1 Overview: Media, cables and connectors

Overview of the available types of cable, connectors and accessories

	Twisted Pair-networks	Fiber Optic-networks	Wireless link
Network topology	Star, linear bus, ring, tree	Star, linear bus, ring, tree	Wireless network
Transmission media	FastConnect cables ITP-Standard Cable TP Cord	FO Standard Cable FO Ground Cable FO Trailing Cable POF Standard Cable POF Trailing Cable PCF Standard Cable GP PCF Trailing Cable GP PCF Trailing Cable	–
Device connection	over FC RJ45 Plug and FastConnect cables ITP Standard Cable ITP XP Standard Cable TP Cord, TP XP Cord TP Converter Cord	FO Standard Cable FO Ground Cable FO Trailing Cable POF Standard Cable POF Trailing Cable PCF Standard Cable GP PCF Trailing Cable GP PCF Trailing Cable Endgeräteanschluss über OMC	over RJ45 Plug and FastConnect cables ITP Standard Cable ITP XP Standard Cable TP Cord, TP XP Cord TP Converter Cord
Tools and accessories	Outlet RJ45 FC Stripping Tool FC RJ45 Plug FC RJ45 Modular Outlet 9-pin ITP sub-D connector 15-pin ITP sub-D connector	BFOC connectors further components on request SC connectors SC RJ connectors	Antennas (incl. RCoax Cable)
Lightning converter	Not relevant since twisted-pair only used in the indoor area	Not applicable	Lightning protector
Documentation	Manual for TP and fiber optic networks		Included in SCALANCE W scope of supply

G_IK10_XX_10014

Figure 10-1 Product overview of cables and connectors

10.2 Contacts for special cables and special lengths

Contacts for special cables and special lengths

If you require special cables and special lengths of the cable types, please contact:

Jürgen Hertlein
SIEMENS A&D SE PS 1
E-mail: juergen.hertlein@siemens.com
Tel.: + + 49 (911) 750-4465
Telefax: + 49 (911) 750-9991

10.3 Notes on installation of electrical and optical bus cables

General

Note

For detailed information on laying electrical and optical bus cables, refer to the Appendix.

See also

Laying bus cables (Page 574)

10.4 Components for electrical networks

10.4.1 Twisted Pair Cord

10.4.1.1 Twisted Pair Cord (4-wire for Fast Ethernet)

Design

The cable consists of two pairs of wires each pair twisted together (PIMPF structure). Each pair is shielded with an aluminum foil. The outer shield is a tinplated copper braid mesh. The outer sheath is PVC.

Shielding

Each pair of wires is shielded by a plastic laminated aluminum foil with an external contact surface. All the pairs making up the cable are surrounded by a braided shield of tinplated copper wires (coverage approximately 88%).

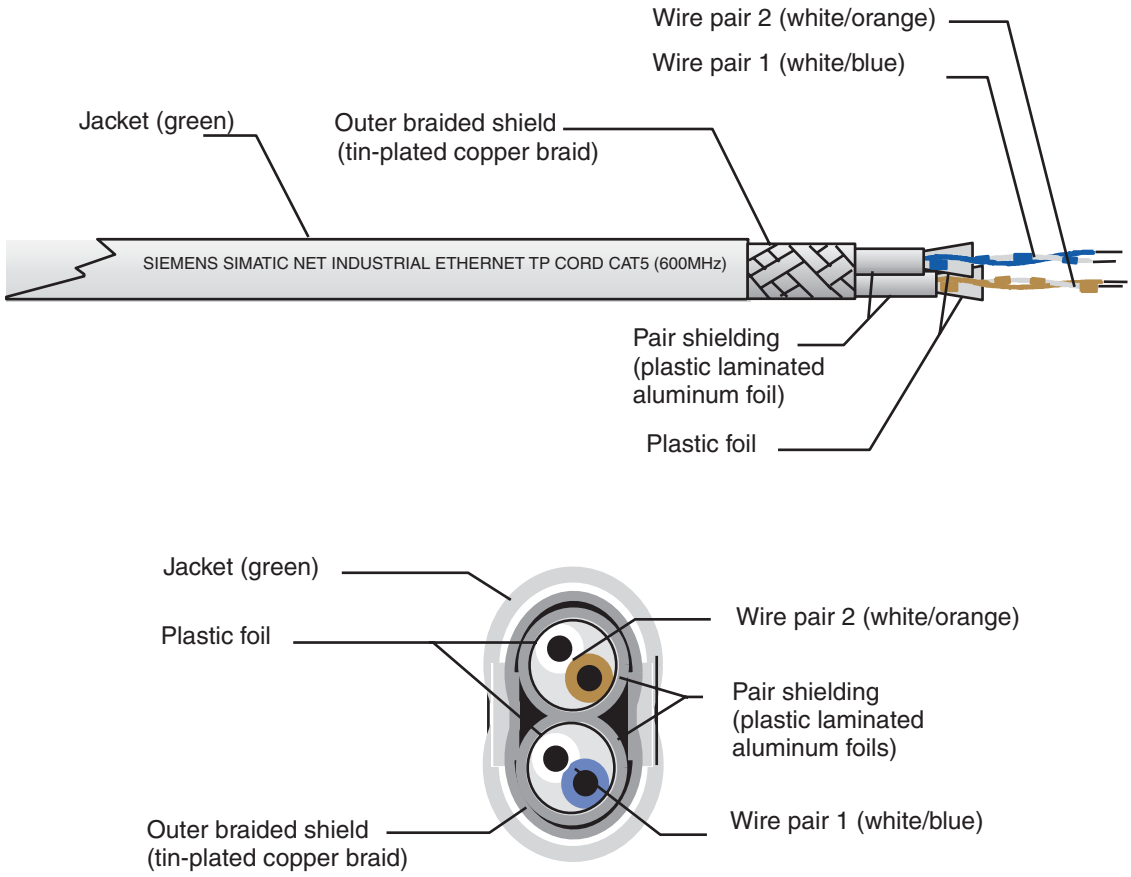


Figure 10-2 Structure of the twopair IE TP CORD (PIMF)

Label

The IE TP CORD is labeled as follows:

"SIEMENS SIMATIC NET INDUSTRIAL ETHERNET TP CORD CAT5 (600MHz)".

Technical specifications

Table 10-1 Electrical data of the IE TP Cord 2x2 at 20 °C

Cable category complying with EN 50173	CAT5		
DC loop resistance		maximum	300 Ω/km
DC insulation resistance		minimum	150 MΩ x km
Attenuation/100 m	at 4 MHz	maximum	5.7 dB
	10 MHz		9.0 dB
	100 MHz		28.5 dB
	300 MHz		49.5 dB
Near end crosstalk loss (NEXT)/100 m	at 4 MHz	minimum	80 dB
	10 MHz		80 dB
	100 MHz		72.5 dB
	300 MHz		65 dB
Characteristic impedance	at 1...100 MHz		100 Ω +15/-15 %
	10...600 MHz		100 Ω +10/-10 %
Transfer impedance	at 10 MHz	maximum	10 mΩ/m
Return loss	at 1...20 MHz	minimum	23 dB
	20..0.100 MHz		23 dB - 10log(f/20)
Longitudinal conversion loss	at 64 KHz	minimum	43 dB
Capacitance unbalance pair to ground	at 1 KHz	maximum	1600 pF/km
Dielectric strength at 50 Hz		effective value	
- conductor/conductor	1 min		700 V
- conductor/shield	1 min		700 V

Table 10-2 Mechanical data of the IE TP 2x2 Cord

Standard code	LI 02YSCY 2x2x0.15/0.98 PIMF ICCS GN
Core diameter to AWG 26	0.5 mm
Core diameter with PE jacket	0.98 mm
Approx. thickness of PVC outer sheath	approx. 0.5 mm
Outer diameter	3.7 x 5.8 +/- 0.2 mm
Permitted bending radius:	over the flat side
Multiple bends	> 60 mm
Single bend	> 40 mm
Permitted tensile force	≤ 48 N
Temperature range:	
Operation	-40 °C to +70 °C
Installation/assembly	-20 °C to +50 °C
Transport/storage	-40 °C to +70 °C
Net weight	33 kg/km
Free of halogens	no
Resistance to fire	Flameretardant complying with DIN VDE 0472, Part 804 test type B
Resistance to oil	Conditionally resistant to mineral oils and fats
Silicone-free	yes

The available preassembled IE TP Cord 2x2 cables are listed in the section Preassembled Twisted Pair Cord cables.

See also

Preassembled twisted-pair cords (Page 451)

10.4.1.2 Twisted Pair Cord (8-wire for Gigabit Ethernet)

Design

The cable consists of four pairs of wires. Each wire has a PE jacket. The pairs are twisted together. Each pair is shielded with an aluminum foil. The outer shield is a tinplated copper braid mesh. The material of the outer jacket is FRNC (flame-retardant, non-corrosive).

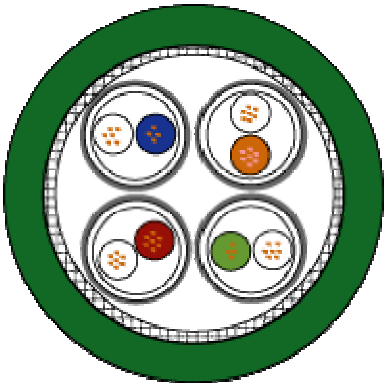


Figure 10-3 Structure of the Twisted Pair Cord (8-wire for Gigabit Ethernet)

Label

The IE TP CORD is labeled as follows:

"meter markers" SIEMENS SIMATIC NET INDUSTRIAL ETHERNET TP Cord 4x2 CAT6 * AWM STYLE 21283 *

Technical specifications

Table 10-3 Electrical data of the IE TP Cord 4x2 at 20 °C

Cable category complying with EN 50173	CAT6		
DC loop resistance		maximum	290 Ω/km
DC insulation resistance		minimum	500 MΩ x km
Attenuation/100 m	at 4 MHz	maximum	5.5 dB
	10 MHz		8.6 dB
	100 MHz		28.0 dB
	300 MHz		50.1 dB
Near end crosstalk loss (NEXT)/100 m	at 4 MHz	minimum	80 dB
	10 MHz		80 dB
	100 MHz		72.4 dB
	300 MHz		65.3 dB
Characteristic impedance	at 1...300 MHz		100 Ω +15/-15 %
	300..00.600 MHz		100 Ω +25/-25 %
Transfer impedance	at 10 MHz	maximum	10 mΩ/m
Return loss	at 10 MHz	minimum	25 dB
	100 MHz		20.1 dB
	350 MHz		17.3 dB
Capacitance unbalance pair to ground	at 1 KHz	maximum	1600 pF/km
Dielectric strength at 50 Hz		effective value	
- conductor/conductor	1 min		700 V
- conductor/shield	1 min		700 V

Table 10-4 Mechanical data of the IE TP 4x2 Cord

Standard code	LI 02YSCH 4x2x0.15 PIMF GN FRNC
Core diameter to AWG 26	0.5 mm
Core diameter with PE insulation	1.0 mm
Approx. thickness of FRNC outer sheath	approx. 0.5 mm
Outer diameter	(6.2 +/- 0.3) mm
Permitted bending radius:	
Multiple bends	7 x outer diameter
Single bend	5 x outer diameter
Temperature range:	
Operation	-25 °C to +70 °C
Installation/assembly	-20 °C to +50 °C
Transport/storage	-25 °C to +70 °C
Net weight	50 kg/km
Free of halogens	yes
Resistance to fire	Flame retardant to IEC 60332-1
Silicone-free	yes

The available preassembled IE TP Cord 4 x 2 cables are listed in the section "Preassembled Industrial Twisted Pair and twisted pair cables".

See also

Preassembled twisted-pair (TP) and Industrial Twisted Pair (ITP) cables (Page 451)

10.4.2 FastConnect (FC) twisted-pair cables

10.4.2.1 FastConnect (FC) twisted-pair cables 4-wire for 100 Mbps Ethernet

Design

The FastConnect (FC) twisted-pair cable is a shielded cable with a symmetrical radial design and 100 W characteristic impedance. The cable consists of 4 conductors arranged as a star quad.

The IE FC Standard Cable and IE FC Food Cable have solid cores, the other cables (the IE FC Trailing Cable, the IE FC Trailing Cable GP, the IE FC Flexible Cable GP, the IE FC Marine Cable, the IE FC Torsion Cable and the IE FC FRNC Cable and IE FC Festoon Cable) have stranded cores.

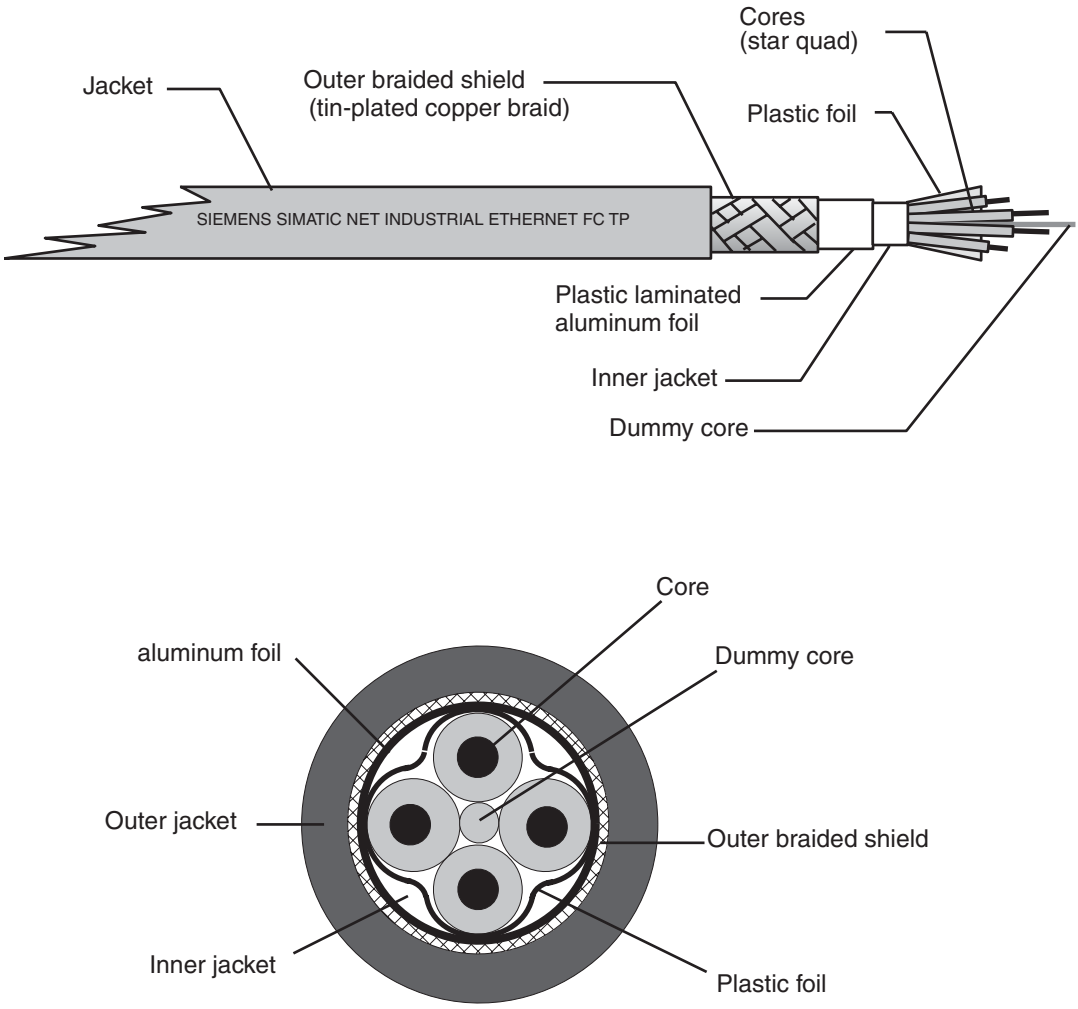


Figure 10-4 Basic structure of the FastConnect (FC) twisted pair cable

Table 10-5 Product overview of the IE FC Cable 2 x 2 (PROFINET-compliant according to PROFINET Installation Guide 1))

	PROFINET Type A	PROFINET Type B	PROFINET Type C
	AWG 22/1 rigid cable	AWG 22/7 flexible cable for occasional movement	AWG 22 highly flexible cable for constant movement, for example drag chains or robots
IE FC TP Standard Cable GP 2 x 2 (Type A) 6XV1 840-2AH10	X	-	-
IE FC TP Flexible Cable GP 2 x 2 (Type B) 6XV1 870-2B	-	X	-
IE FC TP Trailing Cable GP 2 x 2 (Type C) 6XV1 870-2D	-	-	X
IE FC TP Trailing Cable 2 x 2 (Type C) 6XV1 840-3AH10	-	-	X
IE TP Torsion Cable GP 2 x 2 (Type C) 6XV1 870-2F	-	-	X
IE FC TP FRNC Cable GP 2 x 2 (Type B) 6XV1 871-2F	-	X	-
IE FC TP Marine Cable 2 x 2 (Type B) 6XV1 840-4AH10	-	X	-

1) Available as download from www.profibus.com

Table 10-6 Electrical data of the FastConnect (FC) twisted pair cables

Cable type 1)	**IE FC Standard Cable GP 2 x 2 (Type A)**	**IE FC flexible cable GP 2 x 2 (Type B)**	**IE FC torsion cable GP 2 x 2 (Type C)**
Areas of application	Universal application	Occasional movement	Use in robots
Cable specification	Cat 5E	Cat 5E	Cat 5E
Electrical data (at 20 °C)			
Attenuation			
at 10 MHz	typically 5.2 dB/100 m	typically 6 dB/100 m	typically 7.6 dB/100 m
at 100 MHz	typically 19.5 dB/100 m	typically 21 dB/100 m	typically 41 dB/100 m
Characteristic impedance			
at 1-100 MHz	100 Ω ± 15 Ω	100 Ω ± 15 Ω	100 Ω ± 15 Ω
Near end crosstalk loss			
at 1-100 MHz	typically ≥ 50 dB/100 m	typically ≥ 50 dB/100 m	≥ 50 dB/100 m
Transfer impedance			
at 10 MHz	≤ 115 Ω/km	≤ 100 mΩ/m	≤ 100 mΩ/m
DC loop resistance	≤ 124 Ω/km	≤ 120 Ω/km	≤ 120 Ω/km
DC insulation resistance	> 500 MΩ x km	> 500 MΩ x km	> 500 MΩ x km
Transmission range			
with IE FC RJ-45 Plug	100 m	85 m	55 m
with IE FC Outlet RJ-45	90 m	75 m	45 m

Table 10-7 Mechanical data of the FastConnect (FC) twisted pair cables

Cable type	**IE FC Standard Cable GP 2 x 2 (Type A)**	**IE FC flexible cable GP 2 x 2 (Type B)**	**IE FC torsion cable GP 2 x 2 (Type C)**
Cabling (Standard code)	2YY (ST) CY 2x2x0.64/1.5-100 GN	2YY (ST) CY 2x2x0.75/1.5-100LI GN	02YS (ST) C11Y 1 x 4 x 0.75/1.5-100LI GN VZN FRNC
Inner wire diameter (copper)	0.64 mm, AWG22	0.75 mm, AWG22	0.76 mm, AWG22
Core insulation	PE Ø 1.5 mm	PE Ø 1.5 mm	PE ∅ 1.5 mm
Inner jacket	PVC Ø 3.9 mm	PVC Ø 3.9 mm	Ø 4.6 mm
Jacket	PVC Ø (6.5 ± 0.2) mm	PVC Ø (6.5 ± 0.2) mm	PUR Ø (6.5 ± 0.2) mm
Perm. ambient conditions			
Operating temperature			
Transport/storage temperature	-40 ºC to +75 ºC	-10 ºC to +70 ºC	-40 ºC to +80 ºC
	-40 ºC to +75 ºC	-40 ºC to +70 ºC	-40 ºC to +80 ºC
Installation temperature	-20 ºC to +60 ºC	-20 ºC to +60 ºC	-20 ºC to +60 ºC
Permitted bending radius			
multiple	7.5 x ∅	8 x ∅	15 x ∅
single	3 x ∅	5 x ∅	5 x ∅
Bending cycles	-	-	- 4)
Permitted tensile force	≤ 150 N	≤ 150 N	≤ 130 N
Weight approx.	approx. 67 kg/km	approx. 68 kg/km	approx. 54 kg/km
Free of halogens	no	no	yes
Resistance to fire	Flame retardant to UL 1685 (CSA FT 4)	Flame retardant to UL 1685 (CSA FT 4)	Flame retardant to IEC 60332-1-2
Resistance to oil	Conditionally resistant	Conditionally resistant	Conditionally resistant
UL listing / 300 V rating	yes/CM/CMG/PLTC/Sun Res	yes/CM/CMG/PLTC/Sun Res	UL Style 21161
UL style / 600 V rating	yes	no	no
CCC certificate 5)	Not necessary	Not necessary	Not necessary
UV resistance	yes	yes	yes
Fast Connect cable structure	yes	yes	no
Silicone-free	yes	yes	yes

Table 10-8 Electrical data of the FastConnect (FC) twisted pair cables

Cable type 1)	**IE FC Trailing Cable GP 2 x 2 (Type C)**	**IE FC Trailing Cable 2 x 2 (Type C)**	**IE FC Marine Cable 2 x 2 (Type B)**
Areas of application	Use in drag chains	Use in drag chains	Marine and offshore use 2)
Cable specification	Cat 5E	Cat 5E	Cat 5E
Electrical data (at 20 °C)			
Attenuation			
at 10 MHz	6.3 dB/100 m	6.3 dB/100 m	6 dB/100 m
at 100 MHz	22.3 dB/100 m	22.3 dB/100 m	22 dB/100 m
Characteristic impedance			
at 1-100 MHz	100 Ω ± 5 Ω	100 Ω ± 15 Ω	100 Ω ± 15 Ω
Near end crosstalk loss			
at 1-100 MHz	≥ 50 dB/100 m	≥ 50 dB/100 m	≥ 50 dB/100 m
Transfer impedance			
at 10 MHz	≤ 10 mΩ/m	≤ 10 mΩ/m	≤ 10 mΩ/m
DC loop resistance	≤ 120 Ω/km	≤ 120 Ω/km	≤ 120 Ω/km
DC insulation resistance	> 500 MΩ x km	> 500 MΩ x km	> 500 MΩ x km
Transmission range			
with IE FC RJ-45 Plug	85 m	85 m	85 m
with IE FC Outlet RJ-45	75 m	75 m	75 m

Table 10-9 Mechanical data of the FastConnect (FC) twisted pair cables

Cable type	IE FC Trailing Cable GP 2 x 2 (Type C)	IE FC Trailing Cable 2 x 2 (Type C)	IE FC Marine Cable 2 x 2 (Type B)
Cabling (Standard code)	2YY (ST) CY 2x2x0.75/1.5-100 LI GN	2YH (ST) C11Y 2 x 2 x 0.75/1.5-100 LI GN VZN FRNC	L-9YH (ST) CH 2 x 2 x 0.34/1.5-100 GN VZN FRNC
Inner wire diameter (copper)	0.75 mm, AWG22	0.75 mm, AWG22	0.75 mm, AWG22
Core insulation	PE Ø 1.5 mm	PE Ø 1.5 mm	PP Ø 1.5 mm
Inner jacket	PVC Ø 3.9 mm	FRNC Ø 3.9 mm	FRNC Ø 3.9 mm
Jacket	PVC Ø (6.5 ± 0.2) mm	PUR Ø (6.5 ± 0.2) mm	FRNC Ø (6.5 ± 0.2) mm
Perm. ambient conditions			
Operating temperature			
Transport/storage temperature	-25 ºC to +75 ºC	-40 ºC to +75 ºC	-25 ºC to +70 ºC
	-25 ºC to +75 ºC	-50 ºC to +75 ºC	-40 ºC to +70 ºC
Installation temperature	-10 ºC to +60 ºC	-20 ºC to +60 ºC	0 ºC to +50 ºC
Permitted bending radius			
multiple	7.5 x ∅	7.5 x ∅	15 x ∅
single	5 x ∅	3 x ∅	6 x ∅
Bending cycles	3 million 3)	4 million 3)	-
Permitted tensile force	≤ 150 N	≤ 150 N	≤ 150 N
Weight approx.	approx. 68 kg/km	approx. 63 kg/km	approx. 68 kg/km
Free of halogens	no	yes	yes
Resistance to fire	Flame retardant to UL 1685 (CSA FT 4)	Flame retardant to IEC 60332-1	Flame test to IEC 60332-3-22; flame retardant to UL 1685 (CSA FT 4)
Resistance to oil	Conditionally resistant	Conditionally resistant	Conditionally resistant
UL listing / 300 V rating	yes/CMG/PLTC/Sun Res	yes/CMX	yes/CM/CMG/PLTC/Sun Res
UL style / 600 V rating	yes	no	no
CCC certificate 5)	Not necessary	Not necessary	Not necessary
UV resistance	yes	yes	yes
Fast Connect cable structure	yes	yes	yes
Silicone-free	yes	yes	yes

1) Electrical properties at 20 °C, tested to DIN 0472

2) Shipbuilding approvals:

- Germanischer Lloyd
- Lloyds Register of Shipping
- Bureau Veritas
- Det Norske Veritas
- ABS Europe LTD

3) at a bending diameter of 200 mm

4) Torsion-resistant cable for the following requirements:
min. 5 million torsion movements on 1 m cable +/- 180 º

5) All SIMATIC NET cables with order numbers beginning 6XV1 do not require a CCC certificate (confirmation available)

Application

- IE FC Standard Cable GP 2 x 2:
  Standard bus cable with rigid cores and specially designed for fast assembly. Four rigid conductors are arranged as a star quad.
- IE FC Flexible Cable GP 2 x 2:
  Flexible bus cable for special applications with occasional movement; four wires (stranded) arranged as a star quad.
- IE FC Torsion Cable GP 2 x 2:
  Highly flexible bus cable for special applications with constant movement, for example for use in robots; stranded cores.
- IE FC Trailing Cable GP 2 x 2:
  Highly flexible bus cable for special applications with constant movement in a in a drag chain, for example for permanently moving machine parts; not halogen-free; four wires (stranded) arranged as start quad.
- FC TP Trailing Cable 2 x 2:
  Highly flexible bus cable for special applications with constant movement in a in a drag chain, for example for permanently moving machine parts; halogen-free; four wires (stranded) arranged as start quad.
- IE FC Marine Cable 2 x 2:
  Bus cable specially for use on ships; halogen-free, certified for shipbuilding; four wires (stranded) arranged as star quad.

Advantages

For structured cabling in the factory

- Time-saving due to simple and fast installation with FastConnect cables to the Industrial Ethernet FC Outlet RJ-45 and IE FC RJ-45 Plug with insulation piercing technique.
- Convenient stripping with the FastConnect Stripping Tool, with which the outer jacket and braid shield can be removed to the perfect length in one step.
- Versatile application due to special bus cables
- High noise immunity due to double shielding
- Easy length measurement with printed meter markers
- Exceeds the requirements of category 5 (CAT5e) of the international cabling standards ISO/IEC 11801 and EN 50173
- Silicone-free and therefore suitable for use in the automobile industry (for example in paint shops)

Notes on Installation

The bus cables are sold in meters.

FastConnect

Using the IE FastConnect stripping tool, the outer jacket and shield of IE FastConnect cables can be stripped to correct lengths in a single action. This allows the Outlet RJ-45 and the IE FC R-45 Plug to be connected quickly and simply to the Industrial Ethernet FC cable.

Reduced length

Due to the stranded cores used in the cable variants, the signal attenuation is higher. For precise values, refer to the above tables in the electrical data. Make sure that you take this into account in your configuration.

Do not assemble with D-sub connectors

FastConnect twisted-pair cables are not suitable for the use of Industrial Twisted Pair D-sub connectors due to their diameter. If you assemble Industrial Twisted Pair cables yourself with D-sub connectors, use only Industrial Twisted Pair cable!

Laying cables

During storage, transport, and installation, the bus cables must be closed at both ends with a shrink-on cover. Make sure that you do not exceed the bend radii and tensile stress!

Table 10-10 Ordering data

	Order number
IE FC TP Standard Cable GP 2 x 2 (Type A) TP installation cable for attachment to Industrial Ethernet FC Outlet RJ-45 for general application, 4-wire, shielded, sold in meters, maximum length available 1000 m, minimum length available 20 m.	6XV1 840-2AH10
IE FC TP Flexible Cable GP 2 x 2 (Type B) 4-wire, shielded TP installation cable for connection to IE FC Outlet RJ-45/ IE FC RJ-45 Plug for occasional movement; PROFINET-compliant; with UL approval; sold in meters; maximum length available. 1000 m, minimum length available 20 m	6XV1 870-2B
IE FC TP Trailing Cable GP 2 x 2 (Type C) 4-wire, shielded TP installation cable for connection to IE FC Outlet RJ-45/ IE FC RJ-45 Plug for drag chains; PROFINET-compliant; with UL approval; sold in meters; maximum length available. 1000 m, minimum length available 20 m	6XV1 870-2D
IE FC TP Trailing Cable 2 x 2 (Type C) 4-wire, shielded TP installation cable for connection to IE FC Outlet RJ-45/ IE FC RJ-45 Plug 180/90 for drag chains; PROFINET-compliant; with UL approval; sold in meters; maximum length available. 1000 m, minimum length available 20 m	6XV1 840-3AH10

	Order number
IE TP Torsion Cable GP 2 x 2 (Type C) 4-wire, shielded TP installation cable for connection to IE FC Outlet RJ-45/ IE FC RJ-45 Plug for use with robots; PROFINET-compliant; with UL approval; sold in meters; maximum length available. 1000 m, minimum length available 20 m	6XV1 870-2F
IE FC TP FRNC Cable GP 2 x 2 (Type B) TP installation cable for connection to FC OUTLET RJ-45, 4-wire, shielded, CAT 5, sold in meters, maximum length available 1000 m, minimum length available 20 m	6XV1 871-2F
IE FC TP Marine Cable 2 x 2 (Type B) 4-wire, shielded TP installation cable for connection to IE FC Outlet RJ-45/ IE FC RJ-45 Plug 180/90 shipbuilding certified; sold in meters; maximum length available. 1000 m, minimum length available 20 m	6XV1 840-4AH10
IE FC Stripping Tool Preset insulation stripping tool for fast stripping of Industrial Ethernet FC cables	6GK1 901-1GA00
IE FC blade cassettes (12 mm) Cassette with spare blades for the Industrial Ethernet Stripping Tool; for use with IE FC Outlet RJ-45, ELS TP40, set of 5	6GK1 901-1GB00
IE FC blade cassettes (5 mm) Cassette with spare blades for the Industrial Ethernet Stripping Tool; for use with IE FC RJ-45 Plugs and IE FC RJ45 Modular Outlet, set of 5	6GK1 901-1GB01
IE FC Outlet RJ-45 For connecting Industrial Ethernet FC cables and TP Cords; graduated price as of 10 and 50 connectors	6GK1 901-1FC00 0AA0
IE FC RJ-45 Plug 180 RJ-45 cable connector for Industrial Ethernet with robust metal casing and integrated insulation piercing contacts for connection of the Industrial Ethernet FC installation cables; with 180° cable outlet; for network components and CPs/CPUs with Industrial Ethernet interface 1 pack of 1 1 pack of 10 1 pack of 50	 6GK1 901-1BB10-2AA0 6GK1 901-1BB10-2AB0 6GK1 901-1BB10-2AE0
IE FC RJ-45 Plug 90 RJ-45 cable connector for Industrial Ethernet with robust metal casing and integrated insulation piercing contacts for connection of the Industrial Ethernet FC installation cables; with 90° cable outlet; for ET 200S 1 pack of 1 1 pack of 10 1 pack of 50	 6GK1 901-1BB20-2AA0 6GK1 901-1BB20-2AB0 6GK1 901-1BB20-2AE0

	Order number
IE FC RJ-45 Plug 145 RJ-45 cable connector for Industrial Ethernet with robust metal casing and integrated insulation piercing contacts for connection of the Industrial Ethernet FC installation cables; with 145° cable outlet; for SIMOTION and SINAMICS 1 pack of 1 1 pack of 10 1 pack of 50	 6GK1 901-1BB30-0AA0 6GK1 901-1BB30-0AB0 6GK1 901-1BB30-0AE0
SIMATIC NET Manual Collection Electronic manuals for communication systems, protocols, products; on CD-ROM; German/English	6GK1 975-1AA00-3AA0

10.4.2.2 FastConnect (FC) twisted-pair cables 8-wire for Gigabit Ethernet

Cable structure

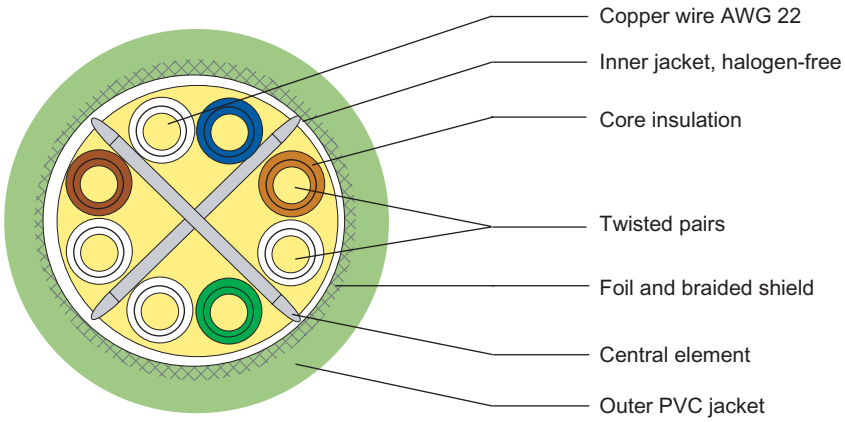


Figure 10-5 FastConnect (FC) twisted-pair cables 8-wire

Design

The FastConnect (FC) Industrial Ethernet cable IE FC Cable 4x2 has a particularly robust design for industrial applications. Its shielded, symmetrical, radial structure allows the use of the IE FC stripping tool.

Table 10-11 Electrical data of the 8-wire FastConnect (FC) twisted pair cable:

Cable type 1)	**IE FC standard cable GP 4x2**
Areas of application	Universal application
Cable specification	Cat 6
Attenuation	
at 10 MHz	typically 6.0 dB/100 m
at 100 MHz	typically 19.9 dB/100 m
at 250 MHz	typically 33.0 dB/100 m
Characteristic impedance	
at 1-100 MHz	100 Ω ± 15 Ω
Near end crosstalk loss	
at 10 MHz	typically 59.3 dB/100 m
at 100 MHz	typically 44.3 dB/100 m
at 250 MHz	typically 38.3 dB/100 m
Transfer impedance	
at 10 MHz	≤ 10 mΩ/m
DC loop resistance	≤ 118 Ω/km
DC insulation resistance	> 5000 MΩ x km
Transmission range	
with IE FC RJ-45 Modular Outlet RJ-45	90 m

Table 10-12 Mechanical data of the FastConnect (FC) twisted pair cables

Cable type 1)	IE FC standard cable GP 4x2
Cabling (Standard code)	SF/UTP 4x2xAWG22
Inner wire diameter (copper)	0.64 mm; AWG22
Core insulation	PE Ø 1.25 mm
Inner jacket/thickness	LSOH approx. 0.6 mm
Jacket/outer diameter	PVC Ø (9.6 ± 0.3) mm; green
Perm. ambient conditions Operating temperature Transport/storage temperature Installation temperature	 -40 ºC to +70 ºC -40 ºC to +70 ºC -20 ºC to +60 ºC
Permitted bending radius in operation during installation	 55 mm 80 mm
Bending cycles	-
Permitted tensile force	≤ 180 N
Total weight approx.	115 kg/km
Free of halogens	no
Resistance to fire	Flame retardant to IEC 60332-1
Resistance to oil	Conditionally resistant
UL approval	CMG, PLTC
UL style / 600 V rating	-
CCC certificate	yes
UV resistance	no
Fast Connect cable structure	yes
Silicone-free	yes

1) Electrical properties at 20 °C; tested to DIN 0472

Application

The IE FC Standard Cable GP 4x2 is an 8-wire, shielded TP installation cable for connection to IE FC RJ-45 Modular Outlet for universal application. It is a standard bus cable with rigid cores and is specially designed for fast assembly with corresponding UL approval (general purpose) for installation in cable bundles and on cable racks according to the regulations of the NEC (National Electrical Code) Article 800/725.

Notes on Installation

The bus cables are sold in meters and have meter markers printed on them.

Using the IE FC stripping tool, the outer jacket and shield of IE FC 4x2 cables can be stripped to correct lengths in a single action. This allows the IE FC RJ-45 modular outlet to be connected quickly and simply to the IE FC 4x2 cable.

Note: The user may need to readjust the IE FC stripping tool 6GK1 901-1GA00 for the 4x2 cable variant. The two setting screws of the knife cassette on the stripping tool must be opened by approximately half a turn. An IE FC stripping tool preset for 4x2 cables is in preparation.

Laying cables

During storage, transport, and installation, the bus cable must be closed at both ends with a shrink-on cover. Make sure that the bend radii and tensile stress are not exceeded!

Label

The IE FC Standard Cable GP 4x2 has the following printed on it every meter:

SIEMENS SIMATIC NET INDUSTRIAL ETHERNET FC TP STANDARD CABLE GP 4x2 CAT6 6XV1870-2E AWG22 SUN RES OIL RES (UL) CMG FT4 E137929 + "lot" + "meter marker"

Table 10-13 Ordering data

	Order number
IE FC TP Standard Cable GP 4x2 TP installation cable for attachment to Industrial Ethernet FC RJ-45 Modular Outlet for general application, 8-wire, shielded, sold in meters, maximum length available 1000 m, minimum length available 20 m	6XV1 870-2E
IE FC Stripping Tool Insulation stripping tool for fast stripping of Industrial Ethernet FC cables	6GK1 901-1GA00

10.4.2.3 IE FC TP FRNC cable GP 2x2

Application

With its flexible cores (stranded wires), this halogen-free cable is suitable for applications with occasional movement. The cable has the FastConnect cable structure and can therefore by stripped with the FastConnect stripping tool and can be assembled with all FastConnect IE connectors.

Table 10-14 Electrical data of the IE FC TP FRNC Cable GP 2x2:

Cable type 1)	IE FC TP FRNC cable GP 2x2
Areas of application	Machine parts that are moved occasionally
Cable specification	Cat5e
Attenuation	
at 10 MHz at 100 MHz	6 dB/100 m 22 dB/100 m
Characteristic impedance	
at 1-100 MHz	100 ± 15 Ω
Near end crosstalk loss	
at 1-100 MHz	≥ 50 dB/100 m
Transfer impedance	
at 10 MHz	≤ 10 mΩ/km
DC loop resistance	≤ 120 Ω/km
Dielectric resistance	≥ 500 MΩ km
Transmission range	
with IE FC RJ-45 Plug with IE FC Outlet RJ-45	85 m 75 m

Table 10-15 Mechanical data of the IE FC TP FRNC Cable GP 2x2:

Cable type (standard code)	L-9YH(ST)CH 2X2X0.34/1.5-100 GN VZN FRNC
Inner wire diameter (copper)	0.75 mm (AWG 22)
Core insulation	PP, Ø 1.5 mm
Inner jacket	FRNC, Ø 3.9 mm
Jacket	PE Ø (6.5 ± 0.2) mm
Perm. ambient conditions	
Operating temperature	-25 ºC to +70 ºC
Transport/storage temperature	-40 ºC to +70 ºC
Installation temperature	0 ºC to +50 ºC
Permitted bending radius	
multiple single	15 x Ø 6 x Ø
Bending cycles	-
Permitted tensile force	≤ 150 N
Weight	approx. 68 kg/km
Free of halogens	Yes
Resistance to fire	Flame retardant to IEC 60332-3-22
Resistance to oil	Conditionally resistant
UL listing / 300 V rating	CMG/PLTC/Sun Res
UL style / 600 V rating	No
UV resistance	Yes
Fast Connect cable structure	Yes

Cable type (standard code)	L-9YH(ST)CH 2X2X0.34/1.5-100 GN VZN FRNC
Silicone-free	Yes
Shipbuilding approvals	-

1) Electrical properties at 20 °C; tested to DIN 47 250 Part 4 or DIN VDE 0472

Table 10-16 Ordering data

	Order number
IE FC TP FRNC cable GP 2x2	6XV1 871-2F

10.4.2.4 IE FC TP Food Cable 2x2 and IE FC Festoon Cable GP 2x2

Application

With its PE outer jacket and stranded wires, the IE FC TP food cable is especially suitable for applications in the food, beverages and tobacco sector. The cable has the FastConnect cable structure and can therefore by stripped with the FastConnect stripping tool and can be assembled with all FastConnect IE connectors.

Due to its mechanical design (stranded wires and PUR outer jacket), the IE FC Festoon Cable GP 2x2 is especially suitable for festoon applications on cranes. The cable has the FastConnect cable structure and can therefore by stripped with the FastConnect stripping tool and can be assembled with all FastConnect IE connectors.

Table 10-17 Electrical data of the IE FC TP Food Cable 2x2 and IE FC Festoon Cable GP 2x2:

Cable type 1)	IE FC TP Food Cable 2x2 (PROFINET Type C)	IE FC Festoon Cable GP 2x2 (PROFINET Type B)
Areas of application	Food, beverages and tobacco industry	Festoon cables
Cable specification	Cat5e	Cat5e
Attenuation		
at 10 MHz	6.9 dB/100 m	6.0 dB/100 m
at 100 MHz	23.5 dB/100 m	23.5 dB/100 m
Characteristic impedance		
at 1-100 MHz	100 ± 15 Ω	100 ± 15 Ω
Near end crosstalk loss	≥ 50 dB/100 m	≥ 50 dB/100 m
at 1-100 MHz		
Transfer impedance	≤ 10 mΩ/km	≤ 10 mΩ/km
at 10 MHz		
DC loop resistance	≤ 120 Ω/km	≤ 120 Ω/km
Dielectric resistance	≥ 500 MΩ km	≥ 500 MΩ km
Transmission range		
with IE FC RJ-45 Plug	85 m	85 m
with IE FC Outlet RJ-45	75 m	75 m

Table 10-18 Mechanical data of the FastConnect (FC) twisted pair cables

Cable type (standard code)	2YH(ST)C2Y 2x2x0.75/1.5-100LI	2YY(ST)CY 2x2x0.75/1.5 LI GN
Inner wire diameter (copper)	0.25 mm (AWG 22)	0.25 mm (AWG 22)
Core insulation	PE, Ø 1.5 mm	PE, Ø 1.5 mm
Inner jacket	FRNC, Ø 3.9 mm	PVC, Ø 3.9 mm
Jacket	PE Ø (6.5 ± 0.2) mm	PVC Ø (6.5 ± 0.2) mm
Perm. ambient conditions		
Operating temperature	-40 ºC to +75 ºC	-40 ºC to +75 ºC
Transport/storage temperature	-45 ºC to +75 ºC	-45 ºC to +75 ºC
Installation temperature	-20 ºC to +60 ºC	-20 ºC to +60 ºC
Permitted bending radius		
multiple	0.05 m	0.07 m
single	0.02 m	0.03 m
Bending cycles	-	5 million
Permitted tensile force	≤ 150 N	≤ 150 N
Weight	approx. 55 kg/km	approx. 68 kg/km
Free of halogens	Yes	No
Resistance to fire	-	Flame retardant to IEC 60332-1
Resistance to oil	Conditionally resistant	Conditionally resistant
UL listing / 300 V rating	-	Yes / CMG/PLTC/SUNRES/OIL RES
UL style / 600 V rating	-	Yes
UV resistance	Yes	Yes
Fast Connect cable structure	Yes	Yes
Silicone-free	Yes	Yes
Shipbuilding approvals	-	-

1) Electrical properties at 20 °C; tested to DIN 0472 Part 4 or DIN VDE 0472

Table 10-19 Ordering data

	Order number
IE FC TP Food Cable 2x2	6XV1 871-2L
IE FC Festoon Cable GP 2x2	6XV1 871-2S

10.4.3 IE Hybrid Cable

Cable structure

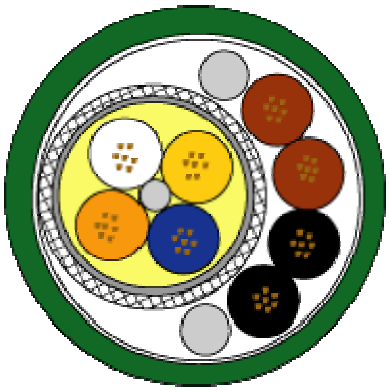


Figure 10-6 Structure of the IE Hybrid Cable

Design

The cables for data transmission have a shielded, symmetrical, radial design. Four cables for power transmission are arranged around them. The entire cable is surrounded by a 1 mm thick green FRNC jacket.

Due to the different structure compared with FastConnect (FC) Industrial Ethernet cables, the IE FC stripping tool cannot be used.

Table 10-20 Technical specifications of the IE Hybrid Cable 2x2 + 4x0.34:

Cable type 1)	**IE Hybrid Cable 2x2 + 4x0.34**
Areas of application	Universal application
Data line:	
Cable specification	CAT 5e
Attenuation	
at 10 MHz	typically 7.5 dB/100 m
at 100 MHz	typically 26 dB/100 m
Characteristic impedance	
at 1-100 MHz	100 Ω ± 15 Ω
Near end crosstalk loss	
at 10 MHz	typically 50.3 dB/100 m
at 100 MHz	typically 35.3 dB/100 m
Transfer impedance	
at 10 MHz	≤ 10 mΩ/m
DC loop resistance	≤ 120 Ω/km

Cable type 1)	IE Hybrid Cable 2x2 + 4x0.34
DC insulation resistance	> 500 MΩ x km
Range with IE FC Outlet RJ-45	80 m + 5 m IE TP Cord
Power supply line:	
Cable resistance	< 54 Ω/km
Max. current per core	< 0.35 A
DC insulation resistance	> 20 MΩ x km
Operating voltage (peak)	< 100 V

Table 10-21 Mechanical specifications of the IE Hybrid Cable 2x2 + 4x0.34:

Cable type 1)	IE Hybrid Cable 2x2 + 4x0.34
Data line:	
Cable type (standard code)	2YH(ST)C 2x2x0.75/1.5LI
Inner wire diameter (copper)	0.76 mm; 7 x 0.25 (AWG22)
Core insulation	PE; Ø 1.6 mm
Power supply line:	
Cable type (standard code)	4 x LIH 1x0.34/1,6; 2 x black, 2 x brown
Inner wire diameter (copper)	0.76 mm; 7 x 0.25 (AWG22)
Core insulation	FRNC; Ø 1.5 mm
Entire cable:	
Cable type (standard code)	2YH(ST)C 2x2x0.75/1.5LI LIH H 2x2x0.34/1.6 GN FRNC
Jacket/outer diameter	FRNC; green / (8.5 + 0.2 - 0.4) mm
Perm. ambient conditions	
Operating temperature; no current over power supply cores	-25 ºC to +70 ºC
Operating temperature; max. 0.35 A per power supply core	-25 ºC to +65 ºC
Transport/storage temperature	-25 ºC to +70 ºC
Installation temperature	-25 ºC to +70 ºC
Permitted bending radius	
- single	5 x cable diameter
- multiple	10 x cable diameter
Bending cycles	-
Permitted tensile force	≤ 260 N
Total weight approx.	105 kg/km
Free of halogens	no
Resistance to fire	Flame retardant to IEC 60332-1
Resistance to oil	Conditionally resistant
UL approval	CMG, PLTC
UL style / 600 V rating	yes
CCC certificate	yes
UV resistance	yes

Cable type 1)	IE Hybrid Cable 2x2 + 4x0.34
Fast Connect cable structure	no
Silicone-free	yes

1) Electrical properties at 20 °C; tested to DIN 0472

Notes on Installation

The IE Hybrid Cable 2x2 + 4x0.34 is available in meters.

Due to its design, it is not possible to use the IE FC stripping tool.

To keep the voltage drop over the power supply cable as low as possible, the two cables with the same color should be connected in parallel. Please note that the power supply voltage at the input to the cable must be higher than the minimum permitted power supply of the device being supplied by the amount of power drop over the outward and return conductor. On the other hand, the power supply voltage must not exceed the maximum permitted power supply of the device being supplied when no current is flowing.

The specified current of 0.35 A per wire of the power supply cable means a maximum current of 0.7 A when two wires are connected in parallel for the outward and return cables. Note that in this case, with an 80 m long IE Hybrid Cable, the voltage input must be >= 24 V to supply the consumer with a voltage of at least 20.4 V.

If the maximum permitted current over the power supply cables is exceeded permanently, the data transmission characteristics of the data lines can no longer be guaranteed. Their attenuation characteristics deteriorate with increasing temperature. For this reason, if 0.35 A is applied to each wire, the lower maximum ambient temperature of +65 °c applies.

Label

The IE Hybrid Cable 2x2 + 4x0.34 has the following printed on it:

"continuous length in meters" SIEMENS SIMATIC NET IE Hybridcable 2x2 + 4x0.34 6XV1870-2J CAT V * 22AWG (SHIELDED) (UL) E119100 CMG 75°C or PLTC or AWM 21287 600V FT4 SUN RES

Order number

	Order number
IE Hybrid Cable 2x2 + 4x0.34 Flexible cable; 4 x Cu CAT 5e, shielded (AWG 22) and 4 x CU (0.34 mm^2 per core) for IE FC RJ-45 Modular Outlet with Power Insert and Hybrid cable connector IP67; available in meters; maximum length available 1000 m.	6XV1 870-2J

10.4.4 Industrial Twisted Pair cables (ITP)

Structure of the ITP Standard Cable for Industrial Ethernet

The standard cable is designed as a 100 ohm S/STP cable (Screened/Shielded Twisted Pair) with two pairs of wires. The basic element consists of two twisted wires along with two blind elements, known as a twisted pair.

The wires are solid copper covered by an insulation layer of cellular polyethylene which is further covered by a noncellular foam skin. The color coding of the conductors can be seen in Table 4-2. The outer sheath is green PVC.

Table 10-22 Color coding of the pairs

Pair	1	2
Conductor a	white	White
Conductor b	blue	Orange

Shielding

Each pair of wires is shielded by two plastic laminated aluminum foils with an external contact surface. All the pairs making up the cable are surrounded by a braided shield of tin-plated copper wires (coverage approximately 90%).

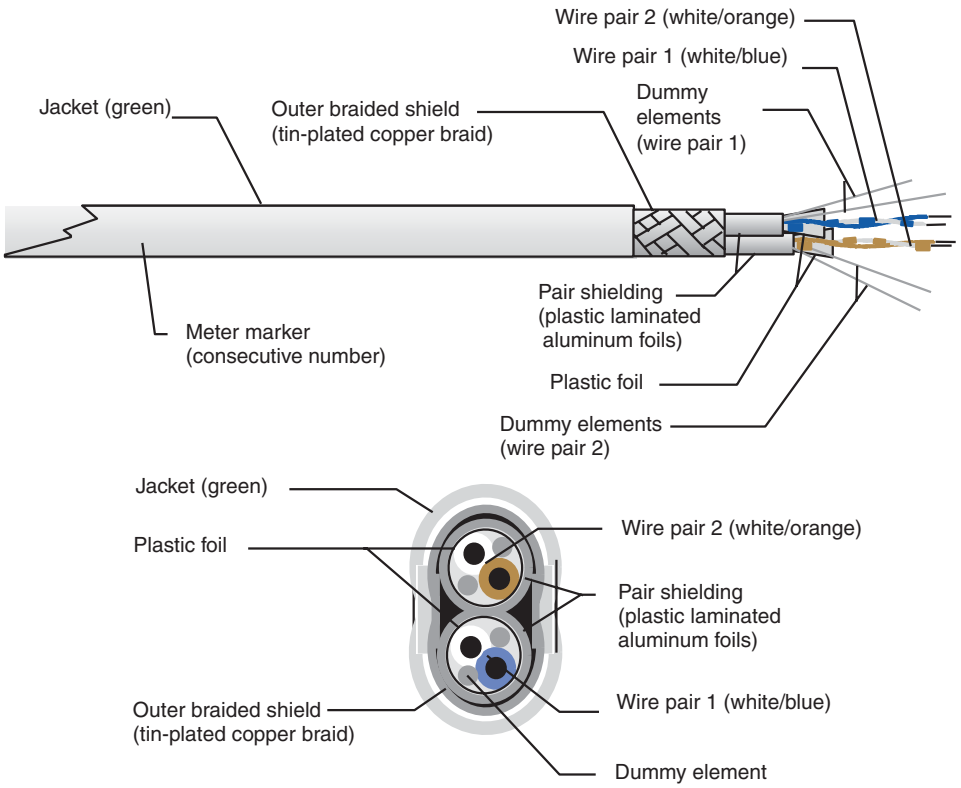


Figure 10-7 Structure of the 2 x 2-wire Industrial Twisted Pair standard cable

Label

The standard cable has the following printed on it

"SIEMENS SIMATIC NET INDUSTRIAL ETHERNET ITP 6XV1850-0AH10 (meter marker)".

There are markers printed at one meter intervals. These make it simple to check the length of the cable.

Structure of the ITP FRNC Cable for Industrial Ethernet

The structure is basically the same as that of the standard cable. In contrast to the standard cable, the outer jacket is of halogen-free material (FRNC).

Label

The FRNC cable has the following printed on it

"SIEMENS SIMATIC NET INDUSTRIAL ETHERNET ITP FRNC CABLE CAT5 6XV1851-0AH10* 22AWG (SHIELDED) (UL) E119100 CMG 75°C or PLTC FT4 SUN RES (meter marker)".

Table 10-23 Electrical data of the ITP Standard Cable and ITP FRNC Cable at 20 °C

Cable category complying with EN 50173	CAT5		
DC loop resistance		maximum	124 Ω/km
DC insulation resistance		minimum	5 GΩ x km
Attenuation/100 m	at 4 MHz	maximum	3.6 dB
	10 MHz		5.7 dB
	100 MHz		18.0 dB
Near end crosstalk loss (NEXT)/100 m	at 1 to 300 MHz	minimum	80 dB
Characteristic impedance	at 1...100 MHz		100 Ω +15/-15 %
	100...300 MHz		100 Ω +45/-30 %
Transfer impedance	at 10 MHz	maximum	2 mΩ/m
Return loss	at 1...100 MHz	minimum	23 dB
	100...300 MHz		15 dB
Longitudinal conversion loss	at 64 KHz related to 100 m cable	minimum	43 dB
Capacitance unbalance pair to ground		maximum	3400 pF/km
Operating voltage		effective value	≤ 165 V

Table 10-24 Mechanical data of the ITP Standard Cable and ITP FRNC Cable

	ITP Standard Cable for Industrial Ethernet	ITP FRNC Cable for Industrial Ethernet
Standard code	J-02YSCY 2x2x0.64/1.5 PIMF F GN	J-02YSCY 2x2x0.64/1.5 PIMF F GN FRNC
Core diameter to AWG 22	0.64 mm	0.64 mm
Outer diameter	approx. (6.0 x 9.4) mm	approx. (6.0 x 9.4) mm
Thickness of the jacket approx.	approx. 0.8 mm	approx. 0.8 mm
Permitted bending radius:	over the flat side	over the flat side
under tensile strain during installation	approx. 48 mm	approx. 48 mm
after installation without tensile strain	approx. 33 mm	approx. 33 mm
Permitted tensile force	≤ 80 N	≤ 80 N
Temperature range:		
Operation	-40 °C to +80 °C	-40 °C to +80 °C
Installation/assembly	-25 °C to +80 °C	-25 °C to +80 °C
Transport/storage	-40 °C to +80 °C	-40 °C to +80 °C
Copper number	46 kg/km	46 kg/km
Net weight	90 kg/km	98 kg/km
Free of halogens	no	yes
Resistance to fire	Flame retardant to VDE 0482-265-2-1 IEC 60332-1	Flame retardant to VDE 0482-266-2-4 IEC 60332-3-24)
Resistance to oil	Conditionally resistant to mineral oils and fats	Conditionally resistant to mineral oils and fats
Silicone-free	yes	yes

Special notes on installation

The maximum total length of a segment is 100 m. To obtain the best transmission characteristics, the segment should consist of one single section of cable. In special situations (for example when using two cabinet feedthroughs), the segment can consist of up to three separate sections of cable.

The excellent transmission characteristics of the entire system can be guaranteed only when SIEMENS Industrial Ethernet network components are used exclusively.

Assembling cables with twistedpair D-sub connectors

When assembling Industrial Twisted Pair cables yourself, make sure that you only combine the ITP standard cable for Industrial Ethernet or the ITP FRNC cable for Industrial Ethernet with the SIMATIC NET ITP D-sub connector for assembly on site. The dimensions of these two components match each other.

Cannot be connected to IE FC Outlet RJ-45, IE FC RJ-45 Plug and IE FC RJ-45 Modular Outlet

The two ITP cables are not suitable for connection to the IE FC Outlet RJ-45, IE FC RJ-45 Plug and IE FC RJ-45 Modular Outlet due to their diameters. Use the FastConnect (FC) twisted pair cables for this.

Versions available

The two ITP cables are available either by the meter without connectors or with 9 and 15-pin D-sub connectors.

At the network component end, metal 9-pin D-sub male connectors are used, at the device end 15-pin connectors. The 15-pin connectors have a special jumper with which the modules with integrated twisted-pair transceiver can switch from AUI to twisted pair mode.

The following preassembled cables use the Industrial Twisted Pair cables:

- ITP Standard Cable 9/15
- ITP XP Standard Cable 9/9
- ITP XP Standard Cable 15/15
- ITP FRNC Cable 9/15

The XP supplement means that this is a crossover cable.

10.4.5 Preassembled twisted-pair (TP) and Industrial Twisted Pair (ITP) cables

10.4.5.1 Preassembled twisted-pair cords

Twisted-pair (TP) cables (cord)

The flexibility of the cords allows simple installation, for example in a wiring closet or to connect devices in a control room with low EMI levels.

A maximum of 10 m of twisted-pair cord can be used between two devices. With structured cabling using two twisted-pair patch cables, this length is the maximum for both patch cables together.

Adapter cables are used to connect devices with a D-sub port to devices with an RJ-45 port.

To convert the RJ-45 interface of an end device to a 15-pin D-sub interface of the ITP cabling system, the TP converter cord 15/RJ-45 can be used.

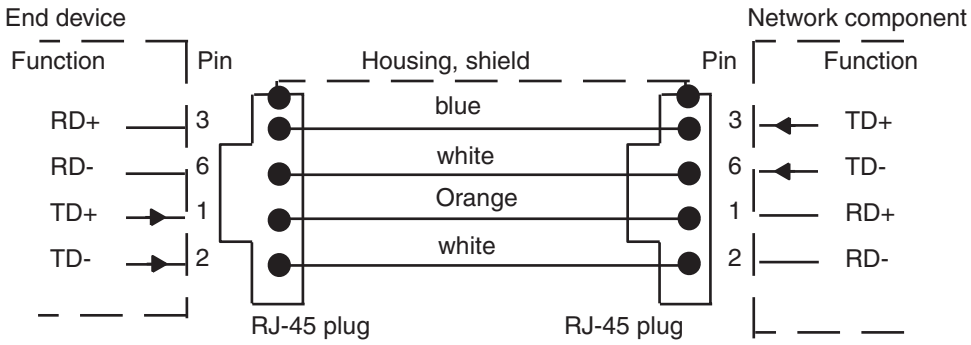
Overview

The following twisted-pair cables are available:

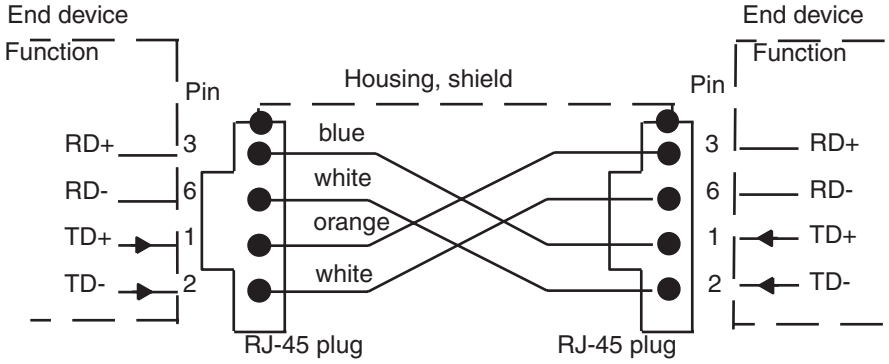
Table 10-25 Data of the preassembled twisted-pair cables

Cable name	Application	Available lengths	MLFB
IE TP Cord RJ-45/RJ-45	TP cable 4 x 2 with 2 RJ-45 plugs	0.5 m 1.0 m 2.0 m 6.0 m 10.0 m	6XV1 870-3QE50 6XV1 870-3QH10 6XV1 870-3QH20 6XV1 870-3QH60 6XV1 870-3QN10
IE TP XP Cord RJ-45/RJ-45	Crossover TP cable 4 x 2 with 2 RJ-45 plugs	0.5 m 1.0 m 2.0 m 6.0 m 10.0 m	6XV1 870-3RE50 6XV1 870-3RH10 6XV1 870-3RH20 6XV1 870-3RH60 6XV1 870-3RN10
IE TP Cord 9/RJ-45	TP cable 2 x 2 with a 9-pin D-sub male connector and an RJ-45 plug	0.5 m 1.0 m 2.0 m 6.0 m 10.0 m	6XV1 850-2JE50 6XV1 850-2JH10 6XV1 850-2JH20 6XV1 850-2JH60 6XV1 850-2JN10
IE TP XP Cord 9/RJ-45	Crossover TP cable 2 x 2 with a 9-pin D-sub male connector and an RJ-45 plug	0.5 m 1.0 m 2.0 m 6.0 m 10.0 m	6XV1 850-2ME50 6XV1 850-2MH10 6XV1 850-2MH20 6XV1 850-2MH60 6XV1 850-2MN10
IE TP Cord 9-45/RJ-45	TP cable 2 x 2 with an RJ-45 plug and a D-sub male connector with 45° cable outlet (only for OSM/ESM)	1.0 m	6XV1 850-2NH10
IE TP XP Cord 9-45/RJ-45	TP crossover cable 2 x 2 with an RJ-45 plug and a D-sub male connector with 45° cable outlet (only for OSM/ESM)	1.0 m	6XV1 850-2PH10
IE TP XP Cord 9/9	Crossover TP cable 2 x 2 for direct connection of two Industrial Ethernet network components with ITP interface with two 9-pin D-sub male connectors	1.0 m	6XV1850-2RH10
IE TP Cord RJ-45/15	TP cable 2 x 2 with a 15-pin D-sub male connector and an RJ-45 plug	0.5 m 1.0 m 2.0 m 6.0 m 10.0 m	6XV1 850-2LE50 6XV1 850-2LH10 6XV1 850-2LH20 6XV1 850-2LH60 6XV1 850-2LN10
IE TP XP Cord RJ-45/15	Crossover TP cable 2 x 2 with a 15-pin D-sub male connector and an RJ-45 plug	0.5 m 1.0 m 2.0 m 6.0 m 10.0 m	6XV1 850-2SE50 6XV1 850-2SH10 6XV1 850-2SH20 6XV1 850-2SH60 6XV1 850-2SN10
For a full list of the order numbers (MLFB), refer to the IK PI catalog			

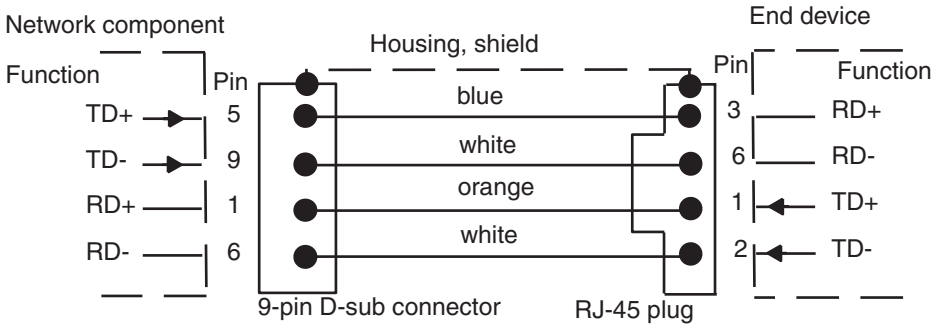
Connector pinout



a) Connector pinout of the TP Cord RJ-45/RJ-45

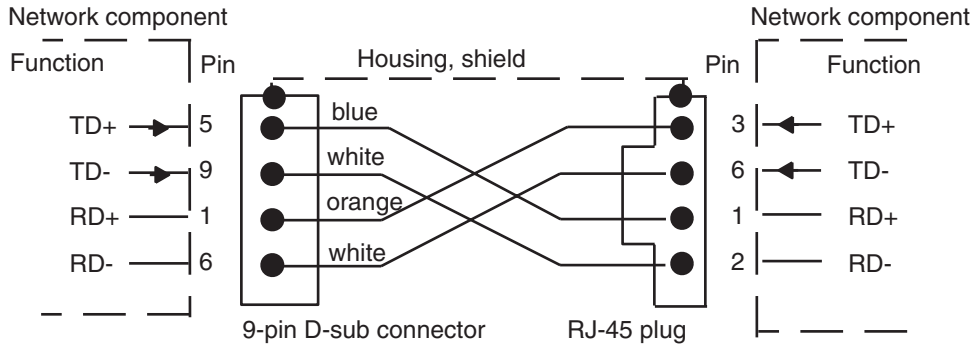


b) Connector pinout of the TP XP Cord RJ-45/RJ-45

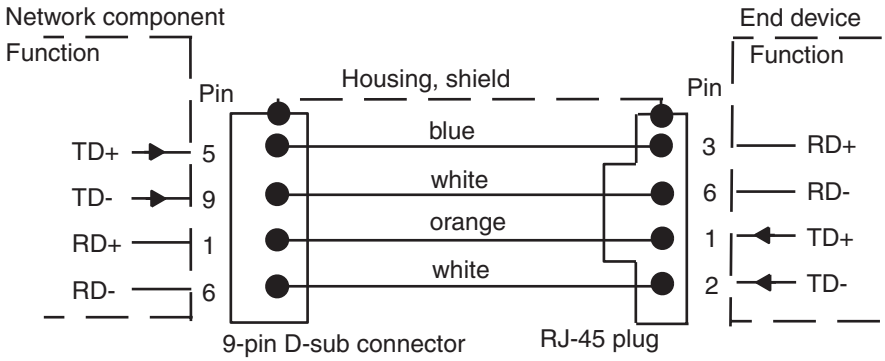


c) Connector pinout of the TP Cord 9/RJ-45

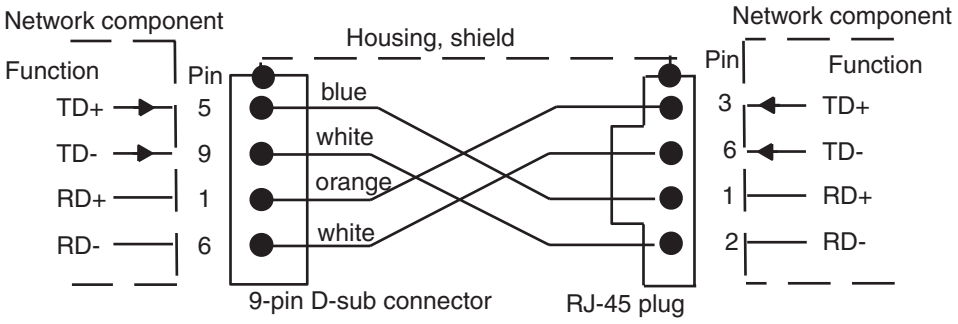
Figure 10-8 Connector pin assignment of the TP cords



d) Connector pinout of the TP XP Cord 9/RJ-45

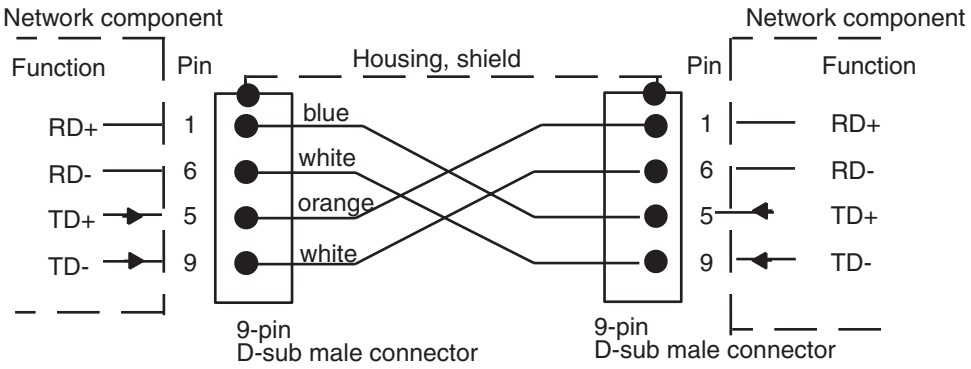


e) Connector pinout of the TP Cord 9-45/RJ-45

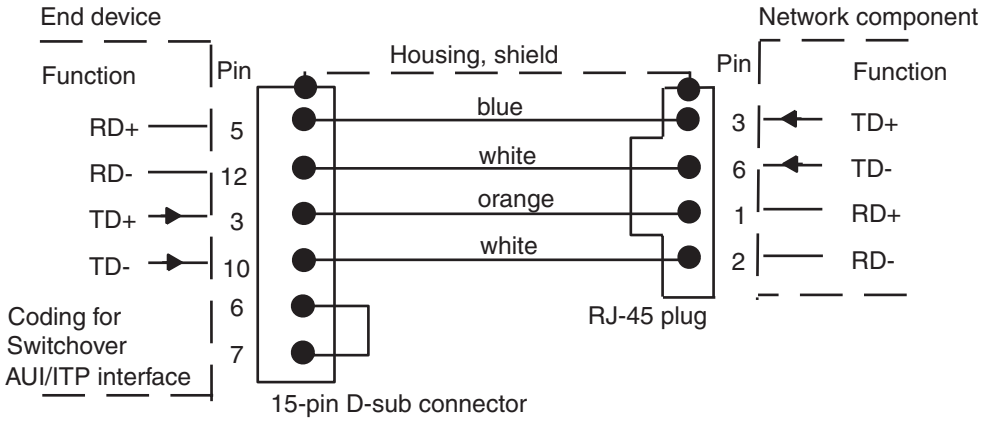


f) Connector pinout of the TP XP Cord 9-45/RJ-45

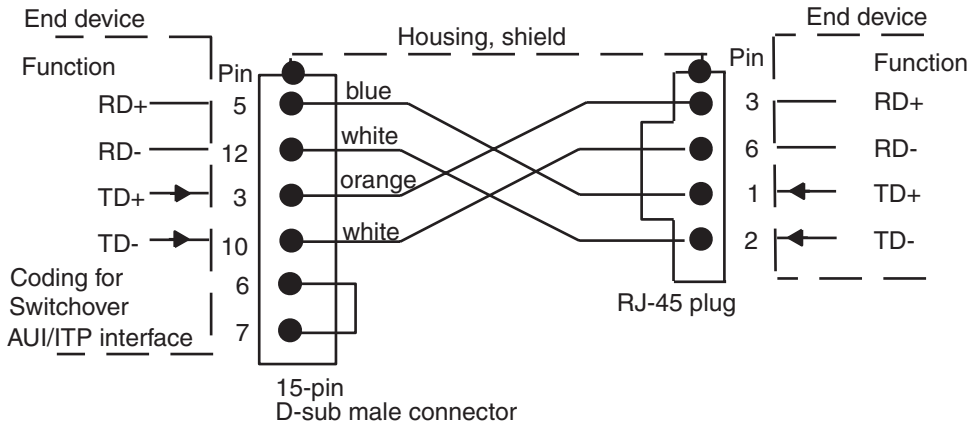
Figure 10-9 Connector pin assignment of the TP cords



g) Connector pinout of the TP XP Cord 9/9



h) Connector pinout of the TP Cord 15/RJ-45



i) Connector pinout of the TP XP Cord 15/RJ-45

Figure 10-10 Connector pin assignment of the TP cords

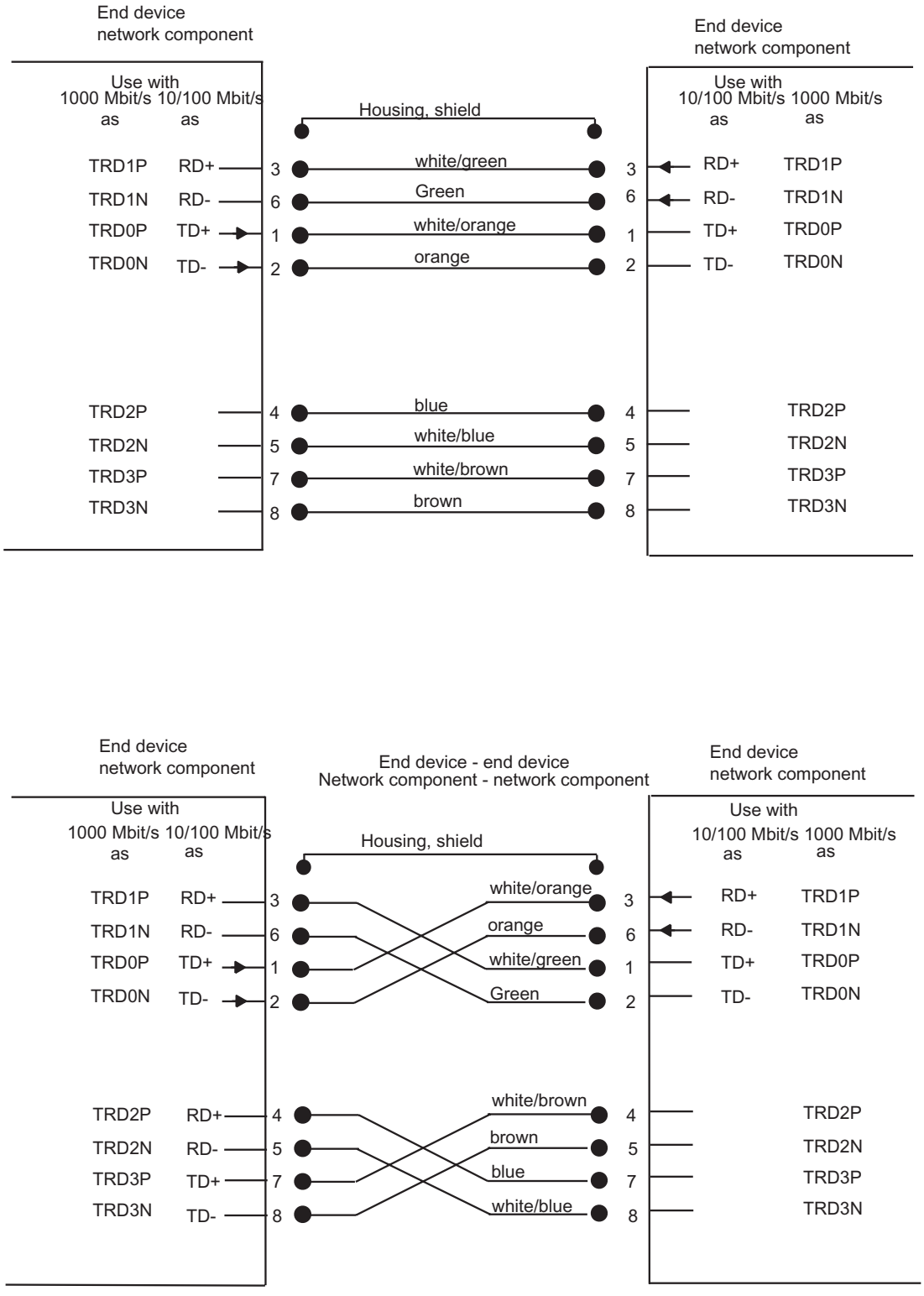


Figure 10-11 Connector pin assignment of the IE TP Cord RJ-45_RJ-45 cables with 4 x 2 wires

1) For network devices and end devices that have the autocrossing function, no crossover cable is necessary even when linking end device to end device or network component to network component.

With devices that do not have the autocrossing function, a crossover cable is required to link end device to end device or network component to network component.

See also

Twisted Pair Cord (4-wire for Fast Ethernet) (Page 423)

10.4.5.2 Twisted pair interface converters

Product range

Table 10-26 Data of the interface converter TP Converter Cord 15/RJ-45

Cable name	Application	Available lengths	MLFB
TP Converter Cord 15/RJ-45	TP patch cable for attachment of end devices with an RJ45 port to the ITP cabling system; with one 15pin D-sub female connector with slide locking mechanism and one RJ45 plug	0.5 m 2 m	6XV1850–2EE50 6XV1850–2EH20

Mounting bracket

The D-sub female connector has a mounting bracket. This allows the female connector to be fixed in place. The mounting bracket has two functions:

- Strain relief
  The TP cord and the RJ45 port on the end device are protected from tensile strain.
- Grounding
  The mounting bracket is electrically connected with the casing of the female connector and therefore also with the cable shields. The bracket should be screwed to a grounded plate or rail ensuring good contact.

Connector pinout

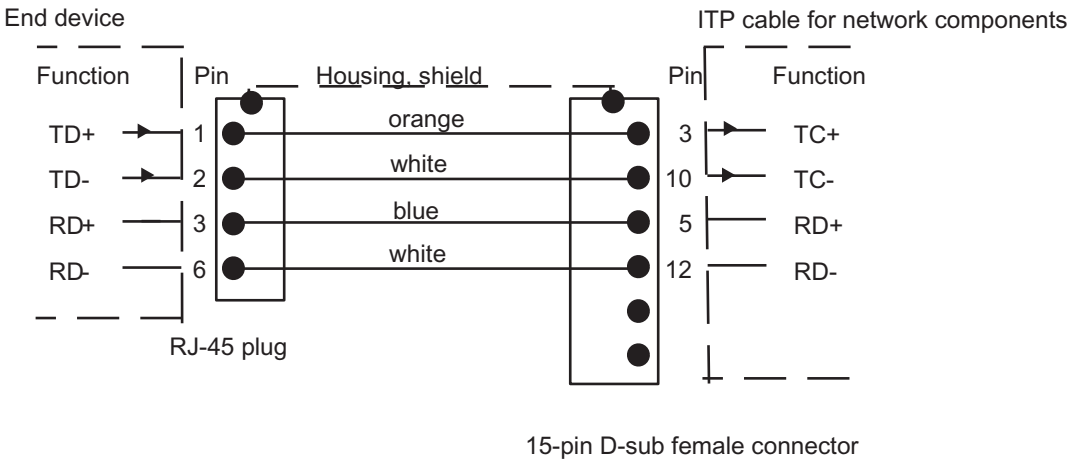


Figure 10-12 Connector pin assignment of the interface converter TP Converter Cord 15/RJ-45

10.4.5.3 IE M12 connecting cable

Overview

Table 10-27 SIMATIC NET IE CONNECTING CABLE M12-180/M12-180, preassembled IE FC TRAILING CABLE GP, with 2 M12 male connectors (D-coded)

Length	Order number
0.3 m	6XV1 870-8AE30
0.5 m	6XV1 870-8AE50
1.0 m	6XV1 870-8AH10
1.5 m	6XV1 870-8AH15
2.0 m	6XV1 870-8AH20
3.0 m	6XV1 870-8AH30
5.0 m	6XV1 870-8AH50
10.0 m	6XV1 870-8AN10
15.0 m	6XV1 870-8AN15

See also

IE M12 Plug PRO (Page 468)

10.4.5.4 Preassembled Industrial Twisted Pair cables

Industrial Twisted Pair cables

Preassembled Industrial Twisted Pair cables are intended for direct links (without patch cables) of up to 100 m in length between two devices.

Due to the double, extra thick shielding, Industrial Twisted Pair cables are particularly suitable for an industrial environment with high levels of EMI, for example for a connection between wiring closets.

The preassembled ITP cables are available in standard versions and as halogen-free FRNC cable.

Overview

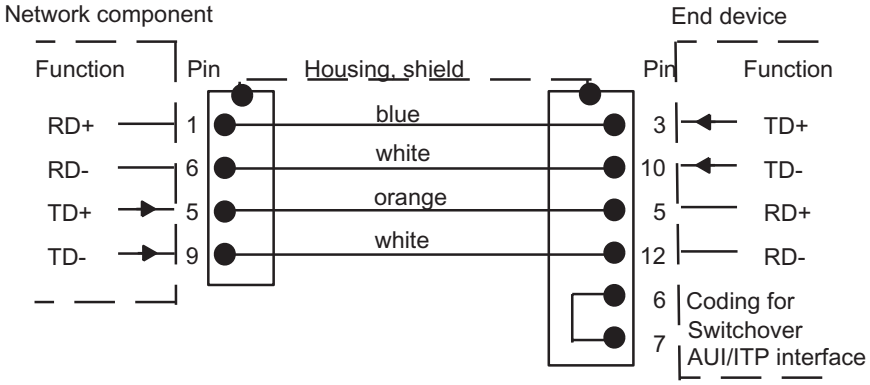
Table 10-28 Data of the Industrial Twisted Pair standard cables

Cable name	Application	Available lengths	MLFB
ITP Standard Cable 9/15	ITP installation cable is used for direct attachment of end devices with an ITP port to Industrial Ethernet network components with an ITP port; with one 9pin and one 15pin D-sub connector	2 m, 5 m, 8 m, 12 m, 15 m, 20 m, 30 m, 40 m, 50 m, 60 m, 70 m, 80 m, 90 m, 100 m	6XV1 850–0Bxxx [1)]
ITP XP Standard Cable 9/9	Crossover ITP installation cable, for direct connection of two Industrial Ethernet network components with ITP interface; with two 9-pin D-sub male connectors	2 m, 5 m, 8 m, 12 m, 15 m, 20 m, 30 m, 40 m, 50 m, 60 m, 70 m, 80 m, 90 m, 100 m	6XV1 850–0Cxxx [1)]
ITP XP Standard Cable 15/15	Crossover ITP installation cable, for direct connection of two end devices with ITP interface; with two 15-pin D-sub male connectors	2 m, 6 m, 10 m	6XV1 850–0Dxxx [1)]
1) For a full list of the order numbers (MLFB), refer to the IK PI catalog			

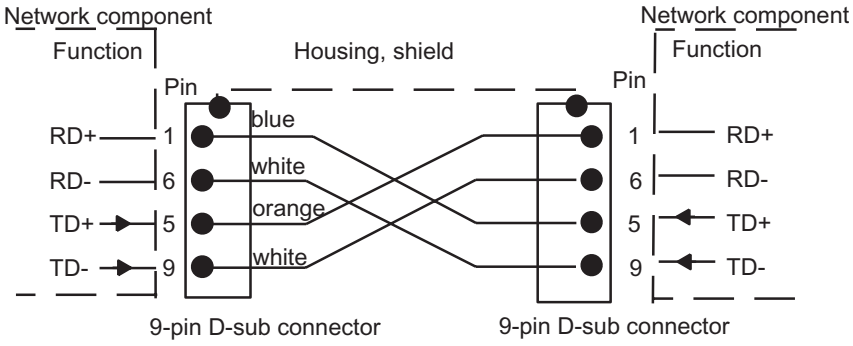
Table 10-29 Data of the Industrial Twisted Pair FRNC cables

Cable name	Application	Available lengths	MLFB
ITP FRNC Cable 9/15	ITP installation cable is used for direct attachment of end devices with an ITP port to Industrial Ethernet network components with an ITP port; with one 9pin and one 15pin D-sub connector	2 m, 5 m, 8 m, 12 m, 15 m, 20 m, 30 m	6XV1 851–1Axxx [1]
1) For a full list of the order numbers (MLFB), refer to the IK PI catalog			

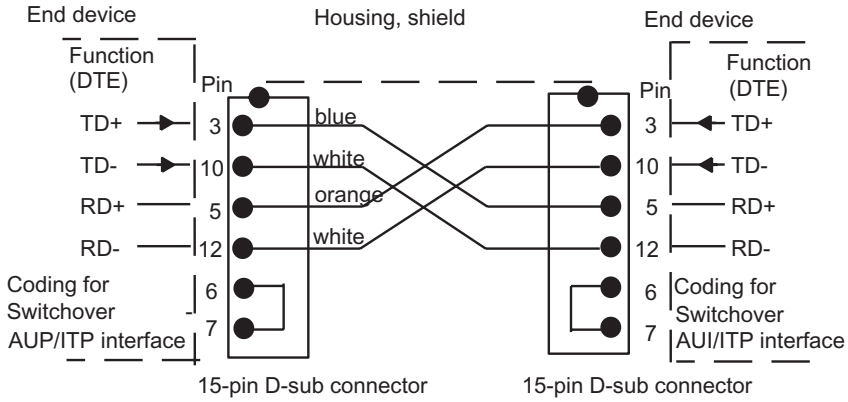
Connector pinout



a) Connector pinout of the ITP Standard Cable 9/15



b) Connector pinout of the ITP XP Standard Cable 9/ 9



c) Connector pinout of the ITP XP Standard Cable 15/15

Connector pin assignment of the Industrial Twisted Pair standard cables

See also

IE Hybrid Cable (Page 445)

Special lengths

Note

Special lengths for TP and ITP cables on request!

See also

Contacts for special cables and special lengths (Page 422)

10.4.6 Cable connectors

10.4.6.1 RJ-45 plugs and IE M12 Plug PRO

RJ-45 plug

The RJ-45 plug is an 8-pin plug designed in compliance with IEC 60603-7. This plug type is recommended according to IEEE 802.3 for 10BASE–T and 100BASE–TX. The RJ-45 plug was developed by Western Electric and is also known as the Western plug.

The RJ45 plug cannot be ordered separately and is supplied only with preassembled cables (TP cord).

- Connector casing with straight cable outlet

- Intended for connecting to:
  - End devices with an RJ45 port and
  - Network components with an RJ45 port

Illustration of an RJ45 connector system

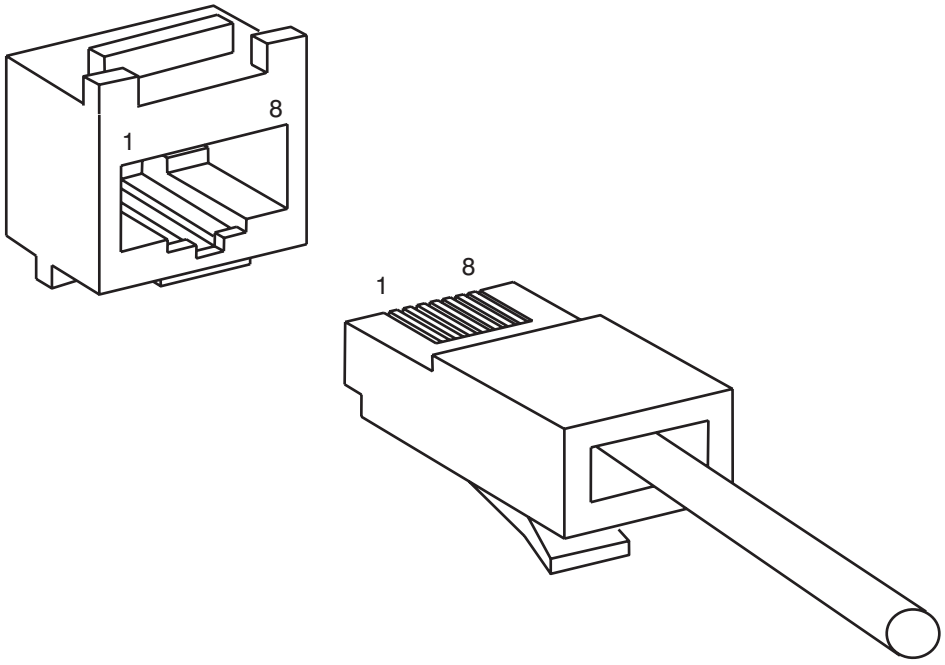


Figure 10-13 RJ45 jack and plug

Use in an industrial environment

Originally designed for an office environment, the connector system was made suitable for industry by various measures including:

- All-round shielding,
- Metal casing,
- Fast Connect technology.

IE FC RJ-45 Plug

Design of the plug for user assembly

Three variants of the plug are available:

- With 180° (straight) cable outlet

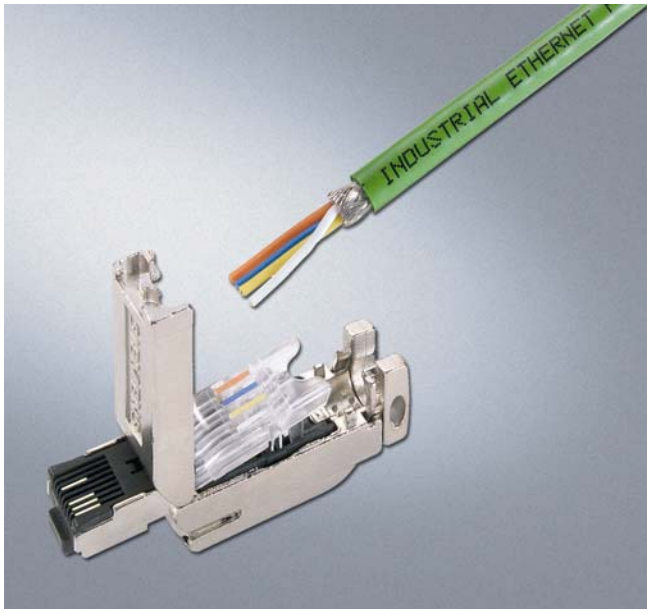


Figure 10-14 FastConnect RJ-45 Plug 180

Due to their compact design, the cable connectors (FastConnect RJ-45 Plug 180) can be used both for devices with individual jacks and for devices with multiple jacks (blocks). The cable connector is particularly suitable for connecting FC TP cables to SIMATIC NET modules and SCALANCE devices.

- With 90° (angled) cable outlet

Figure 10-15 FastConnect RJ-45 Plug 90

The FastConnect RJ-45 Plug 90 is intended, for example, for connection of FC TP cables to ET200 or PN/PN couplers.

- With 145° (angled) cable outlet (SIMOTION and SINAMICS only)

Figure 10-16 FastConnect RJ-45 Plug 145

The FastConnect RJ-45 Plug 145 can be used to connect FC TP cables to SIMOTION and SINAMICS modules.

Installation

With the four integrated insulation piercing contacts, establishing contact with the FC cable variants is simple and error-proof. With the casing open, colored markers on the contact cover make it simple to connect the cores to the insulation piercing contacts. The transparent synthetic material of the contact cover allows the user to check the contacts at any time.

Table 10-30 Connector pin and color assignment

Pins of RJ-45	Wire color	Signal on switch	Signal on end device
1	Yellow	RX+	TX+
2	Orange	RX-	TX-
3	White	TX+	RX+
6	Blue	TX-	RX-

The assembly of the IE FC RJ-45 Plug is described in a separate section .

Note

The insulation piercing contacts of the IE FC RJ-45 Modular Outlet can be released and recontacted up to 10 times. Cable ends that have had a connector fitted, must not be used twice but must be cut off before fitting a new connector.

Technical specifications

Transmission rate	100 Mbps; CAT5e
Maximum cable length	0 - 100 m depending on the type of IE FC cable
Temperature range:	
Operation	-20 °C to +70 °C
Transport/storage	-40 °C to +80 °C
Relative humidity in operation	< 95%
Dimensions (W x H x D) in mm with Plug 180	13.7 x 16 x 55
Dimensions (W x H x D) in mm with Plug 90	13.7 x 16 x 42
Dimensions (W x H x D) in mm with Plug 145	13.9 x 16 x 55.6
Installation	No tools required with insulation piercing technology (FastConnect)
Weight	approx. 35 g
Degree of protection	IP20

Table 10-31 Ordering data

	Order number
IE FC RJ-45 Plug 180 RJ-45 cable connector for Industrial Ethernet with robust metal casing and integrated insulation piercing contacts for connection of the Industrial Ethernet FC installation cables; with 180° cable outlet; for network components and CPs/CPUs with Industrial Ethernet interface	
1 pack of 1	6GK1 901-1BB10-2AA0
1 pack of 10	6GK1 901-1BB10-2AB0
1 pack of 50	6GK1 901-1BB10-2AE0
IE FC RJ-45 Plug 90 RJ-45 cable connector for Industrial Ethernet with robust metal casing and integrated insulation piercing contacts for connection of the Industrial Ethernet FC installation cables; with 90° cable outlet; for ET 200S	
1 pack of 1	6GK1 901-1BB20-2AA0
1 pack of 10	6GK1 901-1BB20-2AB0
1 pack of 50	6GK1 901-1BB20-2AE0
IE FC RJ-45 Plug 145 RJ-45 cable connector for Industrial Ethernet with robust metal casing and integrated insulation piercing contacts for connection of the Industrial Ethernet FC installation cables; with 145° cable outlet; for SIMOTION and SINAMICS	
1 pack of 1	6GK1 901-1BB30-0AA0
1 pack of 10	6GK1 901-1BB30-0AB0
1 pack of 50	6GK1 901-1BB30-0AE0

See also

Fitting the IE FC RJ-45 Plug (Page 530)

Notes on crossover cabling

The need for crossover cabling

The SCALANCE devices described in this manual have the autocrossover function. This means that there is no situation in which crossover cables are necessary. IE FC RJ-45 Plugs with the pin assignment shown above can be connected to both ends of the cable. This corresponds to straight-through wiring.

In particular with older switches and end devices (for example OSM, ESM) it is possible that this function is not implemented. In such cases, a crossover cable is necessary for a direct connection from end device to end device or switch to switch if neither of the switches has the autocrossover function.

Swapping over the send and receive pairs in one of the two plugs of the IE FC cable creates a crossover cable.

IE Hybrid RJ-45 Plug

Installation

The assembly of the IE Hybrid RJ-45 Plug is described in a separate section (Page 533).

Table 10-32 Connector pin assignment of the RJ-45 part

Pin number (RJ-45 part)	Signal	Wire color
Pin 1	TX+	Yellow
Pin 2	TX-	Orange
Pin 3	RX+	White
Pin 6	RX-	Blue

Table 10-33 Pin assignment of the power supply insert module

Pin number	Signal	Wire color
Pin 1	24 V	Brown
Pin 2	24 V	Brown
Pin 3	Ground	Black
Pin 4	Ground	Black

Table 10-34 Technical specifications

Transmission rate	10/100 Mbps; CAT5
Maximum cable length with IE Hybrid Cable 2x2 + 4x0.34	80 m IE FC cables
Connector technology	Insulation piercing technology
Permitted cable cross section for data cables	AWG24 - AWG22
Outer cable diameter	10 mm to 11 mm
Degree of protection	IP67
Ambient temperature	-40 °C to +70 °C

See also

Connecting the IE Hybrid Cable 2x2 + 4x0.34 (Page 533)

IP65 plug

M12 cable connectors

M12 plugs are used not only for data transmission but also for the power supply and the signaling contact. Different coding prevents inserting the wrong plug.

Table 10-35 Pin assignment of the cable socket Power M12 Cable Connector PRO

Pin 1	24 V DC
Pin 2	-
Pin 3	Ground
Pin 4	-

Table 10-36 Pin assignment of the cable socket Signaling Contact M12 Cable Connector PRO

Pin 1	F1
Pin 2	-
Pin 3	-
Pin 4	F2
Pin 5	-

The IE M12 Plug PRO is male and D-coded so that it cannot be confused with the Power M12 Cable Connector PRO.

Table 10-37 Ordering data

	Order number
IE M12 Plug PRO M12 cable connector 4-pin, D-coded, for assembly on IE FC Cable 2 x 2 with robust metal casing and fast connect technology; 180 degree cable outlet 1 pack of 1 1 pack of 8	 6GK1 901-0DB10-6AA0 6GK1 901-0DB10-6AA8
Signaling contact M12 cable connector PRO M12 cable connector 5-pin, B-coded, for connection to power cable 2x0.75	6GK1 908-0DC10-6AA3
Power M12 cable connector PRO M12 cable connector 4-pin, A-coded, connection to power cable 2x0.75	6GK1 907-0DC10-6AA3
Power cable 2x0.75 Sold in meters	6XV1812-8A

See also

IP degrees of protection (Page 579)

IE M12 Plug PRO

Connector pinout

An IE M12 Plug PRO with the pinning as shown in the following table must be connected to both ends of the IE FC cable.

Table 10-38 Pinning at both ends of a straight-through cable

Pin number	Assignment as a network component	Color
Pin 1	RX+	Yellow
Pin 2	TX+	White
Pin 3	RX-	Orange
Pin 4	TX-	Blue

The signal assignment in the table corresponds to the pin assignment of the 4-pin 10/100BaseTX M12 socket of SCALANCE X208 PRO.

The pin assignment of the M12 socket of a network component on the other hand is as follows:

Table 10-39 Crossover pin assignment at one end of a crossover cable

Pin number	Assignment	
Pin 1	TX+	White
Pin 2	RX+	Yellow
Pin 3	TX-	Blue
Pin 4	RX-	Orange

The difference is that the send pin at one end must connect to the receive pin at the other end. With straight-through cables, this is only the case if the connector pin assignment is not the same at both ends. With devices that have autocrossing, a transmission would work even if the pin assignment was the same.

Technical specifications and ordering data

Table 10-40 Technical specifications

Transmission rate	10/100 Mbps; CAT5e
Maximum cable length (depending on cable type)	100 m IE FC cables
Number of pins	4
Cable connector/coding	M12 "D" (Draft IEC 61076-2-101 Amendment 1)
Connector technology	Insulation piercing technology
Permitted cable cross section	AWG24 - AWG22
Outer cable diameter	6.0 mm to 8.0 mm
Degree of protection	IP67
Ambient temperature	-25 °C to +85 °C

Table 10-41 Ordering data

	Order number
IE M12 Plug PRO	
M12 cable connector 4-pin, D-coded, for assembly on IE FC Cable 2 x 2 with robust metal casing and fast connect technology; 180 degree cable outlet	
1 pack of 1	6GK1 901-0DB10-6AA0
1 pack of 8	6GK1 901-0DB10-6AA8

10.4.6.2 IE FC Modular Outlet and IE FC Outlet RJ-45

IE FC Modular Outlet

General

Simple assembly with integrated insulation piercing contacts with color coding allows time-saving and error-free installation of the 8-wire CAT6 Industrial Ethernet FC installation cable in the CAT6 Industrial Ethernet Modular Outlet. The design of the 8-wire AWG22 cable allows the outer jacket and shield to be stripped with the familiar IE FC Stripping Tool in one action (it may be necessary for the user to readjust the tool for the 4x2 cable variant. The two setting screws of the knife cassette on the stripping tool must be opened by approximately half a turn.) After preparing the cable in this way, contact is made immediately via the insulation piercing contacts in the Modular Outlet.

Design

The robust metal housing is intended for industry (IP40) and allows the modular outlet to be installed on a DIN rail. Direct mounting on a wall is also possible.

The metal housing also provides strain relief for the installation cables suitable for industrial surroundings and reliable shield contact. With its higher IP40 degree of protection is can be mounted directly on site.

The IE FC RJ-45 Modular Outlet basic module can be equipped with two different optional inserts without changing the wiring (permanent wiring):

- Insert 2 FE: Two Fast Ethernet connections for attachment of two 10/100 Mbps end devices/network components
- Insert 1 GE: One gigabit Ethernet connection for attaching a 10/100/1000 Mbps end device/network component

The basic module can be ordered without inserts. In this case, the inserts must be ordered separately.

The modular outlet

- FC RJ-45 Modular Outlet Insert 1 GE and
- FC RJ-45 Modular Outlet Insert 2 FE

The ordering unit is a basic module and the relevant insert. When necessary, the insert can be replaced.

Replacing the insert allows an upgrade of a 100 Mbps double connection to a gigabit connection. This is possible only if the wiring was performed with the IE FC standard cable 4 x 2 GP. In this case, there is no need to change the installed wiring.

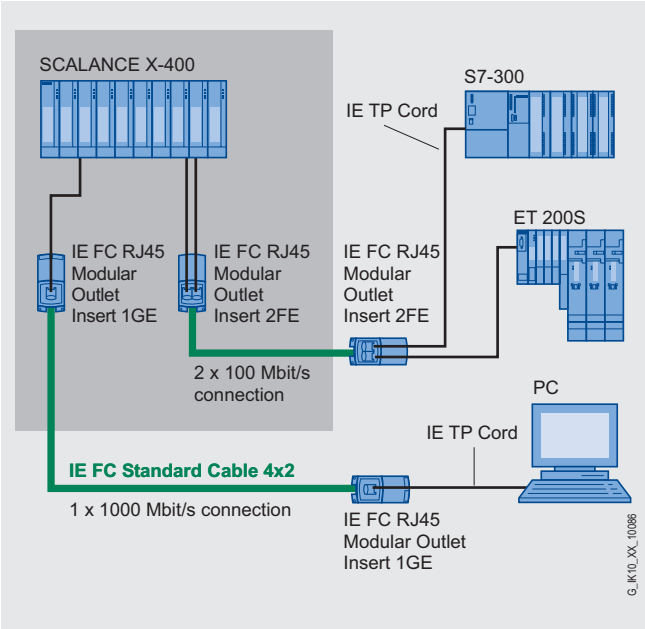


Figure 10-17 Modular Outlet Insert 1GE and IE FC RJ-45 Modular Outlet Insert 2FE

A further modular outlet, the

- FC RJ-45 Modular Outlet Power Insert

Figure 10-18 Basic module with power insert

provides not only a Fast Ethernet connection to connect a 10/100 Mbps end device / network component but also the option of supplying power to the end device by connecting a power supply to a two-wire terminal block. In this case, the wiring of the IE FC RJ-45 Modular Outlet must be performed with the IE Hybrid Cable 2x2 + 4x0.34. Apart from the 2x2 data line, this cable has four wires intended for the power supply.

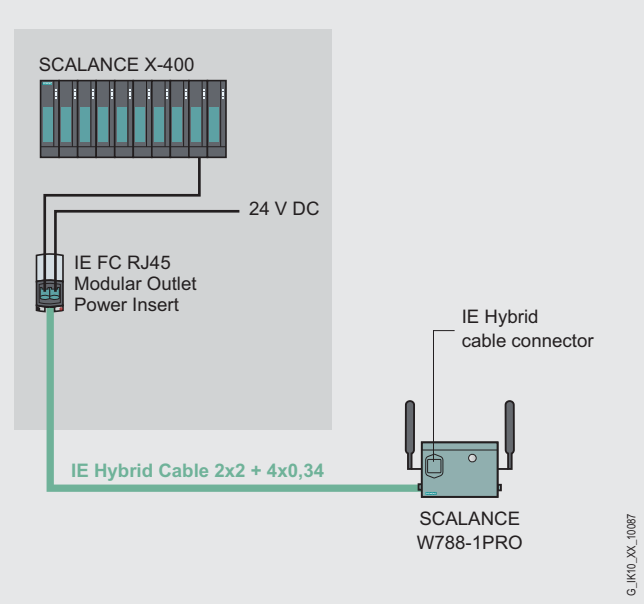


Figure 10-19 Example of wiring with the FC RJ-45 Modular Outlet Power Insert

Installation

You will find instructions on assembling the IE FC RJ-45 Modular Outlet in the relevant section of this manual.

To use the 2FE and 1 GE inserts, the basic modules of the outlets must be connected with the following cable:

- IE FC Standard Cable 4 x 2 GP

The basic module of the FC RJ-45 Modular Outlet Power Insert must be connected with the following cable:

- IE Hybrid Cable 2x2 + 4x0.34

Please note that the IE hybrid cable cannot be be prepared with the stripping tool.

Note

The insulation piercing contacts of the IE FC RJ-45 Modular Outlet can be released and recontacted up to 10 times. Cable ends that have had a connector fitted, must not be used twice but must be cut off before fitting a new connector.

⚠WARNING

Use the power insert only under the following conditions:

- Extra-low voltages SELV, PELV to IEC 60364-4-41
- In USA/CAN with power supplies according to NEC class 2
- In USA/CAN, the cabling must meet the requirements of the NEC/CEC
- Current load maximum 0.5 A.

Table 10-42 Technical specifications

FC RJ-45 Modular Outlet Insert 2 FE	
- Transmission rate of the 2 x RJ-45 jacks	10/100 Mbps; CAT5e
FC RJ-45 Modular Outlet Insert 1 GE	
- Transmission rate of the RJ-45 jack	10/100/1000 Mbps; CAT6
FC RJ-45 Modular Outlet Power Insert	
- Transmission rate of the RJ-45 jack	10/100 Mbps; CAT5e
- Voltage at the power insert terminal	Max. 57 V 1)
Maximum cable length	0 - 100 m depending on the type of IE FC cable
Temperature range:	
Operation	-20 °C to +70 °C
Transport/storage	-40 °C to +80 °C
Relative humidity in operation	< 95%
Dimensions (W x H x D) in mm	50 x 115.25 x 59
Installation	Wall mounting or on DIN rail
Weight	450 g
Degree of protection	IP40
UL listing	yes
Transmission characteristics	Corresponds to category 6 of the international cabling standards ISO/IEC 11801 and EN 50173

1) The minimum voltage supplied depends on the following parameters

- Resistance of the IE Hybrid Cable 2x2 + 4x0.34 per meter
- Actual length of the hybrid cable connected to the IE FC RJ-45 Modular Outlet
- Minimum operating voltage of the connected consumer

The following inserts are available without basic housing

Insert 2FE order no. 6GK1901-1BK00-0AA1

Insert 1GE order no. 6GK1901-1BK00-0AA2

Note that the connection between IE FC RJ-45 Modular Outlets with these inserts requires 8-wire FastConnect cables (Cat6). The IE Hybrid Cable 2x2 + 4x0.34 6XV1870-2J is not suitable for operation of the 2FE and 1GE inserts!

Table 10-43 Ordering data

IE FC RJ-45 Modular Outlet with interface to the slot of an insert	Order number
Base module without insert	6GK1901-1BE00-0AA0
- with insert 2FE; insert for 2 x 100 Mbps interface	6GK1901-1BE00-0AA1
- with insert 1GE; insert for 1 x 1000 Mbps interface	6GK1901-1BE00-0AA2
- with power insert; insert for 1 x 24 V DC and 1 x 100 Mbps interface	6GK1901-1BE00-0AA3
Insert 2FE for FC Modular Outlet Base; 2 x RJ-45 for 2 x 100 Mbps; 1 x set of 4	6GK1901-1BK00-0AA1
Insert 1GE for FC Modular Outlet Base; 1 x RJ-45 for 1 x 1000 Mbps; 1 x set of 4	6GK1901-1BK00-0AA2

See also

Fitting the IE FC Modular Outlet RJ-45 (Page 532)

Industrial Ethernet FC Outlet RJ-45

Installation

The FC Outlet RJ-45 is suitable for mounting on a DIN rail and for wall mounting. There are four drilled holes for wall mounting.

By arranging several FC Outlet RJ-45 devices in a line, you can create a patch panel with any terminal density you require (for example 16 outlets to a width of 19" is possible with a suitably wide rail). The FC Outlet RJ-45 can also be installed behind a metal panel with a suitable cutout (for example in a wiring cubicle).

Application example

The Industrial Ethernet FC Outlet RJ-45 is attached directly to the Industrial Ethernet FC TP cable. To connect the FC Outlet RJ-45 and network components or an end device, various preassembled RJ-45 patch cables are available.

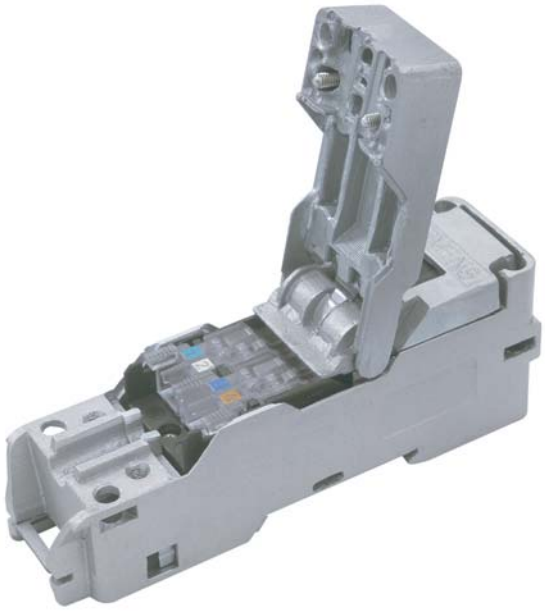


Figure 10-20 Industrial Ethernet FC Outlet RJ-45

Pin assignment of the FC Outlet RJ-45

The contacts of the RJ-45 jack and the insulation-piercing terminals for the FC TP cable are assigned to each other as follows:

RJ-45 pin number	Signal	Insulation-piercing terminal number	Wire color
1	TX+	1	Yellow
2	TX-	3	Orange
3	RX+	2	white
6	RX-	4	blue

Technical specifications

Table 10-44 Specifications of the FC Outlet RJ-45

Interfaces • Attachment of end devices, network components • Attachment of Industrial Ethernet FC TP cables	 RJ-45 jack 4 insulation piercing terminals
Installation	Standard rail or wall installation
Perm. ambient conditions • Operating temperature • Storage/transport temperature	 -25 °C to +70 °C -40 °C to +70 °C
Construction • Dimensions (W x H x D) in mm • Weight	 31.7 x 107 x 30 300 g
Degree of protection	IP20
Transmission characteristics	Correspond to category 5 of the international cabling standards ISO/IEC 11801 and EN 50173

Ordering data

Table 10-45 Ordering data of the FC Outlet RJ-45

Industrial Ethernet FC Outlet RJ-45 For connecting Industrial Ethernet FC TP cables and TP Cords	**6GK1 901-1FC00 0AA0**

Dimension drawings

Front view of the IE FC Outlet RJ-45

Front

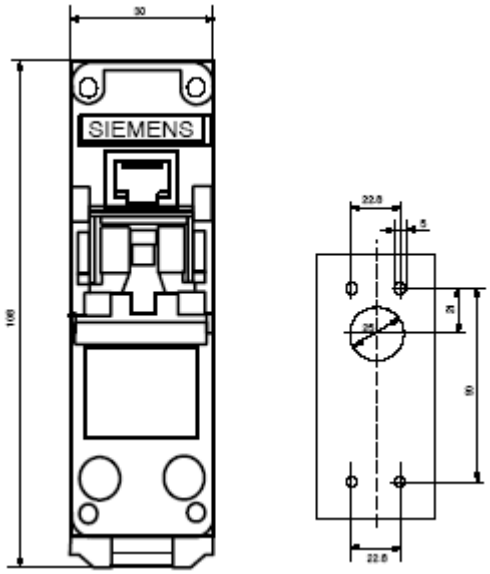


Figure 10-21 IE FC Outlet RJ-45 (dimensions in mm)

See also

Connecting the IE FC TP standard cable 4 x 2 GP / IE FC TP flexible cable 4 x 2 GP (Page 535)

Side view of the IE FC Outlet RJ-45

Left

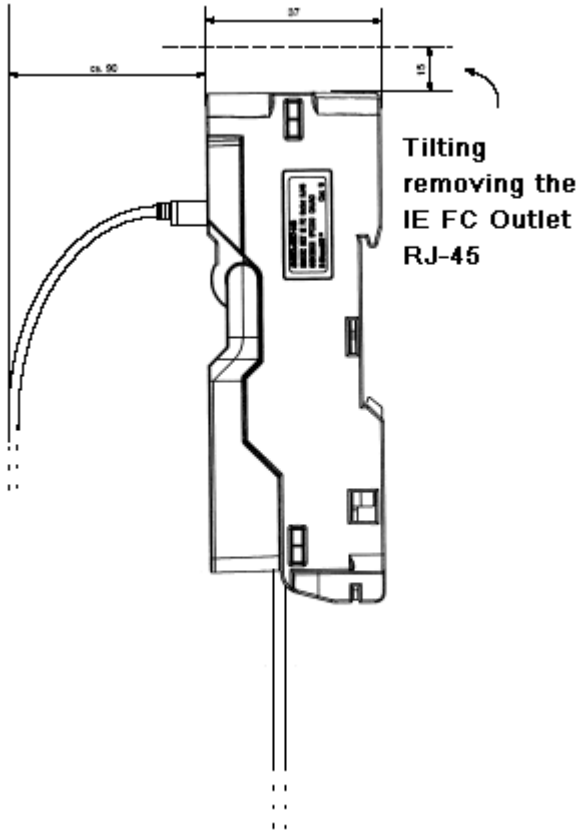


Figure 10-22 IE FC Outlet RJ-45 (dimensions in mm)

Industrial Twisted Pair D-sub connectors

General

The Industrial Twisted Pair D-sub connectors correspond to the standards MIL-C-24308 and DIN 41652. Due to its mechanical strength and its excellent electromagnetic compatibility, for use in a harsh industrial environment, this connector was preferred to the RJ-45 connector recommended for 10BASE-T in IEEE 802.3.

Design of the plug for user assembly

Only the connectors for user assembly are described below.

There are two versions of the Industrial Twisted Pair D-sub connectors for user assembly:

- 9-pin connector with straight cable outlet and securing screws
- 15-pin connector with variable cable outlet (+30° , 0°, -30°) and securing bolts

Both connector types have a metal casing. The Industrial Twisted Pair cables are connected to the connector pins using screw terminals, special tools are not required.

For a detailed description of fitting connectors, refer to the section D-sub connectors.

Industrial Twisted Pair D-sub connectors, 9-pin

- Intended for connecting to:
  - OLM/ELM (port 1–3)
  - OSM/ESM (port 1–6, standby–sync port)
  - Interface card ECTP3 (port 1–3) for star coupler (ASGE)
- Connector casing with straight cable outlet
- Can be mechanically secured to the female connector with integrated knurled screws
- Simple cable assembly with screw terminals

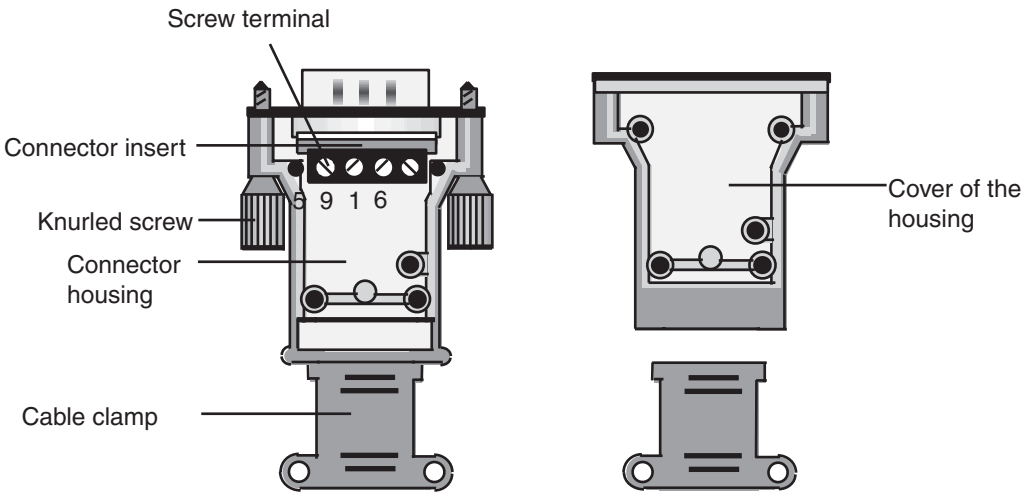


Figure 10-23 Industrial Twisted Pair D-sub male connector (9-pin) for user assembly

Industrial Twisted Pair D-sub connectors, 15-pin

- For connection to end devices with an integrated Industrial Twisted Pair port
- Connector casing with variable cable outlet angle

  +30° , 0° , –30°
- Slide mechanism for locking to female connector
- Two dummy plugs for closing unused cable outlets
- Simple cable assembly with screw terminals
- Internal coding jumper for converting the end device port from AUI to Industrial Twisted Pair

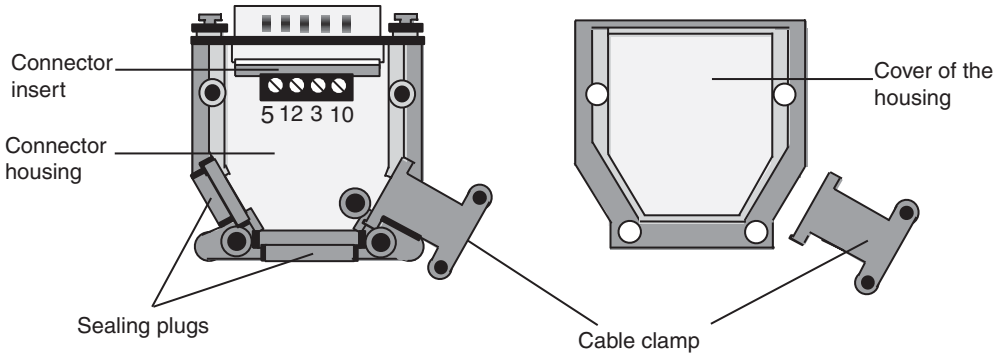


Figure 10-24 Industrial Twisted Pair D-sub male connector (15-pin) for user assembly

See also

Fitting the D-sub male connector (Page 549)

10.5 Components for optical networks

10.5.1 Glass FO cables 50/125

10.5.1.1 Properties of glass FO cable 50/125 µm

Technical specifications

The following tables show an overview of the technical specifications of all SIMATIC NET glass FO cables.

Table 10-46 Technical specifications of the FO Standard Cable GP and FO Ground Cable

Cable type	FO standard cable GP	FO Ground Cable
Areas of application	Universal cable for use indoors and outdoors	Longitudinally and laterally watertight cable for use outdoors with non-metallic rodent protection for direct underground installation
Can be ordered	In meters; preassembled with 4 BFOC or 4 SC connectors	In meters; preassembled with 4 BFOC or 4 SC connectors
Cable type (standard code)	AT-W(ZN)YY 2x1G50/125	AT-WQ(ZN)Y(ZN)B2Y 2G50/125
Fiber type	Multimode graded-index fiber 50/125 µm	Multimode graded-index fiber 50/125 µm
Attenuation		
at 850 nm	≤ 2.7 dB/km	≤ 2.7 dB/km
at 1300 nm	≤ 0.7 dB/km	≤ 0.7 dB/km
Modal bandwidth		
at 850 nm	≥ 600 MHz *km	≥ 600 MHz *km
at 1300 nm	≥ 1200 MHz *km	≥ 1200 MHz *km
Number of fibers	2	2
Cable design	Splittable	Splittable
Core type	Hollow core, filled	Hollow core, filled
Materials		
Basic element	PVC, orange/black	PVC, orange/black
Tensile strain relief	Aramid yarn	Aramid yarn
Outer jacket /color of cable	PVC, green	PE, black
Mechanical characteristics		
Dimensions of basic element	2.9 mm Ø	2.9 mm Ø
Cable dimensions	4.5 x 7.4 mm	10.5 mm ± 0.5 mm
Cable weight	approx. 40 kg/km	approx. 90 kg/km
Permitted tensile force	≤ 500 N	≤ 800 N

Cable type	FO standard cable GP	FO Ground Cable
Bending radius	65 mm	155 mm
Bending cycles	–	–
Transverse compressive strength	300 N/cm	300 N/cm
Impact strength (initial energy / number / hammer Ø)	–	–
Perm. ambient conditions		
Installation temperature	-5 ºC to +50 ºC	-5 ºC to +50 ºC
Operating temperature	-25 ºC to +80 ºC	-25 ºC to +75 ºC
Storage temperature	-25 ºC to +80 ºC	-25 ºC to +75 ºC
Resistance to fire	Flame retardant to IEC 60332-1	–
Free of halogens	–	–
Silicone-free	yes	yes
Resistance to mineral oils and fats	Conditionally resistant	Highly resistant
UL/CSA approval	OFN (NEC Article 770, UL1651)/ OFN, 90°C, FT1, FT4 (CSA Standard C22.2 No232-M1988)	–
UV resistant	yes	yes
Rodent protection	–	yes
Gigabit length		
1000BaseSX	750 m	750 m
1000BaseLX	2000 m	2000 m

Table 10-47 Technical specifications for the FO Trailing Cable and FO Trailing Cable GP

Cable type	FO Trailing Cable	FO Trailing Cable GP
Areas of application	Cable for use in drag chains and for high mechanical strain, PUR outer jacket, no UL approval	Cable for use in drag chains and for lower mechanical strain, PVC outer jacket, UL approval
Can be ordered	In meters; preassembled with 4 BFOC or 4 SC connectors	In meters; preassembled with 4 BFOC or 4 SC connectors
Cable type (standard code)	AT-W(ZN)Y(ZN)11Y 2G50/125	AT-W(ZN)Y(ZN)Y 2G50/125
Fiber type	Multimode graded-index fiber 50/125 µm	Multimode graded-index fiber 50/125 µm
Attenuation		
at 850 nm	≤ 2.7 dB/km	≤ 2.7 dB/km
at 1300 nm	≤ 0.7 dB/km	≤ 0.7 dB/km
Modal bandwidth		
at 850 nm	≥ 600 MHz *km	≥ 600 MHz *km
at 1300 nm	≥ 1200 MHz *km	≥ 1200 MHz *km
Number of fibers	2	2
Cable design	Splittable	Splittable

Cable type	FO Trailing Cable	FO Trailing Cable GP
Core type	Hollow core, filled	Hollow core, filled
Materials		
Basic element	PVC, orange/black	PVC, orange/black
Tensile strain relief	Aramid yarn	Aramid yarn
Outer jacket /color of cable	PUR, green	PVC, green
Mechanical characteristics		
Dimensions of basic element	2.9 mm Ø	2.9 mm Ø
Cable dimensions	10.5 mm Ø ±0.5 mm	10.5 mm Ø ±0.5 mm
Cable weight	approx. 90 kg/km	approx. 90 kg/km
Permitted tensile force	≤ 800 N	≤ 800 N
Bending radius	200 mm	200 mm
Bending cycles	5.000.000	3.500.000
Transverse compressive strength	300 N/cm	300 N/cm
Impact strength (initial energy / number / hammer Ø)	–	–
Perm. ambient conditions		
Installation temperature	-5 ºC to +50 ºC	-5 ºC to +50 ºC
Operating temperature	-25 ºC to +80 ºC	-25 ºC to +80 ºC
Storage temperature	-25 ºC to +80 ºC	-25 ºC to +80 ºC
Resistance to fire	–	Flame retardant to IEC 60332-1
Free of halogens	–	–
Silicone-free	yes	yes
Resistance to mineral oils and fats	Highly resistant	Conditionally resistant
UL/CSA approval	–	OFN (NEC Article 770, UL1651)/ OFN, 90°C, FT1, FT4 (CSA Standard C22.2 No232-M1988)
UV resistant	yes	yes
Rodent protection	–	–
Gigabit length		
1000BaseSX	750 m	750 m
1000BaseLX	2000 m	2000 m

Table 10-48 Technical specifications for the INDOOR fiber optic cable and fiber optic standard cable

Cable type	**INDOOR fiber-optic indoor cable**	**Fiber-optic standard cable**
Areas of application	Non-crush, halogen-free and extremely flame-retardant cable for use indoors	Universal cable for use indoors and outdoors
Can be ordered	In meters, preassembled with 4 BFOC connectors	In meters, preassembled with 4 BFOC connectors
Cable type (standard code)	T-VHH 2G62.5/125 3.2B200+0.9F600 F TB3 OR FRNC	AT-VYY 2G62.5/125 3.1B200 + 0.8F600 F
Fiber type	Multimode graded-index fiber 62.5/125 µm	Multimode graded-index fiber 62.5/125 µm
Power loss at 850 nm Power loss at 1300 nm	≤ 3.1 dB/km ≤ 0.8 dB/km	≤ 3.1 dB/km ≤ 0.8 dB/km
Modal bandwidth at 850 nm Modal bandwidth at 1300 nm	≥ 200 MHz *km ≥ 600 MHz *km	≥ 200 MHz *km ≥ 600 MHz *km
Number of fibers	2	2
Cable design	Splittable indoor cable	Splittable outdoor cable
Core type	Fixed core	Compact core
Cable type	INDOOR fiber-optic indoor cable	Fiber-optic standard cable
Areas of application	Non-crush, halogen-free and extremely flame-retardant cable for use indoors	Universal cable for use indoors and outdoors
Can be ordered	In meters, preassembled with 4 BFOC connectors	In meters, preassembled with 4 BFOC connectors
Cable type (standard code)	T-VHH 2G62.5/125 3.2B200+0.9F600 F TB3 OR FRNC	AT-VYY 2G62.5/125 3.1B200 + 0.8F600 F
Materials		
Basic element	Copolymer, gray (FRNC)	PVC, gray
Tensile strain relief	Aramid yarn	Kevlar yarn and impregnated glass fiber yarn
Outer jacket /color of cable	Copolymer, bright orange (FRNC)	PVC, black
Mechanical characteristics		
Dimensions of basic element	(2.9 ± 0.1) mm Ø	(3.5 ± 0.2) mm Ø
Cable dimensions	(3.9 × 6.8) ± 0.2 mm	(6.3 × 9.8) ± 0.4 mm
Cable weight	approx. 30 kg/km	approx. 74 kg/km
Permitted tensile force	≤ 800 N (brief)	≤ 500 N (brief)
Bending radius	≥ 60 mm (during installation); ≥ 40 mm (in operation) flat surface only	≥ 100 mm only the flat surface
Transverse compressive strength	10,000 N/10 cm (brief)1) 2,000 N/10 cm (permanent)2)	2,000 N

Cable type	INDOOR fiber-optic indoor cable	Fiber-optic standard cable
Impact strength (initial energy / number / hammer Ø)	1.5 Nm/20 blows/12.5 mm	–
Dimensions of basic element	(2.9 ± 0.1) mm Ø	(3.5 ± 0.2) mm Ø
Perm. ambient conditions		
Installation temperature	-5 ºC to +50 ºC	-5 ºC to +50 ºC
Operating temperature	-20 ºC to +60 ºC	-20 ºC to +60 ºC
Storage temperature	-25 ºC to +70 ºC	-25 ºC to +70 ºC
Resistance to fire	Flame retardant to IEC 60332-1 and VDE 0482-265-2-1	Flame retardant to IEC 60332-3 and VDE 0482-266-2-4
Free of halogens	yes	–
Silicone-free	yes	yes
Resistance to mineral oils and fats	–	–
UL approval	–	–
UV resistant	–	yes
Rodent protection	–	–
Gigabit length		
1000BaseSX	–	–
1000BaseLX	–	–

1) Attenuation change reversible max. 0.3 dB, 2) Attenuation change reversible max. 0.1 dB

Table 10-49 Technical specifications for the Flexible Fiber-optic trailing cable and 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 drag chains indoors and outdoors	Fixed installation on ships and offshore facilities in all enclosed spaces and on free decks; shipbuilding approval
Can be ordered	In meters, preassembled with 4 BFOC connectors	Sold in meters
Cable type (standard code)	AT-W11Y (ZN) 11Y 2G62.5/125 3.1B200 + 0.8F600 F	MI-VHH 2G 62.5/125 3.1B200 + 0.8F600 + 2 x 1CU
Fiber type	Multimode graded-index fiber 62.5/125 µm	Multimode graded-index fiber 62.5/125 µm
Power loss at 850 nm Power loss at 1300 nm	≤ 3.1 dB/km ≤ 0.8 dB/km	≤ 3.1 dB/km ≤ 0.8 dB/km
Modal bandwidth at 850 nm Modal bandwidth 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

Cable type	**Flexible fiber-optic trailing cable**	**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 drag chains indoors and outdoors	Fixed installation on ships and offshore facilities in all enclosed spaces and on free decks; shipbuilding approval
Can be ordered	In meters, preassembled with 4 BFOC connectors	Sold in meters
Cable type (standard code)	AT-W11Y (ZN) 11Y 2G62.5/125 3.1B200 + 0.8F600 F	MI-VHH 2G 62.5/125 3.1B200 + 0.8F600 + 2 x 1CU
Materials		
Basic element	PUR, black	Polyolefin
Tensile strain relief	Aramid yarn, also GFK central element	Aramid yarn
Outer jacket /color of cable	PUR, black	SHF1 mixture, black
Mechanical characteristics		
Dimensions of basic element	(3.5 ± 0.2) mm Ø	(2.9 ± 0.2) mm Ø
Cable dimensions	12.9 mm (outer diameter)	13.3 ± 0.5 mm
Cable weight	approx. 136 kg/km	approx. 220 kg/km
Permitted tensile force	≤ 2000 N (brief) ≤ 1000 N (permanent)	≤ 500 N (brief) ≤ 250 N (permanent)
Bending radius	≥ 150 mm min. 100,000 bending cycles	133 mm (once) 266 mm (multiple)
Perm. ambient conditions		
Installation temperature	-30 ºC to +60 ºC	-10 ºC to +50 ºC
Operating temperature	-30 ºC to +60 ºC	–40 ºC to +80 ºC 1) –40 ºC to +70 ºC 2)
Storage temperature	-30 ºC to +70 ºC	-40 ºC to +80 ºC
Resistance to fire	–	Flame retardant to IEC 60332-3 Cat A
Free of halogens	yes	yes
Silicone-free	yes	yes
Resistance to mineral oils and fats	–	–
UL approval	–	–
UV resistant	yes	–
Rodent protection	–	–
Gigabit length		
1000BaseSX	–	–
1000BaseLX	–	–

Cable type	Flexible fiber-optic trailing cable	SIENOPYR Duplex Fiber-Optic Marine Cable
Shipbuilding approvals	–	Lloyds Register of Shipping Germanischer Lloyd Registro Staliano Navale Bureau Veritas

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

10.5.1.2 FO Standard Cable GP 50/125 µm

Brief description of the Fiber Optic Standard Cable GP 6XV1873–2A

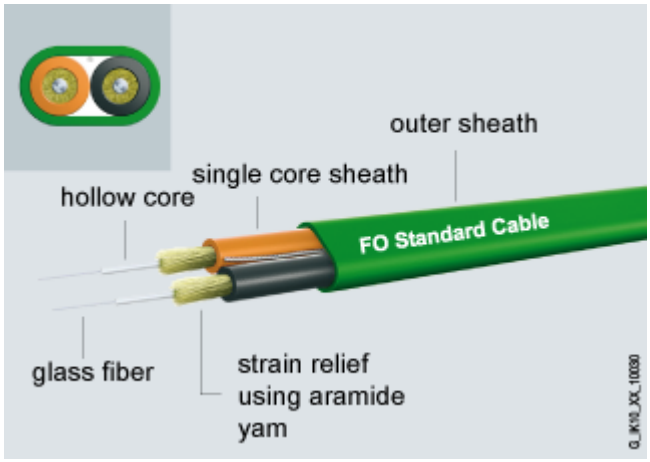


Figure 10-25 Design of the Fiber Optic Standard Cable

The fiberoptic standard cable contains two multimode graded fibers of type 50/125 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET
FO Standard Cable GP 50/125 6XV1 873–2A (UL) E157125 OFN (drum number) / (year of manufacture, e.g. 05) (meter marker)" approximately every 100 cm. The slash can be used as a meter marker. Meter markers make it easier to estimate the length of an installed cable.

Properties

The fiberoptic standard cable has the following properties:

- UV resistant
- Silicone-free
- Suitable for direct connector assembly
- Available in meters up to max. 3000 m
- Preassembled with 4 BFOC connectors in lengths up to 300 m
- Preassembled with 4 SC connectors in lengths up to 300 m

Note

Other special cables and special lengths available on request.

Application

The fiberoptic standard cable is the universal cable for use indoors and outdoors. It is suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

See also

Preassembled FO standard cable GP (Page 508)

10.5.1.3 FO Ground Cable 50/125 µm

Brief description of the Fiber Optic Ground Cable 6XV1873–2G

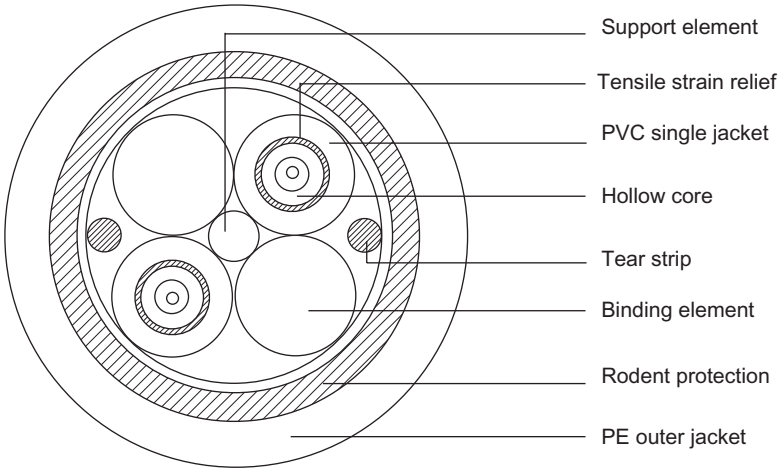


Figure 10-26 Design of the Fiber Optic Ground Cable

The FO Ground Cable contains two multimode graded fibers of type 50/125 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET FO Ground Cable 50/125 6XV1873–2G (drum number) / (year of manufacture, e.g. 05) (meter marker)" approximately every 100 cm. The slash can be used as a meter marker. Meter markers make it easier to estimate the length of an installed cable.

See also

Preassembled FO Ground Cable (Page 508)

10.5.1.4 FO Trailing Cable 50/125 µm Standard (variants with and without UL)

FO Trailing Cable 6XV1873–2C

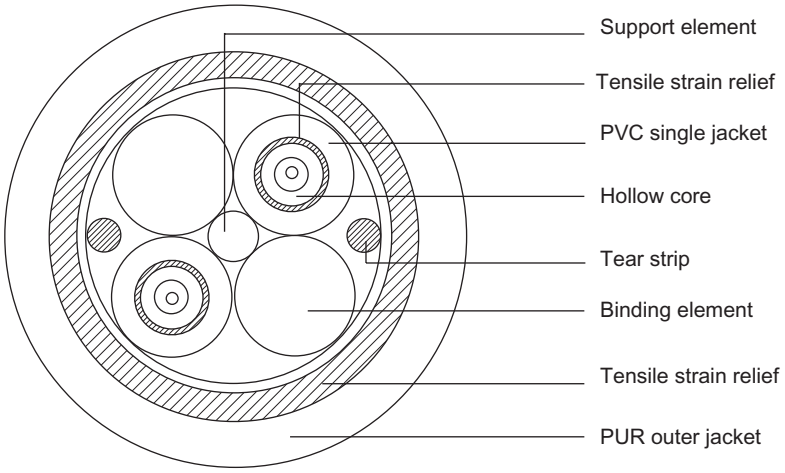


Figure 10-27 Design of the FO Trailing Cable

The FO Trailing Cable contains two multimode graded fibers of type 50/125 µm.

The outer jacket is made of PUR and is labeled "SIEMENS SIMATIC NET FO Trailing Cable 50/125 6XV1873–2C (drum number) / (year of manufacture, e.g. 05) (meter marker)" approximately every 100 cm. The slash can be used as a meter marker. Meter markers make it easier to estimate the length of an installed cable. This cable does not have UL approval.

FO Trailing Cable GP 6XV1873–2D

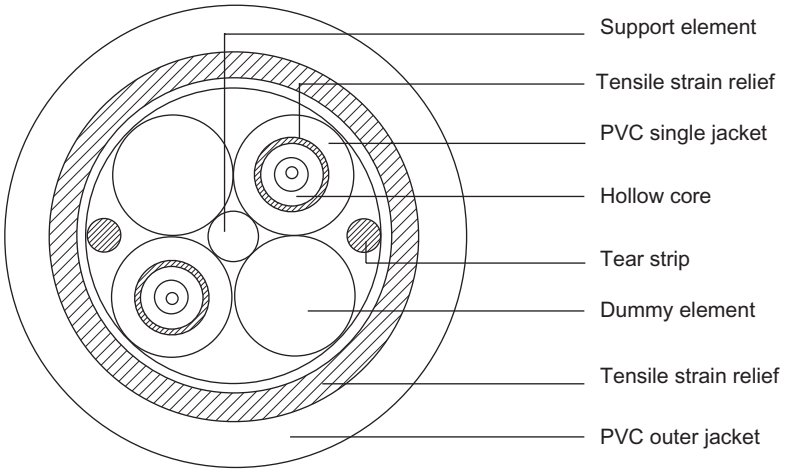


Figure 10-28 Design of the FO Trailing Cable GP

In contrast to the FO Trailing Cable, the material of the outer jacket is PVC. The fiber type is, however, the same. The FO Trailing Cable GP has UL and CSA approval.

The outer jacket is made of PVC and is labeled "SIEMENS SIMATIC NET FO Trailing Cable GP 50/125 6XV1873–2D (UL)E157125 OFN LL 64163 OFN FT4 90C CSA (drum number) / (year of manufacture, e.g. 05) (meter marker)" approximately every 100 cm.

Properties

The FO Trailing Cable and FO Trailing Cable GP have the following properties:

- UV resistant
- Silicone-free
- Suitable for direct connector assembly
- Available in meters up to 3000 m
- Preassembled with 4 BFOC connectors in lengths up to 100 m
- Preassembled with 4 SC connectors in lengths up to 100 m

The FO Trailing Cable also has the following properties:

- Number of bending cycles at least 5,000,000

The FO Trailing Cable GP has the following properties compared with the FO Trailing Cable:

- UL and CSA approval
- Number of bending cycles at least 3,500,000

Application

The FO Trailing Cable is suitable for use in trailing cables for heavy mechanical stress, the FO Trailing Cable GP for less mechanical stress.

Both cables are suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

See also

Preassembled FO Trailing Cable (Page 509)

Preassembled FO Trailing Cable GP (Page 510)

10.5.1.5 FO FRNC Cable 50/125

Application

The FO FRNC Cable with two 50/125 µm fibers is halogen-free and flame retardant and is particularly suitable for fixed installation in buildings. With this cable design, little smoke that is free of halogens is produced in the case of fire therefore reducing secondary damage significantly.

Designed as a breakout cable, it is suitable for direct fitting of connectors.

Technical specifications

Cable type	FO FRNC Cable
Areas of application	Halogen-free cable for fixed installation indoors and outdoors
Can be ordered	Sold in meters
Cable type (standard code)	AT-W(ZN)HH 2G50/125 UV
Fiber type	Multimode graded-index fiber 50/125 µm
Attenuation	
at 850 nm	≤ 2.7 dB/km
at 1300 nm	≤ 0.7 dB/km
Modal bandwidth	
at 850 nm	≥ 600 MHz *km
at 1300 nm	≥ 1200 MHz *km
Number of fibers	2
Cable design	Splittable
Core type	Hollow core, filled diameter 1400 µm
Materials	
Basic element	Halogen-free, flame retardant, orange/black
Tensile strain relief	Aramid yarn
Outer jacket /color of cable	Halogen-free and flame retardant, FRNC, green
Mechanical characteristics	
Dimensions of basic element	2.9 mm Ø
Cable dimensions	9.2 mm
Cable weight	approx. 85 kg/km
Permitted tensile force	≤ 800 N
Bending radius	50 mm
Bending cycles	-
Transverse compressive strength	300 N/cm
Impact strength (initial energy / number / hammer Ø)	-
Perm. ambient conditions	
Installation temperature	-5 ºC to +50 ºC
Operating temperature	-25 ºC to +70 ºC
Storage temperature	-25 ºC to +70 ºC
Resistance to fire	IEC 60332-3, IEC 61034-1 IEC 61034-2
Free of halogens	Yes
Silicone-free	Yes
Resistance to mineral oils and fats	Conditionally resistant

Cable type	FO FRNC Cable
UL/CSA approval	-
UV resistant	Yes
Rodent protection	-
Gigabit length	
1000BaseSX	750 m
1000BaseLX	2000 m

Ordering data

Product name	Order number
FO FRNC Cable 50/125	6XV1 873-2B

10.5.2 Glass FO cables 62.5/125

10.5.2.1 Overview of the glass fiber-optic cables 62.5/125 µm

Technical specifications

The following tables show an overview of the technical specifications of the SIMATIC NET glass FO cables 62.5/125 µm.

Table 10-50 Technical specifications for the INDOOR fiber optic cable and fiber optic standard cable

Cable type	Fiber-optic standard cable	INDOOR fiber-optic indoor cable
Area of application	Universal cable for use indoors and outdoors	Non-crush, halogen-free and extremely flame-retardant cable for use indoors
Can be ordered	Assembled with 4 BFOC connectors in fixed lengths and in meters	Assembled with 4 BFOC connectors in fixed lengths
Cabling (Standard code)	AT–VYY 2G62.5/125 3.1B200+0.8F600 F	I–VHH 2G62.5/125 3.2B200+0.9F600 F TB3 FRNC OR
Fiber type	Multimode graded-index fiber 62.5/125 µm	Multimode graded-index fiber 62.5/125 µm
Power loss at 850 nm Power loss at 1300 nm	<= 3.1 dB/km <= 0.8 dB/km	<= 3.2 dB/km <= 0.9 dB/km
Modal bandwidth at 850 nm at 1300 nm	 200 MHz *km 600 MHz *km	 200 MHz *km 600 MHz *km
Number of fibers	2	2

Cable type	Fiber-optic standard cable	INDOOR fiber-optic indoor cable
Cable design	Splittable outdoor cable	Splittable indoor cable
Core type	Compact core	Fixed core
Materials basic element	PVC, gray	Copolymer, orange (FRNC)
Tensile 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 force	<= 370 N (in operation) <= 500 N (brief)	<= 200 N (in operation) <= 800 N (brief)
Bending radiuses	100 mm Only flat side	100 mm (during installation) 60 mm (in operation) Only flat side
Transverse compressive strength	5,000 N/10 cm	3,000 N/10 cm (brief) 1,000 N/10 cm (permanent)
Resistance to impact	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
Resistance to fire	Flame retardant to IEC 60332–3 Cat. CF	Flame retardant to IEC 60332–3 and DIN VDE 0472 Part 804, test type B
Free of halogens	no	yes
UL approval	no	no
Shipbuilding approval	no	no

Table 10-51 Technical specifications of the flexible fiber optic trailing cable

Cable type	Flexible fiber-optic trailing cable
Area of application	Flexible cable for installation in drag chains indoors and outdoors
Can be ordered	Assembled with 4 BFOC connectors in fixed lengths and in meters
Cabling (Standard code)	AT–W11Y (ZN) 11Y2G62.5/125 3.1B200+0.8F600 LG
Fiber type	Multimode graded-index fiber 62.5/125 µm
Power loss at 850 nm Power loss at 1300 nm	<= 3.1 dB/km <= 0.8 dB/km
Modal bandwidth at 850 nm at 1300 nm	 200 MHz *km 600 MHz *km
Number of fibers	2
Cable design	Splittable outdoor cable
Core type	Hollow core, filled
Materials basic element	PUR, black
Tensile strain relief	GFK central element, Aramid yarn
Outer jacket /color of cable	PUR, black
Dimensions of basic element	(3.5 ± 0.2) mm ∅
Outer dimensions	approx. 12.9 mm
Cable weight	approx. 136 kg/km
Permitted tensile force	<= 2000 N (brief) <= 1000 N (permanent)
Bending radiuses	150 mm Max. 100,000 bending cycles
Installation temperature	–5 °C to +50 °C
Operating temperature	–25 °C to +60 °C
Storage temperature	-25 °C to +70 °C
Behavior in fire	Complies with IEC 60332-1
Free of halogens	no
UL approval	no
Shipbuilding approval	no

10.5.2.2 SIENOPYR Duplex FiberOptic Marine Cable 62.5/125 µm

Cable cross-sectional area

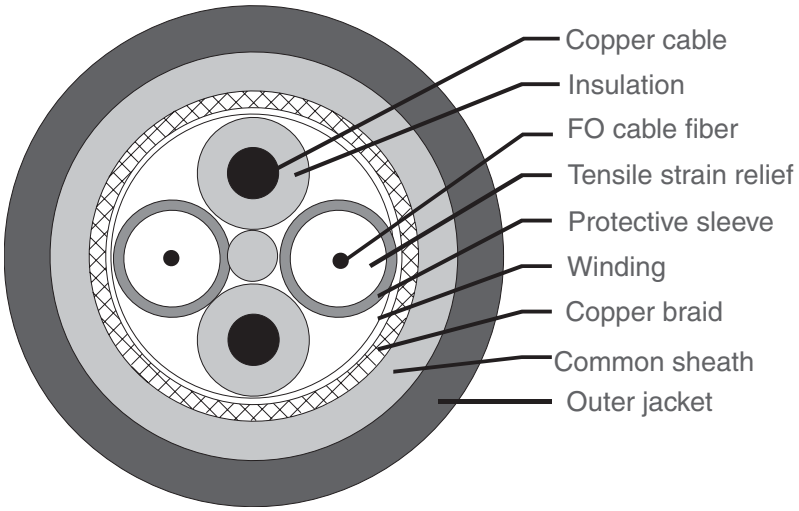


Figure 10-29 Design of the SIENOPYR Duplex FiberOptic Marine Cable

SIENOPYR Duplex FiberOptic Marine Cable 6XV1 830-0NH10

The SIENOPYR Duplex FiberOptic Marine Cable has 2 multimode graded-index fibers 62.5/125 µm. It also has 2 multiwire, rubber insulated copper cores with 1 mm^2 cross section. These allow, for example, power to be supplied to the connected devices.

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

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 fiberoptic marine cable has the following properties:

- Ozone proof complying with DIN VDE 0472 Part 805 test type B
- Silicone-free
- Behavior in fire complying with IEC 603323 cat. A
- Corrosivity of combustion gases complying with IEC 607542
- Smoke density complying with IEC 61031
- Halogen-free
- Is approved for ship building
  - Lloyds Register of Shipping
  - Germanischer Lloyd
  - Registro Staliano Navale
  - Bureau Veritas

The rubber insulated copper cores have the following properties:

- Rated voltage 300 V_{eff}
- Current carrying capacity: The specifications of DIN VDE 0891 apply. The maximum permitted current carried by the copper wires is 6 A at an ambient temperature of 70 °C.
- DC loop resistance: max. 36.2 ohms/km at 20 °C

Application

The SIENOPYR duplex fiberoptic marine cable is intended for fixed installation on ships and offshore facilities in all enclosed spaces and on open decks. The cable is not, however, intended for permanent installation in water.

It is suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

Technical specifications

Table 10-52 Technical specifications of the SIENOPYR duplex fiberoptic marine cable

Cable type	**SIENOPYR marine duplex fiber-optic cable**
Area of application	Fixed installation on ships and offshore facilities in all enclosed spaces and on free decks
Can be ordered	Sold in meters
Cabling (standard designation)	MI–VHH 2G 62.5/125 3.1B200 + 0.8F600 + 2x1CU 300 V
Fiber type	Multimode graded-index fiber 62.5/125 µm
Power loss at 850 nm Power loss at 1300 nm	<= 3.1 dB/km <= 0.8 dB/km
Modal bandwidth at 850 nm at 1300 nm	 200 MHz *km 600 MHz *km
Number of fibers	2
Cable design	Splittable outdoor cable
Core type	Solid core
Materials basic element	Polyolefin
Tensile strain relief	Aramid yarn
Outer jacket /color of cable	SHF1 mixture / black
Dimensions of basic element	(2.9 ± 0.2) mm ∅
Outer dimensions	(13.3 ± 0.5) mm
Cable weight	approx. 220 kg/km
Permitted tensile force	<= 500 N (brief) <= 250 N (permanent)

Cable type	**SIENOPYR marine duplex fiber-optic cable**
Bending radiuses	133 mm (once) 266 mm (multiple)
Installation temperature	-10 °C to +50 °C
Operating temperature	–40 °C to +80 °C 1) –40 °C to +70 °C 2)
Storage temperature	–40 °C to +80 °C
Behavior in fire	Complying with IEC 60332–3 Cat. A
Free of halogens	yes
UL approval	no
Shipbuilding approval	yes

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

10.5.3 Plastic FO cable POF and PCF

10.5.3.1 POF Standard Cable and POF Trailing Cable

Brief description of the POF Standard Cable and POF Trailing Cable

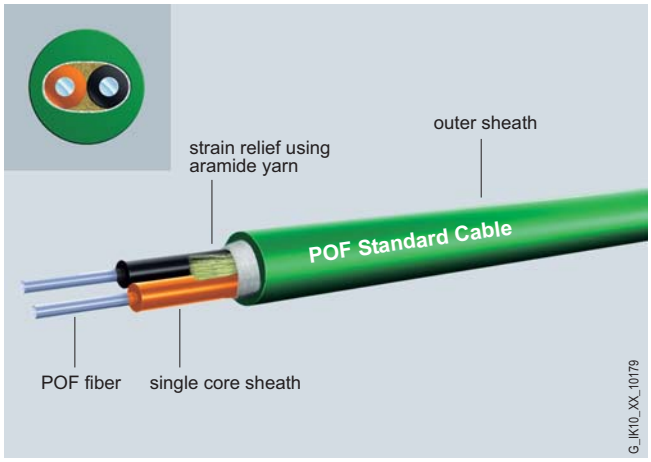


Figure 10-30 POF Standard Cable

The POF Standard Cable contains two step-index fibers of type 980/1000 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET POF Standard Cable GP 980/1000 Profinet 6XV1874–2A E157125 OFN-FT1 c(UL)us OFN (drum number) / (year of manufacture, e.g. 05) (meter marker)" approximately every 100 cm.

The POF Standard Cable is available in meters and is suitable for fitting connectors directly.

Application

SIMATIC NET POF fiber-optic cables are used to set up optical PROFINET and Industrial Ethernet networks indoors. Devices with an integrated optical interface (SC RJ connectors) include, for example SCALANCE X200-4P IRT, SCALANCE X201-3P IRT, SCALANCE X202-2P IRT, SCALANCE X101-1POF, ET 200S.

Rugged round cables with green outer jacket and Kevlar strengthening elements and two plastic fibers with a robust polyamide inner jacket for applications indoors and outdoors with cable lengths up to 50 m. The cables are suitable for connector assembly on site.

- POF Standard Cable GP (General Purpose);
  for indoor and outdoor applications
- POF Trailing Cable;
  for use in drag chains

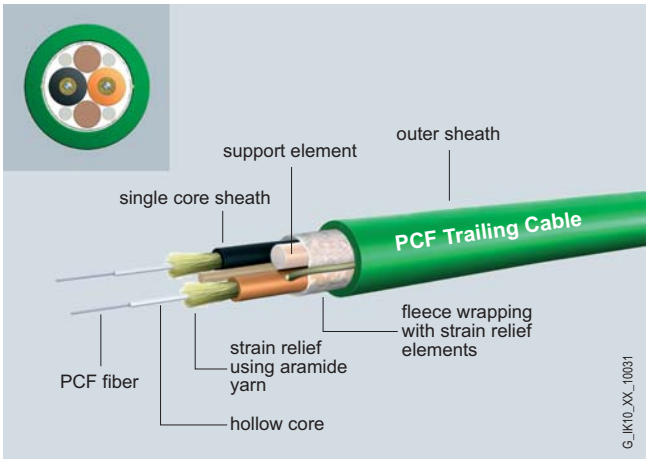
Table 10-53 Technical specifications of the POF Standard Cable GP and POF Trailing Cable

Cable type	POF Standard Cable GP 980/1000	POF Trailing Cable 980/1000
Area of application	For fixed installation indoors	For moving applications (e.g. drag chains)
Can be ordered	Sold in meters	Sold in meters
Cable type (standard code)	I-V4Y(ZN)Y 2P980/1000	I-V4Y(ZN)11Y 2P980/1000 FLEX
Fiber type	POF FO cable 980/1000 µm	POF FO cable 980/1000 µm
Attenuation		
at 650 nm	160 dB/km	180 dB/km
Modal bandwidth		
at 650 nm	10 MHz x 100 m	10 MHz x 100 m
Number of fibers	2	2
Materials		
Fiber core	Polymethyl methacrylate (PMMA)	Polymethyl methacrylate (PMMA)
Cladding	Fluorinated special polymer	Fluorinated special polymer
Inner jacket/color	PA, black orange	PA, black orange
Outer jacket/color	PVC, green	PUR, green
Tensile strain relief	Kevlar fibers	Kevlar fibers
Mechanical characteristics		
Diameter of fiber core	980 µm	980 µm
Cladding outer diameter	1000 µm	1000 µm
Diameter of inner jacket	2.2 mm Ø ±0.01 mm	2.2 mm Ø ±0.01 mm
Cable dimensions	7.8 mm ± 0.3 mm	8 mm
Cable weight	65 kg/km	55 kg/km
Maximum permitted tensile strain	100 N	100 N
Bending radius	150 mm	60 mm
Bending cycles	–	5.000.000

Cable type	POF Standard Cable GP 980/1000	POF Trailing Cable 980/1000
Transverse compressive strength (brief)	100 N/cm	200 N/cm
Resistant to		
mineral oil ASTM no. 2	Conditionally resistant	Highly resistant
Mineral grease/water	Conditionally resistant / -	Highly resistant/ -
UV radiation	yes	yes
Perm. ambient conditions		
Operating temperature	-30 °C to 70 °C	-20 °C to 70 °C
Transport/storage temperature	-30 °C to 70 °C	-40 °C to 80 °C
Installation	0 °C to 50 °C	+5 °C to 50 °C
In short-circuit to cable	–	–
Resistance to fire	Flame retardant to IEC 60332-1	–
UL/CSA approval	OFN-FT1	UL-758 AWM Style 5422
UV resistant	no	no
Halogen-free	no	no
Silicone-free	yes	yes

10.5.3.2 PCF Standard Cable

Brief description of the PCF Standard Cable 6XV1861–2A



PCF-LWL Trailing Cable

Figure 10-31 PCF Standard Cable

The PCF Standard Cable contains two step-index fibers of type 200/230 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET PCF Standard Cable GP 200/230 Profinet 6XV1861–2A (UL)E157125 OFN LL64163 OFN FT4 90C CSA (drum number) / (year of manufacture, e.g. 05) (meter marker)" approximately every 100 cm.

The PCF Standard Cable is available in meters and is suitable for fitting connectors directly.

Application

The PCF standard cable is a rugged round cable with a green PVC outer jacket and Kevlar strengthening elements and two glass fibers with a robust polyamide inner jacket. It is intended for fixed installation indoors with cable lengths up to 100 m. The recommended wavelength is 660 m.

Table 10-54 Technical specifications of the PCF Standard Cable

Cable type	
Area of application	FO cable for fixed installation indoors
Can be ordered	In meters or preassembled with 2 x SCRJ connectors
Cable type (standard code)	I-VY(ZN)YY 2K200/230
Fiber type	Step-index cable
Power loss at 660 nm	10 dB/km
Modal bandwidth at 650 nm	 17 MHz * km
Number of fibers	2
Max. cable length	100 m
Materials Fiber core Single jacket Tensile strain relief Outer jacket /color of cable	 Fused silica PVC Aramid PVC / green
Diameter of single element	2.2 mm
Outer diameter	7.2 mm
Cable weight	approx. 45 kg/km
Maximum permitted tensile strain brief permanent	 800 N 100 N
Bending radius, min. brief permanent	 70 mm 105 mm
Max. transverse compression brief permanent	 500 N/cm 300 N/cm
Installation and assembly temperature	-5 ºC to +50 ºC
Operating temperature	-25 ºC to +75 ºC
Transport/storage temperature	-25 ºC to +75 ºC
UL approval	Type OFN (NEC Article 770, UL 1651)
CSA approval	Type OFN, 90°C, FT1, FT4 (CSA-Standard C22.2 No232-M1988)
Shipbuilding approval	No

Cable type	
Chemical properties	Conditionally resistant to oil, petrol, acids and alkalis
UV resistance	UV resistance of outer jacket to DIN EN ISO 4892-2, procedure A; UV application 500 hours

10.5.3.3 PCF trailing cable

Brief description of the PCF Trailing Cable

Figure 10-32 PCF trailing cable

The PCF Trailing Cable contains two step-index fibers of type 200/230 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET PCF Trailing Cable 200/230 6XV1861–2C (drum number) / (year of manufacture, e.g. 05) (meter marker)" approximately every 100 cm.

The PCF Trailing Cable is available in meters and is suitable for fitting connectors directly.

Application

The PCF trailing cable is a rugged round cable with a green PUR outer jacket and Kevlar strengthening elements and two glass fibers with a robust PVC inner jacket. It is intended for moving applications such as drag chains indoors and outdoors with cable lengths up to 100 m. The recommended wavelength is 660 m.

Table 10-55 Technical specifications of the PCF Trailing Cable

Cable type	
Area of application	FO cable for flexible application in drag chains both indoors and outdoors
Can be ordered	In meters or preassembled with 2 x SCRJ connectors
Cable type (standard code)	AT-V(ZN)Y(ZN)11Y 2K200/230
Fiber type	Step-index cable
Power loss at 660 nm	10 dB/km
Modal bandwidth at 650 nm	 17 MHz * km
Number of fibers	2
Max. cable length	100 m

Cable type	
Materials	
Fiber core	Fused silica
Single jacket	PVC
Tensile strain relief	Aramid
Outer jacket /color of cable	Polyurethane (PUR) / green
Diameter of single element	2.2 mm
Outer diameter	8.8 mm
Cable weight	approx. 85 kg/km
Maximum permitted tensile strain	
brief	2000 N
permanent	800 N
Bending radius, min.	
brief	130 mm
permanent	175 mm
Max. transverse compression	
brief	500 N/cm
permanent	300 N/cm
Bending cycles	5.000.000
Installation and assembly temperature	-5 ºC to +50 ºC
Operating temperature	-25 ºC to +75 ºC
Transport/storage temperature	-30 ºC to +75 ºC
Resistance to fire	Flame retardant
Shipbuilding approval	No
Chemical properties	High resistance to oil, petrol, acids and alkalis
UV resistance	UV resistance of outer jacket to DIN 53 387, procedure 1; condition A

10.5.3.4 PCF trailing cable GP

Brief description of the PCF Trailing Cable GP

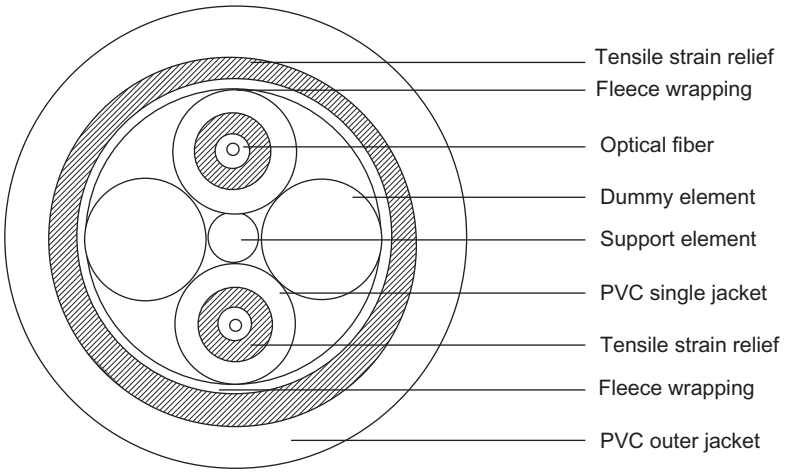


Figure 10-33 PCF trailing cable GP

The PCF Trailing Cable GP contains two step-index fibers of type 200/230 µm.

The outer jacket is labeled "SIEMENS SIMATIC NET PCF Trailing Cable GP 200/230 6XV1861–2D (UL)E157125 OFN LL64163 OFN FT4 90C CSA (drum number) / (year of manufacture, e.g. 05) (meter marker)" approximately every 100 cm.

The PCF Trailing Cable is available in meters and is suitable for fitting connectors directly.

The main difference between PCF Trailing Cable and PCF Trailing Cable GP is that the GP variant as UL approval and that its outer jacket consists of PVC instead of PUR.

Application

The PCF trailing cable GP is a rugged round cable with a green PVC outer jacket and Kevlar strengthening elements and two glass fibers with a robust PVC inner jacket. It is intended for moving applications such as drag chains indoors and outdoors with cable lengths up to 100 m. The recommended wavelength is 660 m.

Table 10-56 Technical specifications of the PCF Trailing Cable GP

Cable type	
Area of application	FO cable for flexible application in drag chains both indoors and outdoors
Can be ordered	In meters or preassembled with 2 x SCRJ connectors
Cable type (standard code)	AT-V(ZN)Y(ZN)Y 2K200/230
Fiber type	Step-index cable
Power loss at 660 nm	10 dB/km
Modal bandwidth at 650 nm	 17 MHz * km

Cable type	
Number of fibers	2
Max. cable length	100 m
Materials Fiber core Single jacket Tensile strain relief Outer jacket /color of cable	 Fused silica PVC Aramid PVC / green
Diameter of single element	2.2 mm
Outer diameter	8.8 mm
Cable weight	approx. 85 kg/km
Maximum permitted tensile strain brief permanent	 2000 N 800 N
Bending radius, min. brief permanent	 130 mm 175 mm
Max. transverse compression brief permanent	 500 N/cm 300 N/cm
Bending cycles	5.000.000
Installation and assembly temperature	-5 ºC to +50 ºC
Operating temperature	-25 ºC to +75 ºC
Transport/storage temperature	-30 ºC to +75 ºC
UL approval	Type OFN (NEC Article 770, UL 1651)
CSA approval	Type OFN, 90°C, FT1, FT4 (CSA-Standard C22.2 No232-M1988)
Shipbuilding approval	No
Chemical properties	Conditionally resistant to oil, petrol, acids and alkalis
UV resistance	UV resistance of outer jacket to DIN EN ISO 4892-2, procedure A; UV application 500 hours

10.5.4 Cable connectors for FO cables

10.5.4.1 Cable connectors for glass FO cables

BFOC cable connectors for glass FO cables

In Industrial Ethernet fiber-optic networks, BFOC cable connectors have been used for many years for glass FO cables.

Figure 10-34 BFOC connectors

In the meantime, the SC connectors have also become established. They are used mainly with the SCALANCE products with a gigabit Ethernet interface.

Figure 10-35 SC cable connectors

Fitting connectors on site

When connectors need to be fitted on site,

- SIEMENS provides this service,
- BFOC and SC connectors and special tools can be ordered.

In this case, speak to your contact for special cable solutions.

Note

Connectors should only be fitted to glass fiberoptic cables by trained personnel. When fitted correctly, they allow extremely low insertion loss and the value is highly reproducible after multiple plugging cycles.

Preassembled cables

To be able to use glass fiberoptic cables with untrained personnel, glass fiberoptic cables are also available with four BFOC or SC connectors already fitted.

For more details, refer to section Preassembled FO cables (Page 508).

⚠ CAUTION

Fiber-optic cable connectors are susceptible to contamination and mechanical damage to the face. Protect open connectors with the supplied dust caps.

Note

Only remove the dust cap immediately before establishing the connection.

10.5.4.2 Cable connectors for plastic and PCF FO cables

SC RJ connectors

POF and PCF FO cables are used to set up optical Ethernet/PROFINET networks indoors and outdoors and used SC RJ connectors.

Ethernet/PROFINET devices with an integrated optical interface with SC RJ connectors include, for example, SCALANCE X-200P IRT, ET200S.

POF/PCF-LWL termination kit

To fit connectors to POF/PCF FO cables on site, the termination kit is available.

Figure 10-36 POF/PCF-LWL termination kit

The kit is available in a termination case. It consists of stripping tool, buffer stripping tool, Kevlar scissors, fiber cutter and microscope.

Table 10-57 Order numbers for kits and accessories

MLFB	Name
6GK1900-0ML00-0AA0	SIMATIC NET termination kit SC RJ POF plug, termination case for on-site assembly of SC RJ connectors consisting of stripping tool, Kevlar scissors, polishing set
6GK1900-0NL00-0AA0	SIMATIC NET termination kit SC RJ PCF plug, termination case for on-site assembly of SC RJ PCF connectors consisting of stripping tool, Kevlar scissors, polishing set, fiber cutter
6GK1900-0MB00-0AC0	SIMATIC NET, IE SC RJ POF PLUG threaded coupling connector for on-site fitting to POF FO cables (set of 20 duplex connectors)
6GK1900-0NB00-0AC0	SIMATIC NET, IE SC RJ PCF plug threaded coupling connector for on-site fitting to PCF FO cables (set of 10 duplex connectors)

10.5.5 Preassembled FO cables

10.5.5.1 Preassembled FO standard cable GP

Preassembled FO standard cable GP

The FO cables are available with two fibers. They are preassembled with 4 BFOC or 4 SC connectors.

Table 10-58 The following preferred lengths of preassembled FO Standard Cable GP are available:

Length	Preassembled with 4 BFOC connectors	Preassembled with 4 SC connectors
0.5 m	6XV1 873-3AH05	6XV1 873-6AH05
1 m	6XV1 873-3AH10	6XV1 873-6AH10
2 m	6XV1 873-3AH20	6XV1 873-6AH20
3 m	6XV1 873-3AH30	6XV1 873-6AH30
5 m	6XV1 873-3AH50	6XV1 873-6AH50
10 m	6XV1 873-3AN10	6XV1 873-6AN10
15 m	6XV1 873-3AN15	6XV1 873-6AN15
20 m	6XV1 873-3AN20	6XV1 873-6AN20
30 m	6XV1 873-3AN30	6XV1 873-6AN30
40 m	6XV1 873-3AN40	6XV1 873-6AN40
50 m	6XV1 873-3AN50	6XV1 873-6AN50
80 m	6XV1 873-3AN80	6XV1 873-6AN80
100 m	6XV1 873-3AT10	6XV1 873-6AT10
150 m	6XV1 873-3AT15	6XV1 873-6AT15
200 m	6XV1 873-3AT20	6XV1 873-6AT20
300 m	6XV1 873-3AT30	6XV1 873-6AT30

Other special cables and special lengths available on request.

See also

FO Standard Cable GP 50/125 µm (Page 487)

10.5.5.2 Preassembled FO Ground Cable

Preassembled FO Ground Cable

The FO cables are available with two fibers. They are preassembled with 4 BFOC or 4 SC connectors.

Table 10-59 The following preferred lengths of preassembled FO Ground Cable are available:

Length	Preassembled with 4 BFOC connectors	Preassembled with 4 SC connectors
100 m	6XV1 873-3GT10	6XV1 873-6GT10
200 m	6XV1 873-3GT20	6XV1 873-6GT20
300 m	6XV1 873-3GT30	6XV1 873-6GT30

Due to the properties and the areas of application of the FO Ground Cable, shorter preassembled lengths are not defined.

Other special cables and special lengths available on request.

See also

FO Ground Cable 50/125 µm (Page 488)

10.5.5.3 Preassembled FO Trailing Cable

Preassembled FO Trailing Cable

The FO cables are available with two fibers. They are preassembled with 4 BFOC or 4 SC connectors.

Table 10-60 The following preferred lengths of preassembled FO Trailing Cable are available:

Length	Preassembled with 4 BFOC connectors	Preassembled with 4 SC connectors
3 m	6XV1 873-3CH30	6XV1 873-6CH30
5 m	6XV1 873-3CH50	6XV1 873-6CH50
10 m	6XV1 873-3CN10	6XV1 873-6CN10
20 m	6XV1 873-3CN20	6XV1 873-6CN20
50 m	6XV1 873-3CN50	6XV1 873-6CN50
10 m	6XV1 873-3CT10	6XV1 873-6CT10

Other special cables and special lengths available on request.

See also

FO Trailing Cable 50/125 µm Standard (variants with and without UL) (Page 489)

10.5.5.4 Preassembled FO Trailing Cable GP

Preassembled FO Trailing Cable GP

The FO cables are available with two fibers. They are preassembled with 4 BFOC or 4 SC connectors.

Table 10-61 The following preferred lengths of preassembled FO Trailing Cable are available:

Length	Preassembled with 4 BFOC connectors	Preassembled with 4 SC connectors
3 m	6XV1 873-3DH30	6XV1 873-6DH30
5 m	6XV1 873-3DH50	6XV1 873-6DH50
10 m	6XV1 873-3DN10	6XV1 873-6DN10
20 m	6XV1 873-3DN20	6XV1 873-6DN20
50 m	6XV1 873-3DN50	6XV1 873-6DN50
10 m	6XV1 873-3DT10	6XV1 873-6DT10

Other special cables and special lengths available on request.

See also

FO Trailing Cable 50/125 µm Standard (variants with and without UL) (Page 489)

10.6 Components for wireless networks

10.6.1 Antennas

10.6.1.1 Characteristics of omnidirectional antennas

Distribution of the RF field

With the omnidirectional antennas ANT795-6MR and ANT795-4MR, the RF field is concentrated in a plane perpendicular to the antenna. The field is uniformly distributed around the antenna and weakens with increasing distance from the antenna. Both antennas have a beamwidth of 30° and similar antenna gain. In contrast to the ANT795-4MR that is mounted directly on the housing, the ANT795-6MR can be installed detached from the device connected by the preassembled antenna cable.

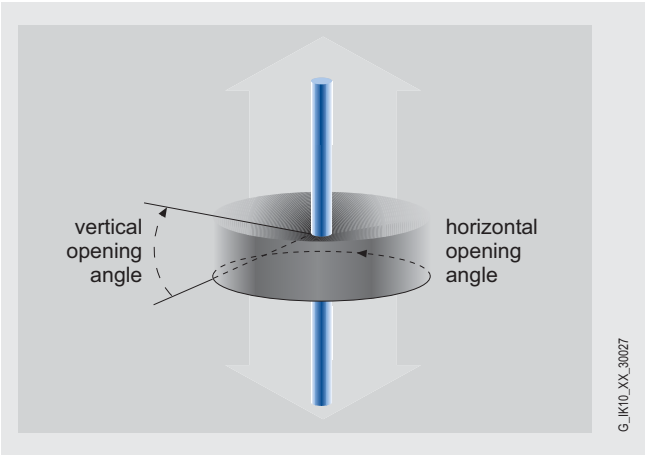


Figure 10-37 Radiation pattern of the omnidirectional antennas ANT 795-6/4 MR

Above and below the antenna there is no radiation. Moving away from the plane perpendicular to the antenna, once the beamwidth is reached, the antenna gain has dropped to half the value. The quality of the wireless connection then becomes noticeable poorer.

10.6.1.2 Characteristics of directional antennas

Distribution of the RF field

The directional antennas ANT792-8DR and ANT793-8DR concentrate the RF in the shape of a lobe (to simplify matters, this is shown as a funnel in the figure below). The emission is best perpendicular to the antenna. If the direction around the beamwidth is left, there is practically no wireless connection possible. This antenna is then known as directional. Antennas are supplied with a preassembled 5 m antenna cable, ANT792-8DR is also available without a cable.

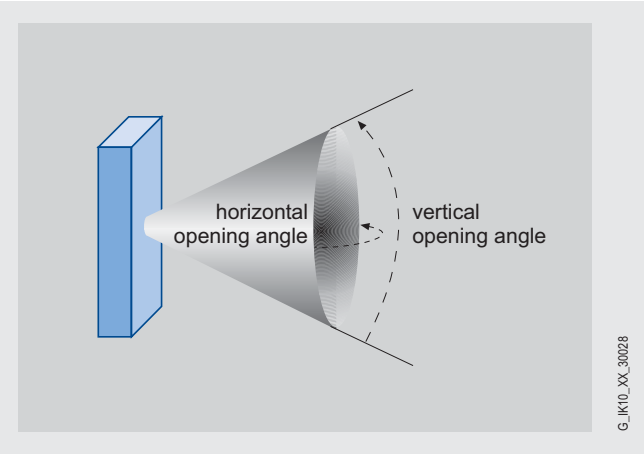


Figure 10-38 Radiation characteristics of the ANT 792/3-8DR directional antennas

The ANT792-8DR and ANT793-8DR antennas differ in the beamwidth of the RF field:

	Beamwidth
ANT792-8DR	approx. 30°
ANT793-8DR	approx. 20°

10.6.1.3 Technical specifications for antennas

Overview

	ANT795-4MR	**ANT795-4MS**	**ANT792-6MN**
Frequency range	2.4 … 5 GHz	2.4 … 5 GHz	2.4 GHz
Characteristics	omnidirectional		
Radiation angle	360° horizontal		
Antenna gain	4 dBi / 4 dBi	4 dBi / 4 dBi	6 dBi
SWR	max. 2.0	max. 2.0	max. 1.8
Connectors	R-SMA male	R-SMA male	N female
Perm. ambient conditions			
Operating temperature	-20 °C to +60 °C	-20 °C to +60 °C	-40 °C to +70 °C
Transport/storage temperature	-20 °C to +60 °C	-20 °C to +60 °C	-40 °C to +70 °C
Relative humidity	100 %		
Degree of protection	IP65		
Dimensions (W x H x D) in mm	35 x 148 x 13	35 x 160 35 x 13	22 x 250 x 22
Installation	Directly on the device	Directly on the device	Wall or mast
Weight	50 g	50 g	300 g
Range with line-of-sight and no disruption	100 m	100 m	200 m

	ANT793-6MN	ANT795-6MN	ANT795-6DN
Frequency range	5 GHz	2.4 … 5 GHz	2.4 … 5 GHz
Characteristics	omnidirectional	omnidirectional	directional
Radiation angle	360° horizontal	360° horizontal	55° horizontal, 55° vertical
Antenna gain	5 dBi	6 dBi / 8 dBi	9 dBi / 9 dBi
SWR	max. 1.5	max. 1.8	max. 1.5
Connectors	N female	N female	N female
Perm. ambient conditions			
Operating temperature	-40 °C to +70 °C	-40 °C to +70 °C	-40 °C to +70 °C
Transport/storage temperature	-40 °C to +70 °C	-40 °C to +70 °C	-40 °C to +70 °C
Relative humidity	100 %		
Degree of protection	IP65		
Dimensions (W x H x D) in mm	16 x 160 x 16	86 x 43 x 86	100 x 95 x 32
Installation	Wall or mast	Ceiling	Wall or mast
Weight	300 g	300 g	110 g
Range with line-of-sight and no disruption	200 m	200 m	200 m

	ANT792-8DN	ANT793-8DN	
Frequency range	2.4 GHz	5 GHz	
Characteristics	directional	directional	
Radiation angle	35° horizontal, 30° vertical	18° horizontal, 18° vertical	
Antenna gain	14 dBi	19 dBi	
SWR	max. 1.5	max. 1.5	
Connectors	N female	N female	
Perm. ambient conditions			
Operating temperature	-40 °C to +70 °C	-40 °C to +70 °C	
Transport/storage temperature	-40 °C to +70 °C	-40 °C to +70 °C	
Relative humidity	100 %		
Degree of protection	IP65		
Dimensions (W x H x D) in mm	200 x 200 x 43	190 x 190 x 31	
Installation	Wall or mast	Wall or mast	
Weight	500 g	700 g	
Range with line-of-sight and no disruption	1000 m	1000 m	

Note

Actual range

The actual range may be significantly shorter than the value listed in the table and depends on the spatial conditions, the wireless standard used, the data rate and the antenna being used at the other end.

Note

Note on national wireless approvals

You will find the current national approvals on the Internet at www.siemens.com/simatic-net/ik-info

10.6.1.4 Dimension drawings for the antennas

ANT795-4MR/MS

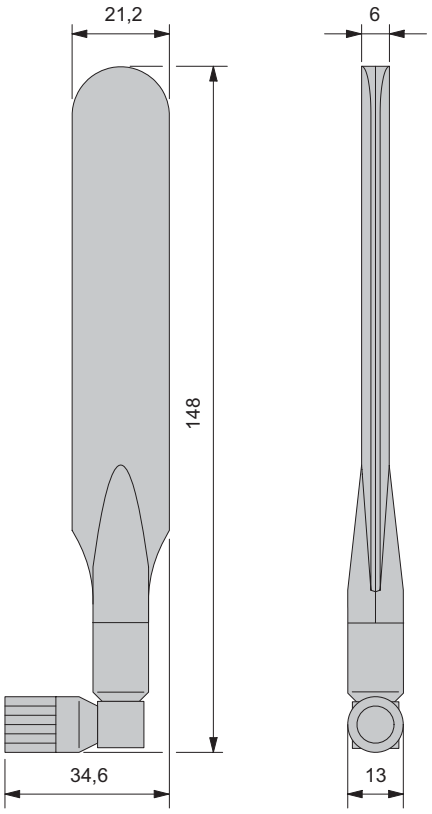


Figure 10-39 Dimension drawing ANT795-4MR/MS

ANT792-6MN

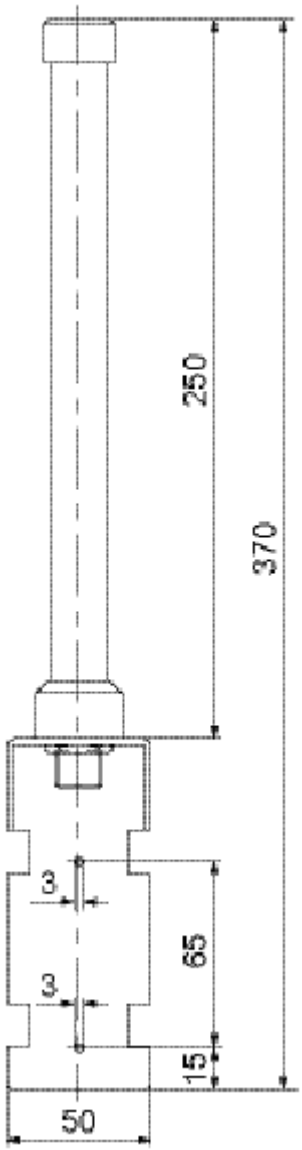


Figure 10-40 Dimension drawing ANT792-6MN

ANT793-6MN

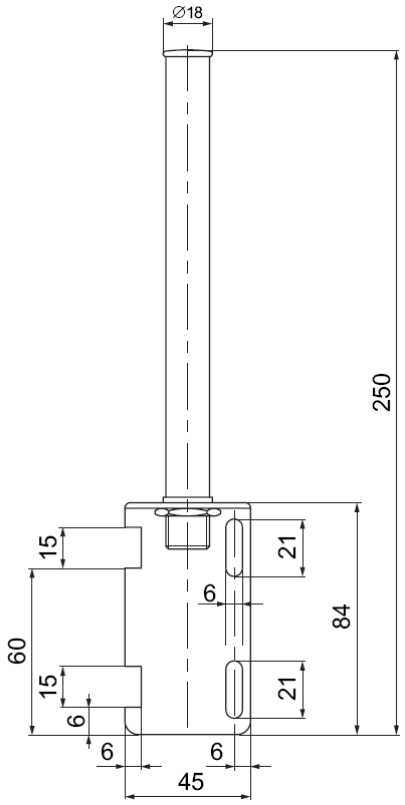


Figure 10-41 Dimension drawing ANT793-6MN

ANT795-6MN

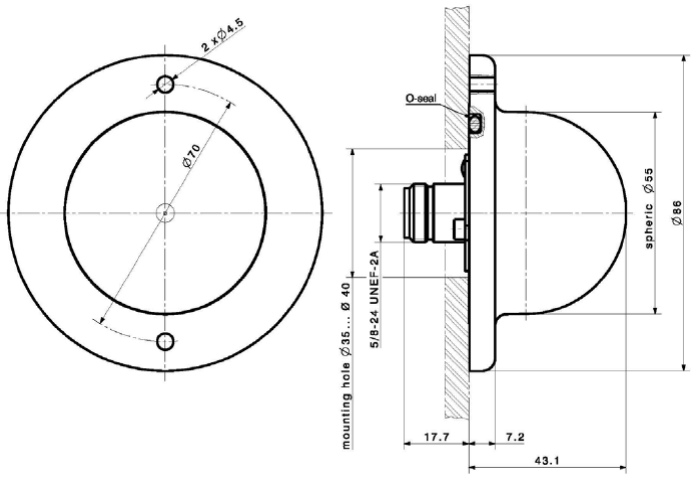


Figure 10-42 Dimension drawing ANT795-6MN

ANT795-6DN

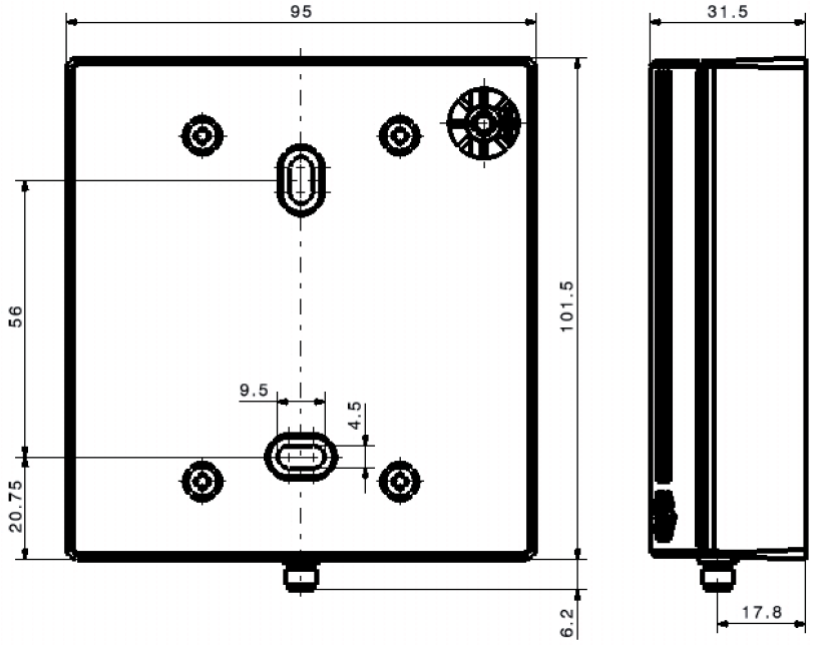


Figure 10-43 Dimension drawing ANT795-6DN

ANT792-8DN

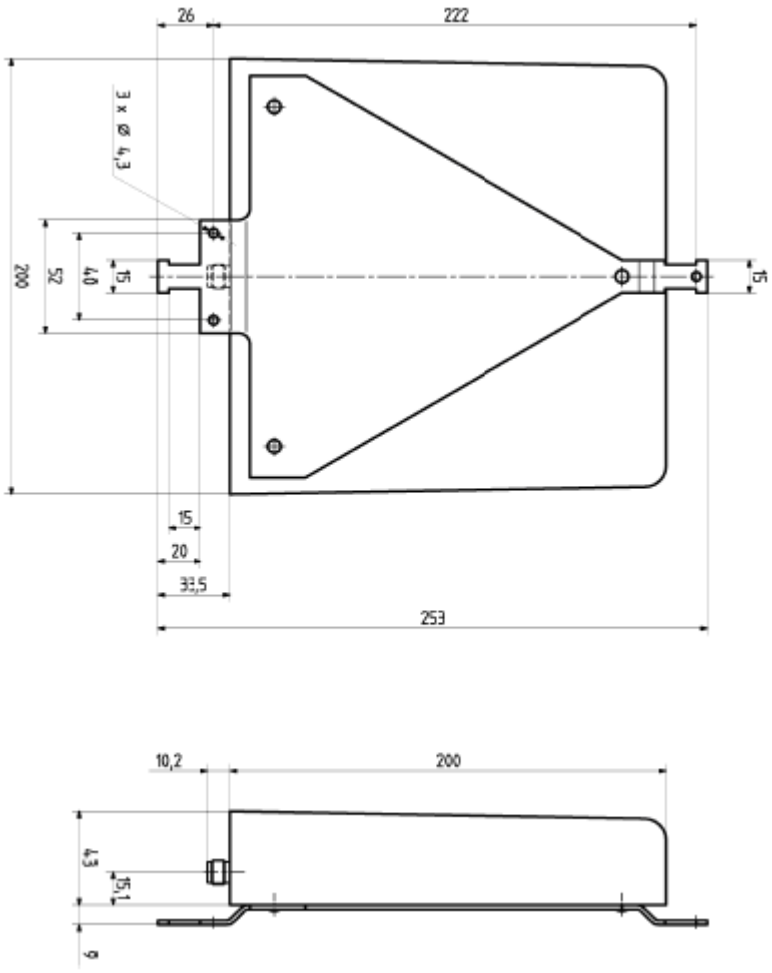


Figure 10-44 Dimension drawing ANT792-8DN

ANT793-8DN

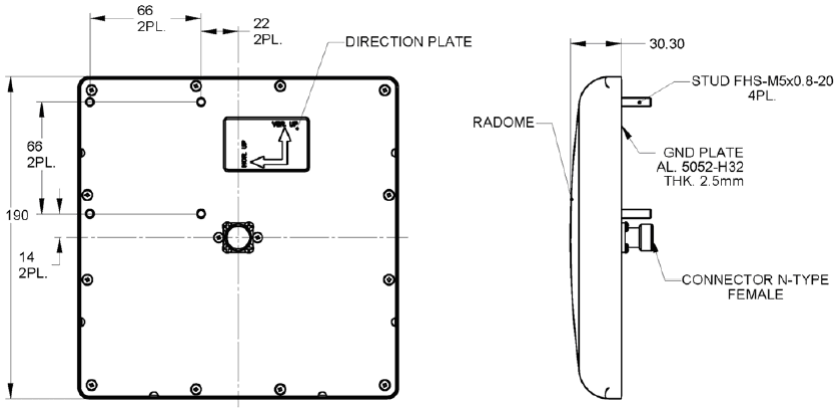


Figure 10-45 Dimension drawing ANT793-8DN

10.6.2 RCoax leaky feeder cable

10.6.2.1 Technical specifications

Overview

The information relates to the two RCoax cables with MLFB numbers 6XV1875-2A for 2.4 GHz and 6XV1875-2D for 5 GHz.

Construction 2.4 GHz / 5 GHz	
Inner conductor	Copper-clad aluminum, diameter: 4.8 mm
Dielectric	Polyethylene foam, diameter: 12.4 mm
Outer conductor	Overlapping copper foil with the slot groups bonded to cable jacket
Cable jacket	Polyethylene, pastel turquoise diameter: 15.5 mm Jacket thickness: 1.3 mm

Mechanical characteristics 2.4 GHz / 5 GHz	
Minimum bending radius (once)	20 cm
Tensile strength	110 daN (1daN = 10 N)
Weight	0.232 kg/m
Recommended mounting distance	0.6 m

Electrical characteristics 2.4 GHz / 5 GHz	
Impedance	50 +/- 2 Ω
Ratio of propagation speed	88%
Capacitance	76 pF/m
DC resistance at 20 °C	Inner conductor: 1.48 Ω/km Outer conductor: 2.9 Ω/km
Prohibited frequencies	535, 1070, 1605 +/- 65 MHz 2140 +/- 40 MHz

Nominal longitudinal attenuation and coupling losses at 20 °C and 2.4 GHz

f [MHz]	α [dB/100m]	C50 [dB]
2400	17.0	59
2500	17.7	59

Nominal longitudinal attenuation at 20 °C and 5 GHz

f [MHz]	α [dB/100m] Cable installation 10 cm over concrete	α [dB/100m] Cable installation 15 mm over aluminum rail
5200	24	35
5800	28	39

Nominal coupling losses at 20 °C and 5 GHz

f [MHz]	C50 [dB]	C95 [dB]
5200	43	47
5800	42	46

Notice: C50 and C95 apply here for an antenna distance of 10 cm from the cable

Permitted ambient conditions

Operating temperature	- 40°C through + 85°C
Operating temperature according to UL listing	- 20°C through + 60°C
Storage temperature	- 70°C through + 85°C
Installation temperature	- 25°C through + 60°C

Resistance to fire

Low corrosive gas emission	IEC 60754-2
Flame retardant	IEC 60332-1 and IEC 60332-3 Cat. C
Low smoke emission	IEC 61034

10.6.3 Various WLAN accessories

Antenna extension cable

Table 10-62 Technical specifications

	Antenna extension cable FRNC
Attenuation	0.5 dB/m at 2.4 GHz, 0.8 dB/m at 5 GHz
Connectors	R-SMA
Antenna cable length	15 m/5 m
Perm. ambient conditions	
Operating temperature	-25 °C to +80 °C
Transport/storage temperature	-40 °C to +80 °C
Relative humidity	100 %
Resistance to fire	IEC 60332-1
Halogen-free	yes
Silicone-free	yes
Resistance to mineral oils and fats	Conditionally resistant
Degree of protection	IP65
Weight	500 g
Approvals	IEC 60754-1/-2, IEC 601034, IEC 60332-1, UL

Table 10-63 Ordering data

	MLFB	
SIMATIC NET, ANTENNA EXTENSION CABLE FRNC FOR IWLAN ANTENNAS ANT 790	6XV1875-3FH50	LENGTH: 5 M
	6XV1875-3FN15	LENGTH: 15 M

Terminator TI795-1R

Table 10-64 Technical specifications

	Termination Impedance TI795-1R
Frequency range	2.4 GHz, 5 GHz
Impedance	50 ohms
Connectors	R-SMA male
Perm. ambient conditions	
Operating temperature	-20 °C to +60 °C
Transport/storage temperature	-20 °C to +60 °C
Relative humidity	100 %
Degree of protection	IP65
Dimensions (L X D) in mm	15 x 10
Weight	5 g

Table 10-65 Ordering data

MLFB	
6GK5795-1TR10-0AA6	SIMATIC NET, IWLAN TERMINATION IMPEDANCE TI 795-1R, TERMINATOR 50 OHMS

Lightning protector LP 798-1N

Table 10-66 Technical specifications

	Lightning protector LP798-1N
Frequency range	0 to 5.8 GHz
Impedance	50 ohms
Connectors	N/N female/female
Perm. ambient conditions	
Operating temperature	-40 °C to +100 °C
Transport/storage temperature	-40 °C to +100 °C
Relative humidity	100 %
Degree of protection	IP65
Dimensions (L X D) in mm	36.8 x 17
Weight	50 g

Table 10-67 Ordering data

MLFB	
6GK5798-2LP00-2AA6	SIMATIC NET, IWLAN LIGHTNING PROTECTOR LP 798-1N

Power supply PS791-1PRO

See alsoIP65 power supply (Page 526)

10.6.4 SINEMA E

Software in continuous development

Note

Note that SINEMA E is a software product that is constantly being developed.
If you want to keep up to date with the current range of functions of the application, check the Internet regularly:

http://www.siemens.de/sinema

Software requirements

To use its full functionality problem-free, SINEMA E requires the following software:

- Windows XP Service Pack 2 The available language versions of SINEMA E are German and English.

Note

The release for Windows Vista is planned for Autumn 2007.

Hardware requirements

The computer on which you install SINEMA E should meet the following minimum requirements:

- Processor speed 1 GHz
- 512 MB RAM
- Hard disk with 20 MB of free space to install SINEMA E. You also require enough space for one or more projects. For more detailed information, refer to the current readme file supplied with the software.
- Monitor resolution at least 1024 x 768 pixels

Supported WLAN components

- WLAN access points
  - SCALANCE W 788-1PRO
  - SCALANCE W 788-2PRO
  - SCALANCE W788-1RR
  - SCALANCE W788-2RR
  - Hipath AP2610,2620,2630,2640 *1)
  - Standard Wi-Fi 802.11 a/b/g/h access points *1)
- WLAN clients
  - SCALANCE W744-1PRO
  - SCALANCE W746-1PRO
  - SCALANCE W747-RR
  - IWLAN/PB Link PN IO
  - Standard Wi-Fi 802.11 a/b/g/h clients *1)
- LAN/WLAN adapters for up/download functions
  - SIMATIC NET CP 1613-A2
  - SIMATIC NET CP 1612
  - Standard LAN adapters *2)
  - SIMATIC NET CP 7515
  - Standard WLAN adapters *3)

- WLAN adapters for WLAN measurement (site survey) *5)
  - Standard mode:
    Standard WLAN adapters *3)
  - Advanced mode:
    SIEMENS CP 7515
    PCMCIA WLAN adapters *4)

Notes:

1) no configuration possible online and offline (Note: Hipath is configured by the Hipath WLAN controller)

2) Integrated LAN interface of notebooks and PGs such as SIEMENS Power PG M

3) WLAN PCMCIA adapters such as SIEMENS CP 7515 or integrated WLAN interface of notebooks and SIEMENS PGs

4) Driver supports cards with the following Atheros chipsets (AR5001A, AR5001X, AR5002G, AR5002X, AR5004G, AR5004X, AR5005GS) such as NetGear WAG511 V2, Cisco Aironet CB21AG 802.11 a/b/g

5) SINEMA E standard license required

Order numbers and software versions

MLFB	Version
6GK1781-0AA00-6AA0	SINEMA E 2006 LEAN ENGINEERING SOFTWARE FOR PLANNING + CONFIGURATION + SIMULATION OF WLAN SOFTWARE + MANUAL ON CD SINGLE LICENSE ON FD, CLASS A 2 LANGUAGES (G,E);WIN XP PRO
6GK1782-0AA00-6AA0	SINEMA E STANDARD ENGINEERING SOFTWARE FOR PLANNING + AUTOPLACEMENT + CONFIGURATION + SIMULATION + OPTIMIZATION * SITE SURVEY OF WLAN SOFTWARE + MANUAL ON CD SINGLE LICENSE ON FD, CLASS A 2 LANGUAGES (G,E);WIN XP PRO
6GK1782-4AA00-6AC0	SINEMA E POWERPACK UPGRADE OF SINEMA E LEAN TO SINEMA E STANDARD LICENSE SINGLE LICENSE ON FD, CLASS A SOFTWARE + MANUAL ON CD 2 LANGUAGES (G,E);WIN XP PRO

10.7 Accessories

10.7.1 C-PLUG configuration memory

Technical specifications of the C-PLUG

Table 10-68 Electrical data

	C-PLUG
Power consumption	0.015 W
Power supply	Supplied by end device
Memory capacity	32 Mbytes
MTBF	> 600 years

Table 10-69 Environmental conditions

	C-PLUG
Operating temperature	-20 °C - +70 °C
Storage/transport temperature	-40 °C - +80 °C
Relative humidity in operation	< 95% (no condensation)
Operating altitude	2000 m at max. 56 °C ambient temperature 3,000 m at max. 50 °C ambient temperature
Degree of protection, tested to	IP20

Table 10-70 Mechanical data

	C-PLUG
Dimensions (W x H x D) mm	24.3 x 17 x 8.1 mm
Weight	approx. 5 g

Table 10-71 Order number

C-PLUG	6GK1900-0AB00

Note

The C-PLUG must only be removed or inserted when the power supply to the device is turned off.

10.7.2 IP65 power supply

Overview

Table 10-72 Technical specifications

	Power supply PS791-1PRO
Interfaces	AC Power 3+PE Cable Connector for 100-240 V AC power supply
	M12 Plug pro or Power Cord M12 for 24 V DC output power
	On/off switch
Input voltage	90 V to 265 V AC at 47 Hz to 63 Hz
Output voltage	24 V DC, +-7%, 0.42 A
Output power	10 W
Network disruption	Bridging min. 20 ms at 230 V AC
Perm. ambient conditions	
Operating temperature	-20 °C to 60 °C
Transport/storage temperature	-40 °C to +85 °C
Relative humidity	100%
Approvals	EMC: EN 55022 Class B, EN 61000-4;
	UL 1950, EN 60950;
Device failure	MTBF 600,000 h at full load, 25 °C
Switching frequency	typ. 100 kHz
Degree of protection	IP65
Dimensions (W x H x D) in mm	125 x 60 x 130
Installation	Wall/standard rail mounting (S7-300) direct on SCALANCE devices
Weight	700 g

Table 10-73 Ordering data

MLFB	
6GK5791-1PS00-0AA6	SIMATIC NET, POWER SUPPLY PS 791 1-1PRO (AC/DC POWER UNIT)

See also

IP65 power supply (Page 224)

Part C: Instructions for fitting connectors, attachments and devices

11

11.1 Note on the installation instructions

Note the following:

This networking manual provides information on installing some of the most common components.

You will find more detailed information on installing and setting up in the documentation of the relevant devices or components.

11.2 Industrial Ethernet FastConnect Stripping Tool

General

This section describes the use of the IE FC Stripping Tool. This is the ideal tool for preparing the IE FC cables and simplifies fitting the IE FC connectors to the IE FC cables. Please refer also to the instructions in the user guide supplied with the IE FC Stripping Tool.

The cables must be prepared before the connector can be fitted. The IE FC connectors are constructed so that the cables can always be stripped in the same way.

Personnel qualification requirements

Qualified personnel as referred to in these 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.

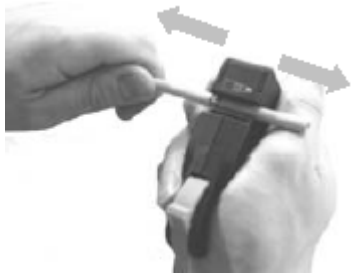
Industrial Ethernet FastConnect Stripping Tool

⚠ WARNING
The tool described in this manual is intended only for stripping SIMATIC NET Industrial Ethernet FastConnect cables. If used elsewhere, accidents may occur or tools and cable may be irreparably damaged. The tool and must not be used on live cables under any circumstances.

1. Fit the required knife cassette in the stripping tool. When using stripping tool supplied with the yellow knife cassette, the cutting depth must be adjusted with the middle socket head screw after converting.

1. Take the stripping tool in your right hand.
2. Measure the cable length by placing the cable on the template. Use the index finger of your left hand as the limit stop.

1. Fit the measured end of the cable in the stripping tool. Limit stop for the cable length is the index finger of your left hand.



1. Clamp the stripping tool as far as it will go.

1. To strip the insulation, turn the tool in the direction of the arrow
   - approx. 4 times for PVC insulation
   - approx, 8 times for PUR insulation.

1. Keeping the it closed, pull the stripping tool with jacket and remnants of the shield off the end of the cable.

1. After releasing the tool, remove the remnants of the cable from the tool.	1. If the white filler is not removed with the insulation, remove it with your hand.	1. The protective foil is easier to remove if you score it between the wires with a screwdriver.
1. Pull the protective foil off the wires.	1. Follow the instructions supplied with your connector or outlet.	1. Replace the knife cassette after approx: • 1500 operations with cables with PVC outer jackets • 150 operations with cables with PUR outer jackets 1. Order numbers for knife cassettes: • Green: 6GK1901-1GB01 • Yellow: 6GK1901-1GB00

Note

Using the IE FC Stripping Tool

The insulation piercing contacts of the FC RJ-45 plug can be released and recontacted up to 10 times.

Cable ends that have had a connector fitted, must not be used twice but must be cut off before fitting a new connector.

To assemble a cable with crossed over wires, connect the color-coded wires at one end of the cable in the connector as shown below:

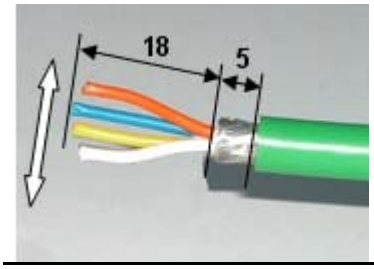
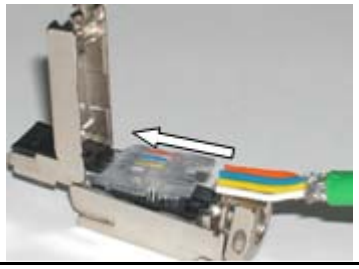
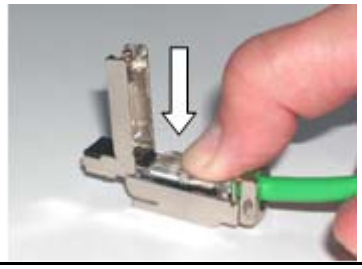
- connect white with yellow

- connect blue with orange.

11.3 Fitting the IE FC RJ-45 Plug

Fitting the IE FC RJ-45 Plug

Fit the IE FC RJ-45 Plug as explained in the instructions below.

In the stripping tool, use the green knife cassette 6GK1901-1GB01 (5.1 mm knife distance)! When using stripping tool supplied with the yellow knife cassette, the cutting depth must be adjusted with the middle socket head screw after replacing the knife cassette.	Take the stripping tool in your right hand. Measure the cable length by placing the cable on the template. Use the index finger of your left hand as the limit stop.	Place the cable in the stripping tool. The index finger of your left hand is the limit stop. Clamp the stripping tool as far as it will go.
Rotate the stripping tool to strip the cable - with PVC insulation approx. 4 times, - for PUR insulation approx. 8 times in the direction of the arrow.	Keeping the it closed, pull the stripping tool with jacket and remnants of the shield off the end of the cable.	If the white filler was not pulled off when you stripped the cable, remove it and the transparent protective foil manually. Cut off the dummy cores.
		

Spread out the cores according to their colors on the contact elements of the FC RJ-45 plug.	Insert the cores as far as they will go into the contact elements of the FC RJ-45 plug.	Press down the contact elements as far as the limit stop to contact the cores.
Close the cover and turn the locking mechanism with your hand as far as possible in the direction of the arrow.	Insert a 2.5 mm screwdriver into the hole in the locking mechanism and continue turning it as far as the limit stop.	The connector is correctly locked when the opening of the locking mechanism is at the side and the side edges are flush with the connector.

Note

The figures show how to fit an IE FC RJ-45 Plug 180. To fit the IE FC RJ-45 Plug 145 or IE FC RJ-45 Plug 90, the procedure is analogous!

Notes:		
Replace the knife cassette if the cut is not clean or after stripping approximately • 1500 operations with cables with PVC outer jackets • 150 operations with cables with PUR outer jackets	The insulation piercing contacts of the FC RJ-45 plug can be released and recontacted up to 10 times. Cable ends that have had a connector fitted, must not be used twice but must be cut off before fitting a new connector.	To assemble a cable with crossed over wires, connect the color-coded wires at one end of the cable in the connector as shown below: Connect white with yellow Connect blue with orange.

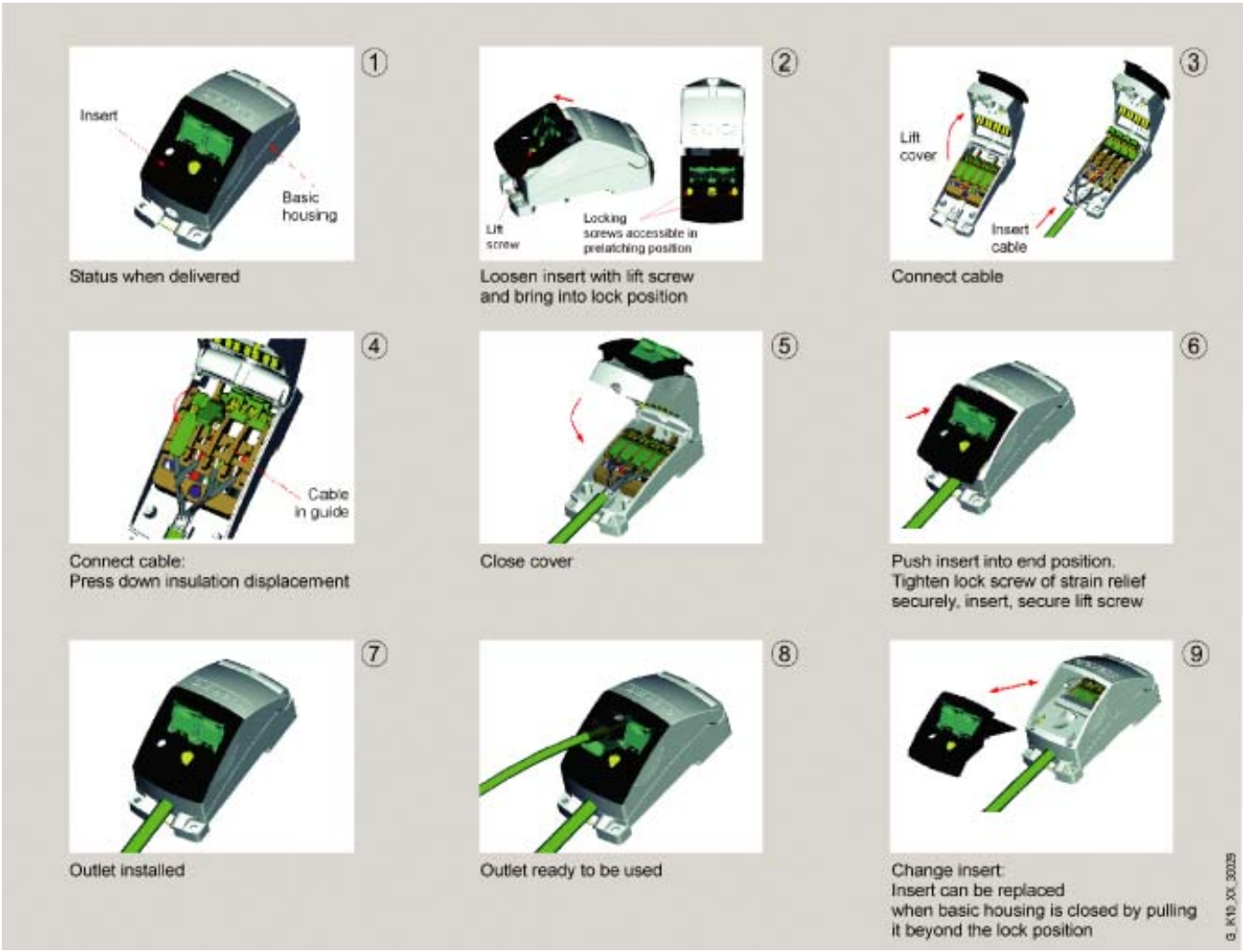
See also

IE FC RJ-45 Plug (Page 463)

11.4 Fitting the IE FC Modular Outlet RJ-45

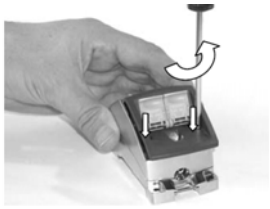
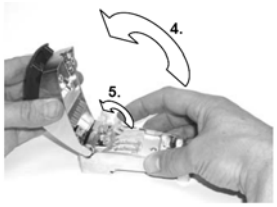
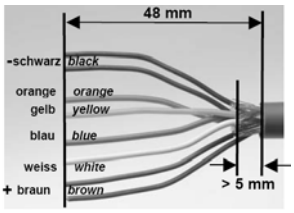
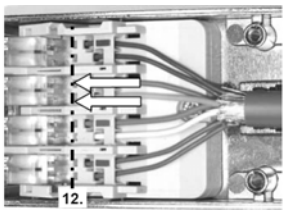
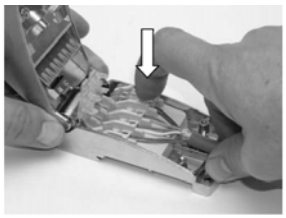
11.4.1 Connecting the RJ-45 Modular Outlet

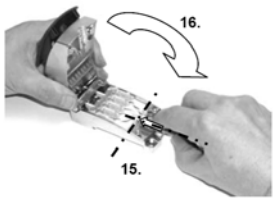
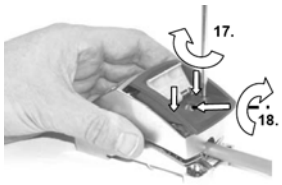
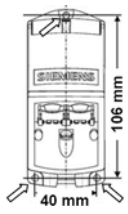
Graphic showing connection of the IE FC RJ-45 Modular Outlet



11.4.2 Connecting the IE Hybrid Cable 2x2 + 4x0.34

Instructions:

		
Remove the locking screw of the insert. (1.) Pull the insert forward as far as the limit stop. (2.)	Now release the two cover screws that are now accessible	Lift up the upper part of the IE FC RJ-45 Modular Outlet. (4.) Lift up the 4 terminals of the terminal block. (5.)
		
Strip the approx. 55 mm of the jacket of the IE Hybrid Cable 2x2 + 4x0.34. Shorten the shield of the data wires by approx. 5 to maximum 20 mm. Cut off the dummy cores. Spread the wires according to the color markings in the figure above. Cut all the wires in a straight line to leave 48 mm to the cable jacket.	Insert the wires pair by pair into the wire channels of the insulation piercing terminals according to the color codes in the picture on the left. **The color codes on the terminal block of the modular outlet have no meaning for the hybrid cable!** The ends of the wires must be visible in the last viewing window of the terminal block and must meet the back panel of the terminal block!	Secure the wires in position by pressing down the terminals as far as the limit stop. Repeat these steps until all four pairs or wires are connected.

		
Center the cable in the shield clamp so that the power wires are at the bottom in the shield clamp and the braided shield makes contact with the pressure surface in the upper part of the outlet. (15.) Fold down the upper part. (16.) Make sure that the power wires do not slip and are not jammed by the lateral metal bars.	Tighten the two cover screws. Tighten the insert screw until the insert is flush with the casing of the outlet.	Fit the outlet on a DIN rail or secure it to a smooth surface using the three holes in the casing.

Note

The insulation piercing contacts of the IE FC RJ-45 Modular Outlet can be released and recontacted up to 10 times.

Cable ends that have had a connector fitted, must not be used twice but must be cut off before fitting a new connector.

Note

The following inserts are available without basic housing

Insert 2FE order no. 6GK1901-1BK00-0AA1

Insert 1GE order no. 6GK1901-1BK00-0AA2

Note that the connection between IE FC RJ-45 Modular Outlets with these inserts requires 8-wire FastConnect cables (Cat6). The IE Hybrid Cable 2x2 + 4x0.34 6XV1870--2J is not suitable for operation of the 2FE and 1GE inserts!

Note

Use the power insert only under the following conditions:

Extra-low voltages SELV, PELV to IEC 60364-4-41

In USA/CAN with power supplies according to NEC class 2

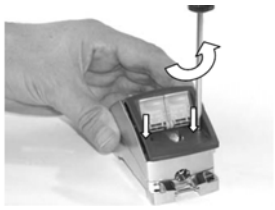
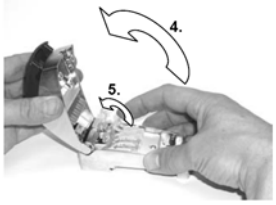
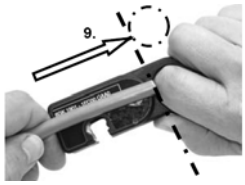
In USA/CAN, the cabling must meet the requirements of the NEC/CEC

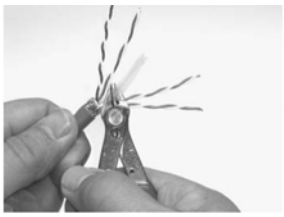
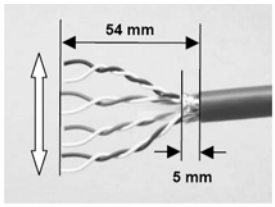
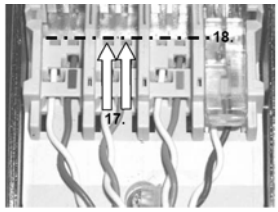
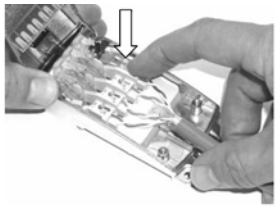
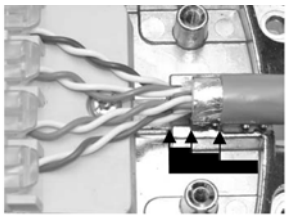
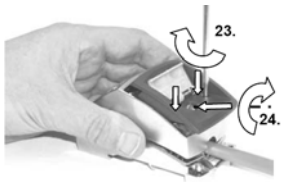
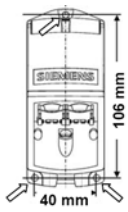
Current load maximum 0.5 A.

⚠WARNING
Keep to the rules in the SCALANCE W manual for fitting an IP67 hybrid cable connector to a SCALANCE W device!

11.4.3 Connecting the IE FC TP standard cable 4 x 2 GP / IE FC TP flexible cable 4 x 2 GP

Instructions

		
Remove the locking screw of the insert. (1.) Pull the insert forward as far as the limit stop. (2.)	Now release the two cover screws that are now accessible.	Lift up the upper part of the IE FC RJ-45 Modular Outlet. (4.) Lift up the 4 terminals of the terminal block. (5.)
		
Use the green knife cassette 6GK1901-1GB01 (5.1 mm knife clearance) in the stripping tool. Adjust the cutting depth of the knife cassette if necessary with the socket-head screws at the head of the tool.	Take the stripping tool in your right hand. Measure the cable length against the stripping tool. Use your left index finger as the limit stop. (9.)	Place the cable in the stripping tool. Your left index finger is the limit stop. Tighten the stripping tool until it locks into place (audible click).

		
Rotate the stripping tool to strip the cable - with PVC insulation approx. 4 times, - for PUR insulation approx. 8 times in the direction of the arrow.	Remove the cable jacket, shield and the white filler with your hand.	Cut off the central support element.
		
Spread out the wires according to the color markings on the terminal block of the Modular Outlet. Do not undo the twisting of the wire more than necessary to make the connection. Shorten the two middle pairs so that all wires end in a line.	Guide the wires according to the color markings, pair by pair into the wire channels of the insulation piercing terminals as far as the limit stop on the back panel. (17.) The ends of the wires must be visible in the last viewing window of the terminal block! (18.)	Secure the wires in position by pressing down the terminals as far as the limit stop. Repeat these steps until all four pairs or wires are connected.
		
Align the cable so that the braided shield is in the center of the middle section of the shield clamp. Fold down the upper part.	Tighten the two cover screws. (23.) Tighten the insert screw until the insert is flush with the casing of the outlet. (24.)	Fit the outlet on a DIN rail or secure it to a smooth surface using the three holes in the casing.

Note

The insulation piercing contacts of the IE FC RJ-45 Modular Outlet can be released and recontacted up to 10 times.

Cable ends that have had a connector fitted, must not be used twice but must be cut off before fitting a new connector.

Note

Use the power insert only under the following conditions:

Extra-low voltages SELV, PELV to IEC 60364-4-41

In USA/CAN with power supplies according to NEC class 2

In USA/CAN, the cabling must meet the requirements of the NEC/CEC

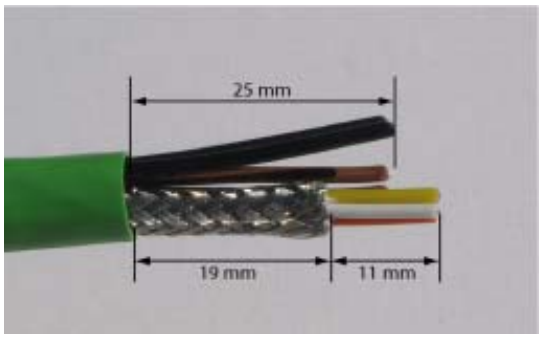
Current load maximum 0.5 A.

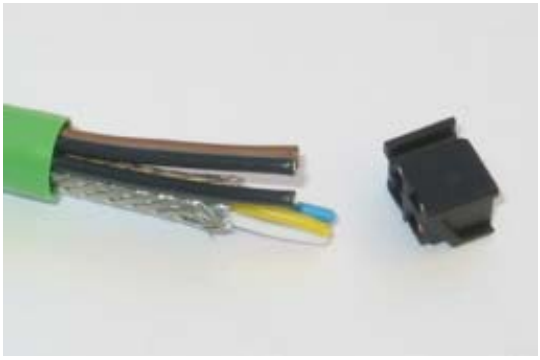
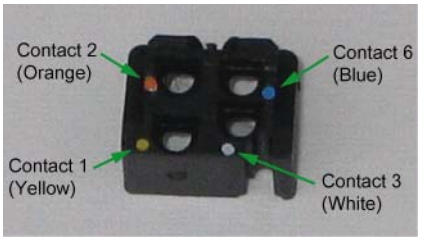
⚠WARNING

Keep to the rules in the SCALANCE W manual for fitting an IP67 hybrid cable connector to a SCALANCE W device!

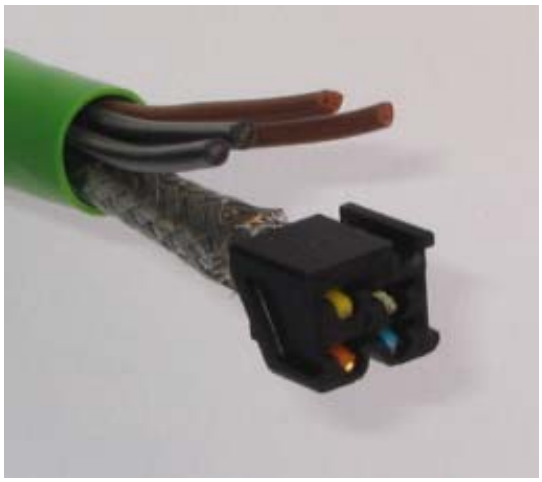
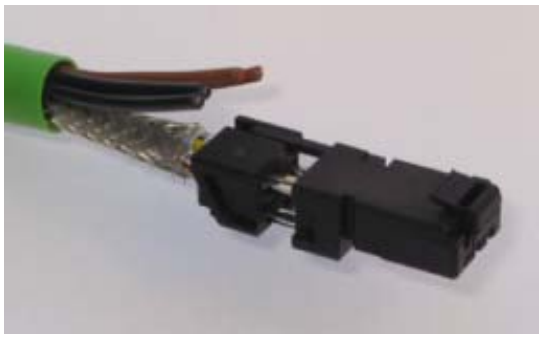
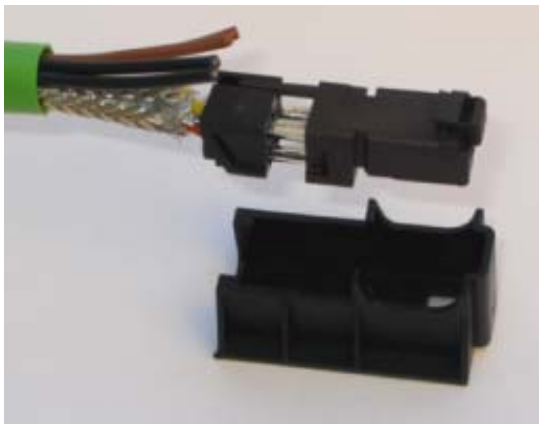
11.5 Assembling an IE hybrid cable 2 x 2 + 4 x 0.34 with an IE IP 67 hybrid connector

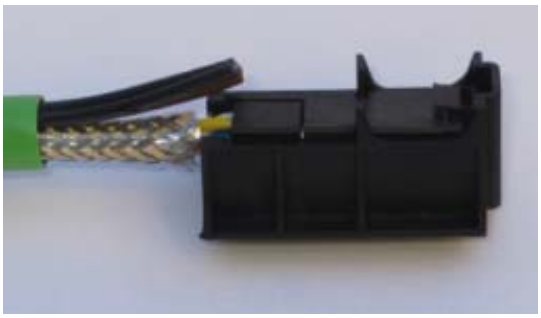
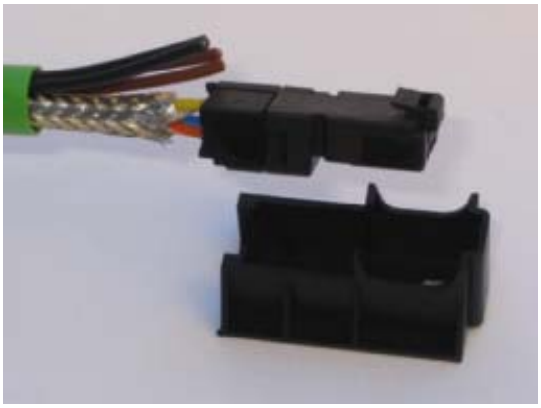
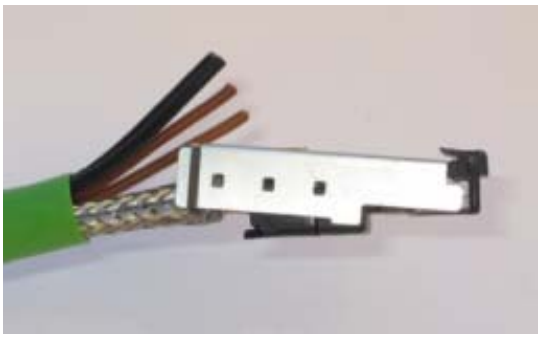
Terminating the IE Hybrid Cable 2x2 + 4x0.34 with an IE IP67 hybrid plug

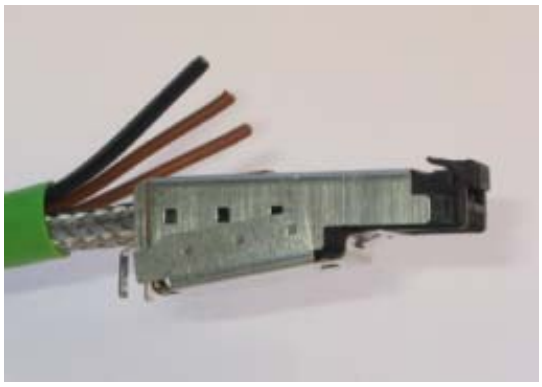
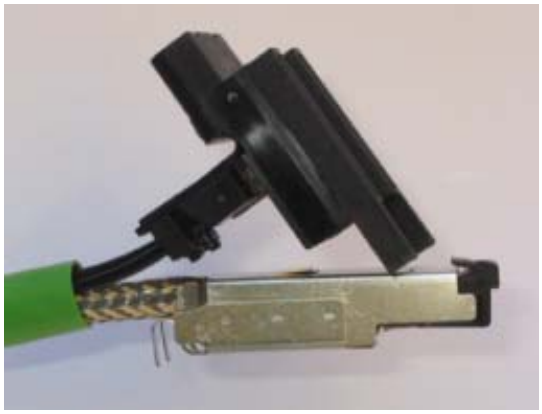
	Remove the two inner shells of the universal sealing ring to adapt it to the diameter of the hybrid cable.
	Push the bushing, the washer, the adapted universal sealing ring and the housing over the cable jacket.
	Remove the following lengths of cable jacket and shield braid: • 25 mm for the power leads. • 30 mm for the data leads (to achieve good shielding, the shield braid must be at least 30 mm long).

	Arrange the data leads according to the color codes on the splice element. The following table shows the assignment of the data leads.
	Contact and color assignment of the splice element.

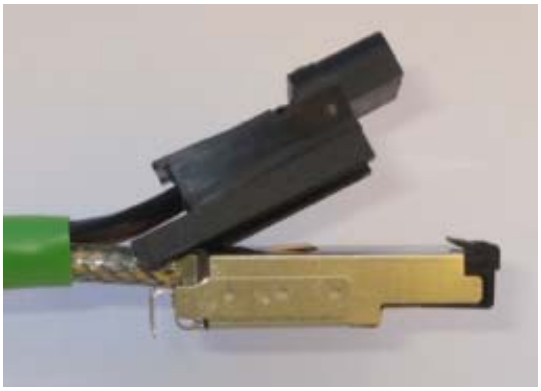
Wire color code (standard)	White	Blue	Yellow	Orange
Connector color code (Siemens IE)	White	Blue	Yellow	Orange
Siemens IE FC RJ-45 socket (reference)	3	6	1	2

	Insert the all the data leads at the same time into the splice element is far as they will go.
	Close the splice element and RJ-45 data module until they lock together.
	Insert the data module and the splice element into the supplied IDC assembly tool.

	Press the data module and the IDC assembly tool together to establish the installation piercing connection.
	Remove the assembled data module from the IDC assembly tool.
	Position the top shield plate and press it over the cable shield.

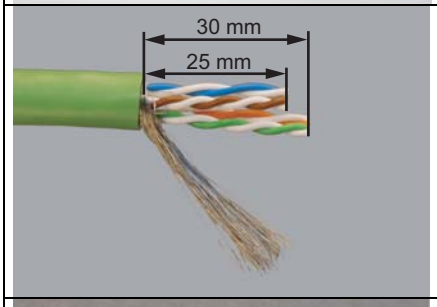
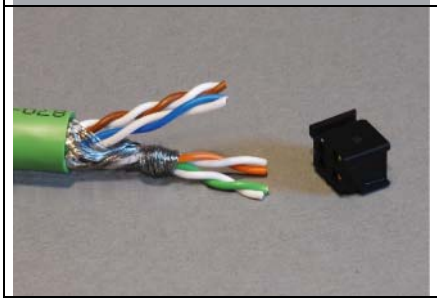
	Position the lower shield plate and press it and the upper shield plate together until they lock together with an audible "click".
	Arrange the power leads and insert them as far as they will go into the hinge elements of the isolation body. The following table shows the pin assignment of the power leads.

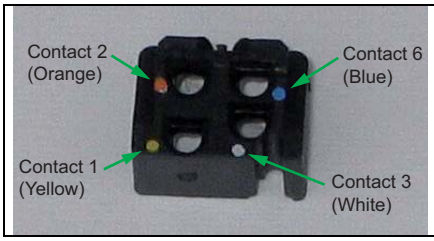
Wire color code (standard)	**Brown**	**Brown**	**Black**	**Black**
	24 V	24 V	Ground	Ground
Power supply insert module	1	2	3	4

	Press each individual hinge element together with the integrated IDC contact. Recommendation: Use a small slotted screwdriver (max. 3.5 mm) as a lever.
	Push the housing over the assembled data module and the insulator body until they lock together (there should be an audible click).
	Tighten the cable gland. We recommend an open ring key with a size of 21 mm.

11.6 Fitting the IE FC TP standard cable 4 x 2 GP to an IE IP 67 hybrid connector

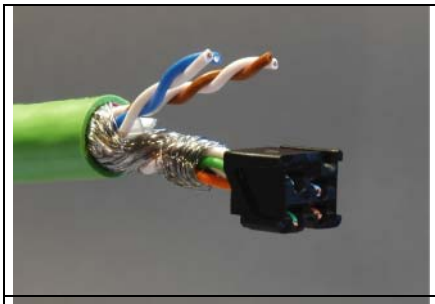
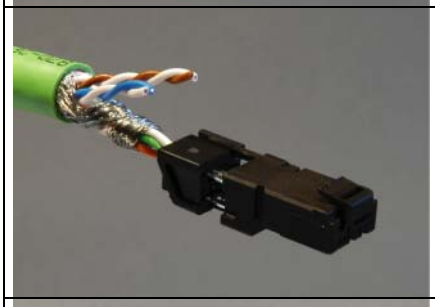
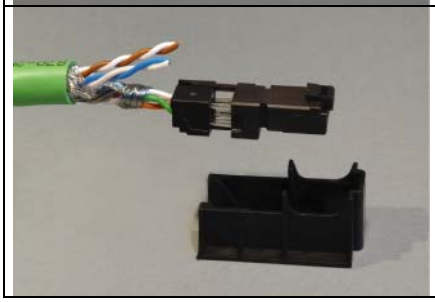
Procedure

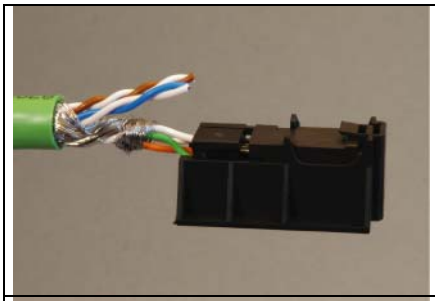
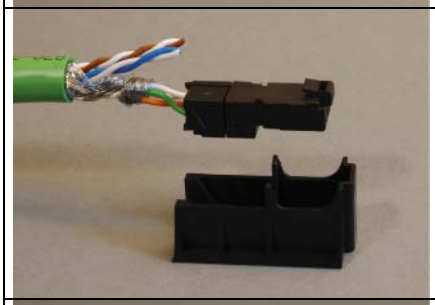
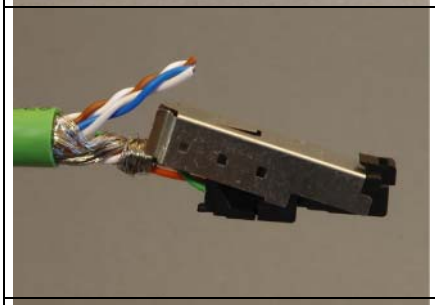
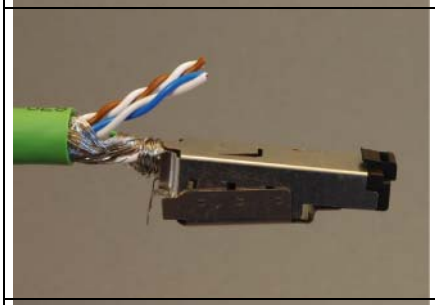
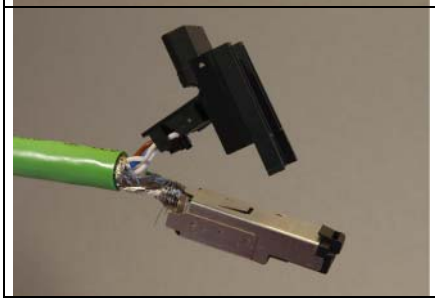
	Remove the two inner shells of the universal sealing ring to adapt it to the diameter of the hybrid cable.
	Push the bushing, washer, adapted universal sealing ring and the housing over the cable jacket.
	Remove the following lengths of cable jacket and shield braid: • 25 mm for the power leads • 30 mm for the data leads To achieve good shielding, the shield braid must be alt least 30 mm long.
	Arrange the data leads according to the color codes on the splice element. The following table shows the assignment of the data leads. Wind the shield braid around the data leads. As a result, the shielding of the cable has contact to the shield plate of the splice element that will be fitted later.

	Contact and color assignment of the splice element.

Color coding of the standard cable	White / orange *	Orange	White / green *	Green
Connector color code (Siemens IE)	White	Blue	Yellow	Orange
Siemens IE FC RJ-45 socket (reference)	3	6	1	2

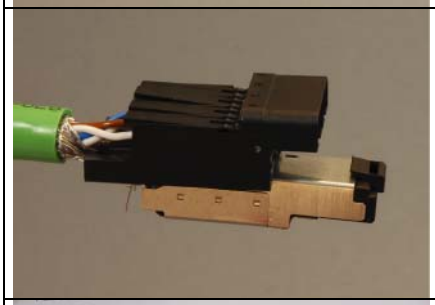
* White wire of the pair.

	Insert the all the data leads at the same time into the splice element is far as they will go.
	Close the splice element and RJ-45 data module until they lock together.
	Insert the data module and the splice element into the supplied IDC assembly tool.

	Press the data module and the IDC assembly tool together to establish the installation piercing connection.
	Remove the assembled data module from the IDC assembly tool.
	Position the top shield plate and press it over the cable shield.
	Position the lower shield plate and press it and the upper shield plate together until they lock together with an audible "click".
	Arrange the power leads and insert them as far as they will go into the hinge elements of the isolation body. The following table shows the assignment of the power leads.

Wire color code (standard)	White / blue *	Blue	White / brown *	Brown
Function	24 V	24 V	Ground	Ground
Power supply insert module	1	2	3	4

* White wire of the pair.

	Press each individual hinge element together with the integrated IDC contact. Recommendation: Use a small slotted screwdriver (max. 3.5 mm) as a lever.
	
	Push the housing over the assembled data module and the insulator body until they lock together (there should be an audible click).
	Tighten the cable gland. We recommend an open key with a size of 21 mm.

11.7 Assembly of Industrial Twisted Pair connectors

11.7.1 Assembling Industrial Twisted Pair Connectors

General

To maintain the excellent EMC and transmission characteristics of the twistedpair cabling system, connectors must be fitted with extreme care. Follow the installation instructions exactly.

How to fit 9pin and 15pin connectors is explained in detail on the following pages.

Note

Fit the D-sub connectors for self-assembly only to the 2x2 Industrial TwistedPair standard cable. The cable clamp used for contacting the shield is designed for the diameter of this cable.

These D-sub male connectors are not suitable for fitting to Industrial Ethernet FC cable types.

11.7.2 Fitting the D-sub male connector

9-pin D-sub male connector

Figure 7-7 shows all the components of a 9-pin D-sub connector.

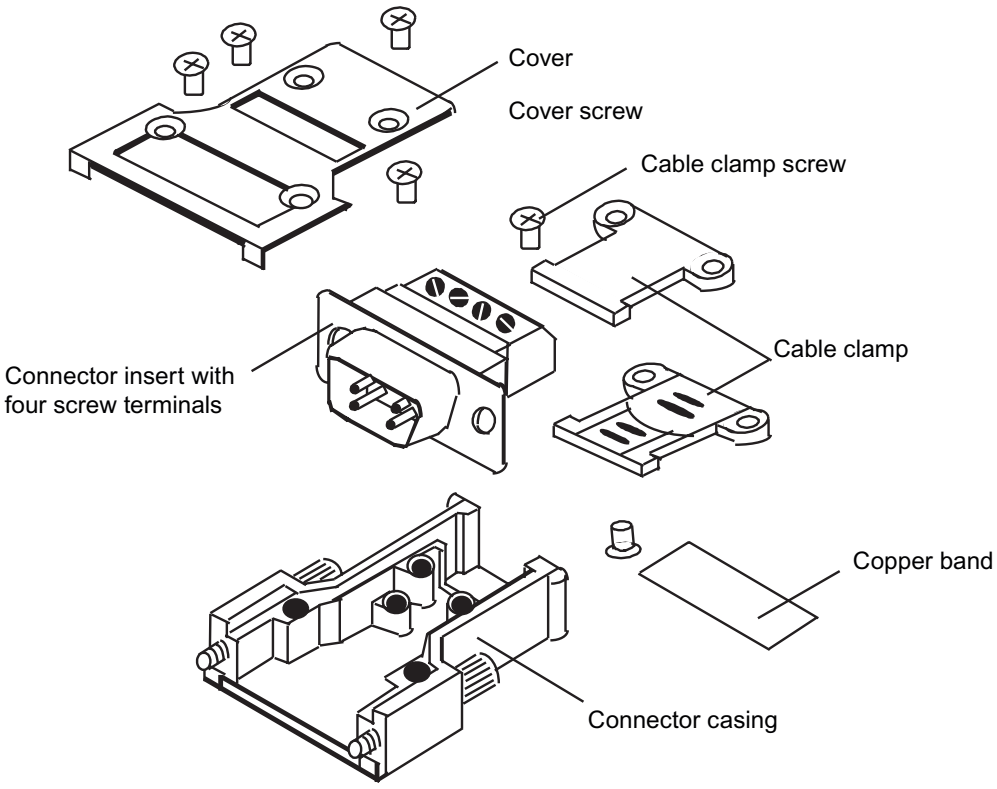
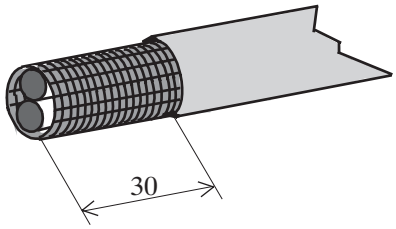


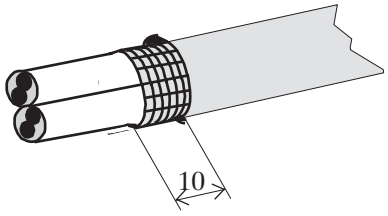
Figure 11-1 Industrial Twisted Pair D-sub male connector (9-pin) for user assembly

Steps

1. Remove approximately 30 mm of the outer sheath from the braided shield.

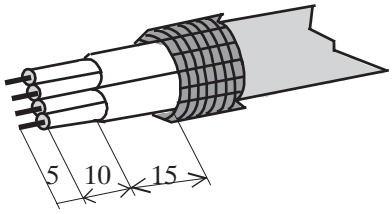


2. Cut the braided shield approximately 10 mm from the edge of the outer sheath and pull off the loose shield.

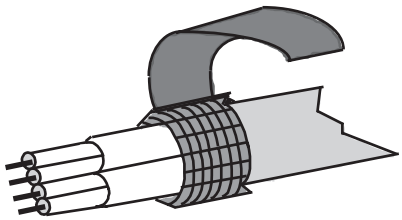


3. Turn back the braided shield over the outer sheath.

- Unwind the aluminum foil shield up to a point approximately 15 mm from the folded back braided shield and cut off the unwound material.
- Remove the plastic foil and blind elements.
- Remove approximately 5 mm of the insulation from the conductors.



4. Wrap copper band around the braided shield.



5. Fit the connector

- Fit the connector insert into the connector casing
- Fit the lower cable clamp into the grooves of the connector casing

- Match the wire pairs to the screw terminals
  You will find the assignment required for a particular cable type in section .
- Fit the cable into the connector casing so that the braided shield with the copper band lies in the cable clamp
- Fit the upper cable clamp into the grooves of the connector casing and screw it tight
- Secure the conductors in the screw terminals
- Screw the cover on to the connector casing

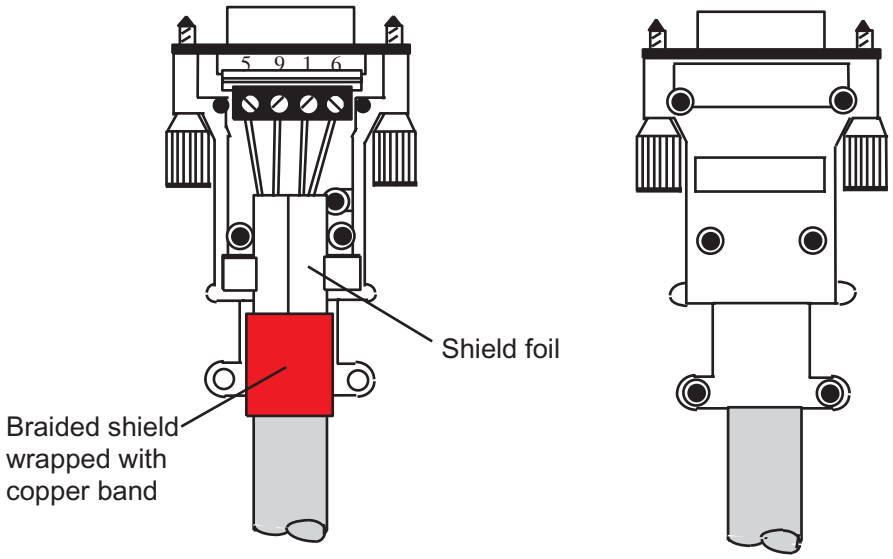


Figure 11-2 9-pin D-sub male connector fitted to the standard cable

15-pin D-sub male connector

Figure 7-9 shows all the components of a 15-pin D-sub connector

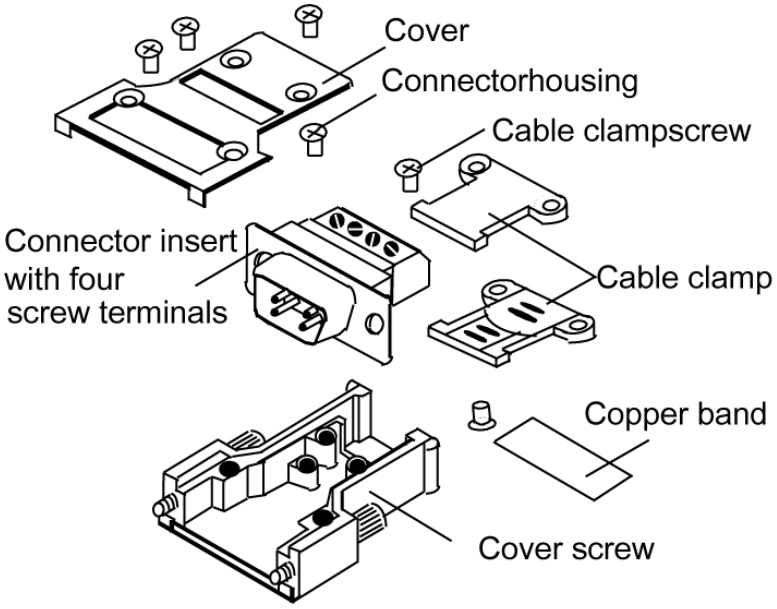
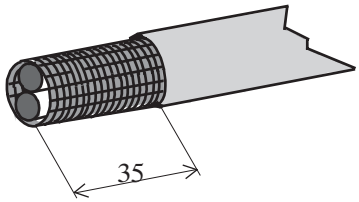


Figure 11-3 15-pin D-sub male connector for user assembly

Steps

1. Remove approximately 35 mm of the outer sheath from the braided shield.

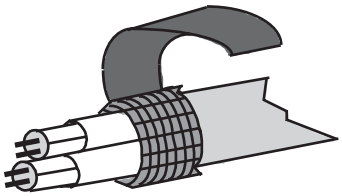


2. Cut the braided shield approximately 10 mm from the edge of the outer sheath and pull off the loose shield.

3. Shorten the white-blue pair by approximately 3 mm to 32 mm (to introduce the cable as shown in Figure 1–10).

- Turn back the braided shield over the outer sheath.
- Unwind the aluminum foil shield leaving approximately 15 mm (shorter pair) or approximately 18 mm (longer pair) to the folded back braided shield and cut off the unwound shield.
- Remove the plastic foil and blind element.
- Remove approximately 5 mm of the insulation from the conductors.

4. Wrap copper band around the braided shield.



5. Fit the connector

- Fit the lower cable clamp into the grooves of the connector casing.
- Fit the cable into the connector casing so that the braided shield with the copper band lies in the cable clamp
- Fit the upper cable clamp into the grooves of the connector casing and screw it tight
- Match the wire pairs to the screw terminals
  You will find the assignment required for a particular cable type in section .
- Secure the conductors in the screw terminals
- Screw the cover on to the connector casing

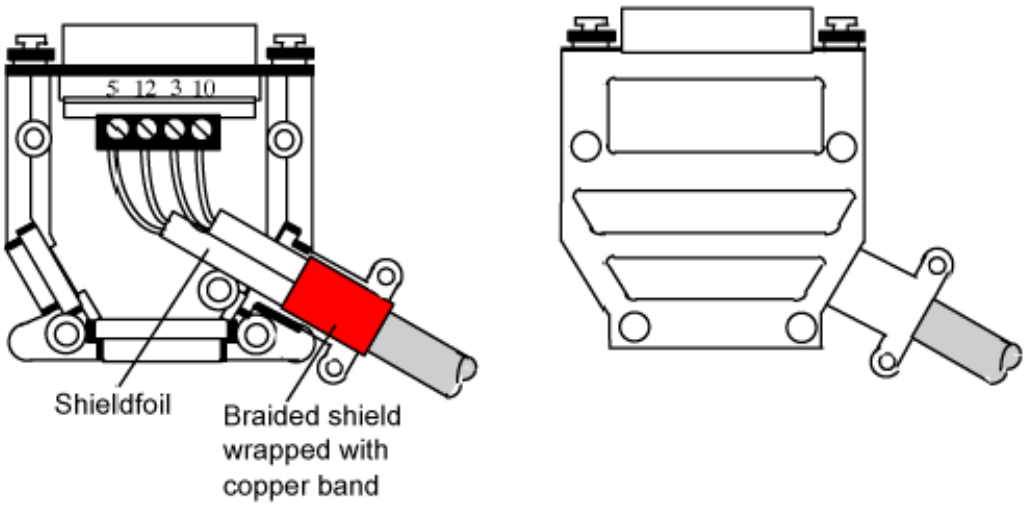


Figure 11-4 15-pin D-sub male connector fitted to the standard cable

See also

Preassembled twisted-pair (TP) and Industrial Twisted Pair (ITP) cables (Page 451)

11.8 Guidelines for setting up networked automation systems in buildings

11.8.1 General notes on networking bus cables

Bus cables in plants

Bus cables are important connections for communication between individual components of an automation system. Mechanical damage or repeated electrical interference affecting these bus connections reduces the transmission capacity of the system. In extreme cases, such problems can lead to failure of the entire automation system. The following sections explain how to protect cables from mechanical and electrical impairment.

Shielding and grounding concept

Bus cables connect programmable controllers. These in turn are connected to transducers, power supply units, peripheral devices etc. over cables.

All the components together form a complex electrically networked automation system.

When connecting system components via electrical cables (in this case bus cables), remember to take into account the requirements of the overall system structure.

Connecting cables, in particular, influence the shielding and grounding concept. Shielding and grounding an electrical installation serves the following purposes:

- Protects both humans and animals from dangerous network voltages
- Prevents unacceptable noise emission and susceptibility to noise
- Protects the system from overvoltage (for example lightning protection)

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 and in the following sections of this book, your automation system will meet the legal and normal industrial requirements for safety and noise immunity.

11.8.2 Protection from electric shock

Twistedpair signal level

The signal levels on twisted pair cables are in the range of only a few volts. Correctly installed and operated twisted-pair cables do not have dangerous electrical voltages.

Nevertheless you should remember the following rules when installing the power supply for all components (end devices, bus components, etc.) that you want to connect to twistedpair cable.

Operation with 24 V DC

Numerous SIMATIC NET components require a voltage of 24 V DC as their operating voltage or as auxiliary contact voltage. This power supply must meet the requirements of an extralow voltage with reliable electrical isolation from the main power system, complying with IEC 60950 or EN 60950 /18/.

Operation with line power

Components operated with line power must meet the requirements for protection against electric shock as stipulated in EN 60950 /18/, EN 611312 /20/, EN 61010 /19/ or other applicable product standards.

All the signals of the twistedpair port must meet the requirements of reliable electrical isolation from the line power supply, complying with IEC 60950 or EN 60950 /18/.

Cabling components

Conductive cable path systems, barriers, and accessories must be included in the protective measures preventing indirect contact (protection against illegal dangerous contact voltage).

Grounding conductors (PE) and equipotential bonding conductors must be installed according to the requirements of systems in buildings complying with HD 384.4.41 (protection against electric shock) and HD 384.5.54 (grounding and grounding conductor). The use of EN 501742 is recommended for the separation of low voltage cabling and IT cabling.

The requirements of HD 384.4.47 S2 (application of measures for protection against electric shock) and HD 384.4.482 S1 (selection of protective measures as a function of external influences) and appropriate national or local regulations must be adhered to.

Safe initial state of the system in case of faults

Problems on communication connections must not be allowed to put system users at risk. Cable or wire breaks must not lead to undefined statuses in the plant or system.

11.8.3 Mechanical protection of bus cables

Protection of electrical and optical bus cables

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

Note

The measures described here for mechanical protection apply both to electrical and optical cables.

Measures for mechanical protection

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

- When cable cannot be installed on a cable rack or similar construction, it should be installed in a conduit (for example PG 11-16)
- In areas where the cable is subject to mechanical stress, install the cable in a heavy-gauge aluminum conduit or in a heavy-gauge plastic conduit (see Figure 1–5)
- 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 1–6).
- In areas where the cable is likely to be walked on or driven over in buildings or in machines, install the cable in a closed heavy-gauge aluminum or steel conduit or in a metal cable gutter.

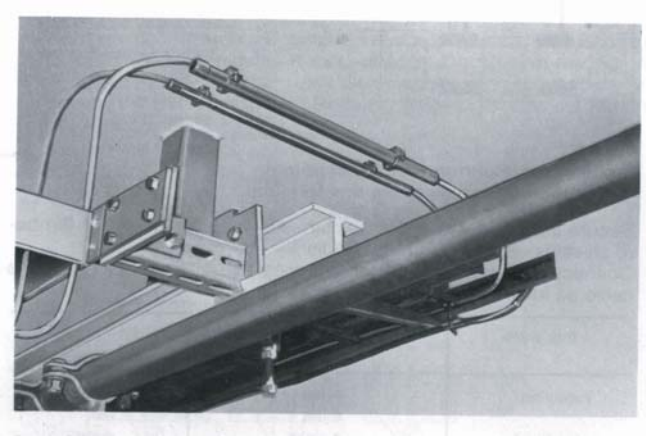


Figure 11-5 Mechanical protection of the bus cable

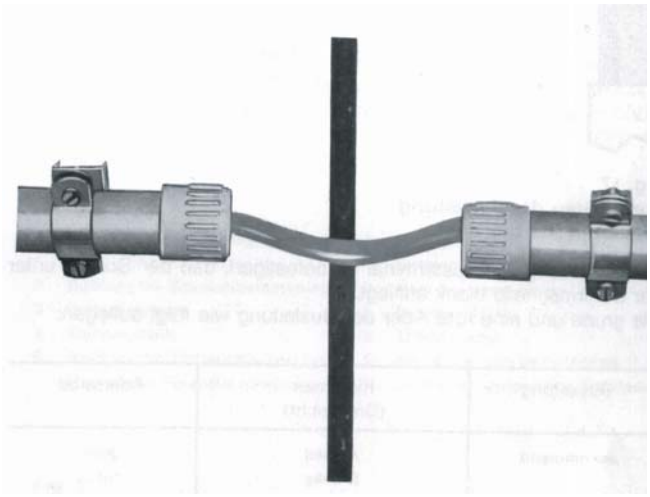


Figure 11-6 Interrupting the conduit at an expansion joint

Redundant bus cables

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

Install bus cables separately

To prevent accidental damage to bus cables, they should be clearly visible and should be separate from all other wiring and cables. To improve EMC, it is often advisable to install the bus cables in a separate cable channel or in conductive metal tubes. Such measures also make it easier to localize a faulty cable.

11.8.4 Electromagnetic compatibility of fiberoptic cables

Fiberoptic cables

For communications between buildings and/or external facilities, the use of fiberoptic cables is generally recommended. Due to the optical transmission principle, fiberoptic cables are not affected by electromagnetic interference. Measures for equipotential bonding and for overvoltage protection are unnecessary with fiberoptic cables.

Note

Fiberoptic cables are ideally suited for connections in areas with high EMI levels. Remember, however, that bus components operating on an electrical basis such as OLMs, OSMs etc. may require additional noise protection measures if they are operated in such areas. These must be protected against unacceptable interference using the measures already mentioned such as shielding, grounding, minimum clearance to sources of interference etc.

11.8.5 Connecting fiber-optic cables

BFOC connectors

Industrial Ethernet fiber-optic network components use only glass fiber-optic cables with BFOC connectors.

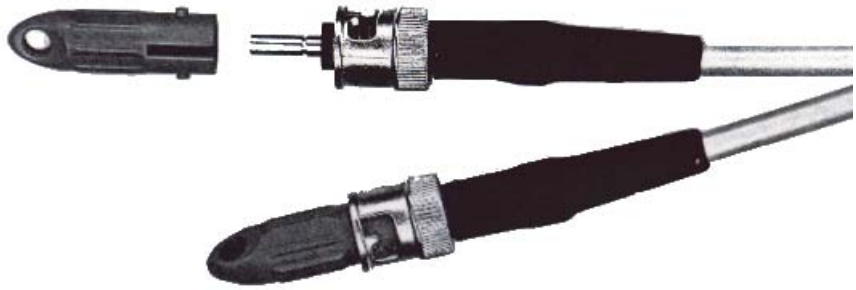


Figure 11-7 BFOC connector with dust cap

Note

Connectors should only be fitted to glass fiber-optic cables by trained personnel. When fitted correctly, they allow extremely low insertion loss and the value is highly reproducible after multiple plugging cycles.

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. See also preassembled FO cables.

Fitting connectors on site

If it is necessary to fit connectors on site,
– BFOC connectors and suitable tools can be ordered
– SIEMENS provides this service.

If this is required, please ask your contact for special cables and special lengths.
You will also find the address:
- in our catalog IK PI
- on the Internet (http//www.ad.siemens.de)

⚠ CAUTION
Fiber-optic cable connectors are susceptible to contamination and mechanical damage to the face. Protect open connectors with the supplied dust caps. Only remove the dust cap immediately before making the connection.

See also

Contacts for special cables and special lengths (Page 422)

Preassembled FO cables (Page 508)

11.8.6 Electromagnetic compatibility of bus cables

Electromagnetic compatibility (EMC)

Electromagnetic compatibility (EMC) is the capability of a electrical equipment to function satisfactorily in its electromagnetic environment without influencing this environment and interfering with other equipment belonging to it (in compliance with DIN VDE 0870).

This mutual influence can take the form of electrical, magnetic, and electromagnetic effects. These effects can spread both over cable connections (for example a common power supply) or due to radiated interference affecting the cable.

To avoid interference affecting electrical systems, these effects must be reduced to a certain level. The measures involved in achieving this limitation include the design, construction, and correct connection of bus cables. The components and bus cables for SIMATIC NET Industrial Ethernet meet the requirements of the European standards for devices used in an industrial environment. This is documented by the CE marking.

Note

Adherence to the specified limit values can only be guaranteed when using components from the SIMATIC NET Industrial Ethernet range exclusively and by keeping to the installation instructions in this manual!

11.8.6.1 Equipotential bonding system

Aims of equipotential bonding

The noise immunity of extended electronic automation systems or, in general, information technology systems largely depends on the suitable design of the grounding and equipotential bonding system of the building.

Equipotential bonding and grounding have two essential aims:

- Protection from the dangers of electricity

  - by limiting the contact voltage and creating a fault to ground path
- Improvement of electromagnetic compatibility
  - by creating a reference potential and equalizing potential differences between parts of the system
  - by shielding.

Causes of potential differences

Wherever electric currents flow, magnetic fields are produced that in turn induce stray currents in electrically conductive materials. Induced stray currents can therefore not be avoided in the vicinity of electrical consumers (drives, electronic controls, lighting etc.) and their power supply cables. They spread in all conductor loops. Conductor loops are formed by parts of buildings such as metal banisters on staircases, water pipes or central heating pipes as well as through the shields of electrical data cables and the protective ground connectors of electrical devices (PE). The flow of current produces a voltage drop. This can be measured as a potential difference between two locations within the system.

Extremely high potential differences between two grounding points result from lightning strikes.

Effects of potential differences in information technology systems

If locations with different grounding potential are connected via cables, currents will flow. The currents flow on all connections between these two points, for example also on the signal cables or cable shields connecting them. Attached devices can be disturbed or even destroyed.

The aim of a grounding and equipotential bonding system is to ensure that the currents flow in the grounding system and not in the electronic circuits.

Measures for grounding and equipotential bonding

According to EN 50310 /21/, a "common bonding network CBN" with a fine mesh of conductive elements must be created in buildings with information technology systems. Systems that extend beyond one floor and that are interconnected by electrical bus cables require a threedimensional CBN with a lattice construction resembling a Faraday cage.

With the following measures, you can create a grounding and bonding system that will improve EMC:

- Include all the metal parts of a building in a common bonding network (CBN) with low impedance and high current carrying capacity. To this network, you should then connect the main grounding terminal or bar, grounding conductors, metal conduits, reinforcing rods, equipotential bonding ring conductor, cable racks and any additional bonding conductors.
- Connect all inactive metal parts in the immediate vicinity of your automation components and bus cables to the bonding system ensuring good conductivity. This includes all metal parts of cabinets, machine parts etc. that have no electrical function in the automation system.
- Include metal, conductive cable channels/racks in the equipotential bonding of the building and between the individual parts of the system. The individual segments of the channels/racks must be connected together with low inductance and low resistance and

connected to the CBN 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 to ensure longterm stability.

- 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 parallel Industrial Twisted Pair cables.
- 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.

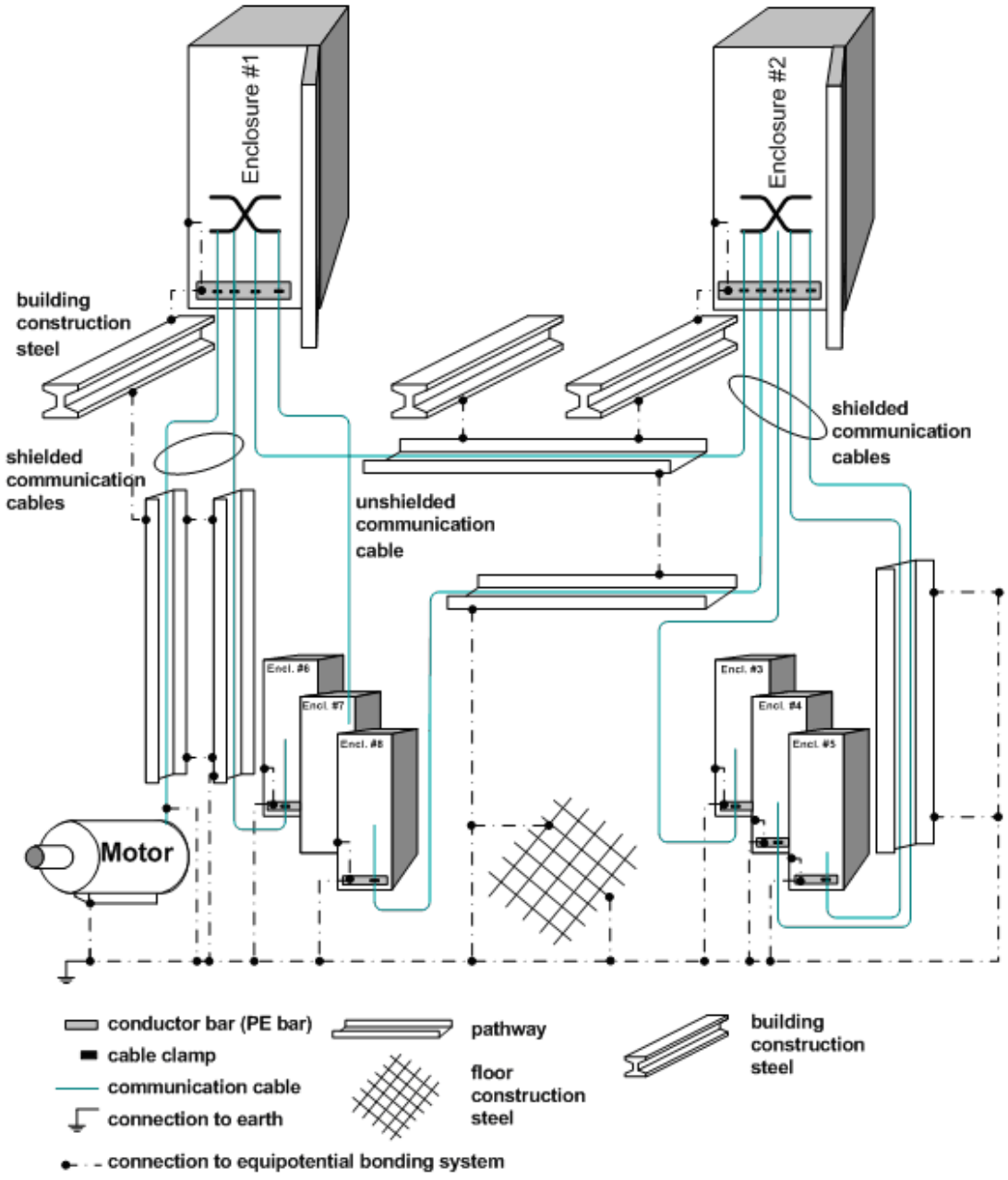


Figure 11-8 Example of meshed bonding system

For information about grounding and bonding techniques, refer to the system manuals of the SIMATIC S7300 /9/, S7400 /10/ programmable controllers.

Note

Equipotential bonding is unnecessary if the sections of a system are connected exclusively using fiberoptic cable (FO).

11.8.6.2 Requirements of the AC power distribution system

General

HD 384.3 S2 (IEC 603643:1993, modified, /22/) describes various power distribution systems (TNS, TNC,S, TNC, TT and IT systems). Additional national or local regulations stipulate the measures required for protection against electric shock and stipulate the requirements for a grounding system (see also section 1.2 Protection against electric shock).

The outer surfaces of switching cubicles, device housings, connectors and bus cables are conductive to provide shielding and must be connected to the grounding system to ensure safety. To ensure that the EMC shield effect is achieved, they make further requirements of the grounding system and grounding of the power distribution system. These result in an alternating power distribution system with noncurrent carrying grounding conductors, for example as in the TNS system.

Cable shields are part of the equipotential bonding network of a system.

Since the shields of twistedpair cables are included in the bonding system, all the currents coupled into the bonding system of a building or plant flow through them.

Depending on the intensity and frequency range, these shield currents can cause disturbances in data communication. Measures must therefore be taken to avoid the alternating power distribution system of a plant including the bonding system in the power return cabling. A TN-S system with separate cables or N and PE, for example, meets these requirements. The EN 50310:2000 /21/ standard provides detailed guidelines for installing a network system for supplying information technology equipment.

Note

End devices and /or network components connected over shielded twistedpair cables must only be supplied by alternating power distribution systems whose grounding conductors cannot contribute to the transmission of energy. There must be no PEN cable within the entire system. This condition is met, for example, by a TNS system.

Signal connections in existing installations

If unexplained, sporadic disturbances occur in data processing systems or on their communication connections, it is advisable to check for unwanted shield currents. These can be measured simply by inserting the cable in question in a clipon ammeter. Currents higher than approximately 0.1 A indicate problems in the electrical installation, for example in the TNC system.

If the alternating current power system supplies a large number of electronic devices or electronically controlled consumers, the highest interference currents can generally be observed at the third harmonic of the frequency.

Other signs of an unsuitable alternating current power supply are as follows:

- Currents on the PE conductor
- Currents through water pipes and heating pipes
- Progressive corrosion at grounding terminals, on lightning conductors, and water pipes.

Remember that sporadic events such as switching, short circuits, or atmospheric discharge (lightning strike) can cause current peaks in the system many times higher than the measured average value.

Troubleshooting

The following measures are suitable for troubleshooting:

- Restructuring the power distribution system (to form a TNS system)
- Replacing the electrical data cabling with fiberoptic cables
- Installing an equipotential bonding conductor parallel to the disturbed data cabling.

Note

If shield currents on bus cables cause problems in communication, the safest often cheapest solution is to replace the disturbed electrical bus connection with a fiberoptic cable.

Example of installing FO cable in a TNCS system

The graphic below illustrates the relationships between the structure of the alternating current network, equipotential bonding system, and information technology cabling in a building.

Three PCs and three S7300 PLCs represent the information technology system. These are networked using two OSMs. The housing of all the end devices and the OSMs are correctly connected to the grounding and bonding system of the building. The PCs are connected to the system via the PE contact of their power supply cable. The housing of the OSMs and the racks of the S7300 PLCs are connected either directly or via a switching cubicle housing locally to the CBN. The shields of the twistedpair cables interconnect all the device housings and are therefore connected to the grounding and bonding systems at both ends.

The horizontal power distribution within a floor corresponds to the requirements of a TNS system. The neutral cable N and grounding conductor PE are separate cables. The PE grounding conductor does not contribute to the power supply of the devices. The parallel cable shields of the twistedpair cables are therefore also free of neutral cable currents.

The vertical, interfloor power distribution is designed as a TNC system (common PEN cable for N and PE). The PEN is the return cable of the power supply of all connected consumers. A connection between the two OSMs at the righthand edge of the picture over shielded twistedpair cables would allow the return cable current of the PEN to flow through the entire bonding system, all PE cables, and all cable shields on both floors. It is therefore strongly recommended to implement the interfloor connection between the two OSMs with fiberoptic cables.

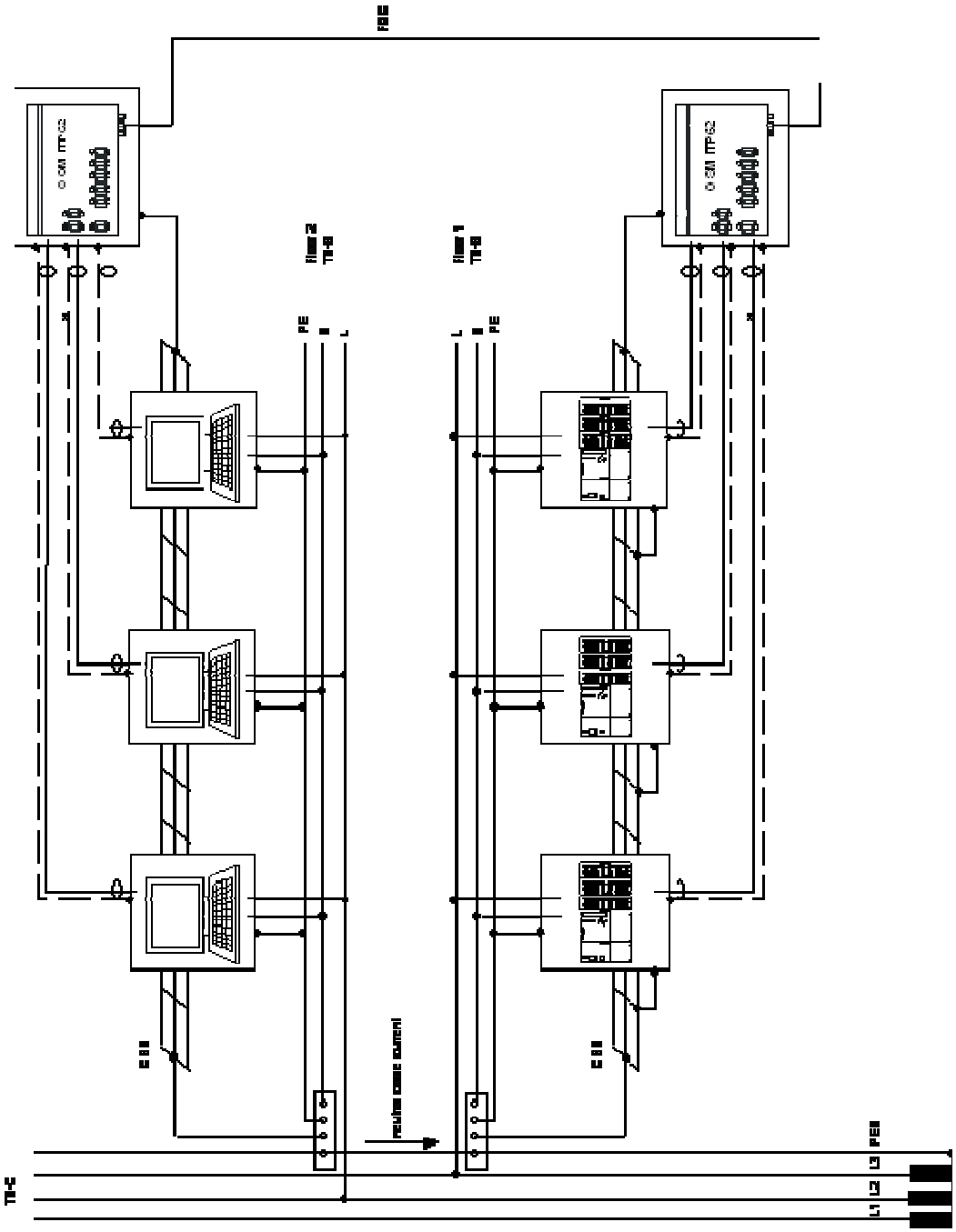


Figure 11-9 Fiberoptic links avoid shield currents in the TNCS network

11.8.6.3 Shielding devices and cables

Shielding cables

The high degree of noise immunity of SIMATIC NET twisted-pair copper networks is achieved by the exclusive use of shielded twisted-pair cables. The highly symmetrical twisted signal wires are surrounded by a combination of foil and braided mesh shields. The shield makes large-area, conductive contact with the casing of the attached end device or network component at both ends of the twisted-pair cable via the connector/outlet. The entire communications electronics, consisting of transmitter and receiver chips as well as the signal cables is protected from electromagnetic influence from the outside world by a closed "cocoon" of electrically conductive device casing and cable shield.

Note

The values specified for noise emission and noise immunity in the technical specifications of all SIMATIC NET Industrial Ethernet components assumes the use of shielded twisted-pair cables.

As explained in the installation rules for the devices, the shields of the twisted-pair cables must make good conductive contact with the device housings at **both** ends. This is ensured by the SIMATIC NET connectors designed specially to match the devices.

If, on the other hand, the rules are ignored and unshielded cables are used or the shields do not make contact with the casing at both ends, there is no longer any guarantee that the technical data regarding noise emission and noise immunity will apply. In this case, the operators of the system must take responsibility themselves for compliance with the legal limit values for noise emission and noise immunity (CE mark)!

Handling bus cable shields

Note the following points about cable shields:

- Use SIMATIC NET twisted-pair cables throughout your system. The shields of these cables have an adequate density to meet the legal requirements regarding noise emission and immunity.
- Always contact the shields of bus cables at both ends. The legal requirements for noise emission and noise immunity in your system (CE marking) can only be achieved when the shields make contact at both ends.
- Secure the shield of the bus cable to the connector casing.
- If cables are installed permanently, it is advisable to remove the insulation of the shielded cable and to establish contact on the shield/PE conductor bar.

  Note

  If there is a potential difference between the grounding points, an illegally high compensating current can flow through the shield grounded at both ends. To rectify the problem, do not, under any circumstances, open the shield of the bus cable.

  This problem can be solved in the following ways:

- Install an additional bonding conductor parallel to the bus cable that takes over the shield current.
- Use fiber-optic cable instead of electrical cable (safest solution).

Establishing shield contact

When contacting the cable shields, please note the following points:

- Secure the braided shield with metal cable clamps.
- The clamps must make good and large-area contact with the shield.
- Contact SIMATIC NET twisted-pair 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.

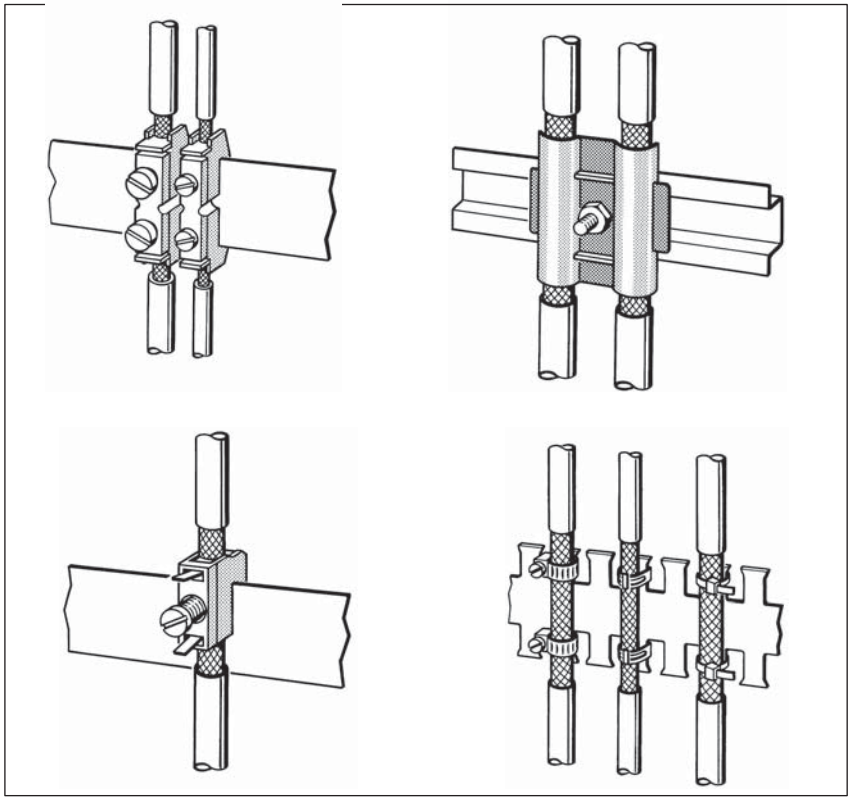


Figure 11-10 Securing shielded cables with cable clamps and ties (schematic representation)

- When removing the sheath of the cable, make sure that the braid shield of the cables is not damaged.
- 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.

- Unless specifically intended for this purpose, shield clamps and contacts should not be used for strain relief. The contact with the shielding bar could be impaired or be broken altogether.

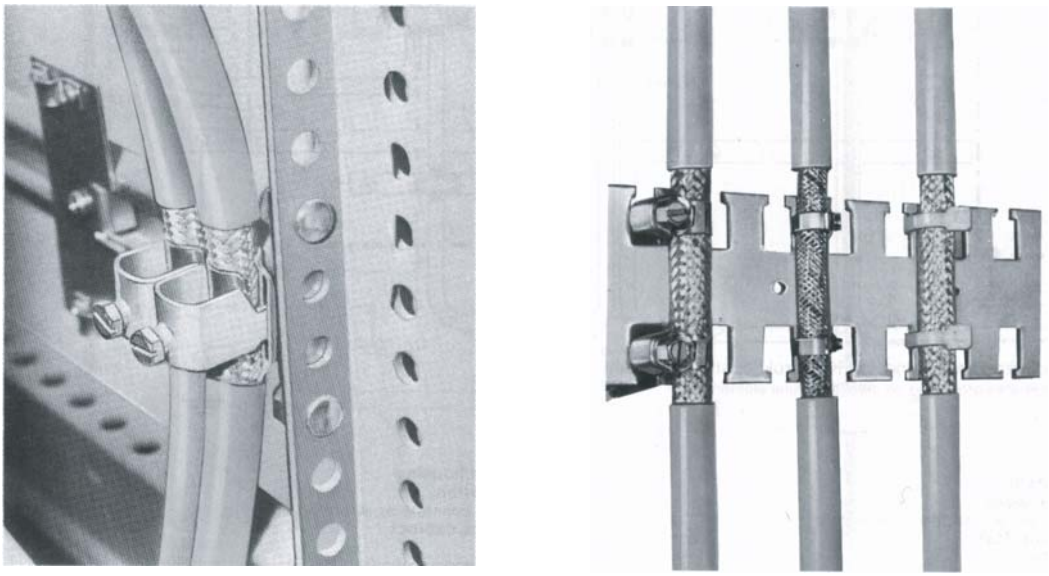


Figure 11-11 Contacting the shield at the point of entry to a cabinet

11.8.6.4 Special noise suppression measures

Connecting switched inductances to suppressors

Some inductive switching devices (for example relays) create interference voltages that are a multiple of the connected operating voltage. The SIMATIC S7-300 /9/ and S7-400 /10/ system manuals contain suggestions on 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 the figure below.

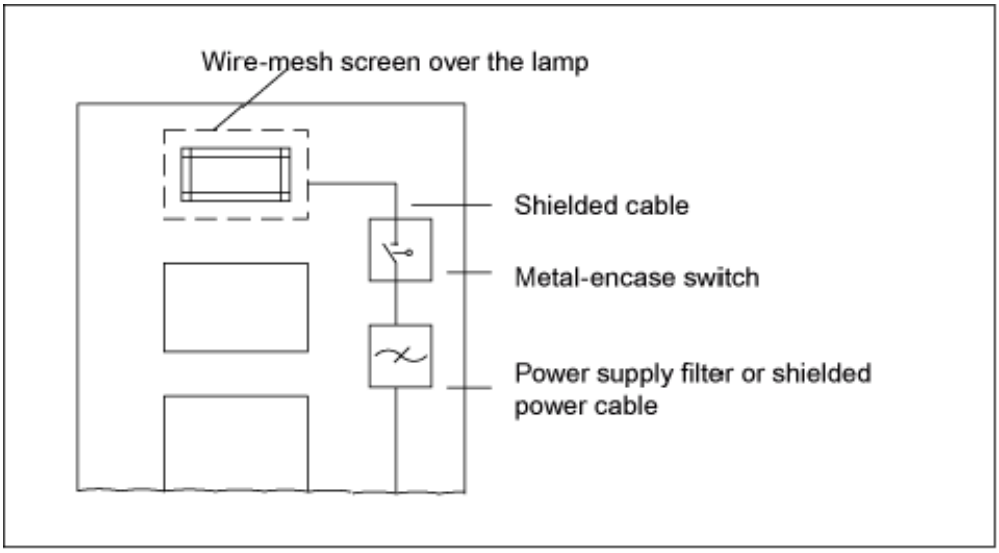


Figure 11-12 Measures for interference suppression of fluorescent lamps in a cabinet

11.8.7 Arrangement of devices and cables

Adequate clearance to reduce the effects of interference

One simple but nevertheless effective method of reducing the effects of interference is to keep the "culprit" and "victim" devices and cables as far apart from each other as possible. Inductive and capacitive interference injection declines in proportion to the square of the distance of the elements involved. This means that doubling the clearance reduces the effects of interference by a factor of four. Taking certain aspects into account during the planning phase of a building generally incurs little extra cost and can save considerable effort later.

Standards recommending the spatial arrangement of devices and cables

EN 501742 /13/ includes recommendations on the spatial arrangement of devices and cables with the aim of achieving the lowest possible mutual interference.

11.8.7.1 The influence of power distribution systems (EN 501742, 6.4.4.2)

Planning the electrical installations

To avoid the power distribution system affecting sensitive devices, the following points must be taken into account when planning the electrical installation:

- Possible sources of interference, for example voltage distributors, voltage transformers, elevators, high currents in power supply bars, must be located at a suitable distance from sensitive devices;
- Metal pipes (for example for water, gas, heating) and cables should enter the building at the same point;
- The metal surfaces, shields, metal pipes, and connections of such conduits must be connected with lowresistance conductors to the main bonding conductor of the building;
- Using a common cable route for lowvoltage cable and signal cables with adequate separation (either by clearance or shielding) between the two to avoid large induction loops that are created by the different lowvoltage cabling;
- The use of either a single multicore cable for all power supplies or (in the case of higher power requirements) of conductor bars with weak magnetic fields.

11.8.7.2 Cable categories and clearances

Fiberoptic cables

When using fiberoptic cables, mechanical protection is necessary, however the EMC rules do not apply.

Grouping in categories

It is useful to group wires and cables into various categories according to the signals they carry, possible interference signals, and their sensitivity to interference. Minimum clearances can be specified for these categories so that interferencefree operation can be expected under normal operating conditions if the clearance is adhered to.

Constraints

Grouping cables according to voltage classes assumes that the interference voltages relate directly to the power supply voltage conducted (the lower the supply voltage, the lower the interference voltage). Remember, however, that DC or 50 Hz power supply voltages do not represent any danger to Industrial Ethernet bus cables. The critical interference voltages in the kHz to MHz frequency range are created by the consumers connected to the cable. A 24 V DC cable with which a relay is switched regularly has a far more critical interference range than a 230 V cable supplying a lightbulb.

In the information shown below, it is assumed that all the components within an automation system and all the plant components controlled by the system (for example machines, robots etc.) at least meet the requirements of the European standards for electromagnetic

compatibility in an industrial environment. If devices are defective or incorrectly installed, higher interference voltages must be expected!

The following is assumed:

- The cables for analog signals, data signals and process signals are always shielded.
- The distance from the cables to the chassis surface of the system (cabinet wall, grounded and conducting 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.

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 1-1 Cabling within buildings

Cables for ...	and cables for ...	Lay ...
Bus signals, shielded (PROFIBUS, Industrial Ethernet) Bus signals, unshielded (ASInterface)	Bus signals, shielded (PROFIBUS, Industrial Ethernet) Bus signals, unshielded (ASInterface) Data signal, shielded (PG, OP, printer, counter inputs etc.) Analog signals, shielded DC voltage (v 60 V), unshielded Process signals (v 25 V), shielded AC voltage (v 25 V), unshielded Monitors (coaxial cable)	In common bundles or cable channels
	DC voltage (u 60 V and v 400 V), unshielded AC voltage (u 25 V and v 400 V), unshielded	In separate bundles or cable channels (no minimum clearance required)

Cables for ...	and cables for ...	Lay ...
	DC and AC voltage (u 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
	HF cables for transmitter high level stages and transmitter antennas with voltages from 10 to 1000 V	Lay HF cables in steel pipes with multiple ground points; at least 30 cm clearance

11.8.7.3 Cabling within closets

Cabling within closets

When running cables within cubicles and cabinets, remember the following rules:

- Install the cables in metallic, electrically conductive cable channels.
- Screw the cable channels to the struts of the rack or cubicle walls approximately every 50 cm making lowresistance and lowinductance contact.
- Separate the cables according to the categories as shown in table 1-1.
- Maintain the minimum clearance between the cables of different categories as explained in table 1-1. 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 approximately at right angles (wherever possible avoid sections where the cables run parallel).
- The shields of all cables entering the wiring closet should make largearea contact with closet ground as close as possible to the point of entry.

11.8.7.4 Cabling within buildings

Cabling within buildings

When laying cables outside cabinets but within buildings, note the following points:

- Install the cables in metallic, electrically conductive cable channels.
- Include the metal cable channels and racks in the bonding system of the building or plant. Note the information on equipotential bonding in Section 1.3 in this manual.

- Separate the cables according to the categories as described in table 11 and run the various categories in their own channels/racks.
- If there is only one common metal channel available for all categories, either the clearances shown in Table 11 must be maintained or the individual categories should be separated from each other by metallic partitions. The partitions must be connected to the channel making lowresistance and lowinductance contact.
- Cable racks should cross each other at right angles.

11.8.7.5 Cabling outside buildings

Using fiberoptic cables

Industrial Twisted Pair is intended for use within buildings (tertiary area). The installation of Industrial Twisted Pair cables between buildings in not permitted. LAN connections between buildings and between buildings and external facilities are only possible with fiberoptic cables (FO). Due to the optical transmission principle, fiberoptic cables are not affected by electromagnetic interference. Measures for equipotential bonding and overvoltage protection are unnecessary with fiberoptic cables.

11.8.8 Laying bus cables

11.8.8.1 Installation instructions for electrical and optical bus cables

Installation instructions for electrical and optical bus 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 shrinkon cover to prevent oxidation of the cores and to keep dampness out of the cable.

Temperatures

During transportation, cabling and operation, the cable must not be exposed to temperatures below the specified minimum temperature or above the specified maximum temperature otherwise the electrical and mechanical characteristics of the cables can deteriorate. The permitted temperature ranges of your bus cable can be found in the technical data sheets of the bus cables

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 bus cable can be found in the technical data sheets of the bus cables.

Pull preassembled cables using cable grips

To pull preassembled cables, make sure that you use cable grips. These surround the connector and protect it from damage when pulling in the cable.

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. Bus cables must therefore not be twisted.

Bending radiuses

To avoid damage within the bus cables, they must at no time be bent more sharply than the minimum bending radius. Note the following:

- The permitted bending radii are larger when pulling in the cable under tensile strain than in the fixed, installed state
- Bending radii for noncircular cables apply only to bending the flat, broader surface. Bends in the narrower surface require much greater radii.

The permitted bending radii for your bus cable can be found in the technical data sheets of the bus cables.

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 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).*

11.8.8.2 Additional instructions on installing fiberoptic cables

Protecting connectors from contamination

Fiberoptic cable connectors are sensitive to contamination. Unconnected male and female connectors must be protected with the supplied dust caps.

Attenuation variations under load

During installation, fiberoptic cables must not be twisted, stretched or squashed. The specified limit values for tensile strain, bending radii and temperature ranges must be adhered to. During installation, the attenuation values can vary slightly, these variations are, however, reversible providing the strain limits are not exceeded.

Pull cables using cable grips and protect connectors

If the cable does not have a Kevlar pulling attachment, 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

Although the BFOC connectors have their own strain relief and kink protection, it is advisable to arrange for additional strain relief as close as possible to the connected device to protect against mechanical strain.

Plan adequate attenuation reserves

When installing cables over greater distances, it is advisable to take into account one or more repair splices in the power loss budget.

Electromagnetic immunity

Fiberoptic cables are immune to electromagnetic interference. Installing cables in cable channels along with other cables (for example 230 V/380 V power supply cables) causes no problems. When installing in cable channels, however, make sure that the permitted strain on the fiberoptic cables is not exceeded when pulling in other cables later.

⚠ WARNING

Keep to the technical specifications

During installation and operation, all mechanical requirements for the cable such as bending radii, tensile strain etc. must be kept to. If these are exceeded, there may be deterioration of the transmission characteristics that can lead to temporary or complete failure of the data transmission.

Part C: Installing network components in cabinets 12

12.1 IP degrees of protection

General

Electrical equipment is normally surrounded by a protective casing.

The purpose of this casing includes

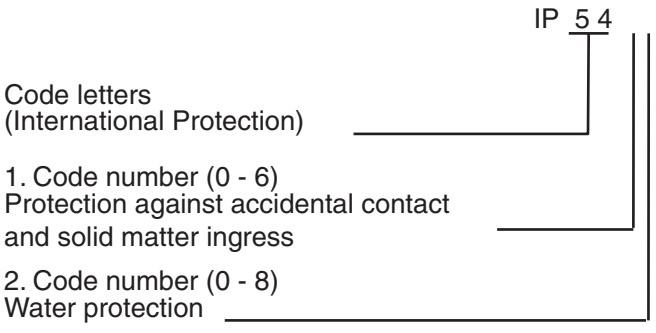
- Protection of persons from touching live components or moving parts (accidental contact protection)
- Protection of equipment from intrusion of solid foreign bodies (solid body protection)
- Protection of equipment from ingress of water (water protection).

IEC 60529, EN 60529 /15/

The degree of protection specifies the degree to which the casing meets these three protective functions.

The degrees of protection are specified uniformly in the "International Standard IEC 60529" or in the identical European standard EN 60529.

The degree of protection of a casing is indicated by a code. The code consists of the letters IP (International Protection) followed by a code number for contact, solid body and water protection as shown below:



In some situations, the degree of protection is specified in even greater detail by adding letters to the code numbers.

Scope of protection

The various degrees of protection are listed briefly in Tables 1-1 and 1-2. For more detailed information on the individual ratings and the test conditions that must be fulfilled, please refer to the standards listed above.

Table 12-1 Contact protection (short form)

First number	Protection of equipment from intrusion of solid foreign bodies	Protection of persons from access to dangerous parts
0	not protected	not protected
1	≥ 50.0 mm diameter	back of hand
2	≥ 12.5 mm diameter	finger
3	≥ 2.5 mm diameter	tool
4	≥ 1.0 mm diameter	wire
5	dust protected	wire
6	dustproof	wire

Table 12-2 Water protection (short form)

Second number	Protection of equipment from ingress of water
0	not protected
1	vertically falling drops of water
2	falling water (15° from vertical)
3	sprayed water
4	splashwater
5	jet water
6	strong jet water
7	temporary immersion
8	long period of immersion

12.2 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 degree of protection IP 20, IP 30 to IP 40. You will find the precise degree of protection of a SIMATIC NET component in its operating instructions.

Components with the degrees of protection mentioned above do not provide protection against dust and water! If the installation site requires such protection, the components must be installed in an additional enclosure such as a switching cubicle that provides the higher degree of protection (for example IP65/ IP67).

If you install these components in an additional enclosure, make sure that the conditions required for operation are maintained!

Heat dissipation

Make sure that the temperature inside the additional enclosure does not exceed the permitted ambient temperature for the installed components. Select an enclosure with adequate dimensions or use heat exchangers.

Outdoor installation

If you install the equipment outdoors, make sure that the additional enclosure is not subjected to direct sunlight. This can lead to a considerable rise in temperature within the enclosure.

Clearances

Make sure that there is adequate clearance around the component so that

- the convection cooling of the component is not restricted
- components do not cause neighboring components to heat up more than permitted
- there is enough space for installing cabling
- there is enough space to remove components for maintenance or repair.

Note

Regardless of the degree of protection of the casing, the electrical and optical ports are always sensitive to

- mechanical damage

- damage caused by electrostatic contact discharge when touched

- contamination by dust and fluids

On devices with degree of protection IP65, always close unused ports with the supplied dust protection caps. Remove these caps only immediately before connecting up the cables to the ports.

Standards

EN 60529:2000 degree of protection due to casing (IP code) (IEC 60529:1999)

Appendix

A

A.1 Overview of the standards relevant for network installation

Introduction

This section provides with a basic overview of the standards generally relevant for installation of networks in buildings and those particularly relevant for Industrial Ethernet.

Note

This section can only include basic information available at the time of going to print.

Fort more detailed and up-to-date guidelines, contact the PROFIBUS user organization e.V.

The PROFIBUS user organization

PROFIBUS User Organization e.V.

Haid-und-Neu-Straße 7,

D-76131 Karlsruhe, Germany

Tel. +49 (0) 7 21 · 96 58 590, Fax +49 (0) 7 21 · 96 58 589

germany@profibus.com, www.profibus.com

Standards for general-purpose cable communications networks in an office environment

Standard	Area of application
ISO/IEC 11801	International standard for network planning in office buildings
EN50173	European standard for network planning in office buildings; adopted as national standard

Due to the use of Ethernet in automation engineering, the existing standards needed to be expanded to include the industrial sector.

Standards for general purpose cable communications networks in an industrial environment

Standard	Area of application
ISO/IEC 24702	International standard for planning general-purpose networks in industrial buildings
EN50173-2 EN50173-3	European standard for network planning in industrial buildings; adopted as national standard

For industrial applications, expanded standards are necessary that describe the constraints for these applications

Cabling standards for industrial networks and their scope

Standard	Area of application	Scope
IEC 61918	International standard for communications networks in industrial automation systems; relevant for various fieldbuses, common aspects of planning, installation, operation[1])	Describes the network structure and general requirements in and between automation cells
IEC61784-5-x	International series of standards for special requirements in industrial networks such as PROFINET / PROFIBUS, supplementing IEC 61918	Describes specific requirements of the communication profile

[1]) Fieldbus-specific aspects are described in separate, ancillary standards

The "PROFINET Cabling and Interconnection Technology" guideline

Among other things, the PROFIBUS User Organization has produced the "PROFINET Cabling and Interconnection Technology" guideline that served as input for IEC 61918 and IEC 61784 and that also references these standards.

It describes the technical benchmark values for cables and connectors (both electrical and optical) for PROFINET networks. These are intended to help new manufacturers to produce PROFINET-compliant products.

The guideline can be downloaded in English from the URL:

`http://www.profibus.com/pall/meta/downloads/article/00327/`

A.2 Content of the standards

Content of the IEC 24702 and EN50173-3 standards

The standards for general purpose building networking of buildings used for industrial purposes describe:

- The structure of the building network,
- The requirements for cables (fibre-optic, electrical),
- The requirements for connectors (fibre-optic, electrical),
- Limit values for installed links.

IEC 24702 references IEC11801.

Technical aspects of installation described in IEC 14763 (EN50174).

Content of the IEC 61918 and IEC61784 standards

the standards for automation networks include a general section describing the following points:

- Design of the network (network structure, grounding, equipotential bonding),
- Planning and installation,
- Requirements of components (table connectors, cables, grounding, ...)
- Acceptance of an installation,
- Maintenance and service.

IEC 61918 contains general requirements common to all fieldbuses (PROFINET, PB, Interbus,…).

Fieldbus-specific aspects/requirements that differ from the general section described in profile-specific standards, for example in *IEC61784-5-3* for PROFIBUS, PROFIBUS PA and PROFINET; IEC61784-5-6 for Interbus.

A.3 Application of the standards

Application of the EN standards 50173/50174

Standard	Project phase	Tasks
EN50173-1	Planning of cabling	Topology, cables, connection technology, limit values for transmission links
EN50174-1 EN50174-2 EN50174-3	Planning phase	Management of the cabling, safety requirements, laying of cables, equipotential bonding)
EN50174-1 EN50174-2 EN50174-3	Implementation phase	
EN501714-1	Operational phase	Quality assurance, management of the cabling, repair and maintenance

Description of the fieldbus-specific characteristics in IEC 61784

This standard references IEC 61918.

Standard	Fieldbus
IEC 61784-5-2	ControlNet, EtherNet/IP
IEC 61784-5-3	PROFIBUS, PROFINET
IEC 61784-5-6	Interbus
IEC 61784-5-10	Vnet/IP (Yokogawa)
IEC 61784-5-11	TCnet (Toshiba)

General-purpose cabling systems: EN 50173/EN 50174

Standard	Contents
EN50173-1	Part 1: General requirements
EN50173-2	Part 2: Office environment
EN50173-3	Part 3: Industrial area
EN50173-4	Part 4: Domestic environment
EN50174-5	Part 5: Computer centers

Installation of communication cabling: EN 50174

Standard	Contents
EN50174-1	Part 1 Specification and quality assurance
EN50174-2	Part 2 Installation planning and practices in buildings
EN50174-3	Part 3 Installation planning and practices outdoors

Glossary: Terms and acronyms

802.11

A series of standards for wireless network protocols developed by the IEEE.

Access point

A node in a WLAN that performs administrative functions in the network while at the same time provides → clients with the connection to wired networks, other clients in the same wireless cell or in other wireless cells.

ACL

"Access Control List", list with → MAC addresses with the right to access the wireless network

Ad hoc network

Ad hoc network (ad hoc: Latin "for this purpose") is used in information technology to describe a wireless network between two or more mobile end devices without a fixed infrastructure.

This technology is used, for example, in Bluetooth to allow the spontaneous linking of mobile phones, for example with headsets.

AES

Advanced Encryption Standard

Aging time

The aging time is the time after which a learned → MAC address is discarded if an IE switch has not received frames with this sender address during this time.

Antenna diversity

The simultaneous availability of two wireless interfaces on one device. In areas hostile to wireless communication, it is possible to switch over to the interface with the frequency currently providing the best reception.

ARP

Address Resolution Protocol

Autocrossover

Technique with which a → TP port is automatically switched over between → MDI and → MDIX pin assignment to make a connection regardless of the port pin assignment of the device being attached. This means that crossover cables are not required. The autocrossover function can only be used when the port is set to → autonegotiation mode.

Autonegotiation

Procedure standardized by IEEE 802.3 in which the transmission parameters (for example 10/100 Mbps, full/half duplex) are negotiated automatically between the devices.

Bandwidth

Practically synonymous with "maximum usable data rate". The term derives from the fact that the transmission at a certain data rate occupiers a proportionally wide part of the wireless spectrum.

BFOC

"Bayonet Fiber Optic Connector", a connector system for glass fiber FO cables with which the cable is secured by a bayonet locking mechanism.

BOOTP

A protocol for automatic assignment of IP addresses. The IP addresses are provided by a BOOTP server. → DHCP.

CLI

Command Line Interpreter. Option for configuring various devices based on a command line. The CLI can be used with → TELNET over every Ethernet Port.

Client

A node of a WLAN without a infrastructure capability of its own that accesses a wireless network via an → access point.

Collision domain

To ensure that the → CSMA/CD protocol functions correctly, the propagation time of a data packet from one node to another is restricted. This propagation time results in a spatially limited span for the network depending on the data rate known as the collision domain.

Connection monitoring

With regular link test pulses, a switch monitors the connected TP and FO cable segments for short-circuits or interruptions. The switch does not send data to a segment from which it is not receiving link test pulses.

CP 1515

Communications processor (wireless adapter) for a wireless connection of a laptop, a programming device or an Internet pad with a WLAN. This is the predecessor to the → CP 7515. Both have been overtaken in the meantime by wireless interfaces integrated in the PG.

CP 7515

Communications processor (wireless adapter) for a wireless connection of a laptop, a programming device or an Internet pad with a WLAN. The CP 7515 has two wireless interfaces (→ antenna diversity) and consists of a PCMCIA type II card that is inserted in the appropriate slot of the laptop. In the meantime, the CP has been replaced by wireless interfaces integrated in the PG.

C-PLUG

The C-PLUG (configuration plug) is an exchangeable memory medium of storing the configuration data. If the device is replaced, the configuration can be adopted by swapping the C-PLUG.

CRC

Cyclic Redundancy Check. A checksum used in transmission protocols to detect errors in frames.

CSMA/CA

"Carrier Sense Multiple Access with Collision Avoidance", a method for detecting "collisions"; in other words, an attempt by more than one sender to start transmission on a frequency at the same time. When this happens, both senders stopped at transmission and wait for a more or less random time. They start their repeated transmission only when the other sender has not started to transmit during this time. A second collision can only occur if both randomly selected delays are identical.

Cut through

In the Cut Through process not the entire data package is stored temporarily in a buffer, but is passed directly onto the target port as soon as the first 6 bytes (target address) have been read. The times required by the data package to pass through the switch are then minimal. The data is only stored temporarily using the store and forward mechanism when the section between the target part and the port of the next switch is in use.

In PROFINET switches, cut through is implemented by using ERTEC-ASICs.

Default gateway

A network node that forwards all frames not addressed to stations in the same LAN (subnet).

DHCP

DHCP (Dynamic Host Configuration Protocol), like → BOOTP, a method for automatic assignment of IP addresses. With DHCP, however, addresses can be assigned while the device is operating.

Dispersion

Broadening and distortion of light pulses in fiber-optic cable due to signals arriving at different times. On → multimode FOC, the distortion of the output signal is greater than with → single mode FOC.

Display mode (DMode)

Display mode that indicates various statuses (port status, power monitoring activated etc.). The modes can be switched over using a button on the switch.

DSSS

"Direct Sequence Spread Spectrum", a wireless modulation technique as used in IEEE 802.11 standard "b".

Duplex connection

A connection between two nodes on which both can send and receive simultaneously. This means that no collisions are possible during communication. "Switched LANs" operate with D.

EAP

"Extensible Authentication Protocol", a protocol with which servers and clients can negotiate a procedure for authentication prior to the actual authentication.

ESM

Electrical **S**witching **M**odule – SIMATIC NET Ethernet switch with electrical ports.

Event

For Alarms & Events: An event is anything that happens that could be of interest to a client. Although events can also be generated when a condition is met, they are not necessarily dependent on conditions. Events that are not linked to conditions include, for example, error messages of the communication system.

Fault mask

Specifies the desired status (good status). Deviations from this occurring during operation are handled as faults.

Firewall

A computer or an application located between a local parent an external network to block illegitimate data traffic between the networks. In this way, they prevent unauthorized access from the outside.

FO port

Fiber **O**ptic port

FRNC

"Flame-Retardant Non-Corrosive" a halogen-free, flame-retardant material for cable jackets. No acids are released when FRNC burns.

Full duplex connection

Synonymous with duplex connection

GARP

"Generic Attribute Registration Protocol", previously "Group Address Registration Protocol", a protocol for LANs with which the switches and end devices can exchange "attributes" (node IDs, addresses etc.). This gives each node an overview of the structure of the entire network.

Half duplex

Two-way alternate transmission mode- it is only possible to either send or receive over the interfaces at any one time.

Half duplex connection

A connection on which only one node can transmit at any one time. The opposite is a duplex connection. Half duplex is typical for shared LANs such shares wireless networks.

Handover

The transfer of a mobile client from one access point and its wireless cell to the next (see roaming); in particular, the reintegration in the network.

Hidden node problem

Two nodes (for example clients) are arranged in a cell so that they are both connected to a third receiver (access point) but they themselves cannot see each other; in other words, both clients are outside the wireless range of the other. If both nodes send to the access point at the same time, the packets collide at the access point without the nodes being aware of it.

Hub

A device that operates like a → switch by connecting individual segments of a networked together. In contrast to a switch, however, there is only a physical connection but no analysis of the network traffic. The administrative advantages of using switches (routing network traffic, collision rejection etc.) are therefore not available with hubs.

ICMP

"Internet Control Message Protocol", is used in networks to exchange information and error messages via the Internet Protocol (→ IP). It is therefore located at the same level as, for example, → TCP and → UDP. ICMP Operates at the same OSI Model layer as IP, at the Network Layer (layer 3).

IEEE

"Institute of Electrics and Electronics Engineers", a US institute that works on guidelines and technical recommendations, to some extent comparable with DIN.

IGMP

"Internet Group Management Protocol", a protocol with which a computer connected to the Internet can inform a neighboring switch of the → multicast groups to which it belongs. This protocol simplifies and speeds up communication when a message is intended for a larger group of recipients. (mailing lists, audio and video streams, ...)

IP30

A degree of protection that indicates that a component in this category is protected from the intrusion of coarse solid foreign bodies (as of 2.5 mm diameter), but is not protected from the ingress of water. This corresponds to a normal electrical household appliance.

IP65

A degree of protection that indicates that the component in this category is fully protected from dust and water jets. This corresponds to a practically airtight encapsulation.

IP67

A degree of protection that indicates that the component in this category is fully protected from dust and water jets and will not be damaged by temporary immersion in water.

iPCF

"Industrial Point Coordination Function", a proprietary network protocol supported by SIEMENS that is the basis of rapid roaming (see entry). The → handover times allow roaming of mobile nodes to be reduced to the order of 30 ms.

IRT

"Isochronous Real Time Technology", real-time communication even under difficult conditions (overload situation, complex network topology etc.). When this acronym is used in device names, it identifies devices such as SCALANCE S switches that support IRT technology.

Isochronous Real-Time Communication, IRT

In PROFINET with IRT, communication over Ethernet is divided into individual cycles. Each cycle consists of two phases, an IRT channel reserved for extremely time-critical data, and an "open channel", within which RT and non-time critical frames can be sent.

This allows time-critical and uncritical data to be sent on the same connection. At the same time, however, a certain data rate (and therefore a transmission time) is reserved for the critical data and real-time capability can therefore be guaranteed.

When this transmission method is implemented in ERTEC-ASICs (Enhanced Real-Time Ethernet Controller), cycle times of 0.25 ms and jitter accuracy below 1 µs are achieved.

ITP

"Industrial Twisted Pair", a cabling and connector technology for Ethernet adapted to the requirements of an industrial environment.

IWLAN

An IWLAN is an "Industrial WLAN", in other words, a wireless network "hardened" to cope with the wireless complications of an industrial environment.

LAN

"Local Area Network", a spatially restricted network, for example compared with the Internet

Latency

Latency specifies the time taken by frames to pass through a switch. This does not include the time required for buffering frames.

LD

"Long Distance", an acronym used with SCALANCE S devices whose optical interfaces are designed for particularly long distances

Load containment

With its filtering functions, a switch makes sure that local data traffic remains local. The local network load of a segment is contained in the originating segment and does not represent extra load on the remainder of the network.

MAC

"Media Access Control", a protocol for controlling access to a transmission medium (cable, wireless) that cannot be accessed by all nodes at the same time.

MAC address

A worldwide unique identification number for every hardware component of importance in a network.

MDI

Medium **D**ependent **I**nterface, - straight.
On a MDI port or a MDI cable, the receive (Rx) and transmit (Tx) cables are not crossed over.

MDI-X

Medium Dependent Interface – Crossover. On an MDI-X port or MDI-X cable, the receive (Rx) and the transmit (Tx) lines are crossed over.

MIB

Management **I**nformation **B**ase. The MIB is a formal description of network objects in the form of a tree structure that contains all the relevant information for network management in → SNMP.

Mirroring

A port (mirror port) with its specific data traffic can be mirrored to another port (monitor port) for test purposes. Protocol analysis devices can be connected to the monitor port, in other words, the monitor port is not available for data exchange. Mirroring has no effect on the mirror port.

Modes

Modes are discrete waves used to transmit data within a fiber-optic cable. With → single mode fibers, only one wave propagates, whereas in → multimode fibers several waves propagate. Modes are patterns of electromagnetic fields in FOCs.

Multicast

A frame with a multicast address is received by all nodes prepared to receive this address.

Multimode

In multimode transmission, the pulse is transferred using many modes (waves) that travel along curved paths or are reflected within the core. Attenuation is mainly caused by physical absorption and dispersion as well as by mechanical bending. The amount of attenuation depends among other things on the wavelength of the input light. Multimode fiber-optic

cables have an outer diameter of 125 µm and 50 or 62.5 µm core diameter. Due to the larger core diameter the pulse edges degrade more than in single mode transmission resulting in shorter transmission distances.

OFDM

"Orthogonal Frequency Division Multiplex", a wireless modulation technique used in the IEEE 802.11 standards "a", "g" and "h"

Omnidirectional antennas

Antennas without a specific directional characteristic in contrast to directional antennas.

OSM

Optical Switching Module – SIMATIC NET Ethernet switch with optical ports.

Passive listening

Support of Rapid Spanning Tree Topology Change frames. When an RSTP topology change frame is received, the → MAC address table is deleted.

PCF

Polymer Cladded Fiber
Optical fiber that can be assembled in the field and whose core is made of glass and jacket made of plastic.

POF

Plastic Optical Fiber
Optical fiber that can be assembled in the field and whose core and jacket are made of plastic.

PROFIDrive

PROFIdrive is the functional interface between controllers and drives in PROFINET and PROFIBUS. PROFIdrive is defined by the PROFIdrive profile of the PROFIBUS user organization (PNO).

PROFISave

A safety profile complying with safety standard IEC 61508 that allows the transmission of standard and safety-oriented data on one bus cable and can be used regardless of the bus medium. PROFIsafe is the first profile certified by the German TÜV for failsafe communication for Ethernet.

PST

"Primary Setup Tool", a software tool for the basic parameter assignment of Web components

RADIUS

"Remote Authentification Dial In User Service". a method in which the authentication is handled on a separate server.

Rapid roaming

Roaming in which the re-establishment of the connection is so fast that there is no appreciable interruption of connectivity (→ handover). Rapid roaming is implemented with → iPCF.

Reconfiguration time

The time required to restore a functional configuration if a device fails or a network cable is interrupted.

Redundancy manager (RM)

A switch in a ring topology that does not forward any frames between its → ring ports if there are functioning connections between all other switches. As soon as a connection between two switches is interrupted, the redundancy manager forwards frames between its ring ports and so restores an intact connection between all switches.

RFC

"Request for Comments", the informal specification of a proposed standard for communication, technology or method.

Ring port

Two ports in a switch via which this switch is connected to other switches to form a ring. One switch must be configured as the → redundancy manager in the ring. This sends test frames via the ring ports that are forwarded by all the ring ports of the other switches in the ring. This makes sure that the ring does not have any interruptions.

RJ-45

"Registered Jack 45", a connector design with oblong jacks and 8 wires. RJ-45 connectors are used, for example for telephones and Ethernet connections.

RMON

Remote Monitoring. RMON-compliant devices allow diagnostic data to be collected on the device and read out by a network management station. This means that network problems are detected early and can be eliminated. The particular advantage of RMON is that it is

independent of location. The acquired data can be analyzed at any point in the network with suitable reporting software.

Roaming

The movement of a WLAN node from one wireless cell to the next.

RR

Acronym that identifies SCALANCE W devices that support → rapid roaming.

RSSI

"Received Signal Strength Indicator", a measure of the strength of the received wireless signal. RSSI is generally standardized so that the value "100" represents the maximum reception strength.

RSTP

"Rapid Spanning Tree Protocol", a protocol with which the switches of a network can determine paths for delivering messages between end devices. If the network has a redundant topology (in other words, if there are several different paths connecting the relevant nodes), the failure of any component or a cable can be compensated by switching over quickly to the alternative path. RSTP is a further development of → STP.

SC connector

A type of connector preferred for fibre-optic cables with a square connector and high packing density.

SC RJ

A type of connector preferred for → PCF/POF fibre-optic cables with a square connector and high packing density.

Segment

In the Ethernet bus system, transceivers connected together over the bus cable along with the nodes connected over patch cables form a segment. Several such segments can be connected via repeaters. When using twisted pair and fiber-optic cables, each subsection forms a segment.

Signaling contact

Floating relay contact via which the detected error states can be signaled.

Single mode

In single mode transmission, (and monomode transmission) the pulse is transmitted by a straight mode (wave). Attenuation is mainly caused by physical absorption and dispersion as well as by mechanical bending. The amount of attenuation depends, among other things, on the wavelength of the input light. The single mode fiber typically has a core diameter of 5 to 9 µm. The outer diameter is, however, once again 125 µm (compare multimode). The smaller core diameter degrades the pulse edges less than multimode transmission and allows greater transmission distances.

SMTP

"Simple Mail Transfer Protocol", the de facto standard for transferring mail over the Internet.

SOFTNET Security Client

A PC application used for the connection of PGs, notebooks and other PCs to networks secured by SCALANCE S. The PC then functions as a VPN client.

Spanning Tree

The Spanning Tree protocol (STP) allows redundant transmission paths. This prevents circulating frames and, if a fault develops, provides an alternative path within 20 - 30 seconds (reconfiguration time).

Spoofing

A term used for various subterfuges used in computer networks to disguise one's own identity.

Spoofing normally involves an attempt to falsify the data packets of the intruder so that they have the sender address of a different (trustworthy) host.

SSID

"Service Set Identifier", within the framework of a → "Wi-Fi" WLAN, the name of a network that needs to be known to all network nodes at the same time and that constitutes part of each transferred message. SSIDs alone provide only extremely weak access protection from third parties and should always be supplemented by other encryption methods.

SSL

"Secure Sockets Layer", a protocol for encrypted data transfer in the Internet is that obtains its security by using "public key" algorithms.

Standby

Indicates the ability of a device to take over operation within a very short time.

Store and forward

With the store and forward mechanism, the switch stores the frames and then queues them. The frames are then forwarded selectively to the specific port that can access the addressed node (store and forward).

STP

"Spanning Tree Protocol", a protocol similar to → RSTP, with which the switches of a network obtain information about the topology in which they are located. STP has various weaknesses that can be exploited by potential attackers and that are avoided in the further development known as RSTP ("Rapid STP").

TCP

"Transmission Control Protocol", along with → UDP a further protocol for communication over the Internet. In contrast to UDP, TCP is connection-oriented; in other words, a dialog is established between the sender and recipient. The advantage of this is that the correct order and completeness of a fragmented message can be checked. The drawbacks are the greater overheads for communication and administration.

TCP/IP

"Transmission Control Protocol/Internet Protocol", a set of protocols governing communication over the Internet. Alongside → TCP that provides the "elementary" functions (exchange of data frames, etc.), the "Internet Protocol" is used to implement the more complex protocol layers (sequence of a session).

TELNET

With this protocol, an interactive connection can be established to another device in the LAN or on the Internet. The user then has the same options as when directly connected to this device with a terminal.

TFTP

"Trivial File Transfer Protocol"; a simple, UDP-based protocol for data transfer. Due to its limited size, it can also be used by network nodes with little ROM.

TKIP

"Temporary Key Integrity Protocol", a protocol for dynamic changing of the RC4 key with which message transmission is coded in a WLAN.

TP port

Port with a TP connector (RJ-45 jack)

UDP

"User Datagram Protocol", along with → TCP a further protocol for communication over the Internet. UDP does not provide any mechanisms for checking the completeness or the order of transmitted packets but does reduce the overheads resulting from the management functions of more complex protocols such as TCP. UDP Is suitable particularly for sending short messages to a large number of recipients (broadcasting/multicasting).

VLAN

Virtual LAN within a physically existing network.

VPN

"Virtual Private Network", the use of a "private" network that uses a "public" network to transfer messages. The use of the private network is transparent for the nodes of the public network; in other words, invisible. In contrast to the nodes of the public network, however, the private messages can be encrypted or hidden using tunnel techniques. A VPN allows the use of a protected network embedded in an unprotected environment.

WAN

"Wide Area Network", a spatially restricted network with a greatest span than a LAN

WBM

"Web Based Management", configurations of an active node from an external Web browser that accesses a Web browser integrated in the node via an IE connection.

WDS

"Wireless Distribution System", a method for grouping several access points to link the access points for an Extended Service Set (ESS).

WEP

"Wired Equivalent Protocol", an encryption method for wireless data traffic.

Western plug

A colloquial for → RJ-45 connector

Wi-Fi

IWLAN product identifier introduced by the "WiFi-Alliance" manufacturers' association for products compatible with a certain subset of the → 802.11 standards; sometimes also (incorrectly) used as a general synonym for → "WLAN".

WLAN

"Wireless Local Area Network", a wireless-based LAN

WPA

"WiFi Protected Access", an encryption method for wireless data traffic.

WPA-PSK

WPA-PSK is a weakened form of WPA. In this method, authentication is not established by a server but is based on a password. This password must be configured manually on the client and server. Wherever possible, you should change to the WPA method to achieve greater security.

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